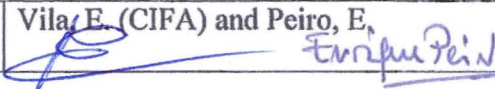# MELiSSA

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TECHNICAL NOTE 94.34

Waste Preparation Unit, User Manual and waste preparation procedure

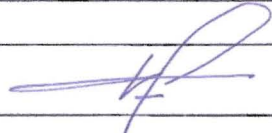|	
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SECTION 1

WPU User Manual (CIFA)

INDEX

1.-INTRODUCTION

The present documentation does reference to the manual of operations of the waste preparation unit (WPU).

1.1.-General information

Variable speed drive

POWER ELECTRONICS SD450

- It's installed in the control panel.
- It works whenever the power supply is connected. Otherwise, should rearm the control panel, so that the variable speed drive works.
- Its objective is to display the motor rotation velocity, to the waste preparation unit pump.

PLC

GE FANUC VERSAMAX MICRO CONTROLLER

- It's installed in the control panel.
- It works whenever the power supply is connected. Otherwise, should rearm the control panel, so that the plc works
- It's function is to control the actions of all equipment elements, analogue or digital, as well as execute the orders received from the user through the program. As well as, can adjust parameters: input frequency, input power factor, momentary power loss, etc.

Load cell

CAJA SUMA UTICELL

- It's installed in the control panel.
- It works whenever the power supply is connected. Otherwise, should rearm the control panel, so that the load cell works.
- Its objective is to add the values obtained by the load cells and show the weight.

Temperature regulator

OSAKA OK83

- It's installed in the control panel.
- It works whenever the power supply is connected. Otherwise, should rearm the control panel, so that the load cell works.

- Its objective is to show the user temperature set point, as well as the real temperature of the mixture.

1.2.-Safeties

The equipment has a number of safety systems that allow to protect workers who handle it as well as the installed elements.

1.2.1. - Mechanical safeties

Pressure relief valve RV_1302_01

- It's installed in tank
- Its function is to avoid an overpressure, P=2,5 bar

Pressure relief valve RV_1303_01

- It's installed in tank
- Its function is to avoid an overpressure, P=6,2 bar

1.2.2. - Electrical safeties

Emergency stop

- It's installed in the control panel.
- There is mushroom type button.
- It cut the electrical supply of the whole equipment.
- It is operated while the equipment is running; the system will interpret this as an arrest warrant. Once you reset the switch to its original position, be necessary to reset the system to boot the equipment.

1.2.3. - Logics safeties

Digital signals blockade

Pump

Will never work if it is selected magneto-thermal protection of the pump or the lower level of the tank, less than programmed.

Utilities
Will never work if the valves are closed.

2. - STARTING INSTALLATION

2.1.- Level fine tuning

The equipment has a self-carrying frame and should be levelled perfectly.

2.2.-Utilities connection

Compressed air

The team needs oil-free compressed air at 6 bar. Consumption is not significant.
Compressed air connection must be made in the FTR-100 air regulator.

Deionized water

Deionized water connection is made in the HV_1301_01 valve.

Soft water

The soft water connection should be in the HV_1301_02 valve.

Cooling water

The cooling water connection should be in the HV_1302_01 valve.

Cooling water return

The equipment allows the cooling water recovery.
The cooling water returns connection should be in the HV_1302_02 valve.

Steam

The steam connection should be in the HV_1305_01 valve.

Drain

All drain valves are directed to the nearest drain.

Electricity

The electrical power equipment needs 220/ 380 V III + T + N, 50 Hz

3.- STARTING THE EQUIPMENT

3.1.-Initial adjustments

Manual valves

The WPU has several manual valves, some of which should be fully open during normal operation, others completely closed and the rest should be adjusted to achieve stable operation of the equipment.
Manual valves must be fully open are:

- HV_1302_02, cooling water outlet.
- HV_1302_01, cooling water inlet.
- HV_1301_01 o HV_1301_02, depending on water use, deionized or softened respectively.

Manual valves to be adjusted to keep the equipment in working order are:

- HV-1304_03, recirculation.
- HV_1304_02, pump output.
- HV_1304_04, as sequence of the equipment.
- HV-1305_01, as sequence of the equipment.
- HV_1304_01, HV_1305_02 y HV_1305_03, as sequence of the equipment.

Magneto thermals

The pump has an overload protection insides the electrical panel. The characteristics plate must be revised in order to know the adjustment value.

Engines rotation direction

It's very important to check the rotation direction of pump. It has an indication of its own rotation direction
Please pay special attention because it can't work without water.

Temperature probes adjustment

The procedure for calibrating temperature probes recommended by CIFA is:
Note
This procedure is a recommendation, but how to act must be determined by laboratory procedures and according to calibration staff, either the same laboratory or by an external company.

To proceed to the calibration of the probes should possess the necessary facilities for this work. The minimum would be a cold bath preferably 40 ° C and a heating capable of reaching 120 ° C.
The computer must be turned in order to read the signs of the probes to be calibrated.

1- Place the sensor to be calibrated in an ice bath, which should be as close to 40 ° C. Without located below this value, check with the probe pattern is temperature.
2 - Enter the minimum value of temperature the value you are dialing the probe pattern, and the minimum value of points that are receiving the PLC of the probe to be calibrated.
3 - Place in a hot bath as close to 120 ° C, without exceeding this value. Drop in the probe to be calibrated and the pattern and wait for it to stabilize.
4 - Enter to the maximum temperature value that is setting the standard probe, and the maximum value of points that are receiving the PLC of the probe to be calibrated.
5-Perform again indicated in item 1 for checking that has not changed the low value. In case you have to touch it again to start the operation, repeat steps 1 and 2

Only when it is satisfied that reading in low and high temperature is right will for good calibration.

Note
It is very important that if you have to replace a tube or touching power cables, cutting power to the control box to prevent damage to the analog input module. of the PLC.

3.2.- Elements manual handling

The system has the potential to act manually on the items of equipment such as pneumatic valve, variously pump speed, etc.
By activating the relays located inside the electrical panel or by programming the drive.
Pay particular attention to the manual handling of the elements. This practice should be limited to specific actions such as preventive maintenance. Never be kept constantly under control element manual.

Note
It is also possible to act manually on the temperature control equipment, pay special attention to this element, as it is completely independent of the programming equipment.

3.3.- Adjust of initial parameters

The system allows you to adjust different parameters to operate the equipment.

Temperature

Jacket tank cooling temperature (TT_1303_01), at what temperature you want the system goes to recirculation cooling water to maintain the preset temperature. To this must be activated cooling selector located on the control panel door.

Weight

There are two values that can be edited in the console, load cell used in automatic mode and get a water refill and entered two, as addition of water to reach the desired weight of the mixture. It is very important to zero in the load cell before editing the options.

Rotational speed of the pump

Pump can be programmed through the inverter and determine how often we grind to improve the particle size.

4.- WORKING

Before starting the equipment, you must ensure that all steps have been indicted in the paragraph, initial adjustments.

4.1.-Description

Manual way

Once you have selected manual mode, selected the order of the weights that we obtain and active cooling tank.

Initialize the filling of the tank (with deionized water), pressing the filling should hold up to the achieve the desired weight.

Once you reach the weight hopper additive supplied by the team to reach the desired weight or rerunning the filling to meet the new order.

Using the hand pump start button, start working the WPU, (remove the hopper and put the cover) when we passed the minimum level of the tank (the led on the lower level should be green) and not reached the top level (top level led should be green).

The grind time depends on the time we pulled the pump start button to stop the shredding must press the stop button manual pump.

When the WPU finish, with the desired particle size, we can start the transfer sequence.

In case of pressing the emergency stop would require a reset of the equipment and the WPU back to previous values.

Automatic way

Once you have selected manual mode, selected the order of the weights that we obtain and active the cooling of the tank.

It begins to fill the water automatically to the set point number 1, default in the console of the weighing cell. Once this level, the system for 15 minutes, time to make the addition to the tank through the hopper. When finished, you must remove the hopper and put the cover on the additions port.

When finish the programmed time, the system will add deionized water if we have not yet reached the value of the set point number 2, preset in the console of the weighing cell.

Reached the second value , and provided that exceed the lower level and not reach the top level. The pump will be put into operation, the milling will last 15 minutes (value set uneditable).

After this time, the equipment is ready for transfer to C1.

In case of, press the emergency button the sequence will stop automatically and will require a reset of the WPU.

4.2.- Equipment information

While the equipment worked through the console of the weighing cell, you can display the weight of the contents of the tank. And the temperature controller can show the temperature of the jacket to avoid overheating by pump works.

4.3.-Warnings

The system understands as advertisements all those alterations of normal operation that does not entail an automatic action by the system itself. The warnings on this equipment are:

- Optical alarm
- The warnings don't stop the equipment

Warning list

- Optical alarm: pump works SP_1304_01
- Optical alarm :manual stop pump SP_1304_01
- Optical alarm: water filling PV_1301_01

5.- MAINTENANCE

5.1.- General information

Concept
The objective of a maintenance plan is to be a supportive guide in the maintenance of elements of equipment that require this.

The success of a maintenance plan depends, basically, on how exhaustive the information is and the correct analysis of this information. For these reasons the maintenance plan should be a live document that can be modified depending on the experience and events.

The maintenance plan is based on a set of actions and checking from diary to yearly periodicity according to the specific element to maintain. The maintenance information must be taken accurately in order to accumulate very useful information for maintenance works in the future.

5.2.- Schedules

Symbols for periodical execution indication

Symbol	Periodicity
D	Daily
W	Weekly
M	Monthly
6M	Twice yearly
Y	Yearly
XY	Every X years e.g. 5Y (every 5 years)

5.3.- Operation description

General

Item	Periodicity	Operation	Tag
000	10A	Every ten years to make the hydraulic test system (pipes and tank	VSL2_1300_01

Piping system

Item	Periodicity	Operation	Tag
100	M	Visual inspection of all pipes and check for leaks	VSL2_1300_01

Valves and spray ball

Item	Periodicity	Operation	Tag
200	M	Visual inspection of pressure relief valves	RV_1303_01, RV_1302_01
210	A	Remove and clean the sanitary valves. Replace gaskets	HV_1304_01-02-03-04,HV_1305_01-02-03
220	A	Remove and clean the pneumatic valves. Replace gaskets	PV_1301_01

230	A	Remove and clean the manual valves. Replace if necessary	HV_1301_01-02, HV_1302_01, HV_1303_01-02
240	A	Remove and clean the 3-way valve. Replace if necessary	S3V_1303_01
250	A	Remove and clean the spray ball. Replace if necessary	NOZ_1306_01

Filter

Item	Periodicity	Operation	Tag
300	M	Visual inspection of the tank vent filter	GF_1302_01

Pump

Item	Periodicity	Operation	Tag
400	6M	Verification of the absence of abnormal noise	SP_1304_01

Pneumatic system

Item	Periodicity	Operation	Tag
500	S	Check the pressure of compressed air supply	N.A.

Item	Periodicity	Operation		Tag
510	M	Check for leaks at all connections air valves		N.A.
520	6M	Check and adjust the air pressure switch		N.A.

Instruments

Item	Periodicity	Operation	Tag
600	6M	Check and correct temperature probes in the control system. Calibrate if necessary	TT_1303_01
610	6M	Check the pressure-gauge. Calibrate if necessary	PI_1302_01, PI_1303_01
620	6M	Check the levels. Calibrate if necessary	LSH_1301_01, LSL_1301_01
630	6M	Check the load cells. Calibrate if necessary	WT_1307_01-02-03

Electrical components

Item	Periodicity	Operation	Tag
700	6M	Clean the box with compressed air	N.A.
710	6M	Check the status of the contacts of contactors	N.A.

720	6M	Check the status of all power cables	N.A.
730	6M	Check the status of all operating cables	N.A.
740	6M	Calibrate all critical sensors	N.A.
750	6M	Check drive status and indications	N.A.
760	A	Check and make sure all cables to terminal blocks	N.A.

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SECTION 2

Waste preparation Procedure (MPP-OP-10-1002)

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Operating Procedure for Grinding and Mixing of C1 Bioreactor Feed with the Waste Preparation Unit

Approval Loop :

Date	Issue	Prepared by (visa):	Checked by (visa):	Approved by (visa):
6/2/12	0	C.MUNGANGA R.MOYANO Analysis Technician and Maintenance technician	E.PEIRO Technical Manager	A. FOSSEN Quality Manager
		Date: 09/01/12	Date: 06/02/12	Date: 06/02/12

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Change log :

Date	Issue	Reason of the change	Modified paragraphs
- -	0	Creation	

Table of content:

1. Scope

This operating procedure describes the steps to follow for the preparation of C1 feeding mixture with the Waste Preparation Unit (WPU) and its transfer into the C1 Influent Tank. The ingredients considered for the mixture include water, vegetables and human faeces in quantities and proportions as defined for the C1 feeding specification (Appendix 1). Three possible operating strategies are defined, in order to supply the necessary feed to the Influent tank for 3.5 and 7.0 days (half-week and one week).

The mixture and particle size reduction takes place in the WPU, considering that the working volume of the C1 influent tank is 50 L, and that the maximum allowable transfer volume is 35 L.

The WPU User Manual is available in order to start the WPU and prepare the feed under nominal conditions.

2. Reference and applicable documents

2.1. Applicable documents

AD1	MPP-QA-07-0001	MPP Quality Manual
AD2	MPP-QA-07-0003	MPP Rules for good lab practices
AD3	MPP-QAP-08-0004	MPP Glossary of terms and definitions
AD4		WPU User Manual
AD5		C1 Feeding Mixture Composition
AD6	MPP-OP-08-1002	Faeces Handling Procedure
AD7	MPP-PID-11-1301	P&ID of the Waste Preparation Unit

3. Reference documents

RD1	MPP-UM-11-0001 (0)	User Manual of the Chilled Water System

4. Acronyms and definitions

WPU   Waste Preparation Unit

For further definitions, please refer to AD3

5. Personal protective equipment

5.1. Lab coat

5.2. Long sleeve gloves

5.3. Boots

5.4. Goggles

5.5. Apron

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5.6. Mask (optional)

5.7. Earplugs / anti-noise earmuffs

6. Equipment

6.1. WPU system

6.2. Weight scale (Gram, model GX-6000)

6.3. Step ladder

6.4. Steel funnel

7. Glassware, Consumables and Tools

7.1. 35 L plastic tank

7.2. 5 L plastic beaker

7.3. Plastic brush for cleaning

7.4. Biohazard waste container

7.5. Stainless steel spoon

7.6. Large hermetic zip plastic bags

7.7. pH test strips

8. Materials

8.1. Feeding mixture (bags of milled vegetables)

8.2. Faecal material (frozen in a hermetic container)

8.3. Commercial NaClO solution (free chlorine: 50 g/L)

8.4. 5 M NaOH solution (200 g/L)

8.5. Phosphoric acid (85%)

9. Preparation of faecal material and chemicals for the mixture and cleaning of the WPU in the 9A room

9.1. Place the biohazard waste container inside the WPU room.

9.2. Pour 3.0 L of commercial NaClO solution into the 35 L plastic tank, and dilute with water until a final volume of 30 L, indicated in the upper internal part of the tank, to make a final concentration of 10% (v/v).

9.3. Take the number of samples with faeces stored in the 9D room freezer (see Procedure for Handling Faeces Samples), according to the amounts defined in Appendix 1, and place them on the dedicated table in the WPU room.

9.4. Open the zip plastic bag, unscrew the cover, remove the internal lid of the faeces containers and dispose them into the biohazard waste container; screw again the cover and close the plastic zip bag.

9.5. Fill a 5 L plastic beaker with 2.5 - 3.0 L of hot tap water at 45 - 50 °C, and place it on the table in WPU room.

9.6. Put the first sample with faeces in the beaker with hot water bath for 5 min, in order to ease the removal of the faecal sample from the plastic container.

9.7. Repeat the previous step with the rest of containers with faecal material until the last sample has been released. If necessary, discard the cool water from the beaker and fill again with fresh hot tap water.

10. WPU Mixing Procedure (Manual Mode)

10.1. Switch on the WPU panel control by activating the red General Switch, on the right part of the front panel (see figure 1).

10.2. Push the blue "RESET" button to restart the safety module (see figure 2).

10.3. Verify that the drain bottom manual valve HV_1305_02 of the WPU closed (see figure 4).

10.4. Remove the hand hole lid and fix the steel funnel with the clamp.

10.5. Tare the weight of the vessel to zero value by pressing "0" on the weight control display of the WPU (see figure 3).

10.6. Select the "Manual Mode" at the manual selector of the WPU control panel (see figure 2).

10.7. Verify that the Deionized Water inlet valve HV_1301_01 is opened.

10.8. Verify that the Compressed Air Supply valve HV_9A15_01 is opened.

10.9. Verify that the pressure indication in gauge PI_1302_03 is 0.4-0.5 MPa. Otherwise adjust the pressure, opening or closing the pressure regulator HPCV_1302_02 (see figure 4).

10.10. Fill the vessel with deionized water pressing the "PV_1301_01" button on the WPU control panel, until the volume indication in the weight scale corresponds to the volume defined in Appendix 1 (see figure 2).

10.11. Take the faeces containers from step (8.6) out of the plastic bags.

10.12. Use the step ladder in order to have a direct vision of the complete steel funnel, and discharge the faeces inside the vessel (use a metal spoon if necessary).

10.13. Place the empty containers inside the plastic zip bags, close the bags and dispose in the biohazard waste container.

10.14. Put the metal spoon in the previously prepared tank with 30 L of diluted NaClO solution (7.5).

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10.15. Put the used gloves in a large hermetic plastic bag and dispose of them in the biohazard waste container. Put on new gloves.

10.16. Wait 15 min until the faeces are thawed inside the WPU vessel.

10.17. Pour the necessary amount of the thawed vegetables mixture in the vessel, according to Appendix 1, keeping a complete vision of the steel funnel entrance.

10.18. Complete the volume of the mixture with deionized water, according to Appendix 1, by pressing the "PV_1301_01" button on the control panel (see figure 2).

10.19. Remove the steel funnel and place it in the 35 L plastic tank with 30 L of (8.2) NaClO solution for disinfection.

10.20. Close the WPU hand hole securely with the lid and clamp connection.

10.21. Dispose the used gloves in the biohazard waste container and put on new gloves.

10.22. if it is necessary to have a temperature control inside the WPU tank, it is possible to activate it following the section 12.

10.23. Put on earmuffs.

10.24. Start the centrifugal pump by pressing the green Start button "SP-1304-01" (see figure 2), and wait for 15 min.

10.25. Verify periodically the status of the mixture through the sight glass using the external light source.

10.26. Stop the pump pressing the red Stop button "SP-1304-02" (see figure 2).

10.27. The Mixing procedure is finished.

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Fig. 1. Isometric view of the Control Panel, indicating the General Switch on the right side
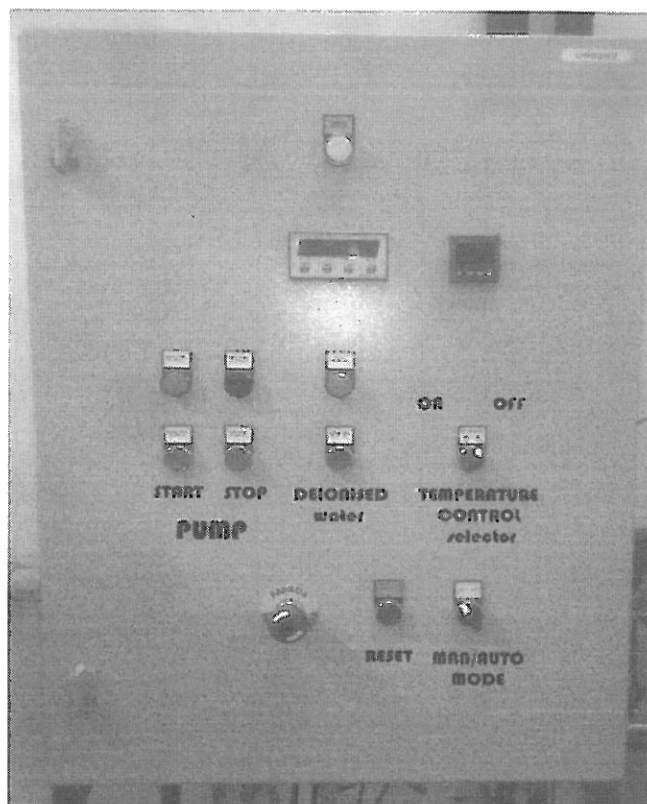
Fig. 2. Front view of the Control Panel, indicating the control switches and buttons.

Fig. 3. Detailed view of the Weight Control Display, showing the Tare Button.

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Fig. 4. P&ID of the Waste Preparation Unit

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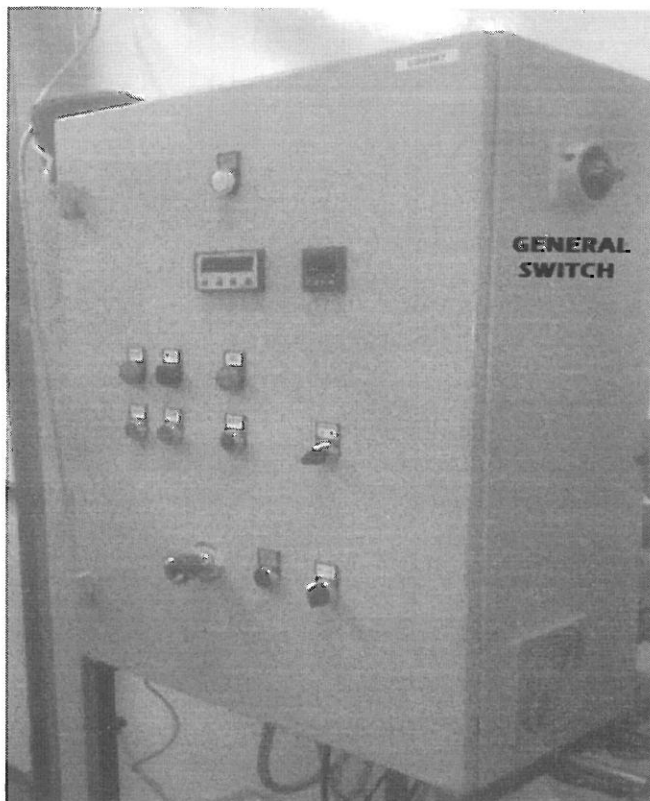| Document Identification: Operating Procedure for Grinding and Mixing of C1 Bioreactor Feed with the Waste Preparation Unit	Type	Chrono	Issue	
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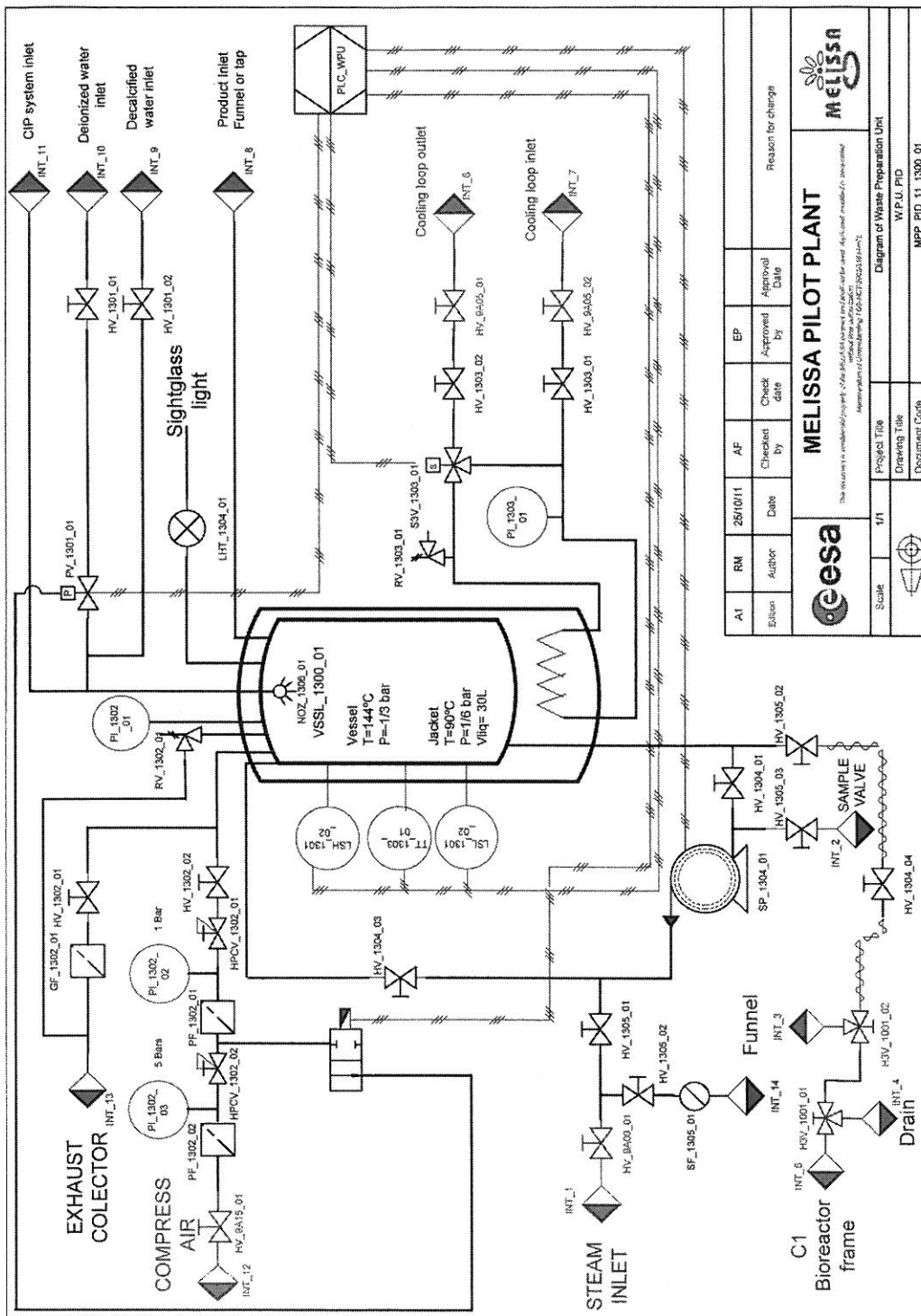
11. Transfer of prepared feeding mixture to the C1 Influent tank

11.1. Open the drain bottom manual valve HV_1305_02 (see figure 4). Verify that the manual valve HV_1304_04 is opened and that the three-way manual valve H3V_1001_01 is in the correct position for transfer (see figure 5).

11.2. Close the exhaust manual valve HV_1302_01 (see figure 4).

11.3. Verify that the pressure indication in gauge PI_1302_02 is about 0.1 MPa (1.0 bar) (see figure 4). Otherwise, adjust the pressure by opening or closing the pressure regulator HPCV_1302_01 (see figure 4) until a pressure of 0.1 MPa is reached.
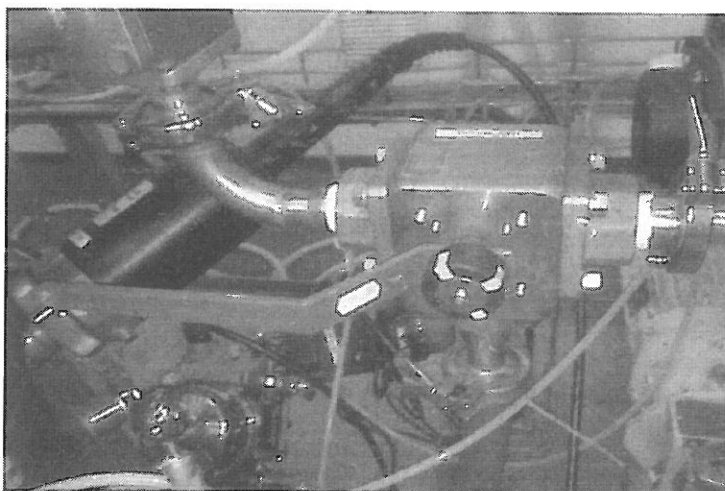
Fig. 5. Position of the three-way valve H3V_1001_01 for feed transfer from the WPU to the Influent tank.

11.4. Open the clamp connection of the Safety Valve RV_1003_01 in Influent Tank, to avoid the overpressure during the transfer process.

11.5. Close the N$_2$ entry manual valve HV_1003_01 to avoid the loss of N$_2$ during the transfer procedure (see figure 7).

11.6. Open the manual valve HV_1302_02 (see figure 4), and control visually the pressure increase in WPU vessel at gauge PI_1302_01 (see figure 4).

11.7. Once the pressure in WPU vessel reaches 300 mbar, verify visually that the feed mixture is flowing through the flexible transfer piping. If the flexible piping is full, proceed to the next step.

11.8. Press the "Edit Values" button at the HMI screen, select the "Feeding Bioreactor MAN Mode" tab, and activate the three-way solenoid valve S3V_1001_02 (it is not necessary to start the recirculation pump GP_1001_01), verify that the S3V_1001_01 is not activated in the screen.

11.9. Set the **MANUAL** operation mode at the HMI screen for the Bioreactor Feeding Control.

11.10. Verify visually that the feed is passing through the transfer line from the WPU to the Influent tank by the following indicators: a) visually in the Influent tank with a

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light source, b) by increase of the Influent tank level in HMI, and c) by the decrease in weight indication at the WPU vessel.

11.11. When the volume indication in the WPU weight control display is less that 2 L, go to the C1 PC panel and just when is not possible to see the feeding in the transparent transfer piping stop the transfer by changing Bioreactor Feeding control to **AUTO**.

11.12. Close the manual valve HV_1302_02, open the hand exhaust valve HV_1302_01 and wait until the pressure at gauge PI_1302_01 in WPU vessel indicates 0 bar (see figure 4).

11.13. Close the bottom valve HV_1305_02 (see figure 4).

11.14. If the C1 bioreactor feed is prepared for more than 3.5 days (according to Appendix 1), continue to step 11.1.

11.15. Press the button "PV_1301_01" on the panel control (see figure 2) to fill the WPU vessel with an additional volume of 10 L of deionized water, following the indication of the weight control display. The objective of this step is to recover the remaining material in the WPU vessel and piping.

11.16. Start the centrifugal pump by pressing the green "Start" button.

11.17. After 2 min stop the pump by pressing the red "Stop" button.

11.18. Repeat the steps 10.6 to 10.12 to complete the transfer of the feed.

11.19. Close the upper port of the Influent tank safety valve RV_1003_01 and open the N$_2$ supply manual valve HV_1003_01 to the influent tank (see figure 7).

The P&IDs in Figures 6 and 7 in next pages describe the elements involved in the feed transfer procedure from WPU to C1 compartment in red color.

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Fig. 6. P&ID of the WPU elements involved in the transfer procedure

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Fig. 7. P&ID of Interconnection between WPU and C1 compartment

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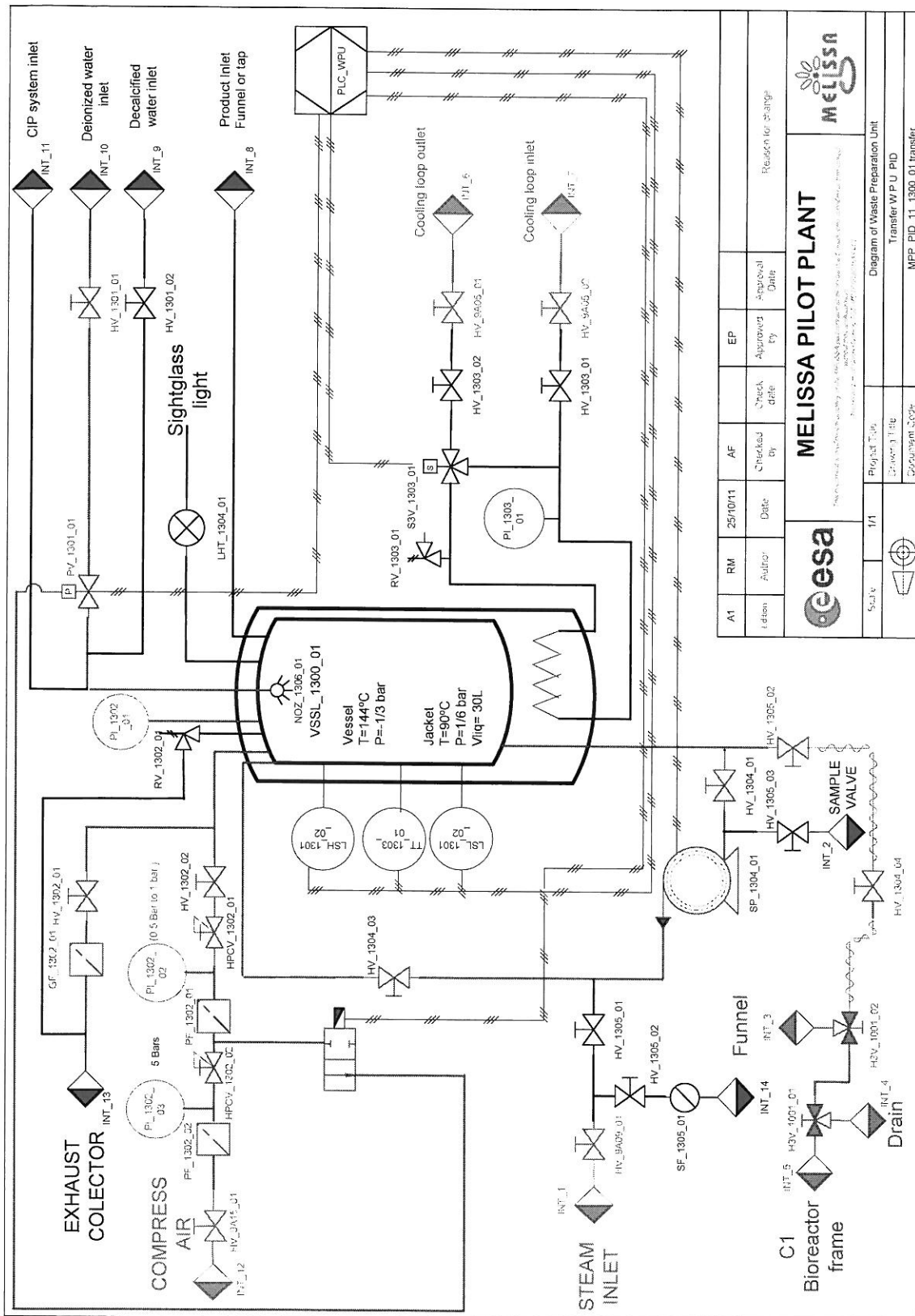| Document Identification: Operating Procedure for Grinding and Mixing of C1 Bioreactor Feed with the Waste Preparation Unit	Type	Chrono	Issue	
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12. Cleaning procedure

12.1.   Verify that the bottom manual valve HV_1305_02 is closed.

12.2.   Verify that the reading at weight control display is 0 kg, otherwise tare the weight controller by pressing the "0" key (see figure 3).

12.3.   Fill the WPU with decalcified water by opening the manual valve HV_1301_01 (see figure 4) until a reading of 40 kg is reached in the weight controller display (see figure 3).

12.4.   Verify that the pressure reading in gauge PI_1302_01 is 0 bar, and remove the handhole lid.

12.5.   Pour carefully 1 L of 5 M NaOH solution into the WPU.

12.6.   Complete the vessel volume with decalcified water by opening the manual valve HV_1301_02 until a value of 50 kg is reached in the weight controller display.

12.7.   Change the position of the three-way manual valve H3V_1001_01 in the C1 room, in order to connect the transfer line to the drain system (see figure 8).

Fig. 8. Position of the three-way valve H3V_1001_01 for emptying the WPU to the drain system.

12.8.   Put on the ear plugs or earmuffs.

12.9.   Push the green "Start" button to start the cleaning process with 0.1 M NaOH.

12.10. Stop the centrifugal pump after 10 min by pressing the red "Stop" button.

12.11. Verify that the pressure indication at PI_1302_01 is 0 bar.

12.12. Open the hand hole lid of the WPU vessel.

12.13. Pour 175 mL of 85% Phosphoric acid into the WPU.

12.14. Close the hand hole with lid and clamp.

12.15. Put on the ear plugs or earmuffs.

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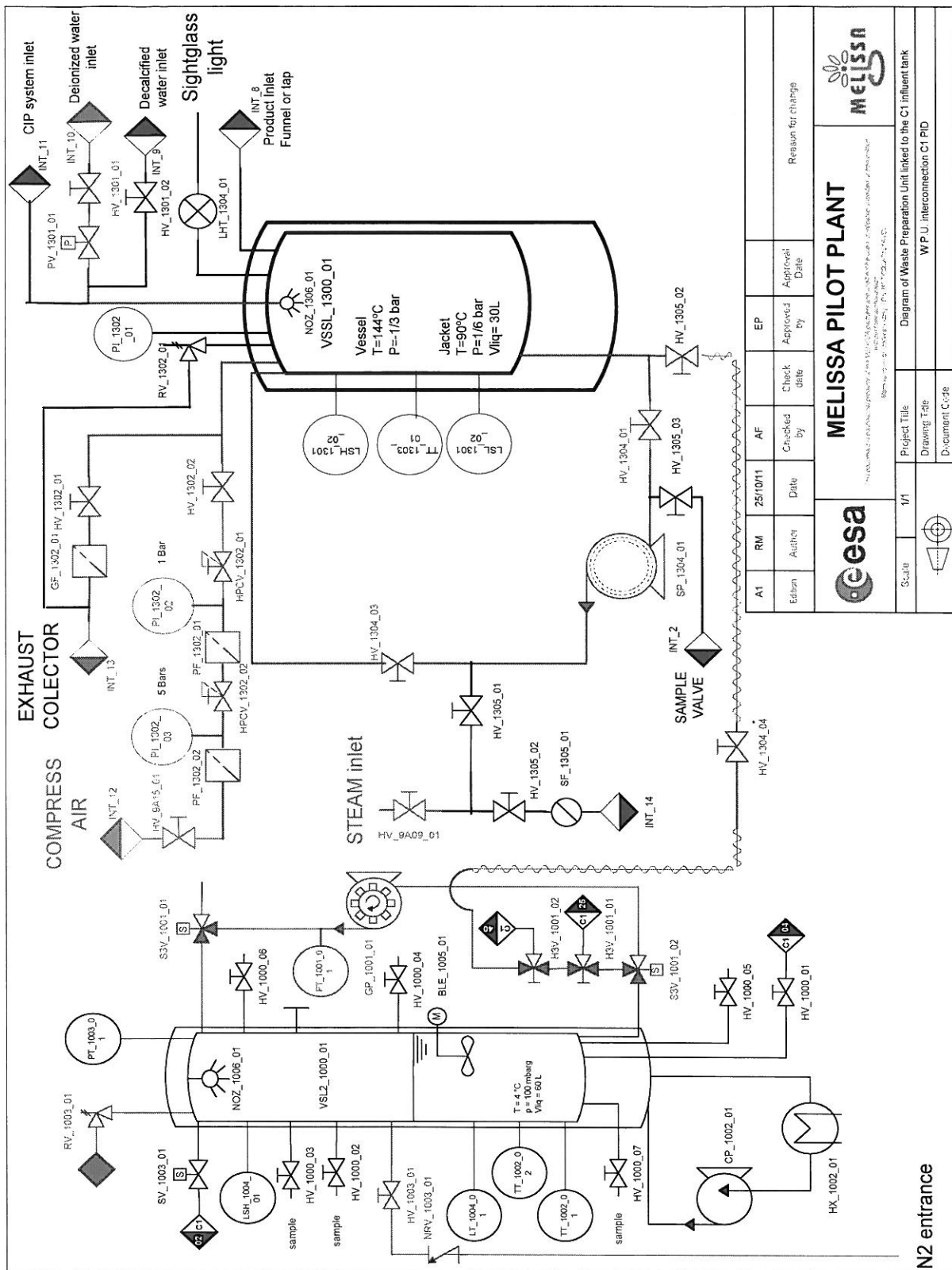| Document Identification: Operating Procedure for Grinding and Mixing of C1 Bioreactor Feed with the Waste Preparation Unit	Type	Chrono	Issue	
	MPP-OP	10-1002	(0)	Page: 14 / 18

12.16. Push the green "Start" button neutralizing the cleaning solution.

12.17. Stop the centrifugal pump after 5 min by pressing the red "Stop" button.

12.18. Open the manual valve HV_1302_02.

12.19. Verify that the pressure indication in gauge PI_1302_01 is between 0.5 and 1.0 bar (see figure 4). Otherwise, it is necessary to adjust the pressure opening or closing the pressure regulator HPCV_1302_01 (see figure 4), to reach that range.

12.20. Make sure that the flexible drain line from the three-way manual valve H3V_1001_01 (see figure 4) is well fixed to the drain collector.

12.21. Open the manual valve HV_1305_02 (see figure 4) and verify that the neutralized cleaning solution is transferred by the gas pressure circulating through the feed line until the drain system.

12.22. When the complete volume of the neutralized cleaning solution has been discharged, close the manual valve HV_1302_02 and open the exhaust hand valve HV_1302_01 (see figure 4).

12.23. Close the bottom manual valve HV_1305_02 (see figure 4).

12.24. Fill the WPU with decalcified water by opening the manual valve HV_1301_01 (see figure 4) until a reading of 100 kg is reached in the weight controller display (see figure 3).

12.25. Start the centrifugal pump by pressing the green "Start" button to initiate the rinsing process with decalcified water for 5 min.

12.26. Open the compressed air supply valve HV_1302_02 and verify that the pressure indication in gauge PI_1302_01 is between 0.5 and 1.0 bar (see figure 4). Otherwise, it is necessary to adjust the pressure by opening or closing the pressure regulator HPCV_1302_01 (see figure 4), to reach that range.

12.27. Open the manual valve HV_1305_02 (see figure 4) and verify that the rinsing water is transferred through the feed line, until the drain system.

12.28. Take a sample in the drain of the C1 to verify the pH, if the pH is between 7-9 follow to the next step, if not repeat the steps 11.24 to 11.28. Write down the pH value on the record sheet MPP-REC 11-1002(0).

12.29. Check visually the cleanliness of the vessel VSSL_1300_01.

12.30. Switch off the WPU panel control in the main switch.

The figure 9 describes a P&ID drawing of the elements involved in the procedure. The elements in blue are those implied in the cleaning process.

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Figure 9. WPU interconnection with C1 cleaning procedure

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13. WPU temperature control for maintaining feeding inside

The WPU is provided with an internal jacket and a controller system to control the temperature of the medium inside the vessel. This control can be used when the MPP team decides to use the WPU to accumulate some extra feeding of C1. The temperature is controlled by a temperature regulator based on the indication of a Pt100, and a three-way automatic valve. This control system is not connected to the PLC, since it is a closed loop control, managed by the temperature regulator. The way of controlling the temperature is explained in the next paragraph.

13.1. *Prerequisites to start up the temperature control :*

- Verify the manual valves HV_1303_01 and HV_1303_02 are in open position.
- Verify that the manual valves of the chilled water supply are open, HV_9A05_01 and HV_9A05_02.
- If some of these valves are closed verify the pressure in the PI_1303_01, if it is around 2 bars it is OK and it is possible to open all the manual valves to start the temperature control, if the Pressure value of PI_1303_01 is less than 1.5 bars check the MPP_UM_11_0001(0) to know how to increase the pressure in the chilled water loop.
- When all the manual valves involved in the temperature control are open the system is OK to start the temperature control of the WPU.

13.2. *Start/stop of the temperature control:*

- The WPU cabinet has an external selector in the front panel to put ON/OFF the temperature control, see figure 2.
- To start the temperature control it is only necessary to change the position of the temperature control selector to ON position, just when the selection is activated the temperature control regulator opens directly the three way automatic valve so that the temperature of the WPU tank reaches the temperature setpoint.
- To stop the temperature control , move the temperature control selector to OFF position.

13.3. *Temperature setpoint:*

- The temperature controller used into the WPU is an Osaka controller, see figure 10.

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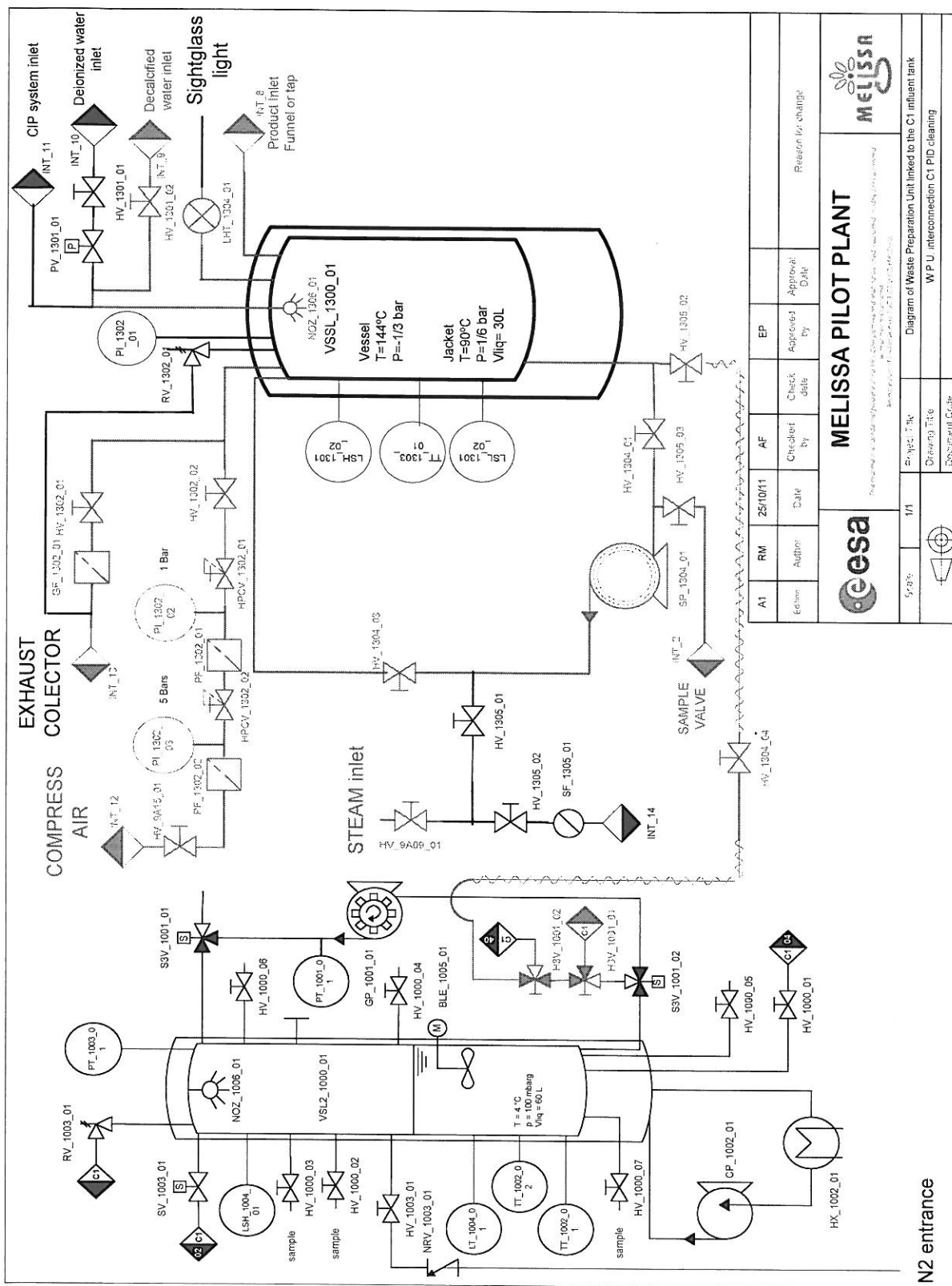| Document Identification: Operating Procedure for Grinding and Mixing of C1 Bioreactor Feed with the Waste Preparation Unit	Type	Chrono	Issue	
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Figure 10: Osaka temperature controller

- The red value of the temperature controller is the actual temperature into the WPU tank, it is provided by a PT100 installed directly in the Tank TT_1301_01.

- The green value is the setpoint programmed into the temperature regulator. If it is necessary to change the set point, it is possible to do it pressing the **SET** key, and adjusting the value of the temperature setpoint increasing or decreasing the value using the ↑ or ↓ arrows keys.

14. Record

The operations above described along this document shall be recorded in the document MPP-REC-11-1002(0).

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Appendix 1

The mixture of vegetables, paper and feces is mixed and milled in the WPU. The following table describes the composition of the feed to be supplied to the unit, considering three possible conditions:

a) Feeding twice a week (3.5 days period)
b) Feeding once in a week (7.0 days period)

Material added	Supply period (days)	
	3.5	**7.0**
Initial water (L)	10	25
Human feces (g)	320	640
Vegetables mixture (kg)*	6.39	12.78
Intermediate volume (L)	25	
Rinsing water (L)	10	
Final volume (L)	**35**	**70**

(*) The vegetables mixture is prepared and stored frozen in 6.39 kg bags.

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ANNEXES

ANNEX 1: User manual of Variable speed drive and Control hardware components

SD450
Series
VARIABLE SPEED DRIVE

Variable Speed Drive
Getting Started Manual

POWER ELECTRONICS®

SD450
Series

VARIABLE SPEED DRIVE

variable speed drive
Getting Started Manual

SAFETY SYMBOLS

Always follow safety instructions to prevent accidents and potential hazards from occurring.

⚠ **WARNING**		This symbol means improper operation may results in serious personal injury or death.
⚡ **CAUTION**		Identifies shock hazards under certain conditions. Particular attention should be given because dangerous voltage may be present. Maintenance operation should be done by qualified personnel.
⚠		Identifies potential hazards under certain conditions. Read the message and follow the instructions carefully.
⚡		Identifies shock hazards under certain conditions. Particular attention should be given because dangerous voltage may be present.

Edition of May 2009

This publication could present technical imprecision or misprints. The information here included will be periodically modified and updated, and all those modifications will be incorporated in later editions.
To consult the most updated information of this product you might access through our website www.power-electronics.com where the latest version of this manual can be downloaded.

Revisions

Date	Revision	Description
06 / 03 / 2006	A	Updated software version SW PE 1.1 Ver 0.3
17 / 10 / 2006	B	Updated MODBUS communication
		Updated software version SW PE 1.2 Ver 0.3
23 / 04 / 2007	C	Misprints updating.
		Update of chapters 4, 5, 11.
		Update (2) software version SW PE 1.2 Ver 0.3 (Stall Prevention Mode)
19 / 11 / 2007	D	Update of Dynamic Braking documentation (chapter 11).
16 / 05 / 2008	E	Adaptation to new name SD450.
		Update of connection drawings in chapter 12 (Common. Used Config.).
21 / 05 / 2009	F	Misprints updating.

INDEX

SAFETY INSTRUCTIONS

IMPORTANT!

- Read this manual carefully to maximise the performance of this product and to ensure its safe use.

- In this manual, safety messages are classified as follows:

⚠ **WARNING**

Do not remove the cover while the power is applied or the unit is in operation.
Otherwise, electric shock could occur.

Do not run the inverter with the front cover removed.
Otherwise, you may get an electric shock due to the high voltage terminals or exposure of charged capacitors.

Do not remove the cover except for periodic inspections or wiring, even if the input power is not applied.
Otherwise, you may access the charged circuits and get an electric shock.

Wiring and periodic inspections should be performed at least 10 minutes after disconnecting the input power and after checking the DC Link voltage is discharged with a meter (below 30VDC).
Otherwise, you may get an electric shock.

Operate the switches with dry hands.
Otherwise, you may get an electric shock.

Do not use cables with damaged insulation.
Otherwise, you may get an electric shock.

Do not subject the cables to abrasions, excessive stress, heavy loads or pinching.
Otherwise, you may get an electric shock.

⚠ CAUTION

Install the inverter on a non-flammable surface. Do not place flammable material nearby.
Otherwise, fire could occur.

Disconnect the input power if the inverter gets damaged.
Otherwise, it could result in a secondary accident or fire.

After the input power is applied or removed, the inverter will remain hot for a couple of minutes.
Touching hot parts may result in skin burns.

Do not apply power to a damaged inverter or to an inverter with parts missing even if the installation is complete.
Otherwise, you may get an electric shock.

Do not allow lint, paper, wood chips, dust, metallic chips or other foreign matter into the inverter.
Otherwise, fire or accident could occur.

⚠ WARNINGS

RECEPTION

- The SD450 is carefully tested and perfectly packed before leaving the factory.

- In the even of transport damage, please ensure that you notify the transport agency and POWER ELECTRONICS: 902 40 20 70 (International (+34) 96 136 65 57) or your nearest agent, within 24hrs from receipt of the goods.

UNPACKING

- Make sure model and serial number of the variable speed drive are the same on the box, delivery note and unit.

- Each variable speed drive is supplied with a SD450 technical manual.

RECYCLING

- Packing of the equipments should be recycled. For this, it is necessary to separate different materials included (plastic, paper, cardboard, wood, ...) and deposit them on proper banks.

- Waste products of electric and electronic devices should be selectively collected for their correct environmental management.

SAFETY

- Before operating the inverter, read this manual thoroughly to gain and understanding of the unit. If any doubt exists then please contact POWER ELECTRONICS, (902 40 20 70 / +34 96 136 65 57) or your nearest agent.

- Wear safety glasses when operating the inverter with power applied and the front cover is removed.

- Handle the inverter with care according to its weight.

- Install the inverter according to the instructions within this manual.

- Do not place heavy objects on the inverter.

- Ensure that the mounting orientation is correct.

- Do not drop the inverter or subject it to impact.

- The SD450 inverters contain static sensitive printed circuits boards. Use static safety procedures when handling these boards.

- Avoid installing the inverter in conditions that differ from those described in the *Technical Characteristics* section.

CONNECTION PRECAUTIONS

- To ensure correct operation of the inverter it is recommended to use a SCREENED CABLE for the control wiring.

- For EMERGENCY STOP, make sure supply circuitry is open.

- Do not disconnect motor cables if input power supply remains connected. The internal circuits of the SD450 Series will be damaged if the incoming power is connected and applied to output terminals (U, V, W).

- It is not recommended to use a 3-wire cable for long distances. Due to increased leakage capacitance between conductors, over-current protective feature may operate malfunction.

- Do not use power factor correction capacitors, surge suppressors, or RFI filters on the output side of the inverter. Doing so may damage these components.

- Always check whether the DC Link LED is OFF before wiring terminals. The charge capacitors may hold high-voltage even after the input power is disconnected. Use caution to prevent the possibility of personal injury.

- The maximum recommended cable length between the inverter and motor is:

  o For models 3.7kW to 22kW: do not exceed 100m when operating at factory default carrier frequency and whenever an unshielded cable is used. If a shielded cable is used, the distance is reduced to half.

  o For models 30kW to 75kW: do not exceed 150m when operating at factory default carrier frequency and whenever an unshielded cable is used. If a shielded cable is used, the distance is reduced to half.

  For greater output cable lengths please consult the Technical Department at POWER ELECTRONICS.

TRIAL RUN

- Verify all parameters before operating the inverter. Alteration of parameters may be required depending on application and load.

- Always apply voltage and current signals to each terminal that are within levels indicated within this manual. Otherwise, damage to the inverter may result.

OPERATION PRECAUTIONS

- When the Auto Restart function is enabled, keep clear of driven equipment, as the motor will restart suddenly after a fault is reset.

- The "STOP / RESET" key on the keypad is active only if the appropriate function setting has been made. For this reason, install a separate EMERGENCY STOP push button that can be operated at the equipment.

- If a fault reset is made with the reference signal still present then a restart will occur. Verify that it is permissible for this to happen, otherwise an accident may occur.

- Do not modify or alter anything within the inverter.

- Before programming or operating the SD450 Series, initialise all parameters back to factory default values.

EARTH CONNECTION

- The inverter is a high frequency switching device, and leakage current may flow. Ground the inverter to avoid electrical shock. Use caution to prevent the possibility of personal injury.

- Connect only to the dedicated ground terminal of the inverter. Do not use the case or the chassis screw for grounding.

- When installing, grounding wire should be connected first and removed last.

- The earth cable must have a minimal cross sectional area that meets local country electrical regulations.

- Motor ground must be connected to the drive ground terminal and not to the installation's ground. We recommend that the section of the ground connection cable should be equal or higher than the active conductor.

- Installation ground must be connected to the inverter ground terminal.

1. INTRODUCTION

1.1. Configuration Table

EXAMPLE

Code: SD45060

SD45	060	
SD450 Series	**Output Current**	
060	60A	
075	75A	
...	...A	

1.2. Standard Ratings

REFERENCE	FRAME	kW	I
SD45008	1	3,7	8
SD45012	2	5,5	12
SD45016		7,5	16
SD45024	3	11	24
SD45030		15	30
SD45039	4	18,5	39
SD45045		22	45
SD45060	5	30	60
SD45075		37	75
SD45090	6	45	90
SD45110	7	55	110
SD45150		75	150

STANDARD MOTORS: **4 POLES.**

1.3. Drive Description
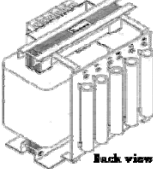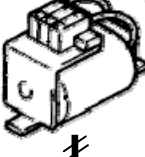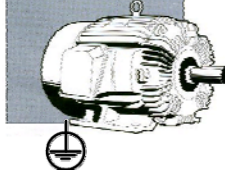
The SD450 is the ideal frequency inverter for ac motor operation from 3,7kW to 90kW, in all kinds of industry and most applications: HVAC (heating ventilation, air conditioning), MMC (multiple motors control), transport, handling…

1. Removable display with independent memory
2. Cables input
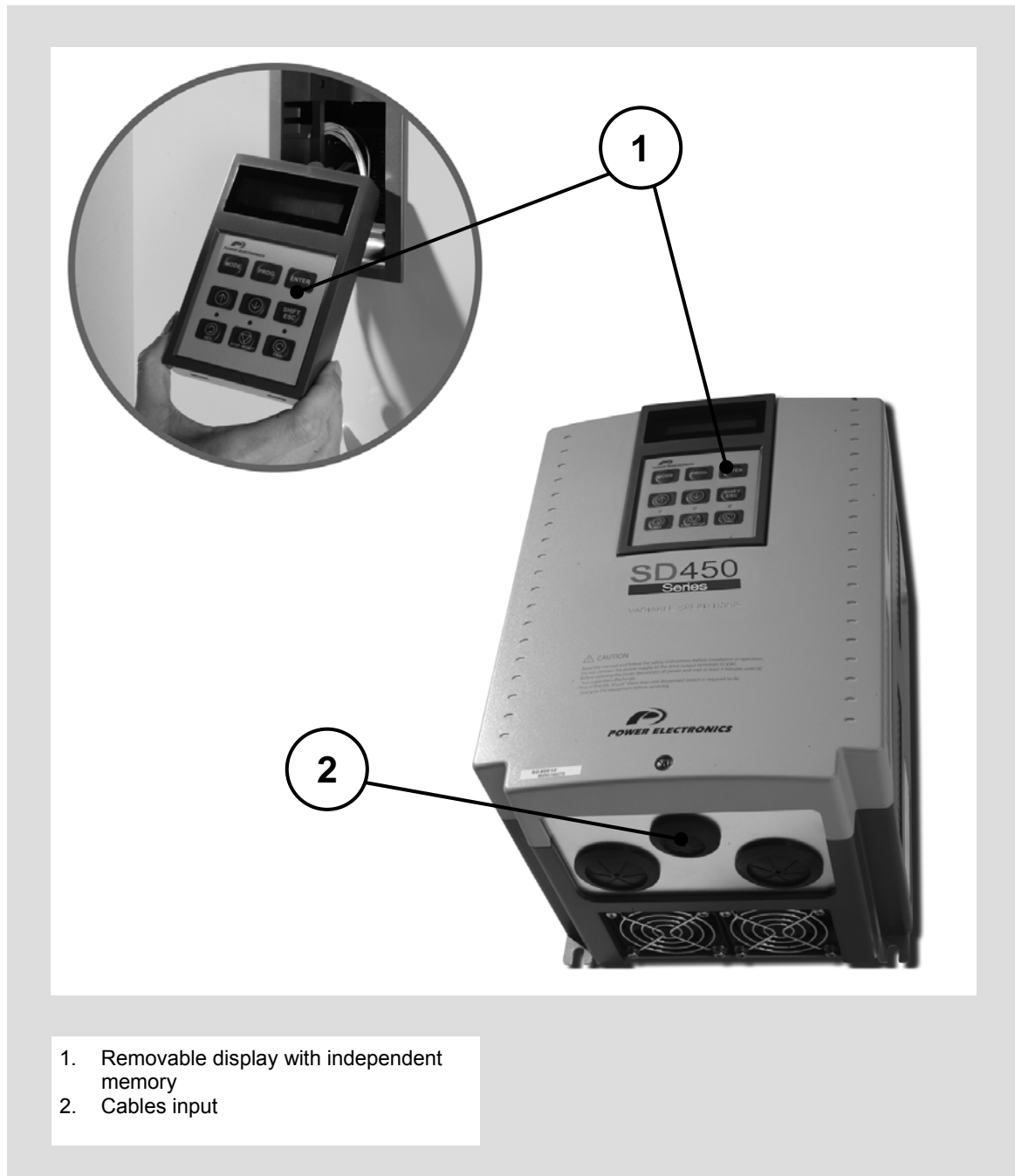
2. INSTALLATION AND CONNECTION

2.1. Basic Configuration

The following devices are required to operate the inverter. Proper peripheral devices must be selected and correct connections must be done to ensure proper operation. An incorrectly applied or installed inverter can result in system malfunction or reduction in product life as well as component damage. You must read and understand this manual thoroughly before proceeding.

	AC Power Supply	Use a power source with a voltage within the permissible range of inverter input power rating.
	Earth leakage circuit breaker (ELB)	Select circuit breakers or fuses in accordance with applicable national and local codes.
	Inline Magnetic Contactor	Install if necessary. When installed, do not use it for the purpose of starting or stopping the drive.
	AC Reactor	The reactors must be used when the power factor is to be improved and harmonic level has been reduced.
	Installation and wiring	To getting a reliable operation of the inverter, install the inverter in the proper orientation and with proper clearances. Incorrect terminal wiring can damage the equipment.
	DC Reactor	DC reactor can be used to reduce harmonic level or improve power factor instead of AC reactor.
	Motor	Do not connect a power factor capacitor, surge suppressor or radio noise filter to the output side of the drive.

2.2. Environmental Conditions

Verify ambient conditions of mounting location.
Ambient temperature should not be below -10ºC (14ºF) or above 50ºC (122ºF).
Relativity humidity should be less than 90% (non-condensing).
Altitude should be below 1.000m (3.300ft).

The inverter must be mounted vertically with sufficient horizontal and vertical space between adjacent equipment.

- A = Higher to 100mm (500mm in case of drives up to 30kW and greater).
- B = Higher to 50mm (200mm in case of drives up to 30kW and greater).
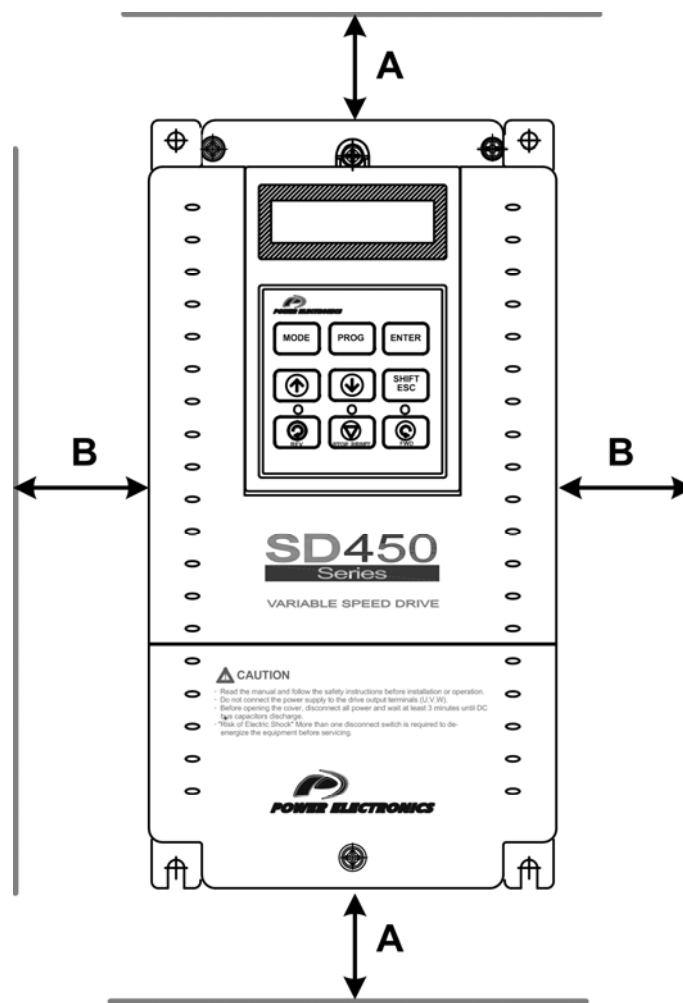
SD45ITM0001BE

Figure 2.1 SD450 mounting

2.3.　Power Terminals Wiring

SYMBOL	DESCRIPTION
R (L1)	AC Line Voltage Input
S (L2)	(3-Phase, 380 ~ 480 VAC)
T (L3)	
G	Earth or Ground
P (+)	**Positive Terminal of DC Bus** Connection terminal for Dynamic Braking Units [P(+)*].
N (-)	**Negative Terminal of DC Bus** Connection terminal for Dynamic Braking Units [N(-)**]
U	Output terminal to Motor
V	(3-Phase, 380 ~ 480 VAC)
W	

POWER TERMINALS (details)	
Figure 2.2 Detail 1	*Figure 2.3 Detail 2*

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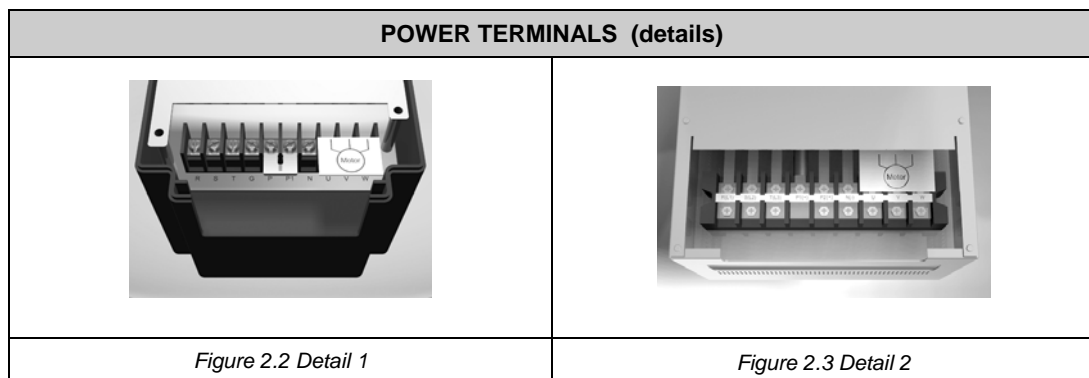
* P terminal is for optional Dynamic Braking Unit.
** N terminal is for optional Dynamic Braking Unit.

2.3.1. Configuration of Frames 1 and 2

- ▪ This configuration is correct for models from SD45008 to SD45016.
- ▪ These drives does not built-in the DC Bus inductance, this connection is optional.
- ▪ Regarding to the braking capacity, an external Dynamic Braking Unit should be connected depending on the ED needed.
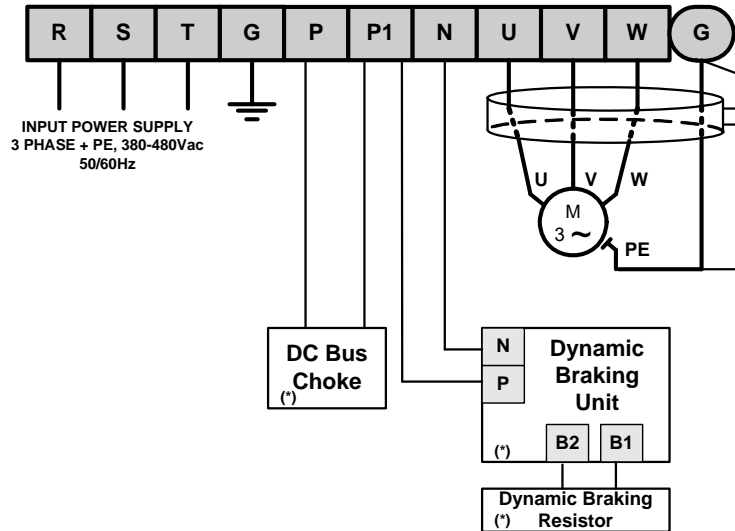
Motor cable shield should be connected to the drive and additionally to
the general earth of the installation.
(*) Options

SD45DTP0001DI

Figure 2.4 Power circuit frames for Frames 1 and 2

2.3.2. Configuration of Frame 3

Dynamic braking resistor or dynamic braking unit can be added to the SD45024 and SD45030 drives.
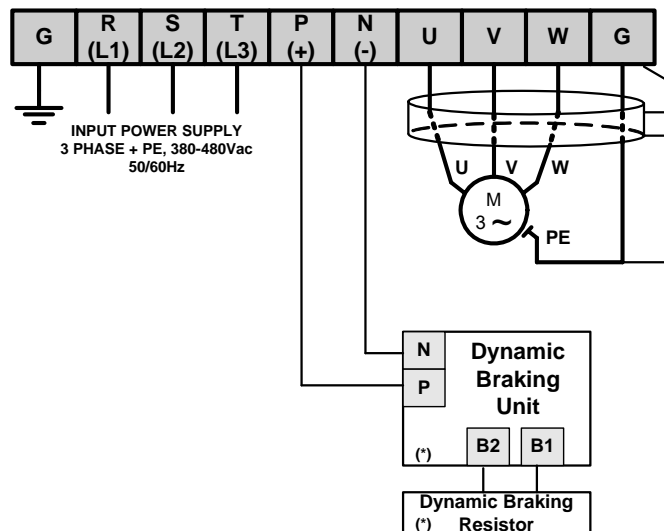
Motor cable shield should be connected to the drive and additionally to
the general earth of the installation.
(*) Options

SD45DTP0002DI

Figure 2.5 Power circuit wiring for Frame 3

2.3.3. Configuration of Frame 4
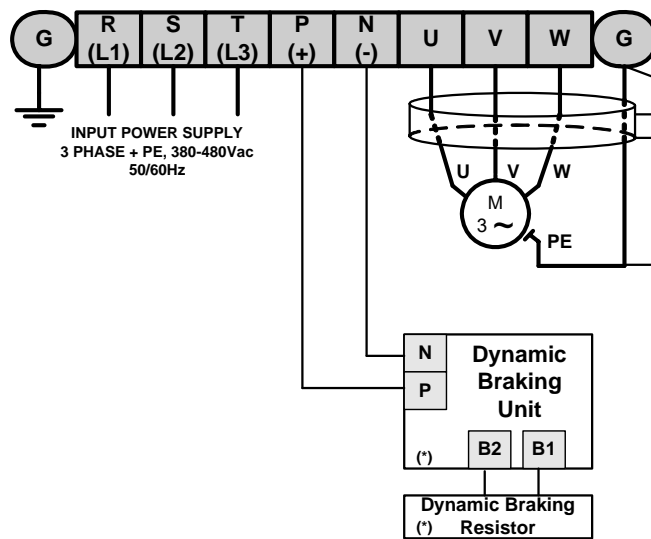
Motor cable shield should be connected to the drive and additionally to
the general earth of the installation.

SD45DTP0003DI

(*) Options

Figure 2.6. Power circuit wiring for Frame 4

2.3.4. Configuration of Frames 5, 6 and 7

The wiring for inverters from SD45060 to SD45150 could be done in a similar way of above
mentioned. The main difference is the physical distribution of the terminals.
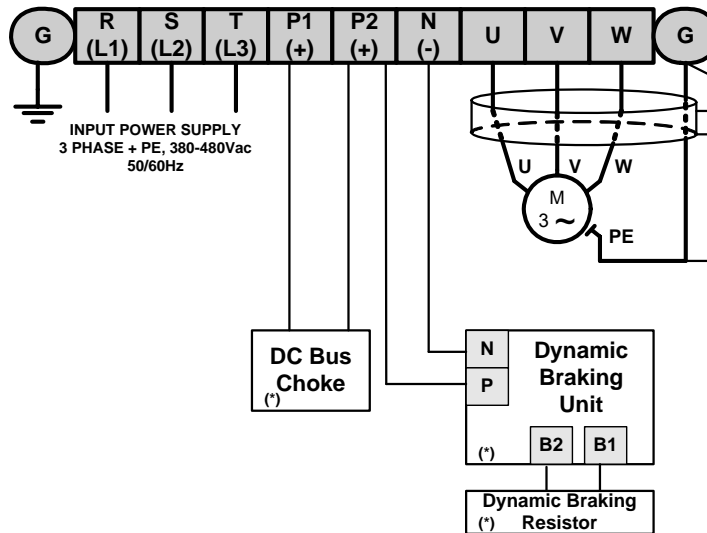
Motor cable shield should be connected to the drive and additionally to the
general earth of the installation.

SD45DTP0004DI

(*) Options

Figure 2.7 Power circuit wiring for Frames 5 to 7

2.3.5. Wiring and Cross Section of Terminals

Pay attention to the following table when information for wiring, cross section of terminals and screws is required to connect correctly the main power supply (R, S, T) and the output to the motor (U, V, W).

Inverter rated power		Terminal screw size	Screw torque* (Kg·cm)	Ring terminals		Cable**			
						mm²		AWG	
				R,S,T	U,V,W	R,S,T	U,V,W	R,S,T	U,V,W
400V Model	3.7kW	M4	15	2-4	2-4	4	2.5	12	14
	5.5kW	M5	15	5.5-5	5.5-5	4	4	12	12
	7.5kW	M5	26	14-5	8-5	6	6	10	10
	11kW	M6	26	14-5	14-5	16	10	6	8
	15kW	M6	45	22-6	22-6	16	10	6	8
	18.5kW	M8	45	38-8	38-8	16	16	4	6
	22kW	M8	100	38-8	38-8	16	16	4	4
	30kW	M8	100	38-8	38-8	25	25	4	4
	37kW	M8	100	38-8	38-8	35	35	2	2
	45kW	M8	100	38-8	38-8	35	35	2	2
	55kW	M8	100	38-8	38-8	70	70	1/0	1/0
	75kW	M10	300	-	-	70	70	1/0	1/0

---

* Apply the rated torque to terminal screws. Loosen screws can cause of short circuit and malfunction. Tightening the screw too much can damage the terminals and cause short circuit and malfunction.
** Use cooper wire with 600V, 75 ºC ratings for wiring.
Recommended cable section. It is absolutely necessary that the installer guaranties the correct observance of the law and the regulations that are in force in those countries or areas where this device is going to be installed.

2.4. Main Power Supply and Motor Connection

Power supply must be connected to the R(L1), S(L2), and T(L3) terminals. Connecting it to the U, V, and W terminals causes internal damages to the inverter. Arranging the phase sequence is not necessary.

Motor should be connected to the U, V, and W terminals. If the forward command (FX) is on, the motor should rotate counter clockwise when viewed from the load side of the motor. If the motor rotates in the reverse, switch the U and V terminals.
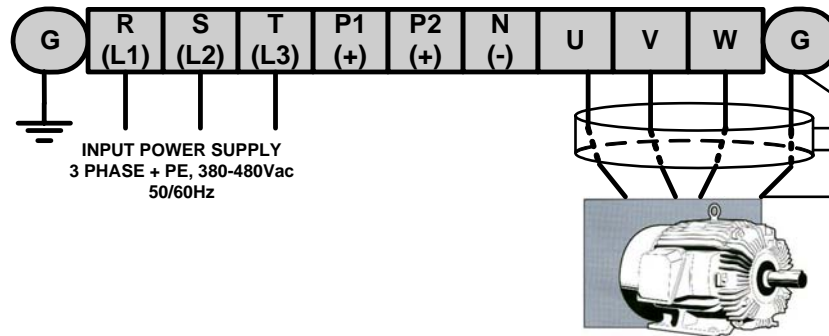
SD45DTP0005CI

Figure 2.8 Inverter and motor connection

2.5. Control Terminals Wiring

2.5.1. Control Terminals Detail
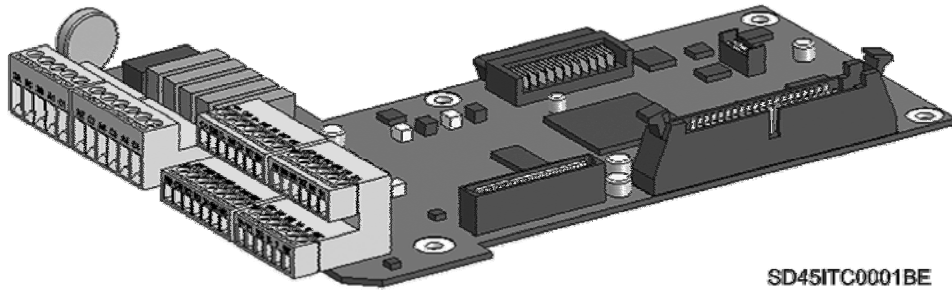
Figure 2.9 Connectors on control board

Control connectors for inverters from SD45008 to SD45045 (3.7kW a 22kW)
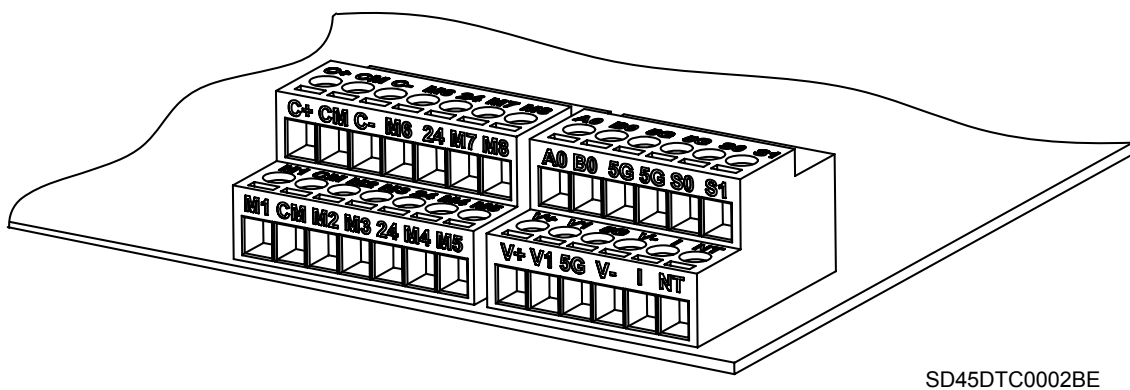
Figure 2.10 Detail of control terminals for Frame 1 to Frame 4

Control connectors for inverters from SD45060 to SD45150 (30kW a 75kW)
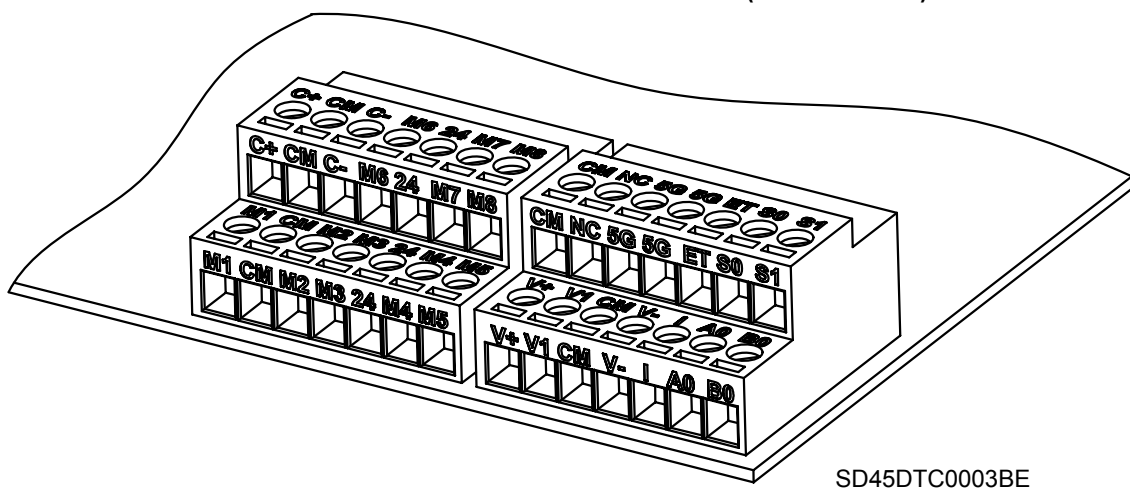
Figure 2.11 Detail of control terminals for Frame 5 to Frame 7

Connection precautions

▪ Do not connect terminals CM and 5G to the power ground.

▪ Use shielded wires or twisted wires for control circuit wiring, and separate these wires from the main power circuits and other high voltage circuits (200V relay sequence circuit).

▪ It is recommended to use the cables of 0.0804mm² (28 AWG) ~ 1.25mm² (16 AWG) for TER1, TER2 control terminals and the cables of 0.33mm² (22 AWG) ~ 2.0mm² (14 AWG) for TER3, TER4 control terminals.

3A	3C	3B	A1	C1	A2	C2	A3	C3	A4	C4

TER4
(22 – 14 AWG)

TER3
(22 – 14 AWG)

C+	CM	C-	M6	24	M7	M8
M1	CM	M2	M3	24	M4	M5

TER2
(28 – 16 AWG)

A0	B0	5G	5G	S0	S1
V+	V1	5G	V-	I	NT

TER1 for 22kW and bellow
(28 – 16 AWG)

CM	NC	5G	5G	ET	S0	S1
V+	V1	CM	V-	I	A0	B0

TER1 for 30kW and above
(28 – 16 AWG)
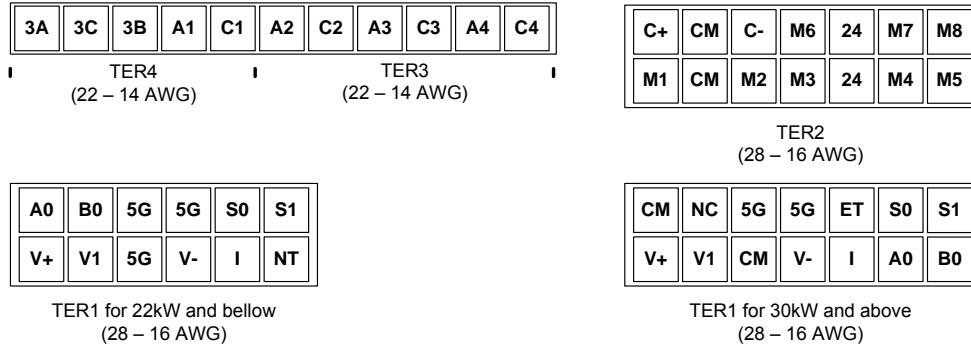
SD45DTC0004AI

Figure 2.12 Detail of control terminals for SD450 Series

Description of control terminals

TYPE		SYMBOL	NAME	DESCRIPTION
Input Signals	Digital Inputs	M1, M2, M3	Programmable digital inputs 1, 2 and 3.	Programmable input terminals to define the digital inputs functions. **Factory setting: Speed-L, Speed-M and Speed-H, for multiple speeds.** It can be programmable also like M1 – M8.
		M7	Programmable digital input, 7.	Activating a contact on this terminal, the drive starts to run in forward direction, by deactivating the contact on the terminal, the drive stops. **Factory setting: Forward command (FX).** It can be programmable also like M1 – M8.
		M8	Programmable digital input, 8.	Activating a contact on this terminal, the drive starts to run in reverse direction, by deactivating the contact on the terminal, the drive stops. **Factory setting: Reverse command (RX).** It can be programmable also like M1 – M8.
		M6	Programmable digital input, 6.	Activating a contact on this terminal, the drive start to run at preset frequency, programmed as JOG frequency, by deactivating the contact the drive stops. **Factory setting: JOG Frequency.** It can be programmable also like M1 – M8.
		M4	Programmable digital input, 4.	By activating a contact on this terminal, the drive is reset after a fault. **Factory setting: Faults Reset (RST).** It can be programmable also like M1 – M8.
		M5	Programmable digital input, 5.	Activating a contact on this terminal, the drive cut its output due to an emergency situation. If emergency conditions disappear, the drive does not need to receive a reset signal and can automatically start to run again. Be careful using this signal. **Factory setting: Emergency.** It can be programmable also like M1 – M8.
		CM	(NPN) Common / 24V Common	Common terminal 0VDC for input contacts at NPN mode and common terminal for 24VDC external supply.
		24	(PNP) Common / +24VDC Supply	Common terminal 24VDC for input contacts at PNP mode. It can also be used like user power supply (maximum: +24V, 50mA).

TYPE		SYMBOL	NAME	DESCRIPTION
Input Signals	**Analogue Inputs**	V+, V-	Analogue power supply (+12V, -12V)	Power supply for analogue reference signal. Maximum output:+12VDC, 100mA; -12VDC, 100mA.
		V1	Frequency Reference Signal (Voltage)	Terminal used to introduce the frequency reference or target, using a voltage signal of 0-12VDC or $\pm$12VDC. (Input impedance 20kΩ).
		I	Frequency Reference Signal (Current)	Terminal used to introduce the frequency reference or target, using a current signal of 0-20mA. (Input impedance 249Ω).
		A0, B0	Frequency Reference Signal (Pulses)	Terminal used to introduce the frequency reference or target, using a pulse signal.
		5G (≤22kW) CM (≥30kW)	Common terminals for analogue signals	Common terminal for all analogue reference signals.
	Motor thermal detection	NT (≤22kW) ET (≥30kW)	Motor temperature input	Motor thermal sensor input. Used to prevent motor from overheating using a NTC or PTC sensor.
Output signals	**Digital Outputs**	3A, 3C, 3B	Fault Relays Contacts	It is a commutate contact. It will be active when a fault is present (250VAC, 1A; 30VDC, 1A). At fault conditions: 3A-3C Closed (3B-3C Open). At normal conditions: 3B-3C Closed (3A-3C Open)
		A1 – A4 C1 – C4	Programmable digital outputs	Free potential relays contacts. To be used as programmable digital outputs (250VAC, 1A; 30VDC, 1A).
		S0, S1, 5G	Programmable analogue outputs	Analogue output voltage settable as one of the following parameters: Output Frequency, Output Current, Output Voltage, DC Link Voltage.
RS485	**Communications**	C+, C-	High and Low RS485 Signal	Communication RS485 Signal.
		CM	RS485 common	Common terminal for RS485 signal.

The SD450 Series provides two different way of functioning regarding to the input signals: NPN or PNP modes. The corresponding connections methods are shown below:

NPN mode

It is necessary to set J1 at NPN (lower position). In that case, the input terminals will be energized using the internal power supply of the drive. CM terminal (GND for 24VDC) will be the common terminal for contact input signals.

SD45DTC0005AI
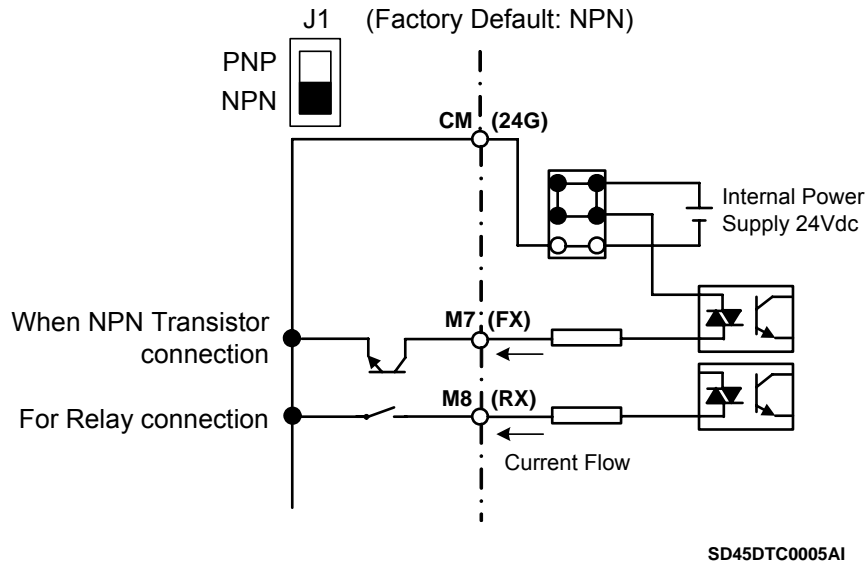
Figure 2.13 Control terminals at NPN mode

PNP mode

It is necessary to set J1 at PNP (upper position). In that case, the input terminals will be energized using the internal power supply of the drive. 24 terminal (24VDC) will be the common terminal for contact input signals.

SD45DTC0006AI
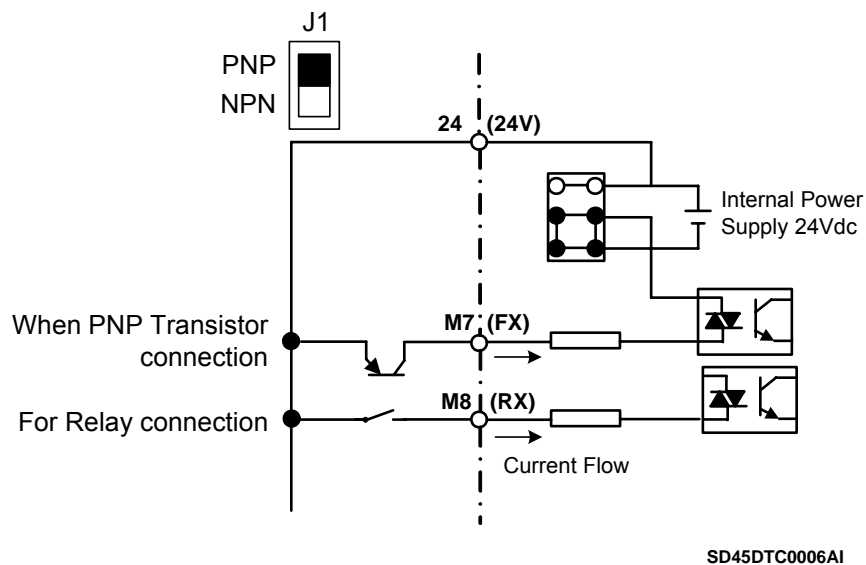
Figure 2.14 Control terminals at PNP mode and internal power supply

PNP mode (external supply)

It is necessary to set J1 at PNP (upper position). In this case, the input terminals will be energized using and external power supply of 24VDC, but its GND terminal must be connected to CM terminal of the drive. 24 terminal of the external power supply will be the common for the contact input signals.
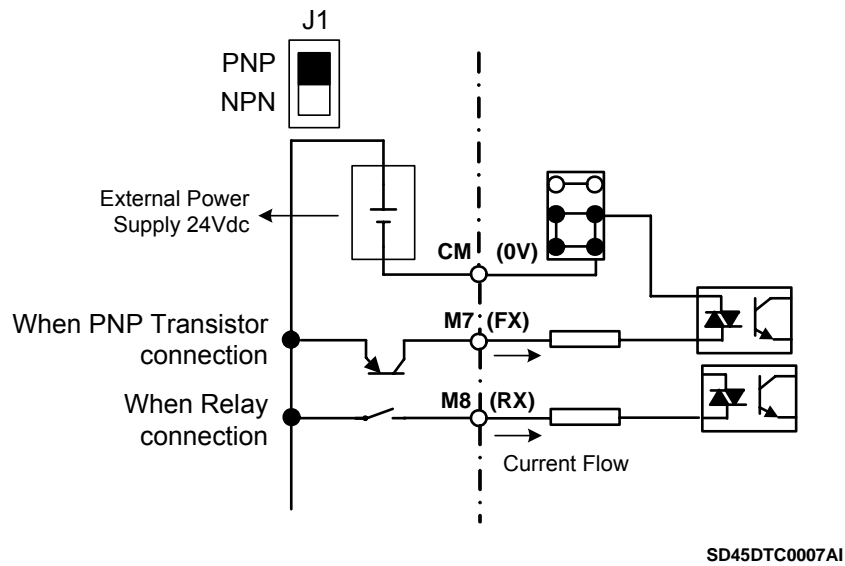
Figure 2.15 Control terminals at PNP mode and external power supply

2.5.2. Standard Connection for Control Terminals

Digital inputs and outputs connection is standard for all drives capacities, as it is shown in the following figure:
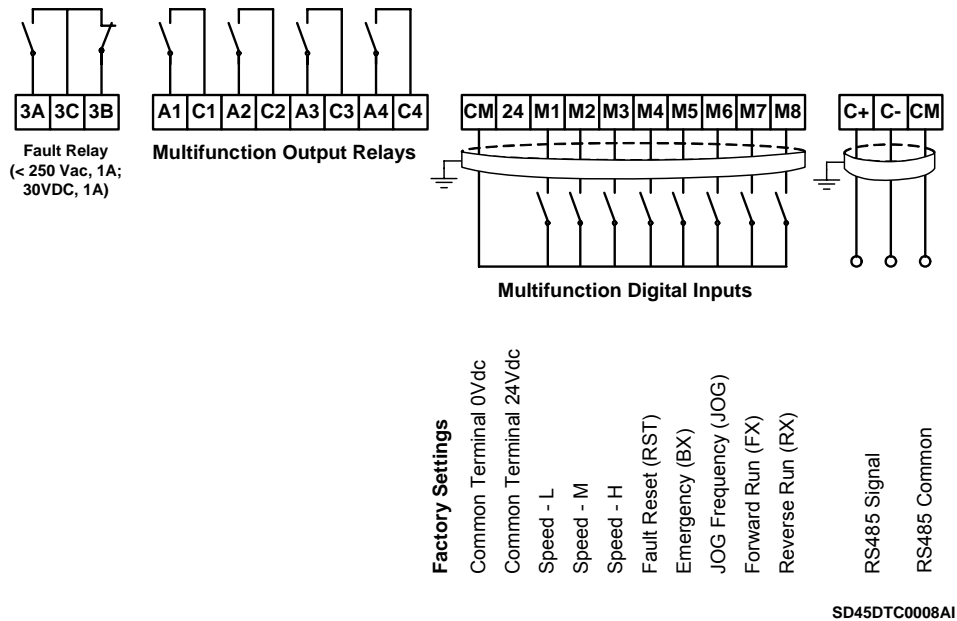
Figure 2.16 General wiring for SD450 Series

Note: Do not apply voltage directly to M7 (FX) and M8 (RX) terminals.

Analogue inputs and outputs are not standard for the complete SD450 series. The following differences must be taken into consideration:

a) Control signal wiring from 3.7kW to 22kW.
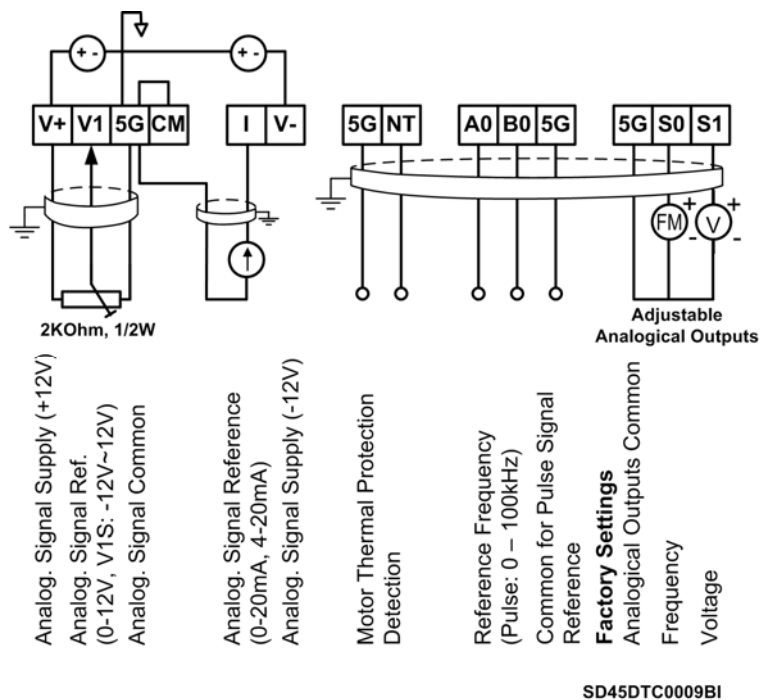
Figure 2.17 General wiring for analogue signals for Frames 1 to 4

b) Control signal wiring from 30kW to 75kW.

SD45DTC0010AI
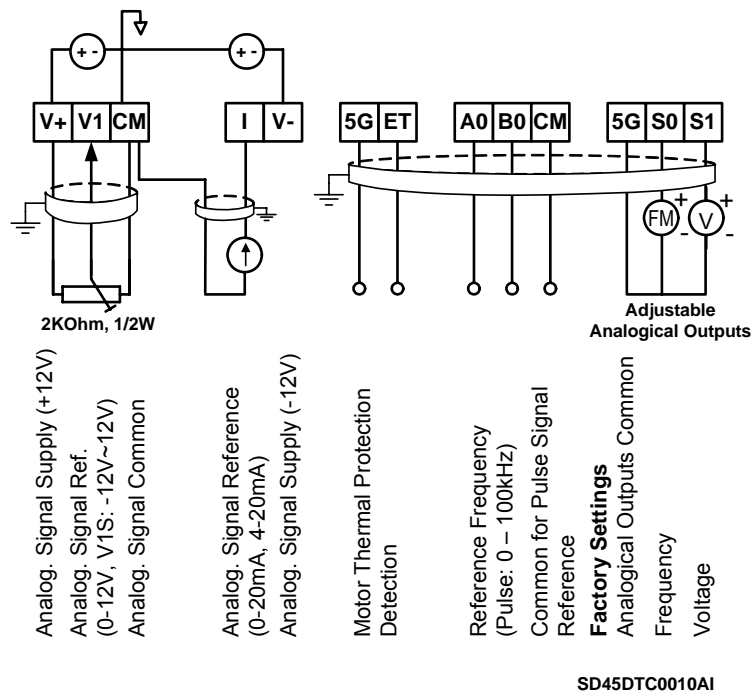
Figure 2.18 General wiring for analogue signals for Frames 5 to 7

3. TECHNICAL CHARACTERISTICS

INPUT	Power supply	380 to 480VAC (-15% to +10%) 3-Phase
	Input frequency	50 ÷ 60Hz ± 5%
	Input power factor	> 0.98 (of fundamental)
	Momentary power loss	> 15ms

OUTPUT	Motor output voltage	0VAC to V. Input (–3V at 100% load)
	Overload capacity	150% during 60 sec.
		200% during 0,5 sec.
	Frequency ratings	0.01Hz to ±120Hz
	Efficiency (at full load)	>98%
	Control method	Space vector technology
	Carrier frequency	Maximum 15kHz

ENVIRONMENTAL CONDITIONS	Degree Protection	IP20
	Ambient temperature	-10ºC to 50ºC
	Storage temperature	-20ºC to +65ºC
	Ambient humidity	<90%, non-condensing
	Altitude	1000m
	Altitude de-rating (> 1000)	-1% per 100m; maximum 3000m
	Vibration	5,9m/sec² (=0,6g)
	Installation site	Recommended: environment with no corrosive gas, combustible gas, oil mist or dust

CONTROL	Control method	V/Hz control, Vector control (Sensorless)
	Analogue inputs	1 input 0-12VDC or ±12VDC, 1 input 4-20mA or 0-20mA
		1 encoder input
	Digital inputs	8 programmable inputs
	PTC input	1 input
	Analogue outputs	2 outputs 0-10VDC
	Relay outputs	1 changeover fault relay (250VAC, 1A; 30VDC, 1A)
		4 normally open programmable relays (250VAC, 1A; 30VDC, 1A)
	Display unit	Removable keypad, digitally programmable (independent memory)
	Communications port	RS485 ModBus RTU protocol built –in
		Profibus and DeviceNet, optional
	Dynamic braking unit	Optional
	Regulations	CE, UL, cUL, cTick

MOTOR PROTECTIONS	Motor thermal model	
	Ground fault	
	Overload warning	
	Dynamic brake resistor thermal model	
	Torque limit and torque limit time (adjustable)	
	Low voltage	
	10% dynamic brake duty cycle	
	Input phase loss	
	Phases current imbalance	
	Motor stall protection	
	Short circuit	
	Speed limit and speed limit time (adjustable)	
	Over voltage	
	Mean torque 100% of braking during 5 sec.	
	Safety stop without input voltage	

SD450 SETTINGS	Thermal model (software)	
	IGBTs overload	
	Over voltage fault	
	Hardware fault	
	Heatsink over temperature	
	Output current limit	
	Regeneration limit	

4. DIMENSIONS

4.1. Dimensions of Frames 1 and 2

DRIVE REF.	DRIVE DIMENSIONS (mm)								RFI FILTER REF.	RFI FILTER DIMENS. (mm)					NET WEIGHT Drive + Filter (kg)
	H1	H2	W1	W2	D	C1	C2	C3		L	Y	W	X	H	
SD45008	284	269	150	130	157	18,5	18,5	18,5	FESD45008	329	315	151	120	50	4,9 + 2
SD45012	284	269	200	180	187,5	28	18,5	28	FESD45016	329	315	201	160	60	6 + 2,5
SD45016	284	269	200	180	187,5	28	18,5	28	FESD45016	329	315	201	160	60	6 + 2,5
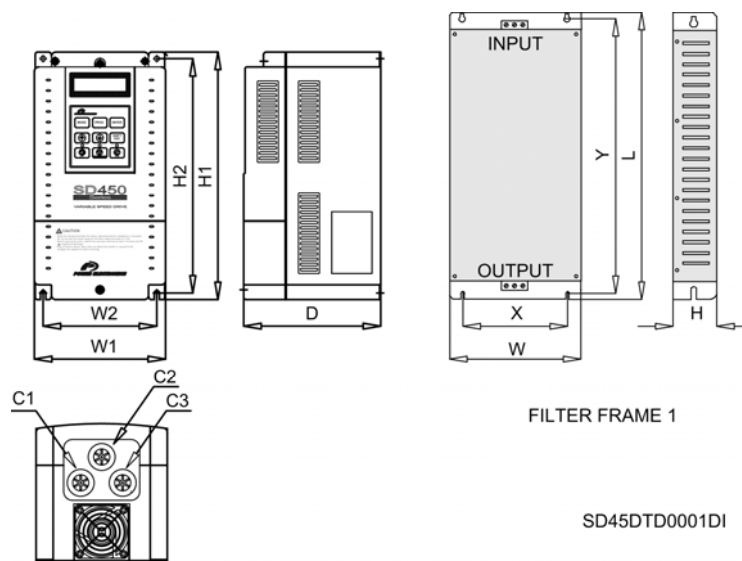
Figure 4.1 Dimensions of Frame 1
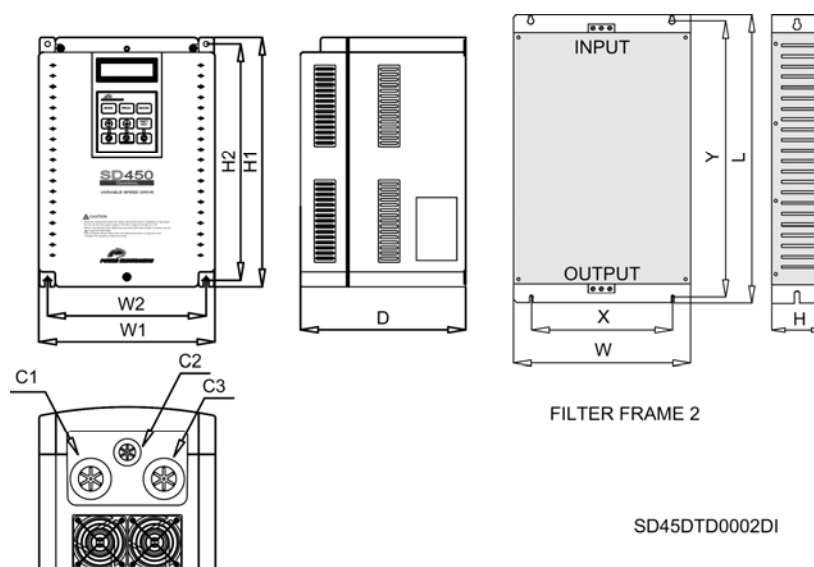
Figure 4.2 Dimensions of Frame 2

4.2. Dimensions of Frames 3 and 4

DRIVE REF.	DRIVE DIMENSIONS (mm)						RFI FILTER REF.	RFI FILTER DIMENS. (mm)					NET WEIGHT Drive + Filter (kg)
	H1	H2	W1	W2	D1	D2		L	Y	W	X	H	
SD45024	475,5	392	250	186	261,2	188,4	FESD45030	475	450	251	181	65	21,2 + 2,8
SD45030	475,5	392	250	186	261,2	188,4	FESD45030	475	450	251	181	65	21,2 + 2,8
SD45039	554,6	468,5	260	220	268,6	211	FESD45045	580	525	281	220	65	29,5 + 2,8
SD45045	554,6	468,5	260	220	268,6	211	FESD45045	580	525	281	220	65	29,5 + 2,8
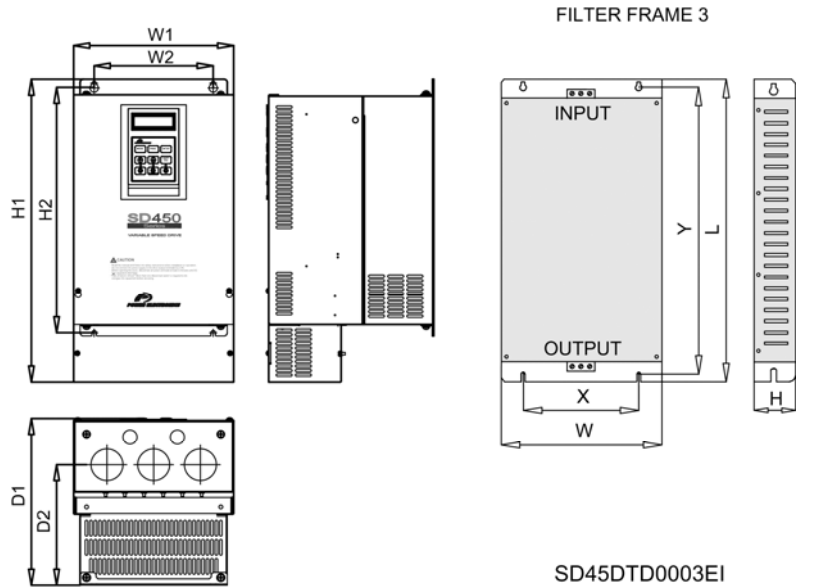
Figure 4.3 Dimensions of Frame 3
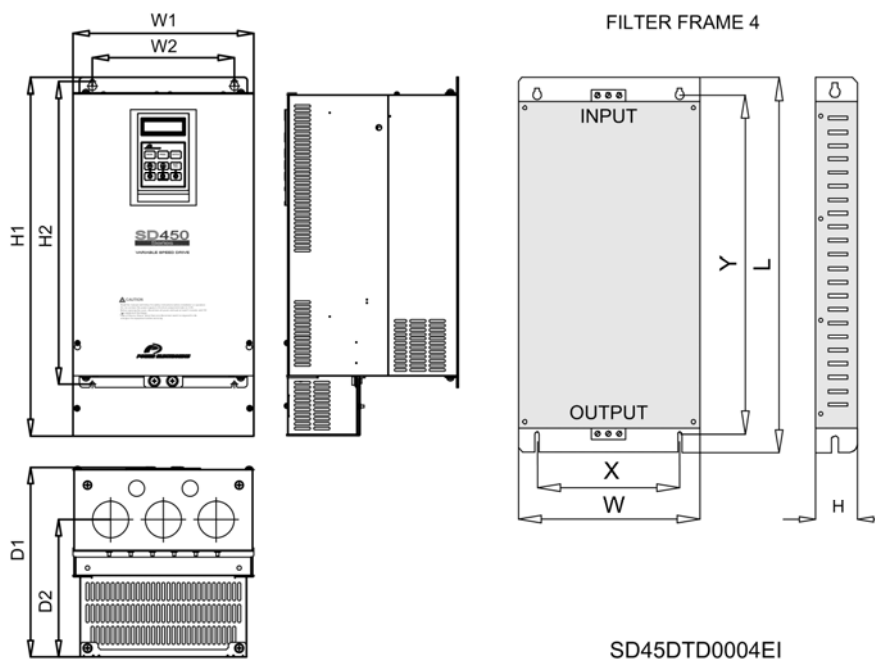
Figure 4.4 Dimensions of Frame 4

4.3. Dimensions of Frame 5

DRIVE REF.	DRIVE DIMENSIONS (mm)						RFI FILTER REF.	RFI FILTER DIMENS. (mm)					NET WEIGHT Drive + Filter (kg)
	H1	H2	W1	W2	D1	D2		L	Y	W	X	H	
SD45060	792	665	300	190	265,6	163,4	**FESD45075**	270	255	90	65	150	41 + 6
SD45075	792	665	300	190	265,6	163,4	**FESD45075**	270	255	90	65	150	42 + 6
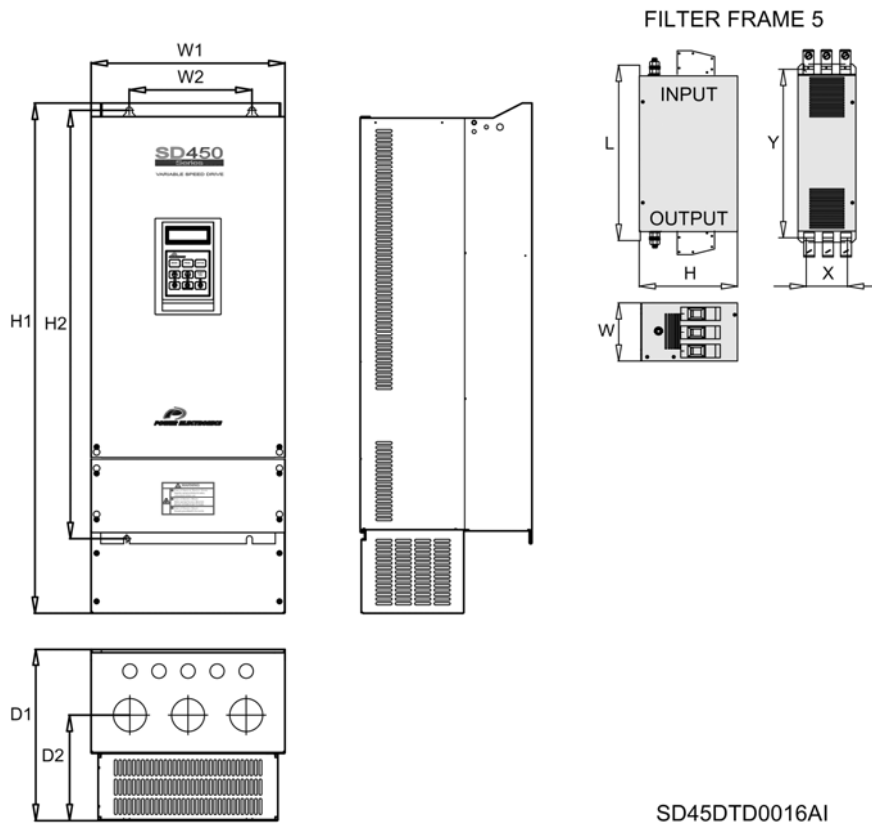
Figure 4.5 Dimensions of Frame 5

4.4. Dimensions of Frame 6

DRIVE REF.	DRIVE DIMENSIONS (mm)						RFI FILTER REF.	RFI FILTER DIMENS. (mm)					NET WEIGHT Drive + Filter (kg)
	H1	H2	W1	W2	D1	D2		L	Y	W	X	H	
SD45090	792	665	300	190	292,6	190,4	FESD45090	270	255	90	65	150	49 + 6
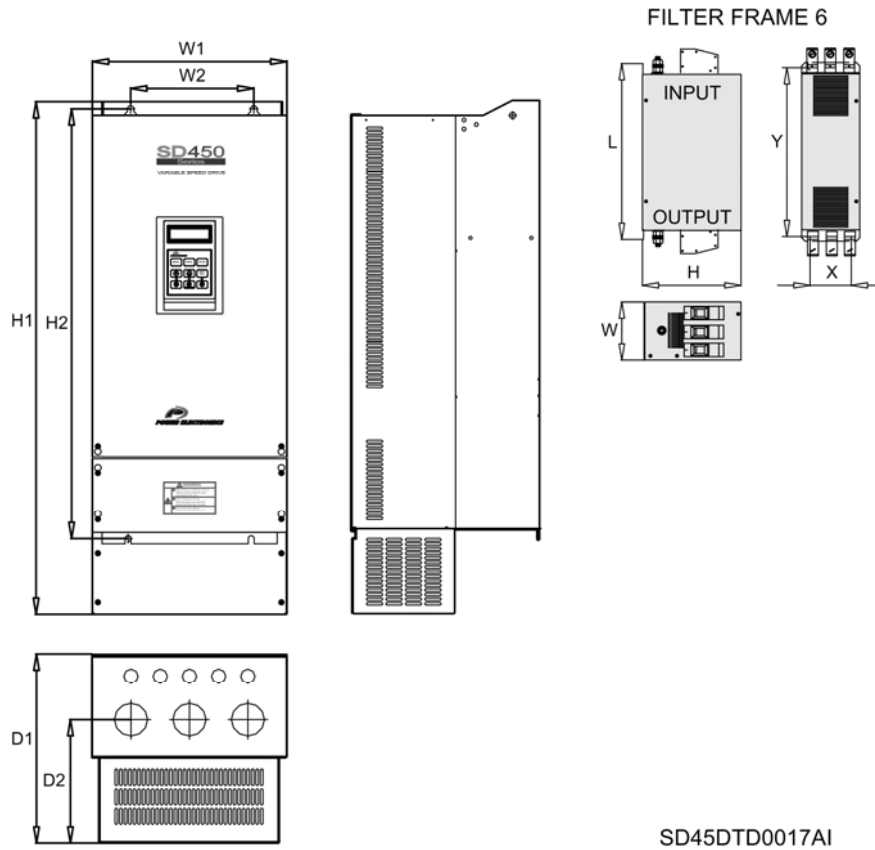
Figure 4.6 Dimensions of Frame 6

4.5. Dimensions of Frame 7

DRIVE REF.	DRIVE DIMENSIONS (mm)						RFI FILTER REF.	RFI FILTER DIMENS. (mm)					NET WEIGHT Drive + Filter (kg)
	H1	H2	W1	W2	D1	D2		L	Y	W	X	H	
SD45110	917,5	737	370	220	337,6	223,4	**FESD4145**	351	320	180	122	95	70,5 + 6
SD45150	917,5	737	370	220	337,6	223,4	**FESD4145**	351	320	180	122	95	72,5 + 6

SD45DTD0018AI
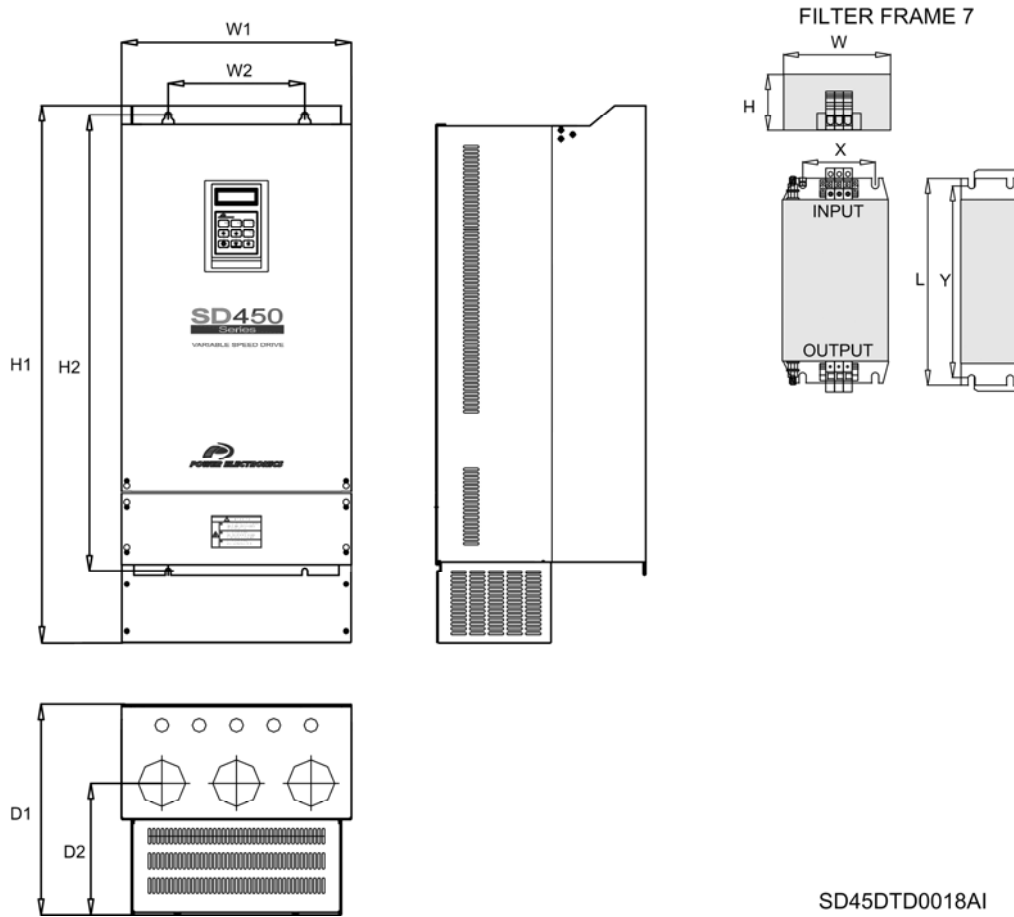
Figure 4.7 Dimensions of Frame 7

5. POWER RANGE

FRAME	CODE	Operation Temperature 50ºC HEAVY DUTY			Operation Temperature 40ºC NORMAL DUTY		
		I(A) Rated	Power (kW) at 400VAC	150% Overload I(A)	I(A) Rated	Power (kW) at 400VAC	110% Overload I(A)
1	SD45008	8	3,7	13	12	5,5	13
2	SD45012	12	5,5	18	16	7,5	18
	SD45016	16	7,5	26	24	11	26
3	SD45024	24	11	33	30	15	33
	SD45030	30	15	45	39	18,5	45
4	SD45039	39	18,5	58	45	22	58
	SD45045	45	22	66	60	30	66
5	SD45060	60	30	90	75	37	90
	SD45075	75	37	112	90	45	112
6	SD45090	90	45	135	110	55	135
7	SD45110	110	55	165	150	75	165
	SD45150	150	75	217	183	90	217

6. DECLARATION OF CONFORMITY CE

The Company:

Name: **POWER ELECTRONICS ESPAÑA, S.L.**
Address: C/ Leonardo Da Vinci, 24-26, 46980 Paterna (Valencia)
Telephone: +34 96 136 65 57
Fax: +34 96 131 82 01

Declares under its own responsibility, that the product:

Variable Speed Drive for A.C. motors

Brand: Power Electronics
Model Name: SD450 Series

Manufacturer: **LS INDUSTRIAL SYSTEMS CO., Ltd.**
                       181, Samsung-Ri, Molchon-Eup
                       Chonan, Chungnam 330-845 Korea

Is in conformity with the following European Directives:

References	Title
2006/95/CE	Electrical Material intended to be used with certain limits of voltage
2004/108/CE	Electromagnetic Compatibility

References of the harmonized technical norms applied under the Low Voltage Directive:

References	Title
IEC 61800-5-1:2007	Adjustable speed electrical power drive systems - Part 5-1: Safety requirements - Electrical, thermal and energy.

References of the harmonized technical norms applied under the Electromagnetic Compatibility Directive:

References	Title
IEC 61800-3:2004	Adjustable speed electrical power drive systems. Part 3: EMC requirements and specific test methods.

Paterna, January 17th 2008

David Salvo
Executive Director

7. PROGRAMMING KEYPAD

7.1. Parameters Groups

SD450 Series has six parameters groups classified according its function as it shown below.

Parameters groups	Display	Description
Main menu	DRV	Frequency reference, accel./decel. time, etc. Basic parameters.
Function group 1 menu	FU1	Start / stop, frequency limits, torque boost, thermal protections, overload and underload protections, etc.
Function group 2 menu	FU2	Fault history, motor data, second acceleration / deceleration, second motor, save parameters display/drive.
Input / Output menu	I/O	Setting of analogue and digital inputs and outputs, frequency steps, several accelerations setting.
Applications menu	APP	Pumps control (Pressure group).
Communications menu	COM	Configuration of communication via Profibus or DeviceNet (options).

7.2. Display Unit

The Liquid Crystal Display (LCD) can show up to 32 alphanumeric characters maximum. That makes possible to check some settings directly on the screen. A description of the keypad unit and display is shown below.

32 character, background light, LCD display.

PROGRAM key is used to go into programming mode to chage data.

MODE key moves you through six program groups:
DRV ➔ FU1 ➔ FU2 ➔ I/O ➔ COM ➔APP.

ENTER key moves you through six program groups:
APP ➔ COM ➔ I/O ➔ FU2 ➔ FU1 ➔DRV.
It is used to enter chaged data within a parameter too.

Arrows **UP** and **DOWN** moves you through a parameter group and allow also modify data.

SHIFT key is used to move cursor across display in programming mode.
ESC key is used to move the program code to the main screen from any program code.

The **REVERSE LED** blinks when the drive Accels or Decels in reverse mode.

The **FORWARD LED** blinks when the drive Accels or Decels in forward mode.

The **STOP** key stops the motor.
The **RESET** key is used to reset faults.
The **LED** blinks when ther is a fault.

SD45ITC0002BI

Figure 7.1 Programming keypad and display

7.2.1. Liquid Crystal Display

Different fields on display and their meaning can be seen at the following figure.

SD45ITG0001AI
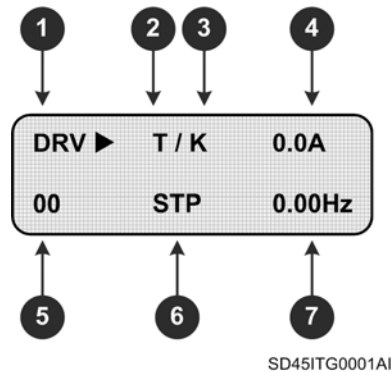
Figure 7.2 LCD display

Screen	Description	
1. Parameter group	It shows the parameter group: DRV, FU1, FU2, I/O, COM, APP.	
2. Start / stop mode	It shows the drive start / stop mode of the inverter.	
	K	Start / stop using FWD, REV keys of programming **K**eypad.
	T	Start / stop using control **T**erminals signals at M7 (FX), M8 (RX).
	R	Start / stop using **R**S485 series communication port.
	O	Start / stop using **O**ptional communication boards.
3. Frequency setting mode	It shows the frequency setting mode.	
	K	Frequency setting by **K**eypad.
	V	Frequency setting using terminals **V**1 (0-12V or -12V R +12V) or **V**1 + I
	I	Frequency setting using terminal **I** (0-20mA or 4-20mA).
	P	Frequency setting using **P**ulse input.
	R	Frequency setting using **R**S485 communication option.
	U	When **U**p/Down function has been selected and the programmed terminal like **U**p function is on. Then the frequency reference is going **U**p.
	D	When Up/**D**own function has been selected and the programmed terminal like **D**own function is on. Then the frequency reference is going **D**own.
	S	**S**top status when Up/Down function has been selected and the drive is stopped.
	O	Frequency setting using the **O**ptional communications boards.
	J	Frequency setting using **J**og input terminal.
	1~ 15	Frequency setting using digital inputs set as 'Frequency Steps'.
4. Output current	It shows the output current during running.	
5. Parameter code	Displays parameter code into a parameter group. Using keys ↑ (Up) and ↓ (Down) it is possible to move through parameters of a group (0~99).	
6. Operation status	It shows the information about the operation status.	
	STP	While it is stopped (**ST**O**P**).
	FWD	While it is running forward (**F**OR**W**AR**D**).
	REV	While it is running reverse (**REV**ERSE).
	DCB	While **D**ynamic **B**raking **C**urrent.
	LOP	Reference from control board is lost (DPRAM fault).
	LOR	Reference from network board is lost.
	LOV	Analogue reference signal is lost (V1: 0-10V).
	LOI	Analogue reference signal is lost (I: 4-20mA).
7. Inverter output frequency. Frequency reference.	Displays the output frequency during running. Displays the command Frequency during stop.	

7.2.2. Procedure for Parameter Setting

- Pressing **MODE** key successively, you will access to different parameters groups (increasing order, from DRV to APP). Pressing **ENTER** key the access is in a decreasing way (from APP to DRV).

- Pressing keys ↑ or ↓ you will access to desired parameter inside the parameter group previously selected. First parameter in each group, coded as 00, is always a "**Parameter jump**". If you already know the parameter code to which you will access, you could directly introduce it here, and then the change will be direct, without passing through all parameters. In DRV group, parameter DRV-00 is not a "parameter jump", in this case this is reference frequency input.

- Pressing **PROG** key all modifiable parameters are edited, to modify parameter value. Cursor starts to blink.

- Key **SHIFT/ESC** is used to move cursor onto the desired digit to be modified. As far as cursor is placed on such a digit, press keys ↑ or ↓ to modify it.

- Pressing **ENT** key all setting data is saved. Cursor stops from blinking.

- When a parameter is being set and the change is not wanted to be saved, because we want to cancel this action, key **MODE,** should be pressed escaping from "Programming" mode.

- If you are at any parameter group and you want to come back to main parameter, key **SHIFT/ESC** should be pressed.

Note: Data cannot be modified when:
Parameter is not adjustable during operating mode.
Parameter lock function is activated in FU2-94 (Parameter lock).

7.2.3. Parameter Navigation
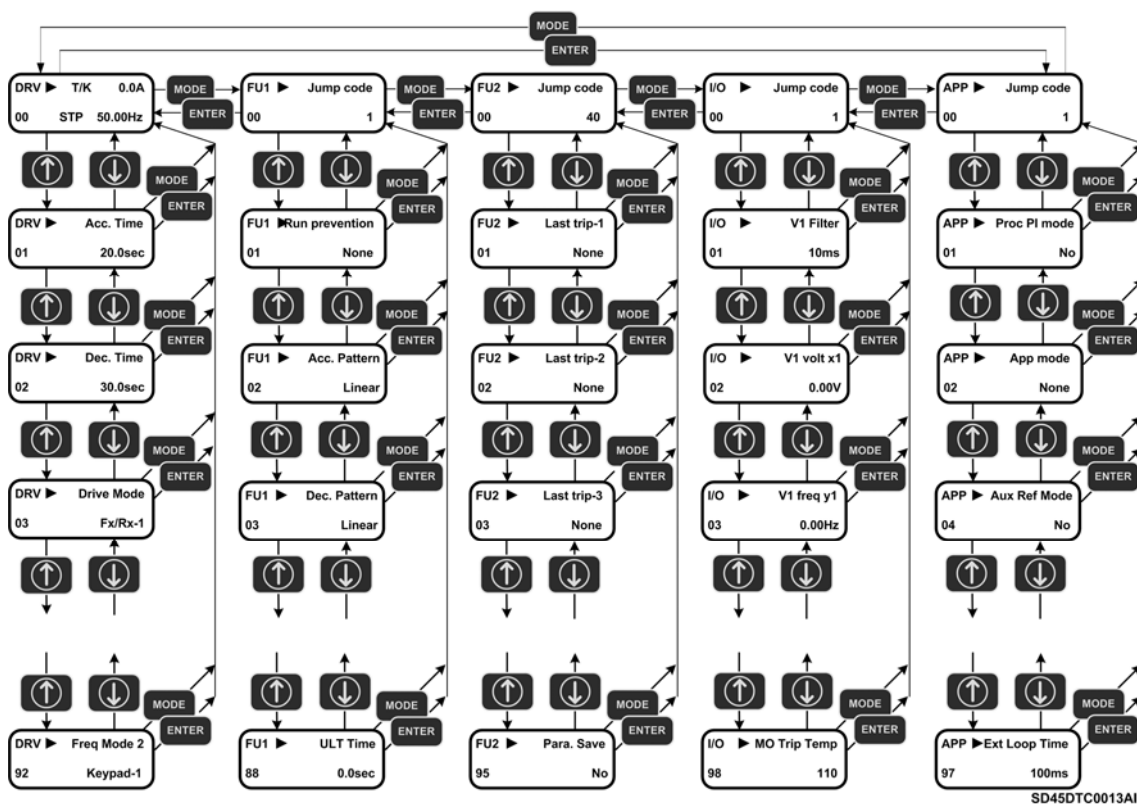
Figure 7.3 Parameter navigation

7.2.4. Operation Modes

SD450 has several operation modes as it is shown below.

Operation modes	Function	Functions configuration
Operation using **keypad**	Reference frequency and start/stop command can be programmed only by the keypad.	DRV-03: Keypad DRV-04: Keypad-1 or -2
Operation via **control terminals**	Closing or opening a contact over terminals M7(FX) or M8(RX) Start/Stop command is given. Frequency reference is set via terminal V1 or I or V1+I.	DRV-03: Fx/Rx-1 or -2 DRV-04: V1 or I or V1+I
Operation using **keypad and control terminals**	Start/Stop command is given by the keypad. Frequency reference is controlled by terminal V1 or I or V1+I.	DRV-03: Keypad-1 or -2 DRV-04: V1 or I or V1+I
	Closing a contact over terminals M7(FX) or M8(RX) Start/Stop command is given. Frequency reference is controlled by keypad.	DRV-03: Fx/Rx-1 or -2 DRV-04: Keypad-1 or -2
Operation through **communication network**	Operation through communication network. Reference frequency and start/stop command can be controlled via communication network. Additionally, the user can access to all parameters of the drive to set them. The SD450 includes Modbus – RTU protocol built-in as standard. Additionally, the SD450 has two communication boards as option. Optional boards: Device-Net, ProfiBus.	For Modbus communication: DRV-03: Int. 485 DRV-04: Int. 485 For optional boards: - Configure parameters of the new available group 'COM' after installing the optional board.

8. PROGRAMMING PARAMETERS LIST

8.1. Basic Functions and Display Parameters Group (DRV)

Display	Description	Range	Default value	Memory address	Function	Set during RUN
DRV[1] ► 00 Cmd. Freq 0.00 Hz	Reference frequency, output current (LCD)	0 A FU1-30 (Max. freq.)	0.00Hz	9100	It supplies information about start/stop motor status, frequency setting mode, output current, drive status, output frequency or reference frequency.	YES
DRV[1] ► T/K 0.00Hz 00 R 0.0%F 0.0%	Reference and feedback value	0 – 100%	0	9100	Setting of reference number 1 in PID mode and displays feedback PID value or sensor value. **Note:** This parameter only appears if option APP-02 is set to "Yes".	YES
DRV[2] ► Acc. Time 01 20.0 sec	Acceleration time	0 to 600.0 sec	20.0sec	9101	This parameter sets acceleration and deceleration time from 0Hz to FU2-70.	YES
DRV[2] ► Dec. Time 02 30.0 sec	Deceleration time	0 to 600.0 sec	30.0sec	9102		YES
DRV ► Drive mode 03 Fx/Rx-1	Start / Stop control mode	Keypad	Fx/Rx-1	9103	Start / stop are controlled by keypad.	NO
		Fx/Rx-1			Control terminals of optional board FX, RX and CM will control start / stop orders. **FX = 1 and RX = 0 ⟹ Forward command. FX = 0 ⟹ Stop. FX = 0 and RX = 1 ⟹ Reverse command. RX = 0 ⟹ Stop.**	
		Fx/Rx-2			Control terminals of optional sub-board FX, RX and CM will control start / stop commands. **FX = 1 and RX = 0 ⟹ Forward command. FX = 0 and RX = 0 ⟹ Stop. FX = 1 and RX = 1 ⟹ Reverse command. FX = 0 and RX = 0 ⟹ Stop.**	
		Int.485			Start / stop are controlled by RS485 communication net.	
DRV[3] ► Freq mode 04 Keypad-1	Frequency control mode (Method to introduce reference frequency)	Keypad-1	Keypad-1	9104	Frequency is set in DRV-00. New reference will not be effective until `ENT` key is pressed.	NO
		Keypad-2			As previous option but in this case the reference is modified at time.	
		V1			Reference frequency (0-12V) is introduced using control terminal V1.	
		V1S			Reference frequency (-12 to +12V) is introduced using control terminal V1.	
		I			Reference frequency (4-20mA/0-20mA) is introduced using control terminal I.	
		V1 + I			Reference frequency (0 ~ 10V, 4 ~ 20mA) is introduced using control terminals V1, I. Signal V1 is added to signal I.	
		Pulse			Reference frequency (0 ~ 100kHz) is introduced using control terminals A0 and B0.	
		Int. 485			Reference frequency is introduced by RS485 communication net using terminals C+, C-.	
		Ext. PID			It will be available when APP-80 'Ext PID Mode' is set to 'Yes'. In this case, 4-20mA signal applied in I will become the reference signal of the inverter for this External PID operation mode. Consult linked parameters (I/O-20 – I/O-27 and APP-80 to APP-97)	

[1] Alternatives options to introduce the frequency are "Multi-function terminals M1.. M3" (I/O-20 to 22), "JOG frequency" (I/O-25).
[2] Function linked with set values in "Maximum frequency" FU1-30, "Selection between Maximum frequency or Delta" FU1-73 and "Time scale" FU1-74.
[3] When other options to introduce reference frequency are selected in "Multi-function terminals M1.. M3" (I/O-20 to 22), "JOG frequency" (I/O-25), option set in DRV-03 is disabled.

Display	Description	Range	Default value	Memory address	Function	Set during RUN
DRV⁴▶ Step Freq-1 **05 10.00 Hz**	Speed at step frequency 1	FU1-32 to FU1-30 (Start freq. at maximum freq.)	10.0Hz	9105	*(see table below)*	YES
DRV⁴▶ Step Freq-2 **06 20.00 Hz**	Speed at step frequency 2		20.0Hz	9106		
DRV⁴▶ Step Freq-3 **07 30.00 Hz**	Speed at step frequency 3		30.0Hz	9107		
DRV▶ Current **08 0.0 A**	Output current	-	A	9108	It shows inverter output current in RMS.	-
DRV▶ Speed **09 0rpm**	Motor speed	Speed motor in RPM	Rpm	9109	It shows motor speed in rpm.	-
DRV▶ DC link Vtg **10 ----- V**	DC voltage	-	V	910A	It shows DC Link voltage.	-
DRV▶ User disp **11 Out 0.0 V**	User display selection	Selection in FU2-81 (User display)	-	910B	It shows parameter selected in FU2-81 'User display'. It exist several types of parameters here: Volts and Watts.	-
DRV▶ Fault **12 None**	Displayed fault in display	-	None	910C	It shows the present fault of the inverter. Use **PROG**, ↑ and ↓ keys before pressing the **RESET** key. *(see fault table below)* **Note:** When an inverter hardware fault occurs, WDOG, EEP and ADC errors are displayed. In this case, inverter will not be reset.	-
DRV▶ TAR 0.00Hz **14 OUT 0.00Hz**	Target / Output frequency displaying	-	0.00Hz	910E	It shows frequency command set in DRV-00 and the inverter output frequency.	-
DRV▶ REF 0.00% **15 FBK 0.00%**	Motor speed displaying	-	-	910F	It shows the reference speed set in percentage and its comparison with the inverter output.	-
DRV▶ Hz/Rpm Disp **16 Hz**	Motor speed displaying	Hz Rpm	Hz	9110	Selection of displaying mode of motor speed that will be shown in DRV-00 at Hz or rpm.	YES
R 0.0Hz T 0.0Hz **F 0.0Hz O 0.0Hz** ** DRV-18**	PID parameters displaying	-	-	9112	Parameters display in PID mode together with motor speed at Hz.	-
V1 0 V2 0 **V1S 0 I 0** ** DRV-19**	AD parameters	-	-	9113	Displaying of conversion from analogue signals to digital signals.	-
R 0.00% O 0.0% **F 0.00% DRV-20**	Displaying of External PID parameters	-	-	9114	Displaying of the parameters in External PID mode together with the motor speed in Hz	-

Binary combination of M1, M2, M3:

Speed-L	Speed-M	Speed-H	Output freq.	Preset speed. Step No.
0	0	0	DRV-00	Speed 0
1	0	0	DRV-05	Speed 1
0	1	0	DRV-06	Speed 2
1	1	0	DRV-07	Speed 3

Fault display (DRV-12):

Fault	Display
Over current 1	Over Current 1
Over voltage	Over Voltage
External fault	Ext. Trip
Emergency stop (No reset)	BX
Low voltage	Low Voltage
Ground fault	Ground Fault
Inverter over temperature	Over Heat
Electro thermal protection	E-Thermal
Over load trip	Over Load
H/W inverter fault - Error EEP - ADC Offset - Error WDOG - Output phase open - Open fuse (>30kW)	HW-Diag
Over current 2	Arm Short
Output phase loss	Phase open
Inverter over load	Inv. OLT

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⁴ These parameters are selected by configuring "Multi-function terminals M1.. M3" (I/O-20 to 22), as table indicates. Display will change according to the selected units (%, Bar, kPa, etc) in PID operation when units of V1 or I or Pulse are selected. See I/O-86 to I/O-88 parameters. (Ex. When % ➔ DRV-05 = Step freq.-1 is selected, 10.00Hz becomes to 20.00%).

Display	Description	Range	Default value	Memory address	Function	Set during RUN
DRV[5] ▶ Drive mode2 91 Fx/Rx-1	Optional Start / Stop control mode	Keypad Fx/Rx-1 Fx/Rx-2	Fx/Rx-1	915B	The value set here will be applied when inverter control will be given by communication net.	-
DRV[5] ▶ Freq mode2 92 Keypad-1	Optional frequency control mode (Method to introduce reference frequency)	Keypad-1 Keypad-2 V1 V1S I V1 + I Pulse	Keypad-1	915C	The value set here will be applied when inverter control will be given by communication net.	-

[5] It is only available if any of digital inputs is set as 'Main-drive' in I/O-20 to I/O-27 and DRV-03 and DRV-04 are set to 'Int 485' at the same time.

8.2. Functions Menu (FU1)

Display	Description	Range	Default value	Memory address	Function	Set during RUN
FU1 ► 00 **Jump code** **1**	Jump to desired parameter	1 to 99	1	9200	Any parameter of FU1 group can be directly selected from here without scrolling up/down to others parameters. You only need to introduce the number of desired parameter and press **ENT** key.	YES
FU1 ► 01 **Run Prev.** **None**	Prevention of direction rotation motor	None / Forward Prev / Reverse Prev	None	9201	**None:** Prevention is not active. **Forward Prev:** Forward direction forbidden. **Reverse Prev:** Reverse direction forbidden.	NO
FU1 ► 02 **Acc. pattern** **Linear**	Acceleration pattern	Linear S-curve U-curve	Linear	9202	**Linear:** Recommended for constant torque applications. **S-Curve:** This pattern allows the motor to accelerate and decelerate smoothly.	NO
FU1 ► 03 **Dec. pattern** **Linear**	Deceleration pattern			9203	**U-Curve:** This pattern provides more efficient control of acceleration and deceleration doing it faster. **Note:** The values set in DRV-01 and DRV-02 are ignored.	NO
FU1[6] ► 04 **Start Curve** **50%**	S-Curve start	0 – 100%	50%	9204	It allows setting the S-curve start selected in acceleration pattern.	NO
FU1[6] ► 05 **End Curve** **50%**	S-Curve end	0 – 100%	50%	9205	It allows setting the S-curve end selected in deceleration pattern.	NO
FU1 ► 10 **Pre-HeatMode** **No**	Motor pre-heat	No / Yes	No	920A	It avoids producing produce a motor condensation when motor is stopped and is installed in areas with humidity. This is possible by a continuous DC current injection. **Note:** This function is only active when the inverter is stopped and together with the activation of one of the multi-function digital input configured with option 'Pre-Heat'.	NO
FU1[7] ► 11 **PreHeat Level** **30%**	Percentage of motor rated current	1 – 50%	30%	920B	This parameter sets the level of pre-heat current to heat the motor, calculated as percentage of the value introduced in motor rated current FU2-43. ⚠**Caution:** Parameters modifications are disabled during pre-heat process. ⚠**Caution:** Decrease the value introduced here if the motor is over heated.	NO
FU1[7] ► 12 **PreHeatPerc** **100%**	Time of DC current application to the motor	1 – 100%	100%	920C	It allows setting the percentage of time that motor pre-heat current will be applied over a total cycle of 10 seconds. If it is set to 100%, the current is applied continuously. ⚠**Caution:** Parameter modifications are disabled during pre-heat process. ⚠**Caution:** Decrease the value introduced here if the motor is over heated.	NO
FU1 ► 20 **Start mode** **Accel**	Inverter start mode	Accel / DC – start / Flying – start	Accel	9214	**Accel start:** Inverter applies the acceleration ramp set until reaching the steady status. **DC start:** Inverter starts to accelerate after applying a magnetizing DC current. **Flying start:** Inverter starts while motor is still running until taking its speed and it makes it operate at steady status again. **Note:** The real direction rotation of the motor and run command should be the same for an optimal use of this function. However, if they are opposite, this function is also effective whenever the speed is below 50% of the rated speed when the inverter starts again.	NO

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[6] It is only available if 'S-Curve' is set in acceleration and deceleration patterns.
[7] It is only available if pre-heat mode is set in FU1-10.

Display	Description	Range	Default value	Memory address	Function	Set during RUN
FU1[8] ▶ 21 DCSt time 0.0sec	Time of DC current application	0.0 – 60.0sec	0.0sec	9215	It is the time that DC current is applied before starting motor acceleration.	NO
FU1[8] ▶ 22 DCSt value 50%	DC current level before starting	0 – 150%	50%	9216	This parameter sets the DC current level applied to the motor as a percentage of rated current introduced in FU2-43. ⚠️**Caution:** If this value is set above the value introduced in FU2-43 'Rated-Curr', motor can be overheated and 'Over load' fault can occur.	NO
FU1 ▶ 23 Stop mode Decel	Inverter stop mode	Decel / DC – brake / Free – run / Fluxe – brake	Decel	9217	**Decel:** Inverter will stop with a deceleration ramp. **DC brake:** Inverter will stop by a DC current injection. **Free run:** Inverter turns off the ouput power supply to the motor immediately after receiving the stop command. The inverter will stop by inertia. **Fluxe brake:** Fast stop is get turning the regenerated energy to heat into the motor. ⚠️**Caution:** Motor can be overheated due to an excessive use of this function.	NO
FU1[9] ▶ 24 DCBlk time 0.10sec	DC current application delay time	0.10 – 60.00sec	0.10sec	9218	It is the locking time while inverter makes a free run stop before applying DC brake.	NO
FU1[9] ▶ 25 DCBr Frq 5.00Hz	DC brake starting frequency	0.10 – 60.00Hz	5.00Hz	9219	This parameter sets the frequency from which the inverter will start to apply DC current injection during deceleration. Note: If this value is very high, there is a possibility of over current trip occurs.	NO
FU1[9] ▶ 26 DCBr time 1.0sec	Time of DC current application	0.0 – 60.0sec	1.0sec	921A	It allows setting the time that the inverter will apply the DC current injection during 'DC brake' operation.	NO
FU1[9] ▶ 27 DCBr value 50%	DC current level applied for DC brake	0 – 200%	50%	921B	It allows setting the DC current level applied to the motor during 'DC brake' mode calculated as a percentage of motor rated current introduced in FU2-43. ⚠️**Caution:** Motor can be overheated if a higher DC current level than motor rated current is set.	NO
FU1 ▶ 28 Safety Stop No	Motor stopped at safety conditions from power supply loss	No / Yes	No	921C	It allows avoiding potential hazards when the complete system is stopped but the load follows running due to high inertia. The inverter will stop the motor by deceleration. Deceleration time will depend on the load inertia. **Note:** The inertia value should be set in FU1-90 'STOP Inertia' carefully until finding the appropriate value. ⚠️**Caution:** This function is effective for loads with high inertias.	NO
FU1 ▶ 29 Line Freq 50.00Hz	Line frequency value	40.00 – 120.00Hz	50.00Hz	921D	It allows setting the line frequency value according to the zone, region or country where the installation is done. ⚠️**Caution:** If the line frequency is changed, then the linked frequencies such as Maximum frequency or Base frequency are changed automatically. To set different values of line the line frequency, user should set the parameters manually.	NO
FU1 ▶ 30 Max Freq 50.00Hz	Maximum output frequency of the inverter	40.00 – 120.00Hz	50.00Hz	921E	It allows setting the maximum output frequency of the inverter. **Note:** Make sure the value set here is not higher than the motor rated speed.	NO
FU1 ▶ 31 Base Freq 50.00Hz	Output frequency for motor rated voltage	30.00 – 120.00Hz	50.00Hz	921F	At this frequency, the inverter supplies the rated voltage. If a 50Hz motor is used, then it should be set to 50Hz.	NO
FU1 ▶ 32 Start Freq 0.50Hz	Start frequency	0.01 – 10.00Hz	0.50Hz	9220	Minimum start frequency that inverter start to apply output voltage. Motor will start to operate at frequency set here.	NO

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[8] It is only available if DC-start as Inverter start mode is selected in FU1-20.
[9] It is only available if DC-brake as Inverter stop mode is selected in FU1-23.

Display	Description	Range	Default value	Memory address	Function	Set during RUN
FU1 ▶ 33 Freq limit No	Frequency limits selection	No Yes	No	9221	It allows selecting the limits for inverter operation frequency. If this parameter is set to 'Yes', then inverter will operate within the upper and lower limit setting. The inverter will operate at the upper limit when the frequency reference is above the high frequency limit. The inverter will operate at the lower limit when the frequency reference is below the low frequency limit.	NO
FU1[10] ▶ 34 F-limit Lo 0.50Hz	Low frequency limit	0.00 – FU1-35 Hz	0.50Hz	9222	It sets the low frequency limit if FU1-33 is set to 'Yes'.	NO
FU1[10] ▶ 35 F-limit Hi 50.00Hz	High frequency limit	FU1-34 – FU1-30 Hz	50.00Hz	9223	It sets the high frequency limit if FU1-33 is set to 'Yes'.	NO
FU1 ▶ 40 V/F pattern Linear	Relation factor between voltage and frequency applied to the motor	Linear Square User V/F	Linear	9228	Motor torque boost depends on this relation factor. **Linear:** Recommended when the application requires constant torque. This model preserves a linear relation factor between voltage and frequency from zero up to Base frequency. **Square:** Recommended when the application requires variable torque at any speed. **User V/F:** Recommended for special applications. User can set the relation between voltage and frequency in four stretches that will provide the curve that will be applied to the motor.	NO
FU1[11] ▶ 41 User Freq 1 15.00Hz	Frequency 1 (User V/F pattern)	0 – FU1-30Hz	15.00Hz	9229		NO
FU1[11] ▶ 42 User volt 1 25%	Voltage 1 (User V/F pattern)	0 – 100%	25%	922A		NO
FU1[11] ▶ 43 User Freq 2 30.00Hz	Frequency 2 (User V/F pattern)	0 – FU1-30Hz	30.00Hz	922B	User can customize the voltage/frequency pattern by the setting of these four parameters included between FU1-31 start frequency and FU1-32 Base frequency. **Note:** See the relation factor between maximum frequency and base frequency. **Note:** When 'User V/F' pattern is selected, then torque boost set in FU2-67 to FU2-69 is ignored.	NO
FU1[11] ▶ 44 User volt 2 50%	Voltage 2 (User V/F pattern)	0 – 100%	50%	929C		NO
FU1[11] ▶ 45 User Freq 3 45.00Hz	Frequency 3 (User V/F pattern)	0 – FU1-30Hz	45.00Hz	922D		NO
FU1[11] ▶ 46 User volt 3 75%	Voltage 3 (User V/F pattern)	0 – 100%	75%	922E		NO
FU1[11] ▶ 47 User Freq 4 50.00Hz	Frequency 4 (User V/F pattern)	0 – FU1-30Hz	50.00Hz	922F		NO
FU1[11] ▶ 48 User volt 4 100%	Voltage 4 (User V/F pattern)	0 – 100%	100%	9230		NO
FU1 ▶ 49 VAC 400.4V 91.0%	Input voltage setting	73.0 – 115.0%	91.0%	9231	It should be correctly set when the inverter input voltage and the standard input voltage are very different. Otherwise, inverter could get damaged. This setting affects to the inverter over voltage trip.	NO
FU1 ▶ 50 Motor Volt 400 V	Motor rated voltage	0 – 600V	400V	9232	It allows holding the output voltage constant independently of input voltage could suffer fluctuations. ⚠ **Caution:** When the input voltage is lower than the value set here, the maximum output voltage cannot exceed the input voltage.	NO
FU1 ▶ 51 Energy save None	Energy save level enabled/disabled	None Manual Auto	None	9233	This function is used to decrease the output voltage for applications that don't require a high torque at steady status. **Note:** When energy saving is active, inverter takes more time to decelerate until stopping.	NO
FU1[12] ▶ 52 Manual save% 0%	Energy save level	0 – 30%	0%	9234	Inverter decreases the output voltage the percentage set here after accelerates up to reference frequency. **Note:** This function can cause over current trip due to the load fluctuations.	NO

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[10] It is only available if the application of frequency limits is set in FU1-33.
[11] It is only available if FU1-40 is set to 'User V/F'.
[12] It is only available if FU1-51 is set to 'Manual'.

Display		Description	Range	Default value	Memory address	Function	Set during RUN
FU1 ▶ 54	KiloWattHour 0M 0.0kW	Displaying of Mega and Kilo watts	-	-	9236	Maximum cumulative value is 9999M999.9kW Note: The value cumulative here is reset by pressing the PROG key during 5 seconds.	YES
FU1 ▶ 55	Inv. Temp. 25	Inverter temperature	0 – 160ºC	25ºC	9237	IGBT surface temperature is displayed in this parameter.	-
FU1 ▶ 56	Motor Temp. 0	Motor temperature	0 – 160ºC	25ºC	9238	Motor temperature detected by a thermal sensor is displayed here.	-
FU1 ▶ 60	ETH select Yes	Electronic thermal protection	No Yes	Yes	923C	This function protects the motor from overheating without using additional thermal overload relay. The inverter turns off its output and will display a fault message when thermal function is activated. Note: If it is set to 'No', protection will be deactivated.	YES
FU1[13] ▶ 61	ETH 1min 150%	Electronic thermal protection level for 1 minute	FU1-62 – 200%	150%	923D	It allows setting the value that determines that the inverter is overheated. Note: This value is calculated as a percentage of inverter rated current introduced in FU2-43.	NO
FU1[13] ▶ 62	ETH cont 105%	Electronic thermal protection level for continuous	50% - FU1-61 (max. 150%)	105%	923E	It allows setting the current level that inverter can operate in continuous form. Usually, this parameter is set to 100%, this means that the inverter will operate at value set in FU2-43. Note: This value never cannot be higher than the value set in FU1-61.	NO
FU1 ▶ 63	Motor type Self-cool	Motor cooling mode	Self-cool Forced-cool	Self-cool	923F	It allows that electronic thermal protection function is optimum. Auto-cooling: Cooling fan (of the motor) is coupled to the motor axis. For this, cooling is worse at low speeds and motor will be overheated quickly. Forced-cooling: Cooling fan is independent. For this, its cooling capacity does not depend on the speed.	NO
FU1 ▶ 64	OL level 110%	Overload warning level	30 – 110%	110%	9240	It sets the percentage of current to generate a warning because of inverter overload. Note: The percentage of current is calculated based on inverter rated current introduced in FU2-43.	NO
FU1 ▶ 65	OL time 10.0sec	Overload warning time	0.0 – 30.0sec	10.0sec	9241	It sets the time has to elapse being the inverter current the value of current set as overload warning level to generate an alarm. This alarm signal can be configured at output relays. See I/O-76 to I/O-79.	NO
FU1 ▶ 66	OLT select Yes	Overload trip selection	No Yes	Yes	9242	It sets the overload trip. Inverter turns off the output to the motor to protect it from unusual operation conditions. Trip is produced when the current is remained above the level set in FU1-67 for a time longer than the time set in FU1-68.	NO
FU1[14] ▶ 67	OLT level 120%	Overload trip level	30 – 150%	120%	9243	It sets the current level to produce overload trip, protecting inverter and motor.	NO
FU1[14] ▶ 68	OLT time 60.0sec	Overload trip time	0.0 – 60.0sec	60.0sec	9244	It sets the time that will have to elapse with the current level above the value set in FU1-67, to produce overload trip.	NO
FU1 ▶ 69	Trip select 100	Input / output phase loss protection	000 – 111 (Bit setting)	100	9245	Setting for inverter trip from input or output phase loss. First bit: To enable output phase loss trip. Second bit: To enable input phase loss trip. Third bit[15]: To enable 'Exchange' function.	NO

[13] It is only available if FU1-60 is set to 'Yes'.
[14] It is only available if FU1-66 is set to 'Yes'.
[15] In this case (100), you need to configure auxiliary inputs and outputs for example (I/O-20 = 'Exchange' and I/O-76 = COMM line'). When I/O-20 is active, the inverter will turn off the output voltage and will activate the corresponding relay to I/O-76 (Aux1).

Display	Description	Range	Default value	Memory address	Function	Set during RUN
FU1 ▶ 70 **Stall prev. 000**	Stall prevention mode	000 – 111 (Bit setting)	000	9246	It allows setting the dynamic limitation of current during acceleration and deceleration status, and during steady status. Also, it allows setting the level of this limitation.	YES
FU1 ▶ 71 **Stall level 100%**	Limitation current level	30 – 150%	100%	9247	(see table below) **Note:** Do not set the value of FU1-71 above the value of inverter rated current. **Note:** FU1-71 is a percentage of motor rated current introduced in FU2-43. **Note:** Acceleration and deceleration times can be increased due to current limitation. **Note:** Output frequency can oscillate if limitation persists at steady status. **Note**: Limitation level can be automatically reduced if the inverter operates at higher frequencies than base frequency.	YES
FU1 ▶ 72 **Acc/Dec ch F 0.00Hz**	Frequency of acceleration and deceleration change	0 – FU1-30	0.00Hz	9248	It allows setting the frequency level that acceleration and deceleration ramps applied to the inverter will be changed. Acceleration: First, the ramp set in I/O-50 will be applied and then, the ramp set in DRV-01. Deceleration: First, the ramp set in DRV-02 will be applied and then, the ramp set in I/O-51	YES
FU1 ▶ 73 **Acc/Dec Freq Max**	Frequency for acceleration and deceleration	Max Delta	Max	9249	This is the frequency used to define acceleration and deceleration ramps.	YES
FU1 ▶ 74 **Time scale 0.1sec**	Time scale	0.01sec 0.1sec 1sec	0.1seg	924A	It allows changing the time scale. **0.01sec:** Maximum time range is 60s. **0.1sec:** Maximum time range is 600s. **1sec:** Maximum time range is 6000s.	NO
FU1 ▶ 80 **Up/Dn Save No**	To memorize the reference of motorized potentiometer	No Yes	No	9250	It allows deciding if the inverter should memorize the reference frequency introduced by motorized potentiometer. **Note:** This function is linked with the reference introduction through digital inputs. See I/O-20 to I/O-27. ⚠️**Caution:** This function cannot be used in PID mode.	NO
FU1 ▶ 81 **Run Delay T 0.0sec**	Delay time at the starting	0.0 – 600.0sec	0.0sec	9251	Delay time for run command. This option is only valid when the signal is introduced by terminals.	NO
FU1 ▶ 85 **ULT select No**	Underload trip selection	No Yes	No	9255	It allows activating underload trip. Inverter will turn off its output if detects that it is operating below established levels.	NO
FU1[16] ▶ 86 **ULT level 30%**	Underload level	0 – 100%	30%	9256	It allows setting underload trip level calculated as a percentage of motor rated current set in FU2-43.	NO
FU1[16] ▶ 87 **ULT Freq 15.00Hz**	Underload frequency	FU1-31 – FU1-30	15.00Hz	9257	To produce underload trip, output frequency has to be higher than the frequency set here since, there are applications (like fans) that need a small torque at low speed.	NO
FU1[16] ▶ 88 **ULT time 0.0sec**	Underload trip time	0.0 – 200.0sec	0.0sec	9258	During the time set here, previous specifications have to be given to produce underload trip.	YES
FU1[17] ▶ 90 **STOP Inertia 8**	Setting of load inertia	8 – 5000	8	925A	It allows setting the approx inertia associated to the application. This parameter is directly linked with 'Safety Stop' function. **Note:** We recommend to begin with values about 1000 as starting point and from now on, begin to prove with load.	NO

Setting Range			FU1-70	Description
3rd Bit	2nd Bit	1st Bit		
0	0	0	000	Current limitation deactivated.
0	0	1	001	Limitation activated during acceleration.
0	1	0	010	Limitation at steady status.
1	0	0	100	Limitation activated during deceleration.
1	1	1	111	Limitation activated at three statuses.

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[16] It is only available if FU1-85 'ULT select' is set to 'Yes'.
[17] It is only available if FU1-28 'Safety Stop' is set to 'Yes'.

8.3. Functions Menu (FU2)

Display	Description	Range	Default value	Memory address	Function	Set during RUN
FU2 ► 00 Jump code 40	Jump to desired parameter	1 to 99	40	9300	Any parameter of FU2 group can be directly selected from here without scrolling up/down to others parameters. You only need to introduce the number of desired parameter and press **ENT** key.	YES
FU2 ► 01 Last trip-1 None	Last trip of fault history	-	None	9301		-
FU2 ► 02 Last trip-2 None	Last trip-1 of fault history	-	None	9302	Before pressing the **RESET** key, if you press the **PROG** key, and using ↑ and ↓ keys is possible to display the frequency, the current and the operation mode at the moment of the fault.	-
FU2 ► 03 Last trip-3 None	Last trip-2 of fault history	-	None	9303		-
FU2 ► 04 Last trip-4 None	Last trip-3 of fault history	-	None	9304		-
FU2 ► 05 Last trip-5 None	Last trip-4 of fault history	-	None	9305		-
FU2 ► 06 Erase trips No	Erase fault history	No Yes	No	9306	It allows erasing fault history. **Note:** Parameters initialize does not erase faults.	-
FU2 ► 07 Dwell time 0.0sec	Dwell time	0.0 – 10.0sec	0.0sec	9307	It allows setting a time to inverter operates at stipulated speed before applying the acceleration ramp. Dwell function.	NO
FU2[18] ► 08 Dwell Freq 5.00Hz	Dwell frequency	FU1-32 – FU1-30	5.00Hz	9308	It allows setting the previous speed of inverter operation before applying the acceleration ramp, once run command is received. Dwell function.	YES
FU2 ► 10 Jump Freq No	Skip frequencies selection	No Yes	No	930A	It allows setting up to three frequency ranges that will be avoided when the inverter operates at steady status. These skips are not considering during acceleration and deceleration. In case of the speed reference is within these ranges, inverter starts to operate at minimum speed of this interval. It allows preventing resonances and vibrations on the structure of the machine.	NO
FU2[19] ► 11 jump Lo 1 10.00Hz	Setting of low frequency skip 1	0 – FU2-12	10.00Hz	930B	It sets the low frequency of the first skip of frequencies.	NO
FU2[19] ► 12 jump Hi 1 15.00Hz	Setting of high frequency skip 1	FU2-11 – FU1-30	15.00Hz	930C	It sets the high frequency of the first skip of the frequencies.	NO
FU2[19] ► 13 jump Lo 2 20.00Hz	Setting of low frequency skip 2	0 – FU2-14	20.00Hz	930D	It sets the low frequency of the second skip of frequencies.	NO
FU2[19] ► 14 jump Hi 2 25.00Hz	Setting of high frequency skip 2	FU2-13 – FU1-30	25.00Hz	930E	It sets the high frequency of the second skip of frequencies.	NO
FU2[19] ► 15 jump Lo 3 30.00Hz	Setting of low frequency skip 3	0 – FU2-16	30.00Hz	930F	It sets the low frequency of the third skip of frequencies.	NO
FU2[19] ► 16 jump Hi 3 35.00Hz	Setting of high frequency skip 3	FU2-15 – FU1-30	35.00Hz	9310	It sets the high frequency of the third skip o frequencies.	NO
FU2 ► 20 Power-on run No	Restart after power supply fault	No Yes	No	9314	It allows inverter restart automatically after power supply is lost and recovered again. **Note:** If the motor is still running when the power supply is recovered, a trip can be produced in the inverter. To avoid this, use the function of 'Speed search' combined. ⚠**Caution:** You should pay special attention to application since the motor restart automatically when power supply is recovered again, to avoid possible damages.	NO
FU2 ► 21 RST restart No	Restart after fault reset	No Yes	No	9315	It allows inverter to start automatically after receiving the signal of fault reset. **Note:** If the motor is still running when the power supply is recovered, a trip can be produced in the inverter. To avoid this, use the function of 'Speed search' combined. ⚠**Caution:** You should pay special attention to application since the motor restart automatically when power supply is recovered again, to avoid possible damages.	NO

[18] It is only available if dwell time is set to a value higher than zero in FU2-07.
[19] It is only available if FU2-10 is set to 'Yes'.

Display	Description	Range	Default value	Memory address	Function	Set during RUN
FU2 ▶ 22 **Speed Search** **0000**	Speed search function	0000 – 1111 (Bit setting)	0000	9316	This function allows an automatic start after a fault occurs or after power supply is lost without waiting for that the motor is stopped. **Bit setting range** / **Description** <table><tr><td>4th</td><td>3rd</td><td>2nd</td><td>1st</td><td>Description</td></tr><tr><td>0</td><td>0</td><td>0</td><td>0</td><td>Speed search deactivated</td></tr><tr><td>0</td><td>0</td><td>0</td><td>1</td><td>Speed search activated during acceleration</td></tr><tr><td>0</td><td>0</td><td>1</td><td>0</td><td>Speed search activated after a fault reset (FU2-21)</td></tr><tr><td>0</td><td>1</td><td>0</td><td>0</td><td>Speed search activated after an instant power supply fault (instant cut off)</td></tr><tr><td>1</td><td>0</td><td>0</td><td>0</td><td>Speed search activated after power supply loss (FU2-20)</td></tr><tr><td>1</td><td>1</td><td>1</td><td>1</td><td>Always Speed search activated</td></tr></table> **Note:** Load inertia should be correctly set. See FU2-46 'Inertia rate'.	NO
FU2[20] ▶ 23 **SS P-Gain** **200**	Proportional gain for speed search	0 – 9999	200	9317	It is the proportional gain that should be set considering the load inertia (GD²) and the load torque. See FU2-46 'Inertia rate'.	YES
FU2[20] ▶ 24 **SS I-Gain** **500**	Integral gain for speed search	0 – 9999	500	9318	It is the integral gain that should be set considering the load inertia (GD²) and the load torque. See FU2-46 'Inertia rate'. ⚠**Caution:** If this value is too high, an over voltage trip can occurs.	YES
FU2 ▶ 25 **Retry number** **0**	Tries of automatic fault resets	0 – 10	0	9319	This function is used to inverter does an autoreset after a fault occurs. The number of tries of autoreset is set here. If the number of tries of fault resets has passed and the fault persists, then inverter does not try to reset again. It is necessary to reset fault conditions. ⚠**Caution:** You should pay special attention to application since the motor restart automatically when power supply is recovered again, to avoid possible damages.	YES
FU2[21] ▶ 26 **Retry delay** **1.0sec**	Time between tries of automatic fault resets	0.0 – 60.0sec	1.0sec	931A	It allows setting the wait time between an automatic fault reset and the next one. If the fault persists for more time than the time set here, and after reset is done, Autoreset function is not carried out. ⚠**Caution:** You should pay special attention to application since the motor restart automatically when power supply is recovered again, to avoid possible damages.	YES
FU2 ▶ 40 **Motor select** **__._kW**	Motor power setting	3.7kW – 75kW	*	9328	It allows setting the capacity of the motor that will be used. Values of motor slip frequency, rated current, no load current, stator resistance and leakage inductance will be automatically changed when this value is modified.	NO
FU2 ▶ 41 **Pole number** **4**	Number of motor poles	2 – 12	4	9329	It allows setting the poles number of motor that will be used.	NO
FU2 ▶ 42 **Rated-Slip** **_.__Hz**	Rated slip frequency of the motor	0 – 10Hz	*	932A	It allows setting the rated slip frequency of the motor that will be controlled.	NO
FU2 ▶ 43 **Rated-Curr** **__._A**	Motor rated current	1 – 200.0A	*	932B	It allows setting the rated current of the motor that will be controlled. This value will be used to calculate other settings (protections, limitations, ...).	NO

[20] It is only available if active speed search is set at any moment in FU2-22.
[21] It is only available if autoreset function is set in FU2-25.
* Depending on the inverter capacity.

Display	Description	Range	Default value	Memory address	Function	Set during RUN
FU2 ▶ 44 Noload-Curr __._A	No load current of the motor	0.5 – 200.0A	*	932C	It allows setting no load current of the motor that will be controlled. This value should be correctly for 'Sensorless' option.	NO
FU2 ▶ 45 Efficiency __%	Motor efficiency	70 – 100%	*	932D	It allows setting the efficiency of the motor that will be controlled.	NO
FU2 ▶ 46 Inertia rate 0	Load inertia rate	0 – 8	0	932E	It allows setting the approx inertia associated to the application. This parameter is directly linked with Speed search.	NO
FU2 ▶ 47 RPM factor 100%	Setting of gain for speed motor	1 – 1000%	100%	932F	It allows setting the gain for speed displaying of the motor that will be controlled.	YES
FU2 ▶ 48 Carrier freq _._kHz	Setting of carrier frequency	0.7 – 15.0kHz	*	9330	It allows setting the carrier frequency (commutation frequency) according to inverter frame. This value affects the audible sound of the motor, noise emission from the inverter, inverter temp, and leakage current.	YES
FU2 ▶ 49 PWM Select Normal 1	Selection of modulation mode	Normal 1 Normal 2 Low Leakage	Normal 1	9331	It allows modifying the leakage current and the noise without modifying the commutation frequency. **Modulation mode** / **Description** Normal 1 / Standard modulation mode PWM. Normal 2 / Operation with pre-defined commutation frequency. Low Leakage / Inverter reduces commutation cycle to reduce leakage current. ⚠ **Caution:** A decrease of commutation frequency can increase noise. If 'Low Leakage' is set and commutation frequency is lower than 2kHz, then the value of FU2-48 will be automatically set to 2kHz.	NO
FU2 ▶ 60 Control mode V/F	Selection of inverter control mode	V/F Slip compen Sensorless	V/F	933C	**V/F:** This mode constantly controls the relation factor voltage/frequency. **Slip compen:** It allows holding constant motor speed. Inverter output frequency changes within the limits of slip frequency set in FU2-42 depending on the load current. **Sensorless:** It allows controlling the motor when a high torque is required at low speed, fluctuation of the load is high and a fast response is needed. We recommend carry out an 'Auto Tuning' of the motor before using this function. ⚠ **Caution:** If no load current is incorrectly set in FU2-44, this function can lose this functionality.	NO
FU2[22] ▶ 61 Auto Tuning No	Auto tuning of motor parameters	No Yes	No	933D	This function allows the inverter measuring automatically all of parameters required for the control mode selected in FU2-60, such as stator resistance, rotor resistance, leakage inductance and no load current.	NO
FU2[22] ▶ 62 Rs _.___ohm	Stator resistance	*	*	933E	Calculation of the stator resistance depending on the motor capacity.	NO
FU2[22] ▶ 63 Lsigma _._mH	Leakage inductance	*	*	933F	Calculation of the leakage inductance depending of the motor capacity.	NO
FU2[22] ▶ 64 PreExTime 1.0sec	Pre-exciting time of the motor	0.0 – 60.0sec	1.0sec	9340	IT allows setting the time that the inverter will apply a DC current to the output before starting to apply the acceleration ramp, once run command is received. **Note:** DCB is displayed.	NO
FU2[22] ▶ 65 SL P-Gain 1000	Proportional gain in Sensorless	0 – 9999	1000	9341	It allows setting the value of proportional gain that will be used in Sensorless control mode. A very high value supplies a faster response, but the system can become unstable. Set an appropriate value for your application	YES
FU2[22] ▶ 66 SL I-Gain 100	Integral gain in Sensorless	0 – 9999	100	9342	It allows setting the value of integral gain that will be used in Sensorless control mode. A low value supplies more stable and slower response of the system, but a trip during speed control can be generated by the inverter. Set an appropriate value for your application.	YES

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* Depending on the inverter capacity.
[22] It is only available if control mode is set to 'Sensorless' in FU2-60.

Display	Description	Range	Default value	Memory address	Function	Set during RUN
FU2 ► 67 **Torque boost Manual**	Torque boost setting	Manual Automatic	Manual	9343	This function is used to increase the torque boost at low speed, increasing the output voltage applied to the motor. If the value is higher than the required value, motor can be saturated generating an overcurrent fault. Torque boost is calculated as a percentage of inverter rated voltage.	NO
FU2[23] ► 68 **Fwd boost 2.0%**	Manual torque boost in forward direction	0.0 – 15.0%	2.0%	9344	**Manual**: Values set in FU2-67 and FU2-68 are applied. If control mode set in FU2-60 is 'V/F', then settings done from FU2-67 to FU2-69 will be ignored. **Note**: A very high value of torque boost could saturate the motor and could generate an overcurrent trip. **Note**: We recommend use this function when the distance from motor to inverter is very big.	NO
FU2[23] ► 69 **Rev boost 2.0%**	Manual torque boost in reverse direction	0.0 – 15.0%	2.0%	9345	**Automatic:** Values automatically calculated by the inverter according to the load are applied. If control mode set in FU2-60 is 'Sensorless', then this function is not available. **Note**: We recommend carry out an 'Auto tuning' of the motor so that this function is effective. **Note**: This function is only available for the first motor. It is not available for settings of the second motor.	NO
FU2 ► 80 **PowerOn disp 0**	Power on display	0 – 12	0	9350	Depending on the code introduced here, a different parameter will be displayed when power supply loss occurs and it is recovered again.	YES
FU2 ► 81 **User disp Voltage**	Displaying for value displayed in DRV-11	Volts Watts	Volts	9351	It allows selecting the units for output voltage or power displaying showed in DRV-11.	YES
FU2 ► 82 **S/W PE x.x Ver y.y**	Software version	-	-	9352	Displaying of software version installed in the equipment.	-
FU2 ► 83 **LastTripTime 0:00:00:00:00**	Time from the last fault	-	-	9353	Displaying of the elapsed time from the last fault. **Note:** this time is automatically reset after each fault.	-
FU2 ► 84 **On-Time 0:00:00:00:00**	Time from the equipment was connected	-	-	9354	Displaying of the elapsed time from the inverter was connected. **Note:** this time is not automatically reset.	-
FU2 ► 85 **Run-time 0:00:00:00:00**	Operation time	-	-	9355	Displaying of the elapse time while inverter is running. **Note:** this time is not automatically reset.	-
FU2 ► 87 **Power Set 100.0%**	Power setting	0.1 – 400.0%	100.0%	9357	Setting of the scale of the inverter output power.	YES
FU2 ► 90 **Para. disp Default**	Selection of parameters displaying	Default All Para Diff Para	Default	935A	**Default:** Default parameters of the inverter are only displayed. **All Para:** All of parameters of the inverter are displayed. **Diff Para:** Parameters that have been modified are only displayed.	NO

Within the FU2-80 Function cell:

Set value	Displaying at the moment of re-connection
0	DRV-00 'Cmd. Freq.'
1	DRV-01 'Acc. Time'
2	DRV-02 'Dec. Time'
3	DRV-03 'Drive mode'
4	DRV-04 'Freq mode'
5	DRV-05 'Step Freq-1'
6	DRV-06 'Step Freq-2'
7	DRV-07 'Step Freq-3'
8	DRV-08 'Current'
9	DRV-09 'Speed'
10	DRV-10 'DC link Vtg'
11	DRV-11 'User disp'
12	DRV-12 'Fault None'

Note: It operates in the same way in PID mode.

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[23] It is only available if torque boost is set to 'Manual' in FU2-67.

Display	Description	Range	Default value	Memory address	Function	Set during RUN
FU2 ► 91 Para. read No	Parameters read	No Yes	No	935B	Functions used for programs of multiple inverters with the same settings. LCD display 'reads' parameters of the inverter memory (load) and can 'write' them into the memory of other inverters (download) when display is connected to these inverters.	NO
FU2 ► 92 Para. write No	Parameters write	No Yes	No	935C	**Note**: When FU2-91 is used, parameters referred to the motor such as FU2-40 – 46, FU2-62 – 63 will be restarted. Carry out 'Auto tuning' function before using 'Sensorless' control mode. **Note**: Carry out FU2-95 'Para. save' before using FU2-91.	NO
FU2 ► 93 Para. init No	Parameters initialize	No All groups DRV FU1 FU2 I/O EXT COM APP	No	935D	It allows initialize selected parameters back to the factory default value together or in a separate way. **Option / Description** No — It is displayed after initializing command. All groups — All of parameters are initialized. DRV — Parameters of DRV group are initialized FU1 — Parameters of FU1 group are initialized FU2 — Parameters of FU2 group are initialized I/O — Parameters of I/O group are initialized EXT — Parameters of EXT group are initialized COM — Parameters of COM group are initialized APP — Parameters of APP group are initialized **Note:** Set motor nameplate data in FU2 again. **Note:** Fault history is not erased if FU2-06 'Erase trips' is not executed.	NO
FU2 ► 94 Para. lock 0	Parameters lock	0 – 9999	0	935E	It allows user to lock parameters so that they cannot be modified. Under these circumstances, arrows of display do not appear full, but empty. Lock and unlock code is 12.	YES
FU2 ► 95 Para. save No	Parameters save	No Yes	No	935F	It allows memorizing parameters value that has been modified. If a parameters read is done before executing FU2-91, modified values will be read.	NO

8.4. Inputs and Outputs Menu (I/O)

Display	Description	Range	Default value	Memory address	Function	Set during RUN
I/O ▶ 00 Jump code 1	Jump to desired parameter	1 to 99	1	9400	Any parameter of **I/O** group can be directly selected from here without scrolling up/down to others parameters. You only need to introduce the number of desired parameter and press **ENT** key.	YES
I/O[24] ▶ 01 V1 Filter 250ms	Filter of analogue voltage input	0 – 9999ms	250ms	9401	Filter for analogue input signal V1. An increase of this value will improve stability in case of the signal is being affected by noise. **Note:** If you increase this value, response time become slower.	YES
I/O[24] ▶ 02 V1 volt x1 0.00V	Minimum voltage of V1 input	0.00 – I/O-04 (12.00V max.)	0.00V	9402	Setting the minimum voltage value of input signal V1 that inverter supplies the minimum output frequency set in I/O-03.	YES
I/O[24] ▶ 03 V1 Freq y1 0.00Hz	Minimum frequency for minimum voltage of V1 input	0.00 – FU1-30 Hz	0.00Hz	9403	Setting of minimum frequency for analogue reference signal V1 corresponding to the minimum voltage set in I/O-02.	YES
I/O[24] ▶ 04 V1 volt x2 10.00V	Maximum voltage of V1 input	I/O-02 (0.00V min.) – 12.00V	10.00V	9404	Setting of maximum voltage value of input signal V1 that inverter supplies the maximum output frequency set in I/O-05.	YES
I/O[24] ▶ 05 V1 Freq y2 50.00Hz	Maximum frequency for maximum voltage of V1 input	0.00 – I/O-03 Hz	50.00Hz	9405	Setting of maximum frequency for analogue reference signal V1 corresponding to the maximum voltage set in I/O-04.	YES
I/O[25] ▶ 06 I Filter 250ms	Filter of analogue current input	0 – 9999ms	250ms	9406	Filter for analogue input signal I. An increase of this value will improve the stability in case of the signal is being affected by noise. **Note:** If you increase this value, response time become slower.	YES
I/O[25] ▶ 07 I curr x1 4.00mA	Minimum current of I input	0.00 – I/O-09 (20.00mA max.)	4.00mA	9407	Setting of minimum current value of input signal I that inverter supplies the minimum output frequency set in I/O-08.	YES
I/O[25] ▶ 08 I Freq y1 0.00Hz	Minimum frequency for minimum current of I input	0.00 – FU1-30 Hz	0.00Hz	9408	Setting of minimum frequency for analogue reference signal I corresponding to the minimum current set in I/O-07.	YES
I/O[25] ▶ 09 I curr x2 20.00mA	Maximum current of I input	I/O-07 (0.00mA min.) – 20.00mA	20.00mA	9409	Setting of maximum current value of input signal I that inverter supplies the maximum output frequency set in I/O-10.	YES
I/O[25] ▶ 10 I Freq y2 50.00Hz	Maximum frequency for maximum current of I input	0.00 – I/O-08 Hz	50.00Hz	940A	Setting of maximum frequency for analogue reference signal I corresponding to the maximum current set in I/O-09.	YES
I/O[26] ▶ 11 P pulse set (A)	Selection of pulse input mode	(A+B) (A)	(A)	940B	Setting of pulse input mode: A or A+B. Do not apply pulse input in both terminals in case of A+B is set.	YES
I/O[26] ▶ 12 P Filter 10ms	Filter of pulse input	0 – 9999ms	10ms	940C	Filter of analogue pulse input signal. An increase of this value will improve operation stability in case of the input is being affected by noise. **Note:** If you increase this value, response time become slower.	YES
I/O[26] ▶ 13 P pulse x1 0.0kHz	Minimum pulse frequency of A0, B0 input	0.0 – I/O-15 (10.0kHz max.)	0.0kHz	940D	Setting of minimum frequency value of pulse input signal that inverter supplies the minimum output frequency set in I/O-14.	YES
I/O[26] ▶ 14 P Freq y1 0.00Hz	Minimum frequency for minimum pulse frequency of A0, B0 input	0.00 – FU1-30 Hz	0.00Hz	940E	Setting of minimum frequency for pulse reference signal corresponding to the minimum pulse frequency set in I/O-13.	YES
I/O[26] ▶ 15 P pulse x2 10.0kHz	Maximum pulse frequency of A0, B0 input	I/O-13 (0.0mA min.) – 10.0kHz	10.0kHz	940F	Setting of maximum frequency value of pulse input signal that inverter supplies the maximum output frequency set in I/O-16.	YES
I/O[26] ▶ 16 P Freq y2 50.00Hz	Maximum frequency for maximum pulse frequency of A0, B0 input	0 – I/O-14 Hz	50.00Hz	9410	Setting of maximum frequency for pulse reference signal corresponding to the maximum pulse frequency set in I/O-15.	YES

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[24] It is only available if reference signal is set to V1, V1S or V1+I in DRV-04 'Frequency mode'.
[25] It is only available if reference signal is set to I or V1+I in DRV-04 'Frequency mode'.
[26] It is only available if reference signal is set to Pulse in DRV-04 'Frequency mode'.

Display	Description	Range	Default value	Memory address	Function		Set during RUN
I/O²⁷ ► **Wire broken** **17** **None**	Criterion for signal loss of reference analogue input	None Half of x1 Less than x1	None	9411	It defines criterion for defining if reference signal has been lost. **None:** Disabled function. **Half of x1:** Inverter determines the reference signal loss when its value is below half of minimum value set in I/O-02, I/O-07 or I/O-13. **Less than x1:** Inverter determines the reference signal loss when its value is below minimum value set in I/O-02, I/O-07 or I/O-13.		YES
I/O²⁷ ► Lostcommand **18** **None**	Stop mode after analogue input signal loss	None FreeRun Stop	None	9412	It defines the stop mode after analogue input signal loss. **None:** It continues operating even if the signal has been lost. **Free Run:** Inverter turns off the output voltage and the system stops by inertia. **Stop**: Inverter stops the system applying a deceleration ramp. <table><tr><td>LOP</td><td>Reference loss from Optional Card (DPRAM fault)</td></tr><tr><td>LOR</td><td>Reference loss from Optional Card (Net communication fault).</td></tr><tr><td>LOV</td><td>Loss of analogue frequency reference (V1: 0-10V)</td></tr><tr><td>LOI</td><td>Loss of analogue frequency reference (I: 4-20mA)</td></tr></table>		YES
I/O²⁷ ► **Time out** **19** **1.0sec**	Delay time after reference signal loss	0.1 – 120.0sec	1.0sec	9413	Delay time after losing the reference signal, before inverter performing according to the previous explained criteria.		YES

²⁷ It is only available if reference signal is set to V1, V1S, I, V1+I or Pulse in DRV-04 'Frequency mode'. Function will be only executed if the values set in I/O-02, I/O-07 or I/O-13 are different from 0.

	Display	Description	Range	Default value	Memory address	Function	Set during RUN
I/O ▶ 20	**M1 define** **Speed-L**	Multi-function digital input. M1 terminal	Speed-L Speed-M Speed-H XCEL-L XCEL-M XCEL-H DC-brake 2nd Func Exchange Reserved Up Down 3-Wire Ext Trip Pre-Heat iTerm Clear Open-loop Main-drive Analog hold XCEL stop P Gain2 Reserved Interlock1 Interlock2 Interlock3 Interlock4 Speed-X RST BX JOG FX RX ANA_CHG Pre-Excite Ext PID Run Up/Dn Clr	Speed-L	9414	Setting of multi-function inputs. **Speed-L, Speed-M, Speed-H:** Multiple step-speeds activating these inputs. **XCEL-L, XCEL-M, XCEL-H:** Multiple acceleration ramps activating these inputs. **DC-brake**: Activation of braking current injection during the stop.	YES
I/O ▶ 21	**M2 define** **Speed-M**	Multi-function digital input. M2 terminal		Speed-M	9415	**2nd Func:** Parameters activation for second motor. **Exchange:** Exchange to commercial power line. **Reserved:** No function. **Up:** To increase reference frequency by motorized potentiometer. **Down:** To decrease reference frequency by motorized potentiometer.	YES
I/O ▶ 22	**M3 define** **Speed-H**	Multi-function digital input. M3 terminal		Speed-H	9416	**3-Wire:** Wiring of start/stop signals by pulse. **Ext trip:** Generation of an external trip in the inverter. **Pre-Heat:** Activation of pre-heat function. **iTerm Clear:** It sets to 0 the value of I gain in PID mode. **Open-loop:** It commutes from PID operation (close loop) to V/F (open loop).	YES
I/O ▶ 23	**M4 define** **RST**	Multi-function digital input. M4 terminal		RST	9417	**Main-drive:** Its activation allows that inverter will be controlled through communication net without additional changes. **Analog hold:** It allows holding fixed the output frequency while this terminal is active and the reference signal is analogue. **XCEL stop:** Inverter stops the acceleration and deceleration when this signal is activated.	YES
I/O ▶ 24	**M5 define** **BX**	Multi-function digital input. M5 terminal		BX	9418	**P Gain2:** Its activation allows that the P2 set value in PID mode is applied. **Reserved:** No function. **Interlock1:** It allows determining if the auxiliary motor 1 is out of service. Use of NC contact. **Interlock2:** It allows determining if the auxiliary motor 2 is out of service. Use of NC contact.	YES
I/O ▶ 25	**M6 define** **JOG**	Multi-function digital input. M6 terminal		JOG	9419	**Interlock3:** It allows determining if the auxiliary motor 3 is out of service. Use of NC contact. **Interlock4:** It allows determining if the auxiliary motor 4 is out of service. Use of NC contact. **Speed-X:** Multiple step-speeds through activation of these inputs.	YES
I/O ▶ 26	**M7 define** **FX**	Multi-function digital input. M7 terminal		FX	941A	**RST:** Fault reset. **BX:** Emergency stop trip. No reset. **JOG:** Activation of this signal allows that the inverter ignores any speed reference and starts to operate at jog frequency programmed in I/O-30. **FX:** Forward run command. **RX:** Reverse run command.	YES
I/O ▶ 27	**M8 define** **RX**	Multi-function digital input. M8 terminal		RX	941B	**ANA_CHG:** If reference signal is set to V1+I, it allows change from V1 to I. **Pre-Excite:** It allows applying a pre-exciting current until start signal is activated. **Ext PID Run:** Its activation allows starting dual PID. **Up/Dn Clr:** It allows clearing memorized frequency introduced by motorized potentiometer.	YES
I/O ▶ 28	**In status** **00000000000**	Digital inputs status	00000000000 – 11111111111	00000000000	941C	It displays the activation or not activation of all of digital inputs.	-
I/O ▶ 29	**Ti Filt Num** **15ms**	Filter of digital inputs	2 – 1000ms	15ms	941D	Filter for digital inputs. This filter is effective in case of inputs are being affected by noise. **Note:** If you increase this value, response time become slower.	YES
I/O ▶ 30	**Jog Freq** **10.00Hz**	Setting of jog frequency	0 – FU1-30 Hz	10.00Hz	941E	Setting of frequency value that the inverter will start to operate independently of any other reference signal whenever some of the digital inputs is configured as 'JOG' and it is activated.	YES

Display	Description	Range	Default value	Memory address	Function	Set during RUN
I/O[28] ▶ 31 Step Freq-4 40.00Hz	Speed at step frequency 4	0 – FU1-30 Hz	40.00Hz	941F	Setting of frequency values that will be applied as multiple speeds by activating input signals according to the attached table:	YES
I/O[28] ▶ 32 Step Freq-5 50.00Hz	Speed at step frequency 5		50.00Hz	9420		YES
I/O[28] ▶ 33 Step Freq-6 40.00Hz	Speed at step frequency 6		40.00Hz	9421		YES
I/O[28] ▶ 34 Step Freq-7 30.00Hz	Speed at step frequency 7		30.00Hz	9422		YES
I/O[29] ▶ 35 Step Freq-8 20.00Hz	Speed at step frequency 8		20.00Hz	9423		YES
I/O[29] ▶ 36 Step Freq-9 10.00Hz	Speed at step frequency 9		10.00Hz	9424		YES
I/O[29] ▶ 37 Step Freq-10 20.00Hz	Speed at step frequency 10		20.00Hz	9425		YES
I/O[29] ▶ 38 Step Freq-11 30.00Hz	Speed at step frequency 11		30.00Hz	9426		YES
I/O[29] ▶ 39 Step Freq-12 40.00Hz	Speed at step frequency 12		40.00Hz	9427		YES
I/O[29] ▶ 40 Step Freq-13 50.00Hz	Speed at step frequency 13		50.00Hz	9428		YES
I/O[29] ▶ 41 Step Freq-14 40.00Hz	Speed at step frequency 14		40.00Hz	9429		YES
I/O[29] ▶ 42 Step Freq-15 30.00Hz	Speed at step frequency 15		30.00Hz	942A	Frequency values set from Step 0=DRV-00, Step 1 to Step 3 in DRV-05 to DRV-07, and the others indicated here.	YES
I/O ▶ 50 Acc time-1 20.0sec	Acceleration time 1	0 – 600.0sec	20.0sec	9432	Values set here will be applied based on the explanation done in FU1-72 'Acc/Dec ch F'. Additionally, these values are used according to the settings done for digital inputs. See I/O-52 to I/O-63.	YES
I/O ▶ 51 Dec time-1 20.0sec	Deceleration time 1		20.0sec	9433		YES
I/O[30] ▶ 52 Acc time-2 30.0sec	Acceleration time 2	0 – 600.0sec	30.0sec	9434	Setting of time values that will be applied as multiple acceleration and deceleration ramps by activating input signals according to the attached table:	YES
I/O[30] ▶ 53 Dec time-2 30.0sec	Deceleration time 2		30.0sec	9435		YES
I/O[30] ▶ 54 Acc time-3 40.0sec	Acceleration time 3		40.0sec	9436		YES
I/O[30] ▶ 55 Dec time-3 40.0sec	Deceleration time 3		40.0sec	9437		YES
I/O[31] ▶ 56 Acc time-4 50.0sec	Acceleration time 4		50.0sec	9438		YES
I/O[31] ▶ 57 Dec time-4 50.0sec	Deceleration time 4		50.0sec	9439		YES
I/O[31] ▶ 58 Acc time-5 40.0sec	Acceleration time 5		40.0sec	943A		YES
I/O[31] ▶ 59 Dec time-5 40.0sec	Deceleration time 5		40.0sec	943B		YES
I/O[31] ▶ 60 Acc time-6 30.0sec	Acceleration time 6		30.0sec	943C		YES
I/O[31] ▶ 61 Dec time-6 30.0sec	Deceleration time 6		30.0sec	943D		YES
I/O[31] ▶ 62 Acc time-7 20.0sec	Acceleration time 7		20.0sec	943E		YES
I/O[31] ▶ 63 Dec time-7 20.0sec	Deceleration time 7		20.0sec	943F		YES
I/O ▶ 68 S0 Level 0.0%	Offset for S0 analogue output	0.0 – 100.0%	0.0%	9444	Setting of the beginning of S0 analogue output. It allows moving level of 0V up to 100.0% of output frequency.	YES
I/O ▶ 69 S1 Level 0.0%	Offset for S1 analogue output	0.0 – 100.0%	0.0%	9445	Setting of the beginning of S0 analogue output. It allows moving level of 0V up to 100.0% of output frequency.	YES

Speed step table (in Function column):

Step	M1 Speed-L	M2 Speed-M	M3 Speed-H	M4 Speed-X
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	0	0	0	1
9	1	0	0	1
10	0	1	0	1
11	1	1	0	1
12	0	0	1	1
13	1	0	1	1
14	0	1	1	1
15	1	1	1	1

Acc/Dec ramp table (in Function column):

Step	M1 XCEL-L	M2 XCEL-M	M3 XCEL-H
DRV-01: Acc-0 / DRV-02: Dec-0	0	0	0
I/O-50: Acc-1 / I/O-51: Dec-1	1	0	0
I/O-52: Acc-2 / I/O-53: Dec-2	0	1	0
I/O-54: Acc-3 / I/O-55: Dec-3	1	1	0
I/O-55: Acc-4 / I/O-57: Dec-4	0	0	1
I/O-58: Acc-5 / I/O-59: Dec-5	1	0	1
I/O-60: Acc-6 / I/O-61: Dec-6	0	1	1
I/O-62: Acc-7 / I/O-63: Dec-7	1	1	1

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[28] It is only available if three of digital inputs are set to 'Speed-L', 'Speed-M' and 'Speed-H'. See configuration of inputs from M1 to M8 (I/O-20 to I/O-27).

[29] It is only available if four of digital inputs are set to 'Speed-L', 'Speed-M', 'Speed-H' and 'Speed-X'. See configuration of inputs from M1 to M8 (I/O-20 to I/O-27).

[30] It is only available if two of digital inputs are set to 'XCEL-L', 'XCEL-M'. See configuration of inputs from M1 to M8 (I/O-20 to I/O-27).

[31] It is only available if three of digital inputs are set to 'XCEL-L', 'XCEL-M' and 'XCEL-H'. See configuration of inputs from M1 to M8 (I/O-20 to I/O-27).

	Display	Description	Range	Default value	Memory address	Function	Set during RUN
I/O ► 70	S0 mode Frequency	S0 analogue output mode (0-10V)	Frequency Current Voltage DC link Vtg Ext PID Out	Frequency	9446	Selection of the magnitude that the signal of 0-10VDC supplied by analogue output S0 will be proportional.	YES
I/O ► 71	S0 adjust 100%	Setting of S0 analogue output	10 – 200%	100%	9447	It allows scaling the voltage level of S0 analogue input signal.	YES
I/O ► 72	S1 mode Voltage	S1 analogue output mode (0-10V)	See S0	Voltage	9448	Selection of the magnitude that the signal of 0-10VDC supplied by analogue output S1 will be proportional.	YES
I/O ► 73	S1 adjust 100%	Setting of S1 analogue output	10 – 200%	100%	9449	It allows scaling the voltage level of S1 analogue input signal.	YES
I/O ► 74	FDT Freq 30.00Hz	Frequency detection level	0 – FU1-30 Hz	30.00Hz	944A	These parameters setting combined with output relays setting allow selecting different bandwidth where detecting the inverter speed and doing that these signals change their status.	YES
I/O ► 75	FDT band 10.00Hz	Frequency detection bandwidth		10.00Hz	944B		YES
I/O ► 76	Aux mode1 None	Selection of configuration for auxiliary relay 1	None FDT-1 FDT-2 FDT-3 FDT-4 FDT-5 OL IOL Stall OV LV OH LostCommand Run Stop Steady INV line COMM line SSearch Ready MMC	None	944C	It allows setting multi-functions outputs: **None:** Output relays do not actuate. **FDT-1:** Activation of output signals when foutput>freference – ((I/O-75)/2). Example: If reference frequency is 50Hz and I/O-75=10, then 50 – (10/2)=45Hz. Contact will close at frequencies higher than 45Hz. **FDT-2:** Contact will be closed when reference frequency is centered in I/O-74 being I/O-75 the bandwidth. If reference frequency is 40Hz, I/O-74=40Hz and I/O-75=4Hz, the contact will be closed from 38Hz to 42Hz. **FDT-3:** Contact would close at frequencies from (I/O-74 – (I/O-75)/2) to (I/O-74 + (I/O-75)/2). If I/O-74=30Hz and I/O-75=10Hz, then the contact will close from (30-(10/2)) to (30+(10/2)), that means, from 25Hz to 35Hz during acceleration.	YES
I/O ► 77	Aux mode2 None	Selection of configuration for auxiliary relay 2		None	944D	**FDT-4:** Contact is closed when output frequency is higher than I/O-74 value and remains closed until frequency decreases below I/O-74 – (I/O-75)/2. That means, the contact will close above 30Hz and will not open until frequency decreases below 25Hz. **FDT-5:** Operation opposite to FDT-4. **OL:** Overload. The contact is closed when current exceeds the overload value set in FU1-64 for the time set in FU1-65. **IOL:** If overload level remains for 1 minute, inverter turns off the output and will trip because of overload current.	YES
I/O ► 78	Aux mode3 None	Selection of configuration for auxiliary relay 3		None	944E	Stall: The contact is closed when current dynamic limitation is active. See FU1-70 and FU1-71. **OV:** Over voltage. The contact is closed with a high level of DC Link. **LV:** Low voltage. The contact is closed with a low level of DC Link. **OH:** The contact is closed when there is an over temperature of the inverter. Lost Command: The contact is closed when detection of reference signal loss has been activated. See I/O-17 to I/O-19. **Run:** The contact is closed when inverter is running.	YES
I/O ► 79	Aux mode4 None	Selection of configuration for auxiliary relay 4		None	944F	**Stop:** The contact is closed when inverter is stopped. **Steady:** The contact is closed when inverter is at steady status. **INV line, COMM line:** Both functions combined with a digital input as 'Exchange', allow the inverter commutation to the commercial power line. **SSearch:** The contact is closed when the Speed search is activated. See FU2-22 to FU2-24. **Ready:** The contact is closed when the inverter is ready for starting to operate. **MMC:** It is used to control multiple auxiliary motors. See APP group.	YES

Display	Description	Range	Default value	Memory address	Function	Set during RUN
I/O ▶ 80 **Relay mode** **010**	Selection of configuration for fault relay	000 – 111	010	9450	It allows configuring the performance of fault relay according to the following table: Table below: **Bit** / **Adjus.** / **Display** / **Description** Bit 1 (LV) / 0 / 000 / Fault relay does not actuate with 'Low voltage' fault. Bit 1 (LV) / 1 / 001 / Fault relay actuates with 'Low voltage' fault. Bit 2 (Fault) / 0 / 000 / Fault relay does not actuate with any fault. Bit 2 (Fault) / 1 / 010 / Fault relay actuates with any fault different to 'Low voltage' and 'EMERG' fault. Bit 3 (Tries) / 0 / 000 / Fault relay does not actuate according to the number of auto tries. Bit 3 (Tries) / 1 / 100 / Fault relay actuates if number of auto tries set in FU2-25 decrease down to 0 because of fault. It is disabled when the function of restart is active.	YES
I/O ▶ 81 **Out status** **00000000**	Activation status of digital outputs	00000000 – 11111111	00000000	9451	It indicates activation or deactivation status of digital outputs.	YES
I/O ▶ 82 **Relay On** **0.0sec**	On delay time of fault relay	0.0 – 999.9sec	0.0sec	9452	Delay time for the connection of fault relay.	YES
I/O ▶ 83 **Relay Off** **0.0sec**	Off delay time of fault relay	0.0 – 999.9sec	0.0sec	9453	Delay time for the disconnection of fault relay.	YES
I/O ▶ 84 **Fan Con. Sel** **PowerOn Fan**	Selection of cooling fan operation	PowerOn Fan Run_Fan Temper_Fan	PowerOn Fan	9454	**PowerOn Fan:** Cooling fan of the inverter is connected when power supply of the equipment is connected. **Run_Fan:** Cooling fan of the inverter is connected when inverter is running. **Temper_Fan:** Cooling fan of the inverter is connected when the temperature is increased above the value set in I/O-85. **Note:** It is only available for inverters with a power rating higher than 30kW.	YES
I/O ▶ 85 **Fan Temp** **70**	Setting of inverter temperature	0 – 70	70	9455	Setting of temperature that cooling fan should be connected. **Note:** It is only available for inverters with a power rating higher than 30kW.	YES
I/O ▶ 86 **V1 Unit Sel** **Speed**	Selection of displaying units for V1 signal	Speed Percent Bar mBar kPa Pa	Speed	9456	Selection of displaying units for V1 signal. It affects to reference signal and feedback loop in PID mode.	NO
I/O ▶ 87 **I Unit Sel** **Speed**	Selection of displaying units for I signal		Speed	9457	Selection of displaying units for I signal. It affects to reference signal and feedback loop in PID mode.	NO
I/O ▶ 88 **PulseUnitSel** **Speed**	Selection of displaying units for A0, B0 signal		Speed	9458	Selection of displaying units for Pulse signal. It affects to reference signal and feedback loop in PID mode.	NO
I/O ▶ 90 **Inv No.** **1**	Slave number in communication net	1 – 250	1	945A	It sets the number of slave in a communication net that is applied to the inverter as participant of the field bus.	YES

Display	Description	Range	Default value	Memory address	Function	Set during RUN
I/O ▶ 91 **Baud rate 9600bps**	Transmission speed in communication net	1200bps 2400bps 4800bps 9600bps 19200bps	9600bps	945B	It sets the speed of transmission of the communication net.	YES
I/O ▶ 92 **COM Lost Cmd None**	Stop mode after reference signal loss in communication net	None Free Run Stop	None	945C	It allows selecting the stop mode after reference signal loss when inverter is controlled through communication net. **None:** It continues operating even if the signal has been lost. **Free Run:** Inverter turns off the output voltage and the motor stops by inertia. **Stop:** Inverter applies a deceleration ramp to stop the motor.	YES
I/O ▶ 93 **COM Time Out 1.0sec**	Setting of time to determine speed reference signal loss	0.1 – 120.0sec	1.0sec	945D	Setting of the time that the inverter will wait for it before considering that the reference signal given by communication net has been lost.	YES
I/O ▶ 94 **Delay Time 5ms**	Setting for RS232/RS485 communication	2 – 1000ms	5ms	945E	It allows correctly setting the use of a RS232/RS485 converter.	YES
I/O ▶ 95 **In NO/NC Set 00000000000**	Logical function of digital inputs	00000000000 – 11111111111	00000000000	945F	It allows setting the logical function of the contacts for digital inputs: normally open contacts (0) or normally close contacts (1).	NO
I/O ▶ 96 **In CheckTime 1ms**	Check time for digital inputs	1 – 1000ms	1ms	9460	It is used when digital inputs are used for speed references or multiple acceleration ramps. Inverter considers the input value valid when the time set here has elapsed.	NO
I/O ▶ 97 **OH Trip Sel 010**	Selection of over temperature trip	000 – 111	010	9461	Inverter overheat protection is activated regardless of motor temperature setting conditions: (see table below)	NO
I/O ▶ 98 **MotTripTemp 110**	Selection of over temperature trip of the motor	0 – 255ºC	110	9462	Setting of the temperature value above which, the inverter will trip to protect the motor. See parameter I/O-97.	NO

Table for I/O-97:

	Bit			ON	OFF	Function
	3	2	1			
I/O-97			●	1	0	Motor overheat trip setting (set at I/O-98)
		●		1	0	Reserve
	●			1	0	External temperature sensor selection (NTC=0 / PTC=1)

8.5. Applications Menu (APP)

Display	Description	Range	Default value	Memory address	Function	Set during RUN
APP ► Jump code 00 1	Jump to desired parameters	1 to 99	1	9700	Any parameter of **APP** group can be directly selected from here without scrolling up/down to others parameters. You only need to introduce the number of desired parameter and press **ENT** key.	YES
APP ► proc PI mode 01 No	Selection of PID operation mode	No Yes	No	9701	It allows selecting PID operation mode to control the speed reference according to the signal that will be desired for measuring (pressure, flow, ...)	NO
APP³² ► App. mode 02 None	Selection of operation with multiple motors	None MMC	None	9702	To select the operation mode of Multiple Auxiliary Motors. **Note:** Selecting this option, Output relays are automatically configured, the others relays can be configured for another functions.	NO
APP³² ► AuxRefMode 04 No	Selection of auxiliary reference in PID mode	No Yes	No	9704	When this value is set to 'Yes', the speed reference will be the signal set in APP-05 and DRV-04 will be ignored.	YES
APP³³ ► Aux Ref Sel 05 V1	Selection of source for auxiliary reference in PID mode	Keypad-1 Keypad-2 V1 V1S I V1+I Pulse Int. 485 Ext. PID	V1	9705	Setting of the source signal for the speed reference of the inverter in PID mode, when APP-04 is set to 'Yes'.	NO
APP³² ► PID F/B 06 I	Selection of source for feedback signal	I V1 Pulse	I	9706	Selection of feedback signal source to close the control loop. **I:** If transducer sends an input signal. **V1:** If transducer sends a voltage signal. **Pulse:** If transducer sends a pulse input.	NO
APP³² ► PID P-Gain 07 100.0%	Proportional gain in PID mode	0.0 – 999.9%	100.0%	9707	It allows setting the proportional gain in PID mode. An increase of this value supplies a faster control response, but the system becomes more instable (oscillations in output).	NO
APP³² ► PID I-Time 08 0.5seg	Integral gain in PID mode	0.0 – 32.0sec	0.5sec	9708	It allows setting the integral gain in PID mode. If you increase this value, error in control response is reduced, that means, the system becomes more stable, but control speed is reduced.	YES
APP³² ► PID D-Time 09 0.0ms	Differential gain in PID mode	0.0 – 100.0ms	0.0ms	9709	It allows setting the differential gain in PID mode. An increase of this value increases the control action, becoming the system faster, but introducing more instability than proportional gain.	YES
APP³² ► PID Limit-H 10 50.00Hz	High limit of output frequency in PID mode	0.00 – 300.00Hz	50.00Hz	970A	It allows setting the maximum value of output frequency in PID mode. Even if the feedback signal does not reach the reference value, speed will not exceed the value set here.	YES
APP³² ► PID Limit-L 11 0.50Hz	Low limit of output frequency in PID mode	FU1-32 – 300.00Hz	0.50Hz	970B	It allows setting the minimum value of output frequency in PID mode. Even if the feedback signal exceeds the reference value, speed will not decrease below the value set here.	YES
APP³² ► PID OutScale 12 100.0%	Output scale in PID mode	0.0 – 999.9%	100.0%	970C	It sets the scale for the output in PID mode.	YES
APP³² ► PID P2-Gain 13 100.0%	Second proportional gain in PID mode	0.0 – 999.9%	100.0%	970D	Second proportional gain in PID mode that will be activated when it is selected through one of the digital inputs is configured as 'P Gain2'.	NO
APP³² ► P-gain Scale 14 100.0%	Scale of proportional gain in PID mode	0.0 – 100.0%	100.0%	970E	It allows setting the scaling factor for the proportional gain applied at the moment.	NO

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[32] It is only available if PID operation mode is activated, set in APP-01.
[33] It is only available if auxiliary reference mode is activated in APP-04.

Display	Description	Range	Default value	Memory address	Function	Set during RUN
APP32 ► PID Out Inv. 15 No	Output inversion in PID mode	No Yes	No	970F	It allows inverting the sense of PID, so that the inverter speed will increase as the feedback signal exceeds the reference. Otherwise, when the feedback signal is lower than the reference signal, the speed will decrease.	NO
APP32 ► PID U Fbk 17 No	Transformation of feedback from linear to square	No Yes	No	9711	It is useful for pumps and fans. It converts the linear pattern of the feedback sensor in square pattern with no additional settings. The response in PID is very faster.	NO
APP32 ► FB Filter 18 10ms	Filter for feedback signal	0 – 9999ms	10ms	9712	Filter for displaying of feedback signal.	NO
APP34 ► 2nd Acc time 20 5.0sec	Acceleration time for second motor	0.0 – 600.0sec	5.0sec	9714	Setting of acceleration ramp for second motor.	NO
APP34 ► 2nd Dec time 21 10.0sec	Deceleration time for second motor	0.0 – 600.0sec	10.0sec	9715	Setting of deceleration ramp for second motor.	YES
APP34 ► 2ndBaseFreq 22 50.00Hz	Base frequency for second motor	30.00 – FU1-30 Hz	50.00Hz	9716	Setting of base frequency applicable to the second motor.	YES
APP34 ► 2nd V/F 23 Linear	Voltage / Frequency pattern for second motor	Linear Square User V/F	Linear	9717	Setting of the relation factor of voltage / frequency applicable to the second motor. In case of User V/F, the steps will be the set ones for the first motor. See FU1-41 to FU1-48.	NO
APP34 ► 2nd F-boost 24 2.0%	Torque boost in forward direction for second motor	0.0 – 15.0%	2.0%	9718	Setting of the torque boost in forward direction that will be applied to the second motor.	NO
APP34 ► 2nd R-boost 25 2.0%	Torque boost in reverse direction for second motor	0.0 – 15.0%	2.0%	9719	Setting of the torque boost in reverse direction that will be applied to the second motor.	NO
APP34 ► 2nd Stall 26 100%	Current limit for second motor	30 – 150%	100%	971A	Setting of the dynamic limitation of current for second motor.	NO
APP34 ► 2ndETH1min 27 130%	Electronic thermal protection for 1 minute for second motor	APP-28 – 200%	130%	971B	Setting of the electronic thermal protection for 1 minute for second motor based on rated current of that motor introduced in APP-29.	NO
APP34 ► 2ndETH cont 28 120%	Electronic thermal protection for continuous for second motor	50.00 – APP-27 (max 150%)	120%	971C	Setting of the electronic thermal protection for continuous for second motor based on rated current of that motor introduced in APP-29.	YES
APP34 ► 2nd R-Curr 29 _._A	Rated current for second motor	1.0 – 200.0A	*	971D	Rated current of second motor.	YES
APP35 ► Aux Mot Run 30 0	Auxiliary motors running	*	0	971E	Displaying of the amount of auxiliary motors running.	NO
APP35 ► Starting Aux 31 1	Selection of starting for auxiliary motors	1 – 4	1	971F	Setting of the motor that will start the connection cycle of auxiliary motors. This allows setting the sequence of normal connection and additionally, in case of activating some mode of motors alternation.	NO
APP35 ► AutoOp Time 32 00:00	Displaying of operation time in rotation mode	*	00:00	9720	It is not available in this software version.	YES
APP35 ► Nbr Aux's 33 4	Number of auxiliary motors	0 – 4	4	9721	It allows setting the maximum number of auxiliary motors that we want to connect (maximum 4 motors).	NO
APP32 ► Sleep Delay 40 60.0sec	Sleep delay time	0.0 – 999.9sec	60.0sec	9728	It allows setting the time that inverter will wait for it before activating sleep mode. In this status, turns off the output to the motor but it remains checking feedback deviation with regard to the reference for activating the output at the precise moment.	YES

[32] It is only available if PID operation mode is activated, set in APP-01.
[34] It is only available if one of digital inputs is set as '2nd Func' in terminals from M1 to M8. See I/O-20 to I/O-27. Values will be only applied when that configured input is activated.
[35] It is only available if PID mode has been activated in APP-01, and additionally, MMC mode is selected in APP-02.

Display	Description	Range	Default value	Memory address	Function	Set during RUN
APP[32] ► Sleep Freq0 41 0.00Hz	Sleep frequency 0	0.00 – FU1-30 Hz	0.00Hz	9729	If the inverter receives the command 0 (DRV-00) as reference and feedback is higher than this one, when the output frequency is equal or lower than the frequency set here for the time set in APP-40, sleep mode will be activated. Example: DRV-00 = 70.00% FBK = 71.00% APP-41 = 42.00Hz APP-40 = 20.0sec Output frequency ≤ 42.00Hz, then sleep mode will be activated after elapsing 20 seconds.	YES
APP[32] ► Sleep Freq1 42 0.00Hz	Sleep frequency 1		0.00Hz	972A	Explanation of APP-41 is valid for APP-42, but for command 1 (DRV-05).	YES
APP[32] ► Sleep Freq2 43 0.00Hz	Sleep frequency 2		0.00Hz	972B	Explanation of APP-41 is valid for APP-43, but for command 2 (DRV-06)	YES
APP[32] ► Sleep Freq3 44 0.00Hz	Sleep frequency 3		0.00Hz	972C	Explanation of APP-41 is valid for APP-44, but for command 3 (DRV-07)	YES
APP[32] ► Sleep Freq4 45 0.00Hz	Sleep frequency 4		0.00Hz	972D	Explanation of APP-41 is valid for APP-45, but for command 4 (I/O-31)	YES
APP[32] ► Sleep Freq5 46 0.00Hz	Sleep frequency 5		0.00Hz	972E	Explanation of APP-41 is valid for APP-46, but for command 5 (I/O-32)	YES
APP[32] ► Sleep Freq6 47 0.00Hz	Sleep frequency 6		0.00Hz	972F	Explanation of APP-41 is valid for APP-47, but for command 6 (I/O-33)	YES
APP[32] ► Sleep Freq7 48 0.00Hz	Sleep frequency 7		0.00Hz	9730	Explanation of APP-41 is valid for APP-48, but for command 7 (I/O-34)	YES
APP[32] ► WakeUp level 49 2.0%	Wake up level for Sleep mode	0.0 – 100.0%	2.0%	9731	When the inverter is in sleep mode, and feedback decreases with regard to the command in an equal or higher percentage of the value set here, the inverter activates the output to the motor again. Previous example: DRV-00 = 70.00% FBK = 70.20% APP-41 = 42.00Hz APP-40 = 20.0sec Output frequency ≤ 42.00Hz, then sleep mode will be activated. APP-49 = 3.0% When FBK = 64.00%, then inverter is activated.	YES
APP[35] ► Start Freq 1 50 49.50Hz	Start frequency of auxiliary motor 1	0.00 – FU1-30 Hz	49.50Hz	9732	Multiple motors operation. When the feedback is hold below the command in a percentage equal or lower than the percentage set in APP-71 and the output frequency is above the value set here, the inverter will wait for the time set in APP-58 and then it will activate the output to start the first auxiliary motor MMC1. Example: DRV-00 = 70.00% FBK = 65.00% Output frequency = 50.00Hz APP-50 = 48.00Hz APP-71 = 4.0% APP-58 = 8.0sec, once elapsed this time, the output MMC1 = ON (contact A1 – C1 is closed).	YES
APP[35] ► Start Freq 2 51 49.50Hz	Start frequency of auxiliary motor 2		49.50Hz	9733	It is the same operation of APP-50, but for starting the second auxiliary motor MMC2.	YES
APP[35] ► Start Freq 3 52 49.50Hz	Start frequency of auxiliary motor 3		49.50Hz	9734	It is the same operation of APP-50, but for starting the third auxiliary motor MMC3.	YES
APP[35] ► Start Freq 4 53 49.50Hz	Start frequency of auxiliary motor 4		49.50Hz	9735	It is the same operation of APP-50, but for starting the fourth auxiliary motor MMC4.	YES

[32] It is only available if PID operation mode is activated, set in APP-01.
[35] It is only available if PID mode has been activated in APP-01, and additionally, MMC mode is selected in APP-02.

Display	Description	Range	Default value	Memory address	Function	Set during RUN
APP[35] ► 54 **Stop Freq 1** 20.00Hz	Stop frequency of auxiliary motor 1	0.00 – FU1-30 Hz	20.00Hz	9736	Multiple Motors Operation. When the feedback signal is hold above the command in a percentage higher than the percentage set in APP-72 and the output frequency is below the value set here, inverter will wait for the time set in APP-59 and then it will deactivate the output for stopping the first auxiliary motor MMC1. Example: DRV-00 = 70.00% FBK = 75.00% Output frequency = 25.00Hz APP-54 = 30.00Hz APP-72 = 4.0% APP-59 = 8.0sec, once elapsed this time the output MMC1 = OFF (contact A1 – C1 is opened).	YES
APP[35] ► 55 **Stop Freq 2** 20.00Hz	Stop frequency of auxiliary motor 2		20.00Hz	9737	It is the same operation of APP-54, but for stopping the second auxiliary motor MMC2.	YES
APP[35] ► 56 **Stop Freq 3** 20.00Hz	Stop frequency of auxiliary motor 3		20.00Hz	9738	It is the same operation of APP-54, but for stopping the third auxiliary motor MMC3.	YES
APP[35] ► 57 **Stop Freq 4** 20.00Hz	Stop frequency of auxiliary motor 4		20.00Hz	9739	It is the same operation of APP-54, but for stopping the fourth auxiliary motor MMC4.	YES
APP[35] ► 58 **Aux start DT** 5.0sec	Delay time before connecting auxiliary motors	0.0 – 999.9sec	5.0sec	973A	Time that the inverter wait for before activating the outputs to connect auxiliary motors from MMC1 to MMC4.	YES
APP[35] ► 59 **Aux stop DT** 5.0sec	Delay time before stopping auxiliary motors	0.0 – 999.9sec	5.0sec	973B	Time that the inverter wait for before deactivating the outputs to disconnect auxiliary motors from MMC1 to MMC4.	NO
APP[35] ► 60 **AUX AccTime** 2.0sec	Time for the ramp at connecting auxiliary motors	0.0 – 600.0sec	2.0sec	973C	Time for fixing the compensation ramp during the connection of auxiliary motors (over pressures compensation).	YES
APP[35] ► 61 **AUX DecTime** 2.0sec	Time for the ramp at disconnecting auxiliary motors	0.0 – 600.0sec	2.0sec	973D	Time for fixing the compensation ramp during the disconnection of auxiliary motors (low pressures compensation).	YES
APP[35] ► 66 **AutoCh_Mode** 0	Rotation mode of auxiliary motors	0 – 2	0	9742	It allows selecting the rotation mode of multiple motors. **Mode 0:** Rotation does not exist. **Mode 1:** Rotation of auxiliary motors exists. The connecting sequence is the same of the disconnecting sequence. The following motor to connect will be the last motor connected plus one. **Mode 2:** Inverter rotation for all of the motors of the system. The disconnecting sequence is the inverse one of the connecting sequence. The following motor to connect will be the last motor disconnected plus one.	YES
APP[35] ► 67 **AutoEx-intv** 72:00	Operation time of the inverter for one of the motors	00:00 – 99:00 (hours:min)	72:00	9743	The time set here only affects to the rotation mode 2. The value is measured in hours and minutes (hh:mm) and this time is scored for the pump driven by the inverter. The rotation will be fulfilled whenever this time has expired.	YES
APP[35] ► 69 **Inter-lock** No	Detection of motors out of service	No Yes	No	9745	It allows activating the detection of auxiliary motors that are out of service, not to consider them at the moment of the connection. For this, It is necessary to configure so many digital inputs as auxiliary motors we have. The option of configuration is 'Interlock1 to 4', and the activation will be by opening a NC contact.	YES
APP[35] ► 71 **Aux STT FB** 2%	Difference for starting auxiliary motors	0 – 100%	2%	9747	It allows setting the difference between the reference signal and the feedback signal needed to start an auxiliary motor.	YES
APP[35] ► 72 **Aux STP FB** 0%	Difference for stopping auxiliary motors	0 – 100%	0%	9748	It allows setting the difference between the reference signal and the feedback signal needed to stop an auxiliary motor.	YES
APP[32] ► 74 **PrePID Freq** 0.00Hz	Setting of filling frequency	0.00 – FU1-30 Hz	0.00Hz	974A	Pipe filling function. It allows setting the fixed speed that inverter will operate when receiving the run command independently of PID control. The equipment will remain operating at this speed until the feedback signal exceeds the level set in APP-75 or until the time set in APP-76 has elapsed. All this depends on the activation or deactivation status of 'Pipe broken' mode.	YES

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[32] It is only available if PID operation mode is activated, set in APP-01.

[35] It is only available if PID has been activated in APP-01, and additionally, MMC mode is selected in APP-02.

Display	Description	Range	Default value	Memory address	Function	Set during RUN
APP32 ▶ 75 PrePID F/B 0.0%	Level for leaving filling mode	0.0 – 100.0%	0.0%	974B	It allows setting the level needed to deactivate the filling function and activate PID regulation. If 'Pipe broken' mode is set to Yes, the feedback signal does not exceed the value set here and it expires the time set in APP-76, a 'Pipe broken' fault is generated and the inverter turns off the power supply to the motor. If the circumstances are the same, but 'Pipe broken' mode is set to No, the fault will be not generated. When the feedback signal reaches this value, filling function will be finished and PID operation mode will be activated.	YES
APP32 ▶ 76 PrePID dly 600sec	Time of filling function application	0 – 9999sec	600sec	974C	It allows fixing the time that inverter will apply the filling function and it will be considered for tripping because of 'Pipe Broken' fault when this function is activated.	YES
APP32 ▶ 77 Pbroken mode No	Pipe broken trip during filling function	No Yes	No	974D	It allows selecting 'Pipe broken' mode during filling process. If this function is active, a fault will be generated and inverter turns off the power supply to the motor when the time set in APP-76 has elapsed if the feedback signal does not reach the value set in APP-75. Otherwise, if this function is not active, no fault will be generated and once elapsed the time, PID mode will be activated.	NO
APP ▶ 80 Ext PI mode No	External PID mode	No Yes	No	9750	It allows activating the external control of PID. This allows control a second system in PID mode using for that, input signals and digital outputs. It is necessary to configure a digital input as 'Ext PID Run', that when it is activated allows the inverter to start the second PID regulation. This regulation will actuate for one of the analogue outputs (S0 or S1) if it has been set as 'Ext PID Out'. Actuation of main PID is displayed in DRV-18 and actuation of external PID is displayed in DRV-20.	NO
APP36 ▶ 81 Ext Ref Sel Keypad	Reference for External PID	I V1 Pulse Keypad	Keypad	9751	Selection of the reference source for External PID.	NO
APP36 ▶ 82 Ext Ref Perc 50.00%	Level for reference of External PID	0.00 – 100.00%	50.00%	9752	Scale of the reference for External PID.	NO
APP36 ▶ 83 Ext Fbk Sel I	Feedback signal of External PID	I V1 Pulse	I	9753	Selection of the feedback signal source for closing the control loop In External PID. **I:** If the transducer sends a current signal. **V1:** If the transducer sends a voltage signal. **Pulse:** If the transducer sends a pulse signal	NO
APP36 ▶ 85 ExtPID Pgain 1.0%	Proportional gain for External PID	0.0 – 999.9%	1.0%	9755	It allows setting the proportional gain of External PID control. An increase of this value supplies a faster control response, but the system becomes more instable (oscillations in output).	NO
APP36 ▶ 86 ExtPID Itime 10.0sec	Integral gain for External PID	0.0 – 32.0sec	10.0sec	9756	It allows setting the integral gain of External PID control. If you increase this value, error in control response is reduced, that means, the system becomes more stable, but control speed is reduced.	NO
APP36 ▶ 87 ExtPID Dtime 0ms	Differential gain for External PID	0 – 2000ms	0ms	9757	It allows setting the differential gain of External PID control. An increase of this value increases the control action, becoming the system faster, but introducing more instability than proportional gain.	NO
APP36 ▶ 88 ExtPID lmt-H 100.00%	High limit for External PID	0.00 – 100.00%	100.00%	9758	It allows setting the maximum value of output frequency in External PID mode. Even if the feedback signal does not reach the reference value, speed will not exceed the value set here.	NO
APP36 ▶ 89 ExtPID lmt-L 0.00%	Low limit for External PID	0.00 – 30.00%	0.00%	9759	It allows setting the minimum value of output frequency in External PID mode. Even if the feedback signal exceeds the reference value, speed will not decrease below the value set here.	NO

[32] It is only available if PID operation mode is activated, set in APP-01.
[36] It is only available if PID operation mode is activated to control other external PID system set in APP-80.

Display	Description	Range	Default value	Memory address	Function	Set during RUN
APP[36] ► **ExtPID Scale** 90 100.0%	Output scale for External PID	0.0 – 999.9%	100.0%	975A	It sets the scale for the output of External PID control.	NO
APP[36] ► **Ext P2-gain** 91 100.0%	Second proportional gain for External PID	0.0 – 999.9%	100.0%	975B	Second proportional gain in External PID mode that will be activated when it is selected through one of digital inputs configured as 'P Gain2'.	NO
APP[36] ► **Ext P Scale** 92 100.0%	Scale of proportional gain for External PID	0.0 – 100.0%	100.0%	975C	It allows setting the scaling factor for the proportional gain applied at the moment, with regard to the External PID.	YES
APP[36] ► **ExtPID Fgain** 93 0.0%	F gain for External PID	0.0 – 999.9%	0.0%	975D	It is not available in this software version.	NO
APP[36] ► **ExtPIDOutInv** 95 No	Output inversion for External PID	No Yes	No	975F	It allows inverting the sense of External PID, so that the inverter speed will increase as the feedback signal exceeds the reference. Otherwise, when the feedback signal is lower than the reference signal, the speed will decrease.	NO
APP[36] ► **ExtLoopTime** 97 100ms	Activation time of External PID controller	50 – 200ms	100ms	9761	It allows setting the delay time to start the External PID.	YES

[36] It is only available if PID operation mode is activated to control other external PID system set in APP-80.

9. FAULT MESSAGES

9.1. Displayed Faults

When a fault occurs, the drive stops turning off the output voltage and displays the fault in DRV-12. The 5 latest trips can be stored from FU2-01 through FU2-05 saving also the operation conditions present on the drive at trip moment. Using **PROG** key before pressing **RESET**, it is possible to read the status present when trips occurred: it is possible to check Frequency, Current and status (acceleration, deceleration or steady status).

Screen	Protective Functions	Descriptions
OverCurrent1	Overcurrent protection.	The drive will trip whether the output current is higher than 200% of rated current value.
Over Voltage	Over voltage protection.	The inverter turns off its output if the DC voltage of the main circuit increases higher than the rated value when the motor decelerates or when regenerative energy flows back to the inverter due to a regenerative load. This fault can also occur due to a surge voltage generated at the power supply system.
Ext. Trip	External trip.	This function can be used when the user needs to turn off the output by an external trip signal. To use a normally open contact or a normally closed contact will depend on the inputs configuration set in I/O-95. The drive will cut the output to the motor protecting it from the situation detected through this terminal.
Emergency	Emergency stop (instantaneous disconnection)	Used for the emergency stop of the drive. The drive instantly turns off the output when the terminal configured as BX is ON, and returns to regular operation when this terminal is turned OFF. Take caution when using this function.
Low Voltage	Low voltage protection	The inverter turns off its output if the DC voltage is below the detection level because insufficient torque or over heating of the motor can occurs when the input voltage of the inverter drops.
Ground Fault	Ground fault protection	The inverter turns off its output when a ground fault occurs and the ground fault current is more than the internal setting value of the inverter. This function may protect the inverter when a ground fault occurs due to a low ground fault resistance.
Over Heat	Over heat protection	The inverter turns off the output if the heat sink is over heated due to a damaged cooling fan or an alien substance in the cooling system. Additionally, this trip is produced when the inverter is over heated according to the setting of the parameters I/O-97, I/O-98 (PTC / NTC connection).
E-Thermal	Electro-thermal protection	The internal electronic thermal model of the inverter determines the over heating of the motor. If the motor is overloaded the inverter turns off the output. The inverter cannot protect the motor when driving a multi-pole motor or when driving multiple motors, so consider thermal relays or other thermal protective devices for each motor.
Over load	Current limit protection (over load protection)	The drive trips when the output current is 270% of the rated current overcoming the limit of temporary protection current (S/W)
HW-Diag	Inverter hardware fault	A fault signal is generated when an error occurs on the control circuitry of the drive. The following faults are included on this trip: Wdog error, EEP error, Phase error, Input Phase Open (fuse), NTC open error and ADC Offset error.
Over Current 2	IGBT short-circuit	The drive trips when a short-circuit occurs in the IGBT or in the output power.
COM Error CPU Error	Communication error	This fault is displayed when the inverter cannot communicate with the keypad.
Inv. OLT	Inverter overload protection	The drive turns off the output when the output current is higher than the settings on the corresponding parameters (165% for 1 minute, 200% for 4 seconds).
NTC Open	Thermal sensor is open	The drive uses an external thermal sensor to detect motor over temperature. If this message is displayed it is possible that the wiring of the thermal sensor was disconnected or damaged. (The drive does not stop operation).
LOP LOR LOV LOI	Operating method when the frequency reference is lost.	According to the selection in I/O-18 (Operation method when frequency reference is lost) there are three options: the drive does not stop, the drive decelerates or the drive stops by free run. LOP: Displayed if frequency reference is set by control board and it is lost (DPRAM time is out). LOR: Displayed if frequency reference is set via the network and it is lost. LOV: Displayed if frequency reference is set by analogue input V1 and it is lost. LOI: Displayed if frequency reference is set by analogue input I and it is lost.

Screen	Protective Functions	Description
Under load	Inverter under load protection	The drive will turn off the output when the conditions of under load are present according to the levels set on the corresponding parameters of under load control. The under load current is a percentage of the rated current set in FU2-43.

To reset the fault, press the **RESET** key, active the digital input set as Reset (M4 by default) or turn off the input power supply of the drive and turn on again. If the problem persists, please contact with the technical service of POWER ELECTRONICS or an authorised agent.

