Elektro-Automatik

INSTALLATION MANUAL

10000 SERIES IN 3U

Programmable DC power supplies and DC loads

Safety, Installation, Commission

Revision: 01

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6. Contact and support

The part of this document that deals with the handling of features on the control panel is only valid for devices with firmwares “KE: 3.10” and “HMI: 4.09” or higher.

1. General

1.1 About this document

1.1.1 Preamble

This document serves as installation and commission guide for the device models as listed in section *«1.1.4 Validity»*. The safety notices in *«1.7 Safety»* are important and must be adhered. Manual operation, remote control and other features of the devices are handled in the separate user manual.

1.1.2 Retention and use

This document is to be kept in the vicinity of the equipment for future reference and explanation of the operation of the device. This document is to be delivered and kept with the equipment in case of change of location and/or user. The most recent issue of this document can be found online, on our website.

1.1.3 Copyright

1.1.4 Validity

This document is valid for the following series:

Series
EA-ELR 10000 3U
EA-PS 10000 3U
EA-PSB 10000 3U
EA-PSBE 10000 3U
EA-PSI 10000 3U

1.1.5 Symbols and warnings in this document

Warning and safety notices as well as general notices in this document are shown in a box with a symbol as follows. The symbols are also valid, where placed, to mark specific spots on the device:

	**Symbol for a life threatening danger (electric shock hazard)**
	**Symbol for risk (of damage to the equipment). If placed on the device it requires the user to read the operating guide prior to start operation.**
	Symbol for general safety notices (instructions and damage protection bans) or important information for operation
	*Symbol for general notices*

1.2 Warranty

EA Elektro-Automatik guarantees the functional competence of the applied technology and the stated performance parameters. The warranty period begins with the delivery of equipment free from defects. The terms of guarantee are included in the general terms and conditions (TOS) of EA Elektro-Automatik.

1.3 Limitation of liability

All statements and instructions in this manual are based on current norms and regulations, up-to-date technology and our long term knowledge and experience. The manufacturer accepts no liability for losses due to:

- Usage for purposes other than designed
- Use by untrained personnel
- Rebuilding by the customer
- Technical changes
- Use of unauthorized spare parts

The actual delivered device(s) may differ from the explanations and diagrams given here due to latest technical changes or due to customized models with the inclusion of additionally ordered options.

1.4 Disposal of equipment

A piece of equipment which is intended for disposal must, according to European laws and regulations (ElektroG, WEEE) be returned to the manufacturer for disposal, unless the person operating the piece of equipment or another, delegated person is conducting the disposal. Our equipment falls under these regulations and is accordingly marked with the following symbol:

	The device contains a Lithium battery cell. Disposal of this battery follows the above stated rule or specific local regulations.

1.5 Product key

Decoding of the product description on the label, using an example:

EA-PSB 10080 - 510 3U

3U	Construction (only stated on type label): **3U** = 19" frame with 3 height units
510	Maximum current of the device in Ampere
10080	Maximum voltage of the device in Volt (“10080” = 80 V)
10	Series: **10/11/12** = Series 10000
EA-PSB	Type identification: **PSB** = Power Supply Bidirectional **PS** = Power Supply **PSI** = Power Supply Intelligent **PSBE** = Power Supply Bidirectional Economy **ELR** = Electronic Load Recovery

1.6 Intended usage

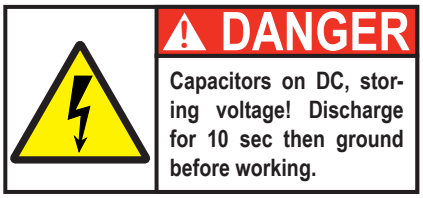
The equipment is intended to be used only as a variable voltage and current source or only as a variable current sink. Furthermore it's only intended to be used installed and operated in suitable equipment (19" rack or similar), together with a rigid, non-retractable AC supply connection.

Typical application for a source is to supply DC power to any relevant consumer, including when used as battery charger to test charge various battery types, and for current sinks the replacement of an ohmic resistor by an adjustable electronic DC load in order to load relevant voltage and current sources of any type.

Additionally to the functionality of a bidirectional device being source or sink of electrical energy on the DC side, they are also so-called recuperating devices and therefore don't just drain energy on the AC side, but also supply energy to the grid when being sinks on the DC side. This is where the term "bidirectional" comes from. In sink mode the devices become energy recoverers, but are not defined or considered as energy generation equipment. The same applies for electronic loads which only work in one direction.

- Claims of any sort due to damage caused by non-intended usage will not be accepted
- All damage caused by non-intended usage is solely the responsibility of the operator

1.6.1 Symbols and warnings on the device

Decal	Explanation
	This warning is primarily related to the reconfiguration of the device on the DC terminal which, for safety reasons, also requires to cut the device from AC (external main switch). The same applies to disconnection and reconnection of the AC terminal.
	Even after disconnection of the DC terminal from an external source there can still be dangerous voltage potential present between the DC terminal poles and/or between DC and the enclosure. For safety reasons the DC terminal must be short-circuited after the capacitors have been discharged and it must also be grounded, i. e. connected to PE.
	There can always be a voltage potential on metallic, openly touchable parts on electrical devices, though the voltage level may not be hazardous. Caution is still advisable, as this potential can still cause mild electrical shock or sparking.
	This is valid for any use of the device.

1.7 Safety

1.7.1 Safety notices

Mortal danger - Hazardous voltage

- **Electrical equipment operation means that some parts accessible on the outside of the device can be under high voltage. Therefore all parts under voltage must be covered during operation! This basically applies to all models, except for the 60 V models according to SELV.**
- **The DC terminal is isolated from the AC input and not connected to ground internally. Hence there can be dangerous potential between the DC poles and PE, for instance caused by a connected external source application. Due to charged capacitors this could even be true if the DC terminal or the device are already switched off.**
- **Do not insert any object, particularly metallic, through the ventilator slots!**
- **For every reconfiguration on the AC or DC terminals, specifically those which can have a dangerous voltage potential, the device must be cut completely from the AC supply (main switch on the distant end of the AC cable); it doesn't suffice to only use the power switch on the front**
- **Always follow 5 safety rules when working with electric devices:**
  - **Disconnect completely**
  - **Secure against reconnection**
  - **Verify that the system is dead**
  - **Carry out earthing and short-circuiting**
  - **Provide protection from adjacent live parts**

- **Air-cooled models: avoid any use of liquids near the equipment. Protect the device from wetness, damp and condensation.**
- **Do not connect external power sources with reversed polarity to the DC terminal! The equipment will be damaged, even when completely powered off.**
- **Never connect external power sources to the DC terminal that can generate a higher voltage than the rated voltage of the device!**
- **Never insert a network cable which is connected to Ethernet or its components into the master-slave sockets on the rear side of the device!**
- **When working with external sources which can deliver an almost unlimited current, such as batteries or fuel cells, there must be at least one fuse in line of the connection; the fuse must either match the rated current of the device or be lower!**

- The equipment must only be used as intended
- The equipment is only approved for use within the connection limits stated on the product label.
- ESD regulations must be applied when plugging interface cards or modules into the relative slot
- Interface cards or modules may only be attached or removed after the device is switched off. It's not necessary to open the device.
- Always configure the various protecting features against overcurrent, overvoltage etc. for sensitive loads to what the target application requires!
- When operating the device as electronic load: always make sure that the energy recovery can feed back the inverted energy and that it does not switch to isolated operation. For situations of isolated operation a supervision device (grid protection) has to be installed
- It's not permitted to run the device on AC sources such as generators or UPS equipment. It must only be connected to a power grid!
- When controlling the device manually on the HMI while it's connected to any controlling unit (PLC, PC etc.) via any analog or digital interface, that controlling unit could take over remote control anytime; for safety reasons it's recommended to block remote control by activating the so-called local mode (also see *«3.4 Manual operation (1)»* in this document and *«2.2.1. Configuration via the menu»* or *«2.3.1. Configuration via the menu»* in the corresponding user manual).

1.7.2 Responsibility of the operator

An operator is any natural person who uses the equipment or delegates the usage to a third party, and is responsible during its usage for the safety of the user, other personnel or third parties.

The equipment is in industrial operation. Therefore the operators are subject to legal safety regulations. In addition to the warning and safety notices in this manual the relevant safety, accident prevention and environmental regulations must also be applied. In particular the operator has to

- be acquainted with the relevant job safety requirements
- identify other possible dangers arising from the specific usage conditions at the work station via a risk assessment
- introduce the necessary steps in the operating procedures for the local conditions
- regularly control that the operating procedures are current
- update the operating procedures where necessary to reflect changes in regulation, standards or operating conditions.
- define clearly and unambiguously the responsibilities for operation, maintenance and cleaning of the equipment.
- ensure that all employees who use the equipment have read and understood the manual. Furthermore the users are to be regularly schooled in working with the equipment and the possible dangers.
- provide all personnel who work with the equipment with the designated and recommended safety equipment

Furthermore, the operator is responsible for ensuring that the device is at all times technically fit for use.

1.7.3 Requirements to the user

Any activity with equipment of this type may only be performed by persons who are able to work correctly and reliably and satisfy the requirements of the job.

- Persons whose reaction capability is negatively influenced by e.g. drugs, alcohol or medication may not operate the equipment.
- Age or job related regulations valid at the operating site must always be applied.

Danger for unqualified users

Improper operation can cause damage to persons or objects. Only persons who have the necessary training, knowledge and experience may use the equipment.

The group of people allowed to operate the equipment is additionally limited to:

Delegated persons: these are persons who have been properly and verifiably instructed in their tasks and the respective dangers.

Qualified persons: these are persons who are able through training, knowledge and experience as well as knowledge of the specific details to carry out all the required tasks, identify dangers and avoid personal and other risks.

1.7.4 Responsibility of the user

The equipment is in industrial operation. Therefore the operators are subject to legal safety regulations. Apart from the warning and safety notices in this manual the relevant safety, accident prevention and environmental regulations must also be applied. In particular the users of the equipment:

- must be informed of the relevant job safety requirements
- must work to the defined responsibilities for operation, maintenance and cleaning of the equipment
- before starting work must have read and understood the operating manual

1.7.5 Alarm signals

The equipment offers various possibilities for signaling alarm conditions, but not for dangerous situations. The signals may be optical (on the display as text or via LED), acoustic (piezo buzzer) or electronic (pin/status output of an analog interface). All alarms will cause the device to switch the DC terminal off. For details about the different alarms refer to section *«3.3 Alarm conditions»*.

The meaning of the signals is as follows:

Signal **OT** (OverTemperature)	• Overheating of the device • DC terminal will be switched off • Non-critical
Signal **OVP / SOVP** (OverVoltage)	• Overvoltage shutdown of the DC terminal due to high voltage entering the device or generated by the device itself due to a defect • Critical! The device and/or the load could be damaged
Signal **OCP** (OverCurrent)	• Shutdown of the DC terminal due to excess of the preset limit • Non-critical, protects the load or source from excessive current consumption
Signal **OPP** (OverPower)	• Shutdown of the DC terminal due to excess of the preset limit • Non-critical, protects the load or source from excessive power consumption
Signal **PF** (Power Fail)	• DC terminal shutdown due to AC undervoltage or defect in the AC section • Critical on overvoltage! AC section could be damaged
Signal **MSP** (Master-Slave Protection)	• DC terminal shutdown due to communication problems on the master-slave bus • Non-critical
Signal **SF** (Share-Bus Fail)	• DC terminal shutdown due to signal distortion on the Share-Bus • Non-critical

1.7.6 Functionality test

The operator of the device must decide when to check the device for correct functionality, by whom and how often. The “when” could either be before every use or after it has been relocated or reconfigured or perhaps in a defined interval.

	*Should the set values not be adjustable as instructed below it could simply be due to adjustment limits interfering. See «3.5.4. Adjustment limits» in the . When reaching a limit when adjusting values, the device would warn in the display.*

1.7.6.1 Test procedure for power supply devices

1. Disconnect all cables (DC, Sense, Share-Bus, analog interface, USB), except for AC
2. Connect a suitable voltage meter to the DC terminal
3. Switch the device on, adjust a voltage of 10% U_{Nom} while the current and power set values all should be at maximum, switch the DC output on and measure the voltage with the multimeter and compare. Also check what the actual voltage on the display shows.
4. Repeat the same thing at 100% U_{Nom}.
5. Switch the DC output off and bridge the DC terminal with a cable or copper rails of suitable current capability of at least I_{Nom}. If available, put a current measuring device (transducer, current probe).
6. Adjust the current for source mode to 10% I_{Nom}, switch the DC output on and measure the current with the external measuring device,if available and compare the measured current to the actual and set value of current on the display or at least compare the actual current on display with the set value.
7. Repeat the same thing at 100% I_{Nom}.

Only if the current and voltage are supplied by the device as adjustable in the range of 0-100% FS, the device can be considered as fully operational.

1.7.6.2 Test procedure for electronic load devices

1. Disconnect all cables (Sense, Share-Bus, analog interface, USB), except for AC
2. Connect an external DC source that can at least deliver as much current and voltage as the rating of the device under test (DUT) and set it to 10% U_{Nom} current of the DUT and full
3. Connect a suitable ampere meter (shunt, current transducer) in line with or around one of the DC cables
4. Switch the device on, adjust a current of 10% I_{Nom} while the voltage set value is set to 0 and the power set values to maximum. Then switch the DC input on and measure the current with the ammeter and compare. Also check what the actual current on the display shows.
5. Repeat the same thing at 100% U_{Nom}.
6. Should the external DC source be adjustable in current, limit the current to 90% INom of the DUT while setting the voltage to 102% U_{Nom} of the DUT. Add a voltage multimeter on the DC input.
7. On the DUT, adjust 10% U_{Nom} and measure with the multimeter on the DC input to verify the adjusted voltage is met. Also check what the actual current on the display shows.
8. Repeat the same thing at 90% or 100% U_{Nom}.

Only if the current and voltage are supplied by the device as adjustable in the range of 0-100% FS, the device can be considered as fully operational.

1.8 Technical Data

1.8.1 Approved operating conditions

1.8.1.1 Ambiance

The allowed ambient temperature range for operation is 0 °C (32 °F) to 50 °C (122 °F). During storage or transport, the allowed range extends to -20 °C (-4 °F) to 70 °C (158 °F). In case water condensation occurred due to transport, the device must be acclimatized prior to operation for at least 2 hours, ideally in a place with good air circulation.

The device is intended to be operation in dry rooms. It must not be exposed or operated to extreme dust, high air humidity, danger of explosion and aggressive chemicals polluting the air. The operating position isn't arbitrary (see *«2.3.3 Installing the device»*),but in any case it requires a sufficient air circulation. The device is allowed to be operated in altitude up to 2000 m (approx. 6,560 ft) above sea level. Technical specifications (here: ratings), when given with tolerance, are valid for a unit warmed up for at least 30 minutes and for an ambient temperature of 23 °C (73 °F). Specifications without tolerance are typical values from an average device.

1.8.1.2 Cooling

Power dissipated inside the device heats up air circulating through the device. With the air-cooled versions a fan at the end of an air flow channel,in which a cooling block is placed, pulls the air through the device. Entry is on the front, exhaust at the back. Depending on the internal temperature, the fan speed is automatically regulated up or down, whereas a certain minimum speed is maintained because some internal components even heat up when the device is idle.

Dust in the air can obstruct the air flow with time, thus it's important to keep the air flow unimpeded at least outside of the device be leaving sufficient room behind it. Since it's usually installed inside cabinets, the cabinet doors are required to be meshed.

At the same time, the ambient temperature should be kept at low levels, perhaps by external means such as an air condition. Should the device heat up internally and the cooling block temperature exceed 80 °C (160 °F), the device will protect itself from overheating by automatically switching off the DC terminal. It could then only continue to operate and switch the DC terminal on again after cooling down for some time.

1.8.2 General technical data

Display:	Color TFT touch screen with gorilla glass, 5", 800pt x 480pt, capacitive
Controls:	2 rotary knobs with pushbutton function, 1 pushbutton

1.8.3 Specific technical data

General specifications	
AC input	
Voltage, Phases	Standard model: Range 1: 208 V, ±10%, 3ph AC Range 2: 380 - 480 V, ±10%, 3ph AC US208V model: 208 V, ±10%, 3ph AC
Frequency	45 - 65 Hz
Power factor	ca. 0.99
Leakage current	<5 mA
Inrush current *1	Standard model @400 V: ca. 54 A per phase US208V model @208 V: ca. 28 A per phase
Overvoltage category	II
DC input/output static	
Load regulation CV	≤0.05% FS (0 - 100% load, at constant AC input voltage and temperature)
Line regulation CV	≤0.01% FS (208 V - 480 V AC ±10%, at constant load and constant temperature)
Stability CV	≤0.02% FS (during 8 h of operation, after 30 minutes of warm-up, at constant AC input voltage, load and temperature)
Temperature coefficient CV	≤30ppm/°C (after 30 minutes of warm-up)
Compensation (remote sense)	≤5% $U_{Nominal}$
Load regulation CC	≤0.1% FS (0 - 100% load, at constant AC input voltage and temperature)
Line regulation CC	≤0.01% FS (208 V - 480 V AC ±10%, at constant load and constant temperature)
Stability CC	≤0.02% FS (during 8 h of operation, after 30 minutes of warm-up, at constant AC input voltage, load and temperature)
Temperature coefficient CC	≤50ppm/°C (after 30 minutes of warm-up)
Load regulation CP	≤0.3% FS (0 - 100% load, at constant AC input voltage and temperature)
Load regulation CR	≤0.3% FS + 0.1% FS of current (0 - 100% load, at constant AC input voltage and temperature)
Protective functions	
OVP	Overvoltage protection, adjustable 0 - 110% $U_{Nominal}$
OCP	Overcurrent protection, adjustable 0 - 110% $I_{Nominal}$
OPP	Overpower protection, adjustable 0 - 110% $P_{Nominal}$
OT	Overtemperature protection (DC terminal shuts down in case of insufficient cooling)
DC input/output dynamic	
Rise time 10 - 90% / Fall time 90 - 10%	CV *2: ≤10 ms CC *3: ≤2 ms
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) *4
AC input to case (PE)	2500 Vrms
DC terminal to case (PE)	Depending on the model, see model tables
DC terminal to interfaces	1000 V DC (models up to 360 V rating), 1500 V DC (models from 500 V rating)
Interfaces digital	
Built-in, galvanically isolated	USB, Ethernet (100 MBit) for communication, 1x USB host for data acquisition
Optional, galvanically isolated	CAN, CANopen, RS232, ModBus TCP, Profinet, Profibus, EtherCAT, Ethernet
Interface analog	
Built-in, galvanically isolated	15 pole D-Sub
Signal range	0 - 10 V or 0 - 5 V (switchable)
Inputs	U, I, P, R, remote control on/off, DC input/output on/off, resistance mode on/off
Outputs	Monitor U and I, alarms, reference voltage, DC input/output status, CV/CC regulation mode
Accuracy U / I / P / R	0 - 10 V: ≤0.2%, 0 - 5 V: ≤0.4%

*1 Calculated for the peak value of the stated voltage including 10% tolerance, at 23°C ambient and first switch-on (cold start)
*2 Valid for power supplies, unidirectional or bidirectional, in source mode operation
*3 Valid for electronic loads or bidirectional power supplies in sink mode operation
*4 Models with up to 80 V DC rating have reinforced insulation while all other models from 200 V DC rating have basic insulation

General specifications			
Device configuration			
Parallel operation	Up to 64 units of any power class in series 10000, with master-slave bus and Share-Bus		
Safety and EMC			
Safety	EN 61010-1 IEC 61010-1 UL 61010-1 CSA C22.2 No 61010-1 BS EN 61010-1		
EMC	EN 55011, class B (standard models), group 1 or class A, group 1 (US208V models) CISPR 11, class B (standard models), group 1 or class A, group 1 (US208V models) FCC 47 CFR Part 15B, unintentional radiator, class B (standard models) or class A (US208V models) EN 61326-1 include 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 *5	0 - 50 °C (32 - 122 °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)		
Dimensions (W x H x D)	Enclosure: 483 mm (19 in) x 132 mm (3U) x 668 mm (26.3 in) Overall depth: min. 785 mm (min. 31 in)		
Weight	5 kW unit: 18 kg (40 lb)	10 kW unit: 25.4 kg (56 lb)	15 kW unit: 32.8 kg (72 lb)

*5 The rated power of the device is available up to approximately +40 °C (104 °F)

1.8.3.1 ELR 10000 3U series

Technical specifications	ELR 10080-170	ELR 10200-70	ELR 10360-40	ELR 10500-30	ELR 10750-20
DC input					
Voltage range	0 - 80 V	0 -200 V	0 - 360 V	0 - 500 V	0 - 750 V
U_{Min} for I_{Max}	0.5 V	2.0 V	2.0 V	2.2 V	2.5 V
Current range	0 - 170 A	0 - 70 A	0 - 40 A	0 - 30 A	0 - 20 A
Power range *1	0 - 5000 W (0 - 3000 W)	0 - 5000 W (0 - 3000 W)	0 - 5000 W (0 - 3000 W)	0 - 5000 W (0 - 3000 W)	0 - 5000 W (0 - 3000 W)
Resistance range	0.016 Ω - 26 Ω	0.1 Ω - 160 Ω	0.3 Ω - 520 Ω	0.6 Ω - 1000 Ω	1.2 Ω - 2200 Ω
Input capacitance	7790 µF	2520 µF	393 µF	180 µF	180 µF
Efficiency (up to)	94.5% *2	94.5% *2	95.5% *2	95.5% *2	95.5% *2
AC input					
P_{Max} (Standard)	Range 1: 3 kW Range 2: 5 kW	Range 1: 3 kW Range 2: 5 kW	Range 1: 3 kW Range 2: 5 kW	Range 1: 3 kW Range 2: 5 kW	Range 1: 3 kW Range 2: 5 kW
P_{Max} (US208V)	5 kW	5 kW	5 kW	5 kW	5 kW
Phase current (Standard) *3	Range 1: ≤27 A Range 2: ≤24 A	Range 1: ≤27 A Range 2: ≤24 A	Range 1: ≤27 A Range 2: ≤24 A	Range 1: ≤27 A Range 2: ≤24 A	Range 1: ≤27 A Range 2: ≤24 A
Phase current (US208V) *3	≤43 A	≤43 A	≤43 A	≤43 A	≤43 A
Insulation					
Negative DC pole <-> PE	±600 V DC	±1000 V DC	±1000 V DC	±1500 V DC	±1500 V DC
Positive DC pole <-> PE	+600 V DC	+1000 V DC	+1000 V DC	+2000 V DC	+2000 V DC
Product codes					
Standard	33200828	33200829	33200830	33200831	33200832
US208V	33238828	33238829	33238830	33238831	33238832

Technical specifications	ELR 10920-20 *4				
DC input					
Voltage range	0 - 920 V				
U_{Min} for I_{Max}	2.5 V				
Current range	0 - 20 A				
Power range *1	0 - 5000 W (0 - 3000 W)				
Resistance range	1.5 Ω - 3300 Ω				
Input capacitance	120 µF				
Efficiency (up to)	95.5% *2				
AC input					
P_{Max} (Standard)	Range 1: 3 kW Range 2: 5 kW				
P_{Max} (US208V)	5 kW				
Phase current (Standard) *3	Range 1: ≤27 A Range 2: ≤24 A				
Phase current (US208V) *3	≤43 A				
Insulation					
Negative DC pole <-> PE	±1500 V DC				
Positive DC pole <-> PE	+2000 V DC				
Product codes					
Standard	33200852				
US208V	33238852				

*1 The value in brackets applies to the state of derating (power reduction) with 208 V ±10% utility
*2 At 100% power and 100% input voltage
*3 Calculated for the default AC supply voltage in the stated range, minus 10% tolerance, at maximum DC input power and max. efficiency of 96.5%
*4 The data listed below this model name are preliminary

Technical specifications	ELR 10080-340	ELR 10200-140	ELR 10360-80	ELR 10500-60	ELR 10750-40
DC input					
Voltage range	0 - 80 V	0 -200 V	0 - 360 V	0 - 500 V	0 - 750 V
U_{Min} for I_{Max}	0.5 V	2 V	2 V	2.2 V	2.5 V
Current range	0 - 340 A	0 - 140 A	0 - 80 A	0 - 60 A	0 - 40 A
Power range *1	0 - 10000 W (0 - 6000 W)	0 - 10000 W (0 - 6000 W)	0 - 10000 W (0 - 6000 W)	0 - 10000 W (0 - 6000 W)	0 - 10000 W (0 - 6000 W)
Resistance range	0.008 Ω - 13 Ω	0.05 Ω - 80 Ω	0.15 Ω - 260 Ω	0.3 Ω - 500 Ω	0.6 Ω - 1100 Ω
Input capacitance	15980 µF	5040 µF	787 µF	360 µF	360 µF
Efficiency (up to)	94.5% *2	94.5% *2	95.5% *2	95.5% *2	95.5% *2
AC input					
P_{Max} (Standard)	Range 1: 6 kW Range 2: 10 kW	Range 1: 6 kW Range 2: 10 kW	Range 1: 6 kW Range 2: 10 kW	Range 1: 6 kW Range 2: 10 kW	Range 1: 6 kW Range 2: 10 kW
P_{Max} (US208V)	10 kW	10 kW	10 kW	10 kW	10 kW
Phase current (Standard) *3	Range 1: ≤26 A Range 2: ≤24 A	Range 1: ≤26 A Range 2: ≤24 A	Range 1: ≤26 A Range 2: ≤24 A	Range 1: ≤26 A Range 2: ≤24 A	Range 1: ≤26 A Range 2: ≤24 A
Phase current (US208V) *3	≤43 A	≤43 A	≤43 A	≤43 A	≤43 A
Insulation					
Negative DC pole <-> PE	±600 V DC	±1000 V DC	±1000 V DC	±1500 V DC	±1500 V DC
Positive DC pole <-> PE	+600 V DC	+1000 V DC	+1000 V DC	+2000 V DC	+2000 V DC
Product codes					
Standard	33200833	33200834	33200835	33200836	33200837
US208V	33238833	33238834	33238835	33238836	33238837

