MELiSSA

DATAPACKAGE 87.3.1 ISSUE 0

Departament d'Enginyeria Química
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DATA PACKAGE 87.3.1

Compartment III Acceptance Review

Control Data Package

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APPROVAL

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Prepared by *Auteur*	C. Bourg, O. Gerbi, J. Duatis, E. Creus, J. Carbonell	Date *Date*	22/10/10

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Approved by *Approuvé par*	F.Gòdia	Date *Date*	28/10/10

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1. Scope

The present datapackage is a status at the date of approval of the control activities performed on Compartment 3 during Call Off Order 7: automation control for C4a and C3 at the MPP- addendum to COO5. These control activities were the last part of the redesign of the C3 pilot plant reactor carried out by the MPP with the companies SNC Lavalin (Belgium) and Bioprocess (Spain).

Therefore the datapackage presents the outcome of the tasks performed by the subcontractors SHERPA for PLC programme design, implementation and testing on the one hand and on the other hand NTE-SENER for control hardware definition, installation and HMI programme design, implementation and testing.

2. Organization of the datapackage

The datapackage is divided into 4 sections.

The first section deals with the description of the PLC programme, mainly developed by the company SHERPA Engineering, going from the requirements and software description, text of the implemented code, list of tags to the test plan and report of the tests.

The following three sections group the work developed by the company NTE-SENER around the following topics :

- design of the hardware of the PLC cabinet able to communicate with C3 compartment
- testing of the PLC cabinet once built
- design and verification of the Human Machine Interface developed by NTE-SENER to allow the operator to control and supervise the compartment C3 and communicate with the C3 PLC.

The detail of the content of each section is given herebelow and recalled in the front page of each section.

SECTION 1: C1 PLC Software description				
Reference	Title	Version	Edition date	Pages Number
TN_CIII_SHERPA_SWDescription_20101022.doc	MELISSA Pilot Plant COMPARTMENT III : Control Requirements and Software Description	1.0	22/10/10	208

V00_10_CIII_PRINTABLE_VERSION.pdf	C3 PLC software in printable version	10	22/10/10	185
CIII_PLC_HMI_20101022.xls	C3 list of tags, control loops, variables for control, tags exchanged between PLC and HMI and alarm thresholds		22/10/10	21
TN12_ControlLoop_TestPlan&Report.doc	Control loops test plan and test report	1.1	Oct. 2010	72
CIII_Software_Modification.xls	Traceability for future software modification	0	Oct. 2010	1

SECTION 2: PLC Design and wiring				
Reference	Title	Version	Edition date	Pages Number
NTE-CIIIP2-ICD-002	CIII HARDWARE INTERFACE DOCUMENT	1.1	16/10/09	41
NTE-CIIIP2-RP-004	MELISSA CIII CONTROL CABINET HARDWARE DESIGN DOCUMENT	1	6/10/09	32

SECTION 3: PLC Cabinet assembly				
Reference	Title	Version	Edition date	Pages Number
NTE-CIIIP2-PR-005	CIII CONTROL CABINET AND CABINET CABLING TEST PROCEDURE	1	08/07/09	13
NTE-CIIIP2-TR-006	CIII CONTROL CABINET AND CABINET CABLING TEST REPORT FOR THE	1.1	6/10/09	10

SECTION 4: Implementation of remote and local HMIs				
Reference	Title	Version	Edition date	Pages Number
NTE-CIIIP2-RP-003	MELISSA CIII HMI DESIGN	1.1	22/01/10	41
NTE-CIIIP2-RP-007	MELISSA CIII LOCAL HMI DESIGN	1.1	26/01/10	21
NTE-CIIIP2-HB-008	CIII HMI SOFTWARE MANUAL	1.2	22/04/10	70
NTE-CIIIP2-MN-009	Review of CIII HMI Displays minutes of meeting	1	14/10/09	3
NTE-CIIIP2-MN-010	Review of CIII HMI Displays minutes	1	29/10/09	2

	of meeting			

3. Conclusion

All the functionalities of the control hardware have been tested successfully as per the control requirements of C3.

Concerning the programme of control implemented in the PLC, the basic functions have been successfully tested but need to be further tested in the campaign of functional tests, where some adjustments or fine tunings might be necessary, with a traceability of the modifications.

The HMI screens have been successfully implemented and tested. If adjustments are needed during the functional tests, they will be implemented with traceability of the modifications.

Based on this datapackage, the control hardware and softwares (PLC and HMI) for Compartment 3 are accepted.

SECTION 1: C1 PLC Software description				
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V00_10_CIII_PRINTABLE_VERSION.pdf	C3 PLC software in printable version	10	22/10/10	185
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TECHNICAL NOTE
MELISSA Pilot Plant COMPARTMENT III: Software Description Control and Requirements

Prepared by/Préparé par	Christophe Bourg / Olivier Gerbi
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Authors Auteur	Christophe Bourg / Olivier Gerbi	Date Date	15/10/2010

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1. Introduction

The compartment CIII, redesigned by SNC-LAVALIN, has been completely installed by BioProcess in the Melissa Pilot Plant. Its main objective is the nitrification within the MELiSSA loop. Nitrifying bacteria are required in a Life Support System to carry out the oxidation of ammonium to nitrate.
Managed by an internal programme developed by Sherpa, a Schneider PLC Quantum controls the equipments of the bioreactor.
The main objective of the software is to control Inlet and outlet liquid flow, gas flow, temperature and level (influent, bioreactor and effluent tank), pH, pressure and dissolved oxygen inside the biorector.
The objective of the document is to give for each control loop:

- Control Requirements (see Annex A)
- a textual description of the function
- the list and description of the variables involved
- the Control tuning parameters and block diagram
- A description of the Alarms, their triggering conditions and actions.

1.1. Software Configuration

PLC program is developed for the Schneider Quantum PLC using the Concept 2.6 software.
Sections are coded using the IEC1131-3 standard language FBD (Function Block Diagram).
The current software version is **V00_10_CIII** (2010.10.19). The Version V01_00_CIII will be created when the whole compartment function will be validated by the end user (UAB/ESA)

1.2. PLC configuration

Here below, the configuration of the I/O of the PLC.
There are two rack connected by a XBE cable.
On the first rack: a power supply card / the CPU (Quantum) card/ the Network (NOE) card / one current input card / one current output card / two voltage output cards.
The second rack: a power supply card / two digital input cards / two digital output cards / two analogical voltage input cards / one analogical current input card.

PLC									
1	2	3	4	5	6	7	8	9	10
140CPS11420	140CPU43412A	140NOE77101	140ACI04000	140AVO02000	140ACO02000	140ACO13000			140XBE10000
Backplane Power Supply module	CPU module	Ethernet module	16 Analog current Input (ACI 1)	4 Analog voltage Input (AVO)	4 Analog current Output (ACO 1)	8 Analog current Output (ACO 2)			Rack expansion
CIII_PLC_CPS	CIII_PLC_CPU	CIII_PLC_NOE	CIII_PLC_IO_ACI1	CIII_PLC_IO_AVO1	CIII_PLC_IO_ACO1	CIII_PLC_IO_AVO2			CIVb_PLC_XBE
Address			300001 --> 300017	400001-400004	400005->400008	400009->400016			
			no free inputs	no free outputs	card not used	4 free outputs			

PLC EXPANSION									
1	2	3	4	5	6		8	9	10
140CPS11420	140DDI84100	140DDI35300	140DDO84300	140DDO35300	140ACI03000		140AVI03000	140AVI03000	140XBE10000
Backplane Power Supply module	16 Digital Input 10..60VDC	32 Digital Input 24V	16 Digital Output 10..60VDC	32 Digital Output 24 V	8 Analog Input channels		8 analog input channels	8 analog input channels	Rack expansion
CIII _PLC_CPS	CIII_PLC_DDI1	CIII_PLC_DDI2	CIII_PLC_DDO1	CIII_PLC_DDO2	CIII_PLC_ACI2		CIII_PLC_AVI1	CIII_PLC_AVI2	CIVb_PLC_XBE
Address	100001->100016	100017 -> 100048	000001 --> 000016	000017 --> 000048	300018 --> 300026		300036 --> 300044	300045 --> 300053	
	card not used	9 free inputs	card not used	3 free outputs	no free inputs		2 free inputs	4 free inputs	

1.3. Equipment Ranges (AO / AI)

The following table presents the analog connected with their implemented ranges in the PLC. If the signal is filtered or averaged, it is indicated in the “Filter” column.

Index	Tags	Description	Signal	PLC Address	ELECTRICAL SIGNAL	RANGE	OFF SET	FILTER
1	TT_3001_01	Temperature element + transmitter (D03)	AI->REAL	300002	4/20 mA	0 / 150 (℃)	NO	NO
2	LT_3002_01	Level transmitter (capacitive)	AI->REAL	300008	4/20 mA	1.4937 / 41.9517 (L)	NO	NO
3	FT_3003_01	Flow element + transmitter (feed)	AI->REAL	300012	4/20 mA	0 / 2 (L/H)	NO	NO
4	PT_3003_01	Pressure transmitter	AI->REAL	300018	4/20 mA	-1000 / 4000 (mbar)	NO	NO
5	BLE_3004_01_MV2	Bioreactor agitator set point	REAL -> AO	400004	-10/10V	0 / 100 (%)	NO	NO
6	BLE_3004_01	Bioreactor agitator speed	AI->REAL	300039	0/10V	0 / 100 (%)	NO	NO
7	TT_3005_02	Temperature element + transmitter (thermost fluid jacket C01)	AI->REAL	300004	4/20 mA	0 / 150 (℃)	NO	NO
8	TT_3005_01	Temperature element + transmitter (middle C01)	AI->REAL	300005	4/20 mA	0 / 150 (℃)	NO	NO
9	TT_3005_03	Temperature element + transmitter (top C01)	AI->REAL	300006	4/20 mA	0 / 150 (℃)	NO	NO
10	TT_3005_04	Temperature element + transmitter (bottom C01)	AI->REAL	300007	4/20 mA	0 / 150 (℃)	NO	NO
11	LT_3006_01	Level transmitter (capacitive)	AI->REAL	300010	4/20 mA	9.9802 / 13.7376 (L)	NO	NO
12	DPT_3007_01	Differential Pressure transmitter	AI->REAL	300011	4/20 mA	0 / 3000 (Mbar)	NO	NO
13	PT_3007_01	Pressure element + transmitter	AI->REAL	300015	4/20 mA	-1000 / 4000 (mbar)	NO	NO
14	AT_3008_01	pH element + transmitter	AI->REAL	300021	4/20 mA	0 / 14	NO	LAG FILTER Gain : 1 LAG : 50 s
15	TT_3008_01	Temperature pH element	AI->REAL	300040	4/20 mA	0 / 100 (℃)	NO	NO

Index	Tags	Description	Signal	PLC Address	ELECTRICAL SIGNAL	RANGE	OFF SET	FILTER
16	AT_3008_02	pH element + transmitter	AI->REAL	300020	4/20 mA	0 / 14	NO	LAG FILTER Gain : 1 LAG : 50 s
17	TT_3008_02	Temperature pH element	AI->REAL	300041	4/20 mA	0 / 100 (℃)	NO	NO
18	WIT_3008_01	Acid Bottle weight indicator (+ weighing scale)	AI->REAL	SCADA	ETHERNET	-	NO	NO
19	WIT_3008_02	Base Bottle weight indicator (+ weighing scale)	AI->REAL	SCADA	ETHERNET	-	NO	NO
20	FQRC_3008_01	Flow element + transmitter (CO2)	AI->REAL	300036	0/5V	0 / 50 (ml/min)	NO	NO
21	FQRC_3008_01_SP	Flow Control Valve non sterile gas (CO2)	REAL -> AO	400001	0/5V	0 / 50 (ml/min)	NO	NO
22	AT_3009_01	Dissolved O2 transmitter (BOTTOM)	AI->REAL	300025	4/20mA	0 / 100 (%)	NO	NO
23	AT_3009_02	Dissolved O2 transmitter (TOP)	AI->REAL	300024	4/20mA	0 / 100 (%)	NO	NO
24	FQRC_3009_01	Flow element + transmitter (O2)	AI->REAL	300037	0/5V	0 / 500 (ml/min)	NO	NO
25	FQRC_3009_01_SP	Flow Control Valve non sterile gas (O2)	REAL -> AO	400002	0/5V	0 / 500 (ml/min)	NO	NO
26	AT_3010_01	Conductivity element + transmitter (BOTTOM)	AI->REAL	300023	4/20 mA	0.02 / 50 (µS/cm)	NO	NO
27	AT_3010_02	Conductivity element + transmitter (TOP)	AI->REAL	300022	4/20 mA	0.02 / 50 (µS/cm)	NO	NO
28	FQRC_3011_01_SP	Flow Control Valve non sterile gas (N2)	REAL -> AO	400003	0/5V	0 / 8333 (ml/min)	NO	NO
29	FQRC_3011_01	Flow element + transmitter (N2)	AI->REAL	300038	0/5V	0 / 8333 (ml/min)	NO	NO
30	FQRC_3011_02_SP	Flow element + transmitter (mix)	REAL -> AO	400013	4/20 mA	0 / 10000 (ml/min)	NO	NO
31	FQRC_3011_02	Flow element + transmitter (mix)	AI->REAL	300019	4/20 mA	0 / 10000 (ml/min)	NO	NO
32	PT_3011_01	Pressure transmitter	AI->REAL	300016	4/20 mA	-1000 / 4000 (mbar)	NO	NO
33	TT_3012_01	Air vent cold water temperature transmitter	AI->REAL	300001	4/20mA	0 / 150 (℃)	NO	NO
34	AT_3013_01	NH4 Analyser	REAL	SCADA	ETHERNET	-	NO	NO

Index	Tags	Description	Signal	PLC Address	ELECTRICAL SIGNAL	RANGE	OFF SET	FILTER
35	AT_3013_02	NO3 Analyser	REAL	SCADA	ETHERNET	-	NO	NO
36	AT_3013_03	NO2 Analyzer Refreshed Value	AI->REAL	300047	4/20 mA	0 / 20 (mg/L)	NO	NO
37	AT_3014_01	Biomass sensor	REAL	SCADA	ETHERNET	-	NO	NO
38	FT_3017_01	Flow element + transmitter (recirc)	AI->REAL	300013	4/20 mA	0 / 5 (L/H)	NO	NO
39	PP_3017_01_MV2	Peristaltic Pump multichannel, variable speed (recirc)	REAL -> AO	400012	4/20 mA	0 / 100 (%)	NO	NO
40	FT_3018_01	Flow element + transmitter (harvest)	AI->REAL	300014	4/20 mA	0/ 2 (bar)	NO	NO
41	PP_3018_01_MV2	Peristaltic Pump multichannel, variable speed (harvest)	REAL -> AO	400010	4/20 mA	0 / 100 (%)	NO	NO
42	TT_3020_01	Temperature element + transmitter (D04)	AI->REAL	300003	4/20 mA	0 / 150 (℃)	NO	NO
43	LT_3021_01	Level transmitter (capacitive)	AI->REAL	300009	4/20 mA	1.551 / 41.607	NO	NO
44	LT_3022_01	Level transmitter (capacitive). Used to detect foam level (2010/10/12: At the current date, this sensor doesn't exist)	AI->REAL	NC	-	-	NO	NO
45	TT_3023_01	Mobile temperature used for sterilisation	AI->REAL	300048	4/20mA	0 / 150 (℃)	NO	NO
46	TT_3023_02	Mobile temperature used for sterilisation	AI->REAL	300049	4/20mA	0 / 150 (℃)	NO	NO
47	TT_3023_03	Mobile temperature used for sterilisation	AI->REAL	300050	4/20mA	0 / 150 (℃)	NO	NO

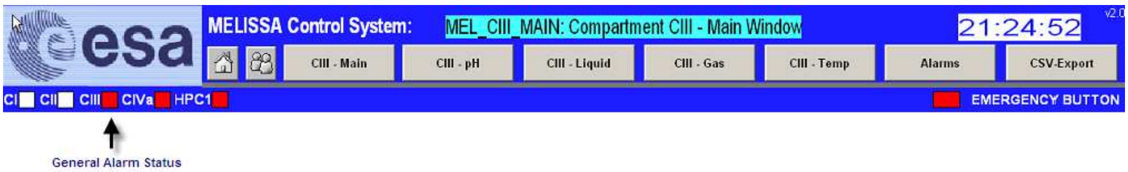
1.4. PLC section List

- Project : CIII
  - Data
    - FBD SYSTEM_STATE
    - FBD ERR_AI
    - FBD output
    - FBD Input
  - Control_Loops
    - FBD ALARM_STATUS
    - FBD System_clock
    - FBD test
    - FBD CL3000_Influent_General
    - FBD CL3001_Influent_Temp_Control
    - FBD CL3002_Influent_Level_Control
    - FBD CL3003_Inlet_Liquid_Control
    - FBD CL3004_Bioreactor_General
    - FBD CL3005_Bioreactor_Temp_Control
    - FBD CL3006_Bioreactor_Level_Control
    - FBD CL3007_Bioreactor_Pressu_Control
    - FBD CL3008_Bioreactor_pH_Control
    - FBD CL3009_Bioreactor_DO2_Control
    - FBD CL3010_Bioreactor_EC_Control
    - FBD CL3011_Gas_Loop
    - FBD CL3012_Gas_Temperature
    - CL3013_Liquid_Analysis
      - FBD CL3013_SFC_CONTROL_PROCEDURE
      - FBD CL3013_NH4_Management
      - SFC CL3013_NH4
      - SFC CL3013_NH4_Stop
      - SFC CL3013_NH4_Calib
      - FBD CL3013_NO3_Management
      - SFC CL3013_NO3
      - SFC CL3013_NO3_Calib
      - SFC CL3013_NO3_Stop
      - FBD CL3013_NO2_Management
      - SFC CL3013_NO2
      - SFC CL3013_NO2_Stop
    - FBD CL3014_Biomass_Control
    - FBD CL3015_Backwashing
    - FBD CL3016_Gas_Pulse
    - FBD CL3017_Liquid_Recirculation
    - FBD CL3018_Outlet_liquid_Control
    - FBD CL3020_Effluent_Temperature
    - FBD CL3021_Effluent_Level
    - FBD CL3022_Foam_Control

The folder “Data” groups three subsections.

- “ERR_AI” corresponds to the errors generated when an analogical sensor sends no current to the PLC card. It means that the wire of the sensor is broken.
- “Inputs” corresponds to all analogical input channels with the scale configuration.
- “Outputs” corresponds to the analogical output channels with the scale configuration.

The folder “Control_loops” groups all the control loops developed in the following chapters. Only “ALARM_STATUS”, “System_clock” are not detailed.
“ALARM_STATUS” section manages all the CIII alarms. It has been implemented to inform the operator, by displaying inside the navigation bar (visible from all the compartment HMI screens) if an alarm is on going.
If an alarm high or low is triggered, the tag “CIII_HighLowAlarm_status” is set and then the square becomes yellow.
If an alarm Very high or Very low is triggered, the tag “CIII_VeryHighLowAlarm_status” is set then the square becomes red.



“System_clock” section manages the PLC internal clock. The system clock is updated by the supervision to permit the recording of the pH valve opening time during injection in automatic mode. It also permits to open the pH valve in manual mode during a defined time.

The other sections are devoted to the specific code for each control loops described in the following chapters of the document.

1.5. Initial Values

The following acronyms are used for the tags identities:
FB: Feed back
PS: pressure switch
IT: Intensity transmitter
FT: Flow transmitter
LT: Level transmitter
DPT: Differential pressure transmitter
PT: Pressure Transmitter
WT: Weight transmitter
FQRC: Flow Quantity recording Controller (Mass Flow Controller)
TT: Temperature Transmitter
AT: Analyser Transmitter
LIM: Limit
AH: High Alarm
AHH: Very High Alarm
AL: Low alarm
ALL: Very Low Alarm

The initial values are the values by default when the PLC starts.

Control Loop	variable	type	address	Initial value	Unit	comments
GENERAL	TT_Range_MAX	REAL		150	℃	Range max for Temperature transmitter
GENERAL	TT_Range_MIN	REAL		0	℃	Range min for Temperature transmitter
GENRAL	DPT_Range_MAX	REAL		3000	Mbar	Range max for differential pressure transmitter
GENRAL	DPT_Range_MIN	REAL		0	Mbar	Range min for differential pressure transmitter
GENRAL	FB_TIME_LIM	TIME	400500	t#5s	time	Time to trigger the alarm of the valve (linked to the feedback)
CL3000	CL3000_ControlLoop_Mode	INT	400230	0	-	Mode Selector (Will not be active untill the CII arrives in the MPP)
CL3001	CL3001_ControlLoop_Mode	INT	400231	0	-	Mode Selector (OFF/Manu/Auto)
CL3001	TT_3001_01_LIM_H	REAL	400512	1	℃	High temperature in the influent Tank. Compared to the set point
CL3001	TT_3001_01_LIM_HH	REAL	400514	2	℃	Very High temperature in the influent Tank. Compared to the set point
CL3001	TT_3001_01_LIM_L	REAL	400516	-1	℃	Low Temperature in the influent Tank. Compared to the set point
CL3001	TT_3001_01_LIM_LL	REAL	400518	-2	℃	Very Low Temperature in the influent Tank. Compared to the set point
CL3001	TT_3001_01_SP	REAL	400074	10	℃	Temperature set point of influent tank
CL3002	LT_3002_01_LIM_H	REAL	400520	30	L	High level in Influent Tank. fix value

Control Loop	variable	type	address	Initial value	Unit	comments
CL3002	LT_3002_01_LIM_HH	REAL	400522	34	L	Very High Level in the Influent Tank. fix value
CL3002	LT_3002_01_LIM_L	REAL	400702	6	L	Very low Level in the Influent Tank. fix value
CL3002	LT_3002_01_LIM_LL	REAL	400524	3	L	Very low Level in the Influent Tank. fix value
CL3002	LT_3002_01_MAX	REAL		41.9517	L	Range max for the Influent Level transmitter
CL3002	LT_3002_01_MIN	REAL		1.4937	L	Range min for Influent Level transmitter
CL3003	FT_3003_01_LIM_H	REAL	400526	0.1	L/h	High Flow on the bioreactor inlet liquid. Implement a time for triggering alarm (5min).. Compared to the set point
CL3003	FT_3003_01_LIM_HH	REAL	400528	0.2	L/h	Very High Flow on the bioreactor inlet liquid. Implement a time for triggering alarm (5min).. Compared to the set point
CL3003	FT_3003_01_LIM_L	REAL	400530	-0.1	L/h	Low Flow on the bioreactor inlet liquid. Implement a time for triggering alarm (5min).. Compared to the set point
CL3003	FT_3003_01_LIM_LL	REAL	400532	-0.2	L/h	Very Low Flow on the bioreactor inlet liquid. Implement a time for triggering alarm (5min).. Compared to the set point
CL3003	FT_3003_01_SP	REAL	400208	0	L/h	Used to configure the flow of the Bioreactor inlet liquid in automatic mode
CL3003	PP_3003_01_SP	REAL	400078	0	%	Used to define the speed of PP_3003_01
CL3003	PT_3003_01_LIM_H	REAL	400534	45	Mbar	High Flow on the bioreactor inlet liquid
CL3003	PT_3003_01_LIM_HH	REAL	400536	50	Mbar	Very High Flow on the bioreactor inlet liquid. The maximum admissible pressure for the membrane has to be confirmed by Enrique
CL3003	PT_3003_01_LIM_L	REAL	400538	5	Mbar	Low Flow on the bioreactor inlet liquid
CL3003	PT_3003_01_LIM_LL	REAL	400540	0	Mbar	Very Low Flow on the bioreactor inlet liquid. The minimum admissible pressure for the membrane has to be confirmed by Enrique
CL3004	BLE_3004_01_LIM_H	REAL	400542	5	%	High speed on the bioreactor blender (Compared to the set point)
CL3004	BLE_3004_01_LIM_L	REAL	400544	-5	%	Low speed on the bioreactor blender (Compared to the set point)
CL3004	BLE_3004_01_SP	REAL	400084	0	%	Used to define the speed of BLE_3004_01
CL3005	TT_3005_01_LIM_H	REAL	400546	1	℃	Compared to the set point. High Temperature in the bioreactor
CL3005	TT_3005_01_LIM_HH	REAL	400548	4	℃	Compared to the set point. Very High Temperature in the bioreactor
CL3005	TT_3005_01_LIM_L	REAL	400550	-1	℃	Compared to the set point. High Temperature in the bioreactor
CL3005	TT_3005_01_LIM_LL	REAL	400552	-4	℃	Compared to the set point. Very High Temperature in the bioreactor
CL3005	TT_3005_02_LIM_H	REAL	400554	1	℃	Compared to the set point. High Temperature in the bioreactor Jacket
CL3005	TT_3005_02_LIM_HH	REAL	400556	4	℃	Compared to the set point. Very High Temperature in the bioreactor Jacket
CL3005	TT_3005_02_LIM_L	REAL	400558	-1	℃	Compared to the set point. High Temperature in the bioreactor Jacket
CL3005	TT_3005_02_LIM_LL	REAL	400560	-4	℃	Compared to the set point. Very High Temperature in the bioreactor Jacket
CL3005	TT_3005_SP	REAL	400088	28	℃	Used to define the temperature set point of the bioreactor
CL3006	CL3006_BioreactorLevel_SP	REAL	400168	12	L	Used to define the level Set Point of the Bioreactor
CL3006	CL3006_ControlLoop_Mode	INT	400245	0	-	Mode Selector (OFF/Auto)
CL3006	LT_3006_01_LIM_H	REAL	400704	12.2	L	High Level in Bioreactor. Need a sensor calibration
CL3006	LT_3006_01_LIM_HH	REAL	400562	12.3	L	Very High Level in Bioreactor. after calibration of the sensor, we will define the HH level threshold similar to the level switch High
CL3006	LT_3006_01_LIM_L	REAL	400706	11.3	L	Low Level in Bioreactor. This alarm should be linked to the recirculation line and also to the output liquid flow line. the alarm is triggered when the level decrease to the limit of

Control Loop	variable	type	address	Initial value	Unit	comments
						these entering pipe.. Need a sensor calibration
CL3006	LT_3006_01_LIM_LL	REAL	400564	11.2	L	Very Low Level in Bioreactor. This alarm should be linked with the bioreactor sensor positionning to prevent bad mesurement.. Need a sensor calibration
CL3007	CL3007_Pressure_Threshold	REAL	400216	80	Mbar	Threshold which triggers the bioreactor pressure releasing
CL3007	DPT_3007_01_LIM_H	REAL	400574	200	Mbar	TO BE CONFIRMED BY UAB. High differential pressure in the bioreactor
CL3007	DPT_3007_01_LIM_HH	REAL	400576	500	Mbar	TO BE CONFIRMED BY UAB. Very High differential pressure in the bioreactor
CL3007	DPT_3007_01_LIM_L	REAL	400578	0	Mbar	Do a test with only beeds to see the DP, then the threshold will be this DP. Low differential pressure in the bioreactor
CL3007	DPT_3007_01_LIM_LL	REAL	400580	0	Mbar	Very Low differential pressure in the bioreactor
CL3007	PT_3007_01_LIM_H	REAL	400566	100	Mbar	High pressure in the bioreactor. (fix value)
CL3007	PT_3007_01_LIM_HH	REAL	400568	200	Mbar	Very High pressure in the bioreactor. (fix value)
CL3007	PT_3007_01_LIM_L	REAL	400570	-20	Mbar	The alarm is triggered after 1min/. Low pressure in the bioreactor. (Compared to SP)
CL3007	PT_3007_01_LIM_LL	REAL	400572	0	Mbar	Very Low pressure in the bioreactor. (fix value)
CL3007	PT_3007_01_SP	REAL	400214	50	Mbar	Set Point of the Controller managing the bioreactor pressure
CL3008	CL3008_ControlLoop_Mode	INT	400235	0	-	Mode Selector (OFF/Manu/Auto)
CL3008	CL3008_DeadZone	REAL	400106	0.1	-	Used to define the Dead Zone of the pH bioreactor
CL3008	CL3008_pH_LIM_H	REAL	400582	0.1	-	High pH in the Bioreactor. Compared to the set point
CL3008	CL3008_pH_LIM_HH	REAL	400584	0.5	-	Very High pH in the Bioreactor. Compared to the set point
CL3008	CL3008_pH_LIM_L	REAL	400586	-0.1	-	Low pH in the Bioreactor. Compared to the set point
CL3008	CL3008_pH_LIM_LL	REAL	400588	-0.5	-	Very Low pH in the Bioreactor. Compared to the set point
CL3008	CL3008_pH_Mode	INT	400247	2	-	Define the pH mode for bioreactor pH control (1-Only CO2 / 2-CO2 and BASE / 3-CO2 is fixed and ACID+BASE)
CL3008	CL3008_pH_selector	INT	400248	0	-	Define the pH probe used for the Control. (0=Average / 1 = AT_3008_01 / 2 = AT_3008_02)
CL3008	CL3008_pH_SP	REAL	400104	8	-	Used to define the pH set point of the bioreactor
CL3008	CL3008_SENSOR_DEVIATION_LIM	REAL	400708	0.5	-	The alarm is permanently checking the sensor deviation. Even if you choose only one of the two pH sensors
CL3008	FQRC_3008_01_LIM_H	REAL	400710	20	Ml/min	High Flow in the CO2 GAS Mass Flow Controller
CL3008	FQRC_3008_01_LIM_HH	REAL	400712	50	Ml/min	Very High Flow in the CO2 GAS Mass Flow Controller
CL3008	FQRC_3008_01_LIM_L	REAL	400714	-20	Ml/min	Low Flow in the GAS CO2 Mass Flow Controller
CL3008	FQRC_3008_01_LIM_LL	REAL	400716	-50	Ml/min	Very Low Flow in the CO2 GAS Mass Flow Controller
CL3008	FQRC_3008_01_OP	REAL	400206	0	Ml/min	Used to define the opening Set point of the mass flow controller valve in manual mode
CL3008	PP_3008_01_OP_TIME	UDINT	400061	0	s	Define the injection time of the ACID pump in Manual mode
CL3008	PP_3008_02_OP_TIME	UDINT	400063	0	s	Define the injection time of the BASE pump in Manual mode
CL3008	WIT_3008_01_LIM_L	REAL	400590	1	Kg	Low Level in the ACID tank
CL3008	WIT_3008_01_LIM_LL	REAL	400592	0.5	Kg	Very Low Level in the ACID tank
CL3008	WIT_3008_02_LIM_L	REAL	400594	1	Kg	Low Level in the BASE tank
CL3008	WIT_3008_02_LIM_LL	REAL	400596	0.5	Kg	Very Low Level in the BASE tank
CL3009	AT_3009_LIM_H	REAL	400598	10	%	High percentage of Dissolved Oxygen. Compared to the set point

Control Loop	variable	type	address	Initial value	Unit	comments
CL3009	AT_3009_LIM_HH	REAL	400600	20	%	Very High percentage of Dissolved Oxygen. Compared to the set point
CL3009	AT_3009_LIM_L	REAL	400602	-20	%	Low percentage of Dissolved Oxygen. Compared to the set point
CL3009	AT_3009_LIM_LL	REAL	400604	-40	%	Very Low percentage of Dissolved Oxygen. Compared to the set point
CL3009	CL3009_ControlLoop_Mode	INT	400236	0	-	Mode Selector (OFF/Manu/Auto)
CL3009	CL3009_DO2_selector	INT	400249	0	-	Define the DO2 probe used for the Control. (0=Average / 1 = AT_3009_01 / 2 = AT_3009_02)
CL3009	CL3009_DO2_SP	REAL	400172	0	%	Used to define the Set point of the Dissolved Oxygen in automatic mode (Controller set point)
CL3009	CL3009_SENSOR_DEVIATION_LIM	REAL	400734	5	%	The alarm is permanently checking the sensor deviation. Even if you choose only one of the two dissolve dioxygen sensors
CL3009	FQRC_3009_01_LIM_H	REAL	400718	100	Ml/min	High Flow in the O2 GAS Mass Flow Controller. Compared to the set point asked by the predictive controller
CL3009	FQRC_3009_01_LIM_HH	REAL	400720	300	Ml/min	Very High Flow in the O2 GAS Mass Flow Controller. Compared to the set point asked by the predictive controller
CL3009	FQRC_3009_01_LIM_L	REAL	400722	-100	Ml/min	Low Flow in the GAS O2 Mass Flow Controller. Compared to the set point asked by the predictive controller
CL3009	FQRC_3009_01_LIM_LL	REAL	400724	-300	Ml/min	Very Low Flow in the O2 GAS Mass Flow Controller. Compared to the set point asked by the predictive controller
CL3009	FQRC_3009_01_OP	REAL	400120	0	Ml/min	Used to define the opening Set point of the mass flow controller valve in manual mode
CL3009	FQRC_3009_01_SP	REAL	400190	0	Ml/min	Flow Control Valve non sterile gas (O2)
CL3010	AT_3010_LIM_H	REAL	400606	7.5	µS/cm	High Electro Conductivity in the Bioreactor
CL3010	AT_3010_LIM_HH	REAL	400608	9	µS/cm	Very High Electro Conductivity in the Bioreactor
CL3010	AT_3010_LIM_L	REAL	400610	4.5	µS/cm	Low Electro Conductivity in the Bioreactor
CL3010	AT_3010_LIM_LL	REAL	400612	3	µS/cm	Very Low Electro Conductivity in the Bioreactor
CL3011	CL3011_N2_FQRC_MAX	REAL		3000	Ml/min	Tag linked to the calculation of the controller max limit.
CL3011	FQRC_3011_01_LIM_H	REAL	400694	100	Ml/min	High Flow in the N2 GAS Mass Flow Controller. Compared to the set point
CL3011	FQRC_3011_01_LIM_HH	REAL	400696	300	Ml/min	Very High Flow in the N2 GAS Mass Flow Controller. Compared to the set point
CL3011	FQRC_3011_01_LIM_L	REAL	400698	-100	Ml/min	Low Flow in the GAS N2 Mass Flow Controller. Compared to the set point
CL3011	FQRC_3011_01_LIM_LL	REAL	400700	-300	Ml/min	Very Low Flow in the N2 GAS Mass Flow Controller. Compared to the set point
CL3011	FQRC_3011_01_OP	REAL	400132	0	Ml/min	Used to define the opening Set point of the mass flow controller valve in manual mode
CL3011	FQRC_3011_02_LIM_H	REAL	400726	100	Ml/min	High Flow in the GAS MIX Mass Flow Controller. Compared to the set point
CL3011	FQRC_3011_02_LIM_HH	REAL	400728	300	Ml/min	Very High Flow in the GAS MIX Mass Flow Controller. Compared to the set point
CL3011	FQRC_3011_02_LIM_L	REAL	400730	-100	Ml/min	Low Flow in the GAS MIX Mass Flow Controller. Compared to the set point
CL3011	FQRC_3011_02_LIM_LL	REAL	400732	-300	Ml/min	Very Low Flow in the GAS MIX Mass Flow Controller. Compared to the set point
CL3011	FQRC_3011_02_OP	REAL	400134	0	Ml/min	Used to define the opening Set point of the mass flow controller valve in manual mode
CL3011	PT_3011_01_LIM_H	REAL	400614	100	Mbar	High pressure in the gas loop system
CL3011	PT_3011_01_LIM_HH	REAL	400616	500	Mbar	Very High pressure in the gas loop system
CL3011	PT_3011_01_LIM_L	REAL	400618	40	Mbar	Need to be tested by sherpa. If the threshold is too high, we can decrease to 30 or 20. Low pressure in the gas loop system
CL3011	PT_3011_01_LIM_LL	REAL	400620	0	Mbar	Very Low pressure in the gas loop system
CL3012	TT_3012_01_LIM_H	REAL	400622	11	℃	To be confirmed by UAB when the reactor will be in nominal work. High Temperature in the Gas Cooling system

Control Loop	variable	type	address	Initial value	Unit	comments
CL3012	TT_3012_01_LIM_HH	REAL	400624	20	℃	To be confirmed by UAB when the reactor will be in nominal work. Very High Temperature in the Gas Cooling system
CL3012	TT_3012_01_LIM_L	REAL	400626	9	℃	To be confirmed by UAB when the reactor will be in nominal work. Low Temperature in the Gas Cooling system
CL3012	TT_3012_01_LIM_LL	REAL	400628	8	℃	To be confirmed by UAB when the reactor will be in nominal work. Very Low Temperature in the Gas Cooling system
CL3013	AT_3013_01_LIM_H	REAL	400630	100	mg/L	High level AMMONIA
CL3013	AT_3013_01_LIM_HH	REAL	400632	400	mg/L	Very High level AMMONIA
CL3013	AT_3013_02_LIM_H	REAL	400638	500	mg/L	High level of NITRATE
CL3013	AT_3013_02_LIM_HH	REAL	400640	600	mg/L	Very High level of NITRATE
CL3013	AT_3013_02_LIM_L	REAL	400642	300	mg/L	Low level of NITRATE
CL3013	AT_3013_02_LIM_LL	REAL	400644	250	mg/L	Very Lowlevel of NITRATE
CL3013	AT_3013_03_LIM_H	REAL	400646	0.5	mg/L	High level of NITRITE
CL3013	AT_3013_03_LIM_HH	REAL	400648	20	mg/L	Very High level of NITRITE
CL3013	CL3013_NH4_Analysis_Time_CFG	UINT	400250	30	min	AUTOMATIC MODE ONLY / Configuration time in minute between two start analysis function (NH4+ analyzer)
CL3013	CL3013_NH4_Calibration_Time_CFG	UINT	400252	24	hour	AUTOMATIC MODE ONLY / Configuration time (in hour)between two Calibration function (NH4+ analyzer)
CL3013	CL3013_NH4_ControlLoop_Mode	INT	400238	0	-	NH4 Analyzer Mode Selector (OFF/Manu/Auto)
CL3013	CL3013_NO2_Analysis_Time_CFG	UINT	400258	30	min	AUTOMATIC MODE ONLY / Configuration time in minute between two start analysis function (NO2- analyzer)
CL3013	CL3013_NO2_ControlLoop_Mode	INT	400274	0	-	NO2 Analyzer Mode Selector (OFF/Manu/Auto)
CL3013	CL3013_NO3_Analysis_Time_CFG	UINT	400254	30	min	AUTOMATIC MODE ONLY / Configuration time in minute between two start analysis function (NO3- analyzer)
CL3013	CL3013_NO3_Calibration_Time_CFG	UINT	400256	24	hour	AUTOMATIC MODE ONLY / Configuration time (in hour) between two Calibration function (NO3- analyzer)
CL3013	CL3013_NO3_ControlLoop_Mode	INT	400273	0	-	NO3 Analyzer Mode Selector (OFF/Manu/Auto)
CL3015	CL3015_ControlLoop_Mode	INT	400239	0	-	Mode Selector (OFF/Manu/Auto)
CL3016	CL3016_ControlLoop_Mode	INT	400240	0	-	Mode Selector (OFF/Manu/Auto)
CL3017	CL3017_ControlLoop_Mode	INT	400241	0	-	Mode Selector (OFF/Manu/Auto)
CL3017	CL3017_FLOW_SP	REAL	400176	3.6	L/hour	Used to define the flow set point of the recirculation loop in automatic mode
CL3017	FT_3017_01_LIM_H	REAL	400662	0.1	L/hour	Compared to the set point. The time for triggering the alarm 1min. High Flow in the Recirculation Loop
CL3017	FT_3017_01_LIM_HH	REAL	400664	0.2	L/hour	Compared to the set point. The time for triggering the alarm 1min. Very High Flow in the recirculation Loop
CL3017	FT_3017_01_LIM_L	REAL	400666	-0.1	L/hour	Compared to the set point. The time for triggering the alarm 1min. Low Flow in the Recirculation Loop
CL3017	FT_3017_01_LIM_LL	REAL	400668	-0.2	L/hour	Compared to the set point. The time for triggering the alarm 1min. Very Low Flow in the Recirculation Loop
CL3017	PP_3017_01_SP	REAL	400150	0	%	Used to define the speed of the peristaltic pump in manual mode
CL3018	CL3018_ControlLoop_Mode	INT	400242	0	-	Mode Selector (OFF/Manu/Auto)
CL3018	CL3018_FLOW_SP	REAL	400170	0	L/hour	Used to define the Set Point of the flow in Automatic mode
CL3018	FT_3018_01_LIM_H	REAL	400670	0.1	L/hour	Compared to the set point and triggered after 1 min. action is done in level control. High Flow in outlet liquid Loop
CL3018	FT_3018_01_LIM_HH	REAL	400672	0.2	L/hour	Compared to the set point and triggered after 1 min. action is done in level control. Very High flow in outlet liquid Loop
CL3018	FT_3018_01_LIM_L	REAL	400674	-0.1	L/hour	Compared to the set point and triggered after 1 min. action is done in level control. Low Flow in outlet liquid Loop
CL3018	FT_3018_01_LIM_LL	REAL	400676	-0.2	L/hour	Compared to the set point and triggered after 1 min. action is done in level control. Very Low Flow in outlet liquid Loop

Control Loop	variable	type	address	Initial value	Unit	comments
CL3018	PP_3018_01_SP	REAL	400154	0	%	Used to define the speed of the peristatic pump in manual mode
CL3020	CL3020_ControlLoop_Mode	INT	400243	0	-	Mode Selector (OFF/Manu/Auto)
CL3020	TT_3020_01_LIM_H	REAL	400678	1	℃	Compared to the set point. High temperature in the effluent Tank
CL3020	TT_3020_01_LIM_HH	REAL	400680	2	℃	Compared to the set point. Very High temperature in the effluent Tank
CL3020	TT_3020_01_LIM_L	REAL	400682	-1	℃	Compared to the set point. Low Temperature in the effluent Tank
CL3020	TT_3020_01_LIM_LL	REAL	400684	-2	℃	Compared to the set point. Very Low Temperature in the effluent Tank
CL3020	TT_3020_01_SP	REAL	400160	10	℃	Used to define the temperature set point of effluent tank
CL3021	LT_3021_01_LIM_H	REAL	400686	30	L	High level on Effluent tank
CL3021	LT_3021_01_LIM_HH	REAL	400688	34	L	Very High level on Effluent tank
CL3021	LT_3021_01_LIM_L	REAL	400690	6	L	Low level in Effluent Tank
CL3021	LT_3021_01_LIM_LL	REAL	400692	3	L	Very Low in Effluent Tank
CL3021	LT_3021_01_MAX	REAL		41.607	L	Range max for the Effluent Level transmitter
CL3021	LT_3021_01_MIN	REAL		1.551	L	Range min for Effluent Level transmitter
CL3022	CL3022_ControlLoop_Mode	INT	400244	0	-	Mode Selector (OFF/Manu/Auto)

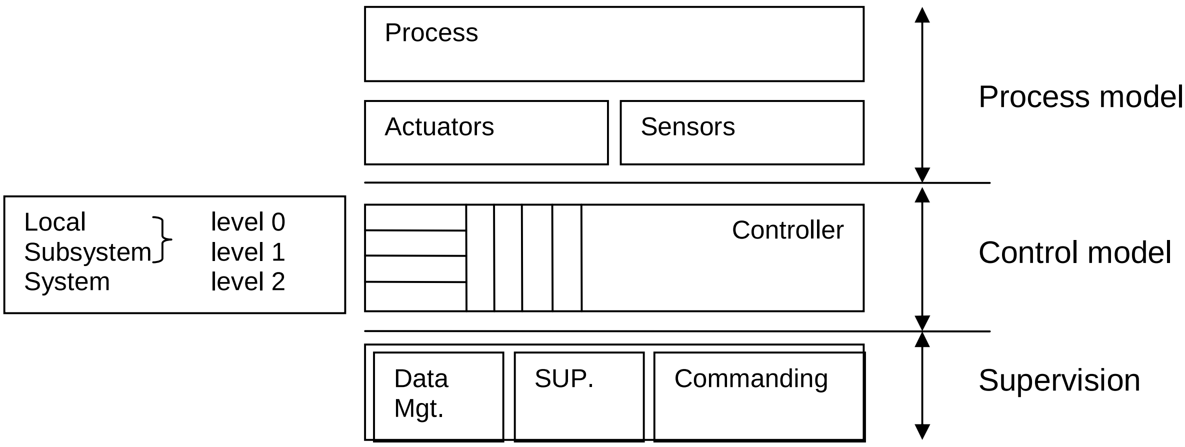
2. System Description

2.1. Control levels

4 levels for the control are commonly used:

- Level 0 control: ancillaries, local regulations
- Level 1 control: dynamic control
- Level 2 control: static/dynamic optimisation
- Level 3 control: planning, sequencing and scheduling.

Different Levels of Model are developed:
Process model including Process, Sensors and Actuators
Control Model: for the Controller and including Local (level 0), subsystem and system (level 1 and 2) control laws.



2.2. Control Loops

Hereafter the list of the control loops as programmed in the PLC. It corresponds to the different sections in the software

Control Loop	***Control Loop Name***	***Location***	***FBD_Name***
3000	Influent General.	Influent	CL3000_Influent_General
3001	Influent Temperature Control.	Influent	CL3001_Influent_Temp_Control
3002	Influent Level Control	Influent	CL3002_Influent_Level_Control
3003	Inlet Liquid Control	Bioreactor	CL3003_Inlet_Liquid_Control
3004	Bioreactor General	Bioreactor	CL3004_Bioreactor_General
3005	Bioreactor Temperature Control	Bioreactor	CL3005_Bioreactor_Temp_Control
3006	Bioreactor Level Control	Bioreactor	CL3006_Bioreactor_Level_Control
3007	Bioreactor Pressure Control	Bioreactor	CL3007_Bioreactor_Pressu_Control
3008	Bioreactor pH Control	Bioreactor	CL3008_Bioreactor_pH_Control
3009	Bioreactor DO2	Bioreactor	CL3009_Bioreactor_DO2_Control
3010	Bioreactor EC Control	Bioreactor	CL3010_Bioreactor_EC_Control
3011	Gas Loop	Bioreactor	CL3011__Gas_Loop
3012	Gas Temperature	Bioreactor	CL3012_Gas_Temperature
3013	Analysis of Liquid	Bioreactor	CL3013_Analysis_of_liquid
3014	Biomass Control	Bioreactor	CL3014_Biomass_Control
3015	Backwashing	Bioreactor	CL3015_Backwashing
3016	Gaz Pulse	Bioreactor	CL3016_Gas_Pulse
3017	Liquid Recirculation	Bioreactor	CL3017_Liquid_Recirculation
3018	Outlet liquid Control	Bioreactor	CL3018_Outlet_Liquid_Control
3019	Effluent General	Effluent	N/A
3020	Effluent Temperature	Effluent	CL3020_Effluent_Temperature
3021	Effluent Level	Effluent	CL3021_Effluent_Level
3022	Foam Control	Bioreactor	CL3022_Foam_Control
3023	Sterilisation	Influent	N/A

Figure 1: Control loop definition

2.3. Influent General (CL3000)

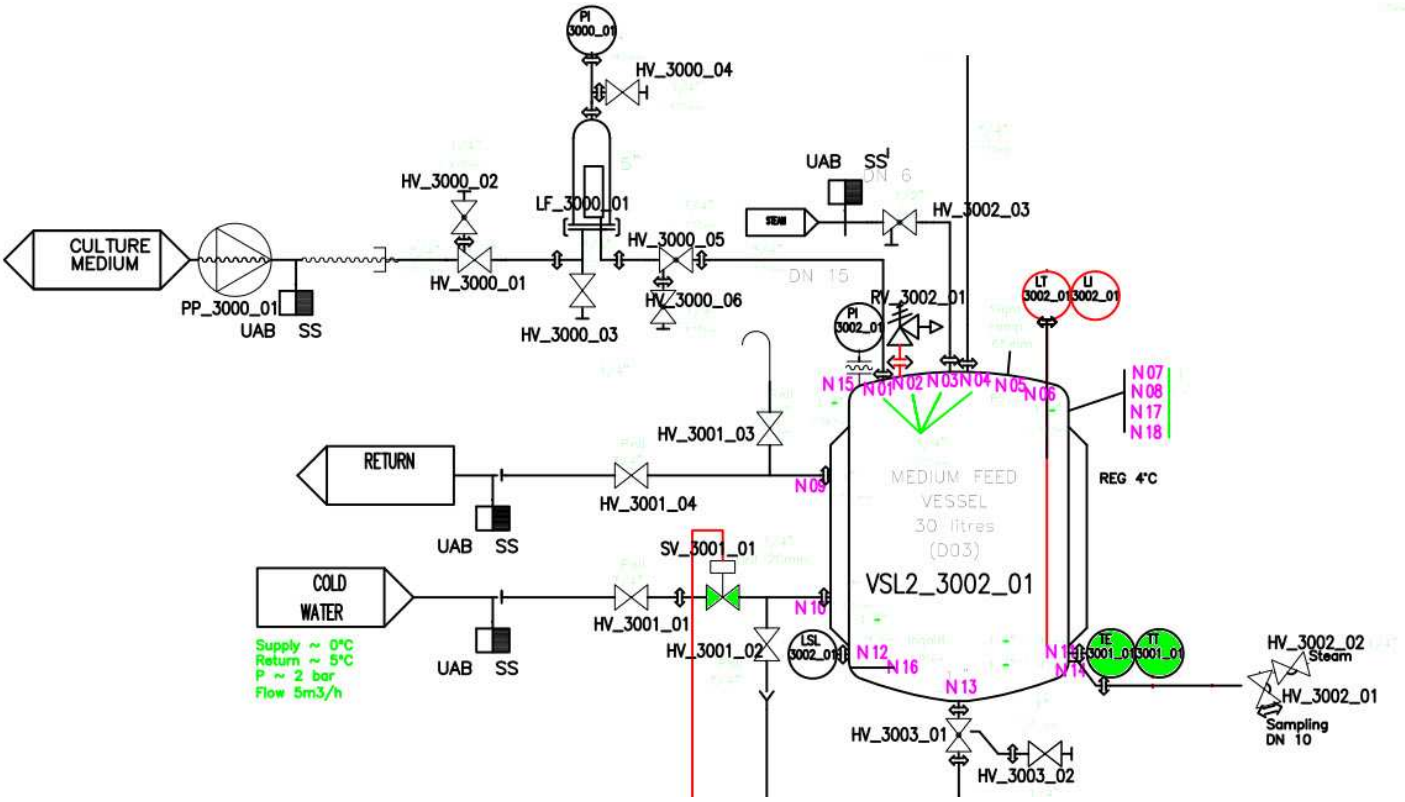
2.3.1.Function

At this step of the project, the connexion between CII and CIII does not exist. Nevertheless, the equipment address and control is already predefined in the PLC program.

PLC Section name	Equipment tag	Type	Address	Comment
CL3000_Influent_General	CL3000_ControlLoop_Mode	INT	400230	Mode Selector (Will be not active until the CII arrive in the MPP)
CL3000_Influent_General	PP_3000_01_OP	BOOL	000049	Used to start or stop the pump in manual mode
CL3000_Influent_General	PP_3000_01_MV	DO	000031	Existing pump for feeding D03 from CII

Figure 2: Influent General – EQUIPMENT / OPERATOR INPUTS

2.4. Influent Temperature Control (CL3001)



2.4.1.Function

Before entering inside the bioreactor, the liquid is maintained to a low temperature. This is done by MPP cold water utilities. The cold water circulates inside the Influent jacket. A boolean valve manages the circulation. Even if the current MPP utilities do not permit to reach, up to now, the required ideal set point (4℃), a controller maintains the temperature to the minimum reachable temperature (around 10℃).

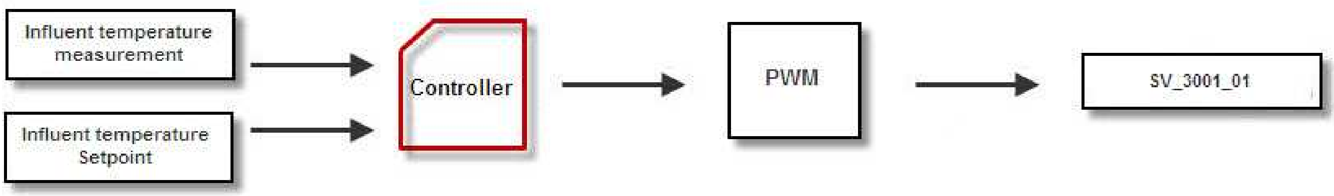
PLC Section name	Equipment tag	Type	Address	Comment
CL3001_Influent_Temp_Control	SV_3001_01_MV	DI	000019	Temperature Control Valve
CL3001_Influent_Temp_Control	SV_3001_01_FB	DO	100025	Temperature Control Valve Feedback
CL3001_Influent_Temp_Control	TT_3001_01	AI ->REAL	400072	Temperature element + transmitter

Figure 3 : Feeding tank Temperature Control – EQUIPMENTS

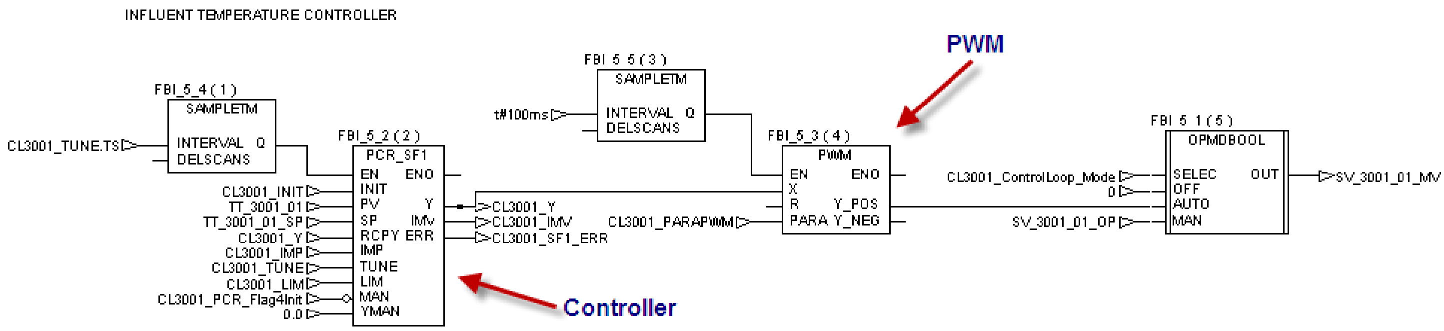
PLC Section name	Equipment tag	Type	Address	Comment
CL3001_Influent_Temp_Control	CL3001_ControlLoop_Mode	INT	400231	Mode Selector (OFF/Manu/Auto)
CL3001_Influent_Temp_Control	SV_3001_01_OP	BOOL	000050	open / close valve SV_3001_01
CL3001_Influent_Temp_Control	TT_3001_01_SP	REAL	400074	Temperature set point of influent tank

Figure 4 : Feeding tank Temperature Control – OPERATOR INPUTS

2.4.1.1. *Controller*

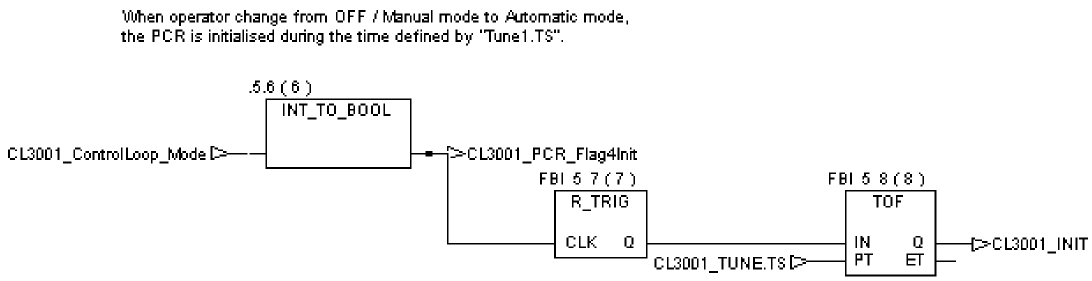


A predictive block "SF1" controls the Influent temperature (for more details on the block, see annex B). The signal is then converted into time by a PWM block because the controlled equipment is a Boolean valve. For more details on PWM block, see annex G.



2.4.1.2. *Controller initialization*

When the operator decides to switch in automatic mode, the controller is initialized during the sample time (see controller parameters).



2.4.1.3. *Controller parameter*

Controlled Variable	PCR CONTROLER TYPE	DEAD ZONE	ZTR Zone Control	PWM	SAMPLETM	PROCESS VALUE (input)	SET POINT
SV_3001_01	SF1	NO	NO	CL3001_PARAPWM t_period : 100ms t_pause : 0s t_brake : 0s t_min : 100ms t_max : 1s up_pos : 1 up_neg : 0	CL3001_TUNE.TS	TT_3001_01	TT_3001_01_SP

INTERNAL MODEL PROCESS	TUNE	LIMIT	SELF_CMP	DECOMP	Manipulated Variable (Controller Output in Auto Mode)	Controlled Equipment
KM : -4.21 TM : 570s DM :130s	TS : 10s H : 10s TRBF : 30m	CL3001_LIM Y_MIN: 0 Y_MIN: 1 YRATE: 10	NO	NO	CL3001_Y	SV_3001_01_MV

2.4.2. Alarms and Thresholds

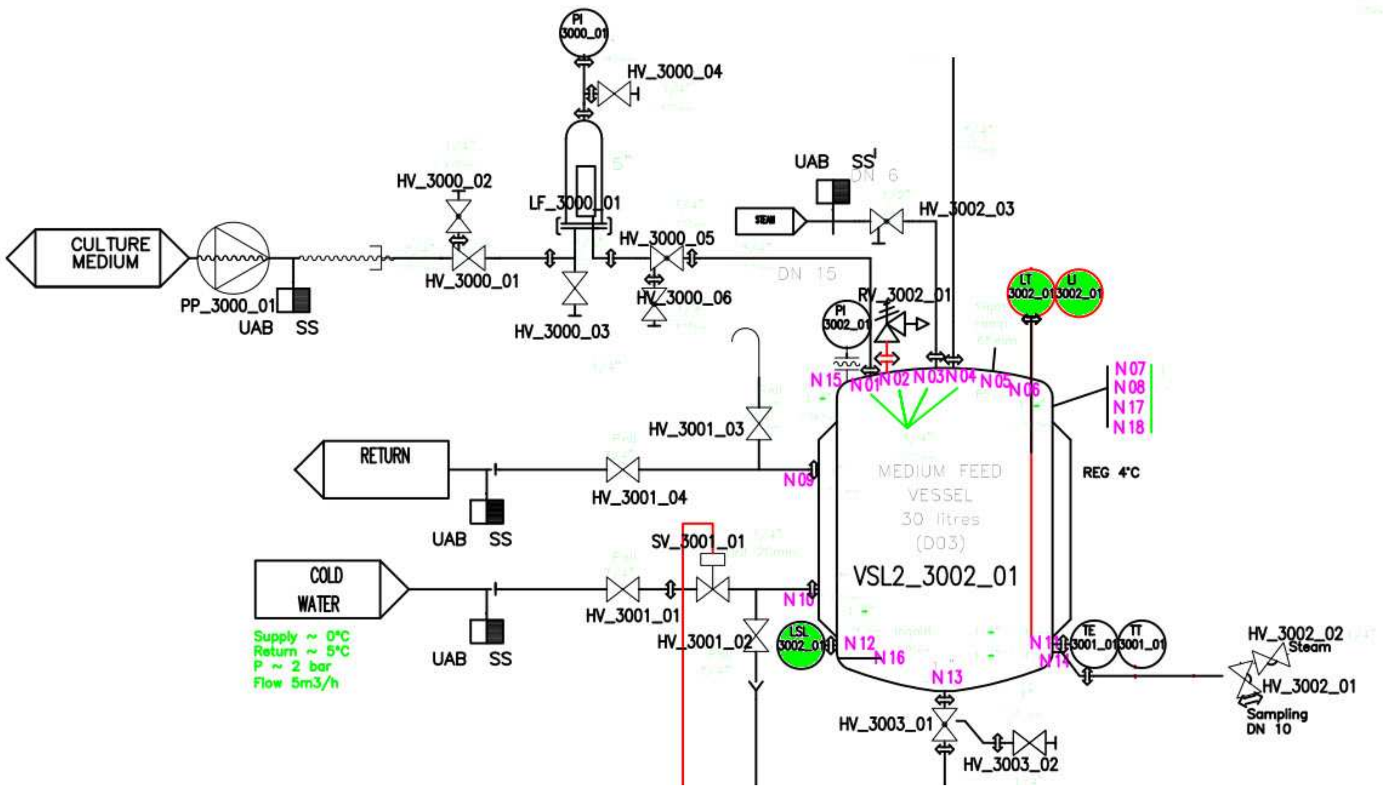
Alarm tag Name	type	Address	description
SV_3001_01_A	BOOL	000051	Valve in alarm / No feed back received
TT_3001_01_AH	BOOL	000052	High temperature alarm in influent tank
TT_3001_01_AHH	BOOL	000053	Very high temperature alarm in influent tank
TT_3001_01_AL	BOOL	000054	Low temperature alarm in influent tank
TT_3001_01_ALL	BOOL	000055	Very low temperature alarm in influent tank
TT_3001_01_ERR	BOOL	000056	Inlet Vessel Temp. Sensor Link Error

Figure 5 : Feeding tank Temperature Control – ALARMS

Threshold tag name	Type	Address	Value	Unit	Action
TT_3001_01_LIM_H	REAL	400512	1	(ºC)	Displays an alarm on the HMI Compared to the set point only in automatic mode
TT_3001_01_LIM_HH	REAL	400514	2	(ºC)	Displays an alarm on the HMI Compared to the set point only in automatic mode
TT_3001_01_LIM_L	REAL	400516	-1	(ºC)	Displays an alarm on the HMI Compared to the set point only in automatic mode
TT_3001_01_LIM_LL	REAL	400518	-2	(ºC)	Displays an alarm on the HMI Compared to the set point only in automatic mode

Figure 6 : Feeding tank Temperature Control – THRESHOLD

2.5. Influent Level Control (CL3002)



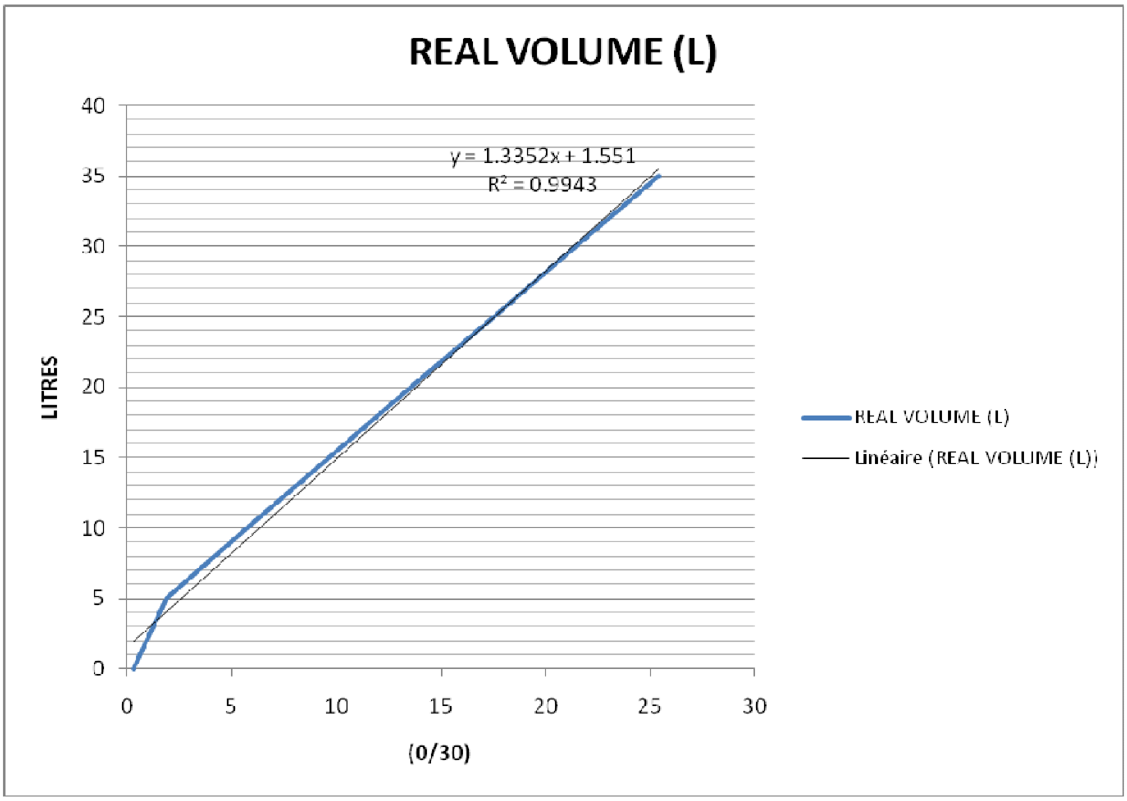
2.5.1.Function

The objective of this control loop is to supervise the Influent Level. It manages the alarms linked to the Low/LowLow and High/HighHigh levels.
There is no associated button in the HMI as the levels are monitored permanently.

Feeding tank Old Level range (0->30)	REAL VOLUME (L)
0.3	0
1.84	5
5.71	10
9.7	15
13.67	20
17.36	25
21.23	30
25.14	35

$y = 1.3486x + 1.4937$
$R^2 = 0.9946$

Following the level test, a correlation law is deducted between the measurement (0 / 30) and the real volume.
So the influent tank level probe range is from 1.4937 to 1.4937+30*1.3486.


REAL VOLUME (L)
LITRES
40
35
30
25
20
15
10
5
0
0
5
10
15
20
25
30
(0/30)
y = 1.3352x + 1.551
R² = 0.9943
REAL VOLUME (L)
Linéaire (REAL VOLUME (L))

PLC Section name	Equipment tag	Type	Address	Comment
CL3002_Influent_Level_Control	LSL_3002_01	DI	100021	Level switch (Vibrating horizontal)
CL3002_Influent_Level_Control	LSL_3002_02	DI	100022	Level switch (Vibrating horizontal)
CL3002_Influent_Level_Control	LT_3002_01	AI->REAL	400076	Level transmitter (capacitive)

Figure 7: Influent Level - EQUIPMENTS

There is no OPERATOR INPUTS for this control loop

2.5.2.Block Diagram

No Block Diagram associated

2.5.3.Alarms and Threshold

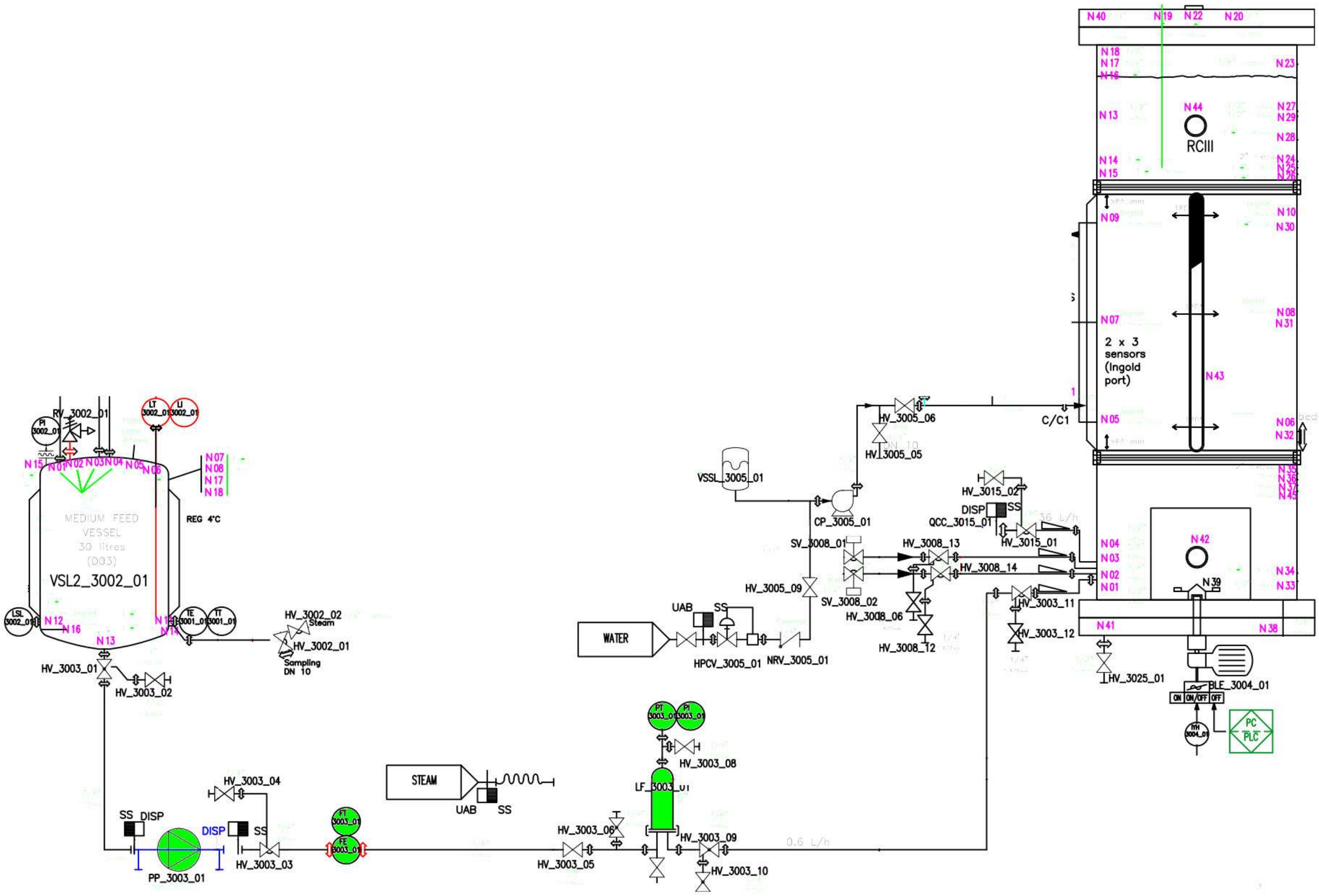
Alarm tag Name	type	Address	description
LSL_3002_01_A	BOOL	000271	The alarm is triggered after 10s
LSL_3002_02_A	BOOL	000272	The alarm is triggered after 10s
LT_3002_01_AH	BOOL	000057	High level in Influent Tank
LT_3002_01_AHH	BOOL	000058	Very High Level in the Influent Tank fix value
LT_3002_01_AL	BOOL	000241	Very low Level in the Influent Tank
LT_3002_01_ALL	BOOL	000059	Very low Level in the Influent Tank **Stop the control loop 3003** (pump PP_3003_01)
LT_3002_01_ERR	BOOL	000060	SET if the wire is broken

Figure 8: Influent Level - ALARMS

Threshold tag name	Type	Address	Value	Unit	ACTION
LT_3002_01_LIM_H	REAL	400520	30	LITRE	fix value Displays an alarm on the HMI
LT_3002_01_LIM_HH	REAL	400522	34	LITRE	fix value Displays an alarm on the HMI / depends on the futur link between CII and CIII.
LT_3002_01_LIM_L	REAL	400702	6	LITRE	fix value Displays an alarm on the HMI
LT_3002_01_LIM_LL	REAL	400524	3	LITRE	fix value **Stop the control loop 3003** (pump PP_3003_01)

Figure 9: Influent Level – THRESHOLD

2.6. Inlet Liquid Flow (CL3003)



2.6.1.Function

Important point:
At the Current time (2010/10/04), Actions linked to the "PT_3003_01_AHH" and "PT_3003_01_ALL (both stop the inlet pump PP_3003_01) are not operational.
As the thresholds are not confirmed, the actions are disconnected.

The aim of this loop is to control the flow of medium from influent tank to the bioreactor.

PLC Section name	Equipment tag	Type	Address	Comment
CL3003_Inlet_Liquid_Control	PP_3003_01_MV1	DO	000045	Peristaltic Pump, variable speed (feed C01), On/Off
CL3003_Inlet_Liquid_Control	PP_3003_01_MV2	REAL->AO	400198	Peristaltic Pump, variable speed (feed C01)
CL3003_Inlet_Liquid_Control	PP_3003_01_MV3	DO	000046	Peristaltic Pump, ROTATION DIRECTION
CL3003_Inlet_Liquid_Control	FT_3003_01	AI->REAL	400080	Flow element + transmitter (feed)
CL3003_Inlet_Liquid_Control	PT_3003_01	AI->REAL	400082	Pressure transmitter

Figure 10: Inlet Liquid Flow – EQUIPMENT

PLC Section name	tag	Type	Address	Comment
CL3003_Inlet_Liquid_Control	CL3003_ControlLoop_Mode	INT	400232	Mode Selector (OFF/Manu/Auto)
CL3003_Inlet_Liquid_Control	PP_3003_01_OP	BOOL	000061	Used to start or stop the pump in manual mode
CL3003_Inlet_Liquid_Control	PP_3003_01_SP	REAL	400078	Used to define the speed of PP_3003_01
CL3003_Inlet_Liquid_Control	PP_3003_01_DIR	BOOL	000062	Used to define the direction of PP_3003_01(CW / CCW)
CL3003_Inlet_Liquid_Control	FT_3003_01_SP	REAL	400208	Used to configure the flow of the Bioreactor inlet liquid in automatic mode

Figure 11: Inlet liquid Flow - OPERATOR INPUT

2.6.2.Block Diagram

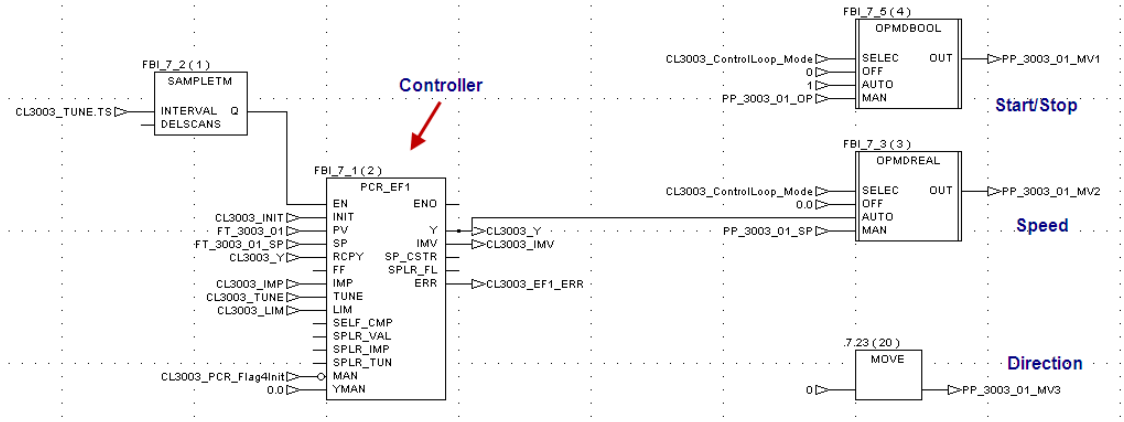
2.6.2.1.1. Controller

The control is done by the Predictive control block EF1 (Simple predictive controller for first order process) (See annex C). An internal model represents the flow function of the pump speed. Depending of this model, the controller will adjust the flow with the pump speed to maintain the desired set point.

The flow control depends on the mode selected by the operator:

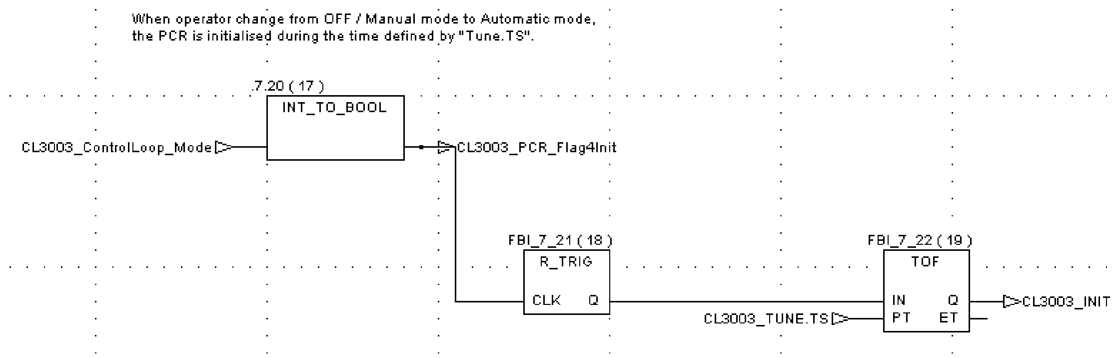
- OFF mode: The pump is switched OFF
- MAN mode: The user can decide to switch ON the pump and define the speed of the pump

➢ AUTO mode: The controller adjusts the pump to satisfy the flow set point



2.6.2.1.2. Controller initialization

When the operator decides to switch to the automatic mode, the controller is initialized during the sample time (see controller parameters)



2.6.2.1.3. Controller parameters

Controlled Variable	PCR CONTROLER TYPE	DEAD ZONE	ZTR Zone Control	PWM	SAMPLETM	PROCESS VALUE (input)	SET POINT
Pump speed of inlet flow (PP_3003_01_MV2)	EF1	NO	NO	NO	CL3003_TUNE.TS	FT_3003_01	FT_3003_01_SP

INTERNAL MODEL PROCESS	TUNE	LIMIT	SELF_CMP	DECOMP	Manipulated Variable (Controller Output in Auto Mode)	Controlled Equipment
KM : 0.06 TM : 1,3s DM : 0s	TS : 100ms H : 100ms TRBF : 4s	CL3003_LIM YMIN : 0 YMAX : 100 YRATE : 100	NO	NO	CL3003_Y	PP_3003_01_MV2

2.6.3. Alarm and Threshold

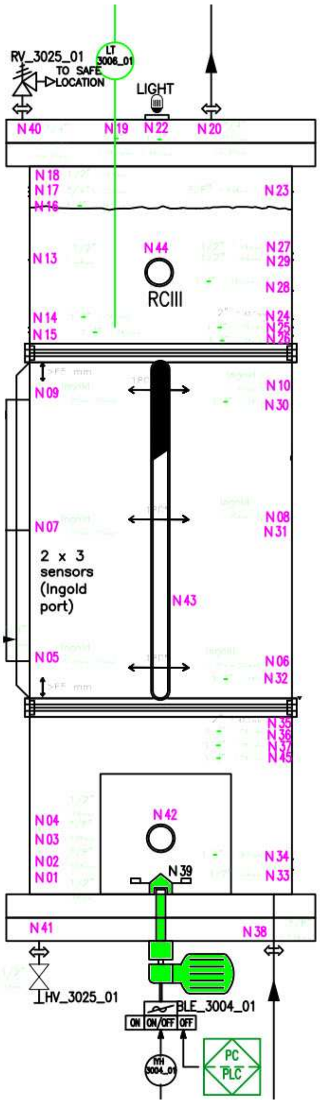
Alarm tag Name	type	Address	description
FT_3003_01_AH	BOOL	000063	High Flow on the bioreactor inlet liquid Implement a time for triggering alarm (5min).
FT_3003_01_AHH	BOOL	000064	Very High Flow on the bioreactor inlet liquid Implement a time for triggering alarm (5min). **Stop the control loop 3003** (pump PP_3003_01)
FT_3003_01_AL	BOOL	000065	Low Flow on the bioreactor inlet liquid Implement a time for triggering alarm (5min). Compared to the set point
FT_3003_01_ALL	BOOL	000066	Very Low Flow on the bioreactor inlet liquid Implement a time for triggering alarm (5min). Compared to the set point
FT_3003_01_ERR	BOOL	000067	SET if the wire is broken
PT_3003_01_AH	BOOL	000228	High Flow on the bioreactor inlet liquid
PT_3003_01_AHH	BOOL	000229	Very High Flow on the bioreactor inlet liquid **Stop the control loop 3003** (pump PP_3003_01)
PT_3003_01_AL	BOOL	000230	Low Flow on the bioreactor inlet liquid
PT_3003_01_ALL	BOOL	000231	Very Low Flow on the bioreactor inlet liquid **Stop the control loop 3003** (pump PP_3003_01)
PT_3003_01_ERR	BOOL	000068	SET if the wire is broken

Figure 12: Inlet Liquid Flow – ALARM

Threshold tag name	Type	Address	Value	Unit	Action
FT_3003_01_LIM_H	REAL	400526	0.1	(L/h)	Displays an alarm on the HMI Compared to the set point only in automatic mode
FT_3003_01_LIM_HH	REAL	400528	0.2	(L/h)	**Stop the control loop 3003** (pump PP_3003_01) Compared to the set point only in automatic mode
FT_3003_01_LIM_L	REAL	400530	-0.1	(L/h)	Displays an alarm on the HMI Compared to the set point only in automatic mode
FT_3003_01_LIM_LL	REAL	400532	-0.2	(L/h)	Displays an alarm on the HMI Compared to the set point only in automatic mode
PT_3003_01_LIM_H	REAL	400534	TBD 45	mbar	Displays an alarm on the HMI
PT_3003_01_LIM_HH	REAL	400536	TBD 50	mbar	**Stop the control loop 3003** (pump PP_3003_01)
PT_3003_01_LIM_L	REAL	400538	TBD 5	mbar	Displays an alarm on the HMI
PT_3003_01_LIM_LL	REAL	400540	TBD 0	mbar	**Stop the control loop 3003** (pump PP_3003_01)

Figure 13: Inlet Liquid Flow – THRESHOLD

2.7. Bioreactor General (CL3004)



2.7.1.Function

This loop manages the blender of the bioreactor.
The Emergency buttons and buzzer are managed in this section.
In case of Emergency Button, all the control loops are stopped.

- OFF Mode: Agitator is stopped
- AUTOMATIC Mode: the operator enters a set point for the speed of the agitator which is started.
- MANUAL mode: The Operator can start/stop the agitator and fix the speed.

PLC Section name	Equipment tag	Type	Address	Comment
CL3004_Bioreactor_General	BLE_3004_01_MV1	DO	000036	Bioreactor agitator ON / OFF
CL3004_Bioreactor_General	BLE_3004_01_MV2	REAL->AO	400194	Bioreactor agitator set point
CL3004_Bioreactor_General	BLE_3004_01	AI->REAL	400086	Bioreactor agitator speed
CL3004_Bioreactor_General	CL3004_Emer_Button_01	DI	100039	Emergency Button
CL3004_Bioreactor_General	CL3004_Buzzer_01	DO	000039	Buzzer

Figure 14: Bioreactor General – EQUIPMENTS

PLC Section name	tag	Type	Address	Comment
CL3004_Bioreactor_General	CL3004_ControlLoop_Mode	INT	400233	Mode Selector (OFF/Manu/Auto)
CL3004_Bioreactor_General	BLE_3004_01_OP	BOOL	000069	Used to start or stop the biorector blender in Manual mode
CL3004_Bioreactor_General	BLE_3004_01_SP	REAL	400084	Used to define the speed of BLE_3004_01

Figure 15: Bioreactor General – OPERATOR INPUTS

2.7.2.Alarms and Threshold

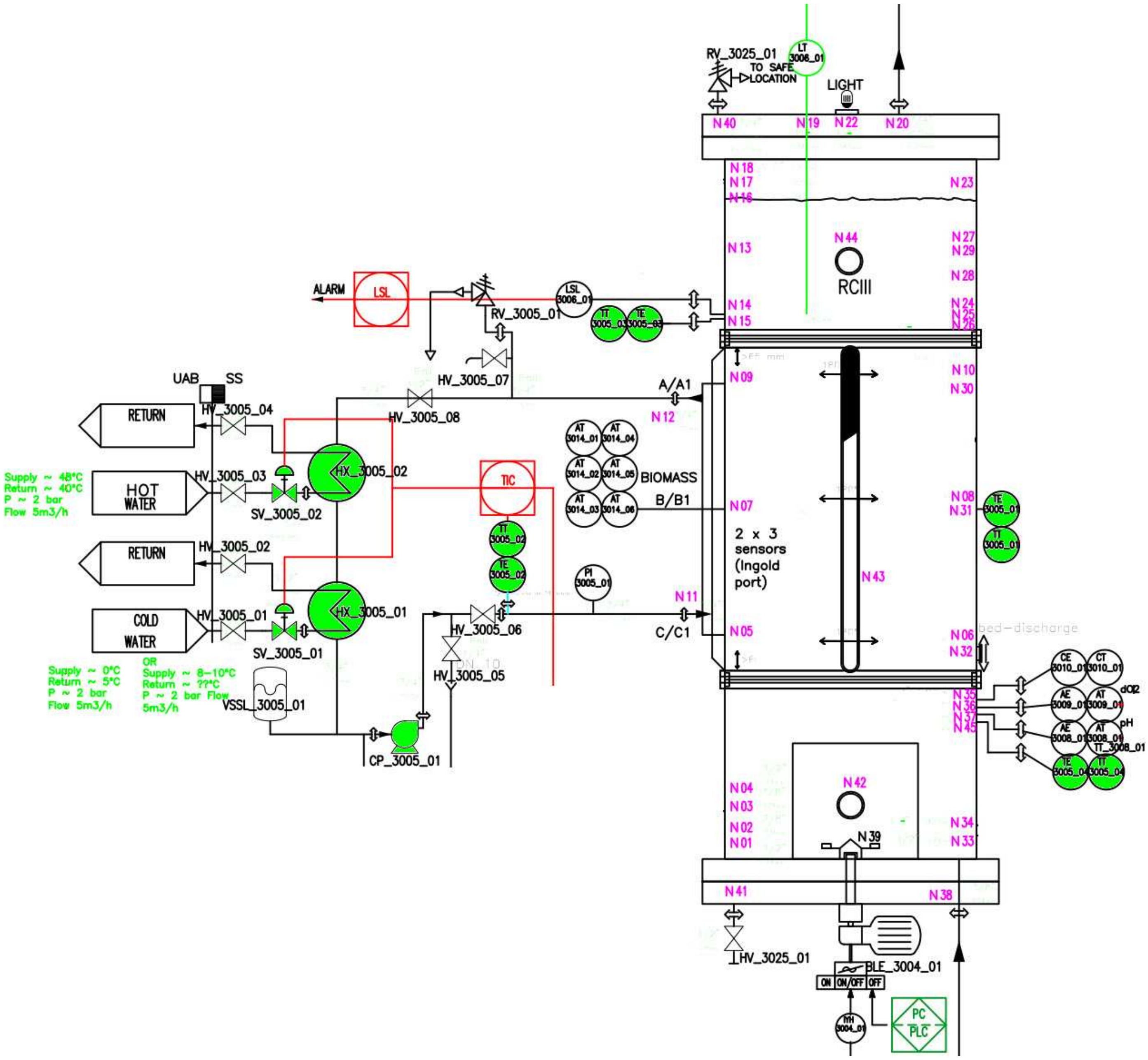
Alarm tag Name	type	Address	description
BLE_3004_01_A	BOOL	000070	Set if blender speed is diffferent of its Feed Back speed (+/-5%)
BLE_3004_01_ERR	BOOL	000251	SET if the wire is broken

Figure 16: Bioreactor General – ALARMS

Threshold tag name	Type	Address	Value	Unit	Action
BLE_3004_01_LIM_H	REAL	400542	5	%	Displays an alarm on the HMI
BLE_3004_01_LIM_L	REAL	400544	-5	%	Displays an alarm on the HMI

Figure 17: Bioreactor General – THRESHOLDS

2.8. Bioreactor temperature control (CL3005)



2.8.1.Function

The temperature is controlled by two equipments. On one hand, a cold water utility provides by a heat exchanger the cooling function. On the other hand, a hot water utility provides by a heat exchanger the cooling function. It permits to control the bioreactor temperature through the jacket temperature.

Three modes are available:

- OFF mode: All equipments are OFF. The control loop is stopped.
- AUTOMATIC mode: The temperature is controlled with hot and cold water.
- MANUAL mode: All equipments are configurable by the operator.

PLC Section name	Equipment tag	Type	Address	Comment
CL3005_Bioreactor_Temp_Control	CP_3005_01_MV	DO	000038	Circulating Pump (thermostat)
CL3005_Bioreactor_Temp_Control	SV_3005_02_MV	DO	000021	Temperature Control Valve see Heat exchanger (HOT)
CL3005_Bioreactor_Temp_Control	SV_3005_02_FB	DI	100035	Temperature Control Valve feedback see Heat exchanger (HOT)
CL3005_Bioreactor_Temp_Control	SV_3005_01_MV	DO	000023	Temperature Control Valve see Heat exchanger (COLD)
CL3005_Bioreactor_Temp_Control	SV_3005_01_FB	DI	100034	Temperature Control Valve feedback see Heat exchanger (COLD)
CL3005_Bioreactor_Temp_Control	TT_3005_02	AI->REAL	400090	Temperature element + transmitter (thermos fluid jacket)
CL3005_Bioreactor_Temp_Control	TT_3005_01	AI->REAL	400092	Temperature element + transmitter
CL3005_Bioreactor_Temp_Control	TT_3005_03	AI->REAL	400094	Temperature element + transmitter (top)
CL3005_Bioreactor_Temp_Control	TT_3005_04	AI->REAL	400096	Temperature element + transmitter (bottom)

Figure 18: Bioreactor Temperature Control – EQUIPMENTS

PLC Section name	Equipment tag	Type	Address	Comment
CL3005_Bioreactor_Temp_Control	CL3005_ControlLoop_Mode	INT	400234	Mode Selector (OFF/Manu/Auto)
CL3005_Bioreactor_Temp_Control	CP_3005_01_OP	BOOL	000071	Used to start or stop the bioreactor circulating pump in Manual mode
CL3005_Bioreactor_Temp_Control	TT_3005_SP	REAL	400088	Used to define the temperature set point of the bioreactor

PLC Section name	Equipment tag	Type	Address	Comment
CL3005_Bioreactor_Temp_Control	SV_3005_02_OP	BOOL	000072	Used to open or close the valve in manual mode
CL3005_Bioreactor_Temp_Control	SV_3005_01_OP	BOOL	000074	Used to open or close the valve in manual mode

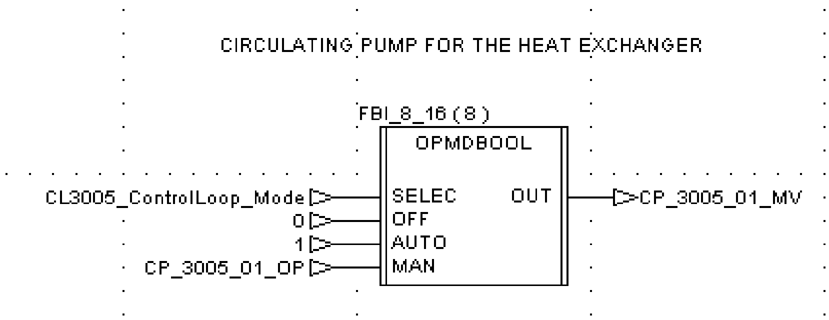
Figure 19: Bioreactor Temperature Control – OPERATOR INPUTS

2.8.2. Block Diagram

2.8.2.1. *Fluid Jacket pump management*

The pump is:

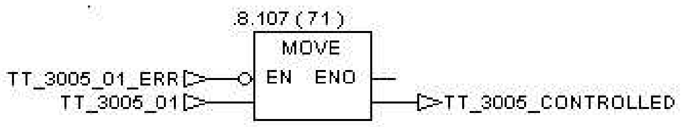
- OFF in OFF mode
- ON in Automatic mode
- ON or OFF in manual mode depending on the choice of the operator.



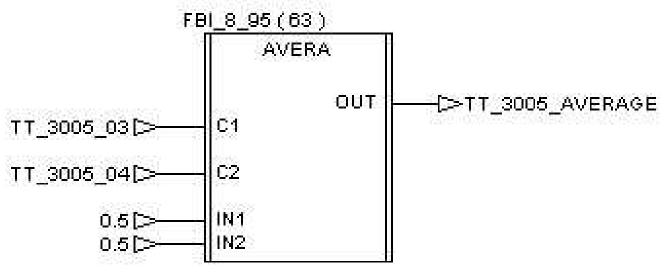
2.8.2.2. *Temperature probe management*

Four temperature probes manage the control Loop. One is used for the bioreactor jacket (TT_3005_02) and three for the bioreactor (TT_3005_01 / 03 / 04).
A probe error management is implemented to ensure a correct temperature control function.
Here is the logic:

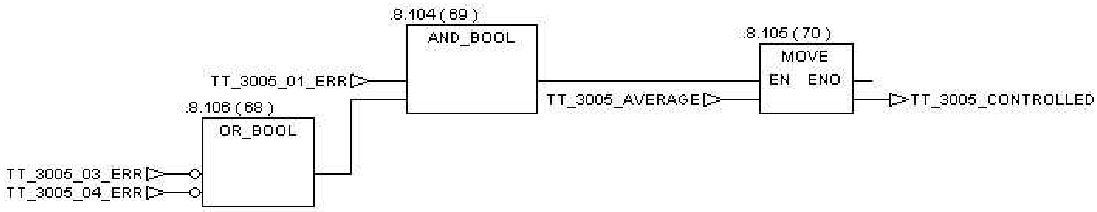
The bioreactor Temperature probe is by default TT_3005_01. The tag named "TT_3005_01_CONTROLLED" is the process value read by the master controller.



An average ("TT_3005_AVERAGE") is calculated with the two other existing probes (TT_3005_03 and TT_3005_04).



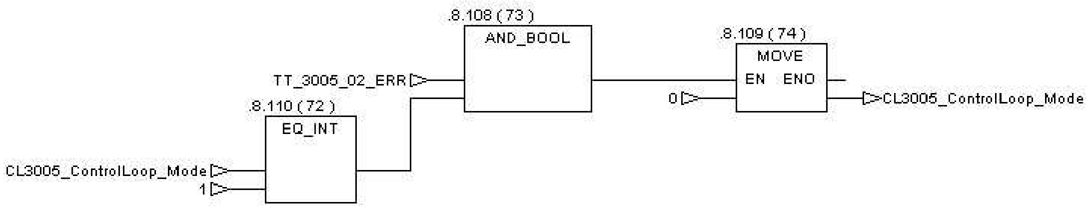
If this default probe is in failure (TT_3005_01), the calculated average becomes automatically the process value of the master controller.



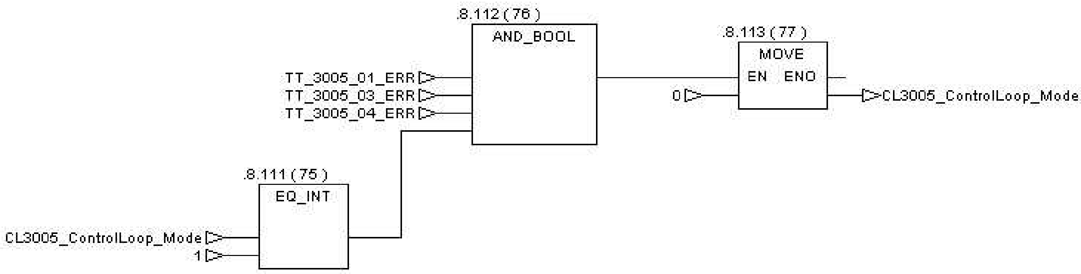
In case of failure of TT_3005_03 or TT_3005_04, the average measurement becomes the other probe.

If TT_3005_04 is in failure, the average measurement becomes TT_3005_03

As only one probe monitor the Jacket temperature (TT_3005_02), the bioreactor temperature mode is triggered to OFF if the probe goes into failure.

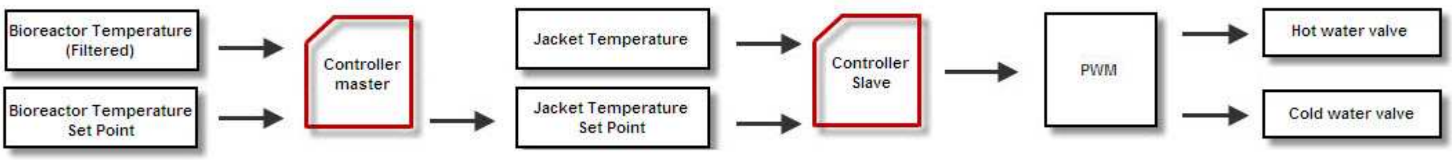


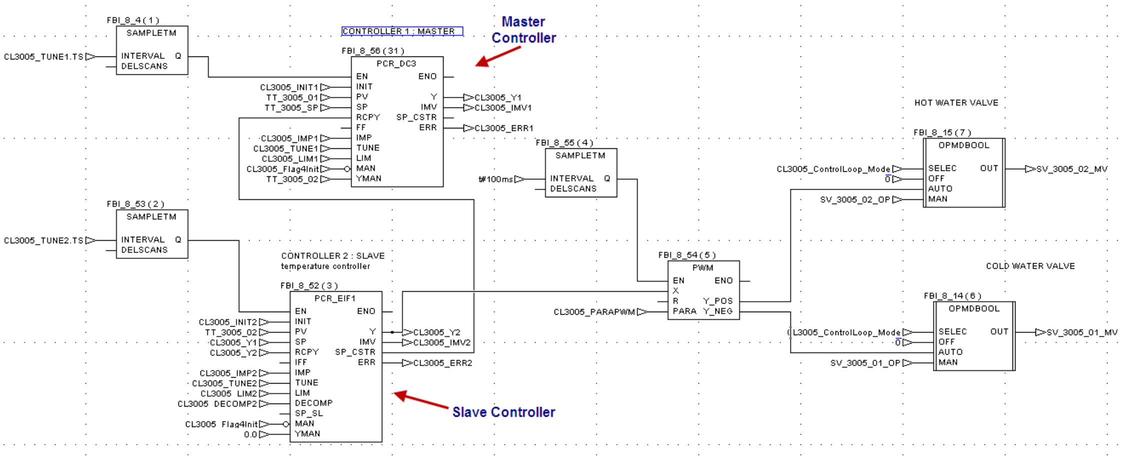
If all the bioreactor temperature probes are in error, the control Loop is triggered to OFF mode.



2.8.2.3. *Controller*

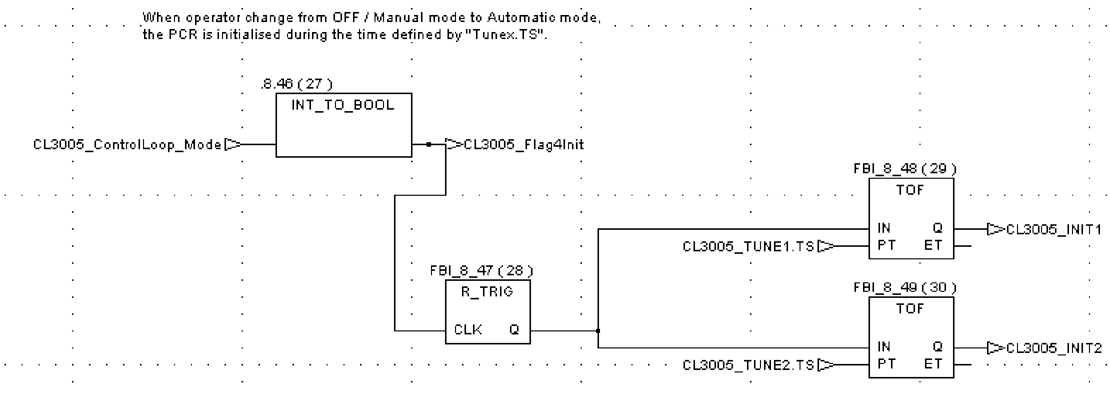
The control is performed by a cascade. The temperature of the bioreactor is controlled by the temperature of the jacket. The temperature of the jacket is controlled, in split-range, by the cold and hot valves.





2.8.2.4. *Controller initialization*

When the operator switches to automatic mode, the controllers are initialized during the sample time (see controller parameters).



2.8.2.5. *Controllers parameters*

MASTER

Controlled Variable	PCR CONTROLER TYPE	DEAD ZONE	ZTR Zone Control	PWM	SAMPLETM	PROCESS VALUE (input)	SET POINT
TT_3005_02	DC3	NO	NO	NO	CL3005_TUNE1.TS (10s)	TT_3005_01	TT_3005_01_SP

INTERNAL MODEL PROCESS	TUNE	LIMIT	SELF_CMP	DECOMP	Manipulated Variable (Controller Output in Auto Mode)	Controlled Equipment
KM : 0.5 TM1 : 235s TM2[1] :22s TM3 : 0s DM : 21s	TS : 10s H : 200s TRBF :10mn	CL3005_LIM1 YMIN : 20 YMAX : 50 YRATE : 1	NO	NO	CL3005_Y1	TT_3005_02

[1] : TM2 is calculated as the specified response time of the SLAVE controller divided par 3.

SLAVE

Controlled Variable	PCR CONTROLER TYPE	DEAD ZONE	ZTR Zone Control	PWM	SAMPLETM	PROCESS VALUE (input)	SET POINT
SV_3005_01 SV_3005_02	EIF1	NO	NO	t_period:100 ms t_min:50ms t_max:1s up_pos :1.0 up_neg :-1.0	Slave Controller: CL3005_TUNE2.TS (1s)	TT_3005_02	CL3005_Y1 Controller master output

INTERNAL MODEL PROCESS	TUNE	LIMIT	SELF_CMP	DECOMP	Manipulated Variable (Controller Output in Auto Mode)	Controlled Equipment
KM : 0.042 TM : 5s DM :5s	TS : 1s H : 1 mn TRBF : 5mn	CL3005_LIM2 YMIN : -1 YMAX : 1 YRATE : 1	NO	5 mn	CL3005_Y2	SV_3005_01_MV SV_3005_02_MV

2.8.3. Alarms and Threshold

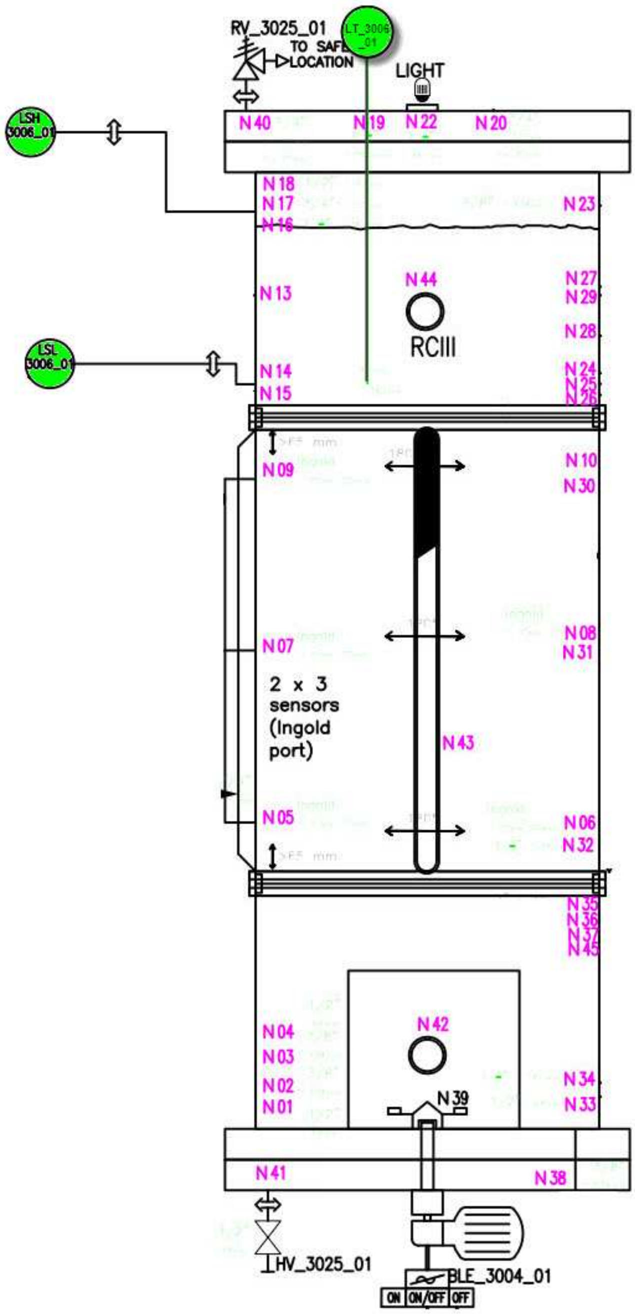
Alarm tag Name	type	Address	description
SV_3005_02_A	BOOL	000073	Alarm ON if SV_3005_02_MV=1 and SV_3005_02_FB=0 during 5seconds
SV_3005_01_A	BOOL	000075	Alarm ON if SV_3005_01_MV=1 and SV_3005_01_FB=0 during 5seconds
TT_3005_02_AH	BOOL	000076	Compare to the set point High Temperature on the bioreactor Jacket
TT_3005_02_AHH	BOOL	000077	Compare to the set point Very High Temperature on the bioreactor Jacket
TT_3005_02_AL	BOOL	000078	Compare to the set point High Temperature on the bioreactor Jacket
TT_3005_02_ALL	BOOL	000079	Compare to the set point Very High Temperature on the bioreactor Jacket
TT_3005_02_ERR	BOOL	000080	SET if the wire is broken And stops the control Loop 3005
TT_3005_01_AH	BOOL	000081	Compare to the set point High Temperature on the bioreactor
TT_3005_01_AHH	BOOL	000082	Compare to the set point Very High Temperature on the bioreactor
TT_3005_01_AL	BOOL	000083	Compare to the set point High Temperature on the bioreactor
TT_3005_01_ALL	BOOL	000084	Compare to the set point Very High Temperature on the bioreactor
TT_3005_01_ERR	BOOL	000085	SET if the wire is broken
TT_3005_03_ERR	BOOL	000086	SET if the wire is broken
TT_3005_04_ERR	BOOL	000087	SET if the wire is broken

Figure 20: Bioreactor Temperature Control – ALARMS

Threshold tag name	Type	Address	Value	Unit	Action
TT_3005_01_LIM_H	REAL	400546	1	℃	Displays an alarm on the HMI only in automatic mode
TT_3005_01_LIM_HH	REAL	400548	4	℃	Displays an alarm on the HMI only in automatic mode
TT_3005_01_LIM_L	REAL	400550	-1	℃	Displays an alarm on the HMI only in automatic mode
TT_3005_01_LIM_LL	REAL	400552	-4	℃	Displays an alarm on the HMI only in automatic mode
TT_3005_02_LIM_H	REAL	400554	1	℃	Displays an alarm on the HMI only in automatic mode
TT_3005_02_LIM_HH	REAL	400556	4	℃	Displays an alarm on the HMI only in automatic mode
TT_3005_02_LIM_L	REAL	400558	-1	℃	Displays an alarm on the HMI only in automatic mode
TT_3005_02_LIM_LL	REAL	400560	-4	℃	Displays an alarm on the HMI only in automatic mode

Figure 21: Bioreactor Temperature Control – THRESHOLDS

2.9. Bioreactor Level Control (CL3006)



2.9.1.Function

As the bioreactor is in permanently feeding, the bioreactor level is controlled by the outlet liquid line. Because the controlled equipment is not in the same control loop, the manual mode doesn't exist.
As both control loops are closely linked, the following conditions happen (they are shown in the block diagram chapter):

-if the level is triggered in automatic mode, the outlet liquid flow loop is also switched in automatic.

Two modes are available:

- OFF: The control is stopped.
- AUTOMATIC: The controller adjusts the outlet liquid flow to regulate bioreactor level depending on the set point.
- MANUAL: No manual mode.

PLC Section name	Equipment tag	Type	Address	Comment
CL3006_Bioreactor_Level_Control	LSH_3006_01	DI	100017	Level switch (Vibrating horizontal)
CL3006_Bioreactor_Level_Control	LSH_3006_02	DI	100018	Level switch (Vibrating horizontal)
CL3006_Bioreactor_Level_Control	LSL_3006_01	DI	100019	Level switch (Vibrating horizontal)
CL3006_Bioreactor_Level_Control	LSL_3006_02	DI	100020	Level switch (Vibrating horizontal)
CL3006_Bioreactor_Level_Control	LT_3006_01	AI->REAL	400098	Level transmitter (capacitive)

Figure 22 : Bioreactor Liquid Level control – EQUIPEMENTS

PLC Section name	Equipment tag	Type	Address	Comment
CL3006_Bioreactor_Level_Control	CL3006_ControlLoop_Mode	INT	400245	Mode Selector (OFF/Auto)
CL3006_Bioreactor_Level_Control	CL3006_BioreactorLevel_SP	REAL	400168	Used to define the level Set Point of the Bioreactor

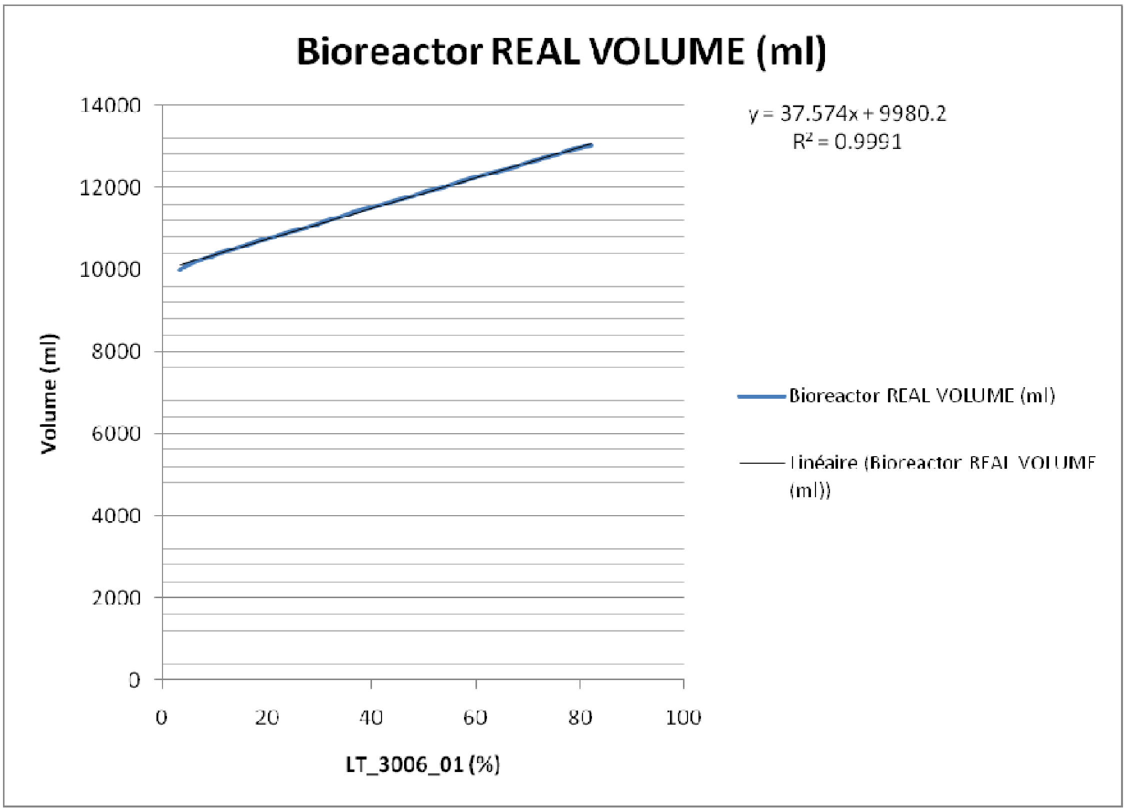
Figure 23 : Bioreactor Liquid Level control – OPERATOR INPUTS

2.9.2.Block Diagram

2.9.2.1. *Level Scale definition*

Here below, the correlation between the level sensor signal and the real bioreactor volume.

LT_3006_01 (%)	Bioreactor REAL VOLUME (ml)	OFFSET =10LITRES (BELOW LSL)
3.26	10000	Here, the LSL is OFF
4.56	10100	
6.49	10200	
8.63	10300	
10.97	10400	
13.42	10500	
16.24	10600	
18.71	10700	
21.43	10800	
24.11	10900	
26.76	11000	
29.44	11100	
31.99	11200	Here the volume is the minimum to start the recycle loop
34.44	11300	
36.81	11400	
39.29	11500	
42.58	11600	
45.43	11700	
48.25	11800	
50.49	11900	
53.68	12000	
56.1	12100	
58.91	12200	
61.36	12300	
64.88	12400	Here, the level switch high is ON
67.43	12500	
69.94	12600	
72.91	12700	
75.48	12800	
78.03	12900	
80.88	13000	
82.17	13030	

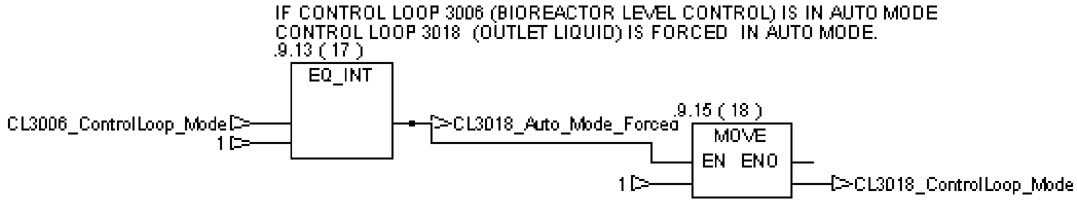


Following the level test, a correlation law is deducted between the measurement (0 / 100) and the real volume.
The new scale of the level sensor is:

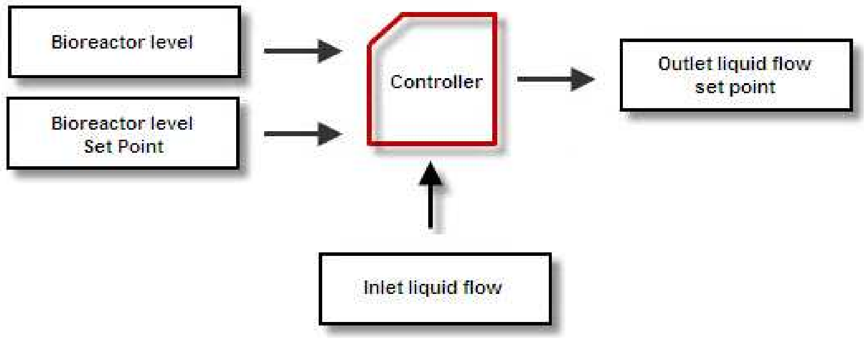
LT_3006_01 Old scale(%)	**LT_3006_01 New scale(L)**
min:0	min:9.9802
max:100	max:13.7376

2.9.2.2. *Control loop mode management*

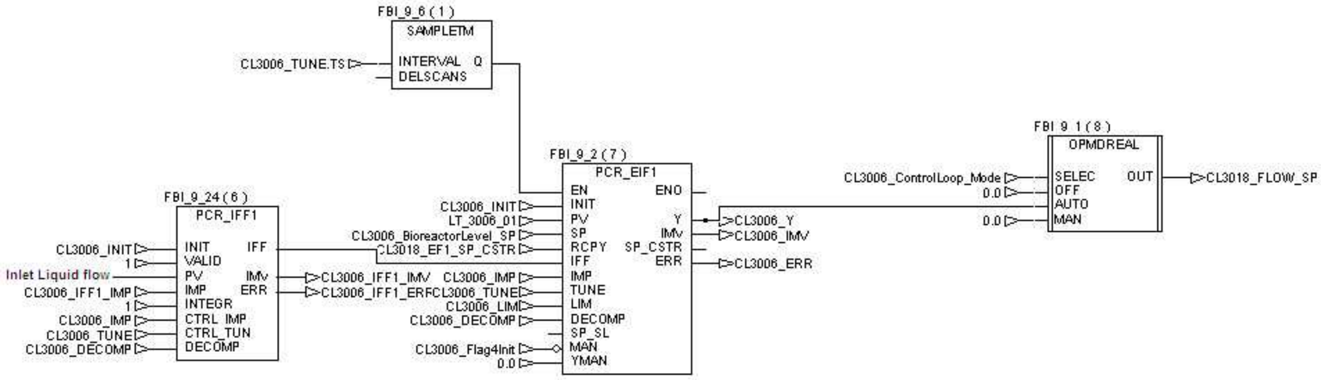
If the level is triggered in automatic mode, the outlet liquid flow loop is also switched in automatic.



2.9.2.3. *Controller*

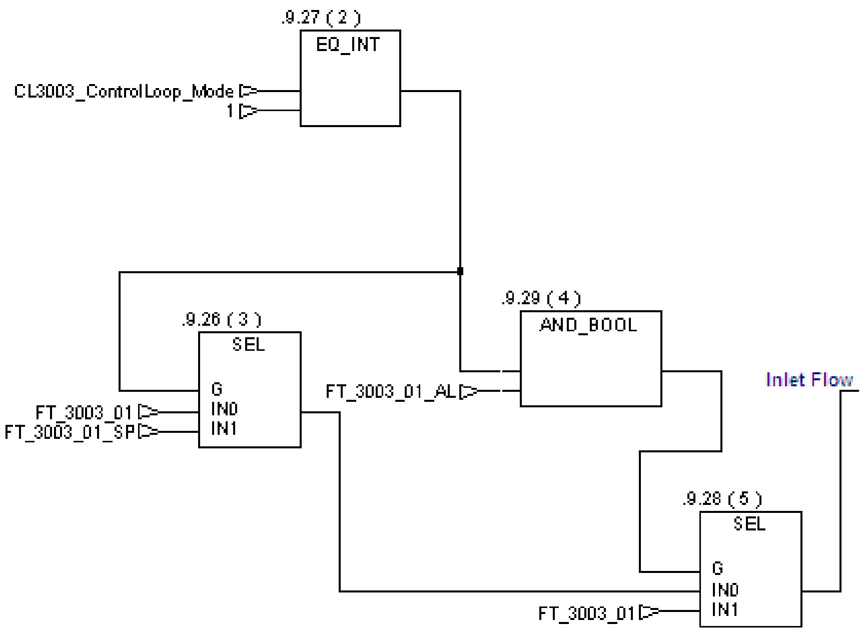


The bioreactor level controller implemented is an integrator first order predictive block EIF1 (see annex E). The parameters are detailed in the chapter “controller parameter”. A Feed-Forward block is also used for taking into account the inlet flow in the control strategy.



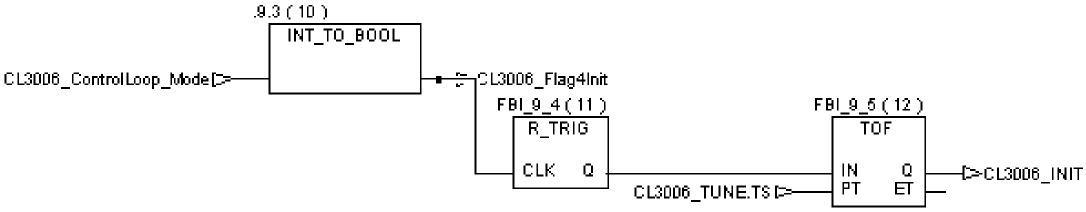
2.9.2.4. *Inlet Flow for Feed-Forward block*

If the Inlet Liquid Flow control loop is in AUTO mode, the measure used by the controller in the Feed-Forward block is the set point. Otherwise the PV is used. This is done to have a more stable value to the FF block.



2.9.2.5. *Controller initialisation*

When the operator decides to switch in automatic mode, the controller is initialized during the sample time (see controller parameters).



2.9.2.6. *Controller parameters*

Main Block

Controlled Variable	PCR CONTROLER TYPE	DEAD ZONE	ZTR Zone Control	PWM	SAMPLETM	PROCESS VALUE (input)	SET POINT
CL3018_FLOW_SP	EIF1	NO	NO	NO	CL3006_TUNE.TS	LT_3006_01	CL3006_BioreactorLevel_SP

INTERNAL MODEL PROCESS	TUNE	LIMIT	SELF_CMP	DECOMP	Manipulated Variable (Controller Output in Auto Mode)	Controlled Equipment
KM : -0.0003 TM : 41s DM :0s	TS : 1s H : 40s TRBF : 15m	CL3006_LIM YMIN: 0 YMAX:0.8 YRATE: 0.8	NO	15m	CL3006_Y	CL3018_FLOW_SP

Feed-Forward Block

Feed-Forward Variable	PCR CONTROLER TYPE	INTERNAL MODEL PROCESS
FT_3003_01 or FT_3003_01_SP	IFF1	KM : 0.00028 TM 41s DM :0s

2.9.3. Alarms and Thresholds

Alarm tag Name	type	Address	description
LSH_3006_01_A	BOOL	000273	The alarm is triggered after 10s
LSH_3006_02_A	BOOL	000274	The alarm is triggered after 10s
LSL_3006_01_A	BOOL	000275	The alarm is triggered after 10s
LSL_3006_02_A	BOOL	000276	The alarm is triggered after 10s
LT_3006_01_AH	BOOL	000243	High Level in Bioreactor
LT_3006_01_AHH	BOOL	000088	Very High Level in Bioreactor
LT_3006_01_AL	BOOL	000244	Low Level in Bioreactor
LT_3006_01_ALL	BOOL	000089	Very Low Level in Bioreactor
LT_3006_01_ERR	BOOL	000250	SET if the wire is broken

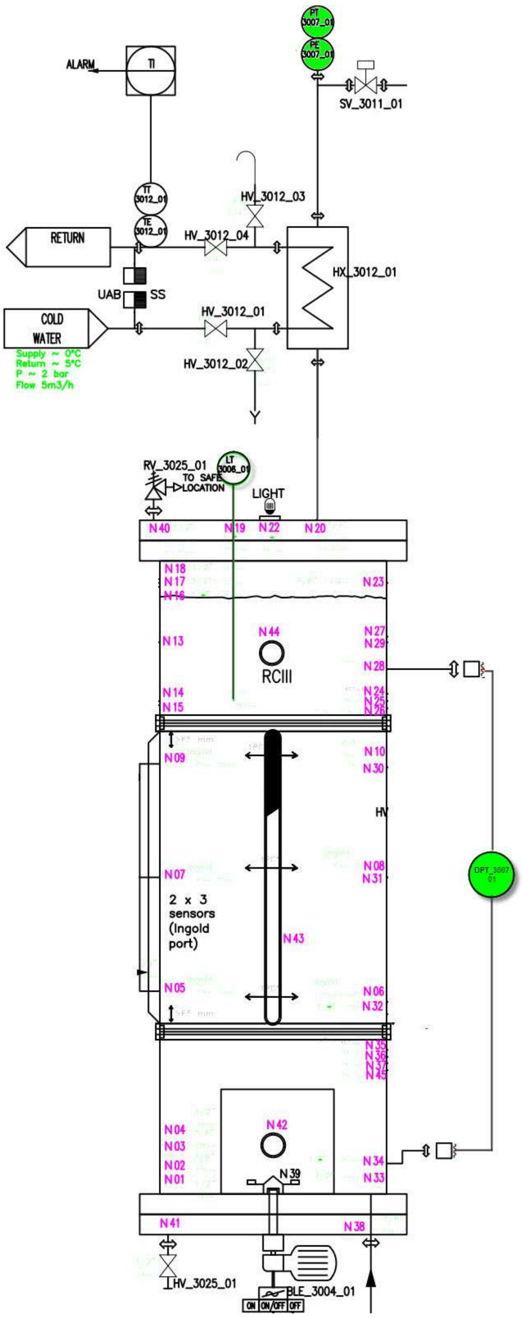
Figure 24 : Bioreactor Liquid Level control – ALARMS

The orange cells need to be validated by the MPP.

Threshold tag name	Type	Address	Value	Unit	Action
LT_3006_01_LIM_H	REAL	400704	12.2	LITRE	Only in automatic mode Displays an alarm on the HMI
LT_3006_01_LIM_HH	REAL	400562	12.3	LITRE	**Stop the Inlet liquid control loop** Only in automatic mode Displays an alarm on the HMI
LT_3006_01_LIM_L	REAL	400706	11.3	LITRE	Only in automatic mode Displays an alarm on the HMI
LT_3006_01_LIM_LL	REAL	400564	11.2	LITRE	**Stop the recirculation loop and the harvesting loop**. Only in automatic mode Displays an alarm on the HMI

Figure 25 : Bioreactor Liquid Level Control – THRESHOLDS

2.10. Bioreactor pressure control (CL3007)



2.10.1.Function

The aim of this control loop is to maintain the pressure inside the bioreactor lower than 80 mbar.
This function is implemented in the Bioreactor Gas loop (3011) as it is physically part of this loop.
Pressure control is activated when the Gas Loop is in AUTO mode.

The 3007 control loop manages the alarms, thresholds and actions linked to the pressure.

PLC Section name	Equipment tag	Type	Address	Comment
CL3007_Bioreactor_Pressu_Control	DPT_3007_01	AI->REAL	400100	Differential Pressure transmitter
CL3007_Bioreactor_Pressu_Control	PT_3007_01	AI->REAL	400102	Pressure element + transmitter

Figure 26: Bioreactor pressure control - EQUIPEMENTS

PLC Section name	Equipment tag	Type	Address	Comment
CL3007_Bioreactor_Pressu_Control	PT_3007_01_SP	REAL	400214	Set Point of the Controller managing the bioreactor pressure
CL3007_Bioreactor_Pressu_Control	CL3007_Pressure_Threshold	REAL	400216	Threshold which triggers the bioreactor pressure releasing

Figure 27: Bioreactor pressure control – OPERATOR INPUTS

2.10.2.Block Diagram

N/A

2.10.3.Alarms and Threshold

Alarm tag Name	type	Address	description
DPT_3007_01_AH	BOOL	000090	High differential pressure in the bioreactor
DPT_3007_01_AHH	BOOL	000091	Very High differential pressure in the bioreactor
DPT_3007_01_AL	BOOL	000092	Low differential pressure in the bioreactor
DPT_3007_01_ALL	BOOL	000093	Very Low differential pressure in the bioreactor
DPT_3007_01_ERR	BOOL	000094	SET if the wire is broken
PT_3007_01_AH	BOOL	000095	High pressure in the bioreactor
PT_3007_01_AHH	BOOL	000096	Very High pressure in the bioreactor

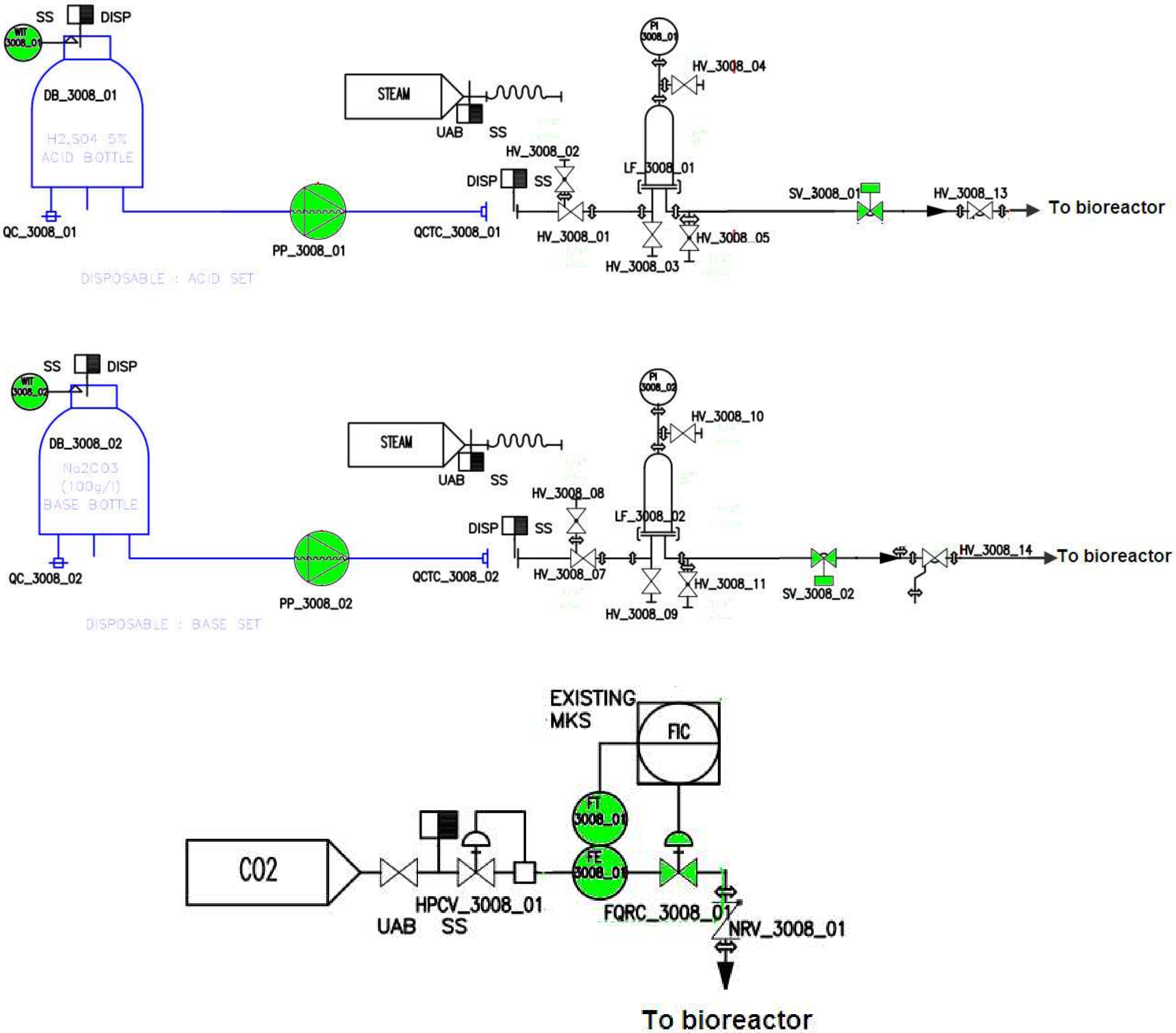
Alarm tag Name	type	Address	description
PT_3007_01_AL	BOOL	000097	as the threshold is compared to the set point, the alarm is triggered after 1min/ Low pressure in the bioreactor
PT_3007_01_ALL	BOOL	000098	Very Low pressure in the bioreactor
PT_3007_01_ERR	BOOL	000099	SET if the wire is broken

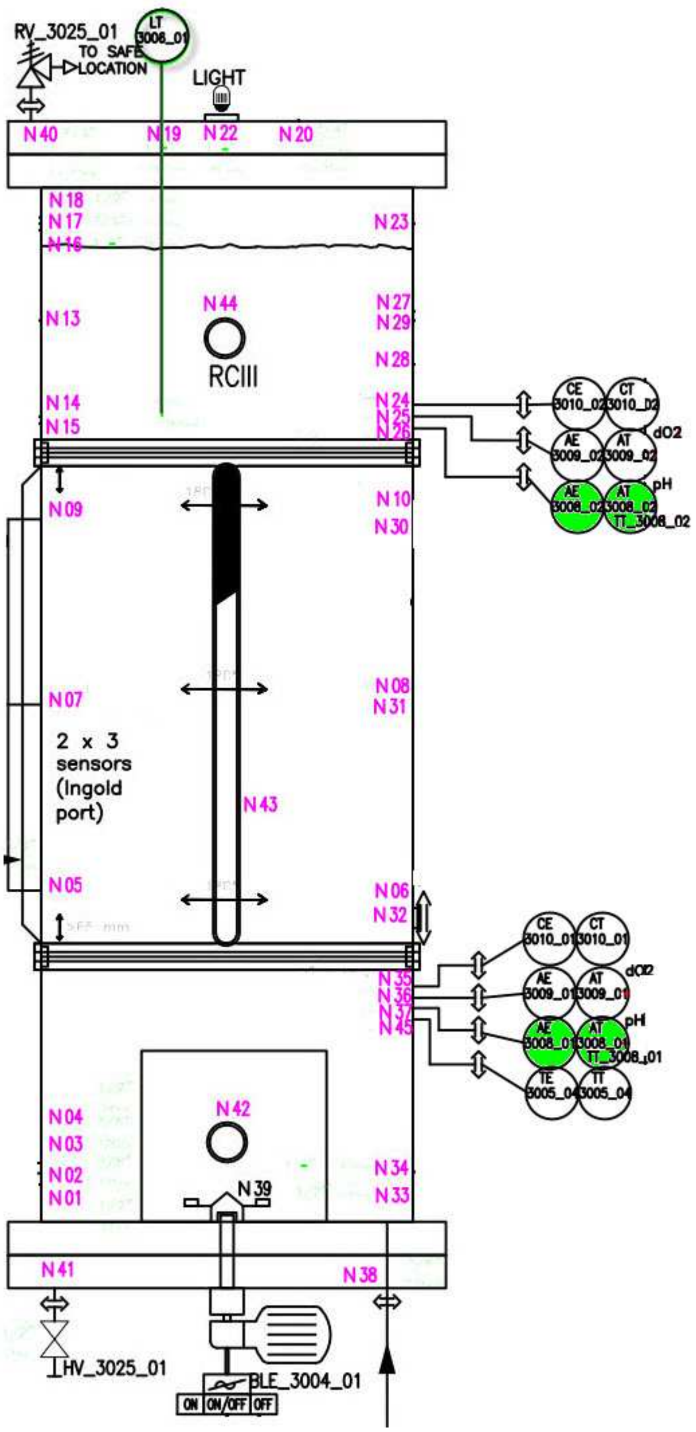
Figure 28: Bioreactor pressure control – ALARMS

Threshold tag name	Type	Address	Value	Unit	Action
PT_3007_01_LIM_H	REAL	400566	100	mBar	Displays an alarm on the HMI
PT_3007_01_LIM_HH	REAL	400568	200	mBar	Displays an alarm on the HMI Need to be validated
PT_3007_01_LIM_L	REAL	400570	-20	mBar	Displays an alarm on the HMI
PT_3007_01_LIM_LL	REAL	400572	0	mBar	Displays an alarm on the HMI
DPT_3007_01_LIM_H	REAL	400574	200	mBar	Displays an alarm on the HMI Need to be validated
DPT_3007_01_LIM_HH	REAL	400576	500	mBar	Displays an alarm on the HMI Need to be validated
DPT_3007_01_LIM_L	REAL	400578	TBD	mBar	Displays an alarm on the HMI Need to be defined
DPT_3007_01_LIM_LL	REAL	400580	0	mBar	Displays an alarm on the HMI

Figure 29: Bioreactor pressure control – THRESHOLDS

2.11. Bioreactor pH Control (CL3008)




RV_3025_01
TO SAFE LOCATION
LT 3008_01
LIGHT
N40
N19
N22
N20
N18
N17
N16
N23
N13
N44
RCIII
N27
N29
N28
N14
N15
N24
N25
N26
CE 3010_02
CT 3010_02
AE 3009_02
AT 3009_02
dO2
AE 3008_02
AT 3008_02
pH
TT_3008_02
N09
N10
N30
N07
N08
N31
2 x 3 sensors (Ingold port)
N43
N05
N06
N32
CE 3010_01
CT 3010_01
AE 3009_01
AT 3009_01
dO2
AE 3008_01
AT 3008_01
pH
TT_3008_01
TE 3005_04
TT 3005_04
N35
N36
N37
N45
N04
N03
N02
N01
N42
N39
N34
N33
N41
N38
HV_3025_01
BLE_3004_01
ON
ON/OFF
OFF

2.11.1.Function

The pH needs to be monitored and controlled. The pH control is managed by three different ways:

pH mode 1: CO_2 only.

pH mode 2: CO_2 and BASE

pH mode 3: ACID and BASE.

Two controllers are designed depending on the selected mode. One for ACID and BASE pumps injection and one for the CO_2 injection linked to a mass flow controller.
The ACID solution and the BASE solution are added to the bioreactor by peristaltic pumps and valves.
The operator can select the measurement to control (probe1/probe2/average of probe 1&2). Due to this choice, an error probe management is implemented (explained in the block diagram chapter).
Three modes are available.

- OFF: valves are closed and pumps are stopped
- AUTOMATIC: The controller adjusts the pH value depending on:
  - -The set point and the dead zone entered by the operator.
  - -The chosen pH mode.
- MANUAL: the operator selects valves, pumps and opening time (in seconds) to inject ACID, BASE or CO_2.

PLC Section name	Equipment tag	Type	Address	Comment
CL3008_Bioreactor_pH_Control	PP_3008_01_MV	DO	000043	Peristaltic Pump (acid)
CL3008_Bioreactor_pH_Control	PP_3008_02_MV	DO	000044	Peristaltic Pump (base)
CL3008_Bioreactor_pH_Control	AT_3008_01	AI->REAL	400108	pH element + transmitter
CL3008_Bioreactor_pH_Control	TT_3008_01	AI->REAL	400110	Temperature pH element
CL3008_Bioreactor_pH_Control	AT_3008_02	AI->REAL	400112	pH element + transmitter
CL3008_Bioreactor_pH_Control	TT_3008_02	AI->REAL	400114	Temperature pH element
CL3008_Bioreactor_pH_Control	WIT_3008_01	AI->REAL	400116	Acid Bottle weight indicator (+ weighing scale)
CL3008_Bioreactor_pH_Control	WIT_3008_02	AI->REAL	400118	Base Bottle weight indicator (+ weighing scale)
CL3008_Bioreactor_pH_Control	SV_3008_01_MV	DO	000025	Acid valve
CL3008_Bioreactor_pH_Control	SV_3008_01_FB	DI	100027	Acid valve feedback
CL3008_Bioreactor_pH_Control	SV_3008_02_MV	DO	000027	Base valve

PLC Section name	Equipment tag	Type	Address	Comment
CL3008_Bioreactor_pH_Control	SV_3008_02_FB	DI	100026	Base valve feedback
CL3008_Bioreactor_pH_Control	FQRC_3008_01	AI->REAL	400158	Flow element + transmitter (CO2)
CL3008_Bioreactor_pH_Control	FQRC_3008_01_SP	REAL -> AO	400188	Flow Control Valve non sterile gas (CO2)

Figure 30: Bioreactor pH control - EQUIPMENTS

PLC Section name	Equipment tag	Type	Address	Comment
CL3008_Bioreactor_pH_Control	CL3008_ControlLoop_Mode	INT	400235	Mode Selector (OFF/Manu/Auto)
CL3008_Bioreactor_pH_Control	PP_3008_01_OP	BOOL	000100	Used to start or stop the ACID pump in Manual mode (If start, the valve SV_3008_01 is automatically opened and closed)
CL3008_Bioreactor_pH_Control	PP_3008_01_OP_TIME	UDINT	400061	Define the injection time of the ACID pump in Manual mode
CL3008_Bioreactor_pH_Control	PP_3008_02_OP	BOOL	000101	Used to start or stop the BASE pump in Manual mode(If start, the valve SV_3008_02 is automatically opened and closed)
CL3008_Bioreactor_pH_Control	PP_3008_02_OP_TIME	UDINT	400063	Define the injection time of the BASE pump in Manual mode
CL3008_Bioreactor_pH_Control	CL3008_Reset_pH_Timer	BOOL	000102	RESET the Timer for both pH pump and set the new starting date and time for Timer
CL3008_Bioreactor_pH_Control	SV_3008_01_OP	BOOL	000245	Used to open or close the valve in manual mode
CL3008_Bioreactor_pH_Control	SV_3008_02_OP	BOOL	000246	Used to open or close the valve in manual mode
CL3008_Bioreactor_pH_Control	CL3008_pH_selector	INT	400248	Define the pH probe used for the Control. (0=Average / 1 = AT_3008_01 / 2 = AT_3008_02)
CL3008_Bioreactor_pH_Control	CL3008_pH_Mode	INT	400247	Define the pH mode for bioreactor pH control (1-Only CO2 / 2-CO2 and BASE / 3-CO2 is fixed and ACID+BASE)
CL3008_Bioreactor_pH_Control	FQRC_3008_01_OP	REAL -> AO	400206	Used to define the opening Set point of the mass flow controller valve in manual mode
CL3008_Bioreactor_pH_Control	CL3008_pH_SP	REAL	400104	Used to define the pH set point of the bioreactor
CL3008_Bioreactor_pH_Control	CL3008_DeadZone	REAL	400106	Used to define the Dead Zone of the pH bioreactor

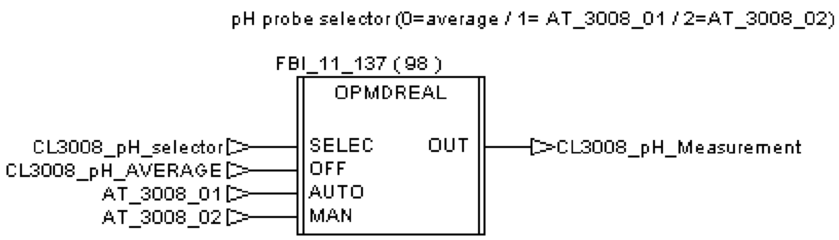
PLC Section name	Equipment tag	Type	Address	Comment
CL3008_Bioreactor_pH_Control	CL3008_pH_AVERAGE	REAL	400218	
CL3008_Bioreactor_pH_Control	CL3008_Base_Opening_Time	REAL	400184	The timer is increasing in second
CL3008_Bioreactor_pH_Control	CL3008_Acid_Opening_Time	REAL	400186	The timer is increasing in second
CL3008_Bioreactor_pH_Control	CL3008_pH_Second	BYTE	400260	Date of the last reset done by the operator
CL3008_Bioreactor_pH_Control	CL3008_pH_Minute	BYTE	400261	Date of the last reset done by the operator
CL3008_Bioreactor_pH_Control	CL3008_pH_Hour	BYTE	400262	Date of the last reset done by the operator
CL3008_Bioreactor_pH_Control	CL3008_pH_Day	BYTE	400263	Date of the last reset done by the operator
CL3008_Bioreactor_pH_Control	CL3008_pH_Month	BYTE	400264	
CL3008_Bioreactor_pH_Control	CL3008_pH_Year	BYTE	400265	Date of the last reset done by the operator

Figure 31: Bioreactor pH control - OPERATOR INPUTS

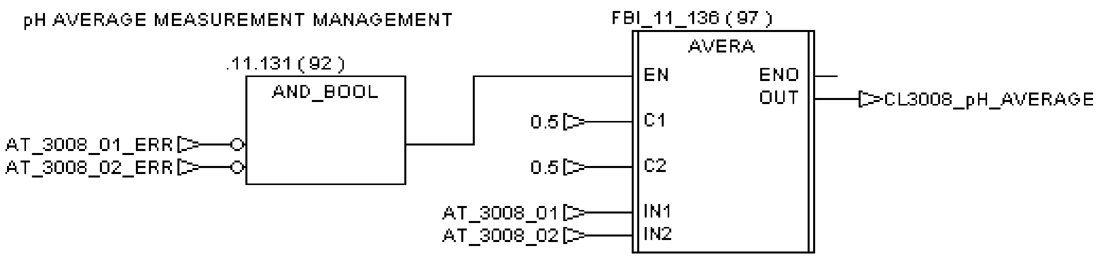
2.11.2.Block Diagram

2.11.2.1. *pH probe selection*

The operator can choose both probes separately or the average of the two probes.

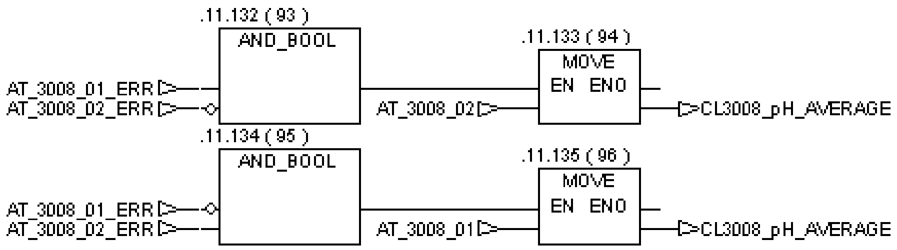


2.11.2.2. *pH probe average calculation*

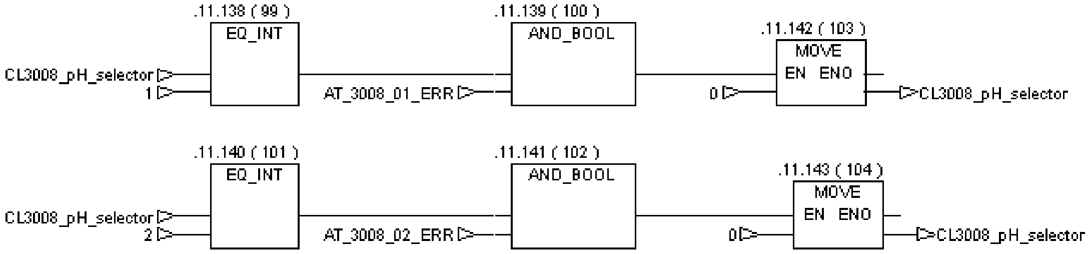


2.11.2.3. *pH probe error management*

If the operator selected probe goes into failure, the PLC automatically takes the second probe as current measurement.

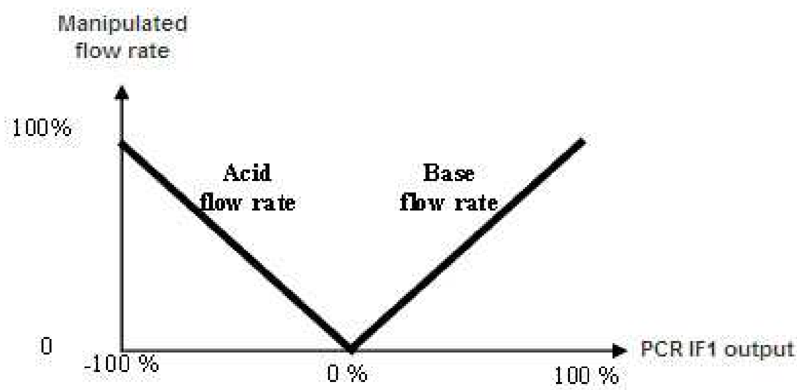


In case of average measurement, if one of the two probes goes into failure, the controlled value becomes the other probe.



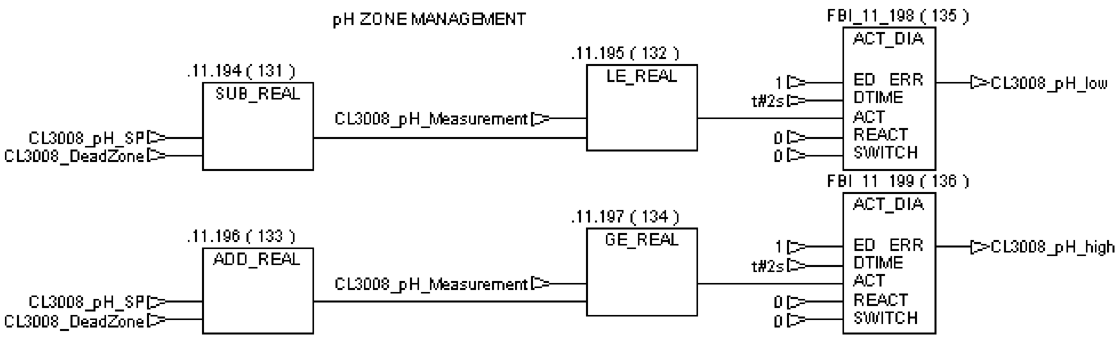
2.11.2.1. *Dead Zone implementation and process value calculation*

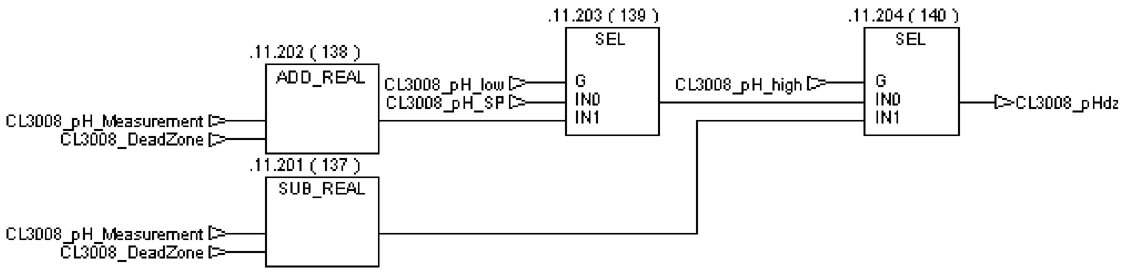
The split range logic is implemented for the pH control. The following scheme gives an explanation of the split range logic:



In order to control the pH, the PLC needs to have, at the input of the controller, the process value +/- the dead zone defined by the operator. Depending on the mode pH state (High or low) the dead zone is added (pH high) or subtracted (pH low) to the analyser value.
Once added, the calculated value becomes the process value measurement: "**pHdz**".
So:
If pH <(SP–DeadZone) we have a pH_low, then pHdz becomes (pH+DeadZone)
If pH >(SP+DeadZone) we have a pH_high, then pHdz becomes (pH-DeadZone)

The limit has to be reached during 2 seconds before it is triggered in pH high or pH low mode.



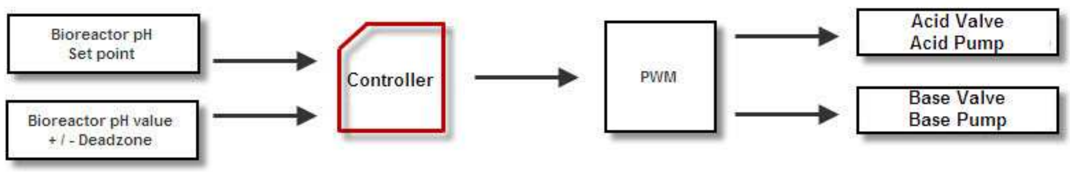


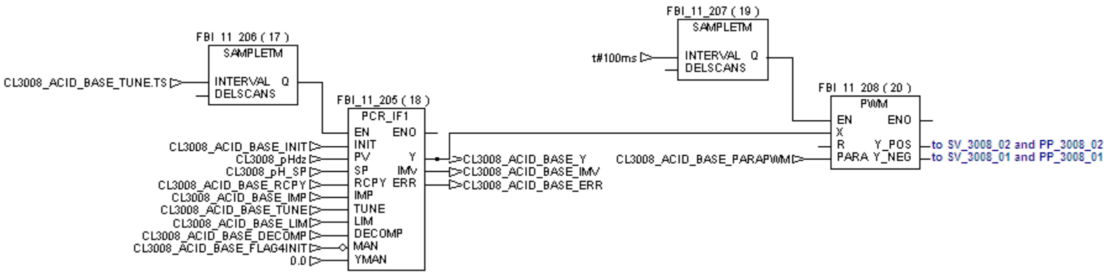
2.11.2.2. *Controllers*

As explained previously, depending on the chosen mode (CO2 / CO2 and BASE / ACID and BASE), only one or both controller will be initialized.

2.11.2.2.1. Controller ACID & BASE

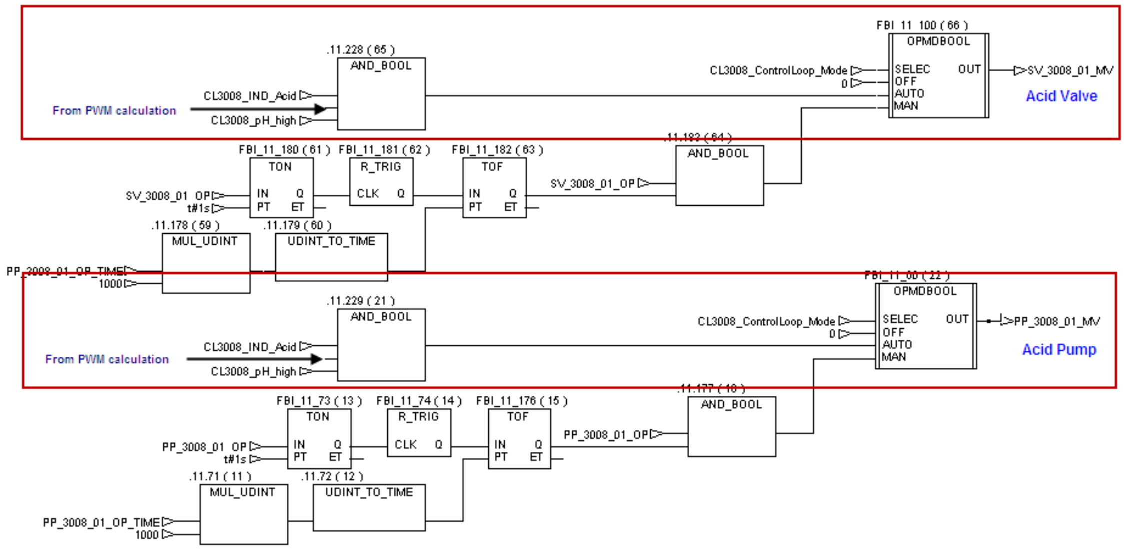
Depending of the dead zone configured by the operator and the pH measurement to be controlled, the controller will decide to inject ACID or BASE. In both case the valve and the pump are managed simultaneously. If the pH mode is CO2 and BASE the controller limits management change to lock the controller in case of pH low (see controller limit management).
As the pumps and the valves are managed in a Boolean logic, a PWM block is implemented to convert analogical signal coming from the controller into time. For more details on PWM block, see annex G.





2.11.2.2.1.1. Acid valve and pump management

In automatic mode, if the operator has chosen the pH mode including ACID solution and depending on the controller calculation, the ACID valve and the ACID pump will be simultaneously opened for injection.



In manual mode, the operator chooses to open valve, pump or both during a defined time. The red rectangle (on the following scheme) corresponds to the implementation of this function.

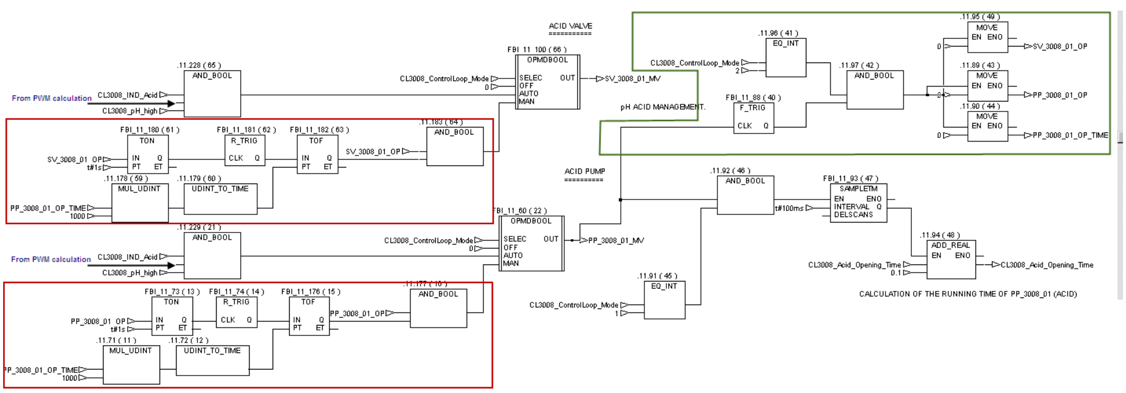
The green rectangle corresponds to the reset of the time and the selected equipment after the task has been executed.

The operator inputs are reset if one of the following conditions appears:

- no time is configured.
- the control loop is set to OFF mode

the desired opening time is over. (This condition doesn't appear on the block diagram).

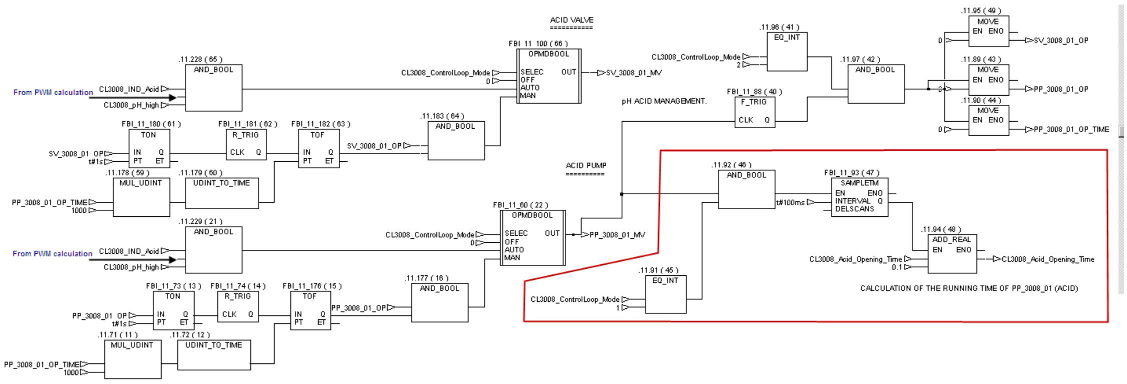
.



2.11.2.2.1.2. Acid valve and pump opening time records

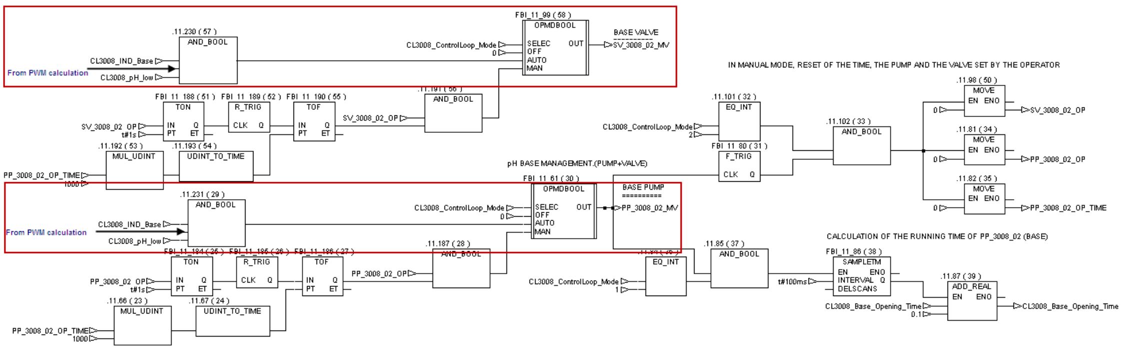
In automatic mode, when the controller asks for ACID injection, the PLC records how long lasted the injection. A starting date is also recorded to be able to calculate the quantity of ACID injected during an elapsed time. The sampling time of record is 100 ms.

The operator can reset this time (see “reset opening time” section)



2.11.2.2.1.3. Base valve and pump management

In automatic mode, if the operator has chosen the pH mode including BASE solution and depending on the controller calculation, the BASE valve and the BASE pump will be simultaneously opened for injection.



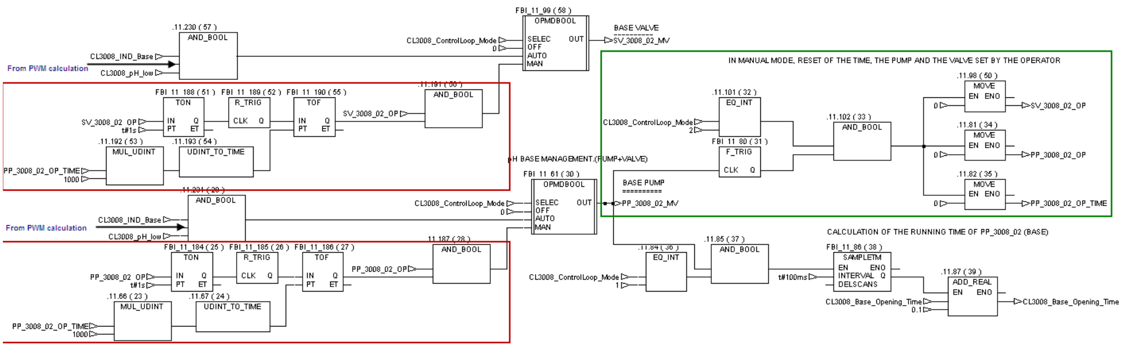
In manual mode, the operator chooses to open valve, pump or both during a defined time. The red rectangle (on the following scheme) corresponds to the implementation of this function.

The green rectangle corresponds to the reset of the time and the selected equipment after the task has been executed.

The operator inputs are reset if one of the following conditions appears:

- no time is configured.
- the control loop is set to OFF mode

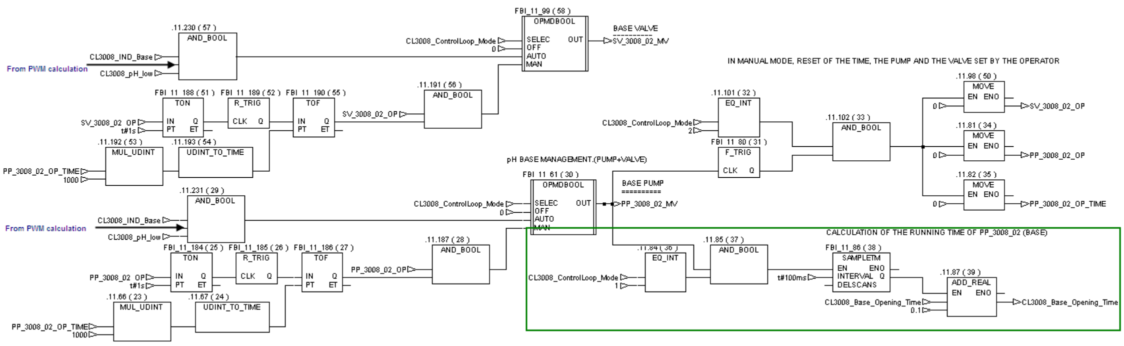
the desired opening time is over. (This condition doesn't appear on the block diagram).



2.11.2.2.1.4. Base valve and pump opening time records

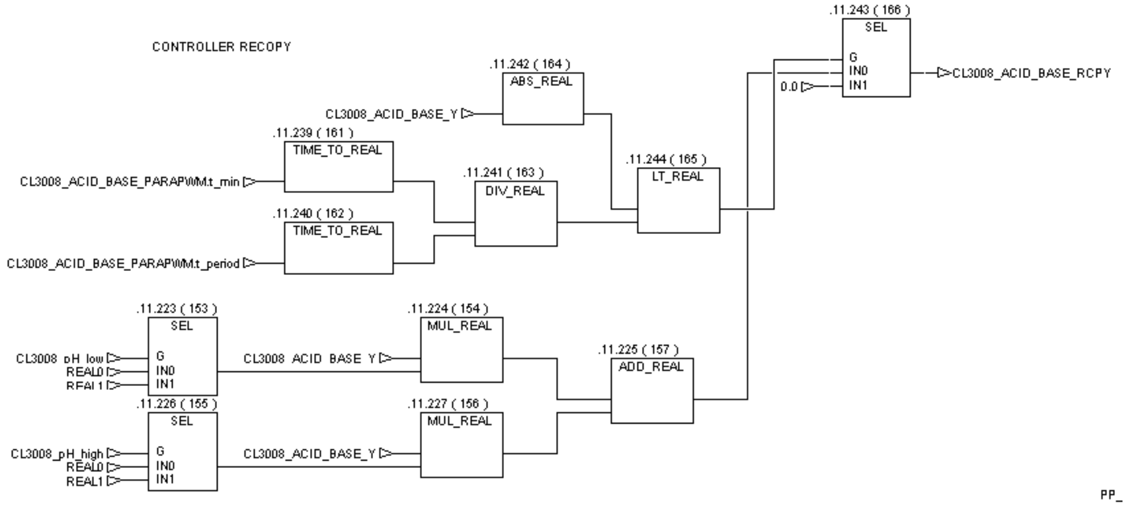
In automatic mode, when the controller asks for BASE injection, the PLC records how long lasted the injection. A starting date is also recorded to be able to calculate the quantity of BASE injected during an elapsed time. The sampling time of record is 100 ms.

The operator can reset this time (see "reset opening time" section)



2.11.2.2.1.5. Controller ACID and BASE recopy

The recopy (RCPY pin of the controller block) corresponds to the real action applied to the process whatever is the calculation of the controller.
In order to preserve equipments from too little opening time calculation, and to let the controller knows that its calculation has not be applied (to conserve the validity of the predictive model), the logic recopy of the controller is implemented as follow:
If the time calculated (for BASE or ACID) is lower than the minimum time of injection of the PWM (1s) divided by calculation period of the PWM (30s), the controller recopy is 0.



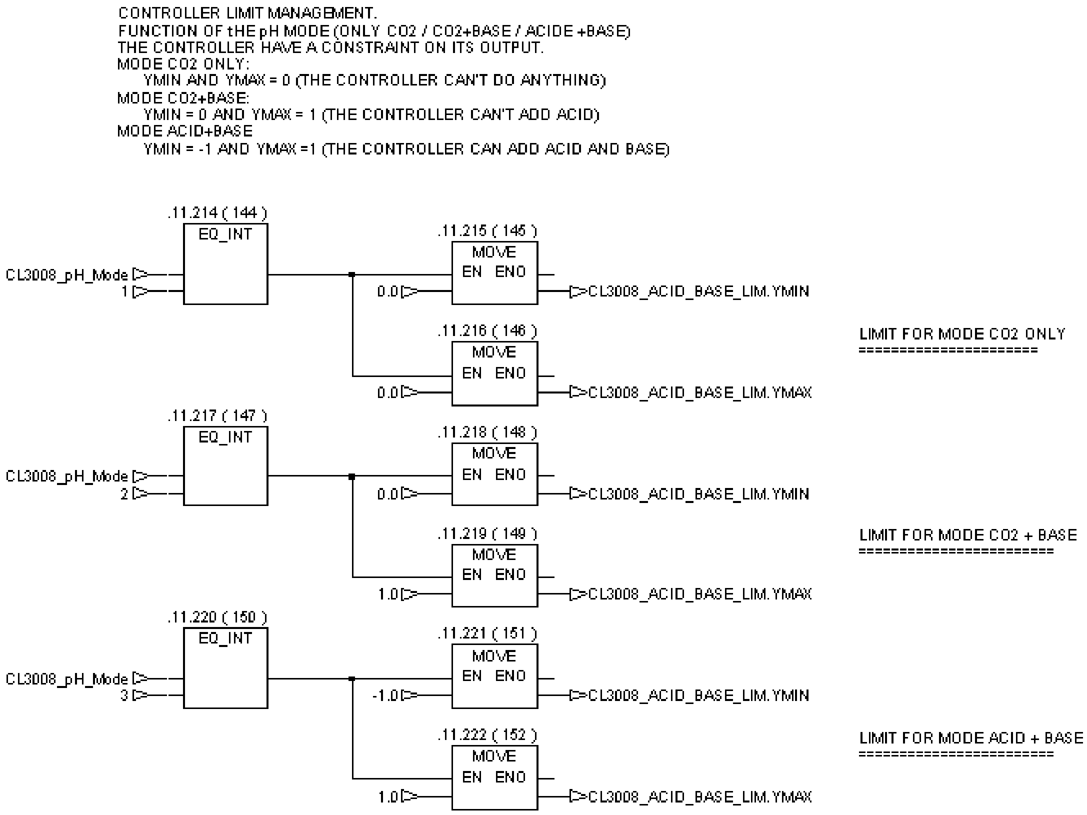
2.11.2.2.1.6. <u>Controller ACID and Base limits</u>

Depending of the pH mode (CO2 only / CO2+BASE / ACID+BASE) the controller has different constraints on its output:

Mode CO2 only : YMIN AND YMAX=0 (the controller is blocked)

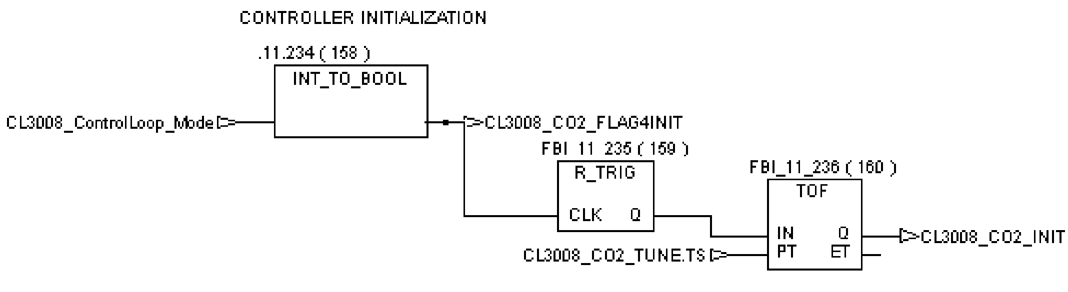
Mode CO2+BASE: YMIN=0 AND YMAX=1 (the controller cannot inject ACID)

Mode ACID+BASE: YMIN=-1 AND YMAX=1(the controller can inject both)



2.11.2.2.1.7. Acid and Base Controller Initialization

When the operator decides to switch to automatic mode, the controller is initialized during the sample time (see controller parameters).



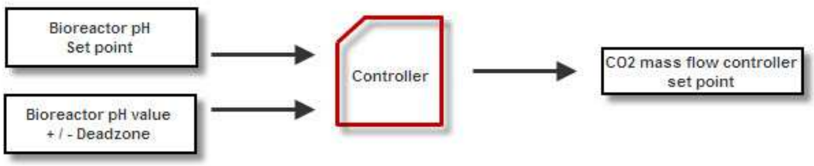
2.11.2.2.1.8. Acid and Base Controller Parameter

Controlled Variable	PCR CONTROLER TYPE	DEAD ZONE	ZTR Zone Control	PWM	SAMPLETM	PROCESS VALUE (input)	SET POINT
SV_3008_01 SV_3008_02 PP_3008_01 PP_3008_02	IF1	YES configurable	NO	CL3006_ACID_BASEPARAPWM t_period : 30s t_pause : 0s t_brake : 0s t_min : 100ms t_max : 30s up_pos : 1 up_neg : 1	CL3008_ACID_BASETUNE.TS	CL3008_pHdz	CL3008_pH_SP

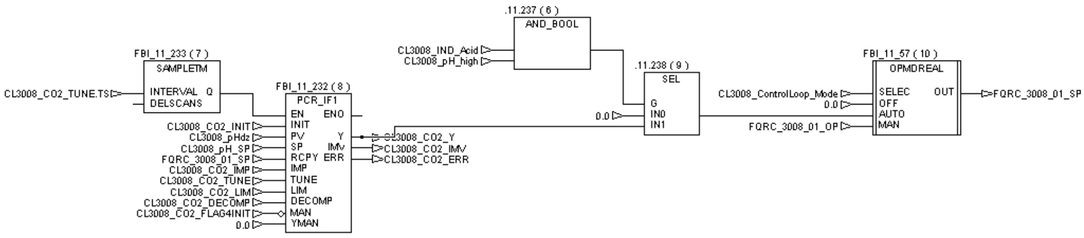
INTERNAL MODEL PROCESS	TUNE	LIMIT	SELF_CMP	DECOMP	Manipulated Variable (Controller Output in Auto Mode)	Controlled Equipment
KM : 0.04 TM : 26s DM :23s	TS : 30s H : 50s TRBF : 900s	CL3008_ACID_BASE_LIM Depends on the pH mode (see Controller ACID and Base limits	NO	15 m	CL3008_ACID_BASE_Y	SV_3008_01_MV SV_3008_02_MV PP_3008_01_MV PP_3008_02_MV

2.11.2.2.2. Controller CO2

The controller which manages the CO2 is linked to a mass flow controller. The output of the predictive controller block IF1 sends a set point in ml/min to the mass flow controller.

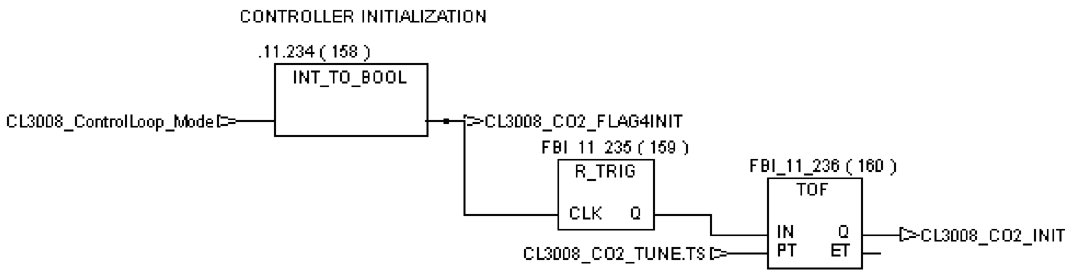


Important point: Because PCR block doesn't accept value lower than 10^{-7} and the gain value is 10^{-8}, we need to change the unit of the PCR equation.
For that, we have decided to convert the unit of the flow from "ml" to "litre".
According to this change we multiply the controller output by 1000 to re-pass in ml unit after the controller.
The logic also concerns the recopy and the limits of the controller.



2.11.2.2.2.1. CO2 Controller Initialization

When the operator decides to switch to automatic mode, the controller is initialized during the sample time (see controller parameters).



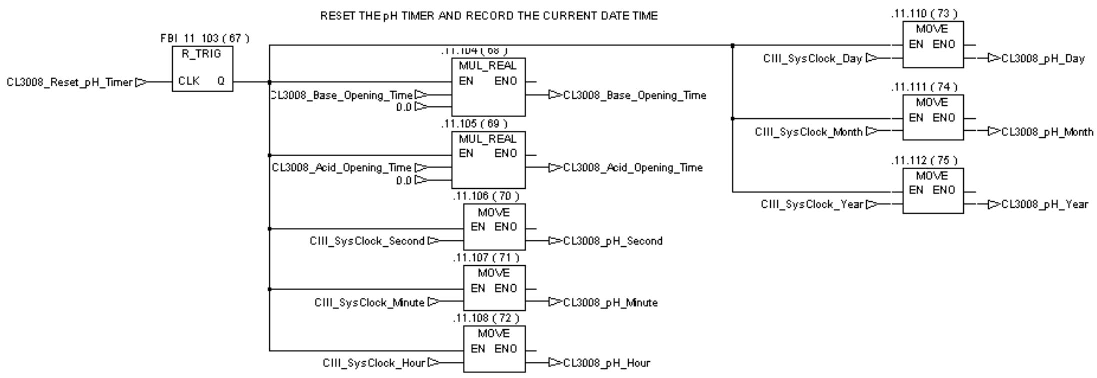
2.11.2.2.2.2. CO2 Controller Parameter

Controlled Variable	PCR CONTROLER TYPE	DEAD ZONE	ZTR Zone Control	PWM	SAMPLETM	PROCESS VALUE (input)	SET POINT
FQRC_3008_01_SP	IF1	YES configurable	NO	NO	CL3008_CO2_TUNE.TS	CL3008_pHdz	CL3008_pH_SP

INTERNAL MODEL PROCESS	TUNE	LIMIT	SELF_CMP	DECOMP	Manipulated Variable (Controller Output in Auto Mode)	Controlled Equipment
KM : -0,000047 TM : 265s DM :0s	TS : 30s H : 250s TRBF : 900s	CL4006_CO2_LIM YMIN: 0 YMAX: 50 YRATE: 50	NO	15m	CL3008_CO2_Y	FQRC_3008_01_SP

2.11.2.3. *Reset timer function.*

The operator can reset the timer recording the ACID and BASE injection time. The PLC current date is then recorded as the starting point of the timer.



2.11.3.Alarms and Threshold

Alarm tag Name	type	Address	description
CL3008_pH_AH	BOOL	000103	High pH in the Bioreactor Only in automatic mode Compared to the set point
CL3008_pH_AHH	BOOL	000104	Very High pH in the Bioreactor cut the control loop Only in automatic mode Compared to the set point
CL3008_pH_AL	BOOL	000105	Low pH in the Bioreactor Only in automatic mode Compared to the set point
CL3008_pH_ALL	BOOL	000106	Very Low pH in the Bioreactor cut the control loop Only in automatic mode Compared to the set point
WIT_3008_01_AL	BOOL	000107	Low Level in the ACID tank
WIT_3008_01_ALL	BOOL	000108	Very Low Level in the ACID tank
WIT_3008_02_AL	BOOL	000109	Low Level in the BASE tank
WIT_3008_02_ALL	BOOL	000110	Very Low Level in the BASE tank
CL3008_SENSOR_DEVIATION_A	BOOL	000252	Triggered when the pH gap between the two probes is more than 2
FQRC_3008_01_AH	BOOL	000253	The value asked is high compared to the value read on the mass flow controller
FQRC_3008_01_AHH	BOOL	000254	The value asked is very high compared to the value read on the mass flow controller
FQRC_3008_01_AL	BOOL	000255	The value asked is low compared to the value read on the mass flow controller

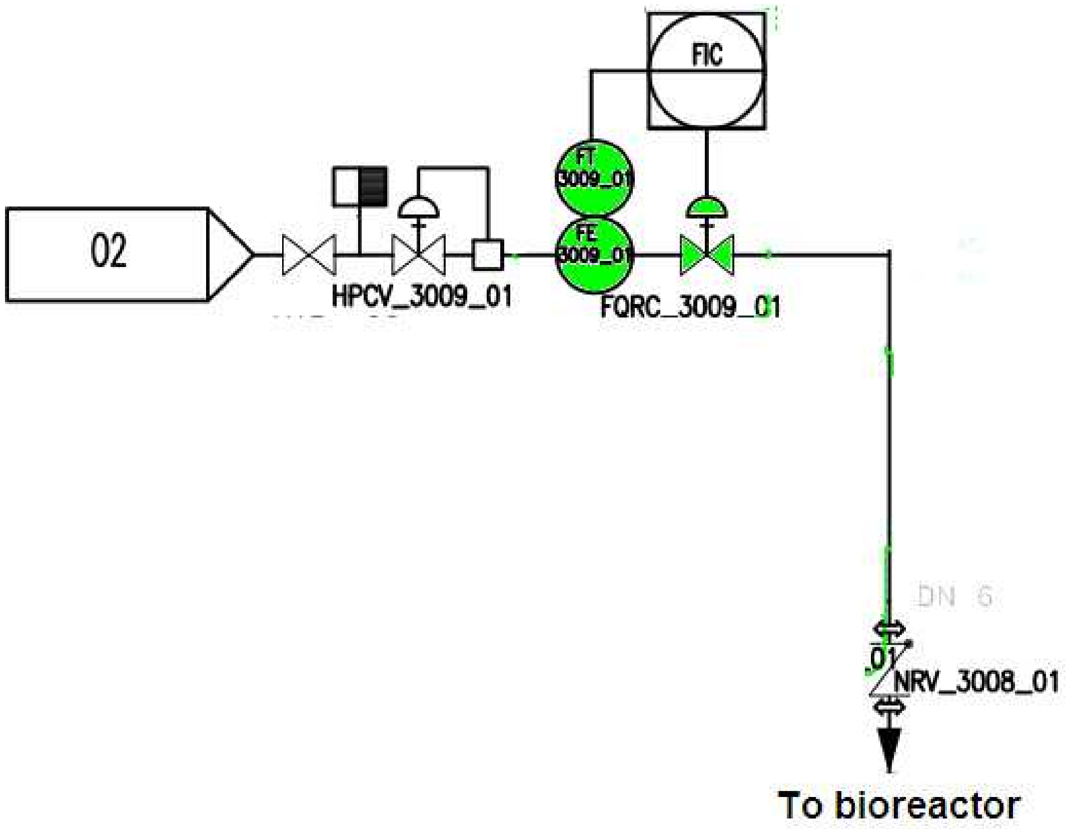
Alarm tag Name	type	Address	description
FQRC_3008_01_ALL	BOOL	000256	The value asked is very low compared to the value read on the mass flow controller
SV_3008_01_A	BOOL	000111	Set if the feed back is not detected after 5 seconds
SV_3008_02_A	BOOL	000112	Set if the feed back is not detected after 5 seconds
AT_3008_01_ERR	BOOL	000113	SET if the wire is broken
TT_3008_01_ERR	BOOL	000114	SET if the wire is broken
AT_3008_02_ERR	BOOL	000115	SET if the wire is broken
TT_3008_02_ERR	BOOL	000116	SET if the wire is broken
WIT_3008_01_ERR	BOOL	000117	SET if the wire is broken
WIT_3008_01_ERR	BOOL	000118	SET if the wire is broken
FQRC_3008_01_ERR	BOOL	000119	SET if the wire is broken

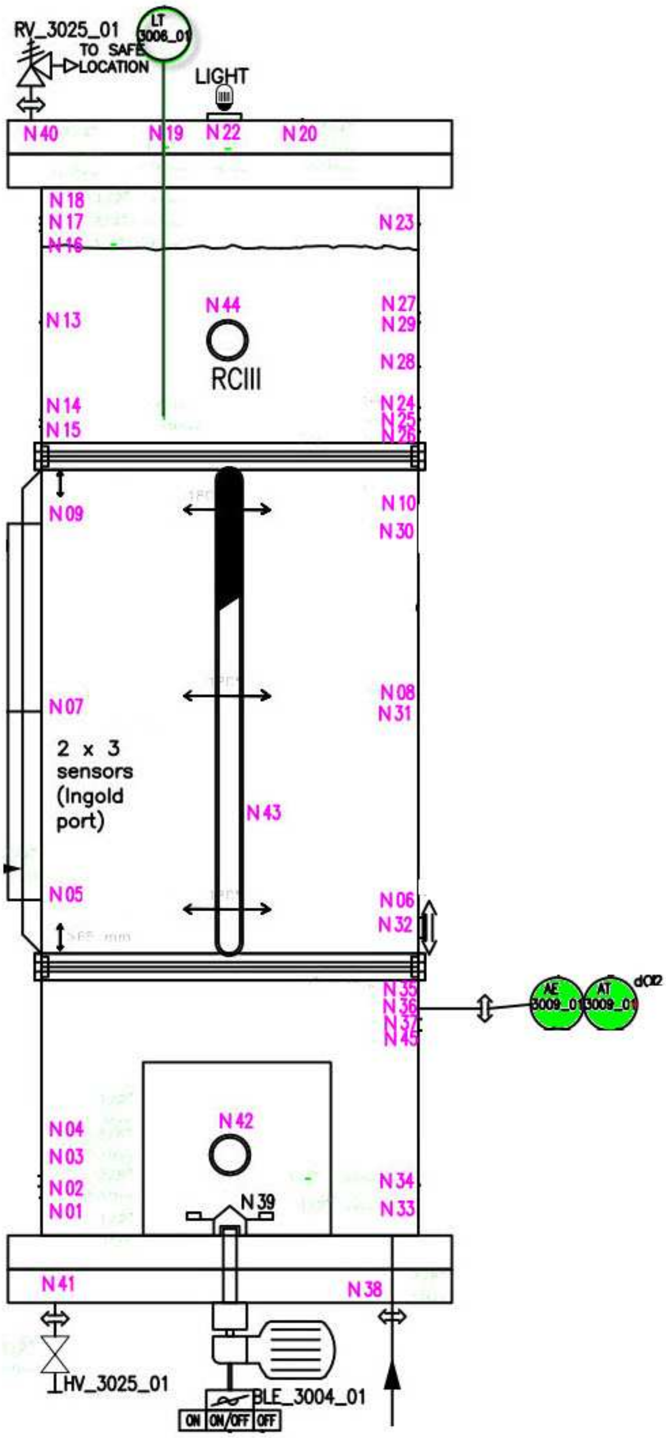
Figure 32: Bioreactor pH control - ALARMS

Threshold tag name	Type	Address	Value	Unit	Action
CL3008_pH_LIM_H	REAL	400582	0.1	-	Displays an alarm on the HMI Only in automatic mode
CL3008_pH_LIM_HH	REAL	400584	0.5	-	cut the control loop Displays an alarm on the HMI Only in automatic mode
CL3008_pH_LIM_L	REAL	400586	-0.1	-	Displays an alarm on the HMI Only in automatic mode
CL3008_pH_LIM_LL	REAL	400588	-0.5	-	cut the control loop Displays an alarm on the HMI Only in automatic mode
CL3008_SENSOR_DEVIATION_LIM	REAL	400708	0.5	(pH)	Displays an alarm on the HMI
FQRC_3008_01_LIM_H	REAL	400710	20	ml/min	Displays an alarm on the HMI
FQRC_3008_01_LIM_HH	REAL	400712	50	ml/min	Displays an alarm on the HMI
FQRC_3008_01_LIM_L	REAL	400714	-20	ml/min	Displays an alarm on the HMI
FQRC_3008_01_LIM_LL	REAL	400716	-50	ml/min	Displays an alarm on the HMI
WIT_3008_01_LIM_L	REAL	400590	1	kg	Displays an alarm on the HMI
WIT_3008_01_LIM_LL	REAL	400592	0.5	kg	**Change in CO2 mode** Displays an alarm on the HMI
WIT_3008_02_LIM_L	REAL	400594	1	kg	Displays an alarm on the HMI
WIT_3008_02_LIM_LL	REAL	400596	0.5	kg	Displays an alarm on the HMI

Figure 33: Bioreactor pH control – THRESHOLDS

2.12. Bioreactor DO2 Control (CL3009)




RV_3025_01
TO SAFE LOCATION
LT 3008_01
LIGHT
N40
N19
N22
N20
N18
N17
N16
N23
N13
N44
RCIII
N27
N29
N28
N14
N15
N24
N25
N26
N09
N10
N30
N07
N08
N31
2 x 3
sensors
(Ingold
port)
N43
N05
N06
N32
N35
N36
N37
N45
AE 3009_01
AT 3009_01
dO2
N04
N03
N02
N01
N42
N39
N34
N33
N41
N38
HV_3025_01
BLE_3004_01
ON
ON/OFF
OFF

2.12.1.Function

The aim of this loop is to control the dissolved dioxygen in the Bioreactor.
It is performed by adding dioxygen in gas phase in the gas loop.

- OFF: the dissolved DO2 is not controlled. No O2 injection in the biorector
- AUTOMATIC: DO2 is automatically controlled with the O2 mass flow controller set point.
- MANUAL: the operator can fix the O2 mass flow controller set point.

PLC Section name	Equipment tag	Type	Address	Comment
CL3009_Bioreactor_D02_Control	AT_3009_01	AI->REAL	400122	Dissolved O2 transmitter (BOTTOM)
CL3009_Bioreactor_D02_Control	AT_3009_02	AI->REAL	400124	Dissolved O2 transmitter (TOP)
CL3009_Bioreactor_D02_Control	FQRC_3009_01	AI->REAL	400126	Flow element + transmitter (O2)
CL3009_Bioreactor_D02_Control	FQRC_3009_01_SP	REAL -> AO	400190	Flow Control Valve non sterile gas (O2)

Figure 34 : Bioreactor DO2 Control – EQUIPEMENTS

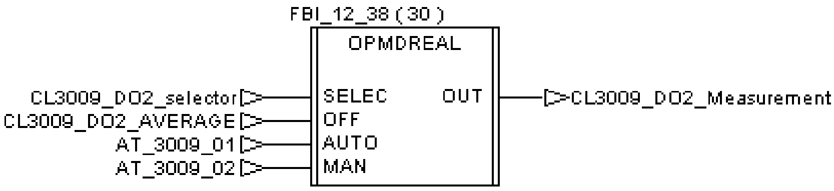
PLC Section name	Equipment tag	Type	Address	Comment
CL3009_Bioreactor_D02_Control	CL3009_ControlLoop_Mode	INT	400236	Mode Selector (OFF/Manu/Auto)
CL3009_Bioreactor_D02_Control	FQRC_3009_01_OP	REAL	400120	Used to define the opening Set point of the mass flow controller valve in manual mode
CL3009_Bioreactor_D02_Control	CL3009_DO2_SP	REAL	400172	Used to define the Set point of the Dissolved Oxygen in automatic mode (Controller set point)
CL3009_Bioreactor_DO2_Control	CL3009_DO2_selector	INT	400249	Define the DO2 probe used for the Control. (0=Average / 1 = AT_3009_01 / 2 = AT_3009_02)

Figure 35: Bioreactor DO2 Control - -OPERATOR INPUT

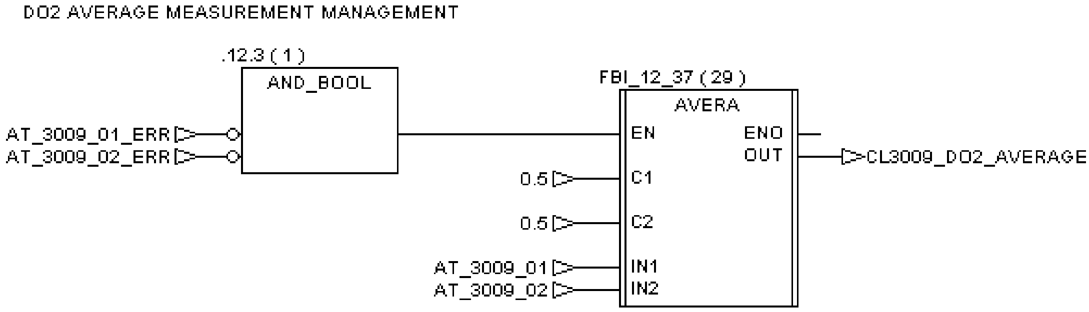
2.12.2.Block Diagram

2.12.2.1. *DO2 probe selection*

The operator can choose both probes separately or the average of the two probes.

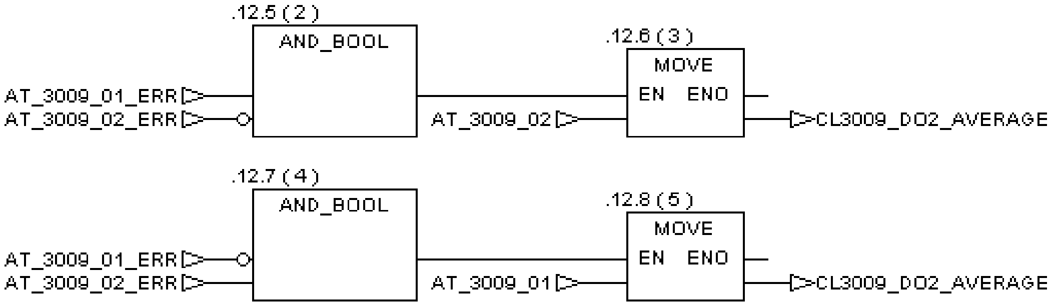


2.12.2.2. *DO2 probe average calculation*

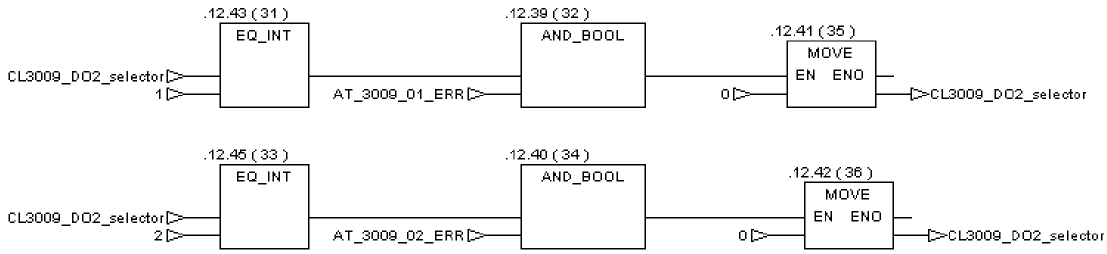


2.12.2.3. *DO2 probe error management*

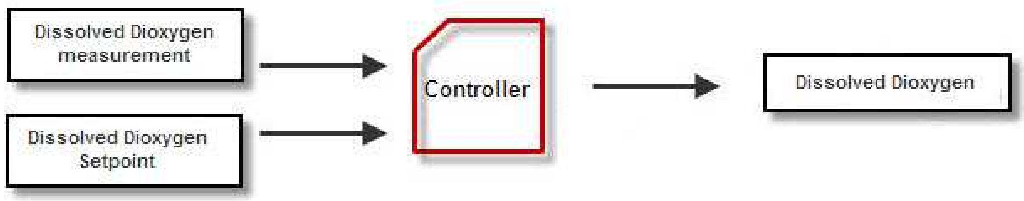
If the operator selected probe goes into failure, the PLC automatically takes the second probe as current measurement.



In case of average measurement, if one of the two probes goes into failure, the controlled value becomes the other probe.



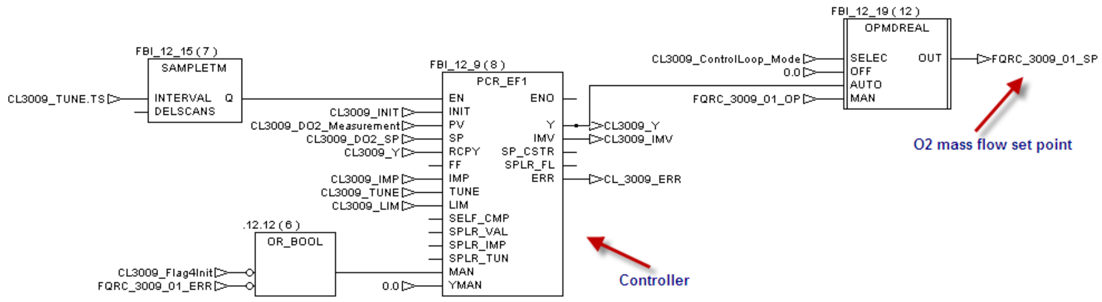
2.12.2.3.1. DO2 Controller



The control is done by the Predictive control block EF1 (Simple predictive controller for first order process) (See annex C). An internal model represents the DO2 function of the O2 mass flow. Depending of this model, the controller will adjust the mass flow to maintain the desired set point.

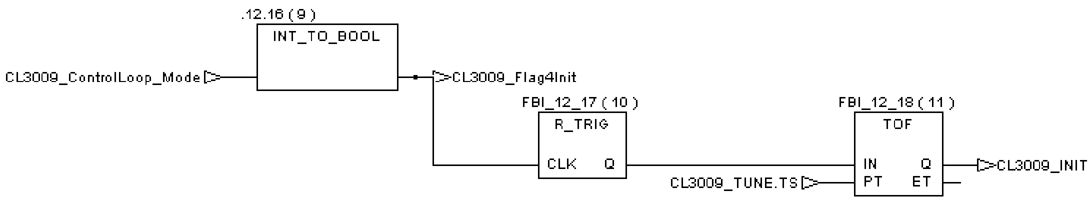
The control depends on the mode selected by the operator:

- OFF mode: The mass flow is switched OFF
- MAN mode: The user can fix the O2 mass flow set point
- AUTO mode: The controller adjusts the O2 mass flow to satisfy the DO2 set point



2.12.2.3.2. Controller initialization

When the operator decides to switch to the automatic mode, the controller is initialized during the sample time (see controller parameters)



2.12.2.3.3. Controller parameters

Controlled Variable	**PCR CONTROLER TYPE**	**DEAD ZONE**	**ZTR Zone Control**	**PWM**	**SAMPLETM**	**PROCESS VALUE (input)**	**SET POINT**
Set Point of the O2 mass flow controller (FQRC_3009_01_SP)	EF1	NO	NO	NO	CL3009_TUNE.TS	CL3009_DO2_Measurement	CL3009_DO2_SP

INTERNAL MODEL PROCESS	**TUNE**	**LIMIT**	**SELF_CMP**	**DECOMP**	**Manipulated Variable (Controller Output in Auto Mode)**	**Controlled Equipment**
KM : TM : DM :	TS : H : TRBF :	CL3009_LIM YMIN : YMAX : YRATE :	NO	NO	CL3009_Y	FQRC_3009_01_SP

2.12.3.Alarms and Thresholds

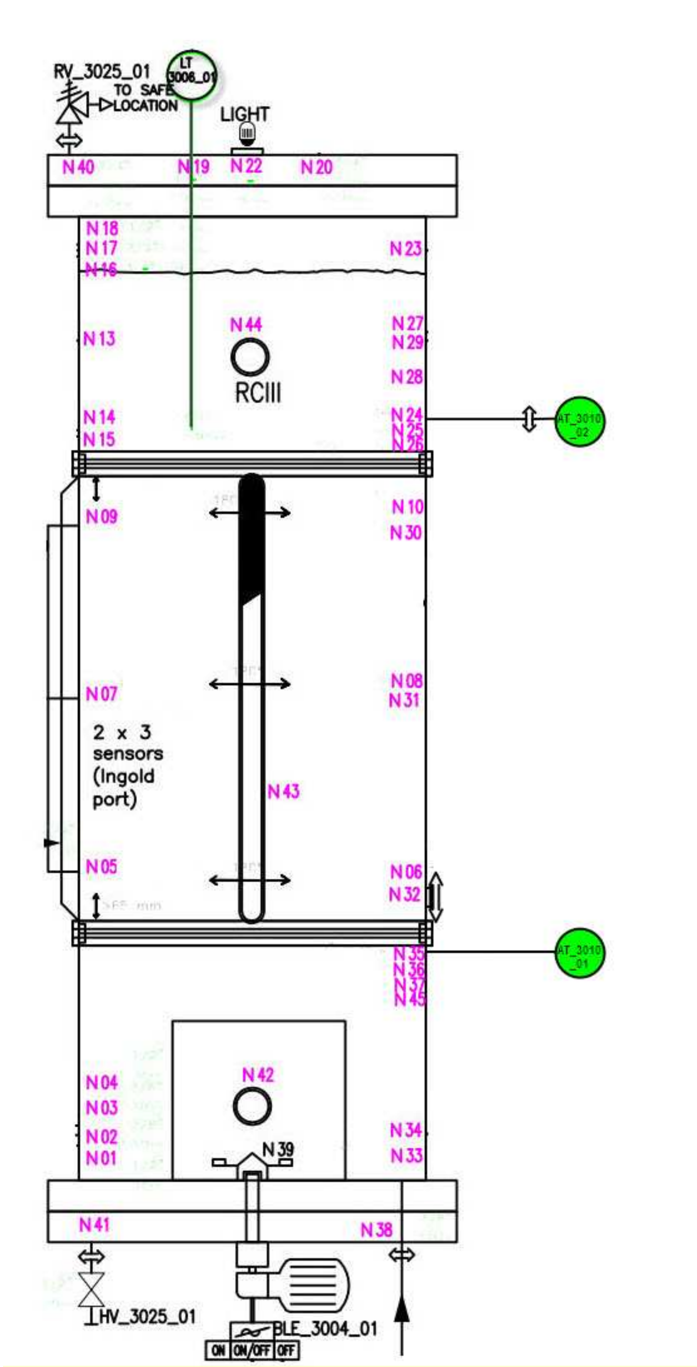
Alarm tag Name	type	Address	description
AT_3009_01_AH	BOOL	000120	High percentage of Dissolved Oxygen Only in automatic mode Compared to the set point
AT_3009_01_AHH	BOOL	000121	Very High percentage of Dissolved Oxygen Only in automatic mode Compared to the set point
AT_3009_01_AL	BOOL	000122	Low percentage of Dissolved Oxygen Only in automatic mode Compared to the set point
AT_3009_01_ALL	BOOL	000123	Very Low percentage of Dissolved Oxygen Only in automatic mode Compared to the set point
AT_3009_01_ERR	BOOL	000124	SET if the wire is broken
AT_3009_02_AH	BOOL	000125	High percentage of Dissolved Oxygen Compared to the set point
AT_3009_02_AHH	BOOL	000126	Very High percentage of Dissolved Oxygen Compared to the set point
AT_3009_02_AL	BOOL	000127	Low percentage of Dissolved Oxygen Compared to the set point
AT_3009_02_ALL	BOOL	000128	Very Low percentage of Dissolved Oxygen Compared to the set point
FQRC_3009_01_AH	BOOL	000257	High Flow in the O2 GAS Mass Flow Controller
FQRC_3009_01_AHH	BOOL	000258	Very High Flow in the O2 GAS Mass Flow Controller
FQRC_3009_01_AL	BOOL	000259	Low Flow in the GAS O2 Mass Flow Controller
FQRC_3009_01_ALL	BOOL	000260	Very Low Flow in the O2 GAS Mass Flow Controller
AT_3009_02_ERR	BOOL	000129	SET if the wire is broken
FQRC_3009_01_ERR	BOOL	000130	SET if the wire is broken
CL3009_SENSOR_DEVIATION_A	BOOL	000262	Triggered when the DO2 gap between the two probes is greater than 5%

Figure 36 : Bioreactor DO2 Control – ALARMS

Threshold tag name	Type	Address	Value	Unit	Action
AT_3009_LIM_H	REAL	400598	10	%	Displays an alarm on the HMI Compared to the set point Only in automatic mode
AT_3009_LIM_HH	REAL	400600	20	%	Displays an alarm on the HMI Compared to the set point Only in automatic mode
AT_3009_LIM_L	REAL	400602	-20	%	Displays an alarm on the HMI Only in automatic mode
AT_3009_LIM_LL	REAL	400604	-40	%	Displays an alarm on the HMI Compared to the set point Only in automatic mode
CL3009_SENSOR_DEVIATION_LIM	REAL	400734	5	%	Displays an alarm on the HMI
FQRC_3009_01_LIM_H	REAL	400718	100	ml/min	Displays an alarm on the HMI
FQRC_3009_01_LIM_HH	REAL	400720	300	ml/min	Displays an alarm on the HMI
FQRC_3009_01_LIM_L	REAL	400722	-100	ml/min	Displays an alarm on the HMI
FQRC_3009_01_LIM_LL	REAL	400724	-300	ml/min	Displays an alarm on the HMI

Figure 37 : Bioreactor DO2 Control – THRESHOLDS

2.13. Bioreactor EC (CL3010)



2.13.1.Function

There is no control. EC is monitored.

PLC Section name	Equipment tag	Type	Address	Comment
CL3010_Bioreactor_EC_Control	AT_3010_01	AI->REAL	400128	Conductivity element + transmitter (BOTTOM)
CL3010_Bioreactor_EC_Control	AT_3010_02	AI->REAL	400130	Conductivity element + transmitter (TOP)

Figure 38 : Bioreactor EC - EQUIPMENTS

2.13.2.Block Diagram

No controller

2.13.3.Alarms and Thresholds

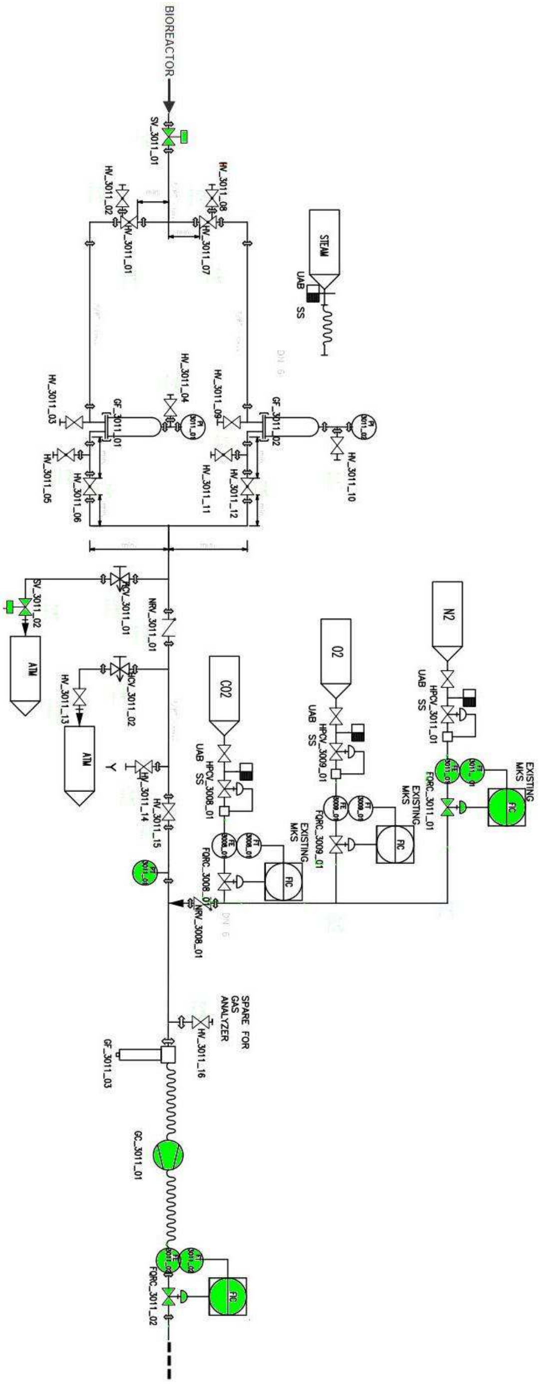
Alarm tag Name	type	Address	description
AT_3010_01_AH	BOOL	000131	High Electro Conductivity in the Bioreactor
AT_3010_01_AHH	BOOL	000132	Very High Electro Conductivity in the Bioreactor
AT_3010_01_AL	BOOL	000133	Low Electro Conductivity in the Bioreactor
AT_3010_01_ALL	BOOL	000134	Very Low Electro Conductivity in the Bioreactor
AT_3010_01_ERR	BOOL	000135	SET if the wire is broken
AT_3010_02_AH	BOOL	000136	High Electro Conductivity in the Bioreactor
AT_3010_02_AHH	BOOL	000137	Very High Electro Conductivity in the Bioreactor
AT_3010_02_AL	BOOL	000138	Low Electro Conductivity in the Bioreactor
AT_3010_02_ALL	BOOL	000139	Very Low Electro Conductivity in the Bioreactor
AT_3010_02_ERR	BOOL	000140	SET if the wire is broken

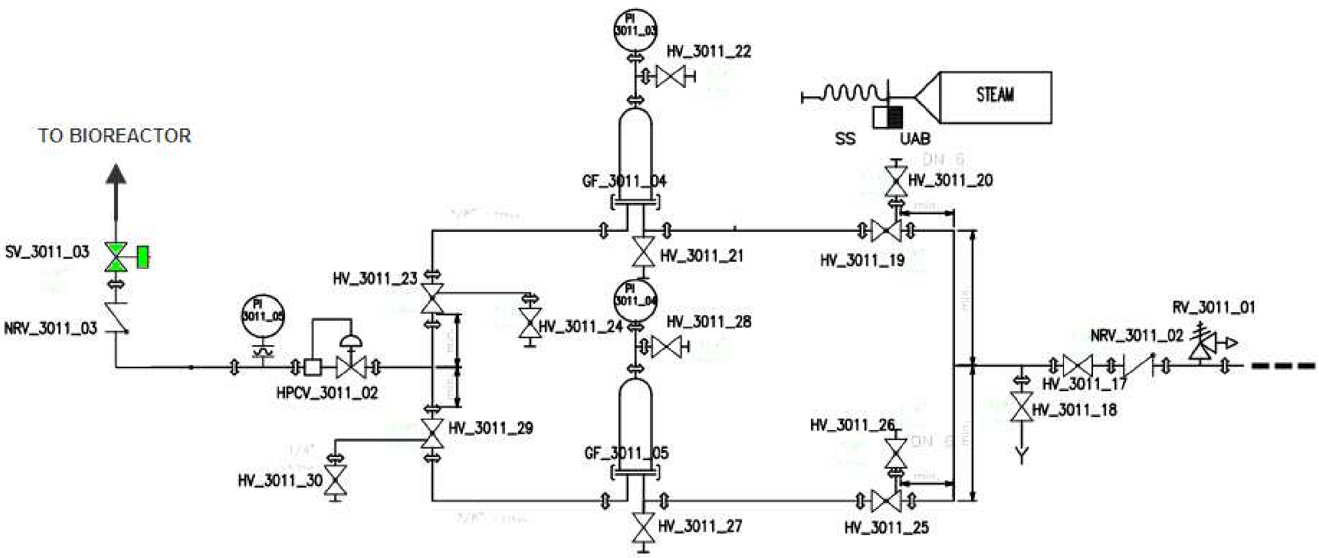
Figure 39: Bioreactor EC - ALARMS

Threshold tag name	Type	Address	Value	Unit	Action
AT_3010_LIM_H	REAL	400606	7.5	millisiemens / cm	Displays an alarm on the HMI
AT_3010_LIM_HH	REAL	400608	9	millisiemens / cm	Displays an alarm on the HMI
AT_3010_LIM_L	REAL	400610	4.5	millisiemens / cm	Displays an alarm on the HMI
AT_3010_LIM_LL	REAL	400612	3	millisiemens / cm	Displays an alarm on the HMI

Figure 40 : Bioreactor EC - THRESHOLD

2.14. Gas Loop (CL3011)





2.14.1.Function

The objective of this loop is to manage the gas loop:

- To maintain the Mix Flow rate, with N2 injection.
- To control the pressure of the bioreactor.

O2 mass flow controller is managed in automatic in the DO2 control loop.
CO2 mass flow controller is managed in automatic in the pH control loop.

PLC Section name	Equipment tag	Type	Address	Comment
CL3011_Gas_Loop	GC_3011_01_MV	DO	000037	Gas compressor
CL3011_Gas_Loop	FQRC_3011_01_SP	REAL -> AO	400192	Flow Control Valve non sterile gas (N2)
CL3011_Gas_Loop	FQRC_3011_01	AI->REAL	400136	Flow element + transmitter (N2)
CL3011_Gas_Loop	FQRC_3011_02_SP	REAL -> AO	400202	Flow element + transmitter (mix)
CL3011_Gas_Loop	FQRC_3011_02	AI->REAL	400138	Flow element + transmitter (mix)
CL3011_Gas_Loop	PT_3011_01	AI->REAL	400140	Pressure transmitter
CL3011_Gas_Loop	SV_3011_01_MV	DO	000022	Reactor venting valve
CL3011_Gas_Loop	SV_3011_01_FB	DI	100028	Reactor venting valve feedback
CL3011_Gas_Loop	SV_3011_02_MV	DO	000018	Gas exhaust valve
CL3011_Gas_Loop	SV_3011_02_FB	DI	100030	Gas exhaust valve feedback

PLC Section name	Equipment tag	Type	Address	Comment
CL3011_Gas_Loop	SV_3011_03_MV	DO	000024	Gas introduction valve / OLD NAME OF THE VALVE: SV_3016_01
CL3011_Gas_Loop	SV_3011_03_FB	DI	100032	Gas introduction valve Feedback / OLD NAME OF THE VALVE: SV_3016_01

Figure 41 : Gas Loop – EQUIPMENTS

PLC Section name	Equipment tag	Type	Address	Comment
CL3011_Gas_Loop	CL3011_ControlLoop_Mode	INT	400237	Mode Selector (OFF/Manu/Auto)
CL3011_Gas_Loop	GC_3011_01_OP	BOOL	000141	Used to start or stop the gas compressor pump in manual mode
CL3011_Gas_Loop	FQRC_3011_01_OP	REAL	400132	Used to define the opening Set point of the mass flow controller valve in manual mode
CL3011_Gas_Loop	FQRC_3011_02_OP	REAL	400134	Used to define the opening Set point of the mass flow controller valve in manual mode
CL3011_Gas_Loop	CL3011_GasMix_SP	REAL	400174	Used to define the Gas Mix Set point of the controller in automatic mode
CL3011_Gas_Loop	SV_3011_01_OP	BOOL	000142	Used to open or close the valve in manual mode
CL3011_Gas_Loop	SV_3011_02_OP	BOOL	000143	Used to open or close the valve in manual mode

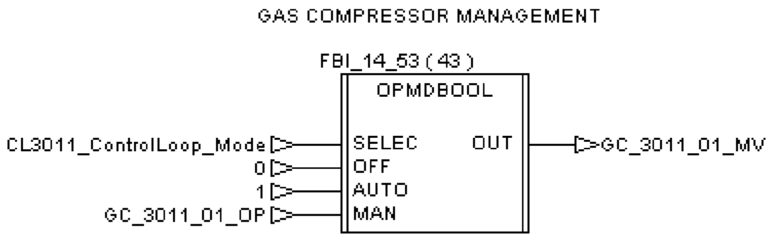
Figure 42 : Gas Loop – OPERATOR INPUTS

2.14.2. Block Diagram

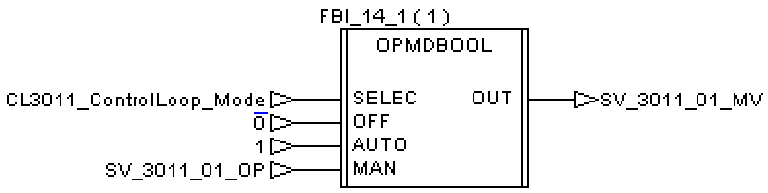
The control depends on the mode selected by the operator:

- OFF mode: The compressor and mass flow controller are switched off. The pressure in the Bioreactor is not controlled.
- MAN mode: The user can start or stop the compressor, set the mix flow set point and N2 set point. User can open/close the atmospheric valve. Pressure is not controlled.
- AUTO mode: The controller adjusts the N2 mass flow and valve to atmosphere to satisfy the pressure set point.

2.14.2.1. *Gas Compressor Management*

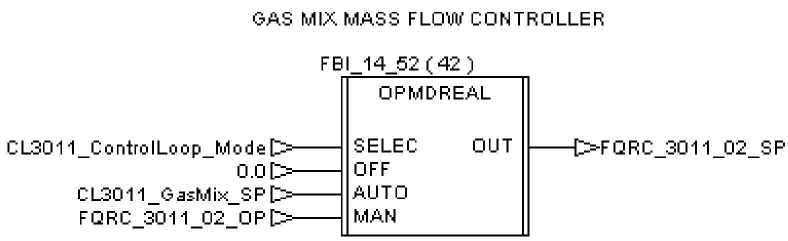


2.14.2.2. *Reactor Venting Valve Management*



In AUTO mode, the reactor venting valve is open
In MAN mode, it is user defined. Excepted when Gas Pulse is in AUTO mode. In this case, it is open/close depending on the cycle of the Gas Pulse.
In OFF mode, the valve is closed.

2.14.2.3. *Gas Mix Flow Controller*



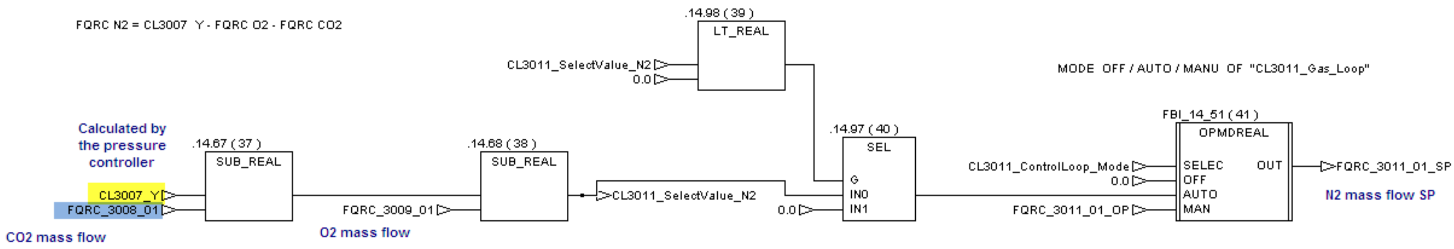
In AUTO mode, the user set the Set Point
In MAN, the user can fix the set point. In case of Gas Pulse, the set point is set by the Gas Pulse Control Loop to 3000 mL/mn.

2.14.2.4. *N2 Mass Flow Controller*

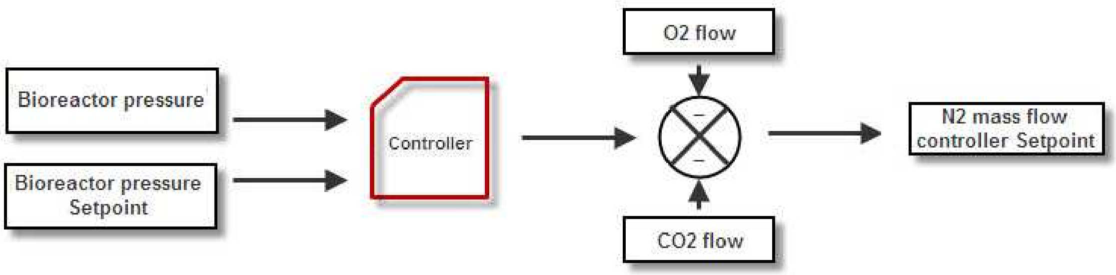
Depending on the selected Mode :
- OFF : N2 mass flow set point is set to 0
- MAN : N2 mass flow set point is set to the user set point desired value

- AUTO : N2 mass flow set point is calculated as :
  - PressureControllerOutput – (O2 mass flow) – (CO2 mass flow)

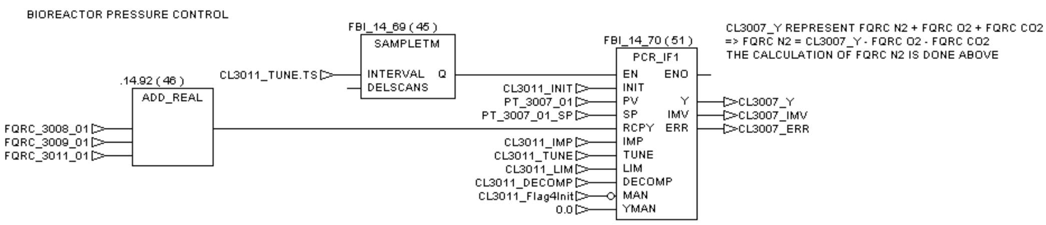
In AUTOMATIC mode, the Pressure controller calculates the total flow needed to maintain the pressure at the desired set point (around 50 mbar). N2 is adjusted consequently.



2.14.2.5. *Controller*

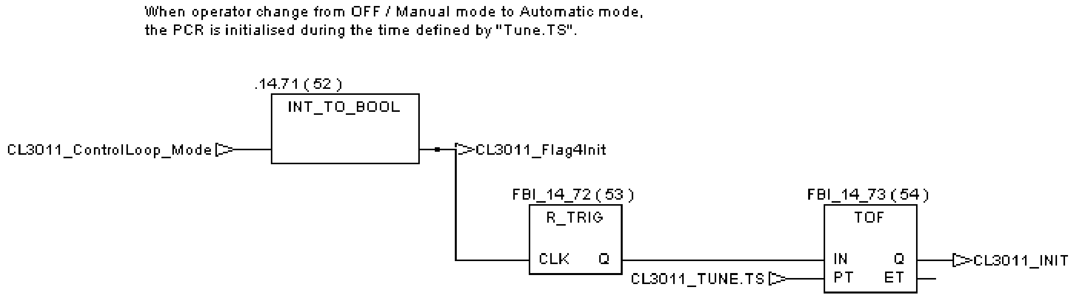


A predictive block "IF1" controls the pressure (for more details on the block, see annex D). The manipulated variable represents the summation of the three inlet gas (N2, O2, CO2). As O2 is used for DO2 control and CO2 for pH control, only N2 is adjusted.



2.14.2.6. *Controller initialization*

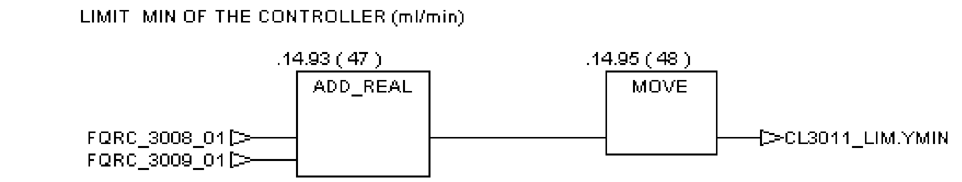
When the operator decides to switch in automatic mode, the controller is initialized during the sample time (see controller parameters).

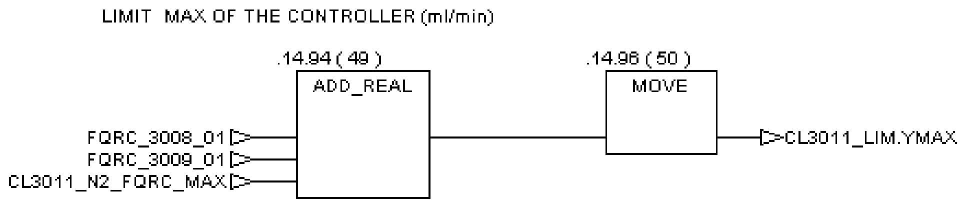


2.14.2.7. *Limits of the controller*

N2 mass flow controller limits (range) are [0 CL3011_N2_FQRC_MAX]
(CL3011_N2_FQRC_MAX = 300 mL/mn)

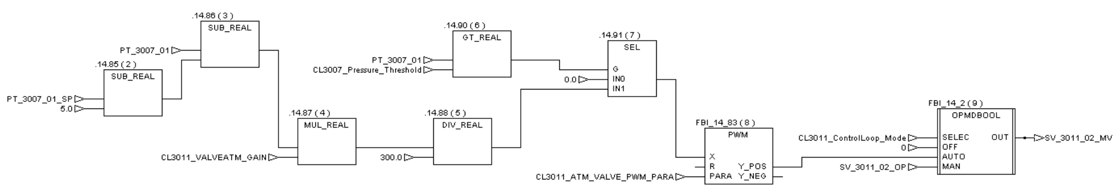
As the output of the controller corresponds to “N2 + O2 + CO2”, the limits of the controller are :
MIN : (0 + O2_measurement + CO2_measurement)
MAX : (CL3011_N2_FQRC_MAX + O2_measurement + CO2_measurement)





2.14.2.8. *Atmospheric Valve Management*

In case of High pressure, the Atmospheric Valve is opened during a calculated time.
The Opening time is calculated with the following equation :
OPENING TIME = GAIN x (BIOREACTOR PRESSURE – (BIOREACTOR PRESSURE SET POINT – 5)).
For instance, if Set Point is 50 mbar and the pressure is 90 mbar, the OPENING TIME will be calculated as GAIN * (90 – (50-5)), in order to reach a pressure value lower than the desired set point.



In order to send the desired time to a PWM, the time is converted to a value between 0 and 1, proportional to the MAX time of the PWM (300 ms here).

