Elektro-Automatik

30 kW

DATASHEET

EA-PU 10000 4U

Programmable DC power units

EA-PU 10000 4U 30 kW

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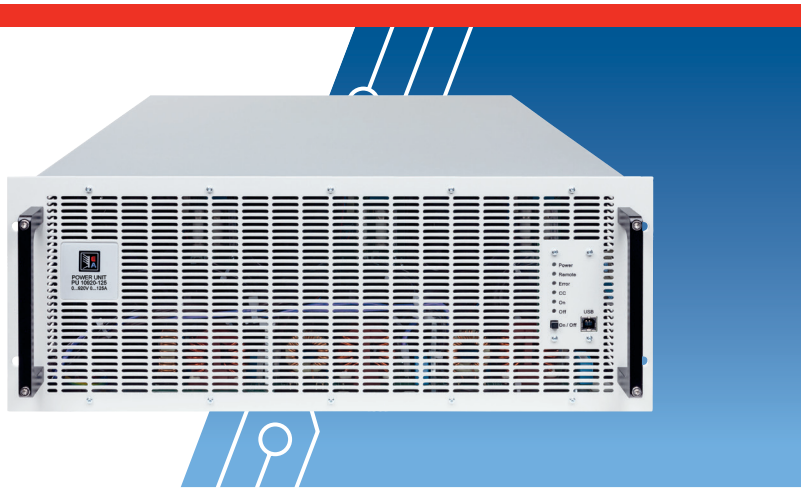


Features

- Wide range input: 208 V - 480 V, +10%, 3ph AC
- Active Power Factor Correction, typical 0.99
- Very high efficiency of up to 96%
- High performance with up to 30 kW per unit
- Voltages from 0 - 60 V up to 0 - 2000 V
- Currents from 0 - 40 A up to 0 - 1000 A
- Flexible power regulated DC output stages (autoranging)
- Regulation modes CV, CC, CP, CR with fast crossover
- Digital regulation, high resolution with 16 bit ADCs and DACs, selection of voltage control speed
- Galvanically isolated Share-Bus for parallel operation of all power classes in the 10000 series
- Master-slave bus for parallel operation of up to 64 units of same type in all power classes of the 10000 series
- Command languages and drivers: SCPI and ModBus, LabVIEW, IVI

Built-in interfaces

- USB
- Ethernet
- Analog
- Master-Slave bus
- Share-Bus
- USB (front panel)

Optional interfaces

- CAN
- CANopen
- RS232
- Profibus
- EtherCAT
- Profinet, with one or two ports
- Modbus, with one or two ports
- Ethernet, with one or two ports

Software

- EA Power Control

Options

- Water Cooling in stainless steel
- Function generator

Technical data

General specifications	
AC input	
Voltage, Phases	Range 1: 208 V, ±10%, 3ph AC Range 2: 380 - 480 V, ±10%, 3ph AC
Frequency	45 - 65 Hz
Power factor	ca. 0.99
Leakage current	<10 mA
Inrush current *1	@208 V: ca. 28 A per phase @400 V: ca. 54 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 *5	≤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
*5 Where featured

General specifications	
Device configuration	
Parallel operation	Up to 64 units of any power class, with 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 CISPR 11, class B FCC 47 CFR part 15B, unintentional radiator, class B EN 61326-1 including tests according to: - EN 61000-4-2 - EN 61000-4-3 - EN 61000-4-4 - EN 61000-4-5 - EN 61000-4-6
Appliance class	I
Ingress protection	IP20
Environmental conditions	
Operating temperature *6	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), optional water cooling
Dimensions (W x H x D)	Enclosure: 483 mm (19 in) x 177 mm (4U) x 668 mm (26.3 in) Overall depth: min. 802 mm (min. 31.6 in)
Weight	50 kg (110 lb)
Weight with water cooling	56 kg (126 lb)

