REGENERATIVE BATTERY PACK TEST SYSTEM MODEL 17040E

The Chroma 17040E Regenerative Battery Pack Test System is a high-precision system specifically designed for secondary battery module and pack tests. The energy recovery function greatly reduces power consumption during discharge, and ensures a stable power grid without generating harmonic pollution on other devices - even under dynamic charge and discharge conditions. Where traditional equipment discharges waste energy in the form of heat, Chroma 17040E can recycle the electric energy discharged by the battery module back to the grid, thus reducing energy waste and alleviating HVAC requirements.

The 17040E has built-in channel parallelization and dynamic profile simulation functions. The parallel capability maximizes the charge and discharge current and power, thus increasing the efficiency and flexibility of equipment utilization. The dynamic profile simulation allows users to load a battery waveform of a given drive profile in either current or power mode to meet the NEDC/FUDS requirements. Its bidirectional architecture assures uninterrupted current during the charge and discharge transient state so that the driving conditions can be accurately simulated in line with the ISO, IEC, UL, and GB/T international test standards.

Equipped with Chroma's powerful Battery Pro software, the test system offers flexible test editing functions to perform independent channel tests, and conforms to various requirements for testing secondary battery packs with high safety and stability.

Chroma 17040E ensures protected charge/discharge testing through multiple safety features including Over Voltage Protection, Over Current Protection, Over Temperature Protection, and external parameter detection. The recovery functions prevent that test data is interrupted or lost in the case of power failure.

Ethernet

CE

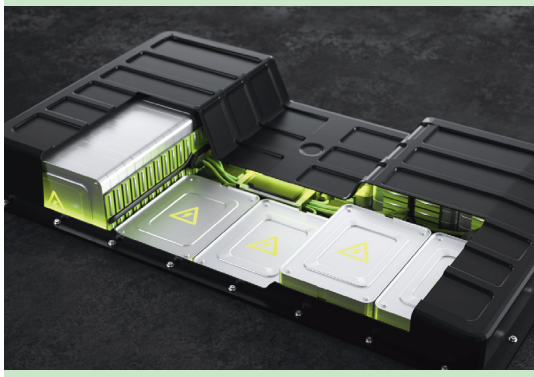
MODEL 17040E

KEY FEATURES

- Meets international standards for battery testing: IEC, ISO, UL, and GB/T, etc.
- Regenerative battery energy discharge (Eff. >92%, PF >0.99, I_THD <3%)
- Auto-ranges with multiple voltage and current ranges for optimal resolution
- High accuracy current/voltage measurement
  ±(0.05% of range) /
  ±(0.02% of reading ± 0.02% of full scale)
- Current slew rate (10%-90%)
  Max speed: 1ms
- 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 abnormalities
- Battery simulator (option)
- High power test equipment
  Voltage range: 5-1700V
  Current range: 0-4800A
  Power range: 0-1.6MW
- Customized integration functions
  - Integrated temperature chamber
  - BMS data analysis
  - Multi-channel voltage/temp. recording

FIELDS OF APPLICATION

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



Chroma
Advancing Excellence

SYSTEM FEATTURES

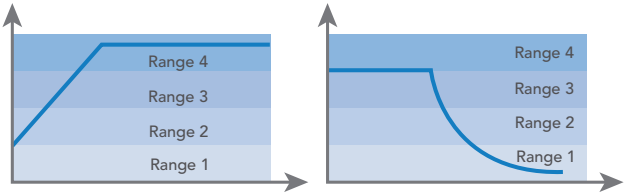
Specifically designed for secondary battery module and pack tests, the Chroma 17040E Regenerative Battery Pack Test System offers ultimate precision, safety, and efficiency. The main features include energy recovery, parallel channels, high power for battery applications, and high accuracy in voltage and current measurement as well as drive cycle simulation.

Precision

High-precision Measurements for Improved Product Quality

The auto voltage/current range function switches between multiple ranges. When there is a dynamic change between large or small currents, the test system automatically adjusts to the right range to optimize the measurement accuracy.

