Elektro-Automatik

Triple output

DATASHEET

EA-PSB 20000 TRIPLE 4U

Programmable bidirectional DC power supply

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EA-PSB 20000 TRIPLE 4U

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 10 kW per channel
- Voltages from 0 - 60 V up to 0 - 920 V per channel
- Currents from 0 - 40 A up to 0 - 6000 A per channel
- Flexible power regulated DC output stages (autoranging)
- Regulation modes CV, CC, CP, CR with fast crossover
- Digital regulation, high resolution with 16bit ADCs and DACs, selection of voltage regulation speed: Normal, Fast, Slow
- Color 5" TFT display with touch control and intuitive user interface
- EtherCAT based master-auxiliary bus for parallel operation of all power classes in the 20000 series
- Integrated function generator with predefined curves
- Automotive test procedures for LV123, LV124 and LV148
- Battery and fuel cell emulation
- Photovoltaics test mode (EN 50530)
- MPP tracking
- Built-in EtherCAT interface with 1 ms communication speed
- Command languages and drivers: SCPI and ModBus, LabVIEW, IVI

Built-in interfaces

- USB
- Ethernet (1 Gbit/s)
- EtherCAT
- CAN FD
- Master-Auxiliary bus
- Share-Bus
- USB host (front panel)
- Digital In/Out

Software

- EA Power Control

Options

- Water cooling in stainless steel

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Technical data

General specifications	
AC input	
Voltage, Phases	Range 1: 208 V, ±10%, 3ph AC Range 2: 380 - 480 V, ±10%, 3ph AC
Frequency	45 - 65 Hz
Power factor	ca. 0.99
Leakage current	<10 mA
Inrush current *1	@208 V: ca. 17 A per phase @400 V: ca. 32 A per phase
Overvoltage category	II
DC input/output static	
Load regulation CV	≤0.05% FS (0 - 100% load, at constant AC input voltage and temperature)
Line regulation CV	≤0.01% FS (208 V - 480 V AC ±10%, at constant load and constant temperature)
Stability CV	≤0.02% FS (during 8 h of operation, after 30 minutes of warm-up, at constant AC input voltage, load and temperature)
Temperature coefficient CV	≤30ppm/°C (after 30 minutes of warm-up)
Compensation (remote sense)	≤5% FS
Load regulation CC	≤0.1% FS (0 - 100% load, at constant AC input voltage and temperature)
Line regulation CC	≤0.01% FS (208 V - 480 V AC ±10%, at constant load and constant temperature)
Stability CC	≤0.02% FS (during 8 h of operation, after 30 minutes of warm-up, at constant AC input voltage, load and temperature)
Temperature coefficient CC	≤50ppm/°C (after 30 minutes of warm-up)
Load regulation CP	≤0.3% FS (0 - 100% load, at constant AC input voltage and temperature)
Load regulation CR *3	≤0.3% FS + 0.1% FS of current (0 - 100% load, at constant AC input voltage and 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 terminal shuts down in case of insufficient cooling)
DC input/output dynamic	
Rise time 10 - 90% / Fall time 90 - 10%	CV: ≤10 ms CC: ≤2 ms
Display & measurement accuracy	
Voltage	≤0.05% FS
Current	≤0.1% FS
Insulation	
AC input to DC terminal	3750 Vrms (1 minute, creepage distance >8 mm) *2
AC input to case (PE)	2500 Vrms
DC terminal to case (PE)	Depending on the model, see model tables
DC terminal to interfaces	1000 V DC (models up to 360 V rating), 1500 V DC (models from 500 V rating)
Communication interfaces	
Rear, galvanically isolated	USB, Ethernet (1 GBit), EtherCAT, CAN FD, all for communication
Communication speed	≤1 ms *4
Front, galvanically isolated	USB host, for data acquisition
Digital In/Out	
Built-in, galvanically isolated	16 pole
Inputs	3x independent, user-configurable
Outputs	3x independent, as dry contact
Sensor inputs	3x independent, for temperature sensor

*1 Calculated for the peak value of the stated voltage including 10% tolerance, at 23°C ambient and first switch-on (cold start)
*2 Models with up to 80 V DC rating have reinforced insulation while all other models from 200 V DC rating have basic insulation
*3 Where featured
*4 When using EtherCAT

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General specifications	
Device configuration	
Parallel operation with Share bus	Up to 8 units per channel or grouping of all 3 channels of one device
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 A, group 1 CISPR 11, class A, group 1 FCC 47 CFR part 15B, unintentional radiator, class A EN 61326-1 including tests according to: - EN 61000-4-2 - EN 61000-4-3 - EN 61000-4-4 - EN 61000-4-5 - EN 61000-4-6
Appliance class	I
Ingress protection	IP20
Environmental conditions	
Operating temperature *5	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)	Chassis: 483 mm (19 in) x 177 mm (4U) x 668 mm (26.3 in) Overall depth: min. 802 mm (min. 31.6 in)
Weight	50 kg (110 lb)
Weight with water cooling	56 kg (126 lb)

*5 The rated power of the device is only permanently available up to approximately +40 °C (104 °F)

