Chroma's 17020 system architecture offers regenerative discharge designed to recycle the electric energy sourced by the battery module either back to the channels in the system performing a charging function or to the utility mains in the most energy efficient manner. This feature saves electricity, reduces the facilities thermal footprint and provides a green solution.

Chroma's 17020 system is equipped with multiple independent channels to support dedicated charge / discharge tests on multiple battery modules / packs, each with discrete test characteristics. The channels can easily be paralleled to support higher current requirements. This feature provides the ultimate flexibility between high channel count and high current testing.

The 17020 advanced hardware design can create seamless transitions between maximum charge and maximum discharge (or maximum discharge and maximum charge) with a rapid 50 ms conversion. This feature allows for charge/discharge modes for simulating real world scenarios.

Chroma's 17020 system has flexible programming functions and may be operated with Chroma's powerful Battery Pro software. Battery Pro utilizes the system to create cycling tests from basic charge or discharge to complex drive cycle testing for each channel or channel groups. A thermal chamber control can be integrated into a profile and triggered by time or test results yielding a dynamic profile. Battery Pro's features allows for quick and intuitive test development to eliminate the need of tedious scripting or programming by a software engineer.

There are multiple safety features including Battery Polarity Check, Over Voltage Protection, Over Current Protection check and Over Temperature Protection to ensure protected charge / discharge testing. In the unlikely event of power or computer communication loss, the data is securely stored in the system, on a non-volatile memory, protecting against potential data loss and allowing for continuous flow after restart.
### APPLICATIONS

<table>
<thead>
<tr>
<th>Battery Pack</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>EV battery module</td>
<td>Drive cycle simulator</td>
</tr>
<tr>
<td>Electric scooter/ bike</td>
<td>Learning test for manufactory</td>
</tr>
<tr>
<td>UPS</td>
<td>Life cycle test</td>
</tr>
<tr>
<td>Electric gardening tools</td>
<td>Balance control test</td>
</tr>
<tr>
<td>Energy storage battery</td>
<td>DCIR test</td>
</tr>
<tr>
<td>Power tools</td>
<td>Capacity test</td>
</tr>
<tr>
<td>Car battery</td>
<td>Performance test</td>
</tr>
<tr>
<td>Lead-acid battery</td>
<td>Reliability test</td>
</tr>
</tbody>
</table>

### REGENERATIVE ENERGY

- Regenerative battery energy discharge
  - Direct recycle back to the battery under charging
  - Regenerate to grid
- Low heat output
- Reduce air-conditioner power consumption
- The THD of 17020 system is under 5% at rated power
  - The PF is over 0.9 at rated power
  - Return to factory directly

### PARALLEL FUNCTIONS

**Parallel function**

**Multi-channels**

- Supports various capacity batteries by paralleling
- The system supports different capacity batteries from a base system configuration
- Battery companies have various capacity configurations. Some customers may purchase a high power system to test all capacity battery packs. The downside is that measurements accuracy are not sufficient for small-capacity battery packs. Using Chroma's systems, customers test under individual channels or parallel to test higher capacity battery packs
### Independent Channels
- Independent channel operation
- Independent testing data
- Independent protection
- Independent testing process

### Operating mode
- Constant current (CC) mode
- Constant voltage (CV) mode
- Constant power (CP) mode
- Constant voltage-limit current mode (CC-CV)
- Waveform current mode
- DCIR mode
- Rest

### Cut-off conditions
- Time (s)
- Capacity (Ah)
- Voltage (V)
- Current (A)
- Temperature (°C)
- Channel data in data logger (Option)

### Protection conditions
- Over voltage protection (V)
- Under voltage protection (V)
- Over current protection (A)
- Over temperature protection (°C)
- Over capacity protection (Ah)
- Wire loss protection (ΔV)
- Channel data in data logger (Option)
- ΔV + ΔV protection (V)
- ΔI / Δt protection (A)
- Delta Protection: Protect internal short of battery cell

### Testing data record
- Independent testing data
- Detail report: STEP / TEST TIME / TEST TIME ID / Cycle / Loop / STEP MODE / STEP TIME / VOLTAGE(V) / CURRENT(A) / CAPACITY (Ah) / Energy (Wh) / TEMPERATURE (°C) / Data Logger Channel (Option)
- STEP / STEP NO / LOOP / CYCLE / STATUS / STEP START TIME / STEP MODE / CUT OFF VOLTAGE(V) / CUT OFF CURRENT(A) / CUT OFF CAPACITY(Ah) / DCIR(mOhm) / Energy (Wh) / TEMPERATURE (°C) / Data Logger Channel (Option)

### High accuracy capacity calculation
Voltage/current sampling rate of 50kHz used for calculations of capacity ratings in dynamic waveform mode.
- Minimum Δt: 10ms

### Compact Size
- The dimensions of a regenerative system is smaller compared to a system that has to dissipate energy.

### Continuous transition
- Continuous charge and discharge transition: No time delay to transit from charge to discharge. The user can verify the battery pack for a design limit.
- Continuous CC-CV transition: No overshoot current or voltage to damage the battery when transiting CC-CV.

