



Elektro-Automatik



ELR 10000 4U

Regenerative DC electronic loads with energy recovery | 30 kW

Energy Recovery Technology: Converts consumed DC energy into AC, feeding it back to the grid with up to 96% efficiency.

Wide Voltage and Current Ranges: Supports 0–80 V to 0–2000 V and currents up to 1000 A in a single device.

Flexible Autoranging Input Stages: Maintains full power across a broad range of voltage and current combinations.

Advanced Function Generator: Built-in generator with predefined curves, arbitrary waveforms, and solar inverter simulation.

Scalable Parallel Operation: Master-Slave and Share Bus allow up to 64 devices to operate as a unified system, achieving up to 1920 kW.

EA-ELR 10000 4U 30 kW

Programmable electronic DC loads
with energy recovery



Features

- Wide range AC input: 208 V - 480 V, +10%, 3ph AC
- Active Power Factor Correction: Typical 0.99
- Regenerative: With energy recovery into the grid
- Very high efficiency: Up to 96%
- High performance: 30 kW per unit
- Voltages: From 0 - 80 V up to 0 - 2000 V
- Currents: From 0 - 40 A up to 0 - 1000 A
- Flexible, power-regulated DC 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 regulation 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
- Battery test mode
- Solar inverter test mode (MPPT)
- 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



Options

- Water Cooling in stainless steel

SPECIFICATIONS

AC Input

- **Voltage, Phases:**
 - Range 1: 208 V, $\pm 10\%$, 3ph AC (with DC input power derating to 18 kW)
 - Range 2: 380 - 480 V, $\pm 10\%$, 3ph AC
- **Frequency:** 45 - 65 Hz
- **Power factor:** ca. 0.99
- **Leakage current:** <10 mA
- **Inrush current / Phase current:** ≤ 56 A
- **Overvoltage category:** 2

DC Output (static)

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

Protective Functions

- **OVP:** Overvoltage protection, adjustable 0 - 110% UNominal
- **OCP:** Overcurrent protection, adjustable 0 - 110% INominal
- **OPP:** Overpower protection, adjustable 0 - 110% PNominal
- **OT:** Overtemperature protection (DC input shuts down in case of insufficient cooling)

DC Input (Dynamic)

- **Rise time 10 - 90% CC:** ≤ 2 ms
- **Fall time 90 - 10% CC:** ≤ 2 ms

Insulation

- **AC input to DC input:** 3750 Vrms (1 minute, creepage distance >8 mm) *1
- **AC input to case (PE):** 2500 Vrms
- **DC input to case (PE):** Depending on the model, see model tables
- **DC input 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 input on/off, resistance mode on/off
- **Outputs:** Monitor U and I, alarms, reference voltage, DC input 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:** ≤ 2000 m ($\leq 6,600$ 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)

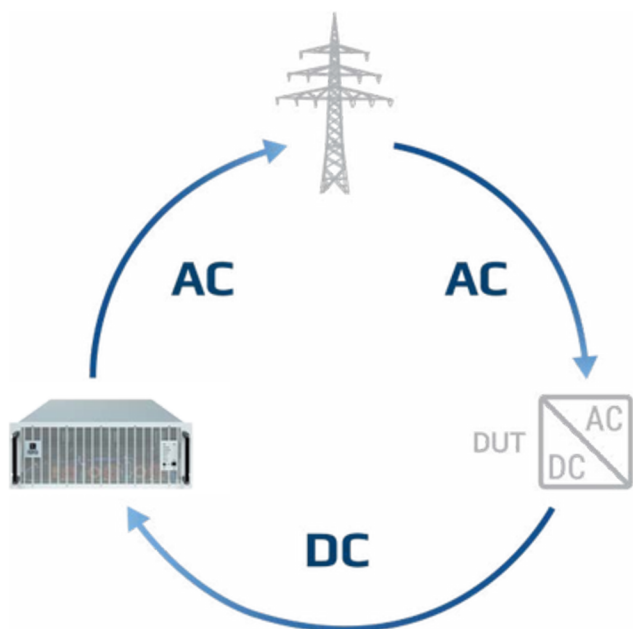
Available Models

Specifications	ELR 10080-1000	ELR 10200-420	ELR 10360-240	ELR 10500-180	ELR 10750-120
Voltage Range (V)	0 - 80 V	0 - 200 V	0 - 360 V	0 - 500 V	0 - 750 V
Ripple in CV (rms)	≤25 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)	≤320 mV (BW 20 MHz)	≤300 mV (BW 20 MHz)	≤320 mV (BW 20 MHz)	≤350 mV (BW 20 MHz)	≤800 mV (BW 20 MHz)
UMin for IMax (V)	0.6 V	1.8 V	2.5 V	1.1 V	1.2 V
Current Range (A)	0 - 1000 A	0 - 420 A	0 - 240 A	0 - 180 A	0 - 120 A
Power Range (W)	0 - 30,000 W	0 - 30,000 W	0 - 30,000 W	0 - 30,000 W	0 - 30,000 W
Resistance Range (Ω)	0.003 - 5 Ω	0.0165 - 25 Ω	0.05 - 90 Ω	0.08 - 170 Ω	0.2 - 370 Ω
Input Capacitance (μF)	25,380 μF	5,400 μF	1,800 μF	675 μF	450 μF
Efficiency (up to)	95.5% *1	95.3% *1	95.8% *1	96.5% *1	96.5% *1

