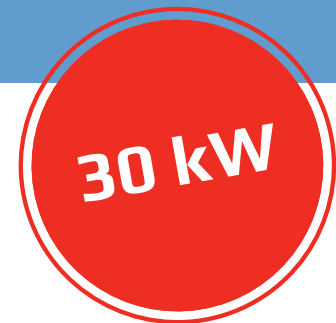




Elektro-Automatik



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 \pm 10 % 3ph AC
- Active Power Factor Correction, typical 0.99
- Very high efficiency up to over 96 %
- High performance of 30 kW per unit
- Voltage from 0 - 10 V up to 0 - 2000 V
- Currents from 0 - 20 A up to 0 - 1000 A
- Flexible power regulated DC-output stages (autoranging)
- Regulation mode CV, CC, CP, CR with fast crossover
- Digital regulation, high resolution with 16bit ADCs and DACs, selection of control 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
- Predefined automotive test procedures for LV123, LV124 and LV148
- Command languages and drivers: SCPI and ModBus, LabVIEW, IVI

Build-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, $\pm 10\%$, 3ph AC (with DC output power derating to 18 kW) Range 2: 380 - 480 V, $\pm 10\%$, 3ph AC
Frequency	45 - 65 Hz
Power factor	ca. 0.99
Leakage current	<10 mA
Inrush current / Phase current	≤ 56 A
Oversvoltage category	2
DC output static	
Load regulation CV	$\leq 0.05\%$ FS (0 - 100% load, constant output voltage and constant temperature)
Line regulation CV	$\leq 0.01\%$ FS (208 V - 480 V AC $\pm 10\%$ supply voltage, constant load and constant temperature)
Stability CV	$\leq 0.02\%$ FS (during 8 h of operation, after 30 minutes warm-up, at constant output voltage, load and temperature)
Temperature coefficient CV	≤ 30 ppm/ $^{\circ}$ C (after 30 minutes of warm-up)
Compensation (Remote Sense)	$\leq 5\%$ U_{Nominal}
Load regulation CC	$\leq 0.1\%$ FS (0 - 100% load, constant output voltage and constant temperature)
Line regulation CC	$\leq 0.01\%$ FS (208 V - 480 V AC $\pm 10\%$ supply voltage, constant load and constant temperature)
Stability CC	$\leq 0.02\%$ FS (during 8 h of operation, after 30 minutes warm-up, at constant output voltage, load and temperature)
Temperature coefficient CC	≤ 50 ppm/ $^{\circ}$ C (after 30 minutes of warm-up)
Load regulation CP	$\leq 0.3\%$ FS (0 - 100% load, constant output voltage and constant temperature)
Load regulation CR	$\leq 0.3\%$ 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	$\leq 0.05\%$ FS
Current	$\leq 0.1\%$ 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 output 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

*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	
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%
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

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 (BWL 300 kHz *2)	≤25 mV (BWL 300 kHz *2)	≤40 mV (BWL 300 kHz *2)	≤55 mV (BWL 300 kHz *2)
Ripple in CV (pp)	≤320 mV (BWL 20 MHz *2)	≤320 mV (BWL 20 MHz *2)	≤300 mV (BWL 20 MHz *2)	≤320 mV (BWL 20 MHz *2)
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

*1 At 100% power and 100% output voltage

*2 BWL = band width limits on the measuring oscilloscope

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 (BWL 300 kHz *2)	≤200 mV (BWL 300 kHz *2)	≤200 mV (BWL 300 kHz *2)	≤300 mV (BWL 300 kHz *2)
Ripple in CV (pp)	≤350 mV (BWL 20 MHz *2)	≤800 mV (BWL 20 MHz *2)	≤800 mV (BWL 20 MHz *2)	≤1600 mV (BWL 20 MHz *2)
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

*1 At 100% power and 100% output voltage

*2 BWL = band width limits on the measuring oscilloscope

Technical specifications	PSI 11500-60	PSI 12000-40		
DC output				
Voltage range	0 - 1500 V	0 - 2000 V		
Ripple in CV (rms)	≤400 mV (BWL 300 kHz *2)	≤500 mV (BWL 300 kHz *2)		
Ripple in CV (pp)	≤2400 mV (BWL 20 MHz *2)	≤3000 mV (BWL 20 MHz *2)		
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		

*1 At 100% power and 100% output voltage

*2 BWL = band width limits on the measuring oscilloscope

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 over 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 W 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 and one 15 kW devices from the PSI 10000 range. Furthermore, typical laboratory functionality is provided. This includes an extensive function generator, alarm and warning management, assorted interfaces and ports, software solutions and many more functions.

