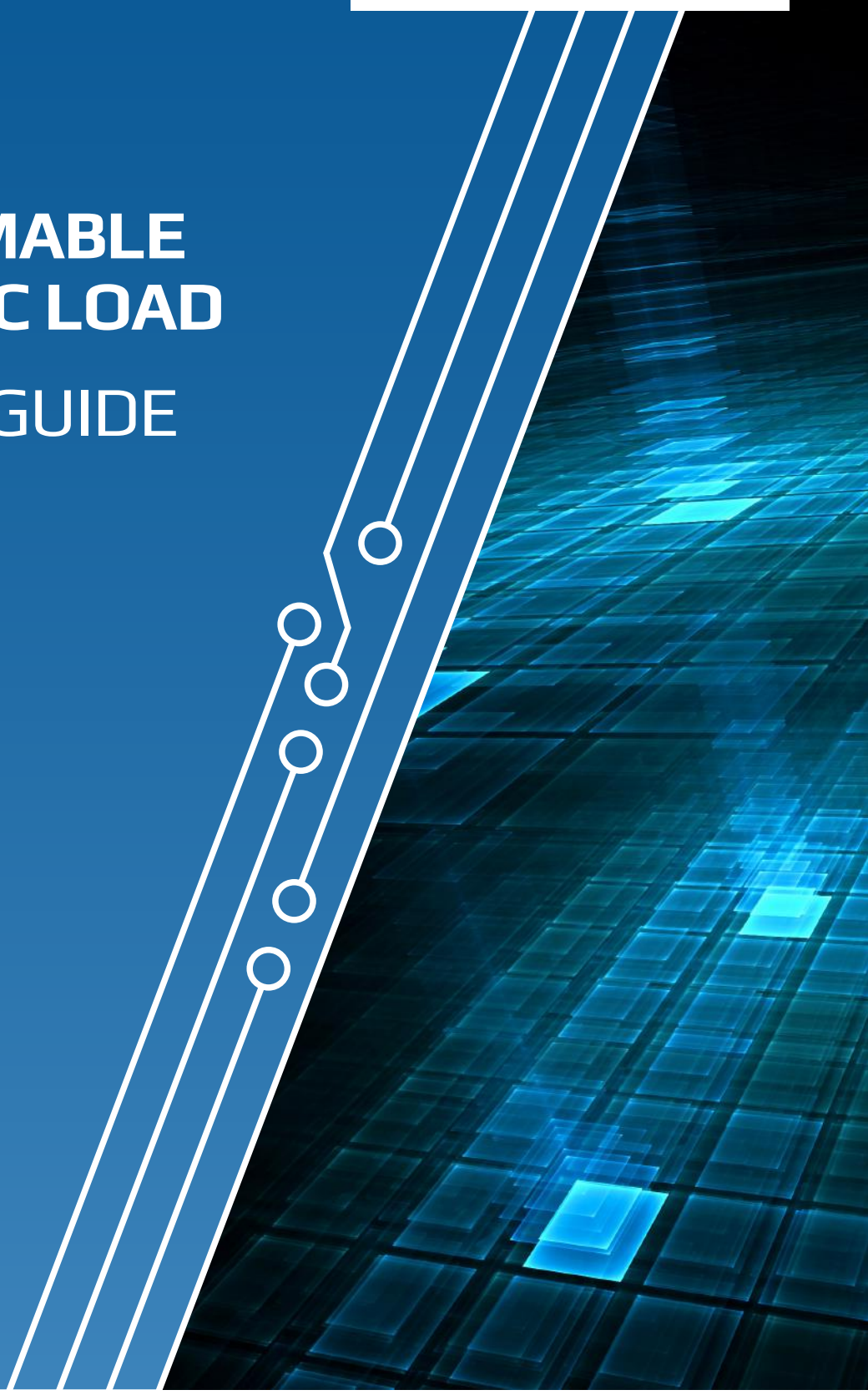
Elektro-Automatik

# PROGRAMMABLE ELECTRONIC LOAD

## SELECTION GUIDE



## Introduction

Today's electronic loads have numerous features for testing electronic devices. The wide range of capabilities can pose a considerable challenge for selecting a cost-effective electronic load that can meet the requirements of a current application and future applications. The definition of the power requirements is certainly the first step in selecting an appropriate electronic load; however, there are numerous other questions to consider. The objective of this guide is to provide guidance on key considerations for selecting an electronic load. This guide will address some important questions you will want to consider:

