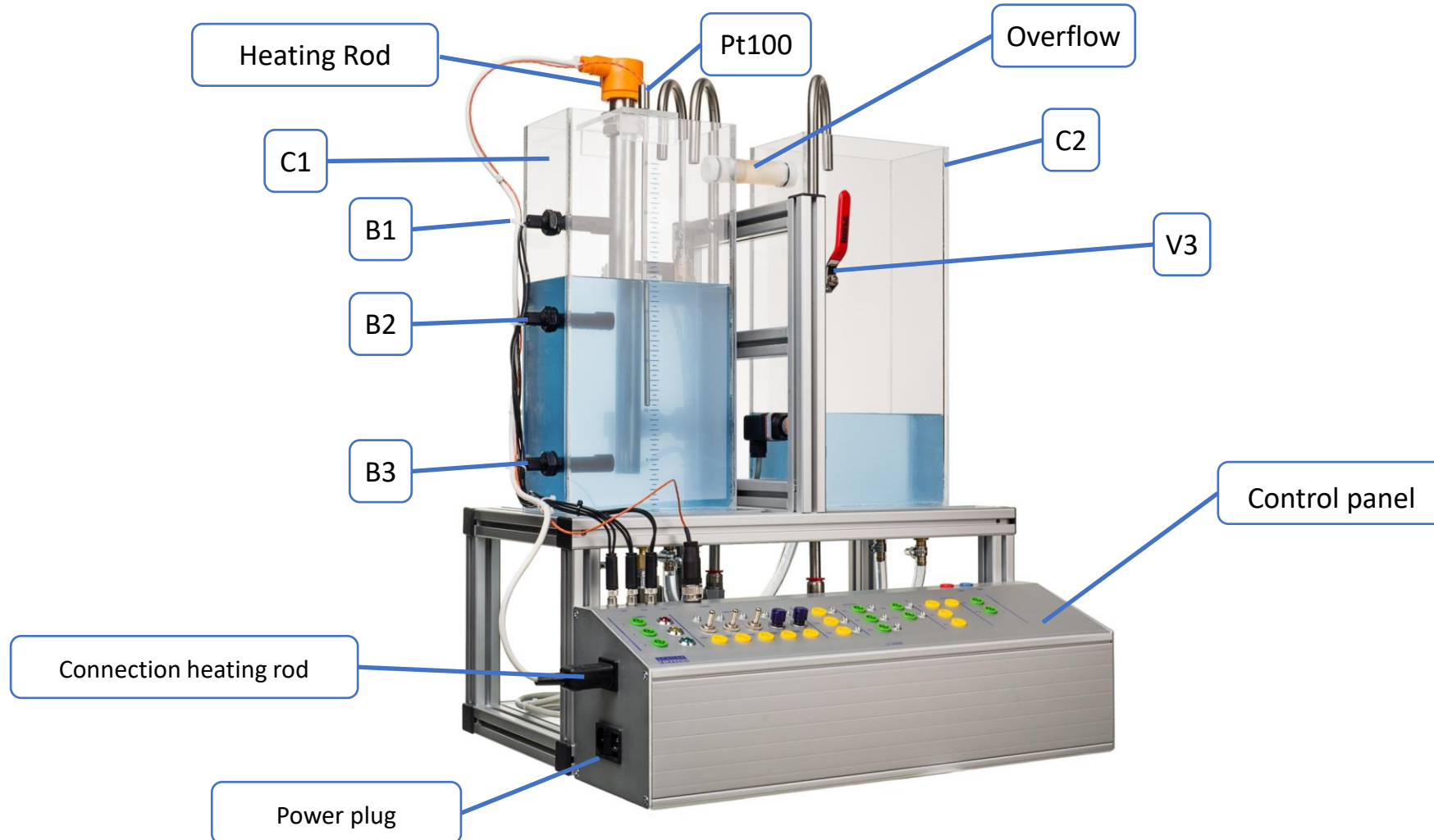


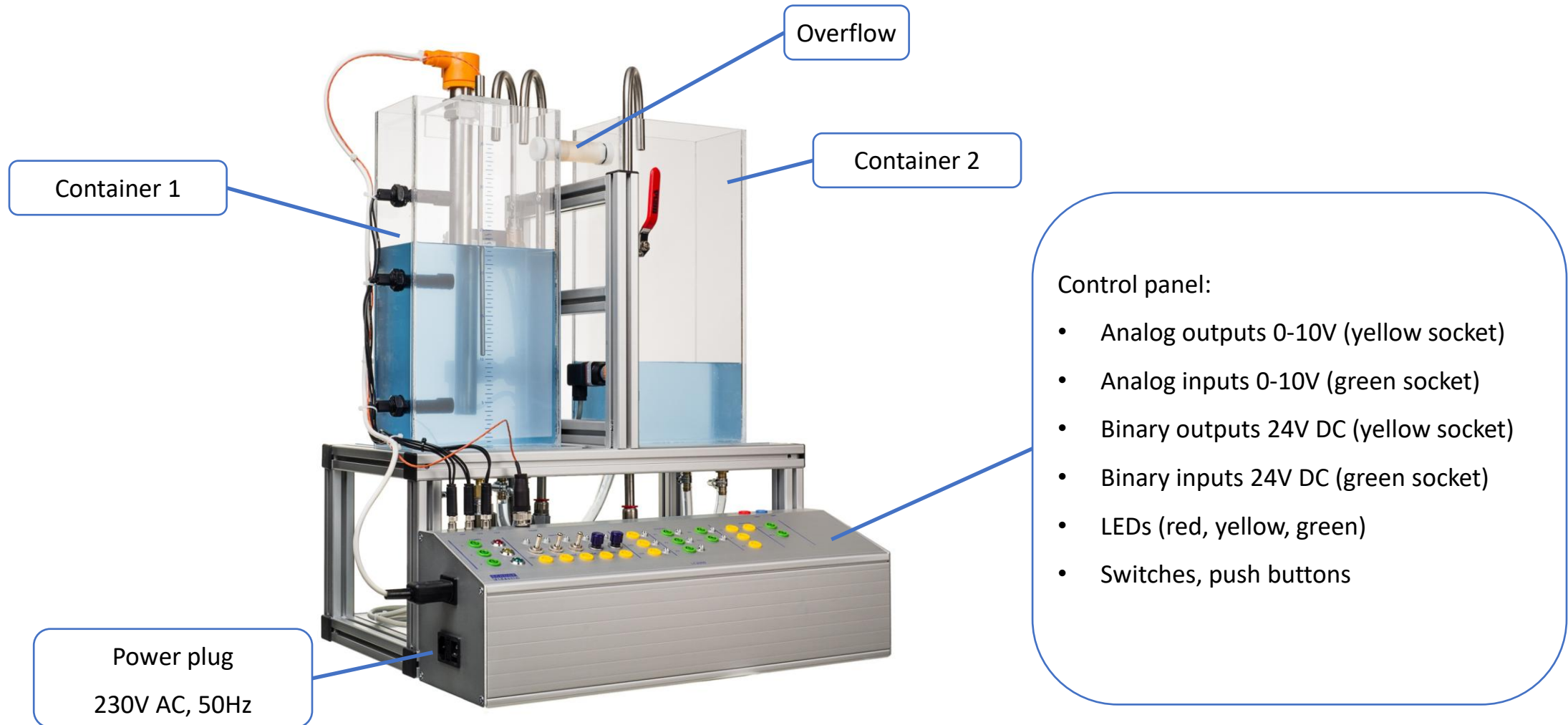
Short Introduction of LC2030 Training Rig

Closed Loop Control – Open Loop Control

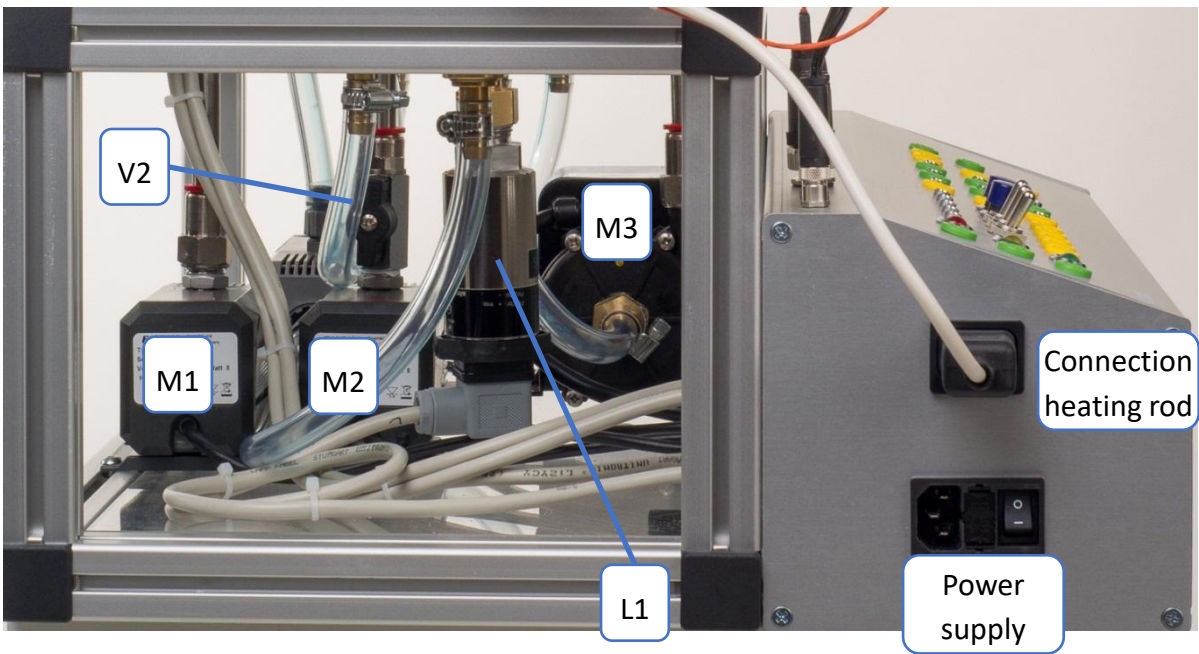
Jannike Schoop
Tel.: +49 40 754 922 30
Mail: info@schoop.de