Technical specifications	PSB 20060-340 Triple	PSB 20080-340 Triple	PSB 20200-140 Triple
Number of channels	3	3	3
Total device power range *2	0 - 30000 W (0 - 18000 W)	0 - 30000 W (0 - 18000 W)	0 - 30000 W (0 - 18000 W)
DC output per channel			
Voltage range	0 - 60 V	0 - 80 V	0 - 200 V
Ripple in CV (rms)	≤25 mV (BWL 300 kHz *1)	≤25 mV (BWL 300 kHz *1)	≤40 mV (BWL 300 kHz *1)
Ripple in CV (pp)	≤320 mV (BWL 20 MHz *1)	≤320 mV (BWL 20 MHz *1)	≤300 mV (BWL 20 MHz *1)
U_{Min} for I_{Max} (sink)	0.65 V	0.65 V	1.8 V
Current range	0 - 340 A	0 - 340 A	0 - 140 A
Power range *2	0 - 10000 W (0 - 6000 W)	0 - 10000 W (0 - 6000 W)	0 - 10000 W (0 - 6000 W)
Resistance range	0.006 - 7.5 Ω	0.008 - 13 Ω	0.05 - 80 Ω
Output capacitance	8460 µF	8460 µF	1800 µF
Efficiency sink/source (up to)	94.5%	95.0%	95.1%
AC input			
P_{Max}	Range 1: 19 kW Range 2: 31 kW	Range 1: 19 kW Range 2: 31 kW	Range 1: 19 kW Range 2: 31 kW
Phase current *4	Range 1: ≤61 A Range 2: ≤53 A	Range 1: ≤61 A Range 2: ≤53 A	Range 1: ≤61 A Range 2: ≤53 A
Insulation			
Negative DC pole <-> PE	±600 V DC	±600 V DC	±1000 V DC
Positive DC pole <-> PE	+600 V DC	+600 V DC	+1000 V DC
Channel DC <-> Channel DC	±1200 V DC	±1200 V DC	±2000 V DC
Product codes			
Standard	30334401	30334402	30334403
Standard + Water cooling	30354401	30354402	30354403

*1 BWL = Bandwidth limit on the measuring oscilloscope
*2 The value in brackets applies to the state of derating (power reduction) when standard models run on 208 V ±10% utility
*3 At 100% power and 100% output voltage
*4 Calculated for the default AC supply voltage in the stated range, minus 10% tolerance, at maximum output power and 10% power loss from AC to DC

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Technical specifications	PSB 20360-80 Triple	PSB 20500-60 Triple	PSB 20920-40 Triple
Number of channels	3	3	3
Total device power range *2	0 - 30000 W (0 - 18000 W)	0 - 30000 W (0 - 18000 W)	0 - 30000 W (0 - 18000 W)
DC output per channel			
Voltage range	0 - 360 V	0 - 500 V	0 - 920 V
Ripple in CV (rms)	≤55 mV (BWL 300 kHz *1)	≤70 mV (BWL 300 kHz *1)	≤70 mV (BWL 300 kHz *1)
Ripple in CV (pp)	≤320 mV (BWL 20 MHz *1)	≤350 mV (BWL 20 MHz *1)	≤700 mV (BWL 20 MHz *1)
U_{Min} for I_{Max} (sink)	2.5 V	2.5 V	2.5 V
Current range	0 - 80 A	0 - 60 A	0 - 40 A
Power range *2	0 - 10000 W (0 - 6000 W)	0 - 10000 W (0 - 6000 W)	0 - 10000 W (0 - 6000 W)
Resistance range	0.15 - 260 Ω	0.28 - 500 Ω	0.8 - 1700 Ω
Output capacitance	600 µF	225 µF	100 µF
Efficiency sink/source (up to)	95.5%	96.0%	96.0%
AC input			
P_{Max}	Range 1: 19 kW Range 2: 31 kW	Range 1: 19 kW Range 2: 31 kW	Range 1: 19 kW Range 2: 31 kW
Phase current *4	Range 1: ≤61 A Range 2: ≤53 A	Range 1: ≤61 A Range 2: ≤53 A	Range 1: ≤61 A Range 2: ≤53 A
Insulation			
Negative DC pole <-> PE	±1000 V DC	±1500 V DC	±1500 V DC
Positive DC pole <-> PE	+1000 V DC	+2000 V DC	+2000 V DC
Channel DC <-> Channel DC	±2000 V DC	±2000 V DC	±2000 V DC
Product codes			
Standard	30334404	30334405	30334407
Standard + Water cooling	30354404	30354405	30354407

*1 BWL = Bandwidth limit on the measuring oscilloscope
*2 The value in brackets applies to the state of derating (power reduction) when standard models run on 208 V ±10% utility
*3 At 100% power and 100% output voltage
*4 Calculated for the default AC supply voltage in the stated range, minus 10% tolerance, at maximum output power and 10% power loss from AC to DC

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General

The bidirectional, three-channel DC laboratory power supplies in the PSB 20000 Triple 4U series from EA Elektro-Automatik are two quadrant devices which can perform the function of a power supply (source) as well as that of an electronic load (sink). In sink mode the device is regenerative and feeds the energy back into the local grid with an efficiency of up to 96%. Together with the wide input range they allow use with practically all global mains voltages.

The DC voltages and currents are determined by the application and the spectrum ranges from 0 - 60 V to 0 - 920 V and from 0 - 40 A up to 0 - 340 A per channel. The DC supply operates as a flexible output stage with a constant power characteristic (autoranging) with a wide voltage and current range. To achieve higher power and current all units are equipped with a master-auxiliary bus. This enables up to 8 parallel connected devices to be combined into one system which can provide up to 80 kW and 2720 A per channel.

