

## REGENERATIVE BATTERY PACK TEST SYSTEM MODEL 17040

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.



## MODEL 17040

### KEY FEATURES

- Conforms to international standards for battery testing: IEC, ISO, UL, and GB/T, etc.
- Regenerative battery energy discharge (Eff. >90%, PF >0.95, I<sub>THD</sub> <5%)
- Multiple voltage and current ranges for auto ranging function to provide optimum resolution
- High accuracy current/voltage measurement ( $\pm 0.05\%FS/\pm 0.02\%FS$ )
- 2ms current slew rate (-90%~90%)
- Dynamic (current/power) driving profile simulation tests for NEDC, FUDS, HPPC
- Test channel parallel function
- Test data analysis function
- Data recovery protection (after power failure)
- Automatic protection for error condition
- Battery simulator (option)
- High power testing equipment
  - Voltage range : 80~1000V
  - Current range : 0~750A
  - Power range : 0~300kW
- Customized integration functions
  - Integrated temperature chamber
  - BMS data analysis
  - Multi-channel voltage/temperature recording

### FIELDS OF APPLICATION

- Power battery module
- Energy storage system
- Motor driver
- Power control system



**Chroma**

## 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

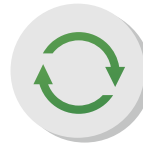
### Precision - Improve Product Quality

- High frequency sampling measurement technology: Max. sampling rate 50kHz to ensure dynamic measurement accuracy
- Voltage accuracy:  $\pm (0.02\% \text{ of rdg. } \pm 0.02\% \text{ of r.n.g.})$
- Current accuracy:  $\pm (0.05\% \text{ of rdg. } \pm 0.05\% \text{ of r.n.g.})$
- Quick response test technology: 2ms (-90% to 90%) current slew rate applicable for various test applications
- Auto voltage/current range switch function: multiple 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

#### Security



#### Efficiency



#### Precision



### Regenerative Battery Pack Test System



Energy



Channel



Parallelable



High

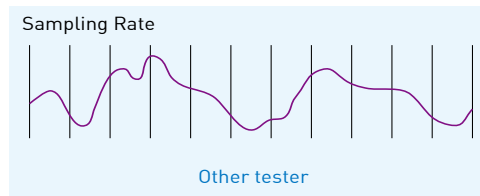


Driving Cycle

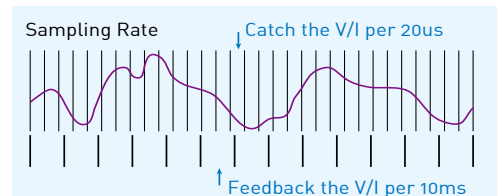
### High frequency sampling measurement technology

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 20 $\mu$ s)
- Integrate calculus: I for capacity; VxI for energy



General charger/discharger sampling rate

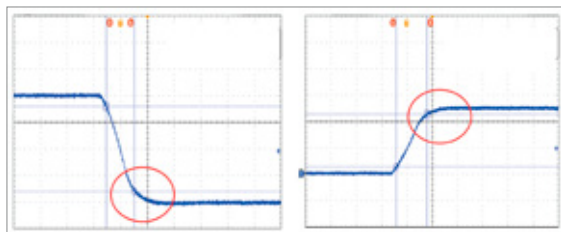


Chroma charger/discharger sampling rate

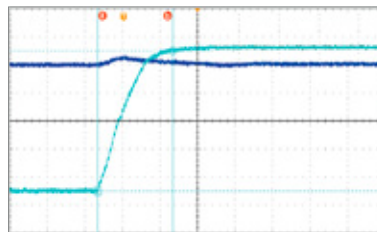
### Quick response test technology

In quick response mode, the current is smooth without overshoot to avoid damaging the battery