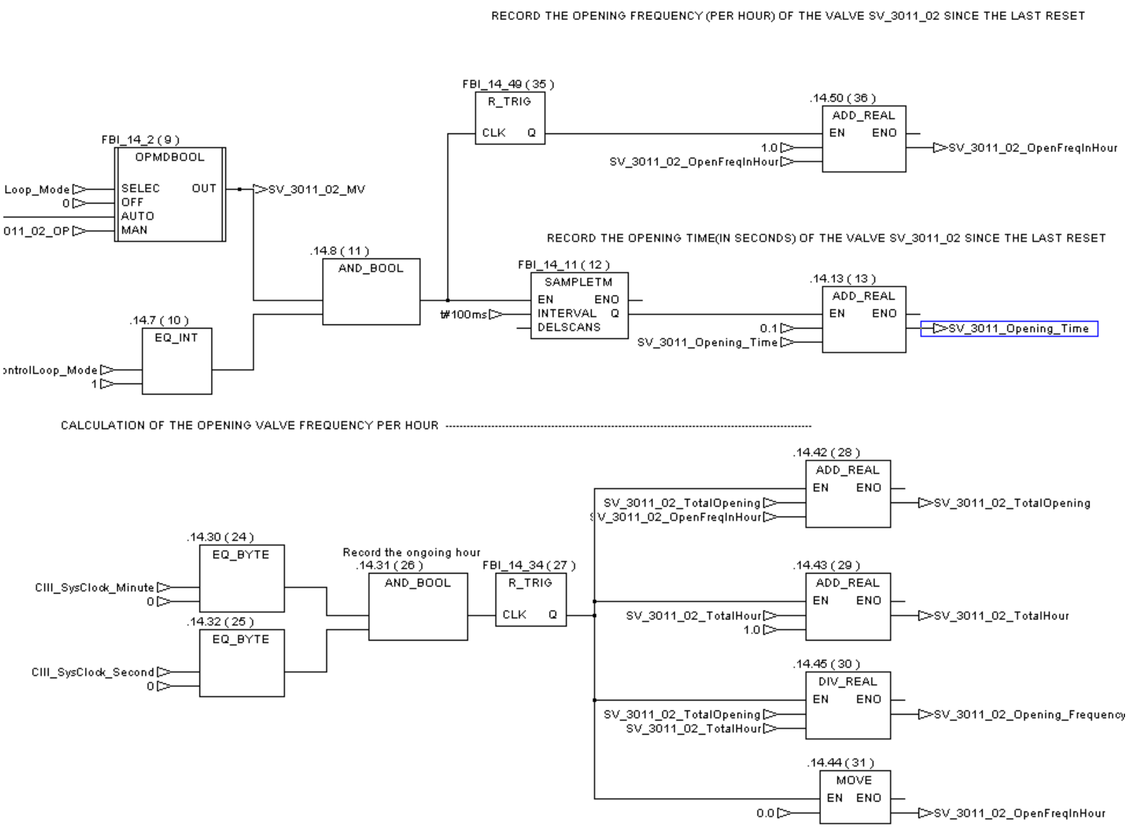
The Atmospheric Valve opening is activated if the pressure is greater than a threshold (CL3007_Pressure_Threshold)

GAIN = CL3011_VALVEATM_GAIN = 6
CL3007_Pressure_Threshold = 80 mbar (from HMI)

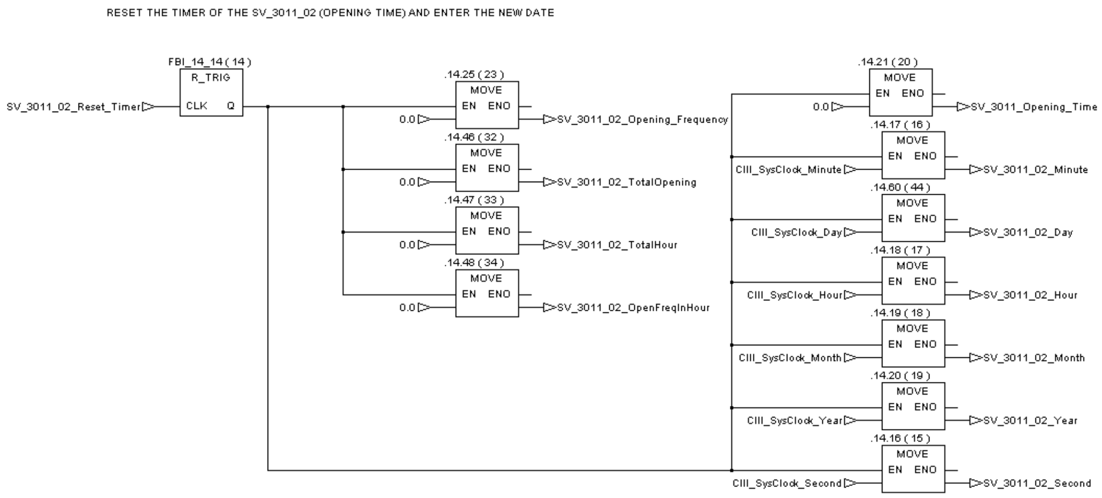
PWM
CL3011_ATM_VALVE_PWM_PARA t_period : 300ms t_pause : 0s t_brake : 0s t_min : 50ms t_max : 300s up_pos : 1 up_neg : 0

2.14.2.8.1. Opening Time of the Atmospheric Valve

Opening Time of the Atmospheric Valve SV_3011_02 is calculated since the last reset of the time. And also the opening valve frequency per hour.



2.14.2.8.2. Reset the Opening Time of the Atmospheric Valve



2.14.2.9. *Controller parameter (Pressure)*

Controlled Variable	PCR CONTROLER TYPE	DEAD ZONE	ZTR Zone Control	PWM	SAMPLETM	PROCESS VALUE (input)	SET POINT
CL3007_Y	IF1	NO	NO	No	CL3011_TUNE.TS	PT_3007_01	PT_3007_01_SP

INTERNAL MODEL PROCESS	TUNE	LIMIT	SELF_CMP	DECOMP	Manipulated Variable (Controller Output in Auto Mode)	Controlled Equipment
KM : 0.015 TM : 0s DM :0s	TS : 0.5s H : 3s TRBF : 10s	CL3011_LIM Y_MIN: calculated Y_MIN: calculated YRATE: 300	NO	10s	CL3007_Y	FQRC_3011_01

2.14.3. Alarms and Thresholds

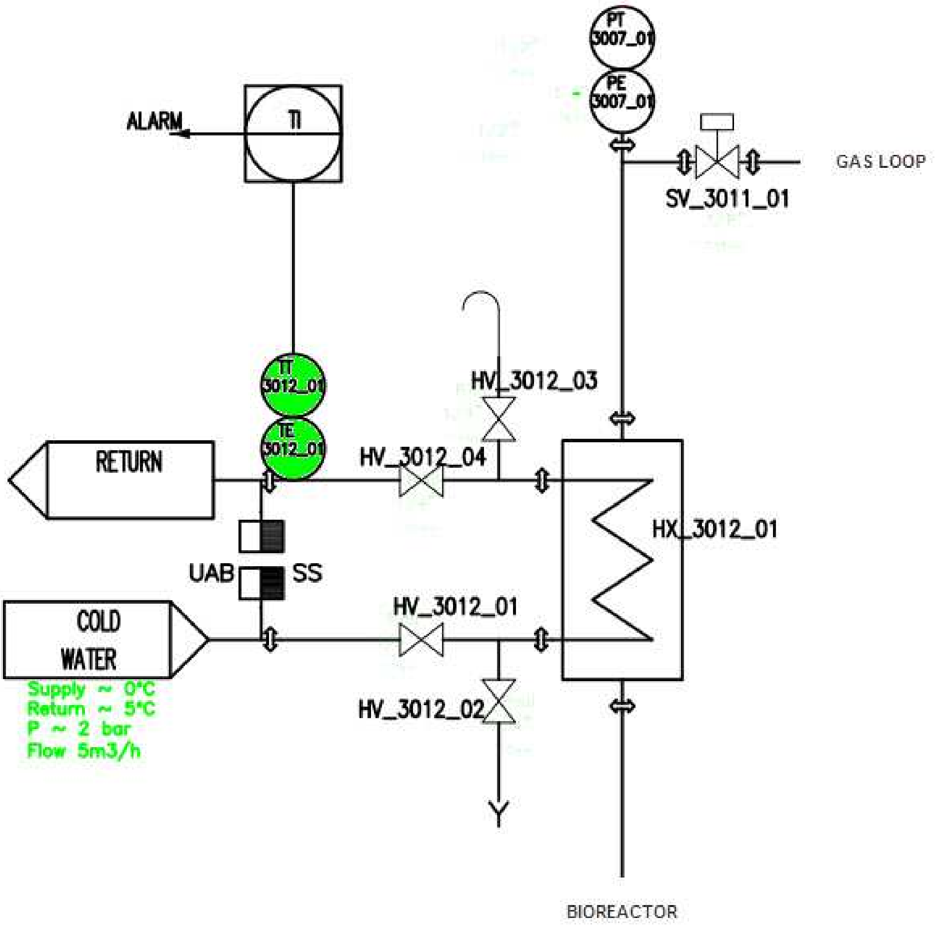
Alarm tag Name	type	Address	description
PT_3011_01_AH	BOOL	000144	High pressure in the gas loop system
PT_3011_01_AHH	BOOL	000145	Very High pressure in the gas loop system
PT_3011_01_AL	BOOL	000146	Low pressure in the gas loop system
PT_3011_01_ALL	BOOL	000147	Very Low pressure in the gas loop system
FQRC_3011_01_AH	BOOL	000263	High Flow in the N2 GAS Mass Flow Controller
FQRC_3011_01_AHH	BOOL	000264	Very High Flow in the N2 GAS Mass Flow Controller
FQRC_3011_01_AL	BOOL	000265	Low Flow in the GAS N2 Mass Flow Controller
FQRC_3011_01_ALL	BOOL	000266	Very Low Flow in the N2 GAS Mass Flow Controller
FQRC_3011_01_ERR	BOOL	000148	SET if the wire is broken
FQRC_3011_02_AH	BOOL	000267	High Flow in the GAS MIX Mass Flow Controller
FQRC_3011_02_AHH	BOOL	000268	Very High Flow in the GAS MIX Mass Flow Controller
FQRC_3011_02_AL	BOOL	000269	Low Flow in the GAS MIX Mass Flow Controller
FQRC_3011_02_ALL	BOOL	000270	Very Low Flow in the GAS MIX Mass Flow Controller
FQRC_3011_02_ERR	BOOL	000149	SET if the wire is broken
PT_3011_01_ERR	BOOL	000150	SET if the wire is broken
SV_3011_01_A	BOOL	000151	Set if the feed back is not detected after 5 seconds
SV_3011_02_A	BOOL	000152	Set if the feed back is not detected after 5 seconds
SV_3011_03_A	BOOL	000190	Set if the feed back is not detected after 5 seconds / OLD NAME OF THE VALVE: SV_3016_01

Figure 43 : Gas Loop – ALARMS

Threshold tag name	Type	Address	Value	Unit	Action
PT_3011_01_LIM_H	REAL	400614	100	mBar	Displays an alarm on the HMI
PT_3011_01_LIM_HH	REAL	400616	500	mBar	Displays an alarm on the HMI
PT_3011_01_LIM_L	REAL	400618	40	mBar	Displays an alarm on the HMI
PT_3011_01_LIM_LL	REAL	400620	0	mBar	Displays an alarm on the HMI
FQRC_3011_01_LIM_H	REAL	400694	100	ml/min	Displays an alarm on the HMI
FQRC_3011_01_LIM_HH	REAL	400696	300	ml/min	Displays an alarm on the HMI
FQRC_3011_01_LIM_L	REAL	400698	-100	ml/min	Displays an alarm on the HMI
FQRC_3011_01_LIM_LL	REAL	400700	-300	ml/min	Displays an alarm on the HMI
FQRC_3011_02_LIM_H	REAL	400726	100	ml/min	Displays an alarm on the HMI
FQRC_3011_02_LIM_HH	REAL	400728	300	ml/min	Displays an alarm on the HMI
FQRC_3011_02_LIM_L	REAL	400730	-100	ml/min	Displays an alarm on the HMI
FQRC_3011_02_LIM_LL	REAL	400732	-300	ml/min	Displays an alarm on the HMI

Figure 44 : Gas Loop – THRESHOLD

2.15. Gas Temperature (CL3012)



2.15.1.Function

There is no control. Temperature of the gas cooling system is monitored to ensure that the condenser is working and ensure that there is no liquid in the gas phase.

PLC Section name	Equipment tag	Type	Address	Comment
CL3012_Gas_Temperature	TT_3012_01	AI->REAL	400142	Air vent cold water temperature transmitter

Figure 45: Gas Temperature – EQUIPMENTS

2.15.2.Alarms and Thresholds

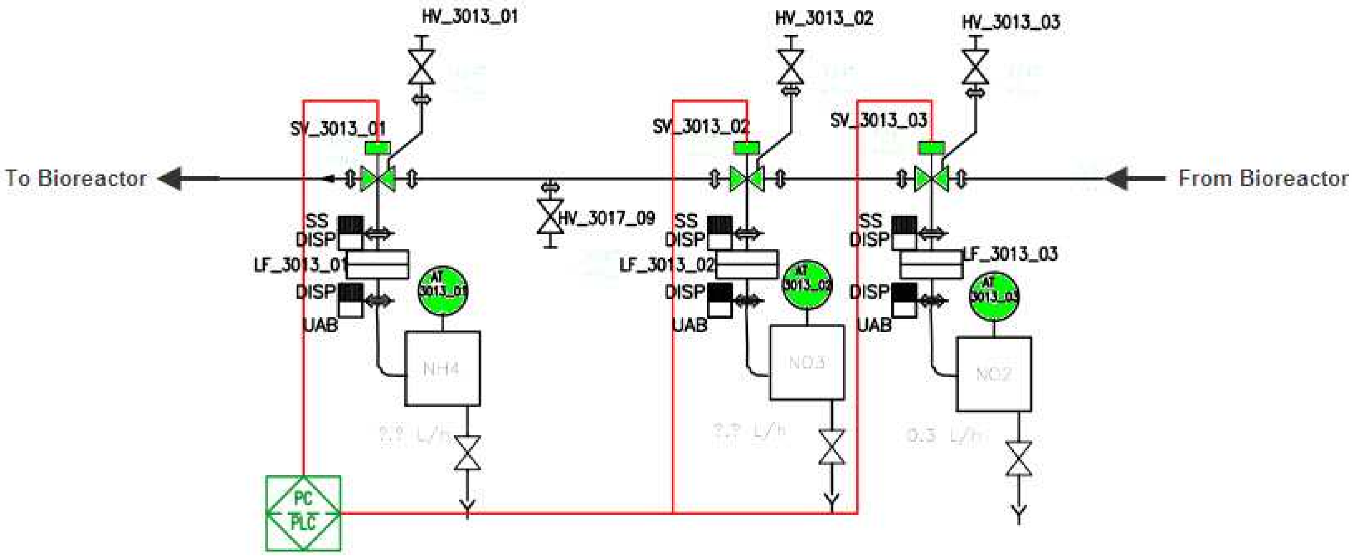
Alarm tag Name	type	Address	description
TT_3012_01_AH	BOOL	000153	High Temperature in the Gas Cooling system
TT_3012_01_AHH	BOOL	000154	Very High Temperature in the Gas Cooling system
TT_3012_01_AL	BOOL	000155	Low Temperature in the Gas Cooling system
TT_3012_01_ALL	BOOL	000156	Very Low Temperature in the Gas Cooling system
TT_3012_01_ERR	BOOL	000232	SET if the wire is broken

Figure 46 : Gas Temperature – ALARMS

Threshold tag name	Type	Address	Value	Unit	Action
TT_3012_01_LIM_H	REAL	400622	11	°C	Displays an alarm on the HMI To be confirmed by UAB when the reactor will be in nominal work
TT_3012_01_LIM_HH	REAL	400624	20	°C	Displays an alarm on the HMI To be confirmed by UAB when the reactor will be in nominal work
TT_3012_01_LIM_L	REAL	400626	9	°C	Displays an alarm on the HMI To be confirmed by UAB when the reactor will be in nominal work
TT_3012_01_LIM_LL	REAL	400628	8	°C	Displays an alarm on the HMI To be confirmed by UAB when the reactor will be in nominal work

Figure 47 : Gas Temperature – THRESHOLDS

2.16. Analysis of Liquid (CL3013)



2.16.1.Function

***IMPORTANT**: Under 2.5 Litres / hour through the recycle line, analysis cannot be performed (In Automatic mode only).*

Three liquid analyzers perform analysis of the bioreactor.

- The $NH4^+$ and the $NO3^-$ analysis are managed by the SCADA system due to the RS 232 protocol. The PLC asks for the starts, the calibration or the stop then waits analyzer status from the SCADA. A routine is called every minute by the Ifix server. Because of that, a delay (1 minute 15 seconds max) can exist between the operator request and analyzer action.
- The $NO2^-$ analysis is managed directly by the PLC. Its calibration is performed locally by the operator.

Each analyzer has three modes (OFF / Automatic / Manual) organised as follow:

- OFF Mode: The entrance valve is closed. If this mode is triggered during a calibration or an analysis, the stop Analyzer function is called.

- Automatic Mode: When triggered, the analysis is started instantaneously. The operator needs to define the Time interval between each analysis and each calibration. When analysis (or calibration) starts, a countdown starts for the next analysis (or calibration). When a calibration is asked during a running analysis, a flag is set. The analysis continues, then when finished the calibration starts. The logic is the same in the opposite way (analysis waits the end of calibration to begin)
- Manual Mode: When triggered, the analyzer countdown is stopped.
  The operator can start directly analysis, calibration (only $NH4^+$ and $NO3^-$ analyzer) or stop the ongoing action from HMI.
  If calibration or analysis are performed during the changing mode, the PLC lets the analyzer finished its action.

PLC Section name	Equipment tag	Type	Address	Comment
CL3013_Analysys of Liquid	SV_3013_01_MV	DO	000028	NH4 sampling valve
CL3013_Analysys of Liquid	SV_3013_01_FB	DI	100036	NH4 sampling valve Feedback
CL3013_Analysys of Liquid	SV_3013_02_MV	DO	000029	N03 sampling valve
CL3013_Analysys of Liquid	SV_3013_02_FB	DI	100037	N03 sampling valve Feedback
CL3013_Analysys of Liquid	SV_3013_03_MV	DO	000030	N02 sampling valve
CL3013_Analysys of Liquid	SV_3013_03_FB	DI	100038	N02 sampling valve Feedback
CL3013_Analysys of Liquid	AT_3013_01	REAL	400144	NH4 Analyser Value
CL3013_Analysys of Liquid	AT_3013_02	REAL	400146	NO3 Analyser Value
CL3013_Analysys of Liquid	AT_3013_03	AI->REAL	400148	NO2 Analyzer Value

Figure 48 : Analysis of Liquid – EQUIPMENTS

PLC Section name	Equipment tag	Type	Address	Comment
CL3013_Analysys of Liquid	SV_3013_01_OP	BOOL	000157	Used to open or close the valve in manual mode
CL3013_Analysys of Liquid	SV_3013_02_OP	BOOL	000158	Used to open or close the valve in manual mode
CL3013_Analysys of Liquid	SV_3013_03_OP	BOOL	000159	Used to open or close the valve in manual mode
CL3013_Analysys of Liquid	CL3013_NH4_ControlLoop_Mode	INT	400238	NH4 Analyzer Mode Selector (OFF/Manu/Auto)
CL3013_Analysys of Liquid	AT_3013_01_Status	BYTE	400422	Status of NH4 analyzer : 0 Stopped, 1 Analysis, 2 Calibration
CL3013_Analysys of Liquid	AT_3013_01_Start_Analysis	BOOL	000279	Start Analysis from PLC and reset from SCADA server when analysis has finished
CL3013_Analysys of Liquid	CL3013_NH4_Analysis_Time_CFG	UINT	400250	AUTOMATIC MODE ONLY / Configuration time in minute between two start analysis function (NH4+ analyzer)
CL3013_Analysys of Liquid	CL3013_NH4_Analysis_Time	UINT	400251	AUTOMATIC MODE ONLY / Remaining time in minute before the next start analysis function (NH4+ analyzer)
CL3013_Analysys of Liquid	AT_3013_01_Stop_Analyzer	BOOL	000289	Stop from PLC NH4+ Analysis
CL3013_Analysys of Liquid	AT_3013_01_Start_Calibration	BOOL	000280	Start Calibration from PLC and reset from SCADA server when calibration has finished
CL3013_Analysys of Liquid	CL3013_NH4_Calibration_Time_CFG	UINT	400252	AUTOMATIC MODE ONLY / Configuration time (in hour)between two Calibration function (NH4+ analyzer)
CL3013_Analysys of Liquid	CL3013_NH4_Calibration_Time	UINT	400253	AUTOMATIC MODE ONLY / Remaining time (in hour) before the next Calibration function (NH4+ analyzer)
CL3013_Analysys of Liquid	CL3013_NO3_ControlLoop_Mode	INT	400273	NO3 Analyzer Mode Selector (OFF/Manu/Auto)

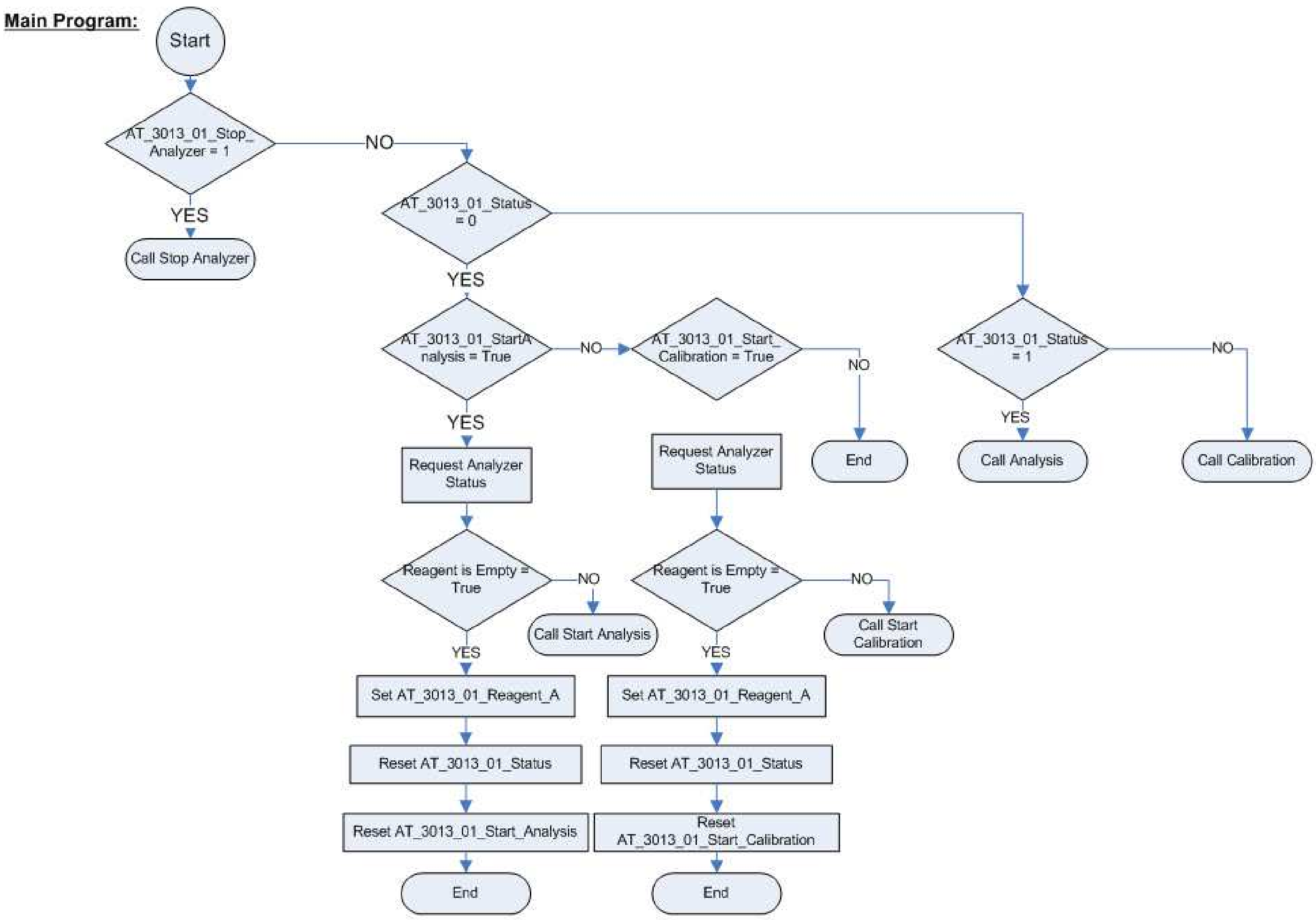
PLC Section name	Equipment tag	Type	Address	Comment
CL3013_Analysys of Liquid	AT_3013_02_Status	BYTE	400423	Status of NO3 analyzer : 0 Stopped, 1 Analysis, 2 Calibration
CL3013_Analysys of Liquid	AT_3013_02_Start_Analysis	BOOL	000284	Start Analysis from PLC and reset from SCADA server when analysis has finished
CL3013_Analysys of Liquid	CL3013_NO3_Analysis_Time_CFG	UINT	400254	AUTOMATIC MODE ONLY / Configuration time in minute between two start analysis function (NO3- analyzer)
CL3013_Analysys of Liquid	CL3013_NO3_Analysis_Time	UINT	400255	AUTOMATIC MODE ONLY / Remaining time in minute before the next start analysis function (NO3- analyzer)
CL3013_Analysys of Liquid	AT_3013_02_Stop_Analyzer	BOOL	000290	Stop from PLC NO3- Analysis
CL3013_Analysys of Liquid	AT_3013_02_Start_Calibration	BOOL	000285	Start Calibration from PLC and reset from SCADA server when calibration has finished
CL3013_Analysys of Liquid	CL3013_NO3_Calibration_Time_CFG	UINT	400256	AUTOMATIC MODE ONLY / Configuration time (in hour) between two Calibration function (NO3- analyzer)
CL3013_Analysys of Liquid	CL3013_NO3_Calibration_Time	UINT	400257	AUTOMATIC MODE ONLY / Remaining time (in hour) before the next Calibration function (NO3- analyzer)
CL3013_Analysys of Liquid	CL3013_NO2_ControlLoop_Mode	INT	400274	NO2 Analyzer Mode Selector (OFF/Manu/Auto)
CL3013_Analysys of Liquid	AT_3013_03_Start_Analysis	DO	000008	Start the NO2 analysis
CL3013_Analysys of Liquid	CL3013_NO2_Analysis_Time_CFG	UINT	400258	AUTOMATIC MODE ONLY / Configuration time in minute between two start analysis function (NO2- analyzer)
CL3013_Analysys of Liquid	CL3013_NO2_Analysis_Time	UINT	400259	AUTOMATIC MODE ONLY / Remaining time in minute before the next start analysis function (NO2- analyzer)
CL3013_Analysys of Liquid	AT_3013_03_Stop_Analysis	DO	000034	stop the NO2 analysis
CL3013_Analysys of Liquid	AT_3013_03_Analyzing	DI	100046	NO2 Analysis Status
CL3013_Analysys of Liquid	AT_3013_03_Calibrating	DI	100048	NO2 Calibration Status

Figure 49 : Analysis of Liquid – OPERATOR INPUTS

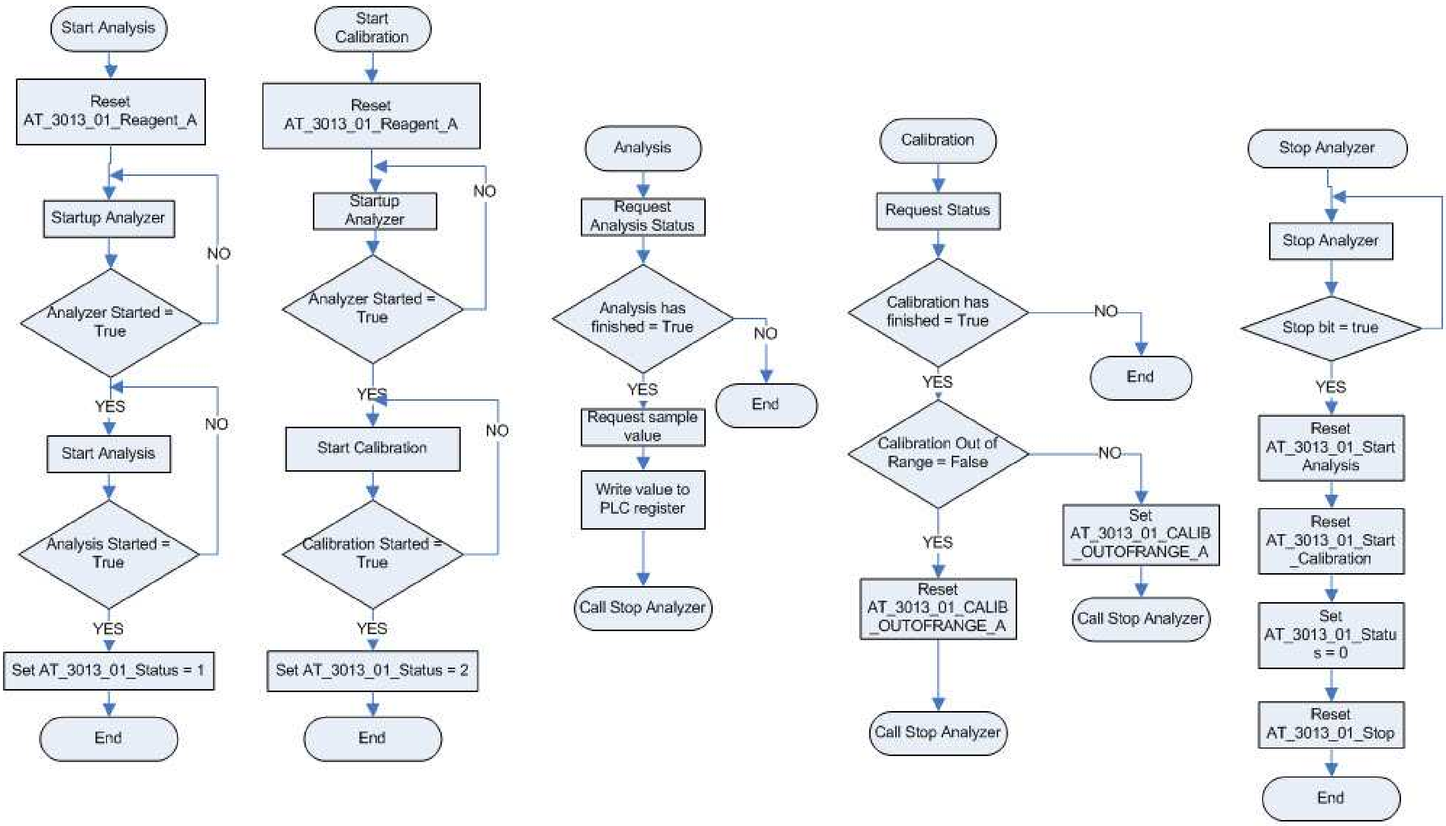
2.16.2.Block Diagram

2.16.2.1. *SCADA Logic for $NH4^+$ and $NO3^-$ Analyzer*

As the Aquamonia and Aquanitra analyzer used RS 232 protocol, it was decided to give the management to the SCADA. The SCADA logic is exposed in that chapter, just for information. To summarize the exchange between SCADA and PLC, the SCADA wait for the PLC request to start a function (Analysis / calibration / stop analyser) then the PLC waits for the Changing status of the analyser (written by the SCADA). *The main routine of the SCADA is executed every minute. It means that a delay exists between the request and its execution.*

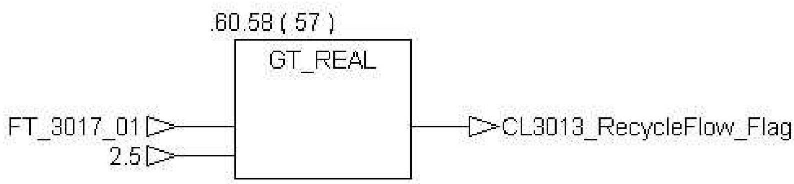


Subrotines:

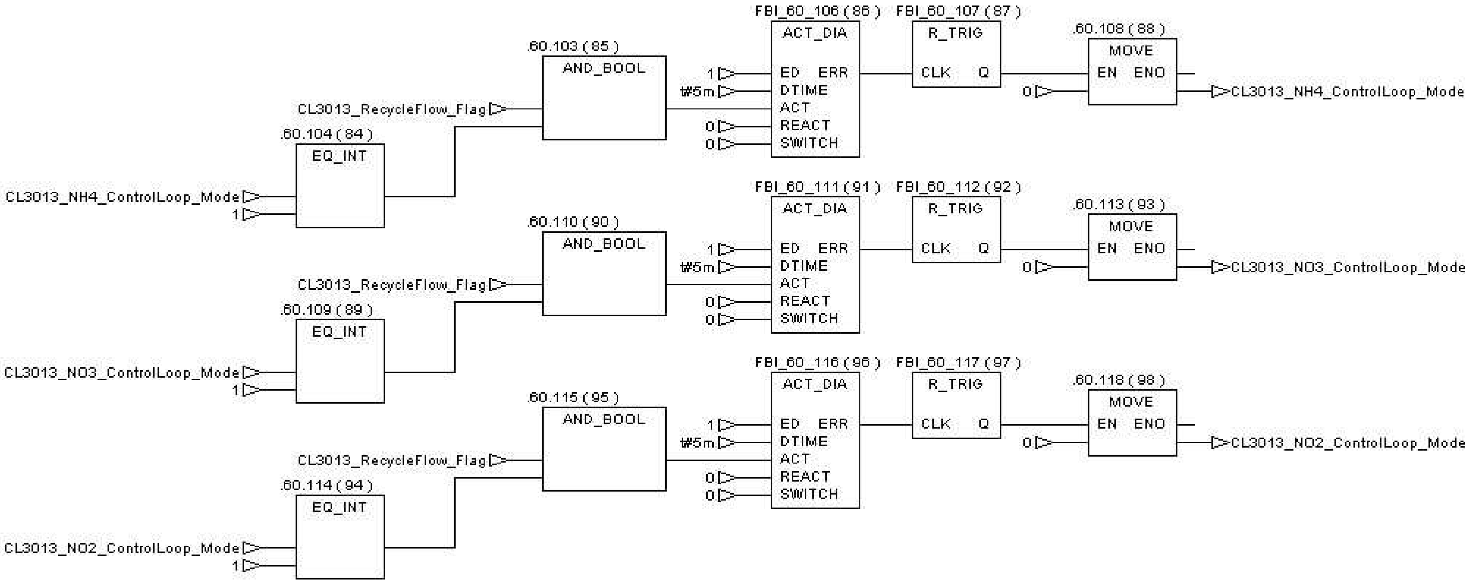


2.16.2.2. *Recycle flow flag*

IF the Recycle line Flow goes under 2.5 Litre/Hour, a flag called "CL3013_RecycleFlow_Flag" is set. When set, no analysis procedure can be performed automatically. This is done to prevent wrong analysis value.



In Automatic Mode, If this flag is SET during 5 minutes, the OFF mode is asked for the Three analyzer.

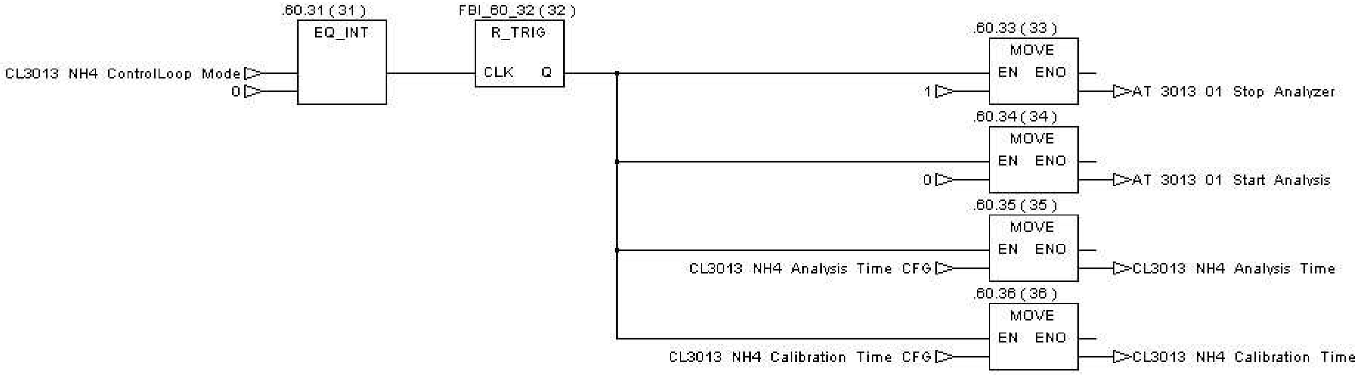


2.16.2.3. *AQUAMONIA Analyzer (NH4+)*

2.16.2.3.1. Control loop mode management

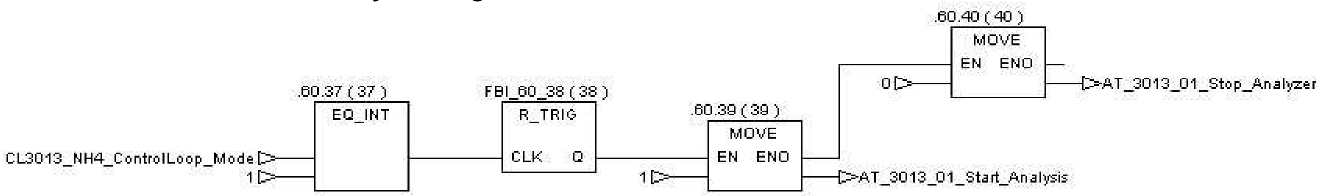
2.16.2.3.1.1. <u>OFF MODE</u>

When the OFF Mode is asked by the operator, the time for starting analysis or calibration are configured to their default value, and the “stop analyzer” function is triggered (see stop procedure in “*Sequential Function*” Chart chapter). The entrance valve is closed, except if an analysis is running. In that case, the PLC waits for the Stop status of the analyzer to close it.



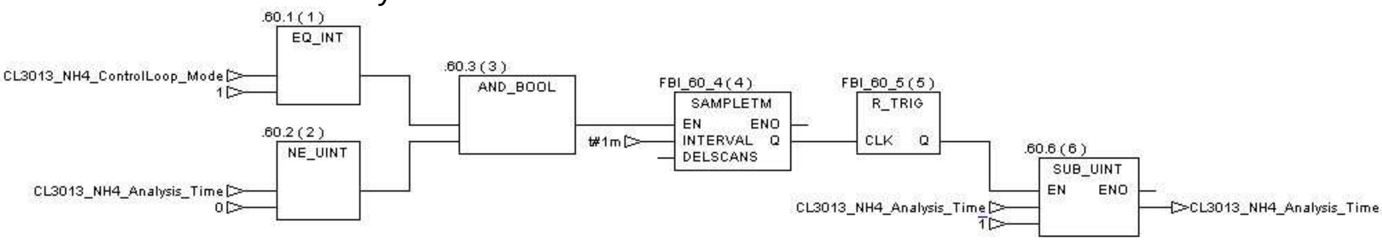
2.16.2.3.1.2.AUTOMATIC MODE

When triggered, the “Start analysis” function is instantaneously asked. If the Flow of the recycle line is above 2.5 L/H, and the “Calibration Out of Range” Alarm is not SET, the analysis begins.

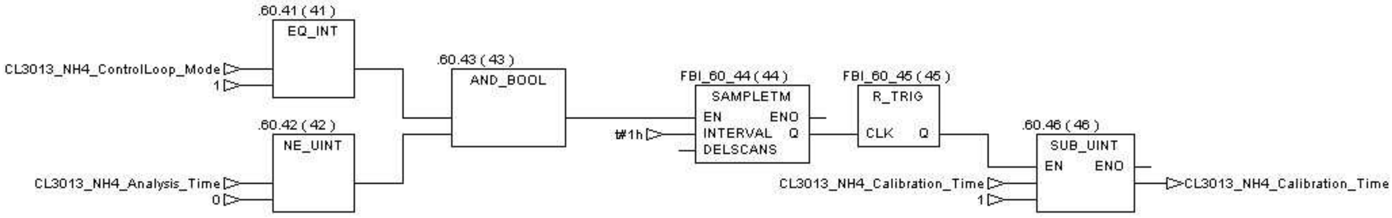


After the first analysis, the automatic mode starts analysis or calibration depending on the time interval defined by the operator.

For analysis, the displayed time corresponds to the number of minutes remaining before the next analysis.



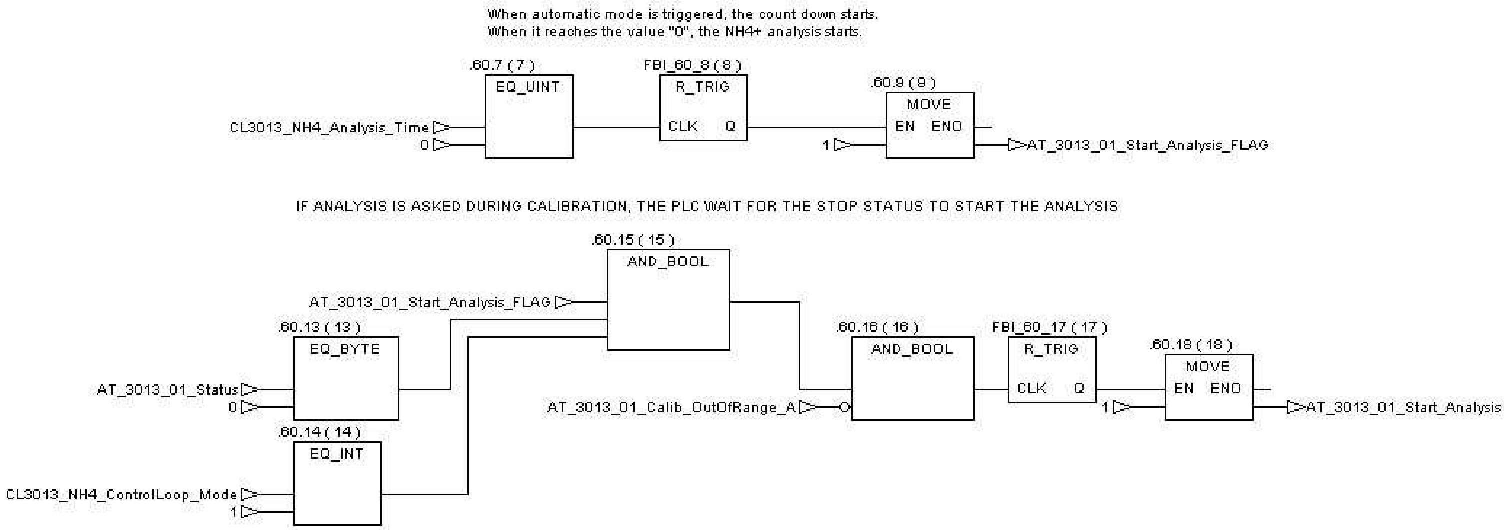
For Calibration, the displayed time corresponds to the number of Hours remaining before the next Calibration.



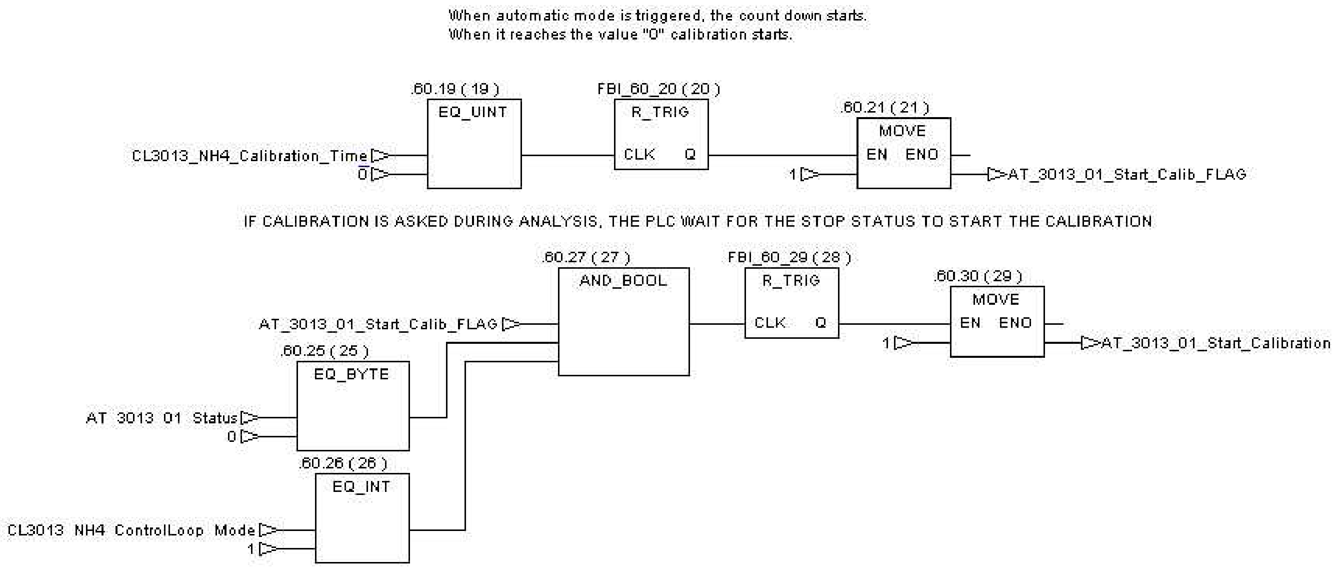
When the time reaches the value “0”, a flag is set. In case of an a running calibration, the analysis will wait for the end of the calibration before starting. The same logic is implemented when a “start calibration” happens during a running analysis. Hereafter are the logics:

For analysis:

The “calibration out of range” alarm should not be set to start the analysis



For Calibration:



2.16.2.3.1.3. MANUAL Mode

In manual mode, the operator can:

1- Start the analysis if the “Calibration out of range” alarm is not set, if the analyzer status is in “Stop mode” and if no communication error is detected between the SCADA and the Analyzer.

2- Start the Calibration if the analyzer status is in “Stop mode” and if no communication error is detected between the SCADA and the Analyzer.
3- Stop the analyzer.

2.16.2.3.2. Sequential Function Chart (Procedures used)

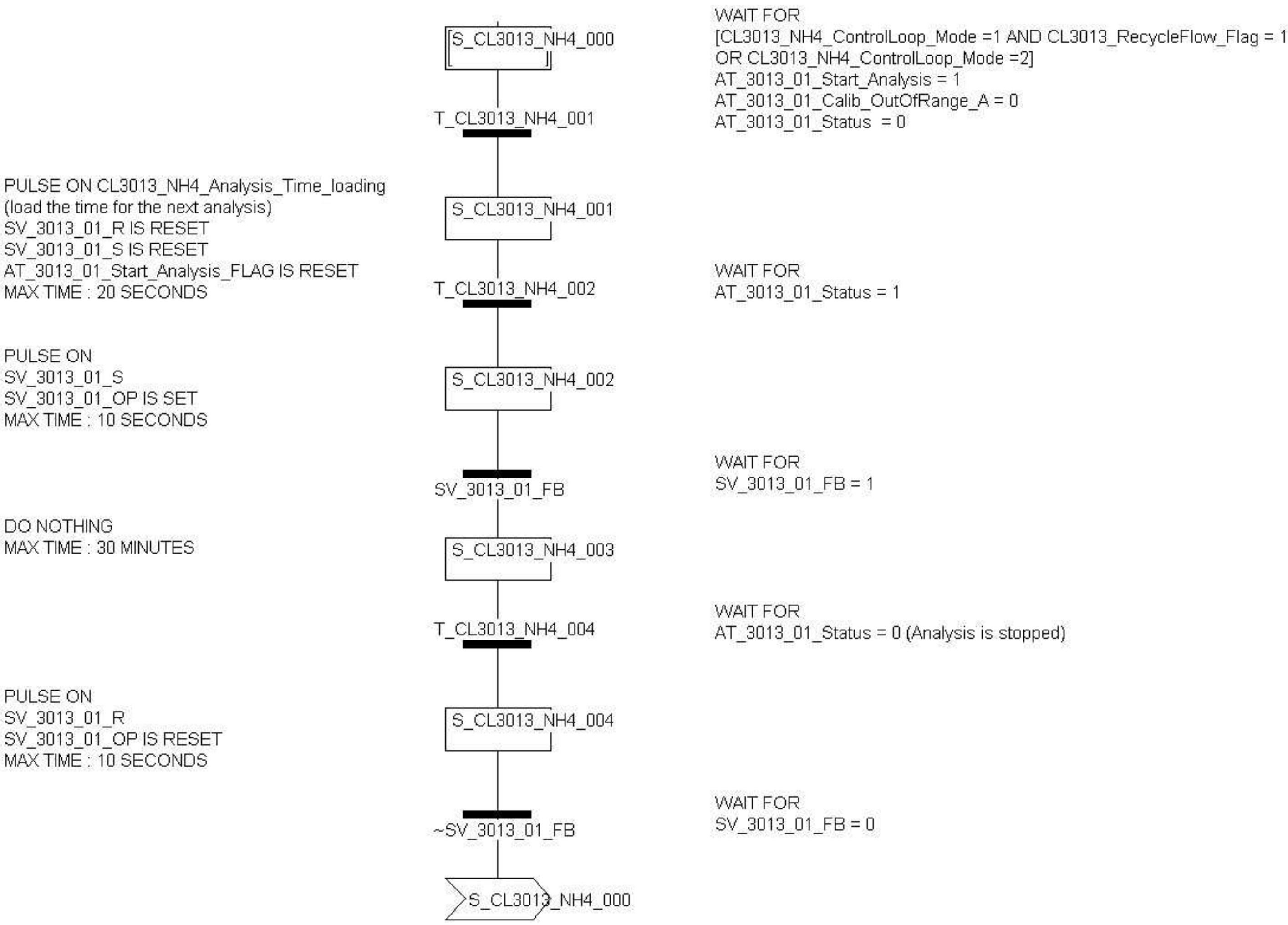
2.16.2.3.2.1. $NH4^+$ Analysis procedure

When an analysis is asked (in automatic mode or in manual mode), the PLC calls the procedure named “CL3013_NH4”. To summarize, the procedure starts if:

No “calibration out of range” alarm is set
No communication error is detected between SCADA system and analyzer
The analyzer is in stop status
The recycle line is above 2.5 litres / Hour (in automatic mode only)

When all these conditions are OK, the PLC opens the analyzer entrance valve, resets the count down counter to the default value and waits for the analyzer stop status. Then the valve is closed until the next analysis.

START THE NH4+ ANALYSIS
THIS PROCEDURE IS CALLED AUTOMATICALLY IN AUTOMATIC MODE
IT CAN ALSO BE CALLED INDEPENDENTLY IN MANUAL MODE

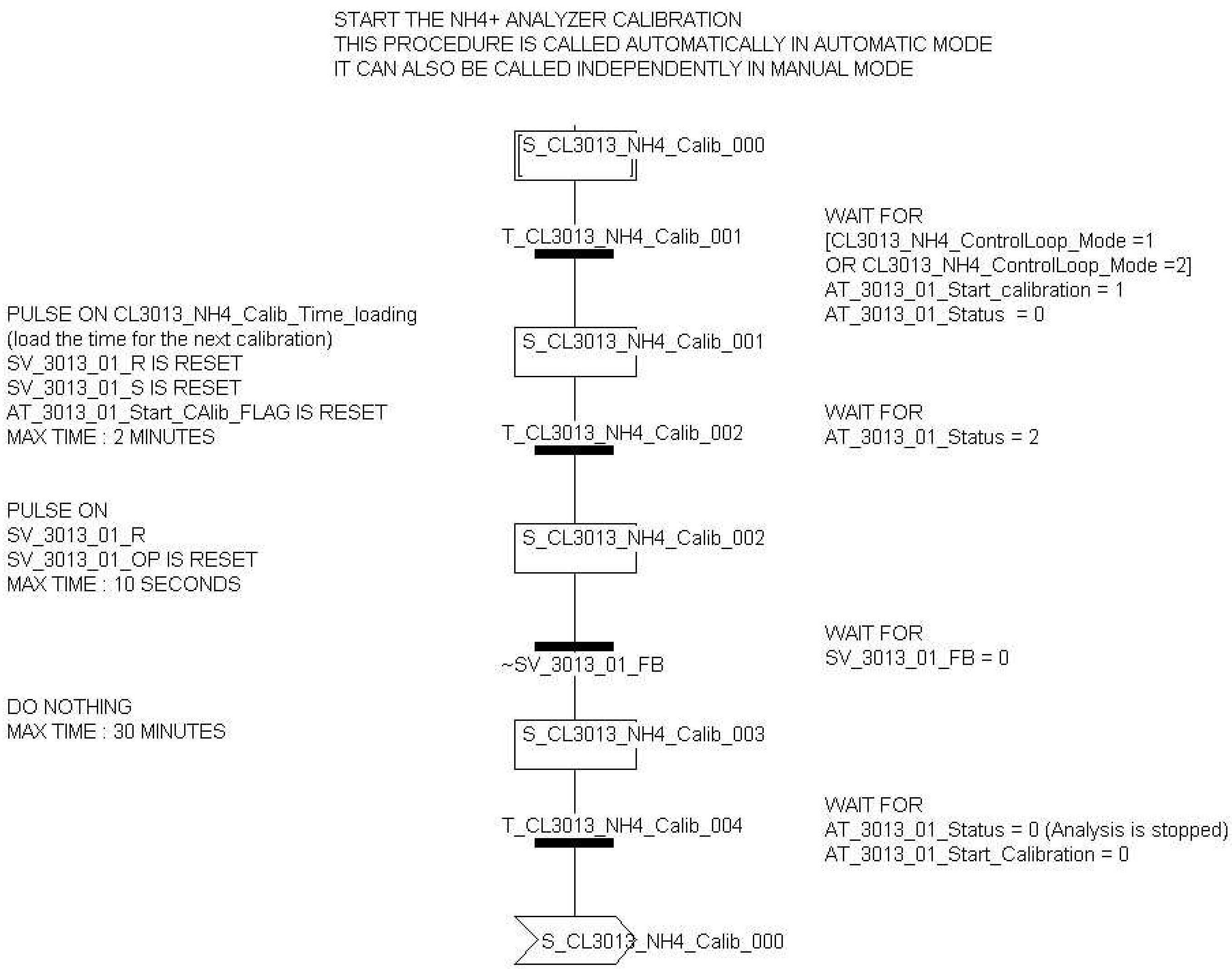


2.16.2.3.2.1. $NH4^+$ Calibration procedure

When a calibration is asked (in automatic mode or in manual mode), the PLC calls the procedure named “CL3013_NH4_Calib”.
To summarize, the procedure starts if:

- No communication error is detected between SCADA system and analyzer
- The analyzer is in stop status

When these conditions are OK, the PLC waits for the analyzer stop status.



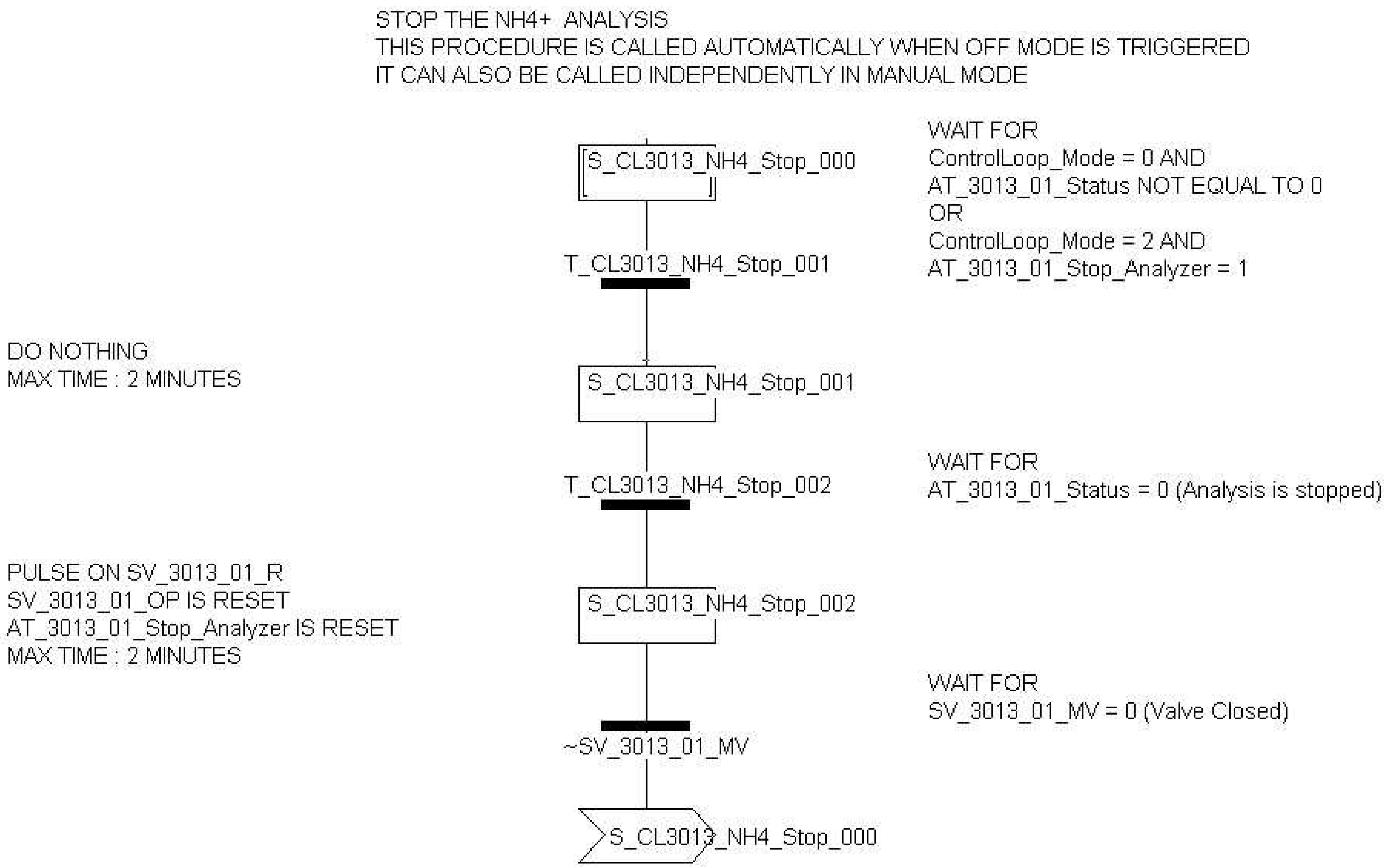
2.16.2.3.2.2. NH4+ Stop procedure

When a stop analyzer is asked (in OFF mode or in manual mode), the PLC calls the procedure named “CL3013_NH4_Stop”.
To summarize, the procedure starts if:

-The Control Loop mode is triggered OFF mode during an analysis or a calibration

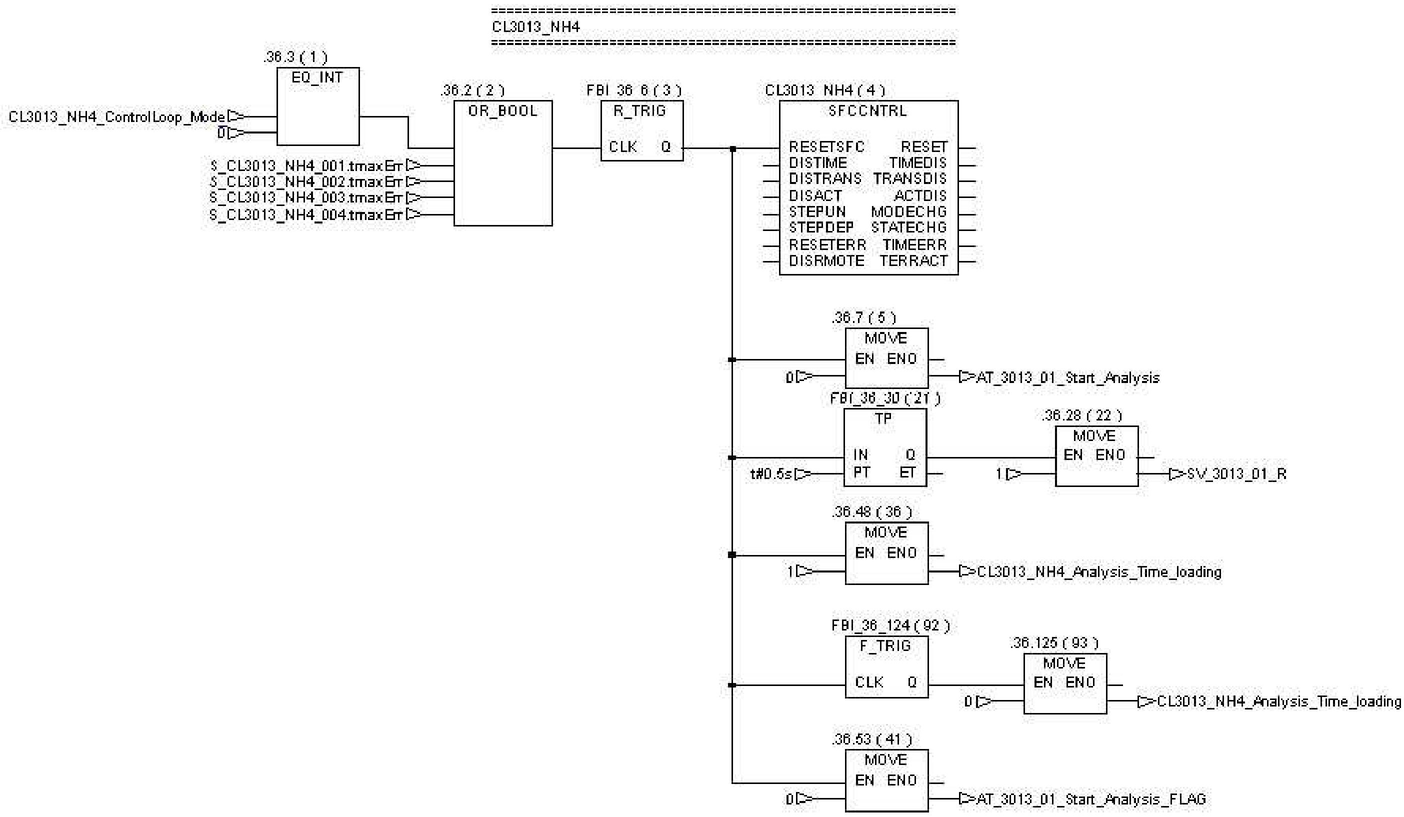
-The operator asks for a stop analyzer in manual mode.

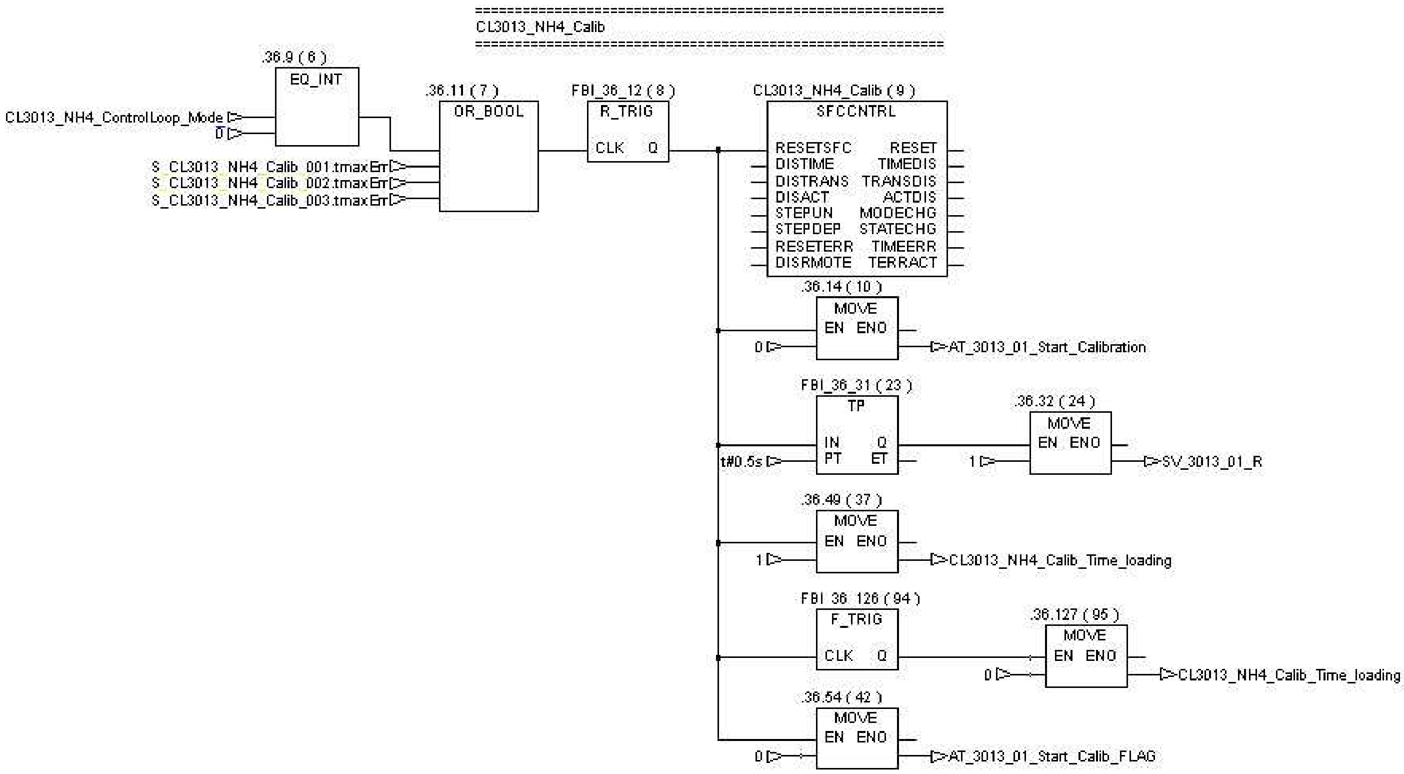
Once executed, the analyzer is in stop mode and the entrance valve is closed

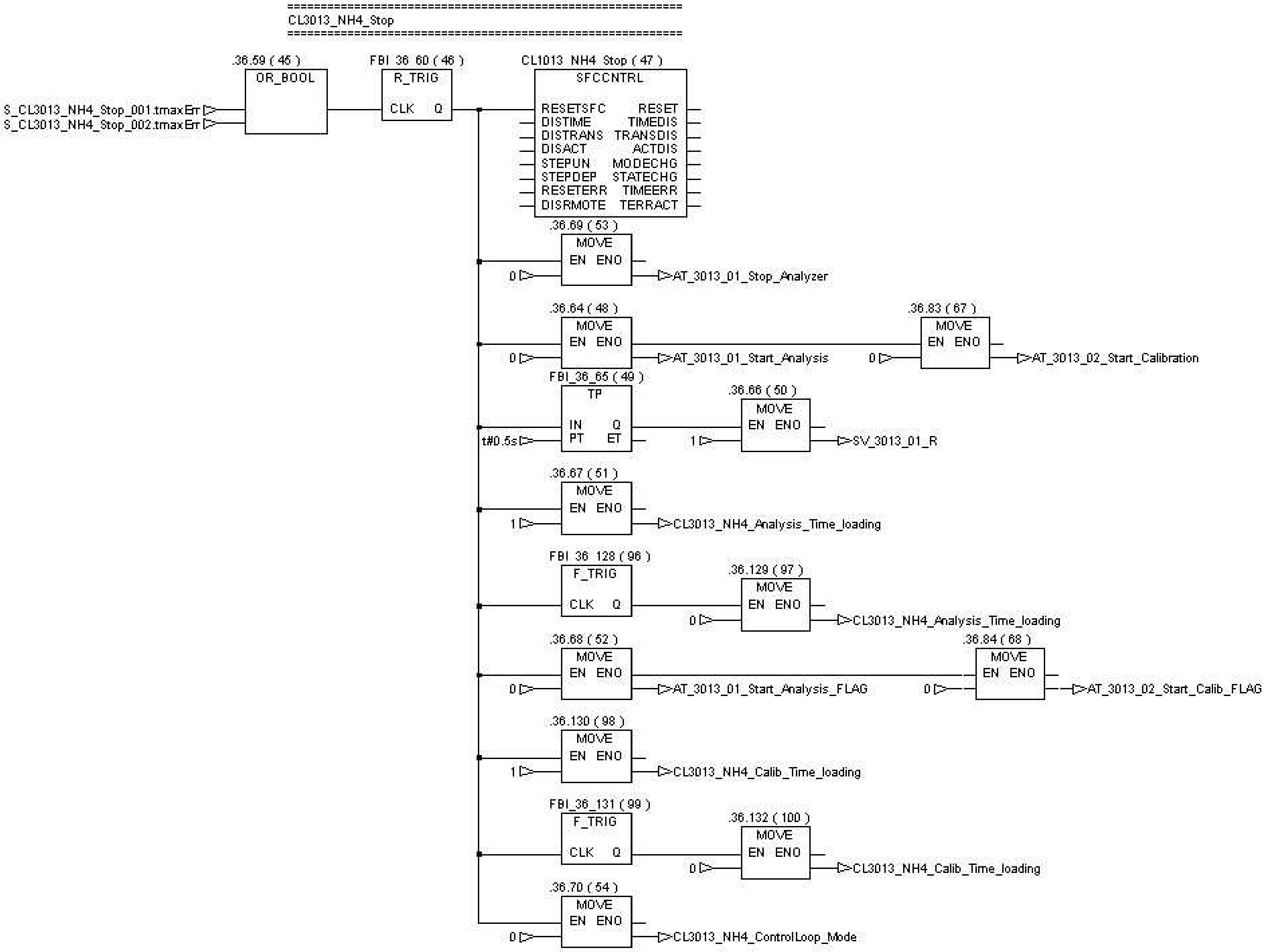


2.16.2.3.3. Control of Sequential Function Chart

Each procedure is controlled by a specific bloc. As each step has a maximum time for its execution, it permits to automatically reset the procedure and the variables linked, in case of equipment failure.
The Reset of a procedure can also occur if the control loop mode is triggered to OFF Mode.




CL3013_NH4_Calib
.36.9 (6)
EQ_INT
CL3013_NH4_ControlLoop_Mode
0
.36.11 (7)
OR_BOOL
S_CL3013_NH4_Calib_001.tmaxErr
S_CL3013_NH4_Calib_002.tmaxErr
S_CL3013_NH4_Calib_003.tmaxErr
FBI_36_12 (8)
R_TRIG
CLK Q
CL3013_NH4_Calib (9)
SFCCNTRL
RESETSFC RESET
DISTIME TIMEDIS
DISTRANS TRANSDIS
DISACT ACTDIS
STEPUN MODECHG
STEPDEP STATECHG
RESETERR TIMEERR
DISRMOTE TERRACT
.36.14 (10)
MOVE
EN ENO
AT_3013_01_Start_Calibration
FBI_36_31 (23)
TP
IN Q
PT ET
t#0.5s
.36.32 (24)
SV_3013_01_R
.36.49 (37)
CL3013_NH4_Calib_Time_loading
FBI_36_126 (94)
F_TRIG
.36.127 (95)
.36.54 (42)
AT_3013_01_Start_Calib_FLAG

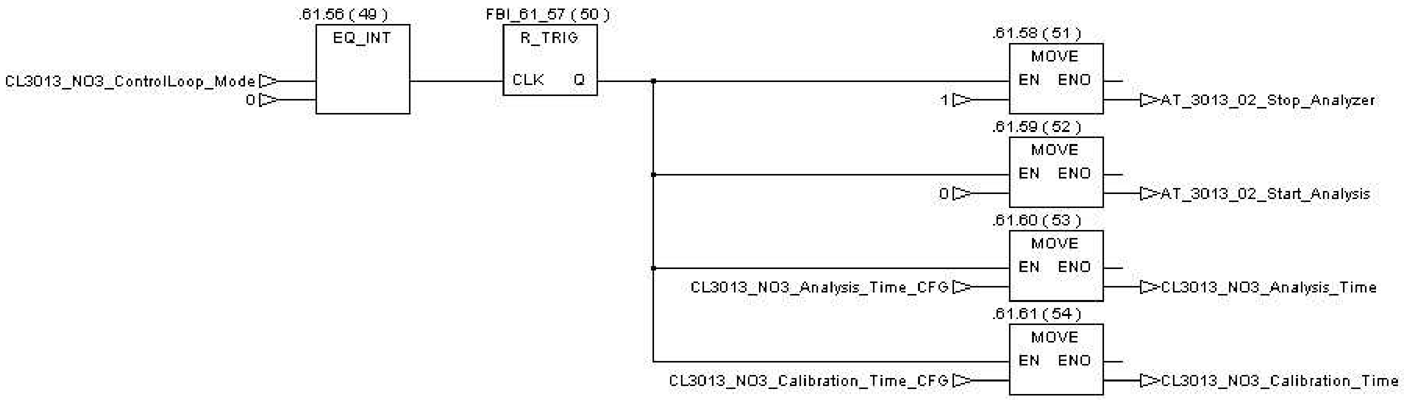

CL3013_NH4_Stop
.36.59 (45)
OR_BOOL
FBI_36_60 (46)
R_TRIG
CLK Q
CL1013_NH4_Stop (47)
SFCCNTRL
S_CL3013_NH4_Stop_001.tmaxErr
S_CL3013_NH4_Stop_002.tmaxErr
RESETSFC RESET
DISTIME TIMEDIS
DISTRANS TRANSDIS
DISACT ACTDIS
STEPUN MODECHG
STEPDEP STATECHG
RESETERR TIMEERR
DISRMOTE TERRACT
.36.69 (53)
MOVE
EN ENO
AT_3013_01_Stop_Analyzer
.36.64 (48)
AT_3013_01_Start_Analysis
.36.83 (67)
AT_3013_02_Start_Calibration
FBI_36_65 (49)
TP
IN Q
PT ET
t#0.5s
.36.66 (50)
SV_3013_01_R
.36.67 (51)
CL3013_NH4_Analysis_Time_loading
FBI_36_128 (96)
F_TRIG
.36.129 (97)
CL3013_NH4_Analysis_Time_loading
.36.68 (52)
AT_3013_01_Start_Analysis_FLAG
.36.84 (68)
AT_3013_02_Start_Calib_FLAG
.36.130 (98)
CL3013_NH4_Calib_Time_loading
FBI_36_131 (99)
.36.132 (100)
CL3013_NH4_Calib_Time_loading
.36.70 (54)
CL3013_NH4_ControlLoop_Mode

2.16.2.4. *AQUANITRA Analyzer (NO3⁻)*

2.16.2.4.1. Control loop mode management

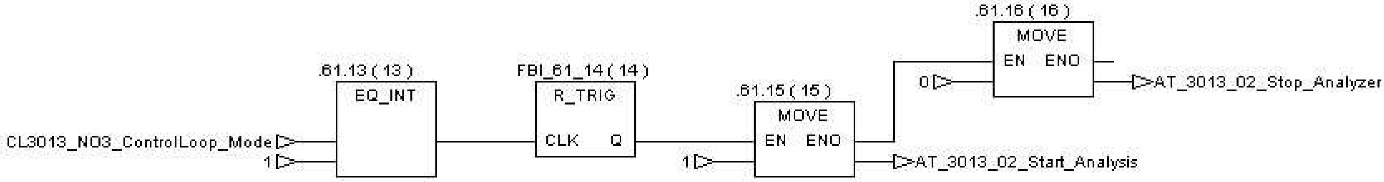
2.16.2.4.1.1. OFF MODE

When the OFF Mode is asked by the operator, the time for starting analysis or calibration are configured to their default value, and the "stop analyzer" function is triggered (see stop procedure in "*Sequential Function*" Chart chapter). The entrance valve is closed, except if an analysis is running. In that case, the PLC waits for the Stop status of the analyzer to close it.



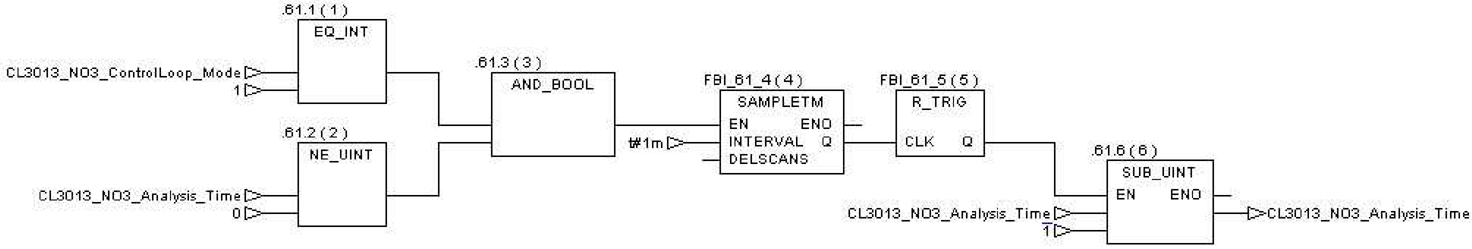
2.16.2.4.1.2. AUTOMATIC MODE

When triggered, the "Start analysis" function is instantaneously asked. If the Flow of the recycle line is above 2.5 L/H, and the "Calibration out of Range" Alarm is not SET, the analysis begins.

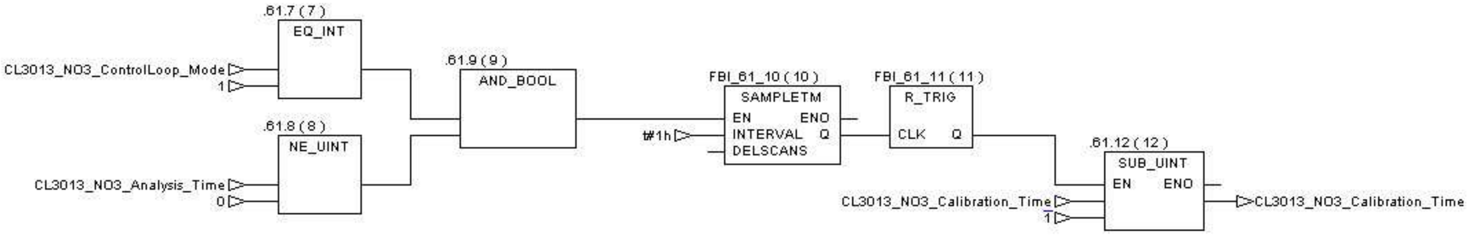


After the first analysis, the automatic mode starts analysis or calibration depending of the time interval defined by the operator.

For analysis, the displayed time corresponds to the number of minutes remaining before the next analysis.



For Calibration, the displayed time corresponds to the number of Hours remaining before the next Calibration.

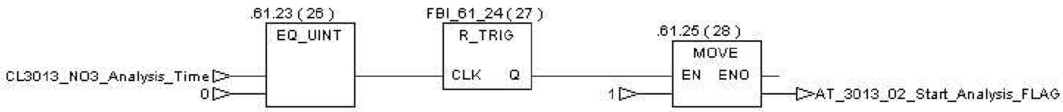


When the time reaches the value “0”, a flag is set. In case of an on going calibration, the analysis will wait for the calibration ending before starting. The same logic is implemented when a “start calibration” happens during an on going analysis. Hereafter are the logics:

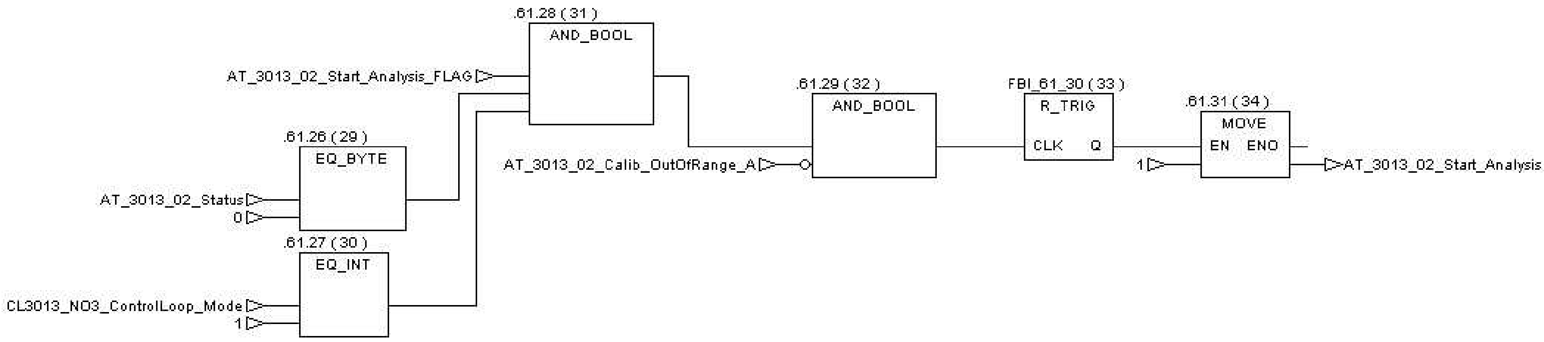
For analysis:

The “calibration out of range” alarm should not be set to start the analysis

When automatic mode is triggered, the count down starts.
When it reaches the value "0" analysis starts.

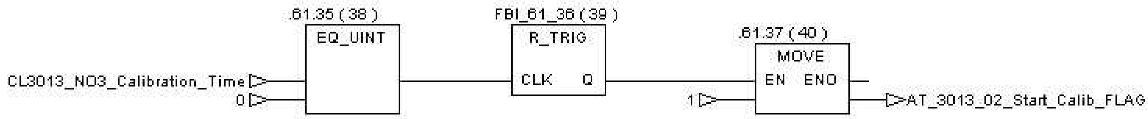


IF ANALYSIS IS ASKED DURING CALIBRATION, THE PLC WAIT FOR THE STOP STATUS TO START THE ANALYSIS

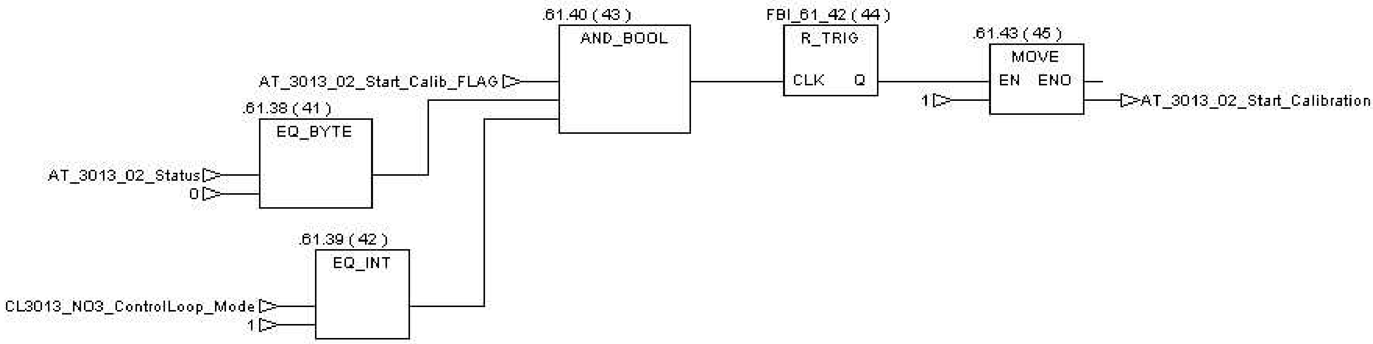


For Calibration:

When automatic mode is triggered, the count down starts.
When it reaches the value "0" calibration starts.



IF CALIBRATION IS ASKED DURING ANALYSIS, THE PLC WAIT FOR THE STOP STATUS TO START THE CALIBRATION



2.16.2.4.1.3. MANUAL Mode

In manual mode, the operator can:

1- Start the analysis if the "Calibration out of range" alarm is not set, if the analyzer status is in "Stop mode" and if no communication error is detected between the SCADA and the Analyzer.
2- Start the Calibration if the analyzer status is in "Stop mode" and if no communication error is detected between the SCADA and the Analyzer.
3- Stop the analyzer.

2.16.2.4.2. Sequential Function Chart (Procedures used)

2.16.2.4.2.1. $NO3^-$ Analysis procedure

When an analysis is asked (in automatic mode or in manual mode), the PLC calls the procedure named "CL3013_NO3". To summarize, the procedure starts if:

No "calibration out of range" alarm is set
No communication error is detected between SCADA system and analyzer
The analyzer is in stop status
The recycle line is above 2.5 litres / Hour (in automatic mode only)

When all these conditions are OK, the PLC opens the analyzer entrance valve, resets the count down counter to the default value and waits for the analyzer stop status. Then the valve is closed until the next analysis.

START THE NO3- ANALYSIS
THIS PROCEDURE IS CALLED AUTOMATICALLY IN AUTOMATIC MODE
IT CAN ALSO BE CALLED INDEPENDENTLY IN MANUAL MODE

S_CL3013_NO3_000

T_CL3013_NO3_001

WAIT FOR
[CL3013_NO3_ControlLoop_Mode =1 AND CL3013_RecycleFlow_Flag = 1
OR CL3013_NO3_ControlLoop_Mode =2]
AT_3013_02_Start_Analysis = 1
AT_3013_02_Calib_OutOfRange_A = 0
AT_3013_02_ERROR = 0
AT_3013_02_Status = 0

S_CL3013_NO3_001

PULSE ON CL3013_NO3_Analysis_Time_loading
(load the time for the next Analysis)
SV_3013_02_R IS RESET
SV_3013_02_S IS RESET
AT_3013_02_Start_Analysis_FLAG IS RESET
MAX TIME : 2 MINUTES

T_CL3013_NO3_002

WAIT FOR
AT_3013_02_Status = 1

S_CL3013_NO3_002

PULSE ON
SV_3013_02_S
SV_3013_02_OP IS SET
MAX TIME : 10 SECONDS

SV_3013_02_FB

WAIT FOR
SV_3013_02_FB = 1

S_CL3013_NO3_003

DO NOTHING
MAX TIME : 30 MINUTES

T_CL3013_NO3_004

WAIT FOR
AT_3013_02_Status = 0 (Analysis is stopped)

S_CL3013_NO3_004

PULSE ON
SV_3013_02_R
SV_3013_02_OP IS RESET
AT_3013_02_Start_Analysis IS RESET
MAX TIME : 10 SECONDS

~SV_3013_02_FB

WAIT FOR
SV_3013_02_FB = 0

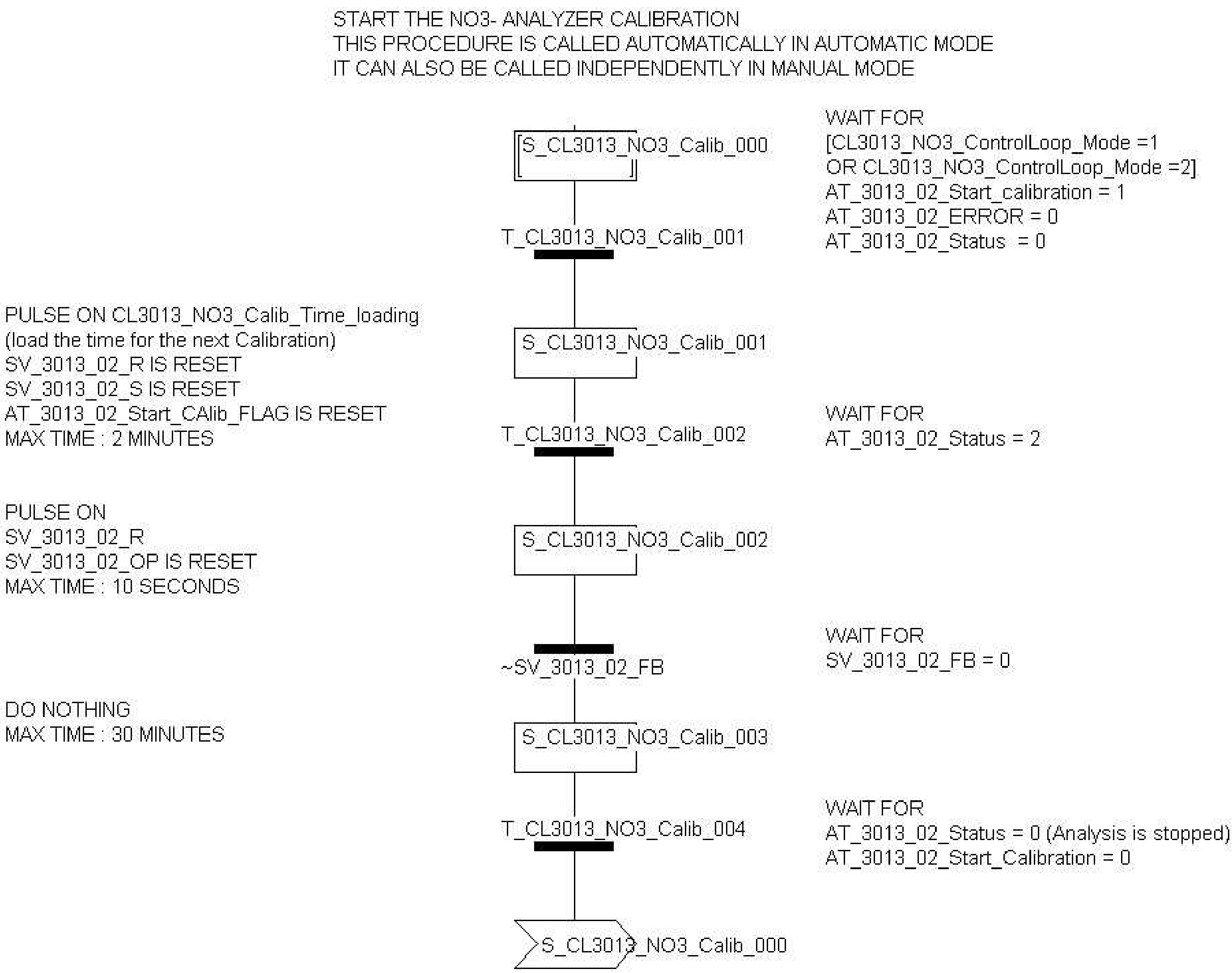
S_CL3013_NO3_000

2.16.2.4.2.2.NO3⁻ Calibration procedure

When a calibration is asks (in automatic mode or in manual mode), the PLC calls the procedure named “CL3013_NO3_Calib”.
To summarize, the procedure starts if:

- No communication error is detected between SCADA system and analyzer
- The analyzer is in stop status

When these conditions are OK, the PLC waits for the analyzer stop status.

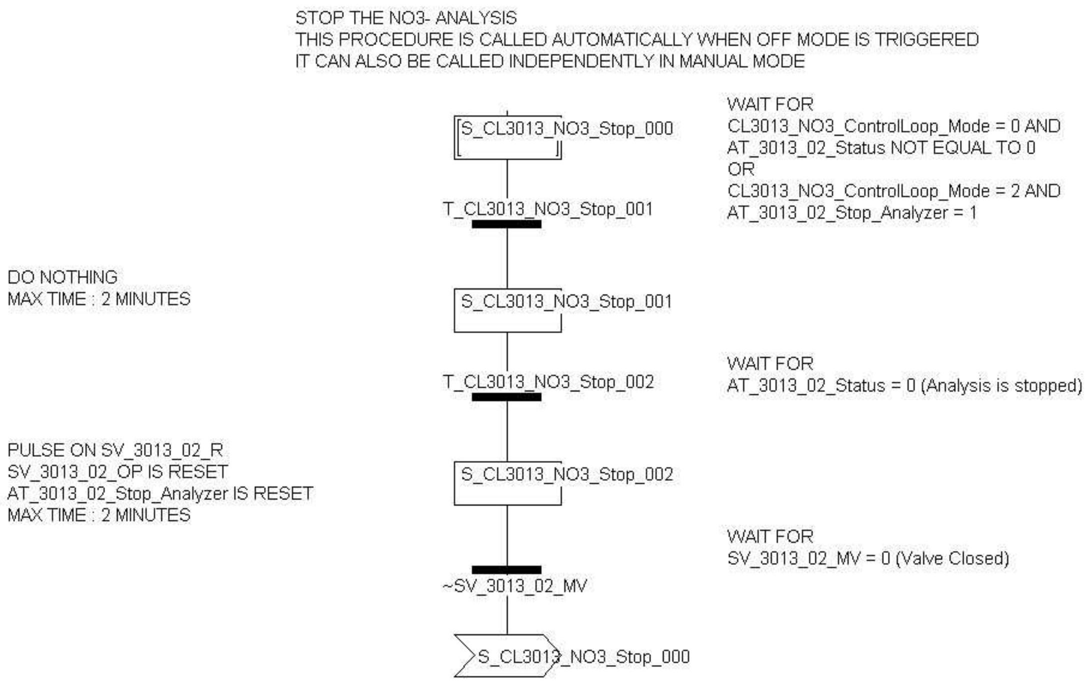


2.16.2.4.2.3. NO3⁻ Stop procedure

When a stop analyzer is asked (in OFF mode or in manual mode), the PLC calls the procedure named "CL3013_NO3_Stop".

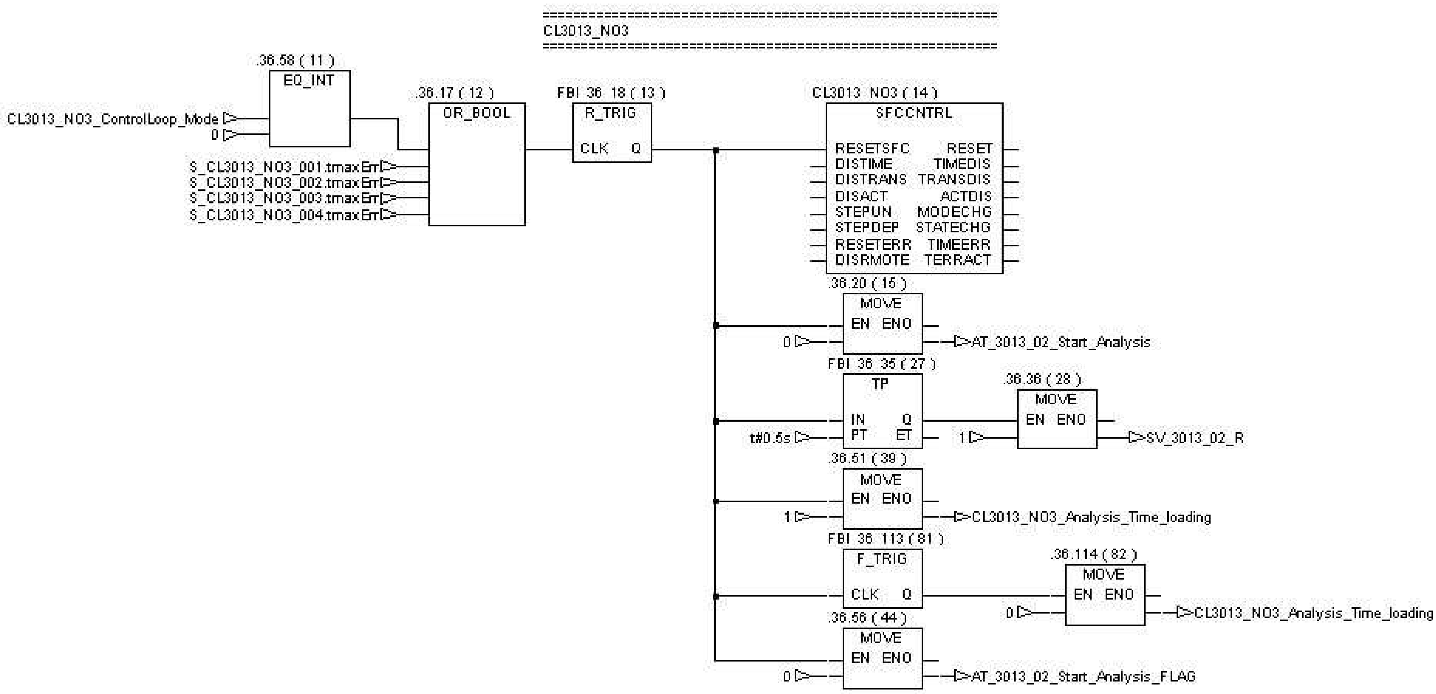
To summarize, the procedure starts if:

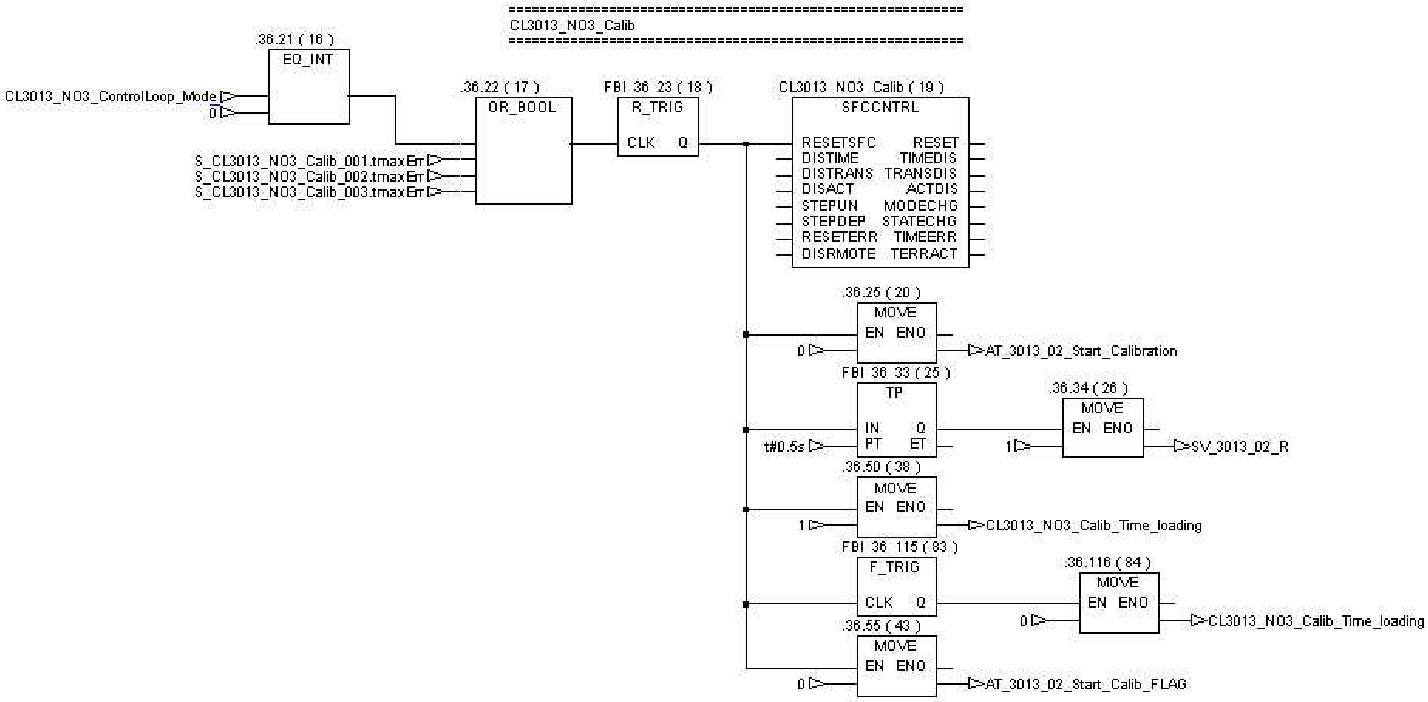
- The Control Loop mode is triggered OFF mode during an analysis or a calibration
- The operator asked for a stop analyzer in manual mode.
- Once executed, the analyzer is in stop mode and the entrance valve is closed

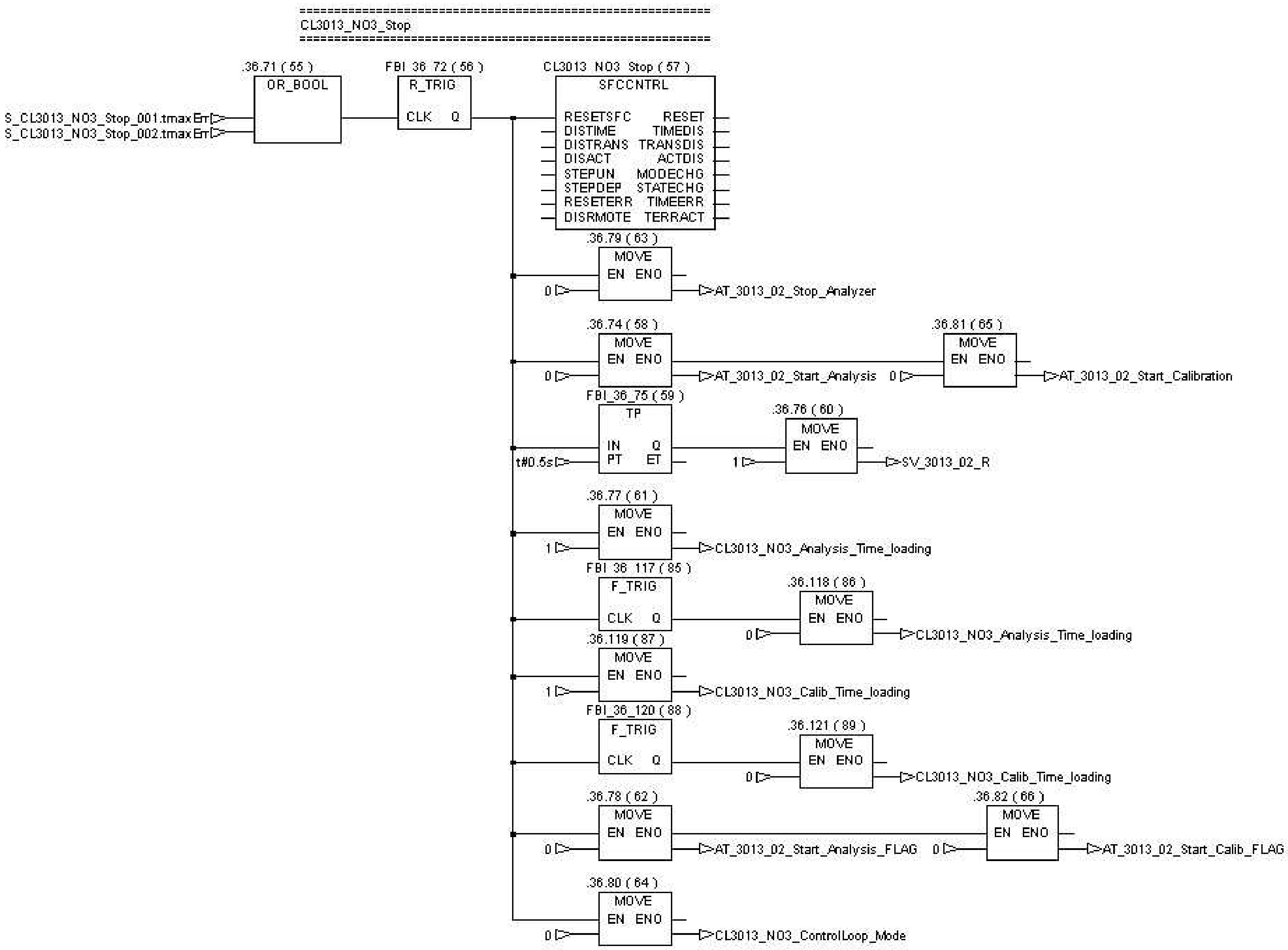


2.16.2.4.3. Control of Sequential Function Chart

Each procedure is controlled by a specific bloc. As each step has a maximum time for its execution, it permits to automatically reset the procedure and the variables linked, in case of equipment failure.
The Reset of a procedure can also occur if the control loop mode is triggered to OFF Mode.




CL3013_NO3_Calib
.36.21 (16)
EQ_INT
CL3013_NO3_ControlLoop_Mode
0
.36.22 (17)
OR_BOOL
S_CL3013_NO3_Calib_001.tmaxErr
S_CL3013_NO3_Calib_002.tmaxErr
S_CL3013_NO3_Calib_003.tmaxErr
FBI_36_23 (18)
R_TRIG
CLK Q
CL3013_NO3_Calib (19)
SFCCNTRL
RESETSFC RESET
DISTIME TIMEDIS
DISTRANS TRANSDIS
DISACT ACTDIS
STEPUN MODECHG
STEPDEP STATECHG
RESETERR TIMEERR
DISRMOTE TERRACT
.36.25 (20)
MOVE
EN ENO
0
AT_3013_02_Start_Calibration
FBI_36_33 (25)
TP
IN Q
PT ET
t#0.5s
.36.34 (26)
MOVE
EN ENO
1
SV_3013_02_R
.36.50 (38)
MOVE
EN ENO
1
CL3013_NO3_Calib_Time_loading
FBI_36_115 (83)
F_TRIG
CLK Q
.36.116 (84)
MOVE
EN ENO
0
CL3013_NO3_Calib_Time_loading
.36.55 (43)
MOVE
EN ENO
0
AT_3013_02_Start_Calib_FLAG


CL3013_NO3_Stop
.36.71 (55)
OR_BOOL
S_CL3013_NO3_Stop_001.tmaxErr
S_CL3013_NO3_Stop_002.tmaxErr
FBI_36_72 (56)
R_TRIG
CLK Q
CL3013_NO3_Stop (57)
SFCCNTRL
RESETSFC RESET
DISTIME TIMEDIS
DISTRANS TRANSDIS
DISACT ACTDIS
STEPUN MODECHG
STEPDEP STATECHG
RESETERR TIMEERR
DISRMOTE TERRACT
.36.79 (63)
MOVE
EN ENO
AT_3013_02_Stop_Analyzer
.36.74 (58)
AT_3013_02_Start_Analysis
.36.81 (65)
AT_3013_02_Start_Calibration
FBI_36_75 (59)
TP
IN Q
PT ET
t#0.5s
.36.76 (60)
SV_3013_02_R
.36.77 (61)
CL3013_NO3_Analysis_Time_loading
FBI_36_117 (85)
F_TRIG
.36.118 (86)
CL3013_NO3_Analysis_Time_loading
.36.119 (87)
CL3013_NO3_Calib_Time_loading
FBI_36_120 (88)
F_TRIG
.36.121 (89)
CL3013_NO3_Calib_Time_loading
.36.78 (62)
AT_3013_02_Start_Analysis_FLAG
.36.82 (66)
AT_3013_02_Start_Calib_FLAG
.36.80 (64)
CL3013_NO3_ControlLoop_Mode

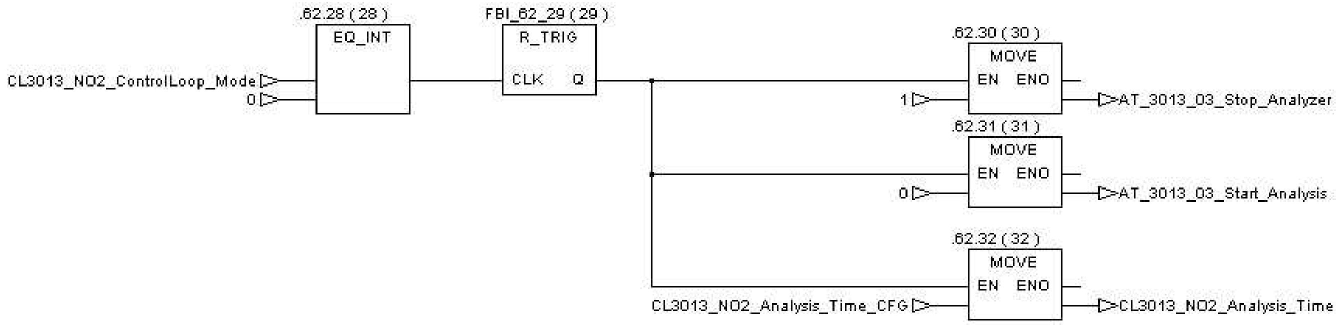
2.16.2.5. *APPLIKON Analyzer (NO2-)*

This analyzer is directly connected to the PLC. The calibration can only be performed locally (the function is not reachable by the SCADA system).

2.16.2.5.1. Control loop mode management

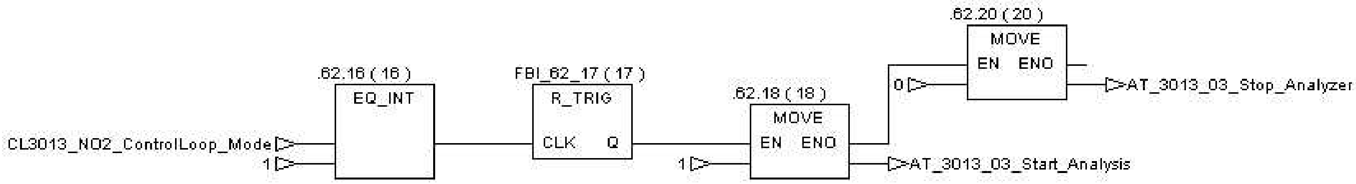
2.16.2.5.1.1. OFF MODE

When the OFF Mode is asked by the operator, the time for starting analysis is configured to its default value, and the "stop analyzer" function is triggered (see stop procedure in *"Sequential Function Chart"* chapter). The entrance valve is closed, except if an analysis is running. In that case, the PLC waits for the Stop status of the analyzer to close it.



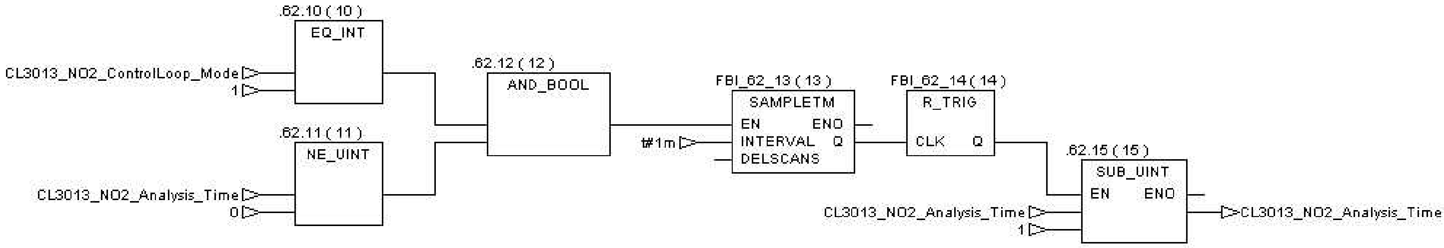
2.16.2.5.1.2. AUTOMATIC MODE

When triggered, the "Start analysis" function is instantaneously asked. If the Flow of the recycle line is above 2.5 L/H and if no calibration is running, the analysis begins.



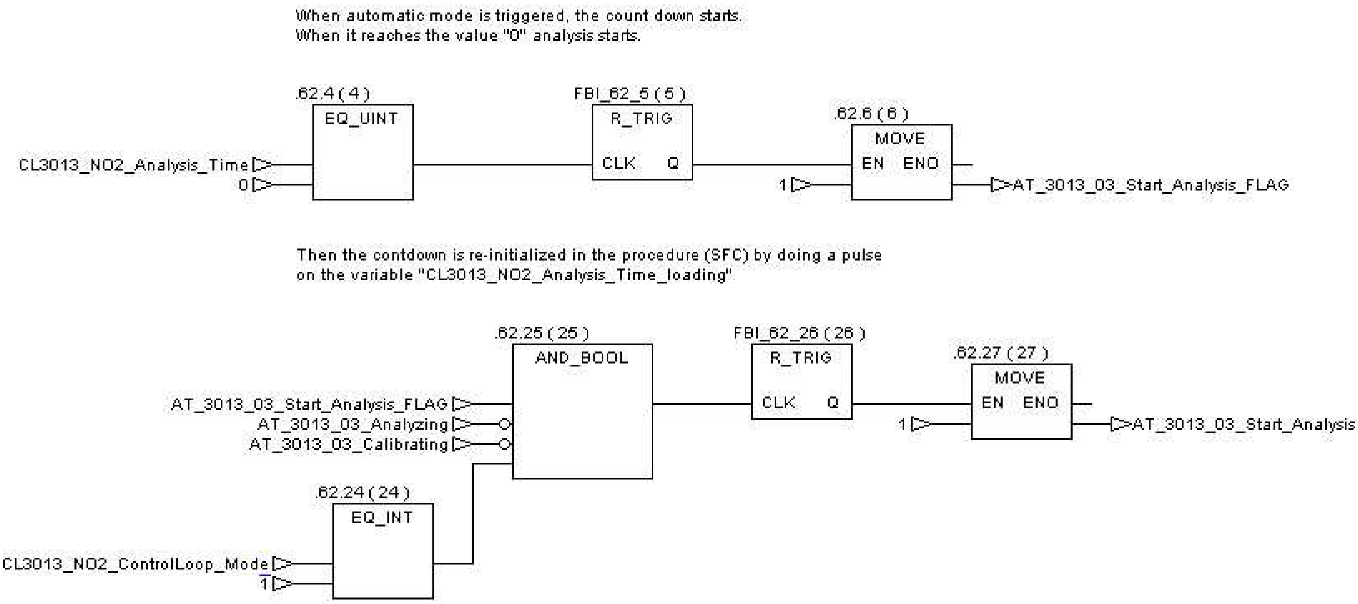
After the first analysis, the automatic mode starts analysis depending of the time interval defined by the operator.

For analysis the displayed time corresponds to the number of minutes remaining before the next analysis.



When the time reaches the value “0”, a flag is set. In case of an on going calibration, the analysis will wait for the calibration ending before starting. *<u>As the calibration is done locally on the analyzer, the operator will stop the running analysis by asking a calibration.</u>*

For analysis:



2.16.2.5.1.3. <u>MANUAL Mode</u>

In manual mode, the operator can:

1- Start the analysis if the no calibration and no analysis are running.
2- Stop the analyzer.

2.16.2.5.2. Sequential Function Chart (Procedures used)

2.16.2.5.2.1. NO2$^-$ Analysis procedure

When an analysis is asked (in automatic mode or in manual mode), the PLC calls the procedure named "CL3013_NO2". To summarize, the procedure starts if:

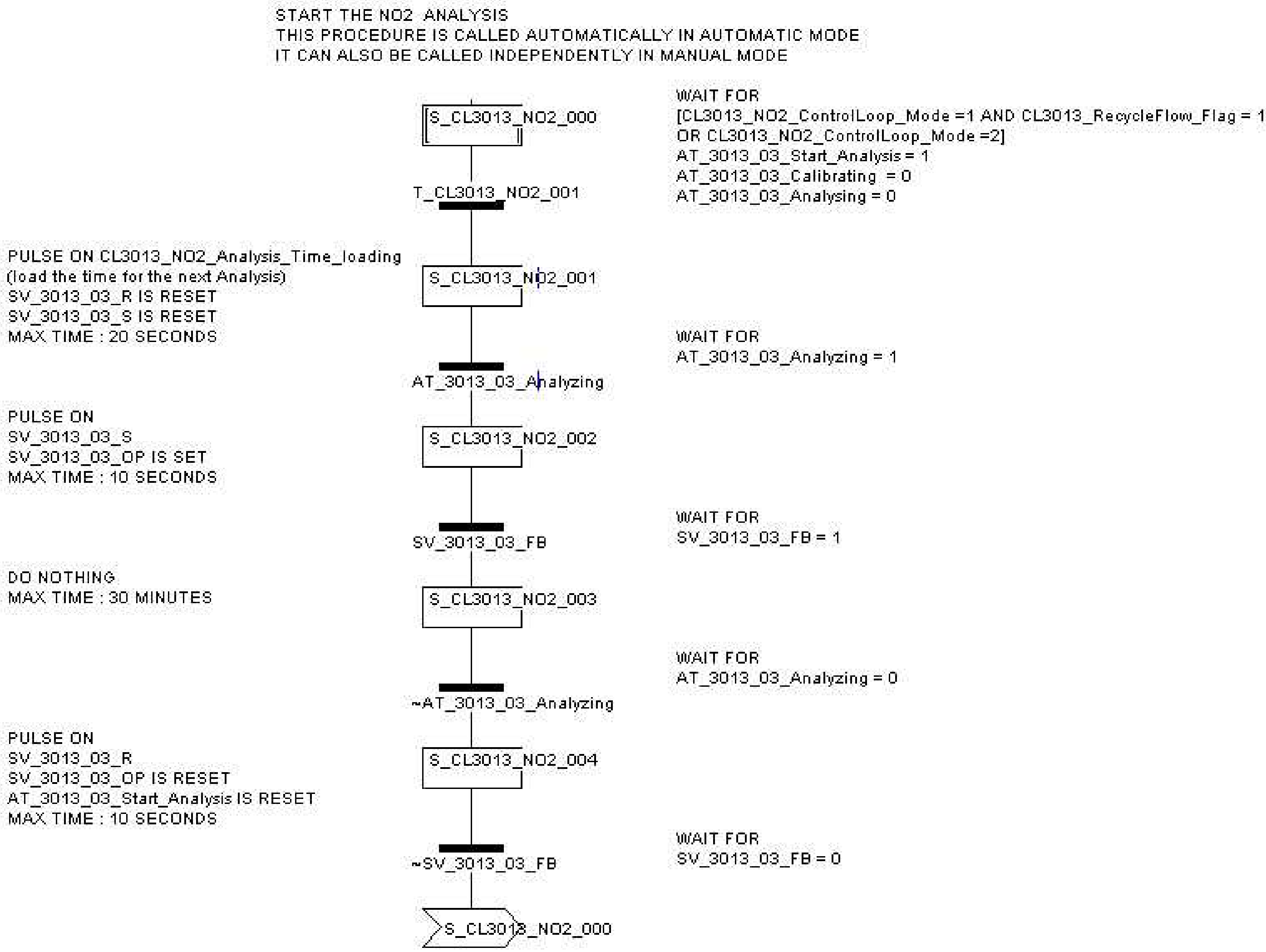
In automatic:

The recycle line is above 2.5 litres / Hour
No calibration is running
No analysis is running

In Manual:

No calibration is running
No analysis is running

When all these conditions are OK, the PLC opens the analyzer entrance valve, reset the count down counter to the default value and waits for the analyzer stop status. Then the valve is closed until the next analysis.

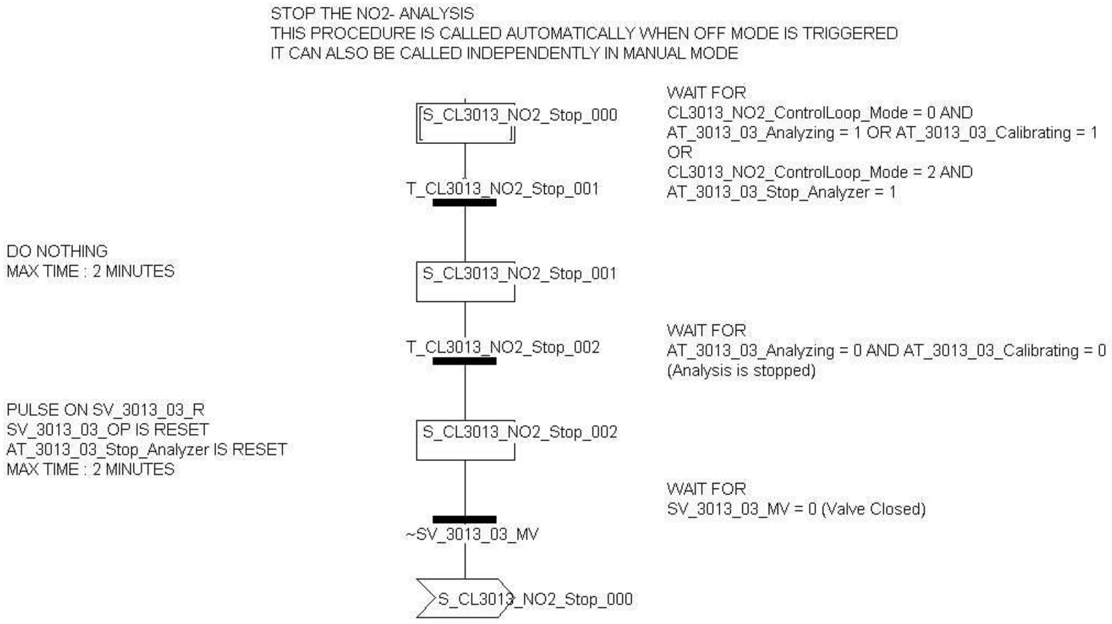


2.16.2.5.2.2. NO2$^-$ Stop procedure

When a stop analyzer is asked (in OFF mode or in manual mode), the PLC calls the procedure named “CL3013_NO2_Stop”.
To summarize, the procedure starts if:

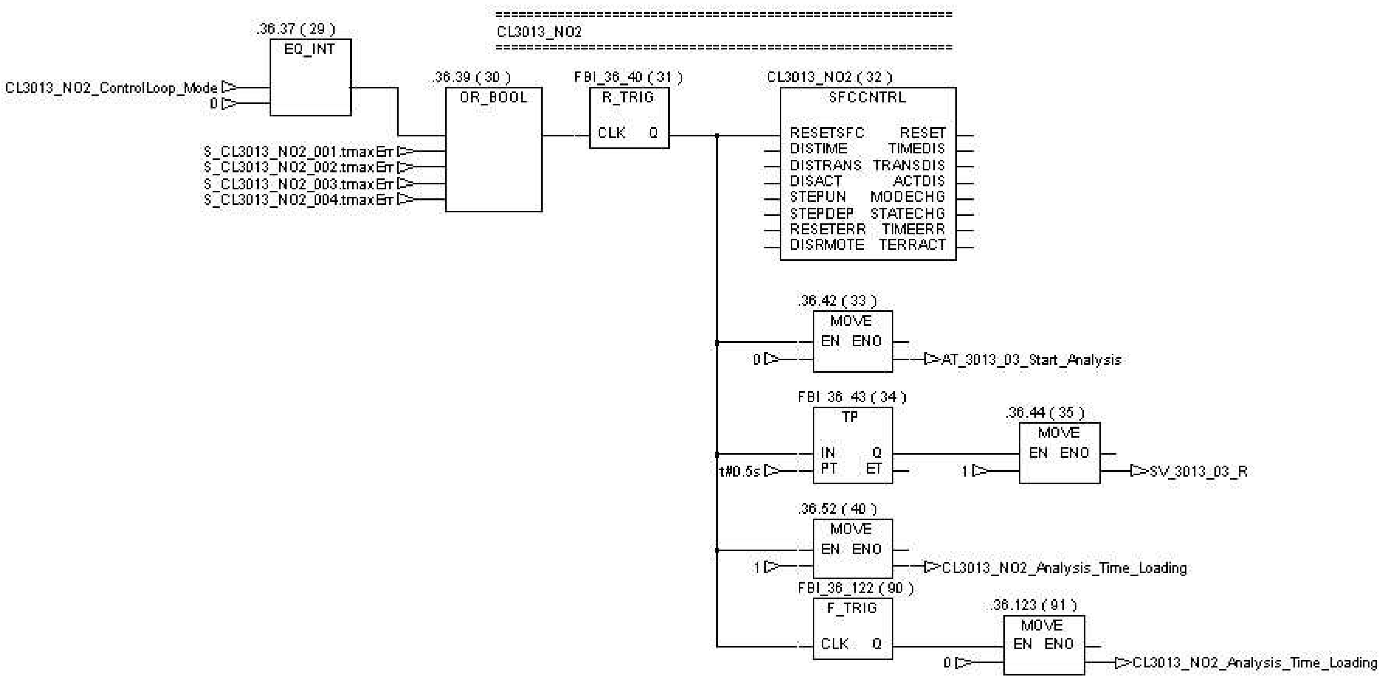
- The Control Loop mode is triggered OFF mode during an analysis or a calibration.
- The operator asks for a stop analyzer in manual mode.

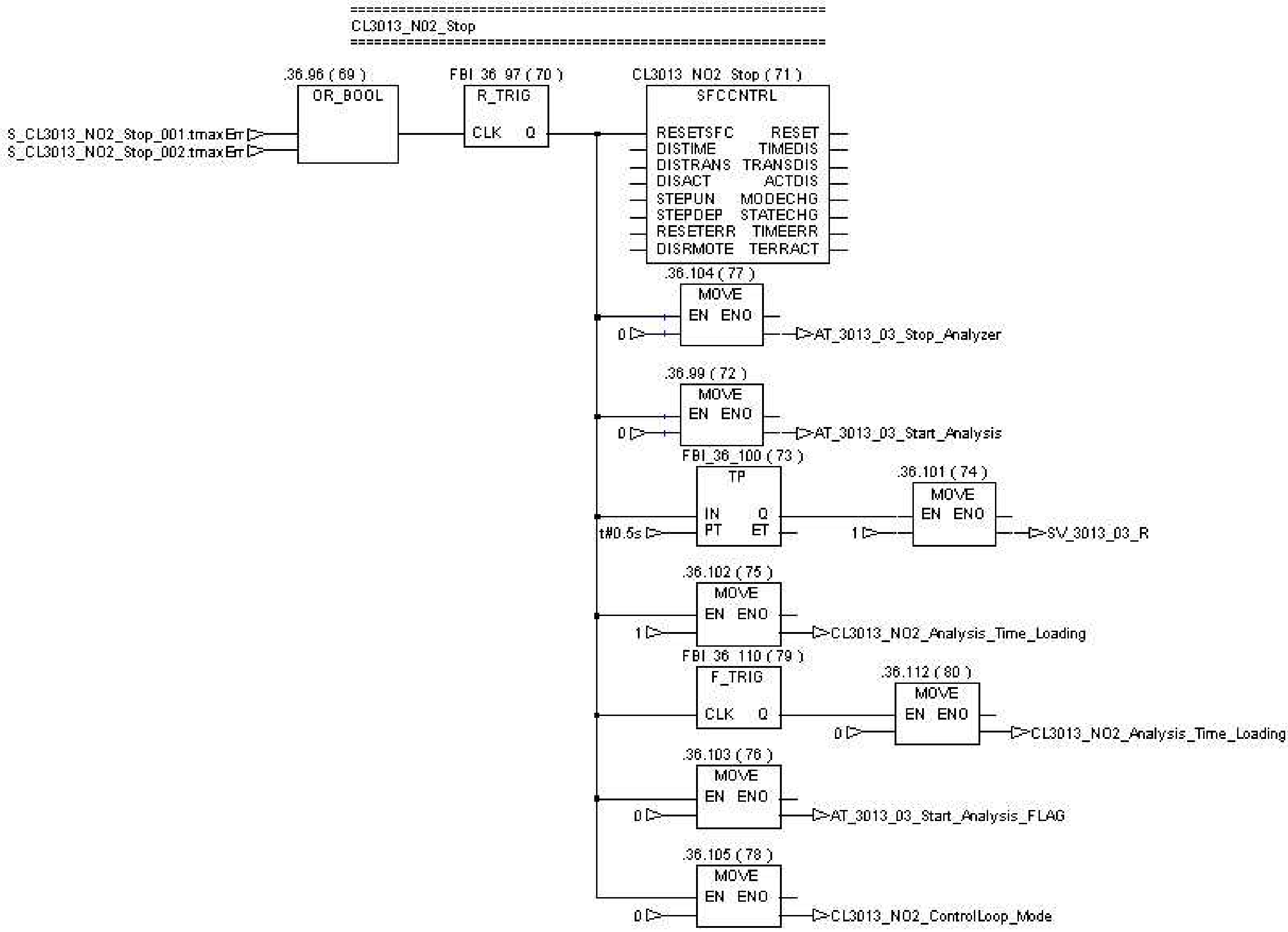
Once executed, the analyzer is in stop mode and the entrance valve is closed



2.16.2.5.3. Control of Sequential Function Chart

Each procedure is controlled by a specific bloc. As each step has a maximum time for its execution, it permits to automatically reset the procedure and the variables linked, in case of equipment failure.
The Reset of a procedure can also occur if the control loop mode is triggered to OFF Mode.




CL3013_N02_Stop
.36.96 (69)
OR_BOOL
S_CL3013_NO2_Stop_001.tmaxErr
S_CL3013_NO2_Stop_002.tmaxErr
FBI_36_97 (70)
R_TRIG
CLK Q
CL3013_NO2_Stop (71)
SFCCNTRL
RESETSFC RESET
DISTIME TIMEDIS
DISTRANS TRANSDIS
DISACT ACTDIS
STEPUN MODECHG
STEPDEP STATECHG
RESETERR TIMEERR
DISRMOTE TERRACT
.36.104 (77)
MOVE
EN ENO
AT_3013_03_Stop_Analyzer
.36.99 (72)
AT_3013_03_Start_Analysis
FBI_36_100 (73)
TP
IN Q
PT ET
t#0.5s
.36.101 (74)
SV_3013_03_R
.36.102 (75)
CL3013_NO2_Analysis_Time_Loading
FBI_36_110 (79)
F_TRIG
.36.112 (80)
CL3013_NO2_Analysis_Time_Loading
.36.103 (76)
AT_3013_03_Start_Analysis_FLAG
.36.105 (78)
CL3013_NO2_ControlLoop_Mode

2.16.3.Alarms and Thresholds

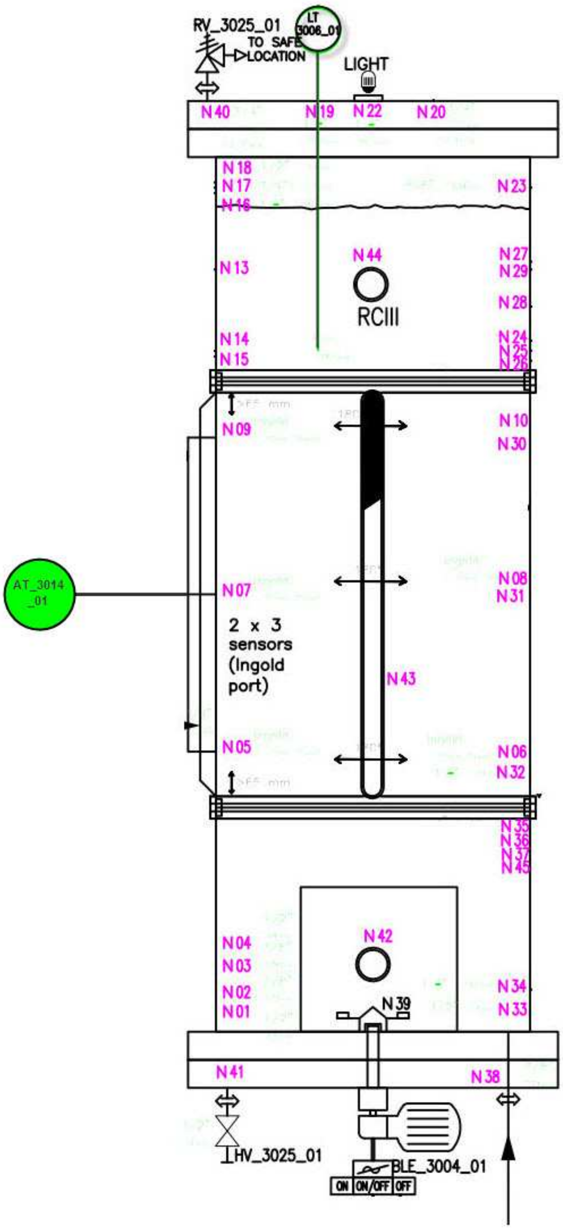
Alarm tag Name	type	Address	description
AT_3013_01_Calib_OutOfRange_A	BOOL	000282	Set from SCADA server when calibration has failed
AT_3013_01_ERROR	BOOL	000283	Alarm set when some communication errors appear.
AT_3013_02_Calib_OutOfRange_A	BOOL	000287	Set from SCADA server when calibration has failed
AT_3013_02_ERROR	BOOL	000288	Alarm set when some communication errors appear.
SV_3013_01_A	BOOL	000163	Set if the feedback is not detected after 5 seconds
SV_3013_02_A	BOOL	000164	Set if the feedback is not detected after 5 seconds
SV_3013_03_A	BOOL	000165	Set if the feedback is not detected after 5 seconds
AT_3013_01_AH	BOOL	000166	High level AMMONIA
AT_3013_01_AHH	BOOL	000167	Very High level AMMONIA
AT_3013_02_AH	BOOL	000170	High level of NITRATE
AT_3013_02_AHH	BOOL	000171	Very High level of NITRATE
AT_3013_02_AL	BOOL	000172	Low level of NITRATE
AT_3013_02_ALL	BOOL	000173	Very Low level of NITRATE
AT_3013_03_AH	BOOL	000174	High level of NITRITE
AT_3013_03_AHH	BOOL	000175	Very High level of NITRITE
AT_3013_03_ERR	BOOL	000180	SET if the wire is broken

Figure 50 : Analysis of Liquid – ALARMS

Threshold tag name	Type	Address	Value	Unit	Action	Threshold tag name
CL3013_Analysys of Liquid	AT_3013_01_LIM_H	REAL	400630	100	mg/L	Displays an alarm on the HMI
CL3013_Analysys of Liquid	AT_3013_01_LIM_HH	REAL	400632	400	mg/L	Displays an alarm on the HMI
CL3013_Analysys of Liquid	AT_3013_02_LIM_H	REAL	400638	500	mg/L	Displays an alarm on the HMI
CL3013_Analysys of Liquid	AT_3013_02_LIM_HH	REAL	400640	600	mg/L	Displays an alarm on the HMI
CL3013_Analysys of Liquid	AT_3013_02_LIM_L	REAL	400642	300	mg/L	Displays an alarm on the HMI
CL3013_Analysys of Liquid	AT_3013_02_LIM_LL	REAL	400644	250	mg/L	Displays an alarm on the HMI
CL3013_Analysys of Liquid	AT_3013_03_LIM_H	REAL	400646	0.5	mg/L	Displays an alarm on the HMI
CL3013_Analysys of Liquid	AT_3013_03_LIM_HH	REAL	400648	20	mg/L	Displays an alarm on the HMI

Figure 51 : Analysis of Liquid – THRESHOLDS

2.17. Biomass Control (CL3014)



2.17.1.Function

No control. Biomass is monitored.

PLC Section name	Equipment tag	Type	Address	Comment
CL3014_Biomass_Control	AT_3014_01	REAL	400204	Biomass sensor

Figure 52 : Biomass – EQUIPMENTS

No operator input

2.17.2.Block Diagram

No software implementation

2.17.3.Alarms and Thresholds

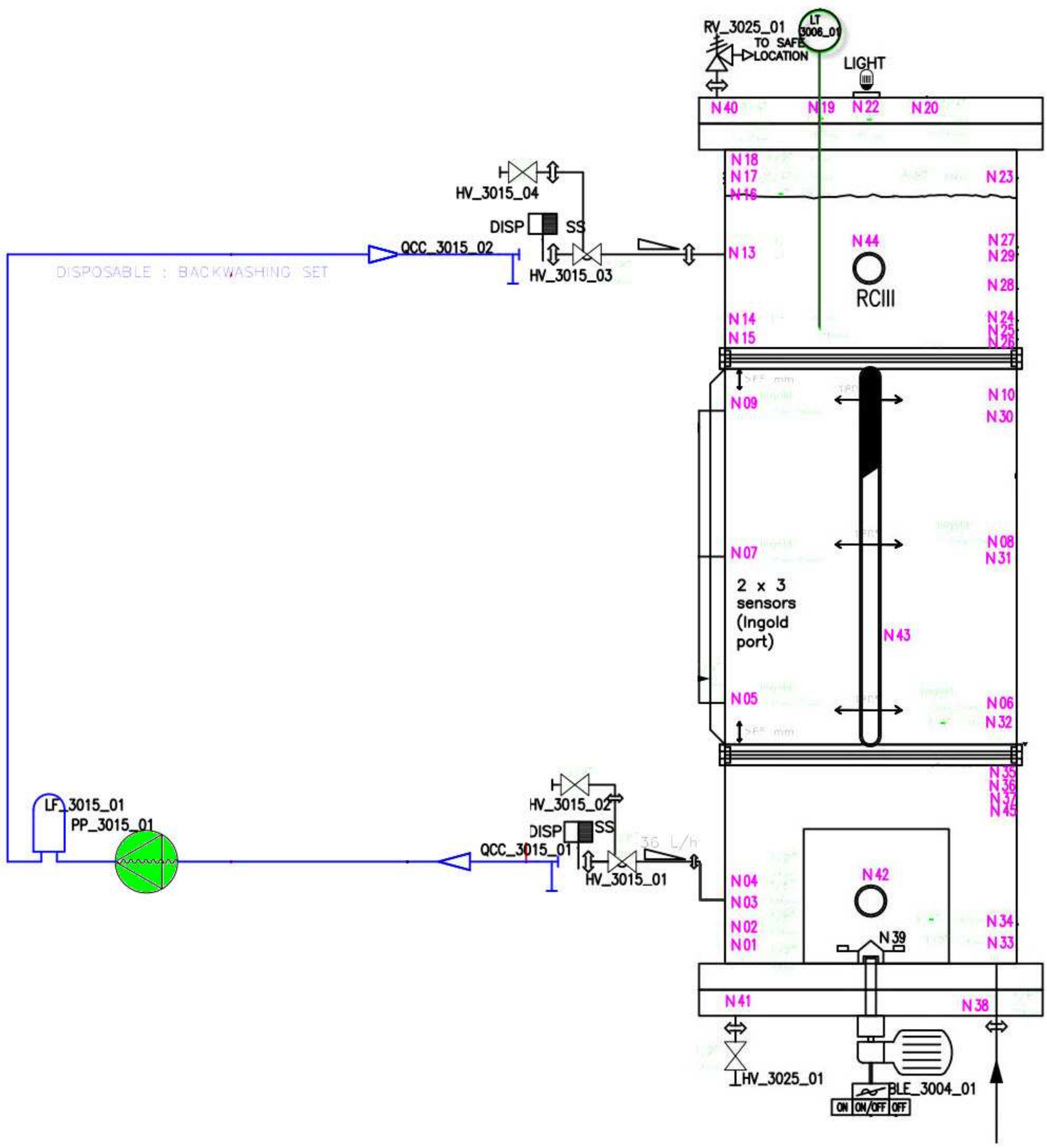
Alarm tag Name	type	Address	description
AT_3014_01_H	BOOL	000182	Displays an alarm on the HMI To be defined with NTE
AT_3014_01_HH	BOOL	000183	Displays an alarm on the HMI To be defined with NTE
AT_3014_01_L	BOOL	000184	Displays an alarm on the HMI To be defined with NTE
AT_3014_01_LL	BOOL	000185	Displays an alarm on the HMI To be defined with NTE
AT_3014_01_ERR	BOOL	000186	SET if the wire is broken

Figure 53 : Biomass – ALARMS

Threshold tag name	Type	Address	Value	Unit	Action
AT_3014_01_LIM_H	REAL	400654	(???)	(???)	Displays an alarm on the HMI
AT_3014_01_LIM_HH	REAL	400656	(???)	(???)	Displays an alarm on the HMI
AT_3014_01_LIM_L	REAL	400658	(???)	(???)	Displays an alarm on the HMI
AT_3014_01_LIM_LL	REAL	400660	(???)	(???)	Displays an alarm on the HMI

Figure 54 : Biomass – THRESHOLDS

2.18. Backwashing (CL3015)



2.18.1.Function

The backwashing is used when a clogging is detected into the bioreactor.
The proposed strategy (SNC) is to performed some gas pulses in the bioreactor, followed by a backwashing.
A differential pressure is implemented in the reactor in order to prevent clogging of the packed-bed due to excess of biofilm generation. This measurement will be used to foresee the needs of preventive backwashing procedures, in order to remove excess of bio film, before severe clogging occurs.

The control depends on the mode selected by the operator:

- OFF mode: The pump is switched OFF
- MAN mode: The user can activate the backwashing pump
- AUTO mode: The pump is activated during a specified duration.

PLC Section name	Equipment tag	Type	Address	Comment
CL3015_Backwashing	PP_3015_01_MV	DO	000040	Peristaltic Pump multichannel, variable speed (backwash)

Figure 55: Backwashing – EQUIPMENTS

PLC Section name	**Equipment tag**	**Type**	**Address**	**Comment**
CL3015_Backwashing	CL3015_ControlLoop_Mode	INT	400239	Mode Selector (OFF/Manu/Auto)
CL3015_Backwashing	PP_3015_01_OP	BOOL	000187	Used to start and stop the pump in manual mode
CL3015_Backwashing	CL3015_BACKWASHING_DURATION	UDINT	400065	Duration of the backwashing (second)

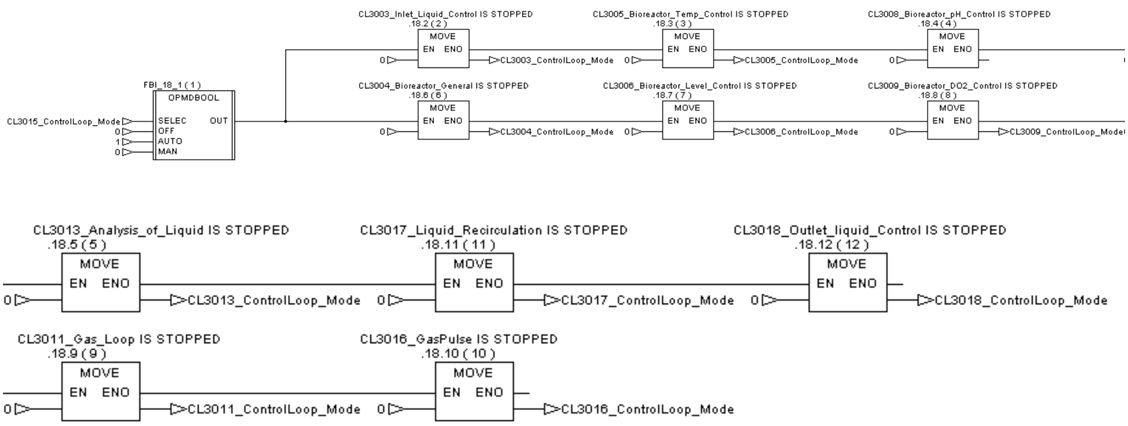
Figure 56: Backwashing – OPERATOR INPUTS

2.18.2.Block Diagram

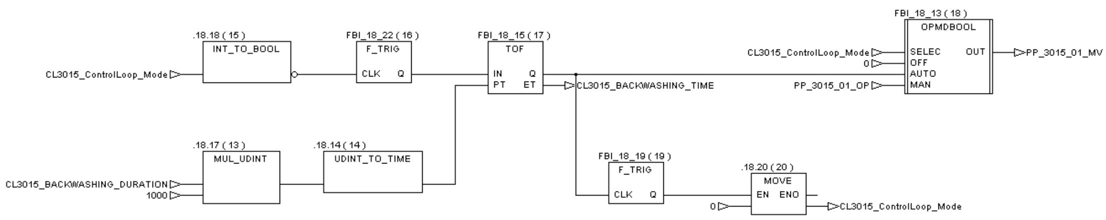
In AUTO Mode, the following loops are stopped:

- CL3003, Inlet Liquid
- CL3004, Bioreactor General
- CL3005, Bioreactor Temperature Control
- CL3006, Bioreactor Level Control
- CL3009, EC Control

- CL3013, Analysis of Liquid
- CL3011, Gas Loop
- CL3016, Gas Pulse
- CL3017, Liquid Recirculation,
- CL3018, Outlet Liquid Flow



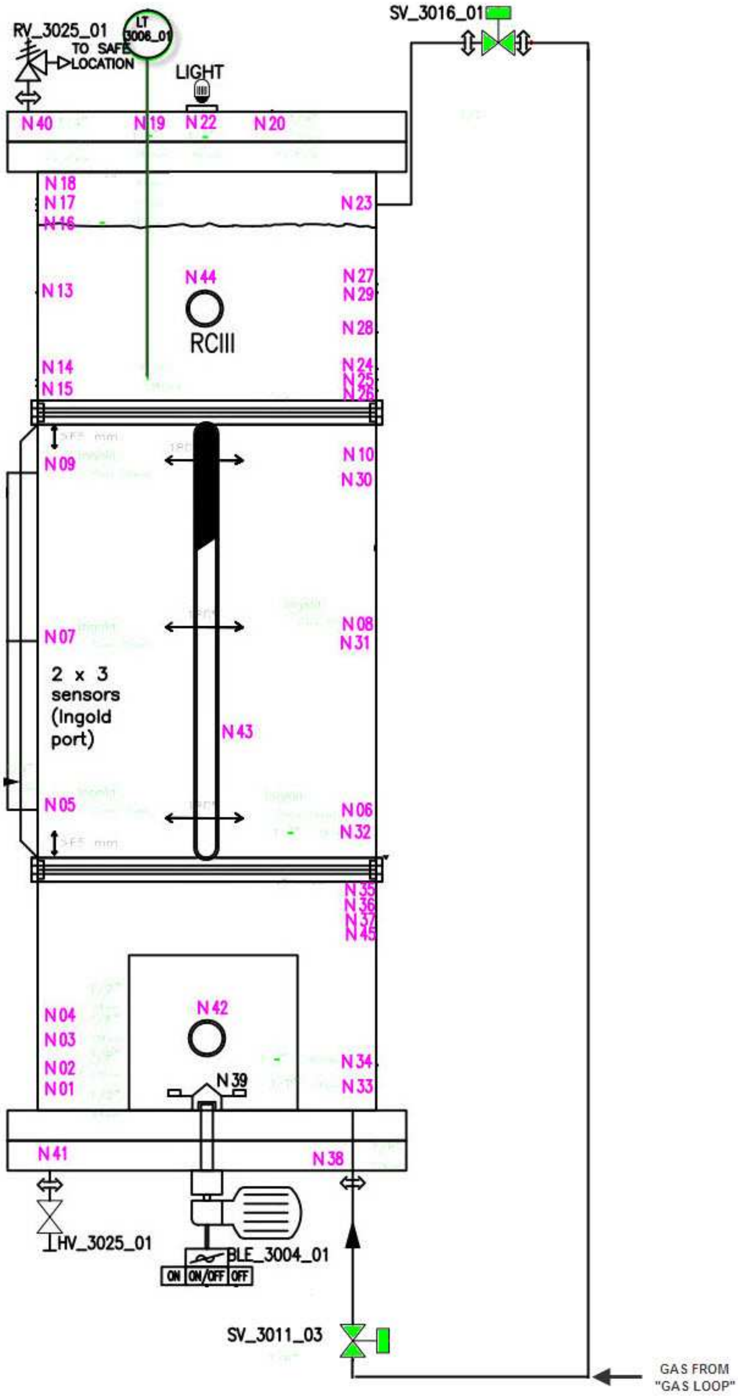
In AUTO mode, the pump PP_3015_01 is activated during CL3015_BACKWASHING_DURATION.



2.18.3.Alarms and Thresholds

Neither Alarms nor Thresholds.

2.19. Gas Pulse (CL3016)



2.19.1.Function

The Gas Pulse is used for preventing the clogging, or for shaking and decompacting the cells
It is activated by the operator, checking the DO2, the biomass and/or the differential pressure of the bioreactor.
It consists to alternatively inject gas at the top and at the bottom of the bioreactor.

PLC Section name	Equipment tag	Type	Address	Comment
CL3016_Gas_Pulse	SV_3016_01_MV	DO	000026	Gas introduction valve / OLD NAME OF THE VALVE: SV_3016_02
CL3016_Gas_Pulse	SV_3016_01_FB	DI	100031	Gas introduction valve Feedback / OLD NAME OF THE VALVE: SV_3016_02

Figure 57: Gas Pulse – EQUIPMENTS

PLC Section name	Equipment tag	Type	Address	Comment
CL3016_Gas_Pulse	CL3016_OXYGENPULSE_NUMBER	INT	400246	Number of the oxygen pulses done during the sequence
CL3016_Gas_Pulse	CL3016_BOTTOM_OPENING_TIME	UDINT	400430	Opening Time of valves SV_3016_01 and SV_3011_01
CL3016_Gas_Pulse	CL3016_BOTTOM_CLOSING_TIME	UDINT	400432	Closing Time of valves SV_3016_01 and SV_3011_01
CL3016_Gas_Pulse	CL3016_TOP_OPENING_TIME	UDINT	400434	Opening Time of valves SV_3016_02
CL3016_Gas_Pulse	CL3016_TOP_CLOSI NG_TIME	UDINT	400436	Closing Time of valves SV_3016_02
CL3016_Gas_Pulse	CL3016_ControlLoop_Mode	INT	400240	Mode Selector (OFF/Manu/Auto)
CL3016_Gas_Pulse	SV_3016_01_OP	BOOL	000189	Used to open or close the valve in manual mode / OLD NAME OF THE VALVE: SV_3016_02

Figure 58: Gas Pulse – OPERATOR INPUTS

2.19.2.Block Diagram

One Oxygen pulse is the complete following cycle:
During the cycle:
- The Mix Flow is at the nominal value (3000 ML/mn), no other additional gas.
- SV_3018_01 closed (Outlet Liquid Flow). Remark: it implies that the level control is also OFF as it is controlled with the outlet flow.
- Inlet Liquid Flow can be active or not. Operator to decide
- PT_3007_01 "alarm" disabled. Atmosphere Valve does not open if ever PT_3007_01>80mbar
- Recirculation Loop can be active or not. To be tested. First without Recirculation.

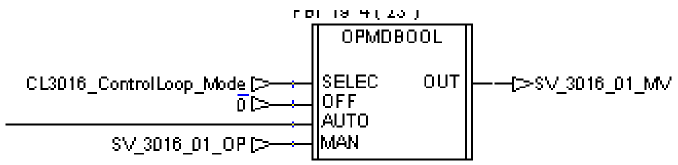
- Open SV_3011_03 (bottom), close SV_3016_01, open SV_3011_01 :
  Duration **CL3016_BOTTOM_OPENING_TIME** seconds
- Close SV_3011_03, close SV_3016_01, close SV_3011_01 :
  Duration **CL3016_BOTTOM_CLOSING_TIME** seconds
- Close SV_3011_03 (bottom), open SV_3016_01, close SV_3011_01 :
  Duration **CL3016_TOP_OPENING_TIME** seconds
- Close SV_3011_03, close SV_3016_01, close SV_3011_01 :
  Duration **CL3016_TOP_CLOSING_TIME** seconds

First assumptions for the tests:
CL3016_BOTTOM_CLOSING_TIME = **CL3016_TOP_CLOSING_TIME** = 0 second
CL3016_BOTTOM_OPENING_TIME = **CL3016_TOP_OPENING_TIME**

The user can also define the number of pulse :
CL3016_OXYGENPULSE_NUMBER

2.19.2.1.1. MANUAL Mode

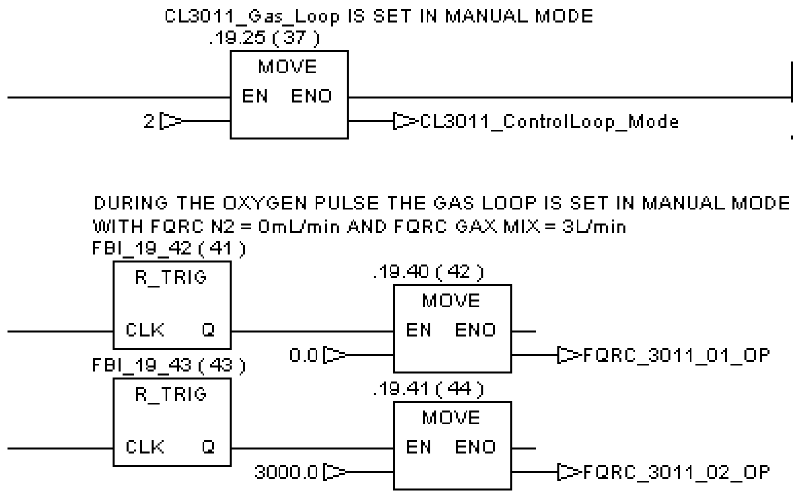
The MANUAL mode permits to open or close the SV_3016_01 (Top) valve.



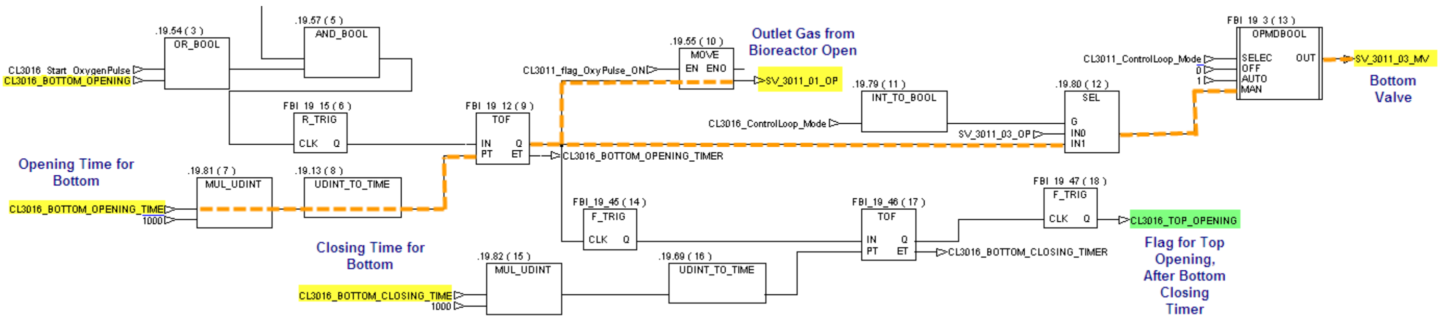
2.19.2.1.2. AUTO Mode

In AUTO Mode, the following loops are automatically stopped:
- CL3003, Inlet Liquid
- CL3004, Bioreactor General
- CL3005, Bioreactor Temperature Control
- CL3006, Bioreactor Level Control
- CL3008, pH Control
- CL3009, EC Control
- CL3013, Analysis of Liquid
- CL3015, Backwashing
- CL3017, Liquid Recirculation,
- CL3018, Outlet Liquid Flow

And the Gas Loop is set in Manual, with FQRC_3011_01_SP (N2) = 0 mL/mn and FQRC_3011_02_SP = 3000 mL/mn (following figure)



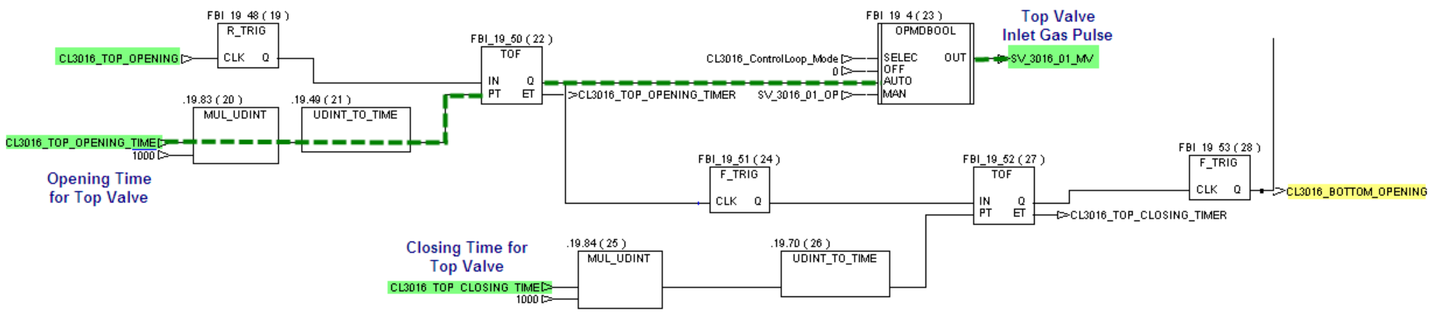
2.19.2.1.1. Bottom Opening and Closing



When Gas Pulse is in Auto or Man mode,

- SV_3011_01 and SV_3011_03 are opened during CL3016_BOTTOM_OPENING_TIME (Orange Line)
- And closed during CL3016_BOTTOM_CLOSING_TIME, before sending the signal CL3016_TOP_OPENING signal to the 2nd part of the cycle

2.19.2.1.2. Top Opening and Closing

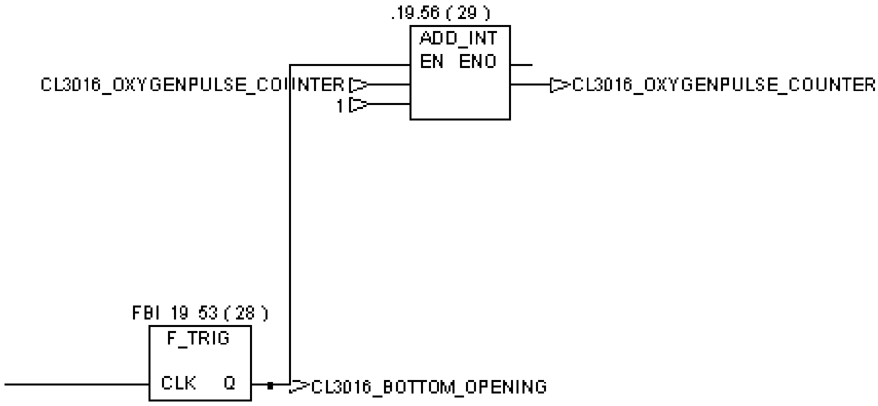


When Gas Pulse is in Auto or Man mode,

- SV_3016_01 is opened during CL3016_TOP_OPENING_TIME (Green Line)
- And closed during CL3016_TOP_CLOSING_TIME, before sending the signal CL3016_BOTTOM_OPENING signal to the 1st part of the cycle.

2.19.2.1.3. Counter of Cycle

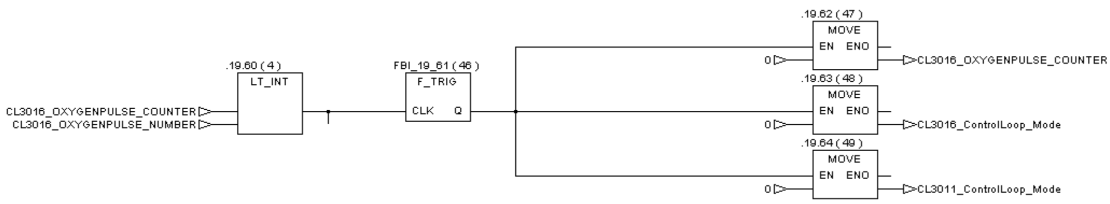
The counter is incremented after the end of the CL3016_TOP_CLOSING_TIME



2.19.2.1.4. End of Cycle

When the cycle is over:
(CL3016_OXYGENPULSE_COUNTER = CL3016_OXYGENPULSE_NUMBER)
then :

- Gas Pulse Control Loop Mode is set to OFF
- Gas Loop Control Loop Mode is set to OFF
- Counter is reset : CL3016_OXYGENPULSE_COUNTER = 0.



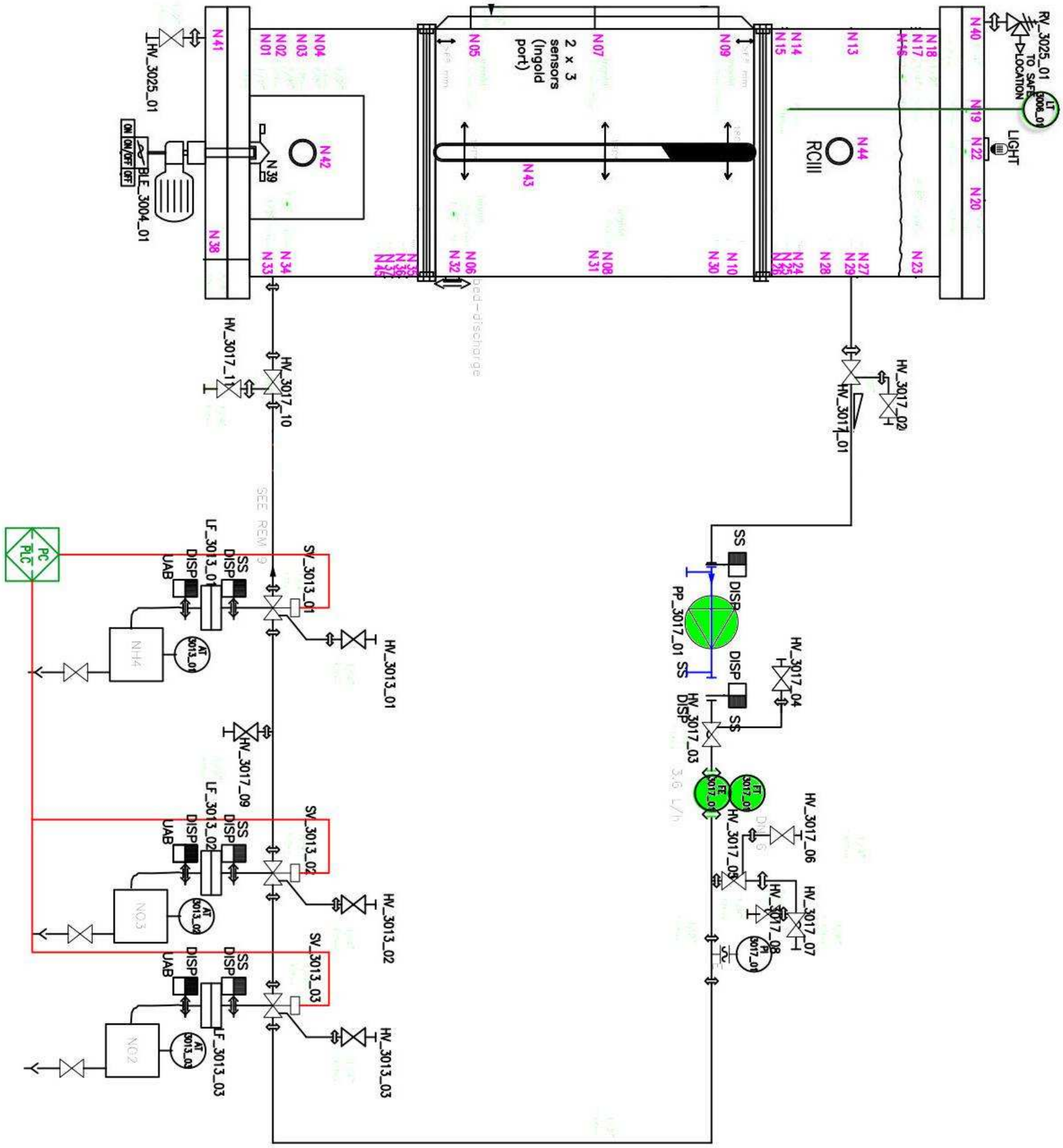
2.19.3.Alarms and Thresholds

Alarm tag Name	type	Address	description
SV_3016_01_A	BOOL	000191	Set if the feed back is not detected after 5 seconds / OLD NAME OF THE VALVE: SV_3016_02

Figure 59 : Gas Pulse – ALARMS

No Threshold

2.20. Liquid Recirculation (CL3017)



2.20.1.Function

The aim of this loop is to control the flow of the liquid recirculation loop of the bioreactor.

PLC Section name	Equipment tag	Type	Address	Comment
CL3017_Liquid_Recirculation	FT_3017_01	AI->REAL	400152	Flow element + transmitter (recirculation)
CL3017_Liquid_Recirculation	PP_3017_01_MV1	DO	000047	Peristaltic Pump multichannel, variable speed (recirculation / ON - OFF)
CL3017_Liquid_Recirculation	PP_3017_01_MV2	REAL -> AO	400200	Peristaltic Pump multichannel, variable speed (recirculation)
CL3017_Liquid_Recirculation	PP_3017_01_MV3	DO	000048	Peristaltic Pump, ROTATION DIRECTION

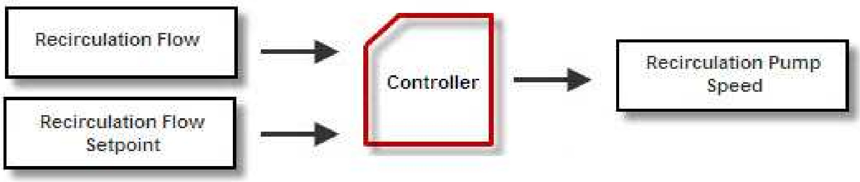
Figure 60: Liquid Recirculation – EQUIPMENT

PLC Section name	tag	Type	Address	Comment
CL3017_Liquid_Recirculation	CL3017_ControlLoop_Mode	INT	400241	Mode Selector (OFF/Manu/Auto)
CL3017_Liquid_Recirculation	PP_3017_01_OP	BOOL	000192	Used to start or stop the peristaltic pump in manual mode
CL3017_Liquid_Recirculation	PP_3017_01_SP	REAL -> AI	400150	Used to define the speed of the peristaltic pump in manual mode
CL3017_Liquid_Recirculation	CL3017_FLOW_SP	REAL -> AI	400176	Used to define the flow set point of the recirculation loop in automatic mode
CL3017_Liquid_Recirculation	PP_3017_01_ROT	BOOL	000193	Used to define the Rotation direction of the peristaltic pump in manual mode

Figure 61: Liquid Recirculation - OPERATOR INPUT

2.20.2.Block Diagram

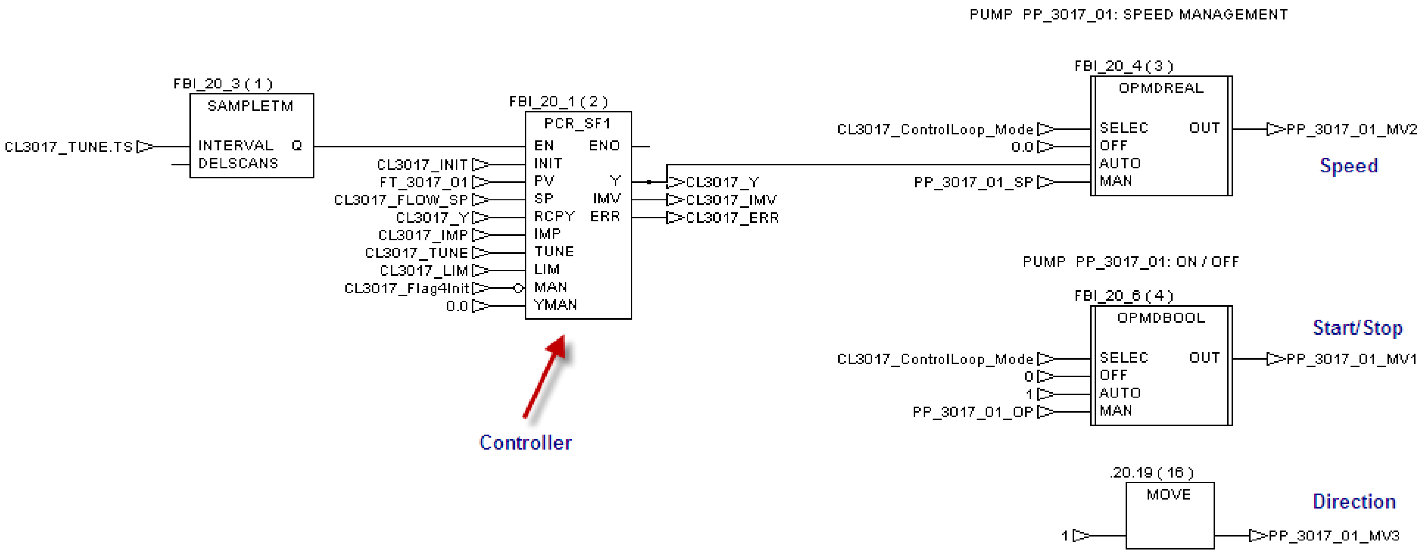
2.20.2.1.1. Controller



The control is done by the Predictive control block SF1 (Simple predictive controller for first order process) (See annex B). An internal model represents the flow function of the pump speed. Depending of this model, the controller will adjust the flow with the pump speed to maintain the desired set point.

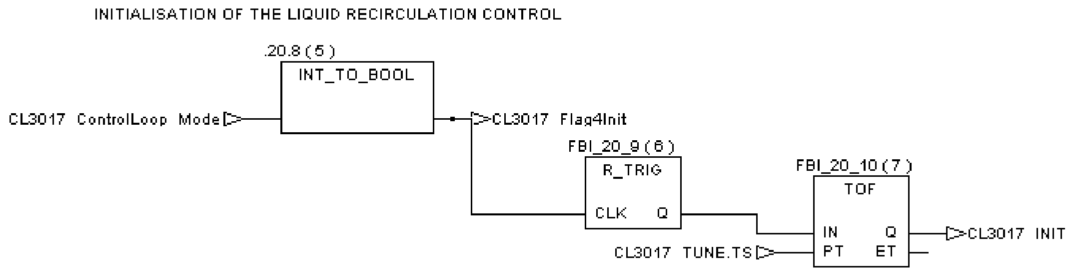
The flow control depends on the mode selected by the operator:

- OFF mode: The pump is switched OFF
- MAN mode: The user can decide to switch ON the pump and define the speed of the pump
- AUTO mode: The controller adjusts the pump to satisfy the flow set point



2.20.2.1.2. Controller initialization

When the operator decides to switch to the automatic mode, the controller is initialized during the sample time (see controller parameters)



2.20.2.1.3. Controller parameters

Controlled Variable	PCR CONTROLER TYPE	DEAD ZONE	ZTR Zone Control	PWM	SAMPLETM	PROCESS VALUE (input)	SET POINT
Pump speed of inlet flow (PP_3017_01_MV2)	SF1	NO	NO	NO	CL3017_TUNE.TS	FT_3017_01	CL3017_FLOW_SP

INTERNAL MODEL PROCESS	TUNE	LIMIT	SELF_CMP	DECOMP	Manipulated Variable (Controller Output in Auto Mode)	Controlled Equipment
KM : 0.49 TM : 2.65s DM : 0s	TS : 100 ms H : 100 ms TRBF : 7.5s	CL3017_LIM YMIN : 0 YMAX : 100 YRATE : 100	NO	NO	CL3017_Y	PP_3017_01_MV2

2.20.3.Alarm and Threshold

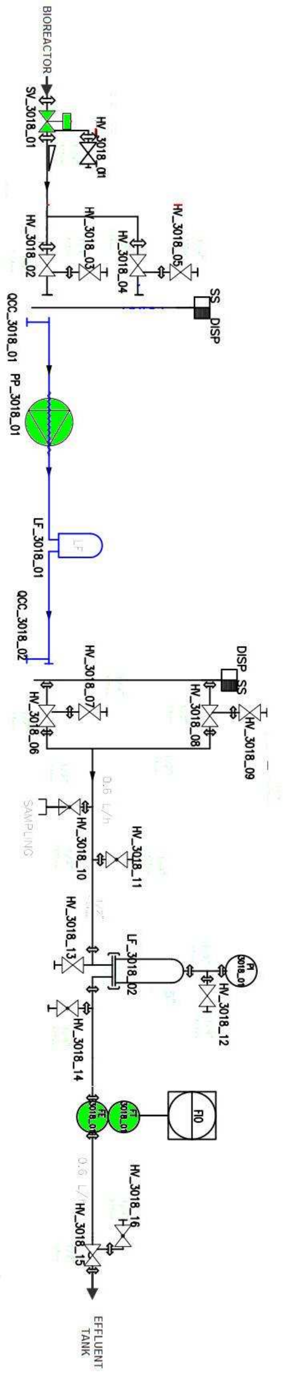
Alarm tag Name	type	Address	description
FT_3017_01_AH	BOOL	000194	The time for triggering the alarm need to be defined (1min) High Flow in the Recirculation Loop
FT_3017_01_AHH	BOOL	000195	The time for triggering the alarm need to be defined (1min) Very High Flow in the recirculation Loop
FT_3017_01_AL	BOOL	000196	The time for triggering the alarm need to be defined (1min) Low Flow in the Recirculation Loop
FT_3017_01_ALL	BOOL	000197	The time for triggering the alarm need to be defined (1min) Very Low Flow in the Recirculation Loop
FT_3017_01_ERR	BOOL	000198	SET if the wire is broken

Figure 62: Liquid Recirculation – ALARM

Threshold tag name	Type	Address	Value	Unit	Action
FT_3017_01_LIM_H	REAL	400662	0.1	L/h	Displays an alarm on the HMI Compared to the set point Only in automatic mode
FT_3017_01_LIM_HH	REAL	400664	0.2	L/h	Displays an alarm on the HMI Compared to the set point Only in automatic mode
FT_3017_01_LIM_L	REAL	400666	-0.1	L/h	Displays an alarm on the HMI Compared to the set point Only in automatic mode
FT_3017_01_LIM_LL	REAL	400668	-0.2	L/h	Displays an alarm on the HMI Compared to the set point Only in automatic mode

Figure 63: Liquid Recirculation – THRESHOLD

2.21. Outlet Liquid Control (CL3018)



2.21.1.Function

The aim of this loop is to control the outlet flow of the of the bioreactor.
This control loop is also linked to the Bioreactor Level Control. In case of Level Control in AUTO mode, the Outlet liquid control is set in AUTO and the set point of the flow is calculated by the Level Controller.

PLC Section name	Equipment tag	Type	Address	Comment
CL3018_Outlet_liquid_Control	FT_3018_01	AI->REAL	400156	Flow element + transmitter (harvest)
CL3018_Outlet_liquid_Control	PP_3018_01_MV1	DO	000041	Peristaltic Pump multichannel, variable speed (harvest / ON - OFF)
CL3018_Outlet_liquid_Control	PP_3018_01_MV2	REAL->AO	400196	Peristaltic Pump multichannel, variable speed (harvest)
CL3018_Outlet_liquid_Control	PP_3018_01_MV3	DO	000042	Peristaltic Pump, ROTATION DIRECTION
CL3018_Outlet_liquid_Control	SV_3018_01_MV	DO	000020	Reactor liquid outlet valve
CL3018_Outlet_liquid_Control	SV_3018_01_FB	DI	100029	Reactor liquid outlet valve Feedback

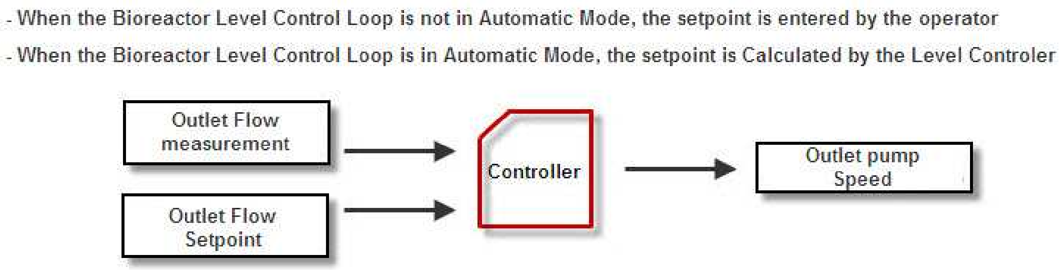
Figure 64: Outlet Liquid Control – EQUIPMENT

PLC Section name	tag	Type	Address	Comment
CL3018_Outlet_liquid_Control	CL3018_ControlLoop_Mode	INT	400242	Mode Selector (OFF/Manu/Auto)
CL3018_Outlet_liquid_Control	PP_3018_01_OP	BOOL	000199	Used to start or stop the peristatic pump in manual mode
CL3018_Outlet_liquid_Control	PP_3018_01_SP	REAL -> AI	400154	Used to define the speed of the peristatic pump in manual mode
CL3018_Outlet_liquid_Control	CL3018_FLOW_SP	REAL -> AI	400170	Used to define the Set Point of the flow in automatic mode
CL3018_Outlet_liquid_Control	PP_3018_01_ROT	BOOL	000200	Used to define the Rotation direction of the peristatic pump in manual mode
CL3018_Outlet_liquid_Control	SV_3018_01_OP	BOOL	000249	Used to open and close the valve in manual mode

Figure 65: Outlet Liquid Control - OPERATOR INPUT

2.21.2.Block Diagram

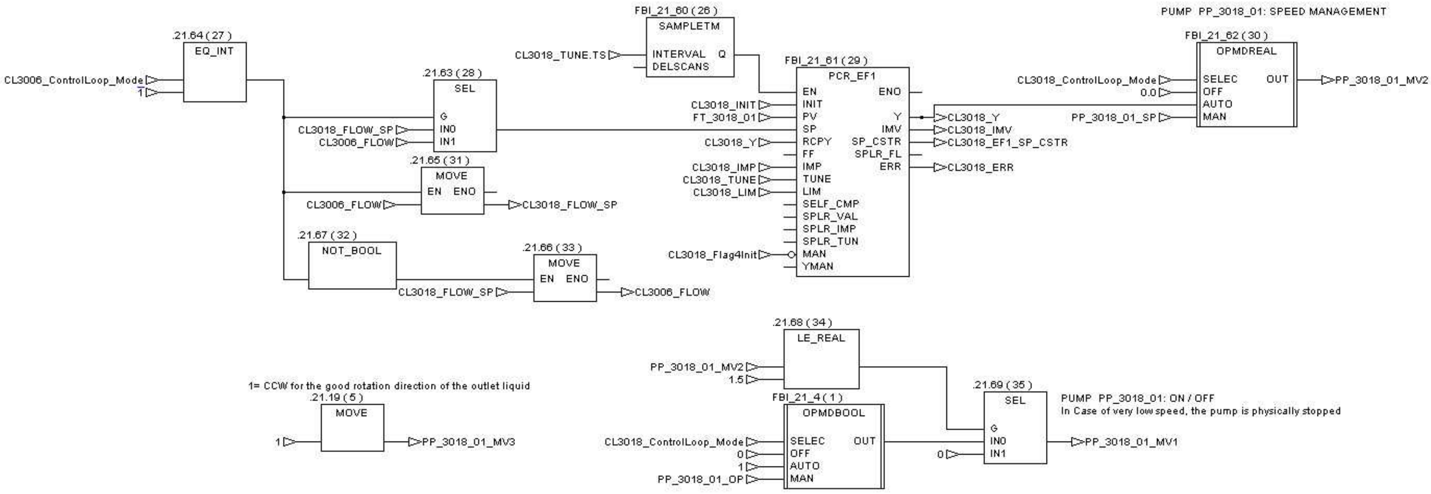
2.21.2.1.1. Controller



The control is done by the Predictive control block EF1 (Simple predictive controller for first order process) (See annex C). An internal model represents the flow function of the pump speed. Depending of this model, the controller will adjust the flow with the pump speed to maintain the desired set point.

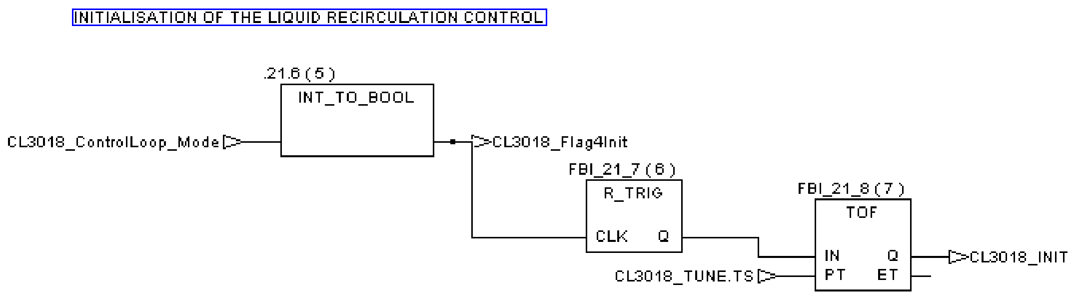
The flow control depends on the mode selected by the operator:

- OFF mode: The pump and the valve are switched OFF
- MAN mode: The user can decide to switch ON the pump and the valve and define the speed of the pump
- AUTO mode: The controller opens the valve and adjusts the pump to satisfy the flow set point



2.21.2.1.2. Controller initialization

When the operator decides to switch to the automatic mode, the controller is initialized during the sample time (see controller parameters)



2.21.2.1.3. Controller parameters

Controlled Variable	PCR CONTROLER TYPE	DEAD ZONE	ZTR Zone Control	PWM	SAMPLETM	PROCESS VALUE (input)	SET POINT
Pump speed of inlet flow (PP_3018_01_MV2)	EF1	NO	NO	NO	CL3018_TUNE.TS	FT_3018_01	IF CL3006 is not in Auto mode: CL3018_FLOW_SP IF CL3006 is in Auto mode: CL3006_FLOW

INTERNAL MODEL PROCESS	TUNE	LIMIT	SELF_CMP	DECOMP	Manipulated Variable (Controller Output in Auto Mode)	Controlled Equipment
KM : 0.069 TM : 76s DM : 0s	TS : 1s H : 1s TRBF : 3mn	CL3018_LIM YMIN : 0 YMAX : 100 YRATE : 100	NO	NO	CL3018_Y	PP_3018_01_MV2

2.21.3.Alarm and Threshold

Alarm tag Name	type	Address	description
FT_3018_01_AH	BOOL	000201	Compared to the set point and triggered after 1 min action is done in level control High Flow in outlet liquid Loop
FT_3018_01_AHH	BOOL	000202	Compared to the set point and triggered after 1 min action is done in level control Very High flow in outlet liquid Loop
FT_3018_01_AL	BOOL	000203	Compared to the set point and triggered after 1 min action is done in level control Low Flow in outlet liquid Loop
FT_3018_01_ALL	BOOL	000204	Compared to the set point and triggered after 1 min action is done in level control Very Low Flow in outlet liquid Loop
FT_3018_01_ERR	BOOL	000205	SET if the wire is broken
SV_3018_01_A	BOOL	000206	Set if the feed back is not detected after 5 seconds

Figure 66: Outlet Liquid Control – ALARM

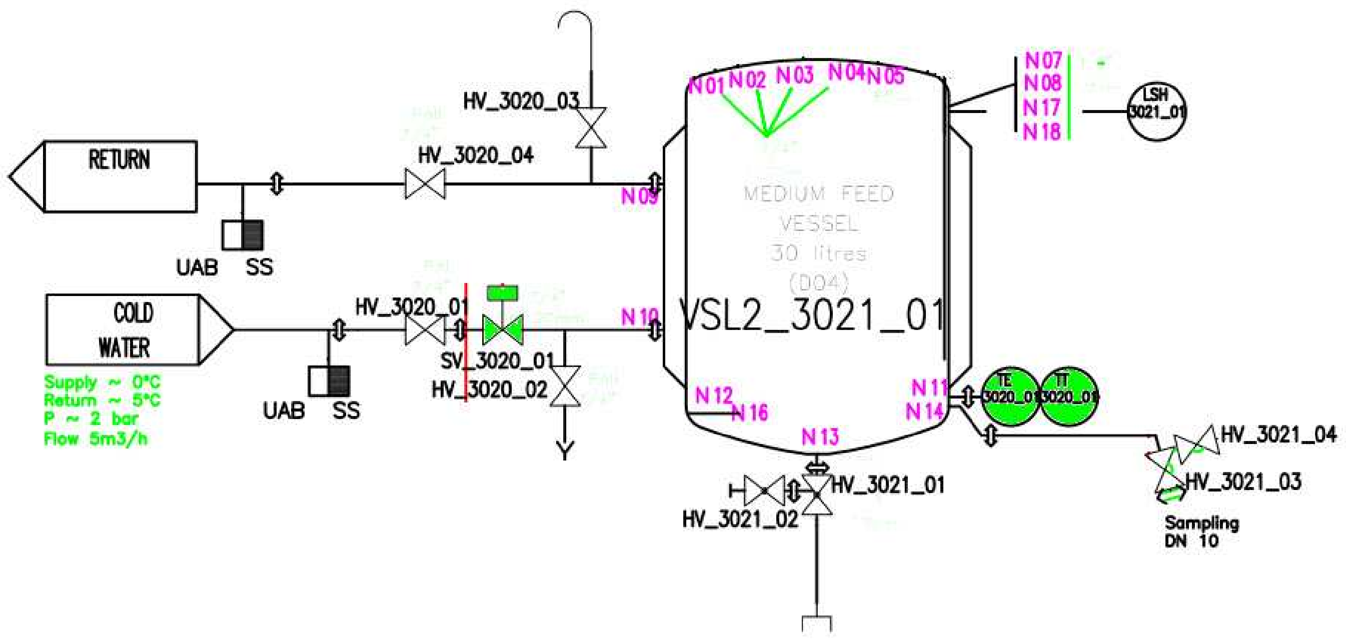
Threshold tag name	Type	Address	Value	Unit	Action
FT_3018_01_LIM_H	REAL	400670	0.1	L/h	Displays an alarm on the HMI Compared to the set point Only in automatic mode
FT_3018_01_LIM_HH	REAL	400672	0.2	L/h	Displays an alarm on the HMI Compared to the set point Only in automatic mode
FT_3018_01_LIM_L	REAL	400674	-0.1	L/h	Displays an alarm on the HMI Compared to the set point Only in automatic mode
FT_3018_01_LIM_LL	REAL	400676	-0.2	L/h	Displays an alarm on the HMI Compared to the set point Only in automatic mode

Figure 67: Outlet Liquid Control – THRESHOLD

2.22. Effluent General (CL3019)

No software implementation

2.23. Effluent Temperature (CL3020)



2.23.1.Function

Depending on the bioreactor level control, the effluent tank collects exceed of liquid. The mixture is conserved at a low temperature. This is done by MPP cold water utilities. The cold water, managed by a Boolean valve, circulates inside the effluent tank jacket. Even if the current MPP utilities do not permit to reach this set point, a controller maintains the temperature to the minimum reachable temperature (around 10℃).

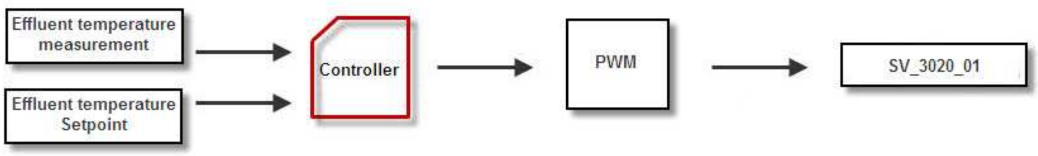
PLC Section name	Equipment tag	Type	Address	Comment
CL3020_Effluent_Temperature	SV_3020_01_MV	DO	000017	Temperature Control Valve
CL3020_Effluent_Temperature	SV_3020_01_FB	DI	100033	Temperature Control Valve Feedback
CL3020_Effluent_Temperature	TT_3020_01	AI->REAL	400162	Temperature element + transmitter

Figure 68 : Effluent Temperature Control – EQUIPMENTS

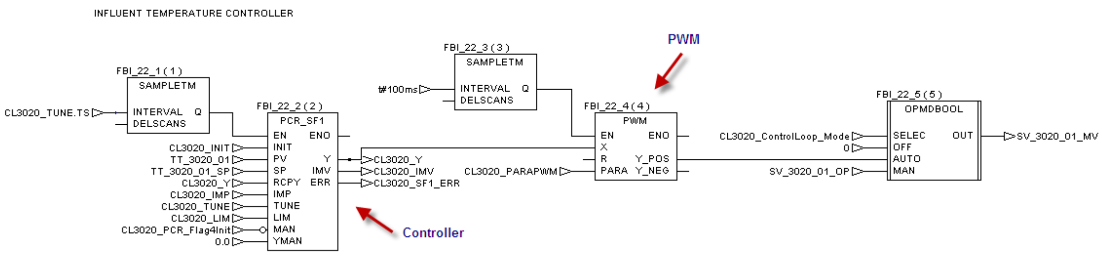
PLC Section name	Equipment tag	Type	Address	Comment
CL3020_Effluent_Temperature	CL3020_ControlLoop_Mode	INT	400243	Mode Selector (OFF/Manu/Auto)
CL3020_Effluent_Temperature	SV_3020_01_OP	BOOL	000207	Used to open and close the valve in manual mode
CL3020_Effluent_Temperature	TT_3020_01_SP	REAL	400160	Used to define the temperature set point of effluent tank

Figure 69 : Effluent Temperature Control – OPERATOR INPUTS

2.23.1.1. *Controller*

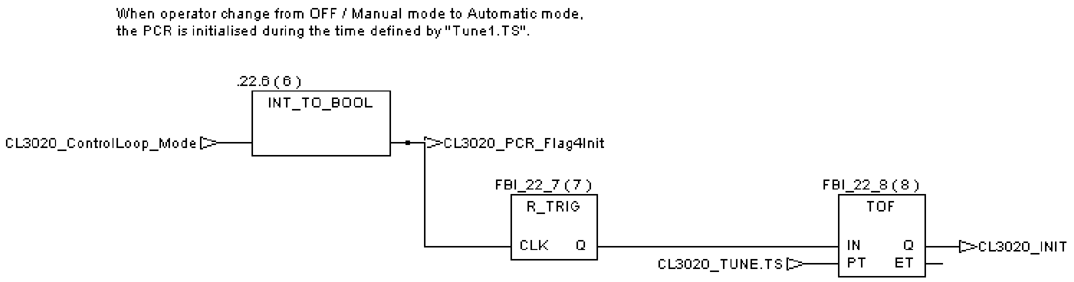


A predictive block “SF1” controls the Influent temperature (for more details on the block, see annex B). The signal is then converted into time by a PWM block because the controlled equipment is a Boolean valve. For more details on PWM block, see annex G.



2.23.1.2. *Controller initialization*

When the operator decides to switch in automatic mode, the controller is initialized during the sample time (see controller parameters).



2.23.1.3. *Controller parameter*

Controlled Variable	**PCR CONTROLER TYPE**	**DEAD ZONE**	**ZTR Zone Control**	**PWM**	**SAMPLETM**	**PROCESS VALUE (input)**	**SET POINT**
SV_3020_01_MV	SF1	NO	NO	CL3020_PARAPWM t_period : 100ms t_pause : 0s t_brake : 0s t_min : 100ms t_max : 1s up_pos : 1 up_neg : 0	CL3020_TUNE.TS	TT_3020_01	TT_3020_01_SP

INTERNAL MODEL PROCESS	**TUNE**	**LIMIT**	**SELF_CMP**	**DECOMP**	**Manipulated Variable (Controller Output in Auto Mode)**	**Controlled Equipment**
KM : -4.21 TM : 570s DM :130s	TS : 10s H : 10s TRBF : 30m	CL3020_LIM Y_MIN: 0 Y_MIN: 1 YRATE: 10	NO	NO	CL3020_Y	SV_3020_01

2.23.2. Alarms and Thresholds

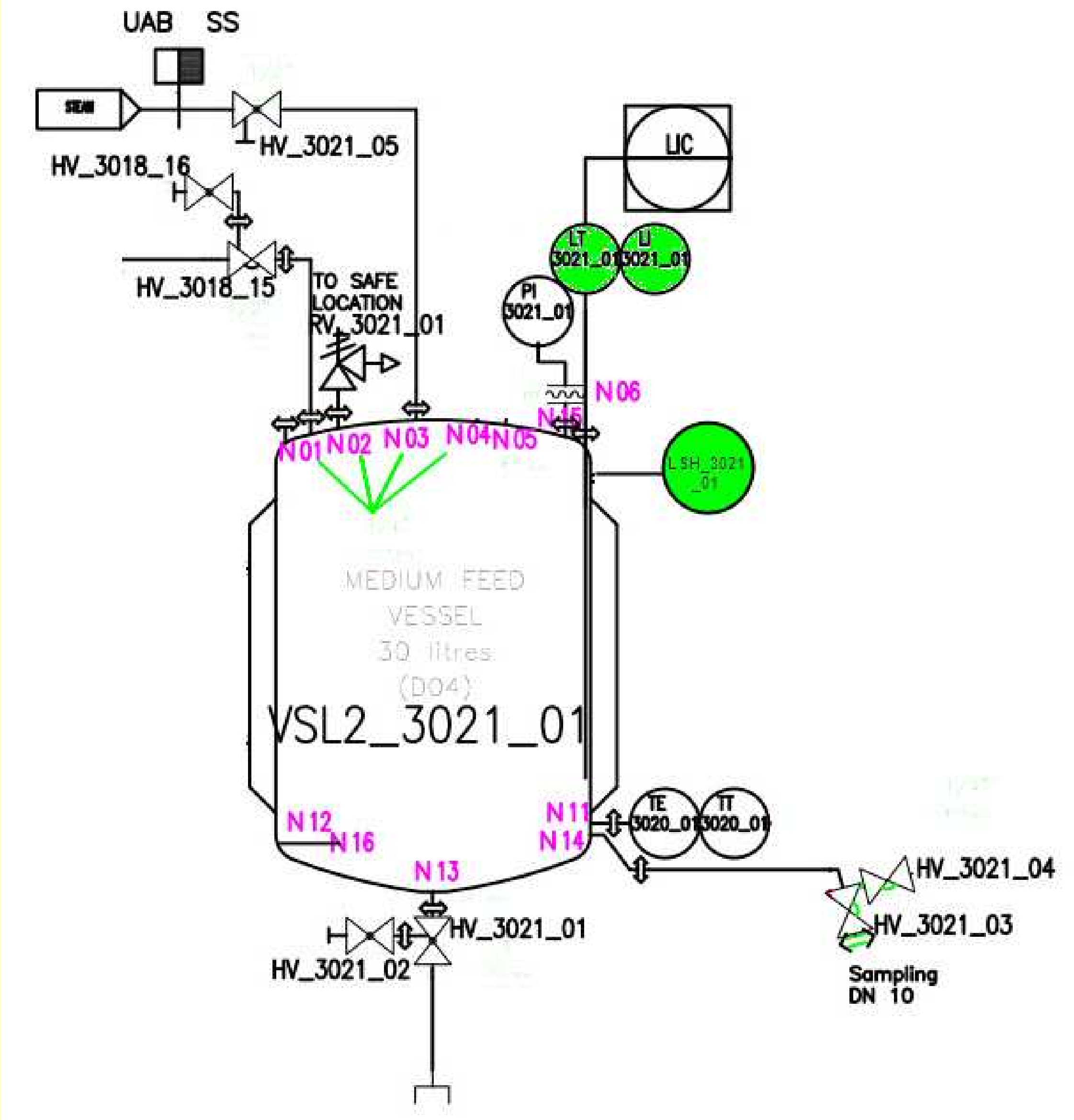
Alarm tag Name	**type**	**Address**	**description**
TT_3020_01_AH	BOOL	000208	High temperature in the effluent Tank
TT_3020_01_AHH	BOOL	000209	Very High temperature in the effluent Tank
TT_3020_01_AL	BOOL	000210	Low Temperature in the effluent Tank
TT_3020_01_ALL	BOOL	000211	Very Low Temperature in the effluent Tank
TT_3020_01_ERR	BOOL	000212	SET if the wire is broken
SV_3020_01_A	BOOL	000213	Set if the feed back is not detected after 5 seconds

Figure 70 : Effluent Temperature Control – ALARMS

Threshold tag name	Type	Address	Value	Unit	Action
TT_3020_01_LIM_H	REAL	400678	1	°C	Displays an alarm on the HMI Compared to the set point Only in automatic mode
TT_3020_01_LIM_HH	REAL	400680	2	°C	Displays an alarm on the HMI Compared to the set point Only in automatic mode
TT_3020_01_LIM_L	REAL	400682	-1	°C	Displays an alarm on the HMI Compared to the set point Only in automatic mode
TT_3020_01_LIM_LL	REAL	400684	-2	°C	Displays an alarm on the HMI Compared to the set point Only in automatic mode

Figure 71 : Effluent Temperature Control – THRESHOLD

2.24. Effluent Level (CL3021)



2.24.1.Function

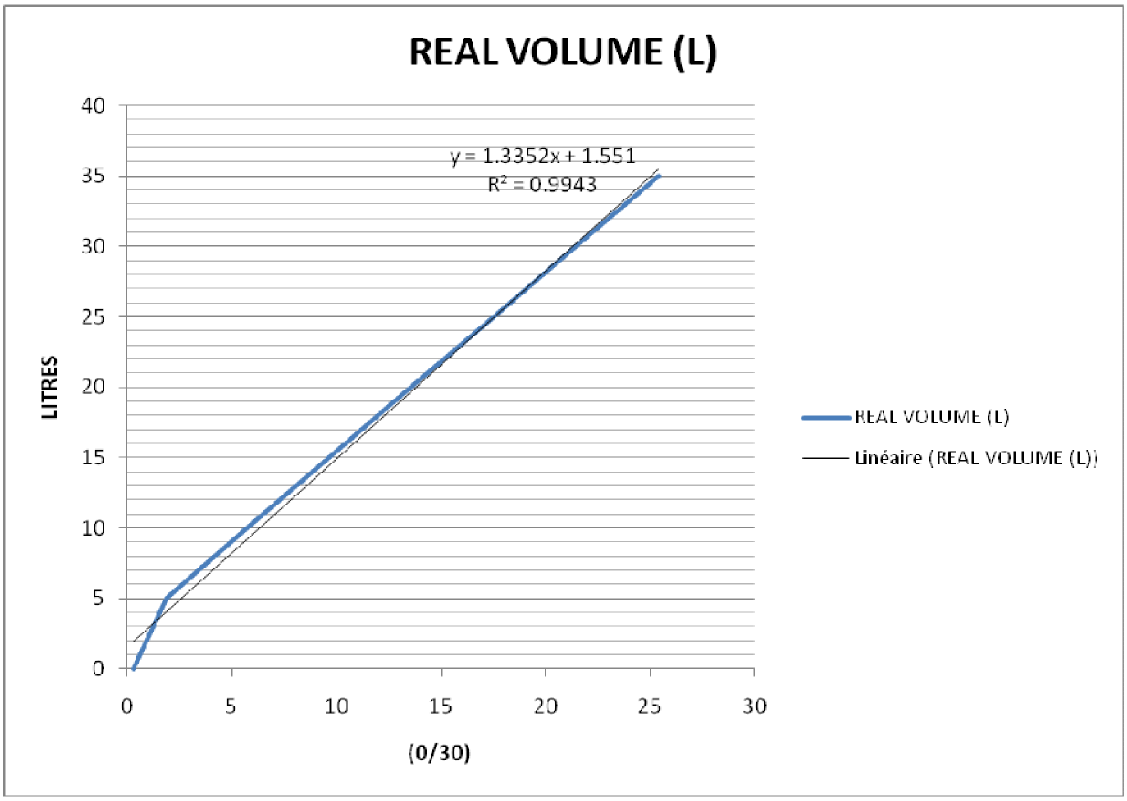
The objective of this control loop is to supervise the Effluent Level. It manages the alarms linked to the Low/LowLow and High/HighHigh levels.
There is no associated button in the HMI as the levels are monitored permanently.

The correlation law implemented thanks to the level test is:

Harvesting tank (0>30)	REAL VOLUME (L)
0.3	0
1.91	5
5.76	10
9.64	15
13.55	20
17.52	25
21.46	30
25.42	35

$y = 1.3352x + 1.551$
$R^2 = 0.9943$

Following the level test, a correlation law is deducted between the measurement (0 / 30) and the real volume.
So the effluent tank level probe range is from 1.551 to 1.551+30 * 1.3352



PLC Section name	Equipment tag	Type	Address	Comment
CL3021_Effluent_Level	LSH_3021_01	DI	100023	Level switch (Vibrating horizontal)
CL3021_Effluent_Level	LSH_3021_02	DI	100024	Level switch (Vibrating horizontal)
CL3021_Effluent_Level	LT_3021_01	AI->REAL	400164	Level transmitter (capacitive)

Figure 72: Effluent Level - EQUIPMENTS

There is no OPERATOR INPUTS for this control loop

2.24.2. Block Diagram

No Block Diagram associated

2.24.3.Alarms and Threshold

Alarm tag Name	Type	Address	Description
LSH_3021_01_A	BOOL	000277	The alarm is triggered after 10s
LSH_3021_02_A	BOOL	000278	The alarm is triggered after 10s
LT_3021_01_AH	BOOL	000248	High level on Effluent tank
LT_3021_01_AHH	BOOL	000214	Very High level on Effluent tank **Stop the Effluent Liquid control loop 3018**
LT_3021_01_AL	BOOL	000215	Low level in Effluent Tank
LT_3021_01_ALL	BOOL	000216	Very Low in Effluent Tank
LT_3021_01_ERR	BOOL	000217	SET if the wire is broken

Figure 73: Effluent Level - ALARMS

Threshold tag name	Type	Address	Value	Unit	ACTION
LT_3021_01_LIM_H	REAL	400686	30	LITRE	Displays an alarm on the HMI
LT_3021_01_LIM_HH	REAL	400688	34	LITRE	**Stop the Effluent Liquid control loop 3018** Displays an alarm on the HMI
LT_3021_01_LIM_L	REAL	400690	6	LITRE	Displays an alarm on the HMI
LT_3021_01_LIM_LL	REAL	400692	3	LITRE	Displays an alarm on the HMI

Figure 74: Effluent Level – THRESHOLD

2.25. Foam Control (CL3022)

No Software Implementation (No Hardware).

Nevertheless, Equipments with their tags, operator inputs, and alarms have been foreseen.

PLC Section name	Equipment tag	Type	Address	Comment
CL3022_Foam_Control	LT_3022_01	AI->REAL	400166	Level transmitter (capacitive)
CL3022_Foam_Control	PP_3022_01_MV	DO	000032	Peristaltic Pump multichannel, variable speed Anti-foam (= future)

Figure 75 : Foam Level Control – EQUIPMENTS (Future)

PLC Section name	Equipment tag	Type	Address	Comment
CL3022_Foam_Control	CL3022_ControlLoop_Mode	INT	400244	Mode Selector (OFF/Manu/Auto)
CL3022_Foam_Control	PP_3022_01_OP	BOOL	000218	Used to start or stop the peristatic pump in manual mode

Figure 76 : Foam Level Control – OPERATOR INPUTS (Future)

Alarm tag Name	Type	Address	Description
LT_3022_01_AH	BOOL	000219	threshold: ?
LT_3022_01_AHH	BOOL	000220	threshold: ?
LT_3022_01_AL	BOOL	000221	threshold: ?
LT_3022_01_ALL	BOOL	000222	threshold: ?
LT_3022_01_ERR	BOOL	000223	SET if the wire is broken

Figure 77: Foam Level Control – ALARMS (Future)

2.26. Sterilization (CL3023)

Three Mobile Temperature sensors are monitored. No strategy or control associated to the sterilization.

PLC Section name	Equipment tag	Type	Address	Comment
CL3023_Sterilisation	TT_3023_01	AI->REAL	400178	Mobile temperature used for sterilisation
CL3023_Sterilisation	TT_3023_02	AI->REAL	400180	Mobile temperature used for sterilisation
CL3023_Sterilisation	TT_3023_03	AI->REAL	400182	Mobile temperature used for sterilisation

Figure 78 : Sterilization – EQUIPMENTS

No Operator input.

Alarm tag Name	Type	Address	Description
TT_3023_01_ERR	BOOL	000225	SET if the wire is broken
TT_3023_02_ERR	BOOL	000226	SET if the wire is broken
TT_3023_03_ERR	BOOL	000227	SET if the wire is broken

Figure 79: Sterilization – ALARMS

Annex A: Predictive Control. PCR description

Predictive Control

This chapter provides information about the general principles of predictive control and general information about PCR.

General Principles of Model Based Predictive Control

Introduction

A Model Based Predictive Controller is a controller that uses a model in real time for the computation of the control action to be applied. The main aspects of this controller are given below.

Model

The model which is embedded in the controller is a mathematical equation that computes a 'model' output which is comparable to the process output PV.
The model represents the relationship linking the process input(s) to the process output.
This model must be identified: the parameters of the model are to be estimated from recorded plant tests.
The model is used to predict the process output and to compute the control action in order to satisfy a given target specified on the PV.

Future Desired Trajectory

At present time (n), the process output is `PV(n)` and the set point value is `SP(n)`. The future desired trajectory (so-called reference trajectory) is the desired behaviour of the process output to move from its present value `PV(n)` to `SP(n)` in the future.

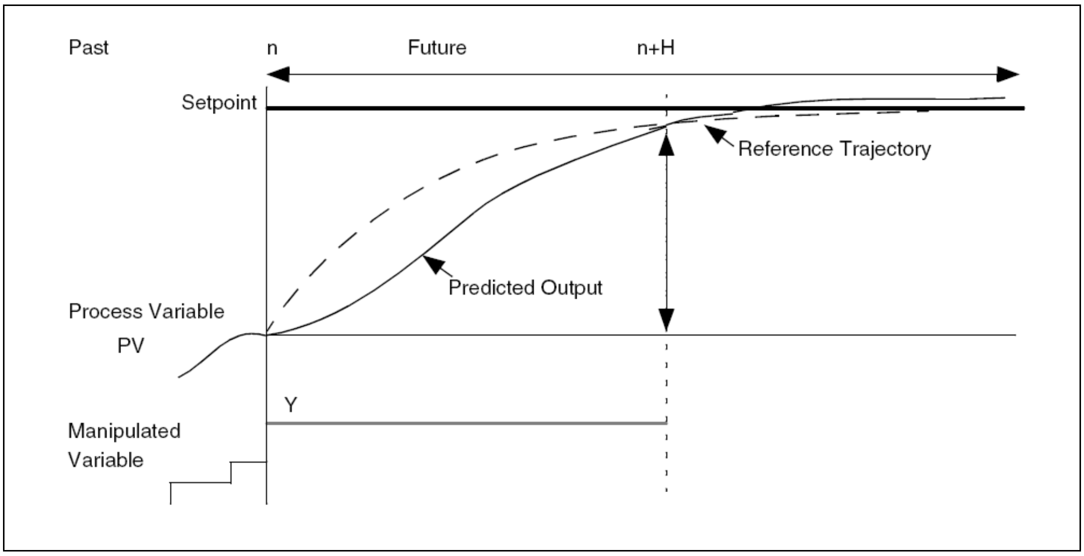


Figure 80: Future desired trajectory

The reference trajectory is computed by a first order system (see above) and the response time of this trajectory is the closed loop response time: the PV will respond to a set point step change with the response time given by the user.
The closed loop response time (TRBF) is a specification which defines the strength or the smoothness of the controller. There is a trade-off between dynamic performance and robustness. The controller is more robust when the specified TRBF is longer.
An intermediate target is selected along that trajectory at a future time (n+H), where H is called the coincidence point. A simple rule for the coincidence point is to set it to the third of the 95% response time: H=TRBF/3.

Solver

The solver is the part of the controller which computes the control action to be applied in such a way the predicted output at time (n+H) is equal to the reference trajectory at the same future instant.
The computed control action takes into account the constraints which limit the input moves (high and low limits and rate of change).

Self Compensation

Some non measured variables may disturb the process.

With unmeasured ramp-type disturbance, a bias between PV and SP may appear. The aim of the self-compensator is to reject this kind of disturbance, and to avoid such a bias.

PCR Description

Introduction

PCR belongs to the Model Based Predictive Control technology and is dedicated to SISO (Single Input Single Output) processes, including feed forwarding facilities.

PCR Design

PCR was initially designed to cope with the control issues met on chemical reactors (batch or continuous). Therefore, that led to some physical modelling of the typical architectures of heat exchanges used on such chemical plants.
The obtained relationships can be represented by non linear first order systems and model based predictive controllers were designed to cope with these targets.
Several complementary functions were developed as complements to these controllers to match the specific requirements of reactor temperature control, such as an efficient SPLIT RANGE module and a smart temperature profile builder linked with a predictive functional controller, which together perform a close tracking of such profiles without overshoots.
Since non linear first order controllers were developed, they can be used profitably on any other kind of SISO process.

Function Blocks

Each PCR module is a programme which is represented as a block with inputs and outputs.
When a control structure is to be integrated, the blocks can be graphically linked (according to the IEC 1131-3 norm) in case of PLCs or DCS boards or embedded into a global programme in case of integration into computers.

Groups

Group	Function Block	Description
Controller	PCR_SF1	simple predictive controller for first order process
	PCR_EF1	enhanced controller for first order process with feed-Forward, cascade with MV constraint transfer, split range, self compensation
	PCR_IF1	controller for integrative first order process
	PCR_EIF1	enhanced controller for integrative first order process with feed-Forward, cascade with MV constraint transfer
	PCR_RD1	ramp & docking set point controller for first order process
	PCR_PAR2	Parabolic set point tracking (for 2nd over-damped order systems)
	PCR_DC3	dedicated Controller for third order process
Generator	PCR_ZTR	zone control with non-linear time response
	PCR_FIL	rate limiter filter
	PCR_RSP	ramp & docking set point generator
Model	PCR_FF1	model for first order feed-forward compensation
	PCR_IFF1	model for feed-forward compensation used with integrative first order system
Supervisor	PCR_SR1	supervisor for two controllers in split range configuration
	PCR_ESR1	enhanced supervisor for 2 controllers in split range configuration with min constraints different from zero

PCR library

Annex B: PCR_SF1 block

Brief Description

Function Description

`PCR_SF1` is an EFB for simple control of first order process with pure time delay.
`PCR_SF1` algorithm is based on predictive control principles:
An internal model of process is used to predict the future behaviour of the system. The model is composed of 3 parameters (see **Erreur ! Source du renvoi introuvable.**):

- KM: static gain
- TM: time constant
- DM: pure time delay

The following constraints on the manipulated variable (Y) can be taken into account:

- YMIN: minimum value for Y
- YMAX: maximum value for Y
- YRATE: maximum variation for Y

Transfer Function

The continuous transfer function of the internal model is:

$$u \rightarrow \boxed{\frac{KM}{1+TM\cdot s}\cdot e^{-DM\cdot s}} \rightarrow y_m$$

Figure 81: 1st order model

Representation

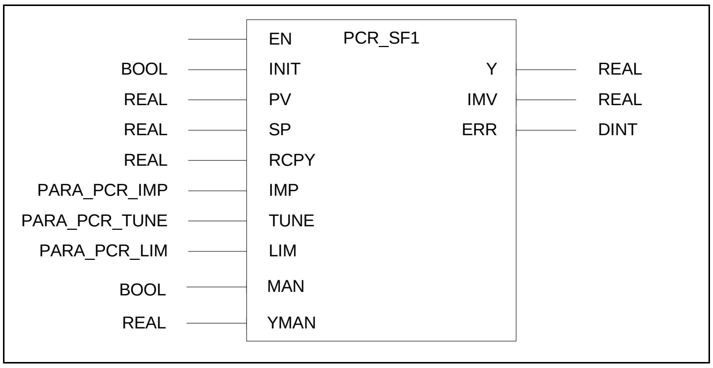


Figure 82: PCR_SF1 block

Parameter Description

Inputs:		
Parameter	**Data Type**	**Meaning**
INIT	BOOL	Command for model INITialization if True
PV	REAL	Process Variable
SP	REAL	Set Point value
RCPY	REAL	ReCoPY of applied Y value
IMP	PARA_PCR_IMP	Internal Model Parameters
TUNE	PARA_PCR_TUNE	Predictive control TUNing parameters
LIM	PARA_PCR_LIM	LIMitations on manipulated variable Y
MAN	BOOL	TRUE = Manual mode
YMAN	REAL	Manual Manipulated Variable

Outputs:		
Parameter	**Data Type**	**Meaning**
Y	REAL	Manipulated variable
IMV	REAL	Internal Model Value: process value estimated by model
ERR	DINT	ERRor code

Type Description

PARA_PCR_IMP: Internal Model Parameters		
Parameter	**Data Type**	**Meaning**
KM	REAL	Static gain
TM	TIME	Time constant
DM	TIME	Pure time delay

PARA_PCR_TUNE: Predictive control TUNing parameters		
Parameter	**Data Type**	**Meaning**
TS	TIME	Sampling time
H	TIME	Coincidence point
TRBF	TIME	95% closed-loop response time

PARA_PCR_LIM: LIMitations on manipulated variable Y		
Parameter	**Data Type**	**Meaning**
YMIN	REAL	MINimum value for Y
YMAX	REAL	MAXimum value for Y
YRATE	REAL	Maximum variation for Y (in unit per second)

Runtime Errors

Value	Meaning	Behaviour
ERR,0: 1	TS = 0	TS is forced to 1
ERR,1: 2	ABS(KM) < 1.0 e-6	KM is forced to +/- 1.0 e-6
ERR,2: 4	DM < 0	DM is forced to 0
ERR,3: 8	DM > 127 * TS	DM is forced to 127 * TS
ERR,4: 16	YRATE < 0	YRATE is forced to 0
ERR,5: 32	YMAX < YMIN	YMIN <-> YMAX and YRATE is forced to 0
ERR,6: 64	TRBF < 0	TRBF is forced to 0
ERR,7: 128	H < TS	H is forced to TS

The runtime error system uses binary type outputs (power of 2). So you can detect several runtime errors occurring at the same time. The output number is the sum of all ERR bits.

Detailed Description

Initialization Mode

The `INIT` flag is used to initialise the current and past states of the internal model. It is needed when the controller inputs (PV, actuator …) are not representative of the process.
For instance: temperature measurement of an empty reactor or opened valve without real action on the process.
Depending on the type of process on which the controller is applied (continuous or batch), the initialisation has to be performed once or at the beginning of each production.
`INIT` has to be done when the process is stabilised, as follows:

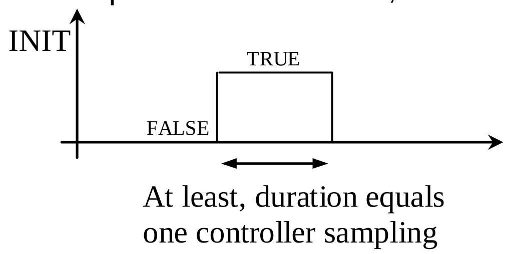


Figure 83: Initialisation

Manual Mode

The manual mode is applied if the input `MAN` is `TRUE`. Then, the output of the control block (`Y`) takes the value of manual manipulated variable `YMAN`.

Annex C: PCR_EF1 block

Brief Description

Function Description

PCR_EF1 is an EFB for enhanced control of first order process with pure time delay.
PCR_EF1 algorithm is based on predictive control principles:
An internal model of process is used to predict the future behaviour of the system. The model is composed of 3 parameters:

- KM: static gain
- TM: time constant
- DM: pure time delay

The following constraints on the manipulated variable (Y) can be taken into account:

- YMIN: minimum value for Y
- YMAX: maximum value for Y
- YRATE: maximum variation for Y

Additional Functions

Compared to PCR_SF1, PCR_EF1 provides the following additional functions:
FEED FORWARD COMPENSATION:

- to take in account a disturbance variable (issued from a disturbance modelling, see PCR_FF1, or from an other controller)

SPLIT RANGE COMPENSATION:

- to optimise the association of controllers, see PCR_SR1

SELF COMPENSATOR:

- to reject unmeasured ramp type disturbances

Representation

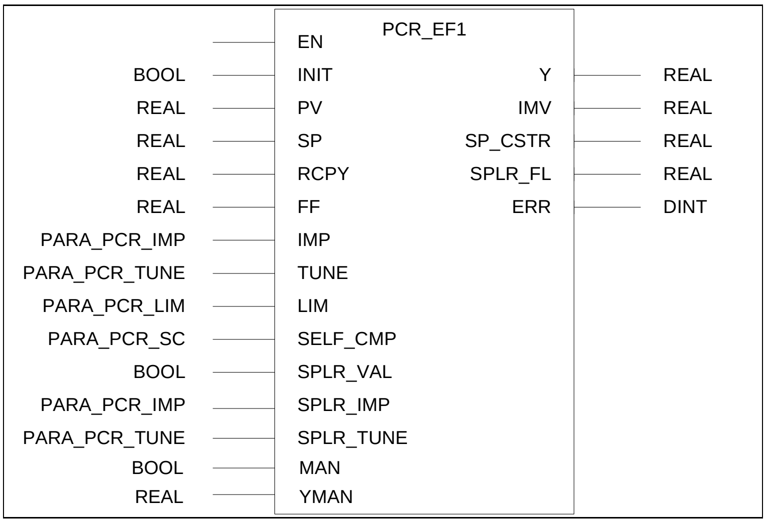


Figure 84: PCR_EF1 block

Parameter Description

Inputs:		
Parameter	**Data Type**	**Meaning**
INIT	BOOL	Command for model INITialization if True
PV	REAL	Process Variable
SP	REAL	Set Point value
RCPY	REAL	ReCoPY of applied Y value
FF	REAL	Feed-forward compensation
IMP	PARA_PCR_IMP	Internal Model Parameters
TUNE	PARA_PCR_TUNE	Predictive control TUNing parameters
LIM	PARA_PCR_LIM	LIMitations on manipulated variable Y
SELF_CMP	PARA_PCR_SC	Self Compensator parameters
SPLR_VAL	BOOL	If True, Split-Range Validation
SPLR_IMP	PARA_PCR_IMP	Internal Model Parameters from associated controller
SPLR_TUNE	PARA_PCR_TUNE	Predictive control TUNing parameters from associated controller
MAN	BOOL	TRUE = Manual mode
YMAN	REAL	Manual Manipulated Variable

Outputs:		
Parameter	**Data Type**	**Meaning**
Y	REAL	Manipulated variable
IMV	REAL	Internal Model Value: process value estimated by model
SP_CSTR	REAL	Set point transferred to upper level
SPLR_FL	REAL	Feed back value for associated controller
ERR	DINT	ERRor code

Type Description

PARA_PCR_IMP: Internal Model Parameters		
Parameter	**Data Type**	**Meaning**
KM	REAL	Static gain
TM	TIME	Time constant
DM	TIME	Pure time delay

PARA_PCR_TUNE: Predictive control TUNing parameters		
Parameter	**Data Type**	**Meaning**
TS	TIME	Sampling time
H	TIME	Coincidence point
TRBF	TIME	95% closed-loop response time

PARA_PCR_LIM: LIMitations on manipulated variable Y		
Parameter	**Data Type**	**Meaning**
YMIN	REAL	MINimum value for Y
YMAX	REAL	MAXimum value for Y
YRATE	REAL	Maximum variation for Y (in unit per second)

PARA_PCR_SC: Self Compensator parameters		
Parameter	**Data Type**	**Meaning**
KSC	REAL	Static gain
TSC	TIME	Time constant

Runtime Errors

Value	Meaning	Behaviour
ERR,0: 1	TS = 0	TS is forced to 1
ERR,1: 2	ABS(KM) < 1.0 e-6	KM is forced to +/- 1.0 e-6
ERR,2: 4	DM < 0	DM is forced to 0
ERR,3: 8	DM > 127 * TS	DM is forced to 127 * TS
ERR,4: 16	YRATE < 0	YRATE is forced to 0
ERR,5: 32	YMAX < YMIN	YMIN <-> YMAX and YRATE is forced to 0
ERR,6: 64	TRBF < 0	TRBF is forced to 0
ERR,7: 128	H < TS	H is forced to TS
Invalid setting in Split Range parameters:		
ERR,8: 256	DM < 0	DM is forced to 0
ERR,9: 512	DM > 127 * TS	DM is forced to 127 * TS
ERR,10: 1024	TRBF < 0	TRBF is forced to 0
ERR,11: 2048	H < TS	H is forced to TS
Invalid setting in Self Compensator parameters:		
ERR,14: 16384	TSC < 0	TSC is forced to 0
ERR,15: 32768	KSC < 0	KSC is forced to 0
ERR,16: 65536	KSC >KSC_MAX	KSC is forced to KSC_MAX (2.0)

The runtime error system uses binary type outputs (power of 2). So you can detect several runtime errors occurring at the same time. The output number is the sum of all ERR bits.

Detailed Description

Cascade Configuration

When a PCR_EF1 controller is used as a SLAVE controller in a cascaded architecture, it receives a set point from the MASTER controller. If the output Y, computed by the SLAVE controller, is constrained, the MASTER Controller **must know** the value of the set point that can be satisfied by the SLAVE controller.
That value is computed by the SLAVE controller (SP_CSTR) and sent back to the master controller.

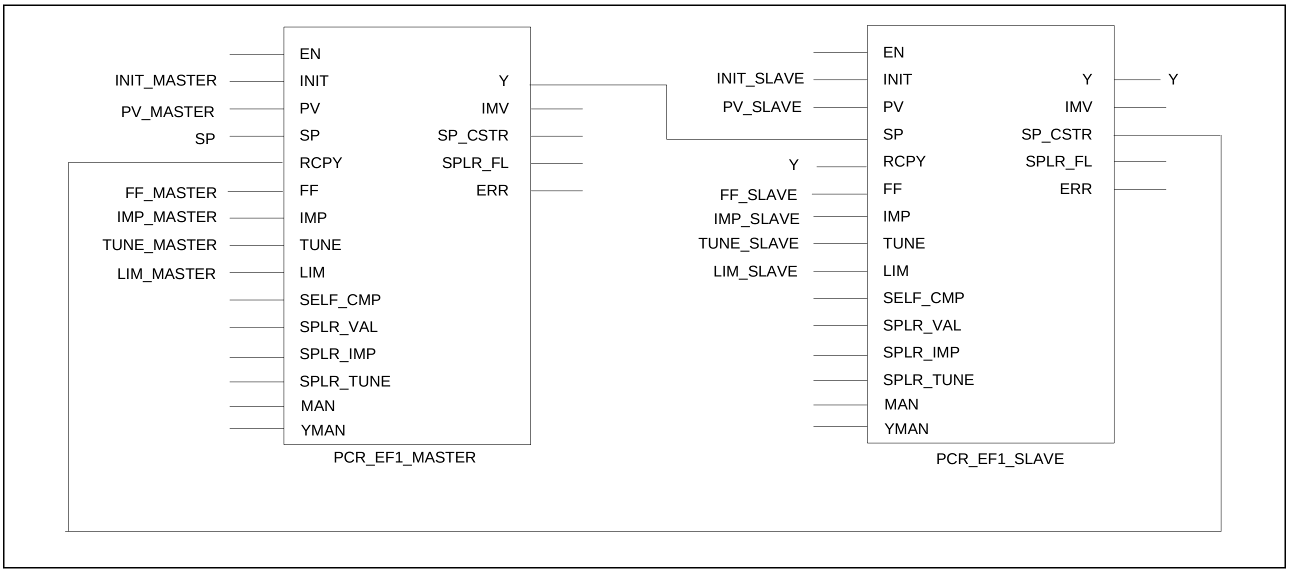


Figure 85: Example of cascade configuration, using PCR_EF1 blocks

Tuning of the Self Compensator Parameters

Some non measured variables may disturb the process. With unmeasured ramp-type disturbance, a bias between `PV` and `SP` may appear. The aim of the self-compensator is to reject this kind of disturbance.
The gain `KSC` and the time constant `TSC` are the parameters of the `PARA_PCR_SC` structure used with the `SELF_CMP` input.
For stability sake, usual values are:
$0 \leq KSC \leq 1$ (KSC=0 means no Self Compensation)
$TSC \geq max(30*TS, 3*TM, TRBF)$

Annex D: PCR_IF1 block

Brief Description

Function Description

PCR_IF1 is an EFB for control of integrative first order process with pure time delay. The algorithm is based on predictive control principles:
An internal model of process is used to predict the future behaviour of the integrative system with delay. The model is composed of 3 parameters (see Figure 86):

- KM: static gain
- TM: time constant
- DM: pure time delay

The integrative part is decomposed. This is tuned by DECOMP input. For stability sake, it is better to set this input at the maximum value among: 30*TS, 3*TM, TRBF
The following constraints on the manipulated variable (Y) can be taken into account:

- YMIN: minimum value for Y
- YMAX: maximum value for Y
- YRATE: maximum variation for Y

Transfer Function

The continuous transfer function of the internal model is:

$$u \longrightarrow \boxed{\frac{KM}{s\cdot(1+TM.s)}\cdot e^{-DM\cdot s}} \longrightarrow y_m$$

Figure 86: integrative 1st order model

Note for initialization

When the process variable PV varies as a ramp before switching on the controller, it is necessary to estimate the slope of this process variable PV in order to initialize correctly the model. This estimation is performed during the initialization phase, as long as INIT equals TRUE. The duration of this phase must be long enough to perform an estimation not biased by the noise. In case of heavy noise, more than ten periods may be required.