AC Connection

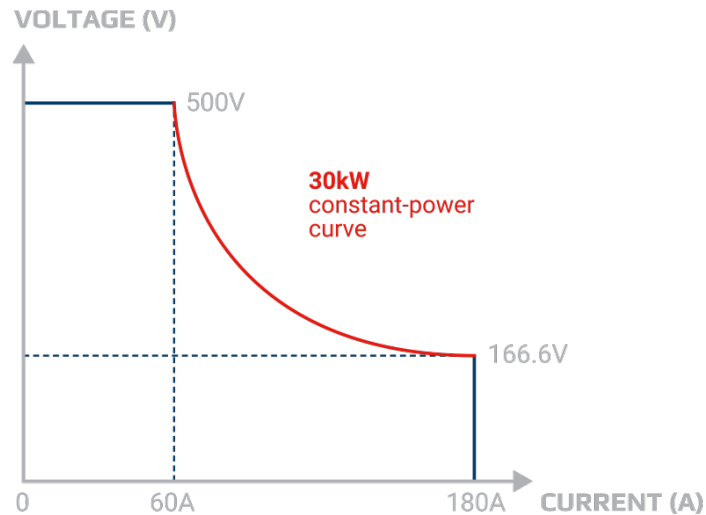
The DC power supplies in the PSI 10000 series are equipped with an active PFC which provides a high efficiency at a low energy consumption. Furthermore, the devices in this series provide a wide input voltage range. This extends from 1-phase 110/120 V up to 240 V AC mains supply and 3-phase 208 V to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

DC Output

The output of the power supply PSI 10000 with a DC voltage of 0 - 60 V up to 0 - 2000 V allows currents of 0 - 6 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.

Function generator

All models in the PSI 10000 series are equipped with a function generator. This allows curve processes such as sine, triangle, square or trapeze to be simply called up. A ramp function and an arbitrary generator allow voltage and current progression to be freely programmable. Test sequences for repeated tests can be saved and reloaded when needed, that's saving time. A LUT allows IU and UI reference lines to be stored. For simulation of a photovoltaic system or fuel cells, adaptable tables are provided. With the standard PV characteristic curve (DIN EN 50530) various solar cells and many other technology parameters can be selected and set. In short, the user is supported by a multitude of useful functions.

Interfaces

As standard EA devices are fitted with the most important digital and analogue interfaces and ports which are galvanically isolated. These include an analogue interface which can be parameterised 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. The following options which use a 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 outputs of many PSI 10000 devices, changing the copper rails to vertical, and connecting in parallel. Thus, a 19" cabinet with 42 U can provide a system with 240 kW occupying 0.6 m² floorspace. The master/slave bus enables up to 8 cabinets with a maximum of 64 units of 30 kW each to behave as one unit.

Master-Slave-Bus and Share-Bus

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



Example representation

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

Application

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 test

The devices in the PSI 10000 range may be used for testing the electrical features of fuel cells, fuel cell stacks and fuel cell systems. Here they generate highly accurate and reproducible results in all electrical modes. To test the resistance, performance, and active life of a fuel cell quickly and economically users can readily incorporate the devices into an automatic test system. The feedback capability guarantees high level of energy and cost efficiency. If higher currents are needed for testing a complete fuel cell system, then multiple devices can be connected in parallel in a master-slave system. Here high accuracy and performance are maintained.