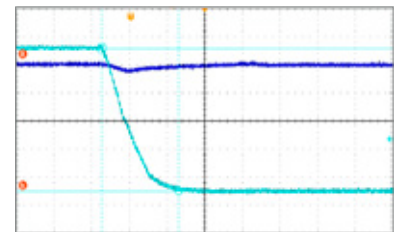
- Current ripple noise <0.5%, Overshoot <1%



Overshoot <1%



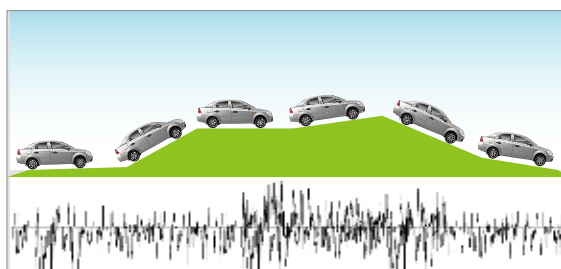
Current slew rate 2ms (-90% to 90%)



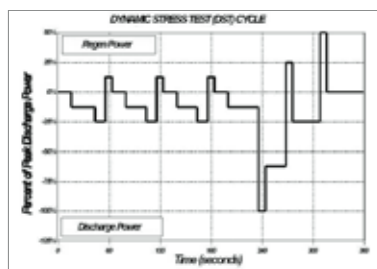
### Dynamic driving profile simulation

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

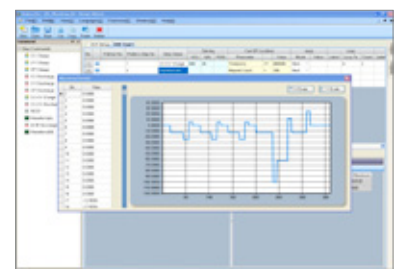
- Dynamic charge/discharge power or current waveforms simulate the drive cycle or any real world application. In the dynamic current mode (waveform), the current transition time for maximum discharge and charge requires only 2ms
- Test steps can specify an Excel file from which to read the stored current/power waveform
- 720,000 points of driving profile memory available to save the waveform profile in each channel



