60 kW

PUB 10000 6U

Bidirectional Power and Unmatched Efficiency for Demanding Applications | 60 kW

Bidirectional Operation: Functions as both a power supply and a regenerative electronic load with energy recovery efficiency of up to 96%.
High Power Capability: Delivers up to 60 kW per unit, with scalability for parallel operation up to 3840 kW.
Flexible Autoranging Output: Provides dynamic voltage and current combinations, supporting a wide range from 0–60 V to 0–2000 V and currents up to 480 A.
Advanced Connectivity: Includes built-in USB, Ethernet, and analog interfaces, with optional industrial protocols such as CAN, Modbus, and Profinet.
Compact and Efficient Design: Features high energy efficiency, reduced heat generation, and space-saving 6U chassis for versatile installation.

EA-PUB 10000 6U 60 kW

Programmable bidirectional DC power supply

Features

- Wide range input: 380 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 60 kW per unit
- Voltages from 0 - 360 V up to 0 - 2000 V
- Currents from 0 - 80 A up to 0 - 480 A
- Flexible power regulated DC output/input stage (autoranging)
- Regulation modes CV, CC, CP, CR with fast crossover
- Digital regulation, high resolution with 16 Bit ADCs and DACs, selection of voltage controller 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 all power classes in the 10000 series
- 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
- Function generator

SPECIFICATIONS

AC Input

- **Voltage, Phases:** 380 V - 480 V ±10%, 3ph AC
- **Frequency:** 45 - 65 Hz
- **Power Factor:** ca. 0.99
- **Leakage Current:** <10 mA
- **Phase Current:** ≤110 A @ 400 V AC
- **Overvoltage Category:** 3

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 6U x 668 mm
- **Weight:** 76 kg (168 lbs)
- **Weight with water cooling:** 82 kg (180 lbs)

Available Models

Specification	PUB 10360-480	PUB 10500-360	PUB 10750-240	PUB 10920-250	PUB 11000-160	PUB 11500-120	PUB 12000-80
Voltage Range (V)	0 - 360 V	0 - 500 V	0 - 750 V	0 - 920 V	0 - 1000 V	0 - 1500 V	0 - 2000 V
Ripple in CV (rms) (mV BW 300 kHz)	≤55 mV	≤70 mV	≤200 mV	≤250 mV	≤300 mV	≤400 mV	≤500 mV
Ripple in CV (pp) (mV BW 20 MHz)	≤320 mV	≤350 mV	≤800 mV	≤1200 mV	≤1600 mV	≤2400 mV	≤3000 mV
UMin for IMax (sink) (V)	2.5 V	1.1 V	1.2 V	2 V	3.4 V	3.2 V	3.7 V
Current Range (A)	0 - 480 A	0 - 360 A	0 - 240 A	0 - 250 A	0 - 160 A	0 - 120 A	0 - 80 A
Power Range (W)	0 - 60000 W	0 - 60000 W	0 - 60000 W	0 - 60000 W	0 - 60000 W	0 - 60000 W	0 - 60000 W
Resistance Range (Ω)	0.025 - 45 Ω	0.04 - 85 Ω	0.1 - 185 Ω	0.125 - 275 Ω	0.2 - 325 Ω	0.4 - 750 Ω	0.85 - 1350 Ω
Output Capacitance (µF)	3480 µF	1560 µF	765 µF	465 µF	387 µF	173 µF	85 µF
Efficiency (sink/source up to, %)	95.8%	96.5%	96.5%	96.5%	95.8%	96.5%	96.5%
Negative DC Pole to PE (V)	±1000 V	±1500 V	±1500 V	±1500 V	±1500 V	±1500 V	±1500 V
Positive DC Pole to PE (V)	+1000 V	+2000 V	+2000 V	+2000 V	+2000 V	+2000 V	+2000 V
Article Number (Standard)	01123011	01123012	01123013	01123014	01123015	01123016	01123017
Article Number (Standard + Water Cooling)	01563001	01563002	01563003	01563004	01563005	01563006	01563007

