The Chroma 17040 Regenerative Battery Pack Test System is a high precision system specifically designed for secondary battery module and pack tests. It has an energy regenerative function to greatly reduce power consumption during discharge, and ensure a stable power grid without generating harmonic pollution on other devices - even in dynamic charge and discharge conditions. It is capable of recycling the electric energy discharged by the battery module back to the grid reducing wasted energy that is discharged by traditional equipment in the form of heat, thus reducing the HVAC requirements.

The Chroma 17040 system has built in parallel channels and dynamic profile simulation functions. The parallel capability increases the charge and discharge current and power to its maximum, thus increasing the efficiency and flexibility of device usage. The dynamic profile simulation allows the user to load a battery waveform of a given drive profile in either current or power mode to meet the NEDC/FUDS requirements. Its bi-directional architecture ensures that the current will not be interrupted during the charge and discharge transient state so that the driving conditions can be accurately simulated to be in line with the ISO, IEC, UL and GB/T international testing standards.

Equipped with Chroma’s powerful “Battery Pro” software, the 17040 system has flexible test editing functions to perform independent channel tests, and conforms to the diversified requirements for testing secondary battery packs with high safety and stability. It also supports power failure recovery functions that ensure test data is not interrupted.

The test system has multiple safety features including Over Voltage Protection, Over Current Protection Check, Over Temperature Protection, and external parameter detection to ensure protected charge/discharge testing on the batteries. Furthermore data loss, storage and recovery are protected against power failure.
SYSTEM FEATURES

Security - Reinforce Risk Management
- Able to load test, cut-off, and protection criteria to a charging/discharging device directly for execution to achieve multi-layer protection through internal software and hardware
- Able to integrate external hardware to get real-time monitoring parameters from BMS, Data Logger, Chamber, and I/O signals to execute warning/cut-off/power off protection
- Able to monitor various voltage and temperature values of battery packs through readings from BMS and measurements on Data Logger; also able to perform instant judgment and protection based on set values
- Built-in multiple warning and protection modes: OVP, UVP, OTP, WIR_LOSS, CAL_ERR, POW_ERR, RMT_RVS

Precision - Improve Product Quality
- High frequency sampling measurement technology: Max. sampling rate 50kHz to ensure dynamic measurement accuracy
- Voltage accuracy: ± (0.02% of rdg. ± 0.02% of r.n.g.)
- Current accuracy: ± (0.05% of rdg. ± 0.05% of r.n.g.)
- Quick response test technology: 2ms (-90% to 90%) current slew rate applicable for various test applications
- Auto voltage/current range switch function: 4 ranges are varied with current change that will be automatically adjusted to optimize the measurement accuracy
- Support dynamic driving profile simulation (waveform), which simulates the current and power state of real driving conditions to comply with the NEDC, FUDS and HPPC standards

High frequency sampling measurement technology
Generally, battery chargers/dischargers use software to read current values for power computing; however, limited data sampling speed could result in large errors when calculating the dynamic current capacity. By increasing the V/I sampling rate and double integrating method, Chroma is able to provide capacity calculation with much higher accuracy. When the current changes, the data is not lost and the transmission speed is not affected.
- V/I sampling rate: 50KHz (per 20µs)
- Integrate calculus: I for capacity; VxI for energy

Quick response test technology
In quick response mode, the current is smooth without overshoot to avoid damaging the battery
- Current ripple noise <0.5%, Overshoot <1%

Dynamic driving profile simulation
Battery packs are used under quick and irregular current conditions. The 17040 system simulates real conditions on the battery pack via the working condition simulator
- Dynamic charge/discharge power or current waveforms simulate the drive cycle or any real world application. In the dynamic current mode (waveform), the current transition time for maximum discharge and charge requires only 2ms
- Test steps can specify an Excel file from which to read the stored current/power waveform
- 720,000 points of driving profile memory available to save the waveform profile in each channel
- Interval for profile condition changes: 1ms~10sec.
Efficiency - Reduce Operating Costs
- Software and hardware integration and customization capabilities including BMS, Data logger, Chamber, external signals, and HIL (HIL, Hardware in the Loop)
- Provides various signal interfaces for a variety of external devices (CANbus, Ethernet, Analog I/O) to support HIL
- Parallel function within the system up to a maximum of 600kW, 1500A
- Equipped with battery charger/discharger and simulator functions
- Embedded with high efficiency discharge energy regeneration technology

