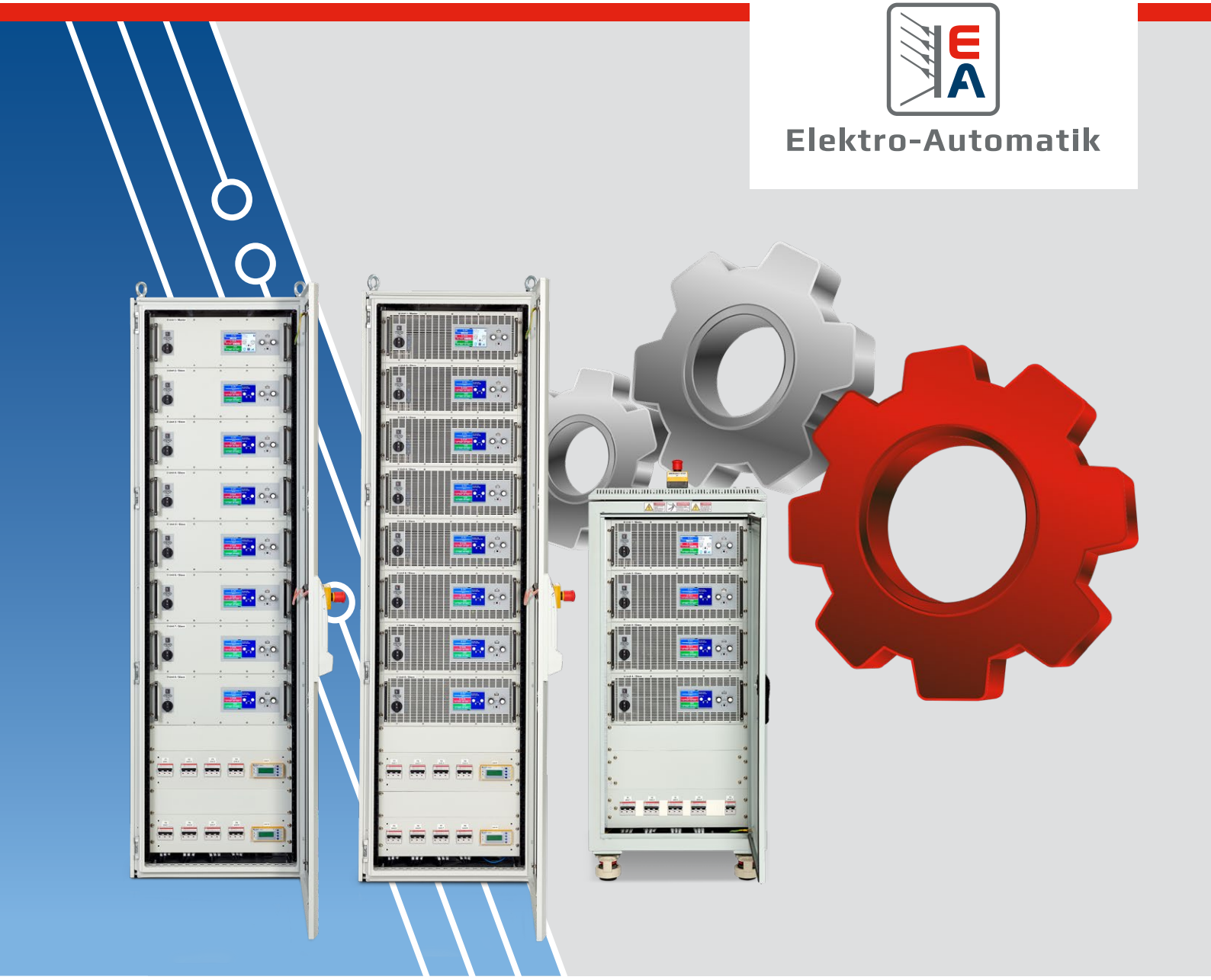
Elektro-Automatik



APPLICATION NOTE:
ADDRESSING THE CHALLENGES OF SPECIFYING AND MAKING POWER RACKS

SPECIFYING AND MAKING POWER RACKS

Programmable DC power supplies are key components for both production testing and product development in everything from photovoltaic technology to battery and fuel cell testing. The complexities that go into specifying, designing, and building these power racks are growing with ever-evolving applications that demand higher power and faster response times with the ability to simulate complex operating scenarios. As these test systems grow in complexity, so do their respective layout, air/water cooling systems, and wiring.

