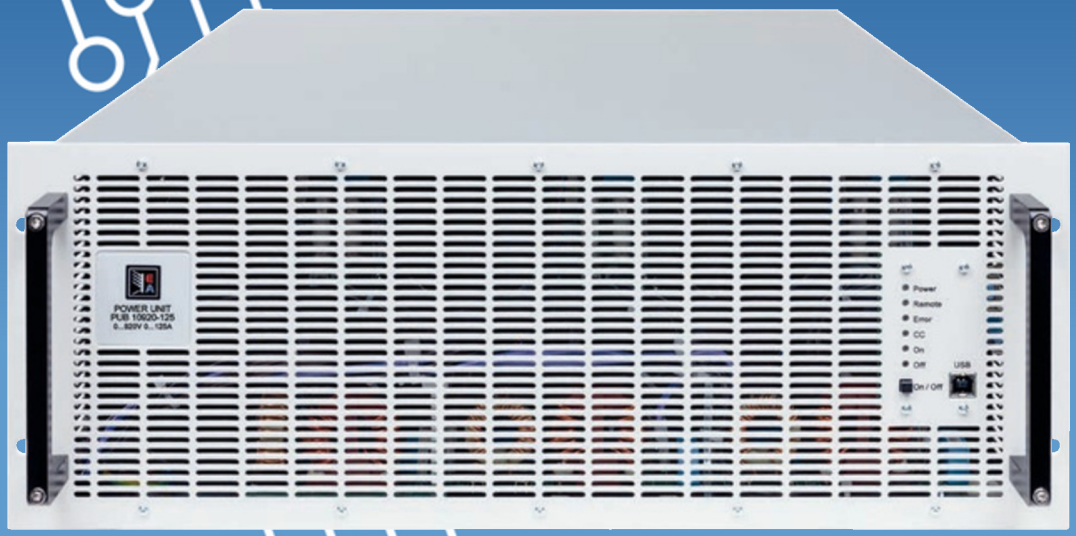


PUB 10000 4U

High-Performance Bidirectional Power for Demanding Applications | 30 kW

Wide Voltage and Current Range: Delivers 0–60 V to 0–2000 V and 0–40 A to 0–1000 A for unparalleled versatility.
High Efficiency: Regenerative energy recovery with efficiency exceeding 96%.
Scalable Power: Parallel operation for up to 3840 kW and 64,000 A with Master-Slave and Share Bus capabilities.
Advanced Control Interfaces: Built-in USB, Ethernet, and optional CAN, EtherCAT, and Modbus support.
Compact Design: 30 kW per 4U unit for optimized space utilization.

EA-PUB 10000 4U 30 kW

Programmable Bidirectional DC Power Supply

Features

- Wide range input: 208 V - 480 V, +10%, 3ph AC
- Active Power Factor Correction, typical 0.99
- Bidirectional power supply, 2-quadrants in source and sink
- In load operation, regenerative with energy recovery into the grid
- 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/input 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: Normal, Fast, Slow
- 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
- USB (front panel)
- 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
- Function generator

SPECIFICATIONS

AC Input

- **Voltage, Phases:** 380 V - 480 V ±10%, 3ph AC (208 V - 240 V ±10%, 3ph AC with derating to 18 kW)
- **Frequency:** 45 - 65 Hz
- **Power Factor:** ca. 0.99
- **Leakage Current:** <10 mA
- **Phase Current:** ≤56 A @ 400 V AC
- **Overvoltage Category:** 2

DC Output (static)

- **Load Regulation CV**: ≤0.05% FS (0 - 100% load, constant AC input voltage and constant temperature)
- **Line Regulation CV:** ≤0.01% FS (380 V - 480 V +10% AC input voltage, constant load and constant temperature)
- **Stability CV:** ≤0.02% FS (during 8h of operation, after 30 minutes warm-up, at constant AC input voltage, load, and temperature)
- **Temperature Coefficient CV:** ≤30 ppm/°C (after 30 minutes warm-up)
- **Compensation (Remote Sense):** ≤5% UNominal
- **Load Regulation CC:** ≤0.1% FS (0 - 100% load, constant AC input voltage and constant temperature)
- **Line Regulation CC:** ≤0.01% FS (380 V - 480 V +10% AC input voltage, constant load and constant temperature)
- **Stability CC:** ≤0.02% FS (during 8h of operation, after 30 minutes warm-up, at constant AC input voltage, load, and temperature)
- **Temperature Coefficient CC:** ≤50 ppm/°C (after 30 minutes warm-up)
- **Load Regulation CP:** ≤0.3% FS (0 - 100% load, constant AC input voltage and constant temperature)
- **Load Regulation CR:** ≤0.3% FS + 0.1% FS current (0 - 100% load, constant AC input 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:** ≤10 ms
- **Fall Time 90 - 10% CV:** ≤10 ms
- **Rise Time 10 - 90% CC:** ≤2 ms
- **Fall Time 90 - 10% CC:** ≤2 ms

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), USB front panel, all for communication
- **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%

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 A), CISPR 11 (Class A), FCC 47 CFR part 15B (Class A)
- **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 °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):** 19” x 4U x 668 mm
- **Weight:** 50 kg (110 lbs)
- **Weight with water cooling:** 56 kg (126 lbs)

