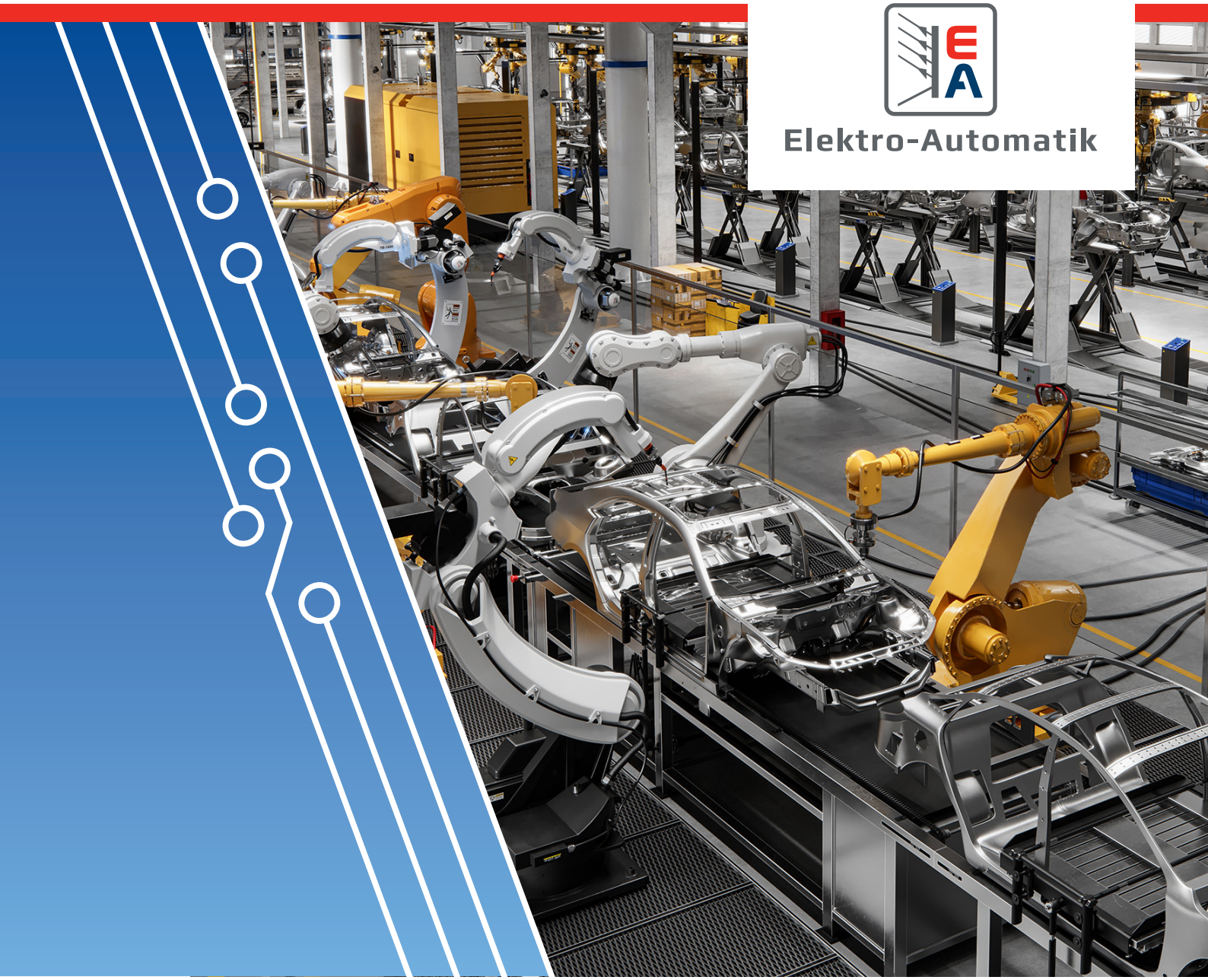
Elektro-Automatik



WHITE PAPER:

ENERGY, SPACE, AND COSTS WITH HIGH-POWER SYSTEMS WHEN TRANSITIONING FROM THE LAB TO MANUFACTURING

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INTRODUCTION

The design is complete, and performance has been validated. The test requirements are defined. Now, the test engineer is challenged to transition the design to the manufacturing floor.

The new product is a high-power system. It could be new power electronics for a renewable energy system, a technologically advanced electric vehicle or avionics system, a battery energy storage system, an energy management system for a server farm or an electrolysis manufacturing process. Other high-power applications could include testing and recycling batteries, testing fuel cells, or simulating batteries and solar energy systems. All these applications are rapidly progressing technologies, and, as a result, test parameters are evolving with each technological advancement.