General

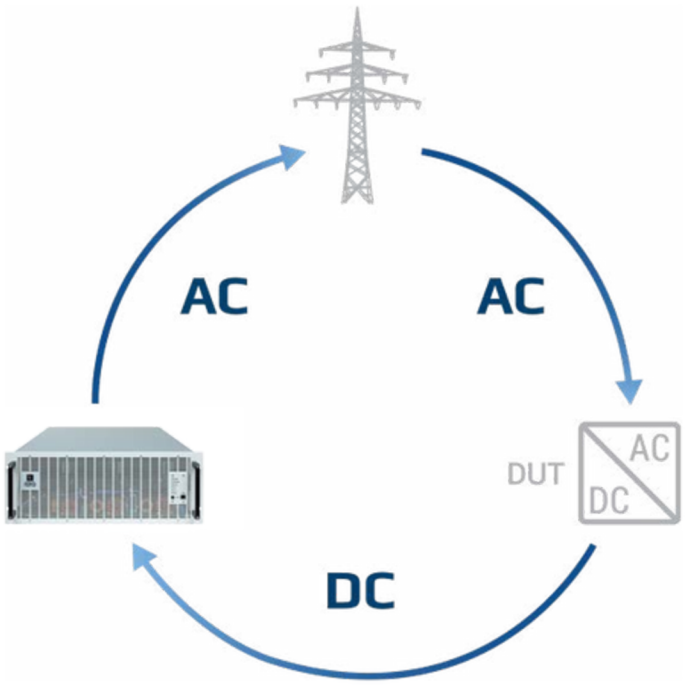
The PUB 10000 series represents cutting-edge bidirectional DC power supplies that excel in delivering high efficiency and versatility. These devices operate as both a power source and an electronic load, with energy recovery capabilities of up to 96% efficiency, reducing both energy consumption and heat output. Designed with global compatibility, their wide input voltage range allows operation on nearly all international mains grids. With autoranging output, these power supplies dynamically adapt to various voltage and current needs, offering unparalleled flexibility for diverse applications.

Energy Recovery

With advanced regenerative capabilities, the PUB 10000 series efficiently returns energy to the grid during load operations, achieving up to 96% efficiency. Unlike traditional systems that dissipate energy as heat, these devices significantly reduce cooling requirements and energy costs. This innovation supports cost-effective and environmentally friendly operation, making them ideal for high-performance industrial settings.

AC Connection

Equipped with active power factor correction (PFC), the PUB 10000 series achieves optimal efficiency while maintaining low energy consumption. These devices support a wide input voltage range of 380–480 V, 3-phase, enabling seamless operation across global power standards. This versatility ensures reliable performance for applications demanding consistent and robust power delivery.



The principle of energy recovery

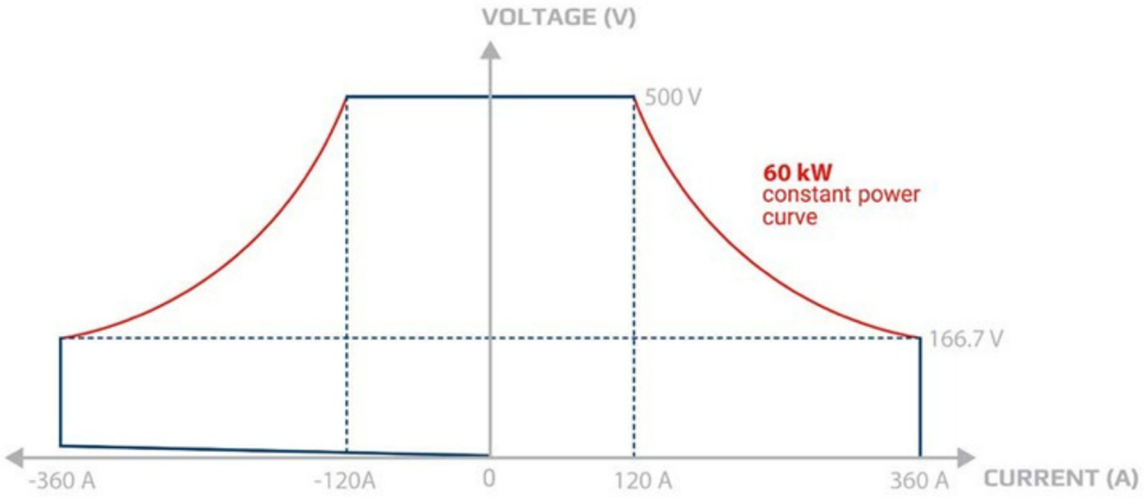
The energy recovery mechanism illustrates how the PUB 10000 series handles energy conversion and recycling. During operation, a device under test (DUT) draws energy from the mains, which is converted into DC power and fed into the PUB 10000 device. The power supply then regenerates this energy back into an AC current, returning it to the grid with minimal loss. This process not only enhances operational efficiency but also reduces environmental impact.