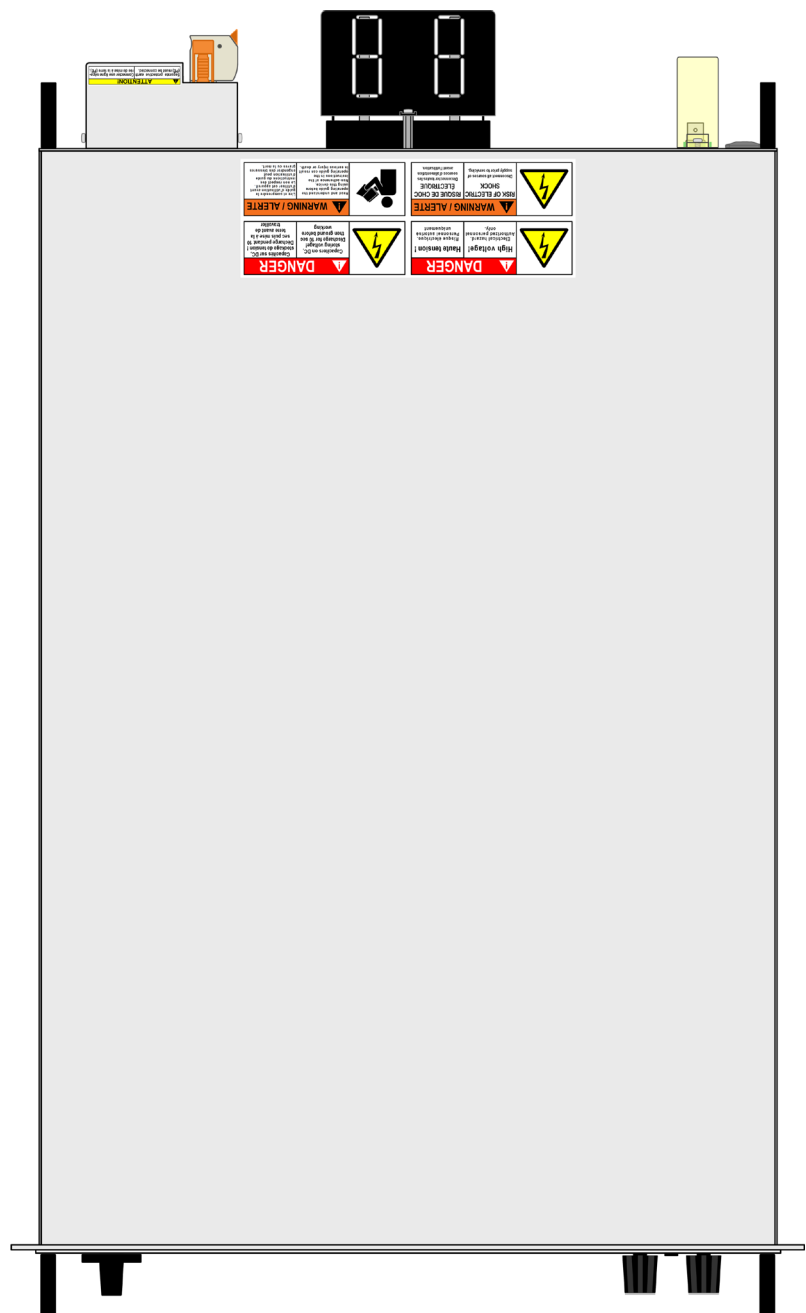
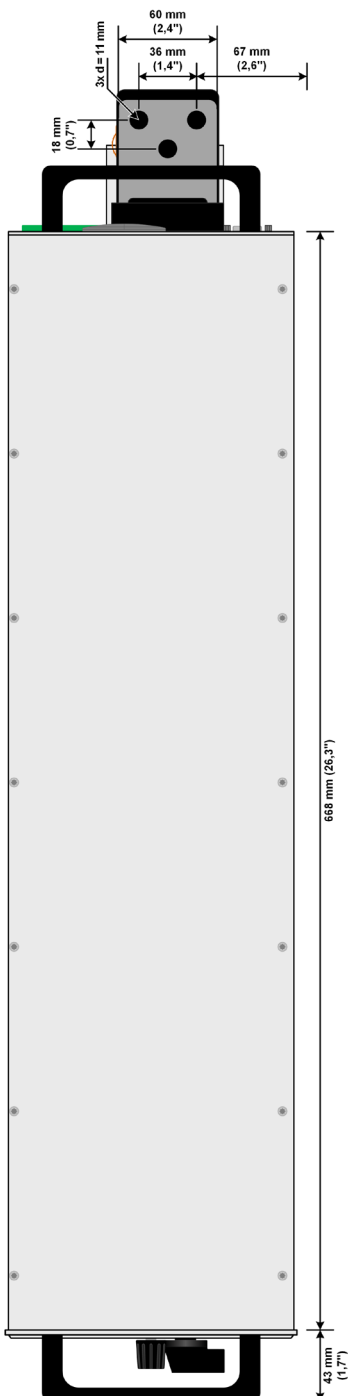
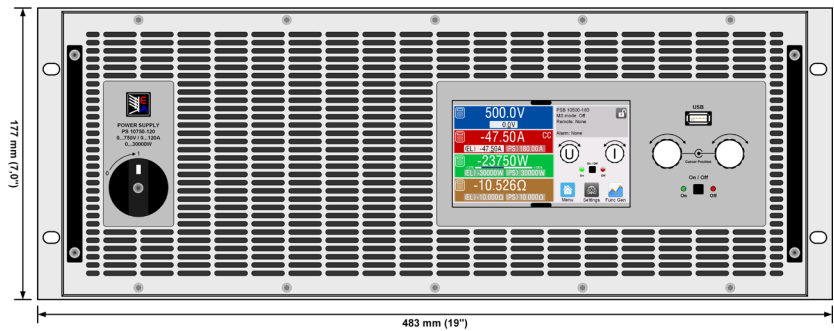
On-board charger test