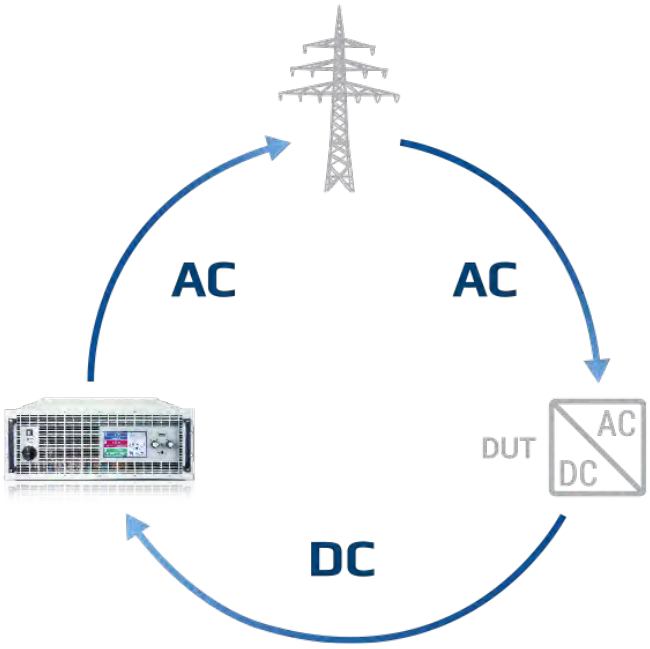
Furthermore, typical laboratory functionality is provided. This includes an extensive function generator, alarm and warning management, various optional industrial interfaces, software solutions and many more functions.

AC connection

The DC power supplies in the PSB 20000 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. It reaches from 208 V to 380/400/480 V. Hence the devices can be operated in the majority of global grids. They adjust automatically, without additional configuration, to the available grid voltage. In a 208 V AC grid a derating of the DC output power is automatically set.

Energy recovery

The energy consumed in load mode is fed back into the connected grid with an efficiency of up to 96%. 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 can already be sufficient for a while range of applications, reducing investment and installation costs.



The principle of energy recovery

The figure above demonstrates, based on a typical application, how a „device under test“ consumes energy from the mains, converts it to DC and feeds that into an EA device. The bidirectional power supply PSB 20000 converts this energy back into an AC current and feeds it back into the grid.

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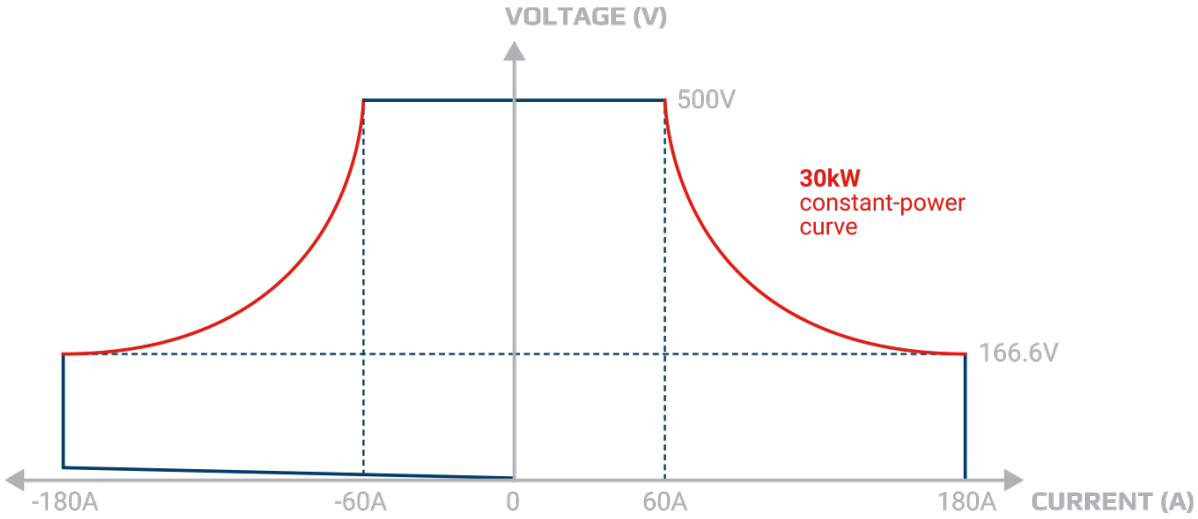
DC output

The DC outputs on the three channel of the power supplies in series PSB 20000 Triple 4U are rated for DC voltages of 0 - 60 V up to 0 - 920 V, allowing currents of 0 - 40 A up to 0 - 340 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 three DC outputs is done via copper blades on the back side of the device. If a system with higher performance is required, the DC channels can simply be connected in parallel to other three-channel devices. A cover for contact protection is provided.
Alternatively, the three outputs of a device can be connected to each to gain one channel with higher current and power as well.



The principle of autoranging

„Autoranging“ is a term used when a programmable DC power supply automatically offers a wider 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 PSB 20000 series are equipped with a function generator. This allows waveforms such as sine, triangle, square or trapezoid to be simply called up and applied to either the voltage or the current. A ramp function and a arbitrary generator allow voltage and current progression to be freely programmable. Test sequences for repeated tests can be saved and reloaded when needed, which saves time. For simulation of a photovoltaics system or fuel cells, adaptable tables are provided. With the integrated and adjustable PV characteristics curve DIN EN 50530 various solar modules can be defined and entire day trend progression can be simulated.
Conclusion: the user is supported by a multitude of useful functions.

Interfaces

As standard, 20000s series devices are fitted with the most important interfaces and ports which are all galvanically isolated from the DC input. These are Ethernet, EtherCAT, CAN FD and USB.

