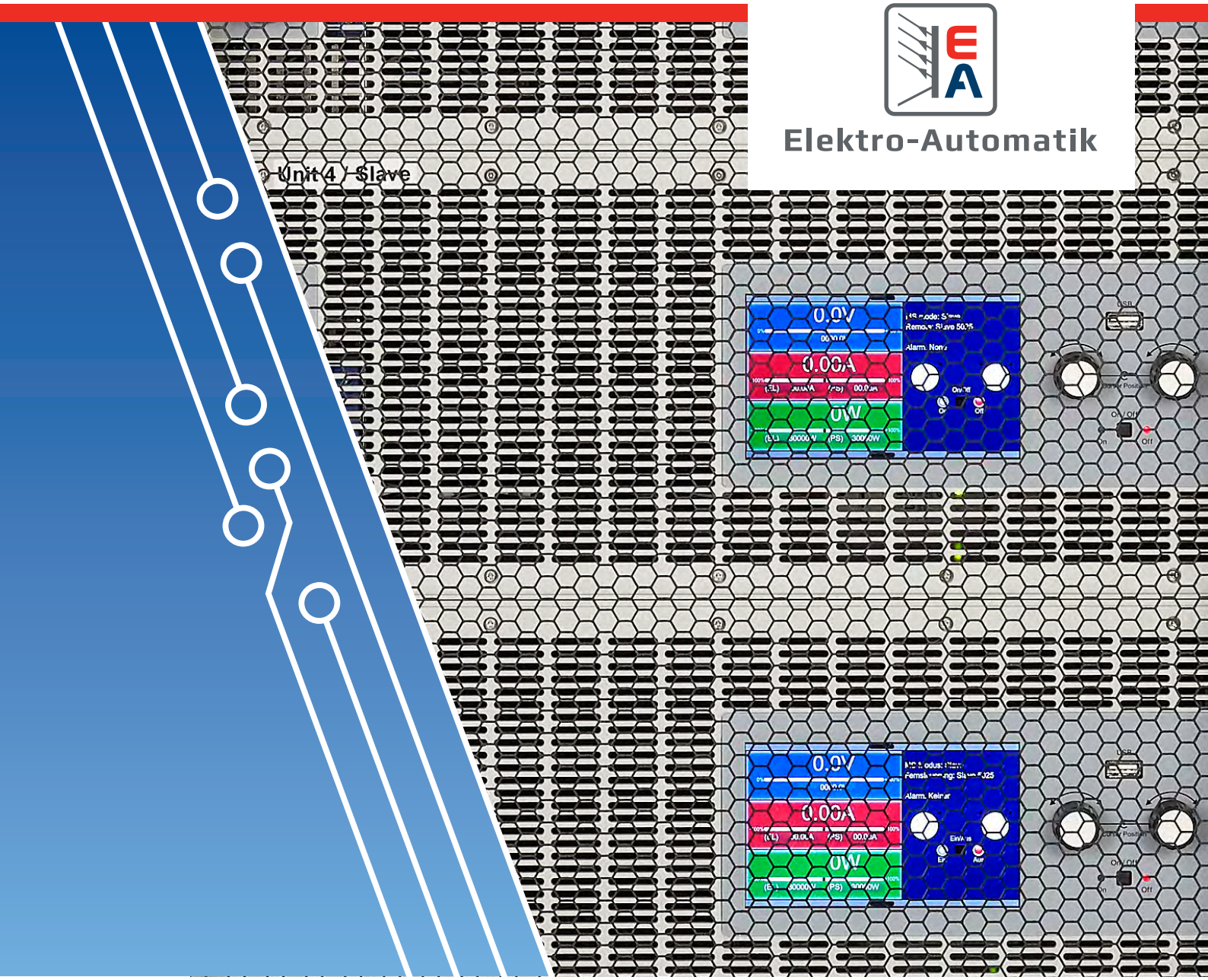
Elektro-Automatik



WHITE PAPER:
DESIGN AND BUILD COST-EFFECTIVE HIGH POWER ATE TEST SYSTEMS

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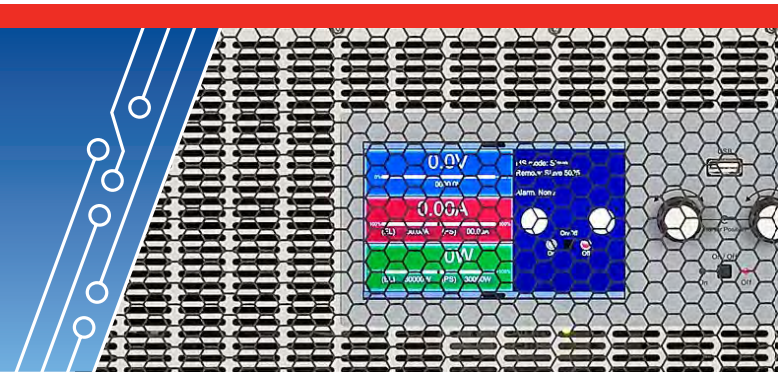


Developing a high-power automated test equipment (ATE) system poses numerous challenges for test engineers. However, testing is essential to ensure a product is safe and meets its published performance specifications. Testing helps avoid high in-warranty repair costs and supports product quality and the company's reputation in the market, which translates into market share and revenue. While testing is accepted as a necessary function, management charges their test engineers to design their test systems for:

- Maximized test performance
- Minimized costs
  - Minimized capital cost
  - Minimized annual operating cost
  - Consumption of the least amount of production floor space
- High test system reliability

Managing these potentially conflicting objectives can lead to challenges, including meeting the production schedule and achieving production throughput targets. Failure to attain both goals ultimately reduces revenue.

A critical element in designing a high-power ATE system is managing the power components. Defining the power requirements for the ATE system significantly affects how well the objectives of maximized test performance, minimized costs, and high reliability are achieved. The following sections describe how test engineers attain demanding ATE system objectives.

MEETING TEST PERFORMANCE REQUIREMENTS WITH FUTURE NEEDS IN MIND WITH HIGHER VOLTAGE AND CURRENT

Maximizing Test Capacity