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

Technical specifications	PU 10060-1000	PU 10080-1000	PU 10200-420	PU 10360-240	PU 10500-180
DC output					
Voltage range	0 - 60 V	0 - 80 V	0 - 200 V	0 - 360 V	0 - 500 V
Ripple in CV (rms)	≤25 mV (BWL 300 kHz *1)	≤25 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)	≤320 mV (BWL 20 MHz *1)	≤320 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 - 1000 A	0 - 1000 A	0 - 420 A	0 - 240 A	0 - 180 A
Power range *2	0 - 30000 W (0 - 18000 W)	0 - 30000 W (0 - 18000 W)	0 - 30000 W (0 - 18000 W)	0 - 30000 W (0 - 18000 W)	0 - 30000 W (0 - 18000 W)
Resistance range	0.003 Ω - 5 Ω	0.003 Ω - 5 Ω	0.0165 Ω - 25 Ω	0.05 Ω - 90 Ω	0.08 Ω - 170 Ω
Output capacitance	25380 µF	25380 µF	5400 µF	1800 µF	675 µF
Efficiency (up to)	95.1% *3	95.5% *3	95.3% *3	95.8% *3	96.5% *3
AC input					
P_{Max}	@208 V: 19 kW @400 V: 31 kW	@208 V: 19 kW @400 V: 31 kW	@208 V: 19 kW @400 V: 31 kW	@208 V: 19 kW @400 V: 31 kW	@208 V: 19 kW @400 V: 31 kW
Phase current *4	@208 V: ≤58 A @400 V: ≤53 A	@208 V: ≤58 A @400 V: ≤53 A	@208 V: ≤58 A @400 V: ≤53 A	@208 V: ≤58 A @400 V: ≤53 A	@208 V: ≤58 A @400 V: ≤53 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	01113000	01113001	01113002	01113003	01113004
Standard + Water Cooling	01443001	01443002	01443003	01443004	01443005

Technical specifications	PU 10750-120	PU 10920-125	PU 11000-80	PU 11500-60	PU 12000-40
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)	≤250 mV (BWL 300 kHz *1)	≤300 mV (BWL 300 kHz *1)	≤400 mV (BWL 300 kHz *1)	≤500 mV (BWL 300 kHz *1)
Ripple in CV (pp)	≤800 mV (BWL 20 MHz *1)	≤1200 mV (BWL 20 MHz *1)	≤1600 mV (BWL 20 MHz *1)	≤2400 mV (BWL 20 MHz *1)	≤3000 mV (BWL 20 MHz *1)
Current range	0 - 120 A	0 - 125 A	0 - 80 A	0 - 60 A	0 - 40 A
Power range *2	0 - 30000 W (0 - 18000 W)	0 - 30000 W (0 - 18000 W)	0 - 30000 W (0 - 18000 W)	0 - 30000 W (0 - 18000 W)	0 - 30000 W (0 - 18000 W)
Resistance range	0.2 Ω - 370 Ω	0.25 Ω - 550 Ω	0.4 Ω - 650 Ω	0.8 Ω - 1500 Ω	1.7 Ω - 2700 Ω
Output capacitance	450 µF	300 µF	200 µF	75 µF	50 µF
Efficiency (up to)	96.5% *3	96.5% *3	95.8% *3	96.5% *3	96.5% *3
AC input					
P_{Max}	@208 V: 19 kW @400 V: 31 kW	@208 V: 19 kW @400 V: 31 kW	@208 V: 19 kW @400 V: 31 kW	@208 V: 19 kW @400 V: 31 kW	@208 V: 19 kW @400 V: 31 kW
Phase current *4	@208 V: ≤58 A @400 V: ≤53 A	@208 V: ≤58 A @400 V: ≤53 A	@208 V: ≤58 A @400 V: ≤53 A	@208 V: ≤58 A @400 V: ≤53 A	@208 V: ≤58 A @400 V: ≤53 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	01113005	01113006	01113007	01113008	01113009
Standard + Water Cooling	01443006	01443007	01443008	01443009	01443010

*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

General

The DC power supplies in the PU 10000 series from EA Elektro-Automatik convert the energy from the grid into a regulated DC voltage with an efficiency up to over 96%. The PU 10000 series are three phase units which, together with the wide input range, allows use with practically all global mains voltages. The DC voltages and currents are determined by the application and the spectrum ranges from 0 - 60 V to 0 - 2000 V and from 0 - 40 A up to 0 - 1000 A in a single device. The DC supply operates as a flexible output stage with a constant power characteristic (autoranging) with a wide voltage and current range. To achieve higher power and current all units are equipped with a Master-Slave bus. This enables up to 64 parallel connected devices to be combined into one system which can provide up to 3840 kW and 64000 A. Such a system works as a single unit and can use different power classes start from 5kW, only the voltage class must remain constant. In this way a user can construct a 150 kW system from two 60 kW 6U and one 30 kW 4U device from the PU 10000 range. Furthermore, typical laboratory functionality is provided. This includes alarm and warning management, various optional industrial interfaces, software solutions and many more functions.

