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MELiSSA – Adaptation for Space

ESA contract 15671/01/NL/ND

TECHNICAL NOTE 72.9.4

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1. Introduction

In the framework of the project ‘MELISSA-Adaptation for Space’ a concept was proposed for the harvest and desalination of *Arthrospira* algae in the MELISSA loop. The breadboard described in this manual was constructed to demonstrate the feasibility of this concept..

The harvest is a concentration cycle consisting of 2 steps:

1. concentration of the algae suspension by ultrasonic separation
2. further concentration of the clarified stream leaving the ultrasound separation system by ultrafiltration

The washing or desalination of the algae is achieved by the dilution of the concentrated cell suspension to the original volume with distilled water followed by a next concentration cycle. The washed and concentrated cell suspension can then be further processed for food production, e.g. drying or pasteurisation.

In this note, the documents related to the breadboard components, instrumentation inventory and user manual are presented. It is so, that the content of this note is the layout which will be used for the functioning of the breadboard. The user will have to follow the procedure described in the manual to start and stop the harvesting of *Arthrospira platensis*.

2. Overview

2.1 Scheme

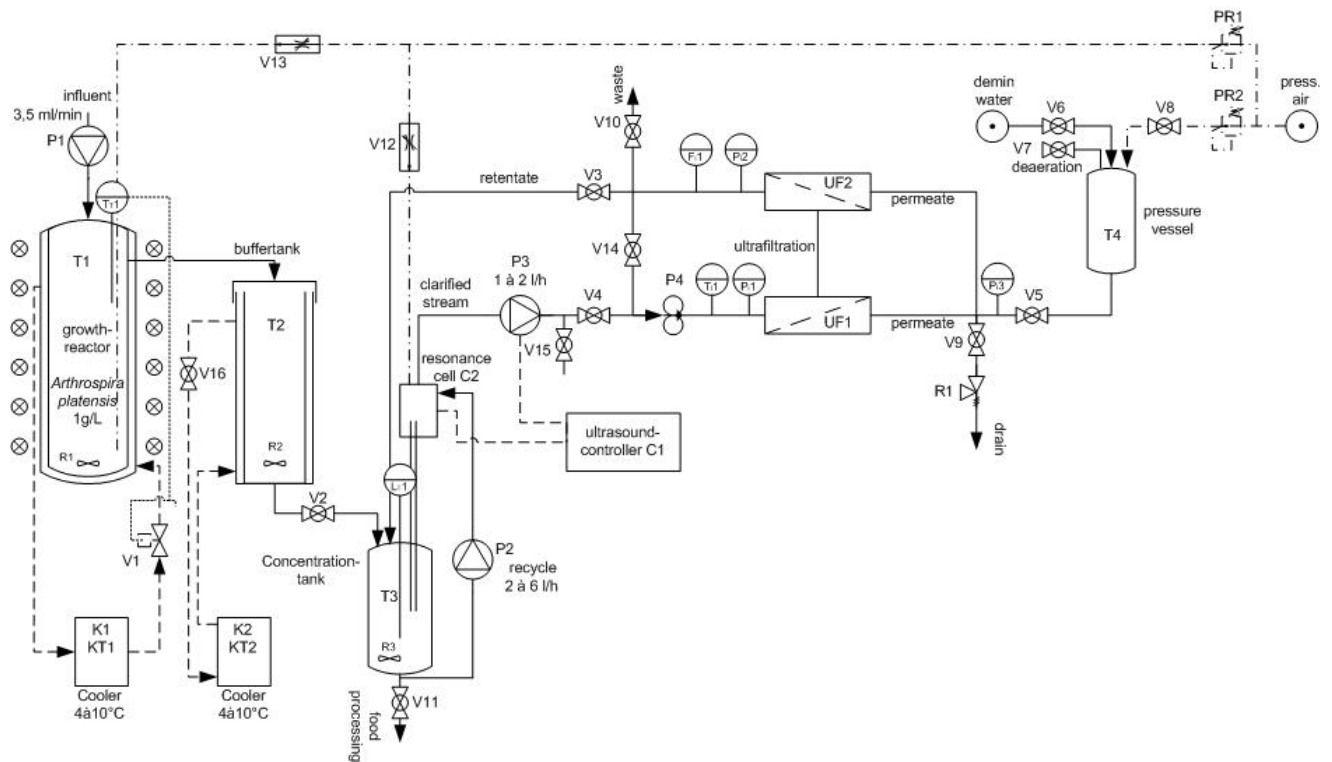



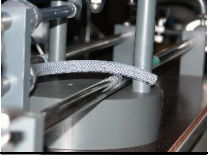





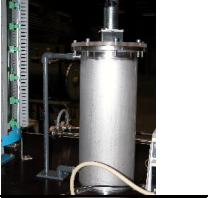

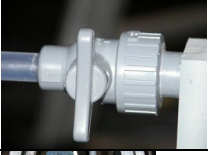

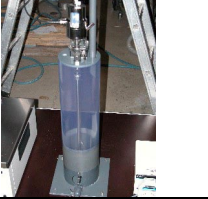





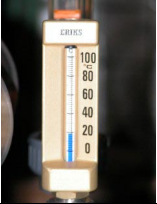






Figure 1. Schematic overview of the breadboard

3. Material inventory

3.1 Technical description

Peristaltic pump		Micro gear pump	
Temperature controller		UF membrane modules	
Magnetic stirrer		Manual valve	
Temperature cooler		Aerator	
Stirrer		Buffer tank	
Electrical valve		Lab valve	
Level detector		Concentration tank	
Ultrasound (US) harvest system		Gear pump	
US controller		Manometer	

Flow meter		Thermometer	
Glass growth reactor with lighting system		Pressure vessel	
Pressure reducer		Air control valve	

3.2 Necessary facilities

- Power supply: 380VAC + N, 50Hz, 32A;
- A cooled buffer tank with influent;
- A receptacle to collect the permeate;
- An enclosure around the installation with board: “restricted area, only for authorized persons” (in the local language);

4. Specific operation of the instruments

4.1 Temperature controller T_{r1}

Normal reading on the screen is the process value. When pushing on button P, the desired setpoint can be set by the ▲ or ▼ button. After 2 seconds the value is accepted.

The temperature controller has a built in self-optimization function. To activate this function the ▲ and ▼ buttons must be pushed together during at least 2 seconds. The tuning will terminate automatically or can be cancelled by pushing a button.

4.2 Cooler K1, K2 & cooler temperature control KT1, KT2

Fill the cooling vessel with tap water and glycol. The pipes towards the bioreactor and the buffer tank must be filled with water by letting the internal pump run. The pipes have manual de-aerators at the top to remove the excess air during filling.

Set the red over-temperature-limiter (see Figure 2) at the back side of the cooler at a temperature higher than the process temperature.



Figure 2. back side of the cooler temperature control

With the black button at the back side below, the pump speed can be set. At the double dots the maximum pump speed is set, at the single dot the pump runs at reduced speed. Best is to run at maximum speed.

At the front panel, activate the power switch. Set the desired cooling water temperature (about 4°C).

4.3 Magnetic stirrer R1

The magnetic stirrer is used to mix the algae reactor by means of a magnetic paddle. Prior to switching on the instrument, rotate the speed control knob to minimum (counter-clockwise). Then switch on the instrument and set the desired stirring speed.

4.4 Stirrer R2 & R3

Both stirrers on the buffer tank and the concentration tank must be switched on/off and can be regulated by means of a potentiometer.

4.5 Lighting system

The lighting system is controlled by a switch with dimming functionality. When the switch is pressed during <400 ms, the light is turned on or off. When the pressing takes longer than 400 ms, the dimming function is activated (rising and dropping). The halogen spots have a power supply of 11V - which is a safety voltage – but become very hot. The power supply towards the spots can be measured with a voltmeter in the 2 plugs at the side of the transformer cabinet. The tension (0 – 12 VAC) is a measure for the calibration of the light flux.

4.6 Micro gear pump P3

Before usage, calibrate the pump with the appropriate tubing. Therefore a chronometer and a graduated cylinder are needed. Make sure the tubing is completely filled with liquid. Measure 5 points (at knob positions 2, 4, 6, 8 and 10) and set up the calibration curve. The desired speed can be selected from the calibration curve. This pump is used as the harvest pump. For proper operation of the ultrasound system, the flow should be 2 l/h at maximum.