Available Models

Parameter	PUB 10060-1000	PUB 10080-1000	PUB 10200-420	PUB 10360-240	PUB 10500-180
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)	≤25 mV (BWL 300 kHz)	≤40 mV (BWL 300 kHz)	≤55 mV (BWL 300 kHz)	≤70 mV (BWL 300 kHz)
Ripple in CV (pp)	≤320 mV (BWL 20 MHz)	≤320 mV (BWL 20 MHz)	≤300 mV (BWL 20 MHz)	≤320 mV (BWL 20 MHz)	≤350 mV (BWL 20 MHz)
UMin for IMax (sink)	0.62 V	0.62 V	1.8 V	2.5 V	1.1 V
Current Range	0 - 1000 A	0 - 1000 A	0 - 420 A	0 - 240 A	0 - 180 A
Power Range	0 - 30000 W	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	0.08 Ω - 170 Ω
Output Capacitance	25380 µF	25380 µF	5400 µF	1800 µF	675 µF
Efficiency (sink/source)	95.1%	95.5%	95.3%	95.8%	96.5%

Available Models

Parameter	PUB 10750-120	PUB 10920-125	PUB 11000-80	PUB 11500-60	PUB 12000-40
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)	≤250 mV (BWL 300 kHz)	≤300 mV (BWL 300 kHz)	≤400 mV (BWL 300 kHz)	≤500 mV (BWL 300 kHz)
Ripple in CV (pp)	≤800 mV (BWL 20 MHz)	≤1200 mV (BWL 20 MHz)	≤1600 mV (BWL 20 MHz)	≤2400 mV (BWL 20 MHz)	≤3000 mV (BWL 20 MHz)
UMin for IMax (sink)	1.2 V	2 V	3.4 V	3.2 V	3.7 V
Current Range	0 - 120 A	0 - 125 A	0 - 80 A	0 - 60 A	0 - 40 A
Power Range	0 - 30000 W	0 - 30000 W	0 - 30000 W	0 - 30000 W	0 - 30000 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	100 µF	200 µF	75 µF	50 µF
Efficiency (sink/source)	96.5%	96.5%	95.8%	96.5%	96.5%

General

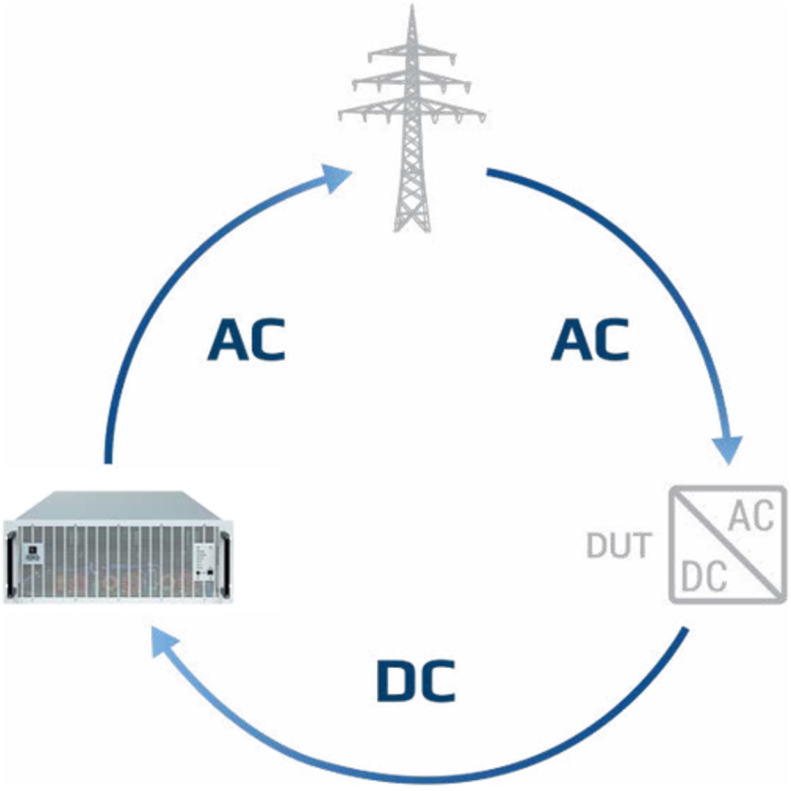
The PUB 10000 4U series is a cutting-edge bidirectional DC power supply designed for versatility and efficiency. Operating as both a power source and a regenerative electronic load, it redefines energy management by returning up to 96% of the energy consumed back into the grid. With its adaptable input range and three-phase operation, this device is compatible with almost any global mains voltage. Its wide output spectrum spans voltages from 0–60 V to 0–2000 V and currents from 0–40 A to 0–1000 A, delivering maximum flexibility in a single, compact 4U unit. Engineers can scale performance by linking up to 64 devices for an astounding 3840 kW and 64,000 A system, simplifying high-power applications and reducing setup costs.

AC Connection

Equipped with an advanced Active Power Factor Correction (PFC), the PUB 10000 4U ensures minimal energy waste and maximum efficiency, keeping energy costs in check. Its broad input range of 208–480 V across three phases makes it ideal for global use. Even in regions with varying power standards, this device operates seamlessly, providing consistent, reliable performance.