AC connection

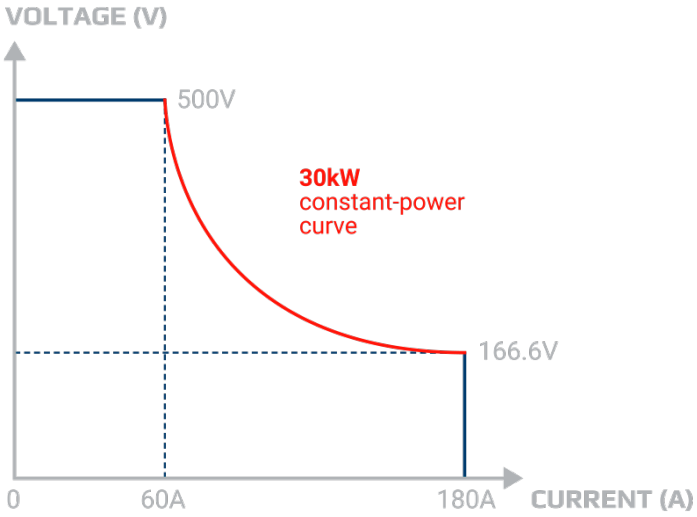
The DC power supplies in the PU 10000 series with 30 kW are equipped with an active PFC which provides a high efficiency at a low energy consumption. Furthermore, the devices in this series provide a wide input voltage range. It reaches with 3-phases from 208 - 240 V (with a derating to 18 kW) and 380 - 480 V. Hence the devices can be operated in the majority of global grids.

DC output

The output of the power supply PU 10000 4U with 30 kW with a DC voltage of 0 - 60 V up to 0 - 2000 V allows currents of 0 - 40 A up to 0 - 1000 A . The flexible output stages (autoranging) provide the user with a wide voltage, current and power range and hence a wider field of working than traditional power supplies.

DC connection

Connection of the DC output is via a copper rail on the back side of the device. If a system with higher performance is required, the devices are simply connected in parallel. With minimal effort devices can be linked with the vertical copper rails. A cover for contact protection is provided.



The principle of autoranging

„Autoranging“ is a term when a programmable DC power supply automatically offers a wide output range of both, voltage and current, to maintain full power across a wide operation range. This type of solution allows the use of a single unit to address multiple voltage and current combinations.

Interfaces

As standard, 10000s series devices are fitted with the most important interfaces and ports which are all galvanically isolated from the DC input. There is an analog interface which can be parameterized for input and output, control and monitoring, of 0 - 5 V or 0 - 10 V for voltage, current, power and resistance, assorted inputs and outputs as well as USB and Ethernet ports. Further optional industrial interface for plug & play slot complete the portfolio:

- CAN
- CANopen
- RS232
- Profibus
- EtherCAT
- Profinet, with one or two ports
- Modbus, with one or two ports
- Ethernet, with one or two ports

High performance systems

High power applications can be covered with high power systems of up to 1920 kW. These are achieved by using the DC outputs of multiple PU 10000 devices with vertical copper rails in parallel. Thus, a 19” cabinet with 42 U can provide a system with 300 kW occupying only 0.6 m² (6.5 sqft) of floor space. The Master-Slave bus allows for up to 13 cabinets with a maximum of 64 units with 30 kW each to behave as one unit.

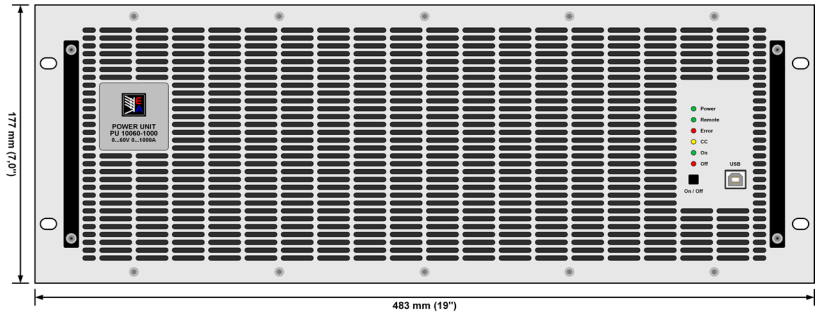
Master-slave bus and Share-Bus

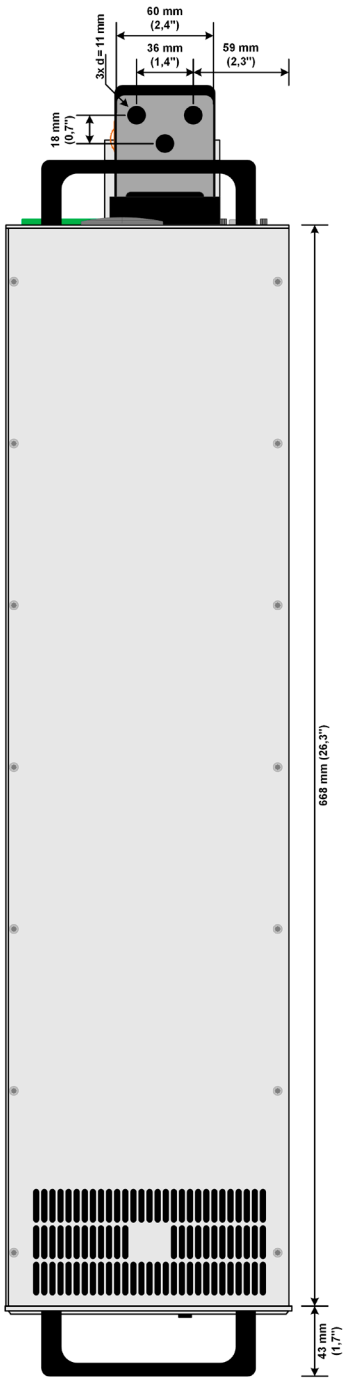
If the integrated master-slave bus and Share-Bus are used, a multi device system behaves as a single device. The master-slave bus and Share-Bus are simply connected between each device. With the master-slave bus the system data, such as total power and total current, are collected and shown on the master device. Warnings and alarms of the slave devices are shown clearly in the display. The Share-Bus equal load distribution to the individual devices.