4.7 Peristaltic pump P1 & P2

Before usage, calibrate the pump with the appropriate tubing. Therefore a chronometer and a graduated cylinder are needed. Make sure the tubing is completely filled with liquid. Measure 5 points (at knob positions 2, 4, 6, 8 and 10) and set up the calibration curve. The desired speed can be selected from the calibration curve.

Influent pump : The flow rate should be fixed to 3,5 ml/min for a hydraulic retention time of 24 h in the photo-bioreactor.

Recirculation pump : The flow rate is dependent on the flow rate of the harvest pump and must be approximately 1,5 to 2,5 times the harvest flow rate for proper functioning of the ultrasonic separation.

4.8 Biosep Ultrasonic harvest system C1 & C2

The controller has a high frequency output to the resonance chamber where the harvest takes place. The harvest pump is controlled by the Biosep controller. Both the ultrasonic field and the harvest pump should be shut off periodically in order to facilitate the settling of aggregates in the resonance chamber. This is done by using the start and the stop timer function on the controller. The best intermittent mode should be selected by trial and error. The tables in the Biosep manual might be a rough guide. The power added to the resonance chamber can be adapted and is also subjected to experimental testing for good results. It is advisable to use low power settings because of the negative influence of thermal effects in the harvest cell. The collection chamber should be cooled by a compressed air flow by regulating V12.

For further details, we refer to the manual of the Biosep system.

4.9 Gear pump P4

The gear pump, P4, is used to circulate the liquid over the membranes and to build up pressure. Speed control is done via the frequency converter (inside the cabinet). The flow can be read off the flow meter Fi1 in the membrane loop. The pressure before and after the membranes is visualized by Pi1 and Pi2.

5. Working principles

The whole installation is operated manually except for the cooling of the algae growth reactor.

To start the installation, the main switch must be put on position I for operation and the reset button must be pushed. The blue operation light will then be lit. If the emergency stop is pushed, the installation will shut down completely and the red stop light will be on.

Make sure that the correct plugs are in the according sockets.

The cabinet with the transformers is continuously actively ventilated and will make some noise.

The bioreactor and the ultrasonic resonance chamber are continuously aerated during operation. Therefore a compressed air supply must be present. The pressure reducer PR1 must be at about 0,5bar and the valves V12 and V13 must be partially open. Aeration via valve V12 is for the cooling of the harvest system and via valve 13 the algae in the bioreactor get air supply. The air-noise induced due to the opening of the valves and the apparition of bubbles in the bioreactor indicate that the aeration is in operation. Pressure reducer PR2 is set at 2 bar and serves for the backwash procedure (5.5 Backwash system).

5.1 Algae reactor T1

Fill the glass growth reactor with 5L of *Arthrospira* and switch on the magnetic stirrer R1. The installation is fed by a peristaltic pump P1 at 5 L/d for a retention time of 1 d. The growth medium (Zarrouk) enters the glass growth reactor at about the top. The growth reactor is illuminated by 56 halogen lamps. Every lamp has a radiation fraction per 1000 lx of about 5,5 W/m² in the wavelength band between 380 and 780 nm. This amount of lamps supplies a maximum light intensity of 300 W/m². However, calibration of the light intensity should be performed in the photobioreactor before operation, using a light calibrating sensor to provide a maximum Photosynthetic Active Radiation (PAR) of 300 W/m². The dichroic reflector lamps have a lifecycle of 4000 h. They have a cool light beam, which reduces the cooling necessity of the photo bioreactor. Light intensity can be reduced via a dimmer.

The reaction vessel must be aerated (by V13 and PR2) continuously. The manometer of PR1 should be at approximately 0,5 bar. The algae growth reactor temperature is to be maintained at 30-35°C by the temperature controller T_T1 which is connected to the cooler K1 (with its own temperature controller KT1). The lid has an opening for measurements of the pH or for sample taking. The overflow pipe discharges the excess volume in the reactor towards the buffer tank T2.

Samples can be taken through an opening in the lid.

5.2 Buffer tank T2

The discharge of the bioreactor is buffered in this tank Every twenty-four hours, when the buffer has been filled with 5 L of liquid, it must be emptied into the concentration tank by manually opening valve V2. The stainless steel tank is double-walled and is cooled and stirred continuously. The stirring velocity can be adapted by means of the according potentiometer (RP1). The tank has a maximum volume of 6 l and has a transparent PMMA lid. Cooling liquid at 4°C cools the algae suspension to 4°C.

Samples can be taken through an opening in the lid.

5.3 Concentration tank T3

The concentration tank is where the algae suspension will be concentrated and washed in several cycles. It must be filled with the daily collected suspension from the buffer tank and stirred continuously. The stirring velocity can be adapted by means of the according potentiometer (RP2). The vessel is made of transparent PVC. On top of the lid, the ultrasonic harvest system can be found. A low level measurement is present and a visual signal (red light on the electricity cabinet) is given when it is reached. In the ultrasonic harvest system the supernatant is separated from the algae, although the separation is not 100%. The concentrated algae suspension is returned to the concentration tank, the clear supernatant is removed via the harvest line. The circulation peristaltic pump (P2) conducts the algae into the ultrasonic harvest system and back to the concentration tank. The harvest pump P3 pumps the clarified stream to the membrane filtration unit. The resonance chamber of the ultrasound system and the harvest pump P3 are controlled by the ultrasound controller.

Firstly, the algae are gathered in the concentration tank and then the circulation pump P2 must be switched on to fill the resonance chamber with the suspension. Secondly, the ultrasound controller and pump P3 can be put into operation (placed in remote instead of local control to allow the ultrasound controller to manage the functions of the ultrasound system). Then the pump P4 should be put on (see 5.4 Membrane filtration loop). When the volume in the concentration tank is reduced to below 500 ml, the low level switch (LT1) will be activated and the red low-level-alarm light will lit. The first 10-fold concentration cycle is finished. First switch off the ultrasound controller and pump P2. Then the

backwash procedure should be started manually. After the last concentration cycle,, the concentrate can be drained for further food processing by opening V11.

5.4 Membrane filtration loop UF1 & UF2

In the ultrafiltration loop, the supernatant coming from the concentration tank should be concentrated starting from a cell concentration of approximately 50 mg/l up to a final cell concentration of approximately 10 g/l. Two membranes with a membrane area of 0.045 m² each are placed in series. Ceramic membranes with 3 channels, a length of 1200 mm and an outer diameter of 10 mm are used (CERAM INSIDE ATZ membranes, purchased from Tami Filtration).

The permeate is drained continuously. The ultrafiltration loop is put on a slight overpressure of about 0,5 bar by relief valve R1 to prevent breakthrough of harvest through pump P3, certainly when this latter is operated at its lower capacity. The velocity of the pump P4 is controlled by a frequency converter and is visualised by flow meter Fi1. The pressure which is visualised by manometer Pi1 should not exceed 2 bar. If the pressure exceeds this limit, the ultrasound-controller and hence the micro pump P3 should be stopped. During the concentration step, valves V4, V9 and V14 are open and valves V3, V5, V10 and V15 are closed. Pump P4 keeps on running.

When the volume of the concentration tank reaches 500 ml, the retentate of the filtration part must be sent back to the concentration tank and the membrane system must be backwashed with demineralised water. The aim of this demineralised water is twofold i.e. cleaning of the ultrafiltration membranes and washing of the cell suspension in the concentration tank to decrease the salt concentration of the cells. The backwash water is collected in the concentration tank until the original volume of 5 l cell suspension is reached and the next concentration cycle can start (for backwash procedure see paragraph 5.5). This procedure should be repeated several times until the salt concentration in the concentrated cell suspension is low enough.

In the membrane filtration part, the liquid is circulated continuously. The supernatant of the concentration tank is sent to the filtration loop (by pump P3) and the same amount flows through the membrane pores as permeate.

5.5 Backwash system

A system for backwashing is present. First, demineralised water should be poured into the pressure vessel T4 via V6. Open the deaeration valve V7 to fill (till 4,5L) the vessel with demineralised water. Be sure to close V7 and V6 after filling. Then pressure can be built up by applying air pressure onto this vessel (open V8) and then close V8 at a pressure of about 2 bar (reading on the manometer of the pressure reducer PR2). In order to backwash, first shut down the US-controller and pump P2, then valves V3 and V5 must be opened and valves V4 and V9 must be closed whereby valve V10 remains closed. Pump P4 keeps on running. Backwash should be stopped when the volume in the concentration tank reaches 5 litres. After a backwash be sure to open valves V4 and V9 and to close V3 and V5. Several wash cycles (each one after about 2 hours 15 minutes of harvesting) are necessary whereby the wash water is drained into the concentration tank. The last time a wash cycle is executed, the resulting wash water is drained as waste by opening V10 instead of V3.