Representation

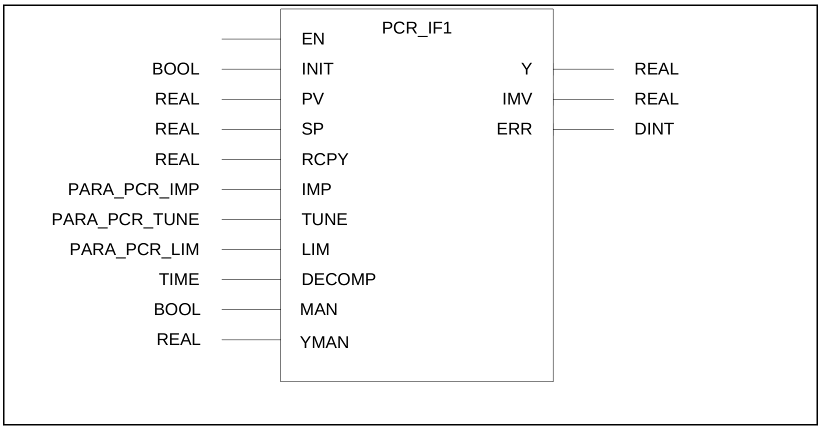


Figure 87: PCR_IF1 block

Parameter Description

Inputs:		
Parameter	**Data Type**	**Meaning**
INIT	BOOL	Command for model INITialization if True
PV	REAL	Process Variable
SP	REAL	Set Point value
RCPY	REAL	ReCoPY of applied Y value
IMP	PARA_PCR_IMP	Internal Model Parameters
TUNE	PARA_PCR_TUNE	Predictive control TUNing parameters
LIM	PARA_PCR_LIM	LIMitations on manipulated variable Y
DECOMP	TIME	Decomposition time constant
MAN	BOOL	TRUE = Manual mode
YMAN	REAL	Manual Manipulated Variable

Outputs:		
Parameter	**Data Type**	**Meaning**
Y	REAL	Manipulated variable
IMV	REAL	Internal Model Value: process value estimated by model
ERR	DINT	ERRor code

Type Description

PARA_PCR_IMP: Internal Model Parameters		
Parameter	**Data Type**	**Meaning**
KM	REAL	Static gain
TM	TIME	Time constant
DM	TIME	Pure time delay

PARA_PCR_TUNE: Predictive control TUNing parameters		
Parameter	**Data Type**	**Meaning**
TS	TIME	Sampling time
H	TIME	Coincidence point
TRBF	TIME	95% closed-loop response time

PARA_PCR_LIM: LIMitations on manipulated variable Y		
Parameter	**Data Type**	**Meaning**
YMIN	REAL	MINimum value for Y
YMAX	REAL	MAXimum value for Y
YRATE	REAL	Maximum variation for Y (in unit per second)

Runtime Errors

Value	Meaning	Behaviour
ERR,0: 1	TS = 0	TS is forced to 1
ERR,1: 2	ABS(KM) < 1.0 e-6	KM is forced to +/- 1.0 e-6
ERR,2: 4	DM < 0	DM is forced to 0
ERR,3: 8	DM > 127 * TS	DM is forced to 127 * TS
ERR,4: 16	YRATE < 0	YRATE is forced to 0
ERR,5: 32	YMAX < YMIN	YMIN <-> YMAX and YRATE is forced to 0
ERR,6: 64	TRBF < 0	TRBF is forced to 0
ERR,7: 128	H < TS	H is forced to TS
ERR,8: 256	DECOMP < 0	Decomposition time constant DECOMP is forced to 0

The runtime error system uses binary type outputs (power of 2). So you can detect several runtime errors occurring at the same time. The output number is the sum of all ERR bits.

Annex E: PCR_ EIF1

Enhanced controller: Integrative First order process with Feed-Forward, constraint transfer, ramp set point (PCR_EIF1)
Brief Description

PCR_EIF1 is an EFB for enhanced control of integrative first order process with pure time delay.
PCR_EIF1 algorithm is based on predictive control principles:

An internal model of process is used to predict the future behaviour of the integrative system with delay. The model is composed of 3 parameters :

- KM : static gain
- TM : time constant
- DM : pure time delay

The integrative part is decomposed. This is tuned by DECOMP input. For stability sake, it is better to set this input at the maximum value between : 30*TS, 3*TM, TRBF

The following constraints on the manipulated variable (Y) can be taken into account :

- YMIN : Minimum value for Y
- YMAX : Maximum value for Y
- YRATE: Maximum variation for Y

Compared to PCR_IF1, PCR_EIF1 provides the following additional functions:

FEED FORWARD COMPENSATION: to take in account a disturbance variable (issued from a disturbance modelling (see PCR_IFF1) or from an other controller)

CONSTRAINTS TRANSFERRING

Follow up of ramp set points

Note for initialization:
When the process variable PV varies as a ramp before switching on the controller, it is necessary to identify the slope of this process variable PV in order to initialize correctly the model. This estimation is performed during the initialization phase, as long as INIT equals TRUE. The duration of this phase must be long enough to perform an estimation not biased by the noise. In case of heavy noise, more than ten periods may be required.

Symbol

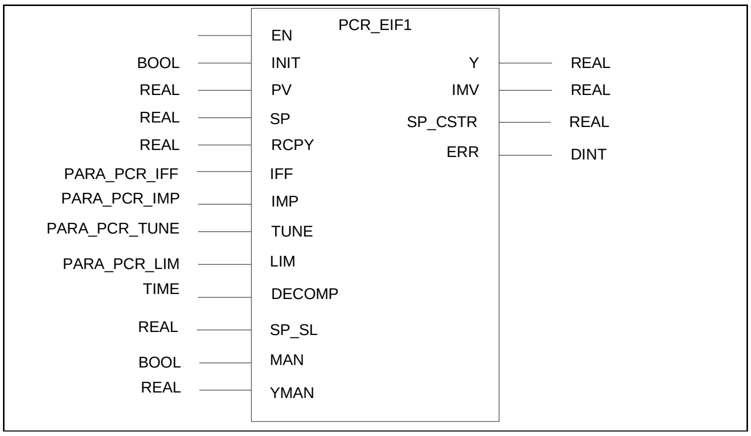


Figure 88: PCR_EIF1 block

Parameters Description

Inputs:		
Parameter	**Type**	**Meaning**
INIT	BOOL	Command for model INITialization if True
PV	REAL	Process Variable
SP	REAL	Set Point value
RCPY	REAL	ReCoPY of applied Y value
IFF	PARA_PCR_IFF	Feed-Forward Compensation
IMP	PARA_PCR_IMP	Internal Model Parameters
TUNE	PARA_PCR_TUNE	Predictive control TUNing parameters
LIM	PARA_PCR_LIM	LIMitations on manipulated variable Y
DECOMP	TIME	Decomposition time constant
SP_SL	REAL	Slope (in unit per second) of the future set point
MAN	BOOL	TRUE = Manual mode
YMAN	REAL	Manual Manipulated Variable

Outputs:		
Parameter	**Type**	**Meaning**
Y	REAL	Manipulated variable
IMV	REAL	Internal Model Value : process value estimated by model

SP_CSTR	REAL	Set point transferred to upper level
ERR	DINT	ERRor code

Type Description

PARA_PCR_IMP : Internal Model Parameters		
Parameter	**Type**	**Meaning**
KM	REAL	Static gain
TM	TIME	Time constant
DM	TIME	Pure time delay

PARA_PCR_TUNE : Predictive control TUNing parameters		
Parameter	**Type**	**Meaning**
TS	TIME	Sampling time
H	TIME	Coincidence point
TRBF	TIME	95% closed-loop response time

PARA_PCR_IFF : Feed-Forward Compensation		
Parameter	**Type**	**Meaning**
IFF1	REAL	Feed-forward compensation for process output estimation
IFF2	REAL	Feed-forward compensation at the coincidence point

PARA_PCR_LIM : LIMitations on manipulated variable Y		
Parameter	**Type**	**Meaning**

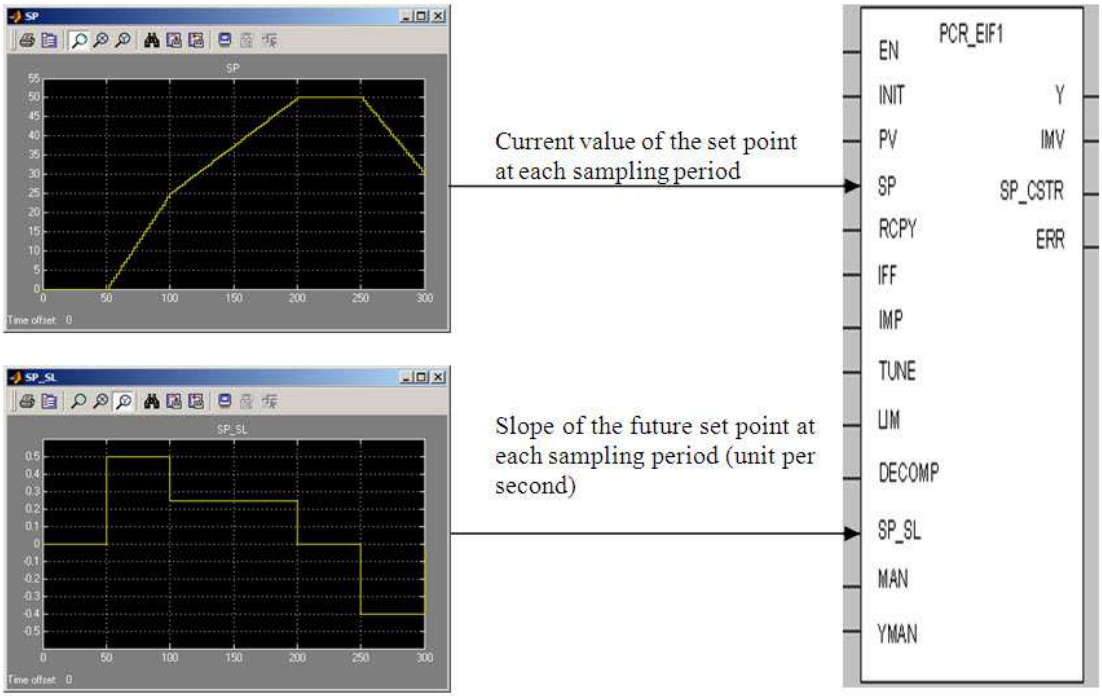
YMIN	REAL	MINimum value for Y
YMAX	REAL	MAXimum value for Y
YRATE	REAL	Maximum variation for Y (in unit per second)

Runtime Errors

Value	**Meaning**	**Behaviour**
ERR,0 : 1	TS = 0	TS is forced to 1
ERR,1 : 2	ABS(KM) < 1.0 e-6	KM is forced to +/- 1.0 e-6
ERR,2 : 4	DM < 0	DM is forced to 0
ERR,3 : 8	DM > 127 * TS	DM is forced to 127 * TS
ERR,4 : 16	YRATE < 0	YRATE is forced to 0
ERR,5 : 32	YMAX < YMIN	YMIN <-> YMAX and YRATE is forced to 0
ERR,6 : 64	TRBF < 0	TRBF is forced to 0
ERR,7 : 128	H < TS	H is forced to TS
ERR,8 : 256	DECOMP < 0	Decomposition time constant DECOMP is forced to 0

The runtime error system uses binary type outputs (power of 2). So you can detect several runtime errors occurring at the same time. The output number is the sum of all ERR bits.

Configuration of EIF1 in case of ramp set point



Annex F: PCR_ZTR block

Brief Description

Function Description

PCR_ZTR is an EFB for changing automatically the Closed-loop Time-Response (TRBF) when the process variable PV is inside or outside a zone.
PCR_ZTR algorithm is based on basic principle:
When the PV is outside the zone, TRBF is set to TRBF_LO. The Controller will put the system back inside the zone.
When the PV is inside the zone, TRBF varies linearly between TRBF_LO and TRBF_HI as a function of the (PV-SP) deviation.

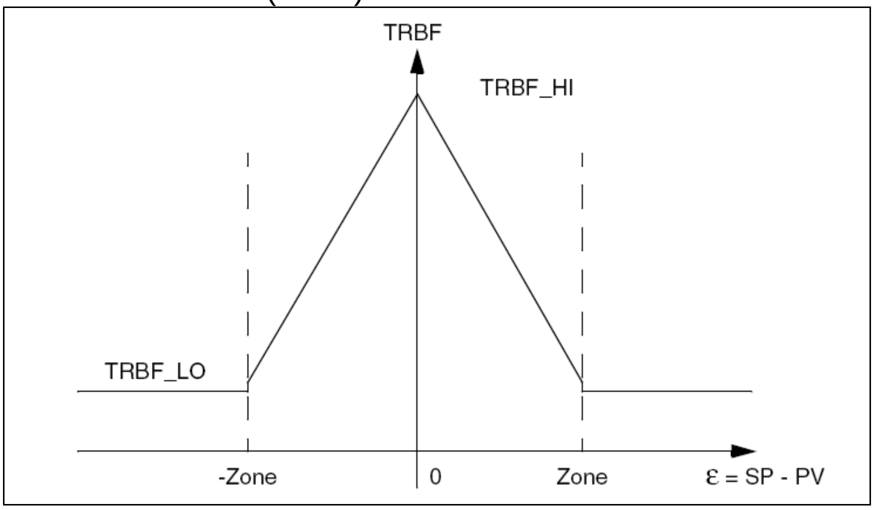


Figure 89: Evolution of TRBF

Representation

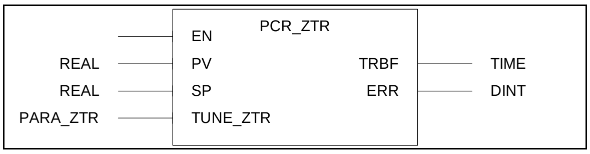


Figure 90: PCR_ZTR block

Parameter Description

Inputs:		
Parameter	**Data Type**	**Meaning**
PV	REAL	Process Variable
SP	REAL	Set Point value
TUNE_ZTR	PARA_ZTR	ZTR Parameters

Outputs:		
Parameter	**Data Type**	**Meaning**
TRBF	TIME	95% closed-loop response time
ERR	DINT	ERRor code

Type Description

PARA_ZTR: ZTR Parameters		
Parameter	**Type**	**Meaning**
ZONE	REAL	Zone value
TRBF_LO	TIME	TRBF Low value
TRBF_HI	TIME	TRBF High value

Runtime Errors

Value	Meaning	Behaviour
ERR,0: 1	TRBF_HI<TRBF_LO	TRBF_HI is set to TRBF_LO
ERR,1: 2	ZONE < 0	ZONE is set to 0

The runtime error system uses binary type outputs (power of 2). So you can detect several runtime errors occurring at the same time. The output number is the sum of all ERR bits.

Detailed Description

Principles

The zone control is a way to obtain a smoother controller when the PV is rather close to its set point in order to avoid active control actions produced by noisy measurements.
The controller is thus less active than when the PV is far from the set point. This technique is not equivalent to a dead zone which does not act as long as the PV is within the dead zone.
The zone control does not leave any constant deviation. It will make the PV move back slowly to the set point value.
When PV is outside the zone, the TRBF is set to TRBF_LO (fastest response)
When PV is inside the zone, TRBF is computed as follows:
TRBF = TRBF_HI – (TRBF_HI – TRBF_LO) x |EPS| / ZONE
with: EPS = SP – PV
This continuous variation of TRBF with EPS avoids bumps when crossing the zone borders and makes the controller strength proportional to the deviation.

Usage

The output TRBF is to be one of the parameters of the PARA_PCR_TUNE of a controller block.

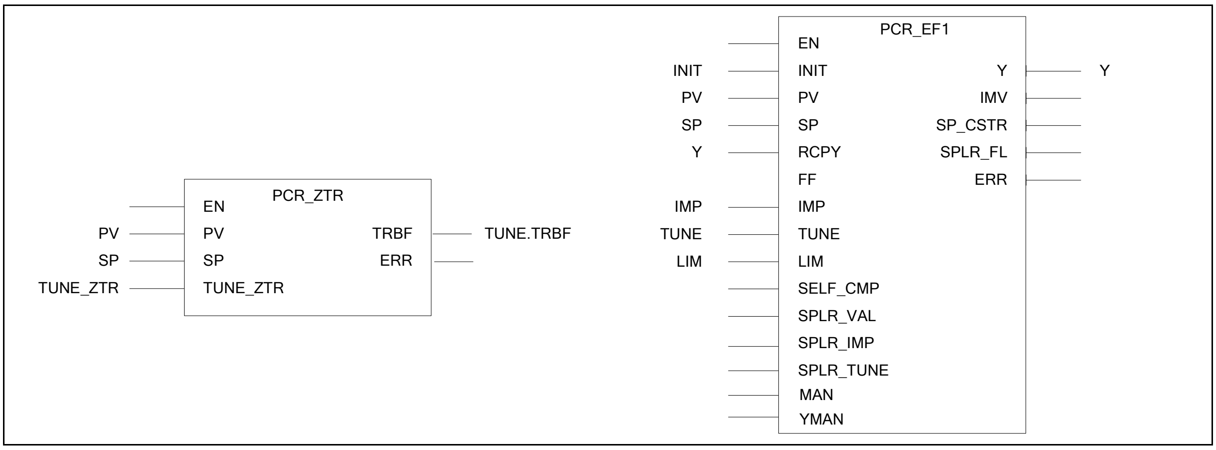


Figure 91: Use of zone control with a PCR_EF1 block

Annex G: PWM Block

Brief description

Block usage

Actuators are driven not only by analog quantities, but also through binary actuating signals. The conversion of analog values into binary output signals is achieved for example, through pulse width modulation (PWM) or pulse duration modulation (PDM).In this context, the preset mean energy level of the actuator is to correspond to the analog input value (X) of the block.

Function description

The function block PWM serves to convert analog values into digital output signals for Concept. In pulse width modulation (PWM), a 1-signal is emitted, at a constant clock rate, for a duration that is a function of the analog value. The adjusted average energy corresponds to the quotient of the fixed duty cycle T_on and the variable cycle period. In order that the adjusted average energy also corresponds to the analog input variable X, the following must apply:

$T\_on \sim X$

EN and ENO can be projected as additional parameter

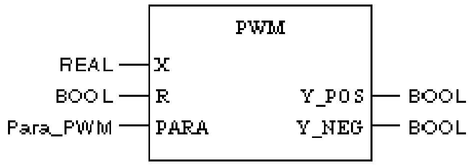
Display

General information about the actuator drive

In general, the binary actuator drive is performed by two binary signals Y_POS and Y_NEG. On a motor the output Y_POS corresponds to the signal "clockwise rotation" and the output Y_NEG the signal "counter-clockwise rotation". For an oven the outputs Y_POS and Y_NEG could be interpreted as corresponding to "heating" and "cooling". Should the actuating drive in question be a motor, it is possible that to avoid over travel for non-self-locking gearboxes, a brake pulse must be output after the engage signal. In order to protect the power electronics, there must be a pause time after switching on T_on and before the brake impulse t_brake so as to avoid short circuits.

Symbol

Block display



PWM parameter description

Block parameter description

Parameter	Data type	Meaning
X	REAL	Input variable
R	BOOL	Reset mode ("1" = Reset)
PARA	Para_PWM	Parameter
Y_POS	BOOL	Positive X value output
Y_NEG	BOOL	Negative X value output

Parameter description Para_PWM

Data structure description

Element	Data type	Meaning
t_period	TIME	Length of period
t_pause	TIME	Pause time
t_brake	TIME	Braking time
t_min	TIME	Minimum actuating pulse time (in sec)
t_max	TIME	Maximum actuating pulse time (in sec)
up_pos	REAL	Upper limiting value for positive X values
up_neg	REAL	Upper limiting value for negative X values

Formulas

The pulse length for Y_POS and Y_NEG

The pulse length T_on for output Y_pos amd Y_neg is determined by the following equations:

Output	Formula	Condition
Y_POS	$T\_on = t\_period \times \frac{X}{up\_pos}$	$0 \leq X \leq up\_pos$
Y_NEG	$T\_on = t\_period \times \frac{\lvert X \rvert}{up\_neg}$	$up\_neg \leq -X \leq 0$

Parametering rule

For correct operation the following rules should be observed:

- $(2 \times t\_pause + t\_brake + t\_max) \leq t\_period$
- From the parameters up_pos and up_neg only the value is evaluated.

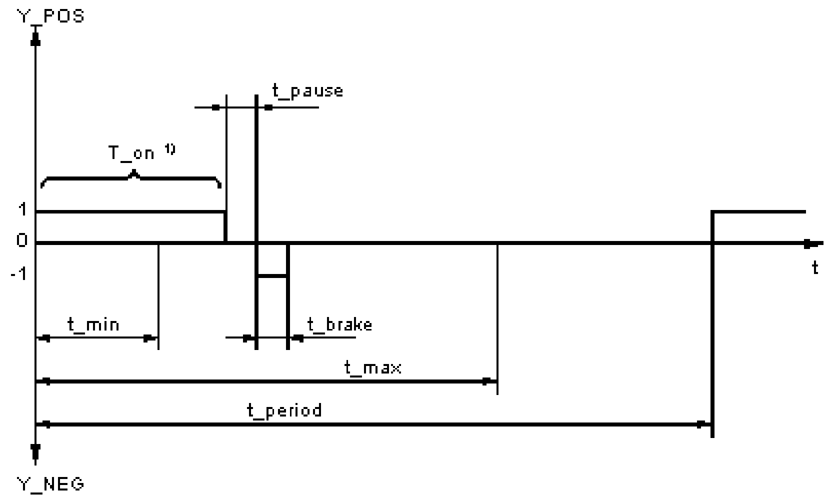
Detailed description

Block mode of operation

The period determines the time, in which the actuating pulses ("1" signal on output Y_POS resp. Y_NEG) are regularly output, i.e. in a constant time-slot pattern. The parameter t_min specifies the minimum pulse length, i.e. the shortest time span for which the output Y_POS and/or Y_NEG should carry "1" signal. If the length of impulse calculated according to the equation in the section "Formulas" is shorter than t_min, then there will be no impulse throughout the whole period. The parameter t_max specifies the minimum pulse length, i.e. the shortest time span in which the output Y_POS resp. Y_NEG should carry "1" signal. Pulse output length is then limited to t_max, should the pulse duration calculated by the above stated formula be greater. It is advisable to perform a freely definable pause time of t_pause = 10 or 20 ms between the actuating and brake pulses to protect the power electronics (hopefully preventing simultaneous firing of the anti parallel connected thyristors).Parameter t_pause specifies the time interval that should be waited after the "1" signal on output Y_POS (Y_NEG), before the opposite output Y_NEG (Y_POS) goes to "1" signal for time span t_brake. The action in question here is a brake pulse, which should take place after the pause time. A pause time of t_pause = 20 ms (t_pause =0.02) corresponds to an interruption of the firing angle control for two half waves. That should guarantee a sufficiently large safety margin for the prevention of short-circuits resp. triggering of the suppressor circuitry as a consequence of antiparallel thyristors firing.

Time ratios display

An overview of the ratios between times is shown in the following diagram:



1 Variable turn-on time. The parameter up_pos mark those positive values of input variable X, for which output Y_POS would continuously carry "1", assuming:

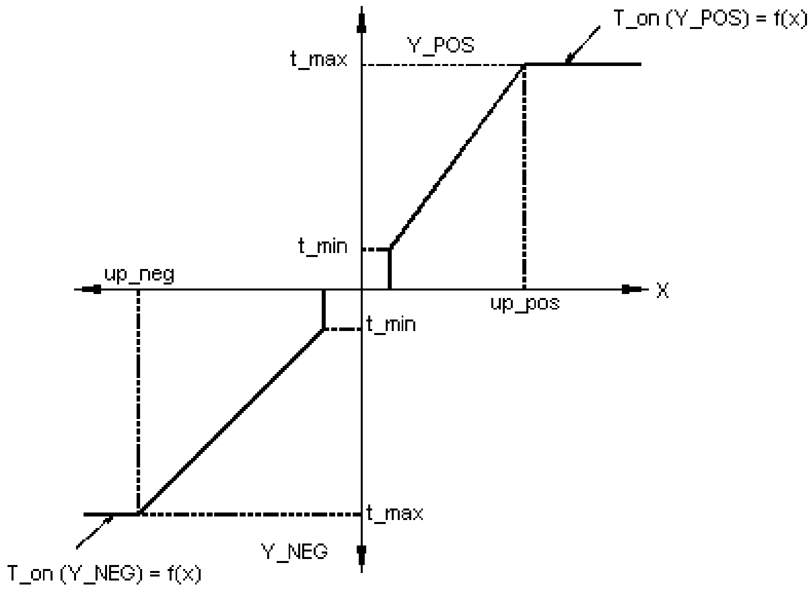
t_pause = t_brake = 0 and t_max = t_period.

The parameter up_neg mark those positive values of input variable X, for which output Y_NEG would continuously carry "1", assuming:

t_pause = t_brake = 0 and t_max = t_period.

Time-span dependency

The dependency of the time duration in which the output Y_POS (Y_NEG) carries a 1-signal, on the input variable X is illustrated in the following diagram (again the figure has put t_pause = t_brake = 0)



Operating mode

In reset mode R = "1", outputs Y_POS and Y_NEG are set to "0" signal. The internal time meters are also standardized, so that the function block begins the transfer to R=0 with the output of a new 1 signal on the associated output.

Boundary conditions

If the PWM block is operated together with a PID controller, then the period t_period should be so selected, that it corresponds to the PID controller's scan time. It is then guaranteed that every new actuating signal from the PID controller within the period time can be fully processed. The PDM scan time should be in proportion with the period vs. pulse time. Though this the smallest possible actuating pulse will be specified. The following ratio is recommended:

t_period/scan time (PWM) >= 10

Example for the PWM block

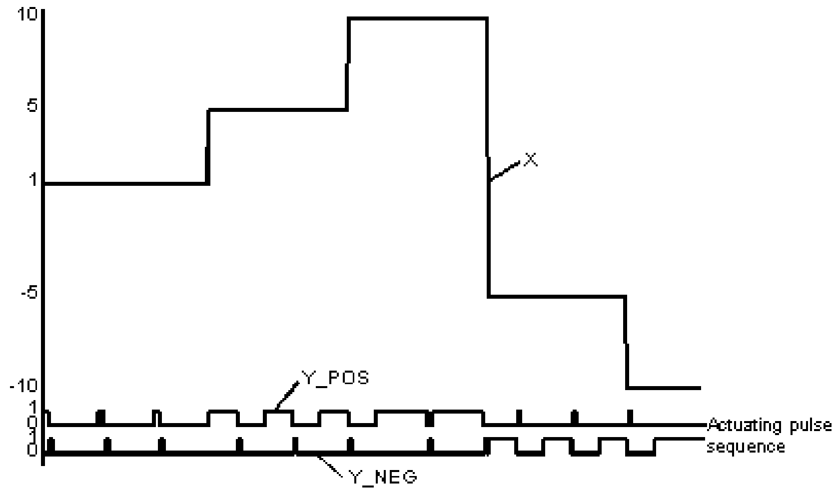
Overview
In the examples, the signal sequences on the outputs Y_POS and Y_NEG are shown for various X input signal values. The examples differ with respect to their selected parameter assignments. The following examples on the PMW function block are to be found in this section
Step Response 1
Step Response 2

Step Response 1

The following parameter specifications apply to the step response 1 display:

Parameter	Settings
t_period	4 s
t_min	0,2 s
t_max	3,8 s
t_pause	0.1 s
t_brake	0.2 s
up_pos	10
up_neg	10

Step Response 1 timing diagram



X analog signal

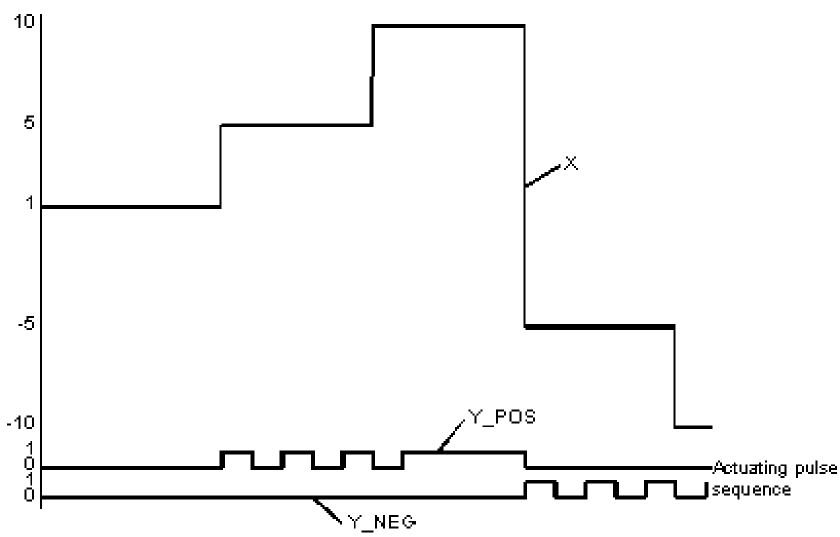
It is easily seen that the time span in which output Y_POS carries "1" signal is directly proportional to input signal X. In addition, it can be seen that a short Y_NEG-signal follows every Y_POS signal, and vice versa. This can be attributed to the non-"0" t_brake parameter. Y_NEG output time span is directly proportional to negative X input signal values. A short Y_POS pulse as brake pulse also follows the Y_NEG pulse here as well.

Step Response 2

The following parameter specifications apply to the step response 2 display:

Parameter	**Settings**
t_period	4 s
t_min	0.5 s
t_max	4 s
t_pause	0 s
t_brake	0 s
up_pos	10
up_neg	10

Step Response 2 timing diagram



X analog signal

The difference to the example "step response 1" is, that here the pause and brake pulses are dropped, as here the appropriate parameters were configured to "0". It is noticeable that pulses are no longer output for very small X input signals. This is directly attributable to the effect of time t_min. Moreover a continuous pulse is output for large X input signals (X = up_pos or up_neg). This is related to having selected t_max = t

Annex H: Control Requirements

Hereafter are the requirements from an automatic point of view.

Control Loop number	Description	Objective	Performances
3000	Influent General.	No Control	
3001	Influent Temperature Control.	Temperature Control	Temperature <= 4℃ +/- 0.5
3002	Influent Level Control	No Control	
3003	Inlet Liquid Control	Flow Set Point	Flow SP = 0.6 L/h +/- x %
3004	Bioreactor General		Accuracy linked to Pressure accuracy
3005	Bioreactor Temperature Control	Control temperature	T = 28 ℃ +/- Time Response TBD
3006	Bioreactor Level Control	Control Level in the Bioreactor (with CL3018)	Level = 8 L +/- Time Response TBD
3007	Bioreactor Pressure Control	Control Pressure into the Bioreactor (with CL 3011)	P < 80 mbar +/- 1 mbar Time Response TBD
3008	Bioreactor pH Control	Level controlled with Outlet Liquid	pH = 8.0 +/- 0.1 Time Response TBD
3009	Bioreactor DO2	DO2 Control with O2 mass flow	DO2 SP = 80% +/- ?
3010	Bioreactor EC Control	No Control	
3011	Gas Loop	See Pressure Control	
3012	Gas Temperature	No Control	
3013	Gas Analyser	No Control	
3014	Biomass Control	No Control	
3015	Backwashing	No Control	
3016	Gas Pulse	No Control	
3017	Liquid Recirculation	Flow Set Point	Flow SP = 3.6 L/h +/- x %
3018	Outlet liquid Control	Flow Set Point	Flow SP = 0.6 L/h +/- x %
3019	Effluent General	No Control	
3020	Effluent Temperature	Temperature Control	Temperature <= 4℃ +/- 0.5
3021	Effluent Level	No Control	
3022	Foam Control	N/A	
3023	Sterilization	No Control	

N/A : Non Available

Annex I: PLC Card configuration

P L C - C o n f i g u r a t i o n

PLC Selection

PLC Type	140 CPU 434 12
Exec Id	883
Memory Size	64 K logic
Extended Memory	96K
IEC Runtime	Enabled
IEC Usable Memory Size	892

PLC Memory Partition

Coils	(0x)	1536	000001-001536
Discrete Inputs	(1x)	512	100001-100512
Input registers	(3x)	512	300001-300512
Holding registers	(4x)	1872	400001-401872

ASCII Setup

Total Message	0
Message area size	0
ASCII Ports	0

Configuration Extensions

Data Protection	No
Peer Cop	No
Hot Standby	No
Ethernet	1
Profibus DP	No

Specials

Battery Coil	No
Timer Register	No
Time Of Day	400400 - 400407
Duplicate coils	No
First Coil Address	-
Watchdog Timeout [ms*10]	30
Online Editing Timeslice [ms]	20

Ethernet Parameters								
Slot	Module Name	IP Cfg	Internet Addr	Subnet Mask	Gateway Addr	Frame Type	Health Block	Diag Block
1-3	140-NOE-771-01	Specify	172.016.000.137	255.255.255.000	000.000.000.000	Ethernet II		

Modbus Port Settings (Bridge Mode: No)									
Port	Baudrate	Data bits	Stop bits	Parity	Delay (ms)	Address	Head Slot	Mode	Protocol
1	9600	8	1	even	10	1	0	RTU	RS232
2	9600	8	1	even	10	1	0	RTU	RS232
3	9600	8	1	even	10	1	0	RTU	RS232

I / O Map

Remote (Head slot 0)							
Drop	Type	Modules	Holdup (ms)	Input-Bits	Output-Bits	Status Reg.	Activate
1	Quantum I/O	15	300	752	304		-

Local Drop						
Drop Type: Quantum I/O				Drop 1		
Slot	Module name	Input Range	Output Range	Module description	In/Out-Type	Timeout-State
1-1	CPS-114-x0			AC PS 115V/230 8A, CPS114-10 summab>		
1-2	CPU-434-12			CPU 2MB 1xMB+ 2xModbus		
1-3	NOE-771-01			ENET 10/100 TCP/IP I/O Scanner		
1-4	ACI-040-00	300001-300017		Analog Input 16 Ch Current		
1-5	AVO-020-00		400001-400004	Analog Output 4 Ch Volt		
1-6	ACO-020-00		400005-400008	Analog Output 4 Ch Current		
1-7	ACO-130-00		400009-400016	Analog Output 8 Ch Current		
2-1	CPS-114-x0			AC PS 115V/230 8A, CPS114-10 summab>		
2-2	DDI-841-00	100001-100016		DC Input 10-60V 8x2	BIN	
2-3	DDI-353-00	100017-100048		DC Input 24V 4x8	BIN	
2-4	DDO-843-00		000001-000016	DC Output 10-60V 2x8	BIN	0000
2-5	DDO-353-00		000017-000048	DC Output 24V 4x8	BIN	0000 0000
2-6	ACI-030-00	300018-300026		Analog Input 8 Ch unipolar		
2-8	AVI-030-00	300036-300044		Analog Input 8 Ch bipolar		
2-9	AVI-030-00	300045-300053		Analog Input 8 Ch bipolar		

Parameter ACI-040-00 (Slot 1-4)

Channel	Range	Channel	Range
1	4..20mA, 0-16000	9	4..20mA, 0-16000
2	4..20mA, 0-16000	10	4..20mA, 0-16000
3	4..20mA, 0-16000	11	4..20mA, 0-16000
4	4..20mA, 0-16000	12	4..20mA, 0-16000
5	4..20mA, 0-16000	13	4..20mA, 0-16000
6	4..20mA, 0-16000	14	4..20mA, 0-16000
7	4..20mA, 0-16000	15	4..20mA, 0-16000
8	4..20mA, 0-16000	16	4..20mA, 0-16000

Parameter AVO-020-00 (Slot 1-5)

Channel	Input-/Output-Type	Timeout Value
1	Last Value	
2	Last Value	
3	Last Value	
4	Last Value	

Parameter ACO-020-00 (Slot 1-6)

Channel	Input-/Output-Type	Timeout Value
1	Last Value	
2	Last Value	
3	Last Value	
4	Last Value	

Parameter ACO-130-00 (Slot 1-7)

Channel:	Range Selection:	Timeout State:	User Defined Timeout Value:
1	4..20mA, 0-16000	Last Value	0
2	4..20mA, 0-16000	Last Value	0
3	4..20mA, 0-16000	Last Value	0
4	4..20mA, 0-16000	Last Value	0
5	4..20mA, 0-16000	Last Value	0
6	4..20mA, 0-16000	Last Value	0
7	4..20mA, 0-16000	Last Value	0
8	4..20mA, 0-16000	Last Value	0

Parameter AVI-030-00 (Slot 2-8)

Data Format: 16-Bit Format

Channel	Range	Channel	Range
1	0V To +5V	5	4mA To +20mA
2	0V To +5V	6	4mA To +20mA
3	0V To +5V	7	-10V To +10V
4	0V To +10V	8	-10V To +10V

Parameter AVI-030-00 (Slot 2-9)

Data Format: 16-Bit Format

Channel	Range	Channel	Range
1	4mA To +20mA	5	4mA To +20mA
2	4mA To +20mA	6	4mA To +20mA
3	4mA To +20mA	7	-10V To +10V
4	4mA To +20mA	8	-10V To +10V

Project Number:

Creation Date: 03/06/2009 22:26:43

Modification Date: 19/10/2010 18:31:37

Language :

X	SFC
X	FBD
X	LD
X	ST
X	IL
X	LL984
X	DFBs

STATUS:

X	DRAFT
	IN REVIEW
	RELEASED
	IN CHANGE
	INVALID

Description:

Comments:

Author(s): Concept Development Team

Approved:

History of Modification:

Rev.	Date	Author	Description of Modifications
2.0	22.07.96	Concept Team	all

Project properties

```
Database version    : 19/10/2010 18:31:37
PLC related version : 19/10/2010 18:31:37
Global DFB Path     : D:\MELISSA\PLC_CIII\V00_10~1\GLB\
Secure Application  : No
```

Project structure

```
Project : CIII

    Group:Data
        FBD:SYSTEM_STATE
        FBD:ERR_AI
        FBD:output
        FBD:Input


    Group:Control_Loops
        FBD:ALARM_STATUS
        FBD:System_clock
        FBD:CL3000_Influent_General
        FBD:CL3001_Influent_Temp_Control
        FBD:CL3002_Influent_Level_Control
        FBD:CL3003_Inlet_Liquid_Control
        FBD:CL3004_Bioreactor_General
        FBD:CL3005_Bioreactor_Temp_Control
        FBD:CL3006_Bioreactor_Level_Control
        FBD:CL3007_Bioreactor_Pressu_Control
        FBD:CL3008_Bioreactor_pH_Control
        FBD:CL3009_Bioreactor_DO2_Control
        FBD:CL3010_Bioreactor_EC_Control
        FBD:CL3011_Gas_Loop
        FBD:CL3012_Gas_Temperature

        Group:CL3013_Liquid_Analysis
            FBD:CL3013_SFC_CONTROL_PROCEDURE
            FBD:CL3013_NH4_Management
            SFC:CL3013_NH4
            SFC:CL3013_NH4_Stop
            SFC:CL3013_NH4_Calib
            FBD:CL3013_NO3_Management
            SFC:CL3013_NO3
            SFC:CL3013_NO3_Calib
            SFC:CL3013_NO3_Stop
            FBD:CL3013_NO2_Management
            SFC:CL3013_NO2
            SFC:CL3013_NO2_Stop

        FBD:CL3014_Biomass_Control
        FBD:CL3015_Backwashing
        FBD:CL3016_Gas_Pulse
        FBD:CL3017_Liquid_Recirculation
        FBD:CL3018_Outlet_liquid_Control
        FBD:CL3020_Effluent_Temperature
        FBD:CL3021_Effluent_Level
        FBD:CL3022_Foam_Control
```

P L C - C o n f i g u r a t i o n

PLC Selection

PLC Type	140 CPU 434 12
Exec Id	883
Memory Size	64 K logic
Extended Memory	96K
IEC Runtime	Enabled
IEC Usable Memory Size	892

PLC Memory Partition

Coils	(0x)	1536	000001-001536
Discrete Inputs	(1x)	512	100001-100512
Input registers	(3x)	512	300001-300512
Holding registers	(4x)	1872	400001-401872

ASCII Setup

Total Message	0
Message area size	0
ASCII Ports	0

Configuration Extensions

Data Protection	No
Peer Cop	No
Hot Standby	No
Ethernet	1
Profibus DP	No

Specials

Battery Coil	No
Timer Register	No
Time Of Day	400400 - 400407
Duplicate coils	No
First Coil Address	-
Watchdog Timeout [ms*10]	30
Online Editing Timeslice [ms]	20

Segment Scheduler

Schedule	Type of Solve	Reference	Sense	Segment	Drop Input	Drop Output
1	Continuous			1	1	1
2	End of Logic			2		
3	End of Logic			3		
4	End of Logic			4		
5	End of Logic			5		
6	End of Logic			6		
7	End of Logic			7		
8	End of Logic			8		
9	End of Logic			9		
10	End of Logic			10		
11	End of Logic			11		
12	End of Logic			12		
13	End of Logic			13		
14	End of Logic			14		
15	End of Logic			15		
16	End of Logic			16		
17	End of Logic			17		
18	End of Logic			18		
19	End of Logic			19		
20	End of Logic			20		
21	End of Logic			21		
22	End of Logic			22		
23	End of Logic			23		
24	End of Logic			24		
25	End of Logic			25		
26	End of Logic			26		
27	End of Logic			27		
28	End of Logic			28		
29	End of Logic			29		
30	End of Logic			30		
31	End of Logic			31		
32	End of Logic			32		

Ethernet Parameters

Slot	Module Name	IP Cfg	Internet Addr	Subnet Mask	Gateway Addr	Frame Type	Health Block	Diag Block
1-3	140-NOE-771-01	Specify	172.016.000.137	255.255.255.000	000.000.000.000	Ethernet II		

Modbus Port Settings (Bridge Mode: No)

Port	Baudrate	Data bits	Stop bits	Parity	Delay (ms)	Address	Head Slot	Mode	Protocol
1	9600	8	1	even	10	1	0	RTU	RS232
2	9600	8	1	even	10	1	0	RTU	RS232
3	9600	8	1	even	10	1	0	RTU	RS232

I / O Map

Remote (Head slot 0)

Drop	Type	Modules	Holdup [ms]	Input-Bits	Output-Bits	Status Reg.	Activate
1	Quantum I/O	15	300	752	304		-

Local Drop

Drop Type: Quantum I/O   Drop 1

Slot	Module name	Input Range	Output Range	Module description	In/Out-Type	Timeout-State
1-1	CPS-114-x0			AC PS 115V/230 8A, CPS114-10 summab>		
1-2	CPU-434-12			CPU 2MB 1xMB+ 2xModbus		
1-3	NOE-771-01			ENET 10/100 TCP/IP I/O Scanner		
1-4	ACI-040-00	300001-300017		Analog Input 16 Ch Current		
1-5	AVO-020-00		400001-400004	Analog Output 4 Ch Volt		
1-6	ACO-020-00		400005-400008	Analog Output 4 Ch Current		
1-7	ACO-130-00		400009-400016	Analog Output 8 Ch Current		
2-1	CPS-114-x0			AC PS 115V/230 8A, CPS114-10 summab>		
2-2	DDI-841-00	100001-100016		DC Input 10-60V 8x2	BIN	
2-3	DDI-353-00	100017-100048		DC Input 24V 4x8	BIN	
2-4	DDO-843-00		000001-000016	DC Output 10-60V 2x8	BIN	0000
2-5	DDO-353-00		000017-000048	DC Output 24V 4x8	BIN	0000 0000
2-6	ACI-030-00	300018-300026		Analog Input 8 Ch unipolar		
2-8	AVI-030-00	300036-300044		Analog Input 8 Ch bipolar		
2-9	AVI-030-00	300045-300053		Analog Input 8 Ch bipolar		

Parameter ACI-040-00 (Slot 1-4)

Channel	Range	Channel	Range
1	4..20mA, 0-16000	9	4..20mA, 0-16000
2	4..20mA, 0-16000	10	4..20mA, 0-16000
3	4..20mA, 0-16000	11	4..20mA, 0-16000
4	4..20mA, 0-16000	12	4..20mA, 0-16000
5	4..20mA, 0-16000	13	4..20mA, 0-16000
6	4..20mA, 0-16000	14	4..20mA, 0-16000
7	4..20mA, 0-16000	15	4..20mA, 0-16000
8	4..20mA, 0-16000	16	4..20mA, 0-16000

Parameter AVO-020-00 (Slot 1-5)

Channel	Input-/Output-Type	Timeout Value
1	Last Value	
2	Last Value	
3	Last Value	
4	Last Value	

Parameter ACO-020-00 (Slot 1-6)

Channel	Input-/Output-Type	Timeout Value
1	Last Value	
2	Last Value	
3	Last Value	
4	Last Value	

Parameter ACO-130-00 (Slot 1-7)

Channel:	Range Selection:	Timeout State:	User Defined Timeout Value:
1	4..20mA, 0-16000	Last Value	0
2	4..20mA, 0-16000	Last Value	0
3	4..20mA, 0-16000	Last Value	0
4	4..20mA, 0-16000	Last Value	0
5	4..20mA, 0-16000	Last Value	0
6	4..20mA, 0-16000	Last Value	0
7	4..20mA, 0-16000	Last Value	0
8	4..20mA, 0-16000	Last Value	0

Parameter AVI-030-00 (Slot 2-8)

Data Format: 16-Bit Format

Channel	Range	Channel	Range
1	0V To +5V	5	4mA To +20mA
2	0V To +5V	6	4mA To +20mA
3	0V To +5V	7	-10V To +10V
4	0V To +10V	8	-10V To +10V

Parameter AVI-030-00 (Slot 2-9)

Data Format: 16-Bit Format

Channel	Range	Channel	Range
1	4mA To +20mA	5	4mA To +20mA
2	4mA To +20mA	6	4mA To +20mA
3	4mA To +20mA	7	-10V To +10V
4	4mA To +20mA	8	-10V To +10V

Variable list (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Type	DType	Address	Initial value	Comment	Used
ALARM_STATUS	IVAR	SECT_CTRL				0
AT_3008_01	VAR	REAL	400108		pH element + transmitter	5
AT_3008_01_ERR	VAR	BOOL	000113		SET if the wire is broken	6
AT_3008_01_Raw	VAR	REAL	400828			1
AT_3008_02	VAR	REAL	400112		pH element + transmitter	5
AT_3008_02_ERR	VAR	BOOL	000115		SET if the wire is broken	6
AT_3008_02_Raw	VAR	REAL	400830			1
AT_3009_01	VAR	REAL	400122		Dissolved O2 transmitter (BOTTOM)	9
AT_3009_01_AH	VAR	BOOL	000120		High percentage of Disolve Oxygen. Compare to the set point	2
AT_3009_01_AHH	VAR	BOOL	000121		Very High percentage of Disolve Oxygen. Compare to the set point	2
AT_3009_01_AL	VAR	BOOL	000122		Low percentage of Disolve Oxygen. Compare to the set point	2
AT_3009_01_ALL	VAR	BOOL	000123		Very Low percentage of Disolve Oxygen. Compare to the set point	2
AT_3009_01_ERR	VAR	BOOL	000124		SET if the wire is broken	6
AT_3009_02	VAR	REAL	400124		Dissolved O2 transmitter (TOP)	9
AT_3009_02_AH	VAR	BOOL	000125		High percentage of Disolve Oxygen. Compare to the set point	2
AT_3009_02_AHH	VAR	BOOL	000126		Very High percentage of Disolve Oxygen. Compare to the set point	2
AT_3009_02_AL	VAR	BOOL	000127		Low percentage of Disolve Oxygen. Compare to the set point	2
AT_3009_02_ALL	VAR	BOOL	000128		Very Low percentage of Disolve Oxygen. Compare to the set point	2
AT_3009_02_ERR	VAR	BOOL	000129		SET if the wire is broken	6
AT_3009_LIM_H	VAR	REAL	400598	10.0	High percentage of Disolve Oxygen. Compared to the set point	2
AT_3009_LIM_HH	VAR	REAL	400600	20.0	Very High percentage of Disolve Oxygen. Compared to the set point	2
AT_3009_LIM_L	VAR	REAL	400602	-20.0	Low percentage of Disolve Oxygen. Compared to the set point	2
AT_3009_LIM_LL	VAR	REAL	400604	-40.0	Very Low percentage of Disolve Oxygen. Compared to the set point	2
AT_3010_01	VAR	REAL	400128		Conductivity element + transmitter (BOTTOM)	5
AT_3010_01_AH	VAR	BOOL	000131		To be confirmed by UAB. High Electro Conductivity in the Bioreactor	2
AT_3010_01_AHH	VAR	BOOL	000132		To be confirmed by UAB. Very High Electro Conductivity in the Bioreactor	2
AT_3010_01_AL	VAR	BOOL	000133		To be confirmed by UAB. Low Electro Conductivity in the Bioreactor	2
AT_3010_01_ALL	VAR	BOOL	000134		To be confirmed by UAB. Very Low Electro Conductivity in the Bioreactor	2
AT_3010_01_ERR	VAR	BOOL	000135		SET if the wire is broken	2
AT_3010_02	VAR	REAL	400130		Conductivity element + transmitter (TOP)	5
AT_3010_02_AH	VAR	BOOL	000136		High Electro Conductivity in the Bioreactor	2
AT_3010_02_AHH	VAR	BOOL	000137		Very High Electro Conductivity in the Bioreactor	2
AT_3010_02_AL	VAR	BOOL	000138		Low Electro Conductivity in the Bioreactor	2
AT_3010_02_ALL	VAR	BOOL	000139		Very Low Electro Conductivity in the Bioreactor	2
AT_3010_02_ERR	VAR	BOOL	000140		SET if the wire is broken	2
AT_3010_LIM_H	VAR	REAL	400606	7.5	High Electro Conductivity in the Bioreactor	2
AT_3010_LIM_HH	VAR	REAL	400608	9.0	Very High Electro Conductivity in the	2

table continued...

Variable list (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Type	DType	Address	Initial value	Comment	Used
					Bioreactor	
AT_3010_LIM_L	VAR	REAL	400610	4.5	Low Electro Conductivity in the Bioreactor	2
AT_3010_LIM_LL	VAR	REAL	400612	3.0	Very Low Electro Conductivity in the Bioreactor	2
AT_3013_01	VAR	REAL	400144		NH4 Analyser	2
AT_3013_01_AH	VAR	BOOL	000166		High level AMMONIA	2
AT_3013_01_AHH	VAR	BOOL	000167		Very High level AMMONIA	2
AT_3013_01_AL	VAR	BOOL	000168		threshold: ?	1
AT_3013_01_ALL	VAR	BOOL	000169		threshold: ?	1
AT_3013_01_Calib_OutOfRange_A	VAR	BOOL	000282		Set from SCADA server when calibration has failed	2
AT_3013_01_ERR	VAR	BOOL	000178		SET if the wire is broken	1
AT_3013_01_ERROR	VAR	BOOL	000283		Alarm set when some communication errors appear.	2
AT_3013_01_LIM_H	VAR	REAL	400630	100.0	High level AMMONIA	1
AT_3013_01_LIM_HH	VAR	REAL	400632	400.0	Very High level AMMONIA	1
AT_3013_01_Reagent_A	VAR	BOOL	000281		Set from SCADA server when reagent tank is empty	0
AT_3013_01_Start_Analysis	VAR	BOOL	000279		Start Analysis from PLC and reset from SCADA server when analysis has finished	8
AT_3013_01_Start_Analysis_FLAG	VAR	BOOL				5
AT_3013_01_Start_Calibration	VAR	BOOL	000280		Start Calibration from PLC and reset from SCADA server when calibration has finished	6
AT_3013_01_Start_Calib_FLAG	VAR	BOOL				4
AT_3013_01_Status	VAR	BYTE	400422		Status of NH4 analyzer : 0 Stopped, 1 Analysis, 2 Calibration	14
AT_3013_01_Stop_Analyzer	VAR	BOOL	000289		Stop from PLC NH4+ Analysis	6
AT_3013_02	VAR	REAL	400146		NO3 Analyser	4
AT_3013_02_AH	VAR	BOOL	000170		High level of NITRATE	2
AT_3013_02_AHH	VAR	BOOL	000171		Very High level of NITRATE	2
AT_3013_02_AL	VAR	BOOL	000172		Low level of NITRATE	2
AT_3013_02_ALL	VAR	BOOL	000173		Very Lowlevel of NITRATE	2
AT_3013_02_Calib_OutOfRange_A	VAR	BOOL	000287		Set from SCADA server when calibration has failed	2
AT_3013_02_ERR	VAR	BOOL	000179		SET if the wire is broken	1
AT_3013_02_ERROR	VAR	BOOL	000288		Alarm set when some communication errors appear.	2
AT_3013_02_LIM_H	VAR	REAL	400638	500.0	High level of NITRATE	1
AT_3013_02_LIM_HH	VAR	REAL	400640	600.0	Very High level of NITRATE	1
AT_3013_02_LIM_L	VAR	REAL	400642	300.0	Low level of NITRATE	1
AT_3013_02_LIM_LL	VAR	REAL	400644	250.0	Very Lowlevel of NITRATE	1
AT_3013_02_Reagent_A	VAR	BOOL	000286		Set from SCADA server when reagent tank is empty	0
AT_3013_02_Start_Analysis	VAR	BOOL	000284		Start Analysis from PLC and reset from SCADA server when analysis has finished	9
AT_3013_02_Start_Analysis_FLAG	VAR	BOOL				5
AT_3013_02_Start_Calibration	VAR	BOOL	000285		Start Calibration from PLC and reset from SCADA server when calibration has finished	8
AT_3013_02_Start_Calib_FLAG	VAR	BOOL				6
AT_3013_02_Status	VAR	BYTE	400423		Status of NO3 analyzer : 0 Stopped, 1 Analysis, 2 Calibration	15
AT_3013_02_Stop_Analyzer	VAR	BOOL	000290		Stop from PLC NO3- Analysis	7
AT_3013_03	VAR	REAL	400148		NO2 Analyzer Refreshed Value	3
AT_3013_03_AH	VAR	BOOL	000174		High level of NITRITE	2
AT_3013_03_AHH	VAR	BOOL	000175		Very High level of NITRITE	2
AT_3013_03_AL	VAR	BOOL	000176		threshold: ?	1
AT_3013_03_ALL	VAR	BOOL	000177		threshold: ?	1

table continued...

Variable list (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Type	DType	Address	Initial value	Comment	Used
AT_3013_03_Analyzing	VAR	BOOL	100046		NO2 Analysis Status	9
AT_3013_03_Calibrating	VAR	BOOL	100048		NO2 Calibration Status	6
AT_3013_03_ERR	VAR	BOOL	000180		SET if the wire is broken	2
AT_3013_03_IND	VAR	BOOL	100043		NO2 Analyser. Calibration Indicator	0
AT_3013_03_LIM_H	VAR	REAL	400646	0.5	High level of NITRITE	1
AT_3013_03_LIM_HH	VAR	REAL	400648	20.0	Very High level of NITRITE	1
AT_3013_03_Start_Analysis	VAR	BOOL	000033		Start the NO2 analysis	9
AT_3013_03_Start_Analysis_FLAG	VAR	BOOL				3
AT_3013_03_Stop_Analyzer	VAR	BOOL	000034		stop the NO2 analysis	7
AT_3014_01	VAR	REAL	400204		Biomass sensor	4
AT_3014_01_ERR	VAR	BOOL	000186		SET if the wire is broken	0
AT_3014_01_H	VAR	BOOL	000182		threshold: ?	0
AT_3014_01_HH	VAR	BOOL	000183		threshold: ?	0
AT_3014_01_L	VAR	BOOL	000184		threshold: ?	0
AT_3014_01_LIM_H	VAR	REAL	400654		To be defined with NTE	1
AT_3014_01_LIM_HH	VAR	REAL	400656		To be defined with NTE	1
AT_3014_01_LIM_L	VAR	REAL	400658		To be defined with NTE	1
AT_3014_01_LIM_LL	VAR	REAL	400660		To be defined with NTE	1
AT_3014_01_LL	VAR	BOOL	000185		threshold: ?	0
BLE_3004_01	VAR	REAL	400086		Bioreactor agitator speed	3
BLE_3004_01_A	VAR	BOOL	000070		Set if blender speed is diffferent of its Feed Back speed (+/- 5%)	2
BLE_3004_01_ERR	VAR	BOOL	000251		SET if the wire is broken	1
BLE_3004_01_LIM_H	VAR	REAL	400542	5.0	High speed on the bioreactor blender (Compared to the set point)	1
BLE_3004_01_LIM_L	VAR	REAL	400544	-5.0	Low speed on the bioreactor blender (Compared to the set point)	1
BLE_3004_01_MV1	VAR	BOOL	000036		Bioreactor agitator ON / OFF	2
BLE_3004_01_MV2	VAR	REAL	400194		Bioreactor agitator set point	2
BLE_3004_01_OP	VAR	BOOL	000069		Used to start or stop the bioreactor blender in Manual mode	1
BLE_3004_01_SP	VAR	REAL	400084	0.0	Used to define the speed of BLE_3004_01	4
CIII_General_alarm_status	VAR	INT	400438		general alarm status (0= no ongoing alarm / 1= High or Low ongoing alarm / 2= Very High or Very low ongoing alarm)	4
CIII_HighLowAlarm_status	VAR	BOOL	000239		general High Low alarm indicator of the CIVB	5
CIII_SC_Activate_Setting	VAR	BOOL	000242			1
CIII_SysClock_Day	VAR	BYTE	400411		Day 1..31	3
CIII_SysClock_dayofweek	VAR	BYTE	400408		1 = Sunday .. 7 = Saturday	1
CIII_SysClock_dayofweek_SET	VAR	BYTE	400415		configure the day of the week (1 = Sunday .. 7 = Saturday)	1
CIII_SysClock_Day_SET	VAR	BYTE	400418		configure the Day (1..31)	1
CIII_SysClock_Hour	VAR	BYTE	400412		Hour 0..23	3
CIII_SysClock_Hour_SET	VAR	BYTE	400419		configure the Hour (0..23)	1
CIII_SysClock_Minute	VAR	BYTE	400413		Minute 0..59	4
CIII_SysClock_Minute_SET	VAR	BYTE	400420		configure the Minute (0..59)	1
CIII_SysClock_Month	VAR	BYTE	400410		Month 1..12	3
CIII_SysClock_Month_SET	VAR	BYTE	400417		configure the Month (1..12)	1
CIII_SysClock_Second	VAR	BYTE	400414		Second 0..59	4
CIII_SysClock_Second_SET	VAR	BYTE	400421		configure the Second (0..59)	1
CIII_SysClock_Year	VAR	BYTE	400409		Year 0..99	3
CIII_SysClock_Year_SET	VAR	BYTE	400416		configure the Year (0..99)	1
CIII_VeryHighLowAlarm_status	VAR	BOOL	000240		general Very High Low alarm indicator of the CIVB	5
CL3000_ControlLoop_Mode	VAR	INT	400230	0	Mode Selector (Will not be active untill the CII arrives in the MPP)	3

table continued...

Variable list (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Type	DType	Address	Initial value	Comment	Used
CL3000_Influent_General	IVAR	SECT_CTRL				0
CL3001_ControlLoop_Mode	VAR	INT	400231	0	Mode Selector (OFF/Manu/Auto)	7
CL3001_IMP	VAR	PARA_PCR_IMP				1
KM	COMP	REAL		-4.21		
TM	COMP	TIME		t#570s		
DM	COMP	TIME		t#130s		
CL3001_IMV	VAR	REAL	400810			1
CL3001_Influent_Temp_Control	IVAR	SECT_CTRL				0
CL3001_INIT	VAR	BOOL				2
CL3001_LIM	VAR	PARA_PCR_LIM				1
YMAX	COMP	REAL		1.0		
YRATE	COMP	REAL		10.0		
CL3001_PARAPWM	VAR	Para_PWM				1
t_period	COMP	TIME		t#100ms		
t_min	COMP	TIME		t#100ms		
t_max	COMP	TIME		t#1s		
up_pos	COMP	REAL		1.0		
CL3001_PCR_Flag4Init	VAR	BOOL				2
CL3001_SF1_ERR	VAR	DINT				1
CL3001_TUNE	VAR	PARA_PCR_TUNE				3
TS	COMP	TIME		t#10s		
H	COMP	TIME		t#10s		
TRBF	COMP	TIME		t#30m		
CL3001_Y	VAR	REAL	400808			2
CL3002_Influent_Level_Control	IVAR	SECT_CTRL				0
CL3003_ControlLoop_Mode	VAR	INT	400232	0	Mode Selector (OFF/Manu/Auto)	16
CL3003_EF1_ERR	VAR	DINT				1
CL3003_IMP	VAR	PARA_PCR_IMP				1
KM	COMP	REAL		0.06		
TM	COMP	TIME		t#1.3s		
CL3003_IMV	VAR	REAL	400816			1
CL3003_INIT	VAR	BOOL				2
CL3003_Inlet_Liquid_Control	IVAR	SECT_CTRL				0
CL3003_LIM	VAR	PARA_PCR_LIM				1
YMAX	COMP	REAL		100.0		
YRATE	COMP	REAL		100.0		
CL3003_PCR_Flag4Init	VAR	BOOL				2
CL3003_TUNE	VAR	PARA_PCR_TUNE				3
TS	COMP	TIME		t#100ms		
H	COMP	TIME		t#100ms		
TRBF	COMP	TIME		t#4s		
CL3003_Y	VAR	REAL				2
CL3004_Bioreactor_General	IVAR	SECT_CTRL				0
CL3004_Buzzer_01	VAR	BOOL	000039		Buzzer	1
CL3004_ControlLoop_Mode	VAR	INT	400233	0	Mode Selector (OFF/Manu/Auto)	6
CL3004_Emer_Button_01	VAR	BOOL	100039		Emergency Button	19
CL3005_Bioreactor_Temp_Control	IVAR	SECT_CTRL				0
CL3005_ControlLoop_Mode	VAR	INT	400234	0	Mode Selector (OFF/Manu/Auto)	19
CL3005_DECOMP2	VAR	TIME		t#5m		1
CL3005_ERR1	VAR	DINT				1
CL3005_ERR2	VAR	DINT				1
CL3005_Flag4Init	VAR	BOOL				3
CL3005_IMP1	VAR	PARA_PCR_IMP>				1
KM	COMP	REAL		0.5		
TM1	COMP	TIME		t#235s		
TM2	COMP	TIME		t#22s		
DM	COMP	TIME		t#21s		

table continued...

Variable list (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Type	DType	Address	Initial value	Comment	Used
CL3005_IMP2	VAR	PARA_PCR_IMP				1
KM	COMP	REAL		0.042		
TM	COMP	TIME		t#5s		
DM	COMP	TIME		t#5s		
CL3005_IMV1	VAR	REAL	400802			1
CL3005_IMV2	VAR	REAL	400806			1
CL3005_INIT1	VAR	BOOL				2
CL3005_INIT2	VAR	BOOL				2
CL3005_LIM1	VAR	PARA_PCR_LIM				1
YMIN	COMP	REAL		20.0		
YMAX	COMP	REAL		50.0		
YRATE	COMP	REAL		1.0		
CL3005_LIM2	VAR	PARA_PCR_LIM				1
YMIN	COMP	REAL		-1.0		
YMAX	COMP	REAL		1.0		
YRATE	COMP	REAL		1.0		
CL3005_PARAPWM	VAR	Para_PWM				3
t_period	COMP	TIME		t#1s		
t_min	COMP	TIME		t#50ms		
t_max	COMP	TIME		t#1s		
up_pos	COMP	REAL		1.0		
up_neg	COMP	REAL		-1.0		
CL3005_RCPY2	VAR	REAL				2
CL3005_TUNE1	VAR	PARA_PCR_TUNE				3
TS	COMP	TIME		t#10s		
H	COMP	TIME		t#200s		
TRBF	COMP	TIME		t#10m		
CL3005_TUNE2	VAR	PARA_PCR_TUNE				4
TS	COMP	TIME		t#1s		
H	COMP	TIME		t#1m		
TRBF	COMP	TIME		t#5m		
CL3005_Y1	VAR	REAL	400800			6
CL3005_Y2	VAR	REAL	400804			3
CL3006_BioreactorLevel_SP	VAR	REAL	400168	12.0	Used to define the level Set Point of the Bioreactor	1
CL3006_Bioreactor_Level_Control	IVAR	SECT_CTRL				0
CL3006_ControlLoop_Mode	VAR	INT	400245	0	Mode Selector (OFF/Auto)	11
CL3006_DECOMP	VAR	TIME		t#15m		2
CL3006_ERR	VAR	DINT				1
CL3006_Flag4Init	VAR	BOOL				2
CL3006_FLOW	VAR	REAL				4
CL3006_IFF1_ERR	VAR	DINT				1
CL3006_IFF1_IMP	VAR	PARA_PCR_IMP				1
KM	COMP	REAL		0.00028		
TM	COMP	TIME		t#26s		
DM	COMP	TIME		t#40s		
CL3006_IFF1_IMV	VAR	REAL	400822			2
CL3006_IMP	VAR	PARA_PCR_IMP				2
KM	COMP	REAL		-0.0003		
TM	COMP	TIME		t#41s		
CL3006_IMV	VAR	REAL	400824			2
CL3006_INIT	VAR	BOOL				3
CL3006_LIM	VAR	PARA_PCR_LIM				1
YMAX	COMP	REAL		0.8		
YRATE	COMP	REAL		0.8		
CL3006_TUNE	VAR	PARA_PCR_TUNE				4
TS	COMP	TIME		t#1s		

table continued...

Variable list (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Type	DType	Address	Initial value	Comment	Used
H	COMP	TIME		t#40s		
TRBF	COMP	TIME		t#15m		
CL3006_Y	VAR	REAL				1
CL3007_Bioreactor_Pressu_Control	IVAR	SECT_CTRL				0
CL3007_ERR	VAR	DINT				1
CL3007_IMV	VAR	REAL				1
CL3007_Pressure_Threshold	VAR	REAL	400216	80.0	Threshold which trigger the bioreactor pressure releasing	1
CL3007_PT_Value_Wanted	VAR	REAL				1
CL3007_Y	VAR	REAL				2
CL3008_ACID_BASE_DECOMP	VAR	TIME		t#900s		1
CL3008_ACID_BASE_ERR	VAR	DINT				1
CL3008_ACID_BASE_FLAG4INIT	VAR	BOOL				2
CL3008_ACID_BASE_IMP	VAR	PARA_PCR_IMP				1
KM	COMP	REAL		0.04		
TM	COMP	TIME		t#26s		
DM	COMP	TIME		t#23s		
CL3008_ACID_BASE_IMV	VAR	REAL				1
CL3008_ACID_BASE_INIT	VAR	BOOL				2
CL3008_ACID_BASE_LIM	VAR	PARA_PCR_LIM				7
YRATE	COMP	REAL		1.0		
CL3008_ACID_BASE_PARAPWM	VAR	Para_PWM				3
t_period	COMP	TIME		t#30s		
t_min	COMP	TIME		t#100ms		
t_max	COMP	TIME		t#30s		
up_pos	COMP	REAL		1.0		
up_neg	COMP	REAL		1.0		
CL3008_ACID_BASE_RCPY	VAR	REAL				2
CL3008_ACID_BASE_TUNE	VAR	PARA_PCR_TUNE				3
TS	COMP	TIME		t#30s		
H	COMP	TIME		t#50s		
TRBF	COMP	TIME		t#900s		
CL3008_ACID_BASE_Y	VAR	REAL				4
CL3008_Acid_Opening_Time	VAR	REAL	400186		The timer is increasing in second	3
CL3008_Base_Opening_Time	VAR	REAL	400184		The timer is increasing in second	3
CL3008_Bioreactor_pH_Control	IVAR	SECT_CTRL				0
CL3008_CO2_DECOMP	VAR	TIME		t#900s		1
CL3008_CO2_ERR	VAR	DINT				1
CL3008_CO2_FLAG4INIT	VAR	BOOL				2
CL3008_CO2_IMP	VAR	PARA_PCR_IMP				1
KM	COMP	REAL		-4.700000E-05		
TM	COMP	TIME		t#265s		
CL3008_CO2_IMV	VAR	REAL				1
CL3008_CO2_INIT	VAR	BOOL				2
CL3008_CO2_LIM	VAR	PARA_PCR_LIM				1
YMAX	COMP	REAL		50.0		
YRATE	COMP	REAL		50.0		
CL3008_CO2_TUNE	VAR	PARA_PCR_TUNE				3
TS	COMP	TIME		t#30s		
H	COMP	TIME		t#250s		
TRBF	COMP	TIME		t#900s		
CL3008_CO2_Y	VAR	REAL				1
CL3008_ControlLoop_Mode	VAR	INT	400235	0	Mode Selector (OFF/Manu/Auto)	23
CL3008_DeadZone	VAR	REAL	400106	0.1	Used to define the Dead Zone of the pH bioreactor	8
CL3008_IND_Acid	VAR	BOOL				3
CL3008_IND_Base	VAR	BOOL				3

table continued...

Variable list (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Type	DType	Address	Initial value	Comment	Used
CL3008_IND_CO2	VAR	BOOL				2
CL3008_pHdz	VAR	REAL				3
CL3008_pH_AH	VAR	BOOL	000103		High pH in the Bioreactor. Compare to the set point	2
CL3008_pH_AHH	VAR	BOOL	000104		Very High pH in the Bioreactor. Compare to the set point	2
CL3008_pH_AL	VAR	BOOL	000105		Low pH in the Bioreactor. Compare to the set point	2
CL3008_pH_ALL	VAR	BOOL	000106		Very Low pH in the Bioreactor. Compare to the set point	2
CL3008_pH_AVERAGE	VAR	REAL	400218		pH probe Average	4
CL3008_pH_Day	VAR	BYTE	400263		Date of the last reset done by the operator	1
CL3008_pH_high	VAR	BOOL				6
CL3008_pH_Hour	VAR	BYTE	400262		Date of the last reset done by the operator	1
CL3008_pH_LIM_H	VAR	REAL	400582	0.1	High pH in the Bioreactor. Compared to the set point	1
CL3008_pH_LIM_HH	VAR	REAL	400584	0.5	Very High pH in the Bioreactor. Compared to the set point	1
CL3008_pH_LIM_L	VAR	REAL	400586	-0.1	Low pH in the Bioreactor. Compared to the set point	1
CL3008_pH_LIM_LL	VAR	REAL	400588	-0.5	Very Low pH in the Bioreactor. Compared to the set point	1
CL3008_pH_low	VAR	BOOL				5
CL3008_pH_Measurement	VAR	REAL				9
CL3008_pH_Minute	VAR	BYTE	400261		Date of the last reset done by the operator	1
CL3008_pH_Mode	VAR	INT	400247	2	Define the pH mode for bioreactor pH control (1-Only CO2 / 2-CO2 and BASE / 3-CO2 is fixed and ACID+BASE)	6
CL3008_pH_Month	VAR	BYTE	400264		Date of the last reset done by the operator	1
CL3008_pH_Second	VAR	BYTE	400260		Date of the last reset done by the operator	1
CL3008_pH_selector	VAR	INT	400248	0	Define the pH probe used for the Control. (0=Average / 1 = AT_3008_01 / 2 = AT_3008_02)	5
CL3008_pH_SP	VAR	REAL	400104	8.0	Used to define the pH set point of the bioreactor	9
CL3008_pH_Year	VAR	BYTE	400265		Date of the last reset done by the operator	1
CL3008_Reset_pH_Timer	VAR	BOOL	000102		RESET the Timer for both pH pump and set the new starting date and time for Timer	3
CL3008_SENSOR_DEVIATION_A	VAR	BOOL	000252		Triggered when the pH gap between the two probes is more than 2	1
CL3008_SENSOR_DEVIATION_LIM	VAR	REAL	400708	0.5	The alarm is permanently checking the sensor deviation. Even if you choose only one of the two pH sensors	2
CL3009_Bioreactor_DO2_Control	IVAR	SECT_CTRL				0
CL3009_ControlLoop_Mode	VAR	INT	400236	0	Mode Selector (OFF/Manu/Auto)	13
CL3009_DO2_AVERAGE	VAR	REAL	400220		Display the Average of both Do2 AVG (yet the average is made 50% of AT_3009_01 and 50% AT_3009_02).	4
CL3009_DO2_Measurement	VAR	REAL				2
CL3009_DO2_selector	VAR	INT	400249	0	Define the DO2 probe used for the Control. (0=Average / 1 = AT_3009_01 / 2 =	5

table continued...

Variable list (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Type	DType	Address	Initial value	Comment	Used
					AT_3009_02)	
CL3009_DO2_SP	VAR	REAL	400172	0.0	Used to define the Set point of the Dissolved Oxygen in automatic mode (Controller set point)	9
CL3009_Flag4Init	VAR	BOOL				2
CL3009_IMP	VAR	PARA_PCR_IMP				1
CL3009_IMV	VAR	REAL				1
CL3009_INIT	VAR	BOOL				2
CL3009_LIM	VAR	PARA_PCR_LIM				1
CL3009_SENSOR_DEVIATION_A	VAR	BOOL	000262		Triggered when the DO2 gap between the two probes is more than 2	1
CL3009_SENSOR_DEVIATION_LIM	VAR	REAL	400734	5.0	The alarm is permanently checking the sensor deviation. Even if you choose only one of the two dissolve dioxygen sensors	2
CL3009_TUNE	VAR	PARA_PCR_TUNE				3
CL3009_Y	VAR	REAL				2
CL3010_Bioreactor_EC_Control	IVAR	SECT_CTRL				0
CL3011_ATM_VALVE_PWM_PARA	VAR	Para_PWM				1
t_period	COMP	TIME		t#300ms		
t_min	COMP	TIME		t#50ms		
t_max	COMP	TIME		t#300ms		
up_pos	COMP	REAL		1.0		
CL3011_ControlLoop_Mode	VAR	INT	400237	0	Mode Selector (OFF/Manu/Auto)	13
CL3011_DECOMP	VAR	TIME		t#10s		1
CL3011_Flag4Init	VAR	BOOL				2
CL3011_flag_OxyPulse_ON	VAR	BOOL				2
CL3011_GasMix_SP	VAR	REAL	400174	0.0	Used to define the Gas Mix Set point of the controller in automatic mode	1
CL3011_Gas_Loop	IVAR	SECT_CTRL				0
CL3011_IMP	VAR	PARA_PCR_IMP				1
KM	COMP	REAL		0.015		
CL3011_INIT	VAR	BOOL				2
CL3011_LIM	VAR	PARA_PCR_LIM				3
YRATE	COMP	REAL		300.0		
CL3011_N2_FQRC_MAX	VAR	REAL		3000.0		1
CL3011_SelectValue_N2	VAR	REAL				2
CL3011_TUNE	VAR	PARA_PCR_TUNE				3
TS	COMP	TIME		t#0.5s		
H	COMP	TIME		t#3s		
TRBF	COMP	TIME		t#10s		
CL3011_VALVEATM_GAIN	VAR	REAL		6.0		1
CL3012_Gas_Temperature	IVAR	SECT_CTRL				0
CL3013_NH4	IVAR	SECT_CTRL				0
CL3013_NH4_Analysis_Time	VAR	UINT	400251		AUTOMATIC MODE ONLY / Remaining time in minute before the next start analysis function (NH4+ analyzer)	8
CL3013_NH4_Analysis_Time_CFG	VAR	UINT	400250	30	AUTOMATIC MODE ONLY / Configuration time in minute between two start analysis function (NH4+ analyzer)	6
CL3013_NH4_Analysis_Time_CFG0	VAR	UINT				4
CL3013_NH4_Analysis_Time_loading	VAR	BOOL				7
CL3013_NH4_Calib	IVAR	SECT_CTRL				0
CL3013_NH4_Calibration_Time	VAR	UINT	400253		AUTOMATIC MODE ONLY / Remaining time (in hour) before the next Calibration function (NH4+ analyzer)	6
CL3013_NH4_Calibration_Time_CFG	VAR	UINT	400252	24	AUTOMATIC MODE ONLY / Configuration time (in hour)between two Calibration function (	6

table continued...

Variable list (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Type	DType	Address	Initial value	Comment	Used
					NH4+ analyzer)	
CL3013_NH4_Calibration_Time_CFG0	VAR	UINT		0		4
CL3013_NH4_Calib_Time_loading	VAR	BOOL				7
CL3013_NH4_ControlLoop_Mode	VAR	INT	400238	0	NH4 Analyzer Mode Selector (OFF/Manu/Auto)	24
CL3013_NH4_Management	IVAR	SECT_CTRL				0
CL3013_NH4_Stop	IVAR	SECT_CTRL				0
CL3013_NO2	IVAR	SECT_CTRL				0
CL3013_NO2_Analysis_Time	VAR	UINT	400259		AUTOMATIC MODE ONLY / Remaining time in minute before the next start analysis function (NO2- analyzer)	7
CL3013_NO2_Analysis_Time_CFG	VAR	UINT	400258	30	AUTOMATIC MODE ONLY / Configuration time in minute between two start analysis function (NO2- analyzer)	6
CL3013_NO2_Analysis_Time_CFG0	VAR	UINT				4
CL3013_NO2_Analysis_Time_Loading	VAR	BOOL				7
CL3013_NO2_ControlLoop_Mode	VAR	INT	400274	0	NO2 Analyzer Mode Selector (OFF/Manu/Auto)	19
CL3013_NO2_Management	IVAR	SECT_CTRL				0
CL3013_NO2_Stop	IVAR	SECT_CTRL				0
CL3013_NO3	IVAR	SECT_CTRL				0
CL3013_NO3_Analysis_Time	VAR	UINT	400255		AUTOMATIC MODE ONLY / Remaining time in minute before the next start analysis function (NO3- analyzer)	8
CL3013_NO3_Analysis_Time_CFG	VAR	UINT	400254	30	AUTOMATIC MODE ONLY / Configuration time in minute between two start analysis function (NO3- analyzer)	6
CL3013_NO3_Analysis_Time_CFG0	VAR	UINT				4
CL3013_NO3_Analysis_Time_loading	VAR	BOOL				7
CL3013_NO3_Calib	IVAR	SECT_CTRL				0
CL3013_NO3_Calibration_Time	VAR	UINT	400257		AUTOMATIC MODE ONLY / Remaining time (in hour) before the next Calibration function (NO3- analyzer)	6
CL3013_NO3_Calibration_Time_CFG	VAR	UINT	400256	24	AUTOMATIC MODE ONLY / Configuration time (in hour) between two Calibration function (NO3- analyzer)	6
CL3013_NO3_Calibration_Time_CFG0	VAR	UINT				4
CL3013_NO3_Calib_Time_loading	VAR	BOOL				7
CL3013_NO3_ControlLoop_Mode	VAR	INT	400273	0	NO3 Analyzer Mode Selector (OFF/Manu/Auto)	25
CL3013_NO3_Management	IVAR	SECT_CTRL				0
CL3013_NO3_Stop	IVAR	SECT_CTRL				0
CL3013_RecycleFlow_Flag	VAR	BOOL				7
CL3013_SFC_CONTROL_PROCEDURE	IVAR	SECT_CTRL				0
CL3014_Biomass_Control	IVAR	SECT_CTRL				0
CL3015_Backwashing	IVAR	SECT_CTRL				0
CL3015_BACKWASHING_DURATION	VAR	UDINT	400065		Duration of the backwashing (second)	1
CL3015_BACKWASHING_TIME	VAR	TIME				1
CL3015_ControlLoop_Mode	VAR	INT	400239	0	Mode Selector (OFF/Manu/Auto)	5
CL3016_BOTTOM_CLOSING_TIME	VAR	UDINT	400432		Closing Time of valves SV_3016_01 and SV_3011_01	1
CL3016_BOTTOM_CLOSING_TIMER	VAR	TIME				1
CL3016_BOTTOM_OPENING	VAR	BOOL				2
CL3016_BOTTOM_OPENING_TIME	VAR	UDINT	400430		Opening Time of valves SV_3016_01 and SV_3011_01	1
CL3016_BOTTOM_OPENING_TIMER	VAR	TIME				1
CL3016_ControlLoop_Mode	VAR	INT	400240	0	Mode Selector (OFF/Manu/Auto)	7
CL3016_Gas_Pulse	IVAR	SECT_CTRL				0
CL3016_OXYGENPULSE_COUNTER	VAR	INT				7
CL3016_OXYGENPULSE_NUMBER	VAR	INT	400246		Number of the oxygen pulse done during the	2

table continued...

Variable list (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Type	DType	Address	Initial value	Comment	Used
					sequence	
CL3016_Start_OxygenPulse	VAR	BOOL				2
CL3016_TOP_CLOSING_TIME	VAR	UDINT	400436		Closing Time of valves SV_3016_02	1
CL3016_TOP_CLOSING_TIMER	VAR	TIME				1
CL3016_TOP_OPENING	VAR	BOOL				2
CL3016_TOP_OPENING_TIME	VAR	UDINT	400434		Opening Time of valves SV_3016_02	1
CL3016_TOP_OPENING_TIMER	VAR	TIME				1
CL3017_ControlLoop_Mode	VAR	INT	400241	0	Mode Selector (OFF/Manu/Auto)	11
CL3017_ERR	VAR	DINT				1
CL3017_Flag4Init	VAR	BOOL				2
CL3017_FLOW_SP	VAR	REAL	400176	3.6	Used to define the flow set point of the recirculation loop in automatic mode	5
CL3017_IMP	VAR	PARA_PCR_IMP				1
KM	COMP	REAL		0.49		
TM	COMP	TIME		t#2.65s		
CL3017_IMV	VAR	REAL	400818			1
CL3017_INIT	VAR	BOOL				2
CL3017_LIM	VAR	PARA_PCR_LIM				1
YMAX	COMP	REAL		100.0		
YRATE	COMP	REAL		100.0		
CL3017_Liquid_Recirculation	IVAR	SECT_CTRL				0
CL3017_TUNE	VAR	PARA_PCR_TUNE				3
TS	COMP	TIME		t#100ms		
H	COMP	TIME		t#100ms		
TRBF	COMP	TIME		t#7.5s		
CL3017_Y	VAR	REAL				2
CL3018_Auto_Mode_Forced	VAR	BOOL				1
CL3018_ControlLoop_Mode	VAR	INT	400242	0	Mode Selector (OFF/Manu/Auto)	14
CL3018_EF1_SP_CSTR	VAR	REAL				2
CL3018_ERR	VAR	DINT				1
CL3018_Flag4Init	VAR	BOOL				2
CL3018_FLOW_SP	VAR	REAL	400170	0.0	Used to define the Set Point of the flow in Automatic mode	7
CL3018_IMP	VAR	PARA_PCR_IMP				1
KM	COMP	REAL		0.069		
TM	COMP	TIME		t#76s		
CL3018_IMV	VAR	REAL	400820			1
CL3018_INIT	VAR	BOOL				2
CL3018_LIM	VAR	PARA_PCR_LIM				1
YMAX	COMP	REAL		100.0		
YRATE	COMP	REAL		100.0		
CL3018_Outlet_liquid_Control	IVAR	SECT_CTRL				0
CL3018_TUNE	VAR	PARA_PCR_TUNE				3
TS	COMP	TIME		t#1s		
H	COMP	TIME		t#1s		
TRBF	COMP	TIME		t#3m		
CL3018_Y	VAR	REAL				2
CL3020_ControlLoop_Mode	VAR	INT	400243	0	Mode Selector (OFF/Manu/Auto)	7
CL3020_Effluent_Temperature	IVAR	SECT_CTRL				0
CL3020_IMP	VAR	PARA_PCR_IMP				1
KM	COMP	REAL		-4.21		
TM	COMP	TIME		t#570s		
DM	COMP	TIME		t#130s		
CL3020_IMV	VAR	REAL	400814			1
CL3020_INIT	VAR	BOOL				2
CL3020_LIM	VAR	PARA_PCR_LIM				1
YMAX	COMP	REAL		1.0		

table continued...

Variable list (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Type	DType	Address	Initial value	Comment	Used
YRATE	COMP	REAL		10.0		
CL3020_PARAPWM	VAR	Para_PWM				1
t_period	COMP	TIME		t#100ms		
t_min	COMP	TIME		t#100ms		
t_max	COMP	TIME		t#1s		
up_pos	COMP	REAL		1.0		
CL3020_PCR_Flag4Init	VAR	BOOL				2
CL3020_SF1_ERR	VAR	DINT				1
CL3020_TUNE	VAR	PARA_PCR_TUNE				3
TS	COMP	TIME		t#10s		
H	COMP	TIME		t#10s		
TRBF	COMP	TIME		t#30m		
CL3020_Y	VAR	REAL	400812			2
CL3021_Effluent_Level	IVAR	SECT_CTRL				0
CL3022_ControlLoop_Mode	VAR	INT	400244	0	Mode Selector (OFF/Manu/Auto)	1
CL3022_Foam_Control	IVAR	SECT_CTRL				0
CL_3009_ERR	VAR	DINT				1
CP_3005_01_MV	VAR	BOOL	000038		Circulating Pump (thermostat)	1
CP_3005_01_OP	VAR	BOOL	000071		Used to start or stop the bioreactor circulating pump in Manual mode	1
DPT_3007_01	VAR	REAL	400100		Differential Pressure transmitter	5
DPT_3007_01_AH	VAR	BOOL	000090		High differential pressure in the bioreactor	2
DPT_3007_01_AHH	VAR	BOOL	000091		Very High differential pressure in the bioreactor	2
DPT_3007_01_AL	VAR	BOOL	000092		Low differential pressure in the bioreactor	2
DPT_3007_01_ALL	VAR	BOOL	000093		Very Low differential pressure in the bioreactor	2
DPT_3007_01_ERR	VAR	BOOL	000094		SET if the wire is broken	2
DPT_3007_01_LIM_H	VAR	REAL	400574	200.0	TO BE CONFIRMED BY UAB. High differential pressure in the bioreactor	1
DPT_3007_01_LIM_HH	VAR	REAL	400576	500.0	TO BE CONFIRMED BY UAB. Very High differential pressure in the bioreactor	1
DPT_3007_01_LIM_L	VAR	REAL	400578	0.0	Do a test with only beeds to see the DPT, then the threshold will vbe this DP. Low differential pressure in the bioreactor	1
DPT_3007_01_LIM_LL	VAR	REAL	400580	0.0	Very Low differential pressure in the bioreactor	1
DPT_Range_MAX	VAR	REAL		3000.0		1
DPT_Range_MIN	VAR	REAL		0.0		1
ERR_AI	IVAR	SECT_CTRL				0
FB_TIME_LIM	VAR	TIME	400500	t#5s		15
FQRC_3008_01	VAR	REAL	400158		Flow element + transmitter (CO2)	9
FQRC_3008_01_AH	VAR	BOOL	000253		The value asked is high compares to the value read on the mass flow controller	1
FQRC_3008_01_AHH	VAR	BOOL	000254		The value asked is very high compares to the value read on the mass flow controller	1
FQRC_3008_01_AL	VAR	BOOL	000255		The value asked is low compares to the value read on the mass flow controller	1
FQRC_3008_01_ALL	VAR	BOOL	000256		The value asked is very low compares to the value read on the mass flow controller	1
FQRC_3008_01_ERR	VAR	BOOL	000119		SET if the wire is broken	2
FQRC_3008_01_LIM_H	VAR	REAL	400710	20.0	High Flow in the CO2 GAS Mass Flow Controller	1
FQRC_3008_01_LIM_HH	VAR	REAL	400712	50.0	Very High Flow in the CO2 GAS Mass Flow	1

table continued...

Variable list (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Type	DType	Address	Initial value	Comment	Used
					Controller	
FQRC_3008_01_LIM_L	VAR	REAL	400714	-20.0	Low Flow in the GAS CO2 Mass Flow Controller	1
FQRC_3008_01_LIM_LL	VAR	REAL	400716	-50.0	Very Low Flow in the CO2 GAS Mass Flow Controller	1
FQRC_3008_01_OP	VAR	REAL	400206	0.0	Used to define the opening Set point of the mass flow controller valve in manual mode	1
FQRC_3008_01_SP	VAR	REAL	400188		Flow Control Valve non sterile gas (CO2)	7
FQRC_3009_01	VAR	REAL	400126		Flow element + transmitter (O2)	9
FQRC_3009_01_AH	VAR	BOOL	000257		High Flow in the O2 GAS Mass Flow Controller	1
FQRC_3009_01_AHH	VAR	BOOL	000258		Very High Flow in the O2 GAS Mass Flow Controller	1
FQRC_3009_01_AL	VAR	BOOL	000259		Low Flow in the GAS O2 Mass Flow Controller	1
FQRC_3009_01_ALL	VAR	BOOL	000260		Very Low Flow in the O2 GAS Mass Flow Controller	1
FQRC_3009_01_ERR	VAR	BOOL	000130		SET if the wire is broken	3
FQRC_3009_01_LIM_H	VAR	REAL	400718	100.0	High Flow in the O2 GAS Mass Flow Controller. Compared to the set point asked by the predictive controller	1
FQRC_3009_01_LIM_HH	VAR	REAL	400720	300.0	Very High Flow in the O2 GAS Mass Flow Controller. Compared to the set point asked by the predictive controller	1
FQRC_3009_01_LIM_L	VAR	REAL	400722	-100.0	Low Flow in the GAS O2 Mass Flow Controller. Compared to the set point asked by the predictive controller	1
FQRC_3009_01_LIM_LL	VAR	REAL	400724	-300.0	Very Low Flow in the O2 GAS Mass Flow Controller. Compared to the set point asked by the predictive controller	1
FQRC_3009_01_OP	VAR	REAL	400120	0.0	Used to define the opening Set point of the mass flow controller valve in manual mode	1
FQRC_3009_01_SP	VAR	REAL	400190	0.0	Flow Control Valve non sterile gas (O2)	6
FQRC_3011_01	VAR	REAL	400136		Flow element + transmitter (N2)	6
FQRC_3011_01_AH	VAR	BOOL	000263		High Flow in the N2 GAS Mass Flow Controller	1
FQRC_3011_01_AHH	VAR	BOOL	000264		Very High Flow in the N2 GAS Mass Flow Controller	1
FQRC_3011_01_AL	VAR	BOOL	000265		Low Flow in the GAS N2 Mass Flow Controller	1
FQRC_3011_01_ALL	VAR	BOOL	000266		Very Low Flow in the N2 GAS Mass Flow Controller	1
FQRC_3011_01_ERR	VAR	BOOL	000148		SET if the wire is broken	2
FQRC_3011_01_LIM_H	VAR	REAL	400694	100.0	High Flow in the N2 GAS Mass Flow Controller. Compared to the set point	1
FQRC_3011_01_LIM_HH	VAR	REAL	400696	300.0	Very High Flow in the N2 GAS Mass Flow Controller. Compared to the set point	1
FQRC_3011_01_LIM_L	VAR	REAL	400698	-100.0	Low Flow in the GAS N2 Mass Flow Controller. Compared to the set point	1
FQRC_3011_01_LIM_LL	VAR	REAL	400700	-300.0	Very Low Flow in the N2 GAS Mass Flow Controller. Compared to the set point	1
FQRC_3011_01_OP	VAR	REAL	400132	0.0	Used to define the opening Set point of the mass flow controller valve in manual mode	2
FQRC_3011_01_SP	VAR	REAL	400192		Flow Control Valve non sterile gas (N2)	6

table continued...

Variable list (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Type	DType	Address	Initial value	Comment	Used
FQRC_3011_02	VAR	REAL	400138		Flow element + transmitter (mix)	5
FQRC_3011_02_AH	VAR	BOOL	000267		High Flow in the GAS MIX Mass Flow Controller	1
FQRC_3011_02_AHH	VAR	BOOL	000268		Very High Flow in the GAS MIX Mass Flow Controller	1
FQRC_3011_02_AL	VAR	BOOL	000269		Low Flow in the GAS MIX Mass Flow Controller	1
FQRC_3011_02_ALL	VAR	BOOL	000270		Very Low Flow in the GAS MIX Mass Flow Controller	1
FQRC_3011_02_ERR	VAR	BOOL	000149		SET if the wire is broken	2
FQRC_3011_02_LIM_H	VAR	REAL	400726	100.0	High Flow in the GAS MIX Mass Flow Controller. Compared to the set point	1
FQRC_3011_02_LIM_HH	VAR	REAL	400728	300.0	Very High Flow in the GAS MIX Mass Flow Controller. Compared to the set point	1
FQRC_3011_02_LIM_L	VAR	REAL	400730	-100.0	Low Flow in the GAS MIX Mass Flow Controller. Compared to the set point	1
FQRC_3011_02_LIM_LL	VAR	REAL	400732	-300.0	Very Low Flow in the GAS MIX Mass Flow Controller. Compared to the set point	1
FQRC_3011_02_OP	VAR	REAL	400134	0.0	Used to define the opening Set point of the mass flow controller valve in manual mode	2
FQRC_3011_02_SP	VAR	REAL	400202		Flow element + transmitter (mix)	6
FT_3003_01	VAR	REAL	400080		Flow element + transmitter (feed)	8
FT_3003_01_AH	VAR	BOOL	000063		High Flow on the bioreactor inlet liquid. Implement a time for triggering alarm (5min).Compared to the set point	2
FT_3003_01_AHH	VAR	BOOL	000064		Very High Flow on the bioreactor inlet liquid. Implement a time for triggering alarm (5min).Compared to the set point	2
FT_3003_01_AL	VAR	BOOL	000065		Low Flow on the bioreactor inlet liquid. Implement a time for triggering alarm (5min).Compared to the set point	3
FT_3003_01_ALL	VAR	BOOL	000066		Very Low Flow on the bioreactor inlet liquid. Implement a time for triggering alarm (5min).. Compared to the set point	2
FT_3003_01_ERR	VAR	BOOL	000067		SET if the wire is broken	2
FT_3003_01_LIM_H	VAR	REAL	400526	0.1	High Flow on the bioreactor inlet liquid. Implement a time for triggering alarm (5min).. Compared to the set point	1
FT_3003_01_LIM_HH	VAR	REAL	400528	0.2	Very High Flow on the bioreactor inlet liquid. Implement a time for triggering alarm (5min).. Compared to the set point	1
FT_3003_01_LIM_L	VAR	REAL	400530	-0.1	Low Flow on the bioreactor inlet liquid. Implement a time for triggering alarm (5min).. Compared to the set point	1
FT_3003_01_LIM_LL	VAR	REAL	400532	-0.2	Very Low Flow on the bioreactor inlet liquid. Implement a time for triggering alarm (5min).. Compared to the set point	1
FT_3003_01_SP	VAR	REAL	400208	0.0	Used to configure the flow of the Bioreactor inlet liquid in automatic mode	6
FT_3017_01	VAR	REAL	400152		Flow element + transmitter (recirc)	7
FT_3017_01_AH	VAR	BOOL	000194		Compared to the set point. The time for triggering the alarm need to be define (1min). High Flow in the Recirculation Loop	2
FT_3017_01_AHH	VAR	BOOL	000195		Compared to the set point. The time for triggering the alarm need to be define (	2

table continued...

Variable list (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Type	DType	Address	Initial value	Comment	Used
					1min). Very High Flow in the recirculation Loop	
FT_3017_01_AL	VAR	BOOL	000196		Compared to the set point. The time for triggering the alarm need to be define (1min). Low Flow in the Recirculation Loop	2
FT_3017_01_ALL	VAR	BOOL	000197		Compared to the set point. The time for triggering the alarm need to be define (1min). Very Low Flow in the Recirculation Loop	2
FT_3017_01_ERR	VAR	BOOL	000198		SET if the wire is broken	2
FT_3017_01_LIM_H	VAR	REAL	400662	0.1	Compared to the set point. The time for triggering the alarm 1min. High Flow in the Recirculation Loop	1
FT_3017_01_LIM_HH	VAR	REAL	400664	0.2	Compared to the set point. The time for triggering the alarm 1min. Very High Flow in the recirculation Loop	1
FT_3017_01_LIM_L	VAR	REAL	400666	-0.1	Compared to the set point. The time for triggering the alarm 1min. Low Flow in the Recirculation Loop	1
FT_3017_01_LIM_LL	VAR	REAL	400668	-0.2	Compared to the set point. The time for triggering the alarm 1min. Very Low Flow in the Recirculation Loop	1
FT_3018_01	VAR	REAL	400156		Flow element + transmitter (harvest)	6
FT_3018_01_AH	VAR	BOOL	000201		Compared to the set point and triggered after 1 min. action is done in level control. High Flow in outlet liquid Loop	2
FT_3018_01_AHH	VAR	BOOL	000202		Compared to the set point and triggered after 1 min. action is done in level control. Very High flow in outlet liquid Loop	2
FT_3018_01_AL	VAR	BOOL	000203		Compared to the set point and triggered after 1 min. action is done in level control. Low Flow in outlet liquid Loop	2
FT_3018_01_ALL	VAR	BOOL	000204		Compared to the set point and triggered after 1 min. action is done in level control. Very Low Flow in outlet liquid Loop	2
FT_3018_01_ERR	VAR	BOOL	000205		SET if the wire is broken	2
FT_3018_01_LIM_H	VAR	REAL	400670	0.1	Compared to the set point and triggered after 1 min. action is done in level control. High Flow in outlet liquid Loop	1
FT_3018_01_LIM_HH	VAR	REAL	400672	0.2	Compared to the set point and triggered after 1 min. action is done in level control. Very High flow in outlet liquid Loop	1
FT_3018_01_LIM_L	VAR	REAL	400674	-0.1	Compared to the set point and triggered after 1 min. action is done in level control. Low Flow in outlet liquid Loop	1
FT_3018_01_LIM_LL	VAR	REAL	400676	-0.2	Compared to the set point and triggered after 1 min. action is done in level control. Very Low Flow in outlet liquid Loop	1
GC_3011_01_MV	VAR	BOOL	000037		Gas compressor	1
GC_3011_01_OP	VAR	BOOL	000141		Used to start or stop the gas compressor pump in manual mode	1
GLOBAL_BIOLEV_MODEL	VAR	REAL	400826			1
Input	IVAR	SECT_CTRL				0

table continued...

Variable list (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Type	DType	Address	Initial value	Comment	Used
LSH_3006_01	VAR	BOOL	100017		Level switch (Vibrating horizontal)	1
LSH_3006_01_A	VAR	BOOL	000273		The alarm is triggered after 10s	1
LSH_3006_02	VAR	BOOL	100018		Level switch (Vibrating horizontal)	1
LSH_3006_02_A	VAR	BOOL	000274		The alarm is triggered after 10s	1
LSH_3021_01	VAR	BOOL	100023		Level switch (Vibrating horizontal)	1
LSH_3021_01_A	VAR	BOOL	000277		The alarm is triggered after 10s	1
LSH_3021_02	VAR	BOOL	100024		Level switch (Vibrating horizontal)	1
LSH_3021_02_A	VAR	BOOL	000278		The alarm is triggered after 10s	1
LSL_3002_01	VAR	BOOL	100021		Level switch (Vibrating horizontal)	1
LSL_3002_01_A	VAR	BOOL	000271		The alarm is triggered after 10s	1
LSL_3002_02	VAR	BOOL	100022		Level switch (Vibrating horizontal)	1
LSL_3002_02_A	VAR	BOOL	000272		The alarm is triggered after 10s	1
LSL_3006_01	VAR	BOOL	100019		Level switch (Vibrating horizontal)	1
LSL_3006_01_A	VAR	BOOL	000275		The alarm is triggered after 10s	1
LSL_3006_02	VAR	BOOL	100020		Level switch (Vibrating horizontal)	1
LSL_3006_02_A	VAR	BOOL	000276		The alarm is triggered after 10s	1
LS_TIME_LIM	VAR	TIME	400736	t#10s		8
LT_3002_01	VAR	REAL	400076		Level transmitter (capacitive)	5
LT_3002_01_AH	VAR	BOOL	000057		High level in Influent Tank. fix value	2
LT_3002_01_AHH	VAR	BOOL	000058		Very High Level in the Influent Tank. fix value	3
LT_3002_01_AL	VAR	BOOL	000241		Very low Level in the Influent Tank. fix value	2
LT_3002_01_ALL	VAR	BOOL	000059		Very low Level in the Influent Tank. fix value	3
LT_3002_01_ERR	VAR	BOOL	000060		SET if the wire is broken	2
LT_3002_01_LIM_H	VAR	REAL	400520	30.0	High level in Influent Tank. fix value	1
LT_3002_01_LIM_HH	VAR	REAL	400522	34.0	Very High Level in the Influent Tank. fix value	1
LT_3002_01_LIM_L	VAR	REAL	400702	6.0	Very low Level in the Influent Tank. fix value	1
LT_3002_01_LIM_LL	VAR	REAL	400524	3.0	Very low Level in the Influent Tank. fix value	1
LT_3002_01_MAX	VAR	REAL		41.9517		1
LT_3002_01_MIN	VAR	REAL		1.4937		1
LT_3006_01	VAR	REAL	400098		Level transmitter (capacitive)	6
LT_3006_01_AH	VAR	BOOL	000243		High Level in Bioreactor	2
LT_3006_01_AHH	VAR	BOOL	000088		Very High Level in Bioreactor	3
LT_3006_01_AL	VAR	BOOL	000244		Low Level in Bioreactor	2
LT_3006_01_ALL	VAR	BOOL	000089		Very Low Level in Bioreactor	3
LT_3006_01_ERR	VAR	BOOL	000250		SET if the wire is broken	1
LT_3006_01_LIM_H	VAR	REAL	400704	12200.0	High Level in Bioreactor. Need a sensor calibration	1
LT_3006_01_LIM_HH	VAR	REAL	400562	12300.0	Very High Level in Bioreactor. after calibration of the sensor, we will define the HH level threshold similar to the level switch High	1
LT_3006_01_LIM_L	VAR	REAL	400706	11300.0	Low Level in Bioreactor. This alarm should be linked to the recirculation line and also to the output liquid flow line. the alarm is triggered when the level decrease to the limit of these entering pipe.. Need a sensor calibration	1
LT_3006_01_LIM_LL	VAR	REAL	400564	11200.0	Very Low Level in Bioreactor. This alarm should be linked with the bioreactor sensor positionning to prevent bad mesurement.. Need a sensor calibration	1

table continued...

Variable list (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Type	DType	Address	Initial value	Comment	Used
LT_3021_01	VAR	REAL	400164		Level transmitter (capacitive)	5
LT_3021_01_AH	VAR	BOOL	000248		High level on Effluent tank	2
LT_3021_01_AHH	VAR	BOOL	000214		Very High level on Effluent tank	3
LT_3021_01_AL	VAR	BOOL	000215		Low level in Effluent Tank	2
LT_3021_01_ALL	VAR	BOOL	000216		Very Low in Effluent Tank	2
LT_3021_01_ERR	VAR	BOOL	000217		SET if the wire is broken	2
LT_3021_01_LIM_H	VAR	REAL	400686	30.0	High level on Effluent tank	1
LT_3021_01_LIM_HH	VAR	REAL	400688	34.0	Very High level on Effluent tank	1
LT_3021_01_LIM_L	VAR	REAL	400690	6.0	Low level in Effluent Tank	1
LT_3021_01_LIM_LL	VAR	REAL	400692	3.0	Very Low in Effluent Tank	1
LT_3021_01_MAX	VAR	REAL		41.607		1
LT_3021_01_MIN	VAR	REAL		1.551		1
LT_3022_01	VAR	REAL	400166		Level transmitter (capacitive)	0
LT_3022_01_AH	VAR	BOOL	000219		High level foam alarm	0
LT_3022_01_AHH	VAR	BOOL	000220		Very High level foam alarm	0
LT_3022_01_AL	VAR	BOOL	000221		Low level foam alarm	0
LT_3022_01_ALL	VAR	BOOL	000222		Very Low level foam alarm	0
LT_3022_01_ERR	VAR	BOOL	000223		SET if the wire is broken	0
LT_Range_MAX	VAR	REAL		13.7376		1
LT_Range_MIN	VAR	REAL		9.9802		1
output	IVAR	SECT_CTRL				0
PP_3000_01_MV	VAR	BOOL	000031		Existing pump for feeding D03 from CII	0
PP_3000_01_OP	VAR	BOOL	000049		Used to start or stop the pump in manual mode	0
PP_3003_01_DIR	VAR	BOOL	000062		Used to define the direction of PP_3003_01(CW / CCW)	0
PP_3003_01_MV1	VAR	BOOL	000045		Peristaltic Pump, variable speed. On/Off	1
PP_3003_01_MV2	VAR	REAL	400198		Peristaltic Pump, variable speed	2
PP_3003_01_MV3	VAR	BOOL	000046		Peristaltic Pump, ROTATION DIRECTION	1
PP_3003_01_OP	VAR	BOOL	000061		Used to start or stop the pump in manual mode	1
PP_3003_01_SP	VAR	REAL	400078	0.0	Used to define the speed of PP_3003_01	1
PP_3008_01_MV	VAR	BOOL	000043		Peristaltic Pump (acid)	1
PP_3008_01_OP	VAR	BOOL	000100		Used to start or stop the ACID pump in Manual mode (If start, the valve SV_3008_01 is automatically opened and closed)	6
PP_3008_01_OP_TIME	VAR	UDINT	400061	0	Define the injection time of the ACID pump in Manual mode	6
PP_3008_02_MV	VAR	BOOL	000044		Peristaltic Pump (base)	1
PP_3008_02_OP	VAR	BOOL	000101		Used to start or stop the BASE pump in Manual mode(If start, the valve SV_3008_02 is automatically opened and closed)	6
PP_3008_02_OP_TIME	VAR	UDINT	400063	0	Define the injection time of the BASE pump in Manual mode	6
PP_3015_01_MV	VAR	BOOL	000040		Peristaltic Pump multichannel, variable speed (backwash)	1
PP_3015_01_OP	VAR	BOOL	000187		Used to start and stop the pump in manual mode	1
PP_3017_01_MV1	VAR	BOOL	000047		Peristaltic Pump multichannel, variable speed (recirc / ON - OFF)	1
PP_3017_01_MV2	VAR	REAL	400200		Peristaltic Pump multichannel, variable speed (recirc)	2
PP_3017_01_MV3	VAR	BOOL	000048		Peristaltic Pump, ROTATION DIRECTION	1
PP_3017_01_OP	VAR	BOOL	000192		Used to start or stop the peristaticr pump in manual mode	1
PP_3017_01_ROT	VAR	BOOL	000193		Used to define the Rotation direction of	0

table continued...

Variable list (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Type	DType	Address	Initial value	Comment	Used
					the peristatic pump in manual mode	
PP_3017_01_SP	VAR	REAL	400150	0.0	Used to define the speed of the peristatic pump in manual mode	1
PP_3018_01_MV1	VAR	BOOL	000041		Peristaltic Pump multichannel, variable speed (harvest / ON - OFF)	1
PP_3018_01_MV2	VAR	REAL	400196		Peristaltic Pump multichannel, variable speed (harvest)	3
PP_3018_01_MV3	VAR	BOOL	000042		Peristaltic Pump, ROTATION DIRECTION	1
PP_3018_01_OP	VAR	BOOL	000199		Used to start or stop the peristatic pump in manual mode	1
PP_3018_01_ROT	VAR	BOOL	000200		Used to define the Rotation direction of the peristatic pump in manual mode	0
PP_3018_01_SP	VAR	REAL	400154	0.0	Used to define the speed of the peristatic pump in manual mode	1
PP_3022_01_MV	VAR	BOOL	000032		Peristaltic Pump multichannel, variable speed Anti-foam (= future)	0
PP_3022_01_OP	VAR	BOOL	000218		Used to start or stop the peristatic pump in manual mode	0
PT_3003_01	VAR	REAL	400082		Pressure transmitter	5
PT_3003_01_AH	VAR	BOOL	000228		High Flow on the bioreactor inlet liquid	2
PT_3003_01_AHH	VAR	BOOL	000229		Very High Flow on the bioreactor inlet liquid	2
PT_3003_01_AL	VAR	BOOL	000230		Low Flow on the bioreactor inlet liquid	2
PT_3003_01_ALL	VAR	BOOL	000231		Very Low Flow on the bioreactor inlet liquid	2
PT_3003_01_ERR	VAR	BOOL	000068		SET if the wire is broken	2
PT_3003_01_LIM_H	VAR	REAL	400534	45.0	High Flow on the bioreactor inlet liquid	1
PT_3003_01_LIM_HH	VAR	REAL	400536	50.0	Very High Flow on the bioreactor inlet liquid. The maximum admissible pressure for the membrane has to be confirmed by Enrique	1
PT_3003_01_LIM_L	VAR	REAL	400538	5.0	Low Flow on the bioreactor inlet liquid	1
PT_3003_01_LIM_LL	VAR	REAL	400540	0.0	Very Low Flow on the bioreactor inlet liquid. The minimum admissible pressure for the membrane has to be confirmed by Enrique	1
PT_3007_01	VAR	REAL	400102		Pressure element + transmitter	8
PT_3007_01_AH	VAR	BOOL	000095		High pressure in the bioreactor	2
PT_3007_01_AHH	VAR	BOOL	000096		Very High pressure in the bioreactor	2
PT_3007_01_AL	VAR	BOOL	000097		as the threshold is compared to the setpoint, the alarm is triggered after 1min/. Low pressure in the bioreactor	2
PT_3007_01_ALL	VAR	BOOL	000098		Very Low pressure in the bioreactor	2
PT_3007_01_ERR	VAR	BOOL	000099		SET if the wire is broken	2
PT_3007_01_LIM_H	VAR	REAL	400566	100.0	High pressure in the bioreactor. (fix value)	1
PT_3007_01_LIM_HH	VAR	REAL	400568	200.0	Very High pressure in the bioreactor. (fix value)	1
PT_3007_01_LIM_L	VAR	REAL	400570	-20.0	The alarm is triggered after 1min/. Low pressure in the bioreactor. (Compared to SP)	1
PT_3007_01_LIM_LL	VAR	REAL	400572	0.0	Very Low pressure in the bioreactor. (fix value)	1
PT_3007_01_SP	VAR	REAL	400214	50.0	Set Point of the Controller managing the bioreactor pressure	2
PT_3011_01	VAR	REAL	400140		Pressure transmitter	5
PT_3011_01_AH	VAR	BOOL	000144		High pressure in the gas loop system	2

table continued...

Variable list (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Type	DType	Address	Initial value	Comment	Used
PT_3011_01_AHH	VAR	BOOL	000145		Very High pressure in the gas loop system	2
PT_3011_01_AL	VAR	BOOL	000146		Need to be tested by sherpa. If the threshold is too high, we can decrease to 30 or 20. Low pressure in the gas loop system	2
PT_3011_01_ALL	VAR	BOOL	000147		Very Low pressure in the gas loop system	2
PT_3011_01_ERR	VAR	BOOL	000150		SET if the wire is broken	2
PT_3011_01_LIM_H	VAR	REAL	400614	100.0	High pressure in the gas loop system	1
PT_3011_01_LIM_HH	VAR	REAL	400616	500.0	Very High pressure in the gas loop system	1
PT_3011_01_LIM_L	VAR	REAL	400618	40.0	Need to be tested by sherpa. If the threshold is too high, we can decrease to 30 or 20. Low pressure in the gas loop system	1
PT_3011_01_LIM_LL	VAR	REAL	400620	0.0	Very Low pressure in the gas loop system	1
REAL0	VAR	REAL		0.0		2
REAL1	VAR	REAL		1.0		2
SV_3001_01_A	VAR	BOOL	000051		Alarm ON if SV_3001_01_MV=1 and SV_3001_01_FB=0 during 5seconds	2
SV_3001_01_FB	VAR	BOOL	100025		Temperature Control Valve Feedback	1
SV_3001_01_MV	VAR	BOOL	000019		Temperature Control Valve	1
SV_3001_01_OP	VAR	BOOL	000050		open / close valve SV_3001_01	1
SV_3005_01_A	VAR	BOOL	000075		Alarm ON if SV_3005_01_MV=1 and SV_3005_01_FB=0 during 5seconds	2
SV_3005_01_FB	VAR	BOOL	100034		Temperature Control Valve feedback see Heat exchanger (COLD)	1
SV_3005_01_MV	VAR	BOOL	000023		Temperature Control Valve see Heat exchanger (COLD)	1
SV_3005_01_OP	VAR	BOOL	000074		Used to open or close the valve in manual mode	1
SV_3005_02_A	VAR	BOOL	000073		Alarm ON if SV_3005_02_MV=1 and SV_3005_02_FB=0 during 5seconds	2
SV_3005_02_FB	VAR	BOOL	100035		Temperature Control Valve feedbacksee Heat exchanger (HOT)	1
SV_3005_02_MV	VAR	BOOL	000021		Temperature Control Valve see Heat exchanger (HOT)	1
SV_3005_02_OP	VAR	BOOL	000072		Used to open or close the valve in manual mode	1
SV_3008_01_A	VAR	BOOL	000111		Set if the feed back is not detected after 5 seconds	2
SV_3008_01_FB	VAR	BOOL	100027		Acid valve feedback	1
SV_3008_01_MV	VAR	BOOL	000025		Acid valve	1
SV_3008_01_OP	VAR	BOOL	000245		Used to open or close the valve in manual mode	6
SV_3008_02_A	VAR	BOOL	000112		Set if the feed back is not detected after 5 seconds	2
SV_3008_02_FB	VAR	BOOL	100026		Base valve feedback	1
SV_3008_02_MV	VAR	BOOL	000027		Base valve	1
SV_3008_02_OP	VAR	BOOL	000246		Used to open or close the valve in manual mode	6
SV_3011_01_A	VAR	BOOL	000151		Set if the feed back is not detected after 5 seconds	2
SV_3011_01_FB	VAR	BOOL	100028		Reactor venting valve feedback	1
SV_3011_01_MV	VAR	BOOL	000022		Reactor venting valve	1
SV_3011_01_OP	VAR	BOOL	000142		Used to open or close the valve in manual mode	2
SV_3011_02_A	VAR	BOOL	000152		Set if the feed back is not detected after 5 seconds	2

table continued...

Variable list (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Type	DType	Address	Initial value	Comment	Used
SV_3011_02_Day	VAR	BYTE	400272		Date of last Reset	1
SV_3011_02_FB	VAR	BOOL	100030		Gas exhaust valve feedback	1
SV_3011_02_Hour	VAR	BYTE	400268		Date of last Reset	1
SV_3011_02_Minute	VAR	BYTE	400267		Date of last Reset	1
SV_3011_02_Month	VAR	BYTE	400269		Date of last Reset	1
SV_3011_02_MV	VAR	BOOL	000018		Gas exhaust valve	1
SV_3011_02_OP	VAR	BOOL	000143		Used to open or close the valve in manual mode	1
SV_3011_02_OpenFreqInHour	VAR	REAL				5
SV_3011_02_Opening_Frequency	VAR	REAL	400212		Display the Frequency per hour of the opening valve since the last reset	2
SV_3011_02_Reset_Timer	VAR	BOOL	000247		Date of last Reset	1
SV_3011_02_Second	VAR	BYTE	400266		Date of last Reset	1
SV_3011_02_TotalHour	VAR	REAL				4
SV_3011_02_TotalOpening	VAR	REAL				4
SV_3011_02_Year	VAR	BYTE	400270		Date of last Reset	1
SV_3011_03_A	VAR	BOOL	000190		Set if the feed back is not detected after 5 seconds / OLD NAME OF THE VALVE: SV_3016_01	1
SV_3011_03_FB	VAR	BOOL	100032		Gas introduction valve Feedback / OLD NAME OF THE VALVE: SV_3016_01	1
SV_3011_03_MV	VAR	BOOL	000024		Gas introduction valve / OLD NAME OF THE VALVE: SV_3016_01	1
SV_3011_03_OP	VAR	BOOL	000188		Used to open or close the valve in manual mode / OLD NAME OF THE VALVE: SV_3016_01	1
SV_3011_Opening_Time	VAR	REAL	400210		Display the time (in second) when the valve is opened since the last reset	3
SV_3013_01_A	VAR	BOOL	000163		Set if the feed back is not detected after 5 seconds	2
SV_3013_01_FB	VAR	BOOL	100036		NH4 sampling valve Feedback	4
SV_3013_01_MV	VAR	BOOL	000028		NH4 sampling valve	2
SV_3013_01_OP	VAR	BOOL	000157		Used to open or close the valve in manual mode	5
SV_3013_01_R	VAR	BOOL				9
SV_3013_01_S	VAR	BOOL				4
SV_3013_02_A	VAR	BOOL	000164		Set if the feed back is not detected after 5 seconds	2
SV_3013_02_FB	VAR	BOOL	100037		N03 sampling valve Feedback	4
SV_3013_02_MV	VAR	BOOL	000029		N03 sampling valve	2
SV_3013_02_OP	VAR	BOOL	000158		Used to open or close the valve in manual mode	5
SV_3013_02_R	VAR	BOOL				9
SV_3013_02_S	VAR	BOOL				4
SV_3013_03_A	VAR	BOOL	000165		Set if the feed back is not detected after 5 seconds	2
SV_3013_03_FB	VAR	BOOL	100038		N02 sampling valve Feedback	3
SV_3013_03_MV	VAR	BOOL	000030		N02 sampling valve	2
SV_3013_03_OP	VAR	BOOL	000159		Used to open or close the valve in manual mode	4
SV_3013_03_R	VAR	BOOL				6
SV_3013_03_S	VAR	BOOL				3
SV_3016_01_A	VAR	BOOL	000191		Set if the feed back is not detected after 5 seconds / OLD NAME OF THE VALVE: SV_3016_02	1
SV_3016_01_FB	VAR	BOOL	100031		Gas introduction valve Feedback / OLD NAME OF THE VALVE: SV_3016_02	1
SV_3016_01_MV	VAR	BOOL	000026		Gas introduction valve / OLD NAME OF THE	1

table continued...

Variable list (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Type	DType	Address	Initial value	Comment	Used
					VALVE: SV_3016_02	
SV_3016_01_OP	VAR	BOOL	000189		Used to open or close the valve in manual mode / OLD NAME OF THE VALVE: SV_3016_02	1
SV_3018_01_A	VAR	BOOL	000206		Set if the feed back is not detected after 5 seconds	1
SV_3018_01_FB	VAR	BOOL	100029		Reactor liquid outlet valve Feedback	1
SV_3018_01_MV	VAR	BOOL	000020		Reactor liquid outlet valve	1
SV_3018_01_OP	VAR	BOOL	000249		Used to open and close the valve in manual mode	1
SV_3020_01_A	VAR	BOOL	000213		Set if the feed back is not detected after 5 seconds	2
SV_3020_01_FB	VAR	BOOL	100033		Temperature Control Valve Feedback	2
SV_3020_01_MV	VAR	BOOL	000017		Temperature Control Valve	2
SV_3020_01_OP	VAR	BOOL	000207		Used to open and close the valve in manual mode	1
System_clock	IVAR	SECT_CTRL				0
SYSTEM_COLD_WARM	VAR	BOOL				1
SYSTEM_STATE	IVAR	SECT_CTRL				0
S_CL3013_NH4_000	IVAR	SFCSTEP_STATE				0
S_CL3013_NH4_001	IVAR	SFCSTEP_STATE				1
S_CL3013_NH4_002	IVAR	SFCSTEP_STATE				1
S_CL3013_NH4_003	IVAR	SFCSTEP_STATE				1
S_CL3013_NH4_004	IVAR	SFCSTEP_STATE				1
S_CL3013_NH4_Calib_000	IVAR	SFCSTEP_STATE				0
S_CL3013_NH4_Calib_001	IVAR	SFCSTEP_STATE				1
S_CL3013_NH4_Calib_002	IVAR	SFCSTEP_STATE				1
S_CL3013_NH4_Calib_003	IVAR	SFCSTEP_STATE				1
S_CL3013_NH4_Stop_000	IVAR	SFCSTEP_STATE				0
S_CL3013_NH4_Stop_001	IVAR	SFCSTEP_STATE				1
S_CL3013_NH4_Stop_002	IVAR	SFCSTEP_STATE				1
S_CL3013_NO2_000	IVAR	SFCSTEP_STATE				0
S_CL3013_NO2_001	IVAR	SFCSTEP_STATE				1
S_CL3013_NO2_002	IVAR	SFCSTEP_STATE				1
S_CL3013_NO2_003	IVAR	SFCSTEP_STATE				1
S_CL3013_NO2_004	IVAR	SFCSTEP_STATE				1
S_CL3013_NO2_Stop_000	IVAR	SFCSTEP_STATE				0
S_CL3013_NO2_Stop_001	IVAR	SFCSTEP_STATE				1
S_CL3013_NO2_Stop_002	IVAR	SFCSTEP_STATE				1
S_CL3013_NO3_000	IVAR	SFCSTEP_STATE				0
S_CL3013_NO3_001	IVAR	SFCSTEP_STATE				1
S_CL3013_NO3_002	IVAR	SFCSTEP_STATE				1
S_CL3013_NO3_003	IVAR	SFCSTEP_STATE				1
S_CL3013_NO3_004	IVAR	SFCSTEP_STATE				1
S_CL3013_NO3_Calib_000	IVAR	SFCSTEP_STATE				0
S_CL3013_NO3_Calib_001	IVAR	SFCSTEP_STATE				1
S_CL3013_NO3_Calib_002	IVAR	SFCSTEP_STATE				1
S_CL3013_NO3_Calib_003	IVAR	SFCSTEP_STATE				1
S_CL3013_NO3_Stop_000	IVAR	SFCSTEP_STATE				0
S_CL3013_NO3_Stop_001	IVAR	SFCSTEP_STATE				1
S_CL3013_NO3_Stop_002	IVAR	SFCSTEP_STATE				1
TT_3001_01	VAR	REAL	400072		Temperature element + transmitter (D03)	6
TT_3001_01_AH	VAR	BOOL	000052		Set point +1 °C	2
TT_3001_01_AHH	VAR	BOOL	000053		Set point +2 °C	2
TT_3001_01_AL	VAR	BOOL	000054		Set point -1 °C	2
TT_3001_01_ALL	VAR	BOOL	000055		Set point -2 °C	2
TT_3001_01_ERR	VAR	BOOL	000056		SET if the wire is broken	2
TT_3001_01_LIM_H	VAR	REAL	400512	1.0	High temperature in the influent Tank.	1

table continued...

Variable list (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Type	DType	Address	Initial value	Comment	Used
TT_3001_01_LIM_HH	VAR	REAL	400514	2.0	Compared to the set point Very High temperature in the influent Tank.	1
TT_3001_01_LIM_L	VAR	REAL	400516	-1.0	Compared to the set point Low Temperature in the influent Tank.	1
TT_3001_01_LIM_LL	VAR	REAL	400518	-2.0	Compared to the set point Very Low Temperature in the influent Tank.	1
TT_3001_01_SP	VAR	REAL	400074	10.0	Compared to the set point Temperature set point of influent tank	5
TT_3005_01	VAR	REAL	400092		Temperature element + transmitter (middle C01)	6
TT_3005_01_AH	VAR	BOOL	000081		Compare to the set point. High Temperature on the bioreactor	2
TT_3005_01_AHH	VAR	BOOL	000082		Compare to the set point. Very High Temperature on the bioreactor	2
TT_3005_01_AL	VAR	BOOL	000083		Compare to the set point. High Temperature on the bioreactor	2
TT_3005_01_ALL	VAR	BOOL	000084		Compare to the set point. Very High Temperature on the bioreactor	2
TT_3005_01_ERR	VAR	BOOL	000085		SET if the wire is broken	5
TT_3005_01_LIM_H	VAR	REAL	400546	1.0	Compared to the set point. High Temperature in the bioreactor	1
TT_3005_01_LIM_HH	VAR	REAL	400548	4.0	Compared to the set point. Very High Temperature in the bioreactor	1
TT_3005_01_LIM_L	VAR	REAL	400550	-1.0	Compared to the set point. High Temperature in the bioreactor	1
TT_3005_01_LIM_LL	VAR	REAL	400552	-4.0	Compared to the set point. Very High Temperature in the bioreactor	1
TT_3005_02	VAR	REAL	400090		Temperature element + transmitter (thermost fluid jacket C01)	7
TT_3005_02_AH	VAR	BOOL	000076		Compare to the set point. High Temperature on the bioreactor Jacket	2
TT_3005_02_AHH	VAR	BOOL	000077		Compare to the set point. Very High Temperature on the bioreactor Jacket	2
TT_3005_02_AL	VAR	BOOL	000078		Compare to the set point. High Temperature on the bioreactor Jacket	2
TT_3005_02_ALL	VAR	BOOL	000079		Compare to the set point. Very High Temperature on the bioreactor Jacket	2
TT_3005_02_ERR	VAR	BOOL	000080		SET if the wire is broken	3
TT_3005_02_LIM_H	VAR	REAL	400554	1.0	Compared to the set point. High Temperature in the bioreactor Jacket	1
TT_3005_02_LIM_HH	VAR	REAL	400556	4.0	Compared to the set point. Very High Temperature in the bioreactor Jacket	1
TT_3005_02_LIM_L	VAR	REAL	400558	-1.0	Compared to the set point. High Temperature in the bioreactor Jacket	1
TT_3005_02_LIM_LL	VAR	REAL	400560	-4.0	Compared to the set point. Very High Temperature in the bioreactor Jacket	1
TT_3005_03	VAR	REAL	400094		Temperature element + transmitter (top C01)	3
TT_3005_03_ERR	VAR	BOOL	000086		SET if the wire is broken	6
TT_3005_04	VAR	REAL	400096		Temperature element + transmitter (bottom C01)	3
TT_3005_04_ERR	VAR	BOOL	000087		SET if the wire is broken	6
TT_3005_AVERAGE	VAR	REAL				4
TT_3005_CONTROLLED	VAR	REAL				3
TT_3005_SP	VAR	REAL	400088	28.0	Used to define the temperature set point of the bioreactor	5
TT_3008_01	VAR	REAL	400110		Temperature pH element	1

table continued...

Variable list (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Type	DType	Address	Initial value	Comment	Used
TT_3008_01_ERR	VAR	BOOL	000114		SET if the wire is broken	2
TT_3008_02	VAR	REAL	400114		Temperature pH element	1
TT_3008_02_ERR	VAR	BOOL	000116		SET if the wire is broken	2
TT_3012_01	VAR	REAL	400142		Air vent cold water temperature transmitter	5
TT_3012_01_AH	VAR	BOOL	000153		High Temperature in the Gas Cooling system	2
TT_3012_01_AHH	VAR	BOOL	000154		Very High Temperature in the Gas Cooling system	2
TT_3012_01_AL	VAR	BOOL	000155		Low Temperature in the Gas Cooling system	2
TT_3012_01_ALL	VAR	BOOL	000156		Very Low Temperature in the Gas Cooling system	2
TT_3012_01_ERR	VAR	BOOL	000232		SET if the wire is broken	2
TT_3012_01_LIM_H	VAR	REAL	400622	11.0	To be confirmed by UAB when the reactor will be in nominal work. High Temperature in the Gas Cooling system	1
TT_3012_01_LIM_HH	VAR	REAL	400624	20.0	To be confirmed by UAB when the reactor will be in nominal work. Very High Temperature in the Gas Cooling system	1
TT_3012_01_LIM_L	VAR	REAL	400626	9.0	To be confirmed by UAB when the reactor will be in nominal work. Low Temperature in the Gas Cooling system	1
TT_3012_01_LIM_LL	VAR	REAL	400628	8.0	To be confirmed by UAB when the reactor will be in nominal work. Very Low Temperature in the Gas Cooling system	1
TT_3020_01	VAR	REAL	400162		Temperature element + transmitter (D04)	6
TT_3020_01_AH	VAR	BOOL	000208		Compared to the set point. High temperature in the effluent Tank	2
TT_3020_01_AHH	VAR	BOOL	000209		Compared to the set point. Very High temperature in the effluent Tank	2
TT_3020_01_AL	VAR	BOOL	000210		Compared to the set point. Low Temperature in the effluent Tank	2
TT_3020_01_ALL	VAR	BOOL	000211		Compared to the set point. Very Low Temperature in the effluent Tank	2
TT_3020_01_ERR	VAR	BOOL	000212		SET if the wire is broken	2
TT_3020_01_LIM_H	VAR	REAL	400678	1.0	Compared to the set point. High temperature in the effluent Tank	1
TT_3020_01_LIM_HH	VAR	REAL	400680	2.0	Compared to the set point. Very High temperature in the effluent Tank	1
TT_3020_01_LIM_L	VAR	REAL	400682	-1.0	Compared to the set point. Low Temperature in the effluent Tank	1
TT_3020_01_LIM_LL	VAR	REAL	400684	-2.0	Compared to the set point. Very Low Temperature in the effluent Tank	1
TT_3020_01_SP	VAR	REAL	400160	10.0	Used to define the temperature set point of effluent tank	5
TT_3023_01	VAR	REAL	400178		Mobile temperature used for sterilisation	1
TT_3023_01_ERR	VAR	BOOL	000225		SET if the wire is broken	2
TT_3023_02	VAR	REAL	400180		Mobile temperature used for sterilisation	1
TT_3023_02_ERR	VAR	BOOL	000226		SET if the wire is broken	2
TT_3023_03	VAR	REAL	400182		Mobile temperature used for sterilisation	1
TT_3023_03_ERR	VAR	BOOL	000227		SET if the wire is broken	2
TT_Range_MAX	VAR	REAL		150.0		7
TT_Range_MIN	VAR	REAL		0.0		7
T_CL3013_NH4_001	IVAR	BOOL				2
T_CL3013_NH4_002	IVAR	BOOL				2
T_CL3013_NH4_004	IVAR	BOOL				2
T_CL3013_NH4_Calib_001	IVAR	BOOL				2
T_CL3013_NH4_Calib_002	IVAR	BOOL				2

table continued...

Variable list (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Type	DType	Address	Initial value	Comment	Used
T_CL3013_NH4_Calib_004	IVAR	BOOL				2
T_CL3013_NH4_Stop_001	IVAR	BOOL				2
T_CL3013_NH4_Stop_002	IVAR	BOOL				2
T_CL3013_NO2_001	IVAR	BOOL				2
T_CL3013_NO2_Stop_001	IVAR	BOOL				2
T_CL3013_NO2_Stop_002	IVAR	BOOL				2
T_CL3013_NO3_001	IVAR	BOOL				2
T_CL3013_NO3_002	IVAR	BOOL				2
T_CL3013_NO3_004	IVAR	BOOL				2
T_CL3013_NO3_Calib_001	IVAR	BOOL				2
T_CL3013_NO3_Calib_002	IVAR	BOOL				2
T_CL3013_NO3_Calib_004	IVAR	BOOL				2
T_CL3013_NO3_Stop_001	IVAR	BOOL				2
T_CL3013_NO3_Stop_002	IVAR	BOOL				2
WIT_3008_01	VAR	REAL	400116		Acid Bottle weight indicator (+ weighing scale)	2
WIT_3008_01_AL	VAR	BOOL	000107		Low Level in the ACID tank	2
WIT_3008_01_ALL	VAR	BOOL	000108		Very Low Level in the ACID tank	2
WIT_3008_01_ERR	VAR	BOOL	000117		SET if the wire is broken	2
WIT_3008_01_LIM_L	VAR	REAL	400590	1.0	Low Level in the ACID tank	1
WIT_3008_01_LIM_LL	VAR	REAL	400592	0.5	Very Low Level in the ACID tank	1
WIT_3008_02	VAR	REAL	400118		Base Bottle weight indicator (+ weighing scale)	2
WIT_3008_02_AL	VAR	BOOL	000109		Low Level in the BASE tank	2
WIT_3008_02_ALL	VAR	BOOL	000110		Very Low Level in the BASE tank	2
WIT_3008_02_LIM_L	VAR	REAL	400594	1.0	Low Level in the BASE tank	1
WIT_3008_02_LIM_LL	VAR	REAL	400596	0.5	Very Low Level in the BASE tank	1

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
AT_3008_01	FBD:Input	LAG_FILTER	FBI_2_48	109,146	OUT	W
	FBD:CL3008_Bioreactor_pH_>Control	MOVE	.11.135	20,24	IN	R
	FBD:CL3008_Bioreactor_pH_>Control	AVERA	FBI_11_136	22,10	IN1	R
	FBD:CL3008_Bioreactor_pH_>Control	OPMDREAL	FBI_11_137	65,10	AUTO	R
	FBD:CL3008_Bioreactor_pH_>Control	SUB_REAL	.11.253	106,224	IN1	R
AT_3008_01_ERR	FBD:ERR_AI	WORD_TO_BIT	FBI_4_2	44,21	BIT11	W
	FBD:ALARM_STATUS	OR_BOOL	.31.2	47,19	IN7	R
	FBD:CL3008_Bioreactor_pH_>Control	AND_BOOL	.11.131	5,7	IN1	R
	FBD:CL3008_Bioreactor_pH_>Control	AND_BOOL	.11.132	4,15	IN1	R
	FBD:CL3008_Bioreactor_pH_>Control	AND_BOOL	.11.134	4,23	IN1	R
	FBD:CL3008_Bioreactor_pH_>Control	AND_BOOL	.11.139	74,19	IN2	R
AT_3008_01_Raw	FBD:Input	I_SCALE	.2.30	88,144	Y	W
AT_3008_02	FBD:Input	LAG_FILTER	FBI_2_47	122,138	OUT	W
	FBD:CL3008_Bioreactor_pH_>Control	MOVE	.11.133	20,16	IN	R
	FBD:CL3008_Bioreactor_pH_>Control	AVERA	FBI_11_136	22,11	IN2	R
	FBD:CL3008_Bioreactor_pH_>Control	OPMDREAL	FBI_11_137	65,11	MAN	R
	FBD:CL3008_Bioreactor_pH_>Control	SUB_REAL	.11.253	106,225	IN2	R
AT_3008_02_ERR	FBD:ERR_AI	WORD_TO_BIT	FBI_4_2	44,20	BIT10	W
	FBD:ALARM_STATUS	OR_BOOL	.31.2	47,21	IN9	R
	FBD:CL3008_Bioreactor_pH_>Control	AND_BOOL	.11.131	5,8	IN2	R
	FBD:CL3008_Bioreactor_pH_>Control	AND_BOOL	.11.132	4,16	IN2	R
	FBD:CL3008_Bioreactor_pH_>Control	AND_BOOL	.11.134	4,24	IN2	R
	FBD:CL3008_Bioreactor_pH_>Control	AND_BOOL	.11.141	74,27	IN2	R
AT_3008_02_Raw	FBD:Input	I_SCALE	.2.29	88,136	Y	W
AT_3009_01	FBD:Input	I_SCALE	.2.34	88,172	Y	W
	FBD:CL3009_Bioreactor_DO2>_Control	MOVE	.12.8	19,26	IN	R
	FBD:CL3009_Bioreactor_DO2>_Control	SUB_REAL	.12.20	5,93	IN1	R
	FBD:CL3009_Bioreactor_DO2>_Control	SUB_REAL	.12.24	3,135	IN1	R
	FBD:CL3009_Bioreactor_DO2>_Control	SUB_REAL	.12.28	69,99	IN1	R
	FBD:CL3009_Bioreactor_DO2>_Control	SUB_REAL	.12.33	70,141	IN1	R
	FBD:CL3009_Bioreactor_DO2>_Control	AVERA	FBI_12_37	35,15	IN1	R
	FBD:CL3009_Bioreactor_DO2>_Control	OPMDREAL	FBI_12_38	67,7	AUTO	R
	FBD:CL3009_Bioreactor_DO2>_Control	SUB_REAL	.12.68	2,182	IN1	R
AT_3009_01_AH	FBD:ALARM_STATUS	OR_BOOL	.31.5	14,91	IN23	R

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
	FBD:CL3009_Bioreactor_DO2>_Control	ACT_DIA	FBI_12_86	58,90	ERR	W
AT_3009_01_AHH	FBD:ALARM_STATUS	OR_BOOL	.31.2	47,26	IN14	R
	FBD:CL3009_Bioreactor_DO2>_Control	ACT_DIA	FBI_12_88	61,130	ERR	W
AT_3009_01_AL	FBD:ALARM_STATUS	OR_BOOL	.31.5	14,92	IN24	R
	FBD:CL3009_Bioreactor_DO2>_Control	ACT_DIA	FBI_12_90	132,91	ERR	W
AT_3009_01_ALL	FBD:ALARM_STATUS	OR_BOOL	.31.2	47,27	IN15	R
	FBD:CL3009_Bioreactor_DO2>_Control	ACT_DIA	FBI_12_92	135,135	ERR	W
AT_3009_01_ERR	FBD:ERR_AI	WORD_TO_BIT	FBI_4_2	44,25	BIT15	W
	FBD:ALARM_STATUS	OR_BOOL	.31.2	47,28	IN16	R
	FBD:CL3009_Bioreactor_DO2>_Control	AND_BOOL	.12.3	4,9	IN1	R
	FBD:CL3009_Bioreactor_DO2>_Control	AND_BOOL	.12.5	3,17	IN1	R
	FBD:CL3009_Bioreactor_DO2>_Control	AND_BOOL	.12.7	3,25	IN1	R
	FBD:CL3009_Bioreactor_DO2>_Control	AND_BOOL	.12.39	85,17	IN2	R
AT_3009_02	FBD:Input	I_SCALE	.2.33	88,165	Y	W
	FBD:CL3009_Bioreactor_DO2>_Control	MOVE	.12.6	19,18	IN	R
	FBD:CL3009_Bioreactor_DO2>_Control	SUB_REAL	.12.22	3,114	IN1	R
	FBD:CL3009_Bioreactor_DO2>_Control	SUB_REAL	.12.26	4,151	IN1	R
	FBD:CL3009_Bioreactor_DO2>_Control	SUB_REAL	.12.31	70,119	IN1	R
	FBD:CL3009_Bioreactor_DO2>_Control	SUB_REAL	.12.35	69,160	IN1	R
	FBD:CL3009_Bioreactor_DO2>_Control	AVERA	FBI_12_37	35,16	IN2	R
	FBD:CL3009_Bioreactor_DO2>_Control	OPMDREAL	FBI_12_38	67,8	MAN	R
	FBD:CL3009_Bioreactor_DO2>_Control	SUB_REAL	.12.68	2,183	IN2	R
AT_3009_02_AH	FBD:ALARM_STATUS	OR_BOOL	.31.5	14,93	IN25	R
	FBD:CL3009_Bioreactor_DO2>_Control	ACT_DIA	FBI_12_87	58,109	ERR	W
AT_3009_02_AHH	FBD:ALARM_STATUS	OR_BOOL	.31.2	47,29	IN17	R
	FBD:CL3009_Bioreactor_DO2>_Control	ACT_DIA	FBI_12_89	61,148	ERR	W
AT_3009_02_AL	FBD:ALARM_STATUS	OR_BOOL	.31.5	14,94	IN26	R
	FBD:CL3009_Bioreactor_DO2>_Control	ACT_DIA	FBI_12_91	133,112	ERR	W
AT_3009_02_ALL	FBD:ALARM_STATUS	OR_BOOL	.31.2	47,30	IN18	R
	FBD:CL3009_Bioreactor_DO2>_Control	ACT_DIA	FBI_12_93	134,154	ERR	W
AT_3009_02_ERR	FBD:ERR_AI	WORD_TO_BIT	FBI_4_2	44,24	BIT14	W
	FBD:ALARM_STATUS	OR_BOOL	.31.2	47,31	IN19	R
	FBD:CL3009_Bioreactor_DO2>_Control	AND_BOOL	.12.3	4,10	IN2	R
	FBD:CL3009_Bioreactor_DO2>_Control	AND_BOOL	.12.5	3,18	IN2	R
	FBD:CL3009_Bioreactor_DO2>	AND_BOOL	.12.7	3,26	IN2	R

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
	_Control					
	FBD:CL3009_Bioreactor_DO2>_Control	AND_BOOL	.12.40	85,25	IN2	R
AT_3009_LIM_H	FBD:CL3009_Bioreactor_DO2>_Control	GT_REAL	.12.21	16,96	IN2	R
	FBD:CL3009_Bioreactor_DO2>_Control	GT_REAL	.12.23	16,117	IN2	R
AT_3009_LIM_HH	FBD:CL3009_Bioreactor_DO2>_Control	GT_REAL	.12.25	16,138	IN2	R
	FBD:CL3009_Bioreactor_DO2>_Control	GT_REAL	.12.27	16,154	IN2	R
AT_3009_LIM_L	FBD:CL3009_Bioreactor_DO2>_Control	LT_REAL	.12.30	88,100	IN2	R
	FBD:CL3009_Bioreactor_DO2>_Control	LT_REAL	.12.32	89,120	IN2	R
AT_3009_LIM_LL	FBD:CL3009_Bioreactor_DO2>_Control	LT_REAL	.12.34	89,142	IN2	R
	FBD:CL3009_Bioreactor_DO2>_Control	LT_REAL	.12.36	88,161	IN2	R
AT_3010_01	FBD:Input	I_SCALE	.2.32	88,158	Y	W
	FBD:CL3010_Bioreactor_EC_>Control	GT_REAL	.13.2	7,18	IN1	R
	FBD:CL3010_Bioreactor_EC_>Control	GT_REAL	.13.5	7,38	IN1	R
	FBD:CL3010_Bioreactor_EC_>Control	LT_REAL	.13.7	75,17	IN1	R
	FBD:CL3010_Bioreactor_EC_>Control	LT_REAL	.13.10	76,35	IN1	R
AT_3010_01_AH	FBD:ALARM_STATUS	OR_BOOL	.31.5	14,95	IN27	R
	FBD:CL3010_Bioreactor_EC_>Control	ACT_DIA	FBI_13_12	43,15	ERR	W
AT_3010_01_AHH	FBD:ALARM_STATUS	OR_BOOL	.31.2	47,33	IN21	R
	FBD:CL3010_Bioreactor_EC_>Control	ACT_DIA	FBI_13_14	43,34	ERR	W
AT_3010_01_AL	FBD:ALARM_STATUS	OR_BOOL	.31.5	14,96	IN28	R
	FBD:CL3010_Bioreactor_EC_>Control	ACT_DIA	FBI_13_16	111,15	ERR	W
AT_3010_01_ALL	FBD:ALARM_STATUS	OR_BOOL	.31.2	47,34	IN22	R
	FBD:CL3010_Bioreactor_EC_>Control	ACT_DIA	FBI_13_18	112,34	ERR	W
AT_3010_01_ERR	FBD:ERR_AI	WORD_TO_BIT	FBI_4_2	44,23	BIT13	W
	FBD:ALARM_STATUS	OR_BOOL	.31.2	47,35	IN23	R
AT_3010_02	FBD:Input	I_SCALE	.2.31	88,151	Y	W
	FBD:CL3010_Bioreactor_EC_>Control	GT_REAL	.13.4	7,25	IN1	R
	FBD:CL3010_Bioreactor_EC_>Control	GT_REAL	.13.6	7,45	IN1	R
	FBD:CL3010_Bioreactor_EC_>Control	LT_REAL	.13.8	75,24	IN1	R
	FBD:CL3010_Bioreactor_EC_>Control	LT_REAL	.13.11	76,44	IN1	R
AT_3010_02_AH	FBD:ALARM_STATUS	OR_BOOL	.31.5	14,97	IN29	R
	FBD:CL3010_Bioreactor_EC_>Control	ACT_DIA	FBI_13_13	43,24	ERR	W
AT_3010_02_AHH	FBD:ALARM_STATUS	OR_BOOL	.31.2	47,36	IN24	R
	FBD:CL3010_Bioreactor_EC_>Control	ACT_DIA	FBI_13_15	43,44	ERR	W

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
AT_3010_02_AL	FBD:ALARM_STATUS	OR_BOOL	.31.5	14,98	IN30	R
	FBD:CL3010_Bioreactor_EC_>Control	ACT_DIA	FBI_13_17	111,24	ERR	W
AT_3010_02_ALL	FBD:ALARM_STATUS	OR_BOOL	.31.2	47,37	IN25	R
	FBD:CL3010_Bioreactor_EC_>Control	ACT_DIA	FBI_13_19	112,43	ERR	W
AT_3010_02_ERR	FBD:ERR_AI	WORD_TO_BIT	FBI_4_2	44,22	BIT12	W
	FBD:ALARM_STATUS	OR_BOOL	.31.2	47,38	IN26	R
AT_3010_LIM_H	FBD:CL3010_Bioreactor_EC_>Control	GT_REAL	.13.2	7,19	IN2	R
	FBD:CL3010_Bioreactor_EC_>Control	GT_REAL	.13.4	7,26	IN2	R
AT_3010_LIM_HH	FBD:CL3010_Bioreactor_EC_>Control	GT_REAL	.13.5	7,39	IN2	R
	FBD:CL3010_Bioreactor_EC_>Control	GT_REAL	.13.6	7,46	IN2	R
AT_3010_LIM_L	FBD:CL3010_Bioreactor_EC_>Control	LT_REAL	.13.7	75,18	IN2	R
	FBD:CL3010_Bioreactor_EC_>Control	LT_REAL	.13.8	75,25	IN2	R
AT_3010_LIM_LL	FBD:CL3010_Bioreactor_EC_>Control	LT_REAL	.13.10	76,36	IN2	R
	FBD:CL3010_Bioreactor_EC_>Control	LT_REAL	.13.11	76,45	IN2	R
AT_3013_01	FBD:CL3013_NH4_Management	GT_REAL	.60.56	174,49	IN1	R
	FBD:CL3013_NH4_Management	GT_REAL	.60.57	174,60	IN1	R
AT_3013_01_AH	FBD:ALARM_STATUS	OR_BOOL	.31.6	38,72	IN3	R
	FBD:CL3013_NH4_Management	ACT_DIA	FBI_60_119	209,48	ERR	W
AT_3013_01_AHH	FBD:ALARM_STATUS	OR_BOOL	.31.3	71,22	IN8	R
	FBD:CL3013_NH4_Management	ACT_DIA	FBI_60_120	208,57	ERR	W
AT_3013_01_AL	FBD:ALARM_STATUS	OR_BOOL	.31.6	38,73	IN4	R
AT_3013_01_ALL	FBD:ALARM_STATUS	OR_BOOL	.31.3	71,23	IN9	R
AT_3013_01_Calib_OutOfRange_A	FBD:CL3013_NH4_Management	AND_BOOL	.60.16	61,46	IN2	R
	FBD:T_CL3013_NH4_001	AND_BOOL	.33.1	64,11	IN2	R
AT_3013_01_ERR	FBD:ALARM_STATUS	OR_BOOL	.31.3	71,28	IN14	R
AT_3013_01_ERROR	FBD:T_CL3013_NH4_001	AND_BOOL	.33.1	64,14	IN5	R
	FBD:T_CL3013_NH4_Calib_001	AND_BOOL	.38.4	64,15	IN2	R
AT_3013_01_LIM_H	FBD:CL3013_NH4_Management	GT_REAL	.60.56	174,50	IN2	R
AT_3013_01_LIM_HH	FBD:CL3013_NH4_Management	GT_REAL	.60.57	174,61	IN2	R
AT_3013_01_Start_Analysis	FBD:CL3013_SFC_CONTROL_PR>OCEDURE	MOVE	.36.7	70,26	OUT	W
	FBD:CL3013_SFC_CONTROL_PR>OCEDURE	MOVE	.36.64	60,134	OUT	W
	FBD:CL3013_NH4_Management	MOVE	.60.18	100,46	OUT	W
	FBD:CL3013_NH4_Management	MOVE	.60.34	67,177	OUT	W
	FBD:CL3013_NH4_Management	MOVE	.60.39	51,84	OUT	W
	FBD:CL3013_NH4_Management	R_TRIG	FBI_60_83	12,221	CLK	R
	FBD:CL3013_NH4_Management	MOVE	.60.90	63,216	OUT	W
	FBD:T_CL3013_NH4_001	AND_BOOL	.33.1	64,10	IN1	R
AT_3013_01_Start_Analysis_FLAG	FBD:CL3013_SFC_CONTROL_PR>OCEDURE	MOVE	.36.53	71,55	OUT	W
	FBD:CL3013_SFC_CONTROL_PR>OCEDURE	MOVE	.36.68	60,158	OUT	W
	FBD:CL3013_NH4_Management	MOVE	.60.9	59,32	OUT	W
	FBD:CL3013_NH4_Management	AND_BOOL	.60.15	35,45	IN1	R
	SFC:CL3013_NH4	TRANSITION	S_CL3013_NH4_001	5,5		W
AT_3013_01_Start_Calibration	FBD:CL3013_SFC_CONTROL_PR>	MOVE	.36.14	73,83	OUT	W

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
	OCEDURE					
	FBD:CL3013_NH4_Management	MOVE	.60.30	80,133	OUT	W
	FBD:CL3013_NH4_Management	R_TRIG	FBI_60_87	85,220	CLK	R
	FBD:CL3013_NH4_Management	MOVE	.60.93	137,215	OUT	W
	FBD:T_CL3013_NH4_Calib_001	AND_BOOL	.38.4	64,14	IN1	R
	FBD:T_CL3013_NH4_Calib_004	AND_BOOL	.40.3	29,7	IN1	R
AT_3013_01_Start_Calib_FLAG	FBD:CL3013_SFC_CONTROL_PR> OCEDURE	MOVE	.36.54	74,108	OUT	W
	FBD:CL3013_NH4_Management	MOVE	.60.21	62,121	OUT	W
	FBD:CL3013_NH4_Management	AND_BOOL	.60.27	41,132	IN1	R
	SFC:CL3013_NH4_Calib	TRANSITION	S_CL3013_NH4_Calib_001	5,5		W
AT_3013_01_Status	FBD:CL3013_NH4_Management	EQ_BYTE	.60.13	9,46	IN1	R
	FBD:CL3013_NH4_Management	EQ_BYTE	.60.25	17,133	IN1	R
	FBD:CL3013_NH4_Management	EQ_BYTE	.60.75	161,16	IN1	R
	FBD:CL3013_NH4_Management	EQ_BYTE	.60.76	161,22	IN1	R
	FBD:CL3013_NH4_Management	NE_BYTE	.60.78	12,215	IN1	R
	FBD:CL3013_NH4_Management	NE_BYTE	.60.85	84,214	IN1	R
	FBD:T_CL3013_NH4_001	EQ_BYTE	.33.3	34,19	IN1	R
	FBD:T_CL3013_NH4_002	EQ_BYTE	.34.2	8,7	IN1	R
	FBD:T_CL3013_NH4_004	EQ_BYTE	.35.2	6,6	IN1	R
	FBD:T_CL3013_NH4_Stop_001	NE_BYTE	.53.5	10,17	IN1	R
	FBD:T_CL3013_NH4_Stop_002	EQ_BYTE	.54.2	8,7	IN1	R
	FBD:T_CL3013_NH4_Calib_001	EQ_BYTE	.38.7	33,22	IN1	R
	FBD:T_CL3013_NH4_Calib_002	EQ_BYTE	.39.2	7,7	IN1	R
	FBD:T_CL3013_NH4_Calib_004	EQ_BYTE	.40.2	4,8	IN1	R
AT_3013_01_Stop_Analyzer	FBD:CL3013_SFC_CONTROL_PR> OCEDURE	MOVE	.36.69	60,128	OUT	W
	FBD:CL3013_NH4_Management	MOVE	.60.33	67,172	OUT	W
	FBD:CL3013_NH4_Management	MOVE	.60.40	76,84	OUT	W
	FBD:CL3013_NH4_Management	MOVE	.60.49	50,201	OUT	W
	FBD:T_CL3013_NH4_Stop_001	AND_BOOL	.53.4	33,26	IN2	R
	SFC:CL3013_NH4_Stop	TRANSITION	S_CL3013_NH4_Stop_002	4,7		W
AT_3013_02	FBD:CL3013_NO3_Management	GT_REAL	.61.65	117,34	IN1	R
	FBD:CL3013_NO3_Management	GT_REAL	.61.66	117,45	IN1	R
	FBD:CL3013_NO3_Management	LT_REAL	.61.67	164,33	IN1	R
	FBD:CL3013_NO3_Management	LT_REAL	.61.68	164,45	IN1	R
AT_3013_02_AH	FBD:ALARM_STATUS	OR_BOOL	.31.6	38,74	IN5	R
	FBD:CL3013_NO3_Management	ACT_DIA	FBI_61_98	149,32	ERR	W
AT_3013_02_AHH	FBD:ALARM_STATUS	OR_BOOL	.31.3	71,24	IN10	R
	FBD:CL3013_NO3_Management	ACT_DIA	FBI_61_99	149,42	ERR	W
AT_3013_02_AL	FBD:ALARM_STATUS	OR_BOOL	.31.6	38,75	IN6	R
	FBD:CL3013_NO3_Management	ACT_DIA	FBI_61_100	201,32	ERR	W
AT_3013_02_ALL	FBD:ALARM_STATUS	OR_BOOL	.31.3	71,25	IN11	R
	FBD:CL3013_NO3_Management	ACT_DIA	FBI_61_101	203,43	ERR	W
AT_3013_02_Calib_OutOfRange_A	FBD:CL3013_NO3_Management	AND_BOOL	.61.29	56,51	IN2	R
	FBD:T_CL3013_NO3_001	AND_BOOL	.42.4	64,22	IN2	R
AT_3013_02_ERR	FBD:ALARM_STATUS	OR_BOOL	.31.3	71,29	IN15	R
AT_3013_02_ERROR	FBD:T_CL3013_NO3_001	AND_BOOL	.42.4	64,25	IN5	R
	FBD:T_CL3013_NO3_Calib_001	AND_BOOL	.46.4	62,14	IN2	R
AT_3013_02_LIM_H	FBD:CL3013_NO3_Management	GT_REAL	.61.65	117,35	IN2	R
AT_3013_02_LIM_HH	FBD:CL3013_NO3_Management	GT_REAL	.61.66	117,46	IN2	R
AT_3013_02_LIM_L	FBD:CL3013_NO3_Management	LT_REAL	.61.67	164,34	IN2	R
AT_3013_02_LIM_LL	FBD:CL3013_NO3_Management	LT_REAL	.61.68	164,46	IN2	R
AT_3013_02_Start_Analysis	FBD:CL3013_SFC_CONTROL_PR> OCEDURE	MOVE	.36.20	160,26	OUT	W
	FBD:CL3013_SFC_CONTROL_PR> OCEDURE	MOVE	.36.74	169,148	OUT	W

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
	FBD:CL3013_NO3_Management	MOVE	.61.15	47,163	OUT	W
	FBD:CL3013_NO3_Management	MOVE	.61.31	95,51	OUT	W
	FBD:CL3013_NO3_Management	MOVE	.61.59	62,178	OUT	W
	FBD:CL3013_NO3_Management	R_TRIG	FBI_61_87	89,203	CLK	R
	FBD:CL3013_NO3_Management	MOVE	.61.95	140,198	OUT	W
	FBD:T_CL3013_NO3_001	AND_BOOL	.42.4	64,21	IN1	R
	SFC:CL3013_NO3	TRANSITION	S_CL3013_NO3_004	5,11		W
AT_3013_02_Start_Analysis_FLAG	FBD:CL3013_SFC_CONTROL_PR>OCEDURE	MOVE	.36.56	160,52	OUT	W
	FBD:CL3013_SFC_CONTROL_PR>OCEDURE	MOVE	.36.78	169,181	OUT	W
	FBD:CL3013_NO3_Management	MOVE	.61.25	60,41	OUT	W
	FBD:CL3013_NO3_Management	AND_BOOL	.61.28	31,50	IN1	R
	SFC:CL3013_NO3	TRANSITION	S_CL3013_NO3_001	5,5		W
AT_3013_02_Start_Calibration	FBD:CL3013_SFC_CONTROL_PR>OCEDURE	MOVE	.36.25	170,88	OUT	W
	FBD:CL3013_SFC_CONTROL_PR>OCEDURE	MOVE	.36.81	194,148	OUT	W
	FBD:CL3013_SFC_CONTROL_PR>OCEDURE	MOVE	.36.83	86,134	OUT	W
	FBD:CL3013_NO3_Management	MOVE	.61.43	69,123	OUT	W
	FBD:CL3013_NO3_Management	R_TRIG	FBI_61_91	162,202	CLK	R
	FBD:CL3013_NO3_Management	MOVE	.61.97	214,197	OUT	W
	FBD:T_CL3013_NO3_Calib_001	AND_BOOL	.46.4	62,13	IN1	R
	FBD:T_CL3013_NO3_Calib_004	AND_BOOL	.48.3	39,9	IN1	R
AT_3013_02_Start_Calib_FLAG	FBD:CL3013_SFC_CONTROL_PR>OCEDURE	MOVE	.36.55	170,115	OUT	W
	FBD:CL3013_SFC_CONTROL_PR>OCEDURE	MOVE	.36.82	198,181	OUT	W
	FBD:CL3013_SFC_CONTROL_PR>OCEDURE	MOVE	.36.84	90,158	OUT	W
	FBD:CL3013_NO3_Management	MOVE	.61.37	51,111	OUT	W
	FBD:CL3013_NO3_Management	AND_BOOL	.61.40	24,122	IN1	R
	SFC:CL3013_NO3_Calib	TRANSITION	S_CL3013_NO3_Calib_001	5,5		W
AT_3013_02_Status	FBD:CL3013_NO3_Management	NE_BYTE	.61.18	9,220	IN1	R
	FBD:CL3013_NO3_Management	EQ_BYTE	.61.26	7,51	IN1	R
	FBD:CL3013_NO3_Management	EQ_BYTE	.61.38	8,127	IN1	R
	FBD:CL3013_NO3_Management	EQ_BYTE	.61.83	112,8	IN1	R
	FBD:CL3013_NO3_Management	EQ_BYTE	.61.84	112,14	IN1	R
	FBD:CL3013_NO3_Management	NE_BYTE	.61.86	89,197	IN1	R
	FBD:CL3013_NO3_Management	NE_BYTE	.61.90	161,196	IN1	R
	FBD:T_CL3013_NO3_001	EQ_BYTE	.42.3	35,30	IN1	R
	FBD:T_CL3013_NO3_002	EQ_BYTE	.43.2	8,7	IN1	R
	FBD:T_CL3013_NO3_004	EQ_BYTE	.44.2	6,6	IN1	R
	FBD:T_CL3013_NO3_Calib_001	EQ_BYTE	.46.5	31,24	IN1	R
	FBD:T_CL3013_NO3_Calib_002	EQ_BYTE	.47.2	6,7	IN1	R
	FBD:T_CL3013_NO3_Calib_004	EQ_BYTE	.48.2	14,10	IN1	R
	FBD:T_CL3013_NO3_Stop_001	NE_BYTE	.50.13	7,12	IN1	R
	FBD:T_CL3013_NO3_Stop_002	EQ_BYTE	.51.2	6,7	IN1	R
AT_3013_02_Stop_Analyzer	FBD:CL3013_SFC_CONTROL_PR>OCEDURE	MOVE	.36.79	169,142	OUT	W
	FBD:CL3013_NO3_Management	MOVE	.61.16	72,163	OUT	W
	FBD:CL3013_NO3_Management	R_TRIG	FBI_61_20	53,217	Q	W
	FBD:CL3013_NO3_Management	MOVE	.61.58	62,173	OUT	W
	FBD:CL3013_NO3_Management	MOVE	.61.64	50,201	OUT	W
	FBD:T_CL3013_NO3_Stop_001	AND_BOOL	.50.10	30,21	IN2	R
	SFC:CL3013_NO3_Stop	TRANSITION	S_CL3013_NO3_Stop_002	4,7		W

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
AT_3013_03	FBD:Input	I_SCALE	.2.43	162,203	Y	W
	FBD:CL3013_NO2_Management	GT_REAL	.62.2	137,48	IN1	R
	FBD:CL3013_NO2_Management	GT_REAL	.62.3	137,59	IN1	R
AT_3013_03_AH	FBD:ALARM_STATUS	OR_BOOL	.31.6	38,76	IN7	R
	FBD:CL3013_NO2_Management	ACT_DIA	FBI_62_60	168,46	ERR	W
AT_3013_03_AHH	FBD:ALARM_STATUS	OR_BOOL	.31.3	71,26	IN12	R
	FBD:CL3013_NO2_Management	ACT_DIA	FBI_62_61	168,56	ERR	W
AT_3013_03_AL	FBD:ALARM_STATUS	OR_BOOL	.31.6	38,77	IN8	R
AT_3013_03_ALL	FBD:ALARM_STATUS	OR_BOOL	.31.3	71,27	IN13	R
AT_3013_03_Analyzing	FBD:CL3013_NO2_Management	VALVBOOL	FBI_62_19	144,13	OFF	R
	FBD:CL3013_NO2_Management	AND_BOOL	.62.25	32,71	IN2	R
	FBD:CL3013_NO2_Management	OR_BOOL	.62.34	25,144	IN1	R
	FBD:CL3013_NO2_Management	OR_BOOL	.62.59	30,187	IN1	R
	FBD:T_CL3013_NO2_001	AND_BOOL	.56.1	47,15	IN2	R
	SFC:CL3013_NO2	TRANSITION		5,6		R
	SFC:CL3013_NO2	TRANSITION		5,10		R
	FBD:T_CL3013_NO2_Stop_001	OR_BOOL	.58.3	26,13	IN1	R
	FBD:T_CL3013_NO2_Stop_002	AND_BOOL	.59.1	12,14	IN1	R
AT_3013_03_Calibrating	FBD:CL3013_NO2_Management	AND_BOOL	.62.25	32,72	IN3	R
	FBD:CL3013_NO2_Management	OR_BOOL	.62.34	25,145	IN2	R
	FBD:CL3013_NO2_Management	OR_BOOL	.62.59	30,188	IN2	R
	FBD:T_CL3013_NO2_001	AND_BOOL	.56.1	47,16	IN3	R
	FBD:T_CL3013_NO2_Stop_001	OR_BOOL	.58.3	26,14	IN2	R
	FBD:T_CL3013_NO2_Stop_002	AND_BOOL	.59.1	12,15	IN2	R
AT_3013_03_ERR	FBD:ERR_AI	WORD_TO_BIT	FBI_4_5	123,21	BIT10	W
	FBD:ALARM_STATUS	OR_BOOL	.31.3	71,30	IN16	R
AT_3013_03_LIM_H	FBD:CL3013_NO2_Management	GT_REAL	.62.2	137,49	IN2	R
AT_3013_03_LIM_HH	FBD:CL3013_NO2_Management	GT_REAL	.62.3	137,60	IN2	R
AT_3013_03_Start_Analysis	FBD:CL3013_SFC_CONTROL_PR> OCEDURE	MOVE	.36.42	241,27	OUT	W
	FBD:CL3013_SFC_CONTROL_PR> OCEDURE	MOVE	.36.99	256,78	OUT	W
	FBD:CL3013_NO2_Management	MOVE	.62.18	45,117	OUT	W
	FBD:CL3013_NO2_Management	MOVE	.62.27	71,71	OUT	W
	FBD:CL3013_NO2_Management	MOVE	.62.31	61,89	OUT	W
	FBD:CL3013_NO2_Management	R_TRIG	FBI_62_48	32,193	CLK	R
	FBD:CL3013_NO2_Management	MOVE	.62.56	83,188	OUT	W
	FBD:T_CL3013_NO2_001	AND_BOOL	.56.1	47,17	IN4	R
	SFC:CL3013_NO2	TRANSITION	S_CL3013_NO2_004	5,11		W
AT_3013_03_Start_Analysis_FLAG	FBD:CL3013_SFC_CONTROL_PR> OCEDURE	MOVE	.36.103	256,101	OUT	W
	FBD:CL3013_NO2_Management	MOVE	.62.6	60,48	OUT	W
	FBD:CL3013_NO2_Management	AND_BOOL	.62.25	32,70	IN1	R
AT_3013_03_Stop_Analyzer	FBD:CL3013_SFC_CONTROL_PR> OCEDURE	MOVE	.36.104	256,72	OUT	W
	FBD:CL3013_NO2_Management	MOVE	.62.20	70,117	OUT	W
	FBD:CL3013_NO2_Management	MOVE	.62.23	52,160	OUT	W
	FBD:CL3013_NO2_Management	MOVE	.62.30	61,84	OUT	W
	FBD:CL3013_NO2_Management	R_TRIG	FBI_62_36	66,139	Q	W
	FBD:T_CL3013_NO2_Stop_001	AND_BOOL	.58.6	41,22	IN2	R
	SFC:CL3013_NO2_Stop	TRANSITION	S_CL3013_NO2_Stop_002	4,7		W
AT_3014_01	FBD:CL3014_Biomass_Control	GT_REAL	.17.1	19,19	IN1	R
	FBD:CL3014_Biomass_Control	LT_REAL	.17.3	19,42	IN1	R
	FBD:CL3014_Biomass_Control	GT_REAL	.17.5	18,29	IN1	R
	FBD:CL3014_Biomass_Control	LT_REAL	.17.6	18,54	IN1	R
AT_3014_01_LIM_H	FBD:CL3014_Biomass_Control	GT_REAL	.17.1	19,20	IN2	R
AT_3014_01_LIM_HH	FBD:CL3014_Biomass_Control	GT_REAL	.17.5	18,30	IN2	R

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
AT_3014_01_LIM_L	FBD:CL3014_Biomass_Control	LT_REAL	.17.3	19,43	IN2	R
AT_3014_01_LIM_LL	FBD:CL3014_Biomass_Control	LT_REAL	.17.6	18,55	IN2	R
BLE_3004_01	FBD:Input	I_SCALE	.2.38	88,203	Y	W
	FBD:CL3004_Bioreactor_Gen>eral	SUB_REAL	.25.32	77,46	IN1	R
	FBD:CL3004_Bioreactor_Gen>eral	SUB_REAL	.25.33	77,52	IN1	R
BLE_3004_01_A	FBD:ALARM_STATUS	OR_BOOL	.31.1	18,26	IN14	R
	FBD:CL3004_Bioreactor_Gen>eral	ACT_DIA	FBI_25_36	157,46	ERR	W
BLE_3004_01_ERR	FBD:ERR_AI	WORD_TO_BIT	FBI_4_4	94,22	BIT11	W
BLE_3004_01_LIM_H	FBD:CL3004_Bioreactor_Gen>eral	GT_REAL	.25.29	95,47	IN2	R
BLE_3004_01_LIM_L	FBD:CL3004_Bioreactor_Gen>eral	LT_REAL	.25.30	95,53	IN2	R
BLE_3004_01_MV1	FBD:CL3004_Bioreactor_Gen>eral	OPMDBOOL	FBI_25_3	36,8	OUT	W
	FBD:CL3004_Bioreactor_Gen>eral	AND_BOOL	.25.27	125,48	IN1	R
BLE_3004_01_MV2	FBD:output	O_SCALE	FBI_3_9	35,43	X	R
	FBD:CL3004_Bioreactor_Gen>eral	OPMDREAL	FBI_25_4	36,20	OUT	W
BLE_3004_01_OP	FBD:CL3004_Bioreactor_Gen>eral	OPMDBOOL	FBI_25_3	17,11	MAN	R
BLE_3004_01_SP	FBD:CL3004_Bioreactor_Gen>eral	OPMDREAL	FBI_25_4	17,22	AUTO	R
	FBD:CL3004_Bioreactor_Gen>eral	OPMDREAL	FBI_25_4	17,23	MAN	R
	FBD:CL3004_Bioreactor_Gen>eral	SUB_REAL	.25.32	77,47	IN2	R
	FBD:CL3004_Bioreactor_Gen>eral	SUB_REAL	.25.33	77,53	IN2	R
CIII_General_alarm_status	FBD:ALARM_STATUS	MOVE	.31.13	127,46	OUT	W
	FBD:ALARM_STATUS	MOVE	.31.15	127,59	OUT	W
	FBD:ALARM_STATUS	MOVE	.31.17	127,52	OUT	W
	FBD:ALARM_STATUS	MOVE	.31.19	127,66	OUT	W
CIII_HighLowAlarm_status	FBD:ALARM_STATUS	OR_BOOL	.31.7	78,69	OUT	W
	FBD:ALARM_STATUS	AND_BOOL	.31.12	98,45	IN1	R
	FBD:ALARM_STATUS	AND_BOOL	.31.14	98,58	IN1	R
	FBD:ALARM_STATUS	AND_BOOL	.31.16	98,51	IN1	R
	FBD:ALARM_STATUS	AND_BOOL	.31.18	98,65	IN1	R
CIII_SC_Activate_Setting	FBD:System_clock	SET_TOD	FBI_27_3	37,9	S_PULSE	R
CIII_SysClock_Day	FBD:System_clock	GET_TOD	FBI_27_1	16,12	DAY	W
	FBD:CL3008_Bioreactor_pH_>Control	MOVE	.11.110	67,202	IN	R
	FBD:CL3011_Gas_Loop	MOVE	.14.60	72,151	IN	R
CIII_SysClock_dayofweek	FBD:System_clock	GET_TOD	FBI_27_1	16,10	D_WEEK	W
CIII_SysClock_dayofweek_SET	FBD:System_clock	SET_TOD	FBI_27_3	37,10	D_WEEK	R
CIII_SysClock_Day_SET	FBD:System_clock	SET_TOD	FBI_27_3	37,12	DAY	R
CIII_SysClock_Hour	FBD:System_clock	GET_TOD	FBI_27_1	16,14	HOUR	W
	FBD:CL3008_Bioreactor_pH_>Control	MOVE	.11.108	31,227	IN	R
	FBD:CL3011_Gas_Loop	MOVE	.14.18	72,156	IN	R
CIII_SysClock_Hour_SET	FBD:System_clock	SET_TOD	FBI_27_3	37,14	HOUR	R
CIII_SysClock_Minute	FBD:System_clock	GET_TOD	FBI_27_1	16,15	MINUTE	W
	FBD:CL3008_Bioreactor_pH_>Control	MOVE	.11.107	31,222	IN	R

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
	FBD:CL3011_Gas_Loop	MOVE	.14.17	72,146	IN	R
	FBD:CL3011_Gas_Loop	EQ_BYTE	.14.30	12,187	IN1	R
CIII_SysClock_Minute_SET	FBD:System_clock	SET_TOD	FBI_27_3	37,15	MINUTE	R
CIII_SysClock_Month	FBD:System_clock	GET_TOD	FBI_27_1	16,11	MONTH	W
	FBD:CL3008_Bioreactor_pH_>Control	MOVE	.11.111	67,208	IN	R
	FBD:CL3011_Gas_Loop	MOVE	.14.19	72,161	IN	R
CIII_SysClock_Month_SET	FBD:System_clock	SET_TOD	FBI_27_3	37,11	MONTH	R
CIII_SysClock_Second	FBD:System_clock	GET_TOD	FBI_27_1	16,16	SECOND	W
	FBD:CL3008_Bioreactor_pH_>Control	MOVE	.11.106	31,217	IN	R
	FBD:CL3011_Gas_Loop	MOVE	.14.16	72,171	IN	R
	FBD:CL3011_Gas_Loop	EQ_BYTE	.14.32	12,193	IN1	R
CIII_SysClock_Second_SET	FBD:System_clock	SET_TOD	FBI_27_3	37,16	SECOND	R
CIII_SysClock_Year	FBD:System_clock	GET_TOD	FBI_27_1	16,13	YEAR	W
	FBD:CL3008_Bioreactor_pH_>Control	MOVE	.11.112	67,214	IN	R
	FBD:CL3011_Gas_Loop	MOVE	.14.20	72,166	IN	R
CIII_SysClock_Year_SET	FBD:System_clock	SET_TOD	FBI_27_3	37,13	YEAR	R
CIII_VeryHighLowAlarm_status	FBD:ALARM_STATUS	OR_BOOL	.31.4	109,18	OUT	W
	FBD:ALARM_STATUS	AND_BOOL	.31.12	98,46	IN2	R
	FBD:ALARM_STATUS	AND_BOOL	.31.14	98,59	IN2	R
	FBD:ALARM_STATUS	AND_BOOL	.31.16	98,52	IN2	R
	FBD:ALARM_STATUS	AND_BOOL	.31.18	98,66	IN2	R
CL3000_ControlLoop_Mode	FBD:CL3002_Influent_Level>_Control	EQ_INT	.6.11	7,63	IN1	R
	FBD:CL3002_Influent_Level>_Control	MOVE	.6.14	63,63	OUT	W
	FBD:CL3004_Bioreactor_Gen>eral	MOVE	.25.10	23,38	OUT	W
CL3001_ControlLoop_Mode	FBD:CL3001_Influent_Temp_>Control	INT_TO_BOOL	.5.6	18,41	IN	R
	FBD:CL3001_Influent_Temp_>Control	EQ_INT	.5.24	49,74	IN1	R
	FBD:CL3001_Influent_Temp_>Control	EQ_INT	.5.25	48,84	IN1	R
	FBD:CL3001_Influent_Temp_>Control	EQ_INT	.5.26	48,94	IN1	R
	FBD:CL3001_Influent_Temp_>Control	EQ_INT	.5.27	48,104	IN1	R
	FBD:CL3001_Influent_Temp_>Control	VALVBOOL	FBI_5_28	67,12	SELECT	R
	FBD:CL3004_Bioreactor_Gen>eral	MOVE	.25.11	23,43	OUT	W
CL3001_IMP	FBD:CL3001_Influent_Temp_>Control	PCR_SF1	FBI_5_2	14,17	IMP	R
CL3001_IMV	FBD:CL3001_Influent_Temp_>Control	PCR_SF1	FBI_5_2	31,15	IMV	W
CL3001_INIT	FBD:CL3001_Influent_Temp_>Control	PCR_SF1	FBI_5_2	14,13	INIT	R
	FBD:CL3001_Influent_Temp_>Control	TOF	FBI_5_8	66,46	Q	W
CL3001_LIM	FBD:CL3001_Influent_Temp_>Control	PCR_SF1	FBI_5_2	14,19	LIM	R
CL3001_PARAPWM	FBD:CL3001_Influent_Temp_>Control	PWM	FBI_5_3	42,15	PARA	R
CL3001_PCR_Flag4Init	FBD:CL3001_Influent_Temp_>	PCR_SF1	FBI_5_2	14,20	MAN	R

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
	Control					
	FBD:CL3001_Influent_Temp_> Control	INT_TO_BOOL	.5.6	37,41	OUT	W
CL3001_SF1_ERR	FBD:CL3001_Influent_Temp_> Control	PCR_SF1	FBI_5_2	31,16	ERR	W
CL3001_TUNE	FBD:CL3001_Influent_Temp_> Control	PCR_SF1	FBI_5_2	14,18	TUNE	R
CL3001_TUNE.TS	FBD:CL3001_Influent_Temp_> Control	SAMPLETM	FBI_5_4	2,10	INTERVAL	R
CL3001_TUNE.TS	FBD:CL3001_Influent_Temp_> Control	TOF	FBI_5_8	50,47	PT	R
CL3001_Y	FBD:CL3001_Influent_Temp_> Control	PCR_SF1	FBI_5_2	14,16	RCPY	R
	FBD:CL3001_Influent_Temp_> Control	PCR_SF1	FBI_5_2	31,14	Y	W
CL3003_ControlLoop_Mode	FBD:CL3002_Influent_Level> _Control	EQ_INT	.6.15	6,76	IN1	R
	FBD:CL3002_Influent_Level> _Control	MOVE	.6.18	62,76	OUT	W
	FBD:CL3003_Inlet_Liquid_C> ontrol	OPMDREAL	FBI_7_3	81,17	SELEC	R
	FBD:CL3003_Inlet_Liquid_C> ontrol	OPMDBOOL	FBI_7_5	81,7	SELEC	R
	FBD:CL3003_Inlet_Liquid_C> ontrol	INT_TO_BOOL	.7.20	21,53	IN	R
	FBD:CL3003_Inlet_Liquid_C> ontrol	EQ_INT	.7.25	19,86	IN1	R
	FBD:CL3003_Inlet_Liquid_C> ontrol	EQ_INT	.7.27	20,106	IN1	R
	FBD:CL3003_Inlet_Liquid_C> ontrol	EQ_INT	.7.30	21,128	IN1	R
	FBD:CL3003_Inlet_Liquid_C> ontrol	EQ_INT	.7.33	21,147	IN1	R
	FBD:CL3004_Bioreactor_Gen> eral	MOVE	.25.12	23,48	OUT	W
	FBD:CL3006_Bioreactor_Lev> el_Control	EQ_INT	.9.19	18,176	IN1	R
	FBD:CL3006_Bioreactor_Lev> el_Control	EQ_INT	.9.27	6,7	IN1	R
	FBD:CL3015_Backwashing	MOVE	.18.2	50,8	OUT	W
	FBD:CL3006_Bioreactor_Lev> el_Control	MOVE	.9.56	77,177	OUT	W
	FBD:CL3006_Bioreactor_Lev> el_Control	EQ_INT	.9.58	18,193	IN1	R
	FBD:CL3006_Bioreactor_Lev> el_Control	MOVE	.9.61	77,194	OUT	W
CL3003_EF1_ERR	FBD:CL3003_Inlet_Liquid_C> ontrol	PCR_EF1	FBI_7_1	61,24	ERR	W
CL3003_IMP	FBD:CL3003_Inlet_Liquid_C> ontrol	PCR_EF1	FBI_7_1	41,24	IMP	R
CL3003_IMV	FBD:CL3003_Inlet_Liquid_C> ontrol	PCR_EF1	FBI_7_1	61,21	IMV	W
CL3003_INIT	FBD:CL3003_Inlet_Liquid_C> ontrol	PCR_EF1	FBI_7_1	41,19	INIT	R
	FBD:CL3003_Inlet_Liquid_C> ontrol	TOF	FBI_7_22	73,62	Q	W
CL3003_LIM	FBD:CL3003_Inlet_Liquid_C>	PCR_EF1	FBI_7_1	41,26	LIM	R

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
	ontrol					
CL3003_PCR_Flag4Init	FBD:CL3003_Inlet_Liquid_C>ontrol	PCR_EF1	FBI_7_1	41,31	MAN	R
	FBD:CL3003_Inlet_Liquid_C>ontrol	INT_TO_BOOL	.7.20	40,53	OUT	W
CL3003_TUNE	FBD:CL3003_Inlet_Liquid_C>ontrol	PCR_EF1	FBI_7_1	41,25	TUNE	R
CL3003_TUNE.TS	FBD:CL3003_Inlet_Liquid_C>ontrol	SAMPLETM	FBI_7_2	28,11	INTERVAL	R
CL3003_TUNE.TS	FBD:CL3003_Inlet_Liquid_C>ontrol	TOF	FBI_7_22	57,63	PT	R
CL3003_Y	FBD:CL3003_Inlet_Liquid_C>ontrol	PCR_EF1	FBI_7_1	41,22	RCPY	R
	FBD:CL3003_Inlet_Liquid_C>ontrol	PCR_EF1	FBI_7_1	61,20	Y	W
CL3004_Buzzer_01	FBD:CL3004_Bioreactor_Gen>eral	MOVE	.25.26	39,91	OUT	W
CL3004_ControlLoop_Mode	FBD:CL3004_Bioreactor_Gen>eral	OPMDBOOL	FBI_25_3	17,8	SELEC	R
	FBD:CL3004_Bioreactor_Gen>eral	OPMDREAL	FBI_25_4	17,20	SELEC	R
	FBD:CL3004_Bioreactor_Gen>eral	MOVE	.25.13	23,53	OUT	W
	FBD:CL3015_Backwashing	MOVE	.18.6	50,15	OUT	W
	FBD:CL3016_Gas_Pulse	MOVE	.19.30	62,25	OUT	W
	FBD:CL3016_Gas_Pulse	MOVE	.19.31	62,18	OUT	W
CL3004_Emer_Button_01	FBD:CL3004_Bioreactor_Gen>eral	MOVE	.25.10	7,37	EN	R
	FBD:CL3004_Bioreactor_Gen>eral	MOVE	.25.11	7,42	EN	R
	FBD:CL3004_Bioreactor_Gen>eral	MOVE	.25.12	7,47	EN	R
	FBD:CL3004_Bioreactor_Gen>eral	MOVE	.25.13	7,52	EN	R
	FBD:CL3004_Bioreactor_Gen>eral	MOVE	.25.14	7,57	EN	R
	FBD:CL3004_Bioreactor_Gen>eral	MOVE	.25.15	7,62	EN	R
	FBD:CL3004_Bioreactor_Gen>eral	MOVE	.25.16	7,67	EN	R
	FBD:CL3004_Bioreactor_Gen>eral	MOVE	.25.17	7,72	EN	R
	FBD:CL3004_Bioreactor_Gen>eral	MOVE	.25.18	41,34	EN	R
	FBD:CL3004_Bioreactor_Gen>eral	MOVE	.25.19	41,39	EN	R
	FBD:CL3004_Bioreactor_Gen>eral	MOVE	.25.20	42,55	EN	R
	FBD:CL3004_Bioreactor_Gen>eral	MOVE	.25.21	42,60	EN	R
	FBD:CL3004_Bioreactor_Gen>eral	MOVE	.25.22	42,65	EN	R
	FBD:CL3004_Bioreactor_Gen>eral	MOVE	.25.23	42,70	EN	R
	FBD:CL3004_Bioreactor_Gen>eral	MOVE	.25.24	42,75	EN	R
	FBD:CL3004_Bioreactor_Gen>	MOVE	.25.25	42,80	EN	R

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
	eral					
	FBD:CL3004_Bioreactor_Gen>eral	MOVE	.25.26	23,91	IN	R
	FBD:CL3004_Bioreactor_Gen>eral	MOVE	.25.34	41,44	EN	R
	FBD:CL3004_Bioreactor_Gen>eral	MOVE	.25.35	42,49	EN	R
CL3005_ControlLoop_Mode	FBD:CL3004_Bioreactor_Gen>eral	MOVE	.25.14	23,58	OUT	W
	FBD:CL3005_Bioreactor_Tem>p_Control	OPMDBOOL	FBI_8_16	103,45	SELEC	R
	FBD:CL3005_Bioreactor_Tem>p_Control	INT_TO_BOOL	.8.46	14,111	IN	R
	FBD:CL3005_Bioreactor_Tem>p_Control	EQ_INT	.8.62	22,143	IN1	R
	FBD:CL3005_Bioreactor_Tem>p_Control	EQ_INT	.8.64	24,165	IN1	R
	FBD:CL3005_Bioreactor_Tem>p_Control	EQ_INT	.8.66	25,183	IN1	R
	FBD:CL3005_Bioreactor_Tem>p_Control	EQ_INT	.8.68	23,201	IN1	R
	FBD:CL3005_Bioreactor_Tem>p_Control	EQ_INT	.8.70	124,142	IN1	R
	FBD:CL3005_Bioreactor_Tem>p_Control	EQ_INT	.8.72	126,161	IN1	R
	FBD:CL3005_Bioreactor_Tem>p_Control	EQ_INT	.8.74	126,178	IN1	R
	FBD:CL3005_Bioreactor_Tem>p_Control	EQ_INT	.8.76	126,195	IN1	R
	FBD:CL3005_Bioreactor_Tem>p_Control	VALVBOOL	FBI_8_84	104,85	SELECT	R
	FBD:CL3005_Bioreactor_Tem>p_Control	VALVBOOL	FBI_8_86	100,68	SELECT	R
	FBD:CL3015_Backwashing	MOVE	.18.3	74,8	OUT	W
	FBD:CL3016_Gas_Pulse	MOVE	.19.29	86,18	OUT	W
	FBD:CL3005_Bioreactor_Tem>p_Control	EQ_INT	.8.110	118,19	IN1	R
	FBD:CL3005_Bioreactor_Tem>p_Control	MOVE	.8.109	160,15	OUT	W
	FBD:CL3005_Bioreactor_Tem>p_Control	EQ_INT	.8.111	134,41	IN1	R
	FBD:CL3005_Bioreactor_Tem>p_Control	MOVE	.8.113	177,33	OUT	W
CL3005_DECOMP2	FBD:CL3005_Bioreactor_Tem>p_Control	PCR_EIF1	FBI_8_52	22,90	DECOMP	R
CL3005_ERR1	FBD:CL3005_Bioreactor_Tem>p_Control	PCR_DC3	FBI_8_56	48,63	ERR	W
CL3005_ERR2	FBD:CL3005_Bioreactor_Tem>p_Control	PCR_EIF1	FBI_8_52	42,86	ERR	W
CL3005_Flag4Init	FBD:CL3005_Bioreactor_Tem>p_Control	INT_TO_BOOL	.8.46	33,111	OUT	W
	FBD:CL3005_Bioreactor_Tem>p_Control	PCR_EIF1	FBI_8_52	22,92	MAN	R
	FBD:CL3005_Bioreactor_Tem>p_Control	PCR_DC3	FBI_8_56	28,67	MAN	R
CL3005_IMP1	FBD:CL3005_Bioreactor_Tem>p_Control	PCR_DC3	FBI_8_56	28,64	IMP	R

table continued...

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)						
CL3005_IMP2	FBD:CL3005_Bioreactor_Tem>p_Control	PCR_EIF1	FBI_8_52	22,87	IMP	R
CL3005_IMV1	FBD:CL3005_Bioreactor_Tem>p_Control	PCR_DC3	FBI_8_56	48,61	IMV	W
CL3005_IMV2	FBD:CL3005_Bioreactor_Tem>p_Control	PCR_EIF1	FBI_8_52	42,84	IMV	W
CL3005_INIT1	FBD:CL3005_Bioreactor_Tem>p_Control	TOF	FBI_8_48	65,116	Q	W
	FBD:CL3005_Bioreactor_Tem>p_Control	PCR_DC3	FBI_8_56	28,59	INIT	R
CL3005_INIT2	FBD:CL3005_Bioreactor_Tem>p_Control	TOF	FBI_8_49	65,123	Q	W
	FBD:CL3005_Bioreactor_Tem>p_Control	PCR_EIF1	FBI_8_52	22,82	INIT	R
CL3005_LIM1	FBD:CL3005_Bioreactor_Tem>p_Control	PCR_DC3	FBI_8_56	28,66	LIM	R
CL3005_LIM2	FBD:CL3005_Bioreactor_Tem>p_Control	PCR_EIF1	FBI_8_52	22,89	LIM	R
CL3005_PARAPWM	FBD:CL3005_Bioreactor_Tem>p_Control	PWM	FBI_8_54	68,83	PARA	R
CL3005_PARAPWM.t_min	FBD:CL3005_Bioreactor_Tem>p_Control	TIME_TO_REAL	.8.78	77,102	IN	R
CL3005_PARAPWM.t_period	FBD:CL3005_Bioreactor_Tem>p_Control	TIME_TO_REAL	.8.79	77,108	IN	R
CL3005_RCPY2	FBD:CL3005_Bioreactor_Tem>p_Control	PCR_EIF1	FBI_8_52	22,85	RCPY	R
	FBD:CL3005_Bioreactor_Tem>p_Control	SEL	.8.83	137,110	OUT	W
CL3005_TUNE1.TS	FBD:CL3005_Bioreactor_Tem>p_Control	SAMPLETM	FBI_8_4	5,56	INTERVAL	R
CL3005_TUNE1.TS	FBD:CL3005_Bioreactor_Tem>p_Control	TOF	FBI_8_48	49,117	PT	R
	FBD:CL3005_Bioreactor_Tem>p_Control	PCR_DC3	FBI_8_56	28,65	TUNE	R
CL3005_TUNE2.TS	FBD:CL3005_Bioreactor_Tem>p_Control	TOF	FBI_8_49	49,124	PT	R
	FBD:CL3005_Bioreactor_Tem>p_Control	PCR_EIF1	FBI_8_52	22,88	TUNE	R
CL3005_TUNE2.TS	FBD:CL3005_Bioreactor_Tem>p_Control	SAMPLETM	FBI_8_53	5,74	INTERVAL	R
CL3005_TUNE2.TRBF	FBD:CL3005_Bioreactor_Tem>p_Control	TIME_TO_REAL	.8.59	6,46	IN	R
CL3005_Y1	FBD:CL3005_Bioreactor_Tem>p_Control	SUB_REAL	.8.27	105,151	IN2	R
	FBD:CL3005_Bioreactor_Tem>p_Control	SUB_REAL	.8.29	106,169	IN2	R
	FBD:CL3005_Bioreactor_Tem>p_Control	SUB_REAL	.8.31	106,186	IN2	R
	FBD:CL3005_Bioreactor_Tem>p_Control	SUB_REAL	.8.33	106,203	IN2	R
	FBD:CL3005_Bioreactor_Tem>p_Control	PCR_EIF1	FBI_8_52	22,84	SP	R
	FBD:CL3005_Bioreactor_Tem>p_Control	PCR_DC3	FBI_8_56	48,60	Y	W
CL3005_Y2	FBD:CL3005_Bioreactor_Tem>p_Control	PCR_EIF1	FBI_8_52	42,83	Y	W
	FBD:CL3005_Bioreactor_Tem>	ABS_REAL	.8.81	95,97	IN	R

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)						
Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
	p_Control					
	FBD:CL3005_Bioreactor_Tem> p_Control	SEL	.8.83	121,110	IN0	R
CL3006_BioreactorLevel_SP	FBD:CL3006_Bioreactor_Lev> el_Control	PCR_EIF1	FBI_9_2	72,19	SP	R
CL3006_ControlLoop_Mode	FBD:CL3004_Bioreactor_Gen> eral	MOVE	.25.15	23,63	OUT	W
	FBD:CL3006_Bioreactor_Lev> el_Control	OPMDREAL	FBI_9_1	116,15	SELEC	R
	FBD:CL3006_Bioreactor_Lev> el_Control	INT_TO_BOOL	.9.3	19,43	IN	R
	FBD:CL3006_Bioreactor_Lev> el_Control	EQ_INT	.9.13	114,34	IN1	R
	FBD:CL3015_Backwashing	MOVE	.18.7	74,15	OUT	W
	FBD:CL3016_Gas_Pulse	MOVE	.19.28	86,25	OUT	W
	FBD:CL3018_Outlet_liquid_> Control	EQ_INT	.21.64	8,4	IN1	R
	FBD:CL3006_Bioreactor_Lev> el_Control	EQ_INT	.9.48	26,126	IN1	R
	FBD:CL3006_Bioreactor_Lev> el_Control	EQ_INT	.9.49	24,103	IN1	R
	FBD:CL3006_Bioreactor_Lev> el_Control	EQ_INT	.9.51	29,146	IN1	R
	FBD:CL3006_Bioreactor_Lev> el_Control	EQ_INT	.9.53	21,84	IN1	R
CL3006_DECOMP	FBD:CL3006_Bioreactor_Lev> el_Control	PCR_EIF1	FBI_9_2	72,25	DECOMP	R
	FBD:CL3006_Bioreactor_Lev> el_Control	PCR_IFF1	FBI_9_24	45,27	DECOMP	R
CL3006_ERR	FBD:CL3006_Bioreactor_Lev> el_Control	PCR_EIF1	FBI_9_2	92,21	ERR	W
CL3006_Flag4Init	FBD:CL3006_Bioreactor_Lev> el_Control	PCR_EIF1	FBI_9_2	72,27	MAN	R
	FBD:CL3006_Bioreactor_Lev> el_Control	INT_TO_BOOL	.9.3	38,43	OUT	W
CL3006_FLOW	FBD:CL3006_Bioreactor_Lev> el_Control	OPMDREAL	FBI_9_1	135,15	OUT	W
	FBD:CL3018_Outlet_liquid_> Control	SEL	.21.63	25,14	IN1	R
	FBD:CL3018_Outlet_liquid_> Control	MOVE	.21.65	17,21	IN	R
	FBD:CL3018_Outlet_liquid_> Control	MOVE	.21.66	42,29	OUT	W
CL3006_IFF1_ERR	FBD:CL3006_Bioreactor_Lev> el_Control	PCR_IFF1	FBI_9_24	63,23	ERR	W
CL3006_IFF1_IMP	FBD:CL3006_Bioreactor_Lev> el_Control	PCR_IFF1	FBI_9_24	45,23	IMP	R
CL3006_IFF1_IMV	FBD:CL3006_Bioreactor_Lev> el_Control	PCR_IFF1	FBI_9_24	63,22	IMV	W
	FBD:CL3006_Bioreactor_Lev> el_Control	ADD_REAL	.9.25	73,34	IN1	R
CL3006_IMP	FBD:CL3006_Bioreactor_Lev> el_Control	PCR_EIF1	FBI_9_2	72,22	IMP	R
	FBD:CL3006_Bioreactor_Lev> el_Control	PCR_IFF1	FBI_9_24	45,25	CTRL_IMP	R
CL3006_IMV	FBD:CL3006_Bioreactor_Lev> el_Control	PCR_EIF1	FBI_9_2	92,19	IMV	W

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
	FBD:CL3006_Bioreactor_Lev>el_Control	ADD_REAL	.9.25	73,35	IN2	R
CL3006_INIT	FBD:CL3006_Bioreactor_Lev>el_Control	PCR_EIF1	FBI_9_2	72,17	INIT	R
	FBD:CL3006_Bioreactor_Lev>el_Control	TOF	FBI_9_5	65,48	Q	W
	FBD:CL3006_Bioreactor_Lev>el_Control	PCR_IFF1	FBI_9_24	45,20	INIT	R
CL3006_LIM	FBD:CL3006_Bioreactor_Lev>el_Control	PCR_EIF1	FBI_9_2	72,24	LIM	R
CL3006_TUNE	FBD:CL3006_Bioreactor_Lev>el_Control	PCR_EIF1	FBI_9_2	72,23	TUNE	R
CL3006_TUNE.TS	FBD:CL3006_Bioreactor_Lev>el_Control	TOF	FBI_9_5	49,49	PT	R
CL3006_TUNE.TS	FBD:CL3006_Bioreactor_Lev>el_Control	SAMPLETM	FBI_9_6	71,8	INTERVAL	R
	FBD:CL3006_Bioreactor_Lev>el_Control	PCR_IFF1	FBI_9_24	45,26	CTRL_TUN	R
CL3006_Y	FBD:CL3006_Bioreactor_Lev>el_Control	PCR_EIF1	FBI_9_2	92,18	Y	W
CL3007_ERR	FBD:CL3011_Gas_Loop	PCR_IF1	FBI_14_70	85,41	ERR	W
CL3007_IMV	FBD:CL3011_Gas_Loop	PCR_IF1	FBI_14_70	85,40	IMV	W
CL3007_Pressure_Threshold	FBD:CL3011_Gas_Loop	GT_REAL	.14.90	41,104	IN2	R
CL3007_PT_Value_Wanted	FBD:CL3007_Bioreactor_Pre>ssu_Control	SUB_REAL	.10.14	83,48	IN2	R
CL3007_Y	FBD:CL3011_Gas_Loop	SUB_REAL	.14.67	11,22	IN1	R
	FBD:CL3011_Gas_Loop	PCR_IF1	FBI_14_70	85,39	Y	W
CL3008_ACID_BASE_DECOMP	FBD:CL3008_Bioreactor_pH_>Control	PCR_IF1	FBI_11_205	19,90	DECOMP	R
CL3008_ACID_BASE_ERR	FBD:CL3008_Bioreactor_pH_>Control	PCR_IF1	FBI_11_205	36,86	ERR	W
CL3008_ACID_BASE_FLAG4INIT	FBD:CL3008_Bioreactor_pH_>Control	PCR_IF1	FBI_11_205	19,91	MAN	R
	FBD:CL3008_Bioreactor_pH_>Control	INT_TO_BOOL	.11.209	28,139	OUT	W
CL3008_ACID_BASE_IMP	FBD:CL3008_Bioreactor_pH_>Control	PCR_IF1	FBI_11_205	19,87	IMP	R
CL3008_ACID_BASE_IMV	FBD:CL3008_Bioreactor_pH_>Control	PCR_IF1	FBI_11_205	36,85	IMV	W
CL3008_ACID_BASE_INIT	FBD:CL3008_Bioreactor_pH_>Control	PCR_IF1	FBI_11_205	19,83	INIT	R
	FBD:CL3008_Bioreactor_pH_>Control	TOF	FBI_11_211	51,145	Q	W
CL3008_ACID_BASE_LIM	FBD:CL3008_Bioreactor_pH_>Control	PCR_IF1	FBI_11_205	19,89	LIM	R
CL3008_ACID_BASE_LIM.YMIN	FBD:CL3008_Bioreactor_pH_>Control	MOVE	.11.215	36,165	OUT	W
CL3008_ACID_BASE_LIM.YMAX	FBD:CL3008_Bioreactor_pH_>Control	MOVE	.11.216	36,171	OUT	W
CL3008_ACID_BASE_LIM.YMIN	FBD:CL3008_Bioreactor_pH_>Control	MOVE	.11.218	36,177	OUT	W
CL3008_ACID_BASE_LIM.YMAX	FBD:CL3008_Bioreactor_pH_>Control	MOVE	.11.219	36,183	OUT	W
CL3008_ACID_BASE_LIM.YMIN	FBD:CL3008_Bioreactor_pH_>Control	MOVE	.11.221	36,189	OUT	W
CL3008_ACID_BASE_LIM.YMAX	FBD:CL3008_Bioreactor_pH_>Control	MOVE	.11.222	36,195	OUT	W

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
CL3008_ACID_BASE_PARAPWM	FBD:CL3008_Bioreactor_pH_>Control	PWM	FBI_11_208	57,84	PARA	R
CL3008_ACID_BASE_PARAPWM.t_min	FBD:CL3008_Bioreactor_pH_>Control	TIME_TO_REAL	.11.239	10,109	IN	R
CL3008_ACID_BASE_PARAPWM.t_peri>od	FBD:CL3008_Bioreactor_pH_>Control	TIME_TO_REAL	.11.240	10,115	IN	R
CL3008_ACID_BASE_RCPY	FBD:CL3008_Bioreactor_pH_>Control	PCR_IF1	FBI_11_205	19,86	RCPY	R
	FBD:CL3008_Bioreactor_pH_>Control	SEL	.11.243	70,117	OUT	W
CL3008_ACID_BASE_TUNE	FBD:CL3008_Bioreactor_pH_>Control	PCR_IF1	FBI_11_205	19,88	TUNE	R
CL3008_ACID_BASE_TUNE.TS	FBD:CL3008_Bioreactor_pH_>Control	SAMPLETM	FBI_11_206	8,78	INTERVAL	R
CL3008_ACID_BASE_TUNE.TS	FBD:CL3008_Bioreactor_pH_>Control	TOF	FBI_11_211	35,146	PT	R
CL3008_ACID_BASE_Y	FBD:CL3008_Bioreactor_pH_>Control	PCR_IF1	FBI_11_205	36,84	Y	W
	FBD:CL3008_Bioreactor_pH_>Control	MUL_REAL	.11.224	22,122	IN1	R
	FBD:CL3008_Bioreactor_pH_>Control	MUL_REAL	.11.227	22,129	IN1	R
	FBD:CL3008_Bioreactor_pH_>Control	ABS_REAL	.11.242	28,104	IN	R
CL3008_Acid_Opening_Time	FBD:CL3008_Bioreactor_pH_>Control	MUL_REAL	.11.105	47,211	OUT	W
	FBD:CL3008_Bioreactor_pH_>Control	MUL_REAL	.11.105	30,211	IN1	R
	FBD:CL3008_Bioreactor_pH_>Control	INTEGRATOR1	FBI_11_291	256,125	Y	W
CL3008_Base_Opening_Time	FBD:CL3008_Bioreactor_pH_>Control	MUL_REAL	.11.104	47,205	OUT	W
	FBD:CL3008_Bioreactor_pH_>Control	MUL_REAL	.11.104	30,205	IN1	R
	FBD:CL3008_Bioreactor_pH_>Control	INTEGRATOR1	FBI_11_286	257,85	Y	W
CL3008_CO2_DECOMP	FBD:CL3008_Bioreactor_pH_>Control	PCR_IF1	FBI_11_232	99,155	DECOMP	R
CL3008_CO2_ERR	FBD:CL3008_Bioreactor_pH_>Control	PCR_IF1	FBI_11_232	116,151	ERR	W
CL3008_CO2_FLAG4INIT	FBD:CL3008_Bioreactor_pH_>Control	PCR_IF1	FBI_11_232	99,156	MAN	R
	FBD:CL3008_Bioreactor_pH_>Control	INT_TO_BOOL	.11.234	105,168	OUT	W
CL3008_CO2_IMP	FBD:CL3008_Bioreactor_pH_>Control	PCR_IF1	FBI_11_232	99,152	IMP	R
CL3008_CO2_IMV	FBD:CL3008_Bioreactor_pH_>Control	PCR_IF1	FBI_11_232	116,150	IMV	W
CL3008_CO2_INIT	FBD:CL3008_Bioreactor_pH_>Control	PCR_IF1	FBI_11_232	99,148	INIT	R
	FBD:CL3008_Bioreactor_pH_>Control	TOF	FBI_11_236	128,174	Q	W
CL3008_CO2_LIM	FBD:CL3008_Bioreactor_pH_>Control	PCR_IF1	FBI_11_232	99,154	LIM	R
CL3008_CO2_TUNE	FBD:CL3008_Bioreactor_pH_>Control	PCR_IF1	FBI_11_232	99,153	TUNE	R
CL3008_CO2_TUNE.TS	FBD:CL3008_Bioreactor_pH_>	SAMPLETM	FBI_11_233	86,145	INTERVAL	R

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)						
Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
	Control					
CL3008_CO2_TUNE.TS	FBD:CL3008_Bioreactor_pH_> Control	TOF	FBI_11_236	112,175	PT	R
CL3008_CO2_Y	FBD:CL3008_Bioreactor_pH_> Control	PCR_IF1	FBI_11_232	116,149	Y	W
CL3008_ControlLoop_Mode	FBD:CL3004_Bioreactor_Gen> eral	MOVE	.25.16	23,68	OUT	W
	FBD:CL3008_Bioreactor_pH_> Control	OPMDREAL	FBI_11_57	153,145	SELEC	R
	FBD:CL3008_Bioreactor_pH_> Control	OPMDBOOL	FBI_11_60	161,113	SELEC	R
	FBD:CL3008_Bioreactor_pH_> Control	OPMDBOOL	FBI_11_61	158,78	SELEC	R
	FBD:CL3008_Bioreactor_pH_> Control	EQ_INT	.11.84	172,87	IN1	R
	FBD:CL3008_Bioreactor_pH_> Control	EQ_INT	.11.91	173,129	IN1	R
	FBD:CL3008_Bioreactor_pH_> Control	EQ_INT	.11.96	196,110	IN1	R
	FBD:CL3008_Bioreactor_pH_> Control	EQ_INT	.11.101	191,67	IN1	R
	FBD:CL3008_Bioreactor_pH_> Control	EQ_INT	.11.146	230,5	IN1	R
	FBD:CL3008_Bioreactor_pH_> Control	EQ_INT	.11.150	191,13	IN1	R
	FBD:CL3008_Bioreactor_pH_> Control	EQ_INT	.11.161	191,33	IN1	R
	FBD:CL3008_Bioreactor_pH_> Control	INT_TO_BOOL	.11.209	9,139	IN	R
	FBD:CL3008_Bioreactor_pH_> Control	INT_TO_BOOL	.11.234	86,168	IN	R
	FBD:CL3008_Bioreactor_pH_> Control	EQ_INT	.11.245	204,138	IN1	R
	FBD:CL3008_Bioreactor_pH_> Control	EQ_INT	.11.247	200,159	IN1	R
	FBD:CL3008_Bioreactor_pH_> Control	EQ_INT	.11.249	129,184	IN1	R
	FBD:CL3008_Bioreactor_pH_> Control	EQ_INT	.11.251	128,202	IN1	R
	FBD:CL3008_Bioreactor_pH_> Control	EQ_INT	.11.277	196,96	IN1	R
	FBD:CL3008_Bioreactor_pH_> Control	EQ_INT	.11.283	229,11	IN1	R
	FBD:CL3008_Bioreactor_pH_> Control	VALVBOOL	FBI_11_292	163,99	SELECT	R
	FBD:CL3008_Bioreactor_pH_> Control	VALVBOOL	FBI_11_293	168,63	SELECT	R
	FBD:CL3008_Bioreactor_pH_> Control	EQ_INT	.11.295	192,55	IN1	R
	FBD:CL3016_Gas_Pulse	MOVE	.19.27	112,18	OUT	W
CL3008_DeadZone	FBD:CL3008_Bioreactor_pH_> Control	ADD_REAL	.11.115	185,152	IN2	R
	FBD:CL3008_Bioreactor_pH_> Control	ADD_REAL	.11.116	175,171	IN2	R
	FBD:CL3008_Bioreactor_pH_> Control	SUB_REAL	.11.123	105,195	IN2	R
	FBD:CL3008_Bioreactor_pH_>	SUB_REAL	.11.124	102,213	IN2	R

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
	Control					
	FBD:CL3008_Bioreactor_pH_>Control	SUB_REAL	.11.194	2,38	IN2	R
	FBD:CL3008_Bioreactor_pH_>Control	ADD_REAL	.11.196	2,47	IN2	R
	FBD:CL3008_Bioreactor_pH_>Control	SUB_REAL	.11.201	5,63	IN2	R
	FBD:CL3008_Bioreactor_pH_>Control	ADD_REAL	.11.202	5,57	IN2	R
CL3008_IND_Acid	FBD:CL3008_Bioreactor_pH_>Control	EQ_INT	.11.15	148,20	OUT	W
	FBD:CL3008_Bioreactor_pH_>Control	AND_BOOL	.11.228	86,101	IN1	R
	FBD:CL3008_Bioreactor_pH_>Control	AND_BOOL	.11.229	86,118	IN1	R
CL3008_IND_Base	FBD:CL3008_Bioreactor_pH_>Control	OR_BOOL	.11.20	168,20	OUT	W
	FBD:CL3008_Bioreactor_pH_>Control	AND_BOOL	.11.230	83,65	IN1	R
	FBD:CL3008_Bioreactor_pH_>Control	AND_BOOL	.11.231	82,82	IN1	R
CL3008_IND_CO2	FBD:CL3008_Bioreactor_pH_>Control	OR_BOOL	.11.19	168,8	OUT	W
	FBD:CL3008_Bioreactor_pH_>Control	AND_BOOL	.11.237	120,141	IN1	R
CL3008_pHdz	FBD:CL3008_Bioreactor_pH_>Control	SEL	.11.204	53,55	OUT	W
	FBD:CL3008_Bioreactor_pH_>Control	PCR_IF1	FBI_11_205	19,84	PV	R
	FBD:CL3008_Bioreactor_pH_>Control	PCR_IF1	FBI_11_232	99,149	PV	R
CL3008_pH_AH	FBD:ALARM_STATUS	OR_BOOL	.31.5	14,87	IN19	R
	FBD:CL3008_Bioreactor_pH_>Control	ACT_DIA	FBI_11_300	247,140	ERR	W
CL3008_pH_AHH	FBD:ALARM_STATUS	OR_BOOL	.31.2	47,13	IN1	R
	FBD:CL3008_Bioreactor_pH_>Control	ACT_DIA	FBI_11_301	246,161	ERR	W
CL3008_pH_AL	FBD:ALARM_STATUS	OR_BOOL	.31.5	14,88	IN20	R
	FBD:CL3008_Bioreactor_pH_>Control	ACT_DIA	FBI_11_302	173,186	ERR	W
CL3008_pH_ALL	FBD:ALARM_STATUS	OR_BOOL	.31.2	47,14	IN2	R
	FBD:CL3008_Bioreactor_pH_>Control	ACT_DIA	FBI_11_303	171,204	ERR	W
CL3008_pH_AVERAGE	FBD:CL3008_Bioreactor_pH_>Control	MOVE	.11.133	36,16	OUT	W
	FBD:CL3008_Bioreactor_pH_>Control	MOVE	.11.135	36,24	OUT	W
	FBD:CL3008_Bioreactor_pH_>Control	AVERA	FBI_11_136	41,5	OUT	W
	FBD:CL3008_Bioreactor_pH_>Control	OPMDREAL	FBI_11_137	65,9	OFF	R
CL3008_pH_Day	FBD:CL3008_Bioreactor_pH_>Control	MOVE	.11.110	83,202	OUT	W
CL3008_pH_high	FBD:CL3008_Bioreactor_pH_>Control	ACT_DIA	FBI_11_199	53,43	ERR	W
	FBD:CL3008_Bioreactor_pH_>Control	SEL	.11.204	37,54	G	R

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
	FBD:CL3008_Bioreactor_pH_>Control	SEL	.11.226	2,129	G	R
	FBD:CL3008_Bioreactor_pH_>Control	AND_BOOL	.11.228	86,103	IN3	R
	FBD:CL3008_Bioreactor_pH_>Control	AND_BOOL	.11.229	86,120	IN3	R
	FBD:CL3008_Bioreactor_pH_>Control	AND_BOOL	.11.237	120,142	IN2	R
CL3008_pH_Hour	FBD:CL3008_Bioreactor_pH_>Control	MOVE	.11.108	47,227	OUT	W
CL3008_pH_LIM_H	FBD:CL3008_Bioreactor_pH_>Control	GT_REAL	.11.114	207,150	IN2	R
CL3008_pH_LIM_HH	FBD:CL3008_Bioreactor_pH_>Control	GT_REAL	.11.118	202,170	IN2	R
CL3008_pH_LIM_L	FBD:CL3008_Bioreactor_pH_>Control	LT_REAL	.11.122	128,193	IN2	R
CL3008_pH_LIM_LL	FBD:CL3008_Bioreactor_pH_>Control	LT_REAL	.11.126	124,214	IN2	R
CL3008_pH_low	FBD:CL3008_Bioreactor_pH_>Control	ACT_DIA	FBI_11_198	53,34	ERR	W
	FBD:CL3008_Bioreactor_pH_>Control	SEL	.11.203	21,54	G	R
	FBD:CL3008_Bioreactor_pH_>Control	SEL	.11.223	2,122	G	R
	FBD:CL3008_Bioreactor_pH_>Control	AND_BOOL	.11.230	83,67	IN3	R
	FBD:CL3008_Bioreactor_pH_>Control	AND_BOOL	.11.231	82,84	IN3	R
CL3008_pH_Measurement	FBD:CL3008_Bioreactor_pH_>Control	SUB_REAL	.11.113	196,146	IN1	R
	FBD:CL3008_Bioreactor_pH_>Control	SUB_REAL	.11.117	188,164	IN1	R
	FBD:CL3008_Bioreactor_pH_>Control	SUB_REAL	.11.120	115,189	IN1	R
	FBD:CL3008_Bioreactor_pH_>Control	SUB_REAL	.11.125	112,207	IN1	R
	FBD:CL3008_Bioreactor_pH_>Control	OPMDREAL	FBI_11_137	84,8	OUT	W
	FBD:CL3008_Bioreactor_pH_>Control	LE_REAL	.11.195	23,36	IN1	R
	FBD:CL3008_Bioreactor_pH_>Control	GE_REAL	.11.197	23,45	IN1	R
	FBD:CL3008_Bioreactor_pH_>Control	SUB_REAL	.11.201	5,62	IN1	R
	FBD:CL3008_Bioreactor_pH_>Control	ADD_REAL	.11.202	5,56	IN1	R
CL3008_pH_Minute	FBD:CL3008_Bioreactor_pH_>Control	MOVE	.11.107	47,222	OUT	W
CL3008_pH_Mode	FBD:CL3008_Bioreactor_pH_>Control	EQ_INT	.11.5	132,8	IN1	R
	FBD:CL3008_Bioreactor_pH_>Control	EQ_INT	.11.11	132,14	IN1	R
	FBD:CL3008_Bioreactor_pH_>Control	EQ_INT	.11.15	132,20	IN1	R
	FBD:CL3008_Bioreactor_pH_>Control	EQ_INT	.11.214	4,164	IN1	R
	FBD:CL3008_Bioreactor_pH_>	EQ_INT	.11.217	4,176	IN1	R

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
	Control					
	FBD:CL3008_Bioreactor_pH_>Control	EQ_INT	.11.220	4,188	IN1	R
CL3008_pH_Month	FBD:CL3008_Bioreactor_pH_>Control	MOVE	.11.111	83,208	OUT	W
CL3008_pH_Second	FBD:CL3008_Bioreactor_pH_>Control	MOVE	.11.106	47,217	OUT	W
CL3008_pH_selector	FBD:CL3008_Bioreactor_pH_>Control	OPMDREAL	FBI_11_137	65,8	SELEC	R
	FBD:CL3008_Bioreactor_pH_>Control	EQ_INT	.11.138	57,18	IN1	R
	FBD:CL3008_Bioreactor_pH_>Control	EQ_INT	.11.140	57,26	IN1	R
	FBD:CL3008_Bioreactor_pH_>Control	MOVE	.11.142	105,19	OUT	W
	FBD:CL3008_Bioreactor_pH_>Control	MOVE	.11.143	106,27	OUT	W
CL3008_pH_SP	FBD:CL3008_Bioreactor_pH_>Control	ADD_REAL	.11.115	185,151	IN1	R
	FBD:CL3008_Bioreactor_pH_>Control	ADD_REAL	.11.116	175,170	IN1	R
	FBD:CL3008_Bioreactor_pH_>Control	SUB_REAL	.11.123	105,194	IN1	R
	FBD:CL3008_Bioreactor_pH_>Control	SUB_REAL	.11.124	102,212	IN1	R
	FBD:CL3008_Bioreactor_pH_>Control	SUB_REAL	.11.194	2,37	IN1	R
	FBD:CL3008_Bioreactor_pH_>Control	ADD_REAL	.11.196	2,46	IN1	R
	FBD:CL3008_Bioreactor_pH_>Control	SEL	.11.203	21,55	IN0	R
	FBD:CL3008_Bioreactor_pH_>Control	PCR_IF1	FBI_11_205	19,85	SP	R
	FBD:CL3008_Bioreactor_pH_>Control	PCR_IF1	FBI_11_232	99,150	SP	R
CL3008_pH_Year	FBD:CL3008_Bioreactor_pH_>Control	MOVE	.11.112	83,214	OUT	W
CL3008_Reset_pH_Timer	FBD:CL3008_Bioreactor_pH_>Control	R_TRIG	FBI_11_103	7,204	CLK	R
	FBD:CL3008_Bioreactor_pH_>Control	INTEGRATOR1	FBI_11_286	238,83	MAN	R
	FBD:CL3008_Bioreactor_pH_>Control	INTEGRATOR1	FBI_11_291	237,123	MAN	R
CL3008_SENSOR_DEVIATION_A	FBD:CL3008_Bioreactor_pH_>Control	ACT_DIA	FBI_11_304	188,222	ERR	W
CL3008_SENSOR_DEVIATION_LIM	FBD:CL3008_Bioreactor_pH_>Control	GT_REAL	.11.255	142,217	IN2	R
	FBD:CL3008_Bioreactor_pH_>Control	MUL_REAL	.11.258	130,227	IN1	R
CL3009_ControlLoop_Mode	FBD:CL3004_Bioreactor_Gen>eral	MOVE	.25.17	23,73	OUT	W
	FBD:CL3009_Bioreactor_DO2>_Control	INT_TO_BOOL	.12.16	15,65	IN	R
	FBD:CL3009_Bioreactor_DO2>_Control	OPMDREAL	FBI_12_19	63,35	SELEC	R
	FBD:CL3009_Bioreactor_DO2>_Control	EQ_INT	.12.46	17,87	IN1	R

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
	FBD:CL3009_Bioreactor_DO2> _Control	EQ_INT	.12.48	17,106	IN1	R
	FBD:CL3009_Bioreactor_DO2> _Control	EQ_INT	.12.50	18,127	IN1	R
	FBD:CL3009_Bioreactor_DO2> _Control	EQ_INT	.12.52	18,145	IN1	R
	FBD:CL3009_Bioreactor_DO2> _Control	EQ_INT	.12.56	86,89	IN1	R
	FBD:CL3009_Bioreactor_DO2> _Control	EQ_INT	.12.58	88,109	IN1	R
	FBD:CL3009_Bioreactor_DO2> _Control	EQ_INT	.12.60	90,132	IN1	R
	FBD:CL3009_Bioreactor_DO2> _Control	EQ_INT	.12.62	90,151	IN1	R
	FBD:CL3015_Backwashing	MOVE	.18.8	100,15	OUT	W
	FBD:CL3016_Gas_Pulse	MOVE	.19.26	112,25	OUT	W
CL3009_DO2_AVERAGE	FBD:CL3009_Bioreactor_DO2> _Control	MOVE	.12.6	35,18	OUT	W
	FBD:CL3009_Bioreactor_DO2> _Control	MOVE	.12.8	35,26	OUT	W
	FBD:CL3009_Bioreactor_DO2> _Control	AVERA	FBI_12_37	54,10	OUT	W
	FBD:CL3009_Bioreactor_DO2> _Control	OPMDREAL	FBI_12_38	67,6	OFF	R
CL3009_DO2_Measurement	FBD:CL3009_Bioreactor_DO2> _Control	PCR_EF1	FBI_12_9	33,40	PV	R
	FBD:CL3009_Bioreactor_DO2> _Control	OPMDREAL	FBI_12_38	86,5	OUT	W
CL3009_DO2_selector	FBD:CL3009_Bioreactor_DO2> _Control	OPMDREAL	FBI_12_38	67,5	SELEC	R
	FBD:CL3009_Bioreactor_DO2> _Control	MOVE	.12.41	116,17	OUT	W
	FBD:CL3009_Bioreactor_DO2> _Control	MOVE	.12.42	117,25	OUT	W
	FBD:CL3009_Bioreactor_DO2> _Control	EQ_INT	.12.43	68,16	IN1	R
	FBD:CL3009_Bioreactor_DO2> _Control	EQ_INT	.12.45	68,24	IN1	R
CL3009_DO2_SP	FBD:CL3009_Bioreactor_DO2> _Control	PCR_EF1	FBI_12_9	33,41	SP	R
	FBD:CL3009_Bioreactor_DO2> _Control	SUB_REAL	.12.20	5,94	IN2	R
	FBD:CL3009_Bioreactor_DO2> _Control	SUB_REAL	.12.22	3,115	IN2	R
	FBD:CL3009_Bioreactor_DO2> _Control	SUB_REAL	.12.24	3,136	IN2	R
	FBD:CL3009_Bioreactor_DO2> _Control	SUB_REAL	.12.26	4,152	IN2	R
	FBD:CL3009_Bioreactor_DO2> _Control	SUB_REAL	.12.28	69,100	IN2	R
	FBD:CL3009_Bioreactor_DO2> _Control	SUB_REAL	.12.31	70,120	IN2	R
	FBD:CL3009_Bioreactor_DO2> _Control	SUB_REAL	.12.33	70,142	IN2	R
	FBD:CL3009_Bioreactor_DO2> _Control	SUB_REAL	.12.35	69,161	IN2	R
CL3009_Flag4Init	FBD:CL3009_Bioreactor_DO2>	OR_BOOL	.12.12	19,51	IN1	R

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
	_Control					
	FBD:CL3009_Bioreactor_DO2>_Control	INT_TO_BOOL	.12.16	34,65	OUT	W
CL3009_IMP	FBD:CL3009_Bioreactor_DO2>_Control	PCR_EF1	FBI_12_9	33,44	IMP	R
CL3009_IMV	FBD:CL3009_Bioreactor_DO2>_Control	PCR_EF1	FBI_12_9	53,41	IMV	W
CL3009_INIT	FBD:CL3009_Bioreactor_DO2>_Control	PCR_EF1	FBI_12_9	33,39	INIT	R
	FBD:CL3009_Bioreactor_DO2>_Control	TOF	FBI_12_18	65,70	Q	W
CL3009_LIM	FBD:CL3009_Bioreactor_DO2>_Control	PCR_EF1	FBI_12_9	33,46	LIM	R
CL3009_SENSOR_DEVIATION_A	FBD:CL3009_Bioreactor_DO2>_Control	TON	FBI_12_73	79,182	Q	W
CL3009_SENSOR_DEVIATION_LIM	FBD:CL3009_Bioreactor_DO2>_Control	GT_REAL	.12.69	38,175	IN2	R
	FBD:CL3009_Bioreactor_DO2>_Control	MUL_REAL	.12.70	26,185	IN1	R
CL3009_TUNE	FBD:CL3009_Bioreactor_DO2>_Control	PCR_EF1	FBI_12_9	33,45	TUNE	R
CL3009_TUNE.TS	FBD:CL3009_Bioreactor_DO2>_Control	SAMPLETM	FBI_12_15	11,38	INTERVAL	R
CL3009_TUNE.TS	FBD:CL3009_Bioreactor_DO2>_Control	TOF	FBI_12_18	49,71	PT	R
CL3009_Y	FBD:CL3009_Bioreactor_DO2>_Control	PCR_EF1	FBI_12_9	33,42	RCPY	R
	FBD:CL3009_Bioreactor_DO2>_Control	PCR_EF1	FBI_12_9	53,40	Y	W
CL3011_ATM_VALVE_PWM_PARA	FBD:CL3011_Gas_Loop	PWM	FBI_14_83	67,115	PARA	R
CL3011_ControlLoop_Mode	FBD:CL3004_Bioreactor_Gen>eral	MOVE	.25.18	57,35	OUT	W
	FBD:CL3011_Gas_Loop	EQ_INT	.14.7	90,120	IN1	R
	FBD:CL3011_Gas_Loop	OPMDREAL	FBI_14_51	78,20	SELEC	R
	FBD:CL3011_Gas_Loop	OPMDREAL	FBI_14_52	76,7	SELEC	R
	FBD:CL3011_Gas_Loop	OPMDBOOL	FBI_14_53	7,7	SELEC	R
	FBD:CL3011_Gas_Loop	INT_TO_BOOL	.14.71	23,81	IN	R
	FBD:CL3011_Gas_Loop	VALVBOOL	FBI_14_127	91,98	SELECT	R
	FBD:CL3011_Gas_Loop	VALVBOOL	FBI_14_128	92,109	SELECT	R
	FBD:CL3015_Backwashing	MOVE	.18.9	123,15	OUT	W
	FBD:CL3016_Gas_Pulse	MOVE	.19.25	135,25	OUT	W
	FBD:CL3016_Gas_Pulse	MOVE	.19.64	109,63	OUT	W
	FBD:CL3016_Gas_Pulse	MOVE	.19.68	47,44	OUT	W
	FBD:CL3016_Gas_Pulse	VALVBOOL	FBI_19_89	138,71	SELECT	R
CL3011_DECOMP	FBD:CL3011_Gas_Loop	PCR_IF1	FBI_14_70	68,45	DECOMP	R
CL3011_Flag4Init	FBD:CL3011_Gas_Loop	PCR_IF1	FBI_14_70	68,46	MAN	R
	FBD:CL3011_Gas_Loop	INT_TO_BOOL	.14.71	42,81	OUT	W
CL3011_flag_OxyPulse_ON	FBD:CL3016_Gas_Pulse	OPMDBOOL	FBI_19_5	31,25	OUT	W
	FBD:CL3016_Gas_Pulse	MOVE	.19.55	81,66	EN	R
CL3011_GasMix_SP	FBD:CL3011_Gas_Loop	OPMDREAL	FBI_14_52	76,9	AUTO	R
CL3011_IMP	FBD:CL3011_Gas_Loop	PCR_IF1	FBI_14_70	68,42	IMP	R
CL3011_INIT	FBD:CL3011_Gas_Loop	PCR_IF1	FBI_14_70	68,38	INIT	R
	FBD:CL3011_Gas_Loop	TOF	FBI_14_73	69,87	Q	W
CL3011_LIM	FBD:CL3011_Gas_Loop	PCR_IF1	FBI_14_70	68,44	LIM	R
CL3011_LIM.YMIN	FBD:CL3011_Gas_Loop	MOVE	.14.95	39,51	OUT	W
CL3011_LIM.YMAX	FBD:CL3011_Gas_Loop	MOVE	.14.96	39,62	OUT	W
CL3011_N2_FQRC_MAX	FBD:CL3011_Gas_Loop	ADD_REAL	.14.94	9,64	IN3	R