Data logger integration technology
The 17040 system uses software to integrate with the 51101 data logger to read multiple voltage and temperature records which can be used for setting cut-off and protection conditions. The data logger is able to perform sampling simultaneously on each channel, and the data acquisition speed can up to 200ms. Other brands of data loggers can be integrated for use if faster data acquisition speed is in demand. The 17040 system supported by the 51101 data logger has 192 channels.
Discharge energy recycling technology

- Bidirectional circuit architecture to accurately control reverse current change
- Regenerative battery energy discharge (efficiency > 90%)
- Static regenerative energy: In compliance with regenerative grid standards for solar energy, current THD < 5%, PF > 0.95
- Dynamic regenerative energy: Real-time transient current phase transitions avoid contaminating the grid

DUAL MODE APPLICATION

- Charger/discharger mode: applicable to battery pack testing via Battery Pro operating interface
- Battery simulator mode: applicable to motor driver/charging pile via Battery Simulator operating interface

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>I_THD</td>
<td>&lt;5%</td>
</tr>
<tr>
<td>Power Factor</td>
<td>&gt;0.95</td>
</tr>
<tr>
<td>Recycle Efficiency</td>
<td>&gt;90%</td>
</tr>
</tbody>
</table>

AC grid output

Discharge state changes to charge state

AC grid recycle

Charge state changes to discharge state

Smooth AC current waveform and real-time phase transition when energy is regenerated to the grid. This prevents other equipment from being affected by false test results or a contaminated grid.

DUAL MODE APPLICATION

- Charger/discharger mode: applicable to battery pack testing via Battery Pro operating interface
- Battery simulator mode: applicable to motor driver/charging pile via Battery Simulator operating interface
**Batter Charge/Discharge Software - Battery Pro**

The software platform “Battery Pro” when used with the Chroma 17040 conforms to the diversified requirements for testing secondary battery packs with high margins of safety and stability. It supports a power failure recovery function to guard against potential data loss.

- **Real-time monitoring**: Real-time browsing of the system test status without any waiting period. The test data and system integrated data can both be viewed at the same time.
- **Icon manager**: Test status of each channel is managed through different icons, easy to read and understand.
- **Authority management**: Sets the user’s authority for operation.
- **Fault record tracking**: Records any abnormal state for each channel independently.

**BATTERY SIMULATION FUNCTION**

The Chroma 17040, Battery Charge/Discharge Tester and Battery Simulator, can test battery pack and battery pack connected products. When a product is still under development and the supplier’s battery is not available, the 17040 can simulate the battery to verify whether or not the system is functioning normally. In addition, the 17040 can control the SOC status of different batteries. Users can download different battery curves to the 17040 to test the DUT for charge and discharge status. The 17040 can also perform battery and DUT collocation evaluation tests in advance that apply to the motor driver for vehicle start-stop systems, light EV electric controllers, car-mounted chargers, etc.

**Battery Pack Simulating Function**

- Multi-channel battery pack simulation
- Battery pack charge/discharge simulation
- Battery behavior curve setting
- Starting voltage and capacity initializing
- Battery pack total capacity setting
- Charge and discharge efficiency setting
- Battery DCR simulation
- Battery pack initialization cycle simulation
- Single channel bidirectional power supply

**Battery Pack Protection**

- OCP
- OVP
- Battery high voltage/power warning
- Battery low voltage/power warning
- Battery OVP/OPP
- Battery LVP/LPP

**Real Time Test Data Display**

- Voltage/Current
- Power Value display
- Voltage/Current
- Power Picture display
- Battery Pack charge/discharge curve display
- Testing report output function
Battery Pro - Operation Interface of the Battery Simulator
An optional battery simulator can be used with the 17040 to charge and discharge the bidirectional power supply. Furthermore, it can be used to set the battery capacity, DCR, and V-SOC curve to be downloaded to the charger, inverter, and motor driver tests via the proprietary software included.