5.6 Sampling

Samples can easily be taken from the bioreactor and the buffer tank by means of a pipette. From the concentration tank a sample can be taken via valve V11. The clarified stream can be inspected by valve V15. A sample from the retentate in the filtration loop can be taken by valve V10 and the permeate sample is taken at the drain at valve V9.

6. Ending a test

At the end of a test cycle, the installation should be cleaned thoroughly. Make sure that the algae-reactor lights are switched off. The installation is conceived to be demounted easily. Remove the US-harvest system first. Water with a non-aggressive detergent can be used. Rinse abundantly afterwards with deminwater.

7. Periodic maintenance

7.1 Peristaltic pump

The tubes at the peristaltic pumps must be checked regularly to prevent leakage caused by the friction of the pump head.

7.2 Growth reactor

In order to remove the hoses unscrew the GL connectors. The list of the different GL connectors with seals is as follows:

GL32-Ø14 (black) : aerator connection onto the lid

GL14-Ø6 : connection aerator with air supply

GL25-Ø10 : connection with influent

GL18-Ø6 : connection for the temperature sensor Pt100

GL45-42x32 with PTFE-seal with silicon: connection with overflow pipe

GL32 : cap

2 x GL32-29x16 with PTFE-seal with silicon : connection with cooling system

The connection order of the seals is as in Figure 3.

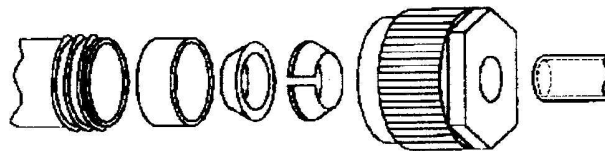


Figure 3. Seal connection order

7.3 Harvest system (see manual)

No steam-in-place (SIP) cleaning procedure should be applied to the resonator chamber. Dismantle the resonator chamber from the frame by opening the tri-clamp and disconnecting the hoses. Use a pipette brush and a detergent solution to carefully clean all parts of the glass cuvette. Use caution because the glass cuvette is extremely fragile. Rinse thoroughly afterwards. The frame itself (without the cuvette) can be placed in a dishwasher. Treat the fragile transducer connections very carefully. After the rinsing, let the resonator chamber dry carefully. Ensure that the transducer contacts are completely dry before using the resonator.

7.4 Membranes

As described earlier (see 5.5 Backwash system), the membranes are backflushed by demineralised water after each concentration cycle. When the membranes are too much fouled, a thorough cleaning step should be applied. The fouling of the membranes can be followed by following the pressure drop over the membrane (manometers Pi1 and Pi2) as the pressure drop will increase with increasing membrane fouling.

A possible chemical cleaning procedure, advised by the membrane manufacturer, is cleaning with a NaOH solution (85°C, 15-20 g/l, 30 min) followed by cleaning with HNO₃ solution (50°C, 4.5 g/l, 15 min) with a clean water rinsing after each step. Experimental results showed that several washing steps were needed to fully recover the initial flux.

When cleaning is necessary, the cleaning solution can be brought in the filtration loop through the demineralised water tank (open valves V8 and V5, close valve V9). During the cleaning procedure, valves V10 and V4 should be closed and valve V14 should be open. Pump P4 should be switched on. After completion of the cleaning procedure, the chemical agent can be drained from the filtration loop by opening valve V10.

Additional tests should be performed on membrane cleaning to determine what is the optimal cleaning procedure and frequency.

8. Troubleshooting

9. Safety

When working with the *Arthrospira* harvest system the following measures should be taken into account:


- The entire manual and the manuals of the parts should be reviewed before operating the installation.
- The use, maintenance or repairing is only to be performed by qualified persons.
- The installation should be connected to a proper power system of 380VAC + N tri-phase, 50Hz, 32A with sufficient grounding.
- Maintenance or repairing should only be performed with the plug disconnected from the main power system of 380VAC.
- When removing or opening any parts from the system, the installation should be unplugged from the main power.
- The installation should be inspected regularly on correct functioning by qualified persons.
- General laboratory safety conditions should be applied : wear safety goggles, laboratory gloves, lab coat, safety shoes.
- An enclosure must be placed around the installation with a board : “restricted area, only for authorized persons” (in the local language).

10. Epilogue

This manual has been written for the *Arthrospira* harvest installation for the partners in the MSA project. It remains the spiritual property of Vito (Flemish Institute for Technological Research) and can not be copied, passed to neither submitted for perusal to third parties without written permission from Vito.

Mol, 2004-01-27

11. Component data sheets of the breadboard

		Component Data Sheet	
		Made by:	EPAS
Project ref:	Melissa3 - L2356	Document ref :	
Issue date:	2004-03-23	Revision date :	
Component reference	KT1- KT2		
Description	Cooling bath temperature control		
Type	C10		
Sub-type	003-509		
Model Number	1200301018058		
Manufacturer	Thermo Haake		
Sales office	Glasatelier Saillart		
Function	Controls the bath cooler temperature		
Remarks			
General Characteristics			
Power source	Electricity	Protection Class (IP)	30
Voltage (V)	230	Dimension (mm)	
Power input (W)	1550	Weight (kg)	
Power output (W)		Design Pressure (bar)	
Current draw (A)		Design Temperature (°C)	20
Fuse protection (A)	2 x 8A	Safety instructions	
Specific Characteristics			
Body materials			
Sealing materials			
Connector type			
Connector size			
Document references			
Component drawing		Certificates	
Input/output list		Guarantee period	
Electric Wiring Diagram		Guarantee documents	
Warning symbols		Manual reference	



Component Data Sheet

Made by:	EPAS	Checked by:	
Project ref:	Melissa3 - L2356	Document ref :	
Issue date:	2004-03-23	Revision date :	
Component reference	K1-K2		
Description	Cooling bath		
Type	K15		
Sub-type	002-4288		
Model Number	1200300581009		
Manufacturer	Thermo Haake		
Sales office	Glasatelier Saillart		
Function	Cooling of the algae bioreactor and the buffertank		
Remarks			
General Characteristics			
Power source	Electricity	Protection Class (IP)	20
Voltage (V)	230	Dimension (mm)	385 x 465 x 415
Power input (W)	2600	Weight (kg)	
Power output (W)		Design Pressure (bar)	
Current draw (A)	12	Design Temperature (°C)	
Fuse protection (A)	2 x 10A; 2 x 5A	Safety instructions	
Specific Characteristics			
Body materials	SS		
Sealing materials			
Connector type			
Connector size			
Document references			
Component drawing		Certificates	
Input/output list		Guarantee period	
Electric Wiring Diagram		Guarantee documents	
Warning symbols		Manual reference	



Component Data Sheet

Made by:	EPAS	Checked by:	
Project ref:	Melissa3 - L2356	Document ref :	
Issue date:	2004-03-23	Revision date :	
Component reference	UFD1		
Description	Frequency converter		
Type	T-verter		
Sub-type	E2 series		
Model Number			
Manufacturer	Taian Electric Co, LTD		
Sales office	Flowtec		
Function	Controls pump P4		
Remarks			
General Characteristics			
Power source		Protection Class (IP)	
Voltage (V)		Dimension (mm)	
Power input (W)		Weight (kg)	
Power output (W)		Design Pressure (bar)	
Current draw (A)		Design Temperature (°C)	
Fuse protection (A)		Safety instructions	
Specific Characteristics			
Body materials			
Sealing materials			
Connector type			
Connector size			
Document references			
Component drawing		Certificates	
Input/output list		Guarantee period	
Electric Wiring Diagram		Guarantee documents	
Warning symbols		Manual reference	



