REGENERATIVE BATTERY PACK TEST SYSTEM MODEL 17020

Chroma's 17020 is a high precision system specifically designed for secondary battery module and pack tests. Highly accurate sourcing and measurements ensure that the test quality is suitable for performing repetitive and reliable tests crucial for battery modules / packs, incoming, and outgoing inspections as well as capacity, performance, production, and qualification testing.

The system architecture of the Chroma 17020 offers regenerative discharge capabilities 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 facility's thermal foot print, and provides a green solution.

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

The Chroma 17020 features advanced hardware design that enables seamless transitions between maximum charge and maximum discharge (and vice versa) with a rapid 50 ms conversion. This feature allows for charge / discharge modes that simulate real world scenarios.

The Chroma 17020 system has flexible programming functions and may be operated with Chroma's powerful "Battery Pro" software. With the Battery Pro software, cycling tests from basic charge or discharge to complex drive cycle testing can be created and utilized for individual channels and 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 allow quick and intuitive test development, eliminating the need of tedious scripting or programming by a software engineer.

The Chroma 17020 system has 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, data is securely stored in non-volatile system memory protecting against potential data loss and allowing for seamless continuation after restart.

Ethernet

CE

MODEL 17020

KEY FEATURES

- Regenerative battery energy discharge, efficiency 85%
  - -Energy saving
  - -Environmental protection
  - -Low heat generation
- Channels parallelable for higher currents
- Charge / discharge modes (CC, CV, CP)
  - -Power Range: 600W, 1.25kW, 2.5kW, 5kW, 10kW, 20kW, 30kW, 50kW, 60kW per channel
  - -Voltage Range: 20V, 60V, 100V, 200V, 500V per channel
  - -Current Range: up to 2600A (parallel)
- Driving cycle simulation
- High precision measurement
- Fast current conversion
- Smooth current without overshoot
- Test data analysis function
- Data recovery protection (after power failure)
- Independent protection for each channel
- BMS data recording
- Thermal chamber control integration

APPLICATIONS

- EV battery module
- Electric scooter
- Electric bike
- UPS
- Energy storage battery
- Power tools
- Car battery
- Lead-acid battery

Chroma
Advancing Excellence

SYSTEM FUNCTIONS

Independent Channels

- Independent channel operation
- Independent testing data
- Independent protection
- Independent testing process

Operating Mode

- Constant current (CC), voltage (CV), power (CP), and voltage-limit current (CC-CV) mode
- Waveform current mode
- DCIR mode
- Rest

Cut-off Conditions

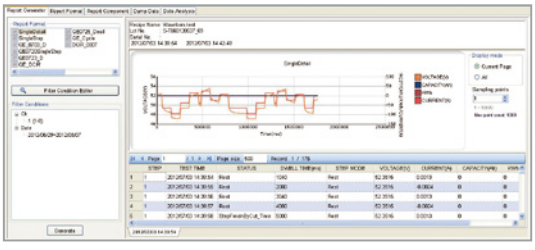
- Time (s), Capacity (Ah), Voltage (V), Current (A), Temperature (˚C)
- Channel data in data logger (Option)

Protection Conditions

- Over voltage (V), over current (A), over temperature (˚C), and over capacity (Ah) protections
- Under voltage protection (V)
- Wire loss protection (ΔV)
- -ΔV / +ΔV (V), +ΔI / -ΔI (A) protections
- Delta Protection: Protect against internal short of battery cell
- Channel data in data logger (option)

Testing Data Records

- Detailed 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 (optional)
- 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 (optional)



Compact Size

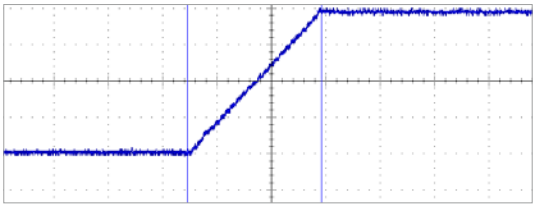
The dimensions of a regenerative system are smaller when compared to a system that has to dissipate energy.

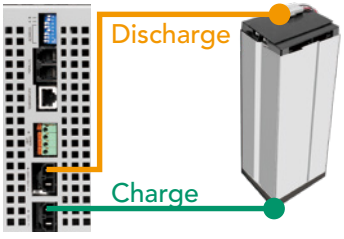
Continuous Transition

- Continuous charge and discharge transition: No time delay to switch 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 transitioning between CC-CV

Response Time

- 50ms trip time between maximum charge and discharge current
- Smooth current without overshoot to avoid damaging the battery





Test for battery pack with split connections

For some battery pack designs, the charge and discharge ports are split into two connectors. The user can set the 17020 software to select charge / discharge using either a single connector or two connectors separately.

