Elektro-Automatik

30 kW

DATASHEET

EA-PSI 10000 4U

Programmable
DC Power Supply

EA-PSI 10000 4U 30 KW

Programmable DC power supply

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 30 kW per unit
- Voltages from 0 - 10 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 16bit ADCs and DACs, selection of voltage regulation speed: Normal, Fast, Slow
- Color 5“ TFT display with touch control and intuitive user interface
- 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 all power classes in the 10000 series
- Integrated function generator with predefined curves
- Automotive test procedures for LV123, LV124 and LV148
- Photovoltaics test mode (EN 50530)
- Command languages and drivers: SCPI and ModBus, LabVIEW, IVI

Built-in interfaces

- USB
- Ethernet
- Analog
- USB Host
- Master-Slave-Bus
- Share-Bus

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
- EA-Battery Simulator

Options

- Water Cooling in stainless steel

Technical data

General specifications	
AC input	
Voltage, Phases	Range 1: 208 V, ±10%, 3ph AC (with DC output power derating to 18 kW) Range 2: 380 - 480 V, ±10%, 3ph AC
Frequency	45 - 65 Hz
Power factor	ca. 0.99
Leakage current	<10 mA
Inrush current / Phase current	≤56 A
Overvoltage category	2
DC output static	
Load regulation CV	≤0.05% FS (0 - 100% load, constant output voltage and constant temperature)
Line regulation CV	≤0.01% FS (208 V - 480 V AC ±10% supply voltage, constant load and constant temperature)
Stability CV	≤0.02% FS (during 8 h of operation, after 30 minutes warm-up, at constant output 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, constant output voltage and constant temperature)
Line regulation CC	≤0.01% FS (208 V - 480 V AC ±10% supply voltage, constant load and constant temperature)
Stability CC	≤0.02% FS (during 8 h of operation, after 30 minutes warm-up, at constant output voltage, load and temperature)
Temperature coefficient CC	≤50ppm/°C (after 30 minutes of warm-up)
Load regulation CP	≤0.3% FS (0 - 100% load, constant output voltage and constant temperature)
Load regulation CR	≤0.3% FS + 0.1% FS current (0 - 100% load, constant output voltage and constant 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 output shuts down in case of insufficient cooling)
DC output dynamic	
Rise time 10 - 90% CV	≤10 ms
Fall time 90 - 10% CV	≤10 ms
Rise time 10 - 90% CC	≤2 ms
Fall time 90 - 10% CC	≤2 ms
Display accuracy	
Voltage	≤0.05% FS
Current	≤0.1% FS
Insulation	
AC input to DC output	3750 Vrms (1 minute, creepage distance >8 mm) *1
AC input to case (PE)	2500 Vrms
DC output to case (PE)	Depending on the model, see model tables
DC uutput 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
Interfaces 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 output on/off, resistance mode on/off
Outputs	Monitor U and I, alarms, reference voltage, DC output status, CV/CC regulation mode
Accuracy U / I / P / R	0 - 10 V: ≤0.2%, 0 - 5 V: ≤0.4%

*1 Models 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 CISPR 11, class B FCC 47 CFR part 15B, unintentional radiator, class B 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
Safety protection class	1
Ingress Protection	IP20
Environmental conditions	
Operating temperature	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: 19" x 4U x 668 mm (26.3 in) Total: 19" x 4U x min. 785 mm (31 in)
Weight	50 kg (110 lb)
Weight with water cooling	56 kg (126 lb)

Technical specifications	PSI 10060-1000	PSI 10080-1000	PSI 10200-420	PSI 10360-240
DC output				
Voltage range	0 - 60 V	0 - 80 V	0 -200 V	0 - 360 V
Ripple in CV (rms)	≤25 mV (BW 300 kHz)	≤25 mV (BW 300 kHz)	≤40 mV (BW 300 kHz)	≤55 mV (BW 300 kHz)
Ripple in CV (pp)	≤320 mV (BW 20 MHz)	≤320 mV (BW 20 MHz)	≤300 mV (BW 20 MHz)	≤320 mV (BW 20 MHz)
Current range	0 - 1000 A	0 - 1000 A	0 - 420 A	0 - 240 A
Power range	0 - 30000 W	0 - 30000 W	0 - 30000 W	0 - 30000 W
Resistance range	0.003 Ω - 5 Ω	0.003 Ω - 5 Ω	0.0165 Ω - 25 Ω	0.05 Ω - 90 Ω
Output capacitance	25380 µF	25380 µF	5400 µF	1800 µF
Efficiency (up to)	95.1% *1	95.5% *1	95.3% *1	95.8% *1
Insulation				
Negative DC pole <-> PE	±600 V DC	±600 V DC	±1000 V DC	±1000 V DC
Positive DC pole <-> PE	+600 V DC	+600 V DC	+1000 V DC	+1000 V DC
Article numbers				
Standard	06230800	06230801	06230802	06230803
Standard + Water Cooling	06250800	06250801	06250802	06250803

