# 16CH BATTERY CELL SIMULATOR MODEL 87001

Chroma 87001 Battery Cell Simulator is a high-precision, programmable, and bidirectional DC power source with both voltage source and current source functions. In addition, the model can be used as a multi-channel DC power supply or an electronic load as well. A single simulator has 16 channels and each of them can set voltage and current respectively via Chroma software.

The Chroma 87001 Battery Cell Simulator can be used in place of lithium-ion batteries to provide a reliable and safe testing environment. The equipped battery management unit (BMU) and its cell supervisor circuit (CSC) subsystem can test the battery cells used in electric vehicles and energy storage batteries.

The simulator has voltage isolated channels that can simulate a 480-cell battery pack (240S2P, Voltage <1,000V) connected in series. It is used to imitate the power characteristics when charging and discharging the battery cell energy. This high-precision battery cell simulator with flexible voltage source and current load regulation has voltage and current measurement capabilities. Each channel provides 0~5V voltage adjustment capability and 0~5A bidirectional current function, with serial and parallel capabilities between channels. The current can be increased by paralleled channels; moreover, the battery cell short circuit simulation tests can be performed via the battery management system (BMS). The BMS testing can be performed directly even when the cable length is 5m long.

The customized Chroma BMS automated test system integrates an 87001 battery simulator and a programmable resistor board. The system provides both temperature simulation for BMS temperature sensors as well as battery voltage data for BMS battery monitoring circuits, offering a comprehensive BMS test solution.

The simulator has a variety of protection features such as over-current protection (OCP), over-voltage protection (OVP), under-voltage protection (UVP), fan fail protection, and output circuit compensation voltage to make sure that the tests are conducted under safe conditions.

Ethernet CE RoHS2 Compliant

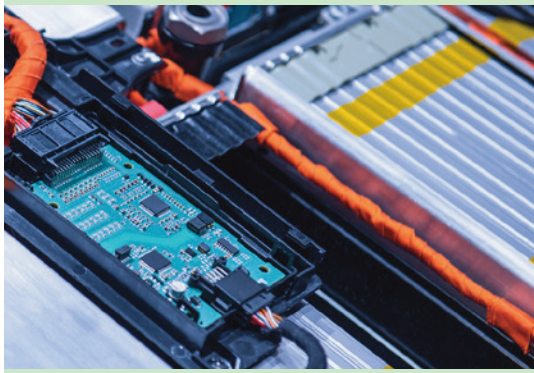
## MODEL 87001

### KEY FEATURES

- Operating mode : CC/CP
  - Channel power 25W
  - Channel voltage 5V
  - Channel current 5A (parallelable)
- Bidirectional power supply design
- Serial and parallel connection function
- 480-cell battery pack voltage simulation ability (240 cells in series and 2 cells in parallel)
- High precision current and voltage measurement
- 4 current ranges for selection per channel
- Current sharing design for parallel operation mode
- Fast voltage setting for rise/fall speed : time (1ms)
- Switch between fast charge and discharge current in current source mode without any interruption
- Low output noise
- Independent channel over-voltage, current limit, and over-temperature protection
- Standard Ethernet control interface
- CE certification granted

### APPLICATIONS

- BMS (Battery Management System) testing and verification
- Power tools production tests