In an on-board charger test (OBC) the electrical features 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 PSI 10000 devices test procedures allow data to be exported and saved. In this way applications can promptly 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 test device, the control frequency of the power supply is adjustable. The modes Normal, Fast and Slow allow the PSI 10000 devices to match the control characteristics of the on board charger.

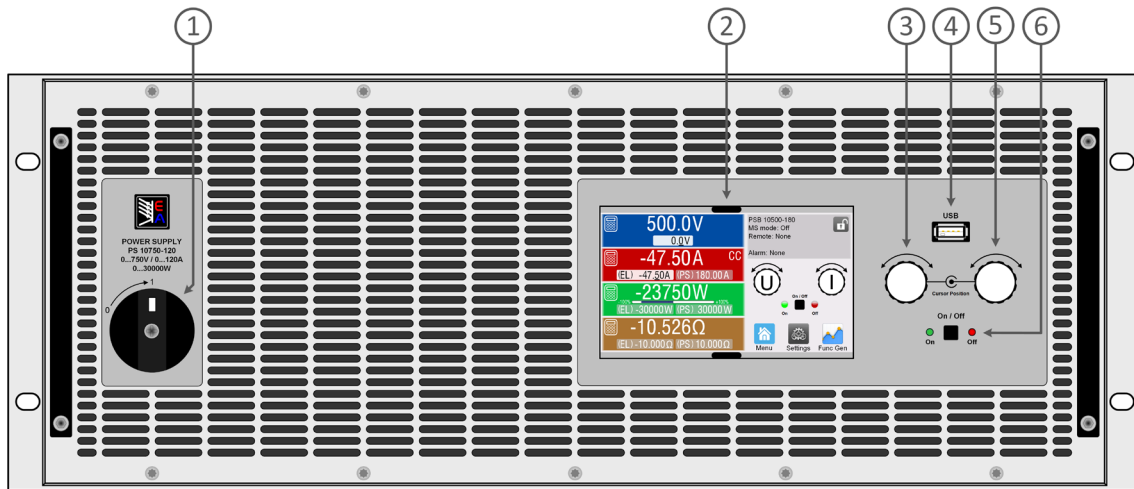
Solar array simulation

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 cells. Users can readily program simulation models according to EN 50530 or Sandia using diverse solar cell materials. An IU curve can be accurately reproduced, parameters such as irradiation, shadow, temperature, clouds, and rain can be included. Thus, the devices can test all the relevant electrical features of a PV inverter including the particularly important determination of the efficiency. Users can select a static or dynamic Maximum-Power-Point-Tracking (MPPT). The high resolution of 16-bit technology and a sampling rate of 1µs enables 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

