



Elektro-Automatik



DATASHEET

EA-PSBE 10000 3U

Programmable Bidirectional
DC-Power Supply

EA-PSBE 10000 3U

5 KW - 10 KW - 15 KW

Programmable Bidirectional
DC-Power Supply



Features

- Wide range input, 208 V - 480 V \pm 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 up to over 96 %
- High performance of up to 15 kW per unit
- Voltage from 0 - 10 V up to 0 - 2000 V
- Currents from 0 - 20 A up to 0 - 510 A
- Flexible power regulated DC input/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
- 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

Technical data

General specifications	
AC Input	
Voltage, Phases	208 V / 380 V / 400 V / 480 V $\pm 10\%$, 3ph AC (208 V 3ph AC with Derating to 3 / 6 / 9 kW)
Frequency	45 - 66 Hz
Power factor	>0.99
Leakage current	<5 mA
Overvoltage category	2
Pollution degree	2
DC Output static	
Load regulation CV	$\leq 0.05\%$ FS (0 - 100% load, constant input voltage and constant temperature)
Line regulation CV	$\leq 0.01\%$ FS (208 V - 480 V AC $\pm 10\%$ input voltage, constant load and constant temperature)
Stability CV	$\leq 0.02\%$ FS (Over 8hrs interval following 30 minutes warm-up, constant input voltage, load and temperature)
Temperature coefficient CV	≤ 30 ppm/ $^{\circ}$ C (Following 30 minutes warm up)
Compensation (Remote Sense)	$\leq 5\%$ $U_{Nominal}$
Load regulation CC	$\leq 0.1\%$ FS (0 - 100% load, constant input voltage and constant temperature)
Line regulation CC	$\leq 0.01\%$ FS (208 V - 480 V AC $\pm 10\%$ input voltage, constant load and constant temperature)
Stability CC	$\leq 0.02\%$ FS (Over 8hrs interval following 30 minutes warm-up, constant input voltage, load and temperature)
Temperature coefficient CC	≤ 50 ppm/ $^{\circ}$ C (Following 30 minutes warm up)
Load regulation CP	$\leq 0.3\%$ FS (0 - 100% load, constant input voltage and constant temperature)
Load regulation CR	
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, output shuts down in case of insufficient cooling
Rise time 10 - 90% CV	≤ 20 ms
Fall time 90 - 10% CV	≤ 20 ms
Rise time 10 - 90% CC	≤ 10 ms
Fall time 90 - 10% CC	≤ 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 >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 (Model up to 360 V output), 1500 V DC (Model from 500 V output)
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, status DC, status CV/CC
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 series 10000, with Master-Slave-Bus and Share-Bus

General specifications

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
Storage temperature	-20 - 70 °C
Humidity	≤80% RH, non-condensing
Altitude	≤2000 m (≤6600 ft)
Mechanical construction	
Cooling	Forced air flow from front to rear, temperature controlled fans
Dimensions (W x H x D)	19" x 3U x 668 mm (Enclosure only, not over all)
Weight	18.0 kg (40 lb) 5 kW unit 25.4 kg (56 lb) 10 kW unit 32.8 kg (72 lb) 15 kW unit

Technical specifications	PSBE 10010-170	PSBE 10060-170	PSBE 10080-170	PSBE 10200-70	PSBE 10360-40
DC Output					
Voltage range	0 - 10 V	0 - 60 V	0 - 80 V	0 - 200 V	0 - 360 V
Ripple rms CV	≤10 mV BW 300 kHz	≤10 mV BW 300 kHz	≤10 mV BW 300 kHz	≤40 mV BW 300 kHz	≤55 mV BW 300 kHz
Ripple and noise p-p CV	≤100 mV BW 20 MHz	≤100 mV BW 20 MHz	≤100 mV BW 20 MHz	≤300 mV BW 20 MHz	≤320 mV BW 20 MHz
U_{Min} for I_{Max} (Sink)	<0.5 V	<0.5 V	<0.5 V	<2.0 V	<2.0 V
Current range	0 - 170 A	0 - 170 A	0 - 170 A	0 - 70 A	0 - 40 A
Power range	0 - 1700 W	0 - 5000 W	0 - 5000 W	0 - 5000 W	0 - 5000 W
Resistance range	0.016 Ω - 26 Ω	0.016 Ω - 26 Ω	0.016 Ω - 26 Ω	0.1 Ω - 160 Ω	0.3 Ω - 520 Ω
Output capacity	7790 μF	7790 μF	7790 μF	2520 μF	393 μF
Efficiency up to	93.5% *1	94.5% *1	94.5% *1	94.5% *1	95.5% *1
Insulation					
Negative DC pole <-> PE	±600 V DC	±600 V DC	±600 V DC	±1000 V DC	±1000 V DC
Positive DC pole <-> PE	+600 V DC	+600 V DC	+600 V DC	+1000 V DC	+1000 V DC
Article number	30000752	30000753	30000754	30000755	30000756