- **The LC2030 workstation was designed for training in control engineering. It offers a wide range of training options, from simple control tasks to different closed loop control systems**
- **It can be operated with:**
 - LC2030 Training (process control system, educational software),
 - Download zip file of software setup and unpack
 - See documentation folder (including Tasks/Solutions, Instruction manual, help file, open-loop control solutions)
 - WinErs Lab version (process control system, developer version),
 - Any control device (e.g. PLS), that is connected to the sockets

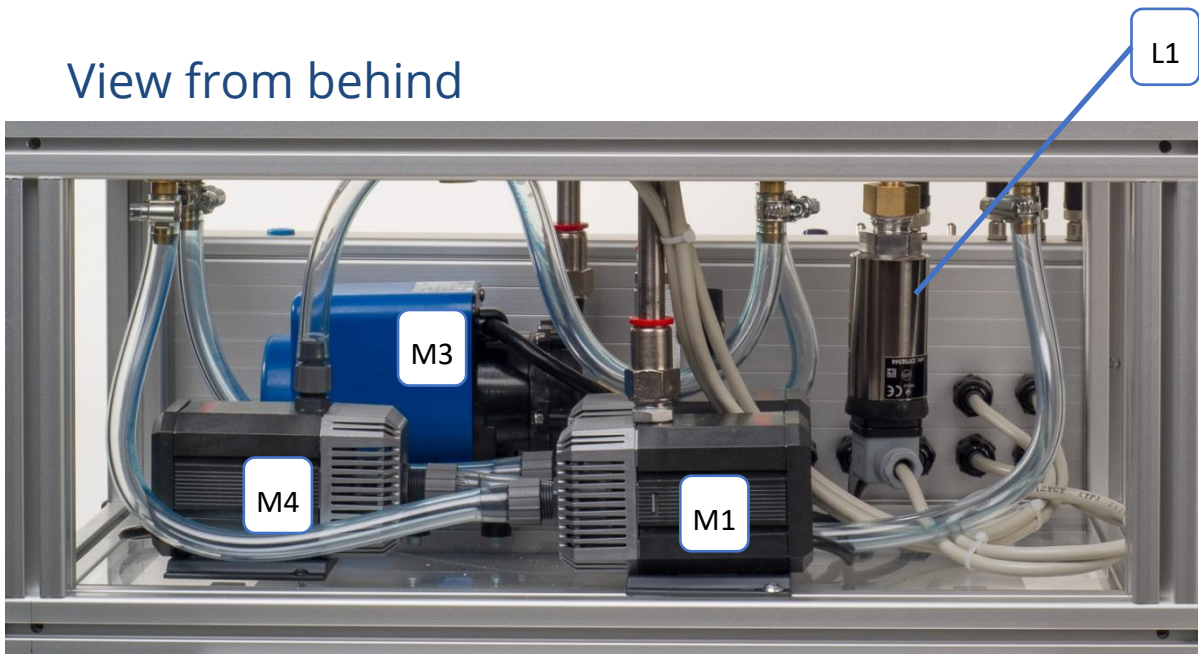




Structure of The System

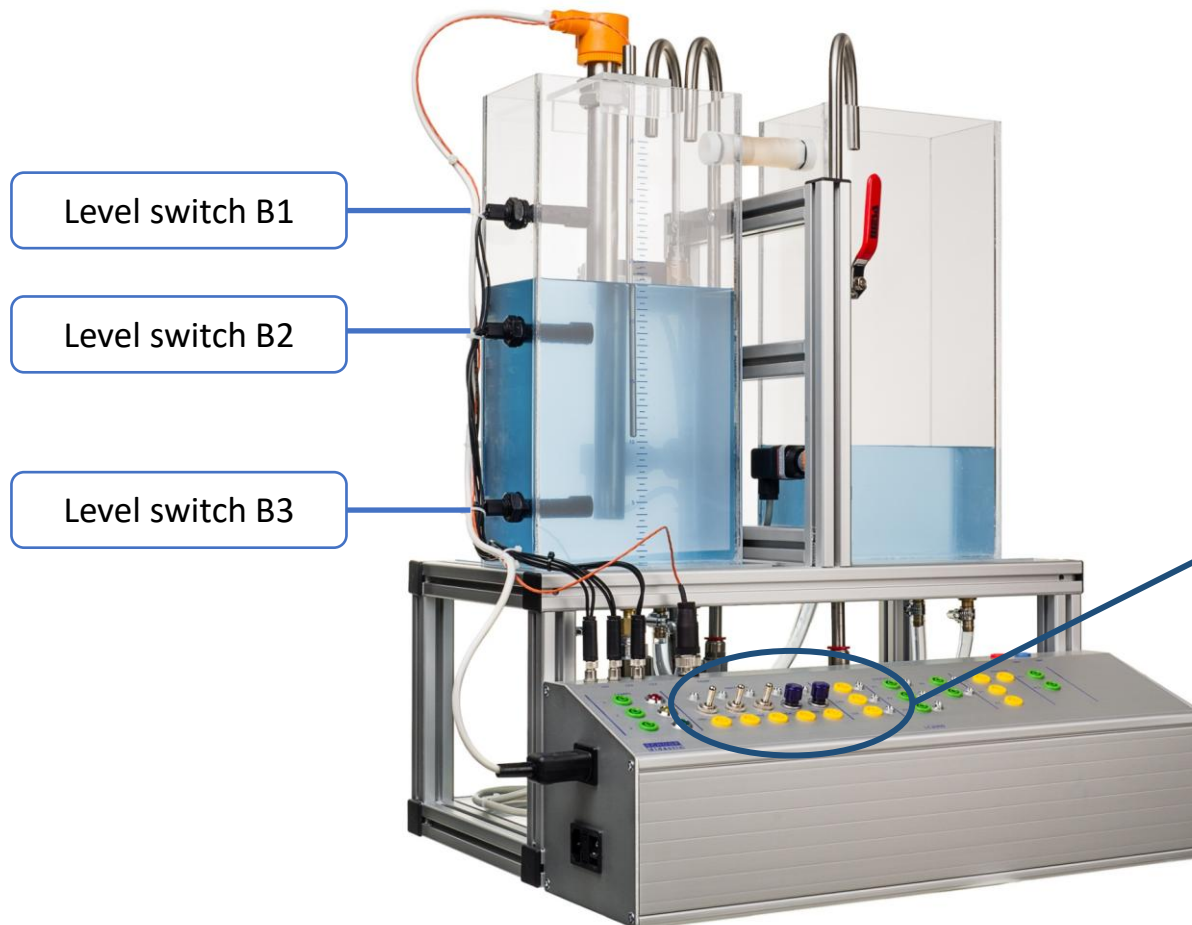


View from left



View from behind

Switches and buttons



Switches and buttons are binary outputs of the rig,
For testing use a voltmeter and check for 24V DC

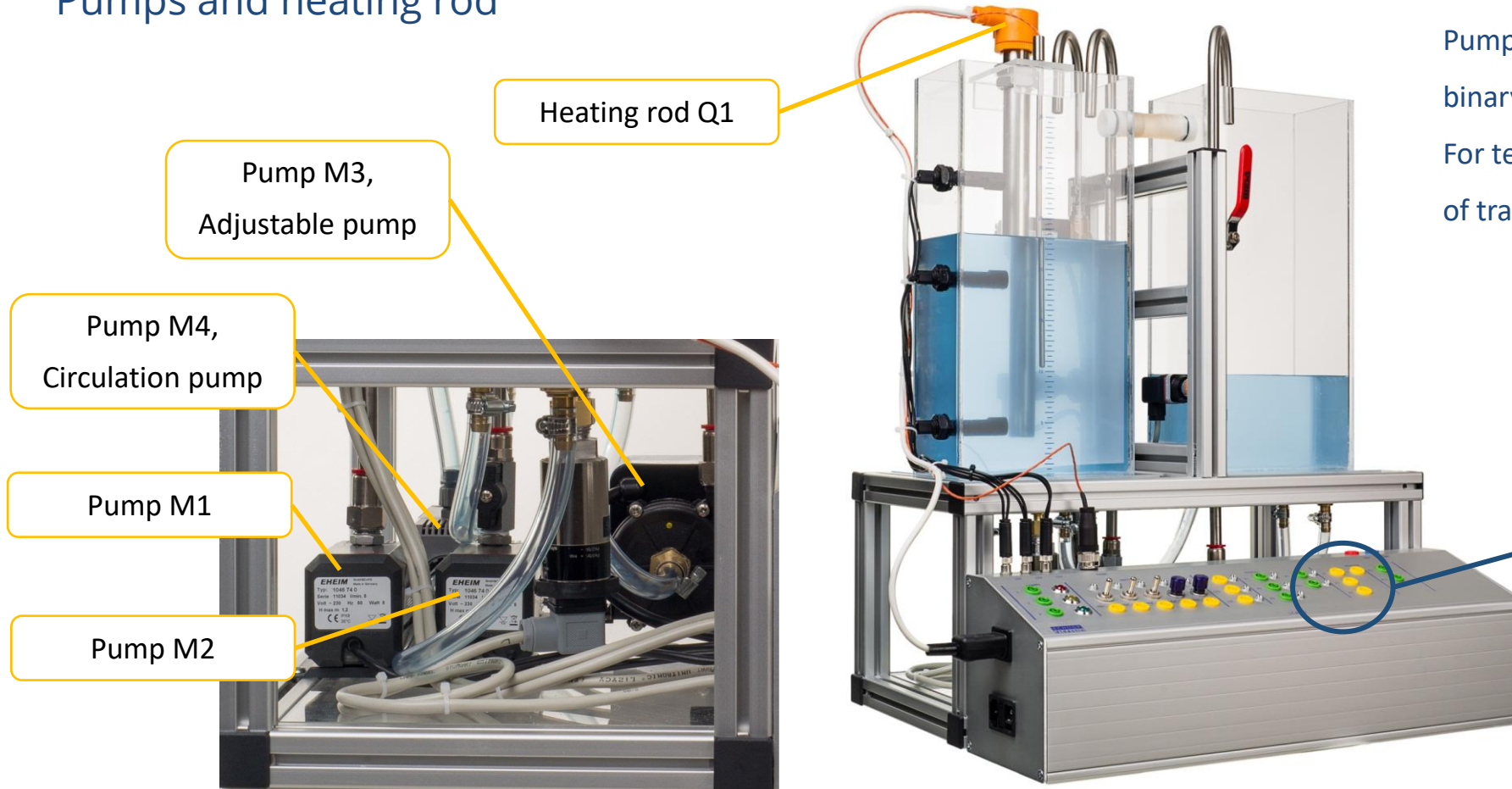


Manual switches
HS1, HS2, HS3

Push buttons
HS4, HS5

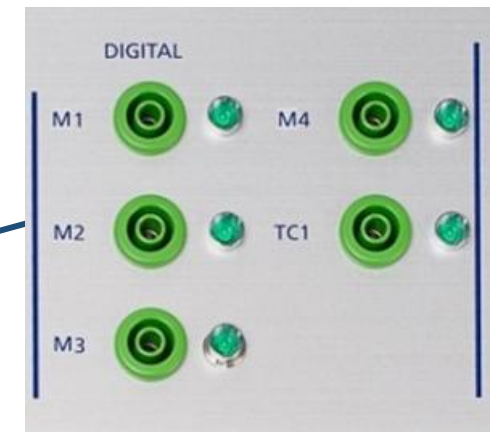
Level switches
B1, B2, B3

Pumps and heating rod



Pumps and heating rod are switched on by binary inputs.