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
CL3011_SelectValue_N2	FBD:CL3011_Gas_Loop	SUB_REAL	.14.68	47,22	OUT	W
	FBD:CL3011_Gas_Loop	LT_REAL	.14.98	45,13	IN1	R
CL3011_TUNE.TS	FBD:CL3011_Gas_Loop	SAMPLETM	FBI_14_69	49,37	INTERVAL	R
	FBD:CL3011_Gas_Loop	PCR_IF1	FBI_14_70	68,43	TUNE	R
CL3011_TUNE.TS	FBD:CL3011_Gas_Loop	TOF	FBI_14_73	53,88	PT	R
CL3011_VALVEATM_GAIN	FBD:CL3011_Gas_Loop	MUL_REAL	.14.87	22,111	IN2	R
CL3013_NH4_Analysis_Time	FBD:CL3013_NH4_Management	NE_UINT	.60.2	12,19	IN1	R
	FBD:CL3013_NH4_Management	SUB_UINT	.60.6	62,18	IN1	R
	FBD:CL3013_NH4_Management	SUB_UINT	.60.6	79,18	OUT	W
	FBD:CL3013_NH4_Management	EQ_UINT	.60.7	20,31	IN1	R
	FBD:CL3013_NH4_Management	MOVE	.60.11	65,67	OUT	W
	FBD:CL3013_NH4_Management	MOVE	.60.35	67,182	OUT	W
	FBD:CL3013_NH4_Management	NE_UINT	.60.42	13,106	IN1	R
	FBD:CL3013_NH4_Management	MOVE	.60.68	286,46	OUT	W
CL3013_NH4_Analysis_Time_CFG	FBD:CL3013_NH4_Management	MOVE	.60.11	49,67	IN	R
	FBD:CL3013_NH4_Management	MOVE	.60.35	51,182	IN	R
	FBD:CL3013_NH4_Management	MOVE	.60.64	259,21	IN	R
	FBD:CL3013_NH4_Management	NE_UINT	.60.66	237,46	IN2	R
	FBD:CL3013_NH4_Management	MOVE	.60.68	270,46	IN	R
	FBD:CL3013_NH4_Management	MOVE	.60.70	270,51	IN	R
CL3013_NH4_Analysis_Time_CFG0	FBD:CL3013_NH4_Management	EQ_UINT	.60.62	237,18	IN1	R
	FBD:CL3013_NH4_Management	MOVE	.60.64	275,21	OUT	W
	FBD:CL3013_NH4_Management	NE_UINT	.60.66	237,45	IN1	R
	FBD:CL3013_NH4_Management	MOVE	.60.70	286,51	OUT	W
CL3013_NH4_Analysis_Time_loading	FBD:CL3013_SFC_CONTROL_PR> OCEDURE	MOVE	.36.48	71,38	OUT	W
	FBD:CL3013_SFC_CONTROL_PR> OCEDURE	MOVE	.36.67	60,146	OUT	W
	FBD:CL3013_SFC_CONTROL_PR> OCEDURE	MOVE	.36.125	81,46	OUT	W
	FBD:CL3013_SFC_CONTROL_PR> OCEDURE	MOVE	.36.129	73,153	OUT	W
	FBD:CL3013_NH4_Management	R_TRIG	FBI_60_10	24,66	CLK	R
	FBD:CL3013_NH4_Management	MOVE	.60.12	55,61	OUT	W
	SFC:CL3013_NH4	TRANSITION	S_CL3013_NH4_001	5,5		W
CL3013_NH4_Calibration_Time	FBD:CL3013_NH4_Management	EQ_UINT	.60.19	23,120	IN1	R
	FBD:CL3013_NH4_Management	MOVE	.60.23	71,150	OUT	W
	FBD:CL3013_NH4_Management	MOVE	.60.36	67,187	OUT	W
	FBD:CL3013_NH4_Management	SUB_UINT	.60.46	71,104	IN1	R
	FBD:CL3013_NH4_Management	SUB_UINT	.60.46	88,104	OUT	W
	FBD:CL3013_NH4_Management	MOVE	.60.73	287,58	OUT	W
CL3013_NH4_Calibration_Time_CFG	FBD:CL3013_NH4_Management	MOVE	.60.23	55,150	IN	R
	FBD:CL3013_NH4_Management	MOVE	.60.36	51,187	IN	R
	FBD:CL3013_NH4_Management	MOVE	.60.61	260,30	IN	R
	FBD:CL3013_NH4_Management	NE_UINT	.60.71	237,58	IN2	R
	FBD:CL3013_NH4_Management	MOVE	.60.73	271,58	IN	R
	FBD:CL3013_NH4_Management	MOVE	.60.74	271,63	IN	R
CL3013_NH4_Calibration_Time_CFG0	FBD:CL3013_NH4_Management	EQ_UINT	.60.59	238,27	IN1	R
	FBD:CL3013_NH4_Management	MOVE	.60.61	276,30	OUT	W
	FBD:CL3013_NH4_Management	NE_UINT	.60.71	237,57	IN1	R
	FBD:CL3013_NH4_Management	MOVE	.60.74	287,63	OUT	W
CL3013_NH4_Calib_Time_loading	FBD:CL3013_SFC_CONTROL_PR> OCEDURE	MOVE	.36.49	73,96	OUT	W
	FBD:CL3013_SFC_CONTROL_PR> OCEDURE	MOVE	.36.127	87,103	OUT	W
	FBD:CL3013_SFC_CONTROL_PR> OCEDURE	MOVE	.36.130	60,164	OUT	W

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
	FBD:CL3013_SFC_CONTROL_PR> OCEDURE	MOVE	.36.132	73,171	OUT	W
	FBD:CL3013_NH4_Management	R_TRIG	FBI_60_22	30,149	CLK	R
	FBD:CL3013_NH4_Management	MOVE	.60.24	58,144	OUT	W
	SFC:CL3013_NH4_Calib	TRANSITION	S_CL3013_NH4_Calib_001	5,5		W
CL3013_NH4_ControlLoop_Mode	FBD:CL3004_Bioreactor_Gen> eral	MOVE	.25.19	57,40	OUT	W
	FBD:CL3013_SFC_CONTROL_PR> OCEDURE	EQ_INT	.36.3	10,12	IN1	R
	FBD:CL3013_SFC_CONTROL_PR> OCEDURE	EQ_INT	.36.9	10,71	IN1	R
	FBD:CL3013_SFC_CONTROL_PR> OCEDURE	MOVE	.36.70	60,176	OUT	W
	FBD:CL3013_NH4_Management	EQ_INT	.60.1	12,12	IN1	R
	FBD:CL3013_NH4_Management	EQ_INT	.60.14	9,52	IN1	R
	FBD:CL3013_NH4_Management	EQ_INT	.60.26	18,139	IN1	R
	FBD:CL3013_NH4_Management	EQ_INT	.60.31	12,171	IN1	R
	FBD:CL3013_NH4_Management	EQ_INT	.60.37	14,83	IN1	R
	FBD:CL3013_NH4_Management	EQ_INT	.60.41	13,99	IN1	R
	FBD:CL3013_NH4_Management	EQ_INT	.60.47	10,200	IN1	R
	FBD:CL3013_NH4_Management	VALVBOOL	FBI_60_55	199,26	SELECT	R
	FBD:CL3013_NH4_Management	EQ_INT	.60.91	11,227	IN1	R
	FBD:CL3013_NH4_Management	EQ_INT	.60.94	84,226	IN1	R
	FBD:CL3013_NH4_Management	EQ_INT	.60.104	94,59	IN1	R
	FBD:CL3013_NH4_Management	MOVE	.60.108	155,53	OUT	W
	FBD:CL3015_Backwashing	MOVE	.18.5	123,8	OUT	W
	FBD:CL3016_Gas_Pulse	MOVE	.19.86	137,18	OUT	W
	FBD:T_CL3013_NH4_001	EQ_INT	.33.4	9,10	IN1	R
	FBD:T_CL3013_NH4_001	EQ_INT	.33.6	9,19	IN1	R
	FBD:T_CL3013_NH4_Stop_001	EQ_INT	.53.2	12,11	IN1	R
	FBD:T_CL3013_NH4_Stop_001	EQ_INT	.53.3	12,25	IN1	R
	FBD:T_CL3013_NH4_Calib_001	EQ_INT	.38.8	24,8	IN1	R
	FBD:T_CL3013_NH4_Calib_001	EQ_INT	.38.10	24,15	IN1	R
CL3013_NO2_Analysis_Time	FBD:CL3013_NO2_Management	EQ_UINT	.62.4	17,47	IN1	R
	FBD:CL3013_NO2_Management	MOVE	.62.8	62,63	OUT	W
	FBD:CL3013_NO2_Management	NE_UINT	.62.11	9,28	IN1	R
	FBD:CL3013_NO2_Management	SUB_UINT	.62.15	66,26	IN1	R
	FBD:CL3013_NO2_Management	SUB_UINT	.62.15	83,26	OUT	W
	FBD:CL3013_NO2_Management	MOVE	.62.32	61,95	OUT	W
	FBD:CL3013_NO2_Management	MOVE	.62.42	252,35	OUT	W
CL3013_NO2_Analysis_Time_CFG	FBD:CL3013_NO2_Management	MOVE	.62.8	46,63	IN	R
	FBD:CL3013_NO2_Management	MOVE	.62.32	45,95	IN	R
	FBD:CL3013_NO2_Management	MOVE	.62.39	230,20	IN	R
	FBD:CL3013_NO2_Management	NE_UINT	.62.40	203,35	IN2	R
	FBD:CL3013_NO2_Management	MOVE	.62.42	236,35	IN	R
	FBD:CL3013_NO2_Management	MOVE	.62.43	236,40	IN	R
CL3013_NO2_Analysis_Time_CFG0	FBD:CL3013_NO2_Management	EQ_UINT	.62.37	208,17	IN1	R
	FBD:CL3013_NO2_Management	MOVE	.62.39	246,20	OUT	W
	FBD:CL3013_NO2_Management	NE_UINT	.62.40	203,34	IN1	R
	FBD:CL3013_NO2_Management	MOVE	.62.43	252,40	OUT	W
CL3013_NO2_Analysis_Time_Loading	FBD:CL3013_SFC_CONTROL_PR> OCEDURE	MOVE	.36.52	241,40	OUT	W
	FBD:CL3013_SFC_CONTROL_PR> OCEDURE	MOVE	.36.102	261,90	OUT	W
	FBD:CL3013_SFC_CONTROL_PR> OCEDURE	MOVE	.36.112	271,96	OUT	W
	FBD:CL3013_SFC_CONTROL_PR>	MOVE	.36.123	255,46	OUT	W

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
	OCEDURE					
	FBD:CL3013_NO2_Management	R_TRIG	FBI_62_7	20,62	CLK	R
	FBD:CL3013_NO2_Management	MOVE	.62.9	48,56	OUT	W
	SFC:CL3013_NO2	TRANSITION	S_CL3013_NO2_001	5,5		W
CL3013_NO2_ControlLoop_Mode	FBD:CL3004_Bioreactor_Gen> eral	MOVE	.25.35	58,50	OUT	W
	FBD:CL3013_SFC_CONTROL_PR> OCEDURE	EQ_INT	.36.37	184,13	IN1	R
	FBD:CL3013_SFC_CONTROL_PR> OCEDURE	MOVE	.36.105	256,107	OUT	W
	FBD:CL3013_NH4_Management	EQ_INT	.60.114	94,79	IN1	R
	FBD:CL3013_NH4_Management	MOVE	.60.118	155,73	OUT	W
	FBD:CL3013_NO2_Management	EQ_INT	.62.10	9,21	IN1	R
	FBD:CL3013_NO2_Management	EQ_INT	.62.16	8,116	IN1	R
	FBD:CL3013_NO2_Management	VALVBOOL	FBI_62_19	144,12	SELECT	R
	FBD:CL3013_NO2_Management	EQ_INT	.62.21	12,159	IN1	R
	FBD:CL3013_NO2_Management	EQ_INT	.62.24	8,73	IN1	R
	FBD:CL3013_NO2_Management	EQ_INT	.62.28	6,83	IN1	R
	FBD:CL3013_NO2_Management	EQ_INT	.62.33	13,139	IN1	R
	FBD:CL3013_NO2_Management	EQ_INT	.62.49	31,199	IN1	R
	FBD:CL3015_Backwashing	MOVE	.18.24	178,8	OUT	W
	FBD:CL3016_Gas_Pulse	MOVE	.19.88	192,18	OUT	W
	FBD:T_CL3013_NO2_001	EQ_INT	.56.2	9,9	IN1	R
	FBD:T_CL3013_NO2_001	EQ_INT	.56.4	20,18	IN1	R
	FBD:T_CL3013_NO2_Stop_001	EQ_INT	.58.2	19,8	IN1	R
	FBD:T_CL3013_NO2_Stop_001	EQ_INT	.58.5	19,21	IN1	R
CL3013_NO3_Analysis_Time	FBD:CL3013_NO3_Management	NE_UINT	.61.2	10,24	IN1	R
	FBD:CL3013_NO3_Management	SUB_UINT	.61.6	65,22	IN1	R
	FBD:CL3013_NO3_Management	SUB_UINT	.61.6	82,22	OUT	W
	FBD:CL3013_NO3_Management	NE_UINT	.61.8	11,95	IN1	R
	FBD:CL3013_NO3_Management	EQ_UINT	.61.23	21,40	IN1	R
	FBD:CL3013_NO3_Management	MOVE	.61.33	58,74	OUT	W
	FBD:CL3013_NO3_Management	MOVE	.61.60	62,183	OUT	W
	FBD:CL3013_NO3_Management	MOVE	.61.77	286,48	OUT	W
CL3013_NO3_Analysis_Time_CFG	FBD:CL3013_NO3_Management	MOVE	.61.33	42,74	IN	R
	FBD:CL3013_NO3_Management	MOVE	.61.60	46,183	IN	R
	FBD:CL3013_NO3_Management	MOVE	.61.74	259,23	IN	R
	FBD:CL3013_NO3_Management	NE_UINT	.61.75	237,48	IN2	R
	FBD:CL3013_NO3_Management	MOVE	.61.77	270,48	IN	R
	FBD:CL3013_NO3_Management	MOVE	.61.78	270,53	IN	R
CL3013_NO3_Analysis_Time_CFG0	FBD:CL3013_NO3_Management	EQ_UINT	.61.72	237,20	IN1	R
	FBD:CL3013_NO3_Management	MOVE	.61.74	275,23	OUT	W
	FBD:CL3013_NO3_Management	NE_UINT	.61.75	237,47	IN1	R
	FBD:CL3013_NO3_Management	MOVE	.61.78	286,53	OUT	W
CL3013_NO3_Analysis_Time_loading	FBD:CL3013_SFC_CONTROL_PR> OCEDURE	MOVE	.36.51	160,39	OUT	W
	FBD:CL3013_SFC_CONTROL_PR> OCEDURE	MOVE	.36.77	169,160	OUT	W
	FBD:CL3013_SFC_CONTROL_PR> OCEDURE	MOVE	.36.114	173,46	OUT	W
	FBD:CL3013_SFC_CONTROL_PR> OCEDURE	MOVE	.36.118	183,166	OUT	W
	FBD:CL3013_NO3_Management	R_TRIG	FBI_61_32	13,73	CLK	R
	FBD:CL3013_NO3_Management	MOVE	.61.34	42,69	OUT	W
	SFC:CL3013_NO3	TRANSITION	S_CL3013_NO3_001	5,5		W
CL3013_NO3_Calibration_Time	FBD:CL3013_NO3_Management	SUB_UINT	.61.12	70,93	IN1	R
	FBD:CL3013_NO3_Management	SUB_UINT	.61.12	87,93	OUT	W

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
	FBD:CL3013_NO3_Management	EQ_UINT	.61.35	11,110	IN1	R
	FBD:CL3013_NO3_Management	MOVE	.61.54	54,148	OUT	W
	FBD:CL3013_NO3_Management	MOVE	.61.61	62,188	OUT	W
	FBD:CL3013_NO3_Management	MOVE	.61.81	287,60	OUT	W
CL3013_NO3_Calibration_Time_CFG	FBD:CL3013_NO3_Management	MOVE	.61.54	38,148	IN	R
	FBD:CL3013_NO3_Management	MOVE	.61.61	46,188	IN	R
	FBD:CL3013_NO3_Management	MOVE	.61.71	260,32	IN	R
	FBD:CL3013_NO3_Management	NE_UINT	.61.79	237,60	IN2	R
	FBD:CL3013_NO3_Management	MOVE	.61.81	271,60	IN	R
	FBD:CL3013_NO3_Management	MOVE	.61.82	271,65	IN	R
CL3013_NO3_Calibration_Time_CFG0	FBD:CL3013_NO3_Management	EQ_UINT	.61.69	238,29	IN1	R
	FBD:CL3013_NO3_Management	MOVE	.61.71	276,32	OUT	W
	FBD:CL3013_NO3_Management	NE_UINT	.61.79	237,59	IN1	R
	FBD:CL3013_NO3_Management	MOVE	.61.82	287,65	OUT	W
CL3013_NO3_Calib_Time_loading	FBD:CL3013_SFC_CONTROL_PR> OCEDURE	MOVE	.36.50	170,102	OUT	W
	FBD:CL3013_SFC_CONTROL_PR> OCEDURE	MOVE	.36.116	184,109	OUT	W
	FBD:CL3013_SFC_CONTROL_PR> OCEDURE	MOVE	.36.119	169,170	OUT	W
	FBD:CL3013_SFC_CONTROL_PR> OCEDURE	MOVE	.36.121	183,176	OUT	W
	FBD:CL3013_NO3_Management	R_TRIG	FBI_61_53	13,147	CLK	R
	FBD:CL3013_NO3_Management	MOVE	.61.55	45,142	OUT	W
	SFC:CL3013_NO3_Calib	TRANSITION	S_CL3013_NO3_Calib_001	5,5		W
CL3013_NO3_ControlLoop_Mode	FBD:CL3004_Bioreactor_Gen> eral	MOVE	.25.34	57,45	OUT	W
	FBD:CL3013_SFC_CONTROL_PR> OCEDURE	EQ_INT	.36.21	106,74	IN1	R
	FBD:CL3013_SFC_CONTROL_PR> OCEDURE	EQ_INT	.36.58	97,12	IN1	R
	FBD:CL3013_SFC_CONTROL_PR> OCEDURE	MOVE	.36.80	169,187	OUT	W
	FBD:CL3013_NH4_Management	EQ_INT	.60.109	94,69	IN1	R
	FBD:CL3013_NH4_Management	MOVE	.60.113	155,63	OUT	W
	FBD:CL3013_NO3_Management	EQ_INT	.61.1	10,17	IN1	R
	FBD:CL3013_NO3_Management	EQ_INT	.61.7	11,88	IN1	R
	FBD:CL3013_NO3_Management	EQ_INT	.61.13	10,162	IN1	R
	FBD:CL3013_NO3_Management	EQ_INT	.61.17	10,214	IN1	R
	FBD:CL3013_NO3_Management	VALVBOOL	FBI_61_22	148,17	SELECT	R
	FBD:CL3013_NO3_Management	EQ_INT	.61.27	7,57	IN1	R
	FBD:CL3013_NO3_Management	EQ_INT	.61.39	11,134	IN1	R
	FBD:CL3013_NO3_Management	EQ_INT	.61.56	9,172	IN1	R
	FBD:CL3013_NO3_Management	EQ_INT	.61.62	10,200	IN1	R
	FBD:CL3013_NO3_Management	EQ_INT	.61.88	88,209	IN1	R
	FBD:CL3013_NO3_Management	EQ_INT	.61.92	161,208	IN1	R
	FBD:CL3015_Backwashing	MOVE	.18.23	150,8	OUT	W
	FBD:CL3016_Gas_Pulse	MOVE	.19.87	164,18	OUT	W
	FBD:T_CL3013_NO3_001	EQ_INT	.42.5	15,14	IN1	R
	FBD:T_CL3013_NO3_001	EQ_INT	.42.8	26,23	IN1	R
	FBD:T_CL3013_NO3_Calib_001	EQ_INT	.46.6	22,10	IN1	R
	FBD:T_CL3013_NO3_Calib_001	EQ_INT	.46.8	22,17	IN1	R
	FBD:T_CL3013_NO3_Stop_001	EQ_INT	.50.5	9,6	IN1	R
	FBD:T_CL3013_NO3_Stop_001	EQ_INT	.50.9	9,20	IN1	R
CL3013_RecycleFlow_Flag	FBD:CL3013_NH4_Management	GT_REAL	.60.58	133,35	OUT	W
	FBD:CL3013_NH4_Management	AND_BOOL	.60.103	108,54	IN1	R
	FBD:CL3013_NH4_Management	AND_BOOL	.60.110	108,64	IN1	R

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)						
Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
	FBD:CL3013_NH4_Management	AND_BOOL	.60.115	108,74	IN1	R
	FBD:T_CL3013_NH4_001	AND_BOOL	.33.5	19,13	IN2	R
	FBD:T_CL3013_NO3_001	AND_BOOL	.42.6	25,17	IN2	R
	FBD:T_CL3013_NO2_001	AND_BOOL	.56.3	19,12	IN2	R
CL3015_BACKWASHING_DURATION	FBD:CL3015_Backwashing	MUL_UDINT	.18.17	21,37	IN1	R
CL3015_BACKWASHING_TIME	FBD:CL3015_Backwashing	TOF	FBI_18_15	63,28	ET	W
CL3015_ControlLoop_Mode	FBD:CL3015_Backwashing	OPMDBOOL	FBI_18_1	8,14	SELEC	R
	FBD:CL3015_Backwashing	OPMDBOOL	FBI_18_13	85,25	SELEC	R
	FBD:CL3015_Backwashing	INT_TO_BOOL	.18.18	21,27	IN	R
	FBD:CL3015_Backwashing	MOVE	.18.20	87,39	OUT	W
	FBD:CL3016_Gas_Pulse	MOVE	.19.22	159,25	OUT	W
CL3016_BOTTOM_CLOSING_TIME	FBD:CL3016_Gas_Pulse	MUL_UDINT	.19.82	53,89	IN1	R
CL3016_BOTTOM_CLOSING_TIMER	FBD:CL3016_Gas_Pulse	TOF	FBI_19_46	112,85	ET	W
CL3016_BOTTOM_OPENING	FBD:CL3016_Gas_Pulse	F_TRIG	FBI_19_53	130,110	Q	W
	FBD:CL3016_Gas_Pulse	OR_BOOL	.19.54	27,66	IN2	R
CL3016_BOTTOM_OPENING_TIME	FBD:CL3016_Gas_Pulse	MUL_UDINT	.19.81	24,82	IN1	R
CL3016_BOTTOM_OPENING_TIMER	FBD:CL3016_Gas_Pulse	TOF	FBI_19_12	76,76	ET	W
CL3016_ControlLoop_Mode	FBD:CL3004_Bioreactor_Gen>eral	MOVE	.25.21	58,61	OUT	W
	FBD:CL3015_Backwashing	MOVE	.18.10	147,15	OUT	W
	FBD:CL3016_Gas_Pulse	OPMDBOOL	FBI_19_5	12,25	SELEC	R
	FBD:CL3016_Gas_Pulse	MOVE	.19.63	109,58	OUT	W
	FBD:CL3016_Gas_Pulse	MOVE	.19.67	47,39	OUT	W
	FBD:CL3016_Gas_Pulse	INT_TO_BOOL	.19.79	96,73	IN	R
	FBD:CL3016_Gas_Pulse	VALVBOOL	FBI_19_90	86,96	SELECT	R
CL3016_OXYGENPULSE_COUNTER	FBD:CL3016_Gas_Pulse	ADD_INT	.19.56	157,104	OUT	W
	FBD:CL3016_Gas_Pulse	ADD_INT	.19.56	141,104	IN1	R
	FBD:CL3016_Gas_Pulse	LT_INT	.19.60	32,57	IN1	R
	FBD:CL3016_Gas_Pulse	MOVE	.19.62	109,53	OUT	W
	FBD:CL3016_Gas_Pulse	MOVE	.19.66	47,34	OUT	W
	FBD:CL3016_Gas_Pulse	MOVE	.19.75	31,50	IN	R
	FBD:CL3016_Gas_Pulse	MOVE	.19.78	87,40	OUT	W
CL3016_OXYGENPULSE_NUMBER	FBD:CL3016_Gas_Pulse	LT_INT	.19.60	32,58	IN2	R
	FBD:CL3016_Gas_Pulse	MOVE	.19.75	47,50	OUT	W
CL3016_Start_OxygenPulse	FBD:CL3016_Gas_Pulse	R_TRIG	FBI_19_44	72,31	Q	W
	FBD:CL3016_Gas_Pulse	OR_BOOL	.19.54	27,65	IN1	R
CL3016_TOP_CLOSING_TIME	FBD:CL3016_Gas_Pulse	MUL_UDINT	.19.84	63,118	IN1	R
CL3016_TOP_CLOSING_TIMER	FBD:CL3016_Gas_Pulse	TOF	FBI_19_52	112,112	ET	W
CL3016_TOP_OPENING	FBD:CL3016_Gas_Pulse	F_TRIG	FBI_19_47	129,82	Q	W
	FBD:CL3016_Gas_Pulse	R_TRIG	FBI_19_48	37,101	CLK	R
CL3016_TOP_OPENING_TIME	FBD:CL3016_Gas_Pulse	MUL_UDINT	.19.83	23,106	IN1	R
CL3016_TOP_OPENING_TIMER	FBD:CL3016_Gas_Pulse	TOF	FBI_19_50	71,102	ET	W
CL3017_ControlLoop_Mode	FBD:CL3004_Bioreactor_Gen>eral	MOVE	.25.22	58,66	OUT	W
	FBD:CL3015_Backwashing	MOVE	.18.11	209,8	OUT	W
	FBD:CL3016_Gas_Pulse	MOVE	.19.23	219,18	OUT	W
	FBD:CL3017_Liquid_Recircu>lation	OPMDREAL	FBI_20_4	54,9	SELEC	R
	FBD:CL3017_Liquid_Recircu>lation	OPMDBOOL	FBI_20_6	55,26	SELEC	R
	FBD:CL3017_Liquid_Recircu>lation	INT_TO_BOOL	.20.8	19,51	IN	R
	FBD:CL3017_Liquid_Recircu>lation	EQ_INT	.20.25	23,79	IN1	R
	FBD:CL3017_Liquid_Recircu>lation	EQ_INT	.20.26	21,101	IN1	R
	FBD:CL3017_Liquid_Recircu>	EQ_INT	.20.28	114,79	IN1	R

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
	lation					
	FBD:CL3017_Liquid_Recircu> lation	EQ_INT	.20.30	115,103	IN1	R
	FBD:CL3006_Bioreactor_Lev> el_Control	MOVE	.9.62	77,199	OUT	W
CL3017_ERR	FBD:CL3017_Liquid_Recircu> lation	PCR_SF1	FBI_20_1	39,14	ERR	W
CL3017_Flag4Init	FBD:CL3017_Liquid_Recircu> lation	PCR_SF1	FBI_20_1	22,18	MAN	R
	FBD:CL3017_Liquid_Recircu> lation	INT_TO_BOOL	.20.8	38,51	OUT	W
CL3017_FLOW_SP	FBD:CL3017_Liquid_Recircu> lation	PCR_SF1	FBI_20_1	22,13	SP	R
	FBD:CL3017_Liquid_Recircu> lation	SUB_REAL	.20.11	3,72	IN2	R
	FBD:CL3017_Liquid_Recircu> lation	SUB_REAL	.20.13	95,74	IN2	R
	FBD:CL3017_Liquid_Recircu> lation	SUB_REAL	.20.15	4,94	IN2	R
	FBD:CL3017_Liquid_Recircu> lation	SUB_REAL	.20.17	95,97	IN2	R
CL3017_IMP	FBD:CL3017_Liquid_Recircu> lation	PCR_SF1	FBI_20_1	22,15	IMP	R
CL3017_IMV	FBD:CL3017_Liquid_Recircu> lation	PCR_SF1	FBI_20_1	39,13	IMV	W
CL3017_INIT	FBD:CL3017_Liquid_Recircu> lation	PCR_SF1	FBI_20_1	22,11	INIT	R
	FBD:CL3017_Liquid_Recircu> lation	TOF	FBI_20_10	63,57	Q	W
CL3017_LIM	FBD:CL3017_Liquid_Recircu> lation	PCR_SF1	FBI_20_1	22,17	LIM	R
CL3017_TUNE	FBD:CL3017_Liquid_Recircu> lation	PCR_SF1	FBI_20_1	22,16	TUNE	R
CL3017_TUNE.TS	FBD:CL3017_Liquid_Recircu> lation	SAMPLETM	FBI_20_3	3,10	INTERVAL	R
CL3017_TUNE.TS	FBD:CL3017_Liquid_Recircu> lation	TOF	FBI_20_10	47,58	PT	R
CL3017_Y	FBD:CL3017_Liquid_Recircu> lation	PCR_SF1	FBI_20_1	22,14	RCPY	R
	FBD:CL3017_Liquid_Recircu> lation	PCR_SF1	FBI_20_1	39,12	Y	W
CL3018_Auto_Mode_Forced	FBD:CL3006_Bioreactor_Lev> el_Control	EQ_INT	.9.13	130,34	OUT	W
CL3018_ControlLoop_Mode	FBD:CL3004_Bioreactor_Gen> eral	MOVE	.25.23	58,71	OUT	W
	FBD:CL3006_Bioreactor_Lev> el_Control	MOVE	.9.15	150,37	OUT	W
	FBD:CL3015_Backwashing	MOVE	.18.12	233,8	OUT	W
	FBD:CL3016_Gas_Pulse	MOVE	.19.24	243,18	OUT	W
	FBD:CL3018_Outlet_liquid_> Control	OPMDBOOL	FBI_21_4	55,31	SELEC	R
	FBD:CL3018_Outlet_liquid_> Control	INT_TO_BOOL	.21.6	20,51	IN	R
	FBD:CL3018_Outlet_liquid_> Control	EQ_INT	.21.35	24,83	IN1	R
	FBD:CL3018_Outlet_liquid_> Control	EQ_INT	.21.47	101,83	IN1	R

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
	FBD:CL3018_Outlet_liquid_>Control	EQ_INT	.21.52	25,108	IN1	R
	FBD:CL3018_Outlet_liquid_>Control	EQ_INT	.21.57	104,108	IN1	R
	FBD:CL3018_Outlet_liquid_>Control	OPMDREAL	FBI_21_62	83,9	SELEC	R
	FBD:CL3018_Outlet_liquid_>Control	VALVBOOL	FBI_21_70	114,14	SELECT	R
	FBD:CL3021_Effluent_Level	EQ_INT	.23.4	7,66	IN1	R
	FBD:CL3021_Effluent_Level	MOVE	.23.7	63,66	OUT	W
CL3018_EF1_SP_CSTR	FBD:CL3006_Bioreactor_Lev>el_Control	PCR_EIF1	FBI_9_2	72,20	RCPY	R
	FBD:CL3018_Outlet_liquid_>Control	PCR_EF1	FBI_21_61	74,14	SP_CSTR	W
CL3018_ERR	FBD:CL3018_Outlet_liquid_>Control	PCR_EF1	FBI_21_61	74,16	ERR	W
CL3018_Flag4Init	FBD:CL3018_Outlet_liquid_>Control	INT_TO_BOOL	.21.6	39,51	OUT	W
	FBD:CL3018_Outlet_liquid_>Control	PCR_EF1	FBI_21_61	54,23	MAN	R
CL3018_FLOW_SP	FBD:CL3018_Outlet_liquid_>Control	SUB_REAL	.21.31	4,76	IN2	R
	FBD:CL3018_Outlet_liquid_>Control	SUB_REAL	.21.45	82,78	IN2	R
	FBD:CL3018_Outlet_liquid_>Control	SUB_REAL	.21.50	5,101	IN2	R
	FBD:CL3018_Outlet_liquid_>Control	SUB_REAL	.21.55	85,103	IN2	R
	FBD:CL3018_Outlet_liquid_>Control	SEL	.21.63	25,13	IN0	R
	FBD:CL3018_Outlet_liquid_>Control	MOVE	.21.65	33,21	OUT	W
	FBD:CL3018_Outlet_liquid_>Control	MOVE	.21.66	26,29	IN	R
CL3018_IMP	FBD:CL3018_Outlet_liquid_>Control	PCR_EF1	FBI_21_61	54,16	IMP	R
CL3018_IMV	FBD:CL3018_Outlet_liquid_>Control	PCR_EF1	FBI_21_61	74,13	IMV	W
CL3018_INIT	FBD:CL3018_Outlet_liquid_>Control	TOF	FBI_21_8	64,57	Q	W
	FBD:CL3018_Outlet_liquid_>Control	PCR_EF1	FBI_21_61	54,11	INIT	R
CL3018_LIM	FBD:CL3018_Outlet_liquid_>Control	PCR_EF1	FBI_21_61	54,18	LIM	R
CL3018_TUNE.TS	FBD:CL3018_Outlet_liquid_>Control	TOF	FBI_21_8	48,58	PT	R
CL3018_TUNE.TS	FBD:CL3018_Outlet_liquid_>Control	SAMPLETM	FBI_21_60	39,5	INTERVAL	R
	FBD:CL3018_Outlet_liquid_>Control	PCR_EF1	FBI_21_61	54,17	TUNE	R
CL3018_Y	FBD:CL3018_Outlet_liquid_>Control	PCR_EF1	FBI_21_61	54,14	RCPY	R
	FBD:CL3018_Outlet_liquid_>Control	PCR_EF1	FBI_21_61	74,12	Y	W
CL3020_ControlLoop_Mode	FBD:CL3004_Bioreactor_Gen>eral	MOVE	.25.24	58,76	OUT	W
	FBD:CL3020_Effluent_Tempe>	INT_TO_BOOL	.22.6	22,42	IN	R

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
	rature					
	FBD:CL3020_Effluent_Tempe> rature	EQ_INT	.22.19	38,87	IN1	R
	FBD:CL3020_Effluent_Tempe> rature	EQ_INT	.22.21	35,102	IN1	R
	FBD:CL3020_Effluent_Tempe> rature	EQ_INT	.22.24	39,125	IN1	R
	FBD:CL3020_Effluent_Tempe> rature	EQ_INT	.22.26	36,146	IN1	R
	FBD:CL3020_Effluent_Tempe> rature	VALVBOOL	FBI_22_28	74,13	SELECT	R
CL3020_IMP	FBD:CL3020_Effluent_Tempe> rature	PCR_SF1	FBI_22_2	18,18	IMP	R
CL3020_IMV	FBD:CL3020_Effluent_Tempe> rature	PCR_SF1	FBI_22_2	35,16	IMV	W
CL3020_INIT	FBD:CL3020_Effluent_Tempe> rature	PCR_SF1	FBI_22_2	18,14	INIT	R
	FBD:CL3020_Effluent_Tempe> rature	TOF	FBI_22_8	72,48	Q	W
CL3020_LIM	FBD:CL3020_Effluent_Tempe> rature	PCR_SF1	FBI_22_2	18,20	LIM	R
CL3020_PARAPWM	FBD:CL3020_Effluent_Tempe> rature	PWM	FBI_22_4	46,16	PARA	R
CL3020_PCR_Flag4Init	FBD:CL3020_Effluent_Tempe> rature	PCR_SF1	FBI_22_2	18,21	MAN	R
	FBD:CL3020_Effluent_Tempe> rature	INT_TO_BOOL	.22.6	41,42	OUT	W
CL3020_SF1_ERR	FBD:CL3020_Effluent_Tempe> rature	PCR_SF1	FBI_22_2	35,17	ERR	W
CL3020_TUNE.TS	FBD:CL3020_Effluent_Tempe> rature	SAMPLETM	FBI_22_1	6,11	INTERVAL	R
	FBD:CL3020_Effluent_Tempe> rature	PCR_SF1	FBI_22_2	18,19	TUNE	R
CL3020_TUNE.TS	FBD:CL3020_Effluent_Tempe> rature	TOF	FBI_22_8	56,49	PT	R
CL3020_Y	FBD:CL3020_Effluent_Tempe> rature	PCR_SF1	FBI_22_2	18,17	RCPY	R
	FBD:CL3020_Effluent_Tempe> rature	PCR_SF1	FBI_22_2	35,15	Y	W
CL3022_ControlLoop_Mode	FBD:CL3004_Bioreactor_Gen> eral	MOVE	.25.25	58,81	OUT	W
CL_3009_ERR	FBD:CL3009_Bioreactor_DO2> _Control	PCR_EF1	FBI_12_9	53,44	ERR	W
CP_3005_01_MV	FBD:CL3005_Bioreactor_Tem> p_Control	OPMDBOOL	FBI_8_16	122,45	OUT	W
CP_3005_01_OP	FBD:CL3005_Bioreactor_Tem> p_Control	OPMDBOOL	FBI_8_16	103,48	MAN	R
DPT_3007_01	FBD:Input	I_SCALE	.2.21	88,79	Y	W
	FBD:CL3007_Bioreactor_Pre> ssu_Control	GT_REAL	.10.2	12,25	IN1	R
	FBD:CL3007_Bioreactor_Pre> ssu_Control	GT_REAL	.10.4	12,35	IN1	R
	FBD:CL3007_Bioreactor_Pre> ssu_Control	LT_REAL	.10.7	13,48	IN1	R
	FBD:CL3007_Bioreactor_Pre> ssu_Control	LT_REAL	.10.9	13,58	IN1	R
DPT_3007_01_AH	FBD:ALARM_STATUS	OR_BOOL	.31.5	14,83	IN15	R

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
	FBD:CL3007_Bioreactor_Pre> ssu_Control	ACT_DIA	FBI_10_22	46,23	ERR	W
DPT_3007_01_AHH	FBD:ALARM_STATUS	OR_BOOL	.31.1	18,39	IN27	R
	FBD:CL3007_Bioreactor_Pre> ssu_Control	ACT_DIA	FBI_10_23	46,33	ERR	W
DPT_3007_01_AL	FBD:ALARM_STATUS	OR_BOOL	.31.5	14,84	IN16	R
	FBD:CL3007_Bioreactor_Pre> ssu_Control	ACT_DIA	FBI_10_24	45,46	ERR	W
DPT_3007_01_ALL	FBD:ALARM_STATUS	OR_BOOL	.31.1	18,40	IN28	R
	FBD:CL3007_Bioreactor_Pre> ssu_Control	ACT_DIA	FBI_10_25	46,56	ERR	W
DPT_3007_01_ERR	FBD:ERR_AI	WORD_TO_BIT	FBI_4_1	17,20	BIT10	W
	FBD:ALARM_STATUS	OR_BOOL	.31.1	18,41	IN29	R
DPT_3007_01_LIM_H	FBD:CL3007_Bioreactor_Pre> ssu_Control	GT_REAL	.10.2	12,26	IN2	R
DPT_3007_01_LIM_HH	FBD:CL3007_Bioreactor_Pre> ssu_Control	GT_REAL	.10.4	12,36	IN2	R
DPT_3007_01_LIM_L	FBD:CL3007_Bioreactor_Pre> ssu_Control	LT_REAL	.10.7	13,49	IN2	R
DPT_3007_01_LIM_LL	FBD:CL3007_Bioreactor_Pre> ssu_Control	LT_REAL	.10.9	13,59	IN2	R
DPT_Range_MAX	FBD:Input	I_SCALE	.2.21	71,80	MX	R
DPT_Range_MIN	FBD:Input	I_SCALE	.2.21	71,79	MN	R
FB_TIME_LIM	FBD:CL3001_Influent_Temp_> Control	VALVBOOL	FBI_5_28	67,18	TIMER	R
	FBD:CL3005_Bioreactor_Tem> p_Control	VALVBOOL	FBI_8_84	104,91	TIMER	R
	FBD:CL3005_Bioreactor_Tem> p_Control	VALVBOOL	FBI_8_86	100,74	TIMER	R
	FBD:CL3008_Bioreactor_pH_> Control	VALVBOOL	FBI_11_292	163,105	TIMER	R
	FBD:CL3008_Bioreactor_pH_> Control	VALVBOOL	FBI_11_293	168,69	TIMER	R
	FBD:CL3011_Gas_Loop	VALVBOOL	FBI_14_127	91,104	TIMER	R
	FBD:CL3011_Gas_Loop	VALVBOOL	FBI_14_128	92,115	TIMER	R
	FBD:CL3013_NH4_Management	VALVBOOL	FBI_60_55	199,32	TIMER	R
	FBD:CL3013_NO3_Management	VALVBOOL	FBI_61_22	148,23	TIMER	R
	FBD:CL3013_NO2_Management	VALVBOOL	FBI_62_19	144,18	TIMER	R
	FBD:CL3016_Gas_Pulse	VALVBOOL	FBI_19_89	138,77	TIMER	R
	FBD:CL3016_Gas_Pulse	VALVBOOL	FBI_19_90	86,102	TIMER	R
	FBD:CL3018_Outlet_liquid_> Control	VALVBOOL	FBI_21_70	114,20	TIMER	R
	FBD:CL3020_Effluent_Tempe> rature	ACT_DIA	FBI_22_9	15,64	DTIME	R
	FBD:CL3020_Effluent_Tempe> rature	VALVBOOL	FBI_22_28	74,19	TIMER	R
FQRC_3008_01	FBD:Input	I_SCALE	.2.36	87,182	Y	W
	FBD:CL3008_Bioreactor_pH_> Control	SUB_REAL	.11.259	231,189	IN1	R
	FBD:CL3008_Bioreactor_pH_> Control	SUB_REAL	.11.262	230,197	IN1	R
	FBD:CL3008_Bioreactor_pH_> Control	SUB_REAL	.11.265	229,206	IN1	R
	FBD:CL3008_Bioreactor_pH_> Control	SUB_REAL	.11.269	229,214	IN1	R
	FBD:CL3011_Gas_Loop	SUB_REAL	.14.67	11,23	IN2	R
	FBD:CL3011_Gas_Loop	ADD_REAL	.14.92	32,41	IN1	R

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
	FBD:CL3011_Gas_Loop	ADD_REAL	.14.93	9,51	IN1	R
	FBD:CL3011_Gas_Loop	ADD_REAL	.14.94	9,62	IN1	R
FQRC_3008_01_AH	FBD:CL3008_Bioreactor_pH_>Control	ACT_DIA	FBI_11_309	276,188	ERR	W
FQRC_3008_01_AHH	FBD:CL3008_Bioreactor_pH_>Control	ACT_DIA	FBI_11_310	276,197	ERR	W
FQRC_3008_01_AL	FBD:CL3008_Bioreactor_pH_>Control	ACT_DIA	FBI_11_311	277,206	ERR	W
FQRC_3008_01_ALL	FBD:CL3008_Bioreactor_pH_>Control	ACT_DIA	FBI_11_312	277,215	ERR	W
FQRC_3008_01_ERR	FBD:ERR_AI	WORD_TO_BIT	FBI_4_4	94,20	BIT9	W
	FBD:ALARM_STATUS	OR_BOOL	.31.2	47,25	IN13	R
FQRC_3008_01_LIM_H	FBD:CL3008_Bioreactor_pH_>Control	GT_REAL	.11.260	245,192	IN2	R
FQRC_3008_01_LIM_HH	FBD:CL3008_Bioreactor_pH_>Control	GT_REAL	.11.263	244,200	IN2	R
FQRC_3008_01_LIM_L	FBD:CL3008_Bioreactor_pH_>Control	LT_REAL	.11.268	244,209	IN2	R
FQRC_3008_01_LIM_LL	FBD:CL3008_Bioreactor_pH_>Control	LT_REAL	.11.270	244,217	IN2	R
FQRC_3008_01_OP	FBD:CL3008_Bioreactor_pH_>Control	OPMDREAL	FBI_11_57	153,148	MAN	R
FQRC_3008_01_SP	FBD:output	O_SCALE	FBI_3_6	36,17	X	R
	FBD:CL3008_Bioreactor_pH_>Control	OPMDREAL	FBI_11_57	172,145	OUT	W
	FBD:CL3008_Bioreactor_pH_>Control	PCR_IF1	FBI_11_232	99,151	RCPY	R
	FBD:CL3008_Bioreactor_pH_>Control	SUB_REAL	.11.259	231,190	IN2	R
	FBD:CL3008_Bioreactor_pH_>Control	SUB_REAL	.11.262	230,198	IN2	R
	FBD:CL3008_Bioreactor_pH_>Control	SUB_REAL	.11.265	229,207	IN2	R
	FBD:CL3008_Bioreactor_pH_>Control	SUB_REAL	.11.269	229,215	IN2	R
FQRC_3009_01	FBD:Input	I_SCALE	.2.35	88,189	Y	W
	FBD:CL3009_Bioreactor_DO2>_Control	SUB_REAL	.12.74	150,92	IN1	R
	FBD:CL3009_Bioreactor_DO2>_Control	SUB_REAL	.12.77	149,100	IN1	R
	FBD:CL3009_Bioreactor_DO2>_Control	SUB_REAL	.12.80	148,109	IN1	R
	FBD:CL3009_Bioreactor_DO2>_Control	SUB_REAL	.12.83	148,117	IN1	R
	FBD:CL3011_Gas_Loop	SUB_REAL	.14.68	30,23	IN2	R
	FBD:CL3011_Gas_Loop	ADD_REAL	.14.92	32,42	IN2	R
	FBD:CL3011_Gas_Loop	ADD_REAL	.14.93	9,52	IN2	R
	FBD:CL3011_Gas_Loop	ADD_REAL	.14.94	9,63	IN2	R
FQRC_3009_01_AH	FBD:CL3009_Bioreactor_DO2>_Control	TON	FBI_12_76	193,94	Q	W
FQRC_3009_01_AHH	FBD:CL3009_Bioreactor_DO2>_Control	TON	FBI_12_79	192,102	Q	W
FQRC_3009_01_AL	FBD:CL3009_Bioreactor_DO2>_Control	TON	FBI_12_82	191,111	Q	W
FQRC_3009_01_ALL	FBD:CL3009_Bioreactor_DO2>_Control	TON	FBI_12_85	191,119	Q	W
FQRC_3009_01_ERR	FBD:ERR_AI	WORD_TO_BIT	FBI_4_4	94,19	BIT8	W

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
	FBD:ALARM_STATUS	OR_BOOL	.31.2	47,32	IN20	R
	FBD:CL3009_Bioreactor_DO2>_Control	OR_BOOL	.12.12	19,52	IN2	R
FQRC_3009_01_LIM_H	FBD:CL3009_Bioreactor_DO2>_Control	GT_REAL	.12.75	164,95	IN2	R
FQRC_3009_01_LIM_HH	FBD:CL3009_Bioreactor_DO2>_Control	GT_REAL	.12.78	163,103	IN2	R
FQRC_3009_01_LIM_L	FBD:CL3009_Bioreactor_DO2>_Control	LT_REAL	.12.81	163,112	IN2	R
FQRC_3009_01_LIM_LL	FBD:CL3009_Bioreactor_DO2>_Control	LT_REAL	.12.84	163,120	IN2	R
FQRC_3009_01_OP	FBD:CL3009_Bioreactor_DO2>_Control	OPMDREAL	FBI_12_19	63,38	MAN	R
FQRC_3009_01_SP	FBD:output	O_SCALE	FBI_3_7	36,26	X	R
	FBD:CL3009_Bioreactor_DO2>_Control	OPMDREAL	FBI_12_19	82,35	OUT	W
	FBD:CL3009_Bioreactor_DO2>_Control	SUB_REAL	.12.74	150,93	IN2	R
	FBD:CL3009_Bioreactor_DO2>_Control	SUB_REAL	.12.77	149,101	IN2	R
	FBD:CL3009_Bioreactor_DO2>_Control	SUB_REAL	.12.80	148,110	IN2	R
	FBD:CL3009_Bioreactor_DO2>_Control	SUB_REAL	.12.83	148,118	IN2	R
FQRC_3011_01	FBD:Input	I_SCALE	.2.37	88,196	Y	W
	FBD:CL3011_Gas_Loop	ADD_REAL	.14.92	32,43	IN3	R
	FBD:CL3011_Gas_Loop	SUB_REAL	.14.103	177,183	IN1	R
	FBD:CL3011_Gas_Loop	SUB_REAL	.14.106	176,191	IN1	R
	FBD:CL3011_Gas_Loop	SUB_REAL	.14.109	175,200	IN1	R
	FBD:CL3011_Gas_Loop	SUB_REAL	.14.112	175,208	IN1	R
FQRC_3011_01_AH	FBD:CL3011_Gas_Loop	TON	FBI_14_105	220,185	Q	W
FQRC_3011_01_AHH	FBD:CL3011_Gas_Loop	TON	FBI_14_108	219,193	Q	W
FQRC_3011_01_AL	FBD:CL3011_Gas_Loop	TON	FBI_14_111	218,202	Q	W
FQRC_3011_01_ALL	FBD:CL3011_Gas_Loop	TON	FBI_14_114	218,210	Q	W
FQRC_3011_01_ERR	FBD:ERR_AI	WORD_TO_BIT	FBI_4_4	94,21	BIT10	W
	FBD:ALARM_STATUS	OR_BOOL	.31.2	47,41	IN29	R
FQRC_3011_01_LIM_H	FBD:CL3011_Gas_Loop	GT_REAL	.14.104	191,186	IN2	R
FQRC_3011_01_LIM_HH	FBD:CL3011_Gas_Loop	GT_REAL	.14.107	190,194	IN2	R
FQRC_3011_01_LIM_L	FBD:CL3011_Gas_Loop	LT_REAL	.14.110	190,203	IN2	R
FQRC_3011_01_LIM_LL	FBD:CL3011_Gas_Loop	LT_REAL	.14.113	190,211	IN2	R
FQRC_3011_01_OP	FBD:CL3011_Gas_Loop	OPMDREAL	FBI_14_51	78,23	MAN	R
	FBD:CL3016_Gas_Pulse	MOVE	.19.40	142,35	OUT	W
FQRC_3011_01_SP	FBD:output	O_SCALE	FBI_3_8	35,35	X	R
	FBD:CL3011_Gas_Loop	OPMDREAL	FBI_14_51	97,20	OUT	W
	FBD:CL3011_Gas_Loop	SUB_REAL	.14.103	177,184	IN2	R
	FBD:CL3011_Gas_Loop	SUB_REAL	.14.106	176,192	IN2	R
	FBD:CL3011_Gas_Loop	SUB_REAL	.14.109	175,201	IN2	R
	FBD:CL3011_Gas_Loop	SUB_REAL	.14.112	175,209	IN2	R
FQRC_3011_02	FBD:Input	I_SCALE	.2.28	88,129	Y	W
	FBD:CL3011_Gas_Loop	SUB_REAL	.14.115	238,183	IN1	R
	FBD:CL3011_Gas_Loop	SUB_REAL	.14.118	237,191	IN1	R
	FBD:CL3011_Gas_Loop	SUB_REAL	.14.121	236,200	IN1	R
	FBD:CL3011_Gas_Loop	SUB_REAL	.14.124	236,208	IN1	R
FQRC_3011_02_AH	FBD:CL3011_Gas_Loop	TON	FBI_14_117	281,185	Q	W
FQRC_3011_02_AHH	FBD:CL3011_Gas_Loop	TON	FBI_14_120	280,193	Q	W
FQRC_3011_02_AL	FBD:CL3011_Gas_Loop	TON	FBI_14_123	279,202	Q	W
FQRC_3011_02_ALL	FBD:CL3011_Gas_Loop	TON	FBI_14_126	279,210	Q	W

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
FQRC_3011_02_ERR	FBD:ERR_AI	WORD_TO_BIT	FBI_4_2	44,19	BIT9	W
	FBD:ALARM_STATUS	OR_BOOL	.31.2	47,42	IN30	R
FQRC_3011_02_LIM_H	FBD:CL3011_Gas_Loop	GT_REAL	.14.116	252,186	IN2	R
FQRC_3011_02_LIM_HH	FBD:CL3011_Gas_Loop	GT_REAL	.14.119	251,194	IN2	R
FQRC_3011_02_LIM_L	FBD:CL3011_Gas_Loop	LT_REAL	.14.122	251,203	IN2	R
FQRC_3011_02_LIM_LL	FBD:CL3011_Gas_Loop	LT_REAL	.14.125	251,211	IN2	R
FQRC_3011_02_OP	FBD:CL3011_Gas_Loop	OPMDREAL	FBI_14_52	76,10	MAN	R
	FBD:CL3016_Gas_Pulse	MOVE	.19.41	142,40	OUT	W
FQRC_3011_02_SP	FBD:output	O_SCALE	FBI_3_13	35,102	X	R
	FBD:CL3011_Gas_Loop	OPMDREAL	FBI_14_52	95,7	OUT	W
	FBD:CL3011_Gas_Loop	SUB_REAL	.14.115	238,184	IN2	R
	FBD:CL3011_Gas_Loop	SUB_REAL	.14.118	237,192	IN2	R
	FBD:CL3011_Gas_Loop	SUB_REAL	.14.121	236,201	IN2	R
	FBD:CL3011_Gas_Loop	SUB_REAL	.14.124	236,209	IN2	R
FT_3003_01	FBD:Input	I_SCALE	.2.22	88,86	Y	W
	FBD:CL3003_Inlet_Liquid_C>ontrol	PCR_EF1	FBI_7_1	41,20	PV	R
	FBD:CL3003_Inlet_Liquid_C>ontrol	SUB_REAL	.7.7	1,94	IN1	R
	FBD:CL3003_Inlet_Liquid_C>ontrol	SUB_REAL	.7.9	2,115	IN1	R
	FBD:CL3003_Inlet_Liquid_C>ontrol	SUB_REAL	.7.11	1,134	IN1	R
	FBD:CL3003_Inlet_Liquid_C>ontrol	SUB_REAL	.7.14	2,156	IN1	R
	FBD:CL3006_Bioreactor_Lev>el_Control	SEL	.9.26	1,23	IN0	R
	FBD:CL3006_Bioreactor_Lev>el_Control	SEL	.9.28	26,33	IN1	R
FT_3003_01_AH	FBD:ALARM_STATUS	OR_BOOL	.31.5	14,73	IN5	R
	FBD:CL3003_Inlet_Liquid_C>ontrol	TON	FBI_7_24	63,89	Q	W
FT_3003_01_AHH	FBD:ALARM_STATUS	OR_BOOL	.31.1	18,20	IN8	R
	FBD:CL3003_Inlet_Liquid_C>ontrol	TON	FBI_7_29	64,109	Q	W
FT_3003_01_AL	FBD:ALARM_STATUS	OR_BOOL	.31.5	14,74	IN6	R
	FBD:CL3003_Inlet_Liquid_C>ontrol	TON	FBI_7_32	65,131	Q	W
	FBD:CL3006_Bioreactor_Lev>el_Control	AND_BOOL	.9.29	17,22	IN2	R
FT_3003_01_ALL	FBD:ALARM_STATUS	OR_BOOL	.31.1	18,21	IN9	R
	FBD:CL3003_Inlet_Liquid_C>ontrol	TON	FBI_7_35	65,150	Q	W
FT_3003_01_ERR	FBD:ERR_AI	WORD_TO_BIT	FBI_4_1	17,21	BIT11	W
	FBD:ALARM_STATUS	OR_BOOL	.31.1	18,22	IN10	R
FT_3003_01_LIM_H	FBD:CL3003_Inlet_Liquid_C>ontrol	GT_REAL	.7.8	20,95	IN2	R
FT_3003_01_LIM_HH	FBD:CL3003_Inlet_Liquid_C>ontrol	GT_REAL	.7.10	21,116	IN2	R
FT_3003_01_LIM_L	FBD:CL3003_Inlet_Liquid_C>ontrol	LT_REAL	.7.13	19,135	IN2	R
FT_3003_01_LIM_LL	FBD:CL3003_Inlet_Liquid_C>ontrol	LT_REAL	.7.15	20,157	IN2	R
FT_3003_01_SP	FBD:CL3003_Inlet_Liquid_C>ontrol	PCR_EF1	FBI_7_1	41,21	SP	R
	FBD:CL3003_Inlet_Liquid_C>ontrol	SUB_REAL	.7.7	1,95	IN2	R

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
	FBD:CL3003_Inlet_Liquid_C>ontrol	SUB_REAL	.7.9	2,116	IN2	R
	FBD:CL3003_Inlet_Liquid_C>ontrol	SUB_REAL	.7.11	1,135	IN2	R
	FBD:CL3003_Inlet_Liquid_C>ontrol	SUB_REAL	.7.14	2,157	IN2	R
	FBD:CL3006_Bioreactor_Lev>el_Control	SEL	.9.26	1,24	IN1	R
FT_3017_01	FBD:Input	I_SCALE	.2.23	88,93	Y	W
	FBD:CL3013_NH4_Management	GT_REAL	.60.58	116,35	IN1	R
	FBD:CL3017_Liquid_Recircu>lation	PCR_SF1	FBI_20_1	22,12	PV	R
	FBD:CL3017_Liquid_Recircu>lation	SUB_REAL	.20.11	3,71	IN1	R
	FBD:CL3017_Liquid_Recircu>lation	SUB_REAL	.20.13	95,73	IN1	R
	FBD:CL3017_Liquid_Recircu>lation	SUB_REAL	.20.15	4,93	IN1	R
	FBD:CL3017_Liquid_Recircu>lation	SUB_REAL	.20.17	95,96	IN1	R
FT_3017_01_AH	FBD:ALARM_STATUS	OR_BOOL	.31.6	38,78	IN9	R
	FBD:CL3017_Liquid_Recircu>lation	TON	FBI_20_20	62,73	Q	W
FT_3017_01_AHH	FBD:ALARM_STATUS	OR_BOOL	.31.3	71,31	IN17	R
	FBD:CL3017_Liquid_Recircu>lation	TON	FBI_20_21	66,96	Q	W
FT_3017_01_AL	FBD:ALARM_STATUS	OR_BOOL	.31.6	38,79	IN10	R
	FBD:CL3017_Liquid_Recircu>lation	TON	FBI_20_22	155,74	Q	W
FT_3017_01_ALL	FBD:ALARM_STATUS	OR_BOOL	.31.3	71,32	IN18	R
	FBD:CL3017_Liquid_Recircu>lation	TON	FBI_20_23	155,96	Q	W
FT_3017_01_ERR	FBD:ERR_AI	WORD_TO_BIT	FBI_4_1	17,22	BIT12	W
	FBD:ALARM_STATUS	OR_BOOL	.31.3	71,33	IN19	R
FT_3017_01_LIM_H	FBD:CL3017_Liquid_Recircu>lation	GT_REAL	.20.12	22,72	IN2	R
FT_3017_01_LIM_HH	FBD:CL3017_Liquid_Recircu>lation	GT_REAL	.20.16	22,94	IN2	R
FT_3017_01_LIM_L	FBD:CL3017_Liquid_Recircu>lation	LT_REAL	.20.14	114,74	IN2	R
FT_3017_01_LIM_LL	FBD:CL3017_Liquid_Recircu>lation	LT_REAL	.20.18	114,97	IN2	R
FT_3018_01	FBD:Input	I_SCALE	.2.24	88,100	Y	W
	FBD:CL3018_Outlet_liquid_>Control	SUB_REAL	.21.31	4,75	IN1	R
	FBD:CL3018_Outlet_liquid_>Control	SUB_REAL	.21.45	82,77	IN1	R
	FBD:CL3018_Outlet_liquid_>Control	SUB_REAL	.21.50	5,100	IN1	R
	FBD:CL3018_Outlet_liquid_>Control	SUB_REAL	.21.55	85,102	IN1	R
	FBD:CL3018_Outlet_liquid_>Control	PCR_EF1	FBI_21_61	54,12	PV	R
FT_3018_01_AH	FBD:ALARM_STATUS	OR_BOOL	.31.6	38,80	IN11	R
	FBD:CL3018_Outlet_liquid_>Control	TON	FBI_21_37	63,77	Q	W
FT_3018_01_AHH	FBD:ALARM_STATUS	OR_BOOL	.31.3	71,34	IN20	R

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
	FBD:CL3018_Outlet_liquid_>Control	TON	FBI_21_54	64,102	Q	W
FT_3018_01_AL	FBD:ALARM_STATUS	OR_BOOL	.31.6	38,81	IN12	R
	FBD:CL3018_Outlet_liquid_>Control	TON	FBI_21_49	142,78	Q	W
FT_3018_01_ALL	FBD:ALARM_STATUS	OR_BOOL	.31.3	71,35	IN21	R
	FBD:CL3018_Outlet_liquid_>Control	TON	FBI_21_59	145,103	Q	W
FT_3018_01_ERR	FBD:ERR_AI	WORD_TO_BIT	FBI_4_1	17,23	BIT13	W
	FBD:ALARM_STATUS	OR_BOOL	.31.3	71,36	IN22	R
FT_3018_01_LIM_H	FBD:CL3018_Outlet_liquid_>Control	GT_REAL	.21.32	23,76	IN2	R
FT_3018_01_LIM_HH	FBD:CL3018_Outlet_liquid_>Control	GT_REAL	.21.51	24,101	IN2	R
FT_3018_01_LIM_L	FBD:CL3018_Outlet_liquid_>Control	LT_REAL	.21.46	101,78	IN2	R
FT_3018_01_LIM_LL	FBD:CL3018_Outlet_liquid_>Control	LT_REAL	.21.56	104,103	IN2	R
GC_3011_01_MV	FBD:CL3011_Gas_Loop	OPMDBOOL	FBI_14_53	26,7	OUT	W
GC_3011_01_OP	FBD:CL3011_Gas_Loop	OPMDBOOL	FBI_14_53	7,10	MAN	R
GLOBAL_BIOLEV_MODEL	FBD:CL3006_Bioreactor_Lev>el_Control	ADD_REAL	.9.25	90,34	OUT	W
LSH_3006_01	FBD:CL3006_Bioreactor_Lev>el_Control	TON	FBI_9_32	97,109	IN	R
LSH_3006_01_A	FBD:CL3006_Bioreactor_Lev>el_Control	TON	FBI_9_32	113,109	Q	W
LSH_3006_02	FBD:CL3006_Bioreactor_Lev>el_Control	TON	FBI_9_33	97,118	IN	R
LSH_3006_02_A	FBD:CL3006_Bioreactor_Lev>el_Control	TON	FBI_9_33	113,118	Q	W
LSH_3021_01	FBD:CL3021_Effluent_Level	TON	FBI_23_17	64,18	IN	R
LSH_3021_01_A	FBD:CL3021_Effluent_Level	TON	FBI_23_17	80,18	Q	W
LSH_3021_02	FBD:CL3021_Effluent_Level	TON	FBI_23_18	64,27	IN	R
LSH_3021_02_A	FBD:CL3021_Effluent_Level	TON	FBI_23_18	80,27	Q	W
LSL_3002_01	FBD:CL3002_Influent_Level>_Control	TON	FBI_6_22	61,12	IN	R
LSL_3002_01_A	FBD:CL3002_Influent_Level>_Control	TON	FBI_6_22	77,12	Q	W
LSL_3002_02	FBD:CL3002_Influent_Level>_Control	TON	FBI_6_23	61,19	IN	R
LSL_3002_02_A	FBD:CL3002_Influent_Level>_Control	TON	FBI_6_23	77,19	Q	W
LSL_3006_01	FBD:CL3006_Bioreactor_Lev>el_Control	TON	FBI_9_30	96,88	IN	R
LSL_3006_01_A	FBD:CL3006_Bioreactor_Lev>el_Control	TON	FBI_9_30	112,88	Q	W
LSL_3006_02	FBD:CL3006_Bioreactor_Lev>el_Control	TON	FBI_9_31	96,97	IN	R
LSL_3006_02_A	FBD:CL3006_Bioreactor_Lev>el_Control	TON	FBI_9_31	112,97	Q	W
LS_TIME_LIM	FBD:CL3002_Influent_Level>_Control	TON	FBI_6_22	61,13	PT	R
	FBD:CL3002_Influent_Level>_Control	TON	FBI_6_23	61,20	PT	R
	FBD:CL3006_Bioreactor_Lev>el_Control	TON	FBI_9_30	96,89	PT	R
	FBD:CL3006_Bioreactor_Lev>	TON	FBI_9_31	96,98	PT	R

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
	el_Control					
	FBD:CL3006_Bioreactor_Lev>el_Control	TON	FBI_9_32	97,110	PT	R
	FBD:CL3006_Bioreactor_Lev>el_Control	TON	FBI_9_33	97,119	PT	R
	FBD:CL3021_Effluent_Level	TON	FBI_23_17	64,19	PT	R
	FBD:CL3021_Effluent_Level	TON	FBI_23_18	64,28	PT	R
LT_3002_01	FBD:Input	I_SCALE	.2.18	88,58	Y	W
	FBD:CL3002_Influent_Level>_Control	LT_REAL	.6.9	8,48	IN1	R
	FBD:CL3002_Influent_Level>_Control	GT_REAL	.6.19	8,21	IN1	R
	FBD:CL3002_Influent_Level>_Control	GT_REAL	.6.20	8,9	IN1	R
	FBD:CL3002_Influent_Level>_Control	LT_REAL	.6.21	8,33	IN1	R
LT_3002_01_AH	FBD:ALARM_STATUS	OR_BOOL	.31.5	14,71	IN3	R
	FBD:CL3002_Influent_Level>_Control	ACT_DIA	FBI_6_24	38,7	ERR	W
LT_3002_01_AHH	FBD:ALARM_STATUS	OR_BOOL	.31.1	18,17	IN5	R
	FBD:CL3002_Influent_Level>_Control	AND_BOOL	.6.12	27,62	IN1	R
	FBD:CL3002_Influent_Level>_Control	ACT_DIA	FBI_6_25	37,19	ERR	W
LT_3002_01_AL	FBD:ALARM_STATUS	OR_BOOL	.31.5	14,72	IN4	R
	FBD:CL3002_Influent_Level>_Control	ACT_DIA	FBI_6_26	37,31	ERR	W
LT_3002_01_ALL	FBD:ALARM_STATUS	OR_BOOL	.31.1	18,18	IN6	R
	FBD:CL3002_Influent_Level>_Control	AND_BOOL	.6.16	26,75	IN1	R
	FBD:CL3002_Influent_Level>_Control	ACT_DIA	FBI_6_27	36,46	ERR	W
LT_3002_01_ERR	FBD:ERR_AI	WORD_TO_BIT	FBI_4_1	17,17	BIT7	W
	FBD:ALARM_STATUS	OR_BOOL	.31.1	18,19	IN7	R
LT_3002_01_LIM_H	FBD:CL3002_Influent_Level>_Control	GT_REAL	.6.20	8,10	IN2	R
LT_3002_01_LIM_HH	FBD:CL3002_Influent_Level>_Control	GT_REAL	.6.19	8,22	IN2	R
LT_3002_01_LIM_L	FBD:CL3002_Influent_Level>_Control	LT_REAL	.6.21	8,34	IN2	R
LT_3002_01_LIM_LL	FBD:CL3002_Influent_Level>_Control	LT_REAL	.6.9	8,49	IN2	R
LT_3002_01_MAX	FBD:Input	I_SCALE	.2.18	71,59	MX	R
LT_3002_01_MIN	FBD:Input	I_SCALE	.2.18	71,58	MN	R
LT_3006_01	FBD:Input	I_SCALE	.2.20	88,72	Y	W
	FBD:CL3006_Bioreactor_Lev>el_Control	LAG_FILTER	FBI_9_42	50,5	IN	R
	FBD:CL3006_Bioreactor_Lev>el_Control	GT_REAL	.9.8	23,112	IN1	R
	FBD:CL3006_Bioreactor_Lev>el_Control	GT_REAL	.9.35	20,90	IN1	R
	FBD:CL3006_Bioreactor_Lev>el_Control	LT_REAL	.9.39	25,134	IN1	R
	FBD:CL3006_Bioreactor_Lev>el_Control	LT_REAL	.9.10	28,156	IN1	R
LT_3006_01_AH	FBD:ALARM_STATUS	OR_BOOL	.31.5	14,81	IN13	R
	FBD:CL3006_Bioreactor_Lev>	ACT_DIA	FBI_9_43	74,86	ERR	W

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
	el_Control					
LT_3006_01_AHH	FBD:ALARM_STATUS	OR_BOOL	.31.1	18,37	IN25	R
	FBD:CL3006_Bioreactor_Lev>el_Control	AND_BOOL	.9.20	38,175	IN1	R
	FBD:CL3006_Bioreactor_Lev>el_Control	ACT_DIA	FBI_9_44	75,105	ERR	W
LT_3006_01_AL	FBD:ALARM_STATUS	OR_BOOL	.31.5	14,82	IN14	R
	FBD:CL3006_Bioreactor_Lev>el_Control	ACT_DIA	FBI_9_45	76,128	ERR	W
LT_3006_01_ALL	FBD:ALARM_STATUS	OR_BOOL	.31.1	18,38	IN26	R
	FBD:CL3006_Bioreactor_Lev>el_Control	ACT_DIA	FBI_9_46	76,148	ERR	W
	FBD:CL3006_Bioreactor_Lev>el_Control	AND_BOOL	.9.59	38,192	IN1	R
LT_3006_01_ERR	FBD:ERR_AI	WORD_TO_BIT	FBI_4_1	17,19	BIT9	W
LT_3006_01_LIM_H	FBD:CL3006_Bioreactor_Lev>el_Control	GT_REAL	.9.35	20,91	IN2	R
LT_3006_01_LIM_HH	FBD:CL3006_Bioreactor_Lev>el_Control	GT_REAL	.9.8	23,113	IN2	R
LT_3006_01_LIM_L	FBD:CL3006_Bioreactor_Lev>el_Control	LT_REAL	.9.39	25,135	IN2	R
LT_3006_01_LIM_LL	FBD:CL3006_Bioreactor_Lev>el_Control	LT_REAL	.9.10	28,157	IN2	R
LT_3021_01	FBD:Input	I_SCALE	.2.19	88,65	Y	W
	FBD:CL3021_Effluent_Level	LT_REAL	.23.3	8,51	IN1	R
	FBD:CL3021_Effluent_Level	GT_REAL	.23.12	8,24	IN1	R
	FBD:CL3021_Effluent_Level	LT_REAL	.23.14	7,37	IN1	R
	FBD:CL3021_Effluent_Level	GT_REAL	.23.19	7,12	IN1	R
LT_3021_01_AH	FBD:ALARM_STATUS	OR_BOOL	.31.6	38,84	IN15	R
	FBD:CL3021_Effluent_Level	ACT_DIA	FBI_23_20	42,11	ERR	W
LT_3021_01_AHH	FBD:ALARM_STATUS	OR_BOOL	.31.3	71,40	IN26	R
	FBD:CL3021_Effluent_Level	AND_BOOL	.23.5	27,65	IN1	R
	FBD:CL3021_Effluent_Level	ACT_DIA	FBI_23_21	42,23	ERR	W
LT_3021_01_AL	FBD:ALARM_STATUS	OR_BOOL	.31.6	38,85	IN16	R
	FBD:CL3021_Effluent_Level	ACT_DIA	FBI_23_22	40,35	ERR	W
LT_3021_01_ALL	FBD:ALARM_STATUS	OR_BOOL	.31.3	71,41	IN27	R
	FBD:CL3021_Effluent_Level	ACT_DIA	FBI_23_23	41,50	ERR	W
LT_3021_01_ERR	FBD:ERR_AI	WORD_TO_BIT	FBI_4_1	17,18	BIT8	W
	FBD:ALARM_STATUS	OR_BOOL	.31.3	71,42	IN28	R
LT_3021_01_LIM_H	FBD:CL3021_Effluent_Level	GT_REAL	.23.19	7,13	IN2	R
LT_3021_01_LIM_HH	FBD:CL3021_Effluent_Level	GT_REAL	.23.12	8,25	IN2	R
LT_3021_01_LIM_L	FBD:CL3021_Effluent_Level	LT_REAL	.23.14	7,38	IN2	R
LT_3021_01_LIM_LL	FBD:CL3021_Effluent_Level	LT_REAL	.23.3	8,52	IN2	R
LT_3021_01_MAX	FBD:Input	I_SCALE	.2.19	71,66	MX	R
LT_3021_01_MIN	FBD:Input	I_SCALE	.2.19	71,65	MN	R
LT_Range_MAX	FBD:Input	I_SCALE	.2.20	71,73	MX	R
LT_Range_MIN	FBD:Input	I_SCALE	.2.20	71,72	MN	R
PP_3003_01_MV1	FBD:CL3003_Inlet_Liquid_C>ontrol	OPMDBOOL	FBI_7_5	100,7	OUT	W
PP_3003_01_MV2	FBD:output	O_SCALE	FBI_3_11	35,86	X	R
	FBD:CL3003_Inlet_Liquid_C>ontrol	OPMDREAL	FBI_7_3	100,17	OUT	W
PP_3003_01_MV3	FBD:CL3003_Inlet_Liquid_C>ontrol	MOVE	.7.23	97,32	OUT	W
PP_3003_01_OP	FBD:CL3003_Inlet_Liquid_C>ontrol	OPMDBOOL	FBI_7_5	81,10	MAN	R
PP_3003_01_SP	FBD:CL3003_Inlet_Liquid_C>	OPMDREAL	FBI_7_3	81,20	MAN	R

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
	ontrol					
PP_3008_01_MV	FBD:CL3008_Bioreactor_pH_>Control	OPMDBOOL	FBI_11_60	180,113	OUT	W
PP_3008_01_OP	FBD:CL3008_Bioreactor_pH_>Control	TON	FBI_11_73	116,124	IN	R
	FBD:CL3008_Bioreactor_pH_>Control	MOVE	.11.89	255,111	OUT	W
	FBD:CL3008_Bioreactor_pH_>Control	OR_BOOL	.11.162	179,41	IN2	R
	FBD:CL3008_Bioreactor_pH_>Control	MOVE	.11.169	254,47	OUT	W
	FBD:CL3008_Bioreactor_pH_>Control	MOVE	.11.173	293,30	OUT	W
	FBD:CL3008_Bioreactor_pH_>Control	AND_BOOL	.11.177	148,123	IN1	R
PP_3008_01_OP_TIME	FBD:CL3008_Bioreactor_pH_>Control	MUL_UDINT	.11.71	109,130	IN1	R
	FBD:CL3008_Bioreactor_pH_>Control	MOVE	.11.90	255,117	OUT	W
	FBD:CL3008_Bioreactor_pH_>Control	EQ_UDINT	.11.164	190,47	IN1	R
	FBD:CL3008_Bioreactor_pH_>Control	MOVE	.11.175	293,40	OUT	W
	FBD:CL3008_Bioreactor_pH_>Control	MUL_UDINT	.11.178	102,113	IN1	R
	FBD:CL3008_Bioreactor_pH_>Control	MOVE	.11.281	254,103	OUT	W
PP_3008_02_MV	FBD:CL3008_Bioreactor_pH_>Control	OPMDBOOL	FBI_11_61	177,78	OUT	W
PP_3008_02_OP	FBD:CL3008_Bioreactor_pH_>Control	MOVE	.11.81	251,71	OUT	W
	FBD:CL3008_Bioreactor_pH_>Control	OR_BOOL	.11.159	179,21	IN2	R
	FBD:CL3008_Bioreactor_pH_>Control	MOVE	.11.160	253,27	OUT	W
	FBD:CL3008_Bioreactor_pH_>Control	MOVE	.11.171	293,20	OUT	W
	FBD:CL3008_Bioreactor_pH_>Control	TON	FBI_11_184	114,87	IN	R
	FBD:CL3008_Bioreactor_pH_>Control	AND_BOOL	.11.187	146,86	IN1	R
PP_3008_02_OP_TIME	FBD:CL3008_Bioreactor_pH_>Control	MUL_UDINT	.11.66	101,93	IN1	R
	FBD:CL3008_Bioreactor_pH_>Control	MOVE	.11.82	251,77	OUT	W
	FBD:CL3008_Bioreactor_pH_>Control	EQ_UDINT	.11.152	190,27	IN1	R
	FBD:CL3008_Bioreactor_pH_>Control	MOVE	.11.174	293,35	OUT	W
	FBD:CL3008_Bioreactor_pH_>Control	MUL_UDINT	.11.192	100,77	IN1	R
	FBD:CL3008_Bioreactor_pH_>Control	MOVE	.11.299	250,62	OUT	W
PP_3015_01_MV	FBD:CL3015_Backwashing	OPMDBOOL	FBI_18_13	104,25	OUT	W
PP_3015_01_OP	FBD:CL3015_Backwashing	OPMDBOOL	FBI_18_13	85,28	MAN	R
PP_3017_01_MV1	FBD:CL3017_Liquid_Recircu>lation	OPMDBOOL	FBI_20_6	74,26	OUT	W

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
PP_3017_01_MV2	FBD:output	O_SCALE	FBI_3_12	35,94	X	R
	FBD:CL3017_Liquid_Recircu>lation	OPMDREAL	FBI_20_4	73,9	OUT	W
PP_3017_01_MV3	FBD:CL3017_Liquid_Recircu>lation	MOVE	.20.19	69,38	OUT	W
PP_3017_01_OP	FBD:CL3017_Liquid_Recircu>lation	OPMDBOOL	FBI_20_6	55,29	MAN	R
PP_3017_01_SP	FBD:CL3017_Liquid_Recircu>lation	OPMDREAL	FBI_20_4	54,12	MAN	R
PP_3018_01_MV1	FBD:CL3018_Outlet_liquid_>Control	SEL	.21.69	114,32	OUT	W
PP_3018_01_MV2	FBD:output	O_SCALE	FBI_3_10	35,78	X	R
	FBD:CL3018_Outlet_liquid_>Control	OPMDREAL	FBI_21_62	102,9	OUT	W
	FBD:CL3018_Outlet_liquid_>Control	LE_REAL	.21.68	87,25	IN1	R
PP_3018_01_MV3	FBD:CL3018_Outlet_liquid_>Control	MOVE	.21.19	71,41	OUT	W
PP_3018_01_OP	FBD:CL3018_Outlet_liquid_>Control	OPMDBOOL	FBI_21_4	55,34	MAN	R
PP_3018_01_SP	FBD:CL3018_Outlet_liquid_>Control	OPMDREAL	FBI_21_62	83,12	MAN	R
PT_3003_01	FBD:Input	I_SCALE	.2.27	88,122	Y	W
	FBD:CL3003_Inlet_Liquid_C>ontrol	GT_REAL	.7.16	107,86	IN1	R
	FBD:CL3003_Inlet_Liquid_C>ontrol	GT_REAL	.7.17	106,99	IN1	R
	FBD:CL3003_Inlet_Liquid_C>ontrol	LT_REAL	.7.18	106,118	IN1	R
	FBD:CL3003_Inlet_Liquid_C>ontrol	LT_REAL	.7.19	107,135	IN1	R
PT_3003_01_AH	FBD:ALARM_STATUS	OR_BOOL	.31.5	14,75	IN7	R
	FBD:CL3003_Inlet_Liquid_C>ontrol	ACT_DIA	FBI_7_38	146,84	ERR	W
PT_3003_01_AHH	FBD:ALARM_STATUS	OR_BOOL	.31.1	18,23	IN11	R
	FBD:CL3003_Inlet_Liquid_C>ontrol	ACT_DIA	FBI_7_39	147,97	ERR	W
PT_3003_01_AL	FBD:ALARM_STATUS	OR_BOOL	.31.5	14,76	IN8	R
	FBD:CL3003_Inlet_Liquid_C>ontrol	ACT_DIA	FBI_7_40	148,117	ERR	W
PT_3003_01_ALL	FBD:ALARM_STATUS	OR_BOOL	.31.1	18,24	IN12	R
	FBD:CL3003_Inlet_Liquid_C>ontrol	ACT_DIA	FBI_7_41	148,132	ERR	W
PT_3003_01_ERR	FBD:ERR_AI	WORD_TO_BIT	FBI_4_2	44,18	BIT8	W
	FBD:ALARM_STATUS	OR_BOOL	.31.1	18,25	IN13	R
PT_3003_01_LIM_H	FBD:CL3003_Inlet_Liquid_C>ontrol	GT_REAL	.7.16	107,87	IN2	R
PT_3003_01_LIM_HH	FBD:CL3003_Inlet_Liquid_C>ontrol	GT_REAL	.7.17	106,100	IN2	R
PT_3003_01_LIM_L	FBD:CL3003_Inlet_Liquid_C>ontrol	LT_REAL	.7.18	106,119	IN2	R
PT_3003_01_LIM_LL	FBD:CL3003_Inlet_Liquid_C>ontrol	LT_REAL	.7.19	107,136	IN2	R
PT_3007_01	FBD:Input	I_SCALE	.2.25	88,107	Y	W
	FBD:CL3007_Bioreactor_Pre>ssu_Control	GT_REAL	.10.11	102,23	IN1	R
	FBD:CL3007_Bioreactor_Pre>	GT_REAL	.10.13	102,34	IN1	R

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
	ssu_Control					
	FBD:CL3007_Bioreactor_Pre> ssu_Control	SUB_REAL	.10.14	83,47	IN1	R
	FBD:CL3007_Bioreactor_Pre> ssu_Control	LT_REAL	.10.17	102,57	IN1	R
	FBD:CL3011_Gas_Loop	PCR_IF1	FBI_14_70	68,39	PV	R
	FBD:CL3011_Gas_Loop	SUB_REAL	.14.86	12,102	IN1	R
	FBD:CL3011_Gas_Loop	GT_REAL	.14.90	41,103	IN1	R
PT_3007_01_AH	FBD:ALARM_STATUS	OR_BOOL	.31.5	14,85	IN17	R
	FBD:CL3007_Bioreactor_Pre> ssu_Control	ACT_DIA	FBI_10_26	138,21	ERR	W
PT_3007_01_AHH	FBD:ALARM_STATUS	OR_BOOL	.31.1	18,42	IN30	R
	FBD:CL3007_Bioreactor_Pre> ssu_Control	ACT_DIA	FBI_10_27	138,32	ERR	W
PT_3007_01_AL	FBD:ALARM_STATUS	OR_BOOL	.31.5	14,86	IN18	R
	FBD:CL3007_Bioreactor_Pre> ssu_Control	ACT_DIA	FBI_10_28	138,45	ERR	W
PT_3007_01_ALL	FBD:ALARM_STATUS	OR_BOOL	.31.1	18,43	IN31	R
	FBD:CL3007_Bioreactor_Pre> ssu_Control	ACT_DIA	FBI_10_29	138,55	ERR	W
PT_3007_01_ERR	FBD:ERR_AI	WORD_TO_BIT	FBI_4_1	17,24	BIT14	W
	FBD:ALARM_STATUS	OR_BOOL	.31.1	18,44	IN32	R
PT_3007_01_LIM_H	FBD:CL3007_Bioreactor_Pre> ssu_Control	GT_REAL	.10.11	102,24	IN2	R
PT_3007_01_LIM_HH	FBD:CL3007_Bioreactor_Pre> ssu_Control	GT_REAL	.10.13	102,35	IN2	R
PT_3007_01_LIM_L	FBD:CL3007_Bioreactor_Pre> ssu_Control	LT_REAL	.10.15	102,48	IN2	R
PT_3007_01_LIM_LL	FBD:CL3007_Bioreactor_Pre> ssu_Control	LT_REAL	.10.17	102,58	IN2	R
PT_3007_01_SP	FBD:CL3011_Gas_Loop	PCR_IF1	FBI_14_70	68,40	SP	R
	FBD:CL3011_Gas_Loop	SUB_REAL	.14.85	2,107	IN1	R
PT_3011_01	FBD:Input	I_SCALE	.2.26	88,114	Y	W
	FBD:CL3011_Gas_Loop	GT_REAL	.14.99	21,218	IN1	R
	FBD:CL3011_Gas_Loop	GT_REAL	.14.100	74,216	IN1	R
	FBD:CL3011_Gas_Loop	LT_REAL	.14.101	21,227	IN1	R
	FBD:CL3011_Gas_Loop	LT_REAL	.14.102	75,225	IN1	R
PT_3011_01_AH	FBD:ALARM_STATUS	OR_BOOL	.31.5	14,99	IN31	R
	FBD:CL3011_Gas_Loop	ACT_DIA	FBI_14_129	60,216	ERR	W
PT_3011_01_AHH	FBD:ALARM_STATUS	OR_BOOL	.31.2	47,39	IN27	R
	FBD:CL3011_Gas_Loop	ACT_DIA	FBI_14_131	107,214	ERR	W
PT_3011_01_AL	FBD:ALARM_STATUS	OR_BOOL	.31.5	14,100	IN32	R
	FBD:CL3011_Gas_Loop	ACT_DIA	FBI_14_130	59,225	ERR	W
PT_3011_01_ALL	FBD:ALARM_STATUS	OR_BOOL	.31.2	47,40	IN28	R
	FBD:CL3011_Gas_Loop	ACT_DIA	FBI_14_132	108,223	ERR	W
PT_3011_01_ERR	FBD:ERR_AI	WORD_TO_BIT	FBI_4_1	17,25	BIT15	W
	FBD:ALARM_STATUS	OR_BOOL	.31.2	47,43	IN31	R
PT_3011_01_LIM_H	FBD:CL3011_Gas_Loop	GT_REAL	.14.99	21,219	IN2	R
PT_3011_01_LIM_HH	FBD:CL3011_Gas_Loop	GT_REAL	.14.100	74,217	IN2	R
PT_3011_01_LIM_L	FBD:CL3011_Gas_Loop	LT_REAL	.14.101	21,228	IN2	R
PT_3011_01_LIM_LL	FBD:CL3011_Gas_Loop	LT_REAL	.14.102	75,226	IN2	R
REAL0	FBD:CL3008_Bioreactor_pH_> Control	SEL	.11.223	2,123	IN0	R
	FBD:CL3008_Bioreactor_pH_> Control	SEL	.11.226	2,130	IN0	R
REAL1	FBD:CL3008_Bioreactor_pH_> Control	SEL	.11.223	2,124	IN1	R

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
	FBD:CL3008_Bioreactor_pH_>Control	SEL	.11.226	2,131	IN1	R
SV_3001_01_A	FBD:ALARM_STATUS	OR_BOOL	.31.1	18,13	IN1	R
	FBD:CL3001_Influent_Temp_>Control	VALVBOOL	FBI_5_28	86,13	ALARM	W
SV_3001_01_FB	FBD:CL3001_Influent_Temp_>Control	VALVBOOL	FBI_5_28	67,17	FEEDBACK	R
SV_3001_01_MV	FBD:CL3001_Influent_Temp_>Control	VALVBOOL	FBI_5_28	86,12	MV	W
SV_3001_01_OP	FBD:CL3001_Influent_Temp_>Control	VALVBOOL	FBI_5_28	67,15	MANUAL	R
SV_3005_01_A	FBD:ALARM_STATUS	OR_BOOL	.31.1	18,28	IN16	R
	FBD:CL3005_Bioreactor_Tem>p_Control	VALVBOOL	FBI_8_84	123,86	ALARM	W
SV_3005_01_FB	FBD:CL3005_Bioreactor_Tem>p_Control	VALVBOOL	FBI_8_84	104,90	FEEDBACK	R
SV_3005_01_MV	FBD:CL3005_Bioreactor_Tem>p_Control	VALVBOOL	FBI_8_84	123,85	MV	W
SV_3005_01_OP	FBD:CL3005_Bioreactor_Tem>p_Control	VALVBOOL	FBI_8_84	104,88	MANUAL	R
SV_3005_02_A	FBD:ALARM_STATUS	OR_BOOL	.31.1	18,27	IN15	R
	FBD:CL3005_Bioreactor_Tem>p_Control	VALVBOOL	FBI_8_86	119,69	ALARM	W
SV_3005_02_FB	FBD:CL3005_Bioreactor_Tem>p_Control	VALVBOOL	FBI_8_86	100,73	FEEDBACK	R
SV_3005_02_MV	FBD:CL3005_Bioreactor_Tem>p_Control	VALVBOOL	FBI_8_86	119,68	MV	W
SV_3005_02_OP	FBD:CL3005_Bioreactor_Tem>p_Control	VALVBOOL	FBI_8_86	100,71	MANUAL	R
SV_3008_01_A	FBD:ALARM_STATUS	OR_BOOL	.31.2	47,17	IN5	R
	FBD:CL3008_Bioreactor_pH_>Control	VALVBOOL	FBI_11_292	182,100	ALARM	W
SV_3008_01_FB	FBD:CL3008_Bioreactor_pH_>Control	VALVBOOL	FBI_11_292	163,104	FEEDBACK	R
SV_3008_01_MV	FBD:CL3008_Bioreactor_pH_>Control	VALVBOOL	FBI_11_292	182,99	MV	W
SV_3008_01_OP	FBD:CL3008_Bioreactor_pH_>Control	OR_BOOL	.11.162	179,40	IN1	R
	FBD:CL3008_Bioreactor_pH_>Control	MOVE	.11.168	254,41	OUT	W
	FBD:CL3008_Bioreactor_pH_>Control	MOVE	.11.172	293,25	OUT	W
	FBD:CL3008_Bioreactor_pH_>Control	TON	FBI_11_180	109,107	IN	R
	FBD:CL3008_Bioreactor_pH_>Control	AND_BOOL	.11.183	141,106	IN1	R
	FBD:CL3008_Bioreactor_pH_>Control	MOVE	.11.280	254,97	OUT	W
SV_3008_02_A	FBD:ALARM_STATUS	OR_BOOL	.31.2	47,18	IN6	R
	FBD:CL3008_Bioreactor_pH_>Control	VALVBOOL	FBI_11_293	187,64	ALARM	W
SV_3008_02_FB	FBD:CL3008_Bioreactor_pH_>Control	VALVBOOL	FBI_11_293	168,68	FEEDBACK	R
SV_3008_02_MV	FBD:CL3008_Bioreactor_pH_>Control	VALVBOOL	FBI_11_293	187,63	MV	W
SV_3008_02_OP	FBD:CL3008_Bioreactor_pH_>Control	MOVE	.11.156	251,21	OUT	W

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
	FBD:CL3008_Bioreactor_pH_>Control	OR_BOOL	.11.159	179,20	IN1	R
	FBD:CL3008_Bioreactor_pH_>Control	MOVE	.11.170	293,15	OUT	W
	FBD:CL3008_Bioreactor_pH_>Control	TON	FBI_11_188	104,70	IN	R
	FBD:CL3008_Bioreactor_pH_>Control	AND_BOOL	.11.191	147,69	IN1	R
	FBD:CL3008_Bioreactor_pH_>Control	MOVE	.11.298	250,56	OUT	W
SV_3011_01_A	FBD:ALARM_STATUS	OR_BOOL	.31.2	47,44	IN32	R
	FBD:CL3011_Gas_Loop	VALVBOOL	FBI_14_127	110,99	ALARM	W
SV_3011_01_FB	FBD:CL3011_Gas_Loop	VALVBOOL	FBI_14_127	91,103	FEEDBACK	R
SV_3011_01_MV	FBD:CL3011_Gas_Loop	VALVBOOL	FBI_14_127	110,98	MV	W
SV_3011_01_OP	FBD:CL3011_Gas_Loop	VALVBOOL	FBI_14_127	91,101	MANUAL	R
	FBD:CL3016_Gas_Pulse	MOVE	.19.55	97,67	OUT	W
SV_3011_02_A	FBD:ALARM_STATUS	OR_BOOL	.31.3	71,15	IN1	R
	FBD:CL3011_Gas_Loop	VALVBOOL	FBI_14_128	111,110	ALARM	W
SV_3011_02_Day	FBD:CL3011_Gas_Loop	MOVE	.14.60	88,151	OUT	W
SV_3011_02_FB	FBD:CL3011_Gas_Loop	VALVBOOL	FBI_14_128	92,114	FEEDBACK	R
SV_3011_02_Hour	FBD:CL3011_Gas_Loop	MOVE	.14.18	88,156	OUT	W
SV_3011_02_Minute	FBD:CL3011_Gas_Loop	MOVE	.14.17	88,146	OUT	W
SV_3011_02_Month	FBD:CL3011_Gas_Loop	MOVE	.14.19	88,161	OUT	W
SV_3011_02_MV	FBD:CL3011_Gas_Loop	VALVBOOL	FBI_14_128	111,109	MV	W
SV_3011_02_OP	FBD:CL3011_Gas_Loop	VALVBOOL	FBI_14_128	92,112	MANUAL	R
SV_3011_02_OpenFreqInHour	FBD:CL3011_Gas_Loop	ADD_REAL	.14.42	55,182	IN2	R
	FBD:CL3011_Gas_Loop	MOVE	.14.44	72,203	OUT	W
	FBD:CL3011_Gas_Loop	MOVE	.14.48	54,157	OUT	W
	FBD:CL3011_Gas_Loop	ADD_REAL	.14.50	159,108	OUT	W
	FBD:CL3011_Gas_Loop	ADD_REAL	.14.50	142,109	IN2	R
SV_3011_02_Opening_Frequency	FBD:CL3011_Gas_Loop	MOVE	.14.25	54,142	OUT	W
	FBD:CL3011_Gas_Loop	DIV_REAL	.14.45	72,196	OUT	W
SV_3011_02_Reset_Timer	FBD:CL3011_Gas_Loop	R_TRIG	FBI_14_14	16,141	CLK	R
SV_3011_02_Second	FBD:CL3011_Gas_Loop	MOVE	.14.16	88,171	OUT	W
SV_3011_02_TotalHour	FBD:CL3011_Gas_Loop	ADD_REAL	.14.43	72,189	OUT	W
	FBD:CL3011_Gas_Loop	ADD_REAL	.14.43	55,189	IN1	R
	FBD:CL3011_Gas_Loop	DIV_REAL	.14.45	55,197	IN2	R
	FBD:CL3011_Gas_Loop	MOVE	.14.47	54,152	OUT	W
SV_3011_02_TotalOpening	FBD:CL3011_Gas_Loop	ADD_REAL	.14.42	72,181	OUT	W
	FBD:CL3011_Gas_Loop	ADD_REAL	.14.42	55,181	IN1	R
	FBD:CL3011_Gas_Loop	DIV_REAL	.14.45	55,196	IN1	R
	FBD:CL3011_Gas_Loop	MOVE	.14.46	54,147	OUT	W
SV_3011_02_Year	FBD:CL3011_Gas_Loop	MOVE	.14.20	88,166	OUT	W
SV_3011_03_A	FBD:CL3016_Gas_Pulse	VALVBOOL	FBI_19_89	157,72	ALARM	W
SV_3011_03_FB	FBD:CL3016_Gas_Pulse	VALVBOOL	FBI_19_89	138,76	FEEDBACK	R
SV_3011_03_MV	FBD:CL3016_Gas_Pulse	VALVBOOL	FBI_19_89	157,71	MV	W
SV_3011_03_OP	FBD:CL3016_Gas_Pulse	SEL	.19.80	115,74	IN0	R
SV_3011_Opening_Time	FBD:CL3011_Gas_Loop	MOVE	.14.21	87,141	OUT	W
	FBD:CL3011_Gas_Loop	ADD_REAL	.14.13	159,121	OUT	W
	FBD:CL3011_Gas_Loop	ADD_REAL	.14.13	142,122	IN2	R
SV_3013_01_A	FBD:ALARM_STATUS	OR_BOOL	.31.3	71,19	IN5	R
	FBD:CL3013_NH4_Management	VALVBOOL	FBI_60_55	218,27	ALARM	W
SV_3013_01_FB	FBD:CL3013_NH4_Management	VALVBOOL	FBI_60_55	199,31	FEEDBACK	R
	SFC:CL3013_NH4	TRANSITION		5,8		R
	SFC:CL3013_NH4	TRANSITION		5,12		R
	SFC:CL3013_NH4_Calib	TRANSITION		5,8		R
SV_3013_01_MV	FBD:CL3013_NH4_Management	VALVBOOL	FBI_60_55	218,26	MV	W

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
	SFC:CL3013_NH4_Stop	TRANSITION		4,8		R
SV_3013_01_OP	FBD:CL3013_NH4_Management	VALVBOOL	FBI_60_55	199,29	MANUAL	R
	SFC:CL3013_NH4	TRANSITION	S_CL3013_NH4_002	5,7		W
	SFC:CL3013_NH4	TRANSITION	S_CL3013_NH4_004	5,11		W
	SFC:CL3013_NH4_Stop	TRANSITION	S_CL3013_NH4_Stop_002	4,7		W
	SFC:CL3013_NH4_Calib	TRANSITION	S_CL3013_NH4_Calib_002	5,7		W
SV_3013_01_R	FBD:CL3013_SFC_CONTROL_PR> OCEDURE	MOVE	.36.28	84,32	OUT	W
	FBD:CL3013_SFC_CONTROL_PR> OCEDURE	MOVE	.36.32	86,90	OUT	W
	FBD:CL3013_SFC_CONTROL_PR> OCEDURE	MOVE	.36.66	73,140	OUT	W
	FBD:CL3013_NH4_Management	RS	FBI_60_54	170,29	R1	R
	SFC:CL3013_NH4	TRANSITION	S_CL3013_NH4_001	5,5		W
	SFC:CL3013_NH4	TRANSITION	S_CL3013_NH4_004	5,11		W
	SFC:CL3013_NH4_Stop	TRANSITION	S_CL3013_NH4_Stop_002	4,7		W
	SFC:CL3013_NH4_Calib	TRANSITION	S_CL3013_NH4_Calib_001	5,5		W
	SFC:CL3013_NH4_Calib	TRANSITION	S_CL3013_NH4_Calib_002	5,7		W
SV_3013_01_S	FBD:CL3013_NH4_Management	RS	FBI_60_54	170,28	S	R
	SFC:CL3013_NH4	TRANSITION	S_CL3013_NH4_001	5,5		W
	SFC:CL3013_NH4	TRANSITION	S_CL3013_NH4_002	5,7		W
	SFC:CL3013_NH4_Calib	TRANSITION	S_CL3013_NH4_Calib_001	5,5		W
SV_3013_02_A	FBD:ALARM_STATUS	OR_BOOL	.31.3	71,20	IN6	R
	FBD:CL3013_NO3_Management	VALVBOOL	FBI_61_22	167,18	ALARM	W
SV_3013_02_FB	FBD:CL3013_NO3_Management	VALVBOOL	FBI_61_22	148,22	FEEDBACK	R
	SFC:CL3013_NO3	TRANSITION		5,8		R
	SFC:CL3013_NO3	TRANSITION		5,12		R
	SFC:CL3013_NO3_Calib	TRANSITION		5,8		R
SV_3013_02_MV	FBD:CL3013_NO3_Management	VALVBOOL	FBI_61_22	167,17	MV	W
	SFC:CL3013_NO3_Stop	TRANSITION		4,8		R
SV_3013_02_OP	FBD:CL3013_NO3_Management	VALVBOOL	FBI_61_22	148,20	MANUAL	R
	SFC:CL3013_NO3	TRANSITION	S_CL3013_NO3_002	5,7		W
	SFC:CL3013_NO3	TRANSITION	S_CL3013_NO3_004	5,11		W
	SFC:CL3013_NO3_Calib	TRANSITION	S_CL3013_NO3_Calib_002	5,7		W
	SFC:CL3013_NO3_Stop	TRANSITION	S_CL3013_NO3_Stop_002	4,7		W
SV_3013_02_R	FBD:CL3013_SFC_CONTROL_PR> OCEDURE	MOVE	.36.34	183,95	OUT	W
	FBD:CL3013_SFC_CONTROL_PR> OCEDURE	MOVE	.36.36	171,33	OUT	W
	FBD:CL3013_SFC_CONTROL_PR> OCEDURE	MOVE	.36.76	182,154	OUT	W
	FBD:CL3013_NO3_Management	RS	FBI_61_21	123,20	R1	R
	SFC:CL3013_NO3	TRANSITION	S_CL3013_NO3_001	5,5		W
	SFC:CL3013_NO3	TRANSITION	S_CL3013_NO3_004	5,11		W
	SFC:CL3013_NO3_Calib	TRANSITION	S_CL3013_NO3_Calib_001	5,5		W
	SFC:CL3013_NO3_Calib	TRANSITION	S_CL3013_NO3_Calib_002	5,7		W
	SFC:CL3013_NO3_Stop	TRANSITION	S_CL3013_NO3_Stop_002	4,7		W
SV_3013_02_S	FBD:CL3013_NO3_Management	RS	FBI_61_21	123,19	S	R
	SFC:CL3013_NO3	TRANSITION	S_CL3013_NO3_001	5,5		W
	SFC:CL3013_NO3	TRANSITION	S_CL3013_NO3_002	5,7		W
	SFC:CL3013_NO3_Calib	TRANSITION	S_CL3013_NO3_Calib_001	5,5		W
SV_3013_03_A	FBD:ALARM_STATUS	OR_BOOL	.31.3	71,21	IN7	R
	FBD:CL3013_NO2_Management	VALVBOOL	FBI_62_19	163,13	ALARM	W
SV_3013_03_FB	FBD:CL3013_NO2_Management	VALVBOOL	FBI_62_19	144,17	FEEDBACK	R
	SFC:CL3013_NO2	TRANSITION		5,8		R
	SFC:CL3013_NO2	TRANSITION		5,12		R
SV_3013_03_MV	FBD:CL3013_NO2_Management	VALVBOOL	FBI_62_19	163,12	MV	W

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
	SFC:CL3013_NO2_Stop	TRANSITION		4,8		R
SV_3013_03_OP	FBD:CL3013_NO2_Management	VALVBOOL	FBI_62_19	144,15	MANUAL	R
	SFC:CL3013_NO2	TRANSITION	S_CL3013_NO2_002	5,7		W
	SFC:CL3013_NO2	TRANSITION	S_CL3013_NO2_004	5,11		W
	SFC:CL3013_NO2_Stop	TRANSITION	S_CL3013_NO2_Stop_002	4,7		W
SV_3013_03_R	FBD:CL3013_SFC_CONTROL_PR>OCEDURE	MOVE	.36.44	256,34	OUT	W
	FBD:CL3013_SFC_CONTROL_PR>OCEDURE	MOVE	.36.101	272,84	OUT	W
	FBD:CL3013_NO2_Management	RS	FBI_62_1	117,15	R1	R
	SFC:CL3013_NO2	TRANSITION	S_CL3013_NO2_001	5,5		W
	SFC:CL3013_NO2	TRANSITION	S_CL3013_NO2_004	5,11		W
	SFC:CL3013_NO2_Stop	TRANSITION	S_CL3013_NO2_Stop_002	4,7		W
SV_3013_03_S	FBD:CL3013_NO2_Management	RS	FBI_62_1	117,14	S	R
	SFC:CL3013_NO2	TRANSITION	S_CL3013_NO2_001	5,5		W
	SFC:CL3013_NO2	TRANSITION	S_CL3013_NO2_002	5,7		W
SV_3016_01_A	FBD:CL3016_Gas_Pulse	VALVBOOL	FBI_19_90	105,97	ALARM	W
SV_3016_01_FB	FBD:CL3016_Gas_Pulse	VALVBOOL	FBI_19_90	86,101	FEEDBACK	R
SV_3016_01_MV	FBD:CL3016_Gas_Pulse	VALVBOOL	FBI_19_90	105,96	MV	W
SV_3016_01_OP	FBD:CL3016_Gas_Pulse	VALVBOOL	FBI_19_90	86,99	MANUAL	R
SV_3018_01_A	FBD:CL3018_Outlet_liquid_>Control	VALVBOOL	FBI_21_70	133,15	ALARM	W
SV_3018_01_FB	FBD:CL3018_Outlet_liquid_>Control	VALVBOOL	FBI_21_70	114,19	FEEDBACK	R
SV_3018_01_MV	FBD:CL3018_Outlet_liquid_>Control	VALVBOOL	FBI_21_70	133,14	MV	W
SV_3018_01_OP	FBD:CL3018_Outlet_liquid_>Control	VALVBOOL	FBI_21_70	114,17	MANUAL	R
SV_3020_01_A	FBD:CL3020_Effluent_Tempe>rature	ACT_DIA	FBI_22_9	31,63	ERR	W
	FBD:CL3020_Effluent_Tempe>rature	VALVBOOL	FBI_22_28	93,14	ALARM	W
SV_3020_01_FB	FBD:CL3020_Effluent_Tempe>rature	ACT_DIA	FBI_22_9	15,66	REACT	R
	FBD:CL3020_Effluent_Tempe>rature	VALVBOOL	FBI_22_28	74,18	FEEDBACK	R
SV_3020_01_MV	FBD:CL3020_Effluent_Tempe>rature	ACT_DIA	FBI_22_9	15,65	ACT	R
	FBD:CL3020_Effluent_Tempe>rature	VALVBOOL	FBI_22_28	93,13	MV	W
SV_3020_01_OP	FBD:CL3020_Effluent_Tempe>rature	VALVBOOL	FBI_22_28	74,16	MANUAL	R
SYSTEM_COLD_WARM	FBD:SYSTEM_STATE	OR_BOOL	.28.2	22,10	OUT	W
S_CL3013_NH4_001.tmaxErr	FBD:CL3013_SFC_CONTROL_PR>OCEDURE	OR_BOOL	.36.2	31,13	IN2	R
S_CL3013_NH4_002.tmaxErr	FBD:CL3013_SFC_CONTROL_PR>OCEDURE	OR_BOOL	.36.2	31,14	IN3	R
S_CL3013_NH4_003.tmaxErr	FBD:CL3013_SFC_CONTROL_PR>OCEDURE	OR_BOOL	.36.2	31,15	IN4	R
S_CL3013_NH4_004.tmaxErr	FBD:CL3013_SFC_CONTROL_PR>OCEDURE	OR_BOOL	.36.2	31,16	IN5	R
S_CL3013_NH4_Calib_001.tmaxErr	FBD:CL3013_SFC_CONTROL_PR>OCEDURE	OR_BOOL	.36.11	34,72	IN2	R
S_CL3013_NH4_Calib_002.tmaxErr	FBD:CL3013_SFC_CONTROL_PR>OCEDURE	OR_BOOL	.36.11	34,73	IN3	R
S_CL3013_NH4_Calib_003.tmaxErr	FBD:CL3013_SFC_CONTROL_PR>OCEDURE	OR_BOOL	.36.11	34,74	IN4	R

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
S_CL3013_NH4_Stop_001.tmaxErr	FBD:CL3013_SFC_CONTROL_PR>OCEDURE	OR_BOOL	.36.59	21,116	IN1	R
S_CL3013_NH4_Stop_002.tmaxErr	FBD:CL3013_SFC_CONTROL_PR>OCEDURE	OR_BOOL	.36.59	21,117	IN2	R
S_CL3013_NO2_001.tmaxErr	FBD:CL3013_SFC_CONTROL_PR>OCEDURE	OR_BOOL	.36.39	205,14	IN2	R
S_CL3013_NO2_002.tmaxErr	FBD:CL3013_SFC_CONTROL_PR>OCEDURE	OR_BOOL	.36.39	205,15	IN3	R
S_CL3013_NO2_003.tmaxErr	FBD:CL3013_SFC_CONTROL_PR>OCEDURE	OR_BOOL	.36.39	205,16	IN4	R
S_CL3013_NO2_004.tmaxErr	FBD:CL3013_SFC_CONTROL_PR>OCEDURE	OR_BOOL	.36.39	205,17	IN5	R
S_CL3013_NO2_Stop_001.tmaxErr	FBD:CL3013_SFC_CONTROL_PR>OCEDURE	OR_BOOL	.36.96	219,60	IN1	R
S_CL3013_NO2_Stop_002.tmaxErr	FBD:CL3013_SFC_CONTROL_PR>OCEDURE	OR_BOOL	.36.96	219,61	IN2	R
S_CL3013_NO3_001.tmaxErr	FBD:CL3013_SFC_CONTROL_PR>OCEDURE	OR_BOOL	.36.17	118,13	IN2	R
S_CL3013_NO3_002.tmaxErr	FBD:CL3013_SFC_CONTROL_PR>OCEDURE	OR_BOOL	.36.17	118,14	IN3	R
S_CL3013_NO3_003.tmaxErr	FBD:CL3013_SFC_CONTROL_PR>OCEDURE	OR_BOOL	.36.17	118,15	IN4	R
S_CL3013_NO3_004.tmaxErr	FBD:CL3013_SFC_CONTROL_PR>OCEDURE	OR_BOOL	.36.17	118,16	IN5	R
S_CL3013_NO3_Calib_001.tmaxErr	FBD:CL3013_SFC_CONTROL_PR>OCEDURE	OR_BOOL	.36.22	130,75	IN2	R
S_CL3013_NO3_Calib_002.tmaxErr	FBD:CL3013_SFC_CONTROL_PR>OCEDURE	OR_BOOL	.36.22	130,76	IN3	R
S_CL3013_NO3_Calib_003.tmaxErr	FBD:CL3013_SFC_CONTROL_PR>OCEDURE	OR_BOOL	.36.22	130,77	IN4	R
S_CL3013_NO3_Stop_001.tmaxErr	FBD:CL3013_SFC_CONTROL_PR>OCEDURE	OR_BOOL	.36.71	132,130	IN1	R
S_CL3013_NO3_Stop_002.tmaxErr	FBD:CL3013_SFC_CONTROL_PR>OCEDURE	OR_BOOL	.36.71	132,131	IN2	R
TT_3001_01	FBD:Input	I_SCALE	.2.12	88,16	Y	W
	FBD:CL3001_Influent_Temp_>Control	PCR_SF1	FBI_5_2	14,14	PV	R
	FBD:CL3001_Influent_Temp_>Control	SUB_REAL	.5.10	11,79	IN1	R
	FBD:CL3001_Influent_Temp_>Control	SUB_REAL	.5.12	11,89	IN1	R
	FBD:CL3001_Influent_Temp_>Control	SUB_REAL	.5.14	11,99	IN1	R
	FBD:CL3001_Influent_Temp_>Control	SUB_REAL	.5.16	11,109	IN1	R
TT_3001_01_AH	FBD:ALARM_STATUS	OR_BOOL	.31.5	14,69	IN1	R
	FBD:CL3001_Influent_Temp_>Control	ACT_DIA	FBI_5_29	90,76	ERR	W
TT_3001_01_AHH	FBD:ALARM_STATUS	OR_BOOL	.31.1	18,14	IN2	R
	FBD:CL3001_Influent_Temp_>Control	ACT_DIA	FBI_5_30	90,86	ERR	W
TT_3001_01_AL	FBD:ALARM_STATUS	OR_BOOL	.31.5	14,70	IN2	R
	FBD:CL3001_Influent_Temp_>Control	ACT_DIA	FBI_5_31	90,96	ERR	W
TT_3001_01_ALL	FBD:ALARM_STATUS	OR_BOOL	.31.1	18,15	IN3	R
	FBD:CL3001_Influent_Temp_>Control	ACT_DIA	FBI_5_32	90,106	ERR	W

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
TT_3001_01_ERR	FBD:ERR_AI	WORD_TO_BIT	FBI_4_1	17,11	BIT1	W
	FBD:ALARM_STATUS	OR_BOOL	.31.1	18,16	IN4	R
TT_3001_01_LIM_H	FBD:CL3001_Influent_Temp_>Control	GT_REAL	.5.11	33,80	IN2	R
TT_3001_01_LIM_HH	FBD:CL3001_Influent_Temp_>Control	GT_REAL	.5.13	33,90	IN2	R
TT_3001_01_LIM_L	FBD:CL3001_Influent_Temp_>Control	LT_REAL	.5.18	33,100	IN2	R
TT_3001_01_LIM_LL	FBD:CL3001_Influent_Temp_>Control	LT_REAL	.5.19	33,110	IN2	R
TT_3001_01_SP	FBD:CL3001_Influent_Temp_>Control	PCR_SF1	FBI_5_2	14,15	SP	R
	FBD:CL3001_Influent_Temp_>Control	SUB_REAL	.5.10	11,80	IN2	R
	FBD:CL3001_Influent_Temp_>Control	SUB_REAL	.5.12	11,90	IN2	R
	FBD:CL3001_Influent_Temp_>Control	SUB_REAL	.5.14	11,100	IN2	R
	FBD:CL3001_Influent_Temp_>Control	SUB_REAL	.5.16	11,110	IN2	R
TT_3005_01	FBD:Input	I_SCALE	.2.15	88,37	Y	W
	FBD:CL3005_Bioreactor_Tem>p_Control	SUB_REAL	.8.19	2,150	IN1	R
	FBD:CL3005_Bioreactor_Tem>p_Control	SUB_REAL	.8.21	3,173	IN1	R
	FBD:CL3005_Bioreactor_Tem>p_Control	SUB_REAL	.8.23	3,190	IN1	R
	FBD:CL3005_Bioreactor_Tem>p_Control	SUB_REAL	.8.25	3,209	IN1	R
	FBD:CL3005_Bioreactor_Tem>p_Control	MOVE	.8.107	14,11	IN	R
TT_3005_01_AH	FBD:ALARM_STATUS	OR_BOOL	.31.5	14,79	IN11	R
	FBD:CL3005_Bioreactor_Tem>p_Control	ACT_DIA	FBI_8_87	69,143	ERR	W
TT_3005_01_AHH	FBD:ALARM_STATUS	OR_BOOL	.31.1	18,32	IN20	R
	FBD:CL3005_Bioreactor_Tem>p_Control	ACT_DIA	FBI_8_88	69,165	ERR	W
TT_3005_01_AL	FBD:ALARM_STATUS	OR_BOOL	.31.5	14,80	IN12	R
	FBD:CL3005_Bioreactor_Tem>p_Control	ACT_DIA	FBI_8_89	68,183	ERR	W
TT_3005_01_ALL	FBD:ALARM_STATUS	OR_BOOL	.31.1	18,33	IN21	R
	FBD:CL3005_Bioreactor_Tem>p_Control	ACT_DIA	FBI_8_90	67,201	ERR	W
TT_3005_01_ERR	FBD:ERR_AI	WORD_TO_BIT	FBI_4_1	17,14	BIT4	W
	FBD:ALARM_STATUS	OR_BOOL	.31.1	18,34	IN22	R
	FBD:CL3005_Bioreactor_Tem>p_Control	AND_BOOL	.8.104	18,20	IN1	R
	FBD:CL3005_Bioreactor_Tem>p_Control	MOVE	.8.107	14,10	EN	R
	FBD:CL3005_Bioreactor_Tem>p_Control	AND_BOOL	.8.112	146,32	IN1	R
TT_3005_01_LIM_H	FBD:CL3005_Bioreactor_Tem>p_Control	GT_REAL	.8.20	21,151	IN2	R
TT_3005_01_LIM_HH	FBD:CL3005_Bioreactor_Tem>p_Control	GT_REAL	.8.22	22,174	IN2	R
TT_3005_01_LIM_L	FBD:CL3005_Bioreactor_Tem>p_Control	LT_REAL	.8.24	21,191	IN2	R

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
TT_3005_01_LIM_LL	FBD:CL3005_Bioreactor_Tem>p_Control	LT_REAL	.8.26	21,210	IN2	R
TT_3005_02	FBD:Input	I_SCALE	.2.14	88,30	Y	W
	FBD:CL3005_Bioreactor_Tem>p_Control	SUB_REAL	.8.27	105,150	IN1	R
	FBD:CL3005_Bioreactor_Tem>p_Control	SUB_REAL	.8.29	106,168	IN1	R
	FBD:CL3005_Bioreactor_Tem>p_Control	SUB_REAL	.8.31	106,185	IN1	R
	FBD:CL3005_Bioreactor_Tem>p_Control	SUB_REAL	.8.33	106,202	IN1	R
	FBD:CL3005_Bioreactor_Tem>p_Control	PCR_EIF1	FBI_8_52	22,83	PV	R
	FBD:CL3005_Bioreactor_Tem>p_Control	PCR_DC3	FBI_8_56	28,68	YMAN	R
TT_3005_02_AH	FBD:ALARM_STATUS	OR_BOOL	.31.5	14,77	IN9	R
	FBD:CL3005_Bioreactor_Tem>p_Control	ACT_DIA	FBI_8_91	166,142	ERR	W
TT_3005_02_AHH	FBD:ALARM_STATUS	OR_BOOL	.31.1	18,29	IN17	R
	FBD:CL3005_Bioreactor_Tem>p_Control	ACT_DIA	FBI_8_92	168,161	ERR	W
TT_3005_02_AL	FBD:ALARM_STATUS	OR_BOOL	.31.5	14,78	IN10	R
	FBD:CL3005_Bioreactor_Tem>p_Control	ACT_DIA	FBI_8_93	168,178	ERR	W
TT_3005_02_ALL	FBD:ALARM_STATUS	OR_BOOL	.31.1	18,30	IN18	R
	FBD:CL3005_Bioreactor_Tem>p_Control	ACT_DIA	FBI_8_94	171,195	ERR	W
TT_3005_02_ERR	FBD:ERR_AI	WORD_TO_BIT	FBI_4_1	17,13	BIT3	W
	FBD:ALARM_STATUS	OR_BOOL	.31.1	18,31	IN19	R
	FBD:CL3005_Bioreactor_Tem>p_Control	AND_BOOL	.8.108	129,14	IN1	R
TT_3005_02_LIM_H	FBD:CL3005_Bioreactor_Tem>p_Control	GT_REAL	.8.28	123,151	IN2	R
TT_3005_02_LIM_HH	FBD:CL3005_Bioreactor_Tem>p_Control	GT_REAL	.8.30	125,169	IN2	R
TT_3005_02_LIM_L	FBD:CL3005_Bioreactor_Tem>p_Control	LT_REAL	.8.32	125,186	IN2	R
TT_3005_02_LIM_LL	FBD:CL3005_Bioreactor_Tem>p_Control	LT_REAL	.8.34	126,203	IN2	R
TT_3005_03	FBD:Input	I_SCALE	.2.16	88,44	Y	W
	FBD:CL3005_Bioreactor_Tem>p_Control	AVERA	FBI_8_95	71,11	C1	R
	FBD:CL3005_Bioreactor_Tem>p_Control	MOVE	.8.101	91,34	IN	R
TT_3005_03_ERR	FBD:ERR_AI	WORD_TO_BIT	FBI_4_1	17,15	BIT5	W
	FBD:ALARM_STATUS	OR_BOOL	.31.1	18,35	IN23	R
	FBD:CL3005_Bioreactor_Tem>p_Control	AND_BOOL	.8.96	72,24	IN1	R
	FBD:CL3005_Bioreactor_Tem>p_Control	AND_BOOL	.8.100	73,33	IN1	R
	FBD:CL3005_Bioreactor_Tem>p_Control	OR_BOOL	.8.106	7,25	IN1	R
	FBD:CL3005_Bioreactor_Tem>p_Control	AND_BOOL	.8.112	146,33	IN2	R
TT_3005_04	FBD:Input	I_SCALE	.2.17	88,51	Y	W
	FBD:CL3005_Bioreactor_Tem>p_Control	AVERA	FBI_8_95	71,13	C2	R

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
	FBD:CL3005_Bioreactor_Tem>p_Control	MOVE	.8.98	90,25	IN	R
TT_3005_04_ERR	FBD:ERR_AI	WORD_TO_BIT	FBI_4_1	17,16	BIT6	W
	FBD:ALARM_STATUS	OR_BOOL	.31.1	18,36	IN24	R
	FBD:CL3005_Bioreactor_Tem>p_Control	AND_BOOL	.8.96	72,25	IN2	R
	FBD:CL3005_Bioreactor_Tem>p_Control	AND_BOOL	.8.100	73,34	IN2	R
	FBD:CL3005_Bioreactor_Tem>p_Control	OR_BOOL	.8.106	7,26	IN2	R
	FBD:CL3005_Bioreactor_Tem>p_Control	AND_BOOL	.8.112	146,34	IN3	R
TT_3005_AVERAGE	FBD:CL3005_Bioreactor_Tem>p_Control	AVERA	FBI_8_95	90,10	OUT	W
	FBD:CL3005_Bioreactor_Tem>p_Control	MOVE	.8.98	106,25	OUT	W
	FBD:CL3005_Bioreactor_Tem>p_Control	MOVE	.8.101	107,34	OUT	W
	FBD:CL3005_Bioreactor_Tem>p_Control	MOVE	.8.105	37,21	IN	R
TT_3005_CONTROLLED	FBD:CL3005_Bioreactor_Tem>p_Control	MOVE	.8.105	53,21	OUT	W
	FBD:CL3005_Bioreactor_Tem>p_Control	PCR_DC3	FBI_8_56	28,60	PV	R
	FBD:CL3005_Bioreactor_Tem>p_Control	MOVE	.8.107	30,11	OUT	W
TT_3005_SP	FBD:CL3005_Bioreactor_Tem>p_Control	SUB_REAL	.8.19	2,151	IN2	R
	FBD:CL3005_Bioreactor_Tem>p_Control	SUB_REAL	.8.21	3,174	IN2	R
	FBD:CL3005_Bioreactor_Tem>p_Control	SUB_REAL	.8.23	3,191	IN2	R
	FBD:CL3005_Bioreactor_Tem>p_Control	SUB_REAL	.8.25	3,210	IN2	R
	FBD:CL3005_Bioreactor_Tem>p_Control	PCR_DC3	FBI_8_56	28,61	SP	R
TT_3008_01	FBD:Input	I_SCALE	.2.39	128,182	Y	W
TT_3008_01_ERR	FBD:ERR_AI	WORD_TO_BIT	FBI_4_4	94,23	BIT12	W
	FBD:ALARM_STATUS	OR_BOOL	.31.2	47,20	IN8	R
TT_3008_02	FBD:Input	I_SCALE	.2.40	128,191	Y	W
TT_3008_02_ERR	FBD:ERR_AI	WORD_TO_BIT	FBI_4_4	94,24	BIT13	W
	FBD:ALARM_STATUS	OR_BOOL	.31.2	47,22	IN10	R
TT_3012_01	FBD:Input	I_SCALE	.2.10	88,9	Y	W
	FBD:CL3012_Gas_Temperature	GT_REAL	.15.2	7,18	IN1	R
	FBD:CL3012_Gas_Temperature	GT_REAL	.15.6	9,29	IN1	R
	FBD:CL3012_Gas_Temperature	LT_REAL	.15.7	83,17	IN1	R
	FBD:CL3012_Gas_Temperature	LT_REAL	.15.8	83,27	IN1	R
TT_3012_01_AH	FBD:ALARM_STATUS	OR_BOOL	.31.6	38,70	IN1	R
	FBD:CL3012_Gas_Temperature	ACT_DIA	FBI_15_9	51,15	ERR	W
TT_3012_01_AHH	FBD:ALARM_STATUS	OR_BOOL	.31.3	71,16	IN2	R
	FBD:CL3012_Gas_Temperature	ACT_DIA	FBI_15_10	50,28	ERR	W
TT_3012_01_AL	FBD:ALARM_STATUS	OR_BOOL	.31.6	38,71	IN2	R
	FBD:CL3012_Gas_Temperature	ACT_DIA	FBI_15_11	117,16	ERR	W
TT_3012_01_ALL	FBD:ALARM_STATUS	OR_BOOL	.31.3	71,17	IN3	R
	FBD:CL3012_Gas_Temperature	ACT_DIA	FBI_15_12	117,26	ERR	W
TT_3012_01_ERR	FBD:ERR_AI	WORD_TO_BIT	FBI_4_1	17,10	BIT0	W
	FBD:ALARM_STATUS	OR_BOOL	.31.3	71,18	IN4	R

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
TT_3012_01_LIM_H	FBD:CL3012_Gas_Temperature	GT_REAL	.15.2	7,19	IN2	R
TT_3012_01_LIM_HH	FBD:CL3012_Gas_Temperature	GT_REAL	.15.6	9,30	IN2	R
TT_3012_01_LIM_L	FBD:CL3012_Gas_Temperature	LT_REAL	.15.7	83,18	IN2	R
TT_3012_01_LIM_LL	FBD:CL3012_Gas_Temperature	LT_REAL	.15.8	83,28	IN2	R
TT_3020_01	FBD:Input	I_SCALE	.2.13	88,23	Y	W
	FBD:CL3020_Effluent_Tempe>rature	PCR_SF1	FBI_22_2	18,15	PV	R
	FBD:CL3020_Effluent_Tempe>rature	SUB_REAL	.22.10	15,80	IN1	R
	FBD:CL3020_Effluent_Tempe>rature	SUB_REAL	.22.12	13,95	IN1	R
	FBD:CL3020_Effluent_Tempe>rature	SUB_REAL	.22.14	15,116	IN1	R
	FBD:CL3020_Effluent_Tempe>rature	SUB_REAL	.22.15	14,135	IN1	R
TT_3020_01_AH	FBD:ALARM_STATUS	OR_BOOL	.31.6	38,82	IN13	R
	FBD:CL3020_Effluent_Tempe>rature	ACT_DIA	FBI_22_29	80,81	ERR	W
TT_3020_01_AHH	FBD:ALARM_STATUS	OR_BOOL	.31.3	71,37	IN23	R
	FBD:CL3020_Effluent_Tempe>rature	ACT_DIA	FBI_22_30	77,96	ERR	W
TT_3020_01_AL	FBD:ALARM_STATUS	OR_BOOL	.31.6	38,83	IN14	R
	FBD:CL3020_Effluent_Tempe>rature	ACT_DIA	FBI_22_31	79,119	ERR	W
TT_3020_01_ALL	FBD:ALARM_STATUS	OR_BOOL	.31.3	71,38	IN24	R
	FBD:CL3020_Effluent_Tempe>rature	ACT_DIA	FBI_22_32	79,139	ERR	W
TT_3020_01_ERR	FBD:ERR_AI	WORD_TO_BIT	FBI_4_1	17,12	BIT2	W
	FBD:ALARM_STATUS	OR_BOOL	.31.3	71,39	IN25	R
TT_3020_01_LIM_H	FBD:CL3020_Effluent_Tempe>rature	GT_REAL	.22.11	37,81	IN2	R
TT_3020_01_LIM_HH	FBD:CL3020_Effluent_Tempe>rature	GT_REAL	.22.13	35,96	IN2	R
TT_3020_01_LIM_L	FBD:CL3020_Effluent_Tempe>rature	LT_REAL	.22.16	37,117	IN2	R
TT_3020_01_LIM_LL	FBD:CL3020_Effluent_Tempe>rature	LT_REAL	.22.17	36,136	IN2	R
TT_3020_01_SP	FBD:CL3020_Effluent_Tempe>rature	PCR_SF1	FBI_22_2	18,16	SP	R
	FBD:CL3020_Effluent_Tempe>rature	SUB_REAL	.22.10	15,81	IN2	R
	FBD:CL3020_Effluent_Tempe>rature	SUB_REAL	.22.12	13,96	IN2	R
	FBD:CL3020_Effluent_Tempe>rature	SUB_REAL	.22.14	15,117	IN2	R
	FBD:CL3020_Effluent_Tempe>rature	SUB_REAL	.22.15	14,136	IN2	R
TT_3023_01	FBD:Input	I_SCALE	.2.44	201,179	Y	W
TT_3023_01_ERR	FBD:ERR_AI	WORD_TO_BIT	FBI_4_5	123,22	BIT11	W
	FBD:ALARM_STATUS	OR_BOOL	.31.3	71,43	IN29	R
TT_3023_02	FBD:Input	I_SCALE	.2.45	201,190	Y	W
TT_3023_02_ERR	FBD:ERR_AI	WORD_TO_BIT	FBI_4_5	123,23	BIT12	W
	FBD:ALARM_STATUS	OR_BOOL	.31.3	71,44	IN30	R
TT_3023_03	FBD:Input	I_SCALE	.2.46	201,202	Y	W
TT_3023_03_ERR	FBD:ERR_AI	WORD_TO_BIT	FBI_4_5	123,24	BIT13	W
	FBD:ALARM_STATUS	OR_BOOL	.31.3	71,45	IN31	R
TT_Range_MAX	FBD:Input	I_SCALE	.2.10	71,10	MX	R

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

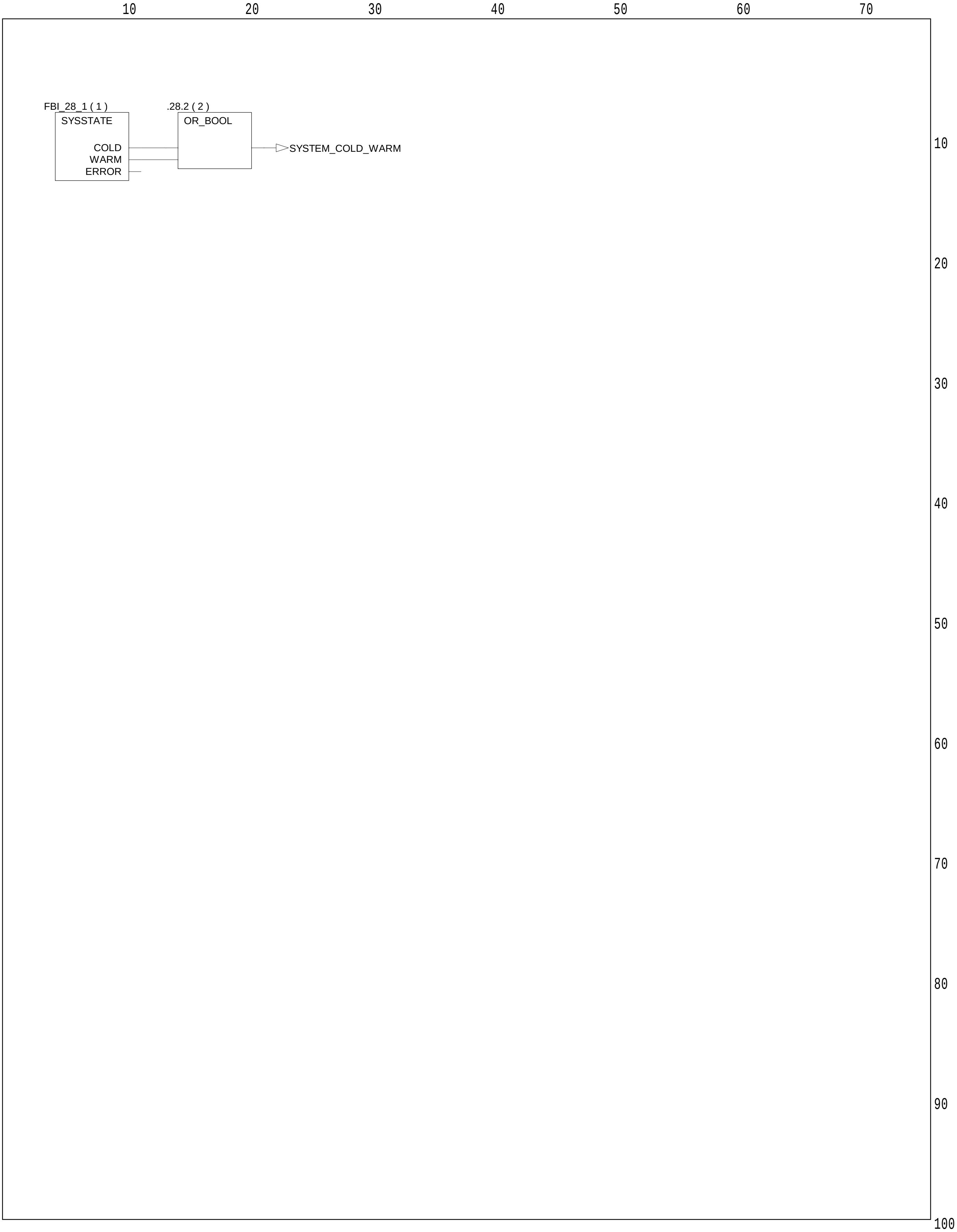
Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
	FBD:Input	I_SCALE	.2.12	71,17	MX	R
	FBD:Input	I_SCALE	.2.13	71,24	MX	R
	FBD:Input	I_SCALE	.2.14	71,31	MX	R
	FBD:Input	I_SCALE	.2.15	71,38	MX	R
	FBD:Input	I_SCALE	.2.16	71,45	MX	R
	FBD:Input	I_SCALE	.2.17	71,52	MX	R
TT_Range_MIN	FBD:Input	I_SCALE	.2.10	71,9	MN	R
	FBD:Input	I_SCALE	.2.12	71,16	MN	R
	FBD:Input	I_SCALE	.2.13	71,23	MN	R
	FBD:Input	I_SCALE	.2.14	71,30	MN	R
	FBD:Input	I_SCALE	.2.15	71,37	MN	R
	FBD:Input	I_SCALE	.2.16	71,44	MN	R
	FBD:Input	I_SCALE	.2.17	71,51	MN	R
T_CL3013_NH4_001	FBD:T_CL3013_NH4_001	AND_BOOL	.33.1	82,10	OUT	W
	SFC:CL3013_NH4	TRANSITION		5,4		R
T_CL3013_NH4_002	FBD:T_CL3013_NH4_002	EQ_BYTE	.34.2	25,7	OUT	W
	SFC:CL3013_NH4	TRANSITION		5,6		R
T_CL3013_NH4_004	FBD:T_CL3013_NH4_004	EQ_BYTE	.35.2	23,6	OUT	W
	SFC:CL3013_NH4	TRANSITION		5,10		R
T_CL3013_NH4_Calib_001	FBD:T_CL3013_NH4_Calib_001	AND_BOOL	.38.4	82,14	OUT	W
	SFC:CL3013_NH4_Calib	TRANSITION		5,4		R
T_CL3013_NH4_Calib_002	FBD:T_CL3013_NH4_Calib_002	EQ_BYTE	.39.2	24,7	OUT	W
	SFC:CL3013_NH4_Calib	TRANSITION		5,6		R
T_CL3013_NH4_Calib_004	FBD:T_CL3013_NH4_Calib_004	AND_BOOL	.40.3	47,7	OUT	W
	SFC:CL3013_NH4_Calib	TRANSITION		5,10		R
T_CL3013_NH4_Stop_001	FBD:T_CL3013_NH4_Stop_001	OR_BOOL	.53.7	62,19	OUT	W
	SFC:CL3013_NH4_Stop	TRANSITION		4,4		R
T_CL3013_NH4_Stop_002	FBD:T_CL3013_NH4_Stop_002	EQ_BYTE	.54.2	25,7	OUT	W
	SFC:CL3013_NH4_Stop	TRANSITION		4,6		R
T_CL3013_NO2_001	FBD:T_CL3013_NO2_001	AND_BOOL	.56.1	65,14	OUT	W
	SFC:CL3013_NO2	TRANSITION		5,4		R
T_CL3013_NO2_Stop_001	FBD:T_CL3013_NO2_Stop_001	OR_BOOL	.58.7	70,15	OUT	W
	SFC:CL3013_NO2_Stop	TRANSITION		4,4		R
T_CL3013_NO2_Stop_002	FBD:T_CL3013_NO2_Stop_002	AND_BOOL	.59.1	30,14	OUT	W
	SFC:CL3013_NO2_Stop	TRANSITION		4,6		R
T_CL3013_NO3_001	FBD:T_CL3013_NO3_001	AND_BOOL	.42.4	82,21	OUT	W
	SFC:CL3013_NO3	TRANSITION		5,4		R
T_CL3013_NO3_002	FBD:T_CL3013_NO3_002	EQ_BYTE	.43.2	25,7	OUT	W
	SFC:CL3013_NO3	TRANSITION		5,6		R
T_CL3013_NO3_004	FBD:T_CL3013_NO3_004	EQ_BYTE	.44.2	23,6	OUT	W
	SFC:CL3013_NO3	TRANSITION		5,10		R
T_CL3013_NO3_Calib_001	FBD:T_CL3013_NO3_Calib_001	AND_BOOL	.46.4	80,13	OUT	W
	SFC:CL3013_NO3_Calib	TRANSITION		5,4		R
T_CL3013_NO3_Calib_002	FBD:T_CL3013_NO3_Calib_002	EQ_BYTE	.47.2	23,7	OUT	W
	SFC:CL3013_NO3_Calib	TRANSITION		5,6		R
T_CL3013_NO3_Calib_004	FBD:T_CL3013_NO3_Calib_004	AND_BOOL	.48.3	57,9	OUT	W
	SFC:CL3013_NO3_Calib	TRANSITION		5,10		R
T_CL3013_NO3_Stop_001	FBD:T_CL3013_NO3_Stop_001	OR_BOOL	.50.7	59,14	OUT	W
	SFC:CL3013_NO3_Stop	TRANSITION		4,4		R
T_CL3013_NO3_Stop_002	FBD:T_CL3013_NO3_Stop_002	EQ_BYTE	.51.2	23,7	OUT	W
	SFC:CL3013_NO3_Stop	TRANSITION		4,6		R
WIT_3008_01	FBD:CL3008_Bioreactor_pH_>Control	LT_REAL	.11.127	257,140	IN1	R
	FBD:CL3008_Bioreactor_pH_>Control	LT_REAL	.11.128	257,149	IN1	R
WIT_3008_01_AL	FBD:ALARM_STATUS	OR_BOOL	.31.5	14,89	IN21	R
	FBD:CL3008_Bioreactor_pH_>	ACT_DIA	FBI_11_305	296,138	ERR	W

table continued...

Variable usage (Name: All, Type: All, DataType: All, Sorted by: name)

Variable name	Used in section	Type	Instance/Network	at	Pin	R/W
	Control					
WIT_3008_01_ALL	FBD:ALARM_STATUS	OR_BOOL	.31.2	47,15	IN3	R
	FBD:CL3008_Bioreactor_pH_>Control	ACT_DIA	FBI_11_306	295,147	ERR	W
WIT_3008_01_ERR	FBD:ALARM_STATUS	OR_BOOL	.31.2	47,23	IN11	R
	FBD:ALARM_STATUS	OR_BOOL	.31.2	47,24	IN12	R
WIT_3008_01_LIM_L	FBD:CL3008_Bioreactor_pH_>Control	LT_REAL	.11.127	257,141	IN2	R
WIT_3008_01_LIM_LL	FBD:CL3008_Bioreactor_pH_>Control	LT_REAL	.11.128	257,150	IN2	R
WIT_3008_02	FBD:CL3008_Bioreactor_pH_>Control	LT_REAL	.11.129	257,158	IN1	R
	FBD:CL3008_Bioreactor_pH_>Control	LT_REAL	.11.130	257,167	IN1	R
WIT_3008_02_AL	FBD:ALARM_STATUS	OR_BOOL	.31.5	14,90	IN22	R
	FBD:CL3008_Bioreactor_pH_>Control	ACT_DIA	FBI_11_307	294,156	ERR	W
WIT_3008_02_ALL	FBD:ALARM_STATUS	OR_BOOL	.31.2	47,16	IN4	R
	FBD:CL3008_Bioreactor_pH_>Control	ACT_DIA	FBI_11_308	294,166	ERR	W
WIT_3008_02_LIM_L	FBD:CL3008_Bioreactor_pH_>Control	LT_REAL	.11.129	257,159	IN2	R
WIT_3008_02_LIM_LL	FBD:CL3008_Bioreactor_pH_>Control	LT_REAL	.11.130	257,168	IN2	R

Graph of section SYSTEM_STATE

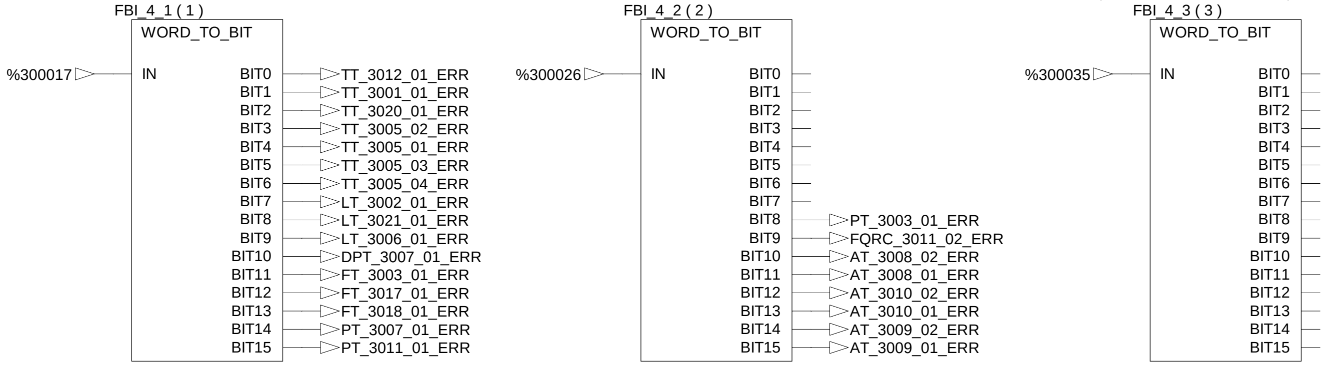


Graph of section ERR_AI

Error coming from card 140AVI04000
situated on Back Plane 1 slot 4
PLC ADDRESS: 300001 -> 3000016

Error coming from card 140ACI03000
situated on Back Plane 2 slot 6
PLC ADDRESS: 300018 -> 3000026

Error coming from card 140ACI03000
situated on Back Plane 2 slot 7
PLC ADDRESS: 300027 -> 3000035
NOT CONNECTED YET
(ONLY FREE ADDRESSES)



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Graph of section ERR_AI

80 90 100 110 120 130 140 150

Error coming from card 140AVI03000
situated on Back Plane 2 slot 8
PLC ADDRESS: 300036 -> 3000044

FBI_4_4 (4)
WORD_TO_BIT

%300044 → IN

BIT0
BIT1
BIT2
BIT3
BIT4
BIT5
BIT6
BIT7
BIT8 → FQRC_3009_01_ERR
BIT9 → FQRC_3008_01_ERR
BIT10 → FQRC_3011_01_ERR
BIT11 → BLE_3004_01_ERR
BIT12 → TT_3008_01_ERR
BIT13 → TT_3008_02_ERR
BIT14
BIT15

Error coming from card 140AVI03000
situated on Back Plane 2 slot 9
PLC ADDRESS: 300045 -> 3000053
NOT CONNECTED YET
(ONLY FREE ADDRESSES)

FBI_4_5 (5)
WORD_TO_BIT

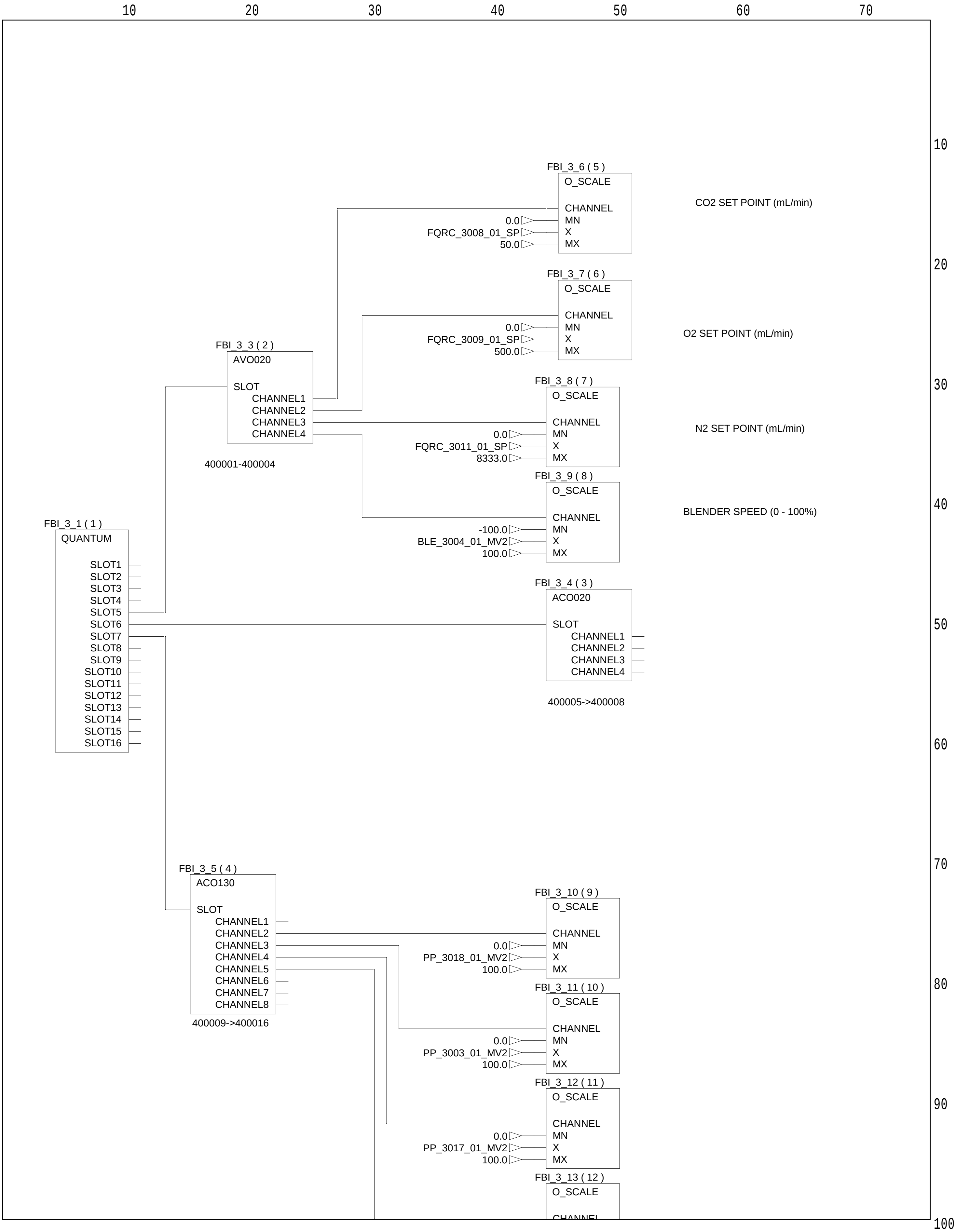
%300053 → IN

BIT0
BIT1
BIT2
BIT3
BIT4
BIT5
BIT6
BIT7
BIT8
BIT9
BIT10 → AT_3013_03_ERR
BIT11 → TT_3023_01_ERR
BIT12 → TT_3023_02_ERR
BIT13 → TT_3023_03_ERR
BIT14
BIT15

10 20 30 40 50 60 70 80 90 100

< page 84

Graph of section output



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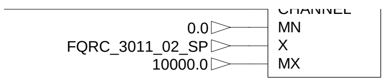
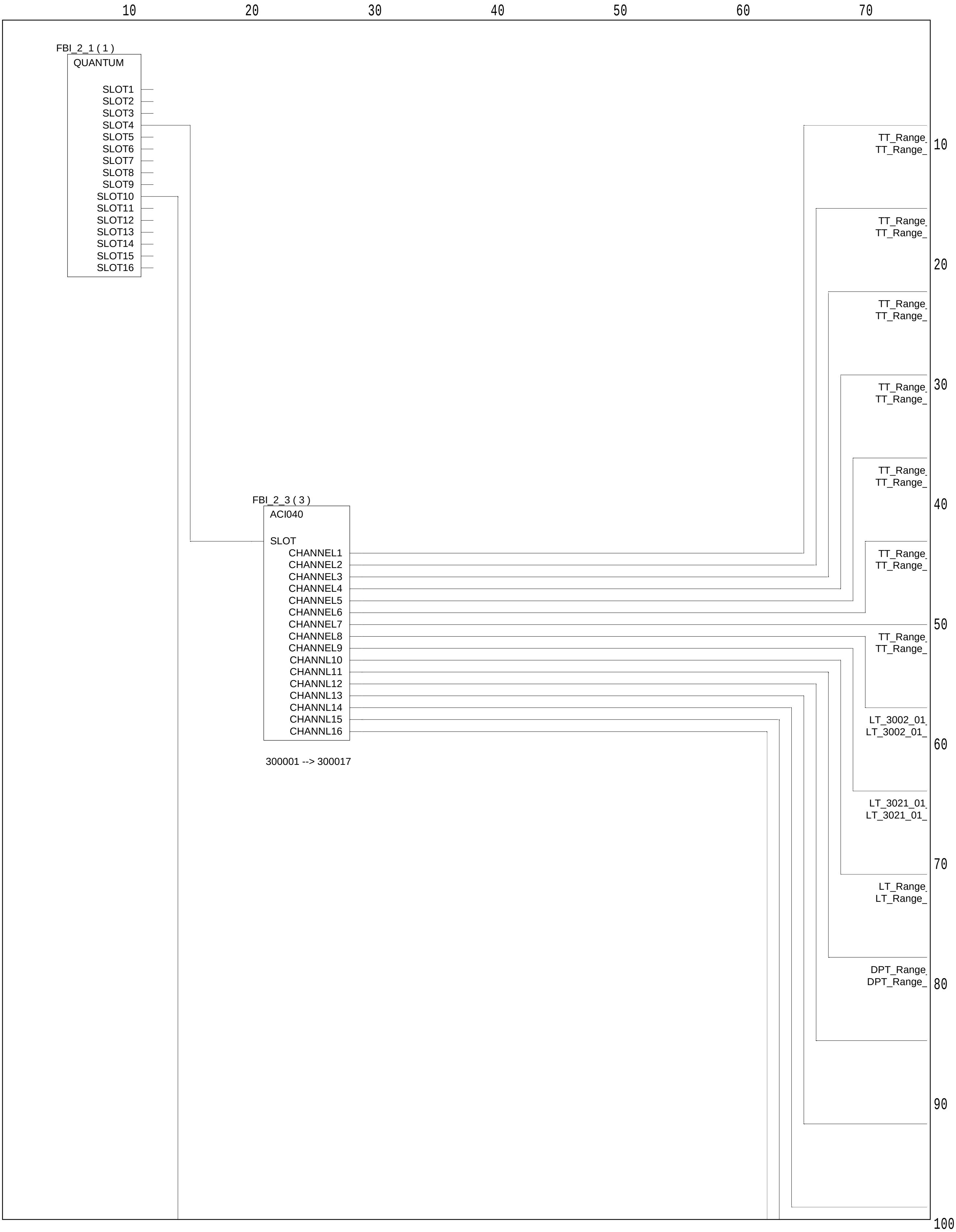
Graph of section output

< page 86



Graph of section Input



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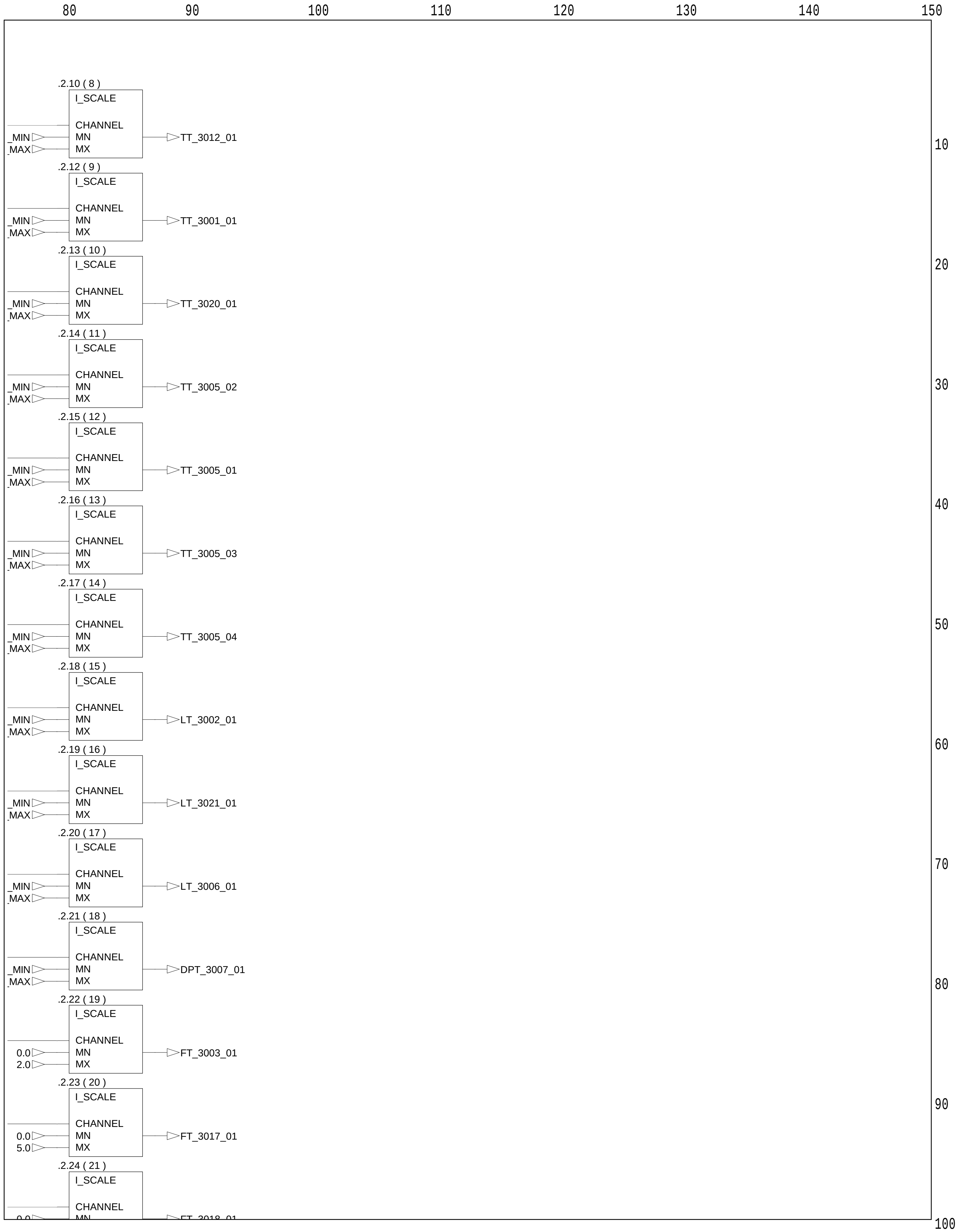
> page 91

Graph of section Input

< page 88



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> page 92

Graph of section Input

160 170 180 190 200 210 220

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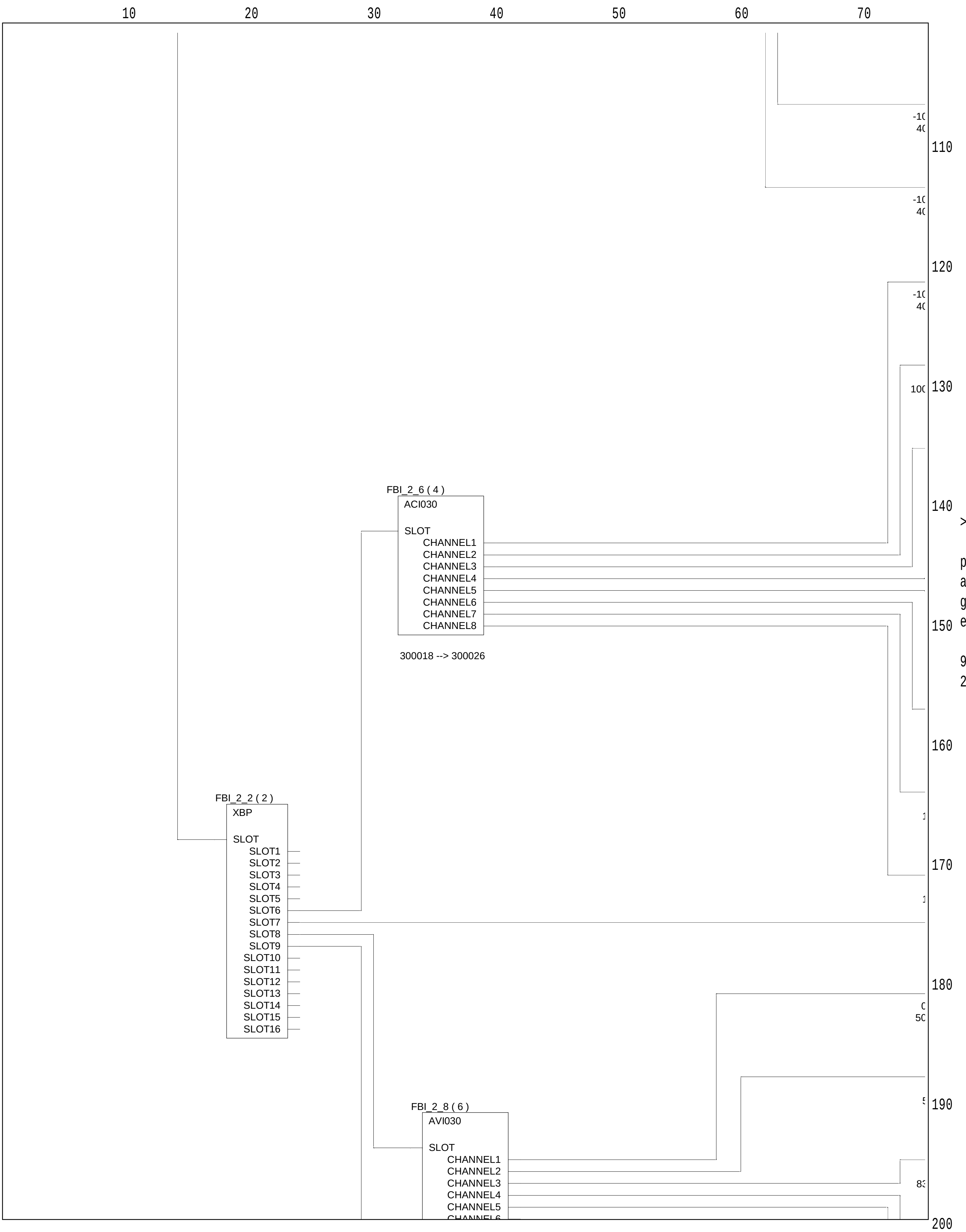
> page 93

Graph of section Input

< page 88



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Graph of section Input

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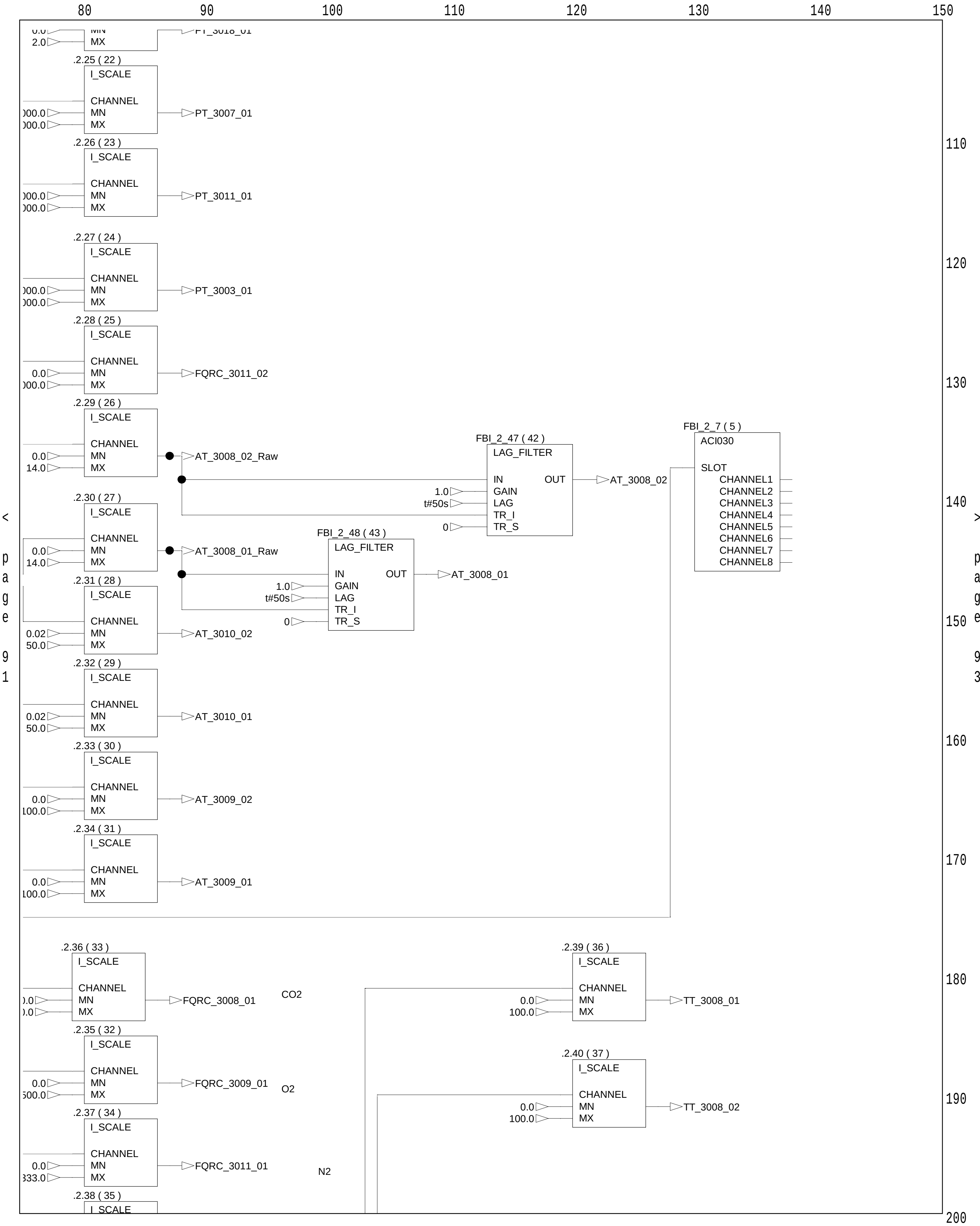

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Graph of section Input

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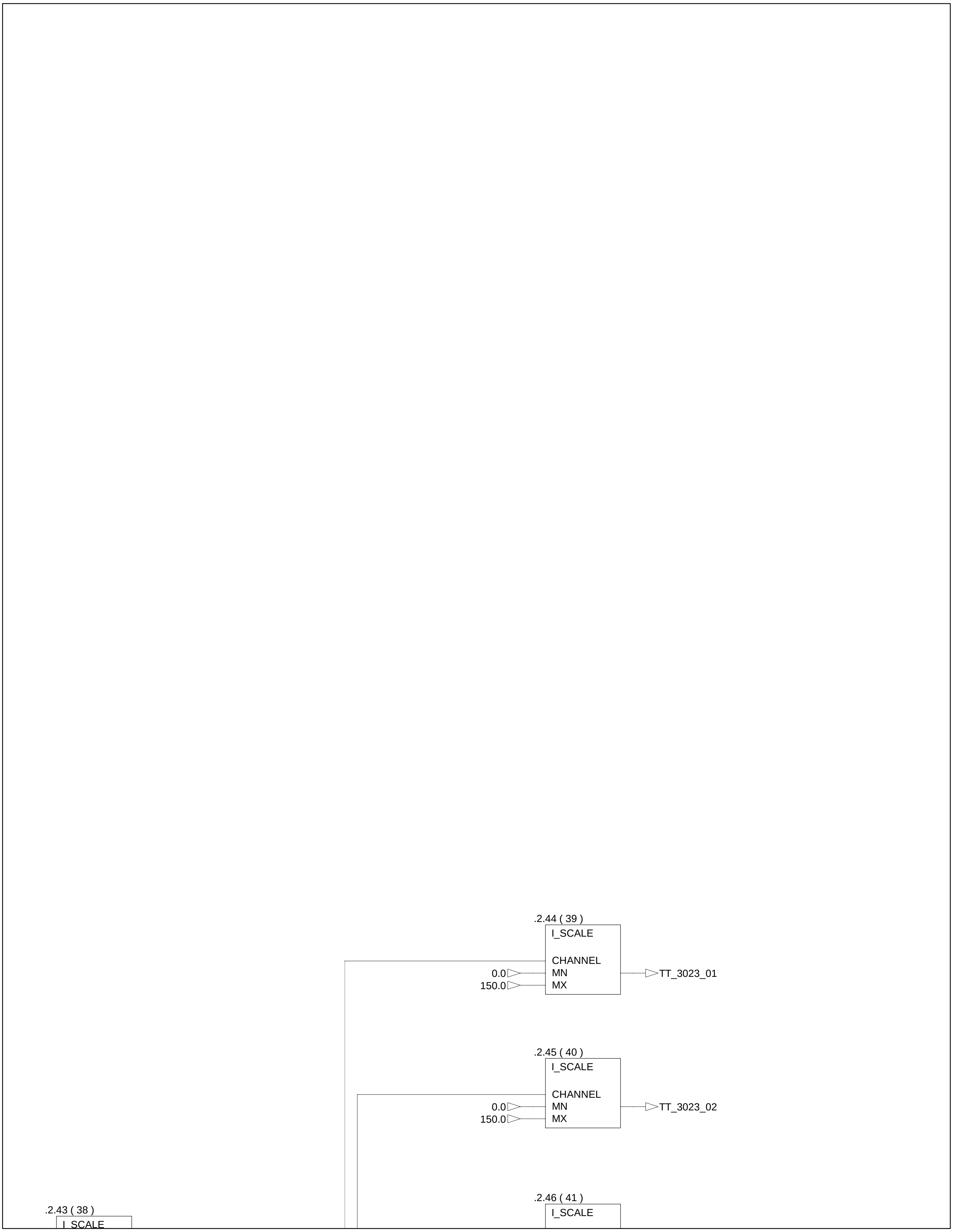

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> page 96

Graph of section Input

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> page 95

Graph of section Input

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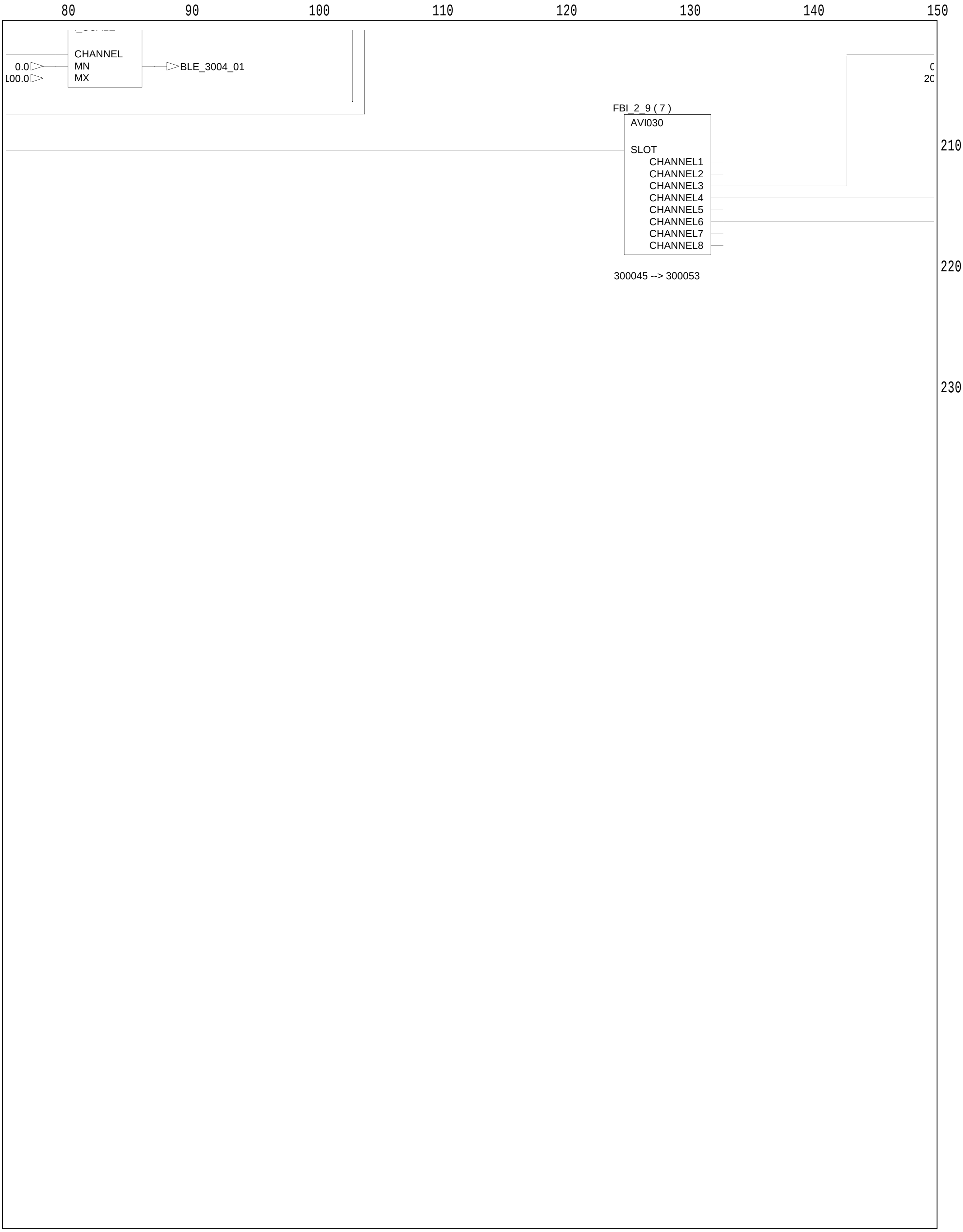

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Graph of section Input

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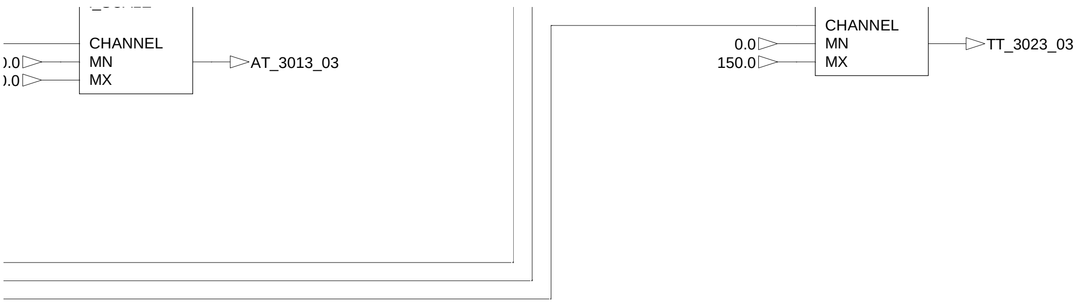

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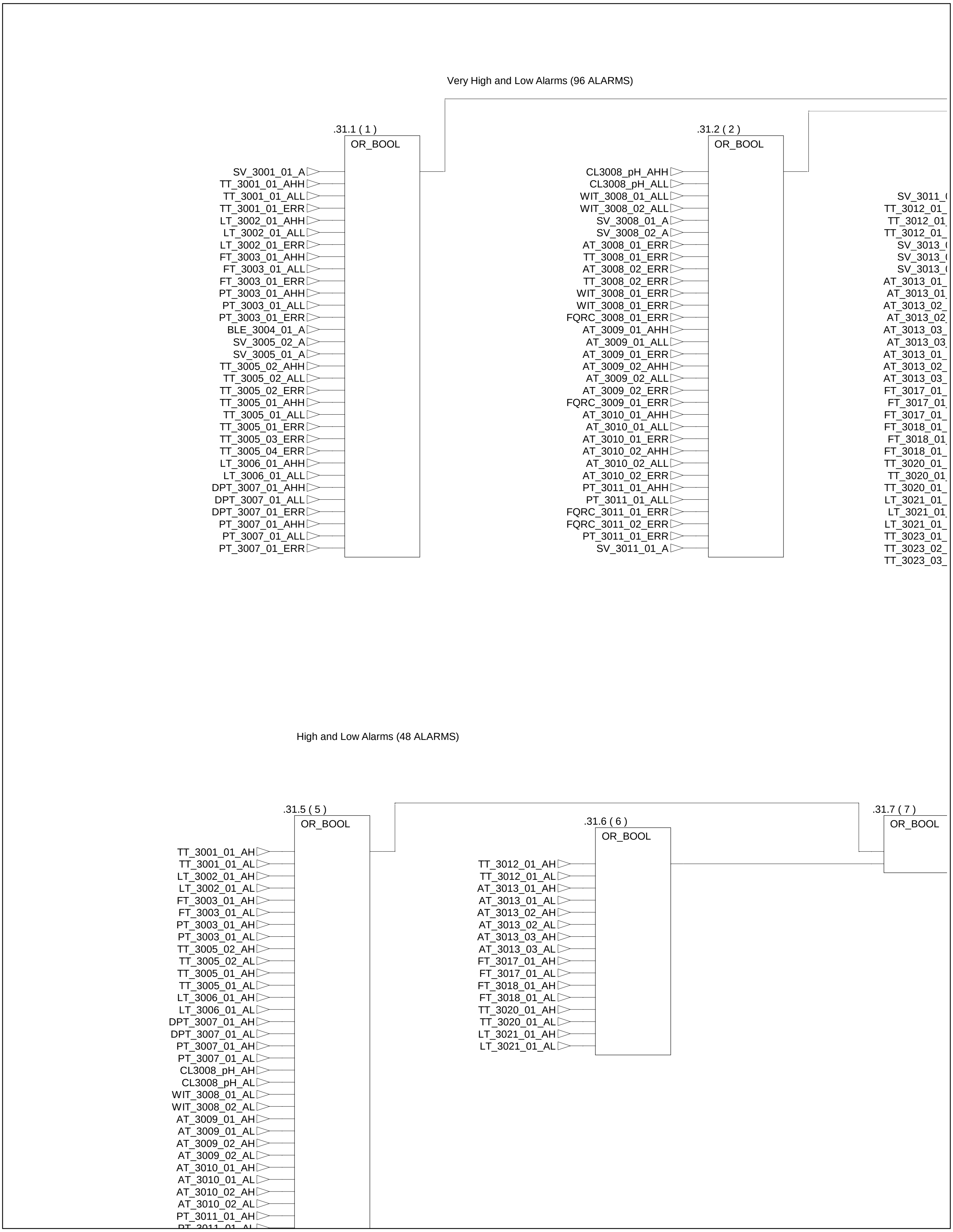
< page 95

Graph of section ALARM_STATUS



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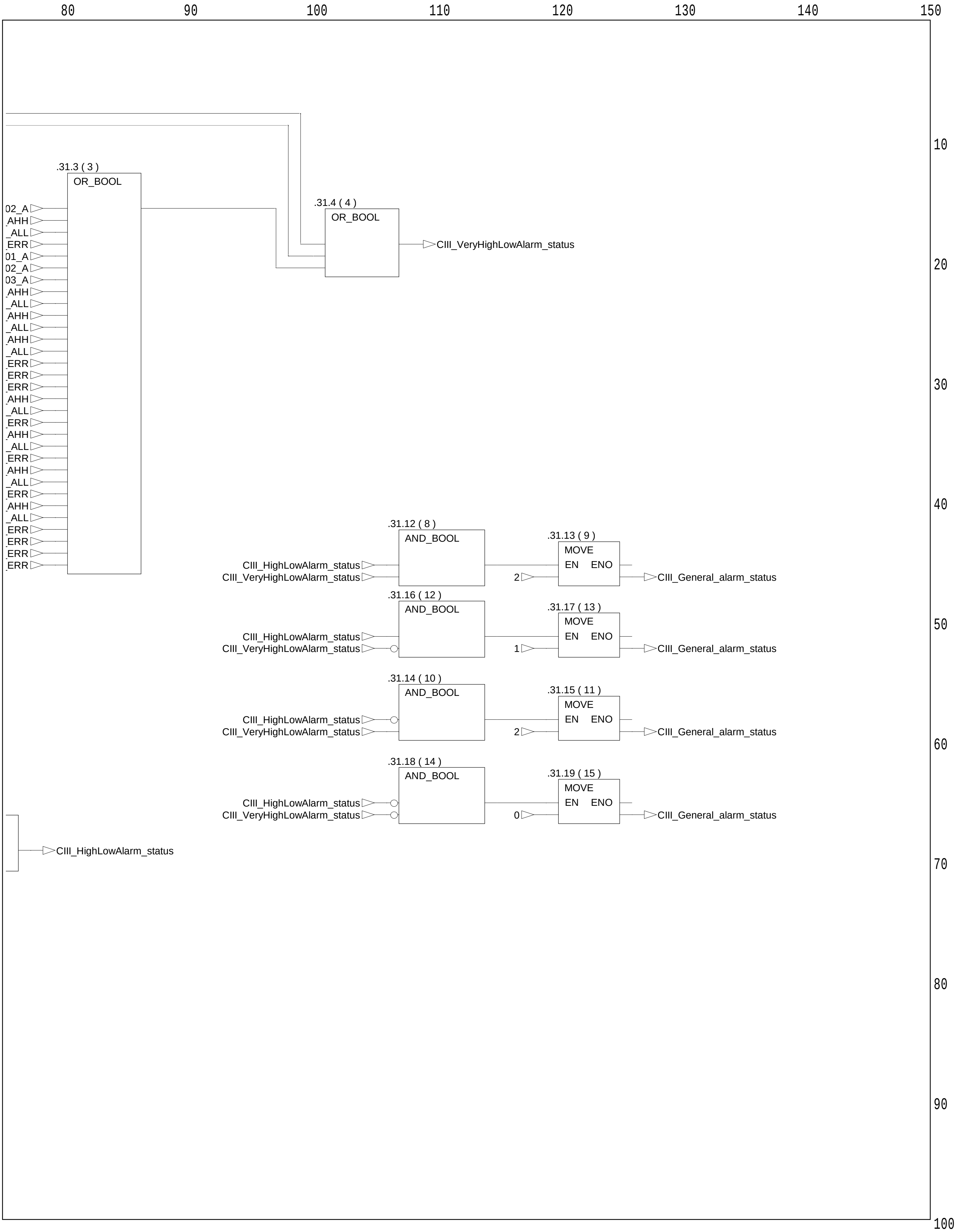
Schneider Automation Concept	Project CIII	22.10.10

Graph of section ALARM_STATUS

< page 97



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Graph of section ALARM_STATUS

< page 97

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PT_3011_01_AL

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> page 100

Graph of section ALARM_STATUS

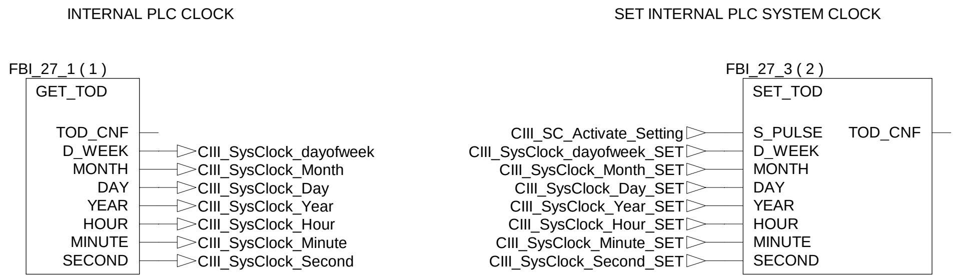
< page 98

80 90 100 110 120 130 140 150

110 120 130 140 150 160 170 180 190 200

< page 99

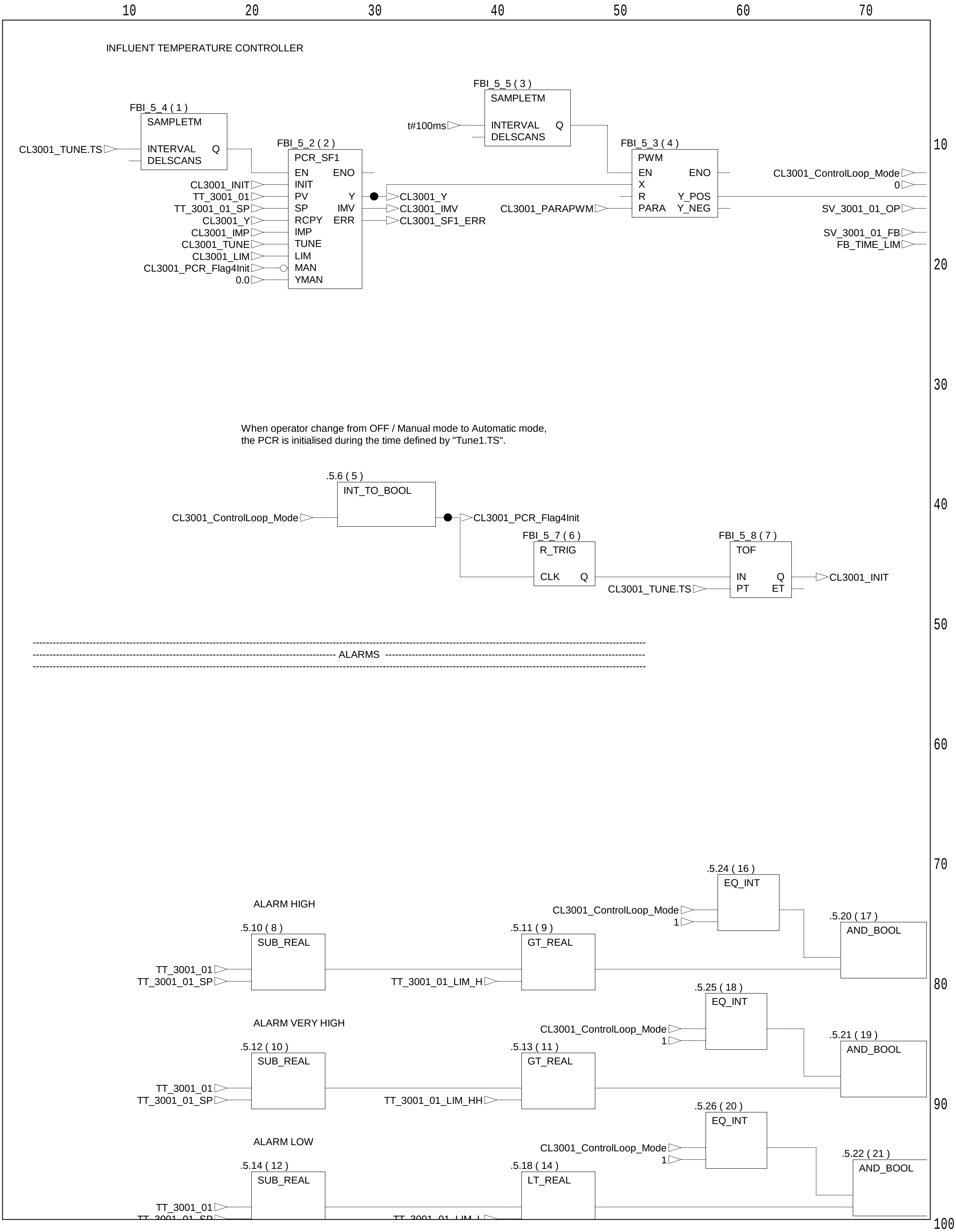
Graph of section System_clock



Graph of section CL3000_Influent_General

2009/07/22:
FOR THE MOMENT THE PUMP BETWEEN CII AND CIII IS NOT IMPLEMENTED.
THIS SECTION WILL BE DEVELLOPPED LATER.

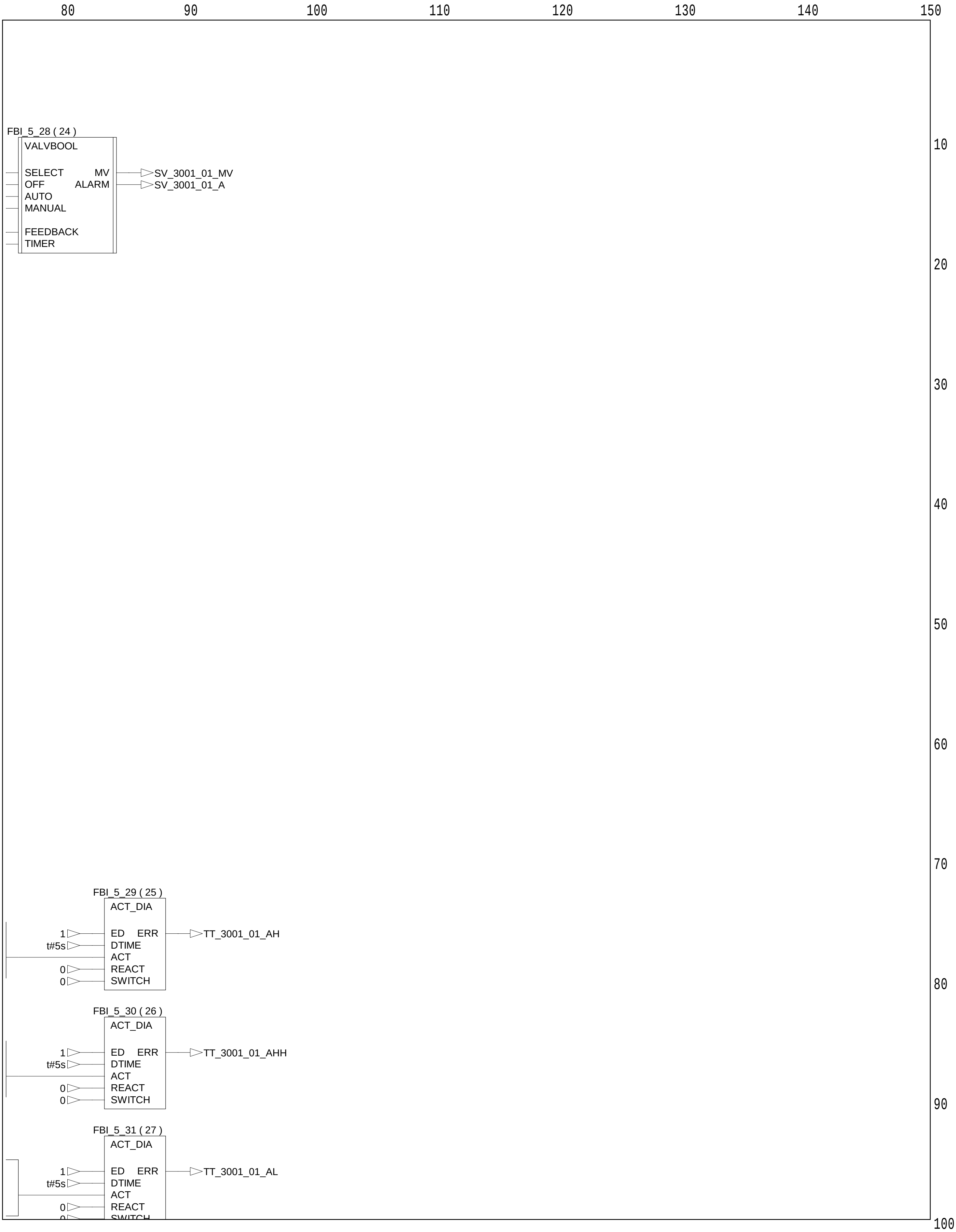
Graph of section CL3001_Influent_Temp_Control



> page 105

Graph of section CL3001_Influent_Temp_Control

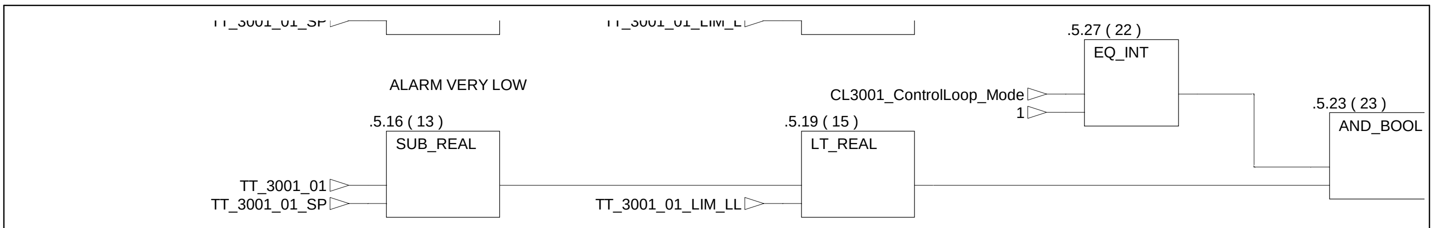
< page 103



> page 106

Graph of section CL3001_Influent_Temp_Control

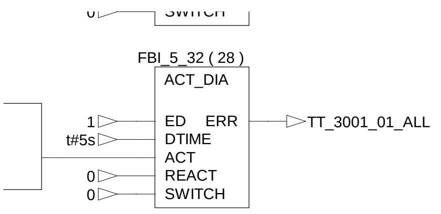
< page 103



> page 106

Graph of section CL3001_Influent_Temp_Control

< page 104



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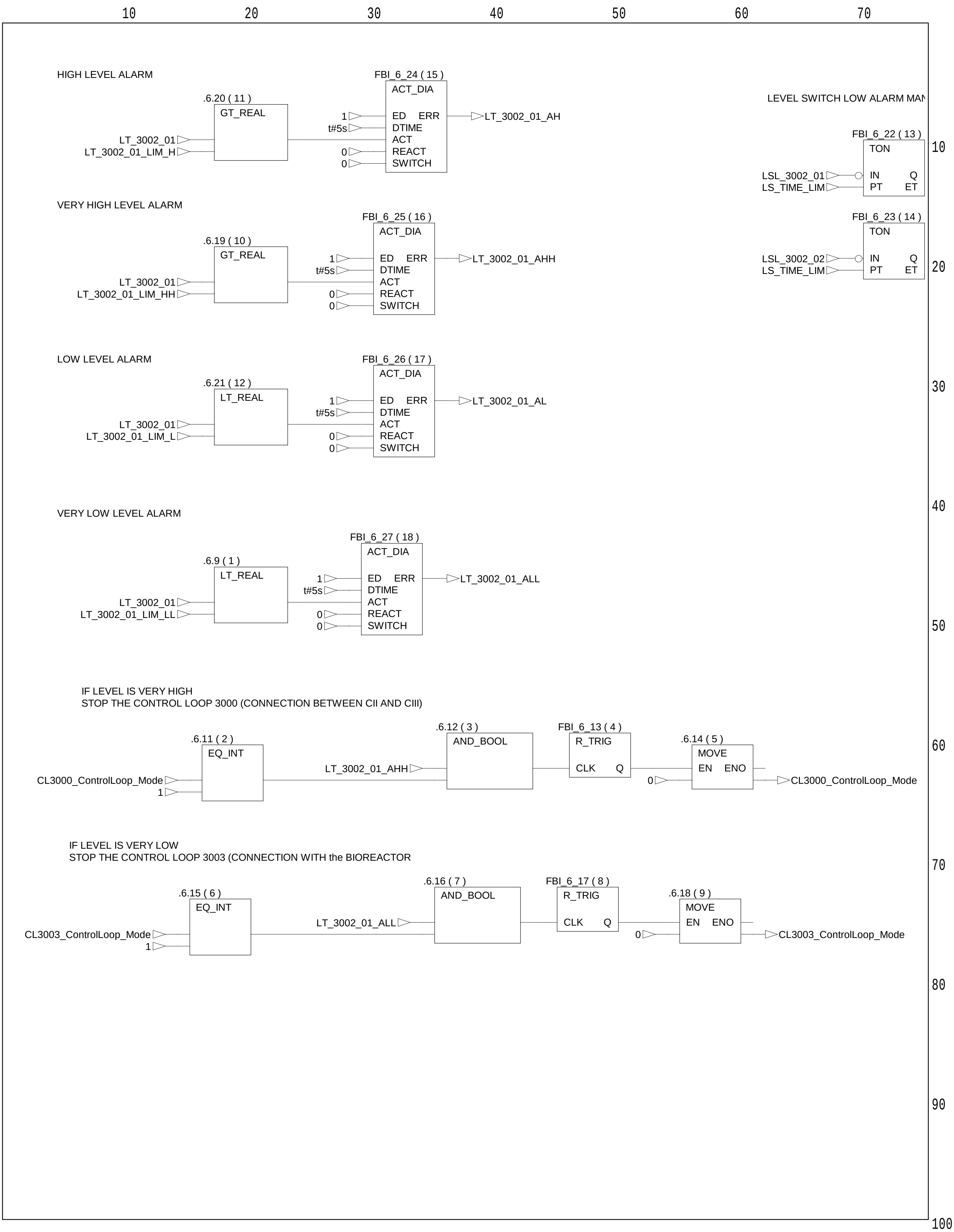
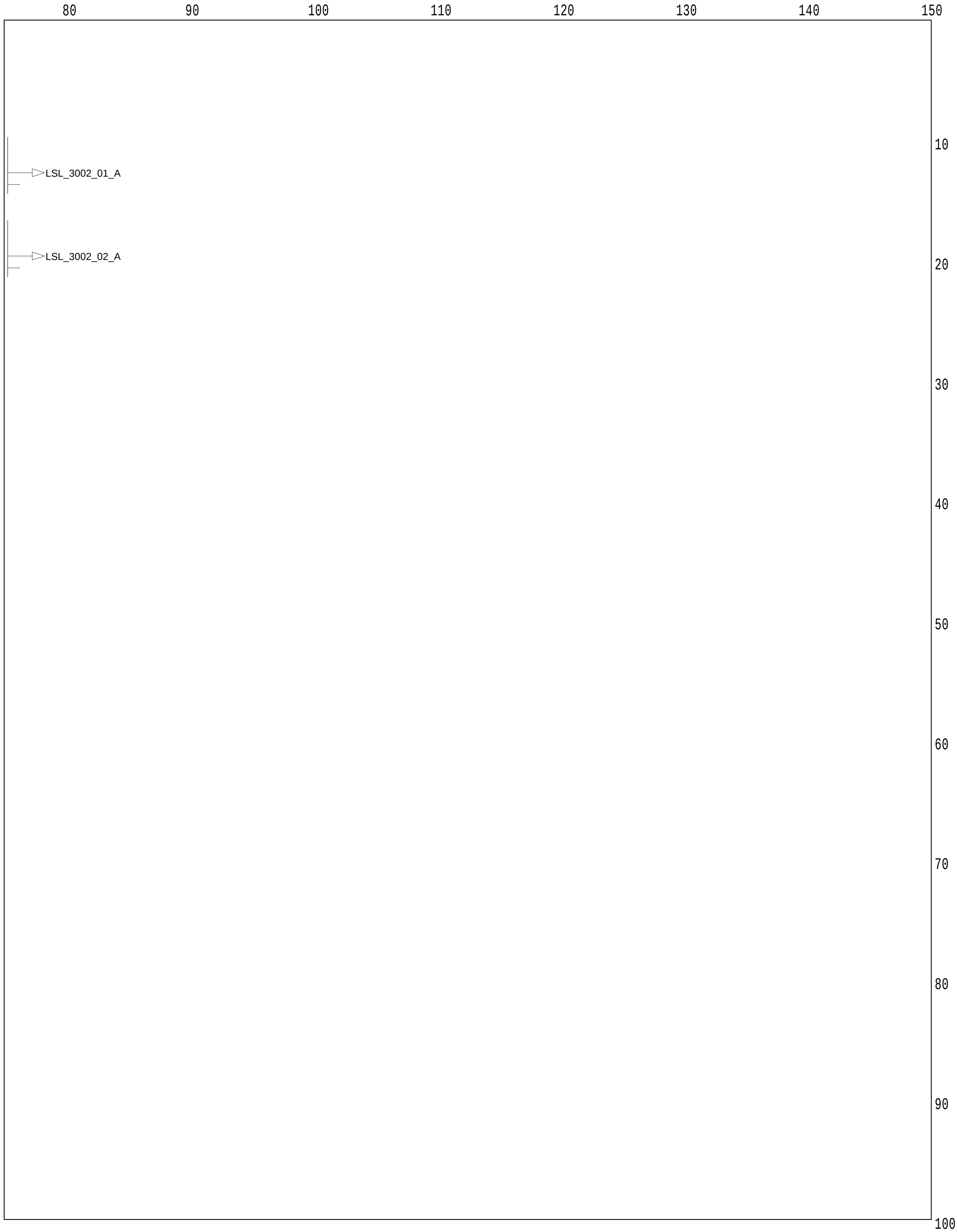
Graph of section CL3002_Influent_Level_Control



Graph of section CL3002_Influent_Level_Control



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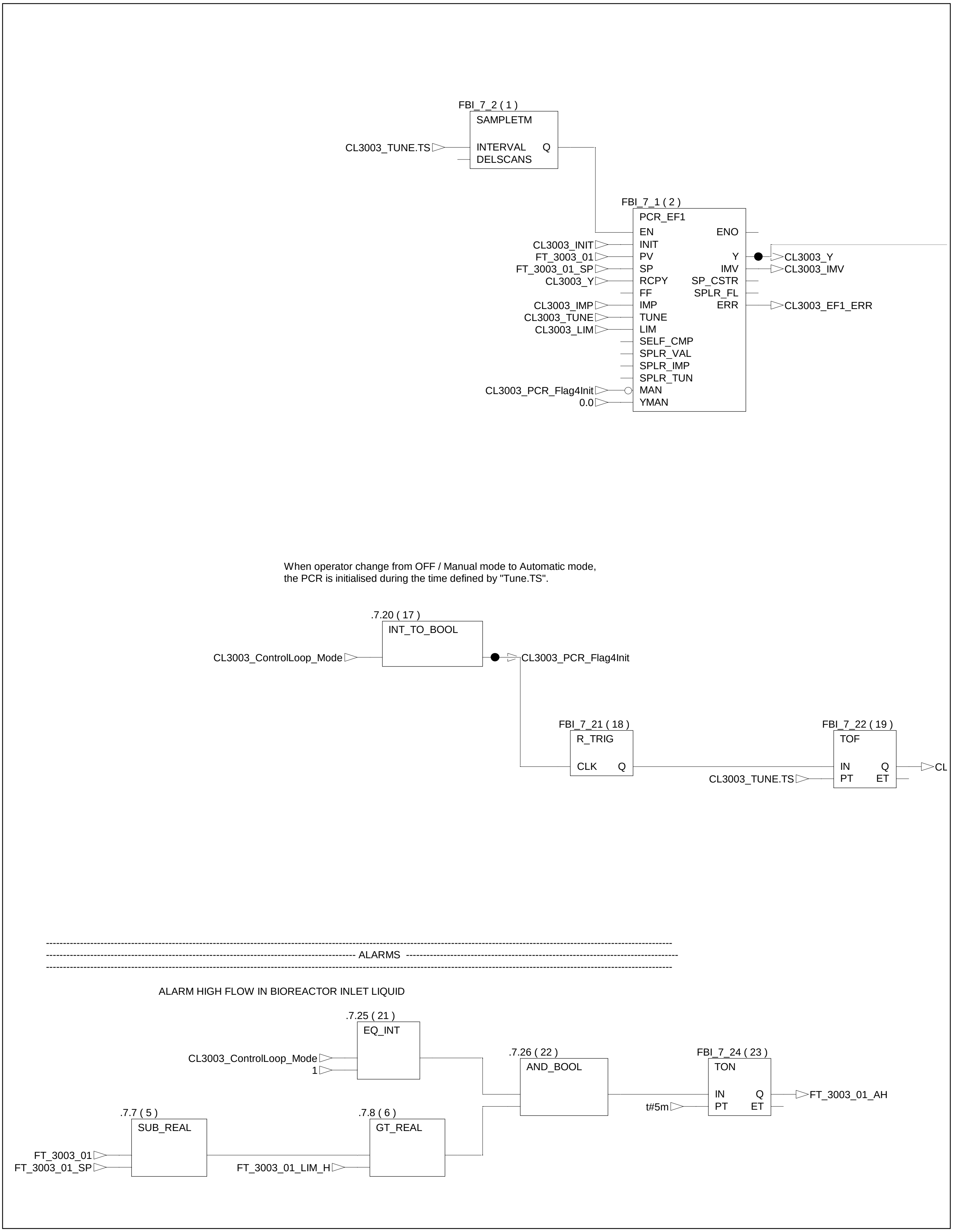
Graph of section CL3003_Inlet_Liquid_Control



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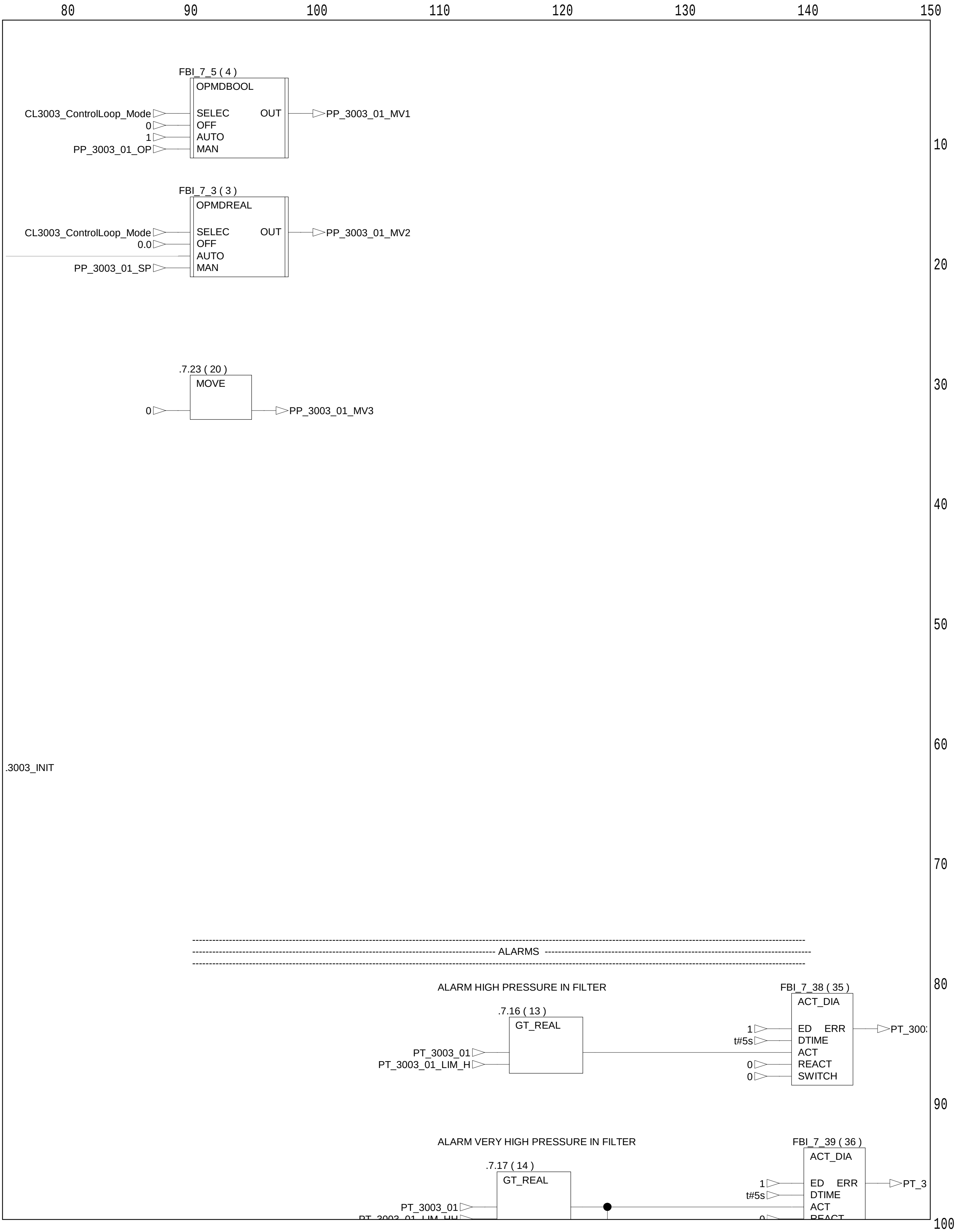
Graph of section CL3003_Inlet_Liquid_Control



< page 109

> page 111

> page 113

Graph of section CL3003_Inlet_Liquid_Control

160 170 180 190 200 210 220

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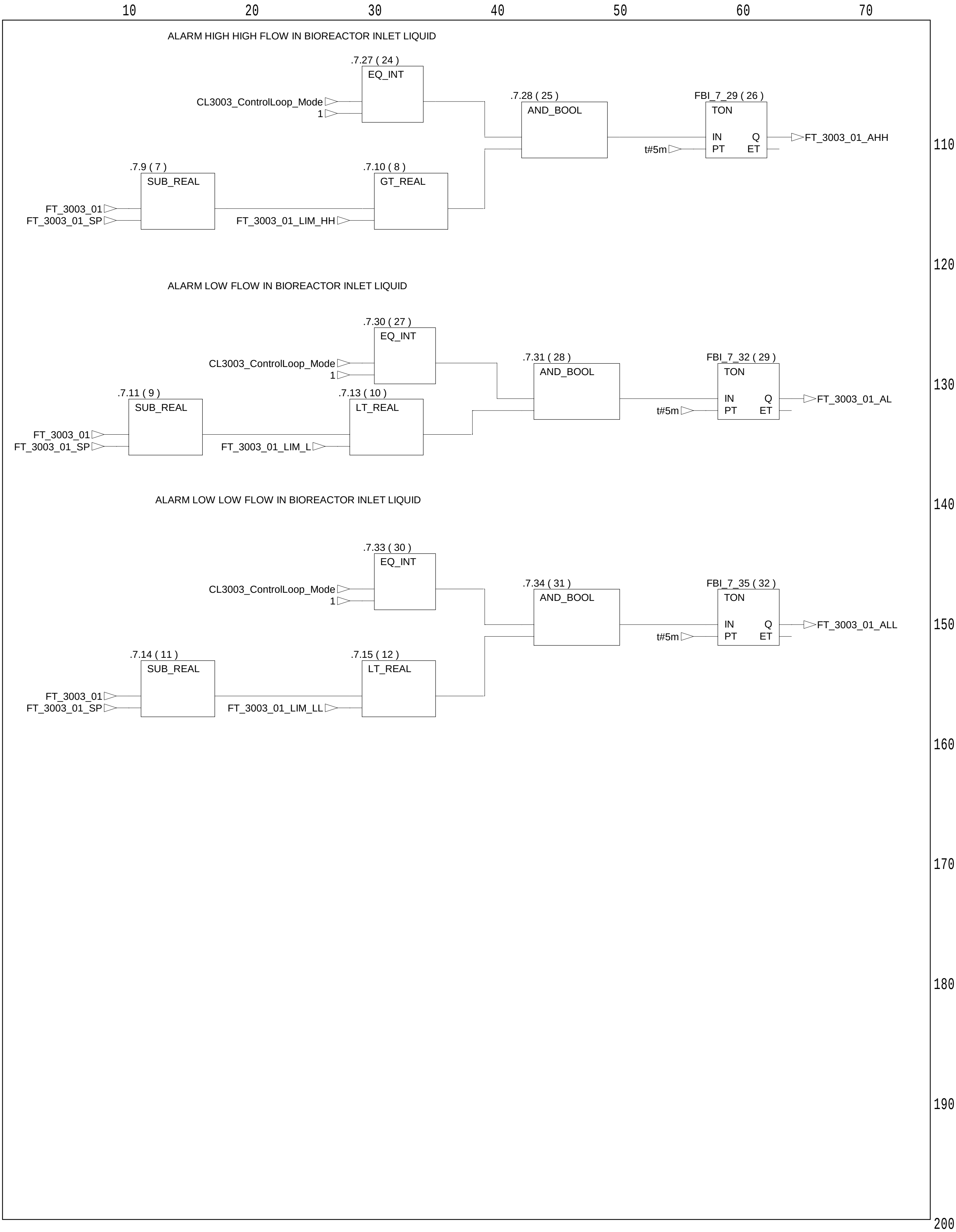
< page 110

3_01_AH

003_01_AHH

> page 114

Graph of section CL3003_Inlet_Liquid_Control < page 109



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Graph of section CL3003_Inlet_Liquid_Control

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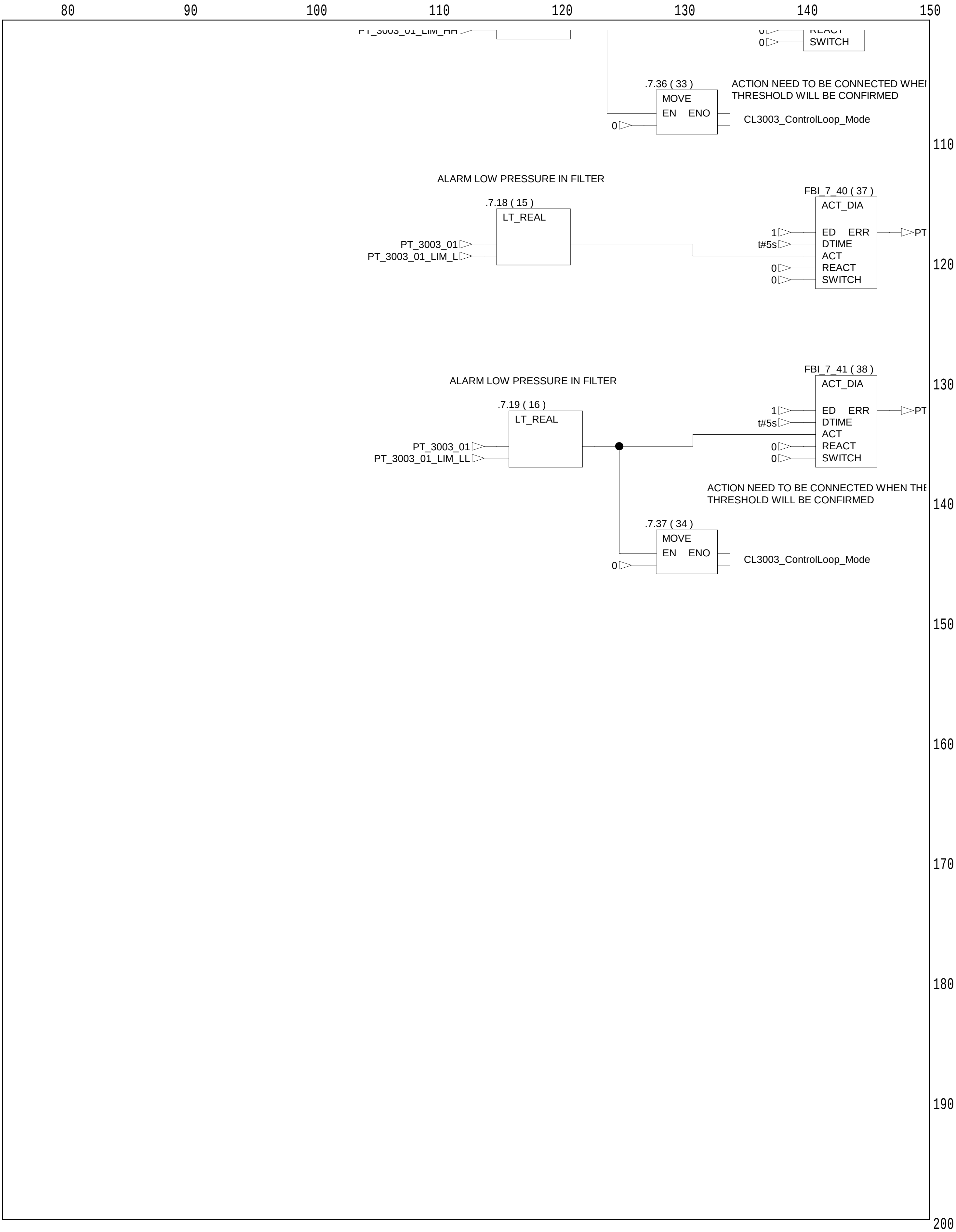

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> page 114

Graph of section CL3003_Inlet_Liquid_Control

< page 111

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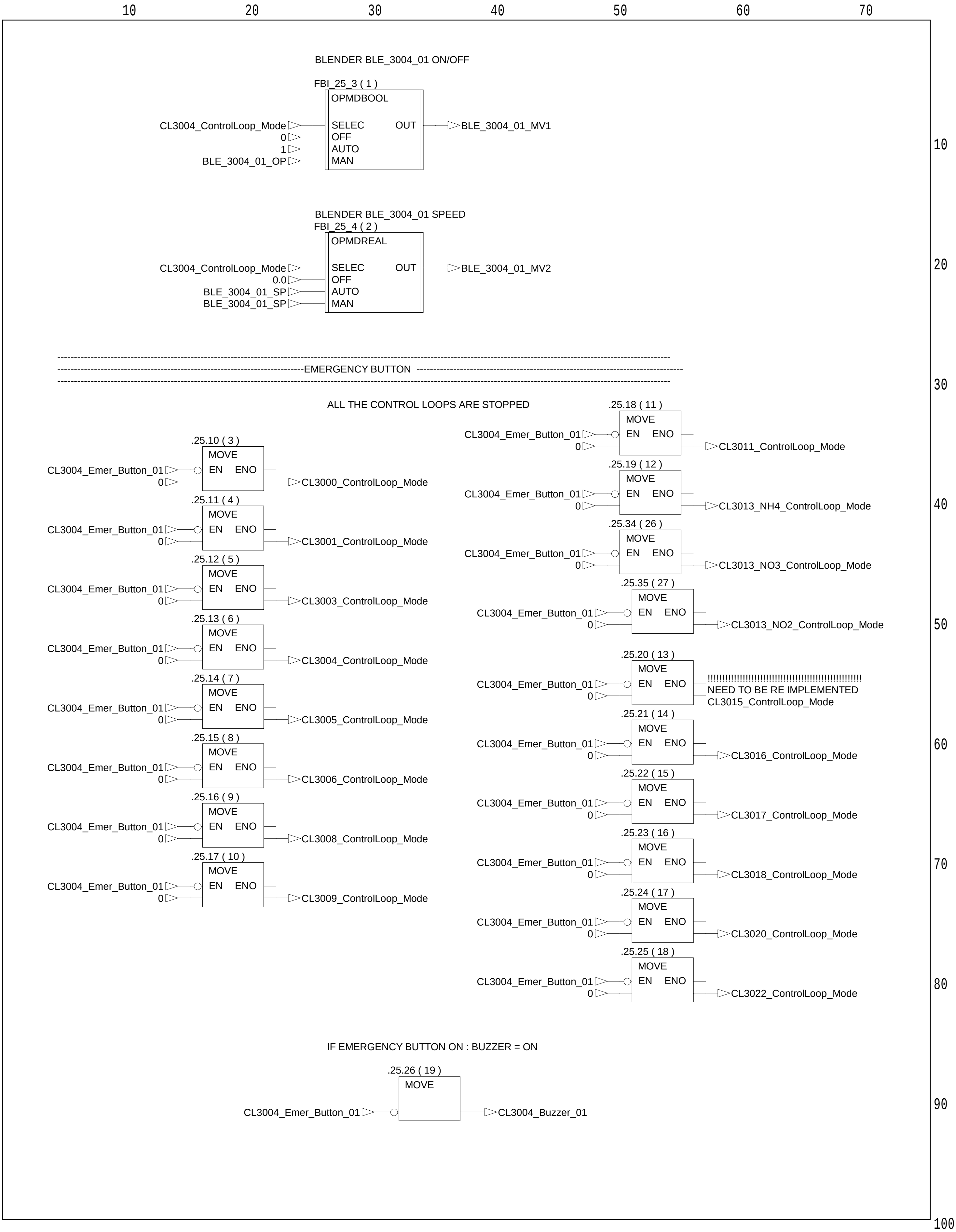
`_3003_01_AL

`_3003_01_ALL

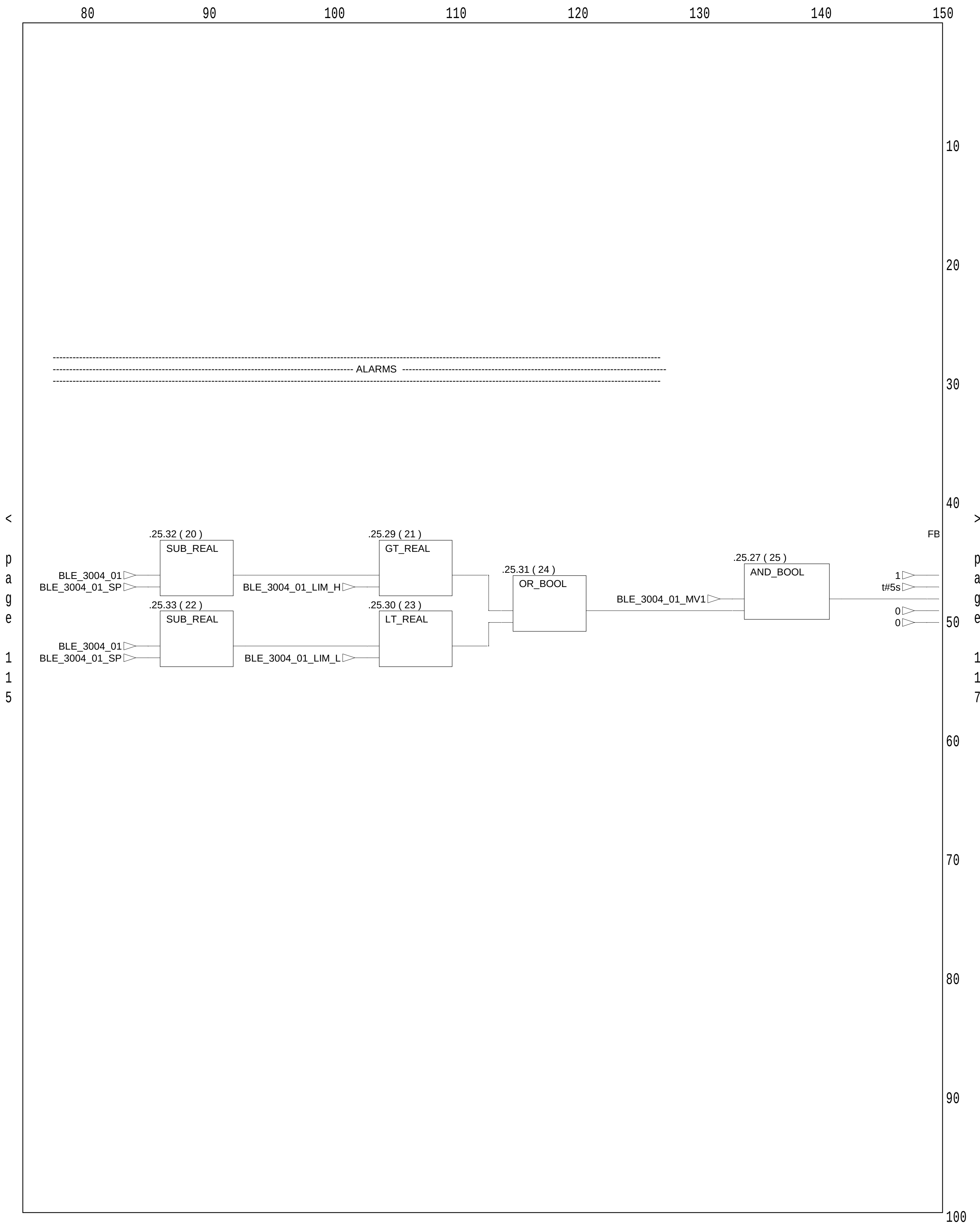
110 120 130 140 150 160 170 180 190 200

< page 113

Graph of section CL3004_Bioreactor_General



Graph of section CL3004_Bioreactor_General



Graph of section CL3004_Bioreactor_General

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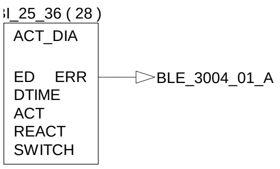
< page 116



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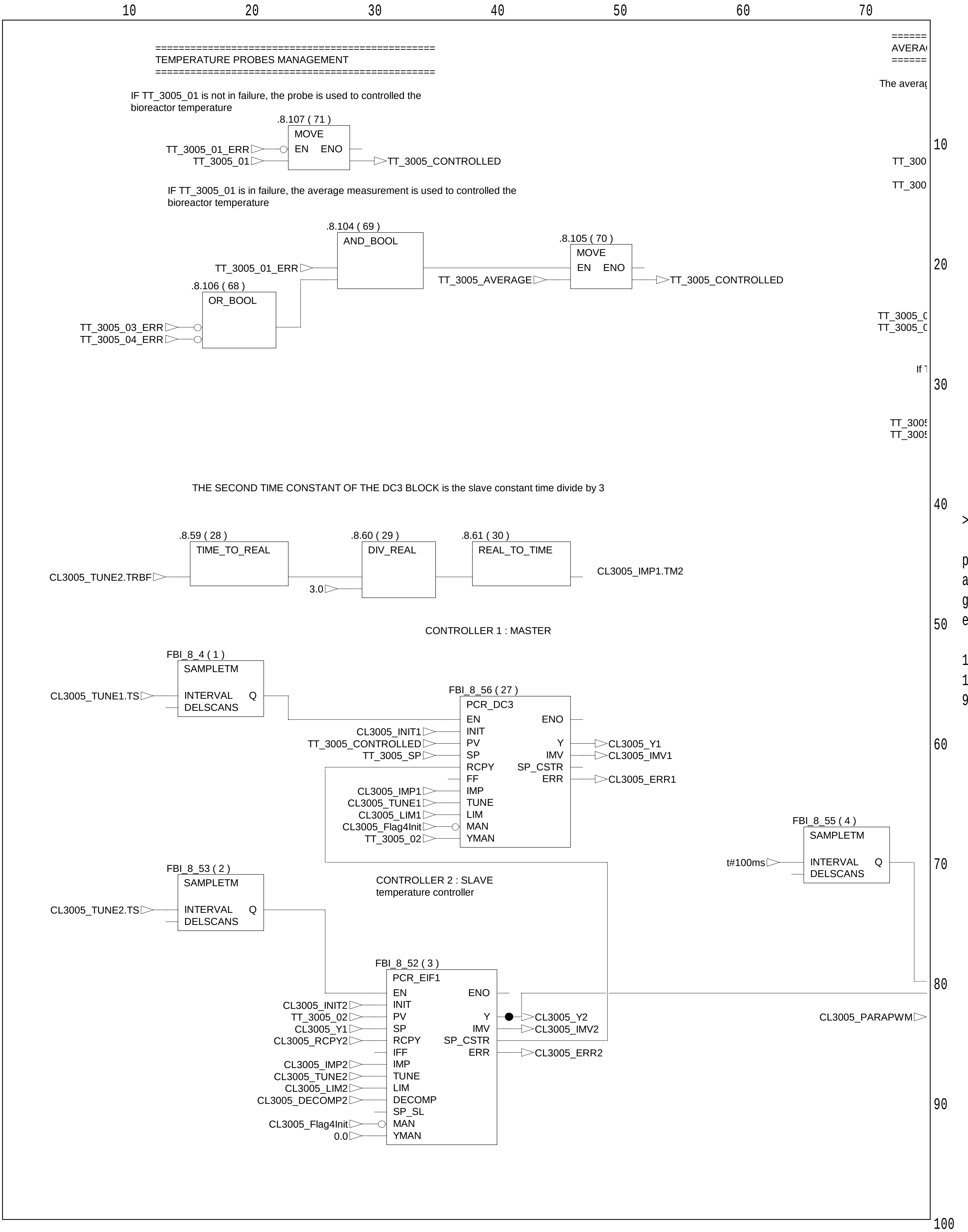
Graph of section CL3005_Bioreactor_Temp_Control