Component Data Sheet

Made by:	EPAS	Checked by:	
Project ref:	Melissa3 - L2356	Document ref :	
Issue date:	2004-03-23	Revision date :	
Component reference	P1		
Description	Peristaltic pump with easy load pumphead		
Type	Masterflex L/S		
Sub-type	Economy drive		
Model Number	7554-85		
Manufacturer	Barnant		
Sales office	Applitek		
Function	Influent pump		
Remarks			
General Characteristics			
Power source	Electricity	Protection Class (IP)	22
Voltage (V)	230	Dimension (mm)	220 x 180 x 135
Power input (W)		Weight (kg)	4,1
Power output (W)	37	Design Pressure (bar)	
Current draw (A)	0,9A	Design Temperature (°C)	0-40
Fuse protection (A)	T1,0	Safety instructions	
Specific Characteristics			
Body materials	Painted Steel		
Sealing materials			
Connector type			
Connector size			
Document references			
Component drawing		Certificates	EN61010-1/A2 EN61326-1/A1
Input/output list		Guarantee period	
Electric Wiring Diagram		Guarantee documents	
Warning symbols		Manual reference	



Component Data Sheet

Made by:	EPAS	Checked by:	
Project ref:	Melissa3 - L2356	Document ref :	
Issue date:	2004-03-23	Revision date :	
Component reference	P2		
Description	Peristaltic pump with easy load pumphead		
Type	Masterflex L/S		
Sub-type	Economy drive		
Model Number	7554-85		
Manufacturer	Barnant		
Sales office	Applitek		
Function	Recirculation pump		
Remarks			
General Characteristics			
Power source	Electricity	Protection Class (IP)	22
Voltage (V)	230	Dimension (mm)	220 x 180 x 135
Power input (W)		Weight (kg)	4,1
Power output (W)	37	Design Pressure (bar)	
Current draw (A)	0,9A	Design Temperature (°C)	0-40
Fuse protection (A)	T1,0	Safety instructions	
Specific Characteristics			
Body materials	Painted steel		
Sealing materials			
Connector type			
Connector size			
Document references			
Component drawing		Certificates	EN61010-1/A2 EN61326-1/A1
Input/output list		Guarantee period	
Electric Wiring Diagram		Guarantee documents	
Warning symbols		Manual reference	



Component Data Sheet

Made by:	EPAS	Checked by:	
Project ref:	Melissa3 - L2356	Document ref :	
Issue date:	2004-03-23	Revision date :	
Component reference	P3		
Description	Gear pump with easy load pumphead		
Type	Micropump		
Sub-type			
Model Number	75211-55		
Manufacturer	Barnant		
Sales office	Applitek		
Function	Recirculation pump		
Remarks	Pumphead : GJ-N21.JF1SA		
General Characteristics			
Power source	Electricity	Protection Class (IP)	23
Voltage (V)	230	Dimension (mm)	292 x 203 x 184
Power input (W)		Weight (kg)	5
Power output (W)	0,075	Design Pressure (bar)	
Current draw (A)	1,1A	Design Temperature (°C)	0-40
Fuse protection (A)	T1,6	Safety instructions	
Specific Characteristics			
Body materials	ABS case, irridite-coated aluminium chassis		
Sealing materials			
Connector type			
Connector size			
Document references			
Component drawing		Certificates	EN61010-1/A2 EN61326-1/A1
Input/output list		Guarantee period	
Electric Wiring Diagram		Guarantee documents	
Warning symbols		Manual reference	



Component Data Sheet

Made by:	EPAS	Checked by:	
Project ref:	Melissa3 - L2356	Document ref :	
Issue date:	2004-03-23	Revision date :	
Component reference	P4		
Description	Magnetic gear pump		
Type	MDG-R15P		
Sub-type			
Model Number	12200923		
Manufacturer	Iwaki		
Sales office	Flowtec		
Function	Circulation in membrane loop		
Remarks			
General Characteristics			
Power source	Electricity	Protection Class (IP)	55
Voltage (V)	Δ 230V	Dimension (mm)	
Power input (W)	180	Weight (kg)	
Power output (W)		Design Pressure (bar)	
Current draw (A)	0,9	Design Temperature (°C)	
Fuse protection (A)		Safety instructions	
Specific Characteristics			
Body materials			
Sealing materials			
Connector type			
Connector size			
Document references			
Component drawing		Certificates	
Input/output list		Guarantee period	
Electric Wiring Diagram		Guarantee documents	
Warning symbols		Manual reference	



Component Data Sheet

Made by:	EPAS	Checked by:	
Project ref:	Melissa3 - L2356	Document ref :	
Issue date:	2004-03-23	Revision date :	
Component reference	Ultrasound cell		
Description	Acoustic resonator assembly		
Type	50 L		
Sub-type	50 L/day		
Model Number			
Manufacturer	Applisens		
Sales office	Applitek		
Function	Algae harvest system		
Remarks			
General Characteristics			
Power source	electricity	Protection Class (IP)	
Voltage (V)	1 x 230V	Dimension (mm)	177 x 97
Power input (W)	10 W	Weight (kg)	1,5
Power output (W)		Design Pressure (bar)	4
Current draw (A)		Design Temperature (°C)	130
Fuse protection (A)		Safety instructions	
Specific Characteristics			
Body materials	Body: SS316 L, cuvette: pyrex glass		
Sealing materials	silicone		
Connector type	½" tri-clamp, 6 mm and 10 mm barbed fitting		
Connector size			
Document references			
Component drawing		Certificates	
Input/output list		Guarantee period	
Electric Wiring Diagram		Guarantee documents	
Warning symbols		Manual reference	



Component Data Sheet

Made by:	EPAS	Checked by:	
Project ref:	Melissa3 - L2356	Document ref :	
Issue date:	2004-03-23	Revision date :	

Component reference	Ultrasound controller
Description	
Type	APS 990 Controller
Sub-type	
Model Number	Z299005020
Manufacturer	Applisens
Sales office	Applitek
Function	Controls the ultrasound resonance cell and the harvest pump
Remarks	

General Characteristics

Power source	electricity	Protection Class (IP)	
Voltage (V)	1 x 240	Dimension (mm)	130 x 130 x 305
Power input (W)	150	Weight (kg)	3,5
Power output (W)	10	Design Pressure (bar)	
Current draw (A)		Design Temperature (°C)	
Fuse protection (A)	2 A slow blow 250V	Safety instructions	

Specific Characteristics

Body materials			
Sealing materials			
Connector type			
Connector size			

Document references

Component drawing		Certificates	
Input/output list		Guarantee period	
Electric Wiring Diagram		Guarantee documents	
Warning symbols		Manual reference	



Component Data Sheet

Made by:	EPAS	Checked by:	
Project ref:	Melissa3 – L2356	Document ref :	
Issue date:	2004-03-23	Revision date :	
Component reference	R1		
Description	Magnetic stirrer		
Type	MR3000		
Sub-type			
Model Number	504-00011-00-1		
Manufacturer	Heidolph		
Sales office	Glasatelier Saillart		
Function	Stirring of the algae bioreactor		
Remarks			
General Characteristics			
Power source	Electricity	Protection Class (IP)	30
Voltage (V)	230	Dimension (mm)	2400 x 155 x 120
Power input (W)	25	Weight (kg)	2,4
Power output (W)		Design Pressure (bar)	
Current draw (A)		Design Temperature (°C)	0-40
Fuse protection (A)		Safety instructions	
Specific Characteristics			
Body materials	Polyamide coat housing; active surface: 1.4301; polyester front panel		
Sealing materials			
Connector type			
Connector size			
Document references			
Component drawing		Certificates	
Input/output list		Guarantee period	
Electric Wiring Diagram		Guarantee documents	
Warning symbols		Manual reference	



Component Data Sheet

Made by:	EPAS	Checked by:	
Project ref:	Melissa3 - L2356	Document ref :	
Issue date:	2004-03-23	Revision date :	
Component reference	R2		
Description	Stirrer		
Type	80 807 0		
Sub-type	80 807 019		
Model Number			
Manufacturer	Crouzet		
Sales office	Breva		
Function	Stirring of the buffertank		
Remarks			
General Characteristics			
Power source	Electricity	Protection Class (IP)	
Voltage (V)	24 DC	Dimension (mm)	
Power input (W)	17	Weight (kg)	0,800
Power output (W)		Design Pressure (bar)	
Current draw (A)		Design Temperature (°C)	40
Fuse protection (A)		Safety instructions	
Specific Characteristics			
Body materials			
Sealing materials			
Connector type			
Connector size			
Document references			
Component drawing		Certificates	
Input/output list		Guarantee period	
Electric Wiring Diagram		Guarantee documents	
Warning symbols		Manual reference	