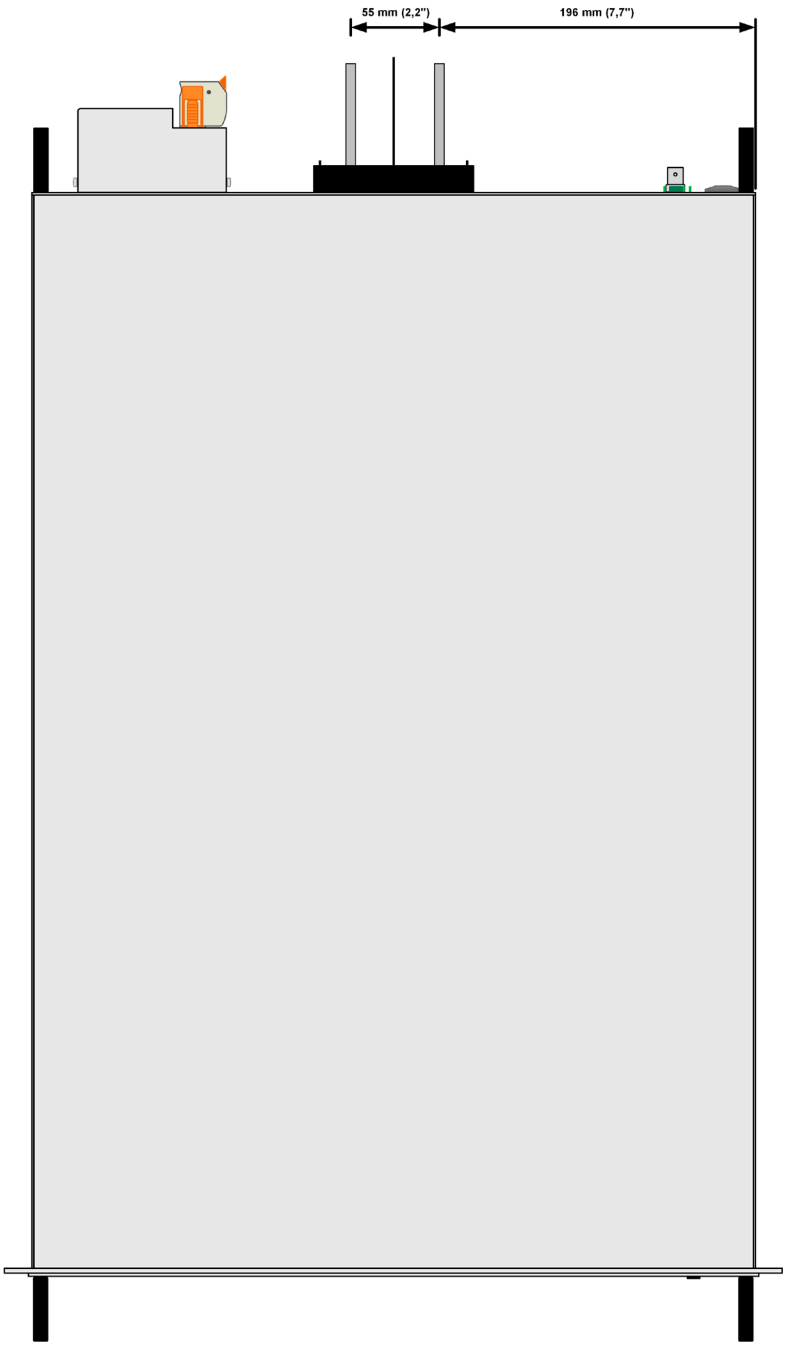
Example representation

In this illustration you can see a fully assembled and wired 240 kW system

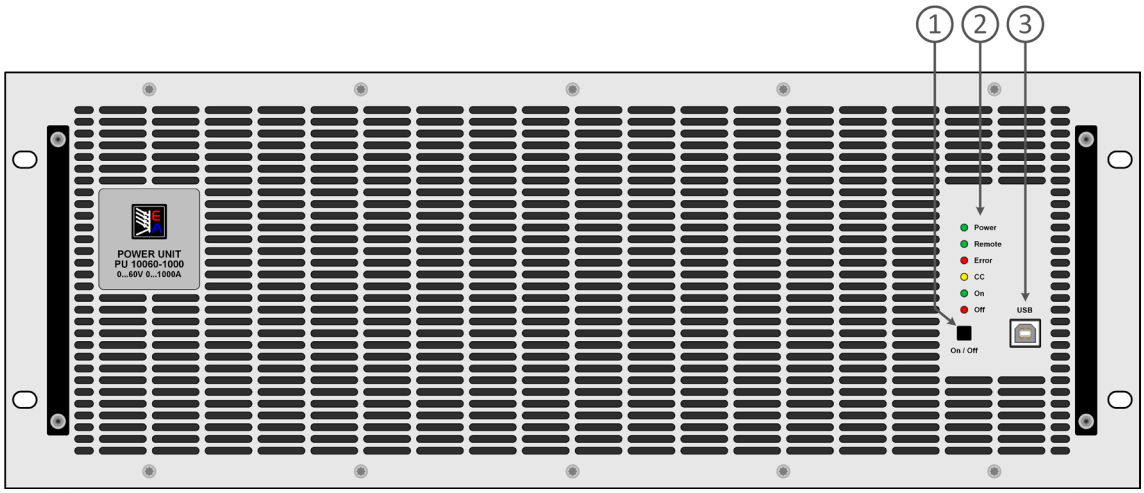
Technical drawings PU 10000 4U ≤200 V





