



Elektro-Automatik



## PSI 10000 3U

### Programmable DC-Power Supply

**High Efficiency & Performance:** Achieves up to 96% efficiency with power ratings of 5 kW, 10 kW, and 15 kW, delivering optimal energy conversion and minimal heat loss.

**Flexible Autoranging DC Output:** Supports a wide range of voltage (0-60 V to 0-2000 V) and current (0-20 A to 0-510 A), enabling engineers to address multiple use cases with a single unit.

**Advanced Regulation Modes:** Includes Constant Voltage (CV), Constant Current (CC), Constant Power (CP), and Constant Resistance (CR) modes, with fast crossover for dynamic applications.

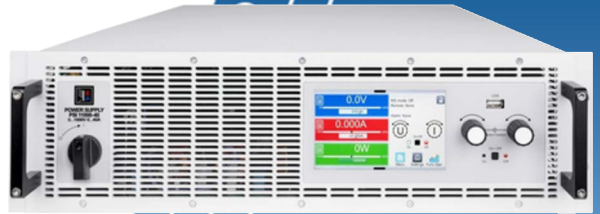
**Scalable Parallel Operation:** Integrates a Master-Slave bus and Share-Bus for parallel operation of up to 64 units, enabling systems to scale up to 1920 kW.

**Intuitive User Interface:** Features a 5-inch color TFT touchscreen with high-resolution 16-bit ADCs and DACs, making operation straightforward and precise.

# EA-PSI 10000 3U

## 5 kW - 10 kW - 15 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 of up to 15 kW per unit
- Voltages from 0 - 60 V up to 0 - 2000 V
- Currents from 0 - 20 A up to 0 - 510 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 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
- 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



# SPECIFICATIONS

## AC Input

- **Voltage, Phases:**
  - Range 1: 208 V,  $\pm 10\%$ , 3ph AC (with DC output power derating to 3 / 6 / 9 kW)
  - Range 2: 380 - 480 V,  $\pm 10\%$ , 3ph AC
- **Frequency:** 45-66 Hz
- **Power factor:** ca. 0.99
- **Leakage current:** <5 mA
- **Inrush current @400 V:** ca. 40 A per phase
- **Overvoltage 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 +10% input voltage, constant load and constant temperature)
- **Stability CV:**  $\leq 0.02\%$  FS (during 8 h of operation, after 30 minutes of warm-up, at constant output voltage, load and temperature)
- **Temperature coefficient CV:**  $\leq 30$ ppm/ $^{\circ}$ C (after 30 minutes of warm-up)
- **Compensation (remote sense):**  $\leq 5\%$  UNominal
- **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 +10% input voltage, constant load and constant temperature)
- **Stability CC:**  $\leq 0.02\%$  FS (during 8 h of operation, after 30 minutes of warm-up, at constant output voltage, load and temperature)
- **Temperature coefficient CC:**  $\leq 50$ 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 of current (0 - 100% load, constant output voltage and constant temperature)

## Protective Functions

- **Overvoltage Protection (OVP):** Adjustable 0 - 110% UNominal
- **Overcurrent Protection (OCP):** Adjustable 0 - 110% INominal
- **Overpower Protection (OPP):** Adjustable 0 - 110% PNominal
- **Overtemperature Protection (OT):** DC output shuts down in case of insufficient cooling

## DC Output (Dynamic)

- **Rise time 10 - 90% CV:**  $\leq 20$  ms
- **Fall time 90 - 10% CV:**  $\leq 20$  ms
- **Rise time 10 - 90% CC:**  $\leq 10$  ms
- **Fall time 90 - 10% CC:**  $\leq 10$  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)
- **AC Input to Case (PE):** 2500 Vrms
- **DC-Output to case (PE):** Depending on the model, see model table
- **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

## 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:  $\leq 0.2\%$ , 0-5 V:  $\leq 0.4\%$

## Device Configuration

- **Parallel Operation:** Up to 64 units of any power class in the 10000 series, with Master-Slave Bus and Share Bus

