kolibrik

Potentiostat

High-power Potentiostat / Galvanostat

PTC-05100EW

Version history

Ver.	Date	Description	Author
1	2021-05-14	First release	M. Ondracek
2	2021-05-16	Minor updates	J. Libra
3	2021-10-26	Update of installation process	J. Holemar
4	2023-11-02	Minor updates	J. Fuksa, P. Libra

Disclaimer

Proprietary Note

Table of content

1. Introduction 6
1.1 Product overview 6
1.2 Standards 6
2. Installation and maintenance 7
2.1 Mechanical mounting 7
2.2 Electric connection 8
2.3 Maintenance instructions 8
3. Technical description 9
3.1 Technical parameters 9
3.2 Interfaces 10
3.3 Indicators and controls 14
3.4 Software 16
4. Instructions for safe disposal of the Product 17
5.1 Typical setup for fuel cell measurement 18
5.2 Typical setup for fuel-cell stack measurement 18
6. Operating instructions 19
6.1 Cooling water flow 19
6.2 Initial start up 20
6.3 Removing water from the device 21

List of Figures

Fig. 1: PTC-05100EW Device – front and rear view 5
Fig. 2: Device dimensions (in mm) 7
Fig. 3: Interlock connector 8
Fig. 4: Device interfaces 10
Fig. 5: External voltage probes (Vref, Vsense) 11
Fig. 6: Accessories 11
Fig. 7: Power output cable with accessories for ring-terminal to 4 mm banana plug reduction 12
Fig. 8: Isolation of ring-terminal connection 13
Fig. 9: Indicators and mains switch 14
Fig. 10: Values on display – example 16
Fig. 11: Typical schematic for a single cell experiment setup 18
Fig. 12: Typical schematic for a short stack experiment setup 18
Fig. 13: Chart for the calculation of the cooling water flow 19

List of Tables

Tab. 1: Table of Terms and abbreviations 5
Tab. 2: Table of standards 6
Tab. 3: Product description 9
Tab. 4: Interfaces 10
Tab. 5: AUX pinout 10
Tab. 6: Pinout of External voltage probe 12
Tab. 7: Pinout of Power output 12
Tab. 8: Indicators on the device 14
Tab. 9: Displayed values 16
Tab. 10: Waste categories 17

Glossary of terms and abbreviations

Tab. 1: Table of Terms and abbreviations

Term	Explanation
DC	Direct current / Direct control
EIS	Electrochemical impedance spectroscopy
CV	Cyclic Voltammetry
USB	Universal serial BUS
AUX	Auxiliary connector
EMC	Electromagnetic Compatibility
RoHS	Restriction of the use of certain Hazardous Substances in electrical and electronic equipment
IPC	Association Connecting Electronics Industries

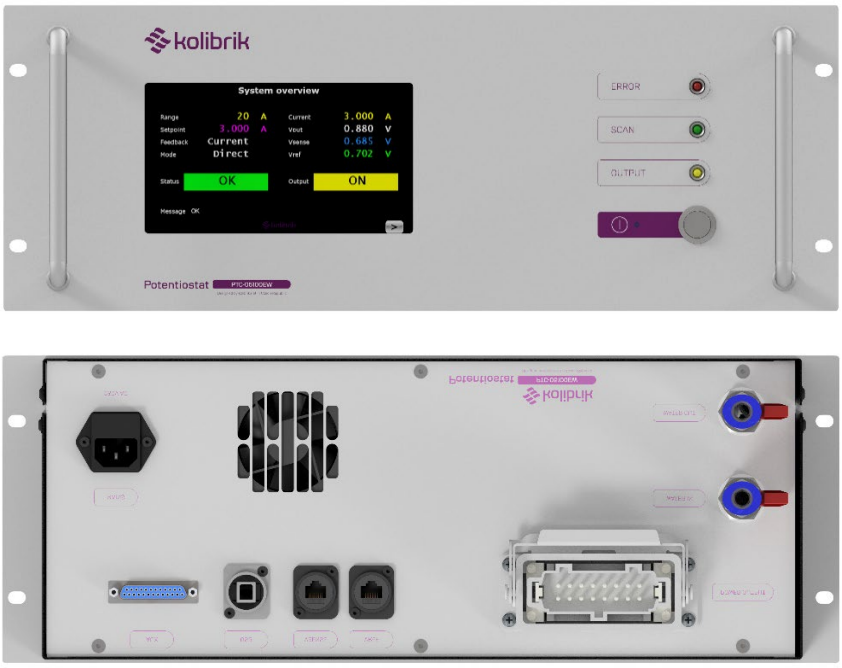


Fig. 1: PTC-05100EW Device – front and rear view

1. Introduction

1.1 Product overview

Potentiostat PTC-05100EW enables measurements up to +/-5V and +/-100A DC. It is equipped with electrochemical impedance spectroscopy (EIS). The product is intended for use with fuel-cells, electrochemical cells, and other electrical and electrochemical measurements..