Specifications	ELR 10920-125	ELR 11000-80	ELR 11500-60	ELR 12000-40
Voltage Range (V)	0 - 920 V	0 - 1000 V	0 - 1500 V	0 - 2000 V
Ripple in CV (rms)	≤200 mV (BW 300 kHz)	≤300 mV (BW 300 kHz)	≤400 mV (BW 300 kHz)	≤400 mV (BW 300 kHz)
Ripple in CV (pp)	≤800 mV (BW 20 MHz)	≤1600 mV (BW 20 MHz)	≤2400 mV (BW 20 MHz)	≤2400 mV (BW 20 MHz)
UMin for IMax (V)	2 V	3.4 V	3.2 V	3.7 V
Current Range (A)	0 - 125 A	0 - 80 A	0 - 60 A	0 - 40 A
Power Range (W)	0 - 30,000 W	0 - 30,000 W	0 - 30,000 W	0 - 30,000 W
Resistance Range (Ω)	0.25 - 550 Ω	0.4 - 650 Ω	0.8 - 1500 Ω	1.7 - 2700 Ω
Input Capacitance (μF)	300 μF	200 μF	75 μF	50 μF
Efficiency (up to)	96.5% *1	95.8% *1	96.5% *1	96.5% *1

General

The ELR 10000 4U series from EA Elektro-Automatik represents a new standard in programmable electronic loads. These regenerative devices efficiently return consumed DC energy to the grid, offering up to 96% efficiency. With models spanning a wide range of voltages and currents, from 0–80 V to 0–2000 V and up to 1000 A, they cater to diverse applications. Their flexible autoranging input stages deliver precise performance across varying conditions, making them ideal for both industrial and laboratory environments. By integrating advanced parallel operation capabilities, these devices can be scaled to meet the most demanding requirements, delivering up to 1920 kW and 64,000 A in unified systems.



The Principle of Energy Recovery

Energy recovery transforms the way electronic loads operate by reintegrating consumed energy into the grid. As a device under test (DUT) draws power, the ELR 10000 converts this DC energy into AC and efficiently transfers it back to the power network. This process not only saves energy but also extends the lifetime of testing systems by minimizing heat buildup and operational strain, making it an ideal solution for high-demand testing environments.

AC Connection

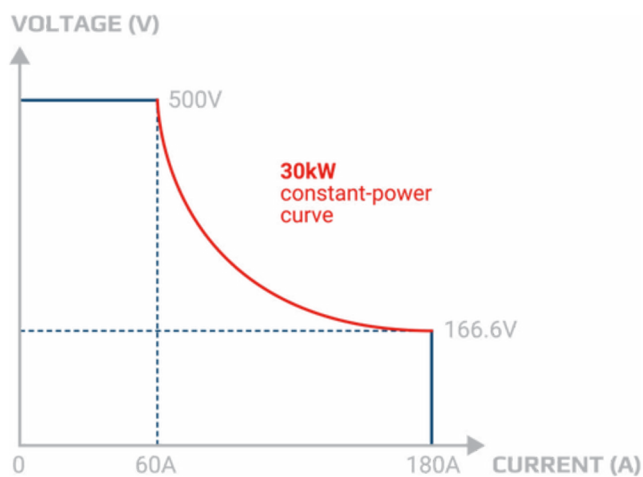
Designed with an active Power Factor Correction (PFC) system, the ELR 10000 4U series ensures highly efficient operation with minimal energy waste. The wide AC input range accommodates global grid standards, from 110/120 V to 480 V across single-phase and three-phase configurations. With seamless automatic adjustment to grid voltage, these devices eliminate the need for manual configurations, ensuring quick deployment and reliable performance even in regions with varying power standards.

Energy Recovery

The ELR 10000 4U series excels in energy recovery, converting consumed DC energy back into AC and feeding it into the grid with an impressive 96% efficiency. Unlike traditional loads that dissipate energy as heat, these devices reduce energy costs and thermal management requirements. This eco-friendly approach not only minimizes operational expenses but also makes the system more sustainable, enhancing its appeal for modern energy-conscious facilities.

DC Input

The flexible DC input stages of the ELR 10000 4U provide unparalleled versatility, supporting voltages ranging from 0–80 V to 0–2000 V and currents up to 1000 A. The autoranging feature ensures optimal performance across diverse load conditions, offering constant power delivery across a wide range of voltage and current combinations. This flexibility simplifies system design, enabling engineers to handle multiple applications with a single device.