- Voltage accuracy: ±(0.02% of reading ±0.02% of full scale)
- Current accuracy: ±(0.05% of range)

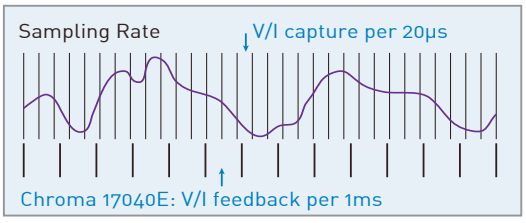


Auto voltage ranges　　Auto current ranges

High-frequency Sampling for Battery Pack Capacity Capture

The high-frequency sampling measurement technology reaches a 50kHz sampling rate to ensure dynamic measurement accuracy. Other battery chargers and 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. Chroma increased the V/I sampling rate and added a double-sampling integrator, so the 17040E test system 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)

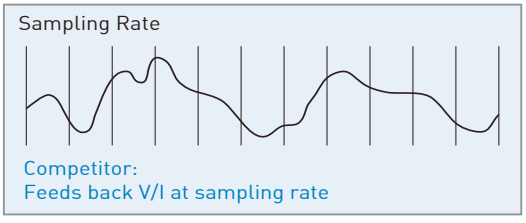


Chroma's charging/discharging sampling speed

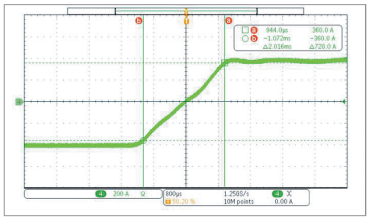
Quick Response Testing for Battery Pack Limit Verification

Chroma 17040E supports dynamic driving profile simulation (waveform), which simulates the current and power states of actual driving conditions to comply with NEDC, FUDS, and HPPC standards. The quick current response enables optimized charge/discharge switch control; the current is smooth without overshoot to avoid damage to the battery.

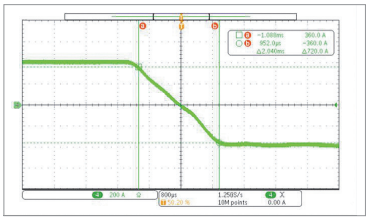
- Current slew rate: 2ms (-90% to 90%)



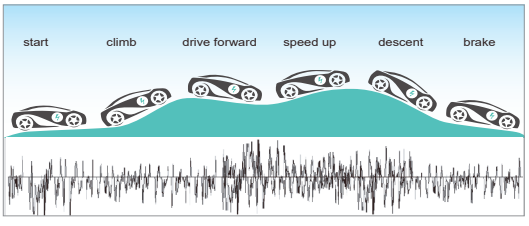
Competitors' charging/discharging sampling speed



Discharge to charge:
Current slew rate < 2ms (-90% to 90%)



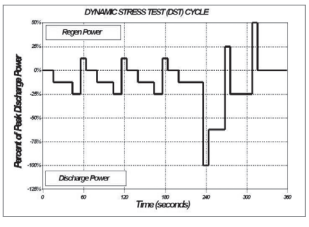
Charge to discharge:
Current slew rate < 2ms (-90% to 90%)



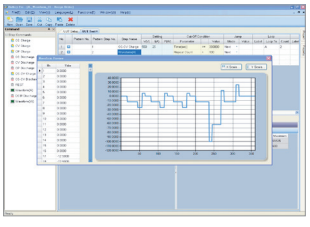
Actual driving profile simulation

Dynamic Driving Profiles for Actual Use Simulation

Battery packs are used under quick and irregular current conditions. Chroma 17040E performs actual dynamic charge/discharge waveforms to simulate working conditions and verify the response of the battery pack in real-life applications. Users can set the test steps to read a specific Excel file with stored current/power waveforms.



Compliant with test standards



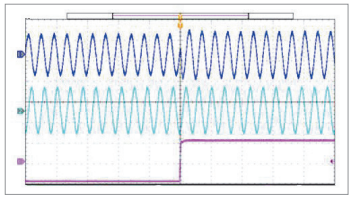
Profile simulation data loading

Safety

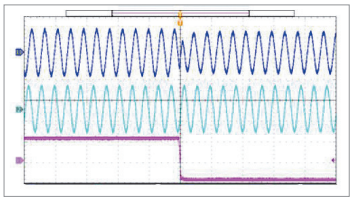
Bidirectional Circuit for Power Supply Protection

The bidirectional circuit architecture allows highly efficient recycling of the discharge energy. Chroma 17040E accurately controls reverse current changes, the AC current waveforms are smooth and show changes in real time, and the design meets the grid requirements without contaminating other equipment on the grid. When any abnormalities on the power grid are detected, the test system will swiftly cut off the main circuit power supply to protect its safety.