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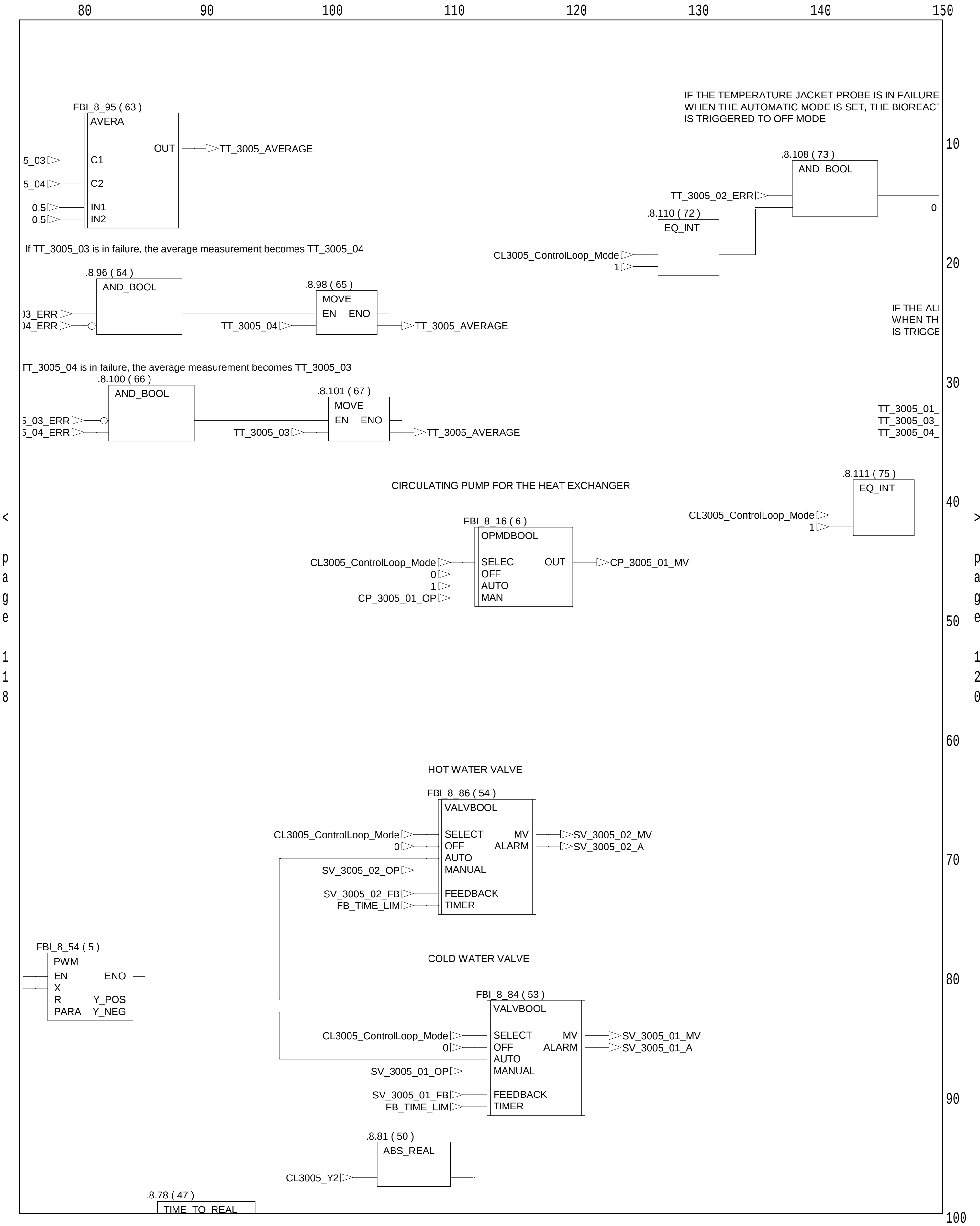
Graph of section CL3005_Bioreactor_Temp_Control



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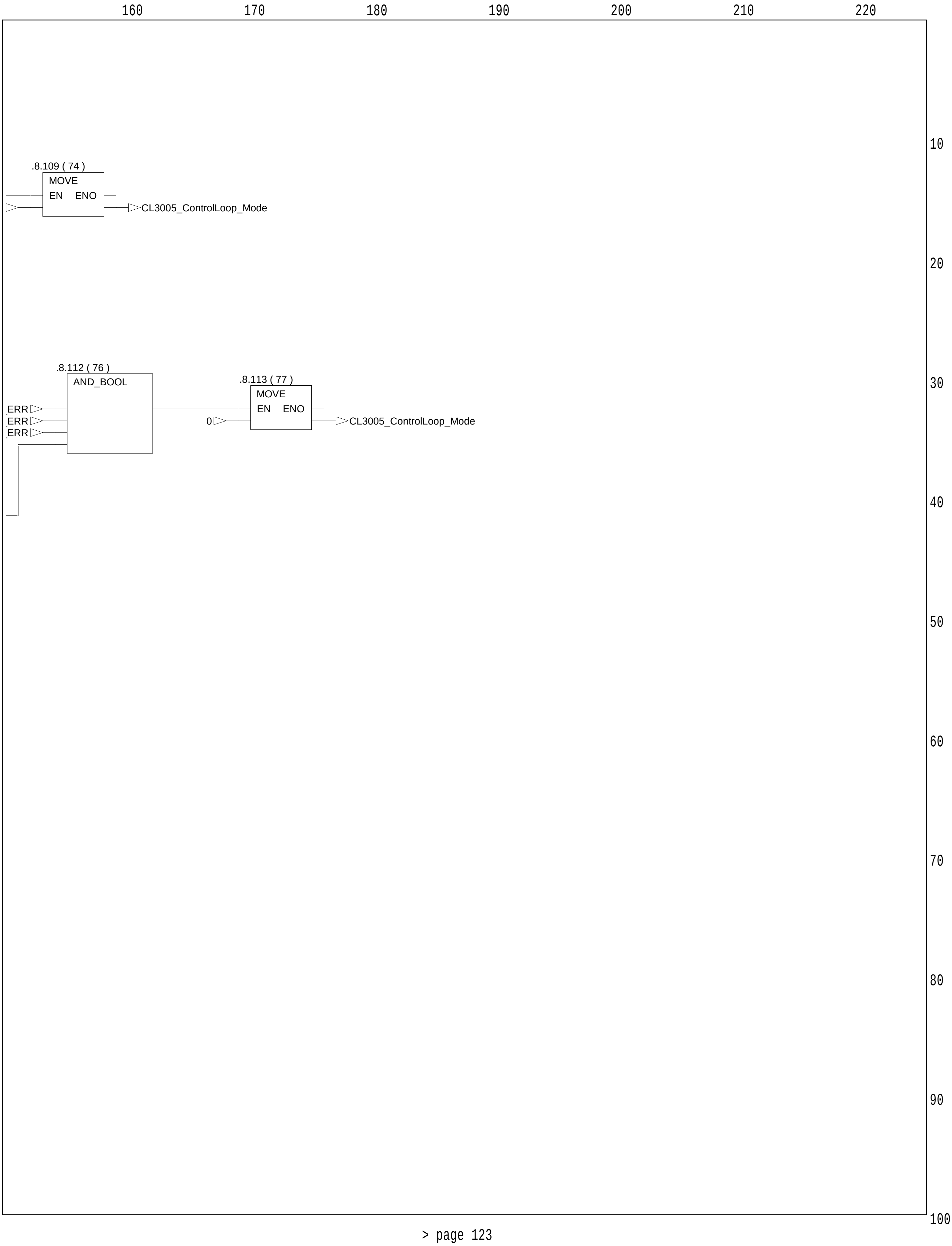
Graph of section CL3005_Bioreactor_Temp_Control



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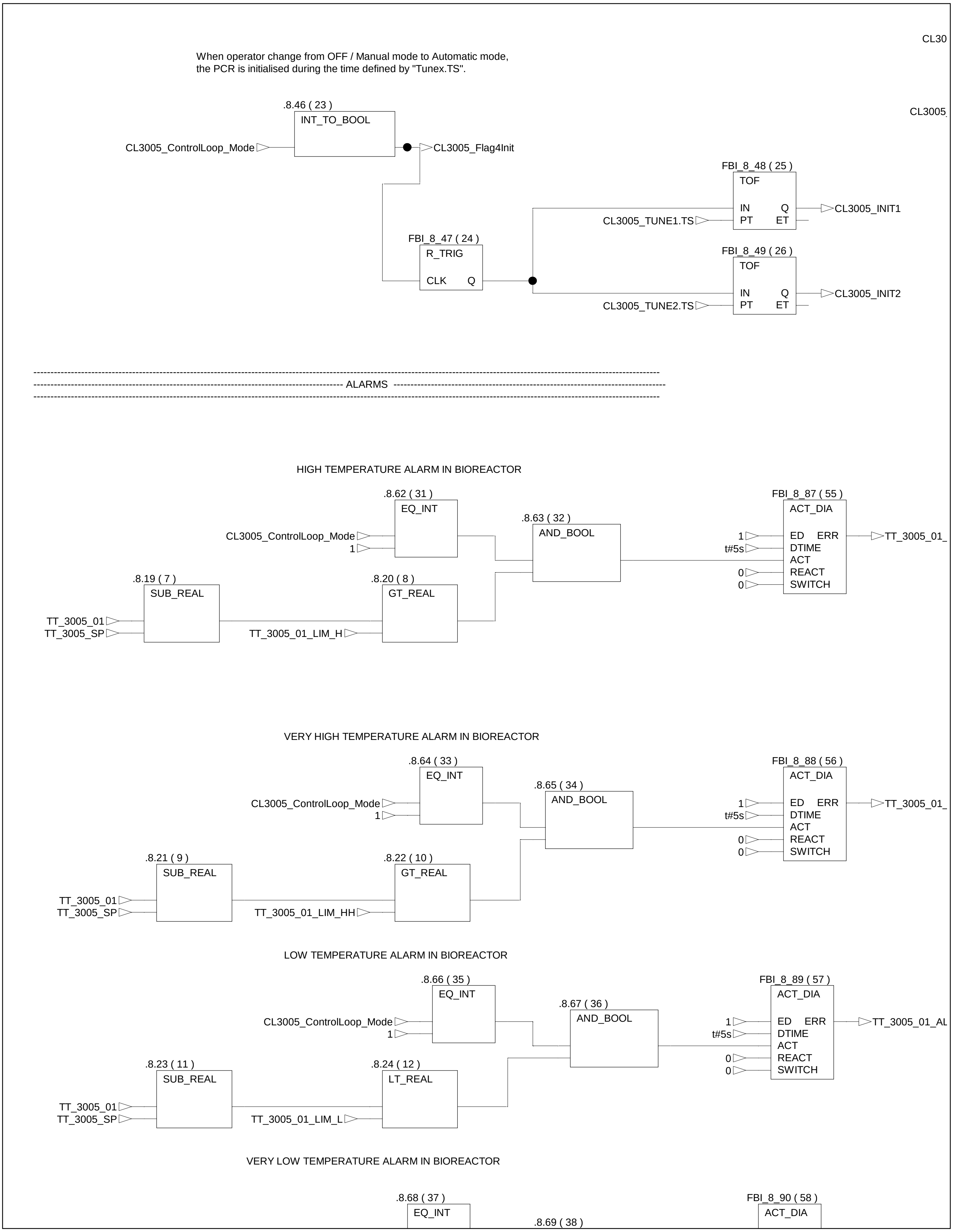
Graph of section CL3005_Bioreactor_Temp_Control

< page 118



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Graph of section CL3005_Bioreactor_Temp_Control

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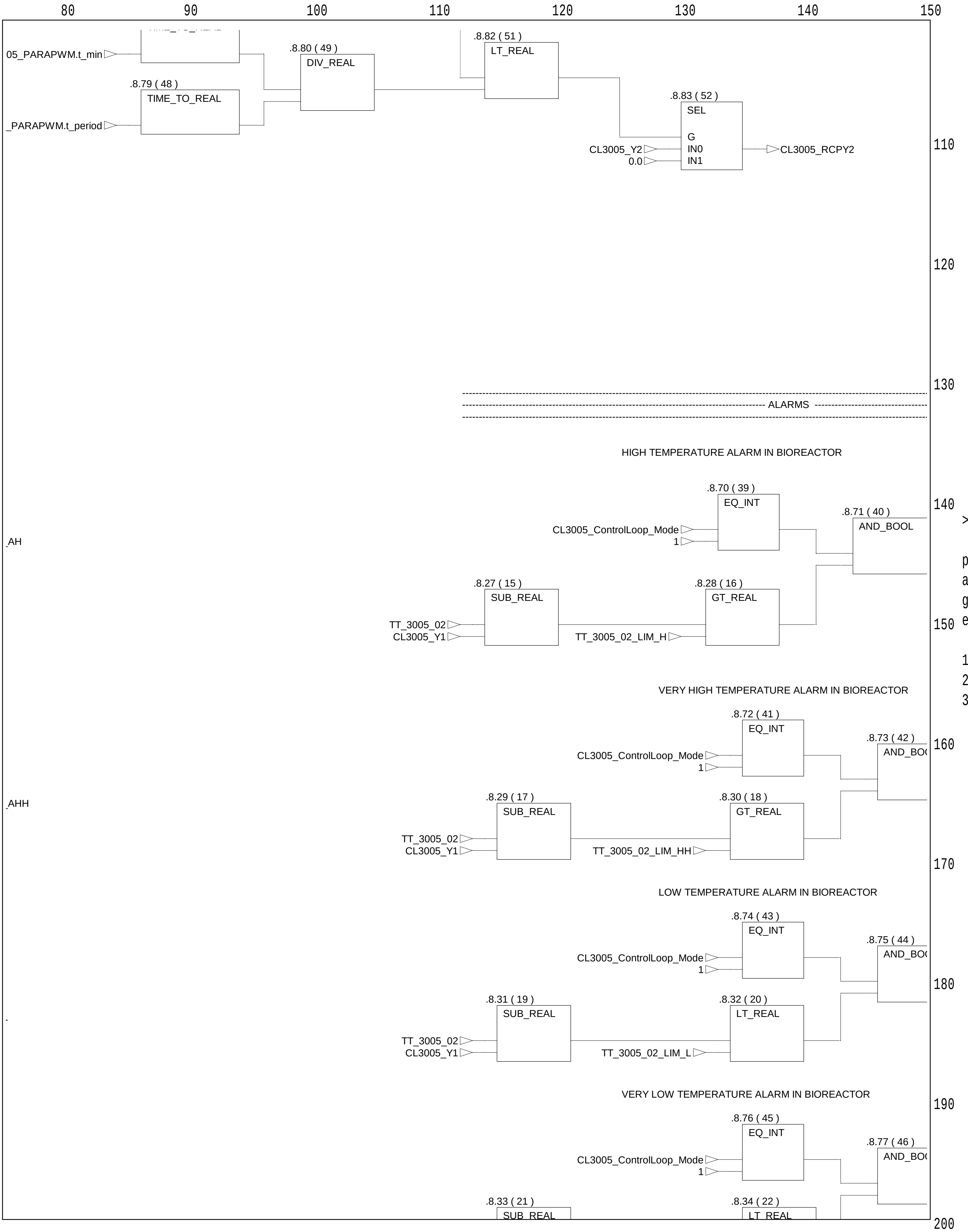

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Graph of section CL3005_Bioreactor_Temp_Control

< page 120

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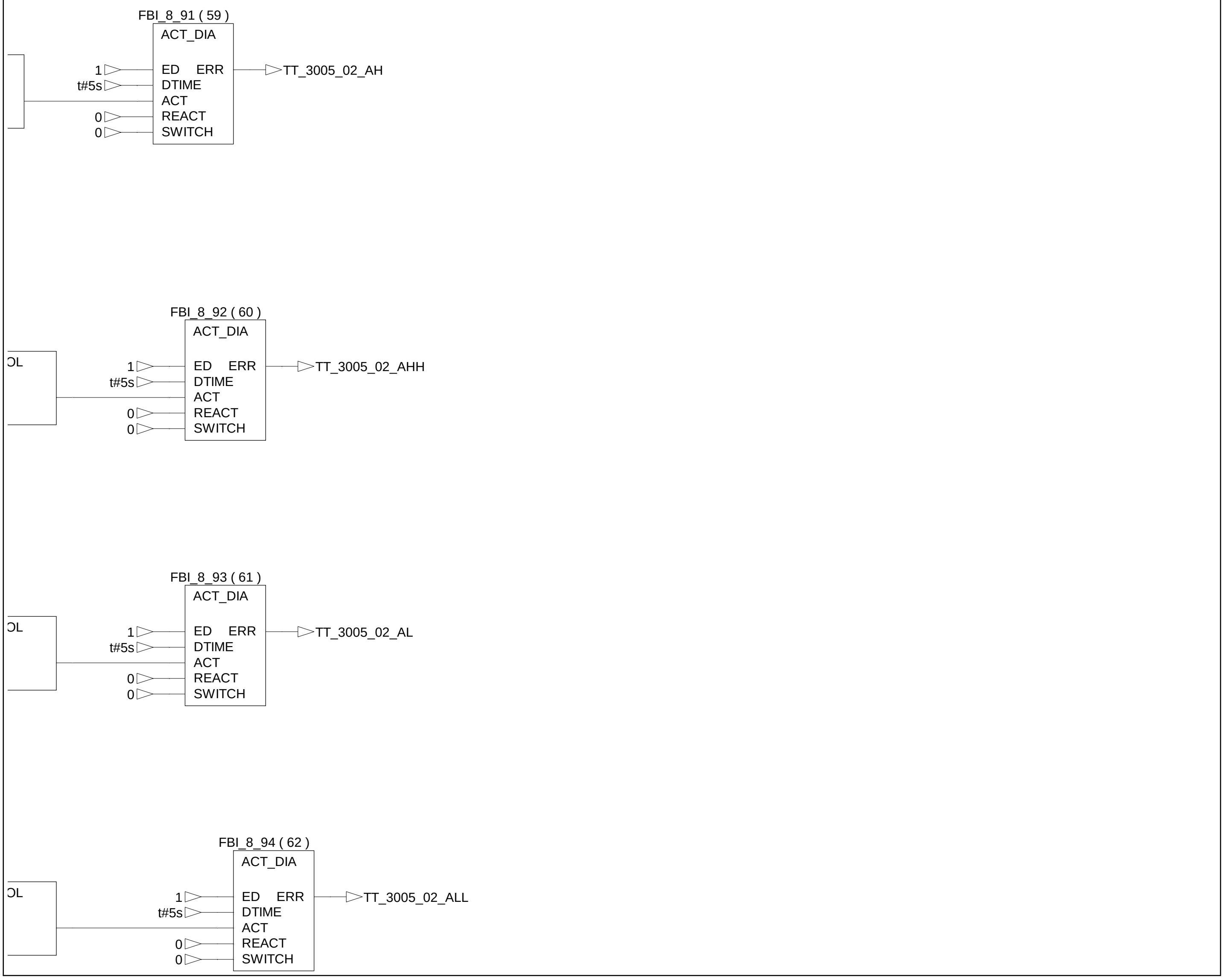

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> page 126

Graph of section CL3005_Bioreactor_Temp_Control < page 121

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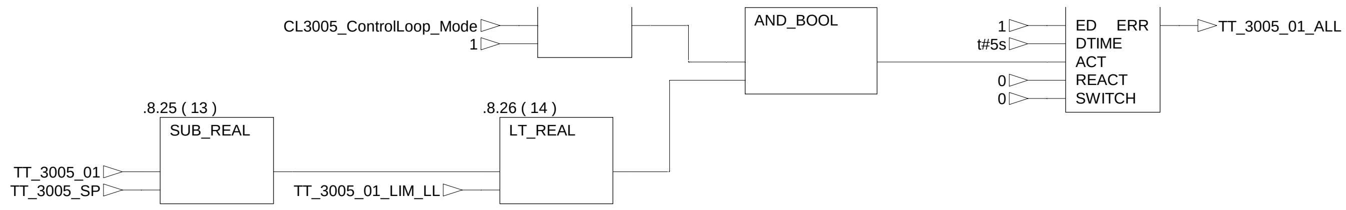

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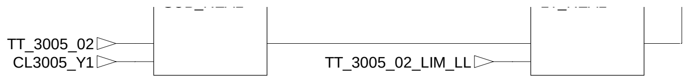
> page 125

Graph of section CL3005_Bioreactor_Temp_Control

< page 122

80 90 100 110 120 130 140 150



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220

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< page 124

> page 126

Graph of section CL3005_Bioreactor_Temp_Control

< page 123

160 170 180 190 200 210 220

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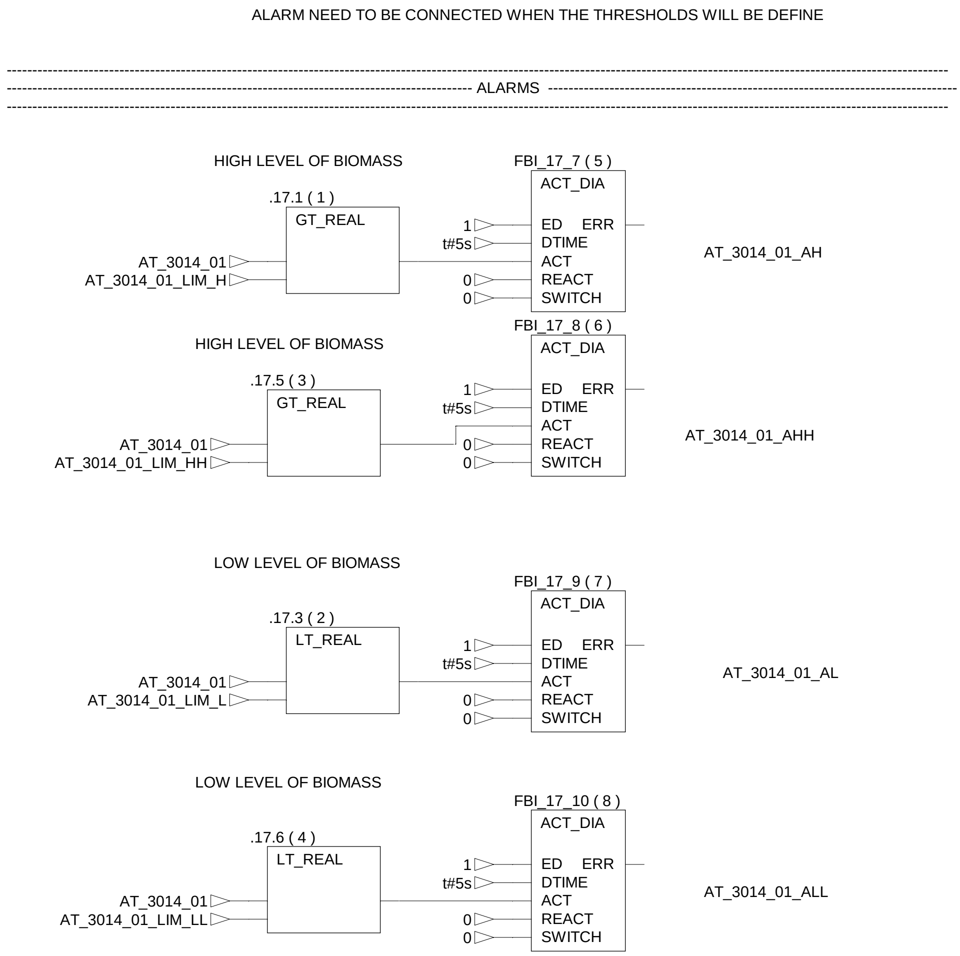
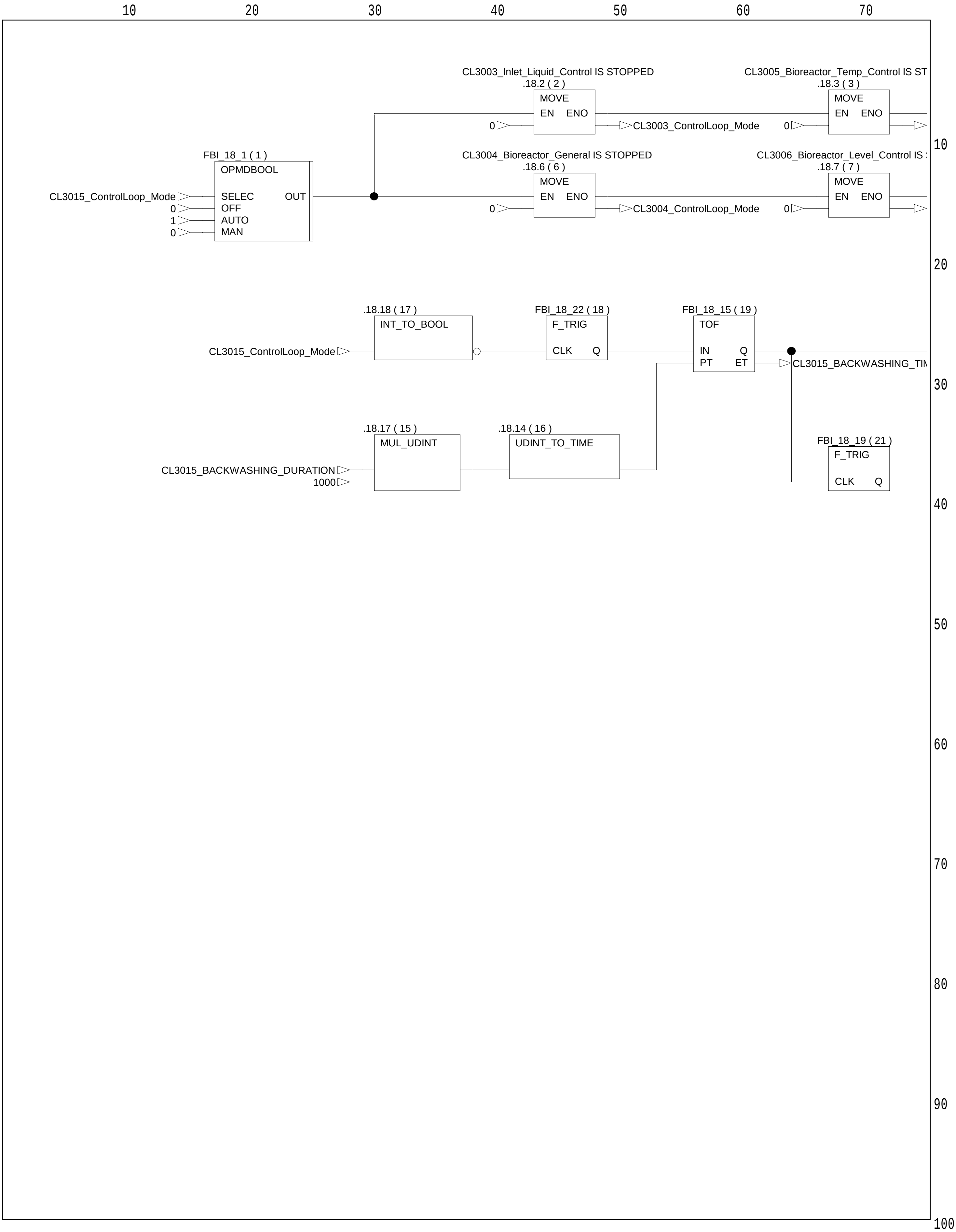
< page 125

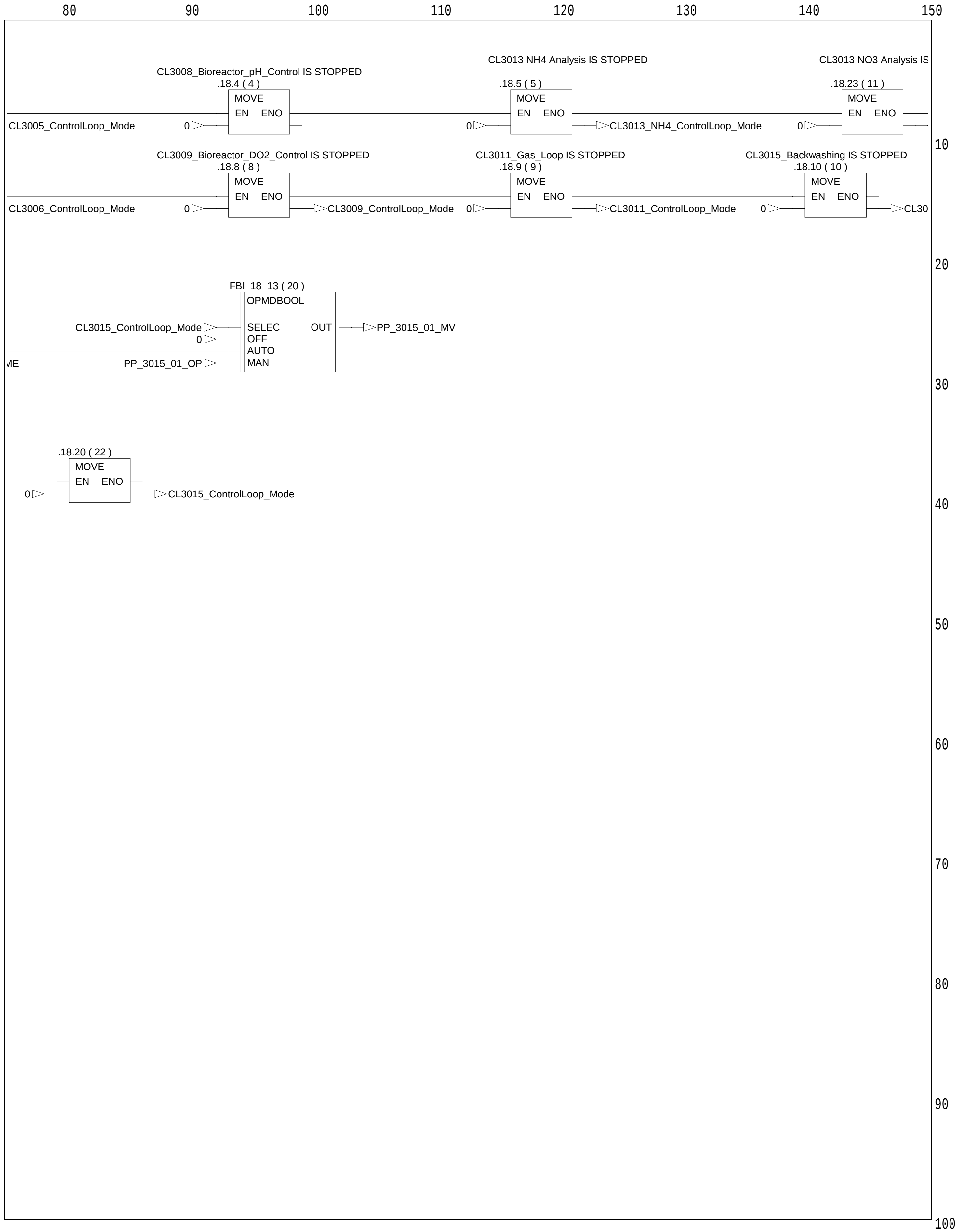
Graph of section CL3014_Biomass_Control



Graph of section CL3015_Backwashing



Graph of section CL3015_Backwashing



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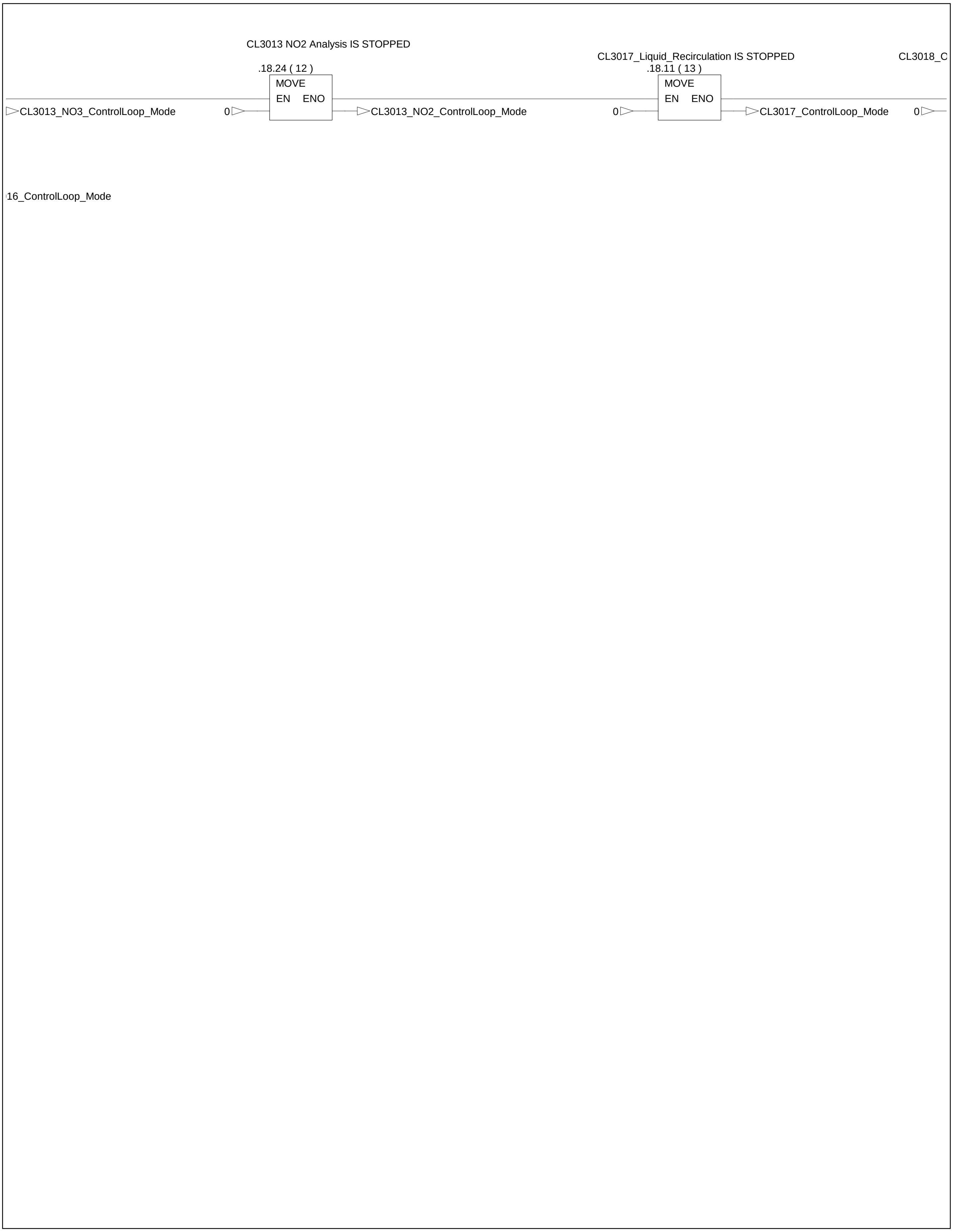
> page 130

Graph of section CL3015_Backwashing



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> page 131

Graph of section CL3015_Backwashing

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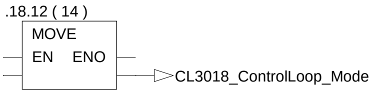

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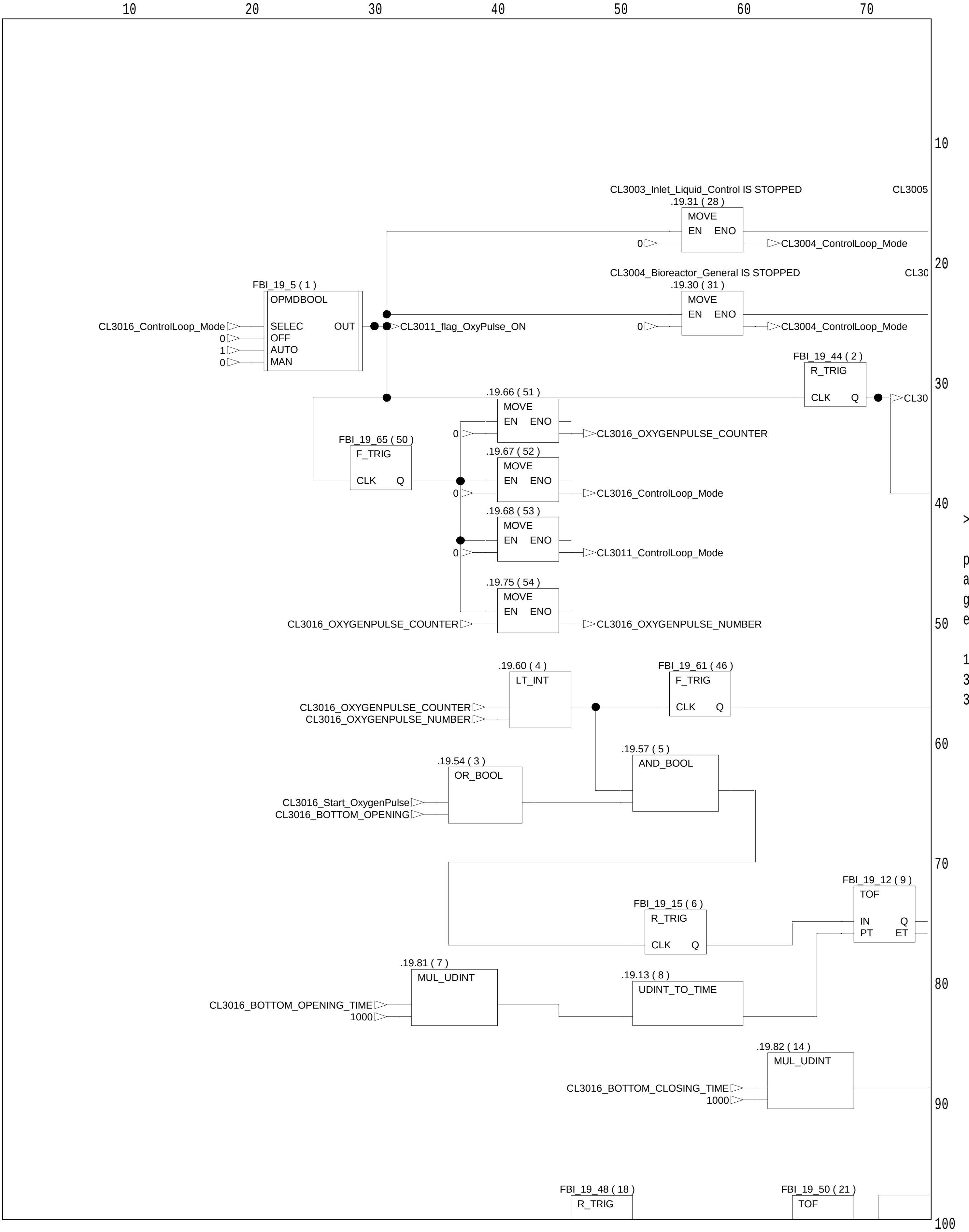
Graph of section CL3016_Gas_Pulse



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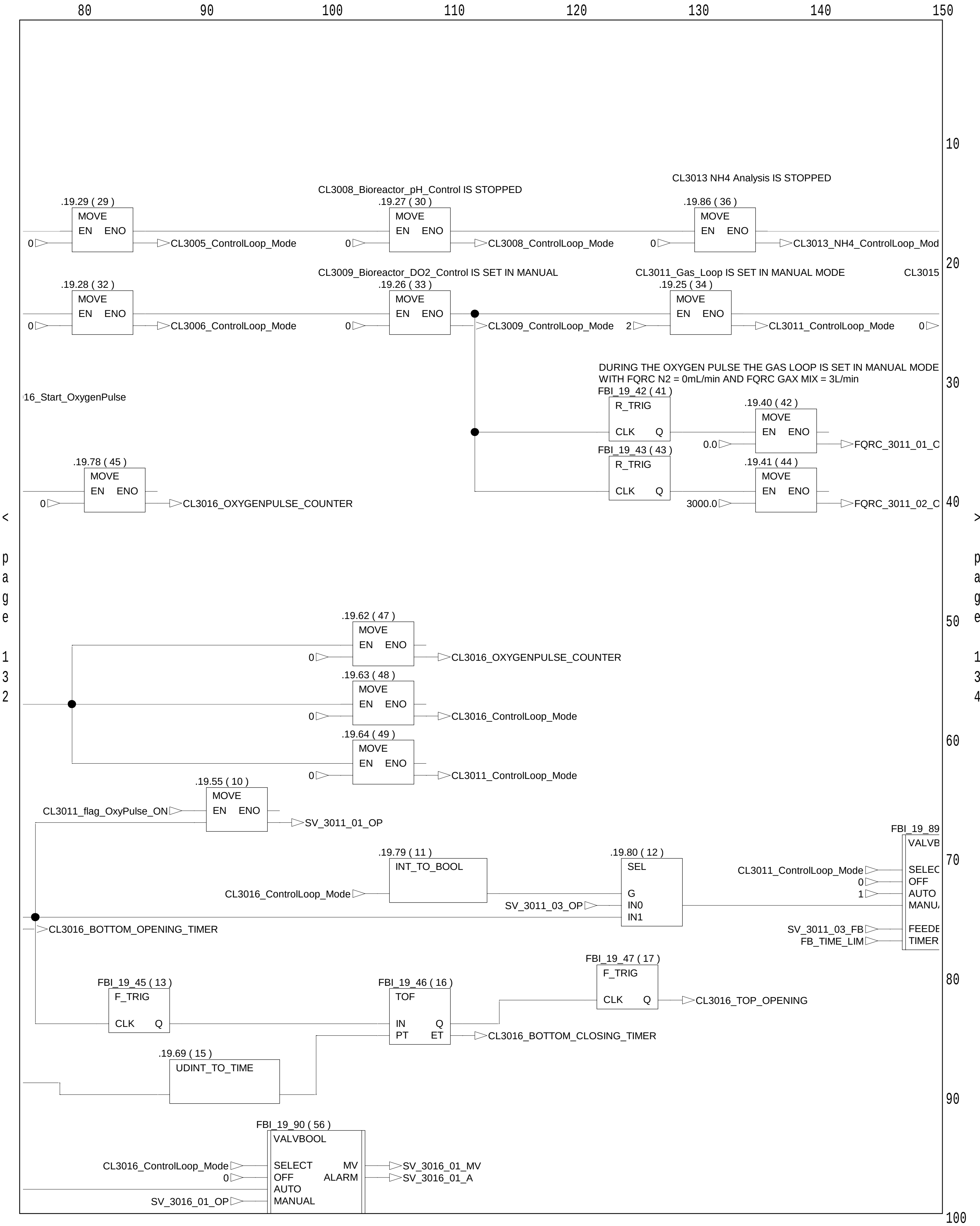
Graph of section CL3016_Gas_Pulse



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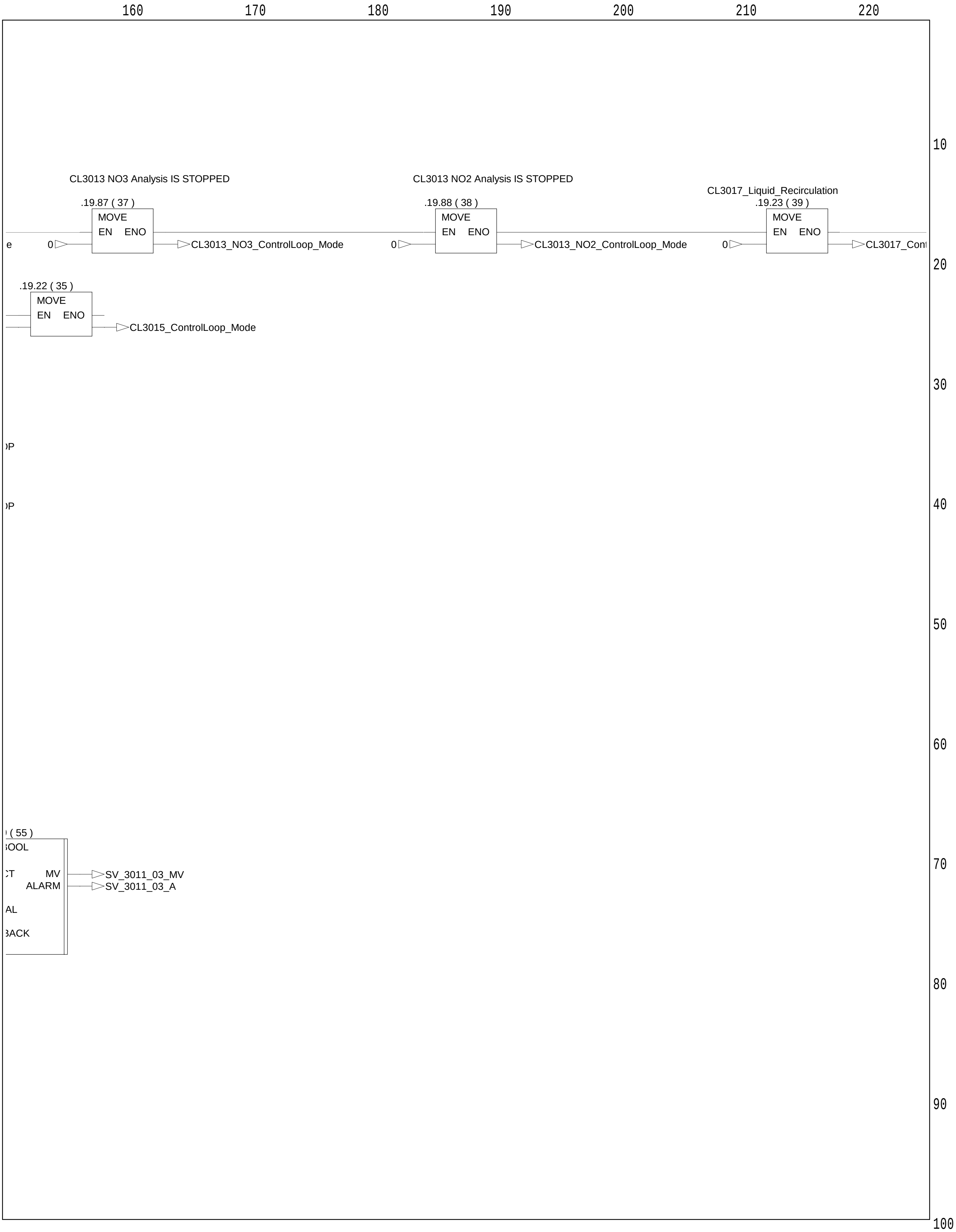
Graph of section CL3016_Gas_Pulse



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> page 138

Graph of section CL3016_Gas_Pulse

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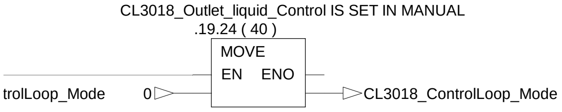

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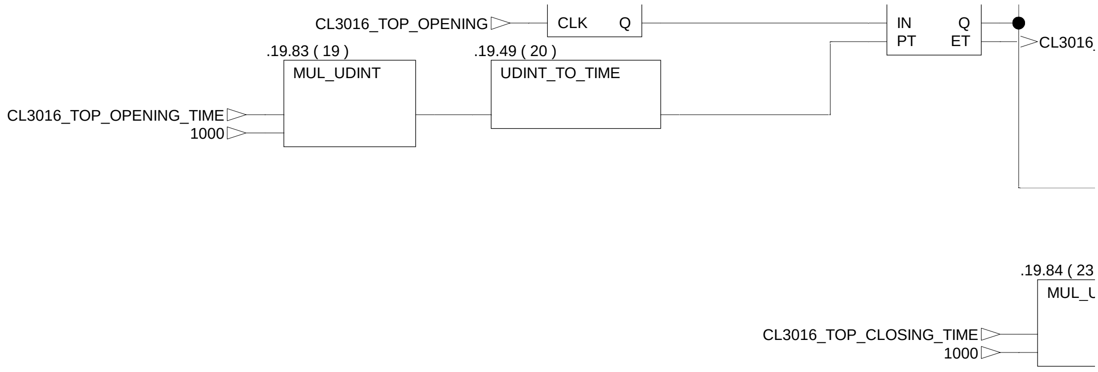
> page 139

Graph of section CL3016_Gas_Pulse

< page 132



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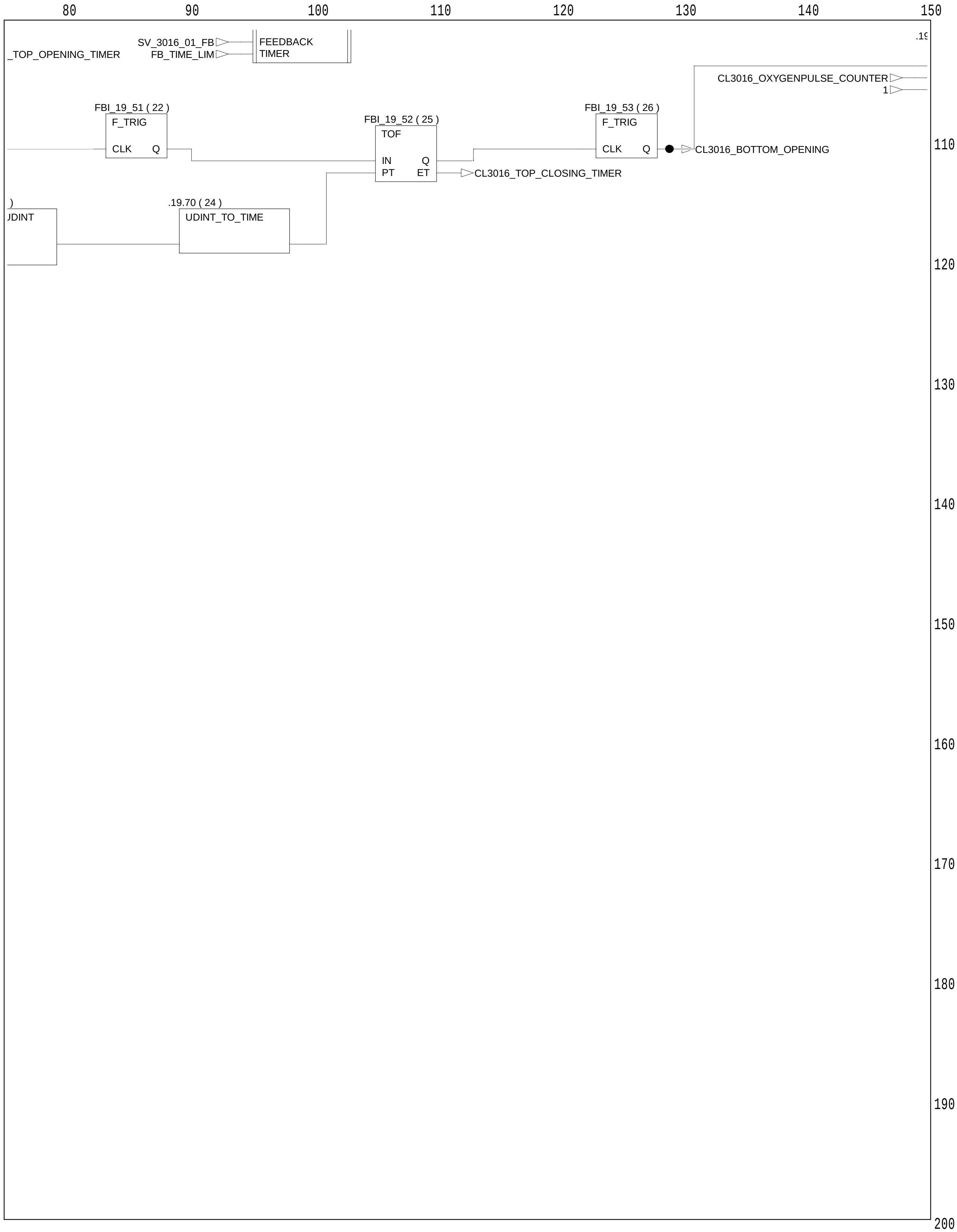
Graph of section CL3016_Gas_Pulse

< page 133



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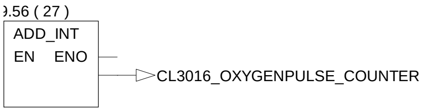
> page 138

Graph of section CL3016_Gas_Pulse

< page 134



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> page 139

Graph of section CL3016_Gas_Pulse

< page 135

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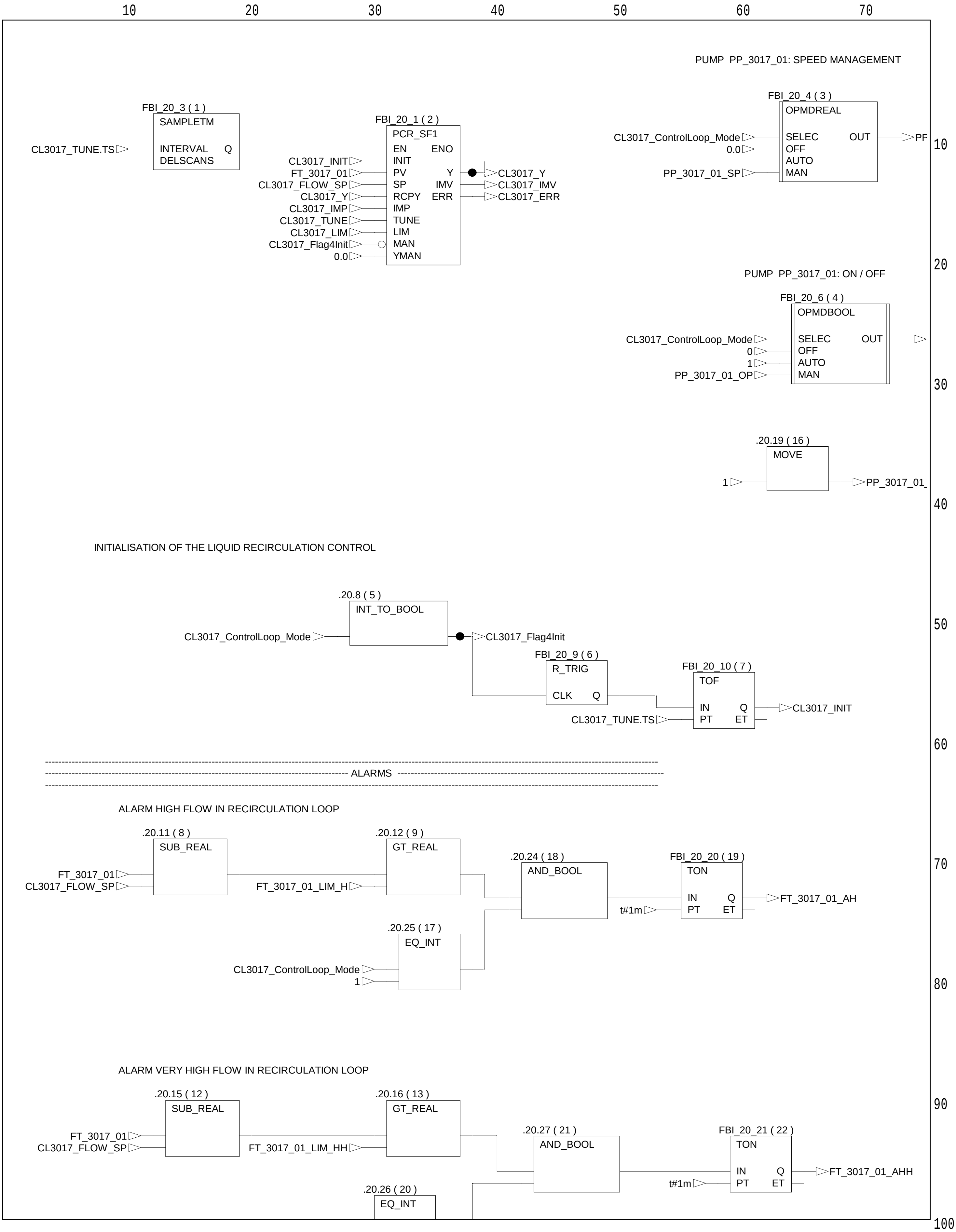
< page 138

Graph of section CL3017_Liquid_Recirculation



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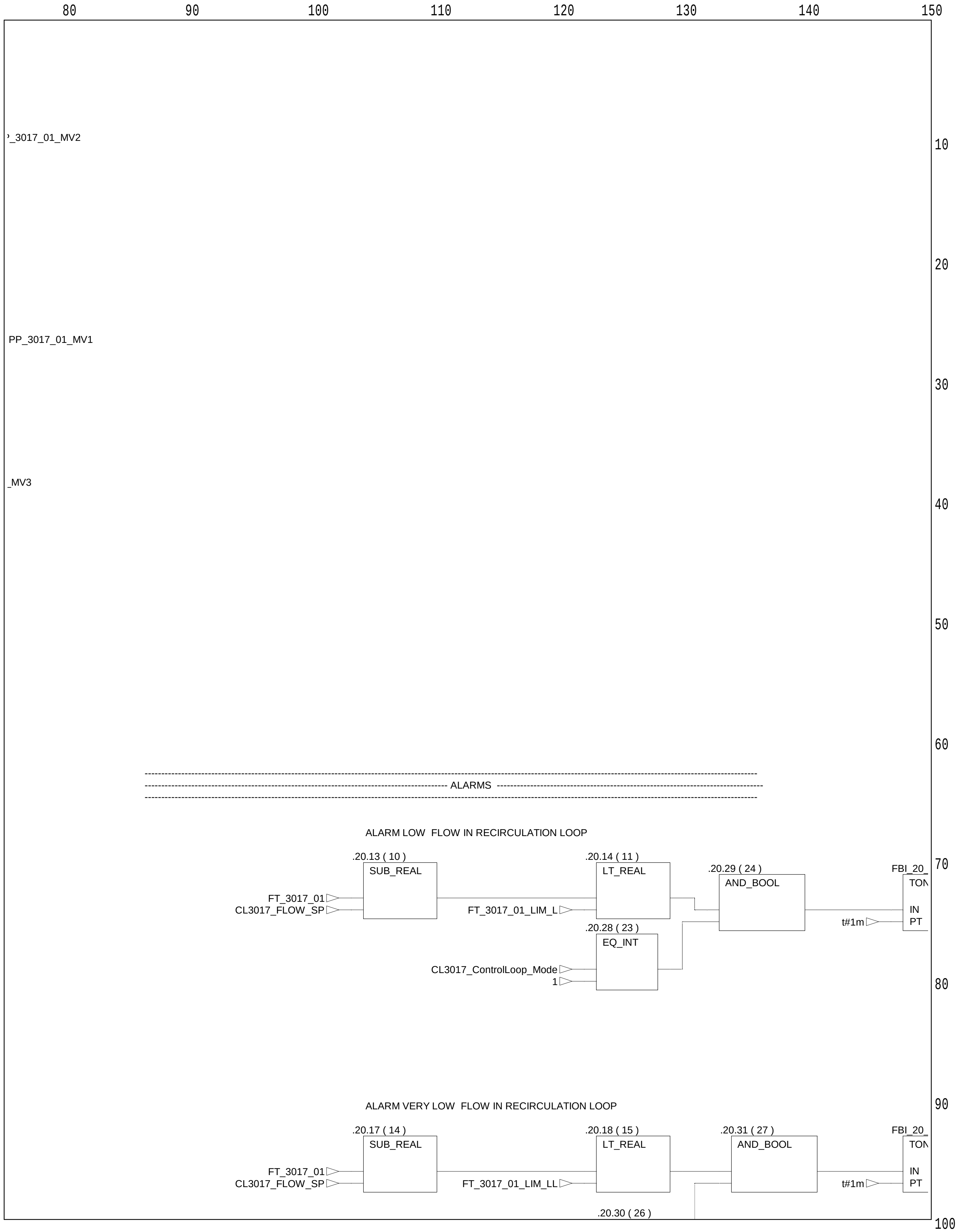
Graph of section CL3017_Liquid_Recirculation



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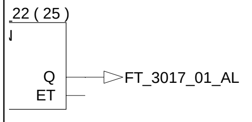
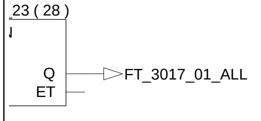
> page 144

Graph of section CL3017_Liquid_Recirculation

< page 141





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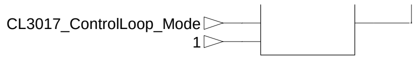
Graph of section CL3017_Liquid_Recirculation

< page 140



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Graph of section CL3017_Liquid_Recirculation

< page 141

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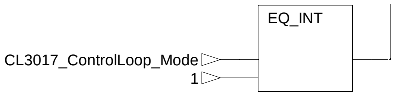

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< page 143

> page 145

Graph of section CL3017_Liquid_Recirculation

< page 142

160 170 180 190 200 210 220

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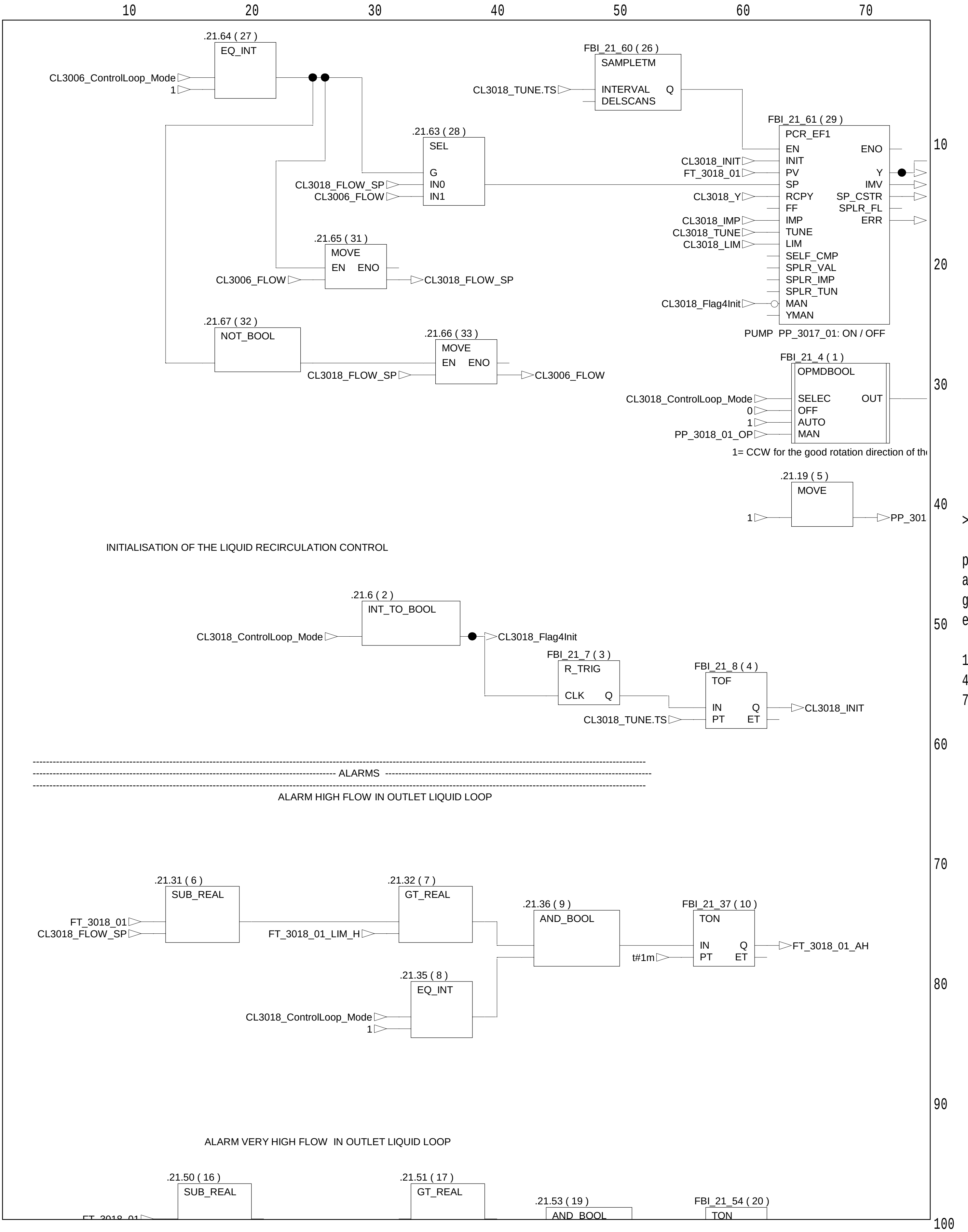
< page 144

Graph of section CL3018_Outlet_liquid_Control



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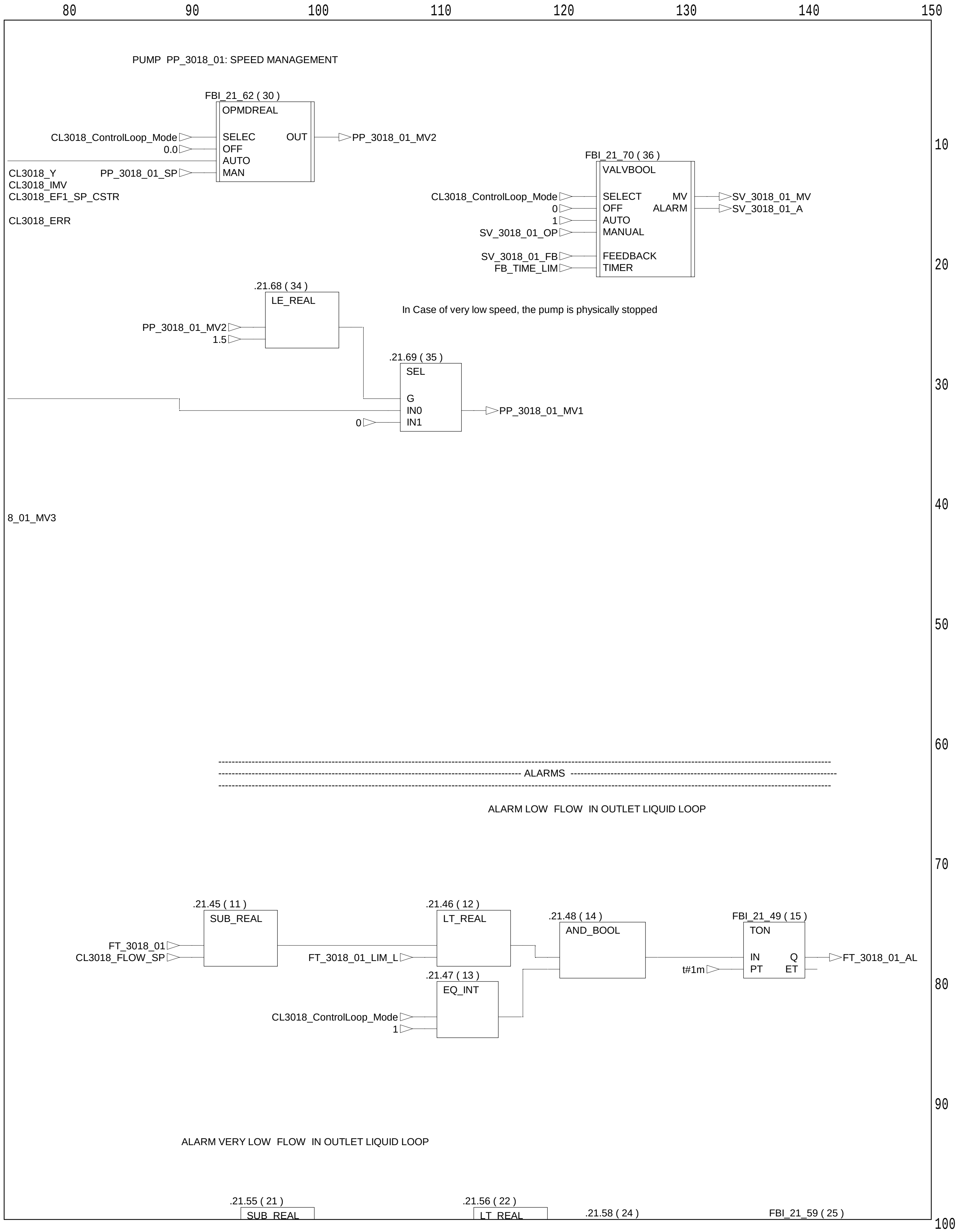
Graph of section CL3018_Outlet_liquid_Control

< page 146



> page 148

> page 151

Graph of section CL3018_Outlet_liquid_Control

160 170 180 190 200 210 220

10 20 30 40 50 60 70 80 90 100

< page 147

> page 149

> page 152

Graph of section CL3018_Outlet_liquid_Control

230 240 250 260 270 280 290 300

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< page 148

> page 153

Graph of section CL3018_Outlet_liquid_Control

< page 146

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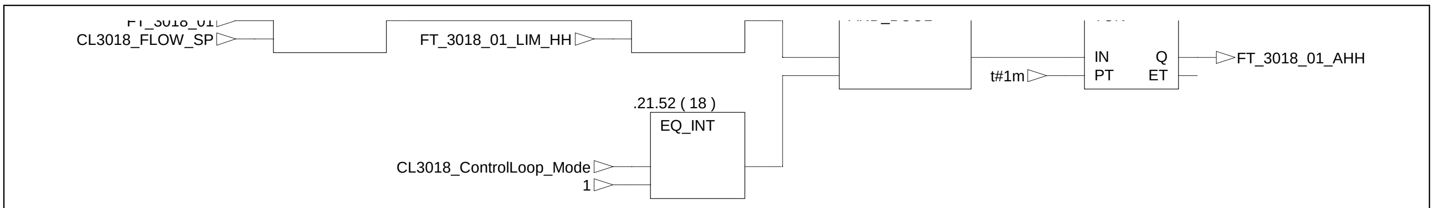

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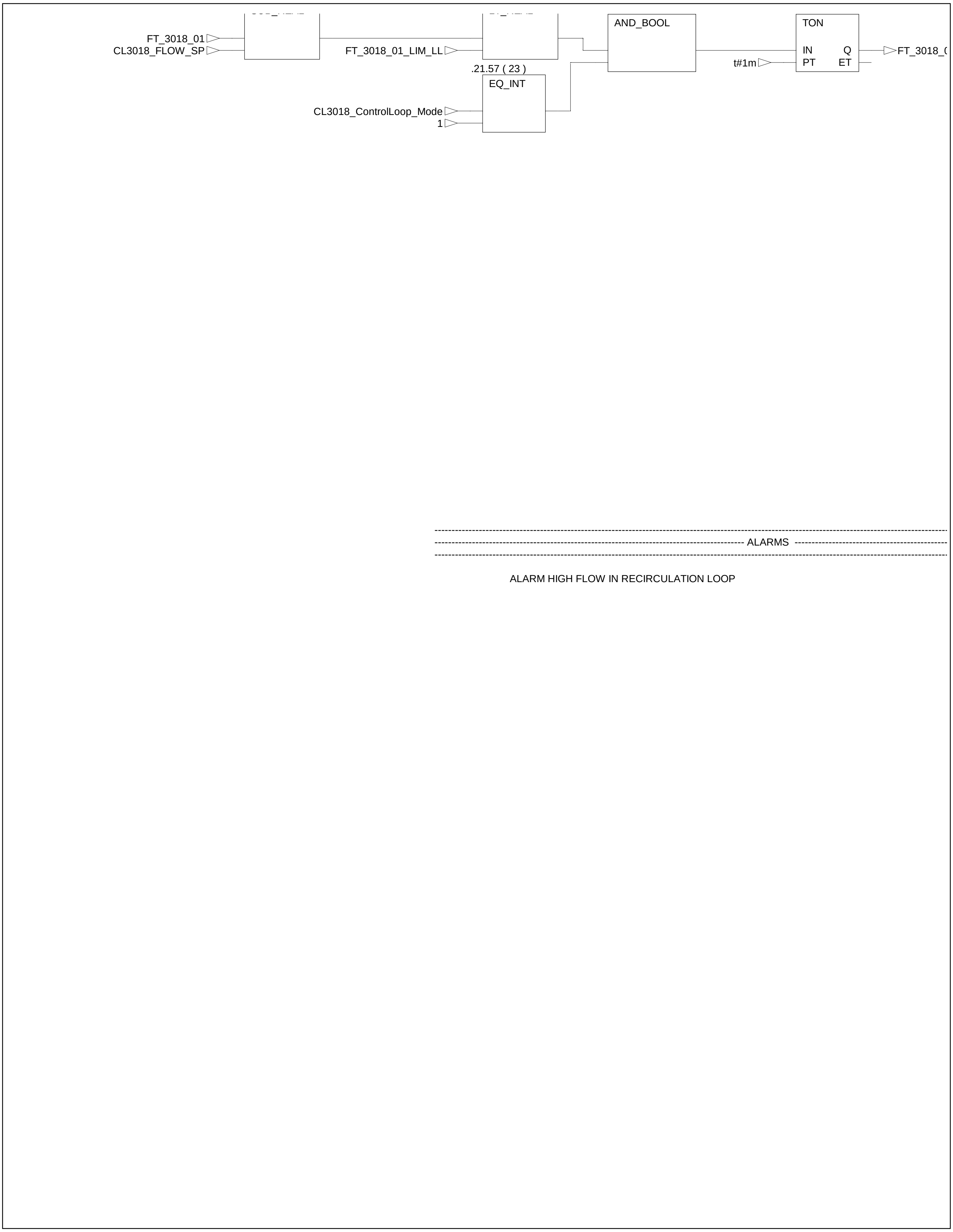
> page 151

Graph of section CL3018_Outlet_liquid_Control

< page 147



< page 150

> page 152

Graph of section CL3018_Outlet_liquid_Control < page 148

160 170 180 190 200 210 220

)1_ALL

110

120

130

140

< page 151

--- ALARMS ----------------

ALARM LOW FLOW IN RECIRCULATIC

150

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160

170

180

190

200

Graph of section CL3018_Outlet_liquid_Control

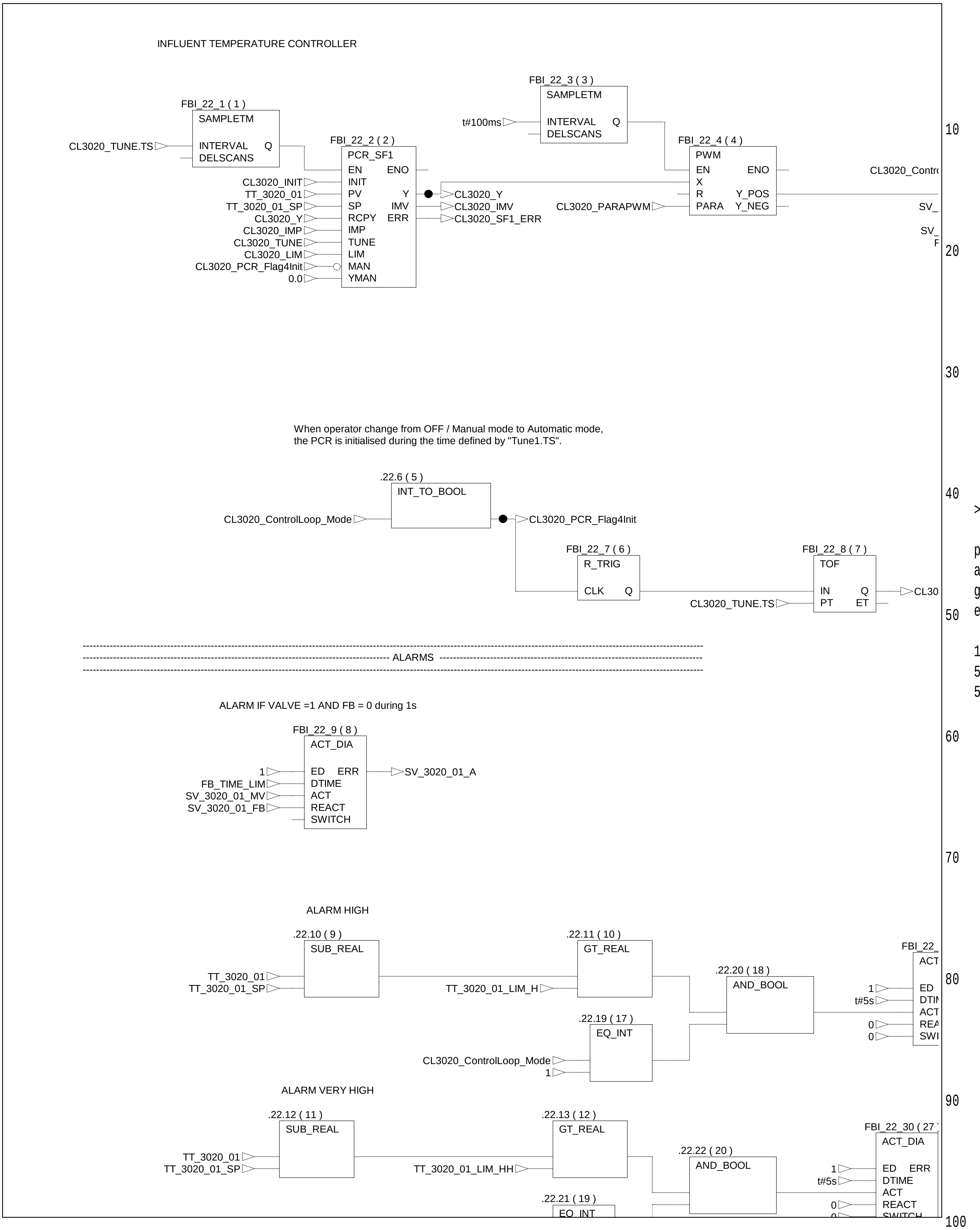
< page 149

230 240 250 260 270 280 290 300

110 120 130 140 150 160 170 180 190 200

< page 152

Graph of section CL3020_Effluent_Temperature



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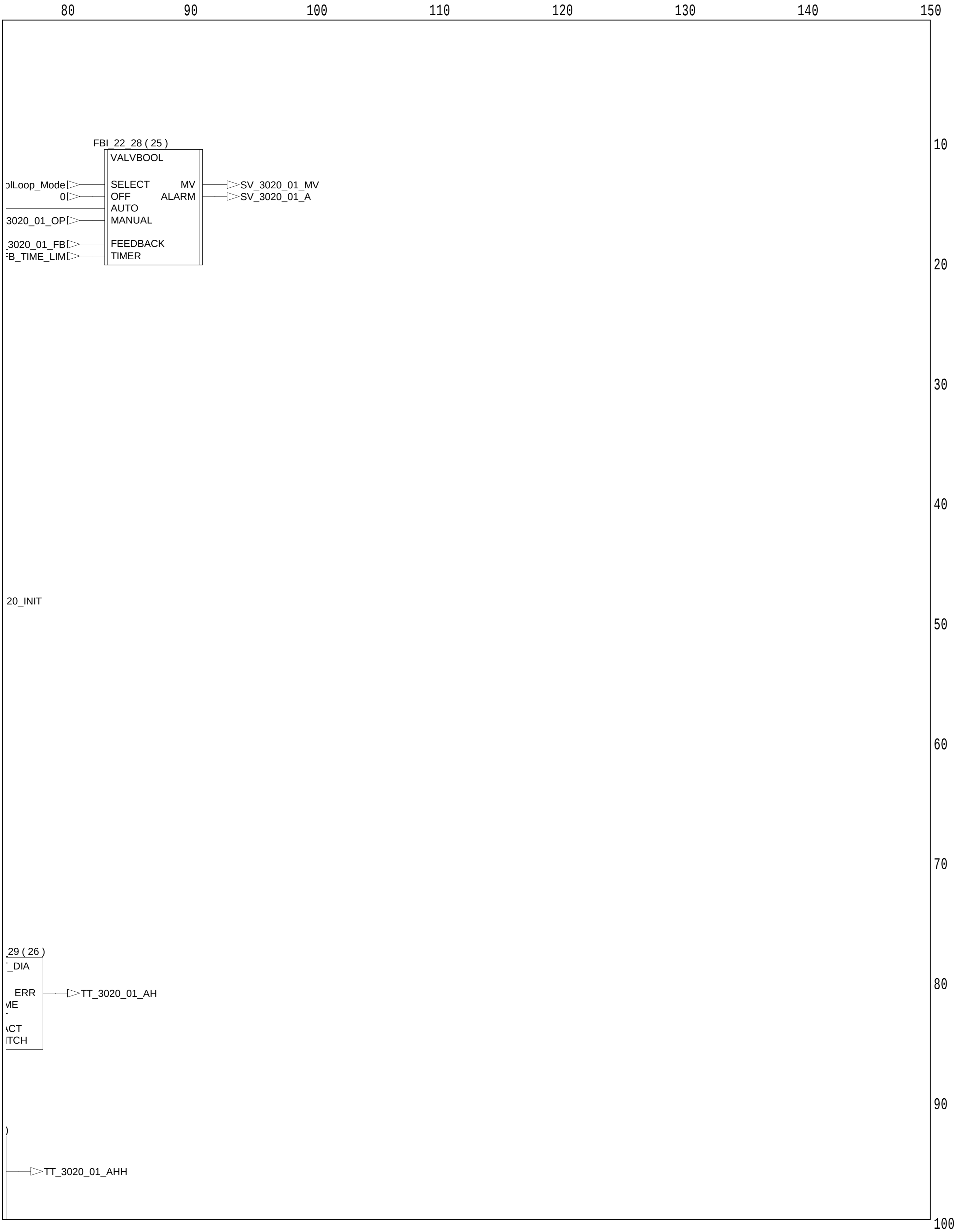
Graph of section CL3020_Effluent_Temperature



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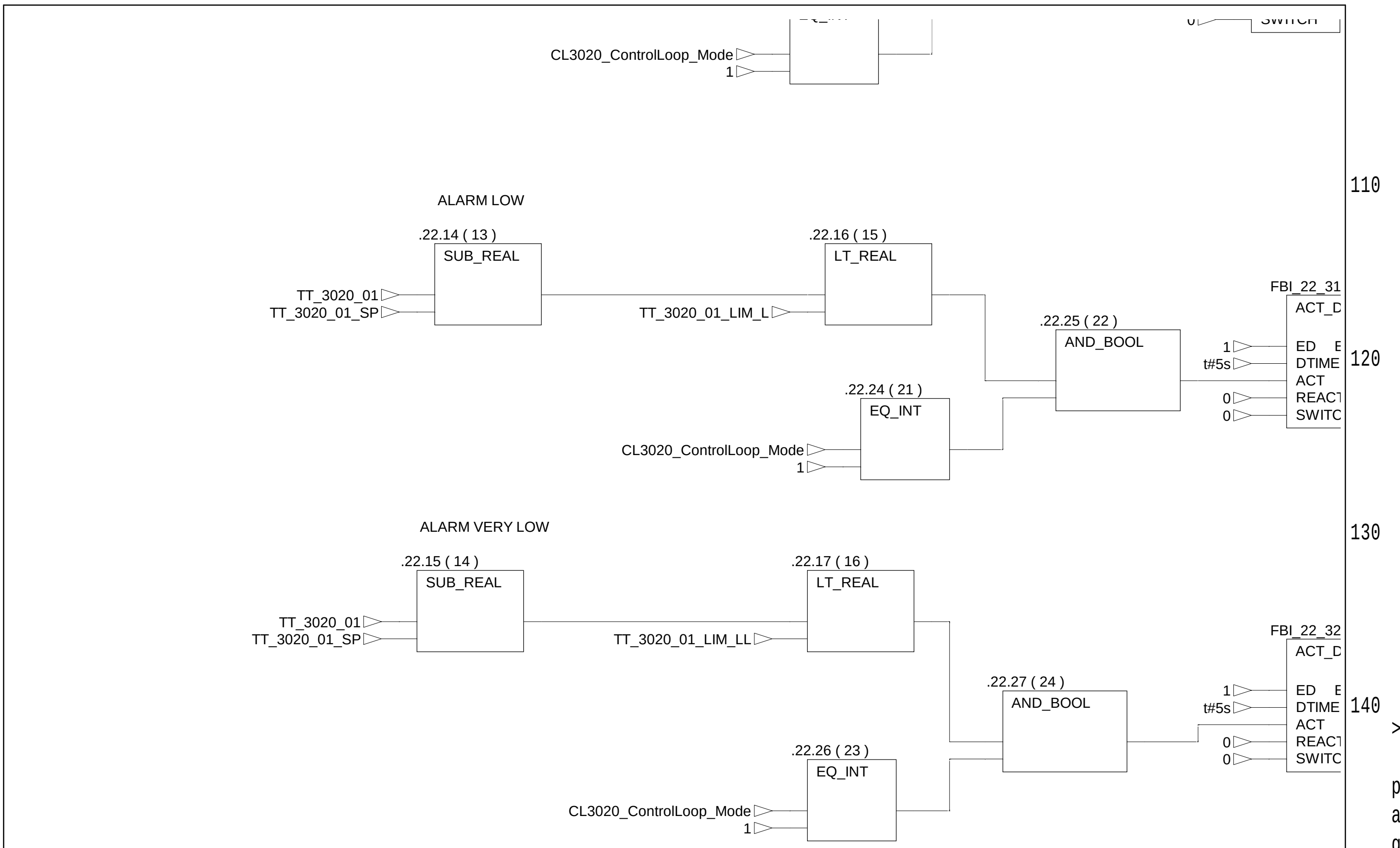
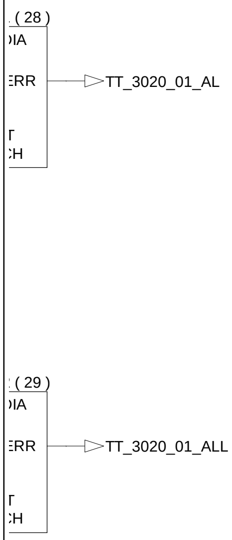
> page 157

Graph of section CL3020_Effluent_Temperature < page 154



Graph of section CL3020_Effluent_Temperature

< page 155



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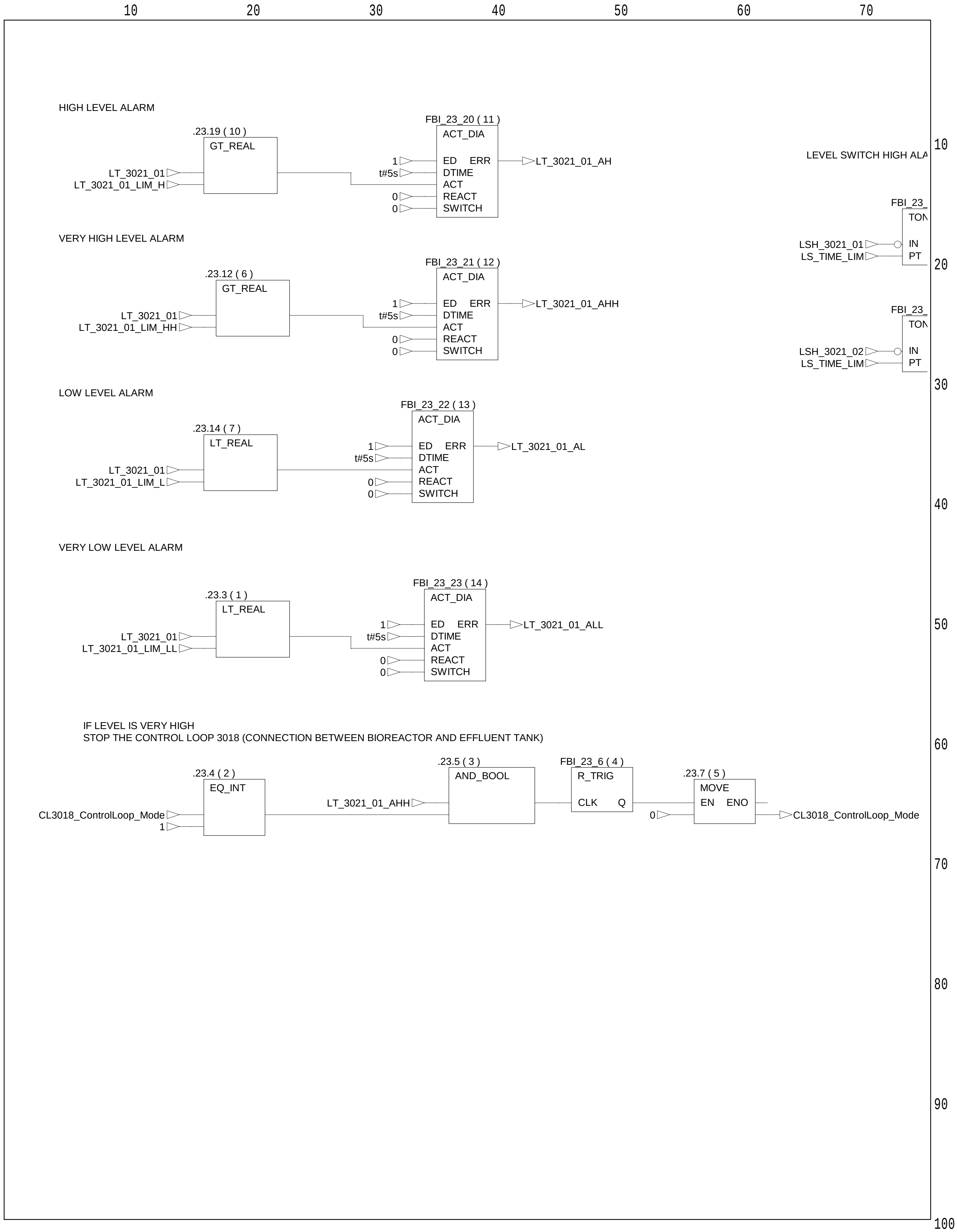
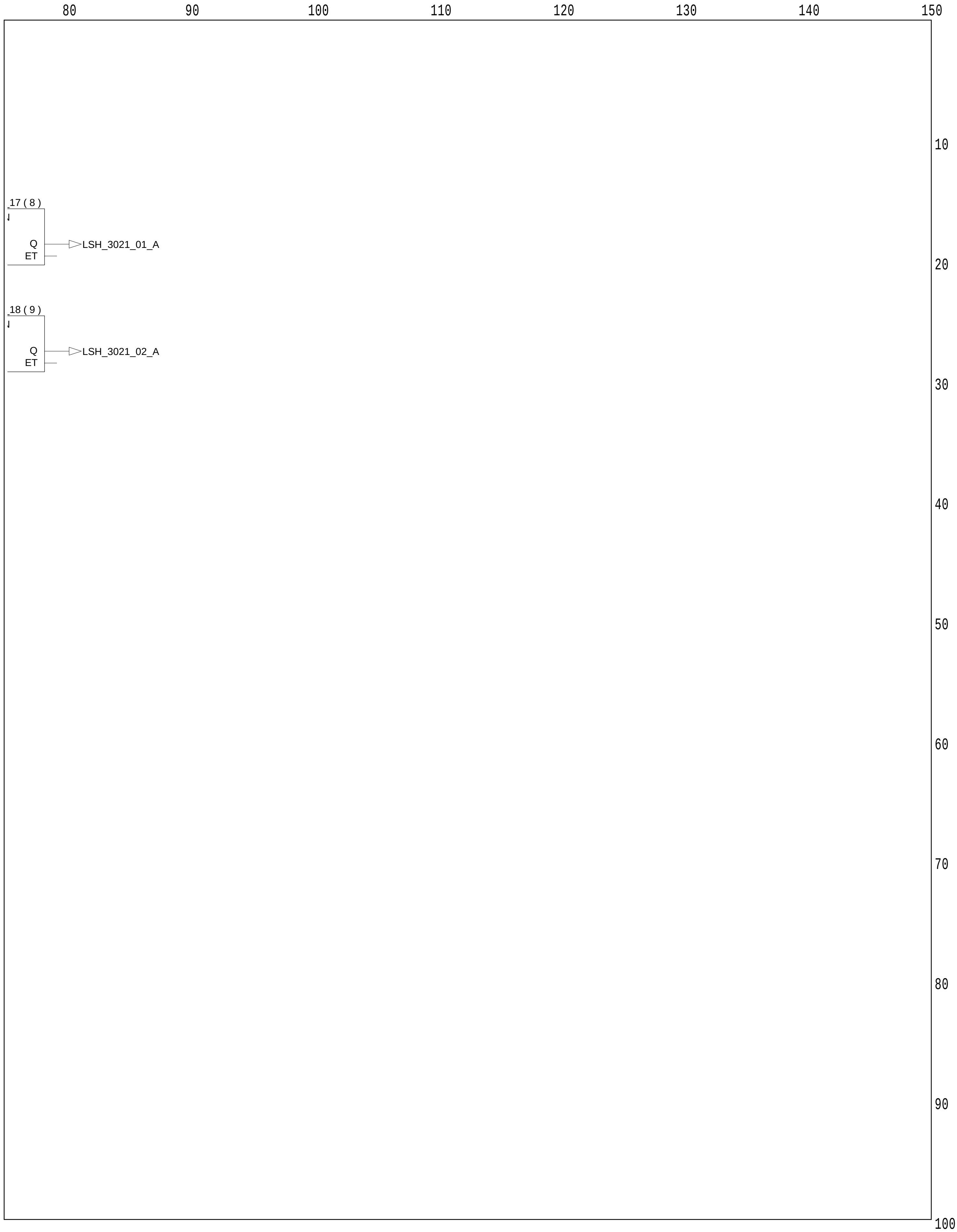
Graph of section CL3021_Effluent_Level



Graph of section CL3021_Effluent_Level



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Graph of section CL3022_Foam_Control

10 20 30 40 50 60 70

10
20
30
40
50
60
70
80
90
100

D F B   u s a g e

Name	Version	Used in section	Instance	at
VALVBOOL	20/07/2010 10:59:55	CL3001_Influent_Temp_Control	FBI_5_28	76,9
		CL3005_Bioreactor_Temp_Control	FBI_8_84	113,82
		CL3005_Bioreactor_Temp_Control	FBI_8_86	109,65
		CL3008_Bioreactor_pH_Control	FBI_11_292	172,96
		CL3008_Bioreactor_pH_Control	FBI_11_293	177,60
		CL3011_Gas_Loop	FBI_14_127	100,95
		CL3011_Gas_Loop	FBI_14_128	101,106
		CL3013_NH4_Management	FBI_60_55	208,23
		CL3013_NO3_Management	FBI_61_22	157,14
		CL3013_NO2_Management	FBI_62_19	153,9
		CL3016_Gas_Pulse	FBI_19_89	147,68
		CL3016_Gas_Pulse	FBI_19_90	95,93
		CL3018_Outlet_liquid_Control	FBI_21_70	123,11
		CL3020_Effluent_Temperature	FBI_22_28	83,10
OPMDREAL	26/09/2003 10:46:37	CL3003_Inlet_Liquid_Control	FBI_7_3	90,14
		CL3004_Bioreactor_General	FBI_25_4	26,17
		CL3006_Bioreactor_Level_Control	FBI_9_1	125,12
		CL3008_Bioreactor_pH_Control	FBI_11_57	162,142
		CL3008_Bioreactor_pH_Control	FBI_11_137	74,5
		CL3009_Bioreactor_DO2_Control	FBI_12_19	72,32
		CL3009_Bioreactor_DO2_Control	FBI_12_38	76,2
		CL3011_Gas_Loop	FBI_14_51	87,17
		CL3011_Gas_Loop	FBI_14_52	85,4
		CL3017_Liquid_Recirculation	FBI_20_4	63,6
		CL3018_Outlet_liquid_Control	FBI_21_62	92,6
OPMDBOOL	26/09/2003 10:06:11	CL3003_Inlet_Liquid_Control	FBI_7_5	90,4
		CL3004_Bioreactor_General	FBI_25_3	26,5
		CL3005_Bioreactor_Temp_Control	FBI_8_16	112,42
		CL3008_Bioreactor_pH_Control	FBI_11_60	170,110
		CL3008_Bioreactor_pH_Control	FBI_11_61	167,75
		CL3011_Gas_Loop	FBI_14_53	16,4
		CL3015_Backwashing	FBI_18_1	17,11
		CL3015_Backwashing	FBI_18_13	94,22
		CL3016_Gas_Pulse	FBI_19_5	21,22
		CL3017_Liquid_Recirculation	FBI_20_6	64,23
		CL3018_Outlet_liquid_Control	FBI_21_4	64,28
AVERA	23/09/2003 15:58:06	CL3008_Bioreactor_pH_Control	FBI_11_136	31,2
		CL3009_Bioreactor_DO2_Control	FBI_12_37	44,7
		CL3005_Bioreactor_Temp_Control	FBI_8_95	80,7

E F B   u s a g e

Name	Version	Kind	EFB Library	Used in section	Instance	at
SYSSTATE	24/03/1997 14:20:55	FB	SYSTEM	SYSTEM_STATE	FBI_28_1	4,7
OR_BOOL	24/03/1997 14:20:55	FUNCT	IEC	SYSTEM_STATE	.28.2	14,7
				ALARM_STATUS	.31.1	27,10
				ALARM_STATUS	.31.2	56,10
				ALARM_STATUS	.31.3	80,12
				ALARM_STATUS	.31.4	101,15
				ALARM_STATUS	.31.5	23,66
				ALARM_STATUS	.31.6	47,67
				ALARM_STATUS	.31.7	70,66
				CL3004_Bioreactor_General	.25.31	115,46
				CL3008_Bioreactor_pH_Control	.11.19	160,5
				CL3008_Bioreactor_pH_Control	.11.20	160,17
				CL3008_Bioreactor_pH_Control	.11.159	188,17
				CL3008_Bioreactor_pH_Control	.11.162	188,37
				CL3008_Bioreactor_pH_Control	.11.254	163,221
				CL3008_Bioreactor_pH_Control	.11.282	261,6
				CL3009_Bioreactor_DO2_Control	.12.12	28,48
				CL3009_Bioreactor_DO2_Control	.12.72	59,179
				CL3013_SFC_CONTROL_PROCEDURE	.36.2	40,9
				CL3013_SFC_CONTROL_PROCEDURE	.36.11	43,68
				CL3013_SFC_CONTROL_PROCEDURE	.36.17	127,9
				CL3013_SFC_CONTROL_PROCEDURE	.36.22	139,71
				CL3013_SFC_CONTROL_PROCEDURE	.36.39	214,10
				CL3013_SFC_CONTROL_PROCEDURE	.36.59	30,113
				CL3013_SFC_CONTROL_PROCEDURE	.36.71	141,127
				CL3013_SFC_CONTROL_PROCEDURE	.36.96	228,57
				CL3013_NH4_Management	.60.77	182,16
				CL3013_NO3_Management	.61.85	133,8
				CL3013_NO2_Management	.62.34	34,141
				CL3013_NO2_Management	.62.59	39,184
				CL3016_Gas_Pulse	.19.54	36,62
				T_CL3013_NH4_001	.33.7	41,9
				T_CL3013_NH4_Stop_001	.53.7	54,16
				T_CL3013_NH4_Calib_001	.38.11	45,5
				T_CL3013_NO3_001	.42.7	47,13
				T_CL3013_NO3_Calib_001	.46.9	43,7
				T_CL3013_NO3_Stop_001	.50.7	51,11
				T_CL3013_NO2_001	.56.5	41,8
				T_CL3013_NO2_Stop_001	.58.3	35,10
				T_CL3013_NO2_Stop_001	.58.7	62,12
				CL3005_Bioreactor_Temp_Control	.8.106	16,22
WORD_TO_BIT	24/03/1997 14:20:55	FB	EXTENDED	ERR_AI	FBI_4_1	7,7
				ERR_AI	FBI_4_2	34,7
				ERR_AI	FBI_4_3	61,7
				ERR_AI	FBI_4_4	84,8
				ERR_AI	FBI_4_5	113,8
QUANTUM	25/08/1999 16:43:56	FB	ANA_IO	output	FBI_3_1	4,42
				Input	FBI_2_1	5,2
AVO020	24/03/1997 14:20:55	FB	ANA_IO	output	FBI_3_3	18,27
ACO020	24/03/1997 14:20:55	FB	ANA_IO	output	FBI_3_4	44,47
ACO130	22/02/2000 09:33:03	FB	ANA_IO	output	FBI_3_5	15,71
O_SCALE	24/03/1997 14:20:55	FB	ANA_IO	output	FBI_3_6	45,12
				output	FBI_3_7	45,21
				output	FBI_3_8	44,30
				output	FBI_3_9	44,38
				output	FBI_3_10	44,73
				output	FBI_3_11	44,81
				output	FBI_3_12	44,89

table continued...

E F B u s a g e

Name	Version	Kind	EFB Library	Used in section	Instance	at
O_SCALE	24/03/1997 14:20:55	FB	ANA_IO	output	FBI_3_13	44,97
XBP	25/08/1999 16:43:56	FB	ANA_IO	Input	FBI_2_2	18,165
ACI040	10/04/2000 14:41:46	FB	ANA_IO	Input	FBI_2_3	21,40
ACI030	24/03/1997 14:20:55	FB	ANA_IO	Input	FBI_2_6	32,139
				Input	FBI_2_7	130,134
AVI030	24/03/1997 14:20:55	FB	ANA_IO	Input	FBI_2_8	34,191
				Input	FBI_2_9	125,207
I_SCALE	24/03/1997 14:20:55	FUNCT	ANA_IO	Input	.2.10	80,5
				Input	.2.12	80,12
				Input	.2.13	80,19
				Input	.2.14	80,26
				Input	.2.15	80,33
				Input	.2.16	80,40
				Input	.2.17	80,47
				Input	.2.18	80,54
				Input	.2.19	80,61
				Input	.2.20	80,68
				Input	.2.21	80,75
				Input	.2.22	80,82
				Input	.2.23	80,89
				Input	.2.24	80,96
				Input	.2.25	80,103
				Input	.2.26	80,110
				Input	.2.27	80,118
				Input	.2.28	80,125
				Input	.2.29	80,132
				Input	.2.30	80,140
				Input	.2.31	80,147
				Input	.2.32	80,154
				Input	.2.33	80,161
				Input	.2.34	80,168
				Input	.2.35	80,185
				Input	.2.36	79,178
				Input	.2.37	80,192
				Input	.2.38	80,199
				Input	.2.39	120,178
				Input	.2.40	120,187
				Input	.2.43	154,199
				Input	.2.44	193,175
				Input	.2.45	193,186
				Input	.2.46	193,198
LAG_FILTER	24/03/1997 14:20:55	FB	CONT_CTL	Input	FBI_2_47	113,135
				Input	FBI_2_48	100,143
				CL3006_Bioreactor_Level_Control	FBI_9_42	59,2
AND_BOOL	24/03/1997 14:20:55	FUNCT	IEC	ALARM_STATUS	.31.12	107,42
				ALARM_STATUS	.31.14	107,55
				ALARM_STATUS	.31.16	107,48
				ALARM_STATUS	.31.18	107,62
				CL3001_Influent_Temp_Control	.5.20	68,75
				CL3001_Influent_Temp_Control	.5.21	68,85
				CL3001_Influent_Temp_Control	.5.22	69,95
				CL3001_Influent_Temp_Control	.5.23	70,105
				CL3002_Influent_Level_Control	.6.12	36,59
				CL3002_Influent_Level_Control	.6.16	35,72
				CL3003_Inlet_Liquid_Control	.7.26	41,86
				CL3003_Inlet_Liquid_Control	.7.28	42,106
				CL3003_Inlet_Liquid_Control	.7.31	43,128

table continued...

EFB usage						
Name	Version	Kind	EFB Library	Used in section	Instance	at
AND_BOOL	24/03/1997 14:20:55	FUNCT	IEC	CL3003_Inlet_Liquid_Control	.7.34	43,147
				CL3004_Bioreactor_General	.25.27	134,45
				CL3005_Bioreactor_Temp_Control	.8.63	42,142
				CL3005_Bioreactor_Temp_Control	.8.65	43,164
				CL3005_Bioreactor_Temp_Control	.8.67	45,182
				CL3005_Bioreactor_Temp_Control	.8.69	43,200
				CL3005_Bioreactor_Temp_Control	.8.71	144,141
				CL3005_Bioreactor_Temp_Control	.8.73	146,160
				CL3005_Bioreactor_Temp_Control	.8.75	146,177
				CL3005_Bioreactor_Temp_Control	.8.77	146,194
				CL3006_Bioreactor_Level_Control	.9.20	47,172
				CL3006_Bioreactor_Level_Control	.9.29	26,18
				CL3008_Bioreactor_pH_Control	.11.85	194,83
				CL3008_Bioreactor_pH_Control	.11.92	193,122
				CL3008_Bioreactor_pH_Control	.11.97	217,110
				CL3008_Bioreactor_pH_Control	.11.102	212,67
				CL3008_Bioreactor_pH_Control	.11.131	14,4
				CL3008_Bioreactor_pH_Control	.11.132	13,12
				CL3008_Bioreactor_pH_Control	.11.134	13,20
				CL3008_Bioreactor_pH_Control	.11.139	83,15
				CL3008_Bioreactor_pH_Control	.11.141	83,23
				CL3008_Bioreactor_pH_Control	.11.153	212,16
				CL3008_Bioreactor_pH_Control	.11.165	212,36
				CL3008_Bioreactor_pH_Control	.11.177	157,120
				CL3008_Bioreactor_pH_Control	.11.183	150,103
				CL3008_Bioreactor_pH_Control	.11.187	155,83
				CL3008_Bioreactor_pH_Control	.11.191	156,66
				CL3008_Bioreactor_pH_Control	.11.228	95,98
				CL3008_Bioreactor_pH_Control	.11.229	95,115
				CL3008_Bioreactor_pH_Control	.11.230	92,62
				CL3008_Bioreactor_pH_Control	.11.231	91,79
				CL3008_Bioreactor_pH_Control	.11.237	129,138
				CL3008_Bioreactor_pH_Control	.11.246	227,139
				CL3008_Bioreactor_pH_Control	.11.248	223,160
				CL3008_Bioreactor_pH_Control	.11.250	153,185
				CL3008_Bioreactor_pH_Control	.11.252	152,203
				CL3008_Bioreactor_pH_Control	.11.278	216,93
				CL3008_Bioreactor_pH_Control	.11.296	212,52
				CL3009_Bioreactor_DO2_Control	.12.3	13,6
				CL3009_Bioreactor_DO2_Control	.12.5	12,14
				CL3009_Bioreactor_DO2_Control	.12.7	12,22
				CL3009_Bioreactor_DO2_Control	.12.39	94,13
				CL3009_Bioreactor_DO2_Control	.12.40	94,21
				CL3009_Bioreactor_DO2_Control	.12.47	37,89
				CL3009_Bioreactor_DO2_Control	.12.49	37,108
				CL3009_Bioreactor_DO2_Control	.12.51	38,129
				CL3009_Bioreactor_DO2_Control	.12.53	38,147
				CL3009_Bioreactor_DO2_Control	.12.57	108,91
				CL3009_Bioreactor_DO2_Control	.12.59	110,111
				CL3009_Bioreactor_DO2_Control	.12.61	112,134
				CL3009_Bioreactor_DO2_Control	.12.63	112,153
				CL3011_Gas_Loop	.14.8	115,116
				CL3011_Gas_Loop	.14.31	33,186
				CL3013_NH4_Management	.60.3	32,12
				CL3013_NH4_Management	.60.15	44,42
				CL3013_NH4_Management	.60.16	70,42
				CL3013_NH4_Management	.60.27	50,129

table continued...

E F B   u s a g e

Name	Version	Kind	EFB Library	Used in section	Instance	at
AND_BOOL	24/03/1997 14:20:55	FUNCT	IEC	CL3013_NH4_Management	.60.43	33,99
				CL3013_NH4_Management	.60.79	32,212
				CL3013_NH4_Management	.60.88	106,211
				CL3013_NH4_Management	.60.103	117,51
				CL3013_NH4_Management	.60.110	117,61
				CL3013_NH4_Management	.60.115	117,71
				CL3013_NO3_Management	.61.3	30,17
				CL3013_NO3_Management	.61.9	31,88
				CL3013_NO3_Management	.61.19	33,214
				CL3013_NO3_Management	.61.28	40,47
				CL3013_NO3_Management	.61.29	65,47
				CL3013_NO3_Management	.61.40	33,119
				CL3013_NO3_Management	.61.89	109,194
				CL3013_NO3_Management	.61.93	183,193
				CL3013_NO2_Management	.62.12	29,21
				CL3013_NO2_Management	.62.25	41,67
				CL3013_NO2_Management	.62.35	46,136
				CL3013_NO2_Management	.62.50	52,184
				CL3016_Gas_Pulse	.19.57	51,61
				CL3017_Liquid_Recirculation	.20.24	42,70
				CL3017_Liquid_Recirculation	.20.27	43,93
				CL3017_Liquid_Recirculation	.20.29	133,71
				CL3017_Liquid_Recirculation	.20.31	134,93
				CL3018_Outlet_liquid_Control	.21.36	43,74
				CL3018_Outlet_liquid_Control	.21.48	120,75
				CL3018_Outlet_liquid_Control	.21.53	44,99
				CL3018_Outlet_liquid_Control	.21.58	123,100
				CL3020_Effluent_Temperature	.22.20	58,80
				CL3020_Effluent_Temperature	.22.22	55,95
				CL3020_Effluent_Temperature	.22.25	59,118
				CL3020_Effluent_Temperature	.22.27	56,139
				CL3021_Effluent_Level	.23.5	36,62
				T_CL3013_NH4_001	.33.1	73,7
				T_CL3013_NH4_001	.33.5	28,9
				T_CL3013_NH4_Stop_001	.53.4	42,22
				T_CL3013_NH4_Stop_001	.53.6	35,11
				T_CL3013_NH4_Calib_001	.38.4	73,11
				T_CL3013_NH4_Calib_004	.40.3	38,4
				T_CL3013_NO3_001	.42.4	73,18
				T_CL3013_NO3_001	.42.6	34,13
				T_CL3013_NO3_Calib_001	.46.4	71,10
				T_CL3013_NO3_Calib_004	.48.3	48,6
				T_CL3013_NO3_Stop_001	.50.10	39,17
				T_CL3013_NO3_Stop_001	.50.12	32,6
				T_CL3013_NO2_001	.56.1	56,11
				T_CL3013_NO2_001	.56.3	28,8
				T_CL3013_NO2_Stop_001	.58.4	47,5
				T_CL3013_NO2_Stop_001	.58.6	50,18
				T_CL3013_NO2_Stop_002	.59.1	21,11
				CL3005_Bioreactor_Temp_Control	.8.96	81,21
				CL3005_Bioreactor_Temp_Control	.8.100	82,30
				CL3005_Bioreactor_Temp_Control	.8.104	27,17
				CL3005_Bioreactor_Temp_Control	.8.108	138,11
				CL3006_Bioreactor_Level_Control	.9.47	47,127
				CL3006_Bioreactor_Level_Control	.9.50	45,104
				CL3006_Bioreactor_Level_Control	.9.52	50,147
				CL3006_Bioreactor_Level_Control	.9.54	42,85

table continued...

EFB usage						
Name	Version	Kind	EFB Library	Used in section	Instance	at
AND_BOOL	24/03/1997 14:20:55	FUNCT	IEC	CL3006_Bioreactor_Level_Control	.9.59	47,189
				CL3005_Bioreactor_Temp_Control	.8.112	155,29
MOVE	24/03/1997 14:20:55	FUNCT	IEC	ALARM_STATUS	.31.13	120,43
				ALARM_STATUS	.31.15	120,56
				ALARM_STATUS	.31.17	120,49
				ALARM_STATUS	.31.19	120,63
				CL3002_Influent_Level_Control	.6.14	56,60
				CL3002_Influent_Level_Control	.6.18	55,73
				CL3003_Inlet_Liquid_Control	.7.23	90,29
				CL3003_Inlet_Liquid_Control	.7.36	128,105
				CL3003_Inlet_Liquid_Control	.7.37	128,142
				CL3004_Bioreactor_General	.25.10	16,35
				CL3004_Bioreactor_General	.25.11	16,40
				CL3004_Bioreactor_General	.25.12	16,45
				CL3004_Bioreactor_General	.25.13	16,50
				CL3004_Bioreactor_General	.25.14	16,55
				CL3004_Bioreactor_General	.25.15	16,60
				CL3004_Bioreactor_General	.25.16	16,65
				CL3004_Bioreactor_General	.25.17	16,70
				CL3004_Bioreactor_General	.25.18	50,32
				CL3004_Bioreactor_General	.25.19	50,37
				CL3004_Bioreactor_General	.25.20	51,53
				CL3004_Bioreactor_General	.25.21	51,58
				CL3004_Bioreactor_General	.25.22	51,63
				CL3004_Bioreactor_General	.25.23	51,68
				CL3004_Bioreactor_General	.25.24	51,73
				CL3004_Bioreactor_General	.25.25	51,78
				CL3004_Bioreactor_General	.25.26	32,88
				CL3004_Bioreactor_General	.25.34	50,42
				CL3004_Bioreactor_General	.25.35	51,47
				CL3006_Bioreactor_Level_Control	.9.15	143,34
				CL3008_Bioreactor_pH_Control	.11.81	244,68
				CL3008_Bioreactor_pH_Control	.11.82	244,74
				CL3008_Bioreactor_pH_Control	.11.89	248,108
				CL3008_Bioreactor_pH_Control	.11.90	248,114
				CL3008_Bioreactor_pH_Control	.11.106	40,214
				CL3008_Bioreactor_pH_Control	.11.107	40,219
				CL3008_Bioreactor_pH_Control	.11.108	40,224
				CL3008_Bioreactor_pH_Control	.11.110	76,199
				CL3008_Bioreactor_pH_Control	.11.111	76,205
				CL3008_Bioreactor_pH_Control	.11.112	76,211
				CL3008_Bioreactor_pH_Control	.11.133	29,13
				CL3008_Bioreactor_pH_Control	.11.135	29,21
				CL3008_Bioreactor_pH_Control	.11.142	98,16
				CL3008_Bioreactor_pH_Control	.11.143	99,24
				CL3008_Bioreactor_pH_Control	.11.156	244,18
				CL3008_Bioreactor_pH_Control	.11.160	246,24
				CL3008_Bioreactor_pH_Control	.11.168	247,38
				CL3008_Bioreactor_pH_Control	.11.169	247,44
				CL3008_Bioreactor_pH_Control	.11.170	286,12
				CL3008_Bioreactor_pH_Control	.11.171	286,17
				CL3008_Bioreactor_pH_Control	.11.172	286,22
				CL3008_Bioreactor_pH_Control	.11.173	286,27
				CL3008_Bioreactor_pH_Control	.11.174	286,32
				CL3008_Bioreactor_pH_Control	.11.175	286,37
				CL3008_Bioreactor_pH_Control	.11.215	29,162
				CL3008_Bioreactor_pH_Control	.11.216	29,168

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Name	Version	Kind	EFB Library	Used in section	Instance	at
MOVE	24/03/1997 14:20:55	FUNCT	IEC	CL3008_Bioreactor_pH_Control	.11.218	29,174
				CL3008_Bioreactor_pH_Control	.11.219	29,180
				CL3008_Bioreactor_pH_Control	.11.221	29,186
				CL3008_Bioreactor_pH_Control	.11.222	29,192
				CL3008_Bioreactor_pH_Control	.11.280	247,94
				CL3008_Bioreactor_pH_Control	.11.281	247,100
				CL3008_Bioreactor_pH_Control	.11.298	243,53
				CL3008_Bioreactor_pH_Control	.11.299	243,59
				CL3009_Bioreactor_DO2_Control	.12.6	28,15
				CL3009_Bioreactor_DO2_Control	.12.8	28,23
				CL3009_Bioreactor_DO2_Control	.12.41	109,14
				CL3009_Bioreactor_DO2_Control	.12.42	110,22
				CL3011_Gas_Loop	.14.21	80,138
				CL3011_Gas_Loop	.14.16	81,168
				CL3011_Gas_Loop	.14.17	81,143
				CL3011_Gas_Loop	.14.18	81,153
				CL3011_Gas_Loop	.14.19	81,158
				CL3011_Gas_Loop	.14.20	81,163
				CL3011_Gas_Loop	.14.25	47,139
				CL3011_Gas_Loop	.14.44	65,200
				CL3011_Gas_Loop	.14.46	47,144
				CL3011_Gas_Loop	.14.47	47,149
				CL3011_Gas_Loop	.14.48	47,154
				CL3011_Gas_Loop	.14.60	81,148
				CL3011_Gas_Loop	.14.95	32,48
				CL3011_Gas_Loop	.14.96	32,59
				CL3013_SFC_CONTROL_PROCEDURE	.36.7	63,23
				CL3013_SFC_CONTROL_PROCEDURE	.36.14	66,80
				CL3013_SFC_CONTROL_PROCEDURE	.36.20	153,23
				CL3013_SFC_CONTROL_PROCEDURE	.36.25	163,85
				CL3013_SFC_CONTROL_PROCEDURE	.36.28	77,29
				CL3013_SFC_CONTROL_PROCEDURE	.36.32	79,87
				CL3013_SFC_CONTROL_PROCEDURE	.36.34	176,92
				CL3013_SFC_CONTROL_PROCEDURE	.36.36	164,30
				CL3013_SFC_CONTROL_PROCEDURE	.36.42	234,24
				CL3013_SFC_CONTROL_PROCEDURE	.36.44	249,31
				CL3013_SFC_CONTROL_PROCEDURE	.36.48	64,35
				CL3013_SFC_CONTROL_PROCEDURE	.36.49	66,93
				CL3013_SFC_CONTROL_PROCEDURE	.36.50	163,99
				CL3013_SFC_CONTROL_PROCEDURE	.36.51	153,36
				CL3013_SFC_CONTROL_PROCEDURE	.36.52	234,37
				CL3013_SFC_CONTROL_PROCEDURE	.36.53	64,52
				CL3013_SFC_CONTROL_PROCEDURE	.36.54	67,105
				CL3013_SFC_CONTROL_PROCEDURE	.36.55	163,112
				CL3013_SFC_CONTROL_PROCEDURE	.36.56	153,49
				CL3013_SFC_CONTROL_PROCEDURE	.36.64	53,131
				CL3013_SFC_CONTROL_PROCEDURE	.36.66	66,137
				CL3013_SFC_CONTROL_PROCEDURE	.36.67	53,143
				CL3013_SFC_CONTROL_PROCEDURE	.36.68	53,155
				CL3013_SFC_CONTROL_PROCEDURE	.36.69	53,125
				CL3013_SFC_CONTROL_PROCEDURE	.36.70	53,173
				CL3013_SFC_CONTROL_PROCEDURE	.36.74	162,145
				CL3013_SFC_CONTROL_PROCEDURE	.36.76	175,151
				CL3013_SFC_CONTROL_PROCEDURE	.36.77	162,157
				CL3013_SFC_CONTROL_PROCEDURE	.36.78	162,178
				CL3013_SFC_CONTROL_PROCEDURE	.36.79	162,139
				CL3013_SFC_CONTROL_PROCEDURE	.36.80	162,184

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Name	Version	Kind	EFB Library	Used in section	Instance	at
MOVE	24/03/1997 14:20:55	FUNCT	IEC	CL3013_SFC_CONTROL_PROCEDURE	.36.81	187,145
				CL3013_SFC_CONTROL_PROCEDURE	.36.82	191,178
				CL3013_SFC_CONTROL_PROCEDURE	.36.83	79,131
				CL3013_SFC_CONTROL_PROCEDURE	.36.84	83,155
				CL3013_SFC_CONTROL_PROCEDURE	.36.99	249,75
				CL3013_SFC_CONTROL_PROCEDURE	.36.101	265,81
				CL3013_SFC_CONTROL_PROCEDURE	.36.102	254,87
				CL3013_SFC_CONTROL_PROCEDURE	.36.103	249,98
				CL3013_SFC_CONTROL_PROCEDURE	.36.104	249,69
				CL3013_SFC_CONTROL_PROCEDURE	.36.105	249,104
				CL3013_SFC_CONTROL_PROCEDURE	.36.112	264,93
				CL3013_SFC_CONTROL_PROCEDURE	.36.114	166,43
				CL3013_SFC_CONTROL_PROCEDURE	.36.116	177,106
				CL3013_SFC_CONTROL_PROCEDURE	.36.118	176,163
				CL3013_SFC_CONTROL_PROCEDURE	.36.119	162,167
				CL3013_SFC_CONTROL_PROCEDURE	.36.121	176,173
				CL3013_SFC_CONTROL_PROCEDURE	.36.123	248,43
				CL3013_SFC_CONTROL_PROCEDURE	.36.125	74,43
				CL3013_SFC_CONTROL_PROCEDURE	.36.127	80,100
				CL3013_SFC_CONTROL_PROCEDURE	.36.129	66,150
				CL3013_SFC_CONTROL_PROCEDURE	.36.130	53,161
				CL3013_SFC_CONTROL_PROCEDURE	.36.132	66,168
				CL3013_NH4_Management	.60.9	52,29
				CL3013_NH4_Management	.60.11	58,64
				CL3013_NH4_Management	.60.12	48,58
				CL3013_NH4_Management	.60.18	93,43
				CL3013_NH4_Management	.60.21	55,118
				CL3013_NH4_Management	.60.23	64,147
				CL3013_NH4_Management	.60.24	51,141
				CL3013_NH4_Management	.60.30	73,130
				CL3013_NH4_Management	.60.33	60,169
				CL3013_NH4_Management	.60.34	60,174
				CL3013_NH4_Management	.60.35	60,179
				CL3013_NH4_Management	.60.36	60,184
				CL3013_NH4_Management	.60.39	44,81
				CL3013_NH4_Management	.60.40	69,81
				CL3013_NH4_Management	.60.49	43,198
				CL3013_NH4_Management	.60.61	269,27
				CL3013_NH4_Management	.60.64	268,18
				CL3013_NH4_Management	.60.68	279,43
				CL3013_NH4_Management	.60.70	279,48
				CL3013_NH4_Management	.60.73	280,55
				CL3013_NH4_Management	.60.74	280,60
				CL3013_NH4_Management	.60.90	56,213
				CL3013_NH4_Management	.60.93	130,212
				CL3013_NH4_Management	.60.108	148,50
				CL3013_NH4_Management	.60.113	148,60
				CL3013_NH4_Management	.60.118	148,70
				CL3013_NO3_Management	.61.15	40,160
				CL3013_NO3_Management	.61.16	65,160
				CL3013_NO3_Management	.61.25	53,38
				CL3013_NO3_Management	.61.31	88,48
				CL3013_NO3_Management	.61.33	51,71
				CL3013_NO3_Management	.61.34	35,66
				CL3013_NO3_Management	.61.37	44,108
				CL3013_NO3_Management	.61.43	62,120
				CL3013_NO3_Management	.61.54	47,145

table continued...

EFB usage						
Name	Version	Kind	EFB Library	Used in section	Instance	at
MOVE	24/03/1997 14:20:55	FUNCT	IEC	CL3013_NO3_Management	.61.55	38,139
				CL3013_NO3_Management	.61.58	55,170
				CL3013_NO3_Management	.61.59	55,175
				CL3013_NO3_Management	.61.60	55,180
				CL3013_NO3_Management	.61.61	55,185
				CL3013_NO3_Management	.61.64	43,198
				CL3013_NO3_Management	.61.71	269,29
				CL3013_NO3_Management	.61.74	268,20
				CL3013_NO3_Management	.61.77	279,45
				CL3013_NO3_Management	.61.78	279,50
				CL3013_NO3_Management	.61.81	280,57
				CL3013_NO3_Management	.61.82	280,62
				CL3013_NO3_Management	.61.95	133,195
				CL3013_NO3_Management	.61.97	207,194
				CL3013_NO2_Management	.62.6	53,45
				CL3013_NO2_Management	.62.8	55,60
				CL3013_NO2_Management	.62.9	41,53
				CL3013_NO2_Management	.62.18	38,114
				CL3013_NO2_Management	.62.20	63,114
				CL3013_NO2_Management	.62.23	45,157
				CL3013_NO2_Management	.62.27	64,68
				CL3013_NO2_Management	.62.30	54,81
				CL3013_NO2_Management	.62.31	54,86
				CL3013_NO2_Management	.62.32	54,92
				CL3013_NO2_Management	.62.39	239,17
				CL3013_NO2_Management	.62.42	245,32
				CL3013_NO2_Management	.62.43	245,37
				CL3013_NO2_Management	.62.56	76,185
				CL3015_Backwashing	.18.2	43,5
				CL3015_Backwashing	.18.3	67,5
				CL3015_Backwashing	.18.4	93,5
				CL3015_Backwashing	.18.5	116,5
				CL3015_Backwashing	.18.6	43,12
				CL3015_Backwashing	.18.7	67,12
				CL3015_Backwashing	.18.8	93,12
				CL3015_Backwashing	.18.9	116,12
				CL3015_Backwashing	.18.10	140,12
				CL3015_Backwashing	.18.11	202,5
				CL3015_Backwashing	.18.12	226,5
				CL3015_Backwashing	.18.20	80,36
				CL3015_Backwashing	.18.23	143,5
				CL3015_Backwashing	.18.24	171,5
				CL3016_Gas_Pulse	.19.22	152,22
				CL3016_Gas_Pulse	.19.23	212,15
				CL3016_Gas_Pulse	.19.24	236,15
				CL3016_Gas_Pulse	.19.25	128,22
				CL3016_Gas_Pulse	.19.26	105,22
				CL3016_Gas_Pulse	.19.27	105,15
				CL3016_Gas_Pulse	.19.28	79,22
				CL3016_Gas_Pulse	.19.29	79,15
				CL3016_Gas_Pulse	.19.30	55,22
				CL3016_Gas_Pulse	.19.31	55,15
				CL3016_Gas_Pulse	.19.40	135,32
				CL3016_Gas_Pulse	.19.41	135,37
				CL3016_Gas_Pulse	.19.55	90,64
				CL3016_Gas_Pulse	.19.62	102,50
				CL3016_Gas_Pulse	.19.63	102,55

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Name	Version	Kind	EFB Library	Used in section	Instance	at
MOVE	24/03/1997 14:20:55	FUNCT	IEC	CL3016_Gas_Pulse	.19.64	102,60
				CL3016_Gas_Pulse	.19.66	40,31
				CL3016_Gas_Pulse	.19.67	40,36
				CL3016_Gas_Pulse	.19.68	40,41
				CL3016_Gas_Pulse	.19.75	40,47
				CL3016_Gas_Pulse	.19.78	80,37
				CL3016_Gas_Pulse	.19.86	130,15
				CL3016_Gas_Pulse	.19.87	157,15
				CL3016_Gas_Pulse	.19.88	185,15
				CL3017_Liquid_Recirculation	.20.19	62,35
				CL3018_Outlet_liquid_Control	.21.19	64,38
				CL3018_Outlet_liquid_Control	.21.65	26,18
				CL3018_Outlet_liquid_Control	.21.66	35,26
				CL3021_Effluent_Level	.23.7	56,63
				CL3005_Bioreactor_Temp_Control	.8.98	99,22
				CL3005_Bioreactor_Temp_Control	.8.101	100,31
				CL3005_Bioreactor_Temp_Control	.8.105	46,18
				CL3005_Bioreactor_Temp_Control	.8.107	23,8
				CL3005_Bioreactor_Temp_Control	.8.109	153,12
				CL3006_Bioreactor_Level_Control	.9.56	70,174
				CL3006_Bioreactor_Level_Control	.9.61	70,191
				CL3006_Bioreactor_Level_Control	.9.62	70,196
				CL3005_Bioreactor_Temp_Control	.8.113	170,30
GET_TOD	24/03/1997 14:20:55	FB	SYSTEM	System_clock	FBI_27_1	8,6
SET_TOD	24/03/1997 14:20:55	FB	SYSTEM	System_clock	FBI_27_3	46,6
PCR_SF1	18/09/2008 17:42:37	FB	PCR	CL3001_Influent_Temp_Control	FBI_5_2	23,10
				CL3017_Liquid_Recirculation	FBI_20_1	31,8
				CL3020_Effluent_Temperature	FBI_22_2	27,11
PWM	24/03/1997 14:20:55	FB	CONT_CTL	CL3001_Influent_Temp_Control	FBI_5_3	51,10
				CL3005_Bioreactor_Temp_Control	FBI_8_54	77,78
				CL3008_Bioreactor_pH_Control	FBI_11_208	66,79
				CL3011_Gas_Loop	FBI_14_83	76,110
				CL3020_Effluent_Temperature	FBI_22_4	55,11
SAMPLETM	24/03/1997 14:20:55	FB	SYSTEM	CL3001_Influent_Temp_Control	FBI_5_4	11,7
				CL3001_Influent_Temp_Control	FBI_5_5	39,5
				CL3003_Inlet_Liquid_Control	FBI_7_2	37,8
				CL3005_Bioreactor_Temp_Control	FBI_8_4	14,53
				CL3005_Bioreactor_Temp_Control	FBI_8_53	14,71
				CL3005_Bioreactor_Temp_Control	FBI_8_55	65,67
				CL3006_Bioreactor_Level_Control	FBI_9_6	80,5
				CL3008_Bioreactor_pH_Control	FBI_11_206	17,75
				CL3008_Bioreactor_pH_Control	FBI_11_207	54,73
				CL3008_Bioreactor_pH_Control	FBI_11_233	95,142
				CL3009_Bioreactor_DO2_Control	FBI_12_15	20,35
				CL3011_Gas_Loop	FBI_14_11	130,117
				CL3011_Gas_Loop	FBI_14_69	58,34
				CL3013_NH4_Management	FBI_60_4	45,13
				CL3013_NH4_Management	FBI_60_44	48,100
				CL3013_NO3_Management	FBI_61_4	43,18
				CL3013_NO3_Management	FBI_61_10	47,89
				CL3013_NO2_Management	FBI_62_13	43,22
				CL3017_Liquid_Recirculation	FBI_20_3	12,7
				CL3018_Outlet_liquid_Control	FBI_21_60	48,2
				CL3020_Effluent_Temperature	FBI_22_1	15,8
				CL3020_Effluent_Temperature	FBI_22_3	43,6
INT_TO_BOOL	12/12/2000 14:20:55	FUNCT	IEC	CL3001_Influent_Temp_Control	.5.6	27,38
				CL3003_Inlet_Liquid_Control	.7.20	30,50

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Name	Version	Kind	EFB Library	Used in section	Instance	at
INT_TO_BOOL	12/12/2000 14:20:55	FUNCT	IEC	CL3005_Bioreactor_Temp_Control	.8.46	23,108
				CL3006_Bioreactor_Level_Control	.9.3	28,40
				CL3008_Bioreactor_pH_Control	.11.209	18,136
				CL3008_Bioreactor_pH_Control	.11.234	95,165
				CL3009_Bioreactor_DO2_Control	.12.16	24,62
				CL3011_Gas_Loop	.14.71	32,78
				CL3015_Backwashing	.18.18	30,24
				CL3016_Gas_Pulse	.19.79	105,70
				CL3017_Liquid_Recirculation	.20.8	28,48
				CL3018_Outlet_liquid_Control	.21.6	29,48
				CL3020_Effluent_Temperature	.22.6	31,39
R_TRIG	24/03/1997 14:20:55	FB	IEC	CL3001_Influent_Temp_Control	FBI_5_7	43,43
				CL3002_Influent_Level_Control	FBI_6_13	46,59
				CL3002_Influent_Level_Control	FBI_6_17	45,72
				CL3003_Inlet_Liquid_Control	FBI_7_21	45,59
				CL3005_Bioreactor_Temp_Control	FBI_8_47	33,119
				CL3006_Bioreactor_Level_Control	FBI_9_4	41,45
				CL3006_Bioreactor_Level_Control	FBI_9_21	57,172
				CL3008_Bioreactor_pH_Control	FBI_11_74	133,121
				CL3008_Bioreactor_pH_Control	FBI_11_103	16,201
				CL3008_Bioreactor_pH_Control	FBI_11_147	270,6
				CL3008_Bioreactor_pH_Control	FBI_11_155	232,17
				CL3008_Bioreactor_pH_Control	FBI_11_167	232,37
				CL3008_Bioreactor_pH_Control	FBI_11_181	126,104
				CL3008_Bioreactor_pH_Control	FBI_11_185	131,84
				CL3008_Bioreactor_pH_Control	FBI_11_189	121,67
				CL3008_Bioreactor_pH_Control	FBI_11_210	33,141
				CL3008_Bioreactor_pH_Control	FBI_11_235	110,170
				CL3008_Bioreactor_pH_Control	FBI_11_284	249,2
				CL3008_Bioreactor_pH_Control	FBI_11_285	248,9
				CL3009_Bioreactor_DO2_Control	FBI_12_17	40,67
				CL3011_Gas_Loop	FBI_14_14	25,138
				CL3011_Gas_Loop	FBI_14_34	42,186
				CL3011_Gas_Loop	FBI_14_49	126,104
				CL3011_Gas_Loop	FBI_14_72	46,84
				CL3013_SFC_CONTROL_PROCEDURE	FBI_36_6	49,9
				CL3013_SFC_CONTROL_PROCEDURE	FBI_36_12	52,68
				CL3013_SFC_CONTROL_PROCEDURE	FBI_36_18	136,9
				CL3013_SFC_CONTROL_PROCEDURE	FBI_36_23	148,71
				CL3013_SFC_CONTROL_PROCEDURE	FBI_36_40	223,10
				CL3013_SFC_CONTROL_PROCEDURE	FBI_36_60	40,113
				CL3013_SFC_CONTROL_PROCEDURE	FBI_36_72	151,127
				CL3013_SFC_CONTROL_PROCEDURE	FBI_36_97	238,57
				CL3013_NH4_Management	FBI_60_5	56,13
				CL3013_NH4_Management	FBI_60_8	39,28
				CL3013_NH4_Management	FBI_60_10	33,63
				CL3013_NH4_Management	FBI_60_17	82,42
				CL3013_NH4_Management	FBI_60_20	42,117
				CL3013_NH4_Management	FBI_60_22	39,146
				CL3013_NH4_Management	FBI_60_29	62,129
				CL3013_NH4_Management	FBI_60_32	31,168
				CL3013_NH4_Management	FBI_60_38	33,80
				CL3013_NH4_Management	FBI_60_45	58,100
				CL3013_NH4_Management	FBI_60_48	29,197
				CL3013_NH4_Management	FBI_60_60	256,24
				CL3013_NH4_Management	FBI_60_63	255,15
				CL3013_NH4_Management	FBI_60_67	254,42

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Name	Version	Kind	EFB Library	Used in section	Instance	at
R_TRIG	24/03/1997 14:20:55	FB	IEC	CL3013_NH4_Management	FBI_60_72	254,54
				CL3013_NH4_Management	FBI_60_83	21,218
				CL3013_NH4_Management	FBI_60_87	94,217
				CL3013_NH4_Management	FBI_60_89	44,212
				CL3013_NH4_Management	FBI_60_92	119,211
				CL3013_NH4_Management	FBI_60_107	138,49
				CL3013_NH4_Management	FBI_60_112	138,59
				CL3013_NH4_Management	FBI_60_117	138,69
				CL3013_NO3_Management	FBI_61_5	53,18
				CL3013_NO3_Management	FBI_61_11	57,89
				CL3013_NO3_Management	FBI_61_14	29,159
				CL3013_NO3_Management	FBI_61_20	46,214
				CL3013_NO3_Management	FBI_61_24	40,37
				CL3013_NO3_Management	FBI_61_30	77,47
				CL3013_NO3_Management	FBI_61_32	22,70
				CL3013_NO3_Management	FBI_61_36	31,107
				CL3013_NO3_Management	FBI_61_42	51,119
				CL3013_NO3_Management	FBI_61_53	22,144
				CL3013_NO3_Management	FBI_61_57	28,169
				CL3013_NO3_Management	FBI_61_63	29,197
				CL3013_NO3_Management	FBI_61_70	256,26
				CL3013_NO3_Management	FBI_61_73	255,17
				CL3013_NO3_Management	FBI_61_76	254,44
				CL3013_NO3_Management	FBI_61_80	254,56
				CL3013_NO3_Management	FBI_61_87	98,200
				CL3013_NO3_Management	FBI_61_91	171,199
				CL3013_NO3_Management	FBI_61_94	121,194
				CL3013_NO3_Management	FBI_61_96	196,193
				CL3013_NO2_Management	FBI_62_5	40,44
				CL3013_NO2_Management	FBI_62_7	29,59
				CL3013_NO2_Management	FBI_62_14	53,22
				CL3013_NO2_Management	FBI_62_17	27,113
				CL3013_NO2_Management	FBI_62_22	31,156
				CL3013_NO2_Management	FBI_62_26	53,67
				CL3013_NO2_Management	FBI_62_29	25,80
				CL3013_NO2_Management	FBI_62_36	59,136
				CL3013_NO2_Management	FBI_62_38	226,14
				CL3013_NO2_Management	FBI_62_41	220,31
				CL3013_NO2_Management	FBI_62_48	41,190
				CL3013_NO2_Management	FBI_62_55	64,184
				CL3016_Gas_Pulse	FBI_19_15	52,74
				CL3016_Gas_Pulse	FBI_19_42	123,31
				CL3016_Gas_Pulse	FBI_19_43	123,36
				CL3016_Gas_Pulse	FBI_19_44	65,28
				CL3016_Gas_Pulse	FBI_19_48	46,98
				CL3017_Liquid_Recirculation	FBI_20_9	44,53
				CL3018_Outlet_liquid_Control	FBI_21_7	45,53
				CL3020_Effluent_Temperature	FBI_22_7	46,45
				CL3021_Effluent_Level	FBI_23_6	46,62
				CL3006_Bioreactor_Level_Control	FBI_9_60	57,189
TOF	24/03/1997 14:20:55	FB	IEC	CL3001_Influent_Temp_Control	FBI_5_8	59,43
				CL3003_Inlet_Liquid_Control	FBI_7_22	66,59
				CL3005_Bioreactor_Temp_Control	FBI_8_48	58,113
				CL3005_Bioreactor_Temp_Control	FBI_8_49	58,120
				CL3006_Bioreactor_Level_Control	FBI_9_5	58,45
				CL3008_Bioreactor_pH_Control	FBI_11_176	141,121
				CL3008_Bioreactor_pH_Control	FBI_11_182	134,104

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Name	Version	Kind	EFB Library	Used in section	Instance	at
TOF	24/03/1997 14:20:55	FB	IEC	CL3008_Bioreactor_pH_Control	FBI_11_186	139,84
				CL3008_Bioreactor_pH_Control	FBI_11_190	137,67
				CL3008_Bioreactor_pH_Control	FBI_11_211	44,142
				CL3008_Bioreactor_pH_Control	FBI_11_236	121,171
				CL3008_Bioreactor_pH_Control	FBI_11_274	227,67
				CL3008_Bioreactor_pH_Control	FBI_11_275	230,110
				CL3008_Bioreactor_pH_Control	FBI_11_279	229,93
				CL3008_Bioreactor_pH_Control	FBI_11_297	225,52
				CL3009_Bioreactor_DO2_Control	FBI_12_18	58,67
				CL3011_Gas_Loop	FBI_14_73	62,84
				CL3015_Backwashing	FBI_18_15	56,24
				CL3016_Gas_Pulse	FBI_19_12	69,72
				CL3016_Gas_Pulse	FBI_19_46	105,81
				CL3016_Gas_Pulse	FBI_19_50	64,98
				CL3016_Gas_Pulse	FBI_19_52	105,108
				CL3017_Liquid_Recirculation	FBI_20_10	56,54
				CL3018_Outlet_liquid_Control	FBI_21_8	57,54
				CL3020_Effluent_Temperature	FBI_22_8	65,45
SUB_REAL	24/03/1997 14:20:55	FUNCT	IEC	CL3001_Influent_Temp_Control	.5.10	20,76
				CL3001_Influent_Temp_Control	.5.12	20,86
				CL3001_Influent_Temp_Control	.5.14	20,96
				CL3001_Influent_Temp_Control	.5.16	20,106
				CL3003_Inlet_Liquid_Control	.7.7	10,91
				CL3003_Inlet_Liquid_Control	.7.9	11,112
				CL3003_Inlet_Liquid_Control	.7.11	10,131
				CL3003_Inlet_Liquid_Control	.7.14	11,153
				CL3004_Bioreactor_General	.25.32	86,43
				CL3004_Bioreactor_General	.25.33	86,49
				CL3005_Bioreactor_Temp_Control	.8.19	11,147
				CL3005_Bioreactor_Temp_Control	.8.21	12,170
				CL3005_Bioreactor_Temp_Control	.8.23	12,187
				CL3005_Bioreactor_Temp_Control	.8.25	12,206
				CL3005_Bioreactor_Temp_Control	.8.27	114,147
				CL3005_Bioreactor_Temp_Control	.8.29	115,165
				CL3005_Bioreactor_Temp_Control	.8.31	115,182
				CL3005_Bioreactor_Temp_Control	.8.33	115,199
				CL3007_Bioreactor_Pressu_Control	.10.14	92,44
				CL3008_Bioreactor_pH_Control	.11.113	205,143
				CL3008_Bioreactor_pH_Control	.11.117	197,161
				CL3008_Bioreactor_pH_Control	.11.120	124,186
				CL3008_Bioreactor_pH_Control	.11.123	114,191
				CL3008_Bioreactor_pH_Control	.11.124	111,209
				CL3008_Bioreactor_pH_Control	.11.125	121,204
				CL3008_Bioreactor_pH_Control	.11.194	11,34
				CL3008_Bioreactor_pH_Control	.11.201	14,59
				CL3008_Bioreactor_pH_Control	.11.253	115,221
				CL3008_Bioreactor_pH_Control	.11.259	240,186
				CL3008_Bioreactor_pH_Control	.11.262	239,194
				CL3008_Bioreactor_pH_Control	.11.265	238,203
				CL3008_Bioreactor_pH_Control	.11.269	238,211
				CL3009_Bioreactor_DO2_Control	.12.20	14,90
				CL3009_Bioreactor_DO2_Control	.12.22	12,111
				CL3009_Bioreactor_DO2_Control	.12.24	12,132
				CL3009_Bioreactor_DO2_Control	.12.26	13,148
				CL3009_Bioreactor_DO2_Control	.12.28	78,96
				CL3009_Bioreactor_DO2_Control	.12.31	79,116
				CL3009_Bioreactor_DO2_Control	.12.33	79,138

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Name	Version	Kind	EFB Library	Used in section	Instance	at
SUB_REAL	24/03/1997 14:20:55	FUNCT	IEC	CL3009_Bioreactor_DO2_Control	.12.35	78,157
				CL3009_Bioreactor_DO2_Control	.12.68	11,179
				CL3009_Bioreactor_DO2_Control	.12.74	159,89
				CL3009_Bioreactor_DO2_Control	.12.77	158,97
				CL3009_Bioreactor_DO2_Control	.12.80	157,106
				CL3009_Bioreactor_DO2_Control	.12.83	157,114
				CL3011_Gas_Loop	.14.67	20,19
				CL3011_Gas_Loop	.14.68	39,19
				CL3011_Gas_Loop	.14.85	11,104
				CL3011_Gas_Loop	.14.86	21,99
				CL3011_Gas_Loop	.14.103	186,180
				CL3011_Gas_Loop	.14.106	185,188
				CL3011_Gas_Loop	.14.109	184,197
				CL3011_Gas_Loop	.14.112	184,205
				CL3011_Gas_Loop	.14.115	247,180
				CL3011_Gas_Loop	.14.118	246,188
				CL3011_Gas_Loop	.14.121	245,197
				CL3011_Gas_Loop	.14.124	245,205
				CL3017_Liquid_Recirculation	.20.11	12,68
				CL3017_Liquid_Recirculation	.20.13	104,70
				CL3017_Liquid_Recirculation	.20.15	13,90
				CL3017_Liquid_Recirculation	.20.17	104,93
				CL3018_Outlet_liquid_Control	.21.31	13,72
				CL3018_Outlet_liquid_Control	.21.45	91,74
				CL3018_Outlet_liquid_Control	.21.50	14,97
				CL3018_Outlet_liquid_Control	.21.55	94,99
				CL3020_Effluent_Temperature	.22.10	24,77
				CL3020_Effluent_Temperature	.22.12	22,92
				CL3020_Effluent_Temperature	.22.14	24,113
				CL3020_Effluent_Temperature	.22.15	23,132
GT_REAL	24/03/1997 14:20:55	FUNCT	IEC	CL3001_Influent_Temp_Control	.5.11	42,76
				CL3001_Influent_Temp_Control	.5.13	42,86
				CL3002_Influent_Level_Control	.6.19	17,18
				CL3002_Influent_Level_Control	.6.20	17,6
				CL3003_Inlet_Liquid_Control	.7.8	29,91
				CL3003_Inlet_Liquid_Control	.7.10	30,112
				CL3003_Inlet_Liquid_Control	.7.16	116,83
				CL3003_Inlet_Liquid_Control	.7.17	115,96
				CL3004_Bioreactor_General	.25.29	104,43
				CL3005_Bioreactor_Temp_Control	.8.20	30,147
				CL3005_Bioreactor_Temp_Control	.8.22	31,170
				CL3005_Bioreactor_Temp_Control	.8.28	132,147
				CL3005_Bioreactor_Temp_Control	.8.30	134,165
				CL3006_Bioreactor_Level_Control	.9.8	32,109
				CL3006_Bioreactor_Level_Control	.9.35	29,87
				CL3007_Bioreactor_Pressu_Control	.10.2	21,22
				CL3007_Bioreactor_Pressu_Control	.10.4	21,32
				CL3007_Bioreactor_Pressu_Control	.10.11	111,20
				CL3007_Bioreactor_Pressu_Control	.10.13	111,31
				CL3008_Bioreactor_pH_Control	.11.114	216,146
				CL3008_Bioreactor_pH_Control	.11.118	211,166
				CL3008_Bioreactor_pH_Control	.11.255	151,213
				CL3008_Bioreactor_pH_Control	.11.260	254,188
				CL3008_Bioreactor_pH_Control	.11.263	253,196
				CL3009_Bioreactor_DO2_Control	.12.21	25,92
				CL3009_Bioreactor_DO2_Control	.12.23	25,113
				CL3009_Bioreactor_DO2_Control	.12.25	25,134

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EFB usage						
Name	Version	Kind	EFB Library	Used in section	Instance	at
GT_REAL	24/03/1997 14:20:55	FUNCT	IEC	CL3009_Bioreactor_DO2_Control	.12.27	25,150
				CL3009_Bioreactor_DO2_Control	.12.69	47,171
				CL3009_Bioreactor_DO2_Control	.12.75	173,91
				CL3009_Bioreactor_DO2_Control	.12.78	172,99
				CL3010_Bioreactor_EC_Control	.13.2	16,15
				CL3010_Bioreactor_EC_Control	.13.4	16,22
				CL3010_Bioreactor_EC_Control	.13.5	16,35
				CL3010_Bioreactor_EC_Control	.13.6	16,42
				CL3011_Gas_Loop	.14.90	50,100
				CL3011_Gas_Loop	.14.99	30,215
				CL3011_Gas_Loop	.14.100	83,213
				CL3011_Gas_Loop	.14.104	200,182
				CL3011_Gas_Loop	.14.107	199,190
				CL3011_Gas_Loop	.14.116	261,182
				CL3011_Gas_Loop	.14.119	260,190
				CL3012_Gas_Temperature	.15.2	16,15
				CL3012_Gas_Temperature	.15.6	18,26
				CL3013_NH4_Management	.60.56	183,46
				CL3013_NH4_Management	.60.57	183,57
				CL3013_NH4_Management	.60.58	125,32
				CL3013_NO3_Management	.61.65	126,31
				CL3013_NO3_Management	.61.66	126,42
				CL3013_NO2_Management	.62.2	146,45
				CL3013_NO2_Management	.62.3	146,56
				CL3014_Biomass_Control	.17.1	28,16
				CL3014_Biomass_Control	.17.5	27,26
				CL3017_Liquid_Recirculation	.20.12	31,68
				CL3017_Liquid_Recirculation	.20.16	31,90
				CL3018_Outlet_liquid_Control	.21.32	32,72
				CL3018_Outlet_liquid_Control	.21.51	33,97
				CL3020_Effluent_Temperature	.22.11	46,77
				CL3020_Effluent_Temperature	.22.13	44,92
				CL3021_Effluent_Level	.23.12	17,21
				CL3021_Effluent_Level	.23.19	16,9
LT_REAL	24/03/1997 14:20:55	FUNCT	IEC	CL3001_Influent_Temp_Control	.5.18	42,96
				CL3001_Influent_Temp_Control	.5.19	42,106
				CL3002_Influent_Level_Control	.6.9	17,45
				CL3002_Influent_Level_Control	.6.21	17,30
				CL3003_Inlet_Liquid_Control	.7.13	28,131
				CL3003_Inlet_Liquid_Control	.7.15	29,153
				CL3003_Inlet_Liquid_Control	.7.18	115,115
				CL3003_Inlet_Liquid_Control	.7.19	116,132
				CL3004_Bioreactor_General	.25.30	104,49
				CL3005_Bioreactor_Temp_Control	.8.24	30,187
				CL3005_Bioreactor_Temp_Control	.8.26	30,206
				CL3005_Bioreactor_Temp_Control	.8.32	134,182
				CL3005_Bioreactor_Temp_Control	.8.34	135,199
				CL3005_Bioreactor_Temp_Control	.8.82	114,101
				CL3006_Bioreactor_Level_Control	.9.10	37,153
				CL3006_Bioreactor_Level_Control	.9.39	34,131
				CL3007_Bioreactor_Pressu_Control	.10.7	22,45
				CL3007_Bioreactor_Pressu_Control	.10.9	22,55
				CL3007_Bioreactor_Pressu_Control	.10.15	111,44
				CL3007_Bioreactor_Pressu_Control	.10.17	111,54
				CL3008_Bioreactor_pH_Control	.11.122	137,189
				CL3008_Bioreactor_pH_Control	.11.126	133,210
				CL3008_Bioreactor_pH_Control	.11.127	266,137

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Name	Version	Kind	EFB Library	Used in section	Instance	at
LT_REAL	24/03/1997 14:20:55	FUNCT	IEC	CL3008_Bioreactor_pH_Control	.11.128	266,146
				CL3008_Bioreactor_pH_Control	.11.129	266,155
				CL3008_Bioreactor_pH_Control	.11.130	266,164
				CL3008_Bioreactor_pH_Control	.11.244	47,108
				CL3008_Bioreactor_pH_Control	.11.256	151,223
				CL3008_Bioreactor_pH_Control	.11.268	253,205
				CL3008_Bioreactor_pH_Control	.11.270	253,213
				CL3009_Bioreactor_DO2_Control	.12.30	97,96
				CL3009_Bioreactor_DO2_Control	.12.32	98,116
				CL3009_Bioreactor_DO2_Control	.12.34	98,138
				CL3009_Bioreactor_DO2_Control	.12.36	97,157
				CL3009_Bioreactor_DO2_Control	.12.71	47,181
				CL3009_Bioreactor_DO2_Control	.12.81	172,108
				CL3009_Bioreactor_DO2_Control	.12.84	172,116
				CL3010_Bioreactor_EC_Control	.13.7	84,14
				CL3010_Bioreactor_EC_Control	.13.8	84,21
				CL3010_Bioreactor_EC_Control	.13.10	85,32
				CL3010_Bioreactor_EC_Control	.13.11	85,41
				CL3011_Gas_Loop	.14.98	54,10
				CL3011_Gas_Loop	.14.101	30,224
				CL3011_Gas_Loop	.14.102	84,222
				CL3011_Gas_Loop	.14.110	199,199
				CL3011_Gas_Loop	.14.113	199,207
				CL3011_Gas_Loop	.14.122	260,199
				CL3011_Gas_Loop	.14.125	260,207
				CL3012_Gas_Temperature	.15.7	92,14
				CL3012_Gas_Temperature	.15.8	92,24
				CL3013_NO3_Management	.61.67	173,30
				CL3013_NO3_Management	.61.68	173,42
				CL3014_Biomass_Control	.17.3	28,39
				CL3014_Biomass_Control	.17.6	27,51
				CL3017_Liquid_Recirculation	.20.14	123,70
				CL3017_Liquid_Recirculation	.20.18	123,93
				CL3018_Outlet_liquid_Control	.21.46	110,74
				CL3018_Outlet_liquid_Control	.21.56	113,99
				CL3020_Effluent_Temperature	.22.16	46,113
				CL3020_Effluent_Temperature	.22.17	45,132
				CL3021_Effluent_Level	.23.3	17,48
				CL3021_Effluent_Level	.23.14	16,34
EQ_INT	24/03/1997 14:20:55	FUNCT	IEC	CL3001_Influent_Temp_Control	.5.24	58,71
				CL3001_Influent_Temp_Control	.5.25	57,81
				CL3001_Influent_Temp_Control	.5.26	57,91
				CL3001_Influent_Temp_Control	.5.27	57,101
				CL3002_Influent_Level_Control	.6.11	16,60
				CL3002_Influent_Level_Control	.6.15	15,73
				CL3003_Inlet_Liquid_Control	.7.25	28,83
				CL3003_Inlet_Liquid_Control	.7.27	29,103
				CL3003_Inlet_Liquid_Control	.7.30	30,125
				CL3003_Inlet_Liquid_Control	.7.33	30,144
				CL3005_Bioreactor_Temp_Control	.8.62	31,140
				CL3005_Bioreactor_Temp_Control	.8.64	33,162
				CL3005_Bioreactor_Temp_Control	.8.66	34,180
				CL3005_Bioreactor_Temp_Control	.8.68	32,198
				CL3005_Bioreactor_Temp_Control	.8.70	133,139
				CL3005_Bioreactor_Temp_Control	.8.72	135,158
				CL3005_Bioreactor_Temp_Control	.8.74	135,175
				CL3005_Bioreactor_Temp_Control	.8.76	135,192

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EFB usage						
Name	Version	Kind	EFB Library	Used in section	Instance	at
EQ_INT	24/03/1997 14:20:55	FUNCT	IEC	CL3006_Bioreactor_Level_Control	.9.13	123,31
				CL3006_Bioreactor_Level_Control	.9.19	27,173
				CL3006_Bioreactor_Level_Control	.9.27	15,4
				CL3008_Bioreactor_pH_Control	.11.5	141,5
				CL3008_Bioreactor_pH_Control	.11.11	141,11
				CL3008_Bioreactor_pH_Control	.11.15	141,17
				CL3008_Bioreactor_pH_Control	.11.84	181,84
				CL3008_Bioreactor_pH_Control	.11.91	182,126
				CL3008_Bioreactor_pH_Control	.11.96	205,107
				CL3008_Bioreactor_pH_Control	.11.101	200,64
				CL3008_Bioreactor_pH_Control	.11.138	66,15
				CL3008_Bioreactor_pH_Control	.11.140	66,23
				CL3008_Bioreactor_pH_Control	.11.146	239,2
				CL3008_Bioreactor_pH_Control	.11.150	200,10
				CL3008_Bioreactor_pH_Control	.11.161	200,30
				CL3008_Bioreactor_pH_Control	.11.214	13,161
				CL3008_Bioreactor_pH_Control	.11.217	13,173
				CL3008_Bioreactor_pH_Control	.11.220	13,185
				CL3008_Bioreactor_pH_Control	.11.245	213,135
				CL3008_Bioreactor_pH_Control	.11.247	209,156
				CL3008_Bioreactor_pH_Control	.11.249	138,181
				CL3008_Bioreactor_pH_Control	.11.251	137,199
				CL3008_Bioreactor_pH_Control	.11.277	205,93
				CL3008_Bioreactor_pH_Control	.11.283	238,8
				CL3008_Bioreactor_pH_Control	.11.295	201,52
				CL3009_Bioreactor_DO2_Control	.12.43	77,13
				CL3009_Bioreactor_DO2_Control	.12.45	77,21
				CL3009_Bioreactor_DO2_Control	.12.46	26,84
				CL3009_Bioreactor_DO2_Control	.12.48	26,103
				CL3009_Bioreactor_DO2_Control	.12.50	27,124
				CL3009_Bioreactor_DO2_Control	.12.52	27,142
				CL3009_Bioreactor_DO2_Control	.12.56	95,86
				CL3009_Bioreactor_DO2_Control	.12.58	97,106
				CL3009_Bioreactor_DO2_Control	.12.60	99,129
				CL3009_Bioreactor_DO2_Control	.12.62	99,148
				CL3011_Gas_Loop	.14.7	99,117
				CL3013_SFC_CONTROL_PROCEDURE	.36.3	19,9
				CL3013_SFC_CONTROL_PROCEDURE	.36.9	19,68
				CL3013_SFC_CONTROL_PROCEDURE	.36.21	115,71
				CL3013_SFC_CONTROL_PROCEDURE	.36.37	193,10
				CL3013_SFC_CONTROL_PROCEDURE	.36.58	106,9
				CL3013_NH4_Management	.60.1	21,9
				CL3013_NH4_Management	.60.14	18,49
				CL3013_NH4_Management	.60.26	27,136
				CL3013_NH4_Management	.60.31	21,168
				CL3013_NH4_Management	.60.37	23,80
				CL3013_NH4_Management	.60.41	22,96
				CL3013_NH4_Management	.60.47	19,197
				CL3013_NH4_Management	.60.91	20,224
				CL3013_NH4_Management	.60.94	93,223
				CL3013_NH4_Management	.60.104	103,56
				CL3013_NH4_Management	.60.109	103,66
				CL3013_NH4_Management	.60.114	103,76
				CL3013_NO3_Management	.61.1	19,14
				CL3013_NO3_Management	.61.7	20,85
				CL3013_NO3_Management	.61.13	19,159
				CL3013_NO3_Management	.61.17	19,211

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Name	Version	Kind	EFB Library	Used in section	Instance	at
EQ_INT	24/03/1997 14:20:55	FUNCT	IEC	CL3013_NO3_Management	.61.27	16,54
				CL3013_NO3_Management	.61.39	20,131
				CL3013_NO3_Management	.61.56	18,169
				CL3013_NO3_Management	.61.62	19,197
				CL3013_NO3_Management	.61.88	97,206
				CL3013_NO3_Management	.61.92	170,205
				CL3013_NO2_Management	.62.10	18,18
				CL3013_NO2_Management	.62.16	17,113
				CL3013_NO2_Management	.62.21	21,156
				CL3013_NO2_Management	.62.24	17,70
				CL3013_NO2_Management	.62.28	15,80
				CL3013_NO2_Management	.62.33	22,136
				CL3013_NO2_Management	.62.49	40,196
				CL3017_Liquid_Recirculation	.20.25	32,76
				CL3017_Liquid_Recirculation	.20.26	30,98
				CL3017_Liquid_Recirculation	.20.28	123,76
				CL3017_Liquid_Recirculation	.20.30	124,100
				CL3018_Outlet_liquid_Control	.21.35	33,80
				CL3018_Outlet_liquid_Control	.21.47	110,80
				CL3018_Outlet_liquid_Control	.21.52	34,105
				CL3018_Outlet_liquid_Control	.21.57	113,105
				CL3018_Outlet_liquid_Control	.21.64	17,1
				CL3020_Effluent_Temperature	.22.19	47,84
				CL3020_Effluent_Temperature	.22.21	44,99
				CL3020_Effluent_Temperature	.22.24	48,122
				CL3020_Effluent_Temperature	.22.26	45,143
				CL3021_Effluent_Level	.23.4	16,63
				T_CL3013_NH4_001	.33.4	18,7
				T_CL3013_NH4_001	.33.6	18,16
				T_CL3013_NH4_Stop_001	.53.2	21,8
				T_CL3013_NH4_Stop_001	.53.3	21,22
				T_CL3013_NH4_Calib_001	.38.8	33,5
				T_CL3013_NH4_Calib_001	.38.10	33,12
				T_CL3013_NO3_001	.42.5	24,11
				T_CL3013_NO3_001	.42.8	35,20
				T_CL3013_NO3_Calib_001	.46.6	31,7
				T_CL3013_NO3_Calib_001	.46.8	31,14
				T_CL3013_NO3_Stop_001	.50.5	18,3
				T_CL3013_NO3_Stop_001	.50.9	18,17
				T_CL3013_NO2_001	.56.2	18,6
				T_CL3013_NO2_001	.56.4	29,15
				T_CL3013_NO2_Stop_001	.58.2	28,5
				T_CL3013_NO2_Stop_001	.58.5	28,18
				CL3005_Bioreactor_Temp_Control	.8.110	127,16
				CL3006_Bioreactor_Level_Control	.9.48	35,123
				CL3006_Bioreactor_Level_Control	.9.49	33,100
				CL3006_Bioreactor_Level_Control	.9.51	38,143
				CL3006_Bioreactor_Level_Control	.9.53	30,81
				CL3006_Bioreactor_Level_Control	.9.58	27,190
				CL3005_Bioreactor_Temp_Control	.8.111	143,38
ACT_DIA	15/11/2000 10:19:45	FB	DIAGNO	CL3001_Influent_Temp_Control	FBI_5_29	83,73
				CL3001_Influent_Temp_Control	FBI_5_30	83,83
				CL3001_Influent_Temp_Control	FBI_5_31	83,93
				CL3001_Influent_Temp_Control	FBI_5_32	83,103
				CL3002_Influent_Level_Control	FBI_6_24	31,4
				CL3002_Influent_Level_Control	FBI_6_25	30,16
				CL3002_Influent_Level_Control	FBI_6_26	30,28

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Name	Version	Kind	EFB Library	Used in section	Instance	at
ACT_DIA	15/11/2000 10:19:45	FB	DIAGNO	CL3002_Influent_Level_Control	FBI_6_27	29,43
				CL3003_Inlet_Liquid_Control	FBI_7_38	139,81
				CL3003_Inlet_Liquid_Control	FBI_7_39	140,94
				CL3003_Inlet_Liquid_Control	FBI_7_40	141,114
				CL3003_Inlet_Liquid_Control	FBI_7_41	141,129
				CL3004_Bioreactor_General	FBI_25_36	150,43
				CL3005_Bioreactor_Temp_Control	FBI_8_87	62,140
				CL3005_Bioreactor_Temp_Control	FBI_8_88	62,162
				CL3005_Bioreactor_Temp_Control	FBI_8_89	61,180
				CL3005_Bioreactor_Temp_Control	FBI_8_90	60,198
				CL3005_Bioreactor_Temp_Control	FBI_8_91	159,139
				CL3005_Bioreactor_Temp_Control	FBI_8_92	161,158
				CL3005_Bioreactor_Temp_Control	FBI_8_93	161,175
				CL3005_Bioreactor_Temp_Control	FBI_8_94	164,192
				CL3006_Bioreactor_Level_Control	FBI_9_43	67,83
				CL3006_Bioreactor_Level_Control	FBI_9_44	68,102
				CL3006_Bioreactor_Level_Control	FBI_9_45	69,125
				CL3006_Bioreactor_Level_Control	FBI_9_46	69,145
				CL3007_Bioreactor_Pressu_Control	FBI_10_22	39,20
				CL3007_Bioreactor_Pressu_Control	FBI_10_23	39,30
				CL3007_Bioreactor_Pressu_Control	FBI_10_24	38,43
				CL3007_Bioreactor_Pressu_Control	FBI_10_25	39,53
				CL3007_Bioreactor_Pressu_Control	FBI_10_26	131,18
				CL3007_Bioreactor_Pressu_Control	FBI_10_27	131,29
				CL3007_Bioreactor_Pressu_Control	FBI_10_28	131,42
				CL3007_Bioreactor_Pressu_Control	FBI_10_29	131,52
				CL3008_Bioreactor_pH_Control	FBI_11_198	46,31
				CL3008_Bioreactor_pH_Control	FBI_11_199	46,40
				CL3008_Bioreactor_pH_Control	FBI_11_300	240,137
				CL3008_Bioreactor_pH_Control	FBI_11_301	239,158
				CL3008_Bioreactor_pH_Control	FBI_11_302	166,183
				CL3008_Bioreactor_pH_Control	FBI_11_303	164,201
				CL3008_Bioreactor_pH_Control	FBI_11_304	181,219
				CL3008_Bioreactor_pH_Control	FBI_11_305	289,135
				CL3008_Bioreactor_pH_Control	FBI_11_306	288,144
				CL3008_Bioreactor_pH_Control	FBI_11_307	287,153
				CL3008_Bioreactor_pH_Control	FBI_11_308	287,163
				CL3008_Bioreactor_pH_Control	FBI_11_309	269,185
				CL3008_Bioreactor_pH_Control	FBI_11_310	269,194
				CL3008_Bioreactor_pH_Control	FBI_11_311	270,203
				CL3008_Bioreactor_pH_Control	FBI_11_312	270,212
				CL3009_Bioreactor_DO2_Control	FBI_12_86	51,87
				CL3009_Bioreactor_DO2_Control	FBI_12_87	51,106
				CL3009_Bioreactor_DO2_Control	FBI_12_88	54,127
				CL3009_Bioreactor_DO2_Control	FBI_12_89	54,145
				CL3009_Bioreactor_DO2_Control	FBI_12_90	125,88
				CL3009_Bioreactor_DO2_Control	FBI_12_91	126,109
				CL3009_Bioreactor_DO2_Control	FBI_12_92	128,132
				CL3009_Bioreactor_DO2_Control	FBI_12_93	127,151
				CL3010_Bioreactor_EC_Control	FBI_13_12	36,12
				CL3010_Bioreactor_EC_Control	FBI_13_13	36,21
				CL3010_Bioreactor_EC_Control	FBI_13_14	36,31
				CL3010_Bioreactor_EC_Control	FBI_13_15	36,41
				CL3010_Bioreactor_EC_Control	FBI_13_16	104,12
				CL3010_Bioreactor_EC_Control	FBI_13_17	104,21
				CL3010_Bioreactor_EC_Control	FBI_13_18	105,31
				CL3010_Bioreactor_EC_Control	FBI_13_19	105,40

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Name	Version	Kind	EFB Library	Used in section	Instance	at
ACT_DIA	15/11/2000 10:19:45	FB	DIAGNO	CL3011_Gas_Loop	FBI_14_129	53,213
				CL3011_Gas_Loop	FBI_14_130	52,222
				CL3011_Gas_Loop	FBI_14_131	100,211
				CL3011_Gas_Loop	FBI_14_132	101,220
				CL3012_Gas_Temperature	FBI_15_9	44,12
				CL3012_Gas_Temperature	FBI_15_10	43,25
				CL3012_Gas_Temperature	FBI_15_11	110,13
				CL3012_Gas_Temperature	FBI_15_12	110,23
				CL3013_NH4_Management	FBI_60_106	130,49
				CL3013_NH4_Management	FBI_60_111	130,59
				CL3013_NH4_Management	FBI_60_116	130,69
				CL3013_NH4_Management	FBI_60_119	202,45
				CL3013_NH4_Management	FBI_60_120	201,54
				CL3013_NO3_Management	FBI_61_98	142,29
				CL3013_NO3_Management	FBI_61_99	142,39
				CL3013_NO3_Management	FBI_61_100	194,29
				CL3013_NO3_Management	FBI_61_101	196,40
				CL3013_NO2_Management	FBI_62_60	161,43
				CL3013_NO2_Management	FBI_62_61	161,53
				CL3014_Biomass_Control	FBI_17_7	41,14
				CL3014_Biomass_Control	FBI_17_8	41,23
				CL3014_Biomass_Control	FBI_17_9	41,37
				CL3014_Biomass_Control	FBI_17_10	41,49
				CL3020_Effluent_Temperature	FBI_22_9	24,60
				CL3020_Effluent_Temperature	FBI_22_29	73,78
				CL3020_Effluent_Temperature	FBI_22_30	70,93
				CL3020_Effluent_Temperature	FBI_22_31	72,116
				CL3020_Effluent_Temperature	FBI_22_32	72,136
				CL3021_Effluent_Level	FBI_23_20	35,8
				CL3021_Effluent_Level	FBI_23_21	35,20
				CL3021_Effluent_Level	FBI_23_22	33,32
				CL3021_Effluent_Level	FBI_23_23	34,47
TON	24/03/1997 14:20:55	FB	IEC	CL3002_Influent_Level_Control	FBI_6_22	70,9
				CL3002_Influent_Level_Control	FBI_6_23	70,16
				CL3003_Inlet_Liquid_Control	FBI_7_24	56,86
				CL3003_Inlet_Liquid_Control	FBI_7_29	57,106
				CL3003_Inlet_Liquid_Control	FBI_7_32	58,128
				CL3003_Inlet_Liquid_Control	FBI_7_35	58,147
				CL3006_Bioreactor_Level_Control	FBI_9_30	105,85
				CL3006_Bioreactor_Level_Control	FBI_9_31	105,94
				CL3006_Bioreactor_Level_Control	FBI_9_32	106,106
				CL3006_Bioreactor_Level_Control	FBI_9_33	106,115
				CL3008_Bioreactor_pH_Control	FBI_11_73	125,121
				CL3008_Bioreactor_pH_Control	FBI_11_154	224,17
				CL3008_Bioreactor_pH_Control	FBI_11_166	224,37
				CL3008_Bioreactor_pH_Control	FBI_11_180	118,104
				CL3008_Bioreactor_pH_Control	FBI_11_184	123,84
				CL3008_Bioreactor_pH_Control	FBI_11_188	113,67
				CL3009_Bioreactor_DO2_Control	FBI_12_73	72,179
				CL3009_Bioreactor_DO2_Control	FBI_12_76	186,91
				CL3009_Bioreactor_DO2_Control	FBI_12_79	185,99
				CL3009_Bioreactor_DO2_Control	FBI_12_82	184,108
				CL3009_Bioreactor_DO2_Control	FBI_12_85	184,116
				CL3011_Gas_Loop	FBI_14_105	213,182
				CL3011_Gas_Loop	FBI_14_108	212,190
				CL3011_Gas_Loop	FBI_14_111	211,199
				CL3011_Gas_Loop	FBI_14_114	211,207

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Name	Version	Kind	EFB Library	Used in section	Instance	at
TON	24/03/1997 14:20:55	FB	IEC	CL3011_Gas_Loop	FBI_14_117	274,182
				CL3011_Gas_Loop	FBI_14_120	273,190
				CL3011_Gas_Loop	FBI_14_123	272,199
				CL3011_Gas_Loop	FBI_14_126	272,207
				CL3017_Liquid_Recirculation	FBI_20_20	55,70
				CL3017_Liquid_Recirculation	FBI_20_21	59,93
				CL3017_Liquid_Recirculation	FBI_20_22	148,71
				CL3017_Liquid_Recirculation	FBI_20_23	148,93
				CL3018_Outlet_liquid_Control	FBI_21_37	56,74
				CL3018_Outlet_liquid_Control	FBI_21_49	135,75
				CL3018_Outlet_liquid_Control	FBI_21_54	57,99
				CL3018_Outlet_liquid_Control	FBI_21_59	138,100
				CL3021_Effluent_Level	FBI_23_17	73,15
				CL3021_Effluent_Level	FBI_23_18	73,24
PCR_EF1	18/09/2008 17:42:37	FB	PCR	CL3003_Inlet_Liquid_Control	FBI_7_1	50,16
				CL3009_Bioreactor_DO2_Control	FBI_12_9	42,36
				CL3018_Outlet_liquid_Control	FBI_21_61	63,8
PCR_EIF1	18/09/2008 17:42:37	FB	PCR	CL3005_Bioreactor_Temp_Control	FBI_8_52	31,79
				CL3006_Bioreactor_Level_Control	FBI_9_2	81,14
PCR_DC3	18/09/2008 17:42:37	FB	PCR	CL3005_Bioreactor_Temp_Control	FBI_8_56	37,56
TIME_TO_REAL	24/03/1997 14:20:55	FUNCT	IEC	CL3005_Bioreactor_Temp_Control	.8.59	15,43
				CL3005_Bioreactor_Temp_Control	.8.78	86,99
				CL3005_Bioreactor_Temp_Control	.8.79	86,105
				CL3008_Bioreactor_pH_Control	.11.239	19,106
				CL3008_Bioreactor_pH_Control	.11.240	19,112
DIV_REAL	24/03/1997 14:20:55	FUNCT	IEC	CL3005_Bioreactor_Temp_Control	.8.60	29,43
				CL3005_Bioreactor_Temp_Control	.8.80	99,102
				CL3008_Bioreactor_pH_Control	.11.241	32,109
				CL3011_Gas_Loop	.14.45	64,193
				CL3011_Gas_Loop	.14.88	43,109
REAL_TO_TIME	24/03/1997 14:20:55	FUNCT	IEC	CL3005_Bioreactor_Temp_Control	.8.61	38,43
ABS_REAL	24/03/1997 14:20:55	FUNCT	IEC	CL3005_Bioreactor_Temp_Control	.8.81	104,94
				CL3008_Bioreactor_pH_Control	.11.242	37,101
SEL	24/03/1997 14:20:55	FUNCT	IEC	CL3005_Bioreactor_Temp_Control	.8.83	130,106
				CL3006_Bioreactor_Level_Control	.9.26	10,19
				CL3006_Bioreactor_Level_Control	.9.28	35,28
				CL3008_Bioreactor_pH_Control	.11.203	30,51
				CL3008_Bioreactor_pH_Control	.11.204	46,51
				CL3008_Bioreactor_pH_Control	.11.223	11,119
				CL3008_Bioreactor_pH_Control	.11.226	11,126
				CL3008_Bioreactor_pH_Control	.11.238	141,143
				CL3008_Bioreactor_pH_Control	.11.243	63,113
				CL3011_Gas_Loop	.14.91	66,101
				CL3011_Gas_Loop	.14.97	64,18
				CL3016_Gas_Pulse	.19.80	124,70
				CL3018_Outlet_liquid_Control	.21.63	34,9
				CL3018_Outlet_liquid_Control	.21.69	107,28
PCR_IFF1	18/09/2008 17:42:37	FB	PCR	CL3006_Bioreactor_Level_Control	FBI_9_24	54,17
ADD_REAL	24/03/1997 14:20:55	FUNCT	IEC	CL3006_Bioreactor_Level_Control	.9.25	82,31
				CL3008_Bioreactor_pH_Control	.11.115	194,148
				CL3008_Bioreactor_pH_Control	.11.116	184,167
				CL3008_Bioreactor_pH_Control	.11.196	11,43
				CL3008_Bioreactor_pH_Control	.11.202	14,53
				CL3008_Bioreactor_pH_Control	.11.225	45,122
				CL3011_Gas_Loop	.14.13	151,118
				CL3011_Gas_Loop	.14.42	64,178
				CL3011_Gas_Loop	.14.43	64,186

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Name	Version	Kind	EFB Library	Used in section	Instance	at
ADD_REAL	24/03/1997 14:20:55	FUNCT	IEC	CL3011_Gas_Loop	.14.50	151,105
				CL3011_Gas_Loop	.14.92	41,38
				CL3011_Gas_Loop	.14.93	18,48
				CL3011_Gas_Loop	.14.94	18,59
MUL_UDINT	24/03/1997 14:20:55	FUNCT	IEC	CL3008_Bioreactor_pH_Control	.11.66	110,90
				CL3008_Bioreactor_pH_Control	.11.71	118,127
				CL3008_Bioreactor_pH_Control	.11.178	111,110
				CL3008_Bioreactor_pH_Control	.11.192	109,74
				CL3015_Backwashing	.18.17	30,34
				CL3016_Gas_Pulse	.19.81	33,79
				CL3016_Gas_Pulse	.19.82	62,86
				CL3016_Gas_Pulse	.19.83	32,103
				CL3016_Gas_Pulse	.19.84	72,115
UDINT_TO_TIME	24/03/1997 14:20:55	FUNCT	IEC	CL3008_Bioreactor_pH_Control	.11.67	123,90
				CL3008_Bioreactor_pH_Control	.11.72	127,127
				CL3008_Bioreactor_pH_Control	.11.179	120,110
				CL3008_Bioreactor_pH_Control	.11.193	123,74
				CL3015_Backwashing	.18.14	41,34
				CL3016_Gas_Pulse	.19.13	51,80
				CL3016_Gas_Pulse	.19.49	43,103
				CL3016_Gas_Pulse	.19.69	87,87
				CL3016_Gas_Pulse	.19.70	89,115
F_TRIG	24/03/1997 14:20:55	FB	IEC	CL3008_Bioreactor_pH_Control	FBI_11_80	200,70
				CL3008_Bioreactor_pH_Control	FBI_11_88	205,114
				CL3008_Bioreactor_pH_Control	FBI_11_276	205,100
				CL3008_Bioreactor_pH_Control	FBI_11_294	201,59
				CL3013_SFC_CONTROL_PROCEDURE	FBI_36_110	250,92
				CL3013_SFC_CONTROL_PROCEDURE	FBI_36_113	152,42
				CL3013_SFC_CONTROL_PROCEDURE	FBI_36_115	163,105
				CL3013_SFC_CONTROL_PROCEDURE	FBI_36_117	162,162
				CL3013_SFC_CONTROL_PROCEDURE	FBI_36_120	162,172
				CL3013_SFC_CONTROL_PROCEDURE	FBI_36_122	234,42
				CL3013_SFC_CONTROL_PROCEDURE	FBI_36_124	60,42
				CL3013_SFC_CONTROL_PROCEDURE	FBI_36_126	66,99
				CL3013_SFC_CONTROL_PROCEDURE	FBI_36_128	53,149
				CL3013_SFC_CONTROL_PROCEDURE	FBI_36_131	53,167
				CL3015_Backwashing	FBI_18_19	67,35
				CL3015_Backwashing	FBI_18_22	44,24
				CL3016_Gas_Pulse	FBI_19_45	82,81
				CL3016_Gas_Pulse	FBI_19_47	122,79
				CL3016_Gas_Pulse	FBI_19_51	83,107
				CL3016_Gas_Pulse	FBI_19_53	123,107
				CL3016_Gas_Pulse	FBI_19_61	54,54
				CL3016_Gas_Pulse	FBI_19_65	28,35
MUL_REAL	24/03/1997 14:20:55	FUNCT	IEC	CL3008_Bioreactor_pH_Control	.11.104	39,202
				CL3008_Bioreactor_pH_Control	.11.105	39,208
				CL3008_Bioreactor_pH_Control	.11.224	31,119
				CL3008_Bioreactor_pH_Control	.11.227	31,126
				CL3008_Bioreactor_pH_Control	.11.258	139,224
				CL3009_Bioreactor_DO2_Control	.12.70	35,182
				CL3011_Gas_Loop	.14.87	31,107
EQ_BOOL	24/03/1997 14:20:55	FUNCT	IEC	CL3008_Bioreactor_pH_Control	.11.151	199,17
				CL3008_Bioreactor_pH_Control	.11.163	199,37
EQ_UDINT	24/03/1997 14:20:55	FUNCT	IEC	CL3008_Bioreactor_pH_Control	.11.152	199,24
				CL3008_Bioreactor_pH_Control	.11.164	199,44
LE_REAL	24/03/1997 14:20:55	FUNCT	IEC	CL3008_Bioreactor_pH_Control	.11.195	32,33
				CL3018_Outlet_liquid_Control	.21.68	96,22

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Name	Version	Kind	EFB Library	Used in section	Instance	at
GE_REAL	24/03/1997 14:20:55	FUNCT	IEC	CL3008_Bioreactor_pH_Control	.11.197	32,42
PCR_IF1	18/09/2008 17:42:37	FB	PCR	CL3008_Bioreactor_pH_Control	FBI_11_205	28,80
				CL3008_Bioreactor_pH_Control	FBI_11_232	108,145
				CL3011_Gas_Loop	FBI_14_70	77,35
INTEGRATOR1	15/02/2001 09:12:41	FB	CONT_CTL	CL3008_Bioreactor_pH_Control	FBI_11_286	247,80
				CL3008_Bioreactor_pH_Control	FBI_11_291	246,120
BOOL_TO_INT	24/03/1997 14:20:55	FUNCT	IEC	CL3008_Bioreactor_pH_Control	.11.287	211,83
				CL3008_Bioreactor_pH_Control	.11.289	210,123
INT_TO_REAL	24/03/1997 14:20:55	FUNCT	IEC	CL3008_Bioreactor_pH_Control	.11.288	224,83
				CL3008_Bioreactor_pH_Control	.11.290	223,123
EQ_BYTE	24/03/1997 14:20:55	FUNCT	IEC	CL3011_Gas_Loop	.14.30	21,184
				CL3011_Gas_Loop	.14.32	21,190
				CL3013_NH4_Management	.60.13	18,43
				CL3013_NH4_Management	.60.25	26,130
				CL3013_NH4_Management	.60.75	170,13
				CL3013_NH4_Management	.60.76	170,19
				CL3013_NO3_Management	.61.26	16,48
				CL3013_NO3_Management	.61.38	17,124
				CL3013_NO3_Management	.61.83	121,5
				CL3013_NO3_Management	.61.84	121,11
				T_CL3013_NH4_001	.33.3	43,16
				T_CL3013_NH4_002	.34.2	17,4
				T_CL3013_NH4_004	.35.2	15,3
				T_CL3013_NH4_Stop_002	.54.2	17,4
				T_CL3013_NH4_Calib_001	.38.7	42,19
				T_CL3013_NH4_Calib_002	.39.2	16,4
				T_CL3013_NH4_Calib_004	.40.2	13,5
				T_CL3013_NO3_001	.42.3	44,27
				T_CL3013_NO3_002	.43.2	17,4
				T_CL3013_NO3_004	.44.2	15,3
				T_CL3013_NO3_Calib_001	.46.5	40,21
				T_CL3013_NO3_Calib_002	.47.2	15,4
				T_CL3013_NO3_Calib_004	.48.2	23,7
				T_CL3013_NO3_Stop_002	.51.2	15,4
SFCCNTRL	18/05/1999 14:20:55	FB	SYSTEM	CL3013_SFC_CONTROL_PROCEDURE	CL3013_NH4	60,9
				CL3013_SFC_CONTROL_PROCEDURE	CL3013_NH4_Calib	63,68
				CL3013_SFC_CONTROL_PROCEDURE	CL3013_NO3	152,9
				CL3013_SFC_CONTROL_PROCEDURE	CL3013_NO3_Calib	159,71
				CL3013_SFC_CONTROL_PROCEDURE	CL3013_NO2	235,10
				CL3013_SFC_CONTROL_PROCEDURE	CL1013_NH4_Stop	51,113
				CL3013_SFC_CONTROL_PROCEDURE	CL3013_NO3_Stop	162,127
				CL3013_SFC_CONTROL_PROCEDURE	CL3013_NO2_Stop	249,57
TP	24/03/1997 14:20:55	FB	IEC	CL3013_SFC_CONTROL_PROCEDURE	FBI_36_30	64,28
				CL3013_SFC_CONTROL_PROCEDURE	FBI_36_31	66,86
				CL3013_SFC_CONTROL_PROCEDURE	FBI_36_33	163,91
				CL3013_SFC_CONTROL_PROCEDURE	FBI_36_35	153,29
				CL3013_SFC_CONTROL_PROCEDURE	FBI_36_43	236,30
				CL3013_SFC_CONTROL_PROCEDURE	FBI_36_65	53,136
				CL3013_SFC_CONTROL_PROCEDURE	FBI_36_75	162,150
				CL3013_SFC_CONTROL_PROCEDURE	FBI_36_100	252,80
NE_UINT	24/03/1997 14:20:55	FUNCT	IEC	CL3013_NH4_Management	.60.2	21,16
				CL3013_NH4_Management	.60.42	22,103
				CL3013_NH4_Management	.60.66	246,42
				CL3013_NH4_Management	.60.71	246,54
				CL3013_NO3_Management	.61.2	19,21
				CL3013_NO3_Management	.61.8	20,92
				CL3013_NO3_Management	.61.75	246,44

table continued...

E F B   u s a g e

Name	Version	Kind	EFB Library	Used in section	Instance	at
NE_UINT	24/03/1997 14:20:55	FUNCT	IEC	CL3013_NO3_Management	.61.79	246,56
				CL3013_NO2_Management	.62.11	18,25
				CL3013_NO2_Management	.62.40	212,31
SUB_UINT	24/03/1997 14:20:55	FUNCT	IEC	CL3013_NH4_Management	.60.6	71,15
				CL3013_NH4_Management	.60.46	80,101
				CL3013_NO3_Management	.61.6	74,19
				CL3013_NO3_Management	.61.12	79,90
				CL3013_NO2_Management	.62.15	75,23
EQ_UINT	24/03/1997 14:20:55	FUNCT	IEC	CL3013_NH4_Management	.60.7	29,28
				CL3013_NH4_Management	.60.19	32,117
				CL3013_NH4_Management	.60.59	247,24
				CL3013_NH4_Management	.60.62	246,15
				CL3013_NO3_Management	.61.23	30,37
				CL3013_NO3_Management	.61.35	20,107
				CL3013_NO3_Management	.61.69	247,26
				CL3013_NO3_Management	.61.72	246,17
				CL3013_NO2_Management	.62.4	26,44
				CL3013_NO2_Management	.62.37	217,14
RS	24/03/1997 14:20:55	FB	IEC	CL3013_NH4_Management	FBI_60_54	179,25
				CL3013_NO3_Management	FBI_61_21	132,16
				CL3013_NO2_Management	FBI_62_1	126,11
NE_BYTE	24/03/1997 14:20:55	FUNCT	IEC	CL3013_NH4_Management	.60.78	21,212
				CL3013_NH4_Management	.60.85	93,211
				CL3013_NO3_Management	.61.18	18,217
				CL3013_NO3_Management	.61.86	98,194
				CL3013_NO3_Management	.61.90	170,193
				T_CL3013_NH4_Stop_001	.53.5	19,14
				T_CL3013_NO3_Stop_001	.50.13	16,9
ADD_INT	24/03/1997 14:20:55	FUNCT	IEC	CL3016_Gas_Pulse	.19.56	150,101
LT_INT	24/03/1997 14:20:55	FUNCT	IEC	CL3016_Gas_Pulse	.19.60	41,54
NOT_BOOL	24/03/1997 14:20:55	FUNCT	IEC	CL3018_Outlet_liquid_Control	.21.67	17,25

T A B L E O F C O N T E N T S

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LOOP	Location	Control Loop Name
3000	Influent	Influent General.
3001	Influent	Influent Temperature Control.
3002	Influent	Influent Level Control
3003	Bioreactor	Inlet Liquid Control
3004	Bioreactor	Bioreactor General
3005	Bioreactor	Bioreactor Temperature Control
3006	Bioreactor	Bioreactor Level Control
3007	Bioreactor	Bioreactor Pressure Control
3008	Bioreactor	Bioreactor pH Control
3009	Bioreactor	Bioreactor DO2
3010	Bioreactor	Bioreactor EC Control
3011	Bioreactor	Gas Loop
3012	Bioreactor	Gas Temperature
3013	Bioreactor	Analysis of Liquid
3014	Bioreactor	Biomass Control
3015	Bioreactor	Backwashing
3016	Bioreactor	Gaz Pulse
3017	Bioreactor	Liquid Recirculation
3018	Bioreactor	Outlet liquid Control
3019	Effluent	Effluent General
3020	Effluent	Effluent Temperature
3021	Effluent	Effluent Level
3022	Bioreactor	Foam Control
3023	ALL	Sterilisation

PLC									
1	2	3	4	5	6	7	8	9	10
140CPS11420	140CPU43412A	140NOE77101	140ACI04000	140AVO02000	140ACO02000	140ACO13000			140XBE10000
Backplane Power Supply module	CPU module	Ethernet module	16 Analog current Input (ACI 1)	4 Analog voltage Input (AVO)	4 Analog current Output (ACO 1)	8 Analog current Output (ACO 2)			Rack expansion
CIII_PLC_CPS	CIII_PLC_CPU	CIII_PLC_NOE	CIII_PLC_IO_ACI1	CIII_PLC_IO_AVO1	CIII_PLC_IO_ACO1	CIII_PLC_IO_AVO2			CIVb_PLC_XBE
Address			300001 --> 300017	400001-400004	400005->400008	400009->400016			
			no free inputs	**no free outputs**	**card not used**	**4 free outputs**			

PLC EXPANSION									
1	2	3	4	5	6		8	9	10
140CPS11420	140DDI84100	140DDI35300	140DDO84300	140DDO35300	140ACI03000		140AVI03000	140AVI03000	140XBE10000
Backplane Power Supply module	16 Digital Input 10..60VDC	32 Digital Input 24V	16 Digital Output 10..60VDC	32 Digital Output 24 V	8 Analog Input channels		8 analog input channels	8 analog input channels	Rack expansion
CIII _PLC_CPS	CIII_PLC_DDI1	CIII_PLC_DDI2	CIII_PLC_DDO1	CIII_PLC_DDO2	CIII_PLC_ACI2		CIII_PLC_AVI1	CIII_PLC_AVI2	CIVb_PLC_XBE
Address	100001->100016	100017 -> 100048	000001 --> 000016	000017 --> 000048	300018 --> 300026		300036 --> 300044	300045 --> 300053	
	card not used	**9 free inputs**	**card not used**	**3 free outputs**	**no free inputs**		**2 free inputs**	**4 free inputs**	

#	Control Loop	CODE	ID	Description	Equipment	MPP TAG NAME	PLC Address	Engineering range	Supplier	Supplier type	Signal range/Misc.	DI	DO	AI	AO	PLC card	Harness	Module	Input	Test	NTE COMMENTS	BIOPROCESS COMMENTS	SHERPA COMMENTS	MPP COMMENTS	(For Memory, Old Sherpa Remarks)
1	3000	P	XX	Existing pump for feeding D03 from CII	PP_3000_01	PP_3000_01_MV	000031		Watson Marlow	621/RE	NOTA BENE Pump supplied by UAB		1							It's not in the bioprocess hardware list					
2	3001	TCV	202	Temperature Control Valve	SV_3001_01	SV_3001_01_MV	000019	0 to 300 l/h	Burkert	178 678			1			DDO	DDO1	DDO1	3	OK					
3	3001	TCV	202	Temperature Control Valve Feedback	SV_3001_01	SV_3001_01_FB	100025	0 to 300 l/h	Burkert	178 678		1				DDI	DDI2	DDI2	1	OK					MV2 : Speed Set Point
4	3001	TT	002	Temperature element + transmitter (D03)	TT_3001_01	TT_3001_01	300002	4 to 250°C	Endress+Hauser	Omnigrad M TR 45	4-20mA			1		ACI1	ACI1	ACI1	2	OK	Range is 0-150ºC		Range to be confirmed		
5	3002	LSL	003	Level switch (Vibrating horizontal)	LSL_3002_01	LSL_3002_01	100021	Contact	Endress+Hauser	Liquiphant M FTL 50 (H)		1				DDI	DDI1	DDI1	5	OK					There are 2 digital inputs, instead of a single one, for security purpose
6	3002	LSL	003	Level switch (Vibrating horizontal)	LSL_3002_01	LSL_3002_02	100022	Contact	Endress+Hauser	Liquiphant M FTL 50 (H)		1				DDI	DDI1	DDI1	6	OK					
7	3002	LT	001	Level transmitter (capacitive)	LT_3002_01	LT_3002_01	300008	Range ?	Endress+Hauser	Liquicap FMI 51	4-20mA			1		ACI1	ACI1	ACI1	8	OK			Range ?		
8	3003	FT	001	Flow element + transmitter (feed)	FT_3003_01	FT_3003_01	300012	0 to 2l/h	E&H	Promass 80A	4-20mA			1		ACI1	ACI1	ACI1	12	OK	Range 0 to 2 L/h				
9	3003	P	004	Peristaltic Pump multichannel(???) No, it´s not multichannel, variable speed (feed C01)	PP_3003_01	PP_3003_01_MV1	000045	ON/OFF	Watson Marlow	323 U/D	All PUMPS in the scope of the BIOREACTOR SUPPLIER		1			DDO	DDO4	DDO4	5	OK					Running at constant speed ! To be decided by UAB Not connected
10	3003	P	004	Peristaltic Pump multichannel(???) No, it´s not multichannel, variable speed (feed C01)	PP_3003_01	PP_3003_01_MV2	400011	0 to 1000 ml/h	Watson Marlow	323 U/D	All PUMPS in the scope of the BIOREACTOR SUPPLIER				1	ACO2	ACO2	ACO2	3	OK					
11	3003	PT	003	Pressure transmitter	PT_3003_01	PT_3003_01	300018	-1000 to 4000mbar	WIKA	SA-11 + A-AI-1	4-20mA			1		ACI2	ACI2	ACI2	1	OK	-1000 to 4000mbar				Temp ! NB: SHOULD BE Inpro3253 TO BE CHECKED BY ETHERNET, converted by NTE
12	3003	P	004	Peristaltic Pump, ROTATION DIRECTION	PP_3003_01	PP_3003_01_MV3	000046	0 --> CCW, 1-->CW	Watson Marlow	323 U/D	All PUMPS in the scope of the BIOREACTOR SUPPLIER		1			DDO	DDO4	DDO4	6	OK	Row added, MPP tag name has to be defined		Ok. Tag Name defined		
13	3004	AC	001	Bioreactor agitator	BLE_3004_01	BLE_3004_01_MV1	000036		?	?	On/Off: DO		1			DDO	DDO3	DDO3	4	OK	16/07/2009				Range to be confirmed by UAB
14	3004	AC	001	Bioreactor agitator	BLE_3004_01	BLE_3004_01_MV2	400004	0-2000 rpm	?	?	Set Point: (-10V, +10V)				1	ACO2	ACO2	ACO2	1	OK	16/07/2009		Speed SP (0/100% ?)		
15	3004	AC	001	Bioreactor agitator	BLE_3004_01	BLE_3004_01	300039	0-2000 rpm	?	?	0-10Volts			1		AVI1	AVI1	AVI1	4	OK	16/07/2009		Speed (0/100%)		ON/OFF
16	3004			Emergency Button	CL3004_Emer_Button_01	CL3004_Emer_Button_01	100039					1				DDI	DDI3	DDI3	7	OK					Pump Direction
17	3004			Buzzer	CL3004_Buzzer_01	CL3004_Buzzer_01	000039						1			DDO	DDO3	DDO3	7	OK					Flow Measurement of the Flow
18	3005	P	005	Circulating Pump (thermostat)	CP_3005_01	CP_3005_01_MV	000038	0 to 350 l/h	Grundfos	UP 20-07N			1			DDO	DDO3	DDO3	6	OK			Tag Name updated		
19	3005	TCV	704	Temperature Control Valve see Heat exchanger (HOT)	SV_3005_02	SV_3005_02_MV	000021		Burkert	178 678			1			DDO	DDO1	DDO1	5	OK					Flow Measurement of the Flow controller
20	3005	TCV	704	Temperature Control Valve feedbacksee Heat exchanger (HOT)	SV_3005_02	SV_3005_02_FB	100035		Burkert	178 678		1				DDI	DDI3	DDI3	3	OK					Flow Controller. PLC sends a Set Point. The Flow Controller adjusts automatically the valve (not measured)
21	3005	TCV	705	Temperature Control Valve see Heat exchanger (COLD)	SV_3005_01	SV_3005_01_MV	000023		Burkert	179 678			1			DDO	DDO1	DDO1	7	OK					
22	3005	TCV	705	Temperature Control Valve feedback see Heat exchanger (COLD)	SV_3005_01	SV_3005_01_FB	100034		Burkert	179 678		1				DDI	DDI3	DDI3	2	OK					

23	3005	TT	004	Temperature element + transmitter (thermost fluid jacket C01)	TT_3005_02	TT_3005_02	300004	4 to 250°C	Endress+Hauser	Omnigrad M TR 45	4-20mA			1		ACI1	ACI1	ACI1	4	OK	Range is 0-150ºC		NTE range to be confirmed		
24	3005	TT	005	Temperature element + transmitter (middle C01)	TT_3005_01	TT_3005_01	300005	4 to 250°C	Endress+Hauser	Omnigrad M TR 45	4-20mA			1		ACI1	ACI1	ACI1	5	OK	Range is 0-150ºC		NTE range to be confirmed		BASE pump - ON/OFF
25	3005	TT	006	Temperature element + transmitter (top C01)	TT_3005_03	TT_3005_03	300006	4 to 250°C	Endress+Hauser	Omnigrad M TR 45	4-20mA			1		ACI1	ACI1	ACI1	6	OK			NTE range to be confirmed		ON/OFF SHERPA : Only 1 DO (ON/OFF) and not 2 as previously mentionned
26	3005	TT	007	Temperature element + transmitter (bottom C01)	TT_3005_04	TT_3005_04	300007	4 to 250°C	Endress+Hauser	Omnigrad M TR 45	4-20mA			1		ACI1	ACI1	ACI1	7	OK	Range is 0-150ºC		NTE range to be confirmed		Flow Controller. PLC sends a Set Point. The Flow Controller adjusts automatically the valve (not measured)
27	3006	LSHH	001	Level switch (Vibrating horizontal)	LSH_3006_01	LSH_3006_01	100017	Contact	Endress+Hauser	Liquiphant M FTL 50 (H)		1				DDI	DDI1	DDI1	1	OK					
28	3006	LSHH	001	Level switch (Vibrating horizontal)	LSH_3006_01	LSH_3006_02	100018	Contact	Endress+Hauser	Liquiphant M FTL 50 (H)		1				DDI	DDI1	DDI1	2	OK					
29	3006	LSL	001	Level switch (Vibrating horizontal)	LSL_3006_01	LSL_3006_01	100019	Contact	Endress+Hauser	Liquiphant M FTL 50 (H)		1				DDI	DDI1	DDI1	3	OK					
30	3006	LSL	001	Level switch (Vibrating horizontal)	LSL_3006_01	LSL_3006_02	100020	Contact	Endress+Hauser	Liquiphant M FTL 50 (H)		1				DDI	DDI1	DDI1	4	OK					
31	3006	LT	003	Level transmitter (capacitive)	LT_3006_01	LT_3006_01	300010	Range ?	Endress+Hauser	Liquicap FMI 51	4-20mA (liquid level)			1		ACI1	ACI1	ACI1	10	OK			Range ?		
32	3007	DPT	001	Differential Pressure transmitter	DPT_3007_01	DPT_3007_01	300011	0 to 3 bar	Endress+Hauser	Deltabar S FMD78	4-20mA			1		ACI1	ACI1	ACI1	11	OK	0 to 3 bar				
33	3007	PT	001	Pressure element + transmitter	PT_3007_01	PT_3007_01	300015	-1000 to 4000mbar	WIKA	SA-11	4-20mA			1		ACI1	ACI1	ACI1	15	OK	-1000 to 4000mbar				For info only for spare I/O for foam detect with Charis SHERPA : Not connected ? Not yet, to be implemented in future if necessary
34	3008	P	002	Peristaltic Pump (acid)	PP_3008_01	PP_3008_01_MV	000043	0 / 10 ml/h (10 ml/24h)	Watson Marlow	323 U/D	All PUMPS in the scope of the BIOREACTOR SUPPLIER		1			DDO	DDO4	DDO4	3	OK					
35	3008	P	003	Peristaltic Pump (base)	PP_3008_02	PP_3008_02_MV	000044	0 / 10 ml/h (10 ml/24h)	Watson Marlow	323 U/D	All PUMPS in the scope of the BIOREACTOR SUPPLIER		1			DDO	DDO4	DDO4	4	OK					
36	3008	PHT	001	pH element + transmitter	AT_3008_01	AT_3008_01	300021	pH 0 to 14	Mettler Toledo	Inpro3253i	4-20mA			1		ACI2	ACI2	ACI2	4	OK					
37	3008	PHT	001	Temperature pH element	TT_3008_01	TT_3008_01	300040	0 to 100ºC	Mettler Toledo	Inpro3253i	4-20mA			1		AVI1	AVI1	AVI1	5	OK (15/09/2009)	Range 0 to 100ºC		Missing Address		Connected to the PLC through the MODBUS cooenction through the
38	3008	PHT	002	pH element + transmitter	AT_3008_02	AT_3008_02	300020	pH 0 to 14	Mettler Toledo	Inpro3253i	4-20mA			1		ACI2	ACI2	ACI2	3	OK					Speed Feedback
39	3008	PHT	002	Temperature pH element	TT_3008_02	TT_3008_02	300041	0 to 100ºC	Mettler Toledo	Inpro3253i	4-20mA			1		AVI1	AVI1	AVI1	6	OK (15/09/2009)	Range 0 to 100ºC		Missing Address		pH + Temp ! NB: SHOULD BE Inpro3253 TO BE CHECKED BY
40	3008	WT	001	Acid Bottle weight indicator (+ weighing scale)	WIT_3008_01	WIT_3008_01	400116	0 - 10kg (precision 1g)	Mettler Toledo		Bioprocess will supply weigth value through 4-20mAsignal			0						OK			!! Tag Name Updated WT--> WIT (TN78.72)		pH + Temp ! NB: SHOULD BE Inpro3253 TO BE CHECKED BY BIOPROCESS
41	3008	WT	002	Base Bottle weight indicator (+ weighing scale)	WIT_3008_02	WIT_3008_02	400118	0 - 10kg (precision 1g)	Mettler Toledo		Bioprocess will supply weigth value through 4-20mAsignal			0						OK			!! Tag Name Updated WT--> WIT (TN78.72)		
42	3008	XV	106	Acid valve	SV_3008_01	SV_3008_01_MV	000025						1			DDO	DDO2	DDO2	1	OK					
43	3008	XV	106	Acid valve feedback	SV_3008_01	SV_3008_01_FB	100027					1				DDI	DDI2	DDI2	3	OK					
44	3008	XV	126	Base valve	SV_3008_02	SV_3008_02_MV	000027						1			DDO	DDO2	DDO2	3	OK					
45	3008	XV	126	Base valve feedback	SV_3008_02	SV_3008_02_FB	100026					1				DDI	DDI2	DDI2	2	OK					

46	3008	FT	005	Flow element + transmitter (CO2)	FQRC_3008_01	FQRC_3008_01	300037	0 to 50 ml/min	MKS or Bronskorst High-tech		0 / 5V			1		AVI1	AVI1	AVI1	1	OK	Hardware has to be checked		What do NTE mean by HW to be checked ?		
47	3008	FCV	005	Flow Control Valve non sterile gas (CO2)	FQRC_3008_01	FQRC_3008_01_SP	400001	0 to 50 ml/min	MKS or Bronskorst High-tech		0 / 5V				1	AVO1	AVO1	AVO1	1	OK					2 signals for 1 equipment (redundancy)
48	3009	DO2T	001	Dissolved O2 transmitter (BOTTOM)	AT_3009_01	AT_3009_01	300025	0 to 100% acc 1%	Mettler Toledo	Inpro 6850	4-20mA			1		ACI2	ACI2	ACI2	8	OK					2 signals for 1 equipment (redundancy)
49	3009	DO2T	002	Dissolved O2 transmitter (TOP)	AT_3009_02	AT_3009_02	300024	0 to 100% acc 1%	Mettler Toledo	Inpro 6850	4-20mA			1		ACI2	ACI2	ACI2	7	OK					ETHERNET, converted by NTE
50	3009	FT	004	Flow element + transmitter (O2)	FQRC_3009_01	FQRC_3009_01	300036	0 to 500 ml/min	MKS or Bronskorst High-tech		0 / 5V			1		AVI1	AVI1	AVI1	2	OK					Range to be confirmed by UAB
51	3009	FCV	004	Flow Control Valve non sterile gas (O2)	FQRC_3009_01	FQRC_3009_01_SP	400002	0 to 500 ml/min	MKS or Bronskorst High-tech		0 / 5V				1	AVO1	AVO1	AVO1	2	OK					
52	3010	XT	001	Conductivity element + transmitter (BOTTOM)	AT_3010_01	AT_3010_01	300023	c = 0,1 cm-1 (0,02 à 50 µS/cm)	Mettler Toledo	Inpro 7001-Vp (see rem)	4-20mA			1		ACI2	ACI2	ACI2	6	OK			Range to be confirmed		Pending. Recirculating medium could block the massflow tube
53	3010	XT	002	Conductivity element + transmitter (TOP)	AT_3010_02	AT_3010_02	300022	c = 0,1 cm-1 (0,02 à 50 µS/cm)	Mettler Toledo	Inpro 7001-Vp (see rem)	4-20mA			1		ACI2	ACI2	ACI2	5	OK			Range to be confirmed		
54	3011	CC	001	Gas compressor	GC_3011_01	GC_3011_01_MV	000037	0 to 6 l / min	KNF	N86KN,18			1			DDO	DDO3	DDO3	5	OK					
55	3011	FCV	003	Flow Control Valve non sterile gas (N2)	FQRC_3011_01	FQRC_3011_01_SP	400003	0 to 8333 ml/min	MKS or Bronskorst High-tech		0 / 5V				1	AVO1	AVO1	AVO1	3	OK					
56	3011	FT	003	Flow element + transmitter (N2)	FQRC_3011_01	FQRC_3011_01	300038	0 to 8333 ml/min	MKS or Bronskorst High-tech		0 / 5V			1		AVI1	AVI1	AVI1	3	OK					
57	3011	FT	007	Flow element + transmitter (mix)	FQRC_3011_02	FQRC_3011_02_SP	400013	0 to 10000 ml/min	Bronkhorst	F201CV-AGD-22-E	Set Point: 4-20mA,				1	ACO2	ACO2	ACO2	5	OK					
58	3011	FT	007	Flow element + transmitter (mix)	FQRC_3011_02	FQRC_3011_02	300019	0 to 10000ml/min	Bronkhorst	F201CV-AGD-22-E	Feedback:4-20mA			1		ACI2	ACI2	ACI2	2	OK					
59	3011	PT	002	Pressure transmitter	PT_3011_01	PT_3011_01	300016	-1000 to 4000mbar	WIKA	SA-11	4-20mA			1		ACI1	ACI1	ACI1	16	OK	-1000 to 4000mbar				
60	3011	XV	002	Gas exhaust valve	SV_3011_02	SV_3011_02_MV	000018						1			DDO	DDO1	DDO1	2	OK					2 signals for 1 equipment (redundancy)
61	3011	XV	002	Gas exhaust valve feedback	SV_3011_02	SV_3011_02_FB	100030					1				DDI	DDI2	DDI2	6	OK					
62	3011	XV	310	Reactor venting valve	SV_3011_01	SV_3011_01_MV	000022						1			DDO	DDO1	DDO1	6	OK					2 signals for 1 equipment (redundancy)
63	3011	XV	310	Reactor venting valve feedback	SV_3011_01	SV_3011_01_FB	100028					1				DDI	DDI2	DDI2	4	OK					
64	3012	TT	001	Air vent cold water temperature transmitter	TT_3012_01	TT_3012_01	300001	0 to 50 °C	?		4-20mA			1		ACI1	ACI1	ACI1	1	OK	Range is 0-150ºC		Range to be confirmed		Pump Direction
65	3013	XV	631	NH4 sampling valve	SV_3013_01	SV_3013_01_MV	000028						1			DDO	DDO2	DDO2	4	OK	16/07/2009				ON/OFF. Only 1 DO with 1 AO (speed)
66	3013	XV	631	NH4 sampling valve Feedback	SV_3013_01	SV_3013_01_FB	100036					1				DDI	DDI3	DDI3	4	OK	16/07/2009				autom adjustment of speed. If confirmed
67	3013	XV	632	N03 sampling valve	SV_3013_02	SV_3013_02_MV	000029						1			DDO	DDO2	DDO2	5	OK	16/07/2009				Flow Controller. PLC sends a Set Point. The Flow Controller adjusts
68	3013	XV	632	N03 sampling valve Feedback	SV_3013_02	SV_3013_02_FB	100037					1				DDI	DDI3	DDI3	5	OK	16/07/2009				
69	3013	XV	633	N02 sampling valve	SV_3013_03	SV_3013_03_MV	000030	0 to 0,3L/h					1			DDO	DDO2	DDO2	6	OK	16/07/2009				The RED color for the missing Engineering Range
70	3013	XV	633	N02 sampling valve Feedback	SV_3013_03	SV_3013_03_FB	100038	0 to 0,3L/h				1				DDI	DDI3	DDI3	6	OK	16/07/2009				ACID pump - ON/OFF
71	3013	YT	004	NH4 Analyser	AT_3013_01	AT_3013_01	300045	0 TO 155.6			4-20mA			1		AVI2	AVI2	AVI2	1	Connected but not checked					
72	3013	YT	004	NH4 Analyser. Calibration Indicator	AT_3013_01	AT_3013_01_IND	100041					1				DDI	DDI4	DDI4	1	Connected but not checked					80A Electronic Module is enough for this project requiremets. 83A-Electronic Module would be
73	3013	YT	003	NO3 Analyser	AT_3013_02	AT_3013_02	300046	0 TO 1000			4-20mA			1		AVI2	AVI2	AVI2	2	Connected but not checked					
74	3013	YT	003	NO3 Analyser. Calibration Indicator	AT_3013_02	AT_3013_02_IND	100042					1				DDI	DDI4	DDI4	2	Connected but not checked					ON/OFF (2 DO is announced by Bioprocess Only 1 : OK ?
75	3013	YT	002	NO2 Analyser	AT_3013_03	AT_3013_03	300047	0 --> 20 ppm			4-20mA			1		AVI2	AVI2	AVI2	3	Connected but not checked					autom adjustment of speed
76	3013	YT	002	NO2 Analyser. Calibration Indicator	AT_3013_03	AT_3013_03_IND	100043					1				DDI	DDI4	DDI4	3	Connected but not checked					Pressure inlet flow for clogging

77	3014	YT	001	Out of scope (ordered by ESA) Biomass sensor(s)	AT_3014_01	AT_3014_01					From computer			0											
78	3015	P	007	Peristaltic Pump multichannel, variable speed (backwash)	PP_3015_01	PP_3015_01_MV	000040	0 to 60 l/h	Watson Marlow	323 U/D	All PUMPS in the scope of the BIOREACTOR SUPPLIER		1			DDO	DDO3	DDO3	8	OK					
79	3016	XV	336	Gas introduction valve	SV_3011_03	SV_3011_03_MV	000024	0 to 3L/min					1			DDO	DDO1	DDO1	8	OK					Temp ! NB: SHOULD BE Inpro3253 TO BE CHECKED BY
80	3016	XV	336	Gas introduction valve Feedback	SV_3011_03	SV_3011_03_FB	100032	0 to 3L/min				1				DDI	DDI2	DDI2	8	OK					
81	3016	XV	337	Gas introduction valve	SV_3016_01	SV_3016_01_MV	000026	0 to 3L/min					1			DDO	DDO2	DDO2	2	OK					
82	3016	XV	337	Gas introduction valve Feedback	SV_3016_01	SV_3016_01_FB	100031	0 to 3L/min				1				DDI	DDI2	DDI2	7	OK					
83	3017	FT	002	Flow element + transmitter (recirc)	FT_3017_01	FT_3017_01	300013	0 to 5 l/h	E&H	Promass 80A	4-20mA			1		ACI1	ACI1	ACI1	13	OK	Range 0 to 5 L/h				Flow Measurement of the Flow controller
84	3017	P	006	Peristaltic Pump multichannel, variable speed (recirc)	PP_3017_01	PP_3017_01_MV1	000047	0 to 6000 ml/h	Watson Marlow	323 U/D	All PUMPS in the scope of the BIOREACTOR SUPPLIER		1			DDO	DDO4	DDO4	7	OK					ON/OFF. Circulating Pump
85	3017	P	006	Peristaltic Pump multichannel, variable speed (recirc)	PP_3017_01	PP_3017_01_MV2	400012	0 to 6000 ml/h	Watson Marlow	323 U/D	All PUMPS in the scope of the BIOREACTOR SUPPLIER				1	ACO2	ACO2	ACO2	4	OK					autom adjustment of speed
86	3017	P	006	Peristaltic Pump, ROTATION DIRECTION	PP_3017_01	PP_3017_01_MV3	000048	0 --> CCW, 1-->CW	Watson Marlow	323 U/D	All PUMPS in the scope of the BIOREACTOR SUPPLIER		1			DDO	DDO4	DDO4	8	OK	Row added, MPP tag name has to be defined		Ok. Tag Name defined		
87	3018	FT	006	Flow element + transmitter (harvest)	FT_3018_01	FT_3018_01	300014	0 to 2l/h	E&H	Promass 80 A	4-20mA			1		ACI1	ACI1	ACI1	14	OK	Range 0 to 2 L/h				
88	3018	P	001	Peristaltic Pump multichannel, variable speed (harvest)	PP_3018_01	PP_3018_01_MV1	000041	0 to 1000 ml/h	Watson Marlow	323 U/D	All PUMPS in the scope of the BIOREACTOR SUPPLIER		1			DDO	DDO4	DDO4	1	OK					
89	3018	P	001	Peristaltic Pump multichannel, variable speed (harvest)	PP_3018_01	PP_3018_01_MV2	400010	0 to 1000 ml/h	Watson Marlow	323 U/D	All PUMPS in the scope of the BIOREACTOR SUPPLIER				1	ACO2	ACO2	ACO2	2	OK					
90	3018	P	001	Peristaltic Pump, ROTATION DIRECTION	PP_3018_01	PP_3018_01_MV3	000042	0 --> CCW, 1-->CW	Watson Marlow	323 U/D	All PUMPS in the scope of the BIOREACTOR SUPPLIER		1			DDO	DDO4	DDO4	2	OK	Row added, MPP tag name has to be defined		Ok. Tag Name defined		
91	3018	XV	005	Reactor liquid outlet valve	SV_3018_01	SV_3018_01_MV	000020						1			DDO	DDO1	DDO1	4	OK					
92	3018	XV	005	Reactor liquid outlet valve Feedback	SV_3018_01	SV_3018_01_FB	100029					1				DDI	DDI2	DDI2	5	OK					
93	3020	TCV	003	Temperature Control Valve	SV_3020_01	SV_3020_01_MV	000017	0 to 300 l/h	Burkert	178 678			1			DDO	DDO1	DDO1	1	OK					
94	3020	TCV	003	Temperature Control Valve Feedback	SV_3020_01	SV_3020_01_FB	100033	0 to 300 l/h	Burkert	178 678		1				DDI	DDI3	DDI3	1	OK					
95	3020	TT	003	Temperature element + transmitter (D04)	TT_3020_01	TT_3020_01	300003	4 to 250°C	Endress+Hauser	Omnigrad M TR 45	4-20mA			1		ACI1	ACI1	ACI1	3	OK	Range is 0-150ºC		Range to be confirmed		Flow Measurement of the Flow controller
96	3021	LSH	004	Level switch (Vibrating horizontal)	LSH_3021_01	LSH_3021_01	100023	Contact	Endress+Hauser	Liquiphant M FTL 50 (H)		1				DDI	DDI1	DDI1	7	OK					The RED color for the missing Engineering Range
97	3021	LSH	004	Level switch (Vibrating horizontal)	LSH_3021_01	LSH_3021_02	100024	Contact	Endress+Hauser	Liquiphant M FTL 50 (H)		1				DDI	DDI1	DDI1	8	OK					Flow Controller. PLC sends a Set Point. The Flow Controller adjusts automatically the valve (not
98	3021	LT	002	Level transmitter (capacitive)	LT_3021_01	LT_3021_01	300009	Range ?	Endress+Hauser	Liquicap FMI 51	4-20mA			1		ACI1	ACI1	ACI1	9	OK			Range ?		The RED color for the missing Engineering Range
99	3022	LT	003	Level transmitter (capacitive)	LT_3022_01	LT_3022_01								1						**It's not in the bioprocess hardware list**					

100	3022	P	008	Peristaltic Pump multichannel, variable speed Anti-foam (= future)	PP_3022_01	PP_3022_01_MV	000032						1							**It's not in the bioprocess hardware list**					ON/OFF + autom adjustment of speed
	3023	-	-	Mobile temperature (sterilisation)	TT_3023_01	TT_3023_01	300048				Input or voltage current?			**1**		AVI2	AVI2	AVI2	4	**OK (15/09/2009)**	Range is 0-150ºC				For info only for spare I/O Not connected
	3023	-	-	Mobile temperature (sterilisation)	TT_3023_02	TT_3023_02	300049				Input or voltage current?			**1**		AVI2	AVI2	AVI2	5	**OK (15/09/2009)**	Range is 0-150ºC				
	3023	-	-	Mobile temperature (sterilisation)	TT_3023_03	TT_3023_03	300050				Input or voltage current?			**1**		AVI2	AVI2	AVI2	6	**OK (15/09/2009)**	Range is 0-150ºC				Pump Direction
												26	29	37	8										

	Input/Output	PLC address	Bioprocess Tag name	MPP Tag name	COMMENTS
140DDI84100 (B2:S2)	1	100001			FREE
	2	100002			FREE
	3	100003			FREE
	4	100004			FREE
	5	100005			FREE
	6	100006			FREE
	7	100007			FREE
	8	100008			FREE
	9	100009			FREE
	10	100010			FREE
	11	100011			FREE
	12	100012			FREE
	13	100013			FREE
	14	100014			FREE
	15	100015			FREE
	16	100016			FREE

	Input/Output	PLC address	Hardware connected	MPP Tag Name	COMMENTS	
140DDI35300 (B2:S3)	1	100017	LSHH-01 Relay-1	LSH_3006_01		
	2	100018	LSHH-01 Relay-2	LSH_3006_02		
	3	100019	LSL-01 Relay-1	LSL_3006_01		
	4	100020	LSL-01 Relay-2	LSL_3006_02		
	5	100021	LSL-03 Relay-1	LSL_3002_01		
	6	100022	LSL-03 Relay-2	LSL_3002_02		
	7	100023	LSH-04 Relay-1	LSH_3021_01		
	8	100024	LSH-04 Relay-2	LSH_3021_02		
	9	100025	TCV-202	SV_3001_01_FB		
	10	100026	XV-126	SV_3008_02_FB		
	11	100027	XV-106	SV_3008_01_FB		
	12	100028	XV-310	SV_3011_01_FB		
	13	100029	XV-005	SV_3018_01_FB		
	14	100030	XV-002	SV_3011_02_FB		
	15	100031	XV-337	SV_3016_02_FB		
	16	100032	XV-336	SV_3016_01_FB		
	17	100033	TCV-003	SV_3020_01_FB		
	18	100034	TCV-705	SV_3005_01_FB		
	19	100035	TCV-704	SV_3005_02_FB		
	20	100036	XV-631	SV_3013_01_FB		
	21	100037	XV-632	SV_3013_02_FB		
	22	100038	XV-633	SV_3013_03_FB		
	23	100039	Emergency Stop	CL3004_Emer_Button_01		
	24	100040			FREE	
	25	100041	YT-004	AT_3013_01_IND	Connected and not checked	Phoenix relays and connector installed in control cabinet
	26	100042	YT-003	AT_3013_02_IND	Connected and not checked	
	27	100043	YT-002	AT_3013_03_IND	Connected and not checked	
	28	100044			FREE, there is no relay in the electrical cabinet	
	29	100045			FREE, there is no relay in the electrical cabinet	
	30	100046			FREE, there is no relay in the electrical cabinet	
	31	100047			FREE, there is no relay in the electrical cabinet	
	32	100048			FREE, there is no relay in the electrical cabinet	

	Input/Output	PLC address	Bioprocess Tag name	MPP Tag name	COMMENTS
140DDO84300 (B2:S4)	1	000001			FREE
	2	000002			FREE
	3	000003			FREE
	4	000004			FREE
	5	000005			FREE
	6	000006			FREE
	7	000007			FREE
	8	000008			FREE
	9	000009			FREE
	10	000010			FREE
	11	000011			FREE
	12	000012			FREE
	13	000013			FREE
	14	000014			FREE
	15	000015			FREE
	16	000016			FREE
	Input/Output	**PLC address**	**Bioprocess Tag name**	**MPP Tag Name**	**COMMENTS**
140DDO35300 (B2:S5)	1	000017	TCV-003	SV_3020_01_MV	
	2	000018	XV-02	SV_3011_02_MV	
	3	000019	TCV-202	SV_3001_01_MV	
	4	000020	XV-05	SV_3018_01_MV	
	5	000021	TCV-704	SV_3005_02_MV	
	6	000022	XV-310	SV_3011_01_MV	
	7	000023	TCV-705	SV_3005_01_MV	
	8	000024	XV-336	SV_3016_01_MV	
	9	000025	XV-106	SV_3008_01_MV	
	10	000026	XV-337	SV_3016_02_MV	
	11	000027	XV-126	SV_3008_02_MV	
	12	000028	XV-631	SV_3013_01_MV	
	13	000029	XV-632	SV_3013_02_MV	
	14	000030	XV-633	SV_3013_03_MV	
	15	000031		PP_3000_01_MV	Not connected. Exists?
	16	000032		PP_3022_01_MV	Not connected. Exists?
	17	000033			FREE
	18	000034		AT_3013_03_Stop_Analysis	TO BE CONFIRMED BY NTE (2010_07_06)
	19	000035	AC-01	AT_3013_03_Start_Analysis	
	20	000036	AC-01	BLE_3004_01_MV1	POWER ON/OFF
	21	000037	CC-01	GC_3011_01_MV	
	22	000038	P-05	CP_3005_01_MV	
	23	000039	Buzzer	CL3004_Buzzer_1	
	24	000040	PP-07 (On/Off)	PP_3015_01_MV	
	25	000041	PP-01 (On/Off)	PP_3018_01_MV1	
	26	000042	PP-01 (Reverse)	PP_3018_01_MV3	
	27	000043	PP-02 (On/Off)	PP_3008_01_MV	
	28	000044	PP-03 (On/Off)	PP_3008_02_MV	
	29	000045	PP-04 (On/Off)	PP_3003_01_MV1	
	30	000046	PP-04 (Reverse)	PP_3003_01_MV3	
	31	000047	PP-06 (On/Off)	PP_3017_01_MV1	
	32	000048	PP-06 (Reverse)	PP_3017_01_MV3	