*1 100% Power and 100% Output voltage

Technical specifications	PSBE 10500-30	PSBE 10750-20			
DC Output					
Voltage range	0 - 500 V	0 - 750 V			
Ripple rms CV	≤70 mV BW 300 kHz	≤200 mV BW 300 kHz			
Ripple and noise p-p CV	≤350 mV BW 20 MHz	≤800 mV BW 20 MHz			
U_{Min} for I_{Max} (Sink)	<2.2 V	<2.2 V			
Current range	0 - 30 A	0 - 20 A			
Power range	0 - 5000 W	0 - 5000 W			
Resistance range	0.6 Ω - 1000 Ω	1.2 Ω - 2200 Ω			
Output capacity	180 μF	180 μF			
Efficiency up to	95.5% *1	95.5% *1			
Insulation					
Negative DC pole <-> PE	±1500 V DC	±1500 V DC			
Positive DC pole <-> PE	+2000 V DC	+2000 V DC			
Article number	30000757	30000758			

*1 100% Power and 100% Output voltage

Technical specifications	PSBE 10010-340	PSBE 10060-340	PSBE 10080-340	PSBE 10200-140	PSBE 10360-80
DC Output					
Voltage range	0 - 10 V	0 - 60 V	0 - 80 V	0 - 200 V	0 - 360 V
Ripple rms CV	≤10 mV BW 300 kHz	≤10 mV BW 300 kHz	≤10 mV BW 300 kHz	≤40 mV BW 300 kHz	≤55 mV BW 300 kHz
Ripple and noise p-p CV	≤100 mV BW 20 MHz	≤100 mV BW 20 MHz	≤100 mV BW 20 MHz	≤300 mV BW 20 MHz	≤320 mV BW 20 MHz
U_{Min} for I_{Max} (Sink)	<0.5 V	<0.5 V	<0.5 V	<2.0 V	<2.0 V
Current range	0 - 340 A	0 - 340 A	0 - 340 A	0 - 140 A	0 - 80 A
Power range	0 - 3400 W	0 - 10000 W	0 - 10000 W	0 - 10000 W	0 - 10000 W
Resistance range	0.008 Ω - 13 Ω	0.008 Ω - 13 Ω	0.008 Ω - 13 Ω	0.05 Ω - 80 Ω	0.15 Ω - 260 Ω
Output capacity	15980 μF	15980 μF	15980 μF	5040 μF	786 μF
Efficiency up to	93.5% *1	94.5% *1	94.5% *1	94.5% *1	95.5% *1
Insulation					
Negative DC pole <-> PE	±600 V DC	±600 V DC	±600 V DC	±1000 V DC	±1000 V DC
Positive DC pole <-> PE	+600 V DC	+600 V DC	+600 V DC	+1000 V DC	+1000 V DC
Article number	30000759	30000760	30000761	30000762	30000763