For testing use a 24V DC source, e.g. switch HS1 of training rig.



LC2030 Training Rig – Analogue Outputs

Sensor signals

Temperature T1

Pressure P1

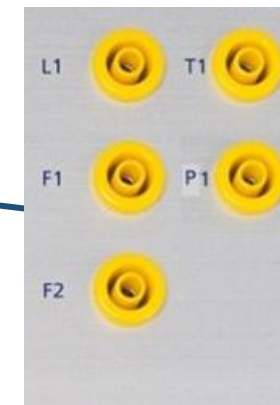
Flow rate F2

Flow rate F1

Liquid Level L1

All sensor outputs are converted into 0-10V or 2-10V signals.

Tipp: For testing use a Voltmeter. The liquid level signal has an output of 2-10V which correspond to 0-40cm. Knowing this the measured voltage can be converted into a level in cm. The calculated value can be compared to the scale.

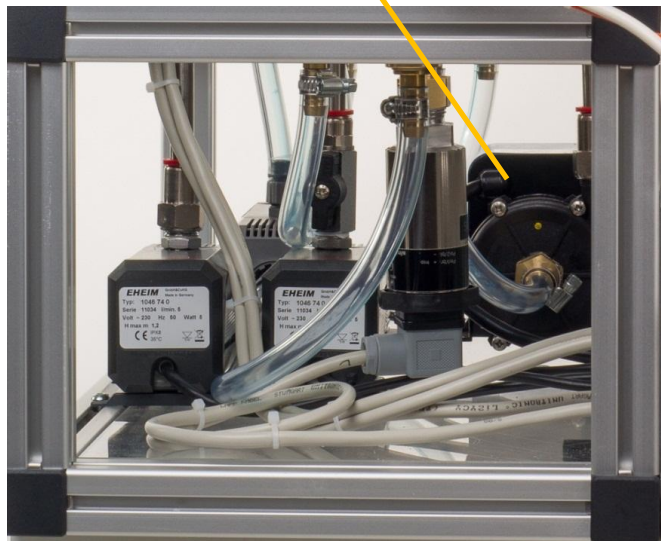


LC2030 Training Rig – Analogue Inputs

Adjustable pump and valve

Pump M3,
Adjustable pump

Valve V1
Adjustable valve

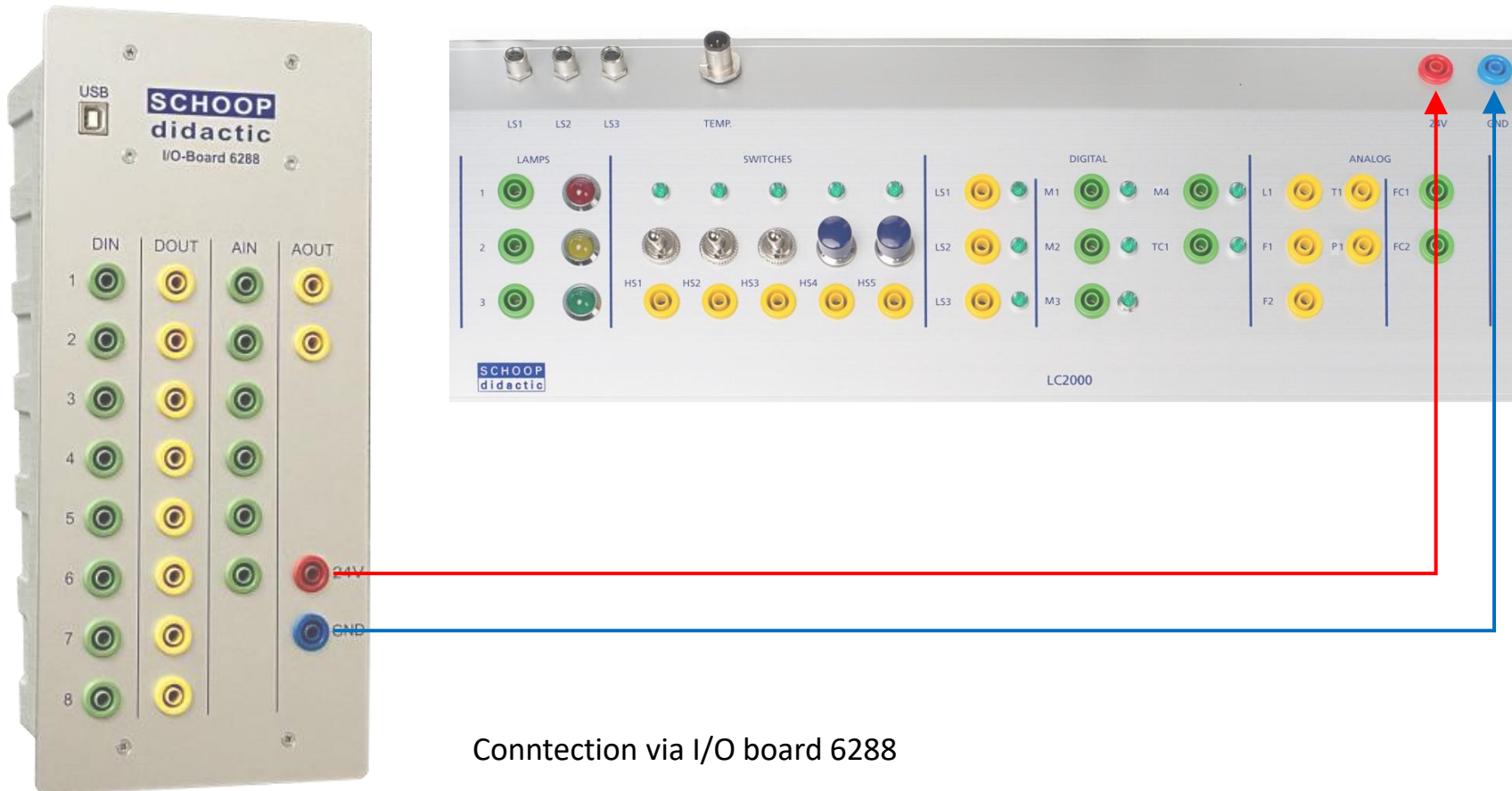


The adjustable pump and valve are controlled by
a 0-10V signal.

For testing use a potentiometer.



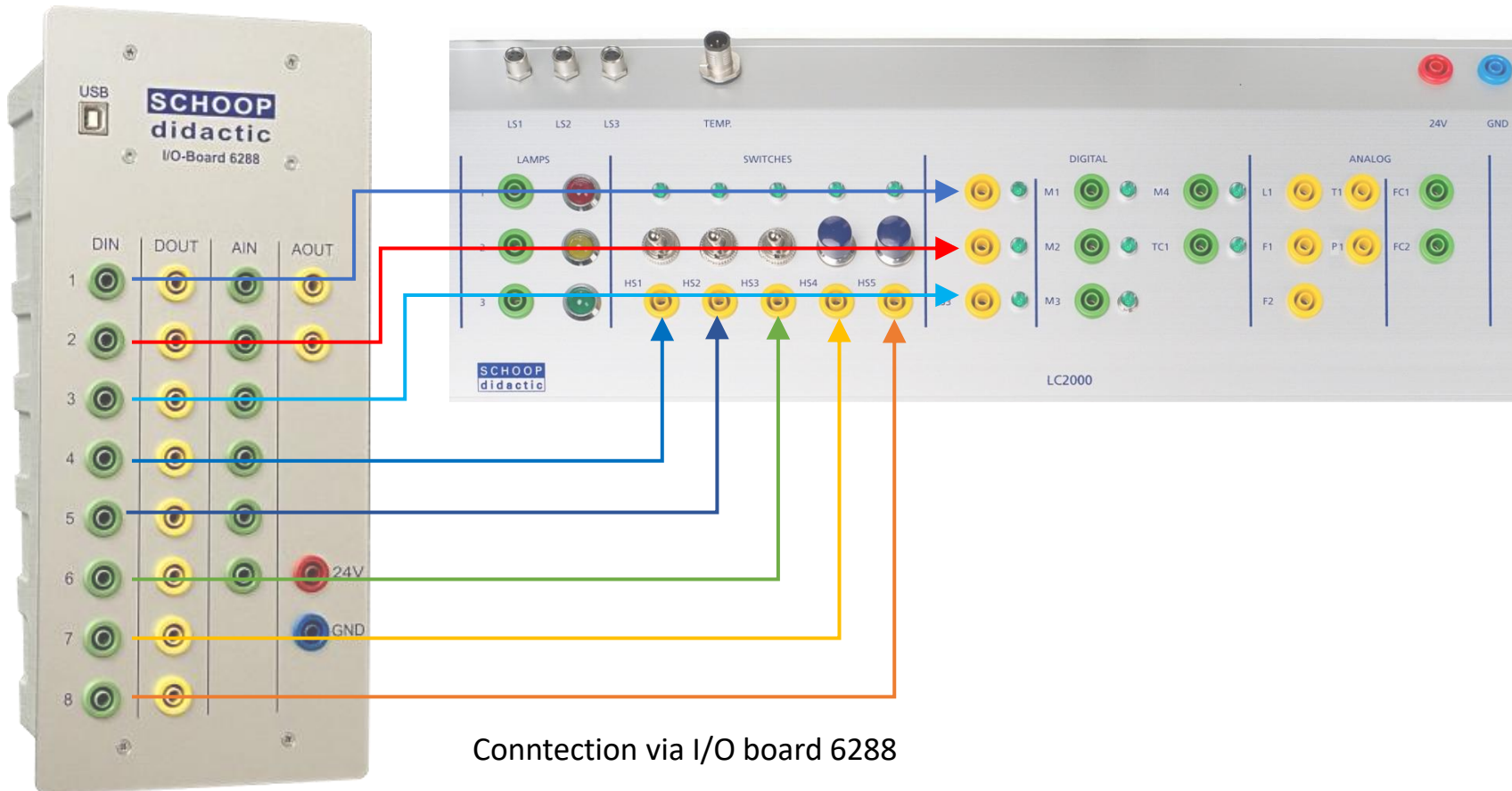
Connection PC – LC2030, Power supply



Connnection via I/O board 6288

- Connect ground socket (blue)
- Connect 12V socket (red)