*1 At 100% power and 100% output voltage

Technical specifications	PSI 10500-180	PSI 10750-120	PSI 10920-125	PSI 11000-80
DC output				
Voltage range	0 - 500 V	0 - 750 V	0 - 920 V	0 - 1000 V
Ripple in CV (rms)	≤70 mV (BW 300 kHz)	≤200 mV (BW 300 kHz)	≤200 mV (BW 300 kHz)	≤300 mV (BW 300 kHz)
Ripple in CV (pp)	≤350 mV (BW 20 MHz)	≤800 mV (BW 20 MHz)	≤800 mV (BW 20 MHz)	≤1600 mV (BW 20 MHz)
Current range	0 - 180 A	0 - 120 A	0 - 125 A	0 - 80 A
Power range	0 - 30000 W	0 - 30000 W	0 - 30000 W	0 - 30000 W
Resistance range	0.08 Ω - 170 Ω	0.2 Ω - 370 Ω	0.25 Ω - 550 Ω	0.4 Ω - 650 Ω
Output capacitance	675 µF	450 µF	100 µF	200 µF
Efficiency (up to)	96.5% *1	96.5% *1	96.5% *1	95.8% *1
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
Article numbers				
Standard	06230804	06230805	06230809	06230806
Standard + Water Cooling	06250804	06250805	06250809	06250806

*1 At 100% power and 100% output voltage

Technical specifications	PSI 11500-60	PSI 12000-40		
DC output				
Voltage range	0 - 1500 V	0 - 2000 V		
Ripple in CV (rms)	≤400 mV (BW 300 kHz)	≤500 mV (BW 300 kHz)		
Ripple in CV (pp)	≤2400 mV (BW 20 MHz)	≤3000 mV (BW 20 MHz)		
Current range	0 - 60 A	0 - 40 A		
Power range	0 - 30000 W	0 - 30000 W		
Resistance range	0.8 Ω - 1500 Ω	1.7 Ω - 2700 Ω		
Output capacitance	75 µF	50 µF		
Efficiency (up to)	96.5% *1	96.5% *1		
Insulation				
Negative DC pole <-> PE	±1500 V DC	±1500 V DC		
Positive DC pole <-> PE	+2000 V DC	+2000 V DC		
Article numbers				
Standard	06230807	06230808		
Standard + Water Cooling	06250807	06250808		

*1 At 100% power and 100% output voltage

General

The DC laboratory power supplies in the PSI 10000 series from EA Elektro-Automatik convert the energy from the grid into a regulated DC voltage with an efficiency of up to 96%. The PSI 10000 series includes single and three phase units, which, together with the wide input range, allows use with practically all global mains voltages. The DC voltage and current are directed by the application and the spectrum ranges from 0 - 60 V to 0 - 2000 V and from 0 - 6 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), and a wide voltage, current and power 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 1920 kW and 64000 A. Such a system works as a single unit and can use different power classes, only the voltage class must remain constant. In this way a user can construct a 75 kW system from two 30 kW 4U and one 15 kW 3U device from the PS or PSI 10000 range. Furthermore, typical laboratory functionality is provided. This includes an extensive function generator, alarm and warning management, various optional industrial interfaces, software solutions and many more functions.

