BATTERY RELIABILITY TEST SYSTEM MODEL 17010

Chroma 17010 Battery Reliability Test System is a high-precision system designed specifically for testing lithium-ion battery (LIB) cells, electric double-layer capacitors (EDLCs), and lithium-ion capacitors (LICs). The test equipment is suitable for product development and quality control by providing characteristic research, cycle life testing, product screening, and quality assessment.

Chroma 17010 system provides two design architecture types. The linear circuit series produce low output noise and high measurement accuracy, suitable for reliability evaluation of small and medium-sized energy storage components in development. The regenerative AC/DC bi-directional series with power saving and low heat generating features fit standard product life evaluation as well as medium and large-sized energy storage components or power battery cell testing.

The Chroma 17010 system adopts the Battery Lab Expert (Battery LEx) software platform, which allows users to quickly reference existing test recipes or add new ones through a multi-layer recipe structure, edit and modify projects, manage individual DUT database, and use shared recipes for different DUTs.

In addition to the common charge and discharge test steps, Battery LEx also combines C-rate, OCV-SOC, Q%, waveform simulation, and chamber control modes, suitable for compliance testing to international test standards such as USABC, IEC, and GB/T as well as various other test applications. The test execution and monitoring design employs a group management method, allowing users to easily track the test status. Various controls can be executed during the test, including starting, pausing, resuming, step skipping, reservation pausing, specific starting.

The Chroma 17010 system integrates a high-precision and multifunctional data logger, which can measure the temperature, voltage, and pressure of the DUT in real-time and in turn serve as an advanced cutoff and protection condition. It also supports the integration of various brands safety chambers. Users can issue commands through safety chamber control steps, with built-in chamber synchronization and secondary adjustment functions that enhance operational convenience.

Chroma 17010 system provides three safety mechanisms: software/hardware detection, equipment abnormality monitoring, and optional independent relay hardware detection to ensure the safety of LIB cells tests.

Ethernet CE RoHS2 Compliant

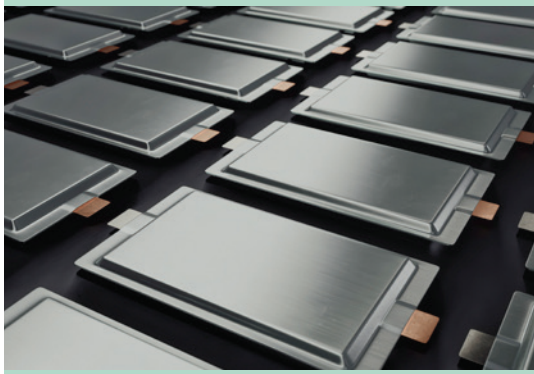
MODEL 17010

KEY FEATURES

- High accuracy output and measurement up to ±0.01% of F.S.
- Fast current response up to <100μS
- High sampling rate (10mS)
- High single point transient sampling rate (1mS)
- Integrating up to 96 channels
- Channel parallel output up to 1200A
- High-efficiency charge and discharge with low heating
- Energy recycling during discharge (AC/DC bi-directional regenerative series)
- Ripple emulation from 100Hz~20kHz, 75App
- Waveform simulation (current/power modes)
- Multi-level safety protections
- Integrable data logger and chamber
- Compliant to IEC and GB/T standards

APPLICATIONS

- Electric vehicle
- Electric scooter/bike
- Energy storage system
- Power tools
- Quality inspection
- Academic research



Chroma
Advancing Excellence

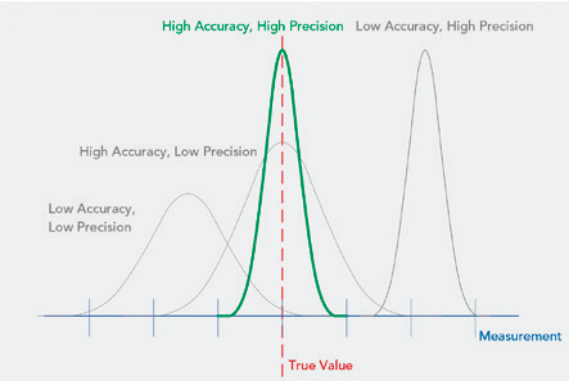
Feature Highlights - Ultra High Precision Charge/Discharge Tester 17208M-5-12C

The Chroma 17208M-5-12C is an ultra-high precision programmable charge/discharge tester specifically designed for high-precision measurement applications. Common applications include Coulombic Efficiency (CE) analysis, Incremental Capacity Analysis(ICA), and Differential Voltage Analysis (DVA), where the instrument is required to measure the voltage and capacity of the battery for a long time with high levels of stability, precision and accuracy to obtain high quality test data without post-processing. The Chroma 17208M-5-12C not only has four current ranges (12A, 4A, 0.4A, 40mA), but also has a voltage measurement range of 0 to 5V for charge/discharge. Each channel is equipped with shielded wiring that isolates the device from noise and improves measurement quality.

High stability, high precision and high accuracy

Through meticulous circuit and mechanism design, the 17208M-5-12C effectively blocks the influence of waste heat on high-precision circuits and components, improving measurement stability during time consuming tests. In addition, the measurement accuracy of up to ±0.01% of F.S. ensures the consistency of each test, while the measurement precision of up to ±0.001% of F.S. guarantees the repeatability of each measurement value.

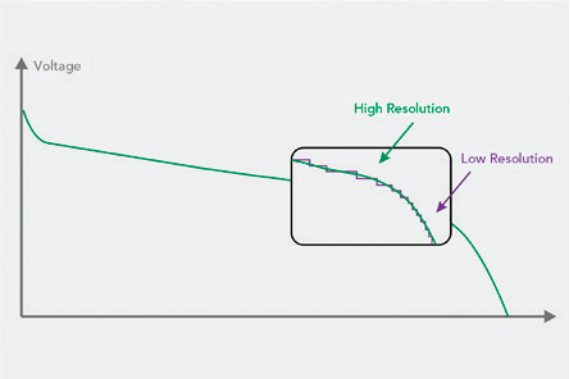
- ±0.01% of F.S. measurement accuracy
- ±0.001% of F.S. measurement precision



High resolution and low output noise

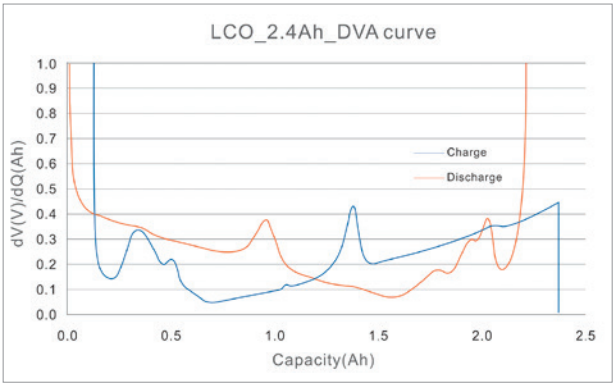
The 17208M-5-12C adopts a 24-bit ADC to improve the measurement resolution and provide users with highly granular test data, accurately presenting the actual electrical signal of the DUT.