EA Elektro-Automatik offers solutions that address these challenges head-on with robust power supply units and turnkey power racks that are certified to EN 60204-1, UL 508, and NFPA 79. This article explores the common challenges faced by engineers when employing power racks and how EA Elektro-Automatik's turnkey solutions provide a safe, user-friendly alternative to custom designs.

THE CHALLENGE OF DESIGNING FOR SAFETY COMPLIANCE

The build out of a power rack, by its very nature, involves compliance with safety standards to ensure the user can properly operate high powered equipment without damage to the rack or the user - but understanding the scope of application standards, certification, and local requirements is a task in and of itself. There are quite a few compliance standards for power equipment, and different regions will have different standards. Ensuring that the power rack meets the customers needs and can be deployed according to the proper standard can be a laborious duty.

Several international safety standards can be used for compliance. For example, the European Norm (EN) 60204-1 standard provides both requirements and recommendations related to electrical equipment to promote:

- The safety of persons and property
- The consistency of control response
- The ease of operation and maintenance

This includes specifications for devices for switching off, protection against electrical shock, protection of equipment, control functions to operator interface, location, mounting, enclosures, wiring practices, and warning signs in the designated area. The block diagram for a typical machine is shown in ***Figure 1*** where the appropriate protective circuitry and disconnect switches are listed.

The national fire protection association (NFPA) 79 standard features very similar specifications for industrial machinery as the EN 60204-1 standard; however, the NFPA 79 standard is more detailed with a comprehensive description of the equipment, installation and mounting, as well as the connection to the electrical supply with schematics instead of more basic block diagrams. The NFPA 79 standard elaborates on the machine's operating environment, operator interface, warning signs, documentation, and testing. This means that a power rack that is compliant with the EN 60204-1 standard may not necessarily meet the requirements of the NFPA 79 standard. The very same principles can be applied to the North American UL 508 standard, where both the EN and NFPA standards do not precisely line up despite the many similarities between them. For instance, the European and North American standards both use different methodologies for determining a system's short-circuit current rating (SCCR).

TURNKEY EA-POWER RACK SOLUTIONS

This is where EA Elektro-Automatik's turnkey power rack solutions offer a significant advantage to customers. All of their power racks are built in accordance with European (EN 60204-1) and North American (UL 508 and NFPA 79) standards, so they can be used in these regions and still be within compliance: operators are protected from any potential electrical danger, the doors are keyed for safety, and all interfaces are galvanically isolated for user safety. Moreover, the racks have a convenient bus bar that allows users to connect all the DC terminals together in parallel for higher current and higher power, and bus bar covers are provided to protect operators that might inadvertently touch the bus bar.