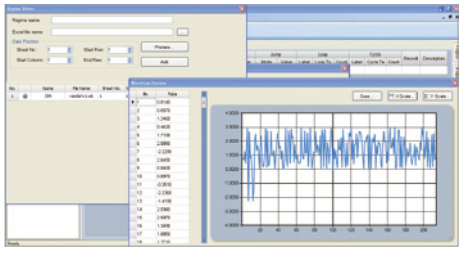
Fault Recovery

17020 supports manual switching between multiple channels, transferring the test channel to an available one, ensuring seamless continuation of test data to resolve customer anxiety regarding failures during long cycle testing.

DRIVING CYCLE SIMULATION

Battery packs are always used under quick and irregular current conditions. The system simulates real conditions on the battery pack via working condition simulator.

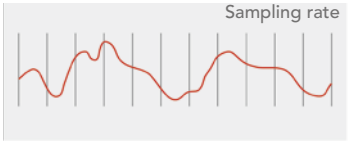
- Import dynamic charge / discharge power or current waveforms to simulate the drive cycle or actual application
- Supports Excel (xls) format
- 720,000 points of driving profile memory to save the waveform profile in each channel
- Minimum Δt: 10ms



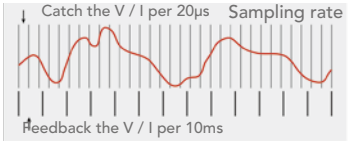
High Accuracy Capacity Calculation

Voltage / current sampling rate of 50kHz used for calculating capacity ratings in dynamic waveform mode

- V / I sampling rate: 50KHz (per 20μs)
- Integrate calculus: I for capacity; VxI for energy