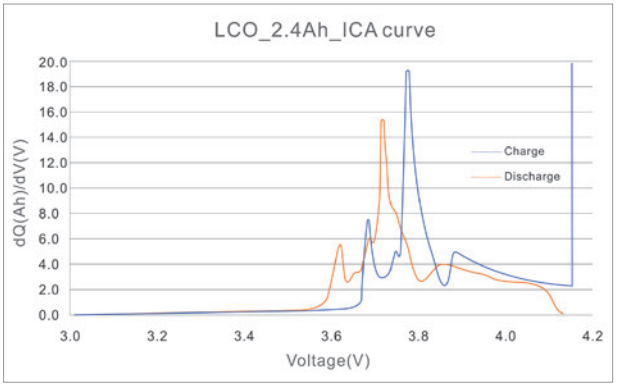
- Voltage measurement resolution up to 1μV
- Current measurement resolution up to 0.01μA



Effectively simplify DVA test data processing

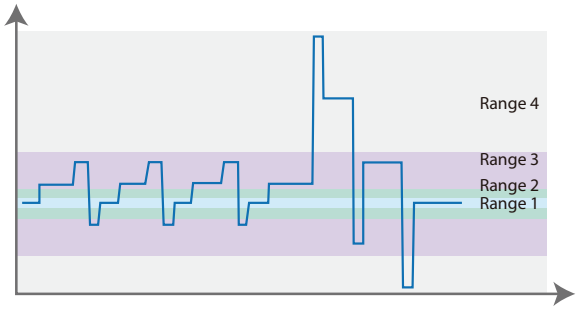
Differential Voltage Analysis (DVA) is a method commonly used to evaluate battery aging. However, poor device accuracy and precision specifications often make it difficult to identify characteristic peaks, requiring a significant amount of human resources for smoothing algorithms and bearing the risk of curve distortion. The 17208M-5-12C provides stable full-range current output throughout the test, which ensures accuracy and eliminates the problem of excessive noise caused by measurement fluctuations while obtaining clearly identifiable characteristic peaks in DVA curves.



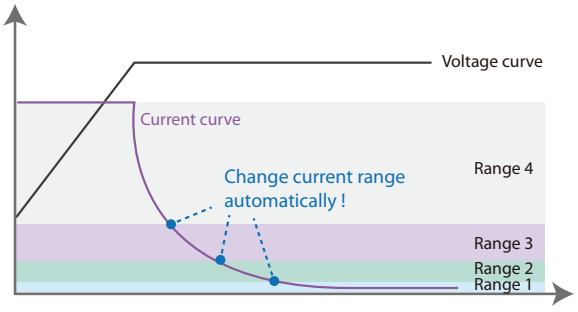


Multiple Current Range Design

- Quick switching of current ranges:
  Chroma 17010 series provide multiple current outputs and measurement range switching, fitting test plans with both large and small currents. At the start of a test step, the system will detect the output current and then automatically and quickly switch to the appropriate current range. This improves the test accuracy and resolution for highly accurate test data.
- Automatic range switching under constant voltage mode:
  Chroma 17010 linear circuit models support automatic switching of the current range in the constant voltage test mode, without any output interruption. This is perfect for applications such as float charging or potential regulation, which require long-term and highly stable testing of extremely small current output.



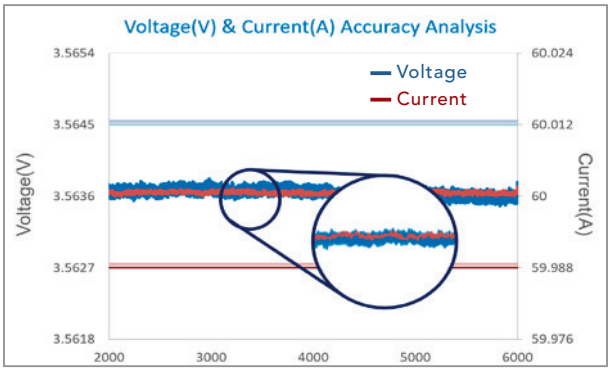
DST Application Test & Current Range
(Using 17216M-6-12 model range)



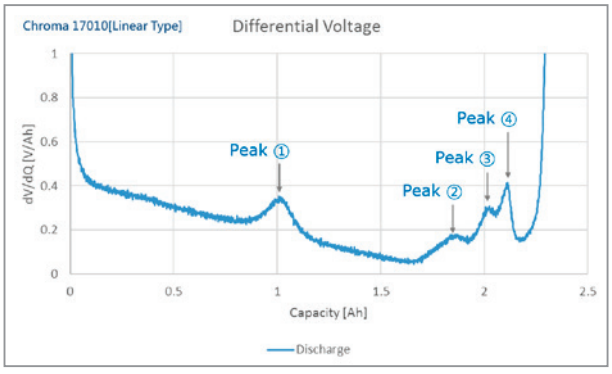
CV Test Current Switching

High Stability of Long-term Output

Chroma 17010 is equipped with low output noise and high measurement accuracy. The test current and voltage data can be converted into highly accurate and clear characteristic peaks to efficiently research the aging mechanism of Li-ion batteries.



Actual Voltage/Current Measurement Accuracy



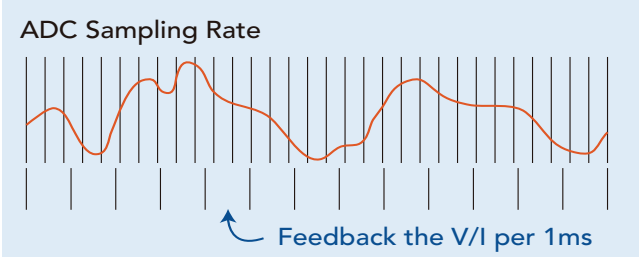
Differential Voltage Analysis Curve

High-speed Sampling Technology

Chroma 17010 uses high-speed voltage and current sampling with double integration of computing to capture transient changes in the test without distortion. The advanced test system provides more accurate capacity calculations to solve the issue that general battery test equipment only use the report sampling speed to record key data, causing large cumulative errors.

- Hardware internal voltage/current sampling rate: 1mS
- Report single point transient sampling rate: 1mS
- Report sampling rate: 10mS

General Testers Charging/Discharging Sampling Rate

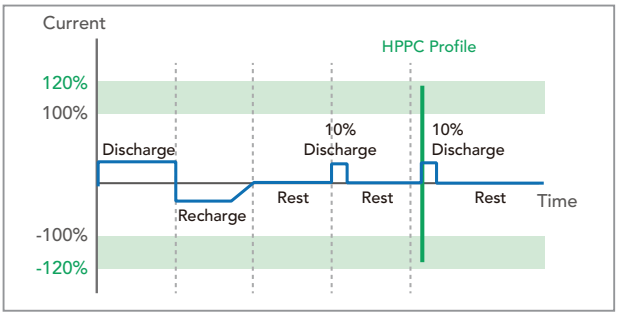


Chroma 17010 Charging/Discharging Sampling Rate

Super Charge/Discharge Output Mode

Chroma 17010 regenerative models provide up to 30 sec. super output functionality. For short-time & high-current pulse applications, the super mode can be set and executed directly through steps, and provides an even wider range of current and power usage.

