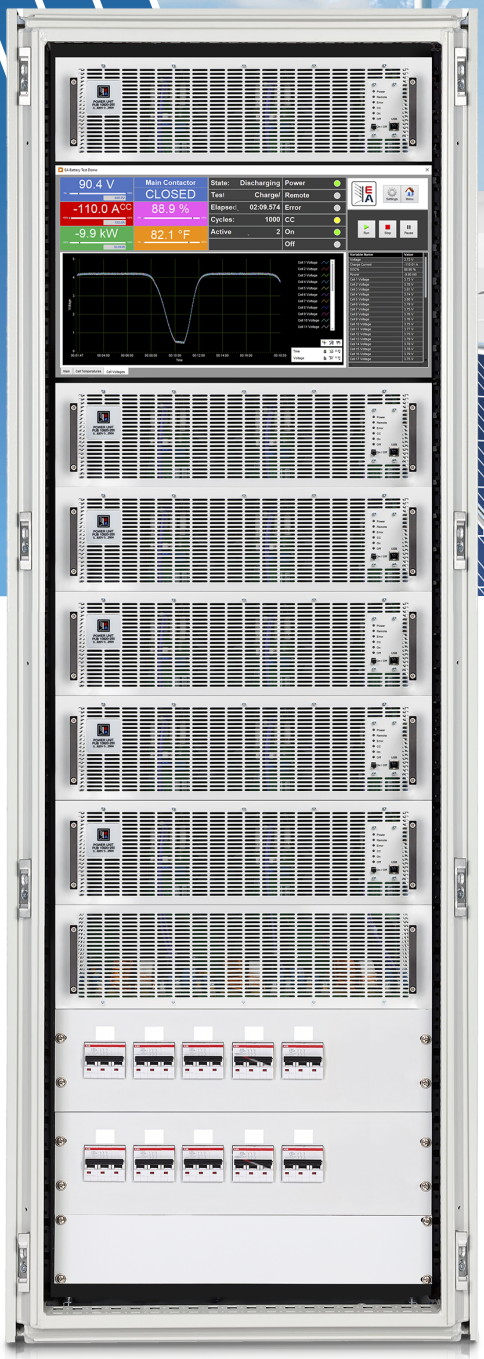
Elektro-Automatik

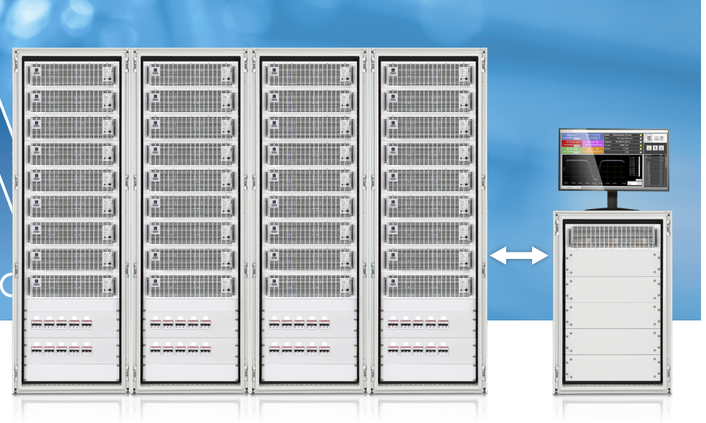


EA-BCTS 10300 SERIES

Battery Cycler and Test System

EA-BCTS 10300 SERIES

Battery Cycler and Test System



1.2 MW setup with PCC (Point of Common Coupling) Additional equipment cost

- 0-1500 VDC (2000 VDC option) capacity for testing high voltage battery packs and modules
- 300 kW in a 42U high rack (parallel racks for up to 3.84 MW)
- Up to 2,400 A per rack and 30,720 A total capacity
- One 300 kW rack consumes only 6.5 sq ft of floor space
- System slew rates are under 500 µs for fast voltage transitions
- System data acquisition rates up to 1.5 kHz
- Systems return absorbed power to the grid with up to 96.5% efficiency
- Program test parameters, test sequences, output displays, and data files without coding
- Performs all standard drive cycle simulations including FUDS, SFUDS, GSFUDS, DST, and ECE-ISL
- Performs DC insulation resistance
- Battery pack temperature monitoring
- CAN bus interface to battery management system (BMS)
- Controls environmental chambers and chillers
- Highly integrated but modular design allows fast changes or simplified system expansion
- Pre-charge and reverse polarity protection
- Air-cooled or optional water-cooled system thermal management
- Modular design allows for easy module switchout in less than an hour. The system can run at lower power for constant operation

