

# BT2200

## Charge-Discharge Platform

- Cost-effective, easily configurable Li-Ion cell charge-discharge
- Modular configurations from 6 A to 200 A, 8 to 256 user channels per chassis
- Supports cell forming and test on small and large capacity cells



### New Challenges in Li-Ion Cell Forming

The future of electric mobility is arriving and the demand for Li-Ion batteries is growing rapidly. The manufacturing environment for Li-Ion cells is very dynamic as massive new investments are planned for new manufacturing capacity. EVs are driving demand for a growing mix of Li-Ion cell types and capacities, while demand from traditional portable applications continues to grow as well.

The entire range of Li-Ion cell manufacturing faces intense pressures related to unit costs, return on investment, and time-to-market. Cell manufacturers must be able to expand capacity quickly, and minimize both the capital and operating costs of adding capacity for new and existing cell types experiencing new demand.



In their cell-forming and test processes, manufacturers experiencing shifts in cell types and capacities need to respond to these changes quickly and at low cost. That means using charge-discharge electronics that can easily be configured for new or additional capacity ratings, rather than being constrained by charge-discharge equipment dedicated to only one cell capacity.

## Keysight BT2200 Charge-Discharge Platform



*Figure 1 - BT2203A Chassis with 8 BT2204A Modules.*

The Keysight BT2200 Charge-Discharge platform is cost-effective and easily configurable for Li-Ion cell forming and test. Modular configurations support cells requiring maximum currents ranging from 6 A to 200 A, with 8-256 cells or user channels per chassis. You can easily deploy different channel configurations as your cell requirements and capacities change; you simply use the same charge-discharge modules and change the external wiring connections to create new parallel combinations of channels.

The BT2200 platform is based on two chassis that support up to 8 charge-discharge modules per chassis. Each module provides 32 physical channels capable of  $\pm 6.25$  A charge-discharge and 6 V.

For 400 VAC 3-phase AC mains operation:

- BT2202A Charge-Discharge Chassis 400 VAC 3-phase
- BT2204B Charge-Discharge Module

For 208 VAC 3-phase AC mains operation:

- BT2203A Charge-Discharge Chassis 208 VAC 3-phase
- BT2204A Charge-Discharge Module

Combinations of up to 32 physical channels on each module can be paralleled in groups for greater charge-discharge current. If all 32 channels on a module are paralleled, a charge-discharge current of  $\pm 200$  A is provided for large-capacity cells.



Figure 2 - Paralleled wiring connections create configurable charge-discharge channels up to 200 A.

The BT2200 platform uses highly efficient AC power regeneration during cell discharge to reduce net energy consumption to lower your operating costs. This generates less heat in the electronics, and less waste heat to be managed in your facility. The compact size of the BT2200 platform reduces floor space you need to devote to your forming process and decreases capital expenses.

Accurate 4-wire measurements of current, voltage, and capacity are made at an update rate of 1s. 4-wire measurements assure accurate charge-discharge levels.



Figure 3 - 4-wire connections (power and sense) to cells enable accurate measurements even with long cables to your fixture

## Keysight Offers Multiple Cell-Forming and Test Solutions to Fit Your Process

<b>Charge-Discharge Electronics</b>	<ul style="list-style-type: none"><li>• Easily configurable for different cell types</li><li>• Compact size</li><li>• Efficient AC regeneration for energy savings</li></ul>
<b>Charge-Discharge Measurement Stations</b>	<ul style="list-style-type: none"><li>• Charge-Discharge Electronics<ul style="list-style-type: none"><li>+ Fixturing, Cabling, Automated Contacts</li><li>+ Software to control station and interface to factory automation</li></ul></li></ul>
<b>Complete Cell-Forming Process</b>	<ul style="list-style-type: none"><li>• Charge-Discharge Measurement Stations<ul style="list-style-type: none"><li>+ Cell Trays</li><li>+ Material handling and movement</li><li>+ Cell Storage/Aging, Temperature-controlled</li><li>+ Factory Automation</li></ul></li></ul>

256 unique sequences consisting of charge, discharge and rest steps may be defined per system. Each sequence may contain up to 8 steps. Each sequence step can define up to 32 test conditions that are checked once per second during the step. This capability means up to 256 cells in a tray can run a unique, individual sequence to support process experimentation. Programming of the charge-discharge system is done through either USB or LAN.