- 17212M-6-100S: CC and CP 120% charge/discharge output

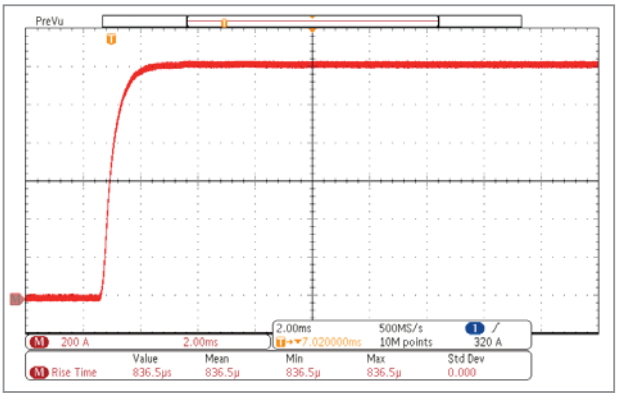


Hybrid Pulse Power Characteristic (HPPC)

Fast Current Response (<1mS)

Chroma 17010 regenerative models are provided with current response time in less than 1mS, which can more realistically simulate the instantaneous peak current of battery charging and discharging behavior when driving, and also meets NEDC, FUDS, and DST test standards.

- 17212M-6-100S: 10% to 90% < 1mS

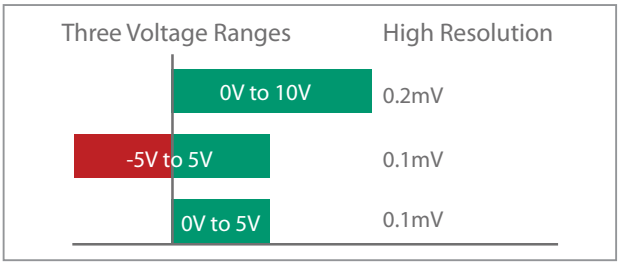


0~1200A Current Rise Time <1mS

Three Voltage Ranges

Chroma 17216M-10-6 model built in three voltage ranges, for more profuse product development applications.

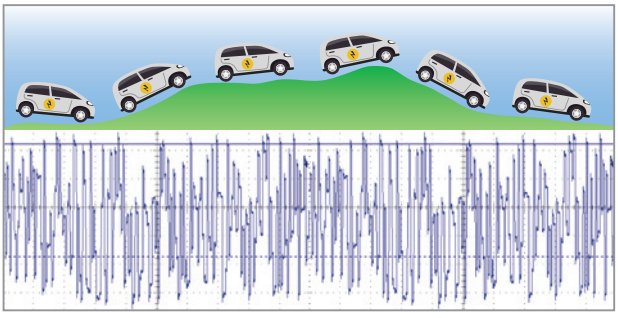
- 0V~+5V: Half-cell, full-cell, EDLC testing
- 0V~+10V: Batteries in series, EDLC testing
- -5V~+5V: Symmetric battery testing



Dynamic Waveform Loading

Chroma 17010 can preload current and power dynamic charging/discharging waveforms. The system simulates acceleration, deceleration, up/downhill, and other waveforms of real-life car driving conditions and then evaluates the battery degradation and life.

- Dynamic/fixed time modes (min. output interval 10mS)
- Dynamic preloading of up to 6,400,000 data points per system

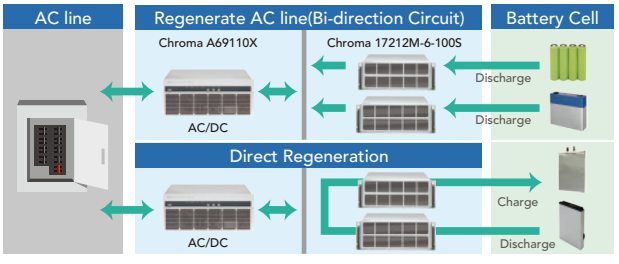


Dynamic Waveform Simulation

Energy Recycling

Chroma 17010 large current models have a high-precision, high-efficiency and power-optimized energy recycling architecture that achieve green and low-carbon performance. The test system so avoids electricity waste heat due to load consumption during discharge.

- DC: Automatically prioritize discharged energy to charging channels with >80% recycling efficiency.
- AC: Recover excess energy to the AC line, with >60% recycling efficiency.
- Feed back current to the grid with <5% total harmonic distortion



Energy Recycling Architecture

Ripple Output

The purpose of Chroma's ripple current testing solution is to superimpose an AC current with frequencies ranging from 100Hz to 20kHz onto the existing 17010 Charge and Discharge System (model 17212M-6-100S), simulating the behavior of an electric vehicle inverter or the behavior of AC current heating batteries in charging stations.

- Ripple frequency ranges from 100Hz to 20kHz, with an amplitude of up to 75App and parallel connection up to 150App (customizable)
- Independent AC/DC circuits, minimizing the impact on DC charge and discharge cut-off judgment.
- Superimposing ripple currents in various CC, CV, and CP charge and discharge modes.

Current Parallel Output

Chroma 17010 series support dynamic parallel functionality, which can connect continuous idle channels in parallel and provide a larger current output. Their characteristics not only improve the test versatility, but also suit a variety of test objects.

Data Protection & Resume Mechanism

In case of power failure, the optional uninterruptible power supply (UPS) can temporarily store test data in the IPC database. After power is restored, the system will automatically obtain the resumed data status and continues testing from the point of disruption. The report data will not be interrupted.

System Integration and Protection

Chroma 17010 supports integration of a variety of renowned environmental chambers and multi-functional data loggers. The Battery LEx software can simultaneously set parameters and monitor data, as well as automatically merge test data into the test report, thus providing users with the most complete test solution.

Integrable data logger

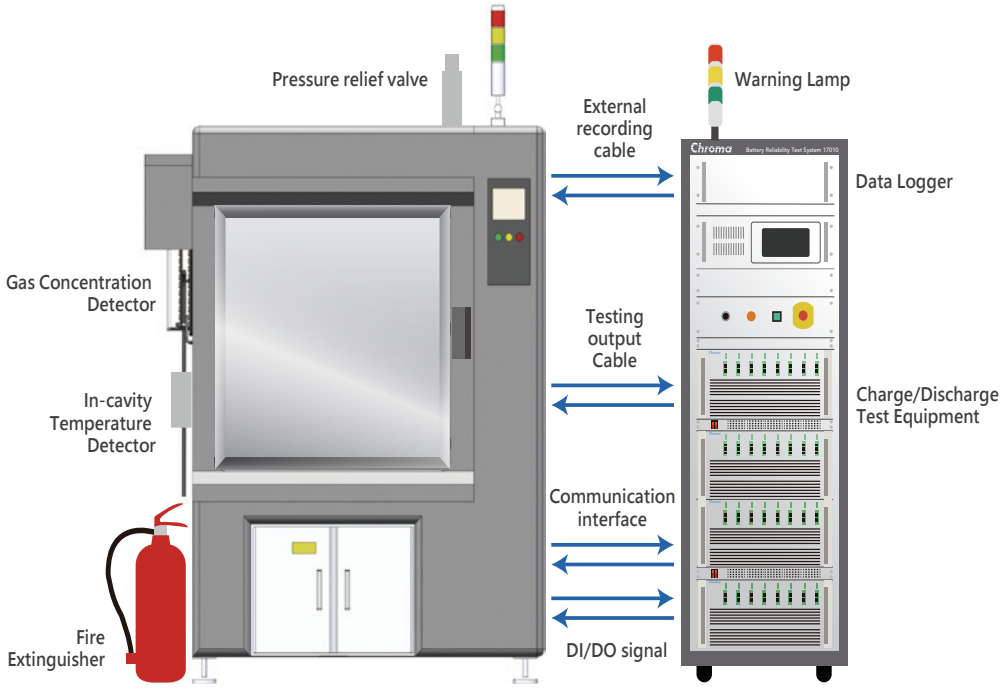
- Recording temperature (°C), voltage (V), pressure (mPa), force (kg).
- External real-time data can serve as cut-off or protection judgments (temperature)