DC Output

The DC output of the PUB 10000 series offers unparalleled flexibility, delivering voltages from 0–360 V to 0–2000 V and currents up to 480 A. As a two-quadrant device, it supports both sourcing and sinking modes, adapting seamlessly to a variety of applications. The advanced autoranging output stage ensures optimal performance, offering a wide voltage, current, and power range that extends far beyond traditional fixed-range power supplies.

DC Connection

The PUB 10000 series features robust DC connections designed for simplicity and scalability. Copper rails at the rear of the device enable efficient and secure power delivery. For higher power systems, multiple devices can be connected in parallel using vertical copper rails, allowing for easy system expansion. A protective cover ensures user safety during operation.



The principle of autoranging

The PUB 10000 series employs autoranging technology, a powerful feature that dynamically adjusts voltage and current levels to maintain full power across a wide operating range. This eliminates the need for multiple power supplies for different applications, enabling engineers to use a single device to achieve multiple voltage and current combinations with maximum efficiency and flexibility.

Interfaces

The PUB 10000 series comes equipped with galvanically isolated interfaces to ensure safe and reliable operation. Standard features include USB, Ethernet, and an analog interface that supports input and output control for voltage, current, power, and resistance. Additional optional industrial interfaces such as CAN, Profinet, and Modbus provide seamless integration into complex systems. These features make the PUB 10000 series adaptable to a wide range of applications and environments.

High-Performance Systems

The PUB 10000 series is engineered to meet the power demands of the most intensive applications, supporting systems of up to 3840 kW. Utilizing vertical copper rails for parallel connections, multiple units can be integrated seamlessly to create compact, high-power configurations. For example, a 19” cabinet with 42U height can house up to 300 kW, occupying just 0.6 m² (6.5 sqft) of floor space. The Master-Slave Bus allows up to 13 cabinets and 64 units (each with 60 kW) to operate as a single synchronized system, offering unmatched scalability and reliability for industrial and research environments.

Master-Slave-Bus and Share-Bus

With the Master-Slave Bus and Share-Bus, the PUB 10000 series transforms multi-unit systems into cohesive, unified power solutions. The Master-Slave Bus facilitates centralized control, displaying aggregated system data like total power and current on the master device. Additionally, warnings and alarms from slave units are displayed clearly on the master interface, simplifying monitoring. The Share-Bus ensures balanced load distribution across all connected devices, maximizing efficiency and extending the operational life of the system.

Example Representation

A fully assembled and operational 240 kW system.

Applications

Fuel Cell Test

The PUB 10000 series delivers precise and reproducible results when testing the electrical characteristics of fuel cells, stacks, and systems. Its advanced technology allows for efficient evaluation of resistance, performance, and lifecycle parameters. These devices integrate seamlessly into automated test systems, ensuring cost-effective operation with high energy recovery efficiency. When higher current is required for testing large-scale fuel cell systems, the master-slave configuration maintains accuracy while scaling performance.

On-board Charger Test

For testing on-board chargers (OBCs), the PUB 10000 series offers a flexible and comprehensive solution. It accommodates various testing conditions, providing dynamic sequencing and logging features for capturing and exporting accurate data. With the EA-Power Control software, test parameters are recorded to ensure repeatable, precise results. Adjustable voltage regulation speeds—Normal, Fast, and Slow modes—allow the system to align with the control loop characteristics of the DUT, preventing operational conflicts and ensuring smooth testing.