Energy Recovery

Designed with sustainability and cost savings in mind, the PUB 10000 4U uses regenerative technology to feed energy back into the grid with efficiencies of up to 96%. By converting load energy into reusable power, this solution minimizes heat generation, reducing the need for costly air conditioning. This efficiency translates directly into lower operating costs, making it a smart investment for labs and industries alike.



The Principle of Energy Recovery

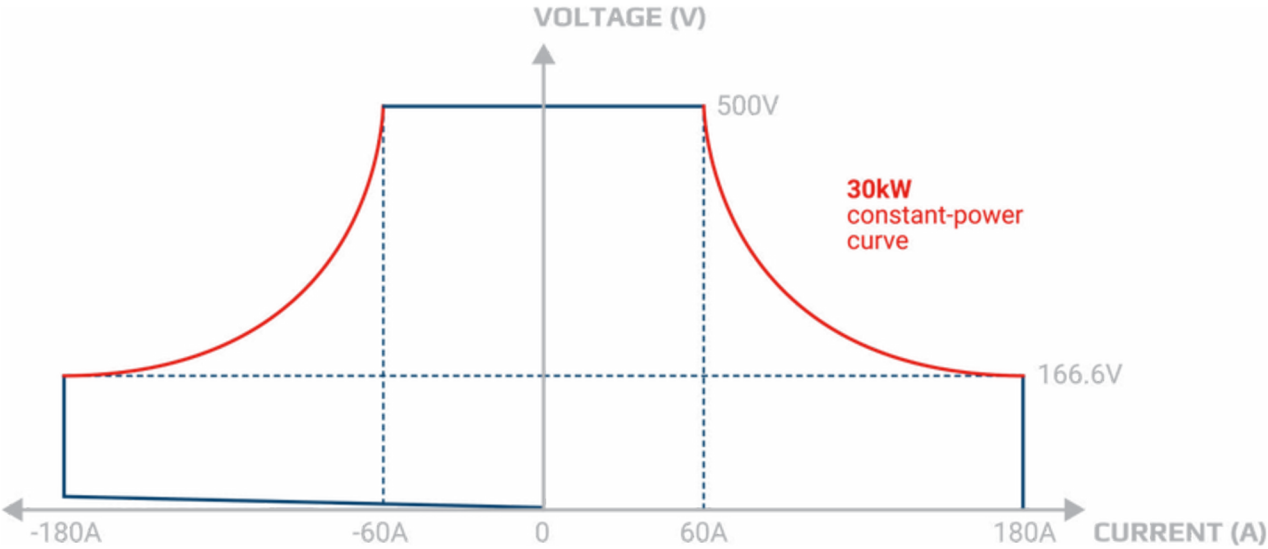
The PUB 10000 4U exemplifies energy efficiency in action. In a typical application, the device under test draws energy from the mains, converts it to DC, and feeds it into the PUB 10000. The power supply then returns the energy as AC back to the grid. This bidirectional capability minimizes energy waste, significantly reducing both costs and environmental impact.

DC Output

The PUB 10000 4U delivers a bidirectional DC output with voltages ranging from 0–60 V to 0–2000 V and currents from 0–40 A to 0–1000 A. Its autoranging design provides a wide range of working conditions, allowing engineers to handle multiple testing and operational scenarios with a single device. The result is improved efficiency, reduced downtime, and significant cost savings.

DC Connection

The DC output connection is designed for simplicity and reliability, utilizing robust copper rails at the rear of the device. For higher performance needs, multiple units can be effortlessly linked in parallel using vertical copper rails, ensuring scalability without extensive modifications. Protective covers enhance safety, maintaining a clean and secure setup.



The Principle of Autoranging

With autoranging, the PUB 10000 4U offers unparalleled flexibility by dynamically adjusting voltage and current to maintain full power across a broad operating range. This eliminates the need for multiple units to accommodate different voltage and current requirements, streamlining workflows and reducing equipment costs.

Interfaces

Standard interfaces, including USB and Ethernet, along with galvanically isolated analog ports, provide seamless control and monitoring. With optional interfaces like CAN, RS232, and EtherCAT, the PUB 10000 4U integrates effortlessly into modern automation systems. Its configurable analog interface supports input and output for voltage, current, power, and resistance, ensuring precise operation for diverse applications.

High-Performance Systems

The PUB 10000 4U series is engineered to meet the demands of high-power applications with systems capable of delivering up to 1920 kW. By connecting multiple units in parallel using vertical copper rails, a 19” cabinet can house up to 300 kW, occupying minimal floor space. With the Master-Slave Bus, up to 13 cabinets (64 units) can be synchronized to operate as a single cohesive system. This flexibility makes the PUB 10000 4U ideal for large-scale industrial setups, providing unmatched power density and operational efficiency.

Master-Slave-Bus and Share-Bus

The Master-Slave Bus and Share Bus systems ensure seamless integration of multiple units, enabling them to function as a unified device. The Master-Slave Bus aggregates total power and current data, displaying them clearly on the master unit, while also managing warnings and alarms from all connected devices. The Share Bus ensures balanced load distribution across units, enhancing reliability and extending the lifespan of the system. These features simplify large-scale power solutions, providing engineers with efficient and reliable power management tools.