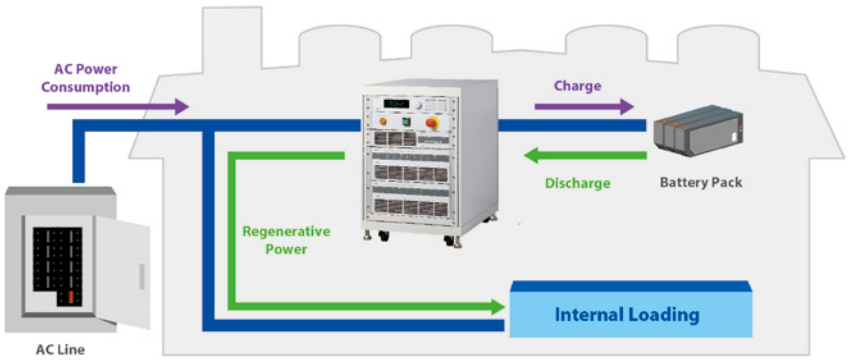
Other cycle



Double integrating method

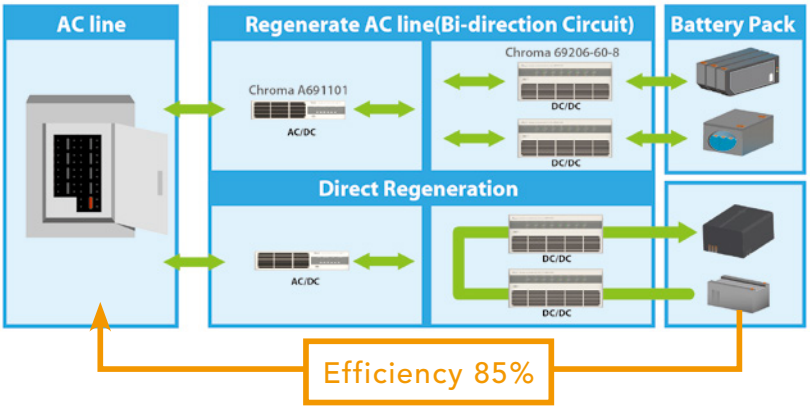
REGENERATIVE ENERGY

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

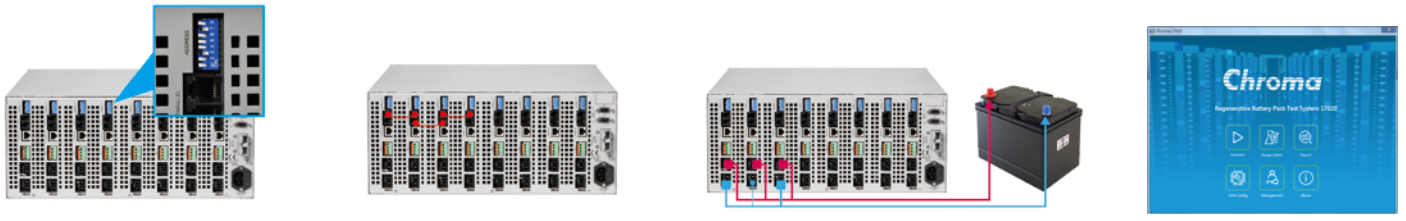


TEST ITEMS

- Drive cycle simulator
- Learning test for manufacturing
- Life cycle test
- Balance control test
- DCIR test
- Capacity test
- Performance test
- Reliability test
- Over charge / discharge test
- Thermal test



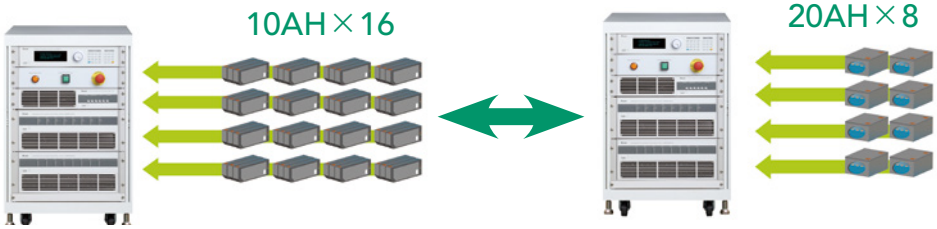
PARALLEL CONTROL-UP TO 60 CHANNELS



1. Set dip switches → 2. Connect communication cables → 3. Connect UUTs → 4. Software automatic detection

Supports Various Capacity Batteries in Parallel

Battery companies have various capacity configurations. Some customers may purchase a high power system to test all capacity battery packs. The downside is that the measurement accuracy is not sufficient for small-capacity battery packs. Using Chroma's system, customers can test under individual or parallel channels for higher capacity battery packs. The system supports different battery capacities from a base system configuration.

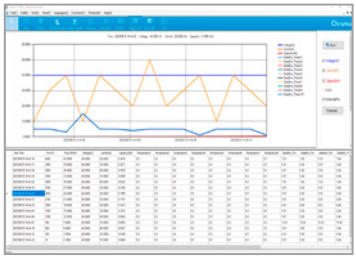


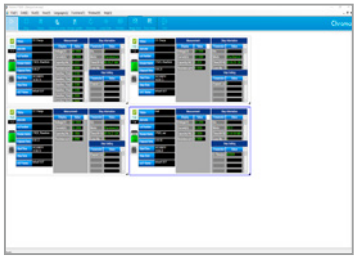
GRAPHIC USER INTERFACE-BATTERY PRO

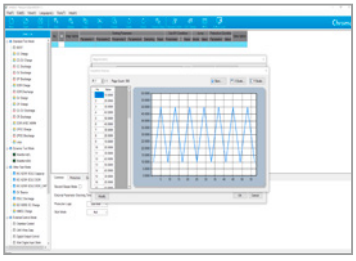
The 17020 test system is specifically designed to meet the diversified requirements of testing secondary battery packs with high safety and stability. Charge and discharge protection will abort tests when abnormal conditions are detected. Data loss, storage and recovery are protected against power failure.

- Real-time multi channel battery pack status browsing
- Icon Manager: Test status of each channel is managed through different icons, easy to read and understand
- Authority management: Set user operating permissions
- Fault record tracking: Records abnormal status of each channel independently