Driving profile simulation



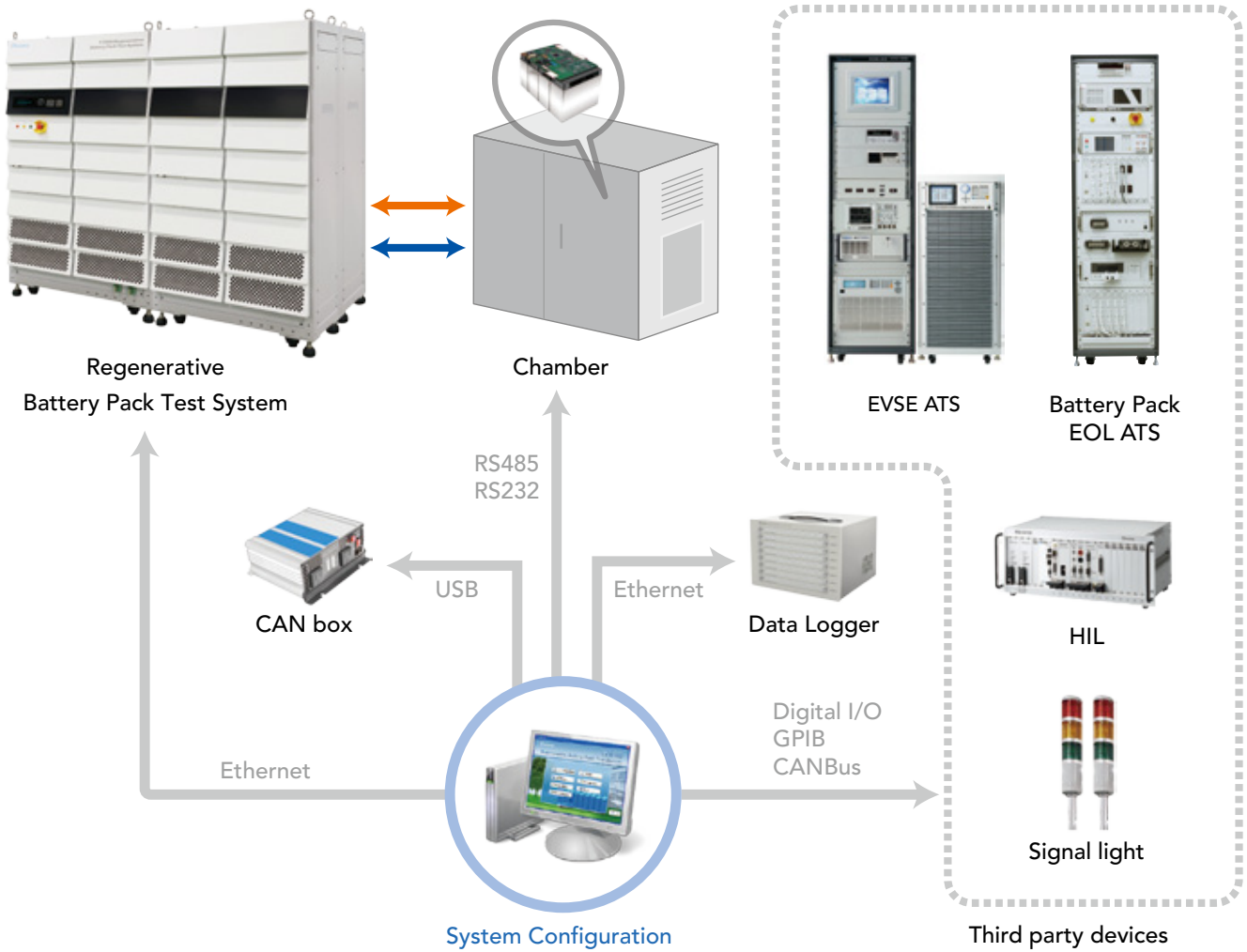
Regulatory compliance testing standards



Profile simulation data loading equipment

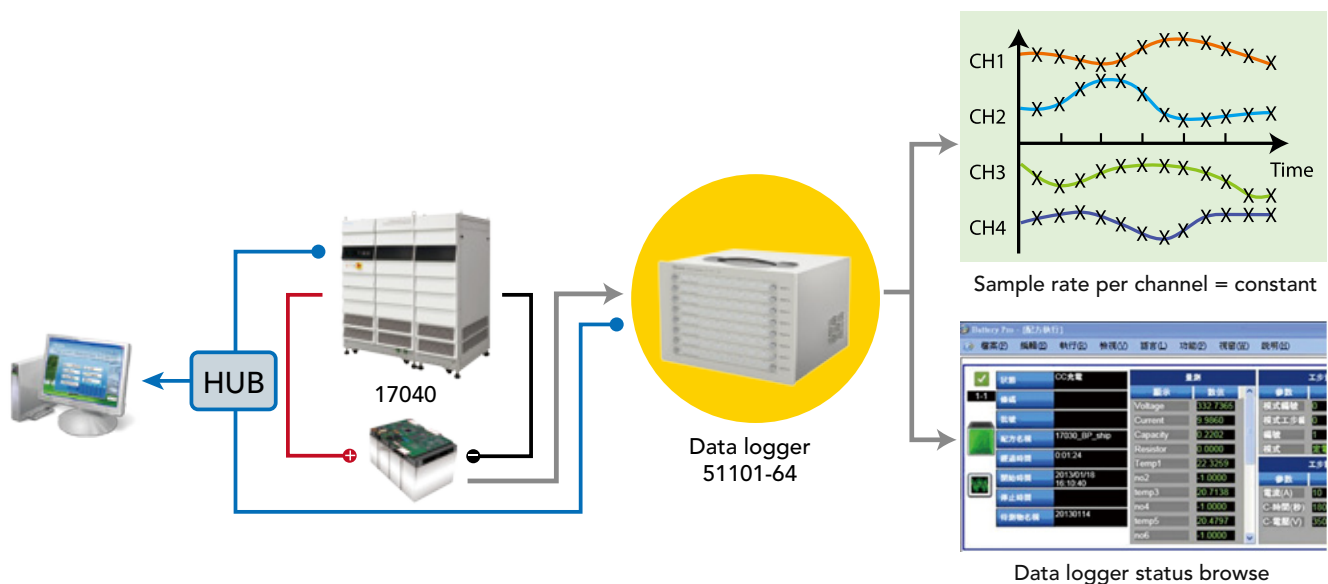
## Efficiency - Reduce Operating Costs

- 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 360kW, 900A (option)
- Equipped with battery charger/discharger and simulator functions
- Embedded with high efficiency discharge energy regeneration technology



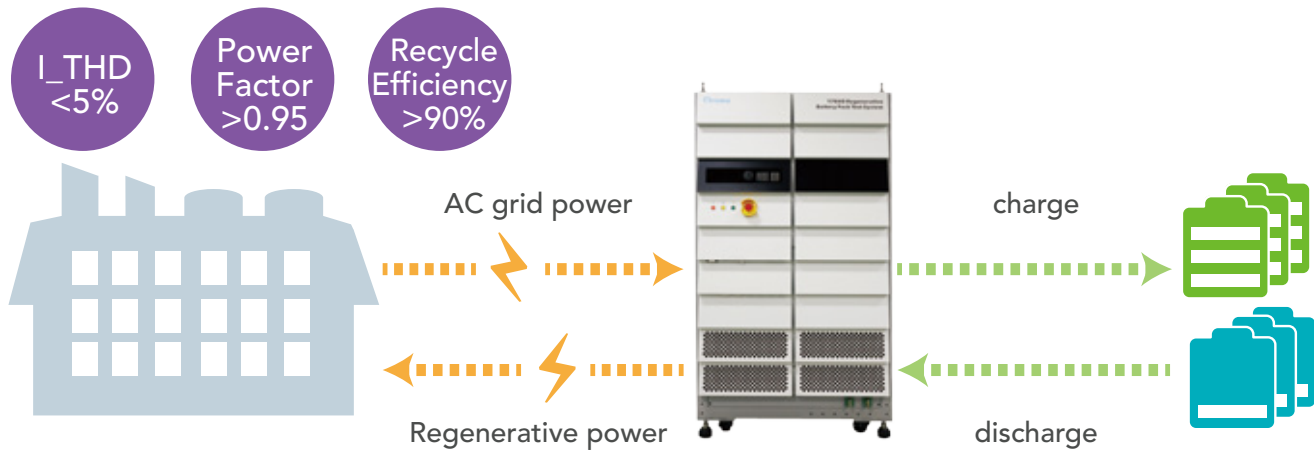
## Data logger integration technology

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.

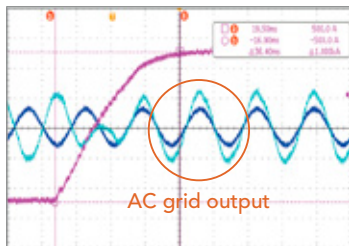


## Discharge energy recycling technology

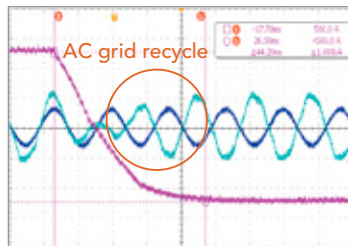
- Bidirectional circuit architecture to accurately control reverse current change
- Regenerative battery energy discharge (efficiency > 90%.)
- Static regenerative energy: In compliance with regenerative grid standards for solar energy, current THD < 5%, PF > 0.95
- Dynamic regenerative energy: Real-time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