Figure 1
Block diagram of a typical machine

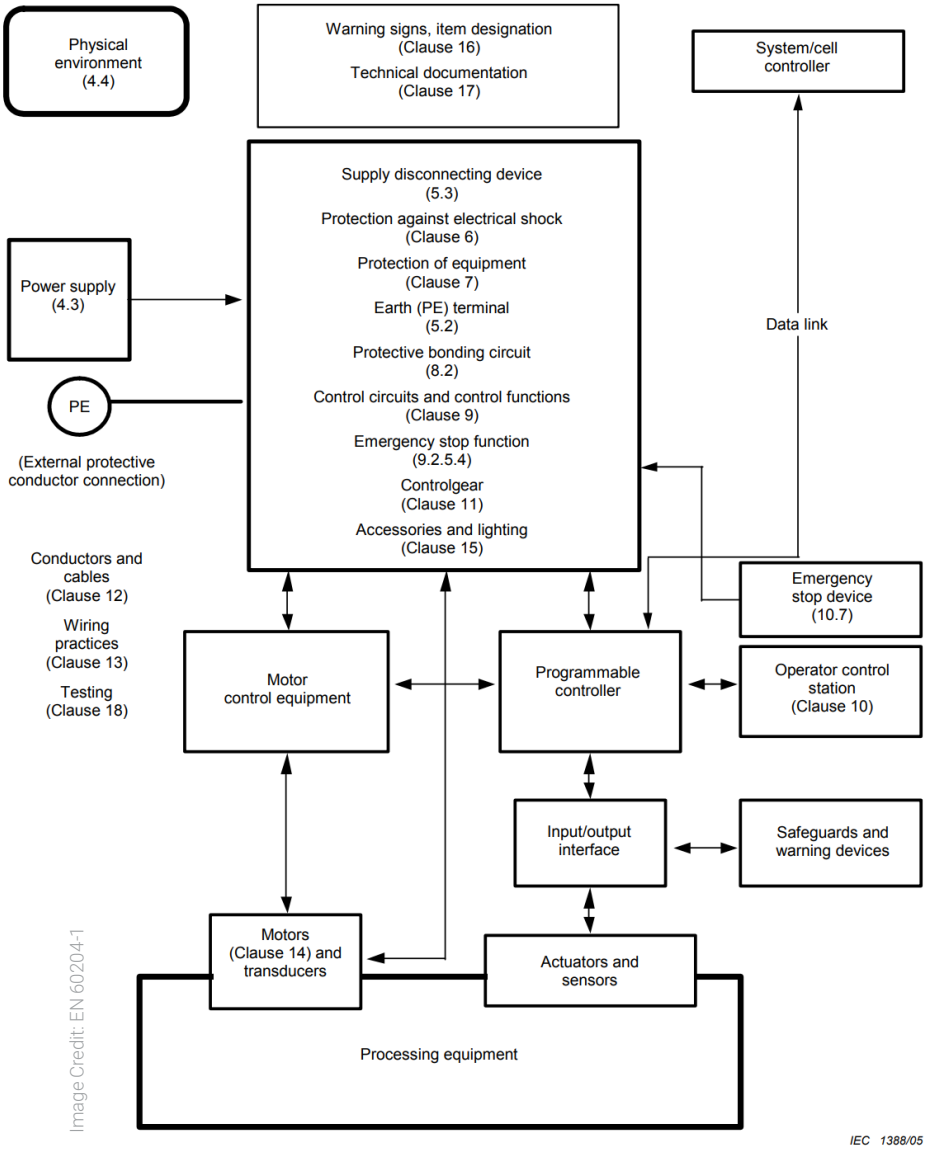


Image Credit: EN 60204-1

SAFETY

As shown in *Figure 2*, a 24 V safety circuit is wired to a front panel emergency stop switch that kills power when required. It also has a door interlock that shuts off power in the event that a user inadvertently opens the doors. Both of these safety circuits ensure the power racks are benign and safe to touch.