## Safety and EMC

- **Safety Standards:** EN 61010-1, IEC 61010-1, UL 61010-1, CSA C22.2 No 61010-1, BS EN 61010-1
- **EMC Compliance:** EN 55011 (Class B), CISPR 11 (Class B), FCC 47 CFR part 15B (Class B), EN 61326-1
- **Includes tests:** EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6
- **Safety Protection Class:** Class 1
- **Ingress Protection:** IP20

## Environmental Conditions

- **Operating Temperature:** 0–50  $^{\circ}$ C (32–122  $^{\circ}$ F)
- **Storage Temperature:** -20–70  $^{\circ}$ C (-4–158  $^{\circ}$ F)
- **Humidity:**  $\leq 80\%$  relative humidity, non-condensing
- **Altitude:**  $\leq 2000$  m ( $\leq 6,600$  ft)
- **Pollution Degree:** 2

## Mechanical Construction

- **Cooling:** Forced air flow from front to rear (temperature-controlled fans)
- **Dimensions (W x H x D):** 19" x 3U x 688 mm (Enclosure only, not over all)
- **Weight:** 5 kW unit: 18 kg (40 lb), 10 kW unit: 25.4 kg (56 lb), 15 kW unit: 32.8 kg (72 lb)

## Available Models

SKU	PSI 10060-170	PSI 10080-170	PSI 10200-70	PSI 10360-40	PSI 10500-30	PSI 10750-20
Voltage Range (V)	0 - 60 V	0 - 80 V	0 - 200 V	0 - 360 V	0 - 500 V	0 - 750 V
Ripple in CV (rms)	≤10 mV (BW 300 kHz)	≤10 mV (BW 300 kHz)	≤40 mV (BW 300 kHz)	≤55 mV (BW 300 kHz)	≤70 mV (BW 300 kHz)	≤200 mV (BW 300 kHz)
Ripple in CV (pp)	≤100 mV (BW 20 MHz)	≤100 mV (BW 20 MHz)	≤300 mV (BW 20 MHz)	≤320 mV (BW 20 MHz)	≤350 mV (BW 20 MHz)	≤800 mV (BW 20 MHz)
Current Range (A)	0 - 170 A	0 - 170 A	0 - 70 A	0 - 40 A	0 - 30 A	0 - 20 A
Power Range (W)	0 - 5000 W (0 - 3000 W)*2	0 - 5000 W (0 - 3000 W)*2	0 - 5000 W (0 - 3000 W)*2	0 - 5000 W (0 - 3000 W)*2	0 - 5000 W (0 - 3000 W)*2	0 - 5000 W (0 - 3000 W)*2
Resistance Range (Ω)	0.016 - 26 Ω	0.016 - 26 Ω	0.1 - 160 Ω	0.3 - 520 Ω	0.6 - 1000 Ω	1.2 - 2200 Ω
Output Capacitance (μF)	7790 μF	7790 μF	2520 μF	393 μF	180 μF	180 μF
Efficiency (up to)	94.5% *1	94.5% *1	94.5% *1	95.5% *1	95.5% *1	95.5% *1

Specification	PSI 10060-340	PSI 10080-340	PSI 10200-140	PSI 10360-80	PSI 10500-60	PSI 10750-40	PSI 11000-30	PSI 11500-20
Voltage Range (V)	0 - 60 V	0 - 80 V	0 - 200 V	0 - 360 V	0 - 500 V	0 - 750 V	0 - 1000 V	0 - 1500 V
Ripple RMS CV (mV BW 300 kHz)	10 mV	10 mV	40 mV	55 mV	70 mV	200 mV	100 mV	150 mV
Ripple Noise p-p CV (mV BW 20 MHz)	100 mV	100 mV	300 mV	320 mV	350 mV	800 mV	2000 mV	6500 mV
Current Range (A)	0 - 340 A	0 - 340 A	0 - 140 A	0 - 80 A	0 - 60 A	0 - 40 A	0 - 30 A	0 - 20 A
Power Range (W)	0 - 10000 W	0 - 10000 W	0 - 10000 W	0 - 10000 W	0 - 10000 W	0 - 10000 W	0 - 10000 W	0 - 10000 W
Resistance Range (Ω)	0.008 - 13 Ω	0.008 - 13 Ω	0.05 - 80 Ω	0.2 - 400 Ω	0.4 - 830 Ω	1 - 1250 Ω	3 - 6000 Ω	8 - 6000 Ω
Output Capacitance (μF)	15580 μF	15580 μF	5040 μF	786 μF	360 μF	100 μF	60 μF	20 μF
Efficiency (%)	95.0%	95.0%	95.5%	95.5%	95.5%	95.5%	95.5%	95.5%