AC connection

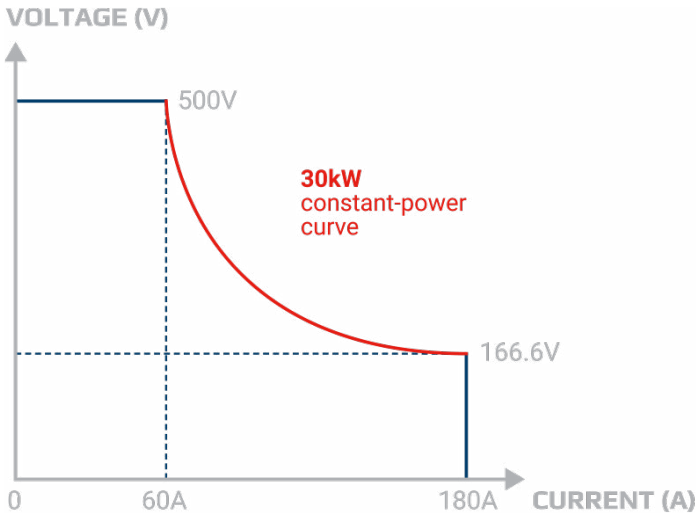
The DC power supplies in the PSI 10000 series are equipped with an active PFC which provides a high efficiency at a low energy consumption. Furthermore, the devices in this series provide a wide input voltage range. It reaches from 110/120 V up to 240 V with 1-phase models and from 208 V to 380/400/480 V with 3-phase models. Hence the devices can be operated in the majority of global grids. They adjust automatically, without additional configuration, to the available grid voltage. In a 110/120 V and 208 V AC grid a derating of the DC output power is automatically set.

DC output

The DC output of the power supplies in series PSI 10000 4U is rated for DC voltages of 0 - 60 V up to 0 - 2000 V, allowing 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 done via copper blades 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 used when a programmable DC power supply automatically offers a wider 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.

Function generator

All models in the PSI 10000 series are equipped with a function generator. This allows waveforms such as sine, triangle, square or trapezoid to be simply called up and applied to either the voltage or the current. A ramp function and a arbitrary generator allow voltage and current progression to be freely programmable. Test sequences for repeated tests can be saved and reloaded when needed, which saves time. For simulation of a photovoltaics system or fuel cells, adaptable tables are provided. With the integrated and adjustable PV characteristics curve DIN EN 50530 various solar modules can be defined and entire day trend progression can be simulated.
Conclusion: the user is supported by a multitude of useful functions.

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. This is achieved by connecting the DC terminals of multiple PSI 10000 4U devices with vertical copper rails in parallel. Thus, a 19" cabinet with 42 U can provide a system with 240 kW occupying only 0.6 m² (6.5 sqft) of floor space. The master-slave bus allows for up to 8 cabinets with a maximum of 64 units with 30 kW each to behave as one unit.

Master-slave bus and Share bus

When the integrated master-slave bus and Share bus are used, a multi device system behaves as a single device. The buses are simply connected between each device. With the master-slave bus the system data, such as total power and total current, are collected and displayed on the master unit. Warnings and alarms of the slave devices are also clearly displayed. The Share bus cares for a balanced load distribution between the individual units.

Example representation

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

Applications

Relay test in the production

Relay manufacturers must carry out assorted tests on their products during production. For these the coils and contacts are provided with exactly defined voltage and current. For the coil tests, important parameters such as operating, holding and decay current, together with the associated voltages must be checked and documented. For the contacts, not only are the current carrying capability and contact resistance important parameters, but also voltage consistency and disconnect threshold indicate much about the product quality. Testing all these is best supported by an automatic test system. A part of such a system can be the devices of the PSI 10000 series with their exact, dynamic, controls of voltage, current, power, and resistance, providing optimal values for the best test results. With their diverse interface connections, they can be integrated into any test system and deliver the necessary data without the need for additional measuring equipment.

Fuel cell simulation

One of further applications where programmable DC power supplies are used for is the simulation of fuel cells. It allows for optimal definition of these energy storages, as well of components powered by these fuel cells. In every application where reproducible data is required, the use of a simulator is typically first choice. This is mainly due to the various built-in mechanisms for the protection of connected consumers. The overcurrent protection (OCP) can, like a safety fuse, switch off the output and generate an alarm. The voltage can be monitored and can, if over or under limits, trigger various functions, and also generate warnings and alarms. Thus, many integrated functions can be safely performed.