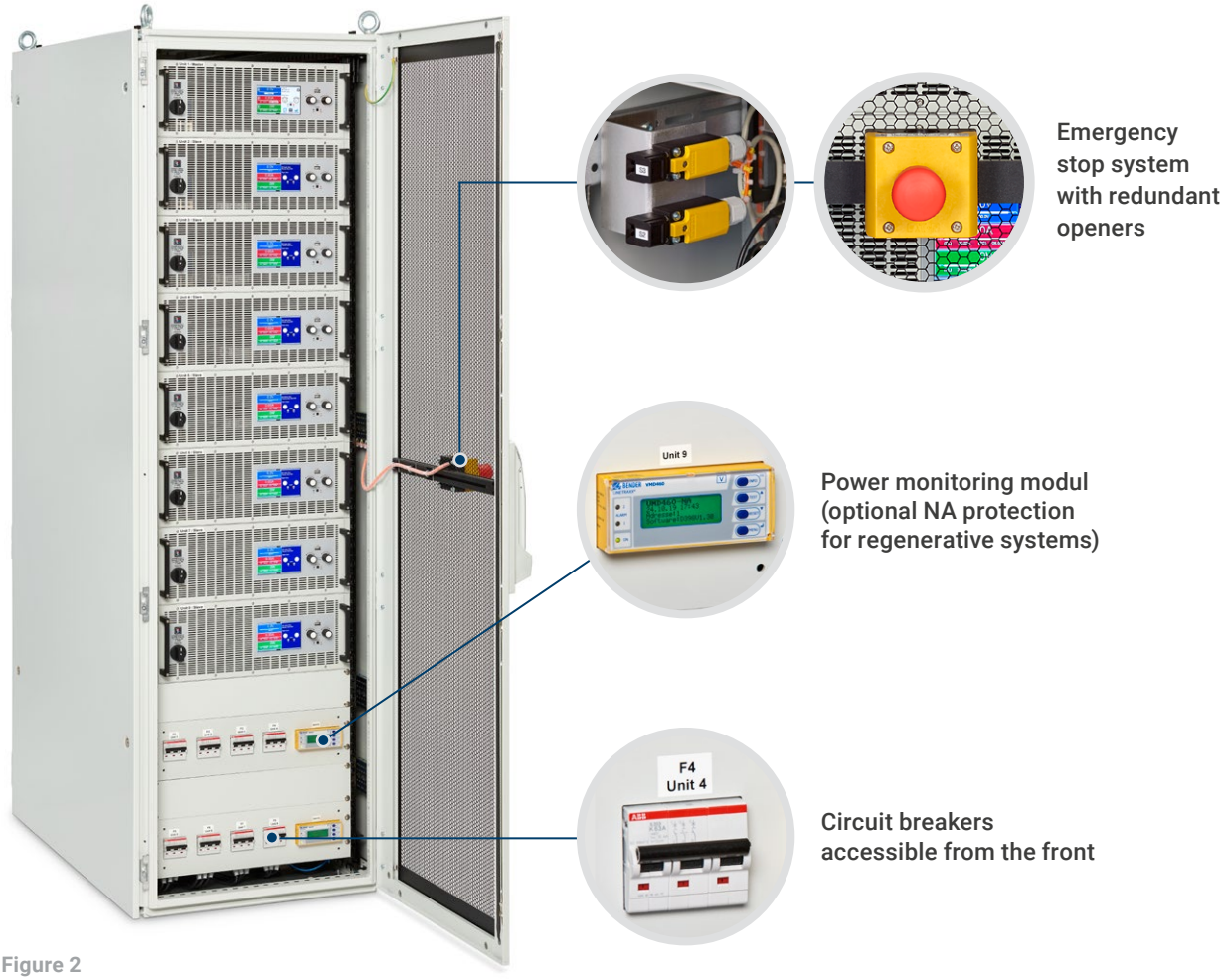


Figure 2

INCORPORATING USER-FRIENDLY DESIGN ELEMENTS

SIMPLICITY IN HEAT DISSIPATION DESIGN

DC power racks will inevitably generate large amounts of heat that could potentially have an adverse effect on performance, reliability, and the operational lifetime of the equipment. This is especially true within an enclosure where hot spots can and will build up during operation. Between wiring, cooling, and installation, power racks that are meant to be user-friendly can easily grow in complexity.

EA Elektro-Automatik's 15U and 24U height DC racks have a power range from 30 kilowatts (kW) up to 120 kW while the large 42U DC racks have up to 240 kW in 19" cabinets -- providing up to nearly 2 MW of power in a 0.6 m2 floor space. The racks provide voltage ratings up to 2,000 volts and current ratings up to 8,000 amps per cabinet and can be paralleled for up to 1.92 megawatts (MW) of total power output. The DC power racks have an optional built-in water distribution system for each of the eight internal units (***Figure 3***) that are designed in accordance with NFPA 79 where the tubing is "not located in enclosures or compartments containing electrical equipment."

This greatly simplifies design where liquid convective cooling is far more effective than the conventional forced air cooling found in most power racks. Even in the event that air cooling is used, the installed doors have a mesh that can allow for sufficient air circulation (again simplifying how users interface with the system).