Component Data Sheet

Made by:	EPAS	Checked by:	
Project ref:	Melissa3 - L2356	Document ref :	
Issue date:	2004-03-23	Revision date :	
Component reference	R3		
Description	Stirrer		
Type	80 807 0		
Sub-type	80 807 019		
Model Number			
Manufacturer	Crouzet		
Sales office	Breva		
Function	Stirring of the concentration tank		
Remarks			
General Characteristics			
Power source	Electricity	Protection Class (IP)	
Voltage (V)	24 DC	Dimension (mm)	
Power input (W)	17	Weight (kg)	0,800
Power output (W)		Design Pressure (bar)	
Current draw (A)		Design Temperature (°C)	40
Fuse protection (A)		Safety instructions	
Specific Characteristics			
Body materials			
Sealing materials			
Connector type			
Connector size			
Document references			
Component drawing		Certificates	
Input/output list		Guarantee period	
Electric Wiring Diagram		Guarantee documents	
Warning symbols		Manual reference	

12. Electrical scheme

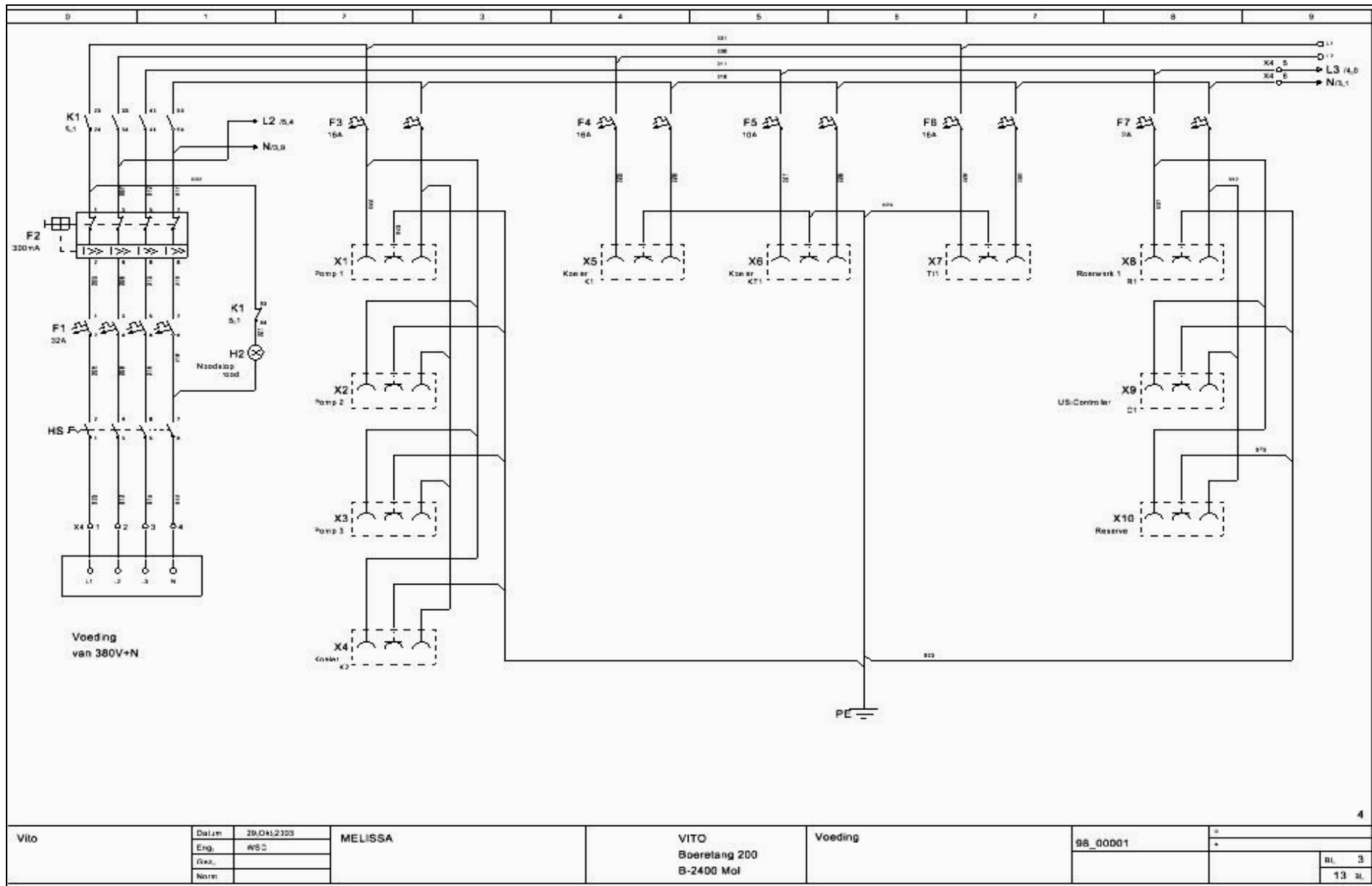
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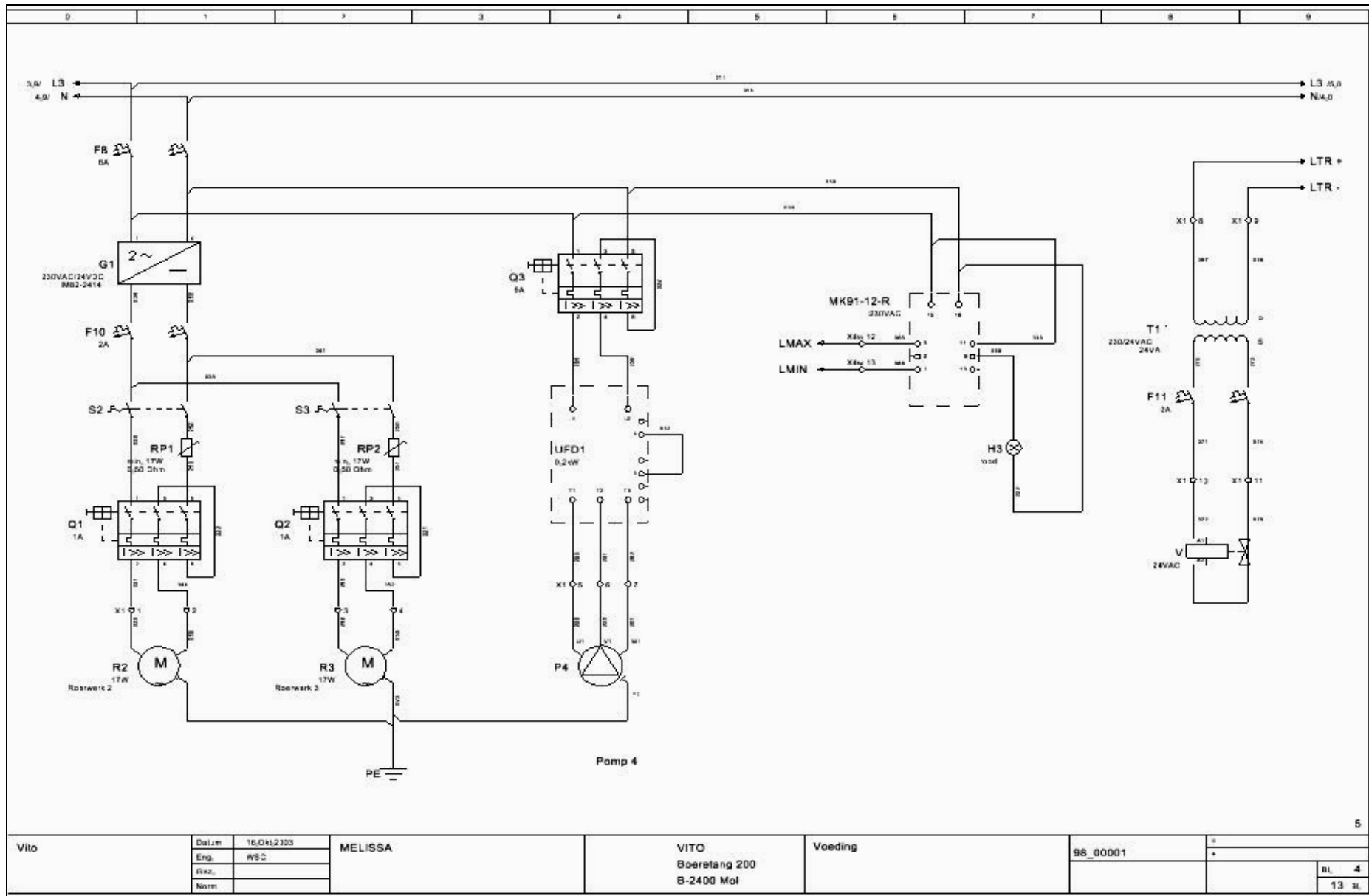
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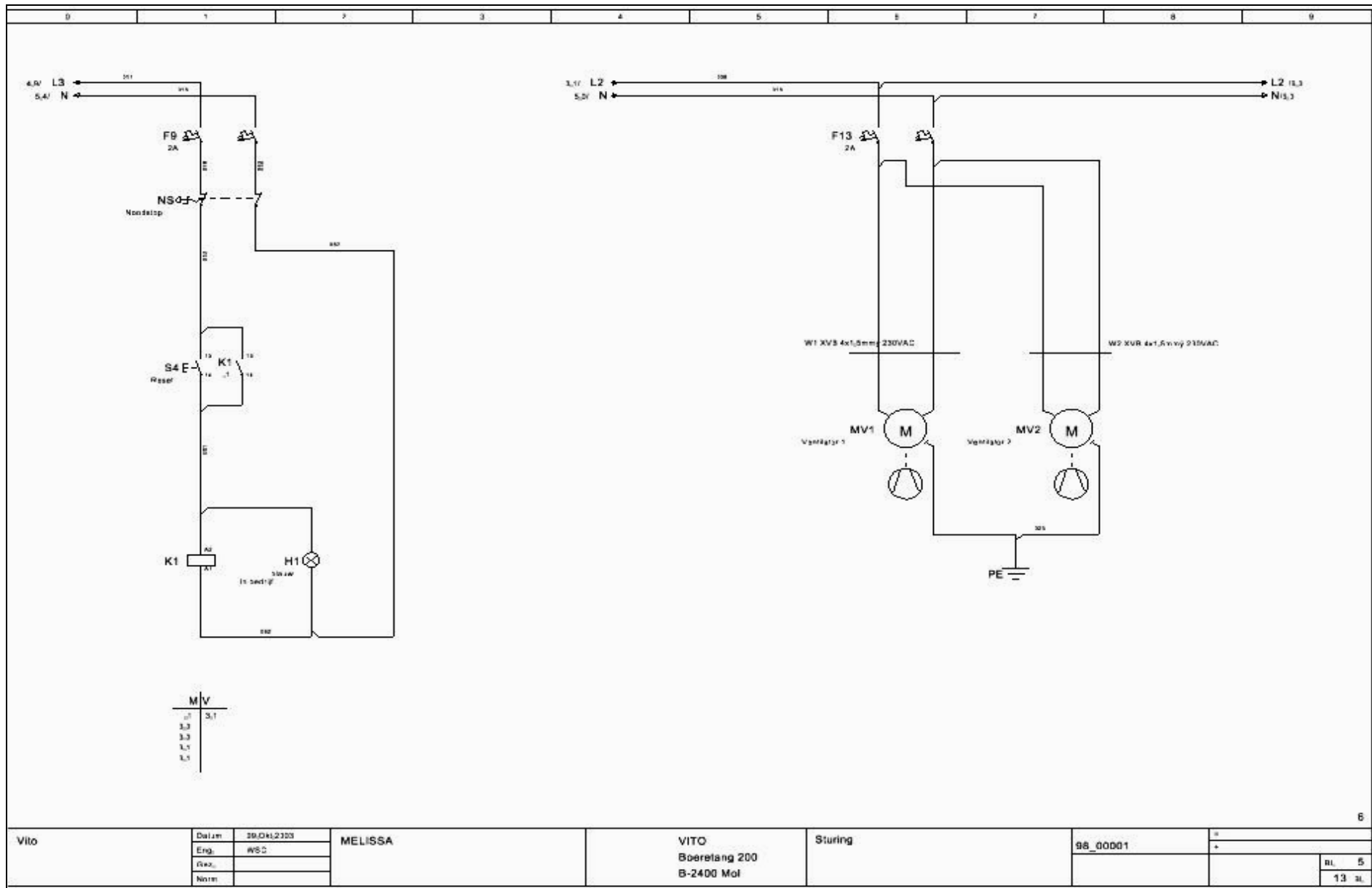
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5	Sturing	MELISSA	WSC	08.Okt.2003	WSC
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6,2	Detail halogeen lampen Transfo T3	MELISSA	WSC	08.Okt.2003	WSC