The Principle of Autoranging

Autoranging technology redefines flexibility by automatically adjusting voltage and current ranges to maintain maximum power output. This eliminates the need for multiple devices to handle varying test conditions, enabling a single unit to adapt to diverse applications. With autoranging, engineers can streamline their workflows, reduce costs, and improve efficiency across their testing systems.

Function Generator

Each model in the ELR 10000 4U series includes a built-in function generator, offering predefined waveforms such as sine, triangle, square, and trapezoid. For advanced testing, the arbitrary generator allows custom voltage and current profiles, enabling engineers to simulate real-world conditions with precision. The ability to save and reload test sequences simplifies repetitive testing, while solar inverter simulation further extends its application versatility.

Interfaces

The ELR 10000 4U series offers comprehensive connectivity options, ensuring seamless integration into any system. Standard built-in interfaces include USB, Ethernet, and an analog port, all galvanically isolated for safety and performance. Optional industrial interfaces such as CAN, RS232, Profinet, and EtherCAT enhance compatibility, supporting automated and complex testing setups with ease.

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 back-panel DC input connections use durable copper blades, ensuring efficient and secure connectivity. When higher power performance is required, multiple devices can be easily connected in parallel using vertical copper rails, forming high-performance systems with minimal effort. A protective cover enhances safety, making the setup both reliable and user-friendly.

High-Performance Systems

Scale your testing capabilities with the ELR 10000 4U series. These devices enable the creation of high-power systems delivering up to 1920 kW in compact configurations. A 19-inch cabinet can house up to 240 kW of power in a footprint of just 0.6 m² (6.5 sqft), maximizing performance while conserving space. These modular solutions cater to high-demand industries, ensuring flexibility and efficiency.

Master-Slave-Bus and Share-Bus

The master-slave bus and Share Bus simplify the management of multi-device systems by enabling them to operate as a single cohesive unit. The master-slave bus consolidates system data, displaying total power and current on the master device, while the Share Bus ensures balanced load distribution. This intuitive integration reduces complexity, enhances performance, and ensures reliability in large-scale operations.



Example Representation

A fully assembled and operational 240 kW system.

Applications

Battery Test for Electro Mobility

The ELR 10000 series is perfectly suited for comprehensive battery testing in the field of electromobility. Whether assessing individual cells, modules, or entire battery packs, these devices deliver highly accurate measurements of voltage and current. They are ideal for State-of-Health (SOH) evaluations, second-life classifications, and end-of-line (EOL) tests. With a flexible design, the ELR 10000 supports seamless integration into automated test systems or standalone laboratory setups, delivering up to 96% efficiency to maximize cost-effectiveness.

Fuel Cell Test

Fuel cell testing is enhanced with the precision and reliability of the ELR 10000 series. These devices handle stack and system-level evaluations with reproducible results, making them indispensable for resistance, performance, and durability assessments. The integrated energy recovery system ensures energy-efficient operations, while parallel device configurations enable testing of high-current systems without compromising on accuracy or performance.