When developing the manufacturing test system for a high-power application, the design engineer must achieve the following objectives:

- Designing a flexible system that can adapt to current and future test requirements
- Designing a safe and reliable system
- Minimizing capital costs and annual operating costs
- Minimizing consumption of manufacturing floor space
- Minimizing energy consumption

These challenges often involve difficult tradeoffs and make the design engineer's decisions problematic.

EA Elektro-Automatik offers a solution that eliminates the tradeoffs and allows the test design engineer to achieve all objectives easily – the EA 10000 Industrial series of bidirectional power supplies, power supplies and regenerative electronic loads. The family has 21 models of 60 kW instruments, including power supplies, regenerative bidirectional power supplies, and regenerative electronic loads. The family also includes 29 models of 30 kW power supplies, bidirectional power supplies, and electronic loads. Figure 1 shows the front panel and rear panel of a 10000 series industrial, 60 kW programmable power supply.

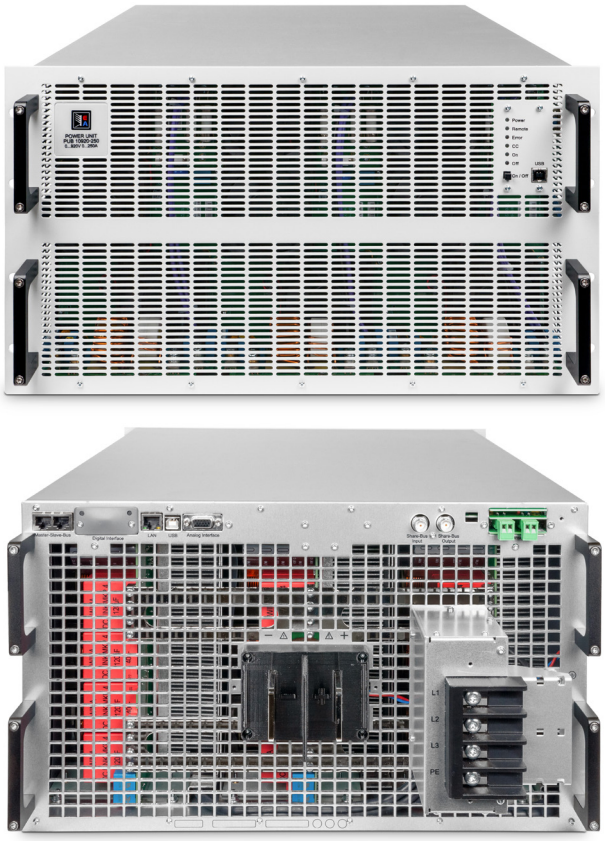

Figure 1. Front and rear panel of the 60 kW Industrial 10000 series instrument

HIGHEST POWER DENSITY FOR CURRENT AND FUTURE APPLICATIONS

With 60 kW in a single 6U high, full rack width enclosure and 30 kW in a 4U enclosure, the EA 10000 Industrial series instruments have the highest power density available. EA's innovative design uses SiC technology, which allows the compression of 60 kW in a 6U enclosure and 30 kW in a 4U enclosure. The design engineer only needs one power instrument to test a device whose total power requirement is either 30 kW or as much as 60 kW.

Models can source or sink as much as 2000 V, or 64,000 A. EA allows the design engineer to use an instrument that can meet system power requirements while providing headroom both for voltage and current. The key to this capability is the EA's exclusive TRUE autoranging output (input) characteristics of the 10000 Industrial series instruments.

Compared with a conventional instrument's rectangular characteristic, equivalently powered EA instruments can output (sink) a higher voltage range and a wider current range. The true autoranging characteristic, unlike a rectangular characteristic, can deliver (or sink) full power from the maximum rated voltage down to 1/3 of that voltage. A rectangular characteristic delivers (or sinks) full power only at one point, its maximum voltage and current. Figure 1 illustrates the true autoranging output characteristic of the 10000 series PU supplies, PUL regenerative loads and PUB bidirectional power supplies. With the wide voltage-current envelope of a single 10000 series instrument, the test engineer can meet the test requirements for the current product and its future version.