- Regenerative discharge efficiency > 93%
- THD <3%
- PF > 0.99



Transition from discharging to charging



Transition from charging to discharging

Energy Recovery Design for Personnel Safety (Option)

VDE test requirements, in short, are the main items to consider when the generator is connected to a low-voltage distribution network on the grid. Even when using multiple devices, they can maintain the safe and reliable operation of the grid in accordance with the German Energy Industry Law and with the voltage limits in the DIN EN 50160 regulations. The optional equipment meets the VDE-4105-AE test requirements with the following protection functions:

- Voltage protection: V < 0.8Un, < 0.2s / V > 1.1Un, < 0.2s / V > 1.15Un, < 0.2s
- Frequency protection: f < 47.5Hz, < 0.2s / f > 1.5Hz, < 0.2s
- Islanding detection: < 5s

Multiple Output Protections for Battery Test Risk Control

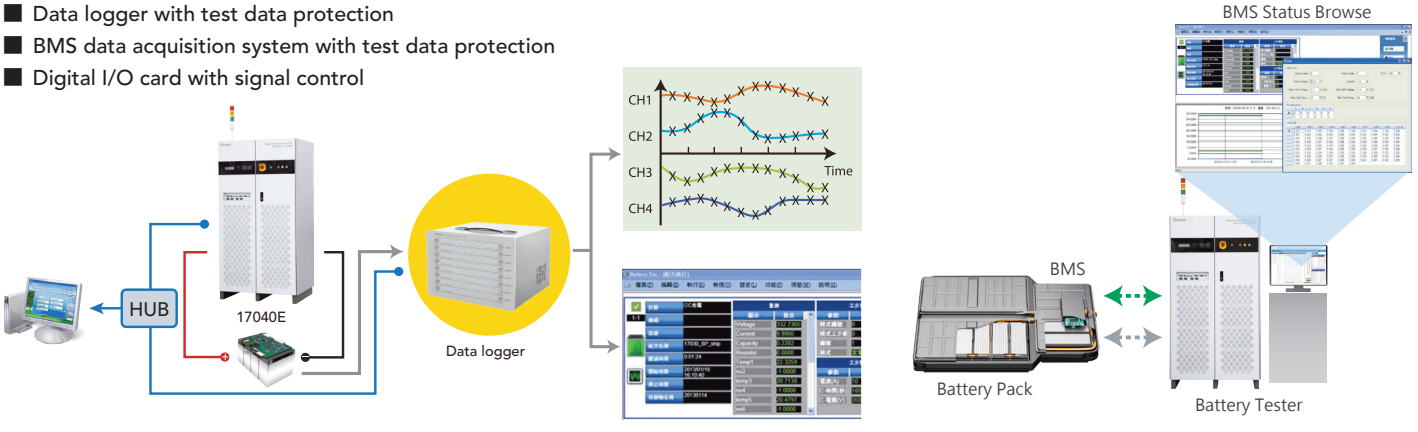
Chroma 17040E meets all test requirements for secondary battery packs and offers a high degree of stability and safety. The charge/discharge protection will stop the test when it detects any abnormal test status. The internal firmware and hardware provide multi-layered protection. Protection parameters of the test procedure are loaded directly into the charge/discharge unit to provide multiple alarms and protection modes.

- Voltage protection: over charge / over discharge / delta voltage change
- Current protection: over current / over capacity / delta current change
- Other protections: over temperature / wire loss / over power / CC-CV transition time / Abnormal DC output insulation protection (optional)

Software and Hardware Protections for Battery Cells (Option)

The Chroma BatteryPro software can integrate with third-party hardware with charge/discharge protections that will stop the test when detecting any abnormal conditions. A designated datalogger can read the charge/discharge voltage and temperature of multiple cells and use the measured data to set the protection conditions. Similarly, a designated battery management system (BMS) data acquisition system can read multiple sets of BMS data through CAN bus and RS-485 interfaces, and then convert the data for protection conditions. An additional Isolated DIO Card can be integrated into the Chroma test system for controlling the high-side/low-side driver signals of device, with function support for digital output, digital input, safety channel output, safety input from external devices, and digital input and output for alarms, cut-off, and power off.

