Elektro-Automatik

30 kW

INSTALLATION MANUAL

EA-ELR 21000-80

High-speed regenerative load

Safety instructions, installation, commissioning

Revision: 01

TABLE OF CONTENTS

1. About this document

1.1 General information 5
1.1.1 Storage and use 5
1.1.2 Copyright protection 5
1.1.3 Application area 5
1.1.4 Characters and symbols used in this document 5
1.1.5 Structure of the warnings 5
1.2 Warranty and guarantee 6
1.3 Limitations of liability 6
1.4 Product key 6

2. General safety regulations

2.1 Intended use 7
2.2 Foreseeable incorrect instruction 7
2.3 Obligations of the operator 7
2.4 Requirements for the operating personnel 8
2.4.1 Responsibility of the operator 8
2.5 Safety 8
2.5.1 Safety instructions 8
2.5.2 Symbols and instructions on the device 10
2.6 Residual risks 10

3. Technical description

3.1 General description 11
3.2 Block diagram 11
3.3 Scope of delivery 12
3.4 Accessories 12
3.5 Options 12

4. Views of the device

4.1 Technical drawings ELR 21000 4U 13
4.2 Description front panel ELR 21000 4U 14
4.3 Description back panel ELR 21000 4U 14
4.4 Description front panel ELR 21000 4U WC (water cooling) 15
4.5 Description back panel ELR 21000 4U WC (water cooling) 15

5. Control elements

5.1 Overview 16
5.2 The control panel (HMI) 17
5.2.1 Display with touchscreen 17
5.2.2 Rotary knobs 18
5.2.3 Touch function of the rotary knobs 18
5.2.4 Resolution of the display values 19
5.2.5 USB port (front) 19
5.3 USB port (rear) 20
5.4 CAN FD port (rear) 20
5.5 Share-Bus connection (rear) 20
5.6 Sense connections, remote sensing (rear) 21
5.7 EtherCAT ports (rear) 21
5.8 Ethernet port (rear) 21
5.9 Digital In / Out port (rear) 22
5.9.1 Technical data of the "Digital In / Out" port 22
5.10 Water cooling 23

6. Installation and commissioning

6.1 Transport and storage 24
6.1.1 Transport 24
6.1.2 Packaging 24
6.1.3 Storage 24
6.2 Unpacking and visual inspection 24
6.3 Installation 24
6.3.1 Safety measures before installation and use 24
6.3.2 Preparation 25
6.3.3 Setting up the device 26
6.3.4 Connecting the water supply (WC models) 27
6.3.5 Connecting to the mains supply (AC) 28
6.3.6 Connecting DC sources 31
6.3.7 Earthing the DC terminal 32
6.3.8 Connecting the remote sensor 33
6.3.9 Connecting the Share-Bus 34
6.3.10 Connecting the USB port (rear) 34
6.3.11 Connecting the CAN FD port 34
6.3.12 Initial commissioning 34
6.3.13 Recommissioning after firmware updates or longer periods of non-use 34
6.3.14 Disposal of the device 34

7. Operation and use (1)

7.1 Terms 35
7.2 Important notes 35
7.2.1 Personal protection 35
7.2.2 General 35
7.3 Manual operation (1) 35
7.3.1 Switching on the device 35
7.3.2 Switching off the device 36
7.3.3 Manual set value adjustment in ELR mode 36
7.3.4 Switch DC terminal on or off 37
7.3.5 Locking the control panel (HMI) 37
7.3.6 Locking the adjustment limits and user profiles 38
7.4 Alarms and monitoring (1) 39
7.4.1 Definition of terms 39
7.4.2 Handling device alarms and events 39
7.5 User-definable events (user events) 41

8. Other applications (1)

8.1 Series connection 42

9. Troubleshooting

9.1 Maintenance / cleaning 43
9.1.1 Battery replacement 43
9.2 Troubleshooting / fault diagnosis / repair 43
9.2.1 Alarm signals 43
9.2.2 Power fail alarm 44
9.2.3 Overtemperature alarm 44
9.2.4 Overvoltage alarm 44
9.2.5 Overcurrent alarm 44
9.2.6 Overpower alarm 44
9.2.7 Share-Bus fail 44
9.2.8 Master-auxiliary protection 45
9.2.9 External overtemperature alarm 45

10. Technical data

10.1 Permissible operating conditions 46
10.1.1 Surroundings 46
10.1.2 Cooling 46
10.2 General technical data 46
10.3 Specific technical data 47

11. Contact and support

11.1 Repairs/technical support 51
11.2 Contact options 51

1. About this document

It is essential that you read this document before you operate the high-speed regenerative load for the first time or if you are tasked with other work on the high-speed regenerative load.

1.1 General information

This document serves as installation instructions for the device models listed in *«1.1.3 Application area»* and for their commissioning. The safety instructions in section *«2.5 Safety»* must be observed and implemented in particular. Operation and use are explained in a separate document, the user manual.

1.1.1 Storage and use

This document should be kept for future reference and, if possible, in the vicinity of the device together with the user manual. It explains how to install the device. This document needs to be transferred when changing location and/or user. The current version of this document can be found online on our website.

1.1.2 Copyright protection

1.1.3 Application area

This document applies to EA-ELR 21000-80.

1.1.4 Characters and symbols used in this document

The following signs and symbols are used in this document:

- Listing: The text after this symbol describes the list of individual points.

1. Numbers: The text after this symbol describes instructions that must be carried out in the specified order from top to bottom.

1.1.5 Structure of the warnings

Warnings, safety instructions and general notes in this document are always enclosed in a box and labeled with a symbol.

Signal word	Use for ...	Possible consequences if the safety instructions are not observed:
DANGER	Personal injury (imminent danger)	Death or serious injury!
WARNING	Personal injury (potentially dangerous situation)	Death or serious injury!
CAUTION	Personal injury	Slight or minor injuries!

The warnings are structured as follows:

- Pictogram with signal word corresponding to warning level
- Description of the hazard (type of hazard)
- Description of the consequences of the hazard (hazard consequences)

DANGER

Type of hazard (text)

- Consequences of danger (Text)

Special safety instructions are provided at the relevant points. They are labeled with the following symbols.

	**Warning of dangerous electrical voltage - This symbol indicates activities where there is a risk of electric shock, possibly with fatal consequences.**
	**Information symbol for a risk of damage to the device - If attached to the device, the symbol prompts the user to consult the device documentation.**
	**General danger zone** - This sign is placed in front of activities where there is a risk of personal injury and extensive damage to property.
	*General note - Additional information*

1.2 Warranty and guarantee

EA Elektro-Automatik GmbH guarantees the functionality of the applied process technology and the specified performance parameters. The warranty period begins with defect-free handover. The warranty provisions can be found in the General Terms and Conditions (GTC) of EA Elektro-Automatik GmbH.

1.3 Limitations of liability

All information and instructions in this manual have been compiled taking into account applicable standards and regulations, the state of the art and our many years of knowledge and experience. The manufacturer accepts no liability for damage due to:

- Improper use
- Use of untrained and uninstructed personnel
- Unauthorized conversions
- Technical changes
- Use of unauthorized spare parts

The actual scope of delivery may differ from the explanations and illustrations described here in the case of special versions, the utilization of additional ordering options or due to the latest technical changes.

1.4 Product key

Breakdown of the product designation on the rating plate using an example:

EA-ELR 21000 - 80 4U xxx

xxx	Options and special versions: **WC** = Water cooling installed
4U	Design/construction (only indicated on type plate): **4U** = 19" design with 4 U
80	Maximum current of the device in Amperes
21000	Maximum voltage of the device in Volts (“21000” = 1000 V)
21	Series designation: **21** = Series 21000
ELR	Type labeling: **ELR** = Electronic Load

2. General safety regulations

TThe ELR 21000 may only be operated when in perfect technical condition and with functioning safety devices.

2.1 Intended use

The device is intended for use as ELR. Furthermore, it is only intended for operation as a device permanently installed in appropriate devices (19" cabinets, etc.), together with a permanent connection to the AC supply.

The ELR is an energy recovery unit. By definition, however, this device is not considered an energy generation system.

- **Claims of any kind due to damage resulting from improper use are excluded.**
- **The operator alone is liable for all damage caused by improper use.**

2.2 Foreseeable incorrect instruction

Any use other than that specified under “intended use” or use beyond this is considered improper use.

For damage resulting from improper use

- the operator bears sole responsibility,
- The manufacturer accepts no liability whatsoever.

2.3 Obligations of the operator

The operator is any natural or legal person who uses the device or allows third parties to use it and is responsible for the safety of the user, staff or third parties during use.

The device is used in the commercial sector. The operator of the device is therefore subject to the legal obligations regarding occupational safety. In addition to the warnings and safety instructions in this manual, the safety, accident prevention and environmental protection regulations applicable to the area of use of the device must be observed. In particular, the operator must:

- inform themselves about the applicable health and safety regulations.
- carry out a risk assessment to determine possible additional hazards arising from the specific application conditions at the place of use of the device.
- implement the necessary behavioral requirements for operating the device at the place of use in operating instructions.
- check regularly whether the operating instructions drawn up by him correspond to the current status of the regulations during the entire period of use of the device.
- adapt the operating instructions to new regulations, standards and operating conditions where necessary.
- clearly and unambiguously regulate the responsibilities for the installation, operation, maintenance and cleaning of the device.
- ensure that all employees working on the device have read and understood the device documentation. In addition, he must train staff in the use of the device at regular intervals and inform them of the potential hazards.
- Provide the prescribed and recommended protective equipment to the personnel authorized to work on the device.

Furthermore, the operator is responsible for ensuring that the device is always in perfect technical condition.

2.4 Requirements for the operating personnel

Only persons who are able to carry out their work properly and reliably and who fulfill the relevant specified requirements may carry out any work on devices of this type.

- Persons whose ability to react is impaired, e.g. by drugs, alcohol or medication, must not carry out any work.
- When deploying personnel, always observe the age and occupation-specific regulations applicable at the place of deployment.

RISK OF INJURY DUE TO INSUFFICIENT QUALIFICATION!
Improper work can lead to personal injury and damage to property.
Only persons who have the necessary training, knowledge and experience may carry out any activities.

In addition, the authorized group of users is restricted to two groups of people:

Instructed personnel: These are persons who have been instructed in detail and verifiably by the operator about the tasks assigned to them and possible hazards.

Specialist personnel: Such personnel are those who, on the basis of their professional training, knowledge and experience as well as knowledge of the relevant regulations, are able to carry out the assigned work properly, recognize possible dangers independently and avoid personal injury or damage to property.

2.4.1 Responsibility of the operator

The device is in commercial use. Staff are therefore subject to the legal obligations regarding occupational safety. In addition to the warnings and safety instructions in this manual, the safety, accident prevention and environmental protection regulations applicable to the area of use must be observed. In particular, the persons operating the device must:

- inform themselves about the applicable health and safety regulations.
- properly fulfill the assigned responsibilities for operating, maintaining and cleaning the device.
- have read and understood the device documentation in full before starting work.

2.5 Safety

2.5.1 Safety instructions

Danger to life - dangerous voltage

When operating electrical devices, certain externally accessible parts of the device are inevitably live, sometimes dangerously. Therefore, all live parts must be covered during operation!

Danger to life - dangerous voltage

The DC terminal is insulated from the mains supply and is not earthed in the device. Therefore, there can always be dangerous potential between the DC poles and PE, e.g. due to the application. Due to charged, internal capacitors, even when the DC terminal is already switched off.

Danger to life - dangerous voltage

Air-cooled models: Do not insert any mechanical parts, especially metal parts, into the device through the ventilation slots.

Danger to life - dangerous voltage

For any type of reconfiguration on the AC and DC terminals, i.e. all connections that could carry a voltage that is dangerous to touch, the device must be completely de-energized, i.e. it must be disconnected from the AC supply (main switch at the other end of the AC line); it is not sufficient to operate the mains switch.

Danger to life - dangerous voltage

Always observe the five safety rules when connecting and disconnecting electrical devices:

- **Disconnect (physical disconnection of all voltage sources from the device)**
- **Secure against being switched on again**
- **Determine absence of voltage**
- **Earthing and short-circuiting**
- **Cover or physically separate neighboring live parts**

Air-cooled devices: avoid using liquids of any kind in the vicinity of the device, as these could get into the device. Protect the device from moisture, humidity and condensation.

Do not connect external voltage sources with reversed polarity to the DC terminal! This will damage the device, even if it is completely switched off.

Do not connect any external voltage sources to the DC terminal that can generate a higher voltage than the nominal voltage of the device!

When working with sources that are not current-limited (e.g. battery, fuel cell), at least one fuse must be integrated in the DC circuit for each channel to which such a source is connected; this fuse must either correspond to the nominal current of the channel or less!

The device may only be used for its intended purpose!

The device is only authorized for operation within the connected loads and technical data specified on the rating plate.

Always configure protection functions against overcurrent, overvoltage etc. that the device offers for the load to be connected to suit the respective application!

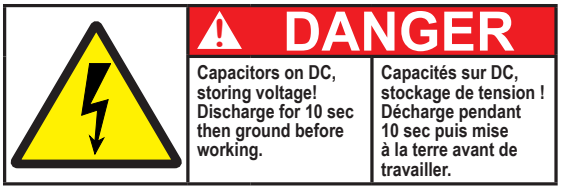
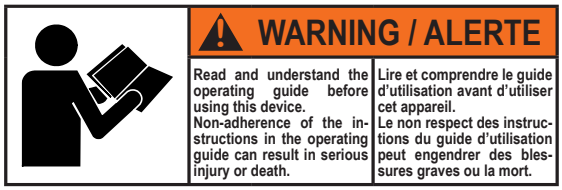
When operating as an electronic load: always ensure that the regenerative function can always safely dissipate the converted energy and that no island operation occurs. A monitoring device (mains and system protection) must be installed for stand-alone operation.

All types of generators or AC UPS power supplies are not permitted as AC connection sources for this device. It may only be operated directly from a mains supply!

With manual operation on the HMI and if the device is connected via any interface, an external control unit (PLC, PC, etc.) could take over the remote control at any time and set a dangerous voltage; it is recommended to disable the remote control when operating on the HMI by activating the so-called local mode (see *«2.4.2 Control locations»* and *«2.3.1 Configuration in the menu»* in the user manual).

The device is not intended for use in residential areas and cannot guarantee adequate protection of radio reception in such environments.

2.5.2 Symbols and instructions on the device

Sticker	Explanation
	Refers to connecting or reconfiguring the DC and/or AC terminal. The AC supply must always be disconnected (main switch) so that the AC supply line is de-energized.
	Even after disconnecting the DC terminal from an external source, voltage may continue to be present between the DC poles or to the housing for an indefinite period of time. To be on the safe side, check that there is no voltage, and discharge, short-circuit and earth if necessary.
	In principle, electrical devices with metallic, touchable points can have voltage potentials, even if they are not life-threatening. There is still a risk of electric shock or sparking.
	Applies to the handling of the device in every respect.

2.6 Residual risks

The high-speed regenerative load is built according to the state of the art and recognized safety regulations.

Even if all safety regulations are observed, a residual risk remains when operating the high-speed regenerative load.

3. Technical description

3.1 General description

The ELR 21000 4U device is a high-speed regenerative load. The main area of application for this device is Datacenter application. The device converts the absorbed energy and feeds it back into the local grid with a high degree of efficiency.

Typical applications including datacenter power validation and DC energy systems like SST, SSCB, BESS.