Technical specifications	ELR 10920-40 *4	ELR 11000-30	ELR 11500-20		
DC input					
Voltage range	0 - 920 V	0 - 1000 V	0 - 1500 V		
U_{Min} for I_{Max}	2.5 V	4 V	5 V		
Current range	0 - 40 A	0 - 30 A	0 - 20 A		
Power range *1	0 - 10000 W (0 - 6000 W)	0 - 10000 W (0 - 6000 W)	0 - 10000 W (0 - 6000 W)		
Resistance range	0.75 Ω - 1600 Ω	1.2 Ω - 2000 Ω	2.6 Ω - 4500 Ω		
Input capacitance	240 µF	197 µF	90 µF		
Efficiency (up to)	95.5% *2	95.5% *2	95.5% *2		
AC input					
P_{Max} (Standard)	Range 1: 6 kW Range 2: 10 kW	Range 1: 6 kW Range 2: 10 kW	Range 1: 6 kW Range 2: 10 kW		
P_{Max} (US208V)	10 kW	10 kW	10 kW		
Phase current (Standard) *3	Range 1: ≤26 A Range 2: ≤24 A	Range 1: ≤26 A Range 2: ≤24 A	Range 1: ≤26 A Range 2: ≤24 A		
Phase current (US208V) *3	≤43 A	≤43 A	≤43 A		
Insulation					
Negative DC pole <-> PE	±1500 V DC	±1500 V DC	±1500 V DC		
Positive DC pole <-> PE	+2000 V DC	+2000 V DC	+2000 V DC		
Product codes					
Standard	33200853	33200838	33200839		
US208V	33238853	33238838	33238839		

*1 The value in brackets applies to the state of derating (power reduction) with 208 V ±10% utility
*2 At 100% power and 100% input voltage
*3 Calculated for the default AC supply voltage in the stated range, minus 10% tolerance, at maximum DC input power and max. efficiency of 96.5%
*4 The data listed below this model name are preliminary

Technical specifications	ELR 10080-510	ELR 10200-210	ELR 10360-120	ELR 10500-90	ELR 10750-60
DC input					
Voltage range	0 - 80 V	0 -200 V	0 - 360 V	0 - 500 V	0 - 750 V
U_{Min} for I_{Max}	0.5 V	2 V	2 V	2 V	2.2 V
Current range	0 - 510 A	0 - 210 A	0 - 120 A	0 - 90 A	0 - 60 A
Power range *1	0 - 15000 W (0 - 9000 W)	0 - 15000 W (0 - 9000 W)	0 - 15000 W (0 - 9000 W)	0 - 15000 W (0 - 9000 W)	0 - 15000 W (0 - 9000 W)
Resistance range	0.006 Ω - 9 Ω	0.03 Ω - 50 Ω	0.1 Ω - 180 Ω	0.2 Ω - 330 Ω	0.4 Ω - 750 Ω
Input capacitance	23970 µF	7560 µF	1180 µF	540 µF	540 µF
Efficiency (up to)	94.5% *2	94.5% *2	95.5% *2	95.5% *2	95.5% *2
AC input					
P_{Max} (Standard)	Range 1: 9 kW Range 2: 15 kW	Range 1: 9 kW Range 2: 15 kW	Range 1: 9 kW Range 2: 15 kW	Range 1: 9 kW Range 2: 15 kW	Range 1: 9 kW Range 2: 15 kW
P_{Max} (US208V)	15 kW	15 kW	15 kW	15 kW	15 kW
Phase current (Standard) *3	Range 1: ≤26 A Range 2: ≤24 A	Range 1: ≤26 A Range 2: ≤24 A	Range 1: ≤26 A Range 2: ≤24 A	Range 1: ≤26 A Range 2: ≤24 A	Range 1: ≤26 A Range 2: ≤24 A
Phase current (US208V) *3	≤43 A	≤43 A	≤43 A	≤43 A	≤43 A
Insulation					
Negative DC pole <-> PE	±600 V DC	±1000 V DC	±1000 V DC	±1500 V DC	±1500 V DC
Positive DC pole <-> PE	+600 V DC	+1000 V DC	+1000 V DC	+2000 V DC	+2000 V DC
Product codes					
Standard	33200820	33200821	33200822	33200823	33200824
US208V	33238820	33238821	33238822	33238823	33238824

Technical specifications	ELR 10920-60 *4	ELR 11000-40	ELR 11500-30	ELR 12000-20	
DC input					
Voltage range	0 - 920 V	0 - 1000 V	0 - 1500 V	0 - 2000 V	
U_{Min} for I_{Max}	2.2 V	5.6 V	5.6 V	7.2 V	
Current range	0 - 60 A	0 - 40 A	0 - 30 A	0 - 20 A	
Power range *1	0 - 15000 W (0 - 9000 W)	0 - 15000 W (0 - 9000 W)	0 - 15000 W (0 - 9000 W)	0 - 15000 W (0 - 9000 W)	
Resistance range	0.5 Ω - 1100 Ω	0.8 Ω - 1300 Ω	1.7 Ω - 3000 Ω	3.5 Ω - 5300 Ω	
Input capacitance	360 µF	131 µF	60 µF	60 µF	
Efficiency (up to)	95.5% *2	95.5% *2	95.5% *2	95.5% *2	
AC input					
P_{Max} (Standard)	Range 1: 9 kW Range 2: 15 kW	Range 1: 9 kW Range 2: 15 kW	Range 1: 9 kW Range 2: 15 kW	Range 1: 9 kW Range 2: 15 kW	
P_{Max} (US208V)	15 kW	15 kW	15 kW	15 kW	
Phase current (Standard) *3	Range 1: ≤26 A Range 2: ≤24 A	Range 1: ≤26 A Range 2: ≤24 A	Range 1: ≤26 A Range 2: ≤24 A	Range 1: ≤26 A Range 2: ≤24 A	
Phase current (US208V) *3	≤43 A	≤43 A	≤43 A	≤43 A	
Insulation					
Negative DC pole <-> PE	±1500 V DC	±1500 V DC	±1500 V DC	±1500 V DC	
Positive DC pole <-> PE	+2000 V DC	+2000 V DC	+2000 V DC	+2000 V DC	
Product codes					
Standard	33200854	33200825	33200826	33200827	
US208V	33238854	33238825	33238826	33238827	

*1 The value in brackets applies to the state of derating (power reduction) with 208 V ±10% utility
*2 At 100% power and 100% input voltage
*3 Calculated for the default AC supply voltage in the stated range, minus 10% tolerance, at maximum DC input power and max. efficiency of 96.5%
*4 The data listed below this model name are preliminary

1.8.3.2 PS 10000 3U series

Technical specifications	PS 10060-170	PS 10080-170	PS 10200-70	PS 10360-40	PS 10500-30
DC output					
Voltage range	0 - 60 V	0 - 80 V	0 -200 V	0 - 360 V	0 - 500 V
Ripple in CV (rms)	≤10 mV (BWL 300 kHz *1)	≤10 mV (BWL 300 kHz *1)	≤40 mV (BWL 300 kHz *1)	≤55 mV (BWL 300 kHz *1)	≤70 mV (BWL 300 kHz *1)
Ripple in CV (pp)	≤100 mV (BWL 20 MHz *1)	≤100 mV (BWL 20 MHz *1)	≤300 mV (BWL 20 MHz *1)	≤320 mV (BWL 20 MHz *1)	≤350 mV (BWL 20 MHz *1)
Current range	0 - 170 A	0 - 170 A	0 - 70 A	0 - 40 A	0 - 30 A
Power range *2	0 - 5000 W (0 - 3000 W)	0 - 5000 W (0 - 3000 W)	0 - 5000 W (0 - 3000 W)	0 - 5000 W (0 - 3000 W)	0 - 5000 W (0 - 3000 W)
Resistance range	0.016 Ω - 26 Ω	0.016 Ω - 26 Ω	0.1 Ω - 160 Ω	0.3 Ω - 520 Ω	0.6 Ω - 1000 Ω
Output capacitance	7990 µF	7990 µF	2520 µF	393 µF	180 µF
Efficiency (up to)	94.5% *3	94.5% *3	94.5% *3	95.5% *3	95.5% *3
AC input					
P_{Max} (Standard)	Range 1: 3.5 kW Range 2: 5.5 kW	Range 1: 3.5 kW Range 2: 5.5 kW	Range 1: 3.5 kW Range 2: 5.5 kW	Range 1: 3.5 kW Range 2: 5.5 kW	Range 1: 3.5 kW Range 2: 5.5 kW
P_{Max} (US208V)	6 kW	6 kW	6 kW	6 kW	6 kW
Phase current (Standard) *4	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A
Phase current (US208V) *4	≤49 A	≤49 A	≤49 A	≤49 A	≤49 A
Insulation					
Negative DC pole <-> PE	±600 V DC	±600 V DC	±1000 V DC	±1000 V DC	±1500 V DC
Positive DC pole <-> PE	+600 V DC	+600 V DC	+1000 V DC	+1000 V DC	+2000 V DC
Product codes					
Standard	06230929	06230930	06230931	06230932	06230933
US208V	06238929	06238930	06238931	06238932	06238933

*1 BWL = Bandwidth limit on the measuring oscilloscope
*2 The value in brackets applies to the state of derating (power reduction) with 208 V ±10% utility
*3 At 100% power and 100% output voltage
*4 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

Technical specifications	PS 10750-20	PS 10920-20 *5			
DC output					
Voltage range	0 - 750 V	0 - 920 V			
Ripple in CV (rms)	≤200 mV (BWL 300 kHz *1)	≤200 mV (BWL 300 kHz *1)			
Ripple in CV (pp)	≤800 mV (BWL 20 MHz *1)	≤800 mV (BWL 20 MHz *1)			
Current range	0 - 20 A	0 - 20 A			
Power range *2	0 - 5000 W (0 - 3000 W)	0 - 5000 W (0 - 3000 W)			
Resistance range	1.2 Ω - 2200 Ω	1.6 Ω - 3300 Ω			
Output capacitance	180 µF	120 µF			
Efficiency (up to)	95.5% *3	95.5% *3			
AC input					
P_{Max} (Standard)	Range 1: 3.5 kW Range 2: 5.5 kW	Range 1: 3.5 kW Range 2: 5.5 kW			
P_{Max} (US208V)	6 kW	6 kW			
Phase current (Standard) *4	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A			
Phase current (US208V) *4	≤49 A	≤49 A			
Insulation					
Negative DC pole <-> PE	±1500 V DC	±1500 V DC			
Positive DC pole <-> PE	+2000 V DC	+2000 V DC			
Product codes					
Standard	06230934	06230957			
US208V	06238934	06238957			

*1 BWL = Bandwidth limit on the measuring oscilloscope
*2 The value in brackets applies to the state of derating (power reduction) with 208 V ±10% utility
*3 At 100% power and 100% output voltage
*4 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
*5 The data listed below this model name are preliminary

Technical specifications	PS 10060-340	PS 10080-340	PS 10200-140	PS 10360-80	PS 10500-60
DC output					
Voltage range	0 - 60 V	0 - 80 V	0 -200 V	0 - 360 V	0 - 500 V
Ripple in CV (rms)	≤10 mV (BWL 300 kHz *1)	≤10 mV (BWL 300 kHz *1)	≤40 mV (BWL 300 kHz *1)	≤55 mV (BWL 300 kHz *1)	≤70 mV (BWL 300 kHz *1)
Ripple in CV (pp)	≤100 mV (BWL 20 MHz *1)	≤100 mV (BWL 20 MHz *1)	≤300 mV (BWL 20 MHz *1)	≤320 mV (BWL 20 MHz *1)	≤350 mV (BWL 20 MHz *1)
Current range	0 - 340 A	0 - 340 A	0 - 140 A	0 - 80 A	0 - 60 A
Power range *2	0 - 10000 W (0 - 6000 W)	0 - 10000 W (0 - 6000 W)	0 - 10000 W (0 - 6000 W)	0 - 10000 W (0 - 6000 W)	0 - 10000 W (0 - 6000 W)
Resistance range	0.008 Ω - 13 Ω	0.008 Ω - 13 Ω	0.05 Ω - 80 Ω	0.15 Ω - 260 Ω	0.3 Ω - 500 Ω
Output capacitance	15980 µF	15980 µF	5040 µF	787 µF	360 µF
Efficiency (up to)	94.5% *3	94.5% *3	94.5% *3	95.5% *3	95.5% *3
AC input					
P_{Max} (Standard)	Range 1: 7 kW Range 2: 11 kW	Range 1: 7 kW Range 2: 11 kW	Range 1: 7 kW Range 2: 11 kW	Range 1: 7 kW Range 2: 11 kW	Range 1: 7 kW Range 2: 11 kW
P_{Max} (US208V)	11 kW	11 kW	11 kW	11 kW	11 kW
Phase current (Standard) *4	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A
Phase current (US208V) *4	≤49 A	≤49 A	≤49 A	≤49 A	≤49 A
Insulation					
Negative DC pole <-> PE	±600 V DC	±600 V DC	±1000 V DC	±1000 V DC	±1500 V DC
Positive DC pole <-> PE	+600 V DC	+600 V DC	+1000 V DC	+1000 V DC	+2000 V DC
Product codes					
Standard	06230935	06230936	06230937	06230938	06230939
US208V	06238935	06238936	06238937	06238938	06238939

*1 BWL = Bandwidth limit on the measuring oscilloscope
*2 The value in brackets applies to the state of derating (power reduction) with 208 V ±10% utility
*3 At 100% power and 100% output voltage
*4 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

Technical specifications	PS 10750-40	PS 10920-40 *5	PS 11000-30	PS 11500-20	
DC output					
Voltage range	0 - 750 V	0 - 920 V	0 - 1000 V	0 - 1500 V	
Ripple in CV (rms)	≤200 mV (BWL 300 kHz *1)	≤200 mV (BWL 300 kHz *1)	≤200 mV (BWL 300 kHz *1)	≤400 mV (BWL 300 kHz *1)	
Ripple in CV (pp)	≤800 mV (BWL 20 MHz *1)	≤800 mV (BWL 20 MHz *1)	≤1000 mV (BWL 20 MHz *1)	≤2000 mV (BWL 20 MHz *1)	
Current range	0 - 40 A	0 - 40 A	0 - 30 A	0 - 20 A	
Power range *2	0 - 10000 W (0 - 6000 W)	0 - 10000 W (0 - 6000 W)	0 - 10000 W (0 - 6000 W)	0 - 10000 W (0 - 6000 W)	
Resistance range	0.6 Ω - 1100 Ω	0.75 Ω - 1600 Ω	1.2 Ω - 2000 Ω	2.6 Ω - 4500 Ω	
Output capacitance	360 µF	240 µF	197 µF	90 µF	
Efficiency (up to)	95.5% *3	95.5% *3	95.5% *3	95.5% *3	
AC input					
P_{Max} (Standard)	Range 1: 7 kW Range 2: 11 kW	Range 1: 7 kW Range 2: 11 kW	Range 1: 7 kW Range 2: 11 kW	Range 1: 7 kW Range 2: 11 kW	
P_{Max} (US208V)	11 kW	11 kW	11 kW	11 kW	
Phase current (Standard) *4	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	
Phase current (US208V) *4	≤49 A	≤49 A	≤49 A	≤49 A	
Insulation					
Negative DC pole <-> PE	±1500 V DC	±1500 V DC	±1500 V DC	±1500 V DC	
Positive DC pole <-> PE	+2000 V DC	+2000 V DC	+2000 V DC	+2000 V DC	
Product codes					
Standard	06230954	06230958	06230955	06230956	
US208V	06238954	06238958	06238955	06238956	

*1 BWL = Bandwidth limit on the measuring oscilloscope
*2 The value in brackets applies to the state of derating (power reduction) with 208 V ±10% utility
*3 At 100% power and 100% output voltage
*4 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
*5 The data listed below this model name are preliminary

Technical specifications	PS 10060-510	PS 10080-510	PS 10200-210	PS 10360-120	PS 10500-90
DC output					
Voltage range	0 - 60 V	0 - 80 V	0 -200 V	0 - 360 V	0 - 500 V
Ripple in CV (rms)	≤10 mV (BWL 300 kHz *1)	≤10 mV (BWL 300 kHz *1)	≤40 mV (BWL 300 kHz *1)	≤55 mV (BWL 300 kHz *1)	≤70 mV (BWL 300 kHz *1)
Ripple in CV (pp)	≤100 mV (BWL 20 MHz *1)	≤100 mV (BWL 20 MHz *1)	≤300 mV (BWL 20 MHz *1)	≤320 mV (BWL 20 MHz *1)	≤350 mV (BWL 20 MHz *1)
Current range	0 - 510 A	0 - 510 A	0 - 210 A	0 - 120 A	0 - 90 A
Power range *2	0 - 15000 W (0 - 9000 W)	0 - 15000 W (0 - 9000 W)	0 - 15000 W (0 - 9000 W)	0 - 15000 W (0 - 9000 W)	0 - 15000 W (0 - 9000 W)
Resistance range	0.006 Ω - 9 Ω	0.006 Ω - 9 Ω	0.03 Ω - 50 Ω	0.1 Ω - 180 Ω	0.2 Ω - 330 Ω
Output capacitance	23970 µF	23970 µF	7560 µF	1180 µF	540 µF
Efficiency (up to)	94.5% *3	94.5% *3	94.5% *3	95.5% *3	95.5% *3
AC input					
P_{Max} (Standard)	Range 1: 10 kW Range 2: 16 kW	Range 1: 10 kW Range 2: 16 kW	Range 1: 10 kW Range 2: 16 kW	Range 1: 10 kW Range 2: 16 kW	Range 1: 10 kW Range 2: 16 kW
P_{Max} (US208V)	16 kW	16 kW	16 kW	16 kW	16 kW
Phase current (Standard) *4	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A
Phase current (US208V) *4	≤49 A	≤49 A	≤49 A	≤49 A	≤49 A
Insulation					
Negative DC pole <-> PE	±600 V DC	±600 V DC	±1000 V DC	±1000 V DC	±1500 V DC
Positive DC pole <-> PE	+600 V DC	+600 V DC	+1000 V DC	+1000 V DC	+2000 V DC
Product codes					
Standard	06230920	06230921	06230922	06230923	06230924
US208V	06238920	06238921	06238922	06238923	06238924

*1 BWL = Bandwidth limit on the measuring oscilloscope
*2 The value in brackets applies to the state of derating (power reduction) with 208 V ±10% utility
*3 At 100% power and 100% output voltage
*4 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

Technical specifications	PS 10750-60	PS 10920-60 *5	PS 11000-40	PS 11500-30	PS 12000-20
DC output					
Voltage range	0 - 750 V	0 - 920 V	0 - 1000 V	0 - 1500 V	0 - 2000 V
Ripple in CV (rms)	≤200 mV (BWL 300 kHz *1)	≤200 mV (BWL 300 kHz *1)	≤300 mV (BWL 300 kHz *1)	≤400 mV (BWL 300 kHz *1)	≤400 mV (BWL 300 kHz *1)
Ripple in CV (pp)	≤800 mV (BWL 20 MHz *1)	≤800 mV (BWL 20 MHz *1)	≤1600 mV (BWL 20 MHz *1)	≤2400 mV (BWL 20 MHz *1)	≤2400 mV (BWL 20 MHz *1)
Current range	0 - 60 A	0 - 60 A	0 - 40 A	0 - 30 A	0 - 20 A
Power range *2	0 - 15000 W (0 - 9000 W)	0 - 15000 W (0 - 9000 W)	0 - 15000 W (0 - 9000 W)	0 - 15000 W (0 - 9000 W)	0 - 15000 W (0 - 9000 W)
Resistance range	0.4 Ω - 750 Ω	0.5 Ω - 1100 Ω	0.8 Ω - 1300 Ω	1.7 Ω - 3000 Ω	3.5 Ω - 5300 Ω
Output capacitance	540 µF	360 µF	131 µF	60 µF	60 µF
Efficiency (up to)	95.5% *3	95.5% *3	95.5% *3	95.5% *3	95.5% *3
AC input					
P_{Max} (Standard)	Range 1: 10 kW Range 2: 16 kW	Range 1: 10 kW Range 2: 16 kW	Range 1: 10 kW Range 2: 16 kW	Range 1: 10 kW Range 2: 16 kW	Range 1: 10 kW Range 2: 16 kW
P_{Max} (US208V)	16 kW	16 kW	16 kW	16 kW	16 kW
Phase current (Standard) *4	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A
Phase current (US208V) *4	≤49 A	≤49 A	≤49 A	≤49 A	≤49 A
Insulation					
Negative DC pole <-> PE	±1500 V DC	±1500 V DC	±1500 V DC	±1500 V DC	±1500 V DC
Positive DC pole <-> PE	+2000 V DC	+2000 V DC	+2000 V DC	+2000 V DC	+2000 V DC
Product codes					
Standard	06230925	06230959	06230926	06230927	06230928
US208V	06238925	06238959	06238926	06238927	06238928

*1 BWL = Bandwidth limit on the measuring oscilloscope
*2 The value in brackets applies to the state of derating (power reduction) with 208 V ±10% utility
*3 At 100% power and 100% output voltage
*4 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
*5 The data listed below this model name are preliminary

1.8.3.3 PSI 10000 3U series

Technical specifications	PSI 10060-170	PSI 10080-170	PSI 10200-70	PSI 10360-40	PSI 10500-30
DC output					
Voltage range	0 - 60 V	0 - 80 V	0 -200 V	0 - 360 V	0 - 500 V
Ripple in CV (rms)	≤10 mV (BW 300 kHz *1)	≤10 mV (BW 300 kHz *1)	≤40 mV (BW 300 kHz *1)	≤55 mV (BW 300 kHz *1)	≤70 mV (BW 300 kHz *1)
Ripple in CV (pp)	≤100 mV (BW 20 MHz *1)	≤100 mV (BW 20 MHz *1)	≤300 mV (BW 20 MHz *1)	≤320 mV (BW 20 MHz *1)	≤350 mV (BW 20 MHz *1)
Current range	0 - 170 A	0 - 170 A	0 - 70 A	0 - 40 A	0 - 30 A
Power range *2	0 - 5000 W (0 - 3000 W)	0 - 5000 W (0 - 3000 W)	0 - 5000 W (0 - 3000 W)	0 - 5000 W (0 - 3000 W)	0 - 5000 W (0 - 3000 W)
Resistance range	0.016 Ω - 26 Ω	0.016 Ω - 26 Ω	0.1 Ω - 160 Ω	0.3 Ω - 520 Ω	0.6 Ω - 1000 Ω
Output capacitance	7990 µF	7990 µF	2520 µF	393 µF	180 µF
Efficiency (up to)	94.5% *3	94.5% *3	94.5% *3	95.5% *3	95.5% *3
AC input					
P_{Max} (Standard)	Range 1: 3.5 kW Range 2: 5.5 kW	Range 1: 3.5 kW Range 2: 5.5 kW	Range 1: 3.5 kW Range 2: 5.5 kW	Range 1: 3.5 kW Range 2: 5.5 kW	Range 1: 3.5 kW Range 2: 5.5 kW
P_{Max} (US208V)	6 kW	6 kW	6 kW	6 kW	6 kW
Phase current (Standard) *4	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A
Phase current (US208V) *4	≤49 A	≤49 A	≤49 A	≤49 A	≤49 A
Insulation					
Negative DC pole <-> PE	±600 V DC	±600 V DC	±1000 V DC	±1000 V DC	±1500 V DC
Positive DC pole <-> PE	+600 V DC	+600 V DC	+1000 V DC	+1000 V DC	+2000 V DC
Product codes					
Standard	06230829	06230830	06230831	06230832	06230833
US208V	06238829	06238830	06238831	06238832	06238833

*1 BWL = Bandwidth limit on the measuring oscilloscope
*2 The value in brackets applies to the state of derating (power reduction) with 208 V ±10% utility
*3 At 100% power and 100% output voltage
*4 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

Technical specifications	PSI 10750-20	PSI 10920-20 *5			
DC output					
Voltage range	0 - 750 V	0 - 920 V			
Ripple in CV (rms)	≤200 mV (BW 300 kHz *1)	≤200 mV (BW 300 kHz *1)			
Ripple in CV (pp)	≤800 mV (BW 20 MHz *1)	≤800 mV (BW 20 MHz *1)			
Current range	0 - 20 A	0 - 20 A			
Power range *2	0 - 5000 W (0 - 3000 W)	0 - 5000 W (0 - 3000 W)			
Resistance range	1.2 Ω - 2200 Ω	1.6 Ω - 3300 Ω			
Output capacitance	180 µF	120 µF			
Efficiency (up to)	95.5% *3	95.5% *3			
AC input					
P_{Max} (Standard)	Range 1: 3.5 kW Range 2: 5.5 kW	Range 1: 3.5 kW Range 2: 5.5 kW			
P_{Max} (US208V)	6 kW	6 kW			
Phase current (Standard) *4	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A			
Phase current (US208V) *4	≤49 A	≤49 A			
Insulation					
Negative DC pole <-> PE	±1500 V DC	±1500 V DC			
Positive DC pole <-> PE	+2000 V DC	+2000 V DC			
Product codes					
Standard	06230834	06230857			
US208V	06238834	06238857			

*1 BWL = Bandwidth limit on the measuring oscilloscope
*2 The value in brackets applies to the state of derating (power reduction) with 208 V ±10% utility
*3 At 100% power and 100% output voltage
*4 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
*5 The data listed below this model name are preliminary

Technical specifications	PSI 10060-340	PSI 10080-340	PSI 10200-140	PSI 10360-80	PSI 10500-60
DC output					
Voltage range	0 - 60 V	0 - 80 V	0 -200 V	0 - 360 V	0 - 500 V
Ripple in CV (rms)	≤10 mV (BW 300 kHz *1)	≤10 mV (BW 300 kHz *1)	≤40 mV (BW 300 kHz *1)	≤55 mV (BW 300 kHz *1)	≤70 mV (BW 300 kHz *1)
Ripple in CV (pp)	≤100 mV (BW 20 MHz *1)	≤100 mV (BW 20 MHz *1)	≤300 mV (BW 20 MHz *1)	≤320 mV (BW 20 MHz *1)	≤350 mV (BW 20 MHz *1)
Current range	0 - 340 A	0 - 340 A	0 - 140 A	0 - 80 A	0 - 60 A
Power range *2	0 - 10000 W (0 - 6000 W)	0 - 10000 W (0 - 6000 W)	0 - 10000 W (0 - 6000 W)	0 - 10000 W (0 - 6000 W)	0 - 10000 W (0 - 6000 W)
Resistance range	0.008 Ω - 13 Ω	0.008 Ω - 13 Ω	0.05 Ω - 80 Ω	0.15 Ω - 260 Ω	0.3 Ω - 500 Ω
Output capacitance	15980 µF	15980 µF	5040 µF	787 µF	360 µF
Efficiency (up to)	94.5% *3	94.5% *3	94.5% *3	95.5% *3	95.5% *3
AC input					
P_{Max} (Standard)	Range 1: 7 kW Range 2: 11 kW	Range 1: 7 kW Range 2: 11 kW	Range 1: 7 kW Range 2: 11 kW	Range 1: 7 kW Range 2: 11 kW	Range 1: 7 kW Range 2: 11 kW
P_{Max} (US208V)	11 kW	11 kW	11 kW	11 kW	11 kW
Phase current (Standard) *4	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A
Phase current (US208V) *4	≤49 A	≤49 A	≤49 A	≤49 A	≤49 A
Insulation					
Negative DC pole <-> PE	±600 V DC	±600 V DC	±1000 V DC	±1000 V DC	±1500 V DC
Positive DC pole <-> PE	+600 V DC	+600 V DC	+1000 V DC	+1000 V DC	+2000 V DC
Product codes					
Standard	06230835	06230836	06230837	06230838	06230839
US208V	06238835	06238836	06238837	06238838	06238839