Main features

- DC potentiostatic and galvanostatic measurements up to ±5 V and ±100 A
- EIS in range of 1 mHz … 100 kHz, limited use up to 1 MHz
- Two independent external voltage probes
- USB communication
- Integrated display with measurement overview and charts
- Water cooling
- 19" rack mount
- Applications: Fuel cells (hydrogen, redox-flow, etc.), electrolyzers, batteries, short stacks

1.2 Standards

Tab. 2: Table of standards

Type	Document No.	Name
EMC	EN 61326-1: 2013	Electrical equipment for measurement, control, and laboratory use – EMC requirements
RoHS	EN 62321: 2009	Electrotechnical products - Determination of level of six regulated substances (Cd, Hg, Pb, Cr+6, PBB, PBDE)
LVD	EN 61010-1: 2003	Safety requirements for electrical equipment for measurement, control, and laboratory use
IPC	IPC-A610-D	Acceptability of Electronic Assemblies
IPC	IPC-A600-F	Acceptability of Printed Boards

2. Installation and maintenance

2.1 Mechanical mounting

PTC-05100EW can be operated free standing in horizontal position or it can be mounted inside a 19" rack. In case of the rack mount, support rails or plane must be installed beneath the device considering its weight. The device intakes cooling air through its sides, hot air output is through rear ventilation grilles. For cooling of power circuits, water cooling is used. Proper cooling circuit with sufficient water flow and temperature must be connected and both rear water valves must be opened before starting an operation.

There shall be appropriate room around the rear, and side ventilation grilles to ensure continuous cooling air intake and venting. Blocking of the airflow can result in operation failures or damage of the device.

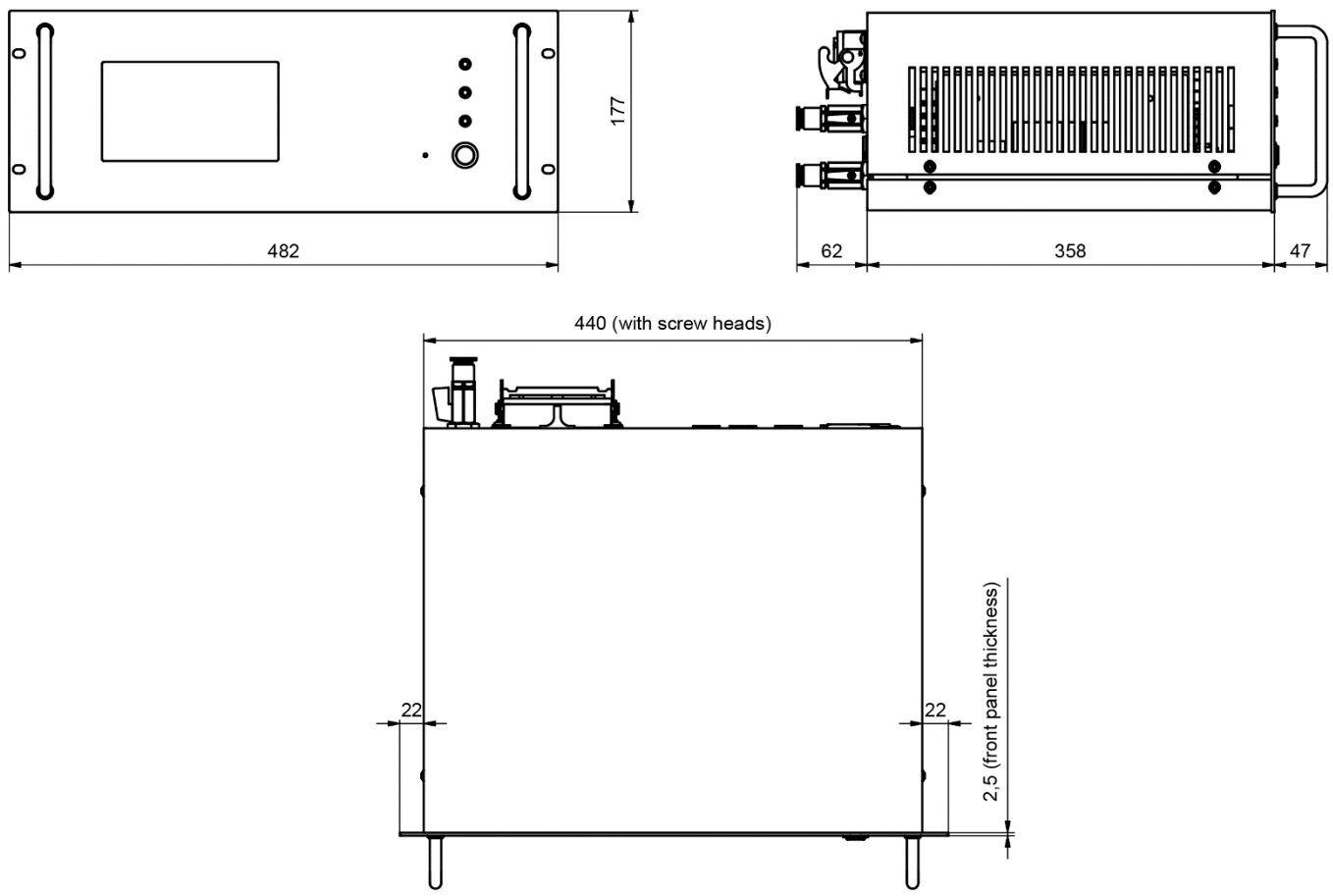


Fig. 2: Device dimensions (in mm)

2.2 Electric connection

Dangerous voltage hazard!