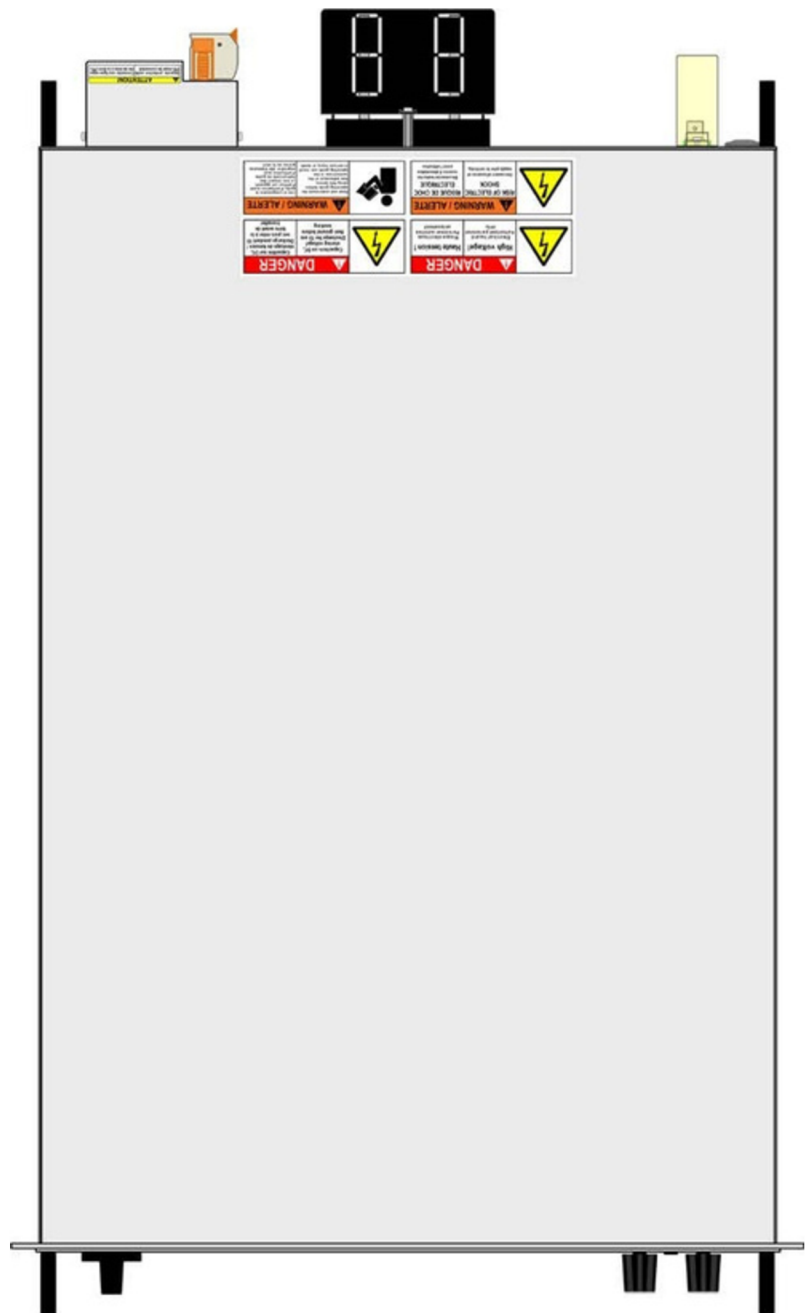
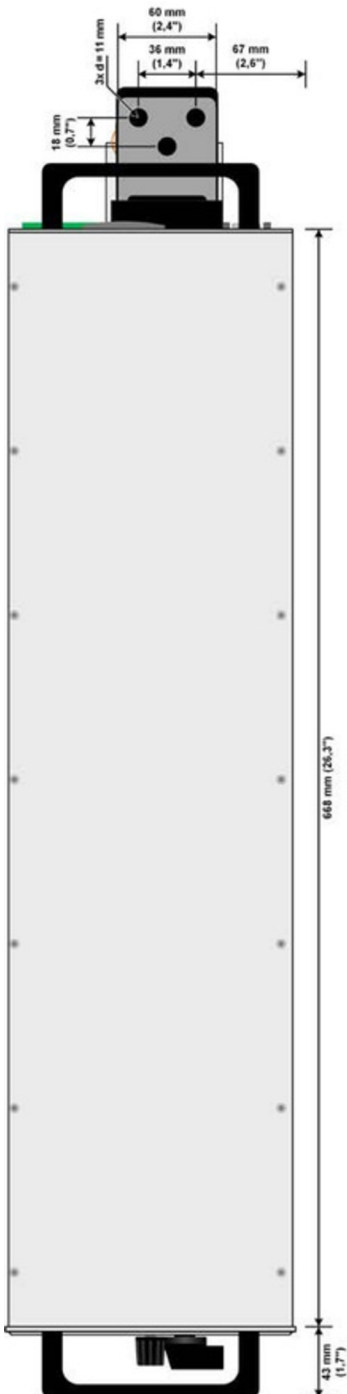
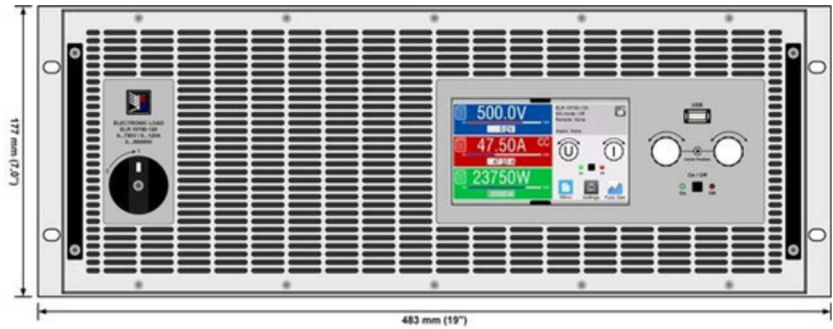
On-Board Charger Test

On-board charger (OBC) testing demands flexibility and precision, both of which the ELR 10000 delivers with ease. The built-in sequencing and logging functions simplify data collection for dynamic tests, while adjustable voltage regulation speeds eliminate conflicts between the test device and the charger. Compatible with EA's PS 10000 and PSI 10000 power supplies for source/sink operation, this system is ideal for creating realistic and reproducible test conditions.