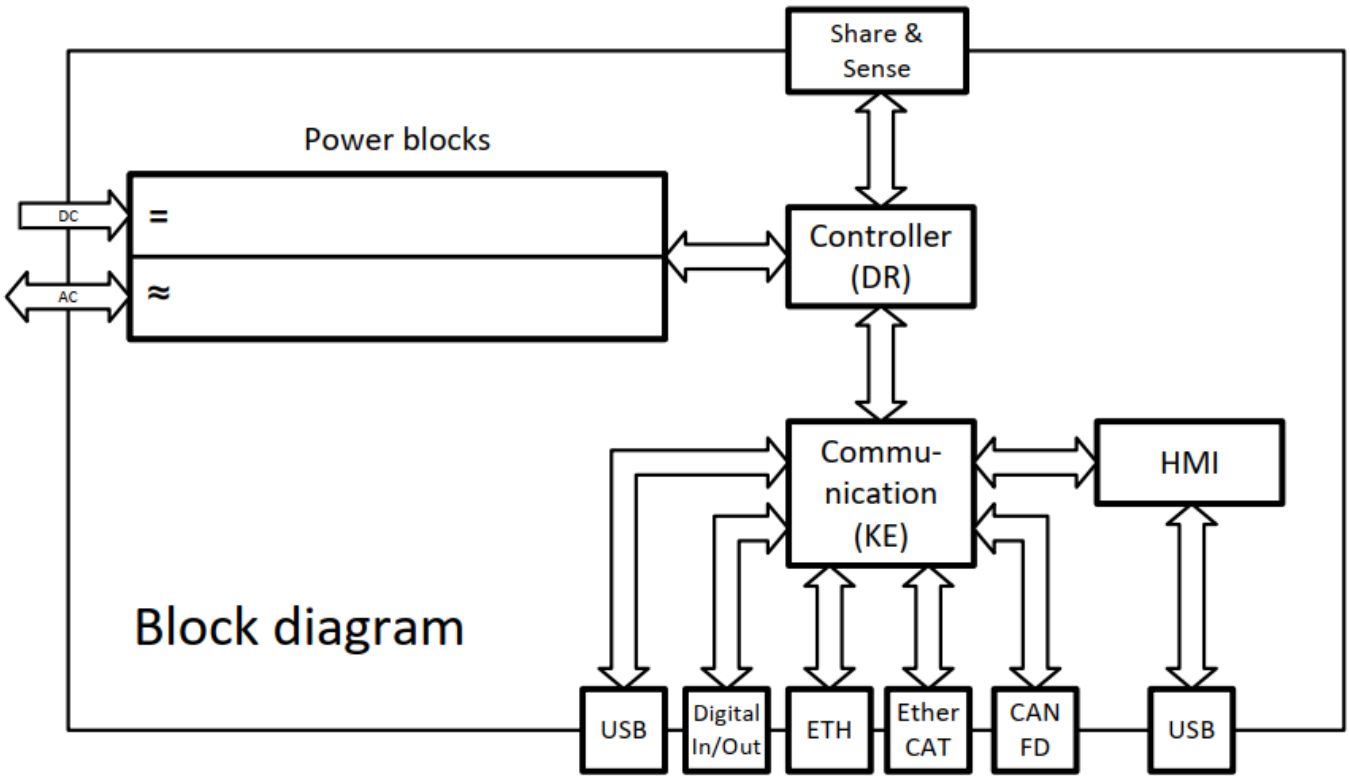
In addition to the standard functions of electronic loads, the integrated function generator can be used to generate sine, rectangular or triangular set value curves as well as other waveforms. Curves for the so-called arbitrary generator (99 interpolation points) can be saved to or loaded from a USB stick.

For remote control, all models have ports for USB, Ethernet, EtherCAT and CAN FD on the rear as standard. The EtherCAT ports also offer the option of setting up a parallel system with up to 64 devices to increase overall performance.

Water-cooled versions can be used as an alternative to the air-cooled versions. These are usually configured and offered in 19" enclosures to form an enclosure system with water cooling. Individual devices for self-construction of a corresponding system are available on request.

3.2 Block diagram

The block diagram is intended to illustrate the individual main components and their interaction. There are three digital, microcontroller-controlled components (KE, DR, HMI) that can be affected by firmware updates.



3.3 Scope of delivery

1 x ELR
2 x plugs for remote sensing (Sense)
1 x 16-pin plug for the I/O connection
1 x USB cable 1.8 m
1 x DC terminal cover
1 x Sense terminal cover
1 x USB stick with documentation and software
1 x AC connection plug (terminal type)
1 x set for AC cable strain relief

3.4 Accessories

As of 07/2026, no accessories are available.

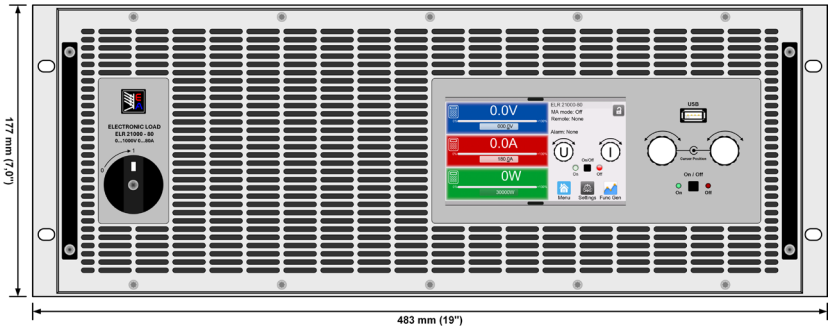
3.5 Options

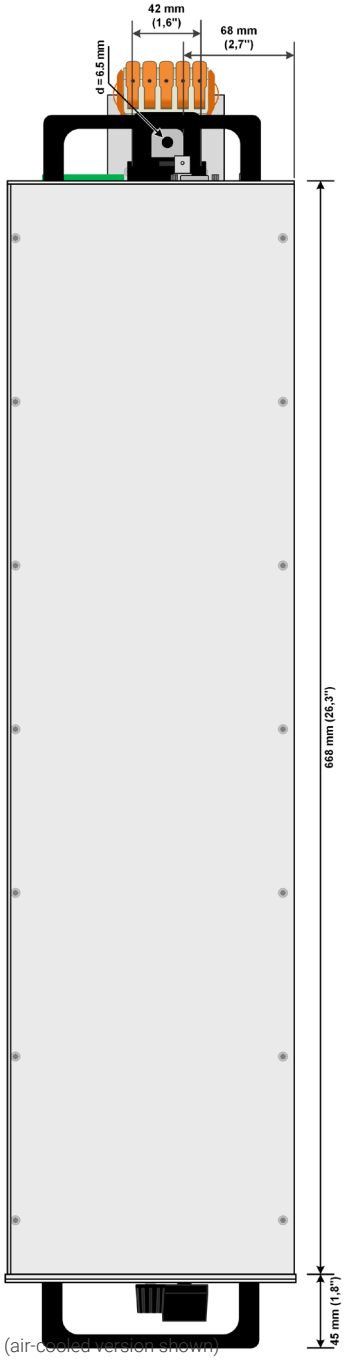
These options cannot be retrofitted, as they are permanently installed or preconfigured at the factory.

POWER RACKS 19" cabinets	Cabinets are available in various configurations up to 42 U as a parallel circuit system, also mixed with electronic loads to realize test systems. For further information see our website or make an inquiry.
WC Water cooling	Replaces the internal, air-cooled cooling blocks of the power stages with three connected, water-cooled blocks with two screw connections at the rear of the device. Water cooling helps to prevent the environment from heating up due to a certain, unavoidable loss of power, which inevitably occurs when a device or an entire system operates at high power in an enclosure. As a side effect, this type of cooling also reduces noise levels and is especially suitable for dust-free operation.

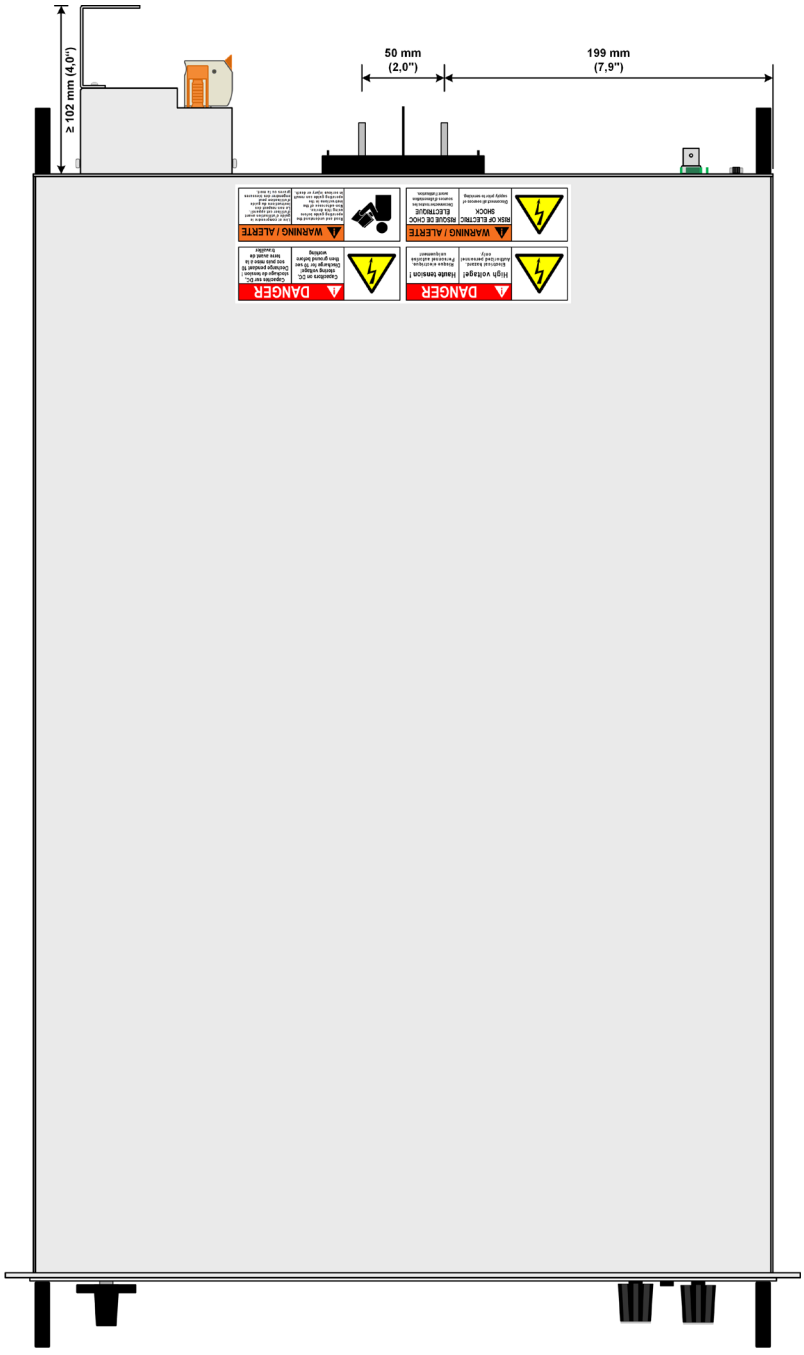
4. Views of the device

4.1 Technical drawings ELR 21000 4U

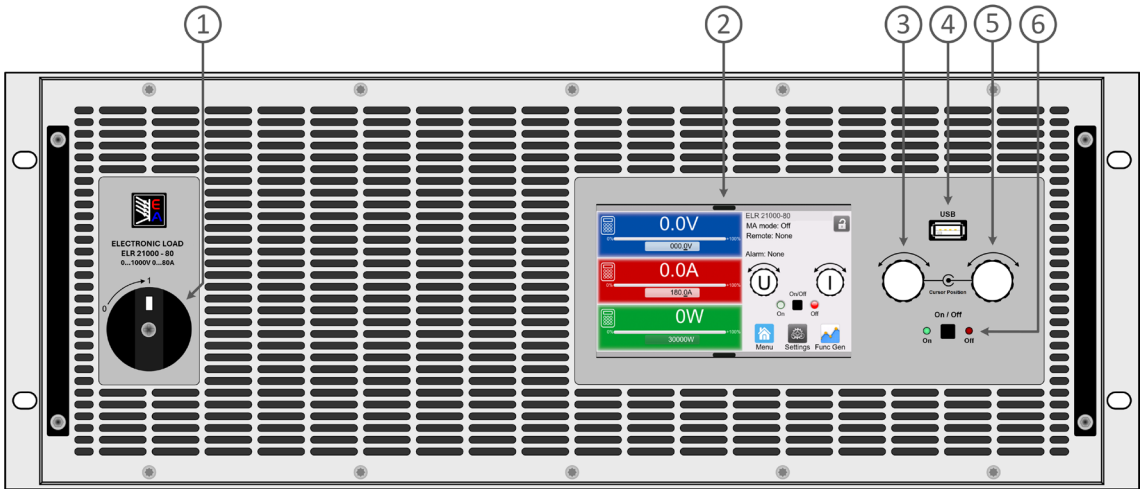




(air-cooled version shown)

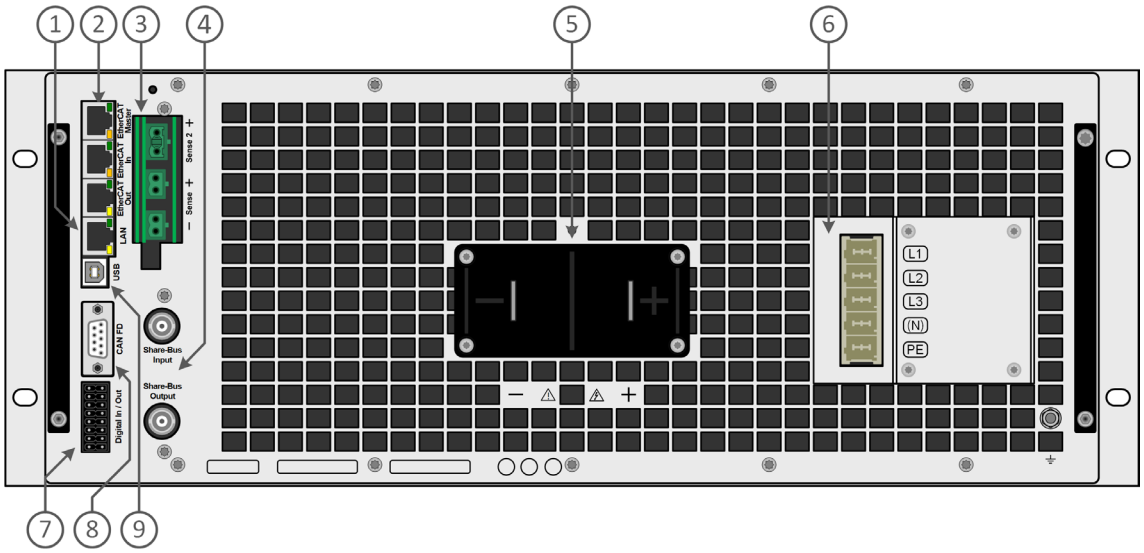


4.2 Description front panel ELR 21000 4U



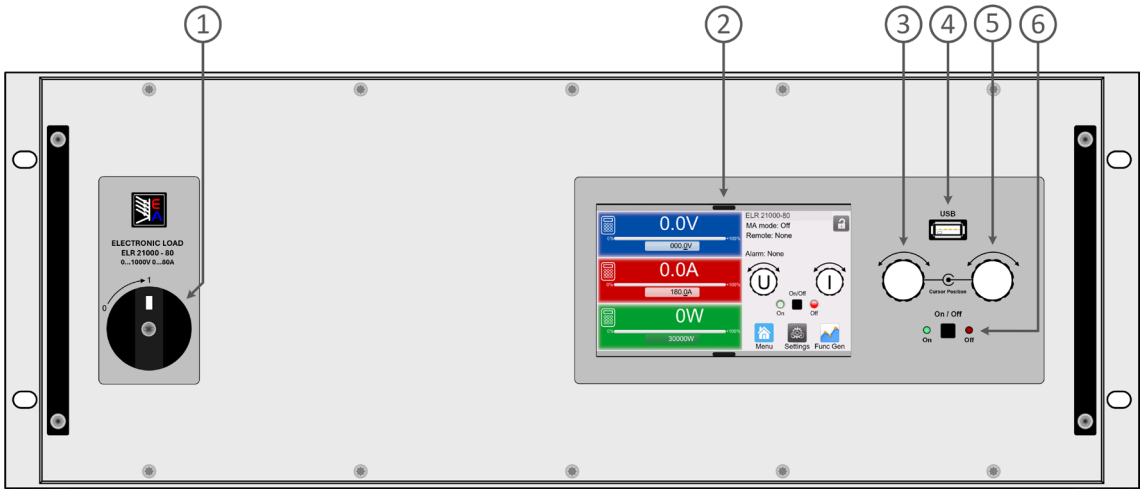
1. Mains switch
2. TFT display with touch-sensitive surface (touchscreen)
3. Rotary knob with touch function for settings
4. USB host for USB sticks for recording and reading data
5. Rotary knob with touch function for settings
6. On/off button with LED status indicator