*1 BWL = Bandwidth limit on the measuring oscilloscope
*2 The value in brackets applies to the state of derating (power reduction) with 208 V ±10% utility
*3 At 100% power and 100% output voltage
*4 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

Technical specifications	PSI 10750-40	PSI 10920-40 *5	PSI 11000-30	PSI 11500-20	
DC output					
Voltage range	0 - 750 V	0 - 920 V	0 - 1000 V	0 - 1500 V	
Ripple in CV (rms)	≤200 mV (BW 300 kHz *1)	≤200 mV (BW 300 kHz *1)	≤200 mV (BW 300 kHz *1)	≤400 mV (BW 300 kHz *1)	
Ripple in CV (pp)	≤800 mV (BW 20 MHz *1)	≤800 mV (BW 20 MHz *1)	≤1000 mV (BW 20 MHz *1)	≤2000 mV (BW 20 MHz *1)	
Current range	0 - 40 A	0 - 40 A	0 - 30 A	0 - 20 A	
Power range *2	0 - 10000 W (0 - 6000 W)	0 - 10000 W (0 - 6000 W)	0 - 10000 W (0 - 6000 W)	0 - 10000 W (0 - 6000 W)	
Resistance range	0.6 Ω - 1100 Ω	0.75 Ω - 1600 Ω	1.2 Ω - 2000 Ω	2.6 Ω - 4500 Ω	
Output capacitance	360 µF	240 µF	197 µF	90 µF	
Efficiency (up to)	95.5% *3	95.5% *3	95.5% *3	95.5% *3	
AC input					
P_{Max} (Standard)	Range 1: 7 kW Range 2: 11 kW	Range 1: 7 kW Range 2: 11 kW	Range 1: 7 kW Range 2: 11 kW	Range 1: 7 kW Range 2: 11 kW	
P_{Max} (US208V)	11 kW	11 kW	11 kW	11 kW	
Phase current (Standard) *4	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	
Phase current (US208V) *4	≤49 A	≤49 A	≤49 A	≤49 A	
Insulation					
Negative DC pole <-> PE	±1500 V DC	±1500 V DC	±1500 V DC	±1500 V DC	
Positive DC pole <-> PE	+2000 V DC	+2000 V DC	+2000 V DC	+2000 V DC	
Product codes					
Standard	06230854	06230858	06230855	06230856	
US208V	06238854	06238858	06238855	06238856	

*1 BWL = Bandwidth limit on the measuring oscilloscope
*2 The value in brackets applies to the state of derating (power reduction) with 208 V ±10% utility
*3 At 100% power and 100% output voltage
*4 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
*5 The data listed below this model name are preliminary

Technical specifications	PSI 10060-510	PSI 10080-510	PSI 10200-210	PSI 10360-120	PSI 10500-90
DC output					
Voltage range	0 - 60 V	0 - 80 V	0 -200 V	0 - 360 V	0 - 500 V
Ripple in CV (rms)	≤10 mV (BW 300 kHz *1)	≤10 mV (BW 300 kHz *1)	≤40 mV (BW 300 kHz *1)	≤55 mV (BW 300 kHz *1)	≤70 mV (BW 300 kHz *1)
Ripple in CV (pp)	≤100 mV (BW 20 MHz *1)	≤100 mV (BW 20 MHz *1)	≤300 mV (BW 20 MHz *1)	≤320 mV (BW 20 MHz *1)	≤350 mV (BW 20 MHz *1)
Current range	0 - 510 A	0 - 510 A	0 - 210 A	0 - 120 A	0 - 90 A
Power range *2	0 - 15000 W (0 - 9000 W)	0 - 15000 W (0 - 9000 W)	0 - 15000 W (0 - 9000 W)	0 - 15000 W (0 - 9000 W)	0 - 15000 W (0 - 9000 W)
Resistance range	0.006 Ω - 9 Ω	0.006 Ω - 9 Ω	0.03 Ω - 50 Ω	0.1 Ω - 180 Ω	0.2 Ω - 330 Ω
Output capacitance	23970 µF	23970 µF	7560 µF	1180 µF	540 µF
Efficiency (up to)	94.5% *3	94.5% *3	94.5% *3	95.5% *3	95.5% *3
AC input					
P_{Max} (Standard)	Range 1: 10 kW Range 2: 16 kW	Range 1: 10 kW Range 2: 16 kW	Range 1: 10 kW Range 2: 16 kW	Range 1: 10 kW Range 2: 16 kW	Range 1: 10 kW Range 2: 16 kW
P_{Max} (US208V)	16 kW	16 kW	16 kW	16 kW	16 kW
Phase current (Standard) *4	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A
Phase current (US208V) *4	≤49 A	≤49 A	≤49 A	≤49 A	≤49 A
Insulation					
Negative DC pole <-> PE	±600 V DC	±600 V DC	±1000 V DC	±1000 V DC	±1500 V DC
Positive DC pole <-> PE	+600 V DC	+600 V DC	+1000 V DC	+1000 V DC	+2000 V DC
Product codes					
Standard	06230820	06230821	06230822	06230823	06230824
US208V	06238820	06238821	06238822	06238823	06238824

*1 BWL = Bandwidth limit on the measuring oscilloscope
*2 The value in brackets applies to the state of derating (power reduction) with 208 V ±10% utility
*3 At 100% power and 100% output voltage
*4 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

Technical specifications	PSI 10750-60	PSI 10920-60 *5	PSI 11000-40	PSI 11500-30	PSI 12000-20
DC output					
Voltage range	0 - 750 V	0 - 920 V	0 - 1000 V	0 - 1500 V	0 - 2000 V
Ripple in CV (rms)	≤200 mV (BW 300 kHz *1)	≤200 mV (BW 300 kHz *1)	≤300 mV (BW 300 kHz *1)	≤400 mV (BW 300 kHz *1)	≤400 mV (BW 300 kHz *1)
Ripple in CV (pp)	≤800 mV (BW 20 MHz *1)	≤800 mV (BW 20 MHz *1)	≤1600 mV (BW 20 MHz *1)	≤2400 mV (BW 20 MHz *1)	≤2400 mV (BW 20 MHz *1)
Current range	0 - 60 A	0 - 60 A	0 - 40 A	0 - 30 A	0 - 20 A
Power range *2	0 - 15000 W (0 - 9000 W)	0 - 15000 W (0 - 9000 W)	0 - 15000 W (0 - 9000 W)	0 - 15000 W (0 - 9000 W)	0 - 15000 W (0 - 9000 W)
Resistance range	0.4 Ω - 750 Ω	0.5 Ω - 1100 Ω	0.8 Ω - 1300 Ω	1.7 Ω - 3000 Ω	3.5 Ω - 5300 Ω
Output capacitance	540 µF	360 µF	131 µF	60 µF	60 µF
Efficiency (up to)	95.5% *3	95.5% *3	95.5% *3	95.5% *3	95.5% *3
AC input					
P_{Max} (Standard)	Range 1: 10 kW Range 2: 16 kW	Range 1: 10 kW Range 2: 16 kW	Range 1: 10 kW Range 2: 16 kW	Range 1: 10 kW Range 2: 16 kW	Range 1: 10 kW Range 2: 16 kW
P_{Max} (US208V)	16 kW	16 kW	16 kW	16 kW	16 kW
Phase current (Standard) *4	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A
Phase current (US208V) *4	≤49 A	≤49 A	≤49 A	≤49 A	≤49 A
Insulation					
Negative DC pole <-> PE	±1500 V DC	±1500 V DC	±1500 V DC	±1500 V DC	±1500 V DC
Positive DC pole <-> PE	+2000 V DC	+2000 V DC	+2000 V DC	+2000 V DC	+2000 V DC
Product codes					
Standard	06230825	06230859	06230826	06230827	06230828
US208V	06238825	06238859	06238826	06238827	06238828

*1 BWL = Bandwidth limit on the measuring oscilloscope
*2 The value in brackets applies to the state of derating (power reduction) with 208 V ±10% utility
*3 At 100% power and 100% output voltage
*4 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
*5 The data listed below this model name are preliminary

1.8.3.4 PSB 10000 3U series

Technical specifications	PSB 10060-170	PSB 10080-170	PSB 10200-70	PSB 10360-40	PSB 10500-30
DC output					
Voltage range	0 - 60 V	0 - 80 V	0 -200 V	0 - 360 V	0 - 500 V
Ripple in CV (rms)	≤10 mV (300 kHz*1)	≤10 mV (300 kHz*1)	≤40 mV (300 kHz*1)	≤55 mV (300 kHz*1)	≤70 mV (300 kHz*1)
Ripple in CV (pp)	≤100 mV (20 MHz*1)	≤100 mV (20 MHz*1)	≤300 mV (20 MHz*1)	≤320 mV (20 MHz*1)	≤350 mV (20 MHz*1)
U_{Min} for I_{Max} (sink)	0.5 V	0.5 V	2 V	2 V	2.2 V
Current range	0 - 170 A	0 - 170 A	0 - 70 A	0 - 40 A	0 - 30 A
Power range *2	0 - 5000 W (0 - 3000 W)	0 - 5000 W (0 - 3000 W)	0 - 5000 W (0 - 3000 W)	0 - 5000 W (0 - 3000 W)	0 - 5000 W (0 - 3000 W)
Resistance range	0.016 Ω - 26 Ω	0.016 Ω - 26 Ω	0.1 Ω - 160 Ω	0.3 Ω - 520 Ω	0.6 Ω - 1000 Ω
Output capacitance	7790 µF	7790 µF	2520 µF	393 µF	180 µF
Efficiency sink/source (up to)	94.5% *3	94.5% *3	94.5% *3	95.5% *3	95.5% *3
AC input					
P_{Max} (Standard)	Range 1: 3.5 kW Range 2: 5.5 kW	Range 1: 3.5 kW Range 2: 5.5 kW	Range 1: 3.5 kW Range 2: 5.5 kW	Range 1: 3.5 kW Range 2: 5.5 kW	Range 1: 3.5 kW Range 2: 5.5 kW
P_{Max} (US208V)	6 kW	6 kW	6 kW	6 kW	6 kW
Phase current (Standard) *4	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A
Phase current (US208V) *4	≤49 A	≤49 A	≤49 A	≤49 A	≤49 A
Insulation					
Negative DC pole <-> PE	±600 V DC	±600 V DC	±1000 V DC	±1000 V DC	±1500 V DC
Positive DC pole <-> PE	+600 V DC	+600 V DC	+1000 V DC	+1000 V DC	+2000 V DC
Product codes					
Standard	30000737	30000738	30000739	30000740	30000741
US208V	30238737	30238738	30238739	30238740	30238741

*1 BWL = Bandwidth limit on the measuring oscilloscope
*2 The value in brackets applies to the state of derating (power reduction) when standard models run on 208 V ±10% utility
*3 At 100% power and 100% output voltage
*4 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

Technical specifications	PSB 10750-20	PSB 10920-20 *5			
DC output					
Voltage range	0 - 750 V	0 - 920 V			
Ripple in CV (rms)	≤200 mV (300 kHz*1)	≤200 mV (300 kHz*1)			
Ripple in CV (pp)	≤800 mV (20 MHz*1)	≤800 mV (20 MHz*1)			
U_{Min} for I_{Max} (sink)	2.5 V	2.5 V			
Current range	0 - 20 A	0 - 20 A			
Power range *2	0 - 5000 W (0 - 3000 W)	0 - 5000 W (0 - 3000 W)			
Resistance range	1.2 Ω - 2200 Ω	1.5 Ω - 3300 Ω			
Output capacitance	180 µF	120 µF			
Efficiency sink/source (up to)	95.5% *3	95.5% *3			
AC input					
P_{Max} (Standard)	Range 1: 3.5 kW Range 2: 5.5 kW	Range 1: 3.5 kW Range 2: 5.5 kW			
P_{Max} (US208V)	6 kW	6 kW			
Phase current (Standard) *4	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A			
Phase current (US208V) *4	≤49 A	≤49 A			
Insulation					
Negative DC pole <-> PE	±1500 V DC	±1500 V DC			
Positive DC pole <-> PE	+2000 V DC	+2000 V DC			
Product codes					
Standard	30000742	30000768			
US208V	30238742	30238768			

*1 BWL = Bandwidth limit on the measuring oscilloscope
*2 The value in brackets applies to the state of derating (power reduction) when standard models run on 208 V ±10% utility
*3 At 100% power and 100% output voltage
*4 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
*5 The data listed below this model name are preliminary

Technical specifications	PSB 10060-340	PSB 10080-340	PSB 10200-140	PSB 10360-80	PSB 10500-60
DC output					
Voltage range	0 - 60 V	0 - 80 V	0 -200 V	0 - 360 V	0 - 500 V
Ripple in CV (rms)	≤10 mV (300 kHz*1)	≤10 mV (300 kHz*1)	≤40 mV (300 kHz*1)	≤55 mV (300 kHz*1)	≤70 mV (300 kHz*1)
Ripple in CV (pp)	≤100 mV (20 MHz*1)	≤100 mV (20 MHz*1)	≤300 mV (20 MHz*1)	≤320 mV (20 MHz*1)	≤350 mV (20 MHz*1)
U_{Min} for I_{Max} (sink)	0.5 V	0.5 V	2 V	2 V	2.2 V
Current range	0 - 340 A	0 - 340 A	0 - 140 A	0 - 80 A	0 - 60 A
Power range *2	0 - 10000 W (0 - 6000 W)	0 - 10000 W (0 - 6000 W)	0 - 10000 W (0 - 6000 W)	0 - 10000 W (0 - 6000 W)	0 - 10000 W (0 - 6000 W)
Resistance range	0.008 Ω - 13 Ω	0.008 Ω - 13 Ω	0.05 Ω - 80 Ω	0.15 Ω - 260 Ω	0.3 Ω - 500 Ω
Output capacitance	15980 µF	15980 µF	5040 µF	787 µF	360 µF
Efficiency sink/source (up to)	94.5% *3	94.5% *3	94.5% *3	95.5% *3	95.5% *3
AC input					
P_{Max} (Standard)	Range 1: 7 kW Range 2: 11 kW	Range 1: 7 kW Range 2: 11 kW	Range 1: 7 kW Range 2: 11 kW	Range 1: 7 kW Range 2: 11 kW	Range 1: 7 kW Range 2: 11 kW
P_{Max} (US208V)	11 kW	11 kW	11 kW	11 kW	11 kW
Phase current (Standard) *4	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A
Phase current (US208V) *4	≤49 A	≤49 A	≤49 A	≤49 A	≤49 A
Insulation					
Negative DC pole <-> PE	±600 V DC	±600 V DC	±1000 V DC	±1000 V DC	±1500 V DC
Positive DC pole <-> PE	+600 V DC	+600 V DC	+1000 V DC	+1000 V DC	+2000 V DC
Product codes					
Standard	30000744	30000745	30000746	30000747	30000748
US208V	30238744	30238745	30238746	30238747	30238748

*1 BWL = Bandwidth limit on the measuring oscilloscope
*2 The value in brackets applies to the state of derating (power reduction) when standard models run on 208 V ±10% utility
*3 At 100% power and 100% output voltage
*4 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

Technical specifications	PSB 10750-40	PSB 10920-40 *5	PSB 11000-30	PSB 11500-20	
DC output					
Voltage range	0 - 750 V	0 - 920 V	0 - 1000 V	0 - 1500 V	
Ripple in CV (rms)	≤200 mV (300 kHz*1)	≤200 mV (300 kHz*1)	≤200 mV (300 kHz*1)	≤400 mV (300 kHz*1)	
Ripple in CV (pp)	≤800 mV (20 MHz*1)	≤800 mV (20 MHz*1)	≤1000 mV (20 MHz*1)	≤2000 mV (20 MHz*1)	
U_{Min} for I_{Max} (sink)	2.5 V	2.5 V	4 V	5 V	
Current range	0 - 40 A	0 - 40 A	0 - 30 A	0 - 20 A	
Power range *2	0 - 10000 W (0 - 6000 W)	0 - 10000 W (0 - 6000 W)	0 - 10000 W (0 - 6000 W)	0 - 10000 W (0 - 6000 W)	
Resistance range	0.6 Ω - 1100 Ω	0.75 Ω - 1600 Ω	1.2 Ω - 2000 Ω	2.6 Ω - 4500 Ω	
Output capacitance	360 µF	240 µF	197 µF	90 µF	
Efficiency sink/source (up to)	95.5% *3	95.5% *3	95.5% *3	95.5% *3	
AC input					
P_{Max} (Standard)	Range 1: 7 kW Range 2: 11 kW	Range 1: 7 kW Range 2: 11 kW	Range 1: 7 kW Range 2: 11 kW	Range 1: 7 kW Range 2: 11 kW	
P_{Max} (US208V)	11 kW	11 kW	11 kW	11 kW	
Phase current (Standard) *4	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	
Phase current (US208V) *4	≤49 A	≤49 A	≤49 A	≤49 A	
Insulation					
Negative DC pole <-> PE	±1500 V DC	±1500 V DC	±1500 V DC	±1500 V DC	
Positive DC pole <-> PE	+2000 V DC	+2000 V DC	+2000 V DC	+2000 V DC	
Product codes					
Standard	30000749	30000769	30000750	30000751	
US208V	30238749	30238769	30238750	30238751	

*1 BWL = Bandwidth limit on the measuring oscilloscope
*2 The value in brackets applies to the state of derating (power reduction) when standard models run on 208 V ±10% utility
*3 At 100% power and 100% output voltage
*4 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
*5 The data listed below this model name are preliminary

Technical specifications	PSB 10060-510	PSB 10080-510	PSB 10200-210	PSB 10360-120	PSB 10500-90
DC output					
Voltage range	0 - 60 V	0 - 80 V	0 -200 V	0 - 360 V	0 - 500 V
Ripple in CV (rms)	≤10 mV (300 kHz*1)	≤10 mV (300 kHz*1)	≤40 mV (300 kHz*1)	≤55 mV (300 kHz*1)	≤70 mV (300 kHz*1)
Ripple in CV (pp)	≤100 mV (20 MHz*1)	≤100 mV (20 MHz*1)	≤300 mV (20 MHz*1)	≤320 mV (20 MHz*1)	≤350 mV (20 MHz*1)
U_{Min} for I_{Max} (sink)	0.5 V	0.5 V	2 V	2 V	2.2 V
Current range	0 - 510 A	0 - 510 A	0 - 210 A	0 - 120 A	0 - 90 A
Power range *2	0 - 15000 W (0 - 9000 W)	0 - 15000 W (0 - 9000 W)	0 - 15000 W (0 - 9000 W)	0 - 15000 W (0 - 9000 W)	0 - 15000 W (0 - 9000 W)
Resistance range	0.006 Ω - 9 Ω	0.006 Ω - 9 Ω	0.03 Ω - 50 Ω	0.1 Ω - 180 Ω	0.2 Ω - 330 Ω
Output capacitance	23970 µF	23970 µF	7560 µF	1180 µF	540 µF
Efficiency sink/source (up to)	94.5% *3	94.5% *3	94.5% *3	95.5% *3	95.5% *3
AC input					
P_{Max} (Standard)	Range 1: 10 kW Range 2: 16 kW	Range 1: 10 kW Range 2: 16 kW	Range 1: 10 kW Range 2: 16 kW	Range 1: 10 kW Range 2: 16 kW	Range 1: 10 kW Range 2: 16 kW
P_{Max} (US208V)	16 kW	16 kW	16 kW	16 kW	16 kW
Phase current (Standard) *4	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A
Phase current (US208V) *4	≤49 A	≤49 A	≤49 A	≤49 A	≤49 A
Insulation					
Negative DC pole <-> PE	±600 V DC	±600 V DC	±1000 V DC	±1000 V DC	±1500 V DC
Positive DC pole <-> PE	+600 V DC	+600 V DC	+1000 V DC	+1000 V DC	+2000 V DC
Product codes					
Standard	30000700	30000701	30000702	30000703	30000704
US208V	30238700	30238701	30238702	30238703	30238704

*1 BWL = Bandwidth limit on the measuring oscilloscope
*2 The value in brackets applies to the state of derating (power reduction) when standard models run on 208 V ±10% utility
*3 At 100% power and 100% output voltage
*4 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

Technical specifications	PSB 10750-60	PSB 10920-60 *5	PSB 11000-40	PSB 11500-30	PSB 12000-20
DC output					
Voltage range	0 - 750 V	0 - 920 V	0 - 1000 V	0 - 1500 V	0 - 2000 V
Ripple in CV (rms)	≤200 mV (300 kHz*1)	≤200 mV (300 kHz*1)	≤300 mV (300 kHz*1)	≤400 mV (300 kHz*1)	≤400 mV (300 kHz*1)
Ripple in CV (pp)	≤800 mV (20 MHz*1)	≤800 mV (20 MHz*1)	≤1600 mV (20 MHz*1)	≤2400 mV (20 MHz*1)	≤2400 mV (20 MHz*1)
U_{Min} for I_{Max} (sink)	2.5 V	2.5 V	5.6 V	5.6 V	7.2 V
Current range	0 - 60 A	0 - 60 A	0 - 40 A	0 - 30 A	0 - 20 A
Power range *2	0 - 15000 W (0 - 9000 W)	0 - 15000 W (0 - 9000 W)	0 - 15000 W (0 - 9000 W)	0 - 15000 W (0 - 9000 W)	0 - 15000 W (0 - 9000 W)
Resistance range	0.4 Ω - 750 Ω	0.5 Ω - 1100 Ω	0.8 Ω - 1300 Ω	1.7 Ω - 3000 Ω	3.5 Ω - 5300 Ω
Output capacitance	540 µF	360 µF	131 µF	60 µF	60 µF
Efficiency sink/source (up to)	95.5% *3	95.5% *3	95.5% *3	95.5% *3	95.5% *3
AC input					
P_{Max} (Standard)	Range 1: 10 kW Range 2: 16 kW	Range 1: 10 kW Range 2: 16 kW	Range 1: 10 kW Range 2: 16 kW	Range 1: 10 kW Range 2: 16 kW	Range 1: 10 kW Range 2: 16 kW
P_{Max} (US208V)	16 kW	16 kW	16 kW	16 kW	16 kW
Phase current (Standard) *4	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A
Phase current (US208V) *4	≤49 A	≤49 A	≤49 A	≤49 A	≤49 A
Insulation					
Negative DC pole <-> PE	±1500 V DC	±1500 V DC	±1500 V DC	±1500 V DC	±1500 V DC
Positive DC pole <-> PE	+2000 V DC	+2000 V DC	+2000 V DC	+2000 V DC	+2000 V DC
Product codes					
Standard	30000705	30000770	30000706	30000707	30000708
US208V	30238705	30238770	30238706	30238707	30238708

*1 BWL = Bandwidth limit on the measuring oscilloscope
*2 The value in brackets applies to the state of derating (power reduction) when standard models run on 208 V ±10% utility
*3 At 100% power and 100% output voltage
*4 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
*5 The data listed below this model name are preliminary

1.8.3.5 PSBE 10000 3U series

Technical specifications	PSBE 10060-170	PSBE 10080-170	PSBE 10200-70	PSBE 10360-40	PSBE 10500-30
DC output					
Voltage range	0 - 60 V	0 - 80 V	0 -200 V	0 - 360 V	0 - 500 V
Ripple in CV (rms)	≤10 mV (300 kHz*1)	≤10 mV (300 kHz*1)	≤40 mV (300 kHz*1)	≤55 mV (300 kHz*1)	≤70 mV (300 kHz*1)
Ripple in CV (pp)	≤100 mV (20 MHz*1)	≤100 mV (20 MHz*1)	≤300 mV (20 MHz*1)	≤320 mV (20 MHz*1)	≤350 mV (20 MHz*1)
U_{Min} for I_{Max} (sink)	0.5 V	0.5 V	2 V	2 V	2.2 V
Current range	0 - 170 A	0 - 170 A	0 - 70 A	0 - 40 A	0 - 30 A
Power range *2	0 - 5000 W (0 - 3000 W)	0 - 5000 W (0 - 3000 W)	0 - 5000 W (0 - 3000 W)	0 - 5000 W (0 - 3000 W)	0 - 5000 W (0 - 3000 W)
Resistance range	0.016 Ω - 26 Ω	0.016 Ω - 26 Ω	0.1 Ω - 160 Ω	0.3 Ω - 520 Ω	0.6 Ω - 1000 Ω
Output capacitance	7990 µF	7990 µF	2520 µF	393 µF	180 µF
Efficiency sink/source (up to)	94.5% *3	94.5% *3	94.5% *3	95.5% *3	95.5% *3
AC input					
P_{Max}	Range 1: 3.5 kW Range 2: 5.5 kW	Range 1: 3.5 kW Range 2: 5.5 kW	Range 1: 3.5 kW Range 2: 5.5 kW	Range 1: 3.5 kW Range 2: 5.5 kW	Range 1: 3.5 kW Range 2: 5.5 kW
Phase current *4	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A
Insulation					
Negative DC pole <-> PE	±600 V DC	±600 V DC	±1000 V DC	±1000 V DC	±1500 V DC
Positive DC pole <-> PE	+600 V DC	+600 V DC	+1000 V DC	+1000 V DC	+2000 V DC
Product codes					
Standard	30000753	30000754	30000755	30000756	30000757