Solar Array Simulation

The PUB 10000 series excels at simulating solar panel conditions for PV inverter testing. Users can access simulation models compliant with EN 50530 or Sandia standards, accommodating diverse panel types and environmental variables like irradiation, temperature, and panel technology. With its 16-bit resolution and high sampling rate, the series ensures precision in assessing inverter efficiency and other electrical parameters, with results that can be documented for further analysis.

Battery Recycling

Optimized for battery recycling operations, the PUB 10000 series supports state-of-health (SOH) assessments and efficient energy recovery. By enabling a comprehensive discharge process with high current and low voltage capabilities, the system ensures maximum energy utilization. Its energy recovery efficiency of up to 96% minimizes operational costs and enhances sustainability. The device's autoranging capabilities further ensure flexibility across a wide range of battery types and conditions.

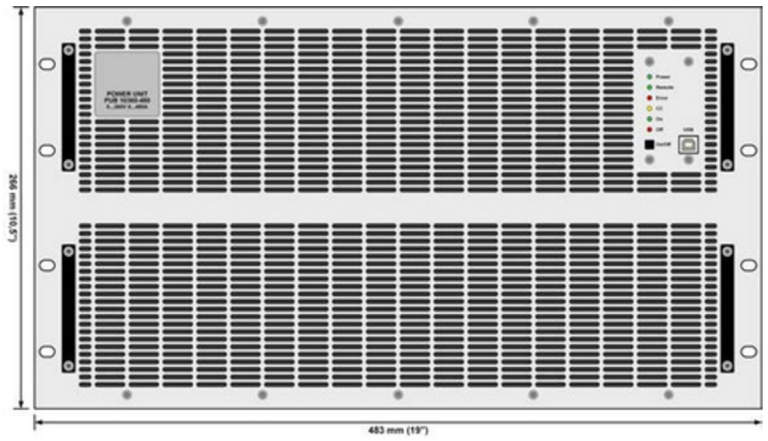
Battery Simulation

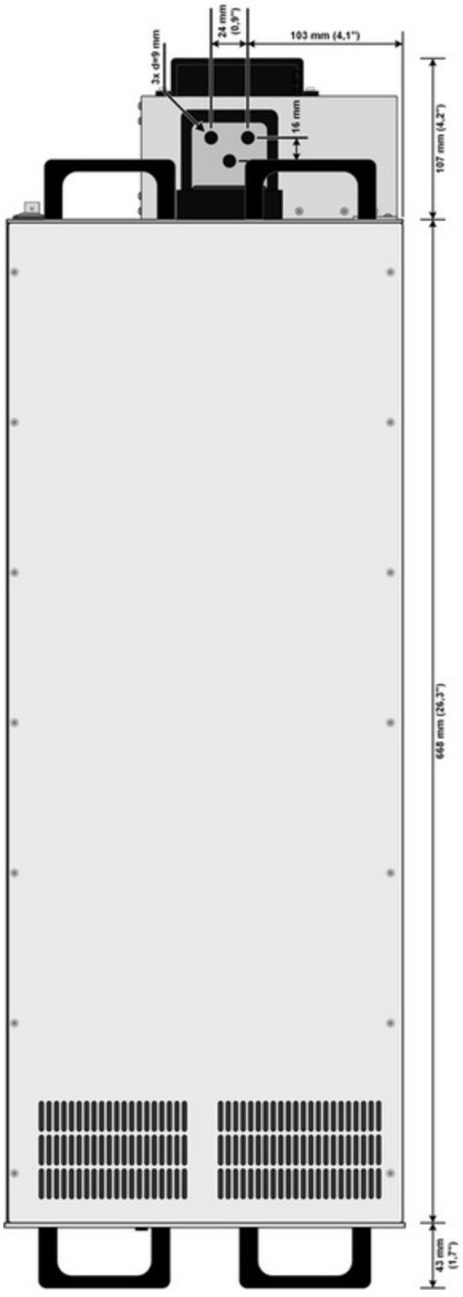
The PUB 10000 series is an ideal solution for battery simulation, enabling engineers to replicate the behavior of real batteries under various operating conditions. Its high dynamic response and precise control allow for accurate simulation of charge and discharge cycles, accommodating a wide range of battery chemistries and capacities. This functionality is particularly valuable for testing battery management systems (BMS) and other components reliant on accurate voltage and current simulation. The system's energy recovery capabilities further enhance efficiency, minimizing energy loss during extended simulation scenarios.