Electric installation shall be always performed by a person with appropriate qualification. Mains 230 V AC input shall be properly earthed and periodically checked.

Before connecting the device, make sure that the mains 230 V AC is switched off! This applies for all connections – 230V AC input, interlock, power output, voltage probes and USB.

Do not connect potentials out of allowable range of the device.

Do not connect circuits where higher current may flow than maximum range of the device.

When connecting power sources with short-circuit current possibly higher than the range of the device, be very careful during the setup of the measurement and double-check all values before the acquisition is started.

Auxiliary interlock connector (AUX) can be used for connecting of E-STOP button or external safety system optionally. The type of external contact must be normally closed (NC), floating potential or isolated. If external system is not used, delivered interlock connector (see Fig. 3) with internally closed interlock contacts must be used. The housing contains clamps, where user can connect cable to external system. If interlock contacts are opened, potentiostat reports an error and power output is disconnected.

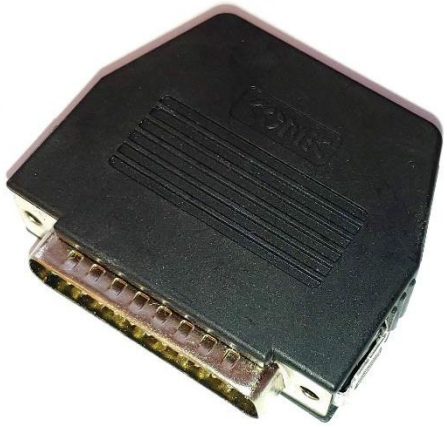


Fig. 3: Interlock connector

2.3 Maintenance instructions

Before each operation, check if the connection wires are not damaged and the venting is not blocked. Avoid moisture penetration inside the device.

At least once a month or after a longer period of operation vacuum the dust from the venting grilles. Always clean the surface of the device with a dry towel. Avoid using aggressive or abrasive cleaning agents.

Device must be during transportation, storage and operation in the ambient air temperature range from 5 °C to 50°C.

3. Technical description

3.1 Technical parameters

Tab. 3: Product description

Power supply	230 V AC: 180 … 264 V / 6 A 110 V AC: 90 … 135 V / 11 A 50 … 60 Hz
Dimensions	19“ rack cabinet, 4U height
Weight	15,2 Kg
Cooling	Water
Protection rating	IP20
Probe input voltage range **Electrometer voltage range**	-10 V … +10 V
Output voltage **Compliance voltage**	-5 V … +5 V
Output current **Compliance current**	-100 A … +100 A
Current ranges	Current ranges 4 current ranges: 100 A; 20 A; 5 A; 0.5 A
Sampling	24-bit ADCs, 1 ksps internal, 50 sps filtered sampling 14-bit ADCs, up to 20 Msps for EIS measurements
Measurement resolution	0.001 % of selected range for ≤ 1 ksps sampling
Accuracy	Voltage ≤ 0.1 % of range + 0.1 % of reading Current ≤ 0.1 % of range + 0.5 % of reading
Acquisition methods	constant V, I, open circuit, manual control chronoamperommetry, chronopotentiommetry linear sweeps, I/V characteristics cyclic voltammetry pulse voltammetry – differential, square, normal impedance spectroscopy programmable sequences of all available methods
EIS frequency	1 mHz … 100 kHz, limited use up to 1 MHz
EIS amplitude	1 … 1000 mV, up to 50 A for < 1 kHz
PC Connection	USB 2.0
Optional accessories	Chiller, heater exchanger

3.2 Interfaces

Fig. 4: Device interfaces

Tab. 4: Interfaces

MAINS 230V AC	Power supply 230V
AUX	Interlock, Input for connection of STOP button
USB	USB output - connecting with PC
Vsense	External voltage probe, remote sense
Vref	External voltage probe, reference voltage
POWER OUTPUT	Power output connector
Water IN	Cooling water input
Water OUT	Cooling water output

Tab. 5: AUX pinout

Pin	Name	Signal	Description
1	Interlock1	GND	Connect Input to GND to enable power output
2		Input	
5	Alarm Output, NC	Collector	Isolated optocoupler 24 V / 1 mA
6		Emitor	
9	Alarm Output, NO	Collector	Isolated optocoupler 24 V / 1 mA
10		Emitor	