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6,4	Detail halogeen lampen Transfo T5	MELISSA	WSC	08.Okt.2003	WSC
7	Klemmenoverzicht	MELISSA	WSC	08.Okt.2003	WSC
8	Klemmenstrook X1	MELISSA	WSC	08.Okt.2003	WSC
9	Klemmenstrook X2	MELISSA	WSC	08.Okt.2003	WSC
10	Klemmenstrook X2 (vervolg)	MELISSA	WSC	08.Okt.2003	WSC
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12	Klemmenstrook X3 (vervolg)	MELISSA	WSC	08.Okt.2003	WSC
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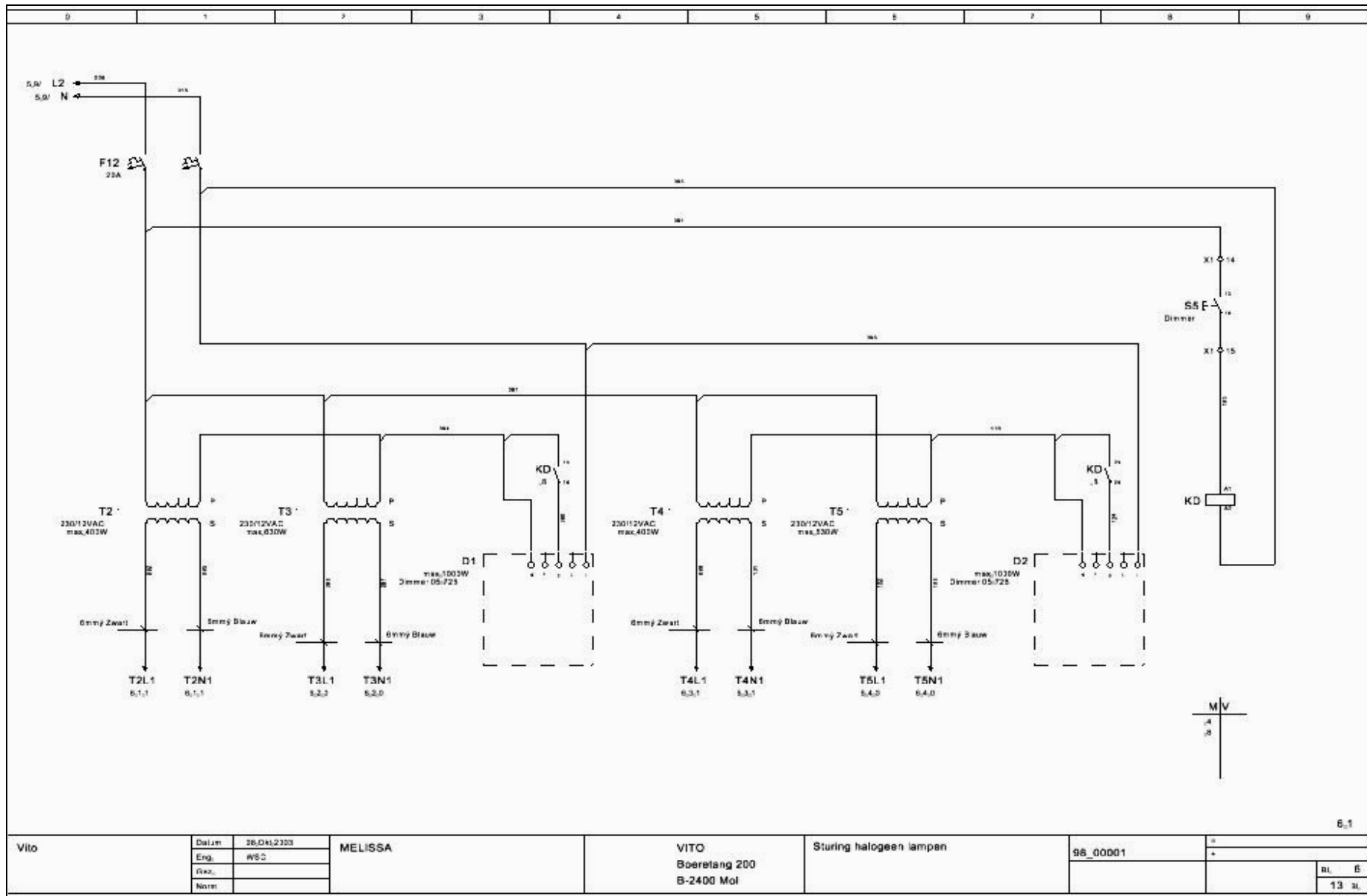
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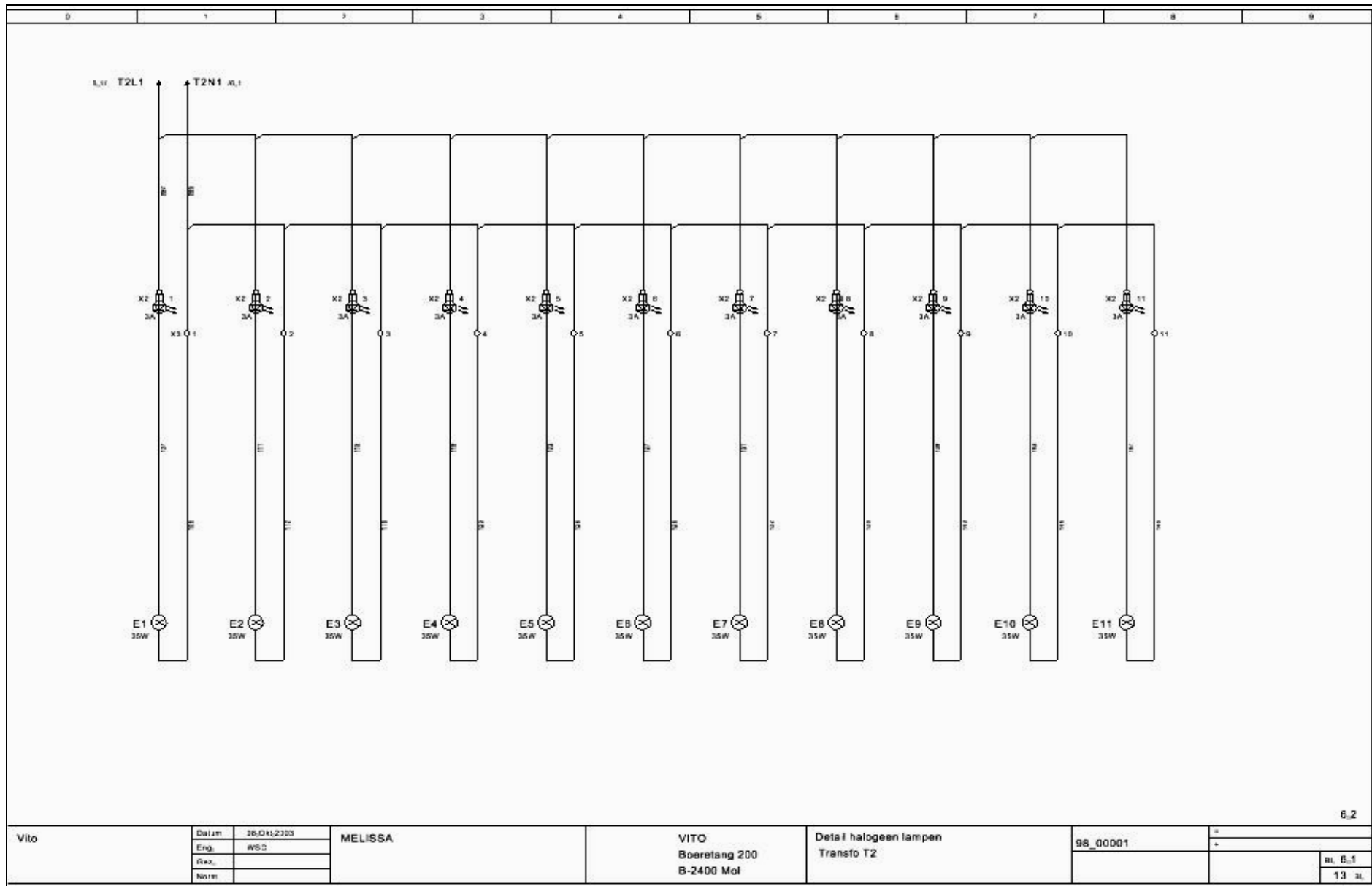
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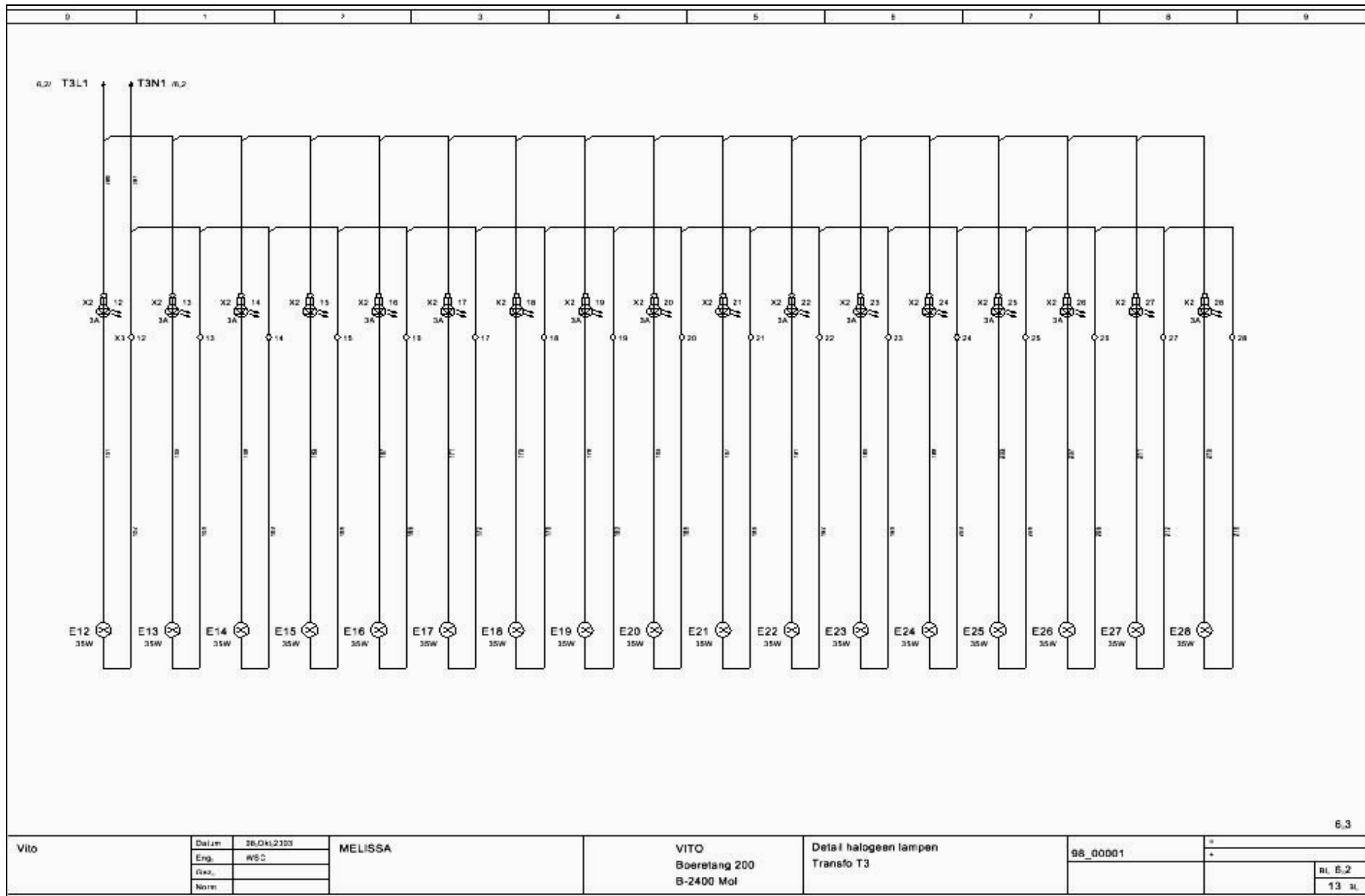