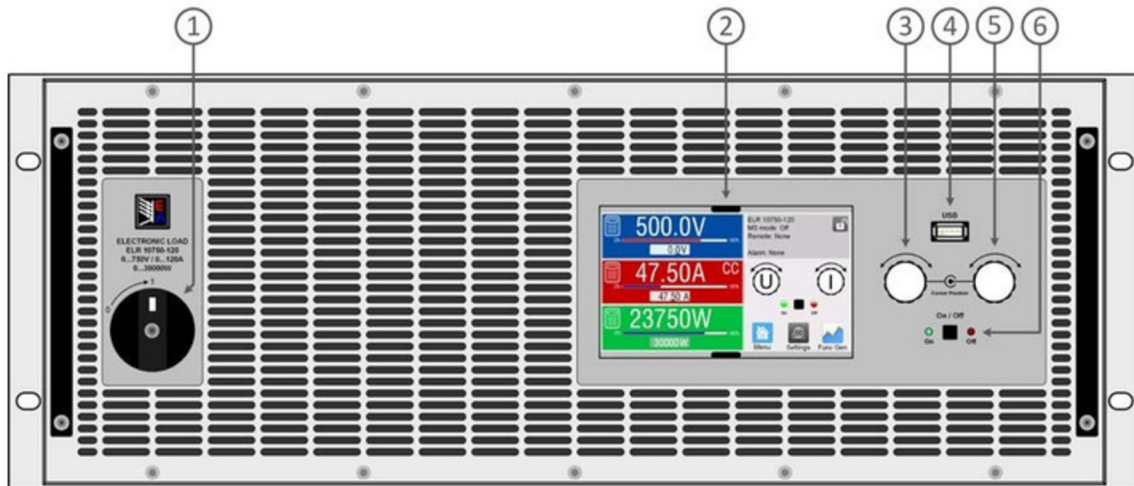
Battery Recycling

The ELR 10000 series plays a critical role in battery recycling, starting with a State-of-Health (SOH) evaluation to determine if a second life is viable. For end-of-life batteries, the device ensures a complete discharge process, even at voltages below 2 V, using its autoranging feature. With 96% efficiency and energy recovery to the grid, the ELR 10000 minimizes operational costs while promoting sustainable recycling practices.