[1]Safety function: E-STOP button or external safety system can be connected

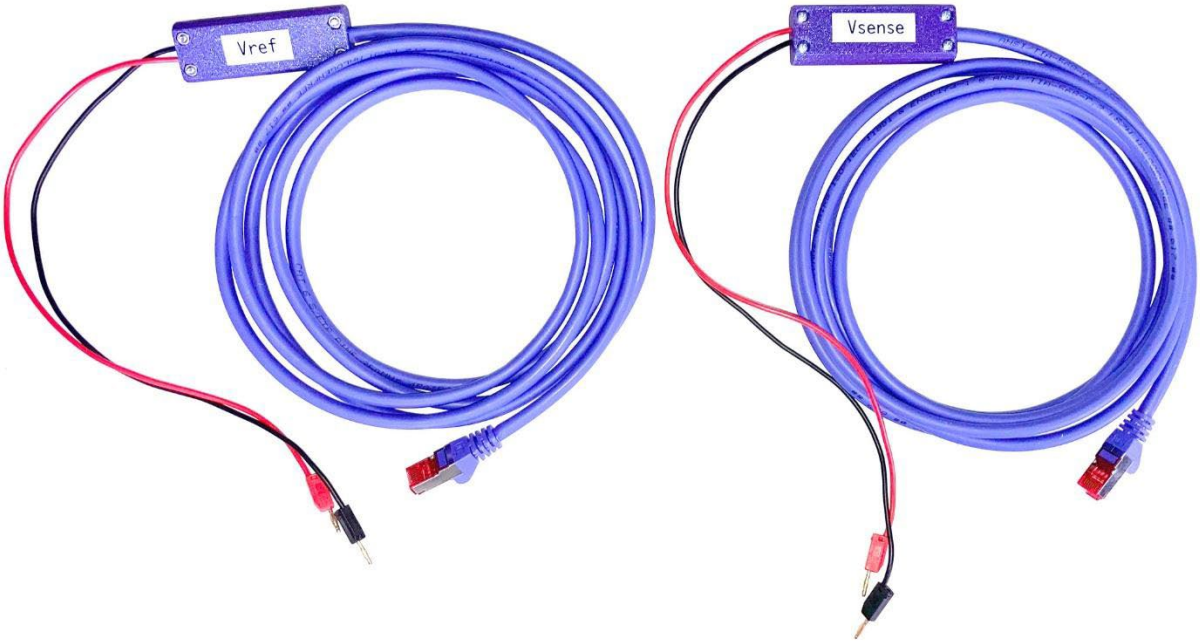


Fig. 5: External voltage probes (Vref, Vsense)