9.2. Solution of Displayed Faults

Function	Cause	Solution
Over current protection	Acceleration / deceleration time is too short compared with the inertia of the load (GD²).	Increase the Acceleration / deceleration.
	The load is larger than the inverter rating.	Increase the inverter capacity.
	The drive tries to start the motor when it is still free running.	Ensure the current programming of the flying start conditions. Set correctly the inertia of the load and the parameters required to activate the speed search functionality. **Note:** Make sure that the system allows setting speed search function without any kind of risk for user or for the system.
	A ground fault or a short-circuit has occurred.	Check the output wiring.
	The mechanical brake of the motor is operating too fast.	Check the operation of the mechanical brake.
	The components of the power circuit are over heated due to a problem with the cooling fan or the cooling system.	Check the cooling fan. Check that the cooling fan is power supplied correctly and it is not obstructed by dirty.
	⚠ **Caution: Inverter operation must be started after the cause of the fault is removed to avoid damage to IGBTs inside the inverter.**	
Ground fault current	Ground fault current has occurred at the output wiring of the inverter.	Check the wiring of the inverter output.
	The insulation of the motor is damaged due to heat.	Replace the motor.
Over voltage	Deceleration time is too short compared with the load inertia (GD²).	Increase deceleration time.
	Excessive power regeneration in the inverter.	Use an optional dynamic brake resistor (dynamic brake units).
	Line voltage is too high.	Check the commercial line voltage.
Current limit protection (overload)	Load exceeds the inverter rated power.	Increase the rated power of the motor and the inverter.
	Incorrect selection of the inverter rated power.	Select the correct rated power of the inverter.
	Incorrect setting of the V/F pattern.	Select a correct V/F pattern.
Overheat	Damaged cooling fan or an alien substance is into the cooling system.	Replace the cooling fan and/or eliminate the alien substances.
	Cooling system has fault.	Check for alien substances clogged in the cooling system.
	Ambient temperature is too high.	Keep ambient temperature below 50º or verify the capacity of the inverter according to this capacity.
	Motor overheating has been produced (PTC / NTC external signal).	Check the motor cooling. Reduce load weight and/or operation duty.
Electronic thermal protection	Motor has been overheated.	Reduce load weight and/or operation duty.
	Load exceeds the inverter capacity.	Use an inverter with higher capacity.
	Electronic thermal protection level (ETH) is too low.	Set ETH level to an appropriate value.
	Incorrect selection of the inverter rated power.	Select the correct rated power of the inverter.
	Incorrect setting of the V/F pattern.	Select a correct V/F pattern.
	Inverter has been operated at low speed for too long.	Install a cooling fan with an external power supply to the motor.
External fault	An external fault has been produced.	Eliminate the cause of the fault at circuit connected through the input fault terminal configured for that.
Low voltage	Line voltage is low.	Check the commercial line voltage.
	Load exceeds the rated power of the line (welding machine, motor with high starting current connected to the commercial line).	Increase the line rated power.
	Faulty magnetic switch at the input side of the inverter.	Replace the magnetic switch.

Function	Cause	Solution
Over current 2	Short circuit between upper and lower IGBT.	Check IGBT.
	Short circuit at the inverter output.	Check the wiring of the inverter output circuit.
	Acceleration / deceleration time is too short compared with the inertia of the load (GD²).	Increase acceleration / deceleration time.
H/W fault	Wdog error (CPU fault).	Disconnect and connect again the input power. If the fault persists, contact with the technical service of Power Electronics.
	EEP error (memory fault).	
	ADC Offset (feedback circuit fault).	
	Open input fuse.	Replace the input fuse.
Communication error	Faulty connection between inverter and display.	Check the connector.
	Wrong operation of the inverter CPU.	Contact with the technical service of Power Electronics.
Operation method when the reference frequency is lost	LOP: Reference signal loss from the control board.	Check that the control board is not damaged to eliminate the fault.
	LOR: Reference signal loss from communication net.	Check that the communication net operates correctly.
	LOV: Reference signal loss given by analogue signal V1.	Check the wiring of the analogue voltage input V1.
	LOI: Reference signal loss given by I signal.	Check the wiring of the analogue current input I.
Inverter overload	Load exceeds the inverter rated power.	Increase the rated power of the motor or the inverter.
	Incorrect selection of the inverter rated power.	Select the correct rated power of the inverter.

9.3. Problems Solution

Fault situation	Checking
Motor does not spin	**Checking of main circuit:** Is the power supply (line) correct? (Is the LED of the inverter lit?) Is the motor correctly connected?
	Checking of the digital input signals: Check the operation of the start/stop signal of the inverter. Check the simultaneous operation of the forward/reverse run signals. Check the input signal of the reference frequency of the inverter.
	Checking of the parameters setting: Is the function of the prevention of reverse direction rotation motor activated? (FU1-01) Is the operation mode correctly configured? (DRV-03) Is the frequency command programmed to 00.00Hz?
	Checking of the load: Is the load too high or is the motor blocked? (mechanical brake)
	Others: Any fault message is displayed and/or is the alarm LED lit? (STOP LED blinks)
Motor spins in reverse direction rotation	Is the phases sequence U, V, W correct at the output terminals to the motor?
	Is the forward/reverse run signal correctly connected?
The difference between the rotation speed and the reference command is too high	Is the frequency reference signal correct? (Check the level of the input signal)
	Is the configuration of the following parameters correct? Low frequency limit (FU1-34), High frequency limit (FU1-35), Gains of analogue input signals (I/O-01 to I/O-16).
	Is the input line affected by an external noise? (Use an screened cable)
The inverter does not accelerate or decelerate softly	Is the programmed acceleration / deceleration time too short?
	Is the load too large?
	Is the value of the manual torque boost (FU2-68, 69) so high that it makes useless the function of current dynamic limitation?
Motor current is too high	Is the load too large?
	Is the value of the manual torque boost (FU2-68, 69) too high?
Rotation speed does not increase	Is the value of the high frequency limit (FU1-35) correct?
	Is the load too large?
	Is the value of the manual torque boost (FU2-68, 69) so high that it makes useless the function of current dynamic limitation?

Fault situation	Checking
Rotation speed oscillates when the inverter is running	**Checking of the load:** Does the load oscillate?
	Check the input signal: Does the signal of the reference frequency oscillate?
	Others: Is the wiring too long when the inverter uses V/F control? (More than 500mts)

9.4. Checking of Power Circuit Components

Before checking the power circuit components, be sure to disconnect the input power supply and wait for until the electrolytic capacitors of the main circuit (DCP-DCN) are discharged.

1. Checking of the rectifier and the inverter bridge for 3.7kW to 22kW.
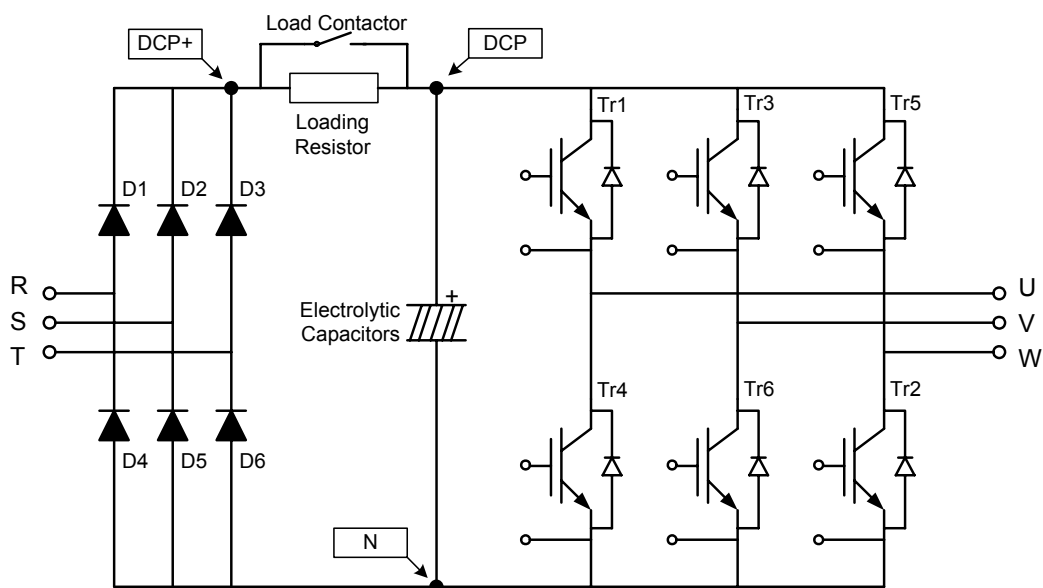
SD45DTP0006AI

Figure 9.1. Drawing of rectifier and inverter bridge up to 22kW

- Disconnect the power wiring of RST and UVW terminals.
- Check if the power terminals of the inverter (R, S, T, U, V, W, P1 (or P2 or P), N) are still charged or not by using an appropriate tester.
- Wait for until the electrolytic capacitors (DCP – DCN) are discharged at a safety level.
- During test, huge amounts of ohms (approx. Mega ohms) will be displayed when we have an 'Open' situation. In case of 'Close' situation, the resistance values that will be displayed are around ten of ohms. Sometimes, the connection will seem to be closed due to the stored load into the Bus capacitors, but it will disappear soon and the value of Mega ohms will be displayed again.
- The displayed values of measurement are not always the same. These values change according to the tester used to carry out the measurements.

▪ Measurements can be carried out according to the attached table:

Module		Polarity test +	Polarity test -	Checking value	Element	Polarity test +	Polarity test -	Checking value
Diodes	D1	R	DCP+	Closed	D4	R	N	Open
		DCP+	R	Open		N	R	Closed
	D2	S	DCP+	Closed	D5	S	N	Open
		DCP+	S	Open		N	S	Closed
	D3	T	DCP+	Closed	D6	T	N	Open
		DCP+	T	Open		N	T	Closed
IGBT's	Tr1	U	DCP	Closed	Tr4	U	N	Open
		DCP	U	Open		N	U	Closed
	Tr3	V	DCP	Closed	Tr6	V	N	Open
		DCP	V	Open		N	V	Closed
	Tr5	W	DCP	Closed	Tr2	W	N	Open
		DCP	W	Open		N	W	Closed

2. Checking of the rectifier and the inverter bridge for 30kW to 75kW.
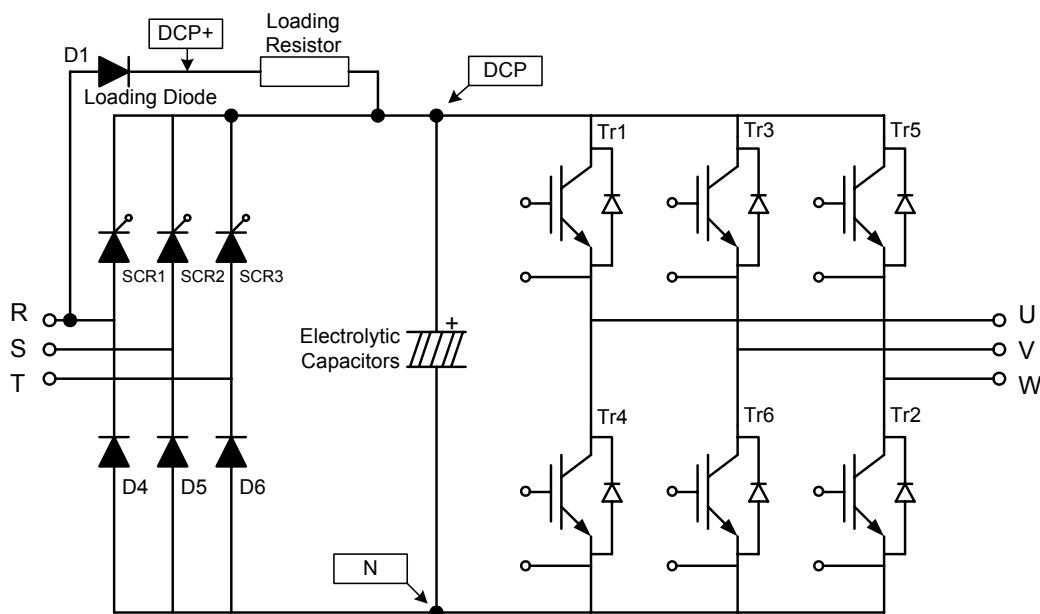
SD45DTP0007AI

Figure 9.2. Drawing of rectifier and inverter bridge from 30kW

▪ Measurements should be carried out following the same safety and precaution instructions recommended in the previous section.
▪ Measurements can be carried out according to the attached table:

Module		Polarity test +	Polarity test -	Checking value	Element	Polarity Test +	Polarity Test -	Checking value
Diodes	D1	R	DCP+	Closed	D4	R	N	Open
		DCP+	R	Open		N	R	Closed
	D5	S	N	Open	D6	T	N	Open
		N	S	Closed		N	T	Closed
IGBT's	Tr1	U	DCP	Closed	Tr4	U	N	Open
		DCP	U	Open		N	U	Closed
	Tr3	V	DCP	Closed	Tr6	V	N	Open
		DCP	V	Open		N	V	Closed
	Tr5	W	DCP	Closed	Tr2	W	N	Open
		DCP	W	Open		N	W	Closed

9.5.   Maintenance

SD450 inverters consist of many electronic parts such as semiconductors devices. Nevertheless, temperature, humidity, vibrations and deteriorated components can reduce its efficiency. To avoid any possible irregularity, we recommend making periodic inspections.

9.5.1. Warnings

- Be sure to remove the input power while performing maintenance.
- Be sure to perform maintenance after checking the DC link capacitor has discharged. Check that the voltage between terminals P – N, or P1 – N or P2 – N, is below DC 30V. The bus capacitors in the inverter main circuit can still be charged even after the power supply is turned off.
- The correct output voltage of the inverter can only be measured by using a rectifier voltage meter. Other voltage meters, including digital voltage meters, are likely to display incorrect values caused by the high frequency PWM output voltage of the inverter.

9.5.2. Routine Inspection

Be sure to check the following points before handling the inverter:
- Conditions of the installation site.
- Conditions of the inverter cooling system.
- Excessive vibrations.
- Excessive overheating.

9.5.3. Periodic Inspection

- Are there screws and bolts loose? Is there corrosion presence due to the ambient conditions? In this case, tighten them or replace the affected parts.
- Are there dust particles or dirty in the inverter cooling system? In this case, clean it with compressed air.
- Are there dust particles or dirty in control boards? In this case, clean it with compressed air.
- Are there connectors faulty? In this case, check the corresponding connector.
- Check the rotation direction of the cooling fan, the condition of capacitors and the connections of the magnetic contactor. Replace them if there are any abnormalities.

9.5.4. Megger / Dielectric Test.

Perform the megger test of the equipment after disconnecting the inverter. Test voltage should not be applied to the inverter. Megger test only should be performed for the power circuit (do not executed for the control circuit).
Use a DC 500V megger. Dielectric test should not be executed to the inverter; otherwise, IGBTs may be damaged.

9.6. Daily and Periodic Check Points

Inspection site	Inspection element	Inspection	Period			Inspection method	Criterion	Instrument of measur.
			Daily	1 year	2 years			
All	Ambient conditions	Are there dust particles? Are the ambient temperature and the humidity proper?	o			See "Warnings"	Temperature: -10~+50 non freezing Humidity: Lower than 50% non condensing	Thermometer, Hygrometer, Recorder
	Module	Is there any noise or abnormal oscillations?	o			Visual and audible	There are no anomalies	
	Input voltage	Is the input voltage to the main circuit correct?	o			Measure the voltage between terminals R, S, T		Digital multimeter. Tester
Main circuit	All	Megger checking (between main circuit and ground) Has any fixed part been modified? Have over temperature signs been observed when the components have been cleaned?		o o o	o	Disconnect the cables of the inverter and short circuit terminals R, S, T, U, V, W and measure between them and ground. Tighten the screws. Visual checking.	More than 5MΩ No anomaly	Megger type DC 500V
	Conductor/ Cable	Is the conductor rusty? Is the sheathing of the cable damaged?		o o		Visual checking	No anomaly	
	Terminal	Has any damaged been produced?		o		Visual checking	No anomaly	
	IGBT's module Diodes module	Check the resistance value between each one of the terminals			o	Disconnect the cables of the inverter and measure the resistance value between: R, S, T ⇔ P, N and U, V, W ⇔ P, N with a tester	(See "Checking of Power Circuit Components")	Digital multimeter. Analogue tester
	Correct capacitor	Have fluid leakages been observed? Is the capacitor well fastened? Is any dilation or retraction sign observed? Measure the capacity	o o	o		Visual checking Measure the capacity with a proper instrument	No anomaly Higher than 85% of rated capacity	Instrument for measuring capacity
	Contactor	Is there any noise (similar to chatter sound) during running? Is the contact damaged?		o o		Audible checking Visual checking	No anomaly	
	Resistance	Is the insulation of the resistance damaged? Is the wiring of the resistance damaged (open)?		o o		Visual checking Disconnect one of the connections and measure with a tester	No anomaly Error should be included at ±10% of the displayed resistance value	Digital multimeter. Analogue tester
Control circuit and protections	Operating check	Is there any imbalance between output voltage phases? Displaying of the circuit status should not show any error after protection sequence has executed		o o		Measure voltage between output terminals U, V and W. Open the protection circuit of the inverter output	Balance voltage between phases for 200V (400V) is lower than 4V (8V). Faulty circuit operates according to the sequence.	Digital multimeter / Rectifier voltage meter

Inspection site	Inspection element	Inspection	Period			Inspection method	Criterion	Instrument of measur.
			Daily	1 year	2 years			
Cooling system	Cooling fan	Is there any noise or abnormal oscillations? Is the cooling fan disconnected?	o		o	Disconnect the power supply (OFF) and rotate the fan manually. Tighten the connections again.	Fan should rotate effortlessly. No anomaly	
Display	Measurement	Is the displayed value correct?	O	o		Check the reading instrument with an external measurement	Check the specified values and the control values	Voltage meter/ Current meter etc.
Motor	All	Is there any noise or abnormal vibrations? Has any unusual smell been perceived?	o o			Audible, sensory and visual checking. Check if damages have been produced by overheating.	No anomaly	
	Insulation resistance	Megger checking (between terminals of the output circuit and ground terminal)			o	Disconnect the cables U, V and W and join them from one another. Check the resistance between this join and ground.	More than 5MΩ	Megger type 500V

Note: Values between ( ) are referred to the inverters of 400V model.
Note: Long life of the main components above indicated is based on a continuous operation for the stipulated load. These conditions can change according to the environment conditions.

10. RS485 COMMUNICATION

10.1. Introduction

Inverter can be controlled and monitored by the sequence program of a PLC or other master module.

Drives or other slave devices can be connected in a RS485 network to be controlled by a PLC or a computer. In this way, parameter settings and monitoring can be executed from a computer, using a user program.

To communicate, user can use any kind of RS232/485 converter, which specifications depend on the manufacturer.
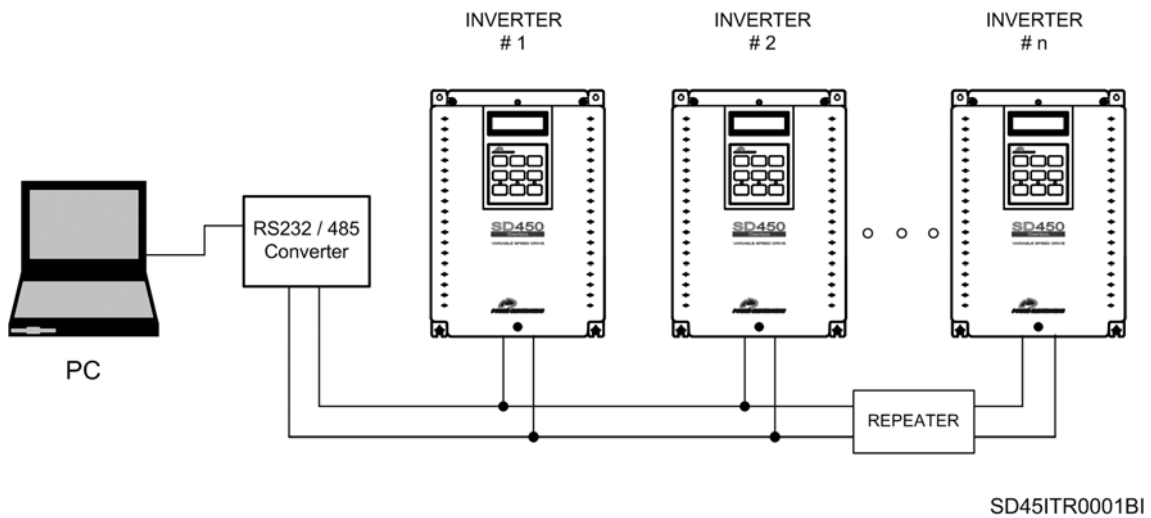
Figure 10.1 System configuration in RS485 network

Note: Install a repeater is recommended for upgrading the communication speed or in case of the length of the communication cable is higher than 1.200m. Its use is necessary to upgrade the communication quality in the noise high environment.

10.2. Specifications

General specifications.

- Communication method: RS485.
- Transmission form: Bus method, Multi drop Link System.
- Applicable drive: SD450.
- Converter: RS232 converter.
- Connectable drives: 31.
- Transmission distance: Below 1.200m maximum (within 700m recommended).

Specifications of the installation.

- Cable recommended: 0.75mm² (18AWG), Shield type twisted-pare.
- Installation: C+, C-, CM terminals of the TER2 connector on control board.
- Power supply: Insulated power supply from the inverter power supply.

Specifications of the communication.

- Communication speed: 19200 / 9600 / 4800 / 2400 / 1200 bps. Selectable.
- Control procedure: Asynchronous communication system.
- Communication system: Half duplex.
- Stop bit length: 1 bit.
- Sum check: 2 byte.
- Parity check: None.
- Protocol supported: Parameter Read/Write, Monitoring parameter register/execution Broadcasting.

10.3. Installation

10.3.1. Connection of the communication cable

Use C+ terminal to connect RS485 high signal and C- terminal to connect RS485 low signal.

If more than one inverter will be connected, to establish communication between them connect CM terminal.

Install a repeater for upgrading the communication speed or in case of the length of the communication cable is higher than 1.200m. Its use is necessary to upgrade the communication quality in the noise high environment.

To connect a terminator resistor (120Ω), set J3 switch ON (upper position). J3 switch is placed on the left side of the connector shown on the picture (TER2).
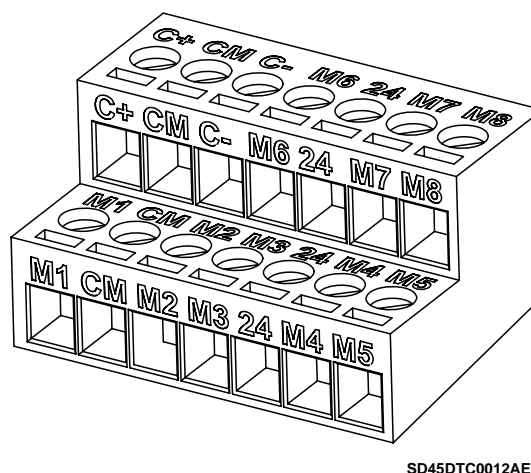
SD45DTC0012AE

Figure 10.2 TER2 connector of control board

After connecting the cable, set the following parameters that refer to the communication as follows:

Parameter	Description	Setting	
DRV-03	Start / Stop control mode	Int.485	RS485 communication.
DRV-04	Frequency control mode	Int.485	RS485 communication.
DRV-91	Optional Start / Stop control mode	Keypad Fx/Rx-1 Fx/Rx-2	Selection of Start / Stop control mode when the inverter control will be given by communication net.
DRV-92	Optional frequency control mode	Keypad-1 Keypad-2 V1 V1S I V1 + I Pulse	Selection of the frequency control mode when the inverter control will be given by communication net.
I/O-20...27	Multi-function digital input. M1...M8 terminal	Main-drive	It allows that the inverter will be controlled through communication net without additional changes.
I/O-90	Slave number in communication net	1 – 250	Use different numbers in case of more than 1 inverter are installed.
I/O-91	Transmission speed in communication net	9600bps	(Default setting).
I/O-92	Stop mode after reference signal loss in communication net	None	It continues operating even if the signal has been lost.
I/O-93	Setting of time to determine speed reference signal loss	1.0seg	(Default setting).

10.3.2. Operation of the inverter in the communication network

After installing the equipment in the communication net, follow the steps below to operate with the inverter integrated in the network:

- Check if the computer and the inverter are connected correctly.
- Turn on the inverter, but do not connect the load until stable communication between the computer and the inverter is verified.
- Start the operating program for the inverter from the computer.
- Verify that the inverter operates in a correct way using the operating program from the computer.
- See '10.6 Fault solutions' if the communication is not operating correctly.

10.4. Communication protocol MODBUS-RTU

Computer or other devices can be 'master' and inverters will be 'slave'. In this way, inverter responds to Read / Write command from master.

Supported function code.

Function code	Description
0x03	Read Hold Register
0x04	Read Input Register
0x06	Preset Single Register
0x10	Preset Multiple Register

Exception code.

Function code		Description
0x01		ILLEGAL FUNCTION When master is sending a code different to a read / write command (see supported function codes).
0x02		ILLEGAL DATA ADDRESS When parameter address does not exist.
0x03		ILLEGAL DATA VALUE When data is a value out of range for an inverter parameter during the writing.
0x06		SLAVE DEVICE BUSY
Defined by user	0x14	1. Write disabled (address 0x0004 value is 0). 2. Read only or not program during run.

10.5. Address list

10.5.1. Common Area

Address	Parameter	Scale	Units	R/W	Data value
0x0000	Inverter model			R	9: SD450
0x0001	Inverter capacity			R	3: 3.7kW 4: 5.5kW 5: 7.5kW 6: 11kW 7: 15kW 8: 18.5kW 9: 22kW A: 30kW B: 37kW C: 45kW D: 55kW E: 75kW
0x0002	Inverter input voltage			R	0: 220VAC 1: 400VAC
0x0003	S/W version			R	(Ex) 0x0100: Version 1.0 (Ex) 0x0101: Version 1.1
0x0004	Parameters setting enabled/disabled			R/W	0: Write disabled 1: Write enabled
0x0005	Reference frequency	0.01	Hz	R/W	Start freq. to Max. freq.

Address	Parameter	Scale	Units	R/W	Data value
0x0006	Run command			R/W	Bit 0: Stop
					Bit 1: Forward run
					Bit 2: Reverse run
					Bit 3: Fault reset
					Bit 4: Emergency stop
				-	Bit 5: Not used
				R	Bit 6 – 7: Reference introduction 0: Terminals 1: Keypad 2: Reserve 3: Communication
					Bit 8 – 14: Reference frequency 0: DRV-00 1: Not used 2: Step frequency 1 3: Step frequency 2 4: Step frequency 3 5: Step frequency 4 6: Step frequency 5 7: Step frequency 6 8: Step frequency 7 9: Step frequency 8 10: Step frequency 9 11: Step frequency 10 12: Step frequency 11 13: Step frequency 12 14: Step frequency 13 15: Step frequency 14 16: Step frequency 15 17: Up speed 18: Down speed 19: Up/down zero 20 – 21: Reserve 22: Analogue V1 23: Analogue V1S 24: Analogue I 25: V1 + I 26: Pulses 27: Option 28: Communication 29: Option 30: Jog frequency 31: PID
					Bit 15: Network error
0x0007	Acceleration time	0.1	sec	R/W	
0x0008	Deceleration time	0.1	sec	R/W	
0x0009	Output current	0.1	A	R	
0x000A	Output frequency	0.01	Hz	R	
0x000B	Output voltage	1	V	R	
0x000C	DC Link voltage	1	V	R	
0x000D	Output power	0.1	kW	R	
0x000E	Inverter status			R	Bit 0: Stop
					Bit 1: Forward run
					Bit 2: Reverse run
					Bit 3: Fault
					Bit 4: Accelerating
					Bit 5: Decelerating
					Bit 6: Steady status
					Bit 7: DC braking
					Bit 8: Stopping
					Bit 9: Not used
					Bit 10: Brake open
					Bit 11: Forward run command
					Bit 12: Reverse run command
					Bit 13: Run/Stop command by Communic. (REM R/S)
					Bit 14: Reference freq. by Communic. (REM Freq.)

Address	Parameter	Scale	Units	R/W	Data value
0x000F	Trip information			R	Bit 0: OCT1
					Bit 1: OV
					Bit 2: EXT-A
					Bit 3: BX
					Bit 4: LV
					Bit 5: RESERVE
					Bit 6: GF
					Bit 7: OHT
					Bit 8: ETH
					Bit 9: OLT
					Bit 10: HW-Diag
					Bit 11: RESERVE
					Bit 12: OCT2
					Bit 13: OPT
					Bit 14: PO
					Bit 15: IOLT
0x0010	Input terminal status			R	Bit 0: M1
					Bit 1: M2
					Bit 2: M3
					Bit 3: M4
					Bit 4: M5
					Bit 5: M6
					Bit 6: M7
					Bit 7: M8
0x0011	Output terminal status			R	Bit 0: AUX1
					Bit 1: AUX2
					Bit 2: AUX3
					Bit 3: AUX4
					Bit 4: Not used
					Bit 5: Not used
					Bit 6: Not used
					Bit 7: 3ACB
0x0012	V1			R	Value corresponding to 0V – +10V
0x0013	V2			R	Value corresponding to 0V – -10V when setting freq. mode to 2
0x0014	I			R	Value corresponding to 0mA – 20mA
0x0015	RPM			R	Output speed
0x001A	Display unit			R	0: Hz 1: rpm
0x001B	Pole number			R	Not used
0x001C	Custom version			R	Not used

Notes:

1. Run / Stop command by communication (address 0x0006)

   All of the bits are activated when changing their status from 0 to 1. For example, if the drive trips due to a fault during running, the drive cannot start after resetting the fault until the start command is given again.

2. Addresses 0x0005 and 0x0006

   The values of the addresses above indicated will be erased after the drive is power off. These addresses only keep their values while the drive is power on.

10.5.2. Basic Functions and Display Parameters Group (DRV)

Address		Screen	Description	Default value	Range	
16 bit	10 bit				Option	Values
9100	37120	**DRV-00** **Cmd. Freq**	Reference frequency, output current (LCD)	0		0 – Max. freq.
9100	37120	**DRV-00** T/K 0.00Hz R 0.0%F 0.0%	Reference and feedback value	0		0 – 100
9101	37121	**DRV-01** **Acc. Time**	Acceleration time	200		0 – 6000
9102	37122	**DRV-02** **Dec. Time**	Deceleration time	300		0 – 6000
9103	37123	**DRV-03** **Drive mode**	Start / Stop control mode	1	Keypad Fx/Rx-1 Fx/Rx-2 Int.485	0 – 3
9104	37124	**DRV-04** **Freq mode**	Frequency control mode (Method to introduce reference frequency)	0	Keypad-1 Keypad-2 V1 V1S I V1 + I Pulse Int. 485 Ext. PID	0 – 8
9105	37125	**DRV-05** **Step Freq-1**	Speed at step frequency 1	1000		Start freq. – Max. freq.
9106	37126	**DRV-06** **Step Freq-2**	Speed at step frequency 2	2000		Start freq. – Max. freq.
9107	37127	**DRV-07** **Step Freq-3**	Speed at step frequency 3	3000		Start freq. – Max. freq.
9108	37128	**DRV-08** **Current**	Output current	-		-
9109	37129	**DRV-09** **Speed**	Motor speed	-		-
910A	37130	**DRV-10** **DC link Vtg**	DC voltage	-		-
910B	37131	**DRV-11** **User disp**	User display selection	-		-
910C	37132	**DRV-12** **Fault**	Displayed fault in display	-		-
910E	37134	**DRV-14 TAR** **OUT**	Target / Output frequency displaying	-		-
910F	37135	**DRV-15 REF** **FBK**	Motor speed displaying	-		-
9110	37136	**DRV-16** **Hz/Rpm Disp**	Motor speed displaying	0	Hz Rpm	0 – 1
9112	37138	**R T** **F O** **DRV-18**	PID parameters displaying	-		-
9113	37139	**V1 V2** **V1S I** **DRV-19**	AD parameters	-		-
9114	37140	**R O** **F DRV-20**	Displaying of External PID parameters	-		-
915B	37211	**DRV-91** **Drive mode2**	Optional Start / Stop control mode	1	Keypad Fx/Rx-1 Fx/Rx-2	0 – 2
915C	37212	**DRV-92** **Freq mode2**	Optional frequency control mode (Method to introduce reference frequency)	0	Keypad-1 Keypad-2 V1 V1S I V1 + I Pulse	0 – 6

10.5.3. Functions Menu (FU1)

Address		Screen	Description	Default value	Range	
16 bit	**10 bit**				**Option**	**Values**
9200	37376	**FU1-00** Jump code	Jump to desired parameter	1		1 – 99
9201	37377	**FU1-01** Run Prev.	Prevention of direction rotation motor	0	None Forward Prev Reverse Prev	0 – 2
9202	37378	**FU1-02** Acc. pattern	Acceleration pattern	0	Linear S-Curve U-Curve	0 – 2
9203	37379	**FU1-03** Dec. pattern	Deceleration pattern	0	Linear S-Curve U-Curve	0 – 2
9204	37380	**FU1-04** Start Curve	S-Curve start	50		0 – 100
9205	37381	**FU1-05** End Curve	S-Curve end	50		0 – 100
920A	37386	**FU1-10** Pre-HeatMode	Motor pre-heat	0	No Yes	0 – 1
920B	37387	**FU1-11** PreHeat Level	Percentage of motor rated current	30		1 – 50
920C	37388	**FU1-12** PreHeatPerc	Time of DC current application to the motor	100		1 – 100
9214	37396	**FU1-20** Start mode	Inverter start mode	0	Accel DC – start Flying – start	0 – 2
9215	37397	**FU1-21** DCSt time	Time of DC current application	0		0 - 600
9216	37398	**FU1-22** DCSt value	DC current level before starting	50		0 – 150
9217	37399	**FU1-23** Stop mode	Inverter stop mode	0	Decel DC – brake Free – run Fluxe – brake	0 – 3
9218	37400	**FU1-24** DCBlk time	DC current application delay time	10		10 – 6000
9219	37401	**FU1-25** DCBr Frq	DC brake starting frequency	500		10 – 6000
921A	37402	**FU1-26** DCBr time	Time of DC current application	10		0 – 600
921B	37403	**FU1-27** DCBr value	DC current level applied for DC brake	50		0 – 200
921C	37404	**FU1-28** Safety Stop	Motor stopped at safety conditions from power supply loss	0	No Yes	0 – 1
921D	37405	**FU1-29** Line Freq	Line frequency value	5000		4000 – 12000
921E	37406	**FU1-30** Max Freq	Maximum output frequency of the inverter	5000		4000 – 12000
921F	37407	**FU1-31** Base Freq	Output frequency for motor rated voltage	5000		3000 – 12000
9220	37408	**FU1-32** Start Freq	Start frequency	50		1 - 1000
9221	37409	**FU1-33** Freq limit	Frequency limits selection	0	No Yes	0 – 1
9222	37410	**FU1-34** F-limit Lo	Low frequency limit	50		0 – FU1-35
9223	37411	**FU1-35** F-limit Hi	High frequency limit	5000		FU1-34 – FU1-30
9228	37416	**FU1-40** V/F pattern	Relation factor between voltage and frequency applied to the motor	0	Linear Square User V/F	0 – 2
9229	37417	**FU1-41** User Freq 1	Frequency 1 (User V/F pattern)	1500		0 – FU1-30

Address		Screen	Description	Default value	Range	
16 bit	10 bit				Option	Values
922A	37418	**FU1-42** User volt 1	Voltage 1 (User V/F pattern)	25		0 – 100
922B	37419	**FU1-43** User Freq 2	Frequency 2 (User V/F pattern)	3000		0 – FU1-30
922C	37420	**FU1-44** User volt 2	Voltage 2 (User V/F pattern)	50		0 – 100
922D	37421	**FU1-45** User Freq 3	Frequency 3 (User V/F pattern)	4500		0 – FU1-30
922E	37422	**FU1-46** User volt 3	Voltage 3 (User V/F pattern)	75		0 – 100
922F	37423	**FU1-47** User Freq 4	Frequency 4 (User V/F pattern)	5000		0 – FU1-30
9230	37424	**FU1-48** User volt 4	Voltage 4 (User V/F pattern)	100		0 – 100
9231	37425	**FU1-49** VAC 400.4V	Input voltage setting	910		730 – 1150
9232	37426	**FU1-50** Motor Volt	Motor rated voltage	400		0 – 600
9233	37427	**FU1-51** Energy save	Energy save level enabled/disabled	0	None Manual Auto	0 – 2
9234	37428	**FU1-52** Manual save%	Energy save level	0		0 – 30
9236	37430	**FU1-54** KiloWattHour	Displaying of Mega and Kilo watts	-		-
9237	37431	**FU1-55** Inv. Temp.	Inverter temperature	25		0 – 160
9238	37432	**FU1-56** Motor Temp.	Motor temperature	25		0 – 160
923C	37436	**FU1-60** ETH select	Electronic thermal protection	1	No Yes	0 – 1
923D	37437	**FU1-61** ETH 1min	Electronic thermal protection level for 1 minute	150		FU1-62 – 200
923E	37438	**FU1-62** ETH cont	Electronic thermal protection level for continuous	105		50 – FU1-61 (max. 150)
923F	37439	**FU1-63** Motor type	Motor cooling mode	0	Self-cool Forced-cool	0 – 1
9240	37440	**FU1-64** OL level	Overload warning level	110		30 – 110
9241	37441	**FU1-65** OL time	Overload warning time	100		0 – 300
9242	37442	**FU1-66** OLT select	Overload trip selection	1	No Yes	0 – 1
9243	37443	**FU1-67** OLT level	Overload trip level	120		30 – 150
9244	37444	**FU1-68** OLT time	Overload trip time	600		0 – 600
9245	37445	**FU1-69** Trip select	Input / output phase loss protection	4 (Bit setting)		0 – 7 (Bit setting)
9246	37446	**FU1-70** Stall prev.	Stall prevention mode	0 (Bit setting)		0 – 7 (Bit setting)
9247	37447	**FU1-71** Stall level	Limitation current level	100		30 – 150
9248	37448	**FU1-72** Acc/Dec ch F	Frequency of acceleration and deceleration change	0		0 – FU1-30
9249	37449	**FU1-73** Acc/Dec Freq	Frequency for acceleration and deceleration	0	Max. Delta	0 – 1
924A	37450	**FU1-74** Time scale	Time scale	1	0.01sec 0.1sec 1sec	0 – 2
9250	37456	**FU1-80** Up/Dn Save	To memorize the reference of motorized potentiometer	0	No Yes	0 - 1

Address		Screen	Description	Default value	Range	
16 bit	10 bit				Option	Values
9251	37457	**FU1-81** Run Delay T	Delay time at the starting	0		0 – 6000
9255	37461	**FU1-85** ULT select	Underload trip selection	0	No Yes	0 – 1
9256	37462	**FU1-86** ULT level	Underload level	30		0 – 100
9257	37463	**FU1-87** ULT Freq	Underload frequency	1500		FU1-31 – FU1-30
9258	37464	**FU1-88** ULT time	Underload trip time	0		0 – 2000
925A	37466	**FU1-90** STOP Inertia	Setting of load inertia	8		8 – 5000

10.5.4. Functions Menu (FU2)

Address		Screen	Description	Default value	Range	
16 bit	10 bit				Option	Values
9300	37632	**FU2-00** **Jump code**	Jump to desired parameter	1		1 – 99
9301	37633	**FU2-01** **Last trip-1**	Last trip of fault history	-		-
9302	37634	**FU2-02** **Last trip-2**	Last trip-1 of fault history	-		-
9303	37635	**FU2-03** **Last trip-3**	Last trip-2 of fault history	-		-
9304	37636	**FU2-04** **Last trip-4**	Last trip-3 of fault history	-		-
9305	37637	**FU2-05** **Last trip-5**	Last trip-4 of fault history	-		-
9306	37638	**FU2-06** **Erase trips**	Erase fault history	0	No Yes	0 – 1
9307	37639	**FU2-07** **Dwell time**	Dwell time	0		0 – 100
9308	37640	**FU2-08** **Dwell Freq**	Dwell frequency	500		FU1-32 – FU1-30
930A	37642	**FU2-10** **Jump Freq**	Skip frequencies selection	0	No Yes	0 – 1
930B	37643	**FU2-11** **jump Lo 1**	Setting of low frequency skip 1	1000		0 – FU2-12
930C	37644	**FU2-12** **jump Hi 1**	Setting of high frequency skip 1	1500		FU2-11 – FU1-30
930D	37645	**FU2-13** **jump Lo 2**	Setting of low frequency skip 2	2000		0 –FU2-14
930E	37646	**FU2-14** **jump Hi 2**	Setting of high frequency skip 2	2500		FU2-13 – FU1-30
930F	37647	**FU2-15** **jump Lo 3**	Setting of low frequency skip 3	3000		0 – FU2-16
9310	37648	**FU2-16** **jump Hi 3**	Setting of high frequency skip 3	3500		FU2-15 – FU1-30
9314	37652	**FU2-20** **Power-on run**	Restart after power supply fault	0	No Yes	0 – 1
9315	37653	**FU2-21** **RST restart**	Restart after fault reset	0	No Yes	0 – 1
9316	37654	**FU2-22** **Speed Search**	Speed search function	0 (Bit setting)		0 – 15 (Bit setting)
9317	37655	**FU2-23** **SS P-Gain**	Proportional gain for speed search	200		0 - 9999
9318	37656	**FU2-24** **SS I-Gain**	Integral gain for speed search	500		0 – 9999
9319	37657	**FU2-25** **Retry number**	Tries of automatic fault resets	0		0 – 10
931A	37658	**FU2-26** **Retry delay**	Time between tries of automatic fault resets	10		0 – 600
9328	37672	**FU2-40** **Motor select**	Motor power setting	-		-
9329	37673	**FU2-41** **Pole number**	Number of motor poles	4		2 – 12
932A	37674	**FU2-42** **Rated-Slip**	Rated slip frequency of the motor	-		0 – 1000
932B	37675	**FU2-43** **Rated-Curr**	Motor rated current	-		1 – 2000
932C	37676	**FU2-44** **Noload-Curr**	No load current of the motor	-		5 – 2000
932D	37677	**FU2-45** **Efficiency**	Motor efficiency	-		70 – 100
932E	37678	**FU2-46** **Inertia rate**	Load inertia rate	0		0 – 8
932F	37679	**FU2-47** **RPM factor**	Setting of gain for speed motor	100		1 – 1000
9330	37680	**FU2-48** **Carrier freq**	Setting of carrier frequency	-		7 – 150

Address		Screen	Description	Default value	Range	
16 bit	10 bit				Option	Values
9331	37681	**FU2-49** **PWM Select**	Selection of modulation mode	0	Normal 1 Normal 2 Low Leakage	0 – 2
933C	37692	**FU2-60** **Control mode**	Selection of inverter control mode	0	V/F Slip Compen Sensorless	0 – 2
933D	37693	**FU2-61** **Auto Tuning**	Auto tuning of motor parameters	0	No Yes	0 – 1
933E	37694	**FU2-62** **Rs**	Stator resistance	-		-
933F	37695	**FU2-63** **Lsigma**	Leakage inductance	-		-
9340	37696	**FU2-64** **PreExTime**	Pre-exciting time of the motor	10		0 – 600
9341	37697	**FU2-65** **SL P-Gain**	Proportional gain in Sensorless	1000		0 – 9999
9342	37698	**FU2-66** **SL I-Gain**	Integral gain in Sensorless	100		0 – 9999
9343	37699	**FU2-67** **Torque boost**	Torque boost setting	0	Manual Automatic	0 – 1
9344	37700	**FU2-68** **Fwd boost**	Manual torque boost in forward direction	20		0 – 150
9345	37701	**FU2-69** **Rev boost**	Manual torque boost in reverse direction	20		0 – 150
9350	37712	**FU2-80** **PowerOn disp**	Power on display	0	DRV-00 'Cmd. Freq.' DRV-01 'Acc. Time' DRV-02 'Dec. Time' DRV-03 'Drive mode' DRV-04 'Freq mode' DRV-05 'Step Freq-1' DRV-06 'Step Freq-2' DRV-07 'Step Freq-3' DRV-08 'Current' DRV-09 'Speed' DRV-10 'DC link Vtg' DRV-11 'User disp' DRV-12 'Fault'	0 – 12
9351	37713	**FU2-81** **User disp**	Displaying for value displayed in DRV-11	0	Volts Watts	0 – 1
9352	37714	**FU2-82** **S/W PE x.x**	Software version	-		-
9353	37715	**FU2-83** **LastTripTime**	Time from the last fault	-		-
9354	37716	**FU2-84** **On-Time**	Time from the equipment was connected	-		-
9355	37717	**FU2-85** **Run-time**	Operation time	-		-
9357	37719	**FU2-87** **Power Set**	Power setting	1000		1 – 4000
935A	37722	**FU2-90** **Para. disp**	Selection of parameters displaying	0	Default All para Diff Para	0 – 2

Address		Screen	Description	Default value	Range	
16 bit	10 bit				Option	Values
935B	37723	**FU2-91** **Para. read**	Parameters read	0	No	0 – 1
					Yes	
935C	37724	**FU2-92** **Para. write**	Parameters write	0	No	0 – 1
					Yes	
935D	37725	**FU2-93** **Para. init**	Parameters initialize	0	No	0 – 8
					All groups	
					DRV	
					FU1	
					FU2	
					I/O	
					EXT	
					COM	
					APP	
935E	37726	**FU2-94** **Para. lock**	Parameters lock	0		0 – 9999
935F	37727	**FU2-95** **Para. save**	Parameters save	0	No	0 – 1
					Yes	

10.5.5. Inputs and Outputs Menu (I/O)

Address		Screen	Description	Default value	Range	
16 bit	10 bit				Option	Values
9400	37888	I/O-00 Jump code	Jump to desired parameter	1		1 – 99
9401	37889	I/O-01 V1 Filter	Filter of analogue voltage input	250		0 – 9999
9402	37890	I/O-02 V1 volt x1	Minimum voltage of V1 input	0		0 – I/O-4
9403	37891	I/O-03 V1 Freq y1	Minimum frequency for minimum voltage of V1 input	0		0 – FU1-30
9404	37892	I/O-04 V1 volt x2	Maximum voltage of V1 input	1000		I/O-2 – 1200
9405	37893	I/O-05 V1 Freq y2	Maximum frequency for maximum voltage of V1 input	5000		0 – I/O-03
9406	37894	I/O-06 I Filter	Filter of analogue current input	250		0 – 9999
9407	37895	I/O-07 I curr x1	Minimum current of I input	400		0 – I/O-9
9408	37896	I/O-08 I Freq y1	Minimum frequency for minimum current of I input	0		0 – FU1-30
9409	37897	I/O-09 I curr x2	Maximum current of I input	1000		I/O-7 – 2000
940A	37898	I/O-10 I Freq y2	Maximum frequency for maximum current of I input	5000		0 – I/O-08
940B	37899	I/O-11 P pulse set	Selection of pulse input mode	1	(A+B) (A)	0 – 1
940C	37900	I/O-12 P Filter	Filter of pulse input	10	0 – 9999	
940D	37901	I/O-13 P pulse x1	Minimum pulse frequency of A0, B0 input	0		0 – I/O-15
940E	37902	I/O-14 P Freq y1	Minimum frequency for minimum pulse frequency of A0, B0 input	0		0 – FU1-30
940F	37903	I/O-15 P pulse x2	Maximum pulse frequency of A0, B0 input	0		I/O-13 – 100
9410	37904	I/O-16 P Freq y2	Maximum frequency for maximum pulse frequency of A0, B0 input	5000		0 – I/O-14
9411	37905	I/O-17 Wire broken	Criterion for signal loss of reference analogue input	0	None Half of x1 Less than x1	0 – 2
9412	37906	I/O-18 Lostcommand	Stop mode after analogue input signal loss	0	None FreeRun Stop	0 – 2
9413	37907	I/O-19 Time out	Delay time after reference signal loss	10		1 – 1200

Address		Screen	Description	Default value	Range	
16 bit	10 bit				Option	Values
9414	37908	**I/O-20** **M1 define**	Multi-function digital input. M1 terminal	0	Speed-L Speed-M Speed-H XCEL-L XCEL-M XCEL-H DC-brake 2nd Func Exchange Reserved Up Down 3-Wire Ext Trip Pre-Heat iTerm Clear Open-loop Main-drive Analog hold XCEL stop P Gain2 Reserved Interlock1 Interlock2 Interlock3 Interlock4 Speed-X RST BX JOG FX RX ANA_CHG Pre-Excite Ext PID Run Up/Dn Clr	0 – 35
9415	37909	**I/O-21** **M2 define**	Multi-function digital input. M2 terminal	0	See I/O-20	0 – 35
9416	37910	**I/O-22** **M3 define**	Multi-function digital input. M3 terminal	1	See I/O-20	0 – 35
9417	37911	**I/O-23** **M4 define**	Multi-function digital input. M4 terminal	27	See I/O-20	0 – 35
9418	37912	**I/O-24** **M5 define**	Multi-function digital input. M5 terminal	28	See I/O-20	0 – 35
9419	37913	**I/O-25** **M6 define**	Multi-function digital input. M6 terminal	29	See I/O-20	0 – 35
941A	37914	**I/O-26** **M7 define**	Multi-function digital input. M7 terminal	30	See I/O-20	0 – 35
941B	37915	**I/O-27** **M8 define**	Multi-function digital input. M8 terminal	31	See I/O-20	0 – 35
941C	37916	**I/O-28** **In status**	Digital inputs status	0 (Bit display)		0 – 2047 (Bit display)
941D	37917	**I/O-29** **Ti Filt Num**	Filter of digital inputs	15		2 – 1000
941E	37918	**I/O-30** **Jog Freq**	Setting of jog frequency	1000		0 – FU1-30
941F	37919	**I/O-31** **Step Freq-4**	Speed at step frequency 4	4000		0 – FU1-30
9420	37920	**I/O-32** **Step Freq-5**	Speed at step frequency 5	5000		0 – FU1-30
9421	37921	**I/O-33** **Step Freq-6**	Speed at step frequency 6	4000		0 – FU1-30
9422	37922	**I/O-34** **Step Freq-7**	Speed at step frequency 7	3000		0 – FU1-30
9423	37923	**I/O-35** **Step Freq-8**	Speed at step frequency 8	2000		0 – FU1-30

Address		Screen	Description	Default value	Range	
16 bit	10 bit				Option	Values
9424	37924	I/O-36 Step Freq-9	Speed at step frequency 9	1000		0 – FU1-30
9425	37925	I/O-37 Step Freq-10	Speed at step frequency 10	2000		0 – FU1-30
9426	37926	I/O-38 Step Freq-11	Speed at step frequency 11	3000		0 – FU1-30
9427	37927	I/O-39 Step Freq-12	Speed at step frequency 12	4000		0 – FU1-30
9428	37928	I/O-40 Step Freq-13	Speed at step frequency 13	5000		0 – FU1-30
9429	37929	I/O-41 Step Freq-14	Speed at step frequency 14	4000		0 – FU1-30
942A	37930	I/O-42 Step Freq-15	Speed at step frequency 15	3000		0 – FU1-30
9432	37932	I/O-50 Acc time-1	Acceleration time 1	200		0 – 6000
9433	37938	I/O-51 Dec time-1	Deceleration time 1	200		0 – 6000
9434	37939	I/O-52 Acc time-2	Acceleration time 2	300		0 – 6000
9435	37940	I/O-53 Dec time-2	Deceleration time 2	300		0 – 6000
9436	37941	I/O-54 Acc time-3	Acceleration time 3	400		0 – 6000
9437	37942	I/O-55 Dec time-3	Deceleration time 3	400		0 – 6000
9438	37943	I/O-56 Acc time-4	Acceleration time 4	500		0 – 6000
9439	37944	I/O-57 Dec time-4	Deceleration time 4	500		0 – 6000
943A	37945	I/O-58 Acc time-5	Acceleration time 5	400		0 – 6000
943B	37946	I/O-59 Dec time-5	Deceleration time 5	400		0 – 6000
943C	37947	I/O-60 Acc time-6	Acceleration time 6	300		0 – 6000
943D	37948	I/O-61 Dec time-6	Deceleration time 6	300		0 – 6000
943E	37949	I/O-62 Acc time-7	Acceleration time 7	200		0 – 6000
943F	37950	I/O-63 Dec time-7	Deceleration time 7	200		0 – 6000
9444	37956	I/O-68 S0 Level	Offset for S0 analogue output	0		0 – 1000
9445	37957	I/O-69 S1 Level	Offset for S1 analogue output	0		0 – 1000
9446	97958	I/O-70 S0 mode	S0 analogue output mode (0-10V)	0	Frequency Current Voltage DC link Vtg Ext PID Out	0 – 4
9447	37959	I/O-71 S0 adjust	Setting of S0 analogue output	100		10 – 200
9448	37960	I/O-72 S1 mode	S1 analogue output mode (0-10V)	2	See I/O-70	0 - 4
9449	37961	I/O-73 S1 adjust	Setting of S1 analogue output	100		10 – 200
944A	37962	I/O-74 FDT Freq	Frequency detection level	3000		0 – FU1-30
944B	37963	I/O-75 FDT band	Frequency detection bandwidth	1000		0 – FU1-30

Address		Screen	Description	Default value	Range	
16 bit	10 bit				Option	Values
944C	37964	**I/O-76** **Aux mode1**	Selection of configuration for auxiliary relay 1	0	None FDT-1 FDT-2 FDT-3 FDT-4 FDT-5 OL IOL Stall OV LV OH LostCommand Run Stop Steady INV line COMM line SSearch Ready MMC	0 – 20
944D	37965	**I/O-77** **Aux mode2**	Selection of configuration for auxiliary relay 2	0	See I/O-76	0 – 20
944E	37966	**I/O-78** **Aux mode3**	Selection of configuration for auxiliary relay 3	0	See I/O-76	0 – 20
944F	37967	**I/O-79** **Aux mode4**	Selection of configuration for auxiliary relay 4	0	See I/O-76	0 – 20
9450	37968	**I/O-80** **Relay mode**	Selection of configuration for fault relay	2 (Bit setting)		0 – 7 (Bit setting)
9451	37969	**I/O-81** **Out status**	Activation status of digital outputs	0 (Bit display)		0 – 255 (Bit display)
9452	37970	**I/O-82** **Relay On**	On delay time of fault relay	0		0 – 9999
9453	37971	**I/O-83** **Relay Off**	Off delay time of fault relay	0		0 – 9999
9454	37972	**I/O-84** **Fan Con. Sel**	Selection of cooling fan operation	0	PowerOn Fan Run_Fan Temper_Fan	0 – 2
9455	37973	**I/O-85** **Fan Temp**	Setting of inverter temperature	70		0 – 70
9456	37974	**I/O-86** **V1 Unit Sel**	Selection of displaying units for V1 signal	0	Speed Percent Bar mBar kPa Pa	0 – 5
9457	37975	**I/O-87** **I Unit Sel**	Selection of displaying units for I signal	0	See I/O-86	0 – 5
9458	37976	**I/O-88** **PulseUnitSel**	Selection of displaying units for A0, B0 signal	0	See I/O-86	0 – 5
945A	37978	**I/O-90** **Inv No.**	Slave number in communication net	1		1 – 250
945B	37979	**I/O-91** **Baud rate**	Transmission speed in communication net	3	1200bps 2400bps 4800bps 9600bps 19200bps	0 - 4
945C	37980	**I/O-92** **COM Lost Cmd**	Stop mode after reference signal loss in communication net	0	None Free Run Stop	0 – 2
945D	37981	**I/O-93** **COM Time Out**	Setting of time to determine speed reference signal loss	10		1 – 1200
945E	37982	**I/O-94** **Delay Time**	Setting for RS232/RS485 communication	5		2 – 1000

Address		Screen	Description	Default value	Range	
16 bit	**10 bit**				**Option**	**Values**
945F	37983	**I/O-95** **In NO/NC Set**	Logical function of digital inputs	0 (Bit setting)		0 – 2047 (Bit setting)
9460	37984	**I/O-96** **In CheckTime**	Check time for digital inputs	1		1 - 1000
9461	37985	**I/O-97** **OH Trip Sel**	Selection of over temperature trip	2 (Bit setting)		0 – 7 (Bit setting)
9462	37986	**I/O-98** **MotTripTemp**	Selection of over temperature trip of the motor	110		0 – 255

10.5.6. Applications Menu (APP)

Address		Screen	Description	Default value	Range	
16 bit	10 bit				Option	Values
9700	38656	APP-00 Jump code	Jump to desired parameters	1		1 – 99
9701	38657	APP-01 proc PI mode	Selection of PID operation mode	0	No Yes	0 – 1
9702	38658	APP-02 App. mode	Selection of operation with multiple motors	0	None MMC	0 – 1
9704	38660	APP-04 AuxRefMode	Selection of auxiliary reference in PID mode	0	No Yes	0 – 1
9705	38661	APP-05 Aux Ref Sel	Selection of source for auxiliary reference in PID mode	2	Keypad-1 Keypad-2 V1 V1S I V1 + I Pulse Int. 485 Ext. PID	0 – 8
9706	38662	APP-06 PID F/B	Selection of source for feedback signal	0	I V1 Pulse	0 – 2
9707	38663	APP-07 PID P-Gain	Proportional gain in PID mode	1000		0 – 9999
9708	38664	APP-08 PID I-Time	Integral gain in PID mode	5		0 – 320
9709	38665	APP-09 PID D-Time	Differential gain in PID mode	0		0 – 1000
970A	38666	APP-10 PID Limit-H	High limit of output frequency in PID mode	5000		0 – 30000
970B	38667	APP-11 PID Limit-L	Low limit of output frequency in PID mode	50		FU1-32 – 30000
970C	38668	APP-12 PID OutScale	Output scale in PID mode	1000		0 – 9999
970D	38669	APP-13 PID P2-Gain	Second proportional gain in PID mode	1000		0 – 9999
970E	38670	APP-14 P-gain Scale	Scale of proportional gain in PID mode	1000		0 – 1000
970F	38671	APP-15 PID Out Inv.	Output inversion in PID mode	0	No Yes	0 – 1
9711	38673	APP-17 PID U Fbk	Transformation of feedback from linear to square	0	No Yes	0 – 1
9712	38674	APP-18 FB Filter	Filter for feedback signal	10		0 – 9999
9714	38676	APP-20 2nd Acc time	Acceleration time for second motor	50		0 – 6000
9715	38677	APP-21 2nd Dec time	Deceleration time for second motor	100		0 – 6000
9716	38678	APP-22 2ndBaseFreq	Base frequency for second motor	5000		3000 – FU1-30
9717	38679	APP-23 2nd V/F	Voltage / Frequency pattern for second motor	0	Linear Square User V/F	0 – 2
9718	38680	APP-24 2nd F-boost	Torque boost in forward direction for second motor	20		0 – 150
9719	38681	APP-25 2nd R-boost	Torque boost in reverse direction for second motor	20		0 – 150
971A	38682	APP-26 2nd Stall	Current limit for second motor	100		30 – 150
971B	38683	APP-27 2ndETH1min	Electronic thermal protection for 1 minute for second motor	130		APP-28 – 200
971C	38684	APP-28 2ndETH cont	Electronic thermal protection for continuous for second motor	120		50 – APP-27 (max. 150)
971D	38685	APP-29 2nd R-Curr	Rated current for second motor	-		10 – 2000

Address		Screen	Description	Default value	Range	
16 bit	10 bit				Option	Values
971E	38686	**APP-30** **Aux Mot Run**	Auxiliary motors running	0		-
971F	38687	**APP-31** **Starting Aux**	Selection of starting for auxiliary motors	1		1 – 4
9720	38688	**APP-32** **AutoOp Time**	Displaying of operation time in rotation mode	0		-
9721	38689	**APP-33** **Nbr Aux's**	Number of auxiliary motors	4		0 – 4
9728	38696	**APP-40** **Sleep Delay**	Sleep delay time	600		0 – 9999
9729	38697	**APP-41** **Sleep Freq0**	Sleep frequency 0	0		0 – FU1-30
972A	38698	**APP-42** **Sleep Freq1**	Sleep frequency 1	0		0 – FU1-30
972B	38699	**APP-43** **Sleep Freq2**	Sleep frequency 2	0		0 – FU1-30
972C	38700	**APP-44** **Sleep Freq3**	Sleep frequency 3	0		0 – FU1-30
972D	38701	**APP-45** **Sleep Freq4**	Sleep frequency 4	0		0 – FU1-30
972E	38702	**APP-46** **Sleep Freq5**	Sleep frequency 5	0		0 – FU1-30
972F	38703	**APP-47** **Sleep Freq6**	Sleep frequency 6	0		0 – FU1-30
9730	38704	**APP-48** **Sleep Freq7**	Sleep frequency 7	0		0 – FU1-30
9731	38705	**APP-49** **WakeUp level**	Wake up level for Sleep mode	20		0 – 1000
9732	38706	**APP-50** **Start Freq 1**	Start frequency of auxiliary motor 1	4950		0 – FU1-30
9733	38707	**APP-51** **Start Freq 2**	Start frequency of auxiliary motor 2	4950		0 – FU1-30
9734	38708	**APP-52** **Start Freq 3**	Start frequency of auxiliary motor 3	4950		0 – FU1-30
9735	38709	**APP-53** **Start Freq 4**	Start frequency of auxiliary motor 4	4950		0 – FU1-30
9736	38710	**APP-54** **Stop Freq 1**	Stop frequency of auxiliary motor 1	2000		0 – FU1-30
9737	38711	**APP-55** **Stop Freq 2**	Stop frequency of auxiliary motor 2	2000		0 – FU1-30
9738	38712	**APP-56** **Stop Freq 3**	Stop frequency of auxiliary motor 3	2000		0 – FU1-30
9739	38713	**APP-57** **Stop Freq 4**	Stop frequency of auxiliary motor 4	2000		0 – FU1-30
973A	38714	**APP-58** **Aux start DT**	Delay time before connecting auxiliary motors	50		0 – 9999
973B	38715	**APP-59** **Aux stop DT**	Delay time before stopping auxiliary motors	50		0 – 9999
973C	38716	**APP-60** **AUX AccTime**	Time for the ramp at connecting auxiliary motors	20		0 – 6000
973D	38717	**APP-61** **AUX DecTime**	Time for the ramp at disconnecting auxiliary motors	20		0 – 6000
9742	38722	**APP-66** **AutoCh_Mode**	Rotation mode of auxiliary motors	0		0 – 2
9743	38723	**APP-67** **AutoEx-intv**	Operation time of the inverter for one of the motors	4320		0 - 5940
9745	38725	**APP-69** **Inter-lock**	Detection of motors out of service	0	No Yes	0 – 1
9747	38727	**APP-71** **Aux STT FB**	Difference for starting auxiliary motors	2		0 – 100
9748	38728	**APP-72** **Aux STP FB**	Difference for stopping auxiliary motors	0		0 – 100
974A	38730	**APP-74** **PrePID Freq**	Setting of filling frequency	0		0 – FU1-30

Address		Screen	Description	Default value	Range	
16 bit	10 bit				Option	Values
974B	38731	**APP-75** PrePID F/B	Level for leaving filling mode	0		0 – 100
974C	38732	**APP-76** PrePID dly	Time of filling function application	600		0 – 9999
974D	38733	**APP-77** Pbroken mode	Pipe broken trip during filling function	0	No / Yes	0 – 1
9750	38736	**APP-80** Ext PI mode	External PID mode	0	No / Yes	0 – 1
9751	38737	**APP-81** Ext Ref Sel	Reference for External PID	3	I / V1 / Pulse / Keypad	0 – 3
9752	38738	**APP-82** Ext Ref Perc	Level for reference of External PID	5000		0 – 10000
9753	38739	**APP-83** Ext Fbk Sel	Feedback signal of External PID	0	I / V1 / Pulse	0 – 2
9755	38741	**APP-85** ExtPID Pgain	Proportional gain for External PID	10		0 – 9999
9756	38742	**APP-86** ExtPID Itime	Integral gain for External PID	100		0 – 320
9757	38743	**APP-87** ExtPID Dtime	Differential gain for External PID	0		0 – 2000
9758	38744	**APP-88** ExtPID lmt-H	High limit for External PID	10000		0 – 10000
9759	38745	**APP-89** ExtPID lmt-L	Low limit for External PID	0		0 – 3000
975A	38746	**APP-90** ExtPID Scale	Output scale for External PID	1000		0 – 9999
975B	38747	**APP-91** Ext P2-gain	Second proportional gain for External PID	1000		0 – 9999
975C	38748	**APP-92** Ext P Scale	Scale of proportional gain for External PID	1000		0 – 1000
975D	38749	**APP-93** ExtPID Fgain	F gain for External PID	0		0 – 9999
975F	38751	**APP-95** ExtPIDOutInv	Output inversion for External PID	0	No / Yes	0 – 1
9761	38753	**APP-97** ExtLoopTime	Activation time of External PID controller	100		50 – 200

10.6. Faults solution

Check points	Corrective measures
Is the power provided the converter?	Provide electric power to the converter.
Are the connections between converter and computer correct?	Refer to converter manual.
Is the connection between converter and communication card right?	Check the wiring (see '10.3 Installation').
Is the communication port selected correctly from the user program?	Verify the selected communication port is the same port used to communicate.
Is master not polling?	Verify the master is polling the inverter.
Is baud rate of the computer and inverter correctly set?	Set the correct value in accordance with '10.3 Installation'.
Is the data format of user program right?	Revise user program.

11. OPTIONS

11.1. Filters

11.1.1. RFI Filters

REFERENCE	Current (A)	Leakage Current (mA)		Voltage (V)	Applicable Drives
		Rated	Maximum		
FESD45008	13	0,5	26	400	SD45008
FESD45016	25	0,5	26	400	SD45012 SD45016
FESD45030	40	0,5	26	400	SD45024 SD45030
FESD45045	60	0,5	26	400	SD45039 SD45045
FESD45075	100	0,5	26	400	SD45060 SD45075
FESD45090	130	0,5	26	400	SD45090
FESD4145	180	0,5	26	400	SD45110 SD45150

Note: See dimension drawings for RFI filters in chapter '4. DIMENSIONS'.

11.1.2. Input Harmonics Filters

REFERENCE	Current (A)	Voltage (V)	Dimensions (mm)			Applicable Drives
			H	W	D	
FHSD4008	8	400	230	170	120	SD45008
FHSD4016	16	400	230	170	120	SD45012 SD45016

Note: Input harmonics filters are built-in as standard for drives from 24A to 145A (SD45024 – SD45150), both included.

NOTE

There are dV/dt filters for the whole range. For references and availability, consult with Power Electronics.

11.2. Accessories

Drives of SD450 Series have multiple options for different applications. Consult the following table.

Option		Name	Dimensions	Description
Internal installation	Communication buses	**SD45TCD**	-	DeviceNet communication card DeviceNet protocol integrated CAN controller Inverter connection: Max. 64 Input voltage: DC 11 ~ 25V Bauds: 125, 250, 500k bps CSMA/CD-NBA method
		SD45TCP	-	Profibus communication net Connection to ProfiBus Network Device type: Profibus DP Slave Inverter connection: Max. 64 Bauds: Max. 12M bps
	Analogue Outputs	**SD45TCS**	-	Board for Current Analogue Outputs. It supplies 2 analogue output signals of current, proportional to the selectable magnitude. Adjustable range from 0 – 20mA.
External installation	Remote cable	**SD4CF1**	5m	Removable cable 5m for remote panel.
	Dynamic braking	**DBSD4030**	See Group 1	Braking unit for inverters 3,7 to 11kW 400V
		DBSD4045		Braking unit for inverters 15 to 18,5kW 400V
		DBSD4075	See Group 2	Braking unit for inverters 22 to 30kW 400V
		DBSD4145		Braking unit for inverters 37 to 75kW 400V

11.2.1. Dynamic Braking Unit

SD450 drives have not dynamic braking circuits as standard component. If you need to conduct the regenerated energy you have to install an optional dynamic braking unit with the corresponding dynamic braking resistors.

Any basic information about these braking units is included here. For additional information, refer the corresponding manual.

11.2.1.1. Terminals Configuration

Terminals for dynamic braking units are the described ones in the attached table:

Group	Terminal	Description
Group 1	CM	Common terminal for the over temperature trip (OH).
	OH	Output terminal for the over temperature trip (Open collector: 20mA, 27VDC).
	G	Ground terminal.
	B2	Connection for B2 terminal of the dynamic braking resistor.
	B1	Connection for B1 terminal of the dynamic braking resistor.
	N	Connection for N terminal of the inverter DC Bus.
	P	Connection for P terminal of the inverter DC Bus.
Group 2	G	Ground terminal.
	N	Connection for N terminal of the inverter DC Bus.
	B2	Connection for B2 terminal of the dynamic braking resistor.
	P/B1	Connection for B1 terminal of the dynamic braking resistor. Connection for P terminal of the inverter DC Bus.

11.2.1.2. Dimensions

Next, dynamic braking units of each group are shown:

a) Group 1.
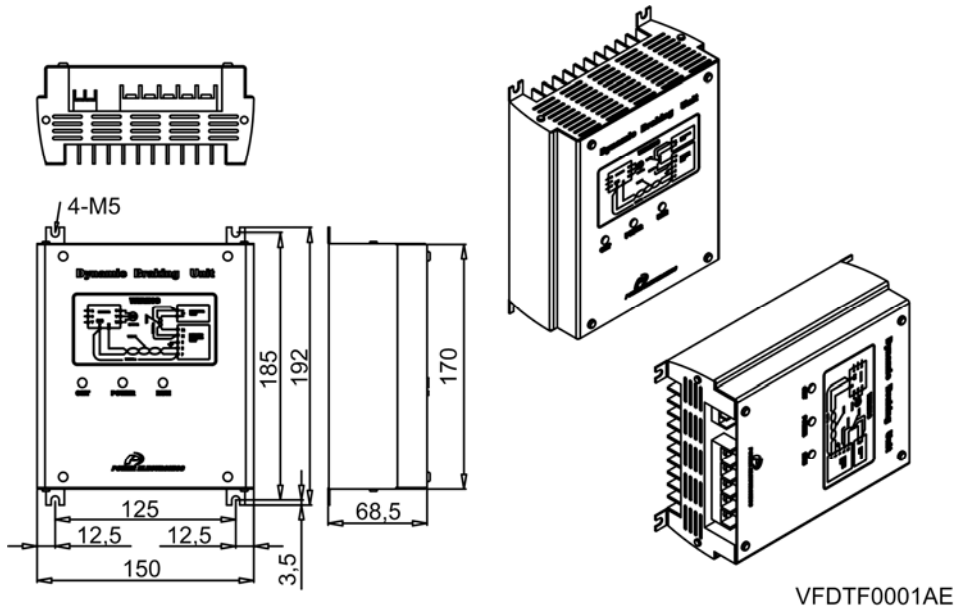
Figure 11.1. Dynamic braking unit for inverters from 3,7kW to 18,5kW

b) Group 2.
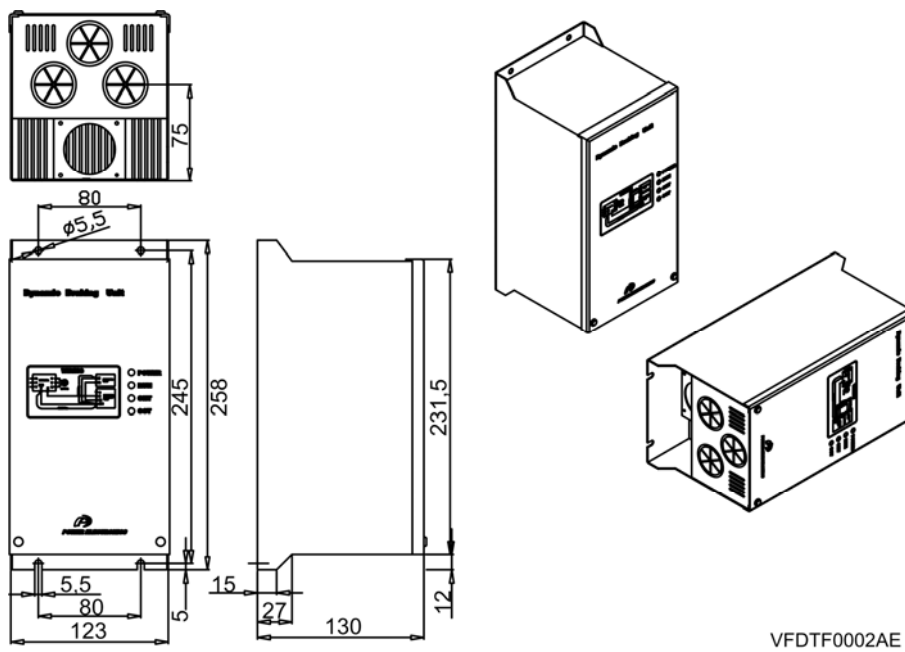
Figure 11.2. Dynamic braking unit for inverters from 22kW to 75kW

11.2.1.3. Leds Description

a) Group 1:
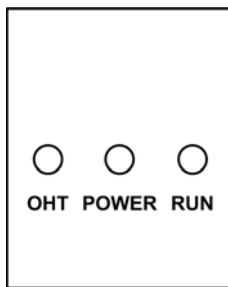
VFDTF0008AE

Led	Description
OHT (Red)	When the heat sink is overheated and the level exceeds its set limit, overheat protection is activated and this led is turned on after the signal is shut off.
POWER (Red)	It is turned on when the braking unit receives power supply, because usually it is connected to the inverter.
RUN (Green)	It is blinking while dynamic braking unit is operating correctly due to the energy regenerated by the motor.

Figure 11.3 Leds – DBU Gr. 1

b) Group 2:
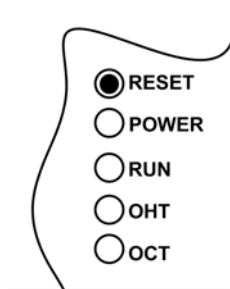
VFDTF0009AE

Led	Description
RESET	Press this switch to release OCT fault (overcurrent). Pressing this switch the OCT led is turned off.
POWER (Green)	It is turned on when the braking unit receives power supply because usually it is connected to the inverter.
RUN (Green)	It is blinking while dynamic braking unit is operating correctly due to the energy regenerated by the motor.
OHT (Red)	When the heat sink is overheated and the level exceeds its set limit, overheat protection is activated and this led is turned on after the signal is shut off.
OCT (Red)	Over current trip signal. When an over current occurs in the IGBT, this protection function turns off the operation signal and the OCT led is turned on.

Figure 11.4 Leds – DBU Gr. 2

11.2.1.4. Terminals of Braking Resistor

Note: It is recommended to use braking resistors equipped with thermal sensors. Connect it to one of the digital input terminals of the drive (M1 to M8) after selecting the option of 'Ext. Trip' in the corresponding I/O parameter.

Braking Resistor Terminals	Description
B1, B2	Connection terminals to connect to the dynamic braking unit. Only connect the cables according to the drawing above detailed. Connect the terminals of the dynamic braking resistor to the terminals B1 and B2 of the dynamic braking unit.
TH1, TH2 [1]	Thermal sensor of the resistor. Normal temperature (ambient): Normally closed (TH1 – TH2 closed). Over temperature of the resistor: Normally open (TH1 – TH2 open). Connect this signal to one input terminal configured as 'External Trip'.

[1] Terminals TH1 and TH2 will be only available whenever the used braking resistor is equipped with thermal sensor.

11.2.1.5. Connection Drawing

The following figure shows the connections between the drive, the dynamic braking unit and the braking resistor.

SD45DTF0005AI
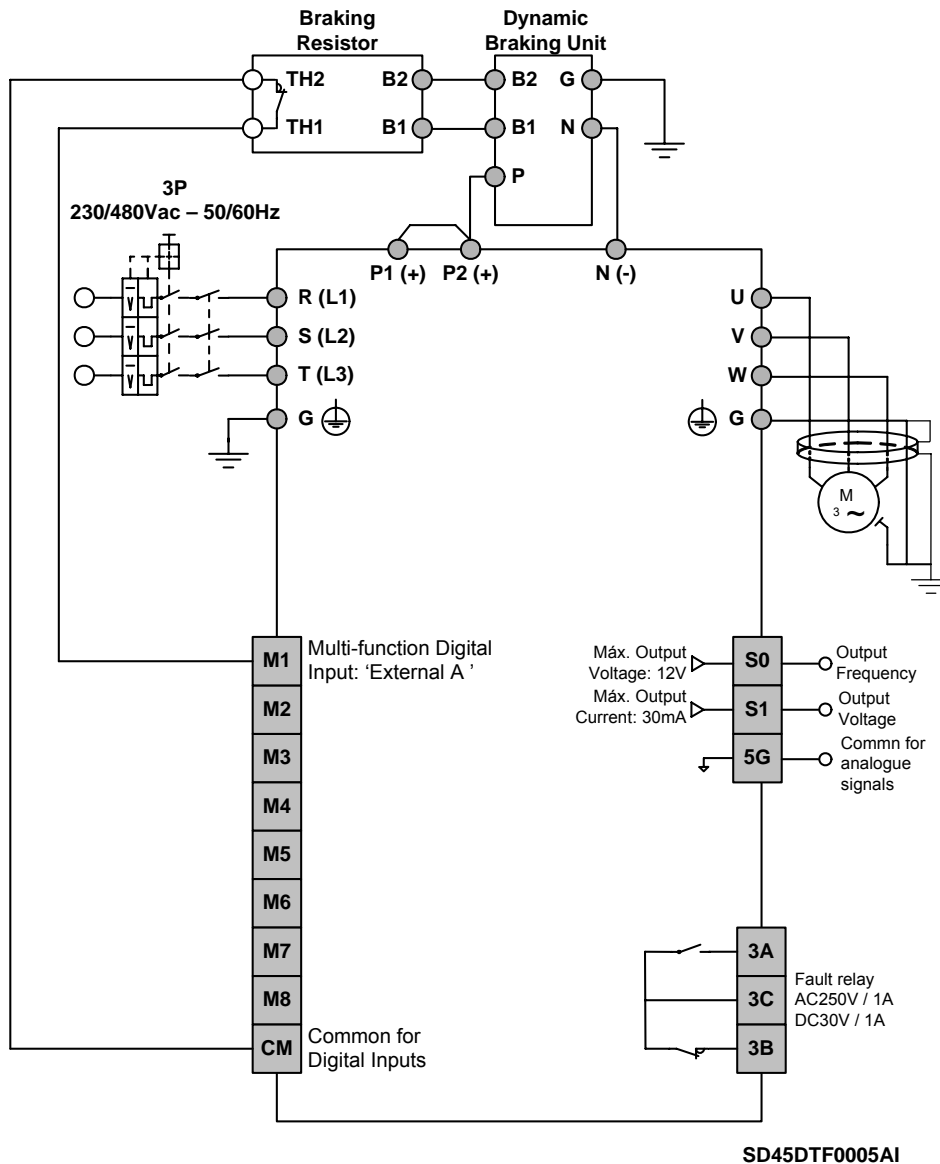
Figure 11.5 Wiring for dynamic braking units (Group 1). Connection of the braking resistor trip

Notes:

- Terminals B1 and P are the same one in the dynamic braking units of the Group 2. Therefore, this terminal will be connected to terminal B1 of the braking resistor and to the positive terminal of the DC Bus of the drive at the same time.

- Maximum cable length between:
  - Drive ➔ Dynamic Braking Unit: max. 10m.
  - Dynamic Braking Unit ➔ Dynamic Braking Resistor: max. 10m.

11.2.2. Dynamic Braking Resistor

11.2.2.1. Selection of the External Braking Resistor

BRAKING UNIT	SD450 DRIVE	CAPACITY (kW)	BRAKING RESISTOR (Braking Torque of 150%)			
			Resistor (Ω)	Soft Enable Duty (5%) Watts (W)	Medium Enable Duty (15%) Watts (W)	Heavy Enable Duty (35%) Watts (W)
DBSD4030 (Group 1)	SD45008	3,7	100	150	555	1295
	SD45012	5,5	70	300	825	1925
	SD45016	7,5	50	400	1125	2625
	SD45024	11	35	600	1650	3850
DBSD4045 (Group 1)	SD45030	15	25	800	2250	5250
	SD45039	18,5	20	1000	2775	6475
DBSD4075 (Group 2)	SD45045	22	17	1100	3300	7700
	SD45060	30	12	1500	4500	10500
DBSD4145 (Group 2)	SD45075	37	10	2000	5550	12950
	SD45090	45	8	2500	6750	15750
	SD45110	55	7	3000	8250	19250
	SD45150	75	6	4000	11250	26250

Note: The values of this table are based on ED (Enable Duty) of 5%, 15% and 35%, with continuous braking of 15 seconds. For other applications, contact with Technical Department of Power Electronics.

⚠ **CAUTION**

Do not touch the braking resistor during drive operation since it could be very hot (more than 150ºC).

12. COMMONLY USED CONFIGURATIONS

12.1. Start /Stop Command and Speed Reference by Keypad or Analogue Input

12.1.1. Parameters Configuration

Parameter	Description	Display	Value
DRV-00	Reference frequency	0.00	50Hz
DRV-01	Acceleration time	Acc. Time	30.0sec
DRV-02	Deceleration time	Dec. Time	30.0sec
DRV-03	Start /Stop control mode	Drive mode	**Keypad:** Start / Stop by keypad. **Fx/Rx-1:** Start / Stop by terminals. **Int. 485:** Start /Stop through communication bus.
DRV-04	Frequency control mode	Freq mode	**Keypad – 1, Keypad – 2:** Frequency setting by keypad. **V1:** Potentiometer connected to the terminals V+, V1 and 5G. **V1S:** Potentiometer connected to the terminals V+, V1 and V-. **I:** 4-20mA / 0-20mA analogue input, terminals I and 5G. **Pulse:** Analogue pulse input, terminals A0 and B0. **Int. 485:** Reference frequency setting through communication bus.
FU1-23	Stop mode	Stop mode	**Decel:** Deceleration controlled by parameter DRV-02. **DC brake:** Inverter will stop by a DC current injection. **Free run:** Deceleration not controlled. Stop by inertia. **Fluxe brake:** Fast stop using the energy regenerated to heat into the motor. (CAUTION WITH THIS OPTION).
FU1-29	Line frequency	Line Freq	50.00Hz – Frequency of the commercial line voltage.
FU1-30	Maximum frequency	Max Freq	50Hz – Maximum speed of the equipment.
FU1-31	Base frequency	Base Freq	50Hz – At that frequency, the inverter supplies the rated output voltage. Set this frequency according to the motor nameplate.
FU1-32	Start frequency	Start Freq	0,1Hz – Minimum speed at the starting.
FU1-33	Frequency limits selection	Freq limit	**No:** Limits are set in parameters FU1-30 and FU1-32. **Yes:** Limits are set in parameters FU1-34 and FU1-35.
FU1-34	Low frequency limit	F-limit Lo	0.00Hz
FU1-35	High frequency limit	F-limit Hi	50.00Hz
FU1-49	Input voltage setting	VAC 400.4V – 91.0%	Setting of the commercial line voltage.
FU1-50	Motor rated voltage	Motor Volt	400V – Setting of the motor rated voltage.
FU1-60	Electronic thermal protection	ETH select	**Yes:** In this case, FU1-61 and FU1-62 are available.
FU1-61	Electronic thermal protection level for 1 minute	ETH 1min	150%
FU1-62	Electronic thermal protection level for continuous	ETH cont	105%
FU1-81	Delay time at the starting	Run Delay T	Delay time at the starting (optional).
FU2-20	Restart after power supply fault	Power-on run	**No:** Inverter will not restart after losing power supply and recovering it again. **Yes:** Inverter will restart after losing power supply and recovering it again.
FU2-21	Restart after fault reset	RST restart	**No:** Inverter will not restart after occuring a fault and resetting it. **Yes:** Inverter will restart after occuring a fault and resetting it.
FU2-40	Motor power setting	Motor select	3,7kW 5,5kW 7,5kW 11kW 15kW 18,5kW 22kW 30kW 37kW 45kW 55kW 75kW
FU2-41	Number of motor poles	Pole number	2 poles ≡ 3000 rpm 4 poles ≡ 1500 rpm 6 poles ≡ 750 rpm
FU2-43	Motor rated current	Rated-Curr	?A (Set the current according to the motor nameplate).
FU2-48	Carrier frequency	Carrier freq	2.0 kHz

Parameter	Description	Display	Value
FU2-60	Control mode	Control mode	V/F control.
FU2-67	Torque boost setting	Torque boost	Manual
FU2-93	Parameters initialize	Para. Init	**All groups:** All of parameters are initialized with the factory settings.
I/O-01	Filter of analogue voltage input V1	V1 Filter	250ms (Filter of the analogue voltage input)
I/O-02	Minimum voltage of V1 input	V1 volt x1	0.00V (Minimum voltage of V1 input)
I/O-03	Frequency for minimum voltage of V1	V1 Freq y1	0Hz (Frequency for the minimum voltage of V1 input)
I/O-04	Maximum voltage of V1 input	V1 volt x2	10.0V (Maximum voltage of V1 input)
I/O-05	Frequency for maximum voltage of V1	V1 Freq y2	50Hz (Frequency for the maximum voltage of V1 input)
I/O-06	Filter of analogue current input I	I Filter	250ms (Filter of the analogue current input)
I/O-07	Minimum current of I input	I curr x1	4.00mA (Minimum current of I input)
I/O-08	Frequency for minimum current of I	I Freq y1	0Hz (Frequency for the minimum current of I input)
I/O-09	Maximum current of I input	I curr x2	20.00mA (Maximum current of I input)
I/O-10	Frequency for maximum current of I	I Freq y2	50Hz (Frequency for the maximum current of I input)

12.1.2. Connections Drawing

Terminals CM / M7: start command (NO status).
Terminals I / 5G: 4-20mA analogue input.
Terminals VR / V1 / 5G: 0-10 V analogue input.

▪ **Connections for inverters from 3,7kW to 22kW.**

SD45DTC0023AI
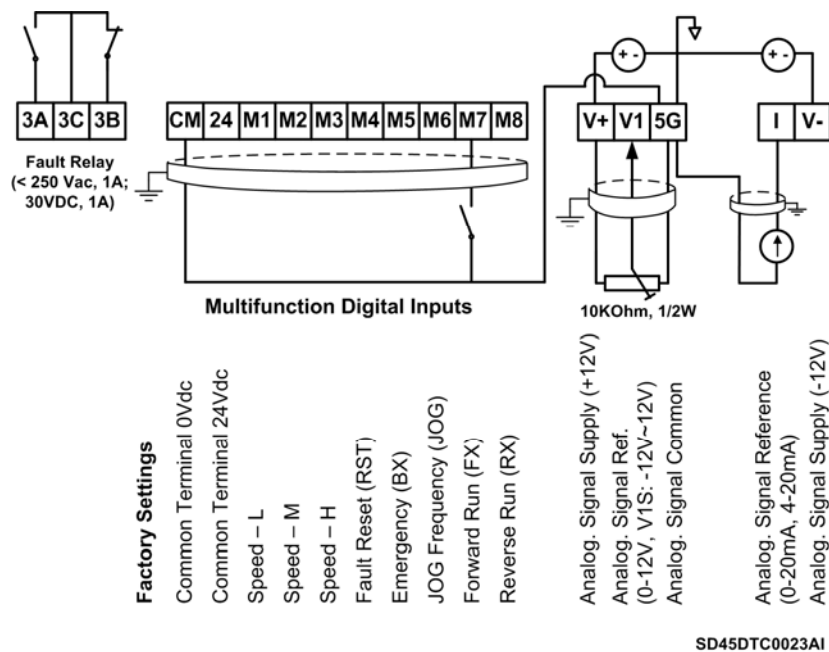
Figure 12.1 Start / Stop command and speed reference by keypad or analogue input.
Inverters with capacities from 3,7 to 22kW

Note: Control cables have to be screened and must be connected to the ground.
5G terminal will be CM terminal for inverters with a capacity equal or higher than 30kW.

▪ **Connections for inverters from 30kW to 75kW.**
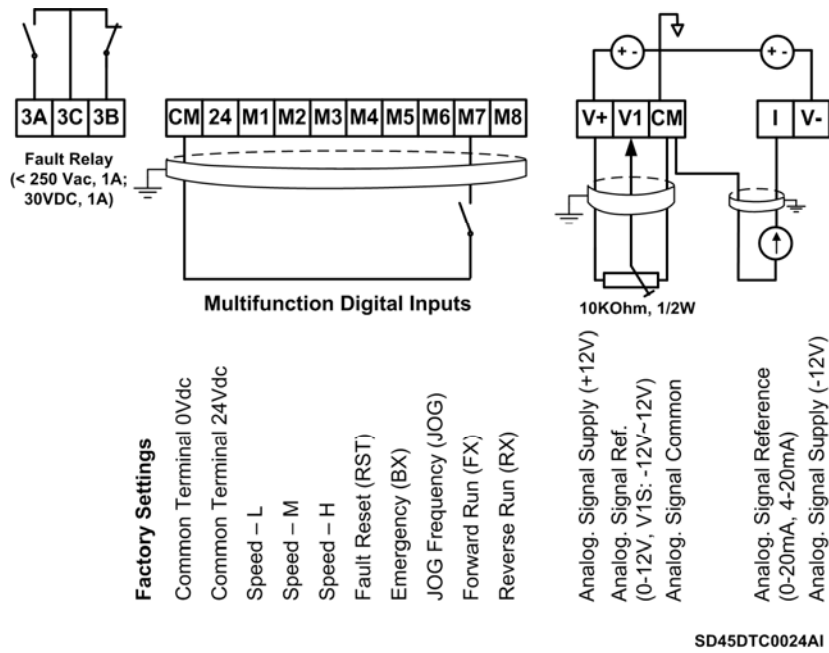
Figure 12.2 Start / Stop command and speed reference by keypad or analogue input. Inverters with capacities from 30 to 75kW

Note: Control cables have to be screened and must be connected to the ground.
5G terminal will be CM terminal for inverters with a capacity equal or higher than 30kW.

12.2. Multi-speed References via M1, M2 and M3 Terminals

12.2.1. Parameters Configuration

Parameter	Description	Display	Value
DRV-00	Reference frequency	0.00	50Hz
DRV-01	Acceleration time	Acc. Time	10.0sec
DRV-02	Deceleration time	Dec. Time	10.0sec
DRV-03	Start / Stop Control mode	Drive mode	**Keypad:** Start / Stop by keypad. **Fx/Rx-1:** Start / Stop by terminals. **Int. 485:** Start / Stop through communication bus.
DRV-04	Frequency control mode	Freq mode	**Keypad – 1, Keypad – 2:** Frequency setting by keypad. **V1:** Potentiometer connected to the terminals V+, V1 and 5G. **V1S:** Potentiometer connected to the terminals V+, V1 and V-. **I:** 4-20mA / 0-20mA analogue input, terminals I and 5G. **Pulse:** Analogue pulse input, terminals A0 and B0. **Int. 485:** Reference frequency setting through communication bus.
DRV-05	Step frequency 1	Step Freq-1	30.00Hz (Multi-speed 1)
DRV-06	Step frequency 2	Step Freq-2	35.00Hz (Multi-speed 2)
DRV-07	Step frequency 3	Step Freq-3	40.00Hz (Multi-speed 3)
FU1-23	Stop mode	Stop mode	**Decel:** Deceleration controlled by parameter DRV-02. **DC brake:** Inverter will stop by a DC current injection. **Free run:** Deceleration not controlled. Stop by inertia. **Fluxe brake:** Fast stop using the energy regenerated to heat into the motor. (CAUTION WITH THIS OPTION).
FU1-29	Line frequency	Line Freq	50.00Hz – Frequency of the commercial line voltage.
FU1-30	Maximum frequency	Max Freq	50Hz – Maximum speed of the equipment.
FU1-31	Base frequency	Base Freq	50Hz – At this frequency, the inverter supplies the rated output voltage. Set this frequency according to the motor nameplate.
FU1-32	Start frequency	Start Freq	0,1Hz – Minimum speed at the starting.
FU1-33	Frequency limits selection	Freq limit	**No:** Limits are set in parameters FU1-30 and FU1-32. **Yes:** Limits are set in parameters FU1-34 and FU1-35 .
FU1-34	Low frequency limit	F-limit Lo	0.00Hz
FU1-35	High frequency limit	F-limit Hi	50.00Hz
FU1-49	Input voltage setting	VAC 400.4V – 91.0%	Setting of the commercial line voltage.
FU1-50	Motor rated voltage	Motor Volt	400V – Setting of the motor rated voltage.
FU1-60	Electronic thermal protection	ETH select	**Yes:** In this case, FU1-61 and FU1-62 available.
FU1-61	Electronic thermal protection level for 1 minute	ETH 1min	150%
FU1-62	Electronic thermal protection level for continuous	ETH cont	105%
FU1-81	Delay time at the starting	Run Delay T	Delay time at the starting (optional).
FU2-20	Restart after power supply fault	Power-on run	**No:** Inverter will not restart after losing power supply and recovering it again. **Yes:** Inverter will restart after losing power supply and recovering it again.
FU2-21	Restart after fault reset	RST restart	**No:** Inverter will not restart after occuring a fault and resetting it. **Yes:** Inverter will restart after occuring a fault and resetting it.
FU2-40	Motor power setting	Motor select	3,7kW 5,5kW 7,5kW 11kW 15kW 18,5kW 22kW 30kW 37kW 45kW 55kW 75kW
FU2-41	Number of motor poles	Pole number	2 poles ≡ 3000 rpm 4 poles ≡ 1500 rpm 6 poles ≡ 750 rpm
FU2-43	Motor rated current	Rated-Curr	?A (Set the current according to the motor nameplate).
FU2-48	Carrier frequency	Carrier freq	2.0 kHz

Parameter	Description	Display	Value
FU2-60	Control mode	Control mode	V/F control.
FU2-67	Torque boost setting	Torque boost	Manual
I/O-20	Configuration of M1 terminal	M1 define	Speed-L (Multi-speed 1)
I/O-21	Configuration of M2 terminal	M2 define	Speed-M (Multi-speed 2)
I/O-22	Configuration of M3 terminal	M3 define	Speed-H (Multi-speed 3)
I/O-31	Step frequency 4	Step Freq-4	45.00Hz (Multi-speed 4)
I/O-32	Step frequency 5	Step Freq-5	50.00Hz (Multi-speed 5)
I/O-33	Step frequency 6	Step Freq-6	47.00Hz (Multi-speed 6)
I/O-34	Step frequency 7	Step Freq-7	42.00Hz (Multi-speed 7)

Depending on the status of the input terminals M1, M2 and M3, different programmed frequencies can be selected:

Programmed frequency	Parameter	Speed-H (M3)	Speed-M (M2)	Speed-L (M1)
50.00Hz	DRV-00	0	0	0
30.00Hz	DRV-05	0	0	1
35.00Hz	DRV-06	0	1	0
40.00Hz	DRV-07	0	1	1
45.00Hz	I/O-31	1	0	0
50.00Hz	I/O-32	1	0	1
47.00Hz	I/O-33	1	1	0
42.00Hz	I/O-34	1	1	1

12.2.2. Connections Drawing

Terminals CM / M7: start command (NO status).
Terminals CM / M1: Multi-reference Speed-L (NO status).
Terminals CM / M2: Multi-reference Speed-M (NO status).
Terminals CM / M3: Multi-reference Speed-H (NO status).
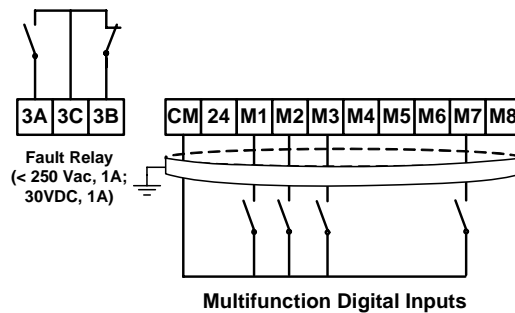
SD45DTC0015AI

Figure 12.3 Multi-speed references via M1, M2 and M3 terminals

Note: Control cables have to be screened and must be connected to the ground.
5G terminal will be CM terminal for inverters with a capacity equal or higher than 30kW.

12.3. Control of one Pump, Eight Speed References and Manual Speed (Under-load) Without Pressure Group Functionality

12.3.1. Parameters Configuration

Parameter	Description	Display	Value
DRV-00	Pressure reference REF1	0.00	40.00% (20Hz) (Pressure reference, 20Hz x 2 =40% transducer range.)
DRV-00R	Reference and feedback values of PID	R 0.0% F 0.0%	R = Displaying of the reference value in % F = Displaying of the feedback value in % of sensor range.
DRV-01	Acceleration time	Acc. Time	10.0sec
DRV-02	Deceleration time	Dec. Time	10.0sec
DRV-03	Start / Stop control mode	Drive mode	**Keypad:** Start / Stop by keypad. **Fx/Rx-1:** Start / Stop by terminals. **Int. 485:** Start / Stop through communication bus.
DRV-04	Frequency control mode	Freq mode	**Keypad – 1, Keypad – 2:** Frequency setting by keypad.
DRV-05	Pressure reference 1	Refer Perc-1	60.00% (Reference 1 – 30.00Hz)
DRV-06	Pressure reference 2	Refer Perc-2	70.00% (Reference 2 – 35.00Hz)
DRV-07	Pressure reference 3	Refer Perc-3	80.00% (Reference 3 – 40.00Hz)
FU1-23	Stop mode	Stop mode	**Decel:** Deceleration controlled by parameter DRV-02. **DC brake:** Inverter will stop by a DC current injection. **Free run:** Deceleration not controlled. Stop by inertia. **Fluxe brake:** Fast stop using the energy regenerated to heat into the motor. (CAUTION WITH THIS OPTION).
FU1-29	Line frequency	Line Freq	50.00Hz – Frequency of the commercial line voltage.
FU1-30	Maximum frequency	Max Freq	50Hz – Maximum speed of the equipment.
FU1-31	Base frequency	Base Freq	50Hz – At this frequency, the inverter supplies the rated output voltage. Set this frequency according to the motor nameplate.
FU1-32	Start frequency	Start Freq	0.2Hz – Minimum speed at the starting.
FU1-49	Input voltage setting	VAC 400.4V – 91.0%	Setting of the commercial line voltage.
FU1-50	Motor rated voltage	Motor Volt	400V – Setting of the motor rated voltage.
FU1-60	Electronic thermal protection	ETH select	**Yes:** In this case, FU1-61 and FU1-62 are available.
FU1-61	Electronic thermal protection level for 1 minute	ETH 1min	150%
FU1-62	Electronic thermal protection level for continuous	ETH cont	105%
FU1-81	Delay time at the starting	Run Delay T	Delay time at the starting (optional).
FU1-85	Underload trip selection	ULT select	Yes
FU1-86	Underload level	ULT level	70% (Motor current at the frequency set in FU1-87).
FU1-87	Underload frequency	ULT freq	40.00Hz (Frequency for activating underload protection).
FU1-88	Underload trip time	ULT time	60.0sec
FU2-20	Restart after power supply fault	Power-on run	**No:** Inverter will not restart after losing power supply and recovering it again. **Yes:** Inverter will restart after losing power supply and recovering it again.
FU2-21	Restart after fault reset	RST restart	**No:** Inverter will not restart after occuring a fault and resetting it. **Yes:** Inverter will restart after occuring a fault and resetting it.
FU2-40	Motor power setting	Motor select	3,7kW 5,5kW 7,5kW 11kW 15kW 18,5kW 22kW 30kW 37kW 45kW 55kW 75kW
FU2-41	Number of motor poles	Pole number	2 poles ≡ 3000 rpm 4 poles ≡ 1500 rpm 6 poles ≡ 750 rpm
FU2-43	Motor rated current	Rated-Curr	?A (Set the current according to the motor nameplate).
FU2-48	Carrier frequency	Carrier freq	2.0 kHz

Parameter	Description	Display	Value
I/O-01	Filter of analogue voltage input	V1 Filter	250ms (Filter of the analogue voltage input)
I/O-02	Minimum voltage of V1 input	V1 volt x1	0.00V (Minimum voltage of V1 input)
I/O-03	Frequency for minimum voltage of V1	V1 Freq y1	0Hz (Frequency for the minimum voltage of V1 input)
I/O-04	Maximum voltage of V1 input	V1 volt x2	10.0V (Maximum voltage of V1 input)
I/O-05	Frequency for maximum voltage of V1	V1 Freq y2	50Hz (Frequency for the maximum voltage of V1 input)
I/O-06	Filter of analogue current input I	I Filter	250ms (Filter of the analogue current input)
I/O-07	Minimum current of I input	I curr x1	4.00mA (Minimum current of I input)
I/O-08	Frequency for minimum current of I	I Freq y1	0Hz (Frequency for the minimum current of I input)
I/O-09	Maximum current of I input	I curr x2	20.00mA (Maximum current of I input)
I/O-10	Frequency for maximum current of I	I Freq y2	50Hz (Frequency for the maximum current of I input)
I/O-20	Configuration of M1 terminal	M1 define	Speed-L (Multi-speed 1)
I/O-21	Configuration of M2 terminal	M2 define	Speed-M (Multi-speed 2)
I/O-22	Configuration of M3 terminal	M3 define	Speed-H (Multi-speed 3)
I/O-23	Configuration of M4 terminal	M4 define	Open-loop (When it is activated, it allows operating at manual speed)
I/O-25	Configuration of M6 terminal	M6 define	JOG frequency (Speed preset by parameter)
I/O-30	Setting of jog frequency	Jog Freq	40.00Hz
I/O-31	Step frequency 4	Refer Perc-4	90.00% (Multi-speed 4 – 45.00Hz)
I/O-32	Step frequency 5	Refer Perc-5	100.00% (Multi-speed 5 – 50.00Hz)
I/O-33	Step frequency 6	Refer Perc-6	94.00% (Multi-speed 6 – 47.00Hz)
I/O-34	Step frequency 7	Refer Perc-7	84.00% (Multi-speed 7 – 42.00Hz)
I/O-76	Configuration for auxiliary relay 1	Aux mode1	Run (Programmable relay is activated when the inverter is running)
I/O-80	Configuration for fault relay	Relay mode	010 (Fault relay)
I/O-86	Selection of displaying units for V1 signal	V1 Unit Sel	**Percentage:** (if the feedback signal is V1). Only thus it will appear the parameter DRV-00R.
I/O-87	Selection of displaying units for I signal	I Unit Sel	**Percentage:** (If the feedback signal is I). Only thus it will appear the parameter DRV-00R.
I/O-88	Selection of displaying units for A0, B0 signal	PulseUnitSel	**Percentage:** (if the feedback signal is A0, B0). Only thus it will appear the parameter DRV-00R.
APP-01	Activation of PID mode	proc PI mode	Yes
APP-06	Feedback signal	PID F/B	I (4-20mA input)
APP-10	High frequency limit in PID mode	PID Limit-H	50.00Hz
APP-11	Low frequency limit in PID mode	PID Limit-L	20.00Hz
APP-15	Output inversion in PID mode	PID Out Inv.	Yes or No (depending on the application)
APP-40	Sleep delay time	Sleep Delay	20.0sec
APP-41	Sleep frequency 0	Sleep Freq0	39.00Hz (Freq. for activating sleep mode with the speed ref. 0 active)
APP-42	Sleep frequency 1	Sleep Freq1	39.00Hz (Freq. for activating sleep mode with the speed ref. 1 active)
APP-43	Sleep frequency 2	Sleep Freq2	39.00Hz (Freq. for activating sleep mode with the speed ref. 2 active)
APP-44	Sleep frequency 3	Sleep Freq3	39.00Hz (Freq. for activating sleep mode with the speed ref. 3 active)
APP-45	Sleep frequency 4	Sleep Freq4	39.00Hz (Freq. for activating sleep mode with the speed ref. 4 active)
APP-46	Sleep frequency 5	Sleep Freq5	39.00Hz (Freq. for activating sleep mode with the speed ref. 5 active)
APP-47	Sleep frequency 6	Sleep Freq6	39.00Hz (Freq. for activating sleep mode with the speed ref. 6 active)
APP-48	Sleep frequency 7	Sleep Freq7	39.00Hz (Freq. for activating sleep mode with the speed ref. 7 active)
APP-49	Wake up level	WakeUp level	5.0% (Starting pressure REF – FBK) Example: ref. 1 = 35% and FBK = 30% Starting at 30% because APP-49 = 5%

Depending on the status of the input terminals M1, M2 and M3, different programmed pressures can be selected:

Programmed pressure	Parameter	Speed-H (M3)	Speed-M (M2)	Speed-L (M1)
40.00% - 20.00Hz	DRV-00	0	0	0
60.00% - 30.00Hz	DRV-05	0	0	1
70.00% - 35.00Hz	DRV-06	0	1	0
80.00% - 40.00Hz	DRV-07	0	1	1
90.00% - 45.00Hz	I/O-31	1	0	0
100.00% - 50.00Hz	I/O-32	1	0	1
94.00% - 47.00Hz	I/O-33	1	1	0
84.00% - 42.00Hz	I/O-34	1	1	1

12.3.2. Connections Drawing

Terminals CM / JOG: Change to manual speed set in parameter I/O-25 (NO status).
Terminals CM / M1: Terminal 1 (NO status).
Terminals CM / M2: Terminal 2 (NO status).
Terminals CM / M3: Terminal 3 (NO status).
Terminals CM / M7: Start command.
Terminals A1/C1: Programmable output relay.
Terminals 3A, 3B, 3C: Programmable fault relay.

▪ **Connections for inverters from 3,7kW to 22kW.**

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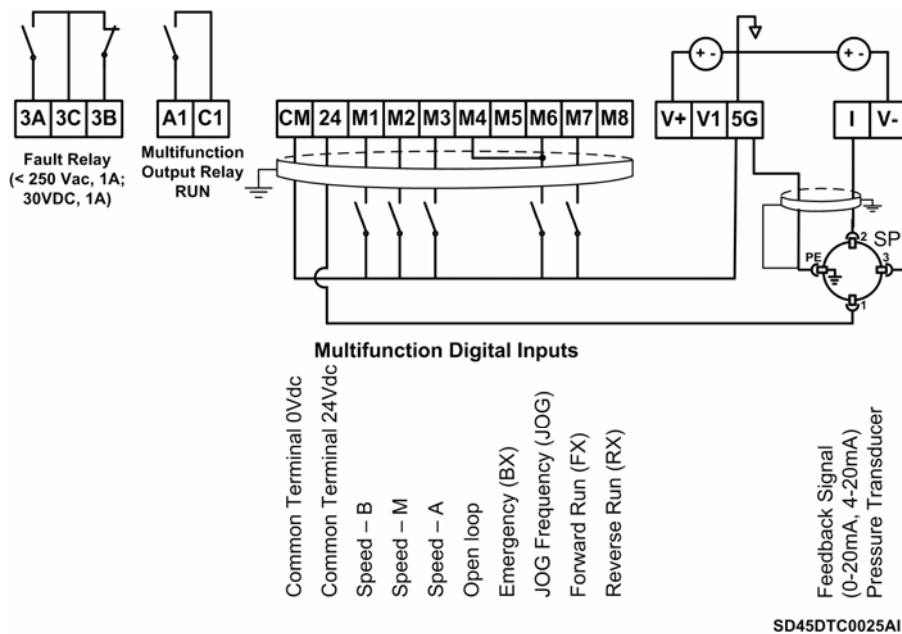
Figure 12.4 Control of one pump, eight speed references and manual speed.
Inverters with capacities from 3,7 to 22kW

Note: Control cables have to be screened and must be connected to the ground.
5G terminal will be CM terminal for inverters with a capacity equal or higher than 30kW.

▪ **Connections for inverters from 30kW to 75kW.**
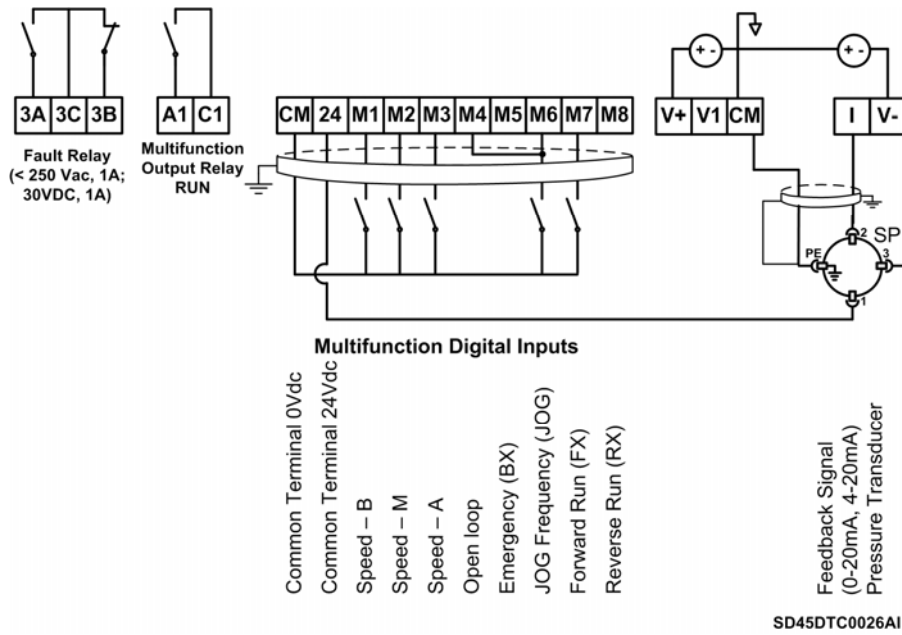
Figure 12.5 Control of one pump, eight speed references and manual speed.
Inverters with capacities from 30 to 75kW

Note: Control cables have to be screened and must be connected to the ground.
5G terminal will be CM terminal for inverters with a capacity equal or higher than 30kW.

12.4. Control of 2 Pumps, Four Speed References and Speed Reference by Keypad (Under-load) as Pressure Group. Without MMC Optional Board

12.4.1. Parameters Configuration

Parameter	Description	Display	Value
DRV-00	Pressure reference REF1	0.00	40.00% (20Hz) (Pressure reference , 20Hz x 2 =40% transducer range)
DRV-00R	Reference and feedback values of PID	R 0.0% F 0.0%	R = Displaying of the reference value in % F = Displaying of the feedback value in % of sensor range.
DRV-01	Acceleration time	Acc. Time	40.0sec
DRV-02	Deceleration time	Dec. Time	40.0sec
DRV-03	Start / Stop control mode	Drive mode	**Keypad:** Start / Stop by keypad. **Fx/Rx-1:** Start / Stop by terminals. **Int. 485:** Start / Stop through communication bus.
DRV-04	Frequency control mode	Freq mode	**Keypad – 1, keypad – 2:** Frequency setting by keypad.
DRV-05	Pressure reference 1	Refer Perc-1	60.00% (Reference 1 – 30.00Hz)
DRV-06	Pressure reference 2	Refer Perc-2	70.00% (Reference 2 – 35.00Hz)
DRV-07	Pressure reference 3	Refer Perc-3	80.00% (Reference 3 – 40.00Hz)
FU1-23	Stop mode	Stop mode	**Decel:** Deceleration controlled by parameter DRV-02. **DC brake:** Inverter will stop by a DC current injection. **Free run:** Deceleration not controlled. Stop by inertia. **Fluxe brake:** Fast stop using the energy regenerated to heat into the motor. (CAUTION WITH THIS OPTION).
FU1-29	Line frequency	Line Freq	50.00Hz – Frequency of the commercial line voltage.
FU1-30	Maximum frequency	Max Freq	50Hz – Maximum speed of the equipment.
FU1-31	Base frequency	Base Freq	50Hz – At this frequency, the inverter supplies the rated output voltage. Set this frequency according to the motor nameplate.
FU1-32	Start frequency	Start Freq	0,5Hz – Minimum speed at the starting.
FU1-49	Input voltage setting	VAC 400.4V – 91.0%	Setting of the commercial line voltage.
FU1-50	Motor rated voltage	Motor Volt	400V – Setting of the motor rated voltage.
FU1-60	Electronic thermal protection	ETH select	**Yes:** In this case, FU1-61 and FU1-62 are available.
FU1-61	Electronic thermal protection level for 1 minute	ETH 1min	150%
FU1-62	Electronic thermal protection level for continuous	ETH cont	105%
FU1-81	Delay time at the starting	Run Delay T	0.0sec – Delay time at the starting (optional).
FU1-85	Underload trip selection	ULT select	Yes
FU1-86	Underload level	ULT level	65% (Motor current at the frequency set in FU1-87).
FU1-87	Underload frequency	ULT freq	48.00Hz (Frequency for activating underload protection).
FU1-88	Underload time	ULT time	60.0sec
FU2-20	Restart after power supply fault	Power-on run	**Yes:** Inverter will restart after losing power supply and recovering it again.
FU2-21	Restart after fault reset	RST restart	**No:** Inverter will not restart after occuring a fault and resetting it. **Yes:** Inverter will restart after occuring a fault and resetting it.
FU2-22	Speed search function	Speed Search	0100: Speed search activated after an instant power supply fault.
FU2-40	Motor power setting	Motor select	3,7kW 5,5kW 7,5kW 11kW 15kW 18,5kW 22kW 30kW 37kW 45kW 55kW 75kW
FU2-41	Number of motor poles	Pole number	2 poles ≡ 3000 rpm 4 poles ≡ 1500 rpm 6 poles ≡ 750 rpm
FU2-43	Motor rated current	Rated-Curr	?A (Set the current according to the motor nameplate).
FU2-44	No load current	Noload-Curr	? A (Calculated based on 55% of In)
FU2-48	Carrier frequency	Carrier freq	3.0 KHz
FU2-67	Torque boost setting	Torque boost	Manual

Parameter	Description	Display	Value
I/O-06	Filter of analogue current input I	I Filter	250ms (Filter of the analogue current input)
I/O-07	Minimum current of I input	I curr x1	4.00mA (Minimum current of I input)
I/O-08	Frequency for minimum current of I	I Freq y1	0Hz (Frequency for the minimum current of I input)
I/O-09	Maximum current of I input	I curr x2	20.00mA (Maximum current of I input)
I/O-10	Frequency for maximum current of I	I Freq y2	50Hz (Frequency for the maximum current of I input)
I/O-20	Configuration of M1 terminal	M1 define	Speed-L (Multi-speed 1)
I/O-21	Configuration of M2 terminal	M2 define	Speed-M (Multi-speed 2)
I/O-22	Configuration of M3 terminal	M3 define	Open-loop (When it is activated, it allows operating at manual speed)
I/O-25	Configuration of M6 terminal	M6 define	Jog frequency (Speed preset by parameter)
I/O-30	Setting of jog frequency	Jog Freq	40.00Hz
I/O-76	Configuration for auxiliary relay	Aux mode1	MMC (Multiple motors control)
I/O-80	Configuration for fault relay	Relay mode	010 (Fault relay)
I/O-86	Selection of displaying units for V1 signal	V1 Unit Sel	**Percentage:** (if the feedback signal is V1). Only thus it will appear the parameter DRV-00R.
I/O-87	Selection of displaying units for I signal	I Unit Sel	**Percentage:** (if the feedback signal is I). Only thus it will appear the parameter DRV-00R.
I/O-88	Selection of displaying units for A0, B0 signal	PulseUnitSel	**Percentage:** (if the feedback signal is A0, B0). Only thus it will appear the parameter DRV-00R.
APP-01	Activation of PID mode	proc PI mode	Yes
APP-02	Activation of pumps control	App. mode	MMC
APP-06	Feedback signal	PID F/B	I (4-20mA input)
APP-10	High freq. limit in PID	PID Limit-H	50.00Hz
APP-11	Low freq. limit in PID	PID Limit-L	20.00Hz
APP-33	Nbr of auxiliary motors	Nbr Aux's	1 (number of auxiliary motors for starting)
APP-40	Sleep delay time	Sleep Delay	20.0sec
APP-41	Sleep frequency 0	Sleep Freq0	39.00Hz (Freq. for activating sleep mode with the speed ref. 0 active)
APP-42	Sleep frequency 1	Sleep Freq1	39.00Hz (Freq. for activating sleep mode with the speed ref. 1 active)
APP-43	Sleep frequency 2	Sleep Freq2	39.00Hz (Freq. for activating sleep mode with the speed ref. 2 active)
APP-44	Sleep frequency 3	Sleep Freq3	39.00Hz (Freq. for activating sleep mode with the speed ref. 3 active)
APP-49	Wake up level	WakeUp level	5.0% (Starting pressure REF – FBK) Example: ref. 1 = 35% and FBK= 30% Starting at 30% because APP-49 = 5%
APP-50	Start frequency of auxiliary motor 1	Start Freq 1	49.80Hz
APP-54	Stop frequency of auxiliary motor 1	Stop Freq 1	43.00 Hz
APP-58	Delay time before connecting aux. motors	Aux start DT	180.0sec
APP-59	Delay time before stopping aux. motors	Aux stop DT	17.0sec
APP-71	Pressure difference for starting aux. motors	Aux STT FB	2%
APP-72	Pressure difference for stopping aux. motors	Aux STP FB	0%

Depending on the status of the input terminals P1and P2, different programmed pressures can be selected:

Programmed pressure	Parameter	Speed-M (M2)	Speed-L (M1)
40.00% - 20.00Hz	DRV-00	0	0
60.00% - 30.00Hz	DRV-05	0	1
70.00% - 35.00Hz	DRV-06	1	0
80.00% - 40.00Hz	DRV-07	1	1

12.4.2. Connections Drawing

Terminals CM / M4 Change to manual speed set in parameter I/O-25 (NO status).
Terminals CM / M1: Terminal 1 (NO status).
Terminals CM / M2: Terminal 2 (NO status).
Terminals CM / M7: Start command.
Terminals A1/C1: Pump 2 start.
Terminals 3A, 3B, 3C: Fault relay.

▪ **Connections for inverters from 3,7kW to 22kW.**

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Figure 12.6 Control of two pumps, four speed references and speed reference by keypad
as pressure group. Inverters with capacities from 3,7 to 22kW

Note: Control cables have to be screened and must be connected to the ground.
5G terminal will be CM terminal for inverters with a capacity equal or higher than 30kW.

▪ **Connections for inverters from 30kW to 75kW.**

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Figure 12.7 Control of two pumps, four speed references and speed reference by keypad
as pressure group. Inverters with capacities from 30 to 75kW

Note: Control cables have to be screened and must be connected to the ground.
5G terminal will be CM terminal for inverters with a capacity equal or higher than 30kW.

12.5. Control of Four Pumps, Four Speed References and Speed Reference by Keypad (Under-load) as Pressure Group

12.5.1. Parameters Configuration

Parameter	Description	Display	Value
DRV-00	Pressure reference REF1	0.00	40.00% (20Hz) (Pressure reference, 20Hz x 2 =40% transducer range.)
DRV-00R	Reference and feedback value of PID	R 0.0% F 0.0%	R = Displaying of the reference value in % F = Displaying of the feedback value in % of sensor range.
DRV-01	Acceleration time	Acc. Time	10.0sec
DRV-02	Deceleration time	Dec. Time	10.0sec
DRV-03	Start / Stop control mode	Drive mode	**Keypad:** Start / Stop by terminals. **Fx/Rx-1:** Start / Stop by terminals. **Int. 485:** Start / Stop through communication bus.
DRV-04	Frequency control mode	Freq mode	**Keypad – 1, Keypad – 2:** Frequency setting by keypad.
DRV-05	Pressure reference 1	Refer Perc-1	60.00% (Reference 1 – 30.00Hz)
DRV-06	Pressure reference 2	Refer Perc-2	70.00% (Reference 2 – 35.00Hz)
DRV-07	Pressure reference 3	Refer Perc-3	80.00% (Reference 3 – 40.00Hz)
FU1-23	Stop mode	Stop mode	**Decel:** Deceleration controlled by parameter DRV-02. **DC brake:** Inverter will stop by a DC current injection. **Free run:** Deceleration not controlled. Stop by inertia. **Fluxe brake:** Fast stop using the energy regenerated to heat into the motor. (CAUTION WITH THIS OPTION).
FU1-29	Line frequency	Line Freq	50.00Hz – Frequency of the commercial line voltage.
FU1-30	Maximum frequency	Max Freq	50Hz – Maximum speed of the equipment.
FU1-31	Base frequency	Base freq	50Hz – At this frequency, the inverter supplies the rated output voltage. Set this frequency according to the motor nameplate.
FU1-32	Start frequency	Start Freq	0.2Hz – Minimum speed at the starting.
FU1-49	Input voltage setting	VAC 400.4V – 91.0%	Setting of the commercial line voltage.
FU1-50	Motor rated voltage	Motor Volt	400V – Setting of the motor rated voltage.
FU1-60	Electronic thermal protection	ETH select	**Yes:** In this case, FU1-61 and FU1-62 are available.
FU1-61	Electronic thermal protection level for 1 minute	ETH 1min	150%
FU1-62	Electronic thermal protection level for continuous	ETH cont	105%
FU1-81	Delay time at the starting	Run Delay T	0.0sec – Delay time at the starting (optional).
FU1-85	Underload trip selection	ULT select	Yes
FU1-86	Underload level	ULT level	60% (Motor current at the frequency set in FU1-87).
FU1-87	Underload frequency	ULT freq	50.00Hz (Frequency for activating underload protection).
FU1-88	Underload time	ULT time	60.0sec
FU2-20	Restart after power supply fault	Power-on run	**No:** Inverter will not restart after losing power supply and recovering it again. **Yes:** Inverter will restart after losing power supply and recovering it again.
FU2-21	Restart after fault reset	RST restart	**No:** Inverter will not restart after occuring a fault and resetting it. **Yes:** Inverter will restart after occuring a fault and resetting it.
FU2-40	Motor power setting	Motor select	3,7kW 5,5kW 7,5kW 11kW 15kW 18,5kW 22kW 30kW 37kW 45kW 55kW 75kW
FU2-41	Number of motor poles	Pole number	2 poles ≡ 3000 rpm 4 poles ≡ 1500 rpm 6 poles ≡ 750 rpm
FU2-43	Motor rated current	Rated-Curr	?A (Set the current according to the motor nameplate).
FU2-48	Carrier frequency	Carrier freq	3.0 KHz
FU2-67	Torque boost setting	Torque boost	Manual

Parameter	Description	Display	Value
I/O-06	Filter of analogue current input I	I Filter	250ms (Filter of the analogue current input)
I/O-07	Minimum current of I input	I curr x1	4.00mA (Minimum current of I input)
I/O-08	Frequency for minimum current of I	I Freq y1	0Hz (Frequency for the minimum current of I input)
I/O-09	Maximum current of I input	I curr x2	20.00mA (Maximum current of I input)
I/O-10	Frequency for maximum current of I	I Freq y2	50Hz (Frequency for the maximum current of I input)
I/O-20	Configuration of M1 terminal	M1 define	Speed-L (Multi-speed 1)
I/O-21	Configuration of M2 terminal	M2 define	Speed-M (Multi-speed 2)
I/O-22	Configuration of M3 terminal	M3 define	Open-loop (When it is activated, it allows operating at manual speed)
I/O-25	Configuration of M6 terminal	M6 define	Jog frequency (Speed preset by parameter)
I/O-30	Jog frequency	Jog Freq	40.00Hz
I/O-76	Config. for aux. relay 1	Aux mode1	Run (Programmable relay is activated when the inverter is running)
I/O-80	Config. for fault relay	Relay mode	010 (Fault relay)
I/O-86	Selection of displaying units for V1 signal	V1 Unit Sel	**Percentage:** (if the feedback signal is V1). Only thus it will appear the parameter DRV-00R.
I/O-87	Selection of displaying units for I signal	I Unit Sel	**Percentage:** (if the feedback signal is I). Only thus it will appear the parameter DRV-00R.
I/O-88	Selection of displaying units for A0, B0 signal	PulseUnitSel	**Percentage:** (if the feedback signal is A0, B0). Only thus it will appear the parameter DRV-00R.
APP-01	Activation of PID mode	proc PI mode	Yes
APP-02	Activ. of pumps control	App. mode	MMC
APP-06	Feedback signal	PID F/B	I (4-20mA input)
APP-10	High freq. limit in PID	PID Limit-H	50.00Hz
APP-11	Low freq. limit in PID	PID Limit-L	20.00Hz
APP-15	Output inversion in PID	PID Out Inv.	Yes or No (depending on the application).
APP-31	Connection order of auxiliary pumps	Starting Aux	1 (The connection will start for the auxiliary motor 1).
APP-33	Nbr of auxiliary motors	Nbr Aux's	4 (number of auxiliary motors for starting)
APP-40	Sleep delay time	Sleep Delay	6.0sec
APP-41	Sleep frequency 0	Sleep freq0	39.00Hz (Freq. for activating sleep mode with the speed ref. 0 active)
APP-42	Sleep frequency 1	Sleep freq1	39.00Hz (Freq. for activating sleep mode with the speed ref. 1 active)
APP-43	Sleep frequency 2	Sleep freq2	39.00Hz (Freq. for activating sleep mode with the speed ref. 2 active)
APP-44	Sleep frequency 3	Sleep freq3	39.00Hz (Freq. for activating sleep mode with the speed ref. 3 active)
APP-49	Wake up level	WakeUp level	5.0% (Starting pressure REF–FBK). Example: ref.1= 35% and FBK= 30% Starting at 30% because APP-49 = 5%
APP-50	Start frequency of auxiliary motor 1	Start Freq 1	49.00Hz
APP-51	Start frequency of auxiliary motor 2	Start Freq 2	49.00Hz
APP-52	Start frequency of auxiliary motor 3	Start Freq 3	49.00Hz
APP-53	Start frequency of auxiliary motor 4	Start Freq 4	49.00Hz
APP-54	Stop frequency of auxiliary motor 1	Stop Freq 1	25.00 Hz
APP-55	Stop frequency of auxiliary motor 2	Stop Freq 2	25.00 Hz
APP-56	Stop frequency of auxiliary motor 3	Stop Freq 3	25.00 Hz
APP-57	Stop frequency of auxiliary motor 4	Stop Freq 4	25.00 Hz
APP-58	Delay time before connecting aux. motors	Aux start DT	20.0sec
APP-59	Delay time before stopping aux. motors	Aux stop DT	5.0sec
APP-71	Pressure difference for starting aux. motors	Aux STT FB	2%
APP-72	Pressure difference for stopping aux. motors	Aux STP FB	0%

Depending on the status of the input terminals M1and M2, different programmed pressures can be selected:

Programmed pressure	Parameter	Speed-M (M2)	Speed-L (M1)
80.00% - 40.00Hz	DRV-00	0	0
60.00% - 30.00Hz	DRV-05	0	1
70.00% - 35.00Hz	DRV-06	1	0
80.00% - 40.00Hz	DRV-07	1	1

12.5.2. Connections Drawing

Terminals CM / JOG: Change to manual speed set in parameter I/O-25 (NO status).
Terminals CM / M1: Terminal 1 (NO status).
Terminals CM / M2: Terminal 2 (NO status).
Terminals CM / M7: Start command.
Terminals A1 / C1: Start command of pump 1.
Terminals A2 / C2: Start command of pump 2.
Terminals A3 / C3: Start command of pump 3.
Terminals A4 / C4: Start command of pump 4.
Terminals 3A, 3C, 3B: Fault relay.

▪ **Connections for inverters from 3,7kW to 22kW.**

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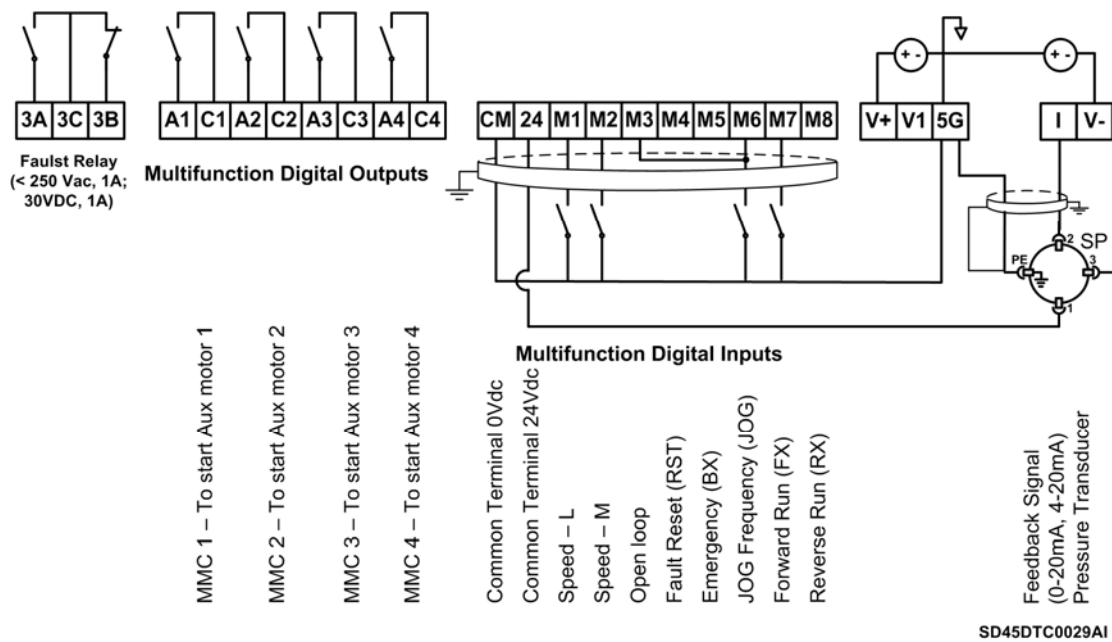
Figure 12.8 Control of four pumps, four speed references and speed reference by keypad as pressure group. Inverters with capacities from 3,7 to 22kW

Note: Control cables have to be screened and must be connected to the ground.
5G terminal will be CM terminal for inverters with a capacity equal or higher than 30kW.

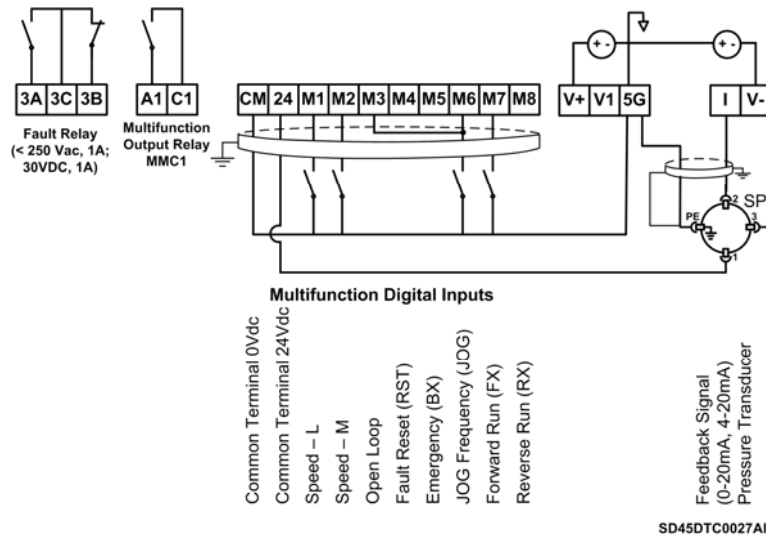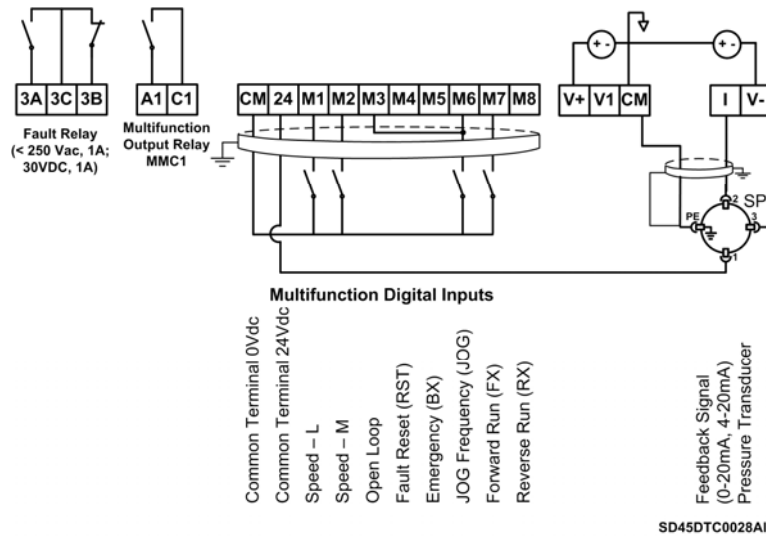▪ **Connections for inverters from 30kW to 75kW.**

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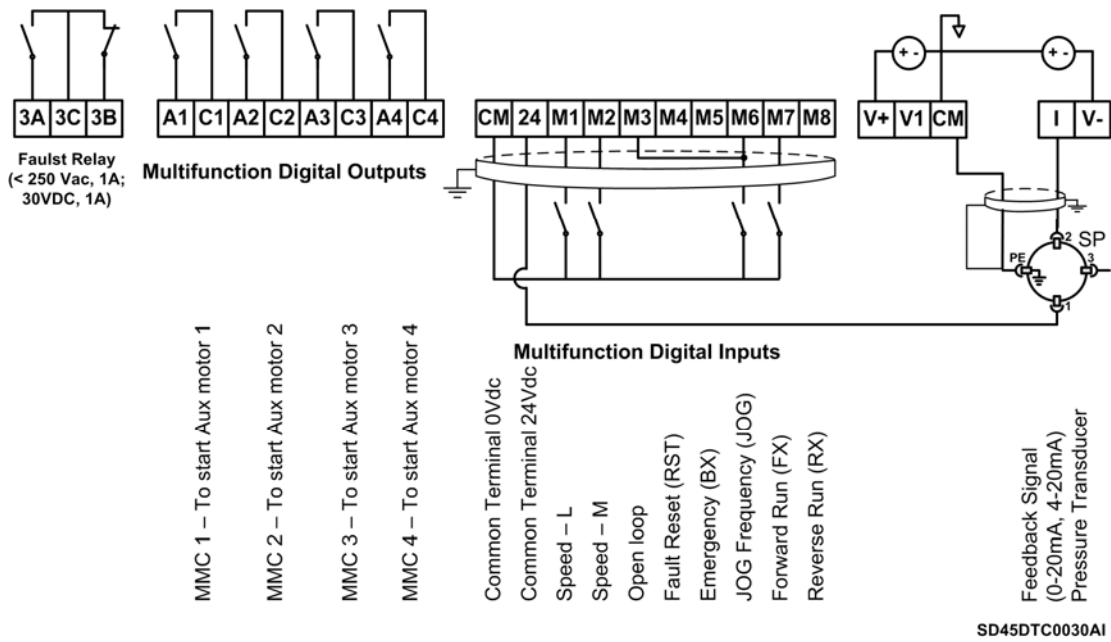
*Figure 12.9 Control of four pumps, four speed references and speed reference by keypad
as pressure group. Inverters with capacities from 30 to 75kW*

Note: Control cables have to be screened and must be connected to the ground.
5G terminal will be CM terminal for inverters with a capacity equal or higher than 30kW.

12.6. Control of Speed by Pushbuttons

12.6.1. Parameters Configuration

Parameter	Description	Display	Value
DRV-00	Reference frequency	0.00	50.00Hz
DRV-01	Acceleration time	Acc. Time	30.0sec (It determines the acceleration ramp of the potentiometer).
DRV-02	Deceleration time	Dec. Time	30.0sec (It determines the deceleration ramp of the potentiometer).
DRV-03	Start / Stop control mode	Drive mode	**Fx/Rx-1:** Start / Stop by terminals.
DRV-04	Frequency control mode	Freq mode	**Keypad – 1:** Frequency setting by keypad.
FU1-29	Line frequency	Line Freq	50.00Hz – Frequency of the commercial line voltage.
FU1-30	Maximum frequency	Max Freq	50Hz – Maximum speed of the equipment.
FU1-31	Base frequency	Base Freq	50Hz – At this frequency, the inverter supplies the rated output voltage. Set this frequency according to the motor nameplate.
FU1-32	Start frequency	Start Freq	0,1Hz – Minimum speed at the starting.
FU1-33	Frequency limits selection	Freq limit	**Yes:** Limits are set in parameters FU1-34 and FU1-35.
FU1-34	Low frequency limit	F-limit Lo	25.00Hz
FU1-35	High frequency limit	F-limit Hi	50.00Hz
FU1-49	Input voltage setting	VAC 400.4V – 91.0%	Setting of the commercial line voltage.
FU1-50	Motor rated voltage	Motor Volt	400V – Setting of the motor rated voltage.
FU1-60	Electronic thermal protection	ETH select	**Yes:** In this case, FU1-61 and FU1-62 available.
FU1-61	Electronic thermal protection level for 1 minute	ETH 1min	150%
FU1-62	Electronic thermal protection level for continuous	ETH cont	105%
FU1-80	Save reference up / down	Up/Dn Save	**Yes:** The reference frequency, introduced by motorized potentiometer, will be memorized by the inverter.
FU1-81	Delay time at the starting	Run Delay T	5.0sec – Delay time at the starting.
FU2-20	Restart after power supply fault	Power-on run	**No:** inverter will not restart after losing power supply and recovering it again. **Yes:** Inverter will restart after losing power supply and recovering it again.
FU2-21	Restart after fault reset	RST restart	**No:** Inverter will not restart after occuring a fault and resetting it. **Yes:** Inverter will restart after occuring a fault and resetting it.
FU2-40	Motor power setting	Motor select	3,7kW 5,5kW 7,5kW 11kW 15kW 18,5kW 22kW 30kW 37kW 45kW 55kW 75kW
FU2-41	Number of motor poles	Pole number	2 poles ≡ 3000 rpm 4 poles ≡ 1500 rpm 6 poles ≡ 750 rpm
FU2-43	Motor rated current	Rated-Curr	?A (Set the current according to the motor nameplate).
FU2-48	Carrier frequency	Carrier freq	2.0 KHz
FU2-67	Torque boost setting	Torque boost	Manual
I/O-20	Configuration of M1 terminal	M1 define	3-Wire (Start / Stop by NC pushbutton)
I/O-21	Configuration of M2 terminal	M2 define	Up (Up speed NO pushbutton)
I/O-22	Configuration of M3 terminal	M3 define	Down (Down speed NO pushbutton)

12.6.2. Connections Drawing

Terminals CM / M7: Start pushbutton (NO status).
Terminals CM / M1: Stop pushbutton (NC status).
Terminals CM / M2: Up speed pushbutton (NO status).
Terminals CM / M3: Down speed pushbutton (NO status).
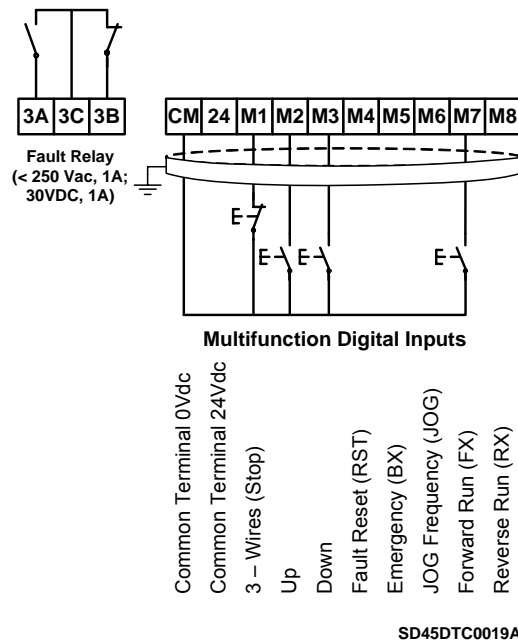
Figure 12.10 Control of speed by pushbuttons

Note: Control cables have to be screened and must be connected to the ground.
5G terminal will be CM terminal for inverters with a capacity equal or higher than 30kW.

Start command will be executed through a NO pushbutton between CM and M7 terminals. Stop command will be executed through a NC pushbutton between CM and M1 terminals. When the start command M7 is executed (CM common) the inverter will start holding the speed at 0.00Hz. When we press M2 pushbutton the speed will be increased up to minimum speed FU1-34, and if we follow pressing M2, the speed will follow being increased according to the acceleration ramp DRV-01. When we stop, the reference speed will be held if we activate the parameter FU1-80 (reference memorization).

12.7. Control of Four Pumps in Alternation mode and Four Speed References

12.7.1. Parameters Configuration

Parameter	Description	Display	Value
DRV-00	Pressure reference REF1	0.00	37.00% (18.50Hz) (Pressure reference, 18.50Hz x 2 =37.00% transducer range)
DRV-00R	Reference and feedback values of PID	R 37.0% F 0.0%	R = Displaying of the reference value in % F = Displaying of the feedback value in % of sensor range.
DRV-01	Acceleration time	Acc. Time	40.0sec
DRV-02	Deceleration time	Dec. Time	40.0sec
DRV-03	Start / Stop control mode	Drive mode	**Fx/Rx-1:** Start / Stop by terminals.
DRV-04	Frequency control mode	Freq mode	**Keypad – 1:** Frequency setting by keypad.
DRV-05	Pressure reference 1	Refer Porc-1	30.00% (Reference 1 – 15.00Hz)
DRV-06	Pressure reference 2	Refer Porc-2	40.00% (Reference 2 – 20.00Hz)
DRV-07	Pressure reference 3	Refer Porc-3	50.00% (Reference 3 – 25.00Hz)
FU1-29	Line frequency	Line Freq	50.00Hz – Frequency of the commercial line voltage.
FU1-30	Maximum frequency	Max Freq	50Hz – Maximum speed of the equipment.
FU1-31	Base frequency	Base Freq	50Hz – At this frequency, the inverter supplies the rated output voltage. Set this frequency according to the motor nameplate.
FU1-32	Start frequency	Start Freq	0.2Hz – Minimum speed at the starting.
FU1-49	Input voltage setting	VAC 400.4V – 91.0%	Setting of the commercial line voltage.
FU1-50	Motor rated voltage	Motor Volt	400V – Setting of the motor rated voltage.
FU1-60	Electronic thermal protection	ETH select	**Yes:** In this case, FU1-61 and FU1-62 are available.
FU1-61	Electronic thermal protection level for 1 minute	ETH 1min	150%
FU1-62	Electronic thermal protection level for continuous	ETH cont	105%
FU1-81	Delay time at the starting	Run Delay T	0.0sec – Delay time at the starting (optional).
FU2-20	Restart after power supply fault	Power-on run	**No:** Inverter will not restart after losing power supply and recovering it again. **Yes:** Inverter will restart after losing power supply and recovering it again.
FU2-21	Restart after fault reset	RST restart	**No:** Inverter will not restart after occuring a fault and resetting it. **Yes:** Inverter will restart after occuring a fault and resetting it.
FU2-40	Motor power setting	Motor select	3,7kW 5,5kW 7,5kW 11kW 15kW 18,5kW 22kW 30kW 37kW 45kW 55kW 75kW
FU2-41	Number of motor poles	Pole number	2 poles ≡ 3000 rpm 4 poles ≡ 1500 rpm 6 poles ≡ 750 rpm
FU2-43	Motor rated current	Rated-Curr	?A (Set the current according to the motor nameplate).
FU2-48	Carrier frequency	Carrier freq	3.0 KHz
FU2-67	Torque boost setting	Torque boost	Manual
I/O-06	Filter of analogue current input I	I Filter	250ms (Filter of the analogue current input)
I/O-07	Minimum current of I input	I curr x1	4.00mA (Minimum current of I input)
I/O-08	Frequency for minimum current of I	I Freq y1	0Hz (Frequency for the minimum current of I input)
I/O-09	Maximum current of I input	I curr x2	20.00mA (Maximum current of I input)
I/O-10	Frequency for maximum current of I	I Freq y2	50Hz (Frequency for the maximum current of I input)
I/O-20	Configuration of M1 terminal	M1 define	Interlock1 (Closed contact for out of service of auxiliary motor 1)
I/O-21	Configuration of M2 terminal	M2 define	Interlock2 (Closed contact for out of service of auxiliary motor 2)
I/O-22	Configuration of M3 terminal	M3 define	Interlock3 (Closed contact for out of service of auxiliary motor 3)

Parameter	Description	Display	Value
I/O-23	Configuration of M4 terminal	M4 define	Interlock4 (Closed contact for out of service of auxiliary motor 4)
I/O-24	Configuration of M5 terminal	M5 define	Speed-L (Multi-speed 1)
I/O-25	Configuration of M6 terminal	M6 define	Speed-M (Multi-speed 2)
I/O-76	Configuration for auxiliary relay 1	Aux mode1	MMC (Programmable relay for activating auxiliary motor 1)
I/O-77	Configuration for auxiliary relay 2	Aux mode2	MMC (Programmable relay for activating auxiliary motor 2)
I/O-78	Configuration for auxiliary relay 3	Aux mode3	MMC (Programmable relay for activating auxiliary motor 3)
I/O-79	Configuration for auxiliary relay 4	Aux mode4	MMC (Programmable relay for activating auxiliary motor 4)
I/O-80	Config. for fault relay	Relay mode	010 (Fault relay)
I/O-86	Selection of displaying units for V1 signal	V1 Unit Sel	**Percentage:** (If the feedback signal is V1). Only thus it will appear the parameter DRV-00R.
I/O-87	Selection of displaying units for I signal	I Unit Sel	**Percentage:** (If the feedback signal is I). Only thus it will appear the parameter DRV-00R.
I/O-88	Selection of displaying units for A0, B0 signal	PulseUnitSel	**Percentage:** (if the feedback signal is A0, B0). Only thus it will appear the parameter DRV-00R.
APP-01	Activation of PID mode	proc PI mode	Yes
APP-02	Activ. of pumps control	App. Mode	MMC
APP-06	Feedback signal	PID F/B	I (4-20mA input)
APP-07	Proportional gain in PID mode	PID P-Gain	100.0%
APP-08	Integral gain in PID mode	PID I-Time	0.5sec
APP-10	High freq. limit in PID	PID Limit-H	50.00Hz
APP-11	Low freq. limit in PID	PID Limit-L	20.00Hz
APP-15	Output inversion in PID	PID Out Inv.	No
APP-31	Connection order of auxiliary pumps	Starting aux	1 (The connection will start for the auxiliary motor 1).
APP-33	Nbr of auxiliary motors	Nbr Aux's	4 (number of auxiliary motors for starting)
APP-40	Sleep delay time	Sleep Delay	6.0sec
APP-41	Sleep frequency 0	Sleep Freq0	39.00Hz (Freq. for activating sleep mode with the speed ref. 0 active)
APP-42	Sleep frequency 1	Sleep Freq1	39.00Hz (Freq. for activating sleep mode with the speed ref. 1 active)
APP-43	Sleep frequency 2	Sleep Freq2	39.00Hz (Freq. for activating sleep mode with the speed ref. 2 active)
APP-44	Sleep frequency 3	Sleep Freq3	39.00Hz (Freq. for activating sleep mode with the speed ref. 3 active)
APP-49	Wake up level	WakeUp level	5.0% (Starting pressure REF–FBK). Example: ref.1= 35% and FBK= 30% Starting at 30% because APP-49 = 5%
APP-50	Start frequency of auxiliary motor 1	Start Freq 1	49.00Hz
APP-51	Start frequency of auxiliary motor 2	Start Freq 2	49.00Hz
APP-52	Start frequency of auxiliary motor 3	Start Freq 3	49.00Hz
APP-53	Start frequency of auxiliary motor 4	Start Freq 4	49.00Hz
APP-54	Stop frequency of auxiliary motor 1	Stop Freq 1	35.00 Hz
APP-55	Stop frequency of auxiliary motor 2	Stop Freq 2	35.00 Hz
APP-56	Stop frequency for auxiliary motor 3	Stop Freq 3	35.00 Hz
APP-57	Stop frequency for auxiliary motor 4	Stop Freq 4	35.00 Hz
APP-58	Delay time before connecting aux. motors	Aux start DT	180.0sec
APP-59	Delay time before stopping aux. motors	Aux stop DT	17.0sec
APP-60	Accel. time for the ramp of auxiliary motors	AUX AccTime	2.0 sec
APP-61	Dec. time for the ramp of auxiliary motors	AUX DecTime	2.0 sec
APP-66	Rotation mode (auto change) of aux. motors	AutoCh_Mode	**2:** Inverter rotates for all of the motors.
APP-67	Time for auto change	AutoEx-intv	**00:01:** Inverter will rotate if more than 1 minute has elapsed operating with the same motor.

Parameter	Description	Display	Value
APP-69	Detection of motors out of service	Inter-lock	**Yes:** Inverter will detect the motors that are out of service, and it will not consider them at the moment of connecting them until they are repaired.
APP-71	Pressure difference for starting aux. motors	Aux STT FB	2%
APP-72	Pressure difference for stopping aux. motors	Aux STP FB	0%

Depending on the status of the input terminals M5 and M6, different programmed pressures can be selected:

Programmed pressure	Parameter	Speed-M (M5)	Speed-L (M6)
37.00% - 18.50Hz	DRV-00	0	0
30.00% - 15.00Hz	DRV-07	0	1
40.00% - 20.00Hz	DRV-08	1	0
50.00% - 25.00Hz	DRV-09	1	1

12.7.2. Connections Drawing

Terminals CM / M7: Start command (NO status).
Terminals CM / M1: Thermal switch of Pump 1 (NC status).
Terminals CM / M2: Thermal switch of Pump 2 (NC status).
Terminals CM / M3: Thermal switch of Pump 3 (NC status).
Terminals CM / M4: Thermal switch of Pump 4 (NC status).
Terminals CM / M5: Selection of pressure reference (NO status).
Terminals CM / M6: Selection of pressure reference (NO status).
Terminals A1 / C1 (Aux Relay 1): Command of Contactor of Pump 1.
Terminals A2 / C2 (Aux Relay 2): Command of Contactor of Pump 2.
Terminals A3 / C3 (Aux Relay 3): Command of Contactor of Pump 3.
Terminals A4 / C4 (Aux Relay 4): Command of Contactor of Pump 4.

▪ **Connections for inverters from 3,7kW to 22kW.**
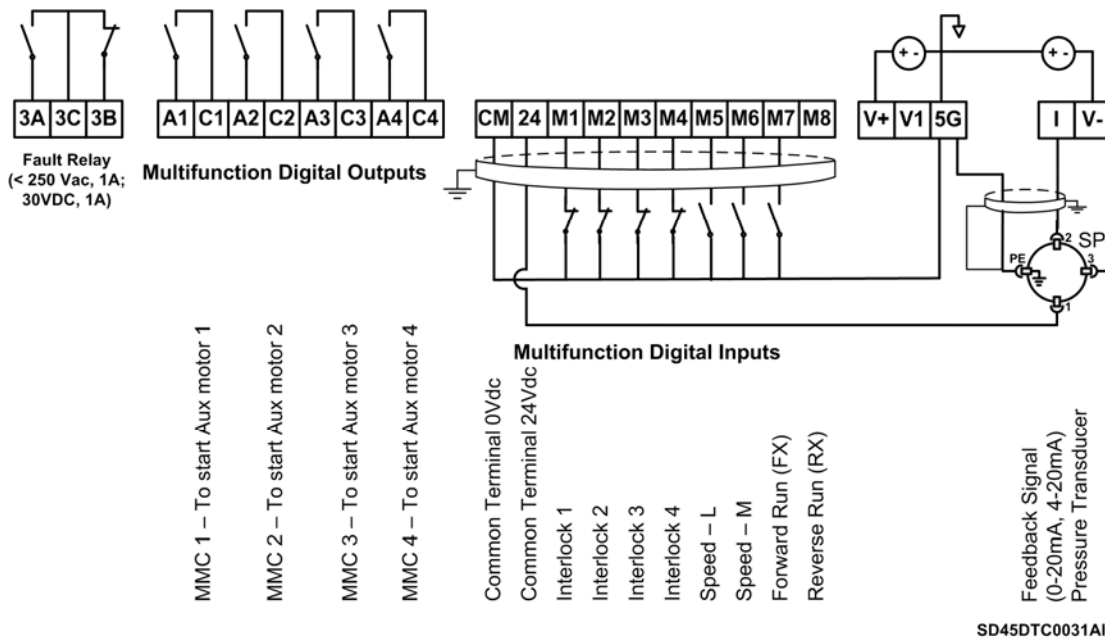
SD45DTC0031AI

Figure 12.11 Control of four pumps in alternation mode and four speed references.
Inverters with capacities from 3,7 to 22kW

Note: Control cables have to be screened and must be connected to the ground.
5G terminal will be CM terminal for inverters with a capacity equal or higher than 30kW.

▪ **Connections for inverters from 30kW to 75kW.**
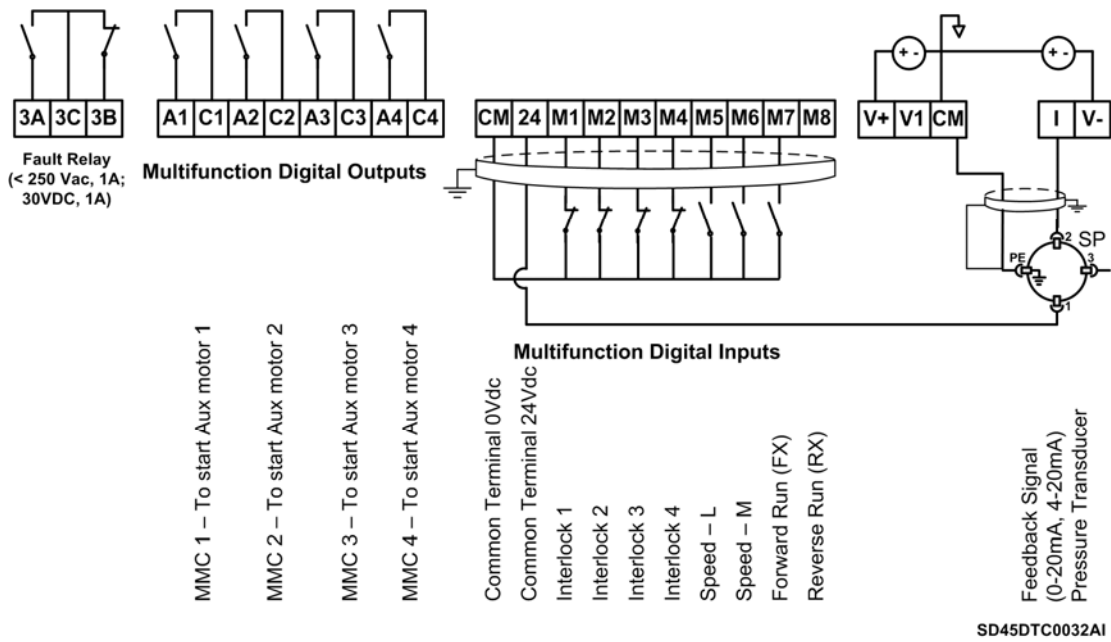
Figure 12.12 Control of four pumps in alternation mode and four speed references.
Inverters with capacities from 30 to 75kW

Note: Control cables have to be screened and must be connected to the ground.
5G terminal will be CM terminal for inverters with a capacity equal or higher than 30kW.

13. CONFIGURATION REGISTER

VARIABLE SPEED DRIVE: SD450.
SERIAL No: MODEL:
APPLICATION:
DATE:
CUSTOMER:
NOTES:

PARAMETERS	FACTORY SETTINGS	SETTING 1	SETTING 2
DRV GROUP: Basic functions and display parameters			
DRV-00 ► Cmd.Freq	0.00Hz	_____	_____
DRV-00 ► R 0.0%F 0.0%	0.0%	_____	_____
DRV-01 ► Acc. Time	20.0sec	_____	_____
DRV-02 ► Dec. Time	30.0sec	_____	_____
DRV-03 ► Drive mode	Fx/Rx-1	_____	_____
DRV-04 ► Freq mode	Keypad-1	_____	_____
DRV-05 ► Step Freq-1	10.00 Hz	_____	_____
DRV-06 ► Step Freq-2	20.00 Hz	_____	_____
DRV-07 ► Step Freq-3	30.00 Hz	_____	_____
DRV-08 ► Current	0.0 A	_____	_____
DRV-09 ► Speed	0rpm	_____	_____
DRV-10 ► DC link Vtg	----- V	_____	_____
DRV-11 ► User disp	Out 0.0 V	_____	_____
DRV-12 ► Fault	None	_____	_____
DRV-14 ► TAR / OUT	0.00Hz / 0.00Hz	_____	_____
DRV-15 ► REF / FBK	00.00% / 00.00%	_____	_____
DRV-16 ► Hz/Rpm Disp	Hz	_____	_____
DRV-18 R 0.0Hz T 0.0Hz F 0.0Hz O 0.0Hz	-	_____	_____
DRV-19 V1 0 V2 0 V1S 0 I 0	-	_____	_____
DRV-20 R 0.00% O 0.0% F 0.00% DRV-20	-	_____	_____
DRV-91 ► Drive mode2	Fx/Rx-1	_____	_____
DRV-92 ► Freq mode2	Keypad-1	_____	_____

PARAMETERS	FACTORY SETTINGS	SETTING 1	SETTING 2
FU1 GROUP: Functions 1			
FU1-00 ► **Jump code**	1	_____	_____
FU1-01 ► **Run Prev.**	None	_____	_____
FU1-02 ► **Acc. pattern**	Linear	_____	_____
FU1-03 ► **Dec. pattern**	Linear	_____	_____
FU1-04 ► **Start Curve**	50%	_____	_____
FU1-05 ► **End Curve**	50%	_____	_____
FU1-10 ► **Pre-Heat Mode**	No	_____	_____
FU1-11 ► **PreHeat Level**	30%	_____	_____
FU1-12 ► **PreHeat Perc**	100%	_____	_____
FU1-20 ► **Start mode**	Accel	_____	_____
FU1-21 ► **DC St time**	0.0sec	_____	_____
FU1-22 ► **DC St value**	50%	_____	_____
FU1-23 ► **Stop mode**	Decel	_____	_____
FU1-24 ► **DC Blk time**	0.10sec	_____	_____
FU1-25 ► **DC Br Frq**	5.00Hz	_____	_____
FU1-26 ► **DC Br time**	1.0sec	_____	_____
FU1-27 ► **DC Br value**	50%	_____	_____
FU1-28 ► **Safety Stop**	No	_____	_____
FU1-29 ► **Line Freq**	50.00Hz	_____	_____
FU1-30 ► **Max Freq**	50.00Hz	_____	_____
FU1-31 ► **Base Freq**	50.00Hz	_____	_____
FU1-32 ► **Start Freq**	0.50Hz	_____	_____
FU1-33 ► **Freq limit**	No	_____	_____
FU1-34 ► **F-limit Lo**	0.50Hz	_____	_____
FU1-35 ► **F-limit-Hi**	50.00Hz	_____	_____
FU1-40 ► **V/F pattern**	Linear	_____	_____
FU1-41 ► **User Freq 1**	15.00Hz	_____	_____
FU1-42 ► **User Volt 1**	25%	_____	_____
FU1-43 ► **User Freq 2**	30.00Hz	_____	_____
FU1-44 ► **User Volt 2**	50%	_____	_____
FU1-45 ► **User Freq 3**	45.00Hz	_____	_____
FU1-46 ► **User Volt 3**	75%	_____	_____
FU1-47 ► **User Freq 4**	50.00Hz	_____	_____
FU1-48 ► **User Volt 4**	100%	_____	_____
FU1-49 ► **VAC 400.4V**	91.0%	_____	_____
FU1-50 ► **Motor Volt**	400V	_____	_____
FU1-51 ► **Energy save**	None	_____	_____

PARAMETERS	FACTORY SETTINGS	SETTING 1	SETTING 2
FU1-52 ► Manual save %	0%	_____	_____
FU1-54 ► KiloWattHour	0M 0.0kW	_____	_____
FU1-55 ► Inv. Temp.	25	_____	_____
FU1-56 ► Motor Temp.	0	_____	_____
FU1-60 ► ETH select	Yes	_____	_____
FU1-61 ► ETH 1min	150%	_____	_____
FU1-62 ► ETH cont	105%	_____	_____
FU1-63 ► Motor type	Self-cool	_____	_____
FU1-64 ► OL level	110%	_____	_____
FU1-65 ► OL time	10.0sec	_____	_____
FU1-66 ► OLT select	Yes	_____	_____
FU1-67 ► OLT level	120%	_____	_____
FU1-68 ► OLT time	60.0sec	_____	_____
FU1-69 ► Trip select	100	_____	_____
FU1-70 ► Stall prev.	000	_____	_____
FU1-71 ► Stall level	100%	_____	_____
FU1-72 ► Acc/Dec ch F	0.00Hz	_____	_____
FU1-73 ► Acc/Dec Freq	Max	_____	_____
FU1-74 ► Time scale	0.1sec	_____	_____
FU1-80 ► Up/Dn Save	No	_____	_____
FU1-81 ► Run Delay T	0.0sec	_____	_____
FU1-85 ► ULT select	No	_____	_____
FU1-86 ► ULT level	30%	_____	_____
FU1-87 ► ULT Freq	15.00Hz	_____	_____
FU1-88 ► ULT time	0.0sec	_____	_____
FU1-90 ► STOP Inertia	8	_____	_____
FU2 GROUP: Functions 2			
FU2-00 ► Jump code	1	_____	_____
FU2-01 ► Last trip-1	None	_____	_____
FU2-02 ► Last trip-2	None	_____	_____
FU2-03 ► Last trip-3	None	_____	_____
FU2-04 ► Last trip-4	None	_____	_____
FU2-05 ► Last trip-5	None	_____	_____
FU2-06 ► Erase trips	No	_____	_____
FU2-07 ► Dwell time	0.0sec	_____	_____
FU2-08 ► Dwell Freq	5.00Hz	_____	_____
FU2-10 ► Jump Freq	No	_____	_____
FU2-11 ► jump Lo 1	10.00Hz	_____	_____

PARAMETERS	FACTORY SETTINGS	SETTING 1	SETTING 2
FU2-12 ► jump Hi 1	15.00Hz	_____	_____
FU2-13 ► jump Lo 2	20.00Hz	_____	_____
FU2-14 ► jump Hi 2	25.00Hz	_____	_____
FU2-15 ► jump Lo 3	30.00Hz	_____	_____
FU2-16 ► jump Hi 3	35.00Hz	_____	_____
FU2-20 ► Power-on run	No	_____	_____
FU2-21 ► RST restart	No	_____	_____
FU2-22 ► Speed Search	0000	_____	_____
FU2-23 ► SS P-Gain	200	_____	_____
FU2-24 ► SS I-Gain	500	_____	_____
FU2-25 ► Retry number	0	_____	_____
FU2-26 ► Retry delay	1.0sec	_____	_____
FU2-40 ► Motor select	__._kW	_____	_____
FU2-41 ► Pole number	4	_____	_____
FU2-42 ► Rated-Slip	_.__Hz	_____	_____
FU2-43 ► Rated-Curr	__._A	_____	_____
FU2-44 ► Noload-Curr	__._A	_____	_____
FU2-45 ► Efficiency	__%	_____	_____
FU2-46 ► Inertia rate	0	_____	_____
FU2-47 ► RPM factor	100%	_____	_____
FU2-48 ► Carrier freq	_._kHz	_____	_____
FU2-49 ► PWM Select	Normal1	_____	_____
FU2-60 ► Control mode	V/F	_____	_____
FU2-61 ► Auto Tuning	No	_____	_____
FU2-62 ► Rs	_.___ohm	_____	_____
FU2-63 ► Lsigma	_.__mH	_____	_____
FU2-64 ► PreEx Time	1.0sec	_____	_____
FU2-65 ► SL P-Gain	1000	_____	_____
FU2-66 ► SL I-Gain	100	_____	_____
FU2-67 ► Torque boost	Manual	_____	_____
FU2-68 ► Fwd boost	2.0%	_____	_____
FU2-69 ► Rev boost	2.0%	_____	_____
FU2-80 ► PowerOndisp	0	_____	_____
FU2-81 ► User disp	Volts	_____	_____
FU2-82 ► S/W PE x.x	S/W PE x.x Ver y.y	_____	_____
FU2-83 ► LastTripTime	0:00:00:00:00	_____	_____
FU2-84 ► On-Time	0:00:00:00:00	_____	_____
FU2-85 ► Run-time	0:00:00:00:00	_____	_____

PARAMETERS	FACTORY SETTINGS	SETTING 1	SETTING 2
FU2-87 ► **Power Set**	100.0%	_____	_____
FU2-90 ► **Para. disp**	Default	_____	_____
FU2-91 ► **Para. read**	No	_____	_____
FU2-92 ► **Para. write**	No	_____	_____
FU2-93 ► **Para. init**	No	_____	_____
FU2-94 ► **Para. lock**	0	_____	_____
FU2-95 ► **Para. save**	No	_____	_____
I/O GROUP: Inputs and Outputs			
I/O-00 ► **Jump code**	1	_____	_____
I/O-01 ► **V1 Filter**	250ms	_____	_____
I/O-02 ► **V1 volt x1**	0.00V	_____	_____
I/O-03 ► **V1 Freq y1**	0.00Hz	_____	_____
I/O-04 ► **V1 volt x2**	10.00V	_____	_____
I/O-05 ► **V1 Freq y2**	50.00Hz	_____	_____
I/O-06 ► **I Filter**	250ms	_____	_____
I/O-07 ► **I curr x1**	4.00mA	_____	_____
I/O-08 ► **I Freq y1**	0.00Hz	_____	_____
I/O-09 ► **I curr x2**	20.00mA	_____	_____
I/O-10 ► **I Freq y2**	50.00Hz	_____	_____
I/O-11 ► **P pulse set**	(A)	_____	_____
I/O-12 ► **P Filter**	10ms	_____	_____
I/O-13 ► **P pulse x1**	0.0kHz	_____	_____
I/O-14 ► **P Freq y1**	0.00Hz	_____	_____
I/O-15 ► **P pulse x2**	10.0kHz	_____	_____
I/O-16 ► **P Freq y2**	50.00Hz	_____	_____
I/O-17 ► **Wire broken**	None	_____	_____
I/O-18 ► **Lostcommand**	None	_____	_____
I/O-19 ► **Time out**	1.0sec	_____	_____
I/O-20 ► **M1 define**	Speed-L	_____	_____
I/O-21 ► **M2 define**	Speed-M	_____	_____
I/O-22 ► **M3 define**	Speed-H	_____	_____
I/O-23 ► **M4 define**	RST	_____	_____
I/O-24 ► **M5 define**	BX	_____	_____
I/O-25 ► **M6 define**	JOG	_____	_____
I/O-26 ► **M7 define**	FX	_____	_____
I/O-27 ► **M8 define**	RX	_____	_____
I/O-28 ► **In status**	00000000000	_____	_____
I/O-29 ► **Ti Filt Num**	15ms	_____	_____

PARAMETERS	FACTORY SETTINGS	SETTING 1	SETTING 2
I/O-30 ► Jog Freq	10.00Hz	_____	_____
I/O-31 ► Step Freq-4	40.00Hz	_____	_____
I/O-32 ► Step Freq-5	50.00Hz	_____	_____
I/O-33 ► Step Freq-6	40.00Hz	_____	_____
I/O-34 ► Step Freq-7	30.00Hz	_____	_____
I/O-35 ► Step Freq-8	20.00Hz	_____	_____
I/O-36 ► Step Freq-9	10.00Hz	_____	_____
I/O-37 ► Step Freq-10	20.00Hz	_____	_____
I/O-38 ► Step Freq-11	30.00Hz	_____	_____
I/O-39 ► Step Freq-12	40.00Hz	_____	_____
I/O-40 ► Step Freq-13	50.00Hz	_____	_____
I/O-41 ► Step Freq-14	40.00Hz	_____	_____
I/O-42 ► Step Freq-15	30.00Hz	_____	_____
I/O-50 ► Acc time-1	20.0sec	_____	_____
I/O-51 ► Dec time-1	20.0sec	_____	_____
I/O-52 ► Acc time-2	30.0sec	_____	_____
I/O-53 ► Dec time-2	30.0sec	_____	_____
I/O-54 ► Acc time-3	40.0sec	_____	_____
I/O-55 ► Dec time-3	40.0sec	_____	_____
I/O-56 ► Acc time-4	50.0sec	_____	_____
I/O-57 ► Dec time-4	50.0sec	_____	_____
I/O-58 ► Acc time-5	40.0sec	_____	_____
I/O-59 ► Dec time-5	40.0sec	_____	_____
I/O-60 ► Acc time-6	30.0sec	_____	_____
I/O-61 ► Dec time-6	30.0sec	_____	_____
I/O-62 ► Acc time-7	20.0sec	_____	_____
I/O-63 ► Dec time-7	20.0sec	_____	_____
I/O-68 ► S0 Level	0.0%	_____	_____
I/O-69 ► S1 Level	0.0%	_____	_____
I/O-70 ► S0 mode	Frequency	_____	_____
I/O-71 ► S0 adjust	100%	_____	_____
I/O-72 ► S1 mode	Voltage	_____	_____
I/O-73 ► S1 adjust	100%	_____	_____
I/O-74 ► FDT Freq	30.00Hz	_____	_____
I/O-75 ► FDT band	10.00Hz	_____	_____
I/O-76 ► Aux mode1	None	_____	_____
I/O-77 ► Aux mode2	None	_____	_____
I/O-78 ► Aux mode3	None	_____	_____

PARAMETERS	FACTORY SETTINGS	SETTING 1	SETTING 2
I/O-79 ► **Aux mode4**	None	_____	_____
I/O-80 ► **Relay mode**	010	_____	_____
I/O-81 ► **Out status**	00000000	_____	_____
I/O-82 ► **Relay On**	0.0sec	_____	_____
I/O-83 ► **Relay Off**	0.0sec	_____	_____
I/O-84 ► **Fan Con.Sel**	PowerOn Fan	_____	_____
I/O-85 ► **Fan Temp**	70	_____	_____
I/O-86 ► **V1 Unit Sel**	Speed	_____	_____
I/O-87 ► **I Unit Sel**	Speed	_____	_____
I/O-88 ► **PulseUnitSel**	Speed	_____	_____
I/O-90 ► **Inv No.**	1	_____	_____
I/O-91 ► **Baud rate**	9600bps	_____	_____
I/O-92 ► **COM Lost Cmd**	None	_____	_____
I/O-93 ► **COM Time Out**	1.0sec	_____	_____
I/O-94 ► **Delay time**	5ms	_____	_____
I/O-95 ► **In NO/NC Set**	00000000000	_____	_____
I/O-96 ► **In Check Time**	1ms	_____	_____
I/O-97 ► **OH Trip Sel**	010	_____	_____
I/O-98 ► **MotTripTemp**	110	_____	_____
APP GROUP: Applications			
APP-00 ► **Jump code**	1	_____	_____
APP-01 ► **proc PI mode**	No	_____	_____
APP-02 ► **App. mode**	None	_____	_____
APP-04 ► **AuxRefMode**	No	_____	_____
APP-05 ► **Aux Ref Sel**	V1	_____	_____
APP-06 ► **PID F/B**	I	_____	_____
APP-07 ► **PID P-Gain**	100.0%	_____	_____
APP-08 ► **PID I-Time**	0.5sec	_____	_____
APP-09 ► **PID D-Time**	0.0ms	_____	_____
APP-10 ► **PID Limit-H**	50.00Hz	_____	_____
APP-11 ► **PID Limit-L**	0.50Hz	_____	_____
APP-12 ► **PID OutScale**	100.0%	_____	_____
APP-13 ► **PID P2-Gain**	100.0%	_____	_____
APP-14► **P-gain Scale**	100.0%	_____	_____
APP-15 ► **PID Out Inv.**	No	_____	_____
APP-17 ► **PID U Fbk**	No	_____	_____
APP-18 ► **FB Filter**	10ms	_____	_____
APP-20 ► **2nd Acc time**	5.0sec	_____	_____

PARAMETERS	FACTORY SETTINGS	SETTING 1	SETTING 2
APP-21 ► **2nd Dec time**	10.0sec	_____	_____
APP-22 ► **2ndBaseFreq**	50.00Hz	_____	_____
APP-23 ► **2 nd V/F**	Linear	_____	_____
APP-24 ► **2nd F-boost**	2.0%	_____	_____
APP-25 ► **2nd R-boost**	2.0%	_____	_____
APP-26 ► **2nd Stall**	100%	_____	_____
APP-27 ► **2ndETH1min**	130%	_____	_____
APP-28 ► **2ndETH cont**	120%	_____	_____
APP-29 ► **2nd R-Curr**	_._A	_____	_____
APP-30 ► **Aux Mot Run**	0	_____	_____
APP-31 ► **Starting Aux**	1	_____	_____
APP-32 ► **AutoOp Time**	00:00	_____	_____
APP-33 ► **Nbr Aux's**	4	_____	_____
APP-40 ► **Sleep Delay**	60.0sec	_____	_____
APP-41 ► **Sleep Freq0**	0.00Hz	_____	_____
APP-42 ► **Sleep Freq1**	0.00Hz	_____	_____
APP-43 ► **Sleep Freq2**	0.00Hz	_____	_____
APP-44 ► **Sleep Freq3**	0.00Hz	_____	_____
APP-45 ► **Sleep Freq4**	0.00Hz	_____	_____
APP-46 ► **Sleep Freq5**	0.00Hz	_____	_____
APP-47 ► **Sleep Freq6**	0.00Hz	_____	_____
APP-48 ► **Sleep Freq7**	0.00Hz	_____	_____
APP-49 ► **WakeUp level**	2.0%	_____	_____
APP-50 ► **Start Freq 1**	49.50Hz	_____	_____
APP-51 ► **Start Freq 2**	49.50Hz	_____	_____
APP-52 ► **Start Freq 3**	49.50Hz	_____	_____
APP-53 ► **Start Freq 4**	49.50Hz	_____	_____
APP-54 ► **Stop Freq 1**	20.00Hz	_____	_____
APP-55 ► **Stop Freq 2**	20.00Hz	_____	_____
APP-56 ► **Stop Freq 3**	20.00Hz	_____	_____
APP-57 ► **Stop Freq 4**	20.00Hz	_____	_____
APP-58 ► **Aux start DT**	5.0sec	_____	_____
APP-59 ► **Aux stop DT**	5.0sec	_____	_____
APP-60 ► **AUX AccTime**	2.0sec	_____	_____
APP-61 ► **AUX DecTime**	2.0sec	_____	_____
APP-66► **AutoCh_Mode**	0	_____	_____
APP-67 ► **AutoExt-intv**	72:00	_____	_____
APP-69 ► **Inter-lock**	No	_____	_____

PARAMETERS	FACTORY SETTINGS	SETTING 1	SETTING 2
APP-71 ► **Aux STT FB**	2%	_____	_____
APP-72 ► **Aux STP FB**	0%	_____	_____
APP-74 ► **PrePID Freq**	0.00Hz	_____	_____
APP-75 ► **PrePID F/B**	0.0%	_____	_____
APP-76 ► **PrePID dly**	600sec	_____	_____
APP-77► **Pbroken mode**	No	_____	_____
APP-80 ► **Ext PI mode**	No	_____	_____
APP-81 ► **Ext Ref Sel**	Keypad	_____	_____
APP-82 ► **Ext Ref Perc**	50.00%	_____	_____
APP-83 ► **Ext Fbk Sel**	I	_____	_____
APP-85 ► **ExtPID Pgain**	1.0%	_____	_____
APP-86 ► **ExtPID Itime**	10.0sec	_____	_____
APP-87 ► **ExtPID Dtime**	0ms	_____	_____
APP-88 ► **ExtPID lmt-H**	100.00%	_____	_____
APP-89 ► **ExtPID lmt-L**	0.00%	_____	_____
APP-90 ► **ExtPID Scale**	100.0%	_____	_____
APP-91 ► **Ext P2-gain**	100.0%	_____	_____
APP-92 ► **Ext P Scale**	100.0%	_____	_____
APP-93 ► **ExtPID Fgain**	0.0%	_____	_____
APP-95 ► **ExtPIDOutInv**	No	_____	_____
APP-97 ► **ExtLoopTime**	100ms	_____	_____

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POWER ELECTRONICS®

GE Fanuc Intelligent Platforms
Programmable Control Products

VersaMax® Micro PLCs and Nano PLCs

User's Manual, GFK-1645J

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Warnings, Cautions, and Notes as Used in this Publication

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Introduction

The VersaMax® PLC family of products includes a broad range of small-size programmable logic controllers (PLCs) with big-PLC features. The VersaMax familiy includes Nano PLCs (10 points), Micro PLCs (up to 176 I/O points), and Micro PLUS PLCs (up to 320 I/O points) using optional Expansion Units. These small PLCs are the perfect solution for applications such as packaging machines, dispensing machines, and relay replacement.

These versatile controllers provide powerful programming features such as built-in high-speed counter functionality, support for floating-point function blocks and subroutines, ability to assign passwords and privilege levels to control access, and override capability.

VersaMax Micro, Micro PLUS and Nano PLC Models

Versions of these compact, powerful controllers are available for AC and DC power, and with several different combinations of discrete and analog input and output points.

This chapter compares the features of the many VersaMax Nano, Micro and Micro PLUS PLC models that are available.

Micro PLUS 20/40/64 CPUs have enhanced memory compared to earlier versions of these CPUs. Firmware versions 4.00 and later cannot be used with the earlier hardware versions.
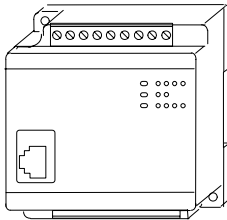
**10-Point
Nano PLCs**
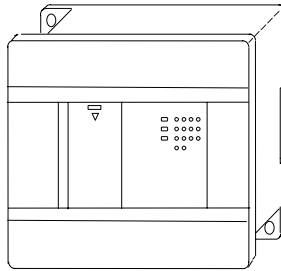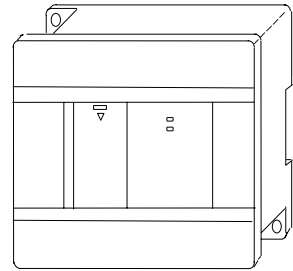
14-Point Micro PLCs

I/O Expansion Units
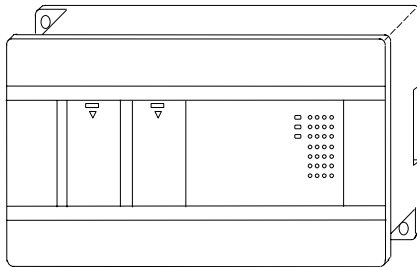
**20-, 23-, 28-, and 40-Point Micro PLCs,
20- and 40-Point Micro Plus PLCs,
and 28-Point Expansion Units**
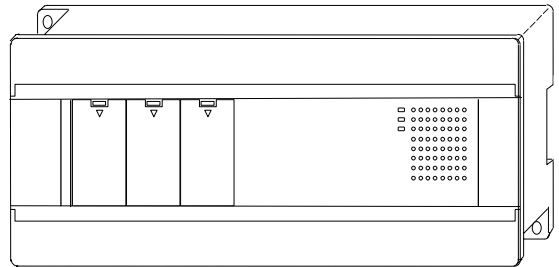
**64-Point Micro PLCs,
64-Point Micro Plus PLCs,
and 64-Point Expansion Units**

VersaMax Nano PLCs

VersaMax Nano PLCs have 10 points of discrete I/O. Two models also provide a 0V to 10V analog input.

Model Number	Description
IC200NAL110	10 Point (6) 12VDC In, (4) 12 Relay Out, (1) Analog Input, 12VDC Power Supply
IC200NAL211	10 Point (6) 24VDC In, (4) 24 Relay Out, (1) Analog Input, 24VDC Power Supply
IC200NDD010	10 Point (6) 12VDC In, (4) 12VDC Out, 12VDC Power Supply
IC200NDD101	10 Point (6) 24VDC In, (4) 24VDC Out, 24VDC Power Supply
IC200NDR001	10 Point (6) 24VDC In, (4) Relay Out, 24VDC Power Supply
IC200NDR010	10 Point (6) 12VDC In, (4) Relay Out, 12VDC Power Supply

VersaMax Micro and Micro PLUS PLCs

VersaMax Micro PLCs are available with 14 to 64 points of I/O. Micro PLUS PLCs are available with 20, 40 or 64 points of I/O.

Model Number	Description
IC200UAA003	14 Point (8) 120VAC In, (6) 120VAC Out, 120/240VAC Power Supply
IC200UAA007	28 Point (16) 120VAC In, (12) 120VAC Out, 120/240VAC Power Supply
IC200UAL004	23 Point (13) 12VDC In, (10) Relay Out, (2) Analog In and (1) Analog Out, 12VDC Power Supply
IC200UAL005	23 Point (13) 24VDC In, (1) 24VDC Out, (9) Relay Out, (2) Analog In and (1) Analog Out, 24VDC Power Supply
IC200UAL006	23 Point (13) 24VDC In, (9) Relay Out, (1) 24VDC Out, (2) Analog In and (1) Analog Out, 120/240 VAC Power Supply
IC200UAR014	14 Point (8) 120 VAC In, (2) Relay Out at 10 Amp, (4) Relay Out at 2 Amp, 120/240 VAC Power Supply
IC200UAR028	28 Point (16) 120 VAC In, (4) Relay Out at 10 Amp, (8) Relay Out at 2 Amp, 120/240 VAC Power Supply
IC200UDD020	20 Point (12) 24VDC In, (4) 24VDC Out with ESCP, (4) 24VDC Out, 24VDC Power Supply
IC200UDD040	40 Point (24) 24VDC In, (16) 24VDC Out (source), 24VDC Power Supply
IC200UDD064	64 Point (40) 24VDC In, (24) 24VDC Out with ESCP (source), 24VDC Power Supply
IC200UDD104	14 Point (8) 24VDC In, (6) 24VDC Out 2 at 1.0 Amp and 4 at 0.5 Amp, 24VDC Power Supply
IC200UDD110	28 Point (16) 24VDC In, (12) 24VDC Out, 6 at 1.0 Amp and, 6 at 0.5 Amp, 24VDC Power Supply
IC200UDD112	14 Point (8) 12VDC In, (6) 12VDC Out, 12VDC Power Supply
IC200UDD120	28 Point (16) 24VDC In, (12) 24VDC Out with ESCP, 24VDC Power Supply
IC200UDD164	64 Point (40) 24VDC In, (24) 24VDC Out (sink), 24VDC Power Supply
IC200UDD212	28 Point (16) 12VDC In, (12) 12VDC Out, 12VDC Power Supply
IC200UDD220	20 Point, (12) 24VDC In, (8) 24VDC Out (sink), 24VDC Power Supply
IC200UDD240	40 Point (24) 24VDC In, (16) 24VDC Out (sink), 24VDC Power Supply
IC200UDR001	14 Point (8) 24VDC In, (6) Relay Out, 120/240 VAC Power Supply
IC200UDR002	14 Point (8) 24VDC In, (6) Relay Out, 24VDC Power Supply
IC200UDR003	14 Point (8) 12VDC In, (6) Relay Out, 12VDC Power Supply
IC200UDR005	28 Point (16) 24VDC In, (11) Relay Out, (1) 24VDC Out, 120/240 VAC Power Supply
IC200UDR006	28 Point (16) 12VDC In, (12) Relay Out, 12VDC Power Supply
IC200UDR010	28 Point (16) 24VDC In, (11) Relay Out, (1) 24VDC Out, 24VDC Power Supply
IC200UDR020	20 Point, (12) 24VDC In, (8) Relay Out, 24VDC Power Supply
IC200UDR040	40 Point (24) 24VDC In, (16) Relay Out, 24VDC Power Supply
IC200UDR064	64 Point (40) 24VDC In, (24) Relay Out, 24VDC Power Supply

Model Number	Description
IC200UDR120	20 Point (12) 24VDC In, (8) Relay Out, 120/240VAC Power Supply
IC200UDR140	40 Point (24) 24VDC In, (16) Relay Out, 120/240VAC Power Supply
IC200UDR164	64 Point (40) 24VDC In, (24) Relay Out, 120/240VAC Power Supply
IC200UDR228	28 Point (16) 24VDC In, (11) Relay Out, (1) 24VDC Out, 12/24VDC Power Supply
IC200UDR440	40 Point (24) 24VDC In, (16) Relay Out, 12/24VDC Power Supply

VersaMax Micro PLC Expansion Units

VersaMax Micro PLC Expansion Units provide additional discrete points and analog I/O channels for the PLC system. Up to four VersaMax Micro PLC Expansion Units of any type can be connected to a VersaMax Micro PLC.

Note: The 64-point Expansion Units are supported on *Micro PLUS* PLCs (20/40/64-point PLCs with release 4.0 or later firmware).

Model Number	Description
IC200UEC008	8 Point (4) 24VDC In, (4) 24VDC Out with ESCP, 24VDC Power Supply
IC200UEC108	8 Point (4) 24VDC In, (4) 24VDC Out, 24VDC Power Supply
IC200UEC208	8 Point (4) 24VDC In, (4) Relay Out, 24VDC Power Supply
IC200UEI008	8 Point (8) 24VDC In, 24VDC Power Supply
IC200UEI016	16 Point (16) 24VDC In, 24VDC Power Supply
IC200UEO008	8 Point (8) 24VDC Out with ESCP, 24VDC Power Supply
IC200UEO016	16 Point (16) 24VDC Out with ESCP, 24VDC Power Supply
IC200UEO108	8 Point (8) 24VDC Out, 24VDC Power Supply
IC200UEO116	16 Point (16) 24VDC Out, 24VDC Power Supply
IC200UER008	8 Point (8) Relay Out, 24VDC Power Supply
IC200UER016	16 Point (16) Relay Out, 24VDC Power Supply
IC200UEX009	14 Point (8) 120 VAC In, (2) Relay Out @ 10 Amps (4) Relay Out @ 2 Amps, 120/240 VAC P.S.
IC200UEX010	14 Point (8) 120 VAC In, (6) 120 VAC Out, 120/240 VAC Power Supply
IC200UEX011	14 Point (8) 24VDC In, (6) Relay Out, 120/240 VAC Power Supply
IC200UEX012	14 Point (8) 24VDC In, (6) Relay Out, 24VDC Power Supply
IC200UEX013	14 Point (8) 12VDC In, (6) Relay Out, 12VDC Power Supply
IC200UEX014	14 Point (8) 24VDC In, (6) 24VDC Out, 24VDC Power Supply
IC200UEX015	14 Point (8) 12VDC In, (6) 12VDC Out, 12VDC Power Supply
IC200UEX064	64 point (40) 24VDC In; (24) Relay Out, 24VDC Power Supply
IC200UEX122	14 Point (8) 24VDC In, (6) 24VDC Out with ESCP, 24VDC Power Supply
IC200UEX164	64 point (40) 24VDC In; (24) Relay Out, 120/240VAC Power Supply
IC200UEX209	28 Point (16) 120 VAC In, (4) Relay Out at 10 Amp, (8) Relay Out at 2 Amp, 120/240 VAC P.S.
IC200UEX210	28 Point (16) 120 VAC In, (12) 120 VAC Out, 120/240 VAC Power Supply
IC200UEX211	28 Point (16) 24VDC In, (12) Relay Out, 120/240 VAC Power Supply
IC200UEX212	28 Point (16) 24VDC In, (12) Relay Out, 24VDC Power Supply
IC200UEX213	28 Point (16) 12VDC In, (12) Relay Out, 12VDC Power Supply
IC200UEX214	28 Point (16) 24VDC In, (12) 24VDC Out, 6 at 1.0 Amp and, 6 at 0.5 Amp, 24VDC Power Supply
IC200UEX215	28 Point (16) 12VDC In, (12) 12VDC Out, 12VDC Power Supply
IC200UEX222	28 Point (16) 24VDC In, (12) 24VDC Out with ESCP, 24VDC Power Supply
IC200UEX264	64 point (40) 24VDC In; (24) 24VDC Source Out, 24VDC Power Supply

Model Number	Description
IC200UEX364	64 point (40) 24VDC In; (24) 24VDC Sink Out, 24VDC Power Supply
IC200UEX616	6 Point (4) Analog In and (2) Analog Out, 12VDC Power Supply
IC200UEX624	4 Point (4) Analog In, 24VDC Power Supply
IC200UEX626	6 Point (4) Analog In and (2) Analog Out, 24VDC Power Supply
IC200UEX636	6 Point (4) Analog In and (2) Analog Out, 100-240 VAC Power Supply
IC200UEX724	4 RTD, Pt 100 In, 24VDC Power Supply
IC200UEX726	4 RTD, Pt 100 In and (2) Analog Out, 0 to 20mA, 4 to 20mA or 0 to 10VDC, 24VDC Power Supply
IC200UEX734	4 RTD, Pt 100 In, 120/240VAC Power Supply
IC200UEX736	4 RTD, Pt 100 In and (2) Analog Out, 0 to 20mA, 4 to 20mA or 0 to 10VDC, 120/240VAC Power Supply
IC200UEX824	4 Thermocouple Input, 24VDC Power Supply
IC200UEX826	4 Thermocouple In and (2) Analog Out, 0 to 20mA or 0 to10VDC, 24VDC Power Supply
IC200UMM002*	2 Axis Servo Motion Module, 24VDC Power Supply
IC200UMM102*	2 Axis Servo Motion Module, 120/240VAC Power Supply

* For Motion Module operating details, refer to the *VersaMax Micro PLC MicroMotion Modules Manual,* GFK-2471A.

Option Modules

Option Modules can be used to enhance the functionality of a 20, 40, or 64-point (release 3.6 or later) VersaMax Micro or Micro PLUS PLC.

IC200USB001	RS232, Extra Port Option Module with 2 analog inputs
IC200USB002	RS485, Extra Port Option Module with 2 analog inputs
IC200UMB001	Memory Pack Module
IC200UUB001	USB / RS232 Conversion Option Module
IC200UEM001	Ethernet Option Module

Comparison of Program and Data Memory Available

The following table compares the amounts of program and data memory available with VersaMax Nano, Micro and Micro PLUS PLCs.

Reference Type	Reference Range	10-Point Nano PLCs	14-Point Micro PLCs	23 and 28-Point Micro PLCs	20, 40, and 64-Point Micro/ Micro PLUS PLCs
User program logic	Not applicable	2K words	9K words	9K words	24K words
Discrete inputs	%I0001 - %I0512	512 bits	512 bits	512 bits	512 bits
Discrete outputs	%Q0001 - %Q0512	512 bits	512 bits	512 bits	512 bits
Discrete global references	%G0001 - %G1280	1280 bits	1280 bits	1280 bits	1280 bits
Discrete internal coils	%M0001 - %M1024	1024 bits	1024 bits	1024 bits	1024 bits
Discrete temporary coils	%T0001 - %T0256	256 bits	256 bits	256 bits	256 bits
System status references	%S0001 - %S0032	32 bits	32 bits	32 bits	32 bits
	%SA0001 - %SA0032	32 bits	32 bits	32 bits	32 bits
	%SB0001 - %SB0032	32 bits	32 bits	32 bits	32 bits
	%SC0001 - %SC0032	32 bits	32 bits	32 bits	32 bits

System register references
    10-pt, 14-pt   PLCs
    23-pt and 28-pt PLCs
    20-pt and 40-pt PLCs
    64-pt PLCs
	%R0001 - %R0256
	%R0001 - %R2048
	%R0001 - %R16384
	%R0001 - %R32640
		256 words	256 words	2K words	32K words
					32K words

Analog and High Speed Counter inputs	%AI0001 - %AI0128	128 words	128 words	128 words	128 words
Analog outputs	%AQ0001 - %AQ0128	128 words	128 words	128 words	128 words

Comparison of PLC Features

The table below compares the features of VersaMax Nano PLCs and Micro PLCs.

Feature	10-Point Nano PLCs	14-Point Micro PLCs	23 Point Micro PLCs	28-Point Micro PLCs	20, 40, and 64-Point Micro/ Micro PLUS PLCs
Run/Stop Mode Select Switch		✓	✓	✓	✓
Connection for an external mode switch	✓				
Potentiometer Inputs (2)		✓	✓	✓	optional
Built-in Analog I/O	1 voltage out on some models		2 in (V/C) and 1 (V/C) out		
Capacitor memory backup time, minimum (Hardware version C and above)	3 days	3 days	30 minutes	30 minutes	30 minutes
External high capacity battery to back up RAM			optional	optional	optional
LEDs: PWR, RUN, OK, point status	✓	✓	✓	✓	✓
Removable wiring terminal assemblies		✓	✓	✓	✓
Accepts Up to 4 Expansion Units		✓	✓	✓	✓
Maximum I/O Count with Expansion Units		126	135	140	20 point: 276 40 point: 296 64 point: 320
RS-232 Port 1 with RJ-45 Connector	✓	✓	✓	✓	✓
SNP/SNPX Master					✓
SNP/SNPX Slave	✓	✓	✓	✓	✓
2-Wire RTU Slave	✓	✓			✓
4-Wire RTU Slave	✓	✓			✓
Configurable for Serial I/O	✓	✓			✓
Modbus RTU Master					✓
Port 2			✓	✓	✓
SNP/SNPX Slave			✓	✓	✓
SNP/SNPX Master			✓	✓	✓
2-Wire RTU Slave			✓	✓	✓
4-Wire RTU Slave			✓	✓	✓
Modbus RTU Master			✓ (rel. 2.02 and later)	✓ (rel. 2.02 and later)	✓
Configurable for Serial I/O			✓	✓	✓

Feature	10-Point Nano PLCs	14-Point Micro PLCs	23 Point Micro PLCs	28-Point Micro PLCs	20, 40, and 64-Point Micro/ Micro PLUS PLCs
RS-232, RS-485/422, USB, and Memory Option Modules					✓
VersaMax Serial to Ethernet support	✓	✓	✓	✓	✓
LD and Instruction List programming	✓	✓	✓	✓	✓
Program Functions compatible with Series 90-30 and Series 90 Micro PLCs	✓	✓	✓	✓	✓
Subroutines	8	64	64	64	64
Floating Point functions	✓	✓	✓	✓	✓
64-Point Expansion support					✓ (Rel 4.0 or later)
Ethernet Communications module support					✓
Motion Module support					✓
Online program changes					✓ (Rel 4.0 or later)

Comparison of I/O and Power Features for PLCs

Model Number	Discrete Points	Input Power	DC Power for inputs and field devices	DC Inputs	AC Inputs	Analog Inputs	Relay Outputs	DC Outputs	AC Outputs	Analog Outputs
Nano PLCs										
NAL110	10	12VDC		6		1	4			
NAL211	10	24VDC		6		1	4			
NDD010	10	12VDC		6				4		
NDD101	10	24VDC		6				4		
NDR001	10	24VDC		6			4			
NDR010	10	12VDC		6			4			
Micro and Micro PLUS PLCs										
UAA003	14	100/240 VAC			8				6	
UAA007	28	100/240 VAC			16				12	
UAL004	23	12VDC	✓	13		2	10			1
UAL005	23	24VDC	✓	13		2	9	1		1
UAL006	23	100/240 VAC	✓	13		2	9	1		1
UAR014	14	100/240 VAC	✓		8		* 6			
UAR028	28	100/240 VAC	✓		16		* 12			
UDD020	20	24VDC	✓	12				4 lcdc, 4 ESCP		
UDD040	40	24VDC	✓	24				16		
UDD104	14	24VDC	✓	8				6		
UDD064	64	24VDC	✓	40				24, ESCP		
UDD110	28	24VDC	✓	16				12		
UDD112	14	12VDC	✓	8				6		
UDD120	28	24VDC	✓	16				12, ESCP		
UDD164	64	24VDC	✓	40				24		
UDD220	20	24VDC	✓	12				8,		
UDD212	28	12VDC	✓	16				12		
UDD240	40	24VDC	✓	24				16		
UDR001	14	100/240 VAC	✓	8			6			
UDR002	14	24VDC	✓	8			6			
UDR003	14	12VDC	✓	8			6			
UDR005	28	100/240 VAC	✓	16			11	1		
UDR006	28	12VDC	✓	16			12			
UDR010	28	24VDC	✓	16			11	1		
UDR020	20	100/240 VAC	✓	12			8			
UDR040	40	24VDC	✓	24			16			
UDR064	64	24VDC	✓	40			24			

Model Number	Discrete Points	Input Power	DC Power for inputs and field devices	DC Inputs	AC Inputs	Analog Inputs	Relay Outputs	DC Outputs	AC Outputs	Analog Outputs
UDR120	20	100/240 VAC	✓	12			8			
UDR140	40	100/240 VAC	✓	24			16			
UDR164	64	100/240 VAC	✓	40			24			
UDR228	28	24VDC	✓	16			11	1		
UDR440	40	12VDC 24VDC	✓	24			16			

* 2 outputs rated 10 Amps

Comparison of I/O and Power Features for Expansion Units

Model Number	Total Points	Input Power	DC Power for inputs and field devices	DC Inputs	AC Inputs	Analog Inputs	Relay Outputs	DC Outputs	AC Outputs	Analog Outputs
UEC008	8	24VDC	✓	4				4, ESCP		
UEC108	8	24VDC	✓	4				4		
UEC208	8	24VDC	✓	4		4				
UEI008	8	24VDC	✓	8						
UEI016	16	24VDC	✓	16						
UEO008	8	24VDC	✓					8, ESCP		
UEO108	8	24VDC	✓	8			8			
UEO016	16	24VDC	✓					16, ESCP		
UEO116	16	24VDC	✓					16		
UER008	8	24VDC	✓				8			
UER016	16	24VDC	✓				16			
UEX009	14	100/240 VAC	✓		8		* 6			
UEX010	14	100/240 VAC	✓		8				6	
UEX011	14	100/240 VAC	✓	8			6			
UEX012	14	24VDC	✓	8			6			
UEX013	14	12VDC	✓	8			6			
UEX014	14	24VDC	✓	8				6		
UEX015	14	12VDC	✓	8				6		
UEX064	64	24VDC	✓	40			24			
UEX122	14	24VDC	✓	8				6, ESCP		
UEX164	64	24VDC	✓	40			24			
UEX209	28	100/240 VAC			16		* 12			
UEX210	28	100/240 VAC	✓		16				12	
UEX211	28	100/240 VAC	✓	16			12	1		
UEX212	28	24VDC	✓	16			12	1		
UEX213	28	12VDC	✓	16			12			
UEX214	28	24VDC	✓	16				12		
UEX215	28	12VDC	✓	16				12		
UEX222	28	24VDC	✓	16				12, ESCP		
UEX264	64	24VDC	✓	40			24			
UEX364	64	24VDC	✓	40			24			
UEX616	6	12VDC				4				2
UEX624	4	24VDC				4				
UEX626	6	24VDC				4				2
UEX636	6	100/240 VAC				4				2
UEX724	4	24VDC				4 RTD				
UEX726	6	24VDC				4 RTD				2
UEX734	4	100/240 VAC				4 RTD				

Model Number	Total Points	Input Power	DC Power for inputs and field devices	DC Inputs	AC Inputs	Analog Inputs	Relay Outputs	DC Outputs	AC Outputs	Analog Outputs
UEX736	6	100/240 VAC				4 RTD				2
UEX824	4	24VDC				4 TC				
UEX826	6	24VDC				4 TC				2
UMM002		24VDC		✓						
UMM102		100/240 VAC		✓						

*   2 outputs rated 10 Amps

VersaMax Serial to Ethernet Adapter

The VersaMax™ IC200SET001 Serial to Ethernet Adapter (VMSE) can be used to connect a VersaMax Micro, Micro PLUS or Nano PLC to an Ethernet network.
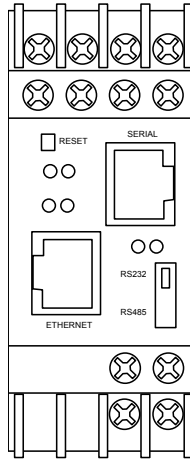
Firmware Options

By default, SRTP/SNP firmware is loaded in flash memory. Use SRTP/SNP to communicate with VersaPro™, CIMPLICITY™ HMI, Series 90-30™, Series 90-70™, and other GE Fanuc products.

Additional firmware options are provided on the CD that is shipped with the VMSE. These include Modbus TCP/RTU, and Pass Thru firmware, which can be used to send serial communication via Ethernet.

Serial Interface

The RJ45 port on the VMSE supports RS232. The screw block port supports both RS232 and RS485/422. Setting the switch on the front of the VMSE and configuring the VMSE setup selects RS232 or RS485/422. Only one port can be used at a time.

Network Interface

The VMSE supports 10/100 Mbit Ethernet through its RJ45 (10BaseT) connector.

Power Requirements

The required input voltage can vary between 9VDC and 30VDC (or 24VAC) with a maximum of 3 Watts. The VMSE can be powered from the 12 or 24 Volt supply on a VersaMax Micro or Micro PLUS PLC (200mA available), or an external supply can be used. For a Nano PLC, an external power supply is required.

Logic-Driven Read/Write Flash Memory Feature

Release 3.0 and later Micro and Micro PLUS PLCs support two Service Requests that can be used in the application program to read data from and write data to flash memory.

The Logic-Driven Read/Write Flash feature can:

- Write selected data to flash using Service Request (SVCREQ) logic in the application program

- Write / read one to ten consecutive Reference Variables of same type with one Service Request

    - Up to 10 words of %R, %AI, %AQ

    - Up to 10 bytes of %I, %Q, %M, %T, %G

- Up to 8k bytes of reference memory can be stored in flash. If a request is made to store more than 8k bytes in flash, a fault is logged in the PLC Fault Table.

See chapter 24 for details and logic examples.

Online Program Changes

In release 4.0 or later Micro PLUS PLCs, you can perform online program changes to edit and download logic to the PLC without putting the PLC into Stop mode. Online program changes consist of:

- Word-for-word change
- Run mode store (RMS)

Word for Word Changes

Changes to the program that do not modify the size of the program are considered word-for-word changes. Examples include changing the type of contact or coil, or changing a reference address used for an existing function block. Changing an operand is usually a word-for-word change. A word-for-word change can be made and downloaded to the PLC while online in programmer mode without having to download the entire block of logic.

Run Mode Store

Run Mode Store consists of downloading logic to a PLC while it is in Run mode. Changes in logic can account for the same or a different amount of memory as the original logic.

The Run Mode Store operation requires the modified logic block(s) size to be within the available free memory.

Example: In order to modify or add a logic block of 10 Kbytes and perform a Run Mode Store, at least 10 Kbytes of free memory should be available. A Run Mode Store with the maximum user logic (48K) is possible only when there is no user logic present in the PLC.

Note: Online program changes should not be performed on active motion function blocks. Motion functionality is not guaranteed if user performs word for word change or Run Mode Store on active motion function blocks.

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Chapter

2

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VersaMax Nano PLCs

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This chapter describes the features and specifications of VersaMax Nano PLCs.

- IC200NAL110   Nano PLC with 10 Discrete Points and 1 Analog Input:
  11 Point (6) 12VDC In, (4) Relay Out, 1 Analog input,
  12VDC Power Supply

- IC200NAL211 Nano PLC with 10 Discrete Points and 1 Analog Input:
  (6) 24VDC In, (4) Relay Out, 1 Analog input,
  24VDC Power Supply

- IC200NDD010 10 Point Nano PLC: (6) 12VDC In, (4) 12VDC Out,
  12VDC Power Supply

- IC200NDD101 10 Point Nano PLC: (6) 24VDC In, (4) 24VDC Out,
  24VDC Power Supply

- IC200NDR001 10 Point Nano PLC: (6) 24VDC In, (4) Relay Out,
  24VDC Power Supply

- IC200NDR010 10 Point Nano PLC: (6) 12VDC In, (4) Relay Out,
  12VDC Power Supply

VersaMax Nano PLC Features

VersaMax Nano PLCs offer the perfect solution for smaller packaging machines, dispensing machines, and relay replacement applications with up to 6 inputs and 4 outputs. In spite of their small size, these versatile controllers provide powerful programming features such as built-in high-speed counter functionality, support for floating-point function blocks and subroutines, ability to assign passwords and privilege levels, and override capability.
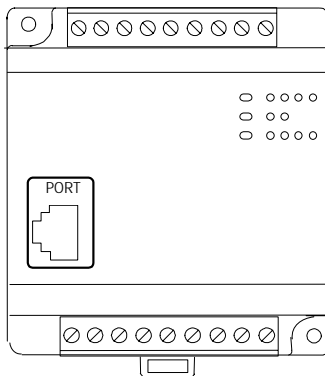
All VersaMax Nano PLCs feature:

- Two non-removable recessed "box-style" terminal strips.
- An external Run/Stop switch can be wired to the Nano PLC. The switch can be configured as a run/stop switch, or a memory protect switch, and used for clearing faults when a fatal fault exists.
- Configurable to read configuration at powerup from either RAM or flash memory (ROM). Can also be configured to read application program from flash at powerup.
- Capacitor backs up RAM for at least 30 minutes on hardware revisions C or above.
- Full-featured programming Instruction Set with floating point math.
- 2K words of program memory, 256 words of registers.

Nano PLC General Specifications

Typical Scan Rate	1.3 ms/K for Boolean logic (see appendix A)
Output Power Supplies	+5VDC on pin 7 of Serial Port, 100mA max
Maximum number of slave devices per RS-485 network	8 (can be increased with a repeater). Requires IC200ACC415.
Realtime clock accuracy (for timer functions)	+/- 0.5%

RS-232 Serial Port

The RS-232 serial port has an RJ-45 connector. The serial port defaults to SNP protocol, and can be configured for SNP/SNPX, slave or RTU slave using the configuration software. It can also be configured for Serial I/O and controlled using COMMREQs from the application program. The port automatically switches from RTU to SNP for programmer communications.

Status LEDs

LEDs provide quick visual verification of operating status. In addition to LEDs for Power, OK, and Run mode, there is an LED for each I/O point.

Input Terminals

RS-232 Serial Port

DIN Rail Release

Output Terminals

Status LEDS
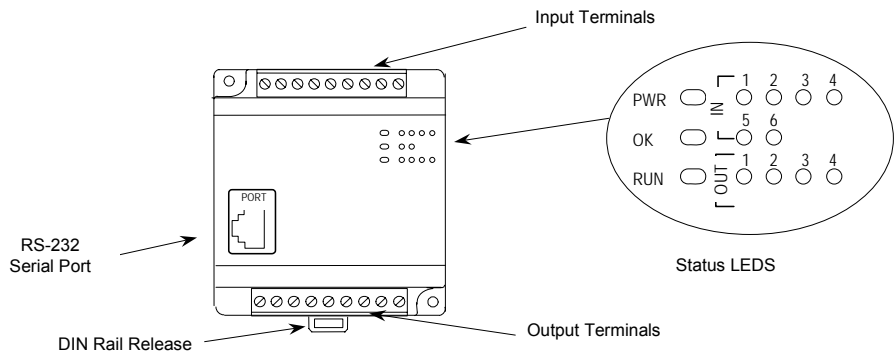
High Speed Counters

A VersaMax Nano PLC can be configured to provide built-in high-speed counter and pulse operation.

When configured for High-speed Counter operation, inputs can be set up as:

- Up to three Type A Counters or
- 1 Type A and 1 Type B Counter.

Each counter provides direct processing of rapid pulse signals up to 10kHz for industrial control applications such as meter proving, turbine flowmeter, velocity measurement, material handling, motion control, and process control.

Each counter can be enabled independently. Type A counters can be configured for up or down counting (default is up) and for positive or negative edge detection (default is positive). The type B counter provides an A Quad B counting function.

Nano PLCs with DC outputs provide up to 3 High-Speed Counter outputs, and/or Pulse Train or Pulse-Width Modulated outputs.

Nano PLCs with relay outputs also provide up to 3 High-Speed Counter outputs. However, relay outputs cannot be used as Pulse Train or Pulse-Width Modulated outputs.

VersaMax Nano PLC IC200NAL110 has six DC inputs, one analog input, and four normally-open 2 Amp relay outputs that can control 5 to 30VDC or 5 to 250VAC output devices. It uses +12VDC nominal input power for PLC operation.

DC Inputs

The module's six configurable DC inputs can be used as positive or negative logic standard inputs or High-speed Counter inputs. When used as standard inputs, the input characteristics are compatible with a wide range of input devices, such as pushbuttons, limit switches, and electronic proximity switches.

Analog Input

Input IN1 can be used as an analog input (8-bit resolution), for analog signals in the 0V to 10V range. The analog input cannot be software-calibrated.

Relay Outputs

The four Form A (SPST-single pole single throw) normally-open relay outputs can control a wide range of devices such as motor starters, solenoids, and indicators. Power for the internal relay coils is provided by the +24 volt DC internal supply. An external source of AC or DC power must be supplied to operate field devices.

The relay outputs can be used as up to three High-Speed Counter outputs. They cannot be used as Pulse Train or Pulse-Width Modulated outputs. Connections and specifications for High-speed Counter outputs are the same as for standard relay outputs.

Nano PLC IC200NAL110 Specifications

Inputs	Six 12 VDC positive/negative logic inputs, one analog input, 0 to 10V
Outputs	Four normally open 2 Amp relay circuits
High Speed Counters	Three Type A or One Type A and One Type B
DC Power Specifications	
Range	9.6VDC - 15VDC
Hold-up	3.0mS
Inrush Current	8A typical at 12 VDC
Inrush Time	200mS typical
Input Current	250mA typical at 12 VDC
Input Power Supply Rating	3W
DC Input Specifications	
Number of Inputs	6
Rated Input Voltage	12 volts DC
Input Voltage Range	0 to 15 volts DC
Input Current	9.0mA typical
Input Impedance	1.3 kOhms
Input Threshold Voltage	ON: 9.5VDC minimum, OFF: 2.5VDC maximum
Input Threshold Current	ON: 6.5mA maximum, OFF: 1.6mA minimum
Response Time	0.5 to 20ms (user configurable) as regular input; 100µs as HSC input
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between group
Analog Input Specifications	
Number of Analog Inputs	1, single
Input range	0 to 10 V (10.24 maximum)
Resolution	8 bits
Accuracy	1% of full scale over temperature range
Voltage input impedance	100K Ohm
Input filter time	200ms to reach 1% error for step input

Relay Output Specifications

Operating Voltage	5 to 30 VDC or 5 to 250 VAC
Isolation	1500 V RMS between field side and logic side 500 V RMS between groups
Leakage Current	15 mA at 240 VAC maximum
Maximum UL Pilot Duty Rating	2 amps at 24 VDC and 240 VAC
Maximum Resistive Load Rating	2 amps at 24 VDC and 240 VAC
Minimum Load	10 mA
Maximum Inrush	5 amps per half cycle
On Response Time	15 ms maximum
Off Response Time	15 ms maximum
Fuse	None
Contact Life: Mechanical	20×10^6 mechanical operations

Contact Life: Electrical 240VAC, 120VAC, 24VDC	Current: Resistive 2A	Current: Lamp and Solenoid 0.6A	Typical Operations 200,000

High-Speed Counter Input and Output Specifications

Maximum Counter Frequency	10kHz
Input Voltage	ON: 9V, OFF: 2.5V
Count Pulse Width	20% to 80% duty cycle at 10kHz
Count Registers	16bits

Outputs

Load Voltage	12V
Number of Pulse Outputs	None

Wiring Diagram, IC200NAL110
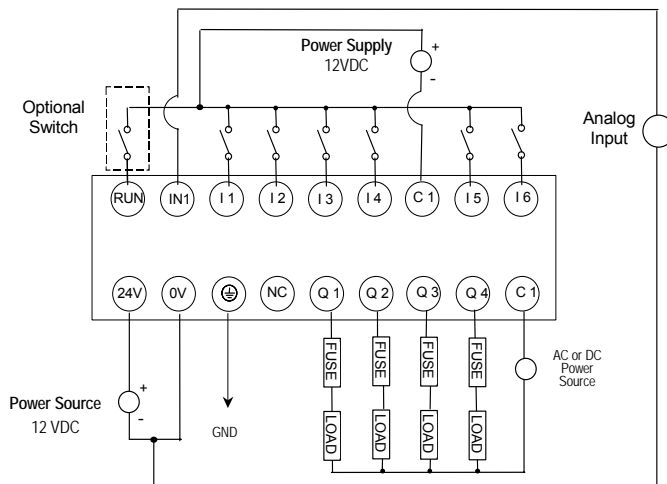
VersaMax Nano PLC IC200NAL211 has six DC inputs, one analog input, and four normally-open 2 Amp relay outputs that can control 5 to 30VDC or 5 to 250VAC output devices. It uses +24VDC nominal input power for PLC operation.

DC Inputs

The module's six configurable DC inputs can be used as positive or negative logic standard inputs. Whether used as a standard or HSC input, each DC input can have positive or negative logic characteristics. When used as standard inputs, the input characteristics are compatible with a wide range of input devices, such as pushbuttons, limit switches, and electronic proximity switches.

Analog Input

Input IN1 can be used as an analog input (8-bit resolution), for analog signals in the 0V to 10V range. The analog input cannot be software-calibrated.

Relay Outputs

The four Form A (SPST-single pole single throw) normally-open relay outputs can control a wide range of devices such as motor starters, solenoids, and indicators. Power for the internal relay coils is provided by the +24 volt DC internal supply. An external source of AC or DC power must be supplied to operate field devices.

The relay outputs can be used as up to three High-Speed Counter outputs. They cannot be used as Pulse Train or Pulse-Width Modulated outputs. Connections and specifications for High-speed Counter outputs are the same as for standard relay outputs.

Nano PLC IC200NAL211 Specifications

Inputs	Six 24 VDC positive/negative logic inputs, one analog input, 0 to 10V
Outputs	Four normally open 2 Amp relay circuits
High Speed Counters	Three Type A or One Type A and One Type B
DC Power Specifications	
Range	19.2VDC - 30.0VDC
Hold-up	10mS at 19.2 VDC
Inrush Current	1 Amp maximum at 30 VDC
Inrush Time	10mS for 1 Amp
Input Current	0.12 Amp typical at 24 VDC
Input Power Supply Rating	3W
DC Input Specifications	
Number of Inputs	6
Rated Input Voltage	24 volts DC
Input Voltage Range	0 to 30 volts DC
Input Current	7.5mA typical
Input Impedance	2.8 kOhms
Input Threshold Voltage	ON: 15VDC minimum, OFF: 5VDC maximum
Input Threshold Current	ON: 4.5mA maximum, OFF: 1.5mA minimum
Response Time	0.5 to 20ms (user configurable) as regular input; 100µs as HSC input
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between group
Analog Input Specifications	
Number of Analog Inputs	1, single
Input range	0 to 10 V (10.24 maximum)
Resolution	8 bits
Accuracy	1% of full scale over temperature range
Voltage input impedance	100K Ohm
Input filter time	200ms to reach 1% error for step input

Relay Output Specifications

Operating Voltage	5 to 30 VDC or 5 to 250 VAC
Isolation	1500 V RMS between field side and logic side 500 V RMS between groups
Leakage Current	15 mA at 240 VAC maximum
Maximum UL Pilot Duty Rating	2 amps at 24 VDC and 240 VAC
Maximum Resistive Load Rating	2 amps at 24 VDC and 240 VAC
Minimum Load	10 mA
Maximum Inrush	5 amps per half cycle
On Response Time	15 ms maximum
Off Response Time	15 ms maximum
Fuse	None
Contact Life: Mechanical	20×10^6 mechanical operations

Contact Life: Electrical 240VAC, 120VAC, 24VDC	Current: Resistive 2A	Current: Lamp and Solenoid 0.6A	Typical Operations 200,000

High-Speed Counter Input and Output Specifications

Maximum Counter Frequency	10kHz
Input Voltage	ON: 15V, OFF: 5V
Count Pulse Width	20% to 80% duty cycle at 10kHz
Count Registers	16bits

Outputs

Load Voltage	12/24V
Number of Pulse Outputs	None

Wiring Diagram, IC200NAL211
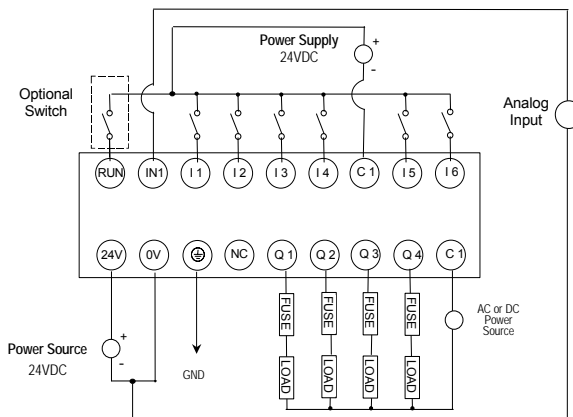
VersaMax Nano PLC IC200NDD010 has six 12VDC inputs and four DC transistor outputs. It uses +12VDC nominal input power for PLC operation.

DC Inputs

The module's six configurable DC inputs can be used as standard inputs or High-speed Counter inputs. Whether used as a standard or HSC input, each input can have positive or negative logic characteristics. When used as standard inputs, the input characteristics are compatible with a wide range of input devices, such as pushbuttons, limit switches, and electronic proximity switches.

Transistor Outputs

The four transistor output circuits can be used to switch devices like valves, lamps or contactors. External fusing should be provided to protect the outputs. Fast fuses are recommended.

The outputs can be configured as regular outputs or as outputs controlled by the High Speed Counters. Then can also be used as Pulse Train and/or Pulse Width Modulation (PWM) outputs.

All outputs are isolated between field and logic and are switching positive voltage. The outputs have one common incoming supply (VC) and one common ground (COM). The outputs are able to drive high inrush currents (8 times the rated current) and are protected against negative voltage pulses. This makes it possible to switch lamps and inductive loads.

Nano PLC IC200NDD010 Specifications

Inputs	Six 12 VDC positive/negative logic input circuits
Outputs	Four transistor outputs
High Speed Counters	Three Type A or One Type A and One Type B
DC Power Specifications	
Range	9.6VDC - 15VDC
Hold-up	3.0mS
Inrush Current	8A typical at 12 VDC
Inrush Time	200mS typical
Input Current	250mA typical at 12 VDC
Input Power Supply Rating	3W
DC Input Specifications	
Number of Inputs	6
Rated Input Voltage	12 volts DC
Input Voltage Range	0 to 15 volts DC
Input Current	9.0mA typical
Input Impedance	1.3 kOhms
Input Threshold Voltage	ON: 9.5VDC minimum, OFF: 2.5VDC maximum
Input Threshold Current	ON: 6.5mA maximum, OFF: 1.6mA minimum
Response Time	0.5 to 20ms (user configurable) as regular input; 100µs as HSC input
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between group
Transistor Output Specifications	
Voltage Range	12VDC (12VDC +20%, -20%)
Maximum Load	0.7A per circuit, 4A per common
Maximum Inrush Current	4A for 20mS
Output Voltage Drop	0.3V maximum
OFF state leakage	0.1mA maximum
Response	OFF to ON: 0.1mS maximum 12VDC 0.2A ON to OFF: 0.1mS maximum 12VDC 0.2A
Isolation Voltage	1500V RMS field side to logic side, 500VAC between field side and logic side
External power supply	12VDC +10%, -20%
Fuse	Outputs should be fused externally. Otherwise, a load short can damage the module output transistor, which is not user replaceable.

High-Speed Counter Input and Output Specifications	
Maximum Counter Frequency	10kHz
Input Voltage	ON: 9V, OFF 2.5V
Count Pulse Width	20% to 80% duty cycle at 10kHz
Count Registers	16bits
Outputs	
Number of Outputs	Up to three HSC/PT and/or PWM outputs
Load Voltage	12V
Maximum Pulse/PWM Frequency	5kHz

Wiring Diagram, IC200NDD010
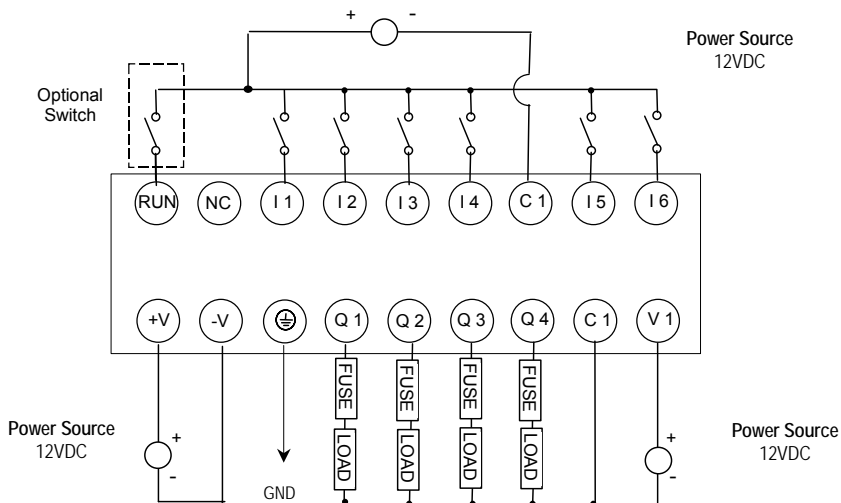
VersaMax Nano PLC IC200NDD101 has six 24VDC inputs and four DC transistor outputs. It uses +24VDC nominal input power for PLC operation.

DC Inputs

Six configurable DC inputs can be used as standard inputs or High-speed Counter inputs. Whether used as a standard or HSC input, each input can have positive or negative logic characteristics. When used as standard inputs, the input characteristics are compatible with a wide range of input devices, such as pushbuttons, limit switches, and electronic proximity switches.

Transistor Outputs

The four transistor output circuits can be used to switch devices like valves, lamps or contactors. External fusing should be provided to protect the outputs. Fast fuses are recommended.

The outputs can be configured as regular outputs or as outputs controlled by the High Speed Counters. Then can also be used as Pulse Train and/or Pulse Width Modulation (PWM) outputs.

All outputs are isolated between field and logic and are switching positive voltage. The outputs have one common incoming supply (VC) and one common ground (COM). The outputs are able to drive high inrush currents (8 times the rated current) and are protected against negative voltage pulses. This makes it possible to switch lamps and inductive loads.

Nano PLC IC200NDD101 Specifications

Inputs	Six 24 VDC positive/negative logic input circuits
Outputs	Four transistor outputs
High Speed Counters	Three Type A or One Type A and One Type B
DC Power Specifications	
Range	19.2VDC - 30.0VDC
Hold-up	10mS at 19.2 VDC
Inrush Current	1 Amp maximum at 30 VDC
Inrush Time	10mS for 1 Amp
Input Current	0.12 Amp typical at 24 VDC
Input Power Supply Rating	3W
DC Input Specifications	
Number of Inputs	6
Rated Input Voltage	24 volts DC
Input Voltage Range	0 to 30 volts DC
Input Current	7.5mA typical
Input Impedance	2.8 Kohms
Input Threshold Voltage	ON: 15VDC minimum, OFF: 5VDC maximum
Input Threshold Current	ON: 4.5mA maximum, OFF: 1.5mA minimum
Response Time	0.5 to 20ms (user configurable) as regular input; 100μs as HSC input
Isolation Voltage	1500V RMS field side to logic side 500V RMS between group
Transistor Output Specifications	
Voltage Range	12VDC/24VDC (24VDC +10% / -43% input at V1,C1)
Maximum Load	0.75A per point (Q1 - Q4) at 24VDC at 100 % ON duration 0.5A per point (Q1 - Q4) at 12VDC at 100 % ON duration
Maximum Inrush Current	8A for 20ms, 1 pulse (0.75A outputs) 4A for 20ms, 1 pulse (0.5A outputs)
Output Voltage Drop	0.3V maximum
OFF state leakage	100μA maximum
Response	OFF to ON: 0.1mS maximum 24VDC 0.2A ON to OFF: 0.1mS maximum 24VDC 0.2A
Isolation Voltage	1500V RMS field side to logic side, 500VAC between field side and logic side
External power supply	16-30VDC required to power the outputs.
Fuse	Outputs should be fused externally. Otherwise, a load short can damage the module output transistor, which is not user replaceable.

High-Speed Counter Input and Output Specifications

Maximum Counter Frequency	10kHz
Input Voltage	ON: 15V, OFF: 5V
Count Pulse Width	20% to 80% duty cycle at 10kHz
Count Registers	16bits
High Speed Counter Outputs	
Number of Outputs	Up to three HSC/PT and/or PWM outputs
Load Voltage	12/24V
Maximum Pulse/PWM Frequency	5kHz

Wiring Diagram, IC200NDD101
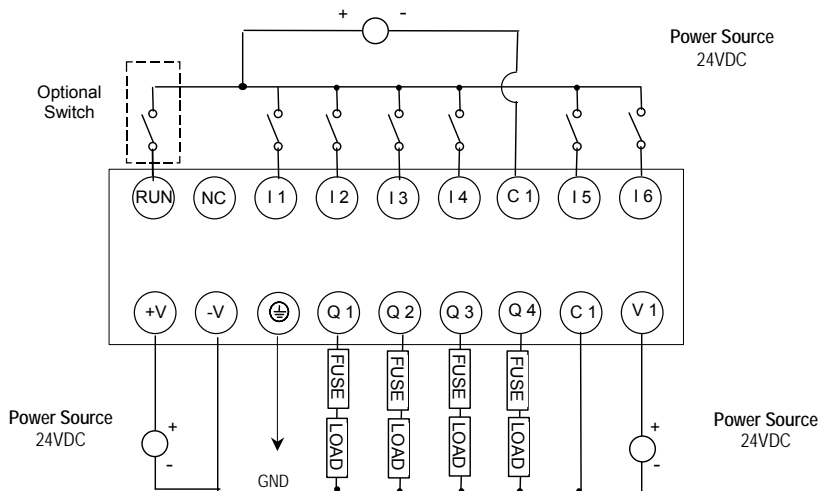
VersaMax Nano PLC IC200NDR001 has six 24VDC inputs, and four normally-open 2 Amp relay outputs that can control 5 to 30VDC or 5 to 250VAC output devices. It uses +12VDC nominal input power for PLC operation.

DC Inputs

The module's six configurable DC inputs can be used as standard inputs or High-speed Counter inputs. Whether used as a standard or High-Speed Counter input, each input can have positive or negative logic characteristics. When used as standard inputs, the input characteristics are compatible with a wide range of input devices, such as pushbuttons, limit switches, and electronic proximity switches.

Relay Outputs

The four Form A (SPST-single pole single throw) normally-open relay outputs can control a wide range of devices such as motor starters, solenoids, and indicators. Power for the internal relay coils is provided by the +24 volt DC internal supply. An external source of AC or DC power must be supplied to operate field devices.

Connections and specifications for HSC outputs are the same as for standard relay outputs.

Nano PLC IC200NDR001 Specifications

Inputs	Six 24 VDC positive/negative logic input circuits
Outputs	Four normally open 2 Amp relay circuits
High Speed Counters	Three Type A or One Type A and One Type B

DC Power Specifications

Range	24 −20%/+25% VDC
Hold-up	10 ms at 19.2 VDC
Inrush Current	1A maximum at 24 VDC
Inrush Time	10 ms for 1 A
Input Current	0.12A typical at 24 VDC
Input Power Supply Rating	3W

Input Specifications

Number of Inputs	6
Rated Input Voltage	24 volts DC
Input Voltage Range	0 to 30 volts DC
Input Current	7.5mA typical
Input Resistance	2.8 Kohms
Input Threshold Voltage	ON: 15VDC minimum, OFF: 5VDC maximum
Input Threshold Current	ON: 4.5mA maximum, OFF: 1.5mA minimum
Response Time	0.5 to 20ms configurable as regular input; 100μs as HSC input
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups

Relay Output Specifications

Operating Voltage	5 to 30 VDC or 5 to 250 VAC		
Isolation	1500 V RMS between field side and logic side, 500 V RMS between groups		
Leakage Current	15 mA at 240 VAC maximum		
Maximum UL Pilot Duty Rating	2 amps at 24 VDC and 240 VAC		
Maximum Resistive Load Rating	2 amps at 24 VDC and 240 VAC		
Minimum Load	10 mA		
Maximum Inrush	5 amps per half cycle		
Response Time	ON: 15 ms maximum, OFF: 15 ms maximum		
Fuse	None		
Contact Life: Mechanical	20×10^6 mechanical operations		
Contact Life: Electrical 240VAC, 120VAC, 24VDC	Current: Resistive 2A	Current: Lamp and Solenoid 0.6A	Typical Operations 200,000

High-Speed Counter Input and Output Specifications	
Maximum Counter Frequency	10kHz
Input Voltage	ON: 15V, OFF: 5V
Count Pulse Width	20% to 80% duty cycle at 10kHz
Count Registers	16bits
High Speed Counter Outputs	
Load Voltage	refer to relay output specifications
Number of Pulse Outputs	None

Wiring Diagram, IC200NDR001
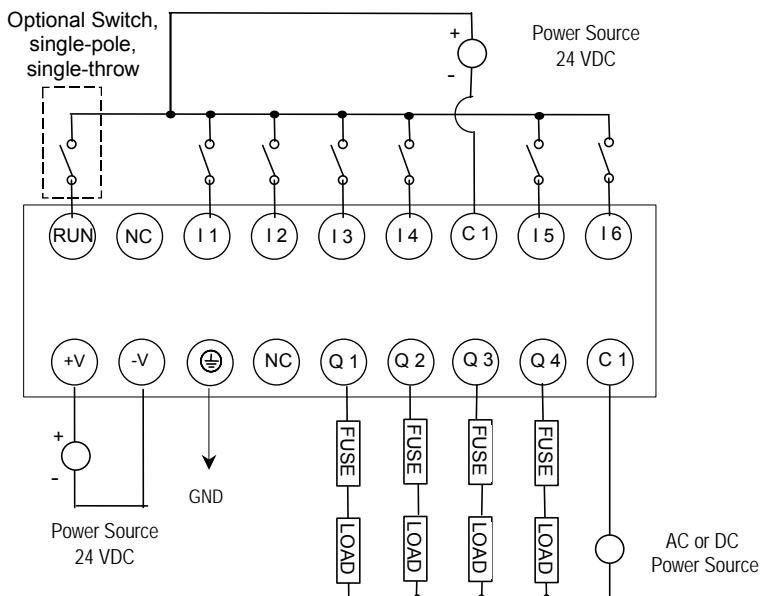
VersaMax Nano PLC IC200NDR010 has six 24VDC inputs, and four normally-open 2 Amp relay outputs that can control 5 to 30VDC or 5 to 250VAC output devices. It uses +12VDC nominal input power for PLC operation.