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High performance systems

High power applications can be covered with high power systems of up to 3x 80 kW. This is achieved by connecting the DC terminals of multiple PSB 20000 Triple 4U devices with vertical copper rails in parallel. Thus, a 19” cabinet with 42 U can provide a system with 3x 80 kW occupying only 0.6 m² (6.5 sqft) of floor space.

Master-auxiliary bus and Share bus

When the integrated master-auxiliary bus and Share bus are used, a multi device system behaves as a single device. The buses are simply connected between each device. With the master-auxiliary bus the system data, such as total power and total current, are collected and displayed on the master unit. Warnings and alarms of the auxiliary devices are also clearly displayed. The Share bus cares for a balanced load distribution between the individual units.

Applications

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 20000 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 up to 96%.

Fuel cell test

The devices in the PSB 20000 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-auxiliary system. High accuracy and performance are maintained here.

On-board charger test

In an on-board charger (OBC) test 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 software EA-Power Control it allows data to be exported and saved. In this way applications can instantly 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 testing device, the voltage regulation speed of the bidirectional power supply is adjustable. The modes Normal, Fast and Slow allow the PSB 20000 devices to be adapted the control characteristics of the on-board charger.

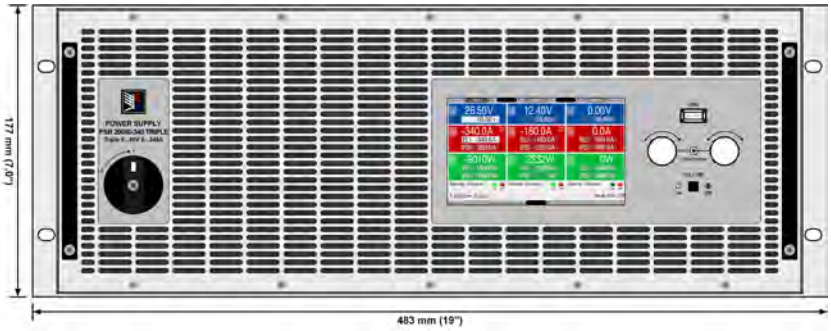
Solar array simulation

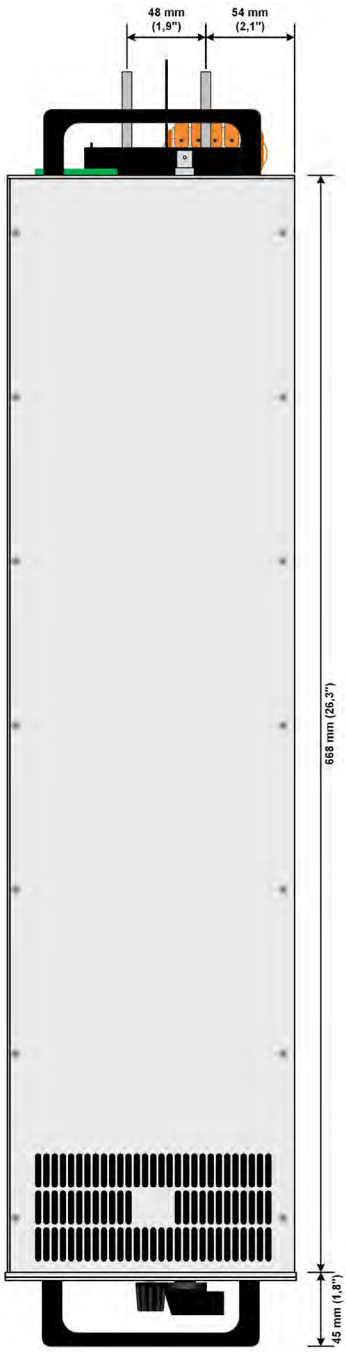
The programmable power supplies of the PSB 20000 range are highly suited to use as test systems for PV inverters as they can provide the necessary simulation for solar panels. Users can quickly access simulation models according to EN 50530 or Sandia while it supports diverse solar panel types. Parameters such as irradiation (varying with shadows), panel technology and temperature can be included. Thus the devices can test all the relevant electrical features of a PV inverter including the important efficiency value.
The high resolution of 16-bit technology and a high sampling rate enable the programmable power supply to deliver accurate results which can be documented and saved to an Excel file.