Technical drawings ELR 10000 4U <200 V

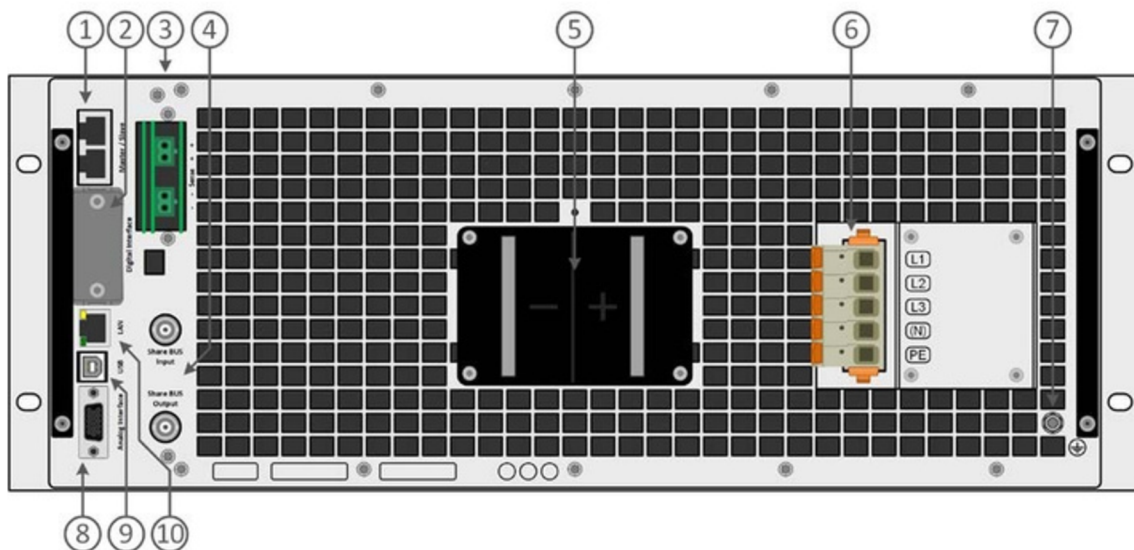


Front panel description ELR 10000 4U



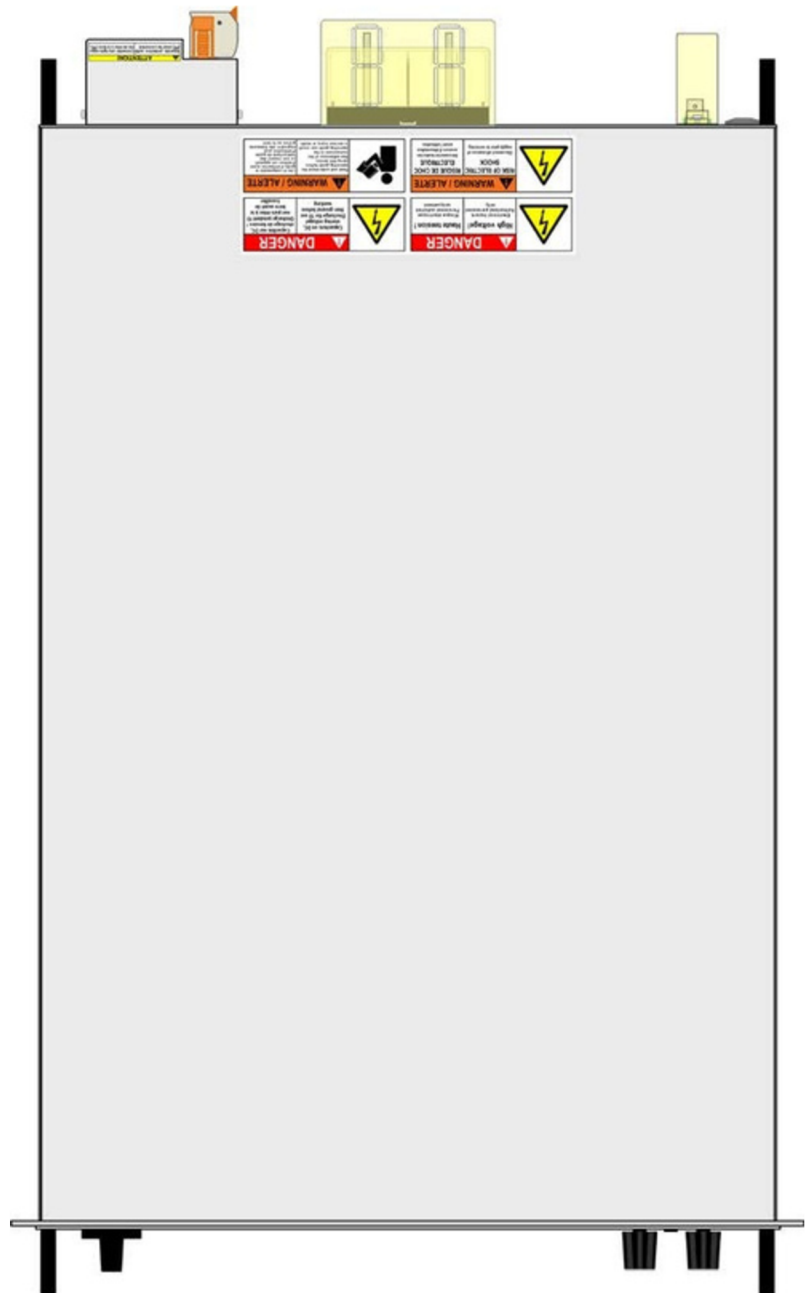
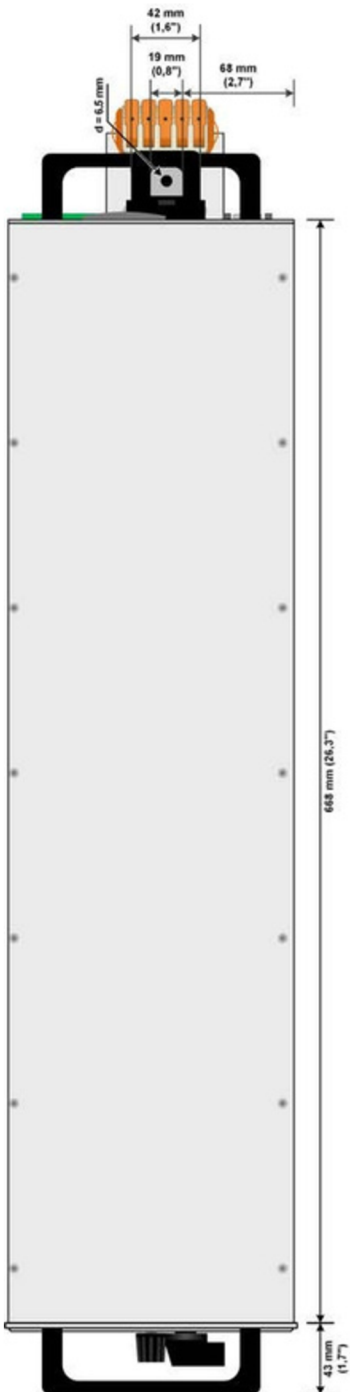
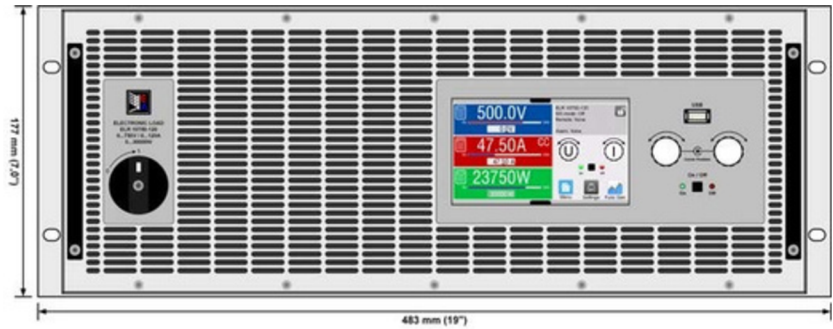
1. Power switch
2. TFT control interface, interactive operation and display
3. Rotary knob with push-button action, for settings and control
4. USB host, uses USB sticks for data logging and sequencing
5. Rotary knob with push-button action, for settings and control
6. On / Off push-button with LED status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