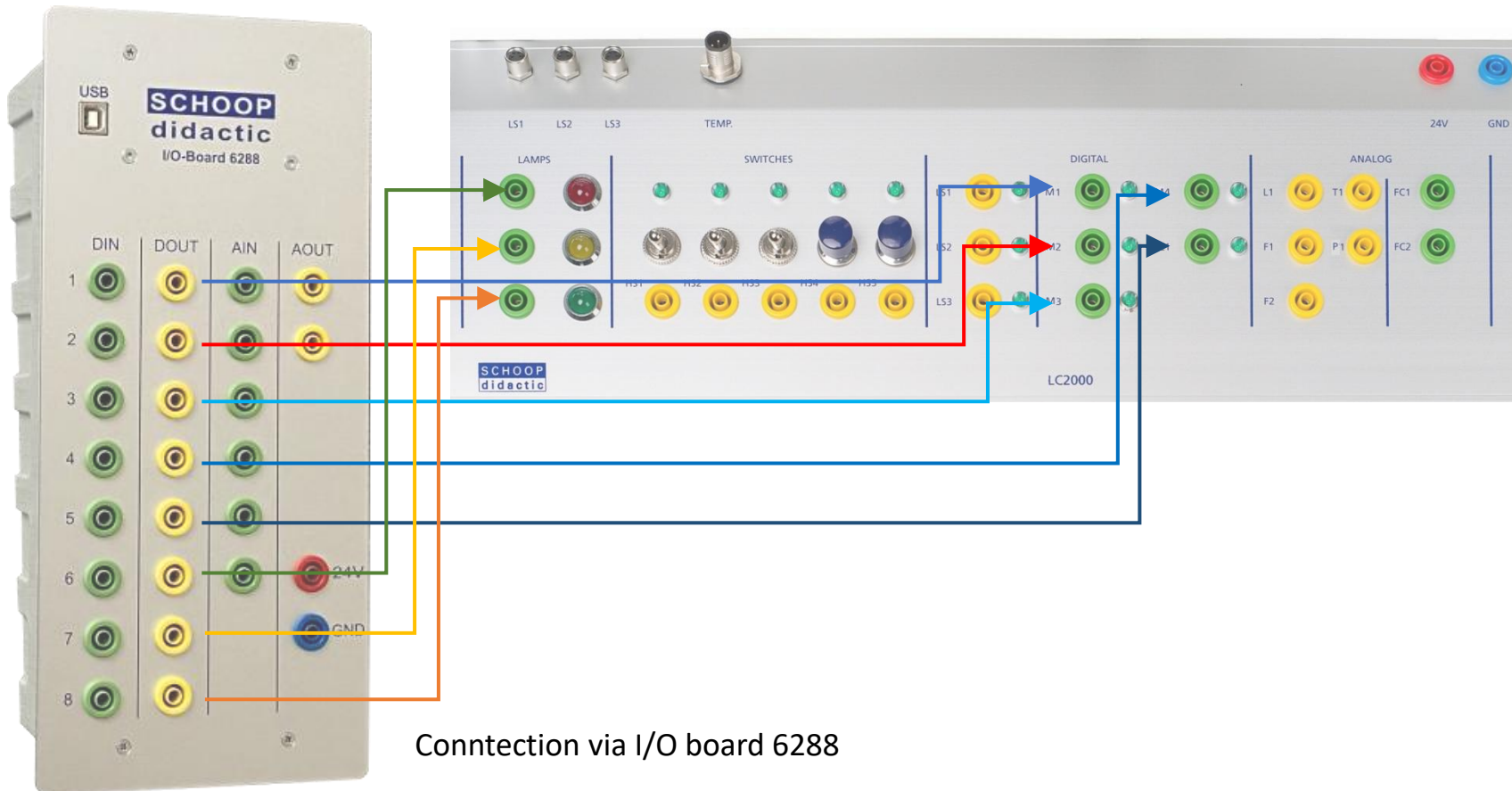
Connection PC – LC2030, Binary Inputs



- Connect output of rig (yellow socket) to input of software (green socket)
- Connect input of rig (green socket) to output of software (yellow socket)

I/O-Board	LC2030	Signal description
DIN 1	B1	Upper level switch
DIN 2	B2	Mid level switch
DIN 3	B3	Lower level switch
DIN 4	HS1	Standard switch HS1
DIN 5	HS2	Standard switch HS2
DIN 6	HS3	Standard switch HS3
DIN 7	HS4	Push button HS4
DIN 8	HS5	Push button HS5

Connection PC – LC2030, Binary Outputs

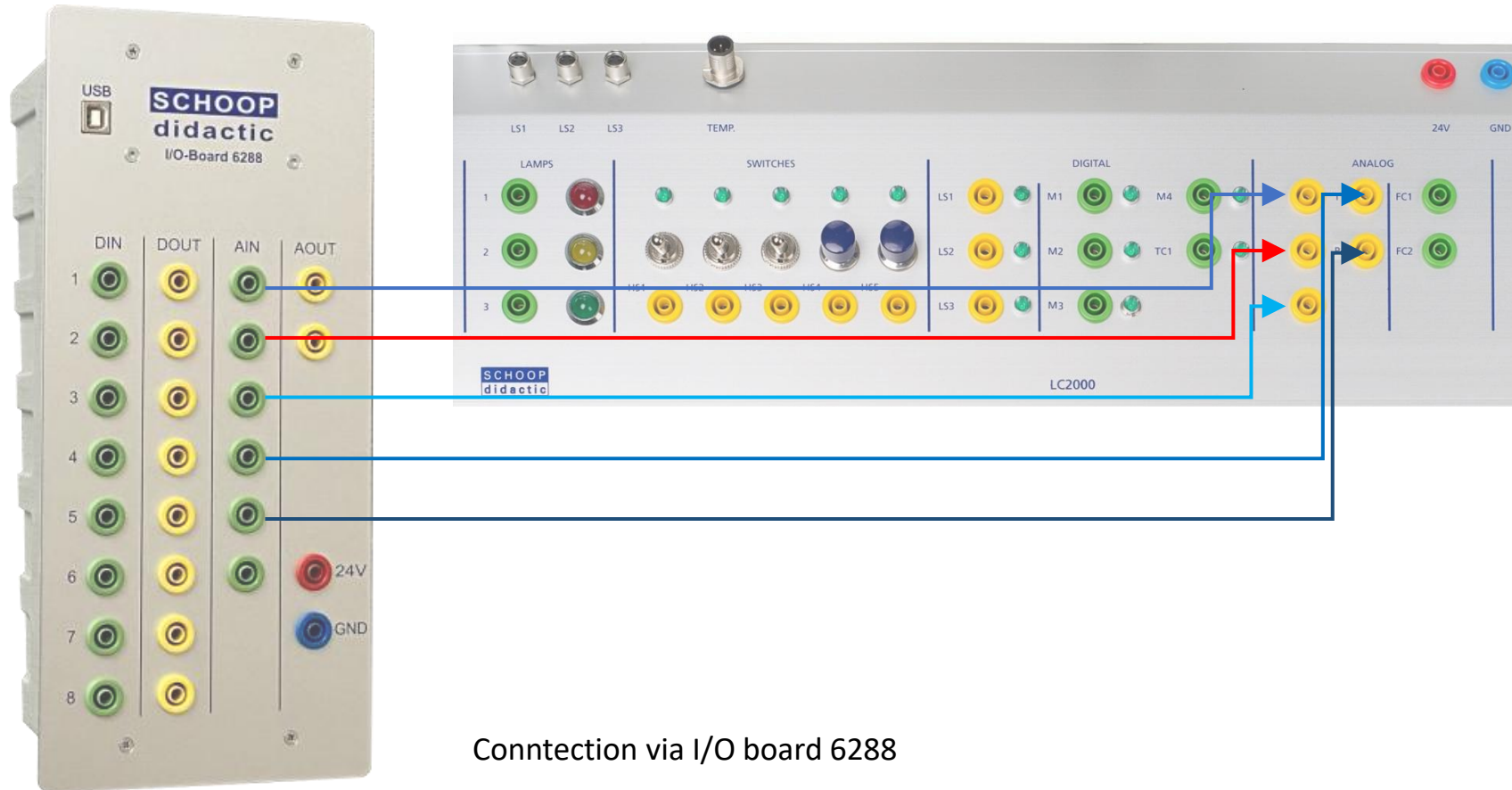


Conntection via I/O board 6288

- Connect output of rig (yellow socket) to input of software (green socket)
- Connect input of rig (green socket) to output of software (yellow socket)

I/O-Board	LC2030	Signal description
DOUT 1	M1	Pump 1
DOUT 2	M2	Pump 2
DOUT 3	M3	Pump 3
DOUT 4	M4	Pump 4, Circul. pump
DOUT 5	TC1	Heating rod
DOUT 6	LAMP 1	Lamp 1, red
DOUT 7	LAMP 2	Lamp 2, yellow
DOUT 8	LAMP 3	Lamp 3, green