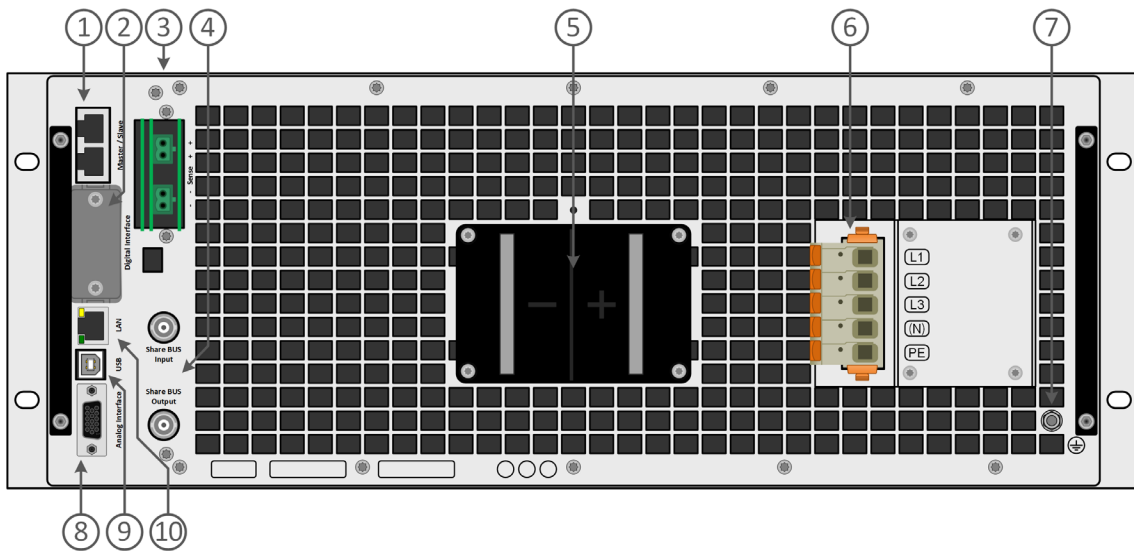


Front panel description PSI 10000 4U



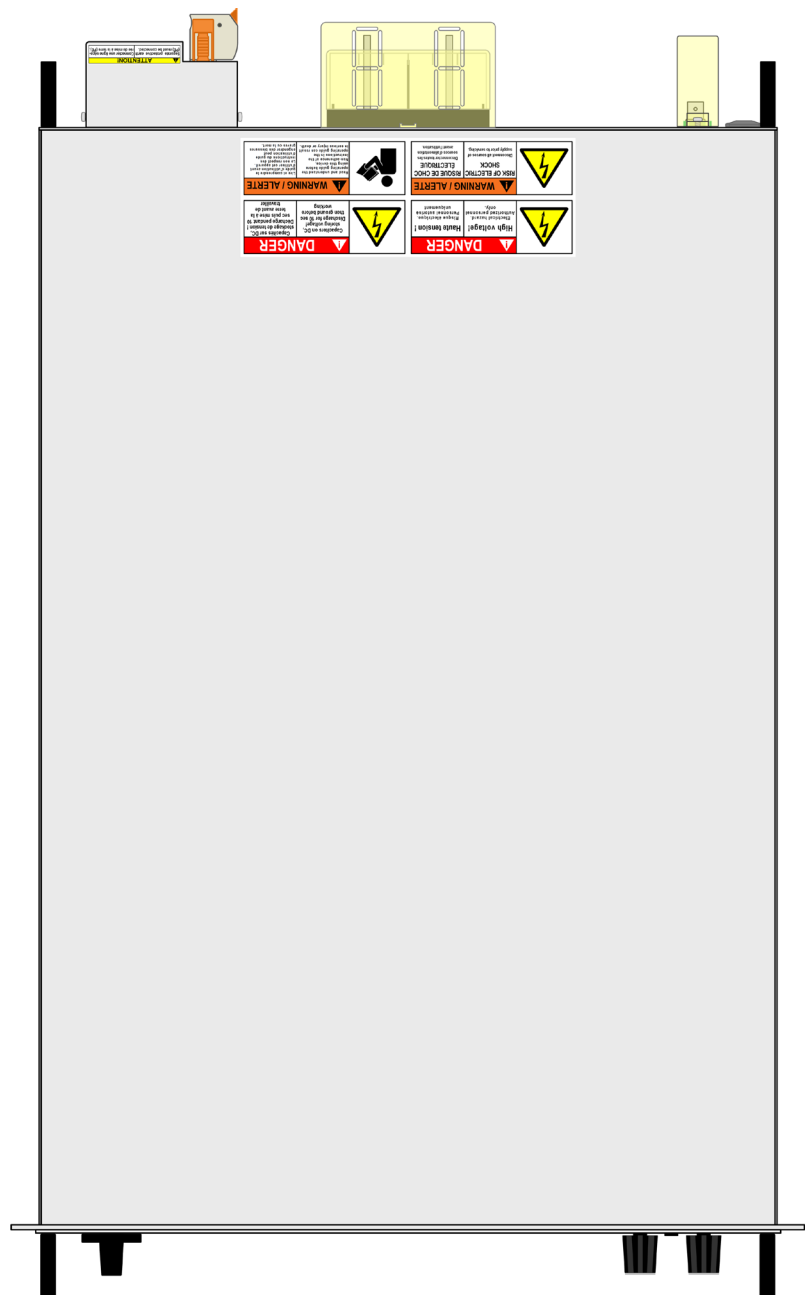
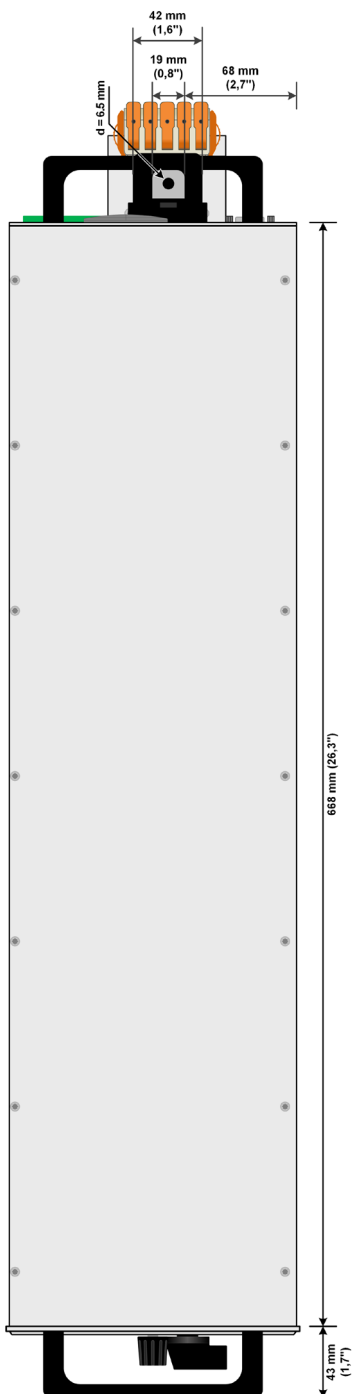
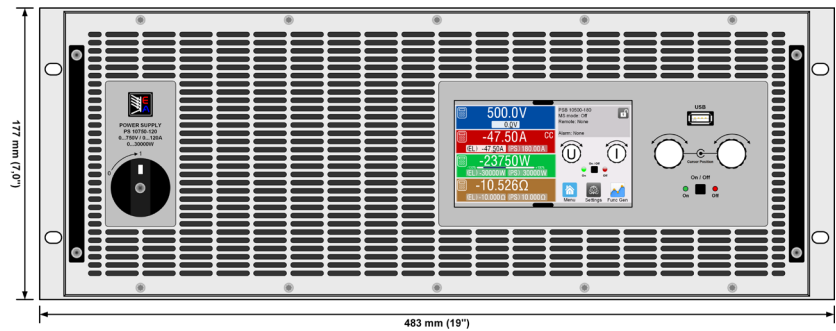
1. Power switch
2. TFT control interface, interactive operation and display
3. Rotary knob with push-button action, for settings and control
4. USB host, uses USB sticks for data logging and sequencing
5. Rotary knob with push-button action, for settings and control
6. On / Off push-button with LED status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