System protection and abnormality detection

- Following the numerous built-in recipe protections, the protection mechanism monitors and triggers with a response speed of 1mS. An independent external voltage/temperature meter relay is optional to achieve reliable two-level protection.
- Real-time abnormality detection in each tester automatically detects deviations based on independent logic. When the system is interrupted, the test can be continued after the exception is eliminated without missing any data.

Integrable chamber and peripheral safety device

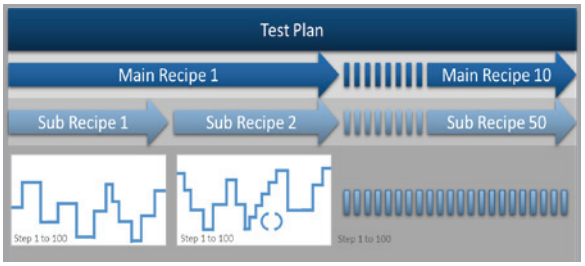
- The Battery LEx software provides built-in chamber setting controller and chamber control steps, which can control temperature and humidity, indicate the temperature control time, delay time, and standby temperature, as well as control timeout and over-temperature protections.
- To ensure consistency of the test state, the grouping management structure allows all testing channels in the same chamber to enter the temperature control phase at the same time.
- The built-in DI/DO function can be connected with smoke/gas detection, fire extinguisher, and alarms for over-temperature, over-voltage, and open door. The system performs different levels of handling according to the degree of damage, including stopping the test or powering off. Alarm data can be sent remotely via e-mail.



Battery LEx Software

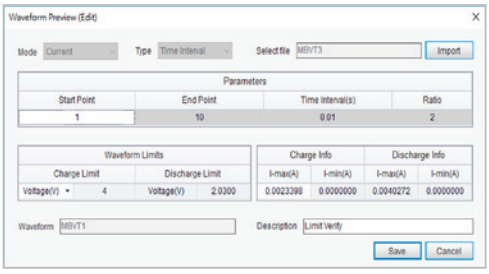
Battery Lab Expert (Battery LEx) is the testing software platform specially developed for Chroma 17010 and offers:

- Group testing: each group can control up to 96 channels and execute up to 50,000 steps
- Variable editing: using the data from the external data logger for flexible programming and complex applications
- Chamber integration: DI/DO amplification monitors the chamber's status and protection mechanisms in real time

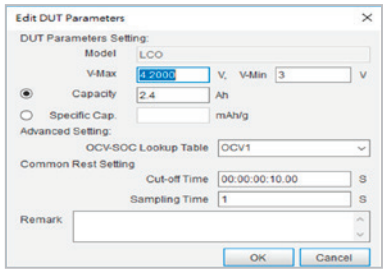


Project Browser

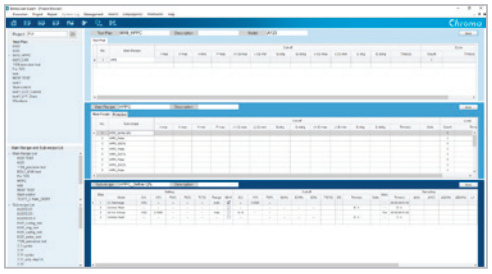
- Easy management: up to 500 projects can be added, and corresponding test plans can be built according to different DUT types or test requirements.
- Intuitive display and real-time modification: convenient for checking and adjusting DUT specifications, waveform simulation data, and recipe content in the test plan. Parameters can be adjusted and saved in real-time during browsing.
- DUT database: create specifications for the devices to be tested, and quickly match parameter conditions when editing recipes. Sharing of recipe tests is also facilitated.
- Operating condition simulation: import data points in xlsx format, and set time intervals (equal intervals/custom intervals), output multiplier, and data range.



Waveform Simulation Database



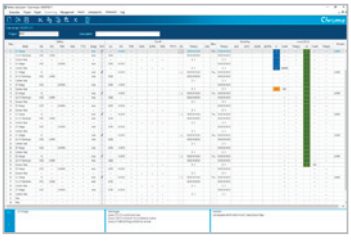
DUT Database

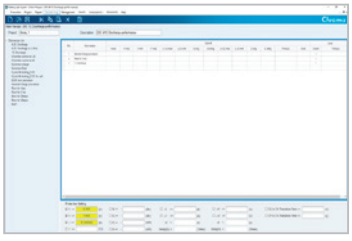


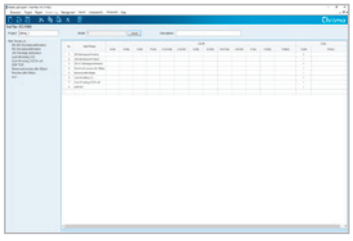
Project Browser

Recipe Editor

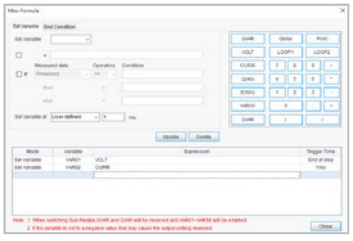
- Layered structure: up to 50,000 steps can be created in a test plan (SR->MR->TP)
- Easy creation: create new recipes to meet various types of test applications.
- Quick editing: quickly combine existed recipes to complete the test plan.
- Special notation for settings: provides special settings for C-rate/OCV-SOC/Q%/±V/variables when editing recipes.
- Variable settings and conditional cutoff function: provides 20 sets of variable definitions, including 2 sets of variable functions that can be used across sub-recipes. The transient capture function (1mS to 100mS) records the variable definition at the start/end of each step as a variable for secondary calculation.