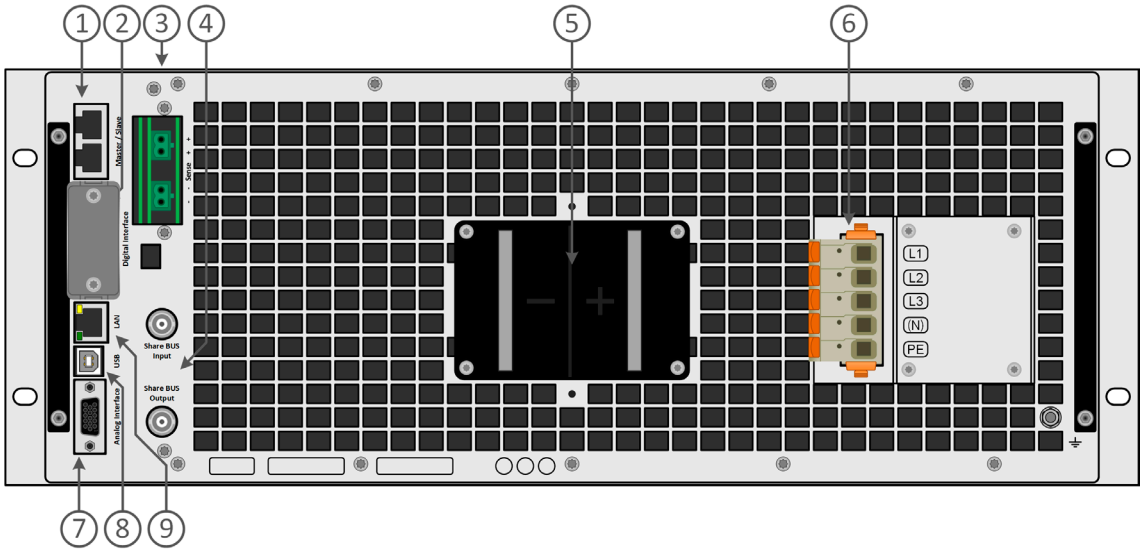


Front panel description PU 10000 4U



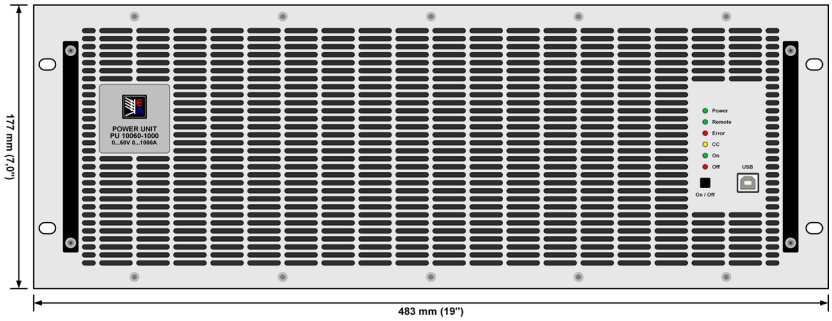
1. On / Off push-button
2. LED status display
3. USB Interface