Technical specifications	PSBE 10750-20	PSBE 10920-20 *5			
DC output					
Voltage range	0 - 750 V	0 - 920 V			
Ripple in CV (rms)	≤200 mV (300 kHz*1)	≤200 mV (300 kHz*1)			
Ripple in CV (pp)	≤800 mV (20 MHz*1)	≤800 mV (20 MHz*1)			
U_{Min} for I_{Max} (sink)	2.5 V	2.5 V			
Current range	0 - 20 A	0 - 20 A			
Power range *2	0 - 5000 W (0 - 3000 W)	0 - 5000 W (0 - 3000 W)			
Resistance range	1.2 Ω - 2200 Ω	1.6 Ω - 3300 Ω			
Output capacitance	180 µF	120 µF			
Efficiency sink/source (up to)	95.5% *3	95.5% *3			
AC input					
P_{Max}	Range 1: 3.5 kW Range 2: 5.5 kW	Range 1: 3.5 kW Range 2: 5.5 kW			
Phase current *4	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A			
Insulation					
Negative DC pole <-> PE	±1500 V DC	±1500 V DC			
Positive DC pole <-> PE	+2000 V DC	+2000 V DC			
Product codes					
Standard	30000758	30000780			

*1 BWL = Bandwidth limit on the measuring oscilloscope
*2 The value in brackets applies to the state of derating (power reduction) when standard models run on 208 V ±10% utility
*3 At 100% power and 100% output voltage
*4 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
*5 The data listed below this model name are preliminary

Technical specifications	PSBE 10060-340	PSBE 10080-340	PSBE 10200-140	PSBE 10360-80	PSBE 10500-60
DC output					
Voltage range	0 - 60 V	0 - 80 V	0 -200 V	0 - 360 V	0 - 500 V
Ripple in CV (rms)	≤10 mV (300 kHz*1)	≤10 mV (300 kHz*1)	≤40 mV (300 kHz*1)	≤55 mV (300 kHz*1)	≤70 mV (300 kHz*1)
Ripple in CV (pp)	≤100 mV (20 MHz*1)	≤100 mV (20 MHz*1)	≤300 mV (20 MHz*1)	≤320 mV (20 MHz*1)	≤350 mV (20 MHz*1)
U_{Min} for I_{Max} (sink)	0.5 V	0.5 V	2 V	2 V	2.2 V
Current range	0 - 340 A	0 - 340 A	0 - 140 A	0 - 80 A	0 - 60 A
Power range *2	0 - 10000 W (0 - 6000 W)	0 - 10000 W (0 - 6000 W)	0 - 10000 W (0 - 6000 W)	0 - 10000 W (0 - 6000 W)	0 - 10000 W (0 - 6000 W)
Resistance range	0.008 Ω - 13 Ω	0.008 Ω - 13 Ω	0.05 Ω - 80 Ω	0.15 Ω - 260 Ω	0.3 Ω - 500 Ω
Output capacitance	15980 µF	15980 µF	5040 µF	787 µF	360 µF
Efficiency sink/source (up to)	94.5% *3	94.5% *3	94.5% *3	95.5% *3	95.5% *3
AC input					
P_{Max}	Range 1: 7 kW Range 2: 11 kW	Range 1: 7 kW Range 2: 11 kW	Range 1: 7 kW Range 2: 11 kW	Range 1: 7 kW Range 2: 11 kW	Range 1: 7 kW Range 2: 11 kW
Phase current *4	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A
Insulation					
Negative DC pole <-> PE	±600 V DC	±600 V DC	±1000 V DC	±1000 V DC	±1500 V DC
Positive DC pole <-> PE	+600 V DC	+600 V DC	+1000 V DC	+1000 V DC	+2000 V DC
Product codes					
Standard	30000760	30000761	30000762	30000763	30000764

Technical specifications	PSBE 10750-40	PSBE 10920-40 *5	PSBE 11000-30	PSBE 11500-20	
DC output					
Voltage range	0 - 750 V	0 - 920 V	0 - 1000 V	0 - 1500 V	
Ripple in CV (rms)	≤200 mV (300 kHz*1)	≤200 mV (300 kHz*1)	≤200 mV (300 kHz*1)	≤400 mV (300 kHz*1)	
Ripple in CV (pp)	≤800 mV (20 MHz*1)	≤800 mV (20 MHz*1)	≤1000 mV (20 MHz*1)	≤2000 mV (20 MHz*1)	
U_{Min} for I_{Max} (sink)	2.5 V	2.5 V	4 V	5 V	
Current range	0 - 40 A	0 - 40 A	0 - 30 A	0 - 20 A	
Power range *2	0 - 10000 W (0 - 6000 W)	0 - 10000 W (0 - 6000 W)	0 - 10000 W (0 - 6000 W)	0 - 10000 W (0 - 6000 W)	
Resistance range	0.6 Ω - 1100 Ω	0.75 Ω - 1600 Ω	1.2 Ω - 2000 Ω	2.6 Ω - 4500 Ω	
Output capacitance	360 µF	240 µF	197 µF	90 µF	
Efficiency sink/source (up to)	95.5% *3	95.5% *3	95.5% *3	95.5% *3	
AC input					
P_{Max}	Range 1: 7 kW Range 2: 11 kW	Range 1: 7 kW Range 2: 11 kW	Range 1: 7 kW Range 2: 11 kW	Range 1: 7 kW Range 2: 11 kW	
Phase current *4	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	
Insulation					
Negative DC pole <-> PE	±1500 V DC	±1500 V DC	±1500 V DC	±1500 V DC	
Positive DC pole <-> PE	+2000 V DC	+2000 V DC	+2000 V DC	+2000 V DC	
Product codes					
Standard	30000765	30000781	30000766	30000767	

*1 BWL = Bandwidth limit on the measuring oscilloscope
*2 The value in brackets applies to the state of derating (power reduction) when standard models run on 208 V ±10% utility
*3 At 100% power and 100% output voltage
*4 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
*5 The data listed below this model name are preliminary

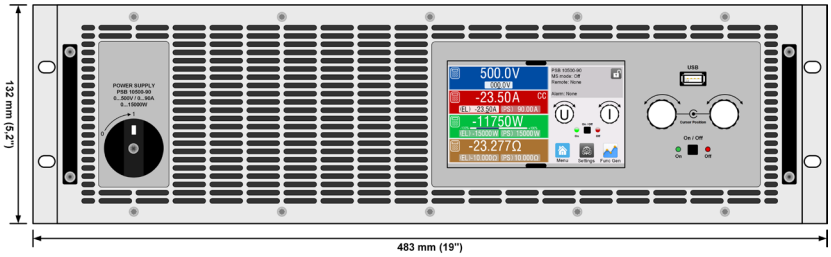
Technical specifications	PSBE 10060-510	PSBE 10080-510	PSBE 10200-210	PSBE 10360-120	PSBE 10500-90
DC output					
Voltage range	0 - 60 V	0 - 80 V	0 -200 V	0 - 360 V	0 - 500 V
Ripple in CV (rms)	≤10 mV (300 kHz*1)	≤10 mV (300 kHz*1)	≤40 mV (300 kHz*1)	≤55 mV (300 kHz*1)	≤70 mV (300 kHz*1)
Ripple in CV (pp)	≤100 mV (20 MHz*1)	≤100 mV (20 MHz*1)	≤300 mV (20 MHz*1)	≤320 mV (20 MHz*1)	≤350 mV (20 MHz*1)
U_{Min} for I_{Max} (sink)	0.5 V	0.5 V	2 V	2 V	2.2 V
Current range	0 - 510 A	0 - 510 A	0 - 210 A	0 - 120 A	0 - 90 A
Power range *2	0 - 15000 W (0 - 9000 W)	0 - 15000 W (0 - 9000 W)	0 - 15000 W (0 - 9000 W)	0 - 15000 W (0 - 9000 W)	0 - 15000 W (0 - 9000 W)
Resistance range	0.006 Ω - 9 Ω	0.006 Ω - 9 Ω	0.03 Ω - 50 Ω	0.1 Ω - 180 Ω	0.2 Ω - 330 Ω
Output capacitance	23970 µF	23970 µF	7560 µF	1180 µF	540 µF
Efficiency sink/source (up to)	94.5% *3	94.5% *3	94.5% *3	95.5% *3	95.5% *3
AC input					
P_{Max}	Range 1: 10 kW Range 2: 16 kW	Range 1: 10 kW Range 2: 16 kW	Range 1: 10 kW Range 2: 16 kW	Range 1: 10 kW Range 2: 16 kW	Range 1: 10 kW Range 2: 16 kW
Phase current *4	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A
Insulation					
Negative DC pole <-> PE	±600 V DC	±600 V DC	±1000 V DC	±1000 V DC	±1500 V DC
Positive DC pole <-> PE	+600 V DC	+600 V DC	+1000 V DC	+1000 V DC	+2000 V DC
Product codes					
Standard	30000710	30000711	30000712	30000713	30000714

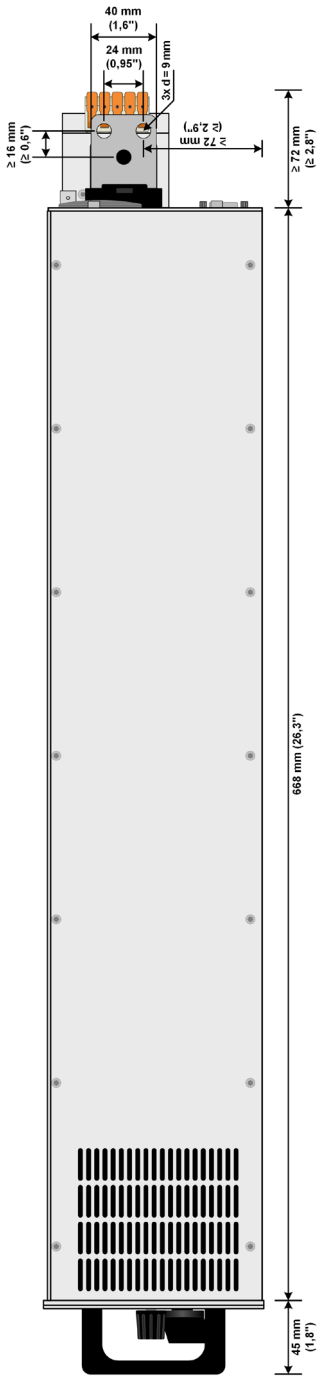
Technical specifications	PSBE 10750-60	PSBE 10920-60 *5	PSBE 11000-40	PSBE 11500-30	PSBE 12000-20
DC output					
Voltage range	0 - 750 V	0 - 750 V	0 - 1000 V	0 - 1500 V	0 - 2000 V
Ripple in CV (rms)	≤200 mV (300 kHz*1)	≤200 mV (300 kHz*1)	≤300 mV (300 kHz*1)	≤400 mV (300 kHz*1)	≤400 mV (300 kHz*1)
Ripple in CV (pp)	≤800 mV (20 MHz*1)	≤800 mV (20 MHz*1)	≤1600 mV (20 MHz*1)	≤2400 mV (20 MHz*1)	≤2400 mV (20 MHz*1)
U_{Min} for I_{Max} (sink)	2.2 V	2.2 V	5.6 V	5.6 V	7.2 V
Current range	0 - 60 A	0 - 60 A	0 - 40 A	0 - 30 A	0 - 20 A
Power range *2	0 - 15000 W (0 - 9000 W)	0 - 15000 W (0 - 9000 W)	0 - 15000 W (0 - 9000 W)	0 - 15000 W (0 - 9000 W)	0 - 15000 W (0 - 9000 W)
Resistance range	0.4 Ω - 750 Ω	0.5 Ω - 1100 Ω	0.8 Ω - 1300 Ω	1.7 Ω - 3000 Ω	3.5 Ω - 5300 Ω
Output capacitance	540 µF	360 µF	131 µF	60 µF	60 µF
Efficiency sink/source (up to)	95.5% *3	95.5% *3	95.5% *3	95.5% *3	95.5% *3
AC input					
P_{Max}	Range 1: 10 kW Range 2: 16 kW	Range 1: 10 kW Range 2: 16 kW	Range 1: 10 kW Range 2: 16 kW	Range 1: 10 kW Range 2: 16 kW	Range 1: 10 kW Range 2: 16 kW
Phase current *4	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A	Range 1: ≤29 A Range 2: ≤27 A
Insulation					
Negative DC pole <-> PE	±1500 V DC	±1500 V DC	±1500 V DC	±1500 V DC	±1500 V DC
Positive DC pole <-> PE	+2000 V DC	+2000 V DC	+2000 V DC	+2000 V DC	+2000 V DC
Product codes					
Standard	30000715	30000782	30000716	30000717	30000718

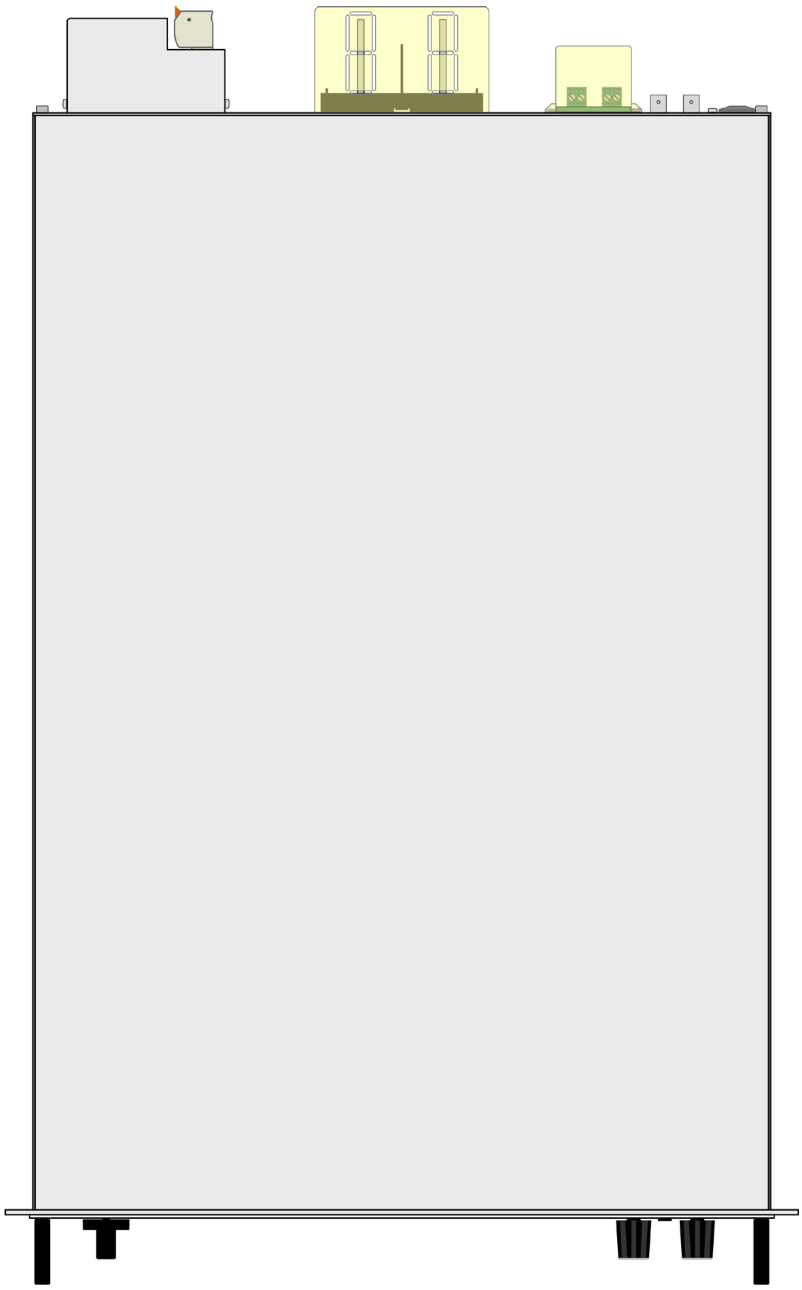
*1 BWL = Bandwidth limit on the measuring oscilloscope
*2 The value in brackets applies to the state of derating (power reduction) when standard models run on 208 V ±10% utility
*3 At 100% power and 100% output voltage
*4 Calculated for the default AC supply voltage in the stated range, minus 10% tolerance, at maximum output power and 10% power loss from AC to DC
*5 The data listed below this model name are preliminary

1.8.4 Views

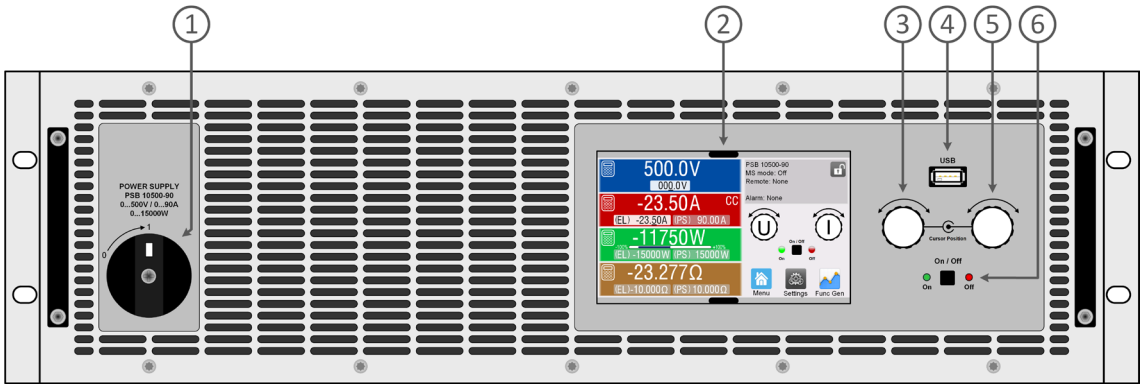
1.8.4.1 Technical drawings 10000 3U ≤200 V





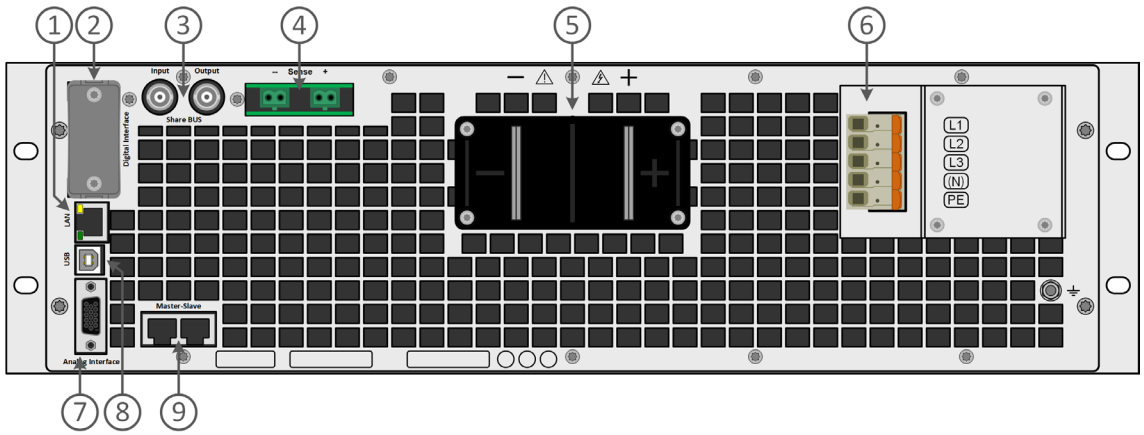


1.8.4.2 Front panel description 10000 3U



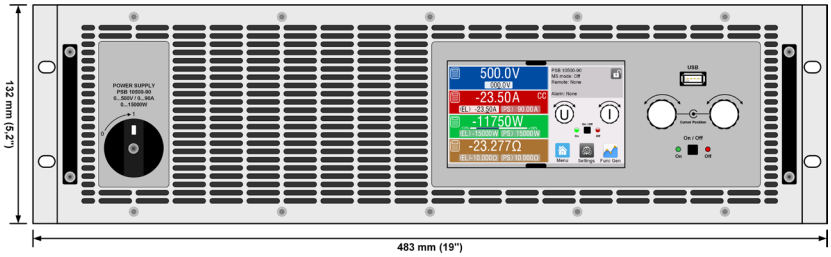
1. Power switch
2. TFT control interface, interactive operation and display
3. Rotary knob with push-button action, for settings and control
4. USB host, uses USB sticks for data logging and sequencing
5. Rotary knob with push-button action, for settings and control
6. On/Off push-button with LED status display

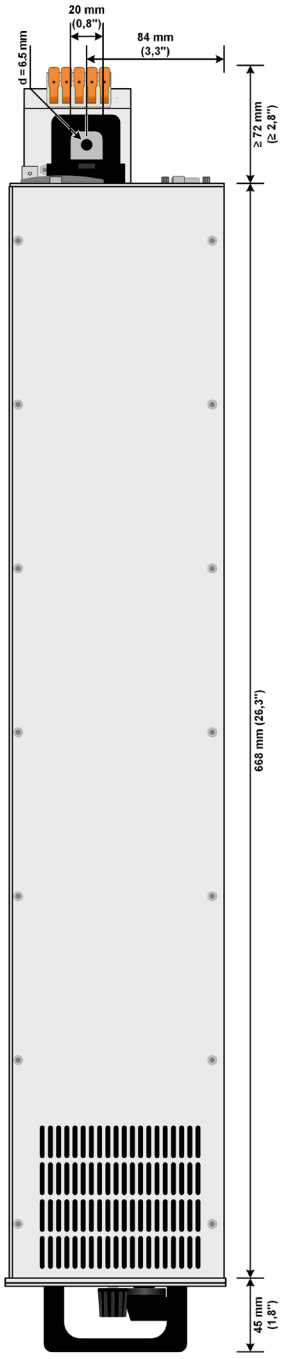
1.8.4.3 Rear panel description 10000 3U ≤200 V

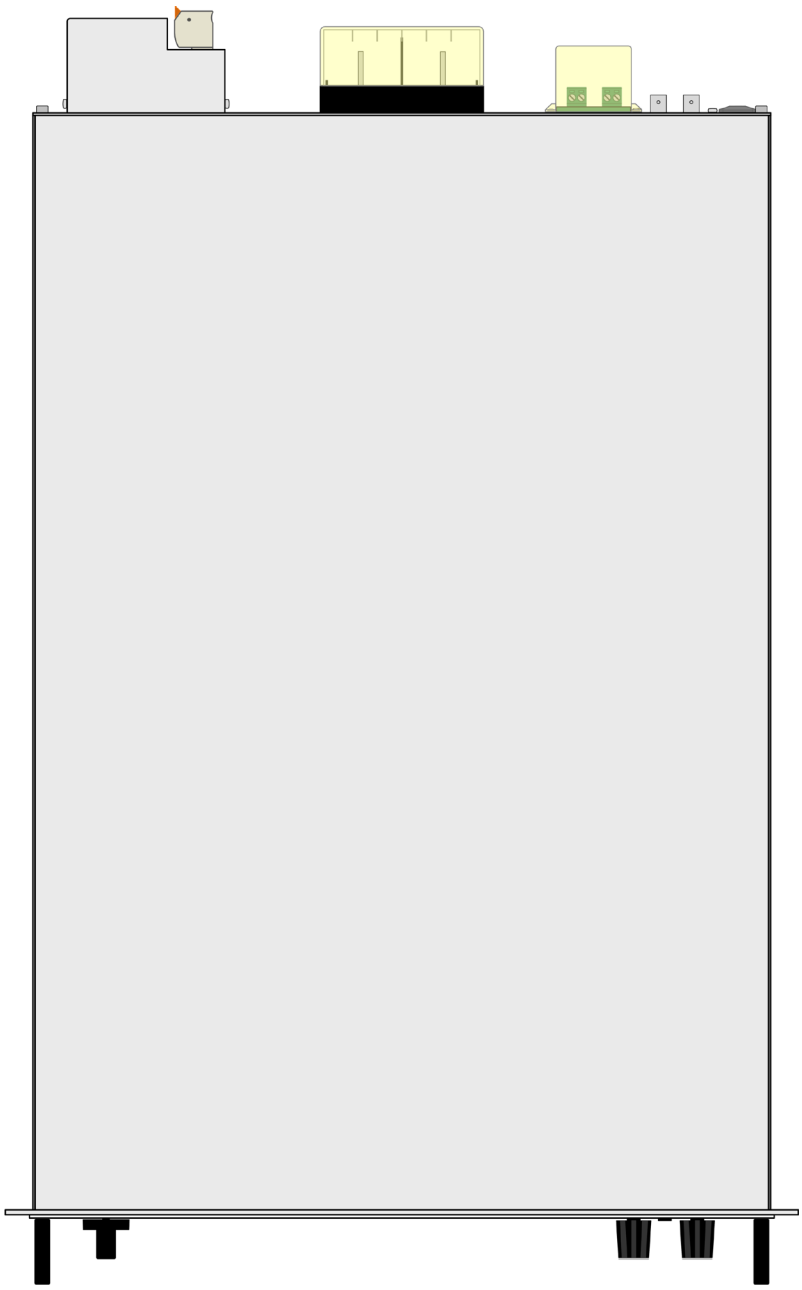


1. Ethernet interface
2. Slot for interfaces
3. Share bus connectors to set up a system for parallel connection
4. Remote sense connectors
5. DC connector (copper blades)
6. AC input connector
7. Connector (DB15 female) for isolated analog programming, monitor and other functions
8. USB interface
9. Master-slave bus connectors to set up a system for parallel connection

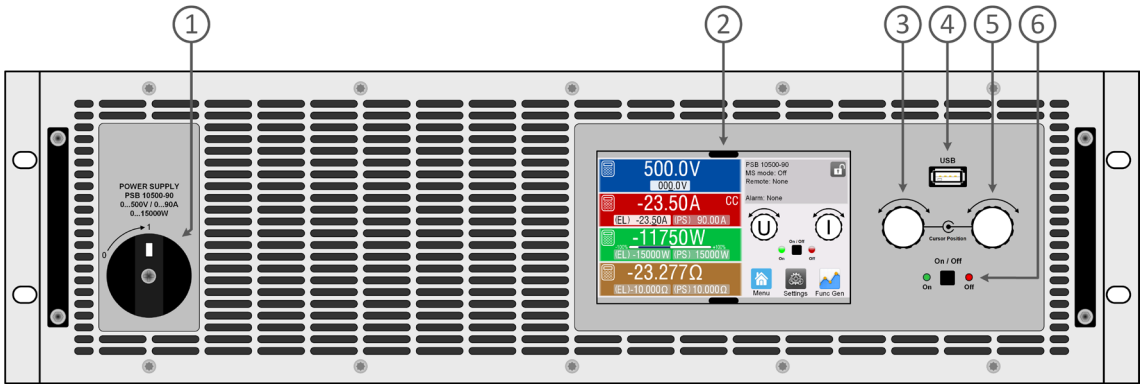
1.8.4.4 Technical drawings 10000 3U ≥360 V