Inputs

The module's six configurable DC inputs can be used as standard inputs or High-speed Counter inputs. Whether used as a standard or High-Speed Counter input, each input can have positive or negative logic characteristics. When used as standard inputs, the input characteristics are compatible with a wide range of input devices, such as pushbuttons, limit switches, and electronic proximity switches.

Relay Outputs

The four Form A (SPST-single pole single throw) normally-open relay outputs can control a wide range of devices such as motor starters, solenoids, and indicators. Power for the internal relay coils is provided by the +24 volt DC internal supply. An external source of AC or DC power must be supplied to operate field devices.

Connections and specifications for High-speed Counter outputs are the same as for standard relay outputs.

Nano PLC IC200NDR010 Specifications

Inputs	Six 12 VDC positive/negative logic input circuits
Outputs	Four normally open 2 Amp relay circuits
High Speed Counters	Three Type A or One Type A and One Type B

DC Power Specifications

Range	9.6VDC - 15VDC
Hold-up	3.0mS
Inrush Current	8A typical at 12 VDC
Inrush Time	200mS typical
Input Current	250mA typical at 12 VDC
Input Power Supply Rating	3W

Input Specifications

Number of Inputs	6
Rated Input Voltage	12 volts DC
Input Voltage Range	0 to 15 volts DC
Input Current	9.0mA typical
Input Resistance	1.3 kOhms
Input Threshold Voltage	ON: 9.5VDC minimum, OFF: 2.5VDC maximum
Input Threshold Current	ON: 6.5mA maximum, OFF: 1.6mA minimum
Response Time	0.5 to 20ms configurable as regular input; 100µs as HSC input
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups

Relay Output Specifications

Operating Voltage	5 to 30 VDC or 5 to 250 VAC
Isolation	1500 V RMS between field side and logic side, 500 V RMS between groups
Leakage Current	15 mA at 240 VAC maximum
Maximum UL Pilot Duty Rating	2 amps at 24 VDC and 240 VAC
Maximum Resistive Load Rating	2 amps at 24 VDC and 240 VAC
Minimum Load	10mA
Maximum Inrush	5 amps per half cycle
Response Time	ON: 15 ms maximum, OFF: 15 ms maximum
Fuse	None
Contact Life: Mechanical	20×10^6 mechanical operations

Contact Life: Electrical 240VAC, 120VAC, 24VDC	Current: Resistive 2A	Current: Lamp and Solenoid 0.6A	Typical Operations 200,000

High-Speed Counter Input and Output Specifications	
Maximum Counter Frequency	10kHz
Input Voltage	ON: 9V, OFF: 2.5V
Count Pulse Width	20% to 80% duty cycle at 10kHz
Count Registers	16bits
Outputs	
Load Voltage	refer to relay output specifications
Number of Pulse Outputs	None

Wiring Diagram, IC200NR010

| *Chapter* *3* | *VersaMax 14-Point Micro PLCs* |

- IC200UAA003 14 Point Micro PLC, (8) 120VAC In, (6) 120VAC Out, 120/240VAC Power Supply

- IC200UAR014 14 Point Micro PLC, (8) 120VAC In, (2) Relay Out at 10 Amps, (4) Relay Out at 2 Amps, 120/240VAC Power Supply

- IC200UDD104 14 Point Micro PLC, (8) 24VDC Source In, (6) 24VDC Source Out, 24VDC Power Supply

- IC200UDD112 14 Point Micro PLC, (8) 12VDC In, (6) 12VDC Out, 12VDC Power Supply

- IC200UDR001 14 Point Micro PLC, (8) 24VDC In, (6) Relay Out, 120/240VAC Power Supply

- IC200UDR002 14 Point Micro PLC, (8) 24VDC In, (6) Relay Out, 24VDC Power Supply

- IC200UDR003 14 Point Micro PLC, (8) 12VDC In, (6) Relay Out, 12VDC Power Supply

VersaMax 14-Point Micro PLC Features
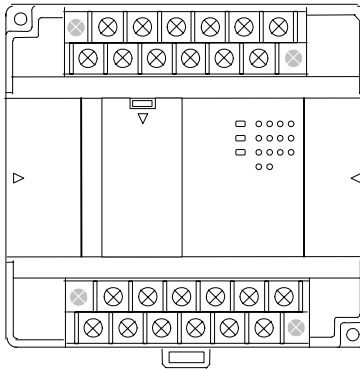
All VersaMax 14 Point Micro PLCs feature:

- Two removable screw-down "barrier-style" terminal strips with protective covers.
- RS-232 serial port that supports SNP/SNPX, RTU slave protocols, and Serial I/O.
- Run/Stop mode switch that can be configured as a run/stop switch, a memory protect switch, and also used for clearing faults when a fatal fault exists.
- Two analog potentiometers.
- Full-featured programming Instruction Set with floating point math The application program can be either Ladder Diagram (LD) or Instruction List (IL) format.
- 9K words of program memory, 256 words of registers.
- Support for up to four Expansion Units in any combination.
- Flash memory (ROM) for non-volatile program storage and for system firmware.
- Configurable to read configuration at powerup from either RAM or flash memory (ROM). Can also be configured to read application program from flash at powerup.
- Capacitor backs up RAM for at least 3 days.

14-Point Micro PLC General Specifications

Typical Scan Rate	1.3 ms/K for Boolean logic (see appendix A)
Output Power Supplies	+5VDC on pin 7 of Serial Port, 100mA max
Maximum number of slave devices per RS-485 network	8 (can be increased with a repeater). Requires IC200ACC415.
Realtime clock accuracy (for timer functions)	+/- 0.5%

High Speed Counters

All VersaMax Micro with DC power can be configured to provide built-in high-speed counter and pulse operation.

When configured for High-speed Counter operation, inputs can be set up as:

- Up to four Type A Counters or

- One Type A and one Type B Counter.

Each counter provides direct processing of rapid pulse signals up to 10kHz for industrial control applications such as meter proving, turbine flowmeter, velocity measurement, material handling, motion control, and process control.

Each counter can be enabled independently. Type A counters can be configured for up or down counting (default is up) and for positive or negative edge detection (default is positive). The type B counter provides an A Quad B counting function.

Models with DC outputs can be configured to provide up to four counter, Pulse Train or PWM outputs.
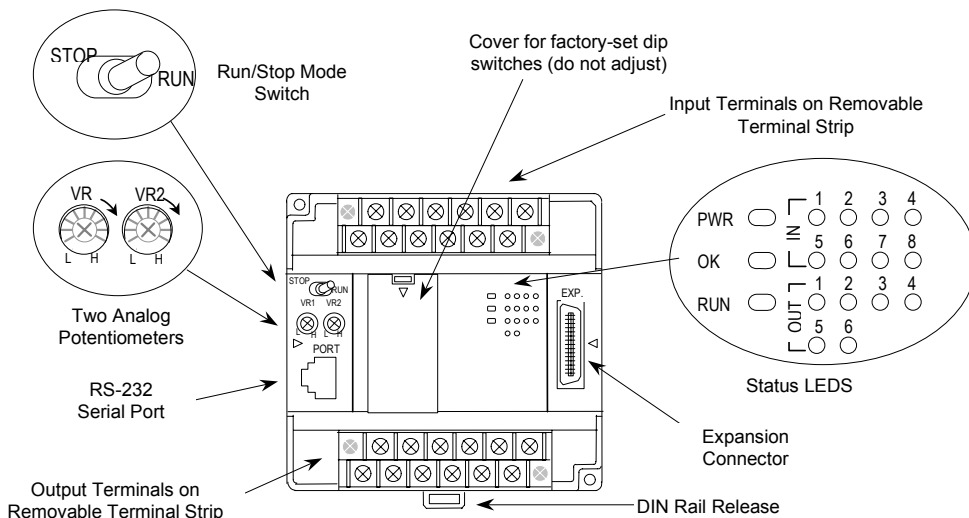
IC200UAA003
14 Point Micro PLC, (8) 120VAC In, (6) 120VAC Out, 120/240VAC Power Supply

VersaMax Micro PLC model IC200UAA003 accepts eight AC inputs and provides six AC outputs. It uses 100VAC to 240VAC nominal input power.

AC Inputs

The module's eight 120 VAC input circuits are reactive (resistor/capacitor) inputs. Inputs are compatible with a wide range of devices, such as pushbuttons, limit switches, and electronic proximity switches. Power to operate the field devices must be supplied. The input circuits require an AC power source: they cannot be used with a DC power source.

AC Outputs

The 120/240 VAC, 0.5 Amp triac outputs are provided in isolated groups. The commons are not tied together inside the module. This allows each group to be used on different phases of the AC supply or to be powered from the same supply. Each group is protected with a replaceable 3.15 amp fuse for its common. Also, an RC snubber is provided for each output to protect against transient electrical noise on the power line.

This module provides a high degree of inrush current (10x the rated current) which makes the outputs suitable for controlling many types of inductive and incandescent loads. AC power to operate loads connected to outputs must be supplied from an external source.

Micro PLC IC200UAA003 Specifications

Inputs	Eight AC inputs
Outputs	Six AC outputs
High-speed Counters	None
AC Power Specifications	
Range	100 -15% to 240 +10% VAC
Frequency	50 -5% to 60 +5% Hz
Hold-up	10mS at 85 to 100VAC, 20mS at 100 to 264VAC
Inrush Time	2mS for 40 Amp
Inrush Current	18 Amp maximum at 120VAC 30 Amp maximum at 200VAC 40 Amp maximum at 265VAC
Input Current	0.05 Amp typical at 200VAC, 0.10 Amp Typical at 100 VAC
Input Power Supply Rating	11 VA

AC Input Specifications

Points/Common	4 (I1–I4) and (I5–I8)
Rated Load Voltage	85–132 VAC, 50 -5% to 60 +5% Hz
Maximum Input Voltage	132V rms, 50/60 Hz
Input Current	8mA rms (100 VAC, 60 Hz)
Voltage	ON: minimum 80V rms, 4.5mA rms, OFF: maximum 30V rms, 2mA rms
Response Time	OFF to ON: maximum 25mS, ON to OFF: maximum 30mS
Isolation	1500V rms field side to logic side, 500V rms between groups

AC Output Specifications

Rated Load Voltage	100 -15% to 240 +10% VAC, 50 -5% to 60 +5% Hz
Maximum Resistive Load Current	0.5 Amp per point
Maximum UL Pilot Duty Rating	0.5 Amp per point at 240 VAC 0.6 Amp maximum on C1 1.2 Amps maximum on C2
Maximum Inrush Current	5A (1 period)/point, 10A (1 period)/common
Maximum voltage drop when ON	1.5 V RMS
Maximum leak current when OFF	1.8 mA RMS (115 VAC), 3.5 mA RMS (230 VAC)
Response Time (Maximum)	OFF to ON: 1 mS, ON to OFF: 1/2 cycle + 1 mS
Isolation	1500V RMS field side to logic side 500V RMS between groups

Wiring Diagram, IC200UAA003

> ## IC200UAR014
> ## 14 Point Micro PLC, (8) 120VAC In, (6) Relay Out, 120/240VAC Power Supply

VersaMax Micro PLC model IC200UAR014 accepts eight AC inputs and provides six relay outputs: 2 at 10 Amps and 4 at 2 Amps. It uses 100VAC to 240VAC nominal input power.

Inputs

The module's 120 VAC input circuits are reactive (resistor/capacitor) inputs. The input circuits require an AC power source: they cannot be used with a DC power source. Inputs are compatible with a wide range of devices, such as pushbuttons, limit switches, and electronic proximity switches. Power to operate the field devices must be supplied.

Relay Outputs

The six normally-open relay outputs can control many types of devices such as motor starters, solenoids, and indicators. There are two individual 10 Amp relay outputs and one group of four 2-Amp relay outputs. Power for the internal relay coils is provided by the internal supply. Separate external sources of AC or DC power must be supplied to operate field output devices.

Micro PLC IC200UAR014 Specifications

Inputs	Eight AC inputs
Outputs	Six Relay outputs
High-speed Counters	None
Output Power Supplies	24VDC for input circuits & user devices, 200mA max. +5VDC on pin 7 of Serial Port, 100mA max.
AC Power Specifications	
Range	100 -15% to 240 +10% VAC
Frequency	50 -5% to 60 +5% Hz
Hold-up	10mS at 85 to 100VAC, 20mS at 100 to 264VAC
Inrush Time	2mS for 40 Amp
Inrush Current	18 Amp maximum at 120VAC 30 Amp maximum at 200VAC 40 Amp maximum at 265VAC
Input Current	0.05 Amp typical at 200VAC, 0.10 Amp Typical at 100 VAC
Input Power Supply Rating	11 VA

AC Input Specifications

Points/Common	4 (I1–I4) and (I5–I8)
Rated Load Voltage	85–132 VAC, 50 -5% to 60 +5% Hz
Maximum Input Voltage	132V rms, 50/60 Hz
Input Current	8 mA rms (100 VAC, 60 Hz)
Voltage	ON: minimum 80V rms, 4.5 mA rms, OFF: maximum 30V rms, 2 mA rms
Response Time	OFF to ON: maximum 25mS, ON to OFF: maximum 30mS
Isolation	1500V rms field side to logic side, 500V rms between groups

Relay Output Specifications

Operating Voltage	5 to 30 VDC or 5 to 250 VAC
Isolation	1500 V RMS between field side and logic side, 500 V RMS between groups
Leakage Current	15 mA maximum
Maximum UL Pilot Duty Rating	Q1 – Q4: 2 amps at 24 VDC and 240 VAC, Q5, Q6: 10 amps at 24 VDC and 240 VAC
Maximum Resistive Load Rating	Q1 – Q4: 2 amps at 24 VDC and 240 VAC, Q5, Q6: 10 amps at 24 VDC and 240 VAC
Minimum Load	10 mA
Maximum Inrush	Q1 – Q4: 5 amps per half cycle, Q5, Q6: 14 amps per half cycle
Response Time	ON: 15 ms maximum, OFF: 15 ms maximum
Fuse	None
Contact Life: Mechanical	20×10^6 mechanical operations

Contact Life: Electrical Voltage:	Current: Resistive	Current: Lamp and Solenoid	Typical Operations:
	2A	0.6A	200,000
	10A	4A	100,000
	4 A	1A	200,000

Wiring Diagram, IC200UAR014

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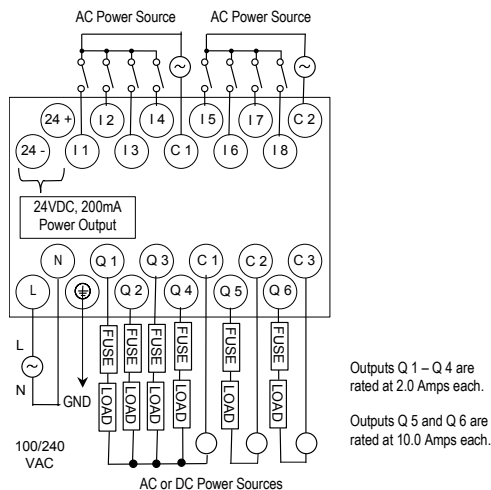
IC200UDD104
14 Point Micro PLC, (8) 24VDC In, (6) 24VDC Source Out, 24VDC Power Supply

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VersaMax Micro PLC IC200UDD104 accepts eight DC inputs and provides four low-current and two high-current DC transistor outputs. It uses +24VDC nominal input power for PLC operation.

DC Power

If configured to disable power-up diagnostics, the PLC begins logic solution 100ms after the voltage level of the power supply input reaches and maintains its nominal voltage (24VDC). The power source for the PLC must have enough transient current capability to support the inrush current of the power supply and to maintain the nominal voltage level (see power supply specifications for inrush requirements).

DC Inputs

The module's eight configurable DC inputs can be used as standard or High-speed Counter inputs. Each input can have positive or negative logic characteristics. When used as standard inputs, they are compatible with a wide range of devices, such as pushbuttons, limit switches, and electronic proximity switches.

The Micro PLC's DC supply can be used for input devices and to power the DC input circuits at about 7.5 mA per input. The combination of input circuit current and external device current must not exceed 200 mA.

Outputs

All outputs are isolated between field and logic and are switching positive voltage.

The outputs can be configured as regular outputs or as outputs controlled by the High Speed Counters. Some outputs can be used as pulse train or pulse width modulation (PWM) outputs.

External fusing should be provided to protect the outputs. Fast fuses are recommended.

The outputs share one common incoming DC supply and one common ground. The outputs are able to drive high inrush currents (8 times the rated current) and are protected against negative voltage pulses. This makes it possible to switch lamps and inductive loads.

Micro PLC IC200UDD104 Specifications

Inputs	Eight 24 VDC positive/negative logic input circuits
Outputs	Four low-current and two high-current DC output circuits
High-speed Counters	Four Type A or One Type A and One Type B
Output Power Supplies	24VDC for input circuits & user devices, 200mA max. +5VDC on pin 7 of Serial Port, 100mA max.

DC Power Specifications

Range	19.2VDC to 30VDC
Hold-up	10 ms at 19.2 VDC
Inrush Current	1A maximum at 30 VDC
Inrush Time	10 ms for 1 A
Input Current	0.16 A typical at 24 VDC
Input Power Supply Rating	4W

DC Input Specifications

Number of Inputs	8
Rated Input Voltage	24 volts DC
Input Voltage Range	0 to 30 volts DC
Input Current	7.5mA typical
Input Resistance	2.8 Kohms
Input Threshold Voltage	ON: 15VDC minimum, OFF: 5VDC maximum
Input Threshold Current	ON: 4.5mA maximum, OFF: 1.5mA minimum
Response Time	0.5 to 20ms configurable as regular input; 100µs as HSC input
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups

Output Specifications

Voltage Range	12VDC/24VDC (24VDC +10% / -43% input at V1,C1)
Maximum Load	1.0A per point (Q1 - Q2) at 24VDC at 100% ON duration 0.75A per point (Q3 - Q6) at 24VDC at 100 % ON duration 0.5A per point (Q3 - Q6) at 12VDC at 100 % ON duration
Maximum Inrush Current	Q1, Q2: 8A for 20ms, 1 pulse Q3, Q4, Q5, Q6: 4A for 20ms, 1 pulse
Output Voltage Drop	0.3V maximum
OFF state leakage	100µA maximum
Response	OFF to ON: 0.1ms maximum (24 VDC, 0.2A), ON to OFF: 0.1ms maximum (24 VDC, 0.2A)
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups
Fuse	Outputs should be fused externally. Otherwise, a load short damage the module output transistor, which is not user replaceable.

High-speed Counter Input and Output Specifications	
Maximum Counter Frequency	10kHz
Input Voltage	ON: 15V, OFF: 5V
Count Pulse Width	20% to 80% duty cycle at 10kHz
Count Registers	16bits
Outputs	
Load Voltage	12/24V
Maximum Pulse/PWM Frequency	5kHz
Number of Pulse Outputs	4
Types available	HSC, PT, PWM

Wiring Diagram, IC200UDD104

The maximum current that can be used for output points Q1 and Q2 is lower for ambient temperatures above 50 degrees C.

VersaMax Micro PLC IC200UDD112 accepts eight DC inputs and provides four low-current and two high-current DC transistor outputs. It uses +12VDC nominal input power for PLC operation.

DC Power

If configured to disable power-up diagnostics, the PLC begins logic solution 100ms after the voltage level of the power supply input reaches and maintains its nominal voltage. The power source for the PLC must have enough transient current capability to support the inrush current of the power supply and to maintain the nominal voltage level (see power supply specifications for inrush requirements).

DC Inputs

Eight configurable DC inputs can be used as positive or negative logic standard or High-speed Counter inputs. When used as standard inputs, they are compatible with a wide range of devices, such as pushbuttons, limit switches, and electronic proximity switches.

The Micro PLC's DC supply can be used for input devices and to power the DC input circuits at about 7.5 mA per input. The combination of input circuit current and external device current must not exceed 200 mA..

Transistor Outputs

Micro PLC IC200UDD112 has two high-current transistor outputs (Q1 and Q2) and four low-current transistor outputs (Q3 to Q6). All outputs are isolated between field and logic and are switching positive voltage.

The outputs can be configured as regular outputs or as outputs controlled by the High Speed Counters. Some outputs can be used as pulse train or pulse width modulation (PWM) outputs.

External fusing should be provided to protect the outputs. Fast fuses are recommended.

The outputs share one common incoming DC supply and one common ground. The outputs are able to drive high inrush currents (8 times the rated current) and are protected against negative voltage pulses. This makes it possible to switch lamps and inductive loads.

Micro PLC IC200UDD112 Specifications

Inputs	Eight 12 VDC positive/negative logic input circuits
Outputs	Four low-current and two high-current DC output circuits
High-speed Counters	Four Type A or One Type A and One Type B
Output Power Supplies	12VDC for input circuits & user devices, 200mA max. +5VDC on pin 7 of Serial Port, 100mA max.

DC Power Specifications

Range	9.6VDC to 15 VDC
Hold-up	3.0mS
Inrush Current	9.2A typical
Inrush Time	200mS typical
Input Current	300mA typical at 12 VDC
Input Power Supply Rating	3W

DC Input Specifications

Number of Inputs	8
Rated Input Voltage	12 volts DC
Input Voltage Range	0 to 15 volts DC
Input Current	9.0mA typical
Input Resistance	1.3 kOhms
Input Threshold Voltage	ON: 9.5VDC minimum, OFF: 2.5VDC maximum
Input Threshold Current	ON: 6.5mA maximum, OFF: 1.6mA minimum
Response Time	0.5 to 20ms configurable as regular input; 100µs as HSC input
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups

Output Specifications

Voltage Range	12VDC –20%, +20%
Maximum Load	0.7A per circuit, 4A per common
Maximum Inrush Current	4A for 20mS
Output Voltage Drop	0.3V maximum
OFF state leakage	0.1mA maximum
Response	OFF to ON: 0.1mS maximum 12VDC 0.2A, ON to OFF: 0.1mS maximum 12VDC 0.2A
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups
Fuse	Outputs should be fused externally. Otherwise, a load short may damage the module output transistor, which is not user replaceable.

High-speed Counter Input and Output Specifications

Maximum Counter Frequency	10kHz
Input Voltage	ON: 15V, OFF: 5V
Count Pulse Width	20% to 80% duty cycle at 10kHz
Count Registers	16bits
Outputs	
Load Voltage	12V
Maximum Pulse/PWM Frequency	5kHz
Number of Pulse Outputs	4
Types available	HSC, PT, PWM

Wiring Diagram, IC200UDD112

IC200UDR001
14 Point Micro PLC, (8) 24VDC In, (6) Relay Out, 120/240VAC Power Supply

VersaMax Micro PLC IC200UDR001 accepts eight DC inputs and provides six normally-open 2 Amp relay outputs that can control 5-30VDC or 5-250VAC output devices. It uses 100VAC to 240VAC nominal input power.

DC Inputs

Eight configurable DC inputs can be used as positive or negative logic standard or High-speed Counter inputs. When used as standard inputs, they are compatible with a wide range of devices, such as pushbuttons, limit switches, and electronic proximity switches.

The Micro PLC provides a +24 VDC supply that can be used for input devices and to power the DC input circuits at about 7.5 mA per input. The combination of input circuit current and external device current must not exceed 200 mA.

Relay Outputs

The six Form A relay outputs (SPST-single pole single throw) normally-open relay outputs can control many types of devices such as motor starters, solenoids, and indicators. Power for the internal relay coils is provided by the internal supply. An external source of AC or DC power must be supplied to operate field devices.

The relay outputs can be configured as up to four counter outputs. They cannot be used as Pulse Train or PWM outputs.

Connections and specifications for HSC outputs are the same as for standard relay outputs.

Micro PLC IC200UDR001 Specifications

Inputs	Eight 24 VDC positive/negative logic input circuits
Outputs	Six normally open 2 Amp relay circuits
High-speed Counters	Up to four Type A or one Type A and one Type B
Output Power Supplies	24VDC for input circuits & user devices, 200mA max. +5VDC on pin 7 of Serial Port, 100mA max.

AC Power Specifications

Range	100 -15% to 240 +10% VAC
Frequency	50 -5% to 60 +5% Hz
Hold-up	10mS at 85 to 100VAC. 20mS at 100 to 264VAC
Inrush Time	2mS for 40A
Inrush Current	18 Amp maximum at 120 VAC 30 Amp maximum at 200 VAC 40 Amp maximum at 265 VAC
Input Current	0.06 Amp typical at 200 VAC, 0.10 Amp typical at 100 VAC
Input Power Supply Rating	13 VA
Isolation	1500VAC RMS field-side to logic (power supply input).

DC Input Specifications

Number of Inputs	8
Rated Input Voltage	24 volts DC
Input Voltage Range	0 to 30 volts DC
Input Current	7.5mA typical
Input Resistance	2.8 Kohms
Input Threshold Voltage	ON: 15VDC minimum, OFF: 5VDC maximum
Input Threshold Current	ON: 4.5mA maximum, OFF: 1.5mA minimum
Response Time	0.5 to 20ms configurable as regular input; 100µs as HSC input
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups

Relay Output Specifications

Operating Voltage	5 to 30 VDC or 5 to 250 VAC		
Isolation	1500 V RMS between field side and logic side, 500 V RMS between groups		
Leakage Current	15 mA at 240 VAC maximum		
Maximum UL Pilot Duty Rating	2 amps at 24 VDC and 240 VAC		
Maximum Resistive Load Rating	2 amps at 24 VDC and 240 VAC		
Minimum Load	10 mA		
Maximum Inrush	5 amps per half cycle		
Response Time	ON: 15 ms maximum, OFF: 15 ms maximum		
Fuse	None		
Contact Life: Mechanical	20×10^6 mechanical operations		
Contact Life: Electrical Voltage 240VAC, 120VAC, 24VDC	Current: Resistive 2A	Current: Lamp and Solenoid 0.6A	Typical Operations 200,000

High-speed Counter Input and Output Specifications

Available High Speed Counters	Four Type A or One Type A and One Type B
Maximum Counter Frequency	10kHz
Input Voltage	ON: 15V, OFF: 5V
Count Pulse Width	20% to 80% duty cycle at 10kHz
Count Registers	16 bits
Outputs	
Available Pulse Outputs	None
Load Voltage	Refer to relay output specifications

Wiring Diagram, IC200UDR001

VersaMax Micro PLC IC200UDR002 accepts eight DC inputs and provides six normally-open 2 Amp relay outputs that can control 5 to 30 VDC or 5 to 250VAC output devices. It uses +24VDC nominal input power for PLC operation.

DC Power

The DC power supply requires more current at startup voltage (approximately 4 VDC) than at rated input voltage. A minimum of 2.0 A is required to start up the DC power supply.

If configured to disable power-up diagnostics, the PLC begins logic solution 100ms after the voltage level of the power supply input reaches and maintains 24VDC. The 24VDC power source for the PLC must have enough transient current capability to support the inrush current of the power supply and to maintain a 24VDC voltage level (see power supply specifications for inrush requirements).

DC Inputs

Eight configurable DC inputs can be used as positive or negative logic standard inputs or High-speed Counter inputs. When used as standard inputs, they are compatible with a wide range of devices, such as pushbuttons, limit switches, and electronic proximity switches.

The Micro PLC's 24VDC supply can be used for input devices and to power the DC input circuits at about 7.5 mA per input. The combination of input circuit current and external device current must not exceed 200 mA.

Relay Outputs

Six Form A (SPST-single pole single throw) normally-open relay outputs can control many types of devices such as motor starters, solenoids, and indicators. Power for the internal relay coils is provided by the internal supply. An external source of AC or DC power must be supplied to operate field devices.

The relay outputs can be configured as HSC outputs. They cannot be used as Pulse Train or PWM outputs. Connections and specifications for HSC outputs are the same as for standard relay outputs.

Micro PLC IC200UDR002 Specifications

Inputs	Eight 24 VDC positive/negative logic input circuits
Outputs	Six normally open 2 Amp relay circuits
High-speed Counters	Up to four Type A or one Type A and one Type B
Output Power Supplies	24VDC for input circuits & user devices, 200mA max. +5VDC on pin 7 of Serial Port, 100mA max.

DC Power Specifications

Range	24 –20%/+25% VDC
Hold-up	10 ms at 19.2 VDC
Inrush Current	1 A maximum at 30 VDC
Inrush Time	10 ms for 1 A
Input Current	0.16 A typical at 24 VDC
Input Power Supply Rating	4W

DC Input Specifications

Number of Inputs	8
Rated Input Voltage	24 volts DC
Input Voltage Range	0 to 30 volts DC
Input Current	7.5mA typical
Input Resistance	2.8 Kohms
Input Threshold Voltage	ON: 15VDC minimum, OFF: 5VDC maximum
Input Threshold Current	ON: 4.5mA maximum, OFF: 1.5mA minimum
Response Time	0.5 to 20ms configurable as regular input; 100µs as HSC input
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups

Relay Output Specifications

Operating Voltage	5 to 30 VDC or 5 to 250 VAC		
Isolation	1500 V RMS between field side and logic side, 500 V RMS between groups		
Leakage Current	15 mA at 240 VAC maximum		
Maximum UL Pilot Duty Rating	2 amps at 24 VDC and 240 VAC		
Maximum Resistive Load Rating	2 amps at 24 VDC and 240 VAC		
Minimum Load	10 mA		
Maximum Inrush	5 amps per half cycle		
Response Time	ON: 15 ms maximum, OFF: 15 ms maximum		
Contact Life: Mechanical	20×10^6 mechanical operations		
Contact Life: Electrical Voltage 240VAC, 120VAC, 24VDC	Current: Resistive 2A	Current: Lamp and Solenoid 0.6A	Typical Operations 200,000

High-speed Counter Input and Output Specifications

Maximum Counter Frequency	10kHz
Input Voltage	ON: 15V, OFF: 5V
Count Pulse Width	20% to 80% duty cycle at 10kHz
Count Registers	16 bits
Outputs	
Available Pulse Outputs	None
Load Voltage	Refer to relay specifications

Wiring Diagram, IC200UDR002

IC200UDR003
14 Point Micro PLC, (8) 12VDC In, (6) Relay Out, 12 VDC Power Supply

VersaMax Micro PLC IC200UDR003 accepts eight DC inputs and provides six normally-open 2 Amp relay outputs that can control 5 to 30 VDC or 5 to 250VAC output devices. It uses +12VDC nominal input power for PLC operation.

DC Power

The DC power supply requires more current at startup voltage (approximately 4 VDC) than at rated input voltage. A minimum of 2.0 A is required to start up the DC power supply. If configured to disable power-up diagnostics, the PLC begins logic solution 100ms after the voltage level of the power supply input reaches and maintains 24VDC. The 24VDC power source for the PLC must have enough transient current capability to support the inrush current of the power supply and to maintain a 24VDC voltage level (see power supply specifications for inrush requirements).

DC Inputs

Eight configurable DC inputs can be used as positive or negative logic standard or High-speed Counter inputs. When used as standard inputs, they are compatible with a wide range of devices, such as pushbuttons, limit switches, and electronic proximity switches.

The Micro PLC's 12VDC supply can be used for input devices and to power the DC input circuits at about 7.5 mA per input. The combination of input circuit current and external device current must not exceed 200 mA.

Relay Outputs

The six normally-open Form A relay outputs (SPST-single pole single throw) can control many types of devices such as motor starters, solenoids, and indicators. Power for the internal relay coils is provided by the internal supply. An external source of AC or DC power must be supplied to operate field devices.

The relay outputs can be configured as HSC outputs. They cannot be used as Pulse Train or PWM outputs. Connections and specifications for HSC outputs are the same as for standard relay outputs.

Micro PLC IC200UDR003 Specifications

Inputs	Eight 12 VDC positive/negative logic input circuits
Outputs	Six normally open 2 Amp relay circuits
High-speed Counters	Up to four Type A or one Type A and one Type B
Output Power Supplies	12VDC for input circuits & user devices, 200mA max. +5VDC on pin 7 of Serial Port, 100mA max.

DC Power Specifications

Range	9.6VDC - 15VDC
Hold-up	3.0mS
Inrush Current	9.2A typical at 12 VDC
Inrush Time	200µS typical
Input Current	200mA typical at 12 VDC
Input Power Supply Rating	3W

DC Input Specifications

Number of Inputs	8
Rated Input Voltage	12 volts DC
Input Voltage Range	0 to 15 volts DC
Input Current	9.0mA typical
Input Resistance	1.3 kOhms
Input Threshold Voltage	ON: 9.5VDC minimum, OFF: 2.5VDC maximum
Input Threshold Current	ON: 6.5mA maximum, OFF: 1.6mA minimum
Response Time	0.5 to 20ms configurable as regular input; 100µs as HSC input
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups

Relay Output Specifications

Operating Voltage	5 to 30 VDC or 5 to 250 VAC		
Isolation	1500 V RMS between field side and logic side 500 V RMS between groups		
Leakage Current	15 mA at 240 VAC maximum		
Maximum UL Pilot Duty Rating	2 amps at 24 VDC and 240 VAC		
Maximum Resistive Load Rating	2 amps at 24 VDC and 240 VAC		
Minimum Load	10 mA		
Maximum Inrush	5 amps per half cycle		
Response Time	ON: 15 ms maximum, OFF: 15 ms maximum		
Contact Life: Mechanical	20×10^6 mechanical operations		
Contact Life: Electrical Voltage 240VAC, 120VAC, 24VDC	Current: Resistive 2A	Current: Lamp and Solenoid 0.6A	Typical Operations 200,000

High-speed Counter Input and Output Specifications

Maximum Counter Frequency	10kHz
Input Voltage	ON: 9V, OFF: 2.5V
Count Pulse Width	20% to 80% duty cycle at 10kHz
Count Registers	16 bits
Outputs	
Available Pulse Outputs	None
Load Voltage	Refer to relay specifications

Wiring Diagram, IC200UDR003

VersaMax 20-Point Micro/Micro PLUS PLCs

This chapter describes the features, specifications, and field wiring for 20-point VersaMax Micro and VersaMax Micro PLUS PLCs.

▪	IC200UDD020	20 point, (12) 24VDC In, (4) 24VDC Outputs with ESCP, (4) 24VDC Transistor Outputs, 24VDC Power Supply
▪	IC200UDD220	20 point, (12) 24VDC In, (8) 24VDC Transistor Outputs, 24VDC Power Supply
▪	IC200UDR020	20 point, (12) 24VDC In, (8) Relay Out, 24VDC Power Supply
▪	IC200UDR120	20 point, (12) 24VDC In, (8) Relay Out, 120/240VAC Power Supply

Note: Firmware releases 4.00 and later require a Micro PLUS CPU, which has enhanced memory. Firmware versions 4.00 cannot be used with the earlier hardware versions.

- ▪ Micro and Micro PLUS PLCs support the same user logic memory size

- ▪ The specifications given in this chapter for Micro PLCs also apply to Micro PLUS PLCs.

Features of VersaMax 20-Point Micro PLCs
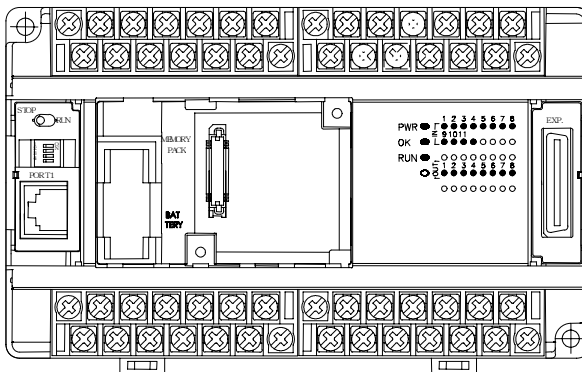
All VersaMax Micro-20 PLCs feature:

- Removable screw-down "barrier-style" terminal strips with protective covers.
- Built-in serial communications port that supports SNP/ SNPX master and slave, Modbus RTU master and slave, and Serial I/O.
- Removable Memory Pack Module available.
- Optional Port 2.
- Run/Stop mode switch that can be configured as a run/stop switch, a memory protect switch, and also used for clearing faults when a fatal fault exists.
- Full-featured programming Instruction Set with floating point math. The application program can be either Ladder Diagram (LD) or Instruction List (IL) format.
- 24K words of program memory, 32K words of registers.
- Flash memory (ROM) for non-volatile program storage and for system firmware.
- Configurable to read configuration and application program at power up from either RAM or flash memory (ROM).
- Capacitor backup for RAM and the Time-of-Day clock for at least 30 minutes at 25° C
- Optional lithium battery backup for RAM and real-time clock.
- Enhanced High-speed Counter / Pulse Train commands for Jogging, Blending, and Homing, plus configurable 32-bit Counters /PTO/ and 32-bit function blocks.

Input Terminals on Removable Terminal Strips

Run/Stop Mode Switch

Option Module Connector

Status LEDS

RS-232 Serial Port 1

Expansion Connector

DIN Rail Release

Output Terminals on Removable Terminal Strips
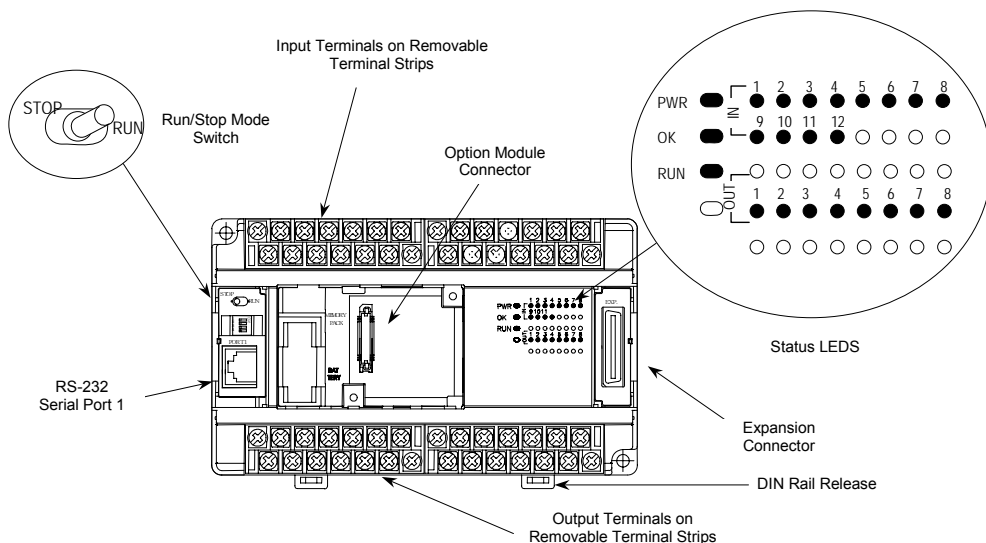
Run/Stop Switch

The Run/Stop switch can be configured as a run/stop switch or a memory protect switch, and used for clearing faults when a fatal fault exists.

Ports

Port 1 is a built-in RS-232 serial port with an RJ-45 connector.

A second port can be added to a Micro-20 PLC using one of the port Option Modules described in chapter 14. If a second port is installed, both ports can be used for programming. Only one port can be used at a time for programming, but both ports can be used for monitoring at the same time.

Port 1 and the optional Port 2 are individually-configurable for SNP master/slave, RTU master/slave, and Serial I/O protocols. Both 4-wire and 2-wire RTU are supported when the RS-485 Port Option module is installed as port 2. Port 2 does not support hardware flow control. When either port is being used for RTU slave, it automatically switches to SNP slave mode when that port is being used by the programmer. If a port is configured for Serial I/O, RTU Master, or SNP Master operation, that port defaults to SNP slave and automatically reverts to SNP slave when the CPU is in Stop mode.

Either port can be software-configured to set up communications between the CPU and various serial devices. An external device can obtain power from the port if it requires 200mA or less at 5VDC.

Analog Inputs

The RS232 Option Module (IC200USB001) or the RS485 Option Module (IC200USB002) can provide two 0-10V analog inputs. See chapter 14 for more information about option modules. The two inputs can be used to adjust the values in analog registers %AI016 (input 1) and %AI017 (input 2). An example use for the analog inputs would be to set threshold values for use in logical relationships with other inputs/outputs.

Removable Terminal Strips

The removable terminal assemblies are protected by hinged covers. After turning off power to the Micro PLC, a terminal assembly and attached field wiring can be separated from the Micro PLC by removing two screws.

Status LEDs

LEDs on the Micro PLC provide quick visual verification of operating status. In addition to LEDs for Power, OK, and Run mode, there is an LED for each I/O point.

Backup Battery

The Micro PLC uses a large value capacitor to provide memory retention current to the System/User RAM and the Time-of-Day clock when the power supply is either not present or not powered up. The capacitor retains memory contents for at least 30 minutes.

To maintain memory for longer than this, a replaceable battery assembly can be installed in the battery holder, as described in chapter 15. The Micro PLC reports the battery state to the PLC Fault Table and also uses Status Bits %SA011 and %S0014 to indicate the battery state.

General Specifications of 20-Point VersaMax Micro PLCs

Module Dimensions	Height: 90mm (3.6 inches) Depth: 76mm (3.0 inches) Width: 150mm (6.0 inches)
Typical Scan Rate	1.7 ms/K for Boolean logic (see appendix A)
Real Time Clock accuracy (for Timer contacts and Timer function blocks)	+/-0.5%
Time-of-Day Clock accuracy	+/-5 sec/day @10degC, +/-5 sec/day @25degC, and +/-11 sec/day @ 55°C or across full temperature range
Maximum number of slave devices per RS-485 network	8 (can be increased with a repeater)
+24 VDC Output Power Supply (for input circuits and user devices)	435mA maximum
+5 VDC output of Serial Ports	200mA per port, 400mA total for both ports, maximum

High-Speed Counters

All VersaMax Micro PLCs with DC power can be configured to provide built-in High-Speed Counter and pulse operation.

When configured for High-Speed Counter operation, inputs can be set up as:

- Up to four Type A Counters or
- One Type A and one Type B Counter.
- Up to four Type A_32 Counters or
- One Type A and one Type B_32 Counter

Each counter provides direct processing of rapid pulse signals up to 100kHz for industrial control applications such as meter proving, turbine flow meter, velocity measurement, material handling, motion control, and process control.

Each counter can be enabled independently. Type A counters can be configured for up or down counting (default is up) and for positive or negative edge detection (default is positive). The type B counter provides an A Quad B counting function.

See chapter 18 for information about High-Speed Counter features.

> ### IC200UDD020
> ### 20 Point Micro PLC, (12) 24VDC In, (4) 24VDC Out with ESCP, (4) LCDC Out, 24VDC Power Supply

VersaMax Micro PLC IC200UDD020 accepts twelve DC inputs and provides four ESCP outputs and four 24VDC low-current outputs. It uses +24VDC nominal input power for PLC operation.

DC Power

If configured to disable power-up diagnostics, the PLC begins logic solution 100ms after the voltage level of the power supply input reaches and maintains its nominal voltage (24VDC). The power source for the PLC must have enough transient current capability to support the inrush current of the power supply and to maintain the nominal voltage level (see power supply specifications for inrush requirements).

DC Inputs

The twelve configurable DC inputs can be used as positive or negative logic standard inputs. Eight of these inputs can be used for High-speed Counter inputs. When used as standard inputs, they are compatible with a wide range of input devices, such as pushbuttons, limit switches, and electronic proximity switches.

The Micro PLC's +24 VDC supply can be used for input devices and to power the DC input circuits at about 8mA per input. The combination of input circuit current and external device current must not exceed 435 mA.

DC Outputs

Outputs 1 – 4 can be used as standard, High-speed Counter, Pulse-Width Modulated, Pulse Train Outputs, or Pulse Train Outputs with Ramping. All standard outputs are all source-type. Outputs can be used to switch devices like valves, lamps or contactors.

Outputs 5 – 8 provide Electronic Short-Circuit Protection.

Micro PLC IC200UDD020 Specifications

Inputs	Twelve 24 VDC positive or negative logic inputs
Outputs	Eight 24 VDC outputs. Outputs 5-8 with ESCP
High-speed Counters	Up to four Type A or one Type A and one Type B, or four Type A_32, or one Type A_32 and one Type B_32

DC Power Specifications

Range	19.2VDC to 30VDC
Hold-up	10mS at 19.2 VDC
Inrush Current	1 Amp maximum at 30VDC
Inrush Time	10mS for 1 Amp
Input Current	0.20 Amp typical at 24VDC
Input Power Supply Rating	5W

DC Input Specifications

Rated Input Voltage	24 volts DC
Input Voltage Range	0 to 30 volts DC
Input Current at 24VDC	I1, I 3, I 5, I 7: 8mA typical; Other inputs: 4.8mA typical
Input Impedance	I1, I 3, I 5, I 7: 2.7 Kohms; Other inputs: 4.7 Kohms
Input Threshold Voltage	ON: 18VDC minimum, OFF: 5VDC maximum
Input Threshold Current	I1, I3, I5, I7: ON 4.5mA maximum, OFF: 1.8mA minimum Other Inputs: ON 3.3mA maximum, OFF: 1.6mA minimum
Response Time	0.5ms to 20ms configurable as regular input; 100μs as HSC input
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups

Output Specifications

Voltage Range	12VDC / 24VDC
External Power Supply	12/24VDC –10%, +20%
Maximum Load Current	0.5A per point (Q1 – Q4) at 24VDC at 100 % ON duration
	0.7A per point (Q5 – Q8) at 24VDC at 100 % ON duration
Minimum Switching Current	10mA
Maximum Inrush Current	Q1-Q4: 2A for 20ms, 1 pulse Q5-Q8: 4A for 20ms, 1 pulse
Output Voltage Drop	0.3V maximum
OFF state leakage current	0.1mA maximum
Response Time	OFF to ON, ON to OFF: 1ms maximum (24 VDC)
Isolation Voltage	1500V RMS between field side and logic side, 500V RMS between groups
Fuse	None, outputs Q5 – Q8 are ESCP protected
Undervoltage shutdown	Q5 – Q8: 5V minimum, 8V maximum
DC short circuit current	Q1 – Q4: 5A typical Q5 – Q8: 0.7A minimum, 2A maximum
Peak short circuit current	Q5 – Q8: 4A maximum
Delay time of peak short circuit current	100 microseconds
Delay time of current limit	100 microseconds

High-speed Counter Input and Output Specifications	
Maximum Counter Frequency	100kHz
Input Voltage	ON : 18V, OFF: 5V
Count Pulse Width	20% to 80% of duty cycle at 100kHz
Count Registers	16/32 bits
Outputs	
Load Voltage	12/24VDC
Maximum Pulse/Pulse Train with Ramping/PWM Frequency	PWM and PTO: 65kHz Pulse Train with Ramping: 65kHz
Types available	Up to four HSC, PTO, PTO with Ramping and/or PWM outputs

Wiring Diagram, IC200UDD020

VersaMax Micro PLC IC200UDD220 accepts twelve DC inputs and provides eight DC outputs. It uses +24VDC nominal input power for PLC operation.

DC Power

If configured to disable power-up diagnostics, the PLC begins logic solution 100ms after the voltage level of the power supply input reaches and maintains 24VDC. The 24VDC power source for the PLC must have enough transient current capability to support the inrush current of the power supply and to maintain a 24VDC voltage level (see power supply specifications for inrush requirements).

DC Inputs

Twelve configurable DC inputs can be used as positive or negative logic standard inputs. Eight of these inputs can be used for High-speed Counter inputs. When used as standard inputs, they are compatible with a wide range of input devices, such as pushbuttons, limit switches, and electronic proximity switches.

The Micro PLC's +24 VDC supply can be used for input devices and to power the DC input circuits at about 8mA per input. The combination of input circuit current and external device current must not exceed 435mA.

DC Outputs

Micro PLC IC200UDD220 has eight Sink-type DC outputs. All outputs are isolated between field and logic and are switching positive voltage. The outputs are able to drive high inrush currents (8 times the rated current) and are protected against negative voltage pulses. This makes it possible to switch lamps and inductive loads.

DC outputs can be used as standard, High-speed Counter, Pulse-Width Modulated, Pulse Train Outputs, or Pulse Train Outputs with Ramping.

Micro PLC IC200UDD220 Specifications

Inputs	Twelve 24 VDC positive or negative logic inputs
Outputs	Eight transistor outputs, 24 VDC.
High-speed Counters	Up to four Type A or one Type A and one Type B, or four Type A_32, or one Type A_32 and one Type B_32

DC Power Specifications

Range	19.2VDC to 30VDC
Hold-up	10mS at 19.2 VDC
Inrush Current	1 Amp maximum at 30VDC
Inrush Time	10mS for 1 Amp
Input Current	0.20 Amp typical at 24VDC
Input Power Supply Rating	5W

DC Input Specifications

Rated Input Voltage	24 volts DC
Input Voltage Range	0 to 30 volts DC
Input Current at 24VDC	I1, I 3, I 5, I 7: 8mA typical; Other inputs: 4.8mA typical
Input Impedance	I1, I 3, I 5, I 7: 2.7 Kohms; Other inputs: 4.7 Kohms
Input Threshold Voltage	ON: 18VDC minimum, OFF: 5VDC maximum
Input Threshold Current	I1, I3, I5, I7: ON 4.5mA maximum, OFF: 1.8mA minimum Other Inputs: ON 3.3mA maximum, OFF: 1.6mA minimum
Response Time	0.5ms to 20ms configurable as regular input; 100µs as HSC input
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups

Output Specifications

Voltage Range	12VDC/24VDC
External Power Supply	12/24VDC –10%, +20%
Maximum Load Current	0.5A per point (Q1 – Q8) at 24VDC
Minimum Switching Current	10mA
Maximum Inrush Current	Q1-Q8: 2A for 20ms, 1 pulse
Output Voltage Drop	0.3VDC maximum
OFF state leakage current	0.1mA maximum
Response Time	OFF to ON, ON to OFF: 1ms maximum @ 24VDC
Isolation Voltage	1500V RMS between field side and logic side, 500V RMS between groups

High-speed Counter Input and Output Specifications

Maximum Counter Frequency	100kHz
Input Voltage	ON : 18V, OFF: 5V
Count Pulse Width	20% to 80% of duty cycle at 100kHz
Count Registers	16/32 bits

Outputs

Load Voltage	12/24VDC
Maximum Pulse/PWM Frequency	PWM and PTO: 65kHz Pulse Train with Ramping: 65kHz
Types available	Up to four HSC, PTO, PTO, and/or PWM outputs

Wiring Diagram, IC200UDD220

Q1 to Q4: 0.5Amp
COM1: 2 Amps

Q5 to Q8: 0.5 Amp
COM2: 2 Amps
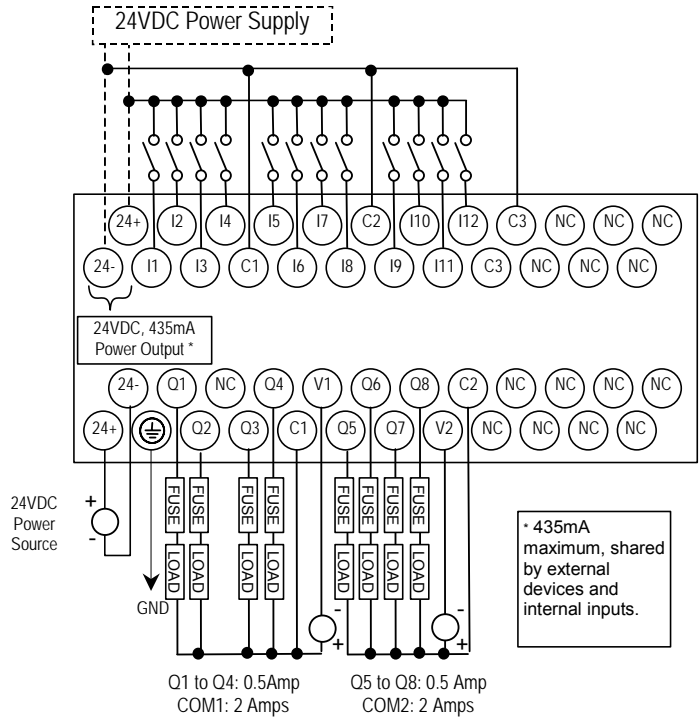
IC200UDR020
20 Point Micro PLC, (12) 24VDC In, (8) Relay Out, 24VDC Power Supply

VersaMax Micro PLC IC200UDR020 accepts twelve DC inputs and provides eight normally-open 2 Amp relay outputs. It uses +24VDC nominal input power for PLC operation.

DC Inputs

Twelve configurable DC inputs can be used as positive or negative logic standard inputs. Eight of these inputs can be used for High-speed Counter inputs. When used as standard inputs, they are compatible with a wide range of input devices, such as pushbuttons, limit switches, and electronic proximity switches.

The Micro PLC's +24 VDC supply can be used for input devices and to power the DC input circuits at about 8mA per input. The combination of input circuit current and external device current must not exceed 435mA.

Relay Outputs

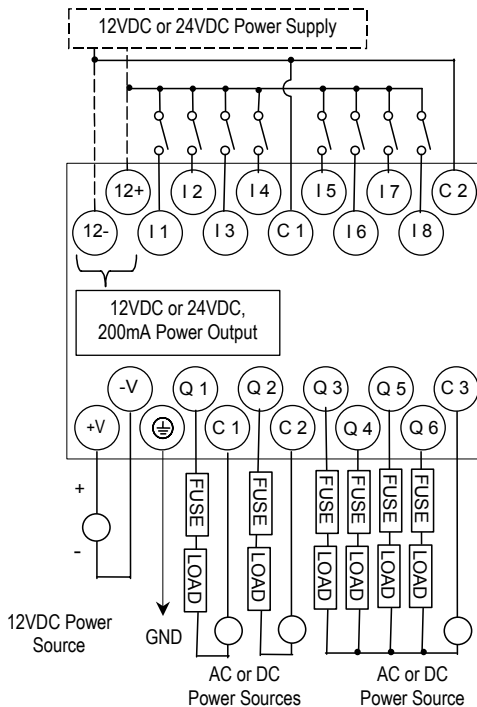The eight normally-open Form A relay outputs (SPST-single pole single throw) can control many types of load devices such as motor starters, solenoids, and indicators. The switching capacity of each of these circuits is 2 amps. An external source of AC or DC power must be supplied to operate field devices.

The relay outputs can be configured as up to four HSC outputs. Relay outputs cannot be used as Pulse Train or PWM outputs.

Micro PLC IC200UDR020 Specifications

Inputs	Twelve 24 VDC positive/negative logic input circuits
Outputs	Eight normally open 2 amp relay circuits
High-speed Counters	Up to four Type A or one Type A and one Type B, or four Type A_32, or one Type A_32 and one Type B_32
+24 VDC Output Power Supply	435mA maximum (for input circuits and user devices)
+5 VDC output of Serial Port	Serial Port 1, pin 7: 100mA maximum

DC Power Specifications

Range	19.2VDC to 30VDC
Hold-up	10mS at 19.2 VDC
Inrush Current	1 Amp maximum at 30VDC
Inrush Time	10mS for 1 Amp
Input Current	0.20 Amp typical at 24VDC
Input Power Supply Rating	5W

DC Input Specifications

Rated Input Voltage	24 volts DC
Input Voltage Range	0 to 30 volts DC
Input Current at 24VDC	I1, I3, I5, I7: 8mA typical; other inputs 4.8mA typical
Input Impedance	I1, I3, I5, I7: 2.7 kOhms; other inputs: 4.7kOhms
Input Threshold Voltage	ON: 18VDC minimum, OFF: 5VDC maximum
Input Threshold Current	I1, I3, I5, I7: ON 4.5mA maximum, OFF: 1.8mA minimum Other inputs: ON 3.3mA maximum, OFF: 1.6mA maximum
Response Time	0.5ms to 20ms configurable as regular input; 100µs as HSC input
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups

Relay Output Specifications

Operating Voltage	5 to 30 VDC or 5 to 250 VAC		
Isolation	1500 V RMS between field side and logic side, 500 V RMS between groups		
Leakage Current	15 mA at 240 VAC maximum		
Maximum UL Pilot Duty Rating	2 amps at 24 VDC and 240 VAC		
Maximum Resistive Load Rating	2 amps at 24 VDC and 240 VAC		
Minimum Load	10 mA		
Maximum Inrush	1.5A,10ms		
Response Time	ON: 15 ms maximum, OFF: 15 ms maximum		
Contact Life: Mechanical	20×10^6 mechanical operations		
Contact Life: Electrical Voltage 240VAC, 120VAC, 24VDC	Current: Resistive 2.0A	Current: Lamp and Solenoid 0.6A	Typical Operations 200,000

High-speed Counter Input and Output Specifications	
Maximum Counter Frequency	100kHz
Input Voltage	ON: 18V, OFF: 5V
Count Pulse Width	20% to 80% of duty cycle at 100kHz
Count Registers	16/32 bits
Outputs	
Load Voltage	Q1: 5/12/24V, Q2-Q4: See relay output specifications
Type available	Up to four HSC outputs. Pulse outputs are not available.

Wiring Diagram, PLC IC200UDR020

GND   Q1 to Q8: 2 Amps

COM1: 2 Amps   COM2: 4 Amps   COM3: 2 Amps   COM4: 2 Amps   COM5: .2 Amps

VersaMax Micro PLC IC200UDR120 accepts twelve DC inputs and provides eight normally-open 2 Amp relay outputs. It uses 100VAC to 240VAC nominal input power for PLC operation.

DC Inputs

Twelve configurable DC inputs can be used as positive or negative logic standard inputs. Eight of these inputs can be used for High-speed Counter inputs. When used as standard inputs, they are compatible with a wide range of input devices, such as pushbuttons, limit switches, and electronic proximity switches.

The Micro PLC's +24 VDC supply can be used for input devices and to power the DC input circuits at about 8mA per input. The combination of input circuit current and external device current must not exceed 435mA.

Relay Outputs

The eight normally-open Form A relay outputs (SPST-single pole single throw) can control many types of load devices such as motor starters, solenoids, and indicators. The switching capacity of each of these circuits is 2 amps. An external source of AC or DC power must be supplied to operate field devices.

The relay outputs can be configured as up to four HSC outputs. Relay outputs cannot be used as Pulse Train or PWM outputs.

Micro PLC IC200UDR120, Specifications

Inputs	Twelve 24 VDC positive/negative logic input circuits
Outputs	Eight normally open 2 amp relay circuits
High-speed Counters	Up to four Type A or one Type A and one Type B, or four Type A_32, or one Type A_32 and one Type B_32
+24 VDC Output Power Supply	435mA maximum (for input circuits and user devices)
+5 VDC output of Serial Port	Serial Port 1, pin 7: 100mA maximum

AC Power Specifications

Range	100 -15% to 240 +10% VAC
Frequency	50 -5% to 60 +5% Hz
Hold-up	10mS at 85 to 100VAC, 20mS at 100 to 265VAC
Inrush Current	30 Amp maximum at 200 VAC, 40 Amp maximum at 265 VAC
Inrush Time	2 ms for 40Amp
Input Current	0.20 Amp typical at 200 VAC 0.10 Amp typical at 100 VAC
Input Power Supply Rating	26 VA

DC Input Specifications

Rated Input Voltage	24 volts DC
Input Voltage Range	0 to 30 volts DC
Input Current at 24VDC	I1, I3, I5, I7: 8mA typical; other inputs 4.8mA typical
Input Impedance	I1, I3, I5, I7: 2.7 kOhms; other inputs: 4.7kOhms
Input Threshold Voltage	ON: 18VDC minimum, OFF: 5VDC maximum
Input Threshold Current	I1, I3, I5, I7: ON 4.5mA maximum, OFF: 1.8mA minimum Other inputs: ON 3.3mA maximum, OFF: 1.6mA maximum
Response Time	0.5ms to 20ms configurable as regular input; 100µs as HSC input
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups

Relay Output Specifications			
Operating Voltage	5 to 30 VDC or 5 to 250 VAC		
Isolation	1500 V RMS between field side and logic side, 500 V RMS between groups		
Leakage Current	15 mA at 240 VAC maximum		
Maximum UL Pilot Duty Rating	2 amps at 24 VDC and 240 VAC		
Maximum Resistive Load Rating	2 amps at 24 VDC and 240 VAC		
Minimum Load	10 mA		
Maximum Inrush	9.4A, 20mSec		
Response Time	ON: 15 ms maximum, OFF: 15 ms maximum		
Contact Life: Mechanical	20×10^6 mechanical operations		
Contact Life: Electrical Voltage 240VAC, 120VAC, 24VDC	Current: Resistive 2.0A	Current: Lamp and Solenoid 0.6A	Typical Operations 200,000
High-speed Counter Input and Output Specifications			
Maximum Counter Frequency	100kHz		
Input Voltage	ON: 18V, OFF: 5V		
Count Pulse Width	20% to 80% of duty cycle at 100kHz		
Count Registers	16/32 bits		
Outputs			
Load Voltage	Q1: 5/12/24V, Q2-Q4: See relay output specifications		
Type available	Up to four HSC outputs. Pulse outputs are not available.		

Wiring Diagram, PLC IC200UDR120

Q1 to Q8: 2 Amps
COM1: 2 Amps COM2: 4 Amps COM3: 2 Amps COM4: 2 Amps COM5: .2 Amps

Chapter 5 | *Micro PLCs with 23 Discrete Points and 3 Analog Channels*

This chapter describes the features and specifications of the VersaMax Micro PLCs with 23 Discrete Points and 3 Analog Channels. It also provides additional information about analog operation and calibration.

- IC200UAL004 Micro PLC with 23 Discrete Points and 3 Analog Channels:
  (13) 12VDC In, (10) Relay Out,
  (2) Analog In and (1) Analog Out, 12VDC Power Supply

- IC200UAL005 Micro PLC with 23 Discrete Points and 3 Analog Channels:
  (13) 24VDC In, (1) 24VDC Out, (9) Relay Out,
  (2) Analog In and (1) Analog Out, 24VDC Power Supply

- IC200UAL006 Micro PLC with 23 Discrete Points and 3 Analog Channels:
  (13) 24VDC In, (1) 24VDC Out, (9) Relay Out,
  (2) Analog In and (1) Analog Out, 120/240VAC Power Supply

VersaMax 23 Discrete / 3 Analog Micro PLC Features

- Supports up to four Expansion Units in any combination.

- Four removable screw-down "barrier-style" terminal strips with protective covers.

- Two Serial communications ports. Port 1 (RS-232) supports SNP/SNPX slave protocols. Port 2 (RS-485) supports SNP/ SNPX master and slave, RTU master and slave, and Serial I/O.

- Run/Stop mode switch that can be configured as a run/stop switch, a memory protect switch, and also used for clearing faults when a fatal fault exists.

- Time-of-Day Clock.

- Two analog potentiometers.

- Full-featured programming Instruction Set with floating point math. The application program can be either Ladder Diagram (LD) or Instruction List (IL) format.

- 9K words of program memory, 2048 words of registers.

- Flash memory (ROM) for non-volatile program storage and for system firmware.

- Configurable to read configuration at powerup from either RAM or flash memory (ROM). Can also be configured to read application program from flash at powerup.

- Capacitor backs up RAM and the Time-of-Day clock for at least 30 minutes.

- Optional lithium battery backup for RAM and real-time clock.

General Specifications for 23-Point VersaMax Micro PLCs

Weight	600 grams (1.32lbs)
Module Dimensions	Height: 90mm (3.6 inches) Depth: 76mm (3.0 inches) Width: 150mm (6.0 inches)
Typical Scan Rate	1.1 ms/K for Boolean logic (see appendix A)
Real Time Clock accuracy (for Timer contacts and Timer function blocks)	+/-0.5%
Time-of-Day Clock accuracy	+/-5 sec/day @10degC, +/-5 sec/day @25degC, and +/-11 sec/day @55degC or across full temperature range
High-speed Counters	Up to four Type A or one Type A and one Type B
Maximum number of slave devices per RS-485 network	8 (can be increased with a repeater)
+5 VDC Output of Serial Ports	Port 1, pin 7: 100mA maximum* Port 2, pin 5: 100mA maximum* *Combined port 1 and port 2 total not to exceed 100mA max.
Lithium battery (IC200ACC403	Storage: Up to 5 years typical at 30 °C Installed: Up to 3 years typical at 55 °C 4 months battery backup time (powered down) minimum at 55 °C

Run/Stop Switch

The Run/Stop switch can be configured as a run/stop switch, a memory protect switch, and used for clearing faults when a fatal fault exists.
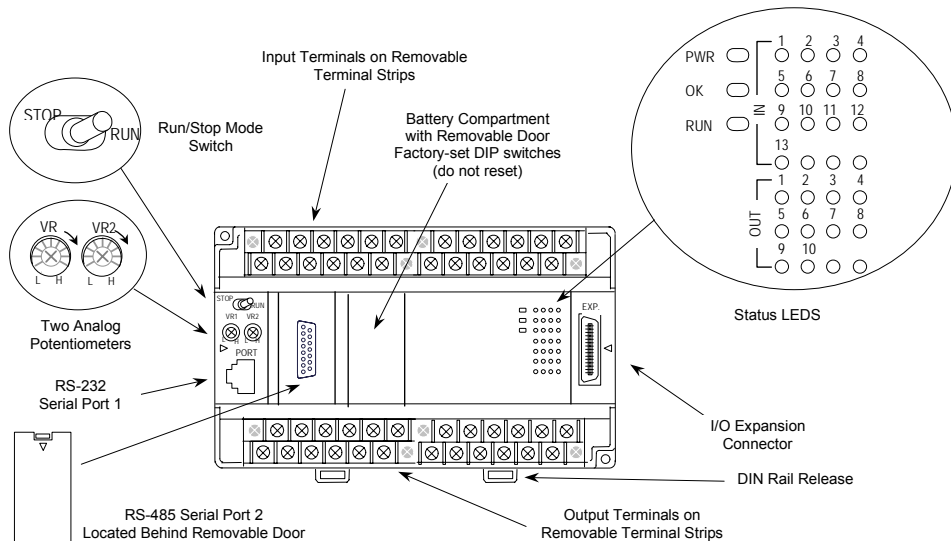
Serial Ports

Port 1 is an RS-232 serial port with an RJ-45 connector. Port 2, located behind a removable door on the front of the Micro PLC, is an RS-485 serial port with a DB-15 connector. Both ports can be used for programming. Only one port can be used at a time for programming, but both ports can be used for monitoring at the same time. Port 1 uses SNP slave protocol. Port 2 is software-configurable for SNP master/slave RTU slave or Serial I/O operation. CPUs with firmware version 2.02 or

later support Modbus RTU Master on port 2. 4-wire and 2-wire RTU are supported. If Port 2 is being used for RTU, it automatically switches to SNP slave mode if necessary. Port 2 defaults to SNP slave and automatically reverts to SNP slave when the CPU is in Stop mode, if configured for Serial I/O.

Either port can be software-configured to set up communications between the CPU and various serial devices. An external device can obtain power from both ports if it requires 100mA or less at 5VDC.

Analog Potentiometers

The two potentiometers can be used to adjust the values in analog registers %AI016 and %AI017. An example use would be to set thresholds for use in logical relationships with other inputs/outputs.

Removable Terminal Strips

The removable terminal assemblies are protected by hinged covers. After turning off power to the Micro PLC, a terminal assembly and attached field wiring can be separated from the Micro PLC by removing two screws.

Status LEDs

LEDs for Power, OK, and Run mode, plus individual LEDs for each I/O point.

Backup Battery

The Micro PLC uses a large value capacitor to provide memory retention current to the System/User RAM and the Time-of-Day clock when the power supply is either not present or not powered up. The capacitor retains memory contents for at least 30 minutes.

To maintain memory for longer than this, a lithium coin cell assembly (IC200ACC403) can be installed in the battery holder. The Micro PLC reports the battery state to the PLC Fault Table and also uses Status Bits %SA011 and %S0014 to indicate the battery state.

High Speed Counters

These VersaMax Micro PLCs can be configured to provide built-in high-speed counter operation.

When configured for High-speed Counter operation, inputs can be set up as:

- Up to four High-speed Counters or
- One Type A and one Type B Counter.

Each counter provides direct processing of rapid pulse signals up to 10kHz for industrial control applications such as meter proving, turbine flowmeter, velocity measurement, material handling, motion control, and process control.

Each counter can be enabled independently. Type A counters can be configured for up or down counting (default is up) and for positive or negative edge detection (default is positive). The type B counter provides an A Quad B counting function.

The relay outputs of IC200UAL004 and IC200UAL005 can be configured as up to four counter outputs. They cannot be used as Pulse Train or PWM outputs.

Analog I/O

All VersaMax 23-Point Micro PLCs provide two analog input channels that can be configured to accept inputs from 0 to +10V or from 0 to 20mA or 4 to 20mA input signals. They also have one analog output configurable for the same voltage or current ranges. See chapter 15 for information about configuring voltage/current operation and range. See chapter 16 for details of analog operation, automatic gain and offset adjustment, automatic program reference configuration, and calibration procedures.

Analog I/O Specifications	
Input and output ranges	0 to 10V (10.24V maximum) 0 to 20mA (20.5mA maximum) 4 to 20mA (20.5mA maximum)
Resolution	12 bits over 0 to 10V range (1 LSB=2.5mV) 12 bits over 0 to 20mA range (1 LSB=5µA) 11+ bits over 4 to 20mA range (1 LSB=5µA)
Accuracy	±1% of full scale over full operating temperature range
Analog Inputs	2, differential
Factory calibrated to:	2.50mV per count on 0 to 10V range 5.00µA per count on 0 to 20mA and 4 to 20mA ranges
Linearity	±3 LSB maximum
Isolation	non-isolated
Common mode voltage	±200 V maximum
Current input impedance	249 ohms
Voltage input impedance	100 Kohms
Input filter time	20ms to reach 1% error for step input
Analog Output	1, single-ended, non isolated

Current: maximum terminal voltage
        user load range
        output load capacitance
        output load inductance
	10V (at 20mA output)
	0 to 500 ohms
	2000 pF maximum
	1 henry maximum

Voltage: output loading output load capacitance	2 Kohm minimum at 10 volts 1 µF maximum

IC200UAL004
Micro PLC, 23 Discrete Points and 3 Analog Channels:
(13) 12VDC In, (10) Relay Out, (2) Analog In, (1) Analog Out, 12VDC Power Supply

VersaMax Micro PLC IC200UAL004 accepts thirteen 12VDC inputs and two analog inputs. It provides ten normally-open 2 Amp relay outputs and one analog output. It uses +12VDC nominal input power.

DC Inputs

Thirteen configurable 12VDC inputs can be used as positive or negative logic standard or High-speed Counter inputs. Inputs are compatible with a wide range of devices, such as pushbuttons, limit switches, and electronic proximity switches.

Normally-Open Relay Outputs

Ten Form A relay outputs (SPST-single pole single throw) can control many types of load devices such as motor starters, solenoids, and indicators. The switching capacity of each relay output is 2 amps. An external source of AC or DC power must be supplied for field devices. External fusing is recommended to protect the relay contacts. Relay outputs can be configured as regular outputs or as outputs controlled by High-speed Counters. They cannot be used as Pulse Train or PWM outputs.

DC Power Supply

The DC power supply requires more current at startup voltage (approximately 4 VDC) than at rated input voltage. A minimum of 2.0 A is required to start up the DC power supply.

If configured to disable power-up diagnostics, the PLC begins logic solution 100ms after the voltage level of the power supply input reaches and maintains 12VDC. The 12VDC power source for the PLC must have enough transient current capability to support the inrush current of the power supply and to maintain a 12VDC voltage level (see power supply specifications for inrush requirements).

Micro PLC IC200UAL004 Specifications

Inputs	13 DC inputs and 2 Analog inputs
Outputs	10 relay outputs and 1 analog output
+12 VDC Output Power Supply	200 mA maximum (for input circuits and user devices)
High Speed Counters	Up to four Type A or one Type A and one Type B
DC Power Specifications	
Range	9.6VDC - 15VDC
Hold-up	3.0mS
Inrush Current	9.6A typical at 12 VDC
Inrush Time	200mS typical
Input Current	480mA typical at 12 VDC
Input Power Supply Rating	8W

Input Specifications

Number of Inputs	13
Rated Input Voltage	12 volts DC
Input Voltage Range	0 to 15 volts DC
Input Current	9.0mA typical
Input Impedance	1.3 kOhms
Input Threshold Voltage	ON: 9.5VDC minimum, OFF: 2.5VDC maximum
Input Threshold Current	ON: 6.5mA maximum, OFF: 1.6mA minimum
Response Time	0.5 to 20ms (user configurable) as regular input; 100µs as HSC input
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups

Relay Output Specifications

Operating Voltage	5 to 30 VDC or 5 to 250 VAC		
Isolation	1500 V RMS between field side and logic side, 500 V RMS between groups		
Leakage Current	15 mA maximum		
Maximum UL Pilot Duty Rating	2 amps at 24 VDC and 240 VAC		
Maximum Resistive Load Rating	2 amps at 24 VDC and 240 VAC		
Minimum Load	1 mA		
Maximum Inrush	5 amps per half cycle		
Response Time	ON: 15 ms maximum, OFF: 15 ms maximum		
Contact Life: Mechanical	20×10^6 mechanical operations		
Contact Life: Electrical Voltage	Current: Resistive 2A	Current: Lamp and Solenoid 0.6A	Typical Operations 200,000

High-speed Counter Specifications

Maximum Counter Frequency	10kHz
Input Voltage	ON: 9V, OFF: Off: 2.5V
Count Registers	16 bits
Available Pulse Outputs	None

Wiring Diagram, IC200UAL004
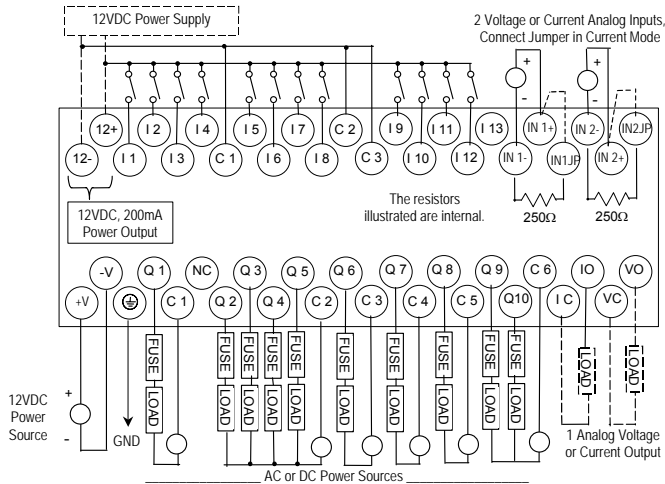
> **IC200UAL005**
> *Micro PLC, 23 Discrete Points and 3 Analog Channels: (13) 24VDC In,*
> *(1) 24VDC Out, (9) Relay Out, (2) Analog In, (1) Analog Out, 24VDC Power Supply*

VersaMax Micro PLC IC200UAL005 accepts thirteen 24VDC inputs and two analog inputs. It provides one 24VDC output, nine normally-open 2 Amp relay outputs, and one analog output. It uses +24VDC nominal input power.

DC Inputs

Thirteen configurable 24VDC inputs can be used as positive or negative logic standard or High-speed Counter inputs. Inputs are compatible with a wide range of input devices, such as pushbuttons, limit switches, and electronic proximity switches.

The module provides +24VDC output power available for field devices.

DC Output (Q1)

The DC output circuit (Q1) can be configured to be a standard, High Speed Counter, Pulse Train or PWM output.

Normally-Open Relay Outputs

Nine Form A relay outputs (SPST-single pole single throw). The nine isolated 2-amp, normally-open outputs can control many types of user-supplied load devices such as motor starters, solenoids, and indicators. The switching capacity of each of these circuits is 2 amps. AC or DC power to operate field devices must be supplied from an external source. External fusing is recommended to protect the relay contacts. Relay outputs can be configured as regular outputs or as outputs controlled by High-speed Counters. They cannot be used as Pulse Train or PWM outputs.

DC Power Supply

The DC power supply requires more current at startup voltage (approximately 4 VDC) than at rated input voltage. A minimum of 2.0 A is required to start up the DC power supply.

If configured to disable power-up diagnostics, the PLC begins logic solution 100ms after the voltage level of the power supply input reaches and maintains 24VDC. The 24VDC power source for the PLC must have enough transient current capability to support the inrush current of the power supply and to maintain a 24VDC voltage level (see power supply specifications for inrush requirements).

Micro PLC IC200UAL005 Specifications

Inputs	13 DC inputs and 2 analog inputs
Outputs	9 relay outputs, 1 analog output, 1 24VDC output
+24 VDC Output Power Supply	200 mA maximum (for input circuits and user devices)
DC Power Specifications	
Range	24 -20%, +25% VDC
Hold-up	10mS at 19.2 VDC
Inrush Current	1 Amp maximum at 30VDC
Inrush Time	10mS for 1 A
Input Current	0.30 Amp typical at 24VDC
Input Power Supply Rating	8W
High-speed Counter Specifications	
Available High Speed Counters	Up to four Type A or one Type A and one Type B
Maximum Counter Frequency	10kHz
Input Voltage	ON: 15V, OFF: 5V
Count Pulse Width	20% to 80% duty cycle at 10kHz
Count Registers	16 bits
High-speed Counter Outputs	Up to four HSC outputs or one Pulse/PWM output plus three HSC outputs.
Load Voltage	Q1: 5/12/24V
Maximum Pulse/PWM Frequency	(Q1 only) 5kHz
Input Specifications	
Number of Inputs	13
Rated Input Voltage	24 volts DC
Input Voltage Range	0 to 30 volts DC
Input Current	7.5mA typical
Input Resistance	2.8 Kohms
Input Threshold Voltage	ON: 15VDC minimum, OFF: 5VDC maximum
Input Threshold Current	ON 4.5mA maximum, OFF: 1.5mA minimum
Response Time	0.5 to 20ms (user configurable) as regular input; 100µs as HSC input
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups

DC Output (Q1) Specifications

Output logic	Positive Logic
Operating Voltage	24VDC / 12VDC / 5VDC
Voltage Range	24 VDC, +20%, -80%
Maximum UL Pilot Duty Rating	0.75A at 24 VDC
Maximum Resistive Load Rating	0.75A at 24 VDC 0.5A at 12 VDC 0.25A at 5 VDC
Output Voltage Drop	0.3 VDC maximum
Response ON	0.1ms maximum (24 VDC, 0.2A)
OFF	0.1ms maximum (24 VDC, 0.2A)
OFF state leakage	0.1mA maximum
Isolation	1500 VAC between field side and logic side 500 VAC between groups
Fuse	Output should be fused externally. Otherwise, a load short can damage the module output transistor, which is not user replaceable.

Relay Output Specifications

Operating Voltage	5 to 30 VDC or 5 to 250 VAC		
Isolation	1500 V RMS between field side and logic side 500 V RMS between groups		
Leakage Current	15 mA at 240 VAC maximum		
Maximum UL Pilot Duty Rating	2 amps at 24 VDC and 240 VAC		
Maximum Resistive Load Rating	2 amps at 24 VDC and 240 VAC		
Minimum Load	10 mA		
Maximum Inrush	5 amps per half cycle		
On Response Time	15 ms maximum		
Off Response Time	15 ms maximum		
Contact Life: Mechanical	20×10^6 mechanical operations		
Contact Life: Electrical Voltage	Current: Resistive	Current: Lamp and Solenoid	Typical Operations
240VAC, 120VAC, 24VDC	2A	0.6A	200,000

Wiring Diagram, IC200UAL005

The resistors illustrated are internal.

> ### IC200UAL006
> *Micro PLC, 23 Discrete Points and 3 Analog Channels: (13) 24VDC In, (1) 24VDC Out, (9) Relay Out, (2) Analog In, (1) Analog Out, 120/240VAC Power Supply*

VersaMax Micro PLC IC200UAL006 accepts thirteen DC inputs and two analog inputs. It provides one DC output, nine normally-open 2 Amp relay outputs, and one analog output. It uses 100VAC to 240VAC nominal input power.

DC Inputs

Thirteen configurable 24VDC inputs can be used as positive or negative logic standard or High-speed Counter inputs. Inputs are compatible with a wide range of input devices, such as pushbuttons, limit switches, and electronic proximity switches. Power to operate field devices and the input circuits is supplied by an isolated +24 VDC supply.

DC Output (Q1)

Output circuit Q1 is a 24 VDC transistor output. It can be used as a normal DC output or as a High-speed Counter-controlled output, Pulse Train output, or Pulse Width Modulation (PWM) output.

Normally-Open Relay Outputs

Nine isolated 2-amp, normally-open Form A relay outputs (SPST-single pole single throw can control many types of user-supplied load devices such as motor starters, solenoids, and indicators. The switching capacity of each of these circuits is 2 amps. AC or DC power to operate field devices must be supplied from an external source. External fusing is recommended to protect the relay contacts. Relay outputs can be configured as regular outputs or as outputs controlled by High-speed Counters. They cannot be used as Pulse Train or PWM outputs.

Micro PLC IC200UAL006 Specifications

Inputs	13 DC inputs and 2 Analog inputs
Outputs	1 DC output, 9 relay outputs, 1 analog output
High Speed Counters	Up to four Type A or one Type A and one Type B
+24 VDC Output Power Supply (for input circuits and user devices)	200 mA maximum

AC Power Specifications

Range	100 -15% to 240 +10% VAC
Frequency	50 -5% to 60 +5% Hz
Hold-up	10 ms at 85 to 100VAC, 20mS at 100 to 265VAC
Inrush Time	2mS for 40A
Inrush Current	35 Amp maximum at 200 VAC 46 Amp maximum at 265 VAC
Input Current	0.13 Amp typical at 200 VAC 0.20 Amp typical at 100 VAC
Input Power Supply Rating	34 VA
Isolation	1500VAC rms field-side to logic (power supply input).

Input Specifications

Number of Inputs	13
Rated Input Voltage	24 volts DC
Input Voltage Range	0 to 30 volts DC
Input Current	7.5mA typical
Input Resistance	2.8 Kohms
Input Threshold Voltage	ON: 15VDC minimum, OFF: 5VDC maximum
Input Threshold Current	ON: 4.5mA maximum, OFF: 1.5mA minimum
Response Time	0.5 to 20ms (user configurable) as regular input; 100µs as HSC input
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups

DC Output Specifications

Output logic	Positive Logic
Operating Voltage	24VDC / 12VDC / 5VDC
Voltage Range	24 VDC, +20%, -80%
Maximum UL Pilot Duty Rating	0.75A at 24 VDC
Maximum Resistive Load Rating	0.75A at 24 VDC 0.5A at 12 VDC 0.25A at 5 VDC
Output Voltage Drop	0.3 VDC maximum
Response Time	ON: 0.1ms maximum (24 VDC, 0.2A), OFF: 0.1ms maximum (24 VDC, 0.2A)
OFF state leakage	0.1mA maximum
Isolation	1500 VAC between field side and logic side, 500 VAC between groups
Fuse	Output should be fused externally. Otherwise, a load short can damage the module output transistor, which is not user replaceable.

Relay Output Specifications

Operating Voltage	5 to 30 VDC or 5 to 250 VAC
Isolation	1500 V RMS between field side and logic side, 500 V RMS between groups
Leakage Current	15 mA at 240 VAC maximum
Maximum UL Pilot Duty Rating	2 amps at 24 VDC and 240 VAC
Maximum Resistive Load Rating	2 amps at 24 VDC and 240 VAC
Minimum Load	10 mA
Maximum Inrush	5 amps per half cycle
Response Time	ON: 15 ms maximum, OFF: 15 ms maximum
Contact Life: Mechanical	20×10^6 mechanical operations

Contact Life: Electrical Voltage	Current: Resistive	Current: Lamp and Solenoid	Typical Operations
240VAC, 120VAC, 24VDC	2A	0.6A	200,000

High-speed Counter Specifications

Maximum Counter Frequency	10kHz
Input Voltage	ON: 15V, OFF: Off: 5V
Count Pulse Width	20% to 80% duty cycle at 10kHz
Count Registers	16 bits
Available Pulse Outputs	None
Outputs	
Load Voltage	Q1: 5/12/24V
Maximum Pulse/PWM Frequency	(Q1 only) 5kHz
Types available	Up to four HSC outputs or one Pulse/PWM output plus three HSC outputs.

Wiring Diagram, IC200UAL006
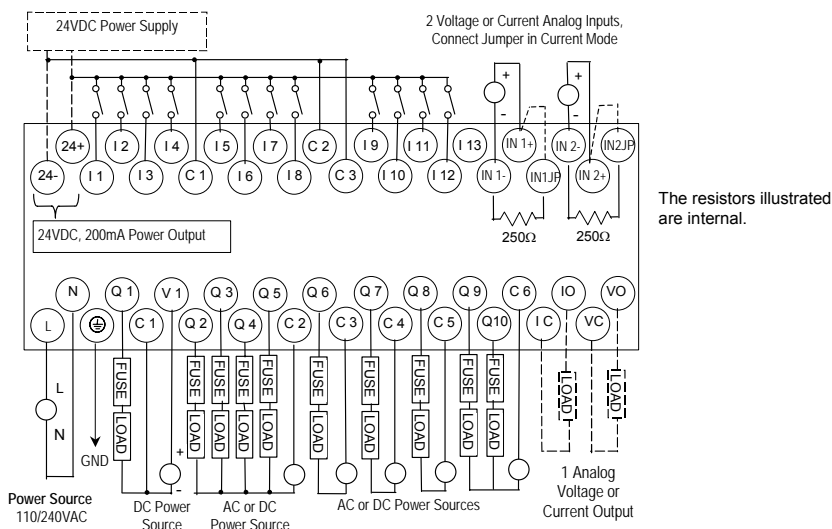
Analog Operation

This section explains how a VersaMax Micro PLC with analog channels processes analog data.

Analog I/O Parameters

Each analog channel can be configured to operate in either voltage or current mode. If current mode operation is selected, the range can then be configured as either 4-20mA or 0-20mA.

Parameter	Choices	Default Value
Voltage or current mode	Voltage, Current	Voltage
Current range selection	4–20mA, 0–20mA	4–20mA

Input/Output Values Compared to Process Data

The Micro PLC processes analog channels using gain and offset values for both current and voltage mode operation. Default gain and offset values are loaded into the Micro PLC flash memory at the factory. For these 23-point Micro PLCs (only) gain and offset can be recalibrated if necessary, as explained later in this section.

The table below shows the relationship between the analog input and output values used by the application program, and the actual analog input or output for each mode. These values include the automatic adjustments for offset and gain.

In this Configured Mode:	This is the Analog Signal Range	This is the Equivalent Process Data %AI or %AQ Range	For the Default Calibration, the Value in the %AI or %AQ Reference Equals:
Voltage 0 to +10V	0 to 10,000mV	0 to 32000	3.2 x mV
Current 0 to 20mA	0 to 20,000μA	0 to 32000	1.6 x μA
Current 4 to 20mA	4,000 to 20,000μA	0 to 32000	2 x μA –8000

The following pages explain how the Micro PLC performs the necessary data conversions between the analog signal levels and the numeric values used by the application program.

Analog Input Processing

The Micro PLC processes analog input channels with a 12-bit successive-approximation A/D converter. It converts the analog value into a digital count, calculates the %AI value as described below, then places the result into the configured %AI input reference.
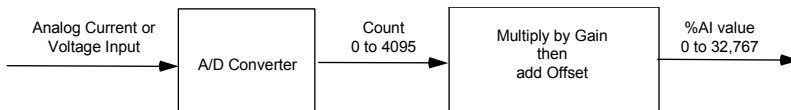
Automatic Conversion of Analog Voltage or Current to Counts

In voltage mode, the Micro PLC first converts the 0 to 10,000mV input signal to a count in the range of 0 to 4,000. The fixed multiplier for this conversion is 2.5.

In current mode, the Micro PLC first converts the 0 to 20,000μA input signal to a count value in the range of 0 to 4,000. The fixed multiplier for this conversion is 5. The conversion for both current modes (0-20mA and 4-20mA) is the same.

Automatic Gain and Offset Adjustment for Analog Inputs

The Micro PLC then converts the A/D converter's input count value from the range of 0 to 4000 to a final %AI input value in the range of 0 to 32,000. It multiplies the count value by a stored gain value and adds an offset value to get the final analog input ($AI):

(input count X Gain) + Offset = %AI value

The default input gain used for this conversion is 8 (32000 / 4000) and the default offset is 0. These can be changed as described later. Any calculated value above 32,767 is clamped at that maximum value. Any calculated value less than 0 is clamped at 0.

Analog Input Conversion Summary

The table below summarizes the conversion of voltage or current inputs to counts and then to %AI values.

Input Signal	Conversion Factor	A/D Converter Value	Default Gain	Default Offset	%AI Range
Voltage Mode (0–10,000mV)	2.5	0–4000 counts	8	0	0–32,000
Current Mode (0–20mA) or (4–20mA)	5	0–4000 counts	8	0	0–32,000

Analog Output Processing

To generate the analog output signal, the Micro PLC converts the value in the %AQ output reference into a count value for the 12-bit D/A converter, which then drives the analog output.

```
%AQ                                          Output count              Analog Current or
reference          Multiply %AQ value by Gain   0 to 4095      D/A      Voltage Output
0 to 32,767              then                              Converter
                      add Offset
```
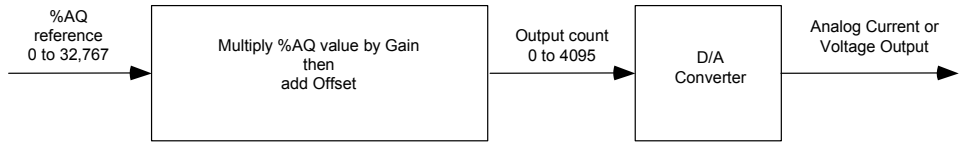
Automatic Gain and Offset Adjustment for Analog Outputs

The application's %AQ output range of 0 to 32000 corresponds to the D/A converter's output count range of 0 to 4000. The Micro PLC first multiplies the %AQ value from the program by a gain value and adds a predefined offset to produce the count value for the D/A converter:

$$(\%AQ \ X \ Gain) + Offset = D/A \ count$$

Any calculated value that exceeds 4095 (2^{12}-1) is clamped at that maximum value. Any calculated value less than 0 is clamped at 0. The range 0 to 4095 corresponds to %AQ values between 0 and 32,767.

The default output gain used for this conversion is 0.125 (4000 / 32000) and the default offset is 0. These can be changed as described later.

Automatic Conversion of Counts to Analog Voltage or Current

In voltage mode, the D/A converter then converts the count value in the range of 0 to 4,000 counts to an analog signal from 0 to 10,000mV. The output voltage gain (ratio) for this conversion is 2.5.

In current mode, the D/A converter converts the count value to an analog signal from 0 to 20,000µA. The output current gain for this conversion is 5. The conversion for both current modes (0-20mA and 4-20mA) is the same.

Analog Output Data Conversion Summary

The table below summarizes the conversion of %AQ values to counts and then to voltage or current levels.

%AQ Range	Default Gain, %AQ to Counts	Default Offset	D/A Converter Range	Conversion Factor	Output Signal
0– 32,000	0.125	0	0–4,000 counts	2.5	Voltage Mode (0–10,000mV)
0–32,000	0.125	0	0–4,000 counts	5	Current Mode (0–20mA) or (4–20mA)

Adjusting the Calibration of Analog Channels

For the 23-point Micro PLCs with analog channels, it is possible to adjust the calibration of the analog channels as described below. Analog channels on Expansion Units and 10-point Nano PLCs cannot be recalibrated. A set of default gains and offsets is maintained in the PLC firmware if you want to restore the original values.

To perform the calibration procedures you will need a precision analog meter (1mV voltage accuracy and 1µA current accuracy). Do not try the procedures in this section unless you are familiar with the operation of D/A and A/D converters.

Recalibrating Input Channels

1. Apply a reference voltage or current at a low range to the input. (The reference signal must be measured accurately by a precision analog meter.) Record the value.
2. For the channel being calibrated, read the %AI register and record the low value.
3. Apply a reference voltage or current at a high range to the input. Precisely measure the reference signal and record the value.
4. For the channel being calibrated, read the %AI register and record the high value.
5. Store the calculated gain and offset values in RAM or flash memory using SVCREQ functions 34 and 35 as instructed in chapter 23.

   The Micro PLC automatically calculates the calibration gain and offset:

$$Gain = \frac{Meter_{High} - Meter_{Low}}{\% AI_{High} - \% AI_{Low}} \times DefaultGain$$

$$Offset = Meter_{High} - \frac{\% AI_{High} \times Gain}{DefaultGain}$$

Recalibrating Output Channels

1. Write a low value to the %AQ register.
2. At the output, measure the voltage or current using a precision analog meter and record the value.
3. Write a high value to the %AQ register.
4. At the output, measure the voltage or current using a precision analog meter and record the value.
5. Store the calculated gain and offset values in RAM or flash memory using SVCREQ functions 34 and 35 as instructed in chapter 23.
6. The Micro PLC automatically calculates the calibration gain and offset:

$$Gain = \frac{\% AQ_{High} - \% AQ_{Low}}{Meter_{High} - Meter_{Low}} xDefaultGain$$

$$Offset = \% AQ_{High} \times DefaultGain - Meter_{High} \times Gain$$

Chapter 6

VersaMax 28-Point Micro PLCs

This chapter describes the features, specifications, and field wiring of these VersaMax Micro PLCs:

▪ IC200UAA007	28 Point Micro PLC, (16) 120VAC In, (12) 120VAC Out, 120/240VAC Power Supply
▪ IC200UAR028	28 Point Micro PLC, (16) 120VAC In, (2) Relay Out at 10 Amps, (10) Relay Out at 2 Amps, 120/240VAC Power Supply
▪ IC200UDD110	28 Point Micro PLC, (16) 24VDC In, (12) 24VDC Out, 24VDC Power Supply
▪ IC200UDD120	28 Point Micro PLC, (16) 24VDC In, (12) 24VDC Out with ESCP, 24VDC Power Supply
▪ IC200UDD212	28 Point Micro PLC, (16) 12VDC In, (12) 12VDC Out, 12VDC Power Supply
▪ IC200UDR005	28 Point Micro PLC, (16) 24VDC In, (1) 24VDC Out, (11) Relay Out, 120/240VAC Power Supply
▪ IC200UDR006	28 Point Micro PLC, (16) 12VDC In, (12) Relay Out, 12VDC Power Supply
▪ IC200UDR010	28 Point Micro PLC, (16) 24VDC In, (1) 24VDC Out, (11) Relay Out, 24VDC Power Supply
▪ IC200UDR228	28 Point Micro PLC, (16) 24VDC In, (1) 24VDC Out, (11) Relay Out, 12/24VDC Power Supply

Features of VersaMax 28-Point Micro PLCs
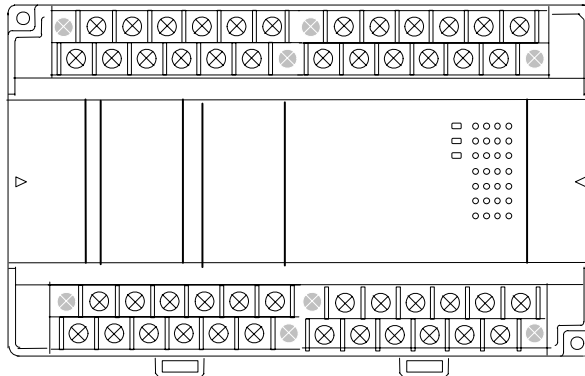
- Supports up to four Expansion Units in any combination.
- Four removable screw-down "barrier-style" terminal strips with protective covers.
- Two Serial communications ports. Port 1 (RS-232) supports SNP/SNPX slave protocols. Port 2 (RS-485) supports SNP/ SNPX master and slave, RTU master and slave protocol, and Serial I/O.
- Run/Stop mode switch that can be configured as a run/stop switch, a memory protect switch, and also used for clearing faults when a fatal fault exists.
- Time-of-Day Clock.
- Two analog potentiometers.
- Full-featured programming Instruction Set with floating point math. The application program can be either Ladder Diagram (LD) or Instruction List (IL) format.
- 9K words of program memory, 2048 words of registers.
- Flash memory (ROM) for non-volatile program storage and for system firmware
- Configurable to read configuration at powerup from either RAM or flash memory (ROM). Can also be configured to read application program from flash at powerup.
- Capacitor backs up RAM and the Time-of-Day clock for at least 30 minutes.
- Optional lithium battery backup for RAM and real-time clock.

Run/Stop Switch

The Run/Stop switch can be configured as a run/stop switch, a memory protect switch, and used for clearing faults when a fatal fault exists.

Serial Ports

Port 1 is an RS-232 serial port with an RJ-45 connector. Port 2, located behind a removable door, is an RS-485 serial port with a standard DB-15 connector. Both ports can be used for programming. Only one port can be used at a time for programming, but both ports can be used for monitoring at the same time. Port 1 uses SNP slave protocol. Port 2 is software-configurable for SNP master/slave or RTU slave operation. CPUs with firmware version 2.02 or later support Modbus RTU Master on port 2. 4-wire and 2-wire RTU are supported. If Port 2 is being used for RTU, it automatically switches to SNP slave mode if necessary. Port 2 defaults to SNP slave and automatically reverts to SNP slave when the CPU is in Stop mode, if configured for Serial I/O.

Either port can be software-configured to set up communications between the CPU and various serial devices. An external device can obtain power from both ports if it requires 100mA or less at 5VDC.

Analog Potentiometers

The two potentiometers on the front of a Micro PLC can be used to adjust the values in analog registers %AI016 and %AI017. An example use for the potentiometers would be to set threshold values for use in logical relationships with other inputs/outputs.

Removable Terminal Strips

The removable terminal assemblies are protected by hinged covers. After turning off power to the Micro PLC, a terminal assembly and attached field wiring can be separated from the Micro PLC by removing two screws.

Status LEDs

LEDs on the Micro PLC provide quick visual verification of operating status. In addition to LEDs for Power, OK, and Run mode, there is an LED for each I/O point.

Backup Battery

The Micro PLC uses a large value capacitor to provide memory retention current to the System/User RAM and the Time-of-Day clock when the power supply is either not present or not powered up. The capacitor retains memory contents for at least 30 minutes.

To maintain memory for longer than this, a replaceable battery assembly can be installed in the battery holder, as described in chapter 14. The Micro PLC reports the battery state to the PLC Fault Table and also uses Status Bits %SA011 and %S0014 to indicate the battery state.

General Specifications for 28-Point VersaMax Micro PLCs

Module Dimensions	Height: 90mm (3.6 inches) Depth: 76mm (3.0 inches) Width: 150mm (6.0 inches)
Typical Scan Rate	1.1 ms/K for Boolean logic (see appendix A)
Real Time Clock accuracy (for Timer contacts and Timer function blocks)	+/-0.5%
Time of Day Clock accuracy	+/-5 sec/day @10degC, +/-5 sec/day @25degC, and +/-11 sec/day @55degC or across full temp. range
Maximum number of slave devices per network	8 (can be increased with a repeater)
+5 VDC output of Serial Ports	Serial Port 1, pin 7: 100mA maximum* Serial Port 2, pin 5: 100mA maximum* *Combined port 1 and port 2 total not to exceed 100mA max

Lithium battery (IC200ACC403):
    shelf life
    installed
	Up to 5 years typical at 30 °C, Up to 3 years typical at 55 °C
	4 months battery backup time (powered down) minimum at 55 °C

High Speed Counters

VersaMax Micro PLCs with DC inputs can be configured to provide built-in high-speed counter and pulse operation.

When configured for High-speed Counter operation, inputs I1 to I8 can be set up as:

- Up to four Type A Counters or
- One Type A and one Type B Counter.

Each counter provides direct processing of rapid pulse signals up to 10kHz for industrial control applications such as meter proving, turbine flowmeter, velocity measurement, material handling, motion control, and process control.

Each counter can be enabled independently. Type A counters can be configured for up or down counting (default is up) and for positive or negative edge detection (default is positive). The Type B counter provides an A Quad B counting function.

Models with DC outputs can be configured to provide up to a total of four counter, Pulse Train, or PWM outputs. Relay outputs cannot be used as Pulse Train or PWM outputs.

IC200UAA007
28 Point Micro PLC, (16) 120VAC In, (12) 120VAC Out, 120/240VAC Power Supply

VersaMax Micro PLC model IC200UAA007 accepts sixteen AC inputs and provides twelve AC outputs. It uses 100VAC to 240VAC nominal input power for PLC operation.

This module does not provide High-speed Counter, PWM or Pulse Train operation.

Inputs

The sixteen 120 VAC input circuits are reactive (resistor/capacitor) inputs. The input circuits require an AC power source: they cannot be used with a DC power source.

Inputs are compatible with a wide range of input devices, such as pushbuttons, limit switches, and electronic proximity switches. Power to operate the field devices must be supplied.

AC Outputs

The 120/240 VAC, 0.5 Amp triac outputs are provided in isolated groups. The commons are not tied together inside the module. This allows each group to be used on different phases of the AC supply or to be powered from the same supply. Each group is protected with a replaceable 3.15 amp fuse for its common. Also, an RC snubber is provided for each output to protect against transient electrical noise on the power line.

AC power to operate loads connected to outputs must be supplied from an external source.

This module provides a high degree of inrush current (10x the rated current) which makes the outputs suitable for controlling many types of inductive and incandescent loads.

Micro PLC IC200UAA007 Specifications

Weight	600 grams (1.32 lb)
Inputs	16 AC inputs
Outputs	12 AC outputs
High-speed Counters	None
AC Power Specifications	
Range	100 -15% to 240 +10% VAC
Frequency	50 -5% to 60 +5% Hz
Hold-up	10mS at 85-100 VAC, 20mS at 100-264 VAC
Inrush Time	2mS for 40 Amp
Inrush Current	30 Amp maximum at 200VAC, 40 Amp maximum at 265VAC
Input Current	0.10 Amp typical at 100VAC, 0.06 Amp typical at 200VAC
Input Power Supply Rating	16 VA
AC Input Specifications	
Points/Common	4 (I1–I4) and (I5–I8)
Rated Load Voltage	85–132 VAC, 50 -5% to 60 +5% Hz
Maximum Input Voltage	132V rms, 50/60 Hz
Input Current	8 mA rms (100 VAC, 60 Hz)
Voltage	ON: minimum 80V rms, 4.5 mA rms, OFF: maximum 30V rms, 2 mA rms
Response Time	OFF to ON: maximum 25 ms, ON to OFF: maximum 30 ms
Isolation	1500V rms field side to logic side, 500V rms between groups
AC Output Specifications	
Rated Load Voltage	100 -15% to 240 +10% VAC, 50 -5% to 60 +5% Hz
Maximum Resistive Load Current	0.5 Amp per point
Maximum UL Pilot Duty Rating	0.5 Amp per point at 240 VAC 0.6 Amp maximum on C1 and C3 1.2 Amps maximum on C2 and C4
Maximum Inrush Current	5A (1 period)/point, 10A (1 period)/common
Maximum voltage drop when ON	1.5 V RMS
Maximum leak current when OFF	1.8 mA RMS (115 VAC), 3.5 mA RMS (230 VAC)
Response Time (Maximum)	OFF to ON: 1ms, ON to OFF: 1/2 cycle + 1 ms
Isolation	1500V RMS field side to logic side, 500V RMS between groups

Wiring Diagram IC200UAA007

IC200UAR028
28 Point Micro PLC, (16) 120VAC In, (2/10) Relay Out, 120/240VAC Power Supply

VersaMax Micro PLC model IC200UAR028 accepts sixteen AC inputs and provides two relay outputs at 10 Amps and ten relay outputs at 2 Amps. It uses 100VAC to 240VAC nominal input power for PLC operation.

This module does not provide High-speed Counter, PWM or Pulse Train operation.

Inputs

The sixteen 120 VAC input circuits are reactive (resistor/capacitor) inputs. The input circuits require an AC power source: they cannot be used with a DC power source.

Inputs are compatible with a wide range of input devices, such as pushbuttons, limit switches, and electronic proximity switches. Power to operate the field devices must be supplied.

Relay Outputs

The Micro PLC's relay outputs can control a wide range of load devices such as motor starters, solenoids, and indicators. The switching capacity of each of these circuits is 2 amps. An external source of AC or DC power must be supplied to operate field devices.

Micro PLC IC200UAR028 Specifications

Weight	600 grams (1.32 lb)
Inputs	16 AC inputs
Outputs	2 relay outputs at 10 Amps and 10 relay outputs at 2 Amps
High-speed Counters	None
+24 VDC Output Power Supply	200mA maximum (for input circuits and user devices)
AC Power Specifications	
Range	100 -15% to 240 +10% VAC
Frequency	50 -5% to 60 +5% Hz
Hold-up	10mS at 85-100 VAC, 20mS at 100-264 VAC
Inrush Time	2mS for 40 Amp
Inrush Current	30 Amp maximum at 200VAC, 40 Amp maximum at 265VAC
Input Current	0.10 Amp typical at 100VAC, 0.06 Amp typical at 200VAC
Input Power Supply Rating	16 VA

AC Input Specifications	
Points/Common	4 (I1–I4) and (I5–I8)
Rated Load Voltage	85–132 VAC, 50 -5% to 60 +5% Hz
Maximum Input Voltage	132V rms, 50/60 Hz
Input Current	8 mA rms (100 VAC, 60 Hz)
Voltage	ON: minimum 80V rms, 4.5 mA rms, OFF: maximum 30V rms, 2 mA rms
Response Time	OFF to ON: maximum 25 ms, ON to OFF: maximum 30 ms
Isolation	1500V rms field side to logic side, 500V rms between groups

Relay Output Specifications			
Operating Voltage	5 to 30 VDC or 5 to 250 VAC		
Isolation	1500 V RMS between field side and logic side, 500 V RMS between groups		
Leakage Current	15 mA at 240 VAC maximum		
Maximum UL Pilot Duty Rating	2 amps at 24VDC and 240VAC	10 amps at 24VDC and 240VAC	
Maximum Resistive Load Rating	2 amps at 24VDC and 240VAC	10 amps at24 VDC and 240VAC	
Minimum Load	10 mA		
Maximum Inrush	5 amps per half cycle	14 amps per half cycle	
Response Time	ON: 15 ms maximum, OFF: 15 ms maximum		
Contact Life: Mechanical	20×10^6 mechanical operations		
Contact Life: Electrical Voltage	Current: Resistive	Current: Lamp and Solenoid	Typical Operations
	2.0A	0.6A	100,000
	10.0A	4.0A	100,000
	4.0A	1.0A	200,000

Wiring Diagram IC200UAR028
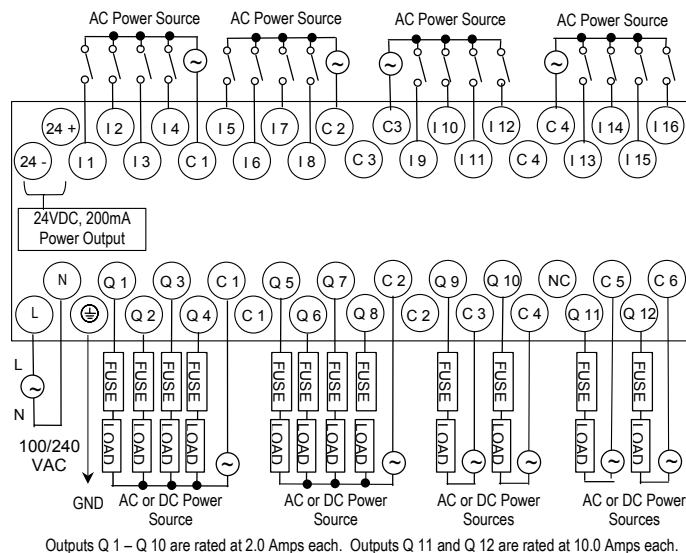
Outputs Q 1 – Q 10 are rated at 2.0 Amps each. Outputs Q 11 and Q 12 are rated at 10.0 Amps each.

IC200UDD110
28 Point Micro PLC, (16) 24VDC In, (12) 24VDC Out, 24VDC Power Supply

VersaMax Micro PLC model IC200UDD110 accepts sixteen DC inputs and provides twelve 24VDC outputs. It uses +24VDC nominal input power for PLC operation.

DC Power

If configured to disable power-up diagnostics, the PLC begins logic solution 100ms after the voltage level of the power supply input reaches and maintains 24VDC. The 24VDC power source for the PLC must have enough transient current capability to support the inrush current of the power supply and to maintain a 24VDC voltage level (see power supply specifications for inrush requirements).

DC Inputs

The module has sixteen configurable DC inputs that can be used as positive or negative logic standard inputs. As standard inputs, they are compatible with a wide range of input devices, such as pushbuttons, limit switches, and electronic proximity switches. Eight of the inputs can be used for High-speed Counter inputs.

The Micro PLC's +24 VDC supply can be used for input devices and to power the DC input circuits at about 7.5 mA per input. The combination of input circuit current and external device current must not exceed 200 mA..

Transistor Outputs

The module provides twelve transistor output circuits that can be used to switch devices like valves, lamps or contactors. External fusing should be provided to protect the outputs. Fast fuses are recommended.

The outputs can be configured as regular outputs or as outputs controlled by the High Speed Counters. Some outputs can be used as pulse train or pulse width modulation (PWM) outputs.

All outputs are isolated between field and logic and are switching positive voltage. The outputs have one common incoming supply (VC) and one common ground (COM). The outputs are able to drive high inrush currents (8 times the rated current) and are protected against negative voltage pulses. This makes it possible to switch lamps and inductive loads.

Micro PLC IC200UDD110 Specifications

Weight	460 grams (1.01 lb)
Inputs	Sixteen 24 VDC positive logic inputs in four groups of four
Outputs	Twelve transistor outputs, 24 VDC. Outputs are grouped in two groups with separated incoming supply. Each group contains 4 outputs with a maximum load of 0.5A and 2 outputs with a maximum load of 1A.
High-speed Counters	Up to four Type A or one Type A and one Type B
+24 VDC Output Power Supply	200mA maximum (for input circuits and user devices)

DC Power Specifications

Range	19.2VDC to 30VDC
Hold-up	10mS at 19.2 VDC
Inrush Current	1 Amp maximum at 30VDC
Inrush Time	10mS for 1 Amp
Input Current	0.20 Amp typical at 24VDC
Input Power Supply Rating	5W

DC Input Specifications

Rated Input Voltage	24 volts DC
Input Voltage Range	0 to 30 volts DC
Input Current	7.5mA typical
Input Resistance	2.8 Kohms
Input Threshold Voltage	ON: 15VDC minimum, OFF: 5VDC maximum
Input Threshold Current	ON: 4.5mA maximum, OFF: 1.5mA minimum
Response Time	0.5 to 20ms configurable as regular input; 100µs as HSC input
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups

Output Specifications

Voltage Range	12VDC/24VDC (24VDC +10% / -43% input at V1,C1)
Maximum Load Current	1.0A per point (Q1, Q2, Q11, Q12) at 24VDC at 100% ON duration
	0.75A per point (Q3 - Q10) at 24VDC at 100 % ON duration
	0.5A per point (Q3 - Q10) at 12VDC at 100 % ON duration
Maximum Inrush Current	Q1,Q2,Q15,Q16: 1A, Q3-Q13: 0.7A
Output Voltage Drop	0.3V maximum
OFF state leakage current	100µA maximum
Response Time	OFF to ON, ON to OFF 0.1ms maximum (24 VDC, 0.2A)
Isolation Voltage	1500V RMS between field side and logic side, 500V RMS between groups
Fuse	Outputs should be fused externally. Otherwise, a load short can damage the module output transistor, which is not user replaceable.

High-speed Counter Input / PWM and Pulse Train Output Specifications	
Maximum Counter Frequency	10kHz
Input Voltage	ON : 15V, OFF: 5V
Count Pulse Width	20% to 80% duty cycle at 10kHz
Count Registers	16bits
Outputs	
Load Voltage	Q1-Q4: 12/24VDC
Maximum Pulse/PWM Frequency	5kHz
Types available	Up to four HSC, PT, and/or PWM outputs

Wiring Diagram IC200UDD110

The maximum current that can be used for output points Q1, Q2, Q11 and Q12 is lower for ambient temperatures above 50 degrees C

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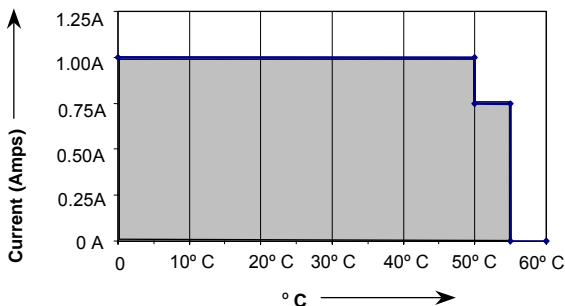
IC200UDD120
28 Point Micro PLC, (16) 24VDC In, (12) 24VDC Out with ESCP, 24VDC Power
Supply

VersaMax Micro PLC model IC220UDD120 accepts sixteen DC inputs and provide twelve 24VDC outputs. The outputs have electronic short-circuit protection. The module uses +24VDC nominal input power for PLC operation.

DC Power

If configured to disable power-up diagnostics, the PLC begins logic solution 100ms after the voltage level of the power supply input reaches and maintains 24VDC. The 24VDC power source for the PLC must have enough transient current capability to support the inrush current of the power supply and to maintain a 24VDC voltage level (see power supply specifications for inrush requirements).

DC Inputs

The module's sixteen configurable DC inputs can be used as positive or negative logic standard inputs. Eight of these inputs can be used for High-speed Counter inputs.

When used as standard inputs, they are compatible with a wide range of input devices, such as pushbuttons, limit switches, and electronic proximity switches.

The Micro PLC's +24 VDC supply can be used for input devices and to power the DC input circuits at about 7.5 mA per input. The combination of input circuit current and external device current must not exceed 200 mA..

Transistor Outputs

The twelve transistor outputs can be configured as regular outputs or as outputs controlled by the High Speed Counters. Some outputs can be used as pulse train or pulse width modulation (PWM) outputs.

The output circuits can be used to switch devices like valves, lamps or contactors.

Outputs require no fusing, they provide electronic short-circuit protection.

Micro PLC IC200UDD120 Specifications

Weight	460 grams (1.01 lb)
Inputs	Sixteen 24 VDC positive logic inputs in four groups of four
Outputs	Twelve transistor outputs, 24 VDC. Outputs are grouped in two groups with separated incoming supply. Each group contains 4 outputs with a maximum load of 0.5A and 2 outputs with a maximum load of 1A.
High Speed Counters	Four Type A or One Type A and One Type B
+24 VDC Output Power Supply	200mA maximum (for input circuits and user devices)

DC Power Specifications

Range	19.2VDC to 30VDC
Hold-up	10mS at 19.2 VDC
Inrush Current	1 Amp maximum at 30VDC
Inrush Time	10mS for 1 Amp
Input Current	0.20 Amp typical at 24VDC
Input Power Supply Rating	5W

DC Input Specifications

Rated Input Voltage	24 volts DC
Input Voltage Range	0 to 30 volts DC
Input Current	7.5mA typical
Input Resistance	2.8 Kohms
Input Threshold Voltage	ON: 15VDC minimum, OFF: 5VDC maximum
Input Threshold Current	ON: 4.5mA maximum, OFF: 1.5mA minimum
Response Time	0.5 to 20ms configurable as regular input; 100µs as HSC input
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups

DC Output Specifications

Voltage Range	Q1 – Q12: 12/24VDC +10%, -15%
External Power Supply (for supplying power to the V terminal)	12/24V -10%, +20%
Maximum Load Current	Q1 and Q2: 1A per point, Q3 - Q12: 0.7A per point
Minimum Switching Current	10mA
Maximum Inrush Current	Q1,Q2,Q11,Q12: 8A for 20ms, 1 pulse, Q3-Q10: 4A for 20ms, 1 pulse
Output Voltage Drop	Q1– Q12: 0.3V maximum
OFF state leakage current	0.1mA
Response Time	OFF to ON, ON to OFF: 0.05mS maximum @ 24VDC
Isolation Voltage	1500V RMS between field side and logic side, 500V RMS between groups
Fuse	Not required
Undervoltage shutdown	Q1 - Q12: 5V minimum, 8V maximum
DC short circuit current	Q1 – Q12: 0.7A minimum, 2A maximum
Peak short circuit current	4A maximum
Delay time of peak short circuit current	100µS
Delay time of current limit	100µS

High-speed Counter Input / PWM and Pulse Train Output Specifications	
Maximum Counter Frequency	10kHz
Input Voltage	ON : 15V, OFF: 5V
Count Pulse Width	20% to 80% duty cycle at 10kHz
Count Registers	16bits
Outputs	
Load Voltage	Q1-Q4: 12/24VDC
Maximum Pulse/PWM Frequency	5kHz
Types available	Up to four HSC, PT, and/or PWM outputs

Wiring Diagram IC200UDD120

VersaMax Micro PLC model IC200UDD212 accepts sixteen 12VDC inputs and provides twelve DC transistor outputs. It uses +12VDC nominal input power for PLC operation.

DC Power

If configured to disable power-up diagnostics, the PLC begins logic solution 100ms after the voltage level of the power supply input reaches and maintains 12VDC. The 12VDC power source for the PLC must have enough transient current capability to support the inrush current of the power supply and to maintain a 12VDC voltage level (see power supply specifications for inrush requirements).

DC Inputs

Sixteen configurable DC inputs can be used as positive or negative logic standard inputs. Eight of the inputs can be configured as four Type A Counters or one Type A and one Type B Counter. When used as standard inputs, they are compatible with a wide range of input devices, such as pushbuttons, limit switches, and electronic proximity switches.

The Micro PLC's +12 VDC supply can be used for input devices and to power the DC input circuits at about 7.5 mA per input. The combination of input circuit current and external device current must not exceed 200 mA.

Transistor Outputs

Micro PLC IC200UDD212 has twelve transistor outputs (Q1 to Q12) with maximum output load of 0.7A per output.

All outputs are isolated between field and logic and are switching positive voltage.

The output circuits can be used to switch devices like valves, lamps or contactors. External fusing should be provided to protect the outputs. Fast fuses are recommended.

The outputs can be configured as regular outputs or as outputs controlled by the High Speed Counters. Some outputs can be used as pulse train or pulse width modulation (PWM) outputs.

Each group of 6 outputs has one common incoming supply (V1, V2) and one common ground (C1, C2). The outputs are able to drive high inrush currents (8 times the rated current) and are protected against negative voltage pulses. This makes it possible to switch lamps and inductive loads.

Micro PLC IC200UDD212 Specifications

Weight	460 grams (1.01 lb)
Inputs	Sixteen 12VDC positive logic inputs in four groups of four
Outputs	Twelve transistor outputs, 12 VDC. Outputs are grouped in two groups with separated incoming supply. Each group contains 4 outputs with a maximum load of 0.5A and 2 outputs with a maximum load of 1A.
High-speed Counters	Up to four Type A or one Type A and one Type B
+12 VDC Output Power Supply)	200mA maximum (for input circuits and user devices

DC Power Specifications

Range	9.6VDC to 15 VDC
Hold-up	3.0mS
Inrush Current	9.6A typical at 12 VDC
Inrush Time	200mS typical
Input Current	480mA typical at 12 VDC
Input Power Supply Rating	8W

DC Input Specifications

Number of Inputs	16
Rated Input Voltage	12 volts DC
Input Voltage Range	0 to 15 volts DC
Input Current	9.0mA typical
Input Resistance	1.3 kOhms
Input Threshold Voltage	ON: 9.5VDC minimum, OFF: 2.5VDC maximum
Input Threshold Current	ON: 6.5mA maximum, OFF: 1.6mA minimum
Response Time	0.5 to 20ms (user configurable) as regular input; 100µs as HSC input
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups

DC Output Specifications

Voltage Range	12VDC (+20%, -20%)
Maximum Load	0.7A per point (Q1 - Q12) at 24VDC at 100 % ON duration, 4A per common
Maximum Inrush Current	4A for 20mS
Output Voltage Drop	0.3V maximum
OFF state leakage	0.1mA maximum
Response	OFF to ON: 0.1mS maximum (12 VDC), ON to OFF 0.1mS maximum (12 VDC)
Isolation Voltage	1500V RMS between field side and logic side, 500V RMS between groups
Fuse	Outputs should be fused externally. Otherwise, a load short can damage the module output transistor, which is not user replaceable.

High-speed Counter Input / PWM & Pulse-Train Output Specifications	
Maximum Counter Frequency	10kHz
Input Voltage	ON: 9V, OFF: 2.5V
Count Pulse Width	20% to 80% duty cycle at 10kHz
Count Registers	16bits
Outputs	
Load Voltage	Q1-Q4: 12VDC
Maximum Pulse/PWM Frequency	5kHz
Types available	Up to four HSC, PT, and/or PWM outputs

Wiring Diagram IC200UDD212
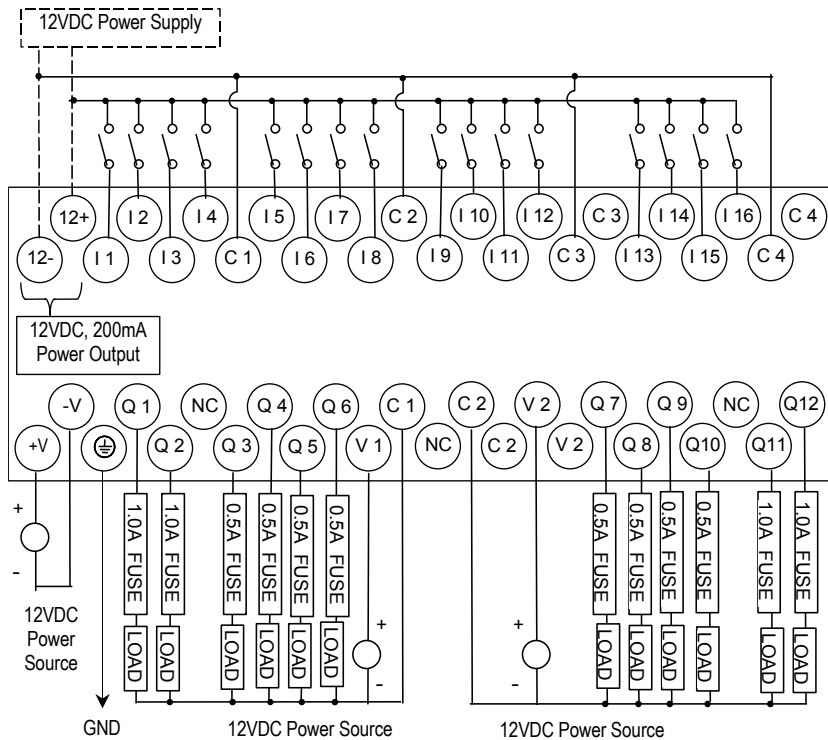
IC200UDR005
28 Point Micro PLC, (16) 24VDC In,
(1) 24VDC Out, (11) Relay Out, 120/240VAC Power Supply

VersaMax Micro PLC IC200UDR005 accepts sixteen DC inputs and provides one 24VDC output and eleven normally-open 2 Amp relay outputs. It uses 100VAC to 240VAC nominal input power for PLC operation.

DC Inputs

The sixteen configurable DC inputs can be used as positive or negative logic standard inputs, including up to four High-speed Counter inputs. Inputs are compatible with a wide range of devices, such as pushbuttons, limit switches, and electronic proximity switches. The module provides +24VDC output power for field devices, up to 200mA maximum.

DC Output (Q1)

The DC output circuit (Q1) can be configured to be a standard, High Speed Counter, pulse train, or PWM output.

Relay Outputs (Q2 – Q12)

The module has eleven Form A relay outputs (SPST-single pole single throw). The normally-open relay outputs can control a wide range of load devices such as motor starters, solenoids, and indicators. The switching capacity of each of these circuits is 2 amps. An external source of AC or DC power must be supplied to operate field devices.

The relay outputs can be configured as up to three High-speed Counter outputs. Relay outputs cannot be used as Pulse Train or PWM outputs.

Micro PLC IC200UDR005 Specifications

Weight	580 grams (1.28lbs)
Inputs	Sixteen 24 VDC positive/negative logic input circuits
Outputs	Eleven normally open 2 amp relay circuits and One DC Output (Q1)
High Speed Counters	Up to four Type A or one Type A and one Type B
+24 VDC Output Power Supply	200mA maximum (for input circuits and user devices)

AC Power Specifications	
Range	100 -15% to 240 +10% VAC
Frequency	50 -5% to 60 +5% Hz
Hold-up	10mS at 85 to 100VAC, 20mS at 100 to 265VAC
Inrush Current	30 Amp maximum at 200 VAC, 40 Amp maximum at 265 VAC
Inrush Time	2 ms for 40Amp
Input Current	0.20 Amp typical at 200 VAC, 0.10 Amp typical at 100 VAC
Input Power Supply Rating	26 VA
DC Input Specifications	
Number of Inputs	16
Rated Input Voltage	24 volts DC
Input Voltage Range	0 to 30 volts DC
Input Current	7.5mA typical
Input Resistance	2.8 Kohms
Input Threshold Voltage	ON: 15VDC minimum, OFF: 5VDC maximum
Input Threshold Current	ON: 4.5mA maximum, OFF: 1.5mA minimum
Response Time	0.5 to 20ms configurable as regular input; 100μs as HSC input
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups
DC Output Specifications	
Output logic	Positive Logic
Operating Voltage	24VDC / 12VDC / 5VDC
Voltage Range	24 VDC, +20%, -80%
Maximum UL Pilot Duty Rating	0.75A at 24 VDC
Maximum Resistive Load Rating	0.75A at 24 VDC 0.5A at 12 VDC 0.25A at 5 VDC
Output Voltage Drop	0.3 VDC maximum
Response	ON: 0.1ms maximum (24 VDC, 0.2A), OFF: 0.1ms maximum (24 VDC, 0.2A)
OFF state leakage	0.1mA maximum
Isolation	1500 VAC between field side and logic side, 500 VAC between groups
Fuse	Output should be fused externally. Otherwise, a load short can damage the module output transistor, which is not user replaceable.

Relay Output Specifications

Operating Voltage	5 to 30 VDC or 5 to 250 VAC
Isolation	1500 V RMS between field side and logic side, 500 V RMS between groups
Leakage Current	15 mA at 240 VAC maximum
Maximum UL Pilot Duty Rating	2 amps at 24 VDC and 240 VAC
Maximum Resistive Load Rating	2 amps at 24 VDC and 240 VAC
Minimum Load	10 mA
Maximum Inrush	5 amps per half cycle
Response Time	ON: 15 ms maximum, OFF: 15 ms maximum
Contact Life: Mechanical	20×10^6 mechanical operations

Contact Life: Electrical Voltage 240VAC, 120VAC, 24VDC	Current: Resistive 2.0A	Current: Lamp and Solenoid 0.6A	Typical Operations 200,000

High-speed Counter / PWM and Pulse Train Output Specifications

Maximum Counter Frequency	10kHz
Input Voltage	ON: 15V, OFF: 5V
Count Pulse Width	20% to 80% duty cycle at 10kHz
Count Registers	16bits
Outputs	
Type available	Up to four HSC outputs or three HSC outputs plus one PT or PWM output.
Load Voltage	Q1: 5/12/24V, Q2-Q4: See relay output specifications
Maximum Pulse/PWM Frequency	5kHz (Q1 only)

Wiring Diagram IC200UDR005
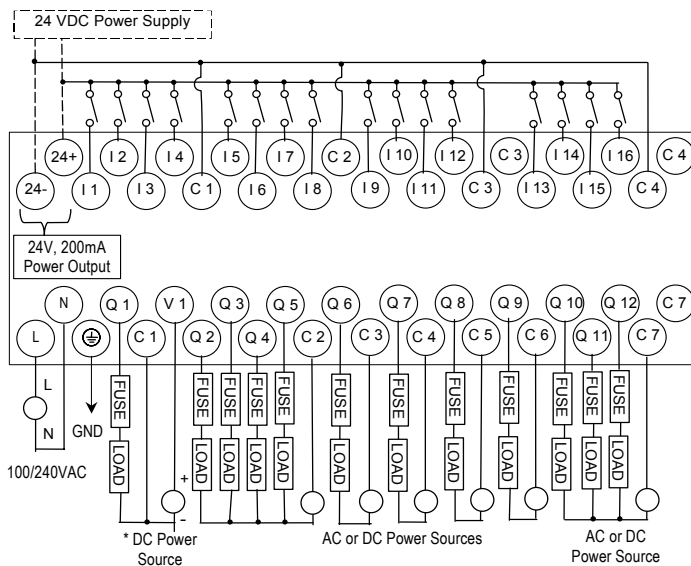
VersaMax Micro PLC IC200UDR006 accepts sixteen 12VDC inputs and provides twelve normally-open 2 Amp relay outputs. It uses +12VDC nominal input power.

DC Power

The DC power supply requires more current at startup voltage (approximately 4 VDC) than at rated input voltage. A minimum of 2.0 A is required to start up the DC power supply.

If configured to disable power-up diagnostics, the PLC begins logic solution 100ms after the voltage level of the power supply input reaches and maintains 12VDC. The 12VDC power source for the PLC must have enough transient current capability to support the inrush current of the power supply and to maintain a 12VDC voltage level (see power supply specifications for inrush requirements).

Inputs

The sixteen configurable 12VDC inputs can be used as positive or negative logic standard inputs or High-speed Counter inputs. Inputs are compatible with a wide range of devices such as pushbuttons, limit switches, and electronic proximity switches.

The Micro PLC's +12 VDC supply can be used for input devices and to power the DC input circuits at about 7.5 mA per input. The combination of input circuit current and external device current must not exceed 200 mA.

Relay Outputs (Q1 – Q12)

The module's twelve Form A relay outputs (SPST-single pole single throw) can be configured as normal or High-speed Counter outputs. Relay outputs cannot be used as Pulse Train or PWM outputs. The 12 normally-open relay outputs can control many types of devices such as motor starters, solenoids, and indicators. The switching capacity of each of these circuits is 2 amps. An external source of AC or DC power must be supplied for field devices.

Micro PLC IC200UDR006 Specifications

Weight	500 grams (1.10 lb)
Inputs	Sixteen 12 VDC positive/negative logic input circuits
Outputs	Twelve normally open 2 amp relay circuits
High-speed Counters	Up to four Type A or one Type A and one Type B
+12 VDC Output Power Supply	200mA maximum (for input circuits and user devices)

DC Power Specifications	
Range	9.6VDC - 15VDC
Hold-up	3.0mS
Inrush Current	9.6A typical at 12 VDC
Inrush Time	200mS typical
Input Current	480mA typical at 12 VDC
Input Power Supply Rating	8W

DC Input Specifications	
Number of Inputs	16
Rated Input Voltage	12 volts DC
Input Voltage Range	0 to 15 volts DC
Input Current	9.0mA typical
Input Impedance	1.3 kOhms
Input Threshold Voltage	ON: 9.5VDC minimum, OFF: 2.5VDC maximum
Input Threshold Current	ON: 6.5mA maximum, OFF: 1.6mA minimum
Response Time	0.5 to 20ms (user configurable) as regular input; 100μs as HSC input
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups

Relay Output Specifications			
Operating Voltage	5 to 30 VDC or 5 to 250 VAC		
Isolation	1500 V RMS between field side and logic side, 500 V RMS between groups		
Leakage Current	15 mA maximum		
Maximum UL Pilot Duty Rating	2 amps at 24 VDC and 240 VAC		
Maximum Resistive Load Rating	2 amps at 24 VDC and 240 VAC		
Minimum Load	1 mA		
Maximum Inrush	5 amps per half cycle		
Response Time	ON: 15 ms maximum, OFF: 15 ms maximum		
Contact Life: Mechanical	20×10^6 mechanical operations		
Contact Life: Electrical Voltage	Current: Resistive 2A	Current: Lamp and Solenoid 0.6A	Typical Operations 200,000

High-speed Counter Input / PWM and Pulse Train Output Specifications	
Maximum Counter Frequency	10kHz
Input Voltage	ON: 9V, OFF: 2.5V
Count Pulse Width	20% to 80% duty cycle at 10kHz
Count Registers	16 bits
Outputs	
Available Pulse Outputs	None
Load Voltage	Refer to relay specifications

Wiring Diagram IC200UDR006

IC200UDR010
28 Point Micro PLC, (16) 24VDC In, (1) 24VDC Out, (11) Relay Out, 24VDC PS
IC200UDR228
28 Point Micro PLC, (16) 24 VC In, (1) 24VDC Out, (11) Relay Out, 12/24 VDC PS

VersaMax Micro PLCs IC200UDR010 and IC200UDR228 accept sixteen DC inputs and provide one DC output and eleven normally-open 2 Amp relay outputs. The only differences between these modules are their power supplies and the output current rating of their Q1 DC output. Micro-28 IC200UDR010 uses +24VDC nominal input power, and provides a 450mA, 24VDC output. Micro-28 IC200UDR228 uses +12/24VDC nominal input power, and provides a 100mA, 24VDC output.

DC Power

The DC power supply requires more current at startup voltage (approximately 4 VDC) than at rated input voltage. A minimum of 2.0 A is required to start up the DC power supply.

If configured to disable power-up diagnostics, the PLC begins logic solution 100ms after the voltage level of the power supply input reaches and maintains nominal DC power. The power source for the PLC must have enough transient current capability to support the inrush current of the power supply and to maintain an adequate VDC voltage level (see specifications for inrush requirements).

DC Inputs

The sixteen configurable DC inputs can be used as positive or negative logic standard inputs or up to three High-speed Counter inputs. Inputs are compatible with a wide range of input devices, such as pushbuttons, limit switches, and electronic proximity switches.

The Micro PLC's +24 VDC supply can be used for input devices and to power the DC input circuits at about 7.5 mA per input. The combination of input circuit current and external device current must not exceed 200 mA.

DC Output (Q1)

The DC output circuit (Q1) can be configured to be a standard, High Speed Counter, pulse train, or PWM output.

Relay Outputs (Q2 – Q12)

Eleven Form A relay outputs (SPST-single pole single throw) can control a wide range of load devices such as motor starters, solenoids, and indicators. The switching capacity of each of these circuits is 2 amps. An external source of AC or DC power must be supplied to operate field devices. Relay outputs cannot be used as Pulse Train or PWM outputs.

Micro PLC IC200UDR010, IC200UDR228 Specifications

Weight	500 grams (1.10 lb)
Inputs	Sixteen 24 VDC positive/negative logic input circuits
Outputs	Eleven normally-open 2 amp relay circuits and One DC Output (Q1)
High-speed Counters	Up to four Type A or one Type A and one Type B
+24 VDC Output Power Supply	200mA maximum (for input circuits and user devices)
Thermal Derating	IC200UDR010: none. IC200UDR228: no derating to 45 degrees C. Above 45 degrees C, number of points on at the same time must not exceed 50%.

DC Power Specifications

Range	IC200UDR010: 24VDC -20%, +25% IC200UDR228: 9.2 to 30 VDC
Hold-up	IC200UDR010: 10ms at 19.2 VDC IC200UDR028: 5ms
Inrush Current	IC200UDR010: 1 Amp maximum at 30VDC IC200UDR228: 13 Amps at 12VDC, 27 Amps at 24VDC
Inrush Time	10mS for 1 A
Input Current	IC200UDR010: 0.30 Amp typical at 24VDC IC200URD228: 1.1 Amp typical at 12VDC; 0.55 Amp typical at 24VDC
Input Power Supply Rating	8W

DC Input Specifications

Number of Inputs	16
Rated Input Voltage	24 volts DC
Input Voltage Range	0 to 30 volts DC
Input Current	7.5mA typical
Input Resistance	2.8 Kohms
Input Threshold Voltage	ON: 15VDC minimum, OFF: 5VDC maximum
Input Threshold Current	ON: 4.5mA maximum, OFF: 1.5mA minimum
Response Time	0.5 to 20ms configurable as regular input; 100µs as HSC input
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups

DC Output Specifications

Output logic	Positive Logic
Operating Voltage	IC200UDR010: 24VDC / 12VDC / 5VDC; IC200UDR228: 24VDC / 12VDC
Voltage Range	IC200UDR010: 24 VDC, +20%, -80%; IC200UDR228: 23.5 - 24.5VDC
Output Current	IC200UDR010: 450mA; IC200UDR228: 100mA
Maximum UL Pilot Duty Rating	0.75A at 24 VDC
Maximum Resistive Load Rating	0.75A at 24 VDC; 0.5A at 12 VDC; 0.25A at 5 VDC
Output Voltage Drop	0.3 VDC maximum
Response	ON: 0.1ms maximum (24 VDC, 0.2A), OFF: 0.1ms maximum (24 VDC, 0.2A)
OFF state leakage	0.1mA maximum
Isolation	1500 VAC between field side and logic side, 500 VAC between groups
Fuse	Output should be fused externally. Otherwise, a load short can damage the module output transistor, which is not user replaceable.

Relay Output Specifications			
Operating Voltage	5 to 30 VDC or 5 to 250 VAC		
Isolation	1500 V RMS between field side and logic side, 500 V RMS between groups		
Leakage Current	15 mA at 240 VAC maximum		
Maximum UL Pilot Duty Rating	2 amps at 24 VDC and 240 VAC		
Maximum Resistive Load Rating	2 amps at 24 VDC and 240 VAC		
Minimum Load	1 mA		
Maximum Inrush	5 amps per half cycle		
Response Time	ON: 15 ms maximum, OFF: 15 ms maximum		
Contact Life: Mechanical	20×10^6 mechanical operations		
Contact Life: Electrical Voltage 240VAC, 120VAC, 24VDC	Current: Resistive 2A	Current: Lamp and Solenoid 0.6A	Typical Operations 200,000

High-speed Counter Input / PWM and Pulse-Train Output Specifications	
Maximum Counter Frequency	10kHz
Input Voltage	ON: 15V, OFF: 5V
Count Pulse Width	20% to 80% duty cycle at 10kHz
Count Registers	16bits
Outputs	
Load Voltage	Q1: IC200UDR010 = 5/12/24V; IC200UDR228 = 12/24V Q2-Q4: See Relay output specifications
Maximum Pulse/PWM Frequency	(Q1 only) 5kHz
Types available	Up to four HSC outputs or three HSC outputs plus one PT/PWM output.

Wiring Diagram IC200UDR010, IC200UDR228
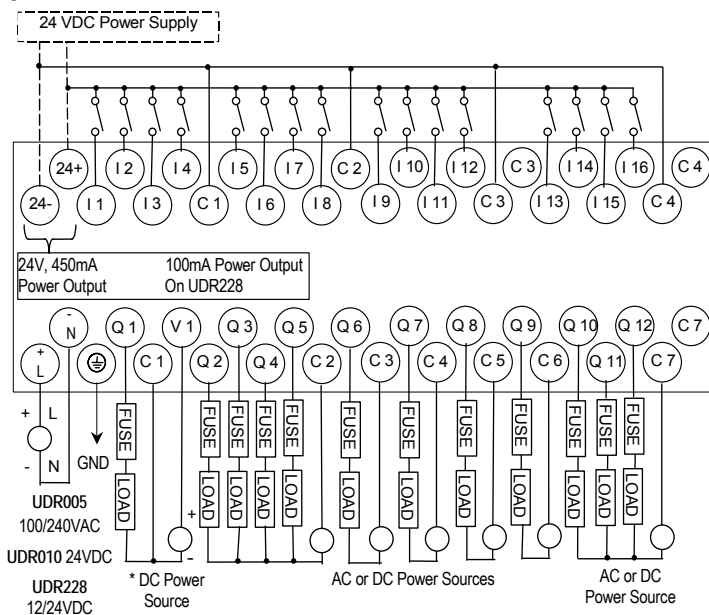
Chapter 7

VersaMax 40-Point Micro/Micro PLUS PLCs

This chapter describes the features, specifications, and field wiring for 40-point VersaMax Micro and VersaMax Micro PLUS PLCs.

▪	IC200UDD040	40 Point Micro PLC, (24) 24VDC In, (16) 24VDC Out (Source), 24VDC Power Supply
▪	IC200UDD240	40 Point Micro PLC, (24) 24VDC In, (12) 24VDC Out with ESCP, (4) 24V LCDC Out, 24VDC Power Supply
▪	IC200UDR040	40 Point Micro PLC, (24) 24VDC In, (16) Relay Out, 24VDC Power Supply
▪	IC200UDR140	40 Point Micro PLC, (24) 24VDC In, (16) Relay Out, 120/240VAC Power Supply
▪	IC200UDR440	40 Point Micro PLC, (24) 24VDC In, (16) Relay Out, 12/24VDC Power Supply

Note: Firmware releases 4.00 and later require a Micro PLUS CPU, which has enhanced memory. Firmware versions 4.00 cannot be used with the earlier hardware versions.

- Micro and Micro PLUS PLCs support the same user logic memory size.

- The specifications given in this chapter for Micro PLCs also apply to Micro PLUS PLCs.

Features of VersaMax 40-Point Micro PLCs

- Supports up to four Expansion Units in any combination.
- Removable screw-down "barrier-style" terminal strips with protective covers.
- Built-in serial communications port supports SNP/ SNPX master and slave, Modbus RTU master and slave, and Serial I/O.
- Removable Memory Pack Module available.
- Optional Port 2.
- Run/Stop mode switch that can be configured as a run/stop switch, a memory protect switch, and also used for clearing faults when a fatal fault exists.
- Resettable calendar clock.
- Full-featured programming Instruction Set with floating point math. The application program can be either Ladder Diagram (LD) or Instruction List (IL) format.
- 24K words of program memory, 32K words of registers.
- Flash memory (ROM) for non-volatile program storage and for system firmware.
- Configurable to read configuration and application program at powerup from either RAM or flash memory (ROM).
- Capacitor backs up RAM and the Time-of-Day clock for at least 30 minutes at 25 degrees C
- Optional lithium battery backup for RAM and real-time clock.
- Enhanced High-speed Counter / Pulse Train commands for Jogging, Blending, and Homing, plus configurable 32-bit Counters /PTO/ and 32-bit function blocks.

Input Terminals on Removable Terminal Strips

Run/Stop Mode Switch

Option Module Connector

Status LEDS

RS-232 Serial Port 1

Expansion Connector

DIN Rail Release

RS-485 Serial Port 2 Located Behind Removable Door

Output Terminals on Removable Terminal Strips

Run/Stop Switch

The Run/Stop switch can be configured as a run/stop switch or a memory protect switch, and used for clearing faults when a fatal fault exists.

Ports

Port 1 is a built-in RS-232 serial port with an RJ-45 connector.
A second port can be added to a 40-Point Micro PLC using one of the port Option Modules described in chapter 14. If a second port is installed, both ports can be used for programming. Only one port can be used at a time for programming, but both ports can be used for monitoring at the same time.

Port 1 and the optional Port 2 are individually-configurable for SNP master/slave, RTU master/slave, and Serial I/O protocols. Both 4-wire and 2-wire RTU are supported when the RS-485 Port Option module is installed as port 2. Port 2 does not support hardware flow control. When either port is being used for RTU slave, it automatically switches to SNP slave mode when that port is being used by the programmer. If a port is configured for Serial I/O, RTU Master, or SNP Master operation, that port defaults to SNP slave and automatically reverts to SNP slave when the CPU is in Stop mode.

Either port can be software-configured to set up communications between the CPU and various serial devices. An external device can obtain power from the port if it requires 200mA or less at 5VDC.

Analog Inputs

The RS232 Option Module (IC200USB001) or the RS485 Option Module (IC200USB002) can provide two 0-10V analog inputs. See chapter 14 for more information about option modules. The two inputs can be used to adjust the values in analog registers %AI016 (input 1) and %AI017 (input 2). An example use for the analog inputs would be to set threshold values for use in logical relationships with other inputs/outputs.

Removable Terminal Strips

The removable terminal assemblies are protected by hinged covers. After turning off power to the Micro PLC, a terminal assembly and attached field wiring can be separated from the Micro PLC by removing two screws.

Status LEDs

LEDs on the Micro PLC provide quick visual verification of operating status. In addition to LEDs for Power, OK, and Run mode, there is an LED for each I/O point.

Backup Battery

The Micro PLC uses a large value capacitor to provide memory retention current to the System/User RAM and the Time-of-Day clock when the power supply is either not present or not powered up. The capacitor retains memory contents for at least 30 minutes.

To maintain memory for longer than this, a replaceable battery assembly can be installed in the battery holder, as described in chapter 15. The Micro PLC reports the battery state to the PLC Fault Table and also uses Status Bits %SA011 and %S0014 to indicate the battery state.

General Specifications of 40-Point VersaMax Micro PLCs

Module Dimensions	Height: 90mm (3.6 inches), Depth: 76mm (3.0 inches) Width: 150mm (6.0 inches)
Typical Scan Rate	1.7 ms/K for Boolean logic (see appendix A)
Real Time Clock accuracy (for Timer contacts and Timer function blocks)	+/-0.5%
Time-of-Day Clock accuracy	+/-5 sec/day @10degC, +/-5 sec/day @25degC, and +/-11 sec/day @ 55°C or across full temperature range
Maximum number of slave devices per RS-485 network	8 (can be increased with a repeater)
+24 VDC Output Power Supply (for input circuits and user devices)	435mA maximum
+5 VDC output of Serial Ports	200mA per port, 400mA total for both ports, maximum

High-Speed Counters

VersaMax 40-Point Micro PLCs can be configured to provide built-in High-Speed Counter and pulse operation. When configured for High-Speed Counter operation, inputs I1 to I8 can be set up as:

- Up to four Type A Counters or

- One Type A and one Type B Counter or

- Up to four Type A_32 Counters or

- One Type A and one Type B_32 Counter

Each counter provides direct processing of rapid pulse signals up to 100kHz for industrial control applications such as meter proving, turbine flow meter, velocity measurement, material handling, motion control, and process control.

Each counter can be enabled independently. Type A counters can be configured for up or down counting (default is up) and for positive or negative edge detection (default is positive). The type B counter provides an A Quad B counting function.

See Chapter 18 for information about High-Speed Counter operation.

IC200UDD040
40 Point Micro PLC, (24) 24VDC In, (12) 24VDC Out with ESCP, (4) LCDC Out, 24VDC Power Supply

VersaMax Micro PLC IC200UDD040 accepts twenty-four DC inputs and provides twelve 24V ESCP outputs and four 24VDC low current outputs. It uses +24VDC nominal input power for PLC operation.

DC Power

If configured to disable power-up diagnostics, the PLC begins logic solution 100ms after the voltage level of the power supply input reaches and maintains 24VDC. The 24VDC power source for the PLC must have enough transient current capability to support the inrush current of the power supply and to maintain a 24VDC voltage level (see power supply specifications for inrush requirements).

DC Inputs

The twenty-four configurable DC inputs can be used as positive or negative logic standard inputs. Eight of these inputs can be used for High-speed Counter inputs. When used as standard inputs, they are compatible with a wide range of input devices, such as pushbuttons, limit switches, and electronic proximity switches.

The Micro PLC's +24 VDC supply can be used for input devices and to power the DC input circuits at about 8mA per input. The combination of input circuit current and external device current must not exceed 435 mA.

DC Outputs

Outputs 1 – 4 can be used as standard, High-speed Counter, Pulse-Width Modulated, Pulse Train Outputs, or Pulse Train Outputs with Ramping. All standard outputs are all source-type. Outputs can be used to switch devices like valves, lamps or contactors.

Outputs 5 – 16 provide Electronic Short-Circuit Protection.

Micro PLC IC200UDD040 Specifications

Inputs	Twenty-four 24 VDC positive or negative logic inputs
Outputs	Sixteen 24VDC outputs. Outputs 5-16 with ESCP
High-speed Counters	Up to four Type A or one Type A and one Type B, or four Type A_32, or one Type A_32 and one Type B_32
DC Power Specifications	
Range	19.2VDC to 30VDC
Hold-up	10mS at 19.2 VDC
Inrush Current	1 Amp maximum at 30VDC
Inrush Time	10mS for 1 Amp
Input Current	0.20 Amp typical at 24VDC
Input Power Supply Rating	5W
DC Input Specifications	
Rated Input Voltage	24 volts DC
Input Voltage Range	0 to 30 volts DC
Input Current at 24VDC	I1, I3, I5, I7: 8mA typical; other inputs 4.8mA typical
Input Impedance	I1, I3, I5, I7: 2.7 kOhms; other inputs: 4.7kOhms
Input Threshold Voltage	ON: 18VDC minimum, OFF: 5VDC maximum
Input Threshold Current	I1, I3, I5, I7: ON 4.5mA maximum, OFF: 1.8mA minimum
	Other inputs: ON 3.3mA maximum, OFF: 1.6mA maximum
Response Time	1ms to 20ms configurable as regular input; 100µs as HSC input
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups
Output Specifications	
Voltage Range	12VDC / 24VDC
External Power Supply	12/24VDC –10%, +20%
Maximum Load Current	0.5A per point (Q1 – Q4) at 24VDC at 100 % ON duration
	0.7A per point (Q5 – Q16) at 24VDC at 100 % ON duration
Minimum Switching Current	10mA
Maximum Inrush Current	Q1-Q4: 2A for 20ms, 1 pulse
	Q5-Q16: 4A for 20ms, 1 pulse
Output Voltage Drop	0.3V maximum
OFF state leakage current	0.1mA maximum
Response Time	OFF to ON, ON to OFF: 1 ms maximum (24 VDC)
Isolation Voltage	1500V RMS between field side and logic side, 500V RMS between groups
Fuse	None, outputs 5-16 are ESCP protected
Undervoltage shutdown	Q5 – Q16: 5V minimum, 8V maximum
DC short circuit current	Q1 – Q4: 5A maximum
	Q5 - Q16: 0.7A maximum ESCP
Peak short circuit current	Q5 - Q16:4A maximum
Delay time of peak short circuit current	100 microseconds
Delay time of current limit	100 microseconds

High-speed Counter Input and Output Specifications	
Maximum Counter Frequency	100kHz
Input Voltage	ON : 18V, OFF: 5V
Count Pulse Width	20% to 80% of duty cycle at 100kHz
Count Registers	16/32 bits
Outputs	
Load Voltage	12/24VDC
Maximum Pulse/Pulse Train with Ramping/PWM Frequency	PWM and PTO: 65kHz Pulse Train with Ramping: 65kHz
Types available	Up to four HSC, PTO, PTO with Ramping and/or PWM outputs

Wiring Diagram, IC200UDD040

IC200UDD240
40 Point Micro PLC, (24) 24VDC In, (16) 24VDC Out (Sink), 24VDC Power Supply

VersaMax Micro PLC IC200UDD240 accepts twenty-four DC inputs and provides sixteen DC outputs. It uses +24VDC nominal input power for PLC operation.

DC Power

If configured to disable power-up diagnostics, the PLC begins logic solution 100ms after the voltage level of the power supply input reaches and maintains 24VDC. The 24VDC power source for the PLC must have enough transient current capability to support the inrush current of the power supply and to maintain a 24VDC voltage level (see power supply specifications for inrush requirements).

DC Inputs

Twenty-four configurable DC inputs can be used as positive or negative logic standard inputs. Eight of these inputs can be used for High-speed Counter inputs. When used as standard inputs, they are compatible with a wide range of input devices, such as pushbuttons, limit switches, and electronic proximity switches.

The Micro PLC's +24 VDC supply can be used for input devices and to power the DC input circuits at about 8mA per input. The combination of input circuit current and external device current must not exceed 435mA.

DC Outputs

Micro PLC IC200UDD240 has 16 Sink-type DC outputs. All outputs are isolated between field and logic and are switching positive voltage. The outputs have one common incoming supply (VC) and one common ground (COM). The outputs are able to drive high inrush currents (8 times the rated current) and are protected against negative voltage pulses. This makes it possible to switch lamps and inductive loads.

DC outputs can be used as standard, High-speed Counter, Pulse-Width Modulated, Pulse Train Outputs, or Pulse Train Outputs with Ramping.

Micro PLC IC200UDD240 Specifications

Inputs	Twenty-four 24 VDC positive or negative logic inputs
Outputs	Sixteen transistor outputs, 24 VDC.
High-speed Counters	Up to four Type A or one Type A and one Type B, or four Type A_32, or one Type A_32 and one Type B_32

DC Power Specifications

Range	19.2VDC to 30VDC
Hold-up	10mS at 19.2 VDC
Inrush Current	1 Amp maximum at 30VDC
Inrush Time	10mS for 1 Amp
Input Current	0.20 Amp typical at 24VDC
Input Power Supply Rating	5W

DC Input Specifications

Rated Input Voltage	24 volts DC
Input Voltage Range	0 to 30 volts DC
Input Current at 24VDC	I1, I3, I5, I7: 8mA typical; other inputs 4.8mA typical
Input Impedance	I1, I3, I5, I7: 2.7 kOhms; other inputs: 4.7kOhms
Input Threshold Voltage	ON: 18VDC minimum, OFF: 5VDC maximum
Input Threshold Current	I1, I3, I5, I7: ON 4.5mA maximum, OFF: 1.8mA minimum
	Other inputs: ON 3.3mA maximum, OFF: 1.6mA maximum
Response Time	1ms to 20ms configurable as regular input; 100μs as HSC input
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups

Output Specifications

Voltage Range	12VDC/24VDC
External Power Supply	12/24VDC –10%, +20%
Maximum Load Current	0.5A per point (Q1 – Q24) at 24VDC
Minimum Switching Current	10mA
Maximum Inrush Current	Q1-Q16: 2A for 20ms, 1 pulse
Output Voltage Drop	Q1– Q16: 0.3VDC
OFF state leakage current	0.1mA
Response Time	OFF to ON, ON to OFF: 1 mS maximum @ 24VDC
Isolation Voltage	1500V RMS between field side and logic side, 500V RMS between groups
Fuses	None
Under-voltage shutdown	Q1 – Q16: 5V minimum, 8V maximum
DC short circuit current	Q1 – Q16: 0.7A minimum, 2A maximum

High-speed Counter Input and Output Specifications	
Maximum Counter Frequency	100kHz
Input Voltage	ON : 18V, OFF: 5V
Count Pulse Width	20% to 80% of duty cycle at 100kHz
Count Registers	16/32 bits
Outputs	
Load Voltage	12/24VDC
Maximum Pulse/PWM Frequency	PWM and PTO: 65kHz Pulse Train with Ramping: 65kHz
Types available	Up to four HSC, PTO, PTO with Ramping and/or PWM outputs

Wiring Diagram, IC200UDD240

IC200UDR040
40 Point Micro PLC, (24) 24VDC In, (16) Relay Out, 24VDC Power Supply
IC200UDR140
40 Point Micro PLC, (24) 24VDC In, (16) Relay Out, 120/240VAC Power Supply
IC200UDR440
40 Point Micro PLC, (24) 24VDC In, (16) Relay Out, 12/24VDC Power Supply

VersaMax Micro PLCs IC200UDR040, IC200UDR140, and IC200UDR440 each accept twenty-four DC inputs and provide sixteen normally-open 2 Amp relay outputs.

- IC200UDR040 uses +24VDC nominal input power for PLC operation.
- IC200UDR140 uses 100VAC to 240VAC nominal input power for PLC operation.
- IC200UDR440 uses +12/24VDC nominal input power for PLC operation.

DC Inputs

Twenty-four configurable DC inputs can be used as positive or negative logic standard inputs. Eight of these inputs can be used for High-speed Counter inputs. When used as standard inputs, they are compatible with a wide range of input devices, such as pushbuttons, limit switches, and electronic proximity switches.

The Micro PLC's +24 VDC supply can be used for input devices and to power the DC input circuits at about 8mA per input. The combination of input circuit current and external device current must not exceed 435mA.

Relay Outputs

The sixteen normally-open Form A relay outputs (SPST-single pole single throw) can control many types of load devices such as motor starters, solenoids, and indicators. The switching capacity of each of these circuits is 2 amps. An external source of AC or DC power must be supplied to operate field devices.

The relay outputs can be configured as up to four HSC outputs. Relay outputs cannot be used as Pulse Train or PWM outputs.

Micro PLC IC200UDR040, IC200UDR140, IC200UDR440 Specifications

Inputs	Twenty-four 24 VDC positive/negative logic input circuits
Outputs	Sixteen normally open 2 amp relay circuits
High-speed Counters	Up to four Type A or one Type A and one Type B, or four Type A_32, or one Type A_32 and one Type B_32
+24 VDC Output Power Supply	435mA maximum (for input circuits and user devices)
+5 VDC output of Serial Port	Serial Port 1, pin 7: 100mA maximum
Power Supply Specifications	
Range	IC200UDR040, IC200UDR440: 19.2VDC to 30VDC IC200UDR140: 100 -15% to 240 +10% VAC
Frequency	IC200UDR140: 50 -5% to 60 +5% Hz
Hold-up	IC200UDR040, IC200UDR440:10mS at 19.2 VDC IC200UDR140: 10mS at 85 to 100VAC, 20mS at 100 to 265VAC
Inrush Current	IC200UDR040, IC200UDR440:1 Amp maximum at 30VDC IC200UDR140: 30 Amp maximum at 200 VAC, 40 Amp maximum at 265 VAC
Inrush Time	IC200UDR040, IC200UDR440:10mS for 1 Amp IC200UDR140: 2 ms for 40Amp
Input Current	IC200UDR040, IC200UDR440:0.20 Amp typical at 24VDC IC200UDR140: 0.20 Amp typical at 200 VAC 0.10 Amp typical at 100 VAC
Input Power Supply Rating	IC200UDR040, IC200UDR440: 5W IC200UDR140: 26 VA
DC Input Specifications	
Rated Input Voltage	24 volts DC
Input Voltage Range	0 to 30 volts DC
Input Current at 24VDC	I1, I3, I5, I7: 8mA typical; other inputs 4.8mA typical
Input Impedance	I1, I3, I5, I7: 2.7 kOhms; other inputs: 4.7kOhms
Input Threshold Voltage	ON: 18VDC minimum, OFF: 5VDC maximum
Input Threshold Current	I1, I3, I5, I7: ON 4.5mA maximum, OFF: 1.8mA minimum Other inputs: ON 3.3mA maximum, OFF: 1.6mA maximum
Response Time	1ms to 20ms configurable as regular input; 100µs as HSC input
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups
High-speed Counter Input and Output Specifications	
Maximum Counter Frequency	100kHz
Input Voltage	ON: 18V, OFF: 5V
Count Pulse Width	20% to 80% of duty cycle at 100kHz
Count Registers	16/32 bits
Outputs	
Load Voltage	Q1: 5/12/24V, Q2-Q4: See relay output specifications
Type available	Up to four HSC outputs. Pulse outputs not available.

Relay Output Specifications			
Operating Voltage	5 to 30 VDC or 5 to 250 VAC		
Isolation	1500 V RMS between field side and logic side, 500 V RMS between groups		
Leakage Current	15 mA at 240 VAC maximum		
Maximum UL Pilot Duty Rating	2 amps at 24 VDC and 240 VAC		
Maximum Resistive Load Rating	2 amps at 24 VDC and 240 VAC		
Minimum Load	10 mA		
Maximum Inrush	IC200UDR040: 1.5A, 10ms IC200UDR140: 9.4A, 20ms		
Response Time	ON: 15 ms maximum, OFF: 15 ms maximum		
Contact Life: Mechanical	20×10^6 mechanical operations		
Contact Life: Electrical Voltage 240VAC, 120VAC, 24VDC	Current: Resistive 2.0A	Current: Lamp and Solenoid 0.6A	Typical Operations 200,000

Wiring Diagram, IC200UDR040, IC200UDR140, IC200UDR440
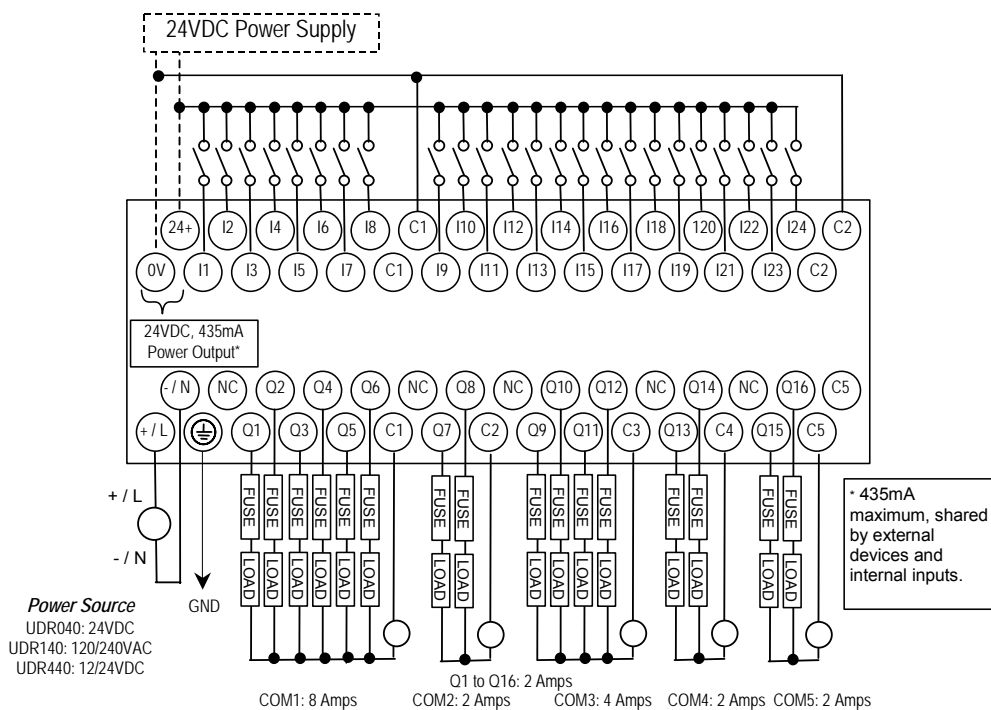
<table>
<tr><td>Chapter
8</td><td>VersaMax 64-Point Micro/Micro PLUS PLCs</td></tr>
</table>

This chapter describes the features, specifications, and field wiring for 64-Point VersaMax Micro and VersaMax Micro PLUS PLCs.

▪	IC200UDD064	64 Point Micro PLC, (40) 24VDC In, (24) 24VDC Out (Source), 24VDC Power Supply
▪	IC200UDD164	64 Point Micro PLC, (40) 24VDC In, (24) 24VDC Out (Sink), 24VDC Power Supply
▪	IC200UDR064	64 Point Micro PLC, (40) 24VDC In, (24) Relay Out, 24VDC Power Supply
▪	IC200UDR164	64 Point Micro PLC, (40) 24VDC In, (24) Relay Out, 120/240VAC Power Supply

Note: Firmware releases 4.00 and later require a Micro PLUS CPU, which has enhanced memory. Firmware versions 4.00 cannot be used with the earlier hardware versions.

- Micro and Micro PLUS PLCs support the same user logic memory size.

- The specifications given in this chapter for Micro PLCs also apply to Micro PLUS PLCs.

Features of VersaMax 64-Point Micro PLCs

- Supports up to four Expansion Units in any combination.
- Removable screw-down "barrier-style" terminal strips with protective covers.
- Built-in serial communications port supports SNP/ SNPX master and slave, Modbus RTU master and slave, and Serial I/O.
- Removable Memory Pack Module available.
- Optional Port 2.
- Run/Stop mode switch that can be configured as a run/stop switch, a memory protect switch, and also used for clearing faults when a fatal fault exists.
- Resettable calendar clock.
- Full-featured programming Instruction Set with floating point math. The application program can be either Ladder Diagram (LD) or Instruction List (IL) format.
- 24K words of program memory, 32K words of registers.
- Flash memory (ROM) for non-volatile program storage and for system firmware.
- Configurable to read configuration and application program at powerup from either RAM or flash memory (ROM).
- Capacitor backs up RAM and the Time-of-Day clock for at least 30 minutes at 25 degrees C
- Optional lithium battery backup for RAM and real-time clock.
- Release 3.6 and later Micro-64 PLCs support enhanced High-speed Counter / Pulse Train commands for Jogging, Blending, and Homing, plus configurable 32-bit Counters /PTO/ and 32-bit function blocks.

General Specifications of 64-Point VersaMax Micro PLCs

Module Dimensions	Height: 90mm (3.6 inches), Depth: 76mm (3.0 inches) Width: 195mm (7.68 inches)
Typical Scan Rate	1.7 ms/K for Boolean logic (see appendix A)
Real Time Clock accuracy (for Timer contacts and Timer function blocks)	+/-0.5%
Time-of-Day Clock accuracy	+/-5 sec/day @10degC, +/-5 sec/day @25degC, and +/-11 sec/day @ 55°C or across full temperature range
Maximum number of slave devices per RS-485 network	8 (can be increased with a repeater)
+24 VDC Output Power Supply (for input circuits and user devices)	435mA maximum
+5 VDC output of Serial Ports	200mA per port, 400mA total for both ports, maximum

High Speed Counters

VersaMax 64-Point Micro PLCs can be configured to provide built-in high-speed counter and pulse operation. When configured for High-speed Counter operation, inputs I1 to I8 can be set up as:

- Up to four Type A Counters or

- One Type A and one Type B Counter or.

- Up to four Type A_32 Counters or

- One Type A and one Type B_32 Counter

Each counter provides direct processing of rapid pulse signals up to 100kHz for industrial control applications such as meter proving, turbine flow meter, velocity measurement, material handling, motion control, and process control.

Each counter can be enabled independently. Type A counters can be configured for up or down counting (default is up) and for positive or negative edge detection (default is positive). The type B counter provides an A Quad B counting function.

The DC output (Q1) can be configured as a counter, Pulse Train, Pulse Train with Ramp, or PWM output. The relay outputs can be configured as up to four HSC outputs. Relay outputs cannot be used as Pulse Train, Pulse Train with Ramp, or PWM outputs.
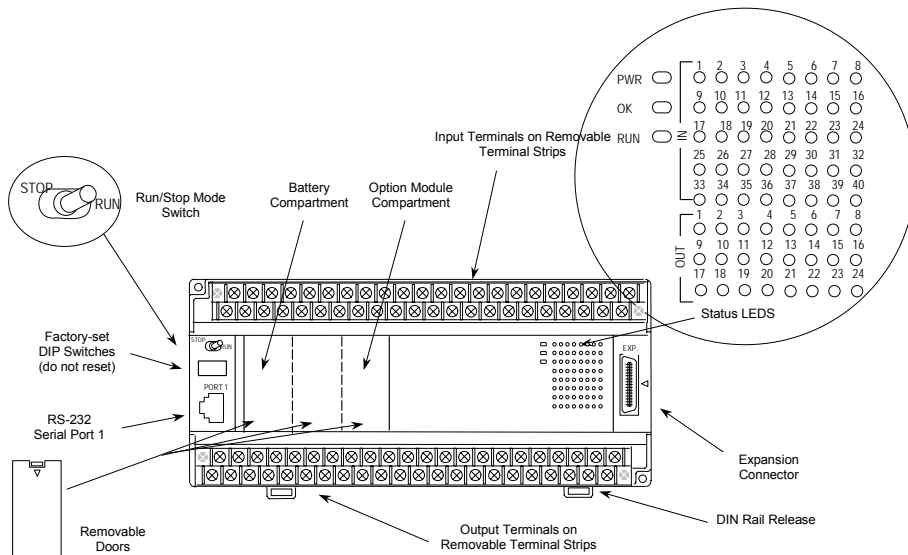
Run/Stop Switch

The Run/Stop switch can be configured as a run/stop switch, a memory protect switch, and used for clearing faults when a fatal fault exists.

Ports

Port 1 is a built-in RS-232 serial port with an RJ-45 connector.

A second port can be added to a 64-Point Micro PLC using one of the port Option Modules described in this section. If a second port is installed, both ports can be used for programming. Only one port can be used at a time for programming, but both ports can be used for monitoring at the same time.

Port 1 and the optional Port 2 are individually-configurable for SNP master/slave, RTU master/slave, and Serial I/O protocols. Both 4-wire and 2-wire RTU are supported when the RS-485 Port Option module is installed as port 2. Port 2 does not support hardware flow control . When either port is being used for RTU slave, it automatically switches to SNP slave mode when that port is being used by the programmer. If a port is configured for Serial I/O, RTU Master, or SNP Master operation, that port defaults to SNP slave and automatically reverts to SNP slave when the CPU is in Stop mode.

Either port can be software-configured to set up communications between the CPU and various serial devices. An external device can obtain power from the port if it requires 200mA or less at 5VDC.

Analog Inputs

If an Option Module with analog inputs is installed as described in this section, the two inputs can be used to adjust the values in analog registers %AI016 (input 1) and %AI017 (input 2). An example use for the analog inputs would be to set threshold values for use in logical relationships with other inputs/outputs.

Removable Terminal Strips

The removable terminal assemblies are protected by hinged covers. After turning off power to the Micro PLC, a terminal assembly and attached field wiring can be separated from the Micro PLC by removing two screws.

Status LEDs

LEDs on the Micro PLC provide quick visual verification of operating status. In addition to LEDs for Power, OK, and Run mode, there is an LED for each I/O point.

Backup Battery

The Micro PLC uses a large value capacitor to provide memory retention current to the System/User RAM and the Time-of-Day clock when the power supply is either not present or not powered up. The capacitor retains memory contents for at least 30 minutes.

To maintain memory for longer than this, a replaceable battery assembly can be installed in the battery holder, as described in chapter 15. The Micro PLC reports the battery state to the PLC Fault Table and also uses Status Bits %SA011 and %S0014 to indicate the battery state.

IC200UDD064
64 Point Micro PLC, (40) 24VDC In, (24) 24VDC Out (Source), 24VDC Power Supply

VersaMax Micro PLC IC200UDD064 accepts forty DC inputs and provides twenty-four DC outputs. It uses +24VDC nominal input power for PLC operation.

DC Power

If configured to disable power-up diagnostics, the PLC begins logic solution 100ms after the voltage level of the power supply input reaches and maintains 24VDC. The 24VDC power source for the PLC must have enough transient current capability to support the inrush current of the power supply and to maintain a 24VDC voltage level (see power supply specifications for inrush requirements).

DC Inputs

The forty configurable DC inputs can be used as positive or negative logic standard inputs. Eight of these inputs can be used for High-speed Counter inputs. When used as standard inputs, they are compatible with a wide range of input devices, such as pushbuttons, limit switches, and electronic proximity switches.

The Micro PLC's +24 VDC supply can be used for input devices and to power the DC input circuits at about 8mA per input. The combination of input circuit current and external device current must not exceed 435 mA.

Transistor Outputs

Outputs 1 – 4 can be used as standard, High-speed Counter, Pulse-Width Modulated, Pulse Train Outputs, or Pulse Train Outputs with Ramping. All standard outputs are source-type. Outputs can be used to switch devices like valves, lamps or contactors.
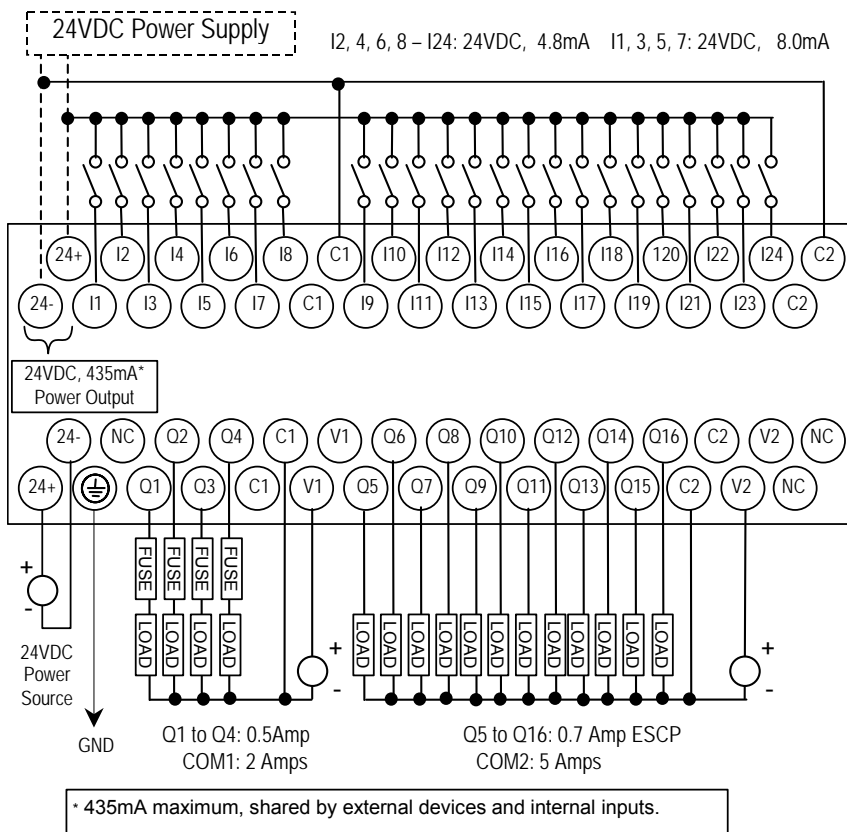
Outputs 5 – 24 provide Electronic Short-Circuit Protection. No external fuses are required.

Micro PLC IC200UDD064 Specifications

Inputs	Forty 24 VDC positive or negative logic inputs
Outputs	Twenty-four transistor outputs, 24 VDC.
High-speed Counters	Up to four Type A or one Type A and one Type B, or four Type A_32, or one Type A_32 and one Type B_32
DC Power Specifications	
Range	19.2VDC to 30VDC
Hold-up	10mS at 19.2 VDC
Inrush Current	1 Amp maximum at 30VDC
Inrush Time	10mS for 1 Amp
Input Current	0.20 Amp typical at 24VDC
Input Power Supply Rating	5W
DC Input Specifications	
Rated Input Voltage	24 volts DC
Input Voltage Range	0 to 30 volts DC
Input Current at 24VDC	I1,I3,I5,I7: 8mA typical, Others : 4.8 mA typical
Input Impedance	I1,I3,I5,I7 2.7 Kohms, Others: 4.7 Kohms
Input Threshold Voltage	ON: 18VDC minimum, OFF: 5VDC maximum
Input Threshold Current	I1, I3, I5, I7: ON 4.5mA maximum, OFF: 1.8mA minimum Other Inputs: ON 3.3mA maximum, OFF: 1.6mA minimum
Response Time	1ms to 20ms configurable as regular input; 100μs as HSC input
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups
Output Specifications	
Voltage Range	12VDC/24VDC
External Power Supply	12/24VDC –10%, +20%
Maximum Load Current	0.5A per point (Q1 – Q4) at 24VDC at 100 % ON duration 0.7A per point (Q5 – Q20) at 24VDC at 100 % ON duration 1.0A per point (Q21 – Q24) at 24VDC at 100% ON duration
Minimum Switching Current	10mA
Maximum Inrush Current	Q1-Q4: 2A for 20ms, 1 pulse Q5-Q20: 4A for 20ms, 1 pulse Q21-Q24: 8A for 20ms, 1 pulse
Output Voltage Drop	0.3V maximum
OFF state leakage current	0.1mA maximum
Response Time	OFF to ON, ON to OFF: 1ms maximum (24 VDC)
Isolation Voltage	1500V RMS between field side and logic side, 500V RMS between groups
Fuse	None, outputs 5–24 are ESCP protected
Undervoltage shutdown	Q5 – Q20: 5V minimum, 8V maximum
DC short circuit current	Q1 – Q4, Q21 – Q24: 5A typical Q5 – Q20: 0.7A minimum, 2A maximum
Peak short circuit current	Q5 – Q20: 4A maximum
Delay time of peak short circuit current	100 microseconds
Delay time of current limit	100 microseconds

High-speed Counter Input and Output Specifications

Maximum Counter Frequency	100kHz
Input Voltage	ON : 18V, OFF: 5V
Count Pulse Width	20% to 80% of duty cycle at 100kHz
Count Registers	16/32 bits
Outputs	
Load Voltage	12/24VDC
Maximum Pulse/Pulse Train with Ramping/PWM Frequency	PWM and PTO: 65kHz Pulse Train with Ramping: 65kHz
Types available	Up to four HSC, PTO, PTO with Ramping and/or PWM outputs

Wiring Diagram, IC200UDD064

VersaMax Micro PLC IC200UDD164 accepts forty DC inputs and provides twenty-four DC outputs. It uses +24VDC nominal input power for PLC operation.

DC Power

If configured to disable power-up diagnostics, the PLC begins logic solution 100ms after the voltage level of the power supply input reaches and maintains 24VDC. The 24VDC power source for the PLC must have enough transient current capability to support the inrush current of the power supply and to maintain a 24VDC voltage level (see power supply specifications for inrush requirements).

DC Inputs

Forty configurable DC inputs can be used as positive or negative logic standard inputs. Eight of these inputs can be used for High-speed Counter inputs. When used as standard inputs, they are compatible with a wide range of input devices, such as pushbuttons, limit switches, and electronic proximity switches.

The Micro PLC's +24 VDC supply can be used for input devices and to power the DC input circuits at about 8mA per input. The combination of input circuit current and external device current must not exceed 435mA.

DC Outputs

Micro PLC IC200UDD164 has 24 Sink-type DC outputs. All outputs are isolated between field and logic and are switching positive voltage. The outputs have one common incoming supply (VC) and one common ground (COM). The outputs are able to drive high inrush currents (8 times the rated current) and are protected against negative voltage pulses. This makes it possible to switch lamps and inductive loads.
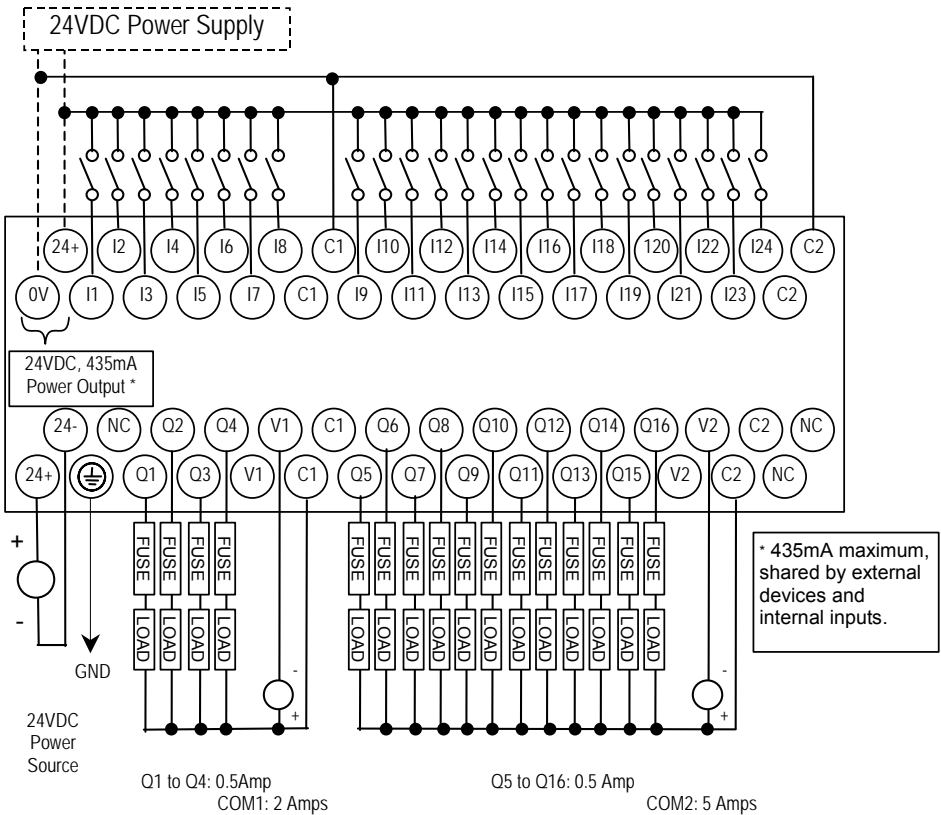
DC outputs can be used as standard, High-speed Counter, Pulse-Width Modulated, Pulse Train Outputs, or Pulse Train Outputs with Ramping.

Micro PLC IC200UDD164 Specifications

Inputs	Forty 24 VDC positive or negative logic inputs
Outputs	Twenty-four transistor outputs, 24 VDC.
High-speed Counters	Up to four Type A or one Type A and one Type B or four Type A_ 32 or one Type A_ 32 and one Type B_32
DC Power Specifications	
Range	19.2VDC to 30VDC
Hold-up	10mS at 19.2 VDC
Inrush Current	1 Amp maximum at 30VDC
Inrush Time	10mS for 1 Amp
Input Current	0.20 Amp typical at 24VDC
Input Power Supply Rating	5W
DC Input Specifications	
Rated Input Voltage	24 volts DC
Input Voltage Range	0 to 30 volts DC
Input Current at 24VDC	I1, I3, I5, I7: 8mA typical; Other inputs: 4.8mA typical
Input Impedance	I1, I3, I5, I7: 2.7 Kohms; Other inputs: 4.7 Kohms
Input Threshold Voltage	ON: 18VDC minimum, OFF: 5VDC maximum
Input Threshold Current	I1, I3, I5, I7: ON 4.5mA maximum, OFF: 1.8mA minimum Other Inputs: ON 3.3mA maximum, OFF: 1.6mA minimum
Response Time	1ms to 20ms configurable as regular input; 100µs as HSC input
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups
Output Specifications	
Voltage Range	12VDC/24VDC
External Power Supply	12/24VDC –10%, +20%
Maximum Load Current	0.5A per point (Q1 – Q24) at 24VDC
Minimum Switching Current	10mA
Maximum Inrush Current	Q1–Q24: 2A for 20ms, 1 pulse
Output Voltage Drop	Q1– Q24: 0.3VDC
OFF state leakage current	0.1mA
Response Time	OFF to ON, ON to OFF: 1 mS maximum @ 24VDC
Isolation Voltage	1500V RMS between field side and logic side, 500V RMS between groups
Fuses	None
Under-voltage shutdown	Q1–Q24: 5V minimum, 8V maximum
DC short circuit current	Q1–Q24: 0.7A minimum, 2A maximum

High-speed Counter Input and Output Specifications

Maximum Counter Frequency	100kHz
Input Voltage	ON : 18V, OFF: 5V
Count Pulse Width	20% to 80% of duty cycle at 100kHz
Count Registers	16/32 bits
Outputs	
Load Voltage	12/24VDC
Maximum Pulse/PWM Frequency	PWM and PTO: 65kHz
Types available	Up to four HSC, PTO, PTO with Ramping and/or PWM outputs

Wiring Diagram, IC200UDD164
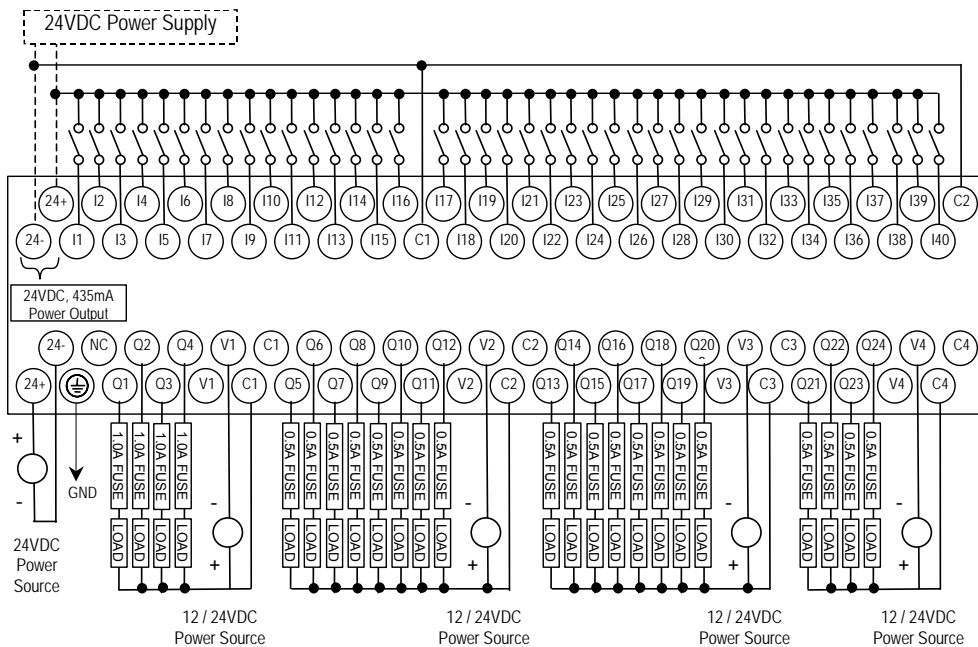
IC200UDR064
64 Point Micro PLC, (40) 24VDC In, (24) Relay Out, 24VDC Power Supply

VersaMax Micro PLC IC200UDR064 accepts forty DC inputs and provides twenty-four normally-open 2 Amp relay outputs. It uses +24VDC nominal input power for PLC operation.

DC Inputs

Forty configurable DC inputs can be used as positive or negative logic standard inputs. Eight of these inputs can be used for High-speed Counter inputs. When used as standard inputs, they are compatible with a wide range of input devices, such as pushbuttons, limit switches, and electronic proximity switches.

The Micro PLC's +24 VDC supply can be used for input devices and to power the DC input circuits at about 8mA per input. The combination of input circuit current and external device current must not exceed 435mA.

Relay Outputs

The twenty-four normally-open Form A relay outputs (SPST-single pole single throw) can control many types of load devices such as motor starters, solenoids, and indicators. The switching capacity of each of these circuits is 2 amps. An external source of AC or DC power must be supplied to operate field devices.

The relay outputs can be configured as up to four HSC outputs. Relay outputs cannot be used as Pulse Train or PWM outputs.

Micro PLC IC200UDR064 Specifications

Weight	580 grams (1.28lbs)
Inputs	Forty 24 VDC positive/negative logic input circuits
Outputs	Twenty-four normally open 2 amp relay circuits
High-speed Counters	Up to four Type A or one Type A and one Type B or four Type A_ 32 or one Type A_ 32 and one Type B_32
+24 VDC Output Power Supply	200mA maximum (for input circuits and user devices)
+5 VDC output of Serial Port	Serial Port 1, pin 7: 100mA maximum

DC Power Specifications

Range	19.2VDC to 30VDC
Hold-up	10mS at 19.2 VDC
Inrush Current	1 Amp maximum at 30VDC
Inrush Time	10mS for 1 Amp
Input Current	0.20 Amp typical at 24VDC
Input Power Supply Rating	5W

DC Input Specifications

Rated Input Voltage	24 volts DC
Input Voltage Range	0 to 30 volts DC
Input Current at 24VDC	I1, I3, I5, I7: 8mA typical; Other inputs: 4.8mA typical
Input Impedance	I1, I3, I5, I7: 2.7 Kohms; Other inputs: 4.7 Kohms
Input Threshold Voltage	ON: 18VDC minimum, OFF: 5VDC maximum
Input Threshold Current	I1, I3, I5, I7: ON 4.5mA maximum, OFF: 1.8mA minimum Other Inputs: ON 3.3mA maximum, OFF: 1.6mA minimum
Response Time	1ms to 20ms configurable as regular input; 100µs as HSC input
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups

Relay Output Specifications

Operating Voltage	5 to 30 VDC or 5 to 250 VAC		
Isolation	1500 V RMS between field side and logic side, 500 V RMS between groups		
Leakage Current	15 mA at 240 VAC maximum		
Maximum UL Pilot Duty Rating	2 amps at 24 VDC and 240 VAC		
Maximum Resistive Load Rating	2 amps at 24 VDC and 240 VAC		
Minimum Load	10 mA		
Maximum Inrush	5 amps per half cycle		
Response Time	ON: 15 ms maximum, OFF: 15 ms maximum		
Contact Life: Mechanical	20×10^{6} mechanical operations		
Contact Life: Electrical Voltage 240VAC, 120VAC, 24VDC	Current: Resistive 2.0A	Current: Lamp and Solenoid 0.6A	Typical Operations 200,000

High-speed Counter Input and Output Specifications	
Maximum Counter Frequency	100kHz
Input Voltage	ON: 18V, OFF: 5V
Count Pulse Width	20% to 80% of duty cycle at 100kHz
Count Registers	16/32 bits
Outputs	
Load Voltage	Q1: 5/12/24V, Q2-Q4: See relay output specifications
Type available	Up to four HSC outputs. Pulse outputs are not available.

Wiring Diagram, PLC IC200UDR064

Power for Relay Outputs: 5VDC to 30VDC or 5VAC to 250VAC

IC200UDR164
64 Point Micro PLC, (40) 24VDC In, (24) Relay Out, 120/240VAC Power Supply

VersaMax Micro PLC IC200UDR164 accepts forty DC inputs and provides twenty-four normally-open 2 Amp relay outputs. It uses 100VAC to 240VAC nominal input power for PLC operation.

DC Inputs

Forty configurable DC inputs can be used as positive or negative logic standard inputs. Eight of these inputs can be used for High-speed Counter inputs. When used as standard inputs, they are compatible with a wide range of input devices, such as pushbuttons, limit switches, and electronic proximity switches.

The Micro PLC's +24 VDC supply can be used for input devices and to power the DC input circuits at about 8mA per input. The combination of input circuit current and external device current must not exceed 435mA.

Relay Outputs

The twenty-four normally-open Form A relay outputs (SPST-single pole single throw) can control many types of load devices such as motor starters, solenoids, and indicators. The switching capacity of each of these circuits is 2 amps. An external source of AC or DC power must be supplied to operate field devices.

The relay outputs can be configured as up to four HSC outputs. Relay outputs cannot be used as Pulse Train or PWM outputs.

Micro PLC IC200 UDR164, Specifications

Weight	580 grams (1.28lbs)
Inputs	Forty 24 VDC positive/negative logic input circuits
Outputs	Twenty-four normally open 2 amp relay circuits
High-speed Counters	Up to four Type A or one Type A and one Type B or four Type A_ 32 or one Type A_ 32 and one Type B_32
+24 VDC Output Power Supply	435mA maximum (for input circuits and user devices)
+5 VDC output of Serial Port	Serial Port 1, pin 7: 100mA maximum
AC Power Specifications	
Range	100 -15% to 240 +10% VAC
Frequency	50 -5% to 60 +5% Hz
Hold-up	10mS at 85 to 100VAC, 20mS at 100 to 265VAC
Inrush Current	30 Amp maximum at 200 VAC, 40 Amp maximum at 265 VAC
Inrush Time	2 ms for 40Amp
Input Current	0.20 Amp typical at 200 VAC 0.10 Amp typical at 100 VAC
Input Power Supply Rating	26 VA

DC Input Specifications

Rated Input Voltage	24 volts DC
Input Voltage Range	0 to 30 volts DC
Input Current at 24VDC	I1, I 3, I 5, I 7: 8mA typical; Other inputs: 4.8mA typical
Input Impedance	I1, I 3, I 5, I 7: 2.7 Kohms; Other inputs: 4.7 Kohms
Input Threshold Voltage	ON: 18VDC minimum, OFF: 5VDC maximum
Input Threshold Current	I1, I3, I5, I7: ON 4.5mA maximum, OFF: 1.8mA minimum Other Inputs: ON 3.3mA maximum, OFF: 1.6mA minimum
Response Time	1ms to 20ms configurable as regular input; 100µs as HSC input
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups

Relay Output Specifications

Operating Voltage	5 to 30 VDC or 5 to 250 VAC		
Isolation	1500 V RMS between field side and logic side, 500 V RMS between groups		
Leakage Current	15 mA at 240 VAC maximum		
Maximum UL Pilot Duty Rating	2 amps at 24 VDC and 240 VAC		
Maximum Resistive Load Rating	2 amps at 24 VDC and 240 VAC		
Minimum Load	10 mA		
Maximum Inrush	5 amps per half cycle		
Response Time	ON: 15 ms maximum, OFF: 15 ms maximum		
Contact Life: Mechanical	20×10^{6} mechanical operations		
Contact Life: Electrical Voltage 240VAC, 120VAC, 24VDC	Current: Resistive 2.0A	Current: Lamp and Solenoid 0.6A	Typical Operations 200,000

High-speed Counter Input and Output Specifications

Maximum Counter Frequency	100kHz
Input Voltage	ON: 18V, OFF: 5V
Count Pulse Width	20% to 80% of duty cycle at 100kHz
Count Registers	16/32 bits
Outputs	
Load Voltage	Q1: 5/12/24V, Q2-Q4: See relay output specifications
Type available	Up to four HSC outputs. Pulse outputs are not available.

Wiring Diagram, IC200UDR164

24VDC Power Supply

24VDC, 435mA
Power Output

| 24+ | I2 | I4 | I6 | I8 | I10 | I12 | I4 | I16 | I17 | I19 | I21 | I23 | I25 | I27 | I29 | I31 | I33 | I35 | I37 | I39 | C2 |
| 24- | I1 | I3 | I5 | I7 | I9 | I11 | I13 | I15 | C1 | I18 | I20 | I22 | I24 | I26 | I28 | I30 | I32 | I34 | I36 | I38 | I40 |

| N | NC | Q2 | Q4 | Q6 | NC | Q8 | NC | Q10 | Q12 | NC | Q14 | NC | Q16 | NC | Q18 | NC | Q20 | NC | Q22 | Q23 | C9 |
| L | ⏚ | Q1 | Q3 | Q5 | C1 | Q7 | C2 | Q9 | Q11 | C3 | Q13 | C4 | Q15 | C5 | Q17 | C6 | Q19 | C7 | Q21 | C8 | Q24 |

L

N

GND

100/240VAC
Power Source

FUSE LOAD

Power for Relay Outputs: 5VDC to 30VDC or 5VAC to 250VAC

VersaMax Micro PLC 8, 14, and 16-Point Expansion Units

This chapter consists of module datasheets for the following VersaMax Micro PLC Expansion Units:

▪	IC200UEC008	8 Points, (4) 24VDC In, (4) 24VDC Out wirh ESCP, 24VDC Power Supply
▪	IC200UEC108	8 Points, (4) 24VDC In, (4) 24VDC Transistor Out, 24VDC Power Supply
▪	IC200UEC208	8 Points, (4) 24VDC In (4) Relay Out 24VDC Power Supply
▪	IC200UEI008	8 Points, (8) 24VDC In, 24VDC Power Supply
▪	IC200UEI016	16 Points, (16) 24VDC In, 24VDC Power Supply
▪	IC200UEO008	8 Points, (8) 24VDC Output with ESCP, 24VDC Power Supply
▪	IC200UEO108	8 Points, (8) 24VDC Transistor Out, 24VDC Power Supply
▪	IC200UEO016	16 Points, (16) 24VDC Output with ESCP, 24VDC Power Supply
▪	IC200UEO116	16 Points, (16) 24VDC Transistor Out, 24VDC Power Supply
▪	IC200UER008	8 Points, (8) Relay Outputs, 24VDC Power Supply
▪	IC200UER016	16 Points, Relay Outputs, 24VDC Power Supply
▪	IC200UEX009	14 Points, (8) 120 VAC In, (2) Relay Out at 10 Amps, (4) Relay Out at 2 Amps, 120/240VAC Power Supply
▪	IC200UEX010	14 Points, (8) 120VAC In, (6) 120VAC Out, 120/240VAC Power Supply
▪	IC200UEX011	14 Points, (8) 24VDC In, (6) Relay Out, 120/240VAC Power Supply
▪	IC200UEX012	14 Points, (8) 24VDC In, (6) Relay Out, 24VDC Power Supply
▪	IC200UEX013	14 Points, (8) 12VDC In, (6) Relay Out, 12VDC Power Supply
▪	IC200UEX014	14 Points, (8) 24VDC In, (6) 24VDC Out, 24VDC Power Supply
▪	IC200UEX015	14 Points, (8) 12VDC In, (6) 12VDC Out, 12VDC Power Supply
▪	IC200UEX122	14 Points, (8) 24VDC In, (6) 24VDC Out with ESCP, 24VDC Power Supply

Features of VersaMax 8, 14, and 16-Point Expansion Units

Modular Expansion Units can be used to increase the total I/O count of a Micro PLC. Up to 4 Expansion Units in any combination can be used with any 14-point to 64-point Micro PLC. Expansion Units can be located up to 2 meters from the Micro PLC.
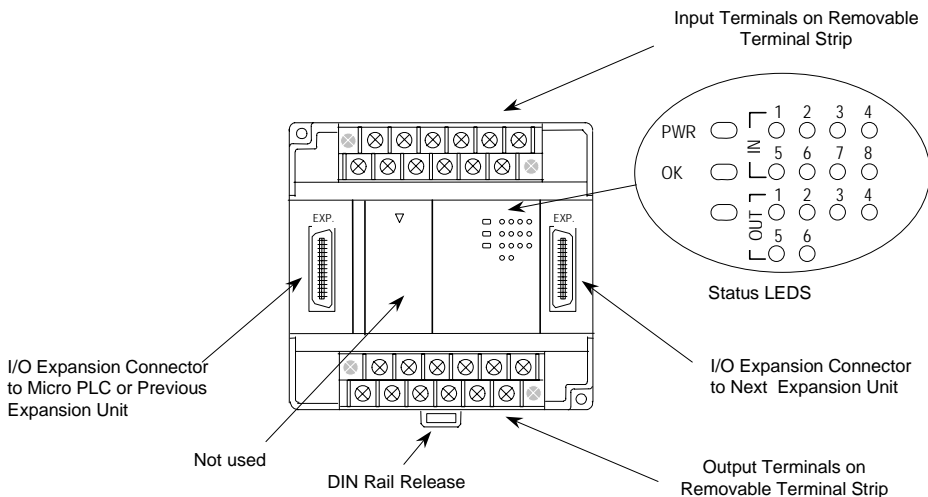
Removable Terminal Strips

VersaMax Expansion Units provide the wiring flexibility of removable terminal assemblies. After turning off power to the Micro PLC, a terminal assembly and attached field wiring can be separated from the Micro PLC by loosening two screws.

Expansion Connector

The connector on the left side of the Expansion Unit is used to connect to the Micro PLC or to the outgoing connector on the previous Expansion Unit. The connector on the right side of the Expansion Unit can be used to attach to the next Expansion Unit.

Status LEDs

LEDs on the Expansion Unit provide quick visual verification of operating status. In addition to LEDs for Expansion Unit local Power and OK mode, there is an LED for each I/O point.

Cables

A 0.1 meter ribbon cable (IC200CBL501) is provided with each Expansion Unit. Cables are also available in 0.5 meter (IC200CBL505) and 1 meter (IC200CBL510) lengths.

VersaMax Micro PLC Expansion Unit IC200UEC008 accepts four 24VDC inputs and provides four 24VDC source-type transistor outputs with Electronic Short Circuit Protection. The module requires +24VDC nominal input power.

DC Inputs

The four 24 volt DC input circuits can have positive or negative logic characteristics. Inputs are compatible with a wide range of devices, such as pushbuttons, limit switches, and electronic proximity switches.

The built-in +24 VDC supply can be used for input devices and to power the DC input circuits. The combination of input circuit current and external device current must not exceed 200 mA.

Transistor Outputs

Expansion Unit IC200UEC008 has four source-type high-current transistor outputs. All outputs are isolated between field and logic and are switching positive voltage.

All outputs have electronic short-circuit protection, no fuses are needed to protect the outputs.

An external source of 12/24VDC power must be provided to power the outputs. The outputs share this common incoming 24VDC supply and one common ground. The outputs are able to drive high inrush currents (8 times the rated current) and are protected against negative voltage pulses. This makes it possible to switch lamps and inductive loads.

Expansion Unit IC200UEC008 Specifications

Inputs	Four 24VDC input circuits
Outputs	Four 24VDC source-type transistor outputs with ESCP
+24 VDC Output Power Supply	200mA maximum(for input circuits and user devices)
DC Power Specifications	
Range	24 –20%/+25% VDC
Hold-up	3ms
Inrush Current	1 A maximum at 30 VDC
Inrush Time	10 ms for 1 Amp
Input Current	0.16 A typical at 24 VDC
Input Power Supply Rating	4W

DC Input Specifications	
Rated Input Voltage	24 volts DC
Input Voltage Range	0 to 30 volts DC
Input Current	7.5mA typical
Input Resistance	2.8 Kohms
Input Threshold Voltage	ON: 15VDC minimum, OFF: 5VDC maximum
Input Threshold Current	ON: 4.5mA maximum, OFF: 1.5mA minimum
Response Time	OFF to ON or ON to OFF: 4ms typical
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups
DC Output Specifications	
Voltage Range	12/24VDC +10%/-15% (at VC)
Maximum Load Current	0.7A per point , 3A per common
Maximum Inrush Current	
Output Voltage Drop	0.3V
OFF state Leakage Current	0.1mA
Response Time	OFF to ON or ON to OFF: 0.05ms maximum at 24VDC 0.2A
Isolation Voltage	1500V RMS field side to logic side, 500VAC between field side and logic side
External power supply	12/24VDC –10%, +20%
Fuse	Not required
Minimum switching current	10mA

Wiring Diagram, IC200UEC008

VersaMax Micro PLC Expansion Unit IC200UEC108 accepts four 24VDC inputs and provides four 24VDC sink-type transistor outputs. It requires +24VDC nominal input power.

DC Inputs

The four 24 volt DC input circuits can have positive or negative logic characteristics. Inputs are compatible with a wide range of devices, such as pushbuttons, limit switches, and electronic proximity switches.

The built-in +24 VDC supply can be used for input devices and to power the DC input circuits. The combination of input circuit current and external device current must not exceed 200 mA.

Transistor Outputs

Expansion Unit IC200UEC108 has four sink-type high-current transistor outputs. All outputs are isolated between field and logic and are switching positive voltage.

External fusing should be provided to protect the outputs. Otherwise, a load short can damage the module output transistor, which is not user replaceable. Fast fuses are recommended.

The outputs share one common incoming 24VDC supply and one common ground. The outputs are able to drive high inrush currents (8 times the rated current) and are protected against negative voltage pulses. This makes it possible to switch lamps and inductive loads.

Expansion Unit IC200UEC108 Specifications

Inputs	Four 24VDC input circuits
Outputs	Four 24VDC sink-type transistor outputs
+24 VDC Output Power Supply	200mA maximum (for input circuits and user devices)
DC Power Specifications	
Range	24 –20%/+25% VDC
Hold-up	10ms at 19.2VDC
Inrush Current	1 A maximum at 30 VDC
Inrush Time	10 ms for 1 Amp
Input Current	0.16 A typical at 24 VDC
Input Power Supply Rating	4W

DC Input Specifications	
Rated Input Voltage	24 volts DC
Input Voltage Range	0 to 30 volts DC
Input Current	7.5mA typical
Input Resistance	2.8 Kohms
Input Threshold Voltage	ON: 15VDC minimum, OFF: 5VDC maximum
Input Threshold Current	ON: 4.5mA maximum, OFF: 1.5mA minimum
Response Time	OFF to ON or ON to OFF: 4ms typical
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups
Transistor Output Specifications	
Voltage Range	12/24VDC +10%/-15% (at VC)
Maximum Load	0.7A per point , 3A per common
Maximum Inrush Current	
Output Voltage Drop	0.3V
OFF state leakage	0.1mA
Response	OFF to ON or ON to OFF: 0.05ms maximum at 24VDC 0.2A
Isolation Voltage	1500V RMS field side to logic side, 500VAC between field side and logic side
External power supply	12/24VDC –10%, +20%
Fuses	Not required
Minimum Switching Current	10mA

Wiring Diagram, IC200UEC108

IC200UEC208
8 Point Expansion Unit , (4) 24VDC Inputs, (4) Relay Outputs, 24VDC Power Supply

VersaMax Micro PLC Expansion Unit IC200UEC208 accepts four 24VDC inputs and provides four normally-open 2 Amp relay outputs that can control 5 to 30 VDC or 5 to 250VAC output devices. It requires +24VDC nominal input power.

DC Inputs

The four DC inputs can be used as positive or negative logic standard inputs. Inputs are compatible with a wide range of devices, such as pushbuttons, limit switches, and electronic proximity switches.

The Expansion Unit's +24 VDC supply can be used for input devices and to power the DC input circuits at about 7.5 mA per input. The combination of input circuit current and external device current must not exceed 200 mA.

Relay Outputs

Four Form A (SPST: single-pole, single-throw) normally-open relay outputs can control many types of devices such as motor starters, solenoids, and indicators. An external source of AC or DC power must be supplied to operate field devices.

Expansion Unit IC200UEC208 Specifications

Inputs	Four 24 VDC positive/negative logic input circuits
Outputs	Four normally open 2 amp relay circuits
+24 VDC Output Power Supply	200mA maximum (for input circuits and user devices)
DC Power Specifications	
Range	24VDC –20% / +25%
Hold-up	10 ms at 19.2 VDC
Inrush Current	1 Amp maximum at 30 VDC
Inrush Time	10 ms for 1 Amp
Input Current	0.16 Amp typical at 24 VDC
Input Power Supply Rating	4W

DC Input Specifications	
Rated Input Voltage	24 volts DC
Input Voltage Range	0 to 30 volts DC
Input Current	7.5mA typical
Input Resistance	2.8 Kohms
Input Threshold Voltage	ON: 15VDC minimum, OFF: 5VDC maximum
Input Threshold Current	ON: 4.5mA maximum, OFF: 1.5mA minimum
Response Time	OFF to ON or ON to OFF: 4ms typical
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups

Relay Output Specifications			
Operating Voltage	5 to 30 VDC or 5 to 250 VAC		
Isolation	1500 V RMS between field side and logic side 500 V RMS between groups		
Leakage Current	15 mA maximum		
Maximum Load Current	2 Amps per point, 5 Amps per common		
Maximum Resistive Load Rating	2 amps at 24 VDC and 240 VAC		
Response Time	ON to OFF, or OFF to ON: 15 ms maximum		
Contact Life: Mechanical	20×10^6 mechanical operations		
Contact Life: Electrical Voltage, 240VAC, 120VAC, 24VDC	Current: Resistive 2A	Current: Lamp and Solenoid 0.6A	Typical Operations 200,000

Wiring Diagram, IC200UEC208

> **IC200UEI008**
> **8 Point Expansion Unit, (8) 24VDC Inputs, 24VDC Power Supply**
> **IC200UEI016**
> **16 Point Expansion Unit, (16) 24VDC Inputs, 24VDC Power Supply**

VersaMax Micro PLC Expansion Units IC200UEI008 and IC200UEI016 accept 24VDC inputs. The modules require +24VDC nominal input power.

DC Inputs

The DC inputs can be used as positive or negative logic standard inputs. Inputs are compatible with a wide range of devices, such as pushbuttons, limit switches, and electronic proximity switches.

The Expansion Unit's +24 VDC supply can be used for input devices and to power the DC input circuits at about 7.5 mA per input. The combination of input circuit current and external device current must not exceed 200 mA.

Expansion Units IC200UEI008 and IC200UEI016 Specifications

Inputs	IC200UEI008: Eight 24 VDC positive/negative logic input circuit IC200UEI016: Sixteen 24 VDC positive/negative logic input circuits
Outputs	None
+24 VDC Output Power Supply	200mA maximum (for input circuits and user devices)
DC Power Specifications	
Range	24VDC –20% / +25%
Hold-up	10 ms at 19.2 VDC
Inrush Current	1 Amp maximum at 30 VDC
Inrush Time	10 ms for 1 Amp
Input Current	0.16 Amp typical at 24 VDC
Input Power Supply Rating	4W
DC Input Specifications	
Rated Input Voltage	24 volts DC
Input Voltage Range	0 to 30 volts DC
Input Current	4.8mA typical
Input Resistance	4.8 Kohms
Input Threshold Voltage	ON: 15VDC minimum, OFF: 5VDC maximum
Input Threshold Current	ON: 3.0mA maximum, OFF: 1.5mA minimum
Response Time	ON to OFF or OFF to ON: 2ms typical
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups

Wiring Diagram, IC200UEI008
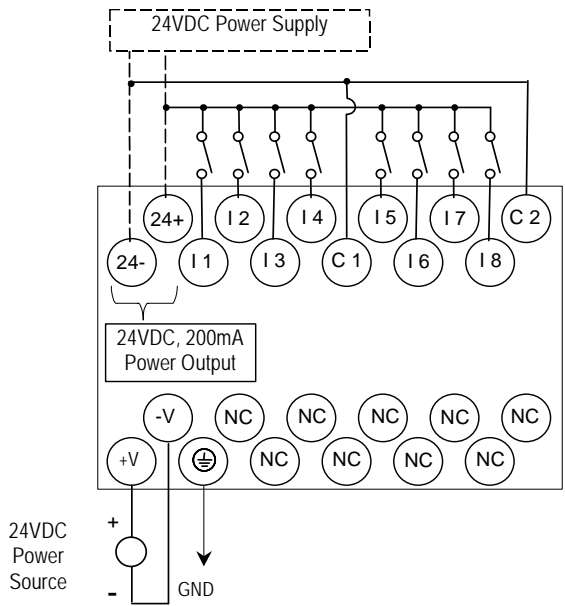
Wiring Diagram, IC200UEI016
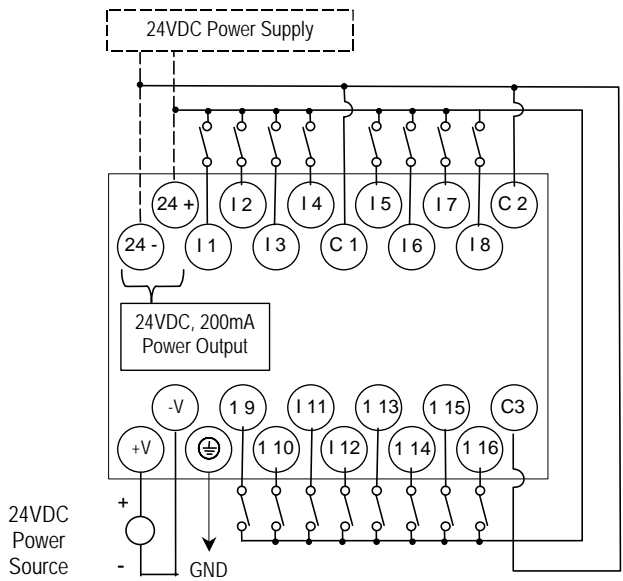
VersaMax Micro PLC Expansion Units IC200UEO008 and IC200UEO016 provide 8 or 16 DC source-type high-current transistor outputs, respectively. Outputs have Electronic Short Circuit Protection. The modules require +24VDC nominal input power.

Transistor Outputs

All outputs are isolated between field and logic and are switching positive voltage. Outputs have electronic short-circuit protection, no fuses are needed to protect the outputs.

An external source of 12/24VDC power must be provided to power the outputs. The outputs share one common incoming 24VDC supply and one common ground. The outputs are able to drive high inrush currents (8 times the rated current) and are protected against negative voltage pulses. This makes it possible to switch lamps and inductive loads.

Expansion Units IC200UEO008 and IC200UEO016 Specifications

Inputs	None
Outputs	IC200UEO008: Eight source-type 24VDC transistor output circuits with ESCP
	IC200UEO016: Sixteen source-type 24VDC transistor output circuits with ESCP
DC Power Specifications	
Range	24 –20%/+25% VDC
Hold-up	10ms at 19.2VDC
Inrush Current	1 A maximum at 30 VDC
Inrush Time	10 ms for 1 Amp
Input Current	0.16 A typical at 24 VDC
Input Power Supply Rating	4W
Transistor Output Specifications	
Voltage Range	12/24VDC +10%/-15% (at VC)
Maximum Load	0.7A per point , 3A per common
Maximum Inrush Current	5.6 Amps
Output Voltage Drop	0.3V maximum
OFF state leakage	0.1mA
Response	OFF to ON or ON to OFF: 0.05ms maximum at 24VDC 0.2A
Isolation Voltage	1500V RMS field side to logic side, 500VAC between field side and logic side
External power supply	12/24VDC –10%, +20%
Fuses	Not required
Minimum switching current	10mA

Wiring Diagram, IC200UEO008

12/24VDC Power Source

Wiring Diagram, IC200UEO016
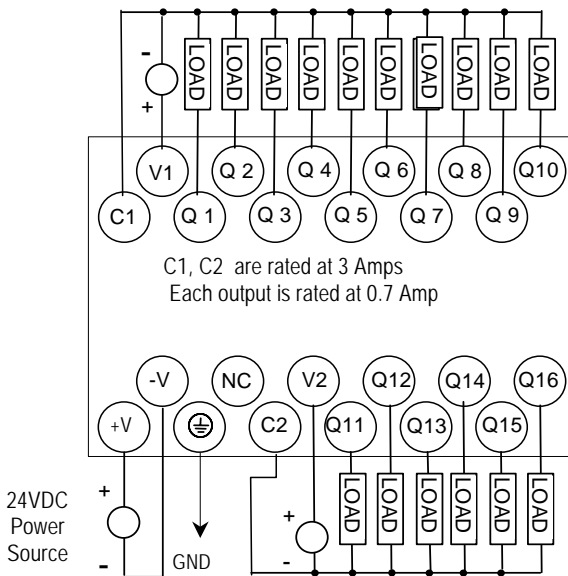
C1, C2 are rated at 3 Amps
Each output is rated at 0.7 Amp

VersaMax Micro PLC Expansion Units IC200UEO108 and IC200UEO116 provide 8 and 16 DC sink-type outputs, respectively. These modules require +24VDC nominal input power.

Transistor Outputs

The sink-type transistor outputs are isolated between field and logic and are switching positive voltage.

External fusing should be provided to protect the outputs. Otherwise, a load short can damage the module output transistor, which is not user replaceable. Fast fuses are recommended.

The outputs share one common incoming 24VDC supply and one common ground. The outputs are able to drive high inrush currents (8 times the rated current) and are protected against negative voltage pulses. This makes it possible to switch lamps and inductive loads.

Expansion Units IC200UEO108 and IC200UEO116 Specifications

Inputs	None
Outputs	IC200UEO108: Eight sink-type DC transistor output circuits IC200UEO116: Sixteen sink-type DC transistor output circuits
DC Power Specifications	
Range	24 −20%/+25% VDC
Hold-up	10ms at 19.2VDC
Inrush Current	1 A maximum at 30 VDC
Inrush Time	10 ms for 1 Amp
Input Current	0.16 A typical at 24 VDC
Input Power Supply Rating	4W
Transistor Output Specifications	
Voltage Range	12/24VDC +10%/-15% (at VC)
Maximum Load	0.5A per point, 3A per common
Maximum Inrush Current	5.6 Amps
Output Voltage Drop	0.3V maximum
OFF state leakage	0.1mA maximum
Response	OFF to ON or ON to OFF: 0.5ms
Isolation Voltage	1500V RMS field side to logic side, 500VAC between field side and logic side
External power supply	10-30VDC required to power the outputs.
Fuses	Outputs should be fused externally.
Minimum Switching Current	1mA

Wiring Diagram, IC200UEO108

12/24VDC Power Source

LOAD LOAD LOAD LOAD LOAD LOAD LOAD LOAD

FUSE FUSE FUSE FUSE FUSE FUSE FUSE FUSE

+ -

| V 1 | Q 2 | Q 4 | Q 6 | Q8 | NC |
| C1 | Q 1 | Q 3 | Q 5 | Q 7 | NC |

| -V | NC | NC | NC | NC | NC |
| +V | ⏚ | NC | NC | NC | NC |

24VDC Power Source

+ −

GND

Wiring Diagram, IC200UEO116

−

LOAD LOAD LOAD LOAD LOAD LOAD LOAD LOAD LOAD LOAD

FUSE FUSE FUSE FUSE FUSE FUSE FUSE FUSE FUSE FUSE

+

| V1 | Q 2 | Q 4 | Q 6 | Q 8 | Q10 |
| C1 | Q 1 | Q 3 | Q 5 | Q 7 | Q 9 |

C1, C2 are rated at 3 Amps
Each output is rated at 0.5 Amp

| -V | NC | V2 | Q12 | Q14 | Q16 |
| +V | ⏚ | C2 | Q11 | Q13 | Q15 |

+ −

GND

24VDC Power Source

FUSE FUSE FUSE FUSE FUSE

LOAD LOAD LOAD LOAD LOAD

−

+

IC200UER008
8 Point Expansion Unit, (8) Relay Outputs, 24VDC Power Supply
IC200UER016
16 Point Expansion Unit, (16) Relay Outputs, 24VDC Power Supply

VersaMax Micro PLC Expansion Units IC200UER008 and IC200UER016 provide 8 or 16 normally-open 2 Amp relay outputs, respectively. The outputs can control 5 to 30 VDC or 5 to 250VAC output devices. The unit requires +24VDC nominal input power.

Relay Outputs

The Form A (SPST: single-pole, single-throw) normally-open relay outputs can control many types of devices such as motor starters, solenoids, and indicators. An external source of AC or DC power must be supplied to operate field devices.

Expansion Units IC200UER008 and IC200UER016 Specifications

Inputs	None		
Outputs	IC200UER008: Eight normally open 2 amp relay circuits IC200UER016: Sixteen normally open 2 amp relay circuits		
DC Power Specifications			
Range	24 –20%/+25% VDC		
Hold-up	10ms at 19.2VDC		
Inrush Current	1 A maximum at 30 VDC		
Inrush Time	10 ms for 1 Amp		
Input Current	0.16 A typical at 24 VDC		
Input Power Supply Rating	4W		
Relay Output Specifications			
Operating Voltage	5 to 30 VDC or 5 to 250 VAC		
Isolation	1500 V RMS between field side and logic side 500 V RMS between groups		
Leakage Current	15 mA maximum		
Maximum Load Current	2 Amps per point, 5 Amps per common		
Maximum Resistive Load Rating	2 amps at 24 VDC and 240 VAC		
Response Time	ON to OFF, or OFF to ON: 15 ms maximum		
Contact Life: Mechanical	20×10^6 mechanical operations		
Contact Life: Electrical Voltage, 240VAC, 120VAC, 24VDC	Current: Resistive 2A	Current: Lamp and Solenoid 0.6A	Typical Operations 200,000

Wiring Diagram, IC200UER008

C1, C2 are rated at 5 Amps
Each output is rated at 2 Amps

Wiring Diagram, IC200UER016

C1, C2, C3 are rated at 5 Amps
Each output is rated at 2 Amps

VersaMax Micro PLC Expansion Unit IC200UEX009 accepts eight AC inputs and provides six relay outputs: 2 at 10 Amps and 4 at 2 Amps. It requires 100VAC to 240VAC nominal input power.

AC Inputs

The 120 VAC input circuits are reactive (resistor/capacitor) inputs. The input circuits require an AC power source: they cannot be used with a DC power source. Inputs are compatible with a wide range of devices, such as pushbuttons, limit switches, and electronic proximity switches. Power to operate the field devices must be supplied.

Relay Outputs

The six normally-open relay outputs can control many types of devices such as motor starters, solenoids, and indicators. There are two individual 10 Amp relay outputs and one group of four 2-Amp relay outputs. Power for the internal relay coils is provided by the internal supply. Separate external sources of AC or DC power must be supplied to operate field output devices.

Expansion Unit IC200UEX009 Specifications

Inputs	Eight AC inputs
Outputs	Six relay outputs
+24 VDC Output Power Supply	200mA maximum (for input circuits and user devices)
AC Power Specifications	
Range	100 -15% to 240 +10% VAC
Frequency	50 -5% to 60 +5% Hz
Hold-up	10 ms at 85 to 100VAC
Inrush Time	2 ms for 40Amp
Inrush Current	18 A maximum at 120VAC, 30 A maximum at 200VAC, 40 A maximum at 265VAC
Input Current	0.05 A typical at 200 VAC, 0.10 A typical at 100 VAC
Input Power Supply Rating	11 VA

AC Input Specifications	
Points/Common	4 (I1–I4) and (I5–I8)
Rated Load Voltage	85–132 VAC, 50 -5% to 60 +5% Hz
Maximum Input Voltage	132V rms, 50/60 Hz
Input Current	8 mA rms (100 VAC, 60 Hz)
Voltage	ON: minimum 80V rms, 4.5 mA rms, OFF: maximum 30V rms, 2 mA rms
Response Time	OFF to ON: maximum 25mS, ON to OFF: maximum 30mS
Isolation	1500V rms field side to logic side, 500V rms between groups

Relay Output Specifications		
Operating Voltage	5 to 30 VDC or 5 to 250 VAC	
Isolation	1500 V RMS between field side and logic side, 500 V RMS between groups	
Leakage Current	15 mA maximum	
Maximum UL Pilot Duty Rating	2 amps at 24 VDC and 240 VAC	10 amps at 24 VDC and 240 VAC
Maximum Resistive Load Rating	2 amps at 24 VDC and 240 VAC	10 amps at 24 VDC and 240 VAC
Minimum Load	10 mA	
Maximum Inrush	5 amps per half cycle	
On Response Time	15 ms maximum	
Off Response Time	15 ms maximum	
Fuse	None	
Contact Life: Mechanical	20×10^6 mechanical operations	

Contact Life: Electrical Voltage	Current: Resistive	Current: Lamp and Solenoid	Typical Operations
	2.0A	0.6A	200,000
	10.0A	4.0A	100,000
	4.0A	1.0A	200,000

Wiring Diagram, IC200UEX009

Outputs Q 1 – Q 4 are rated at 2.0 Amps each.
Outputs Q 5 and Q 6 are rated at 10.0 Amps each.

VersaMax Micro PLC Expansion Unit IC200UEX010 accepts eight AC inputs and provides six AC outputs. The module requires 100VAC to 240VAC nominal input power.

AC Inputs

The eight 120 VAC input circuits are reactive (resistor/capacitor) inputs. The input circuits require an AC power source: they cannot be used with a DC power source. Inputs are compatible with a wide range of devices, such as pushbuttons, limit switches, and electronic proximity switches. Power to operate the field devices must be supplied.

AC Outputs

The six 120/240 VAC, 0.5 Amp triac outputs are provided in isolated groups. The commons are not tied together inside the module. This allows each group to be used on different phases of the AC supply or to be powered from the same supply. Each group is protected with a replaceable 3.15 amp fuse for its common. Also, an RC snubber is provided for each output to protect against transient electrical noise on the power line.

AC power to operate loads connected to outputs must be supplied from an external source.

This module provides a high degree of inrush current (10x the rated current) which makes the outputs suitable for controlling a wide range of inductive and incandescent loads.

Expansion Unit IC200UEX010 Specifications

Inputs	Eight AC inputs
Outputs	Six AC outputs
AC Power Specifications	
Range	100 -15% to 240 +10% VAC
Frequency	50 -5% to 60 +5% Hz
Hold-up	10 ms at 85 to 100VAC, 20 ms at 100 to 264VAC
Inrush Time	2 ms for 40Amp
Inrush Current	18 A maximum at 120VAC, 30 A maximum at 200VAC, 40 A maximum at 265VAC
Input Current	0.05 A typical at 200 VAC, 0.10 A typical at 100 VAC
Input Power Supply Rating	11 VA
AC Input Specifications	
Points/Common	4 (I1–I4) and (I5–I8)
Rated Load Voltage	85–132 VAC, 50 -5% to 60 +5% Hz
Maximum Input Voltage	132V rms, 50/60 Hz
Input Current	8 mA rms (100 VAC, 60 Hz)

Voltage	ON: minimum 80VAC rms, 4.5 mA rms, OFF: maximum 30VAC rms, 2 mA rms
Response Time	OFF to ON: maximum 25mS, ON to OFF maximum 30mS
Isolation	1500V rms field side to logic side, 500V rms between groups
AC Output Specifications	
Rated Load Voltage	100 -15% to 240 +10% VAC, 50 -5% to 60 +5% Hz
Maximum Resistive Load Current	0.5 Amp per point
Maximum UL Pilot Duty Rating	0.5 Amp per point at 240 VAC, 0.6 Amp maximum on C1, 1.2 Amps maximum on C2
Maximum Inrush Current	5A (1 period)/point, 10A (1 period)/common
Maximum voltage drop when ON	1.5 V RMS
Maximum leak current when OFF	1.8 mA RMS (115 VAC), 3.5 mA RMS (230 VAC)
Response Time (Maximum)	OFF to ON: 1 mS, ON to OFF: 1/2 cycle + 1 mS
Isolation	1500V RMS field side to logic side, 500V RMS between groups

Wiring Diagram, IC200UEX010

VersaMax Micro PLC Expansion Unit IC200UEX011 accepts eight DC inputs and provides six normally-open 2 Amp relay outputs that can control 5-30VDC or 5-250VAC output devices. The module requires 100VAC to 240VAC nominal input power.

DC Inputs

The eight DC inputs can be used as positive or negative logic standard inputs. Inputs are compatible with a wide range of devices, such as pushbuttons, limit switches, and electronic proximity switches.

Isolated +24VDC output power is available for field devices, up to 200mA maximum.

Relay Outputs

The six Form A (SPST: single-pole, single-throw) normally-open relay outputs can control many types of devices such as motor starters, solenoids, and indicators. Power for the internal relay coils is provided by the 24VDC internal supply. An external source of AC or DC power must be supplied to operate field devices.

Expansion Unit IC200UEX011 Specifications

Inputs	Eight 24 VDC positive/negative logic input circuits
Outputs	Six normally open 2 Amp relay circuits
+24 VDC Output Power Supply	200mA maximum (for input circuits and user devices)

Relay Output Specifications	
Range	100 -15% to 240 +10% VAC
Frequency	50 -5% to 60 +5% Hz
Hold-up	10 ms at 85 to 100VAC
Inrush Time	2 ms for 40Amp
Inrush Current	18 A maximum at 120VAC, 30 A maximum at 200VAC, 40 A maximum at 265VAC
Input Current	0.05 A typical at 200 VAC, 0.10 A typical at 100 VAC
Input Power Supply Rating	13 VA

DC Input Specifications

Rated Input Voltage	24 volts DC
Input Voltage Range	0 to 30 volts DC
Input Current	7.5mA typical
Input Resistance	2.8 Kohms
Input Threshold Voltage	ON: 15VDC minimum, OFF: 5VDC maximum
Input Threshold Current	ON: 4.5mA maximum, OFF: 1.5mA minimum
Response Time	0.5 to 20ms
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups, if one group is powered by an external 24V power supply.

Relay Output Specifications

Operating Voltage	5 to 30 VDC or 5 to 250 VAC		
Isolation	1500 V RMS between field side and logic side, 500 V RMS between groups		
Leakage Current	15 mA at 240 VAC maximum		
Maximum UL Pilot Duty Rating	2 amps at 24 VDC and 240 VAC		
Maximum Resistive Load Rating	2 amps at 24 VDC and 240 VAC		
Minimum Load	1mA		
Maximum Inrush	5 amps per half cycle		
On Response Time	15 ms maximum		
Off Response Time	15 ms maximum		
Contact Life: Mechanical	20×10^6 mechanical operations		
Contact Life: Electrical Voltage 240VAC, 120VAC, 24VDC	Current: Resistive 2A	Current: Lamp and Solenoid 0.6A	Typical Operations 200,000

Wiring Diagram, IC200UEX011

VersaMax Micro PLC Expansion Unit IC200UEX012 accepts eight DC inputs and provides six normally-open 2 Amp relay outputs that can control 5 to 30 VDC or 5 to 250VAC output devices. The module requires +24VDC nominal input power.