Test engineers should ensure that their power supply has the output performance to serve the current and future needs, such as an electric vehicle (EV) manufacturer changing its battery voltage in a future model. While a DC power supply with a rectangular output characteristic may be satisfactory for the original ATE system requirements, new product design changes could force the test engineer to purchase a new power supply since the rectangular output characteristic supply cannot adapt to the new requirements.

An Autoranging output characteristic, as shown in Figure 1, outputs higher voltages and can supply higher currents than equivalent power supplies with rectangular output characteristics. Figure 1 contrasts an EA 30 kW supply with two conventional output 22 kW power supplies. Note that the EA supply can output substantially higher voltage and higher current than the two rectangular output supplies. Furthermore, while the conventional rectangular output supplies can only deliver maximum power output at their maximum output voltage and maximum current (the top right corner of the output rectangle), the autoranging output supply delivers full power all along the curve between the two points, (1500 V, 20 A) and (500 V, 60 A).

EA Elektro-Automatik's autoranging supplies are unique in providing true autoranging and delivering full power down to 1/3 of the maximum output voltage. This extensive level of capacity gives the test engineer the flexibility to test a product that operates over a wide voltage range and perform overvoltage and undervoltage tests with a single power supply. Using rectangular output power supplies could require using at least two power supplies.

As an example, if an EV manufacturer converts to 900 V or higher from a 400 V battery design, the test engineer can use the same power supply. This saves total test system capital cost. The test engineer could have selected a higher output rectangular output power supply to plan for future changes, but the higher wattage supply penalizes the test engineer with higher capital cost and risks taking up more factory floor space.