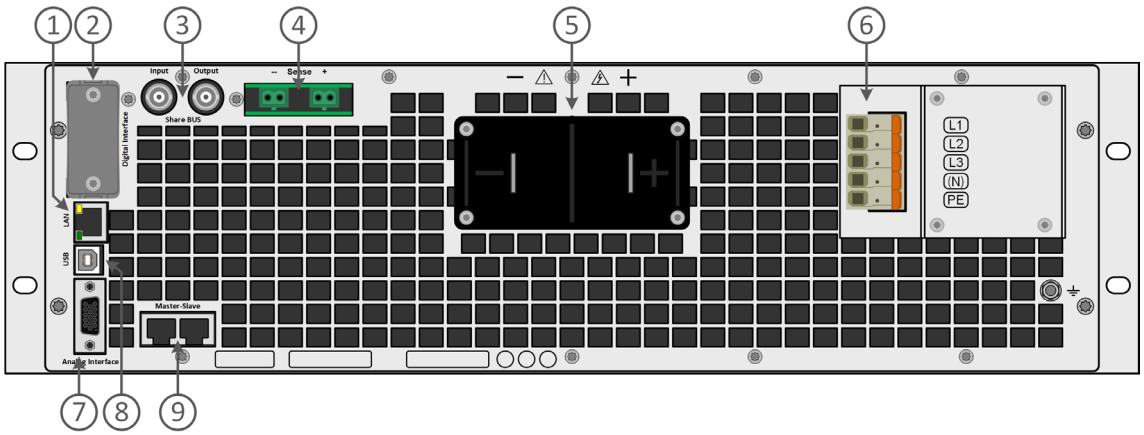


1.8.4.5 Front panel description 10000 3U



1. Power switch
2. TFT control interface, interactive operation and display
3. Rotary knob with push-button action, for settings and control
4. USB host, uses USB sticks for data logging and sequencing
5. Rotary knob with push-button action, for settings and control
6. On/Off push-button with LED status display

1.8.4.6 Rear panel description 10000 3U ≥360 V



1. Ethernet interface
2. Slot for interfaces
3. Share bus connectors to set up a system for parallel connection
4. Remote sense connectors
5. DC connector (copper blades)
6. AC input connector
7. Connector (DB15 female) for isolated analog programming, monitor and other functions
8. USB interface
9. Master-slave bus connectors to set up a system for parallel connection

1.8.5 Control elements

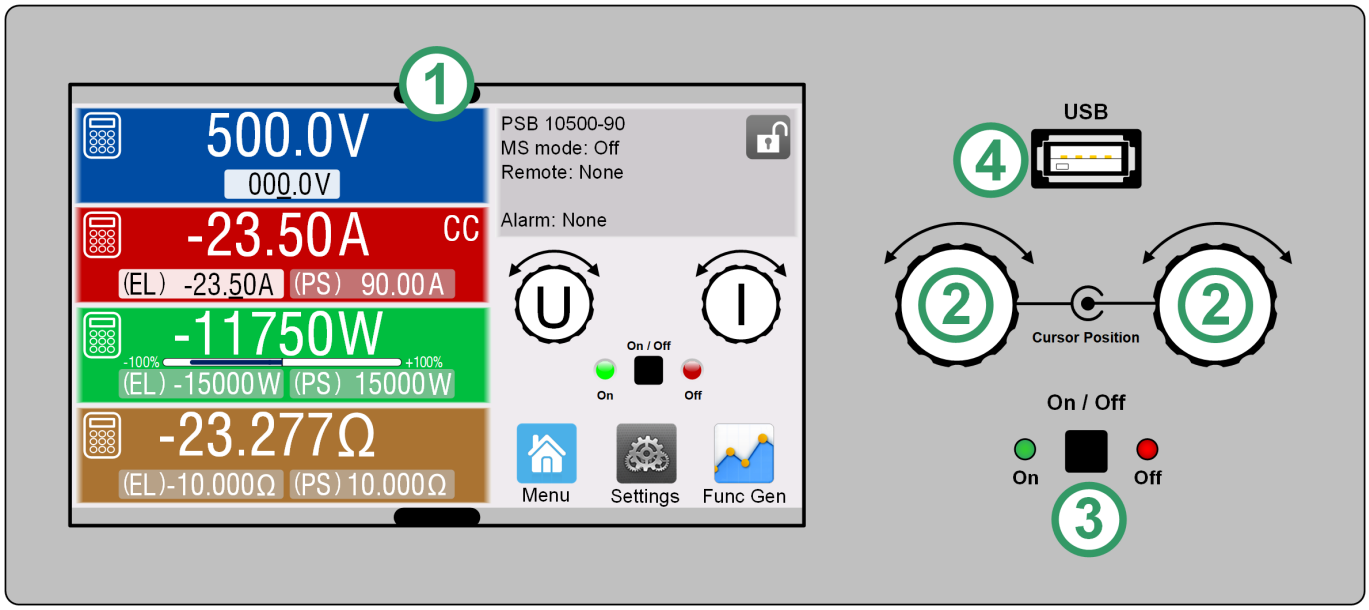


Figure 1- Control Panel (exemplary from a PSB model)

Overview of the elements on the control panel

For a detailed description see section *«1.9.6 The control panel (HMI)»*.

(1)	**Touchscreen display** Used for selection and adjustment of set values, menu calls, as well as display of actual values and status. The touch-screen can be operated with the fingers or with a stylus.
(2)	**Rotary knob with push button function** Left knob (turn): voltage set value adjustment Left knob (push): shift the decimal position (cursor) of the voltage set value Right knob (turn): current, power or resistance set value adjustment Right knob (push): shift the decimal position (cursor) of the currently assigned value
(3)	**On/Off Button for DC terminal** Used to toggle the DC terminal between on and off, also used to start a function run. The LEDs “On” and “Off” indicate the state of the DC terminal, no matter if the device is manually controlled or remotely.
(4)	**Port for USB sticks** For the connection of standard USB sticks. See section *«1.9.6.5 USB port (front side)»* for more details.

1.9 Construction and function

1.9.1 General description

The 10000 series with 3U of height offer three different device types. There are so-called bidirectional devices (PSB 10000 3U & PSBE 10000 3U), incorporating the function of a laboratory power supply (source) and an electronic load (sink) in one unit. They allow for easy setup of applications according to the source-sink principle, with a minimum of required hardware and cabling. Switching between source and sink operation is seamless and without delay at zero point. There are furthermore standard power supplies (PSI 10000 3U & PS 10000 3U) and electronic loads (ELR 10000 3U).

The sink feature of bidirectional devices and electronic loads includes an energy recovery function, same as the one in series ELR 9000, which inverts the consumed DC energy with an efficiency of up to 96% and feeds it back into the local mains.

Apart from basic functions, set point curves can be generated by the integrated function generator (sine, rectangular, triangular and other curve types). Arbitrary generator curves (99 points) can be saved to and loaded from a USB stick. Some of the functions even offer to dynamically switch between source and sink operation mode by setting up positive (for the source) or negative (for the sink) current set values.

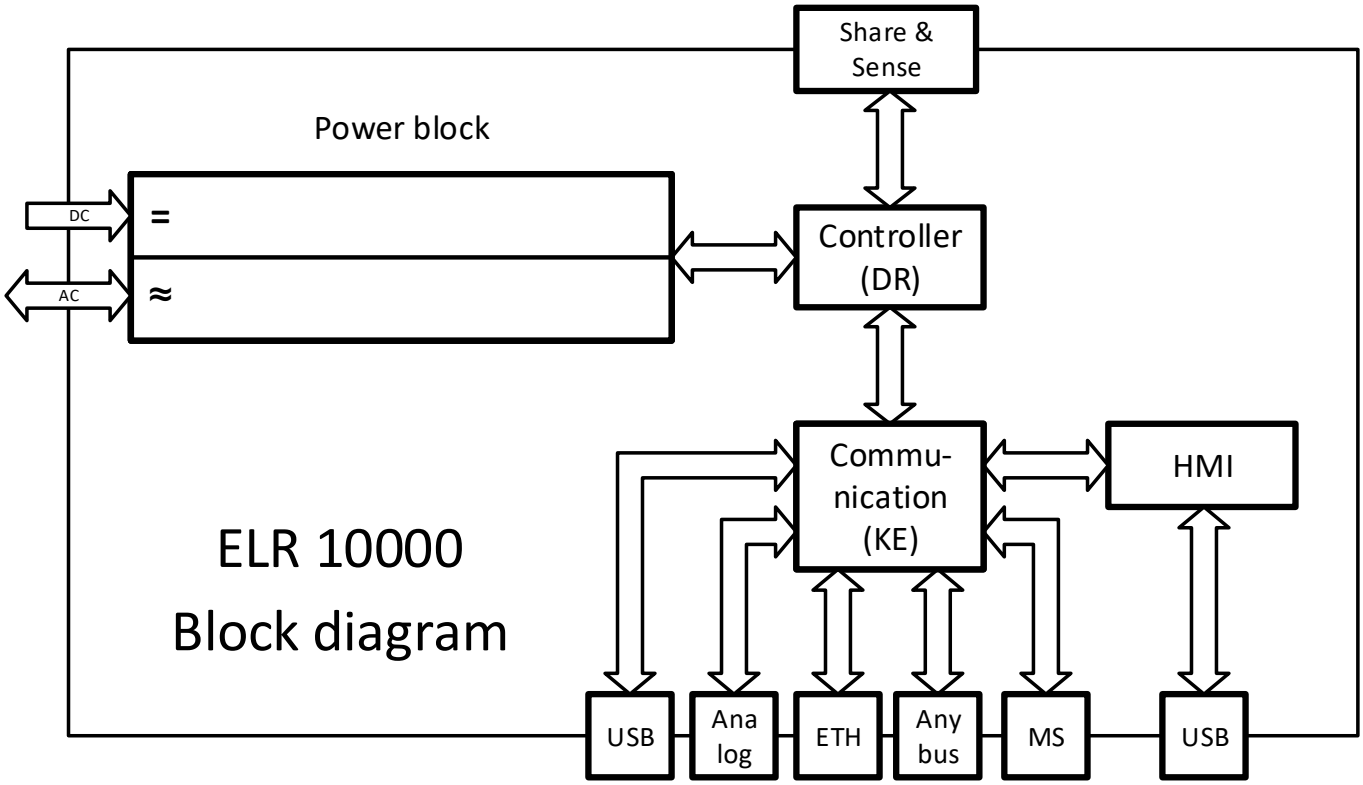
For remote control the devices are provided as standard with USB and Ethernet ports on the rear side, as well as a galvanically isolated analog interface. Via optional plug-in interface modules, another digital interface such as for RS232, Profibus, ProfiNet, ModBus TCP, CAN, CANopen or EtherCAT can be added. These enable the devices to be connected to standard industrial buses simply by changing or adding a small module. The configuration, if necessary at all, is simple.

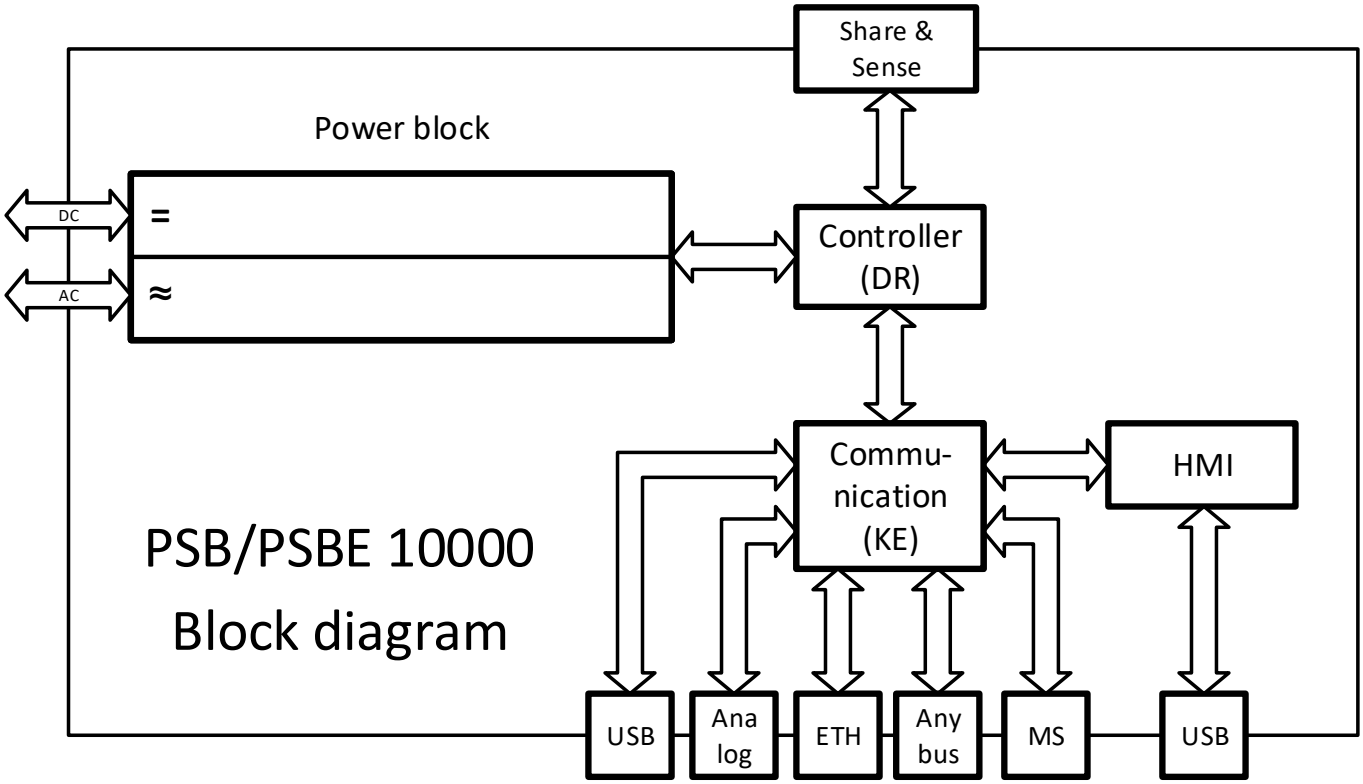
In addition, the devices offer as standard the possibility for parallel connection in so-called Share-Bus operation for constant current sharing, plus a true master-slave connection with totaling of all actual values is also provided as standard.

1.9.2 Block diagrams

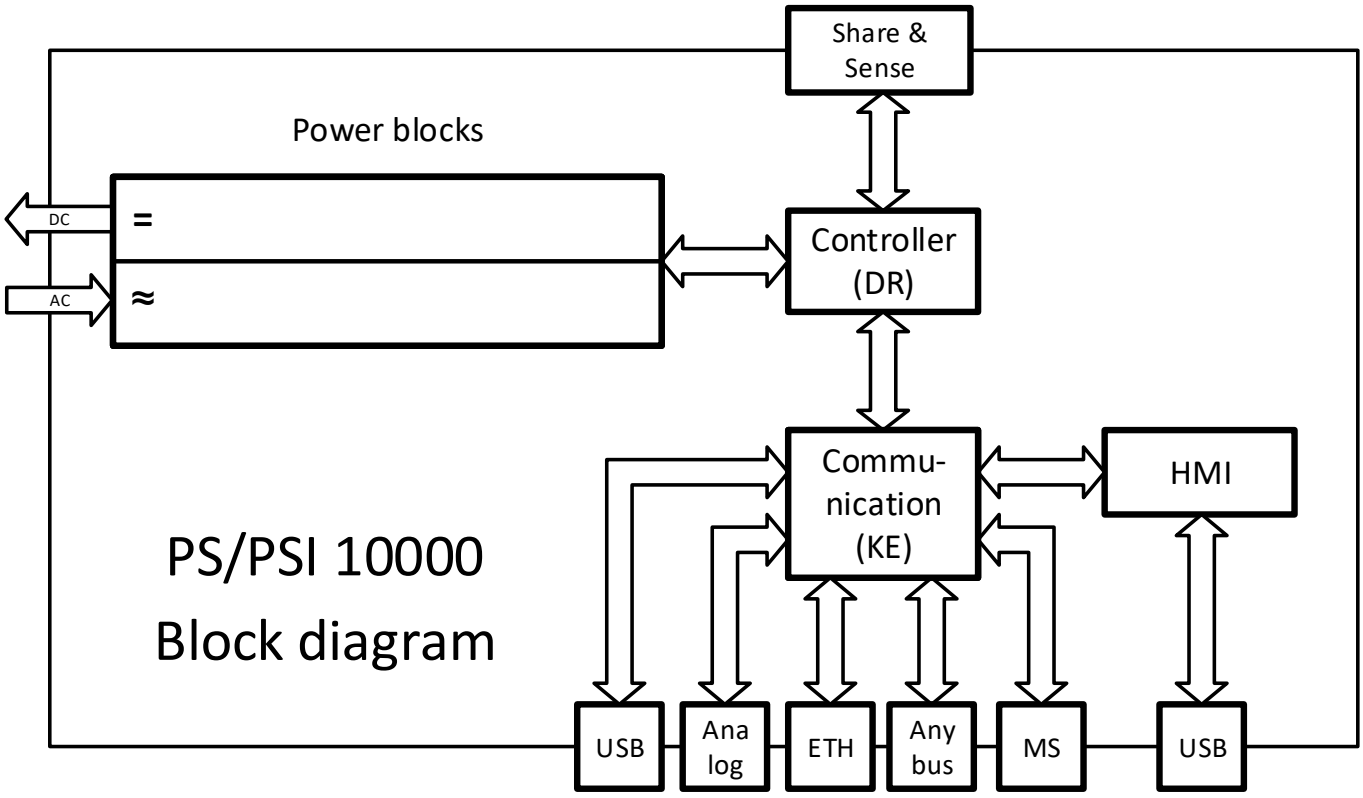
The block diagram illustrates the main components inside the device and their relationships.

There are digital, microprocessor controlled components (KE, DR, HMI), which can be target of firmware updates.





PSB/PSBE 10000
Block diagram



PS/PSI 10000
Block diagram

1.9.3 Scope of delivery

1 x Power supply device (standard or bidirectional) or electronic load device

2 x Remote sensing plugs

1 x 1.8 m (5.9 ft) USB cable

1 x Set of DC terminal covers

1 x Sense terminal cover

1 x USB stick with documentation and software

1 x AC connector plug (clamp type)

1 x Set for AC cable strain relief

1.9.4 Accessories

For all models in this series the following accessories are available:

IF-AB Interface modules	Pluggable and retrofittable, digital interface modules for RS232, CANopen, Profibus, ProfiNet, ModBus TCP, EtherCAT or CAN are available. Details about the interface modules and the programming of the device using those interfaces can be found in separate documentation. It's usually available on the USB stick, which is included with the device, or as PDF download on the manufacturers website.
LICENSE Software licenses	All devices of this series are shipped with a free remote control software for Windows, called **EA Power Control**. Besides free-to-use apps this software has other apps like Multi Control, the Graph and the Function Generator, which can be unlocked with a purchasable license code. These three apps are combined under the license "Multi Control". One license per PC required. There is a single license and a 5-pack available, also a 14-day trial license which can be obtained upon request. More information is available in the user manual of this software or on our website.
EABS Battery simulation	EABS is short for EA Battery Simulator and is an optionally available, USB dongle licensed Windows software. In combination with the bidirectional power supplies of series PSB 9000, PSBE 9000, PSB 10000 and PSBE 10000 it simulates either a single lithium-ion cell or lead-acid battery or multiple in series and/or parallel connection. The simulation works with battery typical values such as capacity, temperature, state of charge, internal resistance and cell voltage, plus adjustable test conditions.

1.9.5 Options

These options are usually ordered together with the device, as they are permanently built in or preconfigured during the manufacturing process.

POWER RACKS 19" rack	Racks in various configurations up to 42U as parallel systems are available, or mixed with electronic load devices to create test systems. Further information is available on our website or upon request
US208V AC connection for 208 V	Available for the series ELR 10000 3U, PS 10000 3U, PSI 10000 3U and PSB 10000 3U, this option offers an alternative AC connection for 208 V supply, as typical for three-phase in the USA. Although the standard models can also run on 208 V, they would reduce the available power which the so-called US208V models don't, as they are especially designed for this supply voltage and provide their full rated power. For the ordering numbers of models with that option refer to the models tables in the technical data section.

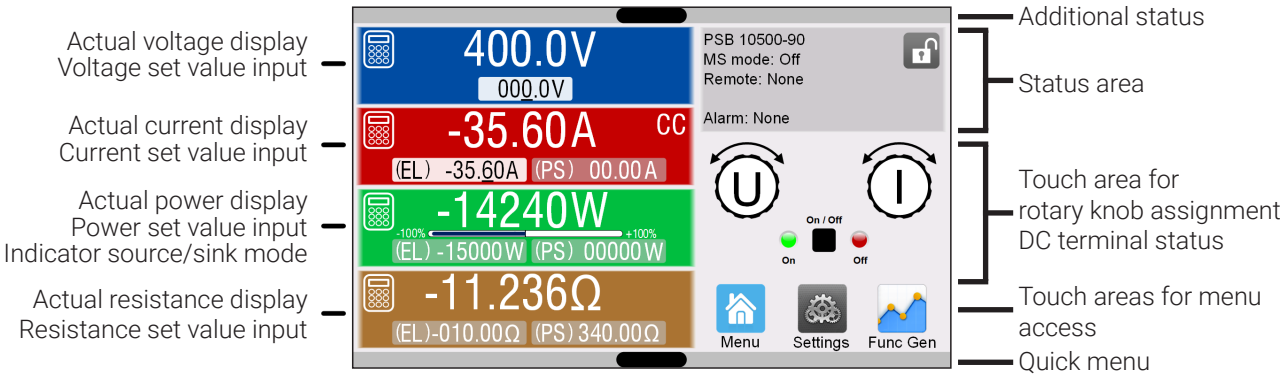
1.9.6 The control panel (HMI)

The HMI (**H**uman **M**achine **I**nterface) consists of a display with touchscreen, two rotary knobs, a pushbutton and a USB port.

1.9.6.1 Touchscreen display

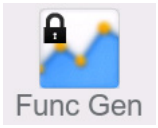
The graphic touchscreen display is divided into a number of areas. The complete display is touch sensitive and can be operated by finger or stylus to control the equipment.

In normal operation the left hand side is used to show actual values and set values and the right hand side is used to display status information. Depiction of the main screen of a bidirectional device which has seven set values on display where a non-bidirectional one has four:



Touch areas may be enabled or disabled:

Black text = Enabled



Grey text = Touch area temporarily disabled

This applies to all touch areas. Some can additionally show a small padlock sign, indicating that the feature is permanently locked, usually due to a specific setting.

- **Actual / set values area (left hand side)**

In normal operation the actual values (large numbers) and set values (small numbers) for voltage, current, power and resistance on the DC terminal are displayed. For the two directions of operation of bidirectional devices, sink (marked as **EL** for distinction from source mode) and source (marked as **PS**), there are two separate set values each for current, power and resistance. The resistance set values are only displayed if resistance mode is active, while an actual resistance is only displayed during sink mode operation.

The actual values of current and power can be negative (signed) or positive (unsigned) with bidirectional devices. A negative value belongs to sink mode and indicates that bidirectional device is working as electronic load. When the DC terminal is switched on the actual control mode is displayed as **CV, CC, CP** or **CR**, next to the corresponding actual value, as shown in the figure above.

The set values can be adjusted with the rotary knobs next to the display screen or can be entered directly via the touchscreen. When adjusting with the knobs, pushing the knob will select the digit to be changed. Logically, the values are increased by clockwise turning and decreased by anti-clockwise turning. General display and setting ranges:

Display	Unit	Range	Description
Actual voltage	V	0.2-125% U_{Nom}	Actual value of the voltage on the DC terminal
Set value of voltage	V	0-102% U_{Nom}	Set value for limiting the DC voltage
Actual current	A	0.2-125% I_{Nom}	Actual value of the current on the DC terminal
Set values of current	A	0-102% I_{Nom}	Set value for limiting the DC current
Actual power	W, kW	0.2-125% P_{Nom}	Actual value of power according to P = U * I
Set values of power	W, kW	0-102% P_{Nom}	Set value for limiting DC power
Actual resistance	Ω	x[1]-99999 / ∞	Actual value of the internal resistance
Set value of resistance	Ω	x[1]-102% R_{Max}	Set value for the internal resistance
Adjustment limits	ditto	0-102% nom	U-max, I-min etc., related to the physical quantities
Protection settings	ditto	0-110% nom	OVP, OCP, OPP (related to U, I and P)

1) The lower limit for resistance set value varies. See the tables in section *1.8.3*

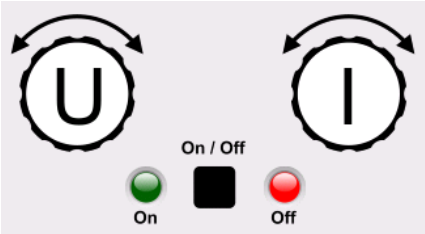
- **Status display (upper right)**

This area displays various status texts and symbols:

Display	Description
	The HMI is locked
	The HMI is unlocked
Remote:	The device is under remote control from....
Analog	...the built-in analog interface
ETH	...the built-in Ethernet interface
USB & others	...the built-in USB port or a plug in interface module
Local	The device has been locked by the user explicitly against remote control
Alarm:	Alarm condition which has not been acknowledged or still exists.
Event:	A user defined event has occurred which is not yet acknowledged.
MS mode: Master (n Sl)	Master-slave mode activated, device is master of n slaves
MS mode: Slave	Master-slave mode activated, device is slave
FG:	Function generator activated, function loaded (only in remote control)
	Data logging to USB stick active or failed

- **Area for assigning the rotary knobs and DC terminal status**

The two rotary knobs next to the display screen can be assigned to various functions. This area shows the actual assignments. These can be changed by tapping this area, as long as the panel is not locked.



The physical quantities on the depiction of the knob show the current assignment. The left knob is always assigned to the voltage (U), while the right knob can be switched by tapping on the depiction. Furthermore, the DC terminal status is indicated by two LEDs (green = on).