- How much power must the load absorb?
- What types of devices will the electronic load be testing?
- Do I need a regenerative load?
- What building facilities are needed to power and cool the load?
- How will the electronic load be controlled?
- What safety features does the electronic load have?
- What other features might be needed?
- Is software available to connect the electronic load

## How Much Power Must the Load Absorb?

Your power requirements will depend both on the power your device-under-test (DUT) can deliver and your test requirements. How much beyond the rated maximum voltage, current, and power will you need to thoroughly exercise your DUT for both functional testing to ensure proper operation and stress testing to ensure reliability? Select your maximum power, voltage, and current ratings for your load accordingly.

### How the Selection of the Load's Input Characteristic Saves on Required Power and Expands Flexibility

Have you thought about how much flexibility you can get from your load and that you can potentially get a lower power load if you select a load with an auto ranging input characteristic? A conventional electronic load has a rectangular input characteristic in which the load can absorb full power only at the maximum rated voltage and current point as shown by the limited power stage rectangular input shown in **Figure 1**. EA Elektro Automatik electronic loads have a true auto ranging input characteristic which allows for a much wider range of input power as shown in **Figure 1**. EA loads can absorb full power down to 33% of rated voltage. For example, a 10 kW EA electronic load with maximum voltage and current ratings at 1000 V and 30 A, can absorb full power at 333 V and 30 A. An electronic load with a conventional input characteristic would have to be a 30 kW load with maximum ratings of 1000 V and 30 A to be capable of supplying 10 kW at 333 V and 30 A. As a result, auto ranging can enable use of a cost-saving, lower power load. The lower power load also has reduced cooling requirements. Therefore, an auto ranging input characteristic can save on capital costs and on annual operating costs.

Similarly, if a new 10 kW DUT delivered a slightly higher voltage, you would need a new conventional input characteristic load. With EA auto ranging loads, you would not need a new load as **Figure 1** illustrates the availability of the extra range of the auto ranging load. This means that an auto ranging load can both save on the required power and can allow adapting to future requirements compared with electronic loads that have conventional input characteristics.

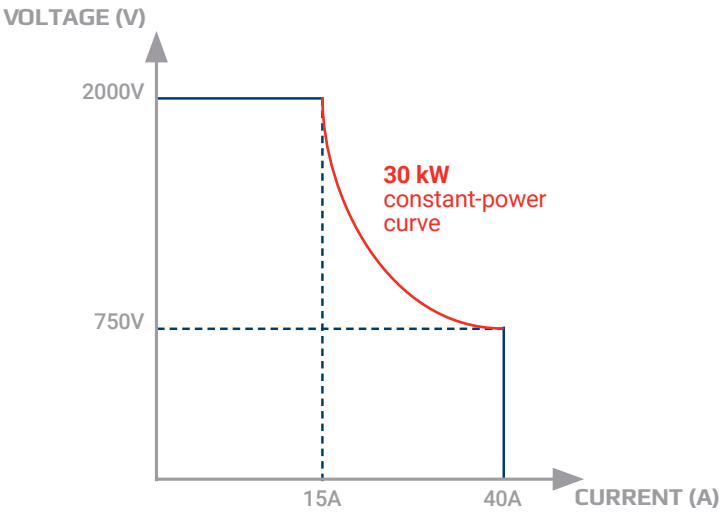



**Figure 1.** Auto ranging load input profile compared with a conventional rectangular load input profile

## What Type of Devices Will the Electronic Load Be Testing?

The type of DUT you need to test and the required parameters that must be tested determine how the electronic load must operate. The following sections offer guidance on the best options for testing different types of devices.