**HARDWARE CONFIGURATION**

1. Control panel: Manual setup mode and equipment calibration mode
2. Power switch/indicator/emergency button
3. Output/input interface: GPIB, Ethernet, HIL, BMS and I/O
4. DC Power output terminal

**17040 STANDARD SYSTEM CONFIGURATION**

- 120kW
- 180kW
- 250kW
## SPECIFICATIONS

<table>
<thead>
<tr>
<th>Model</th>
<th>17040</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Power</td>
<td>60kW 120kW 180kW</td>
</tr>
<tr>
<td>Max. Voltage</td>
<td>500V 750V 1000V 500V 750V 1000V 500V 750V 1000V</td>
</tr>
<tr>
<td>Max. Current</td>
<td>150A 150A 150A 300A 300A 300A 450A 450A 450A</td>
</tr>
</tbody>
</table>

### Constant Voltage Mode

- **Voltages:** 500V 750V 1000V 500V 750V 1000V 500V 750V 1000V
- **Currents:** 150A 150A 150A 300A 300A 300A 450A 450A 450A

### Constant Current Mode

<table>
<thead>
<tr>
<th>Current Range</th>
<th>150A</th>
<th>150A</th>
<th>150A</th>
<th>300A</th>
<th>300A</th>
<th>300A</th>
<th>450A</th>
<th>450A</th>
<th>450A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Accuracy</td>
<td>±0.1%FS</td>
<td>±0.1%FS</td>
<td>±0.1%FS</td>
<td>±0.1%FS</td>
<td>±0.1%FS</td>
<td>±0.1%FS</td>
<td>±0.1%FS</td>
<td>±0.1%FS</td>
<td>±0.1%FS</td>
</tr>
<tr>
<td>Current Resolution</td>
<td>10mA</td>
<td>10mA</td>
<td>10mA</td>
<td>20mA</td>
<td>20mA</td>
<td>20mA</td>
<td>30mA</td>
<td>30mA</td>
<td>30mA</td>
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</tbody>
</table>

### Constant Power Mode

<table>
<thead>
<tr>
<th>Power</th>
<th>100W 100W 100W</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Accuracy</td>
<td>±0.2%FS</td>
</tr>
<tr>
<td>Power Resolution</td>
<td>100W</td>
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</table>

### Battery Simulator Mode

<table>
<thead>
<tr>
<th>Voltage Range</th>
<th>10<del>500V 15</del>750V 30<del>1000V 10</del>500V 15<del>750V 30</del>1000V 10<del>500V 15</del>750V 30~1000V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage Accuracy</td>
<td>±0.1%FS</td>
</tr>
<tr>
<td>Voltage Ripple (rms)</td>
<td>&lt; 1%FS</td>
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</tbody>
</table>

### Measurement

<table>
<thead>
<tr>
<th>Voltage Range (4 Scales as F.S.)</th>
<th>500V 750V 1000V 500V 750V 1000V 500V 750V 1000V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage Accuracy</td>
<td>±0.02%rdg + 0.02% FS</td>
</tr>
<tr>
<td>Voltage Resolution</td>
<td>10mV 15mV 20mV 10mV 15mV 20mV 10mV 15mV 20mV</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Current Range (4 Scales as F.S.)</th>
<th>150A 150A 150A 300A 300A 300A 450A 450A 450A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Accuracy</td>
<td>±0.05%rdg + 0.05% FS</td>
</tr>
<tr>
<td>Current Resolution</td>
<td>10mA 15mA 20mA 10mA 15mA 20mA 10mA 15mA 20mA</td>
</tr>
</tbody>
</table>

### Model 17040

| Max. Power | 250kW 300kW |
| Max. Voltage | 500V 750V 1000V 500V 750V 1000V 500V 750V 1000V |
| Max. Current | 600A 600A 600A 750A 750A 750A 750A 750A 750A |

### Constant Voltage Mode

<table>
<thead>
<tr>
<th>Voltage Range</th>
<th>10<del>500V 15</del>750V 30<del>1000V 10</del>500V 15<del>750V 30</del>1000V 10<del>500V 15</del>750V 30~1000V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage Accuracy</td>
<td>±0.1%FS</td>
</tr>
<tr>
<td>Voltage Resolution</td>
<td>10mV 15mV 20mV 10mV 15mV 20mV 10mV 15mV 20mV</td>
</tr>
</tbody>
</table>

### Constant Current Mode

<table>
<thead>
<tr>
<th>Current Range</th>
<th>10A 10A 10A 20A 20A 20A 30A 30A 30A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Accuracy</td>
<td>±0.05%rdg + 0.05% FS</td>
</tr>
<tr>
<td>Current Resolution</td>
<td>10mA 15mA 20mA 10mA 15mA 20mA 10mA 15mA 20mA</td>
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### Constant Power Mode

<table>
<thead>
<tr>
<th>Power</th>
<th>1mW 1mW</th>
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<tbody>
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<td>±0.15%FS</td>
</tr>
<tr>
<td>Power Resolution</td>
<td>1mW</td>
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</table>