User-defined test conditions monitor the following parameters during individual sequence steps: Voltage, Current, Power, Amp\*Hours, Watt\*Hours,  $\Delta V/\Delta t$ ,  $\Delta I/\Delta t$ ,  $\Delta V$ ,  $\Delta I$ . Once the limits of a condition are exceeded, the cell is considered as failed and further charging/discharging of that cell stops, while other cells continue with the sequence.

The BT2200 platform includes a “probe check” capability to assure good connections to your cells. The integrity of the power and sense leads on each channel are checked at the beginning of charge/discharge operations before connecting to a cell, and monitored continuously thereafter.

An internal calibration source is calibrated by external equipment at a one-year interval. All individual channels are calibrated via an internal transfer calibration process from the internal source.

## Operating Characteristics

Cost-effective, easily reconfigurable Li-Ion cell charge-discharge.

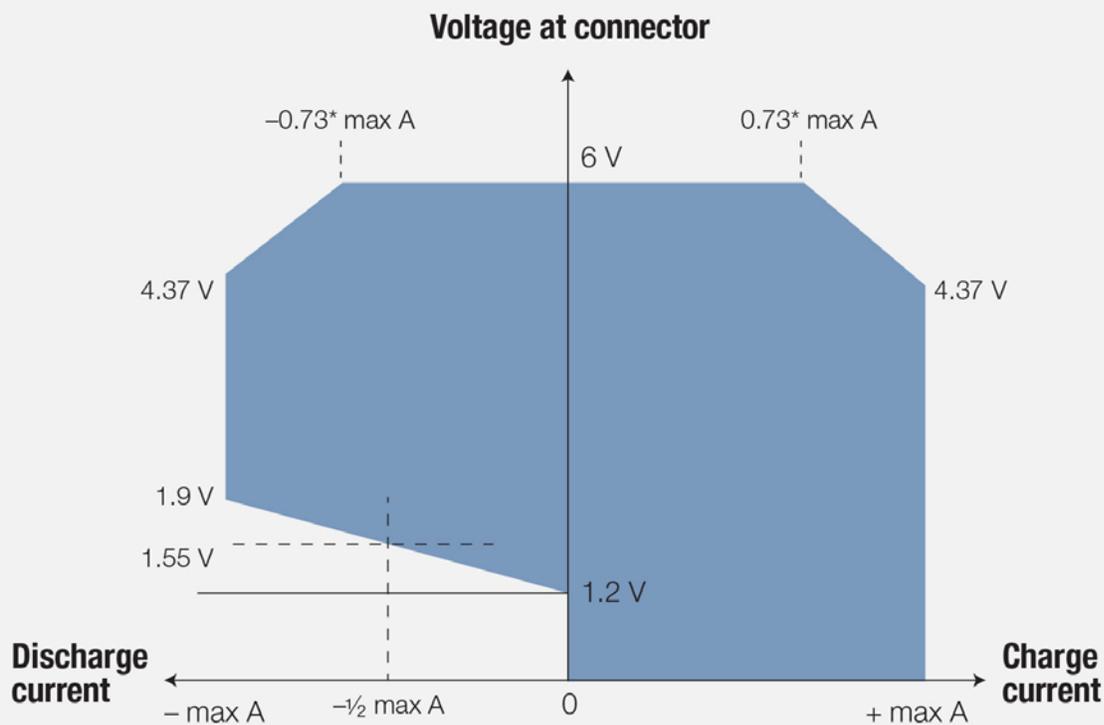
- Modular configurations from 6 A to 200 A, 8 to 256 user charge-discharge channels.
- Up to 8 modules per chassis, 32 physical charge-discharge channels per module.
- Combinations of up to 32 physical channels on one module can be paralleled in groups for greater charge-discharge current.

### Charge-discharge power operating limits

- ✓ BT2202A charge-discharge chassis 400 VAC 3-phase.
- ✓ BT2203A charge-discharge chassis 208 VAC 3-phase.

Each physical channel of the BT2204A/B Charge-Discharge Module is rated for up to  $\pm 6.25$  A of charge-discharge current. Up to 32 physical channels on one BT2204A or BT2204B can be paralleled to create higher-capacity user channels rated up to 200 A of charge-discharge current.