## Available Models

Specification	PSI 10060-510	PSI 10080-510	PSI 10200-210	PSI 10360-120	PSI 10500-90	PSI 10750-60	PSI 11000-40	PSI 11500-30	PSI 12000-20
Voltage Range (V)	0 - 60 V	0 - 80 V	0 - 200 V	0 - 360 V	0 - 500 V	0 - 750 V	0 - 1000 V	0 - 1500 V	0 - 2000 V
Ripple RMS CV (mV BW 300 kHz)	10 mV	10 mV	40 mV	55 mV	70 mV	200 mV	300 mV	400 mV	400 mV
Ripple Noise p-p CV (mV BW 20 MHz)	100 mV	100 mV	300 mV	320 mV	350 mV	800 mV	1600 mV	2400 mV	2400 mV
Current Range (A)	0 - 510 A	0 - 510 A	0 - 210 A	0 - 120 A	0 - 90 A	0 - 60 A	0 - 40 A	0 - 30 A	0 - 20 A
Power Range (W)	0 - 15000 W	0 - 15000 W	0 - 15000 W	0 - 15000 W	0 - 15000 W	0 - 15000 W	0 - 15000 W	0 - 15000 W	0 - 15000 W
Resistance Range ( $\Omega$ )	0.006 - 9 $\Omega$	0.006 - 9 $\Omega$	0.03 - 50 $\Omega$	0.1 - 180 $\Omega$	0.2 - 330 $\Omega$	0.4 - 750 $\Omega$	0.8 - 1300 $\Omega$	1.7 - 3000 $\Omega$	3.5 - 5300 $\Omega$
Output Capacitance ( $\mu$ F)	23970 $\mu$ F	23970 $\mu$ F	7560 $\mu$ F	1179 $\mu$ F	540 $\mu$ F	360 $\mu$ F	131 $\mu$ F	60 $\mu$ F	60 $\mu$ F
Efficiency (%)	94.5%	94.5%	94.5%	95.5%	95.5%	95.5%	95.5%	95.5%	95.5%

## General

The PSI 10000 series DC laboratory power supplies convert energy from the grid into regulated DC voltage with efficiency exceeding 96%. These devices are available in single-phase and three-phase models, making them compatible with virtually all global mains voltages. The PSI 10000 series offers a broad spectrum of DC voltage (0-60 V to 0-2000 V) and current ratings (0-6 A to 0-1000 A) in a single device. Each power supply operates as a flexible output stage with a constant power characteristic (autoranging), providing a wide voltage and current range.

To accommodate higher power and current demands, the PSI 10000 series includes a built-in master-slave bus, enabling up to 64 devices to operate in parallel. This configuration can achieve system outputs of up to 1920 kW and 64,000 A, functioning as a single cohesive unit. Users can combine devices of different power classes as long as the voltage class remains consistent, creating systems tailored to specific needs, such as a 75 kW system composed of two 30 kW 4U and one 15 kW 3U device. The series also includes extensive laboratory functionalities such as a function generator, alarm management, and various industrial interfaces.

## DC Connection

The DC connection is efficiently designed with copper blades located on the rear of the device, simplifying integration into systems. For higher performance requirements, multiple units can be connected in parallel with minimal effort, leveraging the vertical copper rails provided. A contact protection cover is included to ensure safety during operation, offering a practical and secure solution for high-performance setups.

## AC Connection

The PSI 10000 series features active Power Factor Correction (PFC), which ensures high efficiency and low energy consumption. These devices support a wide input voltage range, from 110/120 V to 240 V for single-phase models, and 208 V to 380/400/480 V for three-phase models, enabling operation across most global power grids. The units automatically adapt to the available grid voltage without requiring additional configuration. In 110/120 V and 208 V AC grids, the devices automatically derate the DC output power to match the input capacity.