- Data logger with test data protection
- BMS data acquisition system with test data protection
- Digital I/O card with signal control

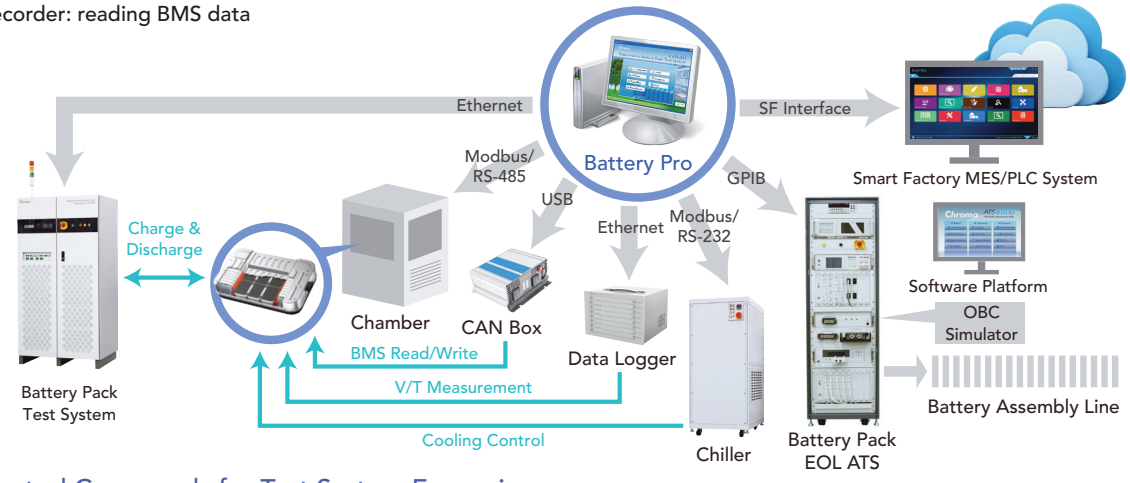


Efficiency

Flexible Integration for Complete Test Solution

The Chroma BatteryPro software can integrate with third-party software and hardware, such as BMS communication devices, data loggers, and thermostats; and uses their data to control the test programs and create complete test solutions.

- Thermostat: temperature and humidity control combined with charge/discharge procedures
- Data logger: temperature and voltage status of single battery cells or modules
- MS data recorder: reading BMS data



Multiple Control Commands for Test System Expansion

Users can develop their own application software to operate the 17040E test system by utilizing SCPI commands, LabVIEW drivers, LabWindows drivers, and CANbus commands. Additionally, with Chroma's robust integration capabilities, the system can be customized and integrated into automatic battery pack testing architectures. Various external signal interfaces (CANbus, Ethernet, Analog I/O) are provided to support hardware-in-the-loop (HIL) test platforms.

VCU simulation function for Battery Pack Verification

Equipped with the ability to simulate a Vehicle Control Unit (VCU) and combined with UDS and BMS communication, the system can send diagnostic service IDs to control battery module relays.

Flexible and Diverse Configurations

The 17040E series offers two model options: 17040E-1700V and 17040E-850V.

The 17040E-1700V features a built-in automatic voltage/current range switching function to optimize measurement accuracy. The low voltage range of 850V provides a maximum output current of 800A; the high voltage range of 1700V provides a maximum output current of 400A. Through external parallel fixtures, it can be flexibly applied to high current or high power requirements, with a maximum output of up to 2400A and 1.6MW. The 17040E-850V can be applied to series and parallel configurations, and its multiple channels can be controlled independently. It provides a maximum output current of 600A. Through external series fixtures, the output voltage can reach 1700V; through external parallel fixtures, the maximum output can reach 7200A and 2.4MW.

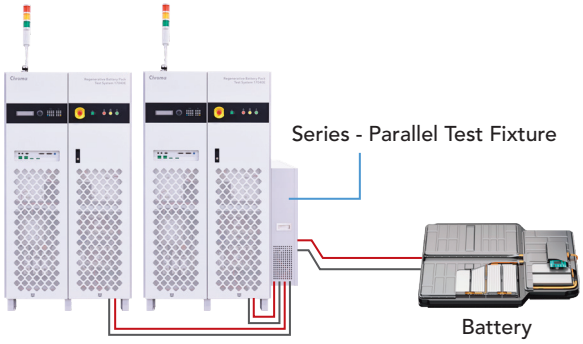
MODEL 17040E-1700V

MODEL 17040E-850V

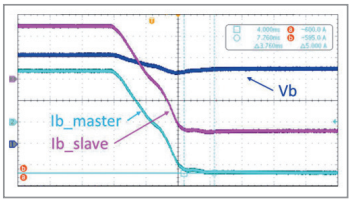
Parallel Synchronization for High Power Charging (HPC)

Chroma 17040E uses parallel synchronization to perform high-power testing with instant current slew synchronization. There is no delay in the slew time between the main channel and the auxiliary channel, which prevents current staircase waveforms from being generated. Users can connect up to two devices of the same model in parallel, and can operate the channels independently or in parallel. The test system provides customizable fixtures and allows parallel running of the output channels.