DC Inputs

The eight DC inputs can be used as positive or negative logic standard inputs. Inputs are compatible with a wide range of devices, such as pushbuttons, limit switches, and electronic proximity switches.

The Expansion Unit's isolated +24 VDC supply can be used for input devices and to power the DC input circuits at about 7.5 mA per input. The combination of input circuit current and external device current must not exceed 200 mA.

Relay Outputs

The six Form A (SPST: single-pole, single-throw) normally-open relay outputs can control many types of devices such as motor starters, solenoids, and indicators. An external source of AC or DC power must be supplied to operate field devices.

Expansion Unit IC200UEX012 Specifications

Inputs	Eight 24 VDC positive/negative logic input circuits
Outputs	Six normally open 2 amp relay circuits
+24 VDC Output Power Supply	200mA maximum (for input circuits and user devices)
DC Power Specifications	
Range	24VDC –20% / +25%
Hold-up	10 ms at 19.2 VDC
Inrush Current	1 Amp maximum at 30 VDC
Inrush Time	10 ms for 1 Amp
Input Current	0.16 Amp typical at 24 VDC
Input Power Supply Rating	4W
DC Input Specifications	
Rated Input Voltage	24 volts DC
Input Voltage Range	0 to 30 volts DC
Input Current	7.5mA typical
Input Resistance	2.8 Kohms
Input Threshold Voltage	ON: 15VDC minimum, OFF: 5VDC maximum
Input Threshold Current	ON: 4.5mA maximum, OFF: 1.5mA minimum
Response Time	0.5 to 20ms
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups

Relay Output Specifications			
Operating Voltage	5 to 30 VDC or 5 to 250 VAC		
Isolation	1500 V RMS between field side and logic side 500 V RMS between groups		
Leakage Current	15 mA at 240 VAC maximum		
Maximum UL Pilot Duty Rating	2 amps at 24 VDC and 240 VAC		
Maximum Resistive Load Rating	2 amps at 24 VDC and 240 VAC		
Minimum Load	1mA		
Maximum Inrush	5 amps per half cycle		
On Response Time	15 ms maximum		
Off Response Time	15 ms maximum		
Contact Life: Mechanical	20×10^6 mechanical operations		
Contact Life: Electrical Voltage, 240VAC, 120VAC, 24VDC	Current: Resistive 2A	Current: Lamp and Solenoid 0.6A	Typical Operations 200,000

Wiring Diagram, IC200UEX012

VersaMax Micro PLC Expansion Unit IC200UEX013 accepts eight 12VDC inputs and provides six normally-open 2 Amp relay outputs that can control 5 to 30 VDC or 5 to 250VAC output devices. The module requires +12VDC nominal input power.

DC Inputs

The eight 12 VDC inputs can be used as positive or negative logic standard inputs. Inputs are compatible with a wide range of devices, such as pushbuttons, limit switches, and electronic proximity switches.

The Expansion Unit's isolated +12 VDC supply can be used for input devices and to power the DC input circuits at about 7.5 mA per input. The combination of input circuit current and external device current must not exceed 200 mA.

Relay Outputs

The six Form A (SPST: single-pole, single-throw) normally-open relay outputs can control many types of devices such as motor starters, solenoids, and indicators. Power for the internal relay coils is provided by the internal supply. An external source of AC or DC power must be supplied to operate field devices.

Expansion Unit IC200UEX013 Specifications

Inputs	Eight 12 VDC positive/negative logic input circuits
Outputs	Six normally open 2 amp relay circuits
+12 VDC Output Power Supply	200mA maximum (for input circuits and user devices)
DC Power Specifications	
Range	9.6VDC - 15VDC
Hold-up	3.0mS
Inrush Current	9.2A typical at 12 VDC
Inrush Time	200ms typical
Input Current	300mA typical at 12 VDC
Input Power Supply Rating	4W
DC Input Specifications	
Number of Inputs	8
Rated Input Voltage	12 volts DC
Input Voltage Range	0 to 15 volts DC
Input Current	9.0mA typical
Input Impedance	1.3 kOhms
Input Threshold Voltage	ON: 9.5VDC minimum, OFF: 2.5VDC maximum
Input Threshold Current	ON: 6.5mA maximum, OFF: 1.6mA minimum
Response Time	0.5 to 20ms (user configurable)
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups

Relay Output Specifications			
Operating Voltage	5 to 30 VDC or 5 to 250 VAC		
Isolation	1500 V RMS between field side and logic side 500 V RMS between groups		
Leakage Current	15 mA maximum		
Maximum UL Pilot Duty Rating	2 amps at 24 VDC and 240 VAC		
Maximum Resistive Load Rating	2 amps at 24 VDC and 240 VAC		
Minimum Load	10 mA		
Maximum Inrush	5 amps per half cycle		
On Response Time	15 ms maximum		
Off Response Time	15 ms maximum		
Contact Life: Mechanical	20×10^6 mechanical operations		
Contact Life: Electrical Voltage	Current: Resistive 2A	Current: Lamp and Solenoid 0.6A	Typical Operations 200,000

Wiring Diagram, IC200UEX013

IC200UEX014
14-Point Expansion Unit with 24DC Power, (8) 24DC Inputs, (2) High-Current and (4) Low-Current Transistor Outputs

VersaMax Micro PLC Expansion Unit IC200UEX014 accepts eight DC inputs and provides two low-current and four high-current DC transistor outputs. It requires +24VDC nominal input power.

DC Inputs

The eight 24 volt DC input circuits can have positive or negative logic characteristics. Inputs are compatible with a wide range of devices, such as pushbuttons, limit switches, and electronic proximity switches.

The built-in isolated +24 VDC supply can be used for input devices and to power the DC input circuits. The combination of input circuit current and external device current must not exceed 200 mA.

Transistor Outputs

Expansion Unit UEX014 has two high-current transistor outputs (Q1 and Q2) and four low-current transistor outputs (Q3 to Q6). All outputs are isolated between field and logic and are switching positive voltage.
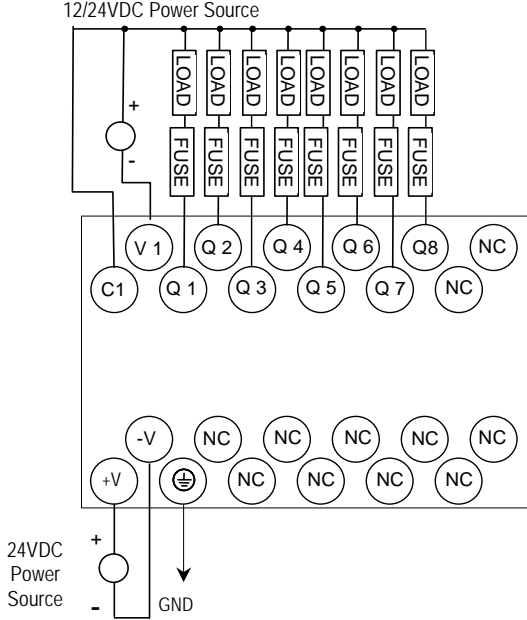
External fusing should be provided to protect the outputs. Otherwise, a load short can damage the module output transistor, which is not user replaceable. Fast fuses are recommended.

The outputs share one common incoming 24VDC supply and one common ground. The outputs are able to drive high inrush currents (8 times the rated current) and are protected against negative voltage pulses. This makes it possible to switch lamps and inductive loads.
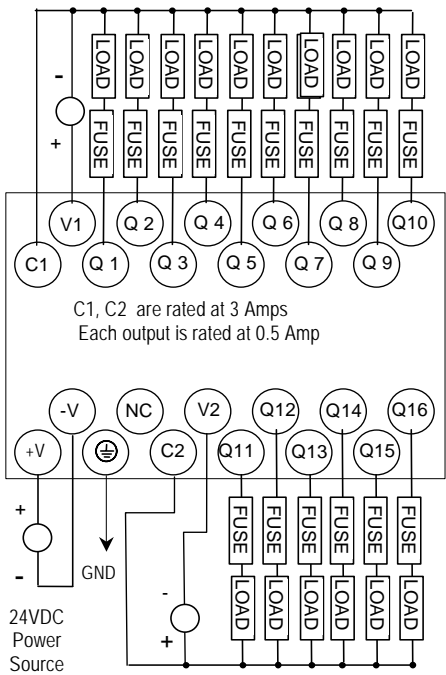
Expansion Unit IC200UEX014 Specifications

Inputs	Eight 24VDC positive/negative logic input circuits
Outputs	Four low-current and two high-current DC transistor output circuits
+24 VDC Output Power Supply	200mA maximum, (for input circuits and user devices)
DC Power Specifications	
Range	24 –20%/+25% VDC
Hold-up	10ms at 19.2VDC
Inrush Current	1 A maximum at 30 VDC
Inrush Time	10 ms for 1 Amp
Input Current	0.16 A typical at 24 VDC
Input Power Supply Rating	4W

DC Input Specifications	
Rated Input Voltage	24 volts DC
Input Voltage Range	0 to 30 volts DC
Input Current	7.5mA typical
Input Resistance	2.8 Kohms
Input Threshold Voltage	ON: 15VDC minimum, OFF: 5VDC maximum
Input Threshold Current	ON: 4.5mA maximum, OFF: 1.5mA minimum
Response Time	0.5 to 20ms
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups
Transistor Output Specifications	
Voltage Range	12/24VDC +10%/-15% (at VC)
Maximum Load (see below)	1A per point (Q1 - Q2) at 100 % ON duration at 24VDC 0.5A per point (Q3 - Q6) at 100 % ON duration at 12VDC 0.75A per point (Q3 - Q6) at 100 % ON duration at 24VDC
Maximum Inrush Current	Q1, Q2: 8A for 20ms, 1 pulse, Q3, Q4, Q5, Q6: 4A for 20ms, 1 pulse
Output Voltage Drop	0.5V maximum
OFF state leakage	100μA maximum
Response	OFF to ON or ON to OFF: 0.1ms maximum at 24VDC, 0.2A
Isolation Voltage	1500V RMS field side to logic side, 500VAC between field side and logic side
External power supply	10-30VDC required to power the outputs.
Fuses	Outputs should be fused externally..

Wiring Diagram, IC200UEX014

The maximum current that can be used for output points Q1 and Q2 is lower for ambient temperatures above 50 degrees C.
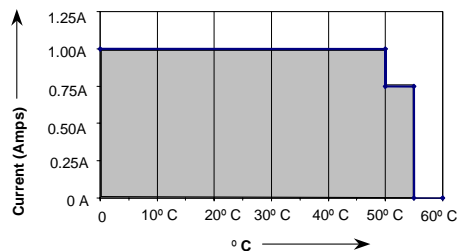
VersaMax Micro PLC Expansion Unit IC200UEX015 accepts eight DC inputs and provides six DC transistor outputs. It requires +12VDC nominal input power.

DC Inputs

The eight 12 volt DC inputs can have positive or negative logic characteristics. Inputs are compatible with a wide range of devices, such as pushbuttons, limit switches, and electronic proximity switches.

The built-in isolated +12 VDC supply can be used for input devices and to power the DC input circuits. The combination of input circuit current and external device current must not exceed 200 mA.

Transistor Outputs

All outputs are isolated between field and logic and are switching positive voltage.

External fusing should be provided to protect the outputs. Otherwise, a load short can damage the module output transistor, which is not user replaceable. Fast fuses are recommended.

The outputs share one common incoming 12VDC supply and one common ground. The outputs are able to drive high inrush currents (8 times the rated current) and are protected against negative voltage pulses. This makes it possible to switch lamps and inductive loads.

Expansion Unit IC200UEX015 Specifications

Inputs	Eight 12VDC positive/negative logic input circuits
Outputs	Six 12VDC output circuits
+12 VDC Output Power Supply	200mA maximum (for input circuits and user devices)
DC Power Specifications	
Range	9.6VDC to 15 VDC
Hold-up	3.0mS
Inrush Current	9.2A typical at 12 VDC
Inrush Time	200ms typical
Input Current	300mA typical at 12 VDC
Input Power Supply Rating	4W

DC Input Specifications	
Number of Inputs	8
Rated Input Voltage	12 volts DC
Input Voltage Range	0 to 15 volts DC
Input Current	9.0mA typical
Input Impedance	1.3 kOhms
Input Threshold Voltage	ON: 9.5VDC minimum, OFF: 2.5VDC maximum
Input Threshold Current	ON: 6.5mA maximum, OFF: 1.6mA minimum
Response Time	0.5 to 20ms (user configurable)
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups
Transistor Output Specifications	
Voltage Range	12VDC +20%, -20%
Maximum Load	0.7A per circuit, 4A per common
Maximum Inrush Current	4A for 20mS
Output Voltage Drop	0.3V maximum
OFF state leakage	0.1mA
Response	OFF to ON or ON to OFF: 0.1ms maximum 12VDC 0.2A
Isolation Voltage	1500V RMS field side to logic side, 500VAC between field side and logic side
External power supply	12VDC required to power the outputs.
Fuse	Outputs should be fused externally.

Wiring Diagram, IC200UEX015
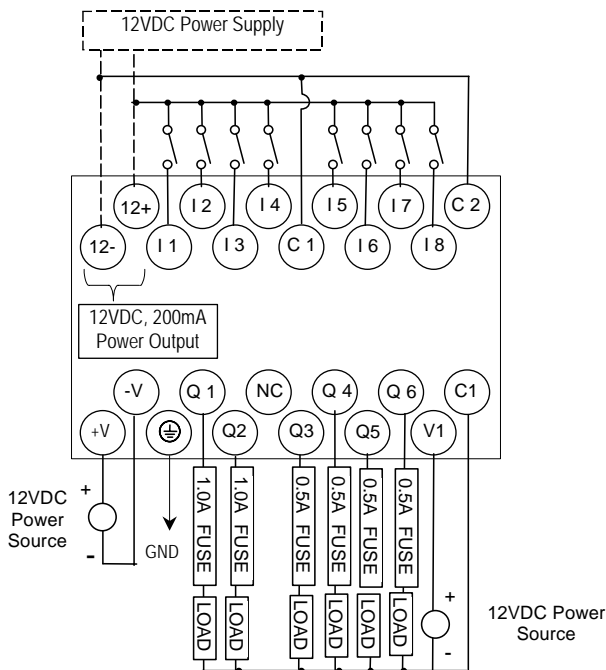
IC200UEX122
14-Point Expansion Unit with 24DC Power, (8) 24DC Inputs,
(2) High-Current and (4) Low-Current Transistor Outputs with ESCP

VersaMax Micro PLC Expansion Unit IC200UEX122 accepts eight DC inputs and provides two low-current and four high-current DC transistor outputs. The outputs have electronic short circuit protection. The module requires +24VDC nominal input power.

DC Inputs

The 24 volt DC input circuits can have positive or negative logic characteristics. Inputs are compatible with a wide range of devices, such as pushbuttons, limit switches, and electronic proximity switches.

The built-in isolated +24 VDC supply can be used for input devices and to power the DC input circuits. The combination of input circuit current and external device current must not exceed 200 mA.

Outputs

Expansion Unit UEX122 has two high-current transistor outputs (Q1 and Q2) and four low-current transistor outputs (Q3 to Q6). They can be used as positive or negative logic standard inputs.

All outputs are isolated between field and logic and are switching positive voltage.

All six outputs have electronic short-circuit protection, no fuses are needed to protect the outputs.

An external source of 12/24VDC power must be provided to power the outputs. The outputs share this common incoming 24VDC supply and one common ground. The outputs are able to drive high inrush currents (8 times the rated current) and are protected against negative voltage pulses. This makes it possible to switch lamps and inductive loads.

Expansion Unit IC200UEX122 Specifications

Inputs	Eight 24VDC positive/negative logic input circuits
Outputs	Four low-current and two high-current DC transistor output circuits with ESCP
+24 VDC Output Power Supply	200mA maximum (for input circuits and user devices)
DC Power Specifications	
Range	19.2VDC to 30VDC
Hold-up	10ms at 19.2VDC
Inrush Current	1 A maximum at 30 VDC
Inrush Time	10 ms for 1 Amp
Input Current	0.16 A typical at 24 VDC
Input Power Supply Rating	4W

DC Input Specifications	
Input Voltage Range	0 to 30 volts DC
Input Current	7.5mA typical
Input Impedance	2.8 Kohms
Input Threshold Voltage	ON: 15VDC minimum, OFF: 5VDC maximum
Input Threshold Current	ON: 4.5mA maximum, OFF: 1.5mA minimum
sResponse Time	0.5 to 20ms
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups
DC Output Specifications	
Voltage Range	12/24VDC +10%/-15% (at VC)
Maximum Load Current	Q1 and Q2: 1A, 3.4A per common, Q3 to Q6: 0.7A per point , 3.4A per common
Maximum Inrush Current	Q1, Q2: 8A for 20ms, 1 pulse, Q3, Q4, Q5, Q6: 4A for 20ms, 1 pulse
Output Voltage Drop	0.3V
OFF state Leakage Current	0.1mA
Response Time	OFF to ON or ON to OFF: 0.05ms maximum at 24VDC
Isolation Voltage	1500V RMS field side to logic side, 500VAC between field side and logic side
External power supply	12/24VDC –10%, +20%
Fuse	Not required
Minimum switching current	10mA

Wiring Diagram, IC200UEX122
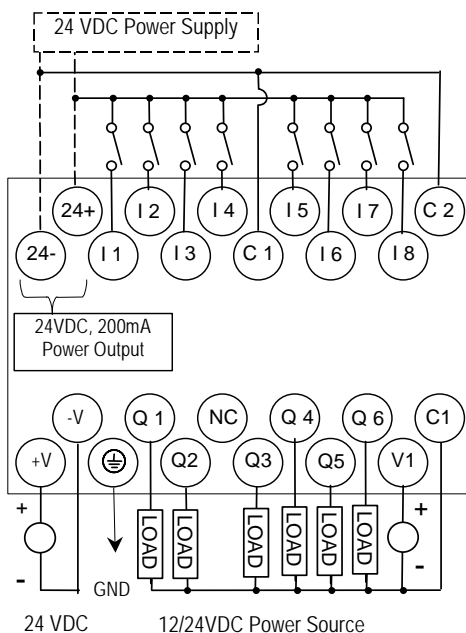
VersaMax Micro PLC 28-Point Expansion Units

This chapter consists of module datasheets for the following VersaMax Micro PLC Expansion Units:

▪	IC200UEX209	28 Point Expansion Unit, (16) 120VAC In, (2) Relay Out at 10 Amps, (10) Relay Out at 2 Amps, 120/240VAC Power Supply
▪	IC200UEX210	28 Point Expansion Unit, (16) 120VAC In, (12) 120VAC Out, 120/240VAC Power Supply
▪	IC200UEX211	28 Point Expansion Unit, (16) 24VDC In, (12) Relay Out, 120/240VAC Power Supply
▪	IC200UEX212	28 Point Expansion Unit, (16) 24VDC In, (12) Relay Out, 24VDC Power Supply
▪	IC200UEX213	28 Point Expansion Unit, (16) 12VDC In, (12) Relay Out, 12VDC Power Supply
▪	IC200UEX214	28 Point Expansion Unit, (16) 24VDC In, (12) 24VDC Out, 24VDC Power Supply
▪	IC200UEX215	28 Point Expansion Unit, (16) 12VDC In, (12) 12VDC Out, 12VDC Power Supply
▪	IC200UEX222	28 Point Expansion Unit, (16) 24VDC In, (12) 24VDC Out with ESCP, 24VDC Power Supply

Features of VersaMax 28-Point Micro PLC Expansion Units

Modular 28-point Expansion Units can be used to increase the total I/O count of a Micro PLC. Expansion Units can be used with any 14- to 64-point Micro PLC. Expansion Units can be located up to 2 meters from the Micro PLC.

Removable Terminal Strips

The removable terminal assemblies are protected by hinged covers. After turning off power to the Expansion Unit, a terminal assembly and attached field wiring can be separated from the Expansion Unit by removing two screws.

Expansion Connector

The connector on the left side of the Expansion Unit is used to connect to the Micro PLC or to the outgoing connector on the previous Expansion Unit. The connector on the right side of the Expansion Unit can be used to attach to the next Expansion Unit.

Status LEDs

LEDs on the Expansion Unit provide quick visual verification of operating status. In addition to LEDs Expansion Unit local Power and OK mode, there is an LED for each I/O point.

Cables

A 0.1 meter ribbon cable (IC200CBL501) is provided with each Expansion Unit. Cables are also available in 0.5 meter (IC200CBL505) and 1 meter (IC200CBL510) lengths.

IC200UEX209
28 Point Micro PLC Expansion Unit, (16) 120VAC In, (2/10) Relay Out,
120/240VAC Power Supply

VersaMax Micro PLC Expansion Unit IC200UEX209 accepts sixteen AC inputs and provides two relay outputs at 10 Amps and ten relay outputs at 2 Amps. It uses 100VAC to 240VAC nominal input power.

AC Inputs

The 120 VAC input circuits are reactive (resistor/capacitor) inputs. The input circuits require an AC power source: they cannot be used with a DC power source. Inputs are compatible with a wide range of input devices, such as pushbuttons, limit switches, and electronic proximity switches. Power to operate the field devices must be supplied.

Relay Outputs

The relay outputs can control many types of load devices such as motor starters, solenoids, and indicators. The switching capacity of each of these circuits is 2 amps. An external source of AC or DC power must be supplied to operate field devices.

Expansion Unit IC200UEX209 Specifications

Inputs	16 AC inputs
Outputs	2 relay outputs at 10 Amps, 10 relay outputs at 2 Amps
+24 VDC Output Power Supply	200mA maximum (for input circuits and user devices)
AC Power Specifications	
Range	100 –15% to 240 +10% VAC
Frequency	50 –5% to 60 +5% Hz
Hold-up	10ms at 85-100 VAC, 20ms at 100-264 VAC
Inrush Time	2ms for 40 Amp
Inrush Current	30 Amp maximum at 200VAC, 40 Amp maximum at 265VAC
Input Current	0.10 Amp typical at 100VAC, 0.06 Amp typical at 200VAC
Input Power Supply Rating	16 VA
AC Input Specifications	
Points/Common	4 (I1–I4) and (I5–I8)
Rated Load Voltage	85–132 VAC, 50 -5% to 60 +5% Hz
Maximum Input Voltage	132V rms, 50/60 Hz
Input Current	8 mA rms (100 VAC, 60 Hz)
Voltage	ON: minimum 80V rms, 4.5 mA rms, OFF: maximum 30V rms, 2 mA rms
Response Time	OFF to ON: maximum 25 ms, ON to OFF: maximum 30 ms
Isolation	1500V rms field side to logic side, 500V rms between groups

Relay Output Specifications			
Operating Voltage	5 to 30 VDC or 5 to 250 VAC		
Isolation	1500 V RMS between field side and logic side 500 V RMS between groups		
Leakage Current	15 mA at 240 VAC maximum		
Maximum UL Pilot Duty Rating	2 amps at 24VDC and 240VAC		10 amps at 24VDC and 240VAC
Maximum Resistive Load Rating	2 amps at 24VDC and 240VAC		10 amps at24 VDC and 240VAC
Minimum Load	10 mA		
Maximum Inrush	5 amps per half cycle		14 amps per half cycle
On Response Time	15 ms maximum		
Off Response Time	15 ms maximum		
Contact Life: Mechanical	20×10^6 mechanical operations		
Contact Life: Electrical Voltage	Current: Resistive 2.0A 10.0A 4.0A	Current: Lamp and Solenoid 0.6A 4.0A 1.0A	Typical Operations 100,000 100,000 200,000

Wiring Diagram, IC200UEX209
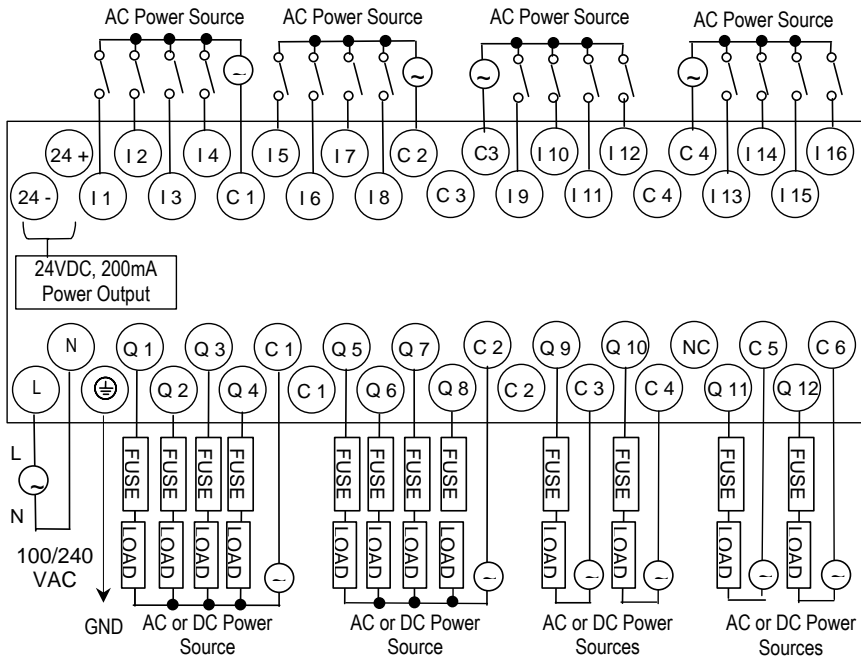
Outputs Q 1 – Q 10 are rated at 2.0 Amps each. Outputs Q 11 and Q 12 are rated at 10.0 Amps each.

VersaMax Micro PLC Expansion Unit IC200UEX210 accepts sixteen AC inputs and provides twelve AC outputs. It uses 100VAC to 240VAC nominal input power.

AC Inputs

The 120VAC input circuits are reactive (resistor/capacitor) inputs. The input circuits require an AC power source: they cannot be used with a DC power source. Inputs are compatible with a wide range of input devices, such as pushbuttons, limit switches, and electronic proximity switches. Power to operate the field devices must be supplied.

AC Outputs

The 120/240 VAC, 0.5 Amp triac outputs are provided in isolated groups. The commons are not tied together inside the module. This allows each group to be used on different phases of the AC supply or to be powered from the same supply. Each group is protected with a replaceable 3.15 amp fuse for its common. Also, an RC snubber is provided for each output to protect against transient electrical noise on the power line.

AC power to operate loads connected to outputs must be supplied from an external source.

This module provides a high degree of inrush current (10x the rated current) which makes the outputs suitable for controlling a wide range of inductive and incandescent loads.

Expansion Unit IC200UEX210 Specifications

Inputs	16 AC inputs
Outputs	12 AC outputs
AC Power Specifications	
Range	100 -15% to 240 +10% VAC
Frequency	50 -5% to 60 +5% Hz
Hold-up	10ms at 85-100 VAC, 20ms at 100-264 VAC
Inrush Time	2ms for 40 Amp
Inrush Current	30 Amp maximum at 200VAC, 40 Amp maximum at 265VAC
Input Current	0.10 Amp typical at 100VAC, 0.06 Amp typical at 200VAC
Input Power Supply Rating	16 VA

AC Input Specifications	
Points/Common	4 (I1–I4) and (I5–I8)
Rated Load Voltage	85–132 VAC, 50 -5% to 60 +5% Hz
Maximum Input Voltage	132V rms, 50/60 Hz
Input Current	8 mA rms (100 VAC, 60 Hz)
Voltage	ON minimum 80V rms, 4.5 mA rms, OFF: maximum 30V rms, 2 mA rms
Response Time	OFF to ON: maximum 25 ms< ON to OFF: maximum 30 ms
Isolation	1500V rms field side to logic side, 500V rms between groups
AC Output Specifications	
Rated Load Voltage	100 -15% to 240 +10% VAC, 50 -5% to 60 +5% Hz
Maximum Resistive Load Current	0.5 Amp per point
Maximum UL Pilot Duty Rating	0.5 Amp per point at 240 VAC 0.6 Amp maximum on C1 and C3 1.2 Amps maximum on C2 and C4
Maximum Inrush Current	5A (1 period)/point, 10A (1 period)/common
Maximum voltage drop when ON	1.5 V RMS
Maximum leak current when OFF	1.8 mA RMS (115 VAC), 3.5 mA RMS (230 VAC)
Response Time (Maximum)	OFF to ON: 1 mS, ON to OFF: 1/2 cycle + 1 ms
Isolation	1500V RMS field side to logic side, 500V RMS between groups

Wiring Diagram, IC200UEX210

VersaMax Micro PLC Expansion Unit IC200UEX211 accepts sixteen DC inputs and provides twelve normally-open 2 Amp relay outputs. It uses 100VAC to 240VAC nominal input power.

DC Inputs

The sixteen configurable DC inputs can be used as positive or negative logic inputs. Inputs are compatible with a wide range of input devices, such as pushbuttons, limit switches, and electronic proximity switches. The +24 VDC supply can be used for input devices and to power the DC input circuits. The combination of input circuit current and external device current must not exceed 200 mA.

Relay Outputs (Q1 – Q12)

The twelve Form A (SPST-single pole single throw) normally-open relay outputs can control many types of load devices such as motor starters, solenoids, and indicators. The switching capacity of each of these circuits is 2 amps. An external source of AC or DC power must be supplied to operate field devices.

Expansion Unit IC200UEX211 Specifications

Inputs	Sixteen 24 VDC positive/negative logic input circuits
Outputs	Twelve normally open 2 amp relay circuits
+24 VDC Output Power Supply	200mA maximum (for input circuits and user devices)
AC Power Specifications	
Range	100 -15% to 240 +10% VAC
Frequency	50 -5% to 60 +5% Hz
Hold-up	10ms at 85 to 100VAC, 20ms at 100 to 265VAC
Inrush Current	30 Amp maximum at 200 VAC, 40 Amp maximum at 265 VAC
Inrush Time	2 ms for 40Amp
Input Current	0.20 Amp typical at 200 VAC, 0.10 Amp typical at 100 VAC
Input Power Supply Rating	26 VA

DC Input Specifications	
Number of Inputs	16
Rated Input Voltage	24 volts DC
Input Voltage Range	0 to 30 volts DC
Input Current	7.5mA typical
Input Resistance	2.8 Kohms
Input Threshold Voltage	ON: 15VDC minimum, OFF: 5VDC maximum
Input Threshold Current	ON: 4.5mA maximum, OFF: 1.5mA minimum
Response Time	0.5 to 20ms configurable
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups

Relay Output Specifications			
Operating Voltage	5 to 30 VDC or 5 to 250 VAC		
Isolation	1500 V RMS between field side and logic side, 500 V RMS between groups		
Leakage Current	15 mA at 240 VAC maximum		
Maximum UL Pilot Duty Rating	2 amps at 24 VDC and 240 VAC		
Maximum Resistive Load Rating	2 amps at 24 VDC and 240 VAC		
Minimum Load	10 mA		
Maximum Inrush	5 amps per half cycle		
Response Time	ON, OFF: 15 ms maximum		
Contact Life: Mechanical	20×10^6 mechanical operations		
Contact Life: Electrical Voltage 240VAC, 120VAC, 24VDC	Current: Resistive 2.0A	Current: Lamp and Solenoid 0.6A	Typical Operations 200,000

Wiring Diagram, IC200UEX211

VersaMax Micro PLC Expansion Unit IC200UEX212 accepts sixteen DC inputs and provides twelve normally-open 2 Amp relay outputs. It uses +24VDC nominal input power.

DC Power

The 24VDC power source must have enough transient current capability to support the inrush current of the power supply and to maintain a 24VDC voltage. The +24 VDC supply can be used for input devices and to power the DC input circuits at about 7.5 mA per input. The combination of input circuit current and external device current must not exceed 200 mA.

DC Inputs

Sixteen configurable DC inputs can be used as positive or negative logic inputs. Inputs are compatible with a wide range of input devices, such as pushbuttons, limit switches, and electronic proximity switches.

Relay Outputs (Q1 – Q12)

Twelve Form A (SPST-single pole single throw) normally-open relay outputs can control many types of load devices such as motor starters, solenoids, and indicators. The switching capacity of each of these circuits is 2A. An external source of AC or DC power must be supplied to operate field devices.

Expansion Unit IC200UEX212 Specifications

Inputs	Sixteen 24 VDC positive/negative logic input circuits
Outputs	Twelve normally open 2 amp relay circuits
DC Power Specifications	
Range	24 -20%, +25% VDC
Hold-up	10ms at 19.2 VDC
Inrush Current	1 Amp maximum at 30VDC
Inrush Time	10ms for 1 A
Input Current	0.30 Amp typical at 24VDC
Input Power Supply Rating	8W
+24 VDC Output Power Supply	200mA maximum (for input circuits and user devices)

DC Input Specifications	
Number of Inputs	16
Rated Input Voltage	24 volts DC
Input Voltage Range	0 to 30 volts DC
Input Current	7.5mA typical
Input Resistance	2.8 Kohms
Input Threshold Voltage	ON: 15VDC minimum, OFF: 5VDC maximum
Input Threshold Current	ON: 4.5mA maximum, OFF: 1.5mA minimum
Response Time	0.5 to 20ms configurable
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups

Relay Output Specifications			
Operating Voltage	5 to 30 VDC or 5 to 250 VAC		
Isolation	1500 V RMS between field side and logic side 500 V RMS between groups		
Leakage Current	15 mA at 240 VAC maximum		
Maximum UL Pilot Duty Rating	2 amps at 24 VDC and 240 VAC		
Maximum Resistive Load Rating	2 amps at 24 VDC and 240 VAC		
Minimum Load	1 mA		
Maximum Inrush	5 amps per half cycle		
Response Time	ON, OFF: 15 ms maximum		
Contact Life: Mechanical	20 x 10^6 mechanical operations		
Contact Life: Electrical Voltage 240VAC, 120VAC, 24VDC	Current: Resistive 2A	Current: Lamp and Solenoid 0.6A	Typical Operations 200,000

Wiring Diagram, IC200UEX212

IC200UEX213
28 Point Micro PLC Expansion Unit, (16) 12VDC In, (12) Relay Out,
12VDC Power Supply

VersaMax Micro PLC Expansion Unit IC200UEX213 accepts sixteen 12VDC inputs and provides twelve normally-open 2 Amp relay outputs. It uses +12VDC nominal input power.

DC Power

The 12VDC power source must have enough transient current capability to support the inrush current of the power supply and to maintain a 12VDC voltage level.

DC Inputs

Sixteen configurable 12VDC inputs can be used as positive or negative logic standard inputs. Inputs are compatible with a wide range of input devices, such as pushbuttons, limit switches, and electronic proximity switches.

The 12 VDC supply can be used for input devices and to power the DC input circuits at about 7.5 mA per input. The combination of input circuit current and external device current must not exceed 200 mA.

Relay Outputs (Q1 – Q12)

Twelve Form A (SPST-single pole single throw) normally-open relay outputs can control many types of load devices such as motor starters, solenoids, and indicators. The switching capacity of each of these circuits is 2 amps. An external source of AC or DC power must be supplied to operate field devices.

Expansion Unit IC200UEX213 Specifications

Inputs	Sixteen 12 VDC positive/negative logic input circuits
Outputs	Twelve normally open 2 amp relay circuits
DC Power Specifications	
Range	9.6VDC - 15VDC
+12 VDC Output Power Supply	200mA maximum (for input circuits and user devices)
Hold-up	3.0mS
Inrush Current	9.6A typical at 12 VDC
Inrush Time	200ms typical
Input Current	480mA typical at 12 VDC
Input Power Supply Rating	8W

DC Input Specifications	
Number of Inputs	16
Rated Input Voltage	12 volts DC
Input Voltage Range	0 to 15 volts DC
Input Current	9.0mA typical
Input Impedance	1.3 kOhms
Input Threshold Voltage	ON : 9.5VDC minimum, OFF: 2.5VDC maximum
Input Threshold Current	ON: 6.5mA maximum , OFF: 1.6mA minimum
Response Time	0.5 to 20ms (user configurable)
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups
Relay Output Specifications	
Operating Voltage	5 to 30 VDC or 5 to 250 VAC
Isolation	1500 V RMS between field side and logic side 500 V RMS between groups
Leakage Current	15 mA maximum
Maximum UL Pilot Duty Rating	2 amps at 24 VDC and 240 VAC
Maximum Resistive Load Rating	2 amps at 24 VDC and 240 VAC
Minimum Load	1 mA
Maximum Inrush	5 amps per half cycle
On Response Time	15 ms maximum
Off Response Time	15 ms maximum
Contact Life: Mechanical	20×10^6 mechanical operations		

Contact Life: Electrical Voltage	Current: Resistive 2A	Current: Lamp and Solenoid 0.6A	Typical Operations 200,000

Wiring Diagram, IC200UEX213

VersaMax Micro PLC Expansion Unit IC200UEX214 accepts sixteen DC inputs and provides four low-current and eight high-current DC transistor outputs. It uses +24VDC nominal input power.

DC Power

The 24VDC power source must have enough transient current capability to support the inrush current of the power supply and to maintain a 24VDC voltage level.

DC Inputs

Sixteen configurable DC inputs can be used as positive or negative logic inputs. The inputs are compatible with a wide range of input devices, such as pushbuttons, limit switches, and electronic proximity switches.

The 24 VDC supply can be used for input devices and to power the DC input circuits at about 7.5 mA per input. The combination of input circuit current and external device current must not exceed 200 mA.

Transistor Outputs

Twelve positive-logic transistor output circuits can be used to switch devices like valves, lamps or contactors. External fusing should be provided to protect the outputs. Otherwise, a load short could damage the module output transistor, which is not user replaceable. Fast fuses are recommended.

Outputs are grouped in two groups with separated incoming supply. Each group contains 4 outputs with a maximum load of 0.5A and 2 outputs with a maximum load of 1A.

All outputs are isolated between field and logic and are switching positive voltage. The outputs have one common incoming supply (VC) and one common ground (COM). The outputs are able to drive high inrush currents (8 times the rated current) and are protected against negative voltage pulses. This makes it possible to switch lamps and inductive loads.

Expansion Unit IC200UEX214 Specifications

Inputs	Sixteen 24 VDC positive logic inputs in four groups of four
Outputs	Twelve transistor outputs, 24 VDC.
DC Power Specifications	
Range	24 -20%, +25% VDC
Hold-up	10ms at 19.2 VDC
+24 VDC Output Power Supply	200mA maximum (for input circuits an user devices)
Inrush Current	1 Amp maximum at 30VDC
Inrush Time	10ms for 1 Amp
Input Current	0.20 Amp typical at 24VDC
Input Power Supply Rating	5W
DC Input Specifications	
Rated Input Voltage	24 volts DC
Input Voltage Range	0 to 30 volts DC
Input Current	7.5mA typical
Input Resistance	2.8 Kohms
Input Threshold Voltage	ON: 15VDC minimum, OFF: 5VDC maximum
Input Threshold Current	ON: 4.5mA maximum, OFF: 1.5mA minimum
Response Time	0.5 to 20ms
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups
Transistor Output Specifications	
Voltage Range	12VDC/24VDC (24VDC +10% / -43% input at V1,C1)
Maximum Load (See below)	1.0A per point (Q1, Q2, Q11, Q12) at 24VDC at 100% ON duration
	0.75A per point (Q3 - Q10) at 24VDC at 100 % ON duration
	0.5A per point (Q3 - Q10) at 12VDC at 100 % ON duration
Maximum Inrush Current	Q1,Q2,Q11,Q12: 8A for 20ms, 1 pulse, Q3-Q10: 4A for 20ms, 1 pulse
Output Voltage Drop	0.3V maximum
OFF state leakage	100μA maximum
Response Time	OFF to ON : 0.1ms maximum (24 VDC, 0.2A) ON to OFF : 0.1ms maximum (24 VDC, 0.2A)
Isolation Voltage	1500V RMS between field side and logic side, 500V RMS between groups
External Fuse	Recommended

The maximum current that can be used for output points Q1, Q2, Q11 and Q12 is lower for ambient temperatures above 50 degrees C

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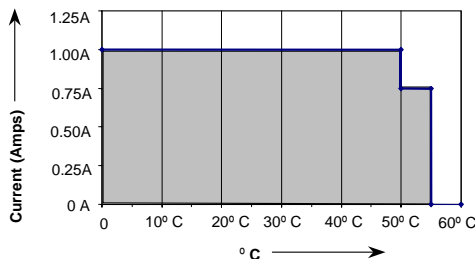
Wiring Diagram, IC200UEX214
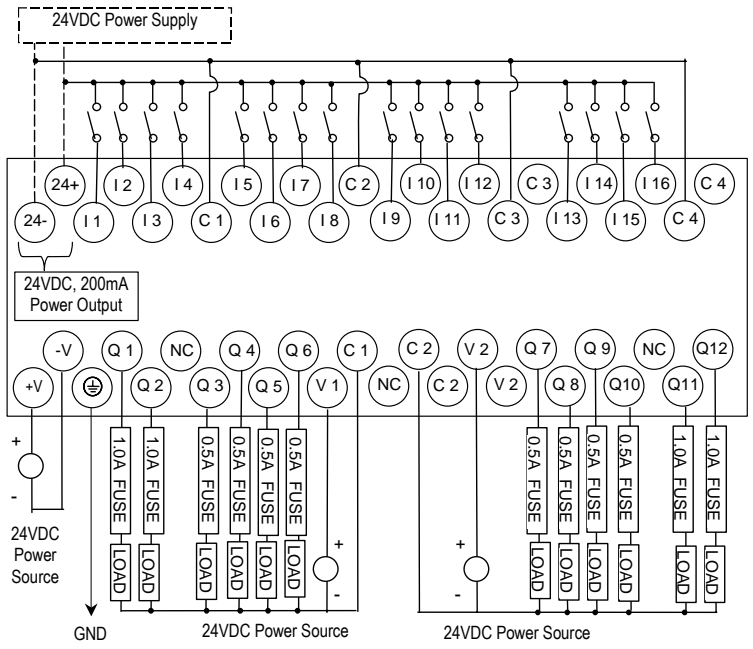
VersaMax Micro PLC Expansion Unit IC200UEX215 accepts sixteen 12VDC inputs and provides twelve DC transistor outputs. It requires +12VDC nominal input power.

DC Power

The 12VDC power source must have enough transient current capability to support the inrush current of the power supply and to maintain a 12VDC voltage level.

DC Inputs

Sixteen configurable DC inputs can be used as positive or negative logic inputs. The inputs are compatible with a wide range of input devices, such as pushbuttons, limit switches, and electronic proximity switches.

The 12 VDC supply can be used for input devices and to power the DC input circuits at about 7.5 mA per input. The combination of input circuit current and external device current must not exceed 200 mA.

Transistor Outputs

Expansion Unit IC200UEX215 has four high-current transistor outputs (Q1, Q2, Q11, and Q12) and eight low-current transistor outputs (Q3 to Q10). All outputs are isolated between field and logic and are switching positive voltage.

Outputs are grouped in two groups with separated incoming supply. Each group contains 4 outputs with a maximum load of 0.5A and 2 outputs with a maximum load of 1A. Each group of 6 outputs has one common incoming supply (V1, V2) and one common ground (C1, C2). The outputs are able to drive high inrush currents (8 times the rated current) and are protected against negative voltage pulses. This makes it possible to switch lamps and inductive loads.

Outputs should be fused externally. Otherwise, a load short can damage the module output transistor, which is not user replaceable. Fast fuses are recommended.

Expansion Unit IC200UEX215 Specifications

Inputs	Sixteen 12VDC positive logic inputs in four groups of four
Outputs	Twelve transistor outputs, 12 VDC.
+12 VDC Output Power Supply	200mA maximum (for input circuits and user devices)

DC Power Specifications	
Range	9.6VDC to 15 VDC
Hold-up	3.0mS
Inrush Current	9.6A typical at 12 VDC
Inrush Time	200ms typical
Input Current	480mA typical at 12 VDC
Input Power Supply Rating	8W
DC Input Specifications	
Number of Inputs	16
Rated Input Voltage	12 volts DC
Input Voltage Range	0 to 15 volts DC
Input Current	9.0mA typical
Input Resistance	1.3 kOhms
Input Threshold Voltage	ON: 9.5VDC minimum, OFF: 2.5VDC maximum
Input Threshold Current	ON: 6.5mA maximum , OFF: 1.6mA minimum
Response Time	0.5 to 20ms (user configurable)
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups
DC Output Specifications	
Voltage Range	12VDC (+20%, -20%)
Maximum Load	0.7A per point (Q1 - Q12) at 24VDC at 100 % ON duration, 4A per common
Maximum Inrush Current	4A for 20mS
Output Voltage Drop	0.3V maximum
OFF state leakage	0.1mA maximum
Response Time	OFF to ON or ON to OFF : 0.1ms maximum (12 VDC)
Isolation Voltage	1500V RMS between field side and logic side, 500V RMS between groups
Fuse	Outputs should be fused externally.

Wiring Diagram, IC200UEX215

IC200UEX222
28 Point Micro PLC Expansion Unit, (16) 24VDC In,
(12) 24VDC Out with ESCP, 24VDC Power Supply

VersaMax Micro PLC Expansion Unit IC200UEX222 accepts sixteen DC inputs and provides twelve 24VDC outputs. The outputs have electronic short circuit protection. The module uses +24VDC nominal input power.

DC Power

The 24VDC power source must have enough transient current capability to support the inrush current of the power supply and to maintain a 24VDC voltage level. 24VDC output power is available for field devices, up to 200mA maximum.

DC Inputs

Sixteen configurable DC inputs can be used as positive or negative logic inputs. The inputs are compatible with a wide range of input devices, such as pushbuttons, limit switches, and electronic proximity switches.

The +24 VDC supply can be used for input devices and to power the DC input circuits at about 7.5 mA per input. The combination of input circuit current and external device current must not exceed 200 mA.

Transistor Outputs

Twelve positive-logic DC outputs can be used to switch devices like valves, lamps or contactors. Outputs provide electronic short-circuit protection.

Outputs are grouped in three groups with separated incoming supply. Each group contains 4 outputs with a maximum load of 0.5A and 4 outputs with a maximum load of 1A.

Expansion Unit IC200UEX222 Specifications

Inputs	Sixteen 24 VDC positive logic inputs in four groups of four
Outputs	Twelve transistor outputs, 24 VDC
DC Power Specifications	
Range	19.2VDC to 30VDC
Hold-up	10ms at 19.2 VDC
24 VDC Output Power Supply	200mA maximum (for input circuits and user devices)
Inrush Current	1 Amp maximum at 30VDC
Inrush Time	10ms for 1 Amp
Input Current	0.20 Amp typical at 24VDC
Input Power Supply Rating	5W

DC Input Specifications	
Rated Input Voltage	24 volts DC
Input Voltage Range	0 to 30 volts DC
Input Current	7.5mA typical
Input Resistance	2.8 Kohms
Input Threshold Voltage	ON: 15VDC minimum, OFF: 5VDC maximum
Input Threshold Current	ON: 4.5mA maximum, OFF: 1.5mA minimum
Response Time	0.5 to 20ms.
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups
DC Output Specifications	
Voltage Range	Q1 – Q12: 12/24VDC +10%, -15%
External Power Supply (for supplying power to the V terminal)	12/24V -10%, +20%
Maximum Load Current	Q1 and Q2: 1A per point, Q3 - Q12: 0.7A per point
Minimum Switching Current	10mA
Maximum Inrush Current	Q1,Q2,Q11,Q12: 8A for 20ms, 1 pulse, Q3-Q10: 4A for 20ms, 1 pulse
Output Voltage Drop	Q1– Q12: 0.3V maximum
OFF state leakage current	0.1mA
Response Time	OFF to ON or ON to OFF: 0.05ms maximum @ 24VDC
Isolation Voltage	1500V RMS between field side and logic side 500V RMS between groups
Fuses	Not required
Undervoltage shutdown	Q1 - Q12: 5V minimum, 8V maximum
DC short circuit current	Q1 – Q12: 0.7A minimum, 2A maximum
Peak short circuit current	4A maximum
Delay time of peak short circuit current	100µS
Delay time of current limit	100µS

Wiring Diagram, IC200UEX222
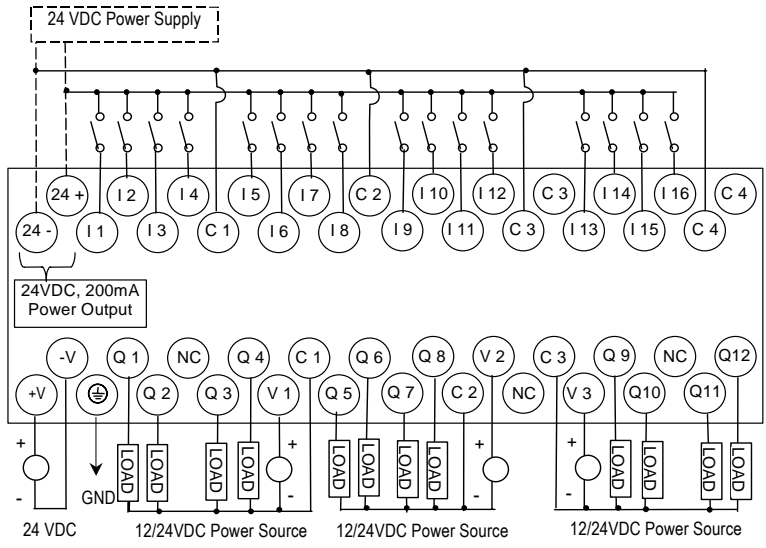
VersaMax Micro PLC 64-Point Expansion Units

This chapter consists of module datasheets for the following VersaMax Micro PLC Expansion Units:

Note: The 64-point Expansion Units are supported on *Micro PLUS* PLCs (20/40/64-point Micro PLCs with release 4.0 or later firmware).

▪	IC200UEX064	64 point (40) 24VDC In; (24) Relay Out; 24VDC Power Supply
▪	IC200UEX164	64 point (40) 24VDC In; (24) Relay Out; 120/240VAC Power Supply
▪	IC200UEX264	64 point (40) 24VDC In; (4) LCDC 24VDC Out; (16) LCDC 24VDC Out with ESCP; (4) HCDC 24VDC with ESCP; 24VDC Power Supply
▪	IC200UEX364	64 point (40) 24VDC In; (24) LCDC 24VDC Out, 24VDC Power Supply

Features of VersaMax 64-Point Micro PLC Expansion Units

Modular 64-point Expansion Units can be used to increase the total I/O count of a Micro PLC. The 64-point Expansion Units can be used with any 20, 40 or 64-point Micro PLC. Expansion Units can be located up to 2 meters from the Micro PLC.

Input filtering is not supported for 64-point Expansion Units.

Removable Terminal Strips

The removable terminal assemblies are protected by hinged covers. After turning off power to the Expansion Unit, a terminal assembly and attached field wiring can be separated from the Expansion Unit by removing two screws.

Expansion Connector

The connector on the left side of the Expansion Unit is used to connect to the Micro PLC or to the outgoing connector on the previous Expansion Unit. The connector on the right side of the Expansion Unit can be used to attach to the next Expansion Unit.

Status LEDs

LEDs on the Expansion Unit provide quick visual verification of operating status. In addition to LEDs Expansion Unit local Power and OK mode, there is an LED for each I/O point.

Cables

A 0.1 meter ribbon cable (IC200CBL501) is provided with each Expansion Unit. Cables are also available in 0.5 meter (IC200CBL505) and 1 meter (IC200CBL510) lengths.

IC200UEX064
64 Point Micro PLC Expansion Unit,
(40) 24VDC In, (24) Relay Out, 24VDC Power Supply

VersaMax Micro PLC Expansion Unit IC200UEX064 accepts forty DC inputs and provides twenty-four relay outputs. It uses 24VDC nominal input power.

DC Inputs

The forty configurable DC inputs can be used as positive or negative logic standard inputs. When used as standard inputs, they are compatible with a wide range of input devices, such as pushbuttons, limit switches, and electronic proximity switches.

The Micro PLC's +24 VDC supply can be used for input devices and to power the DC input circuits at about 8mA per input. The combination of input circuit current and external device current must not exceed 435mA.

Relay Outputs

The relay outputs can control many types of load devices such as motor starters, solenoids, and indicators. The switching capacity of each of these circuits is 2 amps. An external source of AC or DC power must be supplied to operate field devices.

Expansion Unit IC200UEX064 Specifications

Inputs	Forty 24 VDC positive or negative logic inputs
Outputs	Twenty-four normally open 2-Amp relay circuits
DC Power Specifications	
Range	19.2VDC to 30VDC
Hold-up	10mS at 19.2 VDC
Inrush Current	1 Amp maximum at 30VDC
Inrush Time	10mS for 1 Amp
Input Current	0.20 Amp typical at 24VDC
Input Power Supply Rating	5W
DC Input Specifications	
Rated Input Voltage	24 volts DC
Input Voltage Range	0 to 30 volts DC
Input Current at 24VDC	I1, I3, I5, I7: 8mA typical Other inputs: 4.8mA typical
Input Impedance	I1, I3, I5, I7: 2.7 Kohms Other inputs: 4.7 Kohms
Input Threshold Voltage	ON: 18VDC minimum, OFF: 5VDC maximum
Input Threshold Current	I1, I3, I5, I7: ON: 4.5mA maximum, OFF: 1.8mA minimum Other inputs: ON: 3.3mA maximum, OFF: 1.6mA maximum

Response Time (Input Lag)	I1, I3, I5, I7: 1.5ms maximum
	Other inputs: 2ms maximum
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups

Relay Output Specifications	
Operating Voltage	5 to 30 VDC or 5 to 250 VAC
Isolation	1500 V RMS between field side and logic side, 500 V RMS between groups
Leakage Current	15 mA at 240 VAC maximum
Maximum UL Pilot Duty Rating	2 amps at 24 VDC and 240 VAC
Maximum Resistive Load Rating	2 amps at 24 VDC and 240 VAC
Minimum Load	10 mA
Maximum Inrush	5 amps per half cycle
Response Time	ON: 15 ms maximum, OFF: 15 ms maximum
Contact Life: Mechanical	20 x 106 mechanical operations

Contact Life: Electrical Voltage 240VAC, 120VAC, 24VDC	Current: Resistive 2.0A	Current: Lamp and Solenoid 0.6A	Typical Operations 200,000

Wiring Diagram, IC200UEX064

Power for Relay Outputs: 5VDC to 30VDC or 5VAC to 250VAC

IC200UEX164
64 Point Micro PLC Expansion Unit, (40) 24VDC In, (24) Relay Out, 120/240VAC Power Supply

VersaMax Micro PLC Expansion Unit IC200UEX164 accepts forty DC inputs and provides twenty-four relay outputs. It uses 100VAC to 240VAC nominal input power.

DC Inputs

The forty configurable DC inputs can be used as positive or negative logic standard inputs. They are compatible with a wide range of input devices, such as pushbuttons, limit switches, and electronic proximity switches.

The Micro PLC's +24 VDC supply can be used for input devices and to power the DC input circuits at about 8mA per input. The combination of input circuit current and external device current must not exceed 435 mA.

Relay Outputs

The relay outputs can control many types of load devices such as motor starters, solenoids, and indicators. The switching capacity of each of these circuits is 2 amps. An external source of AC or DC power must be supplied to operate field devices.

Expansion Unit IC200UEX164 Specifications

Inputs	Forty 24VDC positive or negative logic inputs
Outputs	Twenty-four relay outputs
AC Power Specifications	
Range	100 -15% to 240 +10% VAC
Frequency	50 -5% to 60 +5% Hz
Hold-up	10ms at 85–100 VAC, 20ms at 100–265 VAC
Inrush Time	2ms for 40 Amp
Inrush Current	30 Amp maximum at 200VAC, 40 Amp maximum at 265VAC
Input Current	0.10 Amp typical at 100VAC, 0.20 Amp typical at 200VAC
Input Power Supply Rating	26 VA
DC Input Specifications	
Rated Input Voltage	24 volts DC
Input Voltage Range	0 to 30 volts DC
Input Current at 24VDC	I1, I3, I5, I7: 8mA typical Other inputs: 4.8mA typical
Input Impedance	I1, I3, I5, I7: 2.7 Kohms Other inputs: 4.7 Kohms
Input Threshold Voltage	ON: 18VDC minimum, OFF: 5VDC maximum
Input Threshold Current	I1, I3, I5, I7: ON 4.5mA maximum, OFF: 1.8mA minimum Other inputs: ON 3.3mA maximum, OFF: 1.6mA maximum

Response Time (Input Lag)	I1, I3, I5, I7: 1.5ms maximum
	Other inputs: 2ms maximum
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups

Relay Output Specifications			
Operating Voltage	5 to 30 VDC or 5 to 250 VAC		
Isolation	1500 V RMS between field side and logic side, 500 V RMS between groups		
Leakage Current	15 mA at 240 VAC maximum		
Maximum UL Pilot Duty Rating	2 amps at 24 VDC and 240 VAC		
Maximum Resistive Load Rating	2 amps at 24 VDC and 240 VAC		
Minimum Load	10 mA		
Maximum Inrush	5 amps per half cycle		
Response Time	ON: 15 ms maximum, OFF: 15 ms maximum		
Contact Life: Mechanical	20 x 106 mechanical operations		
Contact Life: Electrical Voltage 240VAC, 120VAC, 24VDC	Current: Resistive 2.0A	Current: Lamp and Solenoid 0.6A	Typical Operations 200,000

Wiring Diagram, IC200UEX164

Power for Relay Outputs: 5VDC to 30VDC or 5VAC to 250VAC

IC200UEX264
64 Point Micro PLC Expansion Unit, (24) 24VDC In,
(4) LCDC, (16) LCDC with ESCP,
(4) HCDC with ESCP Out, 24VDC Power Supply

VersaMax Micro PLC Expansion Unit IC200UEX264 accepts forty DC inputs and provides twenty-four transistor outputs. It uses 24VDC nominal input power.

DC Inputs

The forty configurable DC inputs can be used as positive or negative logic inputs. Inputs are compatible with a wide range of input devices, such as pushbuttons, limit switches, and electronic proximity switches. The +24 VDC supply can be used for input devices and to power the DC input circuits. The combination of input circuit current and external device current must not exceed 200 mA.

DC Outputs

Outputs 1 – 4 are standard LCDC source-type outputs. Outputs can be used to switch devices like valves, lamps or contactors.

Outputs 5 – 20 are low current (LCDC) source-type outputs with ESCP.

Outputs 21 – 24 are high current (HCDC) source-type outputs with ESCP.

Expansion Unit IC200UEX264 Specifications

Inputs	Forty 24VDC positive or negative logic inputs
Outputs	Twenty-four transistor outputs, 24 VDC.
DC Power Specifications	
Range	19.2VDC to 30VDC
Hold-up	10mS at 19.2 VDC
Inrush Current	1 Amp maximum at 30VDC
Inrush Time	10mS for 1 Amp
Input Current	0.20 Amp typical at 24VDC
Input Power Supply Rating	5W

DC Input Specifications	
Rated Input Voltage	24 volts DC
Input Voltage Range	0 to 30 volts DC
Input Current at 24VDC	I1, I3, I5, I7: 8mA typical Other inputs: 4.8mA typical
Input Impedance	I1, I3, I5, I7: 2.7 Kohms Other inputs: 4.7 Kohms
Input Threshold Voltage	ON: 18VDC minimum, OFF: 5VDC maximum
Input Threshold Current	I1, I3, I5, I7: ON 4.5mA maximum, OFF: 1.8mA minimum Other inputs: ON 3.3mA maximum, OFF: 1.6mA maximum
Response Time (Input Lag)	I1, I3, I5, I7: 1.5ms maximum Other inputs: 2ms maximum
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups
Output Specifications	
Voltage Range	12VDC/24VDC
External Power Supply	12/24VDC –10%, +20%
Maximum Load Current	0.5A per point (Q1 – Q4) at 24VDC at 100% ON duration 0.7A per point (Q5 – Q20) at 24VDC at 100% ON duration 1.0A per point (Q21 – Q24) at 24VDC at 100% ON duration
Minimum Switching Current	10mA
Maximum Inrush Current	Q1-Q4: 2A for 20ms, 1 pulse Q5-Q20: 4A for 20ms, 1 pulse Q21-Q24: 8A for 20ms, 1 pulse
Output Voltage Drop	0.3V maximum
OFF state leakage current	0.1mA maximum
Response Time (OFF-to-ON and ON-to-OFF)	Q1–Q4: 5µs maximum, 24 VDC Q5–Q20: 0.5ms maximum, 24VDC Q21–Q24: 0.5ms maximum, 24VDC
Isolation Voltage	1500V RMS between field side and logic side, 500V RMS between groups
Fuse	None, outputs 5–24 are ESCP protected
Undervoltage shutdown	Q5 – Q20: 5V minimum, 8V maximum
DC short circuit current	Q1 – Q4, Q21 – Q24: 5A typical Q5 - Q20: 0.7A minimum, 2A maximum
Peak short circuit current	Q5 - Q20: 4A maximum
Delay time of peak short circuit current	100 microseconds
Delay time of current limit	100 microseconds

Wiring Diagram, IC200UEX264
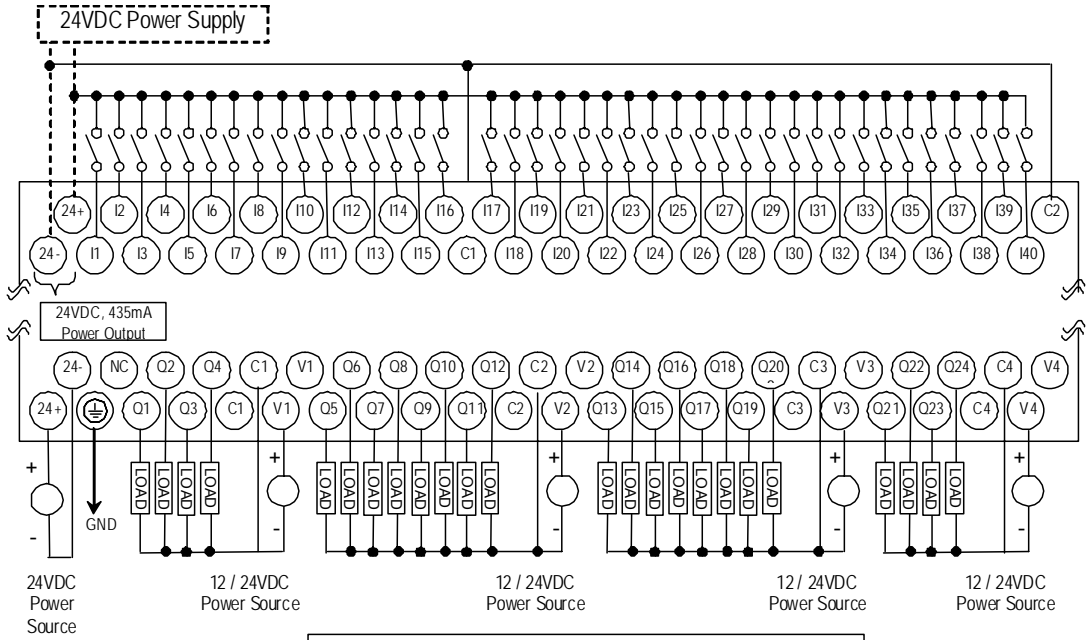
Requires no external fuses. The outputs 5 - 24 are ESCP-protected

IC200UEX364
64 Point Micro PLC Expansion Unit, (40) 24VDC In,
(24) LCDC Out, 24VDC Power Supply

VersaMax Micro PLC Expansion Unit IC200UEX364 accepts forty DC inputs and provides twenty-four low current (LCDC) transistor outputs. It uses 24VDC nominal input power.

DC Power

The 24VDC power source for the Expansion Unit must have enough transient current capability to support the inrush current of the power supply and to maintain a 24VDC voltage level (see power supply specifications for inrush requirements).

DC Inputs

Forty configurable DC inputs can be used as positive or negative logic standard inputs. They are compatible with a wide range of input devices, such as pushbuttons, limit switches, and electronic proximity switches.

The Micro PLC Expansion Unit's +24 VDC supply can be used for input devices and to power the DC input circuits at about 8mA per input. The combination of input circuit current and external device current must not exceed 435mA.

DC Outputs

The Micro PLC Expansion Unit IC200UEX364 has 24 sink-type DC outputs. All outputs are isolated between field and logic and are switching positive voltage. The outputs have one common incoming supply (VC) and one common ground (COM). The outputs are able to drive high inrush currents (8 times the rated current) and are protected against negative voltage pulses. This makes it possible to switch lamps and inductive loads.

Expansion Unit IC200UEX364 Specifications

Inputs	Forty 24 VDC positive or negative logic inputs
Outputs	Twenty-four transistor outputs, 24 VDC.
DC Power Specifications	
Range	19.2VDC to 30VDC
Hold-up	10mS at 19.2VDC
Inrush Current	1 Amp maximum at 30VDC
Inrush Time	10mS for 1 Amp
Input Current	0.20 Amp typical at 24VDC
Input Power Supply Rating	5W

DC Input Specifications	
Rated Input Voltage	24 volts DC
Input Voltage Range	0 to 30 volts DC
Input Current at 24VDC	I1, I3, I5, I7: 8mA typical Other inputs: 4.8mA typical
Input Impedance	I1, I3, I5, I7: 2.7 Kohms Other inputs: 4.7 Kohms
Input Threshold Voltage	ON: 18VDC minimum, OFF: 5VDC maximum
Input Threshold Current	I1, I3, I5, I7: ON 4.5mA maximum, OFF: 1.8mA minimum Other inputs: ON 3.3mA maximum, OFF: 1.6mA maximum
Response Time (Input Lag)	I1, I3, I5, I7: 1.5ms maximum Other inputs: 2ms maximum
Isolation Voltage	1500V RMS field side to logic side, 500V RMS between groups
Output Specifications	
Voltage Range	12VDC/24VDC
External Power Supply	12/24VDC –10%, +20%
Maximum Load Current	0.5A per point (Q1 – Q24) at 24VDC
Minimum Switching Current	10mA
Maximum Inrush Current	Q1-Q24: 2A for 20ms, 1 pulse
Output Voltage Drop	Q1– Q24: 0.3VDC
OFF state leakage current	0.1mA
Response Time (OFF-to-ON and ON-to-OFF)	1mS maximum @ 24VDC
Isolation Voltage	1500V RMS between field side and logic side, 500V RMS between groups
Fuses	None
Under-voltage shutdown	Q1 – Q24: 5V minimum, 8V maximum
DC short circuit current	Q1 – Q24: 0.7A minimum, 2A maximum

Wiring Diagram, IC200UEX364

24VDC Power Supply

24+	I2	I4	I6	I8	I10	I12	I14	I16	I17	I19	I21	I23	I25	I27	I29	I31	I33	I35	I37	I39	C2
24-	I1	I3	I5	I7	I9	I11	I13	I15	C1	I18	I20	I22	I24	I26	I28	I30	I32	I34	I36	I38	I40

24VDC, 435mA
Power Output

24-	NC	Q2	Q4	V1	C1	Q6	Q8	Q10	Q12	V2	C2	Q14	Q16	Q18	Q20	V3	C3	Q22	Q24	V4	C4
24+	GND	Q1	Q3	V1	C1	Q5	Q7	Q9	Q11	V2	C2	Q13	Q15	Q17	Q19	V3	C3	Q21	Q23	V4	C4

+
-
GND

24VDC
Power
Source

1.0A FUSE (×4)
LOAD

12 / 24VDC
Power Source

0.5A FUSE
LOAD

12 / 24VDC
Power Source

0.5A FUSE
LOAD

12 / 24VDC
Power Source

0.5A FUSE
LOAD

12 / 24VDC
Power Source

Chapter *12* Analog Expansion Units

This chapter describes the following VersaMax Micro PLC Analog Expansion Units:

- IC200UEX616   6 Point Analog Expansion Unit, (4) Analog In and (2) Analog Out, 12 VDC Power Supply

- IC200UEX624   4 Point Analog Expansion Unit, (4) Analog In, 24 VDC Power Supply

- IC200UEX626   6 Point Analog Expansion Unit, (4) Analog In and (2) Analog Out, 24 VDC Power Supply

- IC200UEX636   6 Point Analog Expansion Unit, (4) Analog In and (2) Analog Out, 100/240 VAC Power Supply

Features of Analog Expansion Units

Analog, Expansion Units have the features shown below. Expansion Units can be located up to 2 meters from the Micro PLC.

Input Terminals on Removable Terminal Strip

PWR

OK

Status LEDS

I/O Expansion Connector to Micro PLC or Previous Expansion Unit

I/O Expansion Connector to Next Expansion Unit

Cover for factory-set DIP switches

DIN Rail Release

Output Terminals on Removable Terminal Strip

Removable Terminal Strips

The removable terminal assemblies are protected by hinged covers. After turning off power to the Expansion Unit, a terminal assembly and attached field wiring can be separated from the Expansion Unit by removing two screws.

Expansion Connector

The connector on the left side of the Expansion Unit is used to connect to the Micro PLC or to the outgoing connector on the previous Expansion Unit. The connector on the right side of the Expansion Unit can be used to attach to the next Expansion Unit.

Status LEDs

LEDs on the Expansion Unit provide quick visual verification of operating status. Expansion Unit LEDs indicate local Power and OK mode.

Cables

A 0.1 meter ribbon cable (IC200CBL501) is provided with each Expansion Unit. Cables are also available in 0.5 meter (IC200CBL505) and 1 meter (IC200CBL510) lengths.

Analog Expansion Unit Specifications

Module Dimensions	Height: 90mm (3.6 inches), Depth: 76mm (3.0 inches) Width: 150mm (6.0 inches)
Inputs	4 analog inputs
Outputs	2 analog outputs (all models except UEX624)

Power Specifications for Analog Expansion Units

	IC200UEX616	IC200UEX624, UEX626	IC200UEX636
Power voltage	12VDC	24VDC	100/110/120/200/210/220V (50/60Hz) VAC
Range	9.6VDC - 15VDC	19.2VDC to 30VDC	85 to 264VAC
Hold-up	10.1ms at 9.6V	24.5ms at 19.2V	223ms at 85V
Inrush Current/Time	0.9A / 1ms at 15V	2.5V / 1ms at 30V	4A / 5ms at 264V
Input Current	0.15A at 15V	0.1A at 30V	0.06A at 264V
Input Power Supply Rating	2.25W	3W	15VA

The DC power source must have enough transient current capability to support the inrush current of the power supply and to maintain the nominal voltage level.

Input and Output Specifications

Analog Input Channels (IC200UEX6**)	4, differential
Input ranges	0 to 10V (10.23V maximum) -10V to +10V (-10.23V min. and +10.23V max.) 0 to 20mA (20.47mA maximum) 4 to 20mA (20.47mA maximum)
Resolution	12 bits
Accuracy	±1% of full scale over full operating temperature range
Linearity	±3 LSB maximum
Isolation	non-isolated
Common mode voltage	±40 V maximum
Current input impedance	249 Ohms
Voltage input impedance	200 kOhms
Input filter time	20ms to reach 1% error for step input
Analog Output Channels	2, single-ended, non isolated
Output ranges	0 to 10V (10.23V maximum) 0 to 20mA (20.47mA maximum) 4 to 20mA (20.47mA maximum)
Resolution	12 bits
Accuracy	±1% of full scale over operating temperature range
Current: maximum terminal voltage user load range output load capacitance output load inductance	10V (at 20mA output) 10 to 500 ohms 2000 pF maximum 1 Henry maximum
Voltage: output loading output load capacitance	10 kOhm minimum at 10 volts 1 µF maximum

Analog Operation

This section explains how a VersaMax Micro PLC Expansion Unit with analog channels processes analog data. Unlike discrete expansion units, if one analog unit fails all subsequent analog expansion units will stop communicating. However, expansion units before the failed unit continue to be available. If an analog expansion fails at power up, no expansion units (discrete or analog) will be functional.

Analog I/O Parameters

Each analog channel can be configured to operate in either voltage or current mode. If current mode operation is selected, the range can then be configured as either 4-20mA or 0-20mA. If voltage mode operation is selected (inputs only), the range can then be configured as either 0-10V or –10V to +10V.

Parameter	Choices	Default Value
Voltage or current mode	Voltage, Current	Voltage
Current range selection	4–20mA, 0–20mA	4–20mA
Voltage range selection (Inputs Only)	0-10V, -10-+10V	0-10V

Input/Output Values Compared to Process Data

The Expansion Unit processes analog channels using fixed conversion values for both current and voltage mode operation. The table below shows the relationship between the analog input and output values used by the application program, and the actual analog input or output for each mode. These values include the automatic adjustments for gain.

In this Configured Mode:	This is the Analog Signal Range	This is the Equivalent Process Data %AI or %AQ Range	For the Default Calibration, the Value in the %AI or %AQ Reference Equals:
Voltage 0 to +10V	0 to 10,000mV	0 to 32000	3.2 x mV
Voltage –10 to +10V (Inputs Only)	-10,000mv to +10,0000mV	-32000 to 32000	3.2 x mV
Current 0 to 20mA	0 to 20,000μA	0 to 32000	1.6 x μA
Current 4 to 20mA	4,000 to 20,000μA	0 to 32000	2 x μA –8000

Count Resolution for Analog Expansion Units

For analog expansion units, count resolution is controlled by a DIP switch 6, which is set to ON by default. If unexpected results are observed, check the position of switch 6. If switch 6 is not ON, power down the system and set switch 6 to ON. Do NOT change any of the other switches.

**Analog
Expansion Units**
Switch 6 set to ON
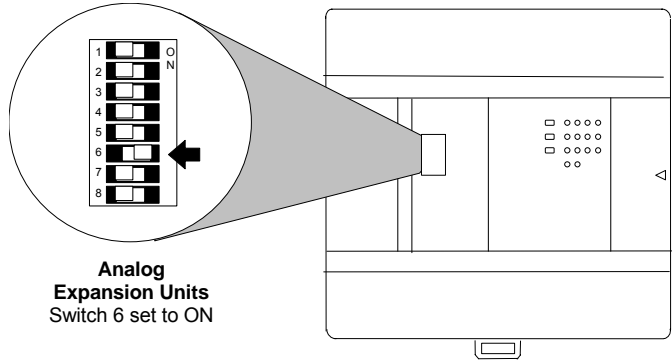
LED Indications

The module's LEDs indicate the status of the module and of the analog inputs.

	IN1	IN2	IN3	IN4
POW ◯	◯	◯	◯	◯
OK ◯				
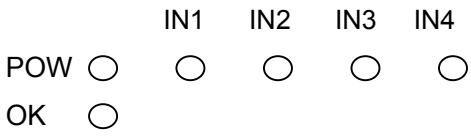
If an initialization error occurs, the OK LED blinks rapidly. During normal operation, the analog input LEDs should be off.

Analog Input Processing

The Expansion Unit processes analog input channels with a 12-bit successive-approximation A/D converter. It converts the analog value into a digital count, calculates the %AI value as described below, then places the result into the appropriate %AI input reference (these references are described in chapter 22).
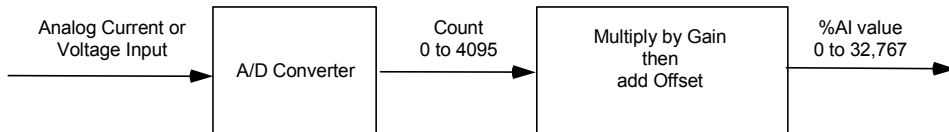
Automatic Conversion of Analog Voltage or Current to Counts

In voltage mode, the Expansion Unit first converts the 0 to 10,000mV input signal to a count in the range of 0 to 4,000 (or –10,000mV to 10,000mV signal to a range of –4,000 to 4,000). The fixed multiplier for this conversion is 2.5.

In current mode, the Expansion Unit first converts the 0 to 20,000µA input signal to a count value in the range of 0 to 4,000. The fixed multiplier for this conversion is 5. The conversion for both current modes (0-20mA and 4-20mA) is the same.

Automatic Gain and Offset Adjustment for Analog Inputs

The Expansion Unit then converts the A/D converter's input count value from the range of 0 to 4000 to a final %AI input value in the range of 0 to 32,000. It multiplies the count value by 8 (32000 / 4000) to get the final analog input ($AI):

$$(input\ count\ X\ 8) = \%AI\ value$$

Any calculated value above 32,767 is clamped at that maximum value. Any calculated value less than 0 is clamped at 0.

Analog Input Conversion Summary

The table below summarizes the conversion of voltage or current inputs to counts and then to %AI values.

Input Signal	Conversion Factor	A/D Converter VAlue	Gain Factor	%AI Range
Voltage Mode (0 to 10,000mV)	2.5	0–4000 counts	8	0–32,000
Voltage Mode (-10,000 to 10,000mV)	2.5	-4000 to 4000 counts	8	-32,000 to 32,000
Current Mode (0–20mA) or (4–20mA)	5	0–4000 counts	8	0–32,000

Analog Output Processing

To generate the analog output signal, the Expansion Unit converts the value in the %AQ output reference into a count value for the 12-bit D/A converter, which then drives the analog output.

Automatic Gain and Offset Adjustment for Analog Outputs

The application's %AQ output range of 0 to 32000 corresponds to the D/A converter's output count range of 0 to 4000. The Expansion Unit first multiplies the %AQ value from the program by .125 (4000 / 32000) to produce the count value for the D/A converter:

$$(\%AQ \ X \ .125) = D/A \ count$$

Any calculated value that exceeds 4095 (2^{12}-1) is clamped at that maximum value. Any calculated value less than 0 is clamped at 0. The range 0 to 4095 corresponds to %AQ values between 0 and 32,767.

Automatic Conversion of Counts to Analog Voltage or Current

In voltage mode, the D/A converter then converts the count value in the range of 0 to 4,000 counts to an analog signal from 0 to 10,000mV. The output voltage gain (ratio) for this conversion is 2.5.

In current mode, the D/A converter converts the count value to an analog signal from 0 to 20,000µA. The output current gain for this conversion is 5. The conversion for both current modes (0-20mA and 4-20mA) is the same.

Analog Output Data Conversion Summary

The table below summarizes the conversion of %AQ values to counts and then to voltage or current levels.

%AQ Range	Gain, Factor	D/A Converter Range	Conversion Factor	Output Signal
0– 32,000	0.125	0–4,000 counts	2.5	Voltage Mode (0–10,000mV)
0–32,000	0.125	0–4,000 counts	5	Current Mode (0–20mA) or (4–20mA)

Wiring Diagram

Connect jumpers in current mode

249Ω   249Ω   249Ω   249Ω

Power Supply:
UEX616: 12VDC
UEX624: 24VDC
UEX626: 24VDC
UEX636: 100/240VAC

GND

* UEX624 has no analog outputs

2 Voltage or Current Analog Outputs
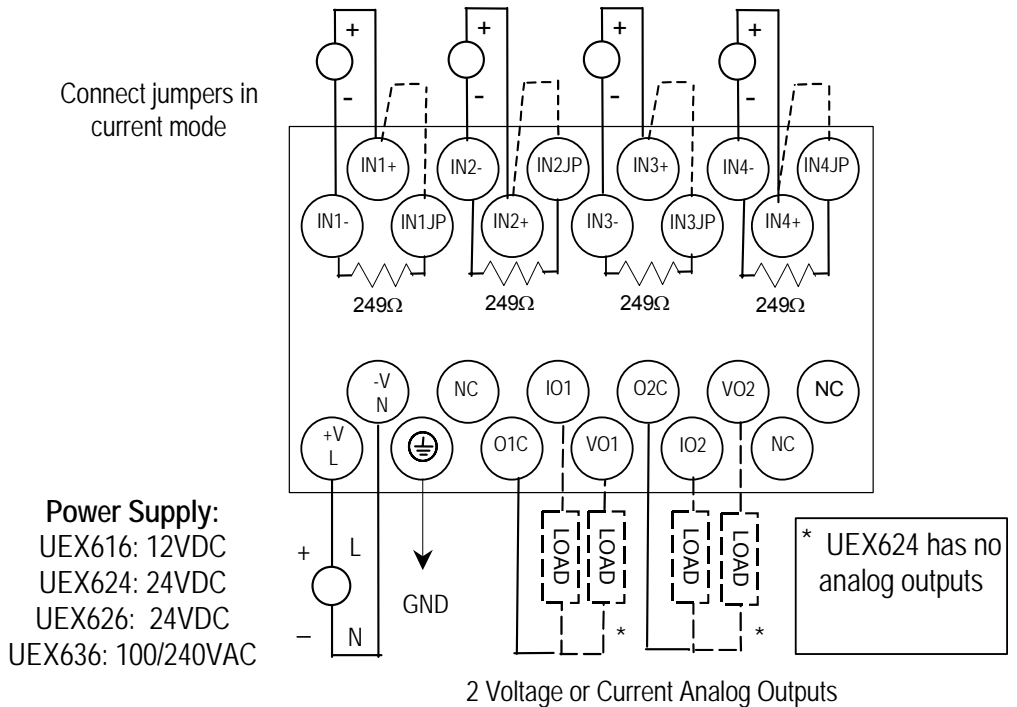
On modules IC200UEX616, UEX626 and UEX 636, voltage and current outputs are present on their respective output terminals at the same time. For proper module operation, only the output terminals that correspond to the voltage / current output configuration should be connected.

<table>
<tr><td>*Chapter*
13</td><td># *RTD and Thermocouple Expansion Units*</td></tr>
</table>

This chapter describes the following VersaMax Micro PLC RTD and Thermocouple Expansion Units:

▪ IC200UEX724	4 RTD, Pt 100 In, 24VDC Power Supply
▪ IC200UEX726	4 RTD, Pt 100 In and 2 Analog Out, 0 – 20mA, 4 – 20mA or 0 – 10VDC, 24VDC Power Supply
▪ IC200UEX734	4 RTD, Pt 100 In, 100/240VAC Power Supply
▪ IC200UEX736	4 RTD, Pt 100 In and 2 Analog Out, 0 – 20mA, 4 – 20mA or 0 – 10VDC, 100/240VAC Power Supply
▪ IC200UEX824	4 Thermocouple Inputs, 24VDC Power Supply
▪ IC200UEX826	4Thermocouple Inputs and 2 Analog Out, 0 – 20mA or 0 – 10VDC, 24VDC Power Supply

Description of RTD and Thermocouple Modules

RTD and Thermocouple Expansion Units have the features shown below. Expansion Units can be located up to 2 meters from the Micro PLC.

Input Terminals on Removable Terminal Strip

PWR

OK

Status LEDS

I/O Expansion Connector to Micro PLC or Previous Expansion Unit

I/O Expansion Connector to Next Expansion Unit

Cover for factory-set DIP switches

DIN Rail Release

Output Terminals on Removable Terminal Strip

Removable Terminal Strips

The removable terminal assemblies are protected by hinged covers. After turning off power to the Expansion Unit, a terminal assembly and attached field wiring can be separated from the Expansion Unit by removing two screws.

Expansion Connector

The connector on the left side of the Expansion Unit is used to connect to the Micro PLC or to the outgoing connector on the previous Expansion Unit. The connector on the right side of the Expansion Unit can be used to attach to the next Expansion Unit.

Status LEDs

LEDs on the Expansion Unit provide quick visual verification of operating status. Expansion Unit LEDs indicate local Power and OK mode.

The input channel LEDs should be OFF during proper operation.

Cables

A 0.1 meter ribbon cable (IC200CBL501) is provided with each Expansion Unit. Cables are also available in 0.5 meter (IC200CBL505) and 1 meter (IC200CBL510) lengths.

RTD Expansion Modules

VersaMax Micro PLC RTD Expansion Units are used for applications that require temperature monitoring and control. Four types are available:

- IC200UEX724   4 RTD, Pt 100 In, 24VDC Power Supply

- IC200UEX726   4 RTD, Pt 100 In and 2 Analog Out, 0 – 20mA, 4 – 20mA, or 0 – 10VDC, 24VDC Power Supply

- IC200UEX734   4 RTD, Pt 100 In, 100/240VAC Power Supply

- IC200UEX736   4 RTD, Pt 100 In and 2 Analog Out, 0 – 20mA, 4 – 20mA, or 0 – 10VDC, 100/240VAC Power

Typical applications include oven control, motor monitoring, refrigerant control, and environmental control. One VersaMax Micro PLC can monitor up to sixteen RTDs (four RTDs per expansion module, four expansion modules per Micro PLC).

Notes:

RTD Expansion Modules support DOIO for inputs and outputs.

If an RTD Expansion module is autoconfigured with DIP switch 3 OFF (Compatibility Mode), it reports its identity as a standard analog expansion module (IC200UEX616/626/636). This has no effect on module operation.

For Micro release 4.0 and later, if the RTD Expansion module is autoconfigured with DIP switch 3 ON (High-Accuracy Mode), it reports as IC200UEX726/736.

Compatibility

RTD Expansion Units are compatible with Micro PLCs having a firmware version of 2.01 or greater.

They are compatible with Logic Developer 2.60 or above and with VersaPro software 2.03 and above. Some compatible software versions do not list these modules separately, but allow them to be configured as analog expansion units. Current software versions list these modules by number and description.

RTD Module General Specifications

Module Dimensions	Height: 90mm (3.6 inches) Depth: 76mm (3.0 inches) Width: 150mm (6.0 inches)	
Inputs	4 RTD inputs	
Outputs	2 analog outputs (all models except UEX724 and UEX734)	
Power Supply Type	*DC Power Supply**	*AC Power Supply*
Power voltage	24VDC	100/110/120/200/210/220V (50/60Hz)
Range	19.2VDC to 30VDC	85 to 264VAC
Allowable momentary power failure	10ms	85 to 100V: 10ms
		100 to 264V: 20ms
Operating ambient temperature	0 to 55 C (Storage ambient temperature –10 to 75 C)	
Operating ambient humidity	5 to 95 % RH (no condensation) (Storage ambient humidity 5 to 95 % RH (no condensation))	
Vibration resistance	Complies with JIS C 0911	
Noise resistance	▪ Noise voltage 1500 Vpp; Noise pulse width 100 ns, 1 micro sec ▪ Static noise: 3000 V at metal exposed area	
Insulation resistance	20 M ohm or more between the AC external terminal and case ground (PE) terminal (based on 500 V DC mega)	
Dielectric withstand voltage	500V DC	1500VAC
Grounding	Class D (100Ω) independent grounding	
Usage environment	No corrosive gases, no excessive dirt	
Structure	Attaches to an open wall	
Cooling	Natural air cooling	
Protection against electrical shock hazard	Class 1 equipment	
	Open equipment	

The DC power source must have enough transient current capability to support the inrush current of the power supply and to maintain the nominal voltage level.

RTD Module Input Specifications

	Compatible	*High Accuracy*
RTD Input Channels	4, differential	
Input Sensor Types	2- and 3-wire types, PT 100	
Input ranges	-100.0 to +600.0°C -150.0 to +1050.0°F	-100.0 to +600.0°C -148 to +1112.0°F
Input Resolution	0.2C / 0.3°F	0.1C / 0.1°F
Accuracy	±0.5% of full scale over operating temperature range	
Data Format	0 to 32000 for °F, or 0 to 28000 for °C	
Constant Current	Approximately 1mA	
Channel Update Time	141/563ms (selectable) for all channels	
Diagnostics	LED on module blinks when input values at – 100°C (-150°F) or less, or 600°C (+1050°F) or more (includes cable disconnection) Also, the channel input data will contain 7FF8H	LED on module blinks when input values at – 110°C (-166°F) or less, or 610°C (+1130°F) or more (includes cable disconnection) Also, the channel input data will contain 7FFFH
Digital Resolution	15 bits + sign	
Open Circuit Detection Time	141ms or 563ms, excluding logic execution	
Channel to Channel Isolation	None	
Maximum Lead Resistance	100Ω	
Converter Type	Successive approximation	
Excitation	Current Source 1.0mA	

RTD Module Output Specifications

Only modules IC200UEX 726 and UEX736 have outputs.

Analog Output Channels	2, single-ended, non isolated
Output ranges	0 to 10V (10.23V maximum) 0 to 20mA (20.47mA maximum) 4 to 20mA (20.47mA maximum)
Resolution	12 bits
Accuracy	±1% of full scale over operating temperature range

Current: maximum terminal voltage
      user load range
      output load capacitance
      output load inductance
	10V (at 20mA output)
	10 to 500 ohms
	2000 pF maximum
	1 Henry maximum

Voltage: output loading output load capacitance	10 kOhm minimum at 10 volts 1 µF maximum
Response Time	8.8ms

Scaling

Scaling for RTD Inputs

An RTD Expansion Unit (in the Compatible mode) processes input channels with a 12-bit successive-approximation A/D converter. It converts the input value into a digital count, calculates the %AI value as described below, then places the result into the appropriate %AI input reference (these references are described in chapter 22).
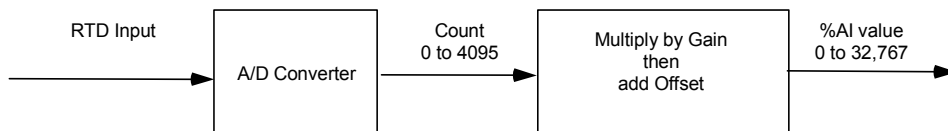
The table below lists equivalent decimal and hexadecimal conversion values for Celsius and Fahrenheit inputs.

Input Signal	A/D Converter Value	Gain Factor	%AI Range
Celsius Mode (-100 to 600)	0 – 3500 counts	8	0 - 28000
Fahrenheit Mode (-150 F to 1050 F)	0 – 4000 counts	8	0 - 32000

Scaling for Analog Outputs

To generate the analog output signal, the RTD Expansion Unit converts the value in the %AQ output reference into a count value for the 12-bit D/A converter, which then drives the analog output.
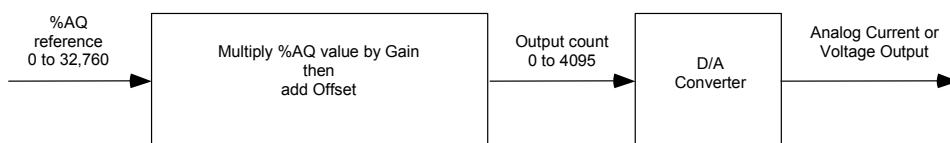
Automatic Gain and Offset Adjustment for Analog Outputs

If DIP switch 6 is in the ON position (default) the D/A Converter's output range is 4,000 counts. If this DIP switch is set to the OFF position, the output range is 4,096 counts.

The application's %AQ output range of 0 to 32000 corresponds to the D/A converter's output count range. The Expansion Unit first multiplies the %AQ value from the program by (output range / 32000) to produce the count value for the D/A Converter:

Compatible resolution mode: $(\%AQ \times \frac{4000}{32000}) = (\%AQ \times 0.125) = D/A\ count$

Maximum resolution mode: $(\%AQ \times \frac{4096}{32000}) = (\%AQ \times X\ 0.128) = D/A\ count$

Any calculated value that exceeds 4095 (2^{12}-1) is clamped at that maximum value. Any calculated value less than 0 is clamped at 0. The range 0 to 4095 corresponds to %AQ values between 0 and 32,760.

Automatic Conversion of Counts to Analog Voltage or Current

In voltage mode, the D/A Converter converts the count value in the range of 0–4,000 or 0–4,096 counts to an analog signal from 0 to 10,000mV. The output voltage gain (ratio) for this conversion is 2.5.

In compatible resolution mode (D/A Converter range is 0–4,000), loading a count value of 32760 results in an analog output value of 10.23V.

In maximum resolution mode (D/A Converter range is 0–4,096), loading a count value of 32760 results in an analog output value of 10.00V

In current mode, the D/A converter converts the count value to an analog signal from 0 to 20,000µA. The output current gain for this conversion is 5. The conversion for both current modes (0-20mA and 4-20mA) is the same.

Range	*0000*	*2000* *H07D0*	*4000* *H0FA0*	*4095* *H0FFF*
0-10V	0V	5V	10V	10.23V
0-20mA	0mA	10mA	20mA	20.47mA
4-20mA	4mA	12mA	20mA	20.38mA

Wiring for RTD Expansion Modules

Three-wire RTD
Connection

For two-wire RTD
connection, add a
jumper from B to b

Power Supply:
UEX724 / UEX726: 24VDC
UEX734 / UEX736: 100/240VAC

GND

2 Voltage or Current
Analog Outputs
(Models IC200UEX726
and UEX736 Only)
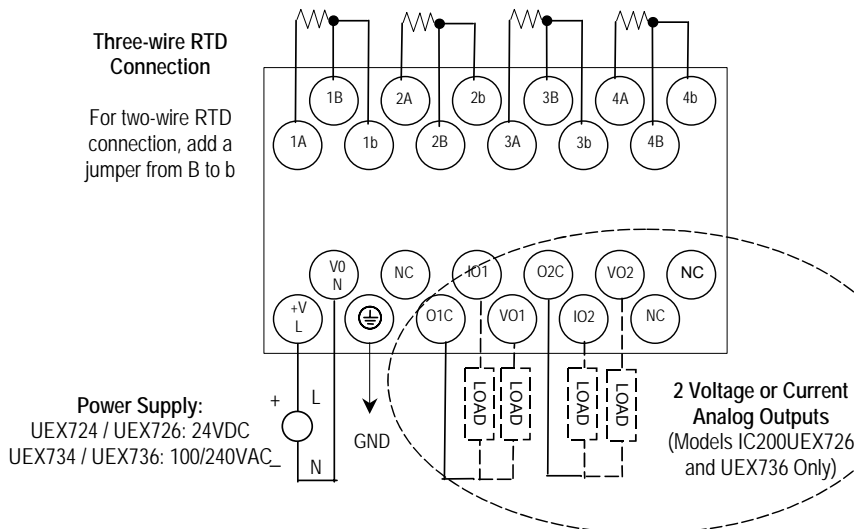
On modules IC200UEX726 and UEX736, voltage and current outputs are present on their respective output terminals at the same time. For proper module operation, only the output terminals that correspond to the voltage / current output configuration should be connected.

Module Installation

1. To avoid risk of electric shock, turn off power to the Micro PLC and disconnect the main power before connecting the RTD expansion modules.

2. Loosen the screws on the terminal block and attach unit power, RTD wires and analog outputs. Tighten all screws securely. The RTD wires should be the same type and length (except for the jumper used in a two-wire RTD) to ensure accuracy. Do not use the shield or drain wire for the third connection.

3. If all RTD channels are not used, a 100 to 300 Ohm resistor can be connected across terminal A to B with a jumper connected from B to b. The resistor will disable the diagnostics and stop the channel LED from flashing.

4. Connect the expansion cable to the Micro PLC or expansion unit to the left of the RTD Expansion Unit.

5. Turn power on. Check the LEDs as shown on the next page. The Power and OK LEDs should be ON. The LEDs for channels 1 to 4 should be OFF during normal operation if the RTDs are connected properly.

DIP Switches

The default DIP switch settings for the RTD units are switches 1-5 and 7-8 OFF and switch 6 ON.

For RTD expansion units, DIP switch 2 selects the RTD channels update rate. In the factory default OFF position, switch 2 selects a 562ms update rate. The update rate can be changed to 141ms by moving switch 2 to the ON position.

From Release 4.0 and above, DIP Switch 3 can be used to select between Compatible (Switch 3 OFF) and High Accuracy (Switch 3 ON) modes. In the PME configuration of RTD module, selection for "Conversion mode" parameter should match this DIP switch selection.

Default DIP Switch Settings for RTD Expansion Module
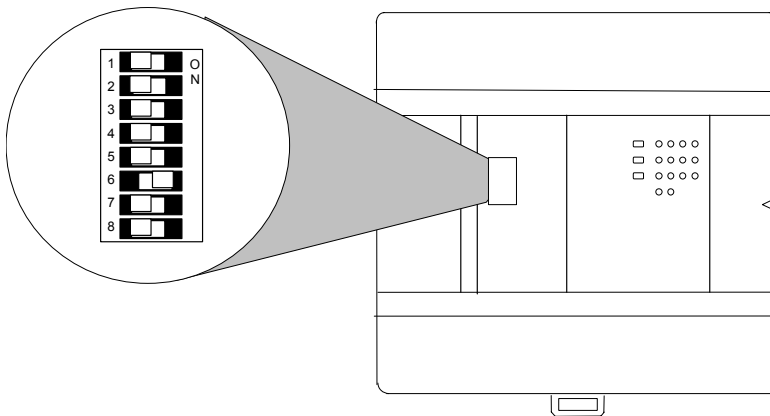
Notes: Do NOT change the settings of any of the other DIP switches.

The module must be powered OFF before changing the DIP switch settings.

LED Indications

The module's LEDs indicate the status of the module and of the RTD inputs.

```
            RTD1  RTD 2  RTD 3  RTD 4

POW  ○        ○      ○      ○      ○

OK   ○
```
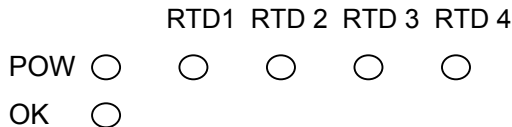
If an initialization error occurs, the OK LED blinks rapidly.

During normal operation, the RTD input LEDs should be off. If an RTD input is outside the range of -100C (-150F) to +600C (1050F), its LED blinks.

Data Conversion for RTD Expansion Units (in Compatible mode)

Individual channels on an RTD Expansion Units can be individually configured for either Celsius or Fahrenheit

If Celsius is configured, the range of data for a channel is 0 to 28,000.

If Fahrenheit is configured, the range of data for the channel is 0 to 32,000.

- Values below 0 indicate shorted cable.

- Values above 28,000 (when configured for Celsius) or 32,000 (when configured for Fahrenheit) indicate disconnected (open) or shorted cable.

Basic Temperature Conversion Logic

The Scaling function (see chapter 23) can be use in the application program to convert the raw counts value for a channel to a temperature measurement in degrees. The ranges are -100 to +600 degrees C and -150 to +1050 degrees F. The example logic shown here applies to Compatible mode only.

```
21 |                 SCALE
   |                  INT
   |                         +72
   | 32000 —|IHI  OUT|— %R00120
   |     0 —|ILO
   |  1050 —|OHI
   |  -150 —|OLO
   | +5936
   | %AI0023 —|IN

22 |                 SCALE
   |                  INT
   |                         +22
   | 28000 —|IHI  OUT|— %R00121
   |     0 —|ILO
   |   600 —|OHI
   |  -100 —|OLO
   | +4904
   | %AI0022 —|IN
```
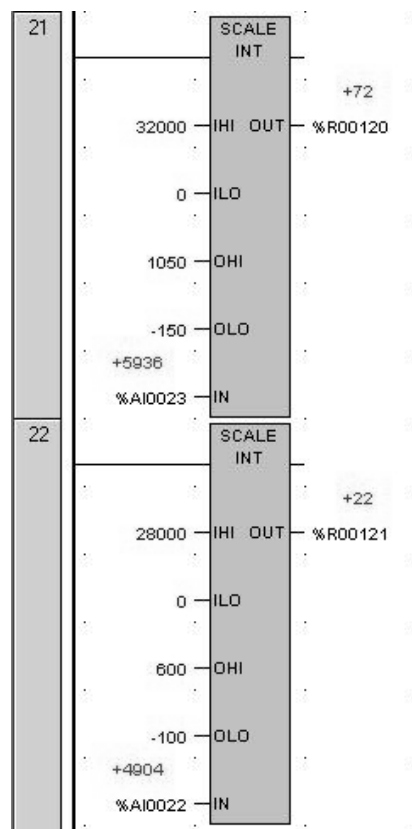
High-Resolution Temperature Conversion Logic for RTD Units

For accuracy in tenths of degrees, the Data Type Conversion functions (see chapter 23) can be added to the program logic. See the examples (for the Compatible mode) below.

Celsius Conversion

Line 15: Converts RTD to Real Value. Data will be stored in two consecutive Registers 100 and 101

Line 16: Divides the raw value by 40.0 (28000/700) 700 comes from the full temperature range of 600 to –100 C. Result is placed in R102 and R103

Line 17: Subtracts 100 for conversion. This is to offset the –100 and the result is in R104 and R105

Fahrenheit Conversion

Line 18: Converts RTD to Real Value. Data will be stored in two consecutive Registers 110 and 111

Line 19: Divides the raw value by 26.66667 (32,000/1200) 1200 comes from the full temperature range of 1050 to –150 F. Result is placed in R112 and R113

Line 20: Subtracts 150 for conversion. This is to offset the –150 and the result is in R114 and R115

```
15                    INT TO
                      REAL
       +4896                      4896.0
       %AI0022 —IN        Q— %R00100

16                    DIV
                      REAL
       4896.0                     122.4
       %R00100 —IN1       Q— %R00102

         40.0 —IN2

17                    SUB
                      REAL
       122.4                      22.4
       %R00102 —IN1       Q— %R00104

        100.0 —IN2

18                    INT TO
                      REAL
       +5920                      5920.0
       %AI0023 —IN        Q— %R00110

19                    DIV
                      REAL
       5920.0                     222.0
       %R00110 —IN1       Q— %R00112

     26.66667 —IN2

20                    SUB
                      REAL
       222.0                      72.0
       %R00112 —IN1       Q— %R00114

        150.0 —IN2
```

Thermocouple Expansion Modules

VersaMax Micro PLC Thermocouple Expansion modules are used for applications such as food and beverage production, process control, and environmental control. The following types of Thermocouple expansion module are available:

- IC200UEX824   4 Thermocouple Inputs, 24VDC Power Supply

- IC200UEX826   4Thermocouple Inputs and 2 Analog Outputs, 24VDC Power Supply

One VersaMax Micro PLC can monitor up to sixteen thermocouples (four thermocouples per expansion module, four expansion modules per Micro PLC).

Notes:

Thermocouple Expansion modules support DOIO for inputs and outputs.

If a Thermocouple Expansion module is autoconfigured with DIP switch 6 OFF (Compatibility Mode), it reports its identity as a standard analog expansion module (IC200UEX616/626/636). This has no effect on module operation.

For Micro release 4.0 and later, if the Thermocouple Expansion module is autoconfigured with DIP switch 6 ON (High-Accuracy Mode), it reports as IC200UEX826.

Compatibility

Thermocouple Expansion modules are compatible with:

- VersaMax Micro-20, -40, and -60 CPUs version 3.81 or later.

- VersaMax Micro-23 and –28 CPUs version 3.55 or later.

- VersaMax Micro-14 CPUs version 3.56 or later.

They are configurable using Logic Developer 5.70 and above. Some compatible software versions do not list these modules separately, but allow them to be configured as RTD expansion units, as described later in this section.

Thermocouple Module General Specifications

Module Dimensions	Height: 90mm (3.6 inches) Depth: 76mm (3.0 inches) Width: 150mm (6.0 inches)
Inputs	4 Thermocouple inputs
Outputs	Model IC200UEX826 only: 2 analog outputs
Power voltage	24VDC
Range	19.2VDC to 30VDC
Inrush Current/Time	2.5A / 1ms at 30V
Input Current	0.1A at 30V
Input Power Supply Rating	3W
Allowable momentary power failure	10ms
Operating ambient temperature	0 to 55 deg C (Storage ambient temperature –10 to 75 °C)
Operating ambient humidity	5 to 95 % RH (no condensation) (Storage ambient humidity 5 to 95 % RH (no condensation))
Vibration resistance	Complies with JIS C 0911
Noise resistance	▪ Noise voltage 1500 Vpp Noise pulse width 100 ns, 1 μs ▪ Static noise: 3000 V at metal exposed area
Insulation resistance	20 M Ohm or more between the AC external terminal and case ground (PE) terminal
Dielectric withstand voltage	500V DC
Grounding	Class D (100Ω) independent grounding
Usage environment	No corrosive gases, no excessive dirt
Structure	Attaches to an open panel
Cooling	Natural air cooling
Protection against electrical shock hazard	Class 1 equipment
	Open equipment

Analog Output Specifications (Model IC200UEX826)

Analog Output Channels	2, single
Output Ranges	0-10 V (10.24 V maximum), 0-20 mA (20.48 mA maximum)
Resolution	0-10 V, 12 bits, 0-20 mA, 12 bits
Accuracy	+/-1% of full scale over temperature range
Current Outputs	Max. Voltage at 20 mA: 10 V User Load Range: 10 to 500 Ohms Output Load Capacitance: 2000 pF Maximum Output Load Inductance: 1 Henry Maximum
Voltage Outputs	Output Loading: 10 k OHM Minimum at 10 V Output Load Inductance: 1 micro F Maximum
Response time	8.8 ms

Thermocouple Module Input Specifications

Input Channels	4, differential		
Sensor type	Following JIS C 1602-1995 Type K, J, E, S, T, B, N, -/+50mV, -/+100mV		
	Type	*Accuracy range **	*Input range **
Temperature range and accuracy (+/-%) at 0 to 55C	K	-200 to 1200°C (-328 to 2192F) 0.4%(FS)	-270 to 1370°C (-454 to 2498°F)
	J	-40 to 750°C (-40 to 1382°F) 0.3%(FS)	-210 to 1200°C (-316 to 2192°F)
	E	-200 to 900°C (-328 to 1652°F) 0.3%(FS)	-270 to 1000°C (-454 to 1832°F)
	S	0 to 1600°C (32 to 2912°F) 1.0%(FS)	-50 to 1760°C (-58 to 3200°F)
	T	-200 to 350C (-328 to 662F) 0.8%(FS)	-270 to 400°C (-454 to 752°F)
	B	600 to 1700°C (1112 to 3092°F) 1.0%(FS)	0 to 1820°C (32 to 3308°F)
	N	-200 to 1200°C (-328 to 2192°F) 0.4%(FS)	-270 to 1300°C (-454 to 2372°F)
	±50mV	-50 to 50mV 0.5%(FS)	-50 to 50mV
	±100mV	-100 to 100mV 0.5%(FS)	-100 to 100mV
TC mode		*High Accuracy Mode*	*Compatible Mode*
Resolution	K,J,E,T,N	0.1°C/0.2°F	0.5C/1°F
	B,S	1.0°C/1.0°F	1.0°C/1°F
	±50mV	0.01mV	0.025mV
	±100mV	0.02mV	0.05mV
Units of data output		0.1°C/0.1°F 0.01mV	0.5°C/1°F 0.025mV, 0.05mV
Conversion data	15 bits + sign		
Cold junction compensation accuracy	Less than +/-2°C (ambient temperature is 0 to 55°C)		
Cold junction input range	-20 to 80C		
Diagnostics (Broken Wire/Under or Over range reporting)		LED indication (per channel) Channel input data is 7FFF hexadecimal	LED indication (per channel) Channel input data is 7FF8 hexadecimal
Conversion time	K, J, E, T, N, B, S	563ms (4ch. total)	
	±50, 100mV	141ms (4ch. total)	

*   Accuracy Range represents measurements within which operation of the module is guaranteed. The Input Range represents an extended range for which operation cannot always be guaranteed.

Scaling for Thermocouple Module Data

Scaling for Inputs

A Thermocouple Expansion Unit (in the Compatibility mode) processes input channels with a 12-bit successive-approximation A/D converter. It converts the input value into a digital count, calculates the %AI value as described below, then places the result into the appropriate %AI input reference (these references are described in chapter 22).

| Thermocouple Input | A/D Converter | Count 0 to 4095 | Multiply by Gain then add Offset | %AI value 0 to 32,760 |
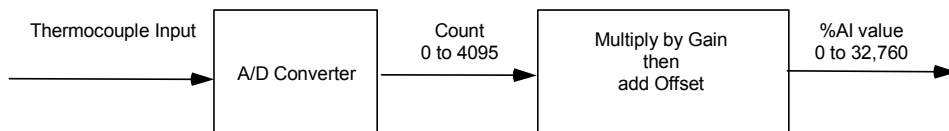
The table below lists equivalent decimal and hexadecimal conversion values for Celsius and Fahrenheit inputs.

Input Signal	A/D Converter Counts Value	Gain Factor	%AI Range
Celsius mode (-249.5 to 1760)	1 – 4020 counts	8	8 - 32160
Fahrenheit mode (-499F to 3308F)	1 – 3808 counts	8	8 - 30464
Voltage mode (+/-50mV)	48 – 4048 counts	8	384 – 32384
Voltage mode (+/-100mV)	48 – 4048 counts	8	384 - 32384

Scaling for Analog Outputs (Model IC200UEX826)

To generate the analog output signal, the Thermocouple Expansion Unit converts the value in the %AQ output reference into a count value for the 12-bit D/A converter, which then drives the analog output.
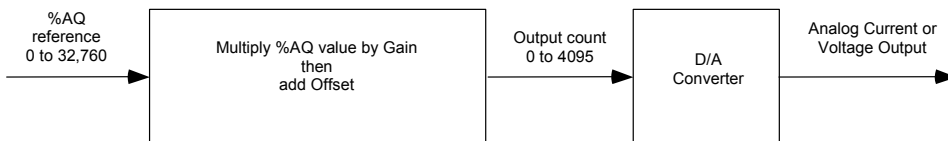
Automatic Gain and Offset Adjustment for Analog Outputs

The application's %AQ output range of 0 to 32000 corresponds to the D/A converter's output count range of 0 to 4000. The Expansion Unit first multiplies the %AQ value from the program by .125 (4000 / 32000) to produce the count value for the D/A converter:

$$(\%AQ \times 0.125) = D/A\ count$$

Any calculated value that exceeds 4095 (2^{12}-1) is clamped at that maximum value. Any calculated value less than 0 is clamped at 0. The range 0 to 4095 corresponds to %AQ values between 0 and 32,760.

Automatic Conversion of Counts to Analog Voltage or Current

In voltage mode, the D/A converter then converts the count value in the range of 0 to 4,000 counts to an analog signal from 0 to 10,000mV. The output voltage gain (ratio) for this conversion is 2.5.

In current mode, the D/A converter converts the count value to an analog signal from 0 to 20,000µA. The output current gain for this conversion is 5.

Range	*0000*	*2000* *H07D0*	*4000* *H0FA0*	*4095* *H0FFF*
0-10V	0V	5V	10V	10.24V
0-20mA	0mA	10mA	20mA	20.48mA

Thermocouple Module Configuration

Micro firmware versions 4.0 and above provide complete support to Thermocouple modules including the High-Accuracy mode. Also PME versions 6.0 SIM1 and above completely support the Thermocouple modules (i.e. no workaround with RTD modules needed for thermocouple configuration). Each channel of a Thermocouple Expansion Unit can be individually configured for Sensor selection, Mode (Celsius or Fahrenheit) and Cold Junction Compensation (Enable or Disable)

The following description of this section is applicable only for CPU and PME versions prior to that of the above mentioned.

With Logic Developer (PME) 5.70 and above, Thermocouple module can easily be configured by selecting the corresponding RTD module in the Module window.

Thermocouple Module	Corresponding RTD Module
IC200UEX824	IC200UEX724
IC200UEX826	IC200UEX726

The Input Channel Mode for each of the Thermocouple channels can be configured as Celsius or Fahrenheit.

For IC200UEX826, the Output Channel Mode parameter can be used to configure the Voltage/Current values of a Thermocouple module.

- If the selection is Voltage, the Output Channel Range is not available.

- If the selection is Current, the Output Channel Range MUST be 0 to 20 mA.

Analog I/O Settings	Wiring
Parameters	**Values**
Length:	4
Input Channel 1 Mode:	Celsius
Input Channel 1 Range:	-100C, +600C
Input Channel 2 Mode:	Celsius
Input Channel 2 Range:	-100C, +600C
Input Channel 3 Mode:	Celsius
Input Channel 3 Range:	-100C, +600C
Input Channel 4 Mode:	Fahrenheit
Input Channel 4 Range:	-150F, +1050F
Reference Address:	%AQ0015
Length:	2
Output Channel 1 Mode:	Voltage
Output Channel 1 Range:	N/A
Output Channel 2 Mode:	Current
Output Channel 2 Range:	0,20 mA

Also, for versions earlier than 4.0, the Cold Junction Compensation is always enabled by default and cannot be disabled either through PME or through DIP switch settings.

Wiring for Thermocouple Expansion Modules

Thermocouple Sensors: -200C to +1700C

Non-polarity   Ch1   Ch2   Ch3   Ch4   Cold
Junction

| NC | NC | IN1+ | IN2+ | IN3+ | IN4+ |

| CJ- | CJ+ | IN1- | IN2- | IN3- | IN4- |

| 0V | NC | NC | IO1 | OC2 | VO2 |

| 24V | ⏚ | NC | OC1 | VO1 | IO2 |

GND

Example Voltage Output

L O A D

Example Current Output

L O A D

Power
Supply: 24V   Ch 1   Ch 2   Two voltage or current outputs
(model IC200UEX826 only)
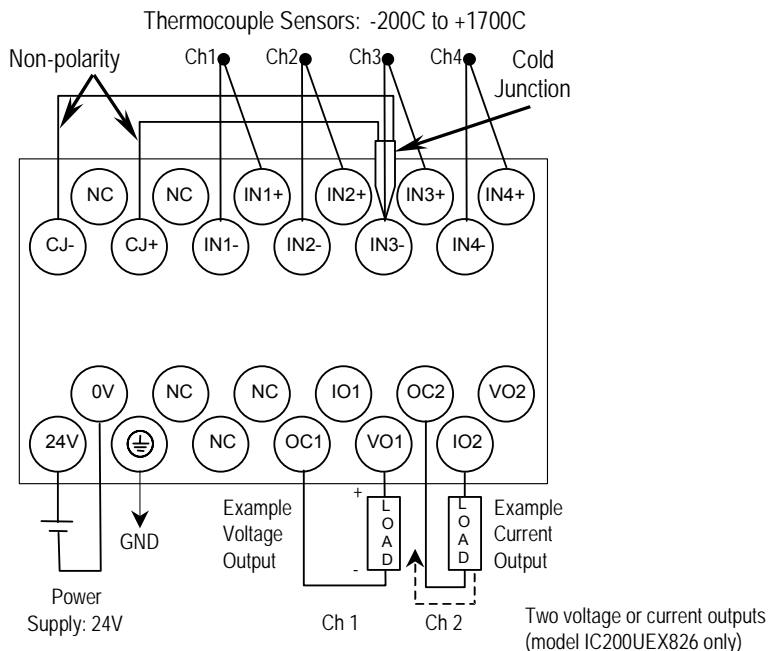
On module IC200UEX826, voltage and current outputs are present on their respective output terminals at the same time. For proper module operation, only the output terminals that correspond to the voltage / current output configuration should be connected.

Module Installation

1. To avoid risk of electric shock, turn off power to the Micro PLC and disconnect the main power before connecting Thermocouple expansion modules.

2. Connect the expansion cable to the Micro PLC or expansion unit to the left of the Thermocouple Expansion Unit.

3. Check the DIP switch settings as shown on the next page.

4. Turn power on. Check the LEDs as shown on the next page. The Power and OK LEDs should be ON. The LEDs for channels 1 to 4 should be OFF during normal operation if the thermocouple inputs are connected properly.

5. Connect the Cold Junction sensor. If that is not done, all four module LEDs flash continuously.

DIP Switch Settings

Micro firmware versions 4.0 and above provide complete support to Thermocouple modules including the High-Accuracy mode. DIP Switch 6 can be used to select between Compatible (Switch6 OFF) and High Accuracy (Switch 6 ON) modes. In the PME configuration of Thermocouple module, selection for "Conversion mode" parameter should match this DIP switch selection. As PME versions 6.0 SIM1 and above completely support the Thermocouple modules, (when the Micro firmware version is 4.0 and above) Sensor/ mV selection should be done using PME instead of through DIP Switches as PME settings always override the DIP switch settings. *Hence the following description applies only to the CPU and PME versions prior to that of the above mentioned.*

The sensor selection for all input channels can be configured ONLY using DIP switches 1 to 3, it cannot be done using Logic Developer. If DIP switches 1-3 are set for mV selection (all On), the settings take precedence over the Logic Developer configuration of Input Channel Mode and Range. The module must be powered OFF before changing the DIP switch settings.

Switch	Default	Function	K	J	E	S	T	B	N	mV
1	off	Input Sensor selection (Ch1-4)	off	on	off	on	off	on	off	on
2	off		off	off	on	on	off	off	on	on
3	off		off	off	off	off	on	on	on	on
4	off	mV selection (Valid when DIP Switches 1,2,3 are all On.)	Off => 50mV				On => 100mV			

Do NOT change settings of any of the other DIP switches. The default setting for all other DIP switches is Off.

For Thermocouple units, setting switch 6 to On causes a System Configuration Mismatch fault in the PLC Fault Table. For these modules, autoconfiguration with specified switch On will flash error code 12-2 on the CPU's OK LED. If this error occurs, the CPU OK LED will repeatedly follow the sequence:

- Blink 12 times

- Go Off (short)

- Blink 2 times

- Go Off (long pause)

To restore normal functionality, turn off power to the PLC and expansion units and set the DIP switch to Off. Turn On power to the PLC and expansion units again.

LED Indications

The module's LEDs indicate the status of the module and the inputs.

                    TC 1   TC 2   TC 3   TC 4

POW ◯   ◯   ◯   ◯   ◯

OK   ◯
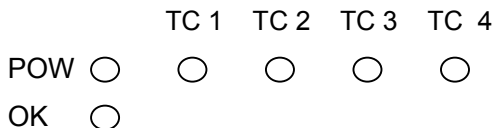
1. If an initialization error occurs, the OK LED blinks rapidly.

2. If an input signal is out of range or the cable is disconnected, its corresponding LED blinks every 1 second with almost equal On and Off time. In addition, in this case the channel input data contains the value 7FF8 (7FFF in High Accuracy mode).

3. If cold junction signal is out of range or the cable is disconnected, all four LEDs blink simultaneously every 1 second with a short on time and longer Off time.

During normal operation, the thermocouple input LEDs should be Off. If any of the four LEDs is On, it indicates a communication error with the PLC CPU.

If multiple errors occur, input signal errors (2 above) have priority over cold junction signal errors (3 above). For example:

Input signal for channel 2 is out of range, for channel 3 cable is disconnected and the cold junction compensation signal is out of range. In this case, LEDs 2 and 3 blink with almost equal On and Off time. LEDs 1 and 4 blink with shorter On time and longer Off time.

Basic Temperature Conversion Logic

The Scaling function (see chapter 23) can be use in the application program to convert the raw counts value for a channel to a temperature measurement in degrees. The example logic shown here applies to Compatible mode only.

```
1    ▣ Conversion Logic for Thermocouple input in Centigrade mode
⚡
                           SCALE
2                          INT

                                      24
              32160 — IHI   OUT — Cent_con
                                      %R00001

                  8 — ILO


               1760 — OHI


               -249 — OLO

               4384
        Therm_imput — IN
           %AI0020
```

```
3    ▣ Conversion Logic for Thermocouple input in Fahrenheit mode
⚡
                           SCALE
4                          INT

                                      78
              30464 — IHI   OUT — Fah_con_
                                      %R00002

                  8 — ILO


               3308 — OHI


               -499 — OLO

               4624
        Therm_imput — IN
           %AI0020
```
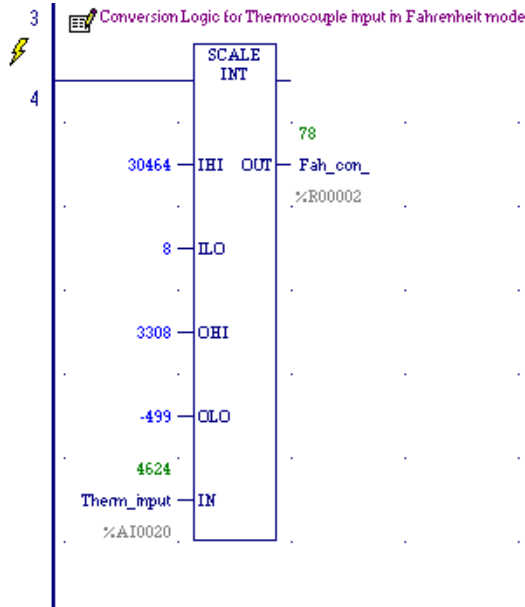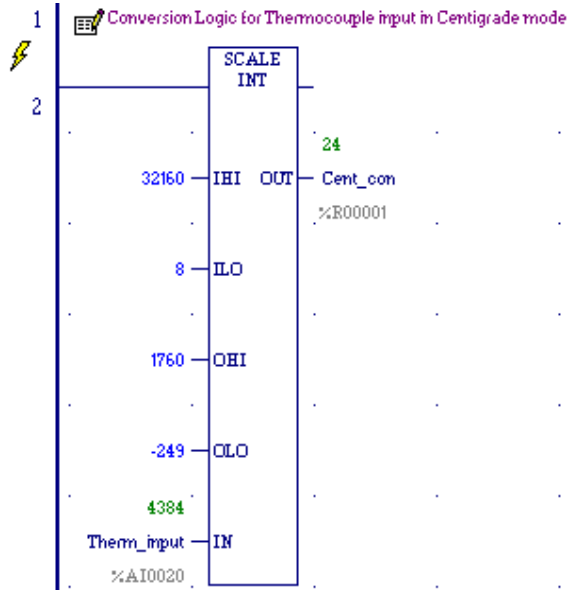
High-Resolution Temperature Conversion Logic for Thermocouple Units

For accuracy in tenths of degrees, the Data Type Conversion functions (see chapter 23) can be added to the program logic. See the examples (for the Compatible mode) below.

Celsius Conversion	
Line 6: Converts thermocouple input to Real Value. Data will be stored in two consecutive Registers 100 and 101	
Line 7: Divides the raw value by 16.0 ((32160-8)/ 2009.5).	
The value 2009.5 comes from the full temperature range of 1760 to –249.5 C. Result is placed in R102 and R103	
Line 8: Subtracts 250 for conversion. This is to offset the –250 and the result is in R104 and R105	
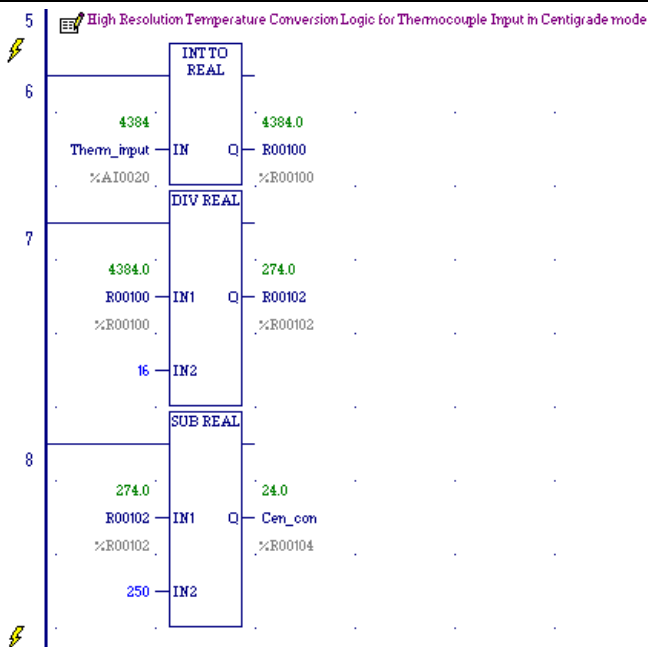
Fahrenheit Conversion

Line 10: Converts thermocouple input to Real Value. Data will be stored in two consecutive Registers 200 and 201

Line 11: Divides the raw value by 8 ((30464-8)/ (3807))

The value 3807 comes from the full temperature range of 3308 to –449 F. Result is placed in R202 and R203

Line 12: Subtracts 500 for conversion. This is to offset the –500 and the result is in R204 and R205

9 — High Resolution Temperature Conversion Logic for Thermocouple Input in Fahrenheit mode

```
              INT TO
              REAL
10
       4616               4616.0
  Therm_input — IN    Q — R00200
      %AI0020               %R00200

              DIV REAL
11
       4616.0              577.0
      R00200 — IN1   Q — R00202
      %R00200             %R00202

           8 — IN2

              SUB REAL
12
       577.0               77.0
      R00202 — IN1   Q — Fah_con
      %R00202             %R00204

         500 — IN2
```
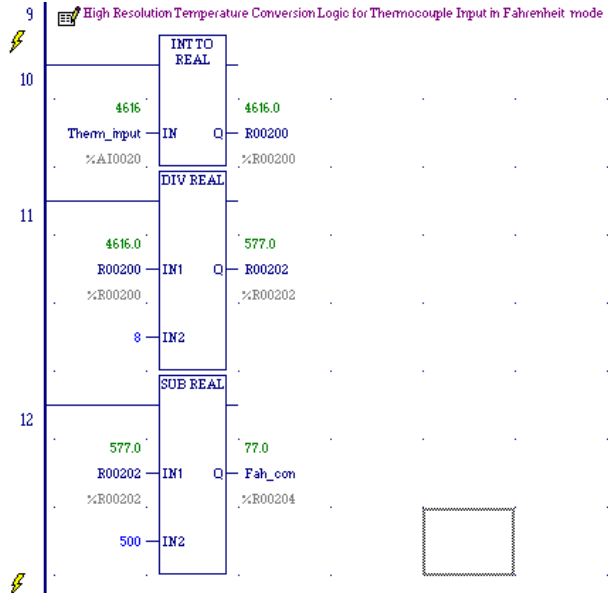
Chapter

14

CPU Option Modules

This chapter describes option modules for 20, 40 and 64-Point VersaMax Micro PLCs.

▪	IC200UMB001	Memory Pack Module
▪	IC200USB001	RS232, Extra Port Option Module
▪	IC200USB002	RS485, Extra Port Option Module
▪	IC200UUB001	USB/RS232 Conversion Option Module
▪	IC200UEM001	10/100 Mbit Ethernet Communications Module

Using Option Modules

Option Modules can be used to enhance the functionality of a 20, 40, or 64-Point VersaMax Micro PLC. These option modules install in the front of the Micro PLC. One Port module (UEM001, USB001, USB002, or UUB001), and/or a Memory Pack module (UMB001) can be installed.

Option modules, except the Memory Pack Module, are configured using the Machine Edition software. The Memory Pack Module does not require software configuration. If the configuration and installed option modules are different, the PLC logs a fault in the Fault Table (System Configuration Mismatch).

Note: If the configured module is RS232/USB and the physically connected module is Ethernet communication module (upon downloading configuration), a system configuration mismatch fault will *not* be logged. The converse is also true.

The VersaMax Micro PLC Memory Pack Module, IC200UMB001, can be used to store and update the configuration, application program, and reference table data of a 20, 40, or 64-Point Micro PLC.

The Memory Pack Module plugs directly into port 2 on the Micro PLC. Power for the device comes from port 2.

A programmer and PLC CPU are used to initially write data to the Memory Pack Module. In addition to writing data to the Memory Pack, the programmer can read data already stored on the Memory Pack and can compare that data with files already present in the programmer.

After the data is stored on the Memory Pack, the data can be copied to one or more other PLC CPUs of the same type, with no programmer needed. To do that, the Memory Pack Module is removed from the Micro PLC, and installed on another Micro PLC (Micro PLCs must be powered down to remove or install an option module). When the second Micro PLC is powered up, all of the data on the Memory Pack is written into the corresponding PLC reference addresses.

Features

- Store 128kB of data.

- Read the data at Power up.

- Read/Write/Verify the data through programmer command.

With the programmer present, the PLC CPU can read, write, or verify a program, configuration and tables in the Memory Pack Module. When reading or verifying data, it is possible to select hardware configuration, logic, and/or reference tables data. However, when writing data to the Memory Pack Module, all the data (logic, configuration and reference tables) must be written. Individual data types cannot be selected for writing.

Reading Data from the Memory Pack Module at Startup

If the Memory Pack Module is connected to the port 2 when the PLC is switched on, the PLC automatically reads all the data (program, configuration, and tables) in the Memory Pack Module. The Micro PLC stores the data in its RAM/FLASH and flash based on the options that have been set in the hardware configuration.

The OK LED keeps blinking while the data is being transferred from the Memory Pack Module to the PLC. Wait until the OK LED stops blinking to do any further operations.

Data Read, Write, Verify Operations Using the Programming Software

Read/Write/Verify operations can be done on the Memory Pack Module using the programming software. The PLC must be placed in Stop mode.

The path for write /read/ verify through programming software is:

Targets -> online commands -> Flash/EEPROM

The popup window for write/read/verify appears. Select the memory storage board option from the two choices (memory storage board or flash memory) to transfer data between the Memory Pack module and the CPU. Then select the write/read/verify operation. The programming software shows the status of the data transfer.

The Memory Pack Module and PLC must both have either no OEM key password or the same OEM key password for the data to be transferred. The Memory Pack Module does not perform special processing for other type of passwords.

Write Protect Switch
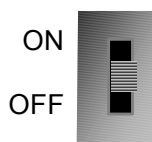
The Write Protect switch on the Memory Pack Module prevents writing data to the module when it is in the ON position.

> ### Caution
>
> **If the Write Protect switch is in ON position and the programming software tries to write data to the Memory Pack Module, the data is NOT written to the module. However, no error message is generated, and there is no indication that the data has not been written. This should be considered before setting the Write Protect switch.**

VersaMax Micro PLC Option Module IC200USB001 can be used with a 20, 40, or 64-Point Micro PLC to provide an extra RS232 Port and two analog inputs.
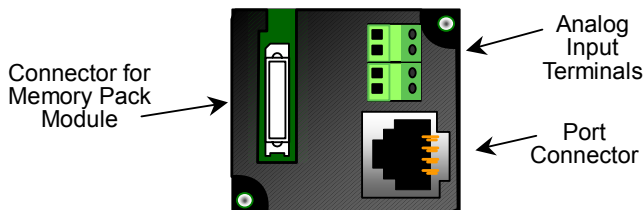
When installed on the Micro PLC, the RS232 Port Option Module becomes port 2. It supports the following communications protocols:

- Modbus Master/Slave
- Serial Read/Write
- SNP/SNPX Master/Slave

Use of the Port Option module as port 2, and the protocol selection must be set up in the configuration software. After making those selections, the communications parameters can also be configured.

Pin assignments for Port 2 are

8	SG	Signal Ground
7	VCC	5VDC Output
6	10V	10VDC Output
5	NC	-
4	SD	Sent Data
3	RD	Received Data
2	NC	-
1	RS	Request to Send

An external device can obtain power from the 5VDC output pin if it requires 200mA or less at 5VDC.

Analog Inputs

The terminals on the Port Option Module can be used for analog inputs with the following characteristics:

Input Ranges	0-10 V (10.24 V Max)
Resolution	0-10 V, 10 bits
Accuracy	+/-1%
Linearity	+/-3 LSB Maximum
Voltage Input Impedance	100KOhm
Isolation	Channel to channel: none CPU to analog signal: none
Analog Terminal Wiring	Solid wire: 0.14mm^2 to 1.5mm^2 Stranded wire: 0.14mm^2 to 0.10mm^2

VersaMax Micro PLC Option Module IC200USB002 can be used with a 20, 40, or 64-Point Micro PLC to provide an extra RS-422/485 Port and two analog inputs.

Connector for Memory Pack Module

Analog Input Terminals

Port Connector
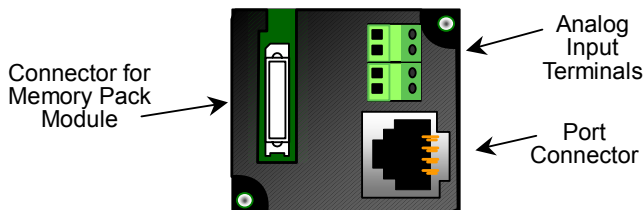
When installed on the Micro PLC, the RS-422/485 Port Option Module becomes port 2. It supports the following communications protocols:

- Modbus Master/Slave
- Serial Read/Write
- SNP/SNPX Master/Slave

Use of the Port Option module as port 2, and the protocol selection must be set up in the configuration software. After making those selections, the communications parameters can also be configured.

Pin assignments for Port 2 are:

8	SG	Signal Ground
7	VCC	5VDC Output
6	NC	Not used
5	TX(+)	Send Data +
4	TX (-)	Send Data -
3	RX (-)	Received Data -
2	RX (+)	Received Data +
1	RT	Terminal Resistor

An external device can obtain power from the 5VDC output pin if it requires 200mA or less at 5VDC.

Analog Inputs

The terminals on the Port Option Module can be used for analog inputs with the following characteristics:

Input Ranges	0-10 V (10.24 V maximum
Resolution	0-10 V, 10 bits
Accuracy	+/-1%
Linearity	+/-3 LSB Maximum
Voltage Input Impedance	100KOhm
Isolation	Channel to channel: none CPU to analog signal: none
Analog Terminal Wiring	Solid wire: $0.14mm^2$ to $1.5mm^2$ Stranded wire: $0.14mm^2$ to $0.10mm^2$

Channel 1
Channel 2

+
-

VersaMax Micro PLC Option Module IC200UUB001 can be used with a 20, 40, or 64-Point Micro PLC to provide a USB Port.

Connector for
Flash Memory
Module
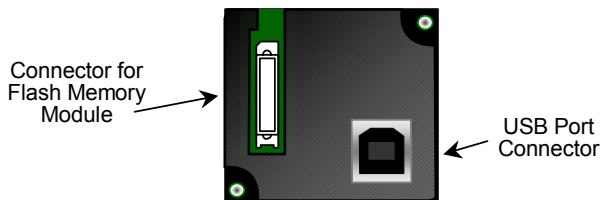
USB Port
Connector

Characteristics of the USB Port are:

Connector	Straight B type
USB version	2.0
Power	Self power
Baud Rates Supported	4800 through 38400 only. Do not configure other baud rates for Port 2 when using the USB Conversion Option Module.

Connecting to the USB board from windows should automatically download the correct driver from Microsoft. To download directly, go to
http://www.ftdichip.com/Drivers/FT232-FT245Drivers.htm

IC200UEM001
RJ 45, 10/100 Mbit Ethernet Communications Module

The VersaMax Micro PLC Option Module IC200UEM001 can be used with a
Micro 20, 40, or 64-Point PLC to provide an Ethernet Port.

Connector for Memory Pack Module

Port Connector
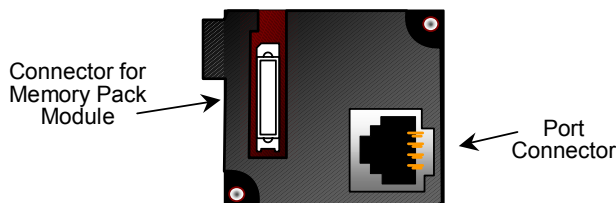
When installed on the PLC, the Ethernet Port Option Module becomes Port 2. It
supports the following communications protocols:

- SRTP Server
- Modbus Server/Client (separate download)
- Pass- through port (separate download).

Protocol options are available on http://support.gefanuc.com/support

Module Specifications

Processor Speed	DSTni-EX CPU, 48MHz
Memory	256 kByte RAM, 512 kByte FLASH
Connection Type	RJ 45 10Base-T/100Base-TX Ethernet
Entity Type	Server/Client
Bus Speed	10/100Mbaud
Number of Connections Supported	Supports up to 8 TCP/IP connections (4 for SRTP, 8 for Modbus TCP, 1 for Tunneling)
Mode	Full Duplex

Status LEDs

Link LED (Amber)	Solid Amber: Connection to Micro 64 established and network is connected
Activity (Green)	Flashing Green when there is any activity on the network
Status (Red)	OFF: No errors Red ON: Duplicate IP address present or network controller error Red BLINK (2x/sec): No DHCP response or Setup menu active

Configuration Options

The option port should be configured for Ethernet. Configuration options are:

Protocol	Parameters	Value
SRTP Server	Port Mode	SNP
	Port Type	Slave
	Data Rate	19.2, 38.4 or 175.0 kbps (default)
	Flow Control	None
	Parity	Odd (default), Even, None
	Stop bits	1 (default), 2
	Time Out	Long
	Turnaround Time	0
Modbus TCP Client/Server	Port Mode	RTU
	Port Type	Slave
	Data Rate	19.2, 38.4 or 175.0 kbps (default)
	Flow Control	None
	Parity	Odd (default), Even, None
	Station Address	0–247. Default = 1.
	Modbus/TCP Client Support (see page 14-12).	Disabled (default) or Enabled. Enabling Modbus/TCP Client Support sets the %I00488 status bit ON.
Pass-Through or Tunneling	Port Mode	Serial I/O
	Data Rate	19.2, 38.4 or 175.0 kbps (default)
	Flow Control	None
	Parity	Odd (default), Even, None
	Stop bits	1 (default), 2
	Bits/Characters	7 or 8
	Station Address (Byte 1 to Byte 8)	0 (default) –FF

For detailed information on the Telnet configuration of the Ethernet Option Module for each protocol, refer to GFK-2436E or later.

Enhanced Data Throughput

The versions 3.83 of Micro and later, and versions 2.0 and later of the Ethernet Option Module firmware provide Enhanced Data Throughput on Port 2 with the Ethernet Option Module.

- Data rates supported for the Ethernet Option Module are: 19,200bps, 38,400bps and 175,000bps. Firmware releases 3.82 and earlier supported data rates 300bps through 38400 on Ethernet Module. Release 3.83 and later do not support 300bps through 9,600bps data rates, but support for a higher data rate of 175,000bps is added.

- The default baud rate for Port 2 with the Ethernet Option module is 175000bps. This is the baud rate for which the Micro Port 2 will be configured during auto-configuration with Ethernet module connected.

- When 175,000bps data rate is selected, a value of 2ms is automatically selected internally for SNP T1 timer value (default T1 value is 5 ms). This will result in increased throughput for communication with SNP protocol.

Setting the IP Address

There are two steps to setting the module's IP address, as described in the datasheet that is packaged with the module:

- First, a temporary IP address and the MAC address must be entered using Proficy Machine Edition Logic Developer.

- Second, the permanent IP address must be set using Ethernet commands.

The permanent IP address setting must be saved to the Flash on the Ethernet board or it will be lost during power cycle.

Downloading Ethernet Drivers

The Ethernet drivers for the Ethernet Option Module are downloaded from GEFanuc.com. Filenames and passwords are listed in the module datasheet. Downloading is done using the PumpKIN utility, which is included.

Modbus/TCP Client Support

The versions 3.83 and later of the Micro firmware and version 2.0 of the Ethernet Option Module provide Modbus TCP Client Support, which allows you to generate read or write requests to the Modbus TCP server device. To use this feature, the CPU's Port 2 must be configured for Modbus RTU Slave. The Ethernet Option Module acts as Modbus RTU master on serial side. Because the Micro PLC is configured as RTU Slave, it cannot send the commands directly to the Ethernet Module. For this reason Micro updates the Modbus TCP request at a specified reference memory location, which is read by the Ethernet module to process the command sent.

The Ethernet module reads the Modbus command framed by the Micro PLC. The Ethernet module then communicates with the server device and updates the response back to the Micro PLC, along with the status. In the Ethernet module, one channel can be configured for Modbus TCP Client. The remaining channels are used for Modbus TCP Server. The server should not use the channel configured for client. Similarly the client should not reclaim the channels configured for server. Channels should not be switched between client/server dynamically until you reconfigure the Ethernet module.

To trigger the Modbus/TCP Client request, complete the following steps.

1. Hardware configuration in Machine Edition. This creates the Sequence and Command data address configurations.

2. Configure Modbus/TCP Client and serial parameters in TELNET.

3. Create logic in Machine Edition to process the Read/Write request.

Note: The MODBUS_TCP_RW function block should be triggered in the logic only when %I00488 is on. (When on, the status bit %I488 indicates the Ethernet Option Module is configured for Modbus Client operation and is ready to accept Modbus Client commands.) Otherwise error "85B0H" will be output in the function block status.

1. Hardware Configuration

In the CPU Settings, set Port 2 Configuration to Ethernet.
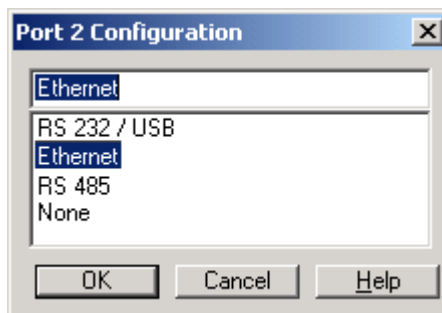
On the Port 2 (Ethernet) tab, set the parameters as follows:

Port Mode:	RTU
Port Type:	Slave
Data Rate:	*Select data rate (Max: 175000bps).*
	For details on data rates supported on Port 2, refer to "Enhanced Data Throughput" on page 14-10.
Modbus/TCP Client Support:	Enabled
Sequence Numbers Start Address:	*Assign %R memory. Occupies 5 words*
Command Data Start Address:	*Assign %R memory. Occupies 12 words*

Note: Sequence Number and Command Data addresses should not overlap or conflict with any other variables used in the logic.

2. Telnet Configuration

Note: The Ethernet option module will be power cycled and reset under the following conditions:

- A connection to the Ethernet option module is established through TELNET and disconnected immediately.

- A connection to the Ethernet option module through is established through TELNET, the configuration is edited, and you press "Q" (Quit without Save).

1. Connect the PLC with Port 2 to the Ethernet Option Module in the network.

2. Type TELNET <Ethernet Option Module IP: x.x.x.x> 9999 at the command prompt.

3. Configure the Modbus/TCP to RTU Bridge as follows.

   Sample Modbus/TCP to RTU Bridge Setup

   1) Network/IP Settings:

      IP Address……………… <x.x.x.x>

      Default Gateway .... <x.x.x.x>

      Netmask ....……..... <x.x.x.x>

      SNMP is enabled

   2) Serial & Mode Settings:

      Protocol ....Modbus/RTU,Slave(s) attached

      Modbus/TCP Client .... disabled

      Serial Interface ....……... 175000,8,O,1

   4) Advanced Modbus Protocol settings:

      Slave Addr/Unit Id Source: Modbus/TCP header

      Modbus Serial Broadcasts ...
      Disabled (Id=0 auto-mapped to 1)

MB/TCP Exception Codes .....
Yes (return 00AH and 00BH)

Char, Message Timeout ......
00050msec, 05000msec

D)efault settings, S)ave, Q)uit without save

Select Command or parameter set (1..4) to change: 2

Attached Device (1=Slave 2=Master) 1

Modbus/TCP Client Enabled (N) Y

Close Idle TCP sockets after (3-60 sec, 0=leave open)
10 Press Enter

Serial Protocol (1=Modbus/RTU 2=Modbus/ASCII) 1
Press Enter

Enter serial parameters (38400,8,0,1) 175000,8,O,1

Modbus/TCP to RTU Bridge Setup

After entering all the values, the Modbus/TCP to RTU Bridge Setup screen
appears showing the configured values.

1) Network/IP Settings:

IP Address 3.212.218.12

Default Gateway 003.212.218.001

Netmask 255.000.000.000

SNMP is enabled

2) Serial & Mode Settings:

Protocol Modbus/RTU,Slave(s) attached

Modbus/TCP Client enabled

Serial Interface 175000,8,O,1

4) Advanced Modbus Protocol settings:

Slave Addr/Unit Id Source Modbus/TCP header

Modbus Serial Broadcasts ...
Disabled (Id=0 auto-mapped to 1)

MB/TCP Exception Codes .....
Yes (return 00AH and 00BH)

Char, Message Timeout 00050msec, 05000msec

D)efault settings, S)ave, Q)uit without save

Select Command or parameter set (1..4) to change: **S**

To save the parameters, press **S.**

3. Logic to Process Read/Write Requests

The MODBUS_TCP_RW function block is used to process read/write requests.

```
        MODBUS TCP RW
            ????
    ─EX          CMPL─

    ─CH          BUSY─

    ─FC           ERR─

    ─LMR          STS─

    ─LMO

    ─RMO

    ─DL

    ─IP

    ─UI
```
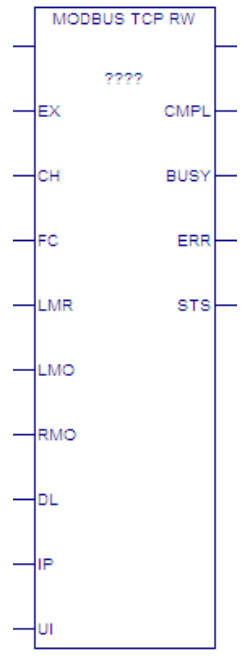
Parameters of MODBUS_TCP_RW

Parameter	Data Type, Memory Area	Description
Inputs		
????	DWord, R	Control word. Requires two bytes in %R memory. Do not write or clear this memory during operation of the MODBUS_TCP_RW function.
Enable	Flow	When the function is enabled, the operation is performed.
EX	Flow	Execute. A low to high transition starts command processing.
CH	Word, Constant	Channel number on which the request will be processed. Should be 1.
FC	Word, AI, AQ, R, Constant	Function code. Modbus RTU function to be carried out. See page 14-17 for valid function codes.
LMR	Word, AI, AQ, R, Constant	Segment selector for Local reference memory type. Destination memory type for a Read operation; Source memory type for a Write operation.

LMR Value	Description
18	%Q discrete output memory (Byte mode)
72	%Q discrete output memory (Bit mode)
8	%R register memory (Word mode)

LMO	Word, AI, AQ, R, Constant	Local PLC reference memory address for Modbus/TCP Client device's location. Destination for a read operation; Source for a write operation.
RMO	Word, AI, AQ, R, Constant	Remote PLC reference memory address for Modbus/TCP Server device's location. Source for a read operation this memory; Destination for a write operation.
DL	Word, AI, AQ, R, Constant	For valid lengths refer to the comments in the table "Modbus/TCP Function Codes Supported by VMNM PLCs" on page 14-17.
IP	Word, AI, AQ, R	IP Start address. This is the IP Address of the Server device. Starting from this address, four words would contain four octets of the IP.

Parameter	Data Type, Memory Area	Description
UI	Word, AI, AQ, R, Constant	Unit Identifier. A control code used in a Modbus/TCP message. This value is 1 for most Modbus/TCP devices except for an Ethernet to Serial bridge used to multi-drop to Modbus RTU devices. Valid values: 0—255
Outputs		
ENO	Flow	Enable output.
CMPL	Bool, I, Q, M, G, T	Complete. Set when the read or write operation has been successfully completed.
BUSY	Bool, I, Q, M, G, T	Busy. Set when the read or write process is in operation and has not been completed.
ERR	Bool, I, Q, M, G, T	Error. Set when an error is identified during operation.
STS	Word, AI, AQ, R	Status. May include the following: Remote Server exceptions Function block parameter errors Client application errors For a list of status/error codes, refer to page 14-18.

MODBUS/TCP Function Codes Supported by VersaMax Micro PLCs

Function	Function Code	Server Reference Memory Type	Data Unit Size	Comments
Read Coils	1	Coils	Bit	Read up to 2,000 bits
Read Input Discrete	2	Discrete Inputs	Bit	Read up to 2,000 bits
Read Multiple Registers	3	Register	Register (16-bit word)	Read up to 125 words
Read Analog Input Registers	4	Analog Input Registers	Register (16-bit word)	Read up to 125 words
Write Coil	5	Coil	Bit	Write one bit
Write Single Register	6	Register	Register (16-bit word)	Write one word
Read Exception Status	7	-NA-	Byte	-NA-
Write Multiple coils	15	Coil	Bit	Write multiple bits, up to 2000
Write Multiple Registers	16	Register	Register (16-bit word)	Write to a maximum of 100 words

Status/Error Codes

Status codes are reported in the following format:

00	00

Minor status code
(high byte)

Major status code
(low byte)
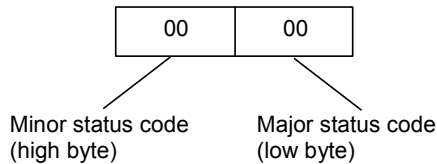
Major Status Codes

Error Status (Hex)	Major Status Description
01H	Successful completion. No minor status code (value can be ignored.)
91H	Modbus TCP Status codes at the server. An error was detected at the Modbus TCP server. See the table on page 14-18 for the associated Minor Status Codes.
B0H	Client Application Error. See the table on page 14-19 for the associated Minor Status Codes.
B1H	Serial link error codes between Micro and Ethernet Module. See the table on page 14-20 for the associated Minor Status Codes.

Minor Status Codes for Major Status 91H

The following table lists minor status codes that can be reported for status code 91H, Remote Server Device error.

Error Status (Hex)	Error Description
0191H	*Illegal Function.* The function code received in the request is not allowed for the server. Causes may be: - The function code is not implemented in the unit selected. For example, it may be a function that applies only to newer controllers. - The server is in the wrong state to process a request of this type, for example because it was not configured and is being asked to return register status. Modbus exception code 01H.
0291H	*Illegal data address.* The data address received in the query is not an allowable address for the server. More specifically, the combination of reference number and transfer length is invalid. MODBUS exception code 02.
0391H	*Illegal data value.* A value contained in the query data field is not an allowable value for server. This indicates a fault in the structure of the remainder of a complex request, such as that the implied length is incorrect. It specifically does NOT mean that a data item submitted for storage in a register has a value outside the expectation of the application program, since the MODBUS protocol is unaware of the significance of any particular value of any particular register. MODBUS exception code 03.

Error Status (Hex)	Error Description
0491H	*Slave Device Failure.* An unrecoverable error occurred while the server was attempting to perform the requested action.
0691H	*Slave Device Busy.* Server service request queue full. MODBUS exception code 06.
0791H	*Negative Acknowledge.* Internal server error occurred. MODBUS exception code 07

Minor Status Codes for Major Status B0H

The following table lists minor status codes that can be reported for status code B0H, Client Application Error.

Error Status (Hex)	Error Description
85B0H	Client device not yet ready to send the request.
86B0H	Server unit data size of zero is not allowed. The data unit size for read/write operations should be greater than zero.
87B0H	Server unit data size is too large. The data unit size for read/write operations should not cross the maximum value.
	Example: If the data length specified for Read/Write coil is greater than 1, this error code is returned.
88B0H	Invalid Channel Number
8BB0H	This error will be triggered when the server reference memory address is zero, which is not allowed.
8CB0H	Invalid Client Memory Type. This error is triggered when the specified client reference memory type is invalid. Refer to page 14-16 for valid memory types.
8EB0H	Invalid IP address integer. All four octets of the IP address should be in the range 0 to 255.
8FB0H	Invalid IP address class.
90B0H	Insufficient TCP connection resources to perform request.
91B0H	Zero local starting address is not allowed, The starting address of the client PLC memory location should be greater than zero.
95B0H	Internal Error. This problem may occur due to the Ethernet Interface being asked to perform beyond its capacity.
96B0H	Underlying TCP connection aborted (reset) by server end point. The server is not responding within the timeout value.
97B0H	Underlying TCP connection aborted (reset) by Client end point.
9CB0H	Invalid frame format. Data response did not arrive in a proper order.
9DB0H	Data response had unexpected size. For example received more data than expected.
9FB0H	Invalid Client PLC Memory reference address.
B6B0H	Unrecognized Function code. The Client device does not support the function code or operation.

Error Status (Hex)	Error Description
B7B0H	Invalid Unit Identifier.
A0B0H	Invalid Server Reference Memory Address.
A2B0H	Failed to update the Micro reference memory. Ethernet Module was unable to write to the Client memory specified in the command data.
A7B0H	Unable to connect to remote device after successful channel establishment.
AAB0H	An attempt to establish a TCP connection with a remote server failed. This error can be caused by the following conditions: Server is not turned on Cables are not properly connected If using a switch, switch is not turned on This error can occur while establishing the connection with the server device.
ACB0H	A protocol error occurred while communicating with the local PLC. This error can occur when a break in the frame or check sum error occurred.
ADB0H	A TCP timeout occurred while communicating with the remote PLC.

Minor Status Codes for Major Status B1H

The following table lists the minor status codes that can be reported for the major status code B1H, which indicates a Serial Link error in the communications between the Ethernet module and the Micro PLC.

If communication between the Ethernet Module and the Micro CPU is not functional, the Ethernet Module indicates the problem by LED blink patterns and through the TELNET connection. If the error codes reported by the Ethernet Module, by LEDs or through TELNET, are different, the Serial Link error code has the highest priority.

Error Status (Hex)	Error Description
01B1H	Unable to read the Sequence Number Data Structure.
02B1H	Unable to read the Command Data Structure
03B1H	Unable to read/write Client PLC reference memory (segment selector/offset specified in command data structure).
04B1H	Unable to update the response status/sequence number
05B1H	Serial Communication error (Parity, Baud rate, framing, Over run etc.) with the Micro CPU.

Examples for MODBUS_TCP_RW

For the following examples:

1. The IP address is stored as integer values in the four words starting at %R1001.
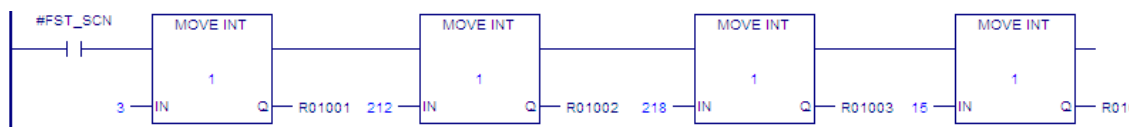
2. When %I00488 is on, the MODBUS_TCP_RW function block is executed on the rising transition of %T0001. For parameter definitions, refer to page 14-16.

Function	*Sample Rung*
Reading Coils (FC=1) Reads a coil at offset 10 (RMO=10) in the remote Modbus TCP server and store the value at the location %Q10 (LMR=72, LMO=10).	

Function	*Sample Rung*
Reading Discrete Inputs (FC=2) Read nine discrete inputs from offset 5 (RMO=5) in the remote Modbus TCP server and store the values in bit mode at %Q3 (LMR=72, LMO=3).	I00488 #ALW_ON ┤ ├ ─────── ┤ ├ **MODBUS TCP RW** T00001 R01005 ┤ ├ ──── EX CMPL ── T00002 1 ── CH BUSY ── T00003 2 ── FC ERR ── T00004 72 ── LMR STS ── R01007 3 ── LMO 5 ── RMO 9 ── DL R01001 ── IP 1 ── UI
Reading Multiple Registers (FC=3) Read 125 registers from the remote server device. The Remote server reference address is %R0101 (LMR=8, LMO=101). The Client or Local PLC reference memory address is %R5001 (LMR=8, RMO=5001).	I00488 #ALW_ON ┤ ├ ─────── ┤ ├ **MODBUS TCP RW** T00001 R01005 ┤ ├ ──── EX CMPL ── T00002 1 ── CH BUSY ── T00003 3 ── FC ERR ── T00004 8 ── LMR STS ── R01007 5001 ── LMO 101 ── RMO 125 ── DL R01001 ── IP 1 ── UI

Function	*Sample Rung*
Reading Analog Inputs (FC=4) Read nine analog input registers at offset 200 (RMO=200) in the remote Modbus TCP device and store the values in the Client PLC memory location %R0020 (LMR=8, LMO=20).	I00488 #ALW_ON MODBUS TCP RW T00001 R01005 EX CMPL — T00002 1 — CH BUSY — T00003 4 — FC ERR — T00004 8 — LMR STS — R01007 20 — LMO 200 — RMO 9 — DL R01001 — IP 1 — UI
Writing a Coil (FC=5) Write the value at %Q4 (LMR=72, LMO=4) in the Client PLC memory location to coil %Q5 (RMO=5) in the remote Modbus TCP device.	I00488 #ALW_ON MODBUS TCP RW T00001 R01005 EX CMPL — T00002 1 — CH BUSY — T00003 5 — FC ERR — T00004 72 — LMR STS — R01007 4 — LMO 5 — RMO 1 — DL R01001 — IP 1 — UI

Function	*Sample Rung*
Writing a Single Register (FC=6) Write one register from %R10 (LMR=8, LMO=10) to a holding register at offset 200 (RMO=200) in the remote Modbus TCP server.	I00488 — #ALW_ON MODBUS TCP RW T00001 R01005 EX CMPL — T00002 1 — CH BUSY — T00003 6 — FC ERR — T00004 8 — LMR STS — R01007 10 — LMO 200 — RMO 1 — DL R01001 — IP 1 — UI
Reading Status (FC=7) Read the Status from the remote Modbus TCP server and store the Status data in bit mode at location %Q4 (LMR=72, LMO=4).	I00488 — #ALW_ON MODBUS TCP RW T00001 R01005 EX CMPL — T00002 1 — CH BUSY — T00003 7 — FC ERR — T00004 72 — LMR STS — R01007 4 — LMO 0 — RMO 1 — DL R01001 — IP 1 — UI

Function	*Sample Rung*
Writing Multiple Coils (FC=15) Write the eight values starting from %Q1 (LMR=72, LMO=1) in the Client reference memory to eight coils starting at offset 1 (RMO=1) in the Remote Modbus TCP device.	I00488 #ALW_ON MODBUS TCP RW —] [——————] [— T00001 R01005 —] [—— EX CMPL — T00002 1 — CH BUSY — T00003 15 — FC ERR — T00004 72 — LMR STS — R01007 1 — LMO 1 — RMO 8 — DL R01001 — IP 1 — UI
Writing Multiple Registers (FC=16) Write 100 registers from the Client reference memory address %R5001 (LMR=8, LMO=5001) to the remote server reference address %R101 (RMO=101).	I00488 #ALW_ON MODBUS TCP RW —] [——————] [— T00001 R01005 —] [—— EX CMPL — T00002 1 — CH BUSY — T00003 16 — FC ERR — T00004 8 — LMR STS — R01007 5001 — LMO 101 — RMO 100 — DL R01001 — IP 1 — UI

Security Settings for the Ethernet Option Module

Security settings can be changed to prevent unauthorized entry into Ethernet Option Module configuration mode.

Two security settings are supported for the Ethernet Option Module (firmware version 2.0 and later): Password support for Telnet configuration and SNMP (Enable/Disable) configuration.

Security settings are provided for the three protocols: SNP/SRTP, Modbus TCP and Tunneling.

For Modbus TCP and SRTP protocols, these security settings options are present in the "Network/IP Settings" menu for. For Tunneling (Passthrough), these security settings are present in the "basic parameters/server" menu.

By default, there is no password and Simple Network Management Protocol (SNMP) is enabled.

Disabling or Enabling the SNMP is configurable.

The maximum password length is 16 characters. These characters can be alphanumeric or special characters. The password requires a minimum length of 8 characters.

A password set on a particular protocol's firmware remains in effect if the firmware is changed to that of a different protocol. For example, if a password is set on Modbus TCP firmware and later the firmware is changed to SNP/SRTP, the same password set on Modbus TCP firmware will still apply.

If the password is set, it will be required before entering to the Telnet configuration Setup Mode. After prompting for password, if the password is not entered within 30 seconds, the Telnet session will expire.

Installing Option Modules

Power to the VersaMax Micro PLC MUST BE TURNED OFF when installing or removing Option Modules.

1. Access the option connector on the front of the unit, as shown below for a Micro-64 PLC.

Press Down Latch and Remove These Two Doors
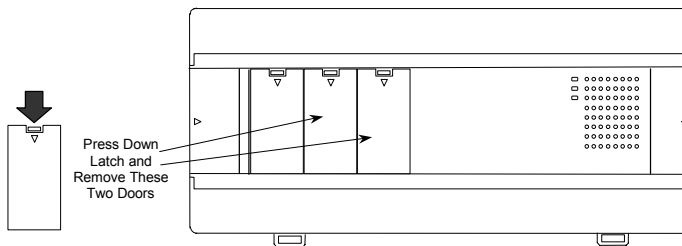
2. If a port-type Option Module is being installed, orient the connector on the Option Module with the connector in the Micro PLC. Be careful to avoid contact with the exposed components in the module.

Connector for Option Module

Screws for Option Module
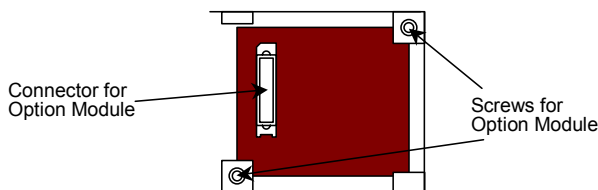
3. Press the Option Module downward until it clicks into place.

4. Install the screws provided with the Option Module into the corners as shown above.

Connector for Memory Pack Module
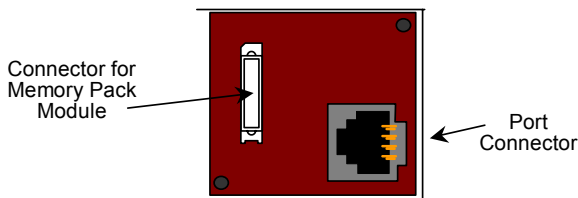
Port Connector

5. If a Memory Pack Module is being installed, orient the connector on the back of the Memory Pack Module with the connector on the Micro PLC or port-type Option Module. Press the Memory Pack Module downward until it clicks into place.

6. Install the protective cover(s). If only the Memory Pack Module is used, both covers may be installed. If a port module is used, the righthand cover is not installed and the port connector remains accessible.

<table>
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Chapter

15

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Installation Instructions

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</table>

This chapter describes the procedures for installing a VersaMax Nano PLC or VersaMax Micro PLC and preparing the system for use. Included in this chapter are instructions for unpacking, inspecting, and installing the PLC. Instructions are also provided for connecting cables to programming devices.

- Preinstallation check
- Agency Approvals, Standards, and General Specifications
- Immunity and Emission Specifications, Relevant Standards, and Level Passed
- Installation Guidelines
- Mounting Dimensions
- Grounding the Equipment
- Installing a PLC or Expansion Unit on a DIN Rail
- Connecting an Expansion Unit to a Micro PLC
- System Wiring Guidelines
- Starting Up the PLC
- Adjusting the Analog Potentiometers
- DIP Switches
- Installing/Replacing a Backup Battery
- Serial Port Connections
- RS485 Port Isolator
- RS-232 to RS-485 Adapter
- Replacing AC Output Module Fuses

Preinstallation Check

Carefully inspect all shipping containers for damage during shipping. If any part of the system is damaged, notify the delivery service immediately. The damaged shipping container should be saved as evidence for inspection by the delivery service. As the consignee, it is your responsibility to register a claim with the delivery service for damage incurred during shipment. However, GE Fanuc will fully cooperate with you, should such action be necessary. After unpacking the equipment, record all serial numbers. Serial numbers are required if you should need to contact Product Service during the warranty period of the equipment. All shipping containers and all packing material should be saved should it be necessary to transport or ship any part of the system.

Keep Micro PLC modules in their boxes during storage and transport.

Agency Approvals, Standards, and General Specifications

The Micro PLC products supplied by GE Fanuc are global products designed and manufactured for use throughout the world. They should be installed and used in conformance with product-specific guidelines as well as the following agency approvals, standards and general specifications:

Agency Approvals		Comments
Industrial Control Equipment [Safety]	UL508, CSA C22.2 No 142-M1987	Certification by Underwriters Laboratories for Revision B and later models
Hazardous Locations [Safety] Class I, Div II, A, B, C, D	UL1604 CSA C22.2 No 142-M1987	Certification by Underwriters Laboratories for Revision B and later models
European EMC & LVD Directives	CE Mark	All models

Environmental		Conditions
Vibration	IEC68-2-6, JISC0911	1G @57-500Hz, 0.15mm p-p @10-57Hz
Shock	IEC68-2-27, JISC0912	15G, 11ms
Operating Temperature		0deg C to 55deg C [ambient]
Storage Temperature		−10deg C to +75deg C
Humidity		5% to 95%, non-condensing
Enclosure Protection	IEC529	Enclosure per IP54; protection from dust & splashing water
Isolation: Dielectric Withstand	UL508, UL840, IEC664	1.5KV for modules rated from 51V to 250V

Immunity and Emission Specifications, Relevant Standards, and Level Passed

Description	*Standards*	*Specifications*
Electrostatic Discharge	EN 61000-4-2	± 4.0 kV (Contact); ± 8.0 kV (Air)
RF Susceptibility	EN 61000-4-3	10 V/m (unmodulated), 80-1000 MHz, 80% AM, 1 kHz sine wave
RF Susceptibility from Digital Radio Telephones	ENV 50204	10 V/m (unmodulated), 900±5Mhz, 100% AM (200 Hz square wave, 50% duty cycle)
Fast Transient	EN 61000-4-4	± 2.2 kV (PS); ± 1.1 kV (I/O)
Voltage Surge	EN 61000-4-5	± 2.2 kV, common mode (PS) ± 1.1 kV, differential (PS)
Conducted RF	EN 61000-4-6	10 V_{rms}, 0.15-80 MHz, 80% AM, 1 kHz sine wave (PS, I/O)
Voltage Dip Voltage Interrupt Voltage Variation	EN 61000-4-11	30% Nom., 10 ms >95% Nom., 10ms 20% Nom. 10 sec.
Radiated Emissions	EN 55011*	30 dBμV/m, 30 – 230 MHz (measured @ 30m) 37 dBμV/m, 230 – 1000 MHz (measured @ 30m)
Conducted Emissions	EN 55011*	79/66 dBμV, 0.15 – 0.5 MHz 73/60 dBμV, 0.5 – 30 MHz

* EN 55011 limits are equivalent to limits specified in EN 55022, CISPR 11, CISPR 22, and 47 CFR 15.

Installation Guidelines

- This equipment is intended for use in typical industrial environments that utilize anti-static materials such as concrete or wood flooring. If the equipment is used in an environment that contains static material such as carpets, personnel should discharge themselves by touching a safely-grounded surface before accessing the equipment.

- If the AC mains are used to provide power for I/O, these lines should be suppressed prior to distribution to the I/O so that immunity levels for the I/O are not exceeded. Suppression for the AC I/O power can be made using line-rated MOVs that are connected line-to-line, as well as line-to-ground. A good high-frequency ground connection must be made to the line-to-ground MOVs.

- Installation should be indoors with primary facility surge protection on the incoming AC power lines.

CE Mark Installation Requirement

For compliance to the Low Voltage Directive, VersaMax Nano and VersaMax Micro systems are considered 'open equipment' (i.e. live electrical parts may be accessible to users) and must be installed in an enclosure. IEC 1131-2:1991 (sect. 4.2, item 2) states: "Open equipment is not required to meet IP2x requirement…. Opening of the enclosure shall only be possible by means of a key or tool." The PLC equipment should be installed in a location that meets the specifications listed on the previous page.

UL Requirements for Class I Div 2 Installations

- Equipment labeled with reference to Class 1 Div. 2 Groups A, B, C & D, hazardous locations is suitable for use in Class 1, Division 2, Groups A, B, C, D or non-hazardous locations only.

- Equipment labeled with reference to Class 1 Zone 2 Groups A, B, C & D, hazardous locations is suitable for use in Class 1, Zone 2, Groups A, B, C, D or non-hazardous locations only.

- Warning - explosion hazard - substitution of components may impair suitability for Class 1, Division 2.

- Warning - explosion hazard - do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous.

Additional Environmental Guidelines

- The temperature must not change so rapidly that condensation could form on or inside the unit.
- There should be no combustible, corrosive or flammable gases.
- The environment should not have excessive dust, salty air, or conductive materials (iron powder, etc.) that could cause internal shorts.
- The PLC should not be installed where it will be exposed to direct sunlight.
- The PLC should not be exposed to water, oil or chemicals.
- Provide adequate ventilation space. Recommended minimum space allowances are approximately: 50mm (2 inches) top, sides and bottom.
- The PLC should not be installed above equipment that generates a large amount of heat.
- If the ambient temperature exceeds 55°C, provide a ventilation fan or air conditioner.
- The equipment should not be installed within 200mm (8 inches) of any high voltage (more than 1000V) or high current (more than 1A) line (except for outputs controlled by the PLC).
- For ease of maintenance and safety, locate the PLC equipment as far away from high voltage equipment and power generation equipment as possible.
- Take appropriate measures when installing systems in locations:
  - subject to static electricity or other forms of noise.
  - subject to strong electromagnetic fields.
  - close to power supplies.

Mounting Dimensions

Dimensions of Nano PLCs

Height and Width   **Depth**
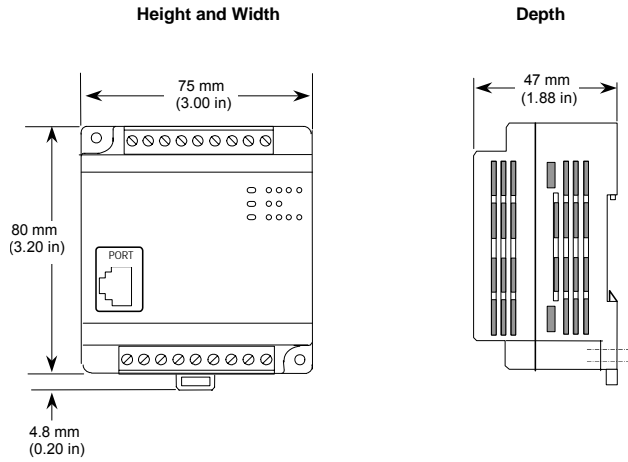
Dimensions of 14, 20, 23, 28, 40, and 64-Point Micro PLCs and Expansion Units
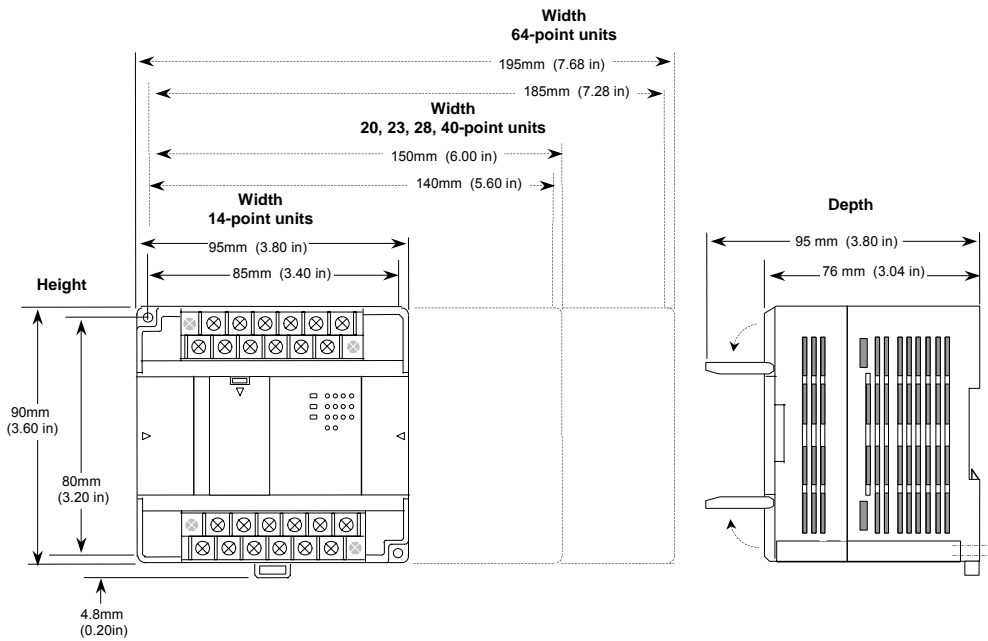
Grounding the Equipment

Equipment grounding procedures must be properly followed for safe operation of your PLC equipment.

The maximum recommended resistance to ground is 200mΩ (equivalent to 100 feet of AWG #12 – 3.29mm^2 – copper cable).

- Grounding installation must conform to National Electrical Code (NEC) standards.

- Ground conductors should be connected with separate branches routed to a central earth ground point.
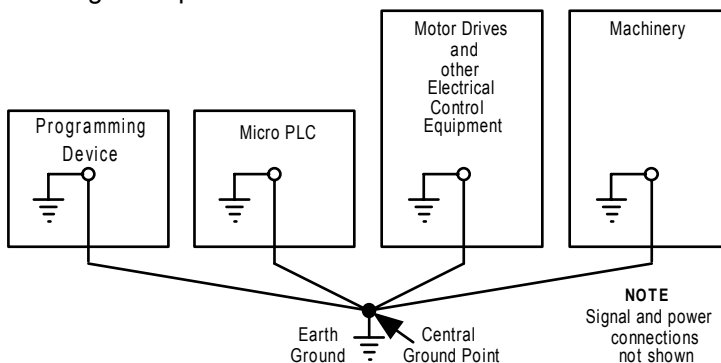
- Ground conductors should be as short and as large in size as possible. Braided straps or ground cables – AWG #12 (3.29mm^2) or larger – can be used to minimize resistance. Conductors must always be large enough to carry the maximum short circuit current of the path being considered.

- Install an external earth leakage breaker and take other safety measures according to external wiring standards.

Grounding the Programmer

For proper operation, the computer for the programming software must have a ground connection in common with the PLC. Normally, this common ground connection is provided by connecting the programmer's power cord to the same power source (with the same ground reference point) as the PLC. If that is not possible, use a port isolator (IC690ACC903) between the programmer PLC serial connection. If the programmer ground is at a different potential than the PLC ground, a shock hazard could exist. Also, damage to the ports or converter (if used) could occur when the programmer serial cable is connected between the two.

Warning

Failure to follow programmer grounding recommendations could result in personal injury, equipment damage, or both.

Installing a PLC or Expansion Unit on a DIN Rail

VersaMax Nano PLC and Micro PLC equipment can be mounted on a 35 mm DIN rail as described below, or mounted on a metal panel using screws as described on the next page. The equipment must be mounted on a vertical surface. Do not mount it on a horizontal surface.

Proper Mounting   Improper Mounting
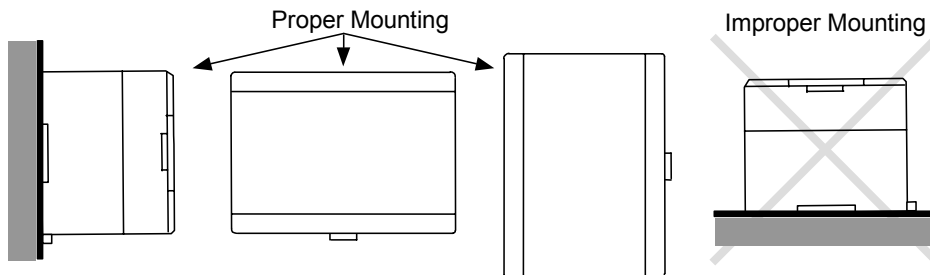
The DIN rail must be electrically grounded to provide EMC protection as described on the next page. DIN rails compliant with DIN EN50032 are preferred.

For vibration resistance, the DIN rail should be installed on a panel using screws spaced approximately 5.24cm (6 inches) apart.

Mounting the PLC on a DIN Rail

Units mount on a 35 mm DIN rail as shown below. Using a small flat screwdriver or similar tool, pull out the retaining clip on the bottom of the unit. Press the unit back and release the retaining clip. Be sure the clip is holding the unit securely.

1   **2**

DIN
Rail

pull clip   release
                                                       clip
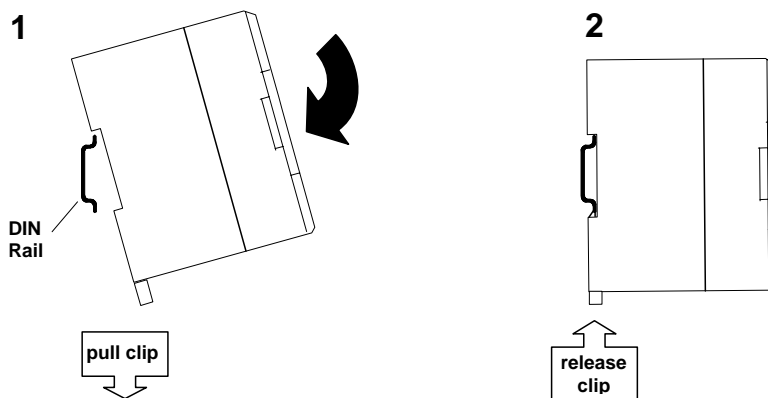
Removing the PLC from a DIN Rail

Pull down the retaining clip on the bottom of the module then pull the unit away from the DIN rail.

Panel-Mounting

For greatest resistance to mechanical vibration and shock, units should installed on a metal panel.

Following the dimensions shown in this chapter or using the module itself as a template, mark the location of the module's panel-mount holes on the panel. Drill the hole in the panel. Install the module using 65x70 M4 (#8-32) screws at least 20mm (0.79 in.) long in the panel-mount holes.
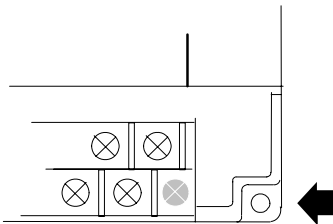
1.1 to 1.4Nm (10 to 12 in/lbs) of torque should be applied to M4 (#8-32) steel screws threaded into material containing internal threads and having a minimum thickness of 2.4mm (0.093in).

Grounding the Metal Panel or DIN Rail

To prevent the risk of electric shock, the metal panel on which the PLC is installed must be properly grounded to protective earth.

Connect the ground wire to the metal panel using a star washer. Where connections are made to a painted panel, the paint should be removed so clean, bare metal is exposed.

Connect the metal plate, duct, pipe, door and side board etc. to protective earth.

Connecting an Expansion Unit to a Micro PLC

Up to four expansion units can be connected in series to a Micro PLC.

Caution

Power down the Micro PLC before connecting an Expansion Unit. Connecting an Expansion Unit with the Micro PLC powered up will damage the unit.

NOTE

The Micro PLC and Expansion Unit(s) should be wired to a common power source and powered up together. If an attached Expansion Unit is left unpowered, the Micro PLC may not power up properly.

The Expansion Cable

A 0.1-meter ribbon cable (IC200CBL501) is provided with each expansion unit. Cables are also available in 0.5 meter (IC200CBL505) and 1 meter (IC200CBL510) lengths. The maximum total overall length is 2 meters. This cable has keyed connectors to prevent incorrect installation. Powering up the system with the cable improperly installed can damage the Expansion Unit. Do not substitute a different cable. If you need to order replacements, expansion cables are available in various lengths. Connect the units as shown below.
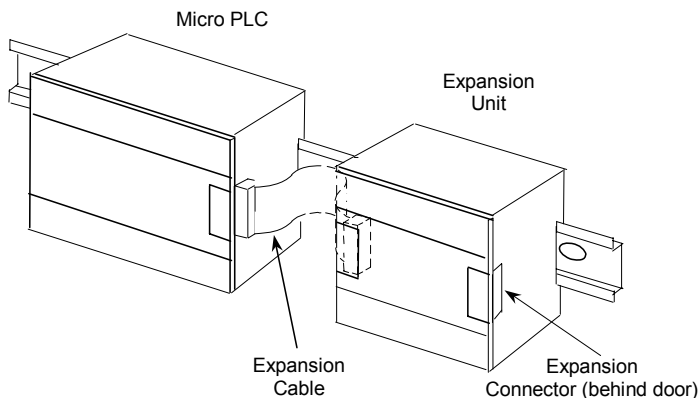
The Expansion Unit(s) and Micro PLC must be connected in the same orientation. Connecting an Expansion Unit "upside down" will damage the DC input circuit when the system is powered up.

After installing the ribbon cable on a unit, close the hinged door.

System Wiring Guidelines

In addition to the following wiring suggestions, we strongly urge that you follow all wiring and safety codes that apply to your area or to your type of equipment. Failure to do so could lead to personal injury or death, property damage or destruction, or both.

Four types of wiring may be encountered in a typical factory installation:

- Power wiring – the plant power distribution, and high power loads such as high horsepower motors. These circuits may be rated from tens to thousands of KVA at 220 VAC or higher.

- Control wiring – usually either low voltage DC or 120 VAC of limited energy rating. Examples are wiring to start/stop switches, contactor coils, and machine limit switches. This is generally the interface level of discrete I/O.

- Analog wiring – transducer outputs and analog control voltages. This is the interface level to I/O analog blocks.

- Communications and signal wiring – the communications network that ties everything together, including computer LANs, MAP, and field busses.

These four types of wiring should be separated as much as possible to reduce the hazards from insulation failure, miss-wiring, and interaction (noise) between signals. A typical control system may require some mixing of the latter three types of wiring, particularly in cramped areas inside motor control centers and on control panels.

Wiring which is external to equipment and in cable trays should be separated following National Electrical Code practices.

Safety Measures

Appropriate emergency stop circuitry, interlock circuitry and similar safety measures should be added to the system in accordance with accepted practices.

Appropriate safety measures should be included in the design of the overall system to ensure safety in the event of incorrect, missing or abnormal signals caused by broken signal lines, momentary power interruptions or other causes.

Installing Additional Suppression

External MOV suppression can be installed at the power line input of a system enclosure (see below). The axial-leaded ZA series of MOVs from Harris is often used. The MOV should be able to handle most line transients. Measurement of actual transients may be required in extreme cases to decide what MOV is best.

Ideally, MOVs should be used at each cabinet in the system for maximum protection. The following illustration shows suppression on both power lines and a communications bus entering an enclosure.
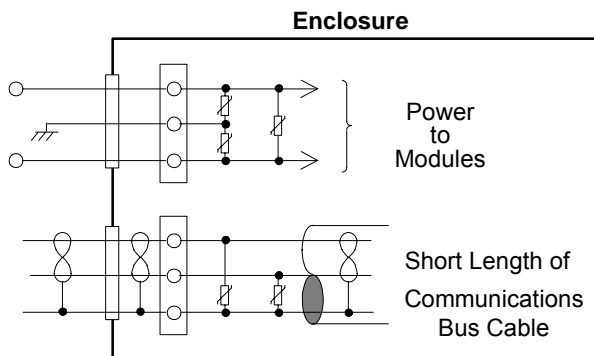
Periodic Inspection and Replacement of MOVs

MOVs do a good job of absorbing transients on communications, control, and power lines, provided the total energy of those transients does not exceed the rating of the device. However, if the energy of the transient exceeds the rating of the device, the MOV may be either damaged or destroyed. *This failure may not be visibly or electrically evident.* MOVs should be regularly inspected for signs of damage to assure continued protection against transients. For some applications, periodic replacement of critical MOVs is recommended, even if they do not show signs of damage.

I/O Installation and Wiring

Wiring diagrams are located in the individual module sections of this manual.

Warning

The PLC must be grounded to minimize electrical shock hazard. Failure to do so could result in injury to personnel.

Warning

You should calculate the maximum current for each wire and observe proper wiring practices. Failure to do so could cause injury to personnel or damage to equipment.

Caution

When connecting stranded conductors, ensure that there are no projecting strands of wire. These could cause a short circuit, thereby damaging equipment or causing it to malfunction.

- *Wiring for Power Supply and I/O Connections*

- Each terminal can accept solid or stranded wires, but the wires into any given terminal must be of the same type and size.

- Use copper conductors rated for 75 °C (167 °F) for all wiring.

- Micro PLC wire sizes: one AWG #14 (2.1 mm^2) conductor or two smaller conductors – AWG #16 (1.3 mm^2) through AWG #20 (0.36mm^2) per terminal. The suggested torque for the terminal connections is 5 in-lbs (5.76 kg-cm).

- Nano PLC wire sizes: each terminal accommodates one AWG #14 (avg 2.1mm^2 cross section) to AWG #22 wire (avg 0.36mm^2 cross section), or two wires up to AWG #18 (avg. 0.86mm^2 cross section). The suggested torque for the terminal connections is 3 in-lbs (3.75 kg-cm).

Removable Wiring Terminals

Input Terminals on
Removable Terminal Strip

Output Terminals on
Removable Terminal Strip
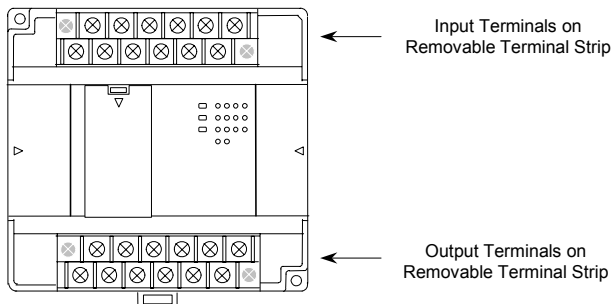
The terminal block assemblies of a Micro PLC can be removed to perform wiring. For example, a 14-point unit (shown above) has two removable terminal assemblies.

<div align="center">

Caution

</div>

Do not insert or remove a terminal assembly with power applied to the PLC/Expansion Unit OR TO FIELD DEVICES. Injury to personnel and damage to the equipment may result. Potentially dangerous voltages from field devices may be present on the screw terminals even though power to the PLC or Expansion Unit is turned off. Care must be taken any time you handle the removable terminal assembly or any wires connected to it

A new Micro PLC or Expansion Unit is shipped with its terminal block assemblies firmly installed. To remove a terminal assembly, use a small Phillips or flat screwdriver to alternately loosen the two captive retaining screws. Hold onto the terminal assembly; when the screws have been backed out of the holes, the terminal assembly is completely detached from the module.

Loosen alternately
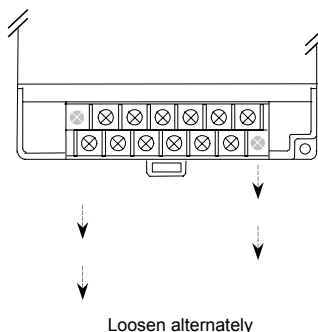
When re-installing terminal assemblies, be sure to place each one in the correct location to avoid miss-wiring the module. The terminal assemblies are not keyed or labeled.

General Wiring Procedures

Follow the procedures below when routing and connecting field wiring from user devices to the PLC inputs and outputs. The individual PLC and Expansion Unit sections of this manual provide detailed wiring information for connecting input and output devices and power sources.

- Turn off power to the PLC before connecting field wiring.

- All low-level signal wires should be run separately from other field wiring.

- All channels must be fed from the same phase for AC power lines.

- Install AC power cables and signal or data lines in separate cable trays or bunches from DC field wiring.

- Field wiring should not be routed close to any device that could be a potential source of electrical interference.

- Route the signal and data lines as close as possible to grounded surfaces such as cabinet elements, metal bars and cabinets panels.

- If severe noise problems are present, additional power supply filtering or an isolation transformer may be required.

- Ensure that proper grounding procedures are followed to minimize potential safety hazards to personnel.

- Label all wires to and from I/O devices.

- Do not attempt to disassemble, repair or modify any part of the PLC.

- Do not pull on cables or bend cables beyond their natural limit. The lines may break.

- Always use the power supply voltage listed in the module specifications. Using other voltages may damage the equipment.

- Do not apply voltages to the inputs in excess of the rated input voltage. The equipment may be damaged if the rated voltage is exceeded.

- Do not use voltages with outputs in excess of the maximum switching capacity. The PLC may be damaged if the maximum switching capacity is exceeded.

- Use shielded cable for analog inputs and outputs, and connect shields to a functional earth ground.

Wiring Connections

The following types of wiring terminals are recommended for use with VersaMax Micro PLC modules:
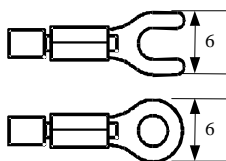
When using wiring terminals, be sure to tighten screws adequately, so the wiring terminals will not become loose.

Alternatively, each module screw can accept:

- One wire, size AWG14 to AWG22 (2.1 to 0.36 mm^2) or:

- Two wires, size AWG16 to AWG22 (1.3 to 0.36 mm^2)

Terminal Screws

Should any of the terminal screws be lost or damaged, they can be replaced with M3 x 0.6mm pitch screws of the type shown below.

M3
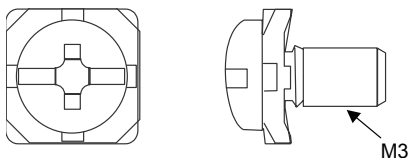
Providing Fusing for Outputs

Outputs with electronic short-circuit protection are available on several Micro PLCs and Expansion Units. All other module outputs should be externally-fused (1 Amp to 2 Amp fuse) to protect the output point contacts. For lighter loads, the internal common fuse (3.15 amp) can be replaced with a 1 amp fuse to protect the output point without adding the external fusing.

Providing Suppression Circuits for Inductive Loads

Typical Relay Output Circuit
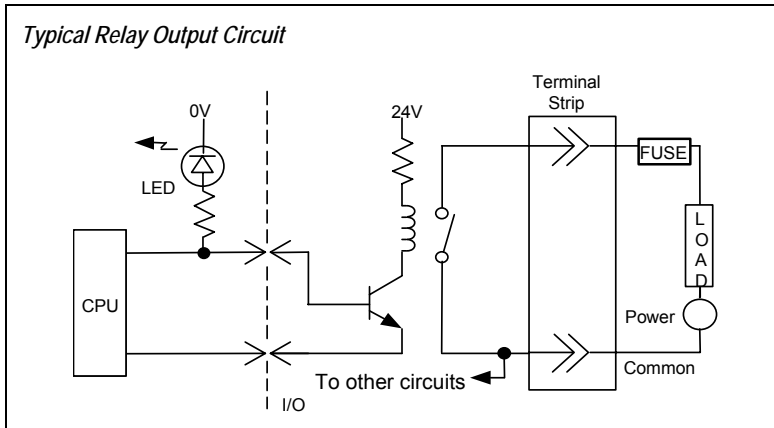
Installing suitable suppression across inductive loads enhances reliability of relay contacts. When switching inductive loads, relay contact life approaches resistive load contact life if suppression circuits are used. The 1A, 100V diode shown in the typical DC load suppression circuit is an industry standard 1N4934.
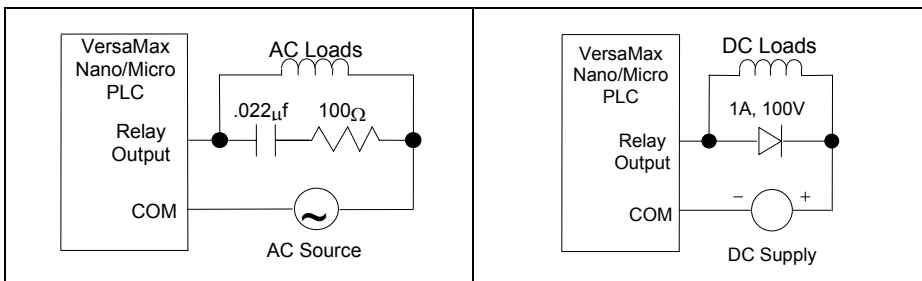
Typical DC Input Circuits

All DC inputs can be connected as either positive or negative logic.

Typical 12/24 VDC Positive/Negative Logic Input Circuit

* Positive connection shown; reverse polarity of 12/24VDC power supply connections for negative connection.

Terminal Strip

5V

5V

LED

2.8kΩ

High Frequency Filter

* 12/24 VDC

COM

To other circuits

I/O

CPU
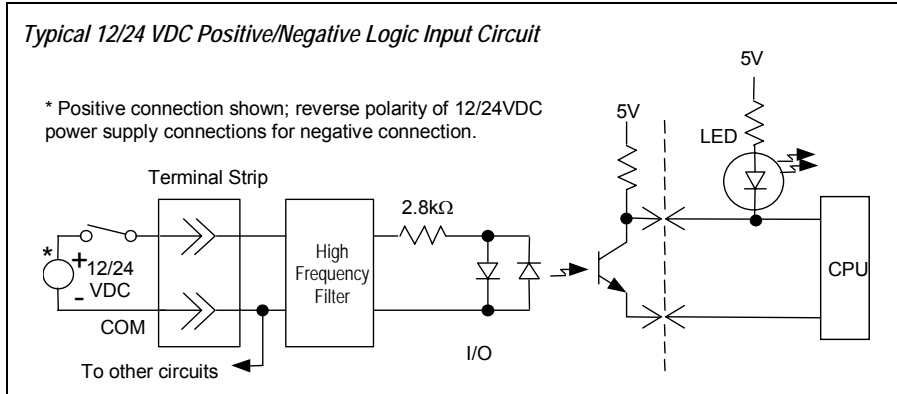
Positive and Negative Logic Definitions

The IEC definitions for positive logic and negative logic, as applied to the PLC I/O circuits, are shown below.

Input Points– Positive Logic	**Input Points – Negative Logic**
IEC Sink In — Input — +24V — 0V — Com	Com — IEC Source In — +24V — 0V — Input
▪ Equivalent to IEC sink input points.	▪ Equivalent to IEC source inputs.
▪ Sink current from the input device to the user common or negative power bus.	▪ Source current through the input device to the user common or positive power bus.
The input device is connected between the positive power bus and the input terminal. The negative bus is connected to the input circuit common.	The input device is connected between the negative power bus and the input terminal. The positive bus is connected to the input circuit common.

Typical DC Output Circuits

Typical Transistor Output Circuit 12 VDC
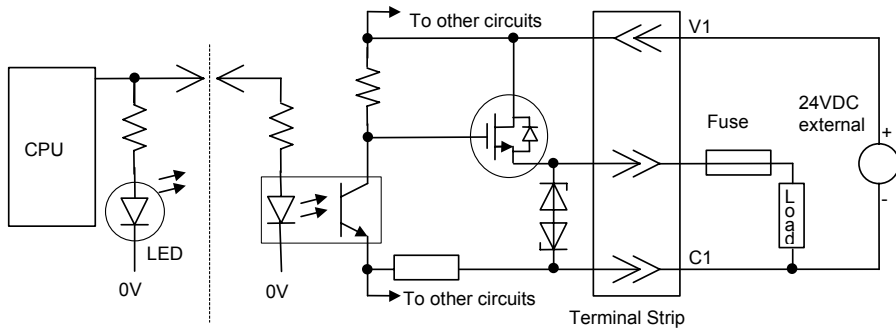
Typical Transistor Output Circuit 24 VDC
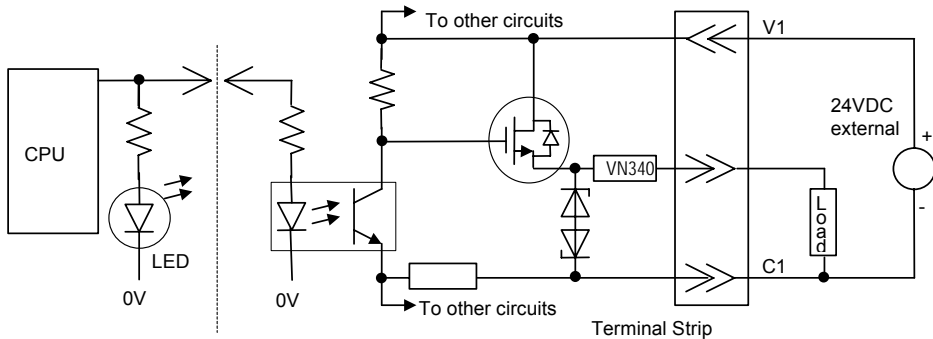
For Micro -10, -14, -23 and -28 PLCs, when using the outputs as PWM or Pulse Train Outputs, and for duty cycles in the lower ranges (5% and lower), a pulldown resistor must be connected between the output point (Q1-Q3) and the common terminal (C1). A 1.5 Kohm, 0.5 watt resistor is recommended.

Micro -20, -40, and –64 PLCs **do not** require a pulldown resistor.

Output Points – Positive Logic

- Equivalent to IEC source output points.
- Source current to the loads from the user common or positive power bus.

The load is connected between the negative power bus and the module output.
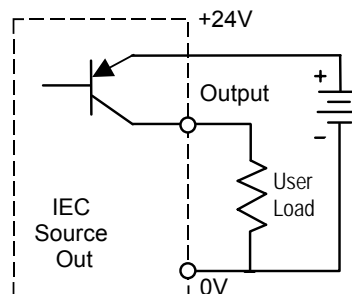
Output Points – Negative Logic

- Equivalent to IEC sink output points
- Load is connected between positive power bus and module output.
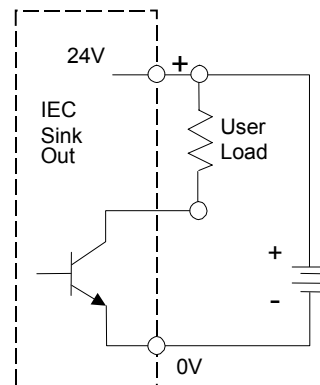
Typical High-Speed Counter Connections

High Speed Counter Circuit – Positive Logic Connection
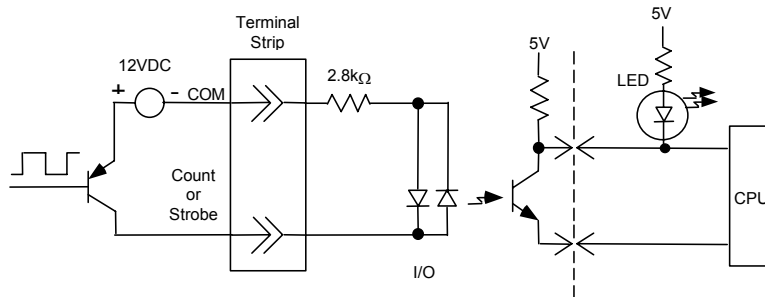
High Speed Counter Circuit – Negative Logic Connection
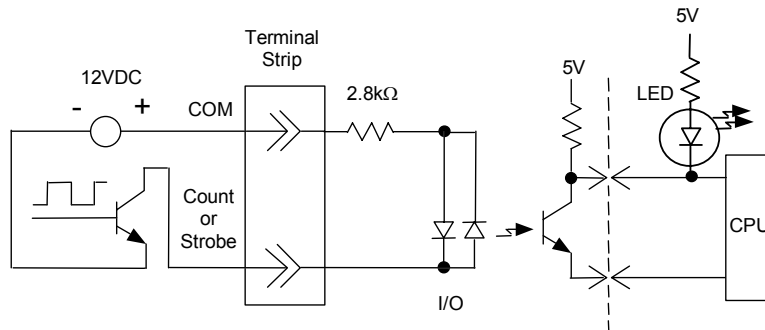
When I1-I6 on a Micro PLC are used as High-speed Counter inputs, the input switches should be solid state to prevent switch bouncing, which could cause unintended high speed counter counts or strobe input signals.

Added Resistance for 20, 40, and 64-Point Micro PLCS at Higher Count Rates

When using count rates about 30KHz on a 20, 40, or 64-Point Micro PLC, a 1kOhm, 3Watt resistor should added between the common and the Count input as shown below.

High Speed Counter Circuit – Positive Logic Connection
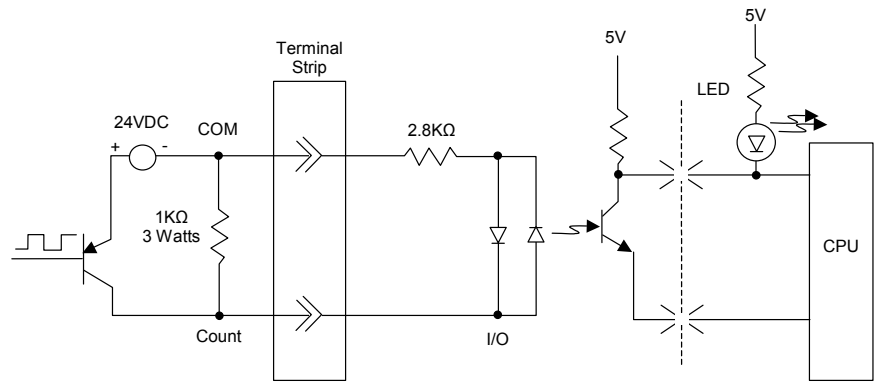
High Speed Counter Circuit – Negative Logic Connection
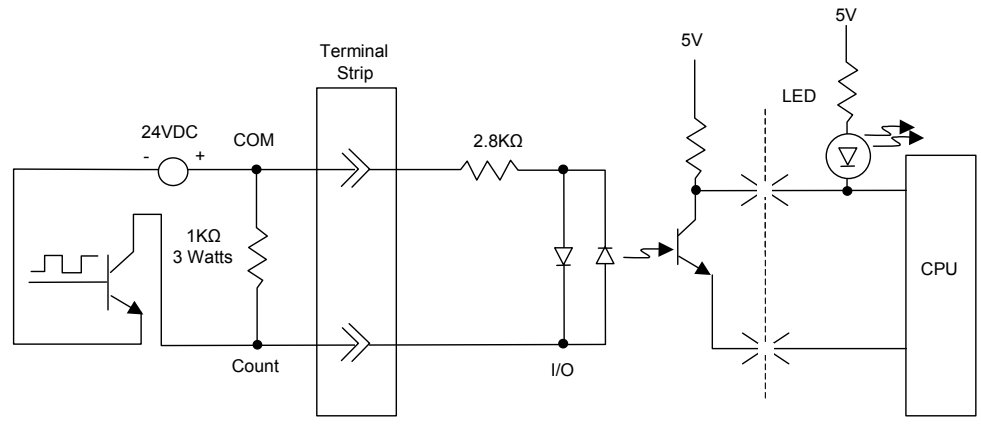
Typical AC Input and Output Circuits

Typical 120 VAC Input Circuit
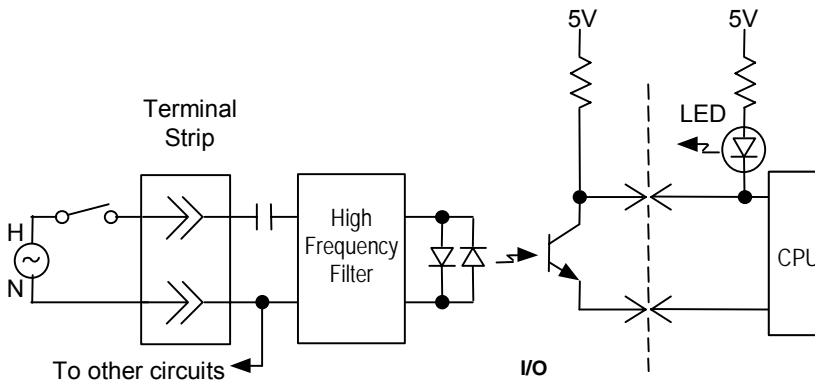
Typical 120/240 VAC Triac Output Circuit
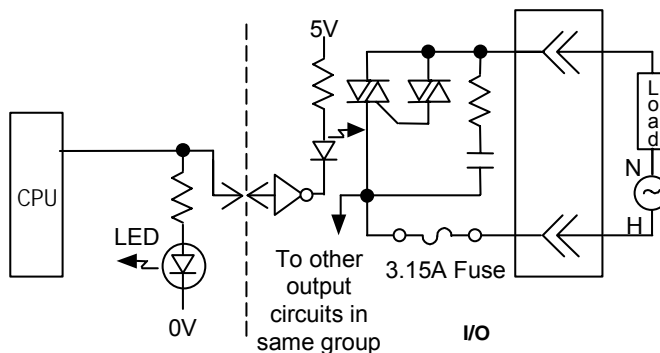
Typical Analog Input and Output Circuits

Analog Input Circuit
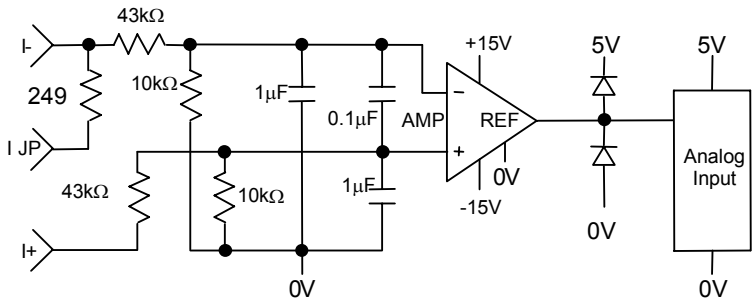
Analog Output Circuit
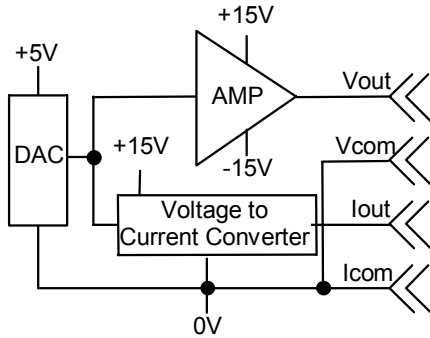
Starting Up the PLC

Before applying power to the PLC:

- Be sure all mounting screws, terminal screws, cables and other items are properly tightened and secured.

Warning

- On a Micro PLC CPU or Expansion Unit, be sure the protective covers are installed over terminals when power is applied to the unit. The covers protect against accidental shock hazard that could cause severe or fatal injury.

- Double-check all wiring. Faulty wiring may damage the PLC.

- Do not turn on the power supply to a broken PLC.

- Be sure that Expansion Units connected to the Micro PLC are wired to the same power source and that the PLC and Expansion Units will power up together. If an attached Expansion Unit is left unpowered, the Micro PLC may not power up properly.

Warning

Always turn off the power supply to the PLC before attempting any of the following. Performing any of these acts may result in electrical shock, damage to the PLC or faulty operation.

A. Assembling the PLC.
B. Connecting or disconnecting cables or wiring.
C. Connecting a Frame Ground (earth) terminal to the metal plate or metal case.

Turning off Power to the PLC

Caution

During a gradual power down, when the input power supply voltage is below the minimum operating voltage, the PLC may power off and then power on again until the input voltage drops low enough to prevent power on again. You should take precautions if this type of behavior cannot be tolerated in your application.

Normal Powerup Sequence

Apply the required power to the power inputs and observe the LEDs. A 14-point Micro PLC is shown below. Other PLC models and expansion units have different LEDs.
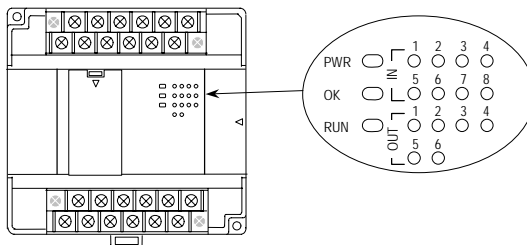
- The PWR LED should light.

- The OK LED blinks during power-up diagnostics. (Micro PLCs that do not have expansion units can be configured to skip powerup diagnostics, as explained in chapter 16.) When diagnostics have successfully completed, the OK LED changes to a steady on state. The RUN LED goes ON if the unit is configured to run on power-up. If the Run LED does not light when you go to Run mode, the cause could be invalid configuration or a fatal error in the CPU fault table.

- If any input points have been wired to field devices that energize those circuits, the corresponding input LEDs should also be ON. (On Analog, RTD and Thermocouple Expansion Units, the input 1-4 LEDs should be OFF during normal operation). Refer to chapter 12 for details of LED operation for analog expansion units. Refer to chapter 13 for details of LED operation for RTD and Thermocouple units.

- If the RUN LED on the Micro PLC CPU is not ON, all output LEDs should be OFF (in STOP with I/O Disabled mode).

- After powerup and program download, check the program for proper execution.

Micro PLC LEDs

Symptom	Action
PWR LED does not light.	1. Check that the proper power source is provided and is on. 2. With power supply off, check wiring to the module unit to be sure it is connected correctly.
PWR LED is ON OK LED is OFF	(This indicates that the power source is good and that the CPU has detected an internal fault. Be sure all the DIP switches are in the "OFF" position (down).
PWR LED is ON. OK and RUN blink together.	The PLC is in system bootloader mode and is awaiting a system firmware download from the Winloader tool.
PWR LED is ON. OK is blinking.	The PLC features built-in blink codes to assist in troubleshooting.

Adjusting the Analog Potentiometers

Two potentiometers located behind the left door of a 14-, 23-, or 28-point Micro PLC can be adjusted to lower or raise the values in analog registers %AI16 and %AI17. The left potentiometer, labeled VR1, adjusts the value in register %AI16. The right potentiometer, VR2, adjusts the value in %AI17.

To adjust the potentiometers, use a small screwdriver. Turning a potentiometer clockwise increases the value.
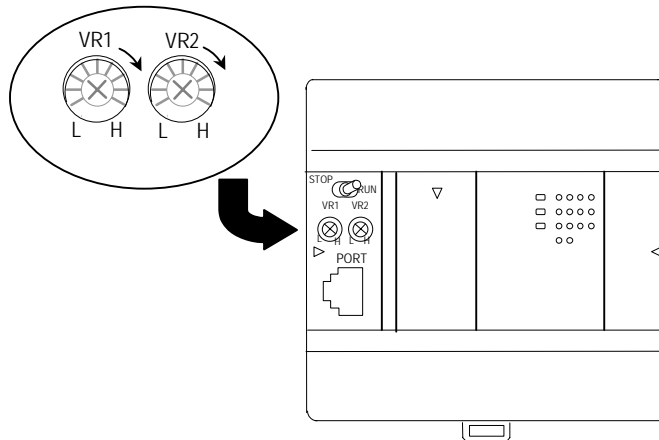
DIP Switches

4-Position DIP Switches on Micro PLC CPUs

The DIP switches located behind the removable door on the front of a 14-, 20-, 23-, 28-, 40-, or 64-point Micro PLC are factory-set to OFF (down position) as shown below, and should not be changed.

Switches should be
set to OFF
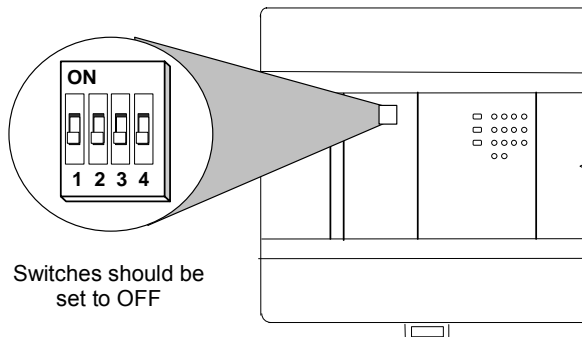
DIP Switches on an Analog Expansion Module Select Count Resolution

For analog expansion units, count resolution is controlled by DIP switch 6, which should be set to ON by default. If unexpected results are observed, check the position of switch 6. If switch 6 is not ON, power down the system and set switch 6 to ON. Do NOT change any of the other switches.

For details, refer to "Count Resolution for Analog Expansion Units" in chapter 12.

DIP Switches on an RTD Expansion Module Select Update Rate

For RTD expansion units, DIP switch 2 can be changed to select channel update rate. For firmware versions 4.0 and higher, DIP switch 3 can be used to select between Compatible and High Accuracy modes.

For IC200UEX726 and UEX736 modules with firmware version 4.0 and higher, DIP switch 6 can be used to select output range.

For details, refer to "DIP Switches" in chapter 13.

DIP Switches on a Thermocouple Expansion Module Select Input Sensors/Mode

On Thermocouple modules, DIP switches 1–3 can be used to select input sensors for channels 1–4.

On Thermocouple modules with firmware versions 4.0 and higher, DIP switch 6 can be used to select between Compatible and High Accuracy modes.

If these settings are configured using Machine Edition software version 6.0 or later, the software configuration will override the DIP switch setting.

For details, refer to "DIP Switches" in chapter 13.

Installing/Replacing a Backup Battery

For 20-, 23-, 28-, 40-, and 64-point Micro PLCs, a backup battery can be installed to protect the RAM memory contents of the PLC when the PLC power supply is removed or turned off. It also backs up the CPU's real-time clock. Note: Use of another battery type may present a risk of fire or explosion.

Important: The Micro PLC power must be OFF when installing/replacing the battery.

IC200ACC414	Nominal Voltage 3.6 VDC @ 790 mAh	
Battery shelf life, not installed	Up to 5 years typical at 30 °C Up to 3 years typical at 55 °C	
Backup time with battery installed, Micro PLC continuously powered down	For units with serial number before 07000069274 13 months minimum at 70 °C 30 months minimum at 20 °C	For units with serial number after 07000069274 19 months minimum at 70 °C 121 months minimum at 20 °C

This battery replaces an earlier coin-type battery, IC200ACC403.

CPU Battery Consumption Data

Power	Battery Consumption per Hour		
	Micro PLC with a serial number before 07000069274	Micro PLC with a serial number after 07000069274	20-, 40-, and 64-Point Micro PLCs
ON	30 micro Amps	3 micro Amps	0 micro Amps
OFF	83 micro Amps @ 70C 36 micro Amps @ 20C	56 micro Amps @ 70C 9 micro Amps @ 20C	31 micro Amps @ 55C 3 micro Amps @ 25C

To replace a previously-installed battery, open the battery compartment door and remove the old battery assembly.

Insert the battery plug into the connector at the bottom of the battery compartment. Press it in until it clicks. Do not force the connection – the plug is keyed to prevent accidentally installing the battery in a reverse polarity.

Battery Compartment Door

TOP

Battery Connector
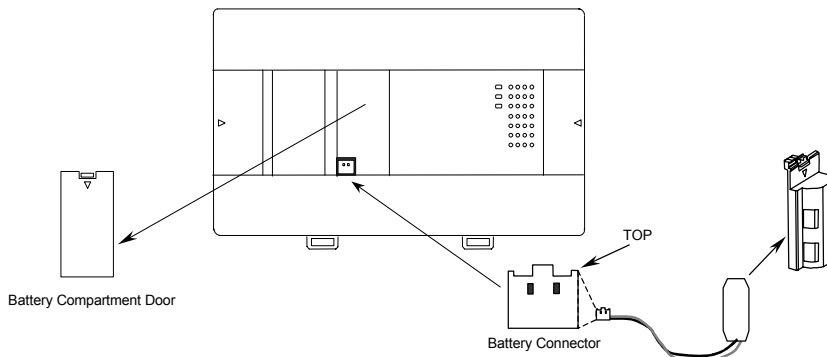
For a cylinder-type battery, tuck in the wires and snap the battery holder (see the illustration above) onto the VersaMax Micro PLC. The original battery compartment door is no longer needed.

For a coin-type battery, place the battery into the holder on the left side of the battery compartment and tuck in the wires. Close the battery compartment door securely.

Caution

Battery may explode if mistreated.

Do not recharge, disassemble, heat above 100 deg.C (212 deg.F) or incinerate.

Serial Port Connections

Providing Power to an External Device from Port 1 or 2

If either port is set up for communications with a serial device that requires 100mA or less at 5VDC, the device can obtain power from either Port 1 or Port 2. The total current drawn from both ports added together cannot exceed 100mA.

Short Circuit Protection on 5VDC for Units Later than June 2005

In the event that a short occurs across 5VDC on any serial port on a VersaMax Micro or Nano PLC manufactured after June 2005, date code 523 (the date code is a three-digit code located on side of unit) the unit will power down until the short is removed. By removing the short, the unit will recover fully.

Micro and Nano PLCs prior to date code 523 have a non-replaceable internal fuse for 5VDC. On those units, if the fuse blows, the RS-232 continues to function but the port no longer provides 5VDC to external devices. The 5VDC is also lost on the RS-485 port.

Cable Lengths and Baud Rates

Maximum cable lengths (the total number of feet from the CPU to the last device attached to the cable) are:

> Port 1 (RS-232) = 15 meters (50 ft.)
> Port 2 (RS-485) = 1200 meters (4000 ft.)

Both ports support configurable baud rates from 300 to 19.2k bps (4800 bps to 38.4k bps for Micro 20/40/64 PLCs).

Port 1: RS-232

Port 1 is an RS-232 port with a 8-pin RJ-45 vertical jack. In addition to being a general serial communications port, this port is also used as the boot loader port for upgrading the PLC firmware.

Top of Module

Pin 8

Pin 1

RJ-45 Cable with Plug

Micro or Nano PLC Serial Port on PLC, 8-Pin RJ-45 Jack Orientation

8
7
6
5
4
3
2
1
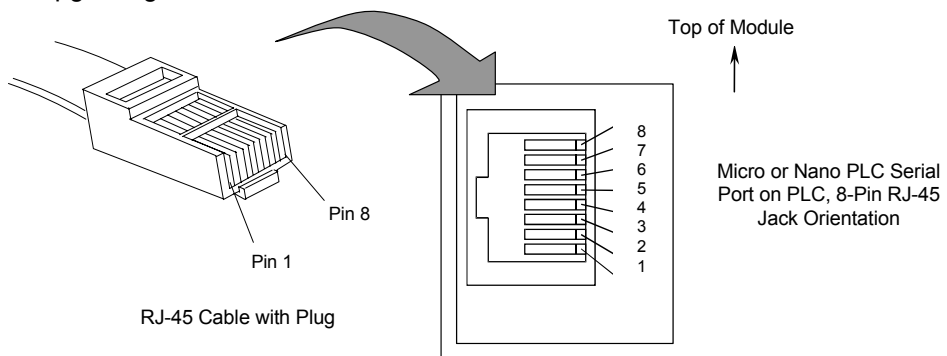
Note: There is no shield or frame-ground or shield pin on this connector.

Pin	Signal	Direction	Function
1	RTS	Output	Request to Send output
2	CTS	Input	Clear to Send input
3	RXD	Input	Receive Data input
4	TXD	Output	Transmit Data output
5	DCD	Input	Data Carrier Detect input
6	DTR	Output	Data Terminal Ready output
7	+5V	Output	+5VDC output to power external protocol converters
8	GND	--	0V/Gnd signal reference

Port 1 Cable Wiring to a 9-pin D-sub PC-style RS-232 Port

An RJ-45 to DB9F adapter can be used to connect Port 1 to the standard 9-pin D-Sub port found on most PCs. Programmer wiring to an RJ-45 to DB9F adapter is shown below. For a PC that is not used as a programmer, only the Transmit, Receive, and Ground wires are needed on port 1 and Port 2.

**To IBM-AT RS232 Port
(9-pin Female)**

**RJ45 Jack
To VersaMax Nano/Micro Port 1
(8-pin RJ-45 to RJ-45 cable wired
straight through)**
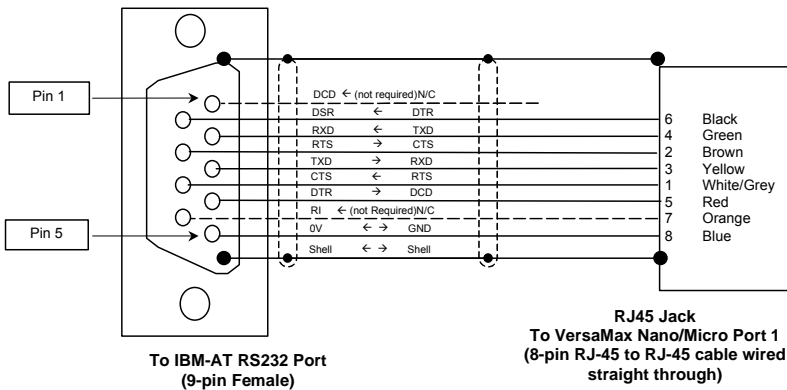
* Dotted lines are optional wires and not required

RJ45 to DB9F Adapter Wiring

The color codes shown below are standard for most RJ-45 to DB9F adapter kits, but be sure to review your kit's particular documentation. Wire the adapter kit following the pin numbers as shown.

Adapter Wire Color	DB9F pin	RJ45 pin	Micro PLC signal	DB9F (PC Serial Port) signal
n/c	1	-	n/c	DCD (in)
Green	2	4	TxD (out)	RxD (in)
Yellow	3	3	RxD (in)	TxD (out)
Red	4	5	DCD (in)	DTR (out)
Blue	5	8	Ground	Ground
Black	6	6	DTR (out)	DSR (in)
Brown	7	2	CTS (in)	RTS (out)
White	8	1	RTS (out)	CTS (in)
Orange	9	7	+5V (out)	RI (in)

Port 2 on 23-Point and 28-Point Micro PLCs: RS-485

Pin Assignments for Port 2

Port 2 on 23-point and 28 point VersaMax Micro PLCs is an RS-485 port with a 15-pin female D-sub connector.
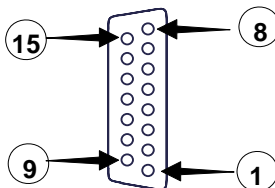
This can be attached directly to an RS-485 to RS-232 adapter (IC693ACC901 or similar).

Pin	Signal	Direction	Function
1	SHLD	--	Cable Shield Drain wire connection
2, 3, 4	n/c		
5	P5V	Output	+5VDC to power external devices (100mA max.)
6	RTSA	Output	Request to Send (A) output
7	GND	--	0V/GND reference signal
8	CTSB'	Input	Clear to Send (B) input
9	RT	--	Resistor Termination (120 ohm) for RDA'
10	RDA'	Input	Receive Data (A) input
11	RDB'	Input	Receive Data (B) input
12	SDA	Output	Transmit Data (A) output
13	SDB	Output	Transmit Data (B) output
14	RTSB	Output	Request to Send (B) output
15	CTSA'	Input	Clear to Send (A) input
Shell	SHLD	--	Cable Shield wire connection / 100% (Continuous) shielding cable shield connection

Connector and Cable Specifications for Port 2 on 23-Point and 28-Point Micro PLCs

Vendor Part numbers below are provided for reference only. Any part that meets the same specification can be used.

Cable: Belden 8105	Low Capacitance Computer cable, overall braid over foil shield 5 Twisted-pairs † Shield Drain Wire † 30 Volt / 80°C (176°F) 24 AWG tinned copper, 7x32 stranding Velocity of Propagation = 78% Nominal Impedance = 100Ω †			
15 Pin Male Connector:	Type: Crimp	Vendor: ITT/Cannon AMP	Plug: DAA15PK87F0 205206-1	Pin: 030-2487-017 66506-9
	Solder	ITT/Cannon AMP	ZDA15P 747908-2	-- --

Connector
Shell:
	Kit* – ITT Cannon DA121073-50 [15-pin size backshell kit]:
	    Metal-Plated Plastic (Plastic with Nickel over Copper) †
	    Cable Grounding Clamp (included)
	    40° cable exit design to maintain low-profile installation
	Plus – ITT Cannon 250-8501-009 [Extended Jackscrew]:
	    Threaded with (metric) M3x0.5 for secure attachment †
	    Order Qty 2 for each cable shell ordered			

† Critical Information – any other part selected should meet or exceed this criteria.

RS-485 Point to Point Connection with Handshaking

In point-to-point configuration, two devices are connected to the same communication line. For RS-485, the maximum cable length is 1200 meters (4000 feet). Modems can be used for longer distances.
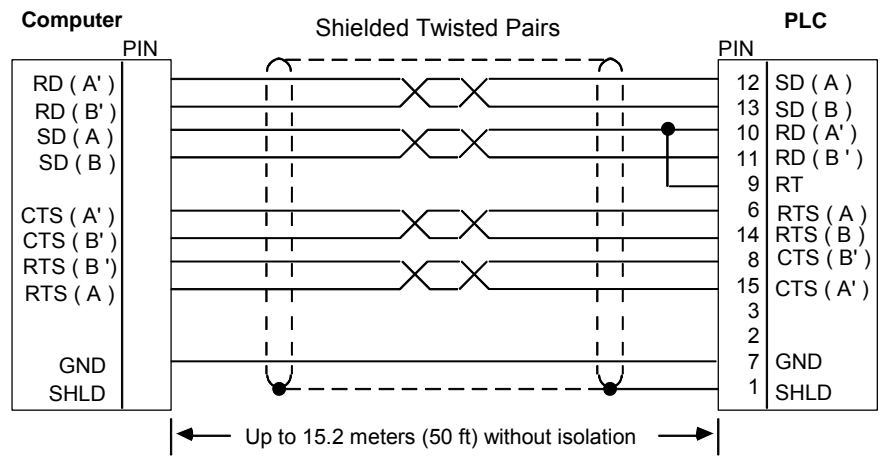
Port 2 RS-485 Option Module on 20 / 40 / 64-Point Micro PLCs

See chapter 13 for more information about communications option modules.
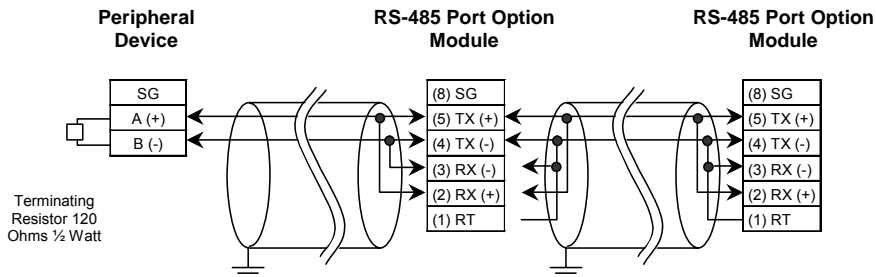
Connections: Peripheral Device to RS-485 Option Module
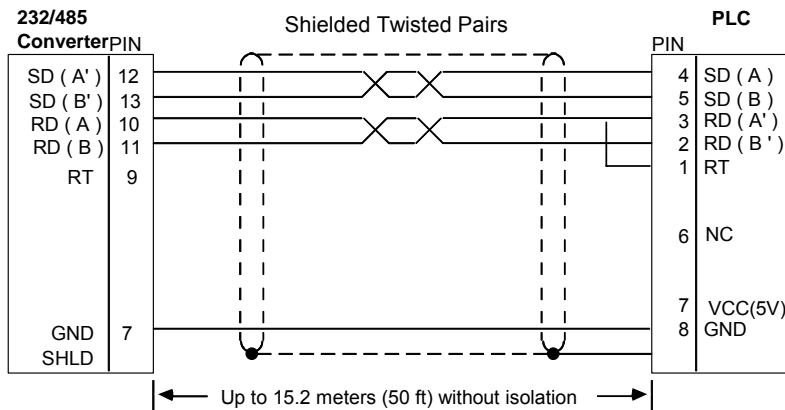
Note : The connection to peripheral device is through 232/485 converter . Diagram gives the RS485 communication part of the PLC with the converter.

On the 232 side of the converter peripheral device needs to be connected.

Connections, Micro-28 PLC to Micro-20,-40 or -64 PLC Master/Slave
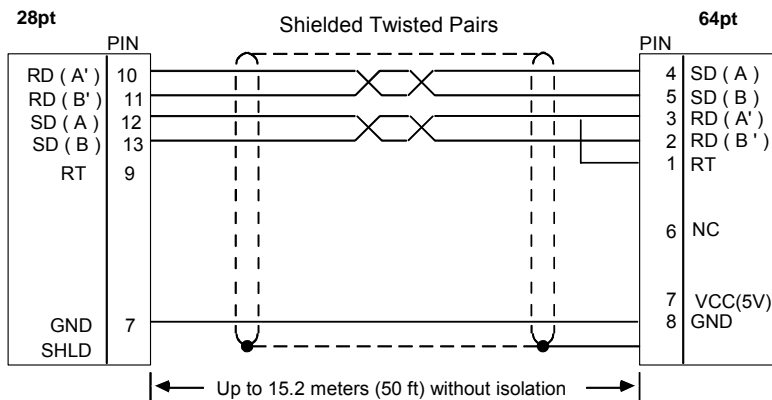
RS-485 Multidrop Serial Connections

The Micro PLC supports a maximum of eight devices on a single serial link per network. This number can be increased with the use of a repeater. For additional information on serial communications, refer to the *Series 90 PLC Serial Communications User's Manual*, GFK-0582.

In the multidrop configuration, the host device is configured as the master and one or more PLCs are configured as slaves. The maximum distance between the master and any slave may not exceed 4000 feet (1200 meters). Any installation with PLCs over 50 feet (15.2 meters) apart must include optical isolation.
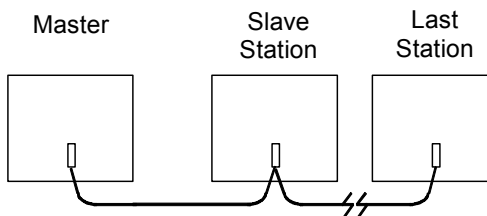
The RS-485 line must include handshaking and use wire type specified earlier. Reflections on the transmission line can be reduced by daisy-chaining the cable as shown. Make connections inside the connector to be attached to the PLC. Avoid using terminal strips to other types of connectors along the length of the transmission line.

Termination resistance for the Receive Data (RD) signal must be connected only on units at the ends of lines. This termination is made at the CPU by connecting a jumper between pin 9 and pin 10 inside the D-shell connector.

Ground Potential: Multiple units not connected to the same power source must have common ground potential or ground isolation for proper operation of the system.