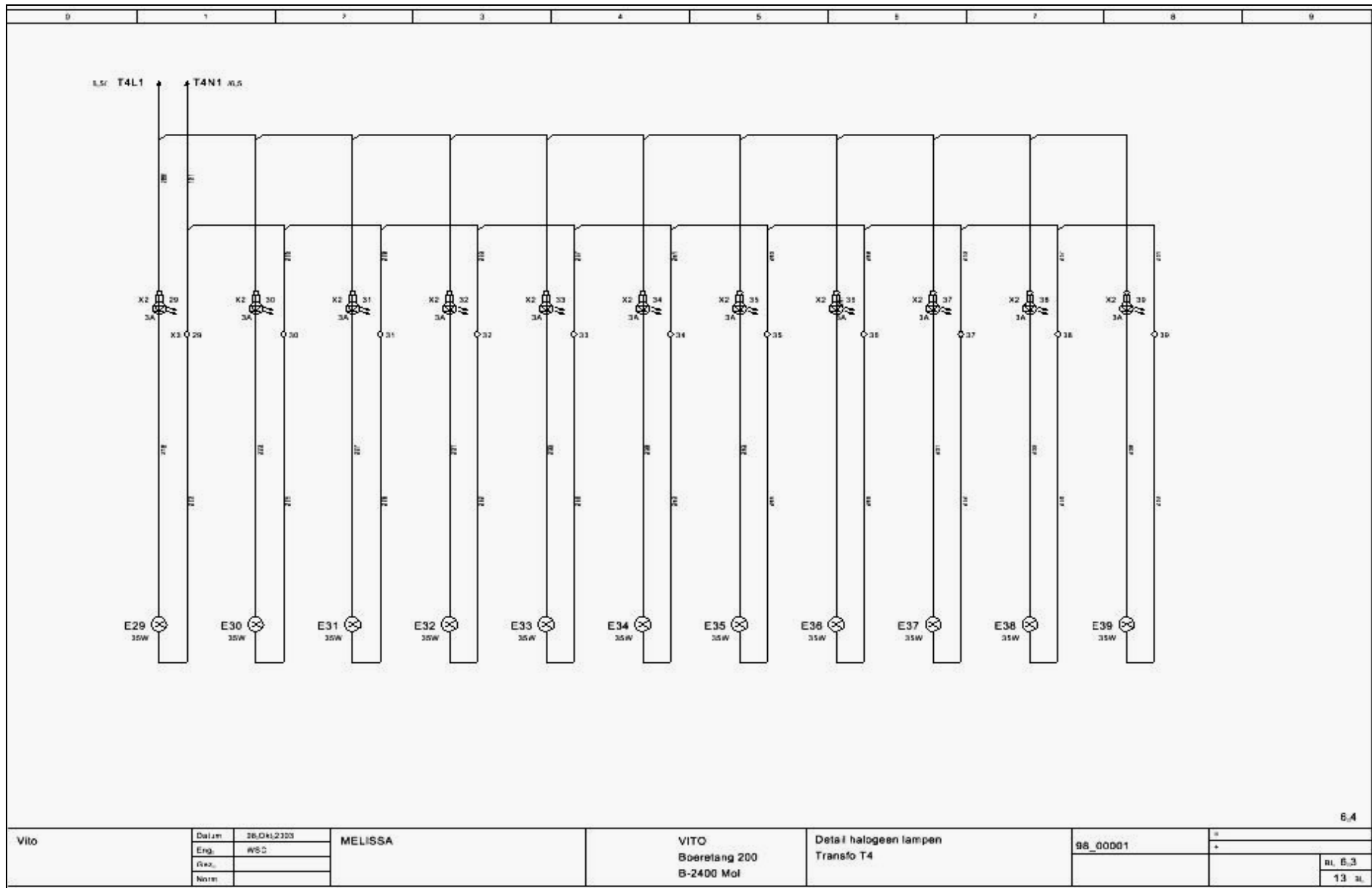


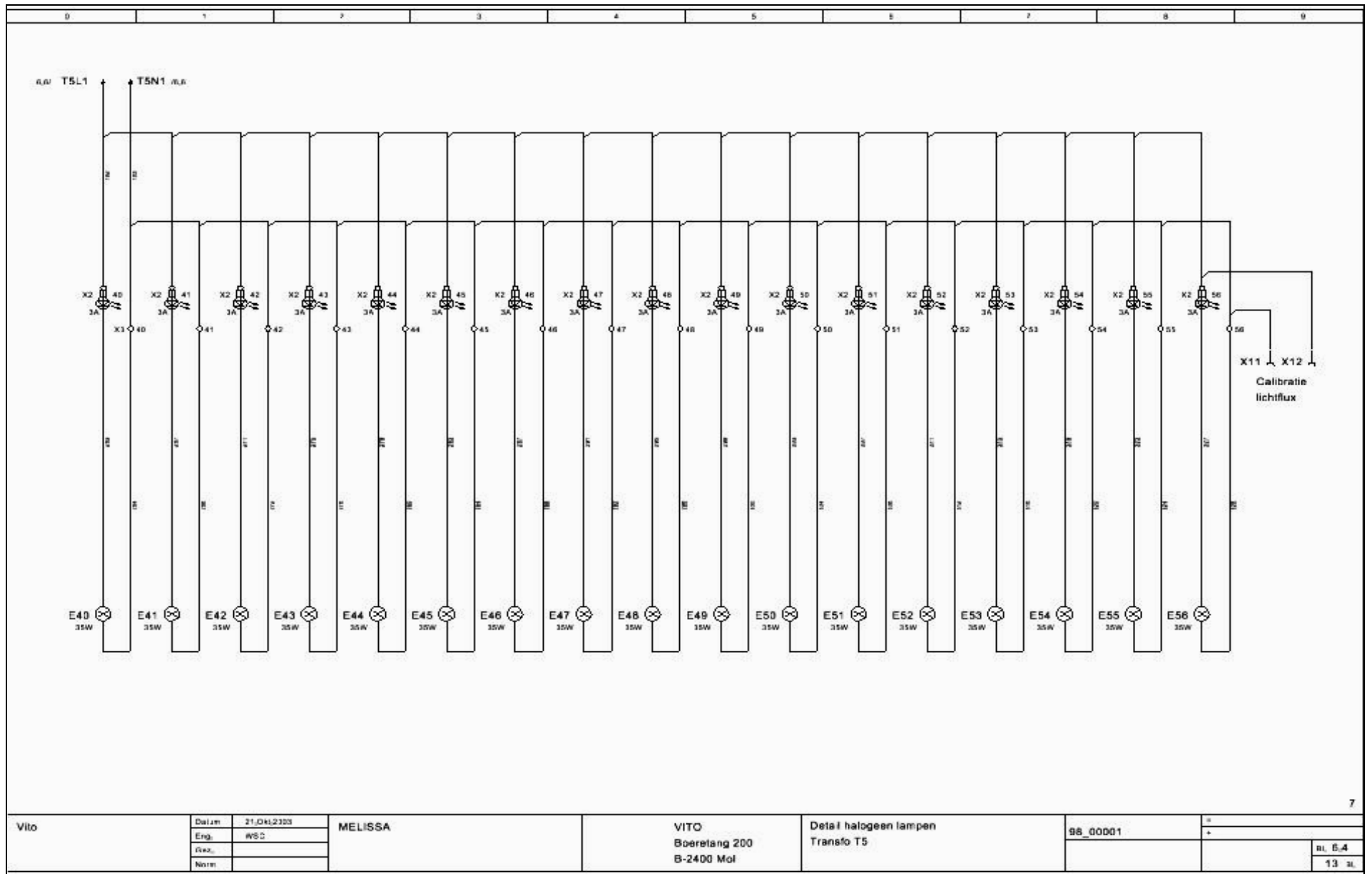












Funksjon i-kontakt	Kabeltype	Kabelbeskring	108	Klemmestrukk X3				Kabeltype	Kabelbeskring	Pålegg / pålegg
				Order-nr. (inkl. bokser)	Aansultskode	KL. nummer	Kabeltype			
			E1	1	T2	T2		6.1.1		
			E2	2				6.1.2		
			E3	3				6.1.2		
			E4	4				6.1.3		
			E5	5				6.1.4		
			E6	6				6.1.4		
			E7	7				6.1.5		
			E8	8				6.1.6		
			E9	9				6.1.6		
			E10	10				6.1.7		
			E11	11		T3		6.1.8		
			E12	12				6.2.0		
			E13	13				6.2.1		
			E14	14				6.2.1		
			E15	15				6.2.2		
			E16	16				6.2.2		
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Vito	Datum 30.Okt.2003	MELISSA	VITO	Klemmenstroom X3	98_00001
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	Des.		B-2400 Mol		
	Notis				