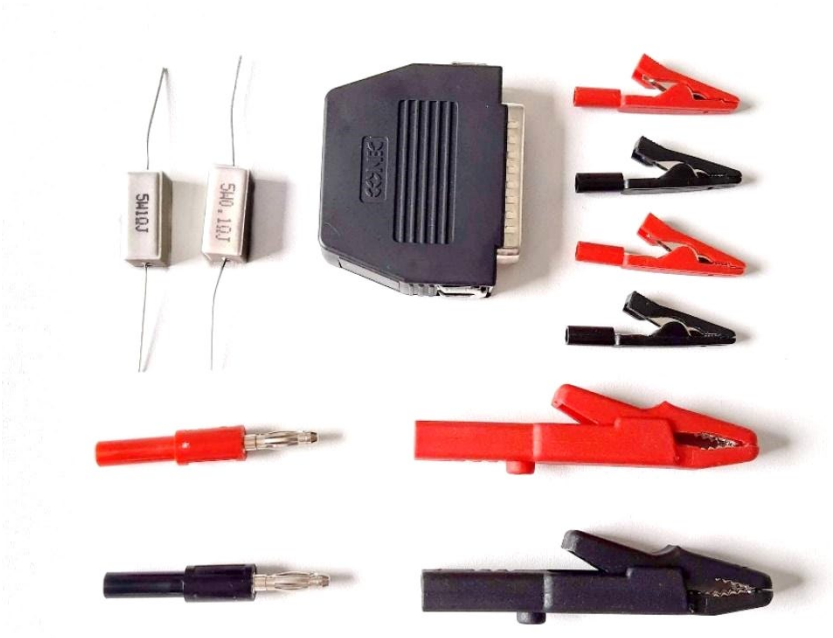


Fig. 6: Accessories

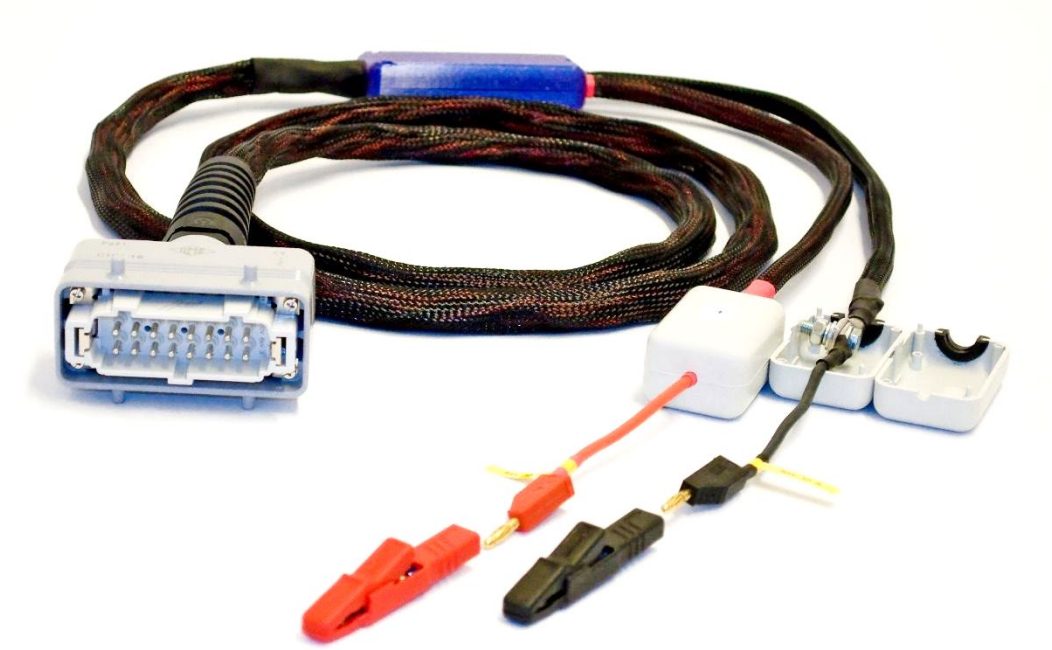


Fig. 7: Power output cable with accessories for ring-terminal to 4 mm banana plug reduction

Tab. 6: Pinout of External voltage probe

Terminal	Name	Description	Connector type
+ (red)	Vref / Vsense plus	Positive terminal of External voltage probe	2 mm banana plug
– (black)	Vref / Vsense minus	Negative terminal of External voltage probe	

Tab. 7: Pinout of Power output

Terminal	Name	Description	Connector type
+ (red)	Power output plus	Positive terminal of Power output	4 mm cable rings
– (black)	Power output minus	Negative terminal of Power output	

Note

Do not swap external probes, they are calibrated only for matching connection. I.e., the Vsense probe must be connected to the Vsense connector and Vref probe must be connected to the Vref connector.

Connect all cables only when the device is switched off by main switch. Failing to do so can result in operation failures or damage of the device.

Never connect any other cables into RJ45 connectors for external probes than original external probes. Connection of an ethernet cable can cause permanent damage of the device.

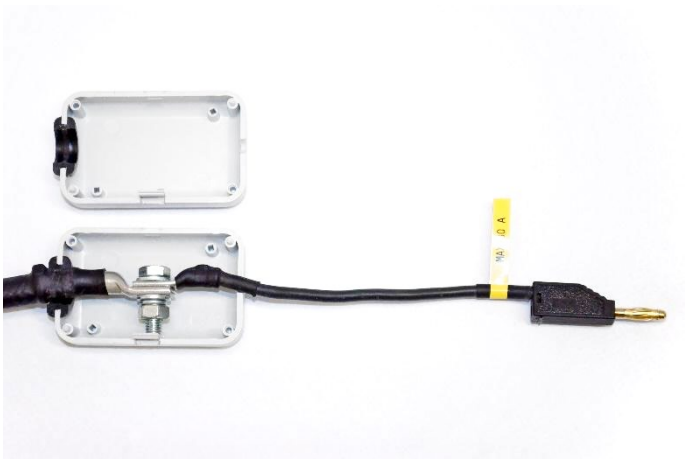


Fig. 8: Isolation of ring-terminal connection

Reduction of power cable ring terminals to 4 mm banana plugs must be isolated in plastic enclosure to prevent short circuits and possible damage or fire. Never apply current higher than 30 A when using banana plugs.

3.3 Indicators and controls

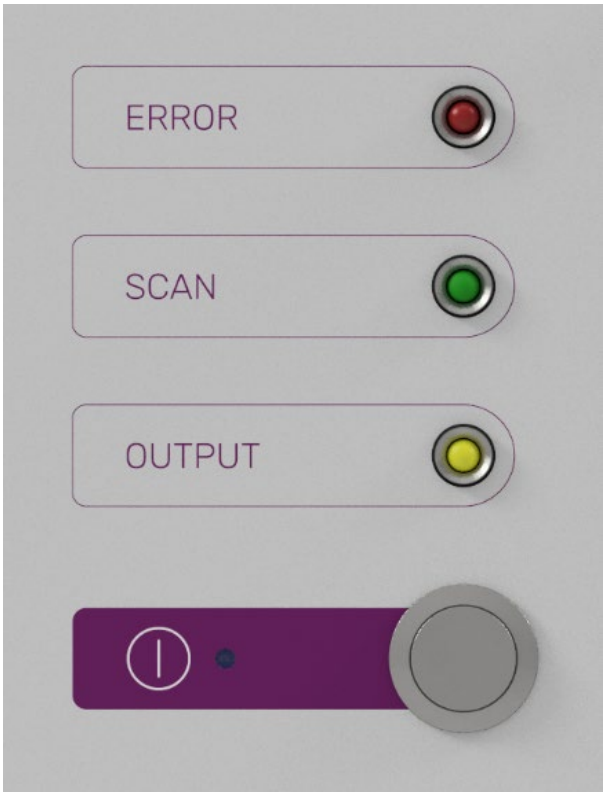
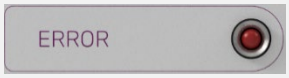
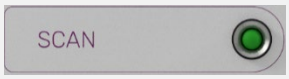
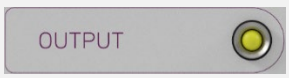
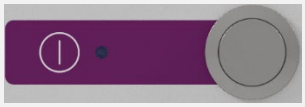