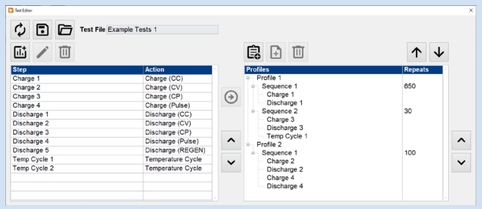
SYSTEM COMPONENTS

EA-BCTS 10300 System Software

EA-BCTS battery test software controls all battery cycling and battery test operations and enables:

- Defining the tests to be performed
- Entering parameters for the tests
- Defining the order in which tests are performed
- Defining the data to be monitored and exported
- Defining the layout of the display screen

The Software uses a Widget-based approach to allow a user-configurable display. Set up and test execution is simple and fast and allows complete tests on a battery or another power source, such as a fuel cell.



Test setup display allows entry of parameters and sequence of execution.

Results display screen showing voltage, current, and the results of a capacity simulation test.

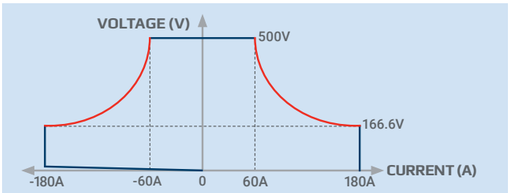
Power Sourcing and Sinking

EA Bidirectional Power Supplies source and sink to minimize system complexity and size

EA bidirectional power supplies comprise the core of the EA-BCTS Battery Cycler and Test System. These instruments operate in two quadrants to combine a power supply and an electronic load. With power capacities from 5 kW to 60 kW in a single instrument, the bidirectional power supplies can assemble into systems as large as 3.84 MW.

True autoranging for fast, continuous battery cycling

EA bidirectional power supplies have a true autoranging output characteristic for both sourcing and sinking. Not only does this allow a wider range of voltage and current compared with a conventional rectangular output power supply, but these instruments can deliver or absorb full-rated power down to 1/3 of the maximum rated voltage. Unlike a system with instruments that do not have true autoranging, a cycling test does not require interruption to allow the instrument to change range as the battery pack voltage ramps up or down.



Autoranging output and input allows a continuous transition over a wide voltage and current range.

SiC design technology allows the highest power density saving test system space

Using SiC high-power transistors, EA power supplies have higher switching frequencies allowing increased operating efficiency. In addition, the higher switching frequency enables reduced heatsink, cooling fan, and magnetic component sizes. The reduced size of magnetic components and fewer power transistors per 5 kW allow EA to offer a bidirectional supply with 30 kW in a 4U enclosure and 60 kW capacity in a 6U high, full rack enclosure. These high-density power supplies allow one test rack to have as much as 300 kW of power in only 6.5 square feet of space. An EA system substantially saves manufacturing floor space.

Master-Auxiliary Bus and Share-Bus safely expand system capacity

Up to 64 EA bidirectional power supplies can connect in parallel with the Master-Auxiliary Bus in which one power supply can control 63 additional supplies. This ability to parallel allows the EA-BCTS Battery Cycler and Test System to have a capacity of up to 3.84 MW. The Share-Bus interface between each power supply protects the supplies by ensuring each supply supports an equal share of the load. The combination of the two buses provides simplified and reliable management of up to 30 kA.