Example Representation

A fully assembled and operational 240 kW system.

Applications

Battery Test for Electro Mobility

The PUB 10000 4U series is optimized for testing the electrical characteristics of batteries across various applications, including cell, module, and pack testing. It supports State-of-Health (SOH) assessments for second-life classification and End-of-Line (EOL) testing with precise measurement and reproducibility. These capabilities ensure reliable data collection for automated or integrated battery testing setups. With efficiencies exceeding 96%, the PUB 10000 4U significantly reduces operational costs while delivering unmatched performance for energy storage systems.

Battery Simulation

Simulating batteries as single cells, modules, or packs is another strength of the PUB 10000 4U. This feature aids in optimizing energy storage systems and testing connected components. Its advanced protection mechanisms, including overcurrent and voltage monitoring, ensure safe and controlled testing environments. With precise simulation capabilities, engineers can rely on reproducible results for component evaluation and system configuration.

Fuel Cell Test

The PUB 10000 4U is ideal for testing the electrical characteristics of fuel cells, stacks, and systems. Its high precision and reproducibility support resistance, performance, and durability testing while maintaining energy efficiency through its regenerative feedback capabilities. For higher currents required in fuel cell system testing, multiple devices can be connected in parallel, ensuring consistent accuracy and performance in scalable setups.

On-Board Charger Test

Testing on-board chargers requires dynamic and flexible systems capable of adapting to various electrical conditions. The PUB 10000 4U series delivers precise sequencing and logging functions, allowing engineers to collect and export reproducible test data. Adjustable voltage regulation speeds (Normal, Fast, Slow) prevent competition between control loops, ensuring accurate results for on-board charger testing scenarios.

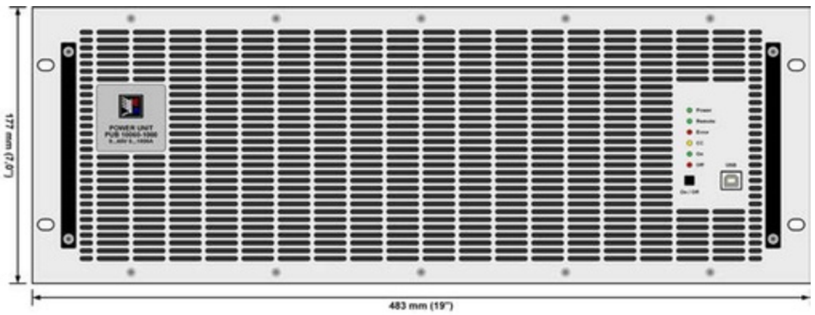
Solar Array Simulation

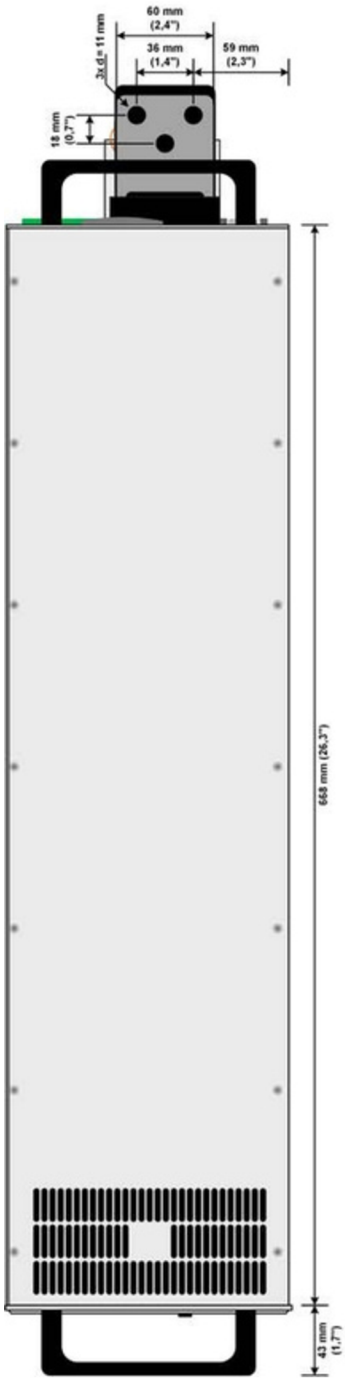
The PUB 10000 4U is highly effective for testing photovoltaic (PV) inverters, simulating solar panel conditions, and adhering to standards such as EN 50530 and Sandia models. Its ability to adjust parameters like irradiation, panel technology, and temperature enables detailed efficiency testing of PV inverters. With 16-bit resolution and high sampling rates, the system ensures accurate results that can be documented for analysis, meeting the needs of solar energy developers.