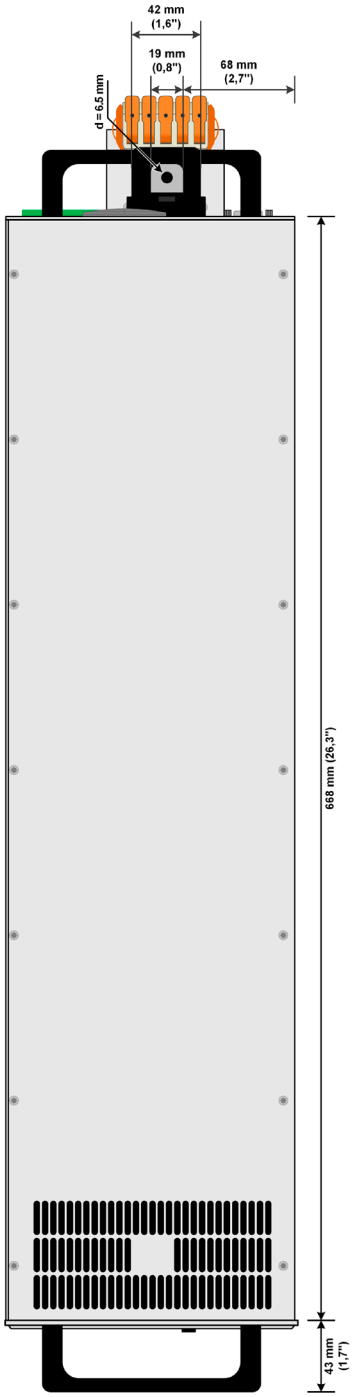
Rear panel description PU 10000 4U ≤200 V