Rear panel description ELR 10000 4U <200 V

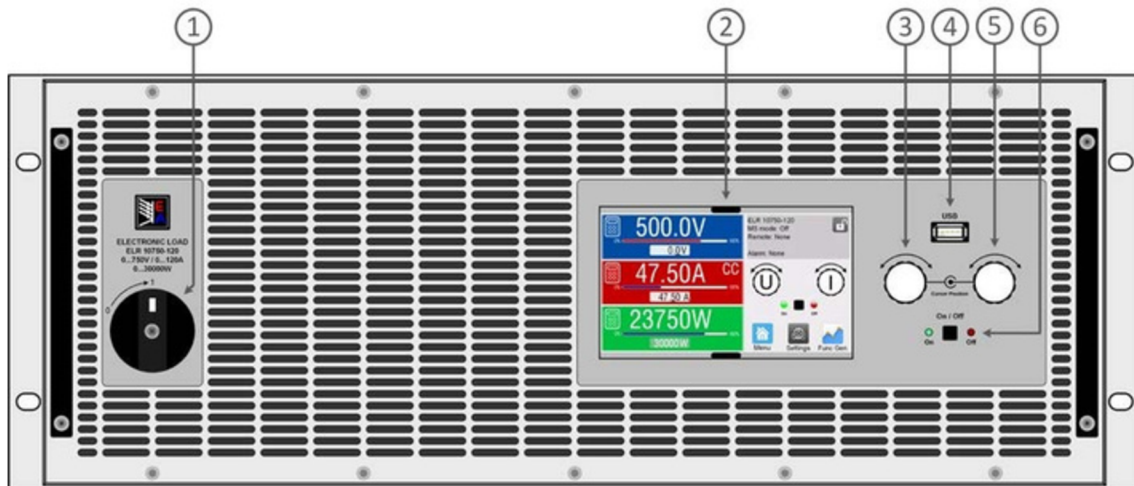


1. Master-Slave-Bus connectors to set up a system for parallel connection
2. Slot for interfaces
3. Remote sense connectors
4. Share bus connectors to set up a system for parallel connection
5. DC input terminal (copper blades)
6. AC input connector
7. Grounding connection screw (PE)
8. Connector (DB15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