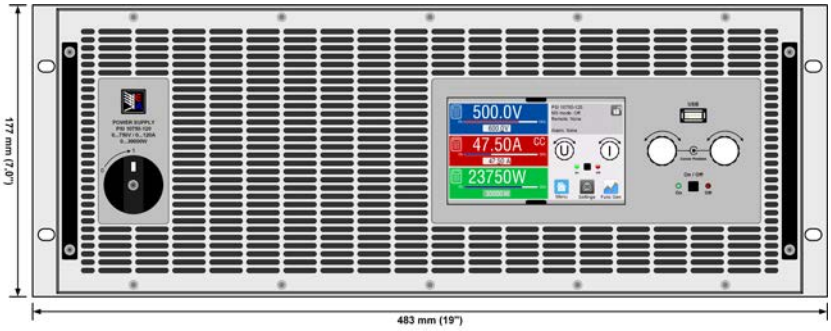
On-board charger test

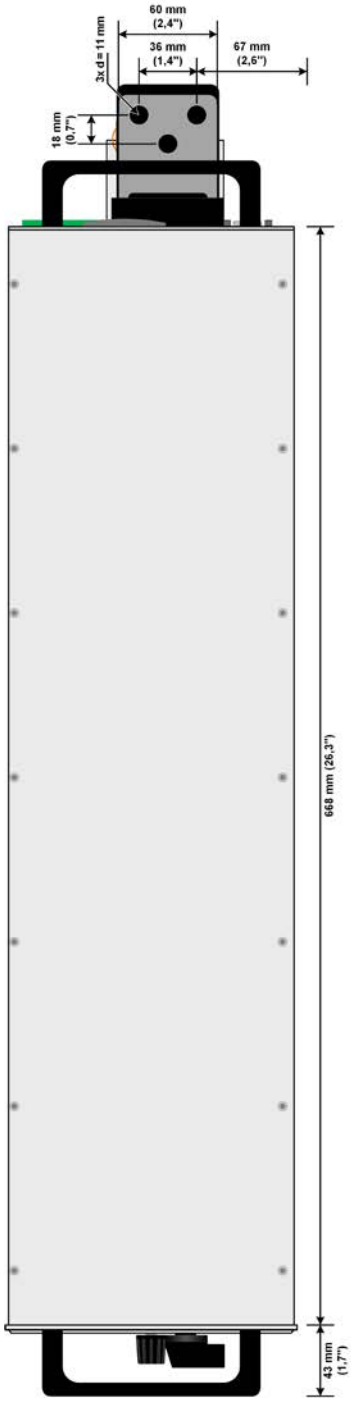
In an on-board charger test (OBC) the electrical features of the charger must be tested under various conditions. This requires a flexible test system which also provides test data. With the sequencing and logging functions of the software EA-Power Control it allows data to be exported and saved. In this way applications can instantly generate reproducible test results based on dynamic and highly accurate set point and measurement data. To avoid competition between two separate control loops of the device under test (DUT) and the testing device, the voltage regulation speed of the power supply is adjustable. The modes Normal, Fast and Slow allow the PSI 10000 devices to be adapted the control characteristics of the on-board charger. Due to the fact that a power supply can only operate as a source, the combination with a sink, here an electronic DC load of ELR 10000 series, might be required.