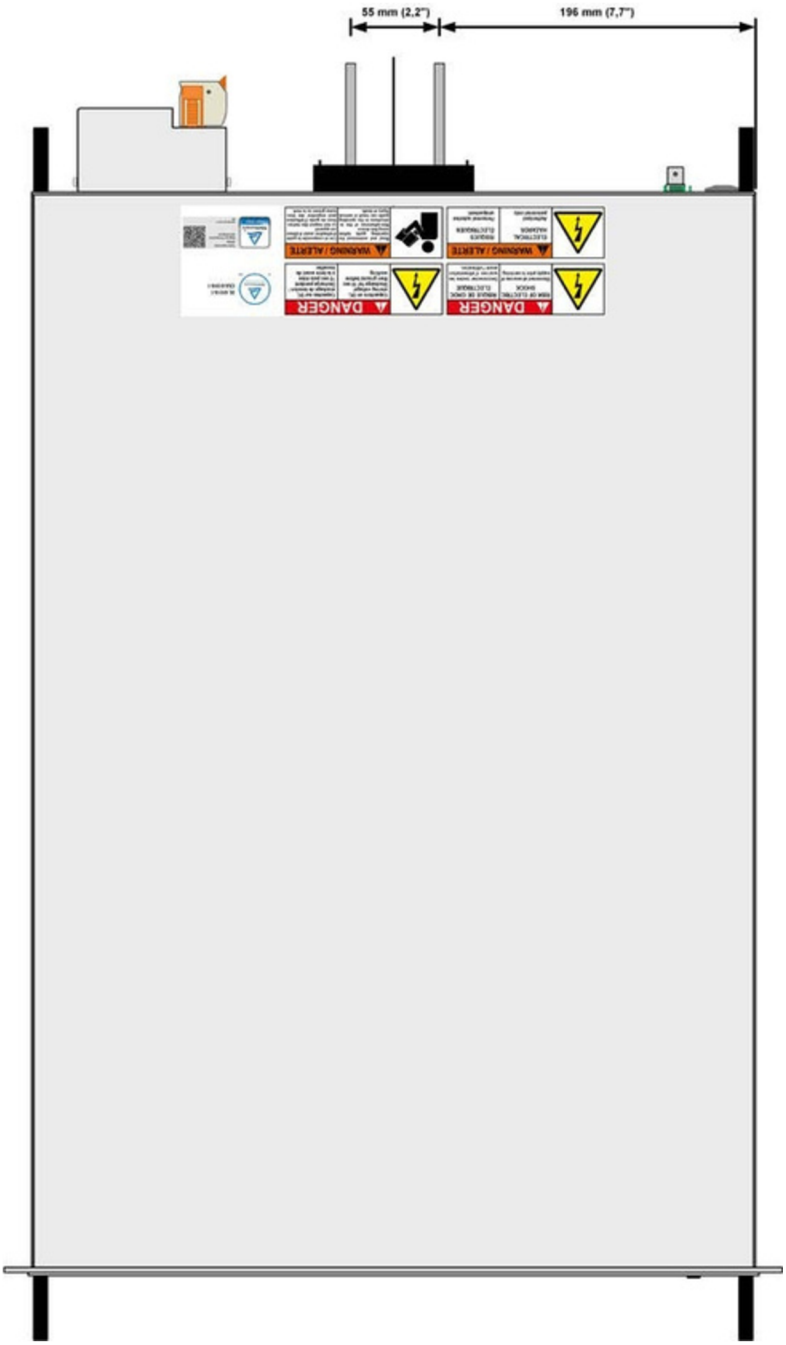
Battery Recycling

The PUB 10000 4U facilitates cost-effective battery recycling through efficient discharge capabilities. Its autoranging feature ensures maximum discharge currents even at low voltages, enabling thorough battery pack evaluation. The device also feeds energy back into the grid with over 96% efficiency, reducing energy costs while ensuring safe and effective recycling processes.