4.3 Description back panel ELR 21000 4U



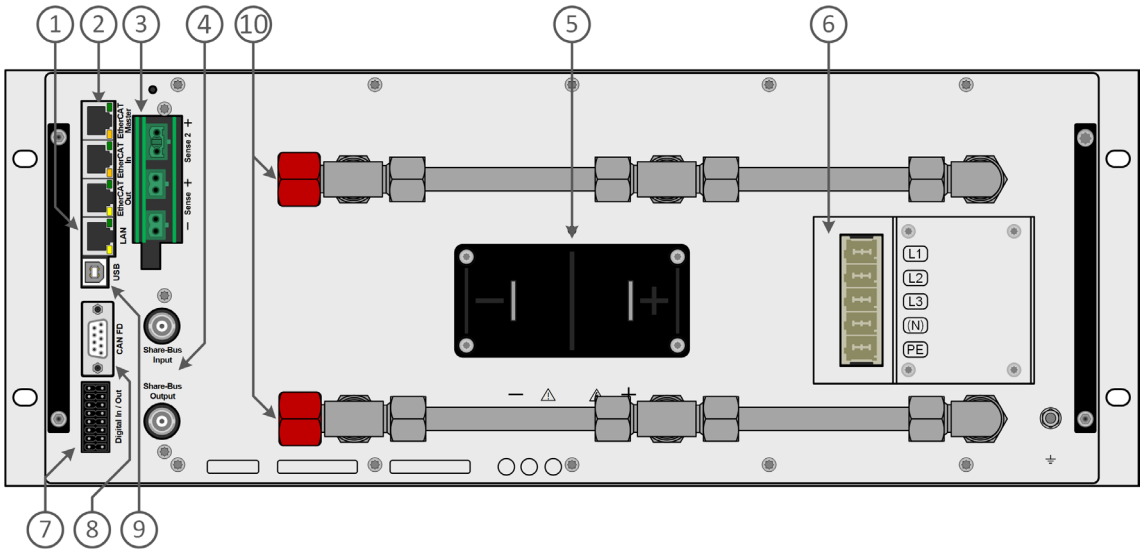
1. Ethernet port
2. EtherCAT ports
3. Remote sense connectors
4. Share-Bus connectors
5. DC terminal with copper blades
6. AC connector
7. Digital In / Out port (16-pin socket)
8. CAN FD interface
9. USB interface

4.4 Description front panel ELR 21000 4U WC (water cooling)



1. Mains switch
2. TFT display with touch-sensitive surface (touchscreen)
3. Rotary knob with touch function for settings
4. USB host for USB sticks for recording and reading data
5. Rotary knob with touch function for settings
6. On/off button with LED status indicator

4.5 Description back panel ELR 21000 4U WC (water cooling)



1. Ethernet port
2. EtherCAT ports
3. Remote sense connectors
4. Share-Bus connectors
5. DC terminal with copper blades
6. AC connector
7. Digital In / Out port (16-pin socket)
8. CAN FD interface
9. USB interface
10. Water connections

5. Control elements

5.1 Overview

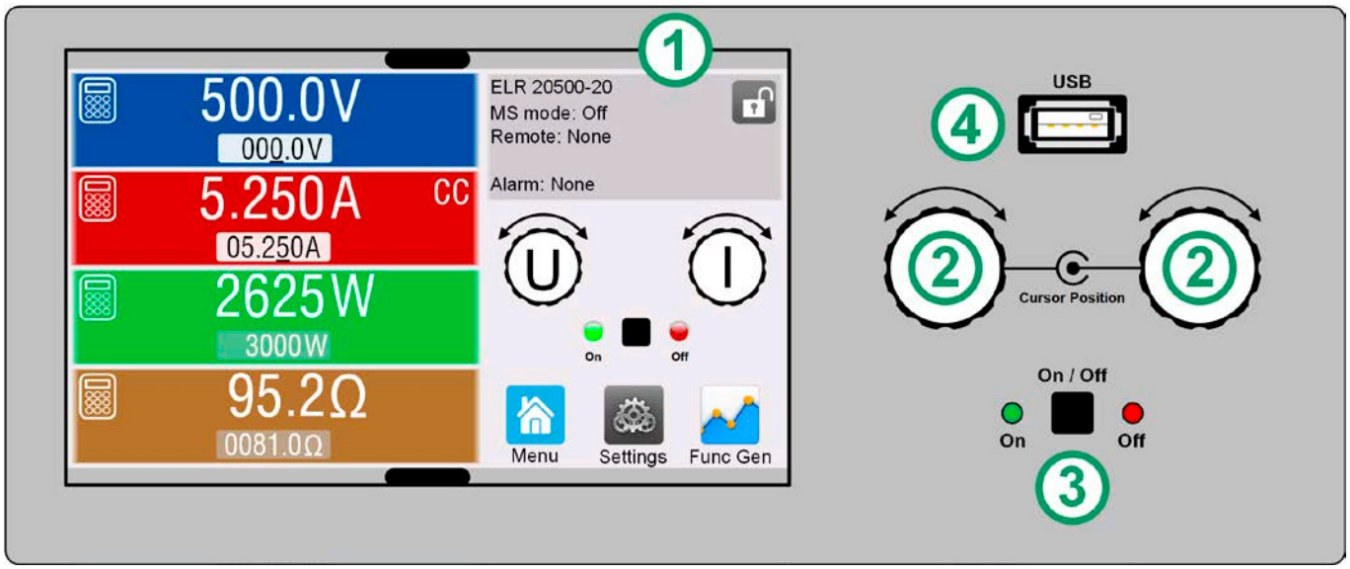


Figure 1 - Control panel

Overview of the control elements on the control panel

For further information, see section *«5.2 The control panel (HMI)»*.

(1)	**Display with touch-sensitive surface (touchscreen)** Used to select or enter set values, call up menus and display the actual values and status. The touchscreen can be operated with your fingers or with a pen (stylus).
(2)	**Rotary knobs with touch function** Left rotary knob (turn): Adjust the voltage set value Left rotary knob (push): Move the decimal place (cursor) of the voltage set value Right rotary knob (turn): Adjust the current or power set value Right rotary knob (press): Move the decimal place (cursor) of the assigned value
(3)	**Button for switching the DC terminal on and off** Used to switch the DC terminal on or off during manual operation and to start or stop a function. The two LEDs “On” and “Off” always indicate the status of the DC terminal, whether in manual mode or remote control mode. An exception for LED “On” and when it displays what is the so-called Active Idle mode, if activated. See *«2.2.1 Active idle mode»* in the user manual. Then the LED would also be on when the DC terminal is actually switched off.
(4)	**Slot for USB sticks** Used to hold commercially available USB sticks. See section *«5.2.5 USB port (front)»* for further information.

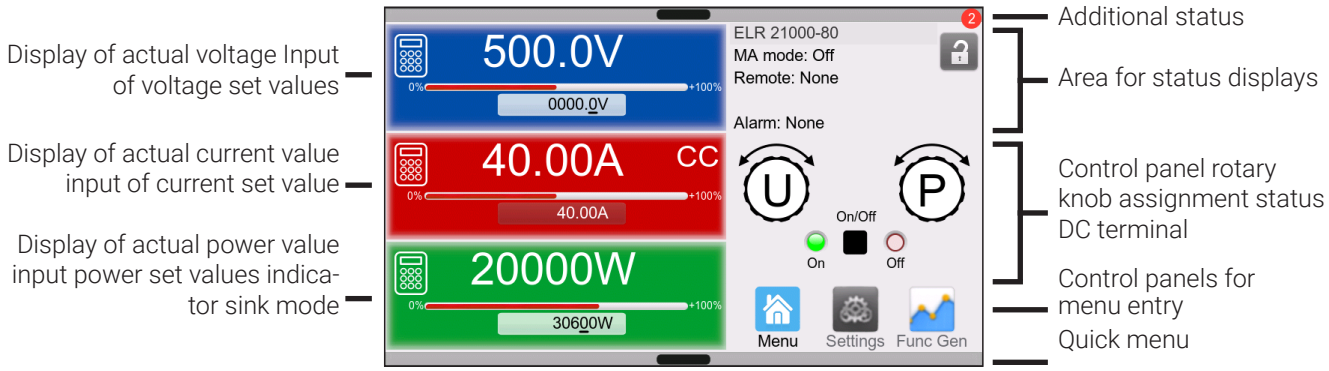
5.2 The control panel (HMI)

HMI stands for **H**uman **M**achine **I**nterface and consists of a display with a touch-sensitive surface (touchscreen), two rotary knobs, a button and a port for USB sticks.

5.2.1 Display with touchscreen

The graphic display with touchscreen is divided into several areas. The entire surface is touch-sensitive and can be operated with a finger or a suitable pen (stylus) to control the device.

In normal operation, actual and set values are displayed on the left side and status information on the right side:



Control panels can be locked or unlocked:

Menu *Text black = released* Func Gen *Text grayed out = control panel currently locked*

This applies to all control panels. Some may also contain a lock symbol. The lock symbol means that the connected function is permanently blocked, e.g. by a specific setting.

- **Set values/actual values range (left-hand section)**

In normal operation, the actual values (large numbers) and set values (small numbers) for voltage (blue background), current (red background) and power (green background) are displayed on the DC terminal.

In addition to the respective actual values, the current regulation mode **CV**, **CC** or **CP** is displayed when the DC terminal is switched on, as shown in the images above with **CC** as an example.

The set values can be adjusted using the rotary knobs to the right of the display or by direct input via the touchscreen, whereby the decimal point can be shifted by pressing the respective rotary knob when adjusting via the rotary knobs. The set values are each increased logically by 1 by turning to the right until they jump back to 0 after reaching the maximum value of 9. When turning clockwise, the set value decreases logically by one until it jumps back to 9 after reaching the minimum value of 0. When turning anti-clockwise, the adjustment works in the same way in the opposite direction.

General display and adjustment ranges:

Display value	Unit	Range	Description
Voltage actual value	V	0.2-125% U_{Nom}	Current value of the DC voltage
Voltage set value	V	0-102% U_{Nom}	Set value for limiting the DC voltage
Current actual value	A	0.2-125% I_{Nom}	Current value of the DC current
Current set values	A	0-102% I_{Nom}	Set value for limiting the DC current
Power actual value	W	0.2-125% P_{Nom}	Current value of the DC power according to P = U * I
Power set values	W, kW	0-125% P_{Nom}	Set value for limiting the DC power
Adjustment limits U/I/P	various	0-125% of the nominal value	U-max, I-min etc., always related to a set value
Protection settings	various	0-125% of the nominal value	OVP, OCP, OPP (related to U, I and P)

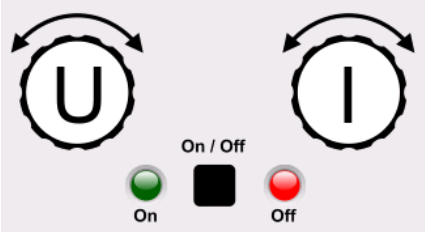
- **Status indicators (top right)**

This field displays various status texts and symbols:

Display	Description
	The HMI is locked
	The HMI is not locked
Remote control:	The device is remotely controlled by...
Ethernet	...the built-in Ethernet interface
EtherCAT	...the integrated EtherCAT auxiliary interface
CAN	...the built-in CAN interface
USB	...the built-in USB interface
Profinet	...the built-in Ethernet interface via Profinet
Local:	The device has been explicitly locked against remote control by user input
Alarm:	A device alarm has occurred that is still present or has not yet been acknowledged
Event:	A user-defined event has been triggered
MA mode: Master (n Aux)	Master-Auxiliary mode is enabled, device is master of n Aux units
MA mode: Auxiliary	Master-Auxiliary is enabled, device is Aux unit
FG:	Function generator enabled, function loaded (only in remote control)
	Data recording on USB stick is running or has failed

- **Field for assigning the rotary knobs and status of the DC terminal**

The two rotary knobs next to the display can be assigned to different control functions. This can be changed by tapping the field if the control panel is not locked.



The physical values on the buttons indicate the assignment. The left rotary knob is permanently assigned to the voltage (U). The right rotary knob can be switched by tapping the graphic on the touchscreen. Furthermore, the status of the DC terminal is indicated by the two LEDs (green = on).

The following rotary knob assignments are possible:

U I

Left rotary knob: Voltage
Right rotary knob: Power

U P

Left rotary knob: Voltage
Right rotary knob: Power

Since the device has two current and power set values, you can switch between the 4 set values by tapping repeatedly. The set values that are not currently selected cannot be adjusted using the rotary knobs until the assignment is changed again.

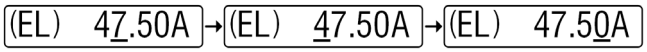
Alternatively, you can tap the set values for voltage, current or power to change the assignment or enter values directly using a numeric keypad. To do this, tap the small numeric keypad symbol (). **This input form enables set value jumps**.

5.2.2 Rotary knobs

As long as the device is operated manually, the two rotary knobs are used to set the set values in the main display. For a more detailed explanation of the individual functions, see *«7.3 Manual operation (1)»*.

5.2.3 Touch function of the rotary knobs

The rotary knobs have a push-button function that is used to move the cursor from lower to higher decimal positions (rotating) when adjusting values manually:



5.2.4 Resolution of the display values

Set values can be set in the display in defined increments. The number of decimal places depends on the device model. The values have 4 or 5 digits. Actual values and set values have the same number of digits.

Adjustment resolution and display width of the set values in the display:

Voltage, OVP, UVD, OVD, U-min, U-max		
Nominal value	**Digits**	**Min. increment**
≤80 V	4	0.01 V
200 V	5	0.01 V
360 V	4	0.1 V
500 V	4	0.1 V
920 V	4	0.1 V
≤1000 V	5	0.1 V

Current, OCP, UCD, OCD, I-min, I-max		
Nominal value*	**Digits**	**Min. increment**
<100 A	4	0.01 A
>100 A	4	0.1 A
1000 A	5	0.1 A
MA ≥3000 A	4	1 A
MA >10,000 A	5	1 A

Power, OPP, OPD, P-max		
Nominal value*	**Digits**	**Min. increment**
10000 W	5	1 W
30000 W	5	1 W
MA <100 kW	4	0.01 kW
MA >100 kW	4	0.1 kW
MA >1000 kW	4	1 kW

Ampere hours		
Value	**Digits**	**Min. increment**
Ah limit	5	0.01 Ah

* MA = Master Auxiliary

5.2.5 USB port (front)

The USB port on the front, which is located above the two rotary knobs, is used to accommodate standard USB sticks. These can be used, among other things, to load or save your own sequences for the arbitrary and XY function generators, as well as to record measurement data during operation.

USB 2.0 and USB 3.0 standard sticks are accepted, which must be formatted in **FAT32** . All supported files must be located in a folder called **HMI_FILES** in the main path of the USB drive, so that, for example, a path G:\HMI_FILES would result if the USB stick was connected to a PC and assigned the drive letter G:. Subfolders are permitted. If a folder contains files of a certain type, e.g. files beginning with "wave", the device will only ever list the first 20 that it can find.

The operating unit of the device can read the following file types and names from the USB stick:

File name	Description	Section in the user manual
wave_u<arbitrary>.csv wave_i<arbitrary>.csv	Function Generator arbitrary function for the voltage U or current I. The name must start with ***wave_u*** or ***wave_i*** , the rest is arbitrary.	*3.9.1*
profile_<arbitrary>.csv	Previously saved user profile. A maximum of 10 profiles are displayed for selection when loading.	*2.3.7*
iu<arbitrary>.csv	IU table for the XY function generator. The name must contain ***iu*** at the beginning, the rest is arbitrary.	*3.11*

The operating unit of the device can write the following file types and names to the USB stick:

File name	Description	Section in the user manual
usb_log_<nr>.csv	Recording file (log) for normal USB data recording in all operating modes. The structure of the log file is identical to that of the logging function in the EA Power Control software. The <nr> field in the file name is automatically incremented if there are already files with the same name in the folder.	*2.3.5*
profile_<nr>.csv	Saved user profile. The number at the end is a consecutive number (1-10) and is not linked to the number of a user profile in the HMI. A maximum of 10 profiles are displayed for selection when loading.	*2.3.7*
wave_u<nr>.csv wave_i<nr>.csv	Data of the 99 interpolation points (sequences) of the arbitrary function for voltage U or current I.	*3.9.1*

5.3 USB port (rear)

The USB port on the back of the device is used only for communication with the device. The device can be connected to a PC using the USB cable supplied (USB 2.0, USB 3.0). The driver is supplied and installs a virtual COM port. Details on remote control can be found in further documentation on the USB stick supplied or on the device manufacturer's website.