- 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



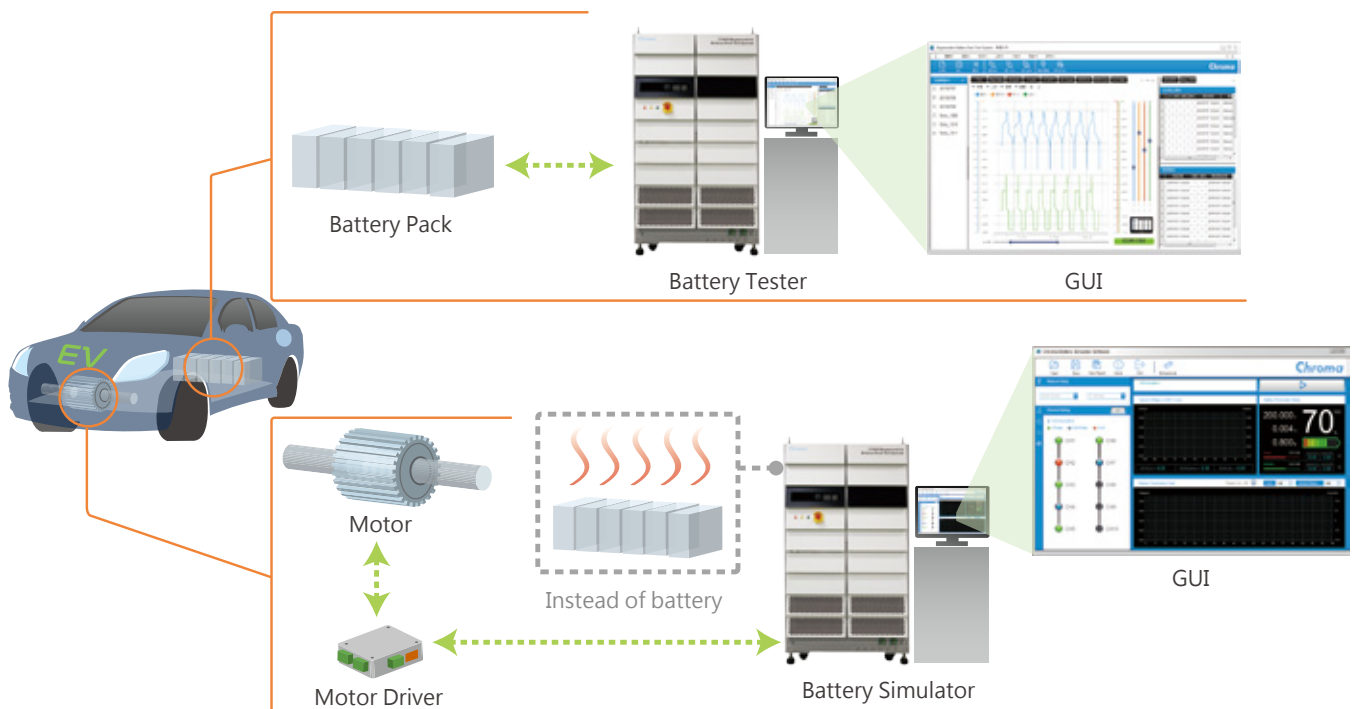
Discharge state changes to charge state



Charge state changes to discharge state

## 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





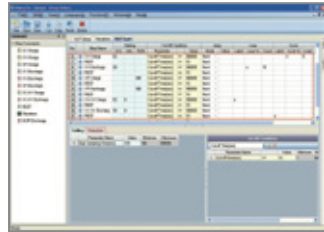
## BATTERY CHARGE/DISCHARGE SOFTWARE - BATTERY PRO

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



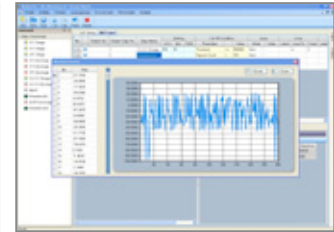
Battery Pro main panel



Charge/Discharge test program



Editor Real time monitoring



Waveform current test editor

### Integrated CANbus/SMBus/LIN communications

- Import the Vector.dbc file directly to complete BMS monitoring setup quickly and easily
- Follow the BMS communication protocol to set the message desired
- The BMS data can be set in the conditions for cut-off or protection during testing

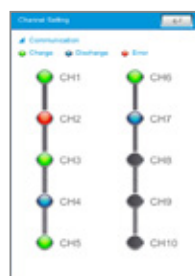


## BATTERY SIMULATION FUNCTION

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.