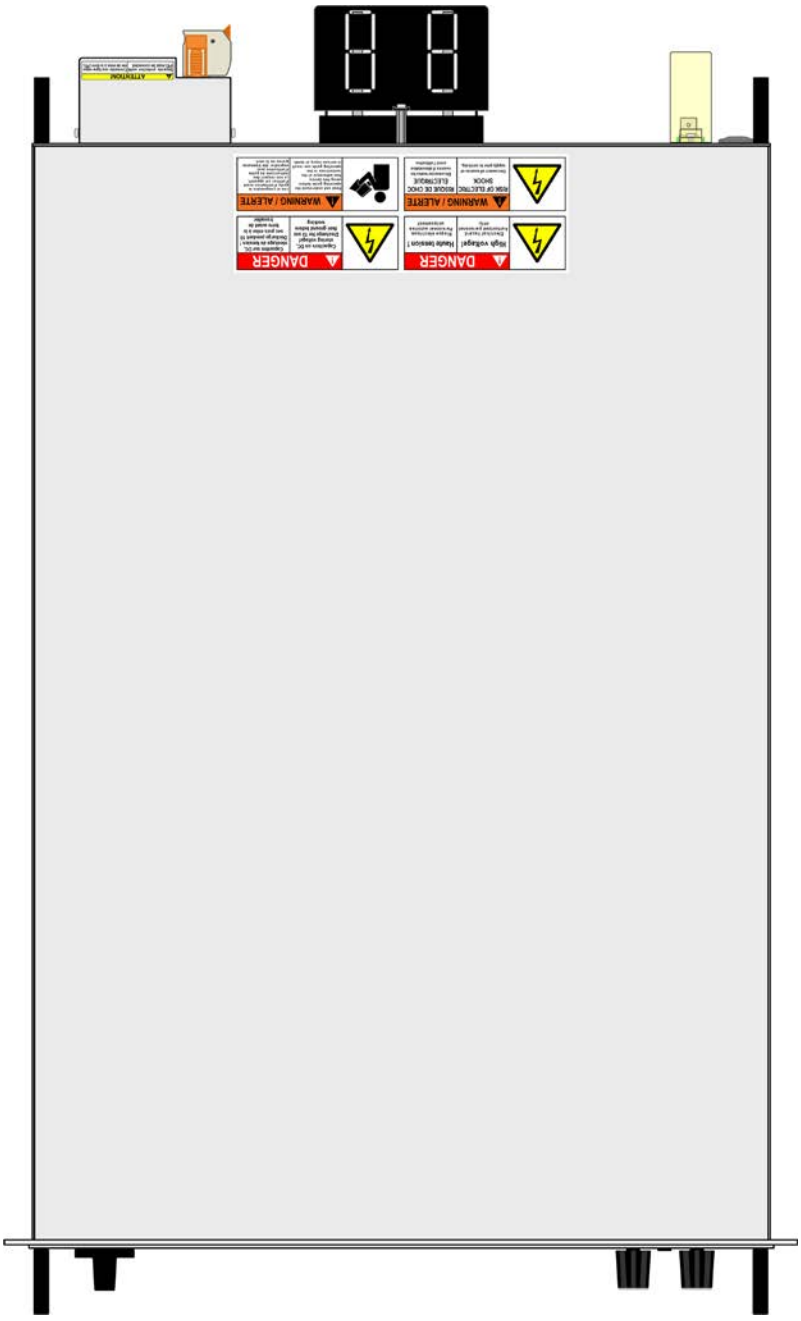
Solar array simulation

The programmable power supplies of the PSI 10000 range are highly suited to use as test systems for PV inverters as they can provide the necessary simulation for solar panels. Users can quickly access simulation models according to EN 50530 or Sandia while it supports diverse solar panel types. Parameters such as irradiation (varying with shadows), panel technology and temperature can be included. Thus the devices can test all the relevant electrical features of a PV inverter including the important efficiency value.
The high resolution of 16-bit technology and a high sampling rate enable the programmable power supply to deliver accurate results which can be documented and saved to an Excel file.