Fig. 9: Indicators and mains switch

Tab. 8: Indicators on the device

Indicator	Physical appearance	Meaning
ERROR	Red lamp 	Slowly blinking – warning Quickly blinking – error
SCAN	Green lamp 	Acquisition in progress
OUTPUT	Yellow lamp 	Lights when output relay is switched on
⏻ **(ON / OFF)**	Mains switch and small blue lamp 	Power supply

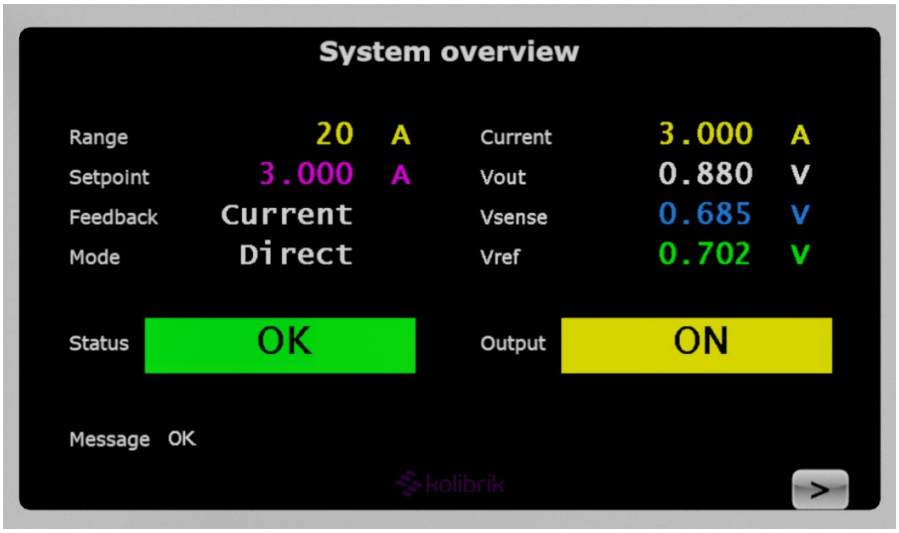


Fig. 10: Values on display – example

Tab. 9: Displayed values

Name	Value / Status	Description
Range	100 A; 20 A; 5 A; 0,5 A	Selected current range
Set point	Up to range	Set value of voltage or current
Feedback	Current, Vout, Vsense, Vref	Feedback mode
Mode	DC, CV, EIS, Oscilo	Mode of measurement
Status	OK / Warning / Error	
Current	Up to range	Actual current value
Vout	Up to range	Measured voltage on Power output
Vsense	Up to range	Measured voltage on Remote sense voltage probe
Vref	Up to range	Measured voltage on External voltage probe
Output	ON/OFF	Output relay on/off indicator

3.4 Software

Potentiostat is controlled by PC software PTC Server. For more details, please refer to PTC Server User Guide.

4. Instructions for safe disposal of the Product

Packaging and waste equipment must be disposed of in accordance with Directive 2002/96/EC and relevant national laws.

Tab. 10: Waste categories

Waste type	Category
Packaging waste	Non-hazardous
Electrical and electronic equipment waste	Hazardous waste

5. Application notes

5.1 Typical setup for fuel cell measurement

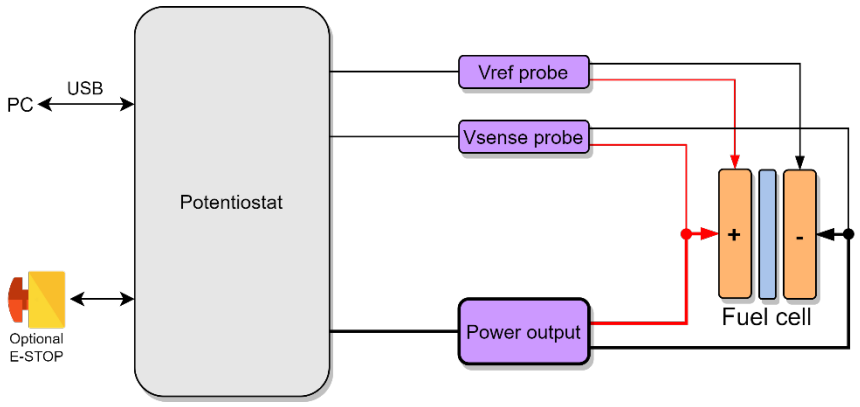


Fig. 11: Typical schematic for a single cell experiment setup

Vsense probe can be used for remote voltage sensing at the power cable connections to the cell. Some cells have additional connections point for more precise measurement at end plates. Vref probe can be used for measurement of the cell potential. If the cell is equipped with a reference electrode, Vref probe can be used for reference potential or half-cells measurement. Anyway, both probes are equal, both can provide same precise measurement, can be used for potentiostatic feedback, and can be used for EIS measurements.