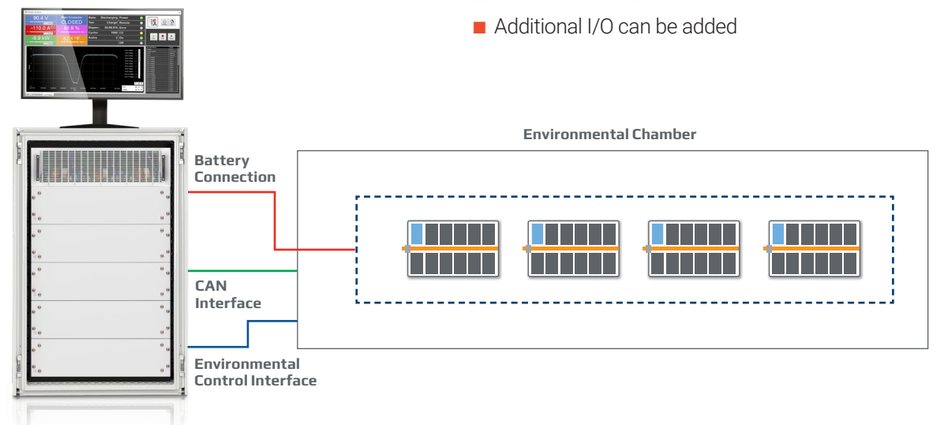
Regenerative energy with 96.5 % efficiency reduces operating costs

Along with active power factor correction and a high-frequency switching power supply topology which yields over 90% sourcing efficiency, the EA bidirectional power supplies return absorbed power to the AC power grid with up to 96.5% efficiency. This allows the supply to run at a lower temperature, reducing cooling infrastructure requirements and enhancing reliability. Furthermore, the high efficiency offers substantial savings on system utility costs.

Power Control and Measurement Module

The Power Control and Measurement Module (PCMM) monitors the battery pack and executes additional tests. The PCMM:

- Monitors battery voltage and current with a 1.5 kHz data acquisition rate, 16-bit resolution (optional 24-bit), and <2% of FS accuracy
- Provides system pre-charge and reverses polarity safety checks
- Performs insulation resistance testing
- Monitors battery pack temperature
- Controls an environmental chamber and a chiller
- Additional I/O can be added



Elektro-Automatik

The total turnkey solution

The EA-BCTS 10300 provides a complete solution for battery cycling and testing. Tests include drive cycle simulations and insulation resistance in addition to battery cycling. The system can control an environmental chamber and interface to the battery management system through the CAN bus interface. The drag-and-drop system software enables quick and easy test setup and execution. All this performance includes:

- High voltage up to 2000 VDC
- High power up to 3.84 MW
- High power density with 300 kW/rack capacity in only 6.5 sq ft of rack space
- High speed with instrument slew rates under 500 µs and continuous, true autoranging
- High efficiency with up to 96.5% return of absorbed energy to the AC grid
- High integration with a complete package of power and control, yet modular for easy system modification and expansion

SPECIFICATIONS

Power configurations

30 kW, 60 kW, 90 kW, 100 kW, 120 kW, 180 kW, 200 kW, 240 kW, 300 kW

Tests

Can be user defined such as capacity, four seasons, pulse, and imported drive cycling

Battery cycling

- **Voltage range:** 0-1500 VDC (0-2000 VDC optional)
- **Current range:** ± 30,720 Amps (single Cabinet ± 2,400 Amps)
- **Power range:** 0-3.84 MW (single rack up to 300 kW)

Drive cycle simulations

FUDS, SFUDS, GSFUDS, DST, and ECE-ISL

Battery monitoring

- **Parameters:** voltage, current, power
- Sampling rate 1.5 kHz
- BMS signals
- Input from battery for limitations from BMS to cycler

Interface to battery management system

CAN bus

Chiller and environmental chamber control

Interface to temperature controllers

Safety features

- **Battery pack temperature monitoring:**
  - Sensor: Multiple type thermocouple chosen by software (i.e. T, K, J, etc.)
  - Temperature range: Depending on thermocouple chosen
  - Accuracy: Depending on thermocouple chosen
- **Pre-charge voltage accuracy:** <= 1% battery voltage
- **Polarity reversal check:**
  - E-Stop
  - Configurable emergency shutdown sequence

Software

- **Export data format:** CSV and TDMS (NI structured binary format; can be read in MATLAB)
- **Widget-based display control**

System input power requirements

380 V / 400 V / 480 V ±10%, 3ph AC (Wide range AC input)

Test system cooling requirements

Forced air (Water cooling optional)

Power delivery and absorption performance

96.5% regeneration to the grid