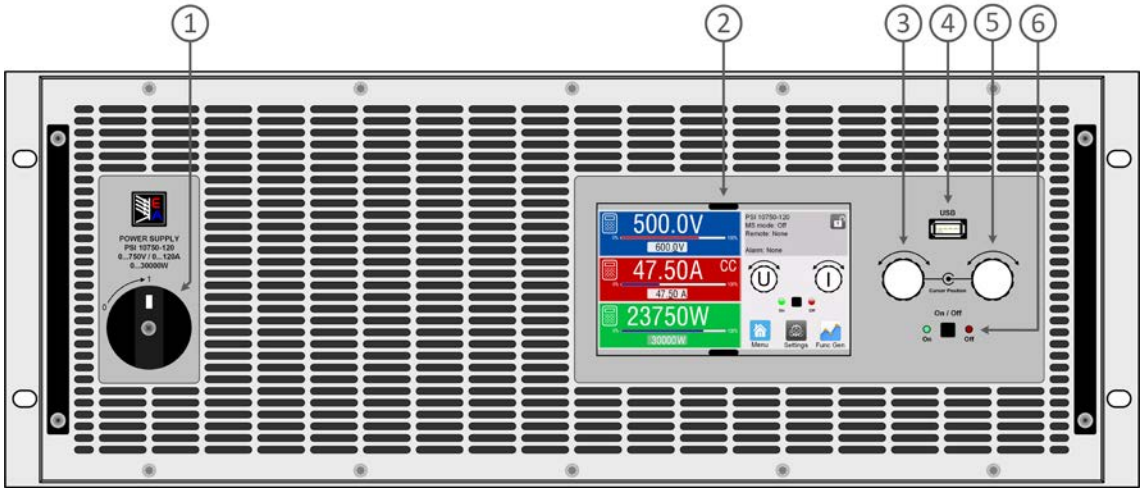
Technical drawings PSI 10000 4U ≤200 V





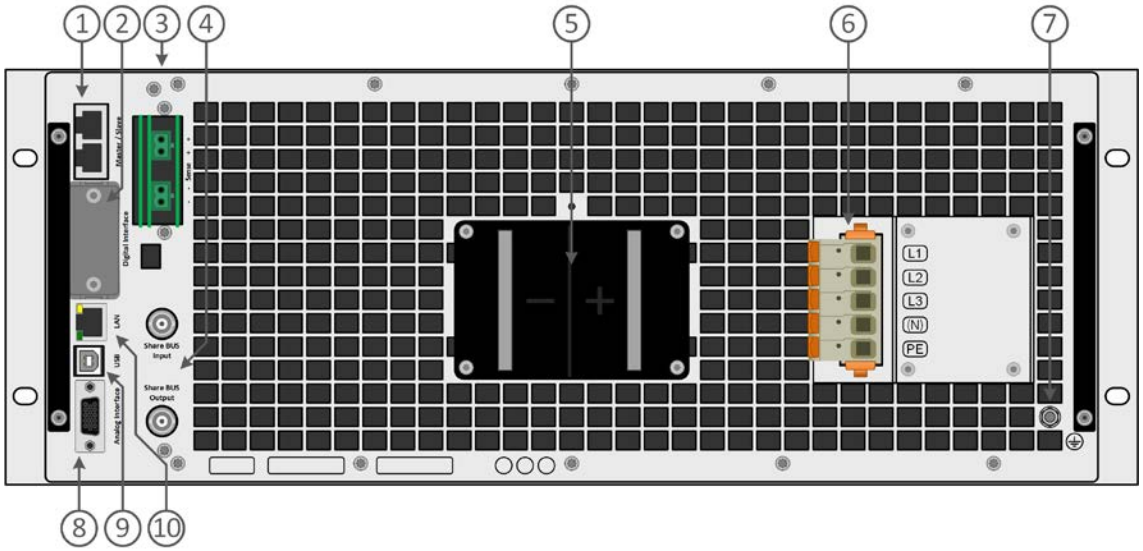


Front panel description PSI 10000 4U



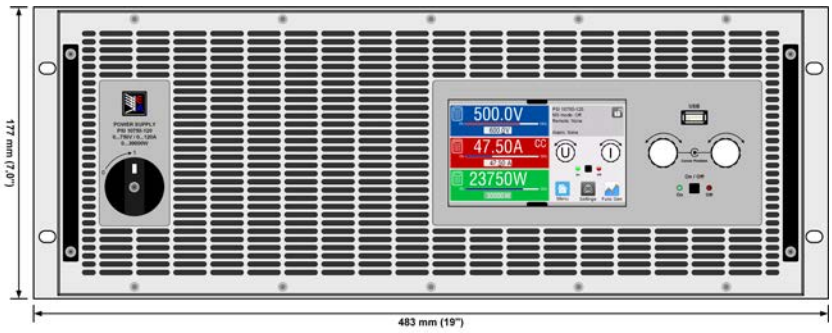
1. Power switch
2. TFT control interface, interactive operation and display
3. Rotary knob with push-button action, for settings and control
4. USB host, uses USB sticks for data logging and sequencing
5. Rotary knob with push-button action, for settings and control
6. On / Off push-button with LED status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

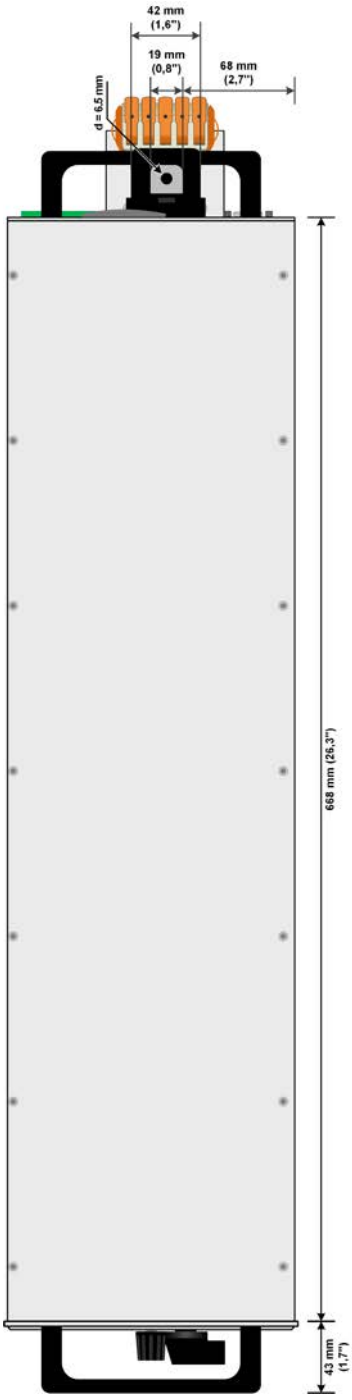
Rear panel description PSI 10000 4U ≤200 V