Battery Pro main menu

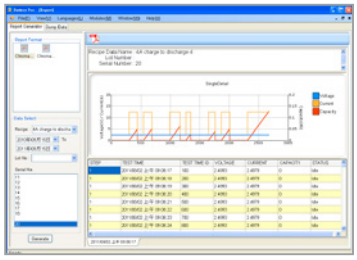

Charge / Discharge test program editor

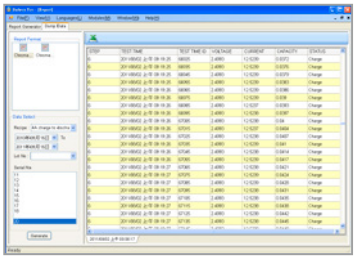

Real time monitoring


Waveform current test editor

Recipe Editor

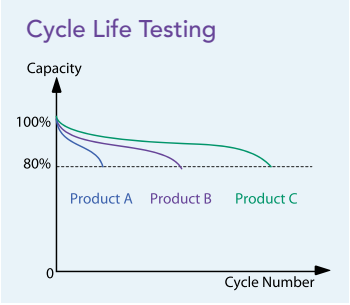
- 255 charge / discharge conditions
- Sets dual layer loops (cycle & loop) with 9999 loops per layer
- Able to edit dynamic charge / discharge waveform with 10ms current switching speed
- Testing Step: CV / CC / CP / CC-CV / Waveform current / DCIR)
- Cut-off conditions (time, current, capacity, cut-off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

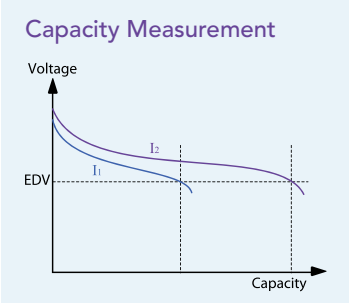




Statistical Reports

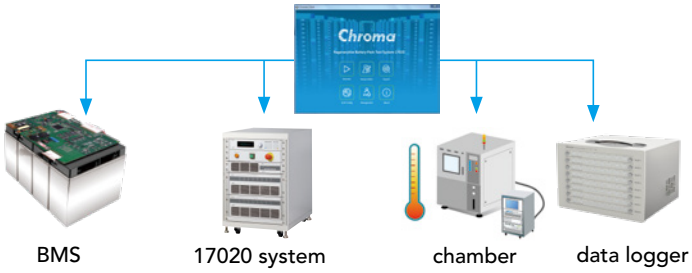
- Generate detailed report and step report
- Customized report format
- Exports test reports in PDF, CSV and XLS
- Graphical report function
- Report analysis Function: Users can create customized reports such as life-cycle report, Q (AH)-V (V) report, V (V) / I (A) / T (˚C)-time report and etc. through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

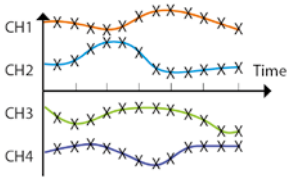




Software Integration

- Thermal chamber: Synchronize temperature control with charge / discharge profile
- Data logger: Temperature or voltage data record that can be used for setting Cut-off and protection conditions
- BMS data recording: Software setting to read data from BMS via data communication unit A692000 / A692001. This supports SmBus and CAN bus. The data can be set in the conditions for cut-off or protection during testing





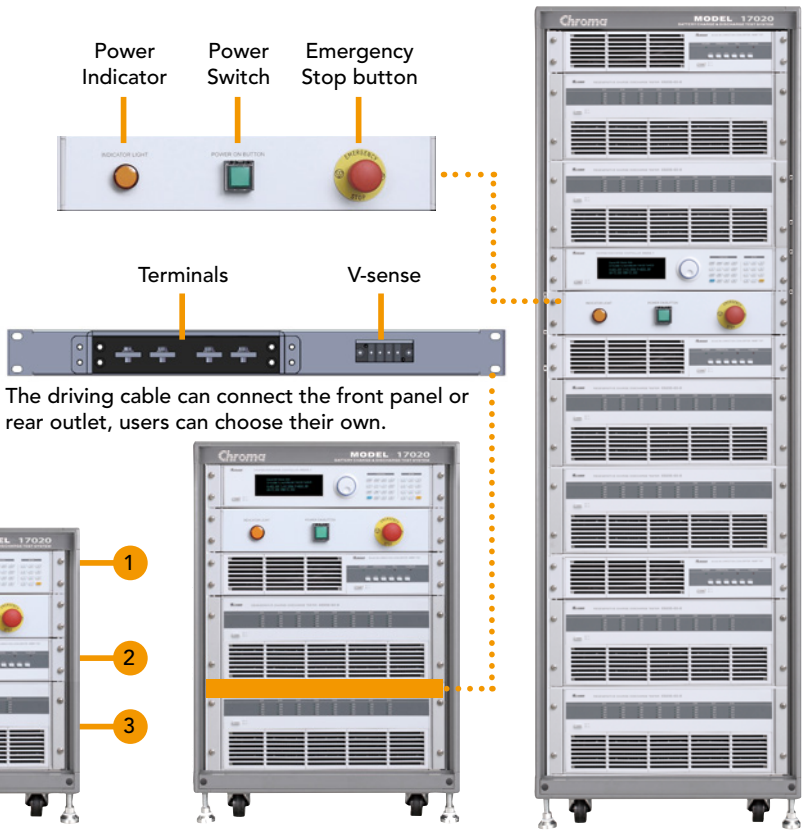
Multifunctional data logger provides synchronized sampling with constant data acquisition rate.