There are following possible rotary knob assignments:

U I
Left rotary knob: voltage
Right rotary knob: current

U P
Left rotary knob: voltage
Right rotary knob: power

U R
Left rotary knob: voltage
Right rotary knob: resistance
(only with R mode active)

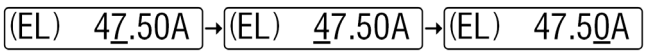
Tapping the knob depiction multiple times will cycle through the assignable set values. The currently not selected set values can't be adjusted via any rotary knob until the assignment is changed, but alternatively by tapping on the small ten-keypad icon  in the colored set value areas. **This method of entering values allows for instant set value steps.**

1.9.6.2 Rotary knobs

As long as the device is in manual operation, the two rotary knobs are used to adjust set values in the main screen. For a detailed description of the individual functions see section *«3.4 Manual operation (1)»*.

1.9.6.3 Pushbutton function of the knobs

The rotary knobs also have a pushbutton function which is used in all value adjustment to move the cursor by rotation as shown here:



1.9.6.4 Resolution of the displayed values

In the display, set values can be adjusted in fixed increments. The number of decimal places depends on the device model. The values have 4 or 5 digits. Actual and set values always have the same number of digits.

Adjustment resolution and number of digits of set values in the display:

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

Current, OCP, UCD, OCD, I-min, I-max		
Nominal*	**Digits**	**Min. increment**
<100 A	4	0.01 A
>100 A	4	0.1 A
MS ≥3000 A	4	1 A
MS >10000 A	5	1 A

Power, OPP, OPD, P-max		
Nominal*	**Digits**	**Min. increment**
≤15000 W	5	1 W
MS <100 kW	4	0.01 kW
MS >100 kW	4	0.1 kW

Resistance, R-max		
Nominal	**Digits**	**Min. increment**
<10 Ω	5	0.0001 Ω
≥10...<100 Ω	5	0.001 Ω
≥100...<1000 Ω	5	0.01 Ω
≥1000 Ω	5	0.1 Ω

* MS = Master-slave

1.9.6.5 USB port (front side)

The frontal USB port, located above the rotary knobs, is intended for the connection of standard USB sticks and can be used for loading or saving sequences for the arbitrary and the XY generator, as well as for recording measured data during running operation.

USB 2.0 and 3.0 sticks are well supported. The stick must be **FAT32** formatted. All supported files must be held in a designated folder in the root path of the USB stick in order to be found. This folder must be named **HMI_FILES**, such that a PC would recognize the path G:\HMI_FILES in case the drive would have been be assigned the letter G. Subfolders are supported. In case there are multiple files of the same type, e. g. those starting with "wave", the device will list the first 20 it can find.

The control panel of the device can read the following file types and names from a stick:

File name	Description	Supported by series					Section in user manual
		ELR	PS	PSB	PSBE	PSI	
wave_u<arbitrary_text>.csv wave_i<arbitrary_text>.csv	Curve data for an arbitrary function on voltage (U) or current (I). The name must begin with ***wave_u*** / ***wave_i***,	✓	-	✓	-	✓	*3.9.1*
profile_<arbitrary_text>.csv	Previously saved user profile. A max. of 10 files to select from is shown when loading a user profile.	✓	✓	✓	✓	✓	*2.3.6* *(2.2.6)*
mpp_curve_<arbitrary_text>.csv	User-defined curve data (100 voltage values) for mode MPP4 of the MPPT function	✓	-	✓	-	-	*3.16.4.1* *(3.13.4.1)*
psb_pv<arbitrary_text>.csv psb_fc<arbitrary_text>.csv	PV or FC table for the XY function generator. The name must begin with ***psb_pv*** or ***psb_fc***	-	-	✓	-	✓	*3.12* *3.13*
pv_day_et_<arbitrary_text>.csv pv_day_ui_<arbitrary_text>.csv	Day trend data file to load for the simulation modes DAY I/T and DAY U/I of the extended PV function.	-	-	✓	-	✓	*3.14.5*
iu<arbitrary_text>.csv	IU table for the XY function generator. The name must begin with ***iu***	✓	-	✓	-	✓	*3.11*

The control panel of the device can save the following file types and names to a USB stick:

File name	Description	Supported by series					Section in user manual
		ELR	PS	PSB	PSBE	PSI	
usb_log_<nr>.csv	File with log data recorded during normal operation in all modes. The file layout is identical to the those generated from the Logging feature in EA Power Control. The <nr> field in the file name is automatically counted up if equally named files already exist in the folder.	✓	✓	✓	✓	✓	*2.3.4* *(2.2.4)*
profile_<nr>.csv	Saved user profile. The number in the file name is a counter and not related to the actual user profile number in the HMI. A max. of 10 files to select from is shown when loading a user profile.	✓	✓	✓	✓	✓	*2.3.6* *(2.2.6)*
wave_u<nr>.csv wave_i<nr>.csv	Sequence point data (here: sequences) of either voltage U or current I from arbitrary function generator	✓	-	✓	-	✓	*3.9.1*
battery_test_log_<nr>.csv	File with log data recorded from the battery test function. For a battery test log, data different and/or additional to log data of normal USB logging is recorded.	✓	-	✓	-	-	*3.15.7* *(3.12.5)*
mpp_result_<nr>.csv	Result data from MPP tracking mode 4 in form of a table with 100 data groups (Umpp, Impp, Pmpp)	✓	-	✓	-	-	*3.16.4.2* *(3.13.4.2)*
psb_pv<nr>.csv	PV function table data, as calculated by the device. Can be loaded again.	-	-	✓	-	✓	*3.12*
psb_fc<nr>.csv	FC function table data, as calculated by the device. Can be loaded again.	-	-	✓	-	✓	*3.13*
pv_record_<nr>.csv	Data from the data recording option in the extended PV function according to EN 50530.	-	-	✓	-	✓	*3.14.5.2*

1.9.7 USB port (rear side)

The USB port on the rear side of the device is provided for communication with the device and for firmware updates. The included USB cable can be used to connect the device to a PC (USB 2.0 or 3.0). The driver is delivered with the device and installs a virtual COM port. Details about remote control can be found in form of a programming guide on the included USB stick or on the web site of the manufacturer.

The device can be addressed via this port either using the international standard ModBus RTU protocol or by SCPI language. The device recognizes the message protocol used automatically.

If remote control is in operation the USB port has no priority over either the interface module (see below) or the analog interface and can, therefore, only be used alternatively to these. However, monitoring is always available.

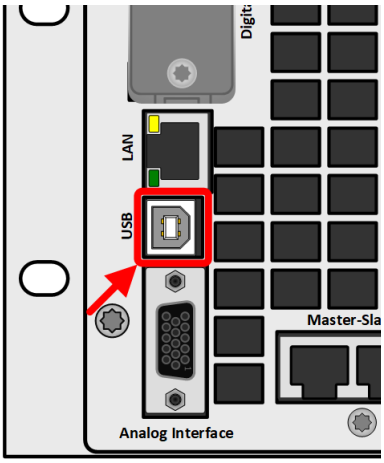


Figure 2 - USB port

1.9.8 Interface module slot

This slot on the rear side of the device can receive various modules of the IF-AB interface series. The following options are available:

Article number	Name	Description / connectors
35400100	IF-AB-CANO	CANopen, 1x DB9, male
35400101	IF-AB-RS232	RS 232, 1x DB9, male (null modem)
35400103	IF-AB-PBUS	Profibus DP-V1 Slave, 1x DB9, female
35400104	IF-AB-ETH1P	Ethernet, 1x RJ45
35400105	IF-AB-PNET1P	ProfiNET IO, 1x RJ45
35400107	IF-AB-MBUS1P	ModBus TCP, 1x RJ45
35400108	IF-AB-ETH2P	Ethernet, 2x RJ45
35400109	IF-AB-MBUS2P	ModBus TCP, 2x RJ45
35400110	IF-AB-PNET2P	ProfiNET IO, 2x RJ45
35400111	IF-AB-CAN	CAN 2.0 A / 2.0 B, 1x DB9, male
35400112	IF-AB-ECT	EtherCAT, 2x RJ45

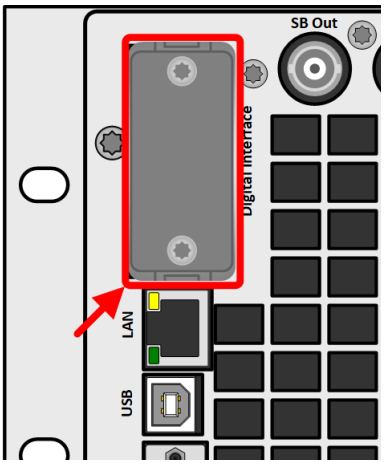


Figure 3 - Interface slot

The modules can be installed by the user and hence retrofitted without problem. A firmware update of the device may be necessary in order to recognize and support certain modules.

Switch your device off before adding or removing modules!

1.9.9 Analog interface

This 15 pole D-sub socket on the rear side of the device is provided for remote control of the device via analog or digital signals.

If remote control is in operation this analog interface can only be used alternately to the digital interface. However, monitoring is always available.

The input voltage range of the set values and the output voltage range of the monitor values, as well as reference voltage level can be switched in the settings menu of the device between 0-5 V and 0-10 V, in each case for 0-100%.

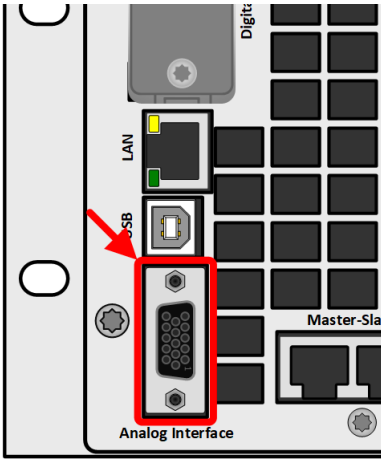


Figure 4 - Analog interface

1.9.10 “Share-Bus” connector

The two BNC sockets (50 Ω type) labeled “Share-Bus” form a digital, passed-through Share-Bus. This bus is bidirectional and connects the bus master unit via “Share-Bus Output” to the next slave unit (“Share-Bus Input”) etc., for use in parallel operation (master-slave). BNC cables of suitable length can be obtained from us or electronics stores.

Basically, all 10000 series are compatible on this Share-Bus, though only connection of the same device type, i. e. power supply with power supply or electronic load with electronic load is supported by the devices for master-slave.

For a 10000 3U series device, different or identical 10000 series models can be used as slave units, such as all PUx 10000 series models which are dedicated power units without display. The models must only match at their voltage rating and device type.

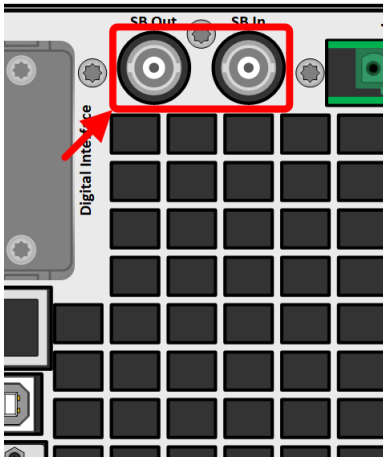


Figure 5 - Share-Bus

1.9.11 “Sense” connector (remote sensing)

In order to compensate for voltage drops along the DC cables to a load or external source, the Sense input (2 plugs included in delivery, one each for positive and negative pole) can be connected to the load resp. external source. The maximum possible compensation is given in the technical specifications.

⚠	In a master-slave system it’s intended to wire remote sensing only to the master which would then forward the compensation to the slaves via Share-Bus.

⚠	**The Sense cover must be installed during operation, because there can be hazardous voltage on the sense lines! Reconfiguration on the Sense terminals is only permissible if the device is disconnected from AC supply and all DC sources!**

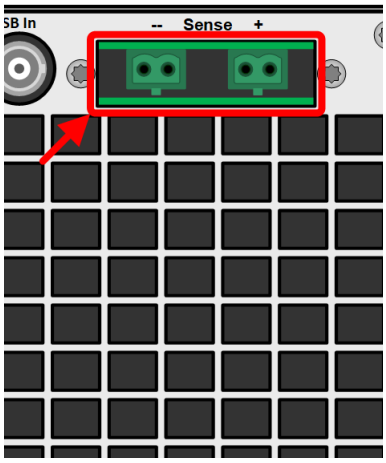


Figure 6 - Remote sensing terminals

1.9.12 Master-Slave bus

There is a further set of connectors on the rear side of the device, comprising two RJ45 sockets, which enables multiple compatible devices to be connected via a digital bus (RS485) in order to create a master-slave system. Connection is made using standard CAT5 cables.

It’s recommended to keep the connections as short as possible and to terminate the bus as required. The termination is done via digital switches and activated in the device setup menu in group “Master-Slave”.

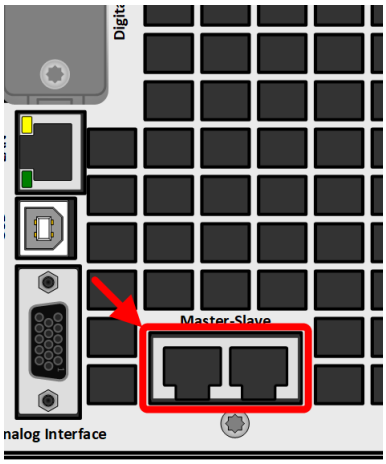


Figure 7 - Master slave bus ports

1.9.13 Ethernet port

The RJ45 LAN/Ethernet port on the rear side of the device is provided for communication with the device in terms of remote control or monitoring. The user has basically two options of access:

1. A website (HTTP, port 80) which is accessible in a standard browser via the IP or the host name given for the device. This website offers a configuration page for network parameters, as well as an input box for SCPI commands to control the device remotely by manually entering commands.

2. TCP/IP access via a freely selectable port (except 80 and other reserved ports). The standard port for this device is 5025. Via TCP/IP and the selected port, communication to the device can be established in most of the common programming languages.

Using this LAN port, the device can either be controlled by commands from SCPI or ModBus RTU protocol, while automatically detecting the type of message.

Access via ModBus TCP protocol is only supported by the optionally and separately available ModBus TCP interface module. See *«1.9.8 Interface module slot»*.

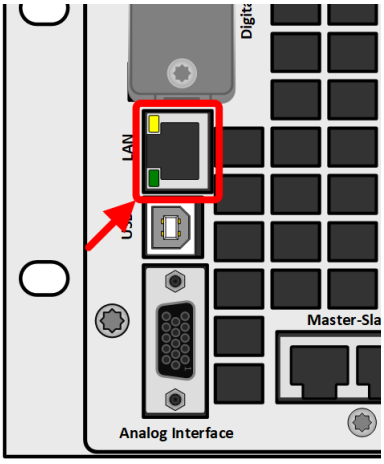


Figure 8 - LAN port

The network setup can be done manually or by DHCP. Transmission speed and duplex mode are on automatic mode.

If remote control is in operation the Ethernet port has no priority over any other interface and can, therefore, only be used alternatively to these. However, monitoring is always available.

2. Installation & commissioning

2.1 Transport and storage

2.1.1 Transport

- The handles on the front side of the device are **not** for carrying!
- Because of its weight, transport by hand should be avoided where possible. If unavoidable then only the housing should be held and not on the exterior parts (handles, DC terminal, rotary knobs).
- Do not transport when switched on or connected!
- When relocating the equipment use of the original packing is recommended
- The device should always be carried and mounted horizontally
- Use suitable safety clothing, especially safety shoes, when carrying the equipment, as due to its weight a fall can have serious consequences.

2.1.2 Packaging

It's recommended to keep the complete transport packaging for the lifetime of the device, for relocation or return to the manufacturer for repair. Otherwise the packaging should be disposed of in an environmentally friendly way.

2.1.3 Storage

In case of long term storage of the equipment it's recommended to use the original packaging or similar. Storage must be in dry rooms, if possible in sealed packaging, to avoid corrosion, especially internal, through humidity.

2.2 Unpacking and visual check

After every relocation, with or without packaging, or before commissioning, the equipment should be visually inspected for damage and completeness using the delivery note and/or parts list (see section *«1.9.3 Scope of delivery»*). An obviously damaged device (e.g. loose parts inside, damage outside) must under no circumstances be put into operation.

2.3 Installation

2.3.1 Safety procedures before installation and use

- The device has a considerable weight. Therefore the proposed location of the equipment (cabinet, shelf, 19" rack) must be able to support the weight without restriction.
- When using a 19" rack, rails suitable for the width of the housing and the weight of the device are to be used (see *«1.8 Technical Data»*
- Before connecting to the mains, ensure the supply voltage is as shown on the product label. Overvoltage on the AC supply can cause equipment damage.
- Bidirectional devices and electronic loads feature an energy recovery function which, similar to solar energy equipment, feeds energy back into the local or public grid. When feeding back into the public grid, it must not be operated without paying attention to guidelines from the local energy supplying company and it must be investigated before the installation or at the latest before initial commission, if there is a requirement to install a network & system protection device!

2.3.2 Preparation

2.3.2.1 Selecting cables

The required AC supply connection for these devices is a fixed connection. It's done via the 5 pole (standard models) or 4 pole (US208V models) connector on the rear (AC filter box). A matching plug is included. Wiring of the plug is at least 4 wire (3x L, PE) of suitable cross section and length. Full configuration with all phases plus N and PE is permissible.

For recommendations for a cable cross section see *«2.3.4 Connection to AC supply»*. Dimensioning of the DC wiring to the load/consumer has to reflect the following:

- The cable cross section should always be specified for at least the maximum current of the device.
- Continuous operation at the approved limit generates heat which must be removed, as well as voltage loss which depends on cable length and heating. To compensate for these the cable cross section should be increased and the cable length reduced.

2.3.2.2 Additional measure for energy recovering devices

Bidirectional device are so-called recuperating devices, at least when they're working in sink mode. In this mode they feed back a specific amount of energy into the local or public grid. The same applies permanently for electronic loads. Both device types can't sink energy without this functionality. The goal is to consume the recovered energy completely in the local power grid of a company or plant. In case it occurs that more energy is recuperated than consumed, the excess will be fed back into the public grid which usually isn't allowed without further precautions.

The operator of the device must, owing to circumstances, contact the local electric utility and clarify what's allowed and if a so-called network & system protection is required to be installed. There are several different international provisions and standards, such as the german VDE-AR-N 4105/4110 or the british ENA EREC G99 which regulate this situation.

The device itself provides a basic protection and would shut down energy feed back in case it can't work, but a full protection against frequency shift or voltage deviation can only be accomplished by such an NS protection device, which will also prevent isolation operation.

We offer NS protection solutions. They already fulfill the german AR-N 4105 and 4410, as well as the italian CEI 0-21 or the british G59/G98/G99.

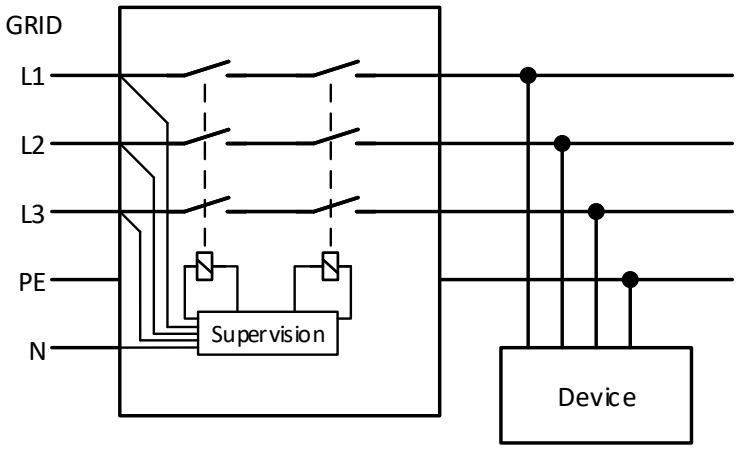
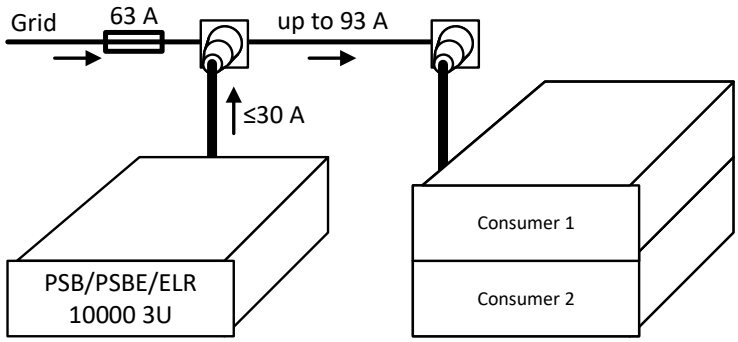


Figure 9 - Principle of an NS protection network

2.3.2.3 Installation concept for energy recovering devices

A bidirectional device working in sink mode or an electronic load recovers energy and feeds it back into the local power grid of a company or big electric plant. The recovered current adds to the grid current (see schematic below) and this can lead to an overload of the existing electric installation. Considering any two outlets, no matter of what type they are, there is usually no extra fusing installed in between. In case of a defect in the AC part (i.e. short-circuit) of any consumer device or when there are multiple devices connected which could take a higher power, the total current could flow across wires which are not laid out for this higher current. It could lead to damage or even fire in the wires or connection points.

In order to avoid damages and accidents, the existing installation concept must be taken into consideration before installing such recovering devices. Schematic depiction with one recovering device and consumers:



When running a higher number of recovering, i. e. energy backfeeding units on the same leg of the installation, the total currents per phase increases accordingly.

2.3.3 Installing the device

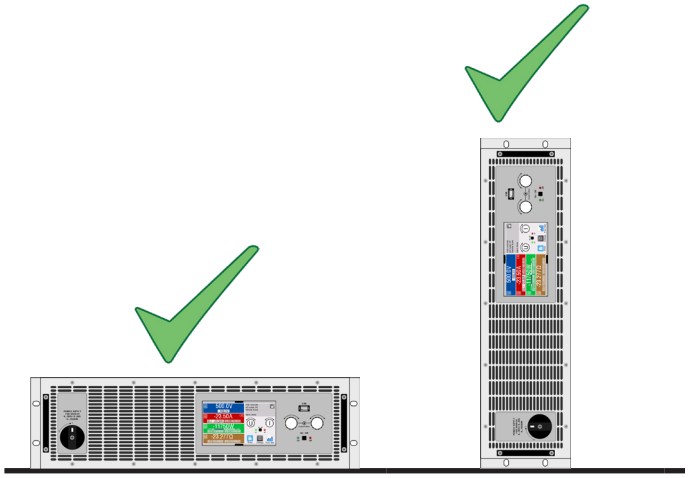
- Select the location for the device so that the connection to the load resp. source is as short as possible.
- Leave sufficient space, at least 30 cm (1 ft), behind the equipment for ventilation
- The device must not be operated without a proper touch protection on the AC connector, which is either only accomplished by installation of the device in a 19” rack/cabinet with lockable doors or by applying further measures (additional cover etc.)

All models in this series require to be installed and operated in a closed appliance, such as a cabinet. It’s also mandatory to install a rigid AC connection. Open operation on a desk or similar isn’t permissible.

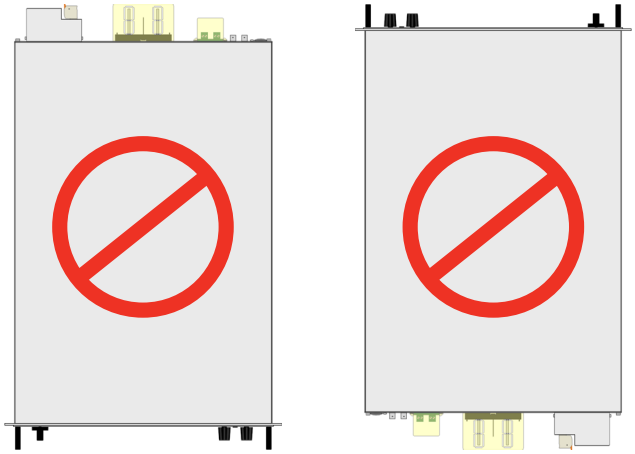
A device in a 19” chassis will usually be mounted on suitable rails and installed in 19” racks or cabinets. The depth of the device and its weight must be taken into account. The handles on the front are for sliding in and out of the cabinet. Slots on the front plate are provided for fixing the device (fixing screws not included).

The unacceptable positions, as shown below, are also valid for the vertical mounting of the device onto a wall (room or inside a cabinet). The required air flow would be insufficient.

Acceptable and unacceptable installation positions:



Standing surface



Wall

2.3.4 Connection to AC supply

- Connection to an AC supply must only be carried out by qualified personnel and the device must always be run directly on a power grid (transformer are permitted) and not on generators or UPS equipment!
- Cable cross section must be suitable for the maximum input current of the device! See tables below.
- According to standard EN 61010-1, the device must be fused externally and the fuse rating must be appropriate to the maximum AC current rating and AC cable cross section
- Ensure that all regulations for the operation of the device and connection to the public grid of energy recovering equipment have been considered and requirements have been met!

All models and variants in this series, as produced since approx. 01/2022, support to run either on 380/400/480 V or also 208 V (US and Japan grids). When running any model on 208 V it would automatically switch into derated power mode in which the available DC power is decreased to 3 kW (5 kW model), 6 kW (10 kW model) or 9 kW (15 kW model). This is detected every time when powering the device, so that the same model could provide the full rated power when being run on 380/400/480 V.

2.3.4.1 AC supply requirements

No matter what particular variant the device is, standard, WC or Slave, the rated AC supply voltage on the type label is decisive. They all use a regular three-phase supply without N. Specification:

Rated DC power	Inputs on AC plug	Supply type	Configuration
5 kW	at least L2, L3, (N), PE	Two/Three-phase (2P/3P)	Delta
10 kW / 15 kW	L1, L2, L3, (N), PE	Three-phase (3P)	Delta

The PE conductor is imperative and must always be wired to the AC plug!