5.2 Typical setup for fuel-cell stack measurement

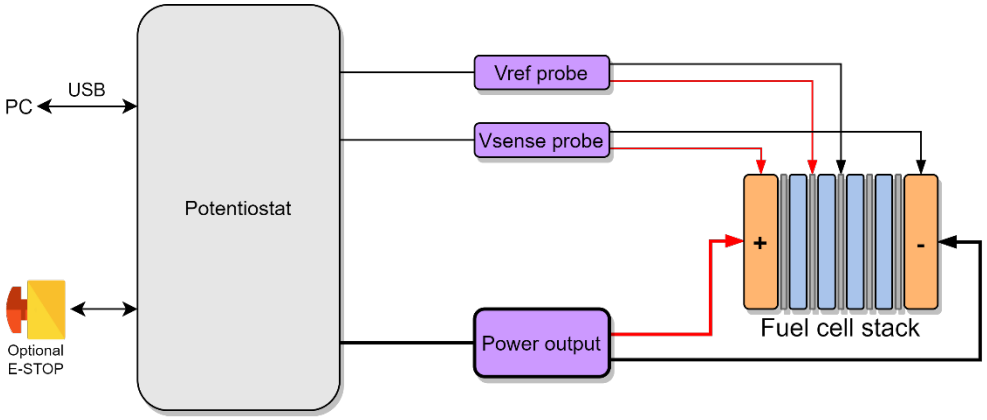


Fig. 12: Typical schematic for a short stack experiment setup

In short stack experiments, Vsense probe can be used for whole stack voltage measurement, while Vref probe can measure an individual cell.

6. Operating instructions

6.1 Cooling water flow

For cooling of high-power circuits, water cooling is used. A proper cooling circuit with sufficient water flow and temperature must be connected and both rear water valves must be opened before starting the operation. Minimum cooling water flow and appropriate cooling water inlet temperature shall be ensured before turning on the power. Otherwise, the measurement may be interrupted by the thermal protection of the device. Operating the device below minimum cooling flow may shorten its lifetime. The cooling water flow is dependent on the water inlet temperature and the required cooling power.

For the calculation of the cooling water flow please refer to the following chart.

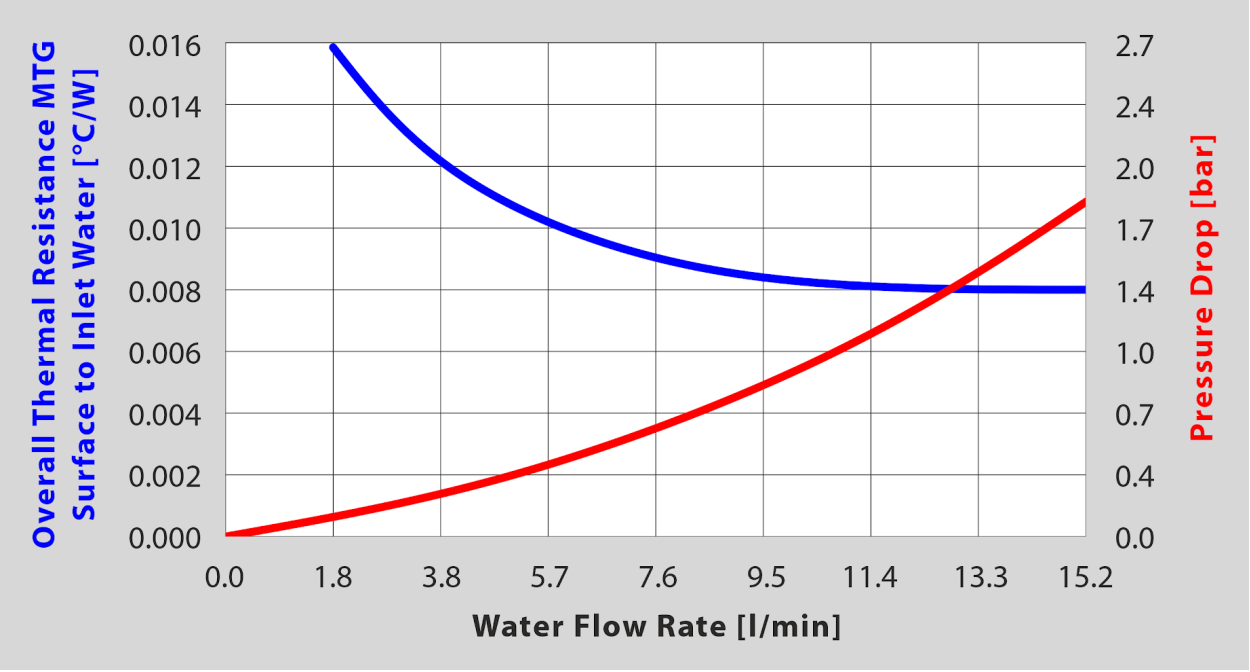
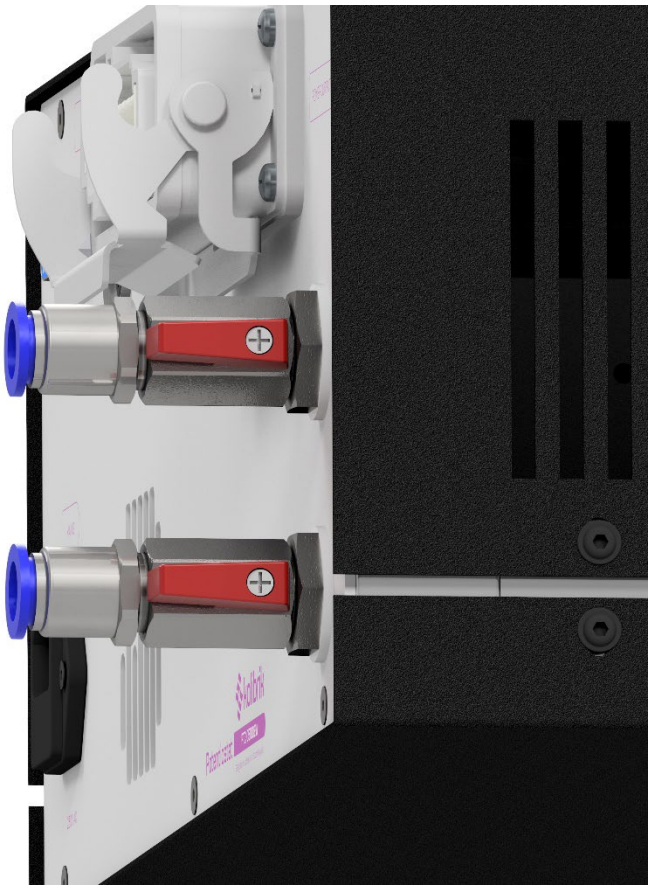