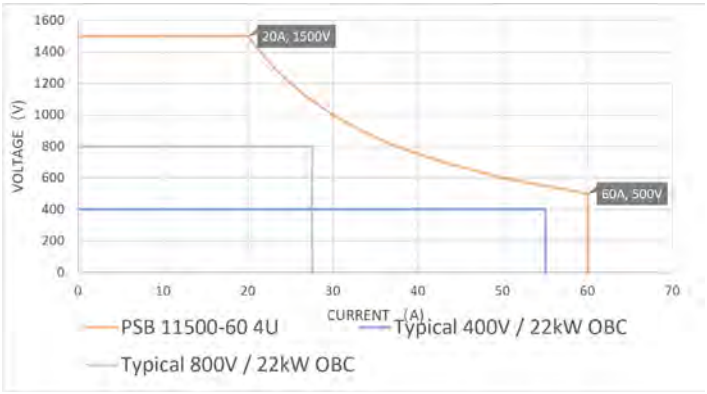
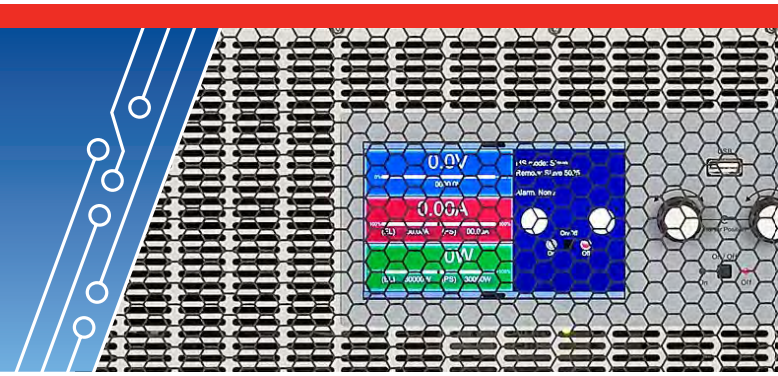


Figure 1. Autoranging output characteristics compared with conventional rectangular output power supplies

The same is true for electronic loads. Autoranging electronic loads such as the new EA-ELR 1000 series, provide more sinking capacity with wider voltage and current ranges, enabling the test engineer to minimize the total load wattage needed for testing a product. A lower power electronic load can reduce both the physical size of the test system and test system cost.



PERFORMING MORE THOROUGH TESTING

Maximizing test performance ensures the system can test to national and international standards. Avionics systems and automotive systems require testing to standards that can involve generating complex waveforms. Interfacing a signal generator into the system to modulate a DC power supply adds an extra instrument to the test system and adds complexity to the test system. EA supplies and electronic loads offer a built-in function generator that can safely and easily generate standard and custom waveforms. Figure 2 shows the capability to generate complex waveforms that both EA power supplies and loads can output (or sink for a load). Also, EA power supplies and loads can simulate battery, fuel cell, and solar cell characteristics for more realistic testing of products powered by these sources. Thus, using EA power supplies and loads, the test engineer can reduce ATE complexity by eliminating the need for extra instrumentation and not compromising on test thoroughness. This saves capital costs and test system size.

The need to acquire and control fewer instruments allows for faster development. A simplified system gives the test engineer a higher probability of transitioning a validated ATE system to production on schedule, allowing for maximizing revenue generation.

MINIMIZING CAPITAL COSTS AND ANNUAL OPERATING COSTS

Saving ATE System Cost

Cost targets tend to compete with the need to meet test system performance requirements. Those conflicting objectives can have test engineers looking to compromise on some aspects of instrument performance to keep costs within the capital budget. EA's autoranging instrumentation can allow use of a lower power instrument compared with a power instrument with a rectangular output/input characteristic. The built-in function generator saves on an extra instrument for signal generation requirements.

If the ATE system does not require simultaneous sourcing and sinking, then the test engineer can select a bidirectional power supply to perform both functions. Furthermore, using instruments with a high capacity, such as the EA-PSI units with capacities of 60 kW, provides the test engineer with numerous opportunities to save on the number of instruments needed for a high-power test system. High-capacity power instrumentation can help the test engineer build the ATE system within the budget.