### Response time
- Trip time between maximum charge and maximum discharge current is 50ms.
- Smooth current without overshoot for avoiding to damage the battery.

### Temperature Measurement
- Temperature measured for each channel within the range of 0~90°C ± 2°C.
- 4 sets of measurements (Max) per channel to measure the battery surface temperature.

### Test for battery pack with split connections
For some battery pack design, the charge and discharge ports are split to two connectors. Users can set 17020 software to select Charge/discharge going through with a single connector or two connectors separately.

### Data Recovery Function
- 60 min of temporary data storage when sampling time is 1 sec.
- Save the test settings to resume after power failure is recovered.
SOFTWARE FUNCTION

The 17020 Test system is specifically designed to meet the various requirements for testing secondary battery packs with high safety and stability. Charge and discharge protection aborts tests when abnormal conditions are detected. Data loss, storage and recovery are protected against power failure.

User friendly
- Real-time multi channel battery pack status browse
- Icon Manager: Test status of each channel is managed through different icons, easy to read and understand.
- Authority management: It sets the user’s authority for operation.
- Fault record tracking: It records the abnormal state of each channel independently.

Recipe editor
- 255 charge/discharge conditions
- Sets dual layer loops (cycle & loop) with 9999 loops per layer
- Able to edit dynamic charge/discharge waveform with 10ms current switching speed
- Testing Step: CV / CC / CP / CC-CV / Waveform current / DCIR
- Cut-off conditions (time, current, capacity, cut-off voltage, cut-off current, etc.)
- Next Step: Next / End / Jump / Rest

Testing Data
- Generate the detailed report and step report
- Customized report format
- Exports test reports in PDF, CSV and XLS
- Graphical report function
- Report analysis Function: Users can create customized reports such as life-cycle report, Q (AH)-V(V) report, V(V)/I(A)/T(°C)-time report etc through the user-defined X and Y axis parameters.
- Real-time browsing test reports of each channel
- Diversified reports & charts: Real-time report, Cut-off report, X-Y scatter chart report

Software integration
- Thermal chamber: Synchronize temperature control with charge/discharge profile.
- Data logger: Temperature or voltage data record. Cut-off and protection conditions setting.
- BMS data record: Software setting to read data from BMS by Data Communication unit A692000/A692001. It supports SmBus and CAN bus. The data can be set the conditions for cut-off or protection during testing.
- CHROMA Data logger 51101 provides synchronized sampling with constant data acquisition rate.

Minimum: 200 ms
Interface: Ethernet


**FLEXIBLE SYSTEM CONFIGURATION**

17020 Regenerative Battery Pack Test System can be configured to specified requirements and expandable to 60 channels.

1. Battery Charge/Discharge Controller: Model 69200-1
2. DC/AC Bi-directional Converter: Model A691101
3. Regenerative Charge/Discharge Tester: Model 69200 series
4. Data logger (option): Model 51101-64
5. BMS data communication unit

- Support B, E, J, K, N, R, S, and T type thermal couples with ITS-90 defined temperature range
- Individual channel cold junction compensation with < ±0.3°C accuracy
- Temperature resolution up to 0.01°C, error down to (0.01% of reading + 0.3°C)
- Voltage full range ±10VDC; resolution 10μV; error down to 0.015% of reading + 100μV
- No matter how many channels are active, the data rate can be as fast as 5 samples per second per channel.

Model 69206-60-8

- 1. Channel No
- 2. Charge Status Indicator
- 3. Discharge Status Indicator
- 4. UUT Connection Indicator
- 5. Parallel Indicator
- 6. Failure Indicator
- 7. Power Switch
- 8. Channel DIP Switch
- 9. Parallel Connector
- 10. Temperature Meas. Terminal
- 11. Voltage Meas. Terminal
- 12. Charge/Discharge Output/Input Connector
- 13. Charge Output Connector
- 14. Controller Connector
- 15. DC BUS Terminal
- 16. AC Input

The driving cable can connect the front panel or rear outlet, users can choose their own.
### SPECIFICATIONS