2.3.4.2 Cross section

For the selection of a suitable cable **cross section** the rated AC current of the device and the cable length are decisive. Based on the connection of a **single unit** the table lists the maximum input current and recommended minimum cross section for each phase:

	L1		L2		L3		PE [1]
Available DC power	**ø [2]**	**I_{Max}**	**ø [2]**	**I_{Max}**	**ø [2]**	**I_{Max}**	**ø [2]**
5 kW (rated) at 380-480 V 3 kW (derated) at 208 V	-	-	≥ 4 mm² (AWG11)	31 A	≥ 4 mm² (AWG11)	31 A	≥ 4 mm² (AWG11)
10 kW (rated) at 380-480 V 6 kW (derated) at 208 V	≥4 mm² (AWG11)	31 A	≥4 mm² (AWG11)	18 A	≥4 mm² (AWG11)	18 A	≥4 mm² (AWG11)
15 kW (rated) at 380-480 V 9 kW (derated) at 208 V	≥4 mm² (AWG11)	31 A	≥4 mm² (AWG11)	31 A	≥4 mm² (AWG11)	31 A	≥4 mm² (AWG11)

1) Valid for both, the ground conductor in the AC cable and the separate PE line for enclosure grounding
2) Minimum sleeved cross section for wires in the WAGO AC plug is 0.5 mm² (AWG20)

2.3.4.3 AC plug & AC cable

The included AC plug can receive cable ends from 0.5 mm² (AWG20) to 10 mm² (AWG8). The longer the connection cable, the higher the voltage loss due to the cable resistance. Therefore the mains cable should be kept as short as possible or have an even bigger cross section. Cables with 3, 4 or 5 conductors can be used. When using a cable with N conductor, it's permissible to clamp it into the spare pin of the AC plug. Ratings of the AC plug:

- Max. cross section without cable end sleeve: 10 mm² (AWG8)
- Max. wire cross section with cable end sleeve: 6 mm² (AWG10)
- Stripping length without cable end sleeve: 18-20 mm (0.75 in)

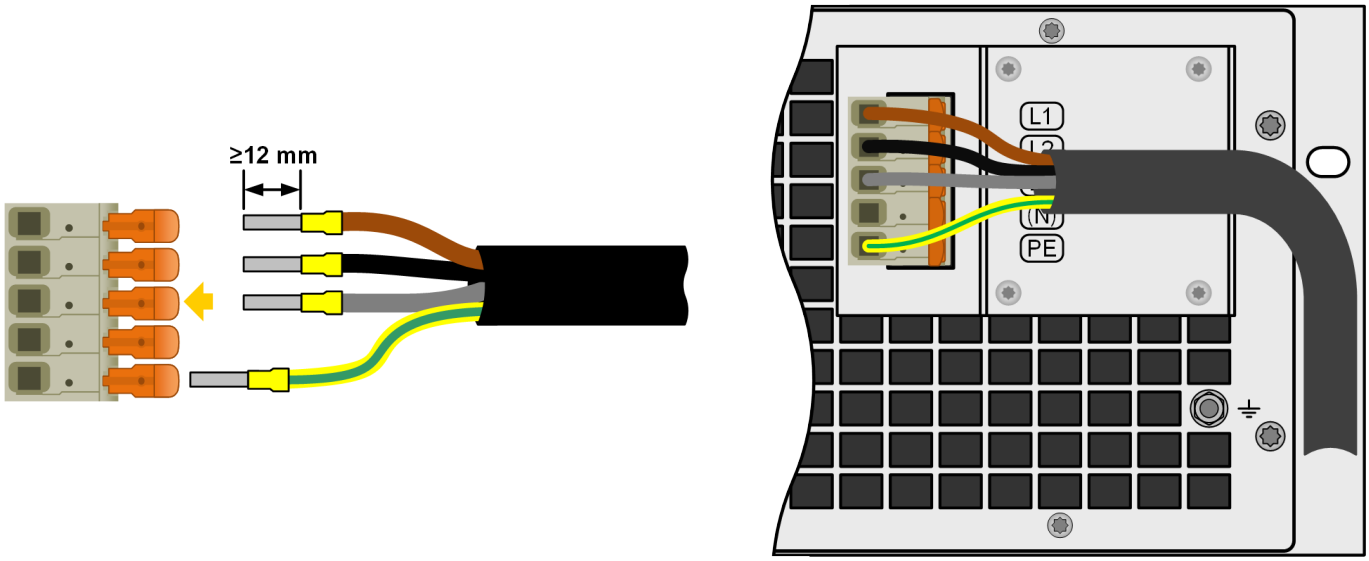


Figure 10 - Example for an AC cable with 4 conductors (european color code, cable not included in delivery)

2.3.4.4 Mounting the strain relief

All models in this series have a strain relief for the AC cable in their scope of delivery. It's recommended to be mounted and used by the installer, unless a different kind of strain relief is intended. Installation steps:

1. Remove the two screws from the AC filter box as marked in *Figure 11* below.
2. Place the bracket and fix it with the included, longer screws (M3x8) and spring/curved washers. See *Figure 12*.
3. Plug the AC plug and lead the cable in front of the bracket, when seen from behind, and fix it with at least one or better both of the included cable ties.

The bracket and the cable ties can remain connected all the time. The AC plug has some space to be pulled if required. Should the device be removed from the installation (cabinet), it's recommended to only pull the plug and dismount the bracket.

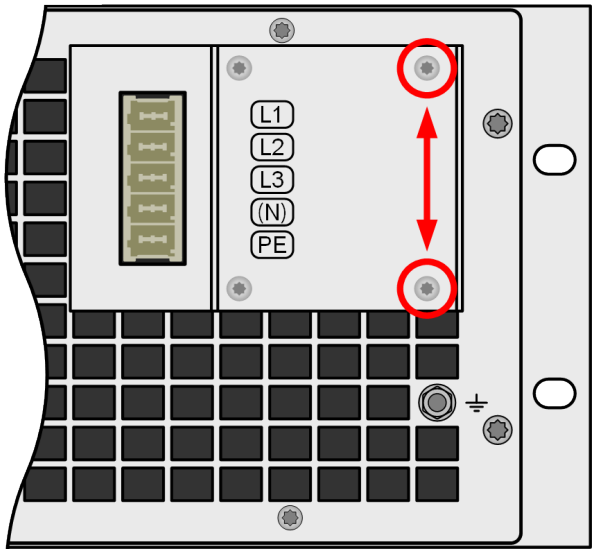


Figure 11 - Mounting position of the bracket

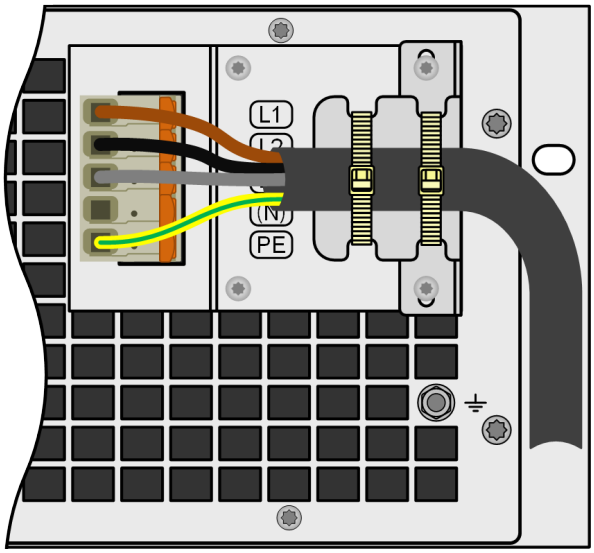


Figure 12 - Fully installed strain relief

2.3.4.5 Grounding the enclosure

The devices feature an additional grounding point on the rear side, as depicted in the figure to the right.

Safety for people working with the device which, amongst other measures, is achieved by keeping the leakage current as low as possible, the enclosure can be grounded additionally to the standard grounding via the AC cable. It's done be laying a separate protective earth line (PE) of the same or higher cross section as in the AC cable and connected here.

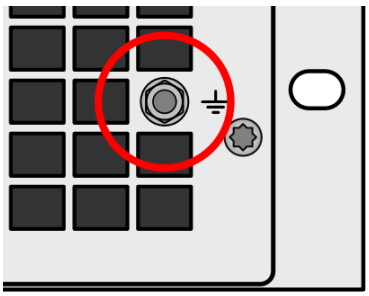


Figure 13 - Grounding point

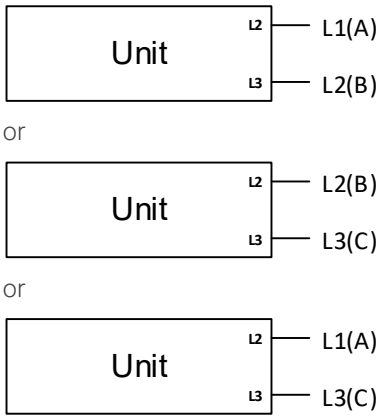
2.3.4.6 Connection variants

Depending on the rated power of a specific model, it requires two or three phases of a three-phase AC supply. In case **multiple units with 5 kW or 10 kW power rating** are connected to the same main terminal it's recommended to take care for balanced current distribution on the three phases. The table in section *2.3.4.2* shows the phase currents.

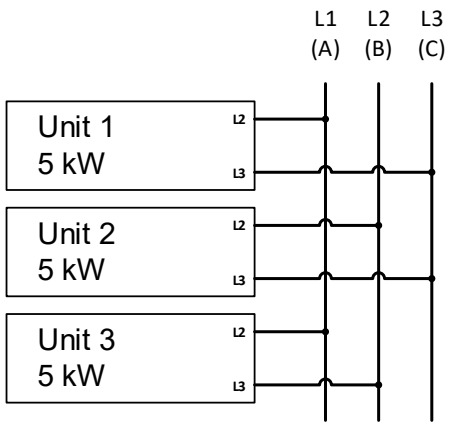
The **15 kW** models are an exception, because they already consume balanced current on all three phases. As long as only such models are installed, no unbalanced AC load is expected. Systems with mixed models are not automatically balanced, but balance can be achieved with a certain number of units by adding up the phase current of every used phase.

Suggestions for phase assignment:

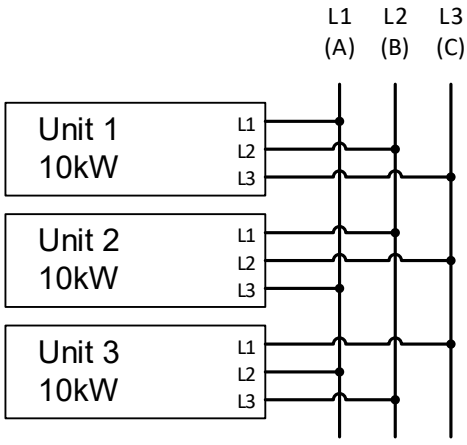
Single unit 5 kW



Multiple units 5 kW, balanced



Multiple units 10 kW, balanced



2.3.5 Connection to DC loads or DC sources

- In the case of a device with a high rated DC current which therefore requires thick and heavy DC connection cable it's necessary to take account of the weight of the cable and the strain imposed on the DC connection. Especially when mounted in a 19" cabinet or similar, where the cable could hang on the DC terminal, a strain reliever should be used.
- Apart from the proper cross section of DC cables the proper electric strength (withstand voltage) of the cables must be considered.

No false polarity protection inside! When connecting sources with false polarity the device will be damaged, also when the device isn't powered!

When connected to DC, an external source charges the internal capacities on the DC terminal, even when the device isn't powered. Dangerous voltage levels can be present on the DC terminal, even after disconnection of that external source.

The DC terminal is located on the rear side of the device and **is not** protected by a fuse. The cross section of the connection cable is determined by the current consumption, cable length and ambient temperature.

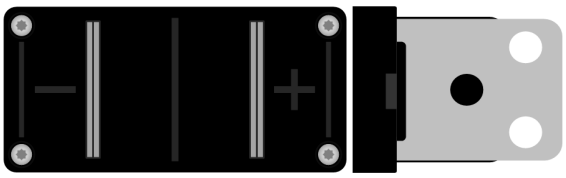
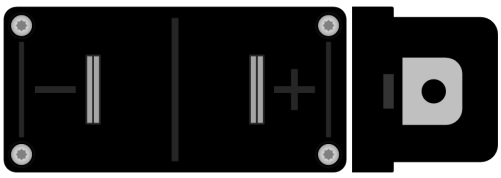
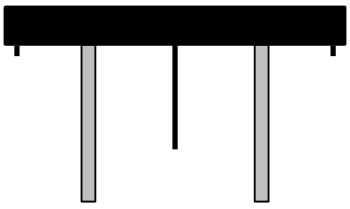
For cables up to **5 m (16.4 ft)** and average ambient temperatures of **up to 30°C (86°F)** we recommend:

Up to **30 A**:	6 mm² (AWG8)	Up to **70 A**:	16 mm² (AWG4)
Up to **90 A**:	25 mm² (AWG3)	Up to **140 A**:	50 mm² (AWG1/0)
Up to **170 A**:	70 mm² (AWG3/0)	Up to **210 A**:	95 mm² (AWG4/0)
Up to **340 A**:	2x 70 mm² (AWG3/0)	Up to **510 A**:	2x 120 mm² (AWG250)

per connection pole (multi-conductor, insulated, openly suspended). Single cables of, for example, 70 mm² may be replaced by e.g. 2x 35 mm² etc. If the cables are long then the cross section must be increased to avoid voltage loss and overheating.

2.3.5.1 DC terminal types

The table below shows an overview of the various DC terminals. It's recommended that connection of load cables always utilizes flexible cables with ring lugs.

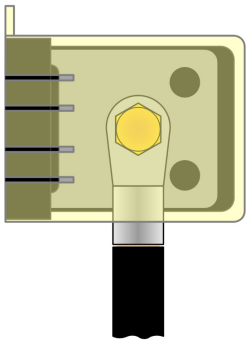
Type 1: Models up to 200 V	**Type 2: Models from 360 V**
	
M8 bolt on a metal rail Recommendation: ring lug with a 9 mm hole	M6 bolt on a metal rail Recommendation: ring lug with a 6.5 mm hole
	

2.3.5.2 Cable lead and plastic cover

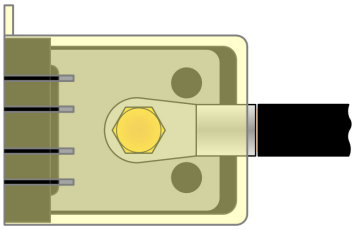
The scope of delivery includes a plastic cover for the DC terminal which serve as contact protection. It must always be installed when operating the device. There are breakouts so that the DC cables can be laid in various directions.

The connection angle and the required bending radius for the DC cable must be taken into account when planning the depth of the complete device, especially when installing in a 19" cabinet or similar installations.

Examples for the type 1 terminal:



- 90° up or down
- space saving in depth
- no bending radius

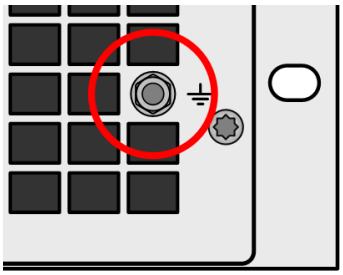


- horizontal lead
- space saving in height
- large bending radius

2.3.6 Grounding of the DC terminal

The extra grounding point on the rear plate, as marked in the figure to the right, can be used to ground one of the DC terminal poles. Doing so causes a potential shift on the opposite pole against PE. Due to insulation, there is a maximum allowed potential shift defined for the negative DC terminal pole, which depends on the device model. Refer to *«1.8.3 Specific technical data»* for details.

Both poles on the DC terminal are floating, which is considered as a basic protection in terms of safety of persons. Grounding any DC terminal voids that basic protection.



When potential shifting a model with 60 V rating, the safety extra low voltage (SELV) can turn into a protective extra low voltage (PELV) or leave the safe range. In such a situation, the voltage levels on the DC terminal become hazardous and thus the DC terminal must be covered.

In case any DC pole is grounded, the operator of the device must reinstate the basic protection for human safety by installing appropriate external means, for instance a cover, everywhere the potential of the DC terminal is connected to.

2.3.7 Connection of remote sensing

- *Remote sensing is only effective during constant voltage operation (CV) and for other control modes the sense input should be disconnected, if possible, because connecting it generally increases the oscillation tendency*
- *The cross section of the sense cables is noncritical. Recommendation for cables up to 5 m (16.4 ft): use at least 0.5 mm²*
- *Sense cables shouldn't be twisted, but laid close to the DC cables, i. e. Sense- cable close to DC- cable to the load etc. to damp or avoid possible oscillation. If necessary, an additional capacitor should be installed at the load/consumer to eliminate oscillation*
- *The Sense+ cable must be connected to DC+ on the load and Sense- to DC- at the load, otherwise the sense input of the power supply can be damaged. For an example see Figure 14 below.*
- *In master-slave operation, the remote sensing should be connected to the master unit only*
- *The dielectric strength of the sense wires must always at least match the DC voltage rating!*

Dangerous voltage possible on the sense connectors! The sense cover(s) must always be installed.

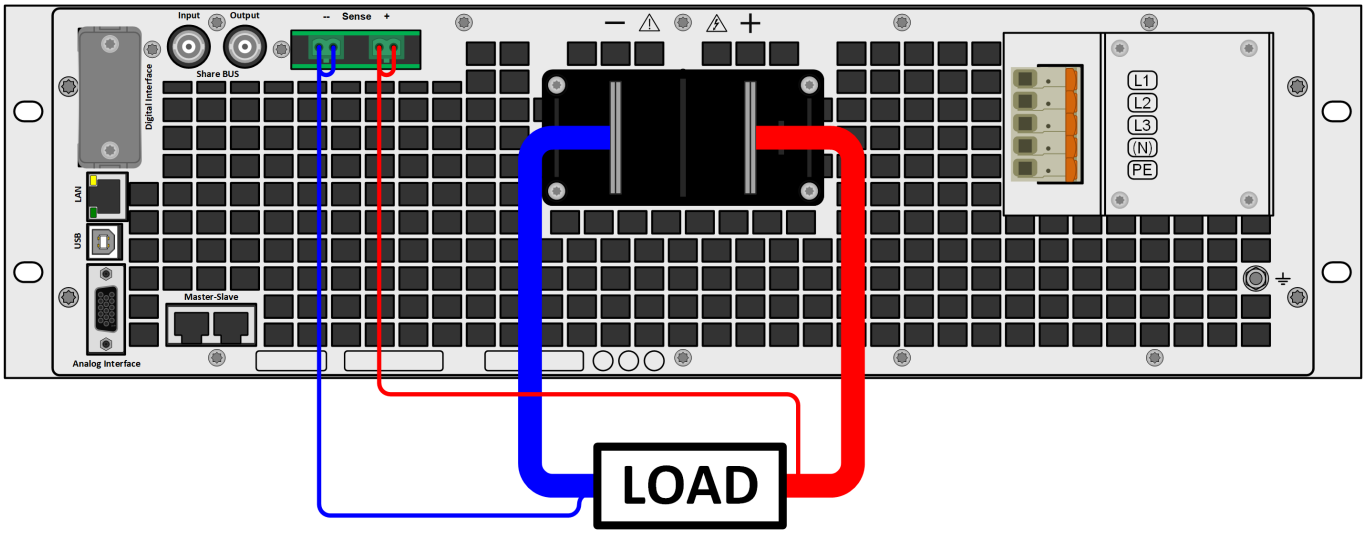
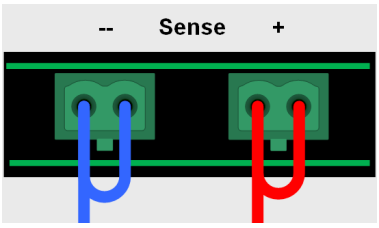
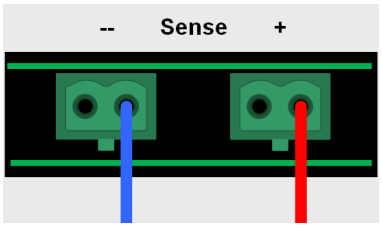
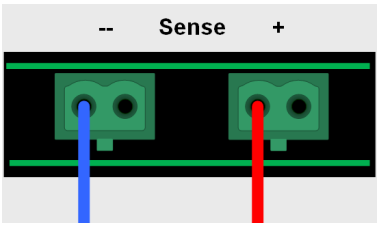


Figure 14 - Example for remote sensing wiring (DC terminal and Sense terminal covers left away for illustrative purposes)

Allowed connection schemes:







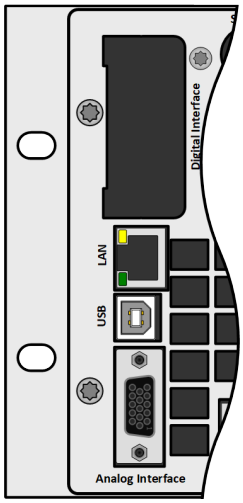
2.3.8 Installation of an interface module

The optionally obtainable interface modules can be retrofitted by the user and are exchangeable with each other. The settings for the currently installed module vary and need to be checked and, if necessary, corrected on initial installation and after module exchange.

- Common ESD protection procedures apply when inserting or exchanging a module.
- The device must be switched off before insertion or removal of a module
- Never insert any other hardware other than an interface module into the slot
- If no module is in use it's recommended that the slot cover is mounted in order to avoid internal dirtying of the device and changes in the air flow (models with air-cooling)

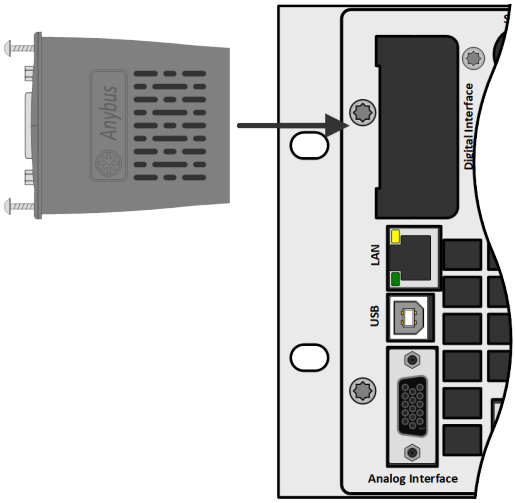
Installation steps:

1.



Remove the slot cover. If needed, use a screw driver.

2.

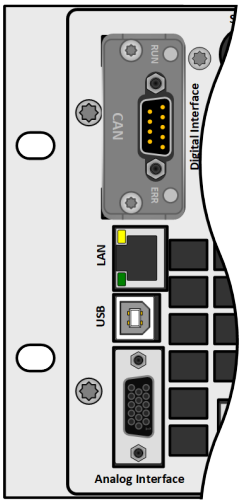


Insert the interface module into the slot. The shape ensures correct alignment.

When inserting take care that it's held as close as possible to a 90° angle to the rear wall of the device. Use the green PCB which you can recognize on the open slot as guide. At the end is a socket for the module.

On the bottom side of the module are two plastic nibs which must click into the green board (PCB) so that the module is properly aligned on the rear wall of the device.

3.



The screws (Torx 8) are provided for fixing the module and should be fully screwed in. After installation, the module is ready for use and can be connected.

Removal follows the reverse procedure. The screws can be used to assist in pulling out the module.

2.3.9 Connection of the analog interface

The 15 pole connector (type: D-sub, VGA) on the rear side is an analog interface. To connect this to a controlling hardware (PC, electronic circuit), a standard plug is necessary (not included in the scope of delivery). It's generally advisable to switch the device completely off before connecting or disconnecting this connector, but at least the DC terminal.

2.3.10 Connection of the Share-Bus

The "Share-Bus" connectors on the rear side (2x BNC type) can be used to connect to the Share-Bus of further. The main purpose of the Share-Bus is to balance the voltage of multiple units in parallel operation, especially when using the integrated function generator of the master unit. For further information about parallel operation refer to section *«4.1. Parallel operation in master-slave (MS)»* or *«3.1. Parallel operation in master-slave (MS)»* in the corresponding user manual.

For the connection of the Share-Bus the following must be paid attention to:

- Connection is only permitted between compatible devices (see *«1.9.10 "Share-Bus" connector»* for details) and between a max. of 64 units
- The Share-Bus of this series works in two directions, for source and sink mode. It's compatible to a few other device series, but it requires careful planning of the entire system, if devices are going to be connected which solely work as sink (el. load) or as source (power supply).

2.3.11 Connection of the USB port (rear side)

In order to remotely control the device via this port, connect the device with a PC using the included USB cable and switch the device on.

2.3.11.1 Driver installation (Windows)

On the initial connection with a PC the operating system will identify the device as new hardware and will try to install a driver. The required driver is for a Communications Device Class (CDC) device and is usually integrated in current operating systems such as Windows 10 or 11. But it's strongly recommended to use and install the included driver installer (on USB stick) to gain maximum compatibility of the device to our softwares.

2.3.11.2 Driver installation (Linux, MacOS)

We can't provide drivers or installation instructions for these operating systems. Whether a suitable driver is available is best carried out by searching the Internet.

2.3.11.3 Alternative drivers

In case the CDC drivers described above are not available on your system, or for some reason do not function correctly, commercial suppliers can help. Search the Internet for suppliers using the keywords "cdc driver windows" or "cdc driver linux" or "cdc driver macos".

2.4 Initial commission

For the first start-up after installation of the device, the following procedures have to be executed:

- Confirm that the connection cables to be used are of a satisfactory cross section!
- Check if the factory settings of set values, safety and monitoring functions and communication are suitable for your intended application of the device and adjust them if required, as described in the manual!
- In case of remote control via PC, read the additional documentation for interfaces and software!
- In case of remote control via the analog interface, read the section in this manual concerning analog interfaces!

2.5 Commission after a firmware update or a long period of non-use

In case of a firmware update, return of the equipment following repair or a location or configuration change, similar measures should be taken to those of initial start up. Refer to *«2.4 Initial commission»*.

Only after successful checking of the device as listed, it may be operated as usual.

3. Operation and application (1)

3.1 Terms

The bidirectional device type is a combination of a power supply and an electronic load. It can work alternately in one of two superior operation modes which are distinguished from each other in several parts of this document below:

- **Source / source mode:**
  - the device works as a power supply, generating and providing DC voltage to an external DC load
  - in this mode, the DC terminal is considered as DC output
- **Sink / sink mode:**
  - the device works as an electronic load, sinking DC energy from an external DC source
  - in this mode, the DC terminal is considered as DC input

3.2 Important notes

3.2.1 Personal safety

- In order to guarantee safety when using the device, it's essential that only persons operate the device who are fully acquainted and trained in the required safety measures to be taken when working with dangerous electrical voltages
- For models which can generate a voltage which is dangerous by contact, or are connected to such, the included DC terminal cover, or an equivalent, must always be used
- Read and follow all safety warnings in section *1.7.1*!