RS485 Port Isolator

The IC690ACC903 RS-485 Port Isolator can be connected directly to the Micro PLC's RS-485 serial port, or panel-mounted and connected to the Micro PLC using a short extender cable. The extender cable is intended for use in applications where direct connection to the port is obstructed by surrounding equipment or where it is not acceptable for the device to protrude from the Micro PLC. The Port Isolator can operate in either single- or multi-drop mode, which is selected by a slide switch on the top of the module. The Port Isolator provides the following features:

- Four opto-isolated signal channels: SD, RD, RTS, and CTS

- Electrical compatibility with RS-485

- Single- or multi-drop operation

- Input termination consistent with standard for serial channels

- A 5V DC/DC converter for power isolation

- Hot insertion is supported
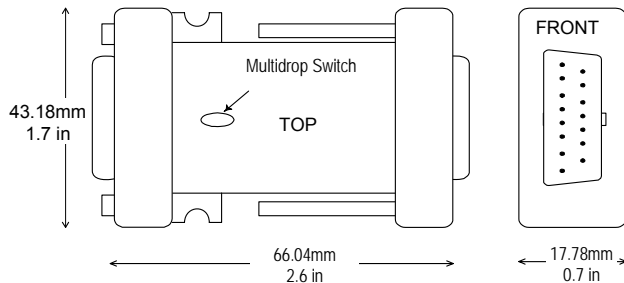
Port Isolator Specifications

Mechanical	
RS-485	15-pin D shell male for direct mounting to serial port on the CPU
	15-pin D shell female for communication cable
Installation Hardware	Two M3 thread connector thumbscrews. Recommended torque: 8 in./lbs. (supplied with Isolator). Two #6/32 thread panel mounting screws. Recommended torque: 12 in./lbs. (user supplied)
Electrical	
Voltage Supply	+5VDC (supplied by port)
Typical Current	25 mA; 100 mA available for external equipment
Ground Isolation	500 Volts
Conformance	EIA-422/485 Balanced Line
Operating Temperature	0° - 70°C (32° - 158° F)
Baud Rate	Those supported by PLC

Port Isolator Connectors

The Isolator has two connectors, one 15 pin male D-type (PL1) and one 15 pin female D-type (PL2). The pin assignments are identical, except that pin 4 on PL2 is connected to the module ID resistor.

RS-485 Connector Pin Assignments

	Pin	Pin Name	Pin Type	Description
PL1	1	SHLD	-	Chassis Ground
	2	NC	-	
	3	NC	-	
	4	NC	-	
	5	5V	-	+5V power
	6	RTS (A)	In	Request to send -
	7	0V	-	Signal Ground
	8	CTS (B')	Out	Clear to send +
	9	NC	-	
	10	RD (A')	Out	Read data -
	11	RD (B')	Out	Read data +
	12	SD (A)	In	Send data -
	13	SD (B)	In	Send data +
	14	RTS (B)	In	Request to send +
	15	CTS (A')	Out	Clear to send -
PL2	1	NC	-	
	2	NC	-	
	3	NC	-	
	4	TESTID	-	ID resistor
	5	5V	-	+5V power
	6	RTS (A)	Out	Request to send -
	7	0V	-	Signal Ground
	8	CTS (B')	In	Clear to send +
	9	RT	-	Terminating Resistor*
	10	RD (A')	In	Read data -
	11	RD (B')	In	Read data +
	12	SD (A)	Out	Send data -
	13	SD (B)	Out	Send data +
	14	RTS (B)	Out	Request to send +
	15	CTS (A')	In	Clear to send -

- Use the terminating resistor if the Port Isolator is used in port-to-port mode or at the end of a multi-drop configuration. To terminate the RD balanced line, place a jumper wire from pin 9 to pin 10.

- A denotes – and B denotes +. A and B denote outputs and A' and B' denote inputs.

Installing the Port Isolator

The Isolator is packaged in a contoured plastic enclosure designed for either direct attachment to a serial port or through a 12" extender cable for panel-mounted equipment. Two M3 thumbscrews secure the device to its mating connector. It can be easily inserted into an existing communication channel with no additional hardware.

Micro PLC

RS-485 Port Isolator

4000 ft SNP Cable
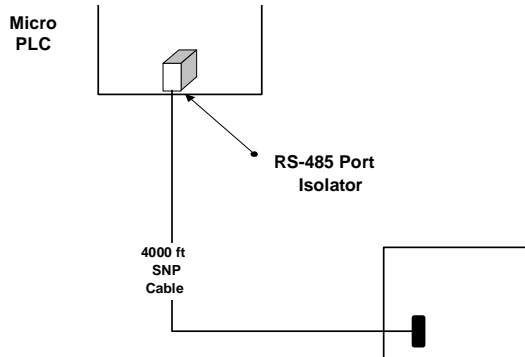
When installing the Port Isolator on a panel, you will need to provide two #6-32 mounting screws.

#6-32 screw

Multidrop Switch

TOP VIEW

#6-32 screw
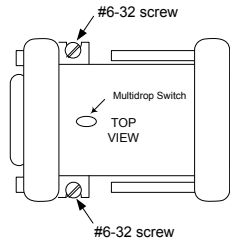
When installing the Isolator, tighten the connector screws and panel mounting screws (if used) to the following torque values:

Screws	Type	Torque
Connector Thumbscrews (supplied with Isolator)	M3	8 in/lbs
Panel Mounting Screws (user-supplied)	#6/32	12 in/lbs

The RS485 Port Isolator supports both port-to-port and multi-drop configurations.

Multidrop Cable Connecting Devices with 15-Pin Ports and 25-Pin Ports

To Other Slave Devices
(Maximum of 8 devices on a multidrop)
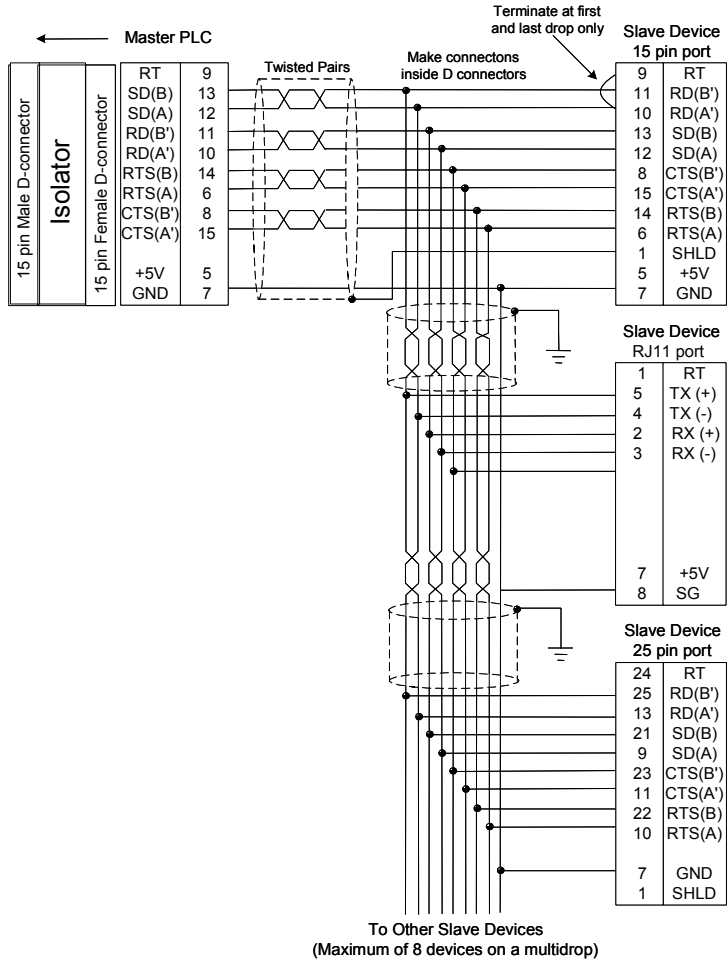
Cable for Supplying External Power Through the Port Isolator

If the Isolator is powered by a source other than the host port, you will need to build a custom cable as shown below.
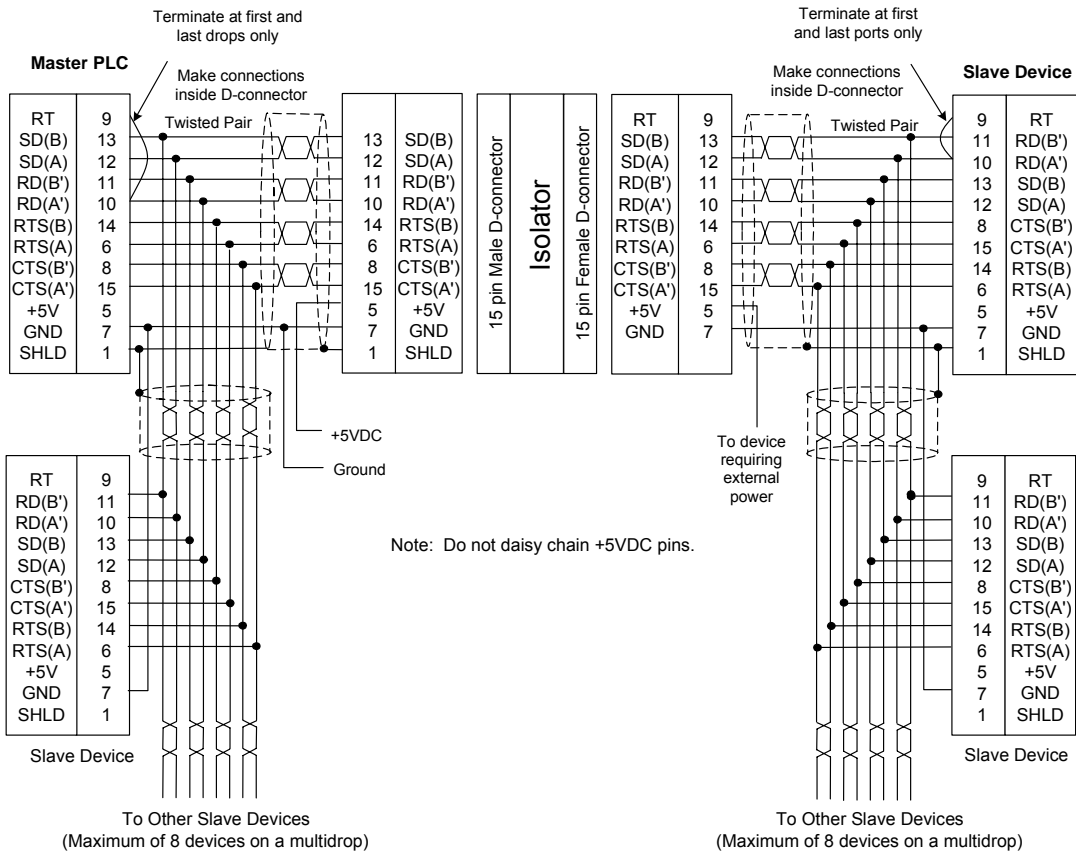
RS-232 to RS-485 Adapter
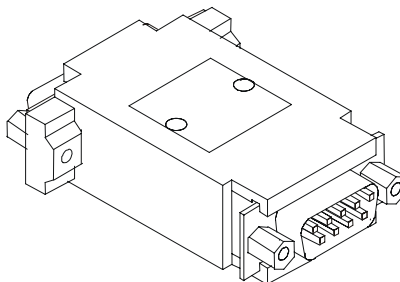
The RS-232 to RS-485 Adapter (IC200ACC415) connects a VersaMax Nano PLC or VersaMax Micro PLC to an RS-485 communications bus. It supports RS-485 multi-drop connections.

In conjunction with an RJ45 to DB9 Female cable (IC200CBL500), the adapter converts from the RS-232 (9-pin D-sub male) connector on the Nano/Micro PLC to an RS-485 (15-pin D-sub female) connector.

Two LEDs on the adapter indicate activity on the transmit and receive lines.

Power for this adapter is provided by the Micro/Nano PLC.

Dimensions of the Adapter are shown below.
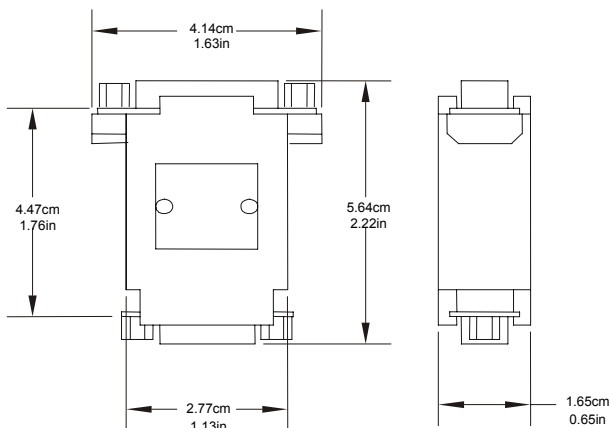
Specifications

Temperature Rating	0 to 55ºC
Storage Temp. Rating	-10 to 75ºC
Humidity	5 to 95%
Shock	MIL-STD 810C, 15G
Noise Immunity	Ansi/EE C37.90A, 801.2 ESD L3, 801.3 L3, 801.6 RF, 801.4 Fast Transient L3, 801.5 Surge, EN55011 Emissions
Agency Approvals	UL (Class 1, Div 2) for Nano/Micro PLC version B and higher , CUL and CE

Adapter 15-pin RS-485 Port Connector

The adapter's RS-485 port is a standard SNP Port (15-pin D-sub female) connector. It supports EIA/TIA-485 (RS-485) compatible signal levels. The pin assignments of the RS-485 connector are shown below.
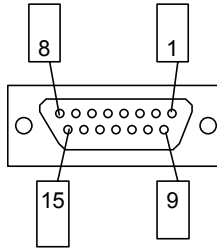
Adapter RS485 Port Pin Assignments

Pin	Function	Dir.	Pin	Function	Dir.
1	Shield / Frame GND	-	9	RT (RD Term)*	-
2	N/C		10	RD(A')	In
3	N/C		11	RD(B')	In
4	N/C		12	SD(A)	Out
5	+5VDC	Out	13	SD(B)	Out
6	RTS(A)	Out	14	RTS(B)	Out
7	GND	-	15	CTS(A')	In
8	CTS(B')	In	[Shell]	Frame GND	

* RT pin is connected with a 120 ohm resistor to pin 11: RD(B') to provide a simple end-of-line termination through a jumper in the backshell between pin 10 and pin 9.

Adapter 9-pin RS-232 (D-sub Male) Port Connector

The Adapter's RS-232 port matches the industry standard PC 9-pin male serial port. This port accepts the same cable (IC200CBL500) used to communicate directly from the Micro/Nano's RJ-45 jack to a PC. This port supports EIA/TIA-232 (RS-232) compatible signal levels. The +5VDC output from the Nano/Micro PLC is routed to pin 9 on this cable and is used to power the converter.
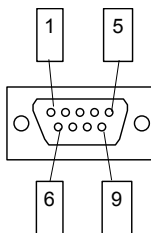
Adapter RS-232 Port Pin Assignments

Pin	Signal	Dir.	Function
1	DCD	Input	(No Connect)
2	RXD	Input	Receive Data
3	TXD	Output	Transmit Data
4	DTR	Output	(No Connect)
5	GND	--	0V/Gnd signal
6	DSR	Input	(No Connect)
7	RTS	Output	Request to Send
8	CTS	Input	Clear to Send
9	+5V	Input	+5VDC power in
SHELL	SHLD	--	Cable Shield wire connection

Replacing AC Output Module Fuses

Caution

There are *no* user-replaceable parts in the DC In/Relay Out or DC In/DC Out Micro PLCs.

The AC In/AC Out model Micro PLCs (IC200UAA003/IC200UAA007) provide user-replacable fuses for their AC output points. Because each output fuse is on the common of several circuits, a blown fuse will prevent the entire group associated with it from working.

Warning

Remove power from the unit before removing field wiring or removing the front cover. Failure to remove power from the unit before disassembling it could cause severe or fatal injury to personnel.

Caution

Do not attempt to remove the circuit boards from the Micro PLC assembly, or to replace fuses on the power supply board. Any disassembly beyond removing the front cover and replacing AC output fuses could damage the unit and will invalidate the warranty.

Fuse replacement should only be performed by qualified service personnel.

The plug-in fuses are located on the I/O circuit board, which is accessible after removing the Micro PLC front cover. To replace these fuses:

1. Remove power from the unit and I/O devices.
2. Remove terminal blocks with attached field wiring from the module
3. Remove front cover from the unit. (Gently press inward on both tabs on the sides of the unit and pull the cover straight off. Note: The CPU board assembly should remain captive inside the front cover as you remove it.)

2. Pull Cover Straight out to remove

1. Push Tabs at both ends of module

Side View

Push in both tabs at once
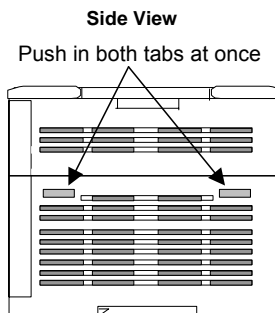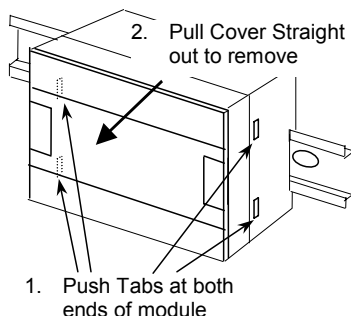
4. Replace each blown fuse with the appropriate fuse type.
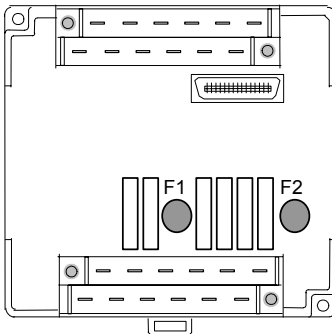
14-point Micro PLC (IC200UAA003)
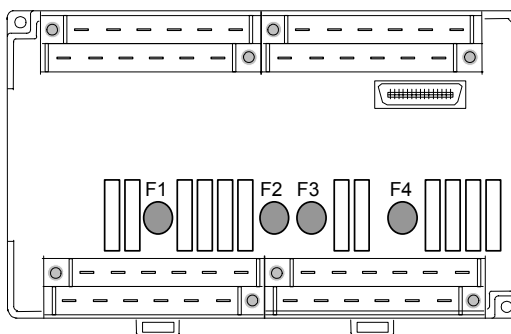
28-point Micro PLC (IC200UAA007)

Note

The fuses listed below are only for the output points on the AC In/AC Out Micro PLCs (IC200UAA003/IC200UAA007). Do not attempt to replace any other parts in any other Micro PLC unit.

AC Output Fuse Specifications

IC200UAA003 007	F1	Q1-Q2
	F2	Q3-Q6
IC200UAA007	F3	Q7-Q8
	F4	Q9-Q12
Rated Load Voltage		250 V
Current Rating		3.15 A
Manufacturer		WICKMANN USA, Inc. http://www.wickmannusa.com/
Manufacturer Part Number		TR5-F-373 series, 3.15A / 250V, Short Leads

Chapter
16

Configuration

This chapter explains how a VersaMax Nano PLC or Micro PLC is configured.

- Configuration Overview

- CPU Configuration

- Port 1 Configuration

- Port 2 Configuration

- Configuring Analog I/O Parameters

- Configuring High-speed Counter, PWM or Pulse Output Operation

Configuration selects the characteristics of module operation. It also establishes program references that will be used for each I/O point.

The PLC supports either autoconfiguration or storing a configuration from a programmer.

Configuration Overview

Autoconfiguration

A VersaMax Nano or Micro PLC automatically configures its default parameters every time it is powered on if no expansion modules are connected. If expansion modules are connected, auto configuration occurs the first time it is powered on and is then disabled after the initial auto configuration completes. Auto configuration may be re-enabled in a system that was previously auto configured with expansion modules by turning the Micro PLC and expansion modules off, disconnecting all expansion modules, and turning the Micro PLC on.

Auto configuration is also disabled when the Nano or Micro PLC receives a valid configuration from Logic Developer. Once auto configuration is disabled, it remains disabled and configuration is retained at power on until configuration is cleared with Logic Developer or the PLC is powered on with the battery removed and the memory backup capacitor discharged.

Software Configuration

Most PLC systems use a customized configuration that is created using configuration software and stored to the CPU from a programmer.

The CPU retains a software configuration across power cycles. After a software configuration is stored to the CPU, the CPU will not autoconfigure when power-cycled.

The configuration software can be used to:

- Create a new configuration
- Store (write) a configuration to the CPU
- Load (read) an existing configuration from a CPU
- Compare the configuration in a CPU with a configuration file stored in the programmer
- Clear a configuration that was previously stored to the CPU

The CPU stores a software configuration in its non-volatile RAM. Storing a configuration disables autoconfiguration, so the PLC will not overwrite the configuration during subsequent startups.

However, actually clearing a configuration from the programmer does cause a new autoconfiguration to be generated. In that case, autoconfiguration is enabled until a configuration is stored from the programmer again.

For a Nano or Micro PLC, one of the parameters that can be controlled by the software configuration is whether the CPU reads the configuration and program from Flash at powerup, or from RAM. If Flash is the configured choice, the CPU will read a previously-stored configuration from its Flash memory at powerup. If RAM is the choice, the CPU will read a configuration and application program from its RAM memory at powerup.

Storing a Configuration from a Programmer

A configuration can be stored from a programmer via the CPU port. The configuration takes place whether I/O scanning is enabled or not.

Storing a configuration disables autoconfiguration.

Note: If a hardware configuration is stored to the CPU, the configuration for the serial port to which the programmer is connected is not actually installed until the programmer is removed. After removal of the programmer, there is a delay before the new protocol begins operating. This delay is equal to the configured T3' time.

Clearing a configuration from the programmer causes a new autoconfiguration to be generated. Autoconfiguration will be enabled until the configuration is stored from the programmer again.

When a programmer is first connected to a Nano or Micro PLC, the PLC communicates using the default communications parameters: 19,200 baud, odd parity, one start bit, one stop bit, and eight data bits. If these parameters are re-configured, the new settings will be used at powerup instead.

CPU Configuration

CPU configuration establishes the basic operating characteristics of the PLC, such as whether it scans I/O while in Stop mode and how it behaves at powerup.

Feature	Description	Default	Choices
I/O Scan-Stop	Determines whether I/O is to be scanned while the PLC is in STOP mode.	No	Yes, No
Powerup Mode	Powerup mode for Nano PLC	Stop	Stop, Run
	Powerup mode for Micro PLC	Last	Last, Stop, Run
Logic/ Configuration from	Source of program and configuration when the a Micro PLC is powered up.	Flash for Nano, RAM for others	RAM, Flash
Registers	Selects source of register data when PLC is powered up.	Flash for Nano, RAM for others	RAM, Flash
Passwords	Determines whether passwords are enabled or disabled. (If passwords are disabled, the only way to enable them is to clear the Micro PLC memory.)	Enabled	Enabled, Disabled
Checksum Words	The number of words in the program to be checksummed each sweep. Entering 0 disables the checksum function.	8	8 to 32
Default Modem Turnaround Time	Modem turnaround time (10ms/unit) This is the time required for the modem to start data transmission after receiving the transmit request.	0mS	0–255mS
Default Idle Time	Time (in seconds) the CPU waits to receive the next message from the programming device before it assumes that the programming device has failed and proceeds to its base state. Communication with the programmer is terminated and will have to be reestablished.	10	1–60
SNP ID	The ID used for SNP communications if a serial port is configured for RTU Slave or Serial I/O. SNP communications will occur between the programmer and the CPU when the CPU is in Stop mode.		Editable value
Switch Run/Stop	Determines whether the switch will control Run/Stop mode operation.	Enabled	Enabled, Disabled
Switch Memory Protect	Determines whether the switch will control RAM memory protection.	Disabled	Enabled, Disabled

Feature	*Description*	*Default*	*Choices*
Diagnostics	Micro PLCs can be configured to power up more quickly by turning off the normal powerup diagnostics. However, unless your application requires unusually fast power up, leave this setting ENABLED. The DISABLED setting causes the Micro PLC to power up without running diagnostics. If powerup diagnostics are disabled, no expansion units can be used. (If expansion units are connected while powerup diagnostics are disabled, faults are logged in the I/O tables.) Micro PLC IC200UDR010 is guaranteed to power up within 100mS when powerup diagnostics is disabled.	Enabled	Enabled, Disabled
Fatal Fault Override	If the PLC powers up with fatal faults, it automatically sets fault references. If this parameter is set to Disabled, the CPU will then go to Stop mode. If this parameter is set to Enabled, the CPU can then be power cycled from Stop/Fault mode and it will go to Run/Stop mode.	Disabled	Enabled, Disabled
Memory Board	(for 20/40/64-Point Micro PLCs only) Sets up use of an optional memory module in the 64 Point Micro PLC.	RAM Only	RAM and Flash
Port 2 Configuration	(for 20/40/64-Point Micro PLCs only) Sets up the use of a Port 2 option module in the PLC. The port 2 options can then be configured.	None	RS232/USB, Ethernet, RS485. None
Sweep Mode	Normal: sweep runs until it is complete. Constant: sweep runs for time specified in Sweep Tmr.	Normal	Normal, Constant
Constant Sweep Time	If Constant Sweep mode was selected, a Constant Sweep Time (in milliseconds) can be specified.	100mS	5–200mS

Port 1 Configuration

Port 1, an RS-232 compatible serial port, is used to communicate with the programmer or for other communications. Configuration options for Port 1 are described below. See chapter 24 for more information about port protocols for the Micro PLC. Note that VersaMax Micro PLC and Nano PLC models prior to Release 3.0 do not support all port modes.

Feature	*Description*	*Default*	*Choices*
Port Mode	Defines the protocol for Port 1. This selection determines which of the additional parameters below are configurable.	SNP	SNP, RTU only, Serial I/O
Port Type	*SNP, RTU:* Configures the serial port as the slave or master device.	Slave	Master, Slave
Data Rate (bps)	Data transmission rate (in bits per second).	19200	300, 600, 1200, 2400, 4800, 9600, 19200, 38400
Flow Control	The type of flow control used on the port. Not editable.	None	None
Parity	Determines whether parity is added to words	Odd	Odd, Even, None
Stop Bits	Number of stop bits used in transmission. (Most serial devices use one stop bit; slower devices use two.)	1	1, 2
Bits / Character	Determines whether the CPU recognizes 8-bit or 7-bit characters.	8 bits	7 bits, 8 bits
Timeout	*SNP only:* Specifies the timeout value used by the protocol.	Long	Long, Medium, Short, None
Turn Around Delay	*SNP* only: Turnaround delay time in ms	0	0-255
SNP ID	*SNP only:* 8-byte network identifier for Port 1.	(none)	(none)
Station Address	*RTU:* Station address of the slave on the RTU network	1	1 to 247
	Serial I/O: A hexadecimal identifier used for Serial I/O protocol.	0	0 to FF hex

Timing Note for RTU Communications

When using RTU communications, it may be necessary to increase the RTU timeout configured on the master device as the PLC slave scan time increases. It is not necessary to change the configuration of the VersaMax CPU when the port is used in RTU slave mode.

Port 2 Configuration

On 23 and 28-point Micro PLCs, the built-in Port 2 provides general-purpose communications using SNP, SNPX, RTU slave and Serial I/O protocols. Port 2 can also be configured as an SNP/SNPX master. On 20-, 40-, and 64-point Micro PLCs, an optional RS-232, RS-485, or USB port module can be installed and configured as Port 2.

Port 2 configuration can be changed through the configuration utility, or by using the COMMREQ (communications request) function block within a logic program.

Feature	*Description*	*Default*	*Choices*
Port Mode	Defines the protocol for Port 2. This selection determines which of the additional parameters below are configurable.	SNP	*RS232/USB:* SNP, Serial I/O, RTU Only
			RS485: SNP, Serial I/O, RTU Only
Port Type	*For Port Modes SNP and RTU Only:* Configures the serial port as a slave (the responding device) or a master (the initiating device) in a master/slave system.	Slave	Slave, Master
Data Rate (bps)	Data transmission rate (in bits per second).	19200	RS-232/USB and RS-485: 300, 600, 1200, 2400, 4800, 9600, 19200, 38400 Ethernet: 19200, 38400,175000
Flow Control	The type of flow control used on the port. Not editable.	None	None
Parity	Determines whether parity is added to words	Odd	Odd, Even, None
Stop Bits	*For SNP, Serial I/O and Modbus with RS-485:* Number of stop bits used in transmission. (Most serial devices use one stop bit; slower devices use two.) For Modbus RTU, when using no parity, Stop Bits should be set to 2. If using Even or Odd parity, Stop Bits should be set to 1.	1	1, 2
Bits / Character	*For Serial I/O:* Determines whether the CPU recognizes 8-bit or 7-bit characters.	8 bits	7 bits, 8 bits

Feature	Description	Default	Choices
Timeout	*For SNP:* Specifies the timeout value used by the protocol.	Long	Long, Medium, Short, None
Turn Around Delay	*For SNP:* Turnaround delay time in ms	0	0-255
SNP ID	*For SNP and RTU only:* 8-byte network identifier for Port 2.	(none)	1 to 247
Station Address	*For Serial I/O:* A hexadecimal identifier used for Serial I/O protocol.	0	0 to FF
Duplex Mode	*For RS485 RTU*	2-Wire	2-Wire 4-Wire
	For RS485 Serial I/O	Point to Point	2-Wire 4-Wire, Point to Point

Configuring Analog I/O Parameters

For Micro PLC and Expansion Units with analog I/O, each analog channel can be individually configured to operate in either voltage or current mode. If current mode operation is selected, the range can then be configured as either 4-20mA or 0-20mA. For Nano PLCs with one analog input, the mode is always voltage. Reference addresses can also be selected as described above.

Mode	*Parameters*	*Default*
Voltage or current mode	Voltage, Current	Voltage
Current range selection	4–20mA 0–20mA	4–20mA
Voltage range selection (Expansion Inputs Only)	0 to 10,000mV -10,000 to 10,000mV	0 to 10,000mV

Configuring High-speed Counter, PWM or Pulse Train

All Nano PLCs and Micro PLCs with DC inputs are configurable for a mix of High-speed Counting features. Nano PLCs and Micro PLCs with DC outputs can also be configured with Pulse-Width Modulation and Pulse Train/Ramping Pulse Train features (only for 20-, 40-, or 64-point Micro PLC).

Configuring High-speed Counter, Pulse Train, Ramping Pulse Train, Motion Support, or PWM operation enables specific features and assigns them to dedicated references on the PLC. You can mix high-speed counting and regular I/O functions on the same Micro PLC, as long as there are references available.

HSC, PWM, and PTO Settings

First, the basic High-speed Counter, Pulse-Width Modulated, or Pulse Train Output Settings should be selected by double-clicking on HSC/PWM/PTO*.
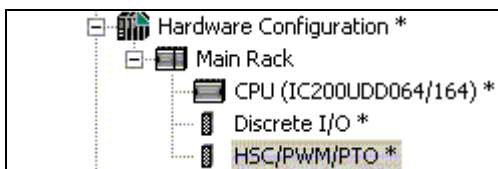
Selecting the Counter Type

Selecting a Counter Type sets up how the module's internal High-speed Counter features will be used. The choice for Counter Type determines which of the subsequent parameters can be configured. Counter Type choices depend on the type of Micro or Nano PLC being configured:

PLC	Counter Type Configuration for PLC Module					Configurable for Each Channel					
	3 Type A,	4 Type A	1 Type A, 1 Type B	4 Type A 32	1 Type A, 1 Type B 32	Standard	Counter	PWM	Pulse Train	Pulse Train with Ramp	Motion Support
All Nano PLCs	Yes	-	Yes	-	-	Yes	Yes	Yes	Yes	-	-
All Micro PLCs except UAA003 and UAA007	-	Yes	Yes	-	-	Yes	Yes	Yes	Yes	-	-
UAA003, 007	Feature Not Available										
20/40/64-Point Micro PLCs * Rel. 3.6 or later	-	Yes	Yes	Yes *	Yes *	Yes	Yes	Yes	Yes	Yes	Yes *

The Counter Type selection made for the module determines, in turn, the features that can be configured for the channels.

3 Type A (for Nano PLCs only)**.** Configures a Nano PLC's High-speed Counter functionality as three separate channels. Each channel can then be configured as a Type A Counter, OR as a standard, Pulse Train, or Pulse-Width Modulated output.

1 Type A / 1 Type B. Combines the functionality of channels 1, 2, and 3 into one Type B counter. For Micro PLCs, channel 4 can then be independently configured as a Type A Counter, OR as a standard, Pulse Train, or Pulse-Width Modulated output. Micro-20, -40, and -64 PLCs also provide Pulse Train with Ramp channel configuration.

4 Type A (for all Micro PLCs). Configures the Micro PLC's High-speed Counter functionality as four separate channels. Each channel can then be configured as a Type A Counter, OR as a standard, Pulse Train, or Pulse-Width Modulated output. Micro-20, -40, and -64 PLCs also provide Pulse Train with Ramp channel configuration.

1 Type A / 1 Type B_32) (for all Micro-20 and Micro-40 PLCs, and for Release 3.60 or later Micro-64 PLCs only). Combines the functionality of channels 1, 2, and 3 into one Type B counter. Channel 4 can then be independently configured as a Type A Counter, OR as a standard, Pulse Train, Pulse-Width Modulated, or Motion Support output.

4 Type A_32 (for all Micro-20 and Micro-40 PLCs, and for Release 3.60 or later Micro-64 PLCs only). Configures the Micro PLC's High-speed Counter functionality as four separate channels. Each channel can then be configured as a Type A Counter, OR as a standard, Pulse Train, Pulse-Width Modulated, or Motion Support output.

Output Stop Mode

This setting determines what outputs will do when the system is in Stop mode.

Normal means that High-speed Counter outputs continue to respond to the counter inputs and standard outputs turn off. Preset outputs continue to operate as though the CPU were present, changing state to reflect the counter Accumulators. Ramp Pulse and Motion outputs (for Micro-20, -40, and -64 PLCs) stop immediately when the PLC is put into Stop Mode.

Force Off means all Preset outputs are turned off and remain off until the CPU returns to normal operation.

Hold Last means Preset outputs retain current levels and do not reflect the counter Accumulators.

Reference Address, Length

The range of CPU memory references that will be used by the High-speed Counter features. Many of these memory references have specific defined functions as described in chapter 17. They can be used by the application program to send parameters and commands to a High-speed Counter, and to monitor counter operation.

Channel #1, 2, 3, 4 Parameters

After selecting the Counter Type on the HSC/PWM/PTO Settings tab, each channel can be configured on its Channel tab:

HSC/PWM/PTO Settings	Channel 1	Channel 2	Channel 3	Channel 4

Parameters	Values
Channel Function:	Counter
Counter Status:	Disabled
Count Direction:	Up
Count Mode:	Continuous
Preload / Strobe:	Preload
Preload / Strobe Input Edge:	Zero to Positive
Count Input Edge:	Zero to Positive
Time Base (mSec):	1000
High Limit:	32767
Low Limit:	0
On Preset:	32767
Off Preset:	0
Preload Value:	0

The Channel Functions that can be configured here depend on the Counter Type and Micro PLC type, as explained previously. Parameters for all Channel Functions are described below.

Channel Function: Counter

In Counter mode, the channel will operate as a High-speed Counter (Type A or Type B). See chapter 17 for a description of this feature. The following additional parameters can then be configured:

Counter Status: specifies whether the counter output is enabled.

Count Direction: for a Type A Counter only, this specifies whether count inputs increment *(Up)* or decrement *(Down)* the accumulator.

Count Mode: defines whether the counter wraps if the count limit is reached (*Continuous*) or if it stops at the counter limit (*Single Shot*).

Preload/Strobe: selects the function of the Preload/Strobe Input.

Preload/Strobe Input Edge: for Type A counters only. This non-editable parameter specifies that the *Zero to Positive* transition is used for a preload or strobe input.

Count Input Edge: for Type A counters only, this parameter specifies which transition of the counter is used as the count input. *Zero to Positive* is a low-to-high transition. *Positive to Zero* is a high-to-low transition.

Time Base (mSec): specifies the timebase for the Counts-per-Timebase register: The default is 1000mS. Range is 10mS to 65530mS.

High Limit: the counter's upper limit. It must be greater than the low limit.

Low Limit: the counter's lower limit.

ON Preset: defines the counter's ON preset.

OFF Preset: defines the counter's OFF preset.

Preload Value: the Preload value for the counter.

Channel Function: PWM

Selecting *PWM* as the Channel Function sets up the channel as a Pulse-Width Modulated output. See chapter 17 for a description of this feature.

The *Counter Status* parameter enables or disables the channel's PWM output.

Channel Function: Pulse Train

Selecting *Pulse Train* as the Channel Function sets up the channel as a Pulse-Train output. See chapter 17 for a description of this feature.

The *Counter Status* parameter enables or disables the channel's Pulse Train Output.

Channel Function: Standard

Selecting *Standard* as the Channel Function sets up the channel as a standard output.

The *Counter Status* parameter enables or disables the Standard output.

Channel Function: Pulse Train with Ramp

(Micro-20, Micro-40, and Micro-64 PLCs). If the Counter Type is configured as either 4 Type A or 1 Type A / 1 Type B (this choice is not available for 4 Type A_32 or 1 Type A / 1 Type B_32), selecting *Pulse Train with Ramp* sets up the channel as a Pulse Train output with the ability to accelerate and decelerate. See chapter 17 for a description of this feature.

The *Counter Status* parameter enables or disables the pulse output.

PTR Acceleration sets up the Pulse Train acceleration rate, from stop to full speed. For channels 1, 2, and 3, the range is 10 through 1,000,000. For channel 4, the range is 90 to 1,000,000.

PTR Deceleration sets up the Pulse Train deceleration rate, from full speed to stop. For channels 1, 2, and 3, the range is 10 through 1,000,000. For channel 4, the range is 90 to 1,000,000.

Channel Function: Motion Support

(Micro-20, -40, and -64 PLCs only. This feature requires Machine Edition version 5.5 SP2, Sim2 or later). Selecting *Motion Support* as the Channel Function sets up the channel as a Pulse Train output with the ability to accelerate and decelerate. See chapter 18 for a description of this feature.

The *Counter Status* parameter enables or disables the pulse output.

The *User Units* and *Counts* parameters set up a scaling factor for the Acceleration and Deceleration parameters of a motion profile. The possible ratio of User Units to Counts is 1:16 through 8:1.

Chapter

17

PLC Operation

This chapter describes the operating modes of the VersaMax Nano and Micro PLCs and shows the relationship between the application program execution and other tasks performed by the PLC CPU.

Operating Modes

The application program in a PLC executes repeatedly. In addition to executing the application program, the PLC regularly obtains data from input devices, sends data to output devices, performs internal housekeeping, and performs communications tasks. This sequence of operations is called the **sweep**.

- The basic operating mode of the PLC is called **Standard Sweep** mode. In this mode, the CPU performs all parts of its sweep normally. Each sweep executes as quickly as possible with a different amount of time consumed each sweep.

- The PLC may instead operate in **Constant Sweep Time** mode. In this mode, the CPU performs the same series of actions but each sweep takes the same amount of time.

- The PLC may also be in either of two Stop modes:

    - Stop with I/O Disabled mode

    - Stop with I/O Enabled mode

Parts of the CPU Sweep

```
          ┌──────────────────┐              ┌──────────────────────┐
          │  Start of Sweep  │              │                      │
          │   Housekeeping   │              │    Housekeeping      │
          └──────────────────┘              │                      │
                                            ├──────────────────────┤
                 ╱╲  NO                      │                      │
               I/O  ──────┐                  │                      │
            Enabled?      │                  │     Data Input       │
                 ╲╱       │                  │                      │
               YES        │                  │                      │
          ┌──────────────┐│                  ├──────────────────────┤
          │  Input Scan  ││                  │                      │
          └──────────────┘                   │                      │
                                            │   Program            │
                 ╱╲  NO                      │   Execution          │
               Run  ──────┐                  │                      │
              Mode?       │                  │                      │
                 ╲╱       │                  ├──────────────────────┤
               YES        │                  │                      │
          ┌──────────────┐│                  │    Data Output       │
          │ Logic Solution│                  │                      │
          └──────────────┘                   ├──────────────────────┤
                                            │   Programmer         │
                 ╱╲  NO                      │    Service           │
               I/O  ──────┐                  ├──────────────────────┤
            Enabled?      │                  │    System            │
                 ╲╱       │                  │  Communications      │
               YES        │                  ├──────────────────────┤
          ┌──────────────┐│                  │                      │
          │ Output Scan  ││                  │   Diagnostics        │
          └──────────────┘                   │                      │
          ┌──────────────┐                   └──────────────────────┘
          │  Programmer  │
          │Communications│              Scan Time of CPU
          └──────────────┘
          ┌──────────────┐
          │   System     │
          │Communications│
          └──────────────┘
          ┌──────────────────┐
          │Application Program│
          │Checksum Calculation│
          └──────────────────┘
            Start Next Sweep
```

Parts of the CPU Sweep

Start of Sweep Housekeeping	Housekeeping includes the tasks necessary to prepare for the start of the sweep. Before starting the actual sweep, the CPU: Calculates the sweep time Schedules the start of the next sweep Determines the mode of the next sweep Updates the fault reference tables Resets the Watchdog timer If the PLC is in Constant Sweep Time mode, the sweep is delayed until the required sweep time elapses. If the required time has already elapsed, the OV_SWP %SA0002 contact is set, and the sweep continues without delay. Next, the CPU updates timer values (hundredths, tenths, and seconds).
Input Scan	When the sweep starts, the CPU first scans inputs in ascending reference address order. The CPU stores this new input data in the appropriate memories. If the CPU has been configured to not scan I/O in Stop mode, the input scan is skipped when the CPU is in Stop mode.
Application Program Logic Scan	Next, the CPU solves the application program logic. It always starts with the first instruction in the program. It ends when the END instruction is executed. Solving the logic creates a new set of output data.
Output Scan	Immediately after the logic solution, the CPU scans all outputs in ascending reference address order. The output scan is completed when all output data has written. If the CPU has been configured to not scan I/O in Stop mode, the output scan is also skipped when the CPU is in Stop mode.
Programmer Communications Window	If there is a programming device attached, the CPU next executes the programmer communications window. In the default limited window mode, each sweep the CPU honors one service request. The time limit for programmer communications is 6 milliseconds. If the programmer makes a request that requires more than 6 milliseconds to process, the processing is spread out over multiple sweeps. In Run to Completion mode, the length of the system communications window is limited to 50 milliseconds. If a module makes a request that requires more than 50 milliseconds to process, the request is spread out over multiple sweeps
System Communications Window	Next, the CPU processes communications requests. In default ("Run to Completion") mode, the length of the system communications window is limited to 200 milliseconds. If a request requires more than 200 milliseconds to process, the request is spread out over multiple sweeps. In Limited mode, if a request requires more than 6 milliseconds to process, the processing is spread out over multiple sweeps. The result is that communications using the system window have less impact on sweep time, but response is slower.
Logic Program Checksum Calculation	A checksum calculation is performed on the application program at the end of every sweep. You can specify the number of words from 8 to 32 to be checksummed. If the calculated checksum does not match the reference checksum, the program checksum failure exception flag is raised. This causes a fault entry to be inserted into the PLC fault table and the PLC mode to be changed to Stop. If the checksum calculation fails, the programmer communications window is not affected.

Standard CPU Sweep Operation

Standard Sweep operation is the normal operating mode of the PLC CPU. In Standard Sweep operation, the CPU repeatedly executes the application program, updates I/O, and performs communications and other tasks shown in the diagram:

1. The CPU performs its start-of-sweep housekeeping tasks.
2. It reads inputs.
3. It executes the application program.
4. It updates outputs
5. If a programming device is present, the CPU communicates with it.
6. It communicates with other devices.
7. It performs diagnostics

Except for communicating with a programmer, all these steps execute every sweep. Programmer communications occur only when needed.

In this mode, the CPU performs all parts of its sweep normally. Each sweep executes as quickly as possible with a different amount of time consumed each sweep.

The Sweep Windows

The programmer communications window and the system communications window have two operating modes:

Limited Mode	The execution time of the window is 6ms. The window terminates when it has no more tasks to complete or when 6ms has elapsed.
Run to Completion Mode	Regardless of the time assigned to a particular window, the window runs until all tasks within that window are completed (up to 200ms for the System Communications Window and up to 50ms for the Programmer Communications Window).

SVCREQ 2 can be used in the application program to obtain the current times for each window.

The Watchdog Timer

When the CPU is in **Standard Sweep** mode, the Watchdog Timer catches failure conditions that could cause an unusually long sweep. The length of the Watchdog Timer is 200 milliseconds. It restarts from zero at the beginning of each sweep.

If the sweep takes longer than 200mS, the OK LED on the CPU module goes off. The CPU resets, executes its powerup logic, generates a watchdog failure fault, and goes to Stop mode. Communications are temporarily interrupted.

Constant Sweep Time Operation

If the application requires that each CPU sweep take the same amount of time, the CPU can be configured to operate in Constant Sweep Time mode. This operating mode assures that the inputs and outputs in the system are updated at constant intervals. This mode can also be used to implement a longer sweep time.

Changing the Configured Default for Constant Sweep Mode

If the PLC is in STOP mode, its Configured Constant Sweep mode can be edited. After this is done, the configuration must be stored to the CPU for the change to take effect. Once stored, Constant Sweep Time mode becomes the default sweep mode.

The Constant Sweep Timer

During operation in Constant Sweep Time mode, the CPU's Constant Sweep Timer controls the length of the sweep. The timer length can be 5 to 200 milliseconds. The time should be at least 10 milliseconds longer than the CPU's sweep time when it is in Standard Sweep mode, to prevent extraneous oversweep faults.

If the Constant Sweep Timer expires before the sweep completes, the CPU still completes the entire sweep, including the windows. However, it automatically provides notice than a too-long sweep has occurred. On the next sweep after the oversweep, the CPU places an oversweep alarm in the PLC fault table. Then, at the beginning of the following sweep, the CPU sets the OV_SWP fault contact (%SA0002). The CPU automatically resets the OV_SWP contact when the sweep time no longer exceeds the Constant Sweep Timer. The CPU also resets the OV_SWP contact if it is not in Constant Sweep Time mode.

As with other fault contacts, the application program can monitor this contact to keep informed about the occurrence of oversweep conditions.

Enabling/Disabling Constant Sweep Time, Reading or Setting the Length of the Timer

SVCREQ 1 can be included in the application program to enable or disable Constant Sweep Time mode, change the length of the Constant Sweep Time, read whether Constant Sweep Time is currently enabled, or read the Constant Sweep Time length.

CPU Stop Modes

The Nano or Micro PLC may be in either of two Stop modes:

- Stop with I/O Disabled mode

- Stop with I/O Enabled mode

When the PLC is in Stop mode, the CPU does not execute the application program logic. You can configure whether or not the I/O will scanned during Stop mode. Communications with the programmer and intelligent option modules continue in Stop mode. In addition, faulted board polling and board reconfiguration execution continue in Stop mode.

SVCREQ 13 can be used in the application program to stop the PLC at the end of the next sweep. All I/O will go to the OFF state and a diagnostic message will be placed in the PLC Fault Table.

Controlling the Execution of a Program

The VersaMax CPU Instruction Set contains several powerful Control functions that can be included in an application program to limit or change the way the CPU executes the program and scans I/O.

Calling a Subroutine Block

The CALL function can be used to cause program execution to go to a specific subroutine. Conditional logic placed before the Call function controls the circumstances under which the CPU performs the subroutine logic. After the subroutine is finished, program execution resumes at the point in the logic directly after the CALL instruction.

Creating a Temporary End of Logic

The END function can be used to provide a temporary end of logic. It can be placed anywhere in a program. No logic beyond the END function is executed, and program execution goes directly back to the beginning. This ability makes the END function useful for debugging a program.

The END function should not be placed in logic associated with or called by a Sequential Function Chart control structure. If this occurs, the PLC will be placed in STOP/FAULT mode at the end of the current sweep and an SFC_END fault will be logged.

Executing Rungs of Logic without Logical Power Flow

The nested Master Control Relay can be used to execute a portion of the program logic with no logical power flow. Logic is executed in a forward direction and coils in that part of the program are executed with negative power flow. Master Control Relay functions can be nested to 8 levels deep.

Jumping to Another Part of the Program

The Jump function can be used to cause program execution to move either forward or backward in the logic. When a nested Jump function is active, the coils in the part of the program that is skipped are left in their previous states (not executed with negative power flow, as they are with a Master Control Relay). Jump functions can also be nested.

Jumps cannot span blocks, SFC actions, SCF transitions, or SFC pre- or post-processing logic.

Privilege Levels and Passwords

Passwords are an optional configurable feature of the Micro PLC (passwords are not available on Nano PLCs). Passwords provide different levels of access privilege to the PLC when the programmer is in Online or Monitor mode. Passwords are not used if the programmer is in Offline mode. Passwords can restrict:

- Changing I/O and PLC configuration data
- Changing programs
- Reading PLC data
- Reading programs

There is one password for each privilege level in the PLC. Each password may be unique or the same password can be used for more than one level. Passwords are one to seven ASCII characters in length.

By default, there is no password protection. Passwords are set up, changed, or removed using the programming software. After passwords have been set up, access to the PLC is restricted unless the proper password is entered. Entering a correct password allows access to the requested level and to all lower levels. For example, the password for level 3 allows access to levels 1, 2, and 3. If PLC communications are suspended, protection automatically returns to the highest unprotected level. For example: If a password is set at levels 2 & 3, but none at level 4, if the software disconnects and reconnects, the access level is 4. Privilege level 1 is always available because no password can be set for this level.

Level	Access Description
4 Least Protected	■ Write to all configuration or logic. Configuration may only be written in Stop mode; logic may be written in Stop or Run mode (if run-mode store is supported). ■ Set or delete passwords for any level. ■ Plus all access from levels 3,2 and 1 ■ NOTE: This is the default if no passwords are defined.
3	■ Write to all configuration and logic when the CPU is in Stop mode, including word-for-word changes (when supported), the addition/deletion of program logic, and the overriding of discrete I/O. ■ Read/Write/Verify user flash. ■ Store reference/override tables. ■ Change sweep mode. ■ Plus all access from levels 2 and 1
2	■ Write to any data memory, but this does not include storing tables. ■ This includes the toggle/force of reference values but does not include overriding discrete I/O. ■ The PLC can be started or stopped. ■ PLC and I/O fault tables can be cleared. ■ Plus all access from level 1
1 Most Protected	Read any PLC data except for passwords. This includes reading fault tables, current status, performing datagrams, verifying logic/config, and loading program and configuration from the PLC. No PLC memory may be changed.

Protection Level Request from Programmer

Upon connection to the CPU, the programming software automatically requests the CPU to move to the highest unprotected level. That gives the programmer access to the highest unprotected level without having to specifically request a particular level.

A privilege change may be to a lower level or to a higher level. The privilege level is changed from the programmer by entering the new level and the correct password for that level. If the wrong password is entered, the change is denied and a fault is logged in the PLC fault table. A request to change to a privilege level that is not password-protected is made by supplying the new level and an empty password.

Notes on Using Passwords

▪ To re-enable passwords after passwords have been disabled, the PLC must be power-cycled with the battery removed for long enough to completely discharge the super-capacitor and erase the PLC's memory.

▪ If the passwords prevent changing the run/stop mode, firmware upgrades cannot be performed if the PLC is in run mode.

▪ The Run/Stop switch (if configured) will place the PLC in run or stop mode regardless of the passwords.

The OEM Protection Feature

The OEM protection feature is similar to the passwords and privilege levels and provides an even higher level of security. The feature is enabled or disabled using a 1 to 7 character password called the *OEM key*. When OEM protection is enabled, no write-access to the PLC program and configuration is permitted. Reading the configuration from the PLC is permitted. In this mode, no user flash operations are allowed.

When the OEM key password has been created, the OEM key can be locked in two ways: by choosing the locked setting from the programming software or by power-cycling the PLC. (The OEM key locked status does not change when PLC communications are suspended.)

Clearing All Memory

It is possible to Clear All memory from the programmer with the CPU at any privilege level, even with the OEM key locked. Operators can clear CPU memory and store a new application program to the CPU without knowing passwords.

If passwords and/or the OEM key have been set and written to flash, a read from flash updates the protection level. In this case, it is not necessary to reenter the password to gain access to a particular level. A Clear All does not clear user flash.

Run/Stop Mode Switch Operation

The CPU Run/Stop mode switch on a VersaMax Micro PLC can be used as a Run/Stop switch, as a memory protect switch, and for clearing faults when a fatal fault exists. A 10-Point VersaMax Nano PLC can provide the same functionality by adding a Single Pole, Single Throw (SPST) switch. An external switch on a Nano PLC is read as a normal 24VDC input. The specifications for the RUN input are the same as the other DC inputs on the Nano PLC.

Run/Stop Mode Operation

If Run/Stop operation is enabled, the Run/Stop switch is use to control the operating mode of the PLC. The PLC monitors the state of the Run/Stop switch and stores the current state in status bit %S0022. The application program can check the state of this bit if necessary, and activate logic based on its setting (in Run mode, the bit is =1, and in Stop mode, it is =0).

If Run/Stop mode switch operation is enabled, the switch can be used to place the Micro PLC CPU in Run mode if a fatal fault condition exists in the CPU. Note that the switch overrides any restrictions on mode selection that have been set up using password protection.

- If the CPU has non-fatal faults and is not in Stop/Fault mode, placing the switch in Run position causes the CPU to go to Run mode. Faults are NOT cleared.

- If the CPU has fatal faults and is in Stop/Fault mode and Run/Stop Enabled is configured, placing the switch in Run position causes the Run LED to blink for 5 seconds. While the Run LED is blinking, the CPU switch can be used to clear the fault table and put the CPU in Run mode. After the switch has been in Run position for at least ½ second, move it to Stop position for at least ½ second. Then move it back to Run position. The faults are cleared and the CPU goes to Run mode. The LED stops blinking and stays on. This can be repeated if necessary.

- If the switch is not toggled as described, after 5 seconds the Run LED goes off and the CPU remains in Stop/Fault mode. Faults stay in the fault table.

- If Run/Stop operation is NOT enabled by configuration and a fatal fault occurs, it is not possible to restore operation using the switch as described above. The CPU remains in Stop/Fault mode and faults stay in the fault table.

Configurable Memory Protection

Operation of the Micro PLC Run/Stop switch (or Nano Run/Stop input) can be configured to prevent writing to program memory and configuration, and to prevent forcing or overriding discrete data.

Configuration Parameters and Switch Position for Run/Stop Modes

Switch Run/Stop Enabled Configuration	I/O Scan Stop Configuration	Switch Position	Allowed Mode	PLC Operation
Disabled	has no effect	has no effect	All	PLC Programmer modes operate the same
Enabled	has no effect	Run/On	All	PLC Programmer modes operate the same
Enabled	No	Stop/Off	Stop/ No I/O	PLC not allowed to go to Run mode.
Enabled	Yes	Stop/Off	Stop/No I/O, Stop I/O	PLC not allowed to go to Run mode.
Enabled	has no effect	Toggle Switch from Stop to Run	n/a	PLC goes to Run mode
Enabled	No	Toggle switch from Run to Stop	n/a	PLC goes to STOP–NO IO
Enabled	Yes	Toggle switch from Run to Stop	n/a	PLC goes to STOP–IO

Configuration Parameters and Switch Position for Memory Protection

Memory Protect Enabled Configuration	Switch Position	PLC Operation
Off	n/a	Normal PLC operation
On	Protect/On	No storing/clearing/loading of PLC allowed
On	Protect/Off	Normal PLC operation

Configuration Parameters and Switch Position for Simultaneous Run/Stop Operation and Memory Protection

Memory Protect Configuration	Run/Stop Configuration	Switch Position	PLC Operation
Enabled	Disabled	Toggled From OFF to ON	Memory Protected
Enabled	Enabled	Toggled From OFF to ON	Memory Protected PLC is in Run Mode
Enabled	Enabled	Toggled From ON to OFF	Memory Protected PLC is in Stop Mode PLC cannot be put in Run Mode with Programmer

Configuration Parameters and Switch Position for Fault Operations

Run/Stop Enabled Configuration	Switch Position	Faults Present in the PLC	PLC Operation
Disabled	n/a	n/a	Normal PLC operation
Enabled	Toggle Switch from Stop to Run	Non-fatal	Places PLC in Run mode Faults are NOT cleared
Enabled	Toggle Switch from Stop to Run	Fatal	Run LED blinks for 5 sec
Enabled	While the Run LED is blinking and ON for at least ½ second, toggled from Run to Stop, then after another ½ second, toggled from Stop to Run	Fatal	PLC goes to Run mode and all faults are cleared

Powerup and Power-Down Sequence

Powerup Sequence

The powerup sequence for the Nano/Micro PLC consists of the following events:

1. The CPU runs self-diagnostics. This includes checking a portion of RAM to determine whether or not the RAM is functional. (For DC Micro PLCs, powerup diagnostics can be disabled by configuration. It is recommended that you not use this feature unless your application requires unusually rapid powerup. For details, see "Installation Instructions".)

2. The hardware configuration is compared with the software configuration. Any mismatches detected constitute faults and are alarmed.

3. If there is no software configuration, the CPU uses the default configuration.

4. The mode of the first sweep is determined based on CPU configuration. The PLC can either copy the program from flash memory into RAM (see below), or power up in Stop or Run mode. See "Flash Memory".

	Nano PLC or 14-Point Micro PLC	23-Point or 28-Point Micro PLC	
		No Backup Battery	Backup Battery
Default Powerup Mode	Stop Mode	Stop Mode	Last Mode
Configurable Powerup Modes	Run Mode or Stop Mode	Run Mode or Stop Mode	Run, Stop, or Last Mode

Flash Memory

A VersaMax Nano or Micro PLC provides non-volatile flash memory to store the application program and system firmware.

Only one application program at a time can be present in non-volatile flash memory. Separate copies of the user data (program, configuration, and retentive data) are maintained in FLASH memory.

During configuration of a Nano or Micro PLC, you can choose whether, in the future, the PLC will read its user data from flash or from RAM.

In addition, Micro PLCs that use the optional backup battery can read their user data from RAM if the unit has been powered down for an extended period of time. If there is no battery backup, RAM may be invalid on powerup. In that case, the default program is installed or the user data must be read from flash.

	User Data		
	Configuration	*Program*	*Retentive Data*
Default Settings			
Read From RAM	X	X	X
Read From FLASH	–	--	–
Recommended Settings			
Read From RAM	–	--	X
Read From FLASH	X	X	X (If battery is not used)

If the application uses svc_req 53 to write additional data to flash memory (supported in firmware rev 3.0), retentive data will be updated. If the retentive data is read from flash on powerup, these updated values will be used instead of the original data values.

Default Conditions for Micro PLC Output Points

At power-up, output points default to off. They stay off until the first output scan.

Power-Down Conditions

System power-down occurs automatically if the power supply detects that incoming AC power has dropped. The minimum hold time is one half cycle.

Note: During a gradual power down, when the input power supply voltage drops below the minimum operating voltage, the PLC will transition to a state where all outputs are disabled. In this state, the Run LED and the OK LED are also turned off. The PLC remains in this state until power is lost completely (the PLC shuts off), or until power is restored (above the minimum operating voltage). In the latter case, the PLC will reset itself and start the normal powerup sequence.

Power Cycle

The table below lists the effects that a power cycle can have on Micro PLC operation under specific conditions.

Condition	Effects
PLC loses power while storing a program to RAM from either the programming software or flash memory.	On the ensuing powerup the program will be deleted from RAM. You will need to store the program again from the programmer.
PLC loses power while storing a configuration to RAM from either the programming software or flash memory.	On the ensuing powerup, the configuration will be deleted from RAM. You will need to store the configuration again from the programmer.
PLC loses power while storing the reference tables to RAM from either the programming software or flash memory.	On the ensuing powerup, the reference table data will be deleted from RAM. You will need to store the data again from the programmer.
PLC loses power while storing a program. configuration, or reference table data to flash memory.	The flash memory area used to store the program, configuration, or reference table data will be considered invalid. You will need to store the program, configuration, or reference tables to flash memory again.
If system includes expansion unit(s): Micro PLC base unit loses power before the expansion unit(s)	Expansion units will be reset (all outputs will be set to zero)
Expansion unit(s) lose power before the Micro PLC base unit while Micro PLC is scanning I/O	A *Loss of Expansion Module* fault may be logged.
Micro PLC base unit powers up before the expansion unit(s)	If expansion units do not power up at the same time as the Micro PLC, a *Loss of Expansion Module* fault may be logged.
Expansion unit(s) power up before the Micro PLC base unit	Expansion unit outputs remain off until the Micro base unit completes powerup and begins scanning I/O.

If the application uses svc_req 53 to write additional data to flash memory (supported in firmware rev 3.0), retentive data will be updated. If the retentive data is read from flash on powerup, these updated values will be used instead of the original data values.

Input Filters

Discrete Input Filtering

Nano and Micro PLCs with DC inputs can provide discrete input filtering, to compensate for switch bounce and other application conditions. This input filtering also applies to discrete expansion units connected to the PLC.

Filter Control Reference

Discrete input filter time can be changed on the fly by simply adjusting the value in reserved reference %AQ11. The filter time can be 0.5mS to 20mS in 0.5mS increments. The value in %AQ11 represents the number of 0.5mS increments in the total filter time.

For 20/40/64-point Micro PLCs, input filtering is configurable in 1ms increments only. Use the values shown below (1ms = 2, 2ms = 4, 3ms = 6 and so on).

Note that input filtering is not provided for 64-point expansion units.

Filter Time in mS	Value to Put in %AQ11	Filter Time in mS	Value to Put in %AQ11	Filter Time in mS	Value to Put in %AQ11	Filter Time in mS	Value to Put in %AQ11
0.5mS	1	5.5mS	11	10.5mS	21	15.5mS	31
1.0mS	2	6.0mS	12	11.0mS	22	16.0mS	32
1.5mS	3	6.5mS	13	11.5mS	23	16.5mS	33
2.0mS	4	7.0mS	14	12.0mS	24	17.0mS	34
2.5mS	5	7.5mS	15	12.5mS	25	17.5mS	35
3.0mS	6	8.0mS	16	13.0mS	26	18.0mS	36
3.5mS	7	8.5mS	17	13.5mS	27	18.5mS	37
4.0mS	8	9.0mS	18	14.0mS	28	19.0mS	38
4.5mS	9	9.5mS	19	14.5mS	29	19.5mS	39
5.0mS	10	10.0mS	20	15.0mS	20	20.0mS	40

The input filter recognizes signals that have a duration within ±0.5mS (±1.0mS for 20/40/64-point Micro PLCs) of the filter time. For example, if the filtering time is 5mS, any input that lasts more than 4.5mS (5.0mS for 20/40/64-point Micro PLCs) is recognized. What will be read on an input is not only based on the input filter setting. It is also based on the scan time. An input will always be seen if it is longer than both the scan time and the filter time.

Because %AQ11 is used to control the discrete input filtering time, it should not be used for any other purpose.

Hardware R/C Filters

In addition to Discrete Input Filters, all the Versamax Nano/Micro modules have simple Hardware R/C Filters for the inputs. The following table provides the filter constants of the simple hardware R/C filter present on each module.

Module	I1 to I4	I5 to I6	I7 to I8	I9 to I12	I13	I14 to I16	I17 to I24	I25 to I40
IC200NDR001	200nS	1µS						
IC200NAL211	200nS	1µS						
IC200NDD101	200nS	1µS						
IC200NDR010	200nS	1µS						
IC200NAL110	200nS	1µS						
IC200NDD010	200nS	1µS						
IC200UAR014	20 mS	20 mS	20 mS					
IC200UAA003	20 mS	20 mS	20 mS					
IC200UDR001	200nS	1µS	1µS					
IC200UDR002	200nS	1µS	1µS					
IC200UDD104	200nS	1µS	1µS					
IC200UDR003	200nS	1µS	1µS					
IC200UDD112	200nS	1µS	1µS					
IC200UDR120	100nS	100nS	100nS	5µS				
IC200UDR020	100nS	100nS	100nS	5µS				
IC200UDD220	100nS	100nS	100nS	5µS				
IC200UDD020	100nS	100nS	100nS	5µS				
IC200UAL006	200nS	1µS	1µS	1µS	1µS			
IC200UAL005	200nS	1µS	1µS	1µS	1µS			
IC200UAL004	200nS	1µS	1µS	1µS	1µS			
IC200UAR028	20mS	20mS	20mS	20mS	20mS	20mS		
IC200UAA007	20mS	20mS	20mS	20mS	20mS	20mS		
IC200UDR005	200nS	1µS	1µS	1µS	1µS	1µS		
IC200UDR010	200nS	1µS	1µS	1µS	1µS	1µS		
IC200UDD110	200nS	1µS	1µS	1µS	1µS	1µS		
IC200UDD120	200nS	1µS	1µS	1µS	1µS	1µS		
IC200UDR006	200nS	1µS	1µS	1µS	1µS	1µS		
IC200UDD212	200nS	1µS	1µS	1µS	1µS	1µS		
IC200UDR228	200nS	1µS	1µS	1µS	1µS	1µS		
IC200UDR140	100nS	100nS	100nS	5µS	5µS	5µS	5µS	
IC200UDR040	100nS	100nS	100nS	5µS	5µS	5µS	5µS	
IC200UDD240	100nS	100nS	100nS	5µS	5µS	5µS	5µS	
IC200UDD040	100nS	100nS	100nS	5µS	5µS	5µS	5µS	
IC200UDR440	100nS	100nS	100nS	5µS	5µS	5µS	5µS	
IC200UDR164	100nS	100nS	100nS	5µS	5µS	5µS	5µS	5µS
IC200UDR064	100nS	100nS	100nS	5µS	5µS	5µS	5µS	5µS
IC200UDD164	100nS	100nS	100nS	5µS	5µS	5µS	5µS	5µS
IC200UDD064	100nS	100nS	100nS	5µS	5µS	5µS	5µS	5µS
IC200UEX009	20mS	20mS	20mS					
IC200UEX010	20mS	20mS	20mS					

Module	I1 to I4	I5 to I6	I7 to I8	I9 to I12	I13	I14 to I16	I17 to I24	I25 to I40
IC200UEX011	200nS	1µS	1µS					
IC200UEX012	200nS	1µS	1µS					
IC200UEX014	200nS	1µS	1µS					
IC200UEX122	200nS	1µS	1µS					
IC200UEX013	200nS	1µS	1µS					
IC200UEX015	200nS	1µS	1µS					
IC200UEI016	3mS	3mS	3mS	3mS	3mS	3mS		
IC200UEX209	20mS	20mS	20mS	20mS	20mS	20mS		
IC200UEX210	20mS	20mS	20mS	20mS	20mS	20mS		
IC200UEX211	200nS	1µS	1µS	1µS	1µS	1µS		
IC200UEX212	200nS	1µS	1µS	1µS	1µS	1µS		
IC200UEX214	200nS	1µS	1µS	1µS	1µS	1µS		
IC200UEX222	200nS	1µS	1µS	1µS	1µS	1µS		
IC200UEX213	200nS	1µS	1µS	1µS	1µS	1µS		
IC200UEX215	200nS	1µS	1µS	1µS	1µS	1µS		
IC200UEX164	100nS	100nS	100nS	5µS	5µS	5µS	5µS	5µS
IC200UEX064	100nS	100nS	100nS	5µS	5µS	5µS	5µS	5µS
IC200UEX364	100nS	100nS	100nS	5µS	5µS	5µS	5µS	5µS
IC200UEX264	100nS	100nS	100nS	5µS	5µS	5µS	5µS	5µS
IC200UEI008	3mS	3mS	3mS					
IC200UEC208	200nS	1µS	1µS					
IC200UEC108	200nS	1µS	1µS					
IC200UEC008	200nS	1µS	1µS					

Analog Potentiometer Input Filtering

Input Settings

VersaMax Micro-14, Micro-23, and Micro-28 PLCs have two potentiometers, located below the Run/Stop switch, that can be used to manually set input values that are stored in %AI16 and %AI17. The left potentiometer controls %AI16, and the right one controls %AI17.

Filter Control Reference

Due to the nature of analog input, the values seen in %AI16 and %AI17 will have some fluctuation. This variation could make these inputs less suitable for certain applications. The Micro PLC uses an averaging filter that samples the values of these inputs once per sweep. When a selected number of samples has been read, it averages them and stores the result in %AI16 and %AI17.

The value in memory reference %AQ1 controls the number of samples to be averaged, calculated as follows:

$$\text{Number of samples} = 2^{\%AQ1}$$

The value in %AQ1 can be from 0 to 7 (for 0 through 128 samples). For example, if 4 is placed in %AQ1, 16 samples are averaged to determine the values to place in %AI16 and %AI17. If 5 is placed in %AQ1, 32 samples are averaged.

The analog value from the potentiometer is not reported until the number of sweeps determined by the value in AQ1 has occurred. If you want to receive a value from the potentiometer on every sweep, including the first sweep, %AQ1 must contain 0.

Default Filter Time

The default value in %AQ1 is 4, meaning that 16 samples will be averaged.

Limitations of Analog Potentiometer Input Filtering

As with any filter, the longer the filter time (i.e., the more samples that are taken), the longer the response time. Although the maximum value of 7 could be used in %AQ1, this value might cause a long response time on larger programs. For example, if the sweep time of a program is 100ms, and if the potentiometer value is changed, the new value would not show up for 12.8 seconds.

High-speed Counter, PWM, and Pulse Train Operation

This chapter describes the configuration and operation of the High-speed Counter, Pulse-Width Modulated Output, and Pulse Train Output features of VersaMax Micro and Nano PLCs.

- Overview

- HSC/PWM/PTO Channels

- Type A Counter Operation

- Type B Counter Operation

- High-speed Counter Outputs

- PWM Outputs

- Pulse Train Outputs

- Pulse Train with Ramp

- COMMREQs for HSC/PWM/PTO Functions

- HSC Application Examples

For a Micro-20, Micro-40, or Micro-64 (Release 3.6 or later) PLC, individual channels can perform the basic Motion Control functions of: Jogging, Homing, Blended Move, and Stop Motion. Details of these features are provided in chapter 19.

Overview

All VersaMax Nano PLCs and Micro PLCs with DC inputs are configurable for a mix of High-speed Counting features. Nano PLCs and Micro PLCs with DC outputs can also be configured with Pulse-Width Modulation, Pulse Train, and Pulse Train with Ramp features.

For added flexibility, the operating parameters of these features can be fine-tuned during operation by including special function blocks in the application program.

Micro-20, Micro-40 and Release 3.6 and later Micro-64 PLCs provide Jog, Homing, and Blended (multi-velocity move) functionality commanded by function blocks in the application program. They also feature configurable 32-bit resolution for both Type A and Type B counters.

Operation at Powerup and Mode Change

High-speed Counters (except PTO with Ramp) run independently of the PLC application program. When the PLC goes from Run to Stop mode, the High-speed Counters continue to operate (as specified in the configuration). High-speed Counters remain in running mode through a power cycle. If a High-speed Counter is running when power is lost, it will start again as soon as power is restored. When power is cycled or the PLC is placed in Run mode, the Accumulator register is loaded with the configured Preload value.

If the PLC goes into Stop mode when the PTO with Ramp is running, the ramp output stops immediately.

If a new configuration has been stored to the PLC, the PLC continues with the existing HSC/PTO/PWM/Pulse Train with Ramp/Motion Features configuration. When the PLC is switched to Run mode, the HSC begins using the new configuration and the Preload value is placed in the Accumulator register.

Basic Setup

There are three basic steps to setting up High Speed Counter, PWM, and Pulse Train features.

- With the configuration software, enable each feature you want to use.

- If you want a counter to control an output you must enable the output, also using the configuration software.

- Finally, you can provide application program control over operation of the output by setting or clearing its associated Enable Output bit from the program or in the data tables. For example, if a High-speed Counter is configured with its output enabled and its Output Enable bit is set, it will control the output. The Output Enable bits are assigned to fixed reference addresses: Q505 through Q508.

A sample ladder logic rung that sets the Output Enable bit for a High-speed Counter is shown below.

```
           FST SCN
            | |          ┌──────────┐─
            ─| |─────────│  MOVE    │
                         │  BOOL    │
           %S0001        │          │
                         │    1     │
                         │          │
                  1  ─┤  │ IN    Q  ├─  %Q505
                         └──────────┘
```
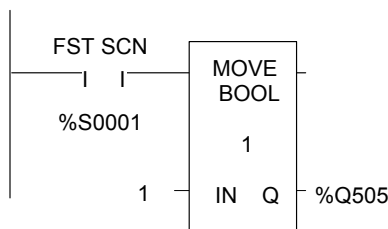
HSC/PWM/PTO Channels

A Micro PLC (which has 14 – 64 points) can be set up to have either four 16-bit Type A counters, or one 16-bit Type A counter and one 16-bit Type B counter. Micro-20, -40, and -64 PLCs can also be set up to have either four 32-bit Type A counters, or one 32-bit Type A and one 32-bit Type B counter.

A Nano PLC (which has 10 points) can be set up to have either three 16-bit Type A counters, or one 16-bit Type A counter and one 16-bit Type B counter).

- Each channel can be configured for High-speed Counter, PWM, Standard, Pulse Train, Pulse Train with Ramping operation (in 16-bit mode) or Motion support (in 32-bit mode).

- A channel that uses High-speed Counter inputs can use its associated output(s) as either High-speed Counter or standard output(s).

- A channel that uses PWM or Pulse Train or Pulse Train with Ramping or Motion support outputs can use its associated inputs as standard inputs.

- High-speed Counter inputs cannot be mixed with PWM, PTO, PTO with Ramping or Motion support outputs on the same channel.

HSC/PWM/PTO Channels for Micro PLCs (14 Point/ 28 Point)

Channel Configuration Choice	Creates this Number of Channels	Number of Type A Counters Configured	Number of Type B Counters	Number of PWM / Pulse Train Outputs
Four Type A	Four	4	0	0
		3	0	1
		2	0	2
		1	0	3
		0	0	4
One Type A and One Type B	Two	1	1	0
		0	1	1

For Micro PLCs that have only one DC output, only one PWM or Pulse Train output can be configured.

HSC/PWM/PTO Channels for Micro-20, -40, or -64 PLC

The following HSC/PWM/PTO features are available for Micro-20, Micro-40, or Micro-64 (Release 3.6 or later) PLCs:

Channel Configuration Choice	Creates this Number of Channels	Number of Type A Counters Configured	Number of Type B Counters	Number of PWM / Pulse Train/Ramp Pulse Train/Motion Support
Four Type A	Four	4	0	0
		3	0	1
		2	0	2
		1	0	3
		0	0	4
One Type A and One Type B	Two	1	1	0
		0	1	1
Four Type A_32	Four	4	0	0
		3	0	1
		2	0	2
		1	0	3
		0	0	4
One Type A and One Type B_32	Two	1	1	0
		0	1	1

For Micro PLCs that have only one DC output, only one PWM or Pulse Train/Ramp Pulse Train Or Motion output can be configured.

Ramp Pulse Train Outputs are available for Four Type A / One Type A and One Type B. Motion Support is available for Four Type A / One Type A and One Type B in 32-bit mode.

HSC/PWM/PTO Channels for Nano PLCs

Channel Configuration Choice	Creates this Number of Channels	Number of Type A Counters Configured	Number of Type B Counters	Number of PWM / Pulse Train Outputs
Three Type A	Three	3	0	0
		2	0	1
		1	0	2
		0	0	3
One Type A and One Type B	Two	1	1	0
		0	1	1

Type A Counter Operation

The Type A counter is one counter that can count up or down. Configurable high and low limits set the counter's range. The Type A counter has an Accumulator register, a Counts per Timebase register, a Strobe register, high limit, low limit, and ON/OFF Preset values. These are signed numbers. The values selected for the Preload, Accumulator, On Preset, and Off Preset registers must be within the counter limits.
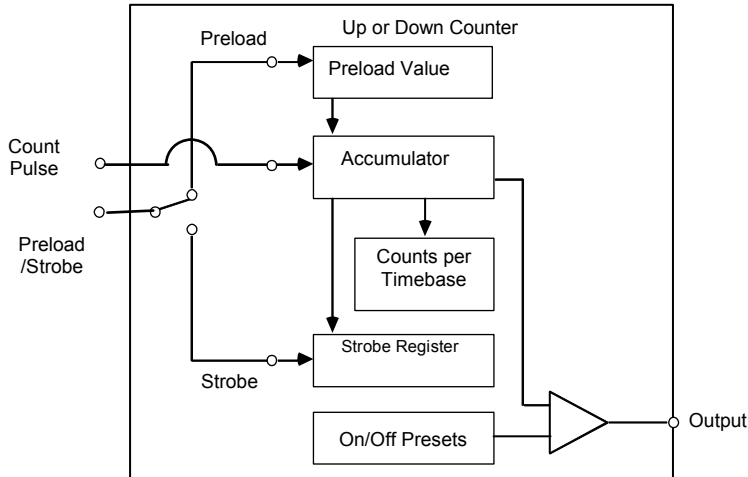
Program References for Type A Counters

The following program references are used for Type A Counter data. The Clear Strobe and Clear Preload output bits are used to clear (reset) the Strobe and Preload status bits within the module (they do not initiate a strobe or preload to the counter).

	Counter 1	Counter 2	Counter 3	Counter 4
Count Input	I0001	I0003	I0005	I0007
Preload or Strobe Input	I0002	I0004	I0006	I0008
Strobe Status Bits	I0497	I0498	I0499	I0500
Preload Status	I0501	I0502	I0503	I0504
Output Status	I0505	I0506	I0507	I0508
Counter Output	Q0001	Q0002	Q0003	Q0004
Clear Strobe Bits	Q0497	Q0498	Q0499	Q0500
Clear Preload Bits	Q0501	Q0502	Q0503	Q0504
Enable Output	Q0505	Q0506	Q0507	Q0508
Counts per Timebase Register	AI002	AI003	AI004	AI005
Accumulator Registers: 16-Bit mode	AI006	AI008	AI010	AI012
32-Bit mode	AI006-007	AI010-011	AI020-021	AI024-025
Strobe Registers : 16-Bit mode	AI007	AI009	AI011	AI013
32-Bit mode	AI008-009	AI012-013	AI 022-023	AI026-027

Type A Counter Operation

The counter can either count continuously within its limits, or count to either limit then stop (one-shot mode). In continuous counting, the Accumulator wraps when the count limit is reached and continues counting. For example, if the Count Direction is up, when the count exceeds the High Limit by 1, the Accumulator value wraps to the Low Limit. In one-shot mode, the counter stops at Limit N+1 for up counters or N-1 for down counters if within the range.

In the example below, the counter has been configured to count on the low to high transition of the Pulse input. The Count signal represents an internal signal that indicates where counting occurs with respect to the pulse input.
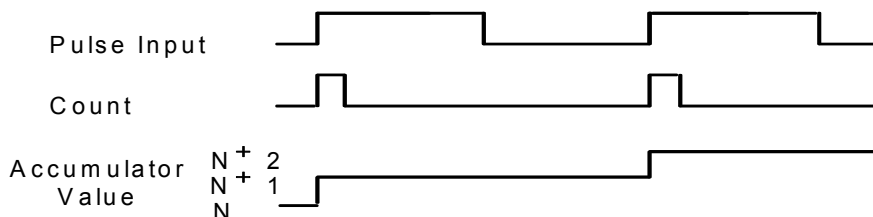
High-speed Counters run independently of the application program. When the PLC goes from Run to Stop mode, its High-speed Counters continue to operate. High-speed Counters remain in run mode through a power cycle. If a High-speed Counter is running when power is lost, it will start again as soon as power is restored. Counters will stop on a store of logic or configuration and a write to the user storage device. When power is cycled or the PLC is placed in Run mode, the Accumulator is loaded with the Preload value and the registers start updating.

Type A High-speed Counter Operation Details

The **Count Pulse** input increments or decrements the counter's accumulator. The count input can be configured to be positive or negative edge-sensitive. The configured **On/Off Preset** values determine when the counter **output** is activated or deactivated. For example:

Lo Limit = 0   Hi Limit = 200
On Preset = 150   Off Preset = 160

Count Direction = Up
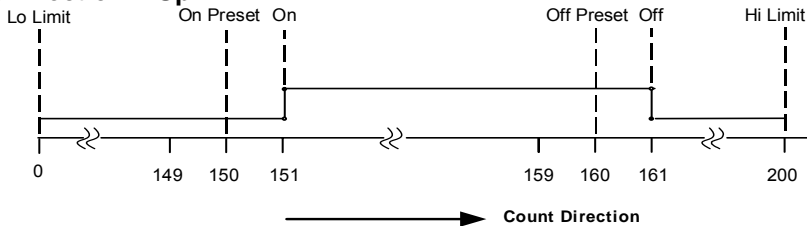
Count Direction = Down
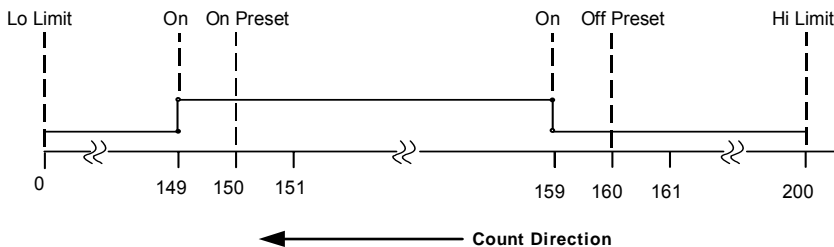
Depending on the configuration for Preload/Strobe, the **Preload/Strobe Input** can either preload a value into the Accumulator or strobe the accumulator value into a register. Preload/Strobe signals are always positive edge-sensitive.

▪ If the Preload/Strobe input is configured as a **Preload** input, the configured Preload value is transferred to the Accumulator Register when the input transitions from low to high. When a preload occurs, the PLC sets the Preload Status bit. The application program can reset the bit before the next preload.

The Preload input always loads the Accumulator regardless of the state of the Preload Status bit. The value in the Preload register can be configured to any value in the counter's range. This selection is part of the PLC configuration. However, the value can be changed during operation using a COMMREQ function in the program. Also, The program can also use a COMMREQ to load an adjustment value to the Accumulator register. The adjustment value can be between -128 and +127.

- If the Preload/Strobe Input is configured as a **Strobe** input, when its Strobe input signal goes active the PLC places the current value in that counter's Accumulator into its Strobe register. The PLC sets the associated Strobe Status bit to indicate that a Strobe value was captured. The Strobe value remains in the Strobe register until the Strobe signal goes active again, at which time it is overwritten by a new value. The Strobe status bit stays on until the program clears it.

  The Strobe input always loads the Strobe register with the Accumulator value regardless of the state of the Strobe bit. Strobe inputs can be used as Pulse Capture Inputs by using the Strobe status bits as a latch.

Timebase is a span of time used to measure the rate of counting. For example, the program could monitor the number of counts that occur in 30 seconds. Timebase is configurable in 1mS increments from 10mS to 65530mS. The **Counts-per-Timebase** register contains the number of counts that occurred during the last-completed timebase interval. The number of counts is a signed number. The sign indicates up (+) or down (-) counts. If the configured timebase is too large, the Counts per Timebase register will lose the overflow values.

Error Status and Status Code: The program should monitor the Error Status bit %I0512 to check for error conditions. When this bit is 1, the program can look at the Status Code register %AI001 to learn what caused the error. After taking any necessary corrective action, the program logic should clear the error status by clearing the Clear Error output bit (%Q0512). See "Command Word Error Responses" later in this chapter for more information.

Type B Counter Operation

The Type B counter uses two counter input signals for A-Quad-B counting. The phase relationship between the counter inputs (A & B) determines whether the accumulator is incremented or decremented on a transition of either counter input.

The count direction is up if A leads B.
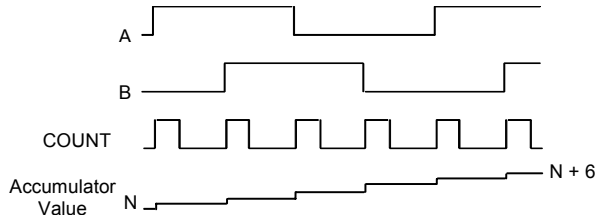
The count direction is down if A lags B.
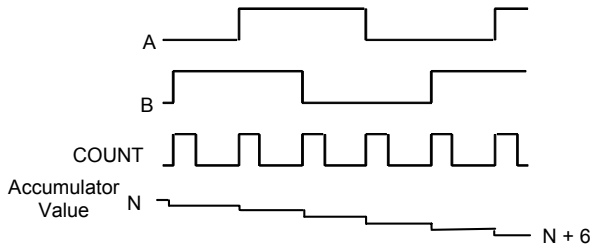
The Type B counter can have one output that is activated based on selected On and Off preset values.
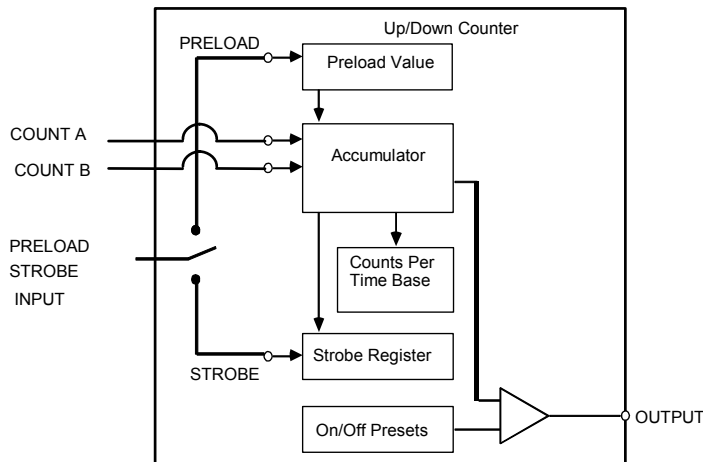
The counter counts continuously within its limits. The Accumulator wraps when the count limit is reached and continues counting. For example, if the Count Direction is up, when the count exceeds the High Limit by 1, the Accumulator value wraps to the Low Limit.

Program References for a Type B Counter

The following program references are used for Type B Counter data. The Clear Strobe and Clear Preload output bits are used to clear (reset) the Strobe and Preload status bits within the module (they do not initiate a strobe or preload to the counter).

	Type B Counter
Count Inputs	Phase 1: I0001 Phase 2: I0003
Preload or Strobe Input	I0006
Strobe Status Bit	I0497
Preload Status Bit	I0501
Counter Output	Q0003
Clear Strobe Bit	Q0497
Clear Preload Bits	Q0501
Counts per Timebase Register	AI002
Accumulator Registers: 16-Bit mode	AI006
32-Bit mode	AI006-007
Strobe Registers : 16-Bit mode	AI007
32-Bit mode	AI008-009

Type B Counter Operation

The Type B counter has a Strobe register, an Accumulator and a Counts-per-Timebase register. Except for the Counts per Timebase Register, these operate as described for Type A counters.

For a B-type counter, the Counts per Timebase value represents the relative shift over the sample time, not an exact number of counts. For example, if the counter starts at 10, counts up to 20, and then counts back to 15, the resulting counts per timebase value is 5.
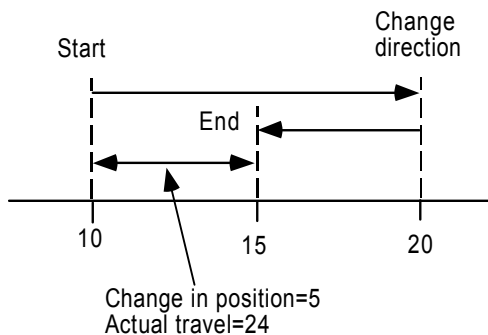
Type B Counter Examples

Low Limit = 0   High Limit = 200
On Preset = 150   Off Preset = 160
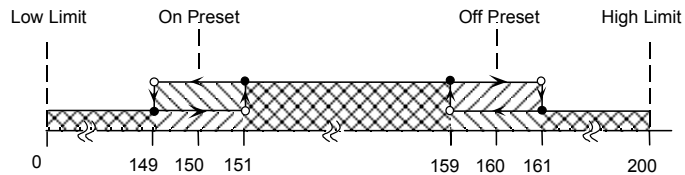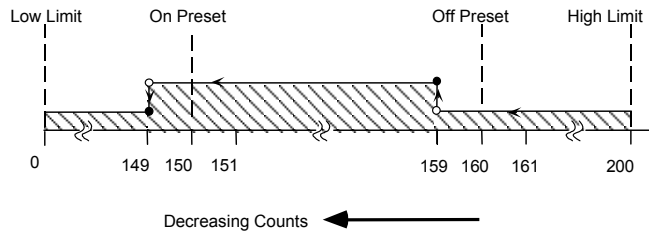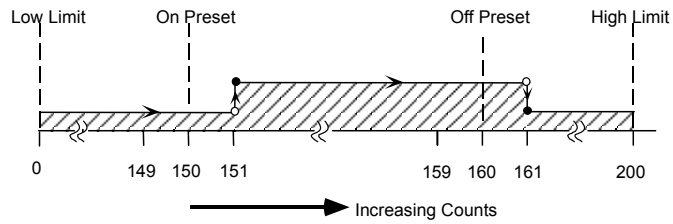
High-speed Counter Outputs

Four high-speed outputs (three for a Nano PLC) can be individually configured as High-speed Counter outputs, PWM outputs, or Pulse Train outputs.

When the Counter Type configured is both Type A and Type B, PWM and Pulse Train outputs 1-3 are not available because A-QUAD-B counting uses output channels 1–3, as shown earlier in this chapter.

If the configurations are changed for HSC, PWM, and Pulse outputs, the new outputs take effect when the PLC changes from Stop to Run mode and the enable output bit is ON. When the transition to Run mode occurs, the currently-configured output stops running and the new configuration takes over.

Results vary with temperature, but the maximums and minimums shown below apply across the entire operating range for the unit (both temperature and DC output voltage).

Pulldown Resistor

For Micro -10, -14, -23 and -28 PLCs, a pulldown resistor, connected between the output (Q1, 2, 3, or 4) and Common, is required for high frequency Pulse and PWM (up to 5kHz) outputs and for duty cycles in the lower ranges (5% and lower). A 1.5 Kohm, 0.5 watt resistor is recommended.

Micro -20, -40, and -64 do not require a pulldown resistor.

Duty Cycle Limits: with 1.5k ohm pulldown resistor - UDR005/006/010 & UAL004/005/006
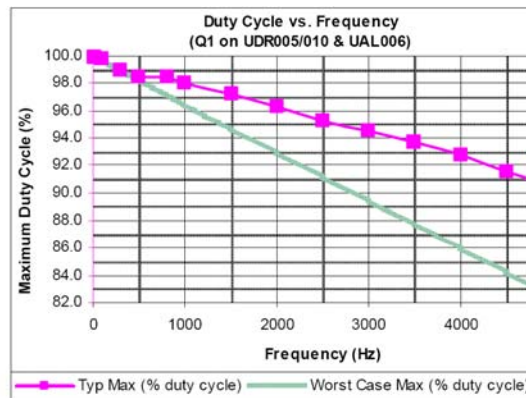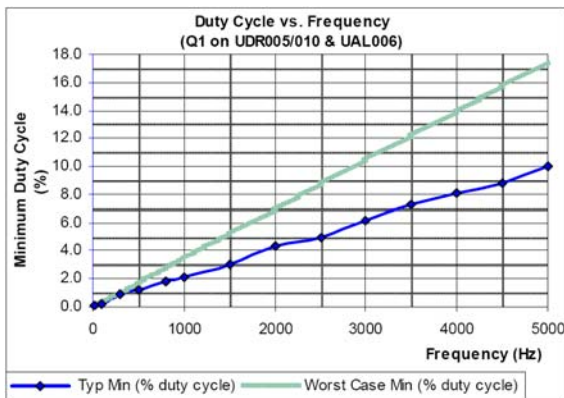
Duty Cycle Limits: with 1.5k ohm pulldown resistor - UDD104/110 & NDD101

Duty Cycle vs. Frequency
(Q1-Q4 on UDD104/110 & NDD101)

Typ Min (% duty cycle)   Worst Case Min (% duty cycle)

Typ Max (% duty cycle)   Worst Case Max (% duty cycle)
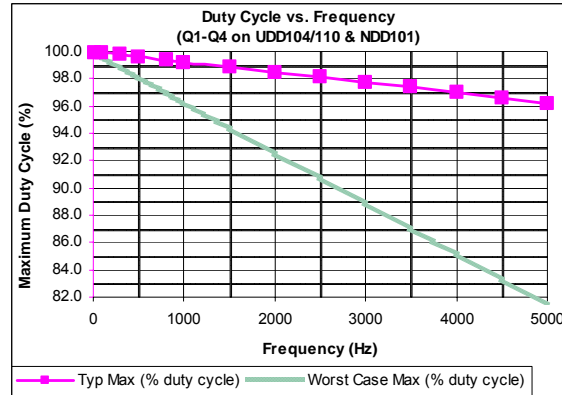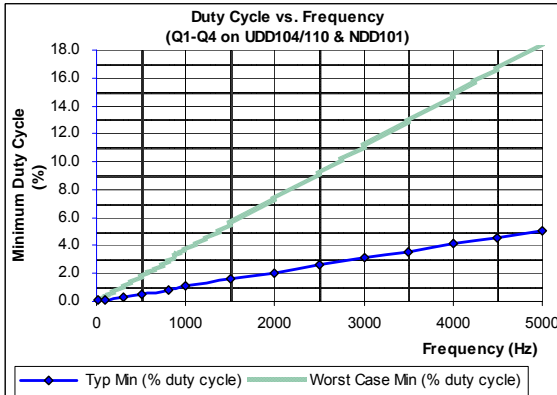
Counter Output Presets

Each counter output has a Preset on and off point. Both points must lie between the counter's configured high and low limits. Both the Presets and the High/Low limits are initially set up as part of the PLC configuration. The Presets can be changed during operation by using a COMMREQ function as explained later in this chapter.

The output state indicates when the Accumulator value is between the Preset on and off points. For example, using the Type B counter:
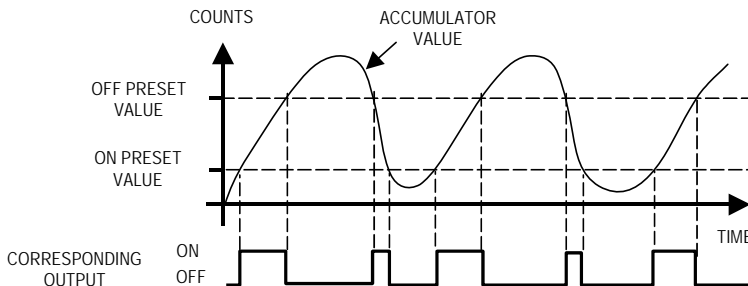
If the output is enabled for the High-speed Counter being used, the output turns on as described in the Type A and Type B counter sections.

The minimum span that should be configured between the On and Off Presets depends on the count frequency.

For this Count Frequency:	Minimum Span Between On Preset and Off Preset Should Be:
100KHz	100 counts
90KHz	90 counts
80KHz	80 counts
70KHz	70 counts
60kHZ	60 counts
50KHz	50 counts
40KHz	40 counts
30KHz	30 counts
25KHz	25 counts
20KHz	20 counts
15KHz	15 counts
10KHz	10 counts
5KHz	5 counts
2KHz	2 counts
1KHz	1 count
less than 1KHz	no gap required

Note: Count frequencies above 10kHz are supported only on 20-, 40, and 64-point Micro PLCs.

PWM Outputs

Pulse Width-Modulated outputs can be used to control DC and stepper motors. Channels are set up for PWM output operation in the PLC configuration by setting the Channel Function to PWM. If a channel is configured as a PWM output, then references %I0001 through %I0008, which are normally reserved for High-speed Counter inputs, can be used as standard inputs in the application.

Enabling and Disabling a PWM Output

A PWM output is turned on from the application program by setting its Enable Output bit to 1. The output is turned off by setting its Enable Output bit to 0.

When a PWM output starts operating, it continues until a new configuration is received, a store occurs (logic and/or configuration), a write to the user storage device occurs, or the Output Enable bit is cleared. A PWM output stops if an invalid frequency or duty cycle value is commanded.

If a PWM output is running when power is lost and the Output Enable bit remains set to 1, the output starts again as soon as power is restored and the PLC transitions to Run mode.

	Channel 1	**Channel 2**	**Channel 3**	**Channel 4**
PWM Frequency	AQ002	AQ004	AQ006	AQ008
PWM Duty Cycle	AQ003	AQ005	AQ007	AQ009
Enable Output	Q0505	Q0506	Q0507	Q0508

PWM Frequency

The frequency of a PWM output (15hz to 65Khz for Micro-20, -40, and -64 PLCs and 15Hz to 5Khz for other models) is specified from the application program by writing a value (15 to 65000 for Micro-20, -40, -64 PLC or 15 to 5000 for other Micro PLCs) to the associated frequency reference, as shown above. The actual frequency output can have a tolerance of 1%.

PWM Duty Cycle

The PWM duty cycle is set up by writing a value (0 to 10000) to the channel's Duty Cycle reference, as shown above. Both frequency and duty cycle can be changed while the output is enabled. The minimum and maximum duty cycle values depend on the frequency.

Load Correction for PWM Outputs

The PLC's optical isolators can skew the duty cycle, depending on temperature and load. To compensate for this, the Micro PLC automatically applies an additional load correction time to the zero output time of each pulse. The default load correction time is: 2 microseconds for 20/40/64-point Micro PLCs with DC outputs, 35 microseconds for other Micro PLCs with DC outputs, 10 microseconds for 20/40/64-point Micro PLCs with relay outputs, or 85 microseconds for other Micro PLCs with relay outputs.

Changing the Load Correction Time

The Load Correction time can be changed within the range 0 to 200 microseconds by sending the new value in a COMMREQ, as explained later in this chapter.

An example is illustrated below. In the diagram, *T*0 is the OFF Time, which is $\frac{1}{2f} + Correction$, where *f* is the pulse frequency. $T1 = \frac{1}{2f}$, *T*2 = Optical Isolator Delay, and *T*1+*T*2 = ON Time.
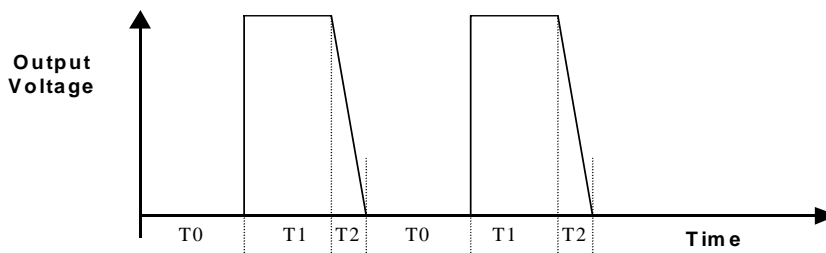
Pulse Train Outputs

Pulse Train Outputs can be used to control stepper motors.

Configuring a Pulse Train Output

Configuring an channel as a Pulse Train Output is done by setting the Channel Function to Pulse Train in the PLC configuration.

Program References for Pulse Train Outputs

The following program references are assigned for use by Pulse Train Outputs.

	Channel 1	Channel 2	Channel 3	Channel 4
Pulse Train Complete	I0494	I0495	I0496	I0511
Enable Output	Q0505	Q0506	Q0507	Q0508
Start Pulse Train	Q0494	Q0495	Q0496	Q0511
Frequency:16 Bit Mode	AQ123	AQ125	AQ127	AQ121
32 Bit Mode	AQ120	AQ123	AQ126	AQ117
Number of Pulses: 16 bit mode	AQ124	AQ126	AQ128	AQ122
32 Bit Mode	AQ 121-122	AQ124-125	AQ127-128	AQ 118-119

Enabling and Disabling Pulse Train Operation

Pulse Train operation starts when the channel's Enable Output bit is set to 1 and the channel's Start Pulse Train bit transitions from 0 to 1. This automatically clears the Pulse Train Complete bit to 0. Pulse Train operation continues until the specified number of pulses have occurred. A Pulse Train Output can be stopped before the requested number of pulses has been completed by setting its Enable Output bit to 0. If the Enable Output bit transitions from 1 to 0, the Pulse Train stops immediately. When the last pulse is completed, the channel's Pulse Train Complete bit goes to 1.

A Pulse Train Output continues to operate when the Micro PLC goes from Run mode to Stop mode. If a Pulse Train Output is running when power is lost, it will restart after power is restored when the PLC transitions with Run mode if both the Enable Output bit and the Start Pulse Train output bits are set to 1.

Setting Up the Pulse Frequency

The application program sets up the frequency of a Pulse Train Output by writing a value to the channel's Frequency reference. The frequency range is 15hz to 65Khz for Micro-20/40/64 PLCs, and 15Hz to 5Khz for other models) .

The sum total of frequency configured for all Pulse Train Outputs on a Micro PLC should be less than or equal to 65kHz (this frequency is available for a Micro-20/40/64 only). The minimum frequency that can be configured on each channel is 15Hz. For example: If all the channels are to be configured for Pulse Train with Ramp for maximum possible frequency, the frequencies on each channel can be 15kHz, 15kHz, 15kHz, and 20kHz.

The frequency of a Pulse Train Output can be changed while the Pulse Train is operating. One application of this feature would be to ramp up at the beginning of the Pulse Train operation, and ramp down at the end. For a Micro-20, -40, -64 PLC, Pulse Ramping can also be done by configuring the channel for Pulse Train with Ramp.

The actual frequency output can have a tolerance of 1%.

If the maximum count speed is more than 30kHz for a Type B Counter, or more than 60kHz for Type A, resistance must be added to the encoder input as shown in the example below:
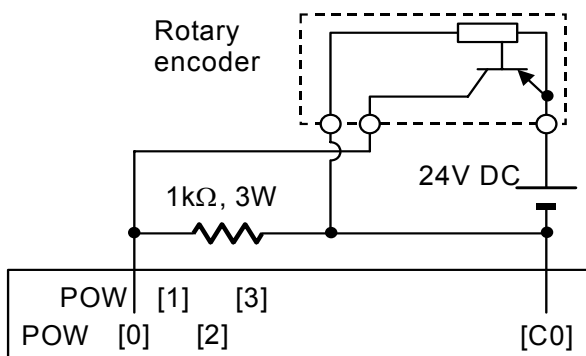
Setting Up the Number of Pulses

The application program sets up the number of pulses to be output (0 to 65535) by writing the value to the channel's Number of Pulses reference.

Load Correction Time

Pulse Train Outputs have a nominal duty cycle of 50%, but the PLC's optical isolators can skew the duty cycle, depending on temperature and load. To compensate for this, the PLC applies an additional load correction time to the zero output time of each pulse. The default load correction time depends on the Micro PLC type. The default times are: 2 microseconds for 20/40/64-point Micro PLCs with DC outputs, 35 microseconds for other Micro PLCs with DC outputs, 10 microseconds for 20/40/64-point Micro PLCs with relay outputs, or 85 microseconds for other Micro PLCs with relay outputs

Changing the Load Correction Time

The Load Correction time can be changed within the range 0 to 200 microseconds by sending the new value in a COMMREQ, as explained later in this chapter.

An example is illustrated below. In the diagram, *T*0 is the OFF Time, which is $\frac{1}{2f} + Correction$, where *f* is the pulse frequency. $T1 = \frac{1}{2f}$, *T*2 = Optical Isolator Delay, and *T*1+*T*2 = ON Time.
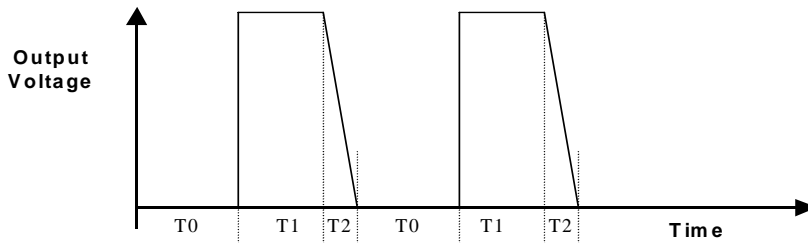
Pulse Train with Ramp

The Pulse Train with Ramp feature of Micro-20, -40, and -64 PLCs combines the basic operation of a Pulse Train Output with configurable acceleration and deceleration times to produce Pulse-Train profile like the example shown below.
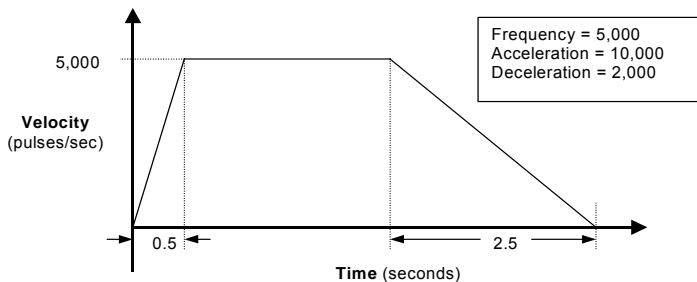
Configuring Pulse Train with Ramp

An output can be set up as a Pulse Train with Ramp by selecting 4 Type A or 1 Type A / 1 Type B as the Counter Type, and selecting Pulse Train with Ramp as the Channel Function.

A Pulse Train with Ramp has configurable acceleration and deceleration rates. The default for both is 1,000,000 (the maximum). Both acceleration and deceleration can be selected during configuration from the range of 90 to 1,000,000. Acceleration and deceleration do not need to be the same. Appropriate values depend on the application and the capability of the stepper motor being driven by the module. Acceleration and Deceleration can also be temporarily changed from the application program.

Program References for Pulse Train with Ramp Outputs

The following program references are used by Pulse Train with Ramp Outputs(Can only be configured in 4TypeA/1TypeA 1TypeB configuration).

	Output 1	Output 2	Output 3	Output 4
Pulse Train Complete	I0494	I0495	I0496	I0511
Start Pulse Train	Q0494	Q0495	Q0496	Q0511
Enable Output	Q0505	Q0506	Q0507	Q0508
Frequency	AQ123	AQ125	AQ127	AQ121
Number of pulses	AQ124	AQ126	AQ128	AQ122

Setting Up the Pulse Frequency for Pulse Train with Ramp

The application program sets up the frequency of a Pulse Train with Ramp by writing a value to the channel's Frequency reference. The frequency range is 15hz to 65Khz.

The sum total of frequency configured for Pulse Train with Ramp channels should be less than or equal to 65kHz. The minimum frequency that can be configured on each channel is 15Hz. For example: If all the channels are to be configured for Pulse Train with Ramp for maximum possible frequency, the frequencies on each channel can be 15kHz, 15kHz, 15kHz, and 20kHz.

The frequency, acceleration, deceleration, and number of counts of a Pulse Train with Ramp cannot be changed when the ramp output has started. If the frequency is changed in the %AQ references after the ramp output has started, the new frequency is used for the next ramp that is generated.

The actual frequency output can have a tolerance of 1%.

Setting Up the Number of Pulses

The application program sets up the number of pulses to be output (0 to 65535) by writing the value to the channel's Number of Pulses reference.

Changing the Acceleration and Deceleration

Acceleration and deceleration are set up in the channel configuration. The configured acceleration and deceleration can also be temporarily changed in the rage of 90 to 1,000,00 using a COMMREQ in the application program, as explained later in this chapter. Acceleration and deceleration cannot be changed while the function is operating.

Controlling Operation of a Pulse Train with Ramp Output

A Pulse Train with Ramp starts when the channel's Enable Output bit is 1 and the channel's Start Pulse Train bit transitions from 0 to 1.

When the Pulse Train begins, the channel's Pulse Train Complete bit is set to 0. The channel outputs the specified number of pulses in varying pulse widths, to produce a velocity profile similar to the one shown below. After the last pulse is completed, the channel's Pulse Train Complete bit is set to 1.

After a Pulse Train with Ramp function has started, it continues until either all of its pulses have been generated or its Output Enable bit changes from1 to 0. The ramp up or ramp down motion occurs in steps of 100ms; so the velocity gradient changes every 100ms until the desired frequency is reached (provided there are sufficient number of pulses to ramp up to the desired frequency).
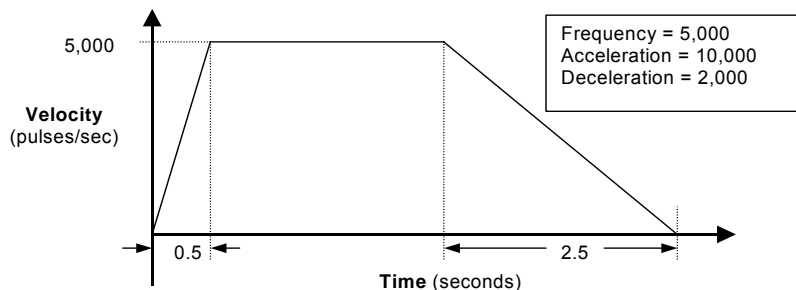
For the example above, the ramp up time is 500ms (1/2 second), so the ramp up takes place in 5 steps: 100ms, 200ms, 300ms, 400ms, 500ms with frequencies of 1KHz, 2KHz, 3Khz, 4KHz, and 5KHz respectively.

The application program can stop a Pulse Train with Ramp before the requested number of pulses have been completed by setting its Enable Output bit to 0. When the Enable Output bit transitions from 1 to 0, the output starts decelerating. The channel outputs a number of pulses based on: (1) the configured deceleration and (2) the velocity at the time the Enable Output bit goes Off. When the last pulse is completed, the channel's Pulse Train Complete bit is set to 1.

Stop Ramp with Deceleration

If the Enable Bit set to 0 during the "at velocity" part of the Pulse Train, the output ramps down normally as shown at left below. If the Enable Bit is set 0 during the acceleration phase, ramping up stops and ramping down begins immediately as shown at right. The deceleration occurs at the configured or commanded rate.
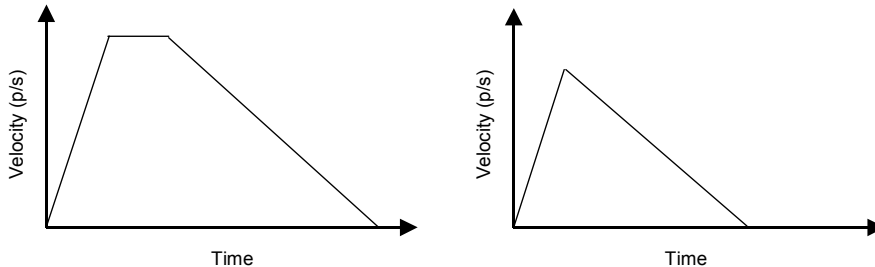
If the Ramp output is already decelerating (because the number of pulses has been reached) when the Enable Output bit transitions from 1 to 0, the Pulse Train output continues decelerating at the same rate.

Stop Ramping Immediately

When the Micro PLC powers up or receives a new configuration, it automatically sets up all Ramp channels to decelerate when the Output Enable bit goes to 0.

If a Pulse Train with Ramp output should stop immediately, a COMMREQ can be used, as described later in this chapter.

COMMREQs for the HSC/PWM/PTO Functions

The application program can use the COMMREQ function to provide data or send the following commands to High-speed Counters, Pulse Train outputs, or PWM outputs that are currently enabled:

- Load Accumulator
- Load High and Low Limits
- Load Accumulator Increment
- Set Counter Direction
- Load Timebase
- Load ON and Off Presets
- Load Preload
- Load Stop Mode or Resume Decelerate Mode (for Micro-20, -40, -64 CPUs only)
- Load Acceleration and Load Deceleration (for Micro-20, -40, -64 CPUs only)
- Load Correction

Program logic should be set up to assure that the command is sent to the module once, not repeatedly. These changes are temporary; they lost when the PLC is powered down and when a new configuration is stored from the programmer.

The COMMREQ Command Block

The command data must be placed in the correct order (in a *command block*) in CPU memory before the command is executed. The command block is composed of 14 words as shown below. All values are hexadecimal unless otherwise indicated. The command block can be placed in any word-oriented area of memory that is not reserved (see chapter 22 for a list of reserved areas).

Offset	*Data*	*Description*
address	0004	Always 0004
address +1	don't care	Not used (always zero). The Micro PLC ignores the Wait flag for all COMMREQ junctions.
address +2	don't care	not used
address +3	don't care	not used
address +4	don't care	not used
address +5	don't care	not used
address +6	don't care	not used
address +7	don't care	not used
address +8	0008	Data type (8 = registers)
address +9	000A	Start location of Command Word –1 (%R0011)
address +10	nnnn	Command Word (see next page)
address +11	nnnn	LS Data Word
address +12	nnnn	MS Data Word used only for ramping in 4 Type A 32-bit or One Type A, One Type B 32-bit mode in Micro 20/40/64 CPU. Not used by other Micro PLCs

Contents of the Command

The last three words of the Command contain the command parameters. These words are treated as independent bytes. They can be entered in hexadecimal or decimal format. The format for the last three words is:

	MSB	LSB
command word	0n	cc
data word (LSW)	dd	dd
data word (MSW)	dd	dd

where: n=counter 1-4
cc=subcommand code
dd=data type

The Command Word, located at "address +10" of the command, identifies the action to be performed. The MSB of the command word specifies the channel number (1 – 4 for Type A, always 1 for Type B).

Example: To set Counter 1 to 1234H, load command registers with:
Command word: 0101
LS data word: 1234
MS data word: 0

Example: To set Counter 1 to 200,000 (30D40H) in 32-bit mode, load command registers with:
Command word: 0101
LS data word: 0D40
MS data word: 0003

Negative values must be entered in 32-bit two's complement format.
Example: To set the Load Preload to a value of –1000 decimal, enter the hex value FFFF FC18 for command word 01nF.

Command Word (hex)	Command	Description
0n01	Load Accumulator	Loads any value within a counter's limits directly into the Accumulator. If a count is received at the same time, the count is lost.
0n02	Load High Limit	Sets the High and Low limit to any value in the counter range. Move the Low Limit first when shifting down or the High Limit first when shifting up. Loading limits in the wrong order can cause an error. The command is successful if all parameters are within the new range.
0n03	Load Low Limit	
0n04	Load Accumulator Increment	Offsets a counter Accumulator by up to +127 or –128 counts. Only the LSB data is used with this command. This can be done at any time, even while the counter is counting at maximum rate. However, if a count is received at the same time the CPU updates the Accumulator value, the count is lost. If the offset causes the counter to exceed its limits, this parameter is rejected.

Command Word (hex)	Command	Description
0n05	Set Counter Direction	(Type A only) Changes the count direction. Only the LSB of the first data word is used for this command (00 = up, 01 = down).
0n06	Load Timebase	Changes the time interval used for the counts/timebase word data. The range is 10 to 1000mS in 10mS intervals.
0n0B	Load ON Preset	Sets up the output turn on points within the counter range. There is one output associated with each counter. See the previous information about Presets for appropriate settings.
0n15	Load OFF Preset	Sets up the output turn off points within the counter range. There is one output associated with each counter. See the previous information about Presets for appropriate settings.
0n1F	Load Preload	Changes the count value loaded into the counter Accumulator when the Preload input is activated.
0n3B	Load Stop Mode (or Resume Decelerate Mode)	(Micro-20/40/64 CPU only) Changes a Pulse Train output's deceleration to stop the Ramp immediately when the Output Enable bit goes Off. The Ramp function must be enabled. The same command can be used to reset the output to Decelerate mode (the default) by entering the value 0001 in the LS data word.

0n3C	Load Acceleration	(Micro-20/40/64 CPU only) Changes a Pulse Train output's acceleration. The Pulse Train with Ramp function must be enabled. For channels 1 – 3, acceleration and deceleration can be selected from the range of 10 p/s^2 to 1,000,000 p/s^2. For channel 4, the range is 90 p/s^2 to 1,000,000 p/s^2. The default for both is 1,000,000.
		
		 In the acceleration and deceleration commands, the data value is a 32-bit number. These are the ONLY Data Commands that should have any value other than 0 in the MS data word.
		
		 Example: to change the acceleration rate of Pulse Train output 1 to 200,000 (30D40H), load:
		     Command word: 013C
		     LS data word: 0D40
		     MS data word: 0003

0n3D	Load Deceleration	(Micro-20/40/64 CPU only) Changes a Pulse Train output's deceleration. The Ramp function must be enabled. See Load Acceleration above for details.
0n3E	Load Correction	Sets the change (in microseconds) that should be applied to the duty cycle of a Pulse Train output to compensate for the slow turn-off time of the optical isolator circuit (35 microseconds – DC outputs; 85 microseconds relay outputs). The range is 0 to 200 microseconds.

Notes:

1. If a Load Accumulator command is executed with the ON Preset value, the Preset will be turned on for that instance only.

2. If a Load Accumulator command is executed with the OFF Preset value, the Preset will be turned off for that instance only.

COMMREQ Example

The example uses a COMMREQ to load the value 1234 into the Accumulator for Counter 3.
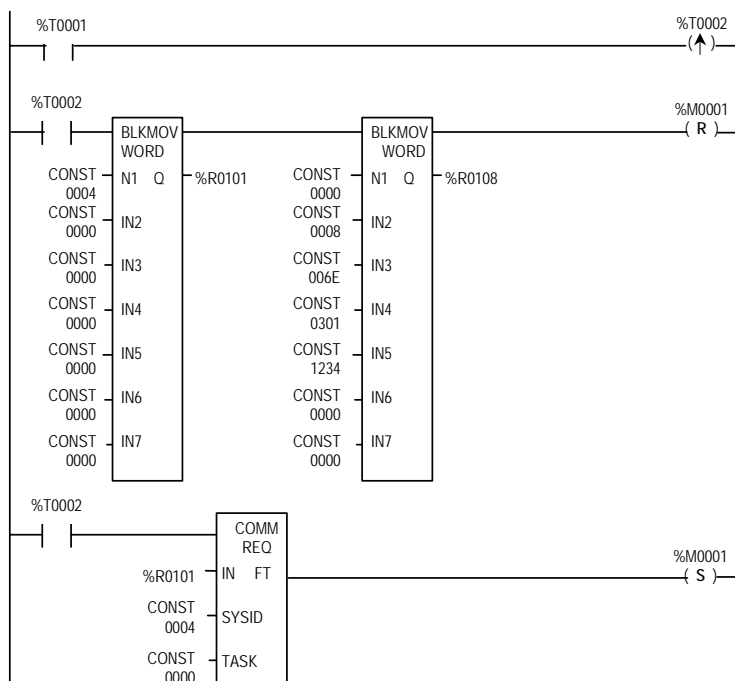
The first rung in the example includes a one-shot coil (%T0002) that executes the COMMREQ once. This prevents multiple messages from being sent.

The next rung uses a Block Move Word function to load the commands. In this example, %R0101 through %R0114 are used for the COMMREQ Command Block. Any registers can be used.

The COMMREQ function has four inputs and one output.

Parameter	Description
enable	%T0002 to enables the COMMREQ function.
IN	Points to the starting address of the Command Block, which is %R0101.
SYSID	Indicates which rack and slot to send the message to (physical location of HSC module). The SYSID is always 0004 for the Micro PLC.
TASK	This parameter is ignored and should be set to zero.
FT	This output is energized if an error is detected during processing of the COMMREQ.

Command Word Error Responses

If the module receives an invalid command parameter in a Command Word, it returns an error code in the first word of its word input (AI) data. The following error codes are used for High-speed Counter COMMREQs:

Note: If the program issues a COMMREQ that changes count direction, the counter will go immediately into the new mode. Remember that the output does not change states at exactly the same points on an Up-counter as it does on a Down-counter.

Error Code		Description	Definition
Decimal	**Hex**		
3	3	Invalid Command	Command number received was invalid for the HSC.
6	6	Invalid Counter Number or Channel	Counter number in the Data Command Word was not a valid counter based on the current configuration.
11	0b	Counter/Channel 1 Limit Error	Invalid Low or High limit value
12	0c	Counter/Channel 2 Limit Error	New limit places Preload value out of range
			New limit places Off Preset out of range
13	0d	Counter/Channel 3 Limit Error	New limit places Accumulator value out of range
14	0e	Counter/Channel 4 Limit Error	Accumulator value is out of range
			Preload value is out of range
			On Preset value is out of range
			Off Preset value is out of range
19	13	Load Stop Mode/Reset Decelerate Mode	Invalid value. Must be 1 (decelerate) or 2 (stop).
20	14	Load Acceleration	Acceleration too low. Must be ≥ 10 for channels 1-3 and >90 for channel 4.
21	15	Load Acceleration	Acceleration too high. Must be $\leq 1,000,000$
22	16	Load Deceleration	Deceleration too low. Must be ≥ 10. for channel 1-3 and >90 for channel 4.
23	17	Load Deceleration	Deceleration too high. Must be $\leq 1,000,000$

HSC Application Examples

RPM Indicator

The HSC can be used as a position/motion indicator when connected to a feedback device (such as an encoder) that is coupled to a rotary motion. RPM indication can be obtained directly from the counter's Counts/Timebase register (CTB) or derived from it by a simple calculation.

The RPM calculation is:

$$RPM = \frac{CTB}{PPR \times T}$$

where: CTB = counts/timebase reading from the counter
PPR = pulses/revolution produced by the feedback device
T = timebase expressed in minutes

If the number of pulses per revolution is an integer power of 10, setting the timebase for 6, 60, 600, 6000, or 60,000 produces a direct reading of RPM in the Counts per Timebase register with an assumed decimal placement.

Example

If feedback produces 1000 pulses/revolution, CTB reading = 5210, and the timebase is configured for 60ms, which gives:

T = 60/60000 = .0001 and 1/T = 1000.

The Counts per Timebase reading equals 521 and

$$RPM = \frac{521}{1000} \times 1000 = 521$$

CTB reading is RPM with 1 RPM resolution.

Input Capture

The High-speed Counter strobe inputs can act as *pulse catch inputs* for inputs 2, 4, 6, and 8 by using the Strobe Status bits as a latch.

To use this feature:

1. Configure a Type A Counter on any channel.

2. Set the Preload//Strobe parameter to "Strobe".

The corresponding Strobe Status bit will be latched if there is a pulse of at least 100 µsec in width. The Reset Strobe bits can be used as clear functions for the latched status bits.

Chapter
19

Motion Control Functions

Micro-20, Micro-40 and Micro-64 PLCs (release 3.6 or later) can perform basic Motion Control functions of Jogging, Homing, Blended Move, and Stop Motion. This chapter describes the use of motion control functions.

- **Overview**
  - Program References for Motion Features
  - Position Registers
  - Function Block Instance Registers
  - Error Codes for Motion Features

- **Finding a Home Position**
  - Find Home Function Block
  - Stopping Find Home
  - Example Program Logic for Find Home

- **Moving to the Home Position**
  - Go Home Function Block
  - Stopping Go Home
  - Example Program Logic for Go Home

- **Jogging**
  - Jogging Function Block
  - Stopping Jogging
  - Example Program Logic for Jogging

- **Blending**
  - Blending Function Block
  - Stopping Blending
  - Example Program Logic for Blending
  - Examples of Blended Moves

- **Stopping Motion on an Axis**
  - Stop Motion Function Block
  - Example Program Logic for Stop Motion

Overview

The High-Speed Counter outputs of a Micro-20, Micro-40. or Micro-64 PLC can be independently configured for motion support. Use of these features requires Proficy Machine Edition version 5.5, SP2, SIM 6 or later.

The channel's configured HSC/PWM/PTO setting must be either 4 Type A_32, or 1 Type A / 1 Type B_32.The channel's Counter Function must be configured as Motion Support. Configuration is described in chapter 16.

Function blocks can be used in the application program to set up and control motion operations. The same function blocks supply additional parameters for the operation.

Program References for Motion Features

	Output 1	*Output 2*	*Output 3*	*Output 4*
Position Register (REAL)	AI006-007	AI010-011	AI020-021	AI024-025
Mode Select Bit (BOOL)	Q497	Q498	Q499	Q500
Rotary Mode High Limit Register (DWORD)	AQ117-118	AQ121-122	AQ125-126	AQ113-114
Rotary Mode Low Limit Register (REAL)	AQ119-120	AQ123-124	AQ127-128	AQ115-116
Motion Enable (BOOL)	Q505	Q506	Q507	Q508
Axis error register (WORD)	AI002	AI003	AI004	AI005
Axis error reset bits (BOOL)	Q489	Q490	Q491	Q492

Position Registers

The Micro PLC stores the cumulative motor position in the channel's Position Register, where it can be read from the application program. The capacity of the Position Register is a 32-bit real value. When used for motion support, the 32-bit Position Registers are used as shown in the table above.

All commanded moves increment or decrement the value in the Position Register, so it reflects the actual motor position. For example, the Position Register is set at 0. A 10,000-count move is commanded in the forward direction. At the end of this move, the Position Register contains the value 10,000. Now a 2,000-count move is commanded in the reverse direction. At the end of this move, the Position Register contains the value 8,000 (10,000–2,000).

The Position Register is automatically cleared: at powerup, when a new configuration is downloaded, when PLC memory is cleared, when the configuration is cleared, and when the CPU transitions from STOP to RUN mode. It is set to zero after a successful Find Home operation. When the Position Register is cleared, the cleared value appears in the reference memory window only when the PLC is put into RUN mode.

Operating Modes of the Position Registers

The position register can function in either Rotary mode or Linear Mode.

Rotary Mode Operation of the Position Registers

In Rotary mode, the Position Register wraps when the configured high limit or low limit is reached, and continues incrementing or decrementing based on the direction of operation. Rotary mode is selected by setting output bit %Q497, Q498, Q499, or Q500 to 1, for channel 1, 2, 3, or 4, respectively. The high limit and the low limits for Rotary mode can be set up using the references shown on the previous page.

Position Register transitions for both clockwise and counter-clockwise motions always start at the configured low limit. For example, if the low limit = -100.0 and the high limit = +100.0, a movement of 5 units in the clockwise direction sets the Position Register value to –95.0, and a movement of 5 units in the counter-clockwise direction sets the position register value to +96.

If the configured High Limit is less than the Low Limit, the error is displayed in %AI0001/2/3/4 memory for each of the channels and the High Limit defaults to the Low Limit +1.

Linear Mode Operation of the Position Registers

In Linear mode, any configured Rotary limits are not used. The Position Registers increment or decrement from zero after powerup, and on every Stop to Run transition. At other times, the Position Registers increment or decrement from the last move position.

Output bits %Q0497-Q0500 can be used to provide inputs for this mode for each of the four channels respectively. A value of 0 selects Linear mode and 1 selects Rotary mode.

Limits of the Position Register value in Linear mode are +3.4e38 and –3.4e38. If either limit is reached, the value stops changing.

Function Block Instance Registers

Each instance of a motion function block in the program requires a separate memory area for its internal status and control data. This must be set up by assigning two contiguous words of %R memory during programming. The reference address location is initially indicated by ???? in the function block.

During operation, the data in these assigned status and control references should not be overwritten by user logic. Overlapping reference addresses may cause erratic operation of the motion function block.

```
      JOGGING
       ????
  AX          ADO
  EF           AC
  EB           ER
  ACC          EI
  DEC          WR
  VEL
```

Instance Register Starting Reference Address

The first word of this data area is used for 16 status and control bits. As the table below shows, the Find Home, Go Home, Blending, and Stop Motion function blocks use the same bit definitions. Jogging uses some different bit definitions. Most of this data is for internal use only; it is not of interest to the application program. The exceptions to this are bit 1 (Active output), which can be monitored for a Jogging function block, and bit 2 (Done output), which can be monitored for the other function block types. See the function block descriptions in this chapter for more information.
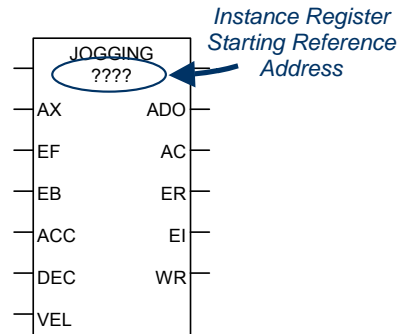
Bit	Description	Find Home, Go Home, Blending, Stop Motion	Jogging
Least significant word			
0	Execute input, previous execution	■	reserved
1	Active output	■	■
2	Done output	■	reserved
3	Error output	■	■
4	Warning output	■	■
5	Motion Started	reserved	reserved
6	Enable input, previous execution	■	■
7	Execute Triggered	reserved	reserved
8	Jogging, Enable Backward active = 1	reserved	■
9	Jogging, Enable Forward active = 1	reserved	■
10	Previous Enable Backward Value	reserved	■
11	Previous Enable Forward Value	reserved	■
12	Runtime Error Occurred	reserved	■
13-15	Not Used	reserved	reserved
Most significant word			
Word	Error ID / Warning ID of the function block error that occurred. See next page.		

Error Codes and Warnings for Motion Features (Hexadecimal)

The following error codes are used for the motion function blocks. These error codes appear in word 2 of the function block's 2 words of instance data, as described on the previous page. They also appear in each function block's Error ID output and in the channel error references: %AI002, 003, 004, and 005 for channels 1, 2, 3, and 4 respectively. The application program should monitor error status using those references.

Error Code (hex)	Error Description
14	Specified acceleration below minimum limit of 10 for channels 1, 2, 3 or below minimum limit of 90 for channel 4
15	Specified acceleration above maximum limit of 1,000,000
16	Specified deceleration is below minimum limit of 10 for channels 1, 2, 3, or below minimum limit of 90 for channel 4
17	Specified deceleration above maximum limit of 1,000,000
18	Specified Velocity is below minimum limit of 10
19	Specified Velocity is above maximum limit of 65000
1B	Specified home offset is negative, which is not valid
1D	Axis not configured for motion In the hardware configuration for HSC/PWM/PTO settings, channel function should be selected as 'Motion Support' to be able to initiate any motion command.
1E	Axis busy with Ramping. User logic issued a motion command on a channel that had Ramping already in progress.
1F *	Axis busy with Jogging. Only one motion function block is allowed to be active at a time but user logic has issued another motion command while jogging command is still in progress.
21 *	Axis busy with Blending. Only one motion function block is allowed to be active at a time but user logic has issued another motion command while blending command is still in progress.
22	Find Home cannot be started because Final Home velocity is greater than Find Home velocity
23	Home switch Input is already On at the time of triggering Find Home command.
24	Go Home function block triggered without a previously successful Find Home being completed.
25	Specified number of profiles is above the maximum limit of 4.
26	Specified number of profiles is below the minimum limit of 1.
27	Configured pulse count is less than the minimum limit of 2.
29 *	Axis busy with Find Home. Only one motion function block is allowed to be active at a time but user logic has issued another motion command while Find Home is still in progress.
2A *	Axis busy with Go Home. Only one motion function block is allowed to be active at a time but user logic has issued another motion command while Go Home is still in progress.

Error Code (hex)	Error Description
2B	Motion function block issued before the axis was enabled (i.e. %Q0505, 506,507,508 bits are low on respective axis)..
2C	No motion is in progress when Stop motion function block triggered.
2E	Channel not configured to support motion function blocks. For the motion features to be supported, the counter type should be either 4 Type A_32 or 1 Type A / 1 Type B_32 counters on settings tab.
2F	In continuous/rotary mode operation of the position register, high limit is less than or equal to low limit.
30	Blending motion parameters array exceeds reference memory size. Eg: Each profile in blending contains four parameters (acceleration, deceleration, velocity, and distance). Each parameter occupies two words. So for each profile 8 words of memory is required. Suppose %AI120 is assigned for blending motion parameters input. If the number of profiles is 4, then 32 words of memory, starting from %AI120, needs to be reserved for blending motion parameters. But %AI memory can only be up t o %AI128.
31	Stop motion function block is re-triggered before function block has finished stopping motion. This is a warning.
33	Both enable forward, enable backward inputs are high on Jogging, which is invalid.
34	Motion cannot be started for the following reasons:
	Either motion function block was triggered while Stop Motion function block is still active (not complete), or the axis is blocked by the Stop Motion function block (Execute input on Stop Motion function block is high). Axis error.
35	Stop Motion function block is issued while another motion function block is pending to start on same axis. This error occurs if a motion function block (Jogging, Blending, or Homing) is triggered on an axis and a Stop Motion function block is triggered before motion can start on that axis.
37	More than one instance of Stop motion function block triggered on the same axis.
38	Motion stopped due to stop mode (PLC has transitioned from Run mode to Stop mode), or power fail. Axis error.
39	Axis error present on the channel. Check %AI002, 3, 4, and 5 for axis error details on respective channel. Axis errors can be cleared by a low-to-high transition of output bits %Q489, 490,491, or 492 for channels 1, 2, 3, or 4 respectively.

*   If an active (not complete) function block instance is re-enabled while motion is still in progress, this condition is recorded as a warning. If a different function block is enabled while motion is in progress, this condition is recorded as an error.

Axis and Function Block Errors

Of the errors listed above, errors 2B, 34, and 38 are axis errors. All other errors are function block errors. If any axis error is present on an axis, no motion can be initiated on that axis by any function block.

Clearing Axis Errors

Axis errors can be cleared by a low-to-high transition of output bits %Q489, 490, 491, or 492 for channel 1, 2, 3, or 4.

Axis errors are also cleared by any of the following:

- clearing/downloading a hardware configuration
- clearing/ downloading logic
- clearing of all memory
- clearing of initial values

After axis errors are cleared in %AI memory, motion can be started by any function block.

Operation of the Instance Registers

While the function block's Enable input is receiving power flow, function block inputs are stored to the Instance Registers, and function block outputs are updated continuously.

When the function block's Enable is not receiving power flow, the function block outputs are not updated. However, they are still updated to the Instance Registers.

The next time Enable receives power flow, the output status data stored in the Instance Registers is updated to function block outputs.

The Instance Register references should not be overwritten by user logic. Overlapping reference addresses may cause erratic function block operation.

Motion Function Block Operation in PLC Run-Stop-Run Transition or Loss of Power

If power is lost or if the Micro PLC goes to Linear mode while a motion function is being executed, the motion stops immediately.

When power returns or when the Micro PLC goes to Run mode, the error 0x38 (see above) is logged in the channel's %AI memory reference. The same error is generated on the function block output when its Enable input receives power flow. Error 0x38 is an axis error; no motion will occur on the axis until the error is cleared.

Avoiding Abrupt Start/Stop of Motion

The following condition must be satisfied in order to avoid abrupt start/stop of motion:

n≥1, where

$$n = \frac{10 \times \text{Velocity}}{\text{Acceleration}} \quad \text{or} \quad n = \frac{10 \times \text{Velocity}}{\text{Deceleration}}$$

If n<1, abrupt start/stop of motion can happen.

Example:

For the Find Home function:

Find Home Velocity = 1000

Final Home Velocity = 500

Acceleration = 10000

Deceleration = 10000

Offset = 0

With these parameters, the values for Final Home Velocity and Deceleration yield a value of n=0.5, which does not satisfy the requirement **n≥1.** Instead of decelerating to home position, the axis goes immediately to zero velocity. To avoid this, select values for Velocity, Acceleration and Deceleration that satisfy the above condition.

Finding a Home Position

The Find Home function defines a Home (zero) position for the axis, relative to a physical location on a machine. The location is represented by a Home Switch, which is connected to a specific input on the Micro PLC. The Home Switch input must come from a normally-open contact. A normally-closed contact cannot be used.

The Home Switch input is assigned to input reference %I002, %I004, %I006, or %I008 depending on the channel. The input reference cannot be used as a standard input when the channel is used for Homing.

When a Find Home Cycle is requested, the following sequence is executed:
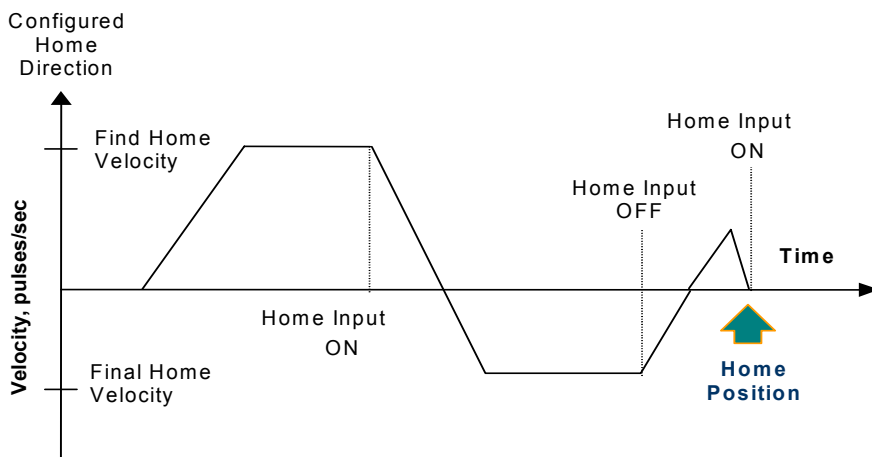
1. After accelerating to the configured Find Home Velocity, the axis moves in the specified direction until the Home Input signal is detected.

2. When the rising edge of Home Input signal is detected, the axis decelerates at the deceleration rate and stops.

3. The axis then accelerates in the opposite direction at the Final Home Velocity until the Home Input signal goes to 0.

4. Once the falling edge of the Home Input signal is detected (Home Input off as shown above), the axis decelerates and stops.

5. At the falling edge of the Home Input, the CPU starts capturing the motor position value. This continues until the motion stops and the axis makes a final move to the Home switch or to the Home Offset.

6. Zero Home Offset: the axis accelerates to the Final Home velocity. It then decelerates and stops at the edge transition of the Home Input. This is the Home position. The position register is automatically zeroed upon completion of the Find Home cycle.

7. Non-zero Home Offset: Depending on the value of the Home Offset and the motor position captured by the CPU, the axis accelerates to the Final Home Velocity in either forward or reverse direction. The axis moves until it decelerates again to reach the Home Offset position. The position register is set to 0 when the axis reaches the Home Offset position.
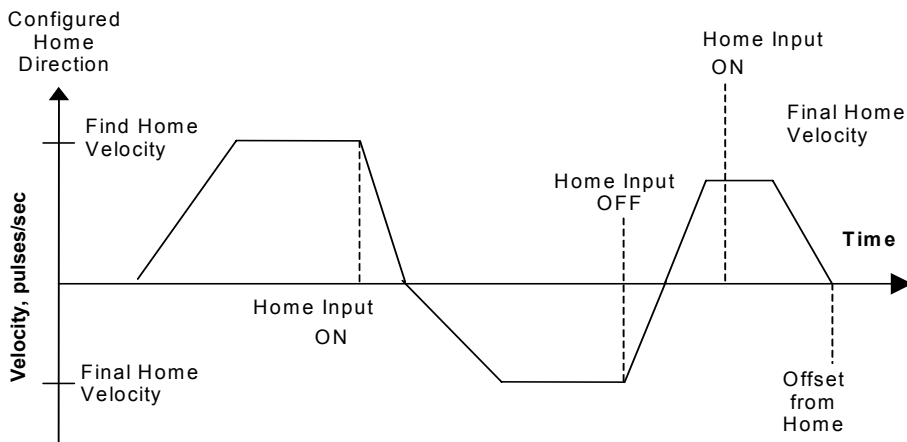
Find Home Function Block

The application program uses the following function block to set up and control a Find Home operation.
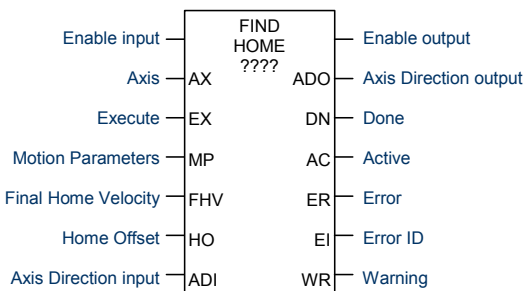
```
                          FIND
      Enable input ───    HOME         ──  Enable output
                          ????
             Axis ─── AX        ADO ──  Axis Direction output
          Execute ─── EX         DN ──  Done
 Motion Parameters ─── MP        AC ──  Active
Final Home Velocity ─── FHV      ER ──  Error
       Home Offset ─── HO        EI ──  Error ID
Axis Direction input ─── ADI     WR ──  Warning
```

The channel's Output Enable bit (for example, Q0505 for channel 1) must be set to 1 to use this or any other motion function block on the channel. If the Output Enable bit is not 1, the function will not execute, and a Channel Enable error will be reported.

When the Enable input receives power flow and the Execute input transitions to 1, the function block parameters are loaded. If the parameters are not valid, a warning is generated, and the function does not start. If the parameters are valid, the motion starts in the direction (CW or CCW) specified by Axis Direction input, and the Active output is set to 1. Active returns to 0 when the function completes or is stopped.

If the Enable input continues passing power flow after the motion completes, Find Home can be restarted with the same parameters by again generating a low to high transition on the Execute input. To execute the function block with different parameters, the Enable input must stop passing power flow. After changing the parameter values, the function block can be executed by again passing power flow to the Enable input and generating a low to high transition on the Execute input.

The function block's Enable output remains high as long as Enable Input is high.

If the Enable input stops receiving power flow while motion is in progress, the function block's Done output will not indicate when motion stops. In this case, the application program should monitor the Done output bit (bit 2) at address +0 of the function block's assigned Instance data to determine when the motion is completed.

Transitions of the Execute input are only monitored while the Enable input is receiving power flow. While the Enable input receives power flow, the Execute input is monitored for a change in its status from the previous logic scan; if Enable and Execute transition in the same scan, the transition of Execute is not detected. Therefore, the application logic must not set both Enable and Execute either low

or high in the same scan. If Enable and Execute were made low in the same scan, the Find Home function block would still see the Execute as high. If Execute and Enable were made high in the same scan, the Find Home function block would not see the transition in Execute status and motion would not start.

Stopping Find Home

Find Home can be stopped by:

▪ Executing a Stop Motion function block, as described later in this chapter. This stops any motion on the channel while leaving the channel active.

▪ Disabling the channel by setting its High-Speed Counter enable output bit to 0. No motion functions will operate on the channel while it is disabled.

<div style="border:1px solid">Caution</div>

To avoid abrupt starting and stopping of motion, the ratio of Velocity/Acceleration or Velocity/Deceleration must be ≥ 0.1. For details, refer to page 19-8.

Inputs to the Find Home Function Block

Enable	The Enable input provides power flow to the function block.
Axis	A Constant representing the channel (1, 2, 3, or 4) on which Find Home will be done.
Execute	Power flow to this input controls execution of the function.
Motion Parameters	Starting address of 6-word reference location in AI, AQ, or R memory for the motion speeds, which are specified in the channel's configured units:

	Words 1, 2	Homing acceleration: 10 to 1,000,000 for channels 1, 2, and 3 90 to 1,000,000 for channel 4.
	Words 3, 4	Homing deceleration: 10 to 1,000,000 for channels 1, 2, and 3 90 to 1,000,000 for channel 4
	Word 5, 6	Find Home velocity, from 15 to 65,000. . The velocity used to reach Home position, the Find Home velocity is usually high, to reach Home position quickly. The sum of velocities on all channels must not exceed 65,000.

Final Home Velocity	Dword variable (%AI, AQ, R) or Constant representing the velocity used after the home switch is detected once. Final Home Velocity ranging from 15 to 65,000 is slower than the Find Home velocity, for greater precision in arriving at the final Home Position.
Home Offset	Real variable (%AI, AQ, R) or constant representing the Offset from the Home Switch.
Axis Direction Input	Boolean variable (%I, Q, M, G, T) or Constant specifying the axis direction. 0 = Clockwise (CW), 1 = Counter-Clockwise (CCW). Note that the actual direction depends on the field connections and drive settings.

Outputs of the Find Home Function Block

Enable output	Power flow output, passes power flow when it receives power flow from the Enable input..
Axis Direction Output	Boolean variable (Q0005 to Q0024). The Micro PLC output point for which direction is to be set. 0 = clockwise, 1 = counterclockwise. The actual direction depends on the field connections and drive settings. The application program should not override the direction output during the Homing operation.
Done	Boolean variable (%I, Q, M, G, T) for the Find Home completion status. Goes to 1 when motion is completed. If the Execute input is a pulse, rather than staying continuously on, Done remains 1/on for one scan after motion completes.
Active	Boolean variable (%I, Q, M, G, T). Set to 1 when motion starts on the channel. Resets to 0 when motion stops.
Error	Boolean variable(%I, Q, M, G, T) . Set to 1 if an error has occurred within function block. See Error ID below.
Error ID	Word variable (%AI, AQ, R). If Error (ER) =1, this is an error ID. If Warning (WR) =1, this is the warning ID. See the list of error definitions on page 19-5.
Warning	Optional parameter. Boolean variable (%I, Q, M, G, T). Set to 1 when a warning has occurred. See Error ID above. Warning is generated when the same motion is triggered again while it is already in progress.

Example Program Logic for Find Home

Moving to the Home Position

The Go Home function moves the motor to a Home position that has been defined by the Find Home function.
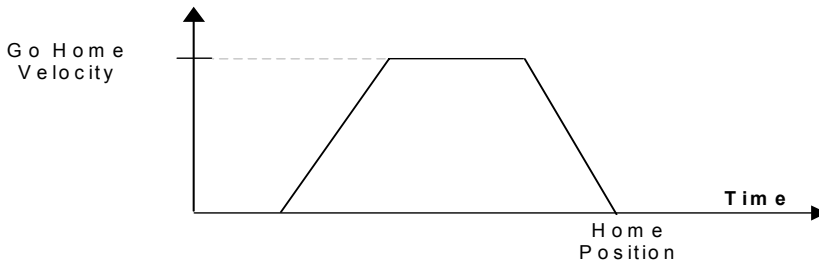
If a Home Offset was set up during execution of the Find Home function, the Go Home function causes the motor to move to the Home Offset position instead.
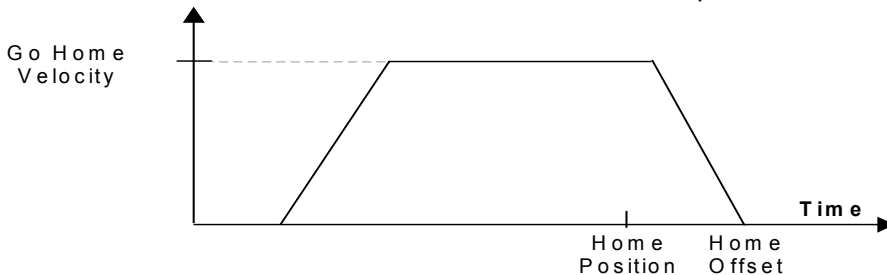
The number of pulses or the distance and the direction of motion are automatically detected based on the Position Register value.

Go Home Function Block

The application program uses the following function block to set up and control a Go Home operation:
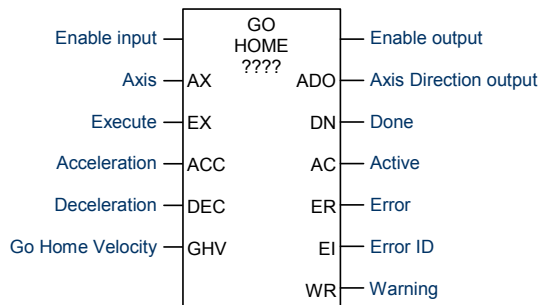
The channel's Output Enable bit (for example, Q0505 for channel 1) must be set to 1 to use this or any other motion function block. If the Output Enable bit is not 1, the function will not execute, and a Channel Enable error will be reported.

When the Enable input receives power flow and the Execute input transitions to 1, the function's parameters are loaded. If the parameters are not valid, an error code is generated, and the function does not start. If the parameters are valid, function execution starts and sets the Active output to 1. Active returns to 0 when the function completes or is stopped.

If the Enable input continues passing power flow after the function completes, Go Home can be restarted with the same parameters by generating a low to high transition on Execute input again. To execute the function block with different parameters, first stop motion and then stop passing power flow to the Enable input. Then, change the parameter values. The function block can then be executed by passing power flow to the Enable input and generating a low-to-high transition on the Execute input.

The function block's Enable output remains high as long as Enable Input is high.

If the Enable input stops receiving power flow while motion is in progress, the function block's Done output will not indicate when motion stops. In this case, the application program should monitor the Done output bit (bit 2) at address +0 of the function block's assigned Instance data to determine when the motion is completed.

Transitions of the Execute input are monitored only while the Enable input is receiving power flow. While the Enable input receives power flow, the Execute input is monitored for a change in its status from the previous logic scan; if Enable and Execute transition in the same scan, the transition of Execute is not detected. Therefore, the application logic must not set both Enable and Execute either low or high in the same scan. If Enable and Execute were made low in the same scan, the Go Home function block would still see the Execute as high. If Execute and Enable were made high in the same scan, the Go Home function block would not see the transition in Execute and motion would not start.

Stopping Go Home

Go Home can be stopped by:

▪ Executing a Stop Motion function block, as described later in this chapter. This stops any motion on the channel while leaving the channel active.

▪ Disabling the channel by setting its High-Speed Counter enable output bit to 0. No motion functions will operate on the channel while it is disabled.

> ### Caution
>
> **To avoid abrupt starting and stopping of motion, the ratio of Velocity/Acceleration or Velocity/Deceleration must be ≥ 0.1. For details, refer to page 19-8.**

Inputs to the Go Home Function Block

Enable	The Enable input provides power flow to the function block.
Axis	A Constant representing the channel (1, 2, 3, or 4) on which Go Home will be done.
Execute	Power flow to this input controls execution of the function. Rising edge is detected to load the parameters and start execution of the function block.
Acceleration	Dword variable or Constant representing the acceleration rate, from 10 to 1,000,000. 90 to 1,000,000 for channel 4.
Deceleration	Dword variable or Constant representing the deceleration rate, from 10 to 1,000,000. 90 to 1,000,000 for channel 4.
Go Home Velocity	Dword variable or Constant representing the velocity at which the Go Home function is to be carried out. From 15 to 65,000. The sum of velocities on all channels must not exceed 65,000.

Outputs of the Go Home Function Block

Enable output	Power flow output, passes power flow when it receives power flow from the Enable input.
Axis Direction Output	Boolean variable (Q0005 to Q0024). The Micro PLC output point for which direction is to be set. 0 = clockwise, 1 = counterclockwise. The actual direction depends on the field connections and drive settings. The application program should not override the direction output during the Homing operation.
Done	Boolean variable (%I, Q, M, G, T) for the GO Home completion status. Goes to 1 when motion is completed and remains 1 until the next homing cycle is started and Execute is continuously on. If the Execute input is a pulse, rather than staying continuously on, Done remains 1/on for one scan after motion completes.
Active	Boolean variable (%I, Q, M, G, T) for the Go Home Active status. 1 = Homing in progress. 0 if motion is complete or has been stopped.
Error	Boolean variable (%I, Q, M, G, T) for the Go Home function block error status. Set to 1 if an error has occurred within function block. See Error ID below.
Error ID	Word variable. If Error (ER) =1, this is an error ID. If Warning (WR) =1, this is the warning ID. See the list of error definitions on page 19-5.
Warning	Optional parameter. Boolean variable (%I, Q, M, G, T). Set to 1 when a warning has occurred. See Error ID above. Warning is generated when the same motion is triggered again while it is already in progress.

Example Program Logic for Go Home
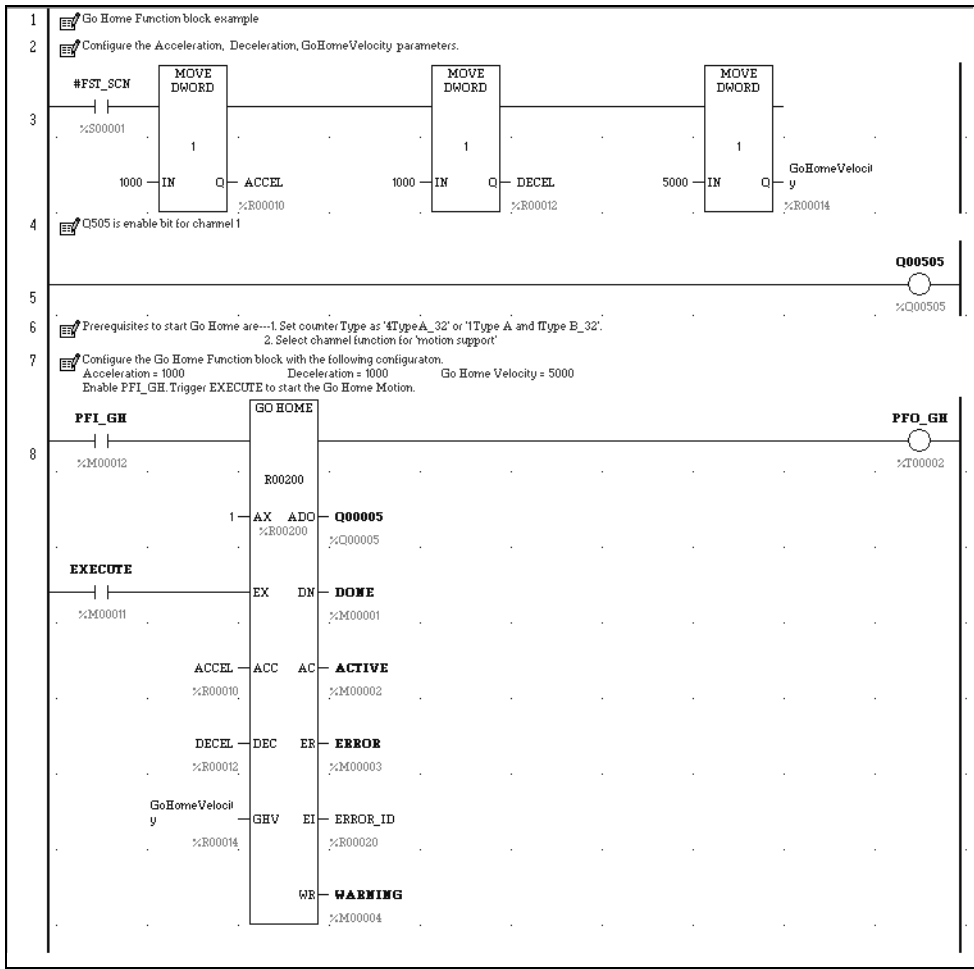
Jogging

A Jogging move consists of Ramp Up (acceleration), At Velocity and Ramp Down (deceleration) velocities.
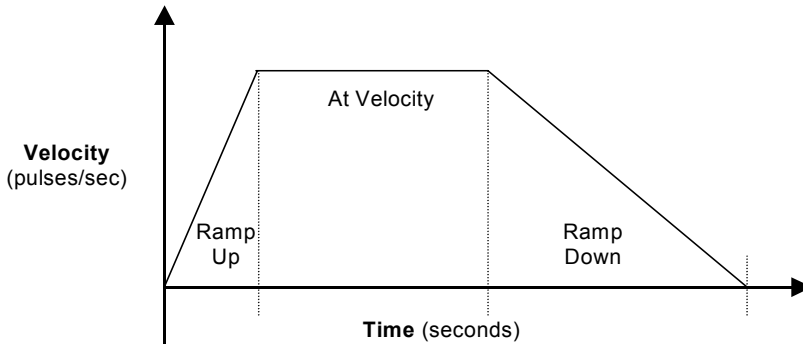
Jogging Function Block

The application program uses the following function block to set up and control Jogging.
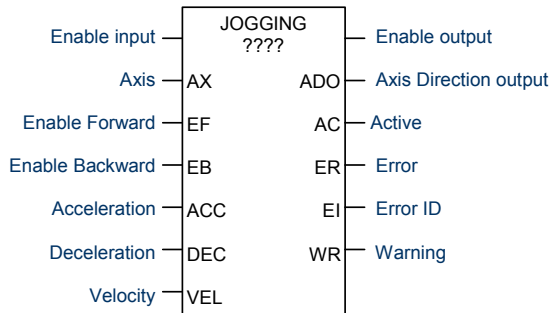
The channel's Output Enable bit (for example, Q0505 for channel 1) must be set to 1 to use this or any other motion function block. If the Output Enable bit is not 1, the function will not execute, and a Channel Enable error will be reported.

When the Enable input receives power flow, if no motion is active on the channel and either Enable Forward (EF) or Enable Backward (EB) begins passing power flow, the function's parameters are loaded. If the parameters are not valid, an error code is generated and the function does not start. If the parameters are valid and the Enable input is high, execution starts in the forward (clockwise) direction if Enable Forward is high, or in the reverse (counter-clockwise) direction if Enable backward is high. The Active output is set to 1. Motion starts at the specified input Acceleration value and continues at the specified input Velocity until power flow is removed from EF or EB. The axis then decelerates at the Deceleration value. Active returns to 0 when the function is fully stopped.

If both Enable Forward and Enable Backward pass power flow, an error is returned. When either input subsequently goes low, motion starts in the other direction and the error clears automatically.

If the Enable input continues passing power flow, Jogging can be restarted with the same parameters by passing power flow to the EF or EB input again. To execute the function block with different parameters, first stop motion. The Enable Forward or Enable Backward input must stop passing power flow. After changing the parameter values, the application logic can again pass power flow to the Enable Forward or Enable Backward input.

Enable Forward / Backward input level is not monitored unless the Enable input is receiving power flow. The Enable Forward / Enable Backward inputs are level-triggered, not edge-triggered.

The function block's Enable output transitions to 0 automatically when EN input becomes 0.

If the Enable input stops receiving power flow while motion is in progress, the function block's Active output will not indicate when motion stops. In this case, the application program should monitor the Active output bit (bit 1) at address +0 of the function block's assigned Instance data to determine when the motion is completed.

Stopping Jogging

Jogging can be stopped by:

▪ Executing a Stop Motion function block, as described later in this chapter. This stops any motion on the channel while leaving the channel active.

▪ Disabling the channel by setting its High-Speed Counter enable output bit to 0. No motion functions will operate on the channel while it is disabled.

Caution

To avoid abrupt starting and stopping of motion, the ratio of Velocity/Acceleration or Velocity/Deceleration must be ≥ 0.1. For details, refer to page 19-8.

Inputs to the Jogging Function Block

Enable	The Enable input provides power flow to the function block.
Axis	A Constant representing the channel (1, 2, 3, or 4) on which Jogging will be done.
Enable Forward	If the Enable input is passing power flow, power flow to EF enables forward motion (clockwise) of the specified axis and starts the Jogging operation. If Jogging is already in progress, removing power flow to EF stops motion.
Enable Backward	If the Enable input is passing power flow, power flow to EB enables backward motion (counter-clockwise) of the specified axis and starts the jogging operation. If Jogging is already in progress, removing power flow to EB stops motion.
Acceleration	Dword variable (AI, AQ, R) or Constant representing the jogging acceleration rate, between 10 and 1,000,000 for channel 1 to 3 and 90 to 1,000,000 for channel 4.
Deceleration	Dword variable (AI, AQ, R) variable or Constant representing the jogging deceleration rate, between 10 and 1,000,000 for channel 1 to 3 and 90 to 1,000,000 for channel 4.
Velocity	Dword variable (AI, AQ, R) or Constant representing the velocity rate, between 15 and 65,000. The sum of velocities on all channels must not exceed 65,000.

Outputs of the Jogging Function Block

Enable output	Power flow output, passes power flow when it receives power flow from the Enable input..
Axis Direction Output	Boolean Variable (Q0005 to Q0024). The Micro PLC output point for which direction is to be set. 0 = clockwise, 1 = counterclockwise. The actual direction depends on the field connections and drive settings. The application program should not override the direction output during the motion operation.
Active	Boolean variable (%I, Q, M, G, T) for the Jogging Active status. 1 = Jogging in progress. 0 = Jogging complete or stopped,
Error	Boolean variable(%I, Q, M, G, T) for the error status. Set to 1 if an error has occurred within function block. See Error ID below.
Error ID	Word variable (%AI, AQ, R). If Error (ER) =1, this is an error ID. If Warning (WR) =1, this is the warning ID. See the list of error definitions on page 19-5.
Warning	Optional parameter. Boolean variable (%I, Q, M, G, T). Set to 1 when a warning has occurred. See Error ID above. Warning is generated when the same motion is triggered again while it is already in progress.

Example Program Logic for Jogging

```
  ┌ Q505 is enable bit for channel 1
 ┘
                                                                      Q00505
                                                                        ( )

  ┌ Prerequisites to start jogging are---1. Set counter Type as '4Type A_32' or '1Type A and fType B_32'.
 ┘                                        2. Select channel function for 'motion support'
  ┌ Axis(channel number) is 1
 ┘ Accelaration 1000, Decelaration 1000, Velocity 2000
    To start jogging make EF or EB high
        EN    ┌─JOGGING─┐                                              ENO
      ─┤ ├    │         │                                              ( )
     %T00010  │         │                                            %T00011
              │ R00001  │
          1 ──┤AX   ADO├── ADO
              │         │  %Q00006
        EF    │         │
      ─┤ ├────┤EF    AC├── Active
     %T00012  │         │  %T00014
        EB    │         │
      ─┤ ├────┤EB    ER├── Error
     %T00013  │         │  %T00015
              │         │
       1000 ──┤ACC   EI├── ErrorID
              │         │  %R00011
              │         │
       1000 ──┤DEC   WR├── Warning
              │         │  %T00016
              │         │
       2000 ──┤VEL      │
              └─────────┘
```

Blending

A Blended Move consists of up to four successive moves that are executed without the output value returning to zero between moves. The speed (pulse rate) and distance (number of pulses) for each of the blended moves can be defined. Transition to the speed of the next move uses ramping. At the end of each blended move, when the motor has moved the defined number of pulses, the motor must be at the speed set for the next move in the sequence.

The simplest form of blended move is shown below.
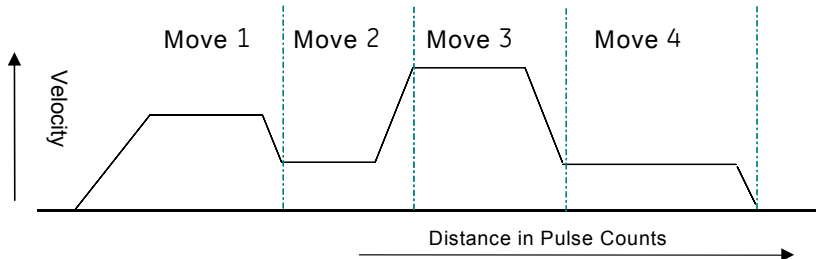
Because each Blend profile is equal to a normal ramping profile, a Pulse train with Ramp can be done using a Blended move with just one blending profile. Use this method if the hardware configuration selected is 4 Type A_32 or 1 Type A/1 Type B_32.

Each move can use any of the combinations of Ramp up (acceleration), At Velocity and Ramp Down (deceleration) states. These combinations depend on velocity of the next move in the sequence.

The parameters of each profile are used until the velocity of the next move is reached.

Based upon the Number of Pulses and the input parameters, the acceleration, deceleration and the flat regions of the profile are calculated in order to reach the target frequency of next profile. The motion is then performed with the calculated parameters.

Examples of Blended Moves

This section describes some different Blended Move operations.

Example 1

In this example, all of the moves have sufficient number of pulses and acceleration to reach the desired velocity.
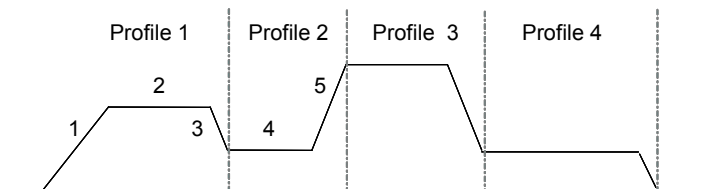
In this example, segments 1, 2, and 3 use the profile 1 parameters:

- The number of pulses for segments 1, 2, and 3 are from distance 1.

- Segment 1 accelerates at acceleration 1.

- Segment 2 moves at velocity 1.

- Segment 3 decelerates at deceleration 1. For segment 3, while calculating the number of pulses, the velocity of profile 2 (segment 4) is taken as the final velocity.

Segments 4 and 5 use the profile 2 parameters:

- Segment 4 moves at velocity 2.

- Segment 5 accelerates at acceleration 2.

The final aim of each move is to reach the next move desired velocity. So in Profile 1, first the acceleration pulses are calculated for segment 1, then the deceleration pulses are calculated for segment 3. The remaining pulses are generated at the profile 1 desired velocity.

Example 2

In this example, the distance 1 value in profile 1 is not enough to reach *velocity 1.*
So in profile 2 (segment 2), *accel2* and *pulses2* are used to reach *velocity 2.*
Velocity 2 and *velocity 3* are configured as equal.
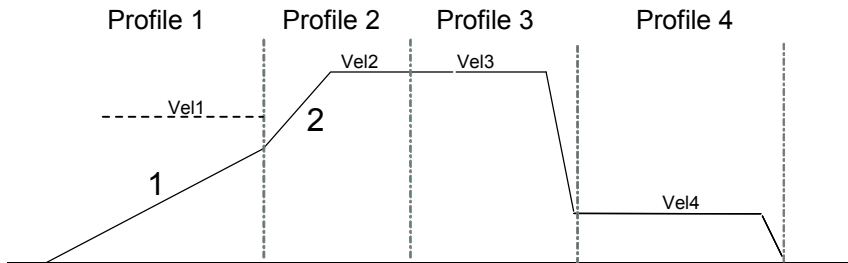
Example 3
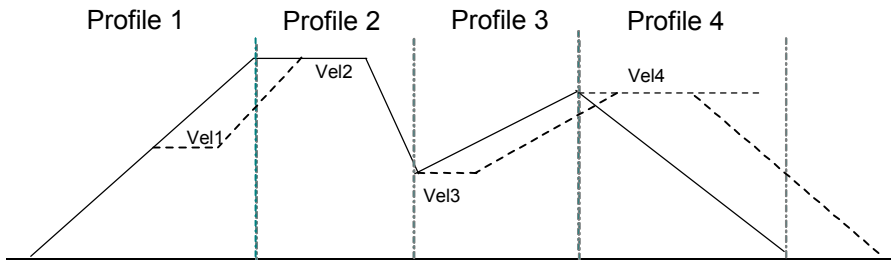
In this example, for profile 1:

1. The acceleration to reach *velocity 1* is calculated,

2. Then the acceleration needed to reach *velocity 2* from *velocity 1* is calculated.

3. The remainder of profile 1 is run at velocity 1. In this example, all of profile 1 is required for acceleration, so there is no constant velocity (dotted line) in profile 1.

Profile 3 – Like profile 1, *distance 3* is just sufficient to accelerate to *velocity 4*, so profile 3 has no motion at v*elocity 3.*

Profile 4 consists entirely of deceleration.

Example 4

In this example, in Profile 1, the acceleration is just enough to reach *velocity 1*. In profile 2, segment 2, *deceleration 2* is used to reach *velocity 2*. Segment 3 of profile 2 is at *velocity 2*. Segment 4, ramps up at *acceleration 2* to reach *velocity 3*.

Profile 1   Profile 2   Profile 3   Profile 4

Vel1

2   4   Vel3

1   3

Vel2
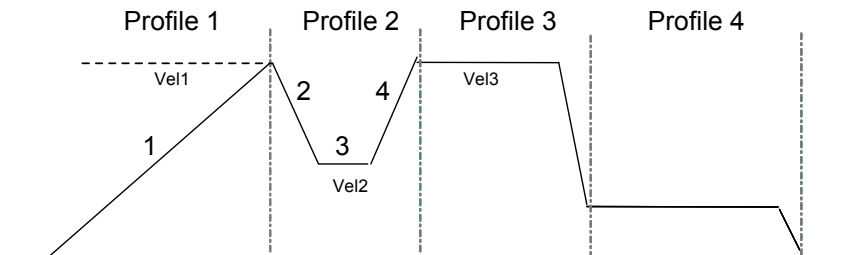
Example 5

In profile 1, *segment 1* accelerates from zero to *velocity 1* then decelerates down to *velocity 2* from *velocity 1* in segment 2. Since the distance is just enough for these segments, profile 1 has no motion at *velocity 1*.
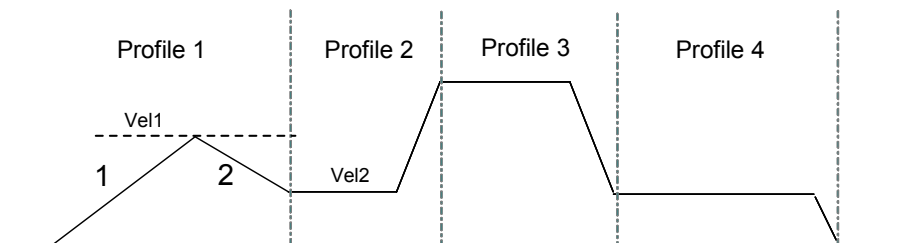
Profile 1   Profile 2   Profile 3   Profile 4

Vel1

1   2   Vel2

Blending Function Block

The application program uses the following function block to set up and control Blended Moves operation:
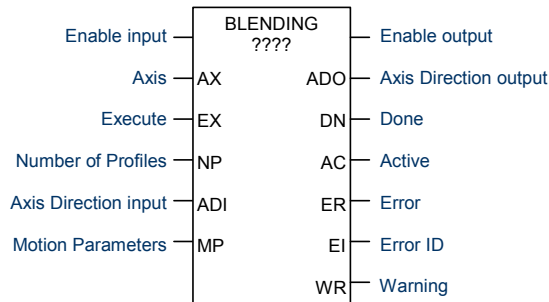
```
                    ┌─────────────┐
                    │   BLENDING  │
Enable input ───────┤     ????    ├─────── Enable output
                    │             │
        Axis ───────┤ AX      ADO ├─────── Axis Direction output
                    │             │
     Execute ───────┤ EX       DN ├─────── Done
                    │             │
Number of Profiles ─┤ NP       AC ├─────── Active
                    │             │
Axis Direction input┤ ADI      ER ├─────── Error
                    │             │
Motion Parameters ──┤ MP       EI ├─────── Error ID
                    │             │
                    │          WR ├─────── Warning
                    └─────────────┘
```

The channel's Output Enable bit (for example, Q0505 for channel 1) must be set to 1 to use this or any other motion function block. If the Output Enable bit is not 1, the function will not execute, and a Channel Enable error will be reported.

When the Enable input receives power flow, if the Execute input is set to 1, the function's parameters are loaded. If the parameters are not valid, an error code is generated, and the Blending function does not start. If the parameters are valid, the function block starts execution and sets the Active output to 1. The Active output returns to 0 when the function completes, or is stopped.

If the Enable input continues passing power flow, Blending can be restarted with the same parameters by generating a low to high transition on Execute input again. To execute the function block with different parameters, stop the motion. Then, remove power flow from the Enable input. After changing the parameter values, the function can be executed by reapplying power flow to the Enable input and generating a low to high transition on the Execute input.

The function block's Enable output transitions to 0 automatically when EN input becomes low.

Transitions of the Execute input are only monitored while the Enable input is receiving power flow. While the Enable input receives power flow, the Execute input is monitored for a change in its status from the previous logic scan; if Enable and Execute transition in the same scan, the transition of Execute is not detected. Therefore, the application logic must not set both Enable and Execute either low or high in the same scan. If Enable and Execute were made low in the same scan, the Blending function block would still see the Execute input as high. If Execute and Enable were made high in the same scan, the Blending function block would not see the transition in Execute status and motion would not start.

The motion status can be monitored by the Active output of the function block. If the Active output is 1, motion is in progress. While motion is in progress, the

Done, Error, and Warning outputs should be 0. After the completion of the motion, the Active output is set to 0 and the Done output is set to 1.

If the Enable input stops receiving power flow while motion is in progress, the function block's Done output will not indicate when motion stops. In this case, the application program should monitor the Done output bit (bit 2) at address +0 of the function block's assigned Instance data to determine when the motion is completed.

When there is any error during the motion or at the start of the motion, the Error indication and the Error Number are updated to the Error output and the Error ID specified in the function block.

Stopping Blending

Blending can be stopped by:

▪ When the PLC has gone though Run-Stop transition. After coming back to Run mode, an axis error (0x38) is logged into the %AI002 register and also at the Blending function block's Error ID output. The error in %AI002 must be cleared using the predefined reset bits for any other motion to start on that axis.

▪ When the PLC is power-cycled.

▪ Executing a Stop Motion function block, as described later in this chapter. This stops any motion on the channel while leaving the channel active.

▪ Disabling the channel by setting its enable output bit to 0. No motion functions will operate on the channel while it is disabled.

$$\boxed{\text{Caution}}$$

To avoid abrupt starting and stopping of motion, the ratio of Velocity/Acceleration or Velocity/Deceleration must be ≥ 0.1. For details, refer to page 19-8.

Inputs to the Blending Function Block

Because some of the profiles in a Blended Move may not have Ramp Up, At Velocity, and Ramp Down segments, some parameters may not be used.

Enable — The Enable input provides power flow to the function block.

Axis — A Constant representing the channel (1, 2, 3, 4) on which the Blended Move will be done.

Execute — Power flow to this input starts execution of the function. Rising edge is detected to load the parameters and start execution of the function block.

Number of Profiles — Word variable or Constant representing the number of profiles (1, 2, 3, or 4). Data for each profile must be present in the Motion Parameters references (below).

Axis Direction Input — Boolean variable (%I, Q, M, G, T) or a Constant specifying the axis direction. 0 = Clockwise (CW), 1 = Counter-Clockwise (CW). The actual direction depends on the field connections and drive settings.

Motion Parameters — Starting address of 32-word reference location in AI, AQ, or R memory that will be used for the Motion Parameters of each profile. Acceleration, deceleration and velocity are specified in the channel's configured units.

Words 1, 2	Profile 1 acceleration, from 10 to 1,000,000 for channels 1, 2, and 3; 90 to 1,000,000 for channel 4
Words 3, 4	Profile 1 deceleration, from 10 to 1,000,000 for channels 1, 2, and 3; 90 to 1,000,000 for channel 4
Words 5, 6	Profile 1 velocity, from 15 to 65,000
Words 7, 8	Real value. Distance in user units for profile 1
Words 9 to 16	Profile 2 acceleration, deceleration, velocity, and distance, as above for Profile 1
Words 17 to 24	Profile 3 acceleration, deceleration, velocity, and distance, as above for Profile 1
Words 25 to 32	Profile 4 acceleration, deceleration, velocity, and distance, as above for Profile 1

Outputs of the Blended Moves Function Block

Enable Output — Power flow output, passes power flow when it receives power flow from the Enable input.

Axis Direction Output — Boolean variable (Q0005 to Q0024). The Micro PLC output point for which direction is to be set. 0 = clockwise, 1 = counterclockwise. The application program should not override the direction output during the motion operation.

Done — Boolean variable (%I, Q, M, G, T) for the Blending completion status. Goes to 1 or passes power flow when motion is complete. If the Execute input is a pulse, rather than continuously on, Done remains 1/on for one scan after motion completes.

Active — Boolean variable (%I, Q, M, G, T). Set to 1 when motion starts on the channel. Resets to 0 when motion stops.

Error — Boolean variable (%I, Q, M, G, T). Set to 1 if an error has occurred within function block. See Error ID below.

Error ID — Word variable (%AI, AQ, R). If Error (ER) =1, this is an error ID. If Warning (WR) =1, this is the warning ID. See the list of error definitions on page 19-5.

Warning — Optional parameter. Boolean variable (%I, Q, M, G, T). Set to 1 when a warning has occurred. See Error ID above. Warning is generated when the same motion is triggered again while it is already in progress.

Example Program Logic for Blending

## Stopping Motion on an Axis

As mentioned for the individual functions, motion can be stopped by:

- Disabling the channel by setting its High-Speed Counter enable output bit to 0. This stops all motion functions on the channel.

- Executing a Stop Motion function block as described below. This stops any motion on the channel while leaving the channel active.

Stop Motion Function Block

The application program can use the Stop Motion function block to stop any motion operation:

```
                    ┌─────────────┐
                    │    STOP     │
 Enable input ──────│   MOTION    │────── Enable output
                    │    ????      │
        Axis ──── AX │         DN  │── Done
     Execute ──── EX │         AC  │── Active
   Stop Mode ──── SM │         ER  │── Error
 Deceleration ──DEC │          EI  │── Error ID
                    │         WR  │── Warning
                    └─────────────┘
```
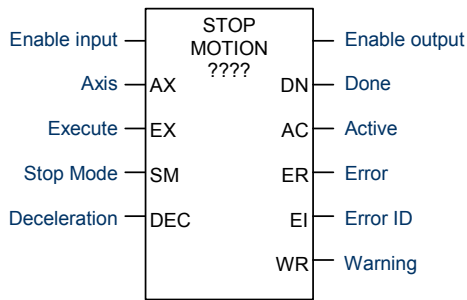
When the Execute input receives power flow and the Enable input is high, and there is no stop motion instance on the axis, the parameters are loaded. If the parameters are valid, a low to high transition on the Execute input starts execution, stops the axis with the specified input deceleration value (or immediately) based on the value of Stop mode input, and sets the Active output to 1. The Done output goes to 1 when the axis stops and the Active output returns to 0. Done remains high until the Execute input transitions low. If Execute is a pulse, Done remains high for one scan after the axis stops (Active becomes low). If the parameters are not valid, an error code is generated, and the function does not start.

To execute the function block with different parameters, remove power flow from the Enable and Execute inputs. Then, change the parameters. The function block will execute with the new parameters when power flow is applied to the Enable input and a low to high transition occurs on the Execute input.

Execute input transitions are not monitored unless the Enable input is receiving power flow. When the Enable input receives power flow, the Execute input is monitored for a change in status from the previous logic scan. Therefore, Enable and Execute should not be made low in the same scan or be made high in the same scan. If both Enable and Execute were set to low in the same logic scan, the change to the Execute state would not be seen by the Stop Motion function

block because Enable is already low. So although the function block's Execute input is low, it still controls the axis and no motion can occur on that axis.

If the Enable input stops receiving power flow while motion is in progress, the function block's Done output will not indicate when motion stops. In this case, the application program should monitor the Done output bit (bit 2) at address +0 of the function block's assigned Instance data to determine when the motion is completed.

More than One Stop Motion Function Block for an Axis

If the application logic contains more than one Stop Motion function block for an axis, the state of the Execute input of the last Stop Motion function block in the scan that has positive power flow determines whether the Stop Motion function block controls motion on the axis.

For example, suppose the logic contains two Stop Motion function blocks for the same axis, and jogging is running on that axis. Execute is triggered for the first Stop Motion function block, but the Execute input of the second Stop Motion function block is 0. The first instance of the Stop Motion function block takes control of the axis and stops the current jogging. After jogging stops, because the Execute input of second (or last) Stop Motion function block is still 0, Stop Motion is not controlling the axis and jogging can again be started on the axis.

Caution

To avoid abrupt starting and stopping of motion, the ratio of Velocity/Acceleration or Velocity/Deceleration must be ≥ 0.1. For details, refer to page 19-8.

Inputs to the Stop Motion Function Block

Enable	The Enable input provides power flow to the function block.
Axis	A Constant representing the channel (1, 2, 3, or 4) on which motion will stop.
Execute	Power flow to this input controls execution of the Function Block.
Stop Mode	Boolean variable (%I, Q, T, M, G) or Constant to control the Stop Mode. 0 = decelerate to stop (normal stop mode). 1 = stop immediately.
Deceleration	Optional Dword variable or Constant representing the jogging deceleration rate, between 10 and 1,000,000 for channels 1, 2, and 3. 90 to 1,000,000 for channel 4.

Outputs of the Stop Motion Block

*Enable output*   Boolean power flow output, passes power flow when it receives power flow from the Enable input.

Done   Boolean variable (%I, Q, M, G, T). Goes to 1 when motion is has stopped. If the Execute input is a pulse, rather than continuously on, Done remains 1/on for one scan.

Active   Boolean variable (%I, Q, M, G, T) for the function status. 1 = Stopping in progress.

Error   Boolean variable (%I, Q, M, G, T). Set to 1 if an error has occurred within function block. See Error ID below.

Error ID   Word variable (%AI, AQ, R). If Error (ER) =1, this is an error ID. If Warning (WR) =1, this is the warning ID . See the list of error definitions on page 19-5.

Warning   Optional parameter. Boolean variable (%I, Q, M, G, T). Set to 1 when a warning has occurred. See Error ID above. Warning is generated when the same motion is triggered again while it is already in progress.

Example Program Logic for Stop Motion
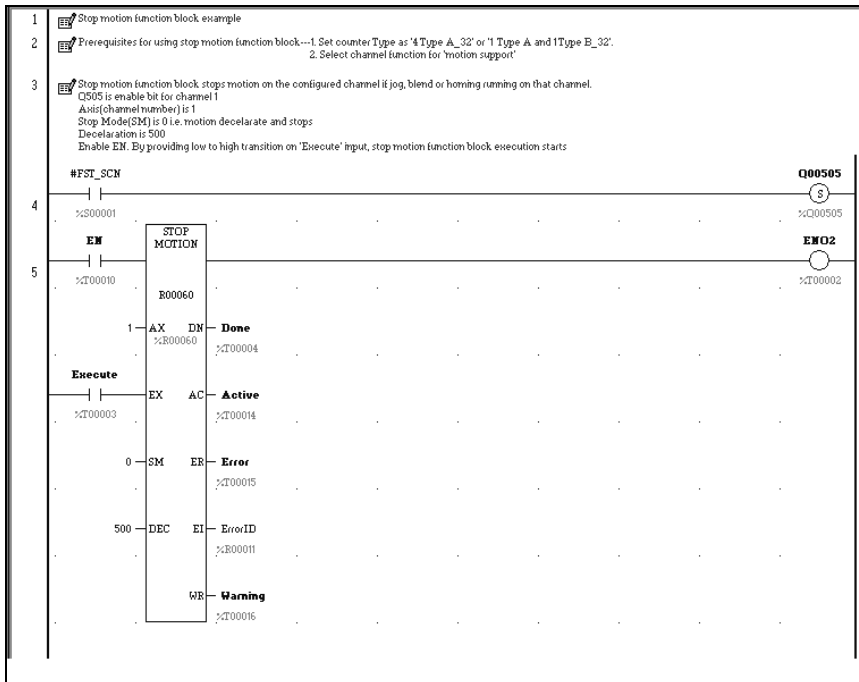
Fault Handling

This chapter discusses how the Micro PLC handles system faults.

Faults and Fault Handling

A *fault* is a failure or condition that can affect the operation and performance of the system. A fault may impair the ability of the PLC to control a machine or process.

Fault Handling

When a fault is detected, the PLC processes the fault and sets the corresponding system bit(s) (See 'System Bit Reference Table'). The PLC logs the fault into a fault table. There are two different fault tables:

- The I/O Fault Table

- The PLC Fault Table

Contents of the fault tables can be monitored and cleared from the programmer.

Classes of Faults

The Micro PLC detects several classes of faults, including:

- Internal Failures
  - Non-responding circuit boards
  - Memory checksum errors
- External Failures
  - Sequence fault
- Operational Failures
  - Communication failures
  - Configuration failures
  - Password access failures

System Responses to Faults

Some faults can be tolerated, while others require that the PLC shut down. I/O failures may be tolerated by the PLC, but not be acceptable for the application. Operational failures can normally be tolerated.

Fault Actions

The PLC categorizes different groups of faults as:

- Informational
- Diagnostic
- Fatal

The PLC logs all faults in the appropriate fault table. For diagnostic and fatal faults, the PLC sets any associated diagnostic variables. The following table lists the fault action, associated fault table, and diagnostic variables for different types of faults. In addition, if the fault is a fatal fault, the PLC halts the system (STOP/FAULTED mode) to prevent possible damage to the equipment, or personal injury.

Fault Group	Action	Fault Table	Diagnostic Variables			
System Configuration Mismatch	Fatal	PLC Fault Table	sy_flt(%SC10)	any_flt(%SC9)	sy_pres(%SC12)	cfg_mm(%SA9)
Expansion Unit Configuration Mismatch	Fatal	PLC Fault Table	sy_flt(%SC10)	any_flt(%SC9)	sy_pres(%SC12)	*cfg_mm(%SA9)*
PLC CPU Hardware Failure	Fatal	PLC Fault Table	sy_flt(%SC10)	any_flt(%SC9)	sy_pres(%SC12)	hrd_cpu(%SA10)
PLC Software Failure (see below)	Fatal	PLC Fault Table	sy_flt(%SC10)	any_flt(%SC9)	sy_pres(%SC12)	sft_cpu(%SB13)
PLC Store Failure (see below)	Fatal	PLC Fault Table	sy_flt(%SC10)	any_flt(%SC9)	sy_pres(%SC12)	stor_er(%SB14)
Program Checksum Failure	Fatal	PLC Fault Table	sy_flt(%SC10)	any_flt(%SC9)	sy_pres(%SC12)	pb_sum(%SA1)
No User Program on Power-up	Diagnostic	-PLC Fault Table	sy_flt(%SC10)	any_flt(%SC9)	no_prog(%SB9)	
Corrupted User RAM	Fatal	PLC Fault Table	sy_flt(%SC10)	any_flt(%SC9)	sy_pres(%SC12)	bad_ram(%SB10)
Unknown PLC Fault	Fatal	PLC Fault Table	sy_flt(%SC10)	any_flt(%SC9)	sy_pres(%SC12)	
Unknown I/O Fault	Fatal	I/O Fault Table	io_flt(%SC11)	any_flt(%SC9)	io_pres(%SC13)	
PLC Fault Table Full	Diagnostic	-	sy_flt(%SC10)			
I/O Fault Table Full	Diagnostic	-	io_full(%S10)			
Application Fault	Diagnostic	PLC Fault Table	sy_flt(%SC10)	any_flt(%SC9)	sy_pres(%SC12)	apl_flt(%SA3)
Password Access Failure	Diagnostic	PLC Fault Table	sy_flt(%SC10)	any_flt(%SC9)	sy_pres(%SC12)	bad_pwd(%SB11)
Constant Sweep Time Exceeded	Diagnostic	PLC Fault Table	sy_flt(%SC10)	any_flt(%SC9)	sy_pres(%SC12)	ov_swp(%SA2)
Loss of Expansion Unit	Diagnostic	I/O Fault Table	io_flt(%SC11)	any_flt(%SC9)	io_pres(%SC13)	los_iom(%SA14)
Addition of Expansion Unit	Diagnostic	I/O Fault Table	io_flt(%SC11)	any_flt(%SC9)	io_pres(%SC13)	add_iom(%SA19)

PLC Software Failure If a PLC Software Failure is logged, the PLC immediately goes into Error Sweep mode. The only way to clear this condition is to cycle power.

PLC Store Failure A *sequence store* is the storage of program blocks and other data preceded by the special Start-of-Sequence command and ending with the End-of-Sequence command. If communications with the programmer are interrupted or if any other failure terminates the download, the PLC Store Failure fault is logged. As long as this fault is present in the system, the PLC will not transition to Run mode.

Fault References

The PLC defines a set of special fault references that can be included in the application program to check for fault conditions, and allow appropriate action to be taken should one of these faults occur.

These special fault references remain set until the PLC is cleared or until the application program clears the fault.

Example Program Logic for Fault References

This example ladder logic shows how the fault reference *ov_swp* can be programmed to check for an oversweep condition, then cleared. In this example, an indicator *light_01* is turned on to alert the operator that an oversweep has occurred. After fixing any problem in the application, the operator presses a pushbutton. This causes program input %I0035 contact to pass power flow to the *ov_swp* reference, which clears the associated memory location.

```
    ov_swp                                          light_01
  ──| |────────────────────────────── — ──────────────( )──

    %I0035                                          ov_swp
  ──| |────────────────────────────── — ──────────────(R)──
```
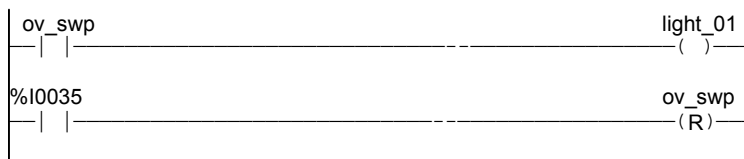
Chapter	*Elements of an Application Program*
21	

This chapter provides basic information about the application program.

- Structure of an application program

- Subroutines

- Program languages

- Instruction set

Structure of an Application Program

The application program consists of all the logic needed to control the operation of the Nano or Micro PLC.

Application programs are created using the programming software and transferred to the PLC. Programs are stored in non-volatile memory.

During the CPU Sweep (described in chapter 17), the Micro PLC reads input data and stores the data in its configured input memory locations. The Micro PLC then executes the entire application program once, utilizing this fresh input data. Executing the application program creates new output data that is placed in the configured output memory locations.

After completing the end of the application program, the CPU provides the output data to the output points.

```
       ┌──────────────────────┐
       │   ┌──────────────┐   │
       │   │ Read Inputs  │   │
       │   └──────────────┘   │
       │          │           │
       │          ▼           │
       │   ┌──────────────┐   │
       │   │   Execute    │   │
       │   │ Application  │   │
       │   │   Program    │   │
       │   └──────────────┘   │
       │          │           │
       │   ┌──────────────┐   │
       │   │Write Outputs │   │
       │   └──────────────┘   │
       │          │           │
       └──────────────────────┘
```
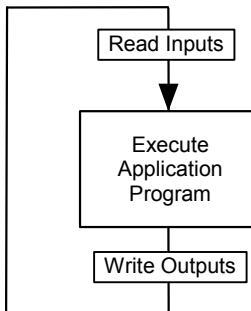
Subroutines

The program can consist of one Main program that executes completely during each CPU sweep.

```
         ┌──────────────┐
         │  ↓           │
         │  ┌────────┐  │
         │  │  Main  │  │
         │  │ Program│  │
         │  └────────┘  │
         └──────────────┘
```
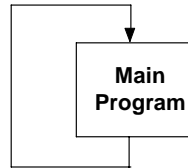
Or a program can be divided into subroutines. The maximum size of a main program block or subroutine block is 16K bytes. A Nano PLC application program can include up to 8 subroutine declarations. A Micro PLC application program can include up to 64 subroutine declarations.

Subroutines can simplify programming and reduce the overall amount of logic. Each subroutine can be called as needed. The main program might serve primarily to sequence the subroutine blocks.

```
    ┌──────────────┐               ┌────────────┐
    │  ↓           │          ┌───→ │ Subroutine │
    │  ┌────────┐  │          │     │     2      │
    │  │        │  │──────────┤     └────────────┘
    │  │Program │  │──────────┼───→ ┌────────────┐
    │  │        │  │          │     │ Subroutine │
    │  └────────┘  │──────────┤     │     3      │
    │              │          │     └────────────┘
    └──────────────┘          └───→ ┌────────────┐
                                    │ Subroutine │
                                    │     4      │
                                    └────────────┘
```
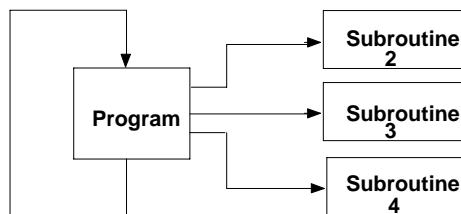
A subroutine block can be called many times as the program executes. Logic that should be repeated can be placed in a subroutine block, reducing total program size.

```
    ┌──────────────┐            ┌────────────┐
    │  ┌────────┐  │──────────→ │ Subroutine │
    │  │Program │  │──────────→ │     2      │
    │  └────────┘  │──────────→ └────────────┘
    └──────────────┘
```
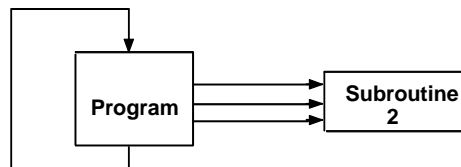
In addition to being called from the program, subroutine blocks can also be called by other subroutine blocks. A subroutine block can even call itself.

```
  ┌──────────────┐          ┌────────────┐
  │  ↓           │     ┌───→ │ Subroutine │
  │  ┌────────┐  │     │     │     2      │──┐
  │  │  Main  │  │─────┤     └────────────┘  │  ┌────────────┐
  │  │ Program│  │     │                     └─→│ Subroutine │
  │  └────────┘  │     │     ┌────────────┐  ┌─→│     4      │
  └──────────────┘     └───→ │ Subroutine │  │  └────────────┘
                             │     3      │──┘
                             └────────────┘
```
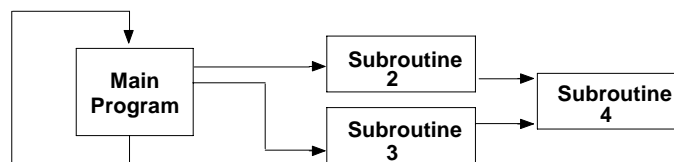
The main program is level 1. The program can include up to eight additional nested call levels.

Declaring a Subroutine

A subroutine must be declared through the block declaration editor of the programming software.

Calling a Subroutine

A subroutine invoked in the program is using a CALL instruction. Up to 64 subroutine block declarations are allowed for Micro CPUs. Up to 8 subroutine block declarations are allowed for NANO CPUs. Regardless of the CPU model, 64 CALL instructions are allowed for each block in the program.
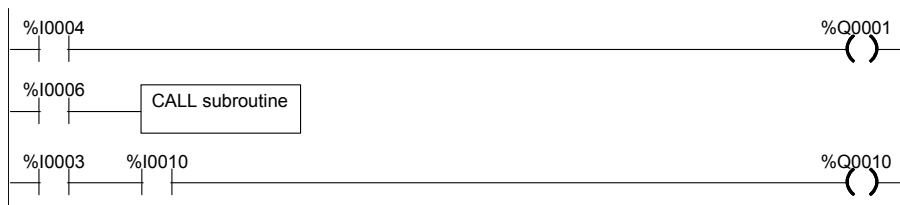
Locking/Unlocking Subroutines

Subroutine blocks can be locked and unlocked from the programming software. There are four levels of locking:

Type of Lock	Description
View	When locked, the subroutine cannot be viewed.
Edit	When locked, the information in the subroutine cannot be changed.
Perm View	The subroutine is permanently locked and cannot be unlocked.
Perm Edit	The subroutine is permanently locked and cannot be unlocked.

Permanently locked subroutines cannot be unlocked, even if the program is copied, backed up, or restored. A previously view-locked or edit-locked subroutine can be unlocked.

Program Languages

Application programs for VersaMax Nano PLCs and Micro PLCs can be created in Ladder Diagram or Instruction List format.

Ladder Diagram

This traditional PLC programming language, with its rung-like structure, executes from top to bottom. The logic execution is thought of as "power flow", which proceeds down along the left "rail" of the ladder, and from left to right along each rung in sequence.
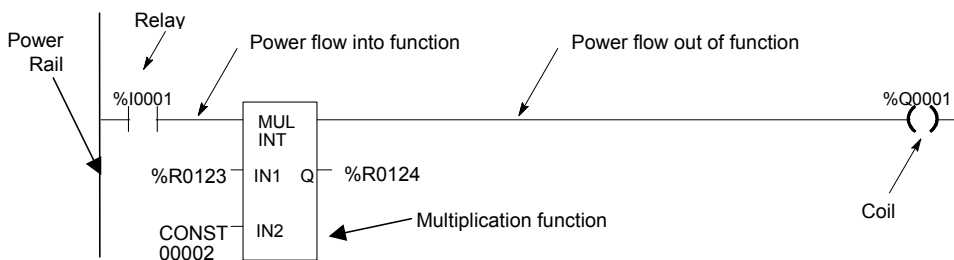
The flow of logical power through each rung is controlled by a set of simple program functions that work like mechanical relays and output coils. Whether or not a relay passes logical power flow along the rung depends on the content of a memory location with which the relay has been associated in the program. For instance, a relay might pass power flow if its associated memory location contained the value 1. The same relay would not pass power flow if the memory location contained the value 0.

If a relay or other function in a rung does not pass logical power flow, the rest of that rung is not executed. Power then flows down along the left rail to the next rung.

A rung contains complex functions that can be used for operations like moving data stored in memory, performing math operations, and controlling communications between the Micro PLC and other devices in the system.

Some program functions, such as the Jump function and Master Control Relay, can be used to control the execution of the program itself.

Together, this large group of Ladder Diagram relays, coils, and functions is called the "Instruction Set" of the Micro PLC.

The Instruction Set

A VersaMax Nano PLC or Micro PLC provides a powerful Instruction Set for building application programs.

As a guide to the programming capabilities of the VersaMax Micro PLC, all of the relays, coils, functions, and other elements of the Instruction Set are listed on the following pages. Complete reference information is included in chapter 23 and in the online help for the programming software.

Contacts

–| |–	Normally Open	Passes power if the associated reference is ON.
–|/|–	Normally Closed	Passes power if the associated reference is OFF.
–|+|–	Continuation	Passes power to the right if the preceding continuation coil is set ON.

Coils

–( )–	Normally Open	Sets the associated reference ON if the coil receives power. Otherwise OFF.
–(/)–	Negated	Sets the associated discrete reference ON if the coil does not receive power. Otherwise OFF.
–(↑)–	Positive Transition	If power flow was OFF to this coil the last time it was executed and is ON this time, then the coil is turned ON. Otherwise, the coil is turned OFF.
–(↓)–	Negative Transition	If power flow was ON to this coil the last time it was executed and is OFF this time, then the coil is turned ON. Otherwise, the coil is turned OFF.
–(S)–	SET	Sets the associated discrete reference ON if the coil receives power. It remains set until reset by an –(R)– coil.
–(R)–	RESET	Sets the associated discrete reference OFF if the coil receives power. It remains reset until set by an –(S)– coil.
–(SM)–	Retentive SET	Sets the associated reference ON if the coil receives power. The reference remains set until reset by an –(RM)– coil. Its state is retained through power failure and **STOP-TO-RUN** transition.
–(RM)–	Retentive RESET	Resets the associated discrete reference OFF if the coil receives power. The reference remains reset until set by an –(SM)– coil. Its state is retained through power failure and **STOP-TO-RUN** transition.
–(/M)–	Negated Retentive	Sets the associated discrete reference ON if the coil does not receive power. The state is retained through power failure and **STOP-TO-RUN** transition. Otherwise OFF.
–(M)–	Retentive	Sets the associated discrete reference ON if the coil receives power. The state is retained through power failure and **STOP-TO-RUN** transition. Otherwise OFF.
– (+)–	Continuation	If power to the coil is ON, the continuation coil sets the next continuation contact ON. If power is OFF, the continuation coil sets the next continuation contact OFF.

Timers and Counters

ONDTR	On-Delay Stopwatch Timer	Accumulates time while receiving power. The current value is reset to zero when the Reset input receives power.
OFDT	Off-Delay Timer	Accumulates time while NOT receiving power. The current value is reset to zero when there is power flow.
TMR	On-Delay Timer	Accumulates time while receiving power. The current value is reset to zero when there is no power flow.
UPCTR	Up Counter	Increments by 1 each time the function receives transitional power.
DNCTR	Down Counter	Counts down from a preset value every time the function receives transitional power.

Math Functions

ADD	Addition	Adds two numbers.
SUB	Subtraction	Subtracts one number from another.
MUL	Multiplication	Multiplies two numbers.
DIV	Division	Divides one number by another, yielding a quotient.
MOD	Modulo Division	Divides one number by another, yielding a remainder.
EXPT	Power of X	Raises X to the power specified by IN and places the result in Q.
SIN	Sine	Finds the trigonometric sine of a real number.
COS	Cosine	Finds the trigonometric cosine of a real number.
TAN	Tangent	Finds the trigonometric tangent of a real number.
ASIN	Inverse Sine	Finds the inverse sine of a real number.
ACOS	Inverse Cosine	Finds the inverse cosine of a real number.
ATAN	Inverse Tangent	Finds the inverse tangent of a real number.
DEG	Convert to Degrees	Performs a RAD_TO_DEG conversion on a real radian value.
RAD	Convert to Radians	Performs a DEG_TO_RAD conversion on a real degree value.
SCALE	Scaling	Scales an input constant or word value.
SQRT	Square Root	Finds the square root of an integer or real value.
LOG	Base 10 Logarithm	Finds the base 10 logarithm of a real value.
LN	Natural Logarithm	Finds the natural logarithm base of a real number.
EXP	Power of e	Raises the natural logarithm base to the power specified by input.

Relational Functions

EQ	Equal	Tests for equality between two numbers.
NE	Not Equal	Tests for non-equality between two numbers.
GT	Greater Than	Tests whether one number is greater than another.
GE	Greater Than or Equal To	Tests whether one number is greater than or equal to another
LT	Less Than	Tests whether one number is less than another.
LE	Less Than or Equal To	Test whether one number is greater than or equal to another.
RANGE	Range	Test the input value against a range of two numbers.

Bit Operation Functions

AND	Logical AND	Performs Logical AND of two bit strings.
OR	Logical OR	Performs Logical OR of two bit strings.
XOR	Logical Exclusive OR	Performs Logical Exclusive OR of two bit strings.
NOT	Logical Invert	Performs a logical inversion of a bit string.
SHL	Shift Left	Shifts a bit string left.
SHR	Shift Right	Shifts a bit string right.
ROL	Rotate Left	Rotates a bit string left.
ROR	Rotate Right	Rotates a bit string right.
BIT_TEST	Bit Test	Test a bit within a bit string to determine whether that bit is currently 1 or 0.
BIT_SET	Bit Set	Sets one bit within a string to true.
BIT_CLR	Bit Clear	Sets one bit within a string to false.
BIT_POS	Bit Position	Locates a bit set to true within a bit string.
MASK_COMP	Masked Compare	Performs a masked compare of two arrays.

Data Move Functions

MOVE	Move	Moves one or more bits of data.
BLKMOV	Block Move	Moves a block of up to 7 constants.
BLK_CLR	Block Clear	Clears to zero one or more bytes/words of memory.
SHFR	Shift Register	Shifts one or more words or bits of data through a block of memory.
BIT_SEQ	Bit Sequencer	Sequences a 1 through a group of bits in PLC memory.
COMM_REQ	Communication Request	Sends a communications request.

Table Functions

ARRAY_MOVE	Array Move	Copies a specified number of data elements from a source array to a destination array.
SEARCH_EQ	Search Equal	Searches array for values equal to a specified value.
SEARCH_NE	Search Not Equal	Searches array for values not equal to a specified value.
SEARCH_GT	Search Greater Than	Searches array for values greater than a specified value.
SEARCH_GE	Search Greater Than or Equal	Searches array for values greater than or equal to a specified value.
SEARCH_LT	Search Less Than	Searches array for values less than a specified value.
SEARCH_LE	Search Less Than or Equal	Searches array for values less than or equal to a specified value.

Conversion Functions

INT_TO_BCD4	Convert to BCD-4 (From INT)	Converts a number to 4-digit BCD format.
REAL_TO_WORD	Convert to Word (From REAL)	Converts a Real value to Word format.
BCD4_TO_INT BCD4_TO_REAL	Convert to INT (From BCD-4 or REAL)	Converts a number to signed integer format.
BCD4_TO_DINT REAL_TO_DINT	Convert to DINT (From BCD-4 or REAL)	Converts a number to double precision integer format.
INT_TO_REAL DINT_TO_REAL BDC4_TO_REAL WORD_TO_REAL	Convert to Real (From INT, DINT, BCD-4 or WORD)	Converts a value to real value format.
REAL_TO_INT	Truncate to INT (from REAL)	Truncates to a 16-bit signed number. The range is –32,768 to +32,767.
REAL_TO_INT	Truncate to Double Precision INT (from REAL)	Truncates to a 32-bit signed number. The range is -2,147,483,648 to +2,147,483,647.

Control Functions

CALL	Call	Causes a program execution to go to a specified subroutine block.
DO_IO	Do I/O	Services a specified range of inputs or outputs immediately (all inputs or outputs on a module will be serviced if any addresses on that module are included in the function – partial I/O module updates are not performed
PID_IND	Independent PID Algorithm	Selects the non-interacting independent PID algorithm.
PID_ISA	ISA PID Algorithm	Selects the ISA PID algorithm.
END	Temporary End of Logic	The program executes from the first rung to the last rung or the END instruction, whichever is encountered first. This instruction is useful for debugging purposes.
COMMENT	Comment	A rung explanation.
SVC_REQ	Service Request	A special PLC service function.
MCRN	Master Control Relay	Starts a master control relay range. An MCR causes all rungs between the MCR and its subsequent ENDMCR to be executed with no power flow. Up to 8 MCRs can be nested.
ENDMCR	End Master Control Relay	Ends a master control relay range.
JUMP	Jump	Jumps to a specified location indicated by a LABEL in the logic.
LABEL	Label	The target location of a JUMP instruction. Multiple Jump instructions can reference the same label.
DRUM	Drum Sequencer	Operates like a mechanical drum sequencer, selecting a 16-bit output pattern from an array of stored patterns, and sending it to a set of outputs.

Communication Function

MODBUS_TCP_RW	MODBUS/TCP read/write	Processes read and write requests for MODBUS/TCP Client support

Motion Functions

FIND_HOME	Find Home	Defines a Home (zero) position for an axis.
GO_HOME	Go Home	Moves the motor to a posositon that has been defined by the Find Home function.
JOGGING	Jogging	Jogs the axis backward or forward at the specified acceleration and velocity.
BLENDING	Blending	Executes up to four successive moves without the distance and velocity output values retuning to zero between moves.
STOP_MOTION	Stop Motion	Stops all motion on the channel while leaving the channel active.

Chapter 22

Program Data and References

This chapter describes the types of data that can be used in an application program, and explains how that data is stored in memory by a VersaMax Nano PLC or VersaMax Micro PLC.

- Data memory references

- Fixed I/O map locations

- Retentiveness of data

- System status references

- Time tick contacts

- How program functions handle numerical data

Data Memory References

Data in PLC programs is referenced by memory addresses that specify both a memory type and a precise address within that memory type. For example:

%I00001   specifies address 1 in Input memory.
%R00256   specifies address 256 in Register memory.

The letter prefix indicates where data is stored in PLC memory.

Memory Allocation

The following table shows the types and sizes of available memory in VersaMax Micro and Nano PLCs. (See appendix B for a further comparison with the Series 90 Micro PLC.)

Reference Type	Reference Range	10-Point Nano PLCs	14-Point Micro PLCs	23 and 28-Point Micro PLCs	20/40/64-Point Micro PLCs
User program logic	Not applicable	2K words	9K words	9K words	48K bytes
Discrete inputs	%I0001 - %I0512	512 bits	512 bits	512 bits	512 bits
Discrete outputs	%Q0001 - %Q0512	512 bits	512 bits	512 bits	512 bits
Discrete global references	%G0001 - %G1280	1280 bits	1280 bits	1280 bits	1280 bits
Discrete internal coils	%M0001 - %M1024	1024 bits	1024 bits	1024 bits	1024 bits
Discrete temporary coils	%T0001 - %T0256	256 bits	256 bits	256 bits	256 bits
System status references	%S0001 - %S0032	32 bits	32 bits	32 bits	32 bits
	%SA0001 - %SA0032	32 bits	32 bits	32 bits	32 bits
	%SB0001 - %SB0032	32 bits	32 bits	32 bits	32 bits
	%SC0001 - %SC0032	32 bits	32 bits	32 bits	32 bits
System register references	%R0001 - %R0256 or %R0001 - %R2042	256 words	256 words	2K words	32640 (close to 32k) words
Analog and High Speed Counter inputs	%AI0001 - %AI0128	128 words	128 words	128 words	128 words
Analog outputs	%AQ0001 - %AQ0128	128 words	128 words	128 words	128 words

* For viewing only; cannot be referenced in a user logic program.

Word Memory References

Each word memory address (reference) is on a 16-bit word boundary. The PLC uses three types of references for data stored in word memory.

%AI   Normally used for analog inputs

%AQ   Normally used for analog outputs.

%R   Registers are normally used to store program data in word format.

An example is represented below. The example shows ten addresses. Each has 16 bits that together contain one value. The PLC cannot directly access individual bits in word memory.

%R Addresses	Example Value
0001	12467
0002	12004
0003	231
0004	359
0005	14
0006	882
0007	24
0008	771
0009	735
0010	0000

Bit Memory References

The PLC uses six types of references for data stored in bit memory.

%I	Normally used for discrete inputs, and viewable in the Input Status Table.
%Q	Normally used for physical output references, and viewable in the Output Status Table. A %Q reference may be either retentive or non-retentive, depending on its use in the program.
%M	Normally used to represent internal references. A specific %M reference may be either retentive or non-retentive, depending on its use in the program.
%T	Used for temporary references that can be used many times in a program. Data with %T references is not retained through loss of power or RUN-TO-STOP-TO-RUN transitions. %T references cannot be used with retentive coils.
%S	▪ System status references, which have specific predefinitions. ▪ %S, %SA, %SB, and %SC can be used for any type of logic contact. ▪ %SA, %SB, and %SC can be used for retentive coils. ▪ %S can be used as inputs to functions or function blocks. ▪ %SA, %SB, and %SC can be used as inputs or outputs of functions and function blocks.
%G	Used for Global Data. Data in %G references is retained through power loss. %G references can be used with contacts and retentive coils, but not on non-retentive coils.

Each bit memory address (reference) is on a bit boundary. Data is stored in bit memory as represented below. The example shows 160 individually-addressed bits, with address 1 in the upper left and address 160 in the lower right.

addresses

1	2	3	4	5	6	7	8								
0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0
0	0	1	1	0	0	0	0	0	0	1	0	1	0	0	0
1	1	1	1	0	0	0	1	1	0	0	1	0	0	0	0
1	1	0	0	0	0	0	1	1	1	0	0	1	0	1	0
0	1	0	1	0	0	0	1	0	1	0	1	0	0	0	0
1	1	0	0	0	0	0	1	1	1	0	0	1	0	1	0
1	1	0	1	0	0	0	1	1	1	0	1	0	0	0	0
1	1	0	0	0	0	0	1	1	0	1	1	1	0	1	1
1	0	0	1	0	0	0	1	1	0	1	1	1	0	0	1
0	0	0	1	0	0	0	0	1	0	1	0	1	0	0	1

... 160

Transition Bits and Override Bits

%I, %Q, %M, and %G references have associated transition and override bits.

%T, %S, %SA, %SB, and %SC references have associated transition bits only.

The CPU uses transition bits for transitional coils. When override bits are set, the associated references can only be changed from the programmer.

Fixed I/O Map Locations

A Nano/Micro PLC automatically reserves some memory locations for specific functions. Use of these addresses for other purposes is not recommended.

Reserved Bit Memory Locations: %I

	Address	Micro PLCS (14 – 64 Points)			Nano PLCs (10 Points)		
		Standard Inputs	*4 Type A Counters*	*1 Type A and 1 Type B*	*Standard Inputs*	*3 Type A Counters*	*1 Type A and 1 Type B*
%I	0001	Input 1	Count 1	Type B counter (Phase 1)	Input 1	Count 1	Type B counter (Phase 1)
	0002	Input 2	Preload/Strobe 1 -or- Home Input 1 *	Not used	Input 2	Preload/Strobe 1	Not used
	0003	Input 3	Count 2	Type B counter (Phase 2)	Input 3	Count 2	Type B counter (Phase 2)
	0004	Input 4	Preload/Strobe 2 -or- Home Input 2 *	Not used	Input 4	Preload/Strobe 2	Preload/Strobe for Type B counter
	0005	Input 5	Count 3	Not used	Input 5	Count 3	Type A counter: Count Input
	0006	Input 6	Preload/Strobe 3 -or- Home Input 3 *	Preload/Strobe for Type B	Input 6	Preload/Strobe 3	Type A counter: Preload/Strobe
	0007	Input 7	Count 4	Type A counter: Count 4	--		
	0008	Input 8	Preload/Strobe 4 -or- Home Input 4 *	Preload/Strobe 4	--		
	0009-16	Inputs for 23 / 28-point Micros, Default first discrete input for 14pt PLCs, configurable.					
	0017	Default first discrete input from expansion unit (28/23pt PLCs), can be reconfigured.					
	0488	Micro 20, 40, 60: Ethernet Option Module configured for Modbus/TCP Client operation.			NA		
	0494 to 0496	Pulse Train Complete for channels 1 to 3			Pulse Train Complete for channels 1 to 3		
	0497 to 0499	Strobe status bits for channels 1 to 3			Strobe status bits for channels 1 to 3		
	00500	Strobe status bit for channels 4			--		
	0501 to 0503	Preload status bits for channels 1 to 3			Preload status bits for channels 1 to 3		
	0504	Preload status bit for channel 4			--		
	0505 to 0507	Output status bits for channels 1 to 3			Output status bits for channels 1 to 3		
	0508	Output status bit for channel 4			--		
	0511	Pulse Train Complete for channel 4			--		
	0512	Counter Error status					

* %I0002, I0004, I0006, and I0008 are reserved as Home Inputs only for Micro-20, -40, and –64 CPUs that are configured for 32-bit counter operation (either 4 Type A Counters, 32 bits, or 1 Type A and 1 Type B counter 32 bits).

Reserved Bit Memory Locations: %Q

	Address	Micro PLCS (14 – 64 Points)			Nano PLCs (10 Points)		
		Standard Outnputs	*4 Type A Counters*	*1 Type A and 1 Type B*	*Standard Outputs*	*3 Type A Counters*	*1 Type A and 1 Type B*
%Q	0001	Output 1	Counter 1 Output/PWM/PT1		Output 1	Counter 1 Output/PWM/PT1	Type B Counter Output
	0002	Output 2	Counter 2 Output/PWM/PT2		Output 2	Counter 2 Output/PWM/PT2	Standard Output 2
	0003	Output 3	Counter 3 Output/PWM/PT3	Standard Output 3	Output 3	Counter 3 Output/PWM/PT3	Type A Counter Output
	0004	Output 4	Counter 4 Output/PWM/PT4	Type A Counter Output	Output 4	Standard	Standard Output 4
	0005	Output 5					
	0006	Output 6					
	0007 - 0009	Outputs 7-9					
	0007-0016	Outputs for 23 and 28-point Micro PLCs, Default first discrete output for 14pt PLCs (can be reconfigured).					
	0017	Default first discrete output for expansion unit (28/23pt PLCs), can be reconfigured.					
	0489-0492	Input Direction for Channel 1 to Channel 4			Reserved		
	0493	Reserved					
	0494	Start Q1 Pulse Train					
	0495	Start Q2 Pulse Train					
	0496	Start Q3 Pulse Train					
	0497	Clear Strobe bit for HSC 1					
	0498	Clear Strobe bit for HSC 2					
	0499	Clear Strobe bit for HSC 3					
	0500	Clear Strobe bit for HSC 4			Reserved		
	0501	Reset Preload bit HSC 1					
	0502	Reset Preload bit HSC 2					
	0503	Reset Preload bit HSC 3					
	0504	Reset Preload bit HSC 4			Reserved		
	0505	Enable Output HSC 1/PTO/PTM					
	0506	Enable Output HSC 2/PTO/PTM					
	0507	Enable Output HSC 3/PTO/PTM					
	0508	Enable Output HSC 4/PTO/PTM			Reserved		
	0509-510	Not used but unavailable					
	0511	Start Q4 Pulse Train			Reserved		
	0512	Clear Error (all counters)					

Reserved Word Memory Locations: %AI

Address	Micro PLCS (14 – 64 Points)		Nano PLCs (10 Points)		
	4 Type A Counter or 1 Type A / 1 Type B: 16 Bits	*4 Type A Counter 32 Bits 1 Type A / 1 Type B: 32 Bits (Micro-20/-40//-64)*	*Standard Outputs*	*3 Type A Counters*	*1 Type A and 1 Type B*
%AI 001	Module Status code				
002	Counts per timebase HSC 1				
003	Counts per timebase HSC 2				
004	Counts per timebase HSC 3				
005	Counts per timebase HSC 4				
006	Accumulator HSC 1 channel 1	Accumulator or Position Register, channel 1	Accumulator HSC 1		
007	Strobe Register HSC 1 channel 2		Strobe Register HSC 1		
008	Accumulator HSC 2 channel 3	Strobe Register HSC 1	Accumulator HSC 2		
009	Strobe Register HSC 2 channel 4		Strobe Register HSC 2		
010	Accumulator HSC 3	Accumulator or Position Register, channel 2	Accumulator HSC 3		
011	Strobe Register HSC 3		Strobe Register HSC 3		
012	Accumulator HSC 4	Strobe Register HSC 2			
013	Strobe Register HSC 4				
014	Not used (set to 0)				
015	Not used (set to 0)				
016	Analog potentiometer 1				
017	Analog potentiometer 2				
018	Analog input channel 1				
019	Analog input channel 2				
020-021	Inputs 1 - 4 from 1st analog expansion unit *	Accumulator or Position Register, channel 3			
022-023		Strobe Register HSC 3			
024-025	Inputs 1 - 4 from 2nd analog expansion unit *	Accumulator or Position Register, channel 4			
026-027		Strobe Register HSC 4			
028-029	Inputs 1 - 4 from 3rd analog expansion unit *	Inputs 1 - 4 from 1st analog expansion unit *			
030-031					
032-033	Inputs 1 - 4 from 4th analog expansion unit *	Inputs 1 - 4 from 2nd analog expansion unit *			
034-035					
036-039	Available references	Inputs 1 - 4 from 3rd analog expansion unit *			
040-043		Inputs 1 - 4 from 4th analog expansion unit *			
044-128	Available references				

* can be reconfigured

Reserved Word Memory Locations: %AQ

Address		Micro PLCS (14 – 64 Points)		Nano PLCs (10 Points)		
		4 Type A Counter or 1 Type A / 1 Type B: 16 Bits	*4 Type A Counter 32 Bits 1 Type A / 1 Type B: 32 Bits (Micro-20/-40//-64)*	*Standard Outputs*	*3 Type A Counters*	*1 Type A and 1 Type B*
%AQ	001	Controls the number of input samples for analog potentiometer input filtering.		Available		
	002	PWM Frequency Q1		Available	PWM Frequency Q1	
	003	PWM Duty Cycle Q1		Available	PWM Duty Cycle Q1	
	004	PWM Frequency Q2		Available	PWM Frequency 2	Available
	005	PWM Duty Cycle Q2		Available	PWM Duty Cycle 2	Available
	006	PWM Frequency Q3		Available	PWM Frequency 3	Available
	007	PWM Duty Cycle Q3		Available	PWM Duty Cycle 3	Available
	008	PWM Frequency Q4		Available		
	009	PWM Duty Cycle Q4		Available		
	011	Discrete input filtering time value		Available		
	012	Analog output channel 1		Available		
	013,014	Outputs 1, 2 for 1st analog expansion unit, can be reconfigured		Available		
	015,016	Outputs 1, 2 for 2nd analog expansion unit, can be reconfigured		Available		
	017,018	Outputs 1, 2 for 3rd analog expansion unit, can be reconfigured		Available		
	019,020	Outputs 1, 2 for 4th analog expansion unit, can be reconfigured		Available		
	117-120	Available	Available	Available		
	121	Frequency of Q4 pulse train		Available		
	122	Number of pulses to send to Q4 output (0 to 65535)				
	123	Frequency of Q1 pulse train		Available	PT Frequency Q1	
	124	Number of pulses to send to Q1 output (0 to 65535)		Available	Number of Pulses Q1	
	125	Frequency of Q2 pulse train		Available	Freq. 2	Available
	126	Number of pulses to send to Q2 output (0 to 65535)		Available	Pulses 2	Available
	127	Frequency of Q3 pulse train		Available	Freq. 3	Available
	128	Number of pulses to send to Q3 output (0 to 65535)		Available	Pulses 3	Available

Retentiveness of Data

Data is called "retentive" if it is automatically saved when the PLC is stopped. Retentive data is also saved when the PLC is power cycled on units that have capacitor or battery-backed memory. The following data is retentive:

- Program logic

- Fault tables and diagnostics

- Overrides

- Word data (%R, %AI, %AQ)

- Bit data (%I, %SC, %G, fault bits and reserved bits)

- Word data stored in %Q and %M.

- Data in %Q or %M references that are used as function block outputs or with retentive coils:

-(M)-	retentive coils
-(/M)-	negated retentive coils
-(SM)-	retentive SET coils
-(RM)-	retentive RESET coils

    The last time a %Q or %M reference is used with a coil, the coil type determines whether the data is retentive or non-retentive. For example, if %Q0001 was last programmed as the reference of a retentive coil, the %Q0001 data is retentive. However, if %Q0001 was last programmed on a non-retentive coil, then the %Q0001 data is non-retentive.

- %Q or %M references that have been made retentive by specifically declaring them to be retentive. %Q and %M references default to non-retentive.

    The following data is non-retentive:

- %T data

- %S, %SA, and %SB data (but %SC bit data IS retentive).

- %Q and %M references that have not been declared to be retentive.

- %Q and %M references that are used with non-retentive coils:

-( )-	coils
-(/)-	negated coils
-(S)-	SET coils
-(R)-	RESET coils

System Status References

The Nano/Micro PLC stores status and other system data in predefined references in %S, %SA, %SB, and %SC memory. Tables on the following pages list all of the System Status References.

Using the System Status References

System status references can be used as needed in application programs. For easier programming, each system status reference has a descriptive nickname. For example, the following function block uses the FST_SCN (first scan) status reference to control power flow to a Block Clear function.

```
          FST SCN
        ┌──┤ ├──┐   ┌─────────┐
        │           │ BLK CLR │
        │           │  WORD   │
        │           │    1    │
        │           │         │
        │  %Q0001 ──┤ IN      │
        │           └─────────┘
```
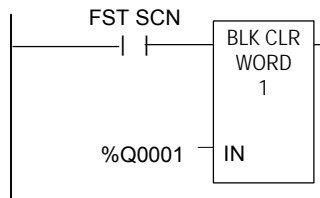
Other system status reference nicknames include T_10MS, T_100MS, T_SEC, and T_MIN (see below), FST_SCN, ALW_ON, and ALW_OFF.

Time-Tick References

Time-tick contacts represent specific locations in %S memory. They can be used to provide regular pulses of power flow to other program functions. The four time-tick contacts have time durations of 0.01 second, 0.1 second, 1.0 second, and 1 minute.

The state of these contacts does not change during the execution of the sweep. These contacts provide a pulse having an equal on and off time duration.

The contacts are referenced as T_10MS (0.01 second), T_100MS (0.1 second), T_SEC (1.0 second), and T_MIN (1 minute).

The following timing diagram represents the on/off time duration of these contacts.

```
                          X
T─XXXXX              ├────────────┤
                          SEC
 ──┤ ├──        ____       ┌────┐       ┌────┐
                    └──────┘    └───────┘
                          ├──┤ ├──┤
                          X/2    X/2
                          SEC    SEC
```
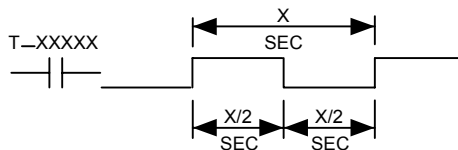
%S References

References in %S memory are read only.

Reference	Nickname	Definition
%S0001	FST_SCN	Set to 1 when the current sweep is the first sweep.
%S0002	LST_SCN	Reset from 1 to 0 when the current sweep is the last sweep.
%S0003	T_10MS	0.01 second timer contact.
%S0004	T_100MS	0.1 second timer contact.
%S0005	T_SEC	1.0 second timer contact.
%S0006	T_MIN	1.0 minute timer contact.
%S0007	ALW_ON	Always ON.
%S0008	ALW_OFF	Always OFF.
%S0009	SY_FULL	Set when the PLC fault table fills up. Cleared when an entry is removed and when the PLC fault table is cleared.
%S0010	IO_FULL	Set when the I/O fault table fills up. Cleared when an entry is removed from the I/O fault table and when the I/O fault table is cleared.
%S0011	OVR_PRE	Set when an override exists in %I, %Q, %M, or %G memory.
%S0012		reserved
%S0013	PRG_CHK	Set when background program check is active. Cleared when the background program check is inactive.
%S0014	PLC_BAT	Set to indicate a bad battery in the CPU. The contact reference is updated once per sweep. This bit is supported by 28-point Micro PLCs only.
%S0015, 16		reserved
%S0017	SNPXACT	SNP-X host is actively attached to CPU port 1. (Port 2 defaults to disabled, and must be activated with a CRQ).
%S0018	SNPX_RD	SNP-X host has read data from CPU port 1.
%S0019	SNPX_WT	SNP-X host has written data to CPU port 1.
%S0020		Set ON when a relational function using REAL data executes successfully. It is cleared when either input is NaN (Not a Number).
%S0021	FF_OVR	Set to report a Fatal Fault Override.
%S0022	USR_SW	Set to reflect the state of the CPU mode switch. 1 = Run/On 0 = Stop/Off
%S0023-32		reserved

%SA, %SB, and %SC References

References in %SA, %SB, and %SC memory can be both read and written to.

Reference	Nickname	Definition
%SA0001	PB_SUM	Set when a checksum calculated on the application program does not match the reference checksum. If the fault was due to a temporary failure, the discrete bit can be cleared by again storing the program to the Micro PLC. If the fault was due to a hard RAM failure, the Micro PLC must be replaced.
%SA0002	OV_SWP	Set when a Micro PLC in CONSTANT SWEEP mode detects that the previous sweep took longer than the time specified. Cleared when the PLC detects that the previous sweep did not take longer than specified. Also cleared during transition from STOP to RUN mode.
%SA0003	APL_FLT	Set when an application fault occurs. Cleared when the Micro PLC transitions from STOP to RUN mode.
%SA0004-8		reserved
%SA0009	CFG_MM	Set when a configuration mismatch is detected during power-up or a configuration store. Cleared by powering up the Micro PLC after correcting the condition.
%SA0010	HRD_CPU	Set when the diagnostics detects a problem with the Micro PLC TOD clock. This bit is *not* supported by Nano and 14-point Micro PLCs.
%SA0011	LOW_BAT	Set when a low battery fault occurs. Cleared by replacing the battery then powering up the Micro PLC. This bit is *not* supported by Nano and 14-point Micro PLCs.
%SA0012,13		reserved
%SA0014	LOS_IOM	Set when an expansion module stops communicating with the CPU. Cleared by replacing the module and cycling system power.
%SA0015-18		reserved
%SA0019	ADD_IOM	Set when an expansion module is added. Cleared by cycling PLC power and when the configuration matches the hardware after a store.
%SA0020-31		reserved

Reference	Nickname	Definition
%SB0001-8		reserved
%SB0009	NO_PROG	Set when an attempt is made to put the PLC in Run mode when there is no executable application program stored in the CPU. Cleared by storing an application program to the CPU and putting the PLC in Run mode.
%SB0010	BAD_RAM	Set when the Micro PLC detects corrupted RAM memory at powerup. Cleared when RAM memory is valid at powerup.
%SB0011	BAD_PWD	Set when a password access violation occurs. Cleared when the PLC fault table is cleared.
%SB0012		reserved
%SB0013	SFT_CPU	Set when the Micro PLC detects an unrecoverable error in the software. Cleared by clearing the PLC fault table.
%SB0014	STOR_ER	Set when an error occurs during a programmer store operation. Cleared when a store operation is completed successfully.
%SC0001-8		reserved
%SC0009	ANY_FLT	Set when any fault occurs. Cleared when both fault tables are cleared.
%SC0010	SY_FLT	Set when any fault occurs that causes an entry to be placed in the PLC fault table. Cleared when the PLC fault table is cleared.
%SC0011	IO_FLT	Set when any fault occurs that causes an entry to be placed in the I/O fault table. Cleared when the I/O fault table is cleared.
%SC0012	SY_PRES	Set as long as there is at least one entry in the PLC fault table. Cleared when the PLC fault table has no entries.
%SC0013	IO_PRES	Set as long as there is at least one entry in the I/O fault table. Cleared when the I/O fault table has no entries.
%SC0014	HRD_FLT	Set when a hardware fault occurs. Cleared when both fault tables have no entries. This bit is **not** supported by Nano and 14-point Micro PLCs.
%SC0015	SFT_FLT	Set when a software fault occurs. Cleared when both fault tables have no entries.