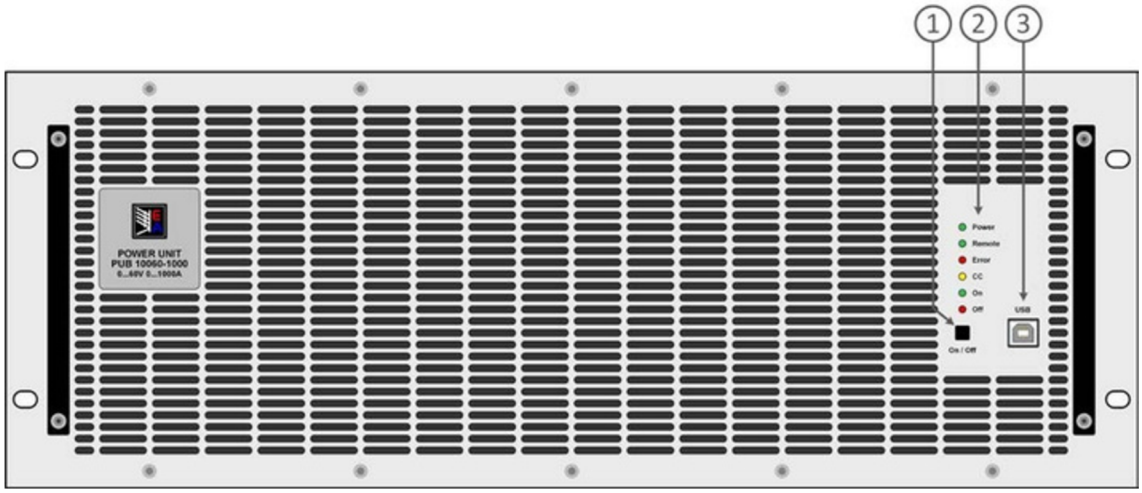
Technical drawings PUB 10000 4U <200 V





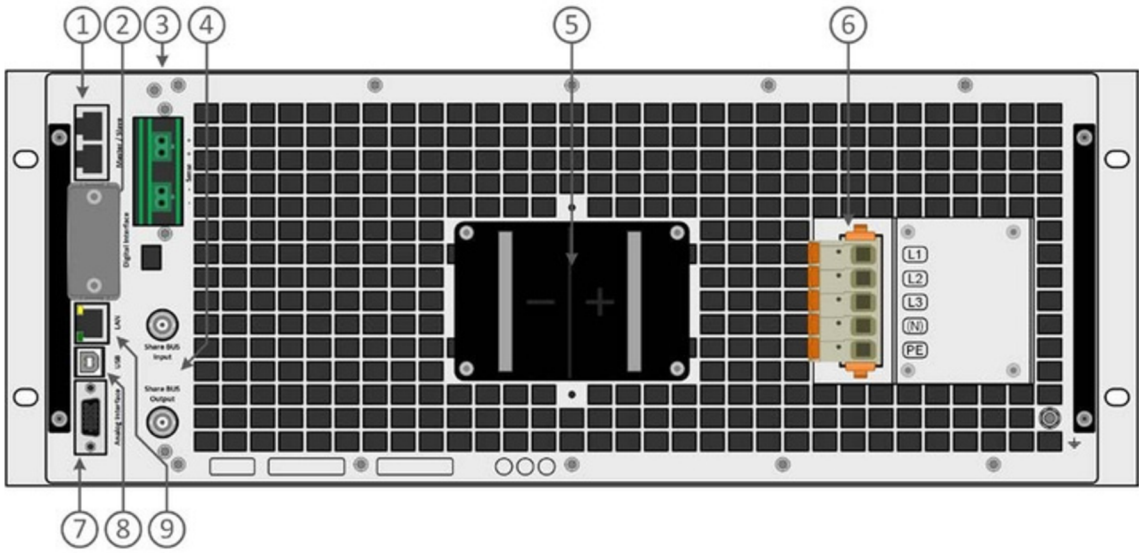


Front panel description PUB 10000 4U



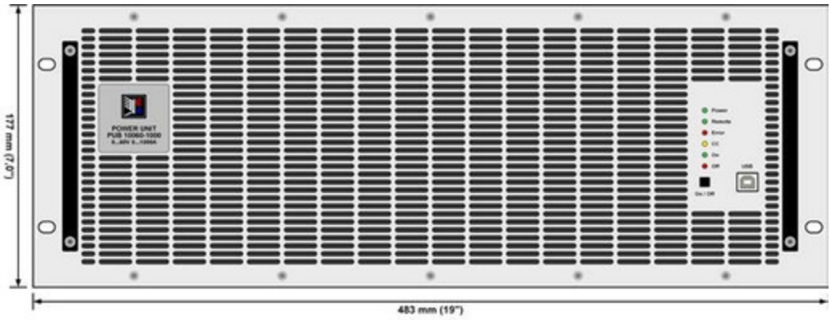
1. On / Off push-button
2. LED status display
3. USB Interface

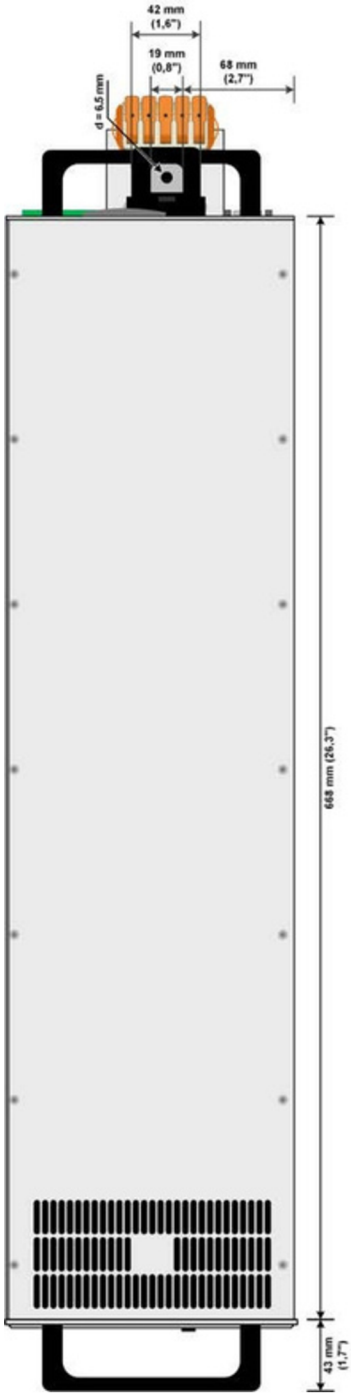
Rear panel description PUB 10000 4U <200 V