## DC Output

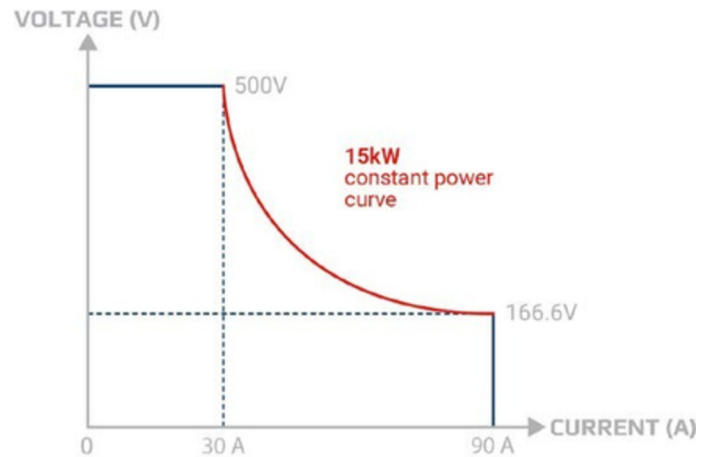
The DC output of the PSI 10000 3U power supply series is designed for flexibility and performance, offering a wide range of DC voltages from 0-60 V to 0-2000 V and currents from 0-20 A to 0-510 A. The autoranging output stages allow for a broad operational scope, enabling users to cover a wider range of applications than traditional power supplies. This flexibility ensures optimal use of the device across various testing and simulation scenarios, maximizing value and utility.

## The Principle of Autoranging

Autoranging in the PSI 10000 series enhances flexibility by dynamically adjusting output voltage and current to deliver full power across a wide operating range. Unlike fixed-range power supplies, it allows a single unit to handle diverse applications, eliminating the need for multiple devices and reducing costs. By adapting to specific voltage and current requirements, autoranging simplifies system design, ensures optimal performance, and provides a versatile, cost-effective solution for engineers tackling complex testing and operational challenges.

## Function Generator

Every model in the PSI 10000 series comes equipped with an integrated function generator, making it simple to generate and apply waveforms such as sine, triangle, square, or trapezoid to either the voltage or the current. Additional features include a ramp function and an arbitrary generator, allowing for the free programmability of voltage and current progressions. Users can save and reload test sequences for repetitive tests, significantly saving time and streamlining workflows. For specialized applications like photovoltaics or fuel cell simulations, the function generator supports adjustable PV characteristic curves compliant with DIN EN 50530. This functionality allows users to define various solar modules and simulate complete day trends, enhancing testing capabilities with precise and adaptable control.



## Interfaces

The PSI 10000 series includes a comprehensive range of built-in and optional interfaces, ensuring seamless integration with existing setups. Standard interfaces are galvanically isolated and include USB, Ethernet, and an analog interface configurable for input, output, control, and monitoring. The analog interface supports voltage, current, power, and resistance parameters, with additional features like alarms and status monitoring. Optional industrial interfaces are available for enhanced functionality, including CAN, CANopen, RS232, Profibus, EtherCAT, Profinet (single or dual ports), Modbus (single or dual ports), and Ethernet (single or dual ports). These plug-and-play options expand the device's versatility, making it adaptable to a wide range of industrial and laboratory environments.

## High-Performance Systems

The PSI 10000 series is built to handle high-power applications, offering system scalability up to an impressive 960 kW. By connecting multiple PSI 10000 3U devices in parallel using copper rails, users can easily build systems tailored to their needs. For example, a 19" cabinet with a 42U height can accommodate up to 12 units of 3U devices, creating a system capable of delivering up to 180 kW while occupying only 0.6 m<sup>2</sup> (6.5 sqft) of floor space. For even greater demands, up to six cabinets containing a total of 64 units can be linked, providing up to 960 kW of power. This modular design ensures that high-performance systems are both efficient and space-saving.

## Master-Slave-Bus and Share-Bus

The PSI 10000 series features integrated master-slave and Share buses, enabling multiple devices to function as a unified system. The master-slave bus consolidates system data such as total power and current, displaying it on the master unit while also managing warnings and alarms from slave devices. The Share bus ensures balanced load distribution across all connected units, optimizing performance and reliability. These features make the PSI 10000 series ideal for building scalable, high-power systems that operate with the precision and coordination of a single device.