- Max. power 1.2MW; max. current 4,800A
- In dynamic current mode (waveform), rated power <600kW, current rise time 1ms (10%-90%)
- In dynamic current mode (waveform), rated power 800kW-1.2MW, current rise time 10ms (10%-90%)



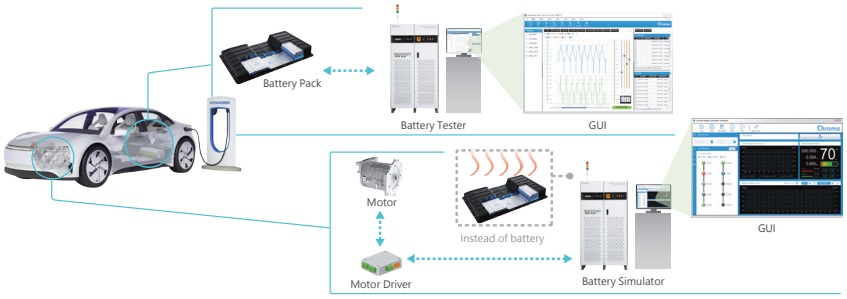
Current Rise Time Waveform
in CC Discharge



DUAL MODE APPLICATION

Chroma 17040E is equipped with a battery charge/discharge tester and a battery simulator, which can test battery packs and their connected products.

- Charger/discharger mode: applicable to battery pack testing via Battery Pro user interface
- Battery simulator mode: applicable to motor driver and charger via Battery Simulator user interface



BATTERY CHARGE/DISCHARGE SOFTWARE - BATTERY PRO

Battery Pro, the software platform for the Chroma 17040E, meets all requirements of testing secondary battery packs with high stability and safety. It can save and restore data when the power is cut off to guard against potential data loss. Real-time monitoring capabilities provide clear and intuitive visualizations and management of test status through various icons. It also offers operation and fault record tracking, and displays abnormality status for individual channels.

- Multilingual interface: English and Chinese (Mandarin)
- User permission setup: easy management of user operation profiles

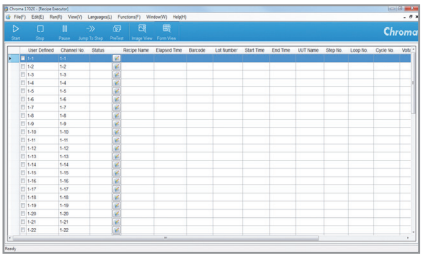
Step Editing

- 255 editable charge and discharge conditions
- Dual layer loops (cycle & loop) with 9,999 per layer
- Editable dynamic charge and discharge waveforms
- Editable charge/discharge conditions incl. CV, CC, CP, CV, with current limit, waveform current, DCIR
- Cut-off conditions: time, power, voltage, current, temperature
- Step completed: next, end, jump, rest

Report Wizard

- Customized report formats, exports in PDF, CSV, and XLS
- Users can determine the X- and Y-axis parameters for report drawing and analysis, and directly produce the necessary test reports
- Reports generated: channel, cut-off, life-cycle, Q-V, V/I/T, etc.

BatteryPro main window

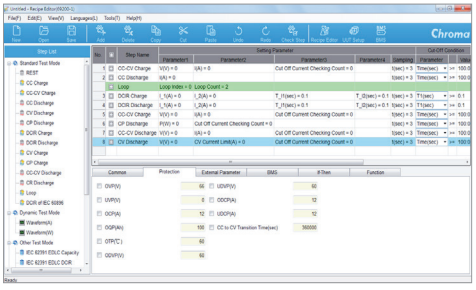


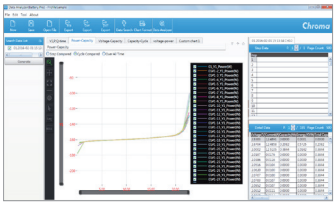
Recipe Executor

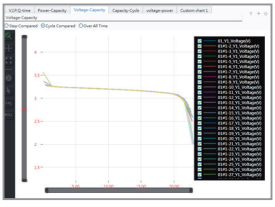
- ☑ Data display updates automatically in real time
- ☑ Flexible graphic and toolbar display based on the number of channels