Minimum: 200 ms
Interface: Ethernet

SYSTEM CONFIGURATION

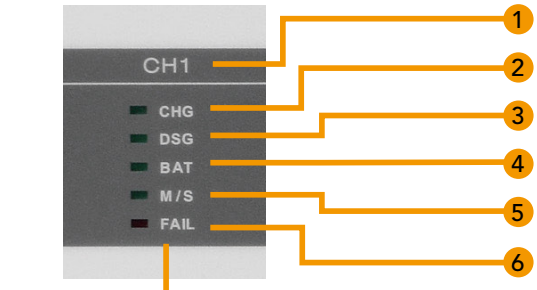
1. Battery Charge / Discharge Controller
   Model 69200-1
2. AC / DC Bi-directional Converter
   Model A691101
3. Regenerative Charge / Discharge Tester
   Model 69200 Series
4. Thermal / Multi-function Data Logger
   Model 51101-64 (option)
5. BMS Communication Unit
   Model A692000 / A692001

* Other equipment supported upon request

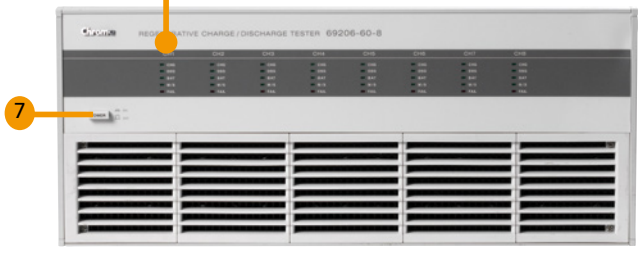


PANEL DESCRIPTION-REGENERATIVE CHARGE / DISCHARGE TESTER

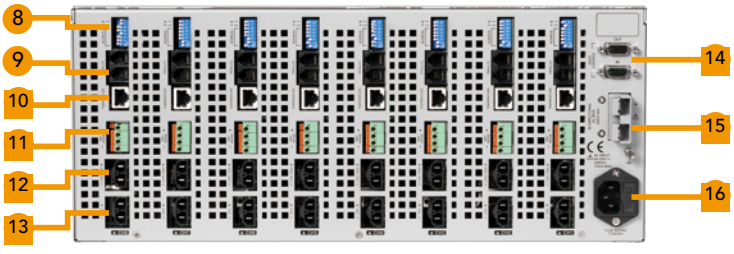
Model 69206-60-8



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



Front panel



Rear panel

BATTERY SIMULATION FUNCTION

The Chroma 17020, equipped with Battery Charging / Discharging Tester and Battery Simulators, can test the battery packs and battery pack-connected products. When a product is still under development and the supplier's battery is not ready, the 17020 can simulate the battery to verify whether or not the system is functioning normally. In addition, the 17020 can control the SOC status of different batteries. Users can download different battery curves to the 17020 to test the DUT for charging and discharging status. The 17020 can also perform battery and DUT collocation evaluation tests in advance that can apply to the motor driver of vehicle start-stop systems, light EV electric controllers, and on-board chargers.

Battery Pack Simulating Function

- Multi-Channel Battery Pack Simulation
- Battery Pack Charging / Discharging Simulation
- Battery Behavior Curve Setting
- Starting Voltage and Capacity Initializing
- Battery Pack Total Capacity Setting
- Charging and Discharging Efficiency Setting
- Battery DCR Simulation
- Battery Pack Initialization Cycle Simulation
- Single Channel Bidirectional Power Supply

Battery Pack Protection

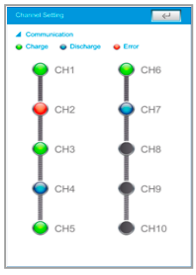
- OCP
- OVP
- Battery High Voltage / Power Warning
- Battery Low Voltage / Power Warning
- Battery OVP / OPP
- Battery LVP / LPP