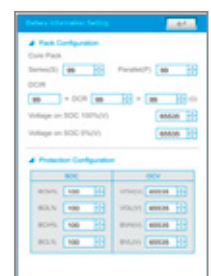
### Battery Pack Simulating Function

- 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



### 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 charge/discharge curve display
- Testing report output function



### Battery Pro - Operation Interface of the Battery Simulator

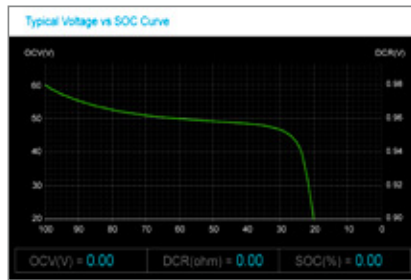
An optional battery simulator can be used with the 17040 to charge and discharge the bidirectional power supply. Furthermore, it can be used to set the battery capacity, DCR, and V-SOC curve to be downloaded to the charger, inverter, and motor driver tests via the proprietary software included.



Battery simulator main panel

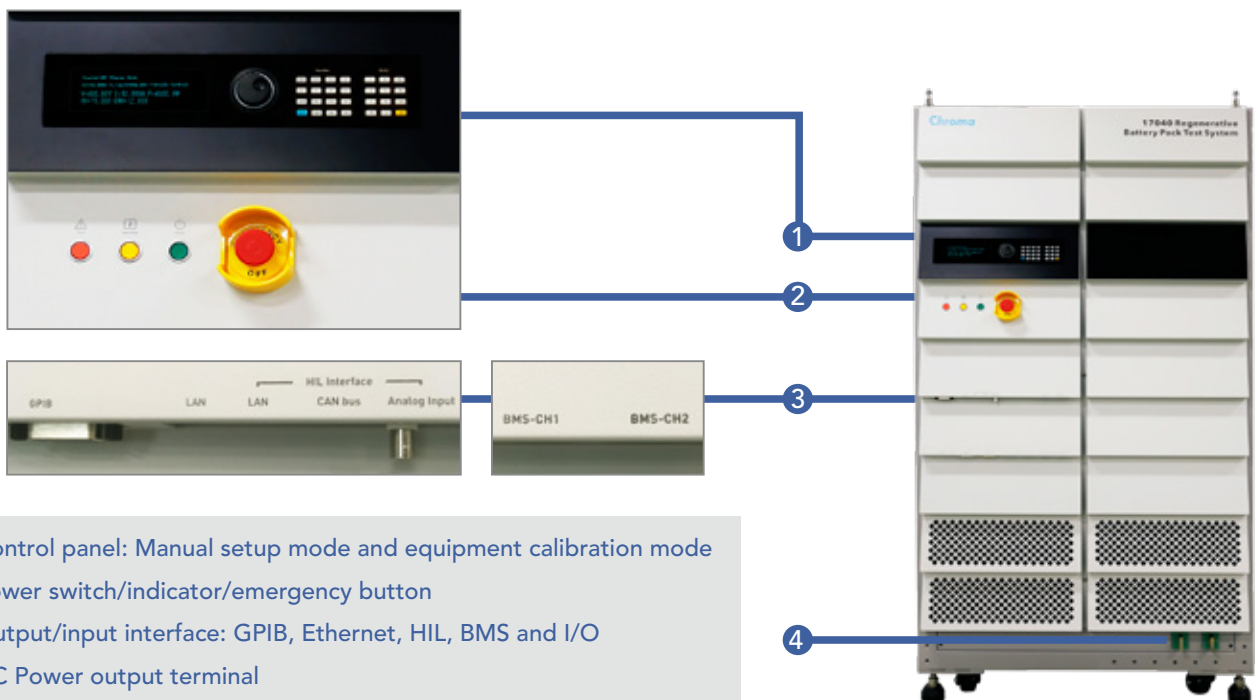


DCR setting



Battery characteristics V-SOC curve setting screen

## 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

Model		17040								
Max. Power		60kW			120kW			180kW		
Max. Voltage		500V	750V	1000V	500V	750V	1000V	500V	750V	1000V
Max. Current		150A	150A	150A	300A	300A	300A	450A	450A	450A
Channel		1			1			1		
Constant Voltage Mode										
Voltage Range		80~500V	80~750V	80~1000V	80~500V	80~750V	80~1000V	80~500V	80~750V	80~1000V
Voltage Accuracy		±0.1%FS			±0.1%FS			±0.1%FS		
Voltage Resolution		10mV	15mV	20mV	10mV	15mV	20mV	10mV	15mV	20mV
Constant Current Mode										
Current Accuracy		±0.1%FS			±0.1%FS			±0.1%FS		
Current Resolution		10mA			20mA			30mA		
Constant Power Mode										
Power Accuracy		±0.2%FS			±0.2%FS			±0.2%FS		
Power Resolution		100mW			100mW			100mW		
Battery Simulator Mode										
Voltage Range		80~500V	80~750V	80~1000V	80~500V	80~750V	80~1000V	80~500V	80~750V	80~1000V
Voltage Accuracy		±0.1%FS			±0.1%FS			±0.1%FS		
Voltage Ripple (rms)		< 1%FS			< 1%FS			< 1%FS		
Measurement										