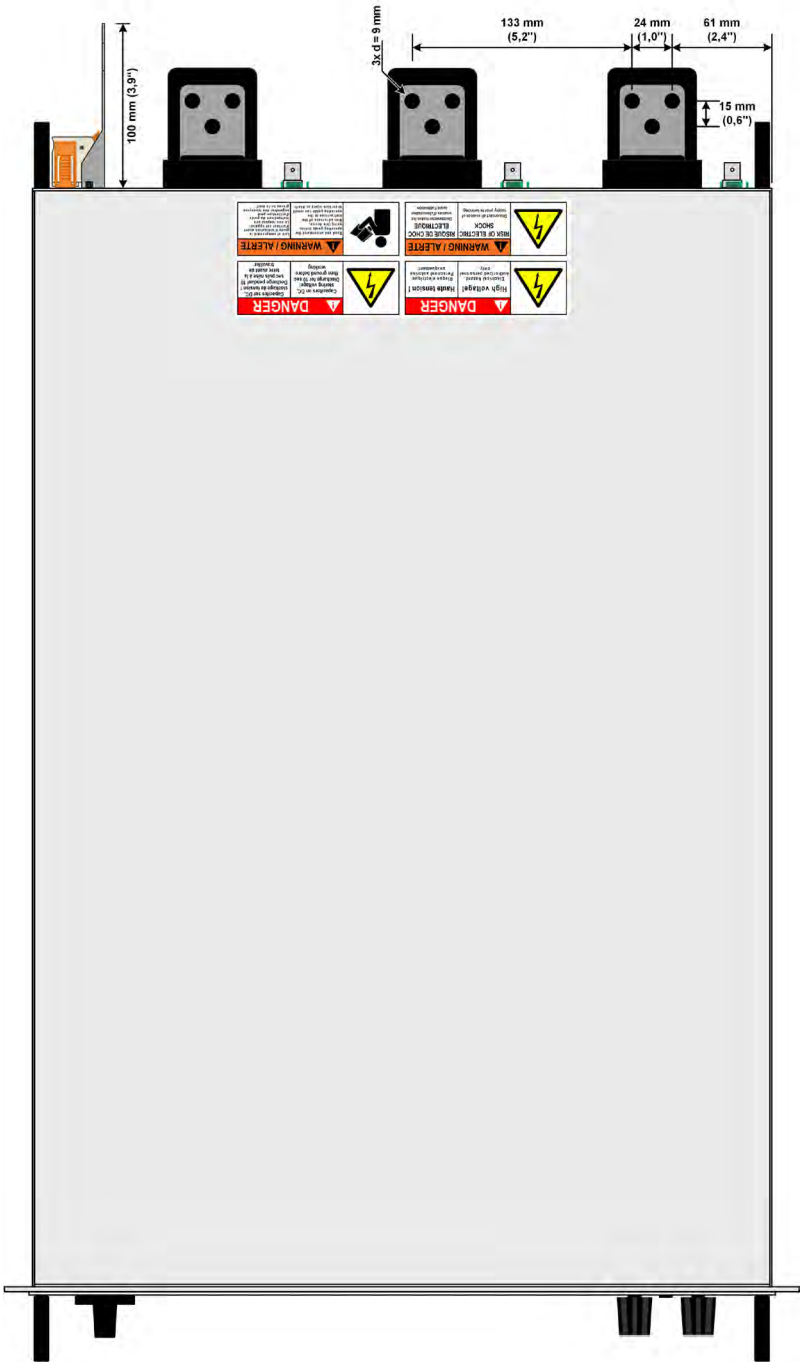
Battery recycling

In combination with the software EA-Power Control it's possible to assess retired batteries from electric vehicles for a possible further use. Assessment of a battery pack starts with a state of health (SOH) check to determine if a second life is feasible. This integrated function can be initiated with one click. 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, even with voltages under 2 V. The mains feedback to the power grid at up to 96% efficiency makes this process highly cost effective.

Technical drawings PSB 20000 4U ≤200 V







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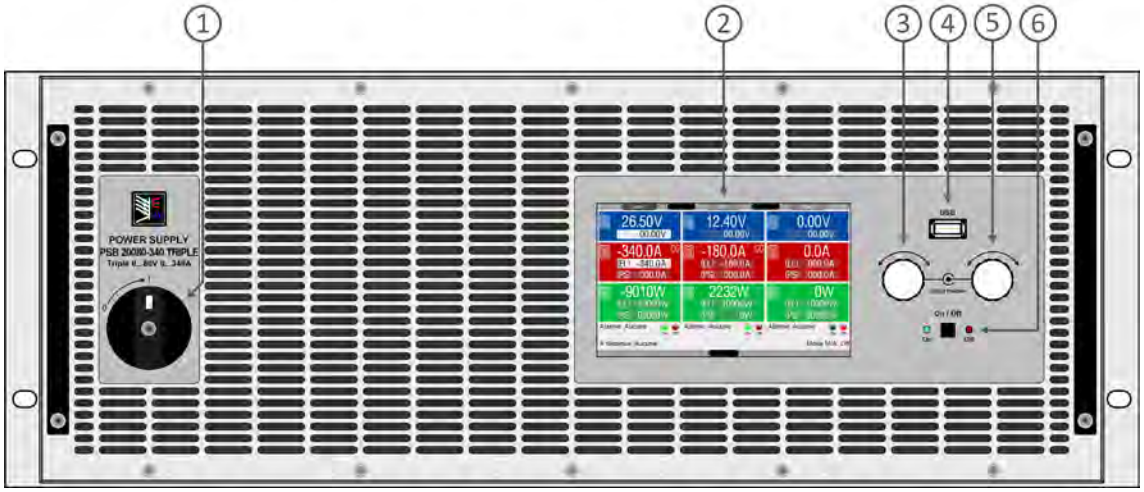
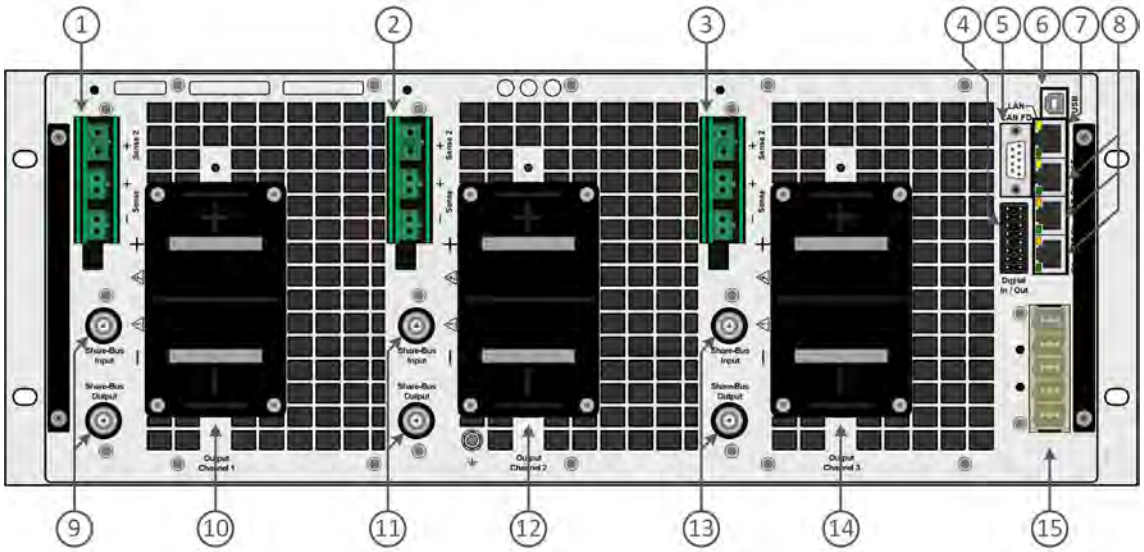
Front panel description PSB 20000 4U