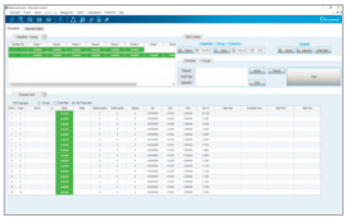
Sub-Recipe / Main Recipe / Test Plan Editor



Variable Definition and Transient Capture

Recipe Executor

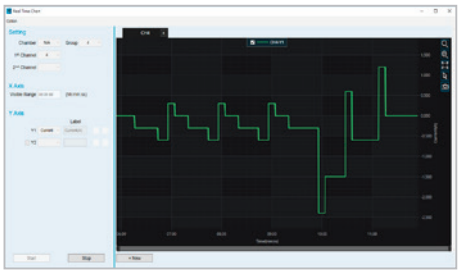
- Multi-channel group management
- Multi-group start
- Various control options: start, pause, resume, stop, reserved pause, specified start, skip to next step, pause and skip to next step, recipe preview
- Real-time test status: real-time display of test data for single channel and entire group
- Supports dynamic parallel setting



Recipe Executor

Real-time Chart Display

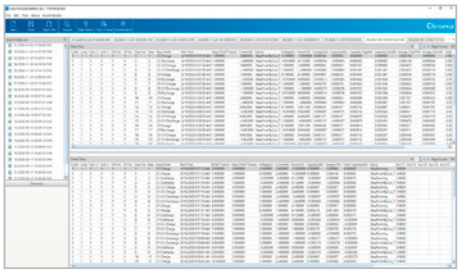
- Real-time data plotting: plots data in real time according to the sampling time, with a maximum of 36,000 data points per screen
- Multi-chart monitoring: displays up to 4 real-time screens, supporting up to 2 channels of test comparison per screen
- Graph capture: provides time-freeze function to save test curves
- Multi-axis analysis: provides dual-Y-axis data display



Real-time Chart Display

Test Report

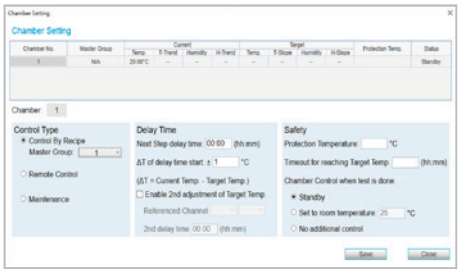
- Automatic Export: automatically export to the user-specified path based on the defined export mode and filename
- Export modes: automatically export reports using sub-recipes as segment point, with options for exporting based on time settings automatically or manually
- The system can adjust effective digits in the data up to 9 decimal places
- Report types: channel report, step report
- Free adjustment of report items and column orders



Test Report Preview

Chamber Control and System DI/DO Signal Control

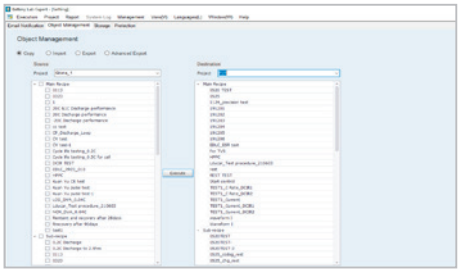
- Three control modes: chamber control steps, real-time remote control, maintenance mode
- Delay function: set a rest time after reaching the set temperature to ensure consistency between the temperatures of the chamber and the DUTs
- Cycle temperature setting: after reaching the set temperature, the intergrated data logger is used to adjust the chamber temperature according to the actual temperature of the DUTs, accurately harmonizing the temperature of the chamber and DUTs
- End-of-test setting modes: end temperature control, adjust to the specified temperature, or maintain temperature
- Dual protection control: over-temperature protection, temperature control timeout protection
- Device external control: provides three-color light signal control and relay signal control
- Synchronized temperature control: automatic sync. mechanism ensures that the chamber temperature control starts only when all channels reach the "temperature control step", ensuring test consistency
- Temperature control inheritance: after the main control group test is completed, the chamber control right can be automatically inherited by other groups



Chamber Control Settings

Management

- Account and permission management: multiple login accounts and passwords and corresponding editing permissions can be set up.
- Alert notifications: email can be set up to provide warning messages
- Recipe transfer: import/export/move recipes and test plans
- Data management: administrators can set up automatic or manual deletion of system data
- Forced global protection: forced set up recipe protection to prevent human error and enhance test security

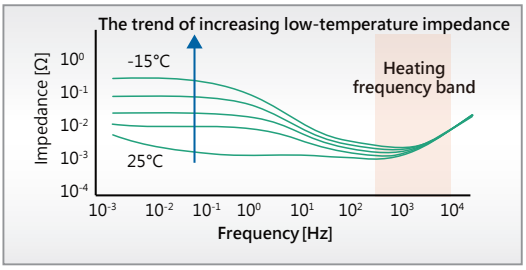


Test Plan Import/Export

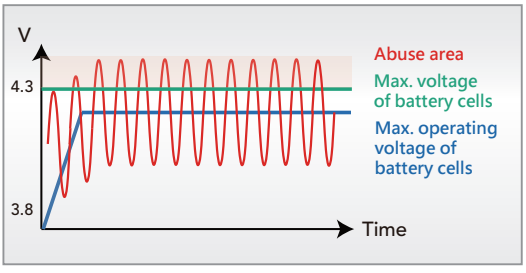
Lithium Battery Test Applications

Application of Ripple Current Superposition

- Efficiency verification of lithium-ion battery heating with AC current
  The conductivity of the electrolyte significantly decreases at temperatures <0℃ , while high internal resistance greatly reduces the battery's power capability, leading to decreased charging efficiency. Therefore, one of the options for battery preheating is to directly heat the battery with AC current to restore its charging efficiency. When selecting the frequency domain of the AC current, it is recommended to prioritize frequencies that do not induce electrochemical reactions in the battery.
- Evaluating the Impact of Ripple on Lithium-ion Battery Degradation
  Ripple mainly originates from inverters in electric vehicles. When the frequency of the ripple exceeds the detection frequency range of the battery management system (BMS) and the ripple voltage exceeds the upper voltage limit of the battery (e.g., when the ripple frequency is a multiple of the voltage detection frequency of the BMS), it may accelerate battery degradation, especially under conditions where the internal resistance of the battery cell increases several times at low temperatures.



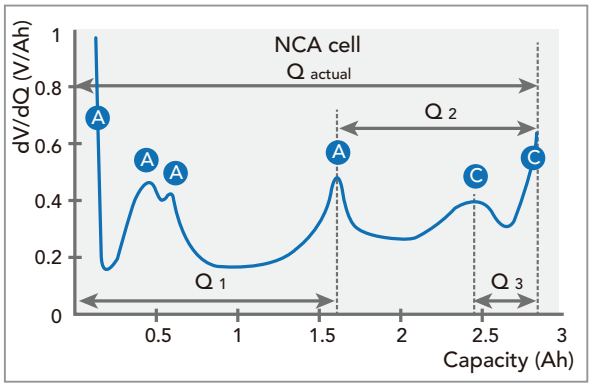
Application of Ripple Current Superposition



Evaluating the Impact of Ripple on Lithium-ion Battery Degradation

Differential Voltage (dV/dQ)

The key to plotting the d V/ d Q curve is to charge and discharge the battery with a small current (<C/20) in order to eliminate polarization effects on the test results. Chroma 17010 has low noise to draw high-definition dV/dQ vs. Q curves, users can view and mark each characteristic peak in detail. The ageing test allows users to analyze the battery's aging system based on the deviation and height of each characteristic peak.