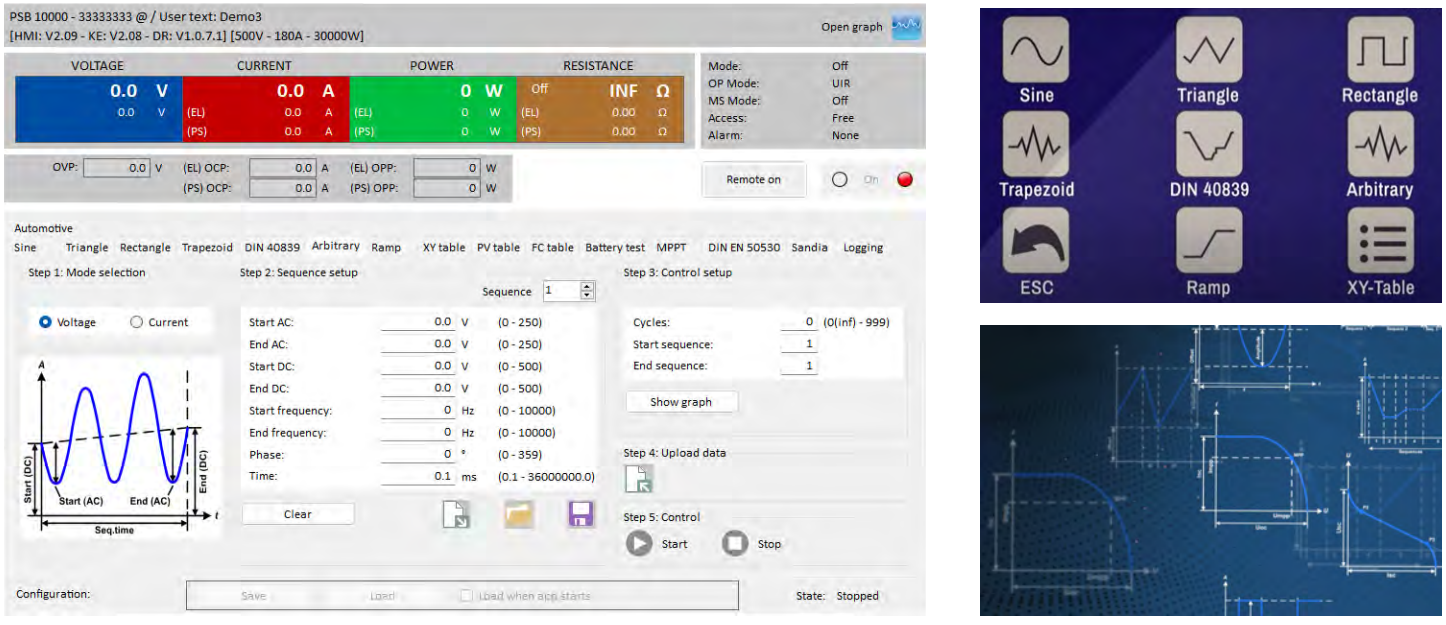
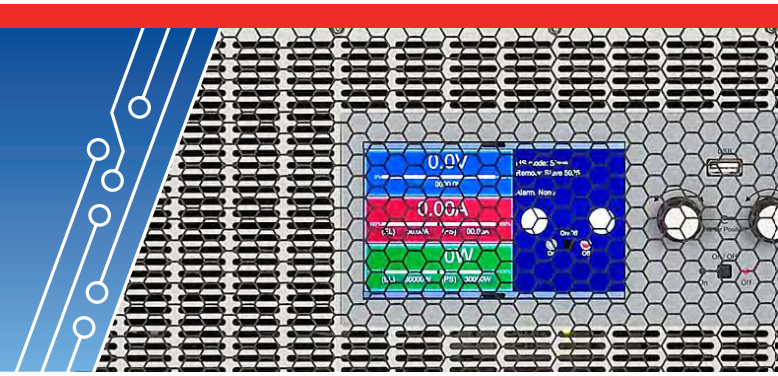


Figure 2. Waveshapes an EA instrument can generate. The picture on the top right illustrates example standard and custom waveforms. The PC display to the left of the waveshapes shows an example of the parameters that the EA Power Control software can use to create a waveform.



SAVING ANNUAL OPERATING COSTS

The efficiency of the power supplies and electronic loads is a huge factor affecting annual operating costs. Test engineers need to look for power instrumentation that has high efficiency. Engineers should use power supplies that have both active power factor correction circuitry providing a power factor of approximately 0.99 and high-efficiency switch mode power supplies.

Test engineers should also consider instrumentation that returns energy to the power grid. Regenerative bidirectional power supplies and regenerative electronic loads can return significant power back to the power grid; in EA Elektro-Automatik's case, its regenerative supplies and loads can return up to 96% of absorbed energy back to the grid.