MOVABILITY

Racks are bulky items that are extremely difficult to move, especially when the power supplies have already been installed. Some racks are created with fork lift bases to lift these steel cabinets; however, this requires large machinery to move around in an open space -- an option that isn't necessarily available for all users. EA Elektro-Automatik's DC power racks come with eye bolts to top lift the rack as well as adjustable feet to easily roll the rack around and set it at a particular height. These feet also allow users to add a brake to prevent the rack from moving once it has been moved to a suitable location within a facility.

EASY-TO-USE WIRING

The AC input wiring is prewired to make it easy to install the power supplies, and the separate breakers per unit allow the user to easily shut off individual supplies without impacting the entire rack. The shelves are prebuilt to readily fit power supply units. All the proper hardware is supplied to secure these units to the front of the rack and to install the bus bar. Panels are also provided to block off shelves that do not have a unit installed. A color TFT touch panel display allows for intuitive operation with multiple language options available (refer to ***Figure 2***). As shown in ***Figure 4***, communication between units is simple to establish during installation. The power racks come with the appropriate ethernet cable for the master, slave connection between units. BNC cables are also provided to go in between each chassis for paralleling. The master-auxiliary bus system allow data such as total power and total current to be collected and shown in the master device.

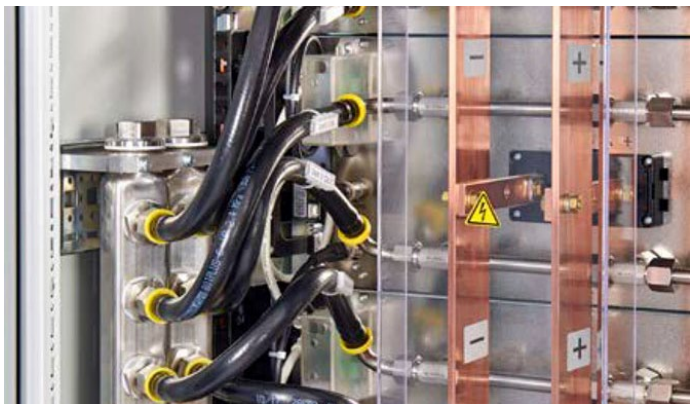


Figure 3
Close-up of the water distribution of the 240 kW cabinet with eight units and water cooling.

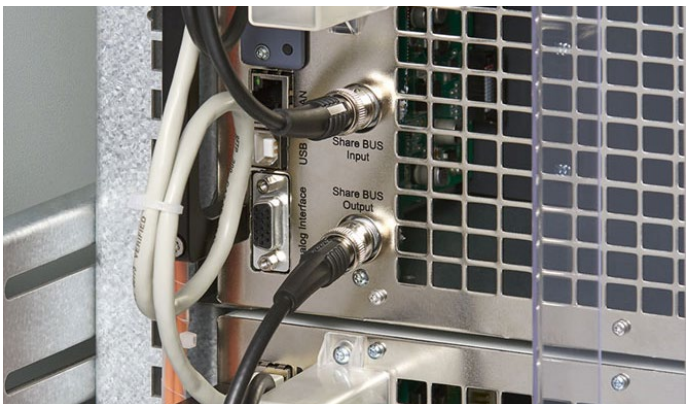


Figure 4
Close-up view of the share bus connected via BNC cables and master-slave bus connected with ethernet cables.

THOROUGH DOCUMENTATION TO MEET SAFETY STANDARDS

All of the standards require appropriate technical documentation that includes the installation diagram, circuit diagram, parts list, programming, sequence of operation, adjustment, maintenance, and more. This is one of the most basic but important requirements of a rack-mount system in order to supply the user with the information necessary to safely use and maintain the equipment. ***Figure 5*** shows the wiring scheme for the 24U DC power racks found in the installation guide.

Easy access to this information is paramount. Outside of the basic installation and safety of the power rack, the right software and documentation are also necessary to more easily enable communications between power supply units. EA Elektro-Automatik's turnkey power racks have full documentation so users can assemble, operate, and disassemble power racks safely and with ease. Each rack comes with a QR code that links to all documents, manuals, and software for the power rack.