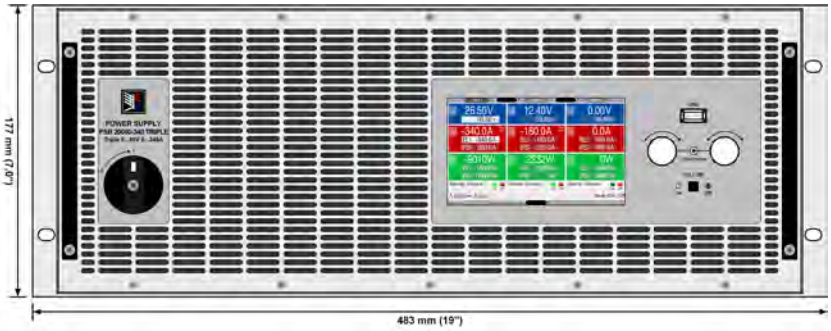
1. Power switch
2. TFT control interface, interactive operation and display
3. Rotary knob with pushbutton action, for settings and control
4. USB host, uses USB sticks for data logging and sequencing
5. Rotary knob with pushbutton action, for settings and control
6. On / Off pushbutton with LED status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

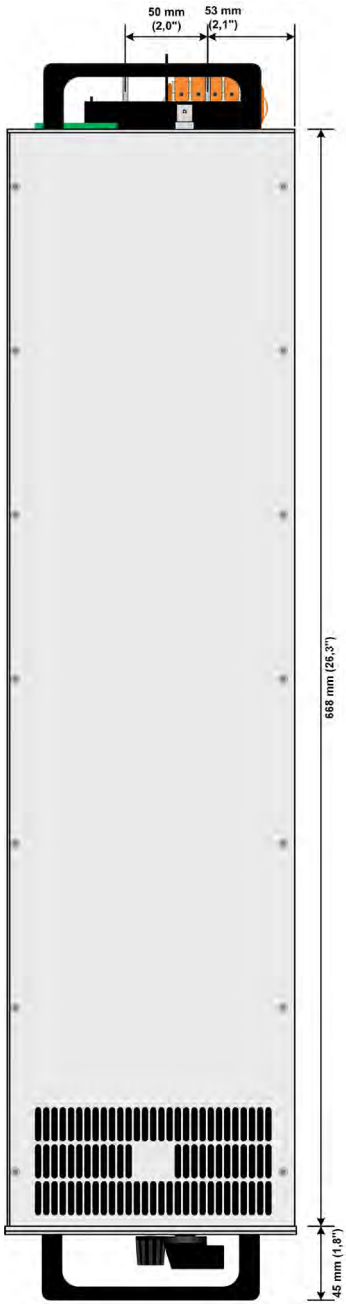
Rear panel description PSB 20000 4U ≤200 V