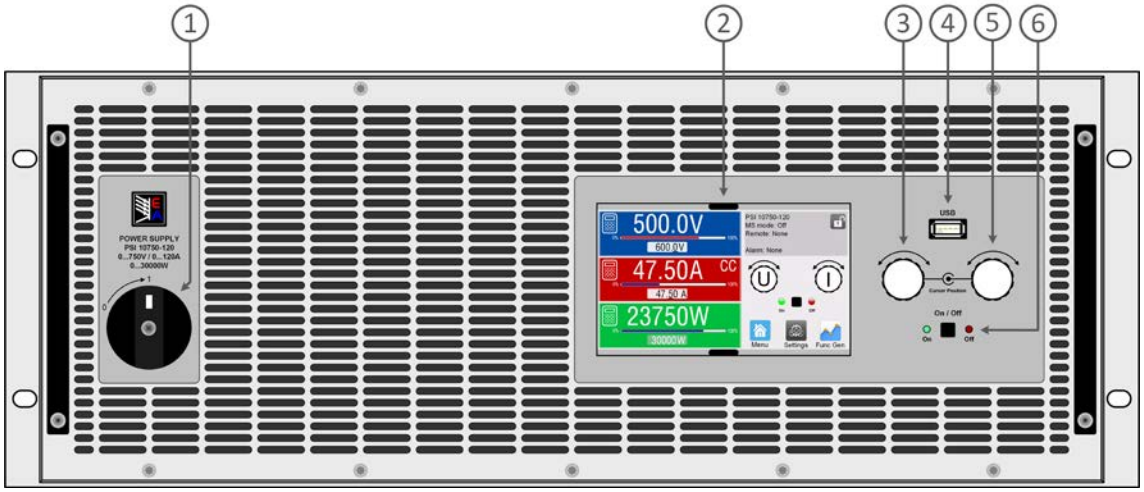
1. Master-Slave bus connectors to set up a system for parallel connection
2. Slot for interfaces
3. Remote sense connectors
4. Share bus connectors to set up a system for parallel connection
5. DC output terminal (copper blades)
6. AC input connector
7. Grounding connection screw (PE)
8. Connector (DB15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

Technical drawings PSI 10000 4U ≥360 V





Front panel description PSI 10000 4U



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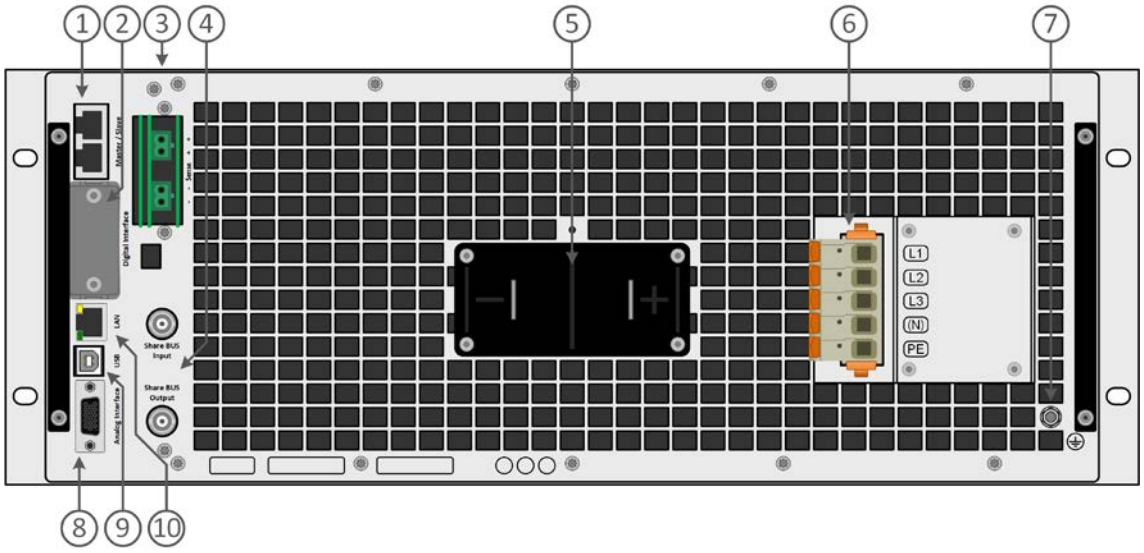
Rear panel description PSI 10000 4U ≥360 V