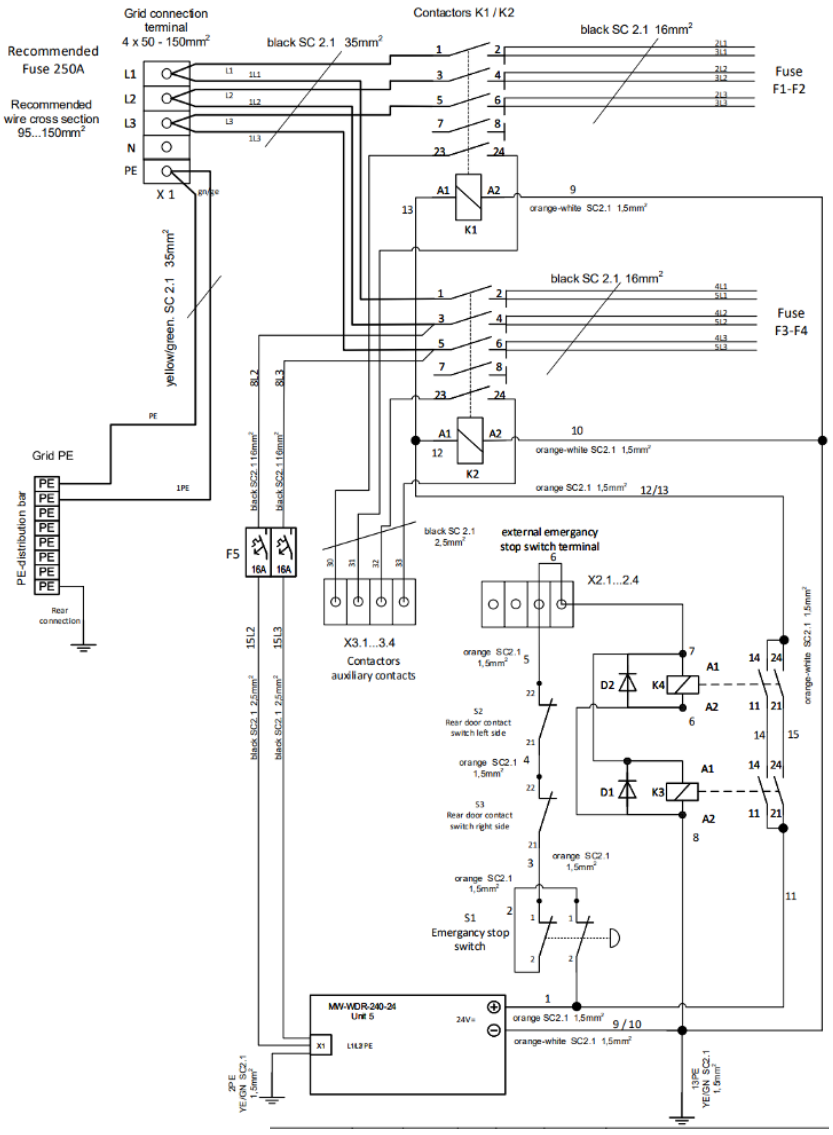


Figure 5
Wiring scheme for the 24U power rack in the installation guide.

POTENTIAL USE CASES FOR EA ELEKTRO-AUTOMATIK'S TURNKEY POWER RACKS

The 19" rack can be designed as pure DC sources using EA Elektro-Automatik's PS, PSI, and PSB programmable power supplies. All of EA Elektro-Automatik's power supplies are true autoranging supplies that automatically adjust current higher at lower voltages, and vice versa, to maintain full power across a wide range of testing requirements. This diverges from the more conventional square power profile of many power supplies where the device under test (DUT) would have to stay within the maximum current or voltage rating of the power supply. With an autoranging supply, users can test either multiple devices with various voltage and current ratings or, a singular device under test (DUT) that might operate under a wide input voltage range by drawing constant power under different input (current and voltage) conditions (e.g. DC motor drive). This greatly expands testing flexibility and power supply versatility.