*1 100% Power and 100% Output voltage

Technical specifications	PSBE 10500-60	PSBE 10750-40	PSBE 11000-30	PSBE 11500-20	
DC Output					
Voltage range	0 - 500 V	0 - 750 V	0 - 1000 V	0 - 1500 V	
Ripple rms CV	≤70 mV BW 300 kHz	≤200 mV BW 300 kHz	≤200 mV BW 300 kHz	≤400 mV BW 300 kHz	
Ripple and noise p-p CV	≤350 mV BW 20 MHz	≤800 mV BW 20 MHz	≤1000 mV BW 20 MHz	≤2000 mV BW 20 MHz	
U_{Min} for I_{Max} (Sink)	<2.2 V	<2.2 V	<4.0 V	<4.0 V	
Current range	0 - 60 A	0 - 40 A	0 - 30 A	0 - 20 A	
Power range	0 - 10000 W	0 - 10000 W	0 - 10000 W	0 - 10000 W	
Resistance range	0.3 Ω - 500 Ω	0.6 Ω - 1100 Ω	1.2 Ω - 2000 Ω	2.6 Ω - 4500 Ω	
Output capacity	360 μF	360 μF	90 μF	90 μF	
Efficiency up to	95.5% *1	95.5% *1	95.5% *1	95.5% *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 number	30000764	30000765	30000766	30000767	

*1 100% Power and 100% Output voltage

Technical specifications	PSBE 10010-510	PSBE 10060-510	PSBE 10080-510	PSBE 10200-210	PSBE 10360-120
DC Output					
Voltage range	0 - 10 V	0 - 60 V	0 - 80 V	0 - 200 V	0 - 360 V
Ripple rms CV	≤10 mV BW 300 kHz	≤10 mV BW 300 kHz	≤10 mV BW 300 kHz	≤40 mV BW 300 kHz	≤55 mV BW 300 kHz
Ripple and noise p-p CV	≤100 mV BW 20 MHz	≤100 mV BW 20 MHz	≤100 mV BW 20 MHz	≤300 mV BW 20 MHz	≤320 mV BW 20 MHz
U_{Min} for I_{Max} (Sink)	<0.5 V	<0.5 V	<0.5 V	<2.0 V	<2.0 V
Current range	0 - 510 A	0 - 510 A	0 - 510 A	0 - 210 A	0 - 120 A
Power range	0 - 5100 W	0 - 15000 W	0 - 15000 W	0 - 15000 W	0 - 15000 W
Resistance range	0.006 Ω - 8 Ω	0.006 Ω - 9 Ω	0.006 Ω - 9 Ω	0.03 Ω - 50 Ω	0.1 Ω - 180 Ω
Output capacity	23970 μF	23970 μF	23970 μF	7560 μF	1179 μF
Efficiency up to	93.5% *1	94.5% *1	94.5% *1	94.5% *1	95.5% *1
Insulation					
Negative DC pole <-> PE	±600 V DC	±600 V DC	±600 V DC	±1000 V DC	±1000 V DC
Positive DC pole <-> PE	+600 V DC	+600 V DC	+600 V DC	+1000 V DC	+1000 V DC
Article number	30000719	30000710	30000711	30000712	30000713

*1 100% Power and 100% Output voltage

Technical specifications	PSBE 10500-90	PSBE 10750-60	PSBE 11000-40	PSBE 11500-30	PSBE 12000-20
DC Output					
Voltage range	0 - 500 V	0 - 750 V	0 - 1000 V	0 - 1500 V	0 - 2000 V
Ripple rms CV	≤70 mV BW 300 kHz	≤200 mV BW 300 kHz	≤300 mV BW 300 kHz	≤400 mV BW 300 kHz	≤400 mV BW 300 kHz
Ripple and noise p-p CV	≤350 mV BW 20 MHz	≤800 mV BW 20 MHz	≤1600 mV BW 20 MHz	≤2400 mV BW 20 MHz	≤2400 mV BW 20 MHz
U_{Min} for I_{Max} (Sink)	<2.2 V	<2.2 V	<5.2 V	<5.2 V	<5.2 V
Current range	0 - 90 A	0 - 60 A	0 - 40 A	0 - 30 A	0 - 20 A
Power range	0 - 15000 W	0 - 15000 W	0 - 15000 W	0 - 15000 W	0 - 15000 W
Resistance range	0.2 Ω - 330 Ω	0.4 Ω - 750 Ω	0.8 Ω - 1300 Ω	1.8 Ω - 3000 Ω	1.7 Ω - 2700 Ω
Output capacity	540 μF	540 μF	131 μF	60 μF	60 μF
Efficiency up to	95.5% *1	95.5% *1	95.5% *1	95.5% *1	95.5% *1
Insulation					
Negative DC pole <-> PE	±1500 V DC	±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	+2000 V DC
Article number	30000714	30000715	30000716	30000717	30000718