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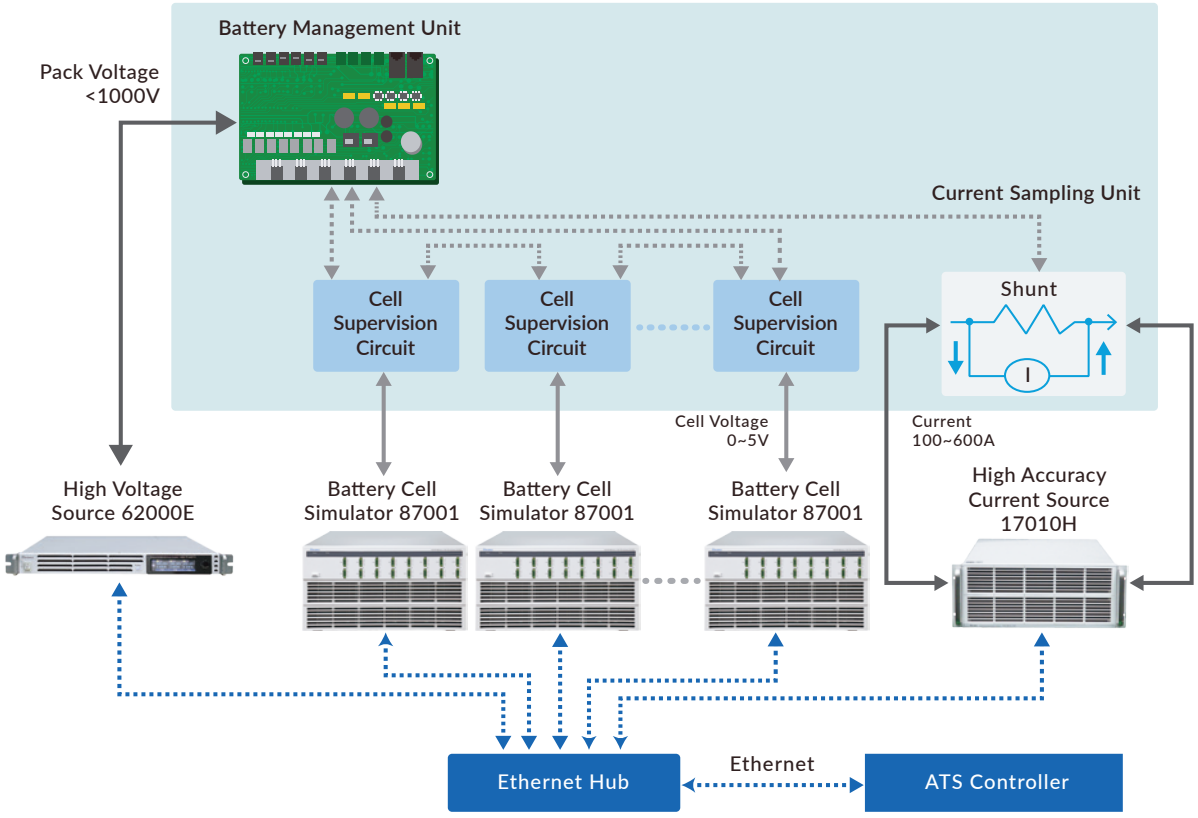
## APPLICATION ARCHITECTURE (Master/Slave Architected Battery Management System)

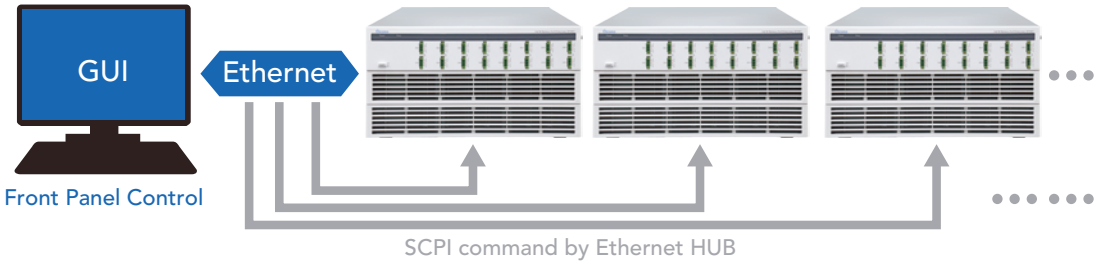
The battery cell simulator 87001 can simulate voltage of battery cells in series and provide current to balanced circuits of BMS boards. When integrated into an automatic BMS test system, the 87001 can test BMS boards as shown in the architecture diagram below.




## BATTERY CELL STATUS IN PARALLEL AND SERIAL OPERATION MODE

- For applications that require more than 16 battery cell strings, users can connect up to 15 units of 87001 simulators in series.
- Users can also independently connect each 87001 through an Ethernet hub. Where the Ethernet bandwidth is sufficient, the upper-layer controller can perform synchronous remote control, issuing voltage modulation commands to multiple 87001 simultaneously with a voltage control response time of less than 10ms for each individual unit.
- The hardware configuration can achieve up to 240S 2P (voltage < 1,000V). The simulator supports co-existing connections of channels in both series and parallel, with an automatic current balancing design in parallel connection mode.

Note: The voltage control response time (phase delay time) = upper-layer controller command sending time + 87001 command processing time + voltage rise/fall time.




## PRECISION VOLTAGE/CURRENT MEASUREMENT

The Chroma 87001 Battery Cell Simulator has voltage source and bidirectional current source modes with a built-in 16-bit high-precision A/D converter. The voltage measurement accuracy is up to ±1mV (0.02%FS) with resolution up to 0.1mV.

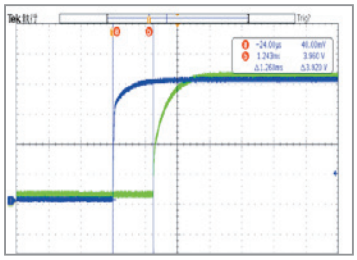
Catering to the market trend of active and passive balance design, the current measurement is divided into four ranges, 0~9A (<500ms), 0~5A, 0~500mA and 0~250uA, with 0.02%FS accuracy. For the 0~5A (power increased in parallel connection) range, the accuracy is ±1mA, which meets most industry requirements for testing actively balancing designed circuits with a current measurement resolution up to 100uA.