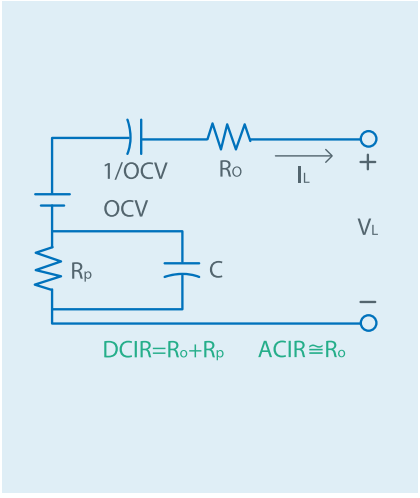
dV/dQ Test

Direct Current Internal Resistance (DCIR)

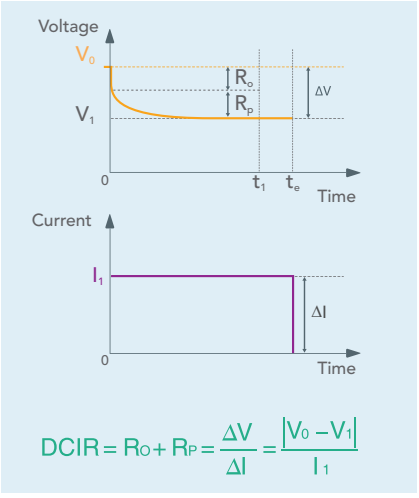
The battery internal resistance is rated to the charge/discharge rate that the battery can be used for. The larger the internal resistance value, the lower the efficiency and cause the temperature rises. ACIR measurement of traditional 1KHz LCR meters can only evaluate the ohmic resistance (Ro) of the battery that affects the instantaneous power output, but is unable to evaluate the polarization resistance (Rp) produced during electrochemical reaction. DCIR assessment includes ACIR and comes closer to the actual polarization effect of the battery under continuous power application.

Chroma 17010 has two programmable DCIR test modes, and – with the variable calculation function – can automatically obtain test results that meet the IEC 61960 standard.

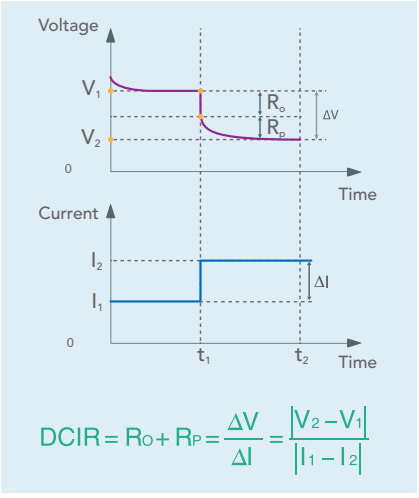
- DCIR (1) is based on the voltage difference caused by one current change
- DCIR (2) is based on the voltage difference caused by the change between two currents



Li-ion battery Equivalent Circuit Model



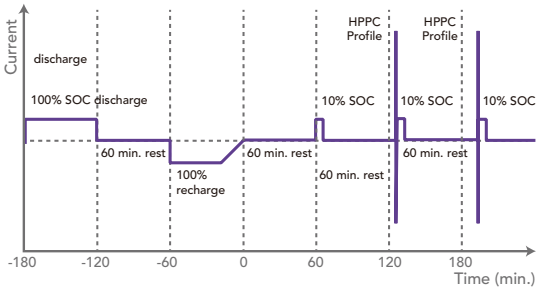
DCIR Test (1)



DCIR Test (2)

Hybrid Pulse Power Characteristic (HPPC)

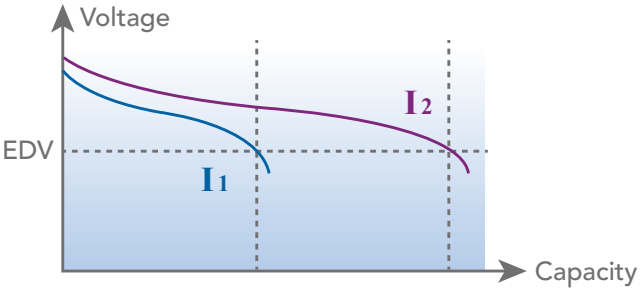
Chroma 17010 has a flexible editing program that can compile HPPC test steps, as used by the U.S. Council for Automotive Research (USCAR) to evaluate the battery performance of new energy vehicles. The purpose is to obtain the open circuit voltage, ohmic resistance (Ro), and polarization resistance (Rp) data of a specific depth of discharge within the operating voltage range, following standard test methods. It establishes a functional relationship between the depth of discharge and the charge/discharge peak power, as an index to evaluate the battery cell's aging and output power capacity.



HPPC Test

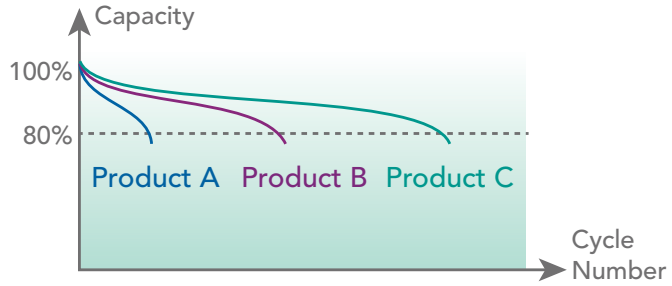
Battery Capacity

The capacity can be obtained by integrating current over time, from the start of charging/discharging until the cutoff condition is reached. Common test items include current ratio and temperature characteristics. Comparing the results lets users analyze performance differences between products. Higher accuracy of current/voltage measurement and faster sampling enable to distinguish more accurately the differences in battery cell capacity.



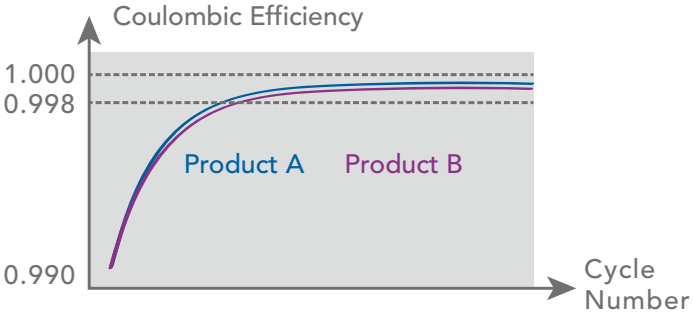
Battery Cycle Life

Cycle life is one of the most important test items for batteries. In accordance with the experimental purpose, it tests the same battery through repeated charge and discharge conditions until the capacity falls to 80%, and then calculates the number of cycles. The cycle life test canbe used to evaluate battery performance or define proper conditions of use.