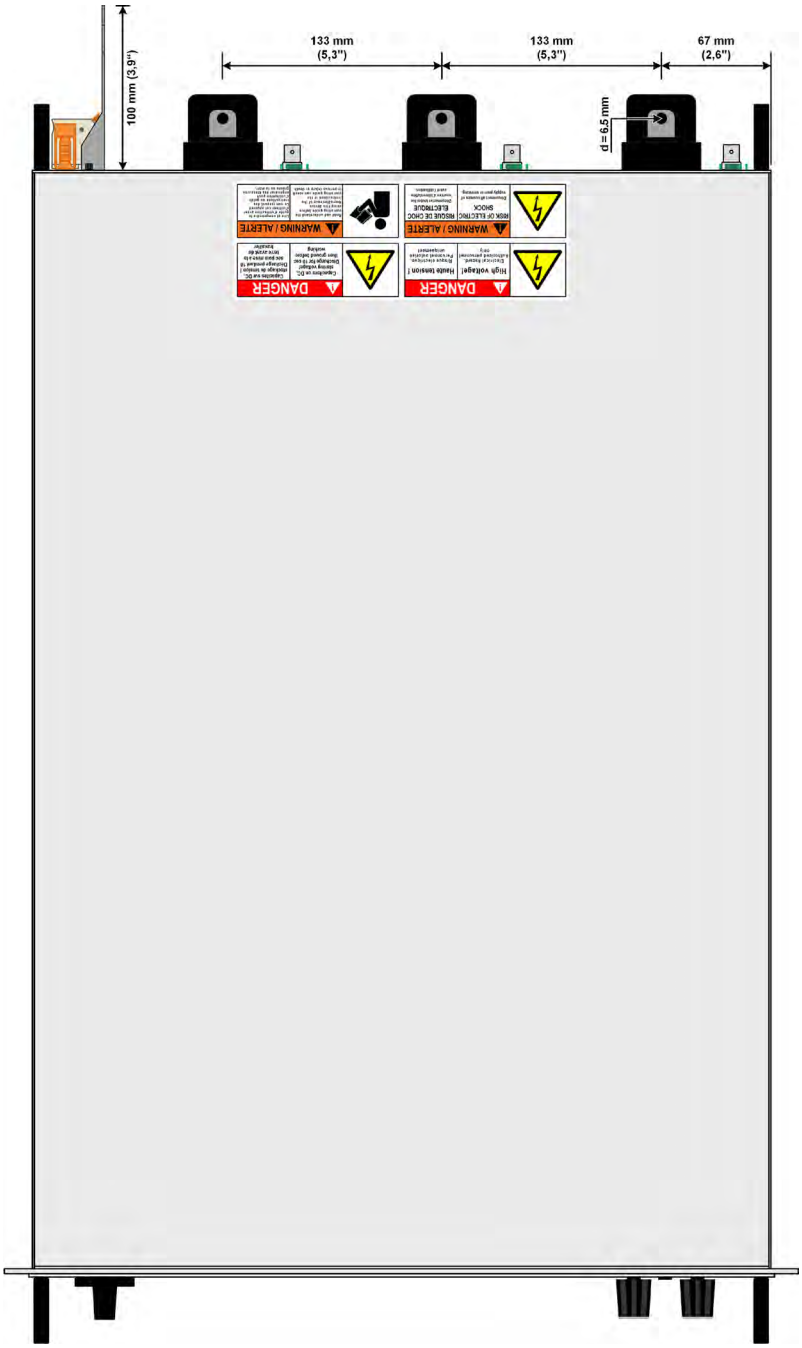


1. Remote sense connectors Channel 1
2. Remote sense connectors Channel 2
3. Remote sense connectors Channel 3
4. Digital In/Out (16 pole connector)
5. CAN FD interface
6. USB interface
7. Ethernet interface
8. EtherCAT ports
9. Share-Bus connectors Channel 1
10. DC output connector (copper blades) Channel 1
11. Share-Bus connectors Channel 2
12. DC output connector (copper blades) Channel 2
13. Share-Bus connectors Channel 3
14. DC output connector (copper blades) Channel 3
15. AC input connector

Technical drawings PSB 20000 4U ≥360 V







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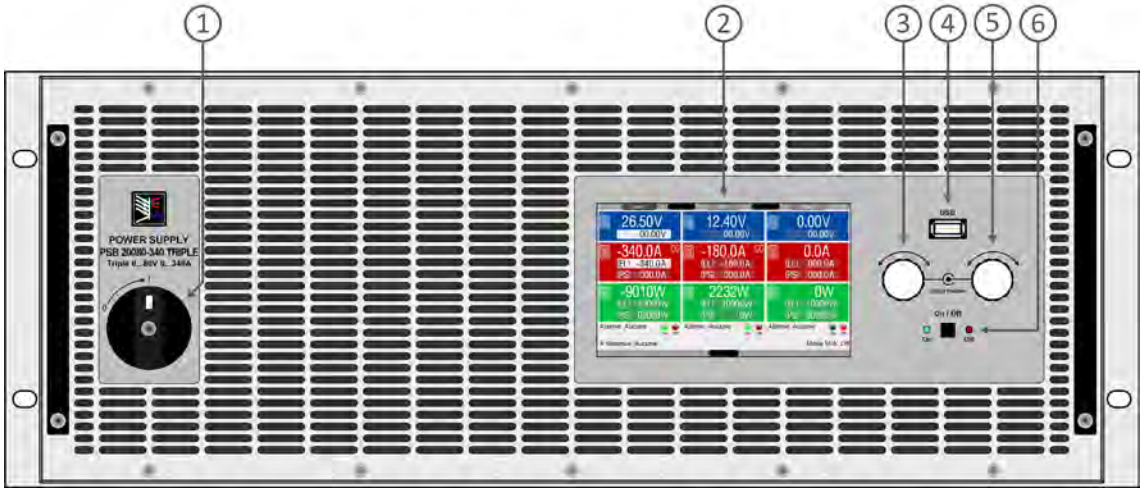

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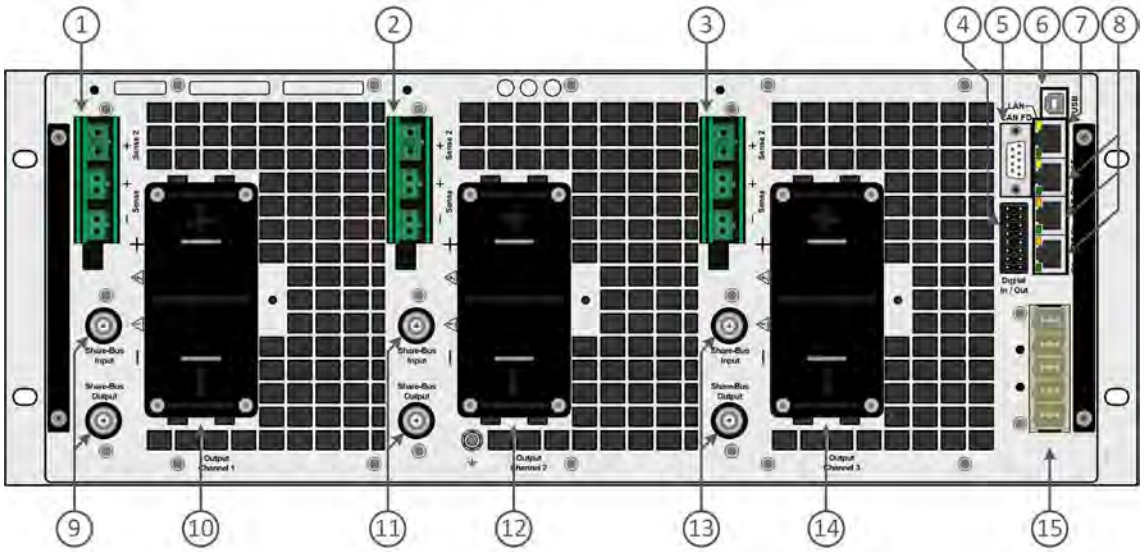
Rear panel description PSB 20000 4U ≥360 V