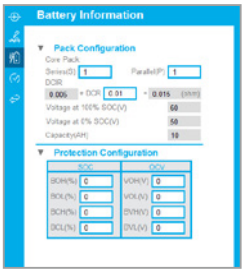
Single Channel Bidirectional Power Supply

- Voltage / Current / Power Display
- Voltage / Current Setting
- Pre-charge Function: Set the time required to generate voltage

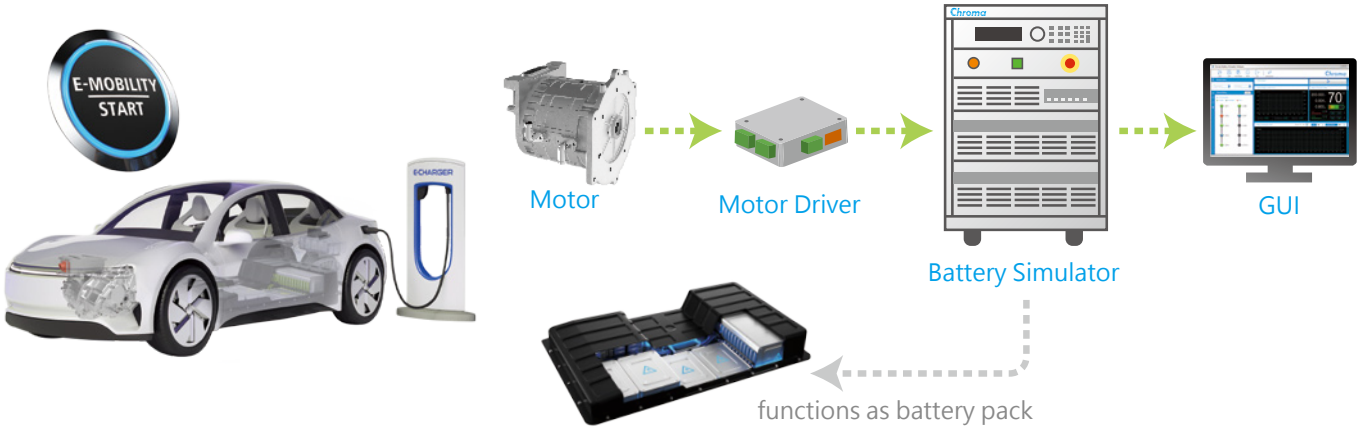
Real Time Test Data Display

- Voltage / Current / Power Value Display
- Voltage / Current / Power Picture Display
- Battery Pack Charging / Discharging Curve Display
- Testing Report Output Function





Motor Driver Testing for Vehicle 48V Start-stop System

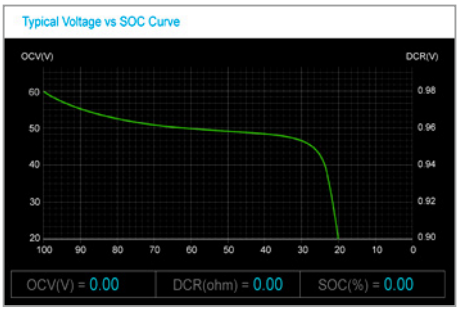


Battery Pro-Operation Interface of the Battery Simulator

An optional battery simulator can be used with the 17020 to charge and discharge the bidirectional power supply. Furthermore, it can set the battery capacity, DCR, and V-SOC curve to be downloaded for charger, inverter, and motor driver testing via the proprietary software enclosed.