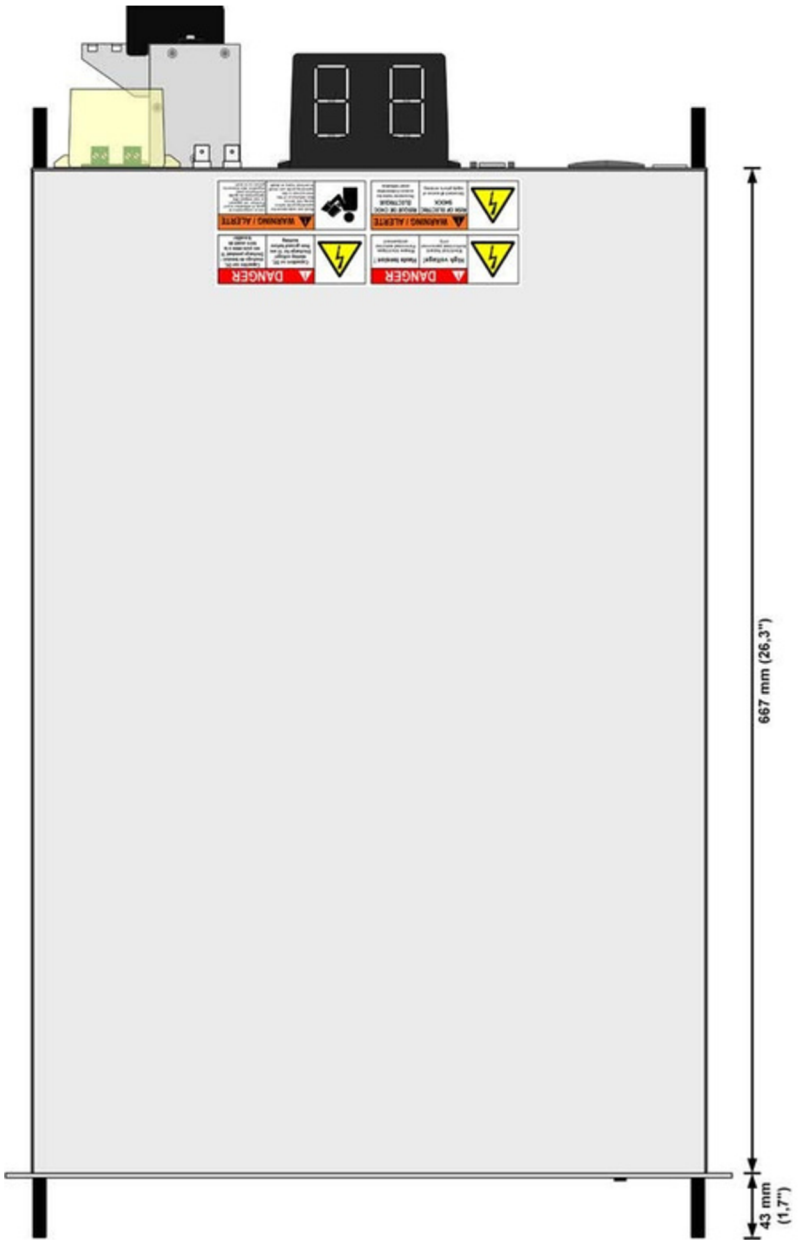
Battery Test for Electro Mobility

The PUB 10000 series is specifically tailored to support the rigorous testing demands of electric vehicle (EV) batteries. With its ability to deliver high currents and voltages, it ensures accurate assessment of battery performance under real-world conditions. The system supports comprehensive testing, including capacity analysis, state-of-health evaluation, and cycle life testing, ensuring batteries meet the highest standards of reliability and efficiency. By combining bidirectional operation with 96% energy recovery efficiency, the PUB 10000 series minimizes testing costs and aligns with sustainability goals, making it an essential tool for advancing electromobility.