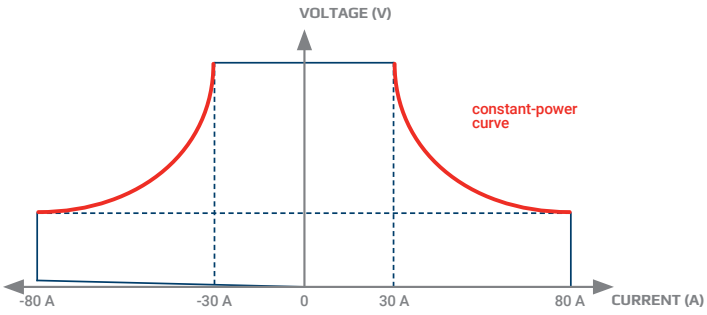

Figure 2. Output characteristic of a 10000 series 60 kW power supply

SAFETY WITH EXPANDED CAPACITY

With a high-power system, safety is paramount. For systems that require MWs of power, the EA 10000 series can connect up to 11 test racks containing a maximum of 64 industrial instruments of 60kW to build a system with 3.84 MW of capacity. A Share-Bus on each instrument allows Master instrument to both control and display the voltage and total current from all paralleled auxiliary instruments, which ensures that each instrument powers (or absorbs) an equal portion of the total load (source). The Share-Bus prevents instruments in the system from being subjected to a dangerous overload. The Share-bus enables safe and simplified connection for high power capacity. Figure 3 presents the rear interconnections of a 240 kW 4U test rack. The power lines are the copper bus bars running down the center of the test instruments. The clean wiring assembly contributes to safe and reliable performance.

Figure 3. Rear of a 240 kW test rack showing the simplified wiring designed for maximum safety and reliability

Each 10000 series instrument includes four protective functions to ensure safe test systems further. Each instrument has overvoltage protection, overcurrent protection, overpower protection, and overtemperature protection. The occurrence of any of those conditions can create an alarm and shut down the instrument to avoid further problems.

HIGHEST EFFICIENCY FOR ENERGY SAVINGS

The 10000 series regenerative bidirectional power supplies and the electronic loads can both absorb energy and return it to the power line with up to 96% efficiency. If a device-under-test outputs 30 kW, then a year's consumption of absorbed energy is 45,000 kW (based on 6 hours/day x 5 days/week x 50 weeks/year). The industrial series instruments can return up to 96.5% of that total energy, representing up to 43,425 kWh annual energy savings compared with a resistive bidirectional power supply or electronic load, which must absorb all power. That represents the energy savings for a single production line. Furthermore, returning energy to the power grid also reduces cooling requirements on the instrument, lowering the cooling infrastructure cost. For testing high-power sources, a regenerative instrument provides substantial utility cost savings and test system capital costs.

On the AC input side, the Industrial series power supplies employ active power factor correction to enhance efficiency even when delivering low power. More efficient sourcing and sinking allow instruments to operate at a lower temperature. Lower internal temperatures put less stress on components. As a result, the instruments, particularly the regenerative bidirectional supplies and electronic loads, are less susceptible to failure due to temperature effects than conventional power instruments.

SMALLEST MANUFACTURING SPACE

The high-power density of the 10000 industrial series allows 60 kW capacity in one 6U high, 48.3 cm (19-inch) rack wide enclosure. One standard 42U high rack can house six instruments, providing up to 360 kW capacity. Thus, the floor space to house 360 kW of capacity occupies only 0.6 m² (6.5 sq ft). That much capacity in one test rack can result in significant annual savings in test overhead costs.

THE MOST FLEXIBLE AUTOMATION

The 10000 series instruments can interface with either a personal computer (PC) or a programmable logic controller (PLC). The instruments have the SCPI or ModBus command language for interfacing with PCs and the ModBus command language for interfacing with a PLC. The 10000 series supports the interfaces for PCs and PLCs. The USB and Ethernet interfaces are standard. Optional interfaces include CAN, CANopen, RS-232, Profibus, EtherCAT, Profinet, ModBus, and multiport Ethernet. The 10000 instruments conveniently operate in automated test systems and process control systems without the need for additional external interface adapter hardware.

Figure 4. Example of an optional AnyBus Communication interface module.

DESIGN ADAPTABLE, SAFE, EFFICIENT, COST-SAVING, HIGH-POWER TEST SYSTEMS

The EA-10000 series can meet all the test engineer's objectives for providing the power capacity for a test system or a process control system. The highest power density permits the use of fewer instruments, which saves both capital costs and manufacturing floor space overhead. The highly efficient regenerative instruments save energy, which saves annual operating costs and saves on cooling infrastructure costs. The true autoranging characteristic allows adaptability to future test system requirements, and the system easily adapts for greater capacity. The instruments and the test racks incorporate features to ensure safe, reliable operation.

The bottom line is that the design engineer does not need to make any tradeoffs with the 10000 series instruments. Learn more by visiting the EA-10000 Industrial Series or talking to an Application Engineer at Contact - EA Elektro-Automatik (eapowered.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.

www.elektroautomatik.com