Battery simulator main window

DCR setting



Battery characteristics V-SOC curve setting screen

SPECIFICATIONS

Model	17020						
Voltage	20V	60V	60V	60V	100V	200V	500V
Current	65A	13A	62.5A	62.5A	50A	30A	13A
Power	1.25kW	600W	1.25kW	2.5kW	2.5kW	2.5kW	2.5kW
Channels	4-40	8-56	4-40	4-60CH *	4-60CH *	4-60CH *	4-60CH *
Max. Power (Parallelable)	50kW	33.6kW	50kW	150kW *	150kW *	150kW *	150kW *
Max. Current (Parallelable)	2600A	728A	2500A	3750A	3000A	1800A	780A
Battery Cycler							
Charge / Discharge Mode per channel							
Voltage Range *1	0-20V	0-60V.	0-60V	0-60V	0-100V	0-200V *3	0-500V *4
Voltage Accuracy ± (% of setting + % of full scale)	0.1% + 0.05%	0.1% + 0.05%	0.1% + 0.05%	0.1% + 0.05%	0.1% + 0.05%	0.1% + 0.05%	0.1% + 0.05%
Voltage Resolution	0.5mV	1mV	2mV	2mV	3mV	5mV	5mV
Curren *2	65A	13A	62.5A	62.5A	50A	30A	13A
Current Accuracy ± (% of setting + % of full scale)	0.1% + 0.05%	0.1% + 0.05%	0.1% + 0.05%	0.1% + 0.05%	0.1% + 0.05%	0.1% + 0.05%	0.1% + 0.05%
Current Resolution	5mA	1mA	5mA	5mA	5mA	5mA	1mA
Power	1.25kW	600W	1.25kW	2.5kW	2.5kW	2.5kW	2.5kW
Power Accuracy ± (% of setting + % of full scale)	0.2% + 0.1%	0.2% + 0.1%	0.2% + 0.1%	0.2% + 0.1%	0.2% + 0.1%	0.2% + 0.1%	0.2% + 0.1%
Power Resolution	0.1W	0.1W	0.3W	0.3W	0.5W	0.5W	0.5W
Measurement per channel							
Voltage Range	0-20V	0-60V	0-60V	0-60V	0-100V	0-200V	0-500V
Voltage Accuracy ± (% of setting + % of range)	0.02% + 0.02%	0.02% + 0.02%	0.02% + 0.02%	0.02% + 0.02%	0.02% + 0.02%	0.02% + 0.02%	0.02% + 0.02%
Voltage Resolution	0.5mV	1mV	2mV	2mV	3mV	5mV	5mV
Current Range	24A / 65A	4.8A / 13A	24A / 62.5A	24A / 62.5A	20A / 50A	12A / 30A	4.8A / 13A
Current Accuracy ± (% of setting + % of range)	0.1% + 0.05%	0.05% + 0.05%	0.1% + 0.05%	0.05% + 0.05%	0.05% + 0.05%	0.05% + 0.05%	0.05% + 0.05%
Current Resolution	5mA	1mA	5mA	5mA	2mA	3mA	1mA
Power Range	1.25kW	600W	1.25kW	2.5kW	2.5kW	2.5kW	2.5kW
Power Accuracy ± (% of setting + % of range)	0.12% + 0.07%	0.07% + 0.07%	0.12% + 0.07%	0.07% + 0.07%	0.07% + 0.07%	0.07% + 0.07%	0.12% + 0.07%
Power Resolution	0.1W	0.1W	0.3W	0.3W	0.2W	0.3W	0.3W

Battery Simulator	
Internal resistance setting	10mΩ-1Ω
Output Noise (0-20MHz)	
Voltage Ripple (P-P) ± (% of full scale)	0.5%
Voltage Ripple(rms) ± (% of full scale)	0.1%
Transient Response Time *5	10 ms
Bi-directional Transient Response Time *6	20 ms
Road Regulation ± (% of full scale)	< 0.1%
Program time *7	< 1s

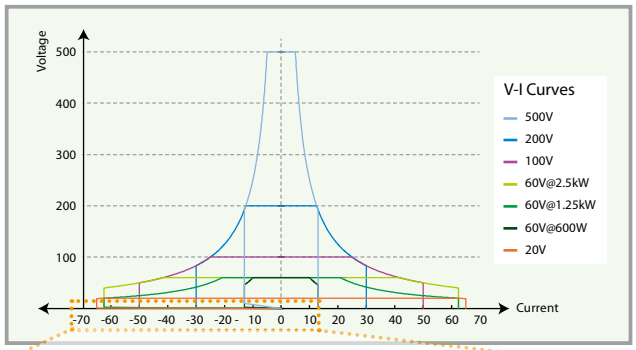
Others-17020 Power / Channels							
Voltage	20V	20V	20V	20V	60V	60V	60V
Current per CH	130A	260A	520A	2600A	125A	125A	250A
Power per CH	2.5KW	5KW	10KW	50KW	2.5KW	5KW	10KW
Channels	2-20	1-0	1-5	1	2-20	2-12	1-6
Model	17020						
Voltage	60V	60V	60V	100V	100V	100V	100V
Current	500A	750A	1500A	100A	200A	400A	600A
Power	20KW	30KW	60KW	5KW	10KW	20KW	30KW
Channels	1-3	1-2	1	2-12	1-6	1-3	1-2
Model	17020						
Voltage	200V	200V	200V	500V	500V	500V	500V
Current	60A	120A	60A	26A	52A	156A	312A
Power	5KW	10KW	30KW	5KW	10KW	30KW	60KW
Channels	2-2	1-6	1-2	2-12	1-6	1-2	1