## Example Representation

A fully assembled and operational 240 kW system.



# Applications

## Relay Testing in Production

Relay manufacturers rely on precise and reliable testing during production to ensure product quality. The PSI 10000 series is perfectly suited for this task, delivering exact voltage and current controls needed to evaluate critical parameters such as operating, holding, and decay currents for coils, as well as current-carrying capacity and contact resistance for relay contacts. The ability to document consistent voltage levels and disconnect thresholds ensures comprehensive quality assessment. With diverse interface options, the PSI 10000 integrates seamlessly into automated test systems, eliminating the need for additional measuring equipment and enhancing productivity.

## Fuel Cell Simulation

Fuel cell development demands precise simulation to evaluate both energy storage systems and the components powered by them. The PSI 10000 series excels in this application, offering robust overcurrent and voltage monitoring to protect connected devices. Its integrated mechanisms, including overcurrent protection (OCP) and alarms for voltage limits, enable safe and repeatable testing. By simulating fuel cell behavior under controlled conditions, the PSI 10000 provides critical data for optimizing designs and ensuring performance.

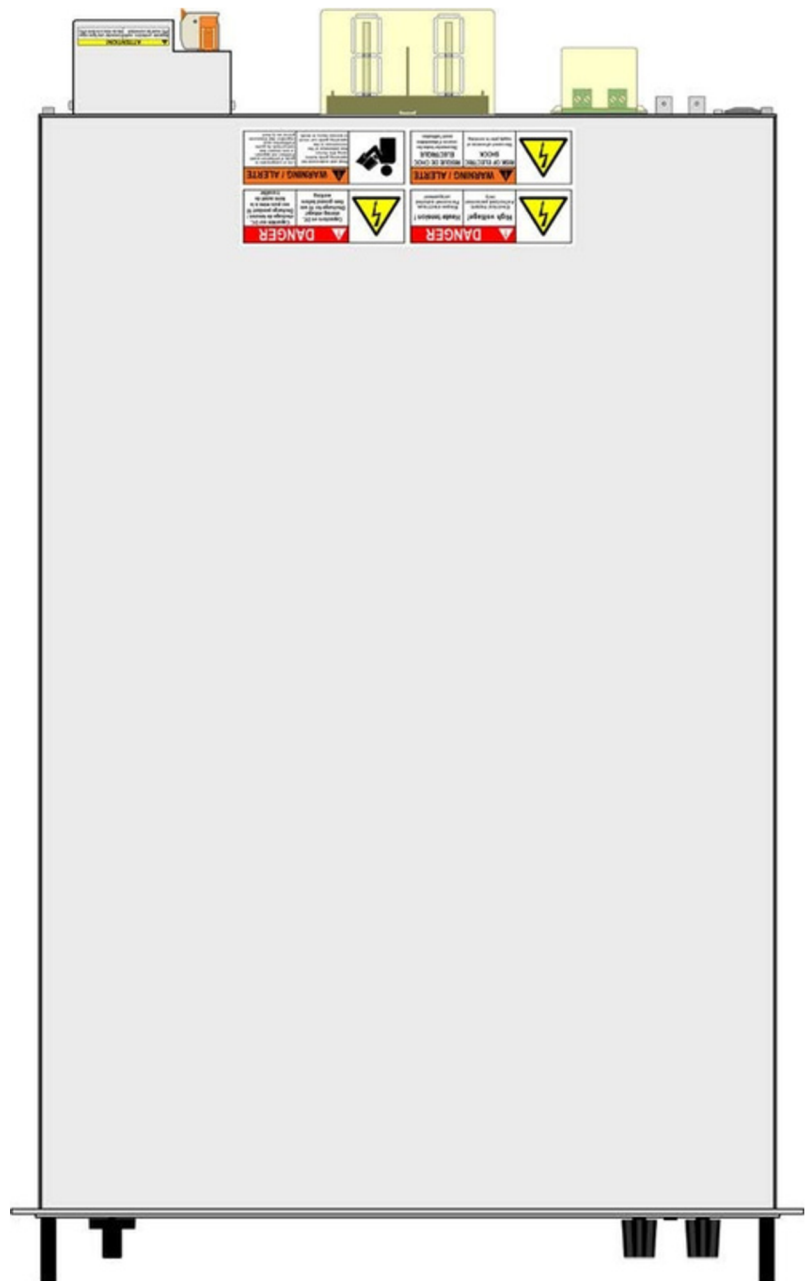
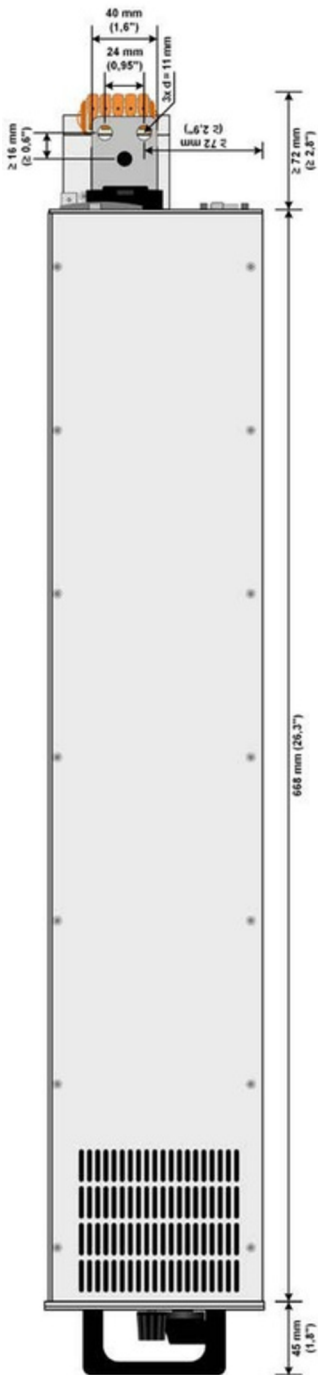
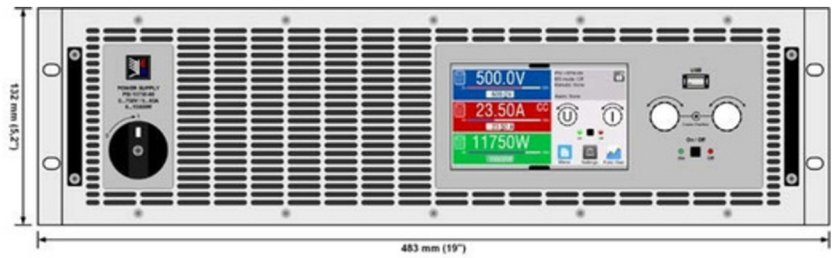
## On-Board Charger Test