How Program Functions Handle Numerical Data

Regardless of where data is stored in memory—in one of the bit memories or one of the word memories--the application program can handle it as different data types.

Type	Name	Description	Data Format
BIT	Bit	A Bit data type is the smallest unit of memory. It has two states, 1 or 0.	
BYTE	Byte	A Byte data type has an 8-bit value. The valid range is 0 to 255 (0 to FF in hexadecimal).	
WORD		A Word data type uses 16 consecutive bits of data memory that are not separately-addressable to hold a value in the range of 0 to +65,535 (FFFF).	
DWORD	Double Word	Has the same characteristics as a single word data type, except that it uses 32 consecutive bits in data memory instead of only 16 bits.	
BCD-4	Four-Digit Binary Coded Decimal	Four-digit BCD numbers use 16-bit data memory locations. Each BCD digit uses four bits and can represent numbers between 0 and 9. This BCD coding of the 16 bits has a value range of 0 to 9999.	
REAL	Floating-Point	Real numbers use two consecutive 16-bit memory locations. The range of numbers that can be stored in this format is ± 1.401298E-45 to ± 3.402823E+38. See the next page for more information.	
INT	Signed Integer	Signed integer data uses 16-bit memory locations. Signed integers are represented in 2's complement notation. Bit 16 is the sign bit, (0 = positive, 1 = negative). Their range is -32,768 to +32,767.	
DINT	Double Precision Signed Integer	Double precision signed integers data uses two consecutive 16-bit memory locations. They are represented in 2's complement notation. Bit 32 is the sign bit, (0 = positive, 1 = negative). Their range is -2,147,483,648 to +2,147,483,647.	

Real Numbers (Floating Point)

The REAL data type, which can be used for some Math functions and Numerical functions, is actually floating point data. Floating-point numbers are stored in single precision IEEE-standard format. This format requires 32 bits, which occupy two (adjacent) 16-bit PLC words.
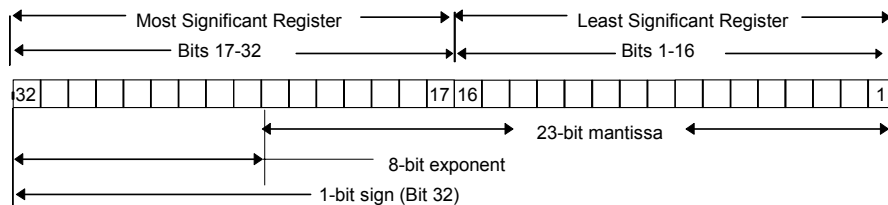
For example, if the floating-point number occupies registers %R0005 and %R0006, then %R0005 is the least significant register and %R0006 is the most significant register.

The range of numbers that can be stored in this format is from $\pm$ 1.401298E–45 to $\pm$ 3.402823E+38 and the number zero.

Errors in Real Numbers and Operations

Overflow occurs when a number greater than 3.402823E+38 or less than -3.402823E+38 is generated by a REAL function. The ok output of the function is set OFF; and the result is set to positive infinity (for a number greater than 3.402823E+38) or negative infinity (for a number less than –3.402823E+38). You can determine where this occurs by testing the sense of the ok output.

POS_INF	= 7F800000h	– IEEE positive infinity representation in hex.
NEG_INF	= FF800000h	– IEEE negative infinity representation in hex.

If the infinities produced by overflow are used as operands to other REAL functions, they may cause an undefined result. This result is referred to as NaN (Not a Number). For example, the result of adding positive infinity to negative infinity is undefined. When the ADD_REAL function is invoked with positive infinity and negative infinity as its operands, it produces NaN for its result.

This section is a reference to the functions in the VersaMax Nano PLC and Micro PLC Instruction Set:

Bit Operation Functions
Logical AND, Logical OR
Exclusive OR, Logical Invert (NOT)
Shift Right/Shift Left
Rotate Right/Rotate Left
Bit Test, Bit Set, Bit Clear
Masked Compare
Bit Position
Bit Sequencer

Control Functions
Do I/O
Call
End
Comment
Jump
Master Control Relay
Drum Sequencer
Service Request (see chapter 24)
PID (see chapter 26)

Communication
MODBUS_TCP_RW (see chapter 14)

Data Move Functions
Move
Block Move
Block Clear
Shift Register
Communication Request

Data Type Conversion Functions
Convert to BCD-4
Convert to Signed Integer
Convert to Double Precision Signed Integer
Convert to Real
Convert Real to Word
Truncate Real Number

Math and Numerical Functions
Add, Subtract, Multiply, Divide
Modulo Division
Scaling
Square Root
Trigonometric Functions
Logarithmic/Exponential Functions
Convert Radians / Degrees

Motion Functions (See chapter 19)
Find Home
Go Home
Jogging
Blending
Stop Motion

Relational Functions
Equal
Not Equal
Greater Than
Less Than
Greater or Equal
Less or Equal
Range

Relay Functions
Contacts, Coils
Fault and No Fault Contacts
Alarm Contacts

Table Functions
Array Move
Search

Timer and Counter Functions
Time-tick Contacts
On Delay Stopwatch Timer
On Delay Timer
Off Delay Timer
Up Counter
Down Counter

Bit Operation Functions

The Bit Operation functions perform comparison, logical, and move operations on bit strings. The Bit Operation functions are:

- Logical AND
- Logical OR
- Exclusive OR
- Logical Invert (NOT)
- Shift Right/Shift Left
- Rotate Right/Rotate Left

- Bit Test
- Bit Set, Bit Clear
- Masked Compare
- Bit Position
- Bit Sequencer

Data Lengths for the Bit Operation functions

The Logical AND, OR, XOR, and NOT (Invert) functions operate on a single word ofo data. The other Bit Operation functions may operate on up to 256 words.

All Bit Operation functions require Word-type data. However, they operate on data as a continuous string of bits, with bit 1 of the first word being the Least Significant Bit (LSB). The last bit of the last word is the Most Significant Bit (MSB). For example, if you specified three words of data beginning at reference %R0100, it would be operated on as 48 contiguous bits.

%R0100	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	← bit 1 (LSB)
%R0101	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	
%R0102	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	

↑

(MSB)

Overlapping input and output reference address ranges in multi-word functions is not recommended, it can produce unexpected results.

Each scan that power is received, a Logical AND or Logical OR function examines each bit in bit string IN1 and the corresponding bit in bit string IN2, beginning at the least significant bit in each. A string length of 256 words can be selected.

Logical AND

If both bits examined by the Logical AND function are 1, a 1 is placed in the corresponding location in output string Q. If either or both bits are 0, a 0 is placed in string Q in that location. The Logical AND function can be used to build masks or screens, where only certain bits are passed through (bits opposite a 1 in the mask), and all other bits are set to 0. The Logical AND function can also be used to clear an area of word memory by ANDing the bits with another bit string known to contain all 0s. The IN1 and IN2 bit strings specified may overlap.

Logical OR

If either or both bits examined by the Logical OR function is 1, a 1 is placed in the corresponding location in output string Q. If both bits are 0, a 0 is placed in string Q in that location. The Logical OR function can be used to combine strings or to control many outputs with one simple logical structure. The Logical OR function is the equivalent of two relay contacts in parallel multiplied by the number of bits in the string. It can be used to drive indicator lamps directly from input states, or to superimpose blinking conditions on status lights.

```
Enable ─┤ AND  ├─ OK
         │ WORD │
Input 1 ─┤ IN1 Q├─ Output
         │      │
Input 2 ─┤ IN2  │
```
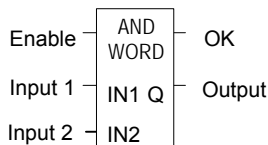
Bit Operation Functions
Logical AND, Logical OR

Parameters of the Logical AND and Logical OR Functions

Input/ Output	Choices	Description
enable	flow	When the function is enabled, the operation is performed.
I1	I, Q, M, T, S, G, R, AI, AQ, constant	Constant or reference for the first word of the first string.
I2	I, Q, M, T, S, G, R, AI, AQ, constant	Constant or reference for the first word of the second string.
ok	flow, none	The OK output is energized whenever enable is energized.
Q	I, Q, M, T, SA, SB, SC (not S), G, R, AI, AQ	Output Q contains the result of the operation.

Example of the Logical AND Function

In the example, when input %I0001 is set, the 16-bit strings represented by nicknames WORD1 and WORD2 are examined. The results of the Logical AND are placed in output string RESULT.

The Exclusive OR function compares each bit in bit string IN1 with the corresponding bit in string IN2. If the bits are different, a 1 is placed in the corresponding position in the output bit string.

```
Enable ─┐ XOR  ┌─ OK
        │ WORD │
Input 1 ─┤ IN1 Q ├─ Output
        │      │
Input 2 ─┤ IN2  │
        └──────┘
```
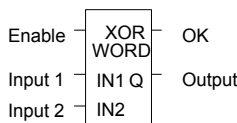
Each scan that power is received, the Exclusive OR function examines each bit in string IN1 and the corresponding bit in string IN2, beginning at the least significant bit in each. For each two bits examined, if only one is 1, then a 1 is placed in the corresponding location in bit string Q. The Exclusive OR function passes power flow to the right whenever power is received.

If string IN2 and output string Q begin at the same reference, a 1 placed in string IN1 will cause the corresponding bit in string IN2 to alternate between 0 and 1, changing state with each scan as long as power is received. Longer cycles can be programmed by pulsing the power flow to the function at twice the desired rate of flashing; the power flow pulse should be one scan long (one-shot type coil or self-resetting timer).

The Exclusive OR function is useful for quickly comparing two bit strings, or to blink a group of bits at the rate of one ON state per two scans.

Parameters of the Exclusive OR Function

Input/ Output	Choices	Description
enable	flow	When the function is enabled, the operation is performed.
IN1	I, Q, M, T, S, G, R, AI, AQ, constant	Constant or reference for the first word to be XORed.
IN2	I, Q, M, T, S, G, R, AI, AQ, constant	Constant or reference for the second word to be XORed.
ok	flow, none	The OK output is energized whenever enable is energized.
Q	I, Q, M, T, SA, SB, SC (not S), G, R, AI, AQ	Output Q contains the result of the operation.

Bit Operation Functions
Exclusive OR

Example

In the example, whenever %I0001 is set, the bit string represented by the nickname WORD3 is cleared (set to all zeros).

```
              %I0001          ┌──────┐
        ──────┤  ├────────────┤ XOR  │
                              │ WORD │
                   WORD3 ─────┤IN1  Q├───── WORD3
                              │      │
                   WORD3 ─────┤IN2   │
                              └──────┘
```
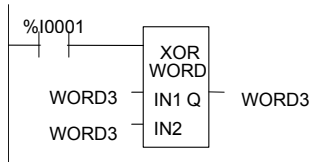
IN1 (WORD3)	0	0	0	1	1	1	1	1	1	1	0	0	1	0	0	0
IN2 (WORD3)	0	0	0	1	1	1	1	1	1	1	0	0	1	0	0	0

Q (WORD3)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

The Logical Invert (NOT) function sets the state of each bit in the output bit string Q to the opposite of the state of the corresponding bit in bit string IN1.

All bits are altered on each scan that power is received, making output string Q the logical complement of IN1. The function passes power flow to the right whenever power is received. A length of 256 words can be selected.

```
Enable ─┐ NOT ┌─ OK
         │ WORD │
         │      │
Input 1 ─┤ IN Q ├─ Output
```
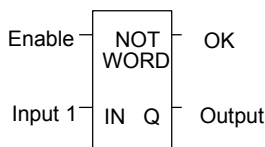
Parameters of the Logical Invert Function

Input/ Output	Choices	Description
enable	flow	When the function is enabled, the operation is performed.
IN	I, Q, M, T, S, G, R, AI, AQ, constant	Constant or reference for the word to be negated.
ok	flow, none	The OK output is energized whenever enable is energized.
Q	I, Q, M, T, SA, SB, SC (not S), G, R, AI, AQ	Output Q contains the result of the operation.

Example

In the example, whenever input %I0001 is set, the bit string represented by the nickname TAC is set to the inverse of bit string CAT.

```
%I0001
 ─┤ ├─────── NOT
            WORD

      CAT ─┤ IN Q ├─ TAC
```
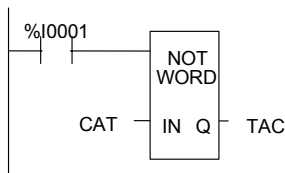
Bit Operation Functions
Shift Bits Right, Shift Bits Left

The Shift Left function shifts all the bits in a word or group of words to the left by a specified number of places. When the shift occurs, the specified number of bits is shifted out of the output string to the left. As bits are shifted out of the high end of the string, the same number of bits is shifted in at the low end.

	MSB														LSB	
B2 ←	1	1	0	1	1	1	1	1	1	1	0	0	1	0	0	0	←B1
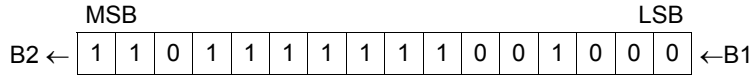
The Shift Right function is used to shift all the bits in a word or group of words a specified number of places to the right. When the shift occurs, the specified number of bits is shifted out of the output string to the right. As bits are shifted out of the low end of the string, the same number of bits is shifted in at the high end.

	MSB														LSB	
B1 →	1	1	0	1	1	1	1	1	1	1	0	0	1	0	0	0	→B2
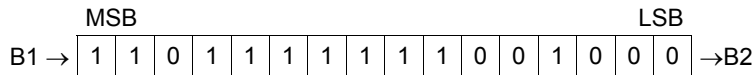
A string length of 1 to 256 words can be selected for either function.
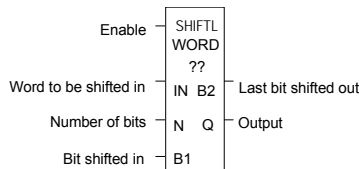
If the number of bits to be shifted (N) is greater than the number of bits in the array * 16, the array (Q) is filled with copies of the input bit (B1), and the input bit is copied to the output power flow (B2). If the number of bits to be shifted is zero, then no shifting is performed; the input array is copied into the output array; and input bit (B1) is copied into the power flow.

The bits being shifted into the beginning of the string are specified via input parameter B1. If a length greater than 1 has been specified as the number of bits to be shifted, each of the bits is filled with the same value (0 or 1). This can be:

- The boolean output of another program function.
- All 1s. To do this, use the special reference nickname ALW_ON as a permissive to input B1.
- All 0s. To do this, use the special reference nickname ALW_OFF as a permissive to input B1.

The function passes power flow to the right, unless the number of bits specified to be shifted is zero.

Output Q is the shifted copy of the input string. If you want the input string to be shifted, the output parameter Q must use the same memory location as the input parameter IN. The entire shifted string is written on each scan that power is received. Output B2 is the last bit shifted out. For example, if four bits were shifted, B2 would be the fourth bit shifted out.

Parameters of the Shift Right / Left Functions

Input/ Output	Choices	Description
enable	flow	When the function is enabled, the shift is performed.
IN	I, Q, M, T, S, G, R, AI, AQ	IN contains the first word to be shifted.
N	I, Q, M, T, G, R, AI, AQ, constant	N contains the number of places (bits) that the array is to be shifted.
B1	flow	B1 contains the bit value to be shifted into the array.
B2	flow, none	B2 contains the bit value of the last bit shifted out of the array.
Q	I, Q, M, T, SA, SB, SC, G, R, AI, AQ	Output Q contains the first word of the shifted array.

Example

In the example, whenever input %I0001 is set, the output bit string contained in the memory location represented by the nickname WORD2 is made a copy of the bits in location WORD1. The output string is left-shifted by 8 bits, as specified by the input LENGTH. The resulting open bits at the beginning of the output string are set to the value of %I0002.

```
        %I0001     SHIFTL
     ─┤  ├──      WORD
                    1

        WORD1  ─ IN   B2 ─  OUTBIT
        LENGTH
          8     ─ N    Q ─  WORD2
        %I0002
     ─┤  ├──      B1
```
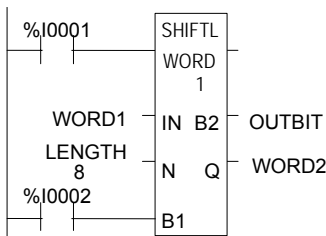
Bit Operation Functions
Rotate Bits Right, Rotate Bits Left

The Rotate Left function rotates all the bits in a string a specified number of places to the left. When rotation occurs, the specified number of bits is rotated out of the input string to the left and back into the string on the right.

The Rotate Right function rotates the bits in the string to the right. When rotation occurs, the specified number of bits is rotated out of the input string to the right and back into the string on the left.

A length of 1 to 256 words can be selected for either function. The number of places to rotate must be more than zero and less than the number of bits in the string.

The Rotate Bits function passes power flow to the right, unless the number of bits specified to be rotated is greater than the total length of the string or is less than zero. The result is placed in output string Q. If you want the input string to be rotated, the output parameter Q must use the same memory location as the input parameter IN. The entire rotated string is written on each scan that power is received.
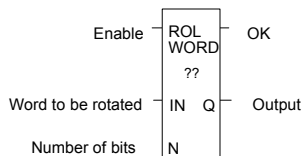
Parameters of the Rotate Bits Right / Left Functions

Input/ Output	Choices	Description
enable	flow	When the function is enabled, the rotation is performed.
IN	I, Q, M, T, S, G, R, AI, AQ	IN contains the first word to be rotated.
N	I, Q, M, T, G, R, AI, AQ, constant	N contains the number of places the array is to be rotated.
ok	flow, none	The OK output is energized when the rotation is energized and the rotation length is not greater than the array size.
Q	I, Q, M, T, SA, SB, SC, G, R, AI, AQ	Output Q contains the first word of the rotated array.

Example

In the example, whenever input %I0001 is set, the input bit string in location %R0001 is rotated 3 bits. The result is placed in %R0002. The input bit string %R0001 is not changed by the function. If the same reference is used for IN and Q, a rotation will occur in place.
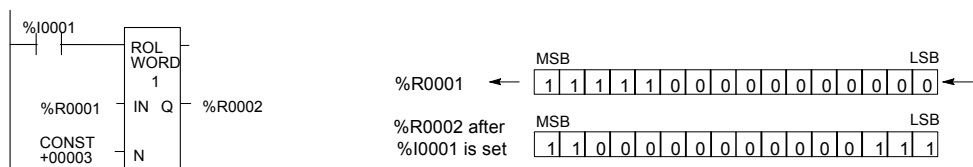
The Bit Test function tests a bit within a bit string to determine whether that bit is currently 1 or 0. The result of the test is placed in output Q.

Each sweep power is received, the Bit Test function sets its output Q to the same state as the specified bit. If a register rather than a constant is used to specify the bit number, the same function block can test different bits on successive sweeps. If the value of BIT is outside the range $(1 \le BIT \le (16 * length))$, then Q is set OFF.

A string length of 1 to 256 words can be selected.

```
              Enable ─┤ BITTEST
                       WORD
                        ??
    Bit to be tested ─┤ IN  Q ├─ Output

   Bit number of IN ─┤ BIT
```
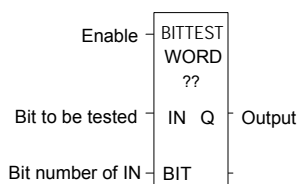
Parameters of the Bit Test Function

Input/ Output	Choices	Description
enable	flow	When the function is enabled, the bit test is performed.
IN	I, Q, M, T, S, G, R, AI, AQ	IN contains the first word of the data to be operated on.
BIT	I, Q, M, T, G, R, AI, AQ, constant	BIT contains the bit number of IN that should be tested. Valid range is $(1 \le BIT \le (16 * length))$.
Q	flow, none	Output Q is energized if the bit tested was a 1.

Example

In the example, whenever input %I0001 is set, the bit at the location contained in reference PICKBIT is tested. The bit is part of string PRD_CDE. If it is 1, output Q passes power flow and the coil %Q0001 is turned on.

```
        %I0001
   ──────┤ ├──────┤ BITTEST
                    WORD
                     1                            %Q0001
       PRD_CDE ─┤ IN  Q ├──────────────────────────( )──

       PICKBIT ─┤ BIT
```
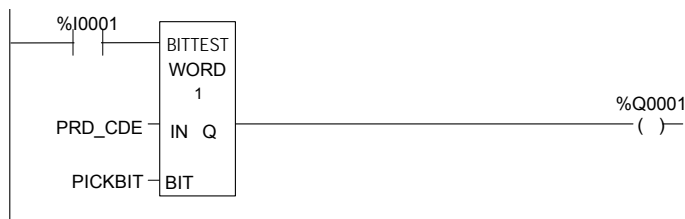
Bit Operation Functions
Bit Set and Bit Clear

The Bit Set function sets a bit in a bit string to 1. The Bit Clear function sets a bit in a string to 0.

Each sweep that power is received, the function sets the specified bit. If a variable (register) rather than a constant is used to specify the bit number, the same function block can set different bits on successive sweeps.

A string length of 1 to 256 words can be selected. The function passes power flow to the right, unless the value for BIT is outside the range $(1 \leq BIT \leq (16 * length))$. Then, OK is set OFF.

```
               Enable ─┤ BIT SET ├─ OK
                        WORD
                         ??
           First word ─┤ IN
        Bit number of IN ─┤ BIT
```
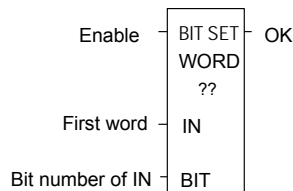
Parameters of the Bit Set and Bit Clear Functions

Input/ Output	Choices	Description
enable	flow	When the function is enabled, the bit operation is performed.
IN	I, Q, M, T, SA, SB, SC, G, R, AI, AQ	IN contains the first word of the data to be operated on.
BIT	I, Q, M, T, G, R, AI, AQ, constant	BIT contains the bit number of IN that should be set or cleared. Valid range is $(1 \leq BIT \leq (16 * length))$.
ok	flow, none	The OK output is energized whenever the bit input is valid and enable is energized.

Example

In the example, whenever input %I0001 is set, bit 12 of the string beginning at reference %R0040 is set to 1.

```
        %I0001
      ───┤ ├───┤ BIT SET ├─
                  WORD
                    1
      %R0040 ─┤ IN   Q
       CONST ─┤ BIT
       00012
```
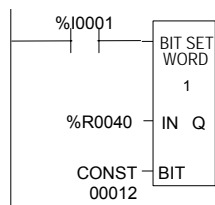
The Masked Compare function compares the contents of two separate bit strings. It provides the ability to mask selected bits. Input string 1 might contain the states of outputs such as solenoids or motor starters. Input string 2 might contain their input state feedback, such as limit switches or contacts.

```
             Enable ─┤ MASK   ├─
                     │ COMP   │
                     │ WORD   │
                     │  1     │
            Input 1 ─┤ IN1 MC ├─ Miscompare
            Input 2 ─┤ IN2  Q ├─ Output
     Bit string mask ─┤ M   BN ├─ Bit number of last compare
         Bit number ─┤ BIT    │
```
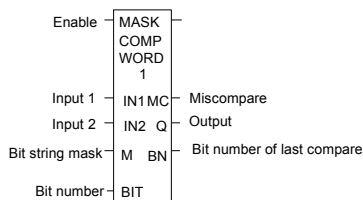
When the function receives power flow, it begins comparing the bits in the first string with the corresponding bits in the second string. Comparison continues until a miss-compare is found or until the end of the string is reached.

The BIT input stores the bit number where the next comparison should start (a *0* indicates the first bit in the string). The BN output stores the bit number where the last comparison occurred (where a *1* indicates the first bit in the string). Using the same reference for BIT and BN causes the compare to start at the next bit position after a miss-compare; or, if all bits compared successfully upon the next invocation of the function block, the compare starts at the beginning.

To start the next comparison at some other location in the string, you can enter different references for BIT and BN. If the value of BIT is a location that is beyond the end of the string, BIT is reset to 0 before starting the next comparison.

Parameters of the Masked Compare Function

Input/ Output	Choices	Description
enable	flow	Permissive logic to enable the function.
IN1	R, AI, AQ For WORD only: I, Q, M, T, S, G	Reference for the first bit string to be compared.
IN2	R, AI, AQ For WORD only: I, Q, M, T, S, G	Reference for the second bit string to be compared.
M	R, AI, AQ For WORD only: I, Q, M, T, SS, SB, SC, G	Reference for the bit string mask.
BIT	I, Q, M, T, S, G, R, AI, AQ, constant	Reference for the bit number where the next comparison should start.
MC	flow, none	User logic to determine if a miscompare has occurred.
Q	R, AI, AQ For WORD only: I, Q, M, T, SA, SB, SC, G	Output copy of the mask (M) bit string.
BN	I, Q, M, T, S, G, R, AI, AQ	Bit number where the last miscompare occurred.
length	Constant	The number of words in the bit string. Max. is 4095 for WORD and 2047 for DWORD.

> Bit Operation Functions
> Masked Compare

Operation of the Masked Compare

If all corresponding bits in strings IN1 and IN2 match, the function sets the "miss-compare" output MC to 0 and BN to the highest bit number in the input strings. The comparison then stops. On the next invocation of a Masked Compare Word, it is reset to 0. When the two bits currently being compared are not the same, the function checks the correspondingly numbered bit in string M (the mask). If the mask bit is a *1*, the comparison continues until it reaches another miss-compare or the end of the input strings. If a miss-compare is detected and the corresponding mask bit is a 0, the function does the following:
1. Sets the corresponding mask bit in M to 1.
2. Sets the miss-compare (MC) output to 1.
3. Updates the output bit string Q to match the new content of mask string M
4. Sets the bit number output (BN) to the number of the miss-compared bit.
5. Stops the comparison.

Example

In the example, after first scan the Masked Compare Word function executes. It compares %M0001–16 with %M0017–32. %M0033–48 contain the mask. The value in %R0001 determines the bit position in the two input strings where the comparison starts.
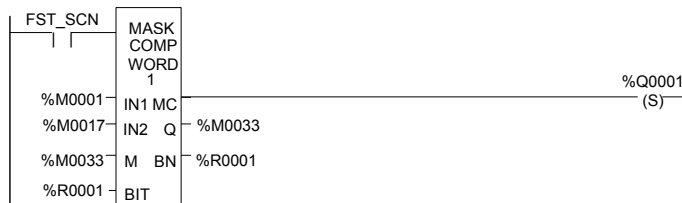
Before the function block is executed, the contents of the above references are:

(IN1) – %M0001 = 6C6Ch =   0 1 1 0 | 1 1 0 0 | 0 1 1 0 | 1 1 0 0

(IN2) – %M0017 = 606Fh =   0 1 1 0 | 1 1 0 1 | 0 1 1 0 | 1 1 1 1

(M/Q) – %M0033 = 000Fh =   0 0 0 0 | 0 0 0 0 | 0 0 0 0 | 1 1 1 1

(BIT/BN) – %R0001   =   0
(MC) – %Q0001   =   OFF

The contents of these references after the function block executes are:

(IN1) – %M0001	= (same)	0	1	1	0	1	1	0	0	0	1	1	0	1	1	0	0
(IN2) – %M0017	= (same)	0	1	1	0	1	1	0	1	0	1	1	0	1	1	1	1
(M/Q) – %M0033 (BIT/BN) – %R0001	= 8	0	0	0	0	0	0	0	1	0	0	0	0	1	1	1	1
(MC) – %Q0001	= ON																

In this example, contact %T1 and coil %M100 force one and only one execution; otherwise the function would repeat with possibly unexpected results.

The Bit Position function locates a bit set to 1 in a bit string.

Each sweep that power is received, the function scans the bit string starting at IN. When the function stops scanning, either a bit equal to 1 has been found or the entire length of the string has been scanned.

POS is set to the position within the bit string of the first non-zero bit; POS is set to zero if no non-zero bit is found.

A string length of 1 to 256 words can be selected. The function passes power flow to the right whenever enable is ON.

```
        Enable ┤ BIT POS ├ OK
                 WORD
                  ??
    First word ┤ IN
                 POS ├ Position of non-zero bit or 0
```
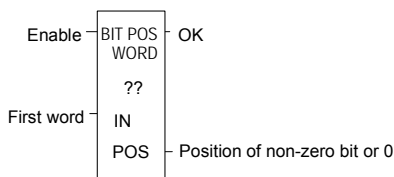
Parameters for the Bit Position Function

Input/ Output	Choices	Description
enable	flow	When the function is enabled, a bit search operation is performed.
IN	I, Q, M, T, S, G, R, AI, AQ	IN contains the first word of the data to be operated on.
ok	flow, none	The OK output is energized whenever enable is energized.
POS	I, Q, M, T, G, R, AI, AQ	The position of the first non-zero bit found, or zero if a non-zero bit is not found.

Example

In the example, if %I0001 is set, the bit string starting at %M0001 is searched until a bit equal to 1 is found. Coil %Q0001 is turned on. If a bit equal to 1 is found, its location within the bit string is written to %AQ001. If %I0001 is set, bit %M0001 is 0, and bit %M0002 is 1, then the value written to %AQ001 is 2

```
     %I0001                                            %Q0001
   ──┤ ├──┬── BIT POS ──────────────────────────────────( )──
          │    WORD
          │     1
   %M0001 ┤ IN
          │    POS │ %AQ0001
```
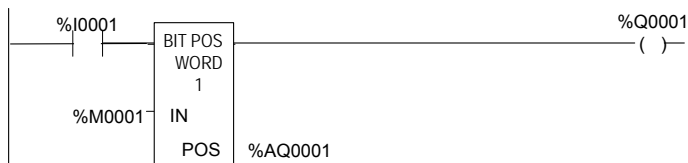
Bit Operation Functions
Bit Sequencer

The Bit Sequencer function performs a bit sequence shift through an array of bits.

```
  Enable ┤BIT SEQ├ OK
         │   ??   │
   Reset ┤R       │
Direction┤DIR     │
  Number ┤STEP    │
Starting ┤ST      │
 Address │        │
         └────────┘
          Address
```
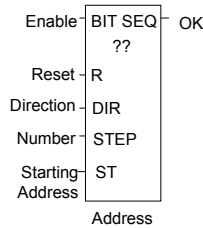
The operation of the function depends on the previous value of the parameter EN:

R Current Execution	EN Previous Execution	EN Current Execution	Bit Sequencer Execution
OFF	OFF	OFF	Bit sequencer does not execute.
OFF	OFF	ON	Bit sequencer increments/decrements by 1.
OFF	ON	OFF	Bit sequencer does not execute.
OFF	ON	ON	Bit sequencer does not execute.
ON	ON/OFF	ON/OFF	Bit sequencer resets.

The reset input (R) overrides the enable (EN) and always resets the sequencer. When R is active, the current step number is set to the value passed in via the step number parameter. If no step number is passed in, step is set to 1. All of the bits in the sequencer are set to 0, except for the bit pointed to by the current step, which is set to 1.

When Enable is active and Reset is not active, the bit pointed to by the current step number is cleared. The current step number is incremented or decremented, based on the direction parameter. Then, the bit pointed to by the new step number is set to 1.

The parameter ST is optional. If it is not used, the Bit Sequencer function operates as described above, except that no bits are set or cleared. The function just cycles the current step number through its legal range.

Memory Required for a Bit Sequencer

Each bit sequencer uses three words (registers) of %R memory to store the information:

word 1	current step number
word 2	length of sequence (in bits)
word 3	control word

Word 3 (the control word) stores the state of the boolean inputs and outputs of its associated function block, in the following format:

Parameters for the Bit Sequencer Function

Input/ Output	Choices	Description
address	R	Address is the location of the bit sequencer's current step, length, and the last enable and OK status.
enable	flow	When the function is enabled, if it was not enabled on the previous sweep and if R is not energized, the bit sequence shift is performed.
R	flow	When R is energized, the bit sequencer's step number is set to the value in STEP (default = 1), and the bit sequencer is filled with zeros, except for the current step number bit.
DIR	flow	When DIR is energized, the bit sequencer's step number is incremented prior to the shift. Otherwise, it is decremented.
STEP	I, Q, M, T, G, R, AI, AQ, constant, none	When R is energized, the step number is set to this value.
ST	I, Q, M, T, SA, SB, SC, G, R, AI, AQ, none	ST contains the first word of the bit sequencer. Optional.
ok	flow, none	The OK output is energized whenever the function is enabled.

Example

In the example, the Bit Sequencer operates on register memory %R0001. Its static data is stored in registers %R0010–12. When CLEAR is active, the sequencer is reset and the current step is set to step number 3. The first 8 bits of %R0001 are set to zero.

When NXT_CYC is active and CLEAR is not active, the bit for step number 3 is cleared and the bit for step number 2 or 4 (depending on whether DIR is energized) is set.
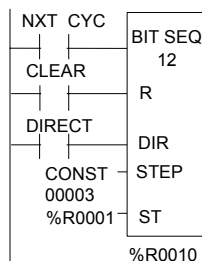
Control Functions

This section describes the control functions, which may be used to limit program execution and to change the way the CPU executes the application program.

- Service specified I/O: DO IO

- Go to a subroutine block: CALL

- Temporary program end: END

- Execute a group of logic rungs without power flow: MCR

- Go to a specified location in the program: JUMP, LABEL

- Place a text explanation in the program logic: COMMENT

- Provide predefined On/Off patterns to a set of 16 discrete outputs in the manner of a mechanical DRUM SEQUENCER.

The more complex Control Functions; Service Request and the PID algorithms, are described in other chapters of this manual.

The Do I/O function updates inputs or outputs for one scan while the program is running. The Do I/O function can also be used to update selected I/O during the program in addition to the normal I/O scan.

```
  enable ─┤ DO IO ├─ OK
          │       │
Starting address ─┤ ST    │
          │       │
Ending address ─┤ END   │
          │       │
          ─┤ ALT   │
          └───────┘
```
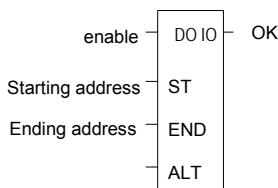
Execution of the function continues until all inputs in the selected range have reported or all outputs have been serviced. Program execution then returns to the next function.

The function passes power to the right whenever power is received, unless:

▪ Not all references of the type specified are present within the selected range.
▪ The Micro PLC is not able to properly handle the temporary list of I/O created by the function.
▪ The range specified includes modules associated with a "Loss of I/O" fault.

Using DO I/O with Expansion Units

The Do I/O function always correctly updates the reference addresses of the I/O being scanned, even if some I/O addresses have been skipped in autoconfiguring the PLC. If a 14-point Micro PLC with attached expansion I/O is autoconfigured, I/O addresses I0009 through I0016 and Q0009 through Q0016 are skipped and the I/O addresses of the first expansion unit will start at I0017 and Q0017. The Do I/O function updates these I/O correctly, without reserving the skipped memory areas. The reference memory at the Do I/O ALT parameter contains 16 points of data: 8 points for the module and 8 points for the expansion unit. Note: Using DO_IO with the ALT parameter to expansion modules IC200UDD06, UEC208, UEI016, UEO008, and UER016 is not supported.

Parameters of the Do I/O Function

Input/Output	Choices	Description
enable	flow	When the function is enabled, a limited input or output scan is performed.
ST	I, Q, AI, AQ	The starting address of the I/O to be serviced.
END	I, Q, AI, AQ	The ending address of the I/O to be serviced.
ALT	I, Q, M, T, G, R, AI, AQ, none	For the input scan, ALT specifies the address to store scanned input point/word values. For the output scan, ALT specifies the address to get output point/word values from. If a constant value is specified for ALT, it is ignored.
ok	flow, none	OK is energized when the scan completes normally.

Control Functions
Do I/O

Do I/O for Inputs

If input references are specified, when the function receives power flow, the PLC scans input points from the starting reference (ST) to the END reference. If a reference is specified for ALT, copies of the new input values are placed in memory beginning at that reference, and the real input values are not updated. ALT must be the same size as the reference type scanned. If a discrete reference is used for ST and END, ALT must also be discrete.

If no reference is specified for ALT, the real input values <u>are</u> updated. This allows inputs to be scanned one or more times during the program execution portion of the CPU sweep.

Example Do I/O for Inputs:

In this example, when the function receives power flow, the PLC scans references %I0001-64 and %Q0001 is turned on. Copies of the scanned inputs are placed in internal memory from %M0001-64. Because a reference is specified for ALT, the real inputs are not updated. This allows the current values of inputs to be compared with their values at the beginning of the scan.

```
   %I0001                                                        %Q0001
   ──┤ ├──┌─────────┐                                            ──( )──
          │  DO IO   │
   %I0001 ┤ ST       │
   %I0064 ┤ END      │
   %M0001 ┤ ALT      │
          └─────────┘
```

Do I/O for Outputs

If output references are specified, when the function receives power flow, the PLC writes the latest output values from the starting reference (ST) to the END reference to the output points. If outputs should be written to the output points from internal memory other than %Q or %AQ, the beginning reference can be specified for ALT.

Example Do I/O For Outputs:

In the next example, when the function receives power flow, the PLC writes values from references %R0001-0004 to analog output channels %AQ001-004 and %Q0001 is turned on. Because a reference is entered for ALT, the values at %AQ001-004 are not written to.

```
   %I0001                                                        %Q0001
   ──┤ ├──┌─────────┐                                            ──( )──
          │  DO IO   │
   %AQ001 ┤ ST       │
   %AQ004 ┤ END      │
   %R0001 ┤ ALT      │
          └─────────┘
```
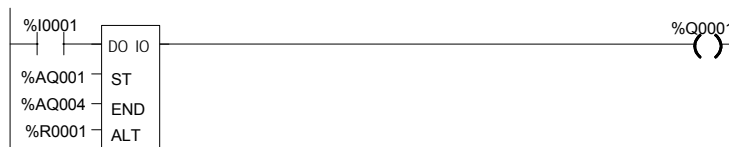
If no reference were specified for ALT, the PLC would write values at references %AQ001-004 to analog output channels.

The Call function causes program execution to go to a specified subroutine block.

```
CALL
(subroutine)
```

When the Call function receives power flow, it causes the scan to go immediately to the designated subroutine block and execute it. After the subroutine block execution is complete, control returns to the point in the logic immediately following the Call instruction.

Example

```
%I0004                                                          %T0001
 | |                                                             ( )

%I0006        CALL
 | |         (subroutine)

%I0003    %I0010                                                %Q0010
 | |       | |                                                   ( )

%I0001
 | |
```
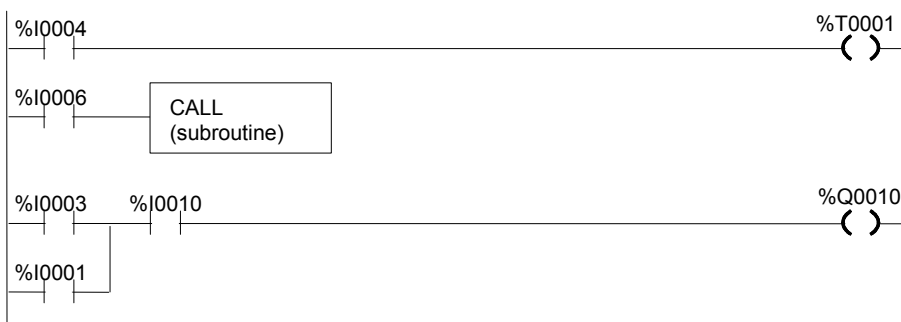
Control Functions
End of Logic

The End of Logic function provides a temporary end of logic. The program executes from the first rung to the last rung or the End of Logic function, whichever is encountered first.

The End of Logic function unconditionally terminates program execution. There can be nothing after the end function in the rung. No logic beyond the End of Logic function is executed, and control is transferred to the beginning of the program for the next sweep.

The End of Logic function is useful for debugging purposes because it prevents any logic which follows from being executed.

The programming software provides an [END OF PROGRAM LOGIC] marker to indicate the end of program execution. This marker is used if no End of Logic function is programmed in the logic.

[END]

Example

In the example, an End of Logic function is programmed to terminate the end of the current sweep.

[STOP]
─┤ [END]├

All rungs between an active Master Control Relay (MCRN) and its corresponding End Master Control Relay (ENDMCRN) function are executed without power flow to coils. The ENDMCRN associated with the Master Control Relay is used to resume normal program execution. Unlike Jump functions, Master Control Relays can only move forward; the ENDMCRN must appear after its corresponding Master Control Relay instruction in a program.

Nested MCR

A Nested Master Control Relay function can be nested completely within another MCRN/ENDMCRN pair.

There can be multiple Master Control Relay functions with a single ENDMCRN.

The Master Control Relay function has an enable input and a name. This name is used again with the ENDMCRN. The Master Control Relay has no outputs; there can be nothing after it in a rung.

```
                        (name)
                 ┌──────────────┐
        enable ─┤    MCR       │
                 └──────────────┘
```
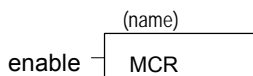
With a Master Control Relay, function blocks within the scope of the Master Control Relay are executed *without power flow*, and coils *are turned off*.

The ENDMCRN function must be tied to power rail; there can be no logic before it in the rung. The name of the ENDMCRN associates it with the corresponding Master Control Relay(s). The ENDMCRN function has no outputs; there can be nothing after it in a rung.

```
                  (name)
           ┌──────────────┐
          ─┤   ENDMCR     │
           └──────────────┘
```
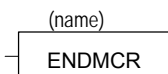
Control Functions
Master Control Relay (MCR) / End MCR

Example Master Control Relay and ENDMCRN Functions

In the example, when %I0002 is ON, the Master Control Relay is enabled. When the Master Control Relay is enabled--even if %I0001 is ON--the Addition function block is executed *without* power flow (i.e., it does not add 1 to %R0001), and %Q0001 is turned OFF.

If %I0003 and %I0004 are ON, %Q0003 is turned OFF and %Q0004 remains ON.

The Nested Jump instruction causes a portion of the program logic to be bypassed. Program execution continues at the Label specified. When the Jump is active, all coils within its scope are left at their previous states. This includes coils associated with timers, counters, latches, and relays.

The Nested Jump instruction has the form ----->>LABEL01, where LABEL01 is the name of the corresponding nested Label instruction.

A nested Jump can be placed anywhere in a program.

There can be multiple nested Jump instructions corresponding to a single nested Label. Nested Jumps can be either forward or backward Jumps.

There can be nothing after the Jump instruction in the rung. Power flow jumps directly from the instruction to the rung with the named label.

> **Caution**

> **To avoid creating an endless loop with forward and backward Jump instructions, a backward Jump must contain a way to make it conditional.**

Label

The Label instruction is the target of a Jump. Use the Label instruction to resume normal program execution. There can be only one Label with a particular name in a program.

The Label instruction has no inputs and no outputs; there can be nothing either before or after a Label in a rung.

Control Functions
Jump, Label

Example Jump and Label Instructions

In the example, whenever Jump TEST1 is active, power flow is transferred to Label TEST1.

With a Jump, any function blocks between the Jump and the Label *are not* executed, and coils *are not affected*. In the example, when %I0002 is ON, the Jump is taken. Since the logic between the Jump and the Label is skipped, %Q0001 is unaffected (if it was ON, it remains ON; if it was OFF, it remains OFF).

```
   %I0001
    | |────────────────────────────────────────────────────────────>>TEST1

   %I0001                                                          %Q0001
    | |────┌────────┐─────────────────────────────────────────────( )───
           │  ADD   │
           │  INT   │
  %R0001───┤IN1   Q ├─── %R0001
        1──┤IN2     │
           └────────┘

    └─── >>TEST1
```
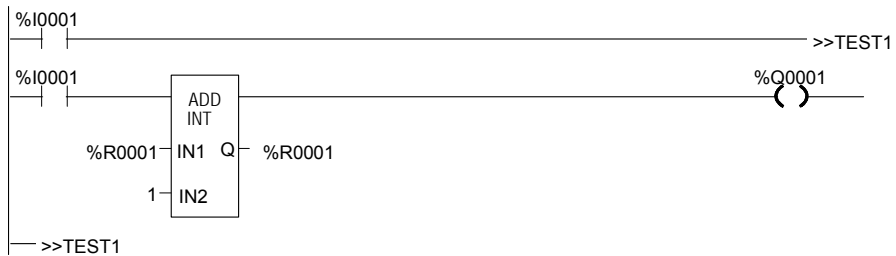
The Comment function is used to enter a comment (rung explanation) in the program. A comment can have up to 2048 characters of text. Longer text can be included in printouts using an annotation text file.

It is represented in the ladder logic like this:

(* COMMENT *)

Control Functions
Drum Sequencer

The Drum Sequencer function is a program instruction that operates like a mechanical drum sequencer. The Drum Sequencer steps through a set of potential output bit patterns and selects one based on inputs to the function block. The selected value is copied to a group of 16 discrete output references.
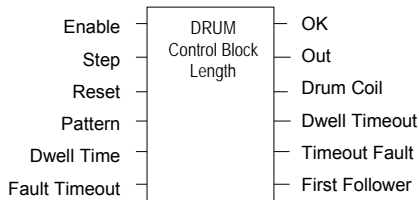
Power flow to the Enable input causes the Drum Sequencer to copy the content of a selected reference to the Out reference.

Power flow to the Reset input or to the Step input selects the reference to be copied.

The Control Block input is the beginning reference for the Drum Sequencer function's parameter block, which includes information used by the function.

Parameters of the Drum Sequencer Function

Input/ Output	Choices	Description
enable	flow	The Enable input controls execution of the function.
Step	flow	The Step input can be used to go one step forward in the sequence. When the Enable input receives power flow and the Step input makes an Off to On transition, the Drum Sequencer moves one step. When Reset is active, the function ignores the Step input.
Reset	flow	The Reset input can be used to select a specific step in the sequence. When Enable and Reset both receive power flow, the function copies the Preset Step value in the Control Block to the Active Step reference, also in the Control Block. Then the function block copies the value in the Preset Step reference to the Out reference bits. When Reset is active, the function ignores the Step input.
Pattern	R, AI, AQ	The starting address of an array of words, each representing one step of the Drum Sequencer. The value of each word represents the desired combination of outputs for a particular value of Active Step. The number of elements in the array is equal to the length input.
Dwell Time	R, AI, AQ, none	This optional input array of words has one element for each element in the Pattern array. Each value in the array represents the dwell time for the corresponding step of the Drum Sequencer in 0.1 second units. When the dwell time expires for a given step the Dwell Timeout bit is set. If a Dwell Time is specified the drum cannot sequence into its next step until the Dwell Time has expired.
Fault Timeout	R, AI, AQ, none	This optional input array of words has one element for each element in the Pattern array. Each value in the array represents the fault timeout for the corresponding step of the Drum Sequencer in 0.1 second units. When the fault timeout has expired the Fault Timeout bit is set.
Control Block	R	The beginning reference address of the function's parameter block. The length of the Control Block is 5 words. A more complete description of what is contained within this block is listed below.
Length	CONST	Value between 1 and 128 that specifies the number of steps.
ok	flow, none	OK is energized if Enable is On and no error condition is detected. If Enable is Off, this output will always be Off.
OUT	I, Q, M, T, G, R, AI, AQ	A word of memory containing the element of the Pattern Array that corresponds to the current Active Step.
Drum Coil	I, Q, M, T, G, none	This optional bit reference is set whenever the function block is enabled and Active Step is not equal to Preset Step.
Dwell Timeout	I, Q, M, T, G, none	This optional bit reference is set if the dwell time for the current step has expired.
Timeout Fault	I, Q, M, T, G, none	This optional bit reference is set if the drum has been in a particular step longer than the step's specified Fault Timeout.
First Follower	I, Q, M, T, G, none	This optional array of bits has one element for each step of the Drum Sequencer. No more than one bit in the array is On at any time and that bit corresponds to the value of the Active Step

Parameter Block for the Drum Sequencer Function

The parameter block (control block) for the Drum Sequencer function contains information needed to operate the Drum Sequencer.

address	Active Step
address + 1	Preset Step
address + 2	Step Control
address + 3	Timer Control

Active Step The active step value specifies the element in the Pattern array to copy to the Out output memory location. This is used as the array index into the Pattern, Dwell Time, Fault Timeout, and First Follower arrays.

Preset Step A word input that is copied to the Active Step output when the Reset is On.

Step Control A word that is used to detect Off to On transitions on both the Step input and the Enable input. The Step Control word is reserved for use by the function block, and must not be written to.

Timer Control Two words of data that hold values needed to run the timer. These values are reserved for use by the function block and must not be written to.

Notes on Using the Drum Sequencer Function

1. The Dwell Timeout Output bit is cleared the first time the drum is in a new step. This is true:

- Whether the drum is introduced to a new step by changing the Active Step or by using the Step Input.

- Regardless of the Dwell Time Array value associated with the step (even if it is 0).

- During the first sweep the Active Step is initialized.

2. The Active and Preset Step of the Drum Sequencer's control block must be initialized for the Drum Sequencer to work or to pass power flow. Even if the Active Step is in the correct range (between 1 and length of the Pattern array) and the Preset Step is not used, the drum will not function if the Preset Step is not in the proper range.

Data Move Functions

The Data Move functions of the Instruction Set provide basic data move capabilities.

- MOVE Data. This function copies data as individual bits, so the new location does not have to be the same data type.

- Block Move. This function places constants into seven specified memory locations.

- Block Clear. This function fills an area of memory with zeros.

- Shift Register. This function shifts one or more data words or data bits from a reference location in to a specified area of memory. Data already in the area is shifted out.

- Communication Request (COMMREQ). This important function allows the CPU to communicate with intelligent modules in the system, for example, communications modules. The basic format of the COMMREQ function is shown in this chapter. The detailed parameters needed to program specific communications tasks are provided in the documentation for each module.

| Data Move Functions |
| Move Data |

The MOVE function copies data as individual bits from one location to another. Because the data is copied in bit format, the new location does not need to be the same data type as the original.

When the Move function receives power flow, it copies data from input parameter IN to output parameter Q as bits. If data is moved from one location in discrete memory to another, (for example, from %I memory to %T memory), the transition information associated with the discrete memory elements is updated to indicate whether or not the Move operation caused any discrete memory elements to change state. Data at the input parameter does not change unless there is an overlap in the source and destination.
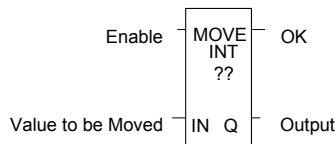
Note that if an array of Bit-type data specified in the Q parameter does not include all the bits in a byte, the transition bits associated with that byte (which are not in the array) are cleared when the Move function receives power flow.

The input IN can be either a reference for the data to be moved or a constant. If a constant is specified, then the constant value is placed in the location specified by the output reference. For example, if a constant value of 4 is specified for IN, then 4 is placed in the memory location specified by Q. If the length is greater than 1 and a constant is specified, then the constant is placed in the memory location specified by Q and the locations following, up to the length specified. Do not allow overlapping of IN and Q parameters.

The result of the Move depends on the data type selected for the function, as shown below. For example, if the constant value 9 is specified for IN and the length is 4, then 9 is placed in the bit memory location specified by Q and the three locations following:
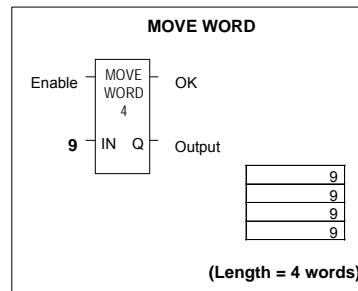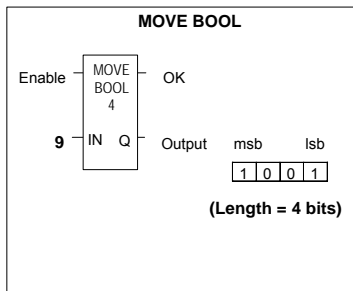
The function passes power to the right whenever power is received.

Parameters for the Move Data Function

Input/ Output	Choices	Description
enable	flow	When the function is enabled, the move is performed.
Length		The number of bits, words, or double words of data to be copied. This is the length of IN. Length must be from 1 to 256 for all types except BOOL. If IN is a constant and Q is type BOOL, the length must be between 1 and 16. If IN is type BOOL, the length must be between 1 and 256 bits.
IN	I, Q, M, T, G, R, AI, AQ, constant For bit or word data only: S For real data: R, AI, AQ	IN contains the value to be moved. For MOVE BOOL, any discrete reference may be used; it does not need to be byte aligned. However, 16 bits, beginning with the reference address specified, are displayed online.
ok	flow, none	The OK output is energized whenever the function is enabled.
Q	I, Q, M, T, G, R, AI, AQ, For bit/ word data: SA, SB, SC For real data: R, AI, AQ	When the move is performed, the value at IN is written to Q. For MOVE BOOL, any discrete reference may be used; it does not need to be byte aligned. However, 16 bits, beginning with the reference address specified, are displayed online.

Data Move Functions
Block Move

The Block Move function copies a block of seven constants to a specified location. When the Block Move function receives power flow, it copies the constant values into consecutive locations beginning at the destination specified in output Q. The function passes power to the right whenever power is received.

```
                    ┌─────────┐
        Enable  ─┤ BLKMV   ├─  OK
                 │  INT    │
Constant value  ─┤ IN1   Q ├─  Output
Constant value  ─┤ IN2     │
Constant value  ─┤ IN3     │
Constant value  ─┤ IN4     │
Constant value  ─┤ IN5     │
Constant value  ─┤ IN6     │
Constant value   │ IN7     │
                 └─────────┘
```
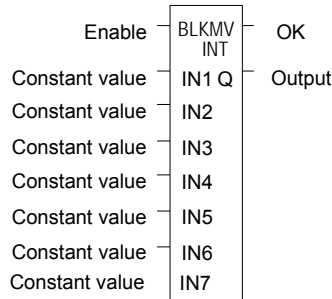
Parameters of the Block Move Function

Input/ Output	Choices	Description
enable	flow	When the function is enabled, the block move is performed.
IN1 to IN7	constant	IN1 through IN7 contain seven constant values.
ok	flow, none	The OK output is energized whenever the function is enabled.
Q	I, Q, M, T, G, R, AI, AQ For Word data: SA, SB, SC For Real data: R, AI, AQ	Output Q contains the first element of the moved array. IN1 is moved to Q.

Revision 2.6 and later Micro-64 PLCs, Micro-20 PLCs and Micro-40 PLCs support both DWORD and DINT data types for a Block Move. Other Micro PLC models do not support 32-bit data types.

Example

In the example, when the enabling input represented by the nickname FST_SCN is ON, the Block Move function copies the input constants into memory locations %R0010–16.

```
     FST_SCN    ┌─────────┐
    ──┤ ├────── │ BLKMV   │
               │  INT    │
       CONST  ─┤ IN1   Q ├─ %R010
       +32767  │         │
       CONST  ─┤ IN2     │
       -32768  │         │
       CONST  ─┤ IN3     │
       +00001  │         │
       CONST  ─┤ IN4     │
       +00002  │         │
       CONST  ─┤ IN5     │
       -00002  │         │
       CONST  ─┤ IN6     │
       -00001  │         │
       CONST   │ IN7     │
       +00001  └─────────┘
```
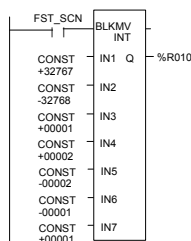
The Block Clear function fills a specified block of data with zeros. When the function receives power flow, it writes zeros into the memory location beginning at the reference specified by IN. When the data to be cleared is from discrete memory (%I, %Q, %M, %G, or %T), the transition information associated with the references is also cleared.

The function passes power to the right whenever power is received.

```
            ┌─ BLKCLR ─┐
Enable  ────┤  WORD    ├──  OK
            │          │
            │  IN      │
Word to be cleared ────┤          │
            └──────────┘
```
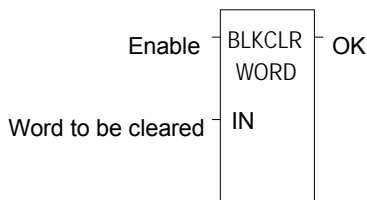
Parameters of the Block Clear Function

Input/ Output	Choices	Description
enable	flow	When the function is enabled, the array is cleared.
IN	I, Q, M, T, SA, SB, SC, G, R, AI, AQ	IN contains the first word of the array to be cleared. The length of IN must be between 1 and 256 words.
Length		The number of words that will be cleared. This is the length of IN.
ok	flow, none	The OK output is energized whenever the function is enabled.

Example

In the example, at powerup, 32 words of %Q memory (512 points) beginning at %Q0001 are filled with zeros. %Q is defined as WORD of length 32.

```
            FST_SCN
       ┌──────┤ ├──────┐ BLKCLR ┐
       │                │ WORD   │
       │                │        │
       │      %Q0001 ───┤ IN     │
       │                └────────┘
```
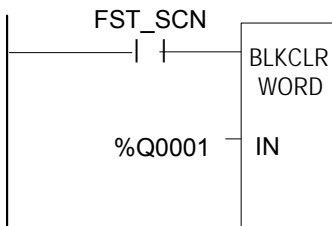
Data Move Functions
Shift Register

The Shift Register function shifts one or more data words or data bits from a reference location into a specified area of memory. For example, one word might be shifted into an area of memory with a specified length of five words. As a result of this shift, another word of data would be shifted out of the end of the memory area.

The reset input (R) takes precedence over the function enable input. When the reset is active, all references beginning at the shift register (ST) up to the length specified for LEN, are filled with zeros.

If the function receives power flow and reset is not active, each bit or word of the shift register is moved to the next highest reference. The last element in the shift register is shifted into Q. The highest reference of the shift register element of IN is shifted into the vacated element starting at ST. The contents of the shift register are accessible throughout the program because they are overlaid on absolute locations in logic addressable memory.

```
                        ┌─────────┐
         Enable ───────│  SHFR   │─── OK
                        │  WORD   │
                        │   ??    │
          Reset ───────│ R     Q │─── Output
Value to be shifted ───│ IN      │
   (first bit or word) │ ST      │
                        └─────────┘
```
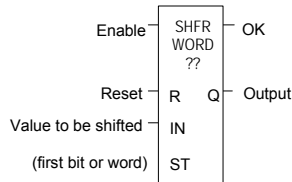
Parameters of the Shift Register Function

Input/ Output	Choices	Description
enable	flow	When enable is energized and R is not, the shift is performed.
Length	1 to 256 bits or words.	The length of the shift register in bits or words. Length is defined as the length of IN.
R	flow	When R is energized, the shift register located at ST is filled with zeros.
IN	I, Q, M, T, S, G, R, AI, AQ, constant	IN contains the value to be shifted into the first bit or word of the shift register. For SHFR BIT, any discrete reference may be used; it does not need to be byte aligned.
ST	I, Q, M, T, SA, SB, SC, G, R, AI, AQ	ST contains the first bit or word of the shift register. For SHFR BIT, any discrete reference may be used; it does not need to be byte aligned.
ok	flow, none	OK is energized whenever the function is enabled and R is not enabled.
Q	I, Q, M, T, SA, SB, SC, G, R, AI, AQ	Output Q contains the bit or word shifted out of the shift register. For SHFR BIT, any discrete reference may be used; it does not need to be byte aligned.

CAUTION: the use of overlapping input and output reference address ranges in multi-word functions is not recommended; it may produce unexpected results.

Example 1:

In the example, the shift register operates on register memory locations %R0001 through %R0100. (%R0001 is defined as type Word of length 100). When the reset reference CLEAR is active, the Shift Register words are set to zero.

When the NXT_CYC reference is active and CLEAR is not active, the word from output status table location %Q0033 is shifted into the Shift Register at %R0001. The word shifted out of the Shift Register from %R0100 is stored in output %M0005.

```
        NXT_CYC       SHFR
         ┤ ├         WORD
                      100
        CLEAR
         ┤ ├          R    Q ─ %M0005

        %Q0033 ─┤ IN

        %R0001 ─┤ ST
```
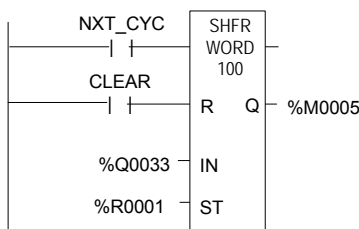
Example 2:

In this example, the Shift Register operates on memory locations %M0001 through %M0100. (%M0001 is defined as type Boolean of length 100). When the reset reference CLEAR is active, the Shift Register function fills %M0001 through %M0100 with zeros.

When NXT_CYC is active and CLEAR is not, the Shift Register function shifts the data in %M0001 to %M0100 down by one bit. The bit in %Q0033 is shifted into %M0001 while the bit shifted out of %M0100 is written to %M0200.

```
        NXT_CYC       SHFR BIT
         ┤ ├          100
        CLEAR
         ┤ ├          R    Q ─ %M0200

        %Q0033 ─┤ IN

        %M0001 ─┤ ST
```
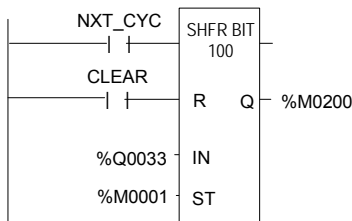
Data Move Functions
Communication Request

The Communication Request (COMMREQ) function is use for specialized communications. Many types of COMMREQs have been defined. The information below describes only the basic format of the function.

When the function receives power flow, a command block of data is sent to the specified module. After sending the COMMREQ, the program can either suspend execution and wait for a reply for a maximum waiting period specified in the command, or resume immediately.

```
                                  ┌──────────┐
                        Enable ───┤ COMM     │
                                  │ REQ      │
                                  │          │
First word of command block ───┤ IN    FT │───
                                  │          │
                       Location ──┤ SYSID    │
                                  │          │
                 Task identifier  │ TASK     │
                                  └──────────┘
```

Parameters of the COMMREQ Function

Input/ Output	Choices	Description
enable	flow	When the function is energized, the communications request is performed.
IN	R, AI, AQ	IN contains the first word of the command block.
SYSID	I, Q, M, T, G, R, AI, AQ, constant	SYSID contains the rack number (most significant byte) and slot number (least significant byte) of the target device.
TASK	R, AI, AQ, constant	TASK contains the task ID of the process on the target device.
FT	flow, none	FT is energized if an error is detected processing the COMM REQ: 1. The specified target address is not present (SYSID). 2. The specified task is not valid for the device (TASK). 3. The data length is 0. 4. The device's status pointer address (in the command block) does not exist.

Command Block for the COMMREQ Function

The Command Block starts at the reference specified in COMMREQ parameter IN. The length of the Command Block depends on the amount of data sent to the device.

The Command Block contains the data to be communicated to the other device, plus information related to the execution of the COMM REQ. The Command Block has the following structure:

address	Length (in words)
address + 1	Wait/No Wait Flag
address + 2	Status Pointer Memory
address + 3	Status Pointer Offset
address + 4	Idle Timeout Value
address + 5	Maximum Communication Time
address + 6 to address + 133	Data Block

Example

In the example, when enabling input %M0020 is ON, a Command Block starting at %R0016 is sent to communications task 1 in the device located at rack 1, slot 2 of the PLC. If an error occurs processing the COMMREQ, %Q0100 is set.

```
   %M0020
    | |         COMM
    | |          REQ                            %Q0100
                                                 ( )
   %R0016       IN   FT

   CONST
   0102         SYSID

   CONST
   00001        TASK
```

Data Type Conversion Functions

The Data Type Conversion functions are used to change a data item from one number type to another. Many programming instructions, such as math functions, must be used with data of one type.

- Convert data to BDC-4

- Convert data to signed integer

- Convert data to double-precision integer

- Convert data to Real

- Convert data to Word

- Round a Real number toward zero (TRUN)

The Convert to BCD-4 function outputs the four-digit BCD equivalent of signed integer data. The original data is not changed by this function. The output data can be used directly as input for another program function.

Data can be converted to BCD format to drive BCD-encoded LED displays or presets to external devices such as high-speed counters.

When the function receives power flow, it performs the conversion, making the result available via output Q. The function passes power flow when power is received, unless the specified conversion would result in a value that is outside the range 0 to 9999.

```
        Enable ─┤ INT TO ├─ OK
                │  BCD4  │
                │        │
Value to be converted ─┤ IN   Q ├─ Output
```
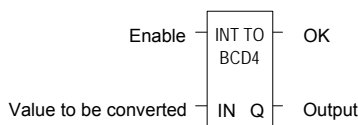
Parameters of the Convert to BCD-4 Function

Input/ Output	Choices	Description
enable	flow	When the function is enabled, the conversion is performed.
IN	I, Q, M, T, G, R, AI, AQ, constant	IN contains a reference for the integer value to be converted to BCD-4.
OK	flow, none	The OK output is energized when the function is performed without error.
Q	I, Q, M, T, G, R, AI, AQ	Output Q contains the BCD-4 form of the original value in IN.

Example

In the example, whenever input %I0002 is set and no errors exist, the integer at input location %I0017 through %I0032 is converted to four BCD digits, and the result is stored in memory locations %Q0033 through %Q0048. Coil %Q1432 is used to check for successful conversion.

```
  %I0002                                                        %Q1432
  ──┤ ├──┬─────────────┬──────────────────────────────────────( )──
         │  INT TO      │
         │  BCD4        │
         │              │
  %I0017 ─┤ IN   Q ├─ %Q0033
```

Data Type Conversion Functions
Convert to Signed Integer

The Convert to Signed Integer function outputs the integer equivalent of BCD-4 or Real data. The original data is not changed by this function. The output data can be used as input for another program function.

When the function receives power flow, it performs the conversion, making the result available via output Q. The function always passes power flow when power is received, unless the data is out of range.

```
              Enable ─┤ BCD4TO ├─ OK
                      │   INT   │
                      │         │
Value to be converted ─┤ IN   Q ├─ Output
```

Parameters of the Convert to Signed Integer Function

Input/ Output	Choices	Description
enable	flow	When the function is enabled, the conversion is performed.
IN	For BCD-4: I, Q, M, T, G, R, AI, AQ, constant For REAL: R, AI, AQ	IN contains a reference for the BCD-4, REAL, or Constant value to be converted to integer.
ok	flow, none	The OK output is energized whenever enable is energized, unless the data is out of range or NaN (Not a Number).
Q	For BCD-4: I, Q, M, T, G, R, AI, AQ For REAL: R, AI, AQ	Output Q contains the integer form of the original value in IN.

Example

In the example, whenever input %I0002 is set, the BCD-4 value in PARTS is converted to a signed integer and passed to the Addition function, where it is added to the signed integer value represented by the reference RUNNING. The sum is output by the Addition function to the reference TOTAL.

```
  %I0002
───┤ ├────┤ BCD4TO ├──────────────────┤  ADD  ├──
          │   INT   │                  │  INT  │
          │         │                  │       │
   PARTS ─┤ IN   Q ├─ %R0001   %R0001 ─┤ IN1 Q ├─ TOTAL
                                       │       │
                             RUNNING ─┤ IN2   │
```

The Convert to Double Precision Signed Integer function outputs the double precision signed integer equivalent of real data. The original data is not changed by this function. The output data can be used directly as input for another program function.

When the function receives power flow, it performs the conversion, making the result available via output Q. The function always passes power flow when power is received, unless the real value is out of range.

```
              ┌─────────┐
Enable ──────┤ REALTO  ├─── OK
              │   INT   │
              │         │
Value to be converted ──┤ IN   Q ├─── Output
              └─────────┘
```
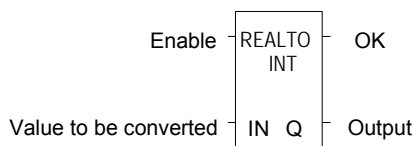
Note that loss of precision can occur when converting from Real-type data to Double-Precision Integer, because Real data has 24 significant bits.

Parameters of the Convert to Double Precision Signed Integer Function

Input/ Output	Choices	Description
rapidan	flow	When the function is enabled, the conversion is performed.
IN	I, Q, M, T, G, R, AI, AQ, constant	Constant or reference for the value to be converted
ok	flow, none	OK is energized whenever enable is energized, unless the real value is out of range.
Q	R, AI, AQ	Reference that contains the double precision signed integer form of the original value.

Example

In the example, whenever input %I0002 is set, the integer value at input location %I0017 is converted to a double precision signed integer and the result is placed in location %R0001. The output %Q1001 is set whenever the function executes successfully.

```
  %I0002                              %Q1001
──┤ ├──────┌─────────┐──────────────────( )──
           │ INT TO  │
           │  DINT   │
           │         │
  %I0017 ──┤ IN   Q ├── %R0001
           └─────────┘
```
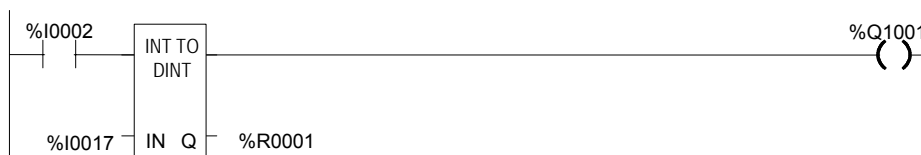
Data Type Conversion Functions
Convert to Real Data

The Convert to Real function outputs the real value equivalent of the input data. The original data is not changed by this function. The output data can be used directly as input for another program function.

When the function receives power flow, it performs the conversion, making the result available via output Q. The function passes power flow when power is received, unless the specified conversion would result in a value that is out of range.

Note that loss of precision can occur when converting from Double-Precision Integer to Real data, because since the number of significant bits is reduced to 24.

```
                        ┌─────────┐
          Enable ─┤     │ INT TO  ├─  OK
                        │  REAL   │
                        │         │
Value to be converted ─┤ IN   Q  ├─  Output
                        └─────────┘
```
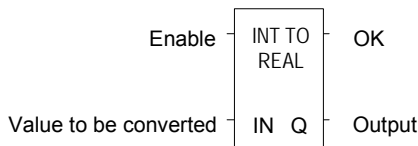
Parameters of the Convert to Real Function

Input/ Output	Choices	Description
enable	flow	When the function is enabled, the conversion is performed.
IN	R, AI, AQ, constant For INT only: I, Q, M, T, G	IN contains a reference for the integer value to be converted to Real.
ok	flow, none	OK is energized when the function is performed without error.
Q	R, AI, AQ	The Real form of the original value in IN.

Example

In the example, the integer value of input IN is 678. The result value placed in %T0016 is 678.000.
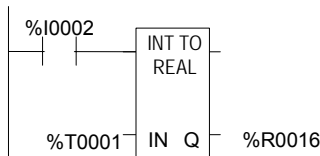
```
  %I0002              ┌─────────┐
───┤ ├────────────────┤ INT TO  │
                      │  REAL   │
                      │         │
         %T0001 ──────┤ IN   Q  ├── %R0016
                      └─────────┘
```

The Convert to Word function outputs the Word equivalent of Real data. The original data is not changed by this function.

When the function receives power flow, it performs the conversion, making the result available via output Q. The function passes power flow when power is received, unless the specified conversion would result in a value that is outside the range 0 to FFFFh.

```
                      ┌─────────┐
          Enable ─────┤ REALTO  ├───── OK
                      │  WORD   │
                      │         │
Value to be converted ┤ IN    Q ├───── Output
                      └─────────┘
```
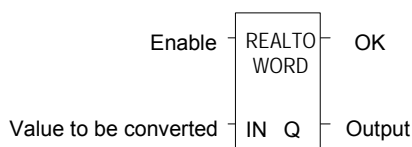
Parameters of the Convert to Word Function

Input/ Output	Choices	Description
enable	flow	When the function is enabled, the conversion is performed.
IN	R, AI, AQ, constant	IN contains a reference for the value to be converted to Word type.
ok	flow, none	OK is energized when the function is performed without error.
Q	I, Q, M, T, G, R, AI, AQ	Contains the unsigned integer form of the original value in IN.

Example

```
  %I0002        ┌─────────┐                    ┌─────────┐
──┤ ├──┤ ├──────┤ REALTO  ├────────────────────┤ RANGE   ├──
                │  WORD   │                     │  WORD   │         %Q1001
                │         │                     │         │        ──( )──
       %R0001 ──┤ IN    Q ├──  %R0003  HI_LIM ──┤ L1    Q │
                └─────────┘                     │         │
                                      LOW_LIM ──┤ L2      │
                                                │         │
                                       %R0003 ──┤ IN      │
                                                └─────────┘
```
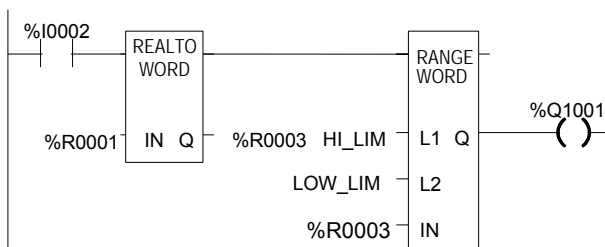
Data Type Conversion Functions
Truncate Real Number

The Truncate function copies a Real number and rounds the copied number down to an integer or double precision integer. The original data is not changed by this function. The output data can be used directly as input for another program function.

When the function receives power flow, it performs the conversion, making the result available via output Q. The function passes power flow when power is received, unless the specified conversion would result in a value that is out of range or unless IN is not a number.

```
                    ┌──────────┐
   Enable ─────────┤  TRUNC   ├───── OK
                    │   INT    │
                    │          │
Value to be converted ─┤ IN   Q ├───── Output
                    └──────────┘
```
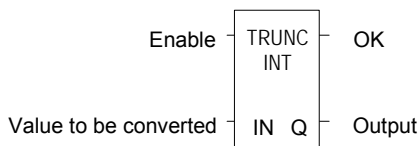
Parameters of the Truncate Function

Input/ Output	Choices	Description
enable	flow	When the function is enabled, the conversion is performed.
IN	R, AI, AQ, constant	IN contains a reference for the real value to be truncated.
ok	flow, none	The OK output is energized when the function is performed without error, unless the value is out of range or IN is NaN.
Q	R, AI, AQ For integer only: I, Q, M, T, G	Q contains the truncated INT or DINT value of the original value in IN.

Example

In the example, the displayed constant is truncated and the integer result 562 is placed in %T0001.

```
   %I0002        ┌──────────┐
───┤ ├──────────┤  TRUNC   ├───── OK
                 │   INT    │
                 │          │
          CONST ─┤ IN     Q ├───── %T0001
       5.62987E+02└──────────┘
```
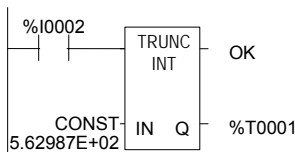
Math and Numerical Functions

This section describes the Math and Numerical functions of the Instruction Set:

- Standard Math Functions: Addition, Subtraction, Multiplication, Division

- Modulo Division

- Scaling Function

- Square Root

- Trigonometric functions

- Logarithmic/Exponential functions

- Convert to Degrees

- Convert to Radians

Converting Data for the Math and Numerical Functions

The program may need to include logic to convert data to a different type before using a Math or Numerical function. The description of each function includes information about appropriate data types. The section *Data Type Conversion Functions* explains how to convert data to a different type.

Math and Numerical Functions
Add, Subtract, Multiply, Divide

The standard math functions are Addition, Subtraction, Multiplication, and Division. The Division function rounds down; it does not round to the closest integer. (For example, 24 DIV 5 = 4.)

When a math function receives power flow, the appropriate operation is performed on input parameters IN1 and IN2. Parameters IN1, IN2, and the output Q must be the same data type.

```
Enable ─┤ ADDINT ├─ OK

Input 1 ─┤ IN1 Q ├─ Output
Input 2 ─┤ IN2
```
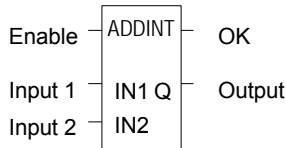
The standard math functions pass power if there is no math overflow. If an overflow occurs, the result is the largest value with the proper sign and no power flow.

Parameters of the Standard Math Functions

Input/ Output	Choices	Description
enable	flow	When the function is enabled, the operation is performed.
IN1	All data types: R, AI, AQ, constant INT data type only: I, Q, M, T, G	IN1 contains a constant or reference for the first value used in the operation. (IN1 is on the left side of the mathematical equation, as in IN1 + IN2). Range for constants in double-precision signed integer operations is minimum/maximum DINT.
IN2	All data types: R, AI, AQ, constant INT data type only: I, Q, M, T, G	IN2 contains a constant or reference for the second value used in the operation. (IN2 is on the right side of the mathematical equation, as in IN1 + IN2). Range for constants in double-precision signed integer operations is minimum/maximum DINT.
ok	flow, none	The OK output is energized when the function is performed without overflow, unless an invalid operation occurs.
Q	All data types: R, AI, AQ INT only: I, Q, M, T, G	Output Q contains the result of the operation.

Data Types for Standard Math Functions

Standard math functions operate on these types of data:

INT	Signed integer
DINT	Double precision signed integer
REAL	Floating Point

The input and output parameter data types must be the same (16 bits or 32 bits).

Avoiding Overflows

Be careful to avoid overflows when using Multiplication and Division functions.

If you have to convert Integer to Double-Precision Integer values, remember that the CPU uses standard 2's complement with the sign extended to the highest bit of the second word. You must check the sign of the low 16-bit word and extend it into the second 16 bit word. If the most significant bit in a 16-bit INT word is 0 (positive), move a 0 to the second word. If the most significant bit in a 16-bit word is –1 (negative), move a –1 or hex 0FFFFh to the second word.

Converting from Double-Precision Integer to Integer data is easier, because the low 16-bit word (first register) is the integer portion of a Double-Precision Integer 32-bit word. The upper 16 bits or second word should be either a 0 (positive) or –1 (negative) value or the Double-Precision Integer number will be too big to convert to 16 bits.

Example

This example uses the Addition and Subtraction functions to keep track of the number of parts in a temporary storage area. Each time a part enters the storage area, power flows through relay %I0004 to a positive transition coil with reference %M0001. Relay %M0001 then enables the Addition function, adding the (constant) value 1 to the current total value in %R0201.

Each time a part leaves the storage area, power flows through relay %I0005 to a positive transition coil with reference %M0002. Relay %M0002 then enables the Subtraction function, subtracting the (constant) value 1 from the current total value in %R0201.
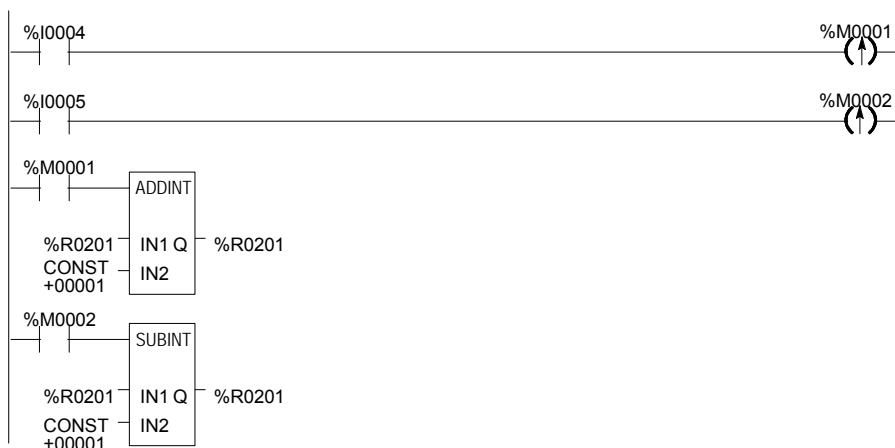
Math and Numerical Functions
Modulo Division

The Modulo Division function divides one value by another of the same data type, to obtain the remainder. The sign of the result is always the same as the sign of input parameter IN1. The Modulo function operates on these types of data:

INT	Signed integer
DINT	Double precision signed integer

When the function receives power flow, it divides input IN1 by input IN2. These parameters must be the same data type. Output Q is calculated using the formula:

$$Q = IN1-((IN1\ DIV\ I2) * I2)$$

The division produces an integer number. Q is the same data type as inputs IN1 and IN2. OK is always ON when the function receives power flow, unless there is an attempt to divide by zero. In that case, it is set OFF.

```
Enable ─┤ MODINT ├─ OK

Input 1 ─┤ IN1  Q ├─ Output
Input 2 ─┤ IN2
```
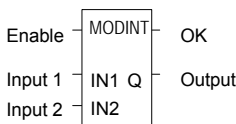
Parameters of the Modulo Division Function

Input/ Output	Choices	Description
enable	flow	When the function is enabled, the operation is performed.
IN1	All data types: R, AI, AQ, constant INT data type only: I, Q, M, T, G	IN1 contains a constant or reference for the value to be divided by IN2. Range for constants in double precision signed integer operations is minimum/maximum DINT.
IN2	All data types: R, AI, AQ, constant INT data type only: I, Q, M, T, G	IN2 contains a constant or reference for the value to be divided into IN1. Range for constants in double precision signed integer operations is minimum/maximum DINT.
ok	flow, none	The OK output is energized when the function is performed without overflow.
Q	All data types: R, AI, AQ INT data type only: I, Q, M, T, G	Output Q contains the result of dividing IN1 by IN2 to obtain a remainder.

Example

In the example, the remainder of the integer division of BOXES into PALLETS is placed into NT_FULL whenever %I0001 is ON.

```
      %I0001
      ─┤ ├──────┐  MODINT
               │
      PALLETS ─┤ IN1  Q ├─ NT_FULL
      -00017            │  -0005
      BOXES   ─┤ IN2
      +0006
```
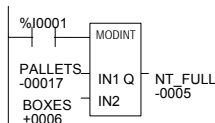
The Scaling function scales an input parameter and places the result in an output location. For integer-type data, all parameters must be integer-based (signed). For word-type data, all parameters must be word-based (unsigned).

```
                            ┌──────────┐
              Enable ───────┤ SCALE    ├─── OK
                            │  INT     │
     Max. Input Value ──────┤ IHI  OUT ├─── Output
      Min. Input Value ─────┤ ILO      │
     Max. Output Value ─────┤ OHI      │
     Min, Output Value ─────┤ OLO      │
               Input ───────┤ IN       │
                            └──────────┘
```
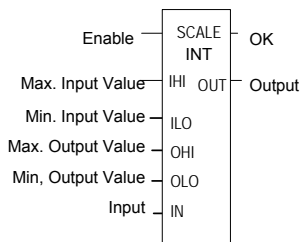
Parameters of the Scaling Function

Input/ Output	Choices	Description
enable	flow	When the function is enabled, the operation is performed.
IHI ILO	R ,AI, AQ, constant	IHI and ILO contain a constant or reference for the upper and lower limits of the unscaled data. These limits, together with the values for OHI and OLO, are used to calculate the scaling factor that will be applied to the input value IN.
OHI OLO	R ,AI, AQ, constant	OHI and OLO contain a constant or reference for the upper and lower limits of the scaled data.
IN	R, AI, AQ, constant	IN contains a constant or reference for the actual value to be scaled.
ok	flow, none	The OK output is energized when the function is performed without overflow.
OUT	R, AI, AQ	Output OUT contains the scaled equivalent of the input value.

Example

In the example, the registers %R0120 through %R0123 are used to store the high and low scaling values. The input value to be scaled is analog input %AI0017. The scaled output data is used to control analog output %AQ0017. The scaling is performed whenever %I0001 is ON.

```
        %I0001          ┌──────────┐
   ──────┤ ├───────────┤ SCALE    ├─── OK
                        │  INT     │
         %R0120 ────────┤ IHI  OUT ├─── %AQ0017
         %R0121 ────────┤ ILO      │
         %R0122 ────────┤ OHI      │
         %R0123 ────────┤ OLO      │
         %AI0017 ───────┤ IN       │
                        └──────────┘
```
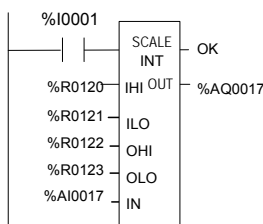
Math and Numerical Functions
Square Root

The Square Root function finds the square root of a value. When the function receives power flow, the value of output Q is set to the integer portion of the square root of the input IN. The output Q must be the same data type as IN.

The Square Root function operates on these types of data:

INT	Signed integer
DINT	Double precision signed integer
REAL	Floating Point

OK is set ON if the function is performed without overflow, unless one of these invalid REAL operations occurs:

- IN < 0

- IN is NaN (Not a Number)

Otherwise, OK is set OFF.
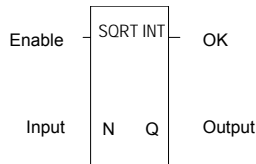
Parameters of the Square Root Function

Input/ Output	Choices	Description
enable	flow	When the function is enabled, the operation is performed.
IN	All data types: R, AI, AQ, constant INT data type only: I, Q, M, T, G	A constant or reference for the value whose square root is to be calculated. If IN is less than zero, the function will not pass power flow. Range for constants is minimum/maximum DINT for double-precision signed integer operations.
ok	flow, none	The OK output is energized when the function is performed without overflow, unless an invalid operation occurs.
Q	All data types: R, AI, AQ INT data type only: I, Q, M, T, G	Output Q contains the square root of IN.

Example

In the example, the square root of the integer number located at %AI001 is placed into the result located at %R0003 whenever %I0001 is ON.

There are six Trigonometric functions: Sine, Cosine, Tangent, Inverse Sine, Inverse Cosine, and Inverse Tangent.

Sine, Cosine, and Tangent

When a Sine, Cosine, or Tangent function receives power flow, it operates on IN, whose units are radians, and stores the result in output Q. Both IN and Q are floating-point values.

```
Enable ─┐  SIN  ┌─ OK

Input  │ IN  Q │  Output
```
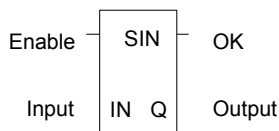
The Sine, Cosine, and Tangent functions accept a broad range of input values, where

$$-2^{63} < IN < +2^{63}, (2^{63} = 9.22 \times 10^{18})$$

Inverse Sine, Cosine, and Tangent

When an Inverse Sine, Cosine, or Tangent function receives power flow, it operates on IN and stores the result in output Q, whose units are radians. Both IN and Q are floating-point values.

The Inverse Sine and Cosine functions accept a narrow range of input values, where

$$-1 \leq IN \leq 1.$$

Given a valid value for the IN parameter, the Inverse Sine Real function produces a result Q such that:

$$ASIN (IN) \quad = \quad \frac{\pi}{2} \leq Q \leq \frac{\pi}{2}$$

The Inverse Cosine Real function produces a result Q such that:

$$ACOS (IN) \quad = \quad 0 \leq Q \leq \pi$$

The Inverse Tangent function accepts the broadest range of input values, where

$$-\infty \leq IN \leq +\infty.$$

Given a valid value for the IN parameter, the Inverse Tangent Real function produces a result Q such that:

$$ATAN (IN) \quad = \quad \frac{\pi}{2} \leq Q \leq \frac{\pi}{2}$$

Math and Numerical Functions
Trigonometric Functions

Parameters of the Trigonometric Functions

Input/ Output	Choices	Description
enable	flow	When the function is enabled, the operation is performed.
IN	R, AI, AQ, constant	IN contains the constant or reference real value to be operated on.
ok	flow, none	OK is energized when the function is performed without overflow, unless an invalid operation occurs and/or IN is NaN.
Q	R, AI, AQ	Output Q contains the trigonometric value of IN.

Example

In the example, the Cosine of the value in %R0001 is placed in %R0033.

```
                    ┌─────────┐
                    │   COS   │
                    │         │
      %R0001 ───────┤ IN   Q  ├─── %R0033
      +3.141500     │         │    -1.000000
                    └─────────┘
```
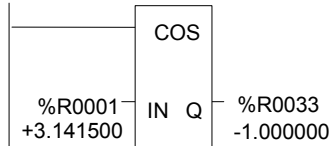
Math and Numerical Functions
Logarithmic / Exponential Functions

When a Logarithmic or Exponential function receives power flow, it performs the appropriate logarithmic/exponential operation on the Real value in input IN and places the result in output Q.

- For the Base 10 Logarithm (LOG) function, the base 10 logarithm of IN is placed in Q.

- For the Natural Logarithm (LN) function, the natural logarithm of IN is placed in Q.

- For the Power of E (EXP) function, **e** is raised to the power specified by IN and the result is placed in Q.

- For the Power of X (EXPT) function, the value of input IN1 is raised to the power specified by the value IN2 and the result is placed in output Q. (The EXPT function has three input parameters and two output parameters.)

The OK output receives power flow unless the input is NaN (Not a Number) or is negative.
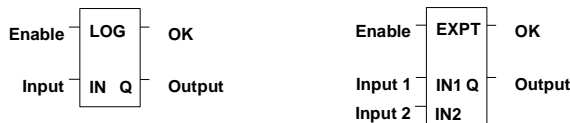
Parameters of the Logarithmic/Exponential Functions

Input/ Output	Choices	Description
enable	flow	When the function is enabled, the operation is performed.
IN or IN1, IN2	R, AI, AQ, constant	For EXP, LOG, and LN, IN contains the real value to be operated on. The EXPT function has two inputs, IN1 and IN2. For EXPT, IN1 is the base value and IN2 is the exponent.
ok	flow, none	OK is energized when the function is performed without overflow, unless an invalid operation occurs and/or IN is NaN or is negative.
Q	R, AI, AQ	Output Q contains the logarithmic/exponential value of IN.

Example of the EXPT Function

In the example, the value of %AI001 is raised to the power of 2.5 and the result is placed in %R0001.
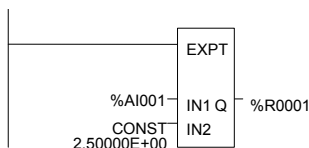
When Degree/Radian Conversion function receives power flow, the appropriate conversion (radians to degrees or degrees to radians) is performed on the Real value in input IN and the result is placed in output Q.

The OK output will receive power flow unless IN is NaN (Not a Number).

```
              ┌─────────┐
Enable ─┤     │ RADTO   │ ── OK
              │  DEG    │
              │         │
Input  ─┤     │ IN    Q │ ── Output
              └─────────┘
```
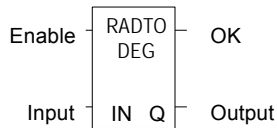
Parameters of the Radian Conversion Function

Input/ Output	Choices	Description
enable	flow	When the function is enabled, the operation is performed.
IN	R, AI, AQ, constant	IN contains the real value to be operated on.
ok	flow, none	The OK output is energized when the function is performed without overflow, unless IN is NaN.
Q	R, AI, AQ	Output Q contains the converted value of IN.

Example

In the example, +1500 is converted to DEG and is placed in %R0001.

```
        │                    ┌─────────┐
        │                    │ RADTO   │
        │                    │  DEG    │
        │          CONST  ───┤ IN    Q ├─── %R0001
        │         +1500.000  │         │     85943.67
        │                    └─────────┘
```
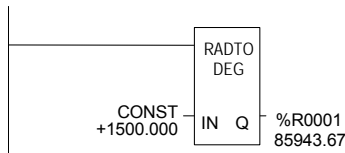
Relational Functions

The Relational functions can be used to compare two numbers and to determine whether a number lies within a specified range.

▪	Equal	Test two numbers for equality
▪	Not Equal	Test two numbers for non-equality
▪	Greater Than	Test whether one number is greater than another
▪	Greater Than or Equal	Test whether one number is greater than or equal to another
▪	Less Than	Test whether one number is less than another
▪	Less Than or Equal	Test whether one number is less than or equal to another
▪	Range	Tests whether one number lies between two other numbers

When the function receives power flow, it compares input IN1 to input IN2. These parameters must be the same data type.

```
           ┌─────────┐
Enable  ─┤ EQ INT    │
           │         │
Input 1 ─┤ IN1  Q   ├─  Output
Input 2 ─┤ IN2       │
           └─────────┘
```
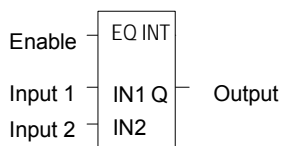
If inputs IN1 and IN2 match the specified relational condition, output Q receives power flow and is set ON (1); otherwise, it is set OFF (0).

Data Types for Relational Functions

Relational functions operate on these types of data:

INT	Signed integer
DINT	Double precision signed integer
REAL	Floating Point

The %S0020 bit is set ON when a relational function using Real data executes successfully. It is cleared when either input is NaN (Not a Number).

> ### Relational Functions
> *Equal, Not Equal, Less Than, Less/Equal, Greater Than, Greater/Equal*

Parameters for the Relational Functions

Input/ Output	Choices	Description
enable	flow	When the function is enabled, the operation is performed.
IN1	R, AI, AQ, constant For INT data only: I, Q, M, T, G	IN1 contains a constant or reference for the first value to be compared. IN1 must be a valid number. Constants must be integers for double precision signed integer operations. IN1 is on the left side of the relational equation, as in IN1 < IN2.
IN2	R, AI, AQ, constant For INT data only: I, Q, M, T, G	IN2 contains a constant or reference for the second value to be compared. IN2 must be a valid number. Constants must be integers for double precision signed integer operations. IN2 is on the right side of the relational equation, as in IN1 < IN2.
Q	flow, none	Output Q is energized when IN1 and IN2 match the specified relation.

Example

In the example, two double precision signed integers are tested for equality. When the relay %I0001 passes power flow to the LE (Less or Equal) function, the value presently in the reference nicknamed PWR_MDE is compared to the value presently in the reference BIN_FUL. If the value in PWR_MDE is less than or equal to the value in BIN_FUL, coil %Q0002 is turned on.

```
      %I0001           ┌─────────┐                                        %Q0002
  ─────┤ ├─────        │ LE INT  │────────────────────────────────────────( )───
                       │         │
        PWR_MDE ───────┤IN1    Q │
        BIN_FUL ───────┤IN2      │
                       └─────────┘
```
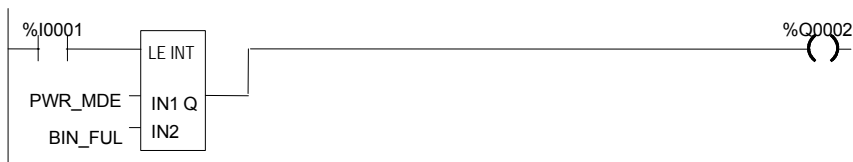
The Range function determines if a value is within the range of two numbers.

Data Types for the Range Function

The Range function operates on these types of data:

INT	Signed integer (default).
DINT	Double precision signed integer.
WORD	Word data type.

When the Range function is enabled, it compares the value of input IN against the range specified by limits L1 and L2. Either L1 or L2 can be the high or low limit. When the value is within the range specified by L1 and L2, inclusive, output parameter Q is set ON (1). Otherwise, Q is set OFF (0).

```
Enable ─┐ ┌─────────┐
        │ │ RANGE   │
        │ │   INT   │
Limit 1 ─┤ L1    Q ├─ Output
        │ │         │
Limit 2 ─┤ L2      │
        │ │         │
Value to be compared │ IN      │
        └─────────┘
```
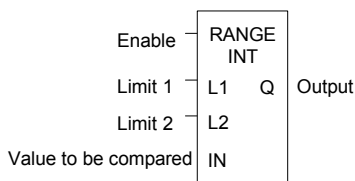
Parameters for the Range Function

Input/ Output	Choices	Description
enable	flow	When the function is enabled, the operation is performed.
L1	R, AI, AQ, constant INT and WORD only: I, Q, M, T, G	L1 contains the start point of the range. Constants must be integer values for double precision signed integer operations.
L2	R, AI, AQ, constant INT and WORD only: I, Q, M, T, G	L2 contains the end point of the range. Constants must be integer values for double precision signed integer operations.
IN	R, AI, AQ INT and WORD only: I, Q, M, T, G	IN contains the value to be compared against the range specified by L1 and L2.
Q	flow, none	Output Q is energized when the value in IN is within the range specified by L1 and L2, inclusive.

Relational Functions
Range

Example

In this example, when the Range function receives power flow from relay %I0001, the function determines whether the value in %AI001 is within the range 0 to 100.

%R0001 contains the value 100. %R2 contains the value 0.

```
   %I0001
 ───┤ ├───      ┌──────────┐
                │  RANGE   │                                    %Q0001
                │   INT    │                                     ( )
   %R0001 ──────┤ L1     Q ├──────────────────────────────────
   %R0002 ──────┤ L2       │
   %AI001 ──────┤ IN       │
                └──────────┘
```

Output coil %Q0001 is On only if the value presently in %AI0001 is within the range 0 to 100.

IN Value %AI001	Q State %Q0001
< 0	OFF
0 — 100	ON
> 100	OFF

Relay Functions

- ▪ Normally Open Contact –| |–
- ▪ Normally Closed Contact –|/|–
- ▪ Normally Open Coil –( )–
- ▪ Retentive SET Coil –(SM)–
- ▪ Retentive RESET Coil –(RM)–
- ▪ Negated Retentive Coil –(/M)–
- ▪ Negated Coil –(/)–
- ▪ Retentive Coil –(M)–
- ▪ SET Coil –(S)–
- ▪ RESET Coil –(R)–
- ▪ Positive Transition Coil –(↑)–
- ▪ Negative Transition Coil –(↓)–
- ▪ Vertical Link vert |
- ▪ Horizontal Link horz –
- ▪ Continuation Coil –––<+>
- ▪ Continuation Contact <+>–––

Each relay contact and coil has one input and one output. Together, they provide logic flow through the contact or coil.

Input→ ─| |─ ← *Output*

A contact is used to monitor the state of a reference. Whether the contact passes power flow depends on the state or status of the reference being monitored and on the contact type. A reference is ON if its state is 1; it is OFF if its state is 0.

Type of Contact	Display	Contact Passes Power to Right:
Normally Open	-| |-	When reference is ON.
Normally Closed	-|/|-	When reference is OFF.
Continuation Contact	<+>---	If the preceding continuation coil is set ON.

Normally Open Contact -| |-

A normally open contact acts as a switch that passes power flow if the associated reference is ON (1).

Normally Closed Contact -|//|-

A normally closed contact acts as a switch that passes power flow if the associated reference is OFF (0).

Example

The example shows a rung with 10 elements having nicknames from E1 to E10. Coil E10 is ON when reference E1, E2, E5, E6, and E9 are ON and references E3, E4, E7, and E8 are OFF.
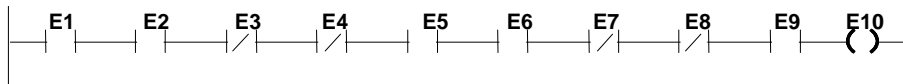
Continuation Coils and Contacts

Continuation coils and continuation contacts are used to continue relay ladder rung logic beyond the last column. The state of the last executed continuation coil is the flow state used on the next executed continuation contact. If the flow of logic does not execute a continuation coil before it executes a continuation contact, the state of the contact is no flow. There can be only one continuation coil and contact per rung; the continuation contact must be in column 1, and the continuation coil must be in the last column.

Coils are used to control discrete references. Conditional logic must be used to control the flow of power to a coil. Coils cause action directly; they do not pass power flow to the right. If additional logic in the program should be executed as a result of the coil condition, an internal reference for the coil, or a continuation coil/contact combination may be used.

Coils are always located at the rightmost position of a line of logic:
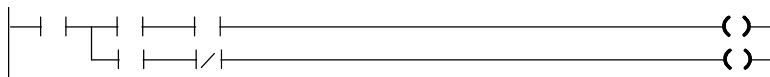
References and Coil Checking

When the level of coil checking is set to "single", you can use a specific %M or %Q reference with only one Coil, but you can use it with one Set Coil and one Reset Coil simultaneously. When the level of coil checking is "warn multiple" or "multiple", each reference can be used with multiple Coils, Set Coils, and Reset Coils. With multiple usage, a reference could be turned On by either a Set Coil or a normal Coil and could be turned Off by a Reset Coil or by a normal Coil.

Power Flow and Retentiveness

The following table summarizes how power flow to different types of coils affects their reference. The states of retentive coils are saved when power is cycled or when the PLC goes from Stop to Run mode. The states of non-retentive coils are set to zero when power is cycled or the PLC goes from Stop to Run mode.

Type of Coil	Symbol	Power to Coil	Result
Normally Open	-( )-	ON OFF	Sets reference ON, non-retentive. Sets reference OFF, non-retentive.
Negated	-(/)-	ON OFF	Sets reference OFF, non-retentive. Sets reference ON, non-retentive.
Retentive	-(M)-	ON OFF	Sets reference ON, retentive. Sets reference OFF, retentive.
Negated Retentive	-(/M)-	ON OFF	Sets reference OFF, retentive. Sets reference ON, retentive.
Positive Transition	-(P)-	OFF to ON	If power flow into the coil was OFF the previous sweep and is ON this sweep, sets the coil ON.
Negative Transition	-(N)-	ON to OFF	If power flow into the coil was ON the previous sweep and is OFF this sweep, sets the coil ON.
SET	-(S)-	ON to OFF	Sets reference ON until reset OFF by (R), non-retentive. Does not change the coil state, non-retentive.
RESET	-(R)-	ON to OFF	Sets reference OFF until set ON by (S), non-retentive. Does not change the coil state, non-retentive.
Retentive SET	-(SM)-	ON to OFF	Sets reference ON until reset OFF by (RM), retentive. Does not change the coil state.
Retentive RESET	-(RM)-	ON to OFF	Sets reference OFF until set ON by (SM)-, retentive. Does not change the coil state.
Continuation Coil	----<+>	ON OFF	Sets next continuation contact ON. Sets next continuation contact OFF.

Relay Functions
Coils

A coil sets a discrete reference ON while it receives power flow. It is non-retentive; therefore, it cannot be used with system status references (%SA, %SB, %SC, or %G).

Example

In the example, coil E3 is ON when reference E1 is ON and reference E2 is OFF.

```
    E1      E2                                            E3
 ───┤ ├─────┤/├──────────────────────────────────────────( )──
```

Negated Coil

A negated coil sets a discrete reference ON when it does not receive power flow. It is not retentive, so it cannot be used with system status references (%SA, %SB, %SC, or %G).

Example

In the example, coil E3 is ON when reference E1 is OFF.

```
    E1                                                    E2
 ───┤ ├───────────────────────────────────────────────────(/)──

    E2                                                    E3
 ───┤ ├───────────────────────────────────────────────────( )──
```
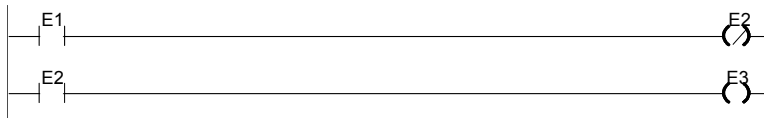
Retentive Coil

Like a normally open coil, the retentive coil sets a discrete reference ON while it receives power flow. The state of the retentive coil is retained across power failure. Therefore, it cannot be used with references from strictly non-retentive memory (%T).

Negated Retentive Coil

The negated retentive coil sets a discrete reference ON when it does not receive power flow. The state of the negated retentive coil is retained across power failure. Therefore, it cannot be used with references from strictly non-retentive memory (%T).

Positive Transition Coil

If the reference associated with a positive transition coil was OFF , when the coil receives power flow it is set to ON until the next time the coil is executed. (If the rung containing the coil is skipped on subsequent sweeps, it will remain ON.) This coil can be used as a one-shot.

Transitional coils can be used with references from either retentive or non-retentive memory (%Q, %M, %T, %G, %SA, %SB, or %SC).

Negative Transition Coil

If the reference associated with this coil is OFF, when the coil stops receiving power flow the reference is set to ON until the next time the coil is executed.

Transitional coils can be used with references from either retentive or non-retentive memory (%Q, %M, %T, %G, %SA, %SB, or %SC).

Example

In the example, when reference E1 goes from OFF to ON, coils E2 and E3 receive power flow, turning E2 ON for one logic sweep. When E2 goes from ON to OFF, power flow is removed from E2 and E3, turning coil E3 ON for one sweep.

```
     E1                                              E2
  ──┤ ├─────────────────────────────────────────────(P)──

     E2                                              E3
  ──┤ ├─────────────────────────────────────────────(N)──
```
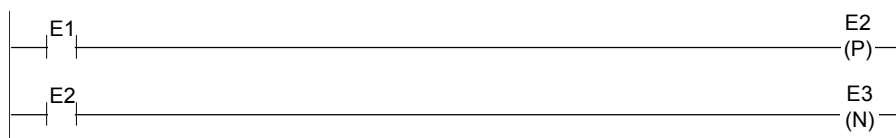
SET Coil

SET and RESET are non-retentive coils that can be used to keep ("latch") the state of a reference either ON or OFF. When a SET coil receives power flow, its reference stays ON (whether or not the coil itself receives power flow) until the reference is reset by another coil.

SET coils write an undefined result to the transition bit for the given reference.

RESET Coil

The RESET coil sets a discrete reference OFF if the coil receives power flow. The reference remains OFF until the reference is set by another coil. The last-solved SET coil or RESET coil of a pair takes precedence.

RESET coils write an undefined result to the transition bit for the given reference.

Example

In the example, the coil represented by E1 is turned ON whenever reference E2 or E6 is ON. The coil represented by E1 is turned OFF whenever reference E5 or E3 is ON.
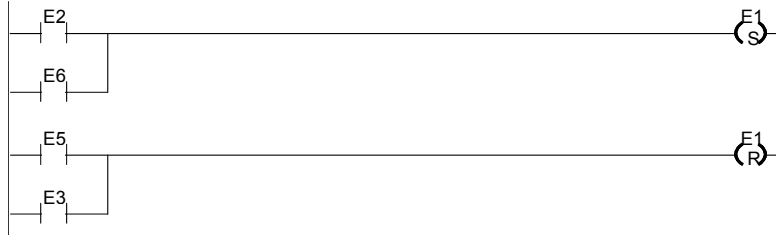
Retentive SET Coil

Retentive SET and RESET coils are similar to SET and RESET coils, but they are retained across power failure or when the PLC transitions from to Run mode. A retentive SET coil sets a discrete reference ON if the coil receives power flow. The reference remains ON until reset by a retentive RESET coil.

Retentive SET coils write an undefined result to the transition bit for the given reference.

Retentive RESET Coil

This coil sets a discrete reference OFF if it receives power flow. The reference remains OFF until set by a retentive SET coil. The state of this coil is retained across power failure or when the PLC transitions from Stop to Run mode.

Retentive RESET coils write an undefined result to the transition bit for the given reference.

Table Functions

The Table functions are used to:

- Copy array data: ARRAY MOVE

- Search for values in an array

The maximum length allowed for these functions is 32,767 for any type.

Data Types for the Table Functions

Table functions operate on these types of data:

INT	Signed integer
DINT	Double precision signed integer
BIT *	Bit data type
BYTE	Byte data type
WORD	Word data type

*   Applies to Array Move only.

Table Functions
Array Move

The Array Move function copies a specified number of elements from a source array to a destination array. When the function receives power flow, it copies the number of elements specified from the input array, starting at the indexed location. The function then writes the copied elements to the output array starting with the indexed location.

For bit data, when word-oriented memory is selected for the parameters of the source array and/or destination array starting address, the least significant bit of the specified word is the first bit of the array.

The indices in an Array Move instruction are 1-based. In using an Array Move, no element outside either the source or destination arrays (as specified by their starting address and length) may be referenced.

The OK output receives power flow unless one of the following occurs:
- Enable is OFF.
- (N + SNX – 1) is greater than (length).
- (N + DNX – 1) is greater than (length).
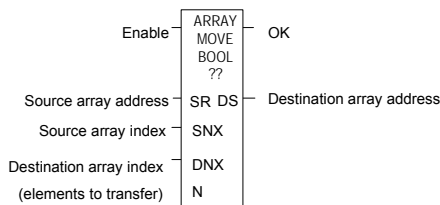
Parameters for the Array Move Function

Input/ Output	Choices	Description
enable	flow	When the function is enabled, the operation is performed.
SR	For all: R, AI, AQ For INT, BIT, BYTE, WORD: I, Q, M, T, G, For BIT, BYTE, WORD: SA, SB, SC	SR contains the starting address of the source array. For ARRAY_MOVE_ BIT, any reference may be used; it does not need to be byte aligned.
SNX	I, Q, M, T, G, R, AI, AQ, constant	SNX contains the index of the source array.
DNX	I, Q, M, T, G, R, AI, AQ, constant	DNX contains the index of the destination array.
N	I, Q, M, T, G, R, AI, AQ, constant	N provides a count indicator.
ok	flow, none	OK is energized whenever enable is energized.
DS	For all: SA, SB, SC, R, AI, AQ For INT, BIT, BYTE, WORD: I, Q, M, T, G	The starting address of the destination array. For ARRAY_MOVE_ BIT, any reference may be used; it does not need to be byte aligned.
length		The number of elements starting at SR and DS that make up each array. It is defined as the length of SR+DS.

Example 1:

In this example, if %R100=3 then %R0003 - %R0007 of the array %R0001 - %R0016 is read and is written into %R0104 - %R0108 of the array %R0100 - %R0115. (%R001 and %R0100 are declared as type WORD of length 16.)

```
        %I0001        ┌──────────┐
        ─┤ ├─         │  ARRAY   │
                      │  MOVE    │
                      │  WORD    │
                      │   16     │
        %R0001  ──────┤ R    DS  ├────── %R0100
        %R0100  ──────┤ SNX      │
        CONST   ──────┤ DNX      │
        00005         │          │
        CONST   ──────┤ N        │
        00005         └──────────┘
```
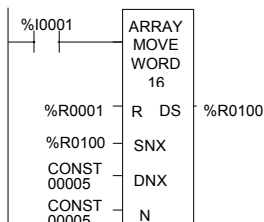
Example 2:

Using bit memory for SR and DS, %M0011 - %M0017 of the array %M0009 - %M0024 is read and then written to %Q0026 - %Q0032 of the array %Q0022 - %Q0037. (%M009 and %Q0022 are declared as type BOOL of length 16).

```
        %I0001        ┌──────────┐
        ─┤ ├─         │  ARRAY   │
                      │  MOVE    │
                      │  BOOL    │
                      │   16     │
        %M0009  ──────┤ SR   DS  ├────── %Q0022
        CONST   ──────┤ SNX      │
        00003         │          │
        CONST   ──────┤ DNX      │
        00005         │          │
        CONST   ──────┤ N        │
        00007         └──────────┘
```
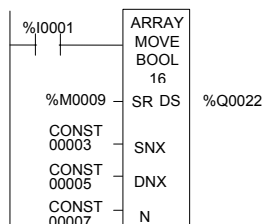
Example 3:

Using word memory, for SR and DS, the third least significant bit of %R0001 through the second least significant bit of %R0002 of the array containing all 16 bits of %R0001 and four bits of %R0002 is read and then written into the fifth least significant bit of %R0100 through the fourth least significant bit of %R0101 of the array containing all 16 bits of %R0100 and four bits of %R0101. 0001 and %R0100 are declared as type BOOL of length 20).

```
        %I0001        ┌──────────┐
        ─┤ ├─         │  ARRAY   │
                      │  MOVE    │
                      │  BOOL    │
                      │   20     │
        %R0001  ──────┤ SR   DS  ├────── %R0100
        CONST   ──────┤ SNX      │
        00003         │          │
        CONST   ──────┤ DNX      │
        00005         │          │
        CONST   ──────┤ N        │
        00016         └──────────┘
```
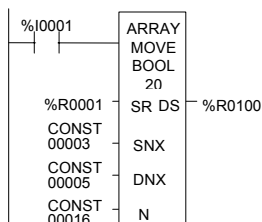
Table Functions
Search for Array Values

Use the Search functions listed below to search for values in an array.

- ▪ Search Equal
- ▪ Search Not Equal
- ▪ Search Greater Than
- ▪ Search Greater Than or Equal
- ▪ Search Less Than
- ▪ Search Less Than or Equal

- ▪ Equal to a specified value.
- ▪ Not equal to a specified value.
- ▪ Greater than a specified value.
- ▪ Greater than or equal to a specified value.
- ▪ Less than a specified value.
- ▪ Less than or equal to a specified value.

When the Search function receives power, it searches the specified array. Searching begins at the starting address (AR) plus the index value (NX).

```
                    SEARCH
          enable    EQ INT
                      ??
Starting address    AR  FD    Found indication
   Input index      NX  NX    Output index
Object of search    IN
```
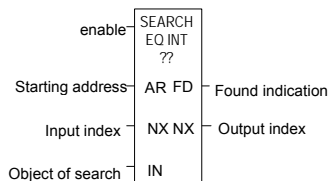
The search continues until the array element of the search object (IN) is found or until the end of the array is reached. If an array element is found, the Found Indication (FD) is set ON and the Output Index (output NX) is set to the relative position of this element within the array. If no array element is found before the end of the array is reached, the Found Indication (FD) is set OFF and the Output Index (output NX) is set to zero.

The valid values for input NX are 0 to (length –1). NX should be set to zero to begin searching at the first element. This value increments by one at the time of execution. The values of output NX are 1 to (length). If the value of input NX is out-of-range, (< 0 or $\geq$ length), its value is set to the default value of zero.

Parameters of the Search Functions

Input/ Output	Choices	Description
enable	flow	When the function is enabled, the search is performed.
AR	For all: R, AI, AQ For INT, BYTE, WORD: I, Q, M, T, G, For BYTE, WORD: S	Contains the starting address of the array.
Input NX	I, Q, M, T, G, R, AI, AQ, constant	Contains the zero-based index into the array at which to begin the search.
IN	For all: R, AI, AQ, constant For INT, BYTE, WORD: I, Q, M, T, G, For BYTE, WORD: S	IN contains the object of the search.
Output NX	I, Q, M, T, G, R, AI, AQ	Holds the one-based position within the array of the search target.
FD	flow, none	FD indicates that an array element has been found and the function was successful.
length	1 to 32,767 bytes or words.	The number of elements starting at AR that make up the array to be searched.

Example 1:

The array AR is defined as memory addresses %R0001 - %R0005. When EN is ON, the portion of the array between %R0004 and %R0005 is searched for an element whose value is equal to IN. If %R0001 = 7, %R0002 = 9, %R0003 = 6, %R0004 = 7, %R0005 = 7, and %R0100 = 7, then the search will begin at %R0004 and conclude at %R0004 when FD is set ON and a 4 is written to %R0101.

```
         %I0001
          | |        SEARCH
          ┤ ├        EQ INT
                        5                                    %Q0001
         %R0001 ─┤ AR  FD ──────────────────────────────────( )──

          CONST ─┤ NX  NX ├─ %R0101
          00003
         %R0100 ─┤ IN
```
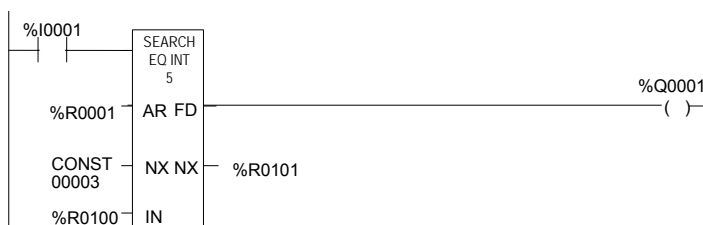
Example 2:

Array AR is defined as memory addresses %AI001 - %AI016. The values of the array elements are 100, 20, 0, 5, 90, 200, 0, 79, 102, 80, 24, 34, 987, 8, 0, and 500. Initially, %AQ001 is 5. When EN is ON, each sweep will search the array looking for a match to the IN value of 0. The first sweep will start searching at %AI006 and find a match at %AI007, so FD is ON and %AQ001 is 7. The second sweep will start searching at %AI008 and find a match at %AI015, so FD remains ON and %AQ001 is 15. The next sweep will start at %AI016. Since the end of the array is reached without a match, FD is set OFF and %AQ001 is set to zero. The next sweep will start searching at the beginning of the array.

```
         %I0001
          | |         SRCH
          ┤ ├        EQ INT
                        16                                   %M001
         %AI001 ─┤ AR  FD ──────────────────────────────────( )──

         %AQ001 ─┤ NX  NX ├─ %AQ001
          00005
          CONST ─┤ IN
          00000
```
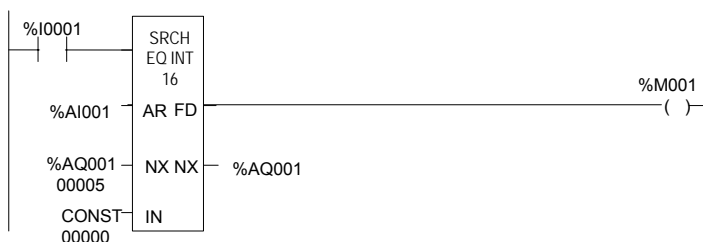
Timer and Counter Functions

This section describes the timing and counting functions of the Instruction Set. The data associated with these functions is retentive through power cycles.

- On-Delay Stopwatch Timer

- Off-Delay Timer

- On-Delay Timer

- Up Counter

- Down Counter

Time-Tick Contacts

In addition to the Timer functions of the Instruction Set, the VersaMax PLC has four time-tick contacts. These contacts can be used to provide regular pulses of power flow to other program functions. The four time-tick contacts have time durations of 0.01 second, 0.1 second, 1.0 second, and 1 minute.

The state of these contacts does not change during the execution of the sweep. These contacts provide a pulse having an equal on and off time duration.

The contacts are referenced as T_10MS (0.01 second), T_100MS (0.1 second), T_SEC (1.0 second), and T_MIN (1 minute).

The following timing diagram represents the on/off time duration of these contacts.

These time-tick contacts represent specific locations in %S memory.

Function Block Data Required for Timers and Counters

Each timer or counter uses three words (registers) of %R memory to store the following information:

current value (CV)	word 1
preset value (PV)	word 2
control word	word 3

When you enter a timer or counter, you must enter a beginning address for these three words (registers). Do not use consecutive registers for the 3 word timer/counter blocks. Timers and counters will not work if you place the current value of a block on top of the preset for the previous block.
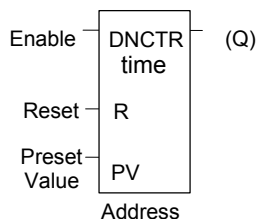
The control word stores the state of the boolean inputs and outputs of its associated function block in the following format:
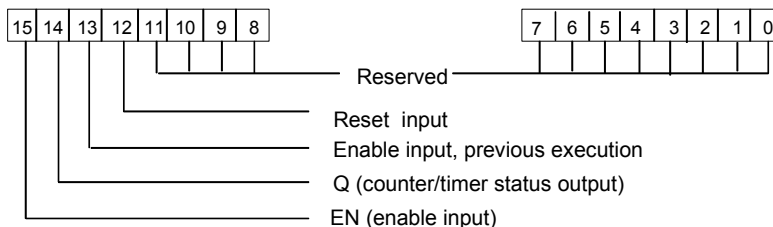
Bits 0 through 11 are used for timer accuracy; not for counters.

If the Preset Value (PV) is not a constant, PV is normally set to a different location than the second word. Some applications use the second word address for the PV, such as using %R0102 when the bottom data block starts at %R0101. It is then possible to change the Preset Value while the timer or counter is running. The first (CV) and third (Control) words can be read but should not be written, or the function will not work.

Timer and Counter Functions
On Delay Stopwatch Timer

A retentive On-Delay Stopwatch Timer (ONDTR) increments while it receives power flow and holds its value when power flow stops. Time may be counted in tenths (0.1), hundredths (0.01), or thousandths (0.001) of a second. The range is 0 to +32,767 time units. The state of this timer is retentive on power failure; no automatic initialization occurs at power-up.

When this function first receives power flow, it starts accumulating time (current value). When this timer is encountered in the ladder logic, its Current Value is updated.

```
Enable ─┐  ┌──────┐  ┌─ (Q)
        │  │ ONDTR│  │
        │  │TENTHS│  │
        │  │ ???? │  │
        │  │      │  │
 Reset ─┤  │ R    │  │
        │  │      │  │
Preset Value ─┤ │ PV   │ ├─ Current Value
           └──────┘
           Address
```
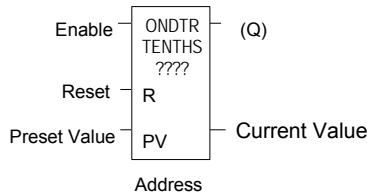
When the Current Value equals or exceeds the Preset Value PV, output Q is energized. As long as the timer continues to receive power flow, it continues accumulating until the maximum value is reached. Once the maximum value is reached, it is retained and output Q remains energized regardless of the state of the enable input.

If multiple occurrences of the same timer with the same reference address are enabled during a CPU sweep, the current values of the timers will be the same.

Parameters of the On Delay Stopwatch Timer Function

Input/ Output	Choices	Description
address	R	The function uses three consecutive words (registers) of %R memory to store the following: - Current value (CV) =word 1. - Preset value (PV) = word 2. - Control word = word 3. Do not use this address with other instructions. **Careful:** Overlapping references cause erratic timer operation.
enable	flow	When enable receives power flow, the timer's Current Value increments.
R	flow	When R receives power flow, it resets the Current Value to zero.
PV	I ,Q, M, T, G, R, AI, AQ, constant, none	The Preset Value, which is used when the timer is enabled or reset.
Q	flow, none	Output Q is energized when the current value of the timer is greater than or equal to the Preset Value.
time	tenths, hundredths, or thousandths of seconds	Time increment for the low bit of the PV preset and CV current value.

Operation of the On Delay Timer Function

A. ENABLE goes high; timer starts accumulating

B. Current value reaches preset value PV; Q goes high

C. RESET goes high; Q goes low, accumulated time is reset (CV=0)

D. RESET goes low; timer then starts accumulating again

E. ENABLE goes low; timer stops accumulating. Whatever time has been accumulated remains. Step F: When ever enable input is high again timer starts accumulating from the earlier accumulated value.

F. ENABLE goes high again; timer starts accumulating time from the earlier accumulated value.

G. Current value becomes equal to preset value PV; Q goes high. Timer continues to accumulate time until ENABLE goes low, RESET goes high or current value becomes equal to the maximum time

H. ENABLE goes low; timer stops accumulating time.

When power flow to the timer stops, the current value stops incrementing and is retained. Output Q, if energized, will remain energized. When the function receives power flow again, the current value again increments, beginning at the retained value. When reset R receives power flow, the current value is set back to zero and output Q is de-energized unless PV equals zero.

Example

In the example, a retentive on-delay timer is used to create a signal (%Q0011) that turns on 8.0 seconds after %Q0010 turns on, and turns off when %Q0010 turns off.
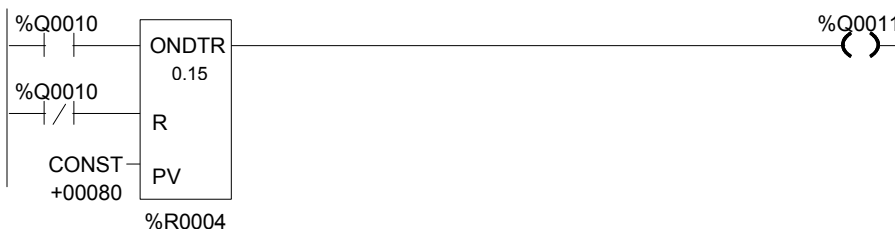
The On-Delay Timer (TMR) increments while it receives power flow and resets to zero when power flow stops. Time may be counted in tenths of a second (the default selection), hundredths of a second, or thousandths of a second. The range is 0 to +32,767 time units. The state of this timer is retentive on power failure; no automatic initialization occurs at power-up.

```
Enable ─┐ ┌─ TMR ─┐ ┌─ (Q)
        │ │ TENTHS │ │
        │ │        │ │
Preset Value ─┤ PV │ │ ├─ Current Value
```

Address-3 words
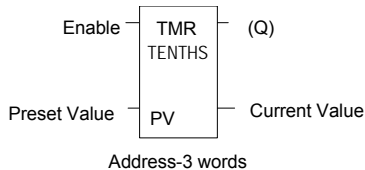
When the On Delay Timer function receives power flow, the timer starts accumulating time (Current Value). The Current Value is updated when it is encountered in the logic to reflect the total elapsed time the timer has been enabled since it was last reset.

If multiple occurrences of the same timer with the same reference address are enabled during a CPU sweep, the Current Values of the timers will be the same.

This update occurs as long as the enabling logic remains ON. When the current value equals or exceeds the Preset Value PV, the function begins passing power flow to the right. The timer continues accumulating time until the maximum value is reached. When the enabling parameter transitions from ON to OFF, the timer stops accumulating time and the Current Value is reset to zero.

Parameters for the On Delay Timer Function

Input/ Output	Choices	Description
address	R	The function uses three consecutive words (registers) of %R memory to store the following: • Current value (CV) = word 1. • Preset value (PV) = word 2. • Control word = word 3. Do not use this address with other instructions. **Careful:** Overlapping references cause erratic operation of the timer.
enable	flow	When enable receives power flow, the timer's current value is incremented. When the TMR is not enabled, the current value is reset to zero and Q is turned off.
PV	I Q, M, T, G, R, AI, AQ, constant, none	PV is the value to copy into the timer's preset value when the timer is enabled or reset.
Q	flow, none	Output Q is energized when TMR is enabled and the current value is greater than or equal to the preset value.
time	tenths (0.1), hundredths (0.01), or thousandths (0.001) of seconds	Time increment for the low bit of the PV preset and CV current value.

Operation of the On-Delay Timer Function
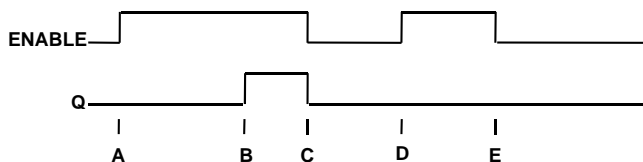
A. ENABLE goes high; timer begins accumulating time.
B. Current value reaches preset value PV; Q goes high, and timer continues accumulating time.
C. ENABLE goes low; Q goes low; timer stops accumulating time and current time is cleared.
D. ENABLE goes high; timer starts accumulating time.
E. ENABLE goes low before current value reaches preset value PV; Q remains low; timer stops accumulating time and is cleared to zero (CV=0).

Example

In the example, a delay timer (with address) TMRID is used to control the length of time that coil is on. This coil has been assigned the Nickname DWELL . When the normally open (momentary) contact with the Nickname DO_DWL is on, coil DWELL is energized.

The contact of coil DWELL keeps coil DWELL energized (when contact DO_DWL is released), and also starts the timer TMRID. When TMRID reaches its preset value of one-half second, coil REL energizes, interrupting the latched-on condition of coil DWELL. The contact DWELL interrupts power flow to TMRID, resetting its current value and de-energizing coil REL. The circuit is then ready for another momentary activation of contact DO_DWL.
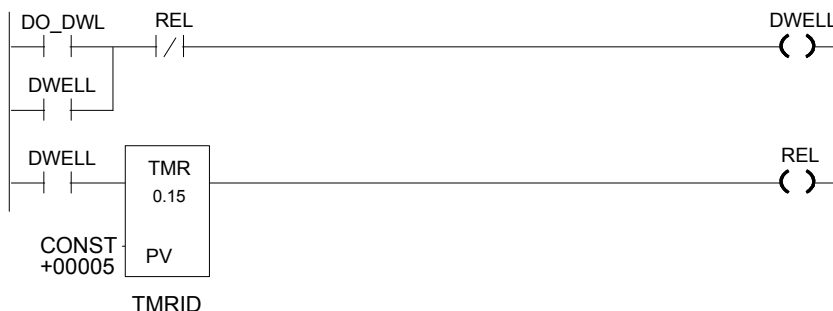
The Off-Delay Timer increments while power flow is off, and resets to zero when power flow is on. Time may be counted in tenths (0.1), hundredths (0.01), or thousandths of a second (0.001). The range is 0 to +32,767 time units. The state of this timer is retentive on power failure; no automatic initialization occurs at power-up.

```
Enable ⌐ OFDT    ⌐ (Q)
       | HUNDS   |
       |         |
Preset Value ⌐ PV CV ⌐ Current Value
```

Address-3 words
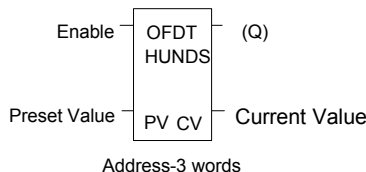
When the Off-Delay Timer first receives power flow, it passes power to the right, and the Current Value (CV) is set to zero. The function uses word 1 as its CV storage location. The output remains on as long as the function receives power flow. If the function stops receiving power flow from the left, it continues to pass power to the right, and the timer starts accumulating time in the Current Value.

If multiple occurrences of the same timer with the same reference address are enabled during a CPU sweep, the Current Values of the timers will be the same.

The Off-Delay Timer does not pass power flow if the Preset Value is zero or negative.

Each time the function is invoked with the enabling logic set to OFF, the Current Value is updated to reflect the elapsed time since the timer was turned off. When the Current Value (CV) is equal to the Preset Value (PV), the function stops passing power flow to the right. When that occurs, the timer stops accumulating. When the function receives power flow again, the current value resets to zero.

When the Off-Delay Timer is used in a program block that is *not* called every sweep, the timer accumulates time between calls to the program block unless it is reset. This means that it functions like a timer operating in a program with a much slower sweep than the timer in the main program block. For program blocks that are inactive for a long time, the timer should be programmed to allow for this catch-up feature. For example, if a timer in a program block is reset and the program block is not called (is inactive) for four minutes, when the program block is called, four minutes of time will already have accumulated. This time is applied to the timer when enabled, unless the timer is first reset.

Example

In the example, an Off-Delay Timer is used to turn off an output (%Q00001) whenever an input (%I00001) turns on. The output is turned on again 0.3 seconds after the input goes off.

```
%I00001   OFDT                              %Q00001
 | |      HUNDS                              ( / )
 |
 | CONST  PV  CV
 | +00003
        %R00019
```

Operation of the Off-Delay Timer Function
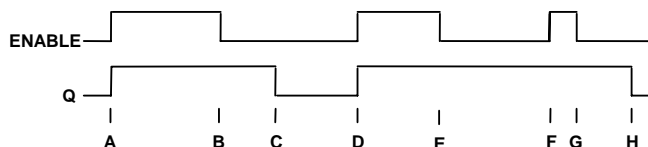
A.   ENABLE and Q both go high; timer is reset (CV = 0).

B.   ENABLE goes low; timer starts accumulating time.

C.   CV reaches PV; Q goes low, and timer stops accumulating time.

D.   ENABLE goes high; timer is reset (CV = 0).

E.   ENABLE goes low; timer starts accumulating time.

F.   ENABLE goes high; timer is reset (CV = 0).

G.   ENABLE goes low; timer begins accumulating time.

H.   CV reaches PV; Q goes low, and timer stops accumulating time.

Parameters of the Off-Delay Timer Function

Input/ Output	Choices	Description
address	R	The function uses three consecutive words (registers) of %R memory to store the following: • Current value (CV) = word 1. • Preset value (PV) = word 2. • Control word = word 3. Do not use this address with other instructions. <u>Careful:</u> Overlapping references cause erratic operation of the timer.
enable	flow	When enable receives power flow, the timer's current value is reset to 0.
PV	I Q, M, T, G, R, AI, AQ, constant, none	PV is the value to copy into the timer's preset value when the timer is enabled or reset. For a register (%R) OV reference, the PV parameter is specified as the second word of the address parameter. For example, an address parameter of %R0001 would use %R0002 as the PV parameter.
Q	flow, none	Output Q is energized when the current value is less than the preset value. The Q state is retentive on power failure; no automatic initialization occurs at power-up.
time	tenths, hundredths, or thousandths of seconds	Time increment for the low bit of the PV preset and CV current value.

Timer and Counter Functions
Up Counter

The Up Counter function counts up to a designated value. The range is 0 to +32,767 counts. When the Up Counter reset is ON, the Current Value of the counter resets to 0. Each time the enable input transitions from OFF to ON, the Current Value increments by 1. The current value can be incremented past the Preset Value PV. The output is ON whenever the Current Value is greater than or equal to the Preset Value. The state of the CTU is retentive on power failure; no automatic initialization occurs at power-up.

```
Enable ─┐ UPCTR ┌─ (Q)
Reset ─┤ R
Preset ─┤ PV
Value
        Address
```
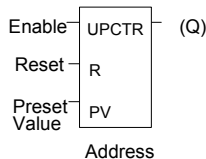
Parameters of the Up Counter Function

Input/ Output	Choices	Description
address	R	The function uses three consecutive words (registers) of %R memory to store the following: • Current value (CV) = word 1. • Preset value (PV) = word 2. • Control word = word 3. Do not use this address with another up counter, down counter, or any other instruction or improper operation will result. **Careful:** Overlapping references cause erratic operation of the counter.
enable	flow	On a positive transition of enable, the current count is incremented by one.
R	flow	When R receives power flow, it resets the current value back to zero.
PV	I, Q, M, T, G, R, AI, AQ, constant, none	PV is the value to copy into the counter's preset value when the counter is enabled or reset.
Q	flow, none	Output Q is energized when the Current Value is greater than or equal to the Preset Value.

Example of the Up Counter Function

In the example, every time input %I0012 transitions from OFF to ON, up counter PRT_CNT counts up by 1; internal coil %M0001 is energized when 100 parts have been counted. When %M0001 is ON, the accumulated count is reset to zero.

```
%I0012                                                          %M0001
 ─┤ ├──┐ UPCTR ────────────────────────────────────────────────( )
%M0001  │
 ─┤ ├──┤ R
        │
 CONST ─┤ PV
 +00100
        PRT_CNT
```

The Down Counter function counts down from a preset value. The minimum Preset Value is zero; the maximum present value is +32,767 counts. The minimum Current Value is –32,768. When reset, the Current Value of the counter is set to the Preset Value PV. When the enable input transitions from OFF to ON, the Current Value is decremented by one. The output is ON whenever the Current Value is less than or equal to zero.

The Current Value of the Down Counter is retentive on power failure; no automatic initialization occurs at power-up.

```
Enable ─┐ DNCTR ┌─  (Q)
        │       │
 Reset ─┤ R     │
        │       │
Preset ─┐ PV    │
 Value    │
        └───────┘
       Address
```
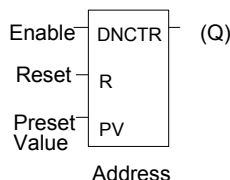
Parameters of the Down Counter Function

Input/ Output	Choices	Description
address	R	The function uses three consecutive words (registers) of %R memory to store the following: • Current value (CV) = word 1. • Preset value (PV) = word 2. • Control word = word 3. Do not use this address with another down counter, up counter, or any other instruction or improper operation will result. **Careful:** Overlapping references will result in erratic counter operation.
enable	flow	On a positive transition of enable, the Current Value is decremented by one.
R	flow	When R receives power flow, it resets the Current Value to the Preset Value.
PV	I, Q, M, T, G, R, AI, AQ, constant, none	PV is the value to copy into the counter's Preset Value when the counter is enabled or reset.
Q	flow, none	Output Q is energized when the Current Value is less than or equal to zero.

Example 1

In the example, the down counter identified as COUNTP counts 500 new parts before energizing output %Q0005.

```
 NEW_PRT   ┌─────────┐                                            %Q0005
 ──┤ ├──────┤  DNCTR  ├──────────────────────────────────────────( )──
 NXT_BAT    │         │
 ──┤ ├──────┤ R       │
            │         │
   CONST  ──┤ PV      │
   +0500    └─────────┘
              COUNTP
```

Example 2

The following example shows how the PLC can keep track of the number of parts in a temporary storage area. It uses an up/down counter pair with a shared register for the accumulated or current value. When parts enter the storage area, the up counter increases the current value of the parts in storage by 1. When a part leaves the storage area, the down counter decrements by 1, decreasing the inventory storage value by 1. The two counters use different register addresses. When a register counts, its current value must be moved to the current value register of the other counter.

```
  %I00003                              ┌─────────┐
  ──┤ ├──────────────────────────────┤  UPCTR  │
  %I00001                             │         │
  ──┤ ├──────────────────┐           │ R       │
  %I00009               CONST   ──────┤ PV      │
  ──┤ ├─────────────    +00005        └─────────┘
                                         %R0100
  %I00003                    ┌────────┐
  ──┤ ├──────────────────────┤ MOVE   │
  %I00001                    │ INT    │
  ──┤ ├──────────  %R0100 ──┤ IN    Q├──  %R0104
                            └────────┘

  %I00003                              ┌─────────┐
  ──┤ ├──────────────────────────────┤  DNCTR  │
  %I00002                             │         │
  ──┤ ├──────────────────┐           │ R       │
  %I00009               CONST   ──────┤ PV      │
  ──┤ ├─────────────    +00005        └─────────┘
                                         %R0104
  %I00002                    ┌────────┐
  ──┤ ├──────────────────────┤ MOVE   │
  %I00003                    │ INT    │
  ──┤ ├──────────  %R0104 ──┤ IN    Q├──  %R0100
                            └────────┘
```
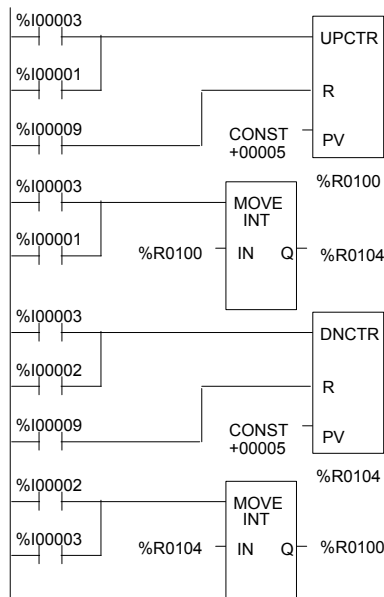
See the pages on Math functions for an example of using the Addition and Subtraction functions to provide storage tracking.

Chapter

24

Service Request Function

This chapter explains the Service Request (SVCREQ) function, which requests a special PLC service. It describes SVCREQ parameters for the VersaMax Nano PLC and Micro PLC.

- SVCREQ Function Numbers
- Format of the SVCREQ Function
- SVCREQ 1: Change/Read Constant Sweep Timer
- SVCREQ 2: Read Window Times
- SVCREQ 3: Change Programmer Communications Window Mode
- SVCREQ 4: Change System Communications Window Mode
- SVCREQ 6: Change/Read Number of Words to Checksum
- SVCREQ 7: Read or Change the Time-of-Day Clock
- SVCREQ 8: Reset Watchdog Timer
- SVCREQ 9: Read Sweep Time from Beginning of Sweep
- SVCREQ 10: Read Folder Name
- SVCREQ 11: Read PLC ID
- SVCREQ 13: Shut Down (Stop) PLC
- SVCREQ 14: Clear Fault
- SVCREQ 15: Read Last-Logged Fault Table Entry
- SVCREQ 16: Read Elapsed Time Clock
- SVCREQ 18: Read I/O Override Status
- SVCREQ 23: Read Master Checksum
- SVCREQ 26/30: Interrogate I/O
- SVCREQ 34: Enter Analog Calibration Mode
- SVCREQ 35: Execute Analog Calibration
- SVCREQ 52: Read from Flash
- SVCREQ 53: Write to Flash

SVCREQ Functions

Each Service Request has its own function number, as listed in the following table.

Function #	Description
1	Change/Read Constant Sweep Timer
2	Read Window Times
3	Change Programmer Communications Window Mode and Time
4	Change System Communications Window Mode and Time
5	reserved
6	Change/Read Number of Words to Checksum
7	Change/Read Time-of-Day Clock
8	Reset Watchdog Timer
9	Read Sweep Time from Beginning of Sweep
10	Read Folder Name
11	Read PLC ID
12	reserved
13	Shut Down the PLC
14	Clear Fault Tables
15	Read Last-Logged Fault Table Entry
16	Read Elapsed Time Clock
17	reserved
18	Read I/O Override Status
19-22	reserved
23	Read Master Checksum
26/30	Interrogate I/O
27, 28	reserved
29	Read Elapsed Power Down Time
31-33	reserved
34	Enter Analog Calibration mode
35	Execute Analog Calibration
36-51	reserved
52	Read from Flash
53	Write to Flash
53-255	reserved

Format of the SVCREQ Function

The SVCREQ function has three inputs and one output.

```
  enable ─┤ SVCREQ ├─ OK
Function number ─┤ FNC
Beginning reference ─┤ PARM
```
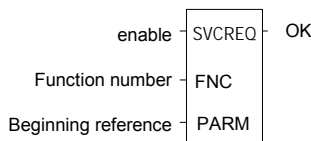
When the SVCREQ receives power flow, the PLC is requested to perform the function number (FNC) indicated. Parameters for the function are located beginning at the reference given for PARM. This is the beginning of the "parameter block" for the function. The number of 16-bit references required depends on the SVCREQ function being used.

Parameter blocks may be used as both inputs for the function and the location where data may be output after the function executes. Therefore, data returned by the function is accessed at the same location specified for PARM.

The SVCREQ function passes power flow unless an incorrect function number, incorrect parameters, or out-of-range references are specified. Specific SVCREQ functions have additional causes for failure.

Parameters of the SVCREQ Function

Input/Output	Choices	Description
enable	flow	When enable is energized, the service request is performed.
FNC	I, Q M, T, G, R, AI, AQ, constant	Contains the constant or reference for the requested service.
PARM	I, Q M, T, G, R, AI, AQ	Contains the beginning reference for the parameter block for the requested service.
ok	flow, none	OK is energized when the function is performed without error.

Example of the SVCREQ Function

In the example, when the enabling input %I0001 is ON, SVCREQ function number 7 is called, with the parameter block located starting at %R0001. Output coil %Q0001 is set ON if the operation succeeds.

```
%I0001                                                          %Q0001
 ─┤├──┬─────┤ SVCREQ ├──────────────────────────────────────────( )──
      │
      │  CONST ─┤ FNC
      │  00007
      │  %R0001 ─┤ PARM
```

SVCREQ 1: Change/Read Constant Sweep Timer

Use SVCREQ 1 to enable or disable Constant Sweep Time mode, change the length of the Constant Sweep Time, read whether Constant Sweep Time is currently enabled, or read the Constant Sweep Time length.

Input Parameter Block for SCVREQ 1

For this function, the parameter block has a length of two words.

Disable Constant Sweep Mode

To disable Constant Sweep mode, enter SVCREQ function #1 with this parameter block:

address	0
address + 1	ignored

Enable Constant Sweep Mode

To enable Constant Sweep mode, enter SVCREQ function #1 with this parameter block:

address	1
address + 1	0 or timer value

Note: If the timer should use a new value, enter it in the second word. If the timer value should not be changed, enter 0 in the second word. If the timer value does not already exist, entering 0 causes the function to set the OK output to OFF.

Change the Constant Sweep Time

To change the timer value **without** changing the selection for sweep mode state, enter SVCREQ function #1 with this parameter block:

address	2
address + 1	new timer value

Read the Constant Sweep State and Time

To read the current timer state and value without changing either, enter SVCREQ function #1 with this parameter block:

address	3
address + 1	ignored

Successful execution will occur, unless:

1. A number other than 0, 1, 2, or 3 is entered as the requested operation:

2. The sweep time value is greater than 500ms (0.5 seconds).

3. Constant sweep time is enabled with no timer value programmed or with an old value of 0 for the timer.

After the function executes, the function returns the timer state and value in the same parameter block references:

	0 = disabled
address	1 = enabled
address + 1	current timer value

Example of SVCREQ 1

In this example, if contact OV_SWP is set, the Constant SweepTimer is read, the timer is increased by two milliseconds, and the new timer value is provided to the CPU. The parameter block is in local memory at location %R0050. Because the MOVE and ADD functions require three horizontal contact positions, the example logic uses discrete internal coil %M00001 as a temporary location to hold the successful result of the first rung line. On any sweep in which OV_SWP is not set, %M00001 is turned off.
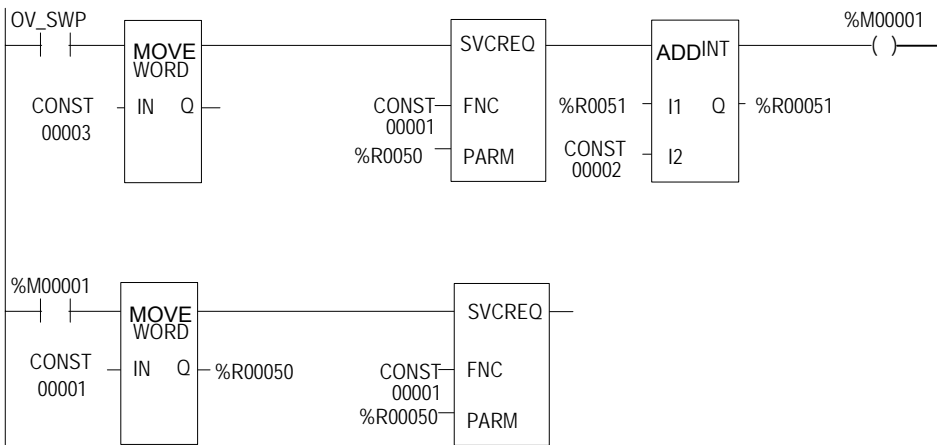
SVCREQ 2: Read Window Times

SVCREQ 2 can be used to read the times of the programmer communications window and the system communications window. These windows can operate in Limited or Run to Completion Mode.

Mode Name	Value	Description
Limited Mode	0	The execution time of the window is limited to 6ms. The window terminates when it has no more tasks to complete or after 6ms elapses.
Run to Completion Mode	2	Regardless of the time assigned to a window, it runs until all tasks within that window are completed (up to 400ms).

A window is disabled when the time value is zero.

Output Parameter Block for SVCREQ 2

The parameter block has a length of three words:

	High Byte	Low Byte	
address	Mode	Value in ms	Programmer Window
address + 1	Mode	Value in ms	System Communications Window
address + 2	must be zero	must be zero	reserved

All parameters are output parameters. It is not necessary to enter values in the parameter block to program this function.

Example of SVCREQ 2

In the following example, when enabling output %Q00102 is set, the Micro PLC CPU places the current time values of the windows in the parameter block starting at location %R0010.

```
%Q00102
  | |          ┌────────┐
  ┤ ├──────────┤ SVCREQ │
                │        │
       CONST ───┤ FNC    │
       00002    │        │
     %R0010 ────┤ PARM   │
                └────────┘
```
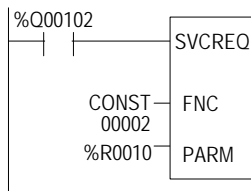
SVCREQ 3: Change Programmer Communications Window Mode

Use SVCREQ 3 to change the programmer communications window mode (Limited or Run-to-Completion). The change occurs during the next CPU sweep after the function is called. The time of the window cannot be changed; it is always 6ms.

SVCREQ 3 passes power flow to the right unless a mode other than 0 (Limited) or 2 (Run-to-Completion) is selected.

The parameter block has a length of one word.

Changing the Programmer Communications Window Mode

To change the programmer window, enter SVCREQ 3 with this parameter block:

	High Byte	Low Byte
address	Mode	6
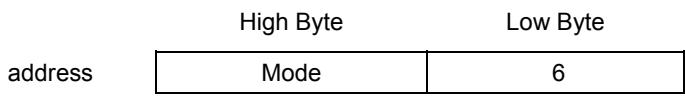
Example of SVCREQ 3

In the following example, when enabling input %I006 goes ON, the programmer communications window is enabled and assigned a value of 6ms. The parameter block is in reference memory location %R0051.

```
     %I0006
      | |        MOVE                          SVCREQ
      | |        WORD
                                     CONST      FNC
   CONST    IN   Q  %R0051           00003
   0006                              %R0051     PARM
```
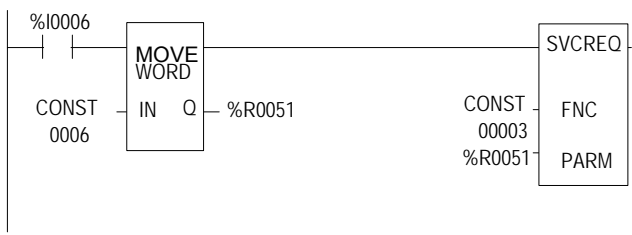
SVCREQ 4: Change System Communications Window Mode

Use SVCREQ 4 to change the system communications window mode (Limited or Run-to-Completion). The change occurs during the next CPU sweep after the function is called. The time of the window cannot be changed; it is always 6ms.

SVCREQ 4 passes power flow to the right unless a mode other than 0 (Limited) or 2 (Run-to-Completion) is selected.

The parameter block has a length of one word.

Changing the System Communications Window Mode

To change the programmer window, enter SVCREQ 4 with this parameter block:

	High Byte	Low Byte
address	Mode	6

Example of SVCREQ 4

In the following example, when enabling input %I0003 is ON the system communications window is changed to Run-to-Completion mode. The parameter block is at location %R0025.
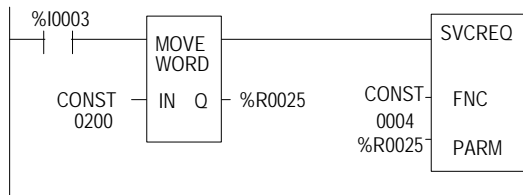
SVCREQ 6: Change/Read Number of Words to Checksum

Use SVCREQ 6 to read or change the number of words in the program to be checksummed. The function is successful unless some number other than 0 or 1 is entered as the requested operation.

Parameter Block Formats for SVCREQ 6

The parameter block has a length of 2 words. To read the word count, the first word of the parameter block must contain a zero:

address	0 (read word count)
address + 1	ignored

The function returns the current word count in the second word of the parameter block.

address	0
address + 1	current word count

To change the word count, the first word of the parameter block must contain a one:

address	1 (change word count)
address + 1	new word count (0 to 32)

The PLC will change the number of words to be checksummed to the new value.

Example of SVCREQ 6

In the example, when enabling contact FST_SCN is set, the parameter blocks for the checksum function are built. Later in the program, if input %I0137 turns on, the SVCREQ reads the number of words being checksummed. The parameter block for the Read function is located at %R0150-151. The ADD function adds 32 to the current word count in %R0151 and places the result in %R0153. The parameter block for the Change function is located at %R00152-153. The second SVCREQ then changes to the new word count specified in %R0153.
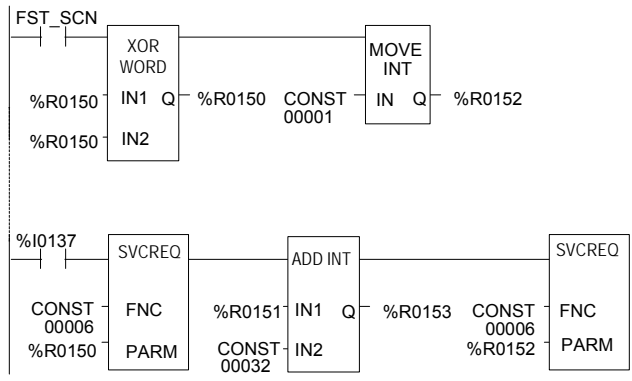
SVCREQ 7: Read or Change the Time-of-Day Clock

Use SVCREQ 7 to read or change the time of day clock in the PLC. The data can be either BCD or ASCII. Either 2-digit-year or 4-digit-year format is available. The function is successful unless some number other than 0 (read) or 1 (change) is entered for the requested operation, or an invalid data format is specified, or data is provided in an unexpected format.

Parameter Block Format for SVCREQ 7

For the date/time functions, the length of the parameter block depends on the data format. The data block is either BCD or ASCII. BCD format requires 6 words; packed ASCII requires 12 words (13 words for 4-digit year). For both data types:

- Hours are stored in 24-hour format.

- Day of the week is a numeric value from 1 (Sunday) to 7 (Saturday).

	2-Digit Year Format	4-Digit Year Format
address	0 = read time and date 1 = set time and date	0 = read time and date 1 = set time and date
address + 1	1 = BCD format 3 = packed ASCII format	81h = BCD format 83h = packed ASCII format
address + 2 to end	data	data

Words 3 to the end of the parameter block contain output data returned by a read function, or new data being supplied by a change function. In both cases, format of these data words is the same. When reading the date and time, words (address + 2) to the end of the parameter block are ignored on input.

SVCREQ 7 Parameter Block Content: BCD Format

In BCD format, each time and date item occupies one byte, so the parameter block has six words.

2-Digit Year

The last byte of the sixth word is not used. When setting the date and time, this byte is ignored; when reading date and time, the function returns 00.

<table>
<tr><th colspan="2">Parameter Block Format:
High Byte: Low Byte</th><th></th><th colspan="2">Example:
Read Date and Time in BCD format
(Sun., July 3, 1998, at 2:45:30 p.m.)</th></tr>
<tr><td>1 = change   or   0 = read</td><td></td><td>address</td><td colspan="2">0 (read)</td></tr>
<tr><td colspan="2">1 (BCD format)</td><td>address + 1</td><td colspan="2">1 (BCD format)</td></tr>
<tr><td>month</td><td>year</td><td>address + 2</td><td>07 (July)</td><td>98 (year)</td></tr>
<tr><td>hours</td><td>day of month</td><td>address + 3</td><td>14 (hours)</td><td>03 (day)</td></tr>
<tr><td>seconds</td><td>minutes</td><td>address + 4</td><td>30 (seconds)</td><td>45 (minutes)</td></tr>
<tr><td>(null)</td><td>day of week</td><td>address + 5</td><td>00</td><td>06 (Friday)</td></tr>
</table>

4-Digit Year

The parameter block has six words. All bytes are used.

<table>
<tr><th colspan="2">Parameter Block Format:
High Byte: Low Byte</th><th></th><th colspan="2">Example:
Read Date and Time in BCD format
(Sun., July 3, 1998, at 2:45:30 p.m.)</th></tr>
<tr><td>1 = change   or   0 = read</td><td></td><td>address</td><td>00</td><td>00 (read)</td></tr>
<tr><td colspan="2">81h (BCD format, 4-digit)</td><td>address + 1</td><td>00</td><td>81h (BCD, 4-digit)</td></tr>
<tr><td>year</td><td>year</td><td>address + 2</td><td>19 (year)</td><td>98 (year)</td></tr>
<tr><td>day of month</td><td>month</td><td>address + 3</td><td>03 (day)</td><td>07 (July)</td></tr>
<tr><td>minutes</td><td>hours</td><td>address + 4</td><td>45 (minutes)</td><td>14 (hours)</td></tr>
<tr><td>day of week</td><td>seconds</td><td>address + 5</td><td>06 (Friday)</td><td>30 (seconds)</td></tr>
</table>

SVCREQ 7 Parameter Block Content: Packed ASCII Format

In Packed ASCII format, each digit of the time and date items is an ASCII formatted byte. Spaces and colons are embedded into the data to format it for printing or display. ASCII format requires 12 words in the parameter block (13 words for 4-digit year).

2-Digit Year

Parameter Block Format: High Byte	Low Byte		Example: Read Date and Time in Packed ASCII Format (Mon, Oct. 5, 1998 at 11:13:00pm)	
1 = change or 0 = read		address	0 (read)	
3 (ASCII format)		address + 1	3 (ASCII format)	
year	year	address + 2	38 (8)	39 (9)
month	(space)	address + 3	31 (1)	20 (space)
(space)	month	address + 4	20 (space)	30 (0)
day of month	day of month	address + 5	35 (5)	30 (leading 0)
hours	(space)	address + 6	31 (1)	20 (space)
:	hours	address + 7	3A (:)	31 (1)
minutes	minutes	address + 8	33 (3)	31 (1)
seconds	:	address + 9	30 (0)	3A (:)
(space)	seconds	address + 10	20 (space)	30 (0)
day of week	day of week	address + 11	32 (2: Mon.)	30 (leading 0)

4-Digit Year

Parameter Block Format: High Byte	Low Byte		Example: Read Date and Time in Packed ASCII Format (Mon, Oct. 5, 1998 at 11:13:00pm)	
1 = change or 0 = read		address	0 (read)	
83h (ASCII 4 digit)		address + 1	83h (ASCII 4 digit)	
year (hundreds)	year (thousands)	address + 2	39 (9)	31 (1)
year (ones)	year (tens)	address + 3	38 (8)	39 (9)
month (tens)	(space)	address + 4	31 (1)	20 (space)
(space)	month (ones)	address + 5	20 (space)	30 (0)
day of month (ones)	day of month (tens)	address + 6	35 (5)	30 (leading 0)
hours (tens)	(space)	address + 7	31 (1)	20 (space)
: (colon)	hours (ones)	address + 8	3A (:)	31 (1)
minutes (ones)	minutes (tens)	address + 9	33 (3)	31 (1)
seconds (tens)	: (colon)	address + 10	30 (0)	3A (:)
(space)	seconds (ones)	address + 11	20 (space)	30 (0)
day of week (ones)	day of week (tens)	address + 12	32 (2: Mon.)	30 (leading 0)

Example of SVCREQ 7

In the example, when called for by previous logic, a parameter block for the time-of-day clock is built. It requests the current date and time, then sets the clock to 12 noon using BCD format. The parameter block is located at location %R0300. Array NOON has been set up elsewhere in the program to contain the values 12, 0, and 0. (Array NOON must also contain the data at %R0300.) BCD format requires six contiguous memory locations for the parameter block.
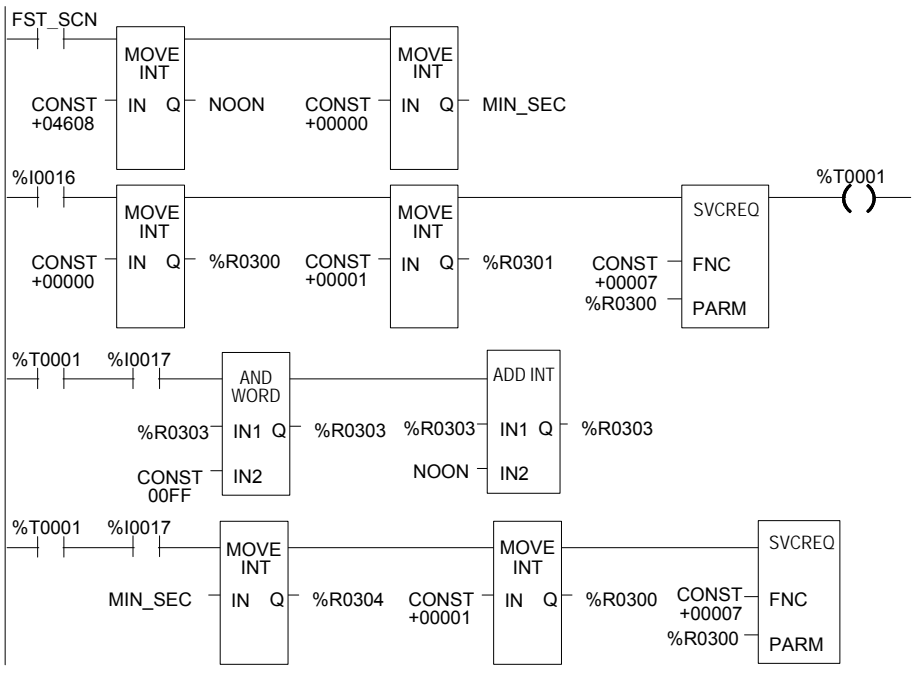
SVCREQ 8: Reset Watchdog Timer

Use SVCREQ 8 to reset the watchdog timer during the sweep. Ordinarily, when the watchdog timer expires the PLC shuts down without warning. SVCREQ 8 allows the timer to keep going during a time-consuming task (for example, while waiting for a response from a communications line).

> Caution

Be sure that resetting the watchdog timer does not adversely affect the controlled process.

Parameter Block Format for SVCREQ 8

This function has no associated parameter block.

Example of SVCREQ 8

In this example, power flow through enabling output %Q0027 or input %I1476 or internal coil %M00010 causes the watchdog timer to be reset.

```
        %Q0127
        ─┤ ├──────────┐           ┌─────────┐
                       │           │ SVCREQ  │
        %I1476         │           │         │
        ─┤ ├───────────┤   CONST───┤ FNC     │
                       │    0008   │         │
        %M0010         │           │         │
        ─┤ ├───────────┘  %R0100───┤ PARM    │
                                   └─────────┘
```
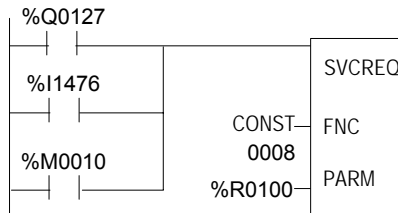
SVCREQ 9: Read Sweep Time from Beginning of Sweep

Use SVCREQ 9 to read the time in milliseconds since the start of the sweep. The data format is unsigned 16-bit integer.

Output Parameter Block Format for SVCREQ 9

The parameter block is an output parameter block only; it has a length of one word.

address | time since start of sweep
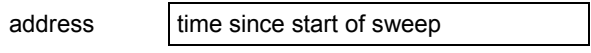
Example of SVCREQ 9

In the following example, the elapsed time from the start of the sweep is always read into location %R0200. If it is greater than 100ms, internal coil %M0200 is turned on.

```
              SVCREQ              GT INT
                                                            %M0200
     CONST  ─ FNC       %R0200 ─ IN1    Q ──────────────────( )──
     00009
     %R0200 ─ PARM       CONST ─ IN2
                          0100
```
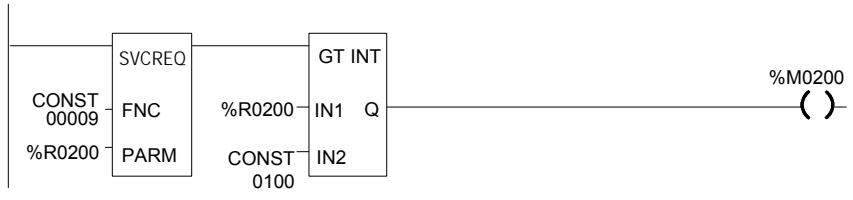
SVCREQ 10: Read Folder Name

Use SVCREQ 10 to read the name of the currently-executing folder.

Output Parameter Block Format for SVCREQ 10

The output parameter block has a length of four words. It returns eight ASCII characters; the last is a null character (00h). If the program name has fewer than seven characters, null characters are added to the end.

	Low Byte	High Byte
address	character 1	character 2
address + 1	character 3	character 4
address + 2	character 5	character 6
address + 3	character 7	00

Example of SVCREQ 10

In this example, when enabling input %I0301 goes OFF, register location %R0099 is loaded with the value 10, which is the function code for the Read Folder Name function. The Program Block READ_ID is then called to retrieve the folder name. The parameter block is located at address %R0100.
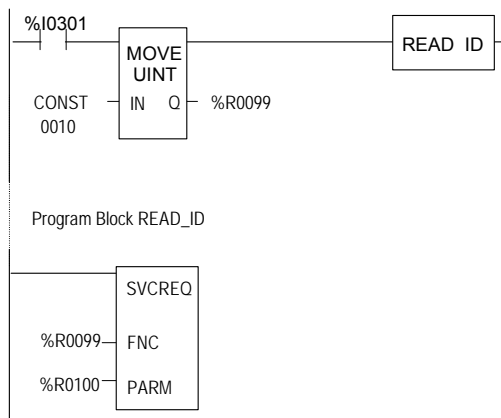
SVCREQ 11: Read PLC ID

Use SVCREQ 11 to read the name of the PLC executing the program.

Output Parameter Block Format for SVCREQ 11

The output parameter block has a length of four words. It returns eight ASCII characters; the last is a null character (00h). If the PLC ID has fewer than seven characters, null characters are added to the end.

	Low Byte	High Byte
address	character 1	character 2
address + 1	character 3	character 4
address + 2	character 5	character 6
address + 3	character 7	00

Example of SVCREQ 11

In this example, when enabling input %I0302 goes OFF, register location %R0099 is loaded with the value 11, which is the function code for the Read PLC ID function. The program block READ_ID is then called to retrieve the ID. The parameter block is located at address %R0100.
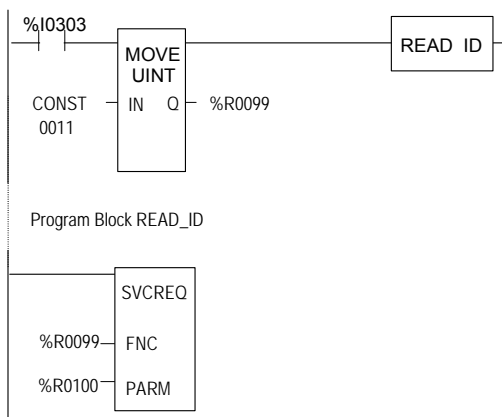
SVCREQ 13: Shut Down (Stop) PLC

Use SVCREQ 13 to stop the Micro PLC *at the end of the next sweep*. All outputs go to the OFF state at the start of the next PLC sweep. An informational "Shut Down PLC" fault is placed in the PLC Fault Table. The I/O scan continues as configured.

Parameter Block for SVCREQ 13

This function has no parameter block.

Example of SVCREQ 13

In the example, when %T0001 is set SVCREQ 13 executes. The PARM input is not used.

This example uses a JUMP to the end of the program to force a shutdown if the Shutdown PLC function executes successfully. This JUMP and LABEL are needed because the transition to Stop mode does not occur until the end of the sweep in which the function executes.

SVCREQ 14: Clear Fault

Use SVCREQ 14 to clear either the PLC fault table or the I/O fault table. The SVCREQ output is set ON unless some number other than 0 or 1 is entered as the requested operation.

Input Parameter Block for SVCREQ 14

For this function, the parameter block has a length of 1 word. It is an input parameter block only. There is no output parameter block.

0 = clear PLC fault table.
1 = clear I/O fault table.

Example of SVCREQ 14

In the example, when input %I0346 is on and input %I0349 is on, the PLC fault table is cleared. When input %I0347 is on and input %I0349 is on, the I/O fault table is cleared. When input %I0348 is on and input %I0349 is on, both are cleared. A positive transition coil should be used to trigger SVCREQ14.

The parameter block for the PLC fault table is located at %R0500; for the I/O fault table the parameter block is located at %R0550. Both parameter blocks are set up elsewhere in the program.
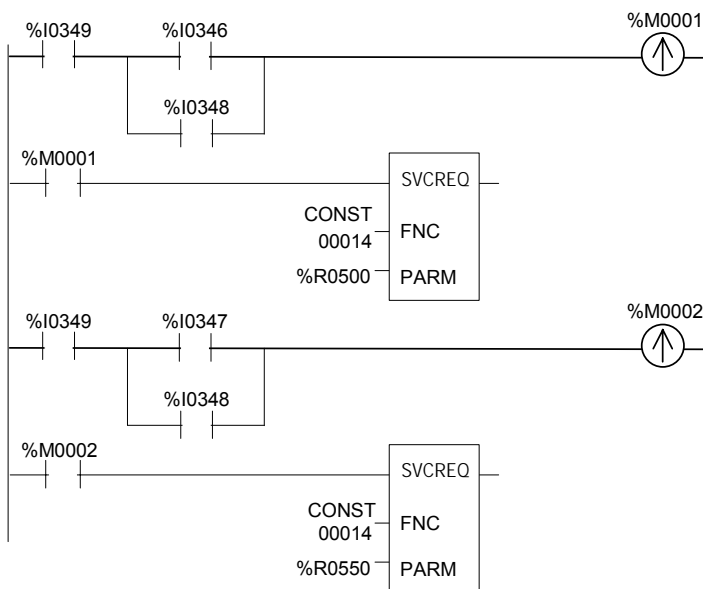
SVCREQ 15: Read Last-Logged Fault Table Entry

Use SVCREQ 15 to read the last entry logged in either the PLC fault table or the I/O fault table. The SVCREQ output is set ON unless some number other than 0 or 1 is entered as the requested operation or the fault table is empty.

Input Parameter Block for SVCREQ 15

For this function, the parameter block has a length of 22 words. The input parameter block has this format:

	2-Digit Year Format	4-Digit Year Format
address	0 = Read PLC fault table.	8 = Read PLC fault table.
	1 = Read I/O fault table.	9 = Read I/O fault table.

The format of the output parameter block depends on whether the function reads data from the PLC fault table or the I/O fault table.

PLC Fault Table Output Format

High Byte	Low Byte	
	0	
spare	long/short	address + 1
spare	spare	address + 2
slot	rack	address + 3
	task	address + 4
fault action	fault group	address + 5
	error code	address + 6
	fault specific data	address + 7
		address + 8
		to
		address + 18
minutes	seconds	address + 19
day of month	hour	address + 20

2-Digit Year Format

year	month	address + 21

or

4-Digit Year Format

spare	month	address + 21
year		address + 22

I/O Fault Table Output Format

High Byte	Low Byte
	1
memory type	long/short
	offset
slot	rack
block	bus
	point
fault action	fault group
fault type	fault category
fault specific data	fault description
minutes	seconds
day of month	hour

2-Digit Year Format

year	month

4-Digit Year Format

spare	month
year	

Long/Short Value

The first byte of word address +1 contains a number that indicates the length of the fault-specific data in the fault entry. These possible values are:

PLC fault table	00 = 8 bytes (short) 01 = 24 bytes (long)
I/O fault table	02 = 5 bytes (short) 03 = 21 bytes (long)

Example of SVCREQ 15

When inputs %I0250 and %I0251 are both on, the first Move function places a zero (read PLC fault table) into the parameter block for SVCREQ 15. When input %I0250 is on and input %I0251 is off, the Move instruction instead places a one (read I/O fault table) in the SVCREQ parameter block. The parameter block is located at location %R0600.

```
   %I0250       %I0251
     | |          | |                    ┌──────┐
     ─┤ ├────────┤ ├──                    │ MOVE │
                                          │ INT  │
                                          │  1   │
                                          │      │
                        CONST ─┤IN    Q├─ %R0600
                        00001  └──────┘

   %I0250       %I0251
     | |          |/|                    ┌──────┐
     ─┤ ├────────┤/├──                    │ MOVE │
                                          │ INT  │
                                          │  1   │
                                          │      │
                        CONST ─┤IN    Q├─ %R0600
                        00001  └──────┘

   ALW_ON
     | |         ┌────────┐
     ─┤ ├────────│ SVCREQ │
                 │        │
       CONST ────│ FNC    │
       00015     │        │
      %R0600 ────│ PARM   │
                 └────────┘
```
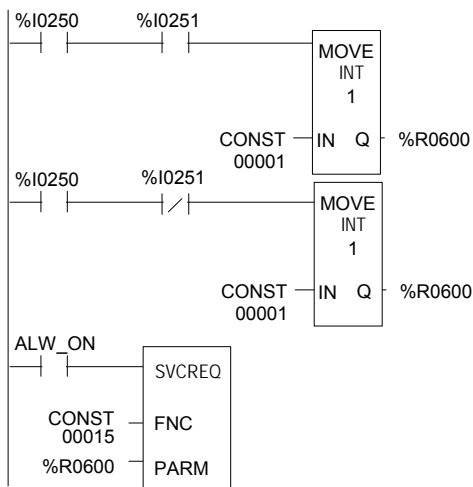
SVCREQ 16: Read Elapsed Time Clock

Use SVCREQ 16 to read the system's elapsed time clock. The elapsed time clock measures the time in seconds since the Micro PLC was powered on.

Output Parameter Block for SVCREQ 16

This function has an output parameter block only. Its length is 3 words.

address	seconds from power on (low order)
address + 1	seconds from power on (high order)
address + 2	100 microsecond ticks

The first two words are the elapsed time in seconds. The last word is the number of 100 microsecond ticks in the current second.

Example of SVCREQ 16

In the example, when internal coil %M0233 is on, the SVCREQ with a parameter block located at %R0127 reads the system's elapsed time clock and sets internal coil %M0234. When coil %M0233 is off, the SVCREQ with a parameter block at %R0131 reads the elapsed time clock again.

The subtraction function finds the difference between the first and second readings, which have been stored in the SVCREQ parameter blocks. The subtraction ignores the hundred microsecond ticks.

The difference between the two readings is placed in memory location %R0250.
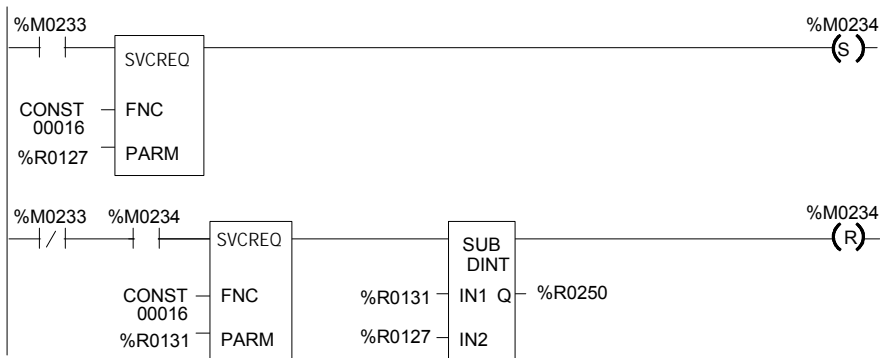
SVCREQ 18: Read I/O Override Status

Use SVCREQ 18 to check for any overrides in the Micro PLC 's %I and %Q memories.

Output Parameter Block for SVCREQ 18

This function has an output parameter block only. Its length is 1 word.

address

0 = No overrides are set.
1 = Overrides are set.

Example of SVCREQ 18

The following SVCREQ reads the status of I/O overrides memory into location %R1003. The equality function checks %R1003 to see if it is equal to (the constant) 1. If it is, the equality function turns on output %T0001.

```
   %I0001
   ─┤ / ├──      ┌─────────┐              ┌─────────┐
                 │ SVCREQ  │              │ EQ INT  │
                 │         │              │         │                    %T0001
   CONST ───────┤ FNC     │   CONST ─────┤ IN1   Q ├───────────────────( )─
   00018         │         │   00001      │         │
                 │         │              │         │
   %R1003 ──────┤ PARM    │   %R1003 ────┤ IN2     │
                 └─────────┘              └─────────┘
```
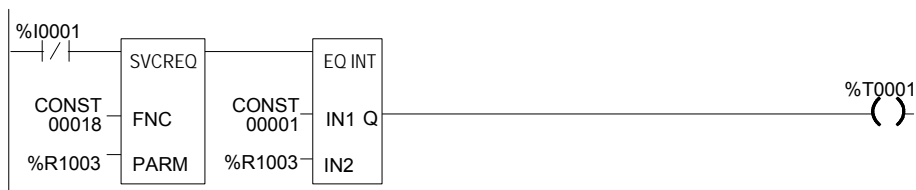
SVCREQ 23: Read Master Checksum

Use SVCREQ 23 to read the master checksums of the application program and the configuration. The SVCREQ output is always ON if the function is enabled.

Output Parameter Block for SVCREQ 23

For this function, the output parameter block has a length of 12 words with this format:

The first two items in the output parameter block indicate when the program and configuration checksums are valid. (Program checksums may not be valid during a Run Mode Store.)

address	Master Program Checksum Valid (0 = not valid, 1 = valid)
address + 1	Master Configuration Checksum Valid (0 = not valid, 1 = valid)
address + 2	Number of Program Blocks (including _MAIN)
address + 3	Size of User Program in Bytes (DWORD data type)
address + 5	Program Additive Checksum
address + 6	Program CRC Checksum (DWORD data type)
address + 8	Size of Configuration Data in Bytes
address + 9	Configuration Additive Checksum
address + 10	Configuration CRC Checksum (DWORD data type)

Example of SVCREQ 23

In the example, when input %I0251 is ON, the master checksum information is placed into the parameter block at %R0050 and the output coil (%Q0001) is turned on.

SVCREQ 26/30: Interrogate I/O

Use SVCREQs 26 and 30 to check whether the installed modules match the software configuration. If not, these SVCREQs place appropriate addition, loss, and mismatch faults in the PLC and/or I/O fault tables. SVCREQs 26 and 30 both perform the same function.

The more configuration faults there are, the longer it takes these SVCREQs longer to execute.

These SVCREQs have no parameter block. They always output power flow.

Example of SVCREQ 26

In the example, when input %I0251 is ON, the SVCREQ checks the installed modules and compares them to the software configuration. Output %Q0001 is turned on after the SVCREQ is complete.

```
%I0251                                                          %Q0001
  | |  ┌─────────┐                                              ( )
  └─┤├─┤ SVCREQ  │
       │         │
 CONST │         │
 00026─┤ FNC     │
       │         │
%R0050─┤ PARM    │
       └─────────┘
```

SVCREQ 29: Read Elapsed Power Down Time

Use SVCREQ 29 to read the amount of time elapsed between the last power-down and the most recent powerup. If the watchdog timer expired before power-down, the PLC is not able to calculate the power down elapsed time, so the time is set to 0.

The SVCREQ output is always ON.

Output Parameter Block for SVCREQ 29

This function has an output parameter block only. The parameter block has a length of 3 words.

address	Power-Down Elapsed Seconds (low order)
address + 1	Power-Down Elapsed Seconds (high order)
address + 2	zero

The first two words are the power-down elapsed time in seconds. The last word is always 0.

Example of SVCREQ 29

In the example, when input %I0251 is ON, the Elapsed Power-Down Time is placed into the parameter block that starts at %R0050. The output coil (%Q0001) is turned on.

```
%I0251                                                    %Q0001
  | |  ┌─────────┐                                          ( )
  └─┤  │ SVCREQ  │                                          
       │         │
 CONST ┤ FNC     │
 00029 │         │
 %R0050┤ PARM    │
       └─────────┘
```
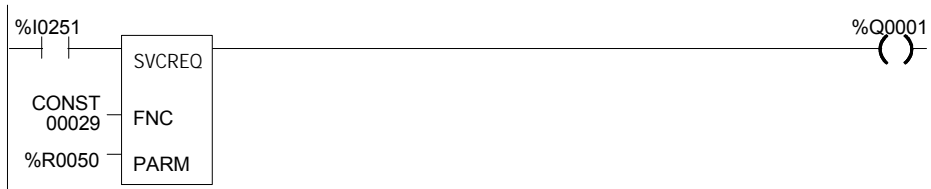
SVCREQ 34: Enter Analog Calibration Mode

The final step of calibrating an analog channel (see the complete process description in chapter 5) consists of storing the calibration values in flash memory. This step requires the use of two SVCREQ functions, SVCREQ 34 and 35.

SVCREQ 34 places the Micro PLC in calibration mode. When SVCREQ 34 is executed, the PLC uses default gain and offset so that you can start the calibration process. No parameter block is needed with SVCREQ 34.

Note: This calibration procedure applies to analog channels on 23 point Micro PLCs only. Software calibration of Analog Expansions and Nano PLCs is not available.

Example of SVCREQ 34

In the following example, when enabling input %I0251 goes ON, the analog calibration defaults are restored and output coil %Q0001 is turned on.

SVCREQ 35: Store Analog Calibration

SVCREQ 35 stores the previously-computed analog calibration in the Micro PLC. The calibration can be stored in either volatile or non-volatile memory.

SVCREQ 35 uses an input parameter block containing the new calibration data and control data. Contents of the parameter block are shown on the next page. When the SVCREQ is successfully completed, the new calibration values take effect.

After the SVCREQ function executes, the PLC returns the function status and the number of tries available to the 2 words of the output parameter block.

Example of SVCREQ 35

In the example, when contact %I0003 is on, the SVCREQ with a parameter block located at %R0127 stores the analog calibration to the memory type specified in the parameter block, and sets coil %Q00234.

```
%I0003                                              %Q0234
  | |        ┌──────────┐                            ( )
             │  SVCREQ  │
  CONST ─────┤ FNC      │
   00035     │          │
  %R0127 ────┤ PARM     │
             └──────────┘
```

Input Parameter Block for SVCREQ 35

The input parameter block for SVCREQ 35 contains the following 32 input words. See the explanations on the next page.

Address	
Address	Password ("CA" 4143H)
address + 1	Password ("LB" 424CH)
address + 2	Destination Control: 0 for RAM, 1 for flash
address + 3	Select Control AI Ch 1 Vol: 0: last, 1: new, 2: default, 3: factory
address + 4	Input Channel 1 %AI0018 High Value, Voltage
address + 5	Input Channel 1 %AI0018 Low Value, Voltage
address + 6	Input Channel 1 Meter High Value, Voltage (mV)
address + 7	Input Channel 1 Meter Low Value, Voltage (mV)
address + 8	Select Control AI Ch 1 Cur: 0: last, 1: new, 2: default, 3: factory
address + 9	Input Channel 1 %AI0018 High Value, Current
address + 10	Input Channel 1 %AI0018 Low Value, Current
address + 11	Input Channel 1 Meter High Value, Current (mA)
address + 12	Input Channel 1 Meter Low Value, Current (mA)
address + 13	Select Control AI Ch 2 Vol: 0: last, 1: new, 2: default, 3: factory
address + 14	Input Channel 2 %AI0019 High Value, Voltage
address + 15	Input Channel 2 %AI0019 Low Value, Voltage
address + 16	Input Channel 2 Meter High Value, Voltage (mV)
address + 17	Input Channel 2 Meter Low Value, Voltage (mV)
address + 18	Select Control AI Ch 2 Cur: 0: last, 1: new, 2: default, 3: factory
address + 19	Input Channel 2 %AI0019 High Value, Current
address + 20	Input Channel 2 %AI0019 Low Value, Current
address + 21	Input Channel 2 Meter High Value, Current (mA)
address + 22	Input Channel 2 Meter Low Value, Current (mA)
address + 23	Select Control AQ Ch 1 Vol: 0: last, 1: new, 2: default, 3: factory
address + 24	Output Channel 1 %AQ0012 High Value, Voltage
address + 25	Output Channel 1 %AQ0012 Low Value, Voltage
address + 26	Output Channel 1 Meter High Value, Voltage (mV)
address + 27	Output Channel 1 Meter Low Value, Voltage (mV)
address + 28	Select Control AQ Ch 1 Cur: 0: last, 1: new, 2: default, 3: factory
address + 29	Output Channel 1 %AQ0012 High Value, Current
address + 30	Output Channel 1 %AQ0012 Low Value, Current
address + 31	Output Channel 1 Meter High Value, Current (mA)
address + 32	Output Channel 1 Meter Low Value, Current (mA)
address + 33	Status
address + 34	Number of tries available

Output Parameter Block for SVCREQ 35

The output parameter block for SVCREQ 35 contains the following 2 output words:

address	Status
address + 1	Number of tries available

Parameter Definitions

Password (address and address +1) must be CALB. If an invalid password is provided, the service request returns error 3 in the status word.

Destination Control (at address +2), determines whether to write the constants in flash or in RAM. You can select the RAM option (0) and calibrate as many times as necessary without burning the calibration constants into the flash memory. When you are satisfied with the calibration, you can select the flash option (1) and finalize the calibration. When the flash option is selected, the calibration data is copied into RAM as well as burned into flash memory. It is important to issue a SVCREQ with the flash option selected in the Destination Control parameter field once the desired calibration state is reached. Otherwise, the new calibration values will be lost when the unit is powered off.

Select Control (address +3) Allows you to calibrate a particular channel in a specific mode. Four choices are allowed for each channel:

0: Last user calibration. The last calibration in flash is used for the channel and for the mode. (If no user calibration exists, the last factory calibration is used.)

1: New. The PLC calculates new gain and offset using the values supplied in the next four words. New calibration value will replace the value in the RAM or flash as determined by the **Destination Control** field.

2: Default. If this option is specified, the default calibration value is used.

3: Factory. If this option is specified, the last factory calibration value is used.

Status (address +33) A status word is returned by the service request:

1=Complete	4=Not in calibration mode
2=Out of tries	5=Calibration values checksum bad
3=Invalid password	6=Invalid calibration data

Number of Tries Available (address +34) Indicates the number of tries remaining.

SVCREQ 52: Read from Flash

This Service Request is available with Release 3.0 and later Micro PLCs..

Service Request 52 reads Reference Variables that were previously written into flash memory using Service Request 53, and stores the variables in CPU reference memory. Each execution of Service Request 52 can read:

- ▪ 1 to 10 words of %R, %AI, or %AQ reference data.
- ▪ 1 to 10 bytes of %I, %Q, %M, %T, or %G reference data.

SVCREQ 52 uses an input parameter block containing the reference memory to be read. After SVCREQ 52 executes, the PLC returns the function status to the two words of the output parameter block.

Example of SVCREQ 52

In this example, when enabling input %M0003 goes on, the Service Request reads the flash memory location specified in the Parameter Block located at %R00040 and places the data into the intended destination. It then sets coil %M0004.

```
%M0003                                                              %M0004
  | |          SVCREQ  ──────────────────────────────────────────( )
               
 CONST  ─┤ FNC
 00052
 %R0040 ─┤ PARM
```

Input Parameter Block for SVCREQ 52

The input parameter block for SVCREQ 52 contains the following 5 input words.

Address	Memory type (number) of the flash memory location of the first byte or word of data to be read. Numbers are:		
	Memory	*Decimal*	*Hex*
	%I (byte)	16	10
	%Q (byte)	18	12
	%T (byte)	20	14
	%M (byte)	22	16
	%G (byte)	56	38
	%R (word)	8	08
	%AI (word)	10	0A
	%AQ (word)	12	0C
address + 1	Offset of the requested data within the memory type in flash memory		
address + 2	Length of data to be read, 1 – 10 bytes or words.		
address + 3	Memory type of the PLC reference memory type where the requested data should be placed. See the numbers above.		
address + 4	Offset to place the requested data within the requested memory type in PLC reference memory.		
address + 5	Memory type of the PLC reference memory type for the completion status. See the numbers above. For example, %R1 = memory type 8.		
address + 6	Offset in PLC Memory to write completion status (zero based). For example, %R1 = offset 0.		

Status Data for SVCREQ 52

SVCREQ 52 returns one of the following status indications:

Word 0			
Hex	**Dec**	**Status**	**Definition**
0x0001	1	Full Success	All requested data was successfully read
0x0101	257	Partial Success	Less than requested data length was read. Can occur if all data requested was not present in flash.
0x0102	258	Insufficient Dest Mem	Can occur if the PLC reference memory location specified is not sufficient to store all the data read from flash
0x0202	514	Invalid Length	Length is beyond minimum 1 and maximum 10
0x0302	770	Source/Dest Mem Wrong	Wrong source or destination reference memory specified in the SVCREQ.
Word 1			
Number of bytes read			

SVCREQ 53: Write to Flash

This Service Request is available with Release 3.0 and later Micro PLCs.

Service Request 53 stores requested PLC reference data in flash memory. Each execution of Service Request 53 can write:

- 1 to 10 words of %R, %AI, or %AQ reference data.

- 1 to 10 bytes of %I, %Q, %M, %T, or %G reference data.

SVCREQ 53 uses an input parameter block containing the reference memory requested to be written. After SVCREQ 53 executes, the PLC returns the function status and the amount of user flash memory still available to the output parameter block.

Example of SVCREQ 53

In the example, when enabling input %M0003 goes on, the Service Request reads the PLC memory location specified in the Parameter Block located at %R00040 and writes the data to flash. It then sets coil %M0004.

Input Parameter Block for SVCREQ 53

The input parameter block for SVCREQ 53 contains the following 5 input words.

Address	Memory type (number) of the PLC memory location of the first byte or word of data to be written. Numbers are:		
	Memory	*Decimal*	*Hex*
	%I (byte)	16	10
	%Q (byte)	18	12
	%T (byte)	20	14
	%M (byte)	22	16
	%G (byte)	56	38
	%R (word)	8	08
	%AI (word)	10	0A
	%AQ (word)	12	0C
address + 1	Offset of the requested data within the memory type in PLC memory		
address + 2	Length of data to be read, 1 – 10 bytes or words.		
address + 3	Memory type of the PLC reference memory type for the completion status. See the numbers above. For example, %R1 = memory type 8.		
address + 4	Offset in PLC Memory to write completion status (zero based). For example, %R1 = offset 0.		

Status Data for SVCREQ 53

SVCREQ 53 returns one of the following status indications:

Word 1			
Hex	*Dec*	*Status*	*Definition*
0x0001	1	Full Success	All requested data was successfully written
0x0101	257	Partial Success	Less than requested data length was written. Can occur if some requested data is already in flash.
0x0102	258	Insufficient Destination Memory	Flash memory area full, connect with the programmer and write all data to flash in order to erase and store latest values.
0x0202	514	Invalid Length	Length is beyond minimum 1 and maximum 10
0x0302	770	Source/Dest Mem Wrong	Wrong source or destination reference memory specified in the SVCREQ.
Word 2			
Number of bytes written			
Word 3			
Number of bytes remaining in flash			

Serial I/O / SNP / RTU Protocols

This chapter describes the VersaMax Micro PLC's Serial I/O feature, which can be used to control the read/write activities of one of the Micro PLC ports directly from the application program.

This chapter also contains instructions for using COMMREQs to configure the CPU serial ports for SNP, RTU, or Serial I/O protocol.

- Format of the COMMREQ Function
- Configuring Serial Ports Using the COMMREQ Function
    - RTU Slave/SNP Slave Operation with a Programmer Attached
    - COMMREQ Command Block for Configuring SNP Protocol
    - COMMREQ Command Block for Configuring RTU Protocol
    - COMMREQ Command Block for Configuring Serial I/O
- Serial I/O COMMREQ Commands
    - Initialize Port
    - Set Up Input Buffer
    - Flush Input Buffer
    - Read Port Status
    - Write Port Control
    - Cancel Operation
    - Autodial
    - Write Bytes
    - Read Bytes
    - Read String

Details of RTU and SNP protocol are described in the *Serial Communications User's Manual* (GFK-0582). For additional information about Modbus Master communications, please refer to the document *Modbus RTU Master Communications* (GFK-2220).

At higher sweep times, serial communication throughput is less and response times are larger. As a result of this, a communication request takes longer to complete.

Format of the Communication Request Function

Serial I/O is implemented through the use of Communication Request (COMMREQ) functions. The operations of the protocol, such as transmitting a character through the serial port or waiting for an input character, are implemented through the COMMREQ function block.

The COMMREQ requires that all its command data be placed in the correct order (in a command block) in PLC memory before it is executed. The COMMREQ should then be executed by a contact of a one-shot coil to prevent sending the data multiple times. A series of Block Move (BLKMV) commands should be used to move the words to create a command block in the Register tables.

The COMMREQ function has three inputs and one output. When the function receives power flow, a command block of data is sent to the specified module.

```
                          ┌─────────┐
           Enable ─────── │  COMM_  │
                          │  REQ    │
First word of command block ─── │ IN   FT │───
                          │         │
         Location ─────── │ SYSID   │
                          │         │
   Task identifier ────── │ TASK    │
                          └─────────┘
```

Parameters of the COMMREQ Function

Input/ Output	Choices	Description
enable	flow	When the function is energized, the communications request is performed.
IN	R, AI, AQ	IN contains the first word of the command block.
SYSID	I, Q, M, T, G, R, AI, AQ, constant	SYSID contains the rack number (most significant byte) and slot number (least significant byte) of the target device. For the CPU, SYSID must specify rack/slot 0.

TASK	R AI, AQ, constant	TASK specifies the port for which the operation is intended:
		    task 19 for port 1
		    task 20 for port 2

FT	flow, none	FT is energized if an error is detected processing the COMMREQ: • The specified target address is not present (SYSID). • The specified task is not valid for the device (TASK). • The data length is 0. • The device's status pointer address (in the command block) does not exist. (applies only to HSC COMMREQs)

Command Block for the COMMREQ Function

The Command Block starts at the reference specified in COMMREQ parameter IN. The length of the Command Block depends on the amount of data sent to the device.

The Command Block contains the data to be communicated to the other device, plus information related to the execution of the COMMREQ. The Command Block has the following structure:

address	Length (in words)
address + 1	Wait/No Wait Flag
address + 2	Status Pointer Memory
address + 3	Status Pointer Offset
address + 4	Idle Timeout Value
address + 5	Maximum Communication Time
address + 6 to address + 133	Data Block

Example of the COMMREQ Function

In the example, when %M0021 is ON, a Command Block located starting at %R0032 is sent to port 2 (communications task 20) of the CPU (rack 0, slot 0). If an error occurs processing the COMMREQ, %Q0110 is set.

```
        %M0021
         | |         COMM
        ─┤ ├─        REQ                              %Q0110
    %R0032─  IN    FT ──────────────────────────────────( )──

     CONST ─
      0000          SYSID

     CONST
     00020          TASK
```

Configuring Serial Ports Using the COMMREQ Function

The following tables list the command block values required for setting up a Serial Port for SNP, RTU, and Serial I/O. All values are in hexadecimal unless otherwise indicated. The BLKMV commands that are used to create the command block are described in the example.

Timing

If a port configuration COMMREQ is sent to a serial port that currently has an SNP/SNPX master (for example, the programmer) connected to it, the serial port configuration specified by the COMMREQ does not take effect until the Micro PLC detects a loss of the SNP/SNPX master. This occurs the configured T3' time after the master disconnects. The COMMREQ status word for the port configuration COMMREQ is updated as soon as the CPU verifies that the specified configuration is valid. That means a COMMREQ Successful value may be returned by the Port Configuration COMMREQ before the specified configuration is actually installed.

Sending Another COMMREQ to the Same Port

The application program must wait at least 2 seconds after a new serial port protocol is installed before sending any COMMREQs specific to that protocol to the port. This applies to a new protocol installed by Storing a new hardware configuration or by a port configuration COMMREQ. If the port is configured for Serial I/O, this waiting period must also follow any Stop to Run mode transition of the Micro PLC.

Invalid Port Configurations

COMMREQs to configure protocols for the port(s) of the Micro PLC are limited to the supported protocols for the given port. Any COMMREQs that request invalid port configurations will be rejected.

Note: For all Nano and Micro PLC CPUs, care must be taken setting timeouts and message lengths when operating at 4800 bps or lower. Messages at this rate are longer in duration, and may cause various timeouts within a system. This can become worse on the Micro-64 CPU because the scan times on this unit are typically slightly longer.

RTU Slave/SNP Slave Operation with Programmer Attached

A programmer (an SNP/SNPX master device) can be attached to port 1 or port 2 while RTU Slave mode is active on the port. For multi-drop connections, the Micro PLC must have been configured to use an appropriate PLC ID. Note that for a multi-drop SNP connection with the port currently configured for RTU Slave, the SNP ID associated with the Micro PLC settings must match the multi-drop ID.

The programmer must use the same serial communications parameters (baud rate, parity, stop bits, etc) as the currently-active RTU Slave protocol for it to be recognized.

When the Micro PLC recognizes the programmer, the Micro PLC removes the RTU Slave protocol from the port and installs SNP Slave as the currently-active protocol. The SNP ID, modem turnaround time, and default idle time for this new SNP Slave session are obtained from the configured Micro PLC settings, not the port 1 or port 2 configurations. Connection should be established within 12 seconds. When the programmer connection has been enabled, normal programmer communications can take place. (Failure of the programmer to establish communications within 12-seconds is treated as a Loss of Programmer Communications).

The programmer may send a new protocol via configuration or a Serial Port Setup COMMREQ. (COMMREQs not supported by SNP Slave protocol are rejected). If a new protocol is received, it will not take effect until the programmer is disconnected.

After the programmer is removed, there is a slight delay (equal to the configured SNP T3' timeout) before the Micro PLC recognizes its absence. During this time, no messages are processed on the port. The Micro PLC detects removal of the programmer as an SNP Slave protocol timeout. Therefore, it is important to be careful when disabling timeouts used by the SNP Slave protocol.

When the Micro PLC recognizes the disconnect, it reinstalls the RTU Slave protocol, unless a new protocol has been received. In that case, the Micro PLC installs the new protocol instead.

Note: If an RTU slave receives a message with length greater than 265 bytes it responds with an error code 0x03 indicating "Invalid Data Field"

Example

1. Port 1 is running RTU Slave protocol at 9600 baud.
2. A programmer is attached to port 1. The programmer is using 9600 baud.
3. The Micro PLC installs SNP Slave on port 1 and the programmer communicates normally.
4. The programmer stores a new configuration to port 1. The new configuration sets the port for SNP Slave at 4800 baud (it will not take effect until the port loses communications with the programmer).
5. When the Micro PLC loses communications with the programmer, the new configuration takes effect.

COMMREQ Command Block for Configuring SNP Protocol

	Values	*Meaning*
Address	10H	Data Block Length
Address + 1	0 = No Wait	WAIT/NOWAIT Flag
Address + 2	0008 = %R, register memory	Status Word Pointer Memory Type
Address + 3	Zero-based number that gives the address of the COMMREQ status word (for example, a value of 99 gives an address of 100 for the status word)	Status Word Pointer Offset
Address + 4	0 (Only used in Wait/No Wait mode)	Idle Timeout Value
Address + 5	0 (Only used in Wait/No Wait mode)	Maximum Communication Time
Address + 6	FFF0H	Command Word (serial port setup)
Address + 7	0001	Protocol: 1=SNP
Address + 8	0000=Slave, 0001=Master	Port Mode
Address + 9	10=175000, 7=38400, 6=19200, 5=9600, 4=4800, 3=2400, 2=1200, 1=600, 0=300	Data Rate (bps)
Address + 10	0 = None, 1 = Odd, 2 = Even	Parity
Address + 11	1 = None	Flow Control
Address + 12	0 = None, 1 = 10ms, 2 = 100ms, 3 = 500ms	Turnaround Delay
Address + 13	0 = Long, 1 = Medium, 2 = Short, 3 = None	Timeout
Address + 14	1 = 8 bits	Bits Per Character
Address + 15	0 = 1 Stop Bit, 1 = 2 Stop bits	Stop Bits
Address + 16	not used	Interface
Address + 17	not used	Duplex Mode
Address + 18	user-provided*	Device identifier bytes 1 and 2
Address + 19	user-provided*	Device identifier bytes 3 and 4
Address + 20	user-provided*	Device identifier bytes 5 and 6
Address + 21	user-provided*	Device identifier bytes 7 and 8

*   The device identifier for SNP Slave ports is packed into words with the least significant character in the least significant byte of the word. For example, if the first two characters are "A" and "B," the Address + 18 will contain the hex value 4241.

COMMREQ Command Block for Configuring RTU Protocol

	Values	*Meaning*
First 6 words		Reserved for COMMREQ use.
Address + 6	FFF0H	Command
Address + 7	3	Protocol: 0003=RTU
Address + 8	0	Port Mode: 0000=Slave
Address + 9	10=175000, 7=38400, 6=19200, 5=9600, 4=4800, 3=2400, 2=1200, 1=600, 0=300	Data Rate
Address + 10	0 = None, 1 = Odd, 2 = Even	Parity
Address + 11	0 = Hardware, 1 = None	Flow Control
Address + 12	0-255 (units of 10ms. For example, 10-100ms)	Turnaround delay. For release 2.02 and later CPUs only. 0 for all other CPUs.
Address + 13	not used	Timeout
Address + 14	not used	Bits per Character
Address + 15	0 = 1, 1 = 2	Stop Bits
Address + 16	not used	Interface
Address + 17	0 = 2-wire, 1 = 4-wire	Duplex Mode
Address + 18	Station Address (1-247)	Device Identifier
Address + 19 - 21	not used	Device Identifier
Address+22*	0 –255 (units of 10ms)	Receive to Transmit Delay
Address + 23*	0-255 (units of 10mS)	RTS Drop Delay

Receive to Transmit Delay and RTS Drop Delay

Release 2.02 and later Micro PLC CPUs support Receive to Transmit Delay and RTS Drop Delay functionality for RTU and Serial IO through the Serial Port Setup COMMREQ.

When configuring the protocol, these two optional parameters can be added to the port setup COMMREQ. The data block length (Address + 0) for a COMMREQ that includes the Receive to Transmit Delay and RTS Drop Delay parameters should be 12H, not 10H. Either length (10H or 12H) is valid for this COMMREQ.

Receive to transmit delay - This is the time interval that defines the end of each received response message. It is measured from the end of the last received character. RTS is off and the transmitter is silent during this interval. If a new query is ready for transmission, RTS is asserted no earlier than the end of this interval.

Zero specifies the default, defined as 3.5 character times at the specified data rate, assuming 11 bits per character.

Data Rate	Default (10 ms Units)	Data Rate	Default (10 ms Units)
1200	322	19200	21
2400	161	38400	10
4800	80	57600	7
9600	40	115200	3

If the required delay is greater than the default value at the current data rate, increase the specified value to required delay in 10-millisecond units. If the required delay is less than the default at the current data rate, no additional delay is necessary.

RTS Drop Delay -This is the time from the end of the last transmitted character to the time when RTS is turned off (dropped). The RTS Drop Delay is also specified in 10 millisecond units. The receiver is disabled during transmission and remains disabled during the RTS drop delay time.

Data Rate	Default (10 ms Units)	Data Rate	Default (10 ms Units)
1200	92	19200	6
2400	46	38400	3
4800	23	57600	2
9600	12	115200	1

COMMREQ Command Block for Configuring Serial I/O Protocol

	Values	*Meaning*
First 6 words		Reserved for COMMREQ use.
Address + 6	FFF0H	Command
Address + 7	0005	Protocol: 0005=Serial IO
Address + 8	0 = Slave	Port Mode
Address + 9	10=175000, 7=38400, 6=19200, 5=9600, 4=4800, 3=2400, 2=1200, 1=600, 0=300	Data Rate (bps)
Address + 10	0 = None, 1 = Odd, 2 = Even	Parity
Address + 11	0 = Hardware, 1 = None	Flow Control
Address + 12	0-255 (units of 10ms). For example, 10 = 100ms).	Turnaround Delay. For release 2.02 and later CPUs only. 0 for all other CPUs.
Address + 13	0 = Long	Timeout
Address + 14	0=7 bits, 1=8 bits	Bits per Character
Address + 15	0 = 1 stop bit, 1 = 2 stop bits	Stop Bits
Address + 16	must be set to 0	Interface
Address + 17	0 = 2-wire, 1 = 4-wire	Duplex Mode
Address + 18—21	not used	Device Identifier
Address + 22*	0-255 (units of 10ms)	Receive to transmit delay / RTS Drop Delay

Release 2.02 and later Micro PLC CPUs support Receive to Transmit Delay and RTS Drop Delay functionality for RTU and Serial IO through the Serial Port Setup COMMREQ. Both of these optional parameters are described on the preceding page.

When configuring the protocol, these two optional parameters can be added to the port setup COMMREQ. The data block length (Address + 0) for a COMMREQ that includes the Receive to Transmit Delay and RTS Drop Delay parameters should be 12H, not 10H. Either length (10H or 12H) is valid for this COMMREQ.

Calling Serial I/O COMMREQs from the PLC Sweep

Implementing a serial protocol using Serial I/O COMMREQs may be restricted by the Micro PLC sweep time. For example, if the protocol requires that a reply to a certain message from the remote device be initiated within 5mS of receiving the message, this method may not be successful if the sweep time is 5mS or longer, since timely response is not guaranteed.

When using Serial I/O protocol with a VersaMax Nano or 14 point Micro PLC, the user switch must be configured. A Nano PLC requires an external switch connection. When a Nano PLC or 14-Point Micro PLC is in Run mode, Serial I/O protocol is active; after a Run-to-Stop transition, the Nano PLC or 14-Point Micro PLC automatically reverts to SNP. An SNP master device (VersaPro, for instance) is not able to communicate with a Nano PLC or 14-Point Micro PLC that is configured for Serial I/O when it is in Run mode.

Since the Serial I/O is completely driven by the application program, in STOP mode a port configured as Serial I/O automatically reverts to SNP slave, to facilitate programmer communication. Therefore, while in Stop mode, Serial I/O protocol is not active; it is only active when the PLC is in Run mode.

Compatibility

The COMMREQ function blocks supported by Serial I/O are not supported by other currently-existing protocols (such as SNP slave, SNP master, and RTU slave). Errors are returned if they are attempted for a port configured for one of those protocols.

Status Word for Serial I/O COMMREQs

A value of 1 is returned in the COMMREQ status word upon successful completion of the COMMREQ. Any other value returned is an error code where the low byte is a major error code and the high byte is a minor error code.

Major Error Code		Description
1 (01h)		Successful Completion (the expected completion value in the COMMREQ status word).
12 (0Ch)		Local error —Error processing local command. Minor error code identifies the specific error.
	1 (01h)	Wait-type command is not permitted. Use No-Wait command.
	2 (02h)	COMMREQ command is not supported.
	5 (05h)	Error writing COMMREQ status word to PLC memory.
	6 (06h)	Invalid PLC memory type specified.
	7 (07h)	Invalid PLC memory offset specified.
	8 (08h)	Unable to access PLC memory.
	12 (0Ch)	COMMREQ data block length too small.
	14 (0Eh)	COMMREQ data is invalid.
13 (0Dh)		Remote error — Error processing a remote command. Minor error code identifies the error.
	2 (02h)	Number of bytes to read exceeds input buffer size, or more than 250 bytes requested to be written.
	3 (03h)	COMMREQ data block length is too small. String data is missing or incomplete.
	4 (04h)	Receive timeout awaiting serial reception of data
	8 (08h)	Unable to access PLC memory.
	12 (0Ch)	COMMREQ data block length too small.
	48 (30h)	Serial output timeout. The port was unable to transmit the string. (Could be missing CTS signal when the serial port is configured to use hardware flow control.)
	50 (32h)	COMMREQ timeout. The COMMREQ did not complete within 20-second time limit.
14 (0Eh)		Autodial Error — An error occurred while attempting to send a command string to an attached external modem. The minor error code identifies the specific error.
	2 (02h)	The modem command string length exceeds end of reference memory type.
	3 (03h)	COMMREQ Data Block Length too small. Output command string data missing or incomplete.
	4 (04h)	Serial output timeout. The port was unable to transmit the modem autodial output.
	5 (05h)	Response was not received from modem. Check modem and cable.
	6 (06h)	Modem responded with BUSY. Modem is unable to complete the requested connection. The remote modem is already in use; retry the connection request later.
	7 (07h)	Modem responded with NO CARRIER. Modem is unable to complete the requested connection. Check the local and remote modems and the telephone line.
	8 (08h)	Modem responded with NO DIALTONE. Modem is unable to complete the requested connection. Check the modem connections and the telephone line.
	9 (09h)	Modem responded with ERROR. Modem is unable to complete the requested command. Check the modem command string and modem.
	10 (0Ah)	Modem responded with RING; the modem is being called by another modem. Modem is unable to complete the requested command. Retry the command later.
	11 (0Bh)	Unknown response from modem. Modem unable to complete the command. Check modem command string and modem. Response should be CONNECT or OK.
	50 (32h)	COMMREQ timeout. The COMMREQ did not complete within 20 seconds.

Serial I/O COMMREQ Commands

The following COMMREQs are used to implement Serial I/O:

- Local COMMREQs - do not receive or transmit data through the serial port.
    - Initialize Port (4300)
    - Set Up Input Buffer (4301)
    - Flush Input Buffer (4302)
    - Read Port Status (4303)
    - Write Port Control (4304)
    - Cancel Operation (4399)
- Remote COMMREQs - receive and/or transmit data through the serial port.
    - Autodial (4400)
    - Write bytes (4401)
    - Read bytes (4402)
    - Read String (4403)

Overlapping COMMREQs

Some of the Serial I/O COMMREQs must complete execution before another COMMREQ can be processed. Others can be left pending while others are executed.

COMMREQS that Must Complete Execution

- Autodial (4400)
- Initialize Port (4300)
- Set Up Input Buffer (4301)
- Flush Input buffer (4302)
- Read port status (4303)
- Write port control (4304)
- Cancel Operation (4399)
- Serial Port Setup (FFF0)

COMMREQs that Can be Pending While Others Execute

The table below shows whether Write Bytes, Read Bytes and Read String COMMREQs can be pending when other COMMREQs are executed.

	New COMMREQ										
Currently-pending COMMREQs	Autodial (4400)	Write Bytes (4401)	Initialize Port (4300)	Set Up Input Buffer (4301)	Flush Input Buffer (4302)	Read Port Status (4303)	Write Port Control (4304	Read Bytes (4402)	Read String (4403)	Cancel Operation (4399)	Serial Port Setup (FFF0)
Write Bytes (4401)	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Read Bytes (4402)	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	No
Read String (4403)	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	No

Initialize Port Function (4300)

This function causes a reset command to be sent to the specified port. It also cancels any COMMREQ currently in progress and flushes the internal input buffer. RTS is set to inactive.

Example Command Block for the Initialize Port Function

	Value (decimal)	Value (hexadecimal)	Meaning
address	0001	0001	Data block length
address +1	0000	0000	NOWAIT mode
address +2	0008	0008	Status word memory type (%R)
address +3	0000	0000	Status word address minus 1 (%R0001)
address +4	0000	0000	Not used
address +5	0000	0000	Not used
address +6	4300	10CC	Initialize port command

Operating Notes

Note: COMMREQs that are cancelled due to this command executing do not have their respective COMMREQ status words updated.

Caution: If this COMMREQ is sent when a Write Bytes (4401) COMMREQ is transmitting a string from a serial port, transmission is halted. The position within the string where the transmission is halted is indeterminate. In addition, the final character received by the device the Micro PLC is sending to is also indeterminate.

Set Up Input Buffer Function (4301)

This function can be used to change the size of the internal memory buffer where input data will be placed as it is received. By default, the buffer is set to a maximum of 2K *bytes*. As data is received from the serial port it is placed in the input buffer. If the buffer becomes full, any additional data received from the serial port is discarded and the Overflow Error bit in the Port Status word (See Read Port Status Function) is set.

Retrieving Data from the Buffer

Data can be retrieved from the buffer using the Read String or Read Bytes function. It is not directly accessible from the application program.

If data is not retrieved from the buffer in a timely fashion, some characters may be lost.

Example Command Block for the Set Up Input Buffer Function

	Value (decimal)	*Value (hexadecimal)*	*Meaning*
address	0002	0002	Data block length
address +1	0000	0000	NOWAIT mode
address +2	0008	0008	Status word memory type (%R)
address +3	0000	0000	Status word address minus 1 (%R0001)
address +4	0000	0000	Not used
address +5	0000	0000	Not used
address +6	4301	10CD	Setup input buffer command
address +7	0064	0040	Buffer length (in words)

Operating Notes

It is not possible to set the buffer length to zero. If zero is entered as the buffer length, the buffer size will be set to the 2K bytes default.

If a length greater than 2K bytes is specified, an error is generated.

Flush Input Buffer Function (4302)

This operation empties the input buffer of any characters received through the serial port but not yet retrieved using a read command. All such characters are lost.

Example Command Block for the Flush Input Buffer Function

	Value (decimal)	Value (hexadecimal)	Meaning
address	0001	0001	Data block length
address +1	0000	0000	NOWAIT mode
address +2	0008	0008	Status word memory type (%R)
address +3	0000	0000	Status word address minus 1 (%R0001)
address +4	0000	0000	Not used
address +5	0000	0000	Not used
address +6	4302	10CE	Flush input buffer command

Read Port Status Function (4303)

This function returns the current status of the port. The following events can be detected:

1. A read request was initiated previously and the required number of characters has now been received or the specified time-out has elapsed.

2. A write request was initiated previously and transmission of the specified number of characters is complete or a time-out has elapsed.

The status returned by the function indicates the event or events that have completed. More than one condition can occur simultaneously, if both a read and a write were initiated previously.

Example Command Block for the Read Port Status Function

	Value (decimal)	Value (hexadecimal)	Meaning
address	0003	0003	Data block length
address +1	0000	0000	NOWAIT mode
address +2	0008	0008	Status word memory type (%R)
address +3	0000	0000	Status word address minus 1 (%R0001)
address +4	0000	0000	Not used
address +5	0000	0000	Not used
address +6	4303	10CF	Read port status command
address +7	0070	0046	Port status memory type (%I)
address +8	0001	0001	Port status memory offset (%I0001)

Port Status

The port status consists of a status word and the number of characters in the input buffer that have not been retrieved by the application (characters which have been received and are available).

word 1	Port status word (see below)
word 2	Characters available in the input buffer

The Port Status Word can be:

Bit	*Name*	*Definition*	*Meaning*	
15	RI	Read In progress	Set	Read Bytes or Read String invoked
			Cleared	Previous Read bytes or String has timed out, been canceled, or finished
14	RS	Read Success	Set	Read Bytes or Read String has successfully completed
			Cleared	New Read Bytes or Read String invoked
13	RT	Read Time-out	Set	Receive timeout occurred during Read Bytes or Read String
			Cleared	New Read Bytes or Read String invoked
12	WI	Write In progress	Set	New Write Bytes invoked
			Cleared	Previously-invoked Write Bytes has timed out, been canceled, or finished
11	WS	Write Success	Set	Previously-invoked Write Bytes has successfully completed
			Cleared	New Write Bytes invoked
10	WT	Write Time-out	Set	Transmit timeout during Write Bytes
			Cleared	New Write Bytes invoked
9	CA	Character Available	Set	Unread characters are in the buffer
			Cleared	No unread characters in the buffer
8	OF	OverFlow error	Set	Overflow error occurred on the serial port or internal buffer
			Cleared	Read Port Status invoked
7	FE	Framing Error	Set	Framing error occurred on the serial port
			Cleared	Read Port Status invoked
6	PE	Parity Error	Set	Parity error occurred on the serial port
			Cleared	Read Port Status invoked
5	CT	CTS is active	Set	CTS line on the serial port is active or the serial port does not have a CTS line
			Cleared	CTS line on the serial port is not active
4 - 0	U	not used, should be 0		

Write Port Control Function (4304)

This function forces RTS for the specified port:

Example Command Block for the Write Port Control Function

	Value (decimal)	*Value (hexadecimal)*	*Meaning*
address	0002	0002	Data block length
address +1	0000	0000	NOWAIT mode
address +2	0008	0008	Status word memory type (%R)
address +3	0000	0000	Status word address minus 1 (%R0001)
address +4	0000	0000	Not used
address +5	0000	0000	Not used
address +6	4304	10D0	Write port control command
address +7	xxxx	xxxx	Port control word

Port Control Word

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RTS	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U

The Port Control Word can be:

15	**RTS**	Commanded state of the **RTS** output
		1 = Activates RTS
		0 = Deactivates RTS
0-14	**U**	**U**nused (should be zero)

Operating Note

For Micro PLC port 2 (RS-485), the RTS signal is also controlled by the transmit driver. Therefore, control of RTS is dependent on the current state of the transmit driver. If the transmit driver is not enabled, asserting RTS with the Write Port Control COMMREQ will not cause RTS to be asserted on the serial line. The state of the transmit driver is controlled by the protocol and is dependent on the current Duplex Mode of the port. For 2-wire and 4-wire Duplex Mode, the transmit driver is only enabled during transmitting. Therefore, RTS on the serial line will only be seen active on port 2 (configured for 2-wire or 4-wire Duplex Mode) when data is being transmitted. For point-to-point Duplex Mode, the transmit driver is always enabled. Therefore, in point-to-point Duplex Mode, RTS on the serial line will always reflect what is chosen with the Write Port Control COMMREQ.

Cancel Commreq Function (4399)

This function cancels the current operations in progress. It can be used to cancel both read operations and write operations. If a read operation is in progress and there are unprocessed characters in the input buffer, those characters are left in the input buffer and available for future reads. The serial port is not reset.

Example Command Block for the Cancel Operation Function

	Value (decimal)	*Value (hexadecimal)*	*Meaning*
address	0002	0002	Data block length
address +1	0000	0000	NOWAIT mode
address +2	0008	0008	Status word memory type (%R)
address +3	0000	0000	Status word address minus 1 (%R0001)
address +4	0000	0000	Not used
address +5	0000	0000	Not used
address +6	4399	112F	Cancel operation command
address +7	0001	0001	Transaction type to cancel 1 All operations 2 Read operations 3 Write operations

Operating Notes

This function does not update the status of words of the cancelled COMMREQs.

Caution: If this COMMREQ is sent in either Cancel All or Cancel Write mode when a Write Bytes (4401) COMMREQ is transmitting a string from a serial port, transmission is halted. The position within the string where the transmission is halted is indeterminate. In addition, the final character received by the device the Micro PLC is sending to is also indeterminate.

Autodial Function (4400)

This feature allows the VersaMax Micro PLC to automatically dial a modem and send a specified byte string.

To implement this feature, the port must be configured for Serial I/O.

For example, pager enunciation can be implemented by three commands, requiring three COMMREQ command blocks:

- **Autodial**: 04400 (1130h)   Dials the modem.

- **Write Bytes**: 04401 (1131h) Specifies an ASCII string, from 1 to 250 bytes in length, to send from the serial port.

- **Autodial**: 04400 (1130h)   It is the responsibility of the Micro PLC application program to hang up the phone connection. This is accomplished by reissuing the autodial command and sending the hang up command string.

Autodial Command Block

The Autodial command automatically transmits an Escape sequence that follows the Hayes convention. If you are using a modem that does not support the Hayes convention, you may be able to use the Write Bytes command to dial the modem.

Examples of commonly used command strings for Hayes-compatible modems are listed below:

Command String	Length	Function
ATDP15035559999<CR>	16 (10h)	Pulse dial the number 1-503-555-9999
ATDT15035559999<CR>	16 (10h)	Tone dial the number 1-503-555-9999
ATDT9,15035559999<CR>	18 (12h)	Tone dial using outside line with pause
ATH0<CR>	5 (05h)	Hang up the phone
ATZ <CR>	4 (04h)	Restore modem configuration to internally saved values

Example Autodial Command Block

This example COMMREQ command block dials the number 234-5678 using a Hayes-compatible modem.

Word	Definition	Values
1	0009h	CUSTOM data block length (includes command string)
2	0000h	NOWAIT mode
3	0008h	Status word memory type (%R)
4	0000h	Status word address minus 1 (Register 1)
5	0000h	not used
6	0000h	not used
7	04400 (1130h)	Autodial command number
8	00030 (001Eh)	Modem response timeout (30 seconds)
9	0012 (000Ch)	Number of bytes in command string
10	5441h	A (41h), T (54h)
11	5444h	D (44h), T (54h)
12	3332h	Phone number: 2 (32h), 3 (33h)
13	3534h	4 (34h), 5 (35h)
14	3736h	6 (36h), 7 (37h)
15	0D38h	8 (38h) <CR> (0Dh)

Write Bytes Function (4401)

This operation can be used to transmit one or more characters to the remote device through the specified serial port. The character(s) to be transmitted must be in a word reference memory. They should not be changed until the operation is complete.

Up to 250 characters can be transmitted with a single invocation of this operation. The status of the operation is not complete until all of the characters have been transmitted or until a timeout occurs (for example, if hardware flow control is being used and the remote device never enables the transmission).

Example Command Block for the Write Bytes Function

	Value (decimal)	*Value (hexadecimal)*	*Meaning*
address	0006	0006	Data block length (includes characters to send)
address +1	0000	0000	NOWAIT mode
address +2	0008	0008	Status word memory type (%R)
address +3	0000	0000	Status word address minus 1 (%R0001)
address +4	0000	0000	Not used
address +5	0000	0000	Not used
address +6	4401	1131	Write bytes command
address +7	0030	001E	Transmit time-out (30 seconds). See note below.
address +8	0005	0005	Number of bytes to write
address +9	25960	6568	'h' (68h), 'e' (65h)
address +10	27756	6C6C	'l' (6Ch), 'l' (6Ch)
address +11	0111	006F	'o' (6Fh)

Although printable ASCII characters are used in this example, there is no restriction on the values of the characters that can be transmitted.

Operating Notes

Note: Specifying zero as the Transmit time-out sets the time-out value to the amount of time actually needed to transmit the data, plus 4 seconds.

Caution: If an Initialize Port (4300) COMMEQ is sent or a Cancel Operation (4399) COMMREQ is sent in either Cancel All or Cancel Write mode while this COMMREQ is transmitting a string from a serial port, transmission is halted. The position within the string where the transmission has halted is indeterminate. In addition, the final character received by the device the Micro PLC is sending to is also indeterminate.

Read Bytes Function (4402)

This function causes one or more characters to be read from the specified port. The characters are read from the internal input buffer and placed in the specified input data area.

The function returns both the number of characters retrieved and the number of unprocessed characters still in the input buffer. If zero characters of input are requested, only the number of unprocessed characters in the input buffer is returned.

If insufficient characters are available to satisfy the request and a non-zero value is specified for the number of characters to read, the status of the operation is not complete until either sufficient characters have been received or the time-out interval expires. In either of those conditions, the port status indicates the reason for completion of the read operation. The status word is not updated until the read operation is complete (either due to timeout or when all the data has been received).

If the time-out interval is set to zero, the COMMREQ remains pending until it has received the requested amount of data, or until it is cancelled.

If this COMMREQ fails for any reason, no data is returned to the buffer. Any data that was already in the buffer remains, and can be retrieved with a subsequent read request.

Example Command Block for the Read Bytes Function

	Value (decimal)	*Value (hexadecimal)*	*Meaning*
address	0005	0005	Data block length
address +1	0000	0000	NOWAIT mode
address +2	0008	0008	Status word memory type (%R)
address +3	0000	0000	Status word address minus 1 (%R0001)
address +4	0000	0000	Not used
address +5	0000	0000	Not used
address +6	4402	1132	Read bytes command
address +7	0030	001E	Read time-out (30 seconds)
address +8	0005	0005	Number of bytes to read
address +9	0008	0008	Input data memory type (%R).
address +10	0001	0001	Input data memory address (%R0001)

Return Data Format for the Read Bytes Function

The return data consists of the number of characters actually read, the number of characters still available in the input buffer after the read is complete (if any), and the actual input characters.

Address	Number of characters actually read
Address + 1	Number of characters still available in the input buffer, if any
Address + 2	first two characters (first character is in the low byte)
Address + 3	third and fourth characters (third character is in the low byte)
Address + n	subsequent characters

Operating Note

If the input data memory type parameter is specified to be a word memory type and an odd number of bytes are actually received, then the high byte of the last word to be written with the received data is set to zero.

As data is received from the serial port it is placed in the internal input buffer. If the buffer becomes full, then any additional data received from the serial port is discarded and the Overflow Error bit in the Port Status word (See Read Port Status Function) is set.

Read String Function (4403)

This function causes characters to be read from the specified port until a specified terminating character is received. The characters are read from the internal input buffer and placed in the specified input data area.

The function returns both the number of characters retrieved and the number of unprocessed characters still in the input buffer. If zero characters of input are requested, only the number of unprocessed characters in the input buffer are returned.

If the terminating character is not in the input buffer, the status of the operation is not complete until either the terminating character has been received or the time-out interval expires. In either of those conditions, the port status indicates the reason for completion of the read operation.

If the time-out interval is set to zero, the COMMREQ remains pending until it has received the requested string, terminated by the specified end character.

If this COMMREQ fails for any reason, no data is returned to the buffer. Any data that was already in the buffer remains, and can be retrieved with a subsequent read request.

Example Command Block for the Read String Function

	Value (decimal)	Value (hexadecimal)	Meaning
address	0005	0005	Data block length
address +1	0000	0000	NOWAIT mode
address +2	0008	0008	Status word memory type (%R)
address +3	0000	0000	Status word address minus 1 (%R0001)
address +4	0000	0000	Not used
address +5	0000	0000	Not used
address +6	4403	1133	Read string command
address +7	0030	001E	Read time-out (30 seconds)
address +8	0013	000D	Terminating character (carriage return): must be between 0 and 255 (0xFF), inclusive
address +9	0008	0008	Input data memory type (%R)
address +10	0001	0001	Input data memory address (%R0001)

Return Data Format for the Read String Function

The return data consists of the number of characters actually read, the number of characters still available in the input buffer after the read is complete (if any), and the actual input characters:

Address	Number of characters actually read
Address + 1	Number of characters still available in the input buffer, if any
Address + 2	first two characters (first character is in the low byte)
Address + 3	third and fourth characters (third character is in the low byte)
Address + n	subsequent characters

Operating Note

If the input data memory type parameter is specified to be a word memory type and an odd number of bytes are actually received, then the high byte of the last word to be written with the received data is set to zero.

As data is received from the serial port it is placed in the internal input buffer. If the buffer becomes full, then any additional data received from the serial port is discarded and the Overflow Error bit in the Port Status word (See Read Port Status Function) is set.

Example

The following Block Move will set up values to perform a serial I/O port configuration. In this example, port 2 is being configured. The entries of the first Block Move set up the following:

IN1	Length of the data block, which is always16 for a configuration COMMREQ
IN2	Wait/No Wait flag: 0 for No Wait
IN3	Status Word pointer: 8 signifies %R
IN4	Status word pointer offset; this number is zero based, so 0 points to %R1
IN5	Idle timeout value; not used with No Wait mode
IN6	Maximum communication time; not used with No Wait mode
IN7	Command Word; FFF0 hex is the command for serial port setup

In the second Block Move:

IN1	Protocol selector; 5 selects Serial I/O
IN2	Port mode; 0 selects slave mode
IN3	Data rate; 6 selects 19200
IN4	Parity; 1 selects odd
IN5	Flow control; 1 selects none
IN6	Turnaround delay; 0 selects none
IN7	Timeout; 0 selects none

In the third Block Move:

IN1   Bits per character; 1 chooses 8 bits per character
IN2   Stop bits; 0 selects 1 stop bit
IN3   Interface; not used so set to 0
IN4   Duplex mode; 1 selects 4-wire
IN5 – IN7   Not used
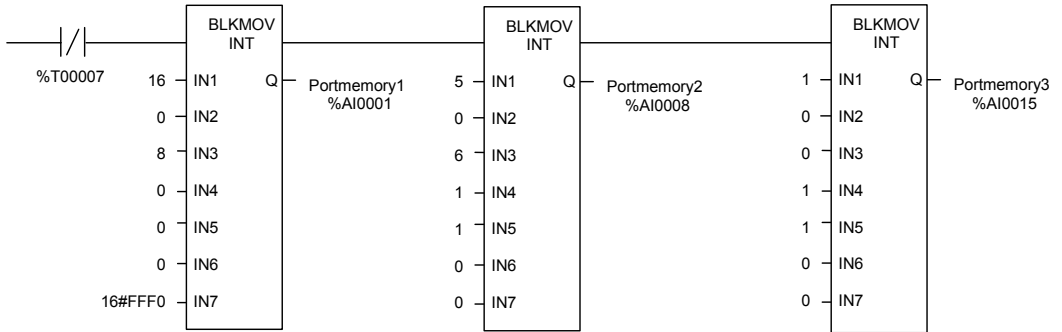
%R1 is used as the status word for the COMMREQ. The following rung clears the word before the COMMREQ is issued:
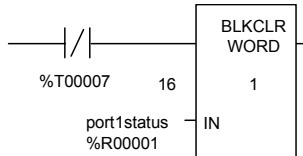
The following logic issues a COMMREQ for port 2. The SYSID is set to rack 0 slot 1. The TASK ID of 20 defines port 2. The IN parameter points to %AI1 which is where all the configuration data was placed with the Block Move statements. If an error occurs, the bit CommreqP1bad (%T6) will be set.

```
         |/|        ┌─────────────┐                                        CommreqP
    ─────┤ ├────────┤  COMMREQ    │                                         ─( S )─
       %T00007      │             │                                         %T00006
                    │             │
    Port1memory ────┤ IN          │
       %AI0001      │             │
                    │             │
              1  ───┤ ISYSID      │
                    │             │
             20  ───┤ TASK        │
                    └─────────────┘
```

The following rung sets the bit Commreq Complete (%T7), which keeps the COMMREQ from being issued more than once and keeps the status from being overwritten.

```
        ALW_ON                                                              CommreqC
    ─────┤ ├──────────────────────────────────────────────────────────────  ─( S )─
       %S00007                                                               %T00007
```

PID Function

This chapter describes the PID (Proportional plus Integral plus Derivative) function, which is used for closed-loop process control. The PID function compares feedback from a process variable with a desired process Set Point and updates a Control Variable based on the error.

- ▪ Format of the PID Function

- ▪ Operation of the PID Function

- ▪ Parameter Block for the PID Function

- ▪ PID Algorithm Selection

- ▪ Determining the Process Characteristics

- ▪ Setting Parameters Including Tuning Loop Gains

- ▪ Sample PID Call

Format of the PID Function

The PID function uses PID loop gains and other parameters stored in an array of 40 16 bit words to solve the PID algorithm at the desired time interval. All parameters are 16 bit integer words. This allows %AI memory to be used for input Process Variables and %AQ to be used for output Control Variables.

```
       enable ─┤ PID IND ├─ OK
    Set Point ─┤ SP   CV ├─ Control Variable
Process Variable ─┤ PV      │
      (logic)  │ MAN     │
      (logic)  │ UP      │
      (logic)  │ DN      │
              Reference Array Address
```
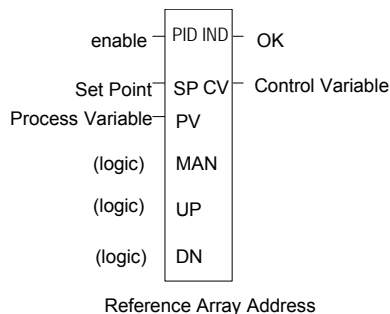
The PID function does not pass power flow if there is an error in the configurable parameters. It can be monitored using a temporary coil while modifying data.