<table>
<thead>
<tr>
<th>Model</th>
<th>69206-60-8</th>
<th>69212-20-4</th>
<th>69212-60-4</th>
<th>69225-60-4</th>
<th>69225-100-4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Channel</strong></td>
<td>8</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
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<tr>
<td><strong>Charge/Discharge Mode</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Voltage Range</td>
<td>4-60Vdc</td>
<td>0V-20Vdc</td>
<td>0V-60Vdc</td>
<td>0V-60Vdc</td>
<td>0V-100Vdc</td>
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<tr>
<td>Maximum Current</td>
<td>13A</td>
<td>65A</td>
<td>62.5A</td>
<td>62.5A</td>
<td>50A</td>
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<tr>
<td>Max Power</td>
<td>600W</td>
<td>1250W</td>
<td>1250W</td>
<td>2500W</td>
<td>2500W</td>
</tr>
<tr>
<td>Current Resolution</td>
<td>0.1% stg. + 0.05% F.S.</td>
<td>0.1% stg. + 0.05% F.S.</td>
<td>0.1% stg. + 0.05% F.S.</td>
<td>0.1% stg. + 0.05% F.S.</td>
<td>0.1% stg. + 0.05% F.S.</td>
</tr>
<tr>
<td>CV mode accuracy</td>
<td>0.1% stg. + 0.05% F.S.</td>
<td>0.1% stg. + 0.05% F.S.</td>
<td>0.1% stg. + 0.05% F.S.</td>
<td>0.1% stg. + 0.05% F.S.</td>
<td>0.1% stg. + 0.05% F.S.</td>
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<tr>
<td>Voltage Range</td>
<td>1mV</td>
<td>5mV</td>
<td>5mA</td>
<td>5mA</td>
<td>5mA</td>
</tr>
<tr>
<td>CP mode accuracy</td>
<td>0.2% stg. + 0.1% F.S.</td>
<td>0.2% stg. + 0.1% F.S.</td>
<td>0.2% stg. + 0.1% F.S.</td>
<td>0.2% stg. + 0.1% F.S.</td>
<td>0.2% stg. + 0.1% F.S.</td>
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<tr>
<td>Power Resolution</td>
<td>0.1W</td>
<td>0.1W</td>
<td>0.3W</td>
<td>0.3W</td>
<td>0.5W</td>
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<tr>
<td><strong>Measurement</strong></td>
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<tr>
<td>Voltage Range</td>
<td>0-60V</td>
<td>0-20V</td>
<td>0-60V</td>
<td>0-60V</td>
<td>0-100V</td>
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<tr>
<td>Voltage accuracy</td>
<td>0.02% rdg. + 0.02% F.S.</td>
<td>0.02% rdg. + 0.02% F.S.</td>
<td>0.02% rdg. + 0.02% F.S.</td>
<td>0.02% rdg. + 0.02% F.S.</td>
<td>0.02% rdg. + 0.02% F.S.</td>
</tr>
<tr>
<td>Voltage resolution</td>
<td>1mA</td>
<td>5mA</td>
<td>5mA</td>
<td>5mA</td>
<td>5mA</td>
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<tr>
<td>Power Range</td>
<td>0-600W</td>
<td>0-1250W</td>
<td>0-1250W</td>
<td>0-2500W</td>
<td>0-2500W</td>
</tr>
<tr>
<td>Power accuracy</td>
<td>0.08% rdg. +0.08% rng.</td>
<td>0.12% rdg. + 0.07% rng.</td>
<td>0.12% rdg. +0.07% rng.</td>
<td>0.12% rdg. +0.07% rng.</td>
<td>0.12% rdg. +0.07% rng.</td>
</tr>
<tr>
<td>Power resolution</td>
<td>0.1W</td>
<td>0.1W</td>
<td>0.3W</td>
<td>0.3W</td>
<td>0.3W</td>
</tr>
<tr>
<td><strong>Temperature</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature range</td>
<td>0°C ~ 40°C</td>
<td>-40°C ~ 85°C</td>
<td>-40°C ~ 85°C</td>
<td>-40°C ~ 85°C</td>
<td>-40°C ~ 85°C</td>
</tr>
<tr>
<td><strong>Others</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Efficiency (Typical)</td>
<td>85~90%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Model A691101 DC/AC Bi-direction Power

**Regenerative Bi-Direction Power**

- Voltage Range: 100V~240V ±5%, 47~63Hz
- Current THD/ Power Factor: <5% / > 0.9 at rated power
- Protection: UVP, OCP, OPP, OTP, FAN

**General Specifications**

- Dimension (H x W x D): 83.94 x 428 x 420mm / 3.5 x 16.9 x 16.5 inch
- Weight: 25kg / 55.2lbs

### Model 69200-1 Battery Charge/Discharge Controller

**Data Acquisition Rate to PC**

- minimum 40ms@4CH independent, 10ms@4CH parallel, 600ms@60CH independent, 100ms@60CH parallel

**PC Interface**

- Ethernet

**Dimension (H x W x D):**

- 88.14 x 428.5 x 696.0mm / 3.5 x 16.8 x 27.4 inch

**Weight:**

- 38.6kg / 85lbs

**Others**

- Efficiency (Typical): 85~90%

**Temperature Coefficient**

- Voltage / Current: 50ppm / °C

### ORDERING INFORMATION

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>17020:600W/60V/13A</td>
<td>per channel, 8-56CH</td>
</tr>
<tr>
<td>17020:1250W/20V/65A</td>
<td>per channel, 4-60CH</td>
</tr>
<tr>
<td>17020:1250W/60V/62.5A</td>
<td>per channel, 4-60CH</td>
</tr>
<tr>
<td>17020:2500W/60V/62.5A</td>
<td>per channel, 4-60CH</td>
</tr>
<tr>
<td>17020:2500W/100V/50A</td>
<td>per channel, 4-60CH</td>
</tr>
</tbody>
</table>

**Developed and Manufactured by:**

**CHROMA ATE INC.**

**Worldwide Distribution and Service Network**