Testing on-board chargers (OBCs) requires flexibility and accuracy, both of which the PSI 10000 series delivers. With built-in sequencing and logging via EA Power Control software, the device enables data export for detailed analysis and reproducibility. Adjustable voltage regulation speeds (Normal, Fast, Slow) prevent conflicts between the control loops of the charger and the testing device, ensuring precise results. For source and sink capabilities, the PSI 10000 pairs seamlessly with electronic DC loads like the ELR 10000 series, creating a complete testing solution.

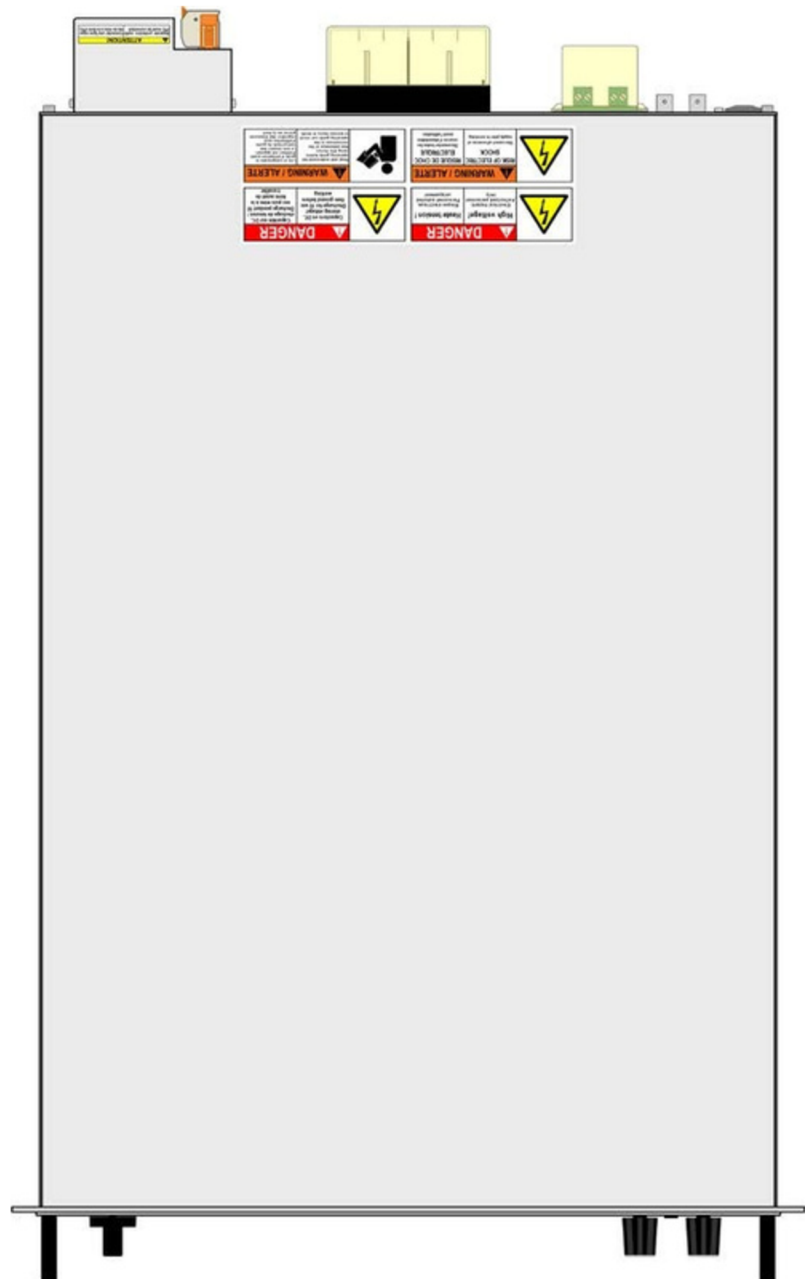
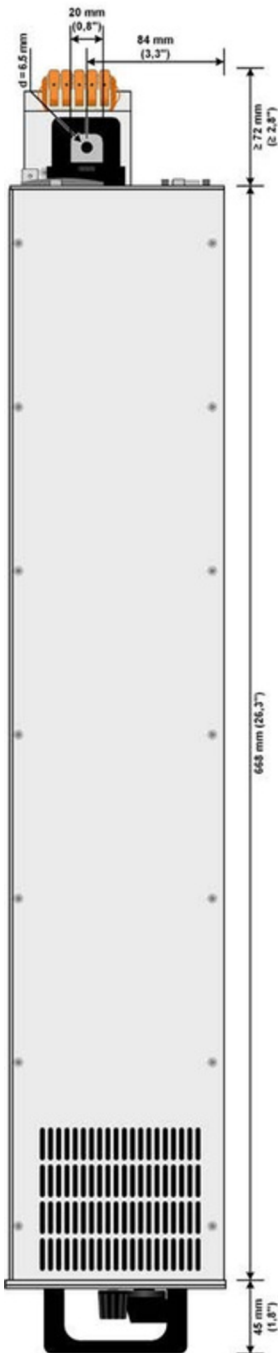
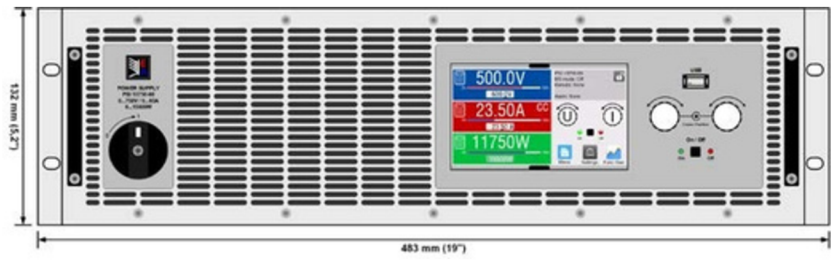
## Solar Array Simulation

The PSI 10000 series is an ideal tool for testing photovoltaic (PV) inverters. With simulation models based on EN 50530 and Sandia standards, users can replicate diverse solar panel conditions, including changes in irradiation, temperature, and panel technology. This capability allows for thorough testing of electrical features, including efficiency metrics. High-resolution 16-bit technology and rapid sampling rates ensure accuracy, while test results can be easily documented and saved, supporting comprehensive analysis and reporting.