Number of user channels per chassis	Max current per user channel
256	$\pm 6.25$ A
64	$\pm 25$ A
32	$\pm 50$ A
16	$\pm 100$ A
8	$\pm 200$ A



## BT2202A and BT2203A Chassis

Parameter	BT2202A Charge-Discharge Chassis 400 VAC 3-phase	BT2203A Charge-Discharge Chassis 208 VAC 3-phase
Charge power limit	7 kW (256 physical channels at 6.25 A, 4.375 V)	7 kW (256 physical channels at 6.25 A, 4.375 V)
Discharge power limit	7 kW (256 physical channels at 6.25 A, 4.375 V)	7 kW (256 physical channels at 6.25 A, 4.375 V)
ACV input phase and range	3-phase; 400 to 480 VAC $\pm$ 10%	3-phase; 200 to 208 VAC $\pm$ 10%
Maximum input VA	11 kVA	11 kVA
Maximum input current per phase	19 A	39 A
Power factor	0.99 at nominal input and rated power	0.99 at nominal input and rated power

	Description
Programming interfaces	USB and LAN
GPIO	Configurable digital IO for fault monitoring and shutdown
Chassis dimensions (WxHxD)	610 mm (24 in) x 310 mm (12.2 in) x 700 mm (27.5 in)

## BT2200 Ordering Information

For 400 VAC 3-phase AC mains operation:

- BT2202A Charge-Discharge Chassis 400 VAC 3-phase
- BT2204B Charge-Discharge Module

For 208 VAC 3-phase AC mains operation:

- BT2203A Charge-Discharge Chassis 208 VAC 3-phase
- BT2204A Charge-Discharge Module

## BT2206A Filler Panel

Any empty slots in a chassis not containing a charge-discharge module must be covered with one BT2206A Filler Panel per empty slot.

For more information on the BT2200 Charge-Discharge Platform, please visit [www.keysight.com/find/BT2200](http://www.keysight.com/find/BT2200) or contact your Keysight representative.

## A New Way of Looking at Li-Ion Cell Self-Discharge in Manufacturing

Li-Ion manufacturing combines multiple cell forming and test processes to achieve the optimum mix of cost, quality, yield, process efficiency, inventory, and return on capital invested. Keysight Technologies has developed a new method of cell self-discharge measurement that can be integrated into forming and test processes. This new method of self-discharge measurement provides:

- Revolutionary improvements in the time required to discern good vs. bad cell self-discharge performance in manufacturing.
- Dramatic reductions in work-in-process, working capital, and facility costs.
- Elimination of weeks or months of cell storage time.

Traditionally, self-discharge isn't a complicated measurement – it's relatively easy to measure how the open circuit voltage (OCV) of cells changes over time. The issue is how long it takes for that OCV to change enough to tell whether the self-discharge of your questionable or suspect cells is within acceptable limits.

As a result, cell manufacturers keep far greater numbers of cells in work-in-process inventory than they would like. That negatively impacts work-in-process inventory metrics, and it consumes expensive floor space to hold that inventory.

## Keysight BT2152A Self-Discharge Analyzer



The BT2152A Self-Discharge Analyzer quickly and accurately measures cell self-discharge current on up to 32 cells. Keysight's patent-pending implementation of the measurement technique delivers a revolutionary reduction in the time required to discern good vs. bad self-discharge performance.

For smaller cells (e.g., 18650 or 21700 cells), the BT2152A can measure the self-discharge current in as little as 1 to 3 hours. And for larger capacity cells, the BT2152A can do this in as little as 2 to 5 hours. That measurement time is much less than the weeks or months required to see much change in the open circuit voltage.

And of greater impact in cell manufacturing, the analyzer's measurements allow you to see a clear difference in the self-discharge current of good vs. bad cells in typically less than 30 minutes.

For more information on how you can integrate this new method of cell self-discharge measurement into your manufacturing processes, please visit [www.keysight.com/find/Self-Discharge](http://www.keysight.com/find/Self-Discharge) and/or contact your Keysight representative.

Learn more at: [www.keysight.com](http://www.keysight.com)

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