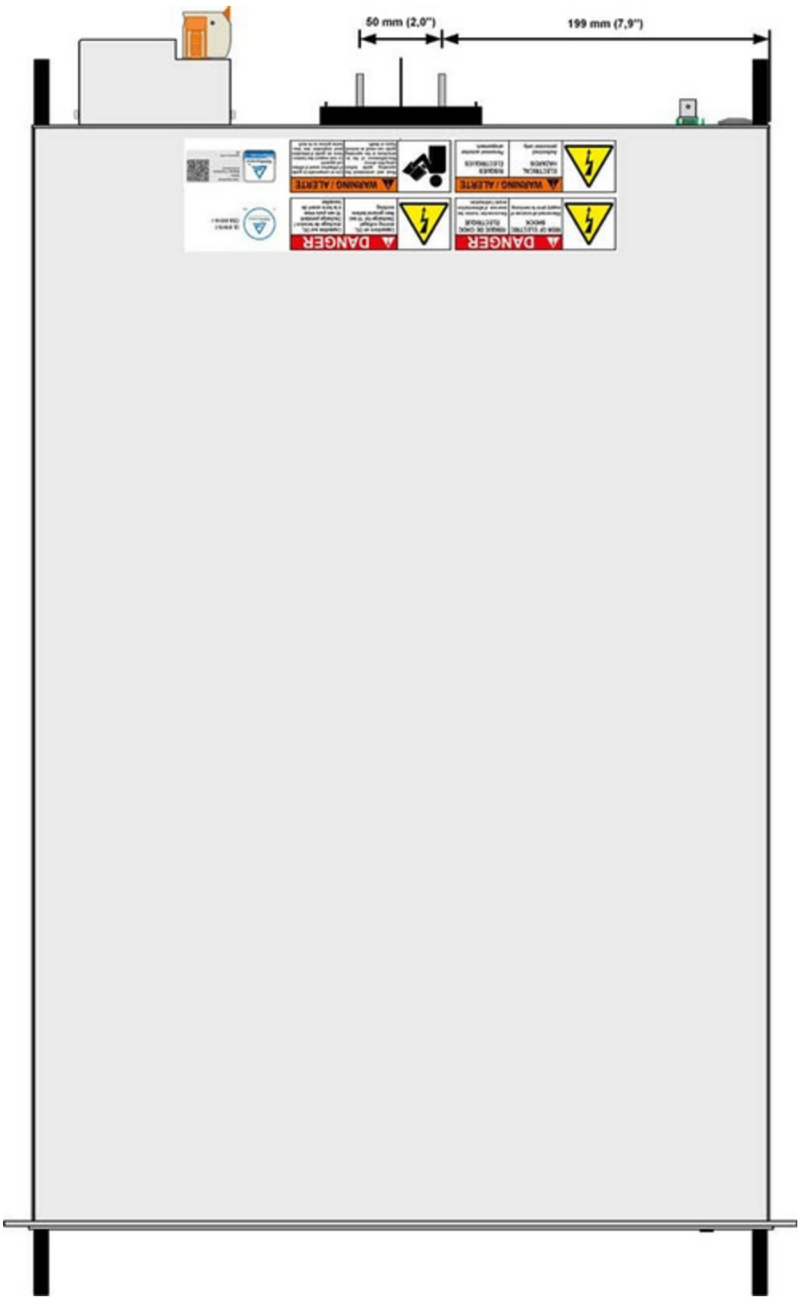


1. Master-Slave-Bus connectors to set up a system for parallel connection
2. Slot for interfaces
3. Remote sense connectors
4. Share bus connectors to set up a system for parallel connection
5. DC output connector (copper blades)
6. AC input connector
7. Connector (DB15 female) for isolated analog programming,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