	Input/Output	PLC address	Bioprocess Tag Name	Hardware connected	COMMENTS		
140ACI04000 (B1:S4)	1	300001	TT-01	TT_3012_01			
	2	300002	TT-02	TT_3001_01			
	3	300003	TT-03	TT_3020_01			
	4	300004	TT-04	TT_3005_02			
	5	300005	TT-05	TT_3005_01			
	6	300006	TT-06	TT_3005_03			
	7	300007	TT-07	TT_3005_04			
	8	300008	LT-01	LT_3002_01			
	9	300009	LT-02	LT_3021_01			
	10	300010	LT-03	LT_3006_01			
	11	300011	DPT-01	DPT_3007_01			
	12	300012	FT-01	FT_3003_01			
	13	300013	FT-02	FT_3017_01			
	14	300014	FT-06	FT_3018_01			
	15	300015	PT-01	PT_3007_01			
	16	300016	PT-02	PT_3011_01			
	Input/Output	PLC address	Bioprocess Tag Name	Hardware connected	COMMENTS		
140ACI03000 (B2:S6)	1	300018	PT-03	PT_3003_01			
	2	300019	FT-07	FQRC_3011_02			
	3	300020	pHT-02	AT_3008_02			
	4	300021	pHT-01	AT_3008_01			
	5	300022	XT-02	AT_3010_02			
	6	300023	XT-01	AT_3010_01			
	7	300024	DO2T-02	AT_3009_02			
	8	300025	DO2T-01	AT_3009_01			
	Input/Output	PLC address	Bioprocess Tag Name	Hardware connected	COMMENTS		
140ACI03000 (B2:S7)	1	300027			FREE		
	2	300028			FREE		
	3	300029			FREE		
	4	300030			FREE		
	5	300031			FREE		
	6	300032			FREE		
	7	300033			FREE		
	8	300034			FREE		
	Input/Output	PLC address	Bioprocess Tag Name	Hardware connected	COMMENTS		
140AVI03000 (B2:S8)	1	300036	MKS-3 CO2	FQRC_3008_01			
	2	300037	MKS-1 O2	FQRC_3009_01			
	3	300038	MKS-2 N2	FQRC_3011_01			
	4	300039	AC-1	BLE_3004_01	(0/10V)		
	5	300040	pHTT-01	TT_3008_01	Temperature of the pH sensor	Connected and checked	
	6	300041	pHTT-02	TT_3008_02	Temperature of the pH sensor	Connected and checked	
	7	300042			FREE		
	8	300043			FREE		
	Input/Output	PLC address	Bioprocess Tag Name	Hardware connected	COMMENTS		
140AVI03000 (B2:S9)	1	300045					
	2	300046					
	3	300047					
	4	300048		TT_3023_01	Mobile temperature transducer	Phoenix module connector installed in Control Cabinet	Connected and checked
	5	300049		TT_3023_02	Mobile temperature transducer		Connected and checked
	6	300050		TT_3023_03	Mobile temperature transducer		Connected and checked
	7	300051			FREE		
	8	300052			FREE		

	Input/Output	PLC address	Bioprocess Tag Name	MPP Tag Name	COMMENTS
140AVO02000 (B1:S5)	1	400001	MKS-3 CO2	FQRC_3008_01_SP	
	2	400002	MKS-1 O2	FQRC_3009_01_SP	
	3	400003	MKS-2 N2	FQRC_3011_01_SP	
	4	400004	AC-01	BLE_3004_01_MV2	(-10V/+10V)
	Input/Output	PLC address	Bioprocess Tag Name	MPP Tag Name	COMMENTS
140ACO02000 (B1:S6)	1	400005			FREE
	2	400006			FREE
	3	400007			FREE
	4	400008			FREE
	Input/Output	PLC address	Bioprocess Tag Name	MPP Tag Name	COMMENTS
140ACO13000 (B1:S7)	1	400009			FREE
	2	400010	PP-01	PP_3018_01_MV2	
	3	400011	PP-04	PP_3003_01_MV2	
	4	400012	PP-06	PP_3017_01_MV2	
	5	400013	FT-07	FQRC_3011_02_SP	
	6	400014			FREE
	7	400015			FREE
	8	400016			FREE

Legend-->	Button : **B**	Alarm : **A**	System Clock : **SC**
	User Input: **U**	Equipment: **E**	Indicator: **I**

INDEX	Control Loop	Legend Choice	PLC FBD	PLC Tag Name	Signal / Variable Type	Physical address	HMI Address	HMI Name	Button HMI Type	Comment
1	3000	B	CL3000_Influent_General	CL3000_ControlLoop_Mode	INT		400230	Influent_Feeding_Mode	0 / 1 / 2	Mode Selector (Will be not active untill the CII arrive in the MPP)
2	3000	B	CL3000_Influent_General	PP_3000_01_OP	BOOL		000049	PP_3000_01	0 / 1 / 2	Used to start or stop the pump in manual mode
3	3000	E	CL3000_Influent_General	PP_3000_01_MV	DO	000031	000031			Existing pump for feeding D03 from CII
4	3001	B	CL3001_Influent_Temp_Control	CL3001_ControlLoop_Mode	INT		400231	Influent_temperature_Mode	0 / 1 / 2	Mode Selector (OFF/Manu/Auto)
5	3001	B	CL3001_Influent_Temp_Control	SV_3001_01_OP	BOOL		000050	SV_3001_01	SET/RESET	open / close valve SV_3001_01
6	3001	E	CL3001_Influent_Temp_Control	SV_3001_01_MV	DO	000019	000019			Temperature Control Valve
7	3001	E	CL3001_Influent_Temp_Control	SV_3001_01_FB	DI	100025	100025			Temperature Control Valve Feedback
8	3001	A	CL3001_Influent_Temp_Control	SV_3001_01_A	BOOL		000051	SV_3001_01_ALARM	AUTO	Alarm ON if SV_3001_01_MV=1 and SV_3001_01_FB=0 during 5seconds
9	3001	E	CL3001_Influent_Temp_Control	TT_3001_01	AI->REAL	300002	400072			Temperature element + transmitter (D03)
10	3001	U	CL3001_Influent_Temp_Control	TT_3001_01_SP	REAL		400074	Influent Temperature Set Point		Temperature set point of influent tank
11	3001	A	CL3001_Influent_Temp_Control	TT_3001_01_AH	BOOL		000052	TT_3001_01_HIGHALARM	AUTO	Set point +1 °C
12	3001	A	CL3001_Influent_Temp_Control	TT_3001_01_AHH	BOOL		000053	TT_3001_01_VERYHIGHALARM	AUTO	Set point +2 °C
13	3001	A	CL3001_Influent_Temp_Control	TT_3001_01_AL	BOOL		000054	TT_3001_01_LOWALARM	AUTO	Set point -1 °C
14	3001	A	CL3001_Influent_Temp_Control	TT_3001_01_ALL	BOOL		000055	TT_3001_01_VERYLOWALARM	AUTO	Set point -2 °C
15	3001	A	ERR_AI	TT_3001_01_ERR	BOOL		000056	TT_3001_01_BROKENWIRE	AUTO	SET if the wire is broken
16	3002	E	CL3002_Influent_Level_Control	LSL_3002_01	DI	100021	100021			Level switch (Vibrating horizontal)
17	3002	A	CL3002_Influent_Level_Control	LSL_3002_01_A	BOOL		000271	LEVEL_SWITCH ALARM	AUTO	The alarm is triggered after 10s
18	3002	E	CL3002_Influent_Level_Control	LSL_3002_02	DI	100022	100022			Level switch (Vibrating horizontal)
19	3002	A	CL3002_Influent_Level_Control	LSL_3002_02_A	BOOL		000272	LEVEL_SWITCH ALARM	AUTO	The alarm is triggered after 10s
20	3002	E	CL3002_Influent_Level_Control	LT_3002_01	AI->REAL	300008	400076			Level transmitter (capacitive)
21	3002	A	CL3002_Influent_Level_Control	LT_3002_01_AH	BOOL		000057	LT_3002_01_HIGHALARM	AUTO	High level in Influent Tank fix value
22	3002	A	CL3002_Influent_Level_Control	LT_3002_01_AHH	BOOL		000058	LT_3002_01_VERYHIGHALARM	AUTO	Very High Level in the Influent Tank fix value
23	3002	A	CL3002_Influent_Level_Control	LT_3002_01_AL	BOOL		000241	LT_3002_01_LOWALARM	AUTO	Very low Level in the Influent Tank fix value
24	3002	A	CL3002_Influent_Level_Control	LT_3002_01_ALL	BOOL		000059	LT_3002_01_VERYLOWALARM	AUTO	Very low Level in the Influent Tank fix value
25	3002	A	ERR_AI	LT_3002_01_ERR	BOOL		000060	LT_3002_01_BROKENWIRE	AUTO	SET if the wire is broken
26	3003	B	CL3003_Inlet_Liquid_Control	CL3003_ControlLoop_Mode	INT		400232	Inlet_Liquid_Mode	0 / 1 / 2	Mode Selector (OFF/Manu/Auto)
27	3003	B	CL3003_Inlet_Liquid_Control	PP_3003_01_OP	BOOL		000061	PP_3003_01	SET/RESET	Used to start or stop the pump in manual mode
28	3003	U	CL3003_Inlet_Liquid_Control	PP_3003_01_SP	REAL		400078	PP_3003_01 Set point	SET/RESET	Used to define the speed of PP_3003_01
29	3003	B	CL3003_Inlet_Liquid_Control	PP_3003_01_DIR	BOOL		000062	PP_3003_01 Direction	SET/RESET	Used to define the direction of PP_3003_01(CW / CCW)
30	3003	E	CL3003_Inlet_Liquid_Control	PP_3003_01_MV1	DO	000045	000045			Peristaltic Pump, variable speed (feed C01). On/Off
31	3003	U	CL3003_Inlet_Liquid_Control	PP_3003_01_MV2	REAL -> AO		400198			Peristaltic Pump, variable speed (feed C01)
32	3003	E	CL3003_Inlet_Liquid_Control	PP_3003_01_MV3	DO	000046	000046			Peristaltic Pump, ROTATION DIRECTION
33	3003	U	CL3003_Inlet_Liquid_Control	FT_3003_01_SP	REAL		400208	FT_3003_01_Set_point		Used to configure the flow of the Bioreactor inlet liquid in automatic mode
34	3003	E	CL3003_Inlet_Liquid_Control	FT_3003_01	AI->REAL	300012	400080			Flow element + transmitter (feed)
35	3003	A	CL3003_Inlet_Liquid_Control	FT_3003_01_AH	BOOL		000063	FT_3003_01_HIGHALARM	AUTO	High Flow on the bioreactor inlet liquid Implement a time for triggering alarm (5min). Compared to the set point
36	3003	A	CL3003_Inlet_Liquid_Control	FT_3003_01_AHH	BOOL		000064	FT_3003_01_VERYHIGHALARM	AUTO	Very High Flow on the bioreactor inlet liquid Implement a time for triggering alarm (5min). Compared to the set point
37	3003	A	CL3003_Inlet_Liquid_Control	FT_3003_01_AL	BOOL		000065	FT_3003_01_LOWALARM	AUTO	Low Flow on the bioreactor inlet liquid Implement a time for triggering alarm (5min). Compared to the set point
38	3003	A	CL3003_Inlet_Liquid_Control	FT_3003_01_ALL	BOOL		000066	FT_3003_01_VERYLOWALARM	AUTO	Very Low Flow on the bioreactor inlet liquid Implement a time for triggering alarm (5min). Compared to the set point
39	3003	A	ERR_AI	FT_3003_01_ERR	BOOL		000067	FT_3003_01_BROKENWIRE	AUTO	SET if the wire is broken
40	3003	E	CL3003_Inlet_Liquid_Control	PT_3003_01	AI->REAL	300018	400082			Pressure transmitter
41	3003	A	CL3003_Inlet_Liquid_Control	PT_3003_01_AH	BOOL		000228	PT_3003_01_HIGHALARM	AUTO	High Flow on the bioreactor inlet liquid
42	3003	A	CL3003_Inlet_Liquid_Control	PT_3003_01_AHH	BOOL		000229	PT_3003_01_VERYHIGHALARM	AUTO	Very High Flow on the bioreactor inlet liquid
43	3003	A	CL3003_Inlet_Liquid_Control	PT_3003_01_AL	BOOL		000230	PT_3003_01_LOWALARM	AUTO	Low Flow on the bioreactor inlet liquid
44	3003	A	CL3003_Inlet_Liquid_Control	PT_3003_01_ALL	BOOL		000231	PT_3003_01_VERYLOWALARM	AUTO	Very Low Flow on the bioreactor inlet liquid
45	3003	A	ERR_AI	PT_3003_01_ERR	BOOL		000068	PT_3003_01_BROKENWIRE	AUTO	SET if the wire is broken
46	3004	B	CL3004_Bioreactor_General	CL3004_ControlLoop_Mode	INT		400233	Bioreactor_General_Mode	0 / 1 / 2	Mode Selector (OFF/Manu/Auto)
47	3004	B	CL3004_Bioreactor_General	BLE_3004_01_OP	BOOL		000069	BLE_3004_01	SET/RESET	Used to start or stop the bioreactor blender in Manual mode
48	3004	U	CL3004_Bioreactor_General	BLE_3004_01_SP	REAL		400084	BLE_3004_01 Set Point		Used to define the speed of BLE_3004_01
49	3004	E	CL3004_Bioreactor_General	BLE_3004_01_MV1	DO	000036	000036			Bioreactor agitator ON / OFF
50	3004	E	CL3004_Bioreactor_General	BLE_3004_01_MV2	REAL -> AO	400004	400194			Bioreactor agitator set point
51	3004	E	CL3004_Bioreactor_General	BLE_3004_01	AI->REAL	300039	400086			Bioreactor agitator speed
52	3004	A	CL3004_Bioreactor_General	BLE_3004_01_A	BOOL		000070	BLE_3004_01_ALARM	AUTO	Set if blender speed is diffferent of its Feed Back speed (+/- 5%)
53	3004	A	ERR_AI	BLE_3004_01_ERR	BOOL		000251	BLE_3004_01_BROKENWIRE	AUTO	SET if the wire is broken
54	3004	E	CL3004_Bioreactor_General	CL3004_Emer_Button_01	DI	100039	100039			Emergency Button
55	3004	E	CL3004_Bioreactor_General	CL3004_Buzzer_01	DO	000039	000039			Buzzer
56	3005	B	CL3005_Bioreactor_Temp_Control	CL3005_ControlLoop_Mode	INT		400234	Bioreactor temperature mode	0 / 1 / 2	Mode Selector (OFF/Manu/Auto)
57	3005	B	CL3005_Bioreactor_Temp_Control	CP_3005_01_OP	BOOL		000071	CP_3005_01	0 / 1 / 2	Used to start or stop the bioreactor circulating pump in Manual mode
58	3005	U	CL3005_Bioreactor_Temp_Control	TT_3005_SP	REAL		400088	Bioreactor temperature setpoint		Used to define the temperature set point of the bioreactor
59	3005	E	CL3005_Bioreactor_Temp_Control	CP_3005_01_MV	DO	000038	000038			Circulating Pump (thermostat)
60	3005	B	CL3005_Bioreactor_Temp_Control	SV_3005_02_OP	BOOL		000072	SV_3005_02	SET/RESET	Used to open or close the valve in manual mode
61	3005	E	CL3005_Bioreactor_Temp_Control	SV_3005_02_MV	DO	000021	000021			Temperature Control Valve see Heat exchanger (HOT)
62	3005	E	CL3005_Bioreactor_Temp_Control	SV_3005_02_FB	DI	100035	100035			Temperature Control Valve feedbacksee Heat exchanger (HOT)

63	3005	A	CL3005_Bioreactor_Temp_Control	SV_3005_02_A	BOOL		000073	SV_3005_02_ALARM	AUTO	Alarm ON if SV_3005_02_MV=1 and SV_3005_02_FB=0 during 5seconds
64	3005	B	CL3005_Bioreactor_Temp_Control	SV_3005_01_OP	BOOL		000074	SV_3005_01	SET/RESET	Used to open or close the valve in manual mode
65	3005	E	CL3005_Bioreactor_Temp_Control	SV_3005_01_MV	DO	000023	000023			Temperature Control Valve see Heat exchanger (COLD)
66	3005	E	CL3005_Bioreactor_Temp_Control	SV_3005_01_FB	DI	100034	100034			Temperature Control Valve feedback see Heat exchanger (COLD)
67	3005	A	CL3005_Bioreactor_Temp_Control	SV_3005_01_A	BOOL		000075	SV_3005_01_ALARM	AUTO	Alarm ON if SV_3005_01_MV=1 and SV_3005_01_FB=0 during 5seconds
68	3005	E	CL3005_Bioreactor_Temp_Control	TT_3005_02	AI->REAL	300004	400090			Temperature element + transmitter (thermost fluid jacket C01)
69	3005	A	CL3005_Bioreactor_Temp_Control	TT_3005_02_AH	BOOL		000076	TT_3005_02_HIGHALARM	AUTO	Compared to the set point High Temperature on the bioreactor Jacket
70	3005	A	CL3005_Bioreactor_Temp_Control	TT_3005_02_AHH	BOOL		000077	TT_3005_02_VERYHIGHALARM	AUTO	Compared to the set point Very High Temperature on the bioreactor Jacket
71	3005	A	CL3005_Bioreactor_Temp_Control	TT_3005_02_AL	BOOL		000078	TT_3005_02_LOWALARM	AUTO	Compared to the set point High Temperature on the bioreactor Jacket
72	3005	A	CL3005_Bioreactor_Temp_Control	TT_3005_02_ALL	BOOL		000079	TT_3005_02_VERYLOWALARM	AUTO	Compared to the set point Very High Temperature on the bioreactor Jacket
73	3005	A	ERR_AI	TT_3005_02_ERR	BOOL		000080	TT_3005_02_BROKENWIRE	AUTO	SET if the wire is broken stops the control Loop 3005
74	3005	E	CL3005_Bioreactor_Temp_Control	TT_3005_01	AI->REAL	300005	400092			Temperature element + transmitter (middle C01)
75	3005	A	CL3005_Bioreactor_Temp_Control	TT_3005_01_AH	BOOL		000081	TT_3005_01_HIGHALARM	AUTO	Compared to the set point High Temperature on the bioreactor
76	3005	A	CL3005_Bioreactor_Temp_Control	TT_3005_01_AHH	BOOL		000082	TT_3005_01_VERYHIGHALARM	AUTO	Compared to the set point Very High Temperature on the bioreactor
77	3005	A	CL3005_Bioreactor_Temp_Control	TT_3005_01_AL	BOOL		000083	TT_3005_01_LOWALARM	AUTO	Compared to the set point High Temperature on the bioreactor
78	3005	A	CL3005_Bioreactor_Temp_Control	TT_3005_01_ALL	BOOL		000084	TT_3005_01_VERYLOWALARM	AUTO	Compared to the set point Very High Temperature on the bioreactor
79	3005	A	ERR_AI	TT_3005_01_ERR	x^2x^2		000085	TT_3005_01_BROKENWIRE	AUTO	SET if the wire is broken
80	3005	E	CL3005_Bioreactor_Temp_Control	TT_3005_03	AI->REAL	300006	400094			Temperature element + transmitter (top C01)
81	3005	A	ERR_AI	TT_3005_03_ERR	BOOL		000086	TT_3005_03_BROKENWIRE	AUTO	SET if the wire is broken
82	3005	E	CL3005_Bioreactor_Temp_Control	TT_3005_04	AI->REAL	300007	400096			Temperature element + transmitter (bottom C01)
83	3005	A	ERR_AI	TT_3005_04_ERR	BOOL		000087	TT_3005_04_BROKENWIRE	AUTO	SET if the wire is broken
84	3006	B	CL3006_Bioreactor_Level_Control	CL3006_ControlLoop_Mode	INT		400245	bioreactor Level Mode	0 / 1 / 2	Mode Selector (OFF/Auto)
85	3006	U	CL3006_Bioreactor_Level_Control	CL3006_BioreactorLevel_SP	REAL		400168	bioreactor Level Set Point		Used to define the level Set Point of the Bioreactor
86	3006	E	CL3006_Bioreactor_Level_Control	LSH_3006_01	DI	100017	100017			Level switch (Vibrating horizontal)
87	3006	A	CL3006_Bioreactor_Level_Control	LSH_3006_01_A	BOOL		000273	LEVEL_SWITCH ALARM	AUTO	The alarm is triggered after 10s
88	3006	E	CL3006_Bioreactor_Level_Control	LSH_3006_02	DI	100018	100018			Level switch (Vibrating horizontal)
89	3006	A	CL3006_Bioreactor_Level_Control	LSH_3006_02_A	BOOL		000274	LEVEL_SWITCH ALARM	AUTO	The alarm is triggered after 10s
90	3006	E	CL3006_Bioreactor_Level_Control	LSL_3006_01	DI	100019	100019			Level switch (Vibrating horizontal)
91	3006	A	CL3006_Bioreactor_Level_Control	LSL_3006_01_A	BOOL		000275	LEVEL_SWITCH ALARM	AUTO	The alarm is triggered after 10s
92	3006	E	CL3006_Bioreactor_Level_Control	LSL_3006_02	DI	100020	100020			Level switch (Vibrating horizontal)
93	3006	A	CL3006_Bioreactor_Level_Control	LSL_3006_02_A	BOOL		000276	LEVEL_SWITCH ALARM	AUTO	The alarm is triggered after 10s
94	3006	E	CL3006_Bioreactor_Level_Control	LT_3006_01	AI->REAL	300010	400098			Level transmitter (capacitive)
95	3006	A	CL3006_Bioreactor_Level_Control	LT_3006_01_AH	BOOL		000243	LT_3006_01_HIGHALARM	AUTO	High Level in Bioreactor
96	3006	A	CL3006_Bioreactor_Level_Control	LT_3006_01_AHH	BOOL		000088	LT_3006_01_VERYHIGHALARM	AUTO	Very High Level in Bioreactor
97	3006	A	CL3006_Bioreactor_Level_Control	LT_3006_01_AL	BOOL		000244	LT_3006_01_LOWALARM	AUTO	Low Level in Bioreactor
98	3006	A	CL3006_Bioreactor_Level_Control	LT_3006_01_ALL	BOOL		000089	LT_3006_01_VERYLOWALARM	AUTO	Very Low Level in Bioreactor
99	3006	A	ERR_AI	LT_3006_01_ERR	BOOL		000250	LT_3006_01_BROKENWIRE	AUTO	SET if the wire is broken
100	3007	E	CL3007_Bioreactor_Pressu_Control	DPT_3007_01	AI->REAL	300011	400100			Differential Pressure transmitter
101	3007	U	CL3007_Bioreactor_Pressu_Control	PT_3007_01_SP	REAL		400214	PT_3007_01_Set_Point		Set Point of the Controller managing the bioreactor pressure
102	3007	U	CL3007_Bioreactor_Pressu_Control	CL3007_Pressure_Threshold	REAL		400216	PT_3007_01_Threshold		Threshold which trigger the bioreactor pressure releasing
103	3007	E	CL3007_Bioreactor_Pressu_Control	PT_3007_01	AI->REAL	300015	400102			Pressure element + transmitter
104	3007	A	CL3007_Bioreactor_Pressu_Control	DPT_3007_01_AH	BOOL		000090	DPT_3007_01_HIGHALARM	AUTO	High differential pressure in the bioreactor
105	3007	A	CL3007_Bioreactor_Pressu_Control	DPT_3007_01_AHH	BOOL		000091	DPT_3007_01_VERYHIGHALARM	AUTO	Very High differential pressure in the bioreactor
106	3007	A	CL3007_Bioreactor_Pressu_Control	DPT_3007_01_AL	BOOL		000092	DPT_3007_01_LOWALARM	AUTO	Low differential pressure in the bioreactor
107	3007	A	CL3007_Bioreactor_Pressu_Control	DPT_3007_01_ALL	BOOL		000093	DPT_3007_01_VERYLOWALARM	AUTO	Very Low differential pressure in the bioreactor
108	3007	A	ERR_AI	DPT_3007_01_ERR	BOOL		000094	DPT_3007_01_BROKENWIRE	AUTO	SET if the wire is broken
109	3007	A	CL3007_Bioreactor_Pressu_Control	PT_3007_01_AH	BOOL		000095	PT_3007_01_HIGHALARM	AUTO	High pressure in the bioreactor
110	3007	A	CL3007_Bioreactor_Pressu_Control	PT_3007_01_AHH	BOOL		000096	PT_3007_01_VERYHIGHALARM	AUTO	Very High pressure in the bioreactor
111	3007	A	CL3007_Bioreactor_Pressu_Control	PT_3007_01_AL	BOOL		000097	PT_3007_01_LOWALARM	AUTO	as the threshold is compared to the setpoint, the alarm is triggered after 1min/ Low pressure in the bioreactor
112	3007	A	CL3007_Bioreactor_Pressu_Control	PT_3007_01_ALL	BOOL		000098	PT_3007_01_VERYLOWALARM	AUTO	Very Low pressure in the bioreactor
113	3007	A	ERR_AI	PT_3007_01_ERR	BOOL		000099	PT_3007_01_BROKENWIRE	AUTO	SET if the wire is broken
114	3008	B	CL3008_Bioreactor_pH_Control	CL3008_ControlLoop_Mode	INT		400235	Bioreactor temperature mode	0 / 1 / 2	Mode Selector (OFF/Manu/Auto)
115	3008	B	CL3008_Bioreactor_pH_Control	PP_3008_01_OP	BOOL		000100	PP_3008_01	SET/RESET	Used to start or stop the ACID pump in Manual mode (If start, the valve SV_3008_01 is automatically opened and closed)
116	3008	B	CL3008_Bioreactor_pH_Control	PP_3008_01_OP_TIME	UDINT		400061	PP_3008_01_TIME	SET/RESET	Define the injection time of the ACID pump in Manual mode
117	3008	B	CL3008_Bioreactor_pH_Control	PP_3008_02_OP	BOOL		000101	PP_3008_02	SET/RESET	Used to start or stop the BASE pump in Manual mode(If start, the valve SV_3008_02 is automatically opened and closed)
118	3008	B	CL3008_Bioreactor_pH_Control	PP_3008_02_OP_TIME	UDINT		400063	PP_3008_01_TIME	SET/RESET	Define the injection time of the BASE pump in Manual mode
119	3008	B	CL3008_Bioreactor_pH_Control	CL3008_Reset_pH_Timer	BOOL		000102	Reset pH Timer	SET	RESET the Timer for both pH pump and set the new starting date and time for Timer
120	3008	B	CL3008_Bioreactor_pH_Control	SV_3008_01_OP	BOOL		000245	SV_3008_01_OP	SET/RESET	Used to open or close the valve in manual mode
121	3008	B	CL3008_Bioreactor_pH_Control	SV_3008_02_OP	BOOL		000246	SV_3008_02_OP	SET/RESET	Used to open or close the valve in manual mode
122	3008	B	CL3008_Bioreactor_pH_Control	CL3008_pH_selector	INT		400248	pH probe selector	SET/RESET	Define the pH probe used for the Control. (0=Average / 1 = AT_3008_01 / 2 = AT_3008_02)
123	3008	B	CL3008_Bioreactor_pH_Control	CL3008_pH_Mode	INT		400247	pH Mode selector		Define the pH mode for bioreactor pH control (1-Only CO2 / 2-CO2 and BASE / 3-CO2 is fixed and ACID+BASE)
124	3008	U	CL3008_Bioreactor_pH_Control	FQRC_3008_01_OP	REAL -> AO		400206	FQRC_3008_01 set point (CO2in ml/min)		Used to define the opening Set point of the mass flow controller valve in manual mode
125	3008	U	CL3008_Bioreactor_pH_Control	CL3008_pH_SP	REAL		400104	Bioreactor pH setpoint		Used to define the pH set point of the bioreactor

126	3008	U	CL3008_Bioreactor_pH_Control	CL3008_DeadZone	REAL		400106	pH Dead Zone configuration (+ / -)		Used to define the Dead Zone of the pH bioreactor
127	3008	I	CL3008_Bioreactor_pH_Control	CL3008_pH_AVERAGE	REAL		400218			
128	3008	I	CL3008_Bioreactor_pH_Control	CL3008_Base_Opening_Time	REAL		400184	Base injection time (s)		The timer is increasing in second
129	3008	I	CL3008_Bioreactor_pH_Control	CL3008_Acid_Opening_Time	REAL		400186	Acid injection time (s)		The timer is increasing in second
130	3008	I	CL3008_Bioreactor_pH_Control	CL3008_pH_Second	BYTE		400260			Date of the last reset done by the operator
131	3008	I	CL3008_Bioreactor_pH_Control	CL3008_pH_Minute	BYTE		400261			Date of the last reset done by the operator
132	3008	I	CL3008_Bioreactor_pH_Control	CL3008_pH_Hour	BYTE		400262			Date of the last reset done by the operator
133	3008	I	CL3008_Bioreactor_pH_Control	CL3008_pH_Day	BYTE		400263			Date of the last reset done by the operator
134	3008	I	CL3008_Bioreactor_pH_Control	CL3008_pH_Month	BYTE		400264			Date of the last reset done by the operator
135	3008	I	CL3008_Bioreactor_pH_Control	CL3008_pH_Year	BYTE		400265			Date of the last reset done by the operator
136	3008	E	CL3008_Bioreactor_pH_Control	PP_3008_01_MV	DO	000043	000043			Peristaltic Pump (acid)
137	3008	E	CL3008_Bioreactor_pH_Control	PP_3008_02_MV	DO	000044	000044			Peristaltic Pump (base)
138	3008	E	CL3008_Bioreactor_pH_Control	AT_3008_01	AI->REAL	300021	400108			pH element + transmitter
139	3008	E	CL3008_Bioreactor_pH_Control	TT_3008_01	AI->REAL	300040	400110			Temperature pH element
140	3008	E	CL3008_Bioreactor_pH_Control	AT_3008_02	AI->REAL	300020	400112			pH element + transmitter
141	3008	E	CL3008_Bioreactor_pH_Control	TT_3008_02	AI->REAL	300041	400114			Temperature pH element
142	3008	E	CL3008_Bioreactor_pH_Control	WIT_3008_01	AI->REAL	SCADA	400116			Acid Bottle weight indicator (+ weighing scale)
143	3008	E	CL3008_Bioreactor_pH_Control	WIT_3008_02	AI->REAL	SCADA	400118			Base Bottle weight indicator (+ weighing scale)
144	3008	E	CL3008_Bioreactor_pH_Control	SV_3008_01_MV	DO	000025	000025			Acid valve
145	3008	E	CL3008_Bioreactor_pH_Control	SV_3008_01_FB	DI	100027	100027			Acid valve feedback
146	3008	E	CL3008_Bioreactor_pH_Control	SV_3008_02_MV	DO	000027	000027			Base valve
147	3008	E	CL3008_Bioreactor_pH_Control	SV_3008_02_FB	DI	100026	100026			Base valve feedback
148	3008	E	CL3008_Bioreactor_pH_Control	FQRC_3008_01	AI->REAL	300036	400158			Flow element + transmitter (CO2)
149	3008	E	CL3008_Bioreactor_pH_Control	FQRC_3008_01_SP	REAL -> AO	400001	400188			Flow Control Valve non sterile gas (CO2)
150	3008	A	CL3008_Bioreactor_pH_Control	CL3008_pH_AH	BOOL		000103	CL3008_pH_HIGHALARM	AUTO	High pH in the Bioreactor Compared to the set point
151	3008	A	CL3008_Bioreactor_pH_Control	CL3008_pH_AHH	BOOL		000104	CL3008_pH_VERYHIGHALARM	AUTO	Very High pH in the Bioreactor Compared to the set point
152	3008	A	CL3008_Bioreactor_pH_Control	CL3008_pH_AL	BOOL		000105	CL3008_pH_LOWALARM	AUTO	Low pH in the Bioreactor Compared to the set point
153	3008	A	CL3008_Bioreactor_pH_Control	CL3008_pH_ALL	BOOL		000106	CL3008_pH_VERYLOWALARM	AUTO	Very Low pH in the Bioreactor Compared to the set point
154	3008	A	CL3008_Bioreactor_pH_Control	WIT_3008_01_AL	BOOL		000107	WIT_3008_01_LOWLEVELALARM	AUTO	Low Level in the ACID tank
155	3008	A	CL3008_Bioreactor_pH_Control	WIT_3008_01_ALL	BOOL		000108	WIT_3008_01_VERYLOWLEVELALARM	AUTO	Very Low Level in the ACID tank
156	3008	A	CL3008_Bioreactor_pH_Control	WIT_3008_02_AL	BOOL		000109	WIT_3008_02_LOWLEVELALARM	AUTO	Low Level in the BASE tank
157	3008	A	CL3008_Bioreactor_pH_Control	WIT_3008_02_ALL	BOOL		000110	WIT_3008_02_VERYLOWLEVELALARM	AUTO	Very Low Level in the BASE tank
158	3008	A	CL3008_Bioreactor_pH_Control	CL3008_SENSOR_DEVIATION_A	BOOL		000252	CL3008_SENSOR_DEVIATION_A	AUTO	Triggered when the pH gap between the two probes is more than 2
159	3008	A	CL3008_Bioreactor_pH_Control	FQRC_3008_01_AH	BOOL		000253	CL3008_FQRC_HIGHALARM	AUTO	The value asked is high compares to the value read on the mass flow controller
160	3008	A	CL3008_Bioreactor_pH_Control	FQRC_3008_01_AHH	BOOL		000254	CL3008_FQRC_VERYHIGHALARM	AUTO	The value asked is very high compares to the value read on the mass flow controller
161	3008	A	CL3008_Bioreactor_pH_Control	FQRC_3008_01_AL	BOOL		000255	CL3008_FQRC_LOWALARM	AUTO	The value asked is low compares to the value read on the mass flow controller
162	3008	A	CL3008_Bioreactor_pH_Control	FQRC_3008_01_ALL	BOOL		000256	CL3008_FQRC_VERYLOWALARM	AUTO	The value asked is very low compares to the value read on the mass flow controller
163	3008	A	ERR_AI	SV_3008_01_A	BOOL		000111	SV_3008_01_NOFEEDBACK	AUTO	Set if the feed back is not detected after 5 seconds
164	3008	A	ERR_AI	SV_3008_02_A	BOOL		000112	SV_3008_02_NOFEEDBACK	AUTO	Set if the feed back is not detected after 5 seconds
165	3008	A	ERR_AI	AT_3008_01_ERR	BOOL		000113	AT_3008_01_BROKENWIRE	AUTO	SET if the wire is broken
166	3008	A	ERR_AI	TT_3008_01_ERR	BOOL		000114	TT_3008_01_BROKENWIRE	AUTO	SET if the wire is broken
167	3008	A	ERR_AI	AT_3008_02_ERR	BOOL		000115	AT_3008_02_BROKENWIRE	AUTO	SET if the wire is broken
168	3008	A	ERR_AI	TT_3008_02_ERR	BOOL		000116	TT_3008_02_BROKENWIRE	AUTO	SET if the wire is broken
169	3008	A	ERR_AI	FQRC_3008_01_ERR	BOOL		000119	FQRC_3008_01_BROKENWIRE	AUTO	SET if the wire is broken
170	3009	B	CL3009_Bioreactor_D02_Control	CL3009_ControlLoop_Mode	INT		400236	Bioreactor temperature mode	0 / 1 / 2	Mode Selector (OFF/Manu/Auto)
171	3009	U	CL3009_Bioreactor_D02_Control	FQRC_3009_01_OP	REAL		400120	FQRC_3009_01 set point (O2)		Used to define the opening Set point of the mass flow controller valve in manual mode
172	3009	U	CL3009_Bioreactor_D02_Control	CL3009_DO2_SP	REAL		400172	CL3009 DO2 Set Point		Used to define the Set point of the Dissolved Oxygen in automatic mode (Controller set point)
173	3009	I	CL3009_Bioreactor_DO2_Control	CL3009_DO2_AVERAGE	REAL		400220	DO2 _AVG	SET/RESET	Display the Average of both Do2 AVG (yet the average is made 50% of AT_3009_01 and 50% AT_3009_02).
174	3009	B	CL3009_Bioreactor_DO2_Control	CL3009_DO2_selector	INT		400249	DO2 probe selector	SET/RESET	Define the DO2 probe used for the Control. (0=Average / 1 = AT_3009_01 / 2 = AT_3009_02)
175	3009	E	CL3009_Bioreactor_D02_Control	AT_3009_01	AI->REAL	300025	400122			Dissolved O2 transmitter (BOTTOM)
176	3009	E	CL3009_Bioreactor_D02_Control	AT_3009_02	AI->REAL	300024	400124			Dissolved O2 transmitter (TOP)
177	3009	E	CL3009_Bioreactor_D02_Control	FQRC_3009_01	AI->REAL	300037	400126			Flow element + transmitter (O2)
178	3009	E	CL3009_Bioreactor_D02_Control	FQRC_3009_01_SP	REAL -> AO	400002	400190			Flow Control Valve non sterile gas (O2)
179	3009	A	CL3009_Bioreactor_D02_Control	AT_3009_01_AH	BOOL		000120	AT_3009_01_HIGHALARM	AUTO	High percentage of Disolve Oxygen Compared to the set point
180	3009	A	CL3009_Bioreactor_D02_Control	AT_3009_01_AHH	BOOL		000121	AT_3009_01_VERYHIGHALARM	AUTO	Very High percentage of Disolve Oxygen Compared to the set point
181	3009	A	CL3009_Bioreactor_D02_Control	AT_3009_01_AL	BOOL		000122	AT_3009_01_LOWALARM	AUTO	Low percentage of Disolve Oxygen Compared to the set point
182	3009	A	CL3009_Bioreactor_D02_Control	AT_3009_01_ALL	BOOL		000123	AT_3009_01_VERYLOWALARM	AUTO	Very Low percentage of Disolve Oxygen Compared to the set point
183	3009	A	ERR_AI	AT_3009_01_ERR	BOOL		000124	AT_3009_01_BROKENWIRE	AUTO	SET if the wire is broken
184	3009	A	CL3009_Bioreactor_D02_Control	AT_3009_02_AH	BOOL		000125	AT_3009_02_HIGHALARM	AUTO	High percentage of Disolve Oxygen Compared to the set point
185	3009	A	CL3009_Bioreactor_D02_Control	AT_3009_02_AHH	BOOL		000126	AT_3009_02_VERYHIGHALARM	AUTO	Very High percentage of Disolve Oxygen Compared to the set point

186	3009	A	CL3009_Bioreactor_D02_Control	AT_3009_02_AL	BOOL		000127	AT_3009_02_LOWALARM	AUTO	Low percentage of Disolve Oxygen Compared to the set point
187	3009	A	CL3009_Bioreactor_D02_Control	AT_3009_02_ALL	BOOL		000128	AT_3009_02_VERYLOWALARM	AUTO	Very Low percentage of Disolve Oxygen Compared to the set point
188	3009	A	CL3009_Bioreactor_DO2_Control	FQRC_3009_01_AH	BOOL		000257	CL3009_FQRC_HIGHALARM	AUTO	High Flow in the O2 GAS Mass Flow Controller
189	3009	A	CL3009_Bioreactor_DO2_Control	FQRC_3009_01_AHH	BOOL		000258	CL3009_FQRC_VERYHIGHALARM	AUTO	Very High Flow in the O2 GAS Mass Flow Controller
190	3009	A	CL3009_Bioreactor_DO2_Control	FQRC_3009_01_AL	BOOL		000259	CL3009_FQRC_LOWALARM	AUTO	Low Flow in the GAS O2 Mass Flow Controller
191	3009	A	CL3009_Bioreactor_DO2_Control	FQRC_3009_01_ALL	BOOL		000260	CL3009_FQRC_VERYLOWALARM	AUTO	Very Low Flow in the O2 GAS Mass Flow Controller
192	3009	A	ERR_AI	AT_3009_02_ERR	BOOL		000129	AT_3009_02_BROKENWIRE	AUTO	SET if the wire is broken
193	3009	A	ERR_AI	FQRC_3009_01_ERR	BOOL		000130	FQRC_3009_01_BROKENWIRE	AUTO	SET if the wire is broken
194	3009	A	CL3009_Bioreactor_DO2_Control	CL3009_SENSOR_DEVIATION_A	BOOL		000262	CL3009_SENSOR_DEVIATION_A	AUTO	Triggered when the DO2 gap between the two probes is more than 2
195	3010	E	CL3010_Bioreactor_EC_Control	AT_3010_01	AI->REAL	300023	400128			Conductivity element + transmitter (BOTTOM)
196	3010	E	CL3010_Bioreactor_EC_Control	AT_3010_02	AI->REAL	300022	400130			Conductivity element + transmitter (TOP)
197	3010	A	CL3010_Bioreactor_EC_Control	AT_3010_01_AH	BOOL		000131	AT_3010_01_HIGHALARM	AUTO	To be confirmed by UAB High Electro Conductivity in the Bioreactor
198	3010	A	CL3010_Bioreactor_EC_Control	AT_3010_01_AHH	BOOL		000132	AT_3010_01_VERYHIGHALARM	AUTO	To be confirmed by UAB Very High Electro Conductivity in the Bioreactor
199	3010	A	CL3010_Bioreactor_EC_Control	AT_3010_01_AL	BOOL		000133	AT_3010_01_LOWALARM	AUTO	To be confirmed by UAB Low Electro Conductivity in the Bioreactor
200	3010	A	CL3010_Bioreactor_EC_Control	AT_3010_01_ALL	BOOL		000134	AT_3010_01_VERYLOWALARM	AUTO	To be confirmed by UAB Very Low Electro Conductivity in the Bioreactor
201	3010	A	ERR_AI	AT_3010_01_ERR	BOOL		000135	AT_3010_01_BROKENWIRE	AUTO	SET if the wire is broken
202	3010	A	CL3010_Bioreactor_EC_Control	AT_3010_02_AH	BOOL		000136	AT_3010_02_HIGHALARM	AUTO	High Electro Conductivity in the Bioreactor
203	3010	A	CL3010_Bioreactor_EC_Control	AT_3010_02_AHH	BOOL		000137	AT_3010_02_VERYHIGHALARM	AUTO	Very High Electro Conductivity in the Bioreactor
204	3010	A	CL3010_Bioreactor_EC_Control	AT_3010_02_AL	BOOL		000138	AT_3010_02_LOWALARM	AUTO	Low Electro Conductivity in the Bioreactor
205	3010	A	CL3010_Bioreactor_EC_Control	AT_3010_02_ALL	BOOL		000139	AT_3010_02_VERYLOWALARM	AUTO	Very Low Electro Conductivity in the Bioreactor
206	3010	A	ERR_AI	AT_3010_02_ERR	BOOL		000140	AT_3010_02_BROKENWIRE	AUTO	SET if the wire is broken
207	3011	B	CL3011_Gas_Loop	CL3011_ControlLoop_Mode	INT		400237	Bioreactor Gas Loop mode	0 / 1 / 2	Mode Selector (OFF/Manu/Auto)
208	3011	B	CL3011_Gas_Loop	GC_3011_01_OP	BOOL		000141	GC_3011_01	SET/RESET	Used to start or stop the gas compressor pump in manual mode
209	3011	U	CL3011_Gas_Loop	FQRC_3011_01_OP	REAL		400132	FQRC_3009_01 set point (N2)		Used to define the opening Set point of the mass flow controller valve in manual mode
210	3011	U	CL3011_Gas_Loop	FQRC_3011_02_OP	REAL		400134	FQRC_3009_01 set point (Gas Mix)		Used to define the opening Set point of the mass flow controller valve in manual mode
211	3011	U	CL3011_Gas_Loop	CL3011_GasMix_SP	REAL		400174	CL3011 Gas Mix Set Point (Gas Mix)		Used to define the Gas Mix Set point of the controller in automatic mode
212	3011	B	CL3011_Gas_Loop	SV_3011_01_OP	BOOL		000142	SV_3011_01	SET/RESET	Used to open or close the valve in manual mode
213	3011	B	CL3011_Gas_Loop	SV_3011_02_OP	BOOL		000143	SV_3011_02	SET/RESET	Used to open or close the valve in manual mode
214	3011	B	CL3011_Gas_Loop	SV_3011_03_OP	BOOL		000188	SV_3011_03	SET/RESET	Used to open or close the valve in manual mode / OLD NAME OF THE VALVE: SV_3016_01
215	3011	I	CL3011_Gas_Loop	SV_3011_Opening_Time	REAL		400210	SV_3011_02 Opening Time (s)		Display the time (in second) when the valve is opened since the last reset
216	3011	I	CL3011_Gas_Loop	SV_3011_02_Second	BYTE		400266			Date of last Reset
217	3011	I	CL3011_Gas_Loop	SV_3011_02_Minute	BYTE		400267			Date of last Reset
218	3011	I	CL3011_Gas_Loop	SV_3011_02_Day	BYTE		400272			Date of last Reset
219	3011	I	CL3011_Gas_Loop	SV_3011_02_Hour	BYTE		400268			Date of last Reset
220	3011	I	CL3011_Gas_Loop	SV_3011_02_Month	BYTE		400269			Date of last Reset
221	3011	I	CL3011_Gas_Loop	SV_3011_02_Year	BYTE		400270			Date of last Reset
222	3011	B	CL3011_Gas_Loop	SV_3011_02_Reset_Timer	BOOL		000247			Date of last Reset
223	3011	I	CL3011_Gas_Loop	SV_3011_02_Opening_Frequency	REAL		400212	SV_3011_02 Opening frequency		Display the Frequency per hour of the opening valve since the last reset
224	3011	E	CL3011_Gas_Loop	GC_3011_01_MV	DO	000037	000037			Gas compressor
225	3011	E	CL3011_Gas_Loop	FQRC_3011_01_SP	REAL -> AO	400003	400192			Flow Control Valve non sterile gas (N2)
226	3011	E	CL3011_Gas_Loop	FQRC_3011_01	AI->REAL	300038	400136			Flow element + transmitter (N2)
227	3011	E	CL3011_Gas_Loop	FQRC_3011_02_SP	REAL -> AO	400013	400202			Flow element + transmitter (mix)
228	3011	E	CL3011_Gas_Loop	FQRC_3011_02	AI->REAL	300019	400138			Flow element + transmitter (mix)
229	3011	E	CL3011_Gas_Loop	PT_3011_01	AI->REAL	300016	400140			Pressure transmitter
230	3011	E	CL3011_Gas_Loop	SV_3011_01_MV	DO	000022	000022			Reactor venting valve
231	3011	E	CL3011_Gas_Loop	SV_3011_01_FB	DI	100028	100028			Reactor venting valve feedback
232	3011	E	CL3011_Gas_Loop	SV_3011_02_MV	DO	000018	000018			Gas exhaust valve
233	3011	E	CL3011_Gas_Loop	SV_3011_02_FB	DI	100030	100030			Gas exhaust valve feedback
234	3011	E	CL3011_Gas_Loop	SV_3011_03_MV	DO	000024	000024			Gas introduction valve / OLD NAME OF THE VALVE: SV_3016_01
235	3011	E	CL3011_Gas_Loop	SV_3011_03_FB	DI	100032	100032			Gas introduction valve Feedback / OLD NAME OF THE VALVE: SV_3016_01
236	3011	A	CL3011_Gas_Loop	PT_3011_01_AH	BOOL		000144	PT_3011_01_HIGHALARM	AUTO	High pressure in the gas loop system
237	3011	A	CL3011_Gas_Loop	PT_3011_01_AHH	BOOL		000145	PT_3011_01_VERYHIGHALARM	AUTO	Very High pressure in the gas loop system
238	3011	A	CL3011_Gas_Loop	PT_3011_01_AL	BOOL		000146	PT_3011_01_LOWALARM	AUTO	Need to be tested by sherpa. If the threshold is too high, we can decrease to 30 or 20 Low pressure in the gas loop system
239	3011	A	CL3011_Gas_Loop	PT_3011_01_ALL	BOOL		000147	PT_3011_01_VERYLOWALARM	AUTO	Very Low pressure in the gas loop system
240	3011	A	CL3011_Gas_Loop	FQRC_3011_01_AH	BOOL		000263	CL3011_FQRC_01_HIGHALARM	AUTO	High Flow in the N2 GAS Mass Flow Controller
241	3011	A	CL3011_Gas_Loop	FQRC_3011_01_AHH	BOOL		000264	CL3011_FQRC_01_VERYHIGHALARM	AUTO	Very High Flow in the N2 GAS Mass Flow Controller
242	3011	A	CL3011_Gas_Loop	FQRC_3011_01_AL	BOOL		000265	CL3011_FQRC_01_LOWALARM	AUTO	Low Flow in the GAS N2 Mass Flow Controller
243	3011	A	CL3011_Gas_Loop	FQRC_3011_01_ALL	BOOL		000266	CL3011_FQRC_01_VERYLOWALARM	AUTO	Very Low Flow in the N2 GAS Mass Flow Controller
244	3011	A	ERR_AI	FQRC_3011_01_ERR	BOOL		000148	FQRC_3011_01_BROKENWIRE	AUTO	SET if the wire is broken
245	3011	A	CL3011_Gas_Loop	FQRC_3011_02_AH	BOOL		000267	CL3011_FQRC_02_HIGHALARM	AUTO	High Flow in the GAS MIX Mass Flow Controller
246	3011	A	CL3011_Gas_Loop	FQRC_3011_02_AHH	BOOL		000268	CL3011_FQRC_02_VERYHIGHALARM	AUTO	Very High Flow in the GAS MIX Mass Flow Controller
247	3011	A	CL3011_Gas_Loop	FQRC_3011_02_AL	BOOL		000269	CL3011_FQRC_02_LOWALARM	AUTO	Low Flow in the GAS MIX Mass Flow Controller

248	3011	A	CL3011_Gas_Loop	FQRC_3011_02_ALL	BOOL		000270	CL3011_FQRC_02_VERYLOWALARM	AUTO	Very Low Flow in the GAS MIX Mass Flow Controller
249	3011	A	ERR_AI	FQRC_3011_02_ERR	BOOL		000149	FQRC_3011_02_BROKENWIRE	AUTO	SET if the wire is broken
250	3011	A	ERR_AI	PT_3011_01_ERR	BOOL		000150	PT_3011_01_BROKENWIRE	AUTO	SET if the wire is broken
251	3011	A	ERR_AI	SV_3011_01_A	BOOL		000151	SV_3011_01_NOFEEDBACK	AUTO	Set if the feed back is not detected after 5 seconds
252	3011	A	ERR_AI	SV_3011_02_A	BOOL		000152	SV_3011_02_NOFEEDBACK	AUTO	Set if the feed back is not detected after 5 seconds
253	3011	A	CL3011_Gas_Loop	SV_3011_03_A	BOOL		000190	SV_3011_03_ALARM	AUTO	Set if the feed back is not detected after 5 seconds / OLD NAME OF THE VALVE: SV_3016_01
254	3012	E	CL3012_Gas_Temperature	TT_3012_01	AI->REAL	300001	400142			Air vent cold water temperature transmitter
255	3012	A	CL3012_Gas_Temperature	TT_3012_01_AH	BOOL		000153	TT_3012_01_HIGHALARM	AUTO	High Temperature in the Gas Cooling system
256	3012	A	CL3012_Gas_Temperature	TT_3012_01_AHH	BOOL		000154	TT_3012_01_VERYHIGHALARM	AUTO	Very High Temperature in the Gas Cooling system
257	3012	A	CL3012_Gas_Temperature	TT_3012_01_AL	BOOL		000155	TT_3012_01_LOWALARM	AUTO	Low Temperature in the Gas Cooling system
258	3012	A	CL3012_Gas_Temperature	TT_3012_01_ALL	BOOL		000156	TT_3012_01_VERYLOWALARM	AUTO	Very Low Temperature in the Gas Cooling system
259	3012	A	ERR_AI	TT_3012_01_ERR	BOOL		000232	TT_3012_01_BROKENWIRE	AUTO	SET if the wire is broken
260	3013	B	CL3013_Analysys of Liquid	SV_3013_01_OP	BOOL		000157	SV_3013_01	SET/RESET	Used to open or close the valve in manual mode
261	3013	B	CL3013_Analysys of Liquid	SV_3013_02_OP	BOOL		000158	SV_3013_02	SET/RESET	Used to open or close the valve in manual mode
262	3013	B	CL3013_Analysys of Liquid	SV_3013_03_OP	BOOL		000159	SV_3013_03	SET/RESET	Used to open or close the valve in manual mode
263	3013	E	CL3013_Analysys of Liquid	SV_3013_01_MV	DO	000028	000028			NH4 sampling valve
264	3013	E	CL3013_Analysys of Liquid	SV_3013_01_FB	DI	100036	100036			NH4 sampling valve Feedback
265	3013	E	CL3013_Analysys of Liquid	SV_3013_02_MV	DO	000029	000029			N03 sampling valve
266	3013	E	CL3013_Analysys of Liquid	SV_3013_02_FB	DI	100037	100037			N03 sampling valve Feedback
267	3013	E	CL3013_Analysys of Liquid	SV_3013_03_MV	DO	000030	000030			N02 sampling valve
268	3013	E	CL3013_Analysys of Liquid	SV_3013_03_FB	DI	100038	100038			N02 sampling valve Feedback
269	3013	B	CL3013_Analysys of Liquid	CL3013_NH4_ControlLoop_Mode	INT		400238	Gas_Analyser Loop mode	0 / 1 / 2	NH4 Analyzer Mode Selector (OFF/Manu/Auto)
270	3013	E	CL3013_Analysys of Liquid	AT_3013_01	REAL	SCADA	400144			NH4 Analyser
271	3013	I	CL3013_Analysys of Liquid	AT_3013_01_Status	BYTE		400422			Status of NH4 analyzer : 0 Stopped, 1 Analysis, 2 Calibration
272	3013	B	CL3013_Analysys of Liquid	AT_3013_01_Start_Analysis	BOOL		000279			Start Analysis from PLC and reset from SCADA server when analysis has finished
273	3013	U	CL3013_Analysys of Liquid	CL3013_NH4_Analysis_Time_CFG	UINT		400250			AUTOMATIC MODE ONLY / Configuration time in minute between two start analysis function (NH4+ analyzer)
274	3013	I	CL3013_Analysys of Liquid	CL3013_NH4_Analysis_Time	UINT		400251			AUTOMATIC MODE ONLY / Remaining time in minute before the next start analysis function (NH4+ analyzer)
275	3013	B	CL3013_Analysys of Liquid	AT_3013_01_Stop_Analyzer	BOOL		000289			Stop from PLC NH4+ Analysis
276	3013	B	CL3013_Analysys of Liquid	AT_3013_01_Start_Calibration	BOOL		000280			Start Calibration from PLC and reset from SCADA server when calibration has finished
277	3013	U	CL3013_Analysys of Liquid	CL3013_NH4_Calibration_Time_CFG	UINT		400252			AUTOMATIC MODE ONLY / Configuration time (in hour)between two Calibration function (NH4+ analyzer)
278	3013	I	CL3013_Analysys of Liquid	CL3013_NH4_Calibration_Time	UINT		400253			AUTOMATIC MODE ONLY / Remaining time (in hour) before the next Calibration function (NH4+ analyzer)
279	3013	A	CL3013_Analysys of Liquid	AT_3013_01_Calib_OutOfRange_A	BOOL		000282			Set from SCADA server when calibration has failed
280	3013	A	CL3013_Analysys of Liquid	AT_3013_01_ERROR	BOOL		000283			Alarm set when some communication errors appear.
281	3013	B	CL3013_Analysys of Liquid	CL3013_NO3_ControlLoop_Mode	INT		400273	Gas_Analyser Loop mode	0 / 1 / 2	NO3 Analyzer Mode Selector (OFF/Manu/Auto)
282	3013	E	CL3013_Analysys of Liquid	AT_3013_02	REAL	SCADA	400146			NO3 Analyser
283	3013	I	CL3013_Analysys of Liquid	AT_3013_02_Status	BYTE		400423			Status of NO3 analyzer : 0 Stopped, 1 Analysis, 2 Calibration
284	3013	B	CL3013_Analysys of Liquid	AT_3013_02_Start_Analysis	BOOL		000284			Start Analysis from PLC and reset from SCADA server when analysis has finished
285	3013	U	CL3013_Analysys of Liquid	CL3013_NO3_Analysis_Time_CFG	UINT		400254			AUTOMATIC MODE ONLY / Configuration time in minute between two start
286	3013	I	CL3013_Analysys of Liquid	CL3013_NO3_Analysis_Time	UINT		400255			AUTOMATIC MODE ONLY / Remaining time in minute before the next start analysis function (NO3- analyzer)
287	3013	B	CL3013_Analysys of Liquid	AT_3013_02_Stop_Analyzer	BOOL		000290			Stop from PLC NO3- Analysis
288	3013	B	CL3013_Analysys of Liquid	AT_3013_02_Start_Calibration	BOOL		000285			Start Calibration from PLC and reset from SCADA server when calibration has finished
289	3013	U	CL3013_Analysys of Liquid	CL3013_NO3_Calibration_Time_CFG	UINT		400256			AUTOMATIC MODE ONLY / Configuration time (in hour) between two Calibration function (NO3- analyzer)
290	3013	I	CL3013_Analysys of Liquid	CL3013_NO3_Calibration_Time	UINT		400257			AUTOMATIC MODE ONLY / Remaining time (in hour) before the next Calibration function (NO3- analyzer)
291	3013	A	CL3013_Analysys of Liquid	AT_3013_02_Calib_OutOfRange_A	BOOL		000287			Set from SCADA server when calibration has failed
292	3013	A	CL3013_Analysys of Liquid	AT_3013_02_ERROR	BOOL		000288			Alarm set when some communication errors appear.
293	3013	B	CL3013_Analysys of Liquid	CL3013_NO2_ControlLoop_Mode	INT		400274	Gas_Analyser Loop mode	0 / 1 / 2	NO2 Analyzer Mode Selector (OFF/Manu/Auto)
294	3013	E	CL3013_Analysys of Liquid	AT_3013_03	AI->REAL	300047	400148			NO2 Analyzer Refreshed Value
295	3013	B	CL3013_Analysys of Liquid	AT_3013_03_Start_Analysis	DO		000033			Start the NO2 analysis
296	3013	U	CL3013_Analysys of Liquid	CL3013_NO2_Analysis_Time_CFG	UINT		400258			AUTOMATIC MODE ONLY / Configuration time in minute between two start
297	3013	I	CL3013_Analysys of Liquid	CL3013_NO2_Analysis_Time	UINT		400259			AUTOMATIC MODE ONLY / Remaining time in minute before the next start analysis function (NO2- analyzer)
298	3013	B	CL3013_Analysys of Liquid	AT_3013_03_Stop_Analyzer	DO		000034			stop the NO2 analysis
299	3013	I	CL3013_Analysys of Liquid	AT_3013_03_Analyzing	DI		100046			NO2 Analysis Status
300	3013	I	CL3013_Analysys of Liquid	AT_3013_03_Calibrating	DI		100048			NO2 Calibration Status
301	3013	A	CL3013_Analysys of Liquid	SV_3013_01_A	BOOL		000163	SV_3013_01__ALARM	AUTO	Set if the feed back is not detected after 5 seconds
302	3013	A	CL3013_Analysys of Liquid	SV_3013_02_A	BOOL		000164	SV_3013_02__ALARM	AUTO	Set if the feed back is not detected after 5 seconds
303	3013	A	CL3013_Analysys of Liquid	SV_3013_03_A	BOOL		000165	SV_3013_03__ALARM	AUTO	Set if the feed back is not detected after 5 seconds
304	3013	A	CL3013_Analysys of Liquid	AT_3013_01_AH	BOOL		000166	AT_3013_01_HIGHALARM	AUTO	High level AMMONIA
305	3013	A	CL3013_Analysys of Liquid	AT_3013_01_AHH	BOOL		000167	AT_3013_01_VERYHIGHALARM	AUTO	Very High level AMMONIA
306	3013	A	CL3013_Analysys of Liquid	AT_3013_02_AH	BOOL		000170	AT_3013_02_HIGHALARM	AUTO	High level of NITRATE
307	3013	A	CL3013_Analysys of Liquid	AT_3013_02_AHH	BOOL		000171	AT_3013_02_VERYHIGHALARM	AUTO	Very High level of NITRATE
308	3013	A	CL3013_Analysys of Liquid	AT_3013_02_AL	BOOL		000172	AT_3013_02_LOWALARM	AUTO	Low level of NITRATE
309	3013	A	CL3013_Analysys of Liquid	AT_3013_02_ALL	BOOL		000173	AT_3013_02_VERYLOWALARM	AUTO	Very Lowlevel of NITRATE
310	3013	A	CL3013_Analysys of Liquid	AT_3013_03_AH	BOOL		000174	AT_3013_03_HIGHALARM	AUTO	High level of NITRITE

311	3013	A	CL3013_Analysys of Liquid	AT_3013_03_AHH	BOOL		000175	AT_3013_03_VERYHIGHALARM	AUTO	Very High level of NITRITE
312	3013	A	ERR_AI	AT_3013_03_ERR	BOOL		000180	AT_3013_01_BROKENWIRE	AUTO	SET if the wire is broken
313	3014	E	CL3014_Biomass_Control	AT_3014_01	REAL	SCADA	400204			Biomass sensor
314	3014	A	CL3014_Biomass_Control	AT_3014_01_H	BOOL		000182	AT_3014_01_HIGHALARM	AUTO	threshold: ?
315	3014	A	CL3014_Biomass_Control	AT_3014_01_HH	BOOL		000183	AT_3014_01_VERYHIGHALARM	AUTO	threshold: ?
316	3014	A	CL3014_Biomass_Control	AT_3014_01_L	BOOL		000184	AT_3014_01_LOWALARM	AUTO	threshold: ?
317	3014	A	CL3014_Biomass_Control	AT_3014_01_LL	BOOL		000185	AT_3014_01_VERYLOWALARM	AUTO	threshold: ?
318	3014	A	CL3014_Biomass_Control	AT_3014_01_ERR	BOOL		000186	AT_3014_01_BROKENWIRE	AUTO	SET if the wire is broken
319	3015	B	CL3015_Backwashing	CL3015_ControlLoop_Mode	INT		400239	Backwashing Loop mode	0 / 1 / 2	Mode Selector (OFF/Manu/Auto)
320	3015	B	CL3015_Backwashing	PP_3015_01_OP	BOOL		000187	PP_3015_01	SET/RESET	Used to start and stop the pump in manual mode
321	3015	E	CL3015_Backwashing	PP_3015_01_MV	DO	000040	000040			Peristaltic Pump multichannel, variable speed (backwash)
322	3015	U	CL3015_Backwashing	CL3015_BACKWASHING_DURATI ON	UDINT		400065	Backwashing Duration		Duration of the backwashing (second)
323	3016	U	CL3016_Gas_Pulse	CL3016_OXYGENPULSE_NUMBE R	INT		400246	Oxygen Pulse Number		Number of the oxygen pulse done during the sequence
324	3016	U	CL3016_Gas_Pulse	CL3016_BOTTOM_OPENING_TIM E	UDINT		400430	Oxygen Pulse Bottom Opening Time		Opening Time of valves SV_3016_01 and SV_3011_01
325	3016	U	CL3016_Gas_Pulse	CL3016_BOTTOM_CLOSING_TIME	UDINT		400432	Oxygen Pulse Bottom Closing Time		Closing Time of valves SV_3016_01 and SV_3011_01
326	3016	U	CL3016_Gas_Pulse	CL3016_TOP_OPENING_TIME	UDINT		400434	Oxygen Pulse Top Opening Time		Opening Time of valves SV_3016_02
327	3016	U	CL3016_Gas_Pulse	CL3016_TOP_CLOSI NG_TIME	UDINT		400436	Oxygen Pulse Top Closing Time		Closing Time of valves SV_3016_02
328	3016	B	CL3016_Gas_Pulse	CL3016_ControlLoop_Mode	INT		400240	Oxygen Loop mode	0 / 1 / 2	Mode Selector (OFF/Manu/Auto)
329	3016	B	CL3016_Gas_Pulse	SV_3016_01_OP	BOOL		000189	SV_3016_01	SET/RESET	Used to open or close the valve in manual mode / OLD NAME OF THE VALVE: SV_3016_02
330	3016	E	CL3016_Gas_Pulse	SV_3016_01_MV	DO	000026	000026			Gas introduction valve / OLD NAME OF THE VALVE: SV_3016_02
331	3016	E	CL3016_Gas_Pulse	SV_3016_01_FB	DI	100031	100031			Gas introduction valve Feedback / OLD NAME OF THE VALVE: SV_3016_02
332	3016	A	CL3016_Gas_Pulse	SV_3016_01_A	BOOL		000191	SV_3016_01_ALARM	AUTO	Set if the feed back is not detected after 5 seconds / OLD NAME OF THE VALVE: SV_3016_02
333	3017	B	CL3017_Liquid_Recirculation	CL3017_ControlLoop_Mode	INT		400241	Liquid_Recirculation Loop mode	0 / 1 / 2	Mode Selector (OFF/Manu/Auto)
334	3017	B	CL3017_Liquid_Recirculation	PP_3017_01_OP	BOOL		000192	PP_3017_01	SET/RESET	Used to start or stop the peristaticr pump in manual mode
335	3017	U	CL3017_Liquid_Recirculation	PP_3017_01_SP	REAL -> AI		400150	PP_3017_01 Set Point		Used to define the speed of the peristatic pump in manual mode
336	3017	U	CL3017_Liquid_Recirculation	CL3017_FLOW_SP	REAL -> AI		400176	Liquid recirculation flow set point		Used to define the flow set point of the recirculation loop in automatic mode
337	3017	B	CL3017_Liquid_Recirculation	PP_3017_01_ROT	BOOL		000193	CW / CCW	SET/RESET	Used to define the Rotation direction of the peristatic pump in manual mode
338	3017	E	CL3017_Liquid_Recirculation	FT_3017_01	AI->REAL	300013	400152			Flow element + transmitter (recirc)
339	3017	E	CL3017_Liquid_Recirculation	PP_3017_01_MV1	DO	000047	000047			Peristaltic Pump multichannel, variable speed (recirc / ON - OFF)
340	3017	E	CL3017_Liquid_Recirculation	PP_3017_01_MV2	REAL -> AO	400012	400200			Peristaltic Pump multichannel, variable speed (recirc)
341	3017	E	CL3017_Liquid_Recirculation	PP_3017_01_MV3	DO	000048	000048			Peristaltic Pump, ROTATION DIRECTION
342	3017	A	CL3017_Liquid_Recirculation	FT_3017_01_AH	BOOL		000194	FT_3017_01_HIGHALARM	AUTO	Compared to the set point The time for triggering the alarm need to be define (1min) High Flow in the Recirculation Loop
343	3017	A	CL3017_Liquid_Recirculation	FT_3017_01_AHH	BOOL		000195	FT_3017_01_VERYHIGHALARM	AUTO	Compared to the set point The time for triggering the alarm need to be define (1min) Very High Flow in the recirculation Loop
344	3017	A	CL3017_Liquid_Recirculation	FT_3017_01_AL	BOOL		000196	FT_3017_01_LOWALARM	AUTO	Compared to the set point The time for triggering the alarm need to be define (1min) Low Flow in the Recirculation Loop
345	3017	A	CL3017_Liquid_Recirculation	FT_3017_01_ALL	BOOL		000197	FT_3017_01_VERYLOWALARM	AUTO	Compared to the set point The time for triggering the alarm need to be define (1min) Very Low Flow in the Recirculation Loop
346	3017	A	ERR_AI	FT_3017_01_ERR	BOOL		000198	FT_3017_01_BROKENWIRE	AUTO	SET if the wire is broken
347	3018	B	CL3018_Outlet_liquid_Control	CL3018_ControlLoop_Mode	INT		400242	Outlet_liquid Loop mode	0 / 1 / 2	Mode Selector (OFF/Manu/Auto)
348	3018	B	CL3018_Outlet_liquid_Control	PP_3018_01_OP	BOOL		000199	PP_3018_01	SET/RESET	Used to start or stop the peristatic pump in manual mode
349	3018	U	CL3018_Outlet_liquid_Control	PP_3018_01_SP	REAL -> AI		400154	PP_3018_01 Set Point		Used to define the speed of the peristatic pump in manual mode
350	3018	U	CL3018_Outlet_liquid_Control	CL3018_FLOW_SP	REAL -> AI		400170	Flow Controler Set Point		Used to define the Set Point of the flow in Automatic mode
351	3018	B	CL3018_Outlet_liquid_Control	PP_3018_01_ROT	BOOL		000200	CW / CCW	SET/RESET	Used to define the Rotation direction of the peristatic pump in manual mode
352	3018	E	CL3018_Outlet_liquid_Control	FT_3018_01	AI->REAL	300014	400156			Flow element + transmitter (harvest)
353	3018	E	CL3018_Outlet_liquid_Control	PP_3018_01_MV1	DO	000041	000041			Peristaltic Pump multichannel, variable speed (harvest / ON - OFF)
354	3018	E	CL3018_Outlet_liquid_Control	PP_3018_01_MV2	REAL -> AO	400010	400196			Peristaltic Pump multichannel, variable speed (harvest)
355	3018	E	CL3018_Outlet_liquid_Control	PP_3018_01_MV3	DO	000042	000042			Peristaltic Pump, ROTATION DIRECTION
356	3018	E	CL3018_Outlet_liquid_Control	SV_3018_01_MV	DO	000020	000020			Reactor liquid outlet valve
357	3018	B	CL3018_Outlet_liquid_Control	SV_3018_01_OP	BOOL		000249	SV_3018_01		Used to open and close the valve in manual mode
358	3018	E	CL3018_Outlet_liquid_Control	SV_3018_01_FB	DI	100029	100029			Reactor liquid outlet valve Feedback
359	3018	A	CL3018_Outlet_liquid_Control	FT_3018_01_AH	BOOL		000201	FT_3018_01_HIGHALARM	AUTO	Compared to the set point and triggered after 1 min action is done in level control High Flow in outlet liquid Loop
360	3018	A	CL3018_Outlet_liquid_Control	FT_3018_01_AHH	BOOL		000202	FT_3018_01_VERYHIGHALARM	AUTO	Compared to the set point and triggered after 1 min action is done in level control Very High flow in outlet liquid Loop
361	3018	A	CL3018_Outlet_liquid_Control	FT_3018_01_AL	BOOL		000203	FT_3018_01_LOWALARM	AUTO	Compared to the set point and triggered after 1 min action is done in level control Low Flow in outlet liquid Loop
362	3018	A	CL3018_Outlet_liquid_Control	FT_3018_01_ALL	BOOL		000204	FT_3018_01_VERYLOWALARM	AUTO	Compared to the set point and triggered after 1 min action is done in level control Very Low Flow in outlet liquid Loop
363	3018	A	ERR_AI	FT_3018_01_ERR	BOOL		000205	FT_3018_01_BROKENWIRE	AUTO	SET if the wire is broken
364	3018	A	CL3018_Outlet_liquid_Control	SV_3018_01_A	BOOL		000206	SV_3018_01_ALARM	AUTO	Set if the feed back is not detected after 5 seconds
365	3020	B	CL3020_Effluent_Temperature	CL3020_ControlLoop_Mode	INT		400243	Outlet_liquid Loop mode	0 / 1 / 2	Mode Selector (OFF/Manu/Auto)
366	3020	B	CL3020_Effluent_Temperature	SV_3020_01_OP	BOOL		000207	SV_3020_01	SET/RESET	Used to open and close the valve in manual mode

367	3020	U	CL3020_Effluent_Temperature	TT_3020_01_SP	REAL		400160	TT_3020_01_Set Point		Used to define the temperature set point of effluent tank
368	3020	E	CL3020_Effluent_Temperature	SV_3020_01_MV	DO	000017	000017			Temperature Control Valve
369	3020	E	CL3020_Effluent_Temperature	SV_3020_01_FB	DI	100033	100033			Temperature Control Valve Feedback
370	3020	E	CL3020_Effluent_Temperature	TT_3020_01	AI->REAL	300003	400162			Temperature element + transmitter (D04)
371	3020	A	CL3020_Effluent_Temperature	TT_3020_01_AH	BOOL		000208	TT_3020_01_HIGHALARM	AUTO	Compared to the set point High temperature in the effluent Tank
372	3020	A	CL3020_Effluent_Temperature	TT_3020_01_AHH	BOOL		000209	TT_3020_01_VERYHIGHALARM	AUTO	Compared to the set point Very High temperature in the effluent Tank
373	3020	A	CL3020_Effluent_Temperature	TT_3020_01_AL	BOOL		000210	TT_3020_01_LOWALARM	AUTO	Compared to the set point Low Temperature in the effluent Tank
374	3020	A	CL3020_Effluent_Temperature	TT_3020_01_ALL	BOOL		000211	TT_3020_01_VERYLOWALARM	AUTO	Compared to the set point Very Low Temperature in the effluent Tank
375	3020	A	ERR_AI	TT_3020_01_ERR	BOOL		000212	TT_3020_01_BROKENWIRE	AUTO	SET if the wire is broken
376	3020	A	CL3020_Effluent_Temperature	SV_3020_01_A	BOOL		000213	SV_3020_01_ALARM	AUTO	Set if the feed back is not detected after 5 seconds
377	3021	E	CL3021_Effluent_Level	LSH_3021_01	DI	100023	100023			Level switch (Vibrating horizontal)
378	3021	A	CL3021_Effluent_Level	LSH_3021_01_A	BOOL		000277	LEVEL SWITCH ALARM	AUTO	The alarm is triggered after 10s
379	3021	E	CL3021_Effluent_Level	LSH_3021_02	DI	100024	100024			Level switch (Vibrating horizontal)
380	3021	A	CL3021_Effluent_Level	LSH_3021_02_A	BOOL		000278	LEVEL SWITCH ALARM	AUTO	The alarm is triggered after 10s
381	3021	E	CL3021_Effluent_Level	LT_3021_01	AI->REAL	300009	400164			Level transmitter (capacitive)
382	3021	A	CL3021_Effluent_Level	LT_3021_01_AH	BOOL		000248	LT_3021_01_VERYHIGHALARM	AUTO	High level on Effluent tank
383	3021	A	CL3021_Effluent_Level	LT_3021_01_AHH	BOOL		000214	LT_3021_01_VERYHIGHALARM	AUTO	Very High level on Effluent tank
384	3021	A	CL3021_Effluent_Level	LT_3021_01_AL	BOOL		000215	LT_3021_01_LOWALARM	AUTO	Low level in Effluent Tank
385	3021	A	CL3021_Effluent_Level	LT_3021_01_ALL	BOOL		000216	LT_3021_01_VERYLOWALARM	AUTO	Very Low in Effluent Tank
386	3021	A	ERR_AI	LT_3021_01_ERR	BOOL		000217	LT_3021_01_BROKENWIRE	AUTO	SET if the wire is broken
387	3022	B	CL3022_Foam_Control	CL3022_ControlLoop_Mode	INT		400244	Outlet_liquid Loop mode	0 / 1 / 2	Mode Selector (OFF/Manu/Auto)
388	3022	B	CL3022_Foam_Control	PP_3022_01_OP	BOOL		000218	PP_3022_01	SET/RESET	Used to start or stop the peristatic pump in manual mode
389	3022	E	CL3022_Foam_Control	LT_3022_01	AI->REAL	NC	400166			Level transmitter (capacitive). Used to detect foam level (2010/10/12: At the current date, this sensor doesn't exist)
390	3022	E	CL3022_Foam_Control	PP_3022_01_MV	DO	000032	000032			Peristaltic Pump multichannel, variable speed Anti-foam (= future)
391	3022	A	CL3022_Foam_Control	LT_3022_01_AH	BOOL		000219	LT_3022_01_HIGHALARM	AUTO	threshold: ?
392	3022	A	CL3022_Foam_Control	LT_3022_01_AHH	BOOL		000220	LT_3022_01_VERYHIGHALARM	AUTO	threshold: ?
393	3022	A	CL3022_Foam_Control	LT_3022_01_AL	BOOL		000221	LT_3022_01_LOWALARM	AUTO	threshold: ?
394	3022	A	CL3022_Foam_Control	LT_3022_01_ALL	BOOL		000222	LT_3022_01_VERYLOWALARM	AUTO	threshold: ?
395	3022	A	ERR_AI	LT_3022_01_ERR	BOOL		000223	LT_3022_01_BROKENWIRE	AUTO	SET if the wire is broken
396	System Clock	SC	-	-	-		400400			PLC Reserved Address
397	System Clock	SC	-	-	-		400401			PLC Reserved Address
398	System Clock	SC	-	-	-		400402			PLC Reserved Address
399	System Clock	SC	-	-	-		400403			PLC Reserved Address
400	System Clock	SC	-	-	-		400404			PLC Reserved Address
401	System Clock	SC	-	-	-		400405			PLC Reserved Address
402	System Clock	SC	-	-	-		400406			PLC Reserved Address
403	System Clock	SC	-	-	-		400407			PLC Reserved Address
404	System Clock	SC	System_Clock	CIII_SysClock_dayofweek	BYTE		400408			1 = Sunday .. 7 = Saturday
405	System Clock	SC	System_Clock	CIII_SysClock_dayofweek_SET	BYTE		400415			configure the day of the week (1 = Sunday .. 7 = Saturday)
406	System Clock	SC	System_Clock	CIII_SysClock_Year	BYTE		400409			Year 0..99
407	System Clock	SC	System_Clock	CIII_SysClock_Year_SET	BYTE		400416			configure the Year (0..99)
408	System Clock	SC	System_Clock	CIII_SysClock_Month	BYTE		400410			Month 1..12
409	System Clock	SC	System_Clock	CIII_SysClock_Month_SET	BYTE		400417			configure the Month (1..12)
410	System Clock	SC	System_Clock	CIII_SysClock_Day	BYTE		400411			Day 1..31
411	System Clock	SC	System_Clock	CIII_SysClock_Day_SET	BYTE		400418			configure the Day (1..31)
412	System Clock	SC	System_Clock	CIII_SysClock_Hour	BYTE		400412			Hour 0..23
413	System Clock	SC	System_Clock	CIII_SysClock_Hour_SET	BYTE		400419			configure the Hour (0..23)
414	System Clock	SC	System_Clock	CIII_SysClock_Minute	BYTE		400413			Minute 0..59
415	System Clock	SC	System_Clock	CIII_SysClock_Minute_SET	BYTE		400420			configure the Minute (0..59)
416	System Clock	SC	System_Clock	CIII_SysClock_Second	BYTE		400414			Second 0..59
417	System Clock	SC	System_Clock	CIII_SysClock_Second_SET	BYTE		400421			configure the Second (0..59)
418	System Clock	SC	System_Clock	CIII_SC_Activate_Setting	BOOL		000242	Used to set the date and the clock of the PLC		
419	3023	E	CL3023_Sterilisation	TT_3023_01	AI->REAL	300048	400178			Mobile temperature used for sterilisation
420	3023	E	CL3023_Sterilisation	TT_3023_02	AI->REAL	300049	400180			Mobile temperature used for sterilisation
421	3023	E	CL3023_Sterilisation	TT_3023_03	AI->REAL	300050	400182			Mobile temperature used for sterilisation
422	3023	A	CL3023_Sterilisation	TT_3023_01_ERR	BOOL		000225	TT_3023_01_BROKENWIRE		SET if the wire is broken
423	3023	A	CL3023_Sterilisation	TT_3023_02_ERR	BOOL		000226	TT_3023_02_BROKENWIRE		SET if the wire is broken
424	3023	A	CL3023_Sterilisation	TT_3023_03_ERR	BOOL		000227	TT_3023_03_BROKENWIRE		SET if the wire is broken
425	General_Alarm	I	ALARM_STATUS	CIII_HighLowAlarm_status	BOOL		000239	High and Low compartment Alarm Status		general High Low alarm indicator of the CIVB
426	General_Alarm	I	ALARM_STATUS	CIII_VeryHighLowAlarm_status	BOOL		000240	Very Hih and Low compartment Alarm Status		general Very High Low alarm indicator of the CIVB
427	General_Alarm	I	ALARM_STATUS	CIII_General_alarm_status	INT		400438	general alarm status		general alarm status (0= no ongoing alarm / 1= High or Low ongoing alarm / 2= Very High or Very low ongoing alarm)

Legend--> to be defined or confirmed

INDEX	Control Loop	DFB Name	Threshold variable name	Type	HMI Address	Value	Unit	ACTION	Comments
1	-	all Valves	FB_TIME_LIM	TIME	400500	5	Second	Displays an alarm on the HMI	Maximum time between the valve command and the feed back
2		All Level switch	LS_TIME_LIM	TIME	400736	10	Second	Displays an alarm on the HMI	Maximum time between the The level triggering and the alarm
3	3001	CL3001_Influent_Temp_Control	TT_3001_01_LIM_H	REAL	400512	1	°C	Displays an alarm on the HMI only in automatic mode	High temperature in the influent Tank Compared to the set point
4	3001	CL3001_Influent_Temp_Control	TT_3001_01_LIM_HH	REAL	400514	2	°C	Displays an alarm on the HMI only in automatic mode	Very High temperature in the influent Tank Compared to the set point
5	3001	CL3001_Influent_Temp_Control	TT_3001_01_LIM_L	REAL	400516	-1	°C	Displays an alarm on the HMI only in automatic mode	Low Temperature in the influent Tank Compared to the set point
6	3001	CL3001_Influent_Temp_Control	TT_3001_01_LIM_LL	REAL	400518	-2	°C	Displays an alarm on the HMI only in automatic mode	Very Low Temperature in the influent Tank Compared to the set point
7	3002	CL3002_Influent_Level_Control	LT_3002_01_LIM_H	REAL	400520	30	LITRE	Displays an alarm on the HMI	High level in Influent Tank fix value
8	3002	CL3002_Influent_Level_Control	LT_3002_01_LIM_HH	REAL	400522	34	LITRE	Displays an alarm on the HMI / depends on the futur link between CII and CIII.	Very High Level in the Influent Tank fix value
9	3002	CL3002_Influent_Level_Control	LT_3002_01_LIM_L	REAL	400702	6	LITRE	Displays an alarm on the HMI	Very low Level in the Influent Tank fix value
10	3002	CL3002_Influent_Level_Control	LT_3002_01_LIM_LL	REAL	400524	3	LITRE	Stop the control loop 3003 (pump PP_3003_01)	Very low Level in the Influent Tank fix value
11	3003	CL3003_Inlet_Liquid_Control	FT_3003_01_LIM_H	REAL	400526	0.1	L/min	Displays an alarm on the HMI only in automatic mode	High Flow on the bioreactor inlet liquid Implement a time for triggering alarm (5min). Compared to the set point
12	3003	CL3003_Inlet_Liquid_Control	FT_3003_01_LIM_HH	REAL	400528	0.2	L/min	Stop the control loop 3003 (pump PP_3003_01) only in automatic mode	Very High Flow on the bioreactor inlet liquid Implement a time for triggering alarm (5min). Compared to the set point
13	3003	CL3003_Inlet_Liquid_Control	FT_3003_01_LIM_L	REAL	400530	-0.1	L/min	Displays an alarm on the HMI only in automatic mode	Low Flow on the bioreactor inlet liquid Implement a time for triggering alarm (5min). Compared to the set point
14	3003	CL3003_Inlet_Liquid_Control	FT_3003_01_LIM_LL	REAL	400532	-0.2	L/min	Displays an alarm on the HMI only in automatic mode	Very Low Flow on the bioreactor inlet liquid Implement a time for triggering alarm (5min). Compared to the set point
15	3003	CL3003_Inlet_Liquid_Control	PT_3003_01_LIM_H	REAL	400534	TBD 45	mBar	Displays an alarm on the HMI	High Flow on the bioreactor inlet liquid
16	3003	CL3003_Inlet_Liquid_Control	PT_3003_01_LIM_HH	REAL	400536	TBD 50	mBar	Stop the control loop 3003 (pump PP_3003_01)	Very High Flow on the bioreactor inlet liquid The maximum admissible pressure for the membrane has to be confirmed by Enrique
17	3003	CL3003_Inlet_Liquid_Control	PT_3003_01_LIM_L	REAL	400538	TBD 5	mBar	Displays an alarm on the HMI	Low Flow on the bioreactor inlet liquid
18	3003	CL3003_Inlet_Liquid_Control	PT_3003_01_LIM_LL	REAL	400540	TBD 0	mBar	Stop the control loop 3003 (pump PP_3003_01)	Very Low Flow on the bioreactor inlet liquid The minimum admissible pressure for the membrane has to be confirmed by Enrique
19	3004	CL3004_Bioreactor_General	BLE_3004_01_LIM_H	REAL	400542	5	%	Displays an alarm on the HMI	High speed on the bioreactor blender (Compared to the set point)
20	3004	CL3004_Bioreactor_General	BLE_3004_01_LIM_L	REAL	400544	-5	%	Displays an alarm on the HMI	Low speed on the bioreactor blender (Compared to the set point)
21	3005	CL3005_Bioreactor_Temp_Control	TT_3005_01_LIM_H	REAL	400546	1	°C	Displays an alarm on the HMI only in automatic mode	Compared to the set point High Temperature in the bioreactor
22	3005	CL3005_Bioreactor_Temp_Control	TT_3005_01_LIM_HH	REAL	400548	4	°C	Displays an alarm on the HMI only in automatic mode	Compared to the set point Very High Temperature in the bioreactor
23	3005	CL3005_Bioreactor_Temp_Control	TT_3005_01_LIM_L	REAL	400550	-1	°C	Displays an alarm on the HMI only in automatic mode	Compared to the set point High Temperature in the bioreactor
24	3005	CL3005_Bioreactor_Temp_Control	TT_3005_01_LIM_LL	REAL	400552	-4	°C	Displays an alarm on the HMI only in automatic mode	Compared to the set point Very High Temperature in the bioreactor
25	3005	CL3005_Bioreactor_Temp_Control	TT_3005_02_LIM_H	REAL	400554	1	°C	Displays an alarm on the HMI only in automatic mode	Compared to the set point High Temperature in the bioreactor Jacket
26	3005	CL3005_Bioreactor_Temp_Control	TT_3005_02_LIM_HH	REAL	400556	4	°C	Displays an alarm on the HMI only in automatic mode	Compared to the set point Very High Temperature in the bioreactor Jacket
27	3005	CL3005_Bioreactor_Temp_Control	TT_3005_02_LIM_L	REAL	400558	-1	°C	Displays an alarm on the HMI only in automatic mode	Compared to the set point High Temperature in the bioreactor Jacket
28	3005	CL3005_Bioreactor_Temp_Control	TT_3005_02_LIM_LL	REAL	400560	-4	°C	Displays an alarm on the HMI only in automatic mode	Compared to the set point Very High Temperature in the bioreactor Jacket
29	3006	CL3006_Bioreactor_Level_Control	LT_3006_01_LIM_H	REAL	400704	12200	LITRE	Only in automatic mode Displays an alarm on the HMI	High Level in Bioreactor
30	3006	CL3006_Bioreactor_Level_Control	LT_3006_01_LIM_HH	REAL	400562	12300	LITRE	Stop the Inlet liquid control loop Only in automatic mode Displays an alarm on the HMI	Very High Level in Bioreactor after calibration of the sensor, we will define the HH level threshold similar to the level switch High
31	3006	CL3006_Bioreactor_Level_Control	LT_3006_01_LIM_L	REAL	400706	11300	LITRE	Only in automatic mode Displays an alarm on the HMI	Low Level in Bioreactor. This alarm should be linked to the recirculation line and also to the output liquid flow line. the alarm is triggered when the level
32	3006	CL3006_Bioreactor_Level_Control	LT_3006_01_LIM_LL	REAL	400564	11200	LITRE	Displays an alarm on the HMI Only in automatic mode Stop the recirculation loop and the outlet loop.	Very Low Level in Bioreactor. This alarm should be linked with the bioreactor sensor positionning to prevent bad mesurement.
33	3007	CL3007_Bioreactor_Pressu_Control	PT_3007_01_LIM_H	REAL	400566	100	mBar	Displays an alarm on the HMI	High pressure in the bioreactor (fix value)
34	3007	CL3007_Bioreactor_Pressu_Control	PT_3007_01_LIM_HH	REAL	400568	200	mBar	Displays an alarm on the HMI	Very High pressure in the bioreactor (fix value)

35	3007	CL3007_Bioreactor_Pressu_Control	PT_3007_01_LIM_L	REAL	400570	-20	mBar	Displays an alarm on the HMI	The alarm is triggered after 1min/ Low pressure in the bioreactor (Compared to SP)
36	3007	CL3007_Bioreactor_Pressu_Control	PT_3007_01_LIM_LL	REAL	400572	0	mBar	Displays an alarm on the HMI	Very Low pressure in the bioreactor (fix value)
37	3007	CL3007_Bioreactor_Pressu_Control	DPT_3007_01_LIM_H	REAL	400574	200 mbar	mBar	Displays an alarm on the HMI	TO BE CONFIRMED BY UAB High differential pressure in the bioreactor
38	3007	CL3007_Bioreactor_Pressu_Control	DPT_3007_01_LIM_HH	REAL	400576	500 mBar	mBar	Displays an alarm on the HMI	TO BE CONFIRMED BY UAB Very High differential pressure in the bioreactor
39	3007	CL3007_Bioreactor_Pressu_Control	DPT_3007_01_LIM_L	REAL	400578	TBD	mBar	Displays an alarm on the HMI	Do a test with only beeds to see the DPT, then the threshold will vbe this DP Low differential pressure in the bioreactor
40	3007	CL3007_Bioreactor_Pressu_Control	DPT_3007_01_LIM_LL	REAL	400580	0	mBar	Displays an alarm on the HMI	Very Low differential pressure in the bioreactor
41	3008	CL3008_Bioreactor_pH_Control	CL3008_pH_LIM_H	REAL	400582	0.1	-	Displays an alarm on the HMI Only in automatic mode	High pH in the Bioreactor Compared to the set point
42	3008	CL3008_Bioreactor_pH_Control	CL3008_pH_LIM_HH	REAL	400584	0.5	-	cut the pH control loop Displays an alarm on the HMI Only in automatic mode	Very High pH in the Bioreactor Compared to the set point
43	3008	CL3008_Bioreactor_pH_Control	CL3008_pH_LIM_L	REAL	400586	-0.1	-	Displays an alarm on the HMI Only in automatic mode	Low pH in the Bioreactor Compared to the set point
44	3008	CL3008_Bioreactor_pH_Control	CL3008_pH_LIM_LL	REAL	400588	-0.5	-	cut the pH control loop Displays an alarm on the HMI Only in automatic mode	Very Low pH in the Bioreactor Compared to the set point
45	3008	CL4006_pH	CL3008_SENSOR_DEVIATION_LIM	REAL	400708	0.5	(pH)	Displays an alarm on the HMI	The alarm is permanently checking the sensor deviation. Even if you choose only one of the two pH sensors
46	3008	CL3008_Gas_Loop	FQRC_3008_01_LIM_H	REAL	400710	20	ml/min	Displays an alarm on the HMI	High Flow in the CO2 GAS Mass Flow Controller
47	3008	CL3008_Gas_Loop	FQRC_3008_01_LIM_HH	REAL	400712	50	ml/min	Displays an alarm on the HMI	Very High Flow in the CO2 GAS Mass Flow Controller
48	3008	CL3008_Gas_Loop	FQRC_3008_01_LIM_L	REAL	400714	-20	ml/min	Displays an alarm on the HMI	Low Flow in the GAS CO2 Mass Flow Controller
49	3008	CL3008_Gas_Loop	FQRC_3008_01_LIM_LL	REAL	400716	-50	ml/min	Displays an alarm on the HMI	Very Low Flow in the CO2 GAS Mass Flow Controller
50	3008	CL3008_Bioreactor_pH_Control	WIT_3008_01_LIM_L	REAL	400590	1	kg	Displays an alarm on the HMI	Low Level in the ACID tank
51	3008	CL3008_Bioreactor_pH_Control	WIT_3008_01_LIM_LL	REAL	400592	0.5	kg	Change in CO2 mode Displays an alarm on the HMI	Very Low Level in the ACID tank
52	3008	CL3008_Bioreactor_pH_Control	WIT_3008_02_LIM_L	REAL	400594	1	kg	Displays an alarm on the HMI	Low Level in the BASE tank
53	3008	CL3008_Bioreactor_pH_Control	WIT_3008_02_LIM_LL	REAL	400596	0.5	kg	Displays an alarm on the HMI	Very Low Level in the BASE tank
54	3009	CL3009_Bioreactor_DO2_Control	AT_3009_LIM_H	REAL	400598	10	%	Displays an alarm on the HMI Compared to the set point Only in automatic mode	High percentage of Disolve Oxygen
55	3009	CL3009_Bioreactor_DO2_Control	AT_3009_LIM_HH	REAL	400600	20	%	Displays an alarm on the HMI Compared to the set point Only in automatic mode	Very High percentage of Disolve Oxygen
56	3009	CL3009_Bioreactor_DO2_Control	AT_3009_LIM_L	REAL	400602	-20	%	Displays an alarm on the HMI Compared to the set point Only in automatic mode	Low percentage of Disolve Oxygen
57	3009	CL3009_Bioreactor_DO2_Control	AT_3009_LIM_LL	REAL	400604	-40	%	Displays an alarm on the HMI TEST TO INCREASE THE SPEED OF THE BLENDER the speed measurment of the blender need to be repair Only in automatic mode	Very Low percentage of Disolve Oxygen
58	3009	CL3009_Bioreactor_DO2_Control	CL3009_SENSOR_DEVIATION_LIM	REAL	400734	5	%	Displays an alarm on the HMI	The alarm is permanently checking the sensor deviation. Even if you choose only one of the two dissolve dioxygen sensors
59	3009	CL3009_Bioreactor_DO2_Control	FQRC_3009_01_LIM_H	REAL	400718	100	ml/min	Displays an alarm on the HMI	High Flow in the O2 GAS Mass Flow Controller Compared to the set point asked by the predictive controller
60	3009	CL3009_Bioreactor_DO2_Control	FQRC_3009_01_LIM_HH	REAL	400720	300	ml/min	Displays an alarm on the HMI	Very High Flow in the O2 GAS Mass Flow Controller Compared to the set point asked by the predictive controller
61	3009	CL3009_Bioreactor_DO2_Control	FQRC_3009_01_LIM_L	REAL	400722	-100	ml/min	Displays an alarm on the HMI	Low Flow in the GAS O2 Mass Flow Controller Compared to the set point asked by the predictive controller
62	3009	CL3009_Bioreactor_DO2_Control	FQRC_3009_01_LIM_LL	REAL	400724	-300	ml/min	Displays an alarm on the HMI	Very Low Flow in the O2 GAS Mass Flow Controller Compared to the set point asked by the predictive controller
63	3010	CL3010_Bioreactor_EC_Control	AT_3010_LIM_H	REAL	400606	7.5	millisiemens / cm	Displays an alarm on the HMI	High Electro Conductivity in the Bioreactor
64	3010	CL3010_Bioreactor_EC_Control	AT_3010_LIM_HH	REAL	400608	9	millisiemens / cm	Displays an alarm on the HMI	Very High Electro Conductivity in the Bioreactor
65	3010	CL3010_Bioreactor_EC_Control	AT_3010_LIM_L	REAL	400610	4.5	millisiemens / cm	Displays an alarm on the HMI	Low Electro Conductivity in the Bioreactor
66	3010	CL3010_Bioreactor_EC_Control	AT_3010_LIM_LL	REAL	400612	3	millisiemens / cm	Displays an alarm on the HMI	Very Low Electro Conductivity in the Bioreactor
67	3011	CL3011_Gas_Loop	PT_3011_01_LIM_H	REAL	400614	100	mBar	Displays an alarm on the HMI	High pressure in the gas loop system
68	3011	CL3011_Gas_Loop	PT_3011_01_LIM_HH	REAL	400616	500	mBar	Displays an alarm on the HMI	Very High pressure in the gas loop system
69	3011	CL3011_Gas_Loop	PT_3011_01_LIM_L	REAL	400618	40	mBar	Displays an alarm on the HMI	Need to be tested by sherpa. If the threshold is too high, we can decrease to 30 or 20
70	3011	CL3011_Gas_Loop	PT_3011_01_LIM_LL	REAL	400620	0	mBar	Displays an alarm on the HMI	Very Low pressure in the gas loop system
71	3011	CL3011_Gas_Loop	FQRC_3011_01_LIM_H	REAL	400694	100	ml/min	Displays an alarm on the HMI	High Flow in the N2 GAS Mass Flow Controller Compared to the set point
72	3011	CL3011_Gas_Loop	FQRC_3011_01_LIM_HH	REAL	400696	300	ml/min	Displays an alarm on the HMI	Very High Flow in the N2 GAS Mass Flow Controller Compared to the set point
73	3011	CL3011_Gas_Loop	FQRC_3011_01_LIM_L	REAL	400698	-100	ml/min	Displays an alarm on the HMI	Low Flow in the GAS N2 Mass Flow Controller Compared to the set point
74	3011	CL3011_Gas_Loop	FQRC_3011_01_LIM_LL	REAL	400700	-300	ml/min	Displays an alarm on the HMI	Very Low Flow in the N2 GAS Mass Flow Controller Compared to the set point

75	3011	CL3011_Gas_Loop	FQRC_3011_02_LIM_H	REAL	400726	100	ml/min	Displays an alarm on the HMI	High Flow in the GAS MIX Mass Flow Controller Compared to the set point
76	3011	CL3011_Gas_Loop	FQRC_3011_02_LIM_HH	REAL	400728	300	ml/min	Displays an alarm on the HMI	Very High Flow in the GAS MIX Mass Flow Controller Compared to the set point
77	3011	CL3011_Gas_Loop	FQRC_3011_02_LIM_L	REAL	400730	-100	ml/min	Displays an alarm on the HMI	Low Flow in the GAS MIX Mass Flow Controller Compared to the set point
78	3011	CL3011_Gas_Loop	FQRC_3011_02_LIM_LL	REAL	400732	-300	ml/min	Displays an alarm on the HMI	Very Low Flow in the GAS MIX Mass Flow Controller Compared to the set point
79	3012	CL3012_Gas_Temperature	TT_3012_01_LIM_H	REAL	400622	11	°C	Displays an alarm on the HMI	To be confirmed by UAB when the reactor will be in nominal work High Temperature in the Gas Cooling system
80	3012	CL3012_Gas_Temperature	TT_3012_01_LIM_HH	REAL	400624	20	°C	Displays an alarm on the HMI	To be confirmed by UAB when the reactor will be in nominal work Very High Temperature in the Gas Cooling system
81	3012	CL3012_Gas_Temperature	TT_3012_01_LIM_L	REAL	400626	9	°C	Displays an alarm on the HMI	To be confirmed by UAB when the reactor will be in nominal work Low Temperature in the Gas Cooling system
82	3012	CL3012_Gas_Temperature	TT_3012_01_LIM_LL	REAL	400628	8	°C	Displays an alarm on the HMI	To be confirmed by UAB when the reactor will be in nominal work Very Low Temperature in the Gas Cooling system
83	3013	CL3013_Analysys of Liquid	AT_3013_01_LIM_H	REAL	400630	100	mg/L	Displays an alarm on the HMI	High level AMMONIA
84	3013	CL3013_Analysys of Liquid	AT_3013_01_LIM_HH	REAL	400632	400	mg/L	Displays an alarm on the HMI	Very High level AMMONIA
85	3013	CL3013_Analysys of Liquid	AT_3013_02_LIM_H	REAL	400638	500	mg/L	Displays an alarm on the HMI	High level of NITRATE
86	3013	CL3013_Analysys of Liquid	AT_3013_02_LIM_HH	REAL	400640	600	mg/L	Displays an alarm on the HMI	Very High level of NITRATE
87	3013	CL3013_Analysys of Liquid	AT_3013_02_LIM_L	REAL	400642	300	mg/L	Displays an alarm on the HMI	Low level of NITRATE
88	3013	CL3013_Analysys of Liquid	AT_3013_02_LIM_LL	REAL	400644	250	mg/L	Displays an alarm on the HMI	Very Lowlevel of NITRATE
89	3013	CL3013_Analysys of Liquid	AT_3013_03_LIM_H	REAL	400646	0.5	mg/L	Displays an alarm on the HMI	High level of NITRITE
90	3013	CL3013_Analysys of Liquid	AT_3013_03_LIM_HH	REAL	400648	20	mg/L	Displays an alarm on the HMI	Very High level of NITRITE
91	3014	CL3014_Biomass_Control	AT_3014_01_LIM_H	REAL	400654	(???)	(???)	Displays an alarm on the HMI	To be defined with NTE
92	3014	CL3014_Biomass_Control	AT_3014_01_LIM_HH	REAL	400656	(???)	(???)	Displays an alarm on the HMI	To be defined with NTE
93	3014	CL3014_Biomass_Control	AT_3014_01_LIM_L	REAL	400658	(???)	(???)	Displays an alarm on the HMI	To be defined with NTE
94	3014	CL3014_Biomass_Control	AT_3014_01_LIM_LL	REAL	400660	(???)	(???)	Displays an alarm on the HMI	To be defined with NTE
95	3017	CL3017_Liquid_Recirculation	FT_3017_01_LIM_H	REAL	400662	0.1	L/h	Displays an alarm on the HMI Only in automatic mode	Compared to the set point The time for triggering the alarm 1min High Flow in the Recirculation Loop
96	3017	CL3017_Liquid_Recirculation	FT_3017_01_LIM_HH	REAL	400664	0.2	L/h	Displays an alarm on the HMI Only in automatic mode	Compared to the set point The time for triggering the alarm 1min Very High Flow in the recirculation Loop
97	3017	CL3017_Liquid_Recirculation	FT_3017_01_LIM_L	REAL	400666	-0.1	L/h	Displays an alarm on the HMI Only in automatic mode	Compared to the set point The time for triggering the alarm 1min Low Flow in the Recirculation Loop
98	3017	CL3017_Liquid_Recirculation	FT_3017_01_LIM_LL	REAL	400668	-0.2	L/h	Displays an alarm on the HMI Only in automatic mode	Compared to the set point The time for triggering the alarm 1min Very Low Flow in the Recirculation Loop
99	3018	CL3018_Outlet_liquid_Control	FT_3018_01_LIM_H	REAL	400670	0.1	L/h	Displays an alarm on the HMI Only in automatic mode	Compared to the set point and triggered after 1 min action are done in level control High Flow in outlet liquid Loop
100	3018	CL3018_Outlet_liquid_Control	FT_3018_01_LIM_HH	REAL	400672	0.2	L/h	Displays an alarm on the HMI Only in automatic mode	Compared to the set point and triggered after 1 min action are done in level control Very High flow in outlet liquid Loop
101	3018	CL3018_Outlet_liquid_Control	FT_3018_01_LIM_L	REAL	400674	-0.1	L/h	Displays an alarm on the HMI Only in automatic mode	Compared to the set point and triggered after 1 min action are done in level control Low Flow in outlet liquid Loop
102	3018	CL3018_Outlet_liquid_Control	FT_3018_01_LIM_LL	REAL	400676	-0.2	L/h	Displays an alarm on the HMI Only in automatic mode	Compared to the set point and triggered after 1 min action are done in level control Very Low Flow in outlet liquid Loop
103	3020	CL3020_Effluent_Temperature	TT_3020_01_LIM_H	REAL	400678	1	°C	Displays an alarm on the HMI Only in automatic mode	Compared to the set point High temperature in the effluent Tank
104	3020	CL3020_Effluent_Temperature	TT_3020_01_LIM_HH	REAL	400680	2	°C	Displays an alarm on the HMI Only in automatic mode	Compared to the set point Very High temperature in the effluent Tank
105	3020	CL3020_Effluent_Temperature	TT_3020_01_LIM_L	REAL	400682	-1	°C	Displays an alarm on the HMI Only in automatic mode	Compared to the set point Low Temperature in the effluent Tank
106	3020	CL3020_Effluent_Temperature	TT_3020_01_LIM_LL	REAL	400684	-2	°C	Displays an alarm on the HMI Only in automatic mode	Compared to the set point Very Low Temperature in the effluent Tank
107	3021	CL3021_Effluent_Level	LT_3021_01_LIM_H	REAL	400686	30	LITRE	Displays an alarm on the HMI	High level on Effluent tank
108	3021	CL3021_Effluent_Level	LT_3021_01_LIM_HH	REAL	400688	34	LITRE	Stop the Effluent Liquid control loop 3018 Displays an alarm on the HMI	Very High level on Effluent tank
109	3021	CL3021_Effluent_Level	LT_3021_01_LIM_L	REAL	400690	6	LITRE	Displays an alarm on the HMI	Low level in Effluent Tank
110	3021	CL3021_Effluent_Level	LT_3021_01_LIM_LL	REAL	400692	3	LITRE	Displays an alarm on the HMI	Very Low in Effluent Tank

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TECHNICAL NOTE TN12

CIII - Control Loop Tests Plan
Control Loop Tests Report

Prepared by/Préparé par	Olivier Gerbi/Christophe Bourg
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TECHNICAL NOTE 12
CIII Control Loop Tests

APPROVAL

Title *Titre*	**CIII Control Loop Tests Plan & Report**	Issue *Edition*	1	Revision *Révision*	1

Author *Auteur*	Olivier Gerbi/ Christophe Bourg	Date *Date*	15/10/2010

Approved by *Approuvé par*		Date *Date*	

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Creation	1	0	Draft	February 2010
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Distribution List

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1. Introduction

CIII compartment was rebuilt at the MPP location and the control loops have been defined and programmed in the Control System, Schneider Quantum PLC.

Specific Objectives of this Technical Note are

- to define the test plan for the control loops of the CIII compartment as part of the complete functional tests of the process.
- to present the test report.

The dynamic control loops have been tested, validated in order to demonstrate that the process is correctly controlled, ie set points are satisfied, according to the requirements.

2. Test Plan

2.1. Closed Loop Tests

Here below the complete list of the control loops of the CIII compartment.

LOOP	Location	Control Loop Name
3000	Influent	Influent General.
3001	Influent	Influent Temperature Control.
3002	Influent	Influent Level Control
3003	Bioreactor	Inlet Liquid Control
3004	Bioreactor	Bioreactor General
3005	Bioreactor	Bioreactor Temperature Control
3006	Bioreactor	Bioreactor Level Control
3007	Bioreactor	Bioreactor Pressure Control
3008	Bioreactor	Bioreactor pH Control
3009	Bioreactor	Bioreactor DO2
3010	Bioreactor	Bioreactor EC Control
3011	Bioreactor	Gas Loop
3012	Bioreactor	Gas Temperature
3013	Bioreactor	Analysis of Liquid
3014	Bioreactor	Biomass Control
3015	Bioreactor	Backwashing
3016	Bioreactor	Gas Pulse
3017	Bioreactor	Liquid Recirculation
3018	Bioreactor	Outlet liquid Control
3019	Effluent	Effluent General
3020	Effluent	Effluent Temperature
3021	Effluent	Effluent Level
3022	Bioreactor	AntiFoam Control
3023	ALL	Sterilisation

The dynamic control loops are :
- Influent Temperature Control (3001)
- Influent Liquid Control (3003)
- Bioreactor Temperature Control (3005)
- Bioreactor Level Control (3006)
- Bioreactor Pressure Control (3007)
- Bioreactor pH Control (3008)
- Bioreactor DO2 Control (3009)
- Liquid Recirculation (3017)
- Outlet Liquid Control (3018)
- Effluent Tank Temperature (3020)

Moreover :
- Influent Level (3002) is not controlled but monitored with thresholds and alarms
- EC (3010) is not controlled
- Gas Loop (3011) is not controlled dynamically.
- Gas Temperature (3012) is monitored
- Analysis of Liquid (3013) is not controlled but monitored with thresholds and alarms
- Biomass (3014) is not controlled
- Backwashing and Gas Pulse are monitored (3015/3016)
- Effluent Level (3021) is not controlled but monitored with thresholds and alarms
- Antifoam Control (3022) is not implemented as there is no sensor.
- Feeding Tank, Bioreactor and Harvesting Tank sterilization procedures (3023) have to be defined and tested in the global functional test plan.

2.1.1.Influent Temperature Control (3001)

Objective :

To Validate the Influent Tank Temperature Control.

2.1.1.1. *Operating Conditions*

Feeding Tank shall be filled with medium or water And not in Low or High Alarm	(HMI) LT_3002_01 > 6 L and LT_3002_01 < 30 L
Temperature Control Mode in OFF	(HMI) Influent Temp = OFF
MPP Cold Water available	
Inlet Liquid Flow Mode can be AUTO, MAN or OFF	

2.1.1.2. *Variables to be recorded*

Feeding Temperature (TT_3001_01) and Set Point (TT_3001_01_SP)
Cooling Valve (SV_3001_01_MV)

2.1.1.3. *Test Procedure*

Seq Nb	Description	Required	Remarks	Status
1	(HMI) TT_3001_01_SP = 12 °C			
2	(HMI) Influent Temp Mode = AUTO			
3	Wait for Stabilisation			
4	(HMI) TT_3001_01_SP = 11°C			
5	Wait for Stabilisation		Indicate Time for Stabilisation	
6*	(HMI) TT_3001_01_SP = 4°C			

7	Wait for Stabilisation		Indicate Time for Stabilisation and Temperature reached	

* : Remark
Step 6, is proposed to check the limits of the system, as the utilities can not provide 4°C water temperature.

Acceptance Criteria:
Temperature Set Point is satisfied (if permitted by Utility Temperature itself)

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2.1.2.Influent Level Control (3002)

There is no level control.
Level LT_3002_01 is monitored and the control loop 3003 (Inlet Liquid Flow) is stopped in case of Low Low Alarm.

2.1.3. Inlet Liquid Control (3003)

Objective :

To Validate the Outlet Flow Liquid Control.

2.1.3.1. *Operating Conditions*

Influent Tank is not in High Alarm	(HMI) LT_3002_01 < 30 L
Inlet Flow Mode in OFF Mode	(HMI) Liquid Inlet = OFF
Outlet Flow Mode in OFF Mode	(HMI) Liquid Outlet = OFF
Inlet Flow Set Point = 0 L/H	FT_3003_01_SP = 0 L/H
Level Control in OFF Mode	(HMI) Bio Level = OFF
Level not in High Alarm, no LSH activated	
Recirculation Mode in OFF	(HMI) Recirculation = OFF

2.1.3.2. *Variables to be recorded*

Inlet Flow and Set Point (FT_3003_01 and FT_3003_01_SP)
Inlet Pump Speed (PP_3003_01)

2.1.3.3. *Test Procedure*

Seq Nb	Description	Required	Remarks	Status
1	(HMI) Liquid Inlet Mode = AUTO			
2	(HMI) Liquid Inlet Set Point = 0.6 L/H			
3	Wait for Stabilisation			
4	(HMI) Liquid Inlet Set Point = 0.7 L/H			

5	Wait for Stabilisation			

Acceptance Criteria:
Flow set Point is satisfied.

2.1.4.Bioreactor General (3004)

No Control.

2.1.5. Bioreactor Temperature Control (3005)

Objective :

To validate the Temperature controller.

2.1.5.1. *Operating Conditions*

This test can be performed during operation or only with water inside the Bioreactor.
The controller can be previously running.

The temperature control is mainly used for heating the bioreactor.

Temperature Mode in AUTO Mode	HMI : Biorea. Temp. Mode = AUTO
Bioreactor shall be filled (Water or Medium)	
Temperature set point = 28 °C	HMI : TT_3005_SP = 28 °C
Agitator Speed in AUTO, 50%	HMI : Bio. General Mode = AUTO BLE_3004_01_SP = 50 %
Influent Tank Temperature is in AUTO mode and controlled at 10°C	HMI : Influent Temp Mode = AUTO TT_3001_01_SP = 10°C
Bioreactor Level in AUTO mode	HMI : Bio Level Mode = AUTO
Bioreactor Inlet Flow set point = 0.6 L/H	HMI : FT_3003_01_SP = 0.6 L/H
Recirculation is in AUTO Mode, Flow Set Point = 3.6 L/H	
The cooling and hot water shall be available	

Remark : as the Level is in AUTO mode, the harvest flow is controlled.

2.1.5.2. *Variables to be recorded*

Temperature and set point (TT_3005_01 and TT_3005_SP).
Circulating pump CP_3005_01_MV
Fluid Jacket Temperature (TT_3005_02).
Tank Top Temperature (TT_3005_03) and Tank Bottom Temperature (TT_3005_04)
pH1 Temperature (TT_3008_01) and pH2 Temperature (TT_3008_02)
Cooling and heating valve (SV_3005_01_MV and SV_3005_02_MV)

2.1.5.3. *Test Procedure*

Perform Temperature set point changes to validate the control.

Seq Nb	Description	Required	Remarks	Status
1	(HMI) Temp Mode = AUTO	Temp = SP		
2	(HMI) TT_3005_SP = 27 °C			
3	Wait For Stabilization	Indicate Time for Stabilisation	Check that the set point is satisfied	
4	(HMI) TT_3005_SP = 28 °C			
5	Wait For Stabilization	Indicate Time for Stabilisation	Check that the set point is satisfied	

Acceptance Criteria:
Controlled Temperature TT_3005_01 is satisfied at +/- 0.1 °C in steady state.

2.1.6.Bioreactor Level Control (3006)

Objective :

To Validate the Level controller.

2.1.6.1. *Operating Conditions*

Level control mode in OFF	(HMI) Bio. Level mode = OFF
Bioreactor shall be filled (Water or Medium) and level not in LL or HH alarm	LSH_3006_01/02 Off LSL_3006_01/02 Off No Level Alarms
Inlet Liquid Flow in OFF mode	(HMI) Liquid Inlet mode = OFF
Outlet Liquid Flow in OFF mode	(HMI) Liquid Outlet mode = OFF
Recirculation in OFF mode	(HMI) Recirculation = OFF
Inlet Tank not in Low Level and no alarms	
Effluent Tanks not in High Level and no alarms	

2.1.6.2. *Variables to be recorded*

Bioreactor Level and Set Point (LT_3006_01 and CL3006_BioreactorLevel_SP)
Inlet Flow and set point (FT_3003_01_SP and FT_3003_01)
Outlet Flow and set point (FT_3018_01_SP and FT_3018_01)
Recirculation Flow and set Point (CL3017_FLOW_SP, FT_3017_01)

2.1.6.3. *Test Procedure*

Level should be steady before the test.

Seq Nb	Description	Required	Remarks	Status
1	(HMI) Level SP = Level Measurement			
2	(HMI) Level Mode = AUTO			
2	(HMI) Decrease Level SP : -0.3 L			
3	Wait for Stabilization	Indicate Time for Stabilisation	Estimated time : ½ hour	
4	(HMI) Inlet Liquid SP = 0.6 L/H			
5	Wait for Stabilisation	Indicate Time for Stabilisation		
6	(HMI) Recirculation Mode = AUTO and Set Point = 3.6 L/H			
7	Wait for Stabilisation	Indicate Time for Stabilisation		
8	(HMI) Increase Level SP : + 0.3 L			
9	Wait for Stabilisation	Indicate Time for Stabilisation	Estimated time : 1/2 hour	

<u>Acceptance Criteria:</u>
Controlled Level is satisfied in steady state at +/- 0.03 L

2.1.7. Bioreactor pressure control (3007)

Objective:

To validate the pressure controller.
The pressure controller is active as soon as the Bioreactor Gas is in Auto mode (Control Loop 3011).

2.1.7.1. *Operating Conditions*

Bioreactor Gas mode in OFF	(HMI) Bioreactor Gas mode = OFF
Bioreactor shall be full (Water or Medium)	
Gas Pulse in OFF Mode	(HMI) Gas Pulse Mode = OFF

2.1.7.2. *Variables to be recorded*

Pressures in the Bioreactor, set point (PT_3007_01, PT_3007_01_SP)
Valve to Atmosphere (SV_3011_02),
Mix Gas Flow (FQRC_3011_02 and FQRC_3011_02_SP) and Inlet Gas Flow (FQRC_3011_01 and FQRC_3011_01_SP, FQRC_3009_01 and FQRC_3009_01_SP, FQRC_3008_01 and FQRC_3008_01_SP)

2.1.7.3. *Test Procedure*

Seq Nb	Description	Required	Remarks	Status
1	(HMI) Pressure Set Point = 50 mbar			
2	(HMI) Pressure Threshold = 80 mbar			
3	(HMI) Mix Flow SP = 3000 mL/mn			
4	(HMI) Bioreactor Gas Mode = AUTO			
5	Wait for Stabilisation			

Acceptance Criteria:
Pressure is maintained at the set point (50 mbar) and below the threshold (80 mbar)

2.1.8. Bioreactor pH Control (3008)

Objective :

To Validate the pH controllers. Either with Acid and Base or CO_2.

2.1.8.1. *Operating Conditions*

pH control mode in OFF	(HMI) PH mode = OFF
Bioreactor shall be filled (Water or Medium) and level not in LL or HH alarm	
Acid Tank filled with Acid	
Base Tank filled with Base	
No L alarm for Acid Tank	
No L alarm for Base Tank	
Appropriate Hand Valves of the Acid and Base Lines shall be opened	
CO_2 shall be available	

2.1.8.2. *Variables to be recorded*

pH, pH Set Point (AT_3008_01, AT_3008_02, CL3008_pH_AVERAGE, CL3008_pH_SP)
Acid and Base Valves and pumps (SV_3008_01, PP_3008_01_MV, SV_3008_02, PP_3008_02_MV)
CO2 set point and measurement (FQRC_3008_01 and FQRC_3008_01_SP)

2.1.8.3. *Test Procedure*

pH should be steady before the test.

Change pH Set Point for different pH mode (Acid/Base/CO2) and wait until the stabilisation.

Seq Nb	Description	Required	Remarks	Status
1	(HMI) pH Probe selection = Average			
2	(HMI) pH Mode = Acid and Base			
3	(HMI) pH set point = pH_Average			
4	(HMI) pH Deadzone = 0.02			
5	(HMI) pH Mode from OFF to AUTO			
6	Wait for 15 minutes	pH = pH set point +/- Deadzone		
7	(HMI) Increase pH Set Point : + 0.1 Ex : From 8.0 to 8.1			
8	Wait for Stabilisation	Indicate Time for Stabilisation	Estimated time: ? hour	
9	(HMI) Decrease pH Set Point : - 0.1 Ex : From 8.1 to 8.0			
10	Wait for Stabilisation	Indicate Time for Stabilisation	Estimated time: ? hour	
11	(HMI) pH Mode = CO_2 and Base			
12	(HMI) Decrease pH Set Point : - 0.1 Ex : From 8.7 to 8.6			
13	Wait for Stabilisation	Indicate Time for Stabilisation	Estimated time: ? hour	

Acceptance Criteria:
Controlled pH is satisfied in the dead zone in steady state.

2.1.9. Bioreactor DO2 (3009)

The dissolved Oxygen is controlled with the O2 inlet gas flow.
This control could only be tuned when the Bioreactor will be under real nitrifying conditions.
It can also be decided to test it with a mock-up culture consuming O2 to save time.
Up to now, this point has not been discussed and the drawback could be not to have the real O2 consumption with a mock-up culture and to retest and retune the controller.

2.1.10.Bioreactor EC Control (3010)

No EC control.

2.1.11.Gas Loop (3011)

Objective :

Linked to the pressure control (3007).
Gas Loop Mode represents :

- Mix Flow Control
- Pressure control (see 3007 Control Loop)

2.1.12.Gas Temperature (3012)

No Control. Only Monitoring.

2.1.13.Analysis of Liquid (3013)

There is no dynamic control associated.

2.1.14.Biomass Control (3014)

There is no dynamic control.

2.1.15.Backwashing (3015)

There is no dynamic control.

2.1.16.Gas Pulse (3016)

There is no dynamic control.

2.1.17.Liquid Recirculation (3017)

Objective :

To Validate the Recirculation Flow Control.

2.1.17.1. *Operating Conditions*

Bioreactor shall be filled (Water or Medium) and level not in L or H alarms. No LSL nor LSH activated	
Level Control in OFF Mode	(HMI) Bio Level = OFF
Inlet Liquid Flow in OFF Mode	(HMI) Liquid Inlet = OFF
Outlet Liquid Flow in OFF Mode	(HMI) Liquid Outlet = OFF
Recirculation Mode in OFF	(HMI) Recirculation = OFF

2.1.17.2. *Variables to be recorded*

Recirculation Flow and Set Point (FT_3017_01 and CL3017_FLOW_SP)
Recirculation Pump Speed (PP_3017_01_MV2)

2.1.17.3. *Test Procedure*

Seq Nb	Description	Required	Remarks	Status
1	(HMI) Recirculation Flow SP = 3.6 L/h			
2	(HMI) Recirculation Mode = AUTO			
3	Wait for Stabilisation			
4	(HMI) Recirculation Flow SP = 3.7 L/h			
5	Wait for Stabilisation			

6	(HMI) Recirculation Flow SP = 3.7 L/h			
7	Wait for Stabilisation			

Acceptance Criteria:
Flow set Point is satisfied.

2.1.18.Outlet liquid Control (3018)

Objective :

To Validate the Outlet Flow Liquid Control.

2.1.18.1. *Operating Conditions*

Effluent Tank is not in High Alarm	(HMI) LT_3021_01 < 30 L
Oulet Flow Mode in OFF Mode	(HMI) Liquid Outlet = OFF
Inlet Flow Mode in OFF Mode	(HMI) Liquid Inlet = OFF
Outlet Flow Set Point = 0 L/H	CL3018_FLOW_SP = 0 L/H
Level Control in OFF Mode	(HMI) Bio Level = OFF
Level not in Low Alarm, no LSL activated	
Recirculation Mode in OFF	(HMI) Recirculation = OFF

2.1.18.2. *Variables to be recorded*

Outlet Flow and Set Point (FT_3018_01 and CL3018_FLOW_SP)
Outlet Pump Speed (PP_3018_01_MV2)

2.1.18.3. *Test Procedure*

Seq Nb	Description	Required	Remarks	Status
1	(HMI) Liquid Outlet Mode = AUTO			
2	(HMI) Liquid Outlet Set Point = 0.6 L/H			
3	Wait for Stabilisation			
4	(HMI) Liquid Outlet Set Point = 0.7 L/H			

5	Wait for Stabilisation			
7	(HMI) Recirculation Mode = AUTO			
5	Wait for Stabilisation			

Acceptance Criteria:
Flow set point is satisfied.

2.1.19.Effluent General (3019)

There is no dynamic control.

2.1.20.Effluent Temperature (3020)

Objective :

To Validate the Effluent Tank Temperature Control.

2.1.20.1. *Operating Conditions*

Harvesting Tank shall be filled with medium or water And not in Low or High Alarm	(HMI) LT_3021_01 > 6 L and LT_3002_01 < 30 L
Temperature Control Mode in OFF	(HMI) Effluent Temp = OFF
MPP Cold Water available	

2.1.20.2. *Variables to be recorded*

Harvest Temperature (TT_3020_01) and Set Point (TT_3020_01_SP)
Cooling Valve (SV_3020_01_MV)

2.1.20.3. *Test Procedure*

Seq Nb	Description	Required	Remarks	Status
1	(HMI) TT_3020_01_SP = 12 °C			
2	(HMI) Effluent Temp Mode = AUTO			
3	Wait for Stabilisation			

4	(HMI) TT_3020_01_SP = 11°C			
5	Wait for Stabilisation		Indicate Time for Stabilisation	
6	(HMI) TT_3020_01_SP = 4°C			
7	Wait for Stabilisation		Indicate Time for Stabilisation and Temperature reached	

<u>Acceptance Criteria:</u>
Temperature Set Point is satisfied (if permitted by Utility Temperature itself)

2.1.21.Effluent Level (3021)

There is no level control.
Level LT_3021_01 is monitored and the control loop 3018 (Outle Liquid Flow) is stopped in case of High High Alarm.

2.1.22.Foam Control (3022)

There is no dynamic control.

2.1.23.Sterilisation (3023)

There is no dynamic control.

3. Test Report

Following the test plan, the control loops have been tested. The results are described hereafter.

At the date of emission of this report, the bioreactor was not in production and the control loops linked to the nitrifying process could not be tested. It is the case for the control loop 3009 (DO2).

3.1. Influent Temperature Control (3001)

The test was performed March 16th 2010.

Test Prerequisites		Status
Feeding Tank shall be filled with medium or water And not in Low or High Alarm	(HMI) LT_3002_01 > 6 L and LT_3002_01 < 30 L	Ok
Temperature Control Mode in OFF	(HMI) Influent Temp = OFF	Ok
MPP Cold Water available		Ok
Inlet Liquid Flow Mode can be AUTO, MAN or OFF		Ok

Seq Nb	Action Description	Required	Remarks	Date/Hour	Observed Results	C/NC
1	(HMI) TT_3001_01_SP = 12 °C			16/03/2010 17:33	Measured TT_3001_01 = 13.4 °C	
2	(HMI) Influent Temp Mode = AUTO					
3	Wait for Stabilisation				Observed Closed Loop Response Time : 30 minutes	C
4	(HMI) TT_3001_01_SP = 11°C			16/03/2010 18:08		
5	Wait for Stabilisation		Indicate Time for Stabilisation		Stabilisation in 30 minutes but above the set point. 11°C is not reachable	
6	(HMI) TT_3001_01_SP = 4°C				Not performed as it is already not possible to obtain 11°C	
7	Wait for Stabilisation		Indicate Time for Stabilization and Temperature reached		N/A	

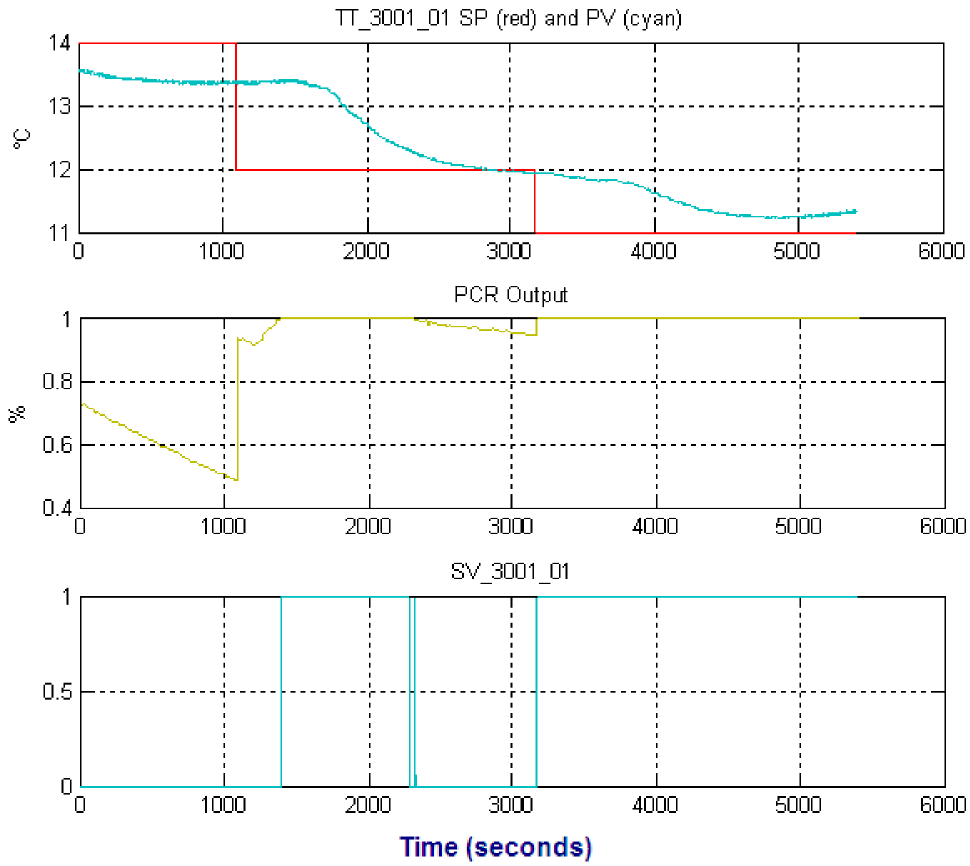

Figure 1: CL3001. Influent Temp. Control test

Data file : CL3001_3020_test_20100316_1732.mat

Remarks :

- PCR Output represents the calculated analog value of the valve opening. This value, between 0 and 1 is converted to a ON/OFF sequence for the digital valve.
- Due to the cold water temperature, it is not possible to obtain temperatures lower than 11°C

Conclusion:
Temperature Set Point is satisfied (if permitted by Utility Temperature itself).
Control loop 3001 is validated.

3.2. Inlet Liquid Control (3003)

The test was performed May 4th 2010

Test Prerequisites		Status	
Influent Tank is not in High Alarm	(HMI) LT_3002_01 < 30 L	32.6 L	Not a problem for the test
Inlet Flow Mode in OFF Mode	(HMI) Liquid Inlet = OFF	OK	
Outlet Flow Mode in OFF Mode	(HMI) Liquid Outlet = OFF	OK	
Inlet Flow Set Point = 0 L/H	FT_3003_01_SP = 0 L/H	OK	
Level Control in OFF Mode	(HMI) Bio Level = OFF	OK	
Level not in High Alarm, no LSH activated		LSH	Not a problem for the test
Recirculation Mode in OFF	(HMI) Recirculation = OFF	OK	

The High Alarm of the Influent tank level is not problematic for the test as there is no influence for the flow control.

Seq Nb	Action Description	Required	Remarks	Date/Hour	Observed Results	C/NC
1	(HMI) Liquid Inlet Mode = AUTO			04/05/2010 11:39		
2	(HMI) Liquid Inlet Set Point = 0.6 L/H					
3	Wait for Stabilisation				Set point is satisfied. Observed Closed Loop Response Time : 3 seconds	C
4	(HMI) Liquid Inlet Set Point = 0.7 L/H			04/05/2010 11:40		
5	Wait for Stabilisation				Set point is satisfied. Observed Closed Loop Response Time : 3 seconds	C
6	(HMI) Liquid Inlet Set Point = 0.8 L/H			04/05/2010 11:41		
7	Wait for Stabilisation				Set point is satisfied. Observed Closed Loop Response Time : 3 seconds	C
8	(HMI) Liquid Inlet Set Point = 0.5 L/H			04/05/2010 11:42		
9	Wait for Stabilisation				Set point is satisfied. Observed Closed Loop Response Time : 3 seconds	C
8	(HMI) Liquid Inlet Set Point = 0.0 L/H			04/05/2010 11:43		
9	Wait for Stabilisation				Flow rate decreases to 0 in 5 s.	C

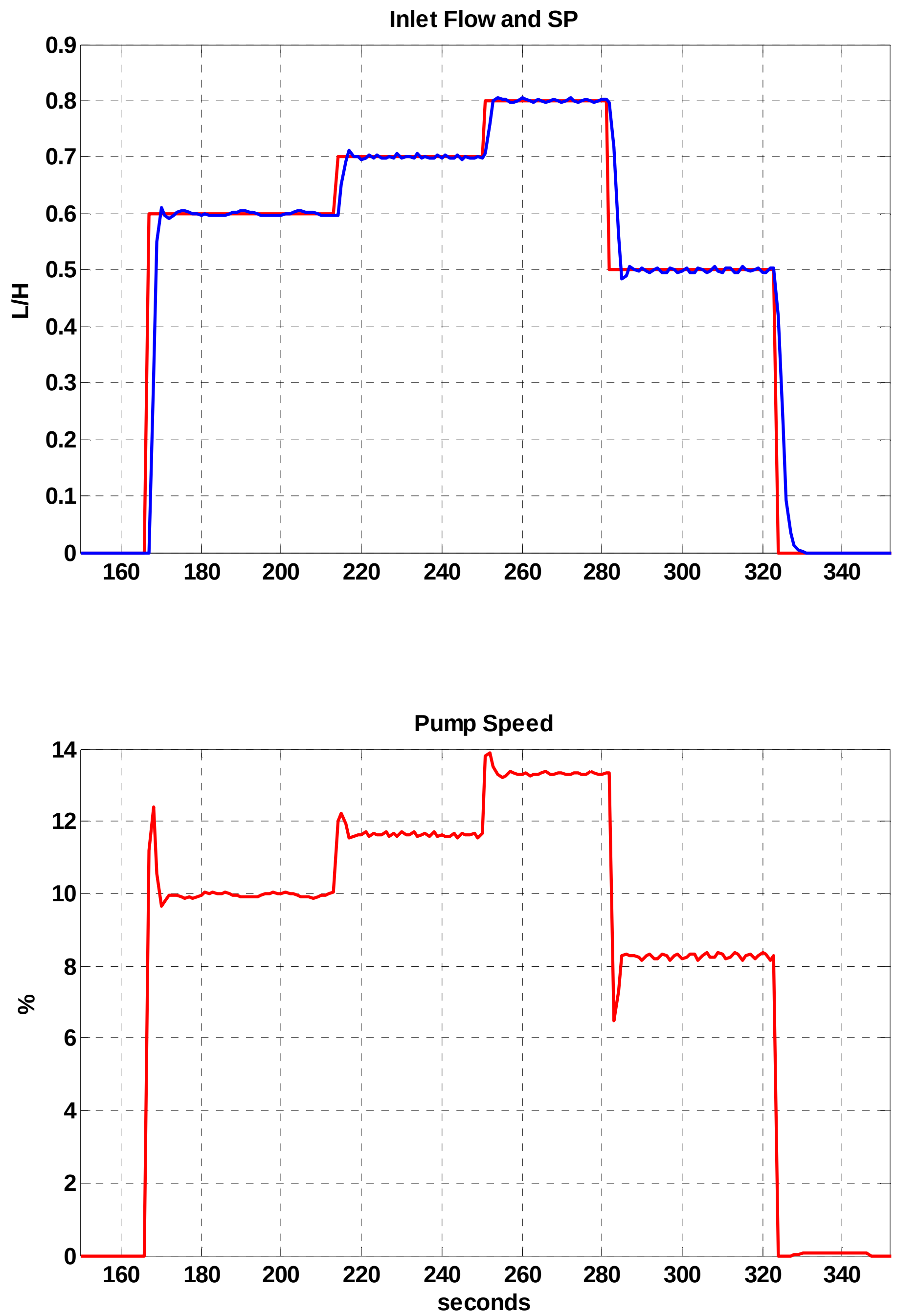

Figure 2: CL3003. Influent Liquid Control test

Data file : CL3003_test_20100504_1137.mat

Conclusion

Flow set point is satisfied.
Control loop 3003 is validated.

3.3. Bioreactor Temperature Control (3005)

The test was performed May 7th 2010

Test Prerequisites		Status
Temperature Mode in AUTO Mode	HMI : Biorea. Temp. Mode = AUTO	Ok
Bioreactor shall be filled (Water or Medium)		Water
Temperature set point = 28 °C	HMI : TT_3005_SP = 28 °C	Ok
Agitator Speed in AUTO, 50%	HMI : Bio. General Mode = AUTO BLE_3004_01_SP = 50 %	Ok Ok
Influent Tank Temperature is in AUTO mode and controlled at 10°C	HMI : Influent Temp Mode = AUTO TT_3001_01_SP = 10°C	Ok Ok
Bioreactor Level in AUTO mode	HMI : Bio Level Mode = AUTO	Ok
Bioreactor Inlet Flow set point = 0.6 L/H	HMI : FT_3003_01_SP = 0.6 L/H	Ok
Recirculation is in AUTO Mode, Flow Set Point = 3.6 L/H		Ok
The cooling and hot water shall be available		Ok

Seq Nb	Action Description	Required	Remarks	Date/Hour	Observed Results	C/NC
1	(HMI) Temp Mode = AUTO	Temp = SP		07/05/2010 13:55	TT_3005_01 = 28°C	
2	(HMI) TT_3005_SP = 27 °C			07/05/2010 15:55		
3	Wait For Stabilization	Indicate Time for Stabilisation	Check that the set point is satisfied		Set point is satisfied. Observed Closed Loop Response Time : 15 minutes	C
4	(HMI) TT_3005_SP = 28 °C			07/05/2010 16:24		
5	Wait For Stabilization	Indicate Time for Stabilisation	Check that the set point is satisfied		Set point is satisfied. Observed Closed Loop Response Time : 13 minutes	C
				07/05/2010 16:43	Ok. End of the test	

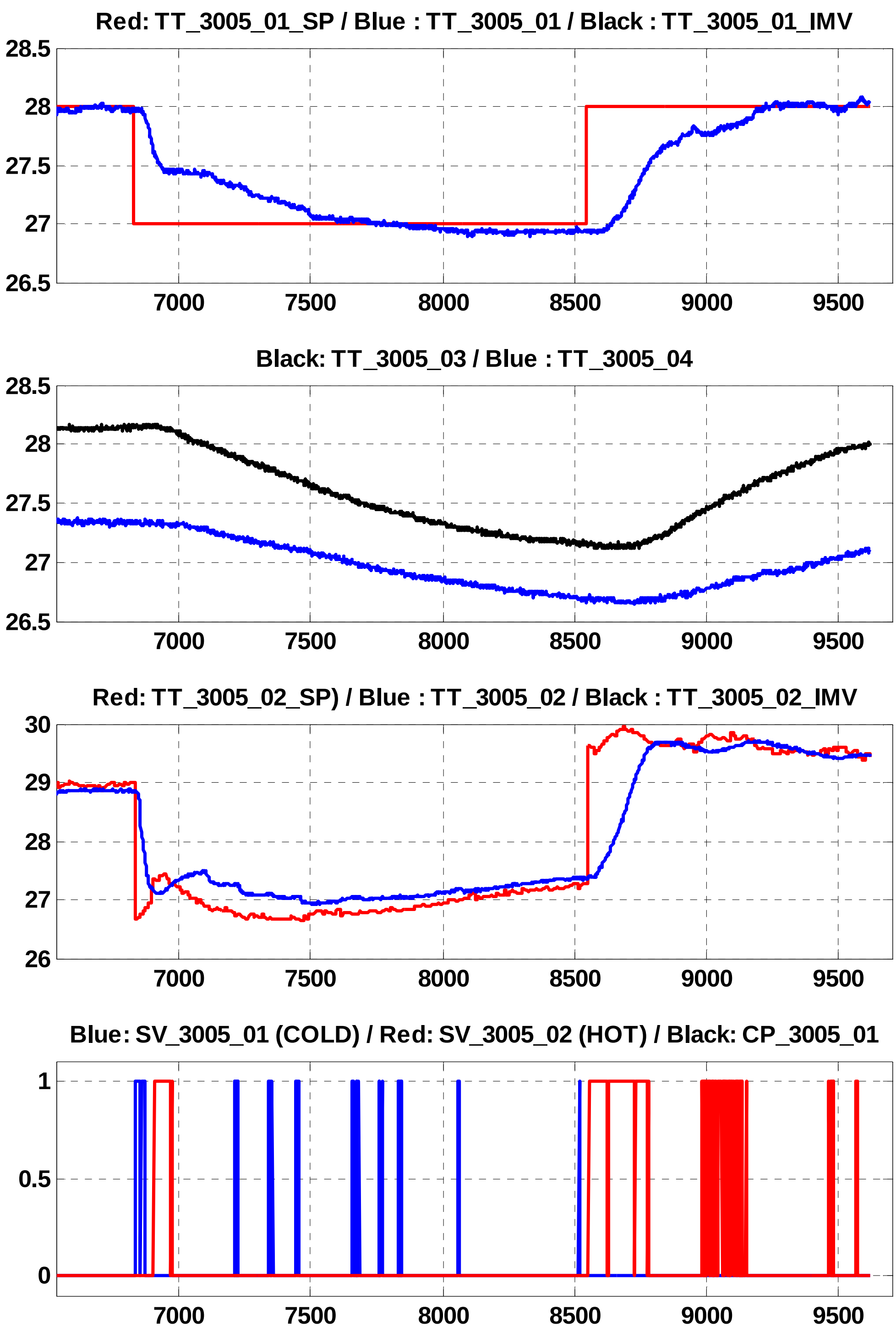

Figure 3: CL3005. Temperature Control test

Time is displayed in seconds.
Data file: OPC_CIII_BR_TEMP__CLOSELOOP_20100507_1400.mat

Remarks :
For information, on the graph, the temperatures TT_3005_03 (top) and TT_3005_04 (bottom) are also displayed.

Conclusion

Temperature of the bioreactor is satisfied at +/- 0.1 °C.
Control loop 3005 is validated.

3.4. Bioreactor Level Control (3006)

The test was performed May 5th 2010

Test Prerequisites		Status	
Level control mode in OFF	(HMI) Bio. Level mode = OFF	OK	
Bioreactor shall be filled (Water or Medium) and level not in LL or HH alarm	LSH_3006_01/02 Off LSL_3006_01/02 Off No Level Alarms	OK OK OK	
Inlet Liquid Flow in OFF mode	(HMI) Liquid Inlet mode = OFF	OK	LT_3006_01=12.2L
Outlet Liquid Flow in OFF mode	(HMI) Liquid Outlet mode = OFF	OK	
Recirculation in OFF mode	(HMI) Recirculation = OFF	OK	
Inlet Tank not in Low Level and no alarms		OK	
Effluent Tanks not in High Level and no alarms		OK	

Seq Nb	Action Description	Required	Remarks	Date/Hour	Observed Results	C/NC
1	(HMI) Level SP = Level Measurement			05/05/2010 11:10	Level is 12.2 L. Set point is fixed at 12.2 L.	
2	(HMI) Level Mode = AUTO					
3	(HMI) Decrease Level SP : -0.3 L			05/05/2010 11:16	Set Point from 12.2 to 11.9	
4	Wait for Stabilization	Indicate Time for Stabilisation	Estimated time : ½ hour		Set point is satisfied. Observed Closed Loop Response Time : 25 minutes	C
5	(HMI) Inlet Liquid SP = 0.6 L/H			05/05/2010 11:54		
6	Wait for Stabilisation	Indicate Time for Stabilisation			Observed Disturbance : 0.03 L for the level	C
7	(HMI) Recirculation Mode = AUTO and Set Point = 3.6 L/H			05/05/2010 12:56	No Visible effect on the level	C
8	Wait for Stabilisation	Indicate Time for Stabilisation				
9	(HMI) Increase Level SP : + 0.3 L			05/05/2010 13:00	Set Point from 11.9 to 12.2 L	
10	Wait for Stabilisation	Indicate Time for Stabilisation	Estimated time : 1/2 hour		Set point is satisfied. Observed Closed Loop Response Time : 25 minutes	C

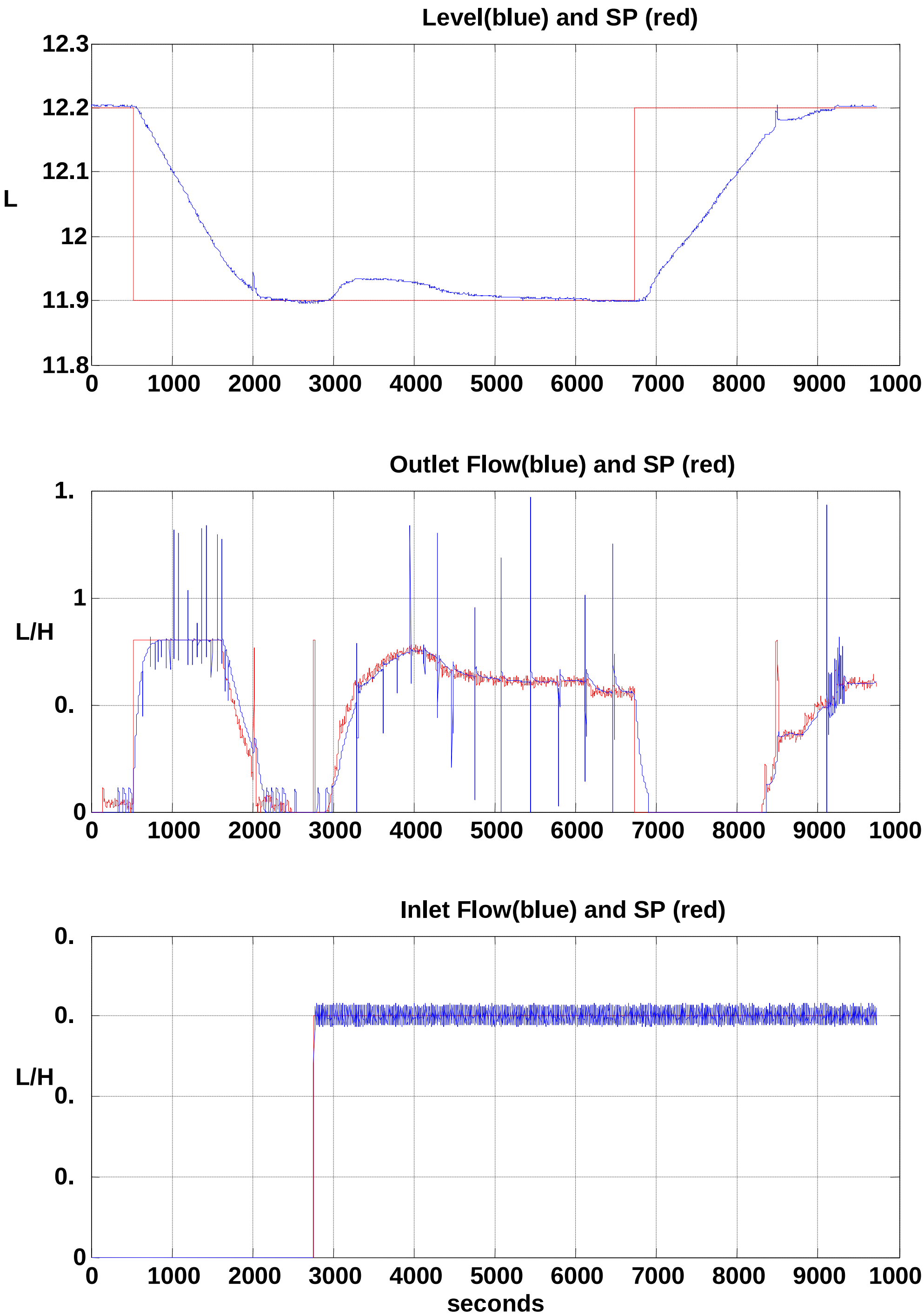

Figure 4: CL3006. Level Control test

Data file: CL3006_test_20100505_1107.mat

Remarks :
Outlet flow measurement is very noisy

Conclusion

Level of the bioreactor is satisfied at +/- 0.03 L
Control loop 3006 is validated.

3.5. Bioreactor pressure control (3007)

The test was performed July 20th 2010

Test Prerequisites		Status	
Bioreactor Gas mode in OFF	(HMI) Bioreactor Gas mode = OFF	Ok	
Bioreactor shall be full (Water or Medium)		Ok.water	Agitator is On, 70%
Gas Pulse in OFF Mode	(HMI) Gas Pulse Mode = OFF	Ok	

Seq Nb	Action Description	Required	Remarks	Date/Hour	Observed Results	C/NC
1	(HMI) Pressure Set Point = 50 mbar					
2	(HMI) Pressure Threshold = 80 mbar					
3	(HMI) Mix Flow SP = 3000 mL/mn					
4	(HMI) Bioreactor Gas Mode = AUTO			20/07/2010 17:42		
5	Wait for Stabilisation				Set Point is satisfied at +/- 5 mbar (noisy)	C
6	(HMI) Pressure Set Point = 60 mbar			20/07/2010 17:47	Set Point is satisfied at +/- 5 mbar (noisy)	C
7	(HMI) Pressure Set Point = 50 mbar			20/07/2010 17:49	Set Point is satisfied at +/-5 mbar (noisy) Overshoot, due to N2 mass flow controller.	C

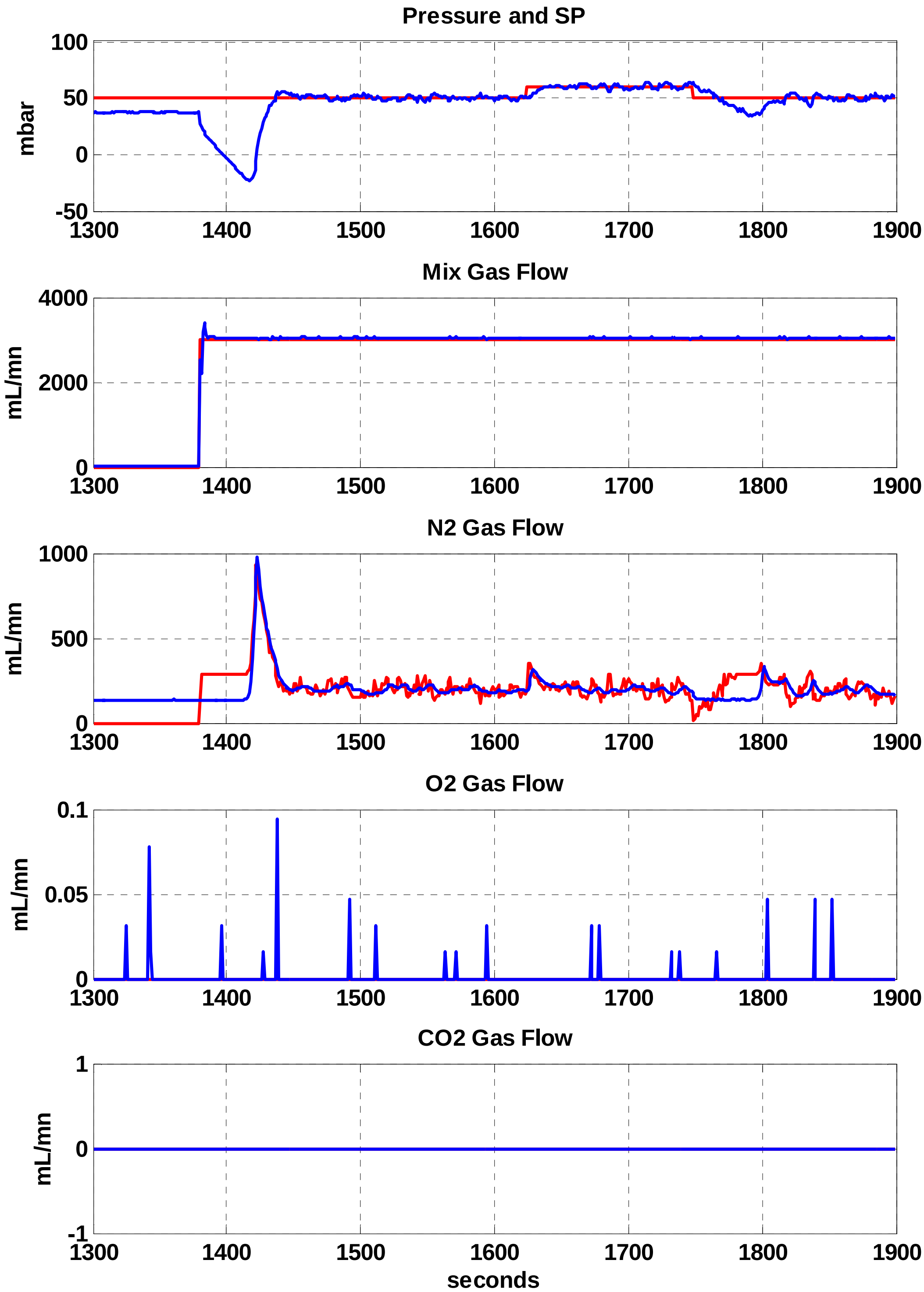

Figure 5: CL3007. Pressure Control test

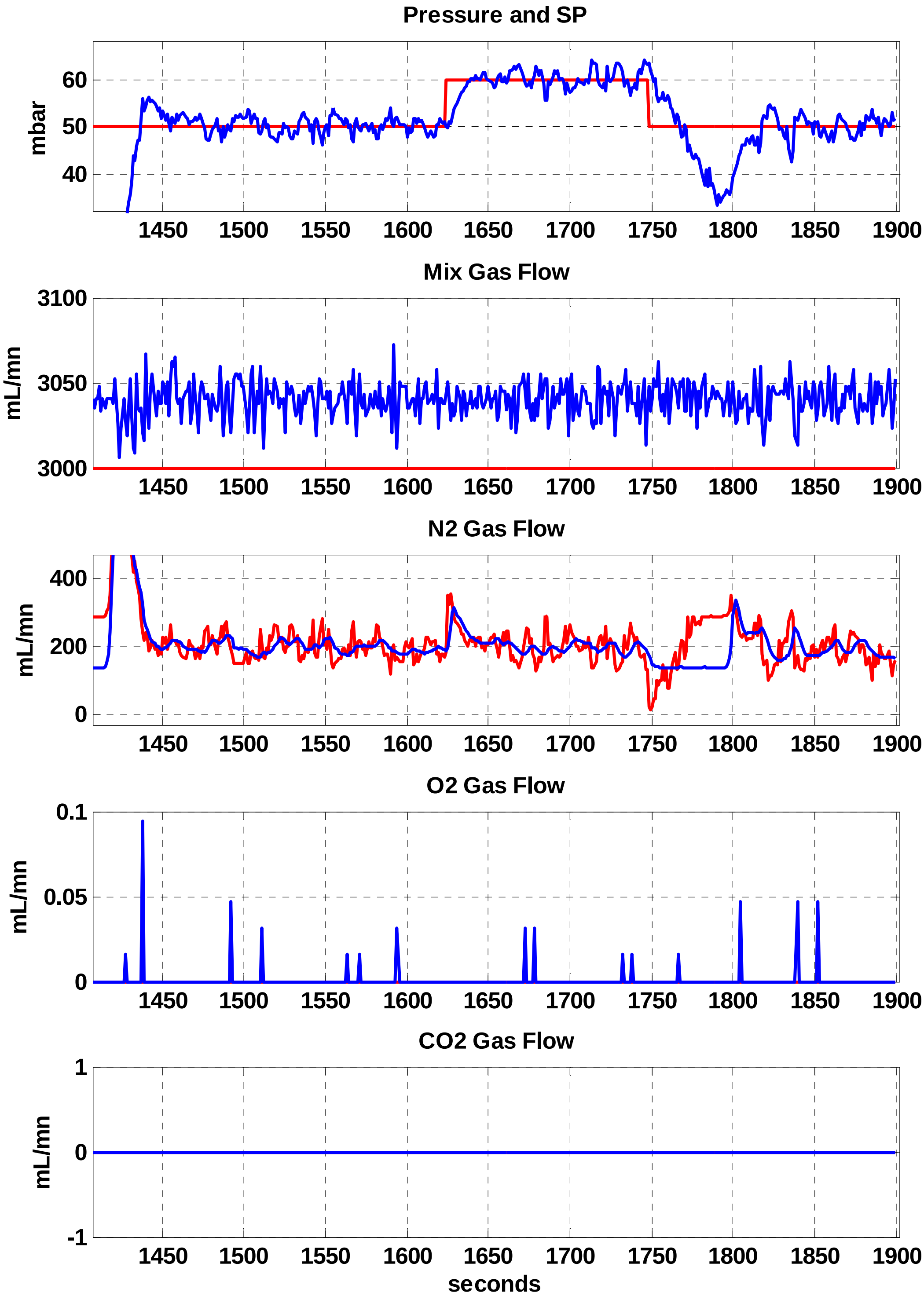

Figure 6: CL3007. Pressure Control test (zoom)

Data file : CL3007_test_20100720_1740.mat

Remarks :

Conclusion

Pressure of the bioreactor is satisfied at +/- 5 mbar.
Control loop 3007 is validated.

3.6. Bioreactor pH Control (3008)

The test was performed May 17th and 18th 2010

Test Prerequisites		Status
pH control mode in OFF	(HMI) PH mode = OFF	
Bioreactor shall be filled (Water or Medium) and level not in LL or HH alarm		Ok
Acid Tank filled with Acid		Ok
Base Tank filled with Base		Ok
No L alarm for Acid Tank		Ok
No L alarm for Base Tank		Ok
Appropriate Hand Valves of the Acid and Base Lines shall be opened		Ok
CO_2 shall be available		Ok

Seq Nb	Action Description	Required	Remarks	Date/Hour	Observed Results	C/NC
1	(HMI) pH Probe selection = Average			17/06/2010 14:40		
2	(HMI) pH Mode = Acid and Base			17/06/2010 14:40		
3	(HMI) pH set point = pH_Average			17/06/2010 14:40	pH set point = 8.1	
4	(HMI) pH Deadzone = 0.04			17/06/2010 14:40		
5	(HMI) pH Mode from OFF to AUTO			17/06/2010 14:40		
6	Wait for 15 minutes	pH = pH set point +/- Deadzone		17/06/2010 14:40	pH set point = 8.1	
7	(HMI) Increase pH Set Point : + 0.1 Ex : From 8.1 to 8.2			17/06/2010 14:58		
8	Wait for Stabilisation	Indicate Time for Stabilisation			pH set point is satisfied (with the dead zone). Observed Response Time : 1 hour	C

Seq Nb	Action Description	Required	Remarks	Date/Hour	Observed Results	C/NC
9	(HMI) Decrease pH Set Point : - 0.1 Ex : From 8.1 to 8.0			18/06/2010 09:27	pH set point from 8.1 to 8.0	
10	Wait for Stabilisation	Indicate Time for Stabilisation			Fast answer for the average pH (15 minutes) and 1 hour for the TOP	C
11	(HMI) pH Mode = CO_2 and Base			18/06/2010 12:21		
12	(HMI) Decrease pH Set Point : - 0.1 Ex : From 8.0 to 7.9			18/06/2010 12:21	pH set point from 8.0 to 7.9	
13	Wait for Stabilisation	Indicate Time for Stabilisation	Estimated time: ? hour		pH set point is satisfied. Observed response time about 1 hour	C

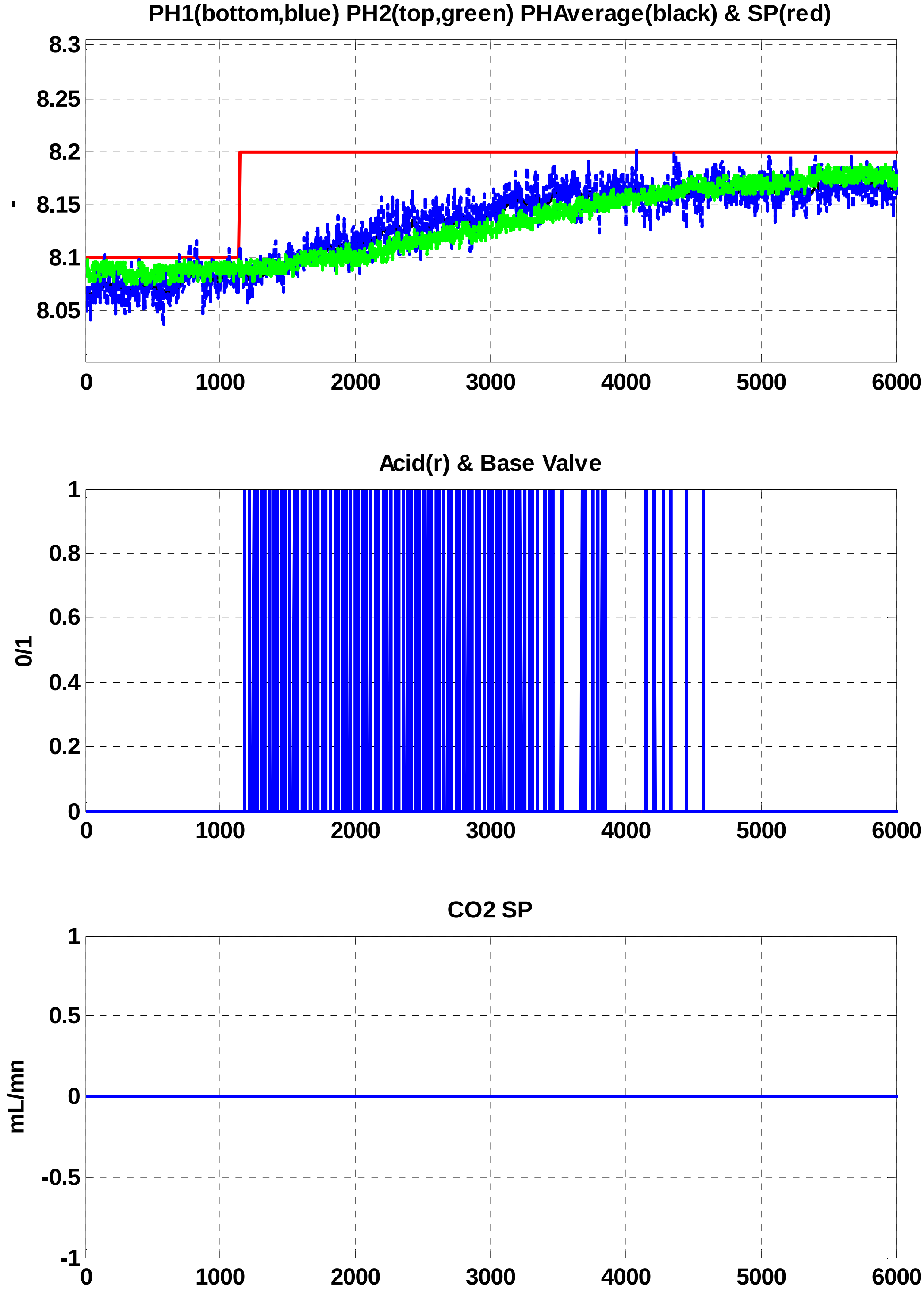

Figure 7: CL3008. pH Control test (part 1)

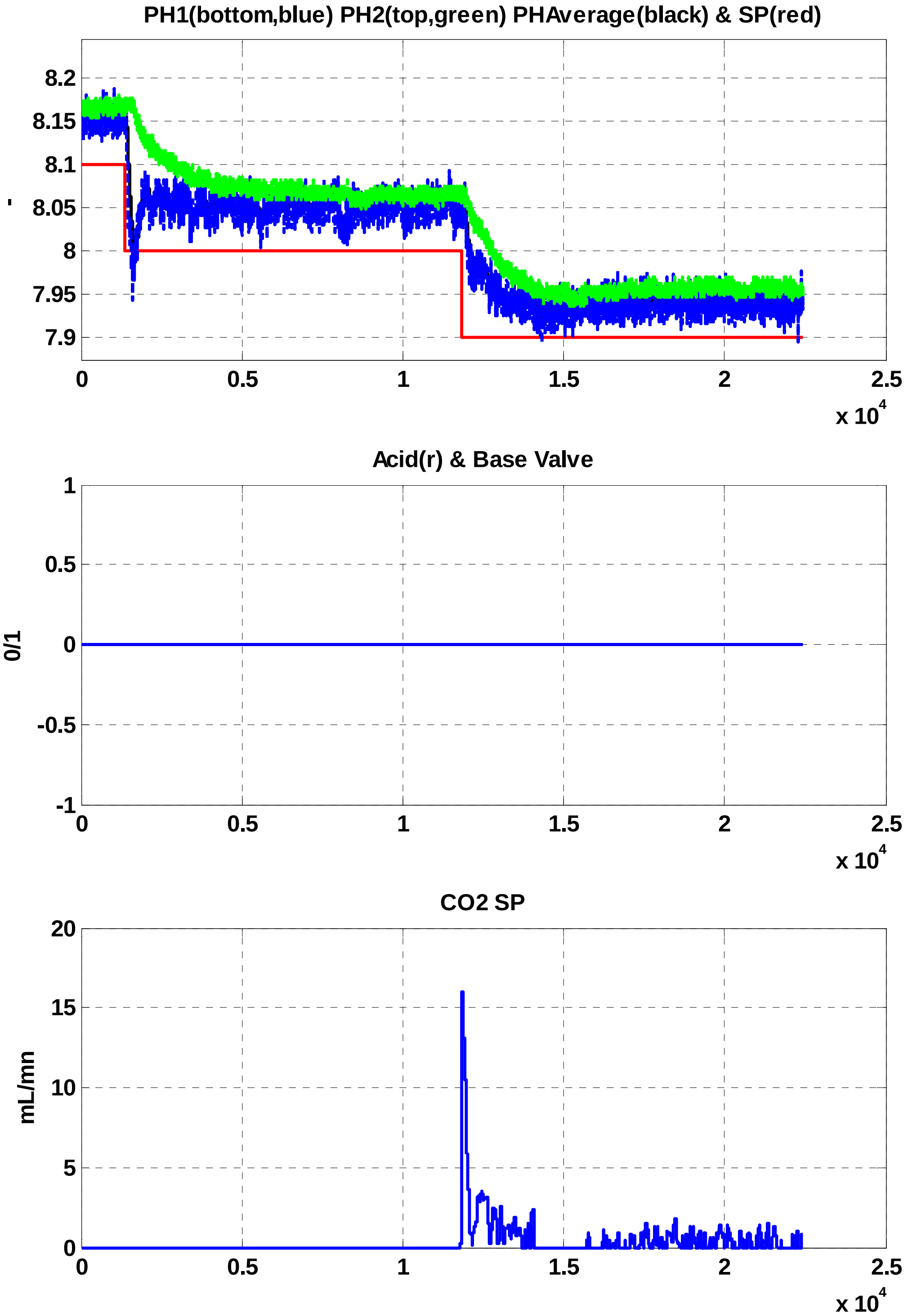

Figure 8: CL3008. pH Control test (part 2)

Unit of time is in seconds.

Data file:

- CL3008_test_20100617_1440.mat (part 1)
- CL3008_test_20100618_0902.mat (part 2)

Remarks :
Acid and Base valves on the graphs are not representative of the real behaviour as the sampling period for the acquired data is 1 second and the time of opening of the valve can be shorter. The openings of the valve are not always seen due to the data acquisition sampling period.

Conclusion

pH is controlled within the deadzone with the different strategies (Acid, Base, CO2)
We noticed a different behaviour between the pH measured in the low and in the high space of the bioreactor. It seems to be linked to the injection of base near the sensor.

Control loop 3008 is validated.

3.7. Bioreactor DO2 (3009)

Waiting for nitrification in order to validate the control loop.

Conclusion

pending

3.8. Liquid Recirculation (3017)

The test was performed May 4th 2010

Test Prerequisites		Status	
Bioreactor shall be filled (Water or Medium) and level not in L or H alarms. No LSL nor LSH activated		OK	LT_3006_01=12.1
Level Control in OFF Mode	(HMI) Bio Level = OFF	OK	
Inlet Liquid Flow in OFF Mode	(HMI) Liquid Inlet = OFF	OK	
Outlet Liquid Flow in OFF Mode	(HMI) Liquid Outlet = OFF	OK	
Recirculation Mode in OFF	(HMI) Recirculation = OFF	OK	

Seq Nb	Action Description	Required	Remarks	Date/Hour	Observed Results	C/NC
1	(HMI) Recirculation Flow SP = 3.6 L/h			04/05/2010 13:38		
2	(HMI) Recirculation Mode = AUTO					
3	Wait for Stabilisation				Set Point is satisfied. Observed Closed Loop Response Time : 90 seconds	C
4	(HMI) Recirculation Flow SP = 3.7 L/h			04/05/2010 13:41		
5	Wait for Stabilisation				Set Point is satisfied. Observed Closed Loop Response Time : 30 seconds	C
6	(HMI) Recirculation Flow SP = 3.5 L/h			04/05/2010 13:44		
7	Wait for Stabilisation				Set Point is satisfied. Observed Closed Loop Response Time : 50 seconds	C

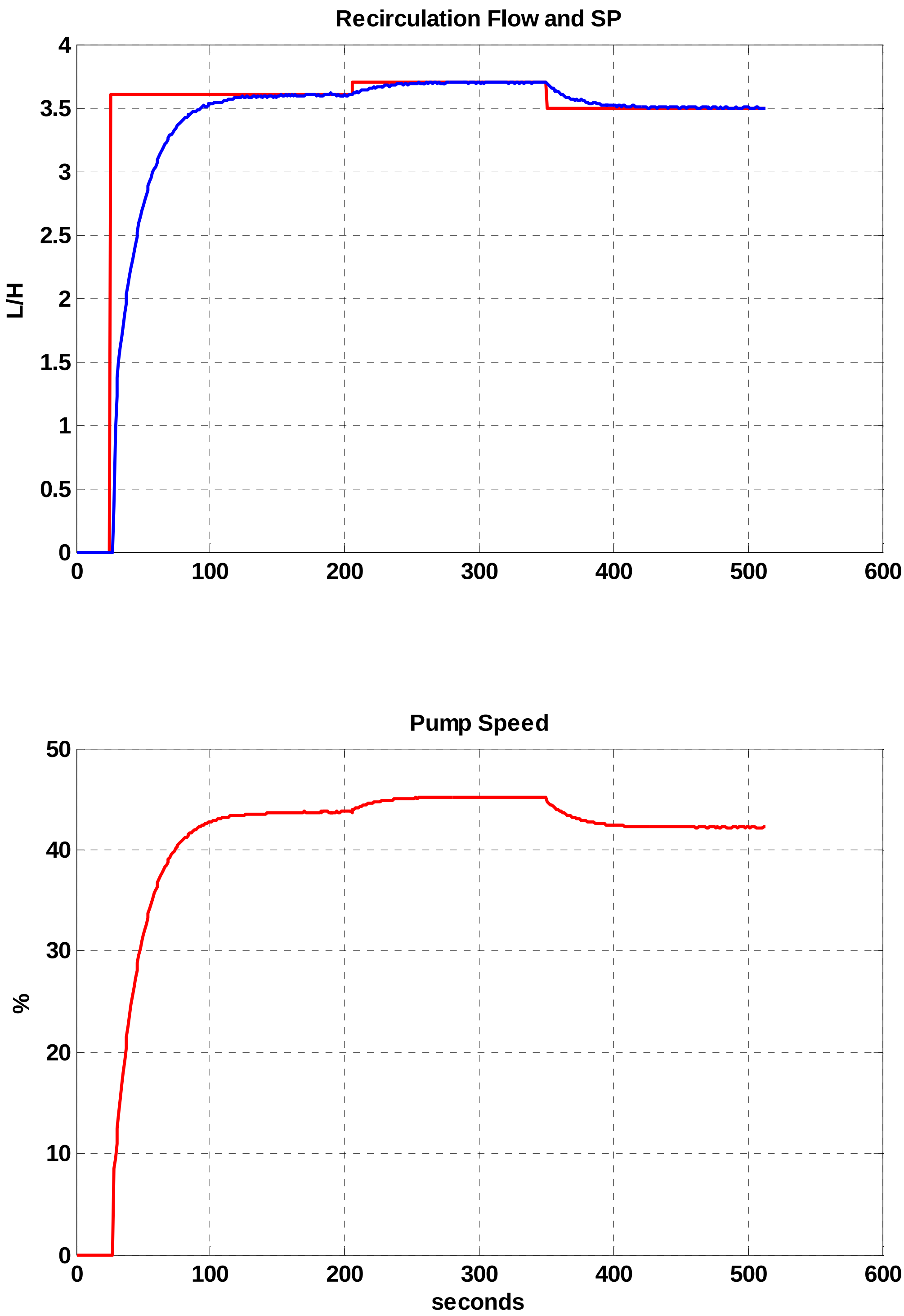

Figure 9: CL3017. Liquid Recirculation Control test

Data file CL3017_test_20100504_1338.mat

Remarks :

Conclusion

Flow set point is satisfied.
Control loop 3017 is validated.

3.9. Outlet liquid Control (3018)

The test was performed May 4th 2010

Test Prerequisites		Status
Effluent Tank is not in High Alarm	(HMI) LT_3021_01 < 30 L	OK
Oulet Flow Mode in OFF Mode	(HMI) Liquid Outlet = OFF	OK
Inlet Flow Mode in OFF Mode	(HMI) Liquid Inlet = OFF	OK
Outlet Flow Set Point = 0 L/H	CL3018_FLOW_SP = 0 L/H	OK
Level Control in OFF Mode	(HMI) Bio Level = OFF	OK
Level not in Low Alarm, no LSL activated		LT_1206_01 = 12.3 L No LSH activated
Recirculation Mode in OFF	(HMI) Recirculation = OFF	OK

Seq Nb	Action Description	Required	Remarks	Date/Hour	Observed Results	C/NC
1	(HMI) Liquid Outlet Mode = AUTO			04/05/2010 13:00		
2	(HMI) Liquid Outlet Set Point = 0.6 L/H			04/05/2010 13:00		
3	Wait for Stabilisation				Set Point is satisfied. Observed Closed Loop Response Time : 5 minutes	C
4	(HMI) Liquid Outlet Set Point = 0.7 L/H			04/05/2010 13:08		
5	Wait for Stabilisation				Set Point is satisfied. Observed Closed Loop Response Time : 3 minutes	C
6	(HMI) Recirculation Mode = AUTO			04/05/2010 13:14		
7	Wait for Stabilisation				No disturbances for the controller.	C

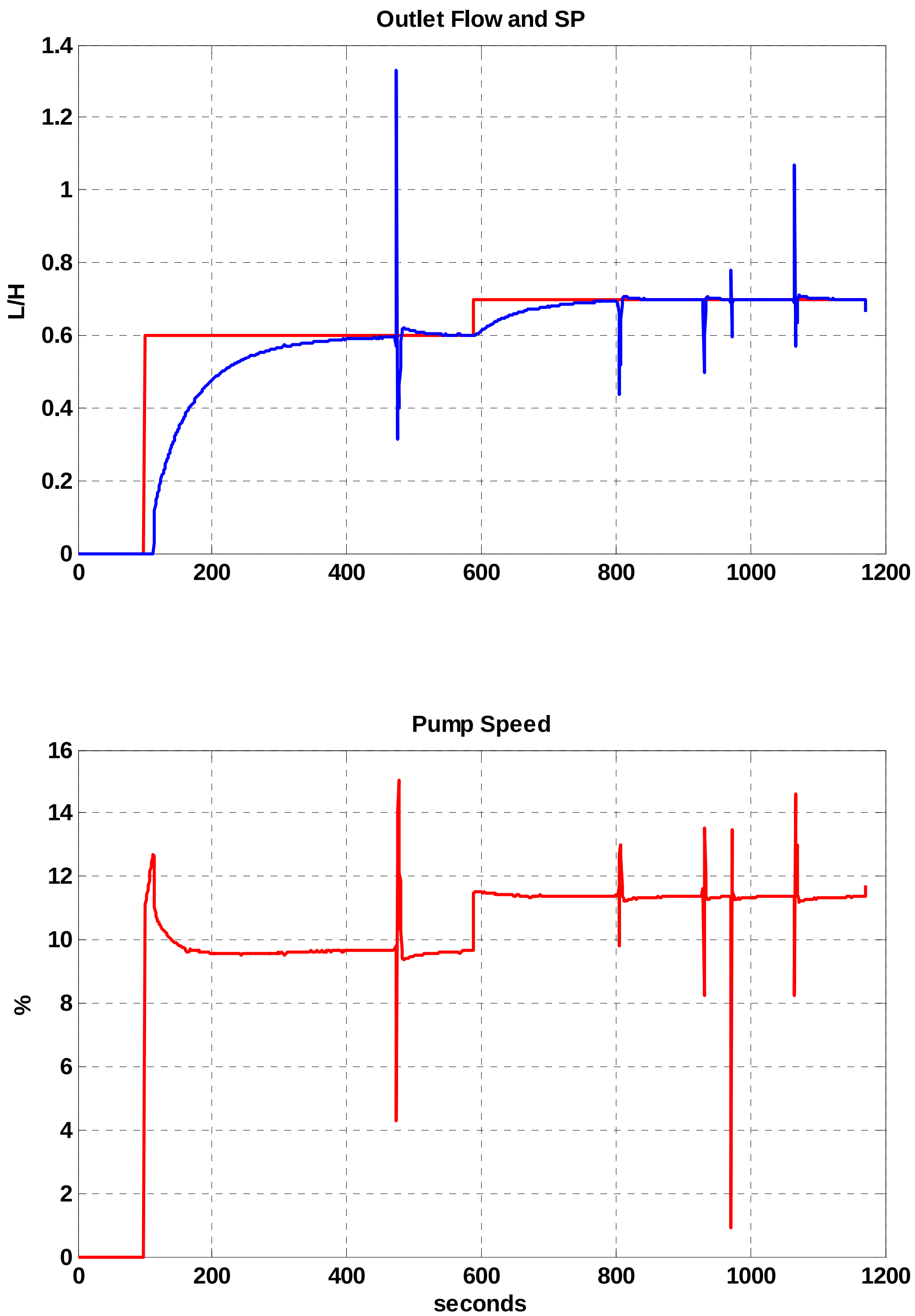

Figure 10: CL3018. Outlet Liquid Control test

Data file : CL3018_test_20100504_1258.mat

Remarks :

- Some problems of measurements of the flow during the test

Conclusion

Flow set point is satisfied.
Control loop 3018 is validated.

3.10. Effluent Temperature (3020)

The test was performed March 16th 2010

Test Prerequisites		Status
Harvesting Tank shall be filled with medium or water And not in Low or High Alarm	(HMI) LT_3021_01 > 6 L and LT_3002_01 < 30 L	OK
Temperature Control Mode in OFF	(HMI) Effluent Temp = OFF	OK
MPP Cold Water available		OK

Seq Nb	Action Description	Required	Remarks	Date/Hour	Observed Results	C/NC
1	(HMI) TT_3020_01_SP = 12 °C			16/03/2010 17:40	Measured TT_3020_01 = 13.29 °C	
2	(HMI) Effluent Temp Mode = AUTO					
3	Wait for Stabilisation				Observed Closed Loop Response Time : 30 minutes	C
4	(HMI) TT_3020_01_SP = 11°C			16/03/2010 18:08		
5	Wait for Stabilisation		Indicate Time for Stabilisation		Stabilisation in 30 minutes but above the set point. 11°C is not reachable	
6	(HMI) TT_3020_01_SP = 4°C				Not performed as it was already not possible to obtain 11°C	
7	Wait for Stabilisation		Indicate Time for Stabilisation and Temperature reached		N/A	

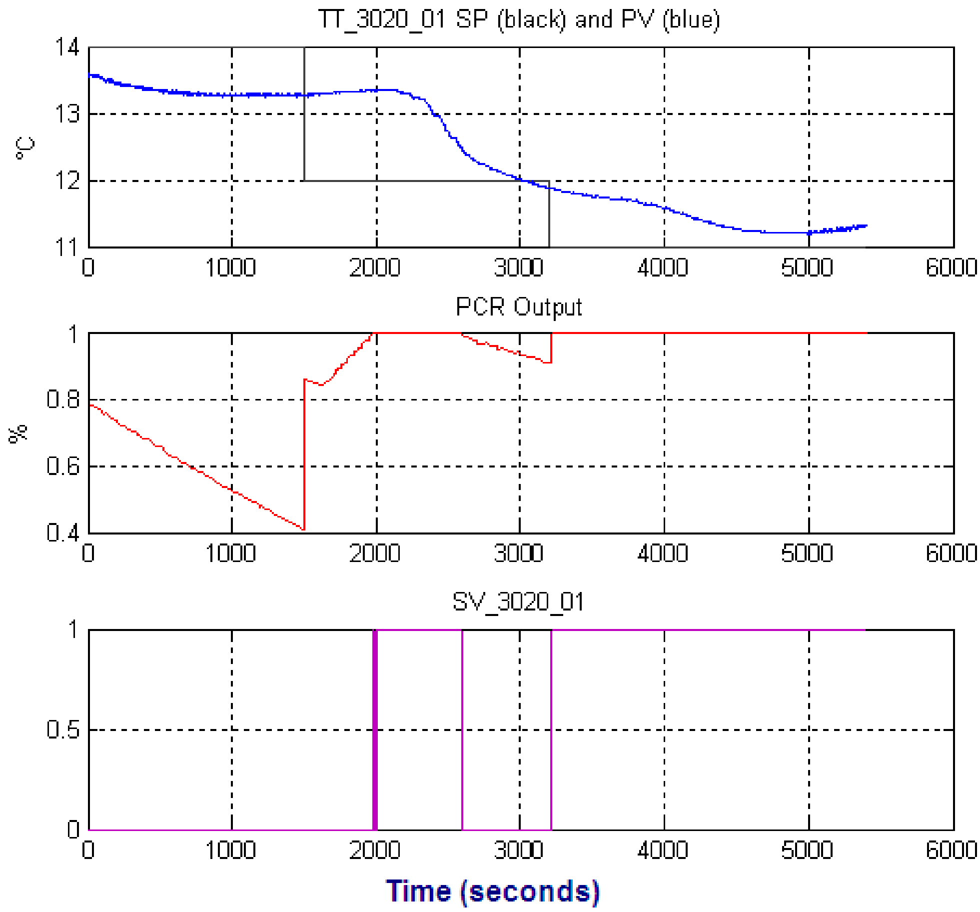

Figure 11: CL3020. Effluent Temp. Control test

Data file : CL3001_3020_test_20100316_1732.mat

Remarks :

- PCR Output represents the calculated analog value of the valve opening. This value, between 0 and 1 is converted to a ON/OFF sequence for the digital valve.
- Due to the cold water temperature, it is not possible to obtain temperatures lower than 11°C

<u>Conclusion</u>:
Temperature Set Point is satisfied (if permitted by Utility Temperature itself).
Control loop 3020 is validated.

4. Conclusion

All the dynamic control loops have been successfully tested and validated.

The pending control loop is CL3009, waiting for nitrification for tuning and testing it.

5. Appendix

5.1. Document evolutions

5.2. Issue 1 / Revision 1

Page/Section	Comment	Answer

Modification Number	Modification reasons	Modification performed	date	Previous referenced version	New referenced version	Comments

SECTION 2: PLC Design and wiring				
Reference	Title	Version	Edition date	Pages Number
NTE-CIIIP2-ICD-002	CIII HARDWARE INTERFACE DOCUMENT	1.1	16/10/09	41
NTE-CIIIP2-RP-004	MELISSA CIII CONTROL CABINET HARDWARE DESIGN DOCUMENT	1	6/10/09	32

CIII Hardware Interface Document

APPROVAL LIST		
NAME	SIGNATURE	DATE
Prepared by: Martí Bassas		21/10/2009
Revised by: Jordi Duatis	Duatis	21/10/2009
Approved by: Eva Creus		21/10/09
Authorised by: Jordi Duatis	Duatis	21/10/2009

DISTRIBUTION LIST		
NAME	POSITION	COMPANY
O. Gerbi		SHERPA ENGINEERING
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A. Fossen		ESA-MPP
G. Tórtoles		BIOPROCESS

CHANGE RECORD			
AUTHOR	ISSUE	DATE	CHANGE
Martí Bassas	1.0	27-04-09	New Document
Martí Bassas	1.1	16-10-09	Updated PLC cards configuration according to CIII PLC Expansion as defined in AD2. Sections 5.1.2, 5.1.2, & 5.4 added.

CONTENTS

ACRONYMS LIST

CIII	Compartment III
I/O	Input / Output
PLC	Programmable Logic Controller
MELiSSA	Micro-Ecological Life Support System Alternative
MPP	MELiSSA Pilot Plant
UAB	Universitat Autònoma de Barcelona

1. SCOPE

This document is meant to provide BIOPROCESS with the information needed to connect and place PHOENIX VARIOFACE modules in CIII BIOPROCESS cabinet, to interface with PLC Cabinet.

2. APPLICABLE AND REFERENCE DOCUMENTS

2.1 Applicable documents

AD1 NTE-CIIIP2-OF-001 NTE OFFER FOR CIII CONTROL SYSTEM CABINET AND HMI UPDATE

AD2 Proposal for CIII PLC Expansion. REF: C3280109/FG, 31/07/2009

2.2 Reference documents

RD1 BIOPROCESS Response_ESA - IO List - Rev3.xls

RD2 Quantum I/O module User Manual. Schneider Doc number: 35010516K01000 Downloadable from: http://www.download.schneider-electric.com/C12573FE002EC02D/all/42ECCC2380F718DBC1257536003F5E2E

RD3 PHOENIX PLC interface relay Datasheet. Document code 5156535. Downloadable from: http://select.phoenixcontact.com/phoenix/dwl/dwl13a.jsp;jsessionid=DF3DBA54F23C7151B3F0BEB327C53450?fct=dwl&asid=904835&name=db_en_plc_rsc_21_101780_en_02.pdf&tstamp=1240395058845&UID=2966171&param1=JrCDnVW3q4k%3d%2f0dDxMIlHrxc%3d&lang=es&from=eshop&f=me_doku/trans/english/5300/db/101780_en_02.pdf

3. MELISSA CIII HARDWARE OVERVIEW

Figure 3.1 shows the general connections between CIII and its electric cabinets.

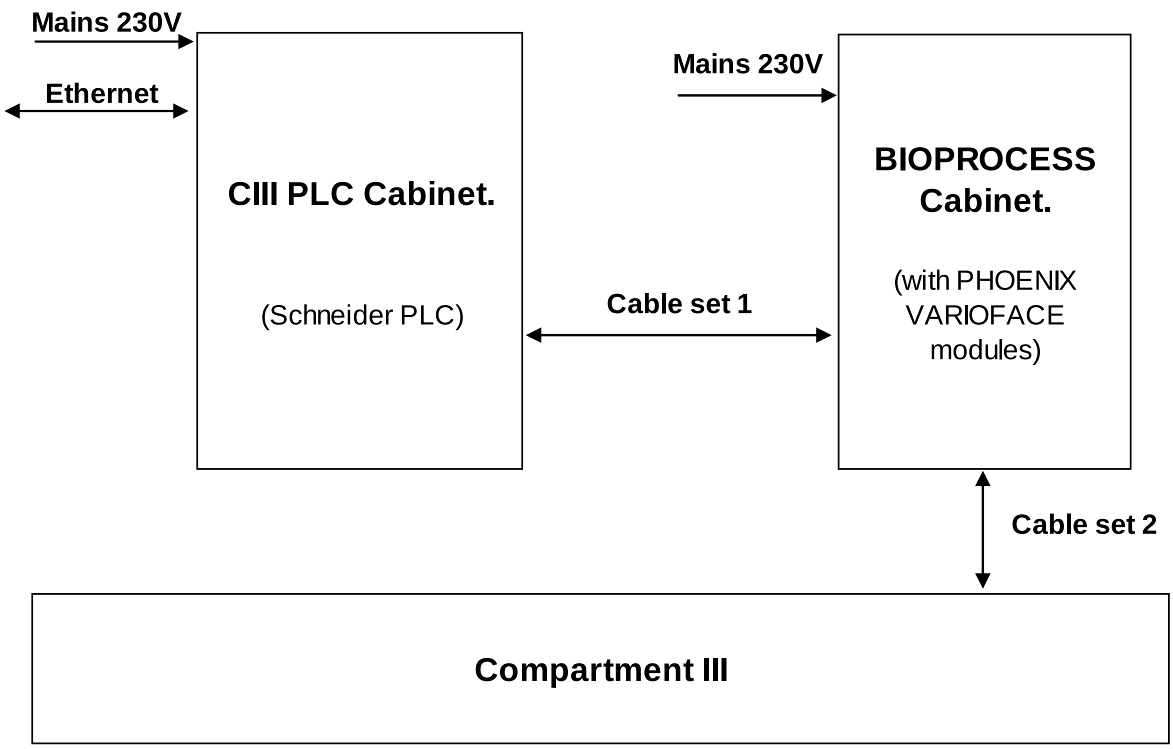

Figure 3.1: CIII general connections diagram.

The software in CIII PLC controls CIII compartment, monitoring sensors readouts and commands actuators accordingly. Communication through Ethernet between the PLC and an iFix server provides general system control and monitoring. The BIOPROCESS cabinet contains part of the electronics used in the cabinet, as well as a number of PHOENIX contact modules and relays to interface with the PLC cabinet.

Communications between the "PLC Cabinet" and the "BIOPROCESS Cabinet" is featured by means of a set of cables type:

PHOENIX FLK 50/EZ-DR/ 1000/KONFEK/S & FLK 14/EZ-DR/ 1000/KONFEK/S.

Figure 3.2: 50-wire shielded cable with flat cable IDC connector termination.

(reference may change depending on required lengths)

The BIOPROCESS cabinet shall be equipped with PHOENIX modules to interface between IDC connectors coming from the PLC and terminal blocks, where wires coming from the sensors and actuators in the compartment are plugged. The different kind of modules used for interfacing and their connection details are described in this document.

Due to lack of space in the BIOPROCESS cabinet, sometimes, the PHOENIX modules shall be installed in the PLC cabinet.

4. LABELING

DIN rail modules and cables with flat cable connectors shall be labeled according to the following table:

Schneider PLC cards	*Number of cards*	*I/O type*	*I/O per card*	*Interface module for cabling*	*Number of Modules*	*Module label*	*Cable label*
140DDI35300	1	digital IN	32	PLC-V8/FLK14/IN	4	DDI 1… DDI 4	DDI 1… DDI 4
140DDI84100	1	digital IN	16	50/MODI-TSX/Q	1	DDI5	DDI5
140DDO35300	1	digital OUT	32	PLC-V8/FLK14/OUT	4	DDO 1… DDO 4	DDO 1… DDO 4
140DDO84300	1	digital OUT	16	50/MODI-TSX/Q	1	DDO5	DDO5
140ACI04000	1	analog current IN	16	50/MODI-TSX/Q	1	ACI 1 - 16Ch	ACI 1 - 16Ch
140ACI03000	1	analog current IN	8	50/MODI-TSX/Q	1	ACI 2 - 8Ch	ACI 2 - 8Ch
140ACI03000	1	analog current IN	8	50/MODI-TSX/Q	1	ACI 3 - 8Ch	ACI 3 - 8Ch
140AVI03000	1	analog voltage IN	8	50/MODI-TSX/Q	1	AVI 1 - 8Ch	AVI 1 - 8Ch
140AVI03000	1	analog voltage IN	8	50/MODI-TSX/Q	1	AVI 2 - 8Ch	AVI 2 - 8Ch
140AVO02000	1	analog voltage OUT	4	50/MODI-TSX/Q	1	AVO 1 - 4Ch	AVO 1 - 4Ch
140ACO13000	1	analog current OUT	8	50/MODI-TSX/Q	1	ACO 1 - 8Ch	ACO 1 - 8Ch
140ACO02000	1	analog current OUT	4	50/MODI-TSX/Q	1	ACO 2 -4Ch	ACO 2 -4Ch

Table 4.1: Cable and module labeling.

Cables PHOENIX FLK 50/EZ-DR/ 250/KONFEK/S & FLK 14/EZ-DR/ 400/KONFEK/S (*Figure 4.1*).

Figure 4.1: 50-wire shielded cable with flat cable IDC connector.

(reference may change depending on required lengths)

Cables shall be labeled using wire strips PHOENIX KME (Figure *4.2*)

Figure *4.2: PHOENIX KME (code 0807083) wire strip for cable labeling.*

One strip with a label shall be placed close to each cable end.

The DIN rail modules and the relay modules are provided with a blank space for labeling, so there is no need to buy a specific label holder.

5. I/O CARDS AND INTERFACE WITH BIOPROCESS CABINET.

The cards foreseen to be used for I/O interfacing with the compartment are the following:

Schneider plc cards	***Number of cards***	***I/O type***	***I/O per card***	***Total available I/Os***
140DDI35300	1	digital IN	32	32
140DDI84100	1	digital IN	16	16
140DDO35300	1	digital OUT	32	32
140DDO84300	1	digital OUT	16	16
140ACI04000	1	analog current IN	16	16
140ACI03000	2	analog current IN	8	16
140AVI03000	2	analog voltage IN	8	16
140AVO02000	1	analog voltage OUT	4	4
140ACO13000	1	analog current OUT	8	8
140ACO02000	1	analog current OUT	4	4

Table 5.1 I/O cards in the PLC cabinet

All these cards are equipped with a PHOENIX electric interface device to provide connectivity through 14-wire or 50-wires cables. These cables are ended with flat cable IDC connectors. DIN rail modules at BIOPROCESS cabinet interface between these IDC connectors and terminal blocks to connect the compartment electronics.

5.1 DIGITAL INPUT

A 140DDI35300 and a 140DDI84100 Schneider modules in the PLC Cabinet receive digital (ON/OFF) inputs.

5.1.1 140DDI35300 DIGITAL INPUT CARD

The 140DDI35300 module is equipped with an FLKM 50/ 4-FLK14/PA-MODI-TSX/Q (*Figure 5.29*)

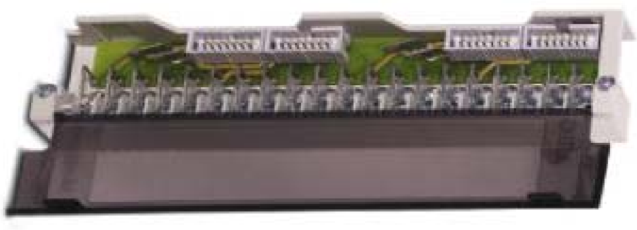

Figure 5.1. PHOENIX FLKM 50/ 4-FLK14/PA-MODI-TSX/Q

This adaptor implements the electrical interface between screw-like PLC terminal blocks and four 14 pins headers for flat ribbon cable connector. Four FLK 14/EZ-DR/ 400/KONFEK/S cables (*Figure 5.30*) are used to interface with the BIOPROCESS cabinet.

Figure 5.2: PHOENIX FLK 14/EZ-DR/ 400/KONFEK/S. One to One cable with IDC flat cable connectors.

Reference is to be confirmed. It may change depending on required length.

These cables shall be labeled as:

- DDI 1, DDI 2, DDI 3 & DDI 4

Each of these cables shall be connected to a PLC-V8/FLK14/IN module (*Figure 5.31*)

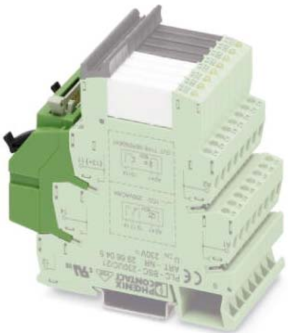

Figure 5.3: PHOENIX PLC-V8/FLK14/IN

Which are connected to 8 DIN rail relays PLC-RSC-24DC/21 each *Figure 5.32*:

Figure 5.4: PHOENIX PLC-RSC-24DC/21

PLC-V8/FLK14/IN module is connected to relay terminals 11 and 14. *Figure 5.5* shows this module connections:

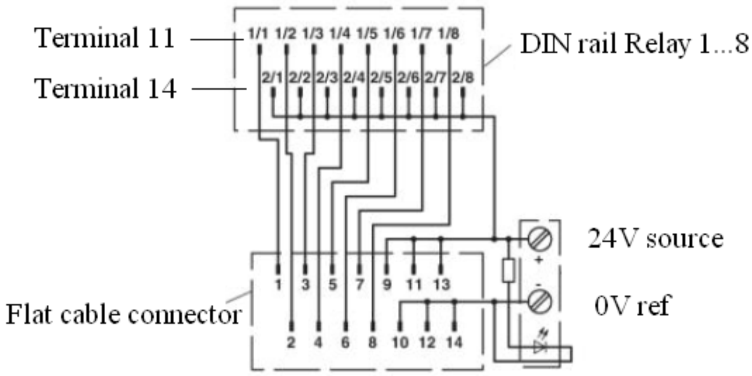

Figure 5.5: PLC-V8/FLK14/IN module connections.

The 0V ref and 24V source are used by the PLC DDI card as the input reference high and low levels. They should be connected to an arbitrary 24Vdc source. 100mA are enough for sensing, so a 0.5A fuse or magnetic switch protection is recommended.

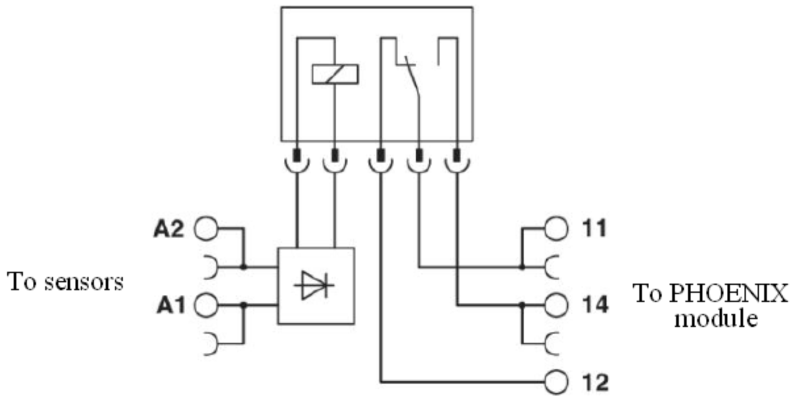

Figure 5.6: PHOENIX PLC-RSC-24DC/21 relay.

The suggested Relay (PHOENIX PLC-RSC-24DC/21) is intended to be controlled by a 24Vdc signal.

A1+ : 0V ➔ Relay open; +24Vdc ➔ Relay closed.

A2- : Reference (0V)

PHOENIX CONTACT provides many other relays compatible with PLC-V8/FLK14/IN module [RD3], with different commutation voltage levels, so that they can be individually replaced to meet the voltage provided by the sensors in the compartment. Notice that these replacements do not affect any connections at the PLC side of the relays (relay output).

The chosen relays can be extracted from their DIN rail chassis, so that they can be easily replaced after the cabling is done. This provides great flexibility in case of error or sensor replacement, etc.

PLC-V8/FLK14/IN modules shall be labeled according to *Table 5.2*:

Connected cable	Module label	Module type	Relay number	Relay type (TBD)
DDI 1	DDI 1	PLC-V8/FLK14/IN	1	PLC-RSC-***xx***/21
			2	PLC-RSC-***xx***/21
			3	PLC-RSC-***xx***/21
			4	PLC-RSC-***xx***/21
			5	PLC-RSC-***xx***/21
			6	PLC-RSC-***xx***/21
			7	PLC-RSC-***xx***/21
			8	PLC-RSC-***xx***/21
DDI 2	DDI 2	PLC-V8/FLK14/IN	1	PLC-RSC-***xx***/21
			2	PLC-RSC-***xx***/21
			3	PLC-RSC-***xx***/21
			4	PLC-RSC-***xx***/21
			5	PLC-RSC-***xx***/21
			6	PLC-RSC-***xx***/21

			7	PLC-RSC-***xx***/21
			8	PLC-RSC-***xx***/21
DDI 3	DDI 3	PLC-V8/FLK14/IN	1	PLC-RSC-***xx***/21
			2	PLC-RSC-***xx***/21
			3	PLC-RSC-***xx***/21
			4	PLC-RSC-***xx***/21
			5	PLC-RSC-***xx***/21
			6	PLC-RSC-***xx***/21
			7	PLC-RSC-***xx***/21
			8	PLC-RSC-***xx***/21
DDI 4	DDI 4	PLC-V8/FLK14/IN	1	PLC-RSC-***xx***/21
			2	PLC-RSC-***xx***/21
			3	PLC-RSC-***xx***/21
			4	PLC-RSC-***xx***/21
			5	PLC-RSC-***xx***/21
			6	PLC-RSC-***xx***/21
			7	PLC-RSC-***xx***/21
			8	PLC-RSC-***xx***/21

Table 5.2: DDI relays and modules' types and labels. Relay type shall depend on the commutation voltage required, which depends on the kind of input sensor to be monitored.

Relays within every module shall also be labeled from 1 to 8 using labels such as

PHOENIX ZB 6,LGS:FORTL.ZAHLEN (*Figure 5.7*)

Figure 5.7: Numbered labels for Relays.

5.1.2 140DDI84100 DIGITAL INPUT CARD

The 140DDI84100 module is equipped with an FLKM 50-PA-MODI-TSX/Q (*Figure 5.8*)

Figure 5.8. PHOENIX FLKM 50-PA-MODI-TSX/Q

These adaptors implement the electrical interface between screw-like PLC terminal blocks and a 50-pins header for a flat ribbon cable connector. Attached to the connector, an FLK 50/EZ-DR/1000/KONFEK/S (*Figure 5.9*) cable interface with the BIOPROCESS cabinet

Figure 5.9: PHOENIX FLK 50/EZ-DR/1000/KONFEK/S. One to One cable with IDC flat cable connectors.

Reference is to be confirmed. It may change depending on required length.

This cable is used to interface between PLC Cabinet and BIOPROCESS cabinet. It shall be labeled as:

- DDI 5

This cable shall be connected to an FLKM 50/MODI-TSX/Q module (*Figure 5.10*)

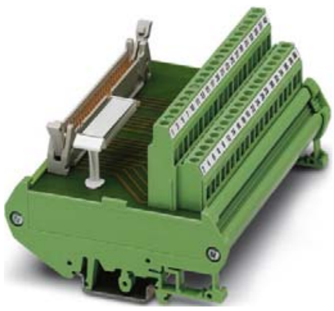

Figure 5.10: PHOENIX 50/MODI-TSX/Q

This module is passive. It provide direct electric connections between a flat cable connector and terminal blocks.

The pinout at terminals' blocks side is the same as at the corresponding PLC DDI module screw connections, which is as shown in *Figure 5.11*:

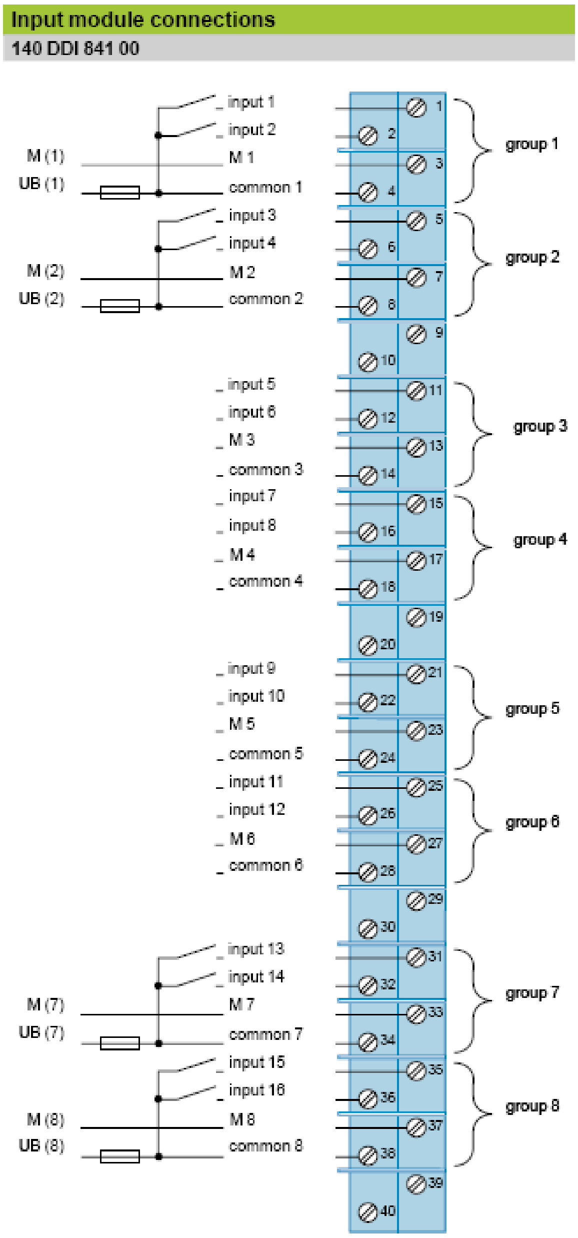

Figure 5.11: Pinout at 50/MODI-TSX/Q terminal block side (DDI).

Relays PLC-RSC-24DC/21 (*Figure 5.12*) are used to interface between PLC inputs and the compartment sensors. These relays function is to Project the PLC card from potential voltage pics generated in the compartment or cabling.

Figure 5.12: PHOENIX PLC-RSC-24DC/21

The relays pinout is as shown in *Figure 5.13*

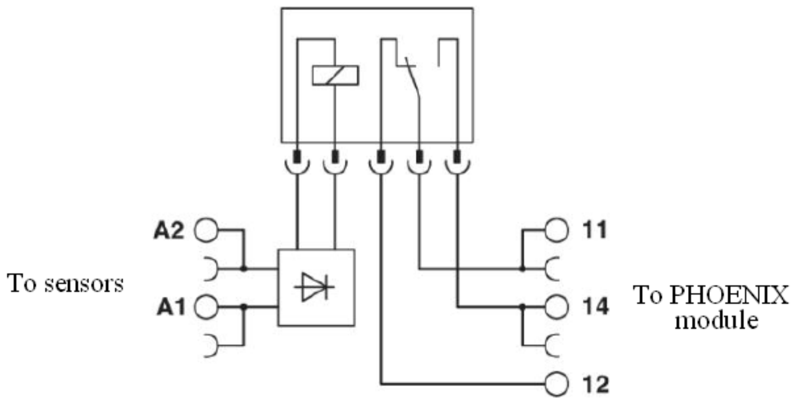

Figure 5.13: PHOENIX PLC-RSC-24DC/21 relay.

Pin 14 of the Relays are connected to +24Vdc. Pins 11 are connected to the PLC corresponding input. *Table 5.3* summarizes the connections to the PLC card.

PLC side			Device side	
Card	Pin	Name	Device	Pin
140DDI841	1	IN 1	Relay IN 1	11
	2	IN 2	Relay IN 2	11
	3	COM A		COM
	4	+ A		+ 24V
	5	IN 3	Relay IN 3	11
	6	IN 4	Relay IN 4	11
	7	COM B		COM
	8	+ B		+ 24V
	9	NC		
	10	NC		
	11	IN 5	Relay IN 5	11
	12	IN 6	Relay IN 6	11
	13	COM C		COM

PLC side			Device side	
	14	+ C		+ 24V
	15	IN 7	Relay IN 7	11
	16	IN 8	Relay IN 8	11
	17	COM D		COM
	18	+ D		+ 24V
	19	NC		
	20	NC		
	21	IN 9	Relay IN 9	11
	22	IN 10	Relay IN 10	11
	23	COM E		COM
	24	+ E		+ 24V
	25	IN 11	Relay IN 11	11
	26	IN 12	Relay IN 12	11
	27	COM F		COM
	28	+ F		+ 24V
	29	NC		
	30	NC		
	31	IN 13	Relay IN 13	11
	32	IN 14	Relay IN 14	11
	33	COM G		COM
	34	+ G		+ 24V
	35	IN 15	Relay IN 15	11
	36	IN 16	Relay IN 16	11
	37	COM H		COM
	38	+ H		+ 24V
	39	NC		
	40	NC		

Table 5.3 Connection DDI84100 with protection relays.

The suggested Relay (PHOENIX PLC-RSC-24DC/21) is intended to be controlled by a 24Vdc signal.

A1+ : 0V ➔ Relay open; +24Vdc ➔ Relay closed.

A2- : Reference (0V)

PHOENIX CONTACT provides many other relays compatible with PLC-V8/FLK14/IN module [RD3], with different commutation voltage levels, so that they can be individually replaced to meet the voltage provided by the sensors in the compartment. Notice that these replacements do not affect any connections at the PLC side of the relays (relay output).

The chosen relays can be extracted from their DIN rail chassis, so that they can be easily replaced after the cabling is done. This provides great flexibility in case of error or sensor replacement, etc.

Relays shall be labeled from 1 to 16 using labels such as

PHOENIX ZB 6,LGS:FORTL.ZAHLEN (*Figure 5.14*)

Figure 5.14: Numbered labels for Relays.

5.2 DIGITAL OUTPUT

A 140DDO35300 and a 140DDO84300 Schneider module in the PLC Cabinet controls discrete (ON/OFF) actuators in the compartment.

5.2.1 140DDO35300 DIGITAL OUTPUT CARD

This module is equipped with an

FLKM 50/ 4-FLK14/PA-MODI-TSX/Q (*Figure 5.15*)

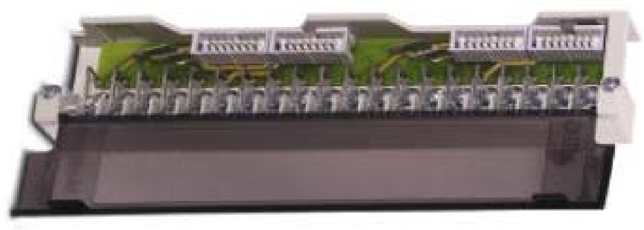

Figure 5.15. PHOENIX FLKM 50/ 4-FLK14/PA-MODI-TSX/Q

To electrically interface between screw-like PLC terminal blocks and four 14 pins headers for flat ribbon cable connectors. Connectors are attached to three Cables such as FLK 14/EZ-DR/ 400/KONFEK/S (*Figure 5.16*). One of the 14-pin headers is left unconnected as not all 32 inputs are necessary.

Figure 5.16: PHOENIX FLK 14/EZ-DR/ 400/KONFEK/S. One to One cable with flat ribbon cable connector ends.

Reference is to be confirmed. It may change depending on required length.

These cables are used to interface between the PLC Cabinet and BIOPROCESS cabinet. They shall be labeled as:

- DDO 1, DDO 2 DDO 3 & DDO 4

Each of these cables shall be connected to a PLC-V8/FLK14/OUT module (*Figure 5.17*)

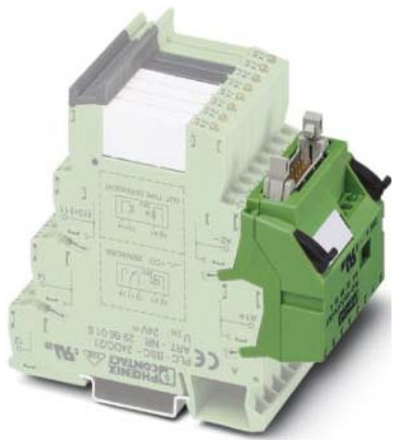

Figure 5.17: PHOENIX PLC-V8/FLK14/OUT

Which are connected to 8 DIN rail relays PLC-RSC-24DC/21 (*Figure 5.18*)

Figure 5.18: PHOENIX PLC-RSC-24DC/21

PLC-V8/FLK14/OUT module is connected to relay terminals A1 and A2. Figure 5.19 shows this module connections:

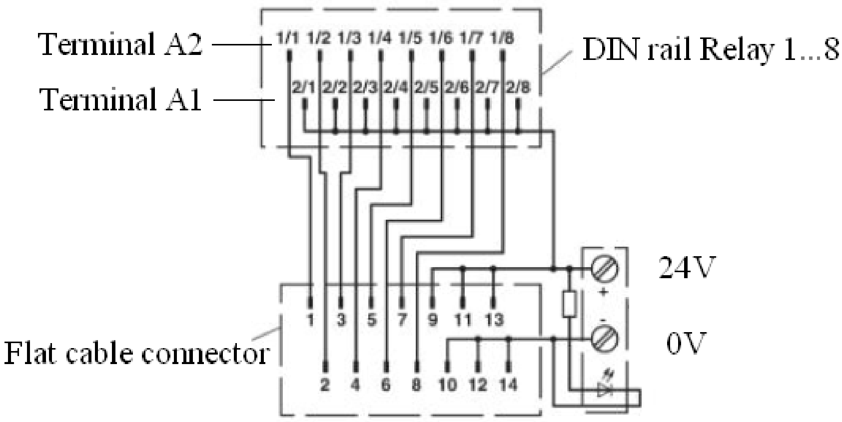

Figure 5.19: PLC-V8/FLK14/OUT module connections.

The 0V and 24V are used by the PLC DDO card as a power supply for the digital outputs. According to Schneider (PLC manufacturer) the 140DDO35300 card can supply 0.5A per output, so that a 24V 16A(minimum) power supply would be required to feed them. In our case the module outputs are just used to open/close a Relay whose minimum commutation current is 10mA.

This means that 320mA would be enough to have all 32 output Relays closed.

A sensible choice would be to connect these pins to the 24V power supply in the BIOPROCESS Cabinet through a 0.5A protection (fuse or magnetic switch).

The PLC-RSC-24DC/21 relays offer the following maximum switching values:

V (max, commutation) = 250Vac / 250Vdc

I (max, continuous) = 6A

so they can be used for a wide variety of actuators. Refer to manufacturer's (PHOENIX) [RD3] product datasheet for further information.

The connections with terminals 11, 12 and 14 in the relays, as well as the choice of power supplies is up to BIOPROCESS, depending on the actuators to be switched.

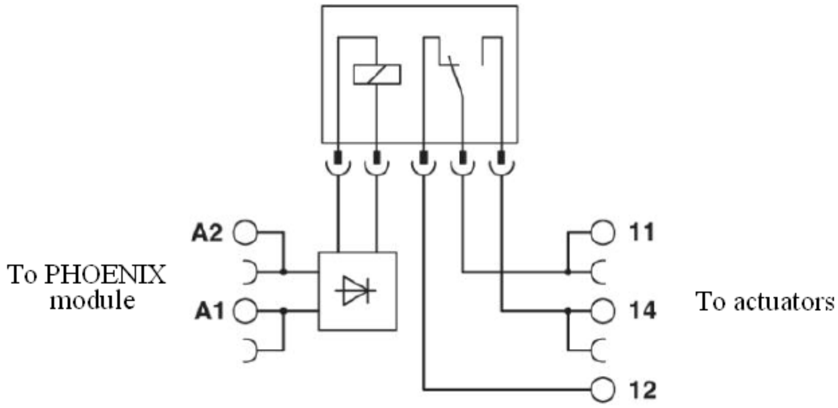

Figure 5.20: PHOENIX PLC-RSC-24DC/21 relay.

PLC-V8/FLK14/OUT modules shall be labeled according to *Table 5.4*:

Connected flat ribbon cable	Module label	Module type	Relay number	Relay type
DDO 1	DDO 1	PLC-V8/FLK14/OUT	1	PLC-RSC-24DC/21
			2	PLC-RSC-24DC/21
			3	PLC-RSC-24DC/21
			4	PLC-RSC-24DC/21
			5	PLC-RSC-24DC/21
			6	PLC-RSC-24DC/21
			7	PLC-RSC-24DC/21
			8	PLC-RSC-24DC/21
DDO 2	DDO 2	PLC-V8/FLK14/OUT	1	PLC-RSC-24DC/21
			2	PLC-RSC-24DC/21
			3	PLC-RSC-24DC/21
			4	PLC-RSC-24DC/21
			5	PLC-RSC-24DC/21
			6	PLC-RSC-24DC/21
			7	PLC-RSC-24DC/21
			8	PLC-RSC-24DC/21
DDO 3	DDO 3	PLC-V8/FLK14/OUT	1	PLC-RSC-24DC/21
			2	PLC-RSC-24DC/21
			3	PLC-RSC-24DC/21
			4	PLC-RSC-24DC/21
			5	PLC-RSC-24DC/21
			6	PLC-RSC-24DC/21
			7	PLC-RSC-24DC/21
			8	PLC-RSC-24DC/21

Table 5.4: DDO relays and module types and labels.

Relays within every module shall also be labeled from 1 to 8 using labels such as

PHOENIX ZB 6,LGS:FORTL.ZAHLEN (*Figure 5.21*)

Figure 5.21: Numbered labels for Relays.

5.2.2 140DDO843 DIGITAL OUTPUT CARD

The 140DDI84300 module is equipped with an FLKM 50-PA-MODI-TSX/Q (*Figure 5.25*)

Figure 5.22. PHOENIX FLKM 50-PA-MODI-TSX/Q

These adaptors implement the electrical interface between screw-like PLC terminal blocks and a 50-pins header for a flat ribbon cable connector. Attached to the connector, an FLK 50/EZ-DR/1000/KONFEK/S (*Figure 5.23*) cable interface with the BIOPROCESS cabinet

Figure 5.23: PHOENIX FLK 50/EZ-DR/1000/KONFEK/S. One to One cable with IDC flat cable connectors.

Reference is to be confirmed. It may change depending on required length.

This cable is used to interface between PLC Cabinet and BIOPROCESS cabinet. It shall be labeled as:

- DDO 5

This cable shall be connected to an FLKM 50/MODI-TSX/Q module (*Figure 5.24*)

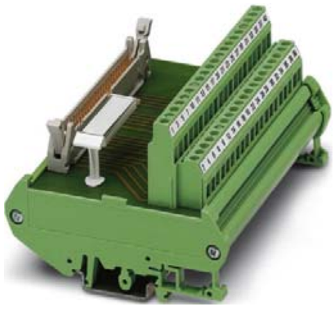

Figure 5.24: PHOENIX 50/MODI-TSX/Q

This module is passive. It provides direct electric connections between a flat cable connector and terminal blocks.

The pinout at terminals' blocks side is the same as at the corresponding PLC DDI module screw connections, which is as shown in *Figure 5.25*:

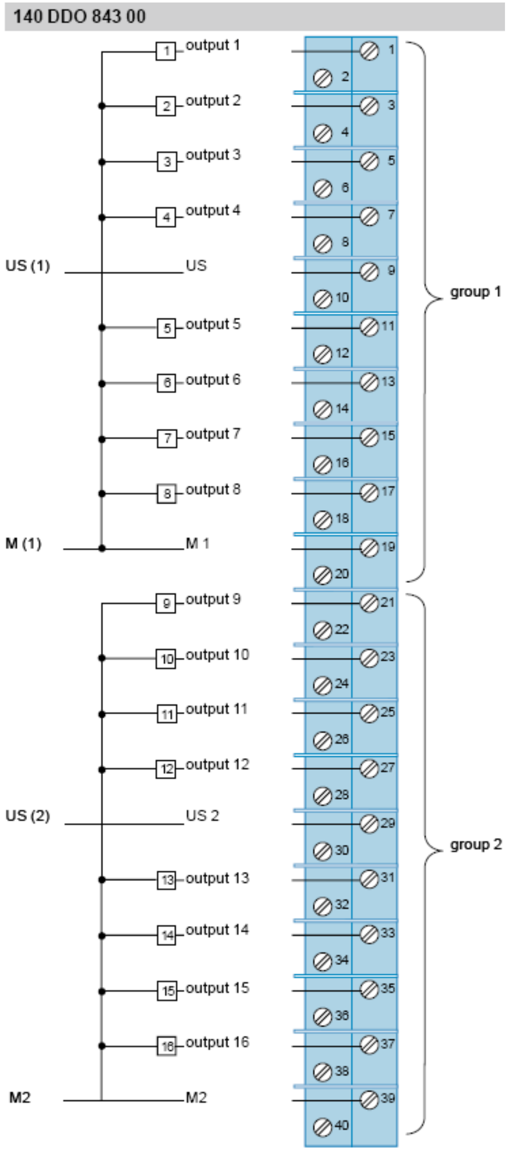

Figure 5.25: Pinout at 50/MODI-TSX/Q terminal block side (DDO).

Relays PLC-RSC-24DC/21 (*Figure 5.26*) are used to interface between PLC outputs and the compartment actuators. These relays function is to Project the PLC card from potential voltage pics generated in the compartment or cabling, and to gain connection flexibility, as each relay is an independent switch that can be connected to a different voltage source, with different reference, etc.

Figure 5.26: PHOENIX PLC-RSC-24DC/21

The relays pinout is as shown in *Figure 5.27*

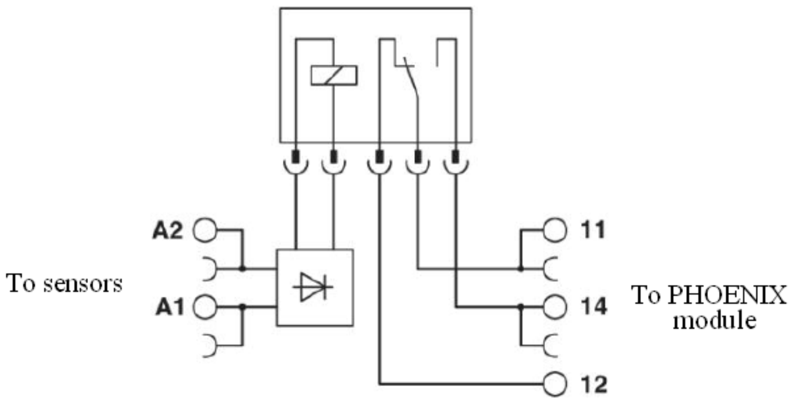

Figure 5.27: PHOENIX PLC-RSC-24DC/21 relay.

Pin A1 of every Relay is connected to the +24Vdc source common. Pins A2 are connected to the PLC corresponding output. *Table 5.5* summarizes the connections to the PLC card.

PLC side			Device side	
Card	Pin	Name	Device	Pin
140DDO843	1	OUT 1	Relay OUT 1	A2
	2	NC		
	3	OUT 2	Relay OUT 2	A2
	4	NC		
	5	OUT 3	Relay OUT 3	A2
	6	NC		
	7	OUT 4	Relay OUT 4	A2
	8	NC		
	9	+ A		+ 24V
	10	NC		
	11	OUT 5	Relay OUT 5	A2
	12	NC		

PLC side			Device side	
	13	OUT 6	Relay OUT 6	A2
	14	NC		
	15	OUT 7	Relay OUT 7	A2
	16	NC		
	17	OUT 8	Relay OUT 8	A2
	18	NC		
	19	COM A		COM
	20	NC		
	21	OUT 9	Relay OUT 9	A2
	22	NC		
	23	OUT 10	Relay OUT 10	A2
	24	NC		
	25	OUT 11	Relay OUT 11	A2
	26	NC		
	27	OUT 12	Relay OUT 12	A2
	28	NC		
	29	+ B		+ 24V
	30	NC		
	31	OUT 13	Relay OUT 13	A2
	32	NC		
	33	OUT 14	Relay OUT 14	A2
	34	NC		
	35	OUT 15	Relay OUT 15	A2
	36	NC		
	37	OUT 16	Relay OUT 16	A2
	38	NC		
	39	COM B		COM
	40	NC		

Table 5.5 Connection DDI84100 with protection relays.

The PLC-RSC-24DC/21 relays offer the following maximum switching values:

V (max, commutation) = 250Vac / 250Vdc

I (max, continuous) = 6A

so they can be used for a wide variety of actuators. Refer to manufacturer's (PHOENIX) [RD3] product datasheet for further information.

The connections with terminals 11, 12 and 14 in the relays, as well as the choice of power supplies is up to BIOPROCESS, depending on the actuators to be switched.

The Relays shall be labeled from 1 to 16 using labels such as

PHOENIX ZB 6,LGS:FORTL.ZAHLEN (*Figure 5.28*)

Figure 5.28: Numbered labels for Relays.