### Determining the Parameters That Need to Be Controlled

Electronic loads can control power, voltage, and current. In addition, EA loads have CR (Constant Resistance) Mode. Ensure that the load you select controls all the parameters that you need for testing the DUT.

### Using an Internal Function Generator to Simulate Load Conditions

If you are testing a battery, a charger, a fuel cell, or a solar panel, you will want to simulate various test conditions. You could use an external function generator to create dynamic load conditions; however, a high-power setup with a function generator adds complexity to a test setup. EA electronic loads offer a built-in function generator that can create custom waveforms to simulate various load conditions to stress a DUT. The function generator can produce ramp and pulse loads to test a DUTs response to dynamic load changes. Sine waves on a DC level can simulate and test the response of a DUT, such as a power supply, to noise.

In addition, EA loads have built-in test functions that that create I-V curves to simulate:

- A battery-powered device for testing battery performance
- A battery for testing on-board charger performance
- A load for a fuel cell or a solar array to test their performance

You will want to consider an electronic load with a built-in function generator to allow the capability to fully test a wide range of devices.

### Testing Power Semiconductor Circuits

If your requirement includes testing power semiconductors, you will need to control the devices at very low voltages. With EA loads, you can control very low voltages and still sink the maximum rated input current. Verify that the electronic load can sink the maximum current sourced by the semiconductor at the on-state voltage of the power semiconductor circuit.

## Do I Need a Regenerative Load?

A traditional electronic load dissipates all the power it sinks as heat. Removing the heat requires cooling by air in the form of fans or by water through a chilled water system. The utility costs for operating the load can be quite high. EA offers regenerative loads which minimizes the power the load consumes by returning power to the AC grid. The load dissipates much less energy as heat and eliminates the need for high-cost cooling infrastructure.

A regenerative load uses an inverter to convert the absorbed DC power into an AC waveform and returns it to the power grid. EA electronic loads can return energy to the grid with up to 96% efficiency offering both a tremendous reduction in power consumption and utility cost savings. In addition, use of regenerative loads avoids the capital costs for cooling infrastructure and the utility costs required to power the cooling equipment. Regenerative loads provide substantial annual utility cost savings, and help your company achieve goals for energy sustainability.

## What Building Facilities Are Needed to Power and Cool the Load?

Most EA loads use 3-phase AC line power. Typically, high power electronic loads require water cooling systems; however, regenerative EA Loads rated up to 30 kW can maintain a safe operating temperature with internal forced air cooling. Make sure you understand and prepare for the utility requirements for the electronic load that you select.

## How Can the Electronic Load Be Controlled?

If you will be manually controlling the load, ensure it has a display and controls. EA loads have touchscreen displays that enable easy access to instrument settings and control functions. EA loads also offer multiple language options to enable text to be more understandable for worldwide use.

If you will be using a load in an automated test system, the load will need a PC interface. All EA loads have USB and Ethernet interfaces. If needed, you can select one of the numerous optional PC interfaces including RS-232, Modbus, CAN, CANopen, EtherCAT, Profibus, or Profinet. EA loads offer use of either standard SCPI commands or Modbus protocol commands for programmable control.

In the event you need a load for an industrial application, you will typically need the load to interface to a programmable logic controller (PLC). EA loads allow convenient integration into a PLC-based control system with the Modbus command language and optional PC interfaces.

In addition, analog signals can control EA loads through an isolated analog interface, included with EA loads as a standard feature. Using an isolated analog interface keeps noisy industrial signals in the PLC environment from interfering with the electronic load.