Selecting high-efficiency power instrumentation can save substantial power consumption which saves on utility costs. In addition, higher efficiency instrumentation and regenerative instrumentation run cooler, which can significantly reduce the capital cost and the annual utility costs to maintain the ATE system at a safe temperature.

Saving Manufacturing Overhead Costs

With fewer instruments and lower power instruments, the ATE system can be smaller. When the test system requires 30 kW or as much as 60 kW capacity, supplies with high power density allow instrument sizes to be only 3U and 4U, respectively. One of EA's newest product offerings, in fact, can provide 60 W instrumentation in a 6U enclosure, the top-performing power density available worldwide.

Test engineers may be able to avoid the need for an additional test rack; or, they can build two systems into one rack. If the test engineers can compress their test system, they can save precious manufacturing floor space, reducing cost of test overhead. The freed-up space can enable the addition of more test systems to allow increased production capacity within existing space leading to greater revenue.

MAXIMIZING SYSTEM RELIABILITY

ATE system downtime slows production output, leading to canceled orders and lost revenues. That is the reason management demands high ATE system reliability. There are several factors affecting reliability:

- Instrument selection
- System design
- Calibration procedures
- Manufacturer's service and support

The use of high-efficiency instrumentation and regenerative instrumentation improves reliability. More efficient instruments operate at a lower temperature putting less stress on components, and the instruments are less susceptible to failure compared with conventional power instrumentation. Furthermore, EA products conform to CE, UL and CSA standards. Attaining national-recognized testing lab approval builds confidence in product quality and reliability. All products include a standard 2-year warranty with options for 3- or 5-year warranties so test engineers can attain lower annual cost of ownership.

Designing appropriate ventilation and cooling in the test rack, proper grounding technique, and compliance with test rack safety measures ensure good quality and stable measurements. Test system designers need to pay attention to all the details of the design to enhance system reliability in performance and system uptime. EA has expertise in building power test racks (see Figure 3) and can provide guidance to the test system engineer.

Figure 3. EA power racks conform to safety standards while providing proper grounding and power distribution wiring.

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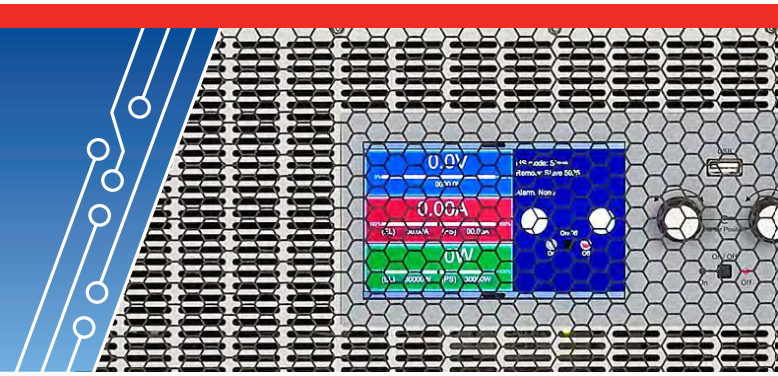

Many customers, particularly avionics customers, will require evidence of ATE system calibration to international standards such as Z540 and ISO 17025. Performance specifications are defined over the calibration interval so test engineers can be confident their products will hold their calibration for at least the specified time interval. This enables test engineers to more carefully predict when system downtime is needed avoiding unplanned disruptions to production.

Test engineers should consider the support they can obtain from their power instrumentation vendor. That is especially important when test system engineering and manufacturing are in different locations, suggesting the need for a partner with global support capabilities.

NO NEED TO TAKE ON THE CHALLENGES ALONE

The design of a cost-effective, high-performance, compact, energy-efficient ATE system involves numerous challenges; so, be sure to consult with a manufacturer to overcome the challenges of cost, space, future needs and capabilities. EA Elektro-Automatik has energy-efficient, compact power instrumentation with the features the test engineer needs to achieve a high-performance ATE system within the allotted budget. EA helps the test engineer maximize performance and minimize annual operating costs over the life cycle of the ATE system. Learn more at www.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