### Battery Simulator Mode

<table>
<thead>
<tr>
<th>Voltage Range</th>
<th>10<del>500V 15</del>750V 30<del>1000V 10</del>500V 15<del>750V 30</del>1000V</th>
</tr>
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<tbody>
<tr>
<td>Voltage Accuracy</td>
<td>±0.1%FS</td>
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<td>&lt; 1%FS</td>
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</table>

### Measurement

<table>
<thead>
<tr>
<th>Voltage Range (4 Scales as F.S.)</th>
<th>500V 750V 1000V 500V 750V 1000V 500V 750V 1000V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage Accuracy</td>
<td>±0.02%rdg + 0.02% FS</td>
</tr>
<tr>
<td>Voltage Resolution</td>
<td>10mV 15mV 20mV 10mV 15mV 20mV 10mV 15mV 20mV</td>
</tr>
</tbody>
</table>
GENERAL SPECIFICATIONS

Battery Charge & Discharge Test System

| Operating Mode | Charge | CC, CV, CP, CC-CV, Waveform Power, Waveform Current, DCIR |
|               | Discharge | CC, CV, CP, CR, CP-CV, Waveform Power, Waveform Current, DCIR |

Current Rising/Falling Time with 0.2 Ω Resistive load
- 2ms (-90% to 90%)

Current Ripple Noise
- <0.5% F.S.

Overshoot
- <1% F.S.

Temperature Coefficient (Voltage/Current)
- <50 ppm/°C

AC Input
- Line Voltage / Frequency
  - Input 200~220Vac / 10% VLL, 47-63Hz
  - Input 380~400Vac / 10% VLL, 47-63Hz
  - Input 440~480Vac / 10% VLL, 47-63Hz
- Power Factor > 0.95 (at rated power)
- I_T.H.D < 5% (at rated power)

Others
- Efficiency >90% (at rated power)
- PC Interface Ethernet
- Operating Temperature
  - 0°C ~ 40°C
- Protection
  - UVP, OCP, OPP, OTP, FAN, Short
- Safety & EMC
  - CE
- Noise Level <70dB
- Interfate Standard: Ethernet, I/O control
- Option: GPIB, HIL(Ethernet, CAN, Analog), BMS read/write
- Dimension (H x W x D) / Weight
  - 60kW 190cm x 100cm x 50cm / 900 kg
  - 120kW 190cm x 100cm x 100cm / 1800 kg
  - 180kW 190cm x 150cm x 100cm / 2700 kg
  - 250kW 190cm x 200cm x 100cm / 3600 kg
  - 300kW 190cm x 250cm x 100cm / 4500 kg

* All specifications are subject to change without notice.

SPECIFICATIONS OF 51101-64 THERMAL/MULTI-FUNCTION DATA LOGGER

<table>
<thead>
<tr>
<th>Voltage Reading</th>
<th>VA-10 Voltage Adaptor</th>
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</thead>
<tbody>
<tr>
<td>Voltage Resolution</td>
<td>100uV</td>
</tr>
<tr>
<td>Voltage Input Type</td>
<td>±10VDC</td>
</tr>
<tr>
<td>Voltage Input Range</td>
<td>±(0.05% of reading + 500uV)</td>
</tr>
<tr>
<td>Voltage Input Accuracy</td>
<td>300 KΩ</td>
</tr>
</tbody>
</table>

ORDERING INFORMATION

Regenerative Battery Pack Test System Model 17040

<table>
<thead>
<tr>
<th>Power Range</th>
<th>Voltage</th>
<th>Current</th>
<th>Channels</th>
</tr>
</thead>
<tbody>
<tr>
<td>60kW</td>
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<td>150A</td>
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<td></td>
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<td>500V</td>
<td>150A</td>
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<tr>
<td>120kW</td>
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<td></td>
<td>750V</td>
<td>300A</td>
<td>1</td>
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<tr>
<td></td>
<td>500V</td>
<td>300A</td>
<td>1</td>
</tr>
<tr>
<td>180kW</td>
<td>1000V</td>
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<td>500V</td>
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</tr>
<tr>
<td></td>
<td>500V</td>
<td>750A</td>
<td>1</td>
</tr>
</tbody>
</table>

Others and Options
- 51101-64 Thermal/Multi-Function Data Logger, 8~64 CH
- A170201 IPC for battery test system
- A692004 AC input cable (5m)
- A692005 DC output cable and sensor (3m)

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