For the 0~500mA range, the accuracy is ±100uA (0.02%F.S.), satisfying the needs of most of the industry’ s passive balance designs with a measurement resolution of up to 10uA. In addition to current measurement for passive balance designs, it can also be used to measure the current consumption of battery cells in a cell supervision circuit (>10mA for general consumption).

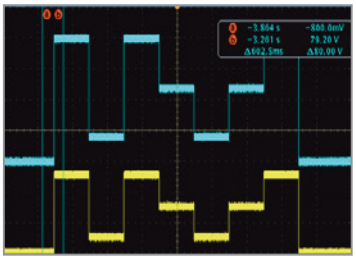
## SEQUENCE PROGRAMMING

The battery cell simulator has 16 channels. Through the software interface, users can set the voltage and current limits for each channel individually and control settings such as the rise and fall of output voltage and synchronized startup between channels. Its low output noise feature allows it to maintain the DC characteristics of a battery cell without any ripples during dynamic load changes, guaranteeing a stable DC output in a timely manner. Additionally, this feature reduces surge voltage caused by load changes, which could otherwise harm the Unit Under Test (UUT). This makes it an ideal solution for non-static products and test applications requiring a reliable DC voltage source.

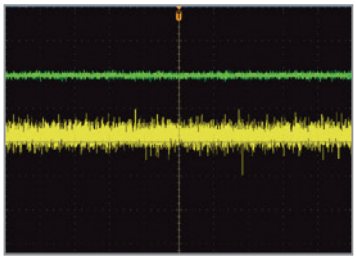
The Chroma 87001 Battery Cell Simulator provides a high-speed, programmable, dynamic, and bidirectional load mode with less than 100us load change capability, simulating a variety of real load current waveforms.



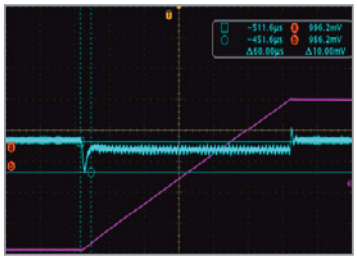
Synchronous startup time difference between channels < 2ms



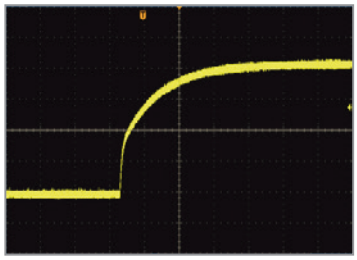
Voltage change of all channels



Low output noise < 0.35 mV rms



Stable DC output generated from load change



High speed voltage response <1ms

## SYSTEM INTEGRATION AND SUPPORT

- Chroma offers two types of commands (SCPI through the Ethernet interface and CANbus commands through the CANbus interface) as well as Labview and Labwindow driver programs, allowing users to develop their own application software for controlling the 87001 Battery Cell Simulator.
- Chroma's system integration capability enables us to provide customized automated test systems for BMS functional testing.

Integrated BMS Test System (16S)

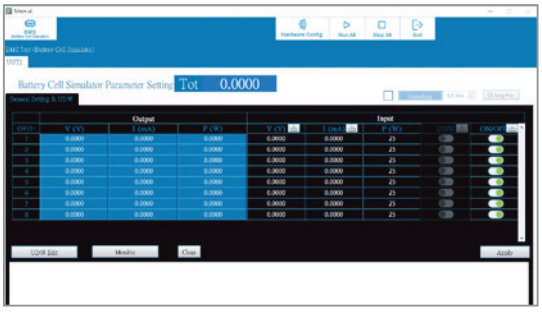
Distributed BMS Test System (96S)

## REMOTE CONTROL FUNCTION

Chroma's proprietary Softpanel is provided to control the battery cell simulator, allowing the user to:

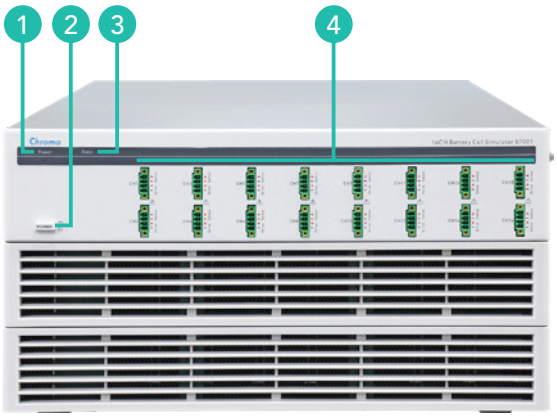
- Individually adjust the voltage of each battery string
- Set the voltage change procedure: OVP/UVP/OVP release /UVP release test

