



Elektro-Automatik



APPLICATION NOTE:
TEST BATTERY CELLS, MODULES AND
PACKS WITH A SINGLE INSTRUMENT

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Battery test engineers face a variety of challenges:

- Accurate data
- Future-proof test racks able to support future battery chemistries
- Lack of production floor space to accommodate bulky multi-rack systems

EA's new EA-BT 20000 Triple Battery Tester was created to address these test roadblocks with a unique design that duplicates the functionality of three previously separate instruments – all in a more powerful test instrument. The EA-BT 20000 is an all-in-one test system with three outputs to process three batteries simultaneously, able to perform electrical characterization, battery simulation, and second-life classification.

The BT 20000 Battery Tester combines the power to test high-power battery packs with kW capacity and the accuracy to test individual cells and modules in a single, efficient instrument. The BT 20000 provides multiple functionalities, increased throughput, energy savings and space savings for high performance battery testing.



Figure 1. BT 20000 Triple Battery Tester.

HIGH PERFORMANCE CELL TESTING

Single cell characterization requires verifying the cell performs within its specifications when subjected to fast load current changes or a current dump. In general, lithium-ion batteries can respond to near-instantaneous load changes within a few milliseconds to tens of milliseconds. This rapid response time is one of the reasons why lithium-ion batteries are commonly used in applications where quick power delivery is essential, such as in portable electronics, electric vehicles and power tools. Thus,

to capture the cell dynamic response to a fast load change, the EA-BT 20000 can create 1 ms changes in the load current draw. The EA-BT 20000 can create a load profile internally or with external control. External control of the load requires millisecond communication over an interface, a capability supported by the EA-BT 20000. Other instruments are 5 to 20 times slower.

EA-BT 20000 Battery Testers can control the load on a battery cell down to 2.5 V and lower voltages. Even models with output voltages as high as 920 V can control load current down to 2 V. The EA-BT 20500-60, with 500 V and 60 A/channel output, for example, has a minimum control voltage of 1.1 V. These control voltage levels are below the discharge cut-off voltage for lithium-ion batteries which is around 2.5 to 2.7 V. Thus, the EA-BT 20000 series battery testers have the performance to test individual cells even when they have the power to test high-power battery packs.

Accurately monitoring battery cell voltage is essential for safe but complete cell discharging and charging. The EA-BT 20000 Battery Testers have a rated voltage accuracy of 0.05%. The 10 V models can monitor a cell voltage with ± 5 mV tolerance. That level of accuracy ensures that the cell is kept within safe voltage limits.

SAFE MODULE TESTING

The EA-BT 20000 has a pre-charge function to safely charge a module. The pre-charge function is meant to protect the power supply and potentially the battery. If the battery is connected to the BT without precharging, the battery will want to discharge all of its energy into the BT which could damage the capacitors on the DC terminals of the BT. It also could result in a spark that could damage the battery terminals. The BT 20000 will use the remote sense to measure the voltage of the battery and set the voltage to match, precharging the capacitors before the contactors are closed. Now, when the contactors are closed, the potential is the same and there is no or minimal current flow.

Protection against an incorrect connection of a module-under test to a battery tester is essential. The EA-BT 20000's have an internal polarity detection circuitry that prevents connection of the output to the battery if the battery polarity is reversed and detected as a negative voltage.

An assembled module of lithium battery cells can be subject to fast load changes. The 1 ms communication rate of the EA-BT 20000 enables testing a module's recovery to millisecond load changes.

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HIGH VOLTAGE BATTERY PACK TESTING

Most automotive batteries in electric vehicles (EVs) are currently in the 350 V to 450 V range. Some high-performance models use 800 V and higher voltages. The higher voltage batteries allow the use of faster charging techniques, which is necessary for wide adoption of EVs. The higher voltage batteries enable lower total current in the EV, reducing the weight of cable assemblies throughout the vehicle and reducing cable costs.

The EA-BT 20000 has models that can output 920 V to test the new higher voltage batteries. Along with the high voltage test capability, the battery tester can compensate for the long load cable runs in EVs and other high power electric power delivery systems with remote sense compensation of up to 5% of the applied voltage. Thus, when testing a 500 V battery, the EA-BT 20000 can maintain the programmed voltage at the load with a voltage drop in long cable runs as high as 25 V. That exceeds the remote compensation capability of other power sources.

3X THROUGHPUT

Whether testing cells, modules, or high-power battery packs, EA-BT 20000 models can test with 4 kW/channel, 6 kW/channel and 10 kW/channel. What is unique about the EA-BT 20000 is that it can test three devices simultaneously, increasing throughput by a factor of three over a single output battery tester. Testing three devices at a time both reduces production test costs by a third and enables increased capacity by a factor of three. Figure 2 shows the three channel outputs on the rear of the EA-BT 20000.