The device can be addressed via this port either via the internationally standardized ModBus RTU protocol or via SCPI language. It automatically recognizes the protocol used in a message.

If the remote control is to be enabled, the USB interface has no priority over one of the other remote control interfaces and can therefore only be used alternately with these. However, monitoring is always possible.

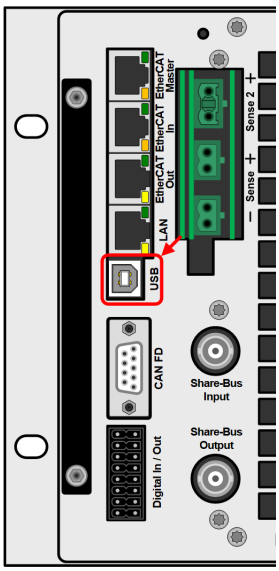


Figure 2 - USB

5.4 CAN FD port (rear)

This 9-pin Sub-D connector with the standard pin layout for CAN offers CAN 2.0 A&B and CAN FD functionality. The standard operating mode is CAN. However, the mode can be switched to CAN FD via a setting in the menu or via a remote control command, or the bit rate switching (BRS) associated with CAN FD can be activated.

In **CAN** mode, the port supports the common baud rates from 10 kbit/s to 1 Mbit/s, as well as 11- or 29-bit ID formats.

In **CAN FD** mode, two additional data rates of 2 Mbit/s and 5 Mbit/s are added, both of which are linked to a 500 kbit/s bus baud rate.

The port also includes an electronically switchable bus termination resistor of 120 Ω, which is controlled via a setting in the menu.

If the remote control is to be enabled, the CAN interface has no priority over one of the other remote control interfaces and can therefore only be used alternately with the others. However, monitoring is always possible.

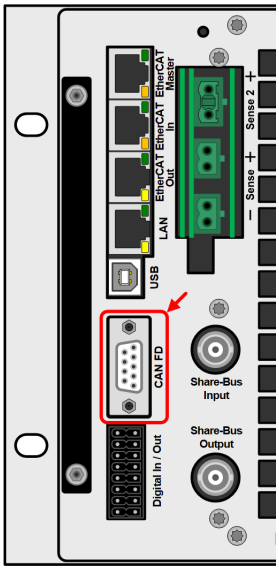


Figure 3 - CAN FD

5.5 Share-Bus connection (rear)

On the rear of the device there are two BNC sockets (50 Ω type) for the digital Share-Bus. This Share -Bus is bidirectional and, when several devices are connected in parallel, connects the master device via “Share-Bus Output” to the next device at its “Share-Bus Input” and then to the next one, and so on. BNC cables of the appropriate length can be purchased from electronics retailers.

For a device from the ELR 21000 series, only other identical models can be used as subordinate units (auxiliary). Devices from the 10000 series are not compatible because the Master-Auxiliary bus used here is technically different.

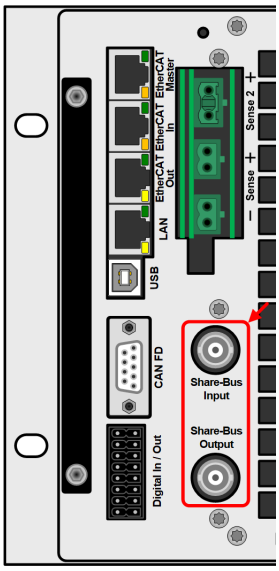


Figure 4 - Share-Bus

5.6 Sense connections, remote sensing (rear)

To compensate for the voltage drop across the lines from the source or to the load, the input can be connected to the external source or load with two double plugs, one for positive and one for negative (included in delivery), using the polarity indicator **Sense**.

If the device is connected correctly and while the DC terminal is switched on, the device will measure the voltage to be regulated at the **Sense** input. The maximum possible regulation is specified in the technical data.

DANGER

Electrical voltage

For safety reasons, the covers supplied for the sense connections must always be fitted during operation if cables are connected to the sense input. Reason: these remote sensor cables can carry dangerously high voltages!

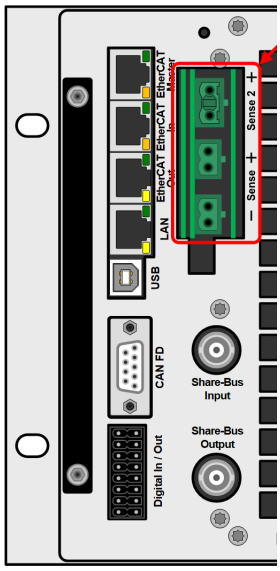


Figure 5 - Remote sense

5.7 EtherCAT ports (rear)

All models in this series have three EtherCAT connections on the rear. The connection, referred to as **Master,** is used exclusively to control other units, called the **Master-Auxiliary-System** (**MA** for short). The subordinate devices (auxiliary, Aux for short), are controlled and monitored by the master via this connection, which then calculates the sum of the actual values and summarizes the status, displays this on its screen and outputs it to its digital interfaces.

The user can enable or disable MA mode on the master or the aux units as required.

The EtherCAT ports, labeled **EtherCAT In** and **EtherCAT Out,** offer the typical functionality of an EtherCAT slave. A single device or a master of an MA system would be remotely controlled via these ports if part of a higher-level EtherCAT network.

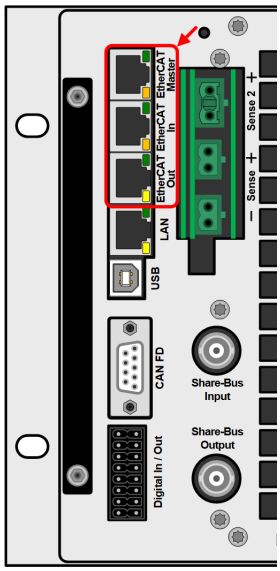


Figure 6 - EtherCAT

5.8 Ethernet port (rear)

The Ethernet/LAN port (type: RJ45) on the rear of the device is used for communication with the device for remote control or monitoring purposes, as well as for firmware updates. It supports the internationally standardized ModBus RTU protocol as well as SCPI and ModBus TCP, in this case via the dedicated socket port 502.

The network parameters can be configured manually or via DHCP. Transmission speed (10/100/1000 MBit/s) and duplex mode are set automatically, independent of DHCP.

If remote control is to be enabled, the Ethernet interface has no priority over one of the other remote control interfaces and can therefore only be used alternately with these. However, monitoring is always possible.

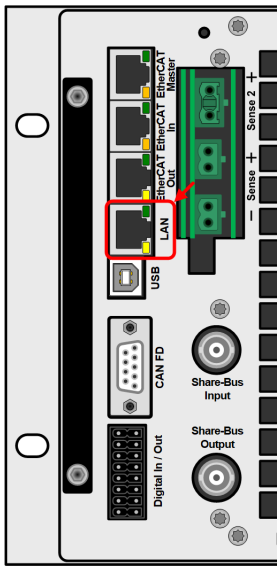


Figure 7 - LAN

5.9 Digital In / Out port (rear)

This connection is used to record and control various signals.

A suitable plug is included in the scope of delivery.

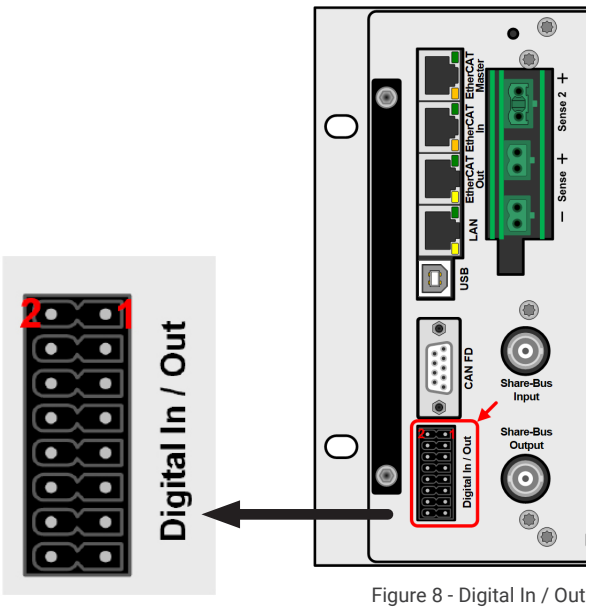


Figure 8 - Digital In / Out

5.9.1 Technical data of the "Digital In / Out" port

Pin	Name	Type	Description	Electrical properties
1	**DI1**	Input	Universal, digital input 1	Nominal voltage: 24 V DC Logical high: 15...35 V DC Logical low: 0...5 V DC
2	**DI1_GND**	Potential	Reference potential for the digital input DI1	
3	**DI2**	Input	Universal, digital input 2	
4	**DI2_GND**	Potential	Reference potential for the digital input DI2	
5	**DI3**	Input	Universal, digital input 3	
6	**DI3_GND**	Potential	Reference potential for the digital input DI3	
7	**REL1_1**	Contact	Potential-free normally open contact of relay 1	Switching voltage: 24 V DC Continuous switching current: 2 A Switching cycles: 100,000
8	**REL1_2**	Contact		
9	**REL2_1**	Contact	Potential-free normally open contact of relay 2 unused	
10	**REL2_2**	Contact		
11	**REL3_1**	Contact	Potential-free normally open contact of relay 3 unused	
12	**REL3_2**	Contact		
13	**TEMP1**	Input	Temperature sensor input. Supported sensor type: Analog Devices DS18B20, MAX31820. Reference: TGND	1-wire supply: 3.3 V DC Logical high: 1.9...3.3 V DC Logical low: 0...0.9 V DC Temperature range: -55...+125°C
14	**TGND**	Potential	Reference potential for TEMP1, TEMP2 and TEMP3	
15	**TEMP3**	Input	Temperature sensor input, unused. Supported sensor type: Analog Devices DS18B20, MAX31820. Reference: TGND	
16	**TEMP2**	Input	Temperature sensor input, unused. Supported sensor type: Analog Devices DS18B20, MAX31820. Reference: TGND	

A **plug** is included with the device. Follow the manufacturer's instructions for installation.

Order designation: Phoenix Contact DFMC 1.5/ 8-ST-3.5

Maximum conductor cross-section: 1.5 mm²

5.10 Water cooling

In contrast to the air-cooled version of the models in this series, water cooling is an optional cooling alternative that is permanently installed during production and therefore cannot be retrofitted. Cooling the device with water instead of air has the following advantages:

- Less noise due to a closed housing
- No direct heat emission into the surroundings of the device

The following are disadvantages compared to conventional air cooling:

- The device must not be operated without a constant water supply
- Water poses an increased risk of damage to the electronics, e.g. due to leaks or condensation in the device caused by humidity (condensation)

The water connection is located on the rear of the device; see also the diagram in section *4*. For more information on the connection, specifications and operation of the water cooling system, refer to section *«6.3.4 Connecting the water supply (WC models)»*.

6. Installation and commissioning

6.1 Transport and storage

6.1.1 Transport

- The handles on the front and rear of the device are **not** for carrying!
- Due to its heavy weight, the device should not be transported by hand if possible or, if transport by hand is unavoidable, it should only be held by the housing and not by the attachments (handles, DC terminal, rotary knobs).
- Do not transport the device when it is switched on or connected!
- If the device is moved to another location, we recommend using the original transport packaging.
- The device should always be set up or carried horizontally.
- If possible, wear suitable protective clothing, especially safety shoes, when carrying the device, as the sometimes heavy weight can cause serious injuries if you fall.

6.1.2 Packaging

It is recommended that the complete transport packaging (delivery packaging) is kept for the lifetime of the device so that it can be reused for subsequent transport of the device to another location or return of the device to the manufacturer for repair. Otherwise, the packaging must be disposed of in an environmentally friendly manner.

6.1.3 Storage

For longer storage of the device when not in use, we recommend using the transport packaging or similar packaging. The device must be stored in dry rooms and packed as airtight as possible to prevent corrosion caused by humidity, especially inside the device.

6.2 Unpacking and visual inspection

After each transport with or without transport packaging or before initial installation, the device must be inspected for visible damage and completeness of the delivery. To do this, compare the delivery with the delivery note and the scope of delivery (see section *«3.3 Scope of delivery»*). An obviously damaged device (e.g. loose parts inside, external damage) must not be put into operation under any circumstances.

6.3 Installation

6.3.1 Safety measures before installation and use

- The device has a considerable weight. Therefore, before setting up the device, make sure that the installation location (cabinet, shelf, 19" rack) can bear the weight of the device without restrictions.
- When installing in a 19" cabinet, mounting rails suitable for the housing width and weight (see *«10. Technical data»*) must be installed.
- Before connecting the device to the AC power supply, ensure that the connection data specified on the device's rating plate is observed. Overvoltage at the AC connection can damage the device.
- The device includes an energy recovery function that feeds energy back into the local or public grid, similar to a solar system. Feeding back into the public grid must not take place without observing the applicable guidelines of the local energy supplier and, if necessary, it must be checked before installation, but at the latest before commissioning, whether so-called grid and system protection must be installed!

6.3.2 Preparation

6.3.2.1 Choice of connection cable

A fixed connection is provided for all models in this series, for which there is a 5-pin connection on the rear of the device. A suitable, touch-safe plug is included in the scope of delivery. At least one 4-pole (3x L, PE) supply cable with an appropriate cross-section and length must be provided for wiring the plug. A full assignment with an additional N conductor is permissible.

For recommendations on the cross-section, see *«6.3.5 Connecting to the mains supply (AC)»*. There are several things to consider when dimensioning the DC cables to match the load:

- The cross-section of the cables should always be designed for at least the maximum current of the device.
- Continuous current loading of the cables at the permissible limit generates heat that may have to be dissipated, as well as a voltage drop that depends on the cable length and the heating of the cable. To compensate for this, the cross-section must be increased or the cable length reduced.

6.3.2.2 Additional measures for feeding devices

All models in this series function as so-called mains regenerative devices when they are operating in sink mode.

With regenerative devices, energy is fed into the local grid or the grid operator's grid, otherwise sink operation is not possible. If the energy fed back into the grid exceeds local demand, the surplus is fed into the public grid. Without prior consultation with the local energy supplier, this feed-back may be unauthorized under certain circumstances.

Under certain circumstances, it may be useful to monitor the grid connection for grid irregularities (e.g. deviations in grid voltage, grid frequency) using a special safety module (network and system protection, for short: NS). This can also prevent so-called "isolated operation". It refers to a self-sufficient energy system that operates without a connection to the public power grid. This is conceivable if an upstream circuit breaker or fuse trips.