3.2.2 General

- When running the device in source mode, unloaded operation is not considered as a normal operation mode and can therefore lead to false measurements, for example when calibrating the device
- The optimal working point of the device is between 50% and 100% voltage and current
- It's recommended not to run the device below 10% voltage and current, in order to make sure technical values like ripple and transient times can be met

3.3 Alarm conditions

This section only gives an overview about device alarms. What to do in case your device indicates an alarm condition is described in section «3.5 Alarms and monitoring».

As a basic principle, all alarm conditions are signaled visually (text + message in the display) and acoustically (if activated), as well as status via digital interface. In addition, most alarms are reported as signals on the analog interface. For later acquisition, an alarm counter can also be shown on display or read via digital interface.

3.3.1 Power fail

Power fail (PF) indicates an alarm condition which may have various causes:

- AC input voltage too low (mains undervoltage, mains failure)
- Defect in the input circuit (PFC)
- One or multiple power stages in the device are faulty

As soon as a power fail occurs, the device will stop to supply or sink power and switch off the DC terminal. In case the power fail was due an undervoltage and disappears later on, the device can continue to work as before, but this depends on a parameter in the settings menu called **DC terminal -> State after PF alarm**. The default setting would keep the DC terminal switched off, but leave the alarm in the display for notification.

Powering the device down (power switch) can't be distinguished from a supply blackout and therefore the device will signalize a PF alarm every time. This can be ignored.

3.3.2 Overtemperature

An overtemperature alarm can occur from an excess temperature inside the device and temporarily causes it to switch the DC terminal off. After cooling down, the device can automatically switch the DC terminal back on, depending on the setting of parameter **DC Terminal -> State after OT alarm**. For more about these settings refer to section *2.2.1.1* or *2.3.1.1* in the corresponding user manual. The alarm will remain in the display as notification and can be cleared anytime.

3.3.3 Overvoltage

An overvoltage alarm (OVP) will switch off the DC terminal and can occur if:

- the device itself, when running in source mode, or an external source (in sink mode) supplied a voltage to the DC terminal higher than set for the overvoltage alarm threshold (OVP, 0...110% U_{Nom}) or the connected load somehow returns voltage higher than this threshold
- the OVP threshold has been adjusted too close above the output setting of a power supply device and if the device is in CC control mode and then experiences a negative load step, this will make the voltage rise quickly, resulting in an voltage overshoot for a short moment which can already trigger the OVP

This function serves to warn the user acoustically or optically that the device probably has generated or experienced an excessive voltage which could damage the connected load application or the device.

- The device is not fitted with protection from external overvoltage and could even be damaged when not powered
- The changeover from operation modes CC -> CV in source mode can cause voltage overshoots

3.3.4 Overcurrent

An overcurrent alarm (OCP) will switch off the DC terminal and can occur if:

- the current in the DC terminal reaches the adjusted OCP limit.

This function serves to protect the connected load application of a power supply or the external source of an electronic load or bidirectional power supply in sink mode, so it's not overloaded and possibly damaged due to an excessive current.

3.3.5 Overpower

An overpower alarm (OPP) will switch off the DC terminal and can occur if:

- the product of the voltage and current in the DC terminal reaches the adjusted OPP limit.

This function serves to protect the connected load application of a power supply or the external source of an electronic load or bidirectional power supply in sink mode, so it's not overloaded and possibly damaged due to an excessive power.

3.3.6 Safety OVP

This extra feature is only built into power supply devices with **60 V rating**. Similar to the regular overvoltage protection (OVP, see section *3.3.3*), the Safety OVP is supposed to protect the application or people according to SELV. The alarm shall prevent the device from providing an output voltage higher than 60 V. However, the alarm could also be triggered by an external source providing an excess voltage to the DC terminal of the device.

A Safety OVP alarm will occur if

- the voltage on the DC terminal of the device or on input Sense reaches the rigid threshold slightly above of 60 V.

If the voltage on the DC terminal exceeds that level for any reason, the DC terminal will be switched off and alarm **Safety OVP** will be indicated in the display. This alarm can't be acknowledged the usual way. It requires to power-cycle the unit.

During normal operation, this alarm should not trigger. There are, however, situations which can trigger the alarm, for example when working with voltages close to the threshold or voltage spikes that can occur when leaving CC mode, such as when the current was set to 0 A or a very low value and abruptly changes to a high value.

When remote sensing is used, i. e. the rear input "Sense" is connected, the true output voltage is higher than set value so the Safety OVP could already trigger at voltage settings lower than 60 V.

3.3.7 Share-Bus fail

The Share-Bus fail alarm (short: SF) is related to the physical Share-Bus (connectors on the rear side of the device) and the condition whether it's connected to at least one other device or not. The alarm is also related to the configuration of master-slave mode.

Depending on the situation, the Share-Bus of the involved devices must either be connected or disconnected or else the alarm might occur, preventing to switch the DC terminal on. Should the alarm occur in the middle of normal operation, it would switch the DC terminal off. Possible causes for an SF alarm:

- After powering the device and/or before initializing master-slave operation: see table below
- After master-slave initialization and in the middle of operation: physical defect of the Share-Bus cable

Possible situations after powering a device or after the configuration has been changed:

Master-slave mode	Share-Bus cable	Result	Necessary action
Off	Disconnected	Normal condition outside of master-slave. Operation unrestricted.	None
Off	Connected	SF alarm will occur on every unit connected on the Share-Bus	Remove the Share-Bus cable and clear the alarm
Master	Disconnected	No SF alarm on the master. The master will initialize the MS system, but if at least one slave with SF alarm has been detected, this alarm will be signaled on the master, blocking th DC terminal from being switched on.	Connect all devices which are supposed to be in the MS system on the Share-Bus and initialize the MS system
Master	Connected	There should be no SF alarm, given that only 1 master and x slaves are in the system	None
Slave	Disconnected	SF alarm occurs and can't be cleared. The master would initialize the system, but the system cannot switch DC on, because the slave reports its SF alarm to the master.	Connect all devices which are supposed to be in the MS system on the Share-Bus and initialize the MS system
Slave	Connected	While booting and later when the master automatically tries to initialize the MS system there should be no SF alarm on all involved devices, given that only 1 master and x slaves are in the system and all have identical firmware versions installed. In case the system is initialized only later on, the slave will signal SF.	None

3.4 Manual operation (1)

While manually operated and while also being connected to any remote control equipment via any of the interfaces, the device could be taken over into remote control anytime without warning or request for confirmation. It's recommended to block remote control by activating the 'Local' mode for the duration of the manual operation.

3.4.1 Switching the device on

The device should, as far as possible, always be switched on by putting the rotary switch on the front of the device to position 1. Alternatively this can be done using an external cutout (contactor, circuit breaker) of suitable current capacity.

After switching on, the display will first show some device related information (model, firmware versions etc.) and then a language selection screen for 3 seconds. A few seconds later it will show the main screen.

In the **Settings** menu (also see section *«2.2.1. Configuration via the menu»* or *«2.3.1. Configuration via the menu»* in the corresponding user manual) in the group **DC terminal** is an option **State after power ON** in which the user can determine the condition of the DC terminal after power-up. The factory setting here is **Off**, meaning that the DC terminal will always be switched off after power-up. **Restore** means that the last condition will be restored, either on or off, so the selection here must be considered carefully.

For the time of the start phase the analog interface can signal undefined statuses on its digital outputs. This must be ignored until the device has finished booting and is ready to work.

3.4.2 Switching the device off

The device is switched off by putting the power switch on the front into position 0. Doing so will cause two things: a) the immediate storage of the last condition of the DC terminal and the most recent set values and b) the occurrence of a PF alarm (power fail) which can be ignored. The DC terminal is also immediately switched off and after a certain stopping time (up to 30 seconds) the display and the fans will go off and then the device is completely powered off.

The power switch on the front cuts the device physically from the AC grid when in position 0. It hence qualifies as a separator.

3.4.3 Manual adjustment of set values

The set values for voltage, current and power are the fundamental operating possibilities of a power supply and hence the two rotary knobs on the front of the device are always assigned to two of the values in manual operation.

With bidirectional power supplies, for each mode, sink and source, the device has separately adjustable set values for current, power and resistance which are labeled accordingly in the display. **(PS)** stands for source mode while **(EL)** is for sink mode.

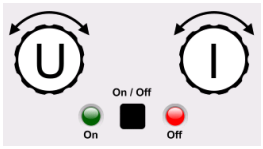
The resistance value is connected to the "R mode" which has to be activated separately, for instance via the quick menu. For details refer to *«2.3.1. Configuration via the menu»* in the user manual, as well as *«2.2.4. Internal resistance control (source mode)»* and *«2.2.5. Resistance control / constant resistance (sink mode)»* for bidirectional devices. For other device types refer to sections *2.2.1* and *2.1.4*.

Set values can be entered manually in two ways, via **rotary knob** or **direct input**. While the rotary knobs adjust values continuously, entering them via numeric pad can be used to change values in bigger steps.

Changing a value is immediately submitted, no matter if the DC terminal is switched on or off.

When adjusting set values, upper and lower limits may come into effect. See section «2.2.2. Adjustment limits» or «2.3.2. Adjustment limits» in the corresponding user manual. Once a limit is reached, the display will show a small notification, such as "Limit: U-max", for a short time in proximity to the adjusted value.

► How to adjust set values U, I, P or R with the rotary knobs



1. First check if the value you want to change is already assigned to one of the rotary knobs. The main screen displays the assignment as depicted in the figure to the right.
2. If, as shown in the example, the assignment is voltage (U, left knob) and current (I, right knob), and it's required to set the power, then the assignment of the right-hand knob can be changed by tapping on its depiction until it shows "P". In the left-hand display area one of the set values of power, for sink or source mode, is indicated as selected by its unit being display in inverted form.
3. After successful selection, the desired value can be set within the defined limits. Selecting the next digit is done by pushing the rotary knob which shifts the cursor from right to left (the selected digit will be underlined):

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

► How to adjust values via direct input:

1. On the main screen, depending on the rotary knob assignment, values can be set for voltage (U), current (I), power (P) or resistance (R) via direct input, by tapping on one of the small ten-key pad symbols, for example the one in the blue area if you wanted to adjust the voltage.
2. Enter the required value using the ten-key pad. Similar to a pocket calculator the key C clears the input. Decimal values are set by tapping the point key. For example, 54.3 V is entered with 5 4 · 3 and Enter.
3. Unless the new value isn't rejected for some reason, the display would then switch back to the main page and the set value would be submitted to the DC terminal.

Upon entering a value which exceeds the corresponding limit, a notification would appear, the value in the frame would be reset to 0, not be accepted and not be submitted.

3.4.4 Switching the DC terminal on or off

The DC terminal of the device can be manually or remotely switched on and off. After the DC terminal has been switched on, a bidirectional device can either work as a DC input (sink mode) or DC output (source mode). More information can be found in *«2.2.6. Sink-source mode switching»* in the user manual of bidirectional devices. With the device type of a standard "power supply", the DC terminal will always be an output and with the device type "electronic load" it will always be an input.

Switching the DC terminal on during manual operation or digital remote control can be disabled by pin REM-SB of the built-in analog interface. For more information refer to section 2.2.1.1 or 2.3.1.1 in the corresponding user manual, as well as example a) in section 2.3.4.7 or 2.4.4.7.

► How to manually switch the DC terminal on or off

1. As long as the control panel isn't completely locked, press the button **On/Off**. Otherwise you are asked to disable the HMI lock. In case the HMI lock is connected to a PIN, you are asked to enter the PIN first.
2. With the possible HMI lock removed, button **On/Off** toggles the DC terminal state, as long as this is not restricted by an alarm or the device being in remote control.

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

1. See section *"«2.2.4. Remote control via the analog interface»* or *2.3.4* in the user manual.

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

1. See the external documentation "Programming Guide ModBus & SCPI" if you are using custom software, or refer to the external documentation from LabVIEW VIs or other software provided by the manufacturer.

3.4.5 Locking the control panel (HMI)

In order to avoid the accidental alteration of a value during manual operation, the rotary knobs or the touchscreen can be locked so that no alteration of values will be accepted without prior unlocking.

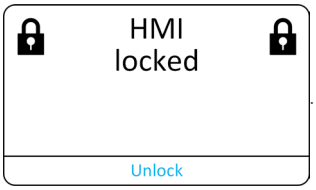
► How to lock the HMI

1. On the main screen, tap the padlock symbol  in upper right corner. If the DC terminal is switched on in this moment, the lock is immediately effective. Otherwise the **Lock** screen will appear where you can select to lock the HMI completely or with the exception of the **On/Off** button by enabling **On/Off possible during HMI lock**. Additionally, you can decide to activate the additional **PIN for user interface lock**. The device would later request to enter this PIN every time you want to unlock the HMI.
2. Activate the lock with **Start**. The device will jump back to the main screen and dim it.

1.

If an attempt is made to tap the screen or rotate a knob whilst the HMI is locked, a requester appears in the display asking if the lock should be disabled.

► How to unlock the HMI

1. Tap any area on the touchscreen or rotate any knob or press the **On/Off** button (only in full lock).
2. This requester will appear: 

3. Unlock the HMI by tapping on **Unlock** within 5 seconds, otherwise the pop-up will disappear and the HMI remains locked. In case the additional PIN code lock has been activated in the **Lock** screen, another requester will pop up, asking you to enter the PIN before it finally unlocks the HMI.

3.4.6 Locking the adjustment limits and user profiles

In order to avoid the alteration of the adjustment limits (also see *«2.2.2. Adjustment limits»* or *«2.3.2. Adjustment limits»* in the corresponding user manual) by an unauthorized user, the screen with the adjustment limit settings ("Limits") can be locked with a PIN code. This will lock group **Limits** in the **Settings** menu and menu **Profiles** until the lock is removed by entering the correct PIN or, in case it has been forgotten, by resetting the device to factory default.

► How to lock the Limits and Profiles

1. While the DC terminal is switched off, tap the padlock symbol  on the main screen. In case the HMI is locked, it has to be unlocked first. After this, the menu page **Lock** will be entered.
2. Activate the switch next to **Lock limits and profiles with user PIN**.
3. Leave the **Settings** menu.

	*The same PIN as for the HMI lock is used here. It should be set before activating the Limits lock. See «3.4.5 Locking the control panel (HMI)»*

	Be careful to enable the lock if you are unsure what PIN is currently set. If in doubt, use ESC to exit the menu page. On menu page **Lock** you can define a different PIN, but not without entering the old one.

► How to unlock the Limits and Profiles

1. While the DC terminal is switched off, tap on touch area 

on the main screen.
2. In the menu tap on **HMI setup**, then on group **Lock**.
3. In the group tap on **Unlock limits and profiles**. You will be requested to enter the 4-digit PIN.
4. Deactivate the lock by entering the correct PIN.

3.5 Alarms and monitoring

3.5.1 Definition of terms

There is a clear distinction between device alarms (see *«3.3 Alarm conditions»*), such as overvoltage protection **OVP** or overheating protection **OT**, and user defined events such as **OVD** (overvoltage detection). Those events are only supported by devices from series PSI, PSB and ELR.

Whilst device alarms only switch off the DC terminal, user defined events can do more. They can also switch off the DC terminal(**Action** = **Alarm**), but can alternatively simply give an acoustic signal to alert the user. Actions driven by **user defined events** can be configured as follows:

Action	Impact	Example
None	User defined event is disabled.	
Signal	On reaching the condition which triggers the event, the action **Signal** will show a text message in the status area of the display.	
Warning	On reaching the condition which triggers the event, the action **Warning** will show a text message in the status area of the display and pop up an additional warning message which can be noticed from a bigger distance.	
Alarm	On reaching the condition which triggers the event, the action **Alarm** will show a text message in the status area of the display with an additional alarm pop-up, and additionally emit an acoustic signal (if activated). Furthermore the DC terminal is switched off.	

3.5.2 Device alarm and event handling

Important to know:

When switching the DC terminal of a bidirectional device in sink mode or an electronic load off while a current limited source still supplies energy, the output voltage of the source can rise immediately and due to transient times the output voltage can have an overshoot to an unknown level and with a duration of several seconds, which might trigger the overvoltage alarm (OVP) or the overvoltage supervision event (OVD) of a 10000 device in case these thresholds are adjusted to sensitive levels.

A device alarm incident will usually result in the DC terminal switching off, the appearance of a pop-up in the middle of the display and, if activated, an acoustic signal to make the user aware. An alarm must always be acknowledged.

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

1. If the alarm is indicated as a pop-up, tap **Acknowledge**.
2. If the alarm has already been acknowledged, but is still displayed in the status area, then first tap the status area to display the pop-up and then **Acknowledge**.

In order to acknowledge an alarm during analog remote control refer to *«2.2.4.2. Acknowledging device alarms»* and *«2.3.4.2. Acknowledging device alarms»* in the corresponding user manual. To acknowledge in digital remote control, refer to the external documentation “Programming Guide ModBus & SCPI”.

Some device alarms are configurable, separately for source and sink mode:

Short	Long	Description	Range	Indication
OVP	**O**ver**V**oltage **P**rotection	Triggers an alarm as soon as the voltage on the DC terminal reaches the defined threshold. The DC terminal will be switched off.	0 V...1.1*U_{Nom}	Display, analog & digital interfaces
OCP	**O**ver**C**urrent **P**rotection	Triggers an alarm as soon as the current in the DC terminal reaches the defined threshold. The DC terminal will be switched off.	0 A...1.1*I_{Nom}	Display, analog & digital interfaces

Short	Long	Description	Range	Indication
OPP	**O**ver**P**ower **P**rotection	Triggers an alarm as soon as the output or input power reaches the defined threshold. The DC terminal will be switched off.	0 W...1.1*P_{Nom}	Display, analog & digital interfaces

These device alarms can't be configured:

Short	Long	Description	Indication
PF	**P**ower **F**ail	AC supply over- or undervoltage. Triggers an alarm in case the AC supply is out of specification or when the device is cut from supply, for example when switching it off with the power switch. The DC terminal will be switched off. The condition of the DC terminal after a temporary PF alarm can be determined by the setting **DC terminal -> State after PF alarm**.	Display, analog & digital interfaces
		Acknowledging a PF alarm during runtime can only occur approx. 15 seconds after the cause of the alarm has gone. Switching the DC terminal on again requires another approx. 5 seconds of waiting time.	
		Power Fail is also triggered at other alarms like OVP, OCP, OPP, OT and SF. It causes a shutdown in the PFC of the power stage(s) and this results in a longer time (approx. 12 seconds) until the device is ready to switch DC on again.	
OT	**O**ver**Tem-perature**	Triggers an alarm in case the internal temperature reaches a certain limit. The DC terminal will be switched off. The condition of the DC terminal after cooling down can be determined by the setting **DC terminal -> State after OT alarm**.	Display, analog & digital interfaces
MSP	**M**aster-**S**lave **P**rotection	Triggers an alarm in case the master unit loses contact to any slave unit. The DC terminal will be switched off. The alarm can be cleared by reinitializing the MS system.	Display, digital interfaces
SOVP	**S**afety **O**ver**V**oltage **P**rotection	Only featured with 60 V models: Triggers a special OVP alarm in case the voltage on the DC terminal exceeds the rigid threshold of 101% rated voltage. The DC terminal will be switched off. For details refer to section *3.3.6*	Display, analog & digital interfaces
SF	**S**hare-Bus **F**ail	Can occur in situations where the Share-Bus signal is damped too much due to wrong or damaged (short-circuit) BNC cables or simply when at least one of the Share-Bus connectors is wired to another device while the alarm reporting one isn't configured for master-slave operation. For details also see section *3.3.7.*	Display, digital interfaces

► How to configure the thresholds of the adjustable device alarms

1. While the DC terminal is switched off, tap on touch area 

on the main screen.
2. In the menu tap on group **Protection**. On the right-hand side of the screen it will list all device alarms with their adjustable thresholds. These are permanently compared to the actual values of voltage, current and power on the DC terminal. Here is also distinguishes between source and sink mode.
3. Set the threshold for the protections relevant to your application if the default value of 110% is unsuitable.

The user also has the possibility of selecting whether an additional acoustic signal will be sounded if an alarm or user defined event occurs.

► How to configure the alarm sound (also see *«2.2.1. Configuration via the menu» (2.3.1)* in the user manual)

1. Swipe with your finger up from the bottom edge of the screen or directly tap on the bottom bar:

2. The quick menu will open. Tap on  to activate the alarm sound, or on  to deactivate it.
3. Leave the quick menu.

3.5.2.1 User defined events

These user defined events are only available with the series ELR, PSI and PSB.

The monitoring functions of the device can be configured for user defined events. By default, events are deactivated (**Action** set to **None**). Contrary to device alarms, the events only work while the DC terminal is switched on. It means, for instance, that you can't detect undervoltage (UVD) anymore after switching the DC terminal off and the voltage would still be sinking (when using a power supply).

The following events can be configured:

Event	Meaning	Description	Range
UVD	**U**nder**V**oltage **D**etection	Triggers an event if the DC voltage falls below the defined threshold.	0 V...U_{Nom}
OVD	**O**ver**V**oltage **D**etection	Triggers an event if the DC voltage exceeds the defined threshold.	0 V...U_{Nom}
UCD	**U**nder**C**urrent **D**etection	Triggers an event if the DC current falls below the defined threshold.	0 A...I_{Nom}
OCD	**O**ver**C**urrent **D**etection	Triggers an event if the DC current exceeds the defined threshold.	0 A...I_{Nom}
OPD	**O**ver**P**ower **D**etection	Triggers an event if the DC power exceeds the defined threshold.	0 W...P_{Nom}

These events shall not be confused with alarms such as OT and OVP which are for device protection. User defined events can, however, if set to action "Alarm", switch off the DC terminal and thus protect the load, like a sensitive electronic application.

► How to configure user defined events

1. While the DC terminal is switched off, tap on touch area 

on the main screen.
2. On the left side tap on group **User events**. It will then let you access all user definable events on the right-hand side. The values you can adjust there are thresholds which are permanently compared to the actual values of voltage, current and power on the DC terminal while it's on.
3. Tap on the values to adjust them with the numeric pad popping up. The adjustable range here isn't restricted by the adjustment limits. The **Action** for every event is set with a drop-down selector. See *«3.5.1 Definition of terms»* for the meaning of the actions.

User events are part of the currently selected user profile. Therefore, if another user profile or the default profile is loaded, the events could either be differently configured or not at all.

4. Other applications (1)

4.1 Series connection of power supplies

- Besides being able to work as a power supply, a bidirectional device can also work as an electronic load (sink mode). Series connection in sink mode operation isn't supported and must thus not be connected and operated (can void warranty claim)!
- Series connection in source mode operation only at one's own risk!

A series connection of bidirectional power supplies in source mode operation is possible, but requires extra measures to ensure the devices cannot enter sink mode. This is achieved by setting the power and current set values for sink mode to zero.

Something that applies for all kinds of power supplies: there is furthermore a technical limit of the achievable total voltage which depends on the strength of insulation of the DC plus and DC minus poles, as given in the technical specifications in section *1.8.3*. These specifications determine how many units with the same or different voltage rating can be operated in series and in case there are different models, it also determines which model can be in what position.

Basic rule: when connecting models with different voltage ratings in series, their current and power ratings are usually also different, which result in a global current and power limit of the series that is defined by the unit with the smallest current or power rating.

4.2 Series connection of electronic loads

Series connection of electronic loads isn't permissible and must thus not be operated! Reason: possible, asymmetrical distribution of the DC input voltage due to different internal control conditions. In worst case and with at least two units being wired in series connection, one unit could have a very low internal resistance and the other a very high one which would cause the one load with the high resistance to "see" almost the full DC input voltage which will most likely damage the DC input stage, as well as insulation.

5. Service and maintenance (1)

5.1 Maintenance / cleaning

The device needs no recurring maintenance. Cleaning may be needed for the internal fans, the frequency of cleaning is dependent on the ambient conditions. The fans serve to cool the components which are heated by the inherent power loss. Heavily dirt filled fans can lead to insufficient airflow and therefore the DC terminal would switch off too early due to overheating or possibly lead to defects.

In case there is requirement for such a maintenance, please contact us.

5.1.1 Battery replacement

The device contains a Lithium cell battery of type CR2032, which is placed on the so-called KE board that is mounted to the right-hand side wall (when looking from the front) of the device. The battery is specified for a life span of at least 5 years, but due to ambient conditions, especially temperature, this span could be lower. The battery is used to buffer the internal real-time clock and if it becomes necessary to replace the battery, it can be done on location by a qualified person while maintaining typical ESD precautionary measures. The KE board would have to be loosened and lifted up carefully to access the battery.

5.2 Fault finding / diagnosis / repair

If the equipment suddenly behaves in an unexpected way, which indicates a fault, or it has an obvious defect, this can't and must not be repaired by the user. Contact the supplier in case of suspicion and elicit the steps to be taken.

It will then usually be necessary to return the device to the supplier (with or without guarantee). If a return for checking or repair is to be carried out, ensure that:

- the supplier has been contacted and it's clarified how and where the equipment should be sent.
- the device is in fully assembled state and in suitable transport packaging, ideally the original packaging.
- optional extras such as an interface module is included if this is in any way connected to the problem.
- a fault description in as much detail as possible is attached.
- if the shipping destination is abroad, the necessary customs papers are attached.

5.2.1 Trouble-shooting device problems

Problem situation	Possible hazard	Probability	Safety measures to take by the operator	Residual risk
A voltage source with reversed polarity has been connected to the DC terminal	Damage of the internal secondary power stage	Low	With all applications which require to connect an external source to the device, especially if the source is a battery, attach an extra warning sign onto the device which instructs the user to be extra careful, watching the polarity. As an additional measure, include fuses in line with the DC cables which could attenuate or even prevent damage to the device.	Low

6. Contact and support

6.1 Repairs/Technical support

Repairs, unless otherwise agreed between the user and the supplier, will be carried out by the manufacturer. For this purpose, the device must be sent to the manufacturer. In order to ensure a fast and smooth handling of a support request or a repair, we kindly ask you to first visit the support section of our website at **www.elektroautomatik.com/en/service** and submit your support or repair request by filling out the respective form field ("Support Request" or "Repair Request"). Without this data input, no service request can be initiated.

6.2 Contact options

Questions or problems with the operation of the device, use of optional components, with the documentation or software, can be addressed to technical support either by telephone or eMail.

Headquarter	eMail addresses	Telephone
EA Elektro-Automatik GmbH Helmholtzstr. 31-37 41747 Viersen Germany	Technical support: support@elektroautomatik.com All other topics: ea1974@elektroautomatik.com	Switchboard: +49 2162 / 37850 Support: +49 2162 / 378566

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Revision: 01