Make sure that the load you select has the interfaces you need for your application. EA loads offer an extensive set of interfaces for a wide range of applications. Not all loads have an isolated analog interface to separate instrument ground from high-noise grounds in industrial applications. If you are using analog control, consider a load with an isolated interface to avoid interference from ground noise. All EA optional interfaces are field-installable modules that insert into the rear panel of the loads so you can easily add an interface if your requirements change at a later date.

## What Safety Features Does the Electronic Load Have?

You will want to protect your investment in your load. Electronic loads can absorb substantial power and must support high voltages and high currents. Thus, it is important to ensure that the load is adequately protected. For example, if the load's internal temperature reaches a high value, the heat can damage the load. You should ensure that your load has overtemperature protection to shut down if the internal temperature reaches a dangerous level. You should also consider overcurrent, overvoltage, and overpower protection for your load. EA loads have all four protection modes.

## What Other Features Might Be Needed?

Even if you are not controlling your load manually, you should consider the convenience of having a front panel display and controls for test system development and for system troubleshooting. A full color touchscreen display on EA electronic loads facilitates development and troubleshooting work.

If you have an application requiring more power than a single load can provide, you will want to select a load that can conveniently and safely enable the paralleling of multiple loads. EA has a master-auxiliary operating mode so that one master load can control the complete set of loads. Furthermore, EA loads have a Share-Bus function that ensures that all loads equally share the incoming power. The Share-bus feature protects each load from absorbing an excessive quantity of power and becoming damaged.

EA offers a range of turnkey DC power racks and cabinets that come wired and ready for use with fully integrated safety systems. Each power rack includes door interlocks and individual breakers for each load, plus an emergency stop on the cabinet door.

These power racks are highly scalable and modular. Units are easily replaced and/or upgraded which allows for improved maintenance and for modification as test requirements change. The test racks flexibly accommodate 2U, 3U, and 4U instruments in any combination to allow cost-effective test solutions.

## Is Software Available to Control the Electronic Load?

For automated testing, you can program an electronic load using standard programming languages such as versions of C or Python or a graphical programming language such as National Instruments' LabView™. If you prefer not to code, EA Elektro Automatik offers Power Control Software to control its instruments including the electronic loads. The software includes the execution of applications to control the load, creation of control sequences by filling out information in a table, and execution of test schemes for battery testing, fuel cell testing, automotive standards tests, and solar panel tests. The EA Power Control Software enables fast development of automated control programs using EA loads.

## Summary

There are a number of questions you need to address to ensure you specify an appropriate electronic load for your application(s). Your answers to the questions presented in this introduction to the electronic load selection guide will help you successfully achieve your test and control requirements.

For more information and personalized guidance on choosing the right electronic load for all your applications, contact EA Elektro-Automatik at:

Sales@elektroautomatik.com

or visit www.eapowered.com.

# Our Main Product Lines

## 19 Inch Slide-in Housing

(Series ELR / Regenerative power generation)

### Features

- Primary clocked, with flexirange or auto-range output
- Externally controlled via analog and digital interfaces
- Permanently integrated interfaces and “plug n play” slot
- State-of-the-art µ-processor control (FPGA)
- Modular highly insulated architecture
- PV (Solar) Array Simulation
- Battery and fuel cell simulation
- Function generator sine, rectangle, trapezoid, ramp, arbitrary
- Alarm Management, User Profiles
- For tabletop, 19" integration and wall mounting
- Analog, Ethernet, USB, CAN, Profibus, GPIB and many more
- Operator Software EA Power Control (Freeware), Multi-Control “App” (license required)

| Series ELR / Regenerative Power Generation | |
|---|---|
| **EA-ELR 10000 3U** | 5 kW / 10 kW / 15 kW @ up to 80 to 2000V |
| **EA-ELR 10000 2U - EA Elektro-Automatik** | 1500-3000W @ up to 0-80V to 0-1500V |
| **EA-ELR 5000 / ELM 5000 6U** | 320-3200W @ up to 0-80V to 0-200V |
| **EA-ELR 10000 4U** | 30kW @ up to 0-80V to 0-200V |

# Programmable Electronic Load

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