Rear panel description PSI 10000 4U $\leq 200\text{ V}$

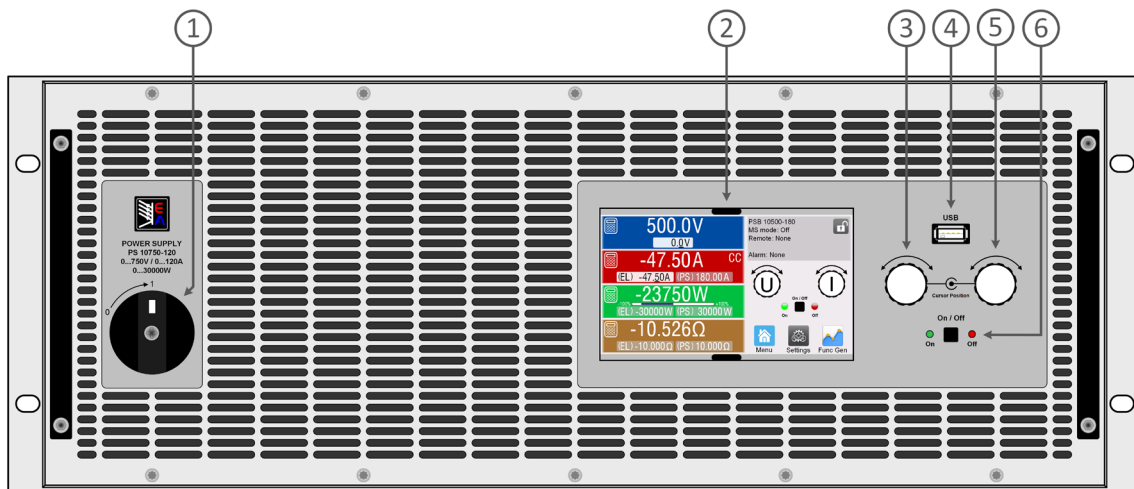


1. Master-Slave bus connectors to set up a system for parallel connection
2. Slot for interfaces
3. Remote sense connectors
4. Share bus connectors to set up a system for parallel connection
5. DC output terminal (copper blades)
6. AC input terminal
7. Grounding connection screw (PE)
8. Connector (DB15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