*1 100% Power and 100% Output voltage

General

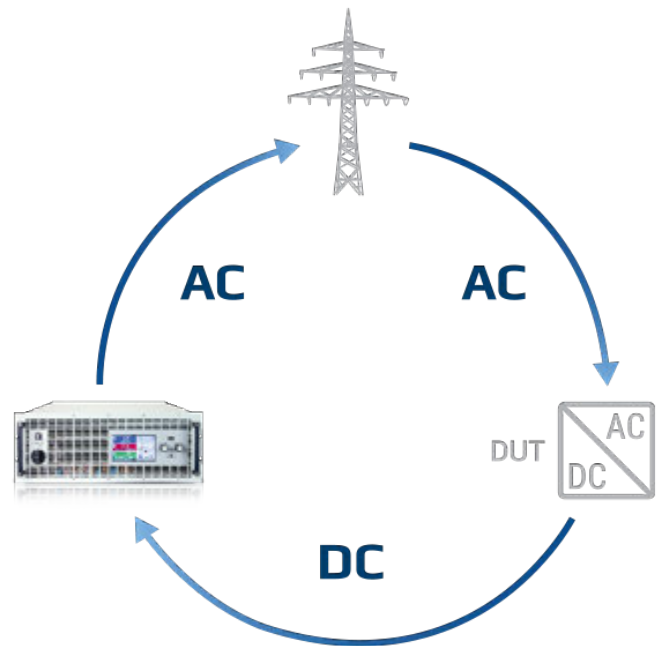
The bidirectional DC laboratory power supplies in the PSBE 10000 series from EA Elektro-Automatik are two quadrant devices which can perform the function of a power supply as well as that of an electronic load. In load mode the device is regenerative and feeds the energy back into the local grid with an efficiency up to over 96%. The PSBE 10000 series includes 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 - 10 V to 0 - 2000 V and from 0 - 20 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 PSBE 10000 range. Furthermore, typical laboratory functionality is provided. This includes an alarm and warning management, assorted interfaces and ports, software solutions and many more functions.

AC Connection

The bidirectional DC power supplies in the PSBE 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 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 208 V AC grid a derating of the output power is set.

Energy recovering

The energy consumed in load mode is fed back into the connected mains supply with an efficiency of over 96 %. This reduces cost: as the energy is not converted to heat as in other loads, the energy costs are reduced. In addition, the devices generate less heat requiring less cost intensive air conditioning. One device is sufficient for the whole application, reducing investment and installation costs.