Parameters of the PID Function

Input/ Output	Choices	Description
enable	flow	When enabled through a contact, the PID algorithm is performed.
SP	I, Q, M, T, G, R, AI, AQ, constant	The control loop or process Set Point. Set using Process Variable counts, the PID function adjusts the output Control Variable so that the Process Variable matches the Set Point (zero error).
PV	I, Q, M, T, G, R, AI, AQ	Process Variable input from the process being controlled, often a %AI input.
MAN	flow	When energized to 1 (through a contact), the PID block is in manual mode. If the PID block is on manual off, the PID block is in automatic mode.
UP	flow	If energized along with MAN, it adjusts the Control Variable up by 1 CV per solution.*
DN	flow	If energized along with MAN, it adjusts the Control Variable down by 1 CV per solution.*
Address	R	Location of the PID control block information (user and internal parameters). Uses 40 %R words that cannot be shared.
ok	flow, none	OK is energized when the function is performed without error. It is Off if errors exist.
CV	I, Q, M, T, G, R, AI, AQ	The Control Variable output to the process, often a %AQ output.

*   Incremented (UP parameter) or decremented (DN parameter) by one (1) per access of the PID function.

As scaled 16 integer numbers, many parameters must be defined in either Process Variable (PV) counts or units or Control Variable (CV) counts or units. For example, the Set Point (SP) input must be scaled over the same range as the Process Variable as the PID block calculates the error by subtracting these two inputs. The Process Variable and Control Variable Counts may be –32000 or 0 to 32000 matching analog scaling or from 0 to 10000 to display variables as 0.00% to 100.00%. The Process Variable and Control Variable Counts do not have to have the same scaling, in which case there will be scale factors included in the PID gains.

Operation of the PID Function

Automatic Operation

The PID function can be called every sweep by providing power flow to Enable and no power flow to Manual input contacts. The block compares the current PLC elapsed time clock with the last PID solution time stored in the internal RefArray. If the difference is greater than the sample period defined in the third word (%Ref+2) of the RefArray, the PID algorithm is solved using the time difference. Both the last solution time and Control Variable output are updated. In Automatic mode, the output Control Variable is placed in the Manual Command parameter %Ref+13.

Manual Operation

The PID block is placed in Manual mode by providing power flow to both the Enable and Manual input contacts. The output Control Variable is set from the Manual Command parameter %Ref+13. If either the UP or DN inputs have power flow, the Manual Command word is incremented or decremented by one CV count every PID solution. For faster manual changes of the output Control Variable, it is also possible to add or subtract any CV count value directly to/from the Manual Command word

The PID block uses the CV Upper and CV Lower Clamp parameters to limit the CV output. If a positive Minimum Slew Time is defined, it is used to limit the rate of change of the CV output. If either the CV amplitude or rate limit is exceeded, the value stored in the integrator is adjusted so that CV is at the limit. This anti-reset windup feature means that even if the error tried to drive CV above (or below) the clamps for a long period of time, the CV output will move off the clamp as soon as the error term changes sign.

This operation, with the Manual Command tracking CV in Automatic mode and setting CV in Manual mode, provides a bumpless transfer between Automatic and Manual modes. The CV Upper and Lower Clamps and the Minimum Slew Time still apply to the CV output in Manual mode and the internal value stored in the integrator is updated. This means that if you were to step the Manual Command in Manual mode, the CV output will not change any faster that the Minimum Slew Time (Inverse) rate limit and will not go above or below the CV Upper or CV Lower Clamp limits.

Time Interval for the PID Function

The PID will not execute more often than once every 10 milliseconds. <u>If it is set up</u> <u>to execute every sweep and the sweep is under 10 milliseconds, the PID function</u> <u>will not run until enough sweeps have occurred to accumulate an elapsed time of</u> <u>10 milliseconds</u>. For example, if the sweep time is 9 milliseconds, the PID function executes every other sweep, so the overall elapsed time between executions is 18 milliseconds. A specific PID function should not be called more than once per sweep.

The longest possible interval between executions is 10.9 minutes. The PID function compensates for the actual time elapsed since the last execution within 100 microseconds.

The PID algorithm is solved only if the current Micro PLC elapsed time clock is at or later than the last PID solution time plus the sample period. If the sample period is set to 0, the function executes each time it is enabled; however, it is restricted to a minimum of 10 milliseconds as noted above.

Scaling Input and Outputs

All parameters of the PID function are 16 bit integer words for compatibility with 16 bit analog process variables. Some parameters must be defined in either process variable counts or units or control variable counts or units.

The set point input must be scaled over the same range as process variable, because the PID function calculates error by subtracting these two inputs. The process variable and control variable counts do not have to use the same scaling. Either may be -32000 or 0 to 32000 to match analog scaling, or from 0 to 10000 to display variables as 0.00% to 100.00%. If the process and control variables do not use the same scaling, scale factors are included in the PID gains.

Example of the PID Function

The example shown below includes typical inputs.
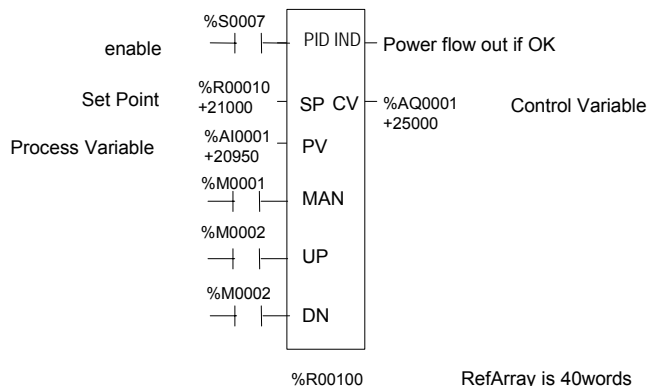
Parameter Block for the PID Function

The parameter block for the PID function occupies 40 words of %R memory. Many of the 40 words are used by the Micro PLC and not configurable. Every PID function call must use a different 40-word memory area even if all 13 configurable parameters are the same.

The first 13 words of the parameter block must be specified before executing the PID function. Zeros can be used for most default values. Once suitable PID values have been chosen, they can be defined as constants in a BLKMOV so they can be changed by the program as needed.

Internal Parameters in RefArray

The PID function reads 13 parameters and uses the rest of the 40-word RefArray for internal PID storage. Normally you would not change these values. If you call the PID block in Auto mode after a long delay, you may want to use SVC_REQ 16 to load the current PLC elapsed time clock into %Ref+23 to update the last PID solution time to avoid a step change on the integrator. If you have set the Override low bit of the Control Word (%Ref+14) to 1, the next four bits of the Control Word must be set to control the PID block input contacts, and the Internal SP and PV must be set as you have taken control of the PID block away from the ladder logic.

	Parameter	*Low Bit Units*	*Range*	*Description*
Address	Loop Number	Integer	0 to 255.	Optional number of the PID block. It provides a common identification in the PLC with the loop number defined by an operator interface device.
Address +1	Algorithm	-	Set by the PLC	1 = ISA algorithm 2 = independent algorithm
Address+2	Sample Period	10ms	0 (every sweep) to 65535 (10.9 Min) At least 10mS.	The shortest time, in 10mS increments, between solutions of the PID algorithm. For example, use a 10 for a 100mS sample period.
Address+3 Address+4	Dead Band + and Dead Band -	PV Counts	0 to 32000 (+ never negative) (- never positive)	INT values defining the upper (+) and lower (-) Dead Band limits in PV Counts. If no Dead Band is required, these values must be 0. If the PID Error (SP - PV) or (PV - SP) is above the (-) value and below the (+) value, the PID calculations are solved with an Error of 0. If non-zero, the (+) value must greater than 0 and the (-) value less than 0 or the PID block will not function. Leave these at 0 until the PID loop gains are set up or tuned. A Dead Band might be added to avoid small CV output changes due to variations in error.
Address+5	Proportional Gain -Kp (Controller gain, Kc, in the ISA version)	0.01 CV%/PV%	0 to 327.67%	Change in the control variable in CV Counts for a 100 PV Count change in the Error term. A Kp entered as 450 is displayed as 4.50 and results in a Kp*Error/100 or 450*Error/100 contribution to the PID Output. Kp is generally the first gain set when adjusting a PID loop.

Parameter	Low Bit Units	Range	Description
Address+6	Derivative Gain-Kd	0.01 seconds	0 to 327.67 sec	Change in the control variable in CV Counts if the Error or PV changes 1 PV Count every 10ms. Entered as a time with the low bit indicating 10ms. For example, a Kd entered as 120 is displayed as 1.20 Sec and results in a Kd * delta Error/delta time or 120*4/3 contribution to the PID Output if Error was changing by 4 PV Counts every 30ms. Kd can be used to speed up a slow loop response, but is very sensitive to PV input noise.
Address+7	Integral Rate-Ki	Repeat/1000 Sec	0 to 32.767 repeat/sec	Change in the control variable in CV Counts if the Error were a constant 1 PV Count. Displayed as 0.000 Repeats/Sec with an implied decimal point of 3. For example, a Ki entered as 1400 is displayed as 1.400 Repeats/Sec and results in a Ki * Error *dt or 1400 * 20 * 50/1000 contribution to PID Output for an Error of 20 PV Counts and a 50ms PLC sweep time (Sample Period of 0). Ki is usually the second gain set after Kp.
Address+8	CV Bias/Output Offset	CV Counts	-32000 to 32000 (add to integrator output)	Number of CV Counts added to the PID Output before the rate and amplitude clamps. It can be used to set non-zero CV values if only Kp Proportional gains are used, or for feed forward control of this PID loop output from another control loop.
Address+9 Address+10	CV Upper and Lower Clamps	CV Counts	-32000 to 32000 (>%Ref+10)	Number of CV Counts that define the highest and lowest value for CV. These values are required. The Upper Clamp must have a more positive value than the Lower Clamp, or the PID block will not work. These are usually used to define limits based on physical limits for a CV output. They are also used to scale the Bar Graph display for CV. The block has anti-reset windup to modify the integrator value when a CV clamp is reached.
Address+11	Minimum Slew Time	Second/Full Travel	0 (none) to 32000 sec to move 32000 CV	Minimum number of seconds for the CV output to move from 0 to full travel of 100% or 32000 CV Counts. It is an inverse rate limit on how fast the CV output can be changed.
				If positive, CV cannot change more than 32000 CV Counts times Delta Time (seconds) divided by Minimum Slew Time. For example, if the Sample Period is 2.5 seconds and the Minimum Slew Time is 500 seconds, CV cannot change more than 32000*2.5/500 or 160 CV Counts per PID solution. The integrator value is adjusted if the CV rate limit is exceeded. If Minimum Slew Time is 0, there is no CV rate limit. Set Minimum Slew Time to 0 while tuning or adjusting PID loop gains.

	Parameter	*Low Bit Units*	*Range*	*Description*
Address+12	Config Word	Low 6 bits used		The low 6 bits of this word are used to modify six default PID settings. The 10 high-order bits should be set to 0.
				Bit 0: Error Polarity. Setting this bit to 1 modifies the standard PID Error Term from the normal (SP – PV) to (PV – SP), reversing the sign of the feedback term. This is for Reverse Acting controls where the CV must go down when the PV goes up.
				Bit 1: Output Polarity: Setting this bit to 1 inverts the Output Polarity so that CV is the negative of the output rather than the normal positive value.
				Bit 2: Setting this bit to 1 removes the setpoint from the Derivative calculation.
				Bit 3: Deadband Action: When this bit is 0, no deadband action is chosen. If the error is within the deadband limits, the error is to be zero. Otherwise the error is not affected by the deadband limit. If this bit is 1, the deadband action is chosen. If the error is within the deadband limits, the error is forced to be zero. If, however, the error is outside the deadband limits, the error is reduced by the deadband limit (error = error – deadband limit).
				Bit 4: Anti-reset windup action. When this bit is 0, the anti-reset windup action uses a reset back calculation. When the output is clamped, this replaces the accumulated Y remainder value with whatever value is necessary to produce the clamped output exactly.
				When the bit is 1, this replaces accumulated Y term with the value of the Y term at the start of the calculation. In this way, the pre-clamp Y value is held as long as the output is clamped.
				Bit 5: Enable derivative filtering. When this bit is set to 0, no filtering is applied to the derivative term.
				When bit 5 is set to 1, a first order filter is applied. This limits the effects of higher frequency process disturbances on the derivative term.
				Bit 0 – Bit 5: Remember that the bits are set in powers of 2.
				To set bit 0, add 1 to the Config Word parameter value.
				To set bit 1, add 2.
				To set bit 2, add 4.
				To set bit 3, add 8.
				To set bit 4, add 16.
				To set bit 5, add 32.
				For example, set Config Word to 0 for default PID configuration. Add 1 to change the Error Term from SP - PV to PV - SP, add 2 to change the Output Polarity from CV = PID Output to CV = – PID Output, or add 4 to change Derivative Action from Error rate of change to PV rate of change, etc.
Address+13	Manual Command	CV Counts	Tracks CV in Auto or Sets CV in Manual	Set to the current CV output while the PID block is in Automatic mode. When the block is switched to Manual mode, this value is used to set the CV output and the internal value of the integrator within the Upper and Lower Clamp and Slew Time limits.

	Parameter	Low Bit Units	Range	Description
Address+14	Control Word	Maintained by the PLC, unless Bit 1 is set.	PLC maintained unless set otherwise: low bit sets Override if 1.	If the Override low bit is set to 1, this word and other internal SP, PV and CV parameters must be used for remote operation of this PID block (see below). This allows remote operator interface devices, such as a computer, to take control away from the PLC program. Caution: if you do not want this to happen, make sure the Control Word is set to 0. If the low bit is 0, the next 4 bits can be read to track the status of the PID input contacts as long as the PID Enable contact has power.

A discrete data structure with the first five bit positions in the following format:

Bit	Word Value	Function	Status or External Action if Override bit set to 1
0	1	Override	If 0, monitor block contacts below. If 1, set them externally.
1	2	Manual /Auto	If 1, block is in Manual mode; other numbers it is in Automatic mode.
2	4	Enable	Should normally be 1; otherwise block is never called.
3	8	UP /Raise	If 1 and Manual (Bit 1) is 1, CV is being incremented every solution.
4	16	DN /Lower	If 1 and Manual (Bit 1) is 1, CV is being incremented every solution.

	Parameter	Low Bit Units	Range	Description
Address+15	Internal SP	Set and maintained by the PLC	Non-configurable	Tracks SP in; must be set externally if Override = 1.
Address+16	Internal CV	"	"	Tracks CV out.
Address+17	Internal PV	"	"	Tracks PV in; must be set externally if Override bit = 1.
Address+18	Output	"	"	Signed word value representing the output of the function block before the optional inversion. If no output inversion is configured and the output polarity bit in the control word is set to 0, this value equals the CV output. If inversion is selected and the output polarity bit is set to 1, this value equals the negative of the CV output.
Address+19	Diff Term Storage			
Address+20 Address+21	Int Term Storage			Used internally for storage of intermediate values. Do not write to these locations
Address+22	Slew Term Storage			
Address+23 to Address+25	Clock			Internal elapsed time storage (time last PID executed). Do not write to these locations
Address+26	Y Remainder Storage			Holds remainder for integrator division scaling for 0 steady state error.
Address+27 Address+28	SP, PV Lower and Upper Range	PV Counts	-32000 to 32000	Optional INT values in PV Counts that define high and low display values.(Ref +27 must be lower than Ref+28)
Address+29 to Address+39	Reserved	N/A	Non-configurable	29-34 are reserved for internal use; 35-39 are reserved for external use. Do not use these references.

PID Algorithm Selection (PIDISA or PIDIND) and Gains

The PID block can be programmed selecting either the Independent (PID_IND) term or standard ISA (PID_ISA) versions of the PID algorithm. The only difference in the algorithms is how the Integral and Derivative gains are defined.

Error Term

The Independent (PID_IND) term and standard ISA (PID_ISA) versions of the PID algorithm both calculate the Error Term as:

Error Term (in Normal Mode) = Set Point (SP) – Process Variable (PV)

Error Term in Reverse-Action Mode

The Error Term calculation can be changed to Reverse Action mode:

Error Term (in Reverse Action Mode) = Process Variable (PV) – Set Point (SP)

by setting the Error Term (low bit 0 in the Config Word %Ref+12) to 1.

Effect of the Process Variable on the Control Variable

In Normal mode, the Control Variable (CV) responds to changes in the Process Variable (PV) by moving in the same direction. In Reverse-Action mode, when the Process Variable goes up, the Control Variable goes down.

Derivative Term

The Derivative term is the time rate of change of the Error term in the interval since the last PID solution.

Derivative = ΔError / Delta time (dt) = (Error – previous Error) / Delta time (dt)

where

Delta time (dt) = Current PLC elapsed time - PLC elapsed time at previous PID solution.

In Normal Mode (without Reverse-Action mode), this is equal to the change in the Error term.

(Error – previous Error) = (SP – PV) – (previous SP – previous PV)
                          = (previous PV – PV) – (previous SP – SP)

However, when the Reverse-Action mode bit (bit 0) in the Config Word is set, the sign of the change in the Error term is reversed.

(Error – previous Error) = (PV – SP) – (previous PV – previous SP)
                          = (PV – previous PV) – (SP – previous SP)

The change in the Error term depends on changes in both the Set Point and the Process Variable. If the Set Point is constant, the difference between SP and the

previous SP is zero and has no effect on the output. However, Set Point changes can cause large changes in the Derivative term and in the output.

Removing Set Point Changes from the Derivative Calculation

Loop stability can be improved by eliminating the effect of Set Point changes on the Derivative term. Set the third bit (bit 2) of the Config Word to 1 to calculate the derivative based only on the change in PV.

For bit 2 set in normal mode (bit 0 = 0),

(Error – previous Error)   = (previous PV – PV),

and with bit 2 set in Reverse-Action mode (bit 0 = 1),

(Error – previous Error) = (PV – previous PV).

Delta Time

The dt (or Delta Time) is determined by subtracting the last PID solution clock time for this block from the current PLC elapsed time clock.

dt = Current PLC Elapsed Time clock - PLC Elapsed Time Clock at Last PID solution
Derivative = (Error - previous Error)/dt or (PV - previous PV)/dt if 3rd bit of Config Word set to 1

The Independent term PID (PID_IND) algorithm calculates the output as:

PID Output = Kp * Error +   Ki * Error * dt + Kd * Derivative + CV Bias

The standard ISA (PID_ISA) algorithm has a different form:

PID Output = Kc * (Error +   Error * dt/Ti + Td * Derivative) + CV Bias

where Kc is the controller gain, and Ti is the Integral time and Td is the Derivative time. The advantage of ISA is that adjusting the Kc changes the contribution for the integral and derivative terms as well as the proportional one, which may make loop tuning easier. If you have PID gains in terms or Ti and Td, use

Kp = Kc   Ki = Kc/Ti   and   Kd = Kc/Td

to convert them to use as PID User Parameter inputs.

The CV Bias term above is an additive term separate from the PID components. It may be required if you are using only Proportional Kp gain and you want the CV to be a non-zero value when the PV equals the SP and the Error is 0. In this case, set the CV Bias to the desired CV when the PV is at the SP. CV Bias can also be used for feed forward control where another PID loop or control algorithm is used to adjust the CV output of this PID loop.

If an Integral Ki gain is used, the CV Bias would normally be 0 as the integrator acts as an automatic bias. Just start up in Manual mode and use the Manual Command word (%Ref+13) to set the integrator to the desired CV, then switch to Automatic mode. This also works if Ki is 0, except the integrator will not be adjusted based on the Error after going into Automatic mode.

Independent Term Algorithm (PIDIND)

The following diagram shows how the PID algorithms work:

a43646
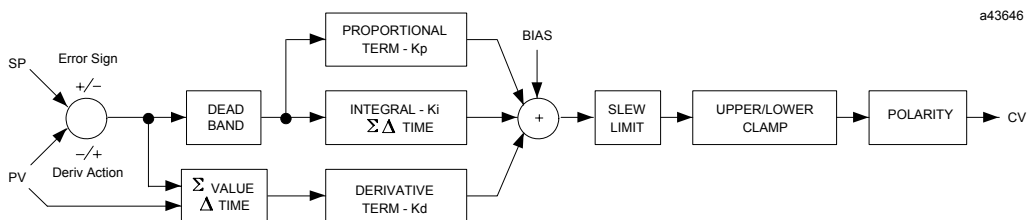
The ISA Algorithm (PIDISA) is similar except the Kp gain is factored out of Ki and Kd so that the integral gain is Kp * Ki and derivative gain is Kp * Kd. The Error sign, DerivAction and Polarity are set by bits in the Config Word user parameter.

CV Amplitude and Rate Limits

The block does not send the calculated PID Output directly to CV. Both PID algorithms can impose amplitude and rate of change limits on the output Control Variable. The maximum rate of change is determined by dividing the maximum 100% CV value (32000) by the Minimum Slew Time, if specified as greater than 0. For example, if the Minimum Slew Time is 100 seconds, the rate limit will be 320 CV counts per second. If the dt solution time was 50 milliseconds, the new CV output can not change more than 320*50/1000 or 16 CV counts from the previous CV output.

The CV output is then compared to the CV Upper and CV Lower Clamp values. If either limit is exceeded, the CV output is set to the clamped value. If either rate or amplitude limits are exceeded modifying CV, the internal integrator value is adjusted to match the limited value to avoid reset windup.

Finally, the block checks the Output Polarity (2nd bit of the Config Word %Ref+12) and changes the sign of the output if the bit is 1.

CV = Clamped PID Output   or
 - Clamped PID Output if Output Polarity bit set

If the block is in Automatic mode, the final CV is placed in the Manual Command %Ref+13. If the block is in Manual mode, the PID equation is skipped as CV is set by the Manual Command, but all the rate and amplitude limits are still checked. That means that the Manual Command can not change the output above the CV Upper Clamp or below the CV Lower Clamps and the output can not change faster than the Minimum Slew Time allowed.

Sample Period and PID Block Scheduling

The PID block is a digital implementation of an analog control function, so the dt sample time in the PID Output equation is not the infinitesimally small sample time available with analog controls. The majority of processes being controlled can be approximated as a gain with a first or second order lag, possibly with a pure time delay. The PID block sets a CV output to the process and uses the process feedback PV to determine an Error to adjust the next CV output. A key process parameter is the total time constant, which is how fast does the PV respond when the CV is changed. As discussed in the Setting Loop Gains section below, the total time constant, Tp+Tc, for a first order system is the time required for PV to reach 63% of its final value when CV is stepped. The PID block will not be able to control a process unless its Sample Period is well under half the total time constant. Larger Sample Periods will make it unstable.

The Sample Period should be no bigger than the total time constant divided by 10 (or down to 5 worst case). For example, if PV seems to reach about 2/3 of its final value in 2 seconds, the Sample Period should be less than 0.2 seconds, or 0.4 seconds worst case. On the other hand, the Sample Period should not be too small, such as less than the total time constant divided by 1000, or the Ki * Error * dt term for the PID integrator will round down to 0. For example, a very slow process that takes 10 hours or 36000 seconds to reach the 63% level should have a Sample Period of 40 seconds or longer.

Unless the process is very fast, it is not usually necessary to use a Sample Period of 0 to solve the PID algorithm every PID sweep. If many PID loops are used with a Sample Period greater than the sweep time, there may be wide variations in PLC sweep time if many loops end up solving the algorithm at the same time. The simple solution is to sequence a one or more 1 bits through an array of bits set to 0 that is being used to enable power flow to individual PID blocks.

Determining the Process Characteristics

The PID loop gains, Kp, Ki and Kd, are determined by the characteristics of the process being controlled. Two key questions when setting up a PID loop are:

1. How big is the change in PV when we change CV by a fixed amount, or what is the open loop gain?

2. How fast does the system respond, or how quickly does PV change after the CV output is stepped?

Many processes can be approximated by a process gain, first or second order lag and a pure time delay. In the frequency domain, the transfer function for a first order lag system with a pure time delay is:

$$PV(s)/CV(s) = G(s) = K * e **(-Tp\ s)/(1 + Tc\ s)$$

Plotting a step response at time t0 in the time domain provides an open loop unit reaction curve:
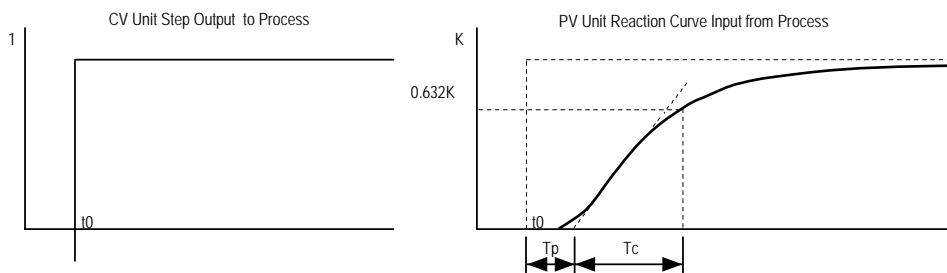
The following process model parameters can be determined from the PV unit reaction curve:

K	Process open loop gain = final change in PV/change in CV at time t0 (Note no subscript on K)
Tp	Process or pipeline time delay or dead time after t0 before the process output PV starts moving
Tc	First order Process time constant, time required after Tp for PV to reach 63.2% of the final PV

Usually the quickest way to measure these parameters is by putting the PID block in Manual mode and making a small step in CV output, by changing the Manual Command %Ref+13, and plotting the PV response over time. For slow processes, this can be done manually, but for faster processes a chart recorder or computer graphic data logging package will help. The CV step size should be large enough to cause an observable change in PV, but not so large that it disrupts the process being measured. A good size may be from 2 to 10% of the difference between the CV Upper and CV Lower Clamp values.

Setting Parameters Including Tuning Loop Gains

As all PID parameters are totally dependent on the process being controlled, there are no predetermined values that will work; however, it is usually simple to find acceptable loop gain.

1. Set all the User Parameters to 0, then set the CV Upper and CV Lower Clamps to the highest and lowest CV expected. Set the Sample Period to the estimated process time constant(above)/10 to 100.

2. Put block in Manual mode and set Manual Command (%Ref+13) at different values to check if CV can be moved to Upper and Lower Clamp. Record PV value at some CV point and load it into SP.

3. Set a small gain, such as 100 * Maximum CV/Maximum PV, into Kp and turn off Manual mode. Step SP by 2 to 10% of the Maximum PV range and observe PV response. Increase Kp if PV step response is too slow or reduce Kp if PV overshoots and oscillates without reaching a steady value.

4. Once a Kp is found, start increasing Ki to get overshooting that dampens out to a steady value in 2 to 3 cycles. This may required reducing Kp. Also try different step sizes and CV operating points.

5. After suitable Kp and Ki gains are found, try adding Kd to get quicker responses to input changes providing it doesn't cause oscillations. Kd is often not needed and will not work with noisy PV.

6. Check gains over different SP operating points and add Dead Band and Minimum Slew Time if needed. Some Reverse Acting processes may need setting Config Word Error Sign or Polarity bits.

Setting Loop Gains Using the Ziegler and Nichols Tuning Approach

Once the three process model parameters, K, Tp and Tc, are determined, they can be used to estimate initial PID loop gains. The following approach provides good response to system disturbances with gains producing an amplitude ratio of 1/4. The amplitude ratio is the ratio of the second peak over the first peak in the closed loop response.

1. Calculate the Reaction rate:

   R = K/Tc

2. For Proportional control only, calculate Kp as:

   Kp = 1/(R * Tp) = Tc/(K * Tp)

   For Proportional and Integral control, use:

   Kp = 0.9/(R * Tp) = 0.9 * Tc/(K * Tp) Ki = 0.3 * Kp/Tp

   For Proportional, Integral   and Derivative control, use:

   Kp = G/(R * Tp) where G is from 1.2 to 2.0
   Ki = 0.5 * Kp/Tp
       Kd = 0.5 * Kp * Tp

3. Check that the Sample Period is in the range

   (Tp + Tc)/10 to (Tp + Tc)/1000

The Ideal Tuning Method

The "Ideal Tuning" procedure provides the best response to SP changes, delayed only by the Tp process delay or dead time.

   Kp = 2 * Tc/(3 * K * Tp)
   Ki = Tc
   Kd = Ki/4   if Derivative term is used

Once initial gains are determined, convert them to integers. Calculate the Process gain K as a change in input PV Counts divided by the output step change in CV Counts and not in process PV or CV engineering units. Specify all times in seconds. Once Kp, Ki and Kd are determined, Kp and Kd can be multiplied by 100 and entered as integer while Ki can be multiplied by 1000 and entered into the User Parameter %RefArray.

Sample PID Call

The following PID example has a sample period of 100Ms, a Kp gain of .4.00 and a Ki gain of 1.500. The set point is stored in %R0001, the control variable output in %AQ0002, and the process variable is returned in %AI0003. CV Upper and CV Lower Clamps must be set, in this case to 20000 and 4000, and an optional small Dead Band of +5 and -5 has been included. The 40-word RefArray starts in %R0100. Normally User Parameters are set in the RefArray, but %M0006 can be set to reinitialize the 14 words starting at %R0102 (%Ref+2) from constants stored in logic (a useful technique).
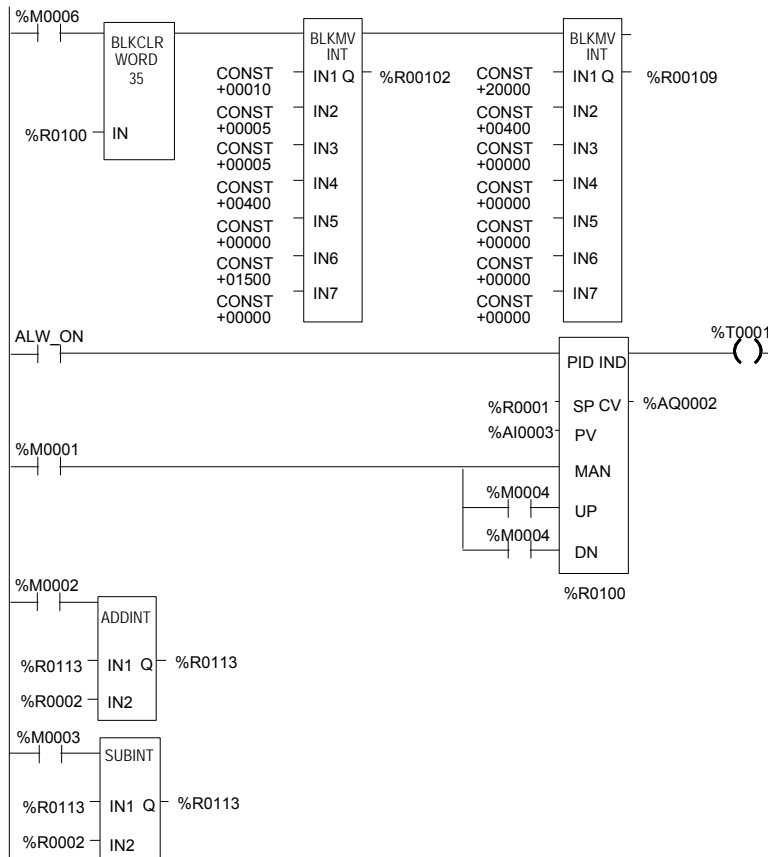
The block can be switched to Manual mode with %M1 so that the Manual Command, %R113, can be adjusted. Bits %M4 or %M5 can be used to increase or decrease %R113 and the PID CV and integrator by 1 every 100 MSec solution. For faster manual operation, bits %M2 and %M3 can be used to add or subtract the value in %R2 to/from %R113 every PLC sweep. The %T1 output is on when the PID is OK.

Chapter 27 | *Reading and Writing Data in Flash Memory*

For Release 3.0 and later VersaMax Micro PLCs, two Service Request commands can be used to read or write flash memory during run time:

- SVCREQ 52: Reads from Flash Memory into Reference Memory

- SVCREQ 53: Writes from Reference Memory into Flash Memory

Chapter 22 gives details of using use these Service Request commands in the application program.

This chapter describes the Logic-driven Write to Flash feature, and gives application program examples.

Logic-Driven Write to Flash

For a VersaMax Micro PLC, one of the configuration choices is whether the CPU will read the initial values from flash or RAM at powerup. If RAM is the choice, the CPU will read the reference tables data from its RAM memory at powerup.

If "Read from flash" is the configured choice, the CPU will read previously-stored reference tables from flash memory at powerup. In addition, Release 3.0 and later VersaMax Micro PLCs (which includes all 20-, 40-, and 64-Point Micro PLCs) will also read from flash all data that has been stored to flash using Service Request 53. This feature is called "Logic-drive write to flash".

The logic-driven flash data area is cleared using the programmer. When storing an application to the PLC, if "Write All To Flash" is configured, all data that has been written to flash using Service Request 53 is automatically deleted. The data area can also be cleared by using the flash-eeprom tab and selecting Write All Data to Flash. This option is not available during Run mode due to the time required to erase flash.

Data Quantities

For 20-, 40-, or 64-point Micro PLCs, the flash memory used for the Logic-driven write to flash feature has a total size of 8192 bytes. Of this, 8 bytes are reserved and cannot be used. So the maximum available capacity is 8184 bytes. For 14, 23, and 28-point Micro PLCs, the Logic-driven user flash memory is 64kB(65536 bytes) and the maximum available capacity is 65528 after 8 bytes are reserved.

Each execution of Service Request 52 or 53 can transfer:

- 1 to 10 words of %R, %AI, or %AQ reference data plus 6 bytes of command data. That means a 1-word write to flash requires 8 bytes of flash memory, while a 10-word write to flash requires 26 bytes of flash memory ((10 words X 2 bytes per word) + 6 bytes of command data).

- 1 to 10 bytes of %I, %Q, %M, %T, or %G reference data plus 6 bytes of command data. A 1-byte write to flash requires 7 bytes of flash memory, while a 10-byte write to flash occupies 16 bytes of flash memory.

Therefore, because each request requires 6 bytes of command data, the most efficient use of flash is by transferring data in 10-word increments.

If Flash Memory Becomes Full

If Service Request 53 attempts to write more data to flash memory than the maximum available, a fault is logged in the PLC Fault Table.

Fault Group	APPLICATION_FLT	22
Fault Action	DIAGNOSTIC	2
Error Code	USERFLASH_FULL	204
Error Message	*Logic Driven Userflash Full*	

If a *Logic Driven Userflash Full* fault is logged in the PLC Fault Table, the PLC must be power-cycled.

After power-cycling the PLC, if another *Logic Driven Userflash Full* fault is logged, the contents of flash memory must be completely erased by downloading new logic with 'Write All To Flash' selected during download to PLC. After power-cycling the PLC, data can again be stored in flash until the *Logic Driven Userflash Full* " fault is logged again.

The same configuration and application program must be stored on RAM and PLC flash to use this feature. It should not be done with configuration stored with 'Read from flash' set and ladder program on RAM. If the program on RAM calls Service Request 53 to store reference memory on flash, then the PLC is power-cycled, if the configuration says to read data from flash, the data will be read but the application program may not be the same one that called Service Request 53.

Important Note

Service request 53 (Logic driven write to flash) should be performed with caution after an operation is performed that makes the application in RAM not equal to the application in flash. The following are few such operations:

- Word for word change or Run Mode store

- Stop mode store of logic to RAM only

- Logic and Registers stored to Flash during Stop mode store but CPU is configured to read Logic from RAM and Registers from Flash on power up.

Such operations may make the data stored by Service request 53 incompatible with the application in flash and hence need to be used carefully.

Example 1, Writing Data to Flash Memory

This example writes 10 continuous bytes from PLC references %G0001 through %G0080 into flash memory. In this example, the segment selector (56) is for byte access and so are the offsets and lengths.

```
 #FST_SCN  BLKMOV                    BLKMOV                                        M00001
 ┌─┐┌ ┌     WORD                      WORD                                          ┌─┐ ┌
 │↯││ ├──┬──┤                    ┌────┤                                    ──────(M)─┤↯│
 └─┘└     │    56                 │     513                                          └─┘
       56─┤IN1   Q├─ R00040   16#0201─┤IN1   Q├─ G00001
        0─┤IN2              16#0403─┤IN2
       10─┤IN3              16#0605─┤IN3
       56─┤IN4              16#0807─┤IN4
       70─┤IN5              16#1009─┤IN5
        0─┤IN6                    0─┤IN6
        0─┤IN7                    0─┤IN7

 M00001   SVCREQ                                                               M00002
 ──┤ ├──┬──┤                                                              ──────(M)──
       53─┤FNC
       56
 ↯ R00040─┤PRM                                                                    ↯
```
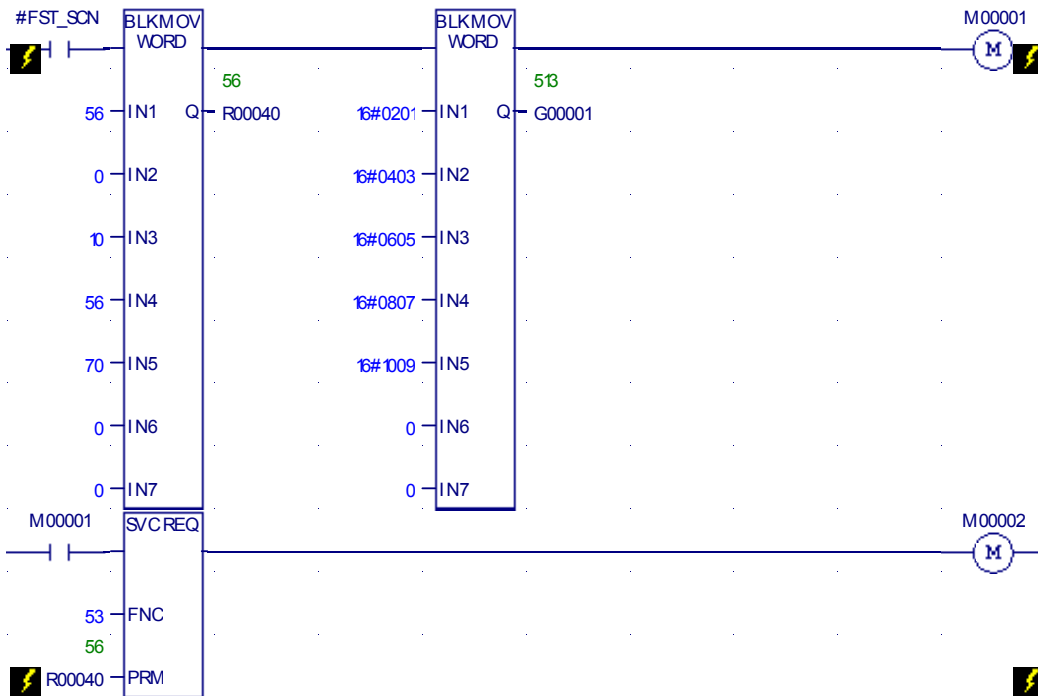
Example 2, Reading Data from Flash Memory

This example reads the same 10 continuous bytes from %G0001 through %G0080 from flash into %G reference memory into the PLC.

```
M00002         BLKMOV                      SVCREQ                    M00003
 ┤├             WORD                                                  (M)
                         56
            56 ─IN1   Q ─ R00040        52 ─FNC
                                          56
             0 ─IN2                 R00040 ─PRM
            10 ─IN3
            56 ─IN4
            24 ─IN5
            56 ─IN6
            36 ─IN7
```
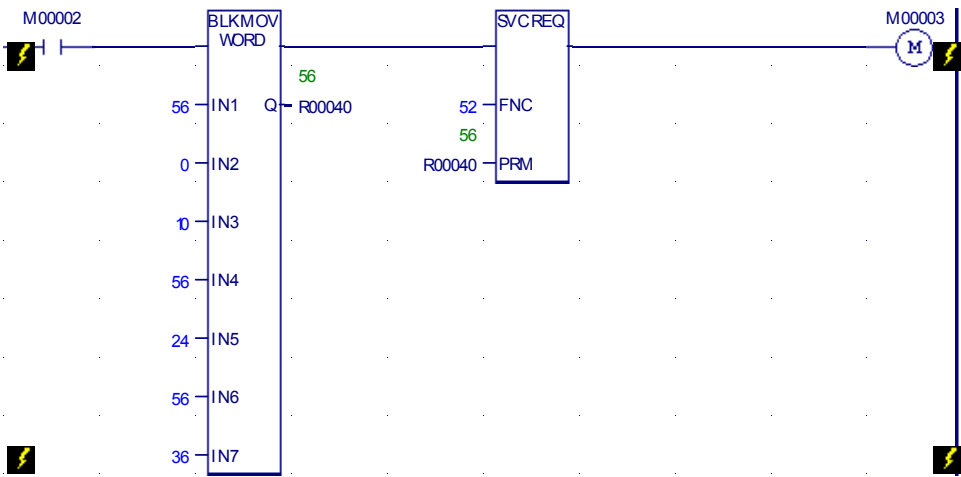
Example 3, Writing Over Data in Reference Memories

By changing values, the same logic can be used to write over some data in the same reference memories.
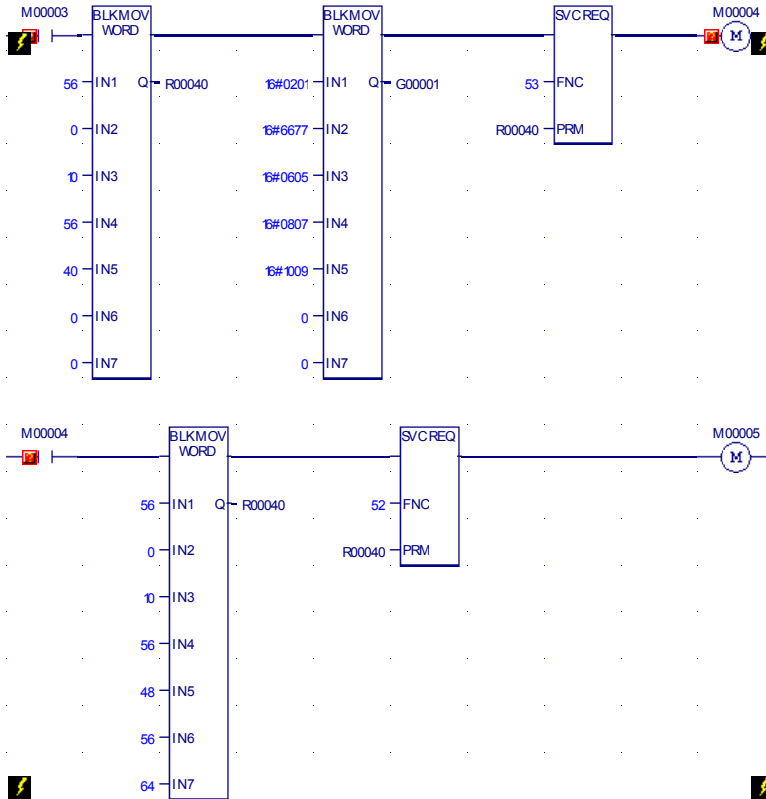
Results of Example 3

In this example, the status words returned for Service Request begin at PLC reference %G00321.

							%G00001	Address
00001000	00000111	00000110	00000101	01100110	01110111	00000010	00000001	%G00001
00001010	00000000	00000000	00000000	00000000	00000000	00010000	00001001	%G00065
00000000	00000000	00000000	00000000	00000000	00011111	11101000	00000000	%G00129
00001000	00000111	00000110	00000101	00000100	00000011	00000010	00000001	%G00193
00000000	00001010	00000000	00000000	00000001	00000000	00010000	00001001	%G00257
00000000	00000000	00011111	11011010	00000000	00001000	00000001	00000000	%G00321
00001000	00000111	00000110	00000101	01100110	01110111	00000010	00000001	%G00385
00000000	00000000	00000000	00000000	00000000	00000000	00010000	00001001	%G00449
00000000	00000001	00000000	00000000	00000000	00001010	00000000	00000001	%G00513
00000000	00000000	00000000	00000000	00011111	11101000	00000000	00001010	%G00577
00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	%G00641
00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	%G00705

Example 4, Multiple Writes and Reads

This 4-part example shows how to perform multiple reads and writes on a 64-point CPU.

Example 4, Part 1

The first part of this example:

1. Writes %R0001 through %R0010 from PLC reference memory to flash. Return Write status data to PLC references starting at %R0051.

2. Reads back %R0001 through %R0010 from flash into CPU references %R0061 through %R0070. It returns status data into PLC references starting at %R0071.
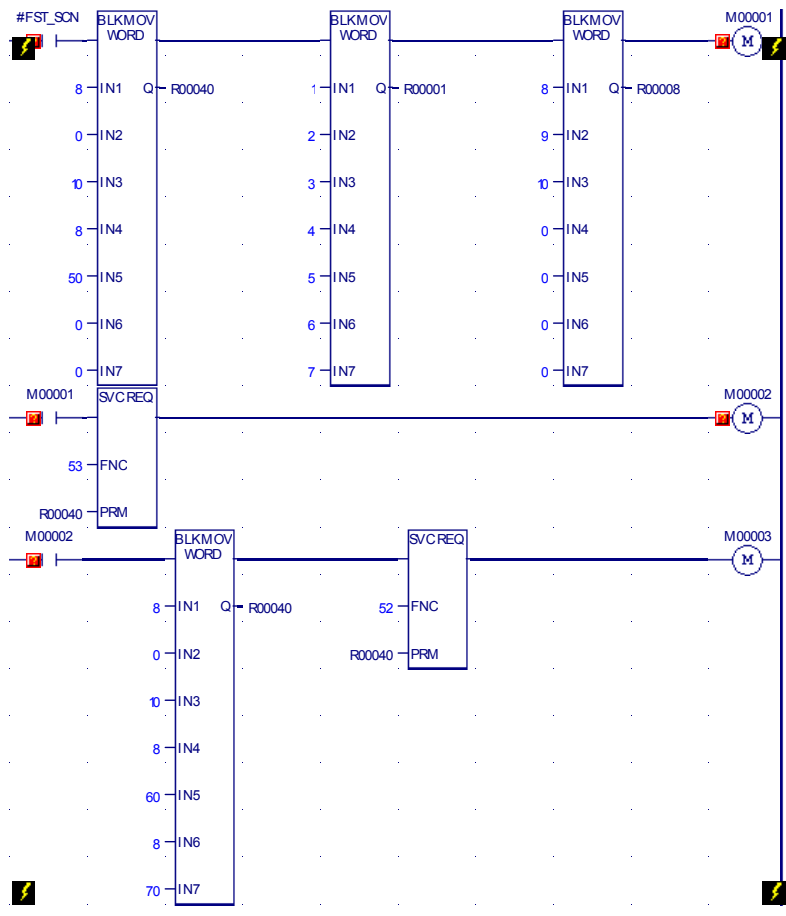
Results of Example 4, Part 1

Looking at the references used by this part of Example 4:

- %R0051 shows the Write status as 1. That means all data was successfully written.

- %R0052 shows that 10 words of data have been written to flash.

- %R0053 shows the remaining available flash memory as 8158 bytes. Note: The available memory will be 65518 for 14, 23, or 28-point Micro PLCs.

The Read status references are not shown here.

+10	+9	8	7	6	5	4	3	2	1	%R00001
+0	+0	+0	1717	1616	1515	14	13	12	11	%R00011
+0	+0	+0	+0	+0	+0	+24	23	22	+0	%R00021
+8	+0	+0	+0	+0	0	0	0	0	0	%R00031
+0	+0	+0	+0	+170	+8	+160	8	10	20	%R00041
+0	+0	+0	0	0	0	0	8158	10	1	%R00051

Example 4, Part 2

The next part of Example 4:

1. Writes the contents of PLC references %R0015 through %R0024 into flash. It returns Write status data to PLC references starting at %R0081.

2. Reads flash references %R0015 through %R0024 into PLC references %R0091 through %R0100 and returns Read status information to PLC references starting at %R0101.
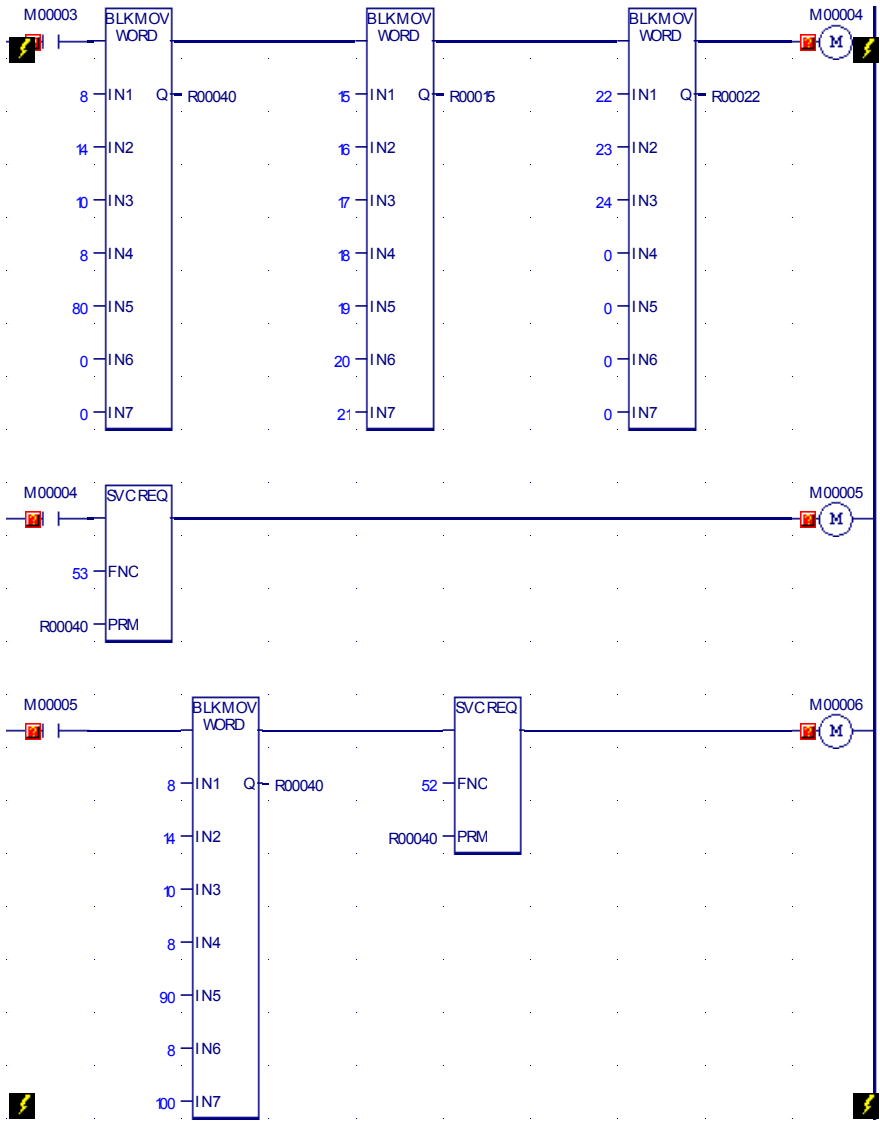
Results of Example 4, Part 2

For Example 4, Part 2, the Write status references start at %R0081:

- %R0081 shows status as 1 signifying full success (all data written)

- %R0082 shows that 10 words of data have been stored

- %R0083 shows that the available flash memory is 8132

The Read status references, which start at %R101, are not shown here. However, the Write status references from part 1 of this example, starting at %R0051, are shown.

+10	+9	8	7	6	5	4	3	2	1	%R00001
+0	+0	+0	1717	1616	1515	14	13	12	11	%R00011
+0	+0	+0	+0	+0	+0	+24	23	22	+0	%R00021
+8	+0	+0	+0	+0	0	0	0	0	0	%R00031
+0	+0	+0	+0	+170	+8	+160	8	10	20	%R00041
+0	+0	+0	0	0	0	0	8158	10	1	%R00051
+10	+9	+8	+7	6	5	4	3	2	1	%R00061
+0	+0	+0	+0	+0	+0	+0	0	10	1	%R00071
+0	+0	+0	+0	0	+0	+0	8132	10	1	%R00081

Example 4, Part 3

This part of Example 4:

1. Writes PLC references %R0008 through %R0017 to flash and returns Write status data to PLC references starting at %R0111. This single Service Request:

   ▪ Overwrites the values in %R0008 through %R0010 that were written in Example 4 Part 1.

   ▪ Writes new data into %R0011 through %R0014.

   ▪ Overwrites the values in %R0015 through %R0017 that were written in Example 4 Part 2.

2. Reads %R0008 through %R017 from flash into PLC references %R0121 through %R0130 and returns Read status data to PLC references starting at %R0131.
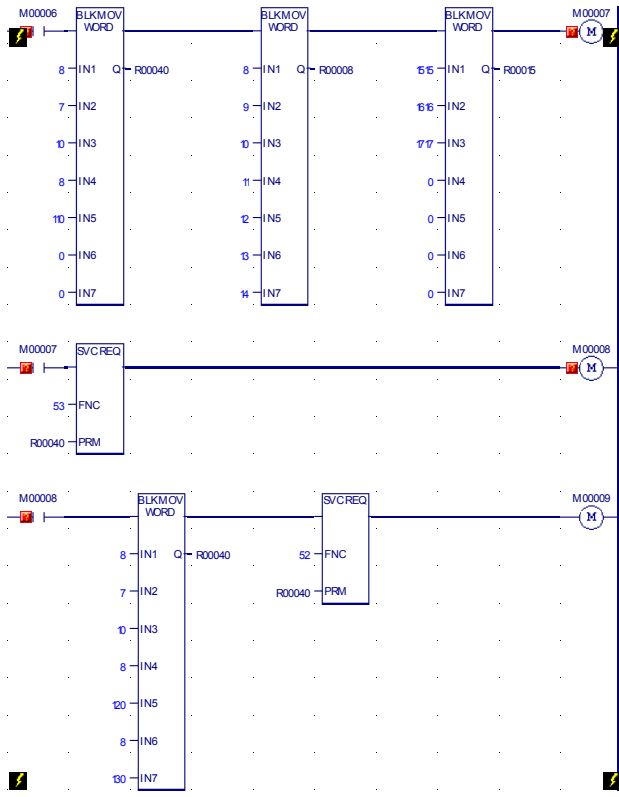
Results of Example 4, Part 3

For Example 4, Part 3, the Write status references start at %R0111:

- The value in status reference %R0111 is 257 (0x0101). That indicates partial success, because not all 10 bytes of data were written to flash. Error 257 may occur if some requested data is already stored in user flash, as was done in this example.

- %R0112 shows that only 7 words of data were stored, not the 10 words requested.

- %R0113 shows that the remaining available flash memory is 8112 bytes.

The Read status references start at %R0131:

- %R0131 shows that the Read Service Request completed successfully.

- %R0132 shows that 10 words of data were read.

+10	+9	8	7	6	5	4	3	2	1	%R00001
+0	+0	+0	1717	1616	1515	14	13	12	11	%R00011
+0	+0	+0	+0	+0	+0	+24	23	22	+0	%R00021
+8	+0	+0	+0	+0	0	0	0	0	0	%R00031
+0	+0	+0	+0	+170	+8	+160	8	10	20	%R00041
+0	+0	+0	0	0	0	0	8158	10	1	%R00051
+10	+9	+8	+7	6	5	4	3	2	1	%R00061
+0	+0	+0	+0	+0	+0	+0	0	10	1	%R00071
+0	+0	+0	+0	0	+0	+0	8132	10	1	%R00081
+24	+23	+22	+21	+20	+19	+18	+17	+16	+15	%R00091
+0	+0	+0	+0	+0	+0	+0	+0	+10	+1	%R00101
+0	+0	+0	+0	+0	+0	+0	8112	7	257	%R00111
+1717	+1616	+1515	+14	+13	+12	+11	+10	+9	+8	%R00121
+0	+0	+0	+0	+0	+0	+0	+0	+10	+1	%R00131

Example 4, Part 4

This part of the example program logic:

1. Reads flash references %R0011 through %R0020 into PLC references %R0141 through %R0150 and returns Read status information to PLC memory starting at %R0151.

2. Reads flash references %R0021 through %R0030 into PLC references %R0161 through %R0170 and returns Read status information to PLC memory starting at %R0171.
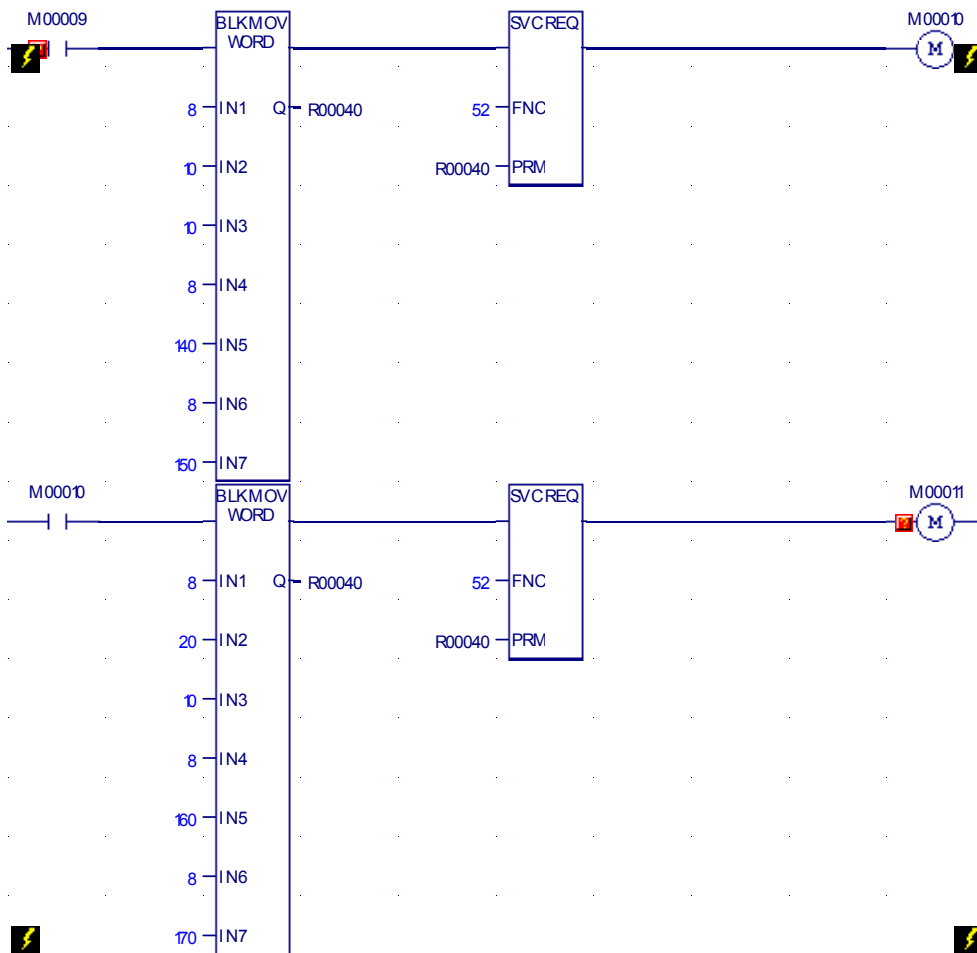
Results of Example 4, Part 4

For Example 4, Section 4, the Read status references start at %R0151 and %R0171:

- The value in Read status reference %R0151 is 1. The Read operation was successful.

- %R0152 shows that all 10 words of data were read into PLC memory.

- The value in Read status reference %R0171 is 257 (0x0101). That indicates partial success, because not all 10 bytes of data were written to flash. That can occur if not enough memory is available in the selected PLC reference area for the data that has been read from flash.

- %R0172 shows that only 4 words of data were read.

<--		Unsigned Decimal			0000000100000001			%R00111		Address
+10	+9	8	7	6	5	4	3	2	1	%R00001
+0	+0	+0	1717	1616	1515	14	13	12	11	%R00011
+0	+0	+0	+0	+0	+0	+24	23	22	+0	%R00021
+8	+0	+0	+0	+0	0	0	0	0	0	%R00031
+0	+0	+0	+0	+170	+8	+160	8	10	20	%R00041
+0	+0	+0	0	0	0	0	8158	10	1	%R00051
+10	+9	+8	+7	6	5	4	3	2	1	%R00061
+0	+0	+0	+0	+0	+0	+0	0	10	1	%R00071
+0	+0	+0	+0	0	+0	+0	8132	10	1	%R00081
+24	+23	+22	+21	+20	+19	+18	+17	+16	+15	%R00091
+0	+0	+0	+0	+0	+0	+0	+0	+10	+1	%R00101
+0	+0	+0	+0	+0	+0	+0	8112	7	257	%R00111
+1717	+1616	+1515	+14	+13	+12	+11	+10	+9	+8	%R00121
+0	+0	+0	+0	+0	+0	+0	+0	+10	+1	%R00131
+20	+19	+18	+1717	+1616	+1515	+14	+13	+12	+11	%R00141
+0	+0	+0	+0	+0	+0	+0	+0	+10	+1	%R00151
+0	+0	+0	+0	+0	+0	+24	+23	+22	+21	%R00161
+0	+0	+0	+0	+0	+0	+0	+0	4	257	%R00171
+0	+0	+0	+0	+0	+0	+0	+0	+0	+0	%R00181

_MAIN   %R - Register

Appendix	*Instruction Timing*
A	

This appendix contains tables listing the memory size in bytes and the execution times in microseconds for each function supported by a VersaMax Nano PLC or Micro PLC.

- Notes on Timing Information

- Typical Execution Times for Boolean Contacts

- Typical Execution Times for Release 4.0 CPUs

- Typical Execution Times for Release 3.8 CPUs

- Typical Execution Times for Release 3.0 CPUs

- Typical Execution Times for Release 2.0 CPUs

- Typical Execution Times for Release 1.1 CPUs

- Typical Execution Times for Release 1.0 CPUs

Notes on the Timing Information

Execution Times with Function Block Enabled or Disabled

Two execution times are shown for each type of function block, labeled "enabled" and "disabled".

For each instance of the function block in the logic program:

- the value in the "enabled" column represents a range of typical contribution times when the function block receives power flow during that sweep.

- the value in the "disabled" column represents the typical contribution time when the function block is not receiving power flow during that sweep and/or there is power flow to reset of the function block.

- All timing values represent typical execution time. Actual execution time may vary with input and error conditions.

Additional Notes

1. Timers and counters are updated each time they are encountered in the logic; timers by the amount of time consumed by the last sweep and counters by one count.

2. For bit operation functions, L = the number of bits. For bit position, N = the bit that is set. For data move functions, N = the number of bits or words. B= the number of bits shifted more than 1 (that is, not counting the first bit). W = the number of words.

3. Memory size refers to the number of bytes required by the function in a ladder diagram application program.

4. For table functions, increment is in units of length specified.

5. Enabled time for single length units of type %R, %AI, and %AQ.

6. The DO I/O function block timing represents execution on 8 points (%I0001 to %I0008).

Typical Execution Times for Boolean Contacts

Boolean contact execution times for Boolean logic are as follows:

	CPU Releases					
	3.8	*3.0*	*2.0, 1.10*	*1.07*	*1.05*	*1.0*
10-point Nano PLCs	1.4 ms/K	1.3 ms/K	1.3 ms/K	N/A	N/A	1.2 ms/K
14-point Micro PLCs	1.5 ms/K	1.1 ms/K	1.1 ms/K	N/A	N/A	1.0 ms/K
20-point Micro PLCs	1.7 ms/K	N/A	N/A	N/A	N/A	N/A
23-point Micro PLCs	1.5 ms/K	1.1 ms/K	1.1 ms/K	N/A	N/A	1.0 ms/K
28-point Micro PLCs	1.5 ms/K	1.1 ms/K	1.1 ms/K	N/A	1.0 ms/K	1.0 ms/K
40-point Micro PLCs	1.7 ms/K	N/A	N/A	N/A	N/A	N/A
28-point Micro PLC with ESCP (IC200UDD120	1.3 ms/K	1.0 ms/K	1.0 ms/K	1.0 ms/K	N/A	N/A
64-point Micro PLC	1.7 ms/K	1.7 ms/K	N/A	N/A	N/A	N/A

Sweep Times for Micro-64 CPUs

No expansion units connected = 2.9ms to 3.1ms

With 1 expansion unit = 3.5ms to 3.8ms

With 2 expansion unit = 3.8ms to 4ms

With 3 expansion unit = 4.3ms to 4.5ms

With 4 expansion unit = 4.4ms to 5ms

Typical Execution Times for Release 4.0 CPUs

The following table details function block timing for Release 4.0, Micro PLCs.

For each instance of a function block, the table shows typical execution times when the function block is enabled (receiving power flow) or disabled (not receiving power flow).

Group	Function	Size bytes	Execution Time (Range in μsec.) 20/40/64-Point Enabled	Disabled
Timers	Off Delay Timer	15	93	63
	On Delay Timer	15	97	70
	Elapsed Timer	15	70	51
Counters	Up Counter	13	64	59
	Down Counter	13	59	57
Math	Addition (INT)	13	39	9
	Addition (DINT)	19	52	9
	Addition (REAL)	17	138	9
	Subtraction (INT)	13	34	9
	Subtraction (DINT)	19	40	9
	Subtraction (REAL)	17	153	9
	Multiplication (INT)	13	43	9
	Multiplication (DINT)	13	33	9
	Multiplication (REAL)	17	145	9
	Division (INT)	13	58	9
	Division (DINT)	19	43	9
	Division (REAL)	17	237	9
	Modulo Division (INT)	13	57	9
	Modulo Division (DINT)	19	59	9
	Square Root (INT)	10	55	9
	Square Root (DINT)	13	46	9
	Square Root (REAL)	11	557	9
Trigonometric	SIN (REAL)	11	1534	9
	COS (REAL)	11	1630	9
	TAN (REAL)	11	2316	12
	ASIN (REAL)	11	1638	9
	ACOS (REAL)	11	1638	9
	ATAN (REAL)	11	951	9
Logarithmic	LOG (REAL)	11	1001	9
	LN (REAL)	11	915	9
Exponential	Power of e	11	703	9
	Power of X	11	368	9

			Execution Time (Range in μsec.)	
			20/40/64-Point	
Group	*Function*	*Size bytes*	*Enabled*	*Disabled*
Radian Conv	Convert RAD to DEG	11	379	9
	Convert DEG to RAD	17	79	9
Relational	Equal (INT)	10	35	9
	Equal (DINT	16	25	9
	Equal (REAL)	14	40	9
	Not Equal (INT)	10	22	9
	Not Equal (DINT)	16	38	9
	Not Equal (REAL)	14	46	9
	Greater Than (INT)	10	31	9
	Greater Than (DINT)	16	30	9
	Greater Than (REAL)	14	41	10
	Greater Than/Equal (INT)	10	22	9
	Greater Than/Equal (DINT)	16	24	9
	Greater Than/Equal (REAL)	14	36	9
	Less Than (INT)	10	22	9
	Less Than (DINT)	16	24	9
	Less Than (REAL)	14	36	9
	Less Than/Equal (INT)	10	21	9
	Less Than/Equal (DINT)	16	24	9
	Less Than/Equal (REAL)	14	40	9
	Range (INT)	13	26	9
	Range (DINT)	22	29	9
	Range (WORD)	13	26	9

Group	Function	Size bytes	Execution Time (Range in μsec.) 20/40/64-Point	
			Enabled	Disabled
Bit Operation	Logical AND	13	33	9
	Logical OR	13	32	9
	Logical Exclusive OR	13	33	9
	Logical Invert, NOT	10	28	9
	Shift Bit Left	16	204	10
	Shift Bit Right	16	139	10
	Rotate Bit Left	16	88	9
	Rotate Bit Right	16	106	9
	Bit Position	13	57	9
	Bit Clear	13	57	9
	Bit Test	13	35	9
	Bit Set	13	52	9
	Mask Compare (WORD)	25	129	9
	Mask Compare (DWORD)	25	113	9
Data Move	Move (INT)	10	27	9
	Move (BOOL)	13	62	9
	Move (WORD)	10	26	9
	Move (REAL)	13	41	9
	Block Move (INT)	28	34	9
	Block Move (WORD)	28	34	9
	Block Move (REAL)	13	61	11
	Block Clear (WORD)	11	59	9
	Shift Register (BIT)	16	103	10
	Shift Register (WORD)	16	85	10
	Bit Sequencer	16	97	93
	COMM_REQ	13	1035	245

			Execution Time (Range in μsec.)	
			20/40/64-Point	
Group	*Function*	*Size bytes*	*Enabled*	*Disabled*
Table	Array Move (INT)	22	83	9
	Array Move(DINT)	22	71	9
	Array Move (BOOL)	22	116	9
	Array Move (BYTE)	22	77	9
	Array Move (WORD)	22	83	9
	Search Equal (INT)	19	70	9
	Search Equal (DINT)	22	62	9
	Search Equal (BYTE)	19	56	9
	Search Equal (WORD)	19	70	9
	Search Not Equal (INT)	19	61	9
	Search Not Equal (DINT)	22	71	9
	Search Not Equal (BYTE)	19	55	9
	Search Not Equal (WORD)	19	68	9
	Search Greater/Equal (INT)	19	65	9
	Search Greater/Equal (DINT)	22	70	9
	Search Greater/Equal (BYTE)	19	44	9
	Search Greater/Equal (WORD)	19	61	9
	Search Greater Than (INT)	19	82	9
	Search Greater Than (DINT)	22	82	9
	Search Greater Than (BYTE)	19	55	9
	Search Greater Than (WORD)	19	70	9
	Search Less Than (INT)	19	66	9
	Search Less Than (DINT)	22	78	9
	Search Less Than (BYTE)	19	43	9
	Search Less Than (WORD)	19	64	9
	Search Less/Equal (INT)	19	64	9
	Search Less/Equal (DINT)	22	60	9
	Search Less/Equal (BYTE)	19	56	9
	Search Less/Equal (WORD)	19	64	9

Group	Function	Size bytes	Execution Time (Range in µsec.) 20/40/64-Point Enabled	Disabled
Conversion	Convert INT to REAL	10	53	9
	Convert REAL to INT	13	766	9
	Convert DINT to REAL	13	45	9
	Convert REAL to DINT	13	757	9
	Convert WORD to REAL	10	35	9
	Convert REAL to WORD	13	757	9
	Convert BDC to INT	10	40	9
	Convert INT to BCD	10	109	9
	Convert BCD to REAL	10	47	9
	Truncate to INT	13	175	9
	Truncate to DINT	13	156	9
Control	Call a Subroutine	7	36	7
	Do I/O	13	275	9
	Service Request #6	10	90	9
	Service Request #7 Read	10	426	9
	Service Request #7 Write	10	1012	9
	Service Request #9	10	145	9
	Service Request #14	10	315	9
	Service Request #15	10	25	9
	Service Request #16	10	162	9
	Service Request #18	10	81	9
	Service Request #23	10	316	9
	Service Request #26, #30	10	510	9
	Service Request #29	10	92	9
	Service Request #34	10	11	9
	Service Request #35	10	19	17
	Service Request #52	10	420	9
	Service Request #53	10	1082	9
	Nested MCR/ENDMCR	4	5	5
	PID-ISA Algorithm	16	236	59
	PID-IND Algorithm	16	236	59
Communication	MODBUS_TCP_RW*	41	214	40

* For the MODBUS_TCP_RW function block, time between Execute ON to busy ON is 720 µSec.

Typical Execution Times for Release 3.8 CPUs

The following table details function block timing for Release 3.8, Micro PLCs.

For each instance of a function block, the table shows typical execution times when the function block is enabled (receiving power flow) or disabled (not receiving power flow).

Group	Function	Size bytes	Execution Time (Range in µsec.) per PLC Type 20/40/64-Point Enabled	Disabled
Timers	Off Delay Timer	15	68-76	49-56
	On Delay Timer	15	70-78	55-62
	Elapsed Timer	15	69-74	36-42
Counters	Up Counter	13	44-51	40-47
	Down Counter	13	64-71	62-69
Math	Addition (INT)	13	33-38	4-10
	Addition (DINT)	19	45-51	4-10
	Addition (REAL)	17	134-139	4-10
	Subtraction (INT)	13	24-29	3-8
	Subtraction (DINT)	19	29-34	3-8
	Subtraction (REAL)	17	104-109	3-8
	Multiplication (INT)	13	37-42	4-10
	Multiplication (DINT)	13	28-33	4-10
	Multiplication (REAL)	17	134-139	4-10
	Division (INT)	13	54-59	4-10
	Division (DINT)	19	42-47	5-10
	Division (REAL)	17	220-225	5-10
	Modulo Division (INT)	13	45-50	5-10
	Modulo Division (DINT)	19	54-60	5-10
	Square Root (INT)	10	29-34	3-8
	Square Root (DINT)	13	34-39	3-8
	Square Root (REAL)	11	453-459	3-8

Typical Execution Times for Release 3.8 CPUs, continued

Group	Function	Size bytes	Execution Time (Range in µsec.) per PLC Type 20/40/64-Point Enabled	Disabled
Trigonometric	SIN (REAL)	11	1142-1148	3-8
	COS (REAL)	11	1328-1333	4-10
	TAN (REAL)	11	1633-1639	3-8
	ASIN (REAL)	11	1633-1639	5-10
	ACOS (REAL)	11	1633-1639	4-10
	ATAN (REAL)	11	850-856	4-10
Logarithmic	LOG (REAL)	11	889-894	5-10
	LN (REAL)	11	820-825	4-10
Exponential	Power of e	11	618-623	4-10
	Power of X	11	339-344	4-10
Radian Conv	Convert RAD to DEG	11	347-353	5-10
	Convert DEG to RAD	17	78-84	4-10
Relational	Equal (INT)	10	25-30	4-10
	Equal (DINT	16	19-25	4-10
	Equal (REAL)	14	36-41	4-10
	Not Equal (INT)	10	17-22	4-10
	Not Equal (DINT)	16	33-38	5-10
	Not Equal (REAL)	14	45-51	4-10
	Greater Than (INT)	10	28-33	4-10
	Greater Than (DINT)	16	22-27	4-10
	Greater Than (REAL)	14	48-53	4-10
	Greater Than/Equal (INT)	10	17-22	4-10
	Greater Than/Equal (DINT)	16	19-24	5-10
	Greater Than/Equal (REAL)	14	37-42	4-10
	Less Than (INT)	10	17-22	4-10
	Less Than (DINT)	16	19-24	4-10
	Less Than (REAL)	14	37-42	4-10
	Less Than/Equal (INT)	10	17-22	4-10
	Less Than/Equal (DINT)	16	19-24	4-10
	Less Than/Equal (REAL)	14	37-42	5-10
	Range (INT)	13	21-26	4-10
	Range (DINT)	22	23-29	4-10
	Range (WORD)	13	21-26	5-10

Typical Execution Times for Release 3.8 CPUs, continued

Group	Function	Size bytes	Execution Time (Range in μsec.) per PLC Type 20/40/64-Point Enabled	Disabled
Bit Operation	Logical AND	13	33-38	4-10
	Logical OR	13	34-39	4-10
	Logical Exclusive OR	13	28-33	3-8
	Logical Invert, NOT	10	29-35	4-10
	Shift Bit Left	16	158-164	4-10
	Shift Bit Right	16	102-108	4-10
	Rotate Bit Left	16	98-103	5-10
	Rotate Bit Right	16	88-93	5-10
	Bit Position	13	48-53	4-10
	Bit Clear	13	51-56	4-10
	Bit Test	13	32-37	4-10
	Bit Set	13	43-48	4-10
	Mask Compare (WORD)	25	122-127	4-9
	Mask Compare (DWORD)	25	97-102	4-10
Data Move	Move (INT)	10	22-27	5-10
	Move (BOOL)	13	53-58	4-10
	Move (WORD)	10	22-27	4-10
	Move (REAL)	13	31-37	5-10
	Block Move (INT)	28	28-34	5-10
	Block Move (WORD)	28	28-34	4-10
	Block Move (REAL)	13	51-57	4-10
	Block Clear (WORD)	11	47-52	4-10
	Shift Register (BIT)	16	89-94	4-10
	Shift Register (WORD)	16	63-69	4-10
	Bit Sequencer	16	82-91	78-87
	COMM_REQ	13	845	210-215

Typical Execution Times for Release 3.8 CPUs, continued

Group	Function	Size bytes	Execution Time (Range in μsec.) per PLC Type 20/40/64-Point	
			Enabled	*Disabled*
Table	Array Move (INT)	22	74-79	4-10
	Array Move(DINT)	22	65-71	4-10
	Array Move (BOOL)	22	105-110	4-10
	Array Move (BYTE)	22	68-74	4-10
	Array Move (WORD)	22	73-79	5-10
	Search Equal (INT)	19	60-66	5-10
	Search Equal (DINT)	22	61-67	5-10
	Search Equal (BYTE)	19	43-48	5-10
	Search Equal (WORD)	19	62-67	5-10
	Search Not Equal (INT)	19	45-50	3-8
	Search Not Equal (DINT)	22	52-58	3-8
	Search Not Equal (BYTE)	19	29-35	3-8
	Search Not Equal (WORD)	19	45-51	3-8
	Search Greater/Equal (INT)	19	49-54	5-10
	Search Greater/Equal (DINT)	22	51-56	5-10
	Search Greater/Equal (BYTE)	19	48-53	5-10
	Search Greater/Equal (WORD)	19	58-63	5-10
	Search Greater Than (INT)	19	51-57	3-8
	Search Greater Than (DINT)	22	54-59	3-8
	Search Greater Than (BYTE)	19	45-50	3-8
	Search Greater Than (WORD)	19	45-50	3-8
	Search Less Than (INT)	19	42-47	3-8
	Search Less Than (DINT)	22	51-57	3-8
	Search Less Than (BYTE)	19	43-49	3-8
	Search Less Than (WORD)	19	57-63	3-8
	Search Less/Equal (INT)	19	53-58	3-8
	Search Less/Equal (DINT)	22	55-60	3-8
	Search Less/Equal (BYTE)	19	42-47	3-8
	Search Less/Equal (WORD)	19	44-49	3-8

Typical Execution Times for Release 3.8 CPUs, continued

Group	Function	Size bytes	Execution Time (Range in µsec.) per PLC Type 20/40/64-Point Enabled	Disabled
Conversion	Convert INT to REAL	10	33-39	4-10
	Convert REAL to INT	13	723-729	4-10
	Convert DINT to REAL	13	29-34	4-10
	Convert REAL to DINT	13	741-747	5-10
	Convert WORD to REAL	10	38-43	4-10
	Convert REAL to WORD	13	728-733	4-10
	Convert BDC to INT	10	51-56	4-10
	Convert INT to BCD	10	107-112	4-10
	Convert BCD to REAL	10	51-56	4-10
	Truncate to INT	13	149-155	3-8
	Truncate to DINT	13	142-147	3-8
Control	Call a Subroutine	7	31-36	2-7
	Do I/O	13	248-253	5-10
	Service Request #6	10	51-56	3-8
	Service Request #7 Read	10	296-301	3-9
	Service Request #7 Write	10	1372-1378	1-5
	Service Request #9	10	82-88	3-8
	Service Request #14	10	245-251	3-8
	Service Request #15	10	146-151	3-8
	Service Request #16	10	71-77	3-8
	Service Request #18	10	65-70	3-8
	Service Request #23	10	212-217	3-8
	Service Request #26, #30	10	323-328	3-8
	Service Request #29	10	39-44	3-8
	Service Request #34	10	na	na
	Service Request #35	10	na	na
	Service Request #52	10	364-369	3-8
	Service Request #53	10	1012-1016	9
	Nested MCR/ENDMCR	4	4	4
	PID-ISA Algorithm	16	213-221	46-54
	PID-IND Algorithm	16	217-219	52-53

Typical Execution Times for Release 3.0 CPUs

The following table details function block timing for Release 3.0, MicroPLCs.

For each instance of a function block, the table shows typical execution times when the function block is enabled (receiving power flow) or disabled (not receiving power flow).

			Execution Time (Range in μsec.) per PLC Type							
			64-Point		14/23/28 pt		28pt ESCP		Nano	
Group	*Function*	*Size bytes*	*Enabled*	*Dis-abled*	*En-abled*	*Dis-abled*	*En-abled*	*Dis-abled*	*En-abled*	*Dis-abled*
Timers	Off Delay Timer	15	68-76	49-56	64-71	35-41	55-60	31-36	61-67	33-38
	On Delay Timer	15	70-78	55-62	79-85	43-49	63-69	37-42	71-76	40-45
	Elapsed Timer	15	69-74	36-42	66-71	53-58	49-53	39-43	60-64	49-53
Counters	Up Counter	13	44-51	40-47	57-63	54-61	41-46	39-45	53-59	50-55
	Down Counter	13	64-71	62-69	48-55	47-53	41-47	39-45	42-48	40-46
Math	Addition (INT)	13	33-38	4-10	30-35	4-9	27-31	4-8	28-33	4-8
	Addition (DINT)	19	45-51	4-10	41-47	4-9	35-39	4-8	38-43	4-8
	Addition (REAL)	17	134-139	4-10	109-114	4-9	87-91	4-8	114-119	4-8
	Subtraction (INT)	13	24-29	3-8	26-31	4-9	21-25	3-7	24-29	4-8
	Subtraction (DINT)	19	29-34	3-8	31-36	4-9	24-28	3-7	29-33	4-8
	Subtraction (REAL)	17	104-109	3-8	125-130	4-9	88-91	3-7	113-117	4-8
	Multiplication (INT)	13	37-42	4-10	34-39	4-9	30-34	4-8	31-36	4-8
	Multiplication (DINT)	13	28-33	4-10	25-30	4-9	23-27	4-8	23-27	4-8
	Multiplication (REAL)	17	134-139	4-10	126-131	4-9	101-104	4-8	106-110	4-8
	Division (INT)	13	54-59	4-10	43-48	4-9	37-41	4-8	44-49	4-8
	Division (DINT)	19	42-47	5-10	27-32	4-9	25-28	4-8	37-42	4-8
	Division (REAL)	17	220-225	5-10	206-211	4-9	165-169	4-8	184-188	4-8
	Modulo Division (INT)	13	45-50	5-10	43-49	4-9	38-42	4-8	45-50	4-8
	Modulo Division (DINT)	19	54-60	5-10	41-46	4-9	36-39	4-8	49-53	4-8
	Square Root (INT)	10	29-34	3-8	32-37	4-9	24-28	3-7	29-34	4-8
	Square Root (DINT)	13	34-39	3-8	36-42	4-9	30-34	3-7	34-39	4-8
	Square Root (REAL)	11	453-459	3-8	498-504	4-9	336-340	3-7	449-454	4-8

Typical Execution Times for Release 3.0 CPUs, continued

			Execution Time (Range in µsec.) per PLC Type							
			64-Point		14/23/28 pt		28pt ESCP		Nano	
Group	Function	Size bytes	Enabled	Dis-abled	Enabled	Dis-abled	Enabled	Dis-abled	Enabled	Dis-abled
Trigonometric	SIN (REAL)	11	1142-1148	3-8	1246-1251	4-9	869-873	3-7	1131-1135	4-8
	COS (REAL)	11	1328-1333	4-10	1212-1217	4-9	964-967	4-8	1088-1092	4-8
	TAN (REAL)	11	1633-1639	3-8	1634-1639	4-9	1290-1293	3-7	1634-1639	4-8
	ASIN (REAL)	11	1633-1639	5-10	1634-1639	4-9	1383-1387	4-8	1581-1586	4-8
	ACOS (REAL)	11	1633-1639	4-10	1634-1639	4-9	1354-1358	4-8	1537-1542	4-8
	ATAN (REAL)	11	850-856	4-10	782-788	4-9	616-620	4-8	704-709	4-8
Logarithmic	LOG (REAL)	11	889-894	5-10	826-831	4-9	650-654	4-8	744-749	4-8
	LN (REAL)	11	820-825	4-10	757-762	4-9	597-600	4-8	690-694	4-8
Exponential	Power of e	11	618-623	4-10	562-568	4-9	442-446	4-8	512-517	4-8
	Power of X	11	339-344	4-10	327-332	4-9	254-258	4-8	294-299	4-8
Radian Conv	Convert RAD to DEG	11	347-353	5-10	319-324	4-9	252-256	34-38	295-300	4-8
	Convert DEG to RAD	17	78-84	4-10	78-83	4-9	63-67	4-8	75-79	4-8
Relational	Equal (INT)	10	25-30	4-10	22-28	4-9	20-24	4-8	21-26	4-8
	Equal (DINT	16	19-25	4-10	18-23	4-9	17-20	4-8	16-21	4-8
	Equal (REAL)	14	36-41	4-10	31-36	4-9	27-31	4-8	34-39	4-8
	Not Equal (INT)	10	17-22	4-10	15-21	4-9	15-18	4-8	14-19	4-8
	Not Equal (DINT)	16	33-38	5-10	29-35	4-9	26-29	4-8	28-32	4-8
	Not Equal (REAL)	14	45-51	4-10	35-40	4-9	30-34	4-8	35-39	4-8
	Greater Than (INT)	10	28-33	4-10	26-31	4-9	22-26	4-8	24-29	4-8
	Greater Than (DINT)	16	22-27	4-10	19-25	4-9	18-21	4-8	18-23	4-8
	Greater Than (REAL)	14	48-53	4-10	34-39	4-9	30-33	4-8	32-37	4-8
	Greater Than/Equal (INT)	10	17-22	4-10	16-21	4-9	14-18	4-8	15-19	4-8
	Greater Than/Equal (DINT)	16	19-24	5-10	17-23	4-9	16-20	4-8	16-20	4-8
	Greater Than/Equal (REAL)	14	37-42	4-10	34-39	4-9	29-33	4-8	21-26	4-8
	Less Than (INT)	10	17-22	4-10	15-21	4-9	14-18	4-8	14-19	4-8
	Less Than (DINT)	16	19-24	4-10	17-22	4-9	16-20	4-8	16-20	4-8
	Less Than (REAL)	14	37-42	4-10	23-29	4-9	22-25	4-8	22-26	4-8
	Less Than/Equal (INT)	10	17-22	4-10	15-21	4-9	15-19	4-8	15-19	4-8
	Less Than/Equal (DINT)	16	19-24	4-10	17-22	4-9	16-20	4-8	16-20	4-8
	Less Than/Equal (REAL)	14	37-42	5-10	24-29	4-9	22-25	4-8	22-26	4-8
	Range (INT)	13	21-26	4-10	19-25	4-9	18-22	4-8	18-22	4-8
	Range (DINT)	22	23-29	4-10	21-27	4-9	20-24	4-8	20-24	4-8
	Range (WORD)	13	21-26	5-10	19-24	4-9	18-21	4-8	18-23	4-8

Typical Execution Times for Release 3.0 CPUs, continued

Group	Function	Size bytes	64-Point Enabled	64-Point Dis-abled	14/23/28 pt En-abled	14/23/28 pt Dis-abled	28pt ESCP En-abled	28pt ESCP Dis-abled	Nano En-abled	Nano Dis-abled
Bit Operation	Logical AND	13	33-38	4-10	31-36	4-9	27-31	4-8	28-32	4-8
	Logical OR	13	34-39	4-10	30-35	4-9	27-31	4-8	28-32	4-8
	Logical Exclusive OR	13	28-33	3-8	30-35	4-9	23-27	3-7	28-33	4-8
	Logical Invert, NOT	10	29-35	4-10	27-32	4-9	24-27	4-8	25-29	4-8
	Shift Bit Left	16	158-164	4-10	118-123	5-10	127-131	4-8	161-166	5-9
	Shift Bit Right	16	102-108	4-10	113-118	5-10	80-84	4-8	103-107	5-9
	Rotate Bit Left	16	98-103	5-10	84-89	4-9	67-71	4-8	76-81	4-8
	Rotate Bit Right	16	88-93	5-10	88-93	4-9	71-75	4-8	80-84	4-8
	Bit Position	13	48-53	4-10	43-48	4-9	38-41	4-8	40-44	4-8
	Bit Clear	13	51-56	4-10	46-52	4-9	34-38	3-7	43-47	4-8
	Bit Test	13	32-37	4-10	29-35	4-9	26-29	4-8	27-32	4-8
	Bit Set	13	43-48	4-10	39-44	4-9	34-38	4-8	37-41	4-8
	Mask Compare (WORD)	25	122-127	4-9	108-113	4-9	89-93	3-7	99-104	3-8
	Mask Compare (DWORD)	25	97-102	4-10	94-99	3-9	77-81	3-7	80-84	4-8
Data Move	Move (INT)	10	22-27	5-10	20-25	4-9	18-22	4-8	18-23	4-8
	Move (BOOL)	13	53-58	4-10	49-54	4-9	42-46	4-8	45-50	4-8
	Move (WORD)	10	22-27	4-10	20-25	4-9	18-22	4-8	18-23	4-8
	Move (REAL)	13	31-37	5-10	28-33	4-9	26-29	4-8	26-31	4-8
	Block Move (INT)	28	28-34	5-10	26-31	4-9	24-27	4-8	24-28	4-8
	Block Move (WORD)	28	28-34	4-10	25-31	4-9	24-27	4-8	24-28	4-8
	Block Move (REAL)	13	51-57	4-10	47-52	4-9	43-47	4-8	51-55	10-14
	Block Clear (WORD)	11	47-52	4-10	43-48	4-9	38-42	4-8	40-45	4-8
	Shift Register (BIT)	16	89-94	4-10	95-100	5-10	69-72	4-8	87-92	5-9
	Shift Register (WORD)	16	63-69	4-10	73-78	5-10	54-58	4-8	67-71	5-9
	Bit Sequencer	16	82-91	78-87	71-79	67-75	59-65	56-62	73-81	70-77
	COMM_REQ	13	82-87	16-21	75-80	12-17	62-66	11-15	65-70	16-21

Typical Execution Times for Release 3.0 CPUs, continued

Group	Function	Size bytes	64-Point En-abled	64-Point Dis-abled	14/23/28 pt En-abled	14/23/28 pt Dis-abled	28pt ESCP En-abled	28pt ESCP Dis-abled	Nano En-abled	Nano Dis-abled
			Execution Time (Range in µsec.) per PLC Type							
Table	Array Move (INT)	22	74-79	4-10	67-72	4-9	58-61	4-8	62-66	4-8
	Array Move(DINT)	22	65-71	4-10	60-65	4-9	52-56	4-8	54-58	4-8
	Array Move (BOOL)	22	105-110	4-10	90-95	4-9	75-79	4-8	83-87	4-8
	Array Move (BYTE)	22	68-74	4-10	63-68	4-9	54-58	4-8	58-62	4-8
	Array Move (WORD)	22	73-79	5-10	66-72	4-9	58-61	4-8	62-66	4-8
	Search Equal (INT)	19	60-66	5-10	58-63	4-9	49-53	4-8	53-58	4-8
	Search Equal (DINT)	22	61-67	5-10	53-58	4-9	45-49	4-8	48-52	4-8
	Search Equal (BYTE)	19	43-48	5-10	49-54	4-9	42-46	4-8	45-50	4-8
	Search Equal (WORD)	19	62-67	5-10	58-63	4-9	49-53	4-8	54-58	4-8
	Search Not Equal (INT)	19	45-50	3-8	59-64	4-9	44-48	3-7	54-59	4-8
	Search Not Equal (DINT)	22	52-58	3-8	52-57	4-9	41-44	3-7	48-53	4-8
	Search Not Equal (BYTE)	19	29-35	3-8	41-46	4-9	31-35	3-7	38-43	4-8
	Search Not Equal (WORD)	19	45-51	3-8	59-64	4-9	44-48	3-7	54-59	4-8
	Search Greater/Equal (INT)	19	49-54	5-10	53-58	4-9	40-44	3-7	49-54	4-8
	Search Greater/Equal (DINT)	22	51-56	5-10	54-59	4-9	40-44	3-7	51-55	4-8
	Search Greater/Equal (BYTE)	19	48-53	5-10	38-43	4-9	30-34	3-7	34-39	4-8
	Search Greater/Equal (WORD)	19	58-63	5-10	50-55	4-9	38-42	3-7	46-50	4-8
	Search Greater Than (INT)	19	51-57	3-8	55-60	4-9	42-46	3-7	51-56	4-8
	Search Greater Than (DINT)	22	54-59	3-8	49-54	4-9	38-41	3-7	46-51	4-8
	Search Greater Than (BYTE)	19	45-50	3-8	47-52	4-9	36-40	3-7	44-48	4-8
	Search Greater Than (WORD)	19	45-50	3-8	49-54	4-9	38-42	3-7	46-51	4-8
	Search Less Than (INT)	19	42-47	3-8	57-62	4-9	42-46	3-7	53-57	4-8
	Search Less Than (DINT)	22	51-57	3-8	66-72	4-9	49-53	3-7	61-66	4-8
	Search Less Than (BYTE)	19	43-49	3-8	38-43	4-9	30-33	3-7	36-40	4-8
	Search Less Than (WORD)	19	57-63	3-8	55-60	4-9	41-45	3-7	50-54	4-8
	Search Less/Equal (INT)	19	53-58	3-8	55-60	4-9	41-45	3-7	52-56	4-8
	Search Less/Equal (DINT)	22	55-60	3-8	58-63	4-9	43-46	3-7	54-58	4-8
	Search Less/Equal (BYTE)	19	42-47	3-8	32-37	4-9	25-29	3-7	30-34	4-8
	Search Less/Equal (WORD)	19	44-49	3-8	42-47	4-9	32-36	3-7	39-43	4-8

Typical Execution Times for Release 3.0 CPUs, continued

Group	Function	Size bytes	Execution Time (Range in μsec.) per PLC Type							
			64-Point		14/23/28 pt		28pt ESCP		Nano	
			En-abled	Dis-abled	En-abled	Dis-abled	En-abled	Dis-abled	En-abled	Dis-abled
Conversion	Convert INT to REAL	10	33-39	4-10	34-39	4-9	29-32	4-8	28-33	4-8
	Convert REAL to INT	13	723-729	4-10	683-688	4-9	543-547	4-8	629-634	4-8
	Convert DINT to REAL	13	29-34	4-10	35-41	4-9	30-34	4-8	25-29	4-8
	Convert REAL to DINT	13	741-747	5-10	671-676	4-9	532-535	4-8	610-615	4-8
	Convert WORD to REAL	10	38-43	4-10	31-36	4-9	23-27	3-7	26-30	4-8
	Convert REAL to WORD	13	728-733	4-10	666-671	4-9	529-533	4-8	612-616	4-8
	Convert BDC to INT	10	51-56	4-10	29-34	4-9	25-29	4-8	26-31	4-8
	Convert INT to BCD	10	107-112	4-10	86-91	4-9	74-78	4-8	78-82	4-8
	Convert BCD to REAL	10	51-56	4-10	37-42	4-9	31-35	4-8	47-52	4-8
	Truncate to INT	13	149-155	3-8	168-173	4-9	117-121	3-7	148-152	4-8
	Truncate to DINT	13	142-147	3-8	161-166	4-9	113-117	3-7	141-145	4-8
Control	Call a Subroutine	7	31-36	2-7	28-33	2-7	26-30	2-6	25-29	2-6
	Do I/O	13	248-253	5-10	207-212	4-9	166-170	4-8	167-171	4-8
	Service Request #6	10	51-56	3-8	59-64	4-9	43-47	3-7	53-57	4-8
	Service Request #7 Read	10	296-301	3-9	308-313	4-9	221-225	3-7	0-0	0-0
	Service Request #7 Write	10	1372-1378	1-5	281-286	1-6	194-198	1-4	0-0	0-0
	Service Request #9	10	82-88	3-8	102-107	4-9	72-76	3-7	90-95	4-8
	Service Request #14	10	245-251	3-8	258-263	4-9	208-212	4-8	104-109	4-8
	Service Request #15	10	146-151	3-8	156-161	4-9	126-130	4-8	132-136	4-8
	Service Request #16	10	71-77	3-8	91-96	4-9	74-77	4-8	71-75	4-8
	Service Request #18	10	65-70	3-8	67-72	4-9	59-63	4-8	55-59	4-8
	Service Request #23	10	212-217	3-8	236-242	4-9	173-177	3-7	207-212	4-8
	Service Request #26, #30	10	323-328	3-8	342-347	4-9	279-283	4-8	293-298	4-8
	Service Request #29	10	39-44	3-8	56-61	4-9	47-51	4-8	40-44	4-8
	Service Request #34	10	na	na	57-62	4-9	n/a	n/a	n/a	n/a
	Service Request #35	10	na	na	494-499	4-9	n/a	n/a	n/a	n/a
	Service Request #52	10	364-369	3-8	333-338	4-9	281-285	4-8	n/a	n/a
	Service Request #53	10	3-4	2-4	3-5	1-5	3-4	2-4	3-4	1-4
	Nested MCR/ENDMCR	4	213-222	46-55	196-204	42-50	155-162	37-43	191-198	50-57
	PID-ISA Algorithm	16	213-221	46-54	196-204	42-50	155-161	37-43	191-198	50-58
	PID-IND Algorithm	16	82-87	16-21	75-80	12-17	62-66	11-15	65-70	16-21

Typical Execution Times for Release 2.0 CPUs

The following table details function block timing for Release 2.0, Micro PLCs and Nano PLCs. PLCs are grouped by similar types: Nano PLCs, 14/23/28 Point Micro PLCs, and 28-Point Micro PLCS with ESCP.

For each instance of a function block, the table shows typical execution times when the function block is enabled (receiving power flow) or disabled (not receiving power flow).

			Execution Time (Range in µsec.)					
			Function Enabled			Function Disabled		
Group	*Function*	*Size (bytes)*	*14/23/28 pt*	*28pt ESCP*	*Nano*	*14/23/28 pt*	*28pt ESCP*	*Nano*
Timers	Off Delay Timer	15	64-112	54-75	63-93	46-76	39-53	44-67
	On Delay Timer	15	63-120	66 - 79	61-100	45-83	40-58	42-71
	Elapsed Timer	15	58-114	59-75	56-96	34-75	40-52	32-66
Counters	Up Counter	13	67-69	–50-53	89-136	63-64	48-48	47-74
	Down Counter	13	47-82	57-63	43-79	39-77	50-60	37-75
Math	Addition (INT)	13	30-63	27-45	28-55	6-10	5-8	6-10
	Addition (DINT)	19	41-57	35-43	38-54	6-10	5-8	6-10
	Addition (REAL)	17	89-121	–77-91	87-118	6-10	5-8	6-10
	Subtraction (INT)	13	26-62	24-45	26-55	6-10	5-8	6-10
	Subtraction (DINT)	19	36-57	27-44	30-53	6-10	5-8	6-10
	Subtraction (REAL)	17	96-112	–83-90	100-117	6-10	5-8	6-9
	Multiplication (INT)	13	34-66	30-47	31-57	6-10	5-8	6-10
	Multiplication (DINT)	13	25-56	23-44	24-53	6-10	5-8	6-10
	Multiplication (REAL)	17	106-149	97-114	109-141	6-10	5-8	6-10
	Division (INT)	13	42-77	34-55	39-67	6-10	5-8	6-10
	Division (DINT)	19	27-65	28-50	26-61	6-10	5-8	6-10
	Division (REAL)	17	187-241	152-186	179-229	6-10	5-8	6-10
	Modulo Division (INT)	13	46-86	38-61	40-75	6-10	5-8	6-10
	Modulo Division (DINT)	19	41-72	38-55	38-68	6-10	5-8	6-10
	Square Root (INT)	10	43-82	38-64	41-79	6-9	5-8	6-10
	Square Root (DINT)	13	51-83	34-77	34-96	6-10	5-8	5-10
	Square Root (REAL)	11	437-534	351 - 406	420-506	6-10	5-8	6-10

Typical Execution Times for Release 2.0 CPUs, continued

Group	Function	Size (bytes)	Execution Time (Range in µsec.)					
			Function Enabled			Function Disabled		
			14/23/28 pt	28pt ESCP	Nano	14/23/28 pt	28pt ESCP	Nano
Trigonometric	SIN (REAL)	11	1103-1523	919-1156	1064-1446	6-10	5-8	6-10
	COS (REAL)	11	1091-1519	908-1192	1048-1444	6-10	5-8	5-9
	TAN (REAL)	11	1691-2256	1370-1708	1622-2144	8-12	5-9	7-10
	ASIN (REAL)	11	1528-1638	1274-1479	1507-1639	6-10	5-8	6-10
	ACOS (REAL)	11	1528-1639	1220-1442	1507-1638	6-10	5-8	6-9
	ATAN (REAL)	11	695-867	564-671	678-822	6-10	5-8	6-10
Logarithmic	LOG (REAL)	11	734-926	599-710	709-878	6-10	5-8	6-10
	LN (REAL)	11	672-866	555-659	646-821	6-10	5-8	6-10
Exponential	Power of e	11	516-623	411-472	497-591	6-10	5-8	6-10
	Power of X	11	292-379	226-287	276-359	6-10	5-8	6-10
Radian Conv	Convert RAD to DEG	11	288-326	238-252	274-308	6-10	5-8	6-10
	Convert DEG to RAD	17	70-100	59-77	66-95	6-10	5-8	6-10
Relational	Equal (INT)	10	25-36	21-28	24-34	8-12	7-9	7-11
	Equal (DINT	16	21-44	19-34	20-42	8-12	7-9	7-10
	Equal (REAL)	14	33-57	29-44	31-54	8-12	7-9	7-11
	Not Equal (INT)	10	18-36	17-28	18-34	8-12	7-9	7-11
	Not Equal (DINT)	16	32-42	27-32	30-39	8-12	7-9	7-11
	Not Equal (REAL)	14	37-57	32-44	34-54	8-12	7-9	7-11
	Greater Than (INT)	10	28-36	24-28	27-34	8-12	7-9	7-11
	Greater Than (DINT)	16	22-42	20-32	21-40	8-12	7-9	7-11
	Greater Than (REAL)	14	37-58	31-44	34-54	8-12	7-9	7-11
	Greater Than/Equal (INT)	10	19-36	17-28	17-34	8-12	7-9	7-11
	Greater Than/Equal (DINT)	16	20-42	19-32	19-39	8-12	7-9	7-11
	Greater Than/Equal (REAL)	14	29-57	32-44	34-54	8-12	7-9	7-11
	Less Than (INT)	10	19-36	16-28	18-34	8-12	7-9	7-11
	Less Than (DINT)	16	20-42	18-32	19-39	8-12	7-9	7-11
	Less Than (REAL)	14	36-58	23-44	24-54	8-12	7-9	7-11
	Less Than/Equal (INT)	10	18-36	17-28	17-34	8-12	7-9	7-11
	Less Than/Equal (DINT)	16	20-42	18-32	19-39	8-12	7-9	7-11
	Less Than/Equal (REAL)	14	26-58	23-44	24-54	8-12	7-9	7-11
	Range (INT)	13	22-44	20-34	20-42	8-12	7-9	7-11
	Range (DINT)	22	24-51	20-39	22-48	8-12	7-9	7-11
	Range (WORD)	13	22-43	20-33	20-41	8-12	7-9	7-11

Typical Execution Times for Release 2.0 CPUs, continued

Group	Function	Size (bytes)	Function Enabled 14/23/ 28 pt	Function Enabled 28pt ESCP	Function Enabled Nano	Function Disabled 14/23/ 28 pt	Function Disabled 28pt ESCP	Function Disabled Nano
Bit Operation	Logical AND	13	30-55	27-42	29-52	6-10	5-8	6-10
	Logical OR	13	30-55	27-42	28-52	6-10	5-8	6-10
	Logical Exclusive OR	13	31-55	27-42	28-52	6-10	5-8	6-10
	Logical Invert, NOT	10	27-45	24-35	25-43	6-10	5-8	6-10
	Shift Bit Left	16	109-130	90-101	102-123	7-11	6-8	7-11
	Shift Bit Right	16	108-120	88-93	102-113	7-11	6-8	7-11
	Rotate Bit Left	16	77-108	64-83	72-102	6-10	5-8	6-10
	Rotate Bit Right	16	82-109	64-71	78-103	6-10	5-8	6-10
	Bit Position	13	43-72	36-55	40-68	6-10	5-9	6-10
	Bit Clear	13	45-67	38-51	43-63	6-10	5-8	6-10
	Bit Test	13	32-54	28-42	29-51	8-12	7-8	7-11
	Bit Set	13	38-66	34-50	36-62	6-10	5-8	6-10
	Mask Compare (WORD)	25	90-145	83-113	82-137	8-12	7-9	7-11
	Mask Compare (DWORD)	25	92-145	77-112	88-137	8-12	7-9	7-11
Data Move	Move (INT)	10	20-42	19-32	19-40	6-10	5-8	6-10
	Move (BOOL)	13	47-75	37-47	45-71	6-10	5-8	6-10
	Move (WORD)	10	20-42	18-32	19-40	6-10	5-8	6-10
	Move (REAL)	13	28-56	26-44	26-53	6-10	5-8	6-10
	Block Move (INT)	28	26-58	24-44	24-54	6-10	5-8	6-10
	Block Move (WORD)	28	26-58	24-44	24-54	6-10	5-8	6-10
	Block Move (REAL)	13	47-108	44-82	46-103	7-10	6-8	7-10
	Block Clear (WORD)	11	43-90	38-70	40-85	6-10	5-8	6-9
	Shift Register (BIT)	16	92-125	73-98	87-119	7-11	6-9	7-10
	Shift Register (WORD)	16	67-111	51-88	65-106	7-11	6-9	7-11
	Bit Sequencer	16	111-142	97-140	109-134	86-104	68-107	78-98
	COMM_REQ	13	616-762	489-541	405-456	6-10	5-8	6-10

Typical Execution Times for Release 2.0 CPUs, continued

Group	Function	Size (bytes)	Execution Time (Range in µsec.)					
			Function Enabled			*Function Disabled*		
			14/23/28 pt	*28pt ESCP*	*Nano*	*14/23/ 28 pt*	*28pt ESCP*	*Nano*
Table	Array Move (INT)	22	61-106	53-83	57-100	6-10	5-8	6-10
	Array Move(DINT)	22	54-95	48-72	51-90	6-10	5-8	6-10
	Array Move (BOOL)	22	77-130	67-101	72-123	6-10	5-8	6-10
	Array Move (BYTE)	22	58-104	51-79	53-98	6-10	5-8	6-10
	Array Move (WORD)	22	62-106	53-83	57-100	6-10	5-8	6-10
	Search Equal (INT)	19	51-85	42-66	47-81	8-12	7-10	7-11
	Search Equal (DINT)	22	41-81	46-63	38-77	8-12	7-10	7-11
	Search Equal (BYTE)	19	50-80	35-62	46-76	8-12	7-9	7-11
	Search Equal (WORD)	19	51-85	42-66	48-81	8-12	7-9	7-11
	Search Not Equal (INT)	19	64-93	42-72	59-88	8-12	7-9	7-11
	Search Not Equal (DINT)	22	67-101	65-80	65-97	8-12	7-9	7-11
	Search Not Equal (BYTE)	19	50-80	33-55	42-66	8-12	7-9	7-11
	Search Not Equal (WORD)	19	44-77	38-60	49-73	8-12	6-9	7-11
	Search Greater/Equal (INT)	19	55-83	49-66	52-80	8-11	7-9	7-11
	Search Greater/Equal (DINT)	22	50-81	49-63	47-77	8-12	7-9	7-11
	Search Greater/Equal (BYTE)	19	44-80	40-62	43-76	8-12	7-9	7-11
	Search Greater/Equal (WORD)	19	48-86	40-66	46-81	8-12	7-9	7-11
	Search Greater Than (INT)	19	56-89	46-72	53-86	8-12	7-9	7-11
	Search Greater Than (DINT)	22	57-87	44-69	53-83	8-12	7-9	7-11
	Search Greater Than (BYTE)	19	46-93	48-67	44-82	8-12	7-9	7-11
	Search Greater Than (WORD)	19	55-91	52-72	52-88	8-12	7-9	7-11
	Search Less Than (INT)	19	54-78	38-61	50-74	8-12	7-9	7-11
	Search Less Than (DINT)	22	66-103	47-80	62-98	8-12	7-9	7-12
	Search Less Than (BYTE)	19	40-71	38-55	36-67	8-12	7-9	7-11
	Search Less Than (WORD)	19	43-79	48-61	40-74	8-12	7-9	7-11
	Search Less/Equal (INT)	19	43-78	46-61	40-73	8-12	7-9	7-11
	Search Less/Equal (DINT)	22	41-81	48-63	38-77	8-12	7-9	7-11
	Search Less/Equal (BYTE)	19	48-71	36-55	45-67	8-12	7-9	7-11
	Search Less/Equal (WORD)	19	55-78	45-61	60-74	8-12	7-9	7-11

Typical Execution Times for Release 2.0 CPUs, continued

Group	Function	Size (bytes)	Function Enabled 14/23/28 pt	Function Enabled 28pt ESCP	Function Enabled Nano	Function Disabled 14/23/28 pt	Function Disabled 28pt ESCP	Function Disabled Nano
Conversion	Convert INT to REAL	10	37-56	29-42	30-52	6-10	5-8	6-10
	Convert REAL to INT	13	616-705	507-547	585-668	6-10	5-8	6-10
	Convert DINT to REAL	13	37-58	28-44	32-54	6-10	5-8	6-9
	Convert REAL to DINT	13	605-695	507-539	567-659	6-10	5-8	6-9
	Convert WORD to REAL	10	34-55	28-42	28-52	6-10	5-8	6-10
	Convert REAL to WORD	13	607-663	501-513	576-628	6-10	5-8	6-10
	Convert BDC to INT	10	28-53	25-40	27-50	6-10	5-8	6-10
	Convert INT to BCD	10	80-170	76-130	76-161	6-10	5-8	6-10
	Convert BCD to REAL	10	41-68	33-52	33-64	6-10	5-8	6-10
	Truncate to INT	13	152-190	134-146	145-179	6-10	5-8	6-10
	Truncate to DINT	13	150-181	113-140	137-171	6-10	5-9	6-10
Control	Call a Subroutine	7	28-56	27-44	26-52	4-6	3-4	4-5
	Do I/O	13	183-206	149-205	168-186	6-10	5-10	6-10
	Service Request #6	10	57-71	41-55	53-67	6-12	5-8	6-10
	Service Request #7 Read	10	289-427 *	236-315	N/A	6-10 *	5-8	N/A
	Service Request #7 Write	10	519-520 *	393-406	N/A	6-10 *	5-8	N/A
	Service Request #9	10	76-112	65-86	105-123	5-10	5-7	5-9
	Service Request #14	10	250-363	199-274	103-149	7-10	5-8	6-10
	Service Request #15	10	66-92	65-72	64-87	6-10	5-8	6-10
	Service Request #16	10	78-103	64-79	71-97	6-10	5-8	6-10
	Service Request #18	10	56-141	52-107	52-133	6-10	5-8	6-10
	Service Request #23	10	206-433	186-325	163-210	6-10	5-8	6-10
	Service Request #26, #30	10	269-362	201-283	249-343	6-10	5-8	6-10
	Service Request #29	10	48-69	41-53	45-65	6-10	5-8	6-10
	Nested MCR/ENDMCR	4	4	3	4	3	3	3
	PID-ISA Algorithm	16	166-194	135-149	155-185	50-79	43-61	47-74
	PID-IND Algorithm	16	164-194	135-150	155-184	50-80	43-61	47-74

* Not applicable for 14-Point CPUs.

Typical Execution Times for Release 1.1 CPUs

Depending upon the application, release 1.1 CPUs show the following estimated reductions in program execution times when compared with release 1.0 CPUs:

Nano PLCs: 20% - 28%
14 Pt Micro PLCs: 28%
28 Pt Micro PLCs: 28%

The following table details function block timing for a Release 1.1, 28-Point Micro PLC CPU with ESCP, model IC200UDD120. For each instance of a function block, the table shows typical execution times when the function block is enabled (receiving power flow) or disabled (not receiving power flow).

Group	Function	Size (bytes)	Rel. 1.07 / 1.1 28-Point CPU with ESCP	
			Function Enabled	*Function Disabled*
			Time, Range	*Time, Typical*
Timers	Off Delay Timer	15	60 - 70	56
	On Delay Timer	15	66 - 77	56
	Elapsed Timer	15	62 - 72	50
Counters	Up Counter	13	40 - 60	58
	Down Counter	13	60	54
Math	Addition (INT)	13	30 - 40	7
	Addition (DINT)	19	40	9
	Addition (REAL)	17	89 - 100	8
	Subtraction (INT)	13	30 - 40	6
	Subtraction (DINT)	19	30 -40	7
	Subtraction (REAL)	17	91 - 100	9
	Multiplication (INT)	13	29 - 42	7
	Multiplication (DINT)	13	24 - 40	8
	Multiplication (REAL)	17	80 - 108	8
	Division (INT)	13	40 - 50	6
	Division (DINT)	19	31 - 49	10
	Division (REAL)	17	150 - 182	9
	Modulo Division (INT)	13	48 - 60	7
	Modulo Division (DINT)	19	44 - 51	10
	Square Root (INT)	10	39 - 60	7
	Square Root (DINT)	13	34 - 74	10
	Square Root (REAL)	11	351 - 404	8

Typical Execution Times for Release 1.1 CPUs, continued

Group	Function	Size (bytes)	Rel. 1.07 / 1.1 28-Point CPU with ESCP	
			Function Enabled	Function Disabled
			Time, Range	Time, Typical
Trigonometric	SIN (REAL)	11	898 - 1149	9
	COS (REAL)	11	867 - 1155	9
	TAN (REAL)	11	1138 - 1710	1
	ASIN (REAL)	11	1242 - 1474	10
	ACOS (REAL)	11	1220 - 1435	10
	ATAN (REAL)	11	552 - 655	10
Logarithmic	LOG (REAL)	11	587 - 697	8
	LN (REAL)	11	545 - 655	8
Exponential	Power of e	11	407 - 466	10
	Power of X	17	226 - 283	10
Radian Conversion	Convert RAD to DEG	11	228 - 246	10
	Convert DEG to RAD	17	65 - 72	9
Relational	Equal (INT)	10	20 - 30	10
	Equal (DINT)	16	20 - 30	10
	Equal (REAL)	14	30 - 40	10
	Not Equal (INT)	10	20 - 24	10
	Not Equal (DINT)	16	20 - 30	10
	Not Equal (REAL)	14	30 - 40	10
	Greater Than (INT)	10	20 - 22	10
	Greater Than (DINT)	16	20 - 30	10
	Greater Than (REAL)	14	40	10
	Greater Than/Equal (INT)	10	23 - 30	10
	Greater Than/Equal (DINT)	16	20 - 30	10
	Greater Than/Equal (REAL)	14	39 - 40	10
	Less Than (INT)	10	20 - 22	10
	Less Than (DINT)	16	30	10
	Less Than (REAL)	14	36 - 40	10
	Less Than/Equal (INT)	10	21 - 23	10
	Less Than/Equal (DINT)	16	30 - 40	10
	Less Than/Equal (REAL)	14	40 - 55	10
	Range (INT)	13	21 - 30	10
	Range (DINT)	22	26 - 38	10
	Range (WORD)	13	25 - 30	10

Typical Execution Times for Release 1.1 CPUs, continued

Group	Function	Size (bytes)	Rel. 1.07 / 1.1 28-Point CPU with ESCP	
			Function Enabled	*Function Disabled*
			Time, Range	*Time, Typical*
Bit Operation	Logical AND	13	36 - 40	4
	Logical OR	13	30 - 40	5
	Logical Exclusive OR	13	30 - 40	5
	Logical Invert, NOT	10	30	4
	Shift Bit Left	16	85 - 96	9
	Shift Bit Right	16	90	10
	Rotate Bit Left	16	61 - 80	4
	Rotate Bit Right	16	70 - 80	5
	Bit Position	13	50	4
	Bit Clear	13	34 - 50	6
	Bit Test	13	30 - 40	10
	Bit Set	13	36 - 47	4
	Mask Compare (WORD)	25	80 - 109	10
	Mask Compare (DWORD)	25	70 - 106	10
Data Move	Move (INT)	10	27 - 30	4
	Move (BOOL)	13	40 - 55	4
	Move (WORD)	10	27 - 30	4
	Move (REAL)	13	40	4
	Block Move (INT)	28	30 - 40	4
	Block Move (WORD)	28	30 - 40	4
	Block Move (REAL)	13	37 - 83	8
	Block Clear (WORD)	11	37 - 65	4
	Shift Register (BIT)	16	77 - 93	9
	Shift Register (WORD)	16	55 - 83	10
	Bit Sequencer	16	92 - 108	83
	COMM_REQ	13	470 - 485	135

Typical Execution Times for Release 1.1 CPUs, continued

Group	Function	Size (bytes)	Rel. 1.07 / 1.1 28-Point CPU with ESCP	
			Function Enabled	Function Disabled
			Time, Range	Time, Typical
Table	Array Move			
	INT	22	51 - 79	4
	DINT	22	50 - 70	4
	BOOL	22	70 - 96	5
	BYTE	22	46 - 75	5
	WORD	22	51 - 79	4
	Search Equal			
	INT	19	46 - 60	10
	DINT	22	50 - 60	10
	BYTE	19	40 - 60	10
	WORD	19	46 - 60	10
	Search Not Equal			
	INT	19	46 - 68	10
	DINT	22	69 - 75	10
	BYTE	19	39 - 50	10
	WORD	16	47 - 68	10
	Search Greater Than/Equal			
	INT	19	51 - 60	10
	DINT	22	50 - 60	10
	BYTE	19	42 - 60	10
	WORD	19	46 - 60	10
	Search Greater Than			
	INT	19	50 - 70	10
	DINT	22	48 - 65	10
	BYTE	19	50 - 61	10
	WORD	19	55 - 69	10
	Search Less Than			
	INT	19	40 - 57	10
	DINT	22	50 - 75	10
	BYTE	19	40 - 50	10
	WORD	19	50 - 58	10
	Search Less Than/Equal			
	INT	19	50 - 58	10
	DINT	22	50 - 60	10
	BYTE	19	40 - 50	10
	WORD	19	50 - 58	10

Typical Execution Times for Release 1.1 CPUs, continued

Group	Function	Size (bytes)	Rel. 1.07 / 1.1 28-Point CPU with ESCP	
			Function Enabled Time, Range	*Function Disabled* Time, Typical
Conversion	Convert INT to REAL	10	28 - 40	4
	Convert REAL to INT	13	495 - 537	4
	Convert DINT to REAL	13	30 - 40	4
	Convert REAL to DINT	13	496 - 534	5
	Convert WORD to REAL	10	30 - 40	3
	Convert REAL to WORD	13	490 - 506	4
	Convert BDC to INT	10	30 - 38	4
	Convert INT to BCD	10	80 - 124	4
	Convert BCD to REAL	10	36 - 50	4
	Truncate to INT	13	132 - 142	4
	Truncate to DINT	13	113 - 134	4
Control	Call a Subroutine	7	30 - 40	0
	Do I/O	13	142 - 144	4
	Service Request			
	#6	10	46 - 50	8
	#7 (read)	10	153 - 165	6
	#7 (set)	10	384 - 387	5
	#9	10	65 - 86	7
	#14	10	97 - 125	5
	#15	10	66 - 69	4
	#16	10	70 - 75	5
	#18	10	56 - 103	5
	#23	10	183 - 322	4
	#26,#30	10	196 - 243	4
	#29	10	40 - 50	5
	Nested MCR/ENDMCR (combined)	4	40 - 50	5
	PID-ISA Algorithm	16	131 - 149	62
	PID-IND Algorithm	16	131 - 150	62

Typical Execution Times for Release 1.0 CPUs

Group	Function	Size (bytes)	Execution Time (µsec.)			
			Function Enabled		Function Disabled	
			Nano PLC (10 points)	Micro PLC (14, 23, 28 pt)	Nano PLC (10 points)	Micro PLC (14, 23, 28 pt)
Coils/Relays	Coils/Relays	3	1.2ms/K	1.0ms/K		
Timers	Off Delay Timer	15	95	100	64	70
	On Delay Timer	15	100	106	70	73
	Elapsed Timer	15	90	99	60	70
Counters	Up Counter	13	76	80	70	80
	Down Counter	13	77	82	71	80
Math	Addition (INT)	13	50	60	10	10
	Addition (DINT)	19	50	59	10	10
	Addition (REAL)	17	119	127	10	10
	Subtraction (INT)	13	50	60	10	10
	Subtraction (DINT)	19	50	52	10	10
	Subtraction (REAL)	17	119	128	10	10
	Multiplication (INT)	13	53	60	10	10
	Multiplication (DINT)	13	50	60	10	10
	Multiplication (REAL)	17	133	137	10	10
	Division (INT)	13	65	70	10	10
	Division (DINT)	19	60	60	10	10
	Division (REAL)	17	213	223	10	10
	Modulo Division (INT)	13	70	80	10	10
	Modulo Division (DINT)	19	65	70	10	10
	Square Root (INT)	10	80	81	10	10
	Square Root (DINT)	13	89	94	10	10
	Square Root (REAL)	11	472	491	10	10
Trigonometric	SIN (REAL)	11	1337	1399	10	10
	COS (REAL)	11	1342	1396	10	10
	TAN (REAL)	11	1993	2077	10	20
	ASIN (REAL)	11	1712	1783	10	10
	ACOS (REAL)	11	1663	1740	10	10
	ATAN (REAL)	11	761	795	10	10
Logarithmic	LOG (REAL)	11	814	848	10	10
	LN (REAL)	11	760	790	10	10
Exponential	Power of e	11	542	569	10	10
	Power of X	17	332	351	10	10

Typical Execution Times for Release 1.0 CPUs continued

Group	Function	Size (bytes)	Execution Time (μsec.)			
			Function Enabled		Function Disabled	
			Nano PLC (10 points)	Micro PLC (14, 23, 28 points)	Nano PLC (10 points)	Micro PLC (14, 23, 28 points)
Radian Conversion	Convert RAD to DEG	11	289	300	10	10
	Convert DEG to RAD	17	89	97	10	10
Relational	Equal (INT)	10	30	40	10	10
	Equal (DINT)	16	40	40	10	10
	Equal (REAL)	14	50	52	10	10
	Not Equal (INT)	10	30	31	10	10
	Not Equal (DINT)	16	40	40	10	10
	Not Equal (REAL)	14	50	51	10	10
	Greater Than (INT)	10	30	32	10	10
	Greater Than (DINT)	16	40	40	10	10
	Greater Than (REAL)	14	50	52	10	10
	Greater Than/Equal (INT)	10	30	31	10	10
	Greater Than/Equal (DINT)	16	40	40	10	10
	Greater Than/Equal (REAL)	14	50	55	10	10
	Less Than (INT)	10	30	32	10	10
	Less Than (DINT)	16	40	40	10	10
	Less Than (REAL)	14	50	59	10	10
	Less Than/Equal (INT)	10	30	31	10	10
	Less Than/Equal (DINT)	16	40	40	10	10
	Less Than/Equal (REAL)	14	50	55	10	10
	Range (INT)	13	40	40	10	10
	Range (DINT)	22	45	50	10	10
	Range (WORD)	13	40	40	10	10

Typical Execution Times for Release 1.0 CPUs continued

Group	Function	Size (bytes)	Execution Time (µsec.)			
			Function Enabled		Function Disabled	
			Nano PLC (10 points)	Micro PLC (14, 23, 28 points)	Nano PLC (10 points)	Micro PLC (14, 23, 28 points)
Bit Operation	Logical AND	13	50	51	10	10
	Logical OR	13	50	51	10	10
	Logical Exclusive OR	13	50	51	10	10
	Logical Invert, NOT	10	40	43	10	10
	Shift Bit Left	16	110	118	10	10
	Shift Bit Right	16	99	109	10	10
	Rotate Bit Left	16	90	99	10	10
	Rotate Bit Right	16	89	98	10	10
	Bit Position	13	61	70	10	10
	Bit Clear	13	60	70	10	10
	Bit Test	13	50	52	10	10
	Bit Set	13	60	70	10	10
	Mask Compare (WORD)	25	129	138	10	10
	Mask Compare (DWORD)	25	128	138	10	10
Data Move	Move (INT)	10	40	40	10	10
	Move (BOOL)	13	79	80	10	10
	Move (WORD)	10	40	40	10	10
	Move (REAL)	13	50	58	10	10
	Block Move (INT)	28	50	52	10	10
	Block Move (WORD)	28	50	52	10	10
	Block Move (REAL)	13	99	108	10	10
	Block Clear (WORD)	11	89	99	10	10
	Shift Register (BIT)	16	118	127	10	10
	Shift Register (WORD)	16	101	109	10	10
	Bit Sequencer	16	121	127	89	10
	COMM_REQ	13	600	590	144	155

Typical Execution Times for Release 1.0 CPUs continued

Group	Function	Size (bytes)	Execution Time (μsec.)			
			Function Enabled		**Function Disabled**	
			Nano PLC (10 points)	**Micro PLC (14, 23, 28 points)**	**Nano PLC (10 points)**	**Micro PLC (14, 23, 28 points)**
Table	Array Move					
	INT	22	98	101	10	10
	DINT	22	89	97	10	10
	BOOL	22	127	133	10	10
	BYTE	22	98	100	10	10
	WORD	22	98	101	10	10
	Search Equal					
	INT	19	79	80	10	10
	DINT	22	70	80	10	10
	BYTE	19	70	80	10	10
	WORD	19	79	80	10	10
	Search Not Equal					
	INT	19	86	90	10	10
	DINT	22	98	100	10	10
	BYTE	19	60	70	10	10
	WORD	16	87	90	10	10
	Search Greater Than/Equal					
	INT	19	80	81	10	10
	DINT	22	70	80	10	10
	BYTE	19	70	80	10	10
	WORD	19	79	80	10	10
	Search Greater Than					
	INT	19	79	90	10	10
	DINT	22	79	89	10	10
	BYTE	19	79	83	10	10
	WORD	19	80	89	10	10
	Search Less Than					
	INT	19	70	78	10	10
	DINT	22	90	99	10	10
	BYTE	19	60	70	10	10
	WORD	19	70	80	10	10
	Search Less Than/Equal					
	INT	19	70	78	10	10
	DINT	22	70	80	10	10
	BYTE	19	60	70	10	10
	WORD	19	70	80	10	10

Typical Execution Times for Release 1.0 CPUs continued

Group	Function	Size (bytes)	Execution Time (μsec.)			
			Function Enabled		Function Disabled	
			Nano PLC (10 points)	Micro PLC (14, 23, 28 points)	Nano PLC (10 points)	Micro PLC (14, 23, 28 points)
Conversion	Convert INT to REAL	10	50	51	10	10
	Convert REAL to INT	13	50	647	10	10
	Convert DINT to REAL	13	50	59	10	10
	Convert REAL to DINT	13	611	641	10	10
	Convert WORD to REAL	10	50	51	10	10
	Convert REAL to WORD	13	583	606	10	10
	Convert BDC to INT	10	50	50	10	10
	Convert INT to BCD	10	156	166	10	10
	Convert BCD to REAL	10	60	70	10	10
	Truncate to INT	13	169	179	10	10
	Truncate to DINT	13	161	173	10	10
Control	Call a Subroutine	7	46	51	10	10
	Do I/O	13	173	185	10	10
	Service Request					
	#6	10	70	71	10	10
	#7 (read)	10	163	173	10	10
	#7 (set)	10	143	150	10	10
	#9	10	107	112	10	9
	#14	10	157	167	10	10
	#15	10	84	90	10	10
	#16	10	98	100	10	10
	#18	10	134	139	10	10
	#23	10	222	476	10	10
	#26,#30	10	298	310	10	10
	#29	10	69	70	10	10
	Nested MCR/ENDMCR (combined)	4	3	4	10	10
	PID-ISA Algorithm	16	188	194	12.8	3.2
	PID-IND Algorithm	16	186	195	70	73

Appendix	*Feature Comparison*
B	

Information in this appendix is arranged to provide a convenient means of comparing the capabilities of the VersaMax Micro PLC and the Series 90 Micro PLC.

Operating Differences: Lists ways in which the VersaMax Nano and Micro PLCs operate differently than earlier PLCs.

Program Functions Supported: This section compares the program functions supported by VersaMax Nano PLCs and Micro PLCs with functions supported by Series 90 Micro PLCs.

Program References: Compares the program references used by VersaMax and Series 90 Micro PLCs.

Operating Differences

1. Subroutines are available on the VersaMax Nano and Micros. The maximum of subroutines is 64 for Micro PLCs and 8 for Nano PLCs.

2. The VersaMax Nano and Micros have several functions that the Series 90 Micro did not support.

   - PID

   - Nested JUMP, LABEL, and MCR. Use of JUMP, LABEL, and MCR functions in Series 90 programs must be changed to nested.

   - Scaling

   - Floating point data types

   - Override capability

3. Word-for-word changes are not allowed by VersaMax Nano & Micro PLCs. The Series 90 Micro allowed word-for-word changes in STOP mode.

4. The VersaMax 14-point Micro PLCs support expansion units; the Series 90 14-point Micro PLCs did not.

5. When a serial port is configured for RTU slave it will revert to SNP when a programmer is attached.

6. VersaMax Nano/Micros support Serial I/O protocol.

7. VersaMax 20, 23, 28, 40, and 64 point units feature a time of day clock.

8. The VersaMax Nano and Micros support Break-free SNP communications for greater compatibility with modems.

9. All VersaMax Nano/Micros support autoconfiguration capability.

10. High-speed Counter/PWM/Pulse Train differences:

    - VersaMax Nano/Micro PLCs do not support negative edge triggering for High-speed Counter Preload/Strobe inputs. This is different from the Series 90 Micro PLC.

    - VersaMax Nano/Micro PLCs have 4 PTO channels where the Series 90 Micro PLC had 3 PTO channels..

    - VersaMax Nano/Micro PLCs output for PTO are on Q1, Q2, Q3, and Q5. While the Series 90 Micro PLCs output PTO on Q1, Q3, Q5. **Wiring changes will be required when a VersaMax Nano/Micro is used to replace a Series 90 PLC.**

    - The PTO #4 Complete bit is I511 and Start is Q511.

- For VersaMax Micro PLCs and Nano PLCs, the High-speed Counter PWM and PTO features use different %AQ settings than in the Series 90 Micro PLC. **A Series 90 Micro PLC folder containing these features will not function properly if converted directly to a VersaMax Micro PLC folder.** The logic which calculates the %AQ frequencies and/or duty cycles must be changed before being used on a VersaMax Micro or Nano PLC. Series 90 Micro programs which used the PWM and PTO features needed to calculate values to put into the %AQ registers, based on the desired frequency and duty cycle. For the VersaMax Nano and Micro PLCs, this calculation is not necessary; the frequency and duty cycle must be input directly into the %AQ registers.

- Frequency limits for the Versamax HSC/Pulse outputs have been improved

	HSC Frequency Limits	PTO/PWM Frequency Limits
Series 90 Micro	19hz - 5Khz	19hz - 2khz
VersaMax Nano	 15hz - 10Khz	 15hz - 5khz
Micro 14- point / 28- point	15hz - 10Khz	15hz - 5khz
Micro 20-, 40-, and 64-point	15hz - 100Khz	15hz - 65khz

- For VersaMax Nano and Micro PLCs, the frequency of Pulse Train outputs can be changed while the Pulse Train is operating. This is different from the Series 90 Micro PLC, which continues at the previous frequency until the start of the next Pulse Train.

- New COMMREQ for load correction value for pulse train outputs. Sets the change (in microseconds) that should be applied to the duty cycle of a Pulse Train output to compensate for the slow turn-off time of the optical isolator circuit (see below). The range is 0 to 200 microseconds.

      35 microseconds - DC outputs for Nano/ 14-point/ 28point;
      02 microseconds - DC outputs for Micro 64-point;
      85 microseconds relay outputs for Nano/ 14-point/ 28-point ;
      10 microseconds relay outputs for micro 64-point.

- HSC/PWM/PTO stops during Store or Clear

- PTO/PWM use enable bits (Q0505 to Q0508). A Series 90 PLC did not use bits to enable the PTO/PWM. These bits must be enabled for the PTO/PWM feature to work in the VersaMax Nano/Micros.

VersaMax Nano/Micro PWM/Pulse Outputs

Operating parameters for PWM and Pulse Train outputs are specified from the application program by writing a value to the associated %AQ reference. For VersaMax Nano/Micro PLCs, you need only to write the desired value to the %AQ reference. Series 90 Micro PLCs require a mathematical conversion to determine the values to be written to the %AQ references for PWM frequency, PWM duty cycle, and Pulse Train frequency. Therefore, these values will be incorrect if you convert a Series 90 Micro application to a VersaMax Nano/Micro application. You will need to change your application program so that it writes the correct values to the %AQ references.

%AQ References for PWM

The frequency of the PWM output (15hz to 5Khz for Nano/14-Point/28-Point; 15hz – 65Khz for 20-, 40-, and 64-Point) is specified from the application program by writing a value to the associated Frequency register. The PWM duty cycle (0 to 100%) is selected using the associated Duty Cycle register. The number of PWM/PTO channels available varies according to the Nano/Micro model.

Output 1	Output 2	Output 3	Output 4	Description
AQ002	AQ004	AQ006	AQ008	PWM Frequency (15 to 5000): Nano
				PWM Frequency (15 to 5000): 14pt
				PWM Frequency (15 to 5000): 28pt
				PWM Frequency (15 to 65000): 64pt
AQ003	AQ005	AQ007	AQ009	PWM Duty Cycle (0 – 10000)
Q0505	Q0506	Q0507	Q0508	Enable Output

If you don't know the PWM frequency and duty cycle specified by the Series 90 Micro application, you can calculate them from the %AQ reference values. See the formulas that follow.

%AQ References for Pulse Train

The pulse frequency (15hz to 5Khz for Nano/14-Point/28-Point; 15hz – 65Khz for 20-, 40-, or 64-Point) can be controlled from the application program by writing a value to the associated Frequency register, as shown below. The number of pulses to be output (0 to 65535) is selected using the associated Number of Pulses register. The number of PWM/PTO channels available varies according to the Nano/Micro model.

Output 1	Output 2	Output 3	Output 4	Description
AQ123	AQ125	AQ127	AQ121	PWM Frequency (15 to 5000): Nano
				PWM Frequency (15 to 5000): 14pt
				PWM Frequency (15 to 5000): 28pt
				PWM Frequency (15 to 65000): 20/40/64pt
AQ124	AQ126	AQ128	AQ122	Number of pulses to send to output (0 to 65535)
Q0505	Q0506	Q0507	Q0508	Enable Output
Q0494	Q0495	Q0496	Q00511	Start Pulse Train
I0494	I0495	I0496	I00511	Pulse Train Complete

If you don't know the pulse frequency specified by the Series 90 Micro application, you can calculate them from the %AQ reference values .

Note: Number of Pulses does not require conversion.

Enabling Outputs

The output for a channel must be enabled before its PWM or Pulse Train function can be used. A PWM or Pulse Train output is enabled from the application program by setting its Output Enable bit to one. The output is disabled by setting its Output Enable bit to zero.

Output 1	Output 2	Output 3	Output 4	Description
Q0505	Q0506	Q0507	Q0508	Enable Output

Load Correction

PWM duty cycles are configurable and Pulse-train outputs have a nominal duty cycle of 50%, but the PLC's optical isolators skew the duty cycle to something greater than 50%, depending on temperature and loading due to the output. To compensate for this, the PLC applies load correction to correct the pulse width (duty cycle) of each pulse. The default Load Correction is 40 microseconds, which approximates the correction needed for an output tied directly to an input at 50% duty cycle. The Load Correction can be changed within the range 0 to 200 microseconds by sending the new value in a COMMREQ.

Formulas for Converting Series 90 Micro Frequencies and Duty Cycles

For additional information about these parameters, refer to the *Series 90 Micro User's Manual*, GFK-1065.

Functions Supported

Function	VersaMax Nano PLC, Micro PLC	Series 90 Micro PLC
Contacts		
Normally Open Contact	all	all
Normally Closed Contact	all	all
Continuation Contact <+>–	all	all
Coils		
Normally Open Coil	all	all
Negated Retentive Coil	all	all
Negated Coil	all	all
Retentive Coil	all	all
SET Coil	all	all
Retentive SET Coil	all	all
RESET Coil	all	all
Retentive RESET Coil	all	all
Positive Transition Coil	all	all
Negative Transition Coil	all	all
Continuation Coil –<+>	all	all
Links		
Horizontal link	all	all
Vertical link	all	all
Timers and Counters		
Elapsed Timer	all	all
On-Delay Timer	all	all
Off-Delay Timer	all	all
Up Counter	all	all
Down Counter	all	all
Math		
Addition	all	all
Addition, double precision	all	all
Addition, Floating Point	all	Not supported
Subtraction	all	all
Subtraction, double precision	all	all
Subtraction, Floating point	all	Not supported
Multiplication	all	all
Mult., double precision	all	all
Multiplication, floating point	all	Not supported
Division	all	all
Division, double precision	all	all
Division, Floating Point	all	Not supported
Modulo Division	all	all
Modulo Div., double precision	all	all
Scaling	all	not supported

Function	*VersaMax Nano PLC, Micro PLC*	*Series 90 Micro PLC*
Square Root	all	all
Power of x	all	not supported
Power of e	all	not supported
Trigonometric sine	all	not supported
Trigonometric cosine	all	not supported
Trigonometric tangent	all	not supported
Inverse sine	all	not supported
Inverse cosine	all	not supported
Inverse tangent	all	not supported
Convert to Degrees	all	not supported
Convert to Radians	all	not supported
Logarithm, base 10	all	not supported
Logarithm, natural	all	not supported
Square Root, double prec.	all	all
Relational		
Equal	all	all
Not Equal	all	all
Less Than or Equal To	all	all
Greater Than or Equal To	all	all
Less Than	all	all
Greater Than	all	all
Equal, double precision	all	all
Not Equal, double precision	all	all
Less Than or Equal To, double precision	all	all
Greater Than or Equal To, double precision	all	all
Less Than, double precision	all	all
Greater Than, double precision	all	all
Range, signed integer	all	all
Range, double precision signed integer	all	all
Range, word	all	all
Range, double word	all	all
Bit Operation		
Bit Set	all	all
Logical AND	all	all
Bit Clear	all	all
Logical OR	all	all
Bit Test	all	all
Logical Exclusive OR	all	all
Bit Position	all	all
Logical Invert	all	all
Shift Left	all	all
Shift Right	all	all
Rotate Left	all	all

Function	VersaMax Nano PLC, Micro PLC	Series 90 Micro PLC
Rotate Right	all	all
Masked Compare, word	all	all
Masked Compare, double word	all	all
Data Move		
Multiple Integer Move	all	all
Constant Block Move, Integer	all	all
Multiple Bit Move	all	all
Multiple Word Move	all	all
Constant Block Move	all	all
Block Clear	all	all
Shift Register Word	all	all
Shift Register Bit	all	all
Bit Sequencer	all	all
Communication Request	all	all
Table Functions		
Search equal to	all	all
Search not equal to	all	all
Search less than	all	all
Search less than or equal to	all	all
Search greater than	all	all
Search greater than or equal to	all	all
Array move	all	all
Conversion		
Integer to BCD	all	all
BCD to integer	all	all
Control		
Comment	all	all
End	all	all
no operation	all	all
Nested Jump	all	not supported
Non-Nested Jump	not supported	All
Nested master control relay	all	not supported
Target number for jump	all	all
Nested endmcr	all	not supported
Master Control Relay (non-nested)	not supported	all
End Master Control Relay (non-nested)	not supported	all
Do I/O update	all	Rel. 3.00
PID-ISA algorithm	all	all
PID-IND algorithm	all	all
Service Request	all	all
Drum Sequencer	all	all

Function	VersaMax Nano PLC, Micro PLC	Series 90 Micro PLC
Communication		
Modbus_TCP_RW	Micro 20, 40, 64 Rel. 3.83 and later	not supported
Motion		
Find Home	Micro 20, 40, 64 Rel. 3.60 and later	not supported
Go Home	Micro 20, 40, 64 Rel. 3.60 and later	not supported
Jogging	Micro 20, 40, 64 Rel. 3.60 and later	not supported
Blending	Micro 20, 40, 64 Rel. 3.60 and later	not supported
Stop Motion	Micro 20, 40, 64 Rel. 3.60 and later	not supported

Program References

The table below compares reference sizes for VersaMax and Series 90 Micro PLCs with similar numbers of I/O points.

Reference Type	Reference Range	VersaMax 10-Point Nano PLCs	VersaMax 14-Point Micro PLCs	VersaMax 23 and 28-Point Micro PLCs	Series 90 14-Point Micro PLCs	Series 90 23 and 28-Point Micro PLCs
User program logic	Not applicable	2K words	9K words	9K words	3K words	6K words
Register references	%R0001 - %R0256 or %R2048	256 words		2K words	256 words	2K words
Discrete inputs	%I0001 - %I0512	512 bits				
Discrete outputs	%Q0001 - %Q0512	512bits				
Discrete global references	%G0001 - %G1280	1280 bits				
Discrete internal coils	%M0001 - %M1024	1024 bits				
Discrete temporary coils	%T0001 - %T0256	256 bits				
System status references	%S0001 - %S0032	32 bits				
	%SA0001 - %SA0032	32 bits				
	%SB0001 - %SB0032	32 bits				
	%SC0001 - %SC0032	32 bits				
Analog and High Speed Counter inputs	%AI0001 - %AI0128	128 words				
Analog outputs	%AQ0001 - %AQ0128	128 words				

Appendix	*Battery Backup Options*
C	

Backup battery options are available for 20-, 23-, 28-, 40-, and 64-point VersaMax Micro PLCs. A backup battery protects the RAM memory contents of the PLC when the PLC power is removed or turned off. The battery also backs up the CPU's real-time clock.

CPU Battery Consumption

The battery consumption of the Micro PLC depends on whether the power is on or off and on the serial number of the Micro PLC. Consumption with the power off is greater at higher temperatures.

Controller Status	*Battery Consumption per Hour*
Power ON	PLCs with serial number prior to 07000069274: 30 micro Amps
	PLCs with serial number after 07000069274: 3 micro Amps
Power OFF	PLCs with serial number prior to 07000069274: 83 micro Amps @ 70C 36 micro Amps @ 20C
	PLCs with serial number after 07000069274: 56 micro Amps @ 70C 9 micro Amps @ 20C
	20-, 40-, and 64-Pt Micro PLCs: 31 micro Amps @ 55C 3 microAmps @ 25C

Backup Batteries for VersaMax Micro PLCs

Two types of backup battery are available, IC200ACC403 and IC200ACC414.

Part Number	Battery Type	Battery Capacity	Memory Backup at 70C (power OFF continuous)	Memory Backup at 20C (power OFF continuous)
IC200ACC403	Coin Type	3.0 vdc @ 210mAh	3.5 months* 5.2 months**	8.1 months* 32.4 months**
IC200ACC414	Cylinder Type	3.6 vdc @ 790mAh	13.2 months* 19.6 months**	30.4 months* 121.9 months**

* Units with serial number prior to 07000069274 (manufactured before November 2002)
** Units with serial number after 07000069274 (manufactured after November 2002)

The High Capacity battery (IC200ACC414) is provided with a special battery holder that is compatible with all 20-, 23-, 28-, 40- and 64-point VersaMax Micro PLCs.

Calculating the Life of a Battery

This example compares typical battery longevity for the two types of Micro PLC backup battery, for VersaMax Micro PLCs with a serial number after 07000069274.

In this example, a machine sits at the OEM facility for 30 days with the battery attached to the Micro PLC CPU, prior to shipment to the end user. No power is applied.

- CPU battery consumption during 30 days with no power: 40,320 micro amps:

   24 hours x 56 micro amps per hour = 1,344 x 30 days = 40,320 micro amps (worst case of 70C storage temperature)

After the machine is shipped and installed, the end user maintains power on the machine 24 hours a day but shuts down the machine during the weekends.

- Power ON: 24 hours x 3 micro amps = 72 micro amps/day

- Power ON: 5 days x 72 micro amps = 360 micro amps/5 days

- Power OFF: 48 hours x 32.5 micro amps (45C cabinet temperature) = 1560 micro amps/weekend

- Total weekly usage: 1,920 micro amps

For Standard Backup Battery IC200ACC403

Standard Backup Battery has 210,000 micro Amps available. In this example, subtracting the CPU battery consumption during the 30 days at the OEM facility (40,320, see above), would leave 169,680 micro Amps still available. Therefore, the battery would last approximately 1.7 years (88 weeks) at the end-user location before needing replacement:

   169,680 divided by 1,920 total weekly usage (see above) = 88 weeks

For High Capacity Battery IC200ACC414

High-capacity Backup Battery has 790,000 micro Amps available. In the example, subtracting the CPU battery consumption at the OEM facility (40,320) would leave 749,680 micro Amps still available. Therefore, the battery would last approximately 7.5 years (390 weeks) at the end user location before needing replacement:

   749,680 divided by 1,920 weekly usage (see above) = 390 weeks

Appendix
D

Input Simulators

This section describes input simulators that can be used to easily turn on or off any DC input point on a VersaMax Nano PLC or VersaMax Micro PLC.

- IC200ACC450 Input Simulator for DC-powered VersaMax Nano PLCs

- IC200ACC451 Input Simulator for DC-powered VersaMax Micro PLCs and Expansion Units

IC200ACC450
Input Simulator for DC-powered VersaMax Nano PLCs

The six-position DC input simulator connects directly to the input terminals on a VersaMax Nano PLC. An external connection for the 12VDC or 24VDC is required.

Input Simulator

External Connection for DC Power
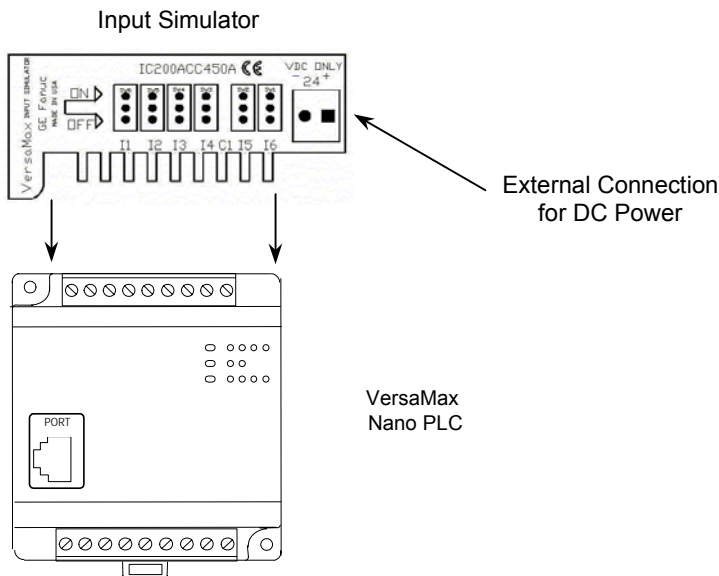
VersaMax Nano PLC

Compatibility

Input Simulator IC200ACC450 is compatible with any <u>DC input</u> VersaMax Nano PLC. ***The input simulator is not to be used with AC Inputs.***

Installation Instructions

Warning

To avoid a risk of electric shock, turn off power to the VersaMax Nano PLC and disconnect the main power before attaching the Input Simulator.

1. Loosen all screws on the input terminal block.
2. Insert the Input Simulator as shown above.
3. Tighten all screws on the input terminal block.
4. Turn power on and turn switches on the simulator ON and OFF. The corresponding LEDs on the VersaMax Nano PLC should light up, showing proper installation. If the LEDs do not light, power down and recheck the screws to make sure they are tight.

The eight position DC input simulator connects directly to the input terminals of a VersaMax Micro PLC or Expansion Unit. The connection takes advantage of the 24VDC provided by the Micro PLC or Expansion Unit; no external wiring is required.
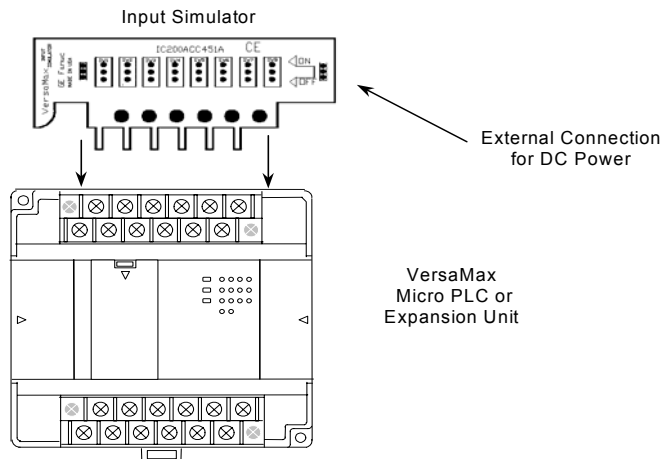
Compatibility

Input Simulator IC200ACC451 is compatible with any VersaMax <u>DC input</u>:

- 14-point, 23-point, or 28-point Micro PLC
- 14-point or 28-point Expansion Unit

The input simulator is not to be used with AC Inputs.

Installation Instructions

> **Warning**

To avoid a risk of electric shock, turn off power to the VersaMax Micro PLC or Expansion Unit, and disconnect the main power before attaching the Input Simulator.

1. Loosen all screws on the input terminal block.
2. Insert the Input Simulator as shown above.
3. Tighten all screws on the input terminal block.
4. Turn power on and turn switches on the simulator ON and OFF. The corresponding LEDs on the Micro PLC or Expansion Unit should light up, showing proper installation. If the LEDs do not light, power down and recheck the screws to make sure they are tight.

Relay Contact Ratings

This section shows relay contact ratings for modules with output relays.

Load Condition		Current (Amps)
125VAC	P.F. = 1 P.F. = 0.7 P.F. = 0.4	0.6 0.4 0.2
250VAC	P.F. = 1 P.F. = 0.7 P.F. = 0.4	0.9 0.6 0.3
30VDC	L/R = 1ms L/R = 7mS L/R = 15mS	0.6 0.3 0.15

P.F = power factor for AC inductive loads
L/R = time constant for DC inductive loads

125VAC

250VAC

Contact Life (x10⁴) vs **Switching Current (Amps)**

P.F. = 1

P.F. = 0.7

P.F. = 0.4

30VDC

Contact Life (x10⁴) vs **Switching Current (Amps)**

L/R = 1mS

L/R = 7mS

L/R = 15mS

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UTILCELL

MANUAL DE INSTALACIÓN Y FUNCIONAMIENTO

DAT-400
Para carril DIN

DAT-500
Para montaje en panel

TRANSMISOR DIGITAL / ANALÓGICO
VERSIÓN 0.7

Características Técnicas

Alimentación y consumo

Tensión de Alimentación	24 Vdc ± 15%
Potencia Consumida	7,5 Watios
Aislamiento	Clase II
Categoría	Categoría II

Condiciones Ambientales de Utilización

Temperatura de Trabajo	-10 a +40 ºC (+14 a +104 ºF)
Temp. de Almacenamiento	-20 a +50ºC (-4 a +122ºF)
Humedad Relativa	85 % sin condensación

Indicación

Tipo	6-dígitos LED rojo, 7 segmentos 1,4 mm (0.55") altura
LEDs de estado	4 LEDs color Rojo
Teclado	4 Teclas membrana

Características

Tensión de excitación	5 V fijos, cortocircuitable
Corriente de carga	85 mA (6 células de carga de 350 Ω)
Velocidad de Conversión	50 veces / segundo (sin filtraje)
Resolución	60.000 puntos
Sensibilidad	0,2 µV / división
Linealidad	< 0,01% a FE
Deriva térmica	<0,001% de FE / ºC
Convertidor A/D	24 Bits
Rango Señal de Entrada	-0,5 mV / V a +3,5 mV / V (-3,9 mV / V a +3,9 mV / V opcional)
Filtro	0,1 Hz a 25 Hz seleccionable
Tamaño escalón	x1, x2, x5, x10, x20, x50
Punto Decimal	0.0, 0.00, 0.000
Método de Calibración	Desde PC o teclado frontal

Salida Analógica (aislada)

Tipo	Conversión D/A de 16 bits
Tensión	0-5 y 0-10 Vcc (mín. Carga 10 K Ω)
Corriente	0-20 y 4-20 mA (máx. Carga 300 Ω)
Linealidad	< 0,012% de FE
Deriva térmica	< 0,001% de FE / ºC

Entradas y Salidas

2 Entradas Lógicas	Opto-aisladas, 24 Vdc PNP (requiere alimentación exterior)
2 Salidas Lógicas	Relé de estado sólido (máxima carga 24 Vdc /100 mA cada una)
Salida Serie	RS-232, RS-422 o RS-485
Longitud máx. Cable	16 m en RS-232, 1060 m en RS-422 y RS-485
Protocolo estándar	*ASCII, Modbus RTU, PRINTER*
Velocidad comunicación	2400, 9600, 19200, 38400 y 115200 seleccionable

Caja

	DAT-400	**DAT-500**
Dimensiones	106 x 90 x 58 mm (LxAxP)	96 x 48 x 139 mm (LxAxP)
Montaje	Raíl DIN	Panel
Material	ABS	ABS
Protección	IP20	IP20
Peso	280 g	310 g
Conexión Eléctrica	Terminales (Paso = 0,5 mm)	Terminales (Paso = 0,5 mm)
Taladro panel		92 x 44 mm

** Los instrumentos **DAT** están configurados según la guía PL-Mbus-300 por MODICOM*
(propietario de la tecnología Modbus)

Queda reservado el derecho de efectuar modificaciones en las características sin previo aviso.

Introducción

Este manual contiene información general sobre instalación, configuración, calibración y operación de los transmisores Digital / Analógico **Serie DAT 400-500.**

Existen dos modelos de esta serie **DAT** cuyas características son:

- Teclado de 4 teclas,
- Iindicación digital de 6 dígitos rojos (LED) y 4 LEDs de estado.

Ambos modelos van montados en cajas de ABS para montaje en Raíl DIN o panel.

Todos los modelos incluyen las siguientes características:

- Controlan hasta 6 células de carga de 350 Ω
- Permiten conexiones a 4 y 6 hilos
- Salidas RS-232, RS-422 o RS-485
- 2 Entradas Lógicas
- 2 Salidas Lógicas (consigna)
- Salida Analógica aislada 0-20 mA, 4-20 mA, 0-5 Vcc o 0-10 Vcc (16 Bit)

Los transmisores de la serie **DAT** pueden trabajar en 3 modos diferentes:

Modo Normal (operación)

En este modo, el instrumento puede indicar el peso bruto, el peso neto o la fuerza máxima (pico).

Modo Configuración (setup)

Este modo se utiliza para la configuración y calibración del instrumento.

Modo Prueba (test)

Este modo permite comprobar las entradas, salidas y la salida analógica.

Funciones del Teclado frontal
Modo Operación

La tecla "SET" permite introducir los valores de las consignas (setpoint) 1 y 2. Pulsando la tecla "SET" aparecerá SET 1 en el indicador. Pulsar la tecla "PRG" para ver el valor actual. Para modificar el valor actual, pulsar la tecla "O" para seleccionar un dígito y las teclas incrementar y decrementar para modificarlo.

Repetir este procedimiento para el resto de los dígitos y pulsar "PRG" para guardar el nuevo valor. Para modificar el valor de consigna 2, pulsar la tecla "SET" de nuevo y repetir el procedimiento explicado arriba o pulsar "O" para salir.

La tecla "FUN" se utiliza para cambiar de modo Bruto a modo Neto o a modo retención valor de Pico.

Para seleccionar el modo retención Pico, mantener pulsada la tecla "FUN" hasta visualizar la "P".

La tecla "O" se utiliza para poner a Cero el transmisor en modo Bruto, tarar el transmisor en modo Neto y reinicializar (reset) el valor a cero en modo retención Pico.

La tecla "PRG" se utiliza para enviar los datos al puerto serie RS-232 hacia el procesador.

Funciones del Teclado frontal.
Modo Configuración

En el modo configuración, se utilizan tres teclas del panel frontal como teclas direccionales para el desplazamiento en los diversos menús. Una etiqueta en la mitad inferior de cada tecla identifica la dirección (orientación) que proporciona la tecla.

Las teclas "SET" y "FUN" se utilizan para navegar en el menú principal y sub-menús. Se utilizan también para incrementar y decrementar el valor numérico del dígito seleccionado.

La tecla "O" se utiliza en algunos parámetros concretos de los sub-menús, o para seleccionar un dígito concreto cuando se visualizan valores numéricos. Se utiliza también para volver al menú principal desde cualquier sub-menú.

La tecla "PRG" cambia el transmisor al modo de "configuración básica". Se utiliza también para entrar en los sub-menús y para guardar (salvar) los cambios de parámetros.

La utilización de las teclas "PRG" y "SET" conjuntamente cambia el transmisor al modo "configuración completa". Se utiliza también para entrar en los sub-menús y para guardar (salvar) los cambios de parámetros.

LEDs indicadores de Estado

En el frontal del transmisor hay 4 LEDs indicadores de estado, uno para Marcha, uno para modo Neto, y uno para cada una de las salidas.

Bloqueo/desbloqueo del teclado

Para evitar el acceso al equipo de personal no autorizado, ha sido implementado un procedimiento para bloquear el teclado. Cada tecla puede ser bloqueada individualmente mediante una selección de 1/0. Ver página 6 para más detalles.

Habilitar la función de «Display Ciego»

La función BLIND permite desactivar el display de peso apareciendo un segmento que circula por el perímetro del display en lugar del valor del peso. Ver página 6 para más detalles.

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Conexión de alimentación

La fuente de alimentación de 24 Vcc ± 15% se conecta en los terminales 8 (+) y 9 (-) del transmisor. La fuente debe tener una potencia mínima de 7,5 Watios.

Conexión del Transductor/es

Conectar el cable del transductor/es al transmisor (terminales 13 al 18). Cuando se utiliza un cable de 4 conductores , se deben hacer unos puentes (cortocircuito) entre los terminales 14 y 15 (+ de excitación y + del sense) y los terminales 13 y 16 (– de excitación y – del sense), como se muestra en la Figura 1.

Conexión de Entradas Lógicas

Conectar la Entrada (1) al terminal 4 y la Entrada (2) al terminal 5. El Terminal 6 es el común. Las entradas necesitan una alimentación de 24 Vcc para activarlas. Para mas información, ver la Figura 1.

La Entrada (1) se utiliza para poner a Cero el equipo cuando esta en modo Bruto, Tarar el equipo en modo Neto y reincializar el equipo (reset) en modo "Retención Pico"

La función de la entrada (2) es la de tecla de Impresión. Cuando se cierra el contacto, envía los valores de peso al puerto Series RS-232.

Conexión de Salidas Lógicas

La salida (1) se conecta en el terminal 1 y salida (2) en el terminal 2. El terminal 3 es el común. Las salidas son relés de estado solido con una carga máxima de 100 mA a 24 Vcc.

Conexión de Salida Analógica

La salida analógica de corriente (mA) se conecta en el terminal 10 (300 Ω máx.), y la salida de tensión (Vcc) en el terminal 11 (10 KΩ max.). El terminal 12 es el común para cualquiera de ellas.

Conexión de Salida Serie

El puerto serie del transmisor soporta comunicaciones vía RS-232, RS-422 o RS-485. La selección de los parámetros de la comunicación serie están en página 17. Una descripción detallada del formato de datos de comunicación serie se encuentran de las páginas 22 a 24. Las conexiones y cableado están en página 27.
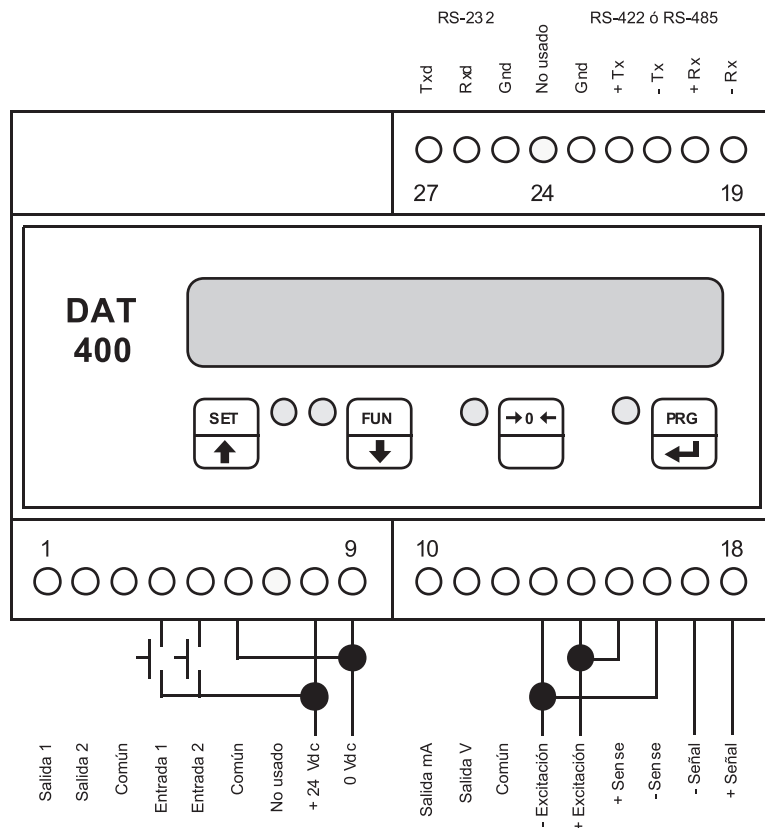
Figura 1

Conexionado práctico en pag. 43
Conexionado para zona de seguridad intrínseca en pag. 45

4

DAT - 500

Conexión de alimentación

La fuente de alimentación de 24 Vcc ± 15% se conecta en los terminales 1 (+) y 2 (-) del transmisor. La fuente debe tener una potencia mínima de 7,5 Watios.

Conexión del Transductor/es

Conectar el cable del transductor/es al transmisor (terminales 19 al 24). Cuando se utiliza un cable de 4 conductores, se deben hacer unos puentes (cortocircuito) entre los terminales 20 y 21 (+ de excitación y + del sense) y los terminales 19 y 22 (– de excitación y – del sense), como se muestra en la Figura2.

Conexión de Entradas Lógicas

Conectar la Entrada (1) al terminal 16 y la Entrada (2) al terminal 17. El Terminal 18 es el común. Las entradas necesitan una alimentación de 24 Vcc para activarlas. Para mas información, ver la figura 2.

La Entrada (1) se utiliza para poner a Cero el equipo cuando esta en modo Bruto, Tarar el equipo en modo Neto y reincializar el equipo (reset) en modo "Retención Pico"

La función de la entrada (2) es la de tecla de Impresión. Cuando se cierra el contacto, envía los valores de peso a el puerto Serie RS-232.

Conexión de Salidas Lógicas

La salida (1) se conecta en el terminal 13 y salida (2) en el terminal 14. El terminal 15 es el común. Las salidas son relés de estado solido con una carga máxima de 100 mA a 24 Vcc.

Conexión de Salida Analógica

La salida analógica de corriente (mA) se conecta en el terminal 3 (300 Ω máx.), y la salida de tensión (Vcc) en el terminal 4 (10 KΩ max.). El terminal 5 es el común para cualquiera de ellas.

Conexión de Salida Serie

El puerto serie del transmisor soporta comunicaciones vía RS-232, RS-422 o RS-485. La selección de los parámetros de la comunicación serie están en página 17. Una descripción detallada del formato de datos de comunicación serie se encuentran de las páginas 22 a 24. Las conexiones y cableado están en página 27.
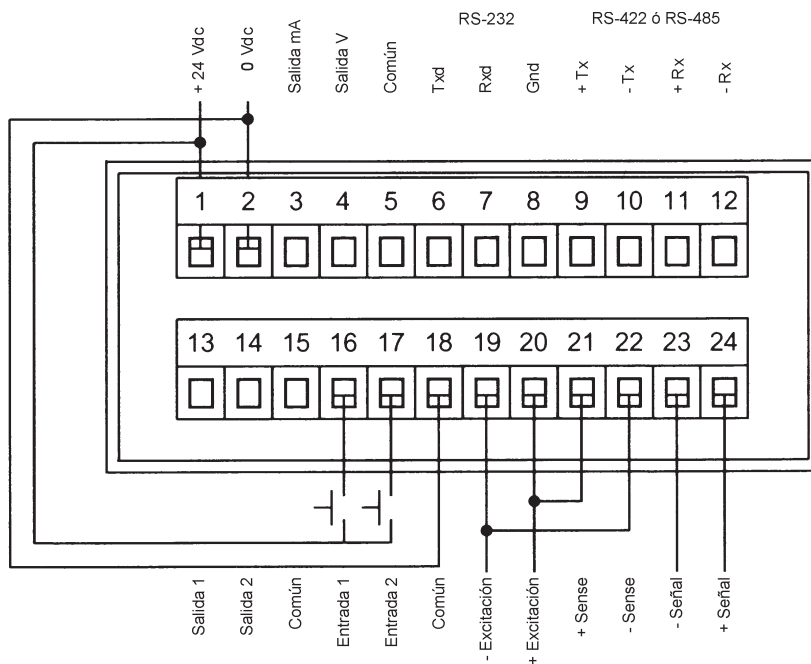
Figura 2

Conexionado práctico en pag. 44
Conexionado para zona de seguridad intrínseca en pag. 45

5

El display mostrará el valor de peso mientras no se haya entrado en el menú de configuración. En algunas condiciones particulares se mostrará alguno de los MENSAJES siguientes:

— — — — — —	• El valor de peso es superior a 9 divisiones sobre el peso introducido en el parámetro "NET" (pag. 8 y 10)
O - L	• No recibe señal de las células. • La señal recibida de las células es ≤ -0,5 mV/V. • La señal recibida es ≥ +3,5 mV/V.

Bloqueo y desbloqueo del teclado (LOCK)

Para evitar el acceso al equipo de personal no autorizado, ha sido implementado un procedimiento para bloquear el teclado. Cada tecla puede ser bloqueada individualmente mediante una selección de 1/0.

Habilitar la función de "Display ciego"

La función BLIND permite desactivar el display de peso, apareciendo un segmento que circula por el perímetro del display en lugar del valor del peso, una vez se haya realizado la cuenta atrás del tiempo programado (01 a 99 seg). Mantenga apretadas las teclas "PRG" y "0". La tecla "0" debe ser pulsada después de la tecla "PRG". Suelte ambas teclas cuando aparezca el mensaje "LOCK" en display.

6
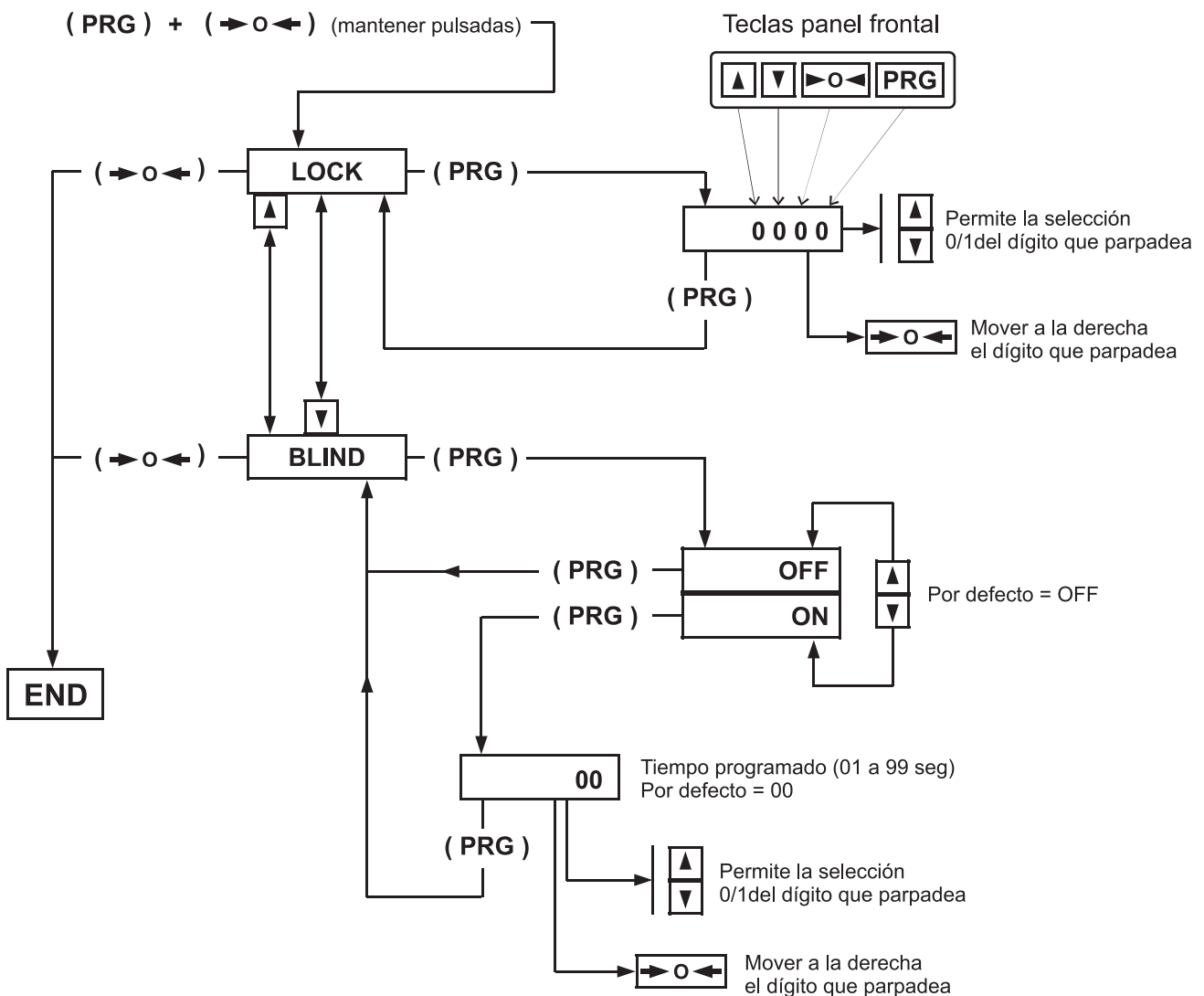
DAT - 400 / DAT - 500

Métodos de Configuración

Los transmisores Digital / Analógicos de la Serie **DAT** se pueden configurar por medio del teclado frontal que permite navegar por los diferentes menús o enviando los datos de configuración y calibración desde PC a través del puerto serie RS-232 mediante el programa INOVATION™ trabajando en entorno MS Windows. El programa INOVATION™ simplifica el procedimiento de configuración y calibración.

Procedimientos de Configuración

Existen dos procedimientos para la configuración (setup) de los transmisores de la Serie **DAT** , la "Configuración Básica" y la "Configuración Completa".

El procedimiento de "Configuración Básica" permite modificar unos parámetros selectivos, mientras el de "Configuración Completa" permite modificar todos los parámetros.

Por ejemplo, si sólo se requiere calibrar el transmisor, se recomienda utilizar el procedimiento de "Calibración Básica".

A continuación se explican detalladamente ambos procedimientos de configuración.

Configuración Básica por teclado frontal

Para efectuar una "Configuración Básica" mantenga pulsada la tecla "PRG" hasta visualizar CAPAC. Pulsar cualquiera de las teclas "Arriba" o "Abajo" para navegar en los ocho sub-menús de configuración básica indicados a continuación.

Indicación	Función Sub-menú
CAPAC	Suma de las capacidades nominales de todas las células
SENSIT	Sensibilidad nominal de las células utilizadas
NET	Valor del peso útil de Pesaje
DEAD L	Valor del peso muerto o estructura
DSPDIV	Resolución, salto de display
SIGNAL	Visualiza la señal de entrada de los transductores (mV/V)
CALIBR	Procedimiento de calibración
ANALOG	Valor de peso en el que dará el fondo de escala analógico

Para acceder a alguno de los siguientes parámetros CAPAC, SENSIT, NET, TARE, DEAD L, DSPDIV o ANALOG, pulsar la tecla "PRG" para ver el valor puesto por defecto o anteriormente introducido en dicho parámetro.

Para cambiar su valor, pulsar la tecla "O" para seleccionar un dígito y las teclas de "Arriba" y "Abajo" para incrementar o disminuir el valor del dígito seleccionado. Cuando aparece el valor deseado en el display, pulsar "PRG" para guardar el nuevo valor. Pulsar cualquiera de las teclas "Arriba" o "Abajo" para pasar al parámetro siguiente.

El parámetro SIGNAL permite ver el valor de la señal en la entrada proveniente del transductor/es. Pulsar la tecla "O" para pasar al siguiente parámetro.

El parámetro CALIBR se utiliza para calibrar el transmisor. El equipo se puede calibrar utilizando el procedimiento de la hoja técnica o el de masas.

El procedimiento de calibración de la hoja técnica, permite calibrar el transmisor sin necesidad de utilizar simulador de transductor (generador) o masas.

Este procedimiento se basa en la capacidad y en la sensibilidad (mV/V) del transductor.

Para realizar la calibración de la hoja técnica, introducir la capacidad total, sensibilidad, peso neto, tara y la resolución de indicación y pulsar la tecla "O". El display indicará STORE?. Pulsar "PRG" para guardar los cambios y volver al modo normal de trabajo.

En la página 7 se explica de forma detallada el procedimiento de calibración utilizando masas.

El parámetro ANALOG se utiliza para introducir el rango de la señal a retransmitir. El rango por defecto es el del peso neto.

Para salir del menú de configuración, pulsar la tecla "O" cuando se esta visualizando cualquiera de estos parámetros CAPAC, SENSIT, ...ANALOG. El display indicará STORE? Pulsar la tecla "PRG" para guardar los cambios y volver al modo normal de trabajo.

Menú de configuración Básica
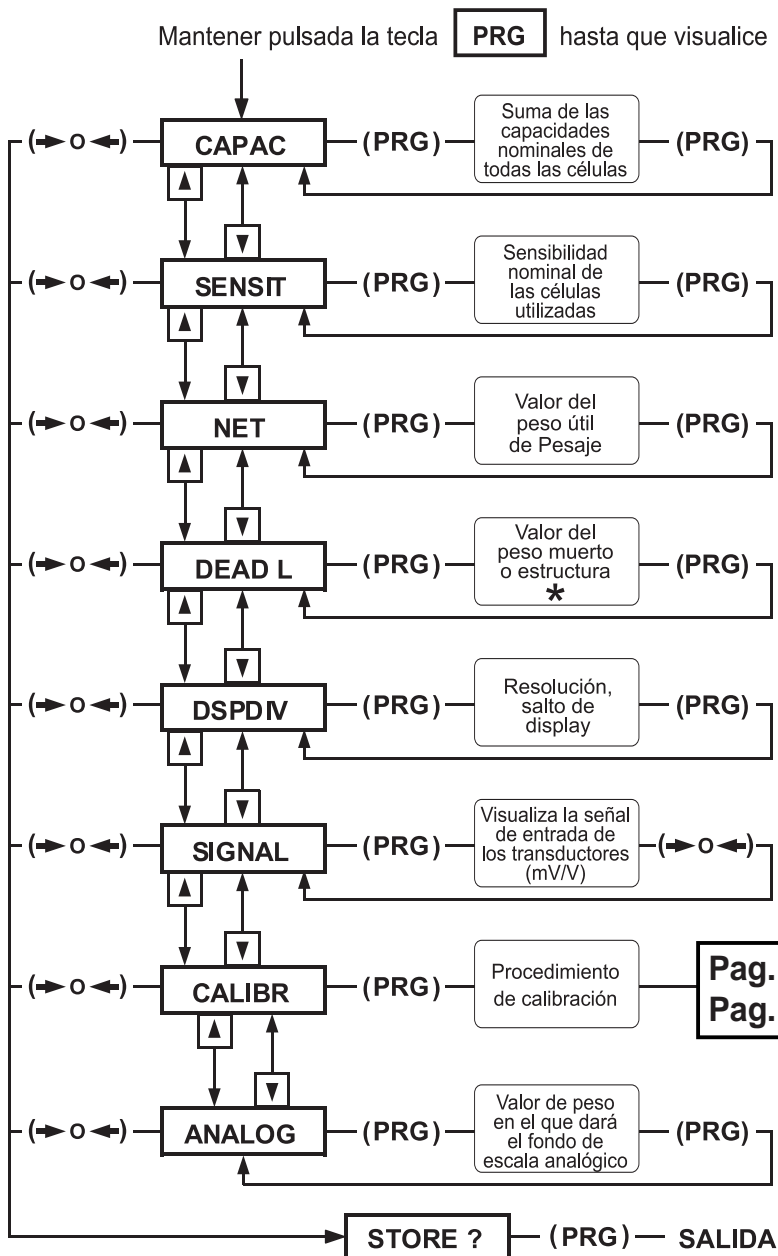
Mantener pulsada la tecla **PRG** hasta que visualice

MUY IMPORTANTE

NET

+

El valor estimado de la estructura o Peso Muerto debe ser siempre **inferior** al valor de

CAPAC

* **DEAD L:** Es recomendable dejar este parámetro en 0 ya que queda automaticamente ajustado con la precisión necesaria al realizar el calibrado de cero.

Pag. 11   Calibrado cero
Pag. 12   Calibrado ganancia (span)

Poner el equipo en modo configuración básica pulsando la tecla "PRG" hasta visualizar CAPAC en el display. Mediante las teclas "Arriba" y "Abajo" podrá desplazarse por los 8 menús de configuración básica mostrados arriba. Para acceder a alguno de los siguientes parámetros CAPAC, SENSIT, NET, DEAD L, DSPDIV o ANALOG, pulsar la tecla "PRG" para ver el valor puesto por defecto o anteriormente introducido en dicho parámetro.

Para cambiar su valor, pulsar la tecla "O" para seleccionar un dígito y las teclas de "Arriba" y "Abajo" para incrementar o disminuir el valor del dígito seleccionado. Pulsar la tecla "PRG" para

guardar (salvar) el nuevo valor. Pulsar cualquiera de las teclas "Arriba" o "Abajo" para pasar al parámetro siguiente.

Para salir del menú de configuración, pulsar la tecla "O" cuando cualquier parámetro de los submenús esta en el display. El display indicará STORE?. Pulsar la tecla "PRG" para guardar los cambios y volver al modo normal de trabajo.

Configuración Completa por teclado frontal

Para realizar una configuración completa, el transmisor debe estar en modo Setup. Para entrar en modo Setup, pulsar y mantener las teclas "PRG" y "SET" del transmisor. La tecla "SET" debe ser pulsada después de la tecla "PRG". Soltar ambas teclas cuando la palabra "CONFIG" se visualiza en el display. El menú CONFIG es el primero de los 6 menús principales utilizados para configurar completamente el transmisor. Usar cualquiera de las teclas "Arriba" o "Abajo" para moverse por los 6 menús abajo indicados.

Indicación	Funciones del Menú principal
CONFIG	Parámetros de capacidad total de báscula, sensibilidad del transductor, valores de peso neto y tara, resolución del display
CALIBR	Calibración de Cero y Span
PARAM	Parámetros para filtro digital, marcha, auto cero y seguimiento de cero
IN-OUT	Selección de modo de operación de las salidas, y prueba de entrada y salida
SERIAL	Configuración de la salida Serie
ANALOG	Configuración y Calibración de la salida analógica

Pulsar la tecla "PRG" para ir a los sub-menús o parámetros deseados. Pulsar la tecla "PRG" para ver los valores introducidos por defecto o anteriormente para dicho parámetro.

Para modificar un parámetro, pulsar la tecla "Arriba" o "Abajo" para ver las selecciones posibles de dicho parámetro. Cuando la selección deseada aparece en el display, pulsar "PRG", entrar la selección y pasar al parámetro siguiente.

Para editar un valor numérico, seleccionar el dígito con tecla "O" y pulsar las teclas "Arriba" o "Abajo" para incrementar o disminuir el valor del dígito seleccionado.

Menú de configuración Completa

Mantener pulsada la tecla ⬛ **PRG** y pulsar (mantener ambas) tecla ⬛ **SET** hasta que visualice

| CONFIG | CALIBR | PARAM | IN-OUT | SERIAL | ANALOG |

(PRG)

CAPAC — (→ o ←) — (PRG) — Suma de las capacidades nominales de todas las células — (PRG)

SENSIT — (→ o ←) — (PRG) — Sensibilidad nominal de las células utilizadas — (PRG)

NET — (→ o ←) — (PRG) — Valor del peso útil de Pesaje — (PRG)

DEAD L — (→ o ←) — (PRG) — Valor del peso muerto o estructura ✱ — (PRG)

DSPDIV — (→ o ←) — (PRG) — Resolución, salto de display — (PRG)

SIGNAL — (→ o ←) — (PRG) — Visualiza la señal de entrada de los transductores (mV/V) — (→ o ←)

COUNTS — (→ o ←) — (PRG) — Visualiza los puntos del convertidor A/D — (→ o ←)

OPMODE — (→ o ←) — (PRG) — | GROSS | NET | PEAK H | — Tipo de modo de operación Bruto-Neto-Pico — (PRG)

MUY IMPORTANTE

⬛ **NET**

+

El valor estimado de la estructura o Peso Muerto debe ser siempre **inferior** al valor de

⬛ **CAPAC**

— — — — — — — —

✱ **DEAD L:** Es recomendable dejar este parámetro en 0 ya que queda automaticamente ajustado con la precisión necesaria al realizar el calibrado de cero.

Poner el transmisor en modo de configuración completo manteniendo pulsadas las teclas "PRG" y "SET" del frontal. La tecla "SET" se debe pulsar después de pulsar la tecla "PRG". Soltar ambas teclas cuando se visualiza CONFIG en el display. Pulsar "PRG" para entrar en el submenú y usar las teclas "Arriba" o "Abajo" para seleccionar un parámetro del submenú. Pulsar "PRG" para ver el valor introducido por defecto o anteriormente para dicho parámetro.

Para cambiar su valor, pulsar la tecla "O" para seleccionar un dígito y las teclas de "Arriba" y

"Abajo" para incrementar o disminuir el valor del dígito seleccionado. Pulsar la tecla "PRG" para guardar (salvar) el nuevo valor. Pulsar cualquiera de las teclas "Arriba" o "Abajo" para pasar al parámetro siguiente o pulsar la tecla "O" para volver al menú principal.

Para salir del menú de configuración, volver al menú principal y pulsar la tecla "O", (el display indicará STORE?), pulsar la tecla "PRG" para salvar (guardar) los cambios y volver al modo normal de trabajo.
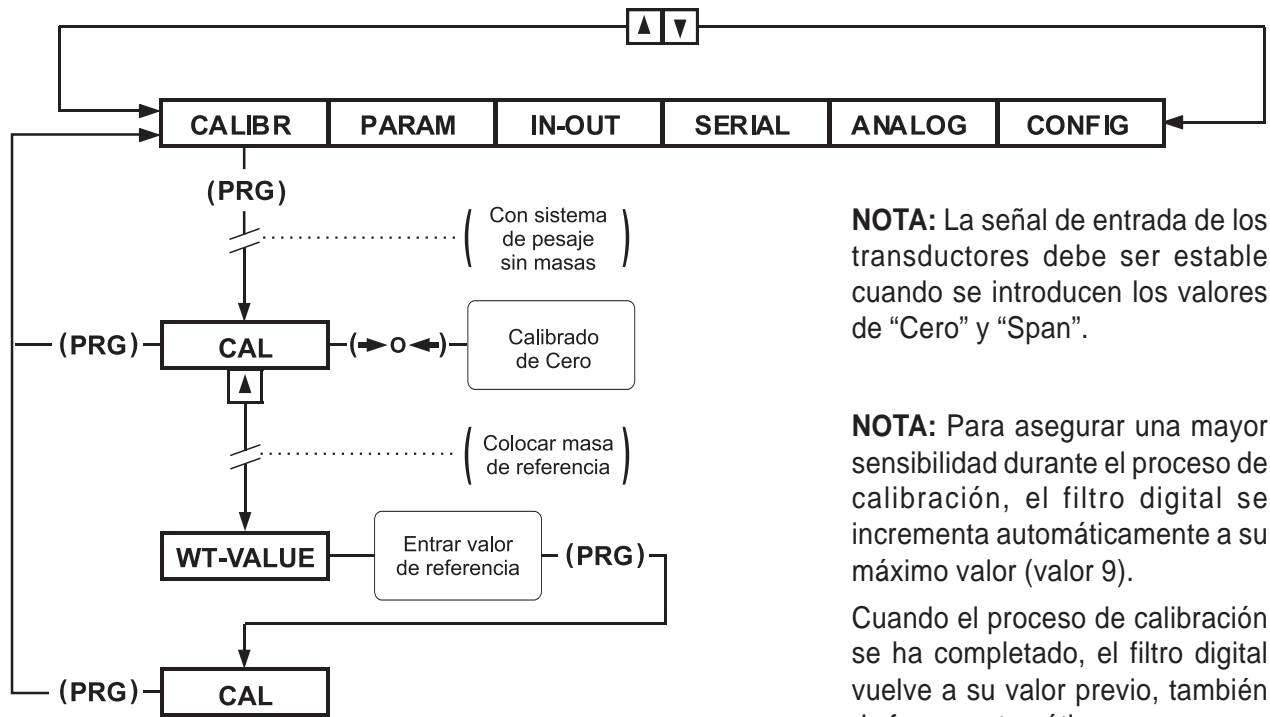
NOTA: La señal de entrada de los transductores debe ser estable cuando se introducen los valores de "Cero" y "Span".

NOTA: Para asegurar una mayor sensibilidad durante el proceso de calibración, el filtro digital se incrementa automáticamente a su máximo valor (valor 9).

Cuando el proceso de calibración se ha completado, el filtro digital vuelve a su valor previo, también de forma automática.

CALIBRACION DEL CERO

...............Visor indica   CALIBR

ASEGURAR QUE EL SISTEMA DE PESAJE ESTÁ EN VACÍO, SOLO LA ESTRUCTURA MECÁNICA QUE SOPORTAN LA(S) CÉLULA(S)

Pulsar la tecla   PRG   hasta que indique **<cal + valor>**   (a)
                                              intermitente

(a) Valor (peso) de la estructura que soportan la (s) célula (s)

Pulsar la tecla   0   hasta que indique   **<cal + 0>**
                                              intermitente

Si es necesario repetir la operación de pulsar 0

Pulsar la tecla   PRG   hasta que indique   **<calibr>**

Pulsar la tecla   0   hasta que indique   **<store?>**

Pulsar la tecla   PRG   hasta que indique   **<....... 0>**

EL CERO ESTA CALIBRADO Y EL SISTEMA EN MODO PESAJE.

NOTA IMPORTANTE: El sistema puede pesar, pero pueden detectarse errores ya que falta realizar el calibrado de ganancia (SPAN) con una masa conocida.

CALIBRACION DE GANANCIA (SPAN)

..........................Visor indica | CALIBR |

COLOCAR LA MASA CONOCIDA EN BÁSCULA.

Pulsar la tecla | PRG | hasta que indique   **<cal + valor>**   (b)
                                                        intermitente

(b) Valor de peso que el equipo interpreta de la masa introducida en báscula.

SI la indicación coincide con el peso (masa) patrón, pasar al punto .... Z
NO coincide, seguir como se indica a continuación.

Pulsar la tecla | SET | indicará   **<VALOR, peso erróneo>**
                                              parpadeando dígito de izquierda

Proceder a : Entrar valor correcto utilizando la tecla | →0← | para desplazar de izquierda-derecha.

La tecla | ↑SET | para subir valor dígito.

La tecla | ↓FUN | para bajar valor dígito.

Cuando tengamos el peso entrado correctamente:

Pulsar la tecla | PRG | indicará   **<cal + valor>**   (c)
                                              intermitente

(c) Valor del peso correcto.

.... Z

Pulsar la tecla | PRG | indicará   **<calibr>**

Pulsar la tecla | 0 | indicará   **<store?>**

Pulsar la tecla | PRG | indicará   **<valor peso>**   (d)

(d) Será el valor de peso (Masa) correcto que está en báscula.

GANANCIA (SPAN) calibrada y Sistema en modo Pesaje.

LINEALIZACION POR PUNTOS
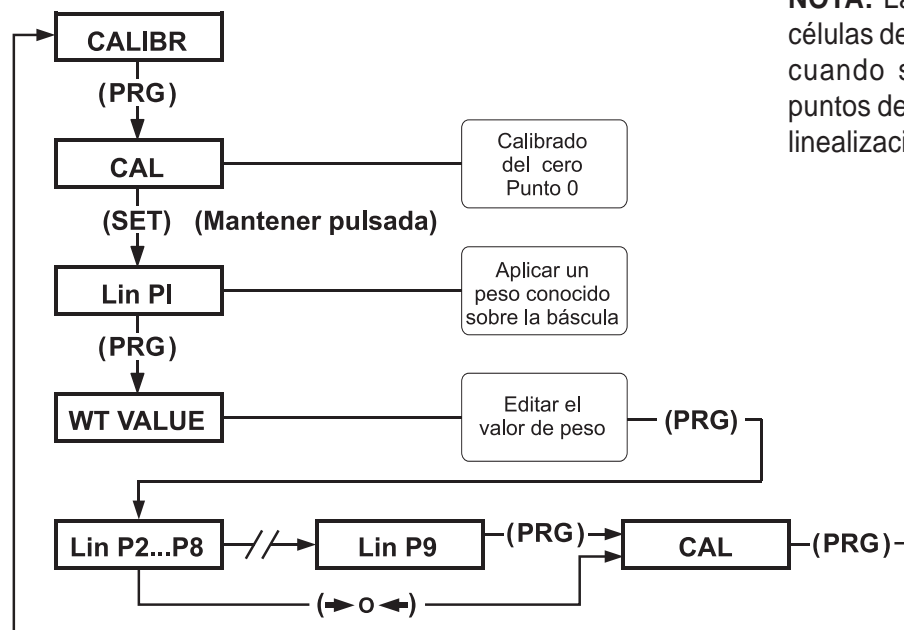
```
        ┌──────────────┐
    ┌──▶│   CALIBR     │
    │   └──────────────┘
    │        (PRG)
    │          │
    │          ▼
    │   ┌──────────────┐        ┌──────────────┐
    │   │     CAL      │───────▶│  Calibrado   │
    │   └──────────────┘        │  del cero    │
    │   (SET)  (Mantener pulsada)│   Punto 0    │
    │          │                └──────────────┘
    │          ▼
    │   ┌──────────────┐        ┌──────────────┐
    │   │    Lin PI    │───────▶│  Aplicar un  │
    │   └──────────────┘        │ peso conocido│
    │        (PRG)              │ sobre la báscula
    │          │                └──────────────┘
    │          ▼
    │   ┌──────────────┐        ┌──────────────┐
    │   │   WT VALUE   │───────▶│  Editar el   │ (PRG)─┐
    │   └──────────────┘        │ valor de peso│       │
    │          │                └──────────────┘       │
    │          ◀───────────────────────────────────────┘
    │          ▼
    │ ┌───────────┐    ┌──────────┐ (PRG)  ┌────────┐ (PRG)─┐
    │ │ Lin P2...P8│─//─▶│  Lin P9  │──────▶│  CAL   │       │
    │ └───────────┘    └──────────┘        └────────┘       │
    │      │              (➡ o ⬅)              ▲            │
    │      └──────────────────────────────────┘            │
    └──────────────────────────────────────────────────────┘
```

La serie DAT dispone de la opción de linealización. Se pueden utilizar hasta 10 puntos, el último debe ser forzosamente el peso máximo definido para el sistema de pesaje o fondo de escala.

Ejemplo: Un punto de corrección de linealidad requerirá un total de dos puntos de muestra, uno en medio del rango y otro a fondo de escala.

Antes de la linealización se debe de haber efectuado como mínimo el calibrado del cero, mientras que el ajuste de fondo de escala no es obligatorio. El instrumento debe estar en modo CALIBR y se debe conocer el valor de los pesos disponibles a aplicar.

Linealización por Puntos vía panel frontal

1. Con el instrumento en modo de "Configuración Básica o Completa", pulse la tecla "PRG" (aparece CAL intermitente).

2. Mantenga pulsada la tecla "SET" hasta que aparezca Lin P1 intermitente.

3. Aplique un peso conocido para el primer punto de linealización y pulse la tecla "PRG".

4. Entre el valor actual del peso. Use la tecla "O" para seleccionar el dígito y la teclas "ARRIBA" y "ABAJO" para cambiar el valor.

5. Pulse la tecla "PRG". La unidad pasará al siguiente punto de linealización (Lin P2).

6. Repita los pasos 3 a 5 para los puntos de linealización adicionales.

7. Si se han linealizado todos los 10 puntos siga por el Procedimiento 1º abajo indicado; mientras que si la corrección de linealidad es menor de 10 puntos siga por el Procedimiento 2º.

Procedimiento 1º (10 puntos de linealización)

7a. Entre el valor de peso para el punto de linealización Lin P9, y pulse la tecla "PRG" (aparece CAL intermitente). Pulse la tecla "PRG" de nuevo, (aparece CALIBR).

7b. Pulse la tecla "O" (aparece STORE?), pulse la tecla "PRG" para guardar los cambios y volver al modo operativo.

Procedimiento 2º (menos de 10 puntos de linealización)

7a. El último punto de linealización debe ser el fondo de escala o valor máximo de pesada definido. Pulse la tecla "O" (aparece CAL intermitente).

7b. Pulse la tecla "PRG" (aparece CALIBR). Pulse la tecla "O" (aparece STORE?).

7c. Pulse la tecla "PRG" para guardar los cambios y volver al modo operativo.

Menú de configuración Completa (continuación)
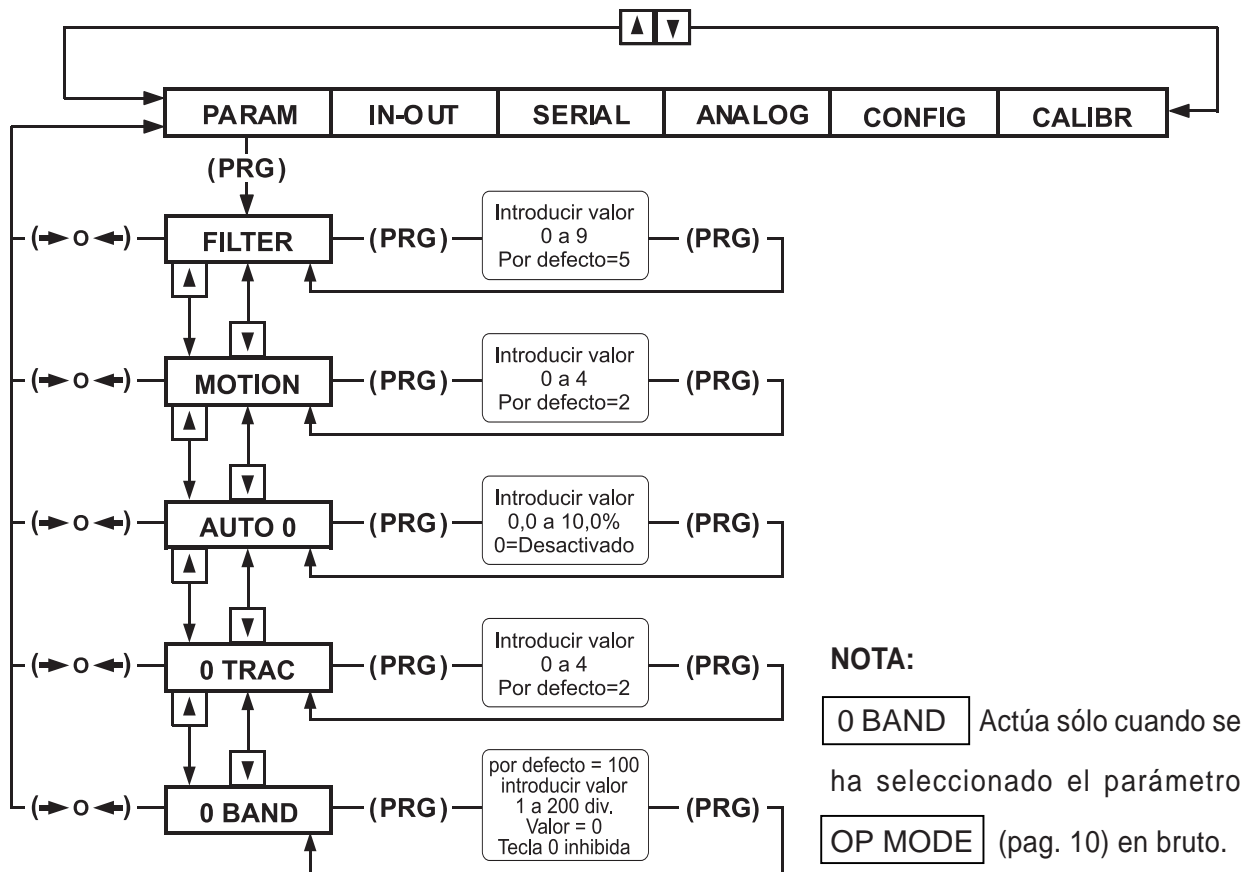
NOTA:

0 BAND   Actúa sólo cuando se ha seleccionado el parámetro OP MODE (pag. 10) en bruto.

1. Con el transmisor en modo "Complete Configuration" (Configuración Completa), pulsar cualquiera de las teclas "Arriba" o "Abajo" hasta visualizar PARAM en el display.

2. Pulsar la tecla "PRG" para entrar en el submenú. Usar las teclas "Arriba" o "Abajo" para seleccionar un parámetro del submenú.

3. Pulsar la tecla "PRG" para ver el valor del parámetro por defecto o el introducido previamente.

4. Para modificar su valor, pulsar la tecla "O" para seleccionar un dígito y las teclas "Arriba" o "Abajo" para incrementar o disminuir su valor.

5. Pulsar la tecla "PRG" para introducir el nuevo valor, y cualquiera de las teclas "Arriba" o "Abajo" para ir al parámetro siguiente del submenú o la tecla "O" para volver al menú principal.

6. Para salir del menú de configuración, volver al menú principal y pulsar la tecla "O" (el display indicará STORE?), pulsar la tecla "PRG" para salvar (guardar) los cambios y volver al modo normal de trabajo.

Encontrará una explicación detallada sobre selección de parámetros "PARAM" en la tabla 2, página 26.

| IN-OUT | SERIAL | ANALOG | CONFIG | CALIBR | PARAM |

(PRG)

(➡ o ⬅)   MODE 1   (PRG)

(PRG) — NET
(PRG) — GROSS
(PRG) — PEAK H

(➡ o ⬅)   HYST 1   (PRG)   Ver notas en página 30. Por defecto=2   (PRG)

(PRG) — N.O.
(PRG) — N.C.

(➡ o ⬅)   TIMER 1   (PRG)   Introducir valor 0.00 - 100.0 Por defecto=0   (PRG)

(➡ o ⬅)   DELAY 1   (PRG)   Introducir valor 0.00 - 100.0 Por defecto=0   (PRG)

(PRG) — POS.
(PRG) — NEG.

(➡ o ⬅)   MODE 2   (PRG)   Remitir a procedimiento para MODE 1

(PRG) — NORMAL
(PRG) — STABLE

(➡ o ⬅)   HYST 2   (PRG)   Ver notas en página 30. Por defecto=2   (PRG)

(➡ o ⬅)   TIMER 2   (PRG)   Introducir valor 0.00 - 100.0 Por defecto=0   (PRG)

(➡ o ⬅)   DELAY 2   (PRG)   Introducir valor 0.00 - 100.0 Por defecto=0   (PRG)

Continúa en la siguiente página

Tabla 1

Display	Salida 1 (Status)	Salida 2 (Status)
OUT 00	OFF	OFF
OUT 10	ON	OFF
OUT 02	OFF	ON
OUT 12	ON	ON

Encontrará una explicación detallada sobre selección de parámetros "IN-OUT" en la tabla 6, página 30.

| SERIAL | ANALOG | CONFIG | CALIBR | PARAM | IN-OUT |

(PRG)

(→ o ←) **BAUD R** — BAUD2R BAUD1R * (PRG)

- (PRG) — 2400
- (PRG) — 9600
- (PRG) — 19200
- (PRG) — 38400
- (PRG) — 115200

(→ o ←) **PROT-1** — (PRG)

- (PRG) — CONTIN
- (PRG) — DEMAND
- (PRG) — AUTOM
- (PRG) — SLAVE
- MODBUS — (PRG)
- (PRG) — BCD
- (PRG) — PRINT
- (PRG) — NONE

- (PRG) — N 8 2
- (PRG) — E 8 1
- (PRG) — O 8 1

(→ o ←) **PROT-2** ** — (PRG)

- (PRG) — PROFIB
- (PRG) — DEVNET
- (PRG) — NONE

Utilizar el "PROT-2" SOLAMENTE cuando el equipo lleva las tarjetas opcionales de Profibus-DP o DeviceNet.

(→ o ←) **ADDRES** — (PRG) — Introducir valor 01 - 32 Máx. # 32 — (PRG)

*
"BAUD1R", BAUD2R" y "DN-ADD" aparecen en el display solamente si el menu "PROT2" se ha puesto a "DEVNET".

(→ o ←) **PR-ADD** — DN-ADD — (PRG) — Introducir valor 001 - 126 — (PRG)

**
Cuando el menu "PROT2" se pone a "PROFIB" o "DEVNET", el menu "ANALOG" se desactivara automáticamente. Por lo tanto, el acceso al menu "ANALOG" solo es posible cuando el "PROT-2" se ha puesto a "NONE".

(→ o ←) **DELAY** — (PRG) — Introducir valor 0.00 - 1.00 Máx. 1 seg. — (PRG)

(→ o ←) **REM-CO** — (PRG) — REMOTE — (→ o ←) — Modo de operación

(→ o ←) **DATA F** — (PRG)

- (PRG) — N 8 1
- (PRG) — N 8 2
- (PRG) — E 8 1
- (PRG) — O 8 1
- (PRG) — N 7 2
- (PRG) — E 7 1
- (PRG) — E 7 2
- (PRG) — O 7 1

Encontrará una explicación detallada sobre selección de parámetros "SERIAL" en las tablas 3 a 5, páginas 28 y 29.
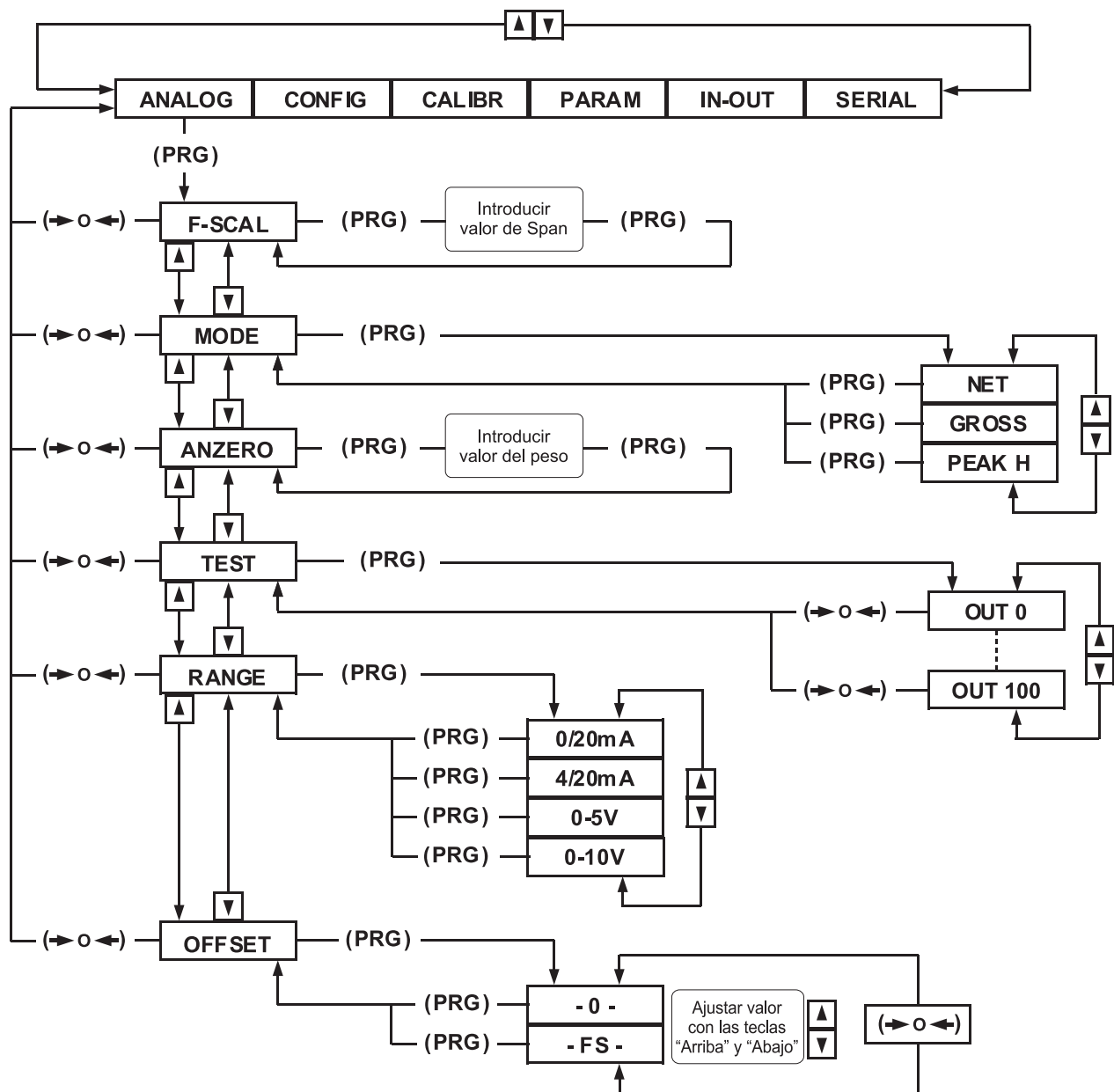
1. Con el transmisor en modo "Complete Configuration" (Configuración Completa), pulsar cualquiera de las teclas "Arriba" o "Abajo" hasta visualizar ANALOG en el display.

2. Pulsar la tecla "PRG" para entrar en el submenú. Usar las teclas "Arriba" o "Abajo" para seleccionar un parámetro del submenú.

3. Pulsar la tecla "PRG" para ver el valor del parámetro por defecto o el introducido previamente.

4. Para modificar un parámetro, pulsar cualquiera de las teclas "Arriba" o "Abajo" para ver las selecciones posibles para dicho parámetro. Cuando aparece la selección deseada en el display, pulsar la tecla "PRG" para salvar (guardar) la selección y pasar al parámetro siguiente.

5. Para editar un valor numérico, seleccionar el dígito con tecla "O" y pulsar las teclas "Arriba" o "Abajo" para incrementar o disminuir el valor del dígito seleccionado.

6. Pulsar la tecla "PRG" para salvar (guardar) el nuevo valor y cualquiera de las teclas "Arriba" o "Abajo" para ir al parámetro siguiente del submenú o la tecla "O" para volver al menú principal.

El parámetro «ANZERO» es un valor negativo del peso para que pueda referenciarse el valor de cero de la salida analógica.

Ejemplo: Si el rango seleccionado es 4/20 mA. y el valor de «ANZERO» es «10», el valor de la salida analógica será de 4 mA. cuando el peso sea de «-10»

Configuración utilizando INOVATION™

Para configurar el transmisor Digital / Analógico, proceder como sigue:

1. Instalar el programa INOVATION™ en un PC-compatible operando con Win 95, 98 o Me.

2. Requerimientos mínimos del sistema: 8 Mb memoria RAM y 5 Mb de disco duro disponibles.

3. Con el PC y el instrumento apagados, conectar el puerto serie del PC a los terminales RS-232 del instrumento.

4. Conectar a la red el PC y el instrumento y arrancar el programa INOVATION™.

DAT-500

Conectar el transmisor en modo remoto para una configuración completa y seleccione «REMOTE» desde el menú «SERIAL».
Ver pág. 17
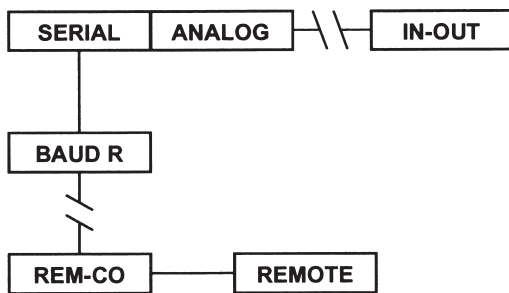
DAT-400

Quitar con cuidado la tapa superior izquierda y mover el jumper (1) a posición "Control Remoto".

Si se establece la comunicación con el transmisor el display indicará REMOTE confirmando que el jumper esta correctamente colocado. Ver pág. 17

    Pins 1-2 = Control Remoto

    Pins 2-3 = Configuración por defecto.
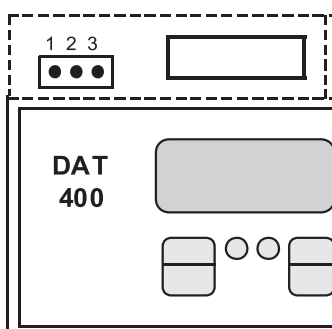
Cuando en el PC se visualiza cualquiera de los dos modelos, el valor de peso actual se indicará debajo del icono indicando que el transmisor esta configurado. Si se visualiza ERROR, comprobar las conexiones y que el jumper (J1) este colocado correctamente en el transmisor.

Hacer doble clic en el icono del transmisor, arrancará el programa INOVATION™ en la pantalla principal de "Setup" (configuración).

En dicha pantalla, se puede seleccionar el modo de operación, poner la dirección o entrar los valores de las dos consignas.

Haciendo clic en el botón SETUP, aparecerán siete carpetas en la mitad inferior de la pantalla. Se abrirá la primera carpeta con nombre "Parametres".

La sección superior de esta carpeta es para introducir la capacidad total de la bascula, sensitividad, el peso neto, el peso bruto. (Parámetros necesarios para realizar una hoja de calibración).

El procedimiento de la hoja de calibración permite calibrar el transmisor sin simulador (generador de señal) o pesos muertos. Este procedimiento se basa en la capacidad y salida mV/V (sensibilidad), certificada, del transductor.

Para realizar la calibración, introducir los valores indicados arriba, hacer clic sobre el botón SEND para este grupo de parámetros.

La sección siguiente de esta carpeta se utiliza para seleccionar la resolución del display. Consiste de un menú desplegable y un botón SEND (enviar).

Los transmisores de la Serie **DAT** cuentan desde 1 hasta 60.000 puntos. Para valores superiores a 10.000, el transmisor selecciona automáticamente una resolución inferior para asegurar mejor estabilidad. Después de seleccionar la resolución deseada, pulsar el botón SEND de este parámetro. No pulsar ningún botón SEND de esta carpeta, ya que el transmisor tomará los parámetros puestos por defecto x2, x5 etc.

Los cambios en la resolución del display deberían efectuarse solamente después de que el transmisor haya sido calibrado por el procedimiento de la hoja de calibración o por el de pesos muertos.

El botón del fondo de selección de parámetros en esta carpeta se llama "Operating Mode" (modo de operación). Permite retener el modo de trabajo del transmisor en caso de perdida de tensión de alimentación. Cuando se recupera la tensión de alimentación, el transmisor vuelve automática- mente al modo de trabajo en el que estaba antes de la perdida de tensión de alimentación.

La segunda carpeta permite la calibración del transmisor mediante simulador de transductor o el peso actual (método de calibración recomendado).

Dentro de esta segunda carpeta, se han modificado algunos de los parámetros de cero, el programa pregunta al usuario si el nuevo cero ha modificado los datos de la calibración. Si se responde que «SI» el valor del «Peso muerto» de la primera carpeta cambiará automáticamente de acuerdo con el nuevo valor de cero. Si se responde que «NO», el valor del «Peso muerto» de la primera carpeta se mantendrá en su valor previo.

La tercera carpeta contiene los parámetros del filtro digital, seguimiento de cero etc.

La cuarta carpeta contiene los parámetros de configuración de las entradas y salidas.

La quinta carpeta contiene los parámetros de la salida serie.

La sexta carpeta contiene los parámetros de la salida analógica.

La séptima carpeta proporciona los medios para probar (comprobar) las salidas y la salida analógica.

La pantalla Main Setup y las carpetas del 1 al 6 disponen de botones SEND (enviar) para transferir los cambios en los parámetros al transmisor.

Cuando el proceso de configuración y calibración haya sido completado, los datos pueden ser guardados en el PC, en disquete o transferidos (enviados) al transmisor. Este procedimiento es muy útil cuando varios transmisores deben llevar la misma configuración o cuando hay que sustituir un transmisor.

Para salir del programa INOVATION™, hacer clic sobre botón Exit Setup en la pantalla, aparecerá una ventana con "Save Changes" (guardar cambios), haga clic en OK. Ahora hacer clic sobre Option (opción) en la esquina superior izquierda de la pantalla, seleccionar EXIT del menú desplegable, esto nos devolverá a la pantalla Configuration Utility (herramienta de configuración), para salir hacer clic en QUIT.

La figura 2 muestra un ejemplo de una de las pantallas de configuración del programa **INOVATION™**.
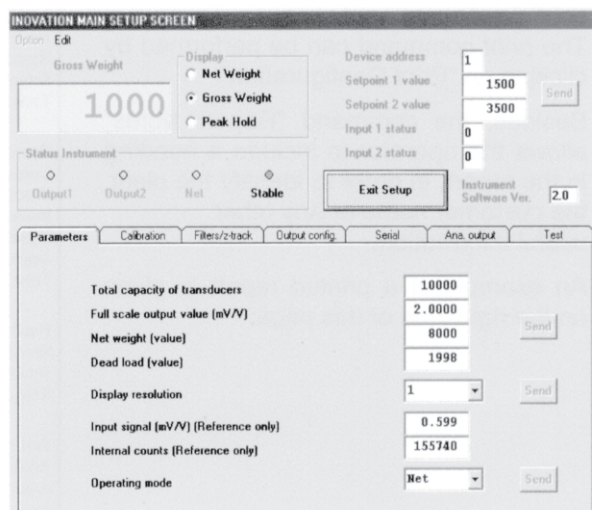
Figura 2
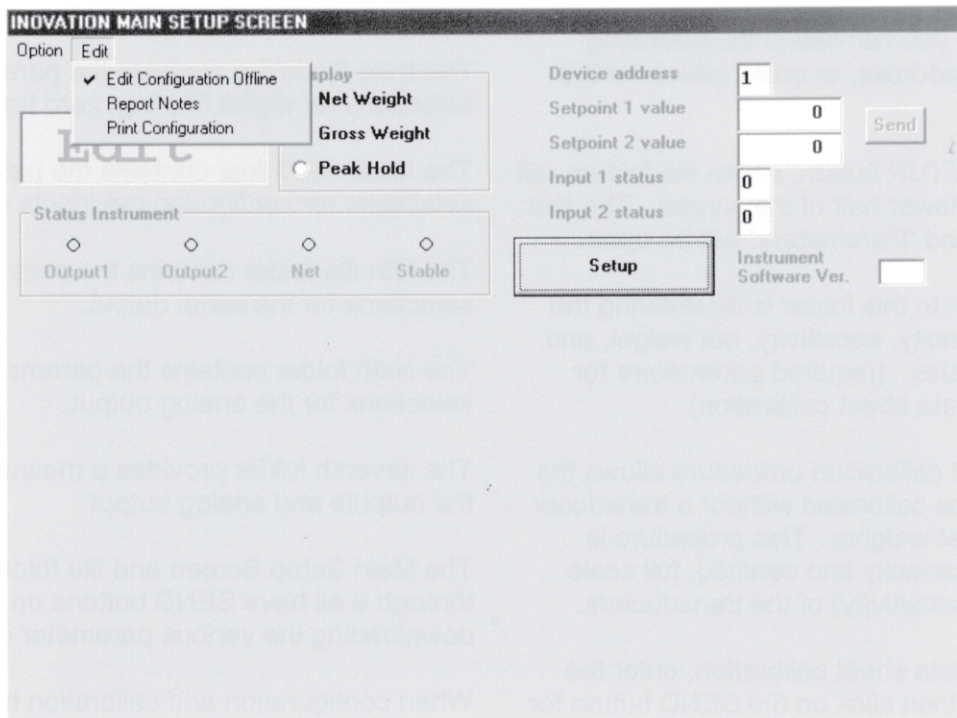
Figura 2.1

La nueva versión 2.0 del programa INOVATION™, permite al usuario crear nuevas configuraciones, salvar nuevos archivos y abrir los existentes sin tener que desconectar ningún instrumento del proceso.

Grácias a esta característica, el traspaso de datos al instrumento para su configuración puede realizarse en cualquier momento.

Para ello habrá que pulsar el menú «Edit» situado en el ángulo superior izquierdo (ver fig. 2.1) para activar la función «Edit Configuration Offline».

El mensaje «Edit» aparecerá en el display, mostrando esta situación.

Otra ventaja de ésta nueva versión, es la de poder imprimir todos los parámetros incluidos en la configuración. La orden de impresión puede modificarse entrando en «Print Configuration».

Además, la orden «Report Notes» permite al usuario incluir un título al listado de parámetros, para identificar la ubicación, el nombre del cliente o cualquier otra información.

A continuación mostramos un ejemplo de impresión:

PRINT CONFIGURATION

Date 13/03/2002   Test Procedure for DAT instruments

Status Instrument

Device address	2
Setpoint 1 value	1500
Setpoint 2 value	3500
Input 1 status	0
Input 2 status	0
Instrument software version	2.0

Parameters

Total capacity of transducers	10000
Full scale output value (mV/V)	2.0000
Net weight (value)	8000
Dead load (value)	1500
Display resolution	1
Input signal	0.599
Internal counts (Reference only)	155729
Operating mode	Net

Filters / z-track

Digital filter value (0 to 9: 0 = no filter; 9 = max filter; default 5)	5
Motion band value (0 to 4: 0 = minimum; 4 = maximum; default 2)	1
Auto zero range setting at power up (0 to 10.0% of net weight: 0 = disble)	0.0
Zero tracking (0 to 4: default 2)	2

Output config.   Out 1

Operating mode	Net
Contact status below setpoint value	N. Open
Positive / Negative weight comparison	Positive
Immediate activation / activation after stabilization	Immediate
Hysteresis (default 2)	2
Setpoint activation time length (in 1/10 sec.) (0 = disable)	0
Time delay for activating setpoint (in 1/10 sec.) (0 = disable)	0

Output config.   Out 2

Operating mode	Gross
Contact status below setpoint value	N. Closed
Positive / Negative weight comparison	Positive
Immediate activation / activation after stabilization	Immediate
Hysteresis (default 2)	50
Setpoint activation time length (in 1/10 sec.) (0 = disable)	0
Time delay for activating setpoint (in 1/10 sec.) (0 = disable)	0

Serial

Baud Rate (default 9600)	9600
Serial port mode (default Continuous transmission)	Slave
Serial address (ID Code) (from 01 to 32)	2
Response delay (Demand or Modbus mode) (in 1/100 sec. Max 1 sec.)	25

Ana. Output

Full scale value (default = Net weight value)	8000
Analog output source (Net Gross Peak H)	Net
Analog output selection	0-20mA
No load zero input value	0

Comunicación Serie

Velocidad de comunicación

2400, 9600, 19200, 38400 y 115200 Baudios

Formato mensaje

Todos los caracteres están en formato ASCII y consisten en lo siguiente:

1 Bit de inicio, 8 Bits de datos, 1 Bit de paro, No paridad.

La transmisión de los datos se puede iniciar de varias maneras como se describe a continuación.

Modo Automático

El modo "Automático" se utiliza para conectar el transmisor a impresoras u otros equipos de adquisición de datos. Los datos se transmiten automáticamente, *sobre estabilización* siempre y cuando el peso haya aumentado o disminuido en mas de 20 divisiones.

Esta función no es modificable cuando el parámetro «MOTION» es «0» (prueba de estabilidad del peso inhabilitada)

Modo Continuo

El modo "Continuo" se utiliza para conectar el transmisor a PC, indicadores remotos u otros equipos que necesitan actualización de datos constantemente.

Modo Manual (a petición)

El modo "Manual" se utiliza para conectar el transmisor a impresoras que necesitan un comando manual para imprimir desde el teclado frontal o cerrando un contacto remoto para iniciar la transmisión.

En los modos descritos arriba, el transmisor envía los mensajes utilizando el siguiente formato:

STX	<status>	<peso neto>	<peso bruto>	<valor de pico>	ETX	<chksum>	EOT

STX (comienzo de texto) = 02h   ETX (final de texto) = 03h   EOT (final de transmisión) = 04h

<status>	= 1 carácter ASCII consiste de:	
"S"	= Estable (Stable)	
"M"	= Marcha (Motion)	
"O"	= Sobrecarga (Overload)	
"E"	= Error	
<peso neto>	= 6 caracteres ASCII	
<peso bruto>	= 6 caracteres ASCII	
<valor pico>	= 6 caracteres ASCII	
<checksum>	= 2 caracteres ASCII (STX y ETX no están incluidos en checksum)	

NOTA: Los paréntesis "<" y ">" no se envían, se usan a modo de aclaración.

El valor del control checksum se obtiene realizando una operación XOR.

Este es expresado en Hexadecimal con 2 dígitos. Ejemplo: 25 = 1D.

El resultado del calculo de arriba es igual a 1 carácter, que puede ser numérico de 0 a 9, o de A a F (Hexadecimal).

Modo Esclavo

El modo "esclavo" se utiliza para conectar el transmisor a un sistema de control distribuido (DCS) o a un autómata (PLC). Este modo requiere de una orden del maestro para iniciar la transmisión.

Petición de Peso

En este modo, el maestro (host) envía un mensaje al transmisor usando el siguiente formato:

<addr>	"N"	EOT

Después de recibir la solicitud, el transmisor responde con un mensaje como sigue:

<addr>	"N"	<status>	<peso neto>	<peso bruto>	<valor de pico>	ETX	<chksum>	EOT

En caso de error, el transmisor responde con este mensaje:

<addr>	NAK	EOT

<addr> dirección + 80h   Ejemplo: dirección 1 sería 1 + 80h = 81h.

ETX (final de texto) = 03h   EOT (final de transmisión) = 04h

<status>	= 1 carácter ASCII consiste de:
"S"	= Estable (Stable)
"M"	= Marcha (Motion)
"O"	= Sobrecarga (Overload)
"E"	= Error
<peso neto>	= 6 caracteres ASCII
<peso bruto>	= 6 caracteres ASCII
<valor pico>	= 6 caracteres ASCII
<checksum>	= 2 caracteres ASCII (addr y ETX no están incluidos en checksum)

NOTA: Los paréntesis "<" y ">" no se envían, se usan a modo de aclaración.

El valor del control checksum se obtiene realizando una operación XOR.

Expresado en Hexadecimal con 2 dígitos. Ejemplo: 25 = 1D.

El resultado del calculo de arriba es igual a 1 carácter, que puede ser numérico de 0 a 9, o de A a F (Hexadecimal).

Configuración consignas

La orden desde el "maestro" es:

<addr>	"S"	<s1>	<s2>	ETX	<chksum>	EOT

<s1> = 6 caracteres ASCII para el valor 1

<s2> = 6 caracteres ASCII para el valor 2

El transmisor responde con el siguiente mensaje:

<addr>	ACK	EOT

En caso de error, el transmisor responderá con el siguiente mensaje:

<addr>	NAK	EOT

Los valores programados se guardan en la memoria RAM, pero se perderán cuando falle la alimentación. No hay límite en el número de veces que se modifiquen estos comandos.

Guardar valores de consigna en la Eeprom

La orden desde el "maestro" es:

| \<addr\> | "M" | EOT |

El transmisor responde con el siguiente mensaje:

| \<addr\> | "M" | EOT |

En caso de error, el transmisor responderá con el siguiente mensaje:

| \<addr\> | NAK | EOT |

Esta orden se utiliza para guardar los valores de consigna programados en la Eeprom y puede modificarse unas 100.000 veces.

Consultar los valores de consigna

La orden desde el "maestro" es:

| \<addr\> | "R" | EOT |

El transmisor responde con el siguiente mensaje:

| \<addr\> | "R" | \<s1\> | \<s2\> | ETX | \<chksum\> | EOT |

En caso de error, el transmisor responderá con el siguiente mensaje:

| \<addr\> | NAK | EOT |

Selección del modo "Peso Bruto"

La orden desde el "maestro" es:

| \<addr\> | "C" | "L" | EOT |

El transmisor responde con el siguiente mensaje:

| \<addr\> | "C" | "L" | ACK | EOT |

En caso de error, el transmisor responderá con el siguiente mensaje:

| \<addr\> | NAK | EOT |

Selección del modo "Peso Neto"

La orden desde el "maestro" es:

| \<addr\> | "C" | "N" | EOT |

El transmisor responde con el siguiente mensaje:

| \<addr\> | "C" | "N" | ACK | EOT |

En caso de error, el transmisor responderá con el siguiente mensaje:

| \<addr\> | NAK | EOT |

Cero / Tara / Pico alto

Este comando se utiliza para poner a cero cuando trabaja en modo Bruto, tarar cuando trabaja en modo Neto y reiniciar el cero cuando trabaja en modo Pico.

La orden desde el "maestro" es:

| \<addr\> | "A" | "A" | EOT |

El transmisor responde con el siguiente mensaje:

| \<addr\> | "A" | "A" | ACK | EOT |

En caso de error, el transmisor responderá con el siguiente mensaje:

| \<addr\> | NAK | EOT |

Modo Modbus

El modo Modbus se utiliza para comunicar el transmisor con los Controladores Programables Modicon utilizando una única estructura de mensaje que los controladores entienden independientemente del tipo de red utilizado.

Pueden referirse a las tablas de especificaciones del protocolo Modbus RTU en las páginas 31 hasta 41.

Modbus® y Modicon® son marcas registradas por Scheneider Automation Group.

¿CÓMO CALCULAR EL CHECKSUM?

Se recibe una secuencia de 19 caracteres antes del checksum.

S			
1 status	6 bruto	6 neto	6 pico

Se toma carácter por carácter y se efectúa una operación lógica XOR.

La operación XOR es poner en binario los dos caracteres y bit a bit se hace una suma,

- si el resultado es par ⟶ 0
- si el resultado es impar ⟶ 1

Ejemplo:

S 8 ⟶ Binario

S ⟶	0	1	0	1	0	0	1	1
8 ⟶	0	0	1	1	1	0	0	0
Σ XOR 8 =	0	1	1	0	1	0	1	1

Se pasa a hexadecimal   6 B

Se pone como dos caracteres ASCII en hexadecimal   36 H   42 H = Checksum

Modo Print

Este protocolo habilita la comunicación con una impresora, imprimiéndose los siguientes datos: NETO, BRUTO Y TARA (+PICO, si estuviera habilitado).

La impresión tendrá lugar al pulsar la tecla PRG y también mediante la activación de la entrada digital input #2. (*)

La impresión se realiza sólo si se cumplen las siguientes condiciones:

- Peso Bruto positivo
- Peso Neto positivo
- Peso Estable (**)
- Función BLIND no habilitada (***)

(*) Si la tecla PRG estuviera bloqueada (ver página 6) el comando print sólo se podrá ejecutar mediante la entrada digital input # 2.

(**) La condición de estabilidad se controla sólo si el parámetro MOTION (ver página 14) está puesto a valor ≠ 0.

Si MOTION = 0 la impresión se podrá realizar realizar incluso con peso inestable.