Technical drawings ELR 10000 4U >360 V

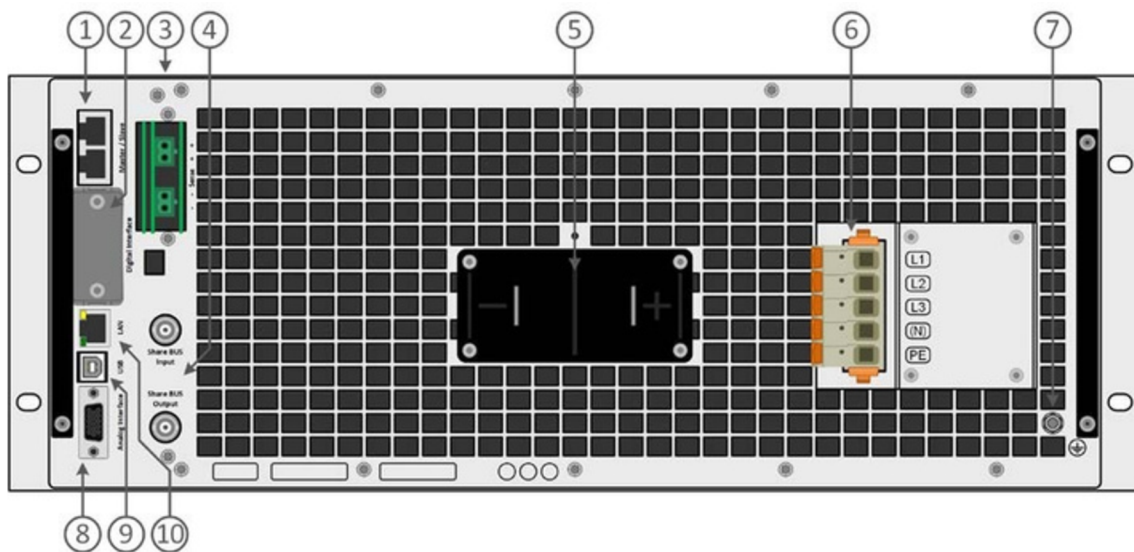


Front panel description ELR 10000 4U



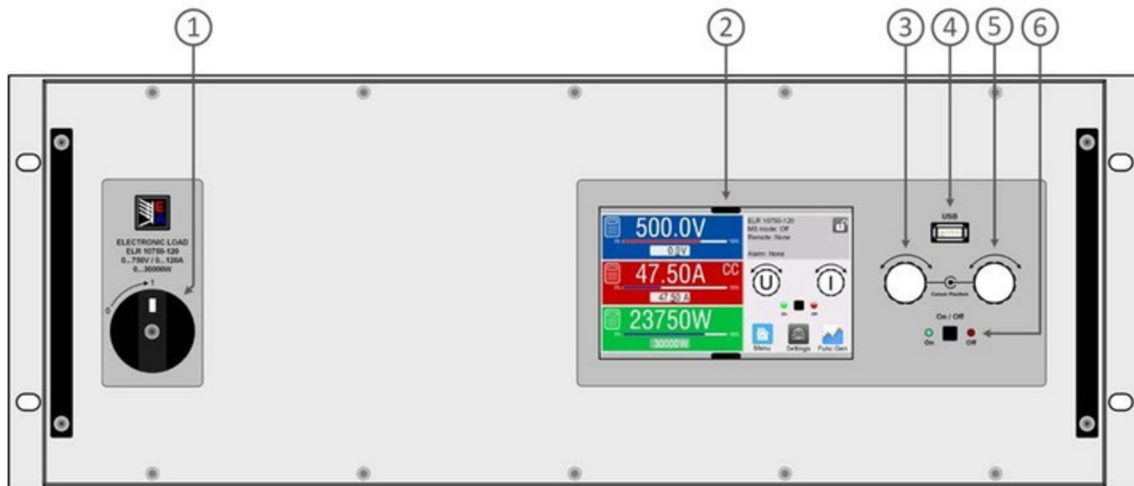
1. Power switch
2. TFT control interface, interactive operation and display
3. Rotary knob with push-button action, for settings and control
4. USB host, uses USB sticks for data logging and sequencing
5. Rotary knob with push-button action, for settings and control
6. On / Off push-button with LED status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

Rear panel description ELR 10000 4U >360 V



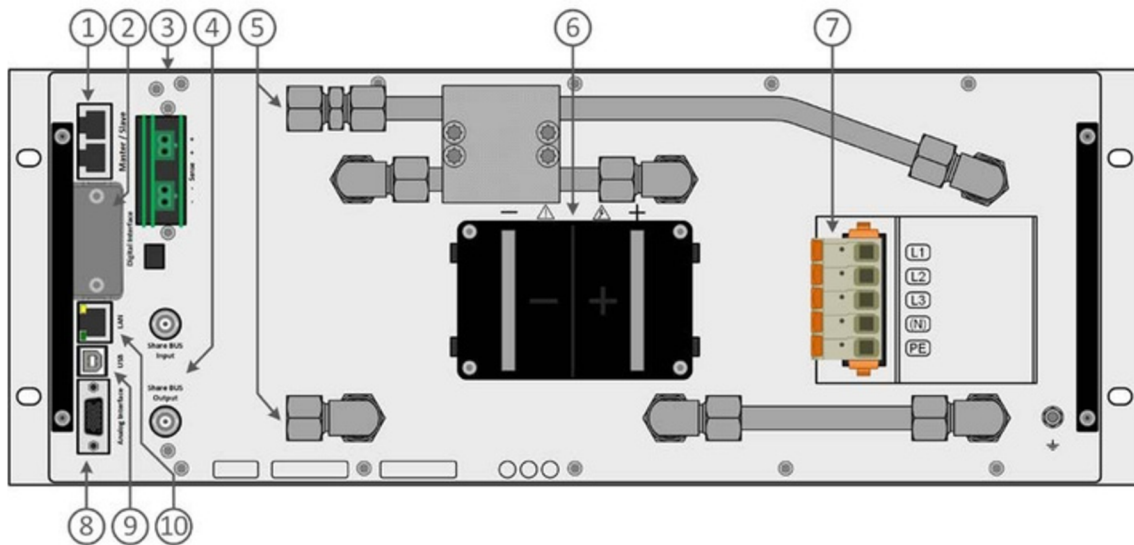
1. Master-Slave-Bus connectors to set up a system for parallel connection
2. Slot for interfaces
3. Remote sense connectors
4. Share bus connectors to set up a system for parallel connection
5. DC input terminal (copper blades)
6. AC input connector
7. Grounding connection screw (PE)
8. Connector (DB15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

Front panel description ELR 10000 4U with Water Cooling option



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

Rear panel description ELR 10000 4U with 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 input terminal (copper blades)
7. AC input connector
8. Grounding connection screw (PE)
9. Connector (DB15 female) for isolated analog programming, monitoring and other functions
10. USB interface
11. Ethernet interface

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

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