The cabinet system can also be designed as a pure sink with electronic loads using the ELR series of power supplies. The ELR series are regenerative electronic loads that save power and cost by sink/absorb current and recover up to 96% of that current, putting it back to the local power grid (***Figure 6***). The regenerative loads also offer an alternative to the traditional method of conducting burn-in test using inexpensive resistive load banks which convert the power output to heat that typically requires fan/water cooling which causes large energy costs. The energy recovery efficiency can reduce heat, noise, and HVAC costs due to significantly cooler operation. Furthermore, if a user wants a mix of source and sink capability, EA Elektro-Automatik power supplies can be both conventional (PS and PSI series) or bidirectional (PSB series) with loads are both conventional or regenerative (ELR series).

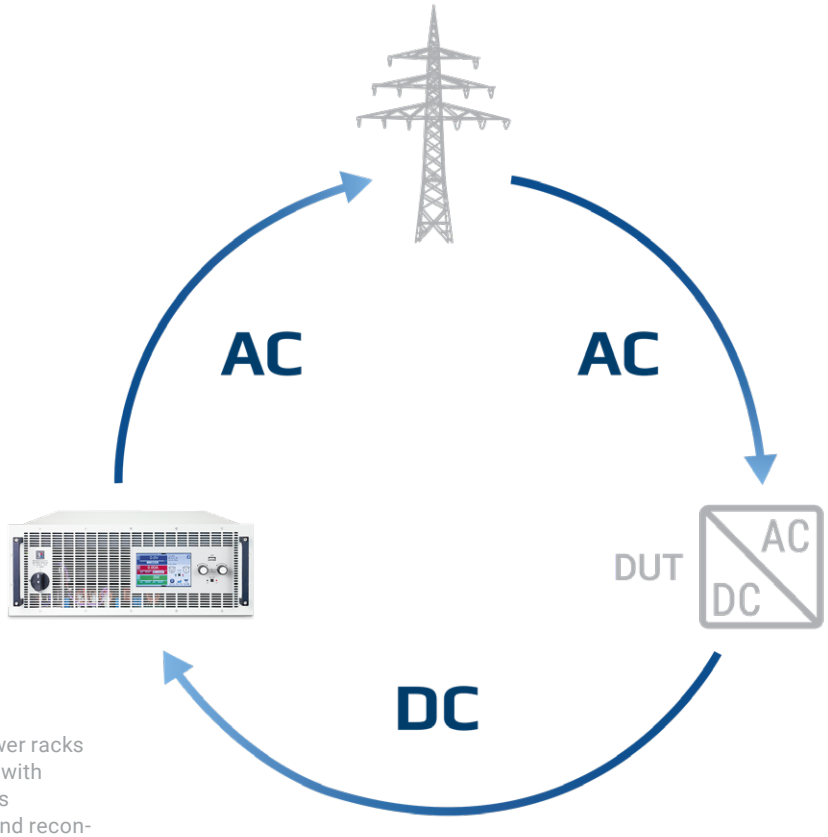


Figure 6
EA Elektro-Automatik's power racks can function as a pure sink with regenerative power supplies taking in AC from the grid and reconverting it at up to 96% efficiency.

CONCLUSION

EA Elektro-Automatik's turnkey DC power rack solutions make paralleling DC power supplies for more power a much safer operation that is in compliance with both European and North American standards. The full documentation, ease-of-use, and support granted by EA Elektro-Automatik allow users to more optimally take advantage of their power rack systems. Using these racks in tandem with EA Elektro-Automatik's power supplies allows users to leverage the power supplies with autoranging and regenerative loads to serve their testing and operational needs.

To get more information about EA-Power Racks please visit:

www.elektroautomatik.com

SERVICE FOR YOU WORLDWIDE.

At the headquarter in Germany in the industrial centre of North Rhine Westphalia more than 300 qualified associates, in a facility of 21000 m², research, develop and manufacture high-tech equipment for laboratory power supply, high power mains adaptors and electronic loads with or without power feedback. The sales network includes branches in China and USA, sales office in Spain and an extensive partner network.

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