Voltage Range (3 Scales as F.S.)	1	500V	750V	1000V	500V	750V	1000V	500V	750V	1000V
	2	350V	500V	700V	350V	500V	700V	350V	500V	700V
	3	150V	350V	450V	150V	350V	450V	150V	350V	450V
Voltage Accuracy		± (0.02% rdg + 0.02% FS)			± (0.02% rdg + 0.02% FS)			± (0.02% rdg + 0.02% FS)		
Current Range (4 Scales as F.S.)	1	150A	150A	150A	300A	300A	300A	450A	450A	450A
	2	75A	75A	75A	150A	150A	150A	225A	225A	225A
	3	30A	30A	30A	60A	60A	60A	90A	90A	90A
	4	10A	10A	10A	20A	20A	20A	30A	30A	30A
Current Accuracy		± (0.05% rdg + 0.05% FS)			± (0.05% rdg + 0.05% FS)			± (0.05% rdg + 0.05% FS)		
Power Accuracy		±0.15% FS			±0.15% FS			±0.15% FS		

Model		17040					
Max. Power		250kW			300kW		
Max. Voltage		500V	750V	1000V	500V	750V	1000V
Max. Current		600A	600A	600A	750A	750A	750A
Channel		1			1		
Constant Voltage Mode							
Voltage Range		80~500V	80~750V	80~1000V	80~500V	80~750V	80~1000V
Voltage Accuracy		± 0.1%FS			± 0.1%FS		
Voltage Resolution		10mV	15mV	20mV	10mV	15mV	20mV
Constant Current Mode							
Current Accuracy		± 0.1%FS			± 0.1%FS		
Current Resolution		40mA			50mA		
Constant Power Mode							
Power Accuracy		± 0.2%FS			± 0.2%FS		
Power Resolution		1W			1W		
Battery Simulator Mode							
Voltage Range		80~500V	80~750V	80~1000V	80~500V	80~750V	80~1000V
Voltage Accuracy		± 0.1%FS			± 0.1%FS		
Voltage Ripple (rms)		< 1%FS			< 1%FS		
Measurement							
Voltage Range (3 Scales as F.S.)	1	500V	750V	1000V	500V	750V	1000V
	2	350V	500V	700V	350V	500V	700V
	3	150V	350V	450V	150V	350V	450V
Voltage Accuracy		± (0.02%rdg+0.02% FS)			± (0.02%rdg+0.02% FS)		
Current Range (4 Scales as F.S.)	1	600A	600A	600A	750A	750A	750A
	2	300A	300A	300A	375A	375A	375A
	3	120A	120A	120A	150A	150A	150A
	4	40A	40A	40A	50A	50A	50A
Current Accuracy		± (0.05% rdg + 0.05% FS)			± (0.05% rdg + 0.05% FS)		
Power Accuracy		± 0.15% FS			± 0.15% FS		