Connection PC – LC2030, Analogue Inputs

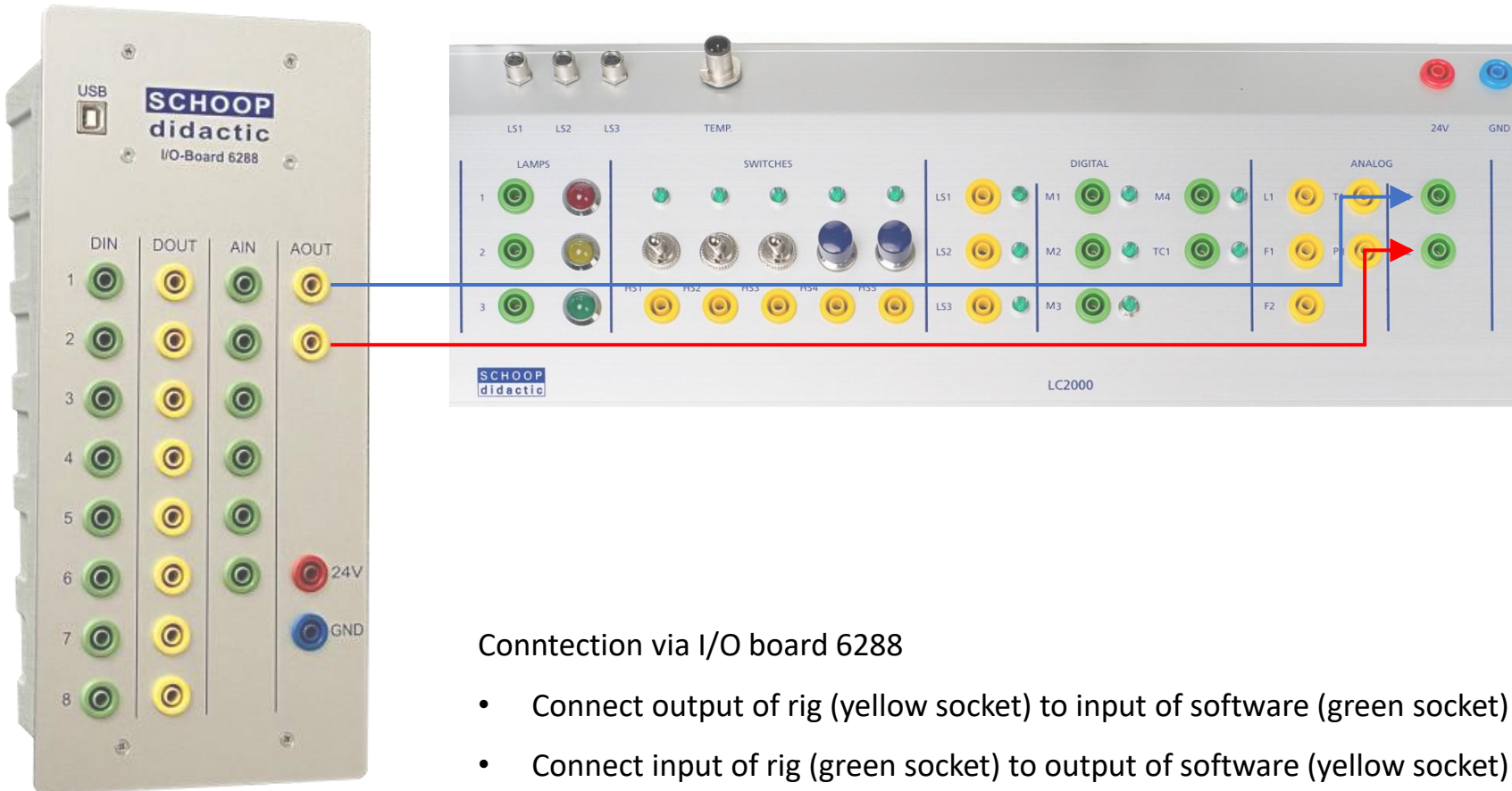


Connnection via I/O board 6288

- Connect output of rig (yellow socket) to input of software (green socket)
- Connect input of rig (green socket) to output of software (yellow socket)

I/O-Board	LC2030	Signal description
AIN 1	L1	Level
AIN 2	F1	Flow rate, control pump
AIN 3	F2	Flow rate, control valve
AIN 4	T1	Temperature
AIN 5	P1	Pressure, control pump
AIN 6	/	Free

Connection PC – LC2030, Analogue Outputs



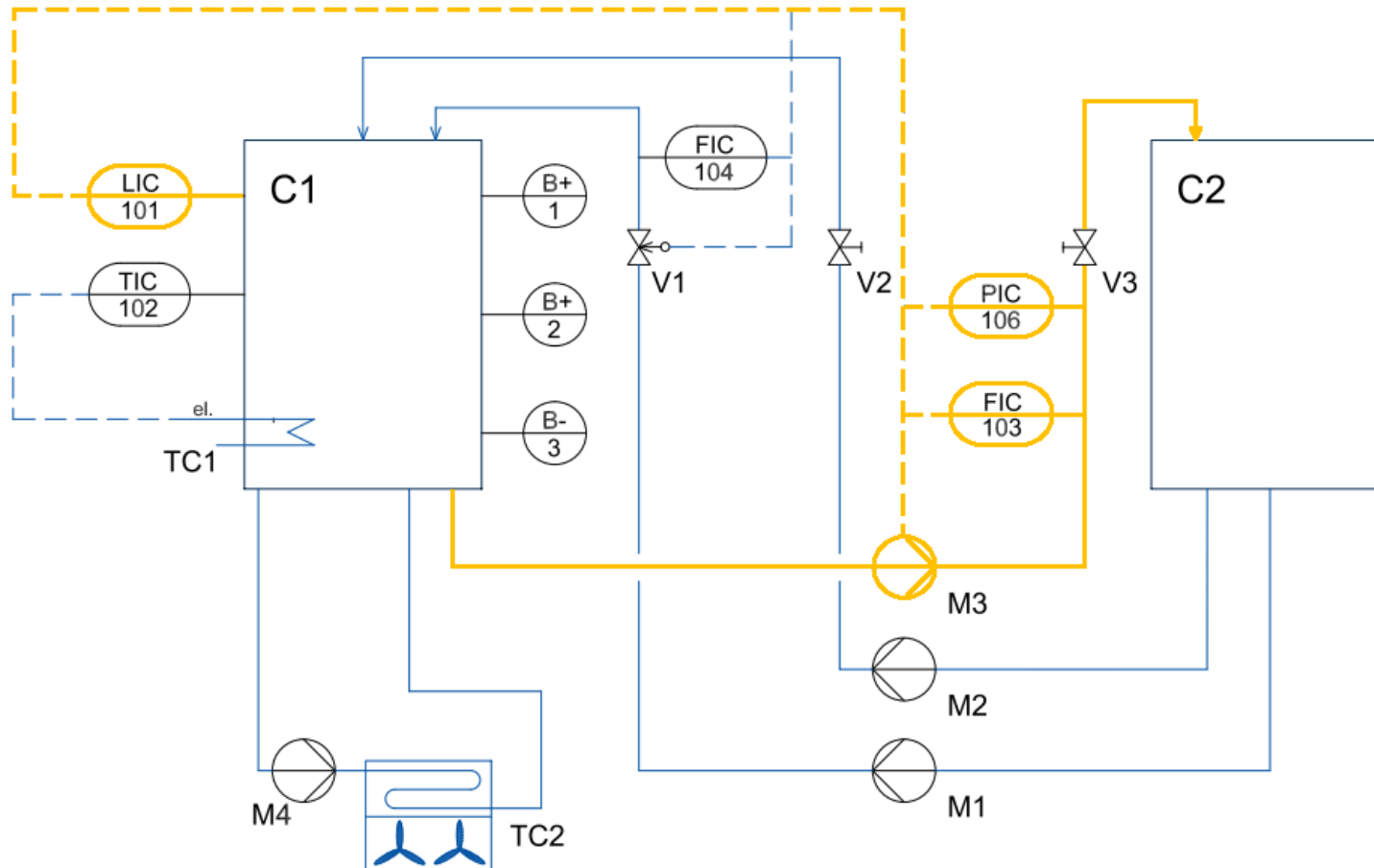
I/O-Board	LC2030	Signal description
AOUT 1	FC1	Contr. Out. for pump M3
AOUT 2	FC2	Contr. Out. for valve V1

Connection via I/O board 6288

- Connect output of rig (yellow socket) to input of software (green socket)
- Connect input of rig (green socket) to output of software (yellow socket)

P&I diagram of LC2030 workstation

Control systems connected to adjustable pump M3:



Level control LIC101

- Level signal at yellow socket L1
- Potential disturbances:
 - Position of manual valve V3
 - Feed of pumps M1 and M2 in l / min