5.3 ANALOG CURRENT INPUTS

A 140ACI04000 and two 140ACI03000 Schneider modules in the PLC cabinet are installed to receive analog current inputs from the compartment. These modules are equipped with an FLKM 50-PA-MODI-TSX/Q (*Figure 5.29*)

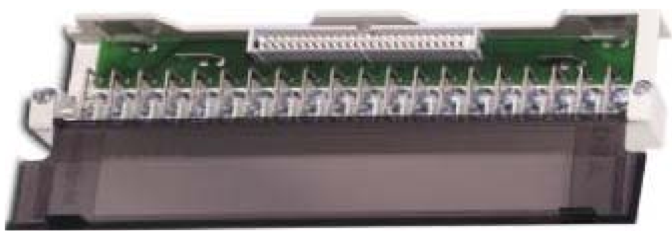

Figure 5.29. PHOENIX FLKM 50-PA-MODI-TSX/Q

These adaptors implement the electrical interface between screw-like PLC terminal blocks and a 50-pins header for a flat ribbon cable connector. Attached to the connectors, two FLK 50/EZ-DR/1000/KONFEK/S (*Figure 5.30*) cables interface with the BIOPROCESS cabinet

Figure 5.30: PHOENIX FLK 50/EZ-DR/1000/KONFEK/S. One to One cable with IDC flat cable connectors.

Reference is to be confirmed. It may change depending on required length.

These cables are used to interface between PLC Cabinet and BIOPROCESS cabinet. They shall be labeled as:

- ACI 1 - 16Ch (for ACI040)
- ACI 2 - 8Ch (for ACI030)
- ACI 3 - 8Ch (for ACI030)

These cables shall be connected to FLKM 50/MODI-TSX/Q modules (*Figure 5.31*)

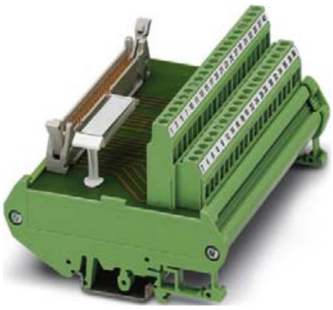

Figure 5.31: PHOENIX 50/MODI-TSX/Q

These modules are passive. They provide direct electric connections between a flat cable connector and terminal blocks.

The pinouts at terminals' blocks side are the same as at the corresponding PLC ACI module screw connections, which are as shown in *Figure 5.32*:

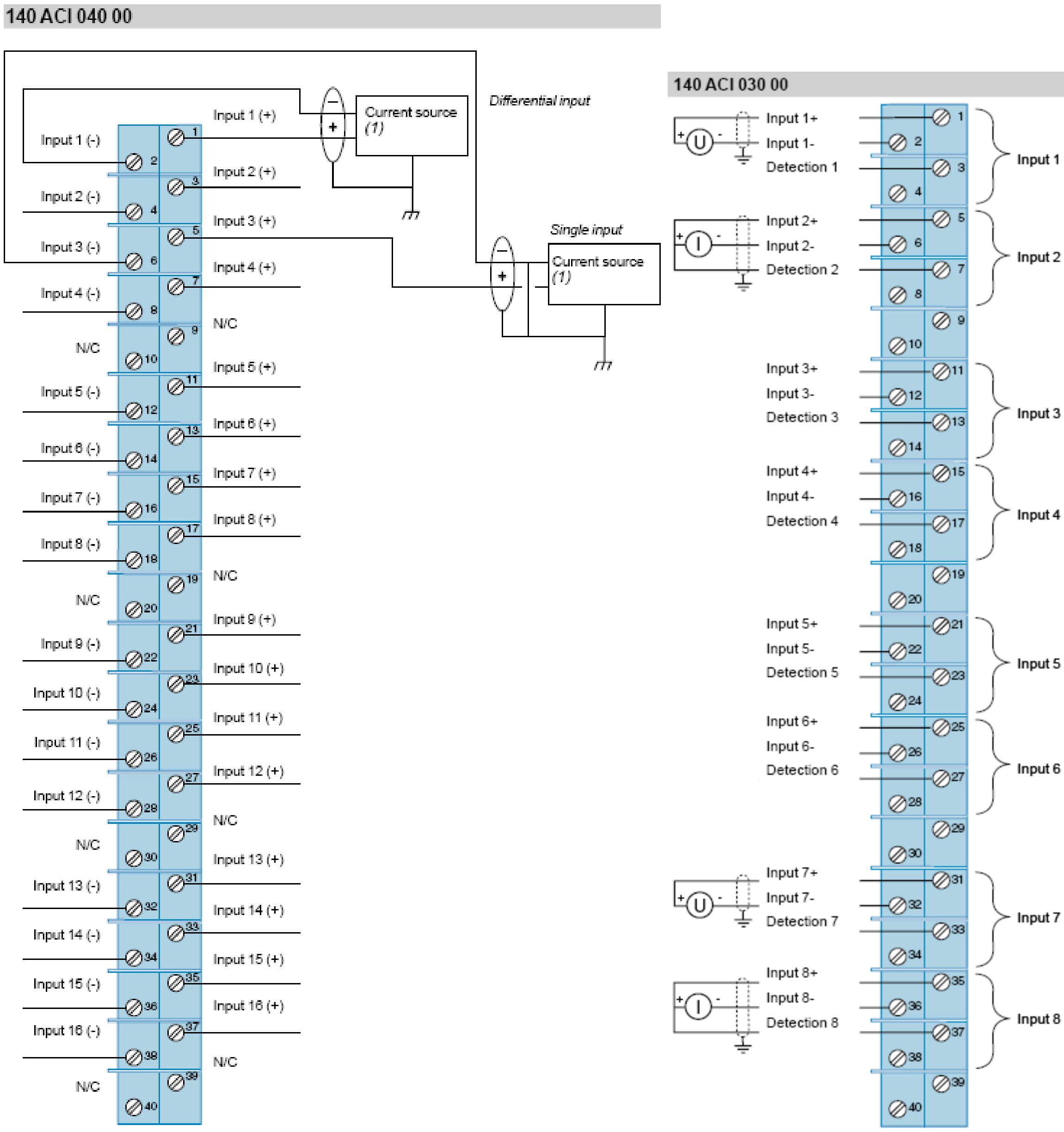

Figure 5.32: Pinout at 50/MODI-TSX/Q terminal block side (ACI).

140ACI04000 module inputs can be used either as differential current inputs and common point current inputs. Cabling differences are also shown in *Figure 5.32*.

Please, refer to Schneider documentation on Quantum 140ACI03000 and 140ACI04000 modules for further and more detailed information RD2.

PHOENIX 50/MODI-TSX/Q modules should be labeled as

- ACI 1 - 16Ch (for ACI040)
- ACI 2 - 8Ch (for ACI030)
- ACI 3 - 8Ch (for ACI030)

5.4 ANALOG VOLTAGE INPUTS

Two 140AVI03000 Schneider module in the PLC cabinet are installed to receive analog voltage inputs from the compartment. These modules are equipped with an FLKM 50-PA-MODI-TSX/Q (*Figure 5.33*)

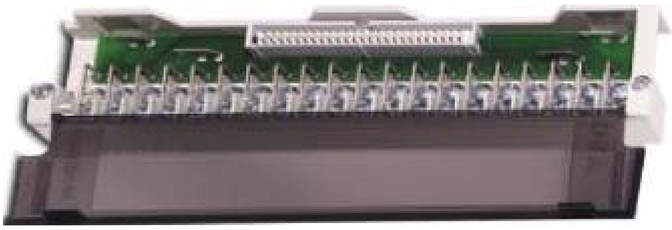

Figure 5.33. PHOENIX FLKM 50-PA-MODI-TSX/Q

These adaptors implement the electrical interface between screw-like PLC terminal blocks and a 50-pins header for a flat ribbon cable connector. Attached to the connectors, two FLK 50/EZ-DR/1000/KONFEK/S (*Figure 5.34*) cables interface with the BIOPROCESS cabinet

Figure 5.34: PHOENIX FLK 50/EZ-DR/1000/KONFEK/S. One to One cable with IDC flat cable connectors.

Reference is to be confirmed. It may change depending on required length.

These cables are used to interface between PLC Cabinet and BIOPROCESS cabinet. They shall be labeled as:

- AVI 1 - 8Ch
- AVI 2 - 8Ch

These cables shall be connected to FLKM 50/MODI-TSX/Q modules (*Figure 5.35*)

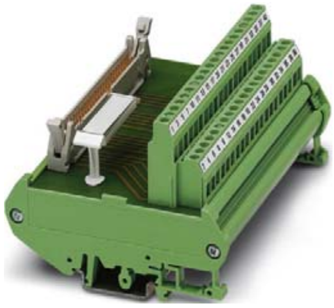

Figure 5.35: PHOENIX 50/MODI-TSX/Q

These modules are passive. They provide direct electric connections between a flat cable connector and terminal blocks.

The pinouts at terminals' blocks side are the same as at the corresponding PLC AVI module screw connections, which are as shown in *Figure 5.36*:

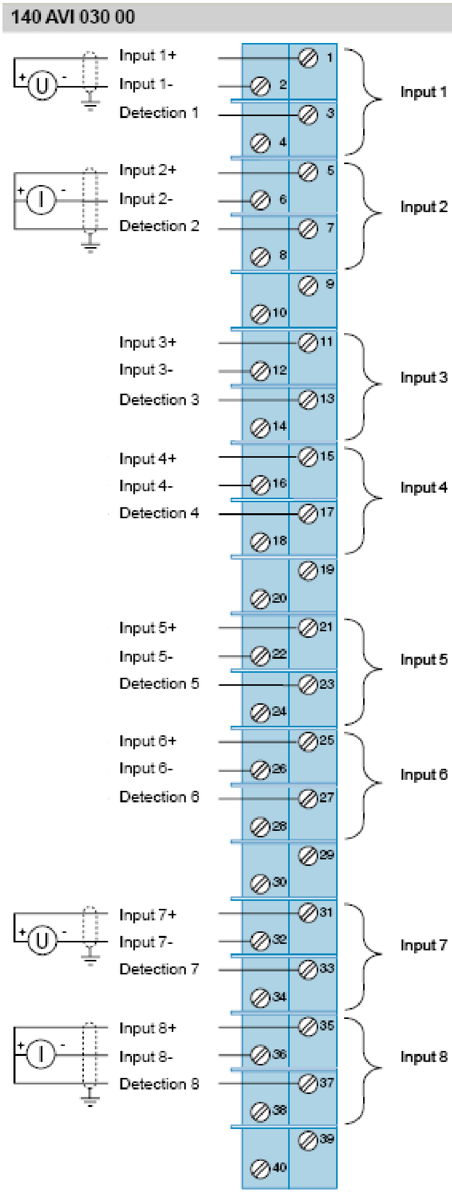

Figure 5.36: Pinout at 50/MODI-TSX/Q terminal block side (ACI).

Please, refer to Schneider documentation on Quantum 140AVI03000 modules for further and more detailed information RD2.

PHOENIX 50/MODI-TSX/Q modules should be labeled as

- AVI 1 - 8Ch
- AVI 2 - 8Ch

5.5 ANALOG VOLTAGE OUTPUTS

A 140AVO02000 Schneider module in the PLC Cabinet is used to generate 4 analog voltage outputs to control actuators in the compartment. This module is equipped with an FLKM 50-PA-MODI-TSX/Q (*Figure 5.37*)

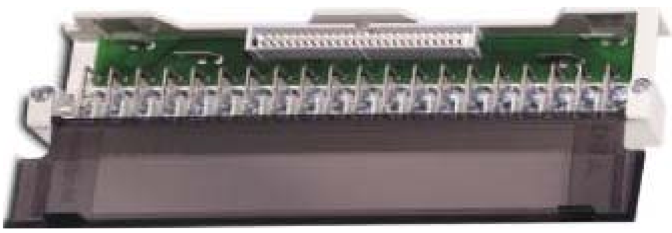

Figure 5.37. PHOENIX FLKM 50-PA-MODI-TSX/Q

The connector implements the electrical interface between screw-like PLC terminal blocks and a 50-pins header for flat ribbon cable connector. The connector is attached to a cable FLK 50/EZ-DR/1000/KONFEK/S (*Figure 5.38*)

Figure 5.38: PHOENIX FLK 50/EZ-DR/1000/KONFEK/S. One to One cable with IDC flat cable connectors.

Reference is to be confirmed. It may change depending on required length.

This cable is used to interface between the PLC Cabinet and BIOPROCESS cabinet. It shall be labeled as:

- AVO 1 - 4Ch

This cable shall be connected to a FLKM 50/MODI-TSX/Q module (*Figure 5.39*)

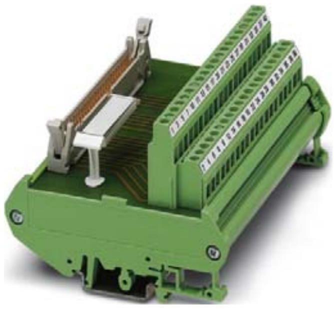

Figure 5.39: PHOENIX 50/MODI-TSX/Q

This module is passive. It provides direct electric connection between a flat ribbon cable connector and terminal blocks.

The pinout at terminal blocks side is the same as the corresponding PLC AVO module screw connections, which is the following (*Figure 5.40*):

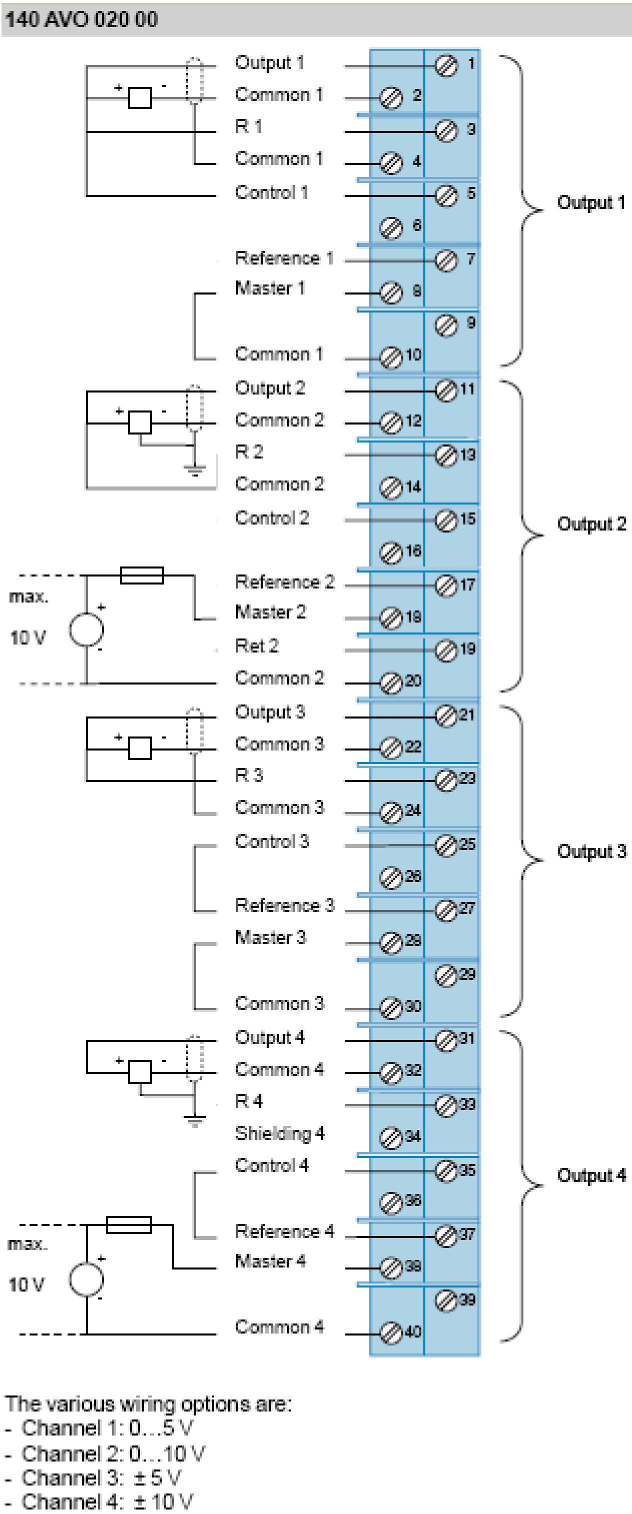

Figure 5.40 : Pinout at 50/MODI-TSX/Q terminal block side (AVO).

140AVO02000 module can be configured to provide 0..5V, 0..10V, +/- 10V, +/- 5V analog outputs. Connections differ depending on the selected kind of output, as shown in Figure 5.40, following the next rules:

- 0 to 5V: Output, R and Control jumpered.

- 0 to 10V: Output jumpered with R
- +/- 5V: Output jumpered with R and Control jumpered with Reference.
- +/- 10V: Control jumpered with Reference.

The Master pin is an input connected to the Output pin via a relay. It is meant to provide a "per default" output voltage when the module is not active. The module disables this connection when the module is active. In case this feature is not used It is recommended by the manufacturer to connect Master pin to its channel Common pin (Channel 1 & 3 cases in Figure 5.40)

Please, refer to Schneider documentation on Quantum 140AVO02000 modules for further and more detailed information RD2.

PHOENIX 50/MODI-TSX/Q modules should be labeled as

- AVO 1 – 4Ch

5.6 ANALOG CURRENT OUTPUTS

A 140ACO13000 and a 140ACO02000 Schneider modules in the PLC Cabinet are used to generate 8 analog current outputs to control actuators in the compartment. Both these modules are equipped with an

FLKM 50-PA-MODI-TSX/Q (*Figure 5.41*)

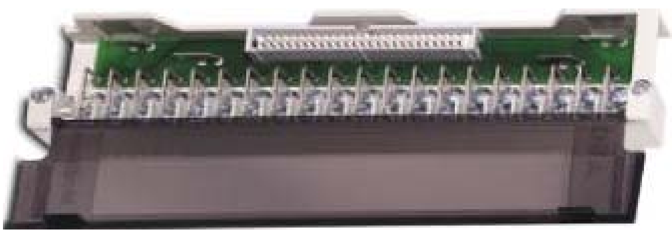

Figure 5.41. PHOENIX FLKM 50-PA-MODI-TSX/Q

To electrically interface between screw-like PLC terminal blocks and a 50-pins header for flat ribbon cable connector.

A FLK 50/EZ-DR/1000/KONFEK/S cable (*Figure 5.42*)

Figure 5.42: PHOENIX FLK 50/EZ-DR/1000/KONFEK/S. One to One cable with IDC flat cable connectors.

Reference is to be confirmed. It may change depending on required length.

These cables are used to interface between the PLC Cabinet and the BIOPROCESS cabinet. They shall be labeled as:

- ACO 1 - 8Ch (for 140ACO13000)
- ACO 2 - 4Ch (for 140ACO02000)

These cables shall be connected to an FLKM 50/MODI-TSX/Q module (*Figure 5.43*)

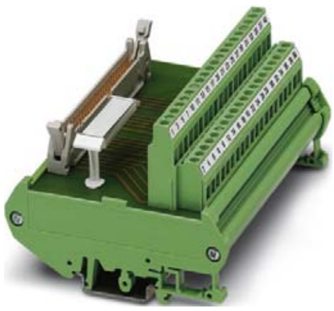

Figure 5.43: PHOENIX 50/MODI-TSX/Q

These modules are passive. They provide direct electric connection between the flat ribbon cable connectors and terminal blocks.

The pinout at terminal blocks side is the same as at the corresponding PLC ACO modules screw connections, which are the following (Figure *5.44*):

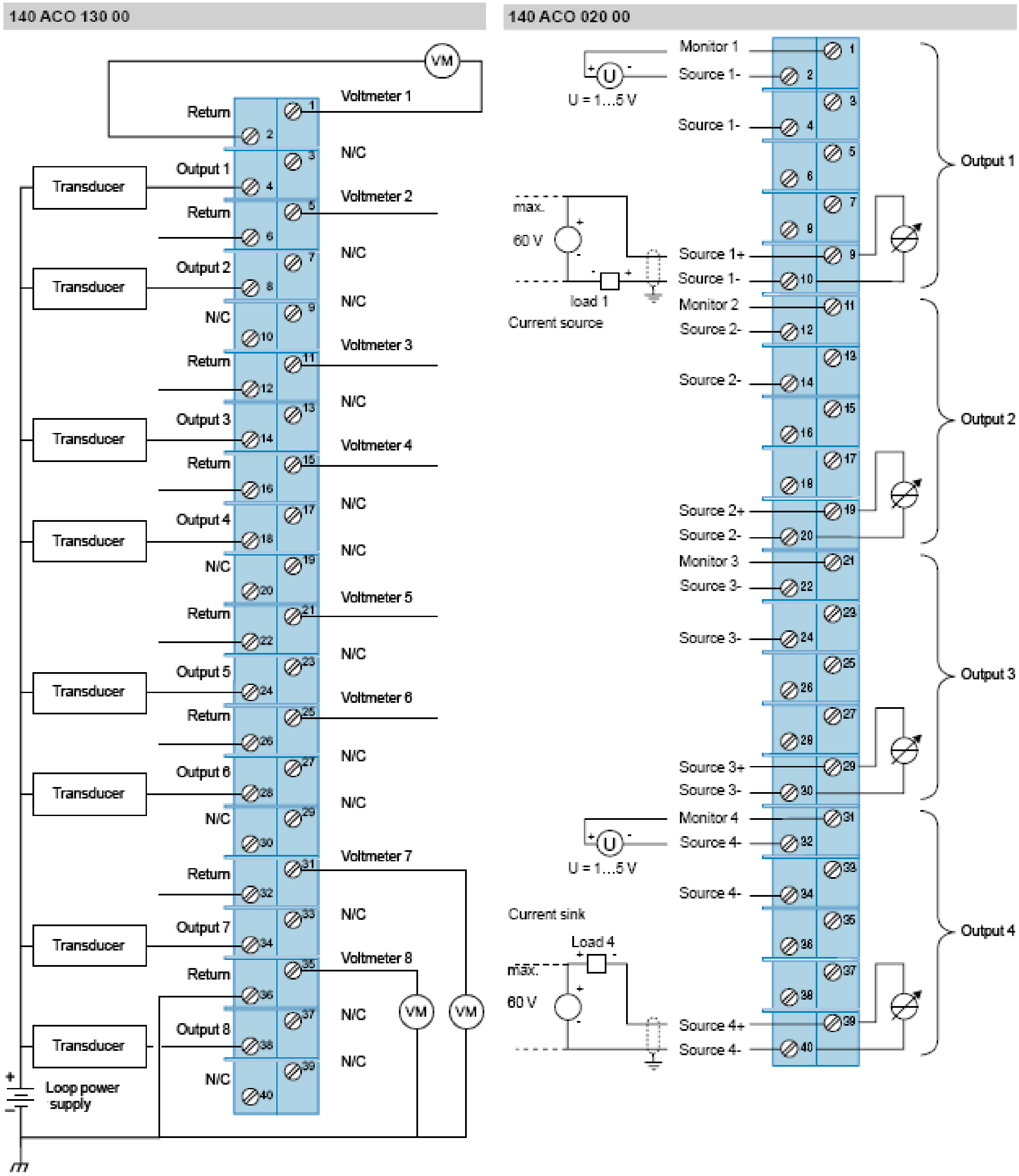

Figure 5.44 : Pinout at 50/MODI-TSX/Q terminal block side (ACO).

Voltmeter pins in 140ACO13000 are outputs whose voltage is proportional to the current furnished by its channel.

140ACO13000 is an **analog current sink** output module. The current has to be generated externally with a power source. All return pins in the module are internally jumpered.

The outputs can be configured as 0..20mA, 4..20mA and 0..25mA.

Please, refer to Schneider documentation on Quantum 140ACO13000 & 140ACO02000 modules for further and more detailed information RD2.

PHOENIX 50/MODI-TSX/Q modules should be labeled as

- ACO 1 - 8Ch (for 140ACO13000)
- ACO 2 - 4Ch (for 140ACO02000)

6. SHIELDED CABLES AND EARTHING

All cables used to interface between BIOPROCESS cabinet and the PLC cabinet are shielded.

Figure 6.1: 50-wire shielded cable with flat IDC cable connector termination.

They are provided with an extra wire (black wire in *Figure 6.1*) ended with a black ferrule.

A PHOENIX USLKG 2.5N terminal block (*Figure 6.2*) shall be used to plug this wire to the ground.

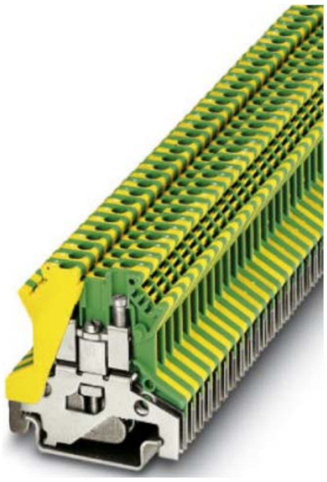

Figure 6.2: PHOENIX USLKG 2.5 N

This grounding terminal block is electrically connected to the DIN rail, so it is not necessary to add an earthing cable at the other side. On the other hand, however, the cabinet has to be designed so that the DIN rails have a proper connection to the cabinet ground.

One of these terminal blocks should be placed next to every DIN rail module (for the analog inputs and outputs) or every 8 PLC relays (for discrete outputs), to plug the corresponding shield wire coming from the PLC cabinet cable.

7. IO LIST

CODE	ID	Description	Engineering range	Supplier	Supplier type	Signal range/Misc	DI	DO	AI	AO
AC	001	Bioreactor agitator		?	?	4-20mA		1	1	1
CC	001	Gas compressor	0 to 6 l / min	KNF	N86KN,18			1		
DO2T	001	Dissolved O2 transmitter	0 to 100% acc 1%	Mettler Toledo	Inpro 6850	4-20mA			1	
DO2T	002	Dissolved O2 transmitter	0 to 100% acc 1%	Mettler Toledo	Inpro 6850	4-20mA			1	
DPT	001	Differential Pressure transmitter	0 to 3 bar	Endress+Hauser	Deltabar S FMD78	4-20mA			1	
FCV	003	Flow Control Valve non sterile gas (N2)	0 to 500 l/h	MKS or Bronskorst High-tech		4-20mA				1
FCV	004	Flow Control Valve non sterile gas (O2)	0 to 30 l/h	MKS or Bronskorst High-tech		4-20mA				1
FCV	005	Flow Control Valve non sterile gas (CO2)	0 to 3 l/h	MKS or Bronskorst High-tech		4-20mA				1
FCV	007	Flow Control Valve non sterile gas (mix)	0 to 600 l/h	???		4-20mA				1
FT	001	Flow element + transmitter (feed)	0 to 2 l/h	E&H	Promass 80A	4-20mA			1	
FT	002	Flow element + transmitter (recirc)	0 to 5 l/h	E&H	Promass 80A	4-20mA			1	
FT	003	Flow element + transmitter (N2)	0 to 500 l/h	MKS or Bronskorst High-tech		4-20mA			1	
FT	004	Flow element + transmitter (O2)	0 to 30 l/h	MKS or Bronskorst High-tech		4-20mA			1	
FT	005	Flow element + transmitter (CO2)	0 to 3 l/h	MKS or Bronskorst High-tech		4-20mA			1	
FT	006	Flow element + transmitter (harvest)	0 to 2l/h	E&H	Promass 80 A	4-20mA			1	
FT	007	Flow element + transmitter (mix)	0 to 600 l/h	Bronkhorst	F201CV-AGD-22-E	4-20mA			1	1
LSHH	001	Level switch (Vibrating horizontal)	Contact	Endress+Hauser	Liquiphant M FTL 50 (H)		2			
LSL	001	Level switch (Vibrating horizontal)	Contact	Endress+Hauser	Liquiphant M FTL 50 (H)		2			
LSL	003	Level switch (Vibrating horizontal)	Contact	Endress+Hauser	Liquiphant M FTL 50 (H)		2			
LSH	004	Level switch (Vibrating horizontal)	Contact	Endress+Hauser	Liquiphant M FTL 50 (H)		2			
LT	001	Level transmitter (capacitive)		Endress+Hauser	Liquicap FMI 51	4-20mA			1	
LT	002	Level transmitter (capacitive)		Endress+Hauser	Liquicap FMI 51	4-20mA			1	
LT	003	Level transmitter (capacitive)		Endress+Hauser	Liquicap FMI 51	4-20mA			1	
LT	003	Level transmitter (capacitive)							1	
P	001	Peristaltic Pump multichannel,	0 to 1000 ml/h	Watson Marlow	323 U/D	4 - 20 mA		2		1

CODE	ID	Description	Engineering range	Supplier	Supplier type	Signal range/Misc	DI	DO	AI	AO
		variable speed (harvest)								
P	002	Peristaltic Pump (acid/base) multichannel, variable speed	0 to 10 ml/h (10 ml/24h)	Watson Marlow	323 U/D	4 - 20 mA		1		
P	003	Peristaltic Pump (acid/base) multichannel, variable speed	0 to 10 ml/h (10 ml/24h)	Watson Marlow	323 U/D	4 - 20 mA		1		
P	004	Peristaltic Pump multichannel, variable speed (feed C01)	0 to 1000 ml/h	Watson Marlow	323 U/D	4 - 20 mA		2		1
P	005	Circulating Pump (thermostat)	0 to 350 l/h	Grundfos	UP 20-07N			1		
P	006	Peristaltic Pump multichannel, variable speed (recirc)	0 to 6000 ml/h	Watson Marlow	323 U/D	4 - 20 mA		2		1
P	007	Peristaltic Pump multichannel, variable speed (backwash)	0 to 60 l/h	Watson Marlow	323 U/D			1		
P	008	Peristaltic Pump multichannel, variable speed Anti-foam (= future)						1		
P	XX	Existing pump for feeding D03 from CII		Watson Marlow	621/RE			1		
PHT	001	pH element + transmitter	pH 0 to 14	Mettler Toledo	Inpro3253i	4-20mA			2	
PHT	002	pH element + transmitter	pH 0 to 14	Mettler Toledo	Inpro3253i	4-20mA			2	
PT	001	Pressure element + transmitter	0 to 1000 mbar	WIKA	SA-11	4-20mA			1	
PT	002	Pressure transmitter	0 to 2 bar	WIKA	SA-11	4-20mA			1	
PT	003	Pressure transmitter	0 to 1 bar	WIKA	SA-11 + A-AI-1	4-20mA			1	
TCV	003	Temperature Control Valve	0 to 300 l/h	Burkert	178 678		1	1		
TCV	202	Temperature Control Valve	0 to 300 l/h	Burkert	178 678		1	1		
TCV	704	Temperature Control Valve see Heat exchanger		Burkert	178 678		1	1		
TCV	705	Temperature Control Valve see Heat exchanger		Burkert	179 678		1	1		
TT	001	Air vent cold water temperature transmitter	0 to 50 °C	?		4-20mA			1	
TT	002	Temperature element + transmitter (D03)	4 to 250°C	Endress+Hauser	Omnigrad M TR 45	4-20mA			1	
TT	003	Temperature element + transmitter (D04)	4 to 250°C	Endress+Hauser	Omnigrad M TR 45	4-20mA			1	
TT	004	Temperature element + transmitter (thermost fluid jacket C01)	4 to 250°C	Endress+Hauser	Omnigrad M TR 45	4-20mA			1	
TT	005	Temperature element + transmitter (middle C01)	4 to 250°C	Endress+Hauser	Omnigrad M TR 45	4-20mA			1	
TT	006	Temperature element + transmitter (top C01)	4 to 250°C	Endress+Hauser	Omnigrad M TR 45	4-20mA			1	

CODE	ID	Description	Engineering range	Supplier	Supplier type	Signal range/Misc	DI	DO	AI	AO
TT	007	Temperature element + transmitter (bottom C01)	4 to 250°C	Endress+Hauser	Omnigrad M TR 45	4-20mA			1	
WT	001	Acid/Base Bottle weight indicator (+ weighing scale)	0 - 10kg (precision 1g)	Mettler Toledo		RS-232				
WT	002	Acid/Base Bottle weight indicator (+ weighing scale)	0 - 10kg (precision 1g)	Mettler Toledo		RS-232				
XT	001	Conductivity element + transmitter	c = 0,1 cm-1 (0,02 à 50 µS/cm)	Mettler Toledo	Inpro 7001-Vp (see rem)	4-20mA			1	
XT	002	Conductivity element + transmitter	c = 0,1 cm-1 (0,02 à 50 µS/cm)	Mettler Toledo	Inpro 7001-Vp (see rem)	4-20mA			1	
XV	002	Gas exhaust valve					1	1	1	
XV	005	Reactor liquid outlet valve					1	1		
XV	310	Reactor venting valve					1	1		
XV	336	Gas introduction valve	0 to 3L/min				1	1	1	
XV	337	Gas introduction valve	0 to 3L/min				1	1		
XV	631	NH4 sampling valve					1	1		
XV	632	N03 sampling valve					1	1		
XV	633	N02 sampling valve	0 to 0,3L/h				1	1		
YT	001	Out of scope (ordered by ESA) Biomass sensor(s)				4-20mA			1	
							20	25	31	8

The scales WT-001 and WT-002 will be connected to the SCADA sever via Ethernet. NTE will provide an Ethernet cable and a switch in the PLC cupboard to enable the Ethernet connection.

MELISSA CIII CONTROL CABINET HARDWARE DESIGN DOCUMENT

APPROVAL LIST		
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CHANGE RECORD			
AUTHOR	ISSUE	DATE	CHANGE
Jordi Carbonell Muñoz	1.0	06/10/2009	First Version

CONTENTS

LIST OF ACRONYMS

CIII	Compartment III
I/O	Input / Output
PLC	Programmable Logic Controller
MELiSSA	Micro-Ecological Life Support System Alternative
MPP	MELiSSA Pilot Plant
UAB	Universitat Autònoma de Barcelona
AI	Analogue input
AO	Analogue output
DI	Digital input
DO	Digital output
EPIC	Electrical Power Interface Cabinet
CW	Clockwise
CCW	Counterclockwise

1. SCOPE

This document describes the design of the Control System for the Compartment III that is to be installed at the MELiSSA Pilot Plant, located at the UAB's premises.

It contains the electrical design, mechanical design and implementation, identification of components and connectivity information for connection to the Compartment III.

2. APPLICABLE AND REFERENCE DOCUMENTS

2.1 APPLICABLE DOCUMENTS

Ref	Title	Reference	Issue	Date
[A1]	NTE Offer for CIII control system cabinet and HMI update.	NTE-CIIIP2-OF-001	1.0	Apr.2009

2.2 REFERENCE DOCUMENTS

Ref	Title	Reference	Issue	Date
[R1]	CIII Hardware Interface Document	NTE-CIIIP2-ICD-002	1.0	April 2009
[R2]	Biomass sensor prototype validation results	NTE-BMC3-TN-007	1.0	Dec. 2007

3. MELISSA CIII SYSTEM OVERVIEW

MELISSA Compartment III (CIII) is the third compartment of MELISSA loop. This compartment has been designed to bioconvert NH_4^+ to NO_3^- using a mix of bacteria, Nitrobacter and Nitrosomonas immobilized on a fixed bed bioreactor.

The Bioreactor shall be redesigned to be operated in strict axenicity (absence of foreign micro-organisms contamination) during long-term period.

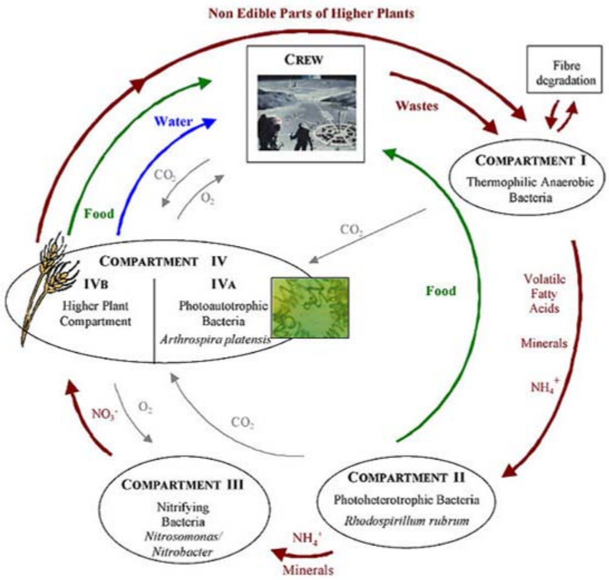

Figure 1 MELISSA LOOP CONCEPT

MELISSA CIII system can be represented by two main hardware blocks (CIII frame and CIII Control Cabinet). All these hardware is needed to correct operation. MELISSA CIIII system overview is show in Figure 2.

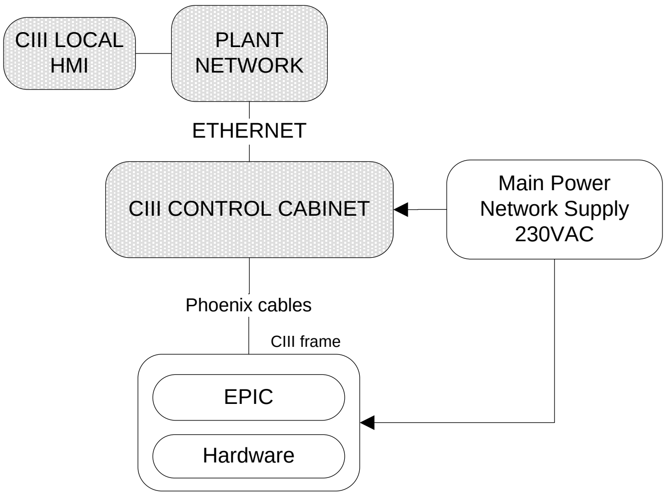

Figure 2: Melissa CIII system overview

CIII Frame

From control point of view consist on a set of about 100 sensors and actuators. All these signals are wired to the EPIC, placed in the CIII frame. The EPIC contains the following elements: electrical protection, power interfaces and electrical interfaces necessary to connect directly to CIII Control Cabinet. This means that all the power is in the EPIC of Compartment III not in CIII Control Cabinet.

Figure 3: Compartment III

CIII Control Cabinet

The CIII Control Cabinet houses the CIII Control System equipment. It contains the PLC (Programmable Logic Controller) with the required processor, I/O and power supply modules, interface connectors, network elements and power safety devices. The CIII Control Cabinet is to be installed next to the CIII frame also at MPP in UAB.

Local HMI

The local HMI consists on a touch screen framed next to the CIII Control Cabinet for local monitoring and control. This equipment allows monitoring of the most significant reading of CIII parameters required to control and monitoring for its automatic operation mode.

Plant Network

Plant network interconnects PLC of the each compartment of the Melissa loop, SCADA server, SCADA clients, embedded PCs of the Biomass systems, EKI-1522 devices and local HMI (Magelis).

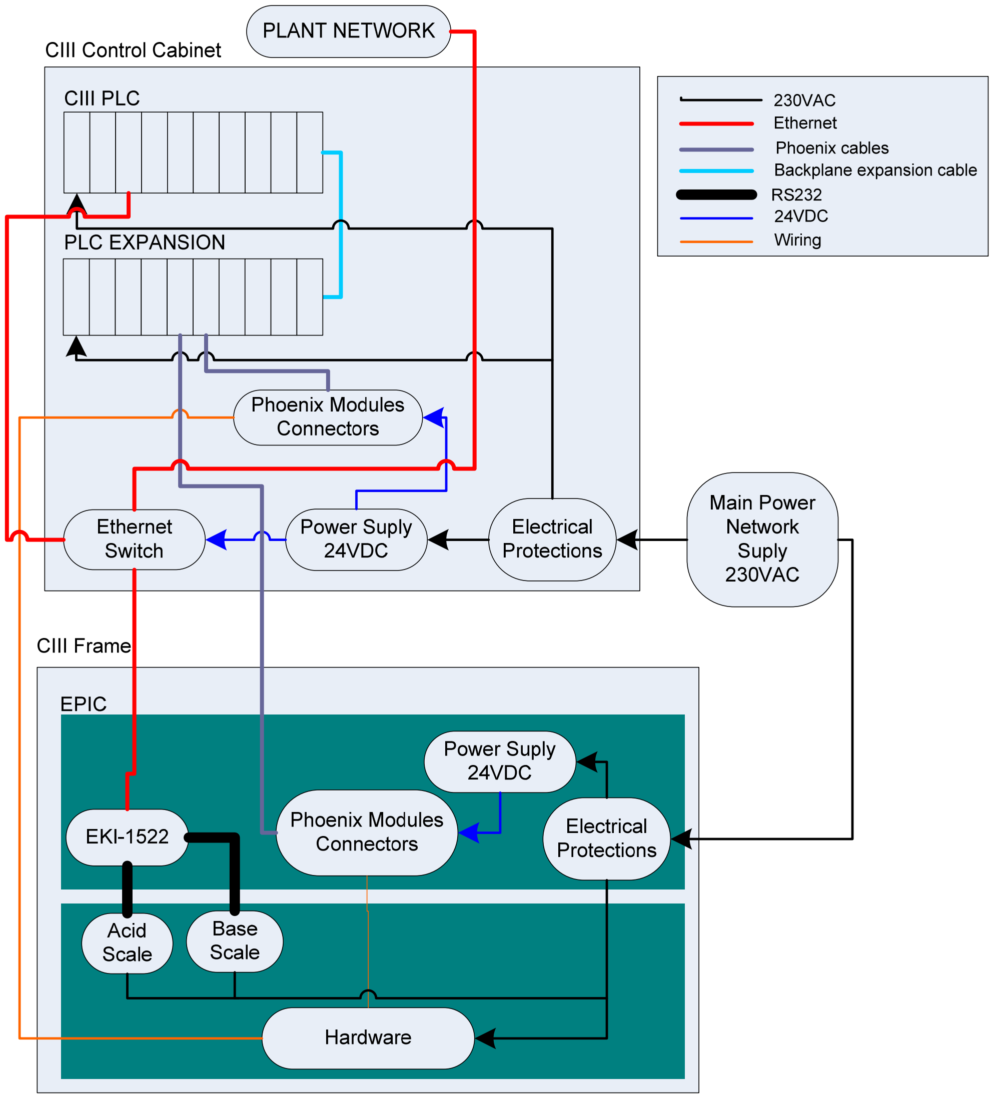

Figure 4: Melissa CIII System

4. CIII CONTROL CABINET OVERVIEW

The MELISSA CIII Control Cabinet acquires from the CIII and supplies to the CIII all the signals needed to control and monitoring the CIII Reactor. Figure 6 reproduces the control concept and details the main elements within the cabinet.

It is a single 600x600x1800 mm Rittal electrical cabinet with one panel assembly and one glass door. See Figure 5.

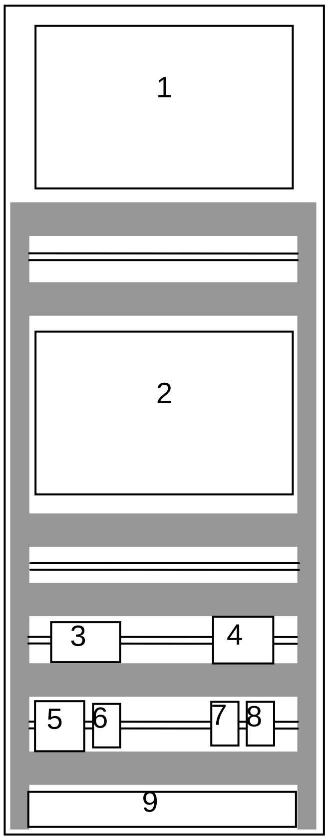

Figure 5: Mounted plate layout.

Mount plate layout component description:

1. PLC BACKPLANE
2. PLC EXPANSION BACKPLANE
3. FLKM 50/MODI-TSX/Q module (Phoenix Contact)
4. PLC-V8/FLK14/IN module (Phoenix Contact)
5. ELECTRICAL PROTECTIONS
6. FILTER
7. 24Volts Power Supply
8. EKI-2525 (Ethernet Switch)
9. UPS

The CIII Control Cabinet features three interfaces:

- Interface to the MPP power supply (mains) with European characteristics (220 - 230 VAC, 50 Hz)
- Interface with the CIII Reactor through the EPIC.
- Interface with the MPP Control Room through the Plant Network, using an Ethernet connection. From the Control Room it is possible the monitoring and surveillance functions of the CIII Reactor using the MPP's central computer

4.1 CIII CONTROL CABINET DESCRIPTION

CIII Control Cabinet diagram is shown in Figure 6: Basically there are 3 subsystems:

1. ENERGY DISTRIBUTION
   1.1. ELECTRICAL PROTECTIONS
   1.2. POWER SUPPLIES
      1.2.1. 24 VDC
      1.2.2. PLC POWER SUPPLY
2. ELECTRONICS
   2.1. PLC
   2.2. ETHERNET SWITCH
3. TERMINAL BLOCKS
   3.1. AIO CONNECTOR (AVI2)
   3.2. DIO RELAYS CONNECTORS (DDI4)

All these subsystems details will be described in the following chapters

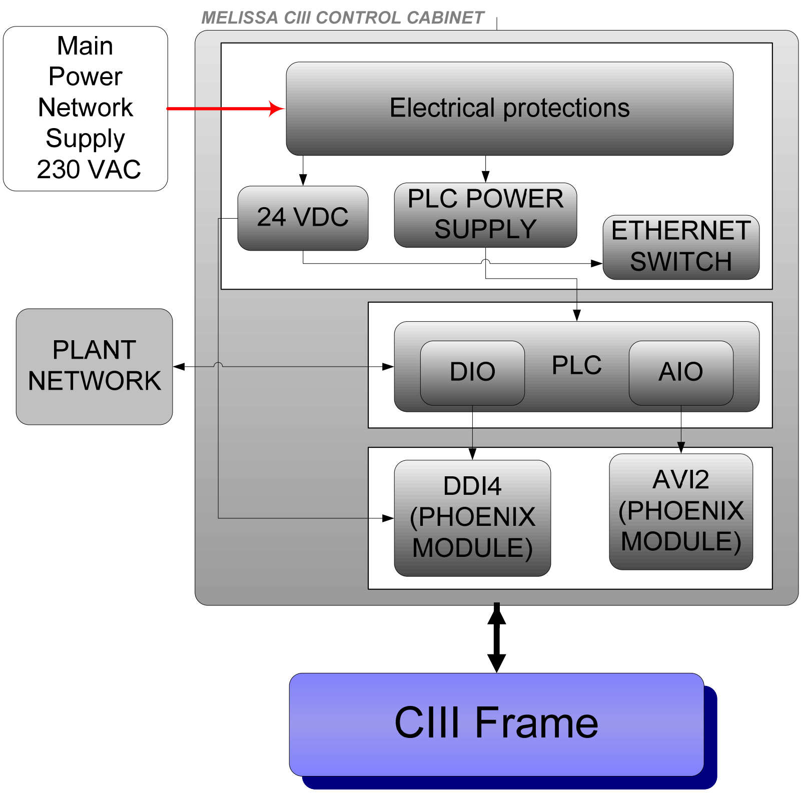

Figure 6: MELISSA CIII CONTROL CABINET DETAIL VIEW

Most of the Phoenix terminal blocks are placed in the EPIC, inside the CIII frame. However, due to the fact that there was not enough room in the EPIC, two Phoenix terminal blocks (AVI-2 and DDI4) have been placed in the CIII Control Cabinet. Electrical signals from analyzers and mobile temperature sensors are wired directly in the CIII Control Cabinet Phoenix terminals blocs.

4.2 MELISSA CIII CONTROL CABINET ENERGY DISTRIBUTION

This subsystem supplies energy to all components inside the CIII Control Cabinet. Power devices like pumps, fans and other actuators in the CIII Frame are powered from other sources.

Components of ENERGY DISTRIBUTION SUBSYSTEM:

- ELECTRICAL PROTECTIONS
  - Magnetothermic AC_MGTH2: MERLIN GERIN MULTI9 C60HB B4
  - Differential: HAGER CDC748M
- POWER SUPPLIES
  - 24 VDC
  - PLC POWER SUPPLY

4.3 CIII CONTROL CABINET ELECTRONICS

4.3.1 PLC configuration

The Schneider PLC I/O cards installed are the following:

- Digital Input, DI cards → model ***140DDI84100***, with 16 ports

  → model ***140DDI35300***, with 32 ports
- Digital Output, DO cards → model ***140DDO84300***, with 16 ports

  → model ***140DDO35300***, with 32 ports
- Analogue Voltage Input, AVI cards, model ***140AVI03000***, with 8 ports
  - Voltage: (0 – 10 VDC) or (0 – 5 VDC) or Current (4 – 20 mA)
  - Resolution 16/15/14 bits, and bipolar option is available.
- Analogue Current Input, ACI cards, model ***140ACI04000***, with 16 ports
  - Current: (0-20mA, 0-25000counts) or (0-20mA, 0-20000counts) or (4-20mA, 0-16000counts) or (4-20mA, 4095 counts).
- Analogue Current Input, ACI cards, model ***140ACI03000***, with 8 ports
  - Voltage (1-5VDC) or Current (4-20mA)
  - Resolution: 12 bits
- Analogue Current Output, ACO card, model ***140ACO13000***, with 8 ports
  - Current: (0-25mA, 0-25000counts) or (0-20mA, 0-20000counts) or (4-20mA, 0-16000counts) or (4-20mA, 4095 counts).
- Analogue Current Output, ACO card, model ***140ACO02000***, with 4 ports
  - Current (4-20mA)
  - Resolution: 12 bits
- Analogue Voltage Output, AVO card, model ***140AVO02000*** with 4 ports.
  - Voltage: (-/+ 10VDC) or (-/+ 5VDC) or (0-10VDC) or (0-5VDC)
  - Resolution: 12 bits

Compartment CIII Quantum (by Schneider) Programmable Logic Controller is mounted on two backplane (named PLC Backplane and PLC Backplane Expansion) with 10 available slots in each backplane. The PLC module and PLC I/O expansion distribution is displayed in the following tables, showing the manufacturer reference identification (140XXXXXXXX), the description of the module and the mnemonic identification. To communicate two backplanes, a backplane expander module (140XBE10000) must be installed in each backplane and two modules are connected through to backplane expander cable (140XCA71703). The cable end is marked with “Primary” and it has to be connected to the primary backplane and must be installed before powering up the backplanes.

PLC									
1	2	3	4	5	6	7	8	9	10
140CPS11420	140CPU43412A	140NOE77101	140ACI04000	140AVO02000	140ACO02000	140ACO13000			140XBE10000
Backplane Power Supply module	CPU module	Ethernet module	16 Analog current input (ACI1)	4 Analog output (AVO1)	4 Analog outputs (ACO1)	8 Analog output (ACO2)			Rack expansion
CIII_PLC_CPS	CIII_PLC_CPU	CIII_PLC_NOE	CIII_PLC_IO_ACI1	CIII_PLC_IO_AVO1	CIII_PLC_IO_ACO1	CIII_PLC_IO_ACO2			CI_PLC_XBE
			300001:300017	400001:400004	400005:400008	400009:400016			

Table 1: PLC BACKPLANE CARD DISTRIBUTION

PLC EXPANSION									
1	2	3	4	5	6	7	8	9	10
140CPS11420	140DDI84100	140DDI35300	140DDO84300	140DDO35300	140ACI03000	140ACI03000	140AVI03000	140AVI03000	140XBE10000
Backplane Power Supply module	16 digital inputs	32 digital inputs	16 digital outputs	32 digital outputs	8 analog inputs	8 analog inputs	8 analog inputs	8 analog inputs	Rack expansion
CI_PLC_CPS	CIII_PLC_DDI5	CIII_PLC_DDI1:4	CIII_PLC_DDO5	CIII_PLC_DDO1:4	CIII_PLC_ACI2	CIII_PLC_ACI3	CIII_PLC_AVI1	CIII_PLC_AVI2	CIVb_PLC_XBE
	100001:100016	100017:100048	000001:000016	000017:000048	300018:300026	300027:300035	300036:300044	300045:300053	

Table 2: PLC BACKPLANE EXPANSION CARD DISTRIBUTION

Figure 7: PLC assembly on backplanes

CIII_PLC_DDI5, CIII_PLC_DDO5, CIII_ACI3 and CIII_ACO2 plc cards are not connected to the Phoenix terminal blocks because they are not used.

Each card has a specific number of IOs. Following tables show IOs available for each card reference.

CARD	Input/Output available	Input/Output used	Input/Output free
140ACI04000 (ACI1)	16	16	0
140ACI03000 (ACI2)	8	8	0
140ACI03000 (ACI3)	8	0	8
140AVI03000 (AVI1)	8	6	2
140AVI03000 (AVI2)	8	6	2
TOTAL	**48**	**36**	**12**

Table 3: AI cards

CARD	Input/Output available	Input/Output used	Input/Output free
140AVO02000 (AVO1)	4	4	0
140ACO02000 (ACO1)	4	0	4
140ACO13000 (ACO2)	8	4	4
TOTAL	**16**	**8**	**8**

Table 4: AO cards

CARD	Input/Output available	Input/Output used	Input/Output free
140DDI84100 (DDI5)	16	0	16
140DDI35300 (DDI1:4)	32	26	6
TOTAL	**48**	**26**	**22**

Table 5: DI cards

CARD	Input/Output available	Input/Output used	Input/Output free
140DDO84300 (DDO5)	16	0	16
140DDO35300 (DDO1:4)	32	29	3
TOTAL	**48**	**29**	**19**

Table 6: DO cards

4.3.2 Weight scales connection

Acid and Base tank levels are controlled through their tank's weight using weight scales. Scales communicate with server though RS-232 serial communication. To communicate scales with the SCADA server an EKI-1522 device (a serial device server that connects RS-232/422/485 serial devices to an IP-based Ethernet LAN) is used. The following figure shows connections implemented between scales and SCADA server.

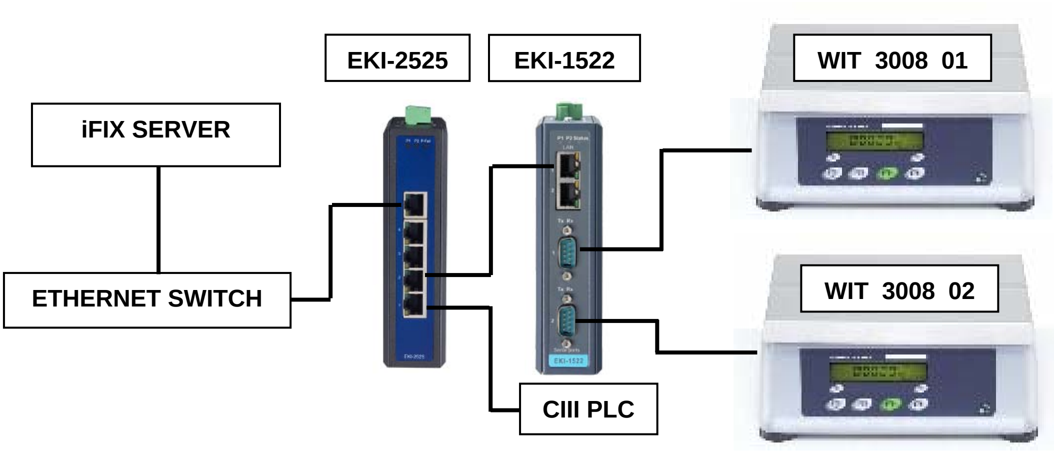

Figure 8: Scales connection

In the SCADA server there is a routine implemented in Visual Basic for Applications that is executed every 10 minutes by the iFIX scheduler. The routine sends a weight measure request to the scales and reads the answer received from the scales with its weight. Then the routine writes this value in a PLC register to use it from the PLC software and displays it in the CIII SCADA displays.

4.3.3 Biomass sensors

There are six biomass probes placed in the CIII Reactor to measure the biomass concentration generated. The biomass measurement is read by an embedded PC. This device receives the signal from the Biomel CIII Main system box, where the signal conditioning is performed, and sends the resulting value to the CIII PLC. For more information see Biomel CIII documentation in [R3].

4.4 CIII TERMINALS BLOCKS

4.4.1 VARIOFACE PHOENIX PLUGGABLE SYSTEM

MELISSA CIII is wired with PHOENIX VARIOFACE PLUGGABLE SYSTEM. In Figure 9, a traditional wiring system and pluggable Phoenix wiring system are compared. Phoenix system uses two idc connectors instead of 80 screws of traditional PLC wiring. Main parts of Phoenix pluggable system are: PLC Schneider adaptor, IDC Phoenix wire and Phoenix terminal block.

MELISSA CIII Control Cabinet is wired from PLC to terminal Phoenix blocks. From user point of view all IOs are available in from the terminal Phoenix blocks. PLC manipulation IOs is not necessary in any circumstance. All relationship between PLC and terminal block are described in IOs table section 4.5.

Further information is available in http://www.phoenixcontact.com

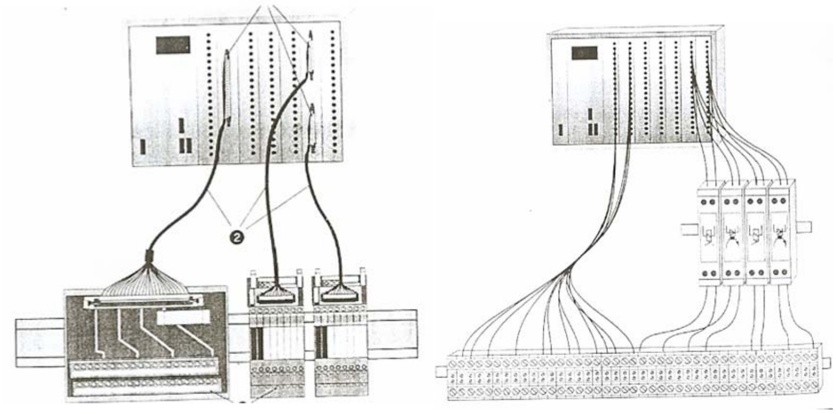

Figure 9: PHOENIX VARIOFACE PLUGGABLE SYSTEM vs TRADITIONAL WIRING SYSTEM

4.5 PHOENIX TERMINAL IDENTIFICATION

Phoenix terminal blocks are installed in two cabinets, the CIII Control Cabinet and the EPIC. The Phoenix terminal blocks are placed in the EPIC (inside the CIII frame). Due to space reasons, in the CIII Control Cabinet there are the AVI-2 and DDI4, which contain all analogue and digital signals from analyzers and mobile temperature sensors, the remaining devices are wired in the EPIC.

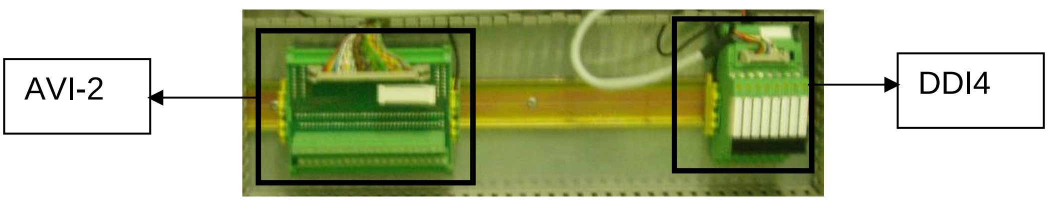

Figure 10: Phoenix terminal modules in the CIII Control Cabinet

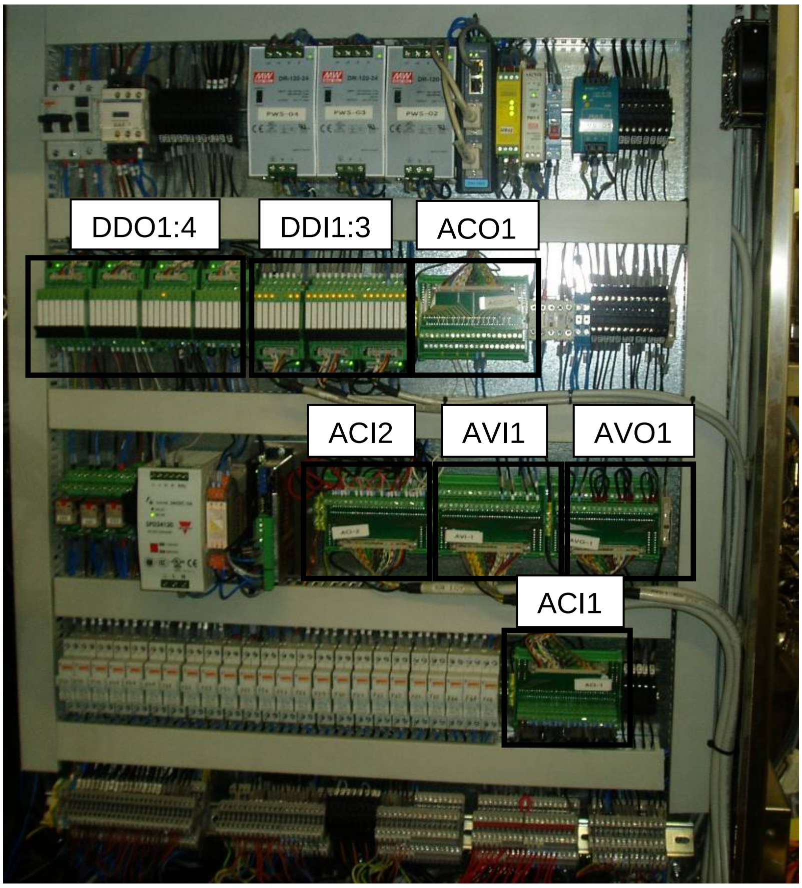

Figure 11: Phoenix terminal modules in the EPIC

For more detailed information see [R1] reference document.

4.5.1 CS CIII Control Cabinet terminal identification

CS-CIII Control Cabinet terminals are divided into four major BLOCKS (DI(32),DO(32),AI(40),AO(12)). Each of them is divided in TERMINAL SET of (DI(32),DO(32),AI(16 or 8), AO (8 or 4)). Again some of them are divided in SUBSET (DI(8),DO(8)). See Figure 9. Each pin of each block is identified by a number labelling.

- PHOENIX Digital Input BLOCKS (32 DI)
    - PHOENIX TERMINAL SET DDI1:4 (32 DI)
        - PHOENIX TERMINAL SUBSET DDI1 (8 DI)
            - DDI1_1
            - …..
            - DDI1_8
        - PHOENIX TERMINAL SUBSET DDI2 (8 DI)
        - PHOENIX TERMINAL SUBSET DDI3 (8 DI)
        - PHOENIX TERMINAL SUBSET DDI4 (8 DI)
- PHOENIX Digital Output BLOCKS (32 DO)
    - PHOENIX TERMINAL SET DDO1:4 (32 DO)
        - PHOENIX TERMINAL SUBSET DDO1 (8 DO)
            - DDO1_1
            - …

            - DDO1_8
        - PHOENIX TERMINAL SUBSET DDO2 (8 DO)
        - PHOENIX TERMINAL SUBSET DDO3 (8 DO)
        - PHOENIX TERMINAL SUBSET DDO4 (8 DO)
- PHOENIX Analog inputs BLOCKS (40 AI)
    - PHOENIX SET TERMINAL ACI1 (16 AI)
    - PHOENIX SET TERMINAL ACI2 (8 AI)
    - PHOENIX SET TERMINAL AVI1 (8 AI)
    - PHOENIX SET TERMINAL AVI2 (8 AI)
- PHOENIX Analog outputs BLOCKS (12 A0)
    - PHOENIX SET TERMINAL ACO1 (8 AO)
    - PHOENIX SET TERMINAL AVO1 (4 AO)

4.6 IOs Tables

4.6.1 Digital Outputs

140 DDO84300 (Backplane 2, Slot 4) 16 Digital outputs						
PLC INPUT	**PLC ADDRESS**	**PHOENIX MODULE**	**PHOENIX HARNESS**	**RELAY**	**MPP VARIABLE NAME**	**COMMENTS**
1	000001				FREE	
2	000002				FREE	
3	000003				FREE	
4	000004				FREE	
5	000005				FREE	
6	000006				FREE	
7	000007				FREE	
8	000008				FREE	
9	000009				FREE	
10	000010				FREE	
11	000011				FREE	
12	000012				FREE	
13	000013				FREE	
14	000014				FREE	
15	000015				FREE	

140 DDO84300 (Backplane 2, Slot 4) 16 Digital outputs						
PLC INPUT	**PLC ADDRESS**	**PHOENIX MODULE**	**PHOENIX HARNESS**	**RELAY**	**MPP VARIABLE NAME**	**COMMENTS**
16	000016				FREE	

140 DDO35300 (Backplane 2, Slot 5) 32 digital outputs						
PLC INPUT	**PLC ADDRESS**	**PHOENIX MODULE**	**PHOENIX HARNESS**	**RELAY**	**MPP VARIABLE NAME**	**COMMENTS**
1	000017	DDO1	DDO1	1	SV_3020_01_MV	Valve manipulate variable
2	000018			2	SV_3011_02_MV	Valve manipulate variable
3	000019			3	SV_3001_01_MV	Valve manipulate variable
4	000020			4	SV_3018_01_MV	Valve manipulate variable
5	000021			5	SV_3005_02_MV	Valve manipulate variable
6	000022			6	SV_3011_01_MV	Valve manipulate variable
7	000023			7	SV_3005_01_MV	Valve manipulate variable
8	000024			8	SV_3016_01_MV	Valve manipulate variable
9	000025	DDO2	DDO2	1	SV_3008_01_MV	Valve manipulate variable
10	000026			2	SV_3016_02_MV	Valve manipulate variable
11	000027			3	SV_3008_02_MV	Valve manipulate variable
12	000028			4	SV_3013_01_MV	Valve manipulate variable

140 DDO35300 (Backplane 2, Slot 5) 32 digital outputs						
PLC INPUT	**PLC ADDRESS**	**PHOENIX MODULE**	**PHOENIX HARNESS**	**RELAY**	**MPP VARIABLE NAME**	**COMMENTS**
13	000029			5	SV_3013_02_MV	Valve manipulate variable
14	000030			6	SV_3013_03_MV	Valve manipulate variable
15	000031			7	PP_3000_01_MV	Reserved but not connected yet
16	000032			8	PP_3022_01_MV	Reserved but not connected yet
17	000033	DDO3	DDO3	1	FREE	
18	000034			2	FREE	
19	000035			3	FREE	
20	000036			4	BLE_3004_01_MV1	Activate/Deactivate Agitator
21	000037			5	GC_3011_01_MV	Activate/deactivate gas compressor
22	000038			6	CP_3005_01_MV	Activate/deactivate circulating pump
23	000039			7	CL3004_Buzzer_1	Activate/deactivate buzzer
24	000040			8	PP_3015_01_MV	Activate/Deactivate peristaltic pump
25	000041	DDO4	DDO4	1	PP_3018_01_MV1	Activate/Deactivate peristaltic pump
26	000042			2	PP_3018_01_MV3	Rotation direction (OFF → CW, ON→ CCW)
27	000043			3	PP_3008_01_MV	Activate/Deactivate peristaltic pump
28	000044			4	PP_3008_02_MV	Activate/Deactivate peristaltic pump
29	000045			5	PP_3003_01_MV1	Activate/Deactivate peristaltic pump
30	000046			6	PP_3003_01_MV3	Rotation direction (OFF → CW, ON→ CCW)

140 DDO35300 (Backplane 2, Slot 5) 32 digital outputs						
PLC INPUT	**PLC ADDRESS**	**PHOENIX MODULE**	**PHOENIX HARNESS**	**RELAY**	**MPP VARIABLE NAME**	**COMMENTS**
31	000047			7	PP_3017_01_MV1	Activate/Deactivate peristaltic pump
32	000048			8	PP_3017_01_MV3	Rotation direction (OFF → CW, ON→ CCW)

4.6.2 Digital inputs cards

140DDI84100 (Backplane 2, Slot 2) 16 Digital Inputs						
PLC INPUT	**PLC ADDRESS**	**PHOENIX MODULE**	**PHOENIX HARNESS**	**RELAY**	**MPP VARIABLE NAME**	**COMMENTS**
1	100001				FREE	
2	100002				FREE	
3	100003				FREE	
4	100004				FREE	
5	100005				FREE	
6	100006				FREE	
7	100007				FREE	
8	100008				FREE	
9	100009				FREE	
10	100010				FREE	
11	100011				FREE	
12	100012				FREE	
13	100013				FREE	
14	100014				FREE	
15	100015				FREE	

140DDI84100 (Backplane 2, Slot 2) 16 Digital Inputs						
PLC INPUT	**PLC ADDRESS**	**PHOENIX MODULE**	**PHOENIX HARNESS**	**RELAY**	**MPP VARIABLE NAME**	**COMMENTS**
16	100016				FREE	

140DDI35300 (Backplane 2, Slot 3) 32 digital inputs						
PLC INPUT	**PLC ADDRESS**	**PHOENIX MODULE**	**PHOENIX HARNESS**	**RELAY**	**MPP VARIABLE NAME**	**COMMENTS**
1	100017	DDI1	DDI1	1	LSH_3006_01	High level switch
2	100018			2	LSH_3006_02	High level switch
3	100019			3	LSL_3006_01	Low level switch
4	100020			4	LSL_3006_02	Low level switch
5	100021			5	LSL_3002_01	Low level switch
6	100022			6	LSL_3002_02	Low level switch
7	100023			7	LSH_3021_01	High level switch
8	100024			8	LSH_3021_02	High level switch
9	100025	DDI2	DDI2	1	SV_3001_01_FB	Valve feedback
10	100026			2	SV_3008_02_FB	Valve feedback
11	100027			3	SV_3008_01_FB	Valve feedback
12	100028			4	SV_3011_01_FB	Valve feedback

140DDI35300 (Backplane 2, Slot 3) 32 digital inputs						
PLC INPUT	**PLC ADDRESS**	**PHOENIX MODULE**	**PHOENIX HARNESS**	**RELAY**	**MPP VARIABLE NAME**	**COMMENTS**
13	100029			5	SV_3018_01_FB	Valve feedback
14	100030			6	SV_3011_02_FB	Valve feedback
15	100031			7	SV_3016_02_FB	Valve feedback
16	100032			8	SV_3016_01_FB	Valve feedback
17	100033	DDI3	DDI3	1	SV_3020_01_FB	Valve feedback
18	100034			2	SV_3005_01_FB	Valve feedback
19	100035			3	SV_3005_02_FB	Valve feedback
20	100036			4	SV_3013_01_FB	Valve feedback
21	100037			5	SV_3013_02_FB	Valve feedback
22	100038			6	SV_3013_03_FB	Valve feedback
23	100039			7	CL3004_Emer_Button_01	Emergency Stop Button
24	100040			8	FREE	
25	100041			1	AT_3013_01_IND	Reserved. (Wired to CIII Control Cabinet)
26	100042			2	AT_3013_02_IND	Reserved (Wired to CIII Control Cabinet)
27	100043			3	AT_3013_03_IND	Reserved (Wired to CIII Control Cabinet)
28	100044			4		
29	100045			5		
30	100046			6		

140DDI35300 (Backplane 2, Slot 3) 32 digital inputs

PLC INPUT	PLC ADDRESS	PHOENIX MODULE	PHOENIX HARNESS	RELAY	MPP VARIABLE NAME	COMMENTS
31	100047			7		
32	100048			8		

4.6.3 Analog Input Cards

140ACI04000 (Backplane 1, Slot 4) 16 analog inputs					
PLC INPUT	**PLC ADDRESS**	**PHOENIX MODULE**	**PHOENIX HARNESS**	**MPP VARIABLE NAME**	**COMMENTS**
1	300001	ACI1	AC1	TT_3012_01	Temperature transmitter (4 – 20mA)
2	300002			TT_3001_01	Temperature transmitter (4 – 20mA)
3	300003			TT_3020_01	Temperature transmitter (4 – 20mA)
4	300004			TT_3005_02	Temperature transmitter (4 – 20mA)
5	300005			TT_3005_01	Temperature transmitter (4 – 20mA)
6	300006			TT_3005_03	Temperature transmitter (4 – 20mA)
7	300007			TT_3005_04	Temperature transmitter (4 – 20mA)
8	300008			LT_3002_01	Level transmitter (4 – 20mA)
9	300009			LT_3021_01	Level transmitter (4 – 20mA)
10	300010			LT_3006_01	Level transmitter (4 – 20 mA)
11	300011			DPT_3007_01	Differential pressure transmitter (4 – 20mA)
12	300012			FT_3003_01	Flow transmitter (4 – 20 mA)
13	300013			FT_3017_01	Flow transmitter (4 – 20 mA)
14	300014			FT_3018_01	Flow transmitter (4 – 20 mA)
15	300015			PT_3007_01	Pressure transmitter (4 – 20 mA)

140ACI04000 (Backplane 1, Slot 4) 16 analog inputs					
PLC INPUT	**PLC ADDRESS**	**PHOENIX MODULE**	**PHOENIX HARNESS**	**MPP VARIABLE NAME**	**COMMENTS**
16	300016			PT_3011_01	Pressure transmitter (4 – 20 mA)

140ACI03000 (Backplane 2, Slot 6) 8 Analog inputs					
PLC INPUT	**PLC ADDRESS**	**PHOENIX MODULE**	**PHOENIX HARNESS**	**MPP VARIABLE NAME**	**COMMENTS**
1	300018	ACI2	AC2	PT_3003_01	Pressure transmitter (4 – 20 mA)
2	300019			FQRC_3011_02	Flow element transmitter (4 – 20 mA)
3	300020			AT_3008_02	pH transmitter (4 -20 mA)
4	300021			AT_3008_01	pH transmitter (4 – 20 mA)
5	300022			AT_3010_02	Conductivity transmitter (4 – 20 mA)
6	300023			AT_3010_01	Conductivity transmitter (4 – 20 mA)
7	300024			AT_3009_02	Dissolved O2 transmitter (4 – 20 mA)
8	300025			AT_3009_01	Dissolved O2 transmitter (4- 20 mA)

140ACI03000 (Backplane 2, Slot 7) 8 Analog inputs					
PLC INPUT	**PLC ADDRESS**	**PHOENIX MODULE**	**PHOENIX HARNESS**	**MPP VARIABLE NAME**	**COMMENTS**
1	300027				
2	300028				

140ACI03000 (Backplane 2, Slot 7) 8 Analog inputs					
PLC INPUT	PLC ADDRESS	PHOENIX MODULE	PHOENIX HARNESS	MPP VARIABLE NAME	COMMENTS
3	300029				
4	300030				
5	300031				
6	300032				
7	300033				
8	300034				

140AVI03000 (Backplane 2, Slot 8) 8 Analog inputs					
PLC INPUT	PLC ADDRESS	PHOENIX MODULE	PHOENIX HARNESS	MPP VARIABLE NAME	COMMENTS
1	300036	AVI1	AVI1	FQRC_3008_01	Flow transmitter (0 – 5V)
2	300037			FQRC_3009_01	Flow transmitter (0 – 5V)
3	300038			FQRC_3011_01	Flow transmitter (0 – 5V)
4	300039			BLE_3004_01	Blender speed (0-10V)
5	300040			TT_3008_01	Temperature of the pH sensor (4 – 20 mA)
6	300041			TT_3008_02	Temperature of the pH sensor (4 – 20 mA)
7	300042			FREE	
8	300043			FREE	

140AVI03000 (Backplane 2, Slot 9) 8 Analog inputs					
PLC INPUT	**PLC ADDRESS**	**PHOENIX MODULE**	**PHOENIX HARNESS**	**MPP VARIABLE NAME**	**COMMENTS**
1	300045	AVI2	AVI2	AT_3013_01	NH4 Analyzer (4-20mA)
2	300046			AT_3013_02	NO3 Analyzer (4-20mA)
3	300047			AT_3013_03	NO2 Analyzer (4-20mA)
4	300048			TT_3023_01	Mobile temperature sensor (4-20mA)
5	300049			TT_3023_02	Mobile temperature sensor (4-20mA)
6	300050			TT_3023_03	Mobile temperature sensor (4-20mA)
7	300051				
8	300052				

4.6.4 Analog Outputs

140AVO02000 (Backplane 1, Slot 5) 4 Analog outputs					
PLC INPUT	**PLC ADDRESS**	**PHOENIX MODULE**	**PHOENIX HARNESS**	**MPP VARIABLE NAME**	**COMMENTS**
1	400001	AVO1	AVO1	FQRC_3008_01_SP	Flow control valve set point (0 – 5V)
2	400002			FQRC_3009_01_SP	Flow control valve set point (0 – 5V)
3	400003			FQRC_3011_01_SP	Flow control valve set point (0 – 5V)
4	400004			BLE_3004_01_MV2	Speed Agitator set point (-10/+10V)

140ACO02000 (Backplane 1, Slot 6) 4 Analog outputs					
PLC INPUT	**PLC ADDRESS**	**PHOENIX MODULE**	**PHOENIX HARNESS**	**MPP VARIABLE NAME**	**COMMENTS**
1	400005			FREE	
2	400006			FREE	
3	400007			FREE	
4	400008			FREE	

140ACO13000 (Backplane 1, Slot 7) 8 Analog outputs					
PLC INPUT	**PLC ADDRESS**	**PHOENIX MODULE**	**PHOENIX HARNESS**	**MPP VARIABLE NAME**	**COMMENTS**
1	400009	ACO2	ACO2	FREE	

140ACO13000 (Backplane 1, Slot 7) 8 Analog outputs					
PLC INPUT	**PLC ADDRESS**	**PHOENIX MODULE**	**PHOENIX HARNESS**	**MPP VARIABLE NAME**	**COMMENTS**
2	400010			PP_3018_01_MV2	
3	400011			PP_3003_01_MV2	
4	400012			PP_3017_01_MV2	
5	400013			FQRC_3011_02_SP	
6	400014			FREE	
7	400015			FREE	
8	400016			FREE	

SECTION 3: PLC Cabinet assembly

Reference	Title	Version	Edition date	Pages Number
NTE-CIIIP2-PR-005	CIII CONTROL CABINET AND CABINET CABLING TEST PROCEDURE	1	08/07/09	13
NTE-CIIIP2-TR-006	CIII CONTROL CABINET AND CABINET CABLING TEST REPORT FOR THE	1.1	6/10/09	10

CIII CONTROL CABINET AND CABINET CABLING TEST PROCEDURE

FOR THE

MELISSA CS CIII

APPROVAL LIST		
NAME	SIGNATURE	DATE
Prepared by: J.Carbonell		23/06/2009
Revised by: M.Bassas		23/06/2009
Approved by: E.Creus		23/6/09.
Authorised by: J.Duatis		23/6/09

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R.Moyano		MPP

CHANGE RECORD			
AUTHOR	ISSUE	DATE	CHANGE
Jordi Carbonell Muñoz	1.0	23/06/2009	New document

CONTENTS

LIST OF ACRONYMS

CIII	Compartment III
PLC	Programmable Logic Controller
MELiSSA	Micro-Ecological Life Support System Alternative
MPP	MELiSSA Pilot Plant
UAB	Universitat Autònoma de Barcelona
AI	Analogue input
AO	Analogue output
DI	Digital input
DO	Digital output
EPIC	Electrical Power Interface Cabinet
CW	Clockwise
CCW	Counterclockwise

1. SCOPE

This document describes the Control cabinet and cabinet cabling procedure to be completed as part of the verification.

The purpose of the test is to verify that the CIII Schneider PLC is correctly connected to the intermediate connectors in the EPIC cabinet and correct address assignation. To test this, the connections from control cabinet until CIII EPIC cabinet are checked, signal per signal.

Tests will be performed in MPP facilities.

2. REFERENCE DOCUMENTS

2.1 APPLICABLE DOCUMENTS

Ref.	Title	Reference	Issue	Date
AD1	Procedimiento de Control de No conformidades	NTE-PG-007	3	05/12/06
AD2	NTE Offer for CIII control System Cabinet and HMI update	NTE-CIIIP2-OF-001	1	14/04/09
AD3	CIII Hardware Interface document	NTE-CIIIP2-ICD-002	1	27/04/2009

2.2 REFERENCE DOCUMENTS

Ref.	Title	Reference	Issue	Date
RD1	BIOPROCESS, PLC MODULES			29/05/2009
RD2	CIII_Equipment_tags_20090616.xls			16/06/2009

3. GENERAL INSTRUCTIONS

3.1 Personnel

At least the following personnel are required for the execution of the tests:

- Raul Moyano (MPP)
- Gabriel Tortoles (Bioprocess Technology)
- Jordi Carbonell (NTE)

3.2 Test Conditions

The test will be performed starting at 25/06/2009 in MPP facilities.

The following environmental requirements are applicable to all tests undertaken.

- Temperature: 22 ºC +/- 5 ºC
- The areas in which materials and equipment preparation for test is to be carried out shall be maintained in a neat orderly fashion, with no loose material (dirt, dust, oils, etc) that can cause contamination of the parts.
- Other environmental conditions are the normal in laboratory.

3.3 Requirements for measurement equipment

When indicated in the test procedure, measurements and test instruments shall be subjected to approve calibration procedures and shall be within the normal calibration periods at the time of test. Instrumentation that will run out of calibration during the planned test time shall be not used.

3.4 Non Conformances

Non Conformances will be issued in case of test deviations or test failures and will be handled as indicated in AD1.

3.5 Safety considerations

Laboratory safety considerations of MPP will apply.

3.6 Test Report

A report shall be prepared for the tests containing for each test executed:

- Device Under Test data, identification and configuration
- Test set-up
- Test Facility and Environmental Data
- Instrumentation used with reference to the corresponding calibration reports and calibration date when required

- As-run test procedures including deviations, NCRs raised and recommendations of corrective actions.
- The test sign-off sheet detailed in Annex #1 including:
    - Remarks and Test Procedures deviations
    - NCRs raised
    - Test conductor name and signature
    - Summary of tests results and conclusion

3.7 Pass / Fail Criteria

In general terms this test can be divided between inputs and outputs.

- For inputs, some kind of action is performed in the compartment hardware and a response is expected in the PLC.
- For outputs an action is performed in the PLC (changing a set-point or a Boolean value) while a response is expected from the compartment hardware.

Whenever possible the test will be performed on the final device hardware, that is, to check that actuators are working and sensors are measuring. In such cases it is assumed that if the device works the electrical connections are right. If, for installation status or hardware manipulation difficulties, such testing is not possible, it will be tested that the signal to/from the PLC reaches the compartment electronics as expected.

Testing the actual devices monitored/commanded by the PLC is out of the scope of this test even if in many cases it has been done for ease.

The criteria used for testing are the following:

3.7.1 Criterion1: Valves with feedback signal. DO and DI

While switching the digital output signal from the test control software, the switching valve is identified on the hardware (valve makes noise when switching). Corresponding digital input feedback signal switching is detected from the test control software.

3.7.2 Criterion 2: Level switches detection. DI

CIII frame manufacturer's technician manipulates the level switch to switch the state of the sensor. The corresponding signal is checked from the test control software.

3.7.3 Criterion 3: Emergency stop button pushed and recovery detection. DI

Emergency stop button pushed: DI switches when one of the emergency stop button is pushed. Feature tested with all the stop buttons installed in the compartment.

Recovery: After a previously pushed emergency stop button is released, DI switches when system is reset.

The corresponding signal is checked from the test control software.

3.7.4 Criterion 4: Gas analyzer calibration detection. DI

Activate the calibration procedure from Analyzer and the corresponding signal is checked from the test control software.

3.7.5 Criterion 5: Peristaltic pumps activation. DO

Peristaltic pump makes noise when DO is turned ON from the test control software.

3.7.6 Criterion 6: Gas compressor. DO

Gas compressor makes noise when DO is turned ON from the test control software.

3.7.7 Criterion 7: Blender agitator. DO

Blender agitator makes noise when DO is turned ON from the test control software.

3.7.8 Criterion 8: Peristaltic pump rotation direction. DO

Peristaltic pump has to be turned ON to check the rotation direction. Using the test control software, switch ON the signal and check the rotor rotates in CW direction and switching OFF the signal the rotor rotates in CCW direction.

3.7.9 Criterion 9: Circulating pump. DO

Circulating pump makes noise when DO is turned ON from the test control software

3.7.10 Criterion 10: Buzzer. DO

Buzzer makes sounds when DO is turned On from the test control software.

3.7.11 Criterion 11: pH sensor. AI

CIII frame manufacturer’s technician manipulates the sensor to make the readout change. Corresponding AI signal variation is checked from the test control software.

3.7.12 Criterion 12: Temperature sensor. AI

CIII frame manufacturer’s technician manipulates the sensor to make the readout change warming the probe. Corresponding AI signal variation is checked from the test control software.

3.7.13 Criterion 13: Level sensor. AI

CIII frame manufacturer’s technician fills the tank with water to make the readout change. Corresponding AI signal variation is checked from the test control software.

3.7.14 Criterion 14: Differential pressure sensor. AI

Pressure readout in PLC changes when pushing the pressure sensor membrane of one of the two probes.

3.7.15 Criterion 15: Flow sensor. AI

CIII frame manufacturer's technician manipulates the display of the device to simulate a flow and to make the readout change. Corresponding AI signal variation is checked from the test control software.

3.7.16 Criterion 16: Pressure sensor. AI

Pressure readout in PLC changes when pushing the pressure sensor membrane.

3.7.17 Criterion 17: Conductivity sensor, Dissolved O2, temperature pH sensor. AI

CIII frame manufacturer's technician manipulates the sensor to make the readout change. Corresponding AI signal variation is checked from the test control software.

3.7.18 Criterion 18: Gas flow control valve. AI and AO

AO: Set point values in the device display changes when changing the corresponding PLC AO from the test control software.

AI: Flow meter measurement changes when changing set point.

3.7.19 Criterion 19: Blender agitator speed control. AI and AO

AO: Set point values in the device display changes when changing the corresponding PLC AO from the test control software.

AI: Speed measurement changes when changing set point.

3.7.20 Criterion 20: Peristaltic pump variable speed. AO

Set point values in the device display changes when changing the corresponding PLC AO from the test control software and check the rotation speed of rotor changes.

3.7.21 Criterion 21: Weight scales configuration and communications

Using the HyperTerminal in the SCADA server, open the COM port assigned to the scale and send an "SI" command. Check that the scale responds with the weight value displayed in the weight scale display.

3.7.22 Criterion 22: Liquid analyzer. AI

The operator makes to flow medium liquid for the pipes analyzer to make the readout change. Corresponding AI signal variation is checked from the test control software.

4. TEST SEQUENCE

Tests steps shall not necessary be executed in the order provided.

5. TESTS RESULTS

Test			
Requirements tested	Communications between the control PLC and CIII EPIC Cabinet		
Unit identification	CIII control cabinet.		
Ambient Temperature			
Start of Execution Date		End of Execution Date	
Test equipment	*Model*	*S/N*	*Calibration certificate*
Remarks			
Sign-off signatures			
Test executor: Date / Signature			

Step nb	TAG tested	PLC address	Type	Pass/Fail criteria	Expected result	Test date	OK/ NOK
10	SV_3020_01_MV	000017	DO	1			
20	SV_3020_01_FB	100033	DI	1			
30	SV_3011_02_MV	000018	DO	1			
40	SV_3011_02_FB	100030	DI	1			
50	SV_3001_01_MV	000019	DO	1			
60	SV_3001_01_FB	100025	DI	1			
70	SV_3018_01_MV	000020	DO	1			
80	SV_3018_01_FB	100029	DI	1			
90	SV_3005_02_MV	000021	DO	1			
100	SV_3005_02_FB	100035	DI	1			
110	SV_3011_01_MV	000022	DO	1			
120	SV_3011_01_FB	100028	DI	1			
130	SV_3005_01_MV	000023	DO	1			
140	SV_3005_01_FB	100034	DI	1			
150	SV_3016_01_MV	000024	DO	1			
160	SV_3016_01_FB	100032	DI	1			
170	SV_3008_01_MV	000025	DO	1			
180	SV_3008_01_FB	100027	DI	1			
190	SV_3016_02_MV	000026	DO	1			
200	SV_3016_02_FB	100031	DI	1			
210	SV_3008_02_MV	000027	DO	1			
220	SV_3008_02_FB	100026	DI	1			
230	SV_3013_01_MV	000028	DO	1			
240	SV_3013_01_FB	100036	DI	1			
250	SV_3013_02_MV	000029	DO	1			
260	SV_3013_02_FB	100037	DI	1			
270	SV_3013_03_MV	000030	DO	1			

280	SV_3013_03_FB	100038	DI	1			
290	BLE_3004_01_MV1	000036	DO	7			
300	GC_3011_01_MV	000037	DO	6			
310	GP_3005_01_MV	000038	DO	9			
320	CL3004_Buzzer_1	000039	DO	10			
330	PP_3015_01_MV	000040	DO	5			
340	PP_3018_01_MV1	000041	DO	5			
350	PP_3018_01_MV3	000042	DO	8			
360	PP_3008_01_MV	000043	DO	5			
370	PP_3008_02_MV	000044	DO	5			
380	PP_3003_01_MV1	000045	DO	5			
390	PP_3003_01_MV3	000046	DO	8			
400	PP_3017_01_MV1	000047	DO	5			
410	PP_3017_01_MV3	000048	DO	8			
420	LSH_3006_01	100017	DI	2			
430	LSH_3006_02	100018	DI	2			
440	LSL_3006_01	100019	DI	2			
450	LSL_3006_02	100020	DI	2			
460	LSL_3002_01	100021	DI	2			
470	LSL_3002_02	100022	DI	2			
480	LSH_3021_01	100023	DI	2			
490	LSH_3021_02	100024	DI	2			
500	CL3004_EMER_BUTTON_01	100039	DI	3			
510	AT_3013_01_IND	100041	DI	4			
520	AT_3013_02_IND	100042	DI	4			
530	AT_3013_03_IND	100043	DI	4			
540	TT_3012_01	300001	AI	12			
550	TT_3001_01	300002	AI	12			
560	TT_3020_01	300003	AI	12			
570	TT_3005_02	300004	AI	12			
580	TT_3005_01	300005	AI	12			
590	TT_3005_03	300006	AI	12			
600	TT_3005_04	300007	AI	12			
610	LT_3002_01	300008	AI	13			
620	LT_3021_01	300009	AI	13			
630	LT_3006_01	300010	AI	13			
640	DPT_3007_01	300011	AI	14			
650	FT_3003_01	300012	AI	15			
660	FT_3017_01	300013	AI	15			
670	FT_3018_01	300014	AI	15			
680	PT_3007_01	300015	AI	16			
690	PT_3011_01	300016	AI	16			
700	PT_3003_01	300018	AI	16			
710	FQRC_3011_04	300019	AI	18			
720	AT_3008_02	300020	AI	11			
730	AT_3008_01	300021	AI	11			
740	AT_3010_02	300022	AI	17			
750	AT_3010_01	300023	AI	17			
760	AT_3009_02	300024	AI	17			

770	AT_3009_01	300025	AI	17			
780	FQRC_3011_03	300036	AI	18			
790	FQRC_3011_02	300037	AI	18			
800	FQRC_3011_01	300038	AI	18			
810	BLE_3004_01	300039	AI	19			
820	TT_3008_01	300040	AI	17			
830	TT_3008_02	300041	AI	17			
840	AT_3013_01	300045	AI	22			
850	AT_3013_02	300046	AI	22			
860	AT_3013_03	300047	AI	22			
870	FQRC_3011_03_SP	400001	AO	18			
880	FQRC_3011_02_SP	400002	AO	18			
890	FQRC_3011_01_SP	400003	AO	18			
900	BLE_3004_01_MV2	400009	AO	19			
910	PP_3018_01_MV2	400010	AO	20			
920	PP_3003_01_MV2	400011	AO	20			
930	PP_3017_01_MV2	400012	AO	20			
940	FQRC_3011_04_SP	400013	AO	18			
950	WT_3008_01	400116	AI	21			
960	WT_3008_02	400118	AI	21			
970	TT_3023_01	300048	AI	12			
980	TT_3023_02	300049	AI	12			
990	TT_3023_03	300050	AI	12			
1000	PP_3000_01_MV	000031	DO	5			
1110	PP_3020_01_MV	000032	DO	5			

ANNEX 1: Procedure sign-off sheet

PROCEDURE SIGN-OFF SHEET			
Test reference:		Issue:	Date:
Remarks :			
Procedure deviations:			
NCRs :			

Test conductor			
Name:			
Date:			
Visa:			

CIII CONTROL CABINET AND CABINET CABLING TEST REPORT

FOR THE

CS MELISSA CIII

APPROVAL LIST		
NAME	SIGNATURE	DATE
Prepared by: Jordi Carbonell		06/10/2009
Revised by: Martí Bassas		06/10/2009
Approved by: Eva Creus		13/10/09
Authorised by: Jordi Duatis		14/10/2009

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R.Moyano		MPP

CHANGE RECORD			
AUTHOR	ISSUE	DATE	CHANGE
Jordi Carbonell	1.0	06/10/2009	New document.

CONTENTS

1. SCOPE

This document is a report of the results of PLC control cabinet connection with the CIII compartment Test.

This report includes:

- Device Under Test data, identification and configuration
- Test Facility and Environmental Data
- Instrumentation used with reference to the corresponding calibration reports and calibration date when required
- As-run test procedures including deviations, NCRs raised and recommendations of corrective actions.
- The test sign-off sheet detailed in Annex 1 including:
    - Test Procedures deviations
    - NCRs raised
    - Test conductor name and signature
    - QA name and signature
    - Summary of tests results and conclusion

2. REFERENCE DOCUMENTS

2.1 APPLICABLE DOCUMENTS

Ref.	Title	Reference	Issue	Date
AD1	Procedimiento de Control de No conformidades	NTE-PG-007	3	05/12/06
AD2	NTE Offer for CIII control System Cabinet and HMI update	NTE-CIIIP2-OF-001	1	14/04/09
AD3	CIII Hardware Interface document	NTE-CIIIP2-ICD-002	1	27/04/2009
AD4	CIII control cabinet and cabinet cabling test procedure	NTE-CIIIP2-PR-005	1	23/06/2009

2.2 REFERENCE DOCUMENTS

Ref.	Title	Reference	Issue	Date
RD1	BIOPROCESS, PLC MODULES			29/05/2009
RD2	CIII_Equipment_tags_20090616.xls			16/06/2009

3. TEST SET-UP

For this test, a laptop is used to control and monitor the PLC inputs and outputs. An intended “*Concept*” project has been used, and the PLC program has been modified so that outputs are not automatically modified by the PLC software. A PLC registers table template has been created in this *Concept project* to control and monitor inputs and outputs. This working environment is referred to as “test control software” in this document.

4. DEVICE UNDER TEST

The device under test was CIII control cabinet and connection with CIII compartment electronics.

5. TEST FACILITY

The tests were carried out from the 25/06/09 to the 15/09/09 in MPP facilities.

6. INSTRUMENTATION USED

The instrumentation used is provided as part of the as-run procedures.

7. RESULTS SUMMARY

The following points found during this test may require further actions:

- Signals from liquid analyzers are connected but not checked, they are pending.

All other connections between the PLC cabinet and the compartment electronics were tested satisfactorily. See as run test procedures and remarks for further information.

8. ANNEX 1: AS RUN TEST PROCEDURES

Test				
Requirements tested	Analog and digital IN/OUT properly detected/modified by control.			
Unit identification	CIII control cabinet.			
Ambient Temperature	22ºC			
Start of Execution Date	*25/06/2009*	End of Execution Date		*16/09/2009*
Test equipment	*Model*		*S/N*	*Calibration certificate*
Remarks				
Sign-off signatures				
Test executor: Date / Signature	Raul Moyano, Gabriel Tortoles, Jordi Carbonell			

Step number	TAG tested	PLC address	Type	Test description	Remarks	Test date	Ok/ NOk
10	SV_3020_01_MV	000017	DO	1		25/06/2009	OK
20	SV_3020_01_FB	100033	DI	1		25/06/2009	OK
30	SV_3011_02_MV	000018	DO	1		25/06/2009	OK
40	SV_3011_02_FB	100030	DI	1		25/06/2009	OK
50	SV_3001_01_MV	000019	DO	1		25/06/2009	OK
60	SV_3001_01_FB	100025	DI	1		25/06/2009	OK
70	SV_3018_01_MV	000020	DO	1		25/06/2009	OK
80	SV_3018_01_FB	100029	DI	1		25/06/2009	OK
90	SV_3005_02_MV	000021	DO	1		25/06/2009	OK
100	SV_3005_02_FB	100035	DI	1		25/06/2009	OK
110	SV_3011_01_MV	000022	DO	1		25/06/2009	OK
120	SV_3011_01_FB	100028	DI	1		25/06/2009	OK
130	SV_3005_01_MV	000023	DO	1		25/06/2009	OK

140	SV_3005_01_FB	100034	DI	1		25/06/2009	OK
150	SV_3016_01_MV	000024	DO	1		25/06/2009	OK
160	SV_3016_01_FB	100032	DI	1		25/06/2009	OK
170	SV_3008_01_MV	000025	DO	1		25/06/2009	OK
180	SV_3008_01_FB	100027	DI	1		25/06/2009	OK
190	SV_3016_02_MV	000026	DO	1		25/06/2009	OK
200	SV_3016_02_FB	100031	DI	1		25/06/2009	OK
210	SV_3008_02_MV	000027	DO	1		25/06/2009	OK
220	SV_3008_02_FB	100026	DI	1		25/06/2009	OK
230	SV_3013_01_MV	000028	DO	1		16/07/2009	OK
240	SV_3013_01_FB	100036	DI	1		16/07/2009	OK
250	SV_3013_02_MV	000029	DO	1		16/07/2009	OK
260	SV_3013_02_FB	100037	DI	1		16/07/2009	OK
270	SV_3013_03_MV	000030	DO	1		16/07/2009	OK
280	SV_3013_03_FB	100038	DI	1		16/07/2009	OK
290	BLE_3004_01_MV1	000036	DO	7		16/07/2009	OK
300	GC_3011_01_MV	000037	DO	6		25/06/2009	OK
310	GP_3005_01_MV	000038	DO	9		25/06/2009	OK
320	CL3004_Buzzer_1	000039	DO	10		25/06/2009	OK
330	PP_3015_01_MV	000040	DO	5		25/06/2009	OK
340	PP_3018_01_MV1	000041	DO	5		25/06/2009	OK
350	PP_3018_01_MV3	000042	DO	8		25/06/2009	OK
360	PP_3008_01_MV	000043	DO	5		25/06/2009	OK
370	PP_3008_02_MV	000044	DO	5		25/06/2009	OK
380	PP_3003_01_MV1	000045	DO	5		25/06/2009	OK
390	PP_3003_01_MV3	000046	DO	8		25/06/2009	OK
400	PP_3017_01_MV1	000047	DO	5		25/06/2009	OK
410	PP_3017_01_MV3	000048	DO	8		25/06/2009	OK
420	LSH_3006_01	100017	DI	2		25/06/2009	OK
430	LSH_3006_02	100018	DI	2		25/06/2009	OK
440	LSL_3006_01	100019	DI	2		25/06/2009	OK
450	LSL_3006_02	100020	DI	2		25/06/2009	OK

460	LSL_3002_01	100021	DI	2		25/06/2009	OK
470	LSL_3002_02	100022	DI	2		25/06/2009	OK
480	LSH_3021_01	100023	DI	2		25/06/2009	OK
490	LSH_3021_02	100024	DI	2		25/06/2009	OK
500	CL3004_EMER_BUTTON_01	100039	DI	3		25/06/2009	OK
510	AT_3013_01_IND	100041	DI	4			
520	AT_3013_02_IND	100042	DI	4	Wired but not checked		
530	AT_3013_03_IND	100043	DI	4	Wired but not checked		
540	TT_3012_01	300001	AI	12	Wired but not checked	26/06/2009	OK
550	TT_3001_01	300002	AI	12		26/06/2009	OK
560	TT_3020_01	300003	AI	12		26/06/2009	OK
570	TT_3005_02	300004	AI	12		26/06/2009	OK
580	TT_3005_01	300005	AI	12		26/06/2009	OK
590	TT_3005_03	300006	AI	12		26/06/2009	OK
600	TT_3005_04	300007	AI	12		26/06/2009	OK
610	LT_3002_01	300008	AI	13		26/06/2009	OK
620	LT_3021_01	300009	AI	13		26/06/2009	OK
630	LT_3006_01	300010	AI	13		26/06/2009	OK
640	DPT_3007_01	300011	AI	14		26/06/2009	OK
650	FT_3003_01	300012	AI	15		26/06/2009	OK
660	FT_3017_01	300013	AI	15		26/06/2009	OK
670	FT_3018_01	300014	AI	15		26/06/2009	OK
680	PT_3007_01	300015	AI	16		26/06/2009	OK
690	PT_3011_01	300016	AI	16		26/06/2009	OK
700	PT_3003_01	300018	AI	16		26/06/2009	OK
710	FQRC_3011_04	300019	AI	18		26/06/2009	OK
720	AT_3008_02	300020	AI	11		26/06/2009	OK
730	AT_3008_01	300021	AI	11		26/06/2009	OK
740	AT_3010_02	300022	AI	17		26/06/2009	OK
750	AT_3010_01	300023	AI	17		26/06/2009	OK
760	AT_3009_02	300024	AI	17		26/06/2009	OK
770	AT_3009_01	300025	AI	17		26/06/2009	OK

780	FQRC_3011_03	300036	AI	18		26/06/2009	OK
790	FQRC_3011_02	300037	AI	18		26/06/2009	OK
800	FQRC_3011_01	300038	AI	18		26/06/2009	OK
810	BLE_3004_01	300039	AI	19		16/07/2009	OK
820	TT_3008_01	300040	AI	17		15/09/2009	OK
830	TT_3008_02	300041	AI	17		15/09/2009	OK
840	AT_3013_01	300045	AI	22	Wired but not checked		
850	AT_3013_02	300046	AI	22	Wired but not checked		
860	AT_3013_03	300047	AI	22	Wired but not checked		
870	FQRC_3011_03_SP	400001	AO	18		26/06/2009	OK
880	FQRC_3011_02_SP	400002	AO	18		26/06/2009	OK
890	FQRC_3011_01_SP	400003	AO	18		26/06/2009	OK
900	BLE_3004_01_MV2	400009	AO	19		16/07/2009	OK
910	PP_3018_01_MV2	400010	AO	20		26/06/2009	OK
920	PP_3003_01_MV2	400011	AO	20		26/06/2009	OK
930	PP_3017_01_MV2	400012	AO	20		26/06/2009	OK
940	FQRC_3011_04_SP	400013	AO	18		26/06/2009	OK
950	WT_3008_01	400116	AI	21		08/07/2009	OK
960	WT_3008_02	400118	AI	21	The serial communication baud rate of the weight scale wasn't configured to 9600 bauds.	08/07/2009	OK
970	TT_3023_01	300048	AI	12		15/09/2009	OK
980	TT_3023_02	300049	AI	12		15/09/2009	OK
990	TT_3023_03	300050	AI	12		15/09/2009	OK
1000	PP_3000_01_MV	000031	DO	5	Not installed for the moment		
1110	PP_3022_01_MV	000032	DO	5	Not installed for the moment		

9. ANNEX 2: PROCEDURE SIGN-OFF SHEET

PROCEDURE SIGN-OFF SHEET			
Test reference:		Issue:	Date:

Remarks :

Valves feedback: when the valve is close feedback is “1” and when is open is “0”.

Level Switch High: When the tank is full and level reaches the level switch high the signal is “0”, otherwise is “1”.

Level Switch Low: When tank is empty and tank level is lower than level switch low the signal is “0”, otherwise is “1”.

Emergency Stop button: When one of the emergency stop buttons, placed in each side of the CIII structure, is pushed the signal is “0”, otherwise is “1”.

Peristaltic pump rotation direction: Signal is “0” to rotate in clockwise direction and “1” in counterclockwise direction.

Peristaltic pump PP_3000_01, used to transfer medium from CII to CIII, doesn’t exist for the moment, may be will be installed in the future
Peristaltic pump PP_3020_01, used for antifoam, is not critical for the moment but if it becomes critical will be installed (depending on the future test results).

Signals from liquid analyzers and mobile temperature sensors are wired to the control cabinet.

Signals from liquid analyzers will be checked in the future with the help of the analyzers after-sales services people.

Procedure deviations:

NCRs :

Test conductor			
Name:	Jordi Carbonell		
Date:	09-2009		
Visa:			

SECTION 4: Implementation of remote and local HMIs

Reference	Title	Version	Edition date	Pages Number
NTE-CIIIP2-RP-003	MELISSA CIII HMI DESIGN	1.1	22/01/10	41
NTE-CIIIP2-RP-007	MELISSA CIII LOCAL HMI DESIGN	1.1	26/01/10	21
NTE-CIIIP2-HB-008	CIII HMI SOFTWARE MANUAL	1.2	22/04/10	70
NTE-CIIIP2-MN-009	Review of CIII HMI Displays minutes of meeting	1	14/10/09	3
NTE-CIIIP2-MN-010	Review of CIII HMI Displays minutes of meeting	1	29/10/09	2

MELISSA CIII HMI DESIGN

FOR THE

MELISSA CS CIIIP2 Project

APPROVAL LIST		
NAME	SIGNATURE	DATE
Prepared by: J.Carbonell		26/01/2010
Revised by: J.Duatis		26/01/2010
Approved by: E.Creus		26/01/2010
Authorised by: J.Duatis		26/01/200

DISTRIBUTION LIST

NAME	POSITION	COMPANY
Olivier Gerbi		SHERPA
Christophe Bourg		SHERPA
Arnaud Fossen		MPP
Enrique Peiro		MPP
Raul Moyano		MPP

CHANGE RECORD

AUTHOR	ISSUE	DATE	CHANGE
J.Carbonell	Draft 1.0	28/08/2009	First Version
J.Carbonell	1.0	12/11/2009	- Updated all the screens according the tag list from SHERPA CIII_PLC_HMI_20091005.xls - Updated set point controls to have the same box set-point input and measured value to harmonize with CI and HPC displays. - Labels with chemical compounds formatted with sub-index. - Updated the analogue indicators with the threshold alarms indicators. - All the pressure units changed to mbar. - All the pumps speed changed to (%). - Added all the CO2 line (gas compressor, valves, etc.) in pH screen. - CO2, O2 and N2 flow meters units changed to ml/min. - Analyzers added to the recirculation loop in Liquid screen (they have been removed from Gas screen). - Added pH control modes (CO2 only, CO2 + base or acid + base). - The valve SV_3016_01 becomes SV_3011_03. The consequence is that the valve SV_3016_02 becomes SV_3016_01. - New tags added: CL3008_DO2_Average,

CHANGE RECORD			
AUTHOR	ISSUE	DATE	CHANGE
			SV_3011_02_Day, PT_3007_01_SP, CL3007_Pressure_Threshold - Changed the functionality of the "CL3009_DO2_selector" tag (0 = average / 1 = AT_3009_01 / 2 = AT_3009_02) - Changed the functionality of the "CL3008_pH_selector" tag (0 = average / 1 = AT_3008_01 / 2 = AT_3008_02) - Added Gas Exhaust valve (SV_3011_02) functionalities related with the opening time.
J.Carbonell	1.1	22/01/2010	Add in section 10 tag description with units, range and accuracy. Updated CIII bioreactor bitmap in all the screens. Modified the screens according to the list attached in the minutes of meeting of 19/10/2009.

CONTENTS

ACRONYMS LIST

CIII	Compartment III
HMI	Human Machine Interface
I/O	Input / Output
MELiSSA	Micro-Ecological Life Support System Alternative
MPP	Melissa Pilot Plant
PLC	Programmable Logic Controller
SP	Set-Point
DO_2	Dissolved O_2

1. SCOPE

This document describes a preliminary design of the CIII HMI screens. The screen design has been derived from Sherpa specifications in [R1]. The work developed herein describes the variables (pressure, temperature, pH, etc) -warnings and alarms- as well as the tools and the instrumentation in Compartment CIII that will be monitored and/ or controlled through the computer as well as to know the entire system status.

2. REFERENCE DOCUMENTS

2.1 APPLICABLE DOCUMENTS

Ref	Title	Reference	Issue	Date
[A1]	NTE Offer for CIII control system cabinet and HMI update.	NTE-CIIIP2-OF-001	1.0	Apr.2009
[A2]	MPP rules for tags and labelling	TN 78.72	2.0	Sept. 2008

2.2 REFERENCE DOCUMENTS

Ref	Title	Reference	Issue	Date
[R1]	CIII_PLC_HMI_20091005.xls			05/10/2009
[R2]	User requirements specification automation, Nitrification Bioreactor.	ESA-URS Automation	Rev2	11/02/2009
[R3]	P&ID of the nitrification bioreactor system	SNC-LAVALIN	RevE	20/01/2009

3. HMI SCREENS

3.1 Screens Hierarchy:

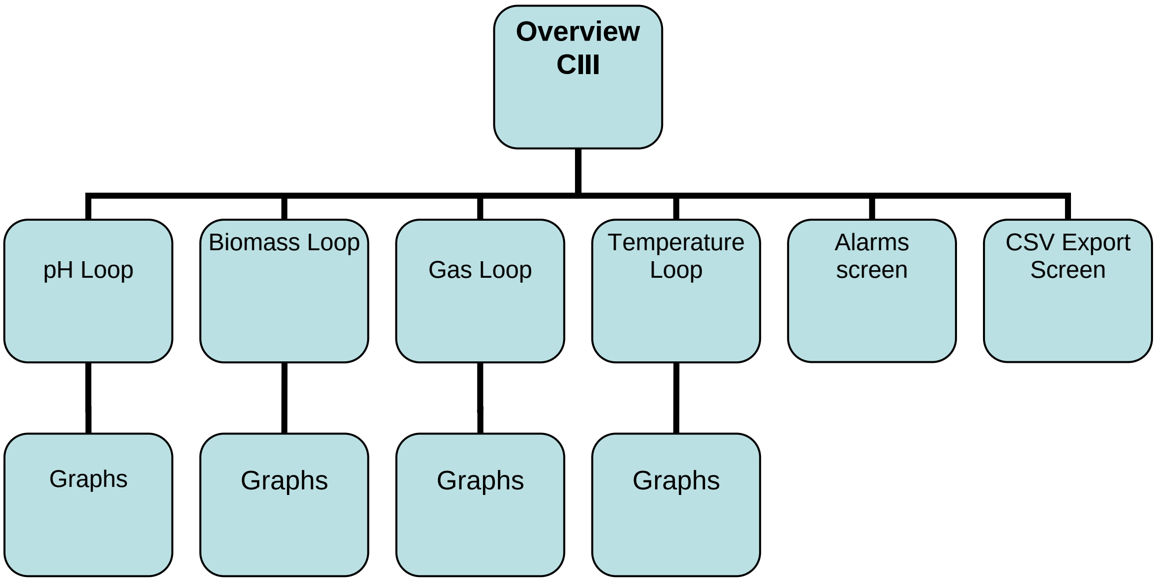

Figure 3-1: Interface architecture

The HMI will allow the user to interact with the PLC. Through the HMI the user can check and monitor the system operation, furthermore the user should be able to operate the compartment from it.

Figure *3-1* shows the general structure of the different screens that will appear. These can be manipulated by the user in order to interact with the automation and control system. This map establishes the logical relations among the screens. Therefore, following Figure *3-2*, the main screen will show an overview of the complete system. From there, the user will be able to navigate to the screens of second level that represent the different loops in the CIII: pH, Liquid, Gas and Temperature. From these screens the user will be able to open graphs showing the history values of the different variables (pH, Temperature, Pressure, level, liquid analysers, etc). Furthermore, the user will be able to open the common Alarms and Export Data screens.

3.2 Overview of the complete system screen

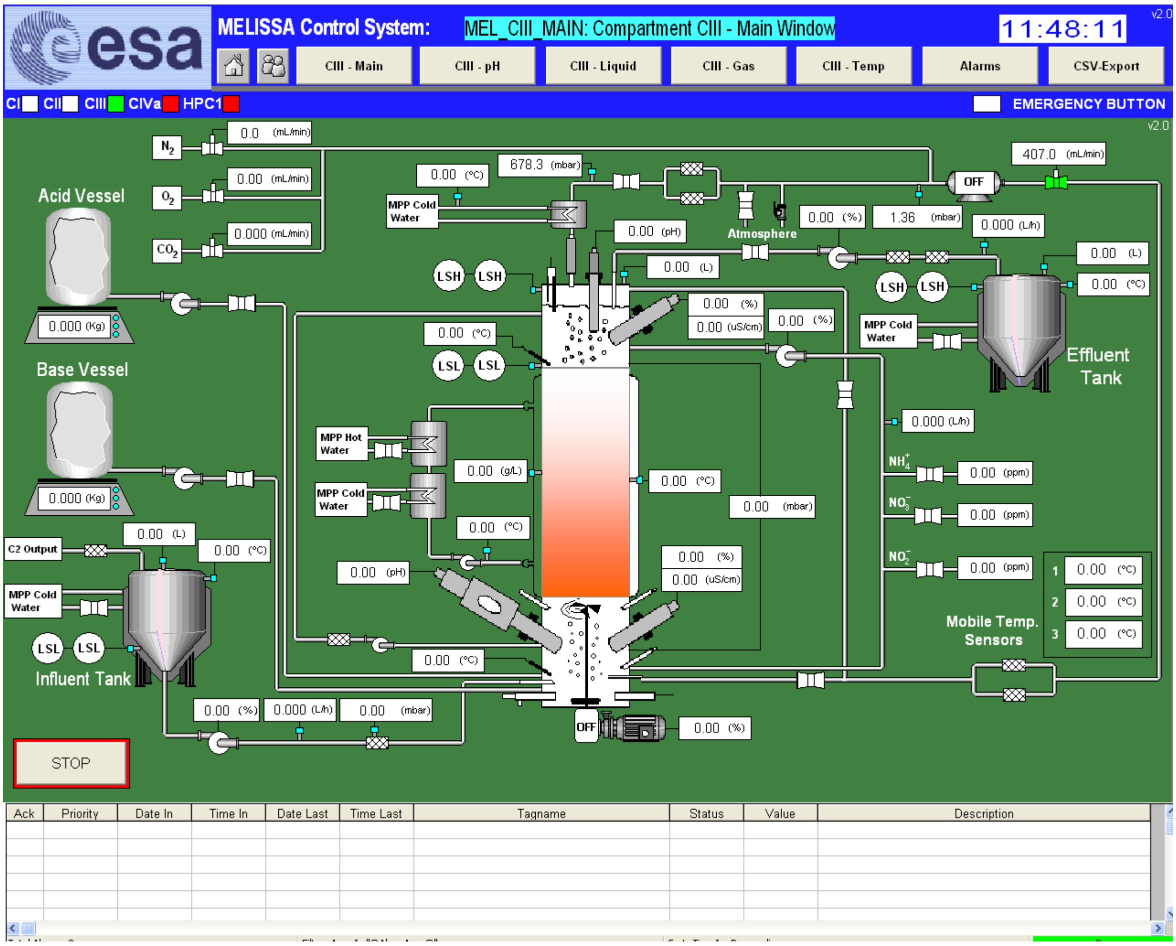

Figure 3-2: CIII Main Screen

To have a general overview of the Compartment CIII, a general schematic will appear in the computer display when user opens the CIII system. The diagram that represents the overview of the system will be something similar as shown in Figure *3-2*. From this schematic user could call the other screens (pH, Liquid, Gas and Temperature). For instance, if the user calls the pH screen, a diagram of this unit will come into view and its instrumentation (valves, pumps, tanks, etc) can be distinguished as well as the different values of the variables that allow controlling it. Moreover, the screen will have an STOP button in order to stop regulation for all loops. Pressing it all control loop outputs will set to 0. To restore the automatic regulation (AUTO mode), user must navigate to every display and change it manually.

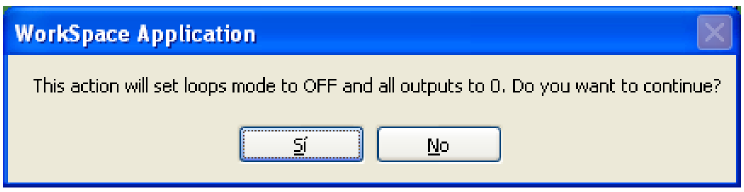

Figure 3-3: CIII Stop Button Dialogue

The overview screen will also show, if user activates it, the on-line value of the most important parameters of CIII when it is operating to check if the system works accurately as well as the status of the actuators. These parameters are shown in Table 3-1.

3.2.1 Tag definition

The screen will display the following tags:

Tag Name	Description	Type
SV_3001_01_FB	Temperature control valve	2-way valve
TT_3001_01	Influent tank temperature	Analogue indicator
LSL_3002_01	Influent tank low level switch	Digital indicator
LSL_3002_02	Influent tank low level switch	Digital indicator
LT_3002_01	Influent tank level transmitter	Analogue indicator
PP_3003_01_MV1	Feeding pump	Pump animated
PP_3003_01_MV2	Speed of feeding pump	Analogue indicator
PP_3003_01_MV3	Rotation direction of feeding pump	Row indicator
FT_3003_01	Feeding flow transmitter	Analogue indicator
PT_3003_01	Feeding pressure	Analogue indicator
BLE_3004_01_MV1	Blender	Pump animated
BLE_3004_01	Blender speed	Analogue indicator
CL3004_Emer_Button_01	Emergency button	Digital indicator
CP_3005_01_MV	Circulation pump	Pump animated
SV_3005_02_FB	Heat exchanger valve (HOT)	2-way valve animated
SV_3005_01_FB	Heat exchanger valve (COLD)	2-way valve animated
TT_3005_02	Reactor jacket temperature	Analogue indicator
TT_3005_01	Bioreactor temperature (middle position)	Analogue indicator
TT_3005_03	Bioreactor temperature (top position)	Analogue indicator
TT_3005_04	Bioreactor temperature (Bottom position)	Analogue indicator
LSH_3006_01	Bioreactor High level switch	Digital indicator
LSH_3006_02	Bioreactor High level switch	Digital indicator
LSL_3006_01	Bioreactor Low level switch	Digital indicator
LSL_3006_02	Bioreactor Low level switch	Digital indicator
LT_3006_01	Bioreactor level	Analogue indicator
DPT_3007_01	Bioreactor differential pressure	Analogue indicator
PT_3007_01	Bioreactor pressure	Analogue indicator
PP_3008_01_MV	Acid pump	Pump animated
PP_3008_02_MV	Base pump	Pump animated
AT_3008_01	pH sensor	Analogue indicator
AT_3008_02	pH sensor	Analogue indicator
WIT_3008_01	Acid bottle weight	Analogue indicator
WIT_3008_02	Base bottle weight	Analogue indicator
SV_3008_01_FB	Acid valve	2-way valve
SV_3008_02_FB	Base valve	2-way valve
FQRC_3008_01	CO2 flow transmitter	Analogue indicator
AT_3009_01	Dissolved O2 (bottom position)	Analogue indicator
AT_3009_02	Dissolved O2 (top position)	Analogue indicator
FQRC_3009_01	O2 flow transmitter	Analogue indicator
AT_3010_01	Conductivity sensor (bottom)	Analogue indicator
AT_3010_02	Conductivity sensor (top)	Analogue indicator
GC_3011_01_MV	Gas compressor	Compressor animated
FQRC_3011_01_SP	N2 flow transmitter	Analogue indicator
FQRC_3011_02	Mix flow transmitter	Analogue indicator
PT_3011_01	Pressure in Gas loop	Analogue indicator
SV_3011_01_FB	Reactor venting valve	2-way valve animated
SV_3011_02_FB	Gas exhaust valve	2-way valve animated
TT_3012_01	Air vent cold water temperature	Analogue indicator
SV_3013_01_FB	NH4 sampling valve	2-way valve animated
SV_3013_02_FB	NO3 sampling valve	2-way valve animated
SV_3013_03_FB	NO2 sampling valve	2-way valve animated
AT_3013_01	NH4 Analyser	Analogue indicator
AT_3013_02	NO3 Analyser	Analogue indicator
AT_3013_03	NO2 Analyser	Analogue indicator

Tag Name	Description	Type
AT_3014_01	Biomass sensor	Analogue indicator
PP_3015_01_MV	Backwashing pump	Pump animated
SV_3011_03_FB	Gas introduction valve	2-way valve animated
SV_3016_01_FB	Gas introduction valve	2-way valve animated
FT_3017_01	Recirculation flow	Analogue indicator
PP_3017_01_MV1	Pump	Pump animated
PP_3017_01_MV2	Pump Speed (%)	Analogue Indicator
PP_3017_01_MV3	Rotation direction of recirculation pump	Row indicator
FT_3018_01	Harvest flow sensor	Analogue indicator
PP_3018_01_MV1	Pump	Pump animated
PP_3018_01_MV2	Pump Speed (%)	Analogue Indicator
PP_3018_01_MV3	Rotation direction of effluent pump	Row indicator
SV_3018_01_FB	Reactor liquid outlet valve	2-way valve animated
SV_3020_01_FB	Temperature control valve	2-way valve animated
TT_3020_01	Effluent tank temperature	Analogue indicator
LSH_3021_01	Effluent high level switch	Digital indicator
LSH_3021_02	Effluent high level switch	Digital indicator
LT_3021_01	Effluent level	Analogue indicator
TT_3023_01	Mobile Temperature used for sterilisation	Analogue indicator
TT_3023_02	Mobile Temperature used for sterilisation	Analogue indicator
TT_3023_03	Mobile Temperature used for sterilisation	Analogue indicator

Table 3-1 Tags of the CIII system main screen

3.2.2 Alarm definition

The following alarms are linked with the operation of the CIII main screen.

TAG NAME	Description	HMI Address
LT_3002_01_AH	LT_3002_01_HIGHALARM	000057
LT_3002_01_AHH	LT_3002_01_VERYHIGHALARM	000058
LT_3002_01_AL	LT_3002_01_LOWALARM	000241
LT_3002_01_ALL	LT_3002_01_VERYLOWALARM	000059
LT_3002_01_ERR	LT_3002_01_BROKENWIRE	000060
FT_3003_01_AH	FT_3003_01_HIGHALARM	000063
FT_3003_01_AHH	FT_3003_01_VERYHIGHALARM	000064
FT_3003_01_AL	FT_3003_01_LOWALARM	000065
FT_3003_01_ALL	FT_3003_01_VERYLOWALARM	000066
FT_3003_01_ERR	FT_3003_01_BROKENWIRE	000067
PT_3003_01_AH	PT_3003_01_HIGHALARM	000228
PT_3003_01_AHH	PT_3003_01_VERYHIGHALARM	000229
PT_3003_01_AL	PT_3003_01_LOWALARM	000230
PT_3003_01_ALL	PT_3003_01_VERYLOWALARM	000231
PT_3003_01_ERR	PT_3003_01_BROKENWIRE	000068
BLE_3004_01_A	Set if blender ON and Bioreactor is empty in manual mode (To be discussed with MPP)	000070
BLE_3004_01_ERR	BLE_3004_01_BROKENWIRE	000251
LT_3006_01_ERR	LT_3006_01_BROKENWIRE	000250
LT_3006_01_AHH	LT_3006_01_VERYHIGHALARM	000088
LT_3006_01_ALL	LT_3006_01_VERYLOWALARM	000089
LT_3006_01_AH	LT_3006_01_HIGHALARM	000243
LT_3006_01_AL	LT_3006_01_LOWALARM	000244
AT_3010_01_AH	AT_3010_01_HIGHALARM	000131
AT_3010_01_AHH	AT_3010_01_VERYHIGHALARM	000132
AT_3010_01_AL	AT_3010_01_LOWALARM	000133
AT_3010_01_ALL	AT_3010_01_VERYLOWALARM	000134
AT_3010_01_ERR	AT_3010_01_BROKENWIRE	000135
AT_3010_02_AH	AT_3010_02_HIGHALARM	000136

TAG NAME	Description	HMI Address
AT_3010_02_AHH	AT_3010_02_VERYHIGHALARM	000137
AT_3010_02_AL	AT_3010_02_LOWALARM	000138
AT_3010_02_ALL	AT_3010_02_VERYLOWALARM	000139
AT_3010_02_ERR	AT_3010_02_BROKENWIRE	000140
SV_3013_01_ERR	SV_3013_01__ALARM	000163
SV_3013_02_ERR	SV_3013_02__ALARM	000164
SV_3013_03_ERR	SV_3013_03__ALARM	000165
AT_3013_01_H	AT_3013_01_HIGHALARM	000166
AT_3013_01_HH	AT_3013_01_VERYHIGHALARM	000167
AT_3013_01_L	AT_3013_01_LOWALARM	000168
AT_3013_01_LL	AT_3013_01_VERYLOWALARM	000169
AT_3013_02_H	AT_3013_02_HIGHALARM	000170
AT_3013_02_HH	AT_3013_02_VERYHIGHALARM	000171
AT_3013_02_L	AT_3013_02_LOWALARM	000172
AT_3013_02_LL	AT_3013_02_VERYLOWALARM	000173
AT_3013_03_H	AT_3013_03_HIGHALARM	000174
AT_3013_03_HH	AT_3013_03_VERYHIGHALARM	000175
AT_3013_03_L	AT_3013_03_LOWALARM	000176
AT_3013_03_LL	AT_3013_03_VERYLOWALARM	000177
AT_3013_01_ERR	AT_3013_01_BROKENWIRE	000178
AT_3013_02_ERR	AT_3013_01_BROKENWIRE	000179
AT_3013_03_ERR	AT_3013_01_BROKENWIRE	000180
AT_3014_01_H	AT_3014_01_HIGHALARM	000182
AT_3014_01_HH	AT_3014_01_VERYHIGHALARM	000183
AT_3014_01_L	AT_3014_01_LOWALARM	000184
AT_3014_01_LL	AT_3014_01_VERYLOWALARM	000185
AT_3014_01_ERR	AT_3014_01_BROKENWIRE	000186
FT_3017_01_AH	FT_3017_01_HIGHALARM	000194
FT_3017_01_AHH	FT_3017_01_VERYHIGHALARM	000195
FT_3017_01_AL	FT_3017_01_LOWALARM	000196
FT_3017_01_ALL	FT_3017_01_VERYLOWALARM	000197
FT_3017_01_ERR	FT_3017_01_BROKENWIRE	000198
FT_3018_01_AH	FT_3018_01_HIGHALARM	000201
FT_3018_01_AHH	FT_3018_01_VERYHIGHALARM	000202
FT_3018_01_AL	FT_3018_01_LOWALARM	000203
FT_3018_01_ALL	FT_3018_01_VERYLOWALARM	000204
FT_3018_01_ERR	FT_3018_01_BROKENWIRE	000205
SV_3018_01_ERR	SV_3018_01_ALARM	000206
LT_3021_01_AHH	LT_3021_01_VERYHIGHALARM	000214
LT_3021_01_AH	LT_3021_01_HIGHALARM	000248
LT_3021_01_AL	LT_3021_01_LOWALARM	000215
LT_3021_01_ALL	LT_3021_01_VERYLOWALARM	000216
LT_3021_01_ERR	LT_3021_01_BROKENWIRE	000217
DPT_3007_01_AH	DPT_3007_01_HIGHALARM	000090
DPT_3007_01_AHH	DPT_3007_01_VERYHIGHALARM	000091
DPT_3007_01_AL	DPT_3007_01_LOWALARM	000092
DPT_3007_01_ALL	DPT_3007_01_VERYLOWALARM	000093
DPT_3007_01_ERR	DPT_3007_01_BROKENWIRE	000094
PT_3007_01_AH	PT_3007_01_HIGHALARM	000095
PT_3007_01_AHH	PT_3007_01_VERYHIGHALARM	000096
PT_3007_01_AL	PT_3007_01_LOWALARM	000097
PT_3007_01_ALL	PT_3007_01_VERYLOWALARM	000098
PT_3007_01_ERR	PT_3007_01_BROKENWIRE	000099
AT_3009_01_AH	AT_3009_01_HIGHALARM	000120
AT_3009_01_AHH	AT_3009_01_VERYHIGHALARM	000121
AT_3009_01_AL	AT_3009_01_LOWALARM	000122
AT_3009_01_ALL	AT_3009_01_VERYLOWALARM	000123

TAG NAME	Description	HMI Address
AT_3009_01_ERR	AT_3009_01_BROKENWIRE	000124
AT_3009_02_AH	AT_3009_02_HIGHALARM	000125
AT_3009_02_AHH	AT_3009_02_VERYHIGHALARM	000126
AT_3009_02_AL	AT_3009_02_LOWALARM	000127
AT_3009_02_ALL	AT_3009_02_VERYLOWALARM	000128
AT_3009_02_ERR	AT_3009_02_BROKENWIRE	000129
FQRC_3009_01_AH	FQRC_3009_01_HIGHALARM	000257
FQRC_3009_01_AHH	FQRC_3009_01_VERYHIGHALARM	000258
FQRC_3009_01_AL	FQRC_3009_01_LOWALARM	000259
FQRC_3009_01_ALL	FQRC_3009_01_VERYLOWALARM	000260
FQRC_3009_01_ERR	FQRC_3009_01_BROKENWIRE	000130
PT_3011_01_AH	PT_3011_01_HIGHALARM	000144
PT_3011_01_AHH	PT_3011_01_VERYHIGHALARM	000145
PT_3011_01_AL	PT_3011_01_LOWALARM	000146
PT_3011_01_ALL	PT_3011_01_VERYLOWALARM	000147
FQRC_3011_01_AH	FQRC_3011_01_HIGHALARM	000263
FQRC_3011_01_AHH	FQRC_3011_01_VERYHIGHALARM	000264
FQRC_3011_01_AL	FQRC_3011_01_LOWALARM	000265
FQRC_3011_01_ALL	FQRC_3011_01_VERYLOWALARM	000266
FQRC_3011_01_ERR	FQRC_3011_01_BROKENWIRE	000148
FQRC_3011_02_AH	FQRC_3011_02_HIGHALARM	000267
FQRC_3011_02_AHH	FQRC_3011_02_VERYHIGHALARM	000268
FQRC_3011_02_AL	FQRC_3011_02_LOWALARM	000269
FQRC_3011_02_ALL	FQRC_3011_02_VERYLOWALARM	000270
FQRC_3011_02_ERR	FQRC_3011_02_BROKENWIRE	000149
PT_3011_01_ERR	PT_3011_01_BROKENWIRE	000150
SV_3011_01_A	SV_3011_01_NOFEEDBACK	000151
SV_3011_02_A	SV_3011_02_NOFEEDBACK	000152
SV_3011_03_A	SV_3011_02_NOFEEDBACK	000190
TT_3012_01_AH	TT_3012_01_HIGHALARM	000153
TT_3012_01_AHH	TT_3012_01_VERYHIGHALARM	000154
TT_3012_01_AL	TT_3012_01_LOWALARM	000155
TT_3012_01_ALL	TT_3012_01_VERYLOWALARM	000156
TT_3012_01_ERR	TT_3012_01_BROKENWIRE	000232
SV_3016_01_A	SV_3016_01_ALARM	000191
FQRC_3008_01_AH	FQRC_3008_01_HIGHALARM	000253
FQRC_3008_01_AHH	FQRC_3008_01_VERYHIGHALARM	000254
FQRC_3008_01_AL	FQRC_3008_01_LOWALARM	000255
FQRC_3008_01_ALL	FQRC_3008_01_VERYLOWALARM	000256
FQRC_3008_01_ERR	FQRC_3008_01_BROKENWIRE	000119
SV_3001_01_A	SV_3001_01_ALARM	000051
TT_3001_01_AH	TT_3001_01_HIGHALARM	000052
TT_3001_01_AHH	TT_3001_01_VERYHIGHALARM	000053
TT_3001_01_AL	TT_3001_01_LOWALARM	000054
TT_3001_01_ALL	TT_3001_01_VERYLOWALARM	000055
TT_3001_01_ERR	TT_3001_01_BROKENWIRE	000056
SV_3005_02_A	SV_3005_02_ALARM	000073
SV_3005_01_A	SV_3005_01_ALARM	000075
TT_3005_02_AH	TT_3005_02_HIGHALARM	000076
TT_3005_02_AHH	TT_3005_02_VERYHIGHALARM	000077
TT_3005_02_AL	TT_3005_02_LOWALARM	000078
TT_3005_02_ALL	TT_3005_02_VERYLOWALARM	000079
TT_3005_02_ERR	TT_3005_02_BROKENWIRE	000080
TT_3005_01_AH	TT_3005_01_HIGHALARM	000081
TT_3005_01_AHH	TT_3005_01_VERYHIGHALARM	000082
TT_3005_01_AL	TT_3005_01_LOWALARM	000083
TT_3005_01_ALL	TT_3005_01_VERYLOWALARM	000084

TAG NAME	Description	HMI Address
TT_3005_01_ERR	TT_3005_01_BROKENWIRE	000085
TT_3005_03_ERR	TT_3005_03_BROKENWIRE	000086
TT_3005_04_ERR	TT_3005_04_BROKENWIRE	000087
TT_3020_01_AH	TT_3020_01_HIGHALARM	000208
TT_3020_01_AHH	TT_3020_01_VERYHIGHALARM	000209
TT_3020_01_AL	TT_3020_01_LOWALARM	000210
TT_3020_01_ALL	TT_3020_01_VERYLOWALARM	000211
TT_3020_01_ERR	TT_3020_01_BROKENWIRE	000212
SV_3020_01_ERR	SV_3020_01_ALARM	000213
CL3008_pH_AH	CL3008_pH_HIGHALARM	000103
CL3008_pH_AHH	CL3008_pH_VERYHIGHALARM	000104
CL3008_pH_AL	CL3008_pH_LOWALARM	000105
CL3008_pH_ALL	CL3008_pH_VERYLOWALARM	000106
WIT_3008_01_AL	WIT_3008_01_LOWLEVELALARM	000107
WIT_3008_01_ALL	WIT_3008_01_VERYLOWLEVELALARM	000108
WIT_3008_02_AL	WIT_3008_02_LOWLEVELALARM	000109
WIT_3008_02_ALL	WIT_3008_02_VERYLOWLEVELALARM	000110
SV_3008_01_ERR	SV_3008_01_NOFEEDBACK	000111
SV_3008_02_ERR	SV_3008_02_NOFEEDBACK	000112
AT_3008_01_ERR	AT_3008_01_BROKENWIRE	000113
TT_3008_01_ERR	TT_3008_01_BROKENWIRE	000114
AT_3008_02_ERR	AT_3008_02_BROKENWIRE	000115
TT_3008_02_ERR	TT_3008_02_BROKENWIRE	000116
WIT_3008_01_ERR	WIT_3008_01_BROKENWIRE	000117
WIT_3008_02_ERR	WIT_3008_02_BROKENWIRE	000118

Table 3-2: Alarm tags of the Main Screen of CIII system

3.3 Liquid control screen

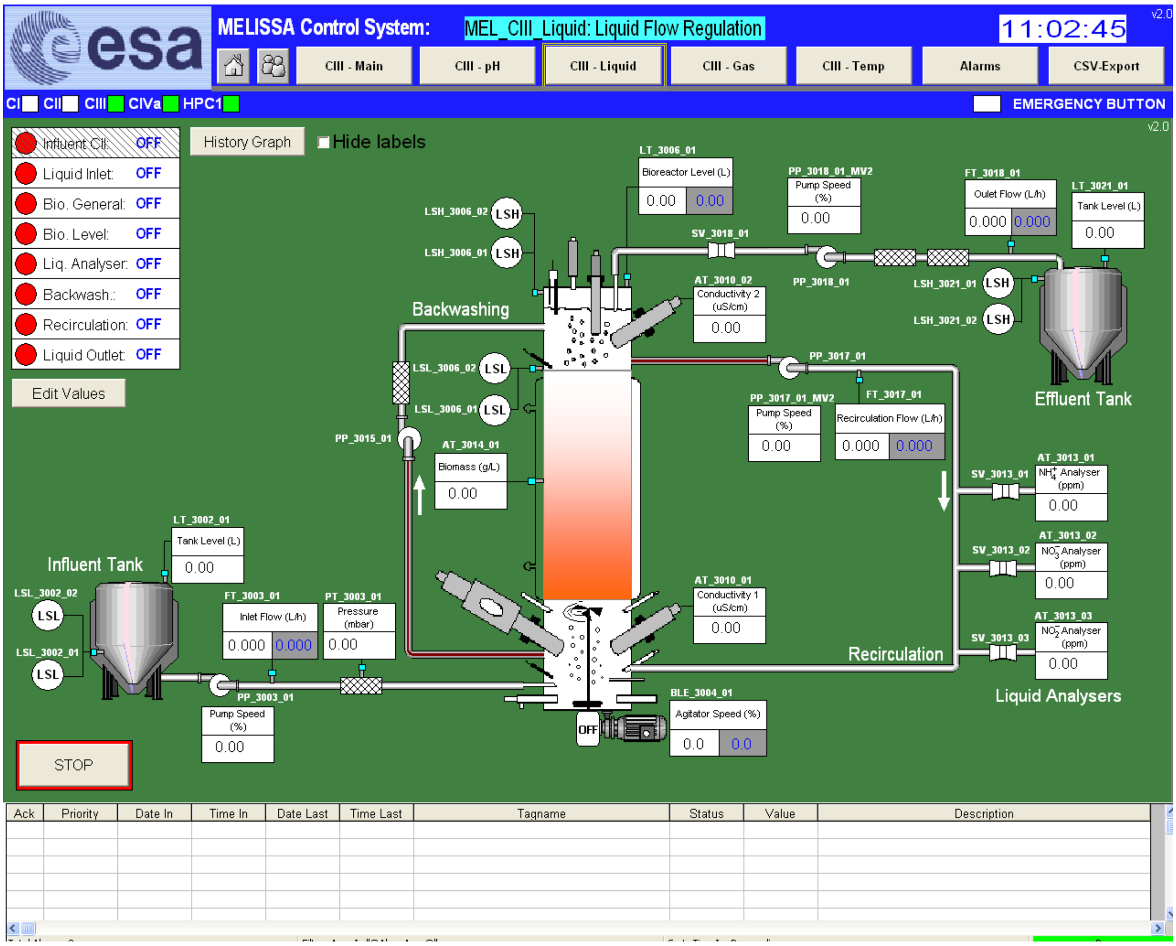

Figure 3-4: Main objects in CIII Liquid Screen

The diagram that represents the Liquid control of the system will be something similar as shown in *Figure 3-4*.

Navigating this screen the user will be able to:

- Monitor the measurements of the reactor's biomass concentration, the liquid level of the reactor, the level of input and output tanks, the lectures of the liquid analysers, the speed of the reactor agitator, the liquid conductivity in the reactor and the input, output and recirculation flow rates.
- Modify the Set-Points of Bioreactor Level, input flow, output flow, recirculation flow and agitator speed.
- Monitor the emergency button indicator. Background colour switch to red when one of the Emergency buttons is pushed.
- Display the history graph clicking on the History graph command button.
- Hide labels selecting the "Hide Labels" check box.
- Stop all control loops implemented on the screen clicking "Stop" command button.
- Edit manual values clicking the "Edit Values" command button. In the Manual Values window user can switch between six submenus:
    - Inlet Liquid Manual Mode: Allows activating the pump PP_3003_01 and the manual value SP.
    - Bioreactor Manual Mode: Allows activating the agitator BLE_3004_01 and selecting the manual value SP.
    - Backwashing Manual Mode: Allows activating the pump PP_3015_01 and selecting the backwashing duration in seconds.

- Liquid Recirculation Manual Mode: Allows activating the pump PP_3017_01 and the manual value SP.
- Outlet Liquid Manual Mode: Allows activating the pump PP_3018_01, the manual value SP and furthermore allows activating the SV_3018_01 effluent liquid valve.
- Liquid Analyser Manual Mode: Allows activating the input liquid valves SV_3016_01, SV_3016_02 and SV_3013_03.

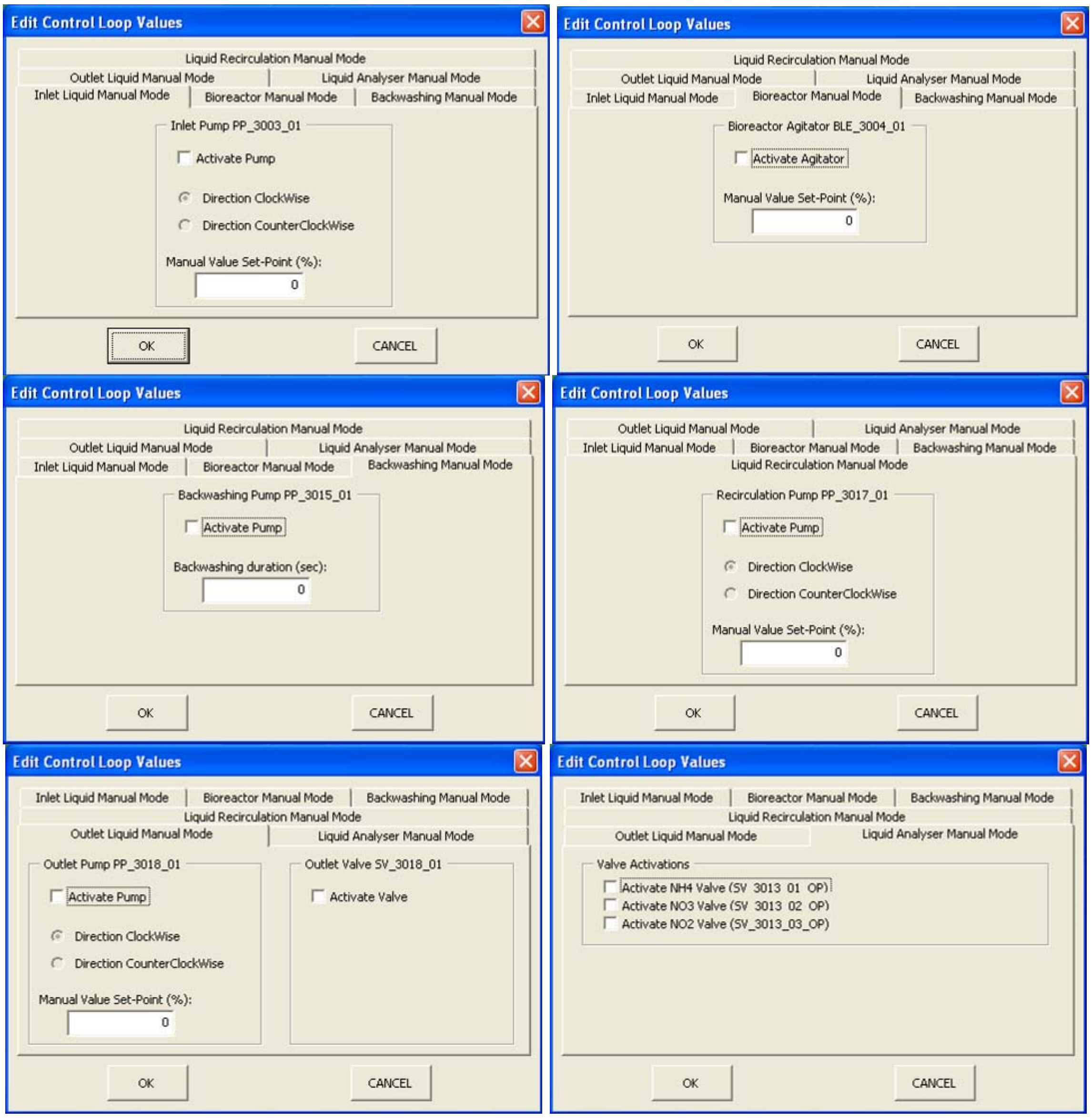

Figure 3-5: Edit Values Dialog

3.3.1 Control Loops

The following control loops are implemented on the screen:

Tag Name	Description	HMI address
CL3000_ControlLoop_Mode	Influent Feeding Mode	400230
CL3003_ControlLoop_Mode	Inlet Liquid Mode	400232
CL3004_ControlLoop_Mode	Bioreactor General Mode	400233
CL3006_ControlLoop_Mode	Bioreactor Level Mode	400245
CL3013_ControlLoop_Mode	Liquid Analyser Loop Mode	400238
CL3015_ControlLoop_Mode	Backwashing loop Mode	400239

Tag Name	Description	HMI address
CL3017_ControlLoop_Mode	Liquid Recirculation loop Mode	400241
CL3018_ControlLoop_Mode	Outlet Liquid loop Mode	400242

Table 3-3 Control Loops of the Liquid loop of CIII system

3.3.2 Tag definition

This screen will contain the following tags (user inputs are highlighted in green):

Tag Name	Description	Type
LSL_3002_01	Influent tank low level switch	Digital indicator
LSL_3002_02	Influent tank low level switch	Digital indicator
LT_3002_01	Influent tank level transmitter	Analogue indicator
PP_3003_01_OP	Feeding pump Activation in Manual Mode	Button
PP_3003_01_SP	Feeding pump SP	SP User Input
PP_3003_01_MV1	Feeding pump	Pump animated
PP_3003_01_MV2	Speed of feeding pump	Analogue indicator
PP_3003_01_MV3	Rotation direction of feeding pump	Row indicator
FT_3003_01	Feeding flow transmitter	Analogue indicator
FT_3003_01_SP	Feeding flow SP	SP User Input
PT_3003_01	Feeding pressure	Analogue indicator
BLE_3004_01_OP	Blender Activation in Manual Mode	Button
BLE_3004_01_SP	Blender SP	SP User Input
BLE_3004_01_MV1	Blender Status	Pump animated
BLE_3004_01_MV2	Blender speed SP	Analogue indicator
BLE_3004_01	Blender speed	Analogue indicator
CL3004_Emer_Button_01	Emergency button	Digital indicator
CL3006_BioreactorLevel_SP	Bioreactor Level SP	SP User Input
LSH_3006_01	Bioreactor High level switch	Digital indicator
LSH_3006_02	Bioreactor High level switch	Digital indicator
LSL_3006_01	Bioreactor Low level switch	Digital indicator
LSL_3006_02	Bioreactor Low level switch	Digital indicator
LT_3006_01	Bioreactor level	Analogue indicator
AT_3010_01	Conductivity sensor (bottom)	Analogue indicator
AT_3010_02	Conductivity sensor (top)	Analogue indicator
SV_3013_01_FB	NH_4^+ sampling valve	2-way valve animated
SV_3013_02_FB	NO_3^- sampling valve	2-way valve animated
SV_3013_03_FB	NO_2^- sampling valve	2-way valve animated
SV_3013_01_OP	NH_4^+ sampling valve	Button
SV_3013_02_OP	NO_3^- sampling valve	Button
SV_3013_03_OP	NO_2^- sampling valve	Button
AT_3013_01	NH_4^+ Analyser	Analogue indicator
AT_3013_02	NO_3^- Analyser	Analogue indicator
AT_3013_03	NO_2^- Analyser	Analogue indicator
AT_3014_01	Biomass sensor	Analogue indicator
PP_3015_01_OP	Pump Activation in Manual Mode	Button
PP_3015_01_MV	Backwashing pump	Pump animated
CL3015_BACKWASHING_DURATION	Backwashing duration	User Input
PP_3017_01_OP	Pump Activation in Manual Mode	Button
PP_3017_01_SP	Recirculation pump SP	SP User Input
CL3017_Flow_SP	Recirculation flow SP	SP User Input
FT_3017_01	Recirculation flow	Analogue indicator
PP_3017_01_MV1	Pump status	Pump animated

Tag Name	Description	Type
PP_3017_01_MV2	Pump speed	Analogue indicator
PP_3017_01_MV3	Pump rotation direction	Row indicator
PP_3018_01_OP	Pump Activation in Manual Mode	Button
PP_3018_01_SP	Outlet pump SP	SP User Input
CL3018_Flow_SP	Outlet flow SP	SP User Input
FT_3018_01	Harvest flow sensor	Analogue indicator
PP_3018_01_MV1	Pump	Pump animated
PP_3018_01_MV2	Pump speed	Analogue indicator
PP_3018_01_MV3	Pump rotation direction	Pump animated
SV_3018_01_FB	Reactor liquid outlet valve	2-way valve animated
SV_3018_01_OP	Reactor liquid outlet valve	Button
LSH_3021_01	Effluent high level switch	Digital indicator
LSH_3021_02	Effluent high level switch	Digital indicator
LT_3021_01	Effluent level	Analogue indicator

Table 3-4 Tags of the Liquid loop of CIII system

3.3.3 Alarm definition

The following alarms are linked with the operation of the liquid control screen.

TAG NAME	Description	HMI Address
LT_3002_01_AH	LT_3002_01_HIGHALARM	000057
LT_3002_01_AHH	LT_3002_01_VERYHIGHALARM	000058
LT_3002_01_AL	LT_3002_01_LOWALARM	000241
LT_3002_01_ALL	LT_3002_01_VERYLOWALARM	000059
LT_3002_01_ERR	LT_3002_01_BROKENWIRE	000060
FT_3003_01_AH	FT_3003_01_HIGHALARM	000063
FT_3003_01_AHH	FT_3003_01_VERYHIGHALARM	000064
FT_3003_01_AL	FT_3003_01_LOWALARM	000065
FT_3003_01_ALL	FT_3003_01_VERYLOWALARM	000066
FT_3003_01_ERR	FT_3003_01_BROKENWIRE	000067
PT_3003_01_AH	PT_3003_01_HIGHALARM	000228
PT_3003_01_AHH	PT_3003_01_VERYHIGHALARM	000229
PT_3003_01_AL	PT_3003_01_LOWALARM	000230
PT_3003_01_ALL	PT_3003_01_VERYLOWALARM	000231
PT_3003_01_ERR	PT_3003_01_BROKENWIRE	000068
BLE_3004_01_A	Set if blender ON and Bioreactor is empty in manual mode (To be discussed with MPP)	000070
BLE_3004_01_ERR	BLE_3004_01_BROKENWIRE	000251
LT_3006_01_ERR	LT_3006_01_BROKENWIRE	000250
LT_3006_01_AHH	LT_3006_01_VERYHIGHALARM	000088
LT_3006_01_ALL	LT_3006_01_VERYLOWALARM	000089
LT_3006_01_AH	LT_3006_01_HIGHALARM	000243
LT_3006_01_AL	LT_3006_01_LOWALARM	000244
AT_3010_01_AH	AT_3010_01_HIGHALARM	000131
AT_3010_01_AHH	AT_3010_01_VERYHIGHALARM	000132
AT_3010_01_AL	AT_3010_01_LOWALARM	000133
AT_3010_01_ALL	AT_3010_01_VERYLOWALARM	000134
AT_3010_01_ERR	AT_3010_01_BROKENWIRE	000135
AT_3010_02_AH	AT_3010_02_HIGHALARM	000136
AT_3010_02_AHH	AT_3010_02_VERYHIGHALARM	000137
AT_3010_02_AL	AT_3010_02_LOWALARM	000138
AT_3010_02_ALL	AT_3010_02_VERYLOWALARM	000139
AT_3010_02_ERR	AT_3010_02_BROKENWIRE	000140
SV_3013_01_ERR	SV_3013_01__ALARM	000163
SV_3013_02_ERR	SV_3013_02__ALARM	000164
SV_3013_03_ERR	SV_3013_03__ALARM	000165

TAG NAME	Description	HMI Address
AT_3013_01_H	AT_3013_01_HIGHALARM	000166
AT_3013_01_HH	AT_3013_01_VERYHIGHALARM	000167
AT_3013_01_L	AT_3013_01_LOWALARM	000168
AT_3013_01_LL	AT_3013_01_VERYLOWALARM	000169
AT_3013_02_H	AT_3013_02_HIGHALARM	000170
AT_3013_02_HH	AT_3013_02_VERYHIGHALARM	000171
AT_3013_02_L	AT_3013_02_LOWALARM	000172
AT_3013_02_LL	AT_3013_02_VERYLOWALARM	000173
AT_3013_03_H	AT_3013_03_HIGHALARM	000174
AT_3013_03_HH	AT_3013_03_VERYHIGHALARM	000175
AT_3013_03_L	AT_3013_03_LOWALARM	000176
AT_3013_03_LL	AT_3013_03_VERYLOWALARM	000177
AT_3013_01_ERR	AT_3013_01_BROKENWIRE	000178
AT_3013_02_ERR	AT_3013_01_BROKENWIRE	000179
AT_3013_03_ERR	AT_3013_01_BROKENWIRE	000180
AT_3014_01_H	AT_3014_01_HIGHALARM	000182
AT_3014_01_HH	AT_3014_01_VERYHIGHALARM	000183
AT_3014_01_L	AT_3014_01_LOWALARM	000184
AT_3014_01_LL	AT_3014_01_VERYLOWALARM	000185
AT_3014_01_ERR	AT_3014_01_BROKENWIRE	000186
FT_3017_01_AH	FT_3017_01_HIGHALARM	000194
FT_3017_01_AHH	FT_3017_01_VERYHIGHALARM	000195
FT_3017_01_AL	FT_3017_01_LOWALARM	000196
FT_3017_01_ALL	FT_3017_01_VERYLOWALARM	000197
FT_3017_01_ERR	FT_3017_01_BROKENWIRE	000198
FT_3018_01_AH	FT_3018_01_HIGHALARM	000201
FT_3018_01_AHH	FT_3018_01_VERYHIGHALARM	000202
FT_3018_01_AL	FT_3018_01_LOWALARM	000203
FT_3018_01_ALL	FT_3018_01_VERYLOWALARM	000204
FT_3018_01_ERR	FT_3018_01_BROKENWIRE	000205
SV_3018_01_ERR	SV_3018_01_ALARM	000206
LT_3021_01_AHH	LT_3021_01_VERYHIGHALARM	000214
LT_3021_01_AH	LT_3021_01_HIGHALARM	000248
LT_3021_01_AL	LT_3021_01_LOWALARM	000215
LT_3021_01_ALL	LT_3021_01_VERYLOWALARM	000216
LT_3021_01_ERR	LT_3021_01_BROKENWIRE	000217

Table 3-5 Alarm tags of the Liquid loop of CIII system

3.3.4 History Graph

The following tags are monitored by default when the user access to the History Graph from the Liquid Control screen.

1. AT_3014_01
2. LT_3006_01
3. LT_3021_01

3.4 CIII Gas Loop screen

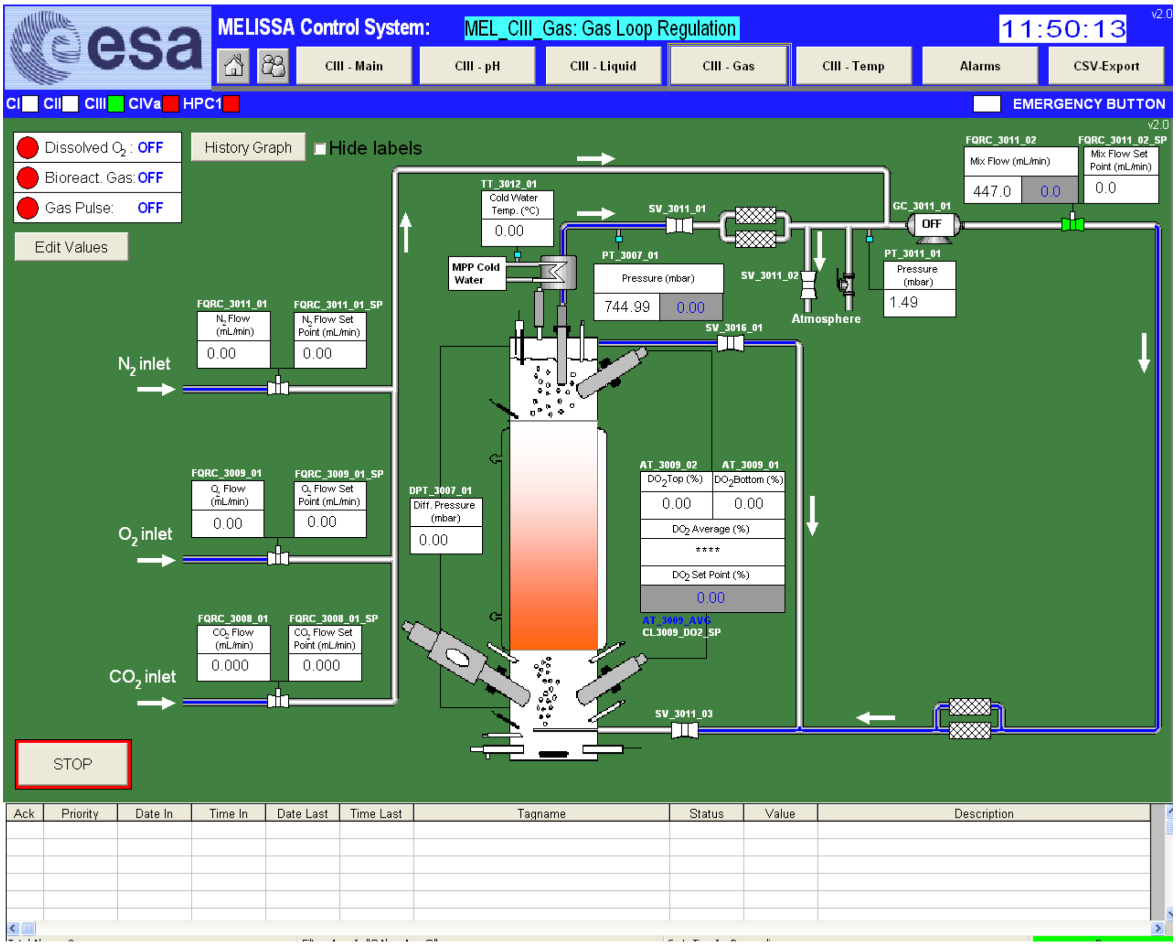

Figure 3-6: Main objects in CIII Gas Screen

The diagram that represents the Gas loop of the system will be something similar as shown in Figure 3-6.

Navigating this screen the user will be able to:

- Monitor the N_2 inlet gas flow, the O_2 inlet gas flow, the CO_2 inlet gas flow, the gas mix flow, the dissolved O_2 concentration and the pressure transmitters.
- Modify the set-points of pressure, DO_2 and gas mix flow.
- Monitor the emergency button indicator. Background colour switch to red when one of the Emergency buttons is pushed.
- Display the history graph clicking on the History graph command button.
- Hide labels selecting “Hide labels” check box.
- Stop all control loops implemented on the screen clicking “Stop” command button.
- Select the DO2 sensor for control clicking over the probe lecture:

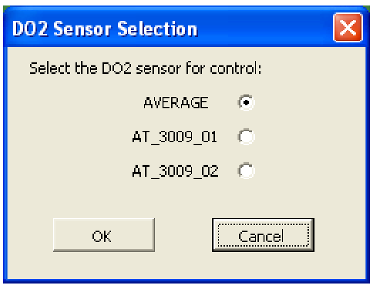

Figure 3-7: Edit Values Dialog

- Edit manual values clicking the “Edit Values” command button. In the Manual Values window user can switch between four submenus:
    - Dissolved O2 Manual Mode: Allows selecting the manual value SP of dissolved O2 flow.
    - Gas Pulse: Allows activating the gas input valve SV_3016_01, selecting the number of gas pulse and choosing the top valve opening/closing time and the bottom valve opening/closing time.
    - Gas Loop Manual Mode: Allows activating the SV_3011_01 reactor venting valve, the SV_3011_02 gas exhaust valve, the SV_3011_03_OP gas input valve, the GC_3011_01 Gas compressor and selecting the manual values SP of N2 flow and gas mix.
    - Gas Loop Auto Mode: Allows resetting the timer of the SV_3011_02 Gas Exhaust Valve, selecting the pressure threshold and reading the opening time, the opening frequency and the date and time of the last timer reset.

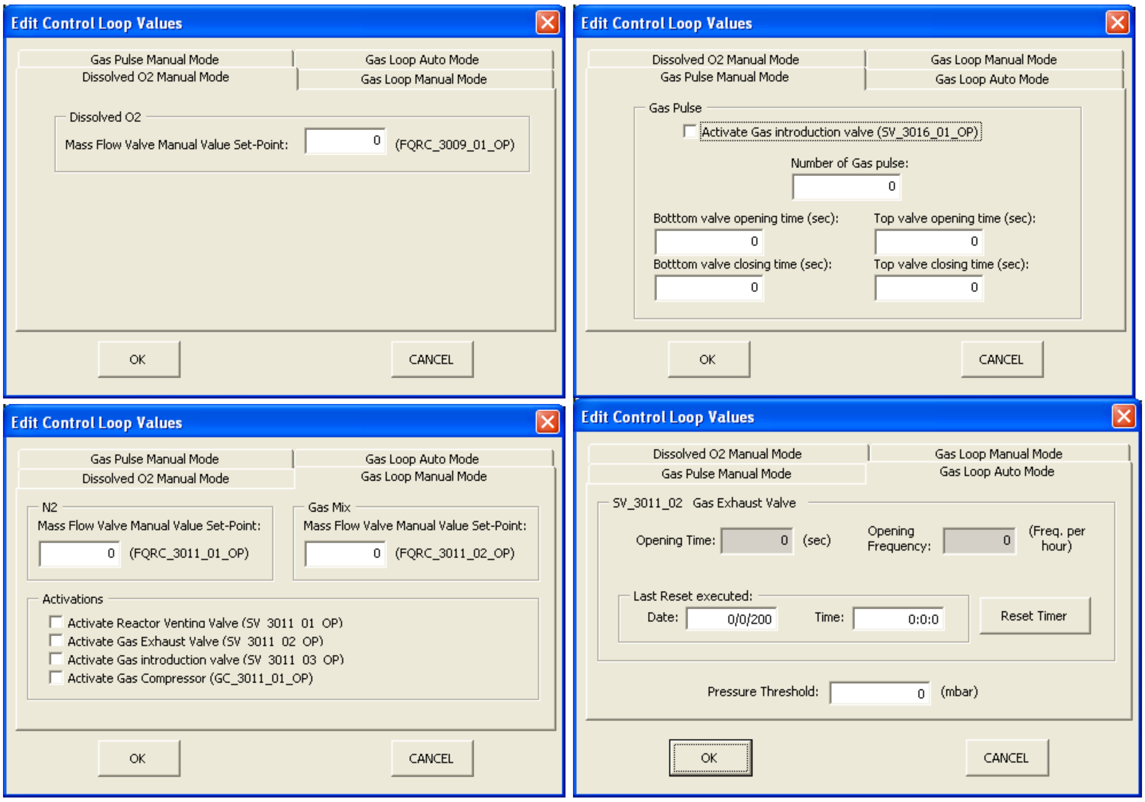

Figure 3-8: Edit Values Dialog

3.4.1 Control Loops

The following control loops are implemented on the screen:

Tag Name	Description	HMI address
CL3009_ControlLoop_Mode	DO2 Mode	400236
CL3011_ControlLoop_Mode	Bioreactor Gas Loop Mode	400237
CL3016_ControlLoop_Mode	Gas pulse loop Mode	400240

Table 3-6 Control Loops of the Gas loop of CIII system

3.4.2 Tag definition

This screen will display the following tags (user inputs are highlighted in green):

Tag Name	Description	Type
DPT_3007_01	Bioreactor differential pressure	Analogue indicator
PT_3007_01	Bioreactor pressure	Analogue indicator
PT_3007_01_SP	PT_3007_01_Set_Point	SP User Input
CL3007_Pressure_Threshold	PT_3007_01_Threshold	User Input
CL3009_DO2_selector	DO2 probe selector	Button
FQRC_3009_01_OP	Mass flow SP in Manual Mode	SP User Input
CL3009_DO2_SP	DO2 SP in automatic mode	SP User Input
AT_3009_01	DO2 transmitter (Bottom)	Analogue indicator
AT_3009_02	DO2 transmitter (TOP)	Analogue indicator
AT_3009_AVERAGE	DO2 Average	Analogue Indicator
FQRC_3009_01	Flow transmitter (O2)	Analogue indicator
FQRC_3009_01_SP	Mass flow SP indicator	Analogue indicator
GC_3011_01_OP	Gas compressor pump Activation in Manual Mode	Button
FQRC_3011_01_OP	N2 Mass flow SP in Manual Mode	SP User Input
FQRC_3011_02_OP	Gas mix Mass flow SP in Manual Mode	SP User Input
CL3011_GasMix_SP	Gas mix SP in automatic mode	SP User Input
SV_3011_01_OP	Valve Activation in Manual Mode	Button
SV_3011_02_OP	Valve Activation in Manual Mode	Button
GC_3011_01_MV	Gas compressor	Compressor animated
SV_3011_Opening_Time	SV_3011_02 Opening Time (s)	Analogue Indicator
SV_3011_02_Second	Date of last reset	Indicator
SV_3011_02_Minute	Date of last reset	Indicator
SV_3011_02_Hour	Date of last reset	Indicator
SV_3011_02_Day	Date of last reset	Indicator
SV_3011_02_Month	Date of last reset	Indicator
SV_3011_02_Year	Date of last reset	Indicator
SV_3011_02_Reset_Timer	Timer Reset	Button
SV_3011_02_Opening_Frequency	SV_3011_02 Opening frequency	Analogue Indicator
FQRC_3011_01_SP	N2 flow transmitter SP indicator	Analogue indicator
FQRC_3011_01	N2 flow transmitter	Analogue indicator
FQRC_3011_02_SP	Mix flow transmitter SP indicator	Analogue indicator
FQRC_3011_02	Mix flow transmitter	Analogue indicator
PT_3011_01	Pressure in Gas loop	Analogue indicator
SV_3011_01_FB	Reactor venting valve	2-way valve animated
SV_3011_02_FB	Gas exhaust valve	2-way valve animated
SV_3011_03_FB	Gas introduction valve	2-way valve animated
TT_3012_01	Air vent cold water temperature	Analogue indicator
SV_3011_03_OP	Valve Activation in Manual Mode	Button
SV_3016_01_OP	Valve Activation in Manual Mode	Button
CL3016_BOTTOM_OPENING_TIME	Oxygen Pulse Bottom Opening Time	User Input
CL3016_BOTTOM_CLOSING_TIME	Oxygen Pulse Bottom Closing Time	User Input
CL3016_TOP_OPENING_TIME	Oxygen Pulse Top Opening Time	User Input
CL3016_TOP_CLOSI NG_TIME	Oxygen Pulse Top Closing Time	User Input
CL3016_OXYGENPULSE_NUMBER	Oxygen Pulse Number	User Input
SV_3016_01_FB	Gas introduction valve	2-way valve animated
CL3004_Emer_Button_01	Emergency button	Digital indicator
FQRC_3008_01	CO2 flow transmitter	Analogue indicator
FQRC_3008_01_SP	CO2 flow transmitter SP indicator	Analogue indicator

Table 3-7 Tags of the Gas loop of CIII system

3.4.3 Alarm definition

The following alarms are linked with the operation of the gas control screen.

TAG NAME	Description	HMI Address
DPT_3007_01_AH	DPT_3007_01_HIGHALARM	000090
DPT_3007_01_AHH	DPT_3007_01_VERYHIGHALARM	000091

TAG NAME	Description	HMI Address
DPT_3007_01_AL	DPT_3007_01_LOWALARM	000092
DPT_3007_01_ALL	DPT_3007_01_VERYLOWALARM	000093
DPT_3007_01_ERR	DPT_3007_01_BROKENWIRE	000094
PT_3007_01_AH	PT_3007_01_HIGHALARM	000095
PT_3007_01_AHH	PT_3007_01_VERYHIGHALARM	000096
PT_3007_01_AL	PT_3007_01_LOWALARM	000097
PT_3007_01_ALL	PT_3007_01_VERYLOWALARM	000098
PT_3007_01_ERR	PT_3007_01_BROKENWIRE	000099
AT_3009_01_AH	AT_3009_01_HIGHALARM	000120
AT_3009_01_AHH	AT_3009_01_VERYHIGHALARM	000121
AT_3009_01_AL	AT_3009_01_LOWALARM	000122
AT_3009_01_ALL	AT_3009_01_VERYLOWALARM	000123
AT_3009_01_ERR	AT_3009_01_BROKENWIRE	000124
AT_3009_02_AH	AT_3009_02_HIGHALARM	000125
AT_3009_02_AHH	AT_3009_02_VERYHIGHALARM	000126
AT_3009_02_AL	AT_3009_02_LOWALARM	000127
AT_3009_02_ALL	AT_3009_02_VERYLOWALARM	000128
AT_3009_02_ERR	AT_3009_02_BROKENWIRE	000129
FQRC_3009_01_AH	FQRC_3009_01_HIGHALARM	000257
FQRC_3009_01_AHH	FQRC_3009_01_VERYHIGHALARM	000258
FQRC_3009_01_AL	FQRC_3009_01_LOWALARM	000259
FQRC_3009_01_ALL	FQRC_3009_01_VERYLOWALARM	000260
FQRC_3009_01_ERR	FQRC_3009_01_BROKENWIRE	000130
PT_3011_01_AH	PT_3011_01_HIGHALARM	000144
PT_3011_01_AHH	PT_3011_01_VERYHIGHALARM	000145
PT_3011_01_AL	PT_3011_01_LOWALARM	000146
PT_3011_01_ALL	PT_3011_01_VERYLOWALARM	000147
FQRC_3011_01_AH	FQRC_3011_01_HIGHALARM	000263
FQRC_3011_01_AHH	FQRC_3011_01_VERYHIGHALARM	000264
FQRC_3011_01_AL	FQRC_3011_01_LOWALARM	000265
FQRC_3011_01_ALL	FQRC_3011_01_VERYLOWALARM	000266
FQRC_3011_01_ERR	FQRC_3011_01_BROKENWIRE	000148
FQRC_3011_02_AH	FQRC_3011_02_HIGHALARM	000267
FQRC_3011_02_AHH	FQRC_3011_02_VERYHIGHALARM	000268
FQRC_3011_02_AL	FQRC_3011_02_LOWALARM	000269
FQRC_3011_02_ALL	FQRC_3011_02_VERYLOWALARM	000270
FQRC_3011_02_ERR	FQRC_3011_02_BROKENWIRE	000149
PT_3011_01_ERR	PT_3011_01_BROKENWIRE	000150
SV_3011_01_A	SV_3011_01_NOFEEDBACK	000151
SV_3011_02_A	SV_3011_02_NOFEEDBACK	000152
SV_3011_03_A	SV_3011_02_NOFEEDBACK	000190
TT_3012_01_AH	TT_3012_01_HIGHALARM	000153
TT_3012_01_AHH	TT_3012_01_VERYHIGHALARM	000154
TT_3012_01_AL	TT_3012_01_LOWALARM	000155
TT_3012_01_ALL	TT_3012_01_VERYLOWALARM	000156
TT_3012_01_ERR	TT_3012_01_BROKENWIRE	000232
SV_3016_01_A	SV_3016_01_ALARM	000191
FQRC_3008_01_AH	FQRC_3008_01_HIGHALARM	000253
FQRC_3008_01_AHH	FQRC_3008_01_VERYHIGHALARM	000254
FQRC_3008_01_AL	FQRC_3008_01_LOWALARM	000255
FQRC_3008_01_ALL	FQRC_3008_01_VERYLOWALARM	000256
FQRC_3008_01_ERR	FQRC_3008_01_BROKENWIRE	000119

Table 3-8 Alarm tags of the Gas loop of CIII system

3.4.4 History Graph

The following tags are monitored by default when the user access to the History Graph from the Gas Control screen.

1. PT_3011_01
2. PT_3007_01
3. FQRC_3011_02

3.5 CIII Temperature Loop screen

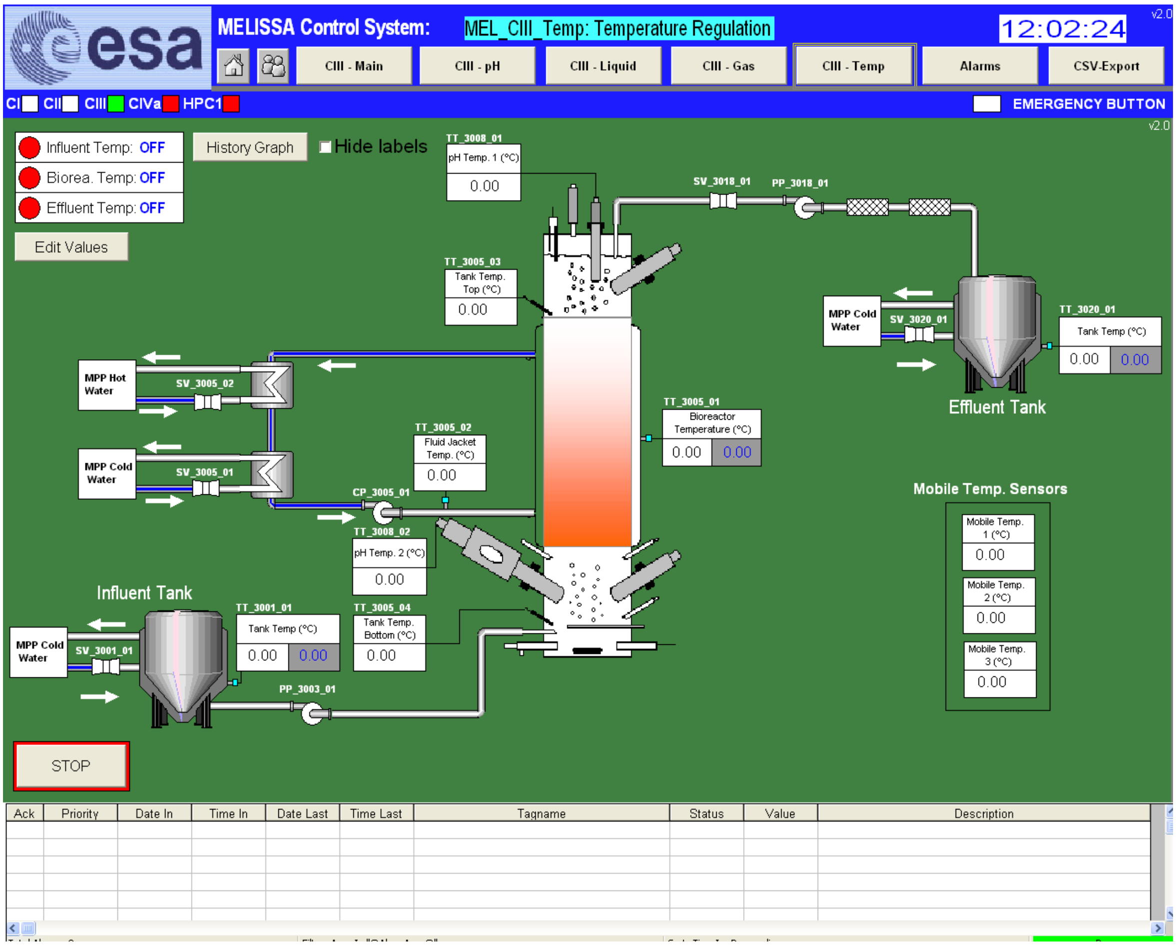

Figure 3-9: Main objects in CIII Temperature Screen

The diagram that represents the Temperature loop of the system will be something similar as shown in Figure 3-9.

Navigating this screen the user will be able to:

- Monitor the temperature of each tank, the bioreactor fluid jacket and the lecture of Mobile Sensors.
- Modify the temperature set-points of each of the tanks and the bioreactor.
- Monitor the emergency button indicator. Background colour switch to red when one of the Emergency buttons is pushed.
- Display the history graph clicking on the History graph command button.
- Hide labels selecting the “Hide Labels” check box.
- Stop all control loops implemented on the screen clicking “Stop” command button.
- Edit manual values clicking the “Edit Values” command button. In the Manual Values window user can switch between three submenus:
    - Bioreactor Tank Temperature: Allows activating the valves SV_3005_01 and SV_3005_02 and the pump CP_3005_01.
    - Effluent Tank Temperature: Allows activating the valve SV_3020_01.
    - Influent Tank Temperature: Allows activating the valve SV_3001_01.

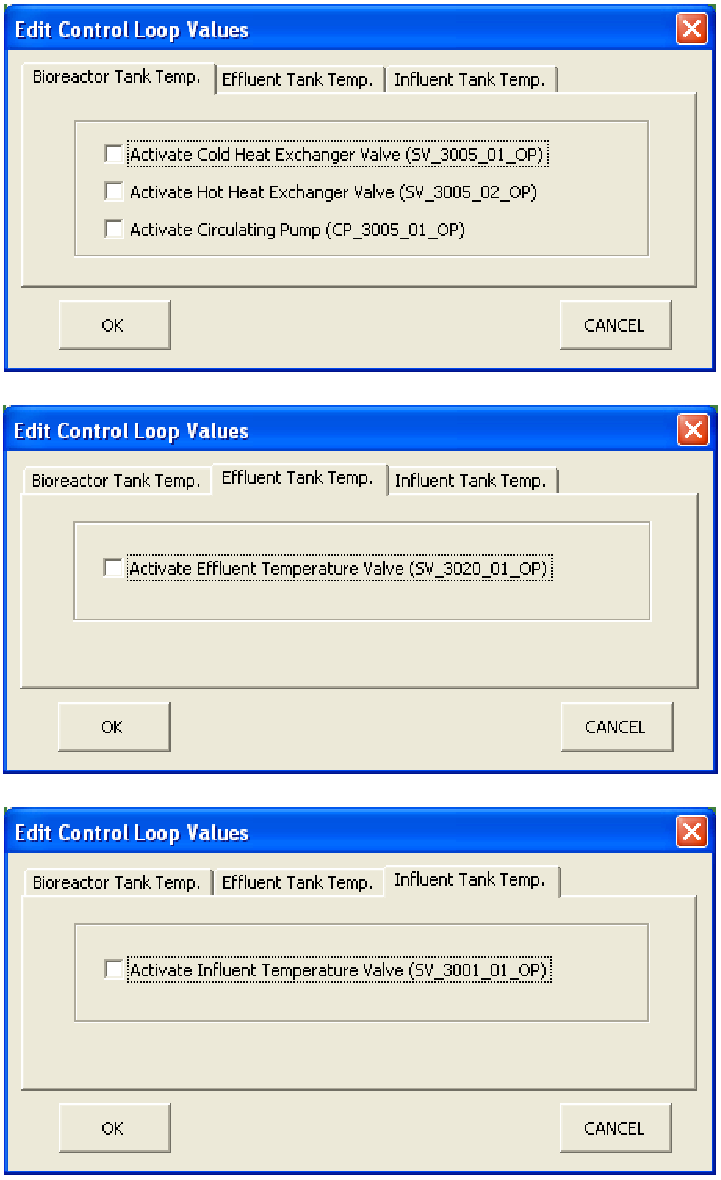

Figure 3-10: Edit Values Dialog

3.5.1 Control Loops

The following control loops are implemented on the screen:

Tag Name	Description	HMI address
CL3001_ControlLoop_Mode	Influent Temperature Mode	400231
CL3005_ControlLoop_Mode	Bioreactor Temperature Mode	400234
CL3020_ControlLoop_Mode	Effluent Temperature Mode	400243

Table 3-9 Control Loops of the Temperature loop of CIII system

3.5.2 Tag definition

The following tags are displayed in this screen. (The user inputs are highlighted in green).

Tag Name	Description	Type
SV_3001_01_OP	Valve Activation in Manual Mode	Button
SV_3001_01_FB	Temperature control valve	2-way valve
TT_3001_01	Influent tank temperature	Analogue indicator
TT_3001_01_SP	Influent tank temperature SP	SP User Input

Tag Name	Description	Type
CP_3005_01_OP	Pump Activation in Manual Mode	Button
TT_3005_SP	Bioreactor temperature SP	SP User Input
SV_3005_02_OP	Valve Activation in Manual Mode	Button
SV_3005_01_OP	Valve Activation in Manual Mode	Button
CP_3005_01_MV	Circulation pump	Pump animated
SV_3005_02_FB	Heat exchanger valve (HOT)	2-way valve animated
SV_3005_01_FB	Heat exchanger valve (COLD)	2-way valve animated
TT_3005_02	Reactor jacket temperature	Analogue indicator
TT_3005_01	Bioreactor temperature (middle position)	Analogue indicator
TT_3005_03	Bioreactor temperature (top position)	Analogue indicator
TT_3005_04	Bioreactor temperature (Bottom position)	Analogue indicator
TT_3008_01	Temperature of the pH sensor	Analogue indicator
TT_3008_02	Temperature of the pH sensor.	Analogue indicator
SV_3020_01_OP	Valve Activation in Manual Mode	Button
TT_3020_01_SP	Effluent tank temperature SP	SP User Input
SV_3020_01_FB	Temperature control valve	2-way valve animated
TT_3020_01	Effluent tank temperature	Analogue indicator
SV_3018_01_FB	Reactor liquid outlet valve	2-way valve animated
PP_3003_01_MV1	Feeding pump	Pump animated
PP_3003_01_MV3	Rotation direction of feeding pump	Row indicator
PP_3018_01_MV1	Harvest pump	Pump animated
PP_3018_01_MV3	Rotation direction of harvest pump	Row indicator
CL3004_Emer_Button_01	Emergency button	Digital indicator
TT_3023_01	Mobile Temperature used for sterilisation	Analogue indicator
TT_3023_02	Mobile Temperature used for sterilisation	Analogue indicator
TT_3023_03	Mobile Temperature used for sterilisation	Analogue indicator

Table 3-10 Tags of the Temperature loop of CIII system

3.5.3 Alarm definition

The following alarms are linked with the operation of the Temperature control screen.

TAG NAME	Description	HMI Address
SV_3001_01_A	SV_3001_01_ALARM	000051
TT_3001_01_AH	TT_3001_01_HIGHALARM	000052
TT_3001_01_AHH	TT_3001_01_VERYHIGHALARM	000053
TT_3001_01_AL	TT_3001_01_LOWALARM	000054
TT_3001_01_ALL	TT_3001_01_VERYLOWALARM	000055
TT_3001_01_ERR	TT_3001_01_BROKENWIRE	000056
SV_3005_02_A	SV_3005_02_ALARM	000073
SV_3005_01_A	SV_3005_01_ALARM	000075
TT_3005_02_AH	TT_3005_02_HIGHALARM	000076
TT_3005_02_AHH	TT_3005_02_VERYHIGHALARM	000077
TT_3005_02_AL	TT_3005_02_LOWALARM	000078
TT_3005_02_ALL	TT_3005_02_VERYLOWALARM	000079
TT_3005_02_ERR	TT_3005_02_BROKENWIRE	000080
TT_3005_01_AH	TT_3005_01_HIGHALARM	000081
TT_3005_01_AHH	TT_3005_01_VERYHIGHALARM	000082
TT_3005_01_AL	TT_3005_01_LOWALARM	000083
TT_3005_01_ALL	TT_3005_01_VERYLOWALARM	000084
TT_3005_01_ERR	TT_3005_01_BROKENWIRE	000085
TT_3005_03_ERR	TT_3005_03_BROKENWIRE	000086
TT_3005_04_ERR	TT_3005_04_BROKENWIRE	000087
TT_3020_01_AH	TT_3020_01_HIGHALARM	000208
TT_3020_01_AHH	TT_3020_01_VERYHIGHALARM	000209
TT_3020_01_AL	TT_3020_01_LOWALARM	000210
TT_3020_01_ALL	TT_3020_01_VERYLOWALARM	000211
TT_3020_01_ERR	TT_3020_01_BROKENWIRE	000212
SV_3020_01_ERR	SV_3020_01_ALARM	000213
SV_3018_01_ERR	SV_3018_01_ALARM	000206

Table 3-11 Alarm tags of the Temperature loop of CIII system

3.5.4 History Graph

The following tags are monitored by default when the user access to the History Graph from the Temperature Control screen.

1. TT_3001_01
2. TT_3005_01
3. TT_3020_01

3.6 CIII pH Loop screen

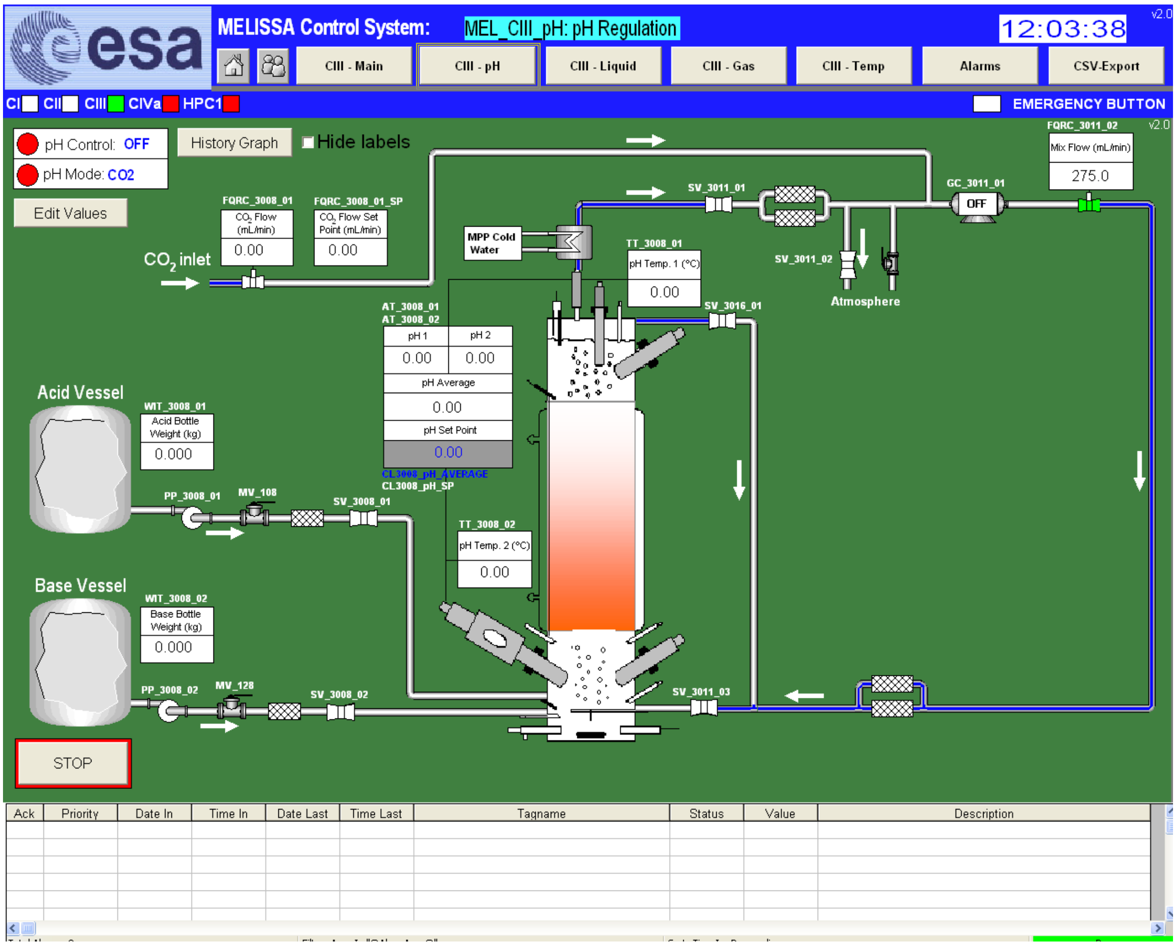

Figure 3-11: Main objects in CIII pH Screen

The diagram that represents the pH loop of the system will be something similar as shown in Figure 3-11.

This loop controls the pH within the reactor. According to the measurement position in comparison to the pH set point the regulator activates the acid solution or basic solution pumps. A probe placed on the top of the engine provides the pH measurement for the control system. There is another probe in the bottom of the engine. The user can select the usable probe to control the process.

There are three modes of regulation:

Mode	Description	CO_2 flow	Base pump	Acid pump
1	Only CO_2 is used to regulate pH	Enabled	Disabled	Disabled
2	CO_2 and Base medium is used to regulate pH.	Enabled	Enabled	Disabled
3	Base and additional Acid media is used to regulate pH.	Disabled	Enabled	Enabled

Actuating in mode 1 or 2, the inlet gas flow control is deactivated.

Navigating this screen the user will be able to:

- Monitor the pH values and the temperature of each pH sensor.
- Monitor the weight of acid and base vessels.
- Monitor the CO_2 flow.
- Select the pH probe to control, clicking over the pH sensor indicators. The label of the selected sensor will be highlighted in blue.

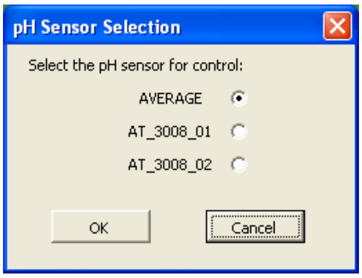

Figure 3-12: Main objects in CIII pH Screen

- Modify the pH set-point.
- Monitor the emergency button indicator. Background colour switch to red when one of the Emergency buttons is pushed.
- Display the history graph clicking on the History graph command button.
- Hide labels selecting "Hide labels" check box.
- Stop all control loops implemented on the screen clicking "Stop" command button.
- Edit manual values clicking the "Edit Values" command button. In the Manual Values window user can switch between two submenus:
  - pH Manual Mode: Allows activating the acid and base pumps and valves (PP_3008_01, PP_3008_02, SV_3008_01 and SV_3008_02 respectively) and select the opening time. Moreover allows selecting the Manual Value Set-Point for the CO_2 valve.
  - pH Automatic Mode: Allows resetting the pH timers and selecting the pH Set-Point and the pH dead zone. Furthermore it is possible to read the date and time of the last timer reset and the opened time of the acid and the base injections.

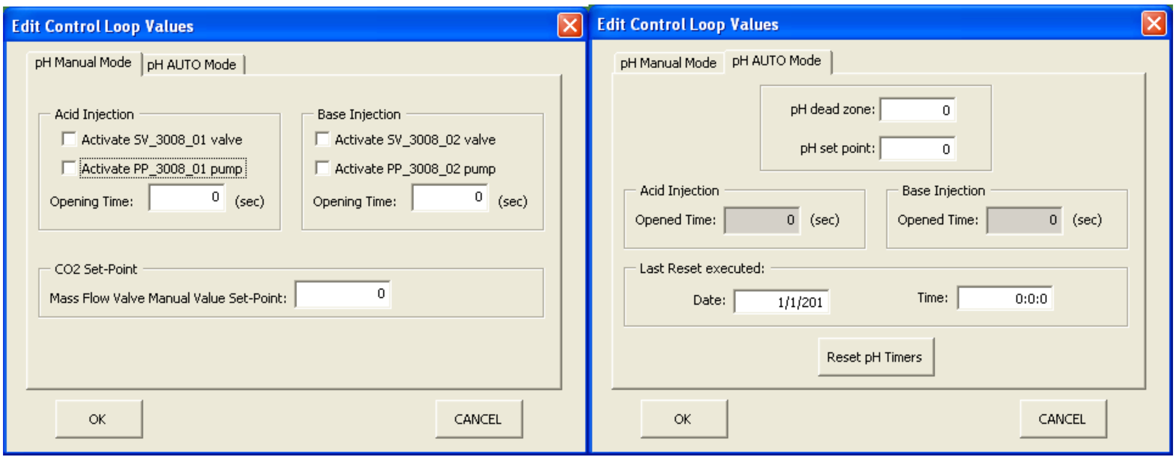

Figure 3-13: Edit Values Dialog

- Select the pH control mode, clicking over the pH mode indicator.

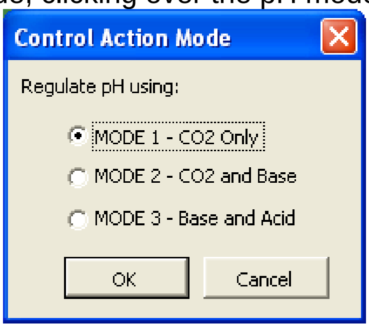

Figure 3-14: pH Mode

3.6.1 Control Loops

The following control loops are implemented on the screen:

Tag Name	Description	HMI address
CL3008_ControlLoop_Mode	pH Control Mode	400235

Table 3-12 Control Loops of the pH loop of CIII system

3.6.2 Tag definition

The screen will display the following tags (user inputs are highlighted in green):

Tag Name	Description	Type
PP_3008_01_OP	Acid Pump Activation in Manual Mode	Button
PP_3008_02_OP	Base Pump Activation in Manual Mode	Button
PP_3008_01_OP_TIME	Acid injection time	User Input
PP_3008_02_OP_TIME	Base injection time	User Input
CL3008_Reset_pH_Timer	pH timer reset	Button
CL3008_pH_AVERAGE	pH Average	Analogue Indicator
CL3008_pH_Mode	pH Mode selector	Button
CL3008_pH_selector	pH sensor selection	Button
FQRC_3008_01_OP	CO2 Mass Flow SP in manual mode	SP User Input
CL3008_pH_SP	pH SP	SP User Input
CL3008_DeadZone	pH DeadZone	SP User Input
CL3008_Base_Opening_Time	Base injection time	Indicator
CL3008_Acid_Opening_Time	Acid injection time	Indicator
CL3008_pH_Second	Date of last reset	Indicator
CL3008_pH_Minute	Date of last reset	Indicator
CL3008_pH_Hour	Date of last reset	Indicator
CL3008_pH_Day	Date of last reset	Indicator
CL3008_pH_Month	Date of last reset	Indicator
CL3008_pH_Year	Date of last reset	Indicator
PP_3008_01_MV	Acid pump	Pump animated
PP_3008_02_MV	Base pump	Pump animated
AT_3008_01	pH sensor	Analogue indicator
TT_3008_01	Temperature of the pH sensor	Analogue indicator
AT_3008_02	pH sensor	Analogue indicator
TT_3008_02	Temperature of the pH sensor.	Analogue indicator
WIT_3008_01	Acid bottle weight	Balance with Analogue indicator
WIT_3008_02	Base bottle weight	Balance with analogue indicator
SV_3008_01_FB	Acid valve	2-way valve
SV_3008_02_FB	Base valve	2-way valve
FQRC_3008_01	CO2 flow transmitter	Analogue indicator
FQRC_3008_01_SP	CO2 flow SP indicator	Analogue indicator
SV_3016_01_FB	Gas introduction valve	2-way valve animated
SV_3011_01_FB	Reactor venting valve	2-way valve animated
SV_3011_02_FB	Gas exhaust valve	2-way valve animated
SV_3011_03_FB	Gas introduction valve	2-way valve animated
FQRC_3011_02	Mix flow transmitter	Analogue indicator
GC_3011_01_MV	Gas compressor	Compressor animated
CL3004_Emer_Button_01	Emergency button	Digital indicator

Table 3-13 Tags of the pH loop of CIII system

3.6.3 Alarm definition

The following alarms are linked with the operation of the pH control screen.

TAG NAME	Description	HMI Address
CL3008_pH_AH	CL3008_pH_HIGHALARM	000103
CL3008_pH_AHH	CL3008_pH_VERYHIGHALARM	000104
CL3008_pH_AL	CL3008_pH_LOWALARM	000105
CL3008_pH_ALL	CL3008_pH_VERYLOWALARM	000106
WIT_3008_01_AL	WIT_3008_01_LOWLEVELALARM	000107
WIT_3008_01_ALL	WIT_3008_01_VERYLOWLEVELALARM	000108
WIT_3008_02_AL	WIT_3008_02_LOWLEVELALARM	000109
WIT_3008_02_ALL	WIT_3008_02_VERYLOWLEVELALARM	000110
SV_3008_01_ERR	SV_3008_01_NOFEEDBACK	000111
SV_3008_02_ERR	SV_3008_02_NOFEEDBACK	000112
AT_3008_01_ERR	AT_3008_01_BROKENWIRE	000113
TT_3008_01_ERR	TT_3008_01_BROKENWIRE	000114
AT_3008_02_ERR	AT_3008_02_BROKENWIRE	000115
TT_3008_02_ERR	TT_3008_02_BROKENWIRE	000116
WIT_3008_01_ERR	WIT_3008_01_BROKENWIRE	000117
WIT_3008_02_ERR	WIT_3008_02_BROKENWIRE	000118
FQRC_3008_01_AH	FQRC_3008_01_HIGHALARM	000253
FQRC_3008_01_AHH	FQRC_3008_01_VERYHIGHALARM	000254
FQRC_3008_01_AL	FQRC_3008_01_LOWALARM	000255
FQRC_3008_01_ALL	FQRC_3008_01_VERYLOWALARM	000256
FQRC_3008_01_ERR	FQRC_3008_01_BROKENWIRE	000119
FQRC_3011_02_AH	FQRC_3011_02_HIGHALARM	000267
FQRC_3011_02_AHH	FQRC_3011_02_VERYHIGHALARM	000268
FQRC_3011_02_AL	FQRC_3011_02_LOWALARM	000269
FQRC_3011_02_ALL	FQRC_3011_02_VERYLOWALARM	000270
FQRC_3011_02_ERR	FQRC_3011_02_BROKENWIRE	000149
SV_3011_01_A	SV_3011_01_NOFEEDBACK	000151
SV_3011_02_A	SV_3011_02_NOFEEDBACK	000152
SV_3011_03_A	SV_3011_03_NOFEEDBACK	000190
SV_3016_01_A	SV_3016_01_ALARM	000191

Table 3-14 Alarm tags of the pH loop of CIII system

3.6.4 History Graph

The following tags are monitored by default when the user access to the History Graph from the pH Control screen.

1. AT_3008_01
2. AT_3008_02
3. FQRC_3008_01

4. CONTROL LOOP MODE OPERATION DESCRIPTION

In the Upper Left corner of each screen there is placed the indicators and configuration of the control loops. To configure the control loops from the screen follow these steps:

1. Clicking in the "Edit Values" command button a configure window is displayed to configure the control loops parameters.

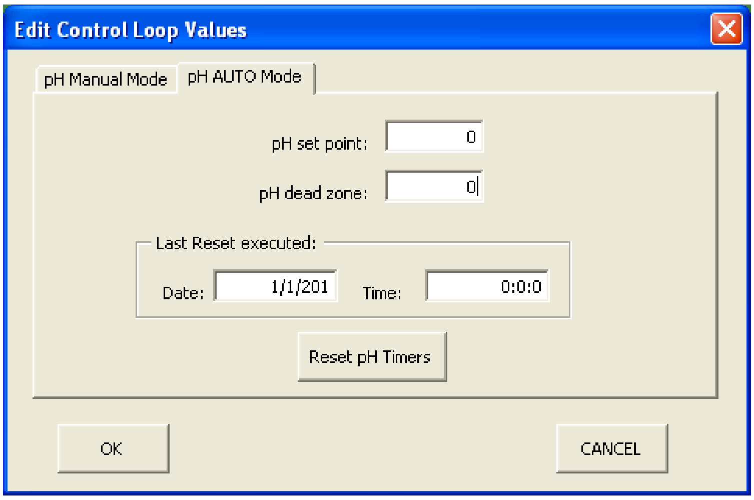

Figure 4-1: Edit Values Dialog

2. Click on the control loop desired to configure it and window from Figure 4-2 is displayed. Circle colour and text are animated depending of the mode selected.
   - OFF mode : circle with red background colour and text is "OFF"
   - Manual mode: circle with yellow background colour and text is "MAN"
   - Automatic mode: circle with green background colour and text is "AUTO".

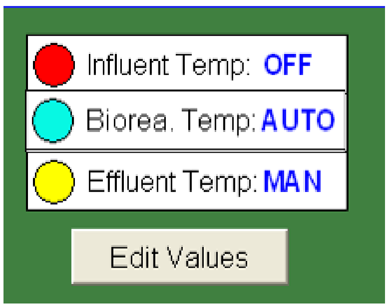

Figure 4-2: Control Loops indicators and configuration

3. The caption of this form shows the control loop selected and permits to the user to change the mode of operation. The user has to select the mode of operation desired and press OK. Once the user has selected the mode and press OK, the mode will be reflected in the indicators of the Figure 4-3 (the circle colour and text).

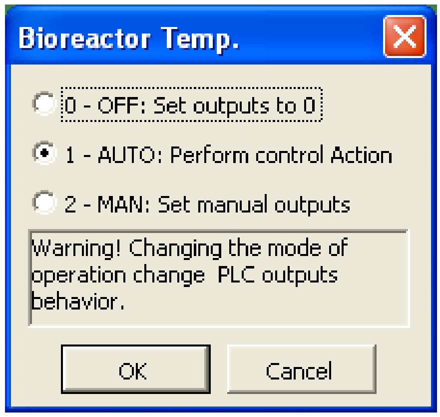

Figure 4-3: Control Loop Configuration Window

5. PLC SYSTEM CLOCK UPDATE

The time displayed in the screen is the system time. It is possible to update the CIII, CIVa and the CIVB-HPC1 PLC system clocks double-clicking on the HMI Clock in anyone of the CIII screens.

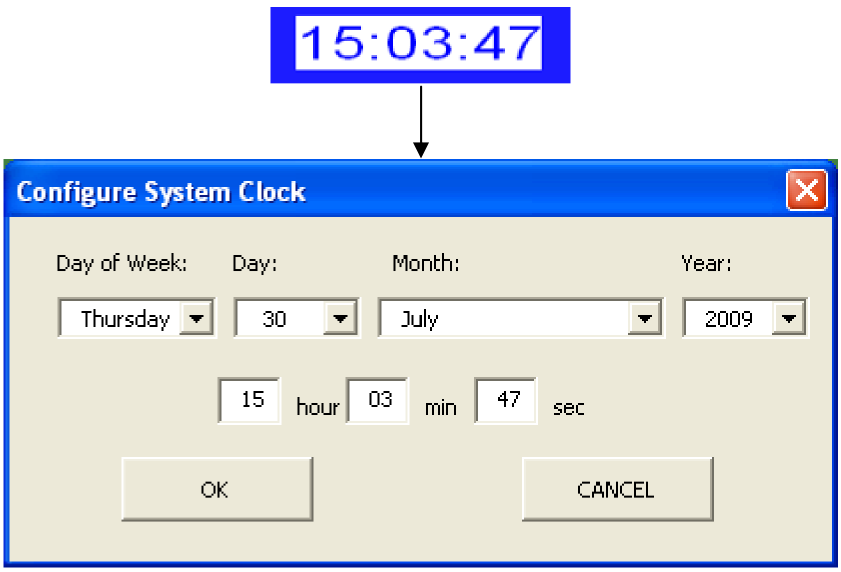

Figure 5-1: PLC system clock configuration

Tag Name	Description	HMI address
CIII_SysClock_dayofweek	1 = Sunday .. 7 = Saturday	400408
CIII_SysClock_dayofweek_SET	configure the day of the week (1 = Sunday .. 7 = Saturday)	400415
CIII_SysClock_Year	Year 0..99	400409
CIII_SysClock_Year_SET	configure the Year (0..99)	400416
CIII_SysClock_Month	Month 1..12	400410
CIII_SysClock_Month_SET	configure the Month (1..12)	400417
CIII_SysClock_Day	Day 1..31	400411
CIII_SysClock_Day_SET	configure the Day (1..31)	400418
CIII_SysClock_Hour	Hour 0..23	400412
CIII_SysClock_Hour_SET	configure the Hour (0..23)	400419
CIII_SysClock_Minute	Minute 0..59	400413
CIII_SysClock_Minute_SET	configure the Minute (0..59)	400420
CIII_SysClock_Second	Second 0..59	400414
CIII_SysClock_Second_SET	configure the Second (0..59)	400421
CIII_SC_Activate_Setting	Used to set the date and the clock of the PLC	000242

Table 5-1 System clock tags of CIII system

6. HMI DATABASE

HMI database defines the tag names, description, plc address, low and high limit, enable alarming tags, etc. It will be attached in a excel file.

7. GLOBAL ALARM INDICATORS

Alarms are defined in each screen.

In the Main Menu there are the general alarm indicators of the each compartment, indicator background colour changes according to:

- Green: There are no alarms activated in the compartment.
- Yellow: some level 1 alarm is activated.
- Red: some level 2 alarm is activated.

In the following picture, compartment CI, CII, CIII and CIVa there isn't any alarm activated and in the compartment CIVb HPC1 there is some level 2 alarm activated.

Figure 7-1:Global alarm indicators

8. HISTORICAL DATA

Following tags will be stored every 30 seconds. The user will be able to display this data using the historical graph accessible from each screen. The following tags are also stored in a Microsoft Access Database every 5 minutes. Microsoft Access is installed in the iFIX client PC and user will be able to access to the database file stored in "Z:\Supervision\PIC\Database\MEL_CIII_DB.mdb"

Tag Name	Description	HMI address
TT_3001_01	Influent tank temperature	400072
TT_3001_01_SP	Influent tank temperature SP	400074
LT_3002_01	Influent tank level transmitter	400076
PP_3003_01_SP	Speed of feeding pump SP	400078
PP_3003_01_MV2	Speed of feeding pump	400198
FT_3003_01	Feeding flow transmitter	400080
PT_3003_01	Feeding pressure	400082
BLE_3004_01_OP	Blender Activation in Manual Mode	000069
BLE_3004_01_SP	Blender SP	400084
BLE_3004_01_MV2	Blender speed SP	400194
BLE_3004_01	Blender speed	400086
TT_3005_SP	Bioreactor temperature SP	400088
TT_3005_02	Reactor jacket temperature	400090
TT_3005_01	Bioreactor temperature (middle position)	400092
TT_3005_03	Bioreactor temperature (top position)	400094
TT_3005_04	Bioreactor temperature (Bottom position)	400096
CL3006_BioreactorLevel_SP	Bioreactor Level SP	400168
LT_3006_01	Bioreactor level	400098
DPT_3007_01	Bioreactor differential pressure	400100
PT_3007_01	Bioreactor pressure	400102
PP_3008_01_OP_TIME	Acid injection time	400161
PP_3008_02_OP_TIME	Base injection time	400063
FQRC_3008_01_OP	CO2 Mass Flow SP in manual mode	400206
CL3008_pH_SP	pH SP	400104
CL3008_DeadZone	pH DeadZone	400106
CL3008_Base_Opening_Time	Base injection time	400184
CL3008_Acid_Opening_Time	Acid injection time	400186
CL3008_pH_Second	Date of last reset	400260
CL3008_pH_Minute	Date of last reset	400261
CL3008_pH_Hour	Date of last reset	400262
CL3008_pH_Day	Date of last reset	400263
CL3008_pH_Month	Date of last reset	400264
CL3008_pH_Year	Date of last reset	400265
AT_3008_01	pH sensor	400108
TT_3008_01	Temperature of the pH sensor	400110
AT_3008_02	pH sensor	400112
TT_3008_02	Temperature of the pH sensor.	400114
WIT_3008_01	Acid bottle weight	400116
WIT_3008_02	Base bottle weight	400118
FQRC_3008_01	CO2 flow transmitter	400158
FQRC_3008_01_SP	CO2 flow SP indicator	400188
FQRC_3009_01_OP	Mass flow SP in Manual Mode	400120
CL3009_DO2_SP	DO2 SP in automatic mode	400172
AT_3009_01	DO2 transmitter (Bottom)	400122
AT_3009_02	DO2 transmitter (TOP)	400124
FQRC_3009_01	Flow transmitter (O2)	400126
FQRC_3009_01_SP	Mass flow SP indicator	400190
AT_3010_01	Conductivity sensor (bottom)	400128
AT_3010_02	Conductivity sensor (top)	400130
FQRC_3011_01_OP	N2 Mass flow SP in Manual Mode	400132
FQRC_3011_02_OP	Gas mix Mass flow SP in Manual Mode	400134
CL3011_GasMix_SP	Gas mix SP in automatic mode	400174

Tag Name	Description	HMI address
FQRC_3011_01_SP	N2 flow transmitter SP indicator	400192
FQRC_3011_01	N2 flow transmitter	400136
FQRC_3011_02_SP	Mix flow transmitter SP indicator	400202
FQRC_3011_02	Mix flow transmitter	400138
PT_3011_01	Pressure in Gas loop	400140
TT_3012_01	Air vent cold water temperature	400142
AT_3013_01	NH4 Analyser	400144
AT_3013_02	NO3 Analyser	400146
AT_3013_03	NO2 Analyser	400148
AT_3014_01	Biomass sensor	400204
CL3015_BACKWASHING_DURATION	Backwashing duration	400065
CL3016_OXYGENPULSE_MODE	Oxygen Pulse Number	400246
PP_3017_01_SP	Recirculation pump SP	400150
CL3017_Flow_SP	Recirculation flow SP	400176
FT_3017_01	Recirculation flow	400152
PP_3017_01_MV2	Pump speed	400200
PP_3018_01_SP	Outlet pump SP	400154
CL3018_Flow_SP	Outlet flow SP	400170
FT_3018_01	Harvest flow sensor	400156
PP_3018_01_MV2	Pump speed	400196
TT_3020_01	Effluent tank temperature	400162
LT_3021_01	Effluent level	400164
PT_3007_01_SP	PT_3007_01_Set_Point	400214
CL3007_Pressure_Threshold	PT_3007_01_Threshold	400216
CL3008_pH_Mode	pH Mode selector	400247
CL3008_pH_AVERAGE	pH Average	400218
SV_3011_Opening_Time	SV_3011_02 Opening Time (s)	400210
SV_3011_02_Opening_Frequency	SV_3011_02 Opening frequency	400212
CL3016_BOTTOM_OPENING_TIME	Oxygen Pulse Bottom Opening Time	400430
CL3016_BOTTOM_CLOSING_TIME	Oxygen Pulse Bottom Closing Time	400432
CL3016_TOP_OPENING_TIME	Oxygen Pulse Top Opening Time	400434
CL3016_TOP_CLOSING_TIME	Oxygen Pulse Top Closing Time	400436

Table 8-1 Historical Data tags of CIII system

9. FILES LIST

In the following table there is a list of the files used and its path. All of them are stored in the server PC.

File name	Path	Description
MELSRV01.MBE	C:\Dynamics\PDB\	Modbus driver configuration
MEL_MBE4.pdb	C:\Dynamics\PDB\	iFIX database file
MEL_Main.grf	D:\Supervision\PIC	Melissa Main screen
MEL_MainMenu.grf	D:\Supervision\PIC	Melissa Main menu screen
MEL_Alarm_Bar.grf	D:\Supervision\PIC	Alarm bar screen
MEL_CIII_Main.grf	D:\Supervision\PIC	Melissa CIII Main screen
MEL_CIII_MainMenu.grf	D:\Supervision\PIC	Melissa CIII Main Menu screen
MEL_CIII_Liquid.grf	D:\Supervision\PIC	Liquid control screen
MEL_CIII_Gas.grf	D:\Supervision\PIC	Gas control screen
MEL_CIII_pH.grf	D:\Supervision\PIC	pH control screen.
MEL_CIII_Temp.grf	D:\Supervision\PIC	Temperature control screen
iFIX1_trend.grf	D:\Supervision\PIC	Graph screen
MEL_QueryTable.grf	D:\Supervision\PIC	CSV data export screen
MEL_Alarms.grf	D:\Supervision\PIC	Alarm screen
Mel_HistAlarms.grf	D:\Supervision\PIC	Historical alarm screen
MEL_CIII_SAVEVALUES.evs	C:\Dynamics\PDB	Schedule executed every 5 minutes to save data in access file
SystemControl.evs	C:\Dynamics\PDB	Daily execution schedule to update the PLC system clock with server clock.
MEL_CIII_DB.mdb	D:\Supervision\PIC\Database	Access file where acquired data is stored.
CIII_MDB.txt	D:\Supervision\PIC\Logs	SQL command executed to save in the access database is stored in txt file.
Historical configuration	D:\Supervision\HTR	There are the historical data assigned to be stored.
Historical data	D:\Supervision\HTR DATA	Historical data packets.
MEL_CIII_Liquid.txt	D:\Supervision\APP\Chart_cfg	Liquid graph tags configuration

File name	Path	Description
MEL_CIII_Gas.txt	D:\Supervision\APP\ Chart_cfg	Gas graph tags configuration
MEL_CIII_pH.txt	D:\Supervision\APP\ Chart_cfg	pH graph tags configuration
MEL_CIII_Temp.txt	D:\Supervision\APP\ Chart_cfg	Temperature control graph tags configuration
Configurations.txt	D:\Supervision\APP\ Chart_cfg	Screens using graph configuration.
ActualConfig.txt	D:\Supervision\APP\ Chart_cfg	Save the actual configuration load on the graph screen.
AuxConfig.txt	D:\Supervision\APP\ Chart_cfg	File used to update ActualConfig.txt
Configurations.txt	D:\Supervision\APP\ CSV_export	Configurations saved to be loaded.
ActualConfig.txt	D:\Supervision\APP\ CSV_export	Configuration loaded in the CSV data export screen.
AuxConfig.txt	D:\Supervision\APP\ CSV_export	File used to update ActualConfig.txt

Table 9-1 File list of CIII system

10. CIII TAGS LIST

In the following list the Units, Range and decimals are indicated. Note that decimals have been determined from the information of sensor accuracy in the working set point. If a sensor has an accuracy of 10% in the range of 1 to 100, only one decimal can be considered to display the value in the HMI screen.

Tag Name	Description	Type	HMI address	Units	Range	Accuracy (decimals)
AT_3008_01	pH sensor	Analogue indicator	400108	(pH)	0 to 14	0.03 (1)
AT_3008_02	pH sensor	Analogue indicator	400112	(pH)	0 to 14	0.03 (1)
AT_3009_01	Dissolved O2 (bottom position)	Analogue indicator	400122	(%)	0 to 100	TBC (2)
AT_3009_02	Dissolved O2 (top position)	Analogue indicator	400124	(%)	0 to 100	TBC (2)
AT_3009_AVERAGE	DO2 Average	Analogue Indicator	400220	(%)	0 to 100	TBC (2)
AT_3010_01	Conductivity sensor (bottom)	Analogue indicator	400128	(uS/cm)	0.02 to 50	0.025 (2)
AT_3010_02	Conductivity sensor (top)	Analogue indicator	400130	(uS/cm)	0.02 to 50	0.025 (2)
AT_3013_01	NH4 Analyser	Analogue indicator	400144	(ppm)	0 to 155.6	TBC (2)
AT_3013_02	NO3 Analyser	Analogue indicator	400146	(ppm)	0 to 1000	TBC (2)
AT_3013_03	NO2 Analyser	Analogue indicator	400148	(ppm)	0 to 20	TBC (2)
AT_3014_01	Biomass sensor	Analogue indicator	400204	(g/L)	TBD	TBC (1)
BLE_3004_01	Blender speed	Analogue indicator	400086	(%)	0 to 100	0.02 (2)
BLE_3004_01_MV1	Blender	Pump animated	000036	---	---	---
BLE_3004_01_MV2	Blender speed SP	Analogue indicator	400194	(%)	0 to 100	0.02 (2)
BLE_3004_01_OP	Blender Activation in Manual Mode	Button	000069	---	---	---
BLE_3004_01_SP	Blender SP	SP User Input	400084	(%)	0 to 100	0.02 (2)
CL3004_Emer_Button_01	Emergency button	Digital indicator	100039	---	---	---
CL3006_BioreactorLevel_SP	Bioreactor Level SP	SP User Input	400168	(L)	0 to 100	0.5 (0)
CL3007_Pressure_Threshold	PT_3007_01_Threshold	User Input	400216	(mBar)	0 to 1000	1 (0)

Tag Name	Description	Type	HMI address	Units	Range	Accuracy (decimals)
CL3008_Acid_Opening_Time	Acid injection time	Indicator	400186	(seconds)	0 to 1000	1 (0)
CL3008_Base_Opening_Time	Base injection time	Indicator	400184	(seconds)	0 to 1000	1 (0)
CL3008_DeadZone	pH DeadZone	SP User Input	400106	(pH)		---
CL3008_pH_AVERAGE	pH Average	Analogue Indicator	400218	(pH)	0 to 14	0.03 (1)
CL3008_pH_Day	Date of last reset	Indicator	400263	(day)	1 to 31	---
CL3008_pH_Hour	Date of last reset	Indicator	400262	(hour)	0 to 23	---
CL3008_pH_Minute	Date of last reset	Indicator	400261	(minute)	0 to 59	---
CL3008_pH_Mode	pH Mode selector	Button	400247	mode	1 to 3	1 (0)
CL3008_pH_Month	Date of last reset	Indicator	400264	(month)	1 to 12	---
CL3008_pH_Second	Date of last reset	Indicator	400260	(second)	0 to 59	---
CL3008_pH_selector	pH sensor selection	Button	400248	nº of selection	0 to 2	1 (0)
CL3008_pH_SP	pH SP	SP User Input	400104	(pH)	0 to 14	0.03 (1)
CL3008_pH_Year	Date of last reset	Indicator	400265	(year)	9 to 99	---
CL3008_Reset_pH_Timer	pH timer reset	Button	102	---	---	---
CL3009_DO2_selector	DO2 probe selector	Button	400249	Nº selection	0 to 2	1 (0)
CL3009_DO2_SP	DO2 SP in automatic mode	SP User Input	400172	(%)	0 to 100	0.5 (0)
CL3011_GasMix_SP	Gas mix SP in automatic mode	SP User Input	400174	(mL/min)	0 to 10000	1 (0)
CL3015_BACKWASHING_DURATION	Backwashing duration	User Input	400065	(seconds)	0 to 10000	1 (0)
CL3016_BOTTOM_CLOSING_TIME	Oxygen Pulse Bottom Closing Time	User Input	400432	(second)	0 to 10000	1 (0)
CL3016_BOTTOM_OPENING_TIME	Oxygen Pulse Bottom Opening Time	User Input	400430	(second)	0 to 10000	1 (0)
CL3016_OXYGENPULSE_NUMBER	Oxygen Pulse Number	User Input	400246	(nº of pulses)	0 to 100	1 (0)
CL3016_TOP_CLOSI NG_TIME	Oxygen Pulse Top Closing Time	User Input	400436	(second)	0 to 10000	1 (0)
CL3016_TOP_OPENING_TIME	Oxygen Pulse Top Opening Time	User Input	400434	(second)	0 to 10000	1 (0)
CL3017_Flow_SP	Recirculation flow SP	SP User Input	400176	(L/h)	0 to 5	0.01 (2)
CL3018_Flow_SP	Outlet flow SP	SP User Input	400170	(L/h)	0 to 2	0.004 (2)
CP_3005_01_MV	Circulation pump	Pump animated	38	---	---	---
CP_3005_01_OP	Pump Activation in Manual Mode	Button	71	---	---	---
DPT_3007_01	Bioreactor differential pressure	Analogue indicator	400100	(mBar)	0 to 3000	2.25 (0)
FQRC_3008_01	CO2 flow transmitter	Analogue indicator	400158	(mL/min)	0 to 50	TBC (0)
FQRC_3008_01_OP	CO2 Mass Flow SP in manual mode	SP User Input	400206	(mL/min)	0 to 50	TBC (0)
FQRC_3008_01_SP	CO2 flow SP indicator	Analogue indicator	400188	(mL/min)	0 to 50	TBC (0)
FQRC_3009_01	Flow transmitter (O2)	Analogue indicator	400126	(mL/min)	0 to 500	TBC (0)
FQRC_3009_01_OP	Mass flow SP in Manual Mode	SP User Input	400120	(mL/min)	0 to 500	TBC (0)
FQRC_3009_01_SP	Mass flow SP indicator	Analogue indicator	400190	(mL/min)	0 to 500	TBC (0)
FQRC_3011_01	N2 flow transmitter	Analogue indicator	400136	(mL/min)	0 to 8333	TBC (0)
FQRC_3011_01_OP	N2 Mass flow SP in Manual Mode	SP User Input	400132	(mL/min)	0 to 8333	TBC (0)
FQRC_3011_01_SP	N2 flow transmitter	Analogue indicator	400192	(mL/min)	0 to 8333	TBC (0)
FQRC_3011_02	Mix flow transmitter	Analogue indicator	400138	(mL/min)	0 to 10000	TBC (0)
FQRC_3011_02	Mix flow transmitter	Analogue indicator	400138	(mL/min)	0 to 10000	TBC (0)
FQRC_3011_02_OP	Gas mix Mass flow SP in Manual Mode	SP User Input	400134	(mL/min)	0 to 10000	TBC (0)
FQRC_3011_02_SP	Mix flow transmitter SP indicator	Analogue indicator	400202	(mL/min)	0 to 10000	TBC (0)
FT_3003_01	Feeding flow transmitter	Analogue indicator	400080	(L/h)	0 to 2	0.004 (2)
FT_3003_01_SP	Feeding flow SP	SP User Input	400208	(L/h)	0 to 2	0.004 (2)
FT_3017_01	Recirculation flow	Analogue indicator	400152	(L/h)	0 to 5	0.01 (2)
FT_3018_01	Harvest flow sensor	Analogue indicator	400156	(L/h)	0 to 2	0.004 (2)
GC_3011_01_MV	Gas compressor	Compressor animated	37	---	---	---
GC_3011_01_OP	Gas compressor pump Activation in Manual Mode	Button	000141	---	---	---
LSH_3006_01	Bioreactor High level switch	Digital indicator	100017	---	---	---
LSH_3006_02	Bioreactor High level switch	Digital indicator	100018	---	---	---
LSH_3021_01	Effluent high level switch	Digital indicator	100023	---	---	---
LSH_3021_02	Effluent high level switch	Digital indicator	100024	---	---	---

Tag Name	Description	Type	HMI address	Units	Range	Accuracy (decimals)
LSL_3002_01	Influent tank low level switch	Digital indicator	100021	---	---	---
LSL_3002_02	Influent tank low level switch	Digital indicator	100022	---	---	---
LSL_3006_01	Bioreactor Low level switch	Digital indicator	100019	---	---	---
LSL_3006_02	Bioreactor Low level switch	Digital indicator	100020	---	---	---
LT_3002_01	Influent tank level transmitter	Analogue indicator	400076	(L)	0 to 30	0.15 (1)
LT_3006_01	Bioreactor level	Analogue indicator	400098	(L)	0 to 100	0.05 (1)
LT_3021_01	Effluent level	Analogue indicator	400164	(L)	0 to 30	0.15 (1)
PP_3003_01_MV1	Feeding pump	Pump animated	45	---	---	---
PP_3003_01_MV2	Speed of feeding pump	Analogue indicator	400198	(%)	0 to 100	0.01 (2)
PP_3003_01_MV3	Rotation direction of feeding pump	Row indicator	46	---	---	---
PP_3003_01_OP	Feeding pump Activation in Manual Mode	Button	61	---	---	---
PP_3003_01_SP	Feeding pump SP	SP User Input	400078	(%)	0 to 100	0.01 (2)
PP_3008_01_MV	Acid pump	Pump animated	43	---	---	---
PP_3008_01_OP	Acid Pump Activation in Manual Mode	Button	100	---	---	---
PP_3008_01_OP_TIME	Acid injection time	User Input	400161	(Seconds)	---	---
PP_3008_02_MV	Base pump	Pump animated	44	---	---	---
PP_3008_02_OP	Base Pump Activation in Manual Mode	Button	101	---	---	---
PP_3008_02_OP_TIME	Base injection time	User Input	400063	(Seconds)	---	---
PP_3015_01_MV	Backwashing pump	Pump animated	40	---	---	---
PP_3015_01_OP	Pump Activation in Manual Mode	Button	187	---	---	---
PP_3017_01_MV1	Pump status	Pump animated	47	---	---	---
PP_3017_01_MV2	Pump speed	Analogue indicator	400200	(%)	0 to 100	0.01 (2)
PP_3017_01_MV3	Pump rotation direction	Pump animated	48	---	---	---
PP_3017_01_OP	Pump Activation in Manual Mode	Button	192	---	---	---
PP_3017_01_SP	Recirculation pump SP	SP User Input	400150	(%)	0 to 100	0.01 (2)
PP_3018_01_MV1	Harvest pump	Pump animated	41	---	---	---
PP_3018_01_MV2	Pump Speed (%)	Analogue Indicator	400196	(%)	0 to 100	0.01 (2)
PP_3018_01_MV3	Rotation direction of harvest pump	Row indicator	42	---	---	---
PP_3018_01_OP	Pump Activation in Manual Mode	Button	199	---	---	---
PP_3018_01_SP	Outlet pump SP	SP User Input	400154	(%)	0 to 100	0.01 (2)
PT_3003_01	Feeding pressure	Analogue indicator	400082	(mBar)	-1000 to 4000	1.25 (0)
PT_3007_01	Bioreactor pressure	Analogue indicator	400102	(mBar)	-1000 to 4000	1.25 (0)
PT_3007_01_SP	PT_3007_01_Set_Point	SP User Input	400214	(mBar)	1000 to 4000	1.25 (0)
PT_3011_01	Pressure in Gas loop	Analogue indicator	400140	(mBar)	-1000 to 4000	1.25 (0)
SV_3001_01_FB	Temperature control valve	2-way valve	100025	---	---	---
SV_3001_01_OP	Valve Activation in Manual Mode	Button	50	---	---	---
SV_3005_01_FB	Heat exchanger valve (COLD)	2-way valve animated	100034	---	---	---
SV_3005_01_OP	Valve Activation in Manual Mode	Button	74	---	---	---
SV_3005_02_FB	Heat exchanger valve (HOT)	2-way valve animated	100035	---	---	---
SV_3005_02_OP	Valve Activation in Manual Mode	Button	72	---	---	---
SV_3008_01_FB	Acid valve	2-way valve	100027	---	---	---
SV_3008_02_FB	Base valve	2-way valve	100026	---	---	---
SV_3011_01_FB	Reactor venting valve	2-way valve animated	100028	---	---	---
SV_3011_01_OP	Valve Activation in Manual Mode	Button	142	---	---	---
SV_3011_02_Day	Date of last reset	Indicator	400272	(Day)	1 to 31	---
SV_3011_02_FB	Gas exhaust valve	2-way valve animated	100030	---	---	---
SV_3011_02_Hour	Date of last reset	Indicator	400268	(Hour)	0 to 23	---
SV_3011_02_Minute	Date of last reset	Indicator	400267	(Minute)	0 to 59	---
SV_3011_02_Month	Date of last reset	Indicator	400269	(Month)	1 to 12	---
SV_3011_02_OP	Valve Activation in Manual	Button	143	---	---	---

Tag Name	Description	Type	HMI address	Units	Range	Accuracy (decimals)
	Mode					
SV_3011_02_Opening_Frequency	SV_3011_02 Opening frequency	Analogue Indicator	400212	Frequency of the opening valve	0 to 100000	---
SV_3011_02_Reset_Timer	Timer Reset	Button	247	---	---	---
SV_3011_02_Second	Date of last reset	Indicator	400266	(Second)	0 to 59	---
SV_3011_02_Year	Date of last reset	Indicator	400270	(Year)	9 to 99	---
SV_3011_03_FB	Gas introduction valve	2-way valve animated	100031	---	---	---
SV_3011_03_OP	Valve Activation in Manual Mode	Button	188	---	---	---
SV_3011_Opening_Time	SV_3011_02 Opening Time (s)	Analogue Indicator	400210	(seconds)	0 to 100000	---
SV_3013_01_FB	sampling valve	2-way valve animated	100036	---	---	---
SV_3013_01_OP	sampling valve	Button	157	---	---	---
SV_3013_02_FB	sampling valve	2-way valve animated	100037	---	---	---
SV_3013_02_OP	sampling valve	Button	158	---	---	---
SV_3013_03_FB	sampling valve	2-way valve animated	100038	---	---	---
SV_3013_03_OP	sampling valve	Button	159	---	---	---
SV_3016_01_FB	Gas introduction valve	2-way valve animated	100032	---	---	---
SV_3016_01_OP	Valve Activation in Manual Mode	Button	189	---	---	---
SV_3018_01_FB	Reactor liquid outlet valve	2-way valve animated	100029	---	---	---
SV_3018_01_OP	Reactor liquid outlet valve	Button	249	---	---	---
SV_3020_01_FB	Temperature control valve	2-way valve animated	100033	---	---	---
SV_3020_01_OP	Valve Activation in Manual Mode	Button	207	---	---	---
TT_3001_01	Influent tank temperature	Analogue indicator	400072	(ºC)	0 to 150	0.10 (1)
TT_3001_01_SP	Influent tank temperature SP	SP User Input	400074	(ºC)	0 to 150	0.10 (1)
TT_3005_01	Bioreactor temperature (middle position)	Analogue indicator	400092	(ºC)	0 to 150	0.2 (1)
TT_3005_02	Reactor jacket temperature	Analogue indicator	400090	(ºC)	0 to 150	0.2 (1)
TT_3005_03	Bioreactor temperature (top position)	Analogue indicator	400094	(ºC)	0 to 150	0.2 (1)
TT_3005_04	Bioreactor temperature (Bottom position)	Analogue indicator	400096	(ºC)	0 to 150	0.2 (1)
TT_3005_SP	Bioreactor temperature SP	SP User Input	400088	(ºC)	0 to 150	0.2 (1)
TT_3008_01	Temperature of the pH sensor	Analogue indicator	400110	(ºC)	0 to 100	TBC (1)
TT_3008_02	Temperature of the pH sensor.	Analogue indicator	400114	(ºC)	0 to 100	TBC (1)
TT_3012_01	Air vent cold water temperature	Analogue indicator	400142	(ºC)	0 to 150	0.2 (1)
TT_3020_01	Effluent tank temperature	Analogue indicator	400162	(ºC)	0 to 150	0.15 (1)
TT_3020_01_SP	Effluent tank temperature SP	SP User Input	400160	(ºC)	0 to 150	0.15 (1)
TT_3023_01	Mobile Temperature used for sterilisation	Analogue indicator	400178	(ºC)	0 to 150	0.2 (1)
TT_3023_02	Mobile Temperature used for sterilisation	Analogue indicator	400180	(ºC)	0 to 150	0.2 (1)
TT_3023_03	Mobile Temperature used for sterilisation	Analogue indicator	400182	(ºC)	0 to 150	0.2 (1)
WIT_3008_01	Acid bottle weight	Balance with Analogue indicator	400116	(Kg.)	0 to 6	0.001 (3)
WIT_3008_02	Base bottle weight	Balance with analogue indicator	400118	(Kg.)	0 to 6	0.001 (3)

MELISSA CIII LOCAL HMI DESIGN

FOR THE

MELISSA CS CIIIP2 Project

APPROVAL LIST		
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CHANGE RECORD			
AUTHOR	ISSUE	DATE	CHANGE
J.Carbonell	1.0	06/10/2009	First Version
J.Carbonell	1.1	26/01/2010	Add in all tag definitions tables, columns with its units, range and accuracy. Update CIII bioreactor bitmap in all the screens. Modify the screens according to the list attached in the minutes of meeting of 19/10/2009.