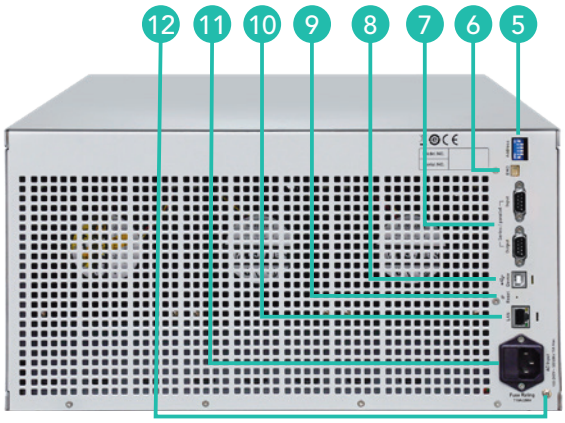
Note: The softpanel is only for a single unit of 87001.



87001 Softpanel

## PANEL DESCRIPTION




1. Power LED
2. States LED
3. Power Switch
4. Output Connector
5. ADDRESS
6. EMO
7. Multi-device Connector
8. N/A
9. IP Reset
10. Ethernet
11. AC Input
12. GND Terminal

## SPECIFICATIONS

| Model | 87001 |
|---|---|
| Channels | 16 |
| Power Out | Normal 400W,<br>Max. 560W (including compensation) |
| **Constant Voltage** | |
| 0~5V | Setting Range: 0mV ~ 5000mV<br>Accuracy: ± (0.02% of F.S.)<br>Setting Resolution: 0.5mV<br>Reading Range: 0 ~ 5200mV<br>Accuracy: ± (0.02% of F.S.)<br>Reading Resolution: 0.1mV |
| **Constant Current** | |
| 250uA | Setting Range: 0.1uA ~ 250uA<br>Accuracy: ± (0.02% of F.S.)<br>Setting Resolution: 0.1uA<br>Reading Range: 0 ~ 250uA<br>Accuracy: ± (0.02% of F.S.)<br>Reading Resolution: 10nA |
| 500mA | Setting Range: 0.1mA ~ 500mA<br>Accuracy: ± (0.02% of F.S.)<br>Setting Resolution: 0.1mA<br>Reading Range: 0 ~ 500mA<br>Accuracy: ± (0.02% of F.S.)<br>Reading Resolution: 0.01mA |
| 5A | Setting Range: 1mA ~ 5A<br>Accuracy: ± (0.02% of F.S.)<br>Setting Resolution: 1mA<br>Reading Range: 0 ~ 5 A<br>Accuracy: ± (0.02% of F.S.)<br>Reading Resolution: 0.1mA |
| 9A (Super mode) | Setting Range: 1mA ~ 9A<br>Accuracy: ± (0.02% of F.S.)<br>Setting Resolution: 1mA<br>Reading Range: 0 ~ 9A<br>Accuracy: ± (0.02% of F.S.)<br>Reading Resolution: 0.2mA<br>Continue Time: Max. 500ms |

| Protection Function (w/ Software) | | | |
|---|---|---|---|
| Protection | OVP, UVP, OCP, OTP (FAN Fail) | | |
| Transient Overvoltage Mains Supply | 2500V | | |
| Isolation Voltage | 1000V CH-TO-CH ; 1000V CH-TO-GND | | |
| **Program Response Time** | | | |
| Current Rise/Fall Times | 100us (condition: 0A to 5A @200cm Wire) | | |
| Programming Voltage Speed | Full load | Up | 1m sec. |
| | No Load | Down | 1m sec. |
| Load Regulation | Voltage | <0.01% + 2 mV | |
| | Current | <0.01% + 250μA | |
| Line Regulation | Voltage | <0.01% + 2 mV | |
| | Current | <0.01% + 250μA | |
| Ripple and Noise | Voltage | <0.35 mV rms | |
| | Voltage | <2 mV p-p | |
| | Current | <2 mA rms | |
| **General Specifications** | | | |
| Operable Environment | 0°C ~40°C<br>0~90% RH (non condensing) | | |
| Altitude | 2000 m | | |
| Input Voltage | 1Φ100V~240V±10%$V_{LN}$ | | |
| Input Current | Max. 10A | | |
| Input Power | 1.2kVA | | |
| Safety & EMC | CE | | |
| Communication Mode | Ethernet interface, CANbus interface *1 | | |
| Dimension (WxHxD) | 428 x 221 x 697mm / 16.9 x 8.8 x 27.5 inch | | |
| Weight | 42 kg/92.6 lb | | |

Note *1: The command update rate via CANbus is 10ms/CANID.

* Specifications are subject to change without notice.

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