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13. Share-Bus connectors Channel 3
14. DC output connector (copper blades) Channel 3
15. AC input connector

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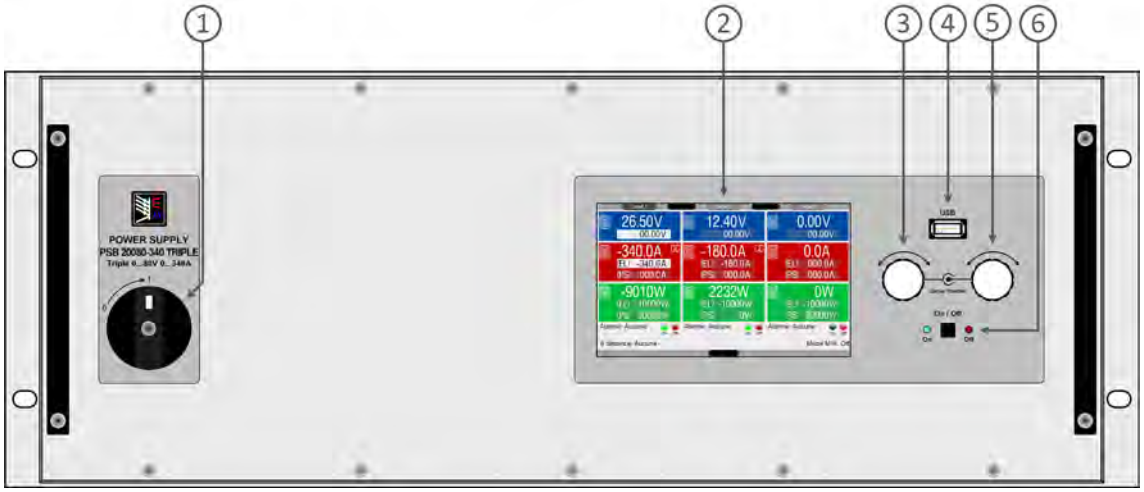
Front panel description PSB 20000 4U with Water Cooling option



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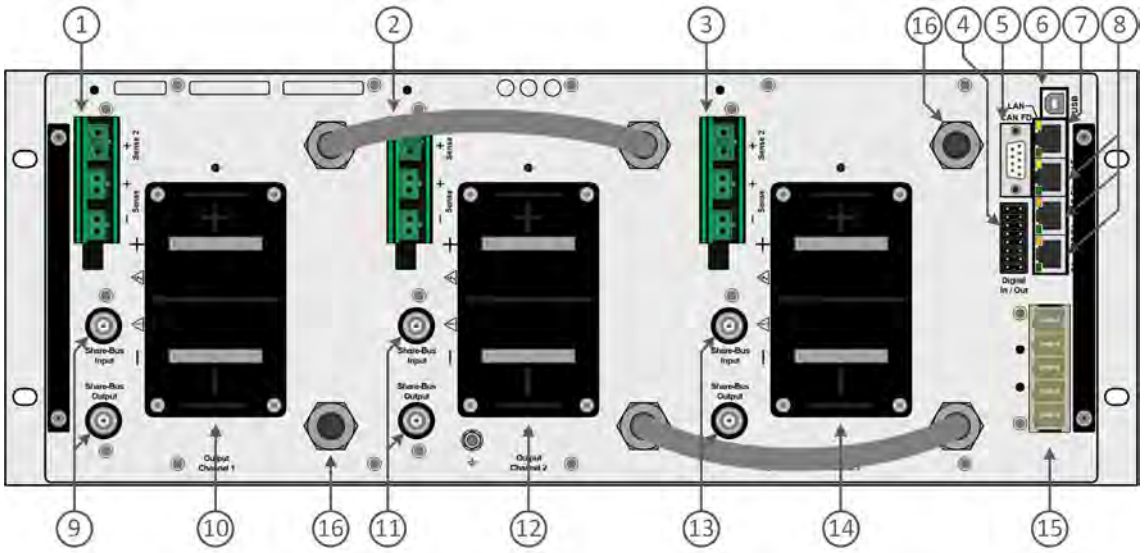
Rear panel description PSB 20000 4U with Water Cooling option



1. Remote sense connectors Channel 1
2. Remote sense connectors Channel 2
3. Remote sense connectors Channel 3
4. Digital In/Out (16 pole connector)
5. CAN FD interface
6. USB interface
7. Ethernet interface
8. EtherCAT ports
9. Share-Bus connectors Channel 1
10. DC output connector (copper blades) Channel 1
11. Share-Bus connectors Channel 2
12. DC output connector (copper blades) Channel 2
13. Share-Bus connectors Channel 3
14. DC output connector (copper blades) Channel 3
15. AC input connector
16. Water inlet/outlet

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