CONTENTS

ACRONYMS LIST

CIII	Compartment III
HMI	Human Machine Interface
I/O	Input / Output
MELiSSA	Micro-Ecological Life Support System Alternative
MPP	Melissa Pilot Plant
PLC	Programmable Logic Controller
SP	Set-Point

1. SCOPE

This document describes the design of the CIII Local HMI screens implemented with the Magelis Software. The screens design has been derived from Sherpa specifications in [R1]. The work developed herein describes the variables (pressure, temperature, pH, etc) as well as the tools and the instrumentation in Compartment CIII that will be monitored through the Magelis touch-screen as well as to monitor the entire system status.

2. REFERENCE DOCUMENTS

2.1 APPLICABLE DOCUMENTS

Ref	Title	Reference	Issue	Date
[A1]	NTE Offer for CIII control system cabinet and HMI update.	NTE-CIIIP2-OF-001	1.0	Apr.2009
A2	MPP rules for tags and labelling	TN 78.72	2.0	Sept. 2008

2.2 REFERENCE DOCUMENTS

Ref	Title	Reference	Issue	Date
[R1]	CIII_PLC_HMI_20090909.xls			09/09/2009
[R2]	MELISSA CIVa HMI Design Document	NTE-CIVaP2-RP-003	1.2	15/07/2009
[R3]	User requirements specification automation, Nitrification Bioreactor	ESA-URS Automation	Rev2	11/02/2009
[R4]	P&ID of the nitrification bioreactor system	SNC-LAVALIN	RevE	20/01/2009
[R5]	MELiSSA CIII HMI Design Document	NTE-CIIIP2-RP-003	1.1	2010/01/22

3. LOCAL HMI SCREENS

3.1 Screens Hierarchy:

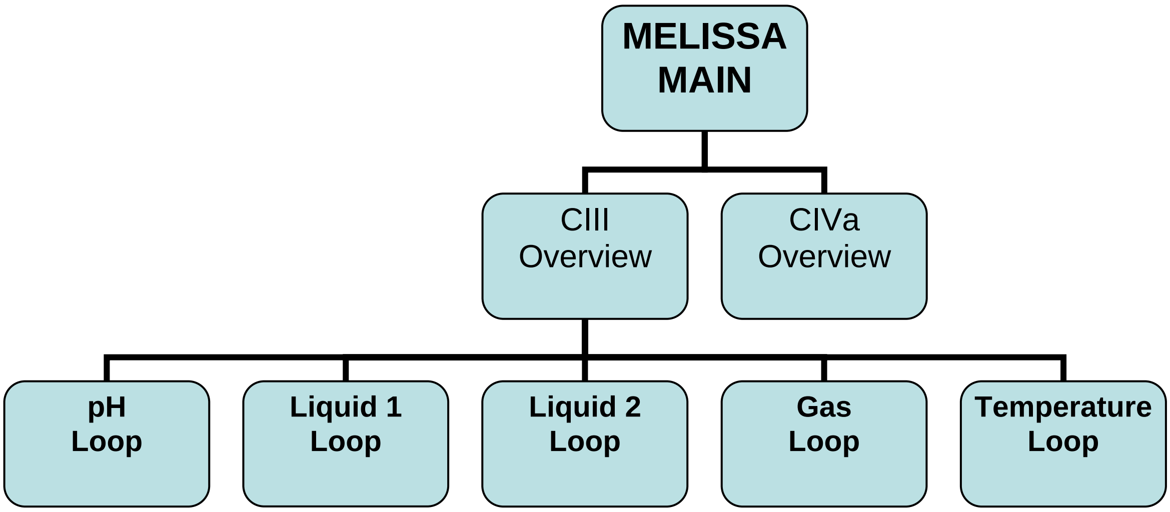


Figure 3-1: Interface architecture

The local HMI will allow the user to interact with the PLC in the proximity of the bioreactor. Through this HMI the user can check and monitor the system operation; however the user will not be able to change variable values of the compartment from it. Another full featured Local HMI will be implemented by assembling a Panel PC with iFIX near to the reactor, therefore, the Magelis local HMI is only left for back-up purposes.

Figure 3-1 shows the general structure of the different Magelis screens. These can be manipulated by the user in order to monitor the system. This map establishes the logical relations among the screens. Therefore, following Figure 3-3, the CIII main screen will show an overview of the complete system. From there, the user will be able to navigate to the screens of second level that represent the different loops in the CIII: pH, Liquid 1, Liquid 2, Gas and Temperature.

3.2 Melissa Main Screen

Figure 3-2: Melissa Main Screen

Melissa main screen is the default screen displayed when Magelis is turned on. From this screen the user can access to the Compartment III and IVa screens and monitors the most significant readings of each compartment.

3.2.1 Tag definition

The following tags are displayed in this screen.

Tag Name	Description	Type
AT_3009_02	Dissolved O_2	Analogue
AT_3013_03	NO_2^- analyser	Analogue
FT_3003_01	Feeding flow	Analogue
FT_3018_01	Harvest flow	Analogue
AT_4010_02	O_2 Analyser	Analogue
CL4009_Biomass_Production	Biomass Production	Analogue
FT_4001_01	Inlet liquid flow to reactor	Analogue
CL4002_PumpSpeed	Flow to the outlet pump	Analogue

Date and system clock values displayed in the Melissa Main Screen and CIII screens are read from CIII PLC system clock. Following tags are displayed:

- Day: CIII_SysClock_day (PLC address: 400411)
- Month: CIII_SysClock_month (PLC address: 400410)
- Year: CIII_SysClock_Year (PLC address: 400409)

- Hour: CIII_SysClock_Hour (PLC address: 400412)
- Minute: CIII_SysClock_Min (PLC address: 400413)

3.3 Overview of the CIII complete system screen

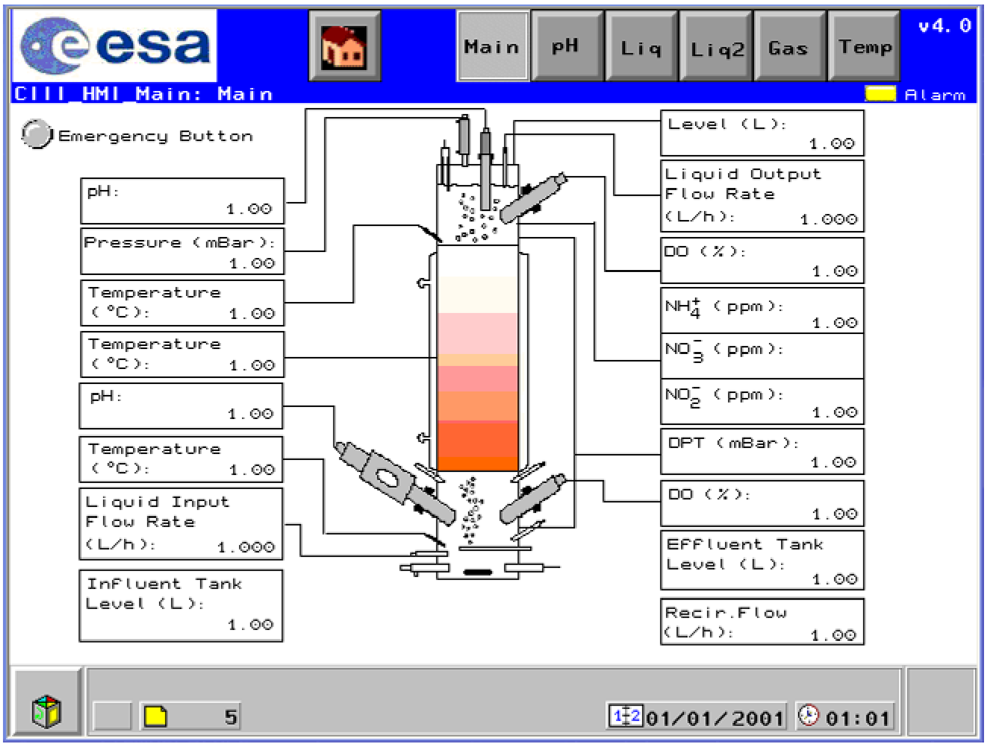


Figure 3-3: CIII Main Screen

To have a general overview of the Compartment CIII, a general schematic will appear in the computer display when user opens the CIII system. The diagram that represents the overview of the system will be something similar as shown in Figure 3-3. From this schematic user could call the other screens (pH, Liquid1, Liquid2, Gas and Temperature). For instance, if the user calls the pH screen, a diagram of this unit will come into view and its instrumentation (valves, pumps, tanks, etc) can be distinguished as well as the different values of the variables that allow controlling it.

The overview screen will also show, if user activates it, the on-line value of the most important parameters of CIII when it is operating to check if the system works accurately as well as the status of the actuators. These parameters are shown in Table 3-1.

3.3.1 Tag definition

The following tags are displayed in this screen.

Tag Name	Description	Type
FT_3003_01	Feeding flow transmitter	Analogue indicator
CL3004_Emer_Button_01	Emergency button	Digital indicator
CIII_General_alarm_status	General alarm indicator	Indicator
TT_3005_01	Bioreactor temperature (middle position)	Analogue indicator
TT_3005_03	Bioreactor temperature (top position)	Analogue indicator
TT_3005_04	Bioreactor temperature (Bottom position)	Analogue indicator

Tag Name	Description	Type
DPT_3007_01	Bioreactor differential pressure	Analogue indicator
PT_3007_01	Bioreactor pressure	Analogue indicator
AT_3008_01	pH sensor	Analogue indicator
AT_3008_02	pH sensor	Analogue indicator
AT_3009_01	Dissolved O2 (bottom position)	Analogue indicator
AT_3009_02	Dissolved O2 (top position)	Analogue indicator
AT_3013_01	NH_4^+ Analyser	Analogue indicator
AT_3013_02	NO_3^- Analyser	Analogue indicator
AT_3013_03	NO_2^- Analyser	Analogue indicator
LT_3002_01	Influent tank level	Analogue indicator
LT_3021_01	Effluent tank level	Analogue indicator
FT_3018_01	Harvest flow sensor	Analogue indicator
LT_3006_01	Bioreactor level	Analogue indicator

Table 3-1 Tags of the CIII system main screen

3.3.2 Alarms

There will be a general alarm indicator which will change the colour depending if there is an alarm in any of the CIII bioreactor systems. The indicator is placed in the right upper corner of all the displays.

- Green: There are no alarms activated in the compartment.
- Yellow: some level 1 alarm is activated.
- Red: some level 2 alarm is activated.

3.4 CIII Liquid1 control screen

The liquid control screens display information related to the liquid flow and level control in the bioreactor. The Liquid control loops have been split into two different screens for the sake of clarity.

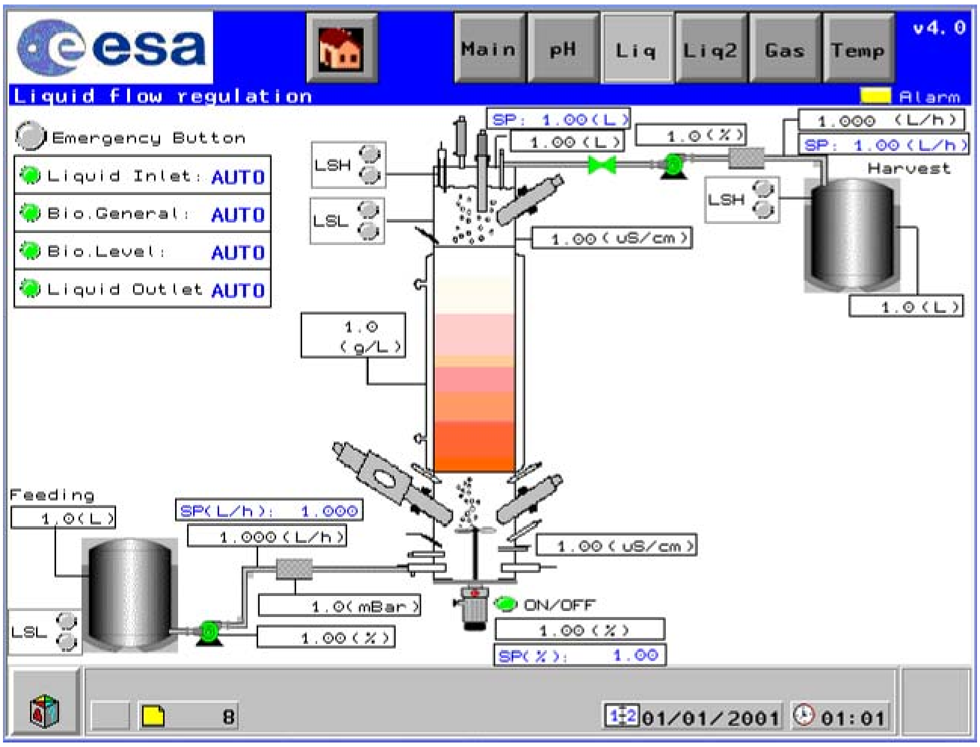


Figure 3-4: Main objects in CIII Liquid1 Screen

The diagram that represents the Liquid1 screen will be something similar as shown in Figure 3-4.

Navigating this screen the user will be able to:

- Monitor the measurements of the liquid level of the reactor, the level of input and output tanks, the speed of the reactor agitator, the liquid conductivity in the reactor, the input and output flow rates.
- Monitor the Set-Points of the bioreactor level, Input flow, output flow and the speed of the reactor agitator.
- Monitor the emergency button indicator. Background colour switch to red when one of the Emergency buttons is pushed.
- Monitor the control loops mode (OFF, AUTO, MAN) implemented in the screen.

3.4.1.1 Control Loops

The following control loops are implemented on the screen:

Tag Name	Description
CL3003	Liquid Inlet
CL3004	Bioreactor General
CL3006	Bioreactor Level
CL3018	Liquid Outlet loop

Table 3-2 Control Loops of the Liquid1 screen of CIII system

3.4.1.2 Tag definition

The following tags are displayed in this screen.

Tag Name	Description	Type
LSL_3002_01	Influent tank low level switch	Digital indicator
LSL_3002_02	Influent tank low level switch	Digital indicator
LT_3002_01	Influent tank level transmitter	Analogue indicator
FT_3003_01_Set_Point	Feeding pump SP	Analogue indicator
PP_3003_01_MV1	Feeding pump	Pump animated
PP_3003_01_MV2	Speed of feeding pump	Analogue indicator
FT_3003_01	Feeding flow transmitter	Analogue indicator
PT_3003_01	Feeding pressure	Analogue indicator
BLE_3004_01_SP	Blender SP	Analogue indicator
BLE_3004_01_MV1	Blender Status	Pump animated
BLE_3004_01	Blender speed	Analogue indicator
CL3004_Emer_Button_01	Emergency button	Digital indicator
CIII_General_alarm_status	General alarm indicator	Indicator
CL3006_BioreactorLevel_SP	Bioreactor Level SP	Analogue indicator
LSH_3006_01	Bioreactor High level switch	Digital indicator
LSH_3006_02	Bioreactor High level switch	Digital indicator
LSL_3006_01	Bioreactor Low level switch	Digital indicator
LSL_3006_02	Bioreactor Low level switch	Digital indicator
LT_3006_01	Bioreactor level	Analogue indicator
AT_3010_01	Conductivity sensor (bottom)	Analogue indicator
AT_3010_02	Conductivity sensor (top)	Analogue indicator
CL3018_Flow_SP	Outlet flow SP	Analogue indicator
FT_3018_01	Harvest flow sensor	Analogue indicator
PP_3018_01_MV1	Pump	Pump animated
PP_3018_01_MV2	Pump speed	Analogue indicator
SV_3018_01_FB	Reactor liquid outlet valve	2-way valve animated
LSH_3021_01	Effluent high level switch	Digital indicator
LSH_3021_02	Effluent high level switch	Digital indicator
LT_3021_01	Effluent level	Analogue indicator
AT_3014_01	Biomass sensor	Analogue indicator

Table 3-3 Tags of the Liquid1 screen of CIII system

3.4.2 CIII Liquid2 control screen

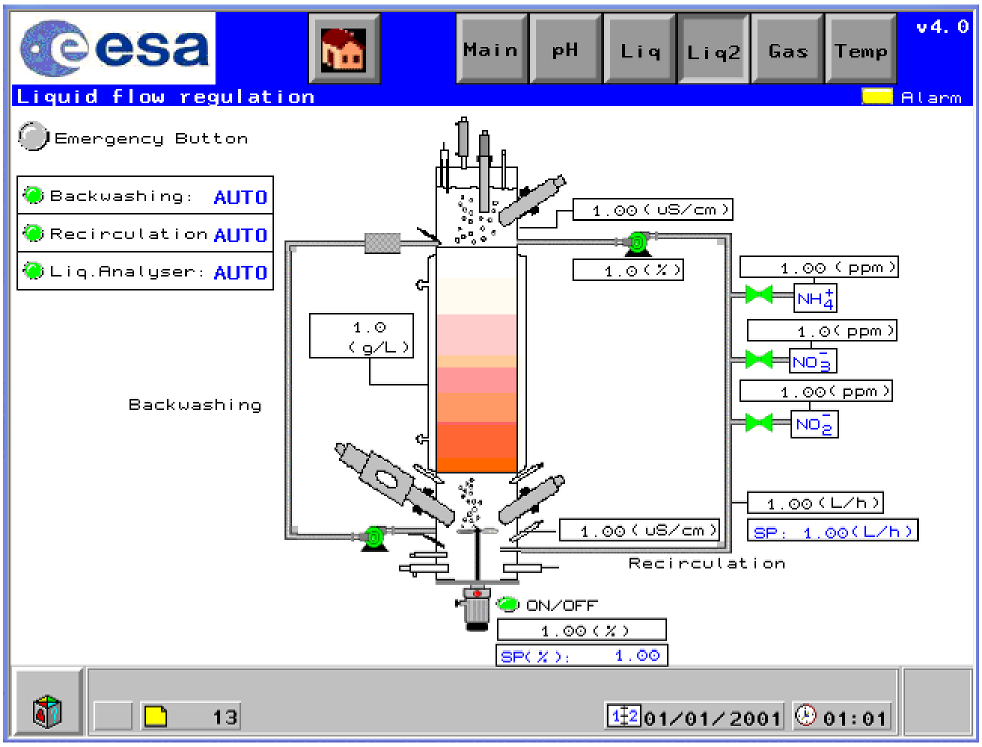


Figure 3-5: Main objects in CIII Liquid2 Screen

The diagram that represents the Liquid2 screen will be something similar as shown in *Figure 3-5*.

Navigating this screen the user will be able to:

- Monitor the measurements of: the speed of the reactor agitator, the liquid conductivity in the reactor, the recirculation flow rate and concentration of the liquid analyzers.
- Monitor the Set-Point of recirculation flow and the speed of the reactor agitator.
- Monitor the emergency button indicator. Background colour switch to red when one of the Emergency buttons is pushed.
- Monitor the control loops mode (OFF, AUTO, MAN) implemented in the screen.

3.4.2.1 Control Loops

The following control loops are implemented on the screen:

Tag Name	Description
CL3015	Backwashing loop
CL3017	Liquid Recirculation loop
CL3013	Gas Analyser Loop

Table 3-4 Control Loops of the Liquid2 screen of CIII system

3.4.2.2 Tag definition

The following tags are displayed in this screen.

Tag Name	Description	Type
BLE_3004_01_SP	Blender SP	Analogue indicator
BLE_3004_01_MV1	Blender Status	Pump animated

Tag Name	Description	Type
BLE_3004_01	Blender speed	Analogue indicator
CL3004_Emer_Button_01	Emergency button	Digital indicator
CIII_General_alarm_status	General alarm indicator	Indicator
AT_3010_01	Conductivity sensor (bottom)	Analogue indicator
AT_3010_02	Conductivity sensor (top)	Analogue indicator
PP_3015_01_MV	Backwashing pump	Pump animated
CL3017_Flow_SP	Recirculation flow SP	Analogue indicator
FT_3017_01	Recirculation flow	Analogue indicator
PP_3017_01_MV1	Pump status	Pump animated
PP_3017_01_MV2	Pump speed	Analogue indicator
SV_3013_01_FB	NH_4^+ sampling valve	2-way valve animated
SV_3013_02_FB	NO_3^- sampling valve	2-way valve animated
SV_3013_03_FB	NO_2^- sampling valve	2-way valve animated
AT_3013_01	NH_4^+ Analyser	Analogue indicator
AT_3013_02	NO_3^- Analyser	Analogue indicator
AT_3013_03	NO_2^- Analyser	Analogue indicator
AT_3014_01	Biomass sensor	Analogue indicator

Table 3-5 Tags of the Liquid loop of CIII system

3.5 CIII Gas Loop screen

This screen shows the information related to the gas control loops.

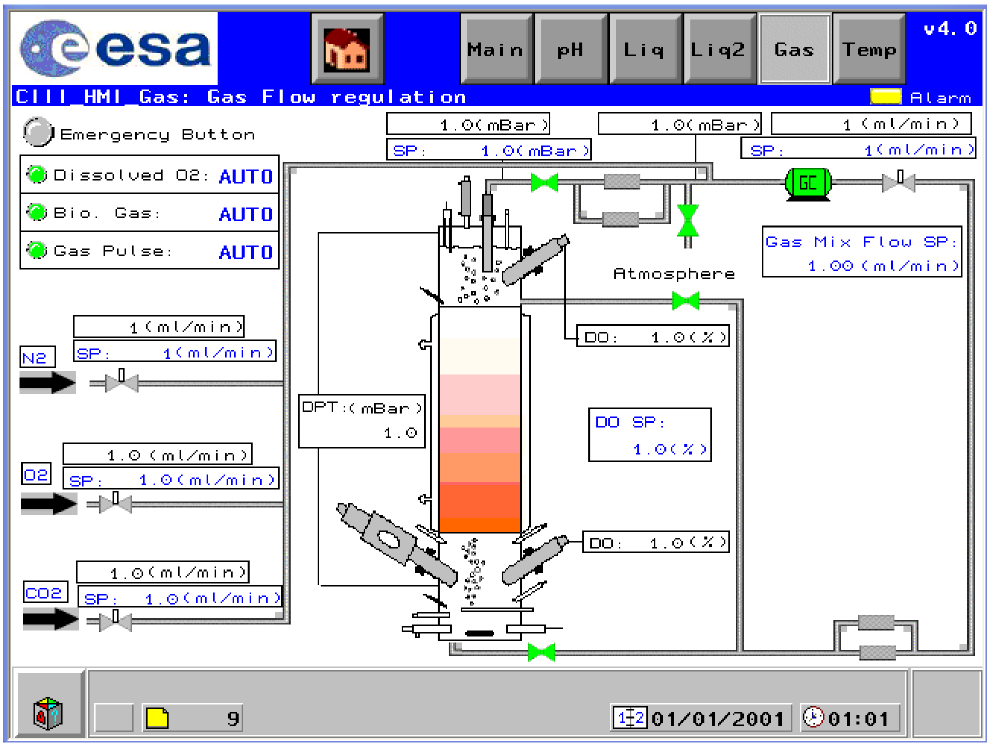


Figure 3-6: Main objects in CIII Gas Screen

The diagram that represents the Gas loop screen will be something similar as shown in *Figure 3-6*.

Navigating this screen the user will be able to:

- Monitor the N_2 gas flow, the O_2 gas flow, the CO_2 gas flow, the gas mix flow, the dissolved O_2 concentration and the pressure transmitters.
- Monitor the set-points of dissolved oxygen and gas mix flow.
- Monitor the emergency button indicator. Background colour switch to red when one of the Emergency buttons is pushed.
- Monitor the control loops mode (OFF, AUTO, MAN) implemented in the screen.

3.5.1 Control Loops

The following control loops are implemented on the screen:

Tag Name	Description
CL3009	DO2
CL3011	Bioreactor Gas Loop
CL3016	Gas pulse loop

Table 3-6 Control Loops of the Gas loop of CIII system

3.5.2 Tag definition

The following tags are displayed in this screen.

Tag Name	Description	Type
DPT_3007_01	Bioreactor differential pressure	Analogue indicator
PT_3007_01	Bioreactor pressure	Analogue indicator
CL3009_DO2_SP	DO2 SP in automatic mode	Analogue indicator

Tag Name	Description	Type
AT_3009_01	DO2 transmitter (Bottom)	Analogue indicator
AT_3009_02	DO2 transmitter (TOP)	Analogue indicator
FQRC_3009_01	Flow transmitter (O2)	Analogue indicator
FQRC_3009_01_SP	Mass flow SP indicator	Analogue indicator
CL3011_GasMix_SP	Gas mix SP in automatic mode	Analogue indicator
GC_3011_01_MV	Gas compressor	Compressor animated
FQRC_3011_01_SP	N2 flow transmitter SP indicator	Analogue indicator
FQRC_3011_01	N2 flow transmitter	Analogue indicator
FQRC_3011_02_SP	Mix flow transmitter SP indicator	Analogue indicator
FQRC_3011_02	Mix flow transmitter	Analogue indicator
PT_3011_01	Pressure in Gas loop	Analogue indicator
SV_3011_01_FB	Reactor venting valve	2-way valve animated
SV_3011_02_FB	Gas exhaust valve	2-way valve animated
SV_3011_03_FB	Gas introduction valve	2-way valve animated
SV_3016_01_FB	Gas introduction valve	2-way valve animated
CL3004_Emer_Button_01	Emergency button	Digital indicator
CIII_General_alarm_status	General alarm indicator	Indicator
FQRC_3008_01	CO2 flow transmitter	Analogue indicator
FQRC_3008_01_SP	CO2 flow SP indicator	Analogue indicator

Table 3-7 Tags of the Gas loop of CIII system

3.6 CIII Temperature Loop screen

This screen displays information related to the temperature control loops of the bioreactor and the influent and effluent tanks.

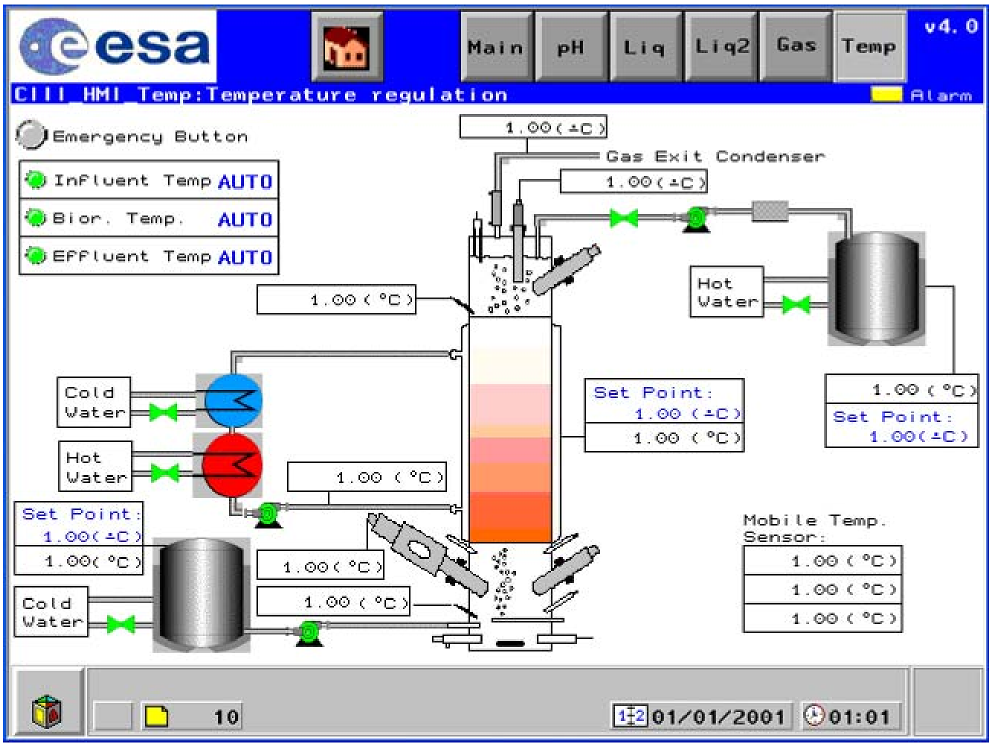


Figure 3-7: Main objects in CIII Temperature Screen

The diagram that represents the Temperature loop of the system will be something similar as shown in *Figure 3-7*.

Navigating this screen the user will be able to:

- Monitor the temperature of each tank, the bioreactor fluid jacket and mobile temperature sensors.
- Monitor the temperature set-points of each of the tanks and the bioreactor.
- Monitor the emergency button indicator. Background colour switch to red when one of the Emergency buttons is pushed.
- Monitor the control loops mode (OFF, AUTO, MAN) implemented in the screen.

3.6.1 Control Loops

The following control loops are implemented on the screen:

Tag Name	Description
CL3001	Influent Temperature
CL3005	Bioreactor Temperature
CL3020	Effluent Temperature

Table 3-8 Control Loops of the Temperature loop of CIII system

3.6.2 Tag definition

The following tags are displayed in this screen. (The user inputs are highlighted in green).

Tag Name	Description	Type
SV_3001_01_FB	Temperature control valve	2-way valve
TT_3001_01	Influent tank temperature	Analogue indicator
TT_3001_01_SP	Influent tank temperature SP	Analogue indicator

Tag Name	Description	Type
TT_3005_SP	Bioreactor temperature SP	Analogue indicator
CP_3005_01_MV	Circulation pump	Pump animated
SV_3005_02_FB	Heat exchanger valve (HOT)	2-way valve animated
SV_3005_01_FB	Heat exchanger valve (COLD)	2-way valve animated
TT_3005_02	Reactor jacket temperature	Analogue indicator
TT_3005_01	Bioreactor temperature (middle position)	Analogue indicator
TT_3005_03	Bioreactor temperature (top position)	Analogue indicator
TT_3005_04	Bioreactor temperature (Bottom position)	Analogue indicator
TT_3020_01_SP	Effluent tank temperature SP	Analogue indicator
SV_3020_01_FB	Temperature control valve	2-way valve animated
TT_3020_01	Effluent tank temperature	Analogue indicator
CL3004_Emer_Button_01	Emergency button	Digital indicator
CIII_General_alarm_status	General alarm indicator	Indicator
TT_3023_01	Mobile Temperature used for sterilisation	Analogue indicator
TT_3023_02	Mobile Temperature used for sterilisation	Analogue indicator
TT_3023_03	Mobile Temperature used for sterilisation	Analogue indicator
PP_3003_01_MV1	Feeding pump	Pump animated
PP_3018_01_MV1	Effluent Pump	Pump animated
SV_3018_01_FB	Reactor liquid outlet valve	2-way valve animated

Table 3-9 Tags of the Temperature loop of CIII system

3.7 CIII pH Loop screen

The pH screen displays information related to the pH control loops.

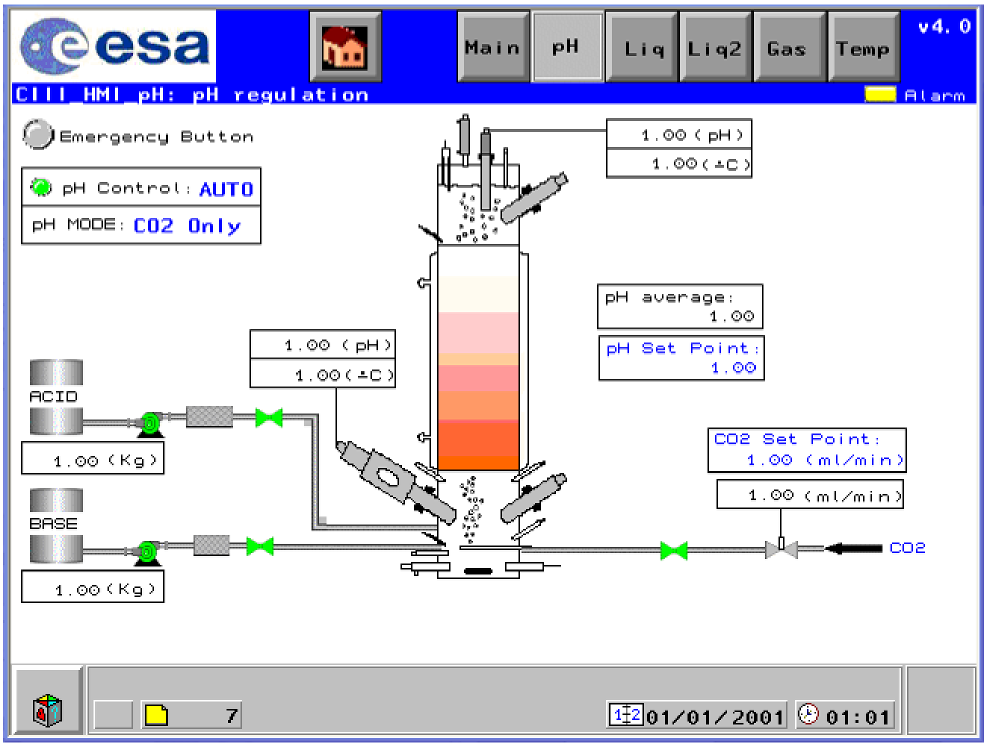


Figure 3-8: Main objects in CIII pH Screen

The screen that represents the pH loop information will be something similar as shown in *Figure 3-8*.

Navigating this screen the user will be able to:

- Monitor the pH values and the temperature of each pH sensor.
- Monitor the weight of acid and base vessels.
- Monitor the CO_2 flow.
- Monitor the pH set-point
- Monitor the pH average.
- Monitor the emergency button indicator. Background colour switch to red when one of the Emergency buttons is pushed.
- Monitor the control loops mode (OFF, AUTO, MAN) implemented in the screen.
- Monitor the pH mode for the bioreactor pH control (CO2 Only, CO2+base or Acid+base).

3.7.1 Control Loops

The following control loops are implemented on the screen:

Tag Name	Description
CL3008	pH Control

Table 3-10 Control Loops of the pH loop of CIII system

3.7.2 Tag definition

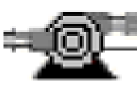
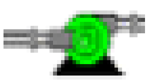
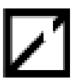
The following tags are displayed in this screen.

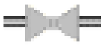
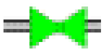
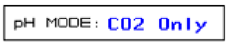
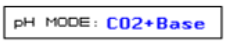
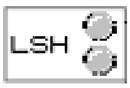
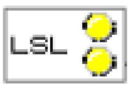
Tag Name	Description	Type
CL3008_pH_SP	pH SP	Analogue indicator
PP_3008_01_MV	Acid pump	Pump animated
PP_3008_02_MV	Base pump	Pump animated
AT_3008_01	pH sensor	Analogue indicator
TT_3008_01	Temperature of the pH sensor	Analogue indicator
AT_3008_02	pH sensor	Analogue indicator
TT_3008_02	Temperature of the pH sensor.	Analogue indicator
WIT_3008_01	Acid bottle weight	Balance with Analogue indicator
WIT_3008_02	Base bottle weight	Balance with analogue indicator
SV_3008_01_FB	Acid valve	2-way valve
SV_3008_02_FB	Base valve	2-way valve
FQRC_3008_01	CO2 flow transmitter	Analogue indicator
FQRC_3008_01_SP	CO2 flow SP indicator	Analogue indicator
CL3004_Emer_Button_01	Emergency button	Digital indicator
CIII_General_alarm_status	General alarm indicator	Indicator
CL3008_pH_AVERAGE	pH Average	Analogue Indicator
CL3008_pH_MODE	pH mode selector (1=CO2 only, 2=CO2+Base and 3= Acid+Base)	Text Indicator

Table 3-11 Tags of the pH loop of CIII system

4. CIII MAGELIS SYMBOLS

Symbols shall be consistently used, that is, same symbol shall be used in all schematics to represent the same type of device.

Device symbol	Description	Events
	Emergency button state indicator	Not pushed
		Pushed
	Generic pump state indicator	Not activated
		Activated
	Gas Filter	Not animated

Device symbol	Description	Events
	Liquid Filter	Not animated
	Control loop mode indicator	OFF: Control loop stopped
		AUTO: Control loop in automatic mode
		MAN: Control loop in manual mode
	Valve feedback indicator	Valve close
		Valve open
	Blender indicator	Blender not activated
		Blender activated
	pH mode indicator	CO2 only
		CO2 + Base
		Acid + Base
	Level switch	Level switch high: Yellow: tank full
		Level Switch low: Yellow: tank empty
	Analogue set point indicator	
	Analogue indicator	
	Flow Meter	

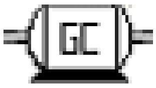
Device symbol	Description	Events
	Gas compressor	Not activated
		Activated
	General alarm indicator	No alarms activated in the compartment
		Some level 1 alarm is activated
		Some level 2 alarm is activated

Table 4-1 Device symbol table

5. TAGS LIST

A list of the Tags with their PLC address, units and accuracy is provided in [R5].

CIII HMI SW USER MANUAL

FOR THE

MELISSA CS CIIIP2 Project

APPROVAL LIST		
NAME	SIGNATURE	DATE
Prepared by: J.Carbonell		22/02/2010
Revised by: J.Duatis		22/02/2010
Approved by: E.Creus		22/02/10
Authorised by: J.Duatis		22/02/2010

DISTRIBUTION LIST		
NAME	POSITION	COMPANY
O.Gerbi		SHERPA ENGINEERING
C.Bourg		SHERPA ENGINEERING
A.Fossen		MPP/ESA
E.Peiro		MPP
R.Moyano		MPP

CHANGE RECORD			
AUTHOR	ISSUE	DATE	CHANGE
J.Carbonell	1.0	12/11/2009	New Version
J.Carbonell	1.1	12/01/2010	Add in all tag definitions tables, columns with its units, range and precision. Update CIII bioreactor bitmap in all the screens. Modify the screens according to the list attached in the minutes of meeting of 19/10/2009.
J.Carbonell	1.2	22/02/2010	Add level switch alarms tags in the Table 5-2 and Table 5-3. Update Magelis screens to the v5 in the section 7 (Change labels “Set Point” to “SP” and identify pH1 and pH2 probe in the specific screens).

CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

1. SCOPE

This Operations Manual is intended to help the operation and maintenance of the compartment CIII in the MELISSA Plant installed in the UAB.

The detailed design description of this system is provided in the "User requirements specification automation, Nitrification Bioreactor" Document [R2].

2. REFERENCE DOCUMENTS

2.1 APPLICABLE DOCUMENTS

Ref	Title	Reference	Issue	Date
[A1]	NTE Offer for CIII control system cabinet and HMI update.	NTE-CIIIP2-OF-001	1.0	Apr.2009
[A2]	MPP rules for tags and labelling	TN 78.72	2.0	Sept. 2008

2.2 REFERENCE DOCUMENTS

Ref	Title	Reference	Issue	Date
[R1]	CIII_PLC_HMI_20100217.xls			17/02/2010
[R2]	User requirements specification automation, Nitrification Bioreactor.	ESA-URS Automation	Rev2	11/02/2009
[R3]	P&ID of the nitrification bioreactor system	SNC-LAVALIN	RevE	20/01/2009
[R4]	MELiSSA CIII HMI Design	NTE-CIIIP2-RP-003	1.1	12/01/2009

LIST OF ACRONYMS

CI	Compartment I
CII	Compartment II
CIII	Compartment III
CIVa	Compartment IVa
CIVb-HPC1	Compartment IVb-HPC1
HMI	Human Machine Interface
I/O	Input / Output
MELiSSA	Micro-Ecological Life Support System Alternative
MPP	Melissa Pilot Plant
PLC	Programmable Logic Controller
SP	Set-Point
DO_2	Dissolved O_2

3. INTRODUCTION

3.1 Intended Readership

This manual is intended for personnel in charge of the operation of the MELISSA Control System for both maintenance and scientific purposes.

- Investigators responsible of performing in-plant experiments.
- Maintenance and troubleshooting personnel in charge of the installation and maintenance of the MELISSA Pilot Plant Software.

It is expected that users have some basic Microsoft® Windows knowledge and familiarity with the MELISSA Pilot Plant.

Note that no detailed explanation about the operation of third-party software(s) used to implement the Control System is given in this manual, but only reference to their corresponding user manuals when more detail is needed.

3.2 Purpose

The purpose of this document is to provide the user with an understanding of the functions available in the MELISSA CIII HMI Software and a description of the common operations to be performed during its utilisation and maintenance. Following the instructions described in this manual will lead to a better understanding and to obtain a full profit of the MELISSA CIII HMI software utilisation.

3.3 How to use this document

The Overview section is intended for all users. It summarises what this system is used for, into the process of using the MELISSA Pilot Plant.

The Table of Contents can be used to easily locate the detailed description of a specific function.

Maintenance and troubleshooting are addressed in par, 8 and 9 respectively.

3.4 Problem reporting instructions

Problems found must be reported to NTE-SENER following the form included in APPENDIX B.

NTE-SENER, S.A.
Pol. Can Malé s/n

08186 Lliça d'Amunt

Barcelona

Spain

www.nte-sener.es

Tel.: 93 860 9001

Fax: 93 860 9019

4. OVERVIEW

The Compartment III has been designed to bioconvert NH_4^+ into NO_3^- using mix of bacteria, Nitrobacter and Nitrosomonas immobilized on a fixed bed bioreactor.

The Compartment III of the Melissa loop is composed of the main following components:

- The feeding vessel that allows storing the NH_4^+ feed coming from the compartment II before to be pumped into the bioreactor.
- The Nitrification Bioreactor where the NH_4^+ feed is transformed into NO_3^- ions.
- The pH correcting systems that are used to operate the bioreactor at its optimum pH.
- The gas distribution system that allows injecting the gas mixture (mainly oxygen) into the bioreactor from dedicated gas sources and to recover the unused gas mixture for recirculation into the Bioreactor with the suitable gas make up mixture.
- The harvesting system that is used to collect the NO_3^- solution leaving the bioreactor and to remove the cells from the harvest. This NO_3^- solution is stored temporally in the harvesting vessel before its use in the next compartment of the Melissa loop.

Figure 4-1: CIII frame

5. DISPLAYS

5.1 Display hierarchy

Supervision displays navigation is implemented as follows:

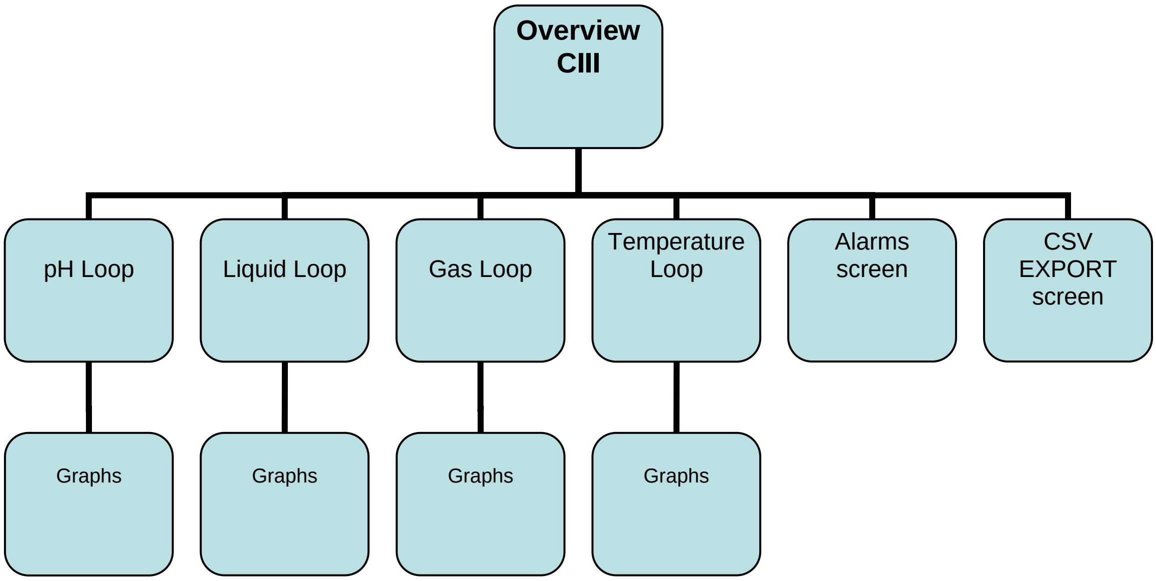


Figure 5-1: Display hierarchy

Figure 5-1 shows the general structure of the different screens that will appear. These can be manipulated by the user in order to interact with the automation and control system. This map establishes the logical relations among the screens.

Therefore, following Figure 5-2, the main screen shows an overview of the complete system. From there, the user can navigate to the screens of second level that represent the different loops in the CIII: pH, Liquid, Gas and Temperature. From these screens the user can open graphs showing the history values of the different variables (pH, Temperature, Pressure, level, liquid analysers, etc). Furthermore, the user is able to open the alarms screen and CSV export data screen.

5.2 MELISSA MAIN WINDOW

From this window, the user can access to the Main window of each compartment.

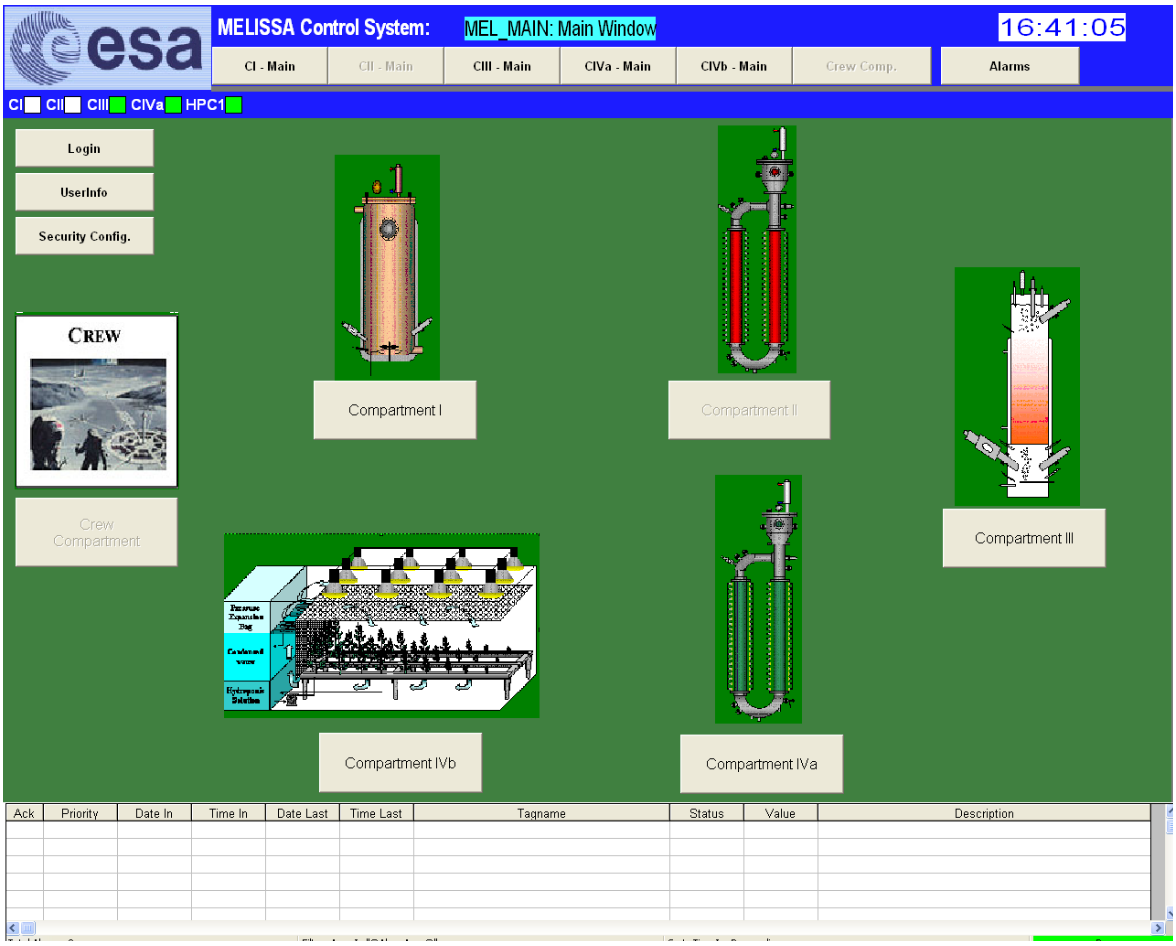


Figure 5-2: Melissa Main Window

In the Main Menu there are the general alarm indicators of each compartment, indicator background colour changes according to:

- Green: There are no alarms activated in the compartment.
- Yellow: some level 1 alarm is activated.
- Red: some level 2 alarm is activated.
- White: general alarm indicator not implement.

In the following picture, compartment CI and CII do not have general alarm indicator implemented (indicator in white), CIII has no alarm activated (indicator in green), in CIVa there is some level 1 alarm activated (indicator in yellow) and in the compartment CIVb HPC1 there is some level 2 alarm activated (indicator in red).

Figure 5-3: Global alarms

5.3 Compartment CIII Main Window

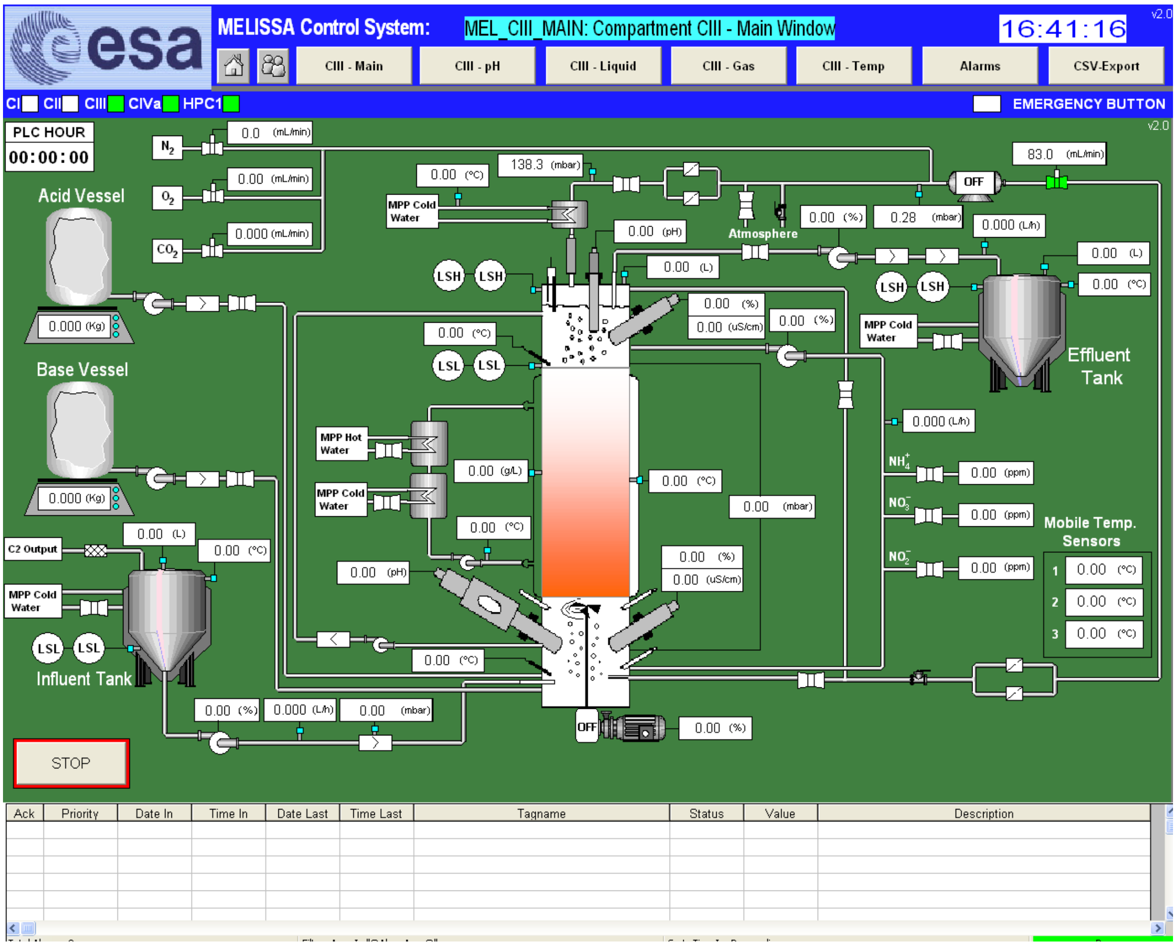


Figure 5-4: Compartment CIII Main Window

5.3.1 CIII Main Menu

On the top of the window it is placed the Compartment CIII Main Menu which is used to navigate for each subsystem of the CIII, to visualize general alarms indicators, to check if any of the emergency buttons has been pressed and to configure the PLCs system clock.

5.3.2 System clock configuration

The system PLC clock can be set from the HMI by double-clicking over the digital clock placed in the CIII Main Menu (Figure 5-5). Once clicked the configuration window (Figure 5-6) will be displayed.

Figure 5-5: CIII Main Menu Window

PLCs system clock configuration window is opened reading the following values from the PLC connected to the CIII:

- Day of week
- Day
- Month

- Year
- Hour
- Minute
- Second

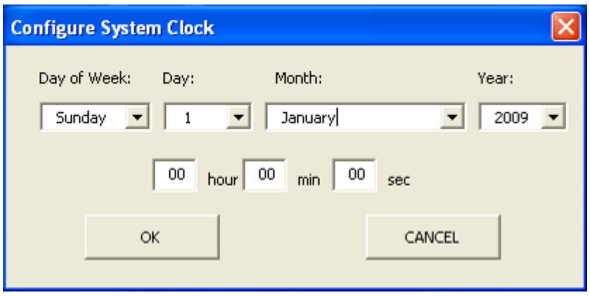


Figure 5-6: CIII system clock configuration window

The user configures the system clock and press “Ok” command button to write updated values. Note that all PLCs in the network will be updated.

Pressing “CANCEL” command button, the window is closed without writing any value.

5.3.3 CIII Main Window

From the compartment CIII Main Window the user has a general view of the compartment CIII and it allows the following actions:

- Monitoring the analogue indicators of the most significant readings.
- Visualizing object alarm animation.
- Visualizing 2-way valves, pumps, level switch, pipes, tank levels, blender and blower animations.
- Pushing the emergency command button, it stops all control loops of the CIII:
    - Influent General Mode (CL3000)
    - Influent Temperature Mode (CL3001)
    - Influent Level Mode (CL3003)
    - Inlet Liquid Mode(CL3004)
    - Bioreactor Temperature Mode (CL3005)
    - Bioreactor Level Mode (CL3006)
    - Bioreactor pH Mode (CL3008)
    - Bioreactor DO2 Mode (CL3009)
    - Gas Loop Mode (CL3011)
    - Liquid Analyzer Mode (CL3013)
    - Backwashing Mode (CL3015)
    - Gas Pulse Mode (CL3016)
    - Liquid Recirculation Mode (CL3017)

- Outlet Liquid Mode (CL3018)
- Effluent Temperature Mode (CL3020)
- Foam Control Mode (CL3022)

5.3.4 Tags

Tag Name	Description	Type	Units	Range
SV_3001_01_FB	Temperature control valve	2-way valve	---	---
TT_3001_01	Influent tank temperature	Analogue indicator	(ºC)	0 to 150
LSL_3002_01	Influent tank low level switch	Digital indicator	---	---
LSL_3002_02	Influent tank low level switch	Digital indicator	---	---
LT_3002_01	Influent tank level transmitter	Analogue indicator	(L)	0 to 30
PP_3003_01_MV1	Feeding pump	Pump animated	---	---
PP_3003_01_MV2	Speed of feeding pump	Analogue indicator	(%)	0 to 100
PP_3003_01_MV3	Rotation direction of feeding pump	Row indicator	---	---
FT_3003_01	Feeding flow transmitter	Analogue indicator	(L/h)	0 to 2
PT_3003_01	Feeding pressure	Analogue indicator	(mBar)	-1000 to 4000
BLE_3004_01_MV1	Blender	Pump animated	---	---
BLE_3004_01	Blender speed	Analogue indicator	(%)	0 to 100
CL3004_Emer_Button_01	Emergency button	Digital indicator	---	---
CP_3005_01_MV	Circulation pump	Pump animated	---	---
SV_3005_02_FB	Heat exchanger valve (HOT)	2-way valve animated	---	---
SV_3005_01_FB	Heat exchanger valve (COLD)	2-way valve animated	---	---
TT_3005_02	Reactor jacket temperature	Analogue indicator	(ºC)	0 to 150
TT_3005_01	Bioreactor temperature (middle position)	Analogue indicator	(ºC)	0 to 150
TT_3005_03	Bioreactor temperature (top position)	Analogue indicator	(ºC)	0 to 150
TT_3005_04	Bioreactor temperature (Bottom position)	Analogue indicator	(ºC)	0 to 150
LSH_3006_01	Bioreactor High level switch	Digital indicator	---	---
LSH_3006_02	Bioreactor High level switch	Digital indicator	---	---
LSL_3006_01	Bioreactor Low level switch	Digital indicator	---	---
LSL_3006_02	Bioreactor Low level switch	Digital indicator	---	---
LT_3006_01	Bioreactor level	Analogue indicator	(L)	0 to 100
DPT_3007_01	Bioreactor differential pressure	Analogue indicator	(mBar)	0 to 3000
PT_3007_01	Bioreactor pressure	Analogue indicator	(mBar)	-1000 to 4000
PP_3008_01_MV	Acid pump	Pump animated	---	---
PP_3008_02_MV	Base pump	Pump animated	---	---
AT_3008_01	pH sensor	Analogue indicator	(pH)	0 to 14

Tag Name	Description	Type	Units	Range
AT_3008_02	pH sensor	Analogue indicator	(pH)	0 to 14
WIT_3008_01	Acid bottle weight	Analogue indicator	(Kg.)	0 to 6
WIT_3008_02	Base bottle weight	Analogue indicator	(Kg.)	0 to 6
SV_3008_01_FB	Acid valve	2-way valve	---	---
SV_3008_02_FB	Base valve	2-way valve	---	---
FQRC_3008_01	CO2 flow transmitter	Analogue indicator	(mL/min)	0 to 50
AT_3009_01	Dissolved O2 (bottom position)	Analogue indicator	(%)	0 to 100
AT_3009_02	Dissolved O2 (top position)	Analogue indicator	(%)	0 to 100
FQRC_3009_01	O2 flow transmitter	Analogue indicator	(mL/min)	0 to 500
AT_3010_01	Conductivity sensor (bottom)	Analogue indicator	(uS/cm)	0.02 to 50
AT_3010_02	Conductivity sensor (top)	Analogue indicator	(uS/cm)	0.02 to 50
GC_3011_01_MV	Gas compressor	Compressor animated	---	---
FQRC_3011_01_SP	N2 flow transmitter	Analogue indicator	(mL/min)	0 to 8333
FQRC_3011_02	Mix flow transmitter	Analogue indicator	(mL/min)	0 to 10000
PT_3011_01	Pressure in Gas loop	Analogue indicator	(mBar)	-1000 to 4000
SV_3011_01_FB	Reactor venting valve	2-way valve animated	---	---
SV_3011_02_FB	Gas exhaust valve	2-way valve animated	---	---
TT_3012_01	Air vent cold water temperature	Analogue indicator	(ºC)	0 to 150
SV_3013_01_FB	NH_4^+ sampling valve	2-way valve animated	---	---
SV_3013_02_FB	NO_3^- sampling valve	2-way valve animated	---	---
SV_3013_03_FB	NO_2^- sampling valve	2-way valve animated	---	---
AT_3013_01	NH_4^+ Analyser	Analogue indicator	(ppm)	0 to 155.6
AT_3013_02	NO_3^- Analyser	Analogue indicator	(ppm)	0 to 1000
AT_3013_03	NO_2^- Analyser	Analogue indicator	(ppm)	0 to 20
AT_3014_01	Biomass sensor	Analogue indicator	(g/L)	TBD
PP_3015_01_MV	Backwashing pump	Pump animated	---	---
SV_3011_03_FB	Gas introduction valve	2-way valve animated	---	---
SV_3016_01_FB	Gas introduction valve	2-way valve animated	---	---
FT_3017_01	Recirculation flow	Analogue indicator	(L/h)	0 to 5
PP_3017_01_MV1	Pump	Pump animated	---	---
PP_3017_01_MV2	Pump Speed (%)	Analogue Indicator	(%)	0 to 100
PP_3017_01_MV3	Rotation direction of recirculation pump	Row indicator	---	---

Tag Name	Description	Type	Units	Range
FT_3018_01	Harvest flow sensor	Analogue indicator	(L/h)	0 to 2
PP_3018_01_MV1	Pump	Pump animated	---	---
PP_3018_01_MV2	Pump Speed (%)	Analogue Indicator	(%)	0 to 100
PP_3018_01_MV3	Rotation direction of effluent pump	Row indicator	---	---
SV_3018_01_FB	Reactor liquid outlet valve	2-way valve animated	---	---
SV_3020_01_FB	Temperature control valve	2-way valve animated	---	---
TT_3020_01	Effluent tank temperature	Analogue indicator	(ºC)	0 to 150
LSH_3021_01	Effluent high level switch	Digital indicator	---	---
LSH_3021_02	Effluent high level switch	Digital indicator	---	---
LT_3021_01	Effluent level	Analogue indicator	(L)	0 to 30
TT_3023_01	Mobile Temperature used for sterilisation	Analogue indicator	(ºC)	0 to 150
TT_3023_02	Mobile Temperature used for sterilisation	Analogue indicator	(ºC)	0 to 150
TT_3023_03	Mobile Temperature used for sterilisation	Analogue indicator	(ºC)	0 to 150

Table 5-1:Tags of the Main Screen

5.3.5 Alarms

The following alarms are linked with the operation of the CIII main screen.

TAG NAME	Description	Colour
LT_3002_01_AH	Influent tank level reaches high level 1 alarm	YELLOW
LT_3002_01_AHH	Influent tank level reaches high level 2 alarm	RED
LT_3002_01_AL	Influent tank level reaches low level 1 alarm	YELLOW
LT_3002_01_ALL	Influent tank level reaches low level 2 alarm	RED
LT_3002_01_ERR	Influent tank level sensor link error	“ERR” text in RED
FT_3003_01_AH	Feeding flow reaches high level 1 alarm	YELLOW
FT_3003_01_AHH	Feeding flow reaches high level 2 alarm	RED
FT_3003_01_AL	Feeding flow reaches low level 1 alarm	YELLOW
FT_3003_01_ALL	Feeding flow reaches low level 2 alarm	RED
FT_3003_01_ERR	Feeding flow sensor link error	“ERR” text in RED
PT_3003_01_AH	Feeding pressure reaches high level 1 alarm	YELLOW
PT_3003_01_AHH	Feeding pressure reaches high level 2 alarm	RED
PT_3003_01_AL	Feeding pressure reaches low level 1 alarm	YELLOW
PT_3003_01_ALL	Feeding pressure reaches low level 2 alarm	RED
PT_3003_01_ERR	Feeding pressure sensor error link	“ERR” text in RED
BLE_3004_01_A	Set if blender ON and Bioreactor is empty in manual mode	RED
BLE_3004_01_ERR	Bioreactor agitator error link	“ERR” text in RED
LT_3006_01_ERR	Bioreactor level sensor link error	“ERR” text in RED
LT_3006_01_AHH	Bioreactor level reaches high level 2 alarm	RED
LT_3006_01_ALL	Bioreactor level reaches low level 2 alarm	RED
LT_3006_01_AH	Bioreactor level reaches high level 1 alarm	YELLOW
LT_3006_01_AL	Bioreactor level reaches low level 1 alarm	YELLOW
AT_3010_01_AH	Bioreactor EC (bottom) reaches high level 1 alarm	YELLOW
AT_3010_01_AHH	Bioreactor EC (bottom) reaches high level 2 alarm	RED
AT_3010_01_AL	Bioreactor EC (bottom) reaches low level 1 alarm	YELLOW
AT_3010_01_ALL	Bioreactor EC (bottom) reaches low level 2 alarm	RED
AT_3010_01_ERR	Bioreactor EC (bottom) sensor link error	“ERR” text in RED
AT_3010_02_AH	Bioreactor EC (top) reaches high level 1 alarm	YELLOW
AT_3010_02_AHH	Bioreactor EC (top) reaches high level 2 alarm	RED
AT_3010_02_AL	Bioreactor EC (top) reaches low level 1 alarm	YELLOW
AT_3010_02_ALL	Bioreactor EC (top) reaches low level 2 alarm	RED

TAG NAME	Description	Colour
AT_3010_02_ERR	Bioreactor EC (top) sensor link error	“ERR” text in RED
SV_3013_01_ERR	NH4 sampling valve in wrong position	RED and “ERR” text in RED
SV_3013_02_ERR	NO3 sampling valve in wrong position	RED and “ERR” text in RED
SV_3013_03_ERR	NO2 sampling valve in wrong position	RED and “ERR” text in RED
AT_3013_01_H	NH4 reaches high level 1 alarm	YELLOW
AT_3013_01_HH	NH4 reaches high level 2 alarm	RED
AT_3013_01_L	NH4 reaches low level 1 alarm	YELLOW
AT_3013_01_LL	NH4 reaches low level 2 alarm	RED
AT_3013_02_H	NO3 reaches high level 1 alarm	YELLOW
AT_3013_02_HH	NO3 reaches high level 2 alarm	RED
AT_3013_02_L	NO3 reaches low level 1 alarm	YELLOW
AT_3013_02_LL	NO3 reaches low level 2 alarm	RED
AT_3013_03_H	NO2 reaches high level 1 alarm	YELLOW
AT_3013_03_HH	NO2 reaches high level 2 alarm	RED
AT_3013_03_L	NO2 reaches low level 1 alarm	YELLOW
AT_3013_03_LL	NO2 reaches low level 2 alarm	RED
AT_3013_01_ERR	NH4 analyzer sensor link error	“ERR” text in RED
AT_3013_02_ERR	NO3 analyzer sensor link error	“ERR” text in RED
AT_3013_03_ERR	NO2 analyzer sensor link error	“ERR” text in RED
AT_3014_01_H	Reactor biomass reaches high level 1 alarm	YELLOW
AT_3014_01_HH	Reactor biomass reaches high level 2 alarm	RED
AT_3014_01_L	Reactor biomass reaches low level 1 alarm	YELLOW
AT_3014_01_LL	Reactor biomass reaches low level 2 alarm	RED
AT_3014_01_ERR	Reactor biomass sensor link error	“ERR” text in RED
FT_3017_01_AH	Recirculation flow reaches high level 1 alarm	YELLOW
FT_3017_01_AHH	Recirculation flow reaches high level 2 alarm	RED
FT_3017_01_AL	Recirculation flow reaches low level 1 alarm	YELLOW
FT_3017_01_ALL	Recirculation flow reaches low level 2 alarm	RED
FT_3017_01_ERR	Recirculation flow sensor link error	“ERR” text in RED
FT_3018_01_AH	Harvesting flow reaches high level 1 alarm	YELLOW
FT_3018_01_AHH	Harvesting flow reaches high level 2 alarm	RED
FT_3018_01_AL	Harvesting flow reaches low level 1 alarm	YELLOW
FT_3018_01_ALL	Harvesting flow reaches low level 2 alarm	RED

TAG NAME	Description	Colour
FT_3018_01_ERR	Harvesting flow sensor link error	“ERR” text in RED
SV_3018_01_ERR	Reactor liquid outlet valve in wrong position	RED and “ERR” text in RED
LT_3021_01_AHH	Effluent tank level reaches high level 2 alarm	RED
LT_3021_01_AH	Effluent tank level reaches high level 1 alarm	YELLOW
LT_3021_01_AL	Effluent tank level reaches low level 1 alarm	YELLOW
LT_3021_01_ALL	Effluent tank level reaches low level 2 alarm	RED
LT_3021_01_ERR	Effluent tank level sensor link error	“ERR” text in RED
DPT_3007_01_AH	Reactor differential pressure reaches high level 1 alarm	YELLOW
DPT_3007_01_AHH	Reactor differential pressure reaches high level 2 alarm	RED
DPT_3007_01_AL	Reactor differential pressure reaches low level 1 alarm	YELLOW
DPT_3007_01_ALL	Reactor differential pressure reaches low level 2 alarm	RED
DPT_3007_01_ERR	Reactor differential pressure sensor link error	“ERR” text in RED
PT_3007_01_AH	Reactor pressure reaches high level 1 alarm	YELLOW
PT_3007_01_AHH	Reactor pressure reaches high level 2 alarm	RED
PT_3007_01_AL	Reactor pressure reaches low level 1 alarm	YELLOW
PT_3007_01_ALL	Reactor pressure reaches low level 2 alarm	RED
PT_3007_01_ERR	Reactor pressure sensor link error	“ERR” text in RED
AT_3009_01_AH	Dissolved O2 (bottom) reaches high level 1 alarm	YELLOW
AT_3009_01_AHH	Dissolved O2 (bottom) reaches high level 2 alarm	RED
AT_3009_01_AL	Dissolved O2 (bottom) reaches low level 1 alarm	YELLOW
AT_3009_01_ALL	Dissolved O2 (bottom) reaches low level 2 alarm	RED
AT_3009_01_ERR	Dissolved O2 (bottom) sensor link error	“ERR” text in RED
AT_3009_02_AH	Dissolved O2 (top) reaches high level 1 alarm	YELLOW
AT_3009_02_AHH	Dissolved O2 (top) reaches high level 2 alarm	RED
AT_3009_02_AL	Dissolved O2 (top) reaches low level 1 alarm	YELLOW
AT_3009_02_ALL	Dissolved O2 (top) reaches low level 2 alarm	RED
AT_3009_02_ERR	Dissolved O2 (top) sensor link error	“ERR” text in RED
FQRC_3009_01_AH	O2 flow reaches high level 1 alarm	YELLOW
FQRC_3009_01_AHH	O2 flow reaches high level 2 alarm	RED
FQRC_3009_01_AL	O2 flow reaches low level 1 alarm	YELLOW
FQRC_3009_01_ALL	O2 flow reaches low level 2 alarm	RED
FQRC_3009_01_ERR	O2 flow sensor link error	“ERR” text in RED
PT_3011_01_AH	Gas Loop pressure reaches high level 1 alarm	YELLOW

TAG NAME	Description	Colour
PT_3011_01_AHH	Gas Loop pressure reaches high level 2 alarm	RED
PT_3011_01_AL	Gas Loop pressure reaches low level 1 alarm	YELLOW
PT_3011_01_ALL	Gas loop pressure reaches low level 2 alarm	RED
FQRC_3011_01_AH	N2 flow reaches high level 1 alarm	YELLOW
FQRC_3011_01_AHH	N2 flow reaches high level 2 alarm	RED
FQRC_3011_01_AL	N2 flow reaches low level 1 alarm	YELLOW
FQRC_3011_01_ALL	N2 flow reaches low level 2 alarm	RED
FQRC_3011_01_ERR	N2 flow sensor link error	“ERR” text in RED
FQRC_3011_02_AH	Gas mix flow reaches high level 1 alarm	YELLOW
FQRC_3011_02_AHH	Gas mix flow reaches high level 2 alarm	RED
FQRC_3011_02_AL	Gas mix flow reaches low level 1 alarm	YELLOW
FQRC_3011_02_ALL	Gas mix flow reaches low level 2 alarm	RED
FQRC_3011_02_ERR	Gas mix flow sensor link error	“ERR” text in RED
PT_3011_01_ERR	Gas Loop pressure sensor link error	“ERR” text in RED
SV_3011_01_A	Reactor venting valve in wrong position	RED and “ERR” text in RED
SV_3011_02_A	Gas exhaust valve in wrong position	RED and “ERR” text in RED
SV_3011_03_A	Gas input valve in wrong position	RED and “ERR” text in RED
TT_3012_01_AH	Gas temperature reaches high level 1 alarm	YELLOW
TT_3012_01_AHH	Gas temperature reaches high level 2 alarm	RED
TT_3012_01_AL	Gas temperature reaches low level 1 alarm	YELLOW
TT_3012_01_ALL	Gas temperature reaches low level 2 alarm	RED
TT_3012_01_ERR	Gas temperature sensor link error	“ERR” text in RED
SV_3016_01_A	Gas pulse input valve in wrong position	RED and “ERR” text in RED
FQRC_3008_01_AH	CO2 flow reaches high level 1 alarm	YELLOW
FQRC_3008_01_AHH	CO2 flow reaches high level 2 alarm	RED
FQRC_3008_01_AL	CO2 flow reaches low level 1 alarm	YELLOW
FQRC_3008_01_ALL	CO2 flow reaches low level 2 alarm	RED
FQRC_3008_01_ERR	CO2 flow sensor link error	“ERR” text in RED
SV_3001_01_A	Influent tank temperature control valve in wrong position	RED and “ERR” text in RED
TT_3001_01_AH	Influent tank temperature reaches high level 1 alarm	YELLOW
TT_3001_01_AHH	Influent tank temperature reaches high level 2 alarm	RED
TT_3001_01_AL	Influent tank temperature reaches low level 1 alarm	YELLOW
TT_3001_01_ALL	Influent tank temperature reaches low level 2 alarm	RED

TAG NAME	Description	Colour
TT_3001_01_ERR	Influent tank temperature sensor link error	“ERR” text in RED
SV_3005_02_A	Reactor temperature valve (HOT) in wrong position	RED and “ERR” text in RED
SV_3005_01_A	Reactor temperature valve (COLD) in wrong position	RED and “ERR” text in RED
TT_3005_02_AH	Reactor jacket temperature reaches high level 1 alarm	YELLOW
TT_3005_02_AHH	Reactor jacket temperature reaches high level 2 alarm	RED
TT_3005_02_AL	Reactor jacket temperature reaches low level 1 alarm	YELLOW
TT_3005_02_ALL	Reactor jacket temperature reaches low level 2 alarm	RED
TT_3005_02_ERR	Reactor jacket temperature sensor link error	“ERR” text in RED
TT_3005_01_AH	Reactor temperature reaches high level 1 alarm	YELLOW
TT_3005_01_AHH	Reactor temperature reaches high level 2 alarm	RED
TT_3005_01_AL	Reactor temperature reaches low level 1 alarm	YELLOW
TT_3005_01_ALL	Reactor temperature reaches low level 2 alarm	RED
TT_3005_01_ERR	Reactor temperature sensor (MIDDLE) link error	“ERR” text in RED
TT_3005_03_ERR	Reactor temperature sensor (TOP) link error	“ERR” text in RED
TT_3005_04_ERR	Reactor temperature sensor (BOTTOM) link error	“ERR” text in RED
TT_3020_01_AH	Effluent tank temperature reaches high level 1 alarm	YELLOW
TT_3020_01_AHH	Effluent tank temperature reaches high level 2 alarm	RED
TT_3020_01_AL	Effluent tank temperature reaches low level 1 alarm	YELLOW
TT_3020_01_ALL	Effluent tank temperature reaches low level 2 alarm	RED
TT_3020_01_ERR	Effluent tank temperature sensor link error	“ERR” text in RED
SV_3020_01_ERR	Effluent temperature control valve in wrong position	RED and “ERR” text in RED
CL3008_pH_AH	pH reactor reaches high level 1 alarm	YELLOW
CL3008_pH_AHH	pH reactor reaches high level 2 alarm	RED
CL3008_pH_AL	pH reactor reaches low level 1 alarm	YELLOW
CL3008_pH_ALL	pH reactor reaches low level 2 alarm	RED
WIT_3008_01_AL	Acid bottle weight reaches low level 1 alarm	YELLOW
WIT_3008_01_ALL	Acid bottle weight reaches low level 2 alarm	RED
WIT_3008_02_AL	Base bottle weight reaches low level 1 alarm	YELLOW
WIT_3008_02_ALL	Base bottle weight reaches low level 2 alarm	RED
SV_3008_01_ERR	Acid input valve in wrong position	RED and “ERR” text in RED
SV_3008_02_ERR	Base input valve in wrong position	RED and “ERR” text in RED
AT_3008_01_ERR	pH sensor (TOP) link error	“ERR” text in RED
TT_3008_01_ERR	Temperature of pH sensor (TOP) link error	“ERR” text in RED

TAG NAME	Description	Colour
AT_3008_02_ERR	pH sensor (BOTTOM) link error	“ERR” text in RED
TT_3008_02_ERR	Temperature of pH sensor (BOTTOM) link error	“ERR” text in RED
WIT_3008_01_ERR	Acid balance wrong communication	“ERR” text in RED
WIT_3008_02_ERR	Base balance wrong communication	“ERR” text in RED
LSL_3002_01_A	Influent tank low level switch Alarm	RED
LSL_3002_02_A	Influent tank low level switch Alarm	RED
LSH_3006_01_A	Bioreactor high level switch Alarm	RED
LSH_3006_02_A	Bioreactor high level switch Alarm	RED
LSL_3006_01_A	Bioreactor low level switch Alarm	RED
LSL_3006_02_A	Bioreactor low level switch Alarm	RED
LSH_3021_01_A	Harvesting tank high level switch Alarm	RED
LSH_3021_02_A	Harvesting tank high level switch Alarm	RED

Table 5-2: Alarm tags of the CIII Main Screen

5.4 Liquid control screen

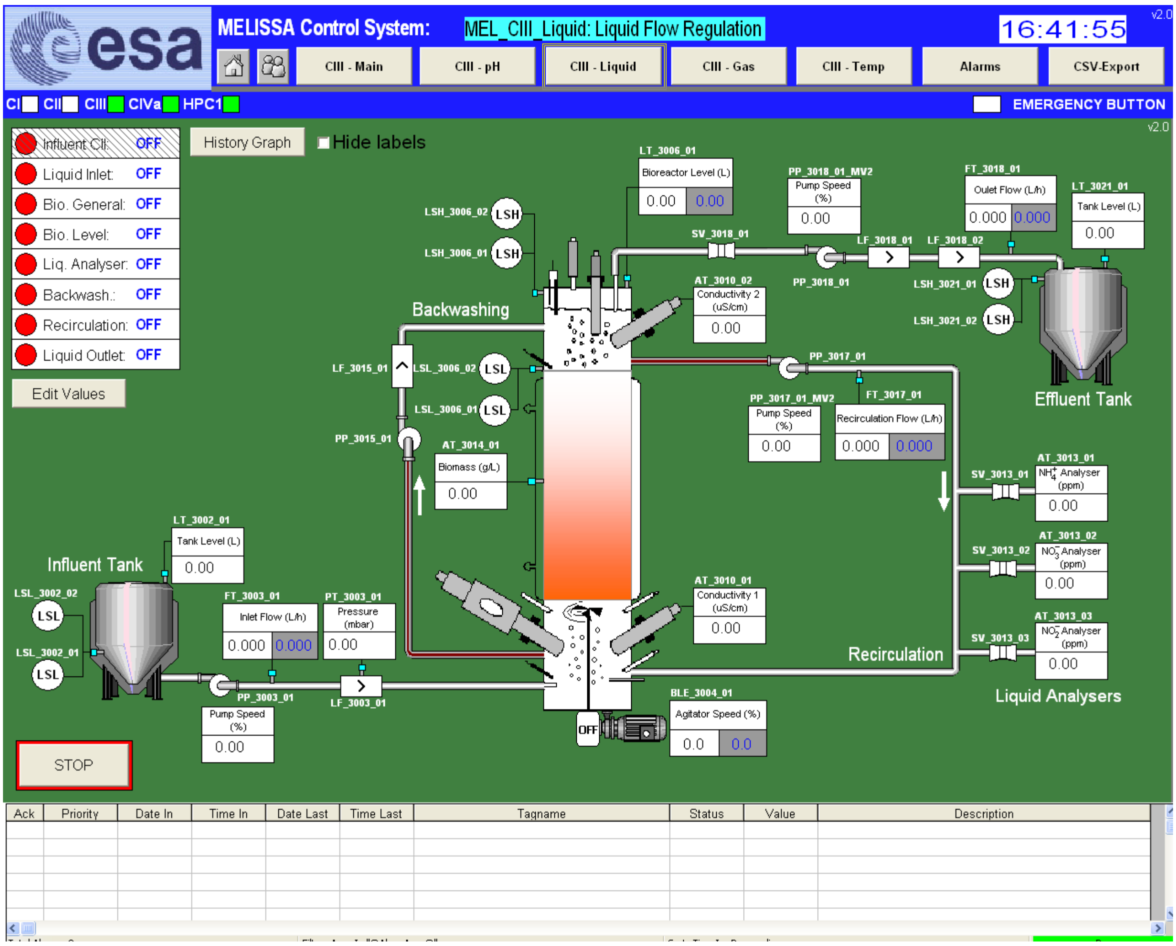
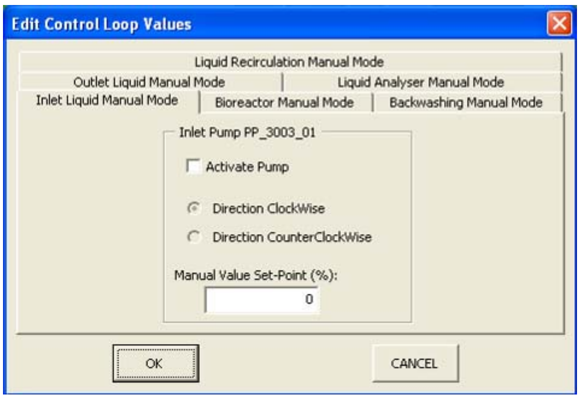


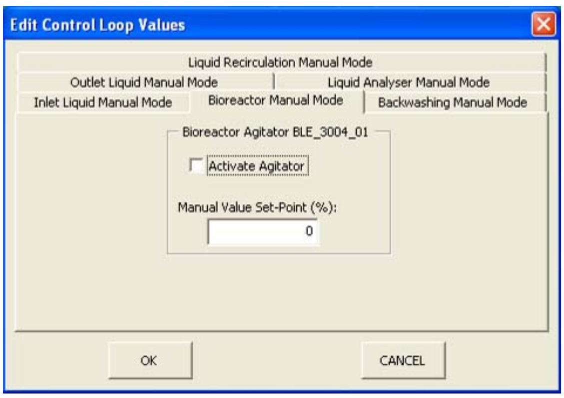
Figure 5-7: Liquid Control Screen

5.4.1 General actions

This display allows the user to:

- Monitor the measurements of the reactor's biomass concentration, the liquid level of the reactor, the level of input and output tanks, the speed of the reactor agitator, the lectures of the liquid analysers, the liquid conductivity in the reactor and the input, output and recirculation flow rates.
- Modify the Set-Points of Tanks Levels, Input flow, output flow and recirculation flow.
- Monitor the emergency button indicator. Background colour switch to red when one of the Emergency buttons is pushed.
- Display the history graph clicking on the History graph command button.
- Hide labels selecting the "Hide labels" check box.
- Stop all control loops implemented on the screen clicking "Stop" command button.
- Monitor animated pipes (changing the colour when the liquid is flowing).
- Monitor 2-way valves, level switches, agitator, pumps and tank levels animations.
- Edit manual values clicking the "Edit Values" command button. In the Manual Values window user can switch between six submenus:
    - o Inlet Liquid Manual Mode: Allows activating the pump PP_3003_01 and the manual value SP.
    - o Bioreactor Manual Mode: Allows activating the agitator BLE_3004_01 and selecting the manual value SP.
    - o Backwashing Manual Mode: Allows activating the pump PP_3015_01 and selecting the backwashing duration in seconds.
    - o Liquid Recirculation Manual Mode: Allows activating the pump PP_3017_01 and the manual value SP.
    - o Outlet Liquid Manual Mode: Allows activating the pump PP_3018_01, the manual value SP and furthermore allows activating the SV_3018_01 effluent liquid valve.
    - o Liquid Analyser Manual Mode: Allows activating the input liquid valves SV_3016_01, SV_3016_02 and SV_3013_03.





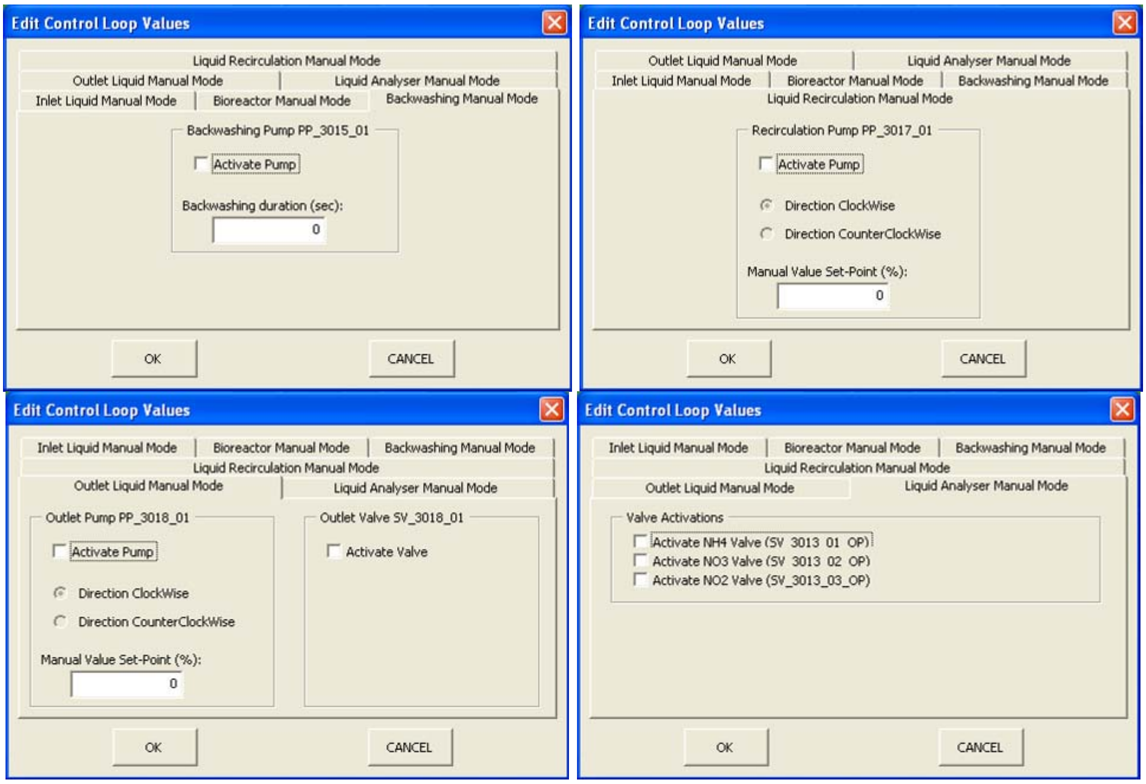


Figure 5-8: Edit Values Dialog

5.4.2 Alarms

The following alarms are linked with the operation of the liquid control screen.

TAG NAME	Description	Colour
LT_3002_01_AH	Influent tank level reaches high level 1 alarm	YELLOW
LT_3002_01_AHH	Influent tank level reaches high level 2 alarm	RED
LT_3002_01_AL	Influent tank level reaches low level 1 alarm	YELLOW
LT_3002_01_ALL	Influent tank level reaches low level 2 alarm	RED
LT_3002_01_ERR	Influent tank level sensor link error	“ERR” text in RED
FT_3003_01_AH	Feeding flow reaches high level 1 alarm	YELLOW
FT_3003_01_AHH	Feeding flow reaches high level 2 alarm	RED
FT_3003_01_AL	Feeding flow reaches low level 1 alarm	YELLOW
FT_3003_01_ALL	Feeding flow reaches low level 2 alarm	RED
FT_3003_01_ERR	Feeding flow sensor link error	“ERR” text in RED
PT_3003_01_AH	Feeding pressure reaches high level 1 alarm	YELLOW
PT_3003_01_AHH	Feeding pressure reaches high level 2 alarm	RED
PT_3003_01_AL	Feeding pressure reaches low level 1 alarm	YELLOW
PT_3003_01_ALL	Feeding pressure reaches low level 2 alarm	RED
PT_3003_01_ERR	Feeding pressure sensor error link	“ERR” text in RED
BLE_3004_01_A	Set if blender ON and Bioreactor is empty in manual mode	RED

TAG NAME	Description	Colour
BLE_3004_01_ERR	Bioreactor agitator error link	“ERR” text in RED
LT_3006_01_ERR	Bioreactor level sensor link error	“ERR” text in RED
LT_3006_01_AHH	Bioreactor level reaches high level 2 alarm	RED
LT_3006_01_ALL	Bioreactor level reaches low level 2 alarm	RED
LT_3006_01_AH	Bioreactor level reaches high level 1 alarm	YELLOW
LT_3006_01_AL	Bioreactor level reaches low level 1 alarm	YELLOW
AT_3010_01_AH	Bioreactor EC (bottom) reaches high level 1 alarm	YELLOW
AT_3010_01_AHH	Bioreactor EC (bottom) reaches high level 2 alarm	RED
AT_3010_01_AL	Bioreactor EC (bottom) reaches low level 1 alarm	YELLOW
AT_3010_01_ALL	Bioreactor EC (bottom) reaches low level 2 alarm	RED
AT_3010_01_ERR	Bioreactor EC (bottom) sensor link error	“ERR” text in RED
AT_3010_02_AH	Bioreactor EC (top) reaches high level 1 alarm	YELLOW
AT_3010_02_AHH	Bioreactor EC (top) reaches high level 2 alarm	RED
AT_3010_02_AL	Bioreactor EC (top) reaches low level 1 alarm	YELLOW
AT_3010_02_ALL	Bioreactor EC (top) reaches low level 2 alarm	RED
AT_3010_02_ERR	Bioreactor EC (top) sensor link error	“ERR” text in RED
SV_3013_01_ERR	NH4 sampling valve in wrong position	RED and “ERR” text in RED
SV_3013_02_ERR	NO3 sampling valve in wrong position	RED and “ERR” text in RED
SV_3013_03_ERR	NO2 sampling valve in wrong position	RED and “ERR” text in RED
AT_3013_01_H	NH4 reaches high level 1 alarm	YELLOW
AT_3013_01_HH	NH4 reaches high level 2 alarm	RED
AT_3013_01_L	NH4 reaches low level 1 alarm	YELLOW
AT_3013_01_LL	NH4 reaches low level 2 alarm	RED
AT_3013_02_H	NO3 reaches high level 1 alarm	YELLOW
AT_3013_02_HH	NO3 reaches high level 2 alarm	RED
AT_3013_02_L	NO3 reaches low level 1 alarm	YELLOW
AT_3013_02_LL	NO3 reaches low level 2 alarm	RED
AT_3013_03_H	NO2 reaches high level 1 alarm	YELLOW
AT_3013_03_HH	NO2 reaches high level 2 alarm	RED
AT_3013_03_L	NO2 reaches low level 1 alarm	YELLOW
AT_3013_03_LL	NO2 reaches low level 2 alarm	RED
AT_3013_01_ERR	NH4 analyzer sensor link error	“ERR” text in RED
AT_3013_02_ERR	NO3 analyzer sensor link error	“ERR” text in RED

TAG NAME	Description	Colour
AT_3013_03_ERR	NO2 analyzer sensor link error	“ERR” text in RED
AT_3014_01_H	Reactor biomass reaches high level 1 alarm	YELLOW
AT_3014_01_HH	Reactor biomass reaches high level 2 alarm	RED
AT_3014_01_L	Reactor biomass reaches low level 1 alarm	YELLOW
AT_3014_01_LL	Reactor biomass reaches low level 2 alarm	RED
AT_3014_01_ERR	Reactor biomass sensor link error	“ERR” text in RED
FT_3017_01_AH	Recirculation flow reaches high level 1 alarm	YELLOW
FT_3017_01_AHH	Recirculation flow reaches high level 2 alarm	RED
FT_3017_01_AL	Recirculation flow reaches low level 1 alarm	YELLOW
FT_3017_01_ALL	Recirculation flow reaches low level 2 alarm	RED
FT_3017_01_ERR	Recirculation flow sensor link error	“ERR” text in RED
FT_3018_01_AH	Harvesting flow reaches high level 1 alarm	YELLOW
FT_3018_01_AHH	Harvesting flow reaches high level 2 alarm	RED
FT_3018_01_AL	Harvesting flow reaches low level 1 alarm	YELLOW
FT_3018_01_ALL	Harvesting flow reaches low level 2 alarm	RED
FT_3018_01_ERR	Harvesting flow sensor link error	“ERR” text in RED
SV_3018_01_ERR	Reactor liquid outlet valve in wrong position	RED and “ERR” text in RED
LT_3021_01_AHH	Effluent tank level reaches high level 2 alarm	RED
LT_3021_01_AH	Effluent tank level reaches high level 1 alarm	YELLOW
LT_3021_01_AL	Effluent tank level reaches low level 1 alarm	YELLOW
LT_3021_01_ALL	Effluent tank level reaches low level 2 alarm	RED
LT_3021_01_ERR	Effluent tank level sensor link error	“ERR” text in RED
LSL_3002_01_A	Influent tank low level switch Alarm	RED
LSL_3002_02_A	Influent tank low level switch Alarm	RED
LSH_3006_01_A	Bioreactor high level switch Alarm	RED
LSH_3006_02_A	Bioreactor high level switch Alarm	RED
LSL_3006_01_A	Bioreactor low level switch Alarm	RED
LSL_3006_02_A	Bioreactor low level switch Alarm	RED
LSH_3021_01_A	Harvesting tank high level switch Alarm	RED
LSH_3021_02_A	Harvesting tank high level switch Alarm	RED

Table 5-3: Alarm tags of the Liquid loop of CIII system

5.4.3 Tags

The following tags are displayed in this screen. (The user inputs are highlighted in green)

Tag Name	Description	Type	Units	Range
LSL_3002_01	Influent tank low level switch	Digital indicator	---	---
LSL_3002_02	Influent tank low level switch	Digital indicator	---	---
LT_3002_01	Influent tank level transmitter	Analogue indicator	(L)	0 to 30
PP_3003_01_OP	Feeding pump Activation in Manual Mode	Button	---	---
PP_3003_01_SP	Feeding pump SP	SP User Input	(%)	0 to 100
PP_3003_01_MV1	Feeding pump	Pump animated	---	---
PP_3003_01_MV2	Speed of feeding pump	Analogue indicator	(%)	0 to 100
PP_3003_01_MV3	Rotation direction of feeding pump	Pump animated	---	---
FT_3003_01	Feeding flow transmitter	Analogue indicator	(L/h)	0 to 2
FT_3003_01_SP	Feeding flow SP	SP User Input	(L/h)	0 to 2
PT_3003_01	Feeding pressure	Analogue indicator	(mBar)	-1000 to 4000
BLE_3004_01_OP	Blender Activation in Manual Mode	Button	---	---
BLE_3004_01_SP	Blender SP	SP User Input	(%)	0 to 100
BLE_3004_01_MV1	Blender Status	Pump animated	---	---
BLE_3004_01_MV2	Blender speed SP	Analogue indicator	(%)	0 to 100
BLE_3004_01	Blender speed	Analogue indicator	(%)	0 to 100
CL3004_Emer_Button_01	Emergency button	Digital indicator	---	---
CL3006_BioreactorLevel_SP	Bioreactor Level SP	SP User Input	(L)	0 to 100
LSH_3006_01	Bioreactor High level switch	Digital indicator	---	---
LSH_3006_02	Bioreactor High level switch	Digital indicator	---	---
LSL_3006_01	Bioreactor Low level switch	Digital indicator	---	---
LSL_3006_02	Bioreactor Low level switch	Digital indicator	---	---
LT_3006_01	Bioreactor level	Analogue indicator	(L)	0 to 100
AT_3010_01	Conductivity sensor (bottom)	Analogue indicator	(uS/cm)	0.02 to 50
AT_3010_02	Conductivity sensor (top)	Analogue indicator	(uS/cm)	0.02 to 50
SV_3013_01_FB	NH_4^+ sampling valve	2-way valve animated	---	---
SV_3013_02_FB	NO_3^- sampling valve	2-way valve animated	---	---
SV_3013_03_FB	NO_2^- sampling valve	2-way valve animated	---	---

Tag Name	Description	Type	Units	Range
SV_3013_01_OP	NH_4^+ sampling valve	Button	---	---
SV_3013_02_OP	NO_3^- sampling valve	Button	---	---
SV_3013_03_OP	NO_2^- sampling valve	Button	---	---
AT_3013_01	NH_4^+ Analyser	Analogue indicator	(ppm)	0 to 155.6
AT_3013_02	NO_3^- Analyser	Analogue indicator	(ppm)	0 to 1000
AT_3013_03	NO_2^- Analyser	Analogue indicator	(ppm)	0 to 20
AT_3014_01	Biomass sensor	Analogue indicator	(g/L)	TBD
PP_3015_01_OP	Pump Activation in Manual Mode	Button	---	---
PP_3015_01_MV	Backwashing pump	Pump animated	---	---
CL3015_BACKWASHING_DURATION	Backwashing duration	User Input	(second)	0 to 10000
PP_3017_01_OP	Pump Activation in Manual Mode	Button	---	---
PP_3017_01_SP	Recirculation pump SP	SP User Input	(%)	0 to 100
CL3017_Flow_SP	Recirculation flow SP	SP User Input	(L/h)	0 to 5
FT_3017_01	Recirculation flow	Analogue indicator	(L/h)	0 to 5
PP_3017_01_MV1	Pump status	Pump animated	---	---
PP_3017_01_MV2	Pump speed	Analogue indicator	(%)	0 to 100
PP_3017_01_MV3	Pump rotation direction	Pump animated	---	---
PP_3018_01_OP	Pump Activation in Manual Mode	Button	---	---
PP_3018_01_SP	Outlet pump SP	SP User Input	(%)	0 to 100
CL3018_Flow_SP	Outlet flow SP	SP User Input	(L/h)	0 to 2
FT_3018_01	Harvest flow sensor	Analogue indicator	(L/h)	0 to 2
PP_3018_01_MV1	Pump	Pump animated	---	---
PP_3018_01_MV2	Pump speed	Analogue indicator	(%)	0 to 100
PP_3018_01_MV3	Pump rotation direction	Pump animated	---	---
SV_3018_01_FB	Reactor liquid outlet valve	2-way valve animated	---	---
SV_3018_01_OP	Reactor liquid outlet valve	Button	---	---
LSH_3021_01	Effluent high level switch	Digital indicator	---	---
LSH_3021_02	Effluent high level switch	Digital indicator	---	---
LT_3021_01	Effluent level	Analogue indicator	(L)	0 to 30

Table 5-4: Tags of the Liquid loop of CIII system

5.4.4 Control loops

The following control loops are implemented on the screen:

Control Loop	Description
CL3000	Influent Feeding Mode
CL3003	Inlet Liquid Mode
CL3004	Bioreactor General Mode
CL3006	Bioreactor Level Mode
CL3013	Liquid Analyser Loop Mode
CL3015	Backwashing loop Mode
CL3017	Liquid Recirculation loop Mode
CL3018	Outlet Liquid loop Mode

Table 5-5: Control Loops of the Liquid loop of CIII system

5.5 Gas loop screen

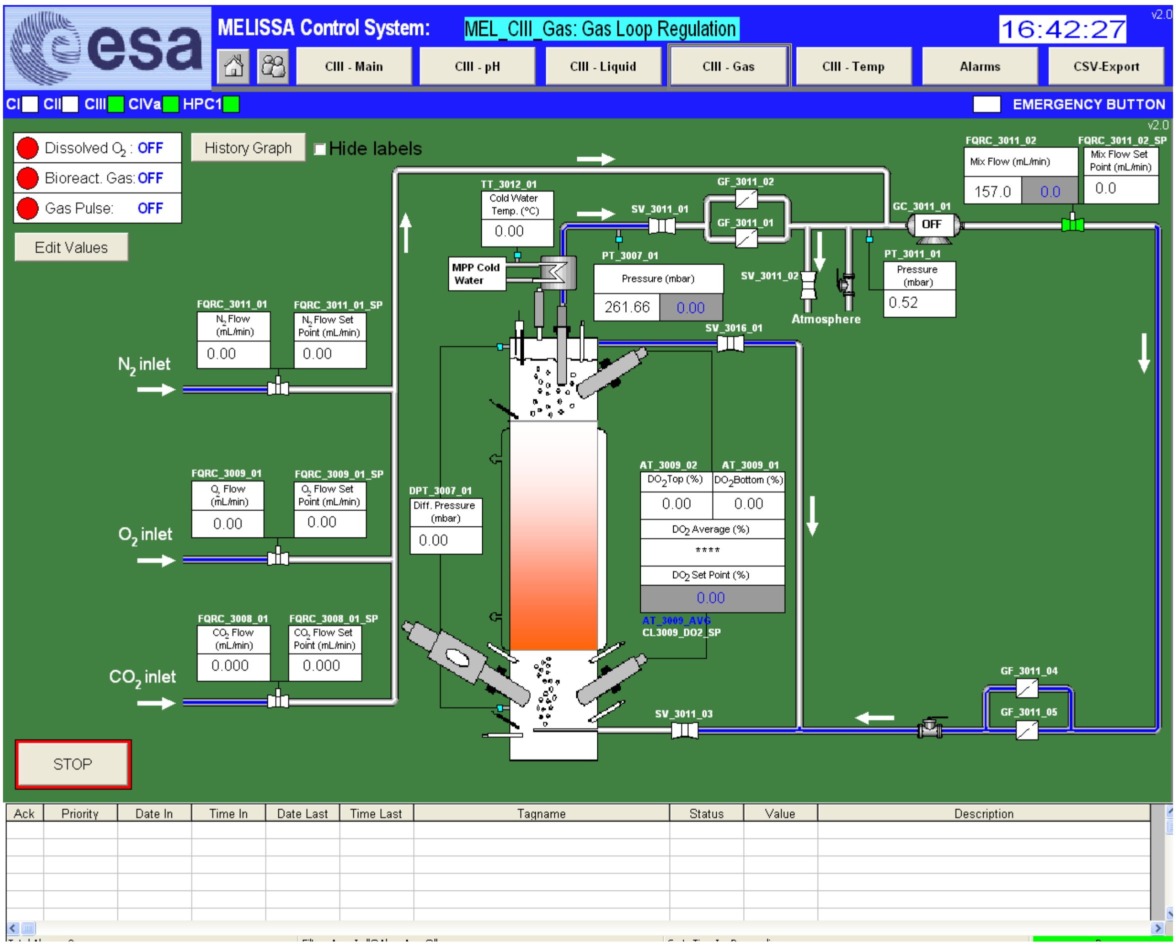


Figure 5-9: Gas Loop screen

5.5.1 General actions

This display allows the user to:

- Monitor the N_2 gas flow, the O_2 gas flow, the CO_2 gas flow, the gas mix flow, the dissolved O_2 concentration and the pressure transmitters.
- Modify the set-points of pressure, DO_2 and gas mix flow.
- Monitor the emergency button indicator. Background colour switch to red when one of the Emergency buttons is pushed.
- Hide labels selecting the “Hide labels” check box.
- Stop all control loops implemented on the screen clicking “Stop” command button.
- Display the history graph clicking on the History graph command button.
- Monitor animated pipes (changing the colour when the gas is flowing).
- Monitor 2-way valves and pumps animations.
- Select the DO2 sensor for control clicking over the probe lecture:

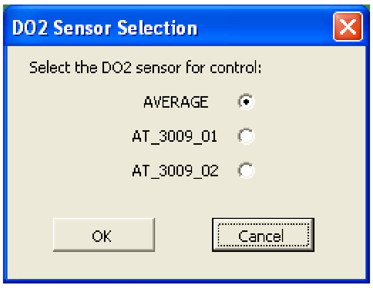


Figure 5-10: Edit Values Dialog

- Edit manual values clicking the “Edit Values” command button. In the Manual Values window user can switch between four submenus:
  - Dissolved O2 Manual Mode: Allows selecting the manual value SP of dissolved O2 flow.
  - Gas Pulse: Allows activating the gas input valve SV_3016_01, selecting the number of gas pulse and choosing the top valve opening/closing time and the bottom valve opening/closing time.
  - Gas Loop Manual Mode: Allows activating the SV_3011_01 reactor venting valve, the SV_3011_02 gas exhaust valve, the SV_3011_03_OP gas input valve, the GC_3011_01 Gas compressor and selecting the manual values SP of N2 flow and gas mix.
  - Gas Loop Auto Mode: Allows resetting the timer of the SV_3011_02 Gas Exhaust Valve, selecting the pressure threshold and reading the opening time, the opening frequency and the date and time of the last timer reset.

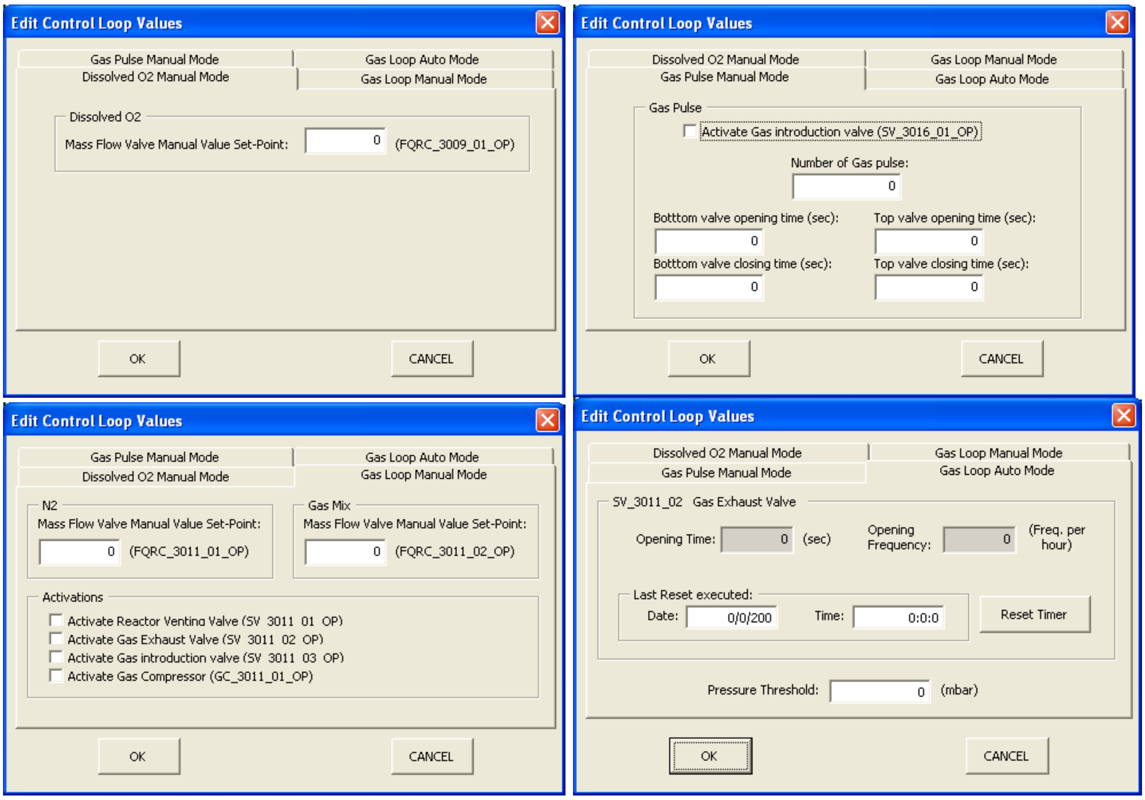


Figure 5-11: Edit Values Dialog

5.5.2 Alarms

The following alarms are linked with the operation of the gas control screen.

TAG NAME	Description	Colour
DPT_3007_01_AH	Reactor differential pressure reaches high level 1 alarm	YELLOW
DPT_3007_01_AHH	Reactor differential pressure reaches high level 2 alarm	RED
DPT_3007_01_AL	Reactor differential pressure reaches low level 1 alarm	YELLOW
DPT_3007_01_ALL	Reactor differential pressure reaches low level 2 alarm	RED
DPT_3007_01_ERR	Reactor differential pressure sensor link error	“ERR” text in RED
PT_3007_01_AH	Reactor pressure reaches high level 1 alarm	YELLOW
PT_3007_01_AHH	Reactor pressure reaches high level 2 alarm	RED
PT_3007_01_AL	Reactor pressure reaches low level 1 alarm	YELLOW
PT_3007_01_ALL	Reactor pressure reaches low level 2 alarm	RED
PT_3007_01_ERR	Reactor pressure sensor link error	“ERR” text in RED
AT_3009_01_AH	Dissolved O2 (bottom) reaches high level 1 alarm	YELLOW
AT_3009_01_AHH	Dissolved O2 (bottom) reaches high level 2 alarm	RED
AT_3009_01_AL	Dissolved O2 (bottom) reaches low level 1 alarm	YELLOW
AT_3009_01_ALL	Dissolved O2 (bottom) reaches low level 2 alarm	RED
AT_3009_01_ERR	Dissolved O2 (bottom) sensor link error	“ERR” text in RED
AT_3009_02_AH	Dissolved O2 (top) reaches high level 1 alarm	YELLOW
AT_3009_02_AHH	Dissolved O2 (top) reaches high level 2 alarm	RED
AT_3009_02_AL	Dissolved O2 (top) reaches low level 1 alarm	YELLOW
AT_3009_02_ALL	Dissolved O2 (top) reaches low level 2 alarm	RED
AT_3009_02_ERR	Dissolved O2 (top) sensor link error	“ERR” text in RED
FQRC_3009_01_AH	O2 flow reaches high level 1 alarm	YELLOW
FQRC_3009_01_AHH	O2 flow reaches high level 2 alarm	RED
FQRC_3009_01_AL	O2 flow reaches low level 1 alarm	YELLOW
FQRC_3009_01_ALL	O2 flow reaches low level 2 alarm	RED
FQRC_3009_01_ERR	O2 flow sensor link error	“ERR” text in RED
PT_3011_01_AH	Gas Loop pressure reaches high level 1 alarm	YELLOW
PT_3011_01_AHH	Gas Loop pressure reaches high level 2 alarm	RED
PT_3011_01_AL	Gas Loop pressure reaches low level 1 alarm	YELLOW
PT_3011_01_ALL	Gas loop pressure reaches low level 2 alarm	RED
FQRC_3011_01_AH	N2 flow reaches high level 1 alarm	YELLOW
FQRC_3011_01_AHH	N2 flow reaches high level 2 alarm	RED

TAG NAME	Description	Colour
FQRC_3011_01_AL	N2 flow reaches low level 1 alarm	YELLOW
FQRC_3011_01_ALL	N2 flow reaches low level 2 alarm	RED
FQRC_3011_01_ERR	N2 flow sensor link error	“ERR” text in RED
FQRC_3011_02_AH	Gas mix flow reaches high level 1 alarm	YELLOW
FQRC_3011_02_AHH	Gas mix flow reaches high level 2 alarm	RED
FQRC_3011_02_AL	Gas mix flow reaches low level 1 alarm	YELLOW
FQRC_3011_02_ALL	Gas mix flow reaches low level 2 alarm	RED
FQRC_3011_02_ERR	Gas mix flow sensor link error	“ERR” text in RED
PT_3011_01_ERR	Gas Loop pressure sensor link error	“ERR” text in RED
SV_3011_01_A	Reactor venting valve in wrong position	RED and “ERR” text in RED
SV_3011_02_A	Gas exhaust valve in wrong position	RED and “ERR” text in RED
SV_3011_03_A	Gas input valve in wrong position	RED and “ERR” text in RED
TT_3012_01_AH	Gas temperature reaches high level 1 alarm	YELLOW
TT_3012_01_AHH	Gas temperature reaches high level 2 alarm	RED
TT_3012_01_AL	Gas temperature reaches low level 1 alarm	YELLOW
TT_3012_01_ALL	Gas temperature reaches low level 2 alarm	RED
TT_3012_01_ERR	Gas temperature sensor link error	“ERR” text in RED
SV_3016_01_A	Gas pulse input valve in wrong position	RED and “ERR” text in RED
FQRC_3008_01_AH	CO2 flow reaches high level 1 alarm	YELLOW
FQRC_3008_01_AHH	CO2 flow reaches high level 2 alarm	RED
FQRC_3008_01_AL	CO2 flow reaches low level 1 alarm	YELLOW
FQRC_3008_01_ALL	CO2 flow reaches low level 2 alarm	RED
FQRC_3008_01_ERR	CO2 flow sensor link error	“ERR” text in RED

Table 5-6: Alarm tags of the Gas loop of CIII system

5.5.3 Tags

The following tags are displayed in this screen. (The user inputs are highlighted in green)

Tag Name	Description	Type	HMI address	Units	Range
DPT_3007_01	Bioreactor differential pressure	Analogue indicator	400100	(mBar)	0 to 3000
PT_3007_01	Bioreactor pressure	Analogue indicator	400102	(mBar)	-1000 to 4000
PT_3007_01_SP	PT_3007_01_Set_Point	SP User Input	400214	(mBar)	-1000 to 4000

Tag Name	Description	Type	HMI address	Units	Range
CL3007_Pressure_Threshold	PT_3007_01_Threshold	User Input	400216	(mBar)	0 to 1000
CL3009_DO2_selector	DO2 probe selector	Button	400249	Selector number	0 to 2
FQRC_3009_01_OP	Mass flow SP in Manual Mode	SP User Input	400120	(mL/min)	0 to 500
CL3009_DO2_SP	DO2 SP in automatic mode	SP User Input	400172	(%)	0 to 100
AT_3009_01	DO2 transmitter (Bottom)	Analogue indicator	400122	(%)	0 to 100
AT_3009_02	DO2 transmitter (TOP)	Analogue indicator	400124	(%)	0 to 100
AT_3009_AVERAGE	DO2 average	Analogue indicator	400220	(%)	0 to 100
FQRC_3009_01	Flow transmitter (O2)	Analogue indicator	400126	(mL/min)	0 to 500
FQRC_3009_01_SP	Mass flow SP indicator	Analogue indicator	400190	(mL/min)	0 to 500
GC_3011_01_OP	Gas compressor pump Activation in Manual Mode	Button	000141	---	---
FQRC_3011_01_OP	N2 Mass flow SP in Manual Mode	SP User Input	400132	(mL/min)	0 to 8333
FQRC_3011_02_OP	Gas mix Mass flow SP in Manual Mode	SP User Input	400134	(mL/min)	0 to 10000
CL3011_GasMix_SP	Gas mix SP in automatic mode	SP User Input	400174	(mL/min)	0 to 10000
SV_3011_01_OP	Valve Activation in Manual Mode	Button	000142	---	---
SV_3011_02_OP	Valve Activation in Manual Mode	Button	000143	---	---
GC_3011_01_MV	Gas compressor	Compressor animated	000037	---	---
SV_3011_Opening_Time	SV_3011_02 Opening Time (s)	Analogue Indicator	400210	(seconds)	0 to 100000
SV_3011_02_Second	Date of last reset	Indicator	400266	(second)	0 to 59
SV_3011_02_Minute	Date of last reset	Indicator	400267	(minute)	0 to 59
SV_3011_02_Hour	Date of last reset	Indicator	400268	(hour)	0 to 23
SV_3011_02_Day	Date of last reset	Indicator	400272	(Day)	1 to 31
SV_3011_02_Month	Date of last reset	Indicator	400269	(Month)	1 to 12
SV_3011_02_Year	Date of last reset	Indicator	400270	(Year)	9 to 99
SV_3011_02_Reset_Timer	Timer Reset	Button	000247	---	---
SV_3011_02_Opening_Frequency	SV_3011_02 Opening frequency	Analogue Indicator	400212	Opening frequency	0 to 100000
FQRC_3011_01_SP	N2 flow transmitter SP indicator	Analogue indicator	400192	(mL/min)	0 to 8333
FQRC_3011_01	N2 flow transmitter	Analogue indicator	400136	(mL/min)	0 to 8333
FQRC_3011_02_SP	Mix flow transmitter SP	Analogue	400202	(mL/min)	0 to 10000

Tag Name	Description	Type	HMI address	Units	Range
	indicator	indicator			
FQRC_3011_02	Mix flow transmitter	Analogue indicator	400138	(mL/min)	0 to 10000
PT_3011_01	Pressure in Gas loop	Analogue indicator	400140	(mBar)	-1000 to 4000
SV_3011_01_FB	Reactor venting valve	2-way valve animated	100028	---	---
SV_3011_02_FB	Gas exhaust valve	2-way valve animated	100030	---	---
SV_3011_03_FB	Gas introduction valve	2-way valve animated	100032	---	---
TT_3012_01	Air vent cold water temperature	Analogue indicator	400142	(ºC)	0 to 150
SV_3011_03_OP	Valve Activation in Manual Mode	Button	000188	---	---
SV_3016_01_OP	Valve Activation in Manual Mode	Button	000189	---	---
CL3016_BOTTOM_OPENING_TIME	Oxygen Pulse Bottom Opening Time	User Input	400430	(second)	0 to 10000
CL3016_BOTTOM_CLOSING_TIME	Oxygen Pulse Bottom Closing Time	User Input	400432	(second)	0 to 10000
CL3016_TOP_OPENING_TIME	Oxygen Pulse Top Opening Time	User Input	400434	(second)	0 to 10000
CL3016_TOP_CLOSI NG_TIME	Oxygen Pulse Top Closing Time	User Input	400436	(second)	0 to 10000
CL3016_OXYGENPULSE_NUMBER	Oxygen Pulse Number	User Input	400246	(number of pulses)	0 to 100
SV_3016_01_FB	Gas introduction valve	2-way valve animated	100031	---	---
CL3004_Emer_Button_01	Emergency button	Digital indicator	100039	---	---
FQRC_3008_01	CO2 flow transmitter	Analogue indicator	400158	(mL/min)	0 to 50
FQRC_3008_01_SP	CO2 flow transmitter SP indicator	Analogue indicator	400188	(mL/min)	0 to 50

Table 5-7: Gas Loop Display Tags

5.5.4 Control Loops

The following control loops are implemented on the screen:

Control Loop	Description
CL3009	DO2 Mode
CL3011	Bioreactor Gas Loop Mode
CL3016	Gas pulse loop Mode

Table 5-8: Control Loops of the Gas loop of CIII system

5.6 Temperature Regulation screen

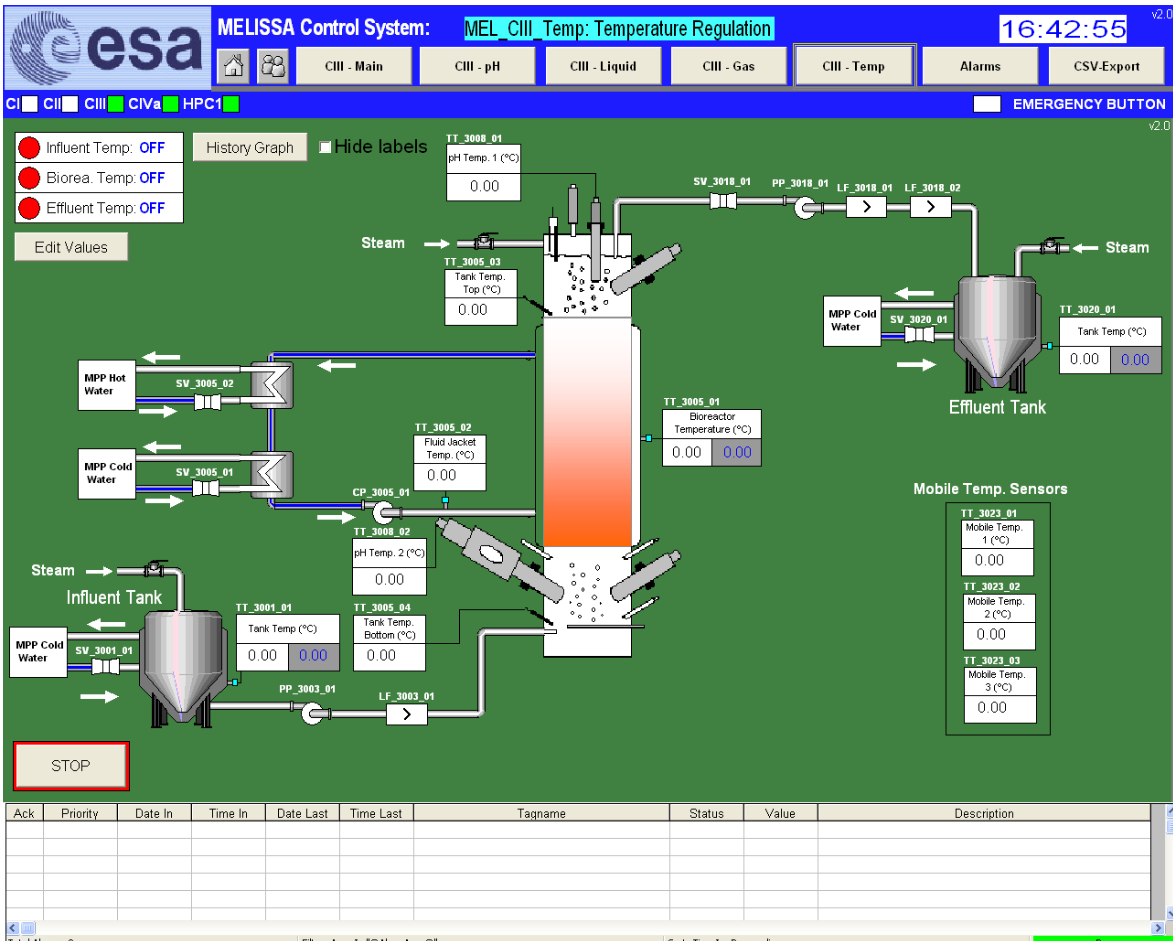


Figure 5-12: CIII Temperature screen

5.6.1 General actions

This display allows the user to:

- Monitor the temperature of each tank, the bioreactor fluid jacket and the lecture of Mobile Sensors.
- Modify the temperature set-points of each of the tanks and the bioreactor.
- Monitor 2-way valves, pumps and level tanks animations.
- Monitor animated pipes (changing the colour when the liquid is flowing).
- Monitor the emergency button indicator. Background colour switch to red when one of the Emergency buttons is pushed.
- Hide labels selecting the “Hide labels” check box.
- Stop all control loops implemented on the screen clicking “Stop” command button.
- Display the history graph clicking on the History graph command button.
- Edit manual values clicking the “Edit Values” command button. In the Manual Values window user can switch between three submenus:
    - o Bioreactor Tank Temperature: Allows activating the valves SV_3005_01 and SV_3005_02 and the pump CP_3005_01.

- o Effluent Tank Temperature: Allows activating the valve SV_3020_01.
- o Influent Tank Temperature: Allows activating the valve SV_3001_01.

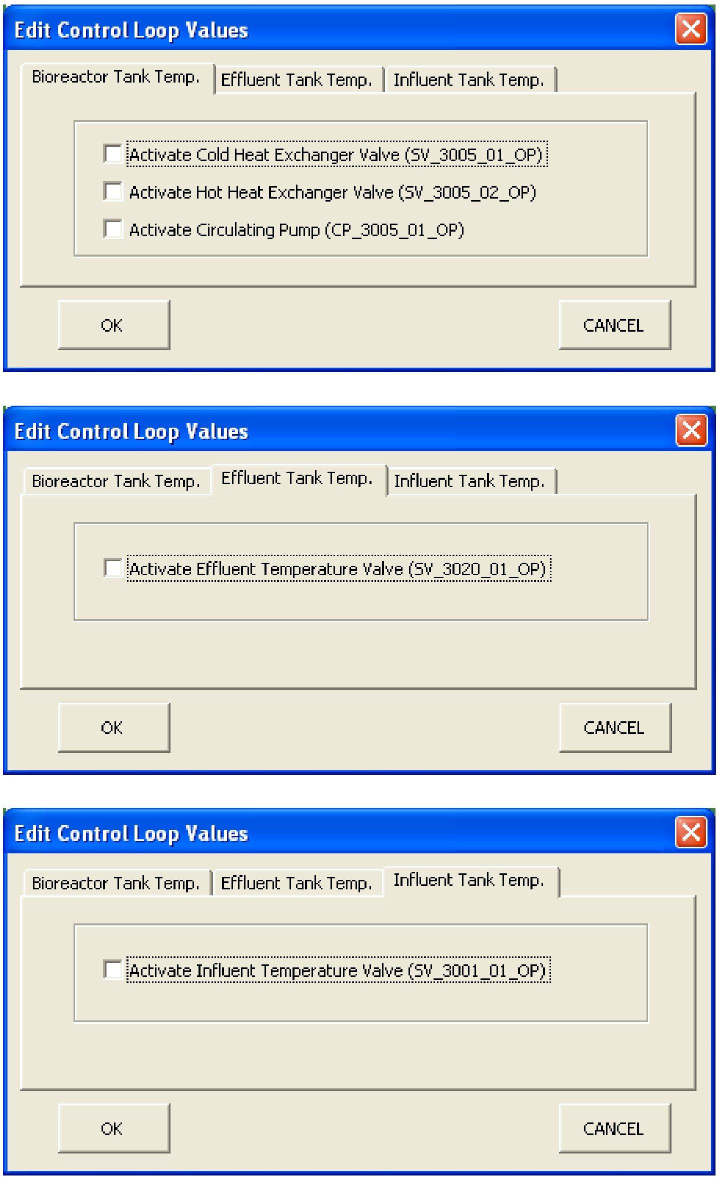


Figure 5-13: Edit Values Dialog

5.6.2 Alarms

The following alarms are linked with the operation of the Temperature control screen.

TAG NAME	Description	Colour
SV_3001_01_A	Influent tank temperature control valve in wrong position	RED and “ERR” text in RED
TT_3001_01_AH	Influent tank temperature reaches high level 1 alarm	YELLOW
TT_3001_01_AHH	Influent tank temperature reaches high level 2 alarm	RED
TT_3001_01_AL	Influent tank temperature reaches low level 1 alarm	YELLOW

TAG NAME	Description	Colour
TT_3001_01_ALL	Influent tank temperature reaches low level 2 alarm	RED
TT_3001_01_ERR	Influent tank temperature sensor link error	“ERR” text in RED
SV_3005_02_A	Reactor temperature valve (HOT) in wrong position	RED and “ERR” text in RED
SV_3005_01_A	Reactor temperature valve (COLD) in wrong position	RED and “ERR” text in RED
TT_3005_02_AH	Reactor jacket temperature reaches high level 1 alarm	YELLOW
TT_3005_02_AHH	Reactor jacket temperature reaches high level 2 alarm	RED
TT_3005_02_AL	Reactor jacket temperature reaches low level 1 alarm	YELLOW
TT_3005_02_ALL	Reactor jacket temperature reaches low level 2 alarm	RED
TT_3005_02_ERR	Reactor jacket temperature sensor link error	“ERR” text in RED
TT_3005_01_AH	Reactor temperature reaches high level 1 alarm	YELLOW
TT_3005_01_AHH	Reactor temperature reaches high level 2 alarm	RED
TT_3005_01_AL	Reactor temperature reaches low level 1 alarm	YELLOW
TT_3005_01_ALL	Reactor temperature reaches low level 2 alarm	RED
TT_3005_01_ERR	Reactor temperature sensor (MIDDLE) link error	“ERR” text in RED
TT_3005_03_ERR	Reactor temperature sensor (TOP) link error	“ERR” text in RED
TT_3005_04_ERR	Reactor temperature sensor (BOTTOM) link error	“ERR” text in RED
TT_3020_01_AH	Effluent tank temperature reaches high level 1 alarm	YELLOW
TT_3020_01_AHH	Effluent tank temperature reaches high level 2 alarm	RED
TT_3020_01_AL	Effluent tank temperature reaches low level 1 alarm	YELLOW
TT_3020_01_ALL	Effluent tank temperature reaches low level 2 alarm	RED
TT_3020_01_ERR	Effluent tank temperature sensor link error	“ERR” text in RED
SV_3020_01_ERR	Effluent temperature valve in wrong position	RED and “ERR” text in RED
SV_3018_01_ERR	Reactor liquid outlet valve in wrong position	RED and “ERR” text in RED

Table 5-9: Alarm tags of the Temperature loop of CIII system

5.6.3 Tags

The following tags are displayed in this screen. (The user inputs are highlighted in green).

Tag Name	Description	Type	Units	Range
SV_3001_01_OP	Valve Activation in Manual Mode	Button	---	---
SV_3001_01_FB	Temperature control valve	2-way valve	---	---
TT_3001_01	Influent tank temperature	Analogue indicator	(ºC)	0 to 150
TT_3001_01_SP	Influent tank temperature SP	SP User Input	(ºC)	0 to 150
CP_3005_01_OP	Pump Activation in Manual Mode	Button	---	---

Tag Name	Description	Type	Units	Range
TT_3005_SP	Bioreactor temperature SP	SP User Input	(ºC)	0 to 150
SV_3005_02_OP	Valve Activation in Manual Mode	Button	---	---
SV_3005_01_OP	Valve Activation in Manual Mode	Button	---	---
CP_3005_01_MV	Circulation pump	Pump animated	---	---
SV_3005_02_FB	Heat exchanger valve (HOT)	2-way valve animated	---	---
SV_3005_01_FB	Heat exchanger valve (COLD)	2-way valve animated	---	---
TT_3005_02	Reactor jacket temperature	Analogue indicator	(ºC)	0 to 150
TT_3005_01	Bioreactor temperature (middle position)	Analogue indicator	(ºC)	0 to 150
TT_3005_03	Bioreactor temperature (top position)	Analogue indicator	(ºC)	0 to 150
TT_3005_04	Bioreactor temperature (Bottom position)	Analogue indicator	(ºC)	0 to 150
TT_3008_01	Temperature of the pH sensor	Analogue indicator	(ºC)	0 to 100
TT_3008_02	Temperature of the pH sensor.	Analogue indicator	(ºC)	0 to 100
SV_3020_01_OP	Valve Activation in Manual Mode	Button	---	---
TT_3020_01_SP	Effluent tank temperature SP	SP User Input	(ºC)	0 to 150
SV_3020_01_FB	Temperature control valve	2-way valve animated	---	---
TT_3020_01	Effluent tank temperature	Analogue indicator	(ºC)	0 to 150
SV_3018_01_FB	Reactor liquid outlet valve	2-way valve animated	---	---
PP_3003_01_MV1	Feeding pump	Pump animated	---	---
PP_3003_01_MV3	Rotation direction of feeding pump	Row indicator	---	---
PP_3018_01_MV1	Harvest pump	Pump animated	---	---
PP_3018_01_MV3	Rotation direction of harvest pump	Row indicator	---	---
CL3004_Emer_Button_01	Emergency button	Digital indicator	---	---
TT_3023_01	Mobile Temperature used for sterilisation	Analogue indicator	(ºC)	0 to 150
TT_3023_02	Mobile Temperature used for sterilisation	Analogue indicator	(ºC)	0 to 150
TT_3023_03	Mobile Temperature used for sterilisation	Analogue indicator	(ºC)	0 to 150

Table 5-10: Tags of the Temperature loop of CIII system

5.6.4 Control loops

The following control loops are implemented on the screen:

Tag Name	Description
CL3001	Influent Temperature Mode
CL3005	Bioreactor Temperature Mode
CL3020	Effluent Temperature Mode

Table 5-11: Control Loops of the Temperature loop of CIII system

5.7 pH loop screen

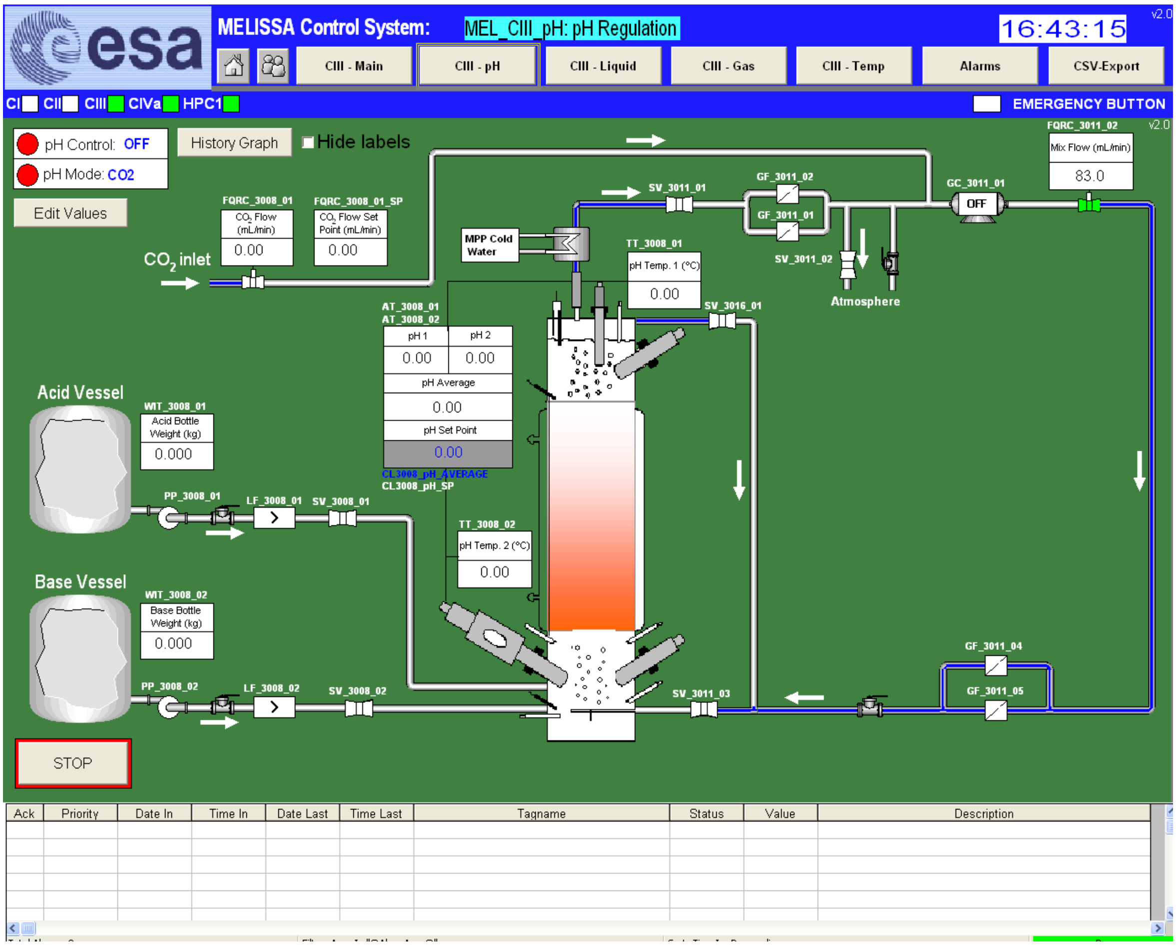


Figure 5-14: CIII pH Regulation screen

5.7.1 General actions

This display allows the user to:

- Monitor the pH values and the temperature of each pH sensor.
- Monitor the weight of acid and base vessels.
- Monitor the CO_2 flow.
- Select the pH probe to control, clicking over the pH sensor indicators. The label of the selected sensor will be highlighted in blue.

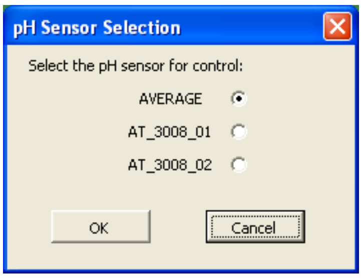


Figure 5-15: pH sensor selection

- Modify the pH set-point.
- Monitor 2-way valves, pumps and level tanks animations.

- Monitor animated pipes (changing the colour when the liquid is flowing).
- Monitor the emergency button indicator. Background colour switch to red when one of the Emergency buttons is pushed.
- Hide labels selecting “Hide labels” check box.
- Stop all control loops implemented on the screen clicking “Stop” command button.
- Display the history graph clicking on the History graph command button.
- Edit manual values clicking the “Edit Values” command button. In the Manual Values window user can switch between two submenus:
    - pH Manual Mode: Allows activating the acid and base pumps and valves (PP_3008_01, PP_3008_02, SV_3008_01 and SV_3008_02 respectively) and select the opening time. Moreover allows selecting the Manual Value Set-Point for the CO_2 valve.
    - pH Automatic Mode: Allows resetting the pH timers and selecting the pH Set-Point and the pH dead zone. Furthermore it is possible to read the date and time of the last timer reset and the opened time of the acid and the base injections.

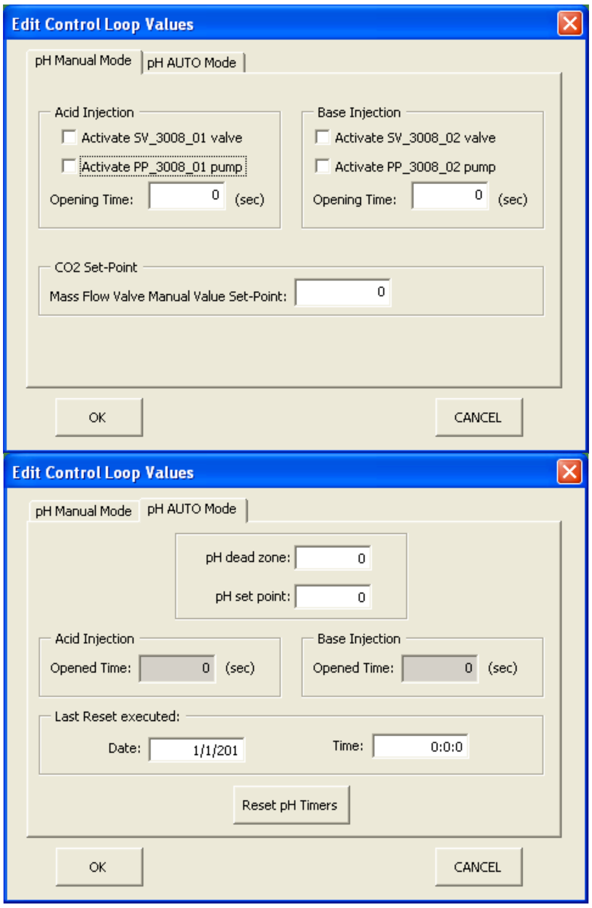


Figure 5-16: Edit Values Dialog

- Select the pH control mode, clicking over the pH mode indicator.

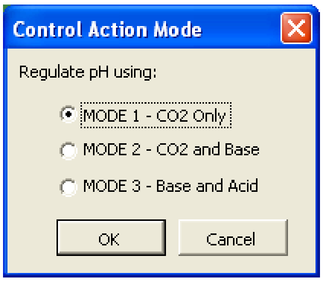


Figure 5-17: pH Mode

There are three modes of regulation:

Mode	Description	CO_2 flow	Base pump	Acid pump
1	Only CO_2 is used to regulate pH	Enabled	Disabled	Disabled
2	CO_2 and Base medium is used to regulate pH.	Enabled	Enabled	Disabled
3	Base and additional Acid media is used to regulate pH.	Disabled	Enabled	Enabled

Actuating in mode 1 or 2, the inlet gas flow control is deactivated.

5.7.2 Alarms

The following alarms are linked with the operation of the pH control screen.

TAG NAME	Description	Colour
CL3008_pH_AH	pH reactor reaches high level 1 alarm	YELLOW
CL3008_pH_AHH	pH reactor reaches high level 2 alarm	RED
CL3008_pH_AL	pH reactor reaches low level 1 alarm	YELLOW
CL3008_pH_ALL	pH reactor reaches low level 2 alarm	RED
WIT_3008_01_AL	Acid bottle weight reaches low level 1 alarm	YELLOW
WIT_3008_01_ALL	Acid bottle weight reaches low level 2 alarm	RED
WIT_3008_02_AL	Base bottle weight reaches low level 1 alarm	YELLOW
WIT_3008_02_ALL	Base bottle weight reaches low level 2 alarm	RED
SV_3008_01_ERR	Acid input valve in wrong position	RED and “ERR” text in RED
SV_3008_02_ERR	Base input valve in wrong position	RED and “ERR” text in RED
AT_3008_01_ERR	pH sensor (TOP) link error	“ERR” text in RED
TT_3008_01_ERR	Temperature of pH sensor (TOP) link error	“ERR” text in RED
AT_3008_02_ERR	pH sensor (BOTTOM) link error	“ERR” text in RED
TT_3008_02_ERR	Temperature of pH sensor (BOTTOM) link error	“ERR” text in RED
WIT_3008_01_ERR	Acid balance wrong communication	“ERR” text in RED
WIT_3008_02_ERR	Base balance wrong communication	“ERR” text in RED
FQRC_3008_01_AH	CO2 flow reaches high level 1 alarm	YELLOW
FQRC_3008_01_AHH	CO2 flow reaches high level 2 alarm	RED
FQRC_3008_01_AL	CO2 flow reaches low level 1 alarm	YELLOW
FQRC_3008_01_ALL	CO2 flow reaches low level 2 alarm	RED

TAG NAME	Description	Colour
FQRC_3008_01_ERR	CO2 flow sensor link error	“ERR” text in RED
FQRC_3011_02_AH	Gas mix flow reaches high level 1 alarm	YELLOW
FQRC_3011_02_AHH	Gas mix flow reaches high level 2 alarm	RED
FQRC_3011_02_AL	Gas mix flow reaches low level 1 alarm	YELLOW
FQRC_3011_02_ALL	Gas mix flow reaches low level 2 alarm	RED
FQRC_3011_02_ERR	Gas mix flow sensor link error	“ERR” text in RED
SV_3011_01_A	Reactor venting valve in wrong position	RED and “ERR” text in RED
SV_3011_02_A	Gas exhaust valve in wrong position	RED and “ERR” text in RED
SV_3011_03_A	Gas input valve in wrong position	RED and “ERR” text in RED
SV_3016_01_A	Gas pulse input valve in wrong position	RED and “ERR” text in RED

Table 5-12: Alarm tags of the pH loop of CIII system

5.7.3 Tags

The following tags are displayed in this screen. (The user inputs are highlighted in green)

Tag Name	Description	Type	Units	Range
PP_3008_01_OP	Acid Pump Activation in Manual Mode	Button	---	---
PP_3008_02_OP	Base Pump Activation in Manual Mode	Button	---	---
PP_3008_01_OP_TIME	Acid injection time	User Input	(second)	0 to 10
PP_3008_02_OP_TIME	Base injection time	User Input	(second)	0 to 10
CL3008_Reset_pH_Timer	pH timer reset	Button	---	---
CL3008_pH_AVERAGE	pH Average	Analogue Indicator	(pH)	0 to14
CL3008_pH_Mode	pH Mode selector	Button	Mode number	1 to 3
CL3008_pH_selector	pH sensor selection	Button	Selector number	0 to 2
FQRC_3008_01_OP	CO2 Mass Flow SP in manual mode	SP User Input	(mL/min)	0 to 50
CL3008_pH_SP	pH SP	SP User Input	(pH)	0 to 14
CL3008_DeadZone	pH DeadZone	SP User Input	(pH)	TBD
CL3008_Base_Opening_Time	Base injection time	Indicator	(second)	0 to 1000
CL3008_Acid_Opening_Time	Acid injection time	Indicator	(second)	0 to 1000
CL3008_pH_Second	Date of last reset	Indicator	(second)	0 to 59
CL3008_pH_Minute	Date of last reset	Indicator	(minute)	0 to 59
CL3008_pH_Hour	Date of last reset	Indicator	(hour)	0 to 23
CL3008_pH_Day	Date of last reset	Indicator	(day)	1 to 31

Tag Name	Description	Type	Units	Range
CL3008_pH_Month	Date of last reset	Indicator	(month)	1 to 12
CL3008_pH_Year	Date of last reset	Indicator	(Year)	9 to 99
PP_3008_01_MV	Acid pump	Pump animated	---	---
PP_3008_02_MV	Base pump	Pump animated	---	---
AT_3008_01	pH sensor	Analogue indicator	(pH)	0 to 14
TT_3008_01	Temperature of the pH sensor	Analogue indicator	(ºC)	0 to 100
AT_3008_02	pH sensor	Analogue indicator	(pH)	0 to 14
TT_3008_02	Temperature of the pH sensor.	Analogue indicator	(ºC)	0 to 100
WIT_3008_01	Acid bottle weight	Balance with Analogue indicator	(Kg)	0 to 15
WIT_3008_02	Base bottle weight	Balance with analogue indicator	(Kg)	0 to 15
SV_3008_01_FB	Acid valve	2-way valve	---	---
SV_3008_02_FB	Base valve	2-way valve	---	---
FQRC_3008_01	CO2 flow transmitter	Analogue indicator	(mL/min)	0 to 50
FQRC_3008_01_SP	CO2 flow SP indicator	Analogue indicator	(mL/min)	0 to 50
SV_3016_01_FB	Gas introduction valve	2-way valve animated	---	---
SV_3011_01_FB	Reactor venting valve	2-way valve animated	---	---
SV_3011_02_FB	Gas exhaust valve	2-way valve animated	---	---
SV_3011_03_FB	Gas introduction valve	2-way valve animated	---	---
FQRC_3011_02	Mix flow transmitter	Analogue indicator	(mL/min)	0 to 10000
GC_3011_01_MV	Gas compressor	Compressor animated	---	---
CL3004_Emer_Button_01	Emergency button	Digital indicator	---	---

Table 5-13: Tags of the pH loop of CIII system

5.7.4 Control loops

The following control loops are implemented on the screen:

Tag Name	Description
CL3008	pH Control Mode

Table 5-14 Control Loops of the pH loop of CIII system

6. MASTER CONTROL

The Master Control is executed by the iFix Scheduler module. This module allows the configuration of a task that needs to be executed periodically at fixed time intervals. The tasks can be configured to run in background, and therefore, it is not necessary to start a Windows session in the Supervision Server. From this module, algorithms can access to process variables. By default, tasks will be running in background, to perform a change or to initialise a control algorithm, task configuration needs to be changed to run in foreground.

Task configuration is managed from the Supervision Server Workspace application.
In MELISSA compartment CIII system, following tasks are configured:

- MEL_CIII_SAVEVALUES

This task saves the principal process variable values of the Compartment CIII in the Supervision Database.

- SystemControl

This task is a daily execution task that updates the CIII system clock with the server clock.

Open configured tasks To access to configure tasks, from the Supervision Server follow these steps:

1) Open Intellution iFix Workspace application. Application will be started in configuration mode.
2) In the object tree, expand Schedules node. There, a list of scheduled tasks will be presented.
3) To modify one task, double-click it. In the right pane, a table will appear displaying all configuration parameters.

6.1 Change the task run mode (foreground/background)

Tasks can be configured to run in foreground or in background. Executing the tasks in foreground will allow the user to test the task by firing its execution manually and initialise algorithm status by changing the run mode. To execute a task in foreground perform following steps:

1) In the iFIX Workspace open the task.
2) Open the pop-up menu, pressing the right mouse button.
3) Select Scheduler Properties. A dialog with Run in Foreground and Run in Background options will appear.
4) In the dialog, select run in foreground.
5) Press OK.
6) Select the task and from the Workspace menu select Workspace and Switch to Run. Task Status is displayed in green showing “Active”. Switching again the Workspace to Configuration mode will stop the task.
7) To restore the run mode to background, open again the configuration dialog, select “Run in background” and confirm changes. Task status will be displayed in green showing “Active”.

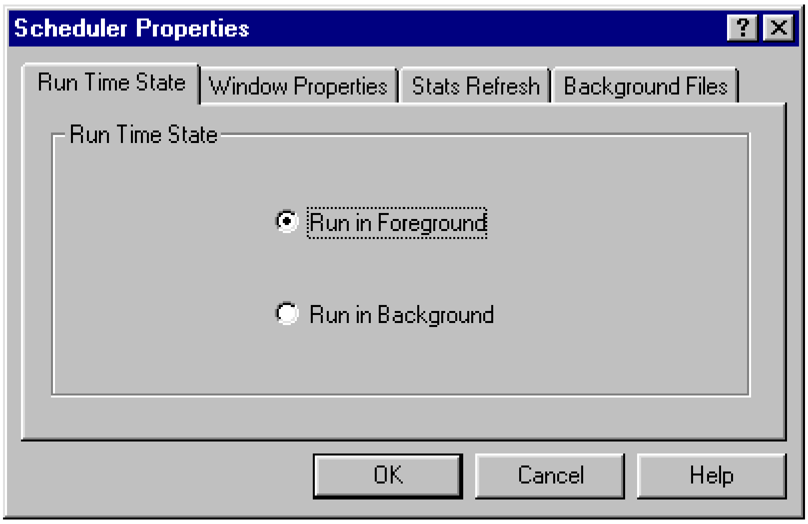


Figure 6-1: Task foreground/background run mode configuration.

6.2 Enable/Disable logs

The Master Control tasks can generate logs to monitor its execution. These logs are stored in the folder SUPERVISION\Pic\Logs. The activation or deactivation of these logs is controlled by a global variable to change the value of this variable perform the following steps:

1) In the iFIX Workspace access to the elements tree.
2) Open the Globals\User branch.
3) Select the EnableLogs item and open the context menu by clicking the right mouse button.
4) Select the “Property Window…” command.
5) Modify the property CurrentValue to True to activate the logs and to False to deactivate it.

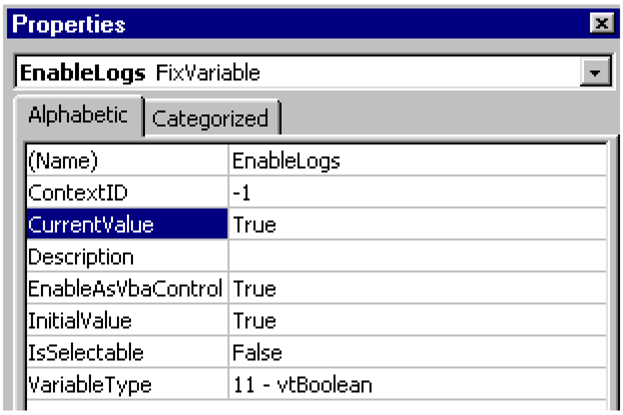


Figure 6-2: EnableLogs configuration dialog.

6.3 Supervision Database

Supervision Database is updated by means of the tasks MEL_CIII running under the iFIX Task Scheduler. These tasks are scripts that build the SQL sentence to update the corresponding Microsoft Access® database. Data can be retrieved using the Microsoft Access® application export features.

6.3.1 Change the update rate

It is possible to change the database update rate to adapt it to the characteristics of the current test.

To change the database update rate perform the following steps:

1) Open the corresponding schedule task.
2) Modify the Interval setting (1 in the figure 20).
3) Close the task and confirm save changes.

This action will reset the task, which will be fired at new time interval.

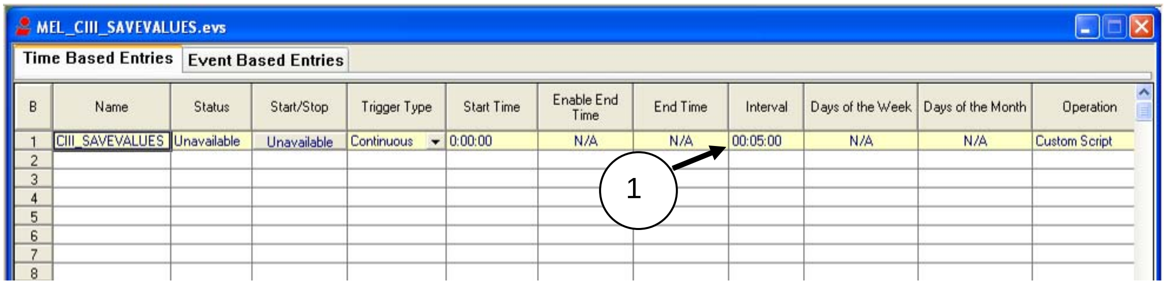


Figure 6-3: Supervision database task configuration

6.3.2 Compartment III

The following values of the “Compartment CIII” are saved in the Supervision Database:

Scheduler Task: MEL_CIII_SAVEVALUES

Tag Name	Description	Units	Range
TT_3001_01	Influent tank temperature	(ºC)	0 to 150
TT_3001_01_SP	Influent tank temperature SP	(ºC)	0 to 150
LT_3002_01	Influent tank level transmitter	(L)	0 to 30
PP_3003_01_SP	Speed of feeding pump SP	(%)	0 to 100
PP_3003_01_MV2	Speed of feeding pump	(%)	0 to 100
FT_3003_01	Feeding flow transmitter	(L/h)	0 to 2
PT_3003_01	Feeding pressure	(mBar)	-1000 to 4000
BLE_3004_01_OP	Blender Activation in Manual Mode	(%)	0 to 100
BLE_3004_01_SP	Blender SP	(%)	0 to 100
BLE_3004_01_MV2	Blender speed SP	(%)	0 to 100
BLE_3004_01	Blender speed	(%)	0 to 100
TT_3005_SP	Bioreactor temperature SP	(ºC)	0 to 150
TT_3005_02	Reactor jacket temperature	(ºC)	0 to 150

Tag Name	Description	Units	Range
TT_3005_01	Bioreactor temperature (middle position)	(ºC)	0 to 150
TT_3005_03	Bioreactor temperature (top position)	(ºC)	0 to 150
TT_3005_04	Bioreactor temperature (Bottom position)	(ºC)	0 to 150
CL3006_BioreactorLevel_SP	Bioreactor Level SP	(L)	0 to 100
LT_3006_01	Bioreactor level	(L)	0 to 100
DPT_3007_01	Bioreactor differential pressure	(mBar)	0 to 3000
PT_3007_01	Bioreactor pressure	(mBar)	-1000 to 4000
PP_3008_01_OP_TIME	Acid injection time	(second)	0 to 10
PP_3008_02_OP_TIME	Base injection time	(second)	0 to 10
FQRC_3008_01_OP	CO2 Mass Flow SP in manual mode	(mL/min)	0 to 50
CL3008_pH_SP	pH SP	(pH)	0 to 14
CL3008_DeadZone	pH DeadZone	(pH)	TBD
CL3008_Base_Opening_Time	Base injection time	(second)	0 to 1000
CL3008_Acid_Opening_Time	Acid injection time	(second)	0 to 1000
CL3008_pH_Second	Date of last reset	(second)	0 to 59
CL3008_pH_Minute	Date of last reset	(minute)	0 to 59
CL3008_pH_Hour	Date of last reset	(hour)	0 to 23
CL3008_pH_Day	Date of last reset	(day)	1 to 31
CL3008_pH_Month	Date of last reset	(Month)	1 to 12
CL3008_pH_Year	Date of last reset	(Year)	9 to 99
AT_3008_01	pH sensor	(pH)	0 to 14
TT_3008_01	Temperature of the pH sensor	(ºC)	0 to 100
AT_3008_02	pH sensor	(pH)	0 to 14
TT_3008_02	Temperature of the pH sensor.	(ºC)	0 to 100
WIT_3008_01	Acid bottle weight	(Kg.)	0 to 15
WIT_3008_02	Base bottle weight	(Kg.)	0 to 15
FQRC_3008_01	CO2 flow transmitter	(mL/min)	0 to 50
FQRC_3008_01_SP	CO2 flow SP indicator	(mL/min)	0 to 50

Tag Name	Description	Units	Range
FQRC_3009_01_OP	Mass flow SP in Manual Mode	(mL/min)	0 to 500
CL3009_DO2_SP	DO2 SP in automatic mode	(%)	0 to 100
AT_3009_01	DO2 transmitter (Bottom)	(%)	0 to 100
AT_3009_02	DO2 transmitter (TOP)	(%)	0 to 100
FQRC_3009_01	Flow transmitter (O2)	(mL/min)	0 to 500
FQRC_3009_01_SP	Mass flow SP indicator	(mL/min)	0 to 500
AT_3010_01	Conductivity sensor (bottom)	(uS/cm)	0.02 to 50
AT_3010_02	Conductivity sensor (top)	(uS/cm)	0.02 to 50
FQRC_3011_01_OP	N2 Mass flow SP in Manual Mode	(mL/min)	0 to 8333
FQRC_3011_02_OP	Gas mix Mass flow SP in Manual Mode	(mL/min)	0 to 10000
CL3011_GasMix_SP	Gas mix SP in automatic mode	(mL/min)	0 to 10000
FQRC_3011_01_SP	N2 flow transmitter SP indicator	(mL/min)	0 to 8333
FQRC_3011_01	N2 flow transmitter	(mL/min)	0 to 8333
FQRC_3011_02_SP	Mix flow transmitter SP indicator	(mL/min)	0 to 10000
FQRC_3011_02	Mix flow transmitter	(mL/min)	0 to 10000
PT_3011_01	Pressure in Gas loop	(mBar)	-1000 to 4000
TT_3012_01	Air vent cold water temperature	(ºC)	0 to 150
AT_3013_01	NH_4^+ Analyser	(ppm)	0 to 155.6
AT_3013_02	NO_3^- Analyser	(ppm)	0 to 1000
AT_3013_03	NO_2^- Analyser	(ppm)	0 to 20
AT_3014_01	Biomass sensor	(g/L)	TBD
CL3015_BACKWASHING_DURATION	Backwashing duration	(second)	0 to 10000
CL3016_OXYGENPULSE_MODE	Oxygen Pulse Number	(mode)	0 to 100
PP_3017_01_SP	Recirculation pump SP	(%)	0 to 100
CL3017_Flow_SP	Recirculation flow SP	(L/h)	0 to 5
FT_3017_01	Recirculation flow	(L/h)	0 to 5
PP_3017_01_MV2	Pump speed	(%)	0 to 100

Tag Name	Description	Units	Range
PP_3018_01_SP	Outlet pump SP	(%)	0 to 100
CL3018_Flow_SP	Outlet flow SP	(L/h)	0 to 2
FT_3018_01	Harvest flow sensor	(L/h)	0 to 2
PP_3018_01_MV2	Pump speed	(%)	0 to 100
TT_3020_01	Effluent tank temperature	(ºC)	0 to 150
LT_3021_01	Effluent level	(L)	0 to 30
PT_3007_01_SP	PT_3007_01_Set_Point	(mBar)	-1000 to 4000
CL3007_Pressure_Threshold	PT_3007_01_Threshold	(mBar)	0 to 1000
CL3008_pH_Mode	pH Mode selector	(mode)	1 to 3
CL3008_pH_AVERAGE	pH Average	(pH)	0 to 14
SV_3011_Opening_Time	SV_3011_02 Opening Time (s)	(second)	0 to 100000
SV_3011_02_Opening_Frequency	SV_3011_02 Opening frequency	(frequency)	0 to 100000
CL3016_BOTTOM_OPENING_TIME	Oxygen Pulse Bottom Opening Time	(second)	0 to 10000
CL3016_BOTTOM_CLOSING_TIME	Oxygen Pulse Bottom Closing Time	(second)	0 to 10000
CL3016_TOP_OPENING_TIME	Oxygen Pulse Top Opening Time	(second)	0 to 10000
CL3016_TOP_CLOSING_TIME	Oxygen Pulse Top Closing Time	(second)	0 to 10000

Table 6-1: Values saved in the MS Access database

7. LOCAL HMI SOFTWARE OPERATION

7.1 HMI General layout

HMI displays are composed by a navigation area, placed at the top of the window with blue background, a working area with a white background and an information area placed at the bottom of the window with grey background.

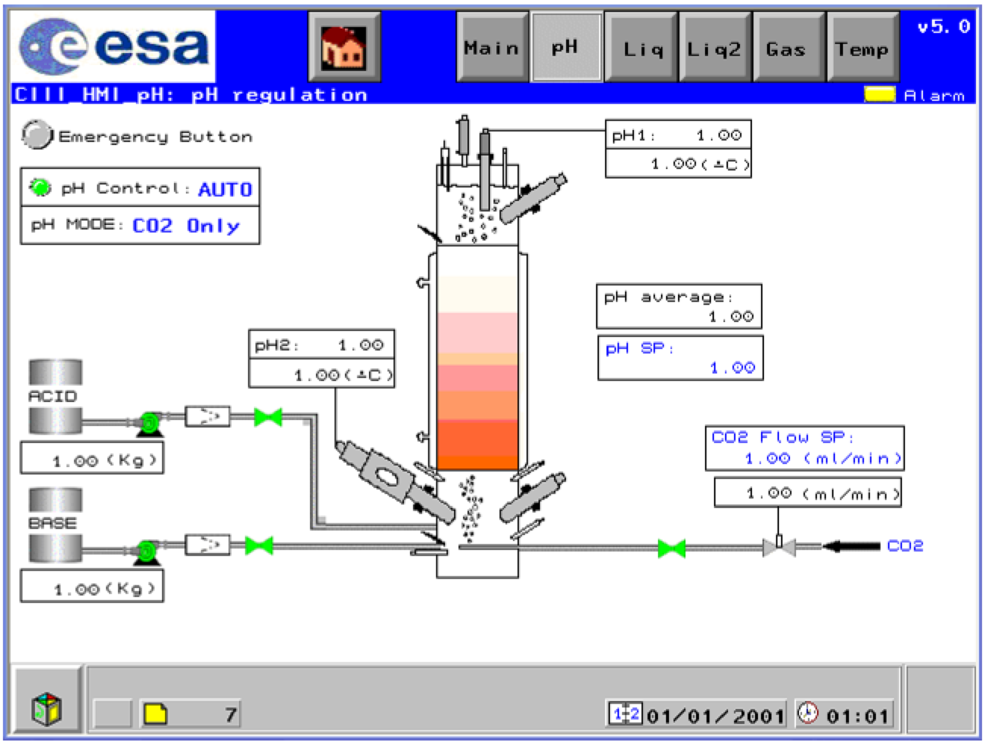


Figure 7-1: Local HMI Layout

7.1.1 Working Area

The working area is where the values are displayed in form of object animations (pumps, valves, etc.) and numerical values.

7.1.1.1 Emergency button indicator

Emergency button is placed on the upper left corner of the working area and changes to red colour when anyone of the stop buttons, placed in each side of the CIII frame, is pushed.

7.1.1.2 Control Loop mode indicators

Under the Emergency button indicator, there are placed the control loops indicators of the process displayed. Circle colour and text are animated depending on the mode selected.

- OFF mode : circle with red background colour and text is “OFF”
- Manual mode: circle with yellow background colour and text is “MAN”
- Automatic mode: circle with green background colour and text is “AUTO”.

7.1.2 Navigation Area

Navigation area is placed on the top of the window. It consists of European Space Agency logo, title of the process displayed, buttons to navigate to the indicated process display or to come back to the HMI main display and CIII general alarm indicator.

7.1.3 Information Area

This area shows the display number, the date and the time.

7.1.3.1 System Button

The System Button is placed on the left corner of this area. By pressing this button the System Toolbar is displayed.

7.1.3.2 System Toolbar

ESC	Return to previous screen.
HOME	Navigate to the Main Display.
MENU	Access to system menu with generic system options (List of pages, List of recipes, List of forms, Password, List of Alarms, Alarm history, Stop printing, Screen lock mode).
SYST	Access to system information menu (Terminal parameters, Protocol parameters, Printer parameters, Password, Product references, Adjust page, PLCs in online mode)
ALARM	Access to alarm screen (not implemented).
HELP	No action (not implemented).

7.2 Local HMI hierarchy

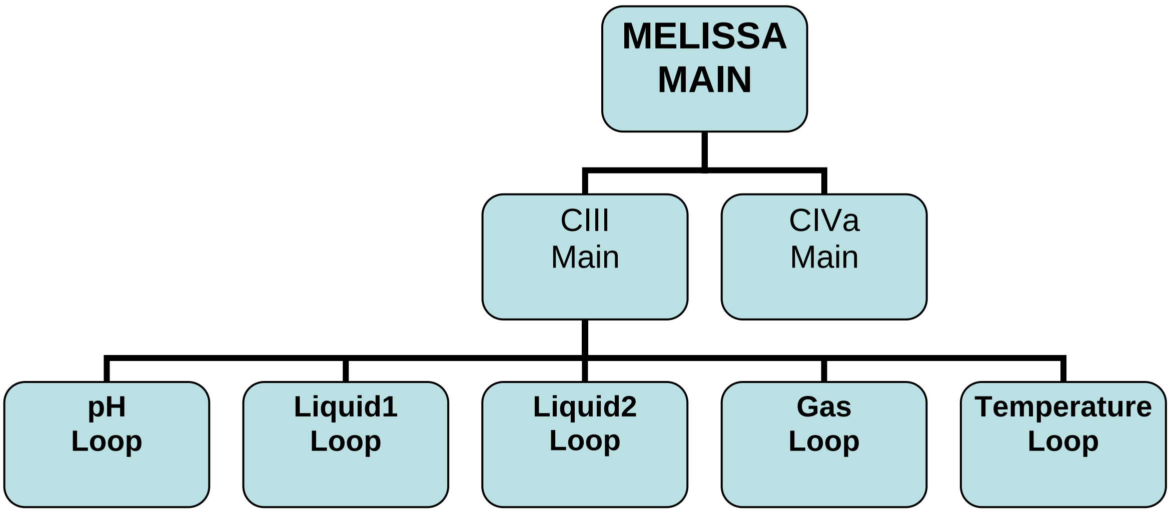


Figure 7-2: Local HMI Interface architecture

The local HMI allows the user to interact with the PLC. Through the HMI the user can check and monitor the system operation; however the user can't operate the compartment from it. Figure 7-2 shows the general structure of the different screens that appears. These can be manipulated by the user in order to monitor the automation and control system. This map establishes the logical relations among the screens. Therefore, following Figure 7-4, the CIII main screen shows an overview of the complete system. From there, the user can navigate to the screens of second level that represent the different loops in the CIII: pH, Liquid1, Liquid2, Gas and Temperature.

7.3 Local HMI main screen

It displays principal values of the compartments III and IVa. It allows navigation to the compartments III and IVa specific displays.

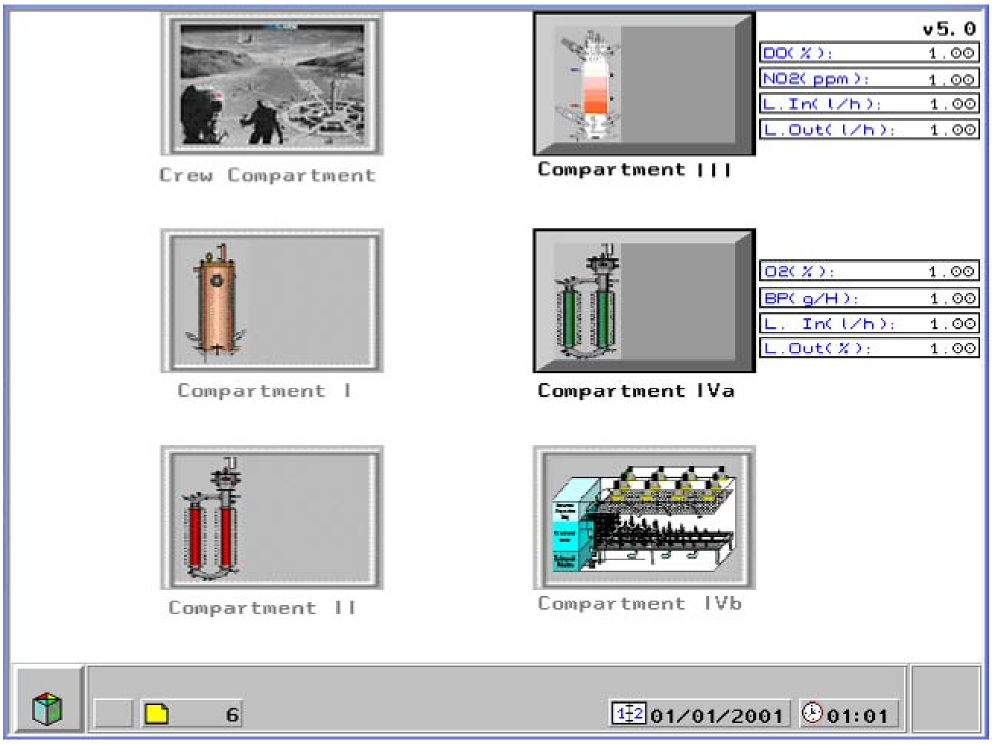


Figure 7-3: Local HMI Main Display.

7.3.1 Tag definition

The following tags are displayed in this screen.

Tag Name	Description	Type	Units	Range
AT_3009_02	Dissolved O_2	Analogue	(%)	0 to 100
AT_3013_03	NO_2^- analyser	Analogue	(ppm)	0 to 20
FT_3003_01	Feeding flow	Analogue	(L/h)	0 to 2
FT_3018_01	Harvest flow	Analogue	(L/h)	0 to 2
AT_4010_02	O_2 Analyser	Analogue	(%)	0 to 25
CL4009_Biomass_Production	Biomass Production	Analogue	(g/H)	TBD
FT_4001_01	Inlet liquid flow to reactor	Analogue	(L/h)	0 to 4
CL4002_PumpSpeed	Flow to the outlet pump	Analogue	(%)	0 to 100

Table 7-1: Tags of the HMi Main Screen

Date and system clock values displayed in the Melissa Main Screen and CIII screens are read from CIII PLC system clock. Following tags are displayed:

- Day: CIII_SysClock_day (PLC address: 400411)
- Month: CIII_SysClock_month (PLC address: 400410)
- Year: CIII_SysClock_Year (PLC address: 400409)

- Hour: CIII_SysClock_Hour (PLC address: 400412)
- Minute: CIII_SysClock_Min (PLC address: 400413)

7.4 Compartment III – main screen

It displays the principal values of the Compartment III.

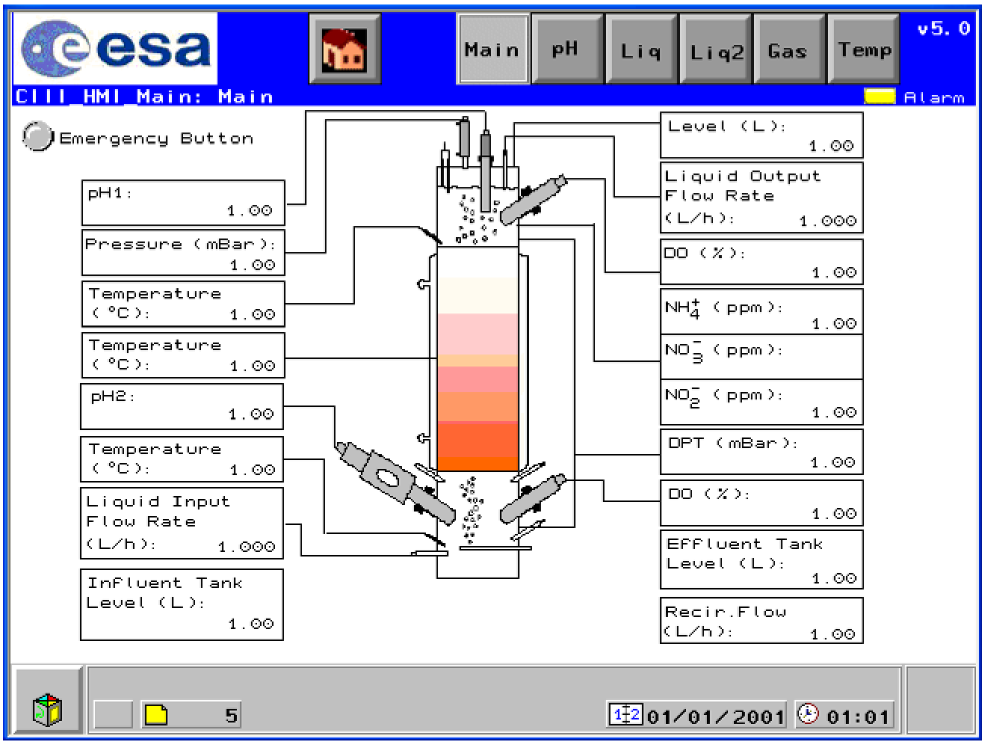


Figure 7-4: Local HMI Compartment III Main Display.

To have a general overview of the Compartment CIII, a general schematic appears in the display when user opens the CIII system. From this schematic user could call the other screens (pH, Liquid, Liquid2, Gas and Temperature). For instance, if the user calls the pH screen, a diagram of this unit comes into view and its instrumentation (valves, pumps, tanks, etc) can be distinguished as well as the different values of the variables that allow controlling it.

7.4.1 Tag definition

Following tags are displayed in this screen:

Tag Name	Description	Type	Units	Range
FT_3003_01	Feeding flow transmitter	Analogue indicator	(L/h)	0 to 2
CL3004_Emer_Button_01	Emergency button	Digital indicator	---	---
TT_3005_01	Bioreactor temperature (middle position)	Analogue indicator	(ºC)	0 to 150
TT_3005_03	Bioreactor temperature (top position)	Analogue indicator	(ºC)	0 to 150
TT_3005_04	Bioreactor temperature (Bottom position)	Analogue indicator	(ºC)	0 to 150
DPT_3007_01	Bioreactor differential pressure	Analogue indicator	(mBar)	0 to 3000
PT_3007_01	Bioreactor pressure	Analogue indicator	(mBar)	-1000 to 4000
AT_3008_01	pH sensor	Analogue indicator	(pH)	0 to 14

Tag Name	Description	Type	Units	Range
AT_3008_02	pH sensor	Analogue indicator	(pH)	0 to 14
AT_3009_01	Dissolved O2 (bottom position)	Analogue indicator	(%)	0 to 100
AT_3009_02	Dissolved O2 (top position)	Analogue indicator	(%)	0 to 100
AT_3013_01	NH_4^+ Analyser	Analogue indicator	(ppm)	0 to 155.6
AT_3013_02	NO_3^- Analyser	Analogue indicator	(ppm)	0 to 1000
AT_3013_03	NO_2^- Analyser	Analogue indicator	(ppm)	0 to 20
LT_3002_01	Influent tank level	Analogue indicator	(L)	0 to 30
LT_3021_01	Effluent tank level	Analogue indicator	(L)	0 to 30
FT_3018_01	Harvest flow sensor	Analogue indicator	(L/h)	0 to 2
LT_3006_01	Bioreactor level	Analogue indicator	(L)	0 to 100

Table 7-2: Tags of the CIII Main local HMI

7.5 Compartment III – pH screen

It displays values related to the pH regulation.

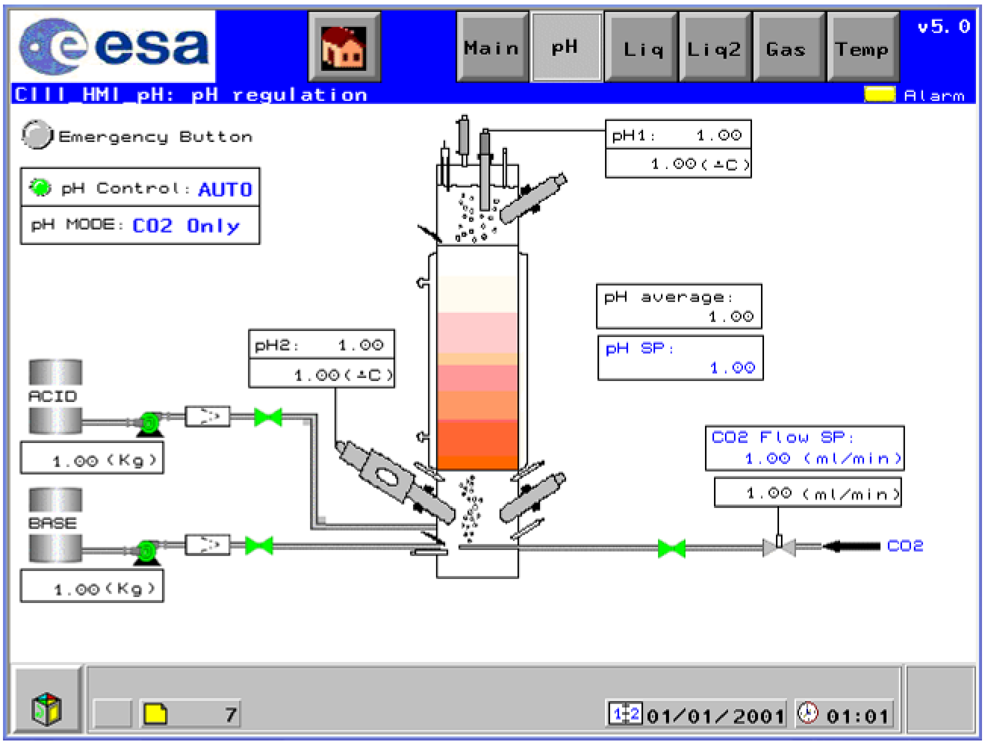


Figure 7-5: Local HMI Compartment III - pH Display

This display allows the user to:

- Monitor the pH values and the temperature of each pH sensor.
- Monitor the weight of acid and base vessels.
- Monitor the CO_2 flow and CO_2 flow set-point (set-point text with blue foreground colour).
- Monitor the pH set-point (text with blue foreground colour).
- Monitor the pH average.
- Monitor the emergency button indicator. Background colour switch to red when one of the Emergency buttons is pushed.
- Monitor the control loops mode (OFF, AUTO, MAN) implemented in the screen.
- Monitor the pH mode for the bioreactor pH control (CO2 Only, CO2+base or Acid+base).

7.5.1 Control Loops

The following control loops are implemented on the screen:

Tag Name	Description
CL3008	pH Control Mode

Table 7-3: Control Loops of the pH loop of the CIII system local HMI

7.5.2 Tag definition

The following tags are displayed in this screen.

Tag Name	Description	Type	Units	Range
CL3008_pH_SP	pH SP	Analogue indicator	(pH)	0 to 14
PP_3008_01_MV	Acid pump	Pump animated	---	---
PP_3008_02_MV	Base pump	Pump animated	---	---
AT_3008_01	pH sensor	Analogue indicator	(pH)	0 to 14
TT_3008_01	Temperature of the pH sensor	Analogue indicator	(ºC)	0 to 100
AT_3008_02	pH sensor	Analogue indicator	(pH)	0 to 14
TT_3008_02	Temperature of the pH sensor.	Analogue indicator	(ºC)	0 to 100
WIT_3008_01	Acid bottle weight	Balance with Analogue indicator	(Kg.)	0 to 6
WIT_3008_02	Base bottle weight	Balance with analogue indicator	(Kg.)	0 to 6
SV_3008_01_FB	Acid valve	2-way valve	---	---
SV_3008_02_FB	Base valve	2-way valve	---	---
FQRC_3008_01	CO2 flow transmitter	Analogue indicator	(mL/min)	0 to 50
FQRC_3008_01_SP	CO2 flow SP indicator	Analogue indicator	(mL/min)	0 to 50
CL3004_Emer_Button_01	Emergency button	Digital indicator	---	---
CL3008_pH_AVERAGE	pH Average	Analogue Indicator	(pH)	0 to 14
CL3008_pH_MODE	pH mode selector (1=CO2 only, 2=CO2+Base and 3= Acid+Base)	Text Indicator	(mode)	1 to 3

Table 7-4: Tags of the pH loop of the CIII system local HMI

7.6 Compartment III – Liquid1 screen

It displays values participating in the liquid input / output regulation.

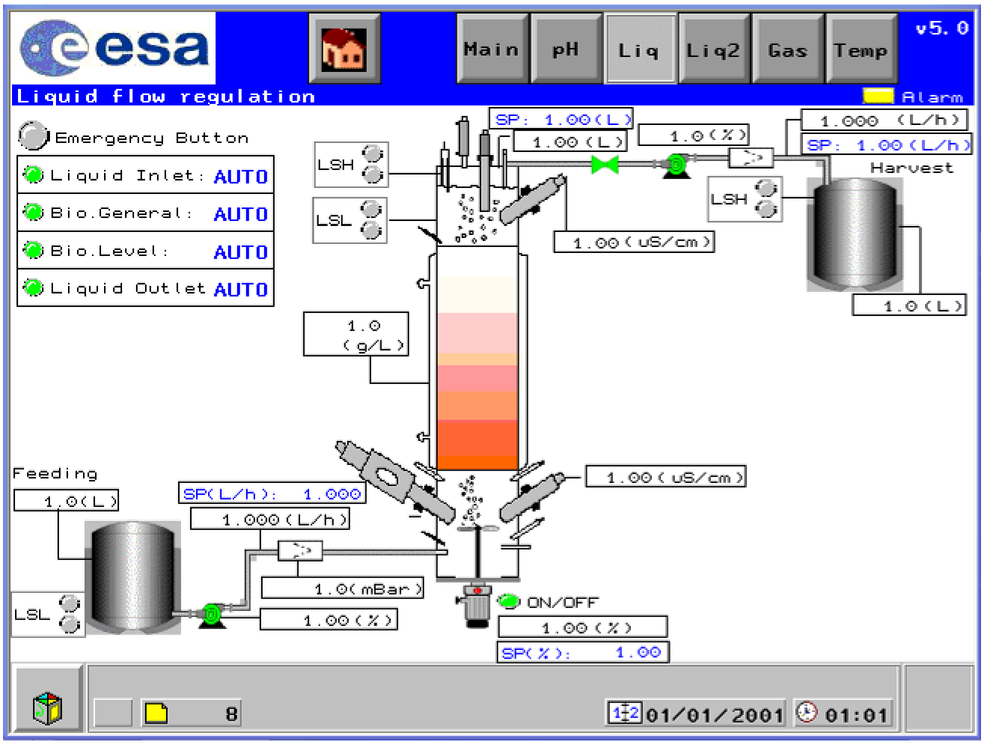


Figure 7-6: Local HMI Compartment III – Liquid1

This display allows the user to:

- Monitor the measurements of the liquid level of the reactor, the level of input and output tanks, the speed of the reactor agitator, the liquid conductivity in the reactor and the input and output flow rates.
- Monitor the Set-Points of Bioreactor Level, input flow, output flow and speed of the reactor agitator. (Set-points text in blue foreground colour).
- Monitor the emergency button indicator. Background colour switch to red when one of the Emergency buttons is pushed.
- Monitor the control loops mode (OFF, AUTO, MAN) implemented in the screen.

7.6.1 Control Loops

The following control loops are implemented on the screen:

Tag Name	Description
CL3003	Liquid Inlet Mode
CL3004	Bioreactor General Mode
CL3006	Bioreactor Level Mode

Tag Name	Description
CL3018	Liquid Outlet loop Mode

Table 7-5: Control Loops of the Liquid1 loop of the CIII system local HMI

7.6.2 Tag definition

The following tags are displayed in this screen.

Tag Name	Description	Type	Units	Range
LSL_3002_01	Influent tank low level switch	Digital indicator	---	---
LSL_3002_02	Influent tank low level switch	Digital indicator	---	---
LT_3002_01	Influent tank level transmitter	Analogue indicator	(L)	0 to 30
FT_3003_01_Set_Point	Feeding pump SP	Analogue indicator	(L/h)	0 to 2
PP_3003_01_MV1	Feeding pump	Pump animated	---	---
PP_3003_01_MV2	Speed of feeding pump	Analogue indicator	(%)	0 to 100
FT_3003_01	Feeding flow transmitter	Analogue indicator	(L/h)	0 to 2
PT_3003_01	Feeding pressure	Analogue indicator	(mBar)	-1000 to 4000
BLE_3004_01_SP	Blender SP	Analogue indicator	(%)	0 to 100
BLE_3004_01_MV1	Blender Status	Pump animated	---	---
BLE_3004_01	Blender speed	Analogue indicator	(%)	0 to 100
CL3004_Emer_Button_01	Emergency button	Digital indicator	---	---
CIII_General_alarm_status	General alarm indicator	Indicator	---	0 to 2
CL3006_BioreactorLevel_SP	Bioreactor Level SP	Analogue indicator	(L)	0 to 100
LSH_3006_01	Bioreactor High level switch	Digital indicator	---	---
LSH_3006_02	Bioreactor High level switch	Digital indicator	---	---
LSL_3006_01	Bioreactor Low level switch	Digital indicator	---	---
LSL_3006_02	Bioreactor Low level switch	Digital indicator	---	---
LT_3006_01	Bioreactor level	Analogue indicator	(L)	0 to 100
AT_3010_01	Conductivity sensor (bottom)	Analogue indicator	(uS/cm)	0.02 to 50
AT_3010_02	Conductivity sensor (top)	Analogue indicator	(uS/cm)	0.02 to 50
CL3018_Flow_SP	Outlet flow SP	Analogue indicator	(L/h)	0 to 2
FT_3018_01	Harvest flow sensor	Analogue indicator	(L/h)	0 to 2
PP_3018_01_MV1	Pump	Pump animated	---	---
PP_3018_01_MV2	Pump speed	Analogue indicator	(%)	0 to 100
SV_3018_01_FB	Reactor liquid outlet valve	2-way valve animated	---	---
LSH_3021_01	Effluent high level switch	Digital indicator	---	---
LSH_3021_02	Effluent high level switch	Digital indicator	---	---
LT_3021_01	Effluent level	Analogue indicator	(L)	0 to 30
AT_3014_01	Biomass sensor	Analogue indicator	(g/L)	TBD

Table 7-6: Tags of the Liquid1 loop of the CIII system local HMI

7.7 Compartment III – Liquid2 screen

It displays values participating in the backwashing and recirculation loop.

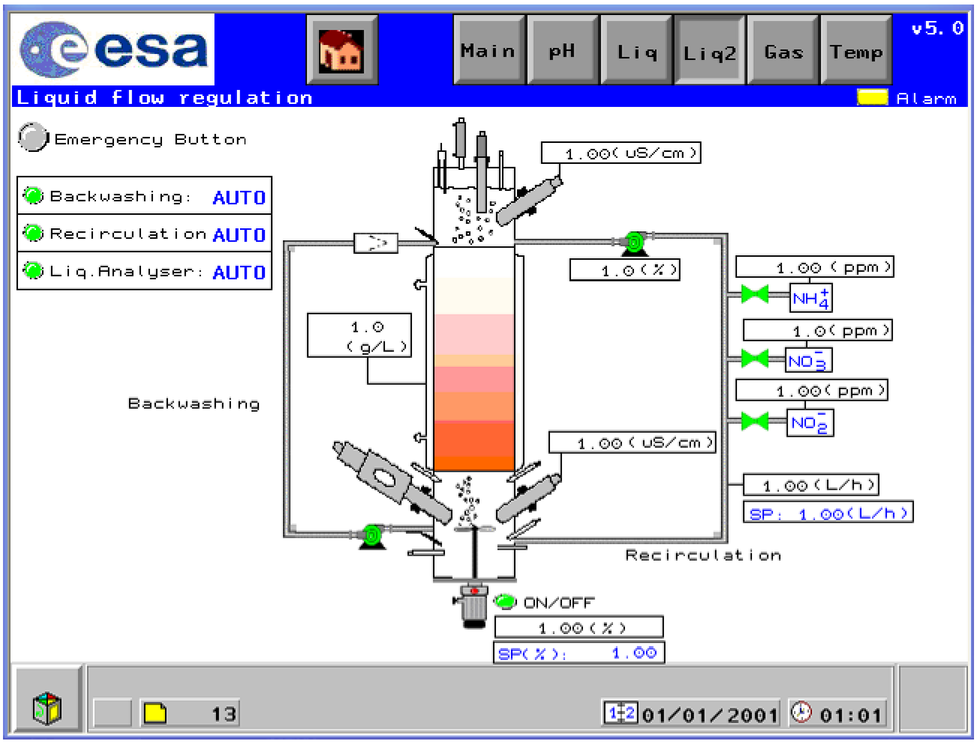


Figure 7-7: Local HMI Compartment III – Liquid2

This display allows the user to:

- Monitor the measurements of the speed of the reactor agitator, the liquid conductivity in the reactor, the recirculation flow rate and concentration of the liquid analyzers.
- Monitor the Set-Points of the speed of the reactor agitator and recirculation flow rate. (Set-points text in blue foreground colour).
- Monitor the emergency button indicator. Background colour switch to red when one of the Emergency buttons is pushed.
- Monitor the control loops mode (OFF, AUTO, MAN) implemented in the screen.

7.7.1 Control Loops

The following control loops are implemented on the screen:

Tag Name	Description
CL3015	Backwashing loop Mode
CL3017	Liquid Recirculation loop Mode
CL3013	Liquid Analyser Loop Mode

Table 7-7: Control Loops of the Liquid2 loop of the CIII system local HMI

7.7.2 Tag definition

The following tags are displayed in this screen.

Tag Name	Description	Type	Units	Range
BLE_3004_01_SP	Blender SP	Analogue indicator	(%)	0 to 100
BLE_3004_01_MV1	Blender Status	Pump animated	---	---
BLE_3004_01	Blender speed	Analogue indicator	(%)	0 to 100
CL3004_Emer_Button_01	Emergency button	Digital indicator	---	---
AT_3010_01	Conductivity sensor (bottom)	Analogue indicator	(uS/cm)	0.02 to 50
AT_3010_02	Conductivity sensor (top)	Analogue indicator	(uS/cm)	0.02 to 50
PP_3015_01_MV	Backwashing pump	Pump animated	---	---
CL3017_Flow_SP	Recirculation flow SP	Analogue indicator	(L/h)	0 to 5
FT_3017_01	Recirculation flow	Analogue indicator	(L/h)	0 to 5
PP_3017_01_MV1	Pump status	Pump animated	---	---
PP_3017_01_MV2	Pump speed	Analogue indicator	(%)	0 to 100
SV_3013_01_FB	NH_4^+ sampling valve	2-way valve animated	---	---
SV_3013_02_FB	NO_3^- sampling valve	2-way valve animated	---	---
SV_3013_03_FB	NO_2^- sampling valve	2-way valve animated	---	---
AT_3013_01	NH_4^+ Analyser	Analogue indicator	(ppm)	0 to 155.6
AT_3013_02	NO_3^- Analyser	Analogue indicator	(ppm)	0 to 1000
AT_3013_03	NO_2^- Analyser	Analogue indicator	(ppm)	0 to 20
AT_3014_01	Biomass sensor	Analogue indicator	(g/L)	TBD

Table 7-8: Tags of the Liquid2 loop of the CIII system local HMI

7.8 Compartment III – Gas screen

It displays values participating in the gas input / output regulation

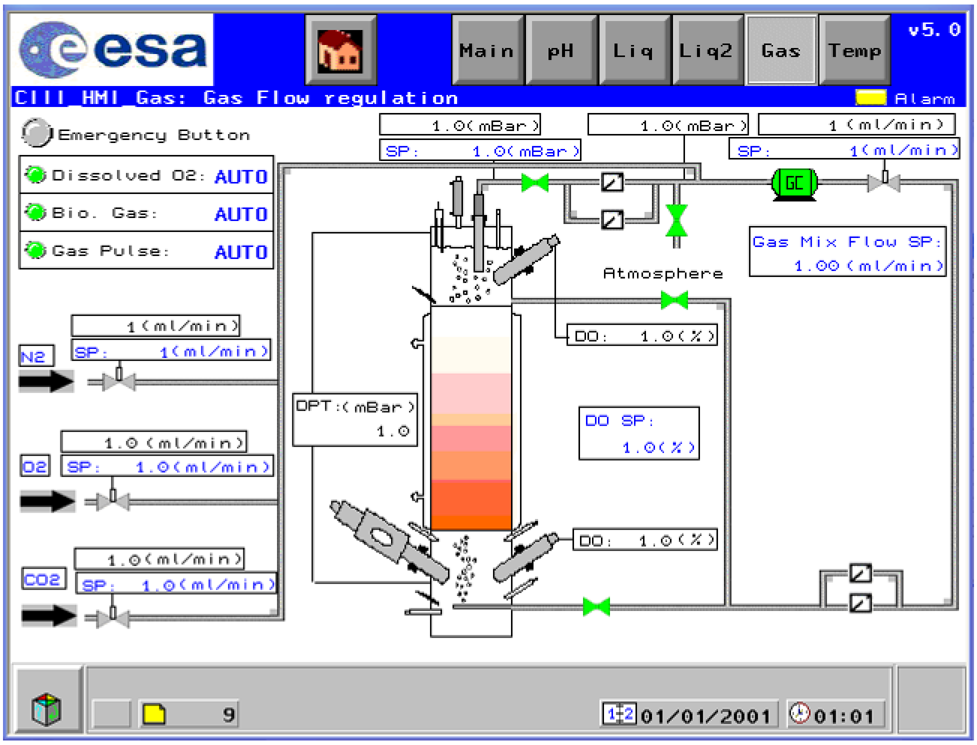


Figure 7-8: Local HMI Compartment III – Gas

This display allows the user to:

- Monitor the N_2 gas flow, the O_2 gas flow, the CO_2 gas flow, the gas mix flow, the dissolved O_2 concentration and the pressure transmitters.
- Monitor the set-points of dissolved oxygen and gas mix flow (text in blue foreground colour).
- Monitor the emergency button indicator. Background colour switch to red when one of the Emergency buttons is pushed.
- Monitor the control loops mode (OFF, AUTO, MAN) implemented in the screen.

7.8.1 Control Loops

The following control loops are implemented on the screen:

Tag Name	Description
CL3009	DO2 Mode
CL3011	Bioreactor Gas Loop Mode
CL3016	Gas pulse loop Mode

Table 7-9: Control Loops of the Gas loop of the CIII system local HMI

7.8.2 Tag definition

The following tags are displayed in this screen.

Tag Name	Description	Type	Units	Range
DPT_3007_01	Bioreactor differential pressure	Analogue indicator	(mBar)	0 to 3000
PT_3007_01	Bioreactor pressure	Analogue indicator	(mBar)	-1000 to 4000
CL3009_DO2_SP	DO2 SP in automatic mode	Analogue indicator	(%)	0 to 100
AT_3009_01	DO2 transmitter (Bottom)	Analogue indicator	(%)	0 to 100
AT_3009_02	DO2 transmitter (TOP)	Analogue indicator	(%)	0 to 100
FQRC_3009_01	Flow transmitter (O2)	Analogue indicator	(mL/min)	0 to 500
FQRC_3009_01_SP	Mass flow SP indicator	Analogue indicator	(mL/min)	0 to 500
CL3011_GasMix_SP	Gas mix SP in automatic mode	Analogue indicator	(mL/min)	0 to 10000
GC_3011_01_MV	Gas compressor	Compressor animated	---	---
FQRC_3011_01_SP	N2 flow transmitter SP indicator	Analogue indicator	(mL/min)	0 to 8333
FQRC_3011_01	N2 flow transmitter	Analogue indicator	(mL/min)	0 to 8333
FQRC_3011_02_SP	Mix flow transmitter SP indicator	Analogue indicator	(mL/min)	0 to 10000
FQRC_3011_02	Mix flow transmitter	Analogue indicator	(mL/min)	0 to 10000
PT_3011_01	Pressure in Gas loop	Analogue indicator	(mBar)	-1000 to 4000
SV_3011_01_FB	Reactor venting valve	2-way valve animated	---	---
SV_3011_02_FB	Gas exhaust valve	2-way valve animated	---	---
SV_3011_03_FB	Gas introduction valve	2-way valve animated	---	---
SV_3016_01_FB	Gas introduction valve	2-way valve animated	---	---
CL3004_Emer_Button_01	Emergency button	Digital indicator	---	---
FQRC_3008_01	CO2 flow transmitter	Analogue indicator	(mL/min)	0 to 50
FQRC_3008_01_SP	CO2 flow SP indicator	Analogue indicator	(mL/min)	0 to 50

Table 7-10: Tags of the Gas loop of the CIII system local HMI

7.9 Compartment III – Temperature screen

It displays values related to temperature regulation.

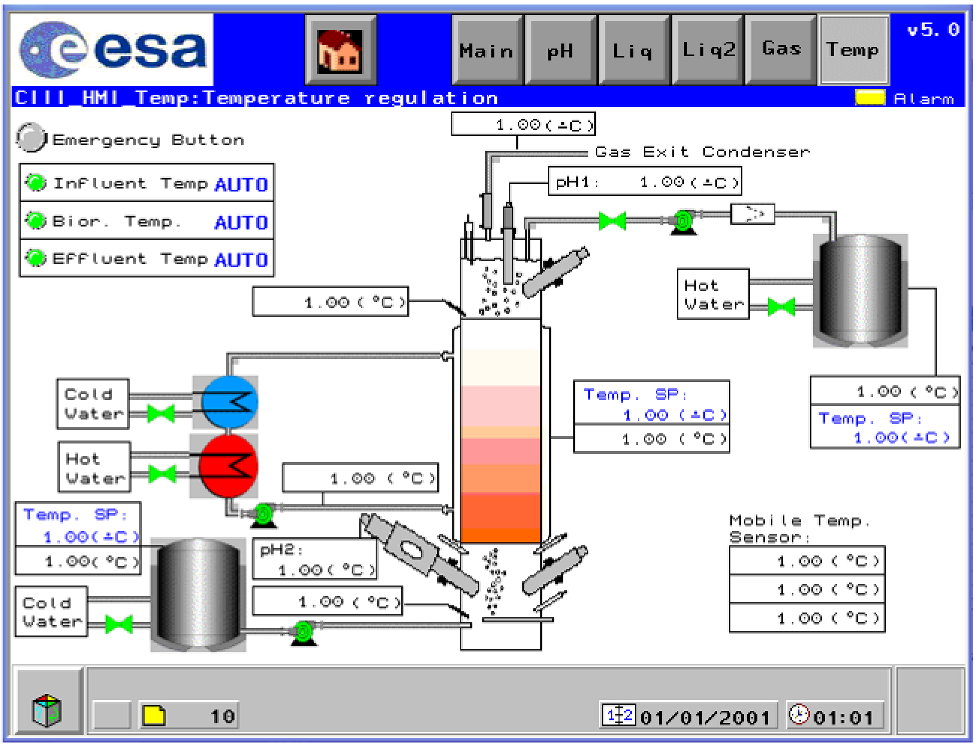


Figure 7-9: Local HMI Compartment III - Temperature

This display allows the user to:

- Monitor the temperature of each tank, the bioreactor fluid jacket and mobile temperature sensors.
- Monitor the temperature set-points of each of the tanks and the bioreactor (text with blue foreground colour).
- Monitor the emergency button indicator. Background colour switch to red when one of the Emergency buttons is pushed.
- Monitor the control loops mode (OFF, AUTO, MAN) implemented in the screen.

7.9.1 Control Loops

The following control loops are implemented on the screen:

Tag Name	Description
CL3001	Influent Temperature Mode
CL3005	Bioreactor Temperature Mode
CL3020	Effluent Temperature Mode

Table 7-11: Control Loops of the Temperature loop of the CIII system local HMI

7.9.2 Tag definition

The following tags are displayed in this screen.

Tag Name	Description	Type	Units	Range
SV_3001_01_FB	Temperature control valve	2-way valve	---	---

Tag Name	Description	Type	Units	Range
TT_3001_01	Influent tank temperature	Analogue indicator	(ºC)	0 to 150
TT_3001_01_SP	Influent tank temperature SP	Analogue indicator	(ºC)	0 to 150
TT_3005_SP	Bioreactor temperature SP	Analogue indicator	(ºC)	O to 150
CP_3005_01_MV	Circulation pump	Pump animated	---	---
SV_3005_02_FB	Heat exchanger valve (HOT)	2-way valve animated	---	---
SV_3005_01_FB	Heat exchanger valve (COLD)	2-way valve animated	---	---
TT_3005_02	Reactor jacket temperature	Analogue indicator	(ºC)	0 to 150
TT_3005_01	Bioreactor temperature (middle position)	Analogue indicator	(ºC)	0 to 150
TT_3005_03	Bioreactor temperature (top position)	Analogue indicator	(ºC)	0 to 150
TT_3005_04	Bioreactor temperature (Bottom position)	Analogue indicator	(ºC)	0 to 150
TT_3020_01_SP	Effluent tank temperature SP	Analogue indicator	(ºC)	0 to 150
SV_3020_01_FB	Temperature control valve	2-way valve animated	---	---
TT_3020_01	Effluent tank temperature	Analogue indicator	(ºC)	0 to 150
CL3004_Emer_Button_01	Emergency button	Digital indicator	---	---
TT_3023_01	Mobile Temperature used for sterilisation	Analogue indicator	(ºC)	0 to 150
TT_3023_02	Mobile Temperature used for sterilisation	Analogue indicator	(ºC)	0 to 150
TT_3023_03	Mobile Temperature used for sterilisation	Analogue indicator	(ºC)	0 to 150
PP_3003_01_MV1	Feeding pump	Pump animated	---	---
PP_3018_01_MV1	Effluent Pump	Pump animated	---	---
SV_3018_01_FB	Reactor liquid outlet valve	2-way valve animated	---	---

Table 7-12: Tags of the Temperature loop of the CIII system local HMI

8. MAINTENANCE

8.1 Backup Procedure

To prevent the system to lose the data stored due to a hardware failure, backups of relevant data must be performed regularly. The periodicity will vary depending on the type of experiments currently performed in the Plant. The recommended approach is to perform a backup of data at the end of every experiment and empty the data files.

In addition, a backup of the entire system is recommended each time a change on the configuration is performed in order to avoid loosing these changes.

To perform a backup use the tape device included in the Supervision Server and the Backup software tool accessible from the Windows menu Programs and Accessories.

Important:
To perform a full backup using the Windows 2000 Backup tool the files must not be locked or otherwise are skipped. In order to avoid files locked the iFIX service must be stopped. To stop the service, close all iFIX applications and from the Control Panel select Services and stop the iFIX service. This will cause the Master Control to be stopped and therefore

this operation can only be performed when there are not experiments on course. Once the backup process is ended, restart the iFIX service.

8.2 Data Management

In a regular basis, data generated must be removed in order to prevent the system to run out of disk space. The time will vary depending on the acquisition data rates used. Therefore, when a long test is going to start it is highly recommended to check if data can be reset for the compartment since data are generated independently for each compartment. To reset the data for a compartment perform the following steps:

1. Perform a backup of the corresponding Microsoft Access Database file (mdb) located in the SUPERVISION\PIC\Database.
2. Empty the database file.

9. TROUBLESHOOTING

9.1 Rack power input is interrupted

When the rack power is interrupted the Uninterrupted Power Supply will start beeping. This is to alert that this device is powering the PLC. The power interruption can be caused for several reasons. To detect the cause of the power interruption perform the following steps:

1) Check that the rack receives external power. This can be checked by verifying that other devices have power. In case that the external power is not available the recovery procedure is out of the scope of this instructions.
2) Check the magnetothermic circuit breaker in the AC input. In case that the differential is open is because an over power consumption has occurred. The rack power consumption is limited to 6 Amp @ 220 V 50 Hz. An over power consumption most probably is caused by a short circuit. Review the connections and devices of the rack to identify and solve the short circuit problem and connect again the magnetothermic.
3) Check the differential circuit breaker status in the AC input. In case that the differential is open is because of a current leak. Review the connections and devices of the rack to identify and solve the current leak problem. After detecting and solving the current leak connect the differential circuit breaker.

9.2 Communications with the PLC are broken

In case the supervision displays @@@@ symbols in the variable values can be due to the lost of communications with the PLC.

1) Check the rack receives power. In case that is not powered follow procedure stated in section 13.1.
2) Check the network connection. The network connection can be checked by looking at the led status of the switch (located in the Supervisory Rack) and the led status of the network module of the PLC. If the led are indicate malfunction check the network connectors to the switch and the PLC (plug and unplug the connectors), if still not working check the cable connectivity.

10. APPENDIX B. PROBLEM REPORT FORM

MELISSA Control System Demonstrator - Problem Report		
Reported by:	Identifier:	Date:
Title:		Reference:
Problem Found		
Suspected Cause		
Disposition Result		
Disposition option: ☐ *Reject*	☐ *Repair, rework*	☐ *Use as is*
Disposition Date:		
Actions		
Close Out		
Verification results:		
Verified by: Date:	Authorised by: Date:	

NTE	**Minutes of Meeting**	*Reference:*	NTE-CIII-MN-009

Identification			
Project Name:	CS MELiSSA CIII		
Subject:	October Project Progress Meeting		
Place:	UAB	*Date:*	14/10/09
Chairman:	J. Duatis	*As Taken by:*	J. Duatis

Participants		
Organization	*Name*	*Signature*
NTE	J. Duatis	Duatis
UAB	Enrique Peiró	Enrique Peiró
ESA	Arnaud Fossen	
SHERPA	Olivier Gerbi	
SHERPA	Christophe Bourg	

Additional copies to	
Organization	*Name*
NTE	Francesc Gallart
ESA	Brigite Lamaze
UAB	Francesc Gòdia

Agenda

- Status of project activities
- Financial issues with current contracts
- Future contracts

Actions Summary			
Number	*Action*	*Actionee*	*Due Date*
001	NTE to launch the purchase order for the CI-Panel PC and notify delivery time.	NTE	23-Oct-09
002	UAB/SHERPA to organise a meeting to discuss the Maintenance Modes and alarms of CI	UAB/SHERPA	02-Nov-09
003	NTE to test and fix HMI graphs display	NTE	23-Oct-09
004	SHERPA to prepare PLC SW of CIVa for time synchronisation.	SHERPA	06-Nov-09
005	NTE to review time synchronisation according to the definition given in this minutes	NTE	23-Oct-09
006	NTE to update the configuration of users proposal and send it to UAB for final review	NTE	06-Nov-09
007	NTE to be install the Export Data display in the MPP	NTE	
008	NTE to provide CIVa updated displays as per comments performed on CIII HMI.	NTE	02-Nov-09
009	NTE to provide CIII data package for review	NTE	23-Oct-09
010	UAB to provide purchase orders for the projects HPC PLC Expansion and HPC HVAC Mapping. Purchase orders must be to NTE-SENER S.A.	UAB	23-Oct-09
011	NTE to send updated proposal for Biomel CIII 2nd phase activities	NTE	23-Oct-09
012	UAB to present final invoice for HPC to EFIS	UAB	23-Oct-09
013	NTE to send a proposal for the maintenance activities for the 2010	NTE	23-Oct-09
014	NTE to provide quotation for conversion of the expansion backplane into a remote backplane	NTE	23-Oct-09

Minutes	**Action**
<u>CI Panel PC</u> NTE presented the configuration for the local HMI to be installed in CI. The main characteristics are the following: - Panel PC Advantech TPC-1570 - Optipanel Box with a fixed arm from Rittal (seal protection according to IP-65) Decision about final emplacement will be taken once the hardware is in the MPP and possibilities can be tested.	

Tentative locations are in the wall in front of the skid or in the skid of the filtration unit (west side). NTE to launch the purchase order for the CI-Panel PC and notify delivery time. NTE will provide cables for connection. However, routing of cables will be performed by MPP once final location decided (power and Ethernet).	#A1 (NTE)
<u>CI Alarms and Maintenance Modes</u> CI Local maintenance modes and alarms still to be defined between NTE, SHERPA and MPP. UAB/SHERPA to organise a meeting to discuss this issue.	#A2 (SHERPA/UAB)
<u>Displays review</u> Several problems were identified when using HMI displays: - Graphs display: o graph is not working, fails when configuration is saved (tested the day of the meeting) o iFix crashes if buttons are pushed fast and repeatedly o Configuration of the graph is not saved once changed o NTE to fix and verify HMI graphs display	#A3 (NTE)
- Time synchronisation o Time changes from display to display, seems that time from the PLC is being displayed. Time to be displayed is the time of the server and be updated to the PLC once every day to avoid time drifts between the different PLCs. PLC from HPC and CIII are already prepared. o SHERPA to prepare PLC SW of CIVa for time synchronisation.	#A4 (SHERPA)
o NTE to review time synchronisation according to the definition given in this minutes. Time synchronisation must include MAGELIS displays.	#A5 (NTE)
- Users o Proposal already performed by UAB, NTE to update the configuration of users proposal and send it to UAB for final review. The guest access would be the default mode with only rights for edition.	#A6 (NTE)
- UAB commented the possibility to include report generation in the HMI. NTE explained that iFIX is prepared to provide reporting capabilities although some programming effort has to be invested since are not end-user tools. This effort was not foreseen in the current contract. - NTE is developing a data exporting display in the HMI which will allow the exportation of iFIX historical data in text files selecting a range of dates/times. NTE to be install the Export Data display in the MPP.	#A7 (NTE)
<u>CIVa Status</u> SHERPA commented that displays from CIII and CIVa look like different. NTE replied that displays from CIVa are being updated from comments performed by SHERPA about CIII. NTE to provide updated displays as per comments performed on CIII HMI. SHERPA mentioned that some failures or absence of some instruments are making it difficult to test the loops.	#A8 (NTE)
<u>CIII Status</u> CIII is being tested by SHERPA right now and tests will tentatively finish by first week of November. NTE will sent data package for review during next week. The period from then to begin of November will be established for review of data package and perform the final updates coming from: - the tests performed by SHERPA - the review of the HMI displays performed by the UAB (and SHERPA) - the review of data package documentation. With respect to the Analysers, NTE exposed that in the old PLC/HMI SW no special action was taken w.r.t. the analysers. The analog input was reading the measured value and the digital input was indicating if the analyser was in calibration or not. Other possibilities can be implemented in the HMI if the digital connection of the analyser is used (similarly to the scales).	#A9 (NTE)
<u>Financial issues</u> NTE asked to the UAB the formal delivery of purchase orders for the following projects: - HPC PLC Expansion - HPC HVAC Mapping Purchase orders must be directed to: NTE-SENER S.A. Can Malé s/n 08186 Lliçà d'Amunt CIF: A-65161614 Bank Account: 0182-0090-46-0201509554	#A10 (UAB)
<u>Biomel CIII</u>: A proposal has to be sent by NTE for the 2nd phase activities covering the changes in the HW from the prototype, the installation of the sensor in the CIII reactor in the MPP and the calibration of the reactor.	#A11 (NTE)
<u>HPC Control</u>: NTE asked to UAB clearance for presenting the final invoice. UAB confirmed the clearance even the final data package has not been already reviewed (sent by end of July 2009). NTE exposed that any comment	#A12 (UAB)

or discrepancy in the documentation resulting from the review will be attended.	
Maintenance contract NTE asked about the maintenance contract and UAB asked for a proposal in the frame of activities for the 2010. NTE to send the proposal by next week.	#A13 (NTE)
HPC Expansion options The current configuration of the HPC PLC does not allow the addition of more analog inputs. During visit of Schneider Barcelona Team several possibilities have been discussed and finally the option of converting the expansion backplane into a remote IO backplane (RIO) is the more effective. This would allow the use of the current 3 free slots, allowing dozens of free analog inputs/outputs by installing additional cards. NTE to provide quotation for conversion of the expansion backplane into a remote (RIO) backplane.	#A14 (NTE)

Conclusions
Substantial progress has been achieved in the on-going projects: - Final activity of installing CI-Panel PC is in course and expected to be finished within the following weeks with the installation in the MPP. - CIII Hardware is almost completely working and the HMI is almost finished, only minor updates are expected. - CIVa Hardware still has some problems related to devices integration and the HMI is being updated. Other projects are to be started in the following weeks: - Biomel CIII

Identification			
Project Name:	CS MELiSSA CIII		
Subject:	Review of MAGELIS displays		
Place:	UAB	*Date:*	29/10/09
Chairman:	J. Duatis	*As Taken by:*	J. Duatis

Participants

Organization	*Name*	*Signature*
NTE	J. Duatis	Duatis
NTE	J. Carbonell	
UAB	Enrique Peiró	Enrique Peiró
UAB	Raul Moyano	R. Moyano
ESA	Arnaud Fossen	A. FOSSEN

Additional copies to

Organization	*Name*
NTE	Francesc Gallart
ESA	Brigite Lamaze
UAB	Francesc Gòdia
SHERPA	Olivier Gerbi

Agenda

- Review of MAGELIS displays for the CIII compartment
- Review of the users account configuration
- AoB

Actions Summary

Number	*Action*	*Actionee*	*Due Date*
A#15	NTE will provide estimated time for issues resolution. See attached list.	NTE	5/11/2009
A#16	UAB to provide the precision of the sensors in order to update the number of decimals in the HMI and MAGELIS displays.	UAB	5/11/2009
A#17	UAB to provide an updated picture for the CIII bioreactor to be incorporated in the HMI and MAGELIS displays	UAB	5/11/2009
A#18	UAB to provide information about passive elements in the P&ID to be displayed in the HMI displays	UAB	5/11/2009
A#19	NTE to investigate the possiblity to leave always logged in the "gest" account in case that a user is logged-off.	NTE	5/11/2009
A#20	UAB authorised the purchase order for the HPC Expansion to former NTE. NTE to find this purchase order and stop it.	UAB	30/10/2009
A#21	UAB to send new purchase order with updated company fiscal information	UAB	5/11/2009
A#22	NTE to send the HVAC mapping offer updated including the PLC hardware update.	NTE	5/11/2009

Minutes	Action

MAGELIS Display

The MAGELIS display is presented. Nowadays, there are two MAGELIS in the plant. One is attached to the HPC PLC cabinet and the other is housed in a stand-alone box. Therefore, the second can be installed freely, only a 220VAC and Ethernet port are needed.

The MAGELIS is connected to the PLC network and communicates directly with the PLCs. Thus, from the MAGELIS it would be possible to monitor any bioreactor, i.e., any reactor PLC.

During the MELiSSA Spacialisation phase 1, the MAGELIS was programmed with displays for the CIII and the CIV and one of the activities of the current CIII and CIVa hardware update contracts, is to update as well this displays to leave it operational, at least with the same display functionality than before.

NTE presents the new displays of the CIII. Design documentation of the displays can be found in NTE-CIIIP2-RP-

007 MELISSA CIII Local HMI Design, already delivered to the MPP. Attached to this minutes there is a list with all issues found. The list will be distributed to UAB/SHERPA. Any new issue found is to be included in this list. NTE will provide estimated time for issues resolution. UAB to provide the precision of the sensors in order to update the number of decimals in the HMI and MAGELIS displays. UAB to provide an updated picture for the CIII bioreactor to be incorporated in the HMI and MAGELIS displays UAB to provide information about passive elements in the P&ID to be displayed in the HMI displays	 A#15 A#16 A#17 A#18	 (NTE) (UAB) (UAB) (UAB)
Users configuration Change "SUPERVISOR" group name for "DISPLAY" group name. Users in this group can only display the screens. Add to the administrators group Arnaud Fossen Include the login names only in one group (the higher) Indicate that SHERPA can also modify thresholds (although nowadays it is not possible to change thresholds from the HMI). Add permissions to Vanessa, Nuria, Cynthia to all compartments Add permissions to Natalia only for the CIVb (HPC1) NTE to investigate the possiblity to leave always logged in the "~~gest~~ guest" account in case that a user is logged-off.	A#19	(NTE)
AoB		
HPC Extension purchase order UAB authorised the purchase order for the HPC Expansion to former NTE. NTE to find this purchase order and stop it. UAB to send new purchase order with updated company fiscal information.	A#20 A#21	(NTE) (UAB)
HVAC Mapping Activity of the HVAC mapping itself could not start until sensors are received and installed. Date to receive sensors is up to the 20th of November. Week of the 23rd NTE+UAB will proceed to the sensors installation. First week of December could start the mapping activity. ESA/UAB indicated to update HVAC offer to include upgrading of the PLC, converting the current backplane expansion to a Remote I/O expansion, allowing then to connect permanently the pressure sensors to the PLC without removing any card. To perform the acquisition of pressure sensors a card that is not used in CIII will be installed in one of the free slots of the HPC1 PLC, on a temporary basis, if the RIO is not available. NTE to send the updated offer including the PLC hardware update.	A#22	(NTE)

Conclusions
MAGELIS displays for the CIII are well advanced. After resolution of issues found, the work will be considered finished. Review of the MAGELIS displays of the CIVa will be performed after delivery of the design. The users configuration is finally agreed. The configuration will be made active after start-up of HMI displays for the CIVa and CIII.