Coulombic Efficiency (CE)

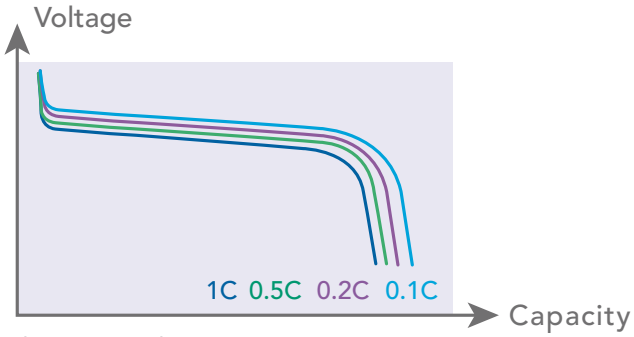
CE is calculated by the charge/discharge capacity ratio when the battery is fully charged and then fully discharged. Good batteries have higher CE, and need high precision and stable equipment to distinguish differences. Chroma 17010 offers accurate CE testing that can estimate the battery lifespan with only a few cycles.



Coulombic Efficiency Test

Charge & Discharge Rate

The battery is charged and discharged at different currents to evaluate how its voltage platform and capacity maintain. Such test results are often used for adjusting the proportion of active materials during product development as well as for verifying performance of power batteries for rapid charging and discharging.



Charge & Discharge Rate

Lithium Battery Test Applications

Chroma 17010 Battery Reliability Test System meets the verification requirements of most international regulations in charge/discharge testing.

Type	Regulation	Standard Number	Test Items
IEC	Secondary lithium-ion cells for the propulsion of electric road vehicles – Part 1: Performance testing	IEC 62660-1 2010	7.1 General charge conditions 7.2 Capacity 7.3 SOC adjustment 7.4.1 Power test method 7.5.1 Energy test method 7.6 Storage test 7.7 Cycle life test 7.8 Common tests
	Secondary cells and batteries containing alkaline or other non-acid electrolytes – Secondary lithium cells and batteries for portable applications	IEC 61960 2011	7.3 Discharge performance 7.4 Charge(Capacity) retention and recovery 7.5 Charge(Capacity) recovery after long term storage 7.6 Endurance in cycle
GB/T	Cycle life requirements and test methods for traction battery of electric vehicle	GB/T 31484 2015	6.1 Test conditions 6.2 Capacity and energy under room temperature (initial capacity and energy) 6.3 Power under room temperature (initial power) 6.4 Standard cycle life 6.5 Operating-condition cycle life
	Electrical performance requirements and test methods for traction battery of electric vehicle	GB/T 31486 2015	6.2.4 Secondary cell charging 6.2.5 Discharge capacity under room temperature (initial capacity)
	General specification of lithium-ion cells and batteries for mobile phone	GB/T 18287 2013	5.3.2.1 Charging methods 5.3.2.2 0.2 ItA discharge 5.3.2.3 Rated discharge 5.3.2.4 High temperature discharge 5.3.2.5 Low temperature discharge 5.2.3.6 Charge retention capability and recovery capacity 5.3.2.7 Storage performance 5.3.2.8 Cycle life 5.3.3.2 Steady damp-heat

* Continued on next page

Type	Regulation	Standard Number	Test Items
USABC	Battery Test Manual for 48 Volt Mild Hybrid Electric Vehicles	Rev.0 2017	3.2 Static Capacity Test 3.3 Constant Power Discharge and Charge Tests 3.4 Hybrid Pulse Power Characterization Test 3.5 Standard Self Discharge Test 3.6 Cold Cranking Test 3.7 Thermal Performance Test 3.8 Energy Efficiency Test 3.9 Operating Set Point Stability Test 3.10 Cycle Life Test 3.11 Calendar Life Test
	Battery Test Manual for 12 V Start/Stop Vehicles	Rev.2 2018	3.2 Static Capacity Test 3.3 Constant Power Discharge and Charge Tests 3.4 Hybrid Pulse Power Characterization Test 3.5 Standard Self Discharge Test 3.6 Cold Cranking Test 3.7 Thermal Performance Test 3.8 Energy Efficiency Test 3.9 Operating Set Point Stability Test 3.10 Cycle Life Test 3.11 Calendar Life Test
	Battery Test Manual for Electric Vehicle	Rev.3.1 2020	3.2 Static Capacity Test 3.3 High Rate Charge 3.4 Hybrid Pulse Power Characterization Test 3.5 Peak Power Test 3.6 Self-Discharge Test 3.7 Thermal Performance Test 3.8 Life Testing 3.9 Cycle Life Dynamic Stress Tests 3.10 Calendar Life Test
	Battery Test Manual for Plug In Hybrid Vehicle	Rev.3	3.2 Static Capacity Test 3.3 Constant Power Discharge Tests 3.4 Hybrid Pulse Power Characterization Test 3.5 Self-Discharge Test 3.6 Cold Cranking Test 3.7 Thermal Performance Test 3.8 Energy Efficiency Test 3.9 Life Testing 3.10 Charge-Sustaining Cycle Life Tests 3.11 Charge-Depleting Cycle Life Test Profile 3.12 Calendar Cycle Life Test

Battery Cell Testing Data Logger

Chroma A172013 multi-channel voltage and A172014 multi-channel temperature data loggers can serve as auxiliary channels for the 17010 system, providing real-time temperature and voltage monitoring of the DUT during charge and discharge tests. Through the Battery LEx software, the data can be integrated into the test report and upper and lower limit protection can be set to ensure test safety.

- Each channel adopts independent 24-bit ADC sampling
- Equipped with cold junction compensation function
- Can be used as a standalone unit or connected to voltage or temperature modules, expandable up to 128 channels

Multi-Channel Voltage Data Logger A172013						
Channels	16					
Number of Modules Connected *1	Up to 8 pcs					
Interface	Ethernet					
Measurement Range	±10V	±5V	±1V	±0.5V	±100mV	±20mV
Accuracy *2	±0.015% of F.S.				±0.05% of F.S.	
Resolution	0.3mV	150μV	30μV	150μV	3μV	0.6μV
Max. Voltage to Ground	±300V					
Max. Voltage between Channels	±250Vdc					
Wire Connection	M3 screw					
Sampling Time *3	10ms					

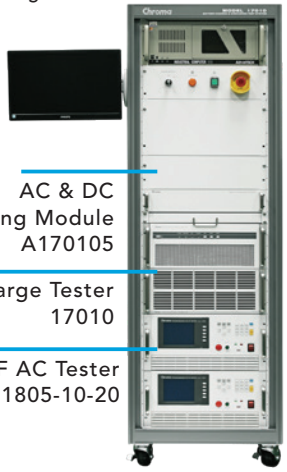
Multi-Channel Temperature Data Logger A172014 (Thermocouple Type)		
Channels	16	
Number of Modules Connected *1	Up to 8 pcs	
Interface	Ethernet	
Measurement Range	Range	Measure Range
	K 100˚C	-100˚C to 100˚C
	K 500˚C	-200˚C to 500˚C
	K 2000˚C	-200˚C to 1350˚C
	J 100˚C	-100˚C to 100˚C
	J 500˚C	-200˚C to 500˚C
	J 2000˚C	-200˚C to 1200˚C
	T 100˚C	-100˚C to 100˚C
	T 500˚C	-200˚C to 400˚C
	T 2000˚C	-200˚C to 400˚C
Accuracy *2	±0.05% of F.S. ±1˚C	
Resolution	0.1˚C	
Temperature Transducer	J, K, T type Thermocouple	
Wire Connection	M3 screw	
Sampling Time *3	10ms	

Note*1: A172013 and A172014 modules can be integrated and used simultaneously.
Note*2: The accuracy specification does not include errors caused by the testing cables, under the condition of 100ms sampling and 23±5˚C .
Note*3: The sampling time is for the single unit specification and does not include data integration and transmission.