The principle of Energy recovering

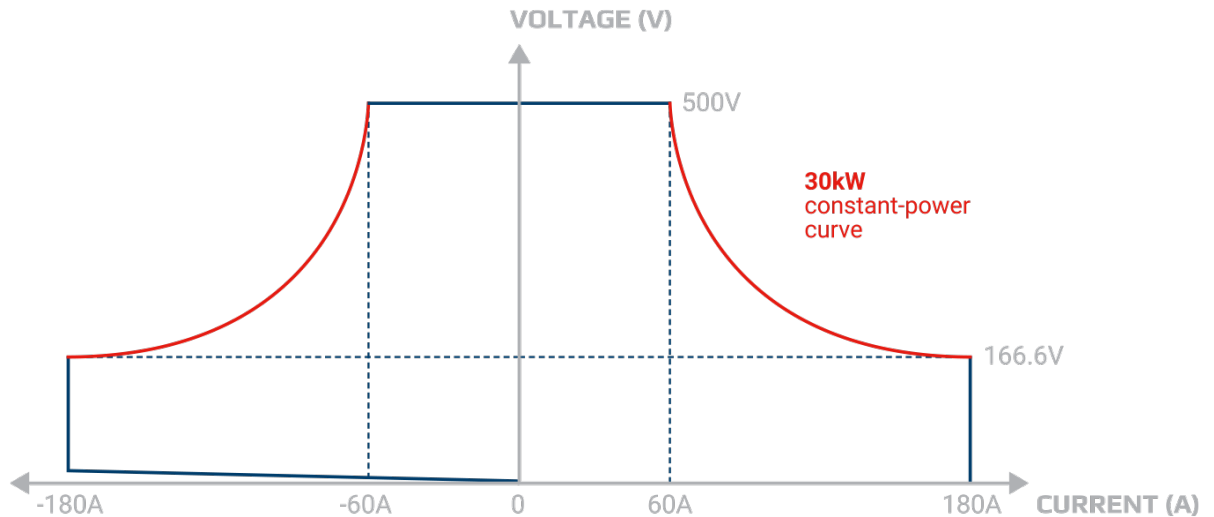
This demonstrates, based on an application, how a 'device under test' takes energy from the mains, converts it to DC and feeds that into an EA device. The bidirectional power supply PSBE 10000 converts this energy back into an AC current and feeds it back into the mains..

DC Output

The output of the bidirectional power supply PSBE 10000 with a DC voltage of 0 - 10 V up to 0 - 2000 V allows positive and negative currents of 0 - 20 A up to 0 - 1000 A as a two-quadrant device. 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 bidirectional programmable DC Power Supply automatically offers a wide output and input 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.

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 PSBE 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

Battery test for electro mobility

A typical application for the bidirectional power supplies from EA Elektro-Automatik is the testing of the electrical characteristics of a battery. The wide application spectrum covers cell, module or pack tests, the determination of the SOH (State-of-Health) for a second life classification as well as the End-of-Line (EOL) test. These applications put many demands on power electronics which are fulfilled by the PSB 10000 range. The excellent features of this device range are: measurement of voltage and current with the required accuracy and performance, reproducibility and reliability of these data and the flexible usability. Whether in an automated test system or in an integrated battery test, all possibilities are open to the user. Furthermore, the devices are clearly economical with efficiencies of 96% or more.

Battery simulation

Additional applications include the simulation of batteries as single cells, modules, or packs. These simulations aid in the optimal configuration of energy storage as well as the supplied components under test. Wherever reproducible data are needed a battery simulator is the first choice. Also, the use of a simulator as a power source provides protection for the connected consuming component. The Over-Current-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.

Fuel cell test

The devices in the PSB 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.