Concept of NS protection:

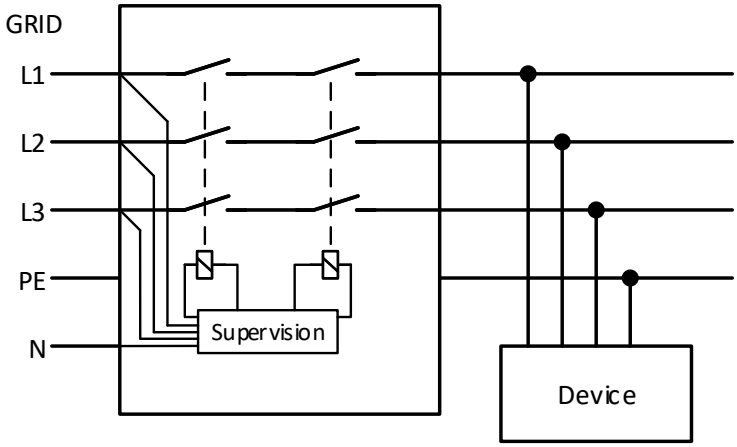
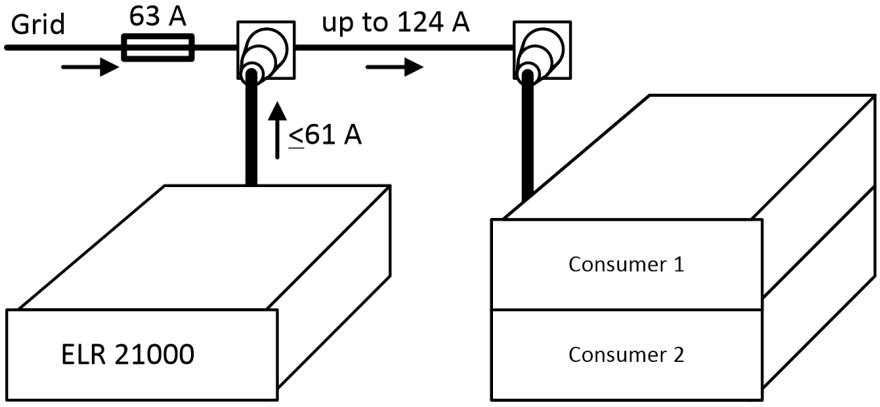


Figure 9 - Principle of an NS protection network

6.3.2.3 System protection for regenerative power supply

An ELR 21000 feeds the energy back into the local grid at the installation site in sink mode. The regenerative current of a ELR 21000 can add to the current fed in from the power supply network and this could overload the existing electrical installation. The connection concept on site must therefore be considered accordingly to avoid damage and accidents.

Illustration with a regenerative device and loads:



With a larger number of regenerative devices on the same line of the installation, the total current per phase increases accordingly.

6.3.3 Setting up the device

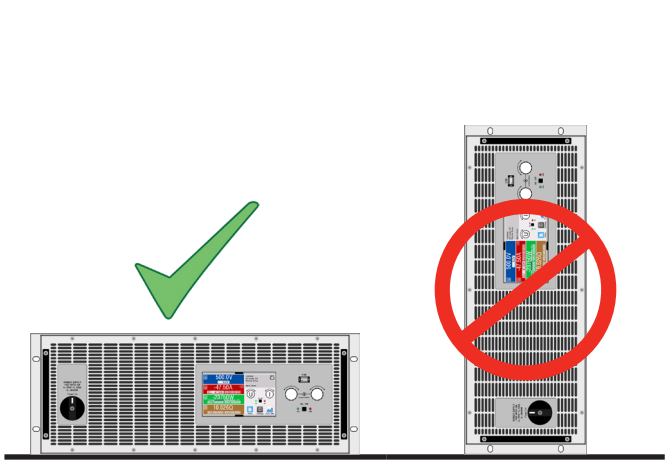
- Select the installation location so that the supply lines to the load or source can be kept as short as possible.
- Leave sufficient space behind the device, but at least 30 cm, for the exhaust air to escape from the rear (standard version, air-cooled).
- The device must not be operated without adequate, double contact protection for the AC plug, which can only be achieved either by installing it in a cabinet with lockable doors or by installing additional protective measures (covers or similar) that are not supplied with the device.

All models in this series require fixed installation in a suitable device (cabinet, etc.) and a fixed connection (AC). Operation on a table is not permitted.

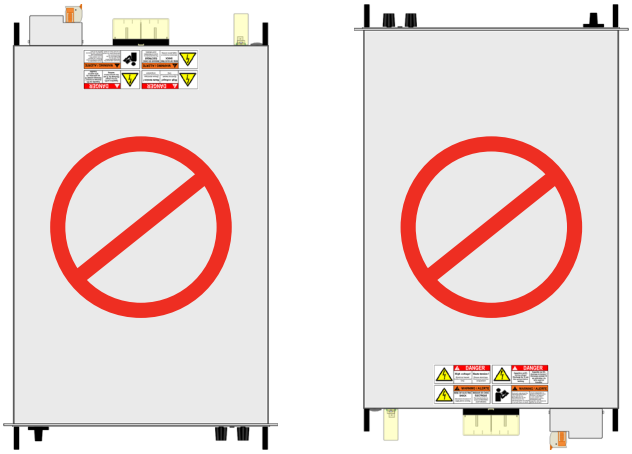
A device in 19" design is usually installed on corresponding mounting rails and in 19" racks or cabinets. Attention must be paid to the installation depth of the device and its weight. The handles on the front are used to push the cupboard in and pull it out. Slotted holes on the front panel are used for mounting in the 19" cabinet (mounting screws not included).

The unauthorised installation positions shown below also refer to installation on a vertical surface, such as a wall (room or in a cabinet). The necessary air flow is then not guaranteed.

Permitted and unauthorised installation positions (with or without water cooling, air cooling is shown):



Floor space



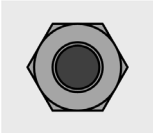
Wall

6.3.4 Connecting the water supply (WC models)

If present, the water cooling system and all other associated measures should be connected before the device is even connected to AC, let alone switched on. Correct connection, **leak test** and subsequent operation of the device with running water cooling are the responsibility of the operator or user.

6.3.4.1 Connection point

The device has three separate internal power levels, each with its own cooling coil, which are led out at the rear and connected to each other on the outside. The water flows through the three cooling coils one after the other. There are two connections on the outside for the inlet and outlet:



Connection: 10 mm hose, M19 nut

You are free to choose which of these is the outlet and which is the inlet. The only important thing for the operation of the device later on is that water flows through the heat sinks in sufficient quantities and at a certain inlet temperature.

The hose is connected either directly to the T or end piece or via an elbow fitting with hose nozzle, e.g. type Schwer Fittings SA-DKL90, which already has a metallic seal (24° internal cone). Only the outer diameter of 9 or max. 10 mm is important for the hose itself.

6.3.4.2 Operation and monitoring

For later operation, the so-called **dew point** must be taken into account, especially with regard to the flow temperature of the water. The cooled water at the inlet, together with the humidity of the air in the device, can cause water to condense in the device, which must be avoided at all costs. This means that it should be possible to regulate the flow temperature in order to adapt it to the environment. Ideally, this is done via an electronic control system that works with a humidity meter and temperature sensors and monitors and regulates the flow temperature.

The dew point is defined in the DIN 4108 standard using a table. This specifies the minimum flow temperature of the water in °C at a certain humidity and ambient temperature:

Surroundings	Relative humidity in per cent										
	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
14°C	2.2	3.76	5.1	6.4	7.58	8.67	9.7	10.71	11.64	12.55	13.36
15°C	3.12	4.65	6.07	7.36	8.52	9.63	10.7	11.69	12.62	13.52	14.42
16°C	4.07	5.59	6.98	8.29	9.47	10.61	11.68	12.66	13.63	14.58	15.54
17°C	5	6.48	7.92	9.18	10.39	11.48	12.54	13.57	14.5	15.36	16.19
18°C	5.9	7.43	8.83	10.12	11.33	12.44	13.48	14.56	15.41	16.31	17.25
19°C	6.8	8.33	9.75	11.09	12.26	13.37	14.49	15.47	16.4	17.37	18.22
20°C	7.73	9.3	10.72	12	13.22	14.4	15.48	16.46	17.44	18.36	19.18
21°C	8.6	10.22	11.59	12.92	14.21	15.36	16.4	17.44	18.41	19.27	20.19
22°C	9.54	11.16	12.52	13.89	15.19	16.27	17.41	18.42	19.39	20.28	21.22
23°C	10.44	12.02	13.47	14.87	16.04	17.29	18.37	19.37	20.37	21.34	22.23
24°C	11.34	12.93	14.44	15.73	17.06	18.21	19.22	20.33	21.37	22.32	23.18
25°C	12.2	13.83	15.37	16.69	17.99	19.11	20.24	21.35	22.27	23.3	24.22
26°C	13.15	14.84	16.26	17.67	18.9	20.09	21.29	22.32	23.32	24.31	25.16
27°C	14.08	15.68	17.24	18.57	19.83	21.11	22.23	23.31	24.32	25.22	26.1
28°C	14.96	16.61	18.14	19.38	20.86	22.07	23.18	24.28	25.25	26.2	27.18
29°C	15.85	17.58	19.04	20.48	21.83	22.97	24.2	25.23	26.21	27.26	28.18
30°C	16.79	18.44	19.96	21.44	23.71	23.94	25.11	26.1	27.21	28.19	29.09
32°C	18.62	20.28	21.9	23.26	24.65	25.79	27.08	28.24	29.23	30.16	31.17
34°C	20.42	22.19	23.77	25.19	26.54	27.85	28.94	30.09	31.19	32.13	33.11
36°C	22.23	24.08	25.5	27	28.41	29.65	30.88	31.97	33.05	34.23	35.06
38°C	23.97	25.74	27.44	28.87	30.31	31.62	32.78	33.96	35.01	36.05	37.03
40°C	25.79	27.66	29.22	30.81	32.16	33.48	34.69	35.86	36.98	38.05	39.11
45°C	30.29	32.17	33.86	35.38	36.85	38.24	39.54	40.74	41.87	42.97	44.03
50°C	34.76	36.63	38.46	40.09	41.58	42.99	44.33	45.55	46.75	47.9	48.98

6.3.4.3 Notes

- The water flow should always be started before the device is switched on, but at the latest before the DC terminal is switched on.

6.3.5 Connecting to the mains supply (AC)

- The device must be permanently connected to an AC distribution board. The connection must only be made by appropriately trained personnel!
- In addition, the device may only be operated directly from a mains supply, but not from generators or UPS systems!
- AC connection cables must be dimensioned according to the maximum AC current of the device! See section *«6.3.5.2 Cross-sections»*.
- The device must be externally fused on the AC side in accordance with standard EN 61010-1, taking into account the maximum AC current and the cross-section of the AC connection cable.
- Ensure that all regulations for the operation and connection of a device that feeds back into a (public) power grid have been observed and that all necessary measures have been taken!
- WC models: For safety reasons, we recommend installing a 30 mA RCD.

The ELR 21000 is suitable for operation from 380V - 480V AC ±10%.

6.3.5.1 AC Connection

The nominal voltages specified on the type plate are decisive, regardless of the variant or hardware revision. The devices require a three-phase main connection without an N conductor:

DC nominal power	Pins on the AC plug	Connection type	Circuit
37.5 kW	L1, L2, L3, (N), PE	Three-phase current (3P)	Triangle

PE is mandatory and must always be connected to the AC plug!

6.3.5.2 Cross-sections

The maximum AC current and the intended length of the connecting cable are decisive for the dimensioning of the cross-section of the connecting cables. Based on the connection of a **single device**, the table specifies the maximum input current of the device on each phase and the recommended minimum cross-section per conductor:

	L1		L2		L3		PE (1
Available nominal power	**ø**	**I_{max}**	**ø**	**I_{max}**	**ø**	**I_{max}**	**ø**
37.5 kW at 380-480V AC ±10%	≥10 mm²	61 A	≥10 mm²	61 A	≥10 mm²	61 A	≥10 mm²

6.3.5.3 Connecting plug & connecting cable

The supplied connector plug can accommodate cable ends up to 25 mm². The longer the connecting cable, the higher the voltage drop due to the cable resistance. Therefore, the mains cable should always be kept as short as possible. 4- or 5-core cables are permitted. In the case of a cable with an N conductor, this can be fixed in the free pin of the AC plug. Nominal data of the connector plug:

- Max. conductor cross-section without ferrule: 25 mm²
- Max. conductor cross-section with ferrule: 16 mm²
- Stripping length without ferrule: 18-20 mm

1) Applies to both conductors, the PE conductor in the AC connection cable and the separate PE conductor for the housing earthing

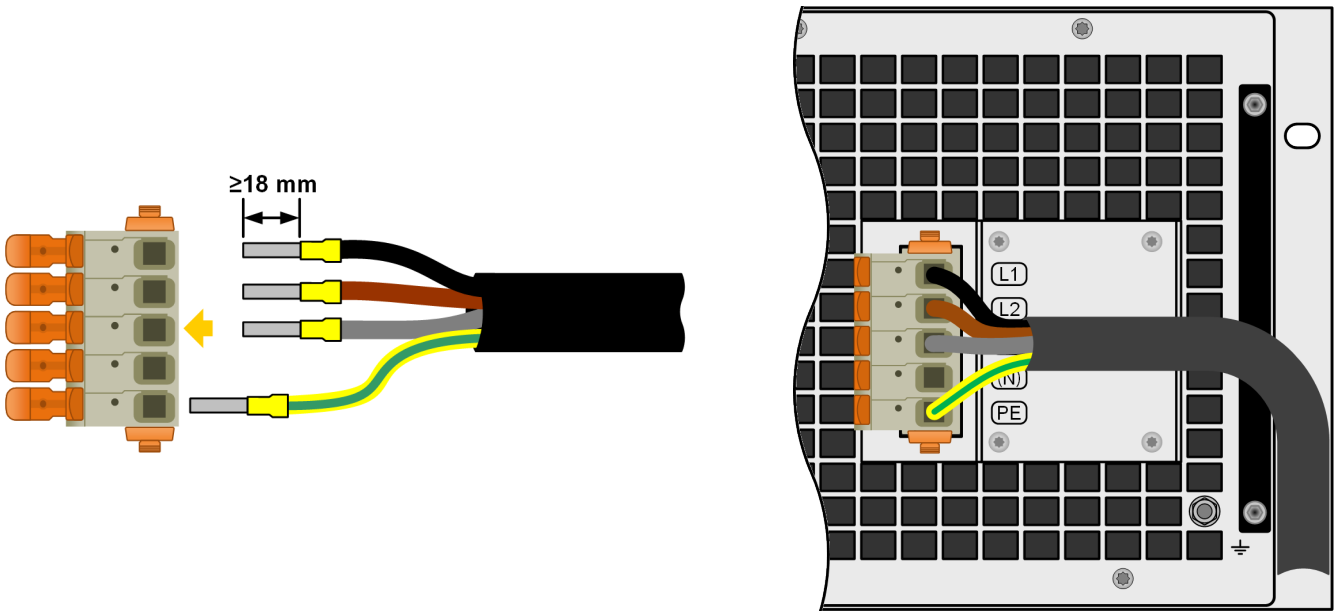


Figure 10 - Example of a mains connection cable with 4 cores (not included in the scope of delivery)

6.3.5.4 Attaching strain relief

All models and variants are supplied with a mechanical strain relief for the AC cable, which should be fitted by the installer of the device if no other measures are provided for strain relief of this cable at the installation site. Installation steps:

1. Loosen the two screws on the right side of the AC filter, as marked in *Figure 11*.
2. Attach the mounting bracket and secure it with the longer screws (M3x8) and washers provided. See *Figure 12*.
3. Plug in the AC cable and, viewed from the rear, guide it past the mounting bracket and secure it with at least one, but preferably both, of the cable ties supplied.

The mounting bracket and the cable ties can remain permanently connected. If the device needs to be removed from the installation (cabinet), the procedure for removing the plug and the strain relief is the other way round.