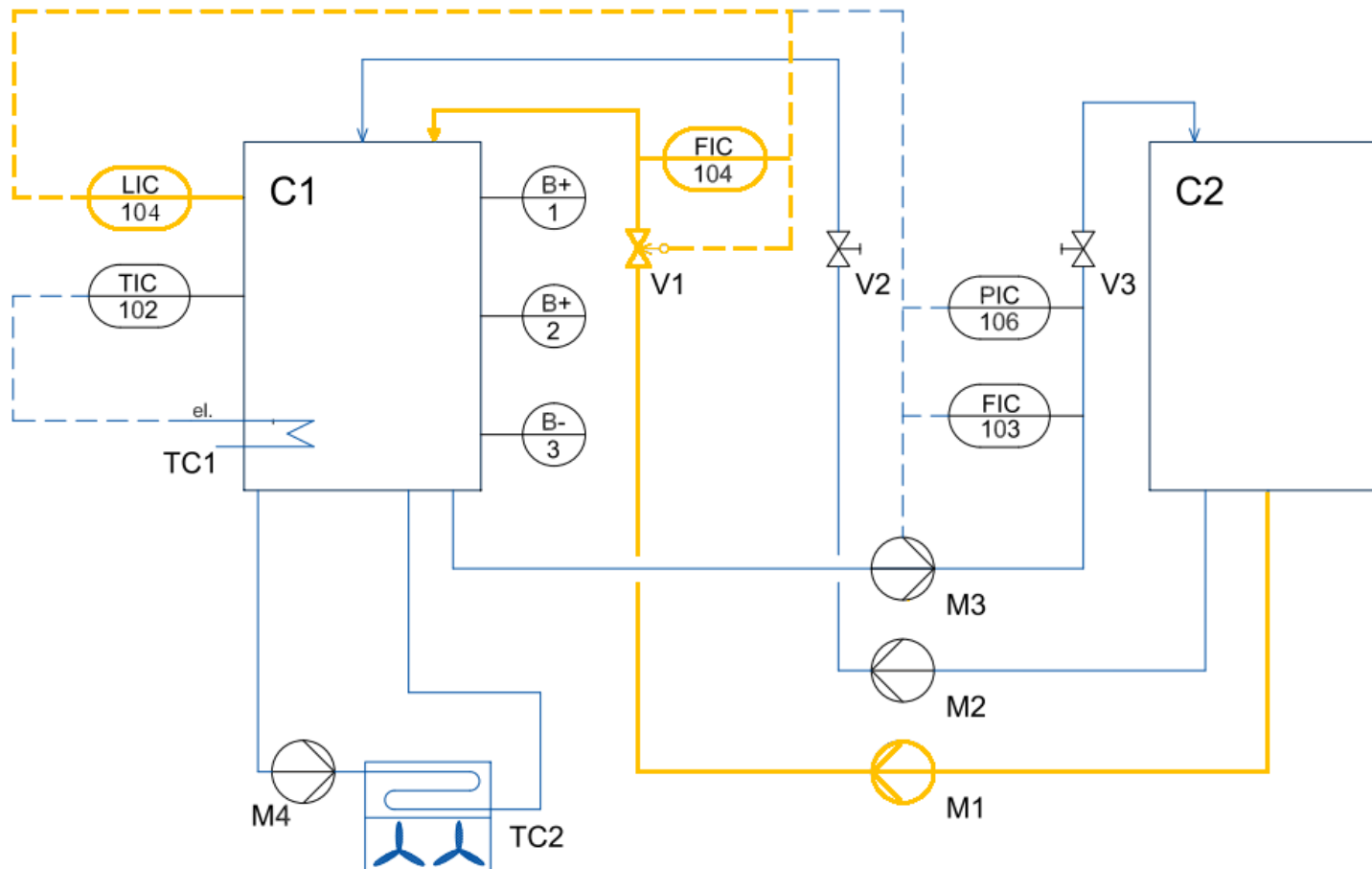
Flow rate control FIC103

- Flow signal at yellow socket F1
- Potential disturbances:
 - Position of manual valve V3
 - Varying level in C1

Pressure control PIC106

- Pressure signal at yellow socket P1
- Potential disturbances:
 - Position of manual valve V3
 - Varying level in C1

Control systems connected to adjustable valve V1:



Level control LIC104

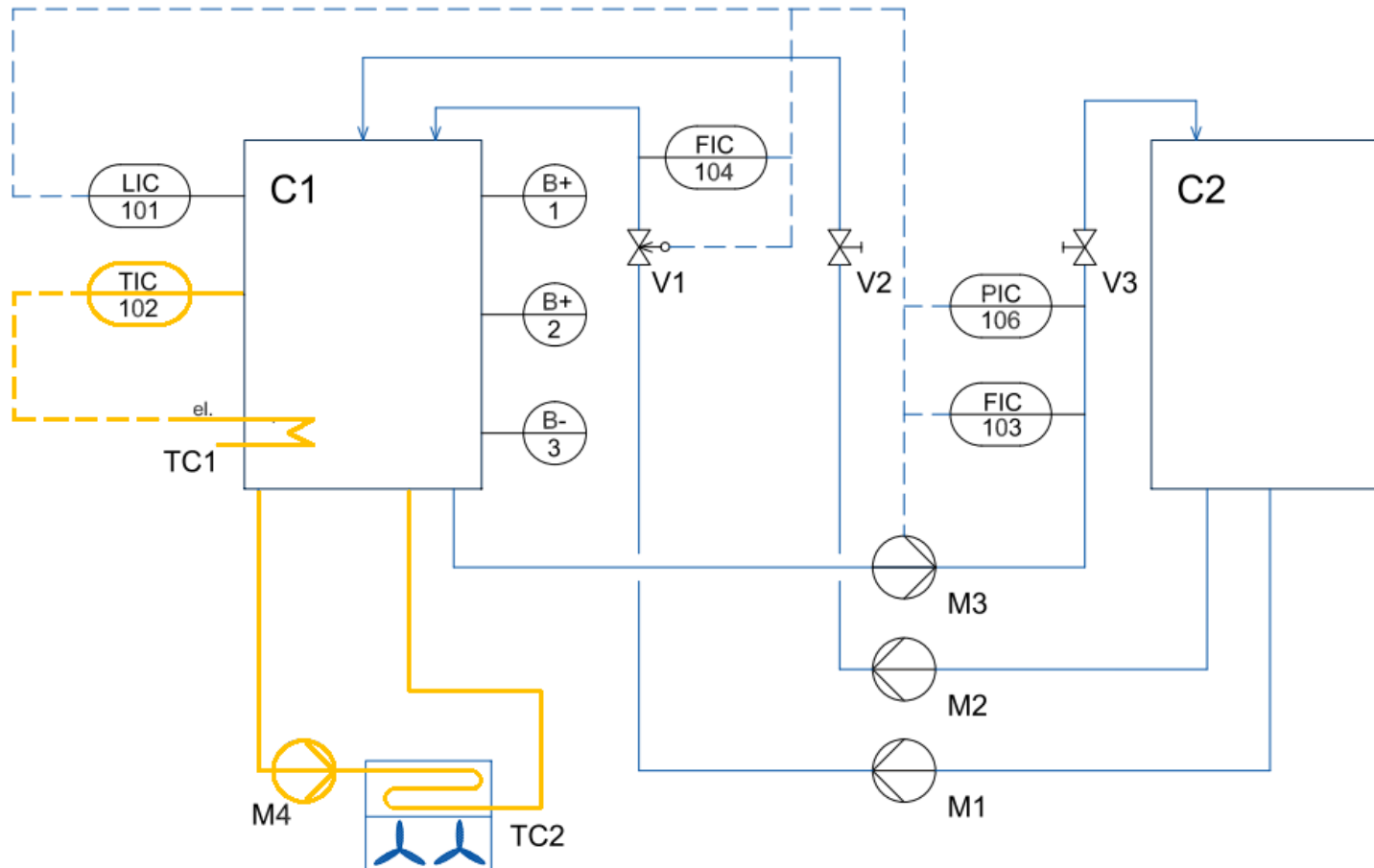
- Level signal at yellow socket L1
- Potential disturbances:
 - Varying level in C2

Flow rate control FIC103

- Flow signal at yellow socket F2
- Potential disturbances:
 - Varying level in C2

P&I diagram of LC2030 workstation

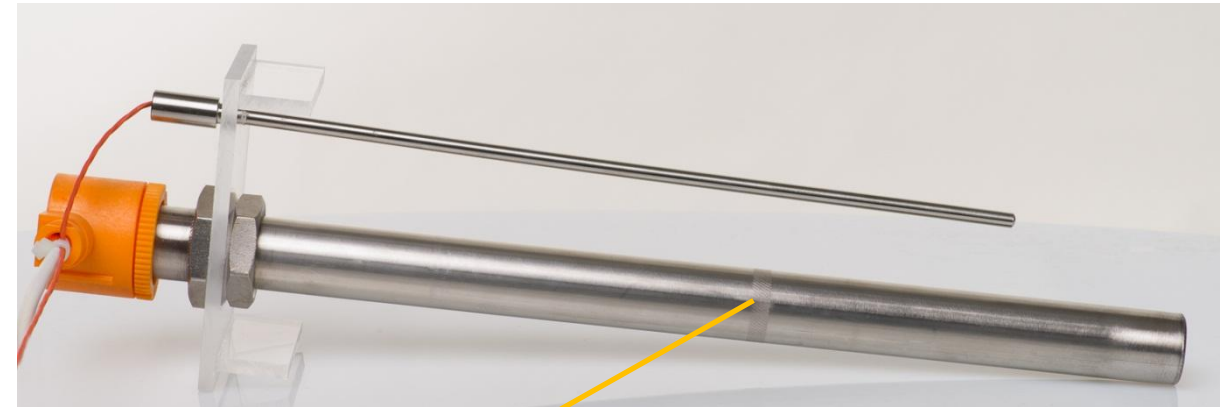
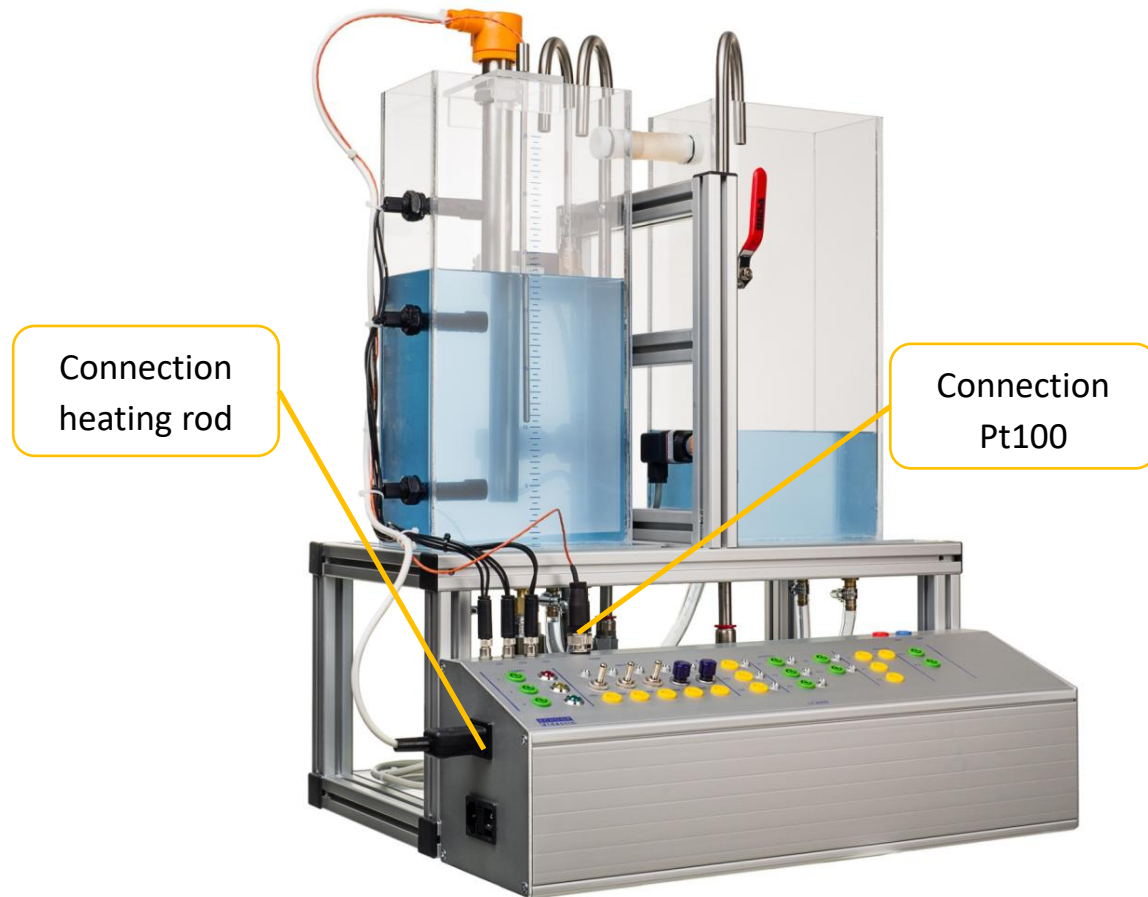
Control systems connected to heating rod TC1:



Temperature control TIC102

- Temperature signal at yellow socket T1
- Potential disturbances:
 - Varying level in C1
 - Ambient temperature

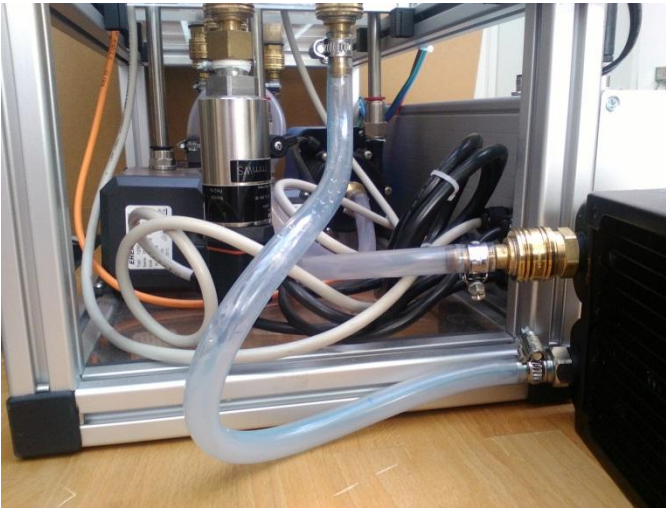
Temperature Control System



Requirements for temperature control

- Pump M4 is a circulation pump for tank 1. This pump should be turned on while temperature control is active.
- Level switch B2, signal „minimum water level for use of heating rod“

Temperature Control System – Cooling Unit



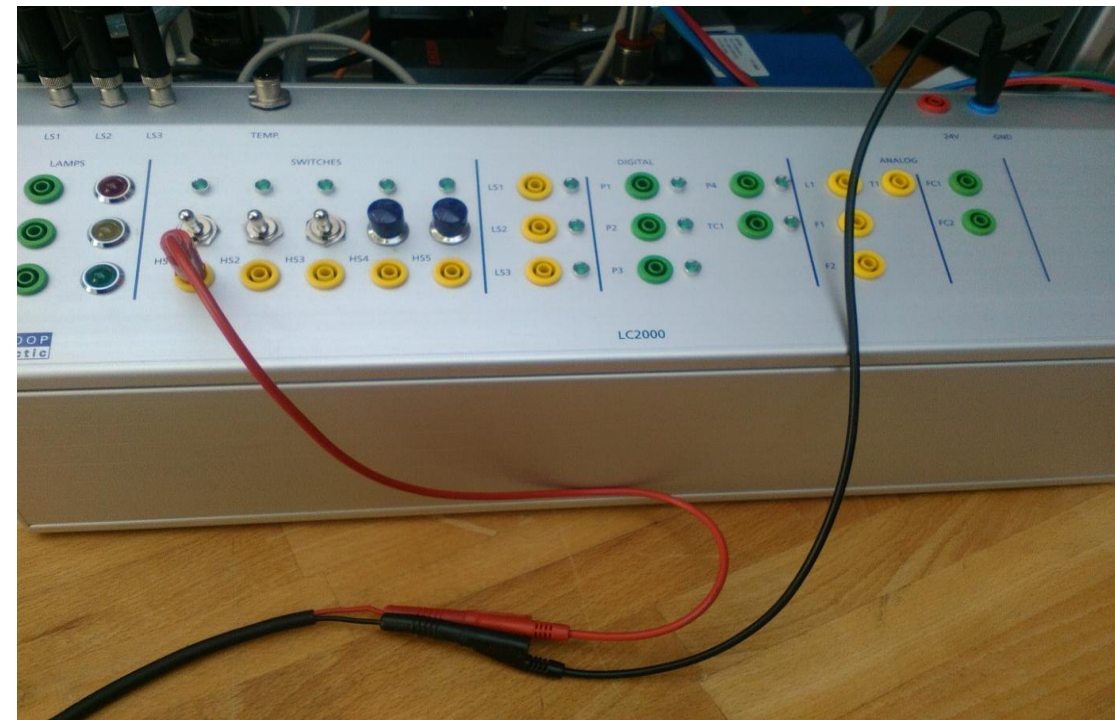
Physical connection of the cooler

Pull the hose from the inlet of the M4 pump out of the quick coupling.

Insert the hose into the quick coupling of the cooler and the hose on the radiator into the free quick coupling on the container.

Electrical connection of the cooler

Extend the jacks of the cooler with laboratory cables and connect the ground cable to the ground of the control panel and the 24V cable to the socket below switch HS1. By pressing HS1, you can then switch the cooler on and off.