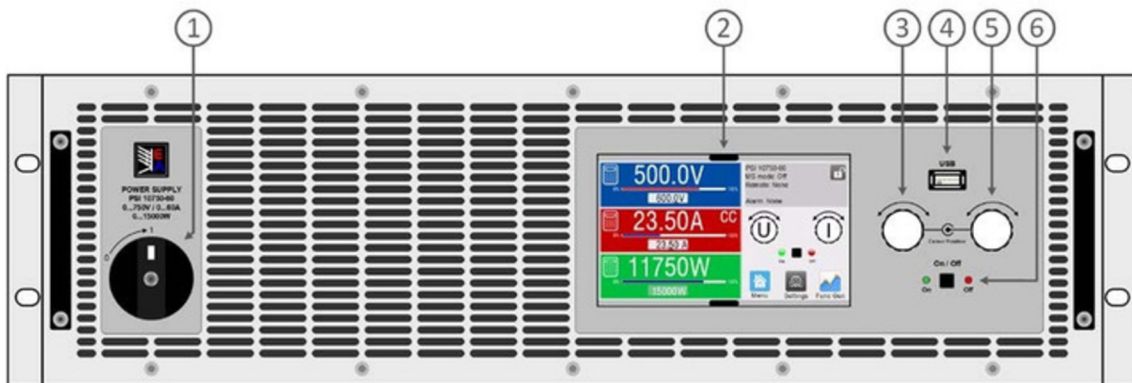
# Technical drawings PSI 10000 3U <200 V



# Technical drawings PSI 10000 3U >360 V

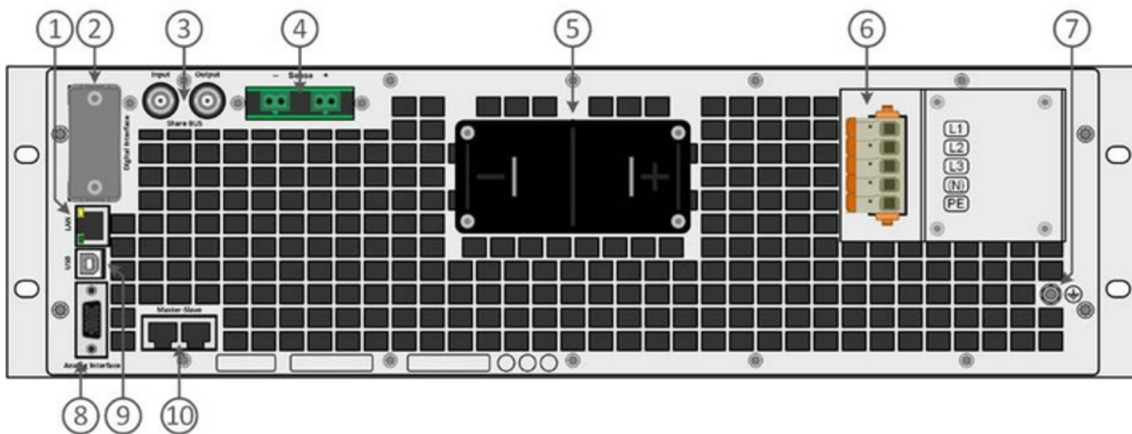


## Front panel description PSI 10000 3U



1. Main switch
2. TFT Control Interface, interactive operation and display
3. Rotary knob with push-button for settings and control
4. USB Host, use USB-stick for data logging and sequencing
5. Rotary knob with push-button for settings and control
6. On / Off push-button with LED status display

## Rear panel description PSI 10000 3U



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 output terminal (copper blades)
6. AC input connector
7. Grounding connection screw (PE)
8. Connector (DB15 female) for isolated analog programming, monitor and other functions
9. USB interface
10. Master-slave bus connectors to set up a system for parallel connection

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