Data Analyzer

- ☑ Draw test charts with one click
- ☑ Define chart and favorite functions
- ☑ Compare multiple test objects







Recipe Editor

- ☑ ISO 12405, GB/T 31467, GB/T 31484, IEC 61960 DCIR and other test curves
- ☑ Interface for setting BMS data control charge/discharge equipment
- ☑ Variable editing functions, external parameters, if-then judgment functions

SPECIFICATIONS

Model		17040E 69420E-1700-400		17040E 69420E-850-600	
Max Power / CH		200kW		200kW[*14]	
Voltage Range[*1]		30-1700V 5-850V		5-850V	
Max Current / CH		400A at 1700V range / 800A at 850V range		600A at 850V range	
Channel[*2]		1CH		1CH	
Max Power in Parallel Mode		1.6MW		400kW (2 units) 2.4MW[*13]	
Control					
Constant Voltage Mode					
Voltage Range [*1]		30-1700V 5-850V		5-850V	
Voltage Accuracy (% of full scale)		0.1		0.05	
Voltage Resolution (16bits)		40mV		20mV	
Constant Current Mode					
Max. Current / CH		400A/800A		600A	
Current Accuracy (% of full scale)		0.1		0.05	
Current Resolution / CH (16bits)		10mA		10mA	
Max. Current / System		2,400A		7,200A[*13]	
Constant Power Mode					
Max Power / CH		200kW		200kW[*14]	
Power Accuracy (% of full scale)		0.1		0.1	
Power Resolution / CH		1W		1W	
Measurement					
Voltage Accuracy		0.02% of reading + 0.02% of range[*3]		±0.02% of reading + 0.02% of full scale	
Voltage Range & Voltage Resolution (4 Scales as full scale)	1	0-1700V / 850V	15mV	0-850V	15mV
	2	0-1200V / 400V	15mV	0-400V	15mV
	3	0-600V / 200V	15mV	0-200V	15mV
	4	0-150V / 100V	15mV	0-100V	15mV
Current Accuracy ± (% of range)		0.05		0.05	
Current Accuracy & Current Resolution (4 Scales as full scale)	1	400A / 800A	10mA	600A	10mA
	2	200A / 400A	10mA	300A	10mA
	3	100A / 200A	10mA	150A	10mA
	4	50A / 100A	10mA	75A	10mA
Power Accuracy (% of full scale)		0.1		0.1	
Current Rising / Falling Time (10% to 90%)					
Max. Power > 8 Units		10ms		10ms	
Max. Power < 6 Units		1ms		1ms	
Current Switching Time (-90% to 90% w/o dead time)					
Max. Power > 8 Units		20ms		20ms	
Max. Power< 6 Units		2ms		2ms	
Data Acquisition Time (HW sampling rate)					
Max. Power		1ms at waveform mode 10ms at CC, CV, CP mode		1ms at waveform mode 10ms at CC, CV, CP mode	
Current Ripple		<0.5%		<0.5%	
Overshoot		<1%		<1%	
Over Current Capability[*5]		Over 20%, 30sec		Over 20%, 30sec.	
Operating Mode (Charge / Discharge)		Rest, CC charge, CC-CV charge, CC discharge, CV discharge, CP discharge, DCIR charge, DCIR discharge, CV charge, CP charge, CC-CV charge, CR discharge, CPCC charge, CPCC discharge, waveform power, waveform current, CV source, Chamber control,CAN write data, digital output control, wait digital input state		Rest, CC charge, CC-CV charge, CC discharge, CV discharge, CP discharge, DCIR charge, DCIR discharge, CV charge, CP charge, CC-CV charge, CR discharge, CPCC charge, CPCC discharge, waveform power, waveform current, CV source, Chamber control, CAN write data, digital output control, wait digital input state	
Line Voltage / Frequency (3 phase/4 wire with earth ground)		380-400V_{ac} ±10% V_{LL} , 50/60Hz 440-480V_{ac} ±10% V_{LL} , 50/60Hz		380-400V_{ac} ±10% V_{LL} , 50/60Hz 440-480V_{ac} ±10% V_{LL} , 50/60Hz[*14]	
Cabinet Dimension (W x D x H)		230cm x 100cm x 190cm		100cm x 100cm x 190cm	
Cabinet Weight		≒2,500kg		≒1,500kg	
Front / Top side for heat dissipation		60cm		60cm	
Front / Rear / Right /Left side for maintenance [*6]		60cm		60cm	