Overview on LC2030 model

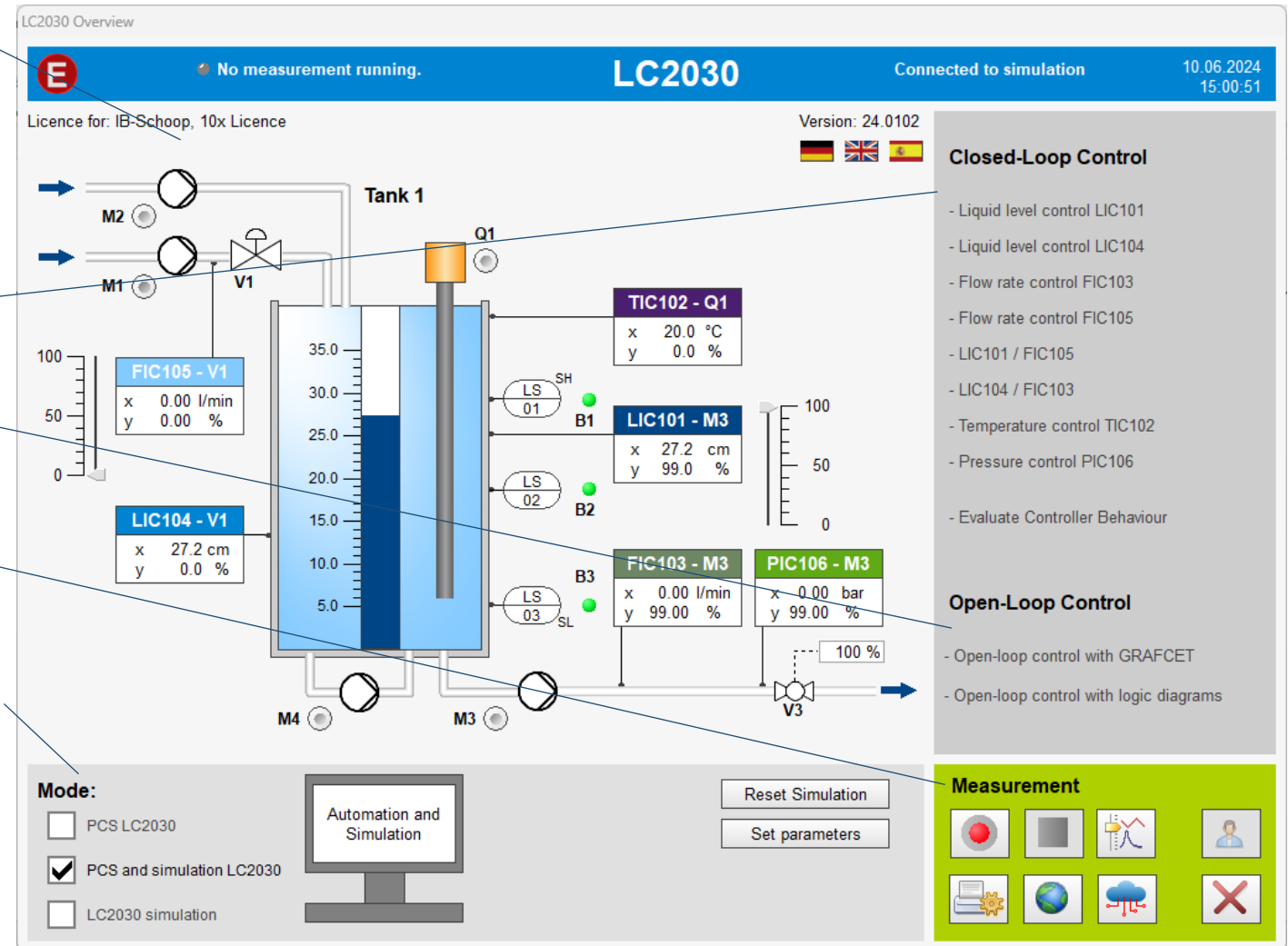
Closed loop control tasks menu

Open loop control tasks menu

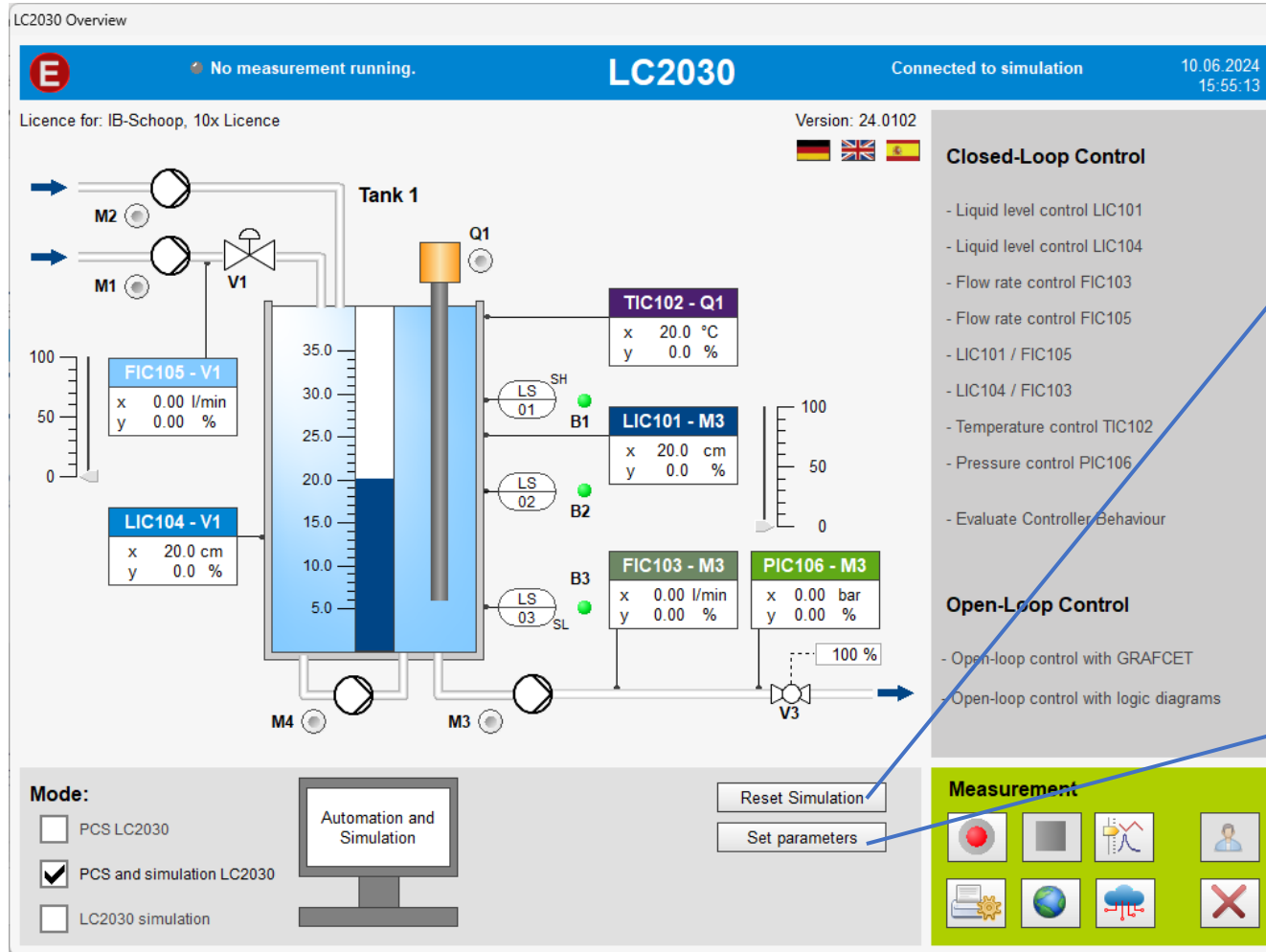
Measurements menu

Operation modes:

- Process control of training rig
- Process control of simulation
- Simulation (external control necessary, e.g. PLC or OPC)



Software LC2030 Training – PCS and simulation LC2030



Reset simulation to default values, e.g. level, temperature

Dimensions	Value	Unit
base area tank	195.0	cm²
Switching point LS2 (high)	30.0	cm
Switching Point LS2 (cente	19.0	cm
Switching Point LS3 (botto	5.000	cm
Heating & Cooling	Value	Unit
Power heating rod	750.0	W
Insulation loss	5.0	W/K
Connection ok	20.0	°C
Connection ok	20.0	°C
Outside temperature	20.0	°C
Flow rates	Value	Unit
M1 max. (100%, 5cm)	3.75	l/min
M3 max. (100%, 35cm)	5.000	l/min
Load original data of LC2030		
Start values	Value	Unit
Liquid level in tank	20.0	cm
Temperature tank	20.000	°C
Set start values		

Software LC2030 Training – PCS LC2030

LC2030 Overview

E No measurement running. **LC2030** Workstation connection 10.06.2024 15:47:16

Licence for: IB-Schoop, 10x Licence Version: 24.0102

Closed-Loop Control

- Liquid level control LIC101
- Liquid level control LIC104
- Flow rate control FIC103
- Flow rate control FIC105
- LIC101 / FIC105
- LIC104 / FIC103
- Temperature control TIC102
- Pressure control PIC106
- Evaluate Controller Behaviour

Open-Loop Control

- Open-loop control with GRAFCET
- Open-loop control with logic diagrams

Measurement

Mode:

- ☒ PCS LC2030
- ☐ PCS and simulation LC2030
- ☐ LC2030 simulation

Process control system

Choose I/O

I/O-Board

LC2030

Signal test

Sensor calibration

Assignment of analog inputs

Assignment of analog inputs happens via choosing signals

Reset assignment

Back

Temperature TIC102 [°C]

node 1	node 2	Current value
0.000	1.000	0.000
Normalised raw		
Temperature	-30.0	70.0
		-30.0

Liquid Level LIC101/LIC104 [cm]

node 1	node 2	Current value
0.200	1.000	0.000
Normalised raw		
Liquid level	0.0	40.0
		-1E+001

Flow rate FIC103 [L/min]

node 1	node 2	Current value
0.000	1.000	0.000
Normalised raw		
Flow rate	0.0	10.0
		0.0

Flow rate FIC105 [L/min]

node 1	node 2	Current value
0.000	1.000	0.000
Normalised raw value		
Flow rate	0.0	10.0
		0.0

Pressure PIC106 [bar]

node 1	node 2	Current value
0.000	1.000	0.000
Normalised raw		
Pressure	0.0	0.6
		0.0

Digital Outputs

AO1

AO2

BO1

BO2

BO3

BO4

BO5

BO6

BO7

BO8

Assignment of analog inputs

AI1

AI2

AI3

AI4

AI5

AI6

L1: Liquid level

F1: Flow rate in outflow

F2: Flow rate in inflow

T1: Temperature

P1: Pressure in outflow

Reset assignment

Back

LC2030 Workstation – Check Outputs

Test signals

Digital Inputs

- BI1 ☒
- BI2 ☒
- BI3 ☒
- BI4 ☒
- BI5 ☒
- BI6 ☒
- BI7 ☒
- BI8 ☒

Digital Outputs

- BO1 ☒
- BO2 ☒
- BO3 ☒
- BO4 ☒
- BO5 ☒
- BO6 ☒
- BO7 ☒
- BO8 ☒

Analog outputs

AO1

AO2

Assignment of analog inputs

AI1

- ☒ L1
- ☐ F1
- ☐ F2
- ☐ T1
- ☐ P1
- ☐ P2

AI2

- ☐ L1
- ☒ F1
- ☐ F2
- ☐ T1
- ☐ P1
- ☐ P2

AI3

- ☐ L1
- ☐ F1
- ☒ F2
- ☐ T1
- ☐ P1
- ☐ P2

AI4

- ☐ L1
- ☐ F1
- ☐ F2
- ☒ T1
- ☐ P1
- ☐ P2

AI5

- ☐ L1
- ☐ F1
- ☐ F2
- ☐ T1
- ☒ P1
- ☐ P2

AI6

- ☐ L1
- ☐ F1
- ☐ F2
- ☐ T1
- ☐ P1
- ☐ P2

Assignment of analog inputs happens via choosing signals

- L1: Liquid level
- F1: Flow rate in outflow
- F2: Flow rate in inflow
- T1: Temperature
- P1: Pressure in outflow

Reset assignment

Back

Test by pushing software button view result on workstation. Attention when Valve V1 is closed check M1 (BO1) only very shortly.

Signal	LC2030	Signal description
BO 1	M1	Pump 1
BO 2	M2	Pump 2
BO 3	M3	Pump 3
BO 4	M4	Pump 4, Circul. pump
BO 5	TC1	Heating rod
BO 6	LAMP 1	Lamp 1, red
BO 7	LAMP 2	Lamp 2, yellow
BO 8	LAMP 3	Lamp 3, green

Check by using the slider and switching on Pump 1 and 3

I/O-Board	LC2030	Signal description
AOUT 1	FC1	Contr. Out. for pump M3
AOUT 2	FC2	Contr. Out. for valve V1

LC2030 Workstation – Check Inputs

Test signals

Digital Inputs

BI1 ☒
BI2 ☒
BI3 ☒
BI4 ☒
BI5 ☒
BI6 ☒
BI7 ☒
BI8 ☒

Digital Outputs

BO1 ☒
BO2 ☒
BO3 ☒
BO4 ☒
BO5 ☒
BO6 ☒
BO7 ☒
BO8 ☒

Analog outputs

AO1 ☒
AO2 ☒

Assignment of analog inputs

AI1 ☒ L1
☐ F1
☐ F2
☐ T1
☐ P1
☐ P2

AI2 ☐ L1
☒ F1
☐ F2
☐ T1
☐ P1
☐ P2

AI3 ☐ L1
☐ F1
☒ F2
☐ T1
☐ P1
☐ P2

AI4 ☐ L1
☐ F1
☐ F2
☒ T1
☐ P1
☐ P2

AI5 ☐ L1
☐ F1
☐ F2
☐ T1
☒ P1
☐ P2

AI6 ☐ L1
☐ F1
☐ F2
☐ T1
☐ P1
☐ P2

Assignment of analog inputs happens via choosing signals

L1: Liquid level
F1: Flow rate in outflow
F2: Flow rate in inflow
T1: Temperature
P1: Pressure in outflow

Reset assignment

Back

Level switches

Switches and push buttons:
Test by switching HS1 – HS5 manually and check LED status

I/O-Board	LC2030	Signal description
DIN 1	B1	Upper level switch
DIN 2	B2	Mid level switch
DIN 3	B3	Lower level switch
DIN 4	HS1	Standard switch HS1
DIN 5	HS2	Standard switch HS2
DIN 6	HS3	Standard switch HS3
DIN 7	HS4	Push button HS4
DIN 8	HS5	Push button HS5

Assignment of analogue inputs is only necessary for old workstations (Year of construction 2015 and older).
Test by turning on pumps and heating rod and view change in raw signals.