Fig. 13: Chart for the calculation of the cooling water flow

6.2 Initial start up

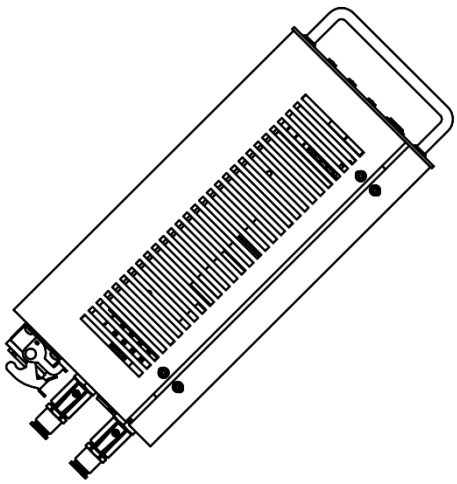
- Remove packaging
- Prepare a cooling device for working process (continue according to the instruction for cooling device)
- After this procedure install the hoses connecting cooling device and potenciostat (be careful to connect output and input correctly)
- Open the shut-off valves



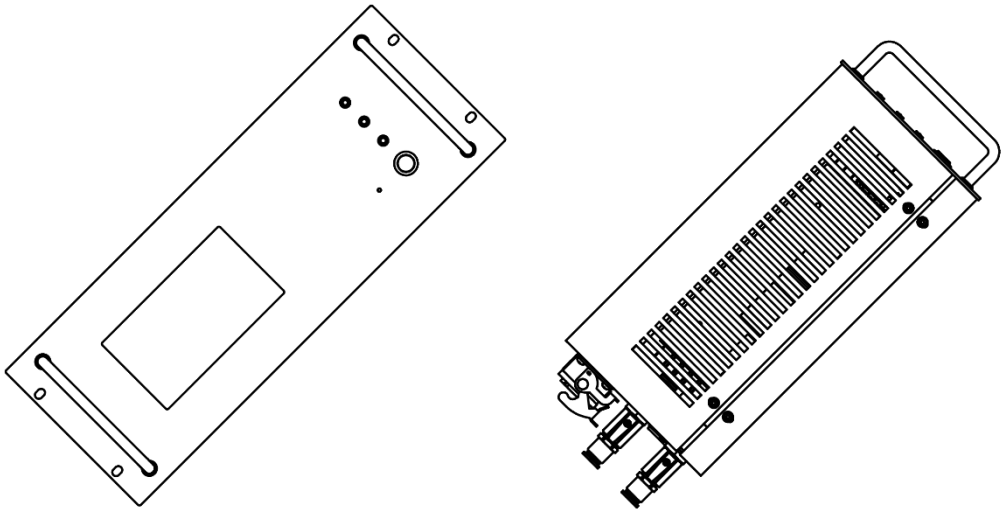
- Cooling device procedure (continue according to the instruction for cooling device)

6.3 Removing water from the device

- Turn off the device.
- Close shut-off valves and remove the hoses
- Open shut-off valves and leave the water to flow out of the device. Then rotate the device in approx. 45° angle



- Then rotate the device on another side and then again at the previous angle.



- Close shut-off valves
- The device is afterwards prepared for storage or transport.