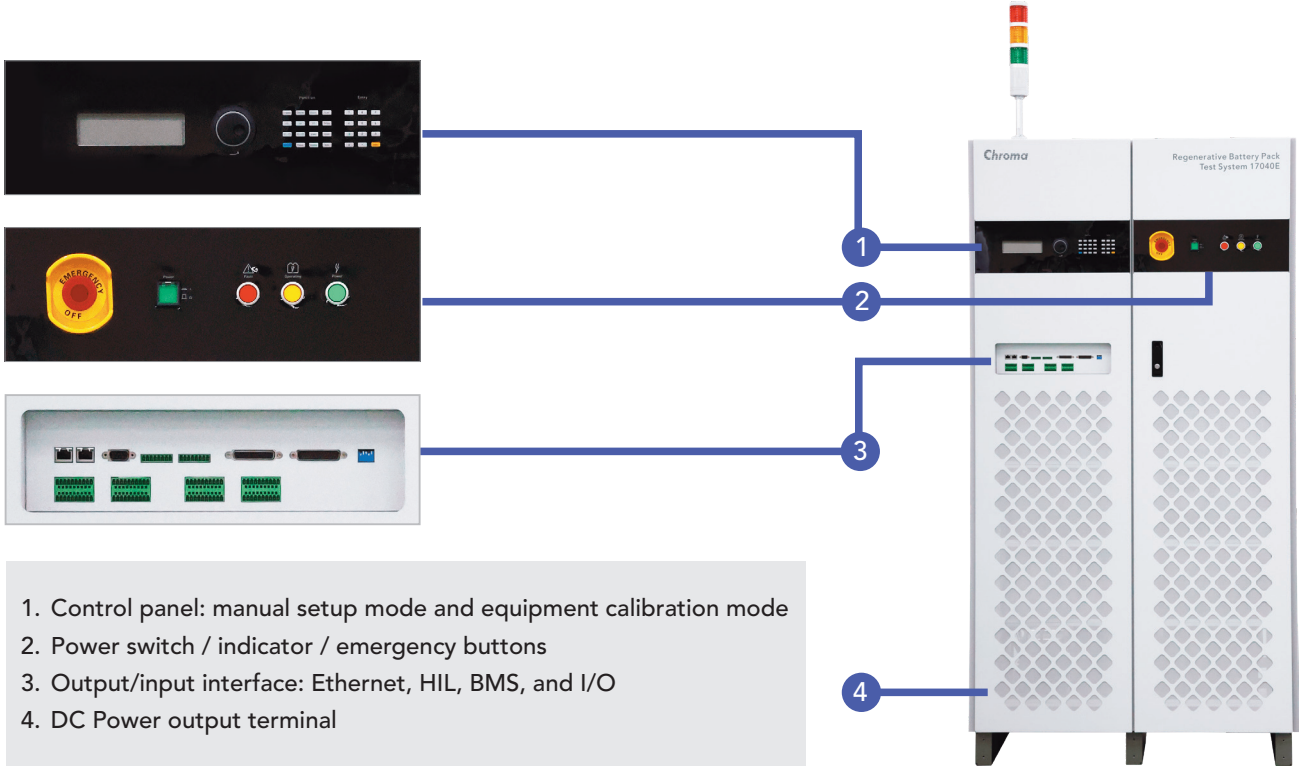
Battery Simulator, CV source	
Internal resistance setting	5 to 400mΩ
Voltage Ripple (P-P) , (0-20MHz) (% of full scale)	<0.5 %
Voltage Ripple (rms) , (0-20MHz) (% of full scale)	<0.5 %
Transient Response Time *7 (Loading time < Max current/msec, based on equipment power)	10ms
Bi-directional Transient Response Time *8	20ms
Load Regulation (@ 10A/msec) (Current sink with Transient Response Time)	<65V, recovery time is within 100ms
Program time *9	
Voltage Slew rate (Fall)	50ms @ No load
Voltage Slew rate (Rise)	50ms @ No load