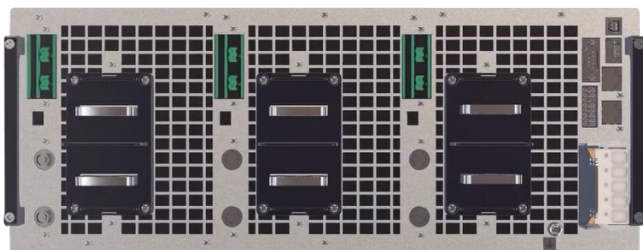


Figure 2. BT 20000 rear panel with three bus bar output channels for simultaneous test of three batteries

COST-SAVING EFFICIENCY

When discharging batteries-under-test, the EA-BT 20000 can return absorbed energy to the grid with as much as to 96% efficiency. When testing kW capacity, battery packs during an 8-hour or longer production day, returning 96% of the absorbed energy to the grid can yield significant utility cost savings.

COST-SAVING HIGH POWER DENSITY

The EA-BT 20000 supports all 30 kW of power and three channels in a compact 4U, 19-inch rack enclosure. This combination of high-power density with multiple channels reduces high-cost floor space in test labs and production facilities.

Another feature that enables the high-power density is the autoranging performance in the EA-BT 20000. The instrument can deliver full power output (or absorb full power) down to 30% of the rated voltage. The autoranging allows the instrument to extend its current output well beyond what a comparably powered instrument with a rectangular output characteristic can provide. Figure 3 shows the sinking and sourcing characteristics of a channel on an EA-BT 20000 Battery Tester.

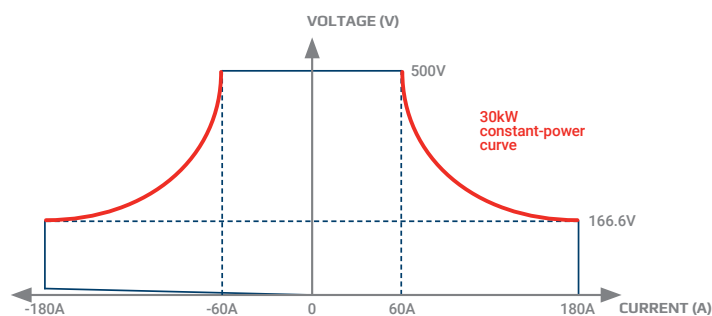


Figure 3. BT 20000 Channel Input/Output characteristic

TEST BATTERY INFRASTRUCTURE SYSTEMS

To test energy storage battery systems, combine EA-BT 20000's into racks of eight instruments to generate 240 kW of test capacity. Each EA-BT 20000 has a master-auxiliary bus for paralleling multiple instruments. This bus combines with a Share-Bus, which ensures all instruments carry equal portions of the load for the safe implementation of multiple instruments. For power requirements in excess of 240 kW, up to eight fully loaded test racks can generate 1.92 MW.

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BATTERY AND INSTRUMENT SAFETY

As mentioned when discussing module testing, the EA-BT 20000 protects the battery with polarity detection, which prevents applying power to the battery if the battery is incorrectly wired to the instrument. The instrument automatically employs a pre-charge function by using the remote sense to measure the voltage of the battery and set the voltage to match, precharging the capacitors before the contactors are closed.

The instrument protects itself with multiple protective functions to prevent damage, which can take it out of service. Protective functions include overvoltage protection, overcurrent protection, overpower protection, and overtemperature protection. The EA-BT 20000 can generate warnings and alarms when a parameter has exceeded a safe limit level.

AUTOMATED TESTING

Each EA-BT 20000 has USB, Ethernet, EtherCAT, and CAN FD interfaces to connect either to a PC or a programmable logic controller (PLC). SCPI command control, LabView, and IVI drivers enable PC control. The ModBus command operation allows PLC control, giving the EA-BT 20000 flexible automated control.

EA-Power Control software and EA-Battery Simulator software enable non-coding, remote control of the EA-BT 20000. The pre-configured software for battery test software saves test development time and simplifies test execution.

THE COMPLETE BATTERY TEST SOLUTION

The EA-BT 20000 family has the performance and range to test, simulate, and re-cycle individual cells and high-power battery packs with voltages up to 920 V and current up to 600 A/channel. With a total power up to 30 kW, a single instrument can meet an extensive range of test requirements. In addition, the EA-BT 20000's increase throughput, save energy and save lab and production floor space. The EA-BT 20000 has everything needed for a high-power density, single-instrument battery test solution. For more information, visit [EA-BT 20000 TRIPLE](#).



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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