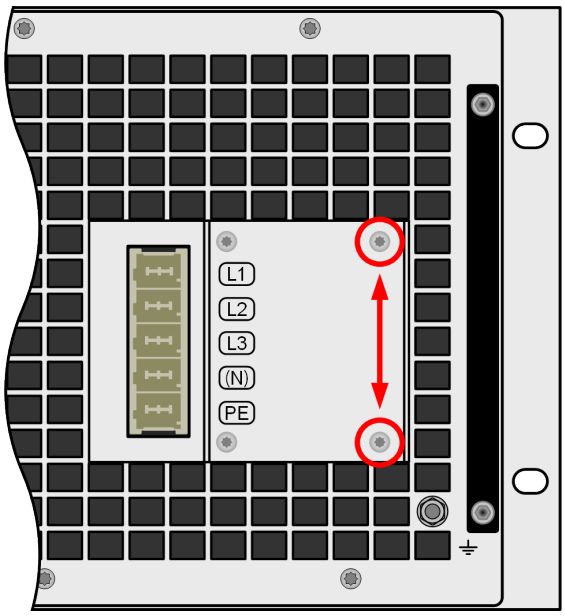


Figure 11 - Mounting position of the mounting bracket

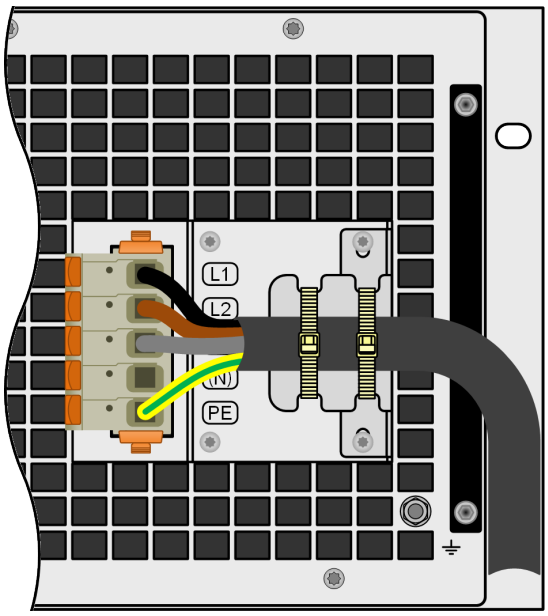


Figure 12 - Pre-assembled strain relief

6.3.5.5 Enclosure earthing

All devices in this series have an earthing point on the back of the housing, as shown on the right. It is located at the bottom right of the back panel when viewed from behind.

The housing can be earthed separately, mainly to minimize the leakage current for personal protection. This means that a separately laid protective earth conductor (PE) can be connected to the earthing point if required. The cross-section should be at least the same as in the AC connection cable.

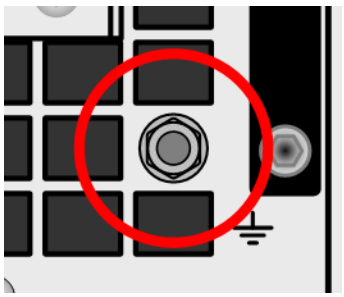


Figure 13 - Earthing point

6.3.6 Connecting DC sources

- In the case of a device with a high DC nominal current and correspondingly thick and heavy DC terminal cables, the weight of the cables and the mechanical load on the DC terminal must be taken into account and strain relief must be provided, especially if the device is installed in a 19" cabinet or similar, where the cables may hang from the DC terminal.
- In addition to the appropriate cross-section of the DC cables, attention must also be paid to the appropriate dielectric strength.

No reverse polarity protection available! Sources connected with reverse polarity will damage the device, even if it is not switched on!

An external source charges the internal capacities available at the DC terminal, even if the device is not switched on. Hazardous voltages may still be present here even after disconnection from the external source!

The DC terminal is located on the back of the device and is **not protected** by a fuse. The cross-section of the supply cables depends on the current consumption, the cable length and the ambient temperature.

For load cables **up to 5 m** and average ambient temperatures up to **30°C** we recommend:

Up to **40 A**: 6 mm²

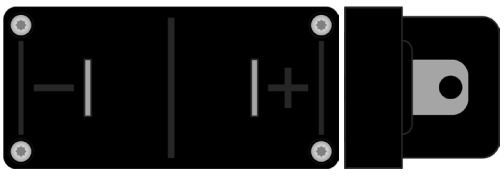
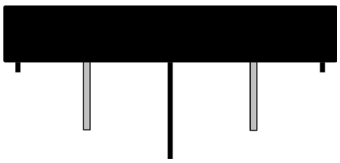
Up to **60 A**: 16 mm²

Up to **80 A**: 25 mm²

per connection pole (multi-core, insulated, freely laid) must be used as a minimum. Individual cables, e.g. 70 mm², can be replaced by 2x 35 mm², etc. For longer load cables, the cross-section must be increased accordingly to avoid a voltage drop across the cables and unnecessary heating.

6.3.6.1 Connection terminal types

The table below contains an overview of the different DC terminal types. Flexible cables with ring cable lugs are always recommended for connecting load cables.

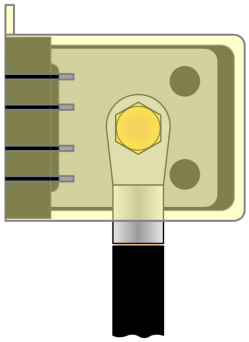
1000 V Model

M6 screw connection to metal rail Recommendation: Ring cable lugs with 6.5 mm hole


6.3.6.2 Protective covers

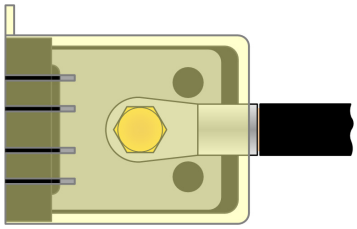
A plastic cover for the DC terminal is supplied, to protect against accidental contact. It must always be installed on the device. There are cut-outs in the covers (top, bottom, front) that can be broken out as required in order to lay supply lines from different directions.

The connection angle and the required bending radius for the DC supply cables must be taken into account when planning the overall depth of the device, especially when installing it in 19" cabinets and similar structures.

Examples based on connection terminal type 1:



- 90° upwards or downwards
- Space-saving depth
- no bending radius

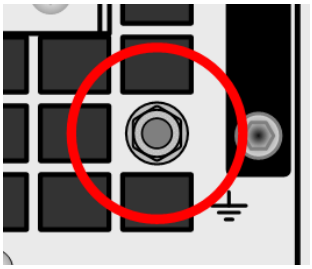


- Horizontal feed
- Space-saving height
- large bending radius

6.3.7 Earthing the DC terminal

The earthing connection point, as shown on the right in the illustration, is used to earth one of the two DC terminal poles in addition to earthing the housing. This is generally permissible, but please note that this always results in a potential shift of the other pole in relation to PE. For insulation reasons, however, only certain model-dependent potential shifts are permitted at the DC negative pole. See *«10.3 Specific technical data»*.

Both poles of a DC terminal are also potential-free, which provides basic protection in terms of contact safety. This is canceled as soon as a DC pole is earthed.



In the event that a DC pole has been earthed, the user must personally ensure the basic protection for contact safety for persons, e.g. by fitting suitable covers wherever the potential of the DC terminal has been connected.

6.3.8 Connecting the remote sensor

6.3.8.1 Remote sensing for voltage compensation

- *It is not recommended to use Remote sensing in HS ELR applications.*
- *Remote sensing is primarily effective in constant voltage mode (CV).*
- *The cross-section of cables for remote sensing is not critical. Recommendation for cable lengths up to 5 m: 0.5 mm².*
- *The remote sensing cables should not be twisted together, but should be laid close to the DC cables. So lay the cable to Sense (-) close to the cable to DC (-) in order to suppress the tendency to oscillate. If oscillation still occurs, an additional capacitor can be fitted either at the load/source or at the channel DC terminal to suppress the tendency to oscillate, depending on the best result.*
- *(+) Sense may only be connected to the (+) of the load/source and (-) Sense only to the (-) of the load/source. Otherwise both systems may be damaged. See Figure 14.*
- *Always ensure that the cables for remote sensing are able to withstand the voltage!*

"Simple" remote sensing is used to compensate for voltage losses via the load line. It will be connected to **Sense -** and to **Sense +**, as shown below.

DANGER

Dangerous voltage possible at the Sense connection!

The Sense terminal cover must always be installed.

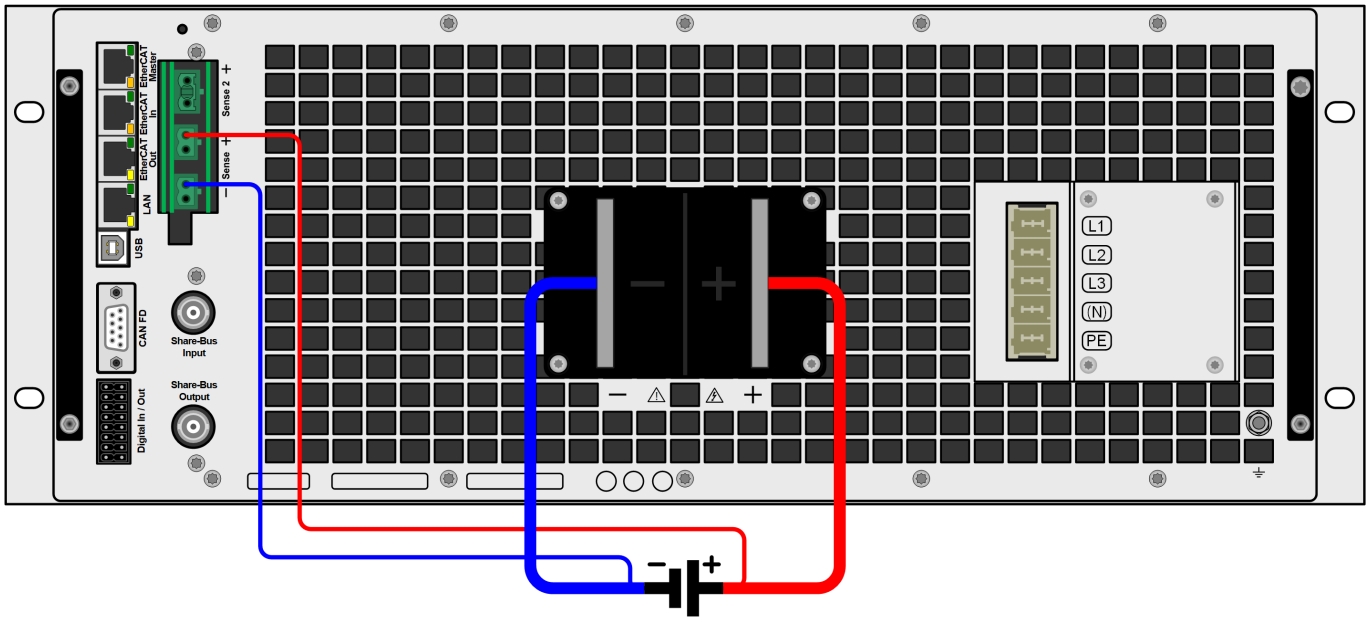
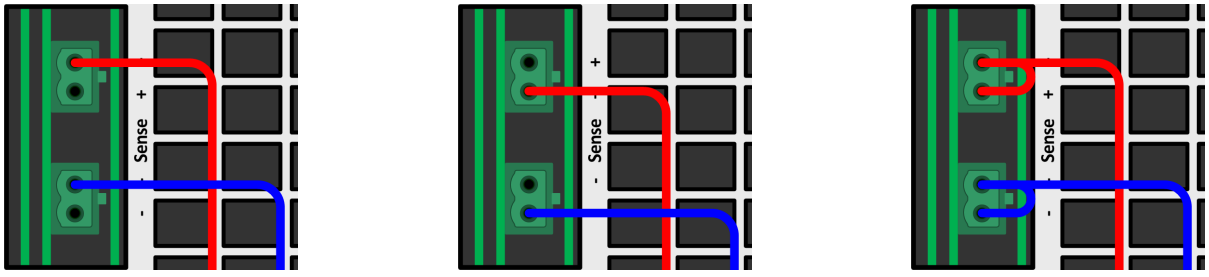


Figure 14 - Example of sense wiring (DC and sense covers omitted for illustrative purposes)

Permissible connection forms:



6.3.9 Connecting the Share-Bus

The “Share-Bus” terminals (type BNC, 2x available) located on the rear of the device are used to connect additional devices to the Share-Bus connection in order to achieve current balancing and fast equalization between the devices during parallel operation, especially when using function generators (sine waves, etc.). Information on parallel operation can be found in section *«4.1 Parallel connection as master-auxiliary system»* in the user manual.

6.3.10 Connecting the USB port (rear)

To be able to control the device remotely via this connection, connect the device and PC using the USB cable supplied and switch on the device if it is still switched off.

6.3.10.1 Driver installation (Windows)

When connecting to the PC for the very first time, the operating system should recognize the device as new and want to install a driver. The driver is of the Communications Device Class (CDC) type and is normally integrated in current operating systems such as Windows 10 or 11. However, we recommend installing the driver supplied on the USB stick to ensure the best possible compatibility of the device with our software.

6.3.10.2 Driver installation (Linux, MacOS)

We cannot provide drivers or installation instructions for these operating systems. The user can find out whether and how a suitable driver is available by searching the Internet.

6.3.10.3 Driver alternatives

If the CDC driver described above is not available on your system or does not work properly for some reason, commercial providers can help. Search and find various providers on the Internet with the keywords “cdc driver windows” or “cdc driver linux” or “cdc driver macos”.

6.3.11 Connecting the CAN FD port

To be able to control the device remotely via this connection, connect any CAN FD-capable CAN adapter, ideally with a D-Sub 9-pin connection, to the device using a standard 1:1 D-Sub cable. An external bus terminating resistor is not required as an electronically switchable one is installed.

6.3.12 Initial commissioning

Additional measures must be taken when commissioning the device for the very first time and during initial installation:

- Check that the connection cables you are using for AC and DC have a sufficient cross-section!
- Check the settings for set values, safety and monitoring functions and communication to ensure that they are suitable for the planned application and adjust them according to the instructions if necessary!
- When controlling the device remotely via PC, also read the available documentation on interfaces and software!

6.3.13 Recommissioning after firmware updates or longer periods of non-use

When recommissioning after a firmware update, recovering the device after a repair or after changing the position or configuration of the device’s environment, similar measures must be taken as for initial commissioning. See *«6.3.12 Initial commissioning»*.

Only after the device has been successfully checked in accordance with the listed points may it be put into operation as usual.

6.3.14 Disposal of the device

According to European laws and regulations (ElektroG, WEEE), a device that is intended for disposal must be taken back and disposed of by the manufacturer, unless the operator of the appliance or a person authorized by him does this himself. Our devices are subject to these regulations and are labeled accordingly with this symbol:

The device contains a lithium battery. They are disposed of in accordance with the above specifications or in accordance with separate, local regulations.

7. Operation and use (1)

7.1 Terms

The device is a electronic load.

- **Sink / Sink mode / Sink mode**
  - The device operates as an electronic load and draws DC energy from an external DC source.
  - In this operating mode, the DC terminal is regarded as a DC-input.

7.2 Important notes

7.2.1 Personal protection

- To ensure safety when using the device, it may only be operated by persons who have been instructed in the necessary safety measures for handling dangerous electrical voltages.
- Always fit the supplied cover for the DC terminal or a similar, sufficiently safe cover for devices that can generate a voltage that is dangerous to touch or are connected to it.

7.2.2 General

- Idle mode, i.e. operation of the device in ELR mode without any DC input, is not a normal operating mode to be considered and can lead to incorrect measurement results.
- It is recommended that the device is not operated below 10% voltage and current so that the technical data such as ripple and stabilization times can be maintained.

7.3 Manual operation (1)

With manual operation and if the device is connected to a controlling unit (e.g. PC) via at least one of the available interfaces, the controlling unit could take over control at any time without warning or a confirmation prompt. For safety reasons, it is recommended to lock the remote by activating 'Local' mode, at least for the duration of manual operation.

7.3.1 Switching on the device

If possible, the device should always be switched on at the mains switch (rotary switch, front) by setting it to position 1. Alternatively, it can be switched on the mains side via an external disconnecting device (main switch, contactor) with an appropriate current carrying capacity.

After switching on, the device shows some device-specific information (model, firmware version(s) etc.) on the display for a few seconds, then a language selection that can be hidden by ticking the box for 3 seconds and is then ready for operation.

In the settings menu (see section *«2.3.1 Configuration in the menu»* in the user manual), there is an option **Settings** in the **DC terminal** submenu under **State after power ON**, with which the user can determine the state of the DC terminals after switching on the device. **Restore** remembers the last state when switching off and restores it, in contrast to **Off**. This setting must therefore be made carefully.

All set values, as well as a previously activated master-auxiliary operating mode, are always restored.

7.3.2 Switching off the device

The device is switched off by turning the mains switch to position 0. This triggers two actions: a) the status of the DC input and the last set values are saved, and b) an **Alarm: PF** is reported, which can be ignored in this situation. The DC input is also switched off immediately and the fans and display stop after a certain run-on time (up to 30 seconds). The device is then completely switched off.

In position 0, the mains switch on the front physically disconnects the device from the mains. It therefore qualifies as a separator. Position 1 means that the device is switched on.