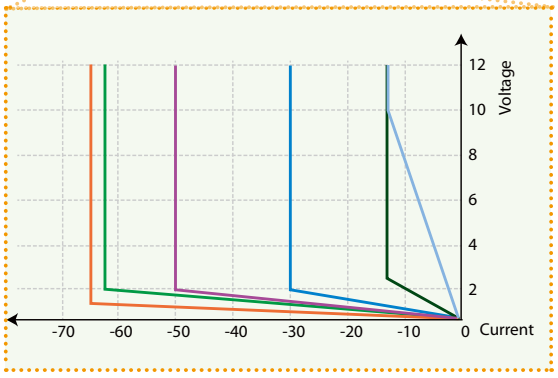
• Continued on next page ➟

GENERAL SPECIFICATIONS

Temperature Coefficient	
Voltage / Current	50ppm / ℃
AC Power	
Voltage Range	1Ø 200-240V ±10% 3Ø 200-220V_{ac} ± 10% V_{LL} 3Ø 380-400V_{ac} ± 10% V_{LL} 47-63Hz for input AC power
Current THD	< 5% at rated power
Power Factor	> 0.9 at rated power
Controller to PC	
Data Acquisition Rate to PC *8	Minimum 40ms @ 4CH independent Minimum 10ms @ 4CH parallel Minimum 600ms @ 60CH independent Minimum 100ms @ 60CH parallel
Others	
Protection	OVP, UVP, OCP, OQP, OTP, ODVP, UDVP, ODCP, UDCP, OPP, FAN (system protection), Short (system protection)
Efficiency (Typical)	85-90% at 20% rated power
Operating Temperature	0℃ to 40℃
Storage Temperature	-40℃ to 85℃
Operating Humidity	10-90% RH, non-condensing
Safety & EMC	CE
Dimension (H x W xD)	
5kW-20kW	120cm x 60cm x 100cm
20kW-30kW	170cm x 60cm x 100cm
40kW-60kW	170cm x 60cm x 100cm x 2 racks

17020 V-I CURVE OF OPERATING





Low Voltage Discharge

Note *1: The output range of voltage is dependent on the cabling.
Note *2: The connection between the device and battery is a 3-meter long cable as standard accessory.
The maximum discharge current will derate at low voltage range, please refer to the detailed V-I curve.
Note *3: The voltage range of the battery simulator and the constant voltage mode is 20V to 200V.
Note *4: The voltage range of the battery simulator and the constant voltage mode is 45V to 500V.
Note *5: When the rated load changes from 10% to 90%, this item is the voltage settling time.
Note *6: When the bi-directional rated load changes from -90% to 90%, this item is the voltage settling time.
Note *7: The time spent from zero to the maximum voltage is at no-load condition.
Note *8: 20μs sampling rate for calculating battery capacity and energy.
Note *9: Cable length limitation

A692001 (8CH)

ORDERING INFORMATION

Regenerative Battery Pack Test System Model 17020			
Power Range	Voltage	Current	Channels
600W	60V	13A	8-56
1.25kW	20V / 60V	65A / 62.5A	4-40
2.5kW	20V / 60V / 60V / 100V / 200V / 500V	130A / 125A / 62.5A / 50A / 30A / 13A	4-60
5kW	20V / 60V / 60V / 100V / 200V / 500V	260A / 250A / 125A / 100A / 60A / 26A	2-10
10kW	20V / 60V / 60V / 100V / 200V / 500V	520A / 500A / 250A / 200A / 120A /52A	1-5
20kW	20V / 60V / 60V / 100V / 200V / 500V	1040A / 1000A / 500A / 400A / 240A / 104A	1-3
50kW	20V / 60V / 60V / 100V / 200V / 500V	2600A / 2500A / 1250A / 1000A / 600A / 260A	1
60kW	60V / 100V / 200V / 500V	1500A / 1200A / 720A / 312A	1
150kW	60V / 100V / 200V / 500V	3750A / 3000A / 1800A / 780A	1

Others and Options	
51101-64	Thermal / Multi-function Data logger, 64 channels
HIOKI LR810X / M710X	Data logger measurement unit
A170201	IPC for battery test system
A170202	Battery simulator softpanel
A692003	Thermal sensor with cable
A692000	BMS data communication unit, 4 Channels
A692001	BMS data communication unit, 8 Channels

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