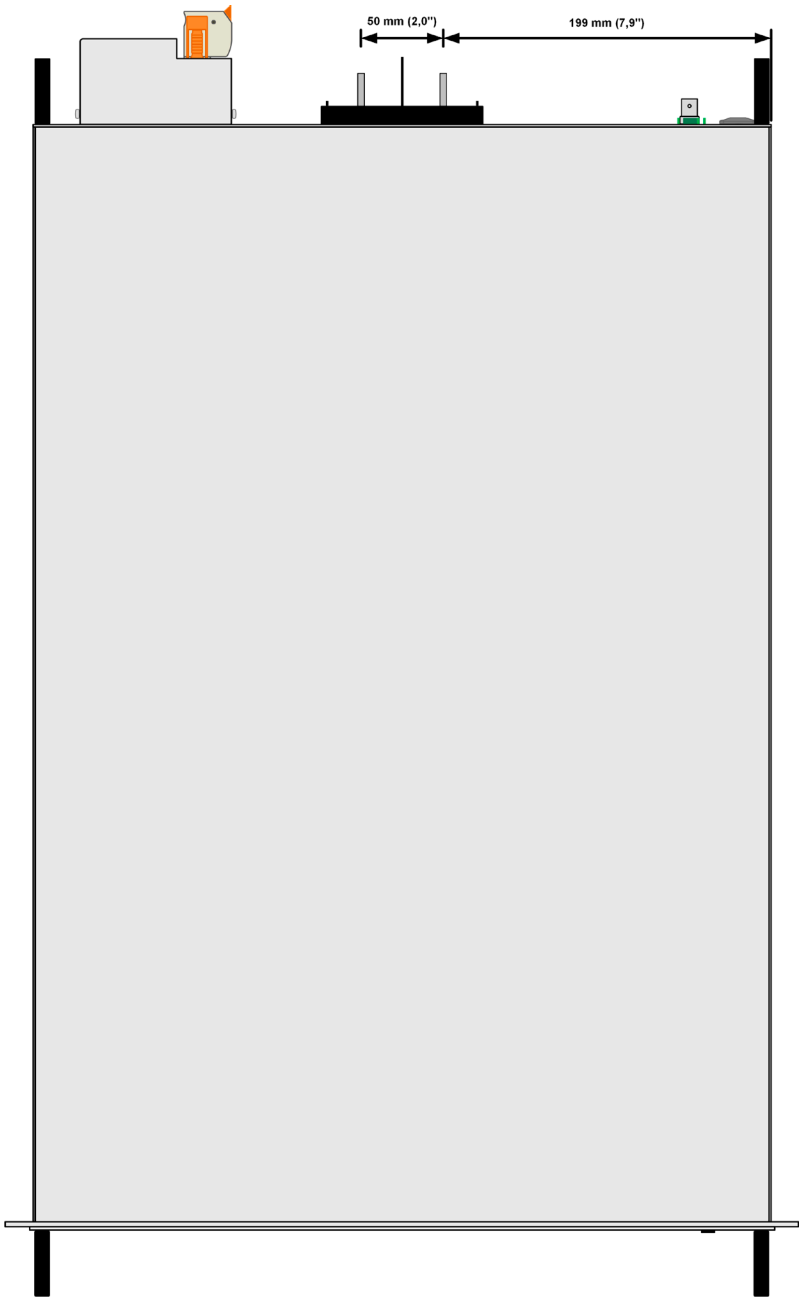


1. Master-Slave bus connectors to set up a system for parallel connection
2. Slot for interfaces
3. Remote sense connectors
4. Share-Bus connectors to set up a system for parallel connection
5. DC output connector (copper blades)
6. AC input connector
7. Connector (DB15 female) for isolated analog programming,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