7.3.3 Manual set value adjustment in ELR mode

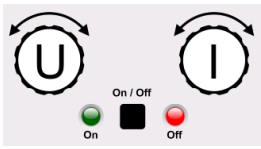
Adjustment of the voltage, current and power set values is the basic operating function of a ELR. Therefore, the two rotary knobs on the front of the unit are always assigned two of these three set values for manual operation.

The set values can be set manually in two ways, by **rotary knob** or **direct input**. When using the rotary knobs, values are adjusted continuously; direct input creates jumps.

Entering set values, whether by button or touchscreen, always sets the set value immediately, regardless of whether the DC terminal is switched on or off.

The adjustment of the set values can be limited upwards or downwards by the adjustment limits. See also «2.3.3 Adjustment limits» in the user manual. When one of the limits is reached, a message such as "Limit: U-max" is displayed briefly near the value on the display.

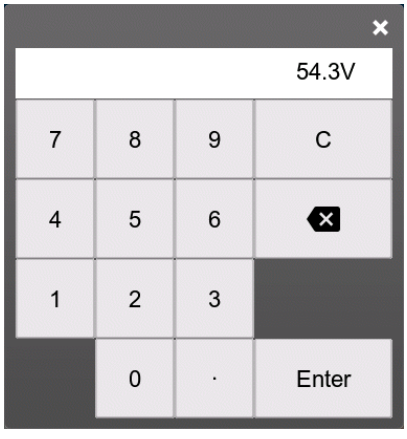
► How to manually adjust set values using the rotary knobs



1. First check whether the set value (U, I, P) that you want to set is already assigned to one of the rotary knobs. The main screen shows the assignment as shown on the right side of the image.
2. If, as shown in the example on the right, the voltage (U) is assigned to the left rotary knob and the current (I) is assigned to the right rotary knob. To set the power, you can change the assignment by tapping the image of the right rotary knob until a "P" (power) is displayed on it. In the left-hand area of the display, the power set value is selected, marked by the inverted field.
3. Once the selection has been made, the desired set value can be set within the specified limits. To change the position, press the respective rotary knob. Turning the rotary knob moves the cursor (underlined digit) from the lower to the higher decimal positions.

(EL) 47.50A → (EL) 47.50A → (EL) 47.50A

► How to manually adjust set values via direct input



1. In the main display, depending on the assignment of the rotary knobs, you can set the set values for voltage (U), current (I) or power (P) by direct input by tapping on the small numeric keypad symbols. For example, click on the symbol in the blue field to set the voltage, etc.
2. Enter the desired value using the numeric keypad. Similar to a calculator, control panel C deletes the input.
   Decimal places can be entered by tapping the decimal point control field. For example, if you wanted to enter 54.3 V, type in 5 4 · 3 and Enter.
3. Unless the new value is rejected for some reason, the display would jump back to the main page and the set value is applied to the DC terminal.

If a value is entered that is higher than the respective adjustment limit, a message appears and the entered value is reset to 0 and is not accepted.

7.3.4 Switch DC terminal on or off

The DC terminal of the device can be switched on or off manually or remotely. After switching on, the DC terminal operates only as a DC input (sink mode).

► How to manually switch the DC terminal on or off

1. If the control panel is not completely locked, press the **On/Off** button. Otherwise, you will first be asked to lift the lock.
2. Depending on whether the DC terminal was switched on or off before the button was pressed, the opposite state is enabled, unless this is prevented by an alarm or the state of the remote control.

► How to switch the DC terminal on or off remotely via a digital interface

1. See further documentation, e.g. the separate programming instructions if you are using your own software, the help for the LabView VIs or the manual for the software provided by the manufacturer. These are all included on the USB stick provided.

7.3.5 Locking the control panel (HMI)

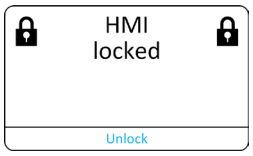
To prevent accidental adjustment of a value during manual operation, the rotary knobs and the touchscreen can be locked so that no adjustment of a value via the rotary knob or operation via the touchscreen is accepted without first cancelling the lock.

► How to lock the HMI

1. Tap the lock icon  on the main page. If the DC terminal is switched on, the lock is enabled immediately.
2. Otherwise, the menu page **Lock** appears, where you can specify whether you want to lock the HMI completely or with the exception of the button **On/Off** (setting: **On/ Off during HMI lock**) or whether the lock should also be protected with a PIN (**Enable PIN for HMI lock**). This PIN must always be entered again later when unlocking as long as it is enabled.
3. Activate the lock with **Start**. The device switches to the main screen and dims it.

As soon as an attempt is made to change something when the HMI is locked, a prompt appears on the display asking whether you want to unlock it.

► How to unlock the HMI

1. Tap in any area of the touchscreen of the locked HMI or press one of the rotary knobs or press the “On/Off” button (only when completely locked).
2. A query appears: 

3. Unlock the HMI using the control panel **Unlock**. If no entry is made within 5 seconds, the prompt disappears again and the HMI remains locked. If the additional PIN lock (see group **Lock**) has been enabled, a further prompt to enter the PIN appears. If this has been entered correctly, the HMI will be unlocked.

7.3.6 Locking the adjustment limits and user profiles

To prevent the person working with the device from setting incorrect set values by accidental or deliberate adjustment, adjustment limits can be defined (see section *«2.3.3 Adjustment limits»* in the user manual) and locked against changes using a PIN. This locks the **Limits** group in the **Settings** menu and the **Profiles** menu. The lock can only be removed by entering the correct PIN or resetting the device.

► How to block the limits and profiles

1. Tap the lock icon  on the main page. If the HMI is also locked, it must first be unlocked by tapping anywhere on the touchscreen, entering the PIN if necessary. The **Lock** menu page then appears.
2. Activate the switch next to **Lock limits and profiles with user PIN**. The lock becomes active immediately.
3. Leave the **Lock** page.

	*The same user PIN is used for the limit and profile lock as for the HMI lock.*

	Caution! Do not activate the lock if you are not sure which PIN is currently set or change it beforehand! The PIN can be set in the **Lock** menu.

► How unlock the limits and profiles

1. With the DC terminal switched off, tap the control panel on the main page 

.
2. In the menu, tap **HMI setup**, then tap **Lock group**.
3. In the group, tap **Unlock limits and profiles** on the right. You will then be asked to enter the four-digit PIN.
4. Disable the lock after entering the correct PIN.

7.4 Alarms and monitoring (1)

7.4.1 Definition of terms

A basic distinction is made between device alarms (see *«9.2.1 Alarm signals»*), such as overvoltage (**OVP**) or overtemperature (**OT**), and user-defined events such as **OVD** (overvoltage monitoring). While device alarms, in which the DC terminal is always switched off immediately, serve to protect the device and the connected load/source, user-defined events can switch off the DC terminal (with **Action = alarm**), but can also only emit an acoustic signal that alerts the user to something.

The action can be selected for **user-defined events**:

Action	Response	Example
None	User event is disabled	
Signal	When the condition that triggers an event with action **Signal** is reached, a text is only output in the display (status field) of the device.	Event: UVD
Warning	When the condition that triggers an event with action **Warning** is reached, a text and an additional message that can be seen from a greater distance are shown in the display (status field) of the device.	
Alarm	When the condition that triggers an event with action **Alarm** or an alarm is reached, a text and an additional message are only shown in the display (status field) of the device and an acoustic signal is emitted (if the alarm sound is enabled). Furthermore, the DC terminal is switched off. All device alarms can also be queried via the digital interfaces.	

7.4.2 Handling device alarms and events

Important to know:

When switching off the DC terminal in sink mode on a current-limited source, its output voltage may rise abruptly and, due to control delays, cause a short-term voltage overshoot lasting a few milliseconds, which may trigger an overvoltage alarm (OVP) or voltage monitoring (OVD) on the device if the thresholds are set too low.

If a device alarm occurs, the DC terminal is usually switched off first, a message is output in the centre of the display and, if enabled, an acoustic signal is generated to draw the user's attention to the alarm. Alarms can also be accessed via all interfaces. An alarm must be confirmed for acknowledgement and cancellation.

► How to acknowledge an alarm in the display (during manual operation)

1. If an alarm is displayed as an overlay message: confirm with Acknowledge.
2. If the alarm has already been confirmed with OK but is still displayed in the status field, first tap on the status field so that the overlay message is displayed again, then press **Acknowledge** to confirm.

To acknowledge alarms with digital remote control, see the separate programming instructions supplied.

Some device alarms can be configured:

Short	Long	Description	Range
OVP	**O**ver**V**oltage **P**rotection	Overvoltage protection. Triggers an alarm when the voltage at the DC terminal reaches the set threshold. The alarm causes the DC terminal to be switched off.	0 V...1.1*U_{Nenn}
OCP	**O**ver**C**urrent **P**rotection	Overcurrent protection. Triggers an alarm when the current in the DC terminal reaches the set threshold. The alarm causes the DC terminal to be switched off.	0 A...1.1*I_{Nenn}
OPP	**O**ver**P**ower **P**rotection	Over-power protection. Triggers an alarm when the input power reaches the set threshold. The alarm causes the DC terminal to be switched off.	0 W...1.25*P_{Nenn}
ETP	**E**xternal **T**emperature **P**rotection	External overtemperature protection. Occurs when the external temperature detected by a sensor, e.g. of a battery, has reached the adjustable threshold for **ETP**. The alarm causes the DC terminal to be switched off and a message to appear on the display.	-55...+125 °C

These device alarms cannot be configured as they are hardware-related:

Short	Long	Description
PF	**P**ower **F**ail	Mains error. Triggers an alarm if the AC supply should operate outside the specifications of the device (undervoltage) or if the device is disconnected from the AC supply, e.g. by switching off at the mains rotary switch. In addition, the DC terminal is switched off. The status of the DC terminal after a temporary PF alarm has disappeared can be set using the setting **DC terminal -> State after PF alarm**.
		The acknowledgment and thus cancellation of a PF alarm during runtime can only take place approx. 15 seconds after the cause of the alarm has subsided, and the DC input can only be switched on again after a further 5 seconds.
OT	**O**ver**T**em-perature	Overtemperature. Triggers an alarm when the internal temperature of the device reaches a certain threshold. In addition, the DC terminal is switched off. The status of the DC terminal after cooling can be set using the setting **DC terminal -> State after OT alarm**.
MAP	**M**aster-**A**uxiliary **P**rotection	Is triggered if the master in an initialized master-auxiliary network loses contact with one or more auxiliary units or if an auxiliary unit has not yet been initialized. In addition, the DC terminal of all devices is switched off. The alarm can be canceled by reinitializing the MA system or disabling MA.
Safety OVP	**Safety O**ver**V**oltage **P**rotection	Only available in the 60 V model: Safety OVP. Triggers a special OVP alarm if the voltage at one of the DC terminals exceeds the threshold of 101% nominal voltage and then switches off all DC terminals. For details, see section *«9.2.5 Overcurrent alarm».*
SF	**S**hare-Bus **F**ail	Share-Bus error. Occurs when the signal on the Share-Bus is disrupted by a short circuit or excessive attenuation, or when one of the Share-Bus connections is connected to another device while the affected device is not configured for Master-auxiliary. In this case, the cable should be removed. The alarm causes the DC terminals of all units in a Master-auxiliary system to be switched off.

► How to configure the thresholds of the adjustable device alarms

1. With the DC terminal switched off, tap on the 

control panel on the main page.
2. Tap the field on the left-hand side labeled **Protection**. All configurable device alarms and their threshold values are displayed on the right-hand side. The device constantly compares these thresholds with the actual values of current, voltage and power at the DC terminal.
3. Set the threshold values for the device alarms here according to your application if the default values of 110% are not suitable.

The user can also choose whether to receive an additional acoustic message when an alarm or user-defined event (user event) occurs.

► How to configure the "Alarm sound" (see also *«2.3.1 Configuration in the menu»* in the user manual)

1. On the main page, swipe your finger upwards from the bottom edge or tap  .
2. A quick menu opens. Click on the  field to switch the alarm sound on or on  to switch it off.
3. Exit the quick menu.

7.5 User-definable events (user events)

The monitoring function of the device can be configured via user-definable events, which are referred to below as “events”. Events are disabled by default (**Action** set to **None**) and, unlike device alarms, only work as long as the DC terminal is switched on. This means, for example, that undervoltage would no longer be detected after the DC terminal has been switched off.

The following events can be configured independently of each other:

Short	Long	Description	Range
UVD	**U**nder**V**oltage **D**etection	Undervoltage detection. Triggers the event if the voltage at the DC terminal falls below the set threshold.	0 V...U_{Nom}
OVD	**O**ver**V**oltage **D**etection	Overvoltage detection. Triggers the event if the voltage at the DC terminal exceeds the set threshold.	0 V...U_{Nom}
UCD	**U**nder**C**urrent **D**etection	Undercurrent detection. Triggers the event if the current in the DC terminal falls below the set threshold.	0 A...I_{Nom}
OCD	**O**ver**C**urrent **D**etection	Overcurrent detection. Triggers the event if the current in the DC terminal exceeds the set threshold.	0 A...I_{Nom}
OPD	**O**ver**P**ower **D**etection	Overpower detection. Triggers the event if the power at the DC terminal exceeds the set threshold.	0 W...P_{Nom}

These events should not be confused with alarms such as OT and OVP, which are used to protect the device. With the action set to “Alarm”, events can also switch off the DC terminal and thus protect the load.

► How to configure the user events

1. With the DC terminal switched off, tap on the 

control panel on the main page.
2. Tap the field on the left-hand side labeled **User events**. All adjustable values and actions are displayed on the right-hand side. The values represent monitoring thresholds that are constantly compared with the actual values of current, voltage and power at the DC terminal.
3. Tap on the values to change them using the numeric keypad that appears. The adjustment range of these values is not limited by the adjustment limits. The **Action** associated with each event can be set via a scroll selection. For the meaning of the selectable actions, see section *«7.4.1 Definition of terms»*.

The events are part of the currently selected user profile. This means that if a different user profile or the default profile is loaded, the events are either configured differently or not configured at all.

8. Other applications (1)

8.1 Series connection

- The device is an electronic load.
- Series connection is not supported and must therefore not be set up or operated (warranty may be void)!

9. Troubleshooting

9.1 Maintenance / cleaning

The devices do not require regular maintenance. Cleaning the internal fans may be necessary sooner or later, depending on the environment in which they are operated. Heavily contaminated fans can lead to insufficient air supply and thus to premature shutdown of the DC input due to overheating or to premature defects. Please contact us for this type of maintenance.

9.1.1 Battery replacement

The device contains a CR2032 lithium button cell, which is located on the so-called KE board, which is attached to the side panel at the rear right of the device (viewed from the front). The battery buffers the real-time clock and is designed for a service life of at least 5 years. However, the service life is also determined by external influences such as temperature and may be shorter. If it is necessary to replace the battery, please contact the manufacturer.

9.2 Troubleshooting / fault diagnosis / repair

In the event that the device suddenly behaves unexpectedly, indicating a possible defect, or has an obvious defect, it cannot and must not be repaired by the user. In case of suspicion, please consult the supplier and clarify further steps with them.

It will then usually be necessary to send the device to the manufacturer for repair (with or without warranty). In the event that the device needs to be sent in for inspection or repair, please ensure that...

- you have contacted your supplier beforehand and clarified with them how and where the device is to be sent
- it is packed securely for transport in its assembled state, ideally in the original packaging.
- options operated together with the device, such as a digital interface module, are sent in with the device if they are related to the problem.
- a detailed description of the fault is enclosed.
- all documents required for customs clearance are enclosed when sending to the manufacturer in another country.

9.2.1 Alarm signals

The device offers various options for signaling alarm situations, but not dangerous situations. Signaling is visual (on the display as text or via LED) and optionally also acoustic (piezo buzzer). All these alarms cause the DC terminal to be switched off.