Technical drawings PSI 10000 4U ≥ 360 V

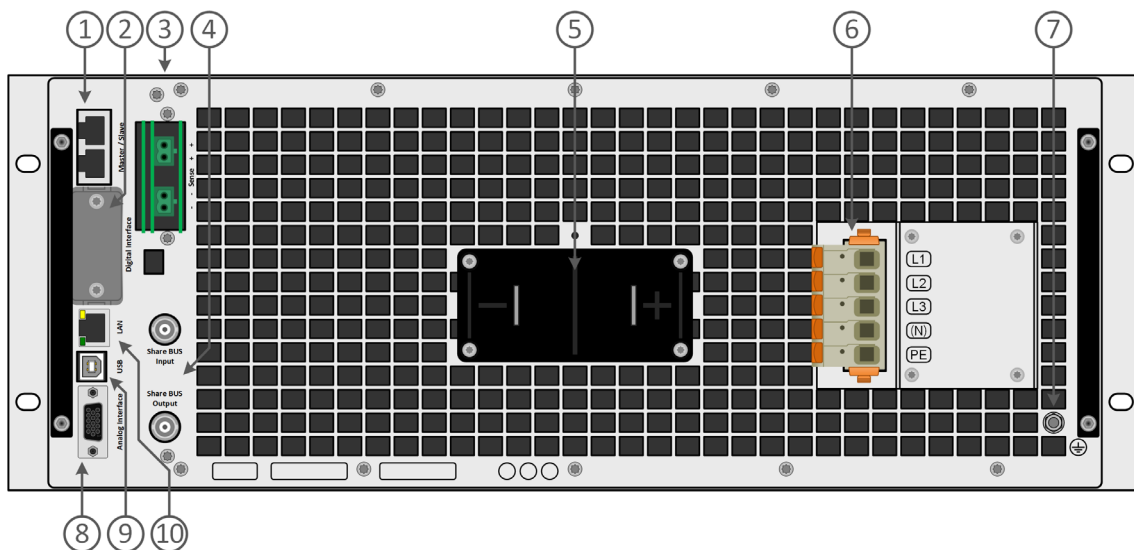


Front panel description PSI 10000 4U



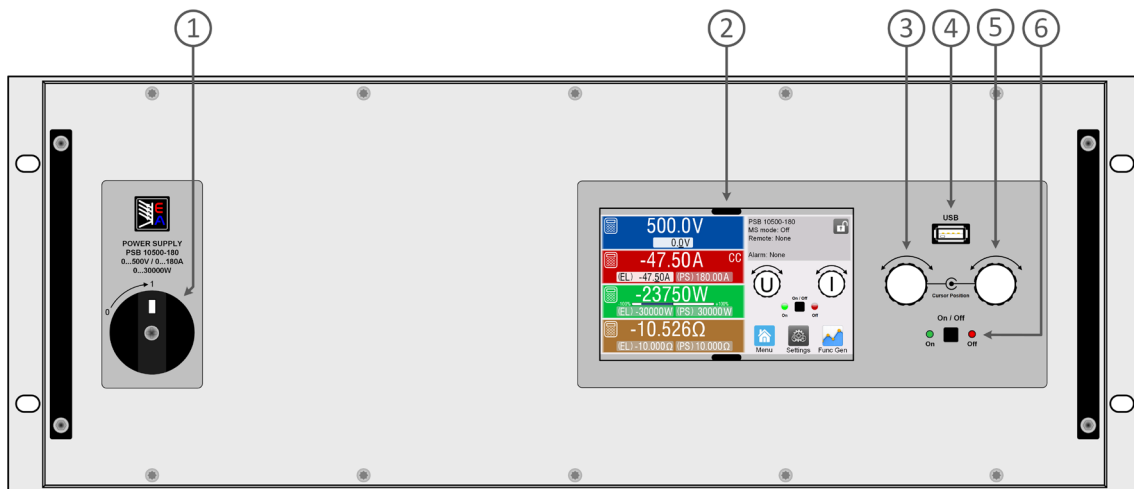
1. Power switch
2. TFT control interface, interactive operation and display
3. Rotary knob with push-button action, for settings and control
4. USB host, uses USB sticks for data logging and sequencing
5. Rotary knob with push-button action, for settings and control
6. On / Off push-button with LED status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

Rear panel description PSI 10000 4U ≥ 360 V



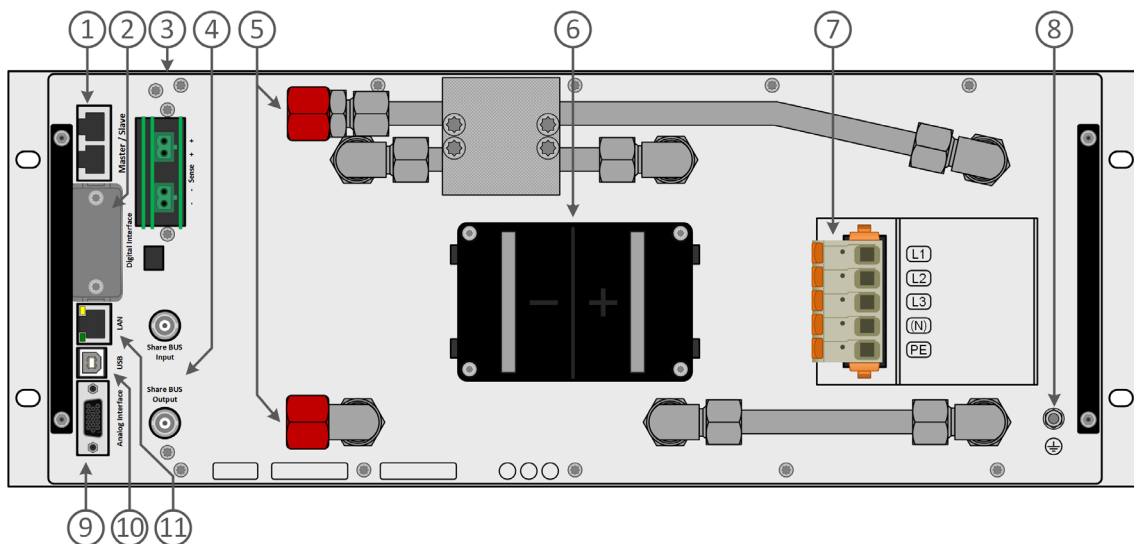
1. Master-Slave bus connectors to set up a system for parallel connection
2. Slot for interfaces
3. Remote sense connectors
4. Share bus connectors to set up a system for parallel connection
5. DC output terminal (copper blades)
6. AC input terminal
7. Grounding connection screw (PE)
8. Connector (DB15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

Front panel description PSI 10000 4U with Water Cooling option



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 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 terminal
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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