GENERAL SPECIFICATIONS

Model	17040E
Power Factor	> 0.99 (at rated power)
I_T.H.D	< 3% (at rated power)
Recovery Efficiency at >50% of rated power	>93%
Leakage current protection (AC input Leakage Current)	Yes, >30mA
Temperature Coefficient (Voltage/Current)	<200 ppm/℃
Operating Temperature	0℃ to 40℃
Storage Temperature	-20℃ to 60℃
Operating Humidity	5-80%, non-condensing
Protection	OVP, UVP, OCP, OPP, OTP, FAN
Safety & EMC	CE UKCA
The Test of Regenerative Certification (option) *11	VDE-AR-N 4110 *10
Isolation Protection (option)	Follow iso685 setting *10 Automatic adaptation to the existing system leakage capacitance Two separately adjustable response value ranges of 1 kΩ to 10 MΩ Locating current injection for selective insulation fault location
Communication Interface*12	Ethernet (RJ45 x 2)
Noise Level (Standby / Operating)	<80dB
Cooling Type	Air
Control Interface for System integrator	
Communication Interface	CANbus
Connector	1 x DB9 male connector
Channels	1CH
Protocol	CAN 2.0A (11-bit) / Extended CAN 2.0B (29-bit)
Data Transfer Rate	Up to 1 Mbit/s via CANbus
CAN Transceiver	ADM3054 (compatible with ISO 11898-2)
Signal Support	CAN_H, CAN_L
Isolation Protection	Optical isolation protection of 4,000 VDC
Communication Interface	Analog programming interface *13
Analog Output (Measurement Volt. & Current)	2 ports (2 wires)
Voltage and Current Monitor/ Programming (Resolution/ Voltage Range/ Response time/ Input Impedance)	16-bit / ±10V / <3ms / MΩ
Analog Input (Current Control)	1 port (2 wires)
Analog Input (Voltage Control)	1 port (2 wires)
Latency Time	5ms
Safety Interface	Digital input / output interface for safety *13
Isolated Digital I/O	8 ports input pin 8 ports output pin
Isolated Digital Input	Logic 0 (VIL): 0-0.8V Logic 1 (VIH): 1.2Vmin (24 V max.)
Isolated Digital Output	Output Type: Dry Contact Open: high ; Close: Low) Output Voltage 5-24 Vdc / Sink Current 1A max.

All specifications are subject to change without notice.
*1: The output range of voltage is referred by the cabling. The connection between the device and battery is 10 meters long as standard accessory.
*2: The BatteryPro software can control up to 4 channels when multiple stand-alone machines are used simultaneously.
*3: The voltage accuracy is 0.1% of reading + 0.1% of full scale at operating voltage closer to 30V.
*4: 0.7% of full scale at operating voltage closer to 30V.
*5: User have to reduce the power load of the test system from 115% to 25% and rest for 10 minutes after finishing the "over current capability".
*6: Please reserve space for maintenance when placing the equipment.
*7: When the rated load change from 10% to 90%, the item is stability time of voltage.
*8: When the bi-directional rated load change from -90% to 90%, the item is stability time of voltage.
*9: The spending time from zero to the maximum voltage is at no-load condition.
*10: Please refer to the Chroma User Manual for the announcement content.
*11: The core part of isolated states is via Bender ISO685.
*12: Interfacing between BatteryPro (IPC) to 17040E is done through Ethernet.
*13: This is used for specific applications, please contact your local Chroma sales representative.
*14: Po_max：200kW @V_{LL}=418~380V_{ac} ≤40℃；Po_normal：170kW @V_{LL}=379~342V_{ac} ≤40℃

HARDWARE CONFIGURATION



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

ORDER INFORMATION

Regenerative Battery Pack Test System Model 17040E				
Power Range	Voltage	Current	Channels	AC Input
200kW	1,700V	800A	1	AC input 380V_{ac} ; AC input 480V_{ac}
200kW[*14]	850V	600A	1	AC input 380V_{ac} ; AC input 480V_{ac} [*13]

Options	
A170201	IPC for Battery Test System
A170202	Battery Simulator SoftPanel
A170402	Battery Pro Software - Battery Pro
Vector 1630 / 1640	CAN Bus Interface Card
L11-005779	VDE protection function
L11-005780	Insulation resistance protection function

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