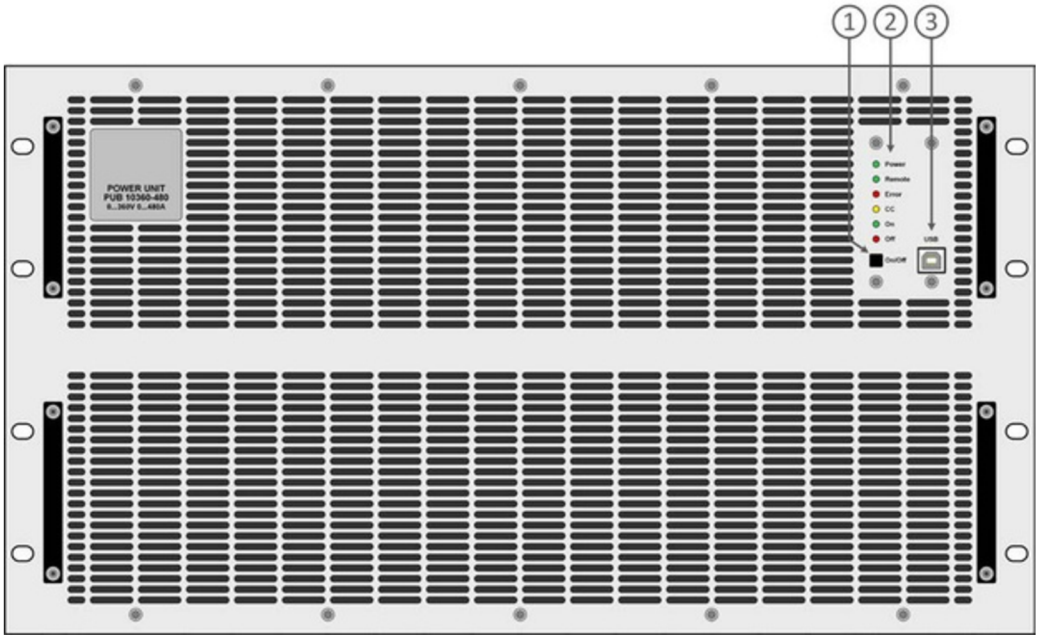
Technical drawings PUB 10000 6U





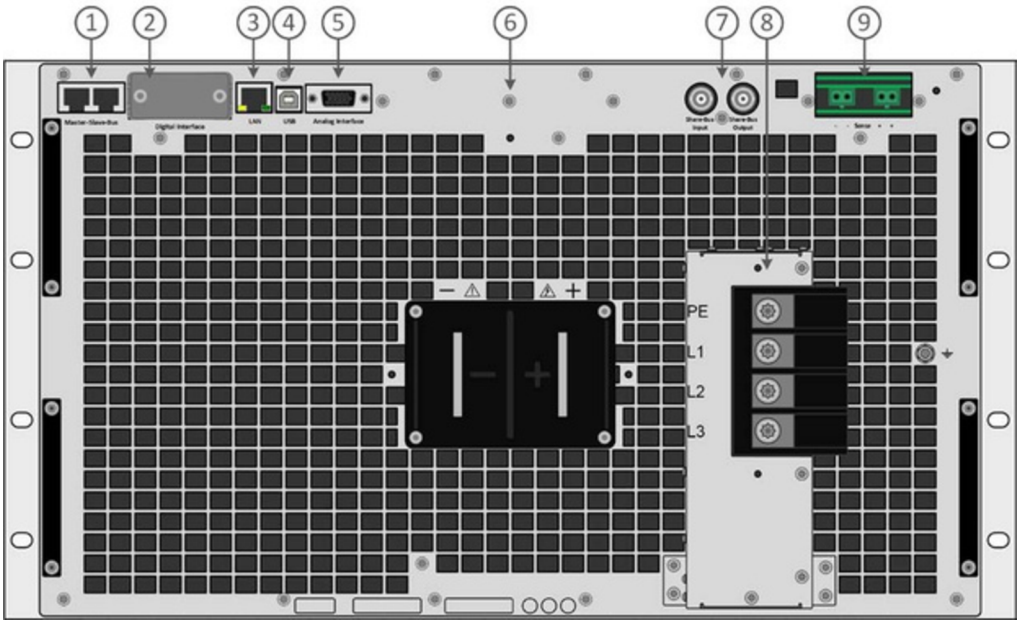


Front panel description PUB 10000 6U



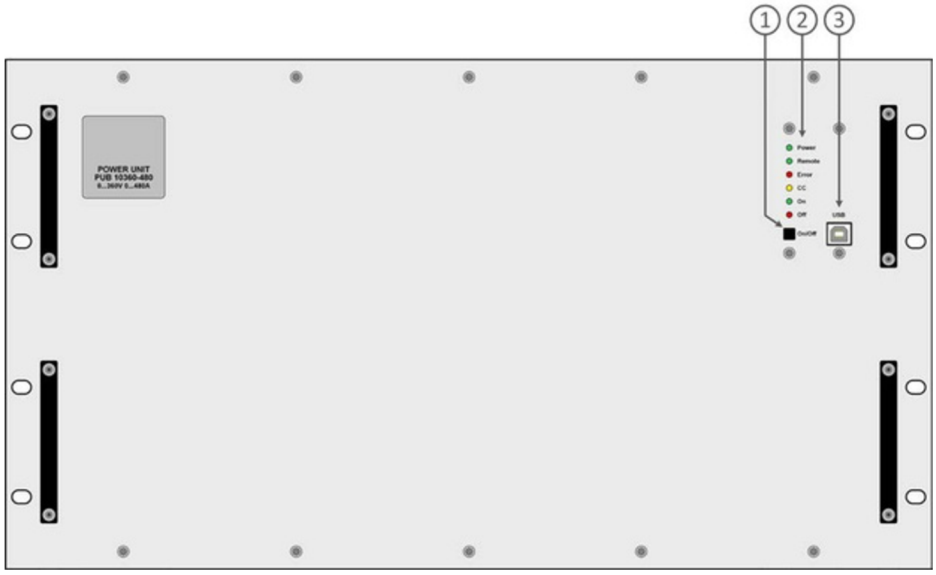
1. On / Off push-button
2. LED status display
3. USB Interface

Rear panel description PUB 10000 6U



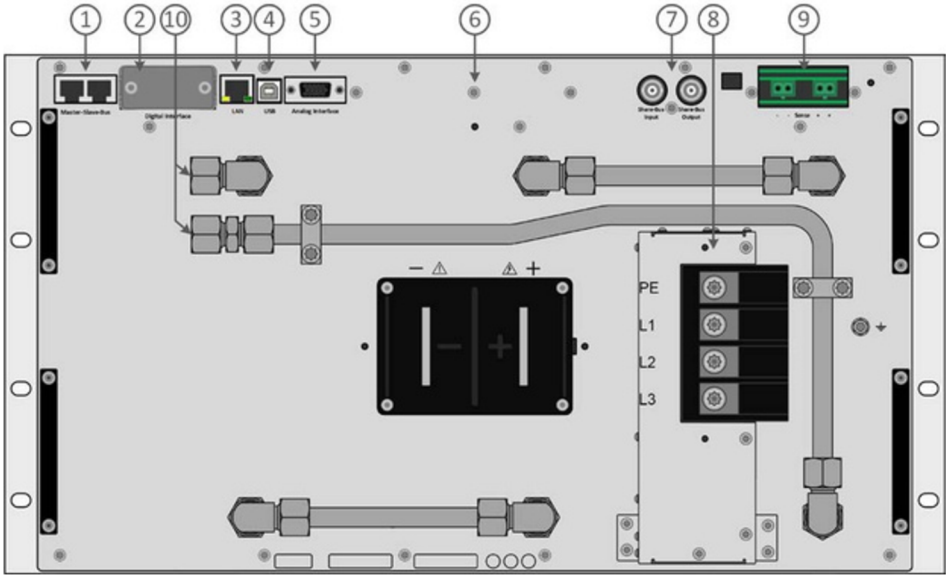
1. Master-Slave-Bus connectors to set up a system for parallel connection
2. Slot for interfaces
3. Ethernet interface
4. USB interface
5. Connector (DB15 female) for isolated analog programming, monitoring and other functions
6. DC output connector (copper blades)
7. Share-Bus connectors to set up a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

Front panel description PUB 10000 6U WC (water cooling option)



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

Rear panel description PUB 10000 6U WC (water cooling option)



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

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