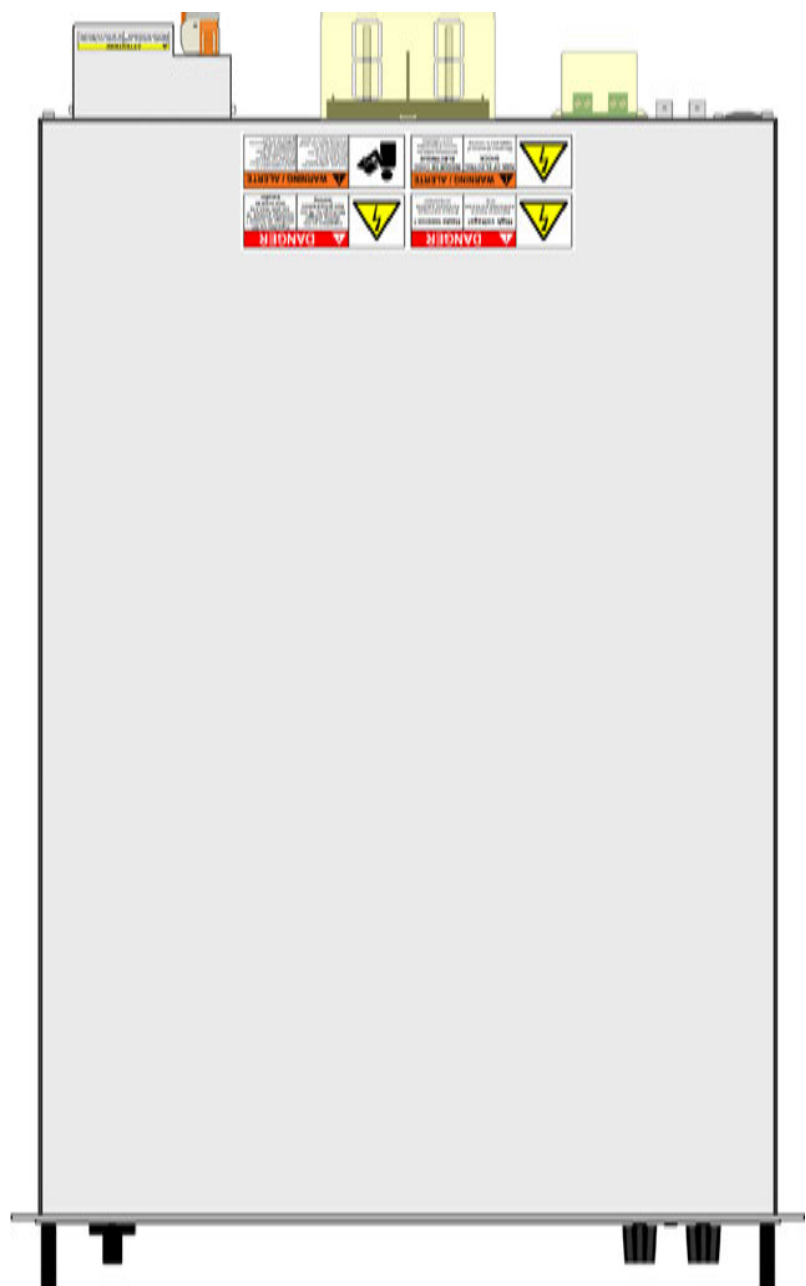
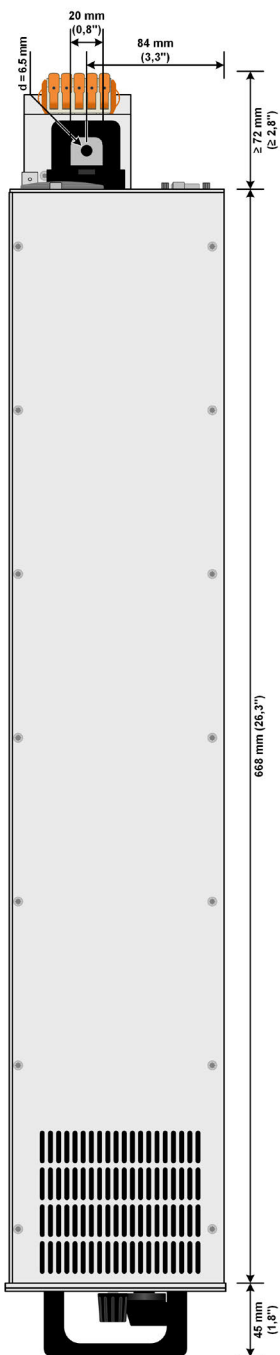
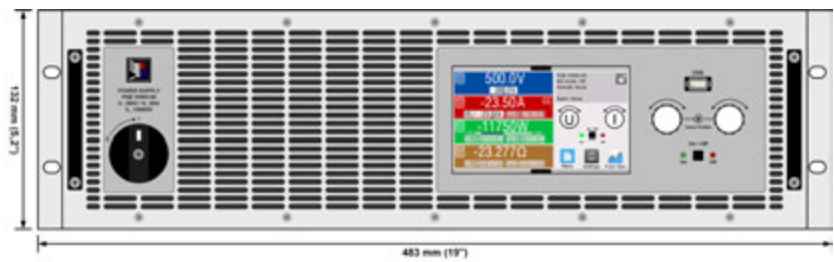
On-board charger test

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 PSB 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 PSB 10000 devices to match the control characteristics of the on board charger.