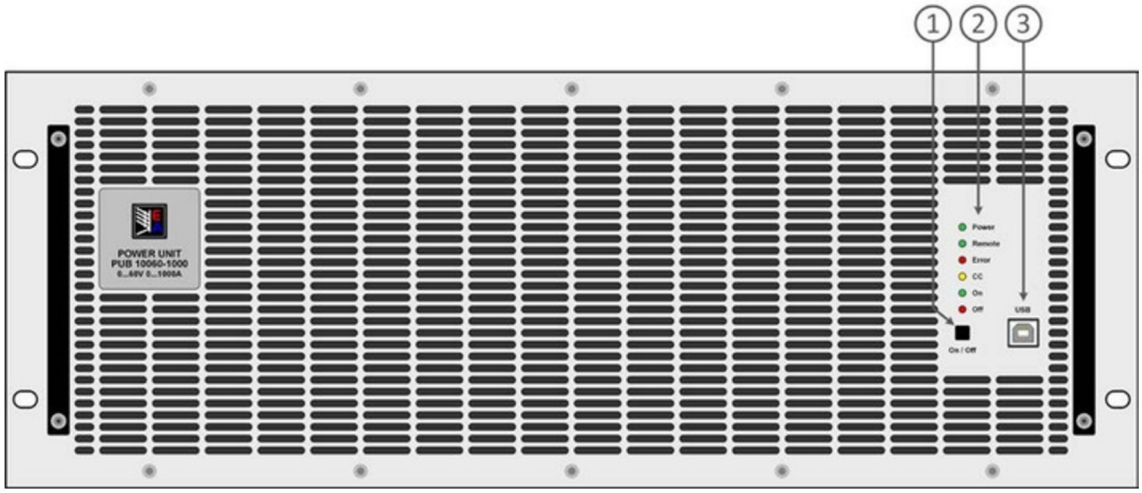
Technical drawings PUB 10000 4U >360 V





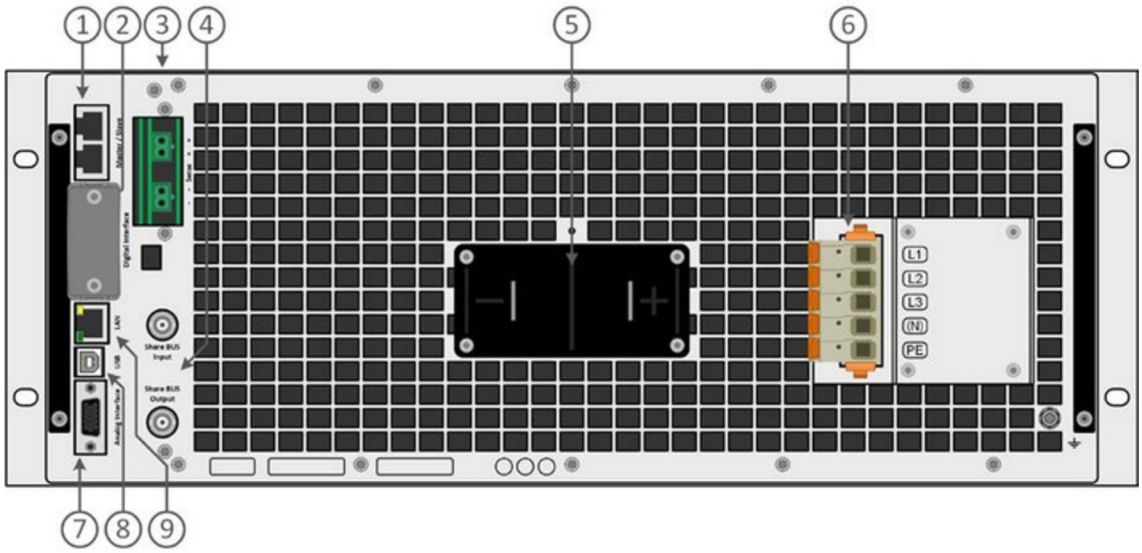


Front panel description PUB 10000 4U



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

Rear panel description PUB 10000 4U >360 V

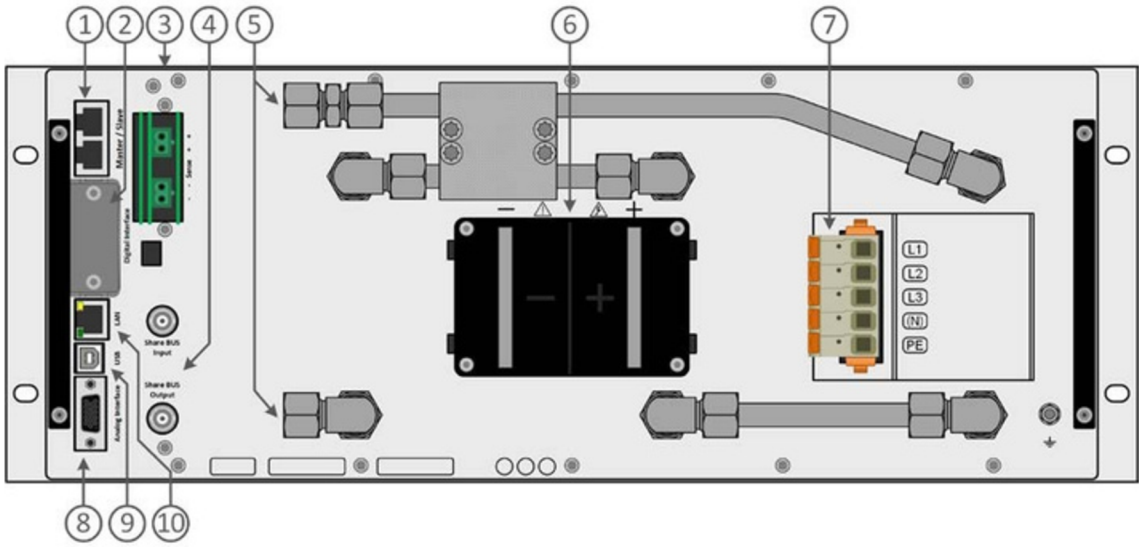


1. Master-Slave-Bus connectors to set up a system for parallel connection
2. Slot for interfaces
3. Remote sense connectors
4. Share bus connectors to set up a system for parallel connection
5. DC output connector (copper blades)
6. AC input connector
7. Connector (DB15 female) for isolated analog programming,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

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

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

Rear panel description PUB 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

W5 Engineering
Phone: (971) 244-8200
Email: help@W5engineering.com
www.W5enginnering.com/eapowered

EA Elektro-Automatik Inc.
9845 Via Pasar
San Diego, CA 92126 USA