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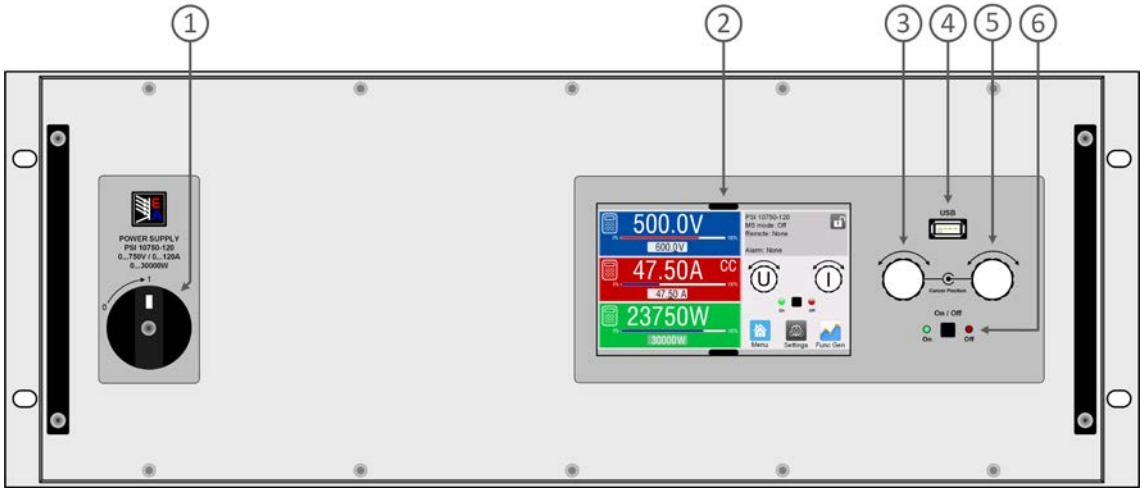
Front panel description PSI 10000 4U with Water Cooling option



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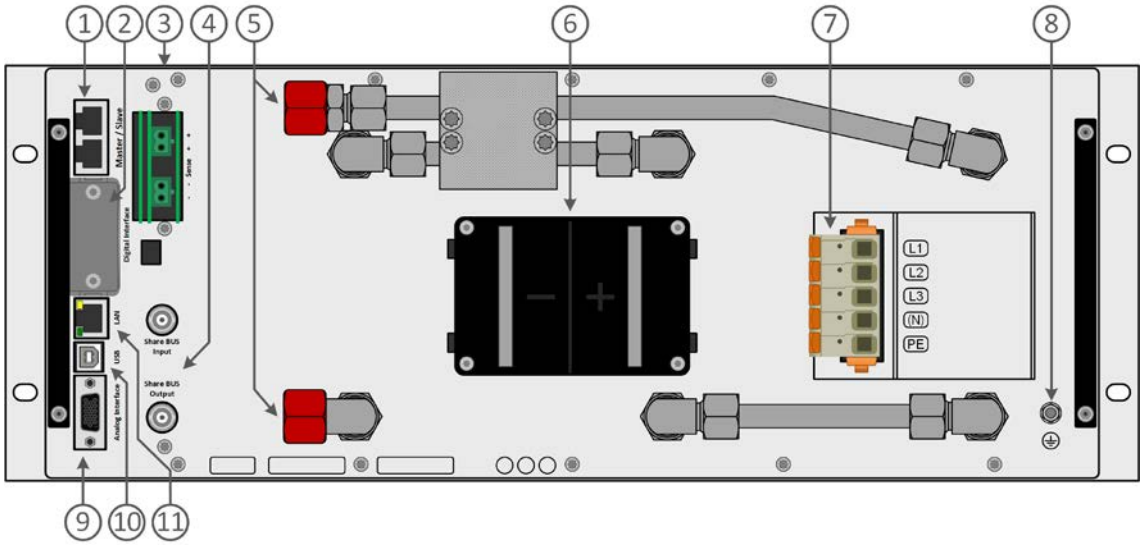
Rear panel description PSI 10000 4U with Water Cooling option



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. Grounding connection screw (PE)
9. Connector (DB15 female) for isolated analog programming, monitoring and other functions
10. USB interface
11. Ethernet interface

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