(***) En caso de que la función BLIND está habilitada (ver página 6) el comando PRINT puede ejecutarse a través de la entrada digital remota input # 2, no vía la tecla PRG.

Entre una impresión y la siguiente el valor de peso debe haber cambiado por lo menos 20 divisiones de display.

Formatos de impresión:

Estándar	
Net	9.488 kg
Gross	19.874 kg
Tare	10.386 kg

Pico habilitado	
Net	9.488 kg
Gross	19.874 kg
Tare	10.386 kg
Peak	35.294 kg

Cableado de la salida comunicación serie DAT

La Figura 3 muestra la conexión de la salida serie RS-232 a un PC, a una impresora, a un indicador remoto u otro equipo de adquisición de datos.

La comunicación RS-485 permite la conexión multipunto de hasta 32 equipos a un sistema de control distribuido (DCS) o a un autómata programable (PLC). Ver Figura 4.

Figura 3
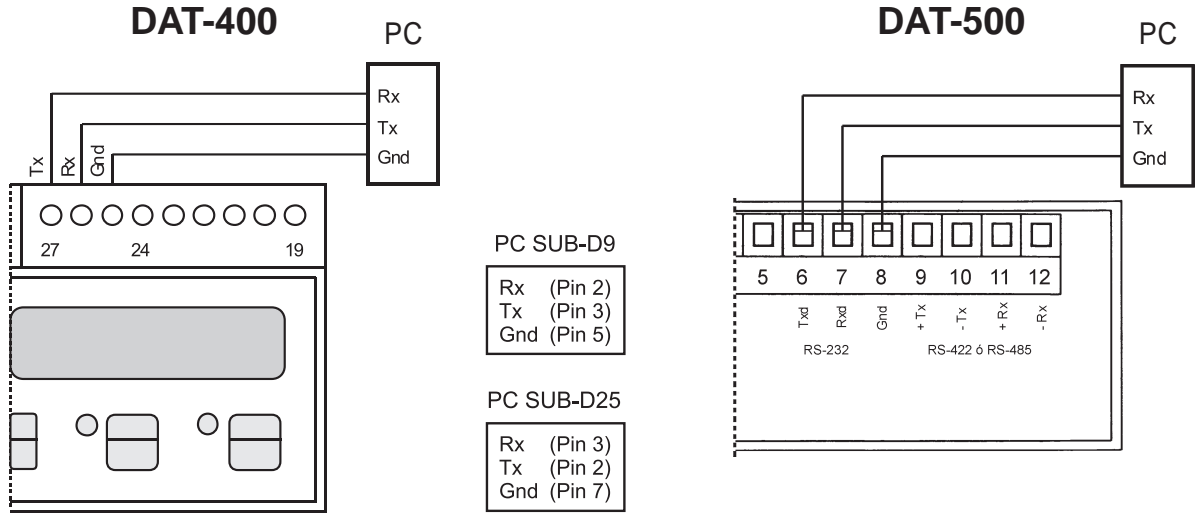
Figura 4
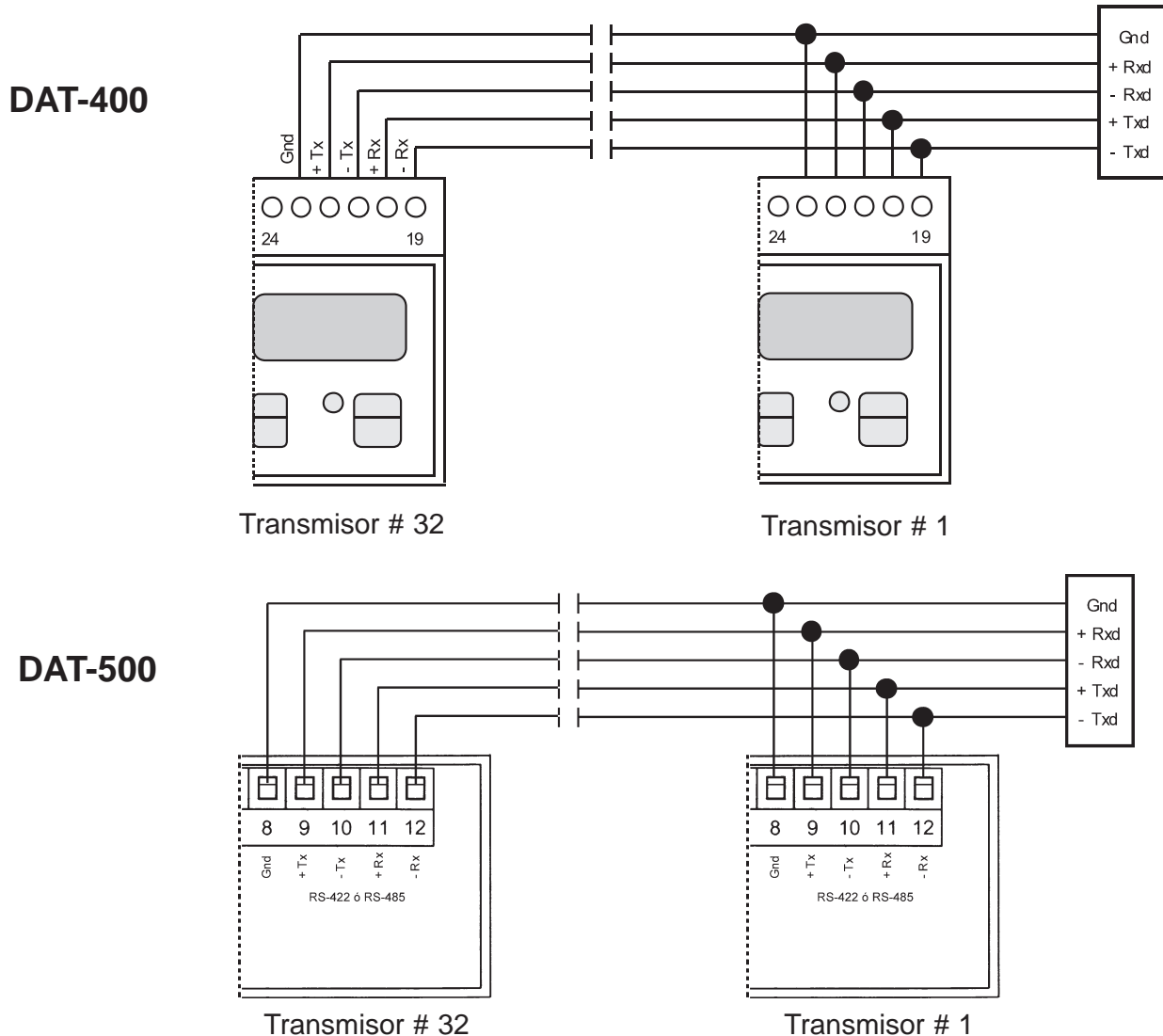
Submenú de selección de parámetros

Tabla 2

Menú "PARAM"			Nº de filtro*	Velocidad de refresco
Parámetros	**Selección**	**Descripción**		
FILTER (Filtro) (Ver nota abajo)	0 a 9 (Por defecto = 5)	Valor de filtro digital 0 = Sin filtro 9 = Filtro máximo	0	25Hz
			1	10Hz
MOTION (Marcha)	0 a 4 (Por defecto = 2)	Estabilización del peso 0 = Peso estable 1 = estabilización lenta 4 = estabilización rápida	2	5Hz
			3	2,5Hz
AUTO 0	0.0 a 10.0% (del peso neto)	Rango de Auto Cero a la conexión de alimentación 0 = Función deshabilitada	4	1,5Hz
			5	1Hz
0 TRAC	0 a 4 (por defecto = 2)	Rango seguimiento de Cero 0 = Función deshabilitada	6	0,7Hz
			7	0,4Hz
0 BAND	1 a 200 (Por defecto = 100) 0 = tecla bloqueada	Banda en divisiones de pesaje, dentro de la cual actuará la tecla "O"	8	0,2Hz
			9	0,1Hz

* El filtro digital afecta a la velocidad de refresco de datos y a la respuesta del transmisor.

0 Band: Este parámetro define el rango de trabajo de la tecla "Zero" (y la entrada 1), utilizada para poner a cero el equipo en modo Gross.

Tabla 3

Menú "SERIAL"		
Parámetros	**Selección**	**Descripción**
Baud R	2400, 9600, 19200 38400, 115200	Selección de velocidad de comunicación COM1 Velocidad de comunicación estándar: 9600
PROT-1	NONE CONTIN (ASCII) DEMAND (ASCII) AUTOM (ASCII) SLAVE (ASCII) MODBUS (*) BCD	Selección de modo de transmisión del puerto Serie COM1 Modo de transmisión estándar: Continuo * Las selecciones posibles del Formato de Datos de este protocolo son: N 8 2, E 8 1, o 8 1 (Paridad, bits de Datos, bits de Stop)
PROT-2	PROFIB DEVNET NONE	Selección modo de transmisión puerto Serie COM2
ADDRES	01 a 32	Dirección de identificación de COM1, seleccionable de 1 a 32
PR ADD DN ADD	001 a 126	Dirección de nodos de Profibus-DP o DeviceNet
DELAY	0.00 a 1.00	Retardo en responder a una petición de datos por parte del servidor en modo "Demand" o MODBUS" (COM1) Unidad de tiempo: 1/100 segundos (máximo 1 segundo)
REM-CO	REMOTE (Remoto)	Permite la comunicación con "INOVATION" sin recolocar el jumper (J1) como se describe en página 19 para el DAT-500
DATA F	N-8-1 N-8-2 E-8-1 O-8-1 N-7-2 E-7-1 E-7-2 O-7-1	Selección de Formato de Datos del protocolo ASCII (Paridad, bits de Datos, bits de Stop). Ver "PROT-1"

Transmisión Continua:

La velocidad de transmisión depende del valor del filtro digital y la velocidad de comunicación seleccionada. Para mas información ver tabla 4.

Tabla 4

		Velocidad de comunicación				
		2400	**9600**	**19200**	**38400**	**115200**
F I L T R O D I G I T A L	0	6 Hz	25 Hz	50 Hz	50 Hz	50 Hz
	1	6 Hz	25 Hz	50 Hz	50 Hz	50 Hz
	2	6 Hz	25 Hz	50 Hz	50 Hz	50 Hz
	3	6 Hz	25 Hz	25 Hz	25 Hz	25 Hz
	4	6 Hz	25 Hz	25 Hz	25 Hz	25 Hz
	5	6 Hz	12 Hz	12 Hz	12 Hz	12 Hz
	6	6 Hz	12 Hz	12 Hz	12 Hz	12 Hz
	7	6 Hz	12 Hz	12 Hz	12 Hz	12 Hz
	8	6 Hz	6 Hz	6 Hz	6 Hz	6 Hz
	9	6 Hz	6 Hz	6 Hz	6 Hz	6 Hz

Driver para opción BCD

La velocidad de transmisión depende del valor del filtro digital y la velocidad de comunicación seleccionada. Para mas información ver tabla 5.

Tabla 5

		Velocidad de comunicación	
		2400	**9600**
F I L T R O D I G I T A L	0	12 Hz	50 Hz
	1	12 Hz	50 Hz
	2	12 Hz	50 Hz
	3	12 Hz	25 Hz
	4	12 Hz	25 Hz
	5	12 Hz	12 Hz
	6	12 Hz	12 Hz
	7	12 Hz	12 Hz
	8	6 Hz	6 Hz
	9	6 Hz	6 Hz

Tabla 6

Menú "IN - OUT"		
Parámetros	**Selección**	**Descripción**
MODE 1 (Modo 1)	Gross (Bruto) NET (Neto) PEAK H (Pico)	Selección del modo de trabajo de la salida 1
	N.O N.C	Estado de los contactos por debajo del valor de consigna
	POS. NEG.	Comparación con valores de peso positivos o negativos
	NORMAL STABLE	Salida habilitada solamente después de estabilizarse el valor de peso leído
HYST. – 1 (Ver notas abajo)	Por defecto = 2	Valor de histéresis, se utiliza para eliminar el rateo del relé en el punto de consigna
TIMER 1 Temporizador 1	0.0 a 10.0 (0 = deshabilitado)	La salida se desconecta después del tiempo programado (incrementos de 1/10 segundo)
DELAY 1 Retardo 1	0.0 a 10.0 (0 = deshabilitada)	La salida conecta después del tiempo programado (incrementos de 1/10 segundo)
Idem anterior para la salida 2		
TEST IN	Ver página 16	Procedimiento para comprobar (test) las entradas
TEST OUT	Ver página 16	Procedimiento para comprobar (test) las salidas

Notas:

1. El valor de histéresis debe ser inferior al valor de la consigna correspondiente. En caso de Introducir un valor de histéresis superior al de consigna, automáticamente tomará el valor por defecto (2).

2. Es posible un valor de histéresis de 10 puntos del valor de su correspondiente consigna, aunque valores inferiores normalmente son suficientes.

3. Un valor alto de histéresis (4.990 puntos) se puede utilizar como se indica a continuación:

Para llenar automáticamente un depósito:

El Setpoint 1 se va a utilizar para llenar un depósito con 5.000 kg y el Setpoint 2 se va a utilizar con un valor superior como detector de alarma de sobrellenado.

Cuando el peso en el depósito alcance los 5.000 kg el relé 1 se desactivará parando la carga del producto (motor, válvula, etc.). Posteriormente debido al uso normal el depósito se irá vaciando, cuando el peso del depósito descienda hasta los 10 kg (5.000 kg del Setpoint 1 - 4990 de HYST) el relé 1 se activará y empezará el proceso de llenado automático.

Especificaciones del protocolo de comunicación Modbus RTU

1. Precaución

El protocolo Modbus escribe directamente en la memoria del instrumento.

Hay que prestar atención cuando se envía datos al instrumento.

La información enviada debe estar dentro de los rangos especificados indicados en las tablas en las páginas siguientes.

Algunos datos se escriben en la memoria E2prom (ver la columna 2Store en E2prom" en las tablas, para más información). Esta memoria sólo permite 100.000 escrituras, así que se debe evitar escribir continuamente en esta memoria.

Para confirmar que un nuevo valor se ha guardado en la E2prom, realizar la función MAKE-BACKUP. Si esta función no se realiza, todos los valores nuevos guardados se perderán cuando el instrumento se desconecta de la tensión de alimentación.

Para introducir la "consigna" no es necesario realizar la función Make-Backup.

Los valores de consigna se expresan como numero de divisiones

Esto significa que, cualquier valor de consigna (temporal o permanente) debe ser multiplicado por el valor de "división del display" para obtener el valor real de la consigna.

Ej. Supongamos que el valor de "división del display" es 0,2; si el PLC pregunta el valor de Setpoint y obtiene el valor "3949" del instrumento, esto significa que el valor real de la consigna es 789.8 (3949x0,2= 789.8)

Los otros **valores de peso** también se expresan como numero de divisiones, excepto el valor de "peso neto" y "peso bruto"

El "peso neto" y el "peso bruto" (dirección Modbus 40006 y 40007) se expresan como valores absolutos.

Todos los valores de peso son dados como divisiones.

Nota: Los valores numéricos de las siguientes páginas de direcciones, códigos y datos están expresados en números decimales.

Las direcciones dados en las siguientes tablas se refieren al estándar proporcionado por la Guía de protocolo Modbus de Modicon (Modicon Modbus Protocol Reference Guide) PI-MBUS-300 Rev J.

2. Formato del mensaje

- 1 Bit de inicio
- 8 Bits de datos. El bit menos significativo se envía primero
- Paridad: No, Even, Odd
- Bits de paro: 1, 2

Selección del formato del mensaje: **N-8-2 E-8-1 O-8-1**

3. Lista de funciones soportadas

	Función	Descripción
	01 (01)	Leer el estado de la bobina
	03 (03)	Leer los registros HOLD (retenimiento)
Entre paréntesis valores en hexadecimal	04 (04)	Leer registros de entrada
	05 (05)	Fuerza de una bobina
	06 (06)	Prefijar (preset) un registro
	15 (0F)	Fuerza de múltiples bobinas
	16 (10)	Prefijar múltiples registros

Las funciones soportadas por el protocolo Modbus del DAT se explican en la siguiente tabla (ver la página 31 del manual de operaciones):

Cada función está explicada con detalle de las páginas 34 hasta 37 del manual de operación.

Cada función se compone de una "Pregunta" (la petición del maestro) y de una "Respuesta" (la respuesta al maestro). Las preguntas y respuestas son una secuencia de datos que se explican a continuación (***).

Nota: El código **"0x"** antes de cualquier valor indica que el valor es un **valor hexadecimal**.

Además, **todas las direcciones Modbus** (indicadas en la columna de la izquierda en las páginas 38 y 39) deben ser valores hexadecimales, pero, **solamente para estas direcciones**, hay **una regla importante a tener en cuenta:**

Antes de convertir el valor a hexadecimal, el 1º dígito a la izquierda no se debe considerar y los 4 dígitos restantes deben decrementarse en "1"

1º Ejemplo:

Para expresar la dirección 40150 ("división del display" en la página 35) en valor hexadecimal, excluir el dígito "4" (queda "0150"), ahora decrementar el número "0150" en "1".

El resultado es "0149", ahora realizar la conversión a hexadecimal. El resultado es "0095". Este es el valor a utilizar en la pregunta del maestro al DAT.

2º Ejemplo:

Para expresar la dirección 40102 ("sensibilidad de célula de carga" en página 35) en hexadecimal, excluir el digito "4" (queda "0102"), ahora decrementar el numero "0102" en "1". El resultado es "0101", ahora realizar la conversión a hexadecimal. El resultado es "00 65". Este es el resultado a utilizar en la pregunta.

(***)

Dirección: es el número de dirección del instrumento, **valor expresado en hexadecimal** (en este caso no decrementar el número en 1)**.**

Función: es el número de función a realizar (ver la tabla de pag. anterior)

Dirección 1ª Salida: dirección donde la lectura del estado de las salidas comienza. **Número de salidas:** es el número de salidas a leer.

Dirección 1º Entrada: dirección donde la lectura de las entradas comienza.

Número de entradas: es el número de entradas a leer.

Número de bytes: es el número de bytes de que se componen los datos.

CRC de 2 bytes: "Comprobación Redundante Cíclica". Es un algoritmo utilizado para comprobar errores de comunicación.

Bytes totales: número total de bytes transmitidos.

Estos datos no están incluidos en las cadenas de caracteres.

4. Tiempo de respuesta del instrumento

El tiempo de respuesta de la mayoría de requerimientos de datos es de unos 20ms.
Excepciones
- Comando E2prom Backup (Tiempo máximo = 350ms)
- La escritura de los siguientes registros: Capacidad total de célula/s de carga, sensibilidad de la célula/s de carga, peso Neto, Tara y Filtro (Tiempo máximo = 550ms)

4.1 Tiempo de respuesta al conectar varios esclavos

Un par trenzado

Pregunta maestro a esclavo 01	Tiempo de respuesta de esclavo 01	Respuesta esclavo 01	Retardo 20ms	Pregunta maestro a esclavo 02

Doble par trenzado

Pregunta maestro a esclavo 01	Tiempo de respuesta de esclavo 01	Respuesta esclavo 01	Retardo	Pregunta maestro a esclavo 02

⟵――――――――――――――――⟶
Con velocidad de comunicación de 19200 Baud el tiempo = 15 a 20ms

Esquema de tiempos de comunicaciones en un sistema RS-485 Maestro – Esclavo, utilizando cable de doble par trenzado.

RTU 9600 Baudios
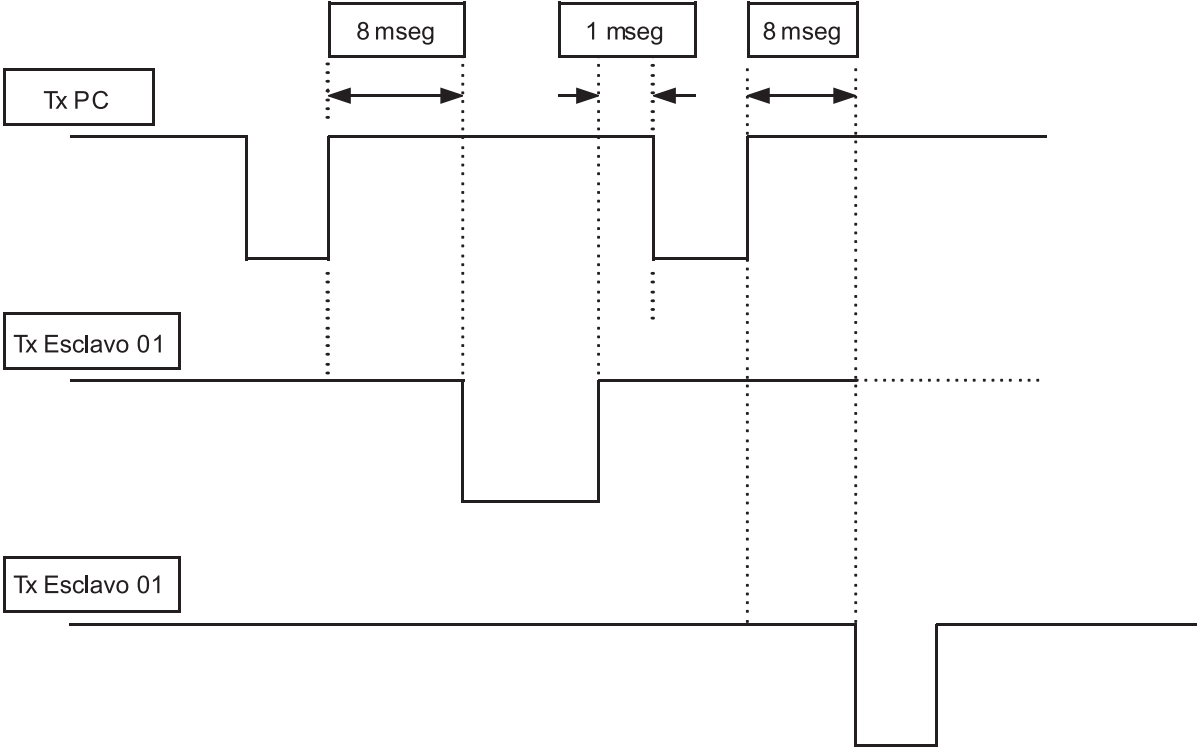
RTU 19200 Baudios
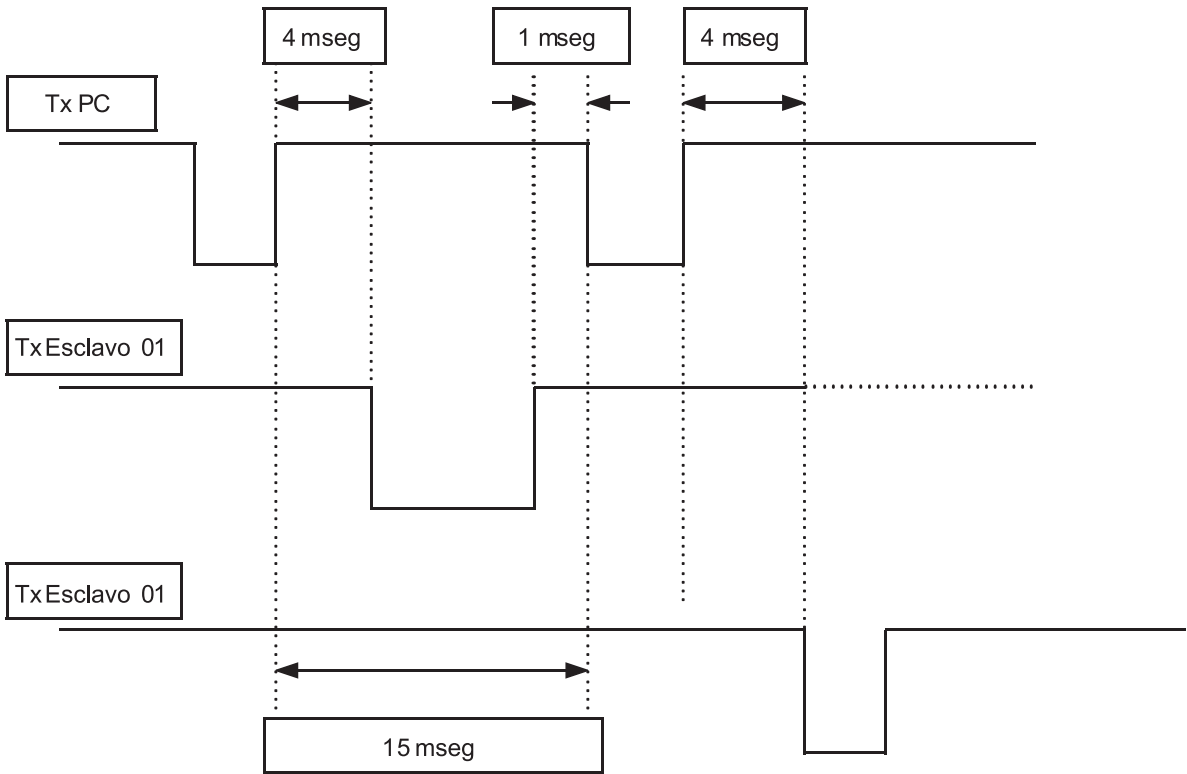
5. Lista de cadenas de transmisión

Símbolos usados en las cadenas
A = 1 byte para dirección del esclavo (ejemplo: Esclavo Nº. 17: A = 0 x 11

5.1 Función 1: Leer estado de bobina

Pregunta

Dirección	Función	Dirección 1ª salida	Numero de salidas	2 byte	Bytes totales
A	0 x 01	0 x 0000	0 x 0008	CRC	8

Respuesta

Dirección	Función	Numero de bytes	Estado de las salidas	2 byte	Bytes totales
A	0 x 01	0 x 01	0 x 00	CRC	6

Estado de las salidas: En este byte cada salida se identifica con 1 bit.

La dirección de la primera salida es el bit menos significativo (LSB) en este byte. (1 = On, 0 = Off)

5.2 Función 2: No utilizada.

5.3 Función 3: Leer registros HOLD (retención)

Pregunta

Dirección	Función	Dirección 1º registro	Numero de registros	2 byte	Bytes totales
A	0 x 03	0 x 0000	0 x 0002	CRC	8

Respuesta

Dirección	Función	Numero de bytes	1er Registro	2º Registro	2 byte	Bytes totales
A	0 x 03	0 x 04	0 x 0064	0 x 00C8	CRC	3 + 2 x N° de registros +2

5.4 Función 4: Leer registros de entrada (solo lectura)

Pregunta

Dirección	Función	Dirección 1º registro	Numero de registros	2 byte	Bytes totales
A	0 x 04	0 x 0000	0 x 0001	CRC	8

Respuesta

Dirección	Función	Numero de bytes	Primer registro	2 byte	Bytes totales
A	0 x 04	0 x 02	0 x 0064	CRC	3 +2 x Nº registros +2

5.5 Función 5: Fuerza de una bobina

Pregunta

Dirección	Función	Dirección de salida	Estado de salida	2 byte	Bytes totales
A	0 x 05	0 x 0000	0 x FF00	CRC	8

Respuesta

Dirección	Función	Dirección de salida	Estado de salida	2 byte	Bytes totales
A	0 x 05	0 x 0000	0 x FF00	CRC	8

5.6 Función 6: Prefijar un registro

Pregunta

Dirección	Función	Dirección del registro	Valor del registro	2 byte	Bytes totales
A	0 x 06	0 x 0000	0 x 1234	CRC	8

Respuesta

Dirección	Función	Dirección del registro	Valor del registro	2 byte	Bytes totales
A	0 x 06	0 x 0000	0 x 1234	CRC	8

La respuesta incluye el hecho de la pregunta.

5.7 Función 7: No utilizada.

5.8 Función 8: No utilizada.

5.11 Función 11: No utilizada.

5.12 Función 12: No utilizada.

5.15 Función 15: Fuerza múltiples bobinas

Pregunta

Dirección	Función	Dirección 1ª Salida	Nº de Salidas	Nº de Bytes	Estado de las salidas	2 Byte	Bytes totales
A	0 x 0F	0 x 0000	0 x 0002	0 x 01	0 x 00	CRC	10

Respuesta

Dirección	Función	Dirección 1ª Salida	Nº de Salidas	2 Byte	Bytes totales
A	0 x 0F	0 x 0000	0 x 0002	CRC	8

Número de salidas: Numero de la salida a escribir, empezando por la dirección.

Número de bytes: Numero de bytes transmitidos indicando estado de salidas (8 salidas cada byte).

Estado de salidas: 1 bit para cada salida (1 = On, 0 = Off); La 1ª salida coincide con bit menos significativo (LSB) de cada byte. Los bits no significativos se ponen a cero.

La respuesta incluye la identificación de las salidas modificadas.

5.16 Función 16: Preselección de registros múltiples

Pregunta

Dirección	Función	Salida del 1º registro	Nº de registros	Nº de Bytes	Valor del 1er registro	Valor del 2º registro	2 byte	Bytes totales
A	0 x 10	0 x 0000	0 x 0002	0 x 04	0 x 0000	0 x 0000	CRC	7 + 2 x Nº de registros+2

Respuesta

Dirección	Función	Dirección 1º registro	Nº de registros	2 Byte	Bytes totales
A	0 x 10	0 x 0000	0 x 0002	CRC	8

Número de registros: Numero de los registros a escribir, empezando por la dirección.

Numero de bytes: Numero de bytes transmitidos como valores de registros (2 bytes para cada registro).

Valor de registros: Indica el contenido de los registros, empezando por el 1º.

La respuesta incluye la identificación de los registros modificados.

6 . Modo Emisión

Esta función no esta implementada en este instrumento.

7.1 Errores de Comunicación

Los mensajes de comunicación están controlados por el CRC (Cyclic Redundancy Check) (comprobación cíclica redundante). Si ocurriera un error en la comunicación, el esclavo no responde. El maestro controla un timeout (tiempo de espera) mientras espera la respuesta del esclavo. Si el esclavo no responde durante este timeout, eso significa que hay error en la comunicación.

7.2 Errores en los datos recibidos

Si el mensaje se recibe correctamente pero no es ejecutable, el esclavo responde al maestro con una RESPUESTA DE EXCEPCION. El campo "función" se transmite con el dígito mas significativo (MSD) puesto a 1.

Respuesta de excepción

Dirección	Función	Código de excepción	2 byte
A	Función + 80h	0 x 01	CRC

Descripción de los códigos de excepción

Código	Descripción
1	Función ilegal (la función no es valida)
2	Dirección de datos ilegal (La dirección de datos especificada no esta disponible)
3	Valor de datos ilegal (El valor de los datos recibidos no es válido)

Listado de Registros Holding (4x)

Dirección Modbus	Descripción		Rango	Guardar en E2prom
	Valores de consignas y peso	Menú correspondiente		
40001	Consigna temporal 1		0 a fondo escala	No
40002	Consigna temporal 2		0 a fondo escala	No
40003	Registro comando		01-05, 10, 12-13, 20 (Hex)	Ver tabla relativa
40004	Consigna permanente 1	SET 1	0 a fondo escala	Si
40005	Consigna permanente 2	SET 2	0 a fondo escala	Si
40006	Valor de peso bruto H		0 a fondo escala	
40007	Valor de peso bruto L			
40008	Bits de estado de entrada			Ver tabla relativa
40009	Valor de peso neto H		0 a fondo escala	
40010	Valor de peso neto L			
	Valores de Pico			
40020	Valor de pico del peso bruto		0 a fondo escala	No
	Registros de comandos y estados			
40081	Registro comando de datos		11 (Hex)	Ver tabla relativa
40082	Registro de estado		00, 03-05 (Hex)	Ver tabla relativa
40083	Registro de estado de datos		06 (Hex)	Ver tabla relativa
	Configuración Básica			
40100	Capacidad célula de carga (Kg) H	CAPAC	0-500000 (1)	Si
40101	Capacidad célula de carga (Kg) L			
40102	Sensibilidad de célula/s de carga	SENSIT	10000-40000 (5)	Si
40103	Valor de peso neto H	NET	0 a fondo escala (1)	Si
40104	Valor de peso neto L			
40105	Valor de tara H	DEAD L	0 a fondo escala (1)	Si
40106	Valor de tara L			
40110	Modo de trabajo	OPMODE	0-2 (3)	Si
40150	Divisiones de display	DSPDIV	0-14 (2) Ver tabla "A"	Si
	Parámetros de pesaje			
40180	Valor de filtro digital	FILTER	0-9 (3)	Si
40181	Valor de banda de marcha	MOTION	0-4 (3)	Si
40182	Valor de auto cero	AUTO 0	0,1-10,00 (3) (5)	Si
40183	Valor seguimiento de cero	0 TRAC	0-4 (3)	Si
	Configuración de consignas			
40200	Modo de trabajo de consigna 1	MODE 1		Si
40201	Histéresis de consigna 1	HYST 1	0 a fondo escala	Si
40202	Temporizador consigna 1	TIMER1	0,1-100,0 (5)	Si
40203	Retardo consigna 1	DELAY1	0,1-100,0 (5)	Si
40204	Modo de trabajo de consigna 2	MODE 2		Si
40205	Histéresis de consigna 2	HYST 2	0 a fondo escala	Si
40206	Temporizador consigna 2	TIMER2	0,1-100,0 (5)	Si
40207	Retardo consigna 2	DELAY2	0,1-100,0 (5)	Si

Listado de Registros Holding (4x) cont.

		Configuración comunicación serie	Menú correspondiente		
	40300	Velocidad comunicación	BAUD R	0-4 (3)	Si
	40301	Dirección	ADDRES	1-32	Si
	40302	Retardo de respuesta	DELAY	0-100	Si
		Salida Analógica			
	40400	Rango máximo de salida analógica	F-SCAL	0 a fondo escala	Sí
	40401	Modo de trabajo de salida analógica	MODE	0-3 (3)	Sí
	40402	Rango de salida analógica	RANGE	0-3 (3)	Sí
	40403	Offset de Cero	OFFSET		(4)
	40404	Rango máximo de offset	OFFSET		(4)
	40405	An-Cero (valor de peso negativo para cero salida analógica)	ANZERO		Sí

(1) Los valores teóricos combinados del peso neto y la tara no deberían superar el valor de capacidad total.

(2) Ver los 15 valores de 0,001 al 50.

(3) Para la lista de valores ver el manual de usuario.

(4) Se guardan el la E2prom si se escribe 0000 en el registro de estado.

(5) Al introducir estos valores, el punto decimal no se debe incluir.

Especificaciones de los parámetros de comunicación serie:

* Cuando se modifican la "dirección de comunicación" y "retardo de respuesta" los nuevos valores toman efecto inmediatamente.

* El modo del puerto serie no se puede modificar vía Modbus.

* Cuando se introduce un nuevo valor de velocidad de comunicación, el instrumento se debe desconectar de la red y conectar de nuevo para que el nuevo valor tome efecto.

Tabla "A"
Códigos de identificación

	Código	Divisiones del display
	0 (00)	0.001
	1 (01)	0.002
	2 (02)	0.005
	3 (03)	0.01
	4 (04)	0.02
	5 (05)	0.05
Entre paréntesis valores en hexadecimal	6 (06)	0.1
	7 (07)	0.2
	8 (08)	0.5
	9 (09)	1
	10 (0A)	2
	11 (0B)	5
	12 (0C)	10
	13 (0D)	20
	14 (0E)	50

Lista de estado de la entrada

Descripción	Significado del Bit		
	0	**1**	
Polaridad del peso Neto	+	-	1
Polaridad del peso Bruto	+	-	0
Peso estable	No	Si	1
Polaridad de mV	+	-	0
Condición bajo carga	No	Si	0
Condición sobre carga	No	Si	0
Condición fuera de rango	No	Si	0
Prefijar condición de tara	No	Si	1
Entrada 1	Desactivado	Activado	0
Entrada 2	Desactivado	Activado	0
Salida relé 1	Desactivado	Activado	1
Salida relé 2	Desactivado	Activado	0
Escala no cargada (*)	No	Si	0
Estado del teclado	Activo	Asegurado	1

(*) La escala se considera no cargada (vacia) cuando el valor del peso está dentro del rango "Banda 0" (Ver página 28, tabla 2)

La dirección Modbus 40008 está compuesta de 2 bytes. La conversión de estos 2 bytes de Hexadecimal a binario da el significado de cada bit descrito en esta tabla.

Ej. Si los bytes de la dirección 40008 son **24 85**, la conversión a binario da la secuencia de bits **100100 10000101**

El digito de la derecha se emparejará con el primer bit (polaridad del peso neto), así que los valores del ejemplo arriba mencionado equivalen a:

Polaridad del peso neto = Negativa

Polaridad del peso bruto = Positiva

Peso estable = Si

Polaridad mV = Positiva

Condiciones de bajo peso, sobrepeso, fuera de rango = no

Prefijar condición tara = no

Entrada 1 = Desactivada

Entrada 2 = Desactivada

Salida relé 1 = Activada

Salida relé 2 = Desactivada

Escala no cargada = no

Estado del teclado = Asegurado

Lista de registros de entrada (3x)

Dirección Modbus	Descripción
30003	Cuenta interna H
30004	Cuenta interna L
30005	mV
30006	Software del instrumento suelto (desenganchado)
30007	Instrumento en linea

Dirección Modbus 30007 = 00 01: El valor del peso se muestra en el display. El instrumento está en linea.

Dirección Modbus 30007 = 00 00: Está ocurriendo alguna de las condiciones de error (peso inferior al rango, sobrecarga, fuera de rango) o algún proceso de programación es incorrecto. El instrumento no está en linea.

Lista de bobinas (0x)

Dirección Modbus	Descripción	Significado del Bit		Rango	Guardar en E2prom
		0	**1**		
00001	Salida Lógica 1	Desactivado	Activado	1 Bit	No
00002	Salida Lógica 2	Desactivado	Activado	1 Bit	No

Lista de funciones de "Registro de comandos"

Códigos Función	Descripción	Función estado de registro de datos	Guardar en E2prom
0001 (01 Hex)	Cero semi-automático		No
0002 (02 Hex)	Auto tara		No
0003 (03 Hex)	Reset del pico		No
0004 (04 Hex)	Forzar visualización peso neto		No
0005 (05 Hex)	Forzar visualización peso bruto		No
0016 (10 Hex)	Calibración del Cero		Sí
0017 (11 Hex)	Calibración fondo escala	Peso muestra	Sí
0018 (12 Hex)	Reset de calibración del cero		Sí
0019 (13 Hex)	Reset de calibración fondo escala		Sí
0032 (20 Hex)	E2prom back-up (de reserva)		Sí

Lista de funciones "Registro de estado"

Códigos Función	Descripción	Función estado de registro de datos	Guardar en E2prom
0000 (00 Hex)	Ninguna función activada		No
0003 (03 Hex)	Ajusta de offset de cero de la salida analógica		Sí
0004 (04 Hex)	Ajuste de offset de fondo escala de la salida analógica		Sí
0005 (05 Hex)	Comprobar entrada/salida		No
0006 (06 Hex)	Comprobar salida analógica	Salida analógica (0-64000)	No

Para mas información sobre el protocolo Modbus, ver el manual de Protocolo Modbus PI-Mbus-300 Rev J.

CONEXIONADO PRÁCTICO DAT-400
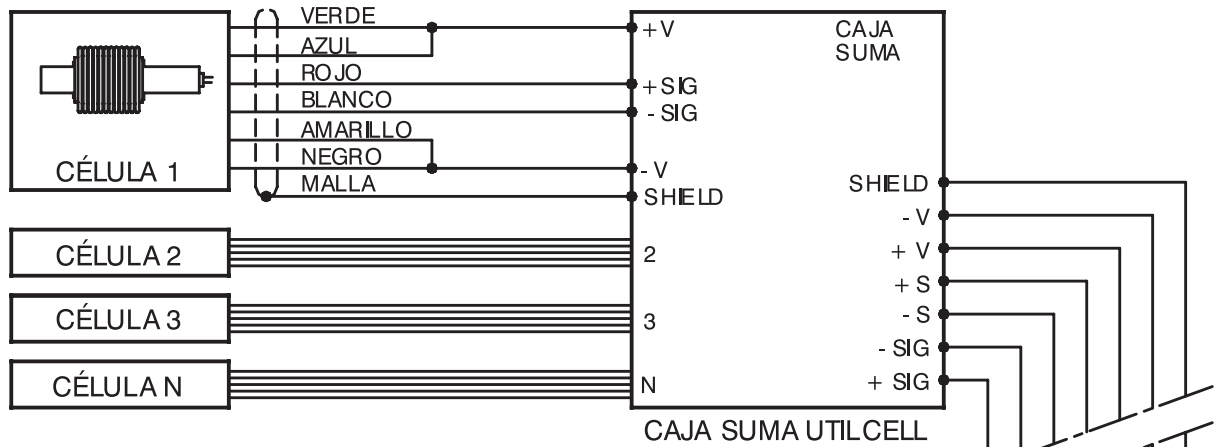
CÉLULA 1
VERDE
AZUL
ROJO
BLANCO
AMARILLO
NEGRO
MALLA

+V
+SIG
- SIG
-V
SHIELD

CAJA SUMA

CÉLULA 2   2
CÉLULA 3   3
CÉLULA N   N

SHIELD
- V
+ V
+ S
- S
- SIG
+ SIG

CAJA SUMA UTILCELL

COLORES CÉLULA UTILCELL

N ⎰ 6 CÉLULAS 350 Ω
  ⎱ 12 CÉLULAS 700 Ω

NOTA: CUANDO NO SE UTILIZA
CAJA DE SUMAS Y SE
INSTALAN CÉLULAS
DE 4 CABLES HACER
PUENTES ENTRE: 14-15=VERDE
y
13-16=NEGRO
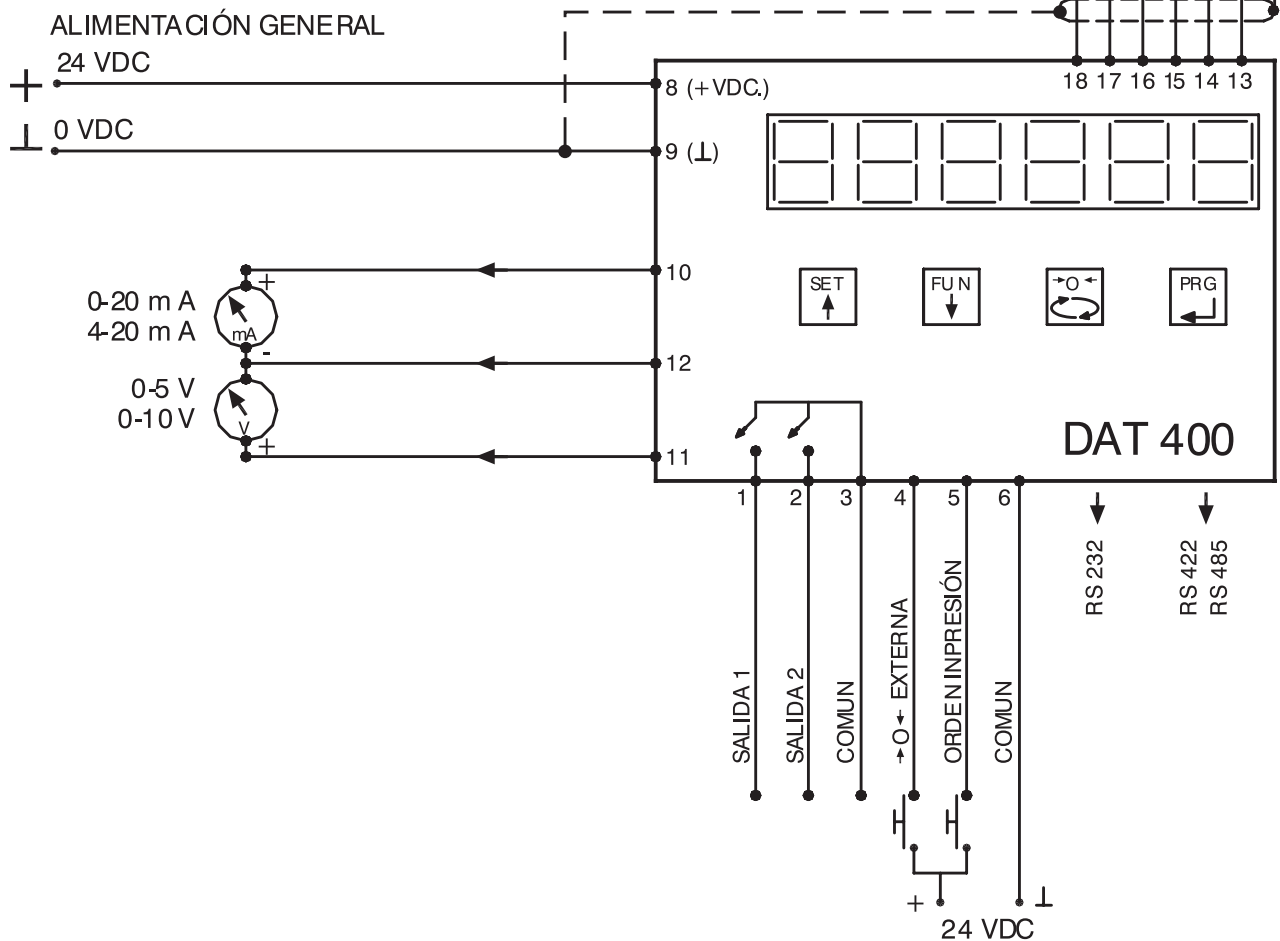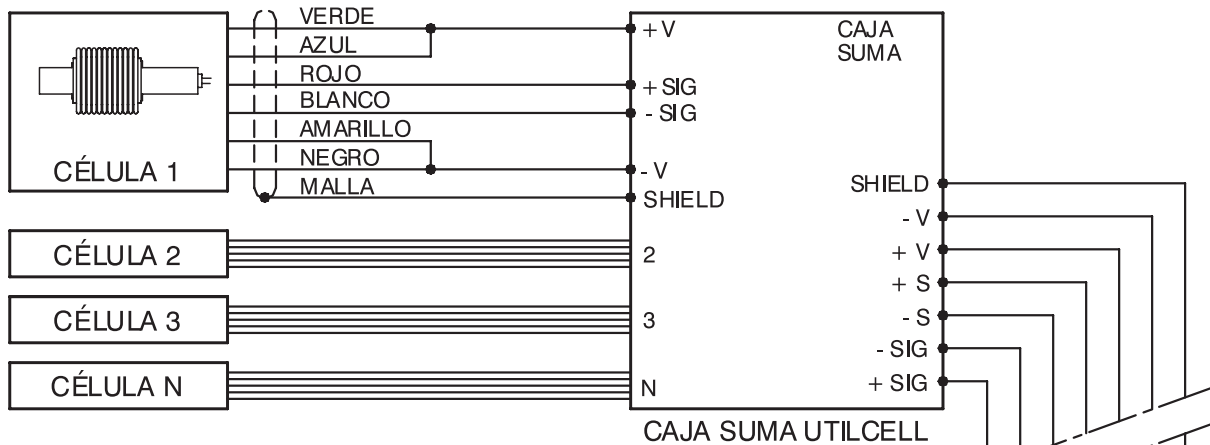
ROJO BLANCO AMARILLO AZUL VERDE NEGRO MALLA

ALIMENTACIÓN GENERAL

24 VDC   8 (+VDC.)   18 17 16 15 14 13

0 VDC   9 (⊥)

0-20 mA
4-20 mA   10

0-5 V
0-10 V   12

                 11

SET   FUN   ↻O↺   PRG

DAT 400

1 2 3 4 5 6

SALIDA 1
SALIDA 2
COMUN
→O← EXTERNA
ORDEN INPRESIÓN
COMUN

RS 232
RS 422
RS 485

+ 24 VDC ⊥

43

CONEXIONADO PRÁCTICO DAT-500

VERDE
AZUL
ROJO
BLANCO
AMARILLO
NEGRO
MALLA

CÉLULA 1

+ V
+ SIG
- SIG
- V
SHIELD

CAJA
SUMA

CÉLULA 2
CÉLULA 3
CÉLULA N

2
3
N

SHIELD
- V
+ V
+ S
- S
- SIG
+ SIG

CAJA SUMA UTILCELL

COLORES CÉLULA UTILCELL

N ⎧ 6 CÉLULAS 350 Ω
⎩ 12 CÉLULAS 700 Ω

NOTA: CUANDO NO SE UTILIZA
CAJA DE SUMAS Y SE
INSTALAN CÉLULAS
DE 4 CABLES HACER
PUENTES ENTRE: 20-21=VERDE
y
19-22=NEGRO

ROJO
BLANCO
AMARILLO
AZUL
VERDE
NEGRO
MALLA

ALIMENTACIÓN GENERAL

24 VDC

0 VDC

1 (+VDC.)

2 (⊥)

24 23 22 21 20 19

0-20 m A
4-20 m A

0-5 V
0-10 V

3

5

4

SET
FUN
→O←
PRG

DAT 500

13 14 15 16 17 18

SALIDA 1
SALIDA 2
COMUN
→O← EXTERNA
ORDEN INPRESIÓN
COMUN

RS 232
RS 422
RS 485

+
24 VDC
⊥

44
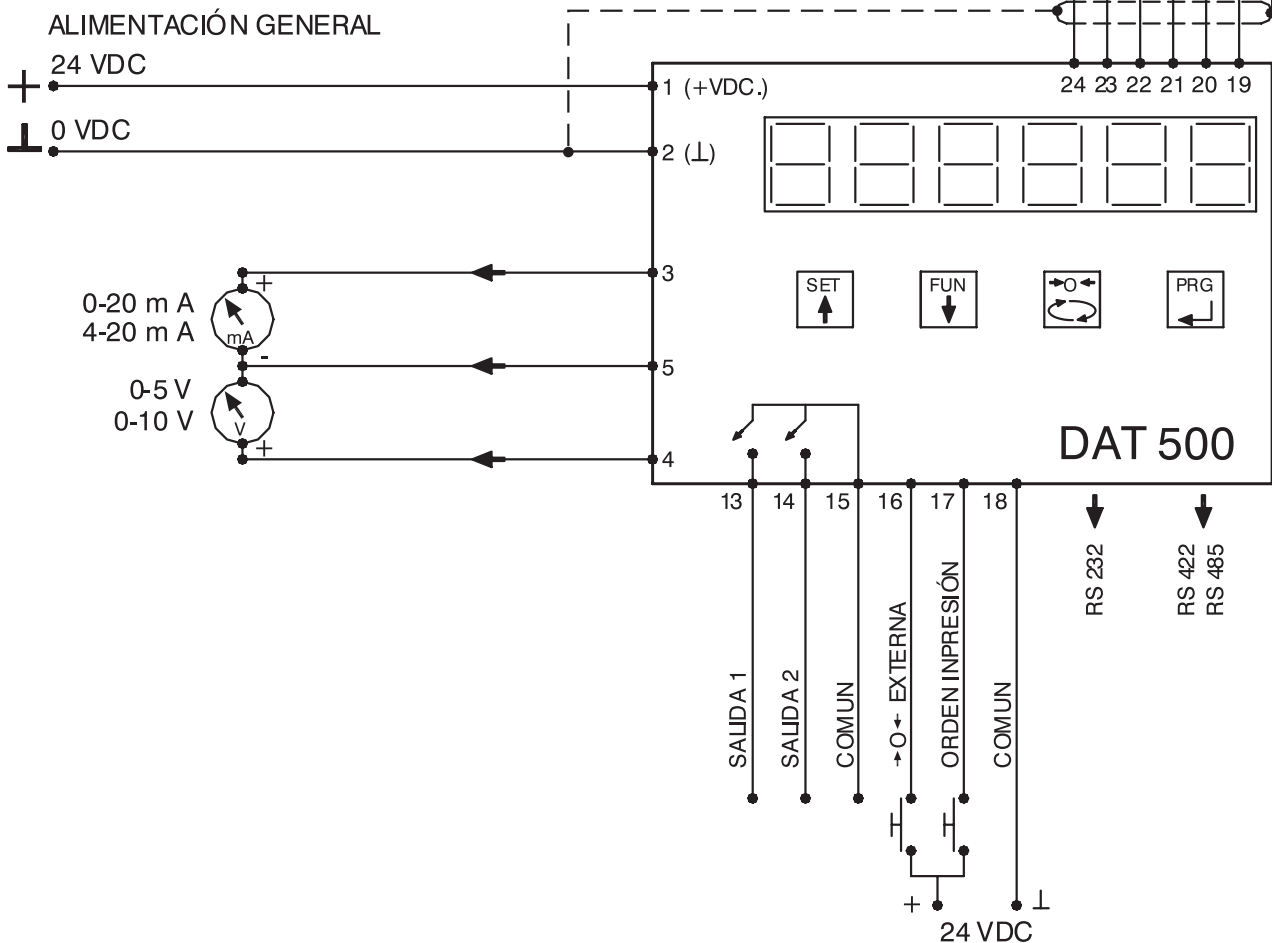
INSTALACION EN AREA PROTEGIDA

CELULAS UTILCELL

CAJA SUMA UTILCELL

Rojo, Verde, Azul, Malla, Amarillo, Negro, Blanco

+ Sig.
+ V
Shield
- V
- Sig.

- Sig.
+ Sig.
- V
+ V
- S
+ S

Shield

AREA PROTEGIDA

N = Máximo 6 células de 350 Ω ó 12 células de 700 Ω

BARRERA DE SEGURIDAD Pepperl & Fuchs

- Sig.
+ Sig.
- V
+ V
- S
+ S

Z961H
Z966H
Z961H

Malla

AREA SEGURA

DAT 400

- V
+ V
+ S
- S
- Sig.
+ Sig.

13 14 15 16 17 18

+
⊥

8 9

24 Vdc

DAT 500

- V
+ V
+ S
- S
- Sig.
+ Sig.

19 20 21 22 23 24

+
⊥

1 2

24 Vdc

45

OSAKA
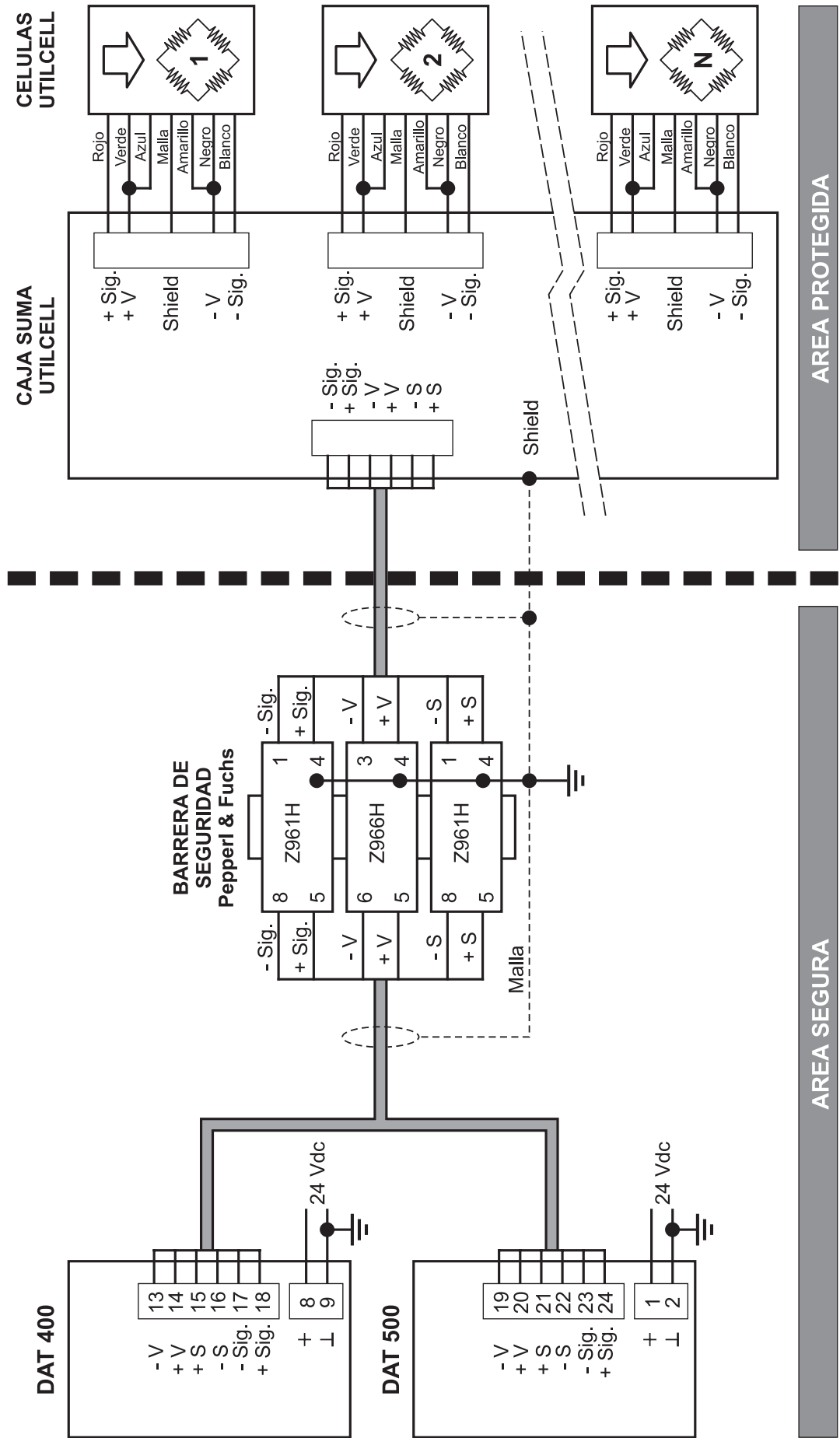
OK 83

REGULADOR ELECTRÓNICO DIGITAL DE PROCESOS CON RAMPAS

MANUAL DE USUARIO

INTRODUCCIÓN

En el presente manual está contenida la información necesaria para una correcta instalación y las instrucciones para la utilización y mantenimiento del producto, por lo tanto se recomienda leer atentamente las siguientes instrucciones.

Esta documentación se ha realizado con sumo cuidado, no obstante, OSAKA no asume ninguna responsabilidad de la utilización de la misma.

Lo mismo se dice para cada persona o sociedad implicadas en la creación del presente manual.

La presente publicación es propiedad exclusiva de OSAKA que prohíbe su absoluta reproducción y divulgación, así como parte del mismo, a no ser de estar expresamente autorizado.

OSAKA se reserva de aportar modificaciones estéticas y funcionales en cualquier momento y sin previo aviso.

1 –DESCRIPCIÓN DEL INSTRUMENTO

1.1 – DESCRIPCIÓN GENERAL

El modelo OK 83 es un regulador digital con microprocesador a dos displays, con regulación ON/OFF, ON/OFF con zona muerta, PID con doble acción (directa e inversa), PID para accionamientos motorizados de posicionamiento temporal.

Para la regulación del PID, el instrumento cuenta con funciones de **AUTOTUNING FAST**, **SELFTUNING** con cálculo automático del parámetro **FUZZY OVESHOOT CONTROL.**

La regulación del PID cuenta con un particular algoritmo a **DOS GRADOS DE LIBERTAD** que optimiza de modo independiente las prestaciones de regulación en presencia de perturbaciones del proceso y variaciones del SET POINT.

El instrumento además ofrece la posibilidad de contar con una interfaz de comunicación serial RS485 con protocolo de comunicación MODBUS-RTU y con velocidad de transmisión hasta 38400 baud.

El valor del proceso se visualiza en 4 dígitos rojos, el valor del SET sobre 4 dígitos verdes, mientras que el estado de las salidas se señala por 4 leds.

El instrumento memoriza hasta 4 Set-Points de regulación y puede tener hasta 4 salidas.

Las 4 salidas pueden ser digitales con relé o estáticos (SSR) o bien puede tener hasta 2 salidas analógicas (0/4..20 mA o 0/2..10 V).

La entrada es multiconfigurable y acepta sondas de temperatura (termopares J, K, S, B, C, E, L, N , R, T ; termoresistencia Pt100; termistores PTC, NTC; sensores de

infrarojo OSAKA IRS) y señales analógicas normalizadas (0/4..20 mA, 0/1..5 V, 0/2..10 V, 0..50/60 mV, 12..60 mV).

El instrumento además puede contar con una entrada para el transformador amperométrico para la función "Heater Break alarm" y una entrada digital configurable en alternativa a la salida OUT4.

Otras funciones importantes presentes son: función de "Loop-Break" alarm, limitación de la potencia de salida, limitación de la velocidad de variación de la potencia de salida, "split-range", alcance del Set-Point con velocidad controlada, control a dos partes con tiempo de mantenimiento intermedio, función de "Soft-Start", protección de parámetros sobre varios niveles.

1.2 – DESCRIPCIÓN DEL PANEL FRONTAL
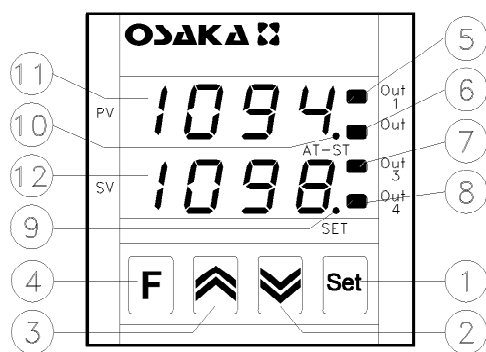
1 - Tecla Set : Utilizada para acceder a la programación de los parámetros de funcionamiento y confirmar la selección.

2 - Tecla DOWN : Decrementa los valores de programación y selecciona los parámetros. Si se mantiene pulsado permite pasar al anterior nivel de programación hasta salir de la modalidad de programación. Cuando no se encuentra en modalidad de programación permite visualizar sobre el display SV la corriente de medida por la entrada TAHB.

3 - Tecla UP : Incrementa los valores de programación y selecciona los parámetros. Si se mantiene pulsado permite pasar al anterior nivel de programación hasta salir de la modalidad de programación. Cuando no se encuentra en modalidad de programación permite visualizar sobre el display SV la potencia de regulación en la salida.

4 - Tecla F: Tecla de funcionamiento configurable por el par USrb". Puede ser configurado para: activación Autotuning o Selftuning, poner el instrumento en regulación manual, apagar la alarma, cambiar el Set-Point activo, desactivar la regulación.

5 - Led OUT1 : Indica el estado de la salida OUT1

6 - Led OUT2 : Indica el estado de la salida OUT2

7 - Led OUT3 : Indica el estado de la salida OUT3

8 - Led OUT4 : Indica el estado de la salida OUT4

9 - Led SET : En intermitencia indica la entrada en la modalidad de programación.

10 - Led AT/ST : Indica que la función Selftuning está activa o en curso.

11 - Display PV: Normalmente indica el valor del proceso.

12 - Display SV: Normalmente indica el valor del Set activo, sin embargo puede ser configurado por el par "diSP" para visualizar otros valores.

2 - PROGRAMACIÓN

2.1 – PUESTA RÁPIDA DEL SET POINT

Este procedimiento permite programar rápidamente el Set Point activo y eventualmente las consignas de alarma (ver par. 2.3).

Pulsar la tecla "Set", confirmar, y el display visualizará **"SP n"** (donde n es el número de Set Point activo en ese momento) y el valor programado.

Para modificarlo pulsar las teclas "UP" para incrementar el valor o "DOWN" para decrementarlo.

Estas teclas actúan con pasos de un dígito pero si se mantienen pulsadas más de un segundo el valor se incrementa o decrementa rápidamente y, después de dos segundos en la misma condición, la velocidad aumenta para alcanzar de forma rápida el valor deseado.

Una vez programado el valor deseado pulsando la tecla "Set" se sale de la modalidad rápida de programación o bien se pasa a la visualización de las consignas de alarma (ver par. 2.3).

La salida del modo de puesta rápida del Set se da pulsando la tecla "Set" después de la visualización del último Set o bien sin actuar sobre ninguna tecla durante 15 segundos, transcurridos los cuales el display volverá al estado normal de funcionamiento.

2.2 – SELECCIÓN DE LOS ESTADOS DE REGULACIÓN Y PROGRAMACIÓN DE LOS PARÁMETROS.

Pulsando la tecla "Set" y manteniéndola 2 segundos se accede al menú de selección principal.

Mediante las teclas "UP" y "DOWN" se puede acceder a las siguiente selecciones..

"OPEr"	Permite acceder al menú de los parámetros operativos
"ConF"	Permite acceder al menú de los parámetros de configuración
"OFF"	Permite programar el regulador en el estado de regulación OFF
"rEG"	Permite programar el regulador en estado de regulación automática
"tunE"	Permite activar la función Autotuning o Selftuning
"OPLO"	Permite programar el regulador en regulación manual y por lo tanto de programar el valor % de regulación pulsando sobre las teclas "UP" y "DOWN"

Una vez seleccionado el menú deseado pulsar la tecla "Set" para confirmar.

Las selecciones "OPEr" y "ConF" acceden a submenús que contienen más parámetros:

"OPEr" – Menú de parámetros operativos: normalmente contiene los parámetros de programación de los Set Point (pero puede contener todos los parámetros deseados (ver pár. 2.3)).

"ConF" – menú de parámetros de configuración: contiene todos lo parámetros operativos y los de configuración de funcionamiento (configuración de alarmas, regulación, entradas, etc...)

Para acceder al menú **"OPEr"** seleccionar el menú "OPEr" y pulsar la tecla "Set".

En este punto el display SV visualizará el código que identifica el primer grupo de parámetros (" ¹SP ") y con las teclas "UP" y "DOWN" se podrá seleccionar el grupo de parámetros que se quiere configurar.

Una vez seleccionado el grupo de parámetros a configurar, pulsar la tecla "Set" y sobre el display PV visualizará el grupo, mientras que en el display SV se visualizará el código que identifica el primer parámetro del grupo seleccionado.

Con las teclas "UP" y "DOWN" se podrá seleccionar el parámetro deseado, y pulsando la tecla "Set", el display PV visualizará el código del parámetro, mientras que el display SV mostrará la programación, que podrá ser modificada con las teclas "UP" y "DOWN".

Una vez programado el valor deseado pulsar de nuevo la tecla "Set": el nuevo valor será memorizado y los displays mostrarán de nuevo el grupo y la sigla del parámetro seleccionado.

Actuando sobre las teclas "UP" o "DOWN" se puede seleccionar otro parámetro y modificarlo como se ha descrito.

Para volver a seleccionar otro grupo de parámetros mantener pulsada la tecla "UP" o la tecla "DOWN" durante 2 segundos, transcurridos los cuales el display SV volverá a visualizar el código del grupo de parámetros.

Soltar la tecla pulsada y con las teclas "UP" y "DOWN" se podrá seleccionar otro grupo.

Para salir del modo de programación no actuar sobre ninguna tecla durante 20 segundos o bien mantener pulsada la tecla "UP" o "DOWN" hasta salir de la modalidad de programación.

Para acceder al menú **"ConF"** se requiere una CONTRASEÑA.

Programar, mediante las teclas "UP" y "DOWN", el número indicado a la última página de este manual y pulsar la tecla "Set".

Si se programara una contraseña errónea, el instrumento volvería al estado de regulación que se encontraba anteriormente.

Si la contraseña se corrige, el display SV visualizará el código que identifica el primer grupo de parámetros (" ¹SP ") y con las teclas UP y DOWN se podrá configurar el grupo de parámetros que se desee.

Las modalidades de programación y de salida para la programación del menú "ConF" son las mismas que las descritas para el menú "OPEr".
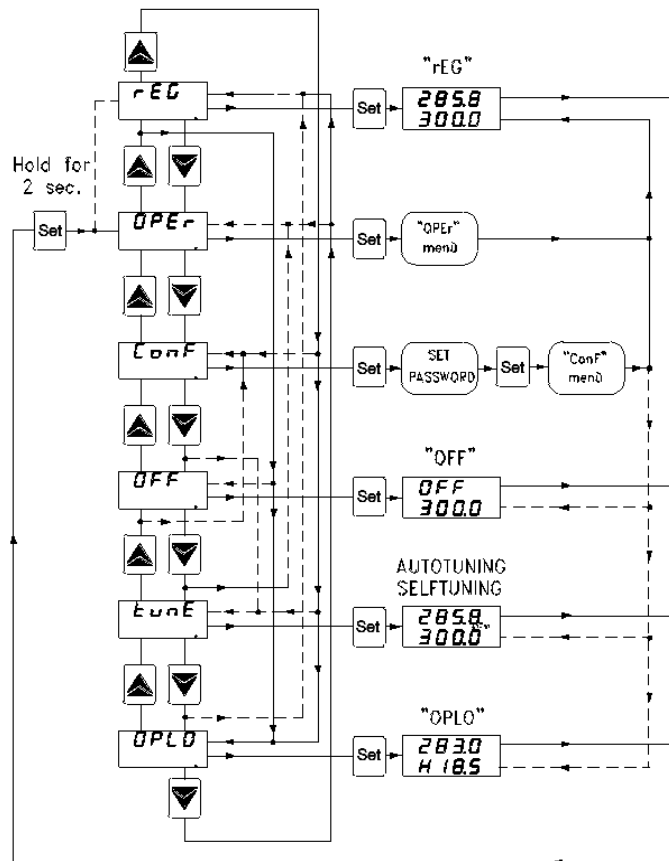
2.3 – NIVELES DE PROGRAMACIÓN DE PARÁMETROS

El menú "OPEr" contiene los parámetros de programación de los Set Point, sin embargo se pueden agregar o quitar todos los parámetros deseados a través del siguiente procedimiento:

Acceder al menú "ConF" y seleccionar el parámetro que se quiere agregar en el menú "OPEr".

Una vez seleccionado el parámetro, si el led SET está apagado significa que el parámetro sólo es programable en el menú "ConF", si en cambio está encendido, significa que el parámetro también es programable en el menú "OPEr".

Para modificar la visibilidad del parámetro pulsar la tecla "F": el led SET cambiará de estado indicando el nivel de accesibilidad del parámetro (iluminado = menú "OPEr" y "ConF"; apagado = solo menú "ConF").

Con el nivel de programación rápida de los Set Point descrito en el par. 2.1 se harán visibles los Set Point Activos y las consignas de alarma sólo si los parámetros relativos se configuran como operativos (es decir, están presentes en el menú "OPEr").

La posible modificación de estos Set con el procedimiento descrito en el par. 2.1 está subordinada a lo programado en el par. **"Edit"** (contenido en el grupo " ¹PAn ").

Este parámetro puede ser programado como:

= SE: El Set point activo resulta configurable mientras que las consignas de alarma no lo son.

= AE : El Set point activo resulta no configurable mientras que las consignas de alarma sí lo son.

= SAE: Set point activo en que las consignas de alarma son configurables.

= SAnE: Set point activo en que las consignas de alarma no son configurables.

2.4 – TIPOS DE REGULACIÓN

El controlador tiene 3 niveles diferentes de regulación: regulación automática **(rEG),** regulación desactivada **(OFF)** y regulación manual **(OPLO).**

El instrumento puede pasar de un estado de regulación a otro:

- Desde el teclado, seleccionado el nivel de programación.

- Desde el teclado mediante la tecla "F" programada convenientemente en el par. "USrb" ("USrb" = tunE; "USrb" = OPLO; "USrb" = OFF) se puede pasar del nivel "rEG" al nivel programado en el parámetro y viceversa.

- Desde entrada digital programada convenientemente en el par. " diF" ("diF"=OFF) se puede pasar del nivel "rEG" al nivel "OFF".

- Automáticamente (el instrumento se activa en el nivel "rEG" al final de la ejecución del autotuning).

Al arrancar, el instrumento lo hace en el nivel en que se encontraba en el momento antes de apagarlo.

REGULACIÓN AUTOMÁTICA (rEG) – El nivel de regulación automática es el nivel normal de funcionamiento.

Durante la regulación automática, se puede visualizar la potencia de regulación sobre el display SV pulsando la tecla "UP".

Los valores visualizables de potencia varían de H100 (100% de potencia en salida de acción inversa) a C100 (100% de potencia en salida de acción directa).

REGULACIÓN DESACTIVADA (OFF) – El instrumento se desactiva (estado de "OFF"), que significa que la regulación y las salidas relativas están desactivadas.

En cambio, las salidas de alarma permanecen operativas.

REGULACIÓN MANUAL BUMPLESS (OPLO) – Esta opción permite programar manualmente el porcentaje de potencia dada en la salida del regulador desactivando la regulación automática.

Cuando el instrumento se activa en regulación manual, el porcentaje de potencia que actúa, visualizada en el display SV, es el último dado en salida y puede ser configurado mediante las teclas "UP" y "DOWN".

En caso de regulación de tipo ON/OFF, el 0% corresponde a la salida desactivada, mientras que cualquier otro valor diferente de 0 corresponde a salida activada.

Como en el caso de los valores dados por la potencia varían de H100 (100% de potencia en salida con acción inversa) a C100 (100% de potencia en salida con acción directa).

En el caso de control por accionamientos motorizados con posicionamiento temporal, el comando de salida manual se efectúa del siguiente modo :
- Pulsando la tecla "UP" se controla la abertura del accionamiento.
- Pulsando la tecla "DOWN", se controla el cierre del accionamiento.
Durante el tiempo en que esté activo el control manual, sobre el display inferior estará presente la inscripción "3 Pt" o bien "OPEn" mientras está pulsada la tecla" UP o "CLOS" mientras está pulsada la tecla "DOWN".
Para volver el regulador al estado de regulación automática, seleccionar "rEG" en el menú de selección.

2.5 – SELECCIÓN DEL SET POINT ACTIVO.
El instrumento permite reconfigurar hasta 4 diferentes Set Point de regulación (**"SP1"**, **"SP2"**, **"SP3"**, **"SP4")** y luego se selecciona cuál se quiere hacer activo.
El número máximo de set point viene determinado por el parámetro **nSP** en el grupo de parámetros " $^{]}$SP ".
El set point activo se puede seleccionar:
- Por el parámetro **"SPAt"** en el grupo de parámetros " $^{]}$SP ".
- Mediante la tecla "F" si el parámetro "USrb" = CHSP.
- Mediante la entrada digital convenientemente programada a través del par. "diF" ("diF" = CHSP o = SP1.2)
- Automáticamente entre SP1 y SP2 en caso de que se programe un tiempo de mantenimiento "dur.t" (ver pár. 4.8).
Los Set point "SP1", "SP2", "SP3", "SP4", estarán visibles en función del número máximo de Set point seleccionados en el parámetro "nSP" y serán configurados con un valor comprendido entre el valor programado en el par. **"SPLL"** y el valor programado en el par. **"SPHL".**
Nota: en los ejemplos que siguen, el Set point está indicado genéricamente como "SP", en todo caso el instrumento actuará en base en el Set point activo seleccionado.

3 – ADVERTENCIAS DE LA INSTALACIÓN Y EMPLEO

3.1 - USO
El instrumento ha sido concebido como aparato de medida y regulación en conformidad con la norma EN61010-1.
Para la utilización del instrumento en aplicaciones no expresamente previstas por la norma sobre emplazada, se deben tomar adecuadas medidas de protección.
El instrumento NO puede ser utilizado en entornos con atmósfera peligrosa, (inflamable o explosiva) sin una adecuada protección.
Se recuerda que el instalador debe cerciorarse de que las normas relativas a la compatibilidad electromagnética también sean respetadas después de la instalación del instrumento, utilizando eventualmente adecuados filtros.
En caso de que una avería o un funcionamiento defectuoso del aparato pueda crear situaciones peligrosas o dañinas para personas, cosas o animales, se recuerda que la instalación debe estar predispuesta con aparatos electromecánicos adicionales para garantizar la seguridad.

3.2 – MONTAJE MECÁNICO
El instrumento, en contenedor DIN 48 x 48 mm , está concebido para el montaje en panel.
Practicar un agujero 45,5 x 45,5 mm e insertar el instrumento con la abrazadera provista.
Se recomienda montar la adecuada guarnición para conseguir el grado de protección frontal declarado.
Evitar colocar la parte interior del instrumento en lugares sometidos a alta humedad o suciedad donde se pueda provocar

agua de condensación o introducir en el instrumento sustancias conductoras.
Asegurarse de que el instrumento tenga una adecuada ventilación y evitar la instalación en contenedores donde estén colocados aparatos que puedan llevar al instrumento funcionar fuera de los límites de temperatura declarados.
Instalar el instrumento lo más lejano posible de fuentes que puedan generar interferencias electromagnéticas como motores, relés, electroválvulas, etc.
El instrumento es frontalmente extraíble del propio contenedor.
Cuando se realiza esta operación se recomienda desconectar la alimentación de todos los bornes.

3.3 – CONEXIONES ELÉCTRICAS
Efectuar las conexiones conectando un sólo conductor por borne y siguiendo el esquema indicado, controlando que la tensión de alimentación sea la indicada para el instrumento y que la carga de los actuadores unidos al instrumento no sea superior a la corriente en principio permitida.
El instrumento, concebido para estar conectado permanentemente dentro de un panel, no está dotado ni de interruptor ni de dispositivos internos de protección al exceso de corriente.
Se recomienda insertar en la instalación de un interruptor/seleccionador de tipo bipolar, marcado como dispositivo de desconexión, que interrumpa la alimentación del aparato.
Dicho interruptor debe estar puesto lo más cercano posible al instrumento y en un lugar fácilmente accesible por el usuario.
Además se recomienda proteger adecuadamente todos los circuitos conexos al instrumento con aparatos (ej. fusibles) adecuados a la corriente efectiva.
Utilizar cables con aislamiento apropiado a la tensión, la temperatura y las condiciones de ejercicio y hacer que los cables de los sensores de la entrada se mantengan alejados de los cables de alimentación y de otros cables de potencia para evitar la inducción de interferencias electromagnéticas.
Si algunos cables utilizados para el cableado están protegidos, se recomienda conectarlos a tierra de un solo lado.
Finalmente controlar que los parámetros programados sean aquellos deseados y que la aplicación funcione correctamente antes de conectar las salidas a los actuadores para evitar anomalías en la instalación que puedan causar daños a personas, cosas o animales.
OSAKA y sus representantes legales no se hacen en ningún modo responsables por eventuales daños a personas, cosas o animales como consecuencia de manipulaciones, empleo impropio, errado o en todo caso sin ir conforme a las características del instrumento.

3.4 – ESQUEMA ELÉCTRICO DE CONEXIONADO
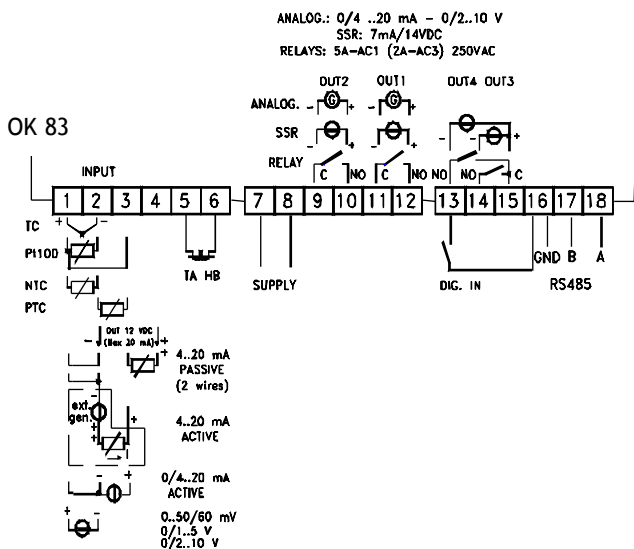
OK 83

ATENCIÓN !!!

Para conectar las sondas pasivas al OK83 se necesita hacer un puente entre los bornes 1 y 2, y conectar la señal 4..20 mA de la sonda al borne 3 y el positivo de la alimentación de la sonda al borne 4.
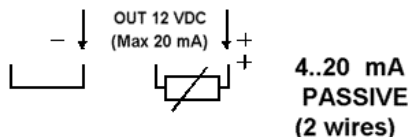
Ejemplos:

CP84-T, hacer puente entre los bornes 1 y 2, conectar cable color azul al borne 3 y el cable + alimentación de color marrón al borne 4.

CP97, hacer puente entre los bornes 1 y 2, conectar cable color negro borne 3 y el cble + alimentación de color rojo al borne 4.

PP10, hacer puente entre los bornes 1 y 2, conectar la salida de la patilla 1 al borne 3 y la salida de la patilla 3 al borne 4.

4 – FUNCIONAMIENTO

4.1 – MEDIDA DE VISUALIZACIÓN

Todos lo parámetros pertinentes a la medida están contenidos en el grupo **"¹]InP".**

Mediante el par. **"HCFG"** se puede seleccionar el tipo de señal de entrada que puede ser: termopar (tc), termoresistencia o termistor (rtd), transductor con señal normalizada de corriente (I) o tensión (UoLt) o bien procedente de la línea serial de comunicación del instrumento (SEr).

Una vez seleccionada el tipo de señal hace falta programar en el par. **"SEnS"** el tipo de sonda de entrada que puede ser:

- para termopares J (J), K (CrAL), S (S), B (b), C (C), E (E), L (L), N (n), R (r), T (t), o por sensores de infrarojo OSAKA serie IRS rango A con linearización J (Ir.J) o K (Ir.CA)

- para termoresistencia Pt100 IEC (Pt1) o termistor PTC KTY81-121 (Ptc) o NTC 103AT-2 (ntc)

- para señal normalizada de corriente 0..20 mA (0.20) o 4..20 mA (4.20)

- para señales normalizadas de tensión 0..50 mV (0.50), 0..60 mV (0.60), 12..60 mV (12.60), 0..5 V (0.5), 1..5 V (1.5), 0..10 V (0.10) o 2..10 V (2.10).

Al cambiar estos parámetros apagar y encender el instrumento para conseguir una medida correcta.

Para los instrumentos con entrada de sonda de temperatura (tc, rtd) se puede seleccionar, mediante el parámetro **"Unit"** la unidad de medida de temperatura (°C, °F) y, mediante el parámetro **"dP"** la resolución de medida deseada (0=1°; 1=0,1°).

En cuanto a lo concerniente a los instrumentos configurados con entrada de señal analógica normalizada es necesario ante todo programar la resolución deseada en el parámetro **"dP"** (0=1; 1=0,1; 2=0,01; 3=0,001) y en el parámetro **"SSC"** el valor que el instrumento debe visualizar correspondiente al inicio de escala (0/4 mA, 0/12 mV, 0/1 V o 0/2 V) y en el parámetro **"FSC"** el valor que el instrumento debe visualizar correspondiente al fondo de escala (20 mA, 50 mV, 60 mV, 5 V o 10 V).

En el caso de que sean utilizados sensores de temperatura con infrarojos (OSAKA IRS rango "A"), configurando el sensor como "Ir.J" o "Ir.CA" está presente también en el par. **"rEFL"** que permite la corrección de errores eventuales de medida causados por la iluminación del entorno y reflexibilidad del material.

Programar dicho parámetro a un valor alto cuando el material a medir resulta particularmente claro/reflectante y reducirlo cuando la superficie resulta particularmente oscura/no reflectante, teniendo presente que para la mayor parte de los materiales el valor aconsejado está comprendido entre 1.00 ... 0.80.

El instrumento permite la calibración de la medida, que puede ser utilizada según las necesidades de la aplicación, a través de los par. **"OFSt"** y **"rot".**

Programando el par. "rot"=1,000, al par. "OFSt" se puede programar una compensación positiva o negativa que sencillamente viene sumada al valor leído por la sonda antes de su visualización y que resulta constante para todas la medidas.

Si en cambio se desea que la compensación programada no sea constante para todas las medidas se puede efectuar la calibración sobre dos puntos a elegir.

En este caso, para establecer los valores a programar por los parámetros "OFSt" e "rot", hará falta aplicar las siguientes fórmulas:

"rot" = (D2-D1) / (M2-M1)   **"OFSt" = D2 - ("rot" x M2)**

donde:

M1 =valor medido 1
D1 = valor a visualizar cuando el instrumento mide M1
M2 =valor medido 2
D2 = valor a visualizar cuando el instrumento mide M2

El instrumento visualizará:

$$DV = MV \times \text{"rot"} + \text{"OFSt"}$$

Donde: DV = Valor visualizado   MV= Valor medido

Ejemplo1: se desea que el instrumento visualice el valor realmente medido a 20 ° pero que a 200° visualiza un valor inferior de 10° (190°).

Se sigue que: M1=20 ; D1=20 ; M2=200 ; D2=190
"rot" = (190 - 20) / (200 - 20) = 0,944
"OFSt" = 190 - (0,944 x 200) = 1,2

Ejemplo2: se desea que el instrumento visualice 10° cuando el valor realmente medido es 0° pero que a 500° visualiza un valor superior de 50° (550°).

Se sigue que: M1=0 ; D1=10 ; M2=500 ; D2=550
"rot" = (550 - 10) / (500 - 0) = 1,08
"OFSt" = 550 - (1,08 x 500) = 10

Mediante el par. **"FiL"** se puede programar la constante de tiempo del filtro software relativo a la medida del valor en entrada, de modo que se puede disminuir la sensibilidad a las molestias de medida (aumentando el tiempo).

En caso de error de medida, el instrumento proporciona en salida la potencia programada en el par. **"OPE".**

Esta potencia será calculada en base al tiempo de ciclo programado por el regulador ID mientras que para los reguladores ON/OFF se considera automáticamente un tiempo de ciclo de 20 seg.

(es. En caso de error sonda con regulación ON/OFF y "OPE"= 50 la salida de regulación se activará por 10 seg., luego quedará desactivada durante 10 seg. hasta quedar el error de medida).

Mediante el par. **"InE"** se puede establecer cuales son las condiciones de error a la entrada que llevan al instrumento a proporcionar en salida la potencia programada en el par. "OPE".

Las posibilidades del par. "InE" son:

=Or : la condición está determinada por el sobrerango o rotura de sonda.

= Ur : la condición está determinada por el bajorango o la rotura de la sonda.

= Our :la condición está determinada por el sobrerango o el bajorango o la rotura de la sonda.

A través del par. **"diSP"** presente en el grupo **"ᴵPAn"** se establece la visualización normal del display SV que puede ser el Set Point activo (SP.F), la potencia de regulación (Pou), el Set Point operativo cuando hay tramos activos (SP.o), la consigna de alarma AL1, 2 o 3 (AL1, AL2 o AL3).

4.2 – CONFIGURACIÓN DE LAS SALIDAS

Las salidas del instrumento se pueden configurar en los grupos de parámetros **"ᴵO1", "ᴵO2", "ᴵO3", "ᴵO4",** donde se encuentran, en función del tipo de salida presente (digital o analógica) diversos parámetros.

N.B.: En todos los ejemplos que siguen, el número de salida está indicado genéricamente con **n**

- SALIDA DIGITAL con relé o con SSR:

En el interior del grupo seleccionado estará presente sólo el parámetro **"OnF"**.

Dicho parámetro puede ser programado para los siguientes funcionamientos:

= 1.rEG : salida de regulación primaria

= 2.rEG : salida de regulación secundaria

= ALno : salida de alarma normalmente abierta

= ALnc : salida de alarma normalmente cerrada

= OFF : salida inhabilitada

La asignación del [número salida - número alarma] se efectúa en el grupo relativo a la alarma ("ᴵAL1","ᴵAL2" o "ᴵAL3")

- SALIDA ANALÓGICA 0/4..20 mA o 0/2..10 V (solo OUT1 y 2):

En el interior del grupo estará presente el parámetro **"Aorn"** con el que es posible programar el inicio de escala utilizado para la salida.

Se programará por tanto este parámetro:

= 0 : si se quiere utilizar el inicio de escala igual a 0 (0 mA si la salida es 0/4...20 mA, o 0 V si la salida es 0/2...10 V)

= no_0 : si se quiere utilizar el inicio de escala diferente a 0 (4 mA si la salida es 0/4...20 mA, o 2 V si la salida es 0/2...10 V)

Con el par. **"AonF"** se puede configurar el funcionamiento de la salida analógica como:

= 1.rEG : Salida de regulación primaria

= 2.rEG : Salida de regulación secundaria

= r.inP : Salida de retransmisión de la medida

= r.Err : Salida de retransmisión del error [SP-PV]

= r.SP : Salida de retransmisión del Set Point Activo

= r.SEr : Salida controlada por la línea serial de comunicación del instrumento

= OFF : Salida inhabilitada

En el caso de que la salida analógica sea configurada 1.rEG o 2.rEG la señal en salida será proporcional a la potencia de regulación calculada por el instrumento a partir del 0% (señal

de salida correspondiente al inicio de escala programado) hasta el 100 % (señal de salida a lo máximo admisible del tipo de salida disponible).

Las salidas analógicas de regulación sólo son utilizables en la regulación PID con acción simple o con doble acción.

Si el modo de regulación programado fuera del tipo ON/OFF la salida analógica sólo podrá adoptar niveles de regulación del 0 % a 100 %.

En el caso de que el funcionamiento de la salida analógica fuera configurado para la retransmisión de la señal, se hace necesario programar otros dos parámetros por los cuales programar los valores de referencia mínima y máxima.

Por tanto, en estos casos, programar con el parámetro **"AonL"** el valor mínimo que el instrumento debe proporcionar en salida (0/4 mA o 0/2 V) y con el parámetro **"AonH"** el valor máximo que el instrumento debe dar en salida (20 mA o 10 V).

4.3 – REGULADOR ON/OFF (1rEG)

Todos los parámetros pertinentes a la regulación "ON/OFF" están contenidos en el grupo **"ᴵrEG".**

Este modo de regulación es factible programando el parámetro **"Cont"** = On.FS o = On.FA y actúa sobre la salida configurada como **1.rEG** en función de la medida, del Set point **"SP"** activo, del modo de funcionamiento **"Func"** y de la histéresis **"HSEt"** programados.

El instrumento emplea una regulación "ON/OFF" con histéresis simétrica si "Cont" = On.FS o bien con histéresis asimétrica "Cont" = On.Fa.

El regulador se comporta de la siguiente forma: en caso de acción inversa, o de calor ("FunC"=HEAt), desactiva la salida cuando el valor del proceso alcanza el valor [SP + HSEt] en el caso de histéresis simétrica o bien [SP] en el caso de histéresis asimétrica reactivar cuando el valor está por debajo de [SP - HSEt].

Viceversa, en caso de acción directa o de frío ("Func"=CooL), desactiva la salida cuando el valor del proceso alcanza el valor [SP - HSEt] en el caso de histéresis simétrica o bien [SP] en el caso de histéresis asimétrica reactivar cuando está por encima del valor [SP + HSEt].
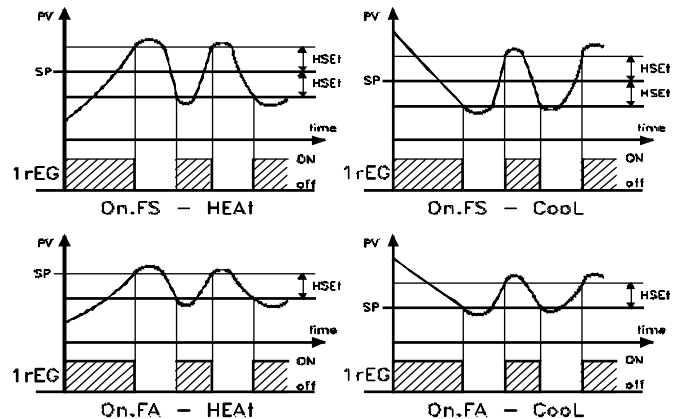
4.4 – REGULACIÓN ON/OFF CON ZONA MUERTA (1rEG - 2rEG)

Todos los parámetros pertinentes a la regulación "ON/OFF" con Zona Muerta están en el grupo **"ᴵrEG".**

El funcionamiento es factible cuando están configuradas 2 salidas respectivamente como 1rEG y 2rEG y se obtiene programando el par. **"Cont"** = nr ,

El funcionamiento con Zona Muerta se utiliza para el control de las instalaciones que poseen un elemento que causa un incremento positivo (por ej. calefactor, Humidificador, etc.) y un

elemento que causa un incremento Negativo (ad ej. Refrigerante, Deshumidificante, etc.).

El funcionamiento de regulación actúa sobre las salidas configuradas en función de la medida, del Set Point **"SP"** activo, y de la histéresis **"HSEt"** programados.

El regulador se comporta del siguiente modo: apaga las salidas cuando el valor del proceso alcanza el Set y activa la salida 1rEG cuando el valor de proceso es menor de [SP-HSEt], o bien enciende la salida 2rEG cuando el valor de proceso es mayor de [SP+HSEt].

Por consiguiente el elemento que causa un incremento Positivo irá unido a la salida configurada como 1rEG mientras que el elemento de incremento negativo irá unido a la salida configurada como 2rEG.
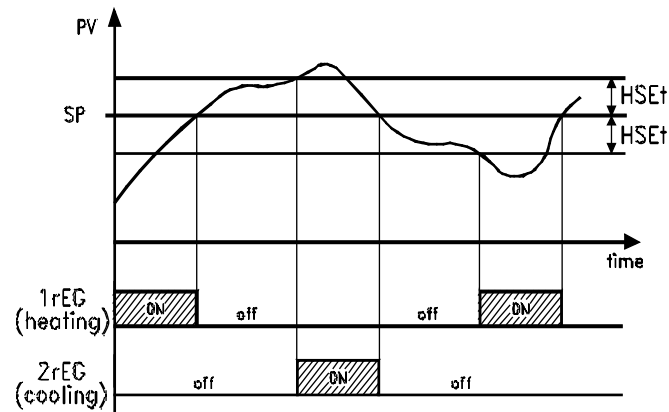
4.5 – REGULADOR PID DE ACCIÓN SENCILLA (1rEG)

Todos los parámetros pertinentes a la regulación PID están contenidos en el grupo **"ᴵrEG".**

El modo de regulación de tipo PID de acción sencilla es factible programando el parámetro **"Cont"** (contenido en el grupo **"ᴵrEG"**) = Pid y actúa sobre la salida 1rEG en función del Set point **"SP"** activo, del modo de funcionamiento **"FunC"**, y del resultado del algoritmo de control PID con dos grados de libertad del instrumento.
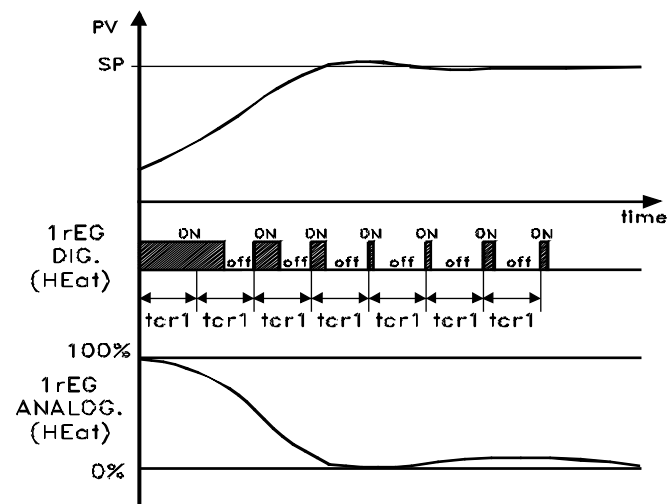
Para conseguir una buena estabilidad de la variable en caso de procesos rápidos y de control del actuador con salida digital, el tiempo de ciclo "tcr1" debe tener un valor bajo con una intervención muy frecuente de la salida de regulación.

En este caso se recomienda el uso de un relé estático (SSR) para el control del actuador.

El algoritmo de regulación PID de simple acción del instrumento facilita la programación de los siguientes parámetros:

"Pb" - Banda Proporcional

"tcr1" - Tiempo de ciclo de la salida 1rEG (sólo para salida de tipo digital)

"Int" – Tiempo Integral

"rS" – Reset manual (solo si "Int =0)

"dEr" - Tiempo derivativo

"FuOC" - Fuzzy Overshoot Control

Este último parámetro elimina las perturbaciones en la carga (overshoot) del arranque del proceso o del cambio de Set Point. Se debe tener presente que un valor bajo del parámetro reduce el "overshoot mientras" que un valor alto lo aumenta.
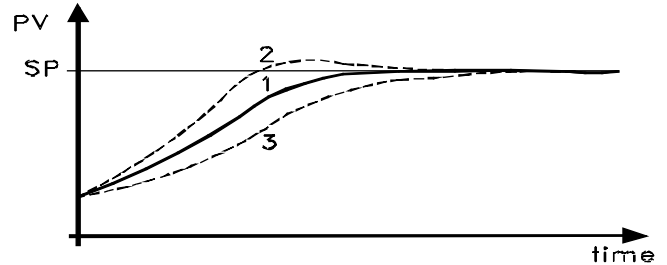
1: Valor "FuOC" OK
2: Valor "FuOC" demasiado alto
3: Valor "FuOC" demasiado bajo

4.6 - REGULADOR PID A DOBLE ACCIÓN (1rEG - 2rEG)

Todos los parámetros pertinentes a la regulación PID están contenidos en el grupo **"ᴵrEG".**

La regulación PID a Doble Acción se utiliza para el control de instalaciones que poseen un elemento que cause un incremento positivo (ej. calor) y un elemento que causa un incremento negativo (ej. frío) y actúa cuando están configuradas 2 salidas como 1rEG y 2rEG y programando el par. **"Cont"** = Pid.

El elemento que causa incremento Positivo irá unido a la salida configurada como 1rEG mientras que el elemento de incremento negativo irá unido a la salida configurada como 2rEG.

El modo de regulación de tipo PID de doble acción actúa por tanto sobre salidas 1rEG y 2rEG en función del Set point **"SP"** activo y del resultado del algoritmo de control PID con dos grados de libertad del instrumento.

Para conseguir una buena estabilidad de la variable en caso de procesos rápidos y control de los actuadores con salidas digitales, los tiempos de ciclo "tcr1" y "tcr2" deben tener un valor bajo con una intervención muy frecuente de las salidas de regulación.

En este caso se recomienda el uso de un relé estático (SSR) para el control de los actuadores.

El algoritmo de regulación PID de doble acción del instrumento facilita la programación de los siguientes parámetros:

"Pb" - Banda Proporcional

"tcr1" - Tiempo de ciclo de la salida 1rEG (sólo para salida de tipo digital)

"tcr2" - Tiempo de ciclo de la salida 2rEG (sólo para salida de tipo digital)

"Int" - Tiempo Integral

"rS" - Reset manual (solo si "Int =0)

"dEr" - Tiempo derivativo

"FuOC" - Fuzzy Overshoot Control

"Prat" - Power Ratio o relación entre potencia del elemento dada en la salida 2rEG y potencia del elemento controlada por la salida 1rEG.

En caso de que el parámetro "Prat" fuera programado = 0 , la salida 2rEG se inhabilita y el regulador se comportará exactamente como un regulador PID de acción sencilla a través de la salida 1rEG.

4.7 – REGULADOR PID PARA ACCIONAMIENTOS MOTORIZADOS CON POSICIONAMIENTO TEMPORAL (1rEG - 2rEG)

Todos los parámetros pertinentes a la regulación PID para accionamientos mecánicos están contenidos en el grupo **"rEG"**.

Este tipo de regulación se utiliza para el control de instalaciones dotadas de un accionamiento motorizado con controles de abertura y cierre de tipo digital que actúa cuando están configuradas respectivamente 2 salidas como 1rEG y 2rEG y programando el par. **"Cont"** = 3 Pt.

El control de abertura del accionamiento estará provisto de la salida configurada como 1rEG mientras que el control de cierre estará provisto de la salida configurada como 2rEG.

El modo de regulación de tipo PID para accionamiento motorizado actúa sobre las salidas 1rEG y 2rEG en función del Set point **"SP"** activo y del resultado del algoritmo de control PID con dos grados de libertad del instrumento.

El sistema de control utilizado, no prevé una realimentación para establecer la posición actual del accionamiento.

En caso de que el actuador no fuera dotado de contactos de seguridad que interrumpan el accionamiento una vez corrido, es necesario dotar la instalación de estos contactos (SQo, SQc) como representa la figura
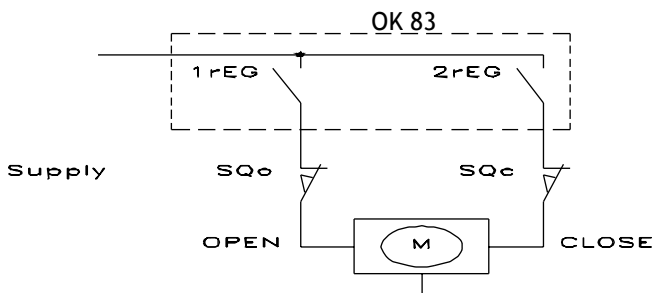
El algoritmo de regulación PID para accionamientos motorizados con posicionamiento temporal facilita la programación de los siguientes parámetros:

"Pb" - Banda Proporcional
"Int" - Tiempo Integral
"rS" - Reset manual (solo si "Int =0)
"dEr" - Tiempo derivativo
"FuOC" - Fuzzy Overshoot Control
"tcor" : Tiempo de carrera del accionamiento.

Es el tiempo, expresado en segundos, que necesita el accionamiento para pasar a la posición "normalmente abierto" a "normalmente cerrado".

"SHrl" : Valor mínimo de regulación.

Es el primer valor que tiene que haber alcanzado la regulación (en %) que tenga efecto sobre la salida. Sirve para evitar que el control intervenga con frecuencia.

"PoSI": Posicionamiento en el arranque.

Es la posición del accionamiento cuando se arranca el instrumento. Puede tener las siguientes posiciones:

nO = el accionamiento queda donde se encuentra
oPEn = el accionamiento está en la posición "normalmente abierto"
cLoS = el accionamiento está en la posición de "normalmente cerrado".

Si se programan las opciones "OPEn" o "CloS", al arrancar el aparato se encenderá la salida 1rEG (si "oPEn") o 2rEG (si "cLoS") para el tiempo programado en par. "tcor" después de que inicie la regulación.

En caso de error en la medida, las salidas están accionadas de modo que dirigen la válvula a la posición establecida por el parámetro "PoSI".

4.8 – FUNCIONES DE AUTOTUNING Y SELFTUNING

Todos los parámetros pertinentes a la función de AUTOTUNING y SELFTUNING están contenidos en el grupo **"rEG"**.

La función de AUTOTUNING y la de SELTUNING permiten la sintonización automática del regulador PID.

La función de **AUTOTUNING** calcula los parámetros PID a través de un ciclo de sintonización de tipo FAST, terminado el cual los parámetros se memorizan y durante la regulación se mantienen constantes.

La función de S**ELFTUNING** (regla basada en "TUNE-IN") monitoriza de la regulación y el continuo cálculo de los parámetros durante la regulación.

Ambas funciones calculan de modo automático las siguientes funciones:

"Pb" - Banda Proporcional
"tcr1" - Tiempo de ciclo de la salida 1rEG
"tcr2" - Tiempo de ciclo de la salida 2rEG
"Int" - Tiempo Integral
"dEr" - Tiempo derivativo
"FuOC" - Fuzzy Overshoot Control

y para la regulación PID de doble acción también:
"Prat" - Relación P 2rEG/ P 1rEG

Para activar la función de AUTOTUNING proceder como sigue:
1) Programar y activar el Set point deseado.
2) Programar el parámetro "Cont" =Pid o bien = 3 Pt , si el instrumento controla un accionamiento motorizado con posicionamiento temporal.
3) Si el control es de acción sencilla programar el parámetro "Func" en función del proceso a controlar por la salida 1rEG.
4) Configurar una salida como 2rEG si el instrumento controla una instalación con doble acción o un accionamiento motorizado con posicionamiento temporal.
5) Programar el parámetro **"Auto"** como:
= 1 - si se desea que el autotuning se active automáticamente cada vez que se enciende el instrumento con la condición de que el valor del proceso sea menor (para "Func" =HEAt) o mayor (para "Func" =CooL) de SP/2
= 2 - si se desea que el autotuning se active automáticamente al arrancar el instrumento con la condición de que el valor del proceso sea menor (para "Func" =HEAt) o mayor (para "Func" =CooL) de SP/2, y, una vez acabada la sintonización, se active automáticamente el par. "Auto"=OFF.
= 3 - si se desea activar manualmente el autotuning, mediante la opción "tunE" en el menú principal o mediante la tecla "F" convenientemente programada ("USrb" = tunE). En este caso el autotuning parte sin verificar ninguna condición de valor de proceso. Se recomienda esta opción para dirigir el autotuning cuando el valor del proceso está lo más lejano posible del Set Point. Para ejecutar del mejor modo el autotuning FAST, es preferible respetar esta condición.
= 4 – si se desea que el autotuning se active automáticamente al final del ciclo de Soft-Start programado. El autotuning se ejecutará a condición de que el valor de proceso sea menor (para "Func" =HEAt) o mayor (para "Func" =CooL) de SP/2.
6) Salir de la programación de parámetros.
7) Conectar el instrumento a la instalación controlada.
8) activar el autotuning apagando y encendiendo el aparato si "Auto" = 1 o 2 o bien mediante la selección de la opción **"tunE"** en el menú principal (o mediante la tecla "F" convenientemente programada).

En este punto la función de Autotuning se activa y se señala por el led AT/ST.

El regulador actúa con una serie de operaciones sobre la instalación para calcular los parámetros de regulación PID más idóneos.

En caso de "Auto" = 1 o "Auto" = 2, y en caso de que al iniciar el autotuning no se verifique la condición del menor valor de proceso (para "Func" =HEAt) o mayor (para "Func" =CooL) de SP/2 el display visualizará **"ErAt"** y el instrumento se pondrá en modo normal de regulación según los parámetros programados anteriormente.

Para hacer desaparecer el error "ErAt" configurar el instrumento en regulación OFF (OFF) y seguidamente programar en regulación automática (rEG).

La duración del ciclo de autotuning está limitada a un máximo de 12 horas.

En el caso de que el proceso no se finalice en el plazo de 12 horas , el instrumento visualizará **"noAt"** .

En el caso de que se hubiera verificado un error en la sonda del instrumento, se interrumpirá el ciclo en ejecución.

Los valores calculados por el autotuning ser memorizarán automáticamente por el instrumento al terminar la correcta ejecución del ciclo autotuning en los parámetros relativos a la regulación PID.

N.B. : El instrumento ya está programado de fábrica para ejecutar el autotuning en cada encendido del instrumento ("Auto" = 1).

Para activar la función de SELFTUNING proceder como sigue:

2) Programar el parámetro "Cont" =Pid o bien = 3 Pt , si el instrumento controla un accionamiento motorizado con posicionamiento temporal.

3) Si el control es de acción sencilla programar el parámetro "Func" en función del proceso a controlar por la salida 1rEG.

4) configurar una salida como 2rEG si el instrumento controla una instalación con doble acción o un accionamiento motorizado con posicionamiento temporal.

5) Programar el parámetro **"SELF"** =yES

6) Salir de la programación de parámetros.

7) conectar el instrumento a la instalación controlada.

8) activar el selftuning seleccionando la opción **"tunE"** en el menú principal (o mediante la tecla "F" convenientemente programada).

Cuando la función de Selftuning está activa, el led AT/ST se enciende de modo fijo, y todos los parámetros de regulación PID ("Pb", "Int", "dEr", ecc.) no se visualizan más.

Para interrumpir el ciclo de Autotuning o desactivar el Selftunting seleccionar del menú "SEL" cualquiera de los estados de regulación: "rEG", "OPLO" o "OFF".

Si el instrumento se apaga durante el autotuning o con la función de selftuning activada, las funciones se integrarán en el arranque.

4.9 – LIMITACIÓN DE LA POTENCIA DE REGULACIÓN

A través de esta función se limita la potencia de regulación en salida (de modo separado por ambas salidas de regulación) dentro de un límite mínimo y uno máximo.

El empleo de estos límites sólo es posible en el caso de regulación PID con acción sencilla o doble y puede ser útil para solventar algunos problemas mecánicos de los actuadores como, por ejemplo, válvulas que no se empiezan a abrir hasta que la salida no ha alcanzado al menos el 20% y/o resulta que están completamente estancas cuando la potencia ha alcanzado el '80%.

El regulador PID del instrumento normalmente trabaja produciendo potencias entre 0 y 100 % en el caso de PID con acción sencilla y –100 (C) y 100 (H) % en el caso de PID con doble acción.

La función por tanto resulta inhabilitada programando "ro1.L" =0 "ro2.L" = 0 y "ro1.H" =100, "ro2.H" = 100.

Programando valores diferentes de potencia viene escalado dentro de los límites programados el modo de explotar al máximo la potencia del actuador.

Los parámetros programados para esta función, contenidos en el bloque **"¹rEG",** son :

"ro1.L" – Potencia mínima en salida 1rEG (H)

"ro1.H" – Potencia máxima en salida 1rEG (H)

"ro2.L" – Potencia mínima en salida 2rEG (C)

"ro2.H" – Potencia máxima en salida 2rEG (C)

La limitación no está activa en modalidad de control manual "OPLO".

4.10 – LIMITACIÓN DE LA VELOCIDAD DE VARIACIÓN DE LA POTENCIA DE REGULACIÓN

Mediante esta función se puede limitar la velocidad de variación de la potencia de regulación en salida (de modo separado en ambas salidas de regulación) .

El empleo de esta función sólo es posible en el caso de la regulación PID con acción sencilla o doble y puede ser útil para solventar algunos problemas de los actuadores que podrían necesitar una lenta y progresiva variación de potencia.

Los parámetros de programación de esta función, contenidos en el bloque **"¹rEG",** son :

"OPS1" – velocidad de variación de la potencia en salida 1rEG (H) expresada en [% / seg].

"OPS2" – Velocidad de variación de la potencia en salida 2rEG (C) expresada en [% / seg].

La función de limitación resulta inhabilitada programando los par. = InF y no está activa en modalidad de control manual "OPLO".

4.11 – FUNCIÓN DE SPLIT RANGE

Esta función se utiliza en caso de regulación PID con doble acción y se puede utilizar para retardar o adelantar la intervención de los dos actuadores controlados por el instrumento.

Con esta función se puede optimizar la intervención de los dos actuadores haciendo que sus acciones no se solapen o bien que se agreguen de forma que se obtiene una mezcla de ambas acciones.

En la práctica se trata de programar dos compensaciones de potencia (una para la acción directa y otra para la acción inversa) que establecen el principio de la intervención del actuador comandado por la salida.

Los parámetros de programación de esta función, contenidos en el bloque **"¹rEG",** son :

"thr1" : Consigna de potencia en el cual la salida 1rEG comienza a operar.

"thr2" : Consigna de potencia en el cual la salida 2rEG comienza a operar.

En la práctica si se desea adelantar la intervención de la acción inversa (1rEG) y retardar la acción directa (2rEG) hará falta programar valores positivos en el par. "thr1" y negativos en el par. "thr2".

De este modo se aumentará la zona dentro de la cual las dos salidas no se activarán al mismo tiempo.
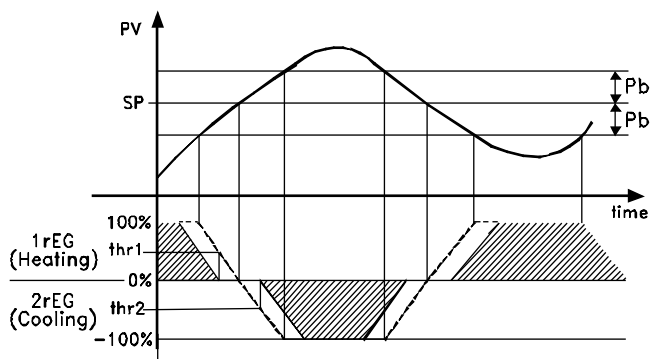
Viceversa si se desea alargar la intervención de la acción inversa (1rEG) y adelantar la acción directa (2rEG) hará falta programar valores negativos en el par. "thr1" y positivos en el par. "thr2".

De este modo aumentará la zona dentro de la cual las dos salidas se activarán al mismo tiempo.
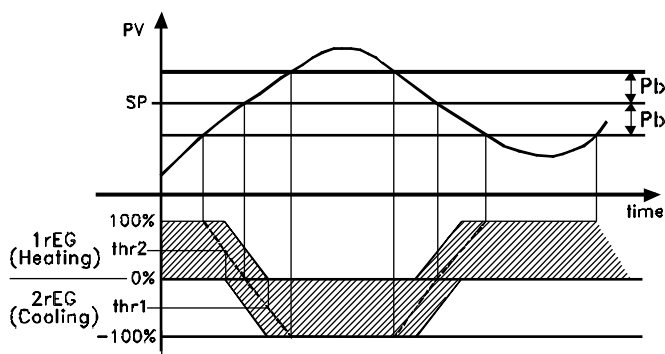
La función de split range se inhabilita programando los correspondientes parámetros =0.
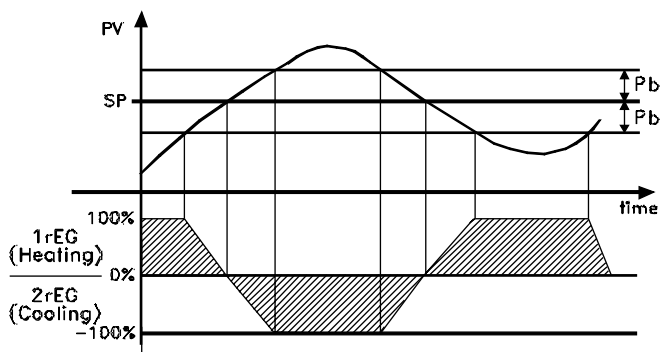
N.B. : Con el objetivo de simplificar la explicación en los gráficos de ejemplo, ha sido considerado un sólo regulador proporcional (y por lo tanto con "dEr" y "Int" = OFF) de doble acción con "Prat" = 1.0 y "rS" = 0.0

4.12 – ALCANCE DEL SET POINT CON VELOCIDAD CONTROLADA Y CONMUTACIÓN AUTOMÁTICA ENTRE DOS SET POINT (RAMPA DE SALIDA, RAMPA DE PENDIENTE Y TIEMPO DE MANTENIMIENTO)

Todos los parámetros pertinentes al funcionamiento de las rampas están contenidos en el grupo **"¹rEG".**

Se puede lograr que el Set point se alcance en un tiempo determinado (en todo caso nunca mayor que el tiempo que el sistema necesita naturalmente).

Esto puede ser útil en aquellos procesos (tratamientos térmicos, químicos, etc.) cuyo Set point debe ser alcanzado gradualmente, en tiempos preestablecidos.

Además se puede lograr que una vez alcanzado el primer Set (SP1) el instrumento conmute automáticamente sobre el segundo Set (SP2) después de un tiempo programable realizando así un simple ciclo térmico automático.

Estas funciones están disponibles para todos los tipos de regulación programable.

El funcionamiento está establecido por los siguientes parámetros:

"SLor" – Inclinación de la rampa de subida (activado cuando el valor del proceso es menor que el Set point), expresada en unidad/minuto.

"SLoF" – Inclinación de la rampa en pendiente (activado cuando el valor del proceso es mayor que Set point), expresado en unidad/minuto.

"dur.t" – Tiempo de mantenimiento del Set Point SP1 antes de conmutar automáticamente sobre SP2 (expresado en horas y minutos).

Las funciones se desactivan cuando se programan los parámetros relativos = InF.

Cuando se cambia el valor del Set point o al encenderse, el instrumento determina automáticamente cuál de los dos valores "SLor" o "SLoF" utilizar.

N.B: En caso del regulador PID si se desea efectuar el autotuning y se activa una rampa ésta no se ejecuta hasta que no se acaba el ciclo de sintonización.

Se recomienda ejecutar el autotuning sin activar ningún tramo y por lo tanto, una vez ejecutada la sintonización, inhabilitar el autotuning ("Auto" = OFF), programar las rampas deseadas y si se desea la sintonización automática, habilitar la función de Selftuning.
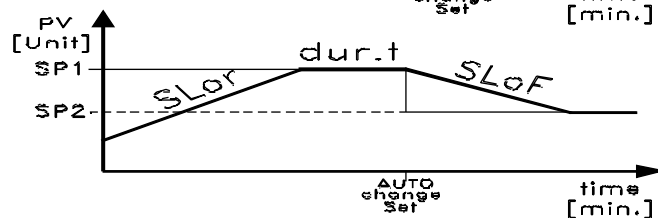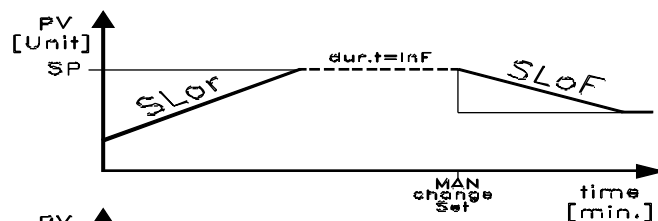
Ejemplos con salida de valores inferiores a SP y con disminución del Set Point.

4.13 – FUNCIÓN DE SOFT-START

Todos los parámetros pertinentes al funcionamiento del "Soft Start" están contenidos en el grupo **"¹rEG".**

La función de Soft-Start sólo es factible con regulación PID y permite limitar la potencia de regulación al arrancar el instrumento durante un tiempo establecido.

Esto resulta útil cuando el actuador controlado por el instrumento se pudiera dañar a causa de una potencia excesiva cuando éste no está todavía en condiciones de régimen (por ejemplo en el caso de algunos elementos calefactores).

El funcionamiento está establecido por los siguientes parámetros:

"St.P" – Potencia de Soft Start

"Sst" – Tiempo de Soft Start (expresado en hh.mm)

y son posibles dos modos de funcionamiento:

1) Si se programan ambos, los parámetros con valores diferentes de OFF al encenderse el instrumento dan en salida

la potencia programada en el par. "St.P" para el tiempo programado en el par. "SSt".

En la práctica el instrumento trabaja con regulación manual para conmutar automáticamente a regulación automática al final del tiempo "SSt".

Se debe tener cuidado de no programar una potencia "St.P" demasiado elevada cuando la función no está habilitada en el momento que la potencia de regulación automática resulta inferior a la ya programada.

2) Si se programa el par. "St.P" = OFF y un valor cualquiera con el par. "SSt" al arrancar, la potencia calculada por el regulador PID se divide por el tiempo "SSt" con el fin de calcular una rampa. La potencia proporcionada en salida parte de 0 y se incrementa progresivamente según la rampa calculada hasta el final del tiempo "SSt" o hasta que la potencia no supere el calculado por el regulador PID.

Para excluir la función de "Soft Start" es suficiente con programar el par. "Sst" = OFF

En caso de que durante la ejecución del "Soft Start", se verifique un error de medida, la función se interrumpe y el instrumento pasa a proporcionar en salida la potencia programada en el par. "OPE".

Si la medida se restablece, el Soft Start queda en todo caso desactivado.

Si se desea ejecutar el Autotuning con el "Soft Start" integrado hace falta programar el par. "Auto"=4.

De este modo el autotuning se ejecutará al final del ciclo de "Soft-Start", con la condición naturalmente de que el valor de proceso en ese momento sea menor (para "Func" =HEAt) o mayor (para "Func" =CooL) de SP/2.

4.14 – FUNCIONAMIENTO DE LAS ALARMAS (AL1, AL2, AL3)

4.14.1 – CONFIGURACIÓN DE LAS SALIDAS DE ALARMA

Para la configuración del funcionamiento de las alarmas cuya intervención está ligada al valor del proceso (AL1, AL2, AL3) es necesario primeramente establecer a qué salida tiene que corresponder la alarma.

Para hacer esto hace falta configurar ante todo en el grupo de parámetros **"]O "** los parámetros relativos a las salidas que se deseen utilizar como alarmas ("O1F" , "O2F" ,"O3F" ,"O4F") programando el parámetro relativo a la salida deseada :

= Alno la salida de alarma permanecerá abierta (no) mientras esté en las condiciones de alarma.

= Alnc la salida de alarma permanecerá cerrada (nc) mientras esté en las condiciones de alarma.

<u>**N.B.:** En todos los ejemplos que siguen el número de alarma está indicado genéricamente con **n**</u>

Acceder al grupo **"]ALn"** relativo a la alarma que se desea configurar y programar al parámetro **"OALn"**, sobre cuya salida deberá ser destinada la señal de alarma.

El funcionamiento de la alarma está establecido en cambio por los parámetros:

"ALnt " - TIPO DE ALARMA
"Abn" – CONFIGURACIÓN DE LA ALARMA
"ALn" – CONSIGNA DE ALARMA
"ALnL" – CONSIGNA INFERIOR DE ALARMA (para alarma con ventana)
"ALnH" – CONSIGNA SUPERIOR DE ALARMA (para alarma con ventana)
"ALnd" – RETRASO DE ACTIVACIÓN DE LA ALARMA (en sec.)
"ALni" – COMPORTAMIENTO ALARMA EN CASO DE ERROR DE MEDIDA

"ALnt" – TIPO DE ALARMA: Se pueden tener 6 diferentes comportamientos de la salida de alarma.

LoAb = ALARMA ABSOLUTA DE MÍNIMA: la alarma se activa cuando el valor de proceso está por debajo de la consigna de alarma programado en el parámetro "ALn"
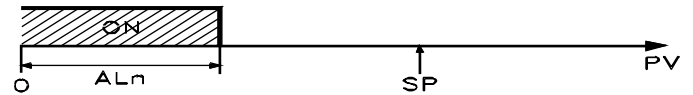
LoAb : Absolute Minimum Alarm

HiAb = ALARMA ABSOLUTA DE MÁXIMA: La alarma se activa cuando el valor de proceso supera el de la consigna de alarma programada en el parámetro "ALn"
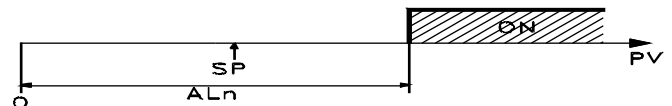
HiAb: Absolute Maximum Alarm

LHAb = ALARMA ABSOLUTA CON VENTANA: La alarma se activa cuando el valor de proceso está por debajo de la consigna de alarma programado en el parámetro "ALnL" o bien cuando supera la consigna de alarma programada en el parámetro "ALnH".
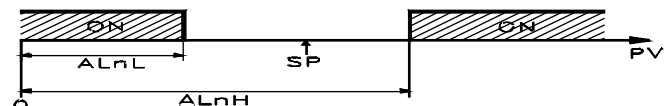
LHAb: Absolute Window Alarm

LodE = ALARMA RELATIVA DE MÍNIMA: La alarma se activa cuando el valor de proceso está por debajo del valor [SP - ALn]
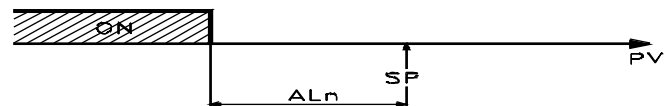
LodE: Relative Minimum Alarm

HidE = ALARMA RELATIVA DE MÁXIMA: La alarma se activa cuando el valor de proceso supera el valor [SP + ALn]
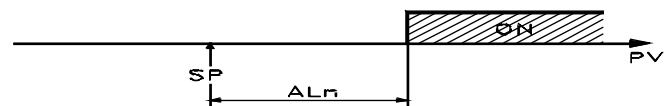
HidE: Relative Maximum Alarm

LHdE = ALARMA RELATIVA CON VENTANA: La alarma se activa cuando el valor de proceso está por debajo del valor [SP - ALnL] o bien cuando el valor de proceso supera el valor [SP + ALnH]
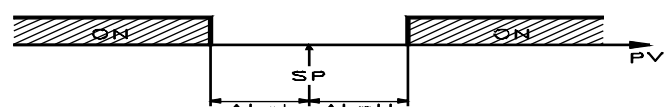
LHdE: Relative Window Alarm

"Abn" – CONFIGURACIÓN DE LA ALARMA: El parámetro puede asumir un valor comprendido entre 0 y 15.

El número de programación, que corresponderá al funcionamiento deseado, se consigue sumando los valores indicados en las siguientes descripciones:

COMPORTAMIENTO ALARMA AL ENCENDERSE: Puede haber dos diferentes comportamientos de la salida de alarma, según el valor sumado al par. "Abn".

+0 = COMPORTAMIENTO NORMAL: La alarma se activa siempre cuando hay las condiciones de alarma.

+1 = ALARMA NO ACTIVA EN EL ARRANQUE Si al arrancar el instrumento se encuentra en las condiciones de alarma éste no se activa. La alarma se activará sólo cuando el valor de proceso, después del encendido, no va de las condiciones de no alarma a las condiciones de alarma sucesivamente.

Start-up Behaviour
(Example with minimum Alarm)
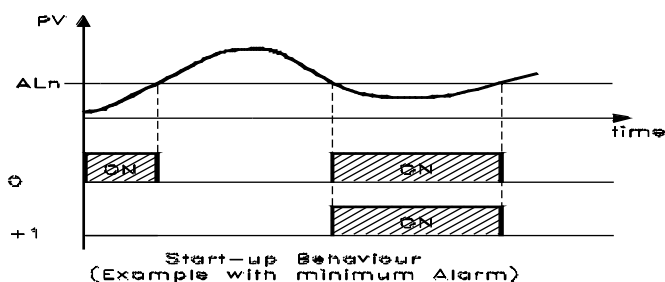
RETARDO ALARMA: Se pueden tener 2 diferentes comportamientos de la salida de alarma, según el valor sumado en el par. "Abn".

+0 = ALARMA NO RETARDADA: La alarma se activa inmediatamente después de verificar las condiciones de alarma.

+2 = ALARMA RETARDADA: Al verificar las condiciones de alarma se activa el retraso programado en el par. "ALnd" (expresado en seg.) y sólo al transcurrir ese tiempo la alarma será activada.

MEMORIA ALARMA: Se pueden tener 2 diferentes comportamientos de la salida de alarma, según el valor sumado en el par. "Abn".

+ 0 = ALARMA NO MEMORIZADA: La alarma permanece activa en las condiciones de alarma.

+ 4 = ALARMA MEMORIZADA: La alarma se activa cuando hay condiciones de alarma y quedan activas, aunque tales condiciones no permanecen, sino cuando no se pulsa la tecla "F" convenientemente programada ("USrb"=Aac)

Alarm Latch Behaviour
(Example with maximum Alarm)
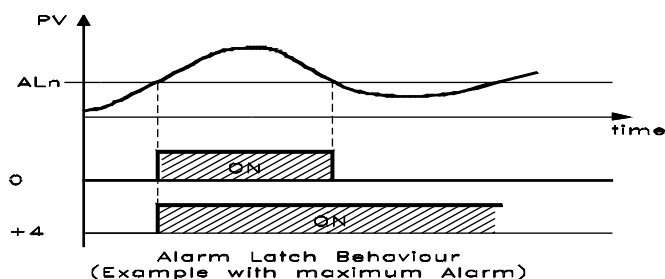
PARADA DE ALARMA: se pueden tener 2 diferentes comportamientos de la salida de alarma, según el valor sumado en el par. "Abn".

+ 0 = ALARMA NO PARADA: La alarma siempre queda activa en las condiciones de alarma.

+ 8 = ALARMA PARADA: La alarma se activa cuando hay condiciones de alarma y se puede desactivar mediante la tecla "F" convenientemente programada ("USrb"=ASi), aunque quedan las condiciones de alarma.

"ALni" – ACTIVACIÓN ALARMA EN CASO DE ERROR DE MEDIDA: permite establecer en qué condición se debe poner la alarma cuando el instrumento tiene un error de medida (yes = alarma activa; no = alarma desactivada).

4.14.2 – HISTÉRESIS DE LAS ALARMAS

El funcionamiento de las alarmas está influenciado por las histéresis de las mismas (par. "HALn"), que operan de modo asimétrico.

En caso de alarma de mínima, la alarma se activará cuando el valor del proceso baja por debajo del valor de la consigna de alarma y se activa cuando supera dicha consigna + "HALn" ; en caso de alarma de máxima, la alarma se activará cuando el valor del proceso sube por encima de la consigna de alarma y se desactiva cuando baja por debajo de la consigna de la misma - "HALn".

Maximum Alarm   Mìnimum Alarm
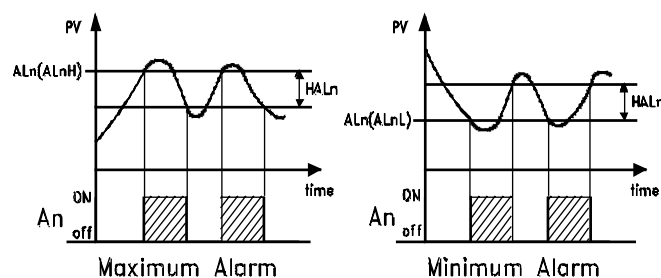
Para alarmas con ventana el ejemplo de la alarma mínima se aplica a la consigna inferior ("ALnL") mientras que el ejemplo de alarma de máxima se aplica a la consigna superior ("ALnH")

4.15 – FUNCIÓN DE ALARMA DE "HEATER BREAK" (HB)

Todos los parámetros pertinentes a las funciones relativas a la alarma tipo "Heater Break" están contenidos en el grupo "ᴵHb".

La función de alarma "Heater Break" (Alarma de rotura del elemento calefactor) sólo es factible cuando el instrumento está dotado de entrada (TAHB) para la medida de corriente absorvida por la carga.

La entrada acepta señales procedentes de transformadores amperométricos (TA) con salida máxima de 50 mA .

La primera operación a efectuar para tener una buena medida de corriente es programar en el par. **"IFS"** la corriente que el instrumento debe medir correspondiente al fondo de escala de la entrada TA (50 mA).

Para la configuración de la salida a la que destinar la alarma de "Heater Break" es necesario primeramente establecer a qué salida debe corresponder la alarma.

Para hacer esto se debe configurar en el grupo de parámetros **"ᴵOut"** el parámetro relativo a la salida que se desea utilizar ("O1F" , "O2F" ,"O3F" ,"O4F") programando el parámetro relativo a dicha salida :

= Alno la salida de alarma permanecerá abierta (no) mientras esté en las condiciones de alarma.

= Alnc la salida de alarma permanecerá cerrada (nc) mientras esté en las condiciones de alarma.

Acceder luego al grupo **"ᴵHb"** y programar en el parámetro **"OHb"**, a qué salida se destinará la señal de alarma.

La modalidad de funcionamiento de la alarma viene establecida en el par. **"HbF"** que se puede programar de las siguientes formas:

= 1 : Alarma activada cuando, en condición de salida 1rEG abierta, la corriente medida por la entrada TAHB es inferior al valor programado en el parámetro **"IHbL"** .

= 2 : Alarma activada cuando, en condición de salida 1rEG cerrada, la corriente medida por la entrada TAHB es superior al valor programado en el parámetro **"IHbH"** .

= 3 : Alarma activada cuando, en condición de salida 1rEG abierta, la corriente medida por la entrada TAHB es inferior al valor programado en el parámetro **"IHbL"** o bien cuando, en condición de salida 1rEG cerrada, la corriente medida es

superior al valor programado en el parámetro **"IHbH"** (en ambos casos anteriores).

= 4 : Alarma activada cuando la corriente medida por la entrada TAHB es inferior al valor programado en el parámetro **"IHbL"** o bien cuando la corriente medida es superior al valor programado en el parámetro **"IHbH"** independientemente del estado de salida 1rEG.

Con el parámetro "IHbL" irá programado el valor de la corriente absorbida por la carga cuando la salida 1rEG está abierta, mientras con el par. "IHbH" la corriente absorbida por la carga cuando la salida 1rEG está cerrada.

La programación de estos parámetros debe ser ejecutada también teniendo en cuenta las oscilaciones de la tensión de la red para evitar alarmas indeseadas.

La histéresis de la alarma HB viene calculada automáticamente por el instrumento como 1 % de las consignas programadas.

Durante el funcionamiento se puede visualizar sobre el display la corriente medida en la entrada TAHB cuando la salida 1rEG está abierta pulsando la tecla "DOWN" y la corriente medida cuando la salida 1rEG está cerrada pulsando al mismo tiempo la tecla DOWN y la tecla "F".

Para excluir la alarma de "Heater Break" es suficiente programar "OHb" = OFF.

N.B. : La medida de la corriente HB es válida si la salida 1rEG está abierta (o cerrada) durante al menos 264 ms.

Esto quiere decir que si el tiempo de ciclo ("tcr1") es de 1s, la alarma HB sólo puede intervenir cuando la potencia en salida es mayor de 26,4%.

OK 83
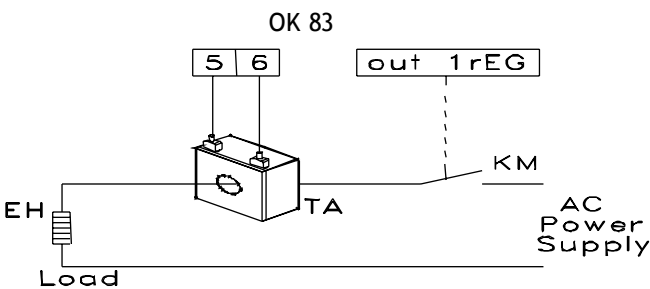
4.16 – FUNCIÓN ALARMA DE "LOOP BREAK"

Todos los parámetros pertinentes a las funciones relativas a la alarma de "Loop Break" están contenidos en el grupo **"ᴶLbA".**

La alarma de "Loop Break" interviene cuando, por un motivo cualquiera (cortocircuito de un termopar, inversión de un termopar, interrupción de la carga) se interrumpe el ciclo de regulación.

Para la configuración de la salida a la que destinar la alarma de "Loop Break" es necesario primeramente establecer a qué salida debe corresponder la alarma.

Para hacer esto se debe configurar en el grupo de parámetros **"ᴶOut"** el parámetro relativo a la salida que se desea utilizar ("O1F" , "O2F" ,"O3F" ,"O4F") programando el parámetro relativo a dicha salida:

= AIno la salida de alarma permanecerá abierta (no) mientras esté en las condiciones de alarma.

= AInc la salida de alarma permanecerá cerrada (nc) mientras esté en las condiciones de alarma.

Luego acceder al grupo **"ᴶLbA"** y programar en el parámetro **"OLbA"**, sobre qué salida se destina la señal de alarma.

La alarma de "Loop Break" se activa si la potencia de salida se mantiene en el valor del 100 % para el tiempo programado en el par. **"LbAt"** (expresado en seg.).

Para no dar lugar a falsas alarmas, el valor programado en este parámetro se debe ejecutar teniendo en cuenta el tiempo de alcance del Set cuando el valor medido está lejos de éste (por ejemplo al arrancar la instalación).

Con la intervención de la alarma, el instrumento visualiza el mensaje **"LbA"** y se comporta como en el caso de un error de medida dando en salida la potencia programada en el par. **"OPE"** (programable en el grupo **"ᴶInP")**.

Para restablecer el normal funcionamiento después de la alarma seleccionar el modo de regulación "OFF" y reprogramar el funcionamiento de regulación automática ("rEG") después de haber revisado el correcto funcionamiento de la sonda y el actuador.

Para excluir la alarma de "Loop Break" es suficiente con programar "OLbA" = OFF.

4.17 – FUNCIONAMIENTO DE LA TECLA F

La función de la tecla "F" se puede definir mediante el parámetro **"USrb"** contenido en el grupo **"ᴶPAn".**

El parámetro se puede programar como:

= noF : La tecla no ejecuta ninguna función.

= tunE : Pulsando la tecla durante al menos 1 seg. se puede activar/desactivar el Autotuning o el Selftuning.

= OPLO : Pulsando la tecla durante al menos 1 seg. se pasa del modo de regulación automática (rEG) a manual (OPLO) y viceversa.

= Aac : Pulsando la tecla durante al menos 1 seg. se resetea una alarma memorizada (ver par. 4.14.1)

= ASi :Pulsando la tecla durante al menos 1 seg. se puede parar una alarma activa (ver par. 4.14.1)

= CHSP : Pulsando la tecla durante al menos 1 seg. se selecciona a rotación uno de los 4 Set Point memorizados.

= OFF : Pulsando la tecla durante al menos 1 seg. se pasa del modo de regulación automática (rEG) al de regulación desactivada (OFF) y viceversa.

4.18 – ENTRADA DIGITAL

En alternativa a la salida OUT4, el instrumento se puede dotar de una entrada digital cuyo funcionamiento es configurable a través del parámetro "diF" contenido en el grupo **"ᴶInP".**

El parámetro puede ser programado como:

= noF : La entrada no ejecuta ninguna función.

= AaC : Cerrando el contacto conexo a la entrada digital se resetea una alarma memorizada (ver par. 4.14.1)

= ASi :Cerrando el contacto conexo a la entrada digital se para una alarma activa (ver par. 4.14.1)

= HoLd : Cerrando el contacto conexo a la entrada digital se bloquea la adquisición de la medida en ese instante (N.B.: no la lectura sobre el display, de este modo la indicación podría estabilizarse con un retraso proporcional al filtro de medida). Con la función de "hold" se opera sobre la regulación en función de la medida memorizada. Volviendo a abrir el contacto, el instrumento retoma la normal adquisición de la medida.

= OFF : Cuando el instrumento está en estado "rEG" cerrando el contacto conexo a la salida digital, el instrumento se desactiva (estado de OFF). Abriendo el contacto el instrumento vuelve al estado de regulación automática "rEG".

= CHSP : Cerrando y abriendo el contacto conectado a la entrada digital es posible seleccionar a rotación uno de los 4 Set Point memorizados.

= SP1.2 : El cierre del contacto conectado a la entrada digital selecciona como activo el set point SP2 mientras que la apertura del contacto selecciona como activo el set point SP1. La función es factible sólo con "nSP" = 2 , además cuando se activa inhabilita la selección del set activo por el parámetro "SPAt" y mediante la tecla "F".

4.19 – INTERFACE SERIAL RS 485

El instrumento se puede dotar de una interface de comunicación serial de tipo RS 485 la cual se conecta a una red en la que se insertan otro tipo de instrumentos (reguladores

o PLC) y a un ordenador personal utilizado como supervisor de la instalación.

Mediante el PC se pueden adquirir todos los datos de funcionamiento y programar todos los parámetros de configuración del instrumento.

El protocolo software adoptado en el OK 83 es del tipo MODBUS-RTU utilizado en muchos PLC y programas de supervisión disponibles en el mercado (el manual del protocolo de comunicación de los instrumentos de la serie OK está disponible).

El circuito de interfaz permite conectar hasta 32 instrumentos sobre la misma línea.

Para mantener la línea en condiciones de reposo, se solicita el enlace de una resistencia (Rt) al final de la línea de valor de 120 Ohm.

El instrumento está dotado de dos bornes llamados A y B que deben ser conectados a todos los bornes homónimos de la red.

Para el cableado de la línea es suficiente un cable doblado entrelazado de tipo telefónico y de conexión a tierra de todos los bornes GND .

Sin embargo, cuando la red resulta muy larga o inestable, y en presencia de diferencias de potencial entre varios bornes GND, conectar un cable de 3 polos entrelazados y protegidos como indica la figura.

Si el instrumento está dotado de interfaz serial, programar los siguientes parámetros disponibles en el grupo "ᴶSEr" :

"Add" : Dirección de la estación. Programar un número diferente para cada estación de 1 a 255

"baud" : Velocidad de transmisión (baud-rate), programable de 1200 a 38400 baud. Todas las estaciones deben la misma velocidad de transmisión.

"PACS" : Acceso a la programación. Si programo como "LoCL" significa que el instrumento sólo se programa por teclado, si programo como "LorE" significa que se programa mediante teclado o por vía serial.

Cuando se intenta entrar en programación de teclado mientras está en curso una comunicación por vía serial, el instrumento visualiza **"buSy"** indicando el estado de ocupado.

4.20 – CONFIGURACIÓN DE PARÁMETROS CON "COPY-KEY"

El instrumento está dotado de un conector que permite la transferencia de los parámetros de funcionamiento a otro instrumento mediante el dispositivo **OSAKA COPY KEY** con conexión a **5 polos.**

Este dispositivo se utiliza para la programación en serie de instrumentos que deben tener la misma configuración de parámetros o bien para conservar una copia de la programación del instrumento y poderla transferir rápidamente.

Para utilizar el dispositivo COPY KEY se puede hacer alimentando sólo dicho dispositivo o el instrumento:

Instrumento alimentado y dispositivo no alimentado

Instrumento alimentado por el dispositivo
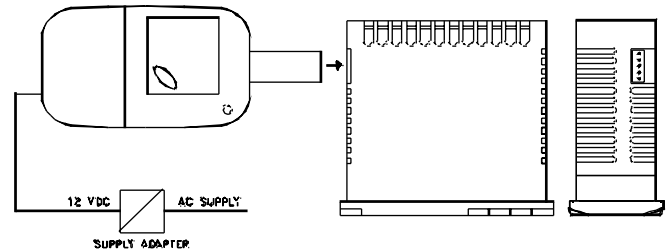
N.B.: Para los instrumentos dotados de portal de comunicación serial RS485 es indispensable que el parámetro "PACS" se programe como = LorE.

Para transferir la configuración de un instrumento al dispositivo **(UPLOAD)** proceder del siguiente modo:

1) posicionar los dos interruptores del dispositivo COPY KEY en la posición **OFF**.

2) conectar el dispositivo al instrumento OK, insertándolo adecuadamente.

3) asegurarse de que el instrumento o el dispositivo están alimentados.

4) observar el led de señalización del COPY KEY: si está verde significa que ya se puede cargar la información en el dispositivo, pero si está verde o rojo en intermitencia, significa que no se puede volcar sobre el dispositivo ninguna información válida.

5) pulsar el botón del dispositivo.

6) observar el led de señalización: después de haber pulsado el interruptor, el led se pone rojo y al finalizar el traslado de datos se vuelve a poner verde.

7) llegado a este punto se puede sacar el dispositivo.

Para volcar la configuración que contiene el dispositivo a un instrumento de las mismas características **(DOWNLOAD)**, proceder del siguiente modo:

1) posicionar los dos interruptores del dispositivo COPY KEY en la posición **ON**.

2) conectar el dispositivo en un instrumento OK que tenga las mismas características de aquel al cual se le ha sacado la configuración que se desea transferir.

3) asegurarse de que el instrumento o el dispositivo están alimentados.

4) observar el led de señalización del COPY KEY: el led debe estar verde, ya que si está en intermitencia (estando verde o rojo) significa que en el dispositivo no hay ninguna información válida y por lo tanto es inútil continuar.

5) por tanto, si el led está verde, pulsar el botón del dispositivo.

6) observar el led de señalización: después de haber pulsado al botón, el led se vuelve rojo hasta acabar de transferir los datos, que vuelve a ponerse verde.

7) una vez acabado este proceso, ya se puede desconectar el dispositivo.

Para más información y para conocer más acerca de las causas de error, ver el manual del dispositivo COPY KEY.

5 – PARÁMETROS PROGRAMABLES

A continuación se describen todos los parámetros que el instrumento puede adoptar, algunos de ellos podrán no estar presentes o porque dependen del tipo de instrumento utilizado o porque se inhabilitan automáticamente en cuanto son parámetros no necesarios.

5.1 – TABLA DE PARÁMETROS

Grupo "SP" (parámetros relativos al Set Point)

	Par.	Descripción	Rango	Def.
1	nSP	Numero Set point programable	1 ÷ 4	1
2	SPAt	Set point Activo	1 ÷ nSP	1
3	SP1	Set Point 1	SPLL ÷ SPHL	0
4	SP2	Set Point 2	SPLL ÷ SPHL	0
5	SP3	Set Point 3	SPLL ÷ SPHL	0
6	SP4	Set Point 4	SPLL ÷ SPHL	0
7	SPLL	Set Point mínimo	-1999 ÷ SPHL	-1999
8	SPHL	Set Point máximo	SPLL ÷ 9999	9999

Grupo "InP" (parámetros relativos a la entrada)

	Par.	Descripción	Rango	Def.
9	HCFG	Tipo de señal en entrada	tc / rtd / I / UoLt / SEr	tc
10	SEnS	Tipo sonda en entrada	tc : J/ CrAL/ S/ b/ E/ L/ n/ r/ t/ C/ Ir.J / Ir.CA rtd : Pt1 / Ptc / ntc I : 0.20 / 4.20 UoLt : 0.50 / 0.60 / 12.60 / 0.5 / 1.5 / 0.10 / 2.10	J
11	rEFL	Coeficiente reflexión para sensores IRS	0.10 ÷ 1.00	1.00
12	SSC	Limite inferior escala señal de entrada V / I	-1999 ÷ FSC	0
13	FSC	Limite superior escala señal de entrada V / I	SSC ÷ 9999	0
14	dP	Número de cifras decimales	tc/rtd : 0 / 1 UoLt / I / SEr: 0 ÷ 3	0
15	Unit	Unidad de medida de la temperatura	tc/rtd : °C / °F	°C
16	FiL	Filtro digital de entrada	0FF÷ 20.0 seg.	0.1
17	OFSt	"Offset" de la medida	-1999 ÷ 9999	0
18	rot	Rotación de la recta de medida	0.000 ÷ 2.000	1.000

19	InE	Condiciones para func. "OPE" en caso de errores de medida	Our / Or / Ur	OUr
20	OPE	Potencia en salida en caso de errores de medida	-100 ÷ 100 %	0
21	dIF	Función de entrada digital	noF / AaC / ASi / HoLd / OFF / CHSP / SP1.2	noF

Grupo "O1" (parámetros relativos a la salida 1)

	Par.	Descripción	Rango	Def.
22	O1F	Función de la salida 1 si de tipo digital.	1.rEG / 2.rEG ALno / ALnc OFF	1.rEG
23	Aor1	Inicio escala salida 1 si de tipo analogico	0 / no_0	0
24	Ao1F	Función de la salida 1 si de tipo analógico	1.rEG / 2.rEG r.inP / r.Err r.SP / r.SEr OFF	1.rEG
25	Ao1L	Referencia mínima salida analógica 1 para retransmisión de señal	-1999 ÷ Ao1H	0
26	Ao1H	Referencia máxima salida analógica 1 para retransmisión de señal	Ao1L ÷ 9999	0

Grupo "O2" (parámetros relativos a la salida 2)

	Par.	Descripción	Rango	Def.
27	O2F	Función de la salida 2 si de tipo digital	1.rEG / 2.rEG ALno / ALnc OFF	OFF
28	Aor2	Inicio escala salida 2 si de tipo analogico	0 / no_0	0
29	Ao2F	Función de la salida 2 si de tipo analógico	1.rEG / 2.rEG r.inP / r.Err r.SP / r.SEr OFF	OFF
30	Ao2L	Referencia mínima salida analógica 2 para retransmisión de señal	-1999 ÷ Ao2H	0
31	Ao2H	Referencia máxima salida analógica 2 para retransmisión de señal	Ao2L ÷ 9999	0

Grupo "O3" (parámetros relativos a la salida 3)

	Par.	Descripción	Rango	Def.
32	O3F	Función de la salida 3	1.rEG / 2.rEG ALno / ALnc OFF	OFF

Grupo "O4" (parámetros relativos a la salida 4)

	Par.	Descripción	Rango	Def.
33	O4F	Función de la salida 4	1.rEG / 2.rEG ALno / ALnc OFF	OFF

Grupo "AL1" (parámetros relativos a la alarma AL1)

	Par.	Descripción	Rango	Def.
34	OAL1	Salida destinada a la alarma AL1	Out1 / Out2 Out3 / Out4 OFF	Out2

35	AL1t	Tipo alarma AL1	LoAb / HiAb LHAb / LodE HidE / LHdE	LoAb
36	Ab1	Configuración funcionamiento alarma AL1	0 ÷ 15	0
37	AL1	Consigna alarma AL1	-1999 ÷ 9999	0
38	AL1L	Consigna inferior alarma AL1 con ventana	-1999 ÷ 9999	0
39	AL1H	Consigna superior alarma AL1 con ventana	-1999 ÷ 9999	0
40	HAL1	histéresis alarma AL1	OFF ÷ 9999	1
41	AL1d	Retardo activación alarma AL1	OFF ÷ 9999 sec.	OFF
42	AL1i	Activación alarma AL1 en caso de error de medida	no / yES	no

Grupo "AL2" (parámetros relativos a la alarma AL2)

Par.		Descripción	Rango	Def.
43	OAL2	Salida destinada a la alarma AL2	Out1 / Out2 Out3 / Out4 OFF	OFF
44	AL2t	Tipo alarma AL2	LoAb / HiAb LHAb / LodE HidE / LHdE	LoAb
45	Ab2	Configuración funcionamiento alarma AL2	0 ÷ 15	0
46	AL2	Consigna alarma AL2	-1999 ÷ 9999	0
47	AL2L	Consigna inferior alarma AL2 con ventana	-1999 ÷ 9999	0
48	AL2H	Consigna superior alarma AL2 con ventana	-1999 ÷ 9999	0
49	HAL2	histéresis alarma AL2	OFF ÷ 9999	1
50	AL2d	Retardo activación alarma AL2	OFF ÷ 9999 sec.	OFF
51	AL2i	Activación alarma AL2 en caso de error de medida	no / yES	no

Grupo "AL3" (parámetros relativos a la alarma AL3)

Par.		Descripción	Rango	Def.
52	OAL3	Salida destinada a la alarma AL3	Out1 / Out2 Out3 / Out4 OFF	OFF
53	AL3t	Tipo alarma AL3	LoAb / HiAb LHAb / LodE HidE / LHdE	LoAb
54	Ab3	Configuración funcionamiento alarma AL3	0 ÷ 15	0
55	AL3	Consigna alarma AL3	-1999 ÷ 9999	0
56	AL3L	Consigna inferior alarma AL3 con ventana	-1999 ÷ 9999	0
57	AL3H	Consigna superior alarma AL3 con ventana	-1999 ÷ 9999	0
58	HAL3	histéresis alarma AL3	OFF ÷ 9999	1
59	AL3d	Retardo activación alarma AL3	OFF ÷ 9999 sec.	OFF
60	AL3i	Activación alarma AL3 en caso de error de medida	no / yES	no

Grupo "LbA" (parámetros relativos al Loop Break Alarm)

Par.		Descripción	Rango	Def.
61	OLbA	Salida destinada a la alarma LbA	Out1 / Out2 Out3 / Out4 OFF	OFF
62	LbAt	Tiempo para alarma LbA	OFF ÷ 9999 sec.	OFF

Grupo "Hb" (parámetros relativos al Heater Break Alarm)

Par.		Descripción	Rango	Def.
63	OHb	Salida destinada a la alarma HB	Out1 / Out2 Out3 / Out4 OFF	OFF
64	IFS	Límite superior escala entrada TA HB	0.0 ÷ 100.0	100.0
65	HbF	Función alarma HB	1 / 2 / 3 / 4	1
66	IHbL	Consigna inferior alarma HB (con Out 1.rEG ON)	0.0 ÷ IFS	0.0
67	IHbH	Consigna superior alarma HB (con Out 1.rEG OFF)	IHbL ÷ IFS	100.0

Grupo "rEG" (parámetros relativos a la regulación)

Par.		Descripción	Rango	Def.
68	Cont	Tipo de regulación	Pid / On.FA On.FS / nr 3 Pt	Pid
69	Func	Modo de funcionamiento salida 1rEg	HEAt / CooL	HEAt
70	HSEt	histéresis regulación ON/OFF	-1999 ÷ 9999	1
71	Auto	Habilitación del autotuning Fast	OFF / 1 / 2 / 3 / 4	1
72	SELF	Habilitación selftuning	no / yES	no
73	Pb	Banda proporcional	0 ÷ 9999	50
74	Int	Tiempo integral	OFF ÷ 9999 sec.	200
75	dEr	Tiempo derivativo	OFF÷ 9999 sec.	50
76	FuOc	Control "Fuzzy overshoot"	0.00 ÷ 2.00	0,5
77	tcr1	Tiempo de ciclo salida 1rEg	0.1 ÷ 130.0 sec.	20,0
78	Prat	Reparto potencia 2rEg / 1rEg	0.0 ÷ 999.9	1.0
79	tcr2	Tiempo de ciclo salida 2rEg	0.1 ÷ 130.0 sec.	10.0
80	rS	Reset manual	-100.0÷100.0 %	0.0
81	tcor	Tiempo de carrera accionamiento motorizado	4 ÷ 1000 sec.	4

82	SHrl	Valor mínimo de regulación accionamiento motorizado	0.0 ÷ 10.0 %	0.0
83	PoSI	Posicionamiento al encendido accionamiento motorizado	no / cLoS / oPEn	no
84	SLor	Velocidad de la rampa de subida	0.00 ÷ 99.99 / InF unit/min.	InF
85	dur.t	Tiempo de duración	0.00 ÷ 99.59 / InF hrs.-min.	InF
86	SLoF	Velocidad de la rampa de bajada	0.00 ÷ 99.99 / InF unit / min.	InF
87	ro1.L	Potencia mínima en salida por 1rEG	0 ÷ ro1.H %	0
88	ro1.H	Potencia máxima en salida por 1rEG	ro1.L ÷ 100 %	100
89	ro2.L	Potencia mínima en salida por 2rEG	0 ÷ ro2.H %	0
90	ro2.H	Potencia máxima en salida por 2rEG	ro2.L ÷ 100 %	100
91	OPS1	Velocidad de variación de la potencia en salida por 1rEG	1 ÷ 50 / InF % / sec.	InF
92	OPS2	Velocidad de variación de la potencia en salida por 2rEG	1 ÷ 50 / InF % / sec.	InF
93	thr1	Consigna de potencia salida "Split Range" 1rEG	-100 ÷ 100 %	0
94	thr2	Consigna de potencia salida "Split Range" 2rEG	-100 ÷ 100 %	0
95	St.P	Potencia "Soft Start"	OFF / -100 ÷ 100 %	OFF
96	SSt	Tiempo "Soft Start"	OFF / 0.1÷7.59 / InF hrs.-min.	OFF

Grupo "PAn" (parámetros relativos a la interfaz operadora)

Par.		Descripción	Rango	Def.
97	USrb	Función de la tecla "F"	noF / tunE / OPLO / Aac / ASi / CHSP / OFF	noF
98	diSP	Variable visualizada sobre el display SV	OFF / Pou / SP.F / SP.o / AL1 / AL2 / AL3	SP.F
99	Edit	Modifica Set Point activo y alarmas con proceso rápido	SE / AE / SAE / SAnE	SAE

Grupo "SEr" (parámetros relativos a la comunicación serial)

Par.		Descripción	Rango	Def.
100	Add	Dirección de la estación por comunicación serial	0 … 255	1
101	baud	Baud rate vía serial	1200 / 2400 / 9600 / 19.2 / 38.4	9600
102	PACS	Acceso a la programación por vía serial	LoCL / LorE	LorE

5.2 – DESCRIPCIÓN DE LOS PARÁMETROS

GRUPO "]SP" (PARÁMETROS RELATIVOS AL SET POINT):
Permiten la regulación de los Set de regulación y las modalidades de funcionamiento de los Set.
nSP - NÚMERO DE SET POINT PROGRAMABLES: Permite establecer el número de los Set Point que se quieren programar y memorizar (de 1 a 4).
SPAt - SET POINT ACTIVO: En caso de que sean memorizados más de 1 Set Point, permite seleccionar el Set Point a activar.
SP1 - SET POINT 1: Valor de Set Point de regulación n. 1
SP2 - SET POINT 2: Valor de Set Point de regulación n. 2 (sólo se activará si "nSP" >2)
SP3 - SET POINT 3: Valor de Set Point de regulación n. 3 (sólo se activará si "nSP" >3)
SP4 - SET POINT 4: Valor de Set Point de regulación n. 4 (sólo se activará si "nSP" = 4)
SPLL - SET POINT MÍNIMO: Valor mínimo programable como Set Point.
SPHL - SET POINT MÁXIMO: Valor máximo programable como Set Point.

GRUPO "]InP" (PARÁMETROS RELATIVOS A LA ENTRADA DE MEDIDA): Permite establecer las características de la medida efectuadas por el instrumento.
HCFG - TIPO DE ENTRADA: Permite seleccionar el tipo de señal de entrada: para termopares (tc), para termoresistencias o termistores (rtd), para señales normalizadas de corriente (I), para señales normalizadas de tensión (UoLt) o para una medida procedente de la línea serial (SEr).
SEnS - SONDA EN ENTRADA: En función de lo programado en el par. "HCFG" permite seleccionar el tipo de sonda de entrada:
- para termopares ("HCFC"=tc): J (J), K (CrAL), S (S), B (b), C (C), E (E), L (L), N (n), R (r), T (t), o para sensores de infrarojos OSAKA serie IRS rango A con linearización J (Ir.J) o K (Ir.CA)
- para termoresistencias/termistores ("HCFC"=rtd): Pt100 IEC (Pt1) o termistores PTC KTY81-121 (Ptc) o NTC 103AT-2 (ntc)
- Para señales normalizadas de corriente ("HCFC"=I): 0..20 mA (0.20) o 4..20 mA (4.20)
- Para señales normalizadas de tensión ("HCFC"=UoLt): 0..50 mV (0.50), 0..60 mV (0.60), 12..60 mV (12.60), 0..5 V (0.5), 1..5 V (1.5), 0..10 V (0.10) o 2..10 V (2.10).
rEFL – COEFICIENTE DE REFLEXIÓN PARA SENSORES IRS: E' utilizable sólo cuando "SEnS" = Ir.J o Ir.CA y permite la corrección de errores de medida causada por la iluminación del entorno y la reflexividad del material. Programar dicho parámetro a un valor alto cuando el material a medir resulte particularmente claro/reflectante y reducirlo cuando la superfície resulte particularmente oscura/no reflectante, teniendo presente que para la mayor parte de los materiales el valor aconsejado está comprendido entre 1.00 ... 0.80.
SSC – LÍMITE INFERIOR DE ESCALA ENTRADA ANALÓGICA PARA SEÑALES NORMALIZADAS : Valor que el instrumento debe visualizar cuando en entrada está presente el valor mínimo medible de la escala (0/4 mA, 0/12 mV, 0/1 V o 0/2 V).
FSC – LÍMITE SUPERIOR DE ESCALA ENTRADA ANALÓGICA PARA SEÑALES NORMALIZADAS: Valor que el

instrumento tiene que visualizar cuando en entrada está presente el valor máximo medible de la escala (20 mA, 50 mV, 60 mV, 5 V o 10 V).

dP – NÚMERO DE CIFRAS DECIMALES: Permite establecer la resolución de la medida como 1 (0), 0.1 (1), 0.01 (2), 0.001 (3). Para sondas de temperatura las resoluciones permitidas son 1° (0) y 0.1° (1).

Unit – UNIDAD DE MEDIDA DE LA TEMPERATURA: Cuando se usan sondas para la medida de la temperatura establecer la visualización en grados Centígrados (°C) o Fahrenheit (°F).

Filt - CONSTANTE DEL FILTRO DIGITAL DE LA ENTRADA: Permite programar la constante de tiempo del filtro software relativo a la medida del valor en la entrada (en seg.) de modo que se pueden disminuir la sensibilidad a la interferencias en la medida (aumentando el tiempo).

OFSt - "OFFSET" DE LA MEDIDA: "Offset" positivo o negativo que se suma al valor leído por la sonda.

rot – ROTACIÓN DE LA RECTA DE MEDIDA: Hace que la compensación programada en el par. "OFSt" no sea constante para todas las medidas. Programando "rot"=1.000, el valor "OFSt" viene sumado al valor leído por la sonda antes de la visualización y resulta constante para todas las medidas. Si en cambio se desea que el "offset" programado no sea constante para todas las medidas se puede calibrar sobre dos puntos concretos.

En este caso, para establecer los valores a programar en los parámetros "OFSt" y "rot", hará falta aplicar las siguientes fórmulas:

$$\text{“rot” = (D2-D1) / (M2-M1)}$$
$$\text{“OFSt” = D2 - (“rot” x M2)}$$

donde: M1 =valor med. 1; D1 = valor de visualización con medida M1 M2 =valor med. 2; D2 = valor de visualización con medida M2

El instrumento visualizará: **DV = MV x "rot" + "OFSt"**

donde: DV = Valor visualizado; MV= Valor medido.

InE – CONDICIONES QUE HABILITAN LA POTENCIA "OPE" EN CASO DE ERRORES DE MEDIDA: Establece cuales son las condiciones de error de la entrada que proporcionan en salida la potencia programada en el par. "OPE". Las posibilidades son:

=Or : la condición está determinada por el sobrerango o por la rotura de la sonda.

= Ur : la condición está determinada por el bajorango o por la rotura de la sonda.

= Our : la condición está determinada por el sobrerango o por el bajorango o por la rotura de la sonda.

OPE – POTENCIA EN SALIDA EN CASO DE ERROR DE MEDIDA: Permite programar la potencia que el instrumento debe dar en salida en caso de error de medida. Para los reguladores ON/OFF la potencia se calcula considerando un tiempo de ciclo de 20 seg.

dIF – FUNCIÓN ENTRADA DIGITAL: Permite definir el funcionamiento de la entrada digital como:

= noF : La entrada no ejecuta ninguna función.

= AaC : Cerrando la entrada se puede resetear una alarma memorizada.

= ASi : Cerrando la entrada se para una alarma activa.

= HoLd : Cerrando la entrada digital se bloquea la adquisición de la medida en ese instante (N.B.: no la lectura sobre el display, por ello la indicación podría estabilizarse con un retardo proporcional al filtro de medida). Con la función de "hold" insertada el instrumento regula en función de la medida memorizada.

= OFF : Cuando el instrumento está en estado "rEG" cerrando la entrada digital el instrumento se pone en estado OFF.

= CHSP : Cerrando y abriendo la entrada digital se puede seleccionar a rotación uno de los 4 Set Point memorizados.

= SP1.2 : El cierre de la entrada digital selecciona como activo el set point SP2 mientras que la abertura del contacto hace activo el set point SP1. La función sólo es factible con "nSP" = 2 .

GRUPO " ᴵ O1" (PARÁMETROS RELATIVOS A LA SALIDA OUT1): Permite configurar el funcionamiento de la salida OUT1.

O1F – FUNCIÓN DE LA SALIDA OUT 1 DE TIPO DIGITAL: Establece el funcionamiento de la salida OUT 1 como: salida de regulación 1 (1.rEG), salida de regulación 2 (2.rEG), salida de alarma normalmente abierta (ALno), salida de alarma normalmente cerrada (ALnc), salida no utilizada (OFF).

Aor1 – INICIO DE ESCALA SALIDA OUT 1 DE TIPO ANALÓGICO: Permite determinar el inicio de escala de la salida analógica OUT1. Se programará con este parámetro: "0" si se quiere utilizar el inicio de escala igual a 0 (0 mA, o 0 V) o "no_0" si se quiere utilizar el inicio de escala diferente de 0 (4 mA, o 2 V).

Ao1F – FUNCIÓN DE LA SALIDA OUT1 DE TIPO ANALÓGICO: Establece el funcionamiento de la salida OUT 1 como: salida de regulación 1 (1.rEG), salida de regulación 2 (2.rEG), salida de retransmisión de la medida (r.inP), salida de retransmisión del error [SP-PV] (r.Err), salida de retransmisión del Set Point Activo (r.SP), salida pilotada a través de la línea serial de comunicación del instrumento (rSEr), salida no utilizada (OFF).

Ao1L – REFERENCIA MÍNIMA SALIDA OUT 1 ANALÓGICA PARA RETRANSMISIÓN DE LA SEÑAL: En el caso de que el funcionamiento de la salida analógica venga configurado para la retransmisión de la señal, programar con este parámetro el valor mínimo que el instrumento debe dar en salida (0/4 mA o 0/2 V)

Ao1H – REFERENCIA MÁXIMA SALIDA OUT 1 ANALÓGICA PARA RETRANSMISIÓN DE LA SEÑAL: En caso de que el funcionamiento de la salida analógica venga configurado para la retransmisión de la señal, programar con este parámetro el valor máximo que el instrumento debe dar en salida (20 mA o 10 V).

GRUPO " ᴵ O2" (PARÁMETROS RELATIVOS A LA SALIDA OUT2): Permite configurar el funcionamiento de la salida OUT2.

O2F – FUNCIÓN DE LA SALIDA OUT 2 DE TIPO DIGITAL: Análogo a "O1F" pero referido a la salida OUT2.

Aor2 – INICIO ESCALA SALIDA OUT 2 DE TIPO ANALÓGICO: Análogo a "Aor1" pero referido a la salida OUT2.

Ao2F – FUNCIÓN DE LA SALIDA OUT2 DE TIPO ANALÓGICO: Análogo a "Ao1F" pero referido a la salida OUT2.

Ao2L – REFERENCIA MÍNIMA SALIDA OUT 2 ANALÓGICA PARA RETRANSMISIÓN DE LA SEÑAL: Análogo a "Ao1L" pero referido a la salida OUT2.

Ao2H – REFERENCIA MÁXIMA SALIDA OUT 2 ANALÓGICA PARA RETRANSMISIÓN DE LA SEÑAL: Análogo a "Ao1H" pero referido a la salida OUT2.

GRUPO " ᴵ O3" (PARÁMETROS RELATIVOS A LA SALIDA OUT3): permite configurar el funcionamiento de la salida OUT3.

O3F – FUNCIÓN DE LA SALIDA OUT 3: análogo a "O1F" pero referido a la salida OUT3.

GRUPO " ᴵ O4" (PARÁMETROS RELATIVOS A LA SALIDA OUT4): Permite configurar el funcionamiento de la salida OUT4.

O3F – FUNCIÓN DE LA SALIDA OUT 4: Análogo a "O1F" pero referido a la salida OUT4.

GRUPO "]AL1" (PARÁMETROS RELATIVOS A LA ALARMA AL1): Permite configurar el funcionamiento de la alarma de proceso AL1.

OAL1 – SALIDA DESTINADA A LA ALARMA AL1: Establece sobre qué salida debe operar la alarma AL1.

AL1t - TIPO ALARMA AL1: Permite establecer el tipo de alarma AL1 a través de 6 posibles selecciones:

= **LoAb** – ALARMA ABSOLUTA DE MÍNIMA: La alarma se activa cuando el valor de proceso está por debajo de la consigna de alarma programado en el parámetro "AL1"

= **HiAb** – ALARMA ABSOLUTA DE MÁXIMA: La alarma se activa cuando el valor de proceso supera la consigna de alarma programado con el parámetro "AL1"

= **LHAb** – ALARMA ABSOLUTA CON VENTANA: La alarma se activa cuando el valor de proceso está por debajo de la consigna de alarma programado en el parámetro "AL1L" o bien supera la consigna de alarma programado en el parámetro "AL1H"

= **LodE** – ALARMA RELATIVA DE MÍNIMA: La alarma se activa cuando el valor de proceso está por debajo del valor [SP - AL1]

= **HidE** – ALARMA RELATIVA DE MÁXIMA: La alarma se activa cuando el valor de proceso supera el valor [SP + AL1]

= **LHdE** – ALARMA RELATIVA CON VENTANA: La alarma se activa cuando el valor de proceso está por debajo del valor [SP - AL1L] o bien cuando el valor de proceso supera el valor [SP + AL1H]

Ab1 – CONFIGURACIÓN FUNCIONAMIENTO ALARMA AL1 : Permite establecer el funcionamiento de la alarma AL1 mediante la programación de un número comprendido entre 0 y 15.

El número a programar, que corresponderá al funcionamiento deseado, se consigue sumando los valores indicados en las siguientes descripciones:

COMPORTAMIENTO ALARMA AL ENCENDERSE:

+0 – COMPORTAMIENTO NORMAL: La alarma se activa siempre que existen las condiciones de alarma.

+1 – ALARMA NO ACTIVA AL ARRANCAR: Si al arrancar el instrumento se encuentra en las condiciones de alarma, éste no se activa. La alarma sólo se activará cuando el valor de proceso, después de encendido, no va de las condiciones de no alarma a las condiciones de alarma sucesivamente.

RETARDO ALARMA:

+0 = ALARMA NO RETARDADA: La alarma se activa inmediatamente al verificar las condiciones de alarma.

+2 = ALARMA RETARDADA: Con la verificación de las condiciones de alarma salta el retardo programado en el par. "AL1d" (expresado en seg.) y sólo el transcurso de dicho tiempo activará la alarma.

MEMORIA ALARMA:

+ 0 = ALARMA NO MEMORIZADA: La alarma sólo se queda activa en las condiciones de alarma.

+ 4 = ALARMA MEMORIZADA: La alarma se activa cuando están las condiciones de alarma hasta que no se pulsa la tecla "F" convenientemente programada ("USrb"=Aac)

PARADA DE ALARMA:

+ 0 = ALARMA NO PARADA: La alarma siempre permanece activa en las condiciones de alarma.

+ 8 = ALARMA PARADA: La alarma se activa cuando están las condiciones de alarma y se puede desactivar mediante la tecla "F", convenientemente programada ("USrb"=ASi), aunque las condiciones de alarma permanecen.

AL1 – CONSIGNA DE ALARMA AL1 : consigna de intervención de la alarma AL1 para alarmas de mínima o de máxima.

AL1L – CONSIGNA INFERIOR ALARMA AL1: consigna de intervención de la alarma AL1 como alarma de mínima cuando la alarma es de tipo con ventana.

AL1H – CONSIGNA SUPERIOR ALARMA AL1 : consigna de intervención de la alarma AL1 como alarma de máxima cuando la alarma es de tipo con ventana.

HAL1 - HISTÉRESI ALARMA AL1: Semibanda asimétrica relativa a la consigna de la alarma AL1 que establece el valor de desactivación de la alarma AL1.

AL1d – RETARDO ACTIVACIÓN ALARMA AL1: Permite establecer el retraso de la activación de la alarma AL1 cuando se activa la función de retraso de alarma en el par. "Ab1".

AL1i – COMPORTAMIENTO ALARMA AL1 EN CASO DE ERROR DE MEDIDA: Permite establecer si en condiciones de error de medida, la alarma AL1 se activada ("yES") o no activada ("no").

GRUPO "]AL2" (PARÁMETROS RELATIVOS A LA ALARMA AL2): Permite configurar el funcionamiento de la alarma de proceso AL2.

OAL2 – SALIDA DESTINADA A LA ALARMA AL2: Establece sobre qué salida debe operar la alarma AL2.

AL2t - TIPO ALARMA AL2: Análogo a "AL1t" pero referido a al alarma AL2.

Ab2 – CONFIGURACIÓN FUNCIONAMIENTO ALARMA AL2 : Análogo a "Ab1" pero referido a la alarma AL2.

AL2 – CONSIGNA ALARMA AL1 : Análogo a "AL1" pero referido a la alarma AL2.

AL2L – CONSIGNA INFERIOR ALARMA A2 : Análogo a "AL1L" pero referido a la alarma AL2.

AL2H – CONSIGNA SUPERIOR ALARMA AL2 : Análogo a "AL1H" pero referido a la alarma AL2.

HAL2 - HISTÉRESIS ALARMA AL2: Análogo a "HAL1" pero referido a la alarma AL2.

AL2d – RETRASO ACTIVACIÓN ALARMA AL2: Análogo a "AL1d" pero referido a la alarma AL2.

AL2i – COMPORTAMIENTO ALARMA AL2 EN CASO DE ERROR DE MEDIDA: Análogo a "AL1i" pero referido a la alarma AL2.

GRUPO "]AL3" (PARÁMETROS RELATIVOS A LA ALARMA AL3): Permite configurar el funcionamiento de la alarma de proceso AL3.

OAL3 – SALIDA DESTINADA A LA ALARMA AL3: Establece sobre qué salida debe operar la alarma AL3.

AL3t - TIPO ALARMA AL3: Análogo a "AL1t" pero referido a la alarma AL3.

Ab3 – CONFIGURACIÓN FUNCIONAMIENTO ALARMA AL3 : Análogo a "Ab1" pero referido a la alarma AL3.

AL3 – CONSIGNA ALARMA AL3 : Análogo a "AL1" pero referido a la alarma AL3.

AL3L – CONSIGNA INFERIOR ALARMA A3 : Análogo a "AL1L" pero referido a la alarma AL3.

AL3H – CONSIGNA SUPERIOR ALARMA AL3 : Análogo a "AL1H" pero referido a la alarma AL3.

HAL3 - HISTÉRESIS ALARMA AL3: Análogo a "HAL1" pero referido a la alarma AL3.

AL3d – RETRASO ACTIVACIÓN ALARMA AL3: Análogo a "AL1d" pero referido a la alarma AL3.

AL3i – COMPORTAMIENTO ALARMA AL3 EN CASO DE ERROR DE MEDIDA: Análogo a "AL1i" pero referido a la alarma AL3.

GRUPO "LbA" (PARÁMETROS RELATIVOS A LA ALARMA "LOOP BREAK"): Contiene los parámetros relativos al funcionamiento de la alarma "Loop Break" (interrupción del ciclo de regulación), que interviene cuando, por un motivo cualquiera (cortocircuito de un termopar, interrupción de la carga, etc.) se interrumpe el ciclo de regulación.

OLbA – SALIDA DESTINADA A LA ALARMA DE "LOOP BREAK": Establece sobre qué salida debe operar la alarma de "Loop Break".

LbAt – TIEMPO PARA ALARMA DE "LOOP BREAK": Tiempo de retraso de intervención de la alarma "Loop Break". La alarma interviene cuando la potencia en salida se mantiene en el 100 % del valor durante el tiempo programado (en seg).

GRUPO " [1]Hb" (PARÁMETROS RELATIVOS A LA ALARMA "HEATER BREAK"): contiene los parámetros relativos al funcionamiento de la alarma de "Heater Break" (rotura del elemento calefactor).
La función sólo es factible cuando el instrumento está dotado de entrada (TAHB) para la medida de la corriente absorvida por la carga. Dicha entrada acepta señales procedentes de transformadores amperométricos (TA) con salida máxima de 50 mA.

OHb – SALIDA DESTINADA A LA ALARMA DE "HEATER BREAK": Establece sobre qué salida debe operar la alarma de "Heater Break".

IFS – LÍMITE SUPERIOR ESCALA ENTRADA TA HB: Valor que el instrumento debe medir cuando en la entrada TA HB está presente el valor de 50 mA.

HbF – FUNCIÓN ALARMA HB: Establece el funcionamiento de la alarma de "Heater Break" como:

= 1 : Alarma activada cuando, en condiciones de salida 1rEG abierta, la corriente medida por la entrada TAHB es inferior al valor programado en el parámetro "IHbL" .

= 2 : Alarma activada cuando, en condiciones de salida 1rEG cerrada, la corriente de medida por la entrada TAHB es superior al valor programado en el parámetro "IHbH" .

= 3 : Alarma activada cuando, en condiciones de salida 1rEG abierta, la corriente medida por al entrada TAHB es inferior al valor programado en el parámetro "IHbL" o bien cuando, en condiciones de salida 1rEG cerrada, la corriente medida es superior al valor programado en el parámetro "IHbH" (OR de los dos casos anteriores).

= 4 : Alarma activada cuando la corriente medida por la entrada TAHB es inferior al valor programado en el parámetro "IHbL" o bien cuando la corriente medida es superior al valor programado en el parámetro "IHbH" independientemente del estado de la salida 1rEG

IHbL – CONSIGNA INFERIOR ALARMA "HEATER BREAK": consigna inferior de intervención de la alarma de "Heater Break". Programar el valor de la corriente normalmente absorvida por la carga mandada por la salida 1rEG cuando ésta está activa.

IHbL – CONSIGNA SUPERIOR ALARMA "HEATER BREAK": consigna superior de intervención de la alarma de "Heater Break". Programar el valor de la corriente normalmente absorvida por la carga controlada por la salida 1rEG cuando ésta no está activa.

GRUPO " [1]rEG" (PARÁMETROS RELATIVOS A LA REGULACIÓN): Contiene todos los parámetros relativos al funcionamiento de regulación.
Parámetros relativos a la regulación:

Cont – TIPO DE REGULACIÓN: Permite seleccionar uno de los posibles modos de regulación que el instrumento ofrece: PID de acción sencilla y doble (Pid), PID para accionamientos motorizados (3 Pt), ON/OFF con histéresis asimétrica (On.FA), ON/OFF con histéresis simétrica (On.FS), ON/OFF en Zona muerta (nr).

Func - MODO DE FUNCIONAMIENTO SALIDA 1rEG: Establece si en la salida de regulación 1rEG debe actuar una acción inversa, como por ejemplo un proceso de Calor ("HEAt") o bien una acción directa, como por ejemplo un proceso de Frío ("CooL").

HSEt - HISTÉRESIS REGULACIÓN ON/OFF: Semibanda relativa al Set Point que establece los valores de activación y desactivación de la salida/s de regulación para el funcionamiento con regulación ON/OFF (On.FA, On.FS, nr).

Auto - CONFIGURACIÓN AUTOTUNING : parámetro que permite establecer las modalidades de ejecución de la función de Autotuning. Las posibles selecciones son:

= 1 - el autotuning se activa automáticamente cada vez que se enciende el instrumento con la condición de que el valor de proceso sea menor (para "Func" =HEAt) o mayor (para "Func" =CooL) de SP/2

= 2 - el autotuning se activa automáticamente al arrancar con la condición de que el valor de proceso sea menor (para "Func" =HEAt) o mayor (para "Func" =CooL) de SP/2, y, una vez acabada la sintonización, se activa automáticamente el par. "Auto"=OFF.

= 3 - el autotuning se activa sólo manualmente, mediante la selección de la opción "tunE" en el menú principal o mediante la tecla "F" convenientemente programada ("USrb" = tunE). En este caso el autotuning parte sin verificar ninguna condición del valor de proceso. Se recomienda utilizar esta opción activando el autotuning cuando el valor de proceso está lo más alejado posible del valor de Set Point en cuanto, para ejecutar de la mejor manera el autotuning FAST, es preferible respetar esta condición.

= 4 – el autotuning se activa automáticamente al final del ciclo de Soft-Start programado a condición que en ese momento el valor de proceso sea menor (para "Func" =HEAt) o mayor (para "Func" =CooL) de SP/2.

= OFF - Autotuning inhabilitado.

Cuando está activo un ciclo de Autotuning, el led AT está en intermitencia.

SELF - CAPACITACIÓN SELFTUNING: Parámetro de habilitación (yES) o inhabilitación (no) de la función de Selftuning. Después de tener habilitada la función, el Selftuning se debe activar mediante la selección de la opción "tunE" en el menú principal o mediante la tecla "F" convenientemente programada ("USrb" = tunE).

Cuando la función de Selftuning está activa, el led AT se enciende de modo fijo, y todos los parámetros de regulación PID ("Pb", "Int", "dEr", etc.) no se visualizan más.

Pb - BANDA PROPORCIONAL: Amplitud de la banda en torno al Set Point en el que interviene la regulación proporcional.

Int - TIEMPO INTEGRAL: Tiempo integral a programar en el algoritmo de regulación PID expresado en seg.

dEr - TIEMPO DERIVATIVO: Tiempo derivativo a programar en el algoritmo de regulación PID expresado en seg.

FuOc - FUZZY OVERSHOOT CONTROL: Parámetro que permite eliminar los excesos de la variable ("overshoot") con el arranque del proceso o con el cambio de Set Point.

Se debe tener presente que un valor bajo del parámetro reduce el overshoot mientras que un valor alto lo aumenta.

tcr1 – TIEMPO DE CICLO DE SALIDA C1 : Tiempo de ciclo para la salida 1rEG en el modo de regulación PID expresado en seg.

Prat – RELACIÓN ENTRE POTENCIA 2rEG Y POTENCIA 1rEG: Parámetro al cual se programa la relación de potencia entre el elemento mandado por la salida 2rEG (ej: frío) y potencia del elemento controlado por la salida 1rEG (ej: calor) cuando el instrumento actúa con regulación PID con doble acción.

tcr2 – TIEMPO DE CICLO SALIDA 2rEG : Tiempo de ciclo para la salida 2rEG en el modo de regulación PID con doble acción expresado en seg.

rS - RESET MANUAL: Offset de potencia que se suma a la contribución de potencia del término proporcional al objetivo de

anular el error en régimen cuando no está presente la contribución integral. Este parámetro se visualiza sólo si "Int" =0.

Parámetros específicos de la regulación PID para accionamientos motorizados con controles de apertura y cierre. En caso de que el actuador no estuviese dotado de contactos que interrumpan el accionamiento, es necesario dotar la instalación de estos contactos.

tcor – TIEMPO DE CARRERA ACCIONAMIENTO MOTORIZADO: Va programado en este parámetro el tiempo, expresado en segundos, que necesita el accionamiento para pasar de la posición "totalmente abierto" a la posición "totalmente cerrado".

SHrI – VALOR MÍNIMO DE REGULACIÓN ACCIONAMIENTO MOTORIZADO: Es el primer valor que debe haber alcanzado la regulación (en %) que tenga efecto sobre la salida.

PoSi – POSICIONAMIENTO AL ENCENDER ACCIONAMIENTO MOTORIZADO : Permite establecer si al encender el instrumento el accionamiento tiene que quedar donde se encuentra ("no"), se tiene que llevar en la posición de máxima apertura ("oPEn") o en la posición de máximo cierre ("cLoS").

Parámetros relativos a las rampas, que permiten actuar de manera que el Set point se alcance en un tiempo predeterminado. Es posible actuar de modo que una vez alcanzado el primer Set (SP1) el instrumento conmute automáticamente sobre el segundo Set (SP2) después de un tiempo programable realizando así un simple ciclo térmico automático (funciones factibles para todo tipo de regulación).

SLor – VELOCIDAD DE LA RAMPA DE SUBIDA: Pendiente de la rampa en subida para actuar por la regulación cuando el valor de proceso es menor que el Set point activo, expresado en unidad/minuto.

Programando el parámetro = InF la rampa no está activa.

dur.t – TIEMPO DE DURACIÓN: Tiempo de mantenimiento del Set Point SP1 antes de conmutar automáticamente sobre SP2 (expresado horas y min.). Mediante este parámetro se puede actuar de manera que una vez alcanzado el primer Set (SP1) el instrumento conmuta automáticamente el segundo Set (SP2) después del tiempo programado, realizando así un simple ciclo térmico automático.

Programando el parámetro = InF la función no está activa.

SLoF – VELOCIDAD DE LA RAMPA DE BAJADA: Pendiente de la rampa en bajada cuando el valor de proceso es mayor que el Set point activo, expresada en unitdad/minuto.

Programando el parámetro = InF la rampa no está activa.

Parámetros relativos a las funciones de limitación de la potencia y la velocidad de variación de la potencia en salida, funciones factibles sólo con regulación PID con acción sencilla o doble.

ro1.L – POTENCIA MÍNIMA EN SALIDA 1rEG: Programar con este parámetro el valor que se desea tener en la salida 1rEG cuando el regulador interno establece que la potencia debe de ser del 0 %.

ro1.H – POTENCIA MÁXIMA EN SALIDA 1rEG: Programar con este parámetro el valor que se desea tener en la salida 1rEG cuando el regulador interno establece que la potencia debe ser del 100 %.

ro2.L – POTENCIA MÍNIMA EN SALIDA 2rEG: Programar con este parámetro el valor que se desea tener en la salida 2rEG cuando el regulador interno establece que la potencia debe ser del 0 %.

ro2.H – POTENCIA MÁXIMA EN SALIDA 2rEG: Programar con este parámetro el valor que se desea tener en la salida 2rEG cuando el regulador interno establece que la potencia debe ser del 100 %.

OPS1 – VELOCIDAD DE VARIACIÓN DE LA POTENCIA EN SALIDA 1rEG: Permite establecer la velocidad de variación de la potencia de regulación en la salida 1rEG (expresada en % / seg).

OPS2 – VELOCIDAD DE VARIACIÓN DE LA POTENCIA EN SALIDA 2rEG: Permite establecer la velocidad de variación de la potencia de regulación en la salida 2rEG (expresada en % / seg).

Parámetros relativos a la función de SPLIT RANGE factible sólo con regulación PID con doble acción y se puede utilizar para retrasar o adelantar la intervención de los dos actuadores controlados por el instrumento. Con esta función se puede optimizar la intervención de los dos actuadores haciendo que sus acciones no se solapen o bien de otro modo, que se solapen para obtener una mezcla de las dos acciones de los actuadores.

thr1 - CONSIGNA DE POTENCIA EN EL QUE LA SALIDA 1rEG COMIENZA A OPERAR: Programar con este parámetro el valor de potencia en el que la salida 1rEG comienza a operar, teniendo en cuenta que los valores positivos adelantan la acción mientras que los negativos la retrasan.

thr2 - CONSIGNA DE POTENCIA EN EL QUE LA SALIDA 2rEG COMIENZA A OPERAR: Programar con este parámetro el valor de potencia en el que la salida 2rEG comienza a operar, teniendo en cuenta que los valores positivos adelantan la acción mientras que los negativos la retrasan.

Parámetros relativos a la función de Soft-Start, que permite limitar la potencia de regulación al encender el instrumento por un tiempo determinado. La función sólo es factible con regulación PID.

St.P – POTENCIA SOFT START: si el parámetro "SSt" se programa con un valor diferente de "OFF" éste es la potencia dotada en salida al arrancar el instrumento durante el tiempo "SSt". En la práctica el instrumento opera en regulación manual para conmutar automáticamente a regulación automática al acabar el tiempo "SSt". En cambio si el parámetro "St.P" viene programado = OFF, al encenderse, la potencia calculada por el regulador PID se divide por el tiempo "SSt" con el fin de calcular una rampa. La potencia dotada en salida parte de 0 y se incrementa progresivamente según la rampa calculada hasta el final del tiempo "SSt" o hasta que la potencia no supera el valor calculado por el PID.

SSt – TIEMPO SOFT START: Tiempo de duración en horas y min. del Soft-Start descrito en el parámetro "St.P".

Para excluir la función de Soft Start es suficiente con programar el par. "Sst" = OFF.

GRUPO " [1]PAn" (PARÁMETROS RELATIVOS A LA INTERFAZ OPERADORA): contiene los parámetros relativos al funcionamiento de la tecla "F" y al funcionamiento del display.

Usrb – FUNCIÓN DE LA TECLA "F" : Permite establecer la función que debe desarrollar la tecla "F". Las posibles selecciones son:

= noF - La tecla no ejecuta ninguna función.

= tunE - Pulsando la tecla durante al menos 1 seg. se puede activar/desactivar el Autotuning o el Selftuning.

= OPLO – Pulsando la tecla durante al menos 1 seg. es posible pasar al modo de regulación automática (rEG) o manual (OPLO) y viceversa.

= Aac – Pulsando la tecla durante al menos 1 seg. se resetea una alarma memorizada.

= Asi – Pulsando la tecla durante al menos 1 seg. se para una alarma activa.

= CHSp – Pulsando la tecla durante al menos 1 seg. se selecciona a rotación uno de los 4 Set Point memorizados.

= OFF – Pulsando la tecla durante al menos 1 seg. se pasa del modo de regulación automática (rEG) al de regulación desactivada (OFF) y viceversa.

diSP – VARIABLE VISUALIZADA SOBRE EL DISPLAY: parámetro mediante el cual se puede establecer la visualización normal del display SV que puede ser el Set Point activo (= SP.F), el Set Point operativo cuando hay rampas activas (= SP.o), la potencia de regulación (= Pou), la consigna de alarma AL1, 2 o 3 (= AL1, AL2 o AL3) o puede ser apagado (OFF).

Edit – MODIFICACIÓN SET ACTIVO Y ALARMA DE PROCESO RÁPIDO: permite establecer cuáles son los Set programables con el proceso rápido de programación. El parámetro se puede programar como:

= SE: El Set point activo es configurable mientras que las consignas de alarma no son configurables.

= AE : El Set point activo no es configurable mientras que las consignas de alarma son configurables.

= SAE: Set point activo en que las consignas de alarma son configurables.

= SAnE: Set point activo en que las consignas de alarma no son configurables.

Grupo " ¹SEr" (PARÁMETROS RELATIVOS A LA COMUNICACIÓN SERIAL): Si el instrumento está dotado de interfaz serial RS 485 estos parámetros permiten la configuración del dispositivo para la comunicación.

Add – DIRECCIÓN DE LA ESTACIÓN PARA COMUNICACIÓN SERIAL: Sirve para definir la dirección del instrumento en la red de comunicación. Programar un número diferente para cada estación, de 1 a 255

baud - BAUD RATE VIA SERIAL: Programar la velocidad de transmisión de los datos (Baud-rate) de la red en la que está instalado el instrumento. Las posibles selecciones son 1200, 2400, 9600, 19.2 (19200), 38.4 (38400). Todas las estaciones deben tener la misma velocidad de transmisión.

PACS ACCESO A LA PROGRAMACIÓN TRANSMITIDA VIA SERIAL : Si programara como "LoCL" significa que el instrumento sólo es programable por teclado, si está programado como "LorE" significa que es programable por teclado y por vía serial.

6 – PROBLEMAS, MANTENIMIENTO Y GARANTÍA

6.1 – SEÑALES DE ERROR:

Error	Motivo	Acción
- - - -	Interrupción de la sonda	Verificar la correcta conexión de la sonda con el instrumento y verificar el correcto funcionamiento de la sonda
uuuu	Variable medida bajo los límites de la sonda (bajorango)	
oooo	Variable medida sobre los límites de la sonda (sobrerango)	
ErAt	Autotuning no ejecutable porque el valor de proceso es menor (o mayor) de SP/2.	Poner el instrumento en regulación OFF (OFF) y sucesivamente en regulación automática (rEG) para hacer desaparecer el error. Repetir el l'autotuning después de haber verificado la causa del error.
noAt	Autotuning no terminado en 12 horas	Probar de repetir el autotuning después de haber controlado el funcionamiento de la sonda y el actuador.

		sonda y el actuador.
LbA	Interrupción del ciclo de regulación (Loop break alarm)	Reponer el instrumento en el estado de regulación (rEG) después de haber controlado el funcionamiento de la sonda y del actuador
ErEP	Posible anomalía en la memoria EEPROM	Pulsar la tecla P

En condiciones de error de medida el instrumento da en salida la potencia programada en el par. "OPE" y activa las alarmas deseadas si el parámetro relativo "ALni" se programa = yES.

6.2 - MANTENIMIENTO

Se recomienda limpiar el instrumento sólo con un paño ligeramente mojado o detergente no abrasivo y que no contenga solventes.

6.3 – GARANTÍA Y REPARACIONES

El instrumento tiene garantía por defectos de construcción o de material hallados dentro de los 12 meses a partir de la fecha de entrega.

La garantía se limita a la reparación o la substitución del producto.

La eventual apertura del contenedor, la manipulación del instrumento o el empleo e instalación no adecuada del producto comporta automáticamente al decaimiento de la garantía.

En caso de producto defectuoso en período de garantía o fuera de dicho período, contactar con el despacho de ventas de OSAKA para conseguir la autorización de envío.

El producto defectuoso, acompañado por las indicaciones del defecto hallado, debe ser enviado a OSAKA salvo acuerdos diferentes.

7 – DATOS TÉCNICOS

7.1 – CARACTERÍSTICAS ELÉCTRICAS

<u>Alimentación:</u> 24 VAC/VDC, 100... 240 VAC +/- 10%

<u>Frecuencia AC:</u> 50/60 Hz

<u>Consumo:</u> 10 VA aproximadamente

<u>Entrada/as:</u> 1 entrada por sonda de temperatura: tc J,K,S,B,C,E,L,N, R,T; sensores infrarojos OSAKA IRS J y K rango A ; RTD Pt 100 IEC; PTC KTY 81-121 (990 Ω @ 25 °C); NTC 103AT-2 (10KΩ @ 25 °C) o señales en mV 0...50 mV, 0...60 mV, 12 ...60 mV o señales normalizadas 0/4...20 mA, 0/1...5 V , 0/2...10 V.

1 entrada por transformador amperométrico (max. 50 mA)

1 entrada digital por contactos libres de tensión.

<u>Señal impedancia de entrada normalizada:</u> 0/4..20 mA: 51 Ω; mV y V: 1 MΩ

<u>Salida/s:</u> Hasta 4 salidas digitales: con relé SPST-NO (5 A-AC1, 2 A-AC3 / 250 VAC) o en tensión de pilotaje SSR (7mA/ 14VDC). Hasta 2 salidas analógicas : 0/4 ..20 mA o 0/2 ..10 V.

<u>Salida alimentación auxiliar:</u> 12 VDC / 20 mA Max.

<u>Vida eléctrica salida con relé:</u> 100000 operaciones

<u>Categoría de instalación:</u> II

<u>Clase de protección contra las descargas eléctricas:</u> Frontal en Clase II

<u>Aislamientos:</u> Reforzado entre partes a baja tensión (alimentación y salidas con relé) y frontal; Reforzado entre partes en baja tensión (alimentación y salida con relé) entre partes a bajísima tensión (entradas, salidas estáticas, salidas analógicas); Salidas estáticas y analógicas respecto a la

entrada; Aislamiento a 50 V entre RS485 y partes a baja tensión**.**

7.2 – CARACTERÍSTICAS MECÁNICAS
Contenedor: Plástico autoextinguible UL 94 V0
Dimensiones: 48 x 48 mm DIN, prof. 98 mm
Peso: 190 g aproximadamente
Instalación: Insertar panel en agujero 45,5 x 45,5 mm
Conexiones: Regletero para una sección 2,5 mm^2
Grado de protección frontal: IP 54 con guarnición
Grado de polución: 2
Temperatura ambiente de funcionamiento: 0 ... 55 °C
Humedad ambiente de funcionamiento: 30 ... 95 RH% sin condensación.
Temperatura de transporte y almacenamiento: -10 ... 60 °C

7.3 – DIMENSIONES MECÁNICAS [mm]
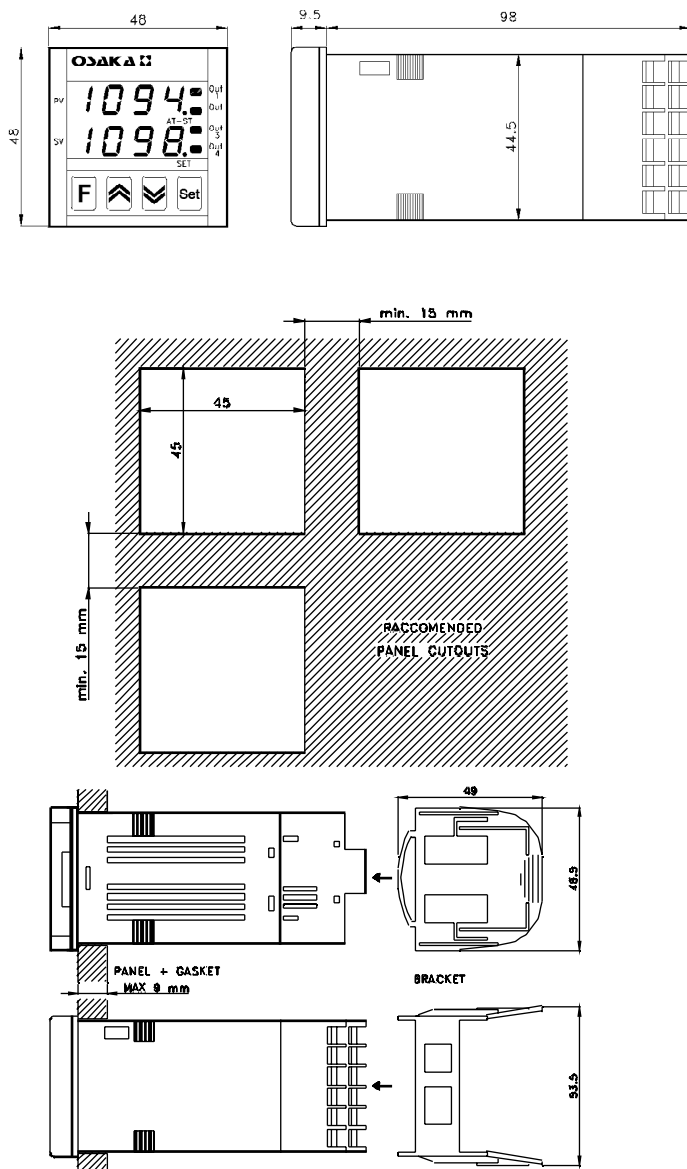
7.4 – CARACTERÍSTICAS DE FUNCIONAMIENTO
Regulación: ON/OFF, PID con acción sencilla, PID con doble acción, PID para accionamientos motorizados con posición temporal.
Rango de medida: Según la sonda utilizada (ver tabla)
Resolución visualización: Según la sonda utilizada. 1/0,1/0,01/0,001
Precisión total: +/- 0,15 % fs

Máximo error de compensación del empalme frío (en tc) : 0,04 °C/°C con temperatura ambiente 0 ... 50 °C después de un tiempo warm-up (arranque instrumento) de 20 min.
Tiempo de muestreo : 130 ms
Tipo interfaz serial : RS 485 aislado
Protocolo de comunicación: MODBUS RTU (JBUS)
Velocidad de transmisión serial: seleccionable 1200 ... 38400 baud
Display: 1 Rojo (PV) y 1 Verde (SV) h 7 mm, 4 digit
Conformidades: Directiva CEE EMC 89/336 (EN 61326), Directiva CEE BT 73/23 y 93/68 (EN 61010-1).

7.5 – TABLA RANGO DE MEDIDA

ENTRADA	SIN D.P.	CON D.P.
tc J "HCFG" = tc "SEnS" = J	-160 ... 1000 °C - 256 ... 1832 °F	-160.0 ... 999.9 °C -199.9 ... 999.9 °F
tc K "HCFG" = tc "SEnS" = CrAl	-270 ... 1370 °C - 454 ... 2498 °F	-199.9 ... 999.9 °C -199.9 ... 999.9 °F
tc S "HCFG" = tc "SEnS" = S	-50 ... 1760 °C -58 ... 3200 °F	-50.0 ... 999.9 °C -58.0 ... 999.9 °F
tc B "HCFG" = tc "SEnS" = b	72 ... 1820 °C 162 ... 3308 °F	72.0 ... 999.9 °C 162.0 ... 999.9 °F
tc E "HCFG" = tc "SEnS" = E	-150 ... 750 °C -252 ... 1382 °F	-150.0 ... 999.9 °C -199.9 ... 999.9 °F
tc L "HCFG" = tc "SEnS" = L	-150 ... 900 °C -252 ... 1652 °F	-150.0 ... 900.0 °C -199.9 ... 999.9 °F
tc N "HCFG" = tc "SEnS" = n	-270 ... 1300 °C -454 ... 2372 °F	-199.9 ... 999.9 °C -199.9 ... 999.9 °F
tc R "HCFG" = tc "SEnS" = r	-50 ... 1760 °C -58 ... 3200 °F	-50.0 ... 999.9 °C -58.0 ... 999.9 °F
tc T "HCFG" = tc "SEnS" = t	-270 ... 400 °C -454 ... 752 °F	-199.9 ... 400.0 °C -199.9 ... 752.0 °F
tc C "HCFG" = tc "SEnS" = C	0 ... 2320 °C 32 ... 4208 °F	0.0 ... 999.9 °C 32.0 ... 999.9 °F
OSAKA IRS rango "A" "HCFG" = tc "SEnS"= Ir.J - Ir.CA	-46 ... 785 °C -50 ... 1445 °F	-46.0 ... 785.0 °C -50.8 ... 999.9 °F
Pt100 (IEC) "HCFG" = rtd "SEnS" = Pt1	-200 ... 850 °C -328 ... 1562 °F	-199.9 ... 850.0 °C -199.9 ... 999.9 °F
PTC (KTY81-121) "HCFG" = rtd "SEnS" = Ptc	-55 ... 150 °C -67 ... 302 °F	-55.0 ... 150.0 °C -67.0 ...302.0 °F
NTC (103-AT2) "HCFG" = rtd "SEnS" = ntc	-50 ... 110 °C -58 ... 230 °F	-50.0 ... 110.0 °C -58.0 ... 230.0 °F
0..20 mA "HCFG" = I "SEnS" = 0.20	-1999 ... 9999	-199.9 ... 999.9 -19.99 ... 99.99 -1.999 ... 9.999
4..20 mA "HCFG" = I "SEnS" = 4.20	-1999 ... 9999	-199.9 ... 999.9 -19.99 ... 99.99 -1.999 ... 9.999
0 ... 50 mV "HCFG" = UoLt "SEnS" = 0.50	-1999 ... 9999	-199.9 ... 999.9 -19.99 ... 99.99 -1.999 ... 9.999
0 ... 60 mV "HCFG" = UoLt "SEnS" = 0.60	-1999 ... 9999	-199.9 ... 999.9 -19.99 ... 99.99 -1.999 ... 9.999

12 ... 60 mV "HCFG" = UoLt "SEnS" = 12.60	-1999 ... 9999	-199.9 ... 999.9 -19.99 ... 99.99 -1.999 ... 9.999
0 ... 5 V "HCFG" = UoLt "SEnS" = 0.5	-1999 ... 9999	-199.9 ... 999.9 -19.99 ... 99.99 -1.999 ... 9.999
1 ... 5 V "HCFG" = UoLt "SEnS" = 1.5	-1999 ... 9999	-199.9 ... 999.9 -19.99 ... 99.99 -1.999 ... 9.999
0 ... 10 V "HCFG" = UoLt "SEnS" = 0.10	-1999 ... 9999	-199.9 ... 999.9 -19.99 ... 99.99 -1.999 ... 9.999
2 ... 10 V "HCFG" = UoLt "SEnS" = 2.10	-1999 ... 9999	-199.9 ... 999.9 -19.99 ... 99.99 -1.999 ... 9.999
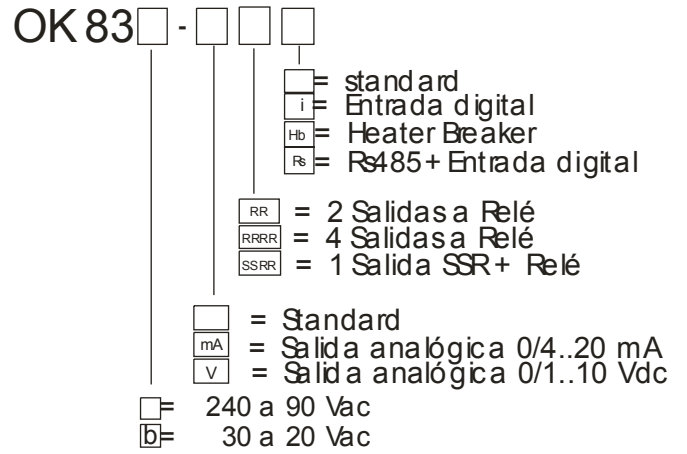
7.6 – CODIFICACIÓN DEL INSTRUMENTO

ALIMENTACIÓN
[ ] = 240 a 90 VAC
[b] = 30 a 20 VAC

SALIDAS
[ ] = standard
[mA] = salida analógica 0/4..20 mA
[V] = salida analógica 0/1..10 VDC
[RR] = 2 salidas relé
[RRRR] = 4 salidas relé
[SSRR] = 1 salida SSR + relé

ENTRADAS
[ ] = standard
[i] = entrada digital
[Hb] = heater break
[Rs] = Rs485 + entrada digital

ESQUEMA CODIFICACIÓN

OK 83☐ - ☐☐☐

☐ = standard
i = Entrada digital
Hb = Heater Breaker
Rs = Rs485 + Entrada digital

RR = 2 Salidas a Relé
RRRR = 4 Salidas a Relé
SSRR = 1 Salida SSR + Relé

☐ = Standard
mA = Salida analógica 0/4..20 mA
V = Salida analógica 0/1..10 Vdc

☐ = 240 a 90 Vac
b = 30 a 20 Vac

OK 83 CONTRASEÑA = 381

DIAGRAMAS DE PROGRAMACIÓN OK 83

PROGRAMACIÓN ALARMA DE MÁXIMA Y MÍNIMA

CALOR EN R1 Y R2 cuando no sale el parámetro Alni
HUMECTAR EN R1 Y R2 cuando no sale el parámetro Alni

Ejemplo:
Histéresis=1°C
SET1=25°C
SET2=70°C

NO PULSAR NINGUNA TECLA DURANTE 40s PARA SALIR DE PROGRAMACIÓN

CALOR EN R1 Y R2
HUMECTAR EN R1 Y R2

Calor/humectar en R1 y R2
R1 y R2 independientes

NO PULSAR NINGUNA TECLA DURANTE 40s PARA SALIR DE PROGRAMACIÓN

CALOR EN R1 Y FRÍO EN R2 con paros en SP1 y AL1
HUMECTAR EN R1 Y DESHUMECTAR EN R2 con paros en SP1 y AL1

Calor/hum.=R1;
Frio/deshum.=R2
R1 y R2 independientes
R1 ON=SP1-HSET, OFF=SP1
R2 ON=AL1+HAL1, OFF=AL1

3s

Set

1s Set

Pulsar

Sp1

EXIT PROGRAMACIÓN

PULSAR 1,5S SALIR PROGRAMACIÓN

DESPLAZAMIENTO POR EL MENÚ

MENÚ INICIO

"OPER" | "OPLO" | "TUNE" | "OFF/REG" | "ConF" | ACCESO
[PARÁMETROS ACCESIBLES PARA EL USUARIO] | [ACTIVA REGULACIÓN MANUAL] | [ACTIVA/DESACTIVA AUTOTUNNING] | [ACTIVA/DESACTIVA REGULACIÓN]

Set

"381"

PASSWORD DE ACCESO

Set

NIVEL 1

DESPLAZAMIENTO POR EL MENÚ

PARÁMETROS AGRUPADOS POR BLOQUES TEMÁTICOS

NIVEL 1   NIVEL 2

INP | OUT | AL1 | LBR | REG | PRN | SP

Según tipo sonda:
tc J = J
tc K = CrAl
tc S = S

SENS [Según tipo sonda]
DP
FIL
OFS1
ROT
INE
OFE
SSC 0
FSC 100
mA / V

Según tipo sonda:
Pt100 = Pt1
PTC = Ptc
NTC = ntc

OTF 1.REG
OCF ALN1
OCF

OAL1 OUT2
ALT1 LOAB
AB1
ALT1 45
HAL1 5
AUD
ALI1

OLBA
LBAT

CONT ONFA
FUNC HEAT
HSET 2
AUTO
SLOR
DURT
SLOF
SP

USRD
DKP
ADE
EDT

NSP 1
SP1 20
SPLL
SPAL

parámetros interiores "tema elegido"

PULSAR 1,5S NIVEL 1

NO PULSAR NINGUNA TECLA DURANTE 40s PARA SALIR DE PROGRAMACIÓN

CALOR EN R1 Y ALARMA MÁXIMA INDEPENDIENTE
HUMECTAR EN R1 Y ALARMA MÁXIMA INDEPENDIENTE

3s

Set

1s Set

Pulsar

Sp1

EXIT PROGRAMACIÓN

PULSAR 1,5S SALIR PROGRAMACIÓN

DESPLAZAMIENTO POR EL MENÚ

MENÚ INICIO

"OPER" | "OPLO" | "TUNE" | "OFF/REG" | "ConF" | ACCESO
[PARÁMETROS ACCESIBLES PARA EL USUARIO] | [ACTIVA REGULACIÓN MANUAL] | [ACTIVA/DESACTIVA AUTOTUNNING] | [ACTIVA/DESACTIVA REGULACIÓN]

Set

"381"

PASSWORD DE ACCESO

Set

NIVEL 1

DESPLAZAMIENTO POR EL MENÚ

PARÁMETROS AGRUPADOS POR BLOQUES TEMÁTICOS

NIVEL 1   NIVEL 2

INP | OUT | AL1 | LBR | REG | PRN | SP

Según tipo sonda:
tc J = J
tc K = CrAl
tc S = S

SENS [Según tipo sonda]
DP
FIL
OFS1
ROT
INE
OFE
SSC 0
FSC 100
mA / V

Según tipo sonda:
Pt100 = Pt1
PTC = Ptc
NTC = ntc

OTF 1.REG
OCF ALN0
OCF

OAL1 OUT2
ALT1 HIAB
AB1
ALT1 20
HAL1 1
AUD
ALI1

OLBA
LBAT

CONT ONFA
FUNC HEAT
HSET 2
AUTO
SLOR
DURT
SLOF
SP

USRD
DKP
ADE
EDT

NSP 1
SP1 15
SPLL
SPAL

parámetros interiores "tema elegido"

PULSAR 1,5S NIVEL 1

NO PULSAR NINGUNA TECLA DURANTE 40s PARA SALIR DE PROGRAMACIÓN

CALOR EN R1 Y ALARMA MÍNIMA DEPENDIENTE
HUMECTAR EN R1 Y ALARMA MÍNIMA DEPENDIENTE

Relé 2 dependiente Relé 1

DESPLAZAMIENTO POR EL MENÚ

3s

1s

Set

Pulsar

Sp1

EXIT PROGRAMACIÓN

MENÚ INICIO

"OPER" — [PARÁMETROS ACCESIBLES PARA EL USUARIO]
"OPLO" — [ACTIVA REGULACIÓN MANUAL]
"TUNE" — [ACTIVA/DESACTIVA AUTOTUNNING]
"OFF/REG" — [ACTIVA/DESACTIVA REGULACIÓN]
"ConF" — ACCESO

PULSAR 1,5S SALIR PROGRAMACIÓN

"381" — PASSWORD DE ACCESO

DESPLAZAMIENTO POR EL MENÚ

NIVEL 1 — PARÁMETROS AGRUPADOS POR BLOQUES TEMÁTICOS — NIVEL 1

NIVEL 2

INP — OUT — RL1 — LBR — REG — PRN — SP

Según tipo sonda:
tc J = J
tc K = CrAl
tc S = S

Según tipo sonda:
Pt100 = Pt1
PTC = Ptc
NTC = ntc

parámetros interiores "Tema elegido"

PULSAR NIVEL 1

INP: SENS, UNI, FIL, OFST, ROT, INE, OPE, SSC (0), FSC (100) — mA/V

OUT: OTF, O2F, OZF, ONF — ALNO

RL1: OAL1 (OUT2), ALT1 (LODE), AB1, ALT1 (-10), HAL1 (2), AHO, ALH

LBR: OLBR, LBAT

REG: CONT (ONFA), FUNC (HEAT), HSET (3), AUTO, SLOR, DURT, SLOF, SP

PRN: USRB, DISP, ADE, EDT

SP: NSP (1), SP1 (80), SPLL, SPAL

NO PULSAR NINGUNA TECLA DURANTE 40s PARA SALIR DE PROGRAMACIÓN

CALOR EN R1 Y FRÍO EN R2 CON ZONA MUERTA CON 1 SOLO SET
HUMECTAR EN R1 Y DESHUMECTAR EN R2 CON ZONA MUERTA CON 1 SOLO SET

Calor/Hum.= R1
Frio/Deshum.= R2
R2 ON >[Set+HSet]
R1 ON <[Set-HSet]
Sensor: mA, V

DESPLAZAMIENTO POR EL MENÚ

3s

1s

Set

Pulsar

Sp1

EXIT PROGRAMACIÓN

MENÚ INICIO

"OPER" — [PARÁMETROS ACCESIBLES PARA EL USUARIO]
"OPLO" — [ACTIVA REGULACIÓN MANUAL]
"TUNE" — [ACTIVA/DESACTIVA AUTOTUNNING]
"OFF/REG" — [ACTIVA/DESACTIVA REGULACIÓN]
"ConF" — ACCESO

PULSAR 1,5S SALIR PROGRAMACIÓN

"381" — PASSWORD DE ACCESO

DESPLAZAMIENTO POR EL MENÚ

NIVEL 1 — PARÁMETROS AGRUPADOS POR BLOQUES TEMÁTICOS — NIVEL 1

NIVEL 2

INP — OUT — RL1 — LBR — REG — PRN — SP

Según tipo sonda:
tc J = J
tc K = CrAl
tc S = S

Según tipo sonda:
Pt100 = Pt1
PTC = Ptc
NTC = ntc

parámetros interiores "Tema elegido"

PULSAR NIVEL 1

INP: SENS, UNI, FIL, OFST, ROT, INE, OPE, SSC (0), FSC (100) — mA/V

OUT: OTF (1.REG), O2F (2.REG), OZF, ONF

RL1: OAL1, ALT1, AB1, ALT1, HAL1, AHO, ALH

LBR: OLBR, LBAT

REG: CONT (NR), FUNC, HSET (5), AUTO, SLOR, DURT, SLOF, SP

PRN: USRB, DISP, ADE, EDT

SP: NSP (1), SP1 (50), SPLL, SPAL

NO PULSAR NINGUNA TECLA DURANTE 40s PARA SALIR DE PROGRAMACIÓN

Diagram 1

CALOR EN R1 Y FRÍO EN R2 *sin par. Alni*
HUMECTAR EN R1 Y DESHUMECTAR EN R2 *sin par. Alni*

Calor/Hum.=R1
Frío/deshum.=R2
R1 ON=[SP1-HSET], OFF=[SP1]
R2 ON=[AL1], OFF=[AL1-HAL1]

↓ 1s
Set

↓ 3s
Set ← DESPLAZAMIENTO POR EL MENÚ

↓ Pulsar
Sp1

MENÚ INICIO

EXIT PROGRAMACIÓN

PULSAR 1,5S SALIR PROGRAMACIÓN

"OPER"	"OPLO"	"TUNE"	"OFF/REG"	"ConF"	ACCESO
[PARÁMETROS ACCESIBLES PARA EL USUARIO]	[ACTIVA REGULACIÓN MANUAL]	[ACTIVA/DESACTIVA AUTOTUNNING]	[ACTIVA/DESACTIVA REGULACIÓN]		

Set
"381"   PASSWORD DE ACCESO
Set

DESPLAZAMIENTO POR EL MENÚ

PARÁMETROS AGRUPADOS POR BLOQUES TEMÁTICOS

NIVEL 1   NIVEL 1
NIVEL 2

INP	OUT	AL1	LBR	REG	PAN	SP
SENS [Según tipo sonda]	O1F 1.REG	OAL1 OUT2	OLBA	CONT ONFA	USBO	NSP 1
DP 1	O2F ALNO	ALT1 HIAB	LBAT	FUNC HEAT	DISP	SP1 15.2
FIL	O2F	AB1		HSET 0.4	ADE	SPLL
OFST	O2F	ALT1 16.0		AUTO		SPHL
ROT	O1F	HAL1 0.4		SLOR		
INE		AUO		DURT		
OPE		AL1		SLOF		
SSC 0				SP		
FSC 100						

Según tipo sonda:
tc J = J
tc K = CrAl
tc S = S

Según tipo sonda:
Pt100 = Pt1
PTC = Ptc
NTC = ntc

parámetros interiores "Tema elegido"

PULSAR 1,5S NIVEL 1

NO PULSAR NINGUNA TECLA DURANTE 40s PARA SALIR DE PROGRAMACIÓN

Diagram 2

FRÍO EN R1 Y R2 cuando no sale el parámetro Alni
DESHUMECTAR EN R1 Y R2 cuando no sale el parámetro Alni

Ejemplo:
Histéresis=1°C
SET1=0°C
SET2=3°C

↓ 1s
Set

↓ 3s
Set ← DESPLAZAMIENTO POR EL MENÚ

↓ Pulsar
Sp1

MENÚ INICIO

EXIT PROGRAMACIÓN

PULSAR 1,5S SALIR PROGRAMACIÓN

"OPER"	"OPLO"	"TUNE"	"OFF/REG"	"ConF"	ACCESO
[PARÁMETROS ACCESIBLES PARA EL USUARIO]	[ACTIVA REGULACIÓN MANUAL]	[ACTIVA/DESACTIVA AUTOTUNNING]	[ACTIVA/DESACTIVA REGULACIÓN]		

Set
"381"   PASSWORD DE ACCESO
Set

DESPLAZAMIENTO POR EL MENÚ

PARÁMETROS AGRUPADOS POR BLOQUES TEMÁTICOS

NIVEL 1   NIVEL 1
NIVEL 2

INP	OUT	AL1	LBR	REG	PAN	SP
SENS Pt1	O1F 1.REG	OAL1 OUT2	OLBA	CONT ONFA	USBO	NSP 1
UNIT	O2F ALNO	ALT1 HIAB	LBAT	FUNC COOL	DISP	SP1 0
FIL	O2F	AB1		HSET 2	ADE	SPLL
OFST	O2F	ALT1 3		AUTO		SPHL
ROT	O1F	HAL1 1		SLOR		
INE		AUO		DURT		
OPE		AL1		SLOF		
SSC 0				SP		
FSC 100						

Según tipo sonda:
tc J = J
tc K = CrAl
tc S = S

Según tipo sonda:
Pt100 = Pt1
PTC = Ptc
NTC = ntc

parámetros interiores "Tema elegido"

PULSAR 1,5S NIVEL 1

NO PULSAR NINGUNA TECLA DURANTE 40s PARA SALIR DE PROGRAMACIÓN

Frío/deshum.= R1
Calor/hum.=R2
R1 ON=SET, OFF=SET+HSET
R2 ON=AL1, OFF=AL1-HAL1

DESPLAZAMIENTO POR EL MENÚ

Set 1s
Sp1 Pulsar

EXIT PROGRAMACIÓN

Set 3s

MENÚ INICIO

"OPER"
[PARÁMETROS ACCESIBLES PARA EL USUARIO]

"OPLO"
[ACTIVA REGULACIÓN MANUAL]

"TUNE"
[ACTIVA/DESACTIVA AUTOTUNNING]

"OFF/REG"
[ACTIVA/DESACTIVA REGULACIÓN]

"ConF" ACCESO

Set
"381" PASSWORD DE ACCESO
Set

PULSAR 1,5S SALIR PROGRAMACIÓN

DESPLAZAMIENTO POR EL MENÚ

PARÁMETROS AGRUPADOS POR BLOQUES TEMÁTICOS

NIVEL 1   NIVEL 1
NIVEL 2

INP — OUT — AL1 — LBA — REG — PAN — SP

Según tipo sonda:
tc J = J
tc K = CrAl
tc S = S

Según tipo sonda:
Pt100 = Ptl
PTC = Ptc
NTC = ntc

parámetros interiores "ítem a elegido"

SENS [Según tipo sonda]
DP 1
FIL
OFST
ROT
INE
OPE
SSC 0
FSC 100
mA / V

OIF
1.REG
O2F
ALN1

OAL1 OUT2
ALT HIAB
AO1
ALT 15,2
HAL1 0.4
AU0
ALI

OLBA
LBAT

CONT ONFA
FUNC COOL
HSET 0.4
AU0
SLOR
DURT
SLOF
SP

USRO
DISP
AOE
EDT

NSP 1
SP1 16.0
SPLL
SPAL

PULSAR 1,5S NIVEL 1

NO PULSAR NINGUNA TECLA DURANTE 40s PARA SALIR DE PROGRAMACIÓN

Relé 2 dependiente relé 1

DESPLAZAMIENTO POR EL MENÚ

Set 1s
Sp1 Pulsar

EXIT PROGRAMACIÓN

Set 3s

MENÚ INICIO

"OPER"
[PARÁMETROS ACCESIBLES PARA EL USUARIO]

"OPLO"
[ACTIVA REGULACIÓN MANUAL]

"TUNE"
[ACTIVA/DESACTIVA AUTOTUNNING]

"OFF/REG"
[ACTIVA/DESACTIVA REGULACIÓN]

"ConF" ACCESO

Set
"381" PASSWORD DE ACCESO
Set

PULSAR 1,5S SALIR PROGRAMACIÓN

DESPLAZAMIENTO POR EL MENÚ

PARÁMETROS AGRUPADOS POR BLOQUES TEMÁTICOS

NIVEL 1   NIVEL 1
NIVEL 2

INP — OUT — AL1 — LBA — REG — PAN — SP

Según tipo sonda:
tc J = J
tc K = CrAl
tc S = S

Según tipo sonda:
Pt100 = Ptl
PTC = Ptc
NTC = ntc

parámetros interiores "ítem a elegido"

SENS [Según tipo sonda]
DP
FIL
OFST
ROT
INE
OPE
SSC 0
FSC 100
mA / V

OIF
1.REG
O2F
ALNO

OAL1 OUT2
ALT HIDE
AO1
ALT 5
HAL1 2
AU0
ALI

OLBA
LBAT

CONT ONFA
FUNC COOL
HSET 1
AU0
SLOR
DURT
SLOF
SP

USRO
DISP
AOE
EDT

NSP 1
SP1 -10
SPLL
SPAL

PULSAR 1,5S NIVEL 1

NO PULSAR NINGUNA TECLA DURANTE 40s PARA SALIR DE PROGRAMACIÓN

FRÍO EN R1 CON ALARMA MÁXIMA INDEPENDIENTE
DESHUMECTAR EN R1 CON ALARMA MÁXIMA INDEPENDIENTE

Relé 2 independiente del relé 1

3s

1s

Set

Set

Pulsar

Sp1

DESPLAZAMIENTO POR EL MENÚ

EXIT PROGRAMACIÓN

MENÚ INICIO

PULSAR 1,5S SALIR PROGRAMACIÓN

"OPER"
[PARÁMETROS ACCESIBLES PARA EL USUARIO]

"OPLO"
[ACTIVA REGULACIÓN MANUAL]

"TUNE"
[ACTIVA/DESACTIVA AUTOTUNNING]

"OFF/REG"
[ACTIVA/DESACTIVA REGULACIÓN]

"ConF"   ACCESO

Set

"381"   PASSWORD DE ACCESO

Set

HIVEL 1

DESPLAZAMIENTO POR EL MENÚ

PARÁMETROS AGRUPADOS POR BLOQUES TEMÁTICOS

NIVEL 1

HIVEL 1

HIVEL 2

INP   OUT   AL1   LBA   REG   PAN   SP

Según tipo sonda:
tc J = J
tc K = CrAl
tc S = S

Según tipo sonda:
Pt100 = Pt1
PTC = Ptc
NTC = ntc

parámetros interiores "Tema elegido"

SENS [Según tipo sonda]   OTF   1.REG OAL1   OUT2   OLBA   CONT   ONFA   USRD   NSP   1

DP   O2F   ALM0   ALT   HIAB   LBAT   FUNC   COOL   DISP   SP1   -10

FL   O2F   ABT   HSET   AUTO   SPL

OFST   O3F   ALT   2   AUTO   ADE   SPAL

ROT   ONF   HALT   2   SLOR

INE   ALID   DURT

OPE   ALM   SLOF

55C   0   SP

F5C   100

m A / V

PULSAR 1,5S NIVEL 1

NO PULSAR NINGUNA TECLA DURANTE 40s PARA SALIR DE PROGRAMACIÓN

FRÍO EN R1 Y R2
DESHUMECTAR EN R1 Y R2

Relé 1 y 2 independientes

3s

1s

Set

Set

Pulsar

Sp1

DESPLAZAMIENTO POR EL MENÚ
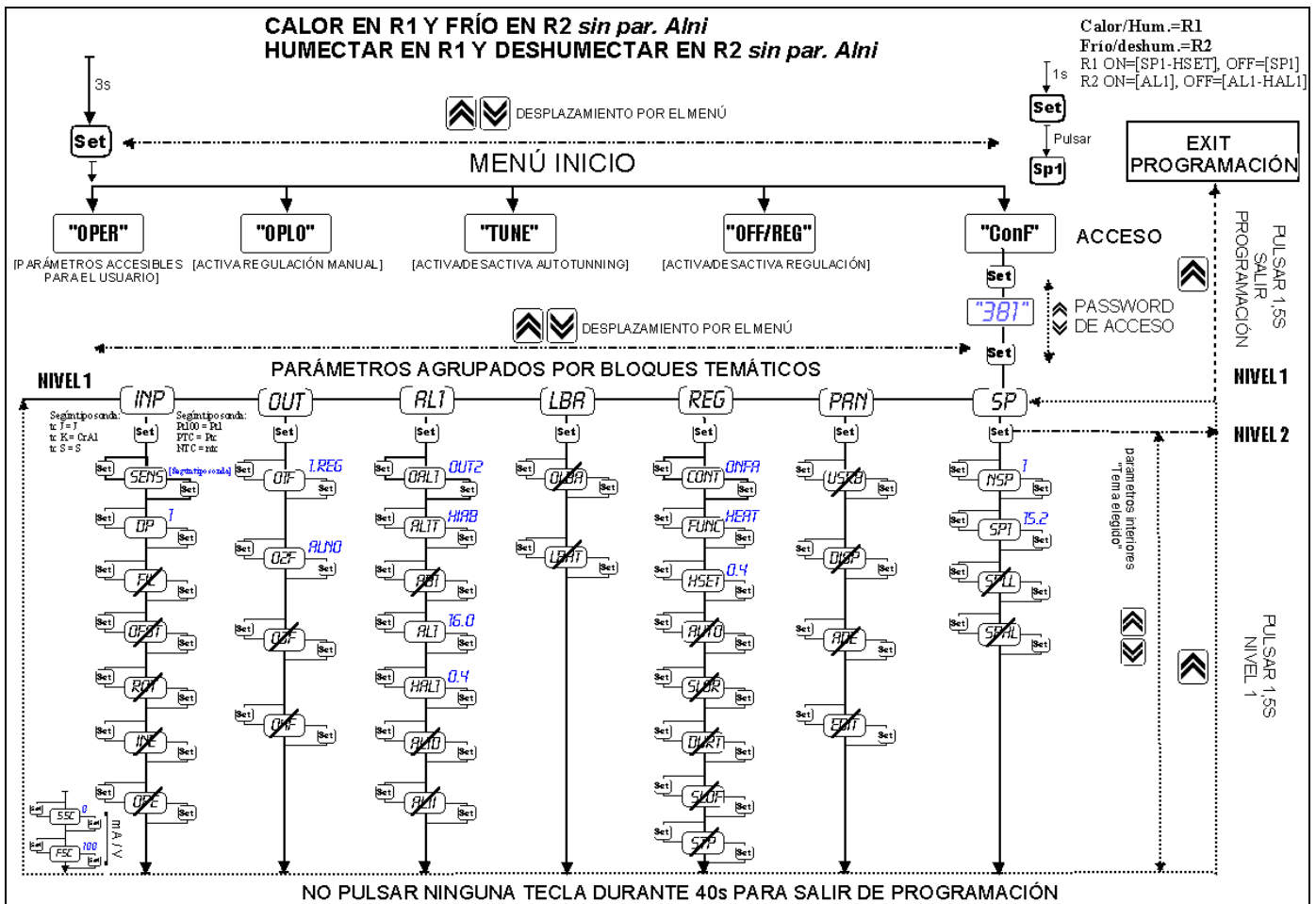
EXIT PROGRAMACIÓN

MENÚ INICIO

PULSAR 1,5S SALIR PROGRAMACIÓN

"OPER"
[PARÁMETROS ACCESIBLES PARA EL USUARIO]

"OPLO"
[ACTIVA REGULACIÓN MANUAL]

"TUNE"
[ACTIVA/DESACTIVA AUTOTUNNING]

"OFF/REG"
[ACTIVA/DESACTIVA REGULACIÓN]

"ConF"   ACCESO

Set

"381"   PASSWORD DE ACCESO

Set

DESPLAZAMIENTO POR EL MENÚ

PARÁMETROS AGRUPADOS POR BLOQUES TEMÁTICOS

NIVEL 1

HIVEL 1

HIVEL 2

INP   OUT   AL1   LBA   REG   PAN   SP

Según tipo sonda:
tc J = J
tc K = CrAl
tc S = S

Según tipo sonda:
Pt100 = Pt1
PTC = Ptc
NTC = ntc

parámetros interiores "Tema elegido"

SENS [Según tipo sonda]   OTF   1.REG   OAL1   OUT2   OLBA   CONT   ONFA   USRD   NSP   1

DP   O2F   ALM1   ALT   LOAB   LBAT   FUNC   COOL   DISP   SP1   20

FL   O2F   ABT   HSET   2   AUTO   SPL

OFST   O3F   ALT   45   AUTO   ADE   SPAL

ROT   ONF   HALT   5   SLOR

INE   ALID   DURT

OPE   ALM   SLOF

55C   0   SP

F5C   100

m A / V

PULSAR 1,5S NIVEL 1

NO PULSAR NINGUNA TECLA DURANTE 40s PARA SALIR DE PROGRAMACIÓN