Meaning of the alarm signals:

Signal **PF** (mains error)	• Shutdown of the DC terminal due to mains undervoltage or a fault in the AC section. • Critical in case of overvoltage! AC part could be damaged.
Signal **OT** (excess temperature)	• Overheating of the device. • DC terminal is switched off. • Uncritical.
Signal **OVP / SOVP** (overvoltage)	• Overvoltage switch-off of the DC terminal occurred due to excessive voltage reaching the device from outside or generated by a defect in the device. • Critical! The device and/or the DUT could be damaged.
Signal **OCP** (overcurrent)	• Overcurrent shutdown of the DC terminal occurred because an adjustable threshold was reached. • Non-critical, serves to protect the load from excessive current consumption.
Signal **OPP** (excess power)	• Overload shutdown of the DC terminal occurred because an adjustable threshold was reached. • Non-critical, serves to protect the load from excessive power consumption.
Signal **SF** (Share-Bus error)	• Shutdown of the DC terminal due to a signal fault on the Share-Bus. • Uncritical.
Signal **MAP** (Master-auxiliary protection)	• Switch-off of all DC terminals of a Master-Auxiliary system due to communication problems on the Master-Auxiliary bus. • Uncritical.
Signal **ETP** (External overtemperature)	• Overheating of the battery or another external component. • DC terminal is switched off. • Non-critical for the device, but critical for the test specimen.

9.2.2 Power fail alarm

Power Fail (PF) indicates an alarm condition of the device, which can have several causes:

- AC input voltage too low (mains undervoltage, mains failure)
- Internal defect in the AC input stage (PFC)

In the event of a power fail, the device stops consumption and switches off the DC terminal. If the PF alarm was only a temporary mains undervoltage, the device can continue to operate, i.e. automatically switch the DC terminal back on. The response is determined via the setting **DC terminal -> State after PF alarm**, whereby the default setting is "Off".

Disconnecting the device from the power supply is interpreted as a power failure. Therefore, an "Alarm: PF" occurs each time the device is switched off, which can be ignored in this case.

9.2.3 Overtemperature alarm

An overtemperature alarm (OT for short) occurs when a device automatically switches off the power levels due to excessive internal temperatures. After cooling down, the device can automatically switch the power levels back on, depending on what has been selected in the setup at **DC terminal -> State after OT alarm**. For more information, refer to section *«2.3.1 Configuration in the menu»* in the user manual. The alarm remains on the display for information purposes until it is acknowledged.

9.2.4 Overvoltage alarm

An overvoltage alarm (OVP) causes the DC terminal to be switched off and can occur if

- the external source (sink mode) applies a higher output voltage to the DC terminal than that specified by the adjustable overvoltage alarm threshold (OVP, 0...110% U_{Nom}).
- If the OVP threshold value set by the user is too close to the voltage present and the device in CC mode experiences a sudden voltage jump due to sudden load relief, this can lead to voltage overshoot, which is regulated shortly afterwards but may trigger the OV alarm.

This function is used to inform the operator of the device acoustically or visually that it may have generated an excessive voltage or experienced an excessive voltage from outside and that either the device or the connected load may be defective.

- **The device is not equipped with protective measures against external overvoltage.**
- **Changing the operating mode CC -> CV can lead to voltage overshoot.**

9.2.5 Overcurrent alarm

An overcurrent alarm (short: OCP) causes the DC terminal to be switched off if

- the current flowing in the DC terminal reaches the set OCP threshold.

This protective function is not intended to protect the device, but to protect the external source in sink mode so that it is not damaged by excessive current or irreparably destroyed in the event of a fault that results in excessive current.

9.2.6 Overpower alarm

An overpower alarm (short: OPP) causes the DC terminal to be switched off if

- the product of the voltage and current present at the DC terminal reaches the set OPP threshold.

This protective function is not intended to protect the device, but to protect the connected load or the external source (sink mode) if it could be damaged by excessive power consumption.

9.2.7 Share-Bus fail

A Share-Bus fail alarm (short: SF) causes the DC terminal to be switched off and can occur if

- the Share-Bus is already connected to at least two devices, while at least one of them has not yet been switched to master-auxiliary operating mode,
- a short circuit has occurred on the Share-Bus, e.g. due to a defective BNC cable.

This protective function is designed to prevent auxiliary units from receiving irregular settings via the Share-Bus or behaving differently. The alarm must be acknowledged after the cause of the fault has been rectified.

If the device is neither the master nor the auxiliary unit, the Share-Bus cable should be removed to ensure uninterrupted operation.

9.2.8 Master-auxiliary protection

A master-auxiliary protection alarm (short: MAP) causes the DC terminals of devices in master-auxiliary operation to switch off their DC terminals if

- a short circuit has occurred in the master-auxiliary connection, e.g. due to a defective cable,
- communication between the master and auxiliary devices is disrupted.

This protective function is intended to prevent the units of the master-auxiliary network from entering an irregular operating state. The alarm must be acknowledged after the cause of the fault has been rectified..

9.2.9 External overtemperature alarm

An alarm from the external temperature protection (short: ETP) causes the DC terminal to be switched off and can occur if

- the measured value of at least one of the temperature sensors that can be connected to the "Digital In / Out" port has exceeded the threshold for ETP that can be set separately for the respective temperature sensor.

The device would then not switch on the DC terminal and the related DC contactor won't be closed. The alarm must be acknowledged after the cause of the fault has been rectified.

10. Technical data

10.1 Permissible operating conditions

10.1.1 Surroundings

The permissible ambient temperature range during operation is from 0 °C to 35 °C. During storage or transport, an extended range of -20 °C to 70 °C is permitted. If condensation has formed during storage or transport, the device must be acclimatised for at least 2 hours before use or dried by suitable air circulation.

The device is generally intended for operation in dry rooms. It must not be operated where there is a particularly high dust or moisture content in the air, where there is a risk of explosion or where there is an aggressive chemical effect. The operating position is not arbitrary (see *«6.3.3 Setting up the device»*), but sufficient air circulation must be ensured. The device may be operated up to an altitude of 2000 m above sea level. Nominal data with tolerance apply after a warm-up time of at least 30 minutes and at an ambient temperature of 23 °C. Values without tolerance are standard values for an average device.

10.1.2 Cooling

Power loss generated in the device heats the air flowing through the device. The flow direction is from the front (inlet) to the rear (outlet). The fan speed is regulated up or down depending on the internal temperature of the device. A certain minimum speed is required, as internal components heat up even when the device is idling.

Dust in the air settles on all parts in the air path and can impair the air flow to a certain extent. It is therefore important to ensure an unobstructed air flow, at least outside the device, by leaving sufficient space behind the device or, if the device is installed in a cabinet, ensuring that the doors of the cabinet have meshes.

At the same time, the ambient temperature should be kept as low as possible, if necessary using external measures such as air conditioning. Should the device nevertheless heat up internally to such an extent that the heat sink temperature rises above 80 °C, it protects itself by automatically switching off the power level and only switching on again once it has cooled down.

In water-cooled versions, water is the main cooling medium that flows through the internal heat sinks. The air inside the otherwise almost hermetically sealed housing is circulated by internal fans to cool the remaining components, which also heat up but are not located on the heat sink.

10.2 General technical data

Display:	Color TFT touchscreen with Gorilla Glass, 5”, 800 x 480 pixels, capacitive
Control elements:	2 rotary knobs with push function, 1 push button

10.3 Specific technical data

General specifications	
AC input	
Voltage, Phases	380 - 480 V, ±10%, 3ph AC
Frequency	45 - 65 Hz
Power factor	ca. 0.99
Leakage current	<10 mA
Inrush current *1	@400 V: ca. 54 A per phase
Overvoltage category	II
Protective functions	
OVP	Overvoltage protection, adjustable 0 - 110% $U_{Nominal}$
OCP	Overcurrent protection, adjustable 0 - 110% $I_{Nominal}$
OPP	Overpower protection, adjustable 0 - 110% $P_{Nominal}$ Overpower protection, adjustable 110 - 125% $P_{Nominal}$ *4
OT	Overtemperature protection (DC terminal shuts down in case of insufficient cooling)
DC input dynamic	

di/dt performance - 1 Device -

Stepwith	Basic configuration *2	Enhanced performance settings *2	Max. performance settings *2
10% - 60% 4A - 22A 3.2KW - 17.6KW	di/dt: 0.5A/µs current overshoot: 20%	di/dt: 0.8A/µs current overschoot: 30%	di/dt: N/A current overschoot: N/A
50% - 100% 19A - 37A 15.2KW - 29.6KW	di/dt: 0.5A/µs current overshoot: 40%	di/dt: 0.8A/µs current overshoot: 55%	di/dt: N/A current overshoot: N/A
10% - 100% 4A - 37A 3.2KW - 29.6KW	di/dt: 1.1A/µs current overshoot: 30%	di/dt: 1.3A/µs current overshoot: 30%	di/dt: 1.5A/µs current overshoot: 80%
10% - 120% *3 4A - 47A 3.2KW - 37.6KW	di/dt: 1.5A/µs current overshoot: 25%	di/dt: 1.7A/µs current overshoot: 20%	di/dt: 1.9A/µs current overshoot: 45%

di/dt performance - 2 Devices -

Stepwith	Basic configuration *2	Enhanced performance settings *2	Max. performance settings *2
10% - 60% 7A - 45A 5.6KW - 36KW	di/dt: 1.1A/µs current overshoot: 30%	di/dt: 1.6A/µs current overschoot: 35%	di/dt: N/A current overschoot: N/A
50% - 100% 37A - 75A 29.6KW - 60KW	di/dt: 1.3A/µs current overshoot: 45%	di/dt: 1.6A/µs current overshoot: 50%	di/dt: N/A current overshoot: N/A
10% - 100% 7A - 75A 5.6KW - 60KW	di/dt: 2.3A/µs current overshoot: 35%	di/dt: 2.7A/µs current overshoot: 35%	di/dt: 3.1A/µs current overshoot: 50%
10% - 120% *3 7A - 93A 5.6KW - 74.4KW	di/dt: 3.0A/µs current overshoot: 35%	di/dt: 3.3A/µs current overshoot: 35%	di/dt: 3.7A/µs current overshoot: 45%

*1 Calculated for the peak value of the stated voltage including 10% tolerance, at 23°C ambient and first switch-on (cold start)
*2 Measured with following configuration:
- cable lenght: 3m
- cable twisted together
- cable diameter: 25mm²
- number of cables: 1x per pole (2 per device)
- Voltage: 800V
*3 120% with overpower feature enabled
*4 for Overpower feature

General specifications				
di/dt performance - 4 Devices -	Stepwith	Basic configuration *2	Enhancedperformancesettings*2	Max. performance settings *2
	10% - 60% 15A - 90A 12KW - 72KW	di/dt: 1.6A/µs currentovershoot:10%	di/dt: 2.0A/µs current overschoot: 15%	di/dt: 2.9A/µs current overschoot: 30%
	50% - 100% 75A - 150A 60KW-120KW	di/dt: 1.9A/µs currentovershoot:20%	di/dt: 2.4A/µs current overshoot: 20%	di/dt: 3.1A/µs current overshoot: 30%
	10% - 100% 15A - 150A 12KW-120KW	di/dt: 3.3A/µs currentovershoot:15%	di/dt: 3.7A/µs current overshoot: 15%	di/dt: 4.5A/µs current overshoot: 20%
	10% - 120% *4 15A - 187A 12KW-150KW	di/dt: 4.3A/µs currentovershoot:15%	di/dt: 4.6A/µs current overshoot: 10%	di/dt: 5.5A/µs current overshoot: 20%
di/dt performance - 8 Devices -	Stepwith	Basic configuration *2	Enhancedperformancesettings*2	Max. performance settings *2
	10% - 60% 30A - 180A 24KW - 144KW	di/dt: 3.4A/µs currentovershoot:10%	di/dt: 4.7A/µs current overschoot: 15%	di/dt: 6.4A/µs current overschoot: 35%
	50% - 100% 150A - 300A 120KW-240KW	di/dt: 4.1A/µs currentovershoot:25%	di/dt: 5.6A/µs current overshoot: 20%	di/dt: 6.8A/µs current overshoot: 45%
	10% - 100% 30A - 300A 24KW - 240KW	di/dt: 7.0A/µs currentovershoot:15%	di/dt: 7.8A/µs current overshoot: 10%	di/dt: 10.0A/µs current overshoot: 25%
	10% - 120% *3 30A - 375A 24KW - 300KW	di/dt: 9.4A/µs currentovershoot:20%	di/dt: 10.1A/µs current overshoot: 10%	di/dt: 12A/µs current overshoot: 20%

Display & measurement accuracy	
Voltage	≤0.05% FS
Current	≤0.1% FS
Insulation	
AC input to DC terminal	3750 Vrms (1 minute, creepage distance >8 mm)
AC input to case (PE)	2500 V DC
DC terminal to case (PE)	see model table
DC terminal to interfaces	1500 V DC
Communication interfaces	
Rear, galvanically isolated	USB, Ethernet (1 GBit), EtherCAT, CAN FD, all for communication
Communication speed	≤1 ms *4
Front, galvanically isolated	USB host, for data acquisition
Digital In/Out	
Built-in, galvanically isolated	16 pole
Inputs	3x independent, user-configurable
Outputs	3x independent, as dry contact
Sensor inputs	3x independent, for temperature sensor

*2 Measured with following configuration:
- cable lenght: 3m
- cable twisted together
- cable diameter: 25mm²
- number of cables: 1x per pol (2 per device)
- Voltage: 800V
*3 120% with overpower feature enabled
*4 When using EtherCAT

General specifications	
Device configuration	
Parallel operation with Share bus	Up to 64 units of the same series
Safety and EMC	
Safety	EN 61010-1 IEC 61010-1 BS EN 61010-1
EMC	EN 55011, class A, group 1 CISPR 11, class A, group 1 EN 61326-1 including tests according to: - EN 61000-4-2 - EN 61000-4-3 - EN 61000-4-4 - EN 61000-4-5 - EN 61000-4-6
Appliance class	I
Ingress protection	IP20
Environmental conditions	
Operating temperature	0 - 35 °C (32 - 95 °F)
Storage temperature	-20 - 70 °C (-4 - 158 °F)
Humidity	≤80% relative humidity, non-condensing
Altitude	≤2000 m (≤6,600 ft)
Pollution degree	2
Mechanical construction	
Cooling	Forced air flow from front to rear (temperature controlled fans), optional water cooling
Dimensions (W x H x D)	Chassis: 483 mm (19 in) x 177 mm (4U) x 668 mm (26.3 in) Overall depth: min. 802 mm (min. 31.6 in)
Weight	50 kg (110 lb)
Weight with water cooling	56 kg (126 lb)

Technical specifications	ELR 21000-80 HS
DC input	
Voltage range	0 - 1000 V
U_{Min} for I_{Max} (sink)	36.5 V
Current range	0 - 80 A
Power range	nominal: 0 - 30000 W with overpower: 0 - 37500 W
Output capacitance	80 µF
Efficiency sink/source (up to) *1	95,1 %
AC input	
P_{Max}	33 kW
Phase current *2	≤56 A
Insulation	
Negative DC pole <-> PE	±1500 V DC
Positive DC pole <-> PE	+2000 V DC
Product codes	
Standard	33530406
Standard + Water cooling	On request

*1 At 100 % power and 80 % output voltage
*2 Calculated for the default AC supply voltage in the stated range, minus 10 % tolerance, at maximum output power and 10 % power loss from AC to DC

11. Contact and support

11.1 Repairs/technical support

Repairs, unless otherwise agreed between user and supplier, are carried out by the manufacturer. To do this, the device must be sent to the manufacturer. To ensure that a support request or repair is processed as quickly and smoothly as possible, please visit the support area of our website at **www.tek.com/en/services/ea-factory-service** and submit your support or repair request by filling in the relevant form field ("Support Request" or "Repair Request"). No service order can be generated without this data input.

11.2 Contact options

If you have any questions or problems with the operation of the device, use of optional components, documentation or software, you can contact technical support by phone or e-mail.

Head office	E-mail addresses	Telephone numbers
EA Elektro-Automatik GmbH Helmholtzstr. 31-37 41747 Viersen	Technical assistance: support@elektroautomatik.com All other topics: ea1974@elektroautomatik.com	Head office: 02162 / 37850 Support: 02162 / 378566

EA Elektro-Automatik GmbH
Helmholtzstr. 31-37
41747 Viersen
Germany

Phone: +49 (0) 2162 3785 - 0
ea1974@elektroautomatik.com

www.tek.com

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