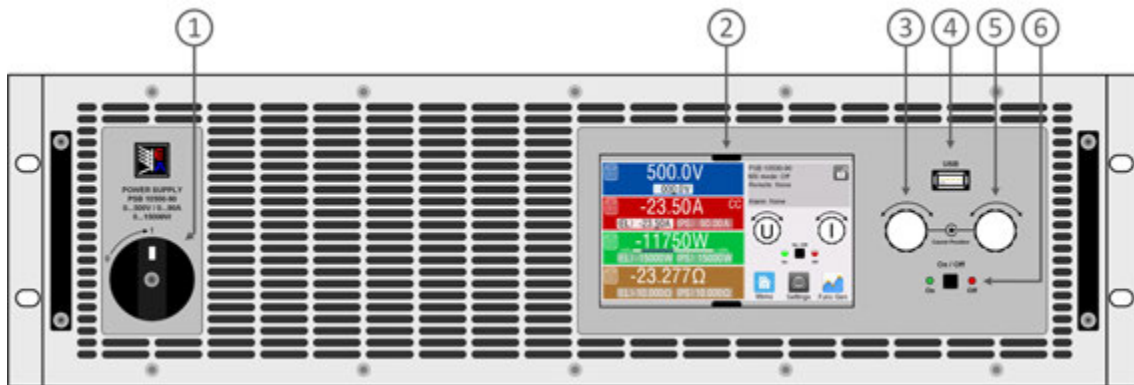
Battery recycling

The bidirectional power supplies of the PSB 10000 range enable retired batteries from electric vehicles to be considered for a possible further use. Assessment of the battery pack starts with a State of Health (SOH) check to determine if a second life is feasible. This standard integral function can be initiated with one clic. If this check shows too little rest capacity, then the battery must be fully discharged before recycling. The autoranging of the devices guarantees the maximum possible total discharge though the high load current, even with voltages under 2 V. The mains feedback to the power grid at 96% efficiency makes this process highly cost effective.

Outline drawing PSBE 10000 3U ≥ 360 V

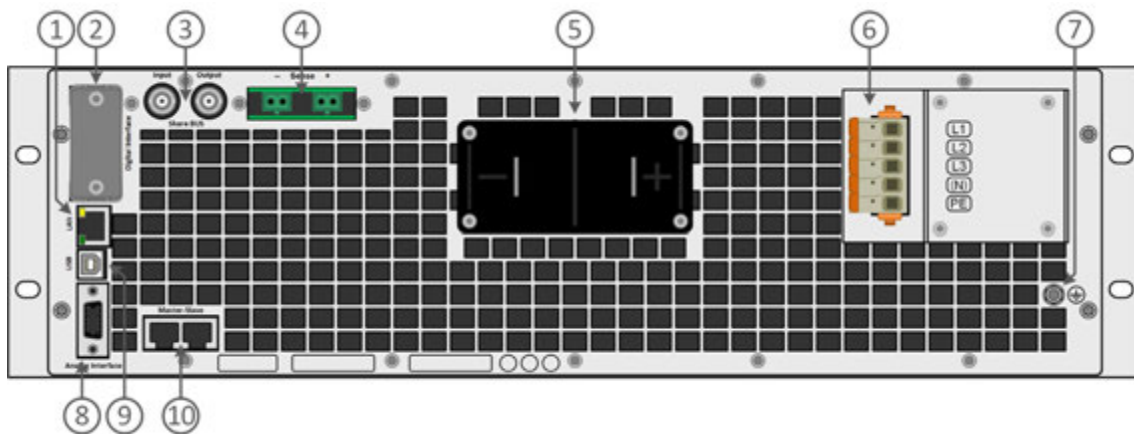


Front panel description PSBE 10000 3U



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 PSBE 10000 3U



1. Ethernet interface
2. Slot for Interfaces
3. Share-Bus Interface to set up a system for parallel connection
4. Output voltage Remote Sense input terminal
5. Output terminal, Copper busbar
6. Mains input terminal
7. Grounding connection screw (PE)
8. Connector (DB15 Female) for isolated analog program, monitor and other functions
9. USB interface
10. Master-Slave-Bus interface to set up a system for parallel connection



Test Equipment Depot - 800.517.8431 - TestEquipmentDepot.com