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

Model	51101-64
Temperature Reading	
Number of Inputs (option)	8, 16, 24, 32, 40, 48, 56, 64
Temperature Sensor Type	Thermocouple : B, E, J, K, N, R, S, T
Temperature Resolution	$\pm 0.01\text{ }^{\circ}\text{C}$
Temperature Accuracy	$\pm (0.01\% \text{ of reading} + 0.3)\text{ }^{\circ}\text{C}$
CJC Error	$\pm 0.3\text{ }^{\circ}\text{C}$
Maximum Sample Rate	5 sample/sec.
Channel to Channel Isolation	1000VDC/750 Vrms

Voltage Reading	
Voltage Input Type	VA-10 Voltage Adaptor
Voltage Resolution	100uV
Voltage Input Range	$\pm 10\text{VDC}$
Voltage Input Accuracy	$\pm (0.05\% \text{ of reading} + 500\text{uV})$
Input Resistance	300 K $\Omega$

\* All specifications are subject to change without notice.

## 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 0.2Ω Resistive load		2ms (-90% to 90%)	
Current Ripple		<0.5%F.S.	
Overshoot		<1%F.S.	
Temperature Coefficient (Voltage/Current)		<50 ppm/°C	
AC Input			
Line Voltage / Frequency (3 phase/4 wire with earth ground)		Input 200~220V <sub>ac</sub> ± 10% V <sub>LL</sub> , 47-63Hz Input 380~400V <sub>ac</sub> ± 10% V <sub>LL</sub> , 47-63Hz Input 440~480V <sub>ac</sub> ± 10% V <sub>LL</sub> , 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	
Interface		Standard : Ethernet, I/O control Option : GPIB, HIL(Ethernet, CAN, Analog), BMS read/write	
Dimension and Weight			
	Cabinet (H x W xD) / Weight	Front / Rear / Right side for heat dissipation	Front / Rear / Right side for maintenance
60kW	190cm x 100cm x 50cm / 900 kg	30cm / -- / --	60cm / -- / --
120kW	190cm x 100cm x 100cm / 1800 kg	30cm / 30cm / --	60cm / 60cm / --
180kW	190cm x 150cm x 100cm / 2700 kg	30cm / 30cm / 30cm	60cm / 60cm / 60cm
250kW	190cm x 200cm x 100cm / 3600 kg	30cm / 30cm / --	60cm / 60cm / --
300kW	190cm x 250cm x 100cm / 4500 kg	30cm / 30cm / 30cm	60cm / 60cm / 60cm

\* All specifications are subject to change without notice.

## ORDERING INFORMATION

Regenerative Battery Pack Test System Model 17040				Others and Options	
Power Range	Voltage	Current	Channels		
60kW	1000V	150A	1,2	51101-64	Thermal/Multi-Function Data Logger, 8~64 CH
	750V	150A		A170201	IPC for battery test system
	500V	150A		A170202	Battery simulator softpanel
120kW	1000V	300A	1,2	A170400	Battery Pro software
	750V	300A		A692004	AC input cable (5m)
	500V	300A		A692005	DC output cable and sensor (3m)
180kW	1000V	450A	1		
	750V	450A			
	500V	450A			
250kW	1000V	600A	1		
	750V	600A			
	500V	600A			
300kW	1000V	750A	1		
	750V	750A			
	500V	750A			

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