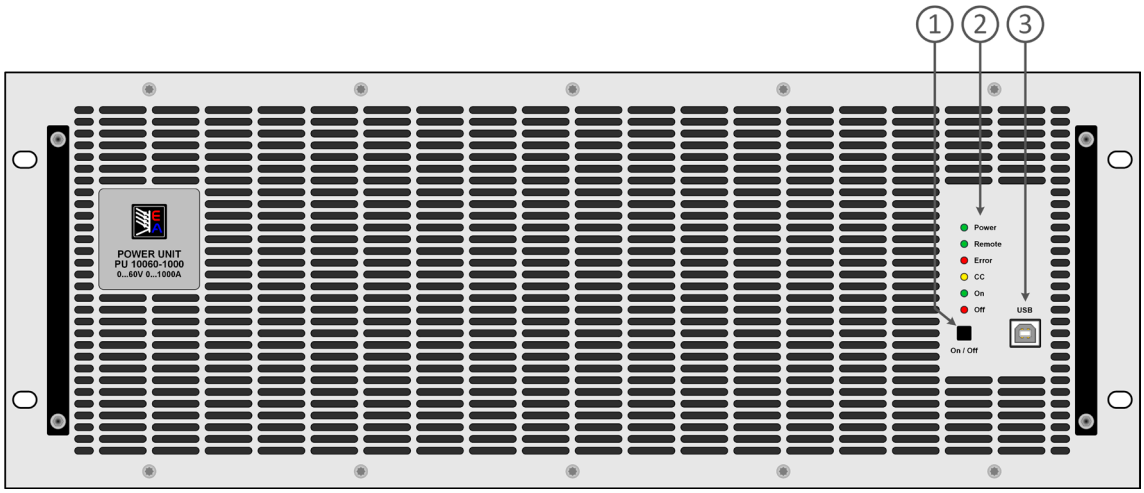
Technical drawings PU 10000 4U ≥360 V





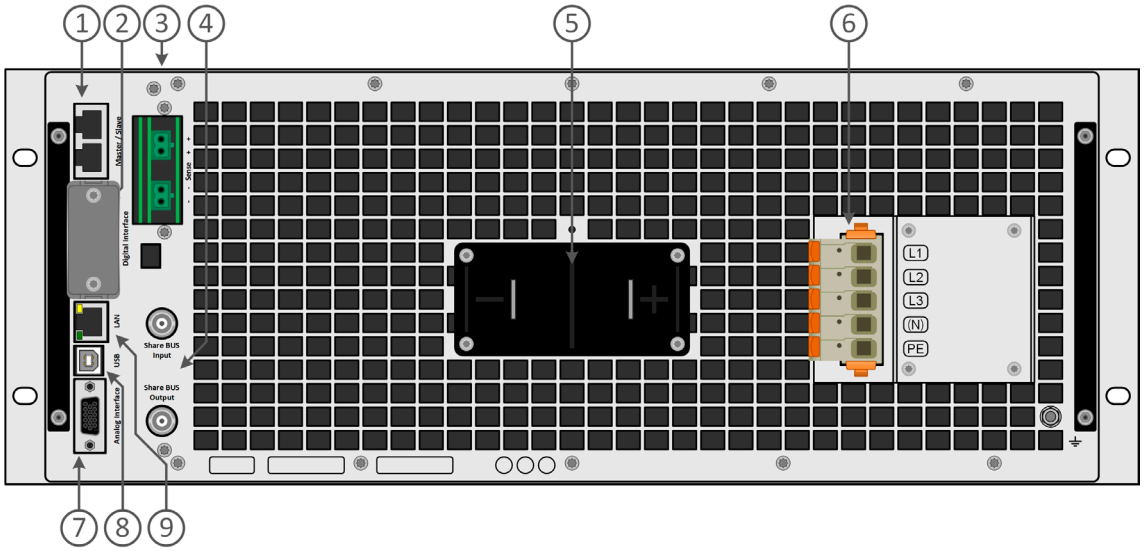


Front panel description PU 10000 4U



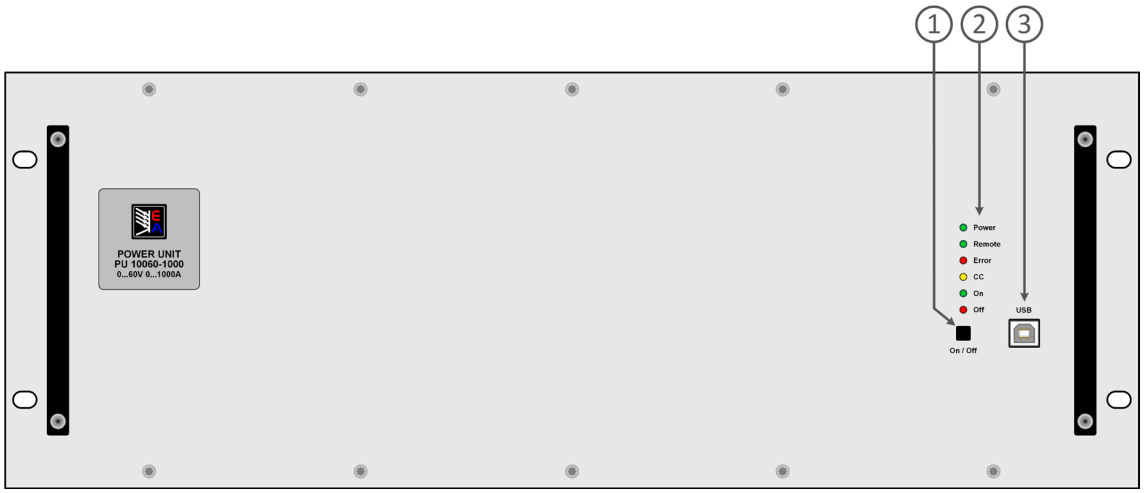
1. On / Off push-button
2. LED status display
3. USB Interface

Rear panel description PU 10000 4U ≥360 V



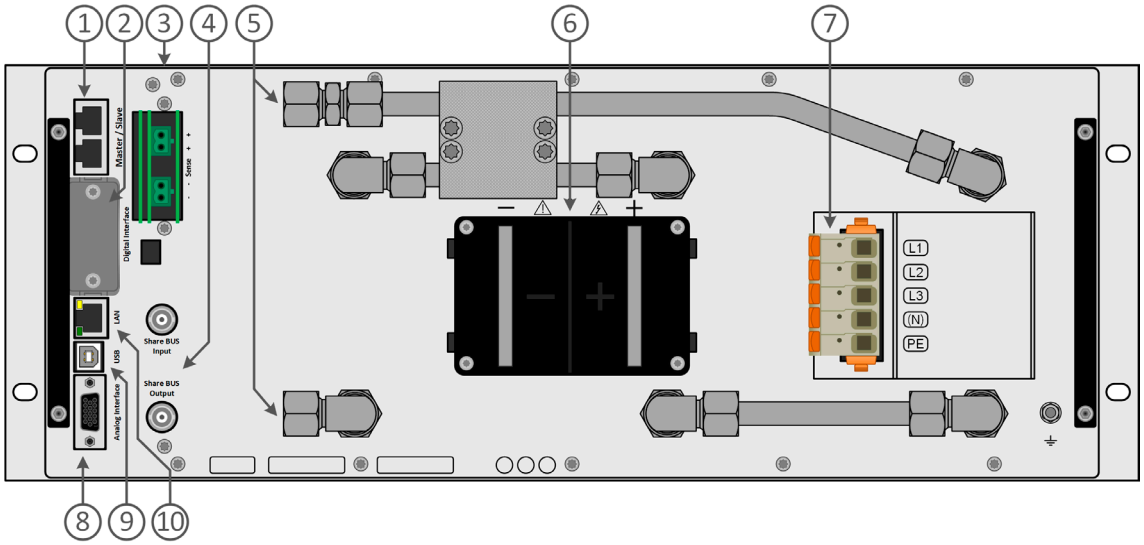
1. Master-Slave bus connectors to set up a system for parallel connection
2. Slot for interfaces
3. Remote sense connectors
4. Share-Bus connectors to set up a system for parallel connection
5. DC output connector (copper blades)
6. AC input connector
7. Connector (DB15 female) for isolated analog programming,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

Front panel description PU 10000 4U WC (water cooling option)



1. On / Off push-button
2. LED status display
3. USB Interface

Rear panel description PU 10000 4U WC (water cooling option)



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

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