Ripple Current Superposition Test System

Chroma's Ripple Current Superposition Test System consists of a programmable high-frequency AC tester, an AC/DC decoupling module, and a DC charge-discharge tester. The independent AC and DC loops can be applied to various charge and discharge modes, with minimal impact on the cut-off judgment of DC charge and discharge tests, aiding in cycle life comparison.

11805-20-10 & A170105 Specifications		
Max. Integrated Channels in the System		1-4ch
Communication Interface		RS485, DI/DO
Output	Frequency	100Hz-20kHz
	Waveform	Sine Wave
	Max. AC Amplitude	75 Ap-p
	Channels in parallel	2ch (150Ap-p)
Oscilloscope		option
AC Output Cable		2-meter low-inductance output



AC & DC Decoupling Module A170105

Charge & Discharge Tester 17010

HF AC Tester 11805-10-20

Battery Cell Test System Auto Calibrator

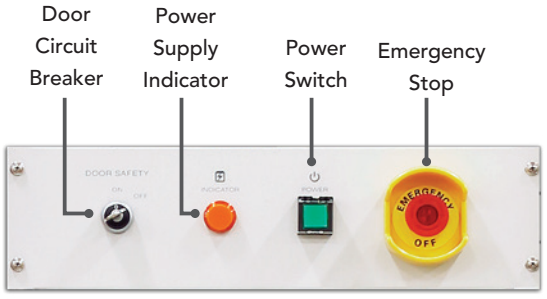
Chroma A170103 is a complete automated calibration and verification equipment with a variety of high-precision calibration standard components built-in for programmable test tasks. Chroma A170103 applies to Chroma 17010 products up to 150A in order to ensure that the equipment maintains its high precision and traceability.

- Consistent standards verification: reducing human errors and test variables
- Efficient calibration and verification: cutting down labor costs
- Automated report generation: managing maintenance records and traceability

Specifications	
Voltage	0~10V
Current	1mA/10mA/100mA/1A/6A/30A/150A (7 ranges)
Channels	16CHs/time
Input	Single-phase AC 100V~120V / Single-phase AC 200V~240V ±10% (manual switch)
Dimensions (W x D x H) (mm)	600 x 900 x1100
Weight (Kg)	<150
Equipment	
Standard	A170103, A820001 S/W, IPC & Windows 10 & Office, RS-485 card, 7230 I/O card
Option	30ppm digital DMM, Monitor, Keyboard & mouse

Environmental and Eaternal Specifications

Environmental and External Specifications		
Operating temperature		0°C~40°C
Operating humidity		<90 RH%
Input		3Φ 200~220Vac ± 10% V_{LL} 3Φ 380~400Vac ± 10% V_{LL} Frequency 47~63Hz
Dimensions (W x D x H) (mm)	25U	600 x 1100 x 1340
	36U	600 x 1100 x 1830
	41U	600 x 1100 x 2060
Weight (Kg)	25U	<160
	36U	<370
	41U	<510



Emergency Panel

25U Rack

36U Rack

41U Rack

Ordering Information

System	17010						
Model	Current Range	Voltage Range	Super Mode	0V Discharge	Regenerative Mode	Channels	Rack
17216-6-6	6A/1.2A/0.6A/1mA	0~6V	--	--	--	16/32/48/64/80/96	19" (25U) (36U) (41U)
17216-6-12	12A/2.4A/1.2A/1mA	0~6V	--	--	--	16/32/48/64/80/96	
17216M-10-6	6A/0.2A/6mA/0.2mA	0~10V / 0~5V / ±5V	--	Yes	--	16/32/48/64/80/96	
17216M-6-12	12A/3A/1A/0.1A	0~6V	--	Yes	--	16/32/48/64/80/96	
17208M-5-12C	12A/4A/0.4A/0.04A	0~5V	--	Yes	--	8/16/32/40/48/56/64	
17208M-6-30	30A/10A/0.1A/1mA	0~6V	--	Yes	--	8/16/24/32/40/48/56/64	
17208M-6-60	60A/15A/5A/0.5A	0~6V	--	Yes	--	8/16/24/32/40/48/56/64	
17212M-6-100S	100A/50A/25A	0~6V	Yes	--	Yes	12/24/36/48	

Option		
Model	Items	Channels
A172013	Multi-Channel Voltage Data Logger	16/32/48/64/80/96/112/128
A172014	Multi-Channel Temperature Data Logger (Thermocouple Type)	16/32/48/64/80/96/112/128
A170103	Battery Cell Test System Auto Calibrator	16
A170105	AC & DC Decoupling Module	2
11805-20-10	Programmable HF AC Tester	1

* Continued on next page

Specifications

Model		17208M-5-12C			
Voltage					
Accuracy		± 0.01% of F.S.			
Precision *1		±0.001% of F.S.			
Range		0V~5V			
Resolution	Setting	10μV			
	Measurement	1μV			
Current					
Accuracy		±0.01% of F.S.			
Precision *1		±0.001% of F.S.			
Range		40mA	400mA	4A	12A
Resolution	Setting	100nA	1μA	10μA	100μA
	Measurement	10nA	100nA	1μA	10μA
Power					
Accuracy		± 0.022% F.S			
Range		0.2W	2W	20W	60W
Resolution	Setting	0.5μW	5μW	50μW	150μW
	Measurement	50nW	0.5μW	5μW	15μW
Minimum Data Sampling Time		10mS			
Current Rise Time (+10%~+90%)		<1mS			

Model		17216-6-6				17216-6-12			
Voltage									
Accuracy		±0.015% of F.S.							
Range		Charge 0V~6V ; Discharge 1.5V~6V							
Resolution	Setting	1mV							
	Measurement	0.1mV							
Current									
Accuracy		6A : ±0.02% of F.S. Others : ±0.04% of F.S.				12A : ±0.02% of F.S. Others : ±0.04% of F.S.			
Range		1mA	0.6A	1.2A	6A	1mA	1.2A	2.4A	12A
Resolution	Setting	1μA	1mA	1mA	1mA	1μA	1mA	1mA	10mA
	Measurement	0.1μA	0.1mA	0.1mA	0.2mA	0.1μA	0.1mA	0.1mA	1mA
Power									
Accuracy		36W : ±0.035% of F.S. Others : ±0.055% of F.S.				72W : ±0.035% of F.S. Others : ±0.055% of F.S.			
Range		6mW	3.6W	7.2W	36W	6mW	7.2W	14.4W	72W
Resolution	Setting	1μW	1mW	1mW	10mW	1μW	1mW	10mW	10mW
	Measurement	0.1μW	0.1mW	0.1mW	1mW	0.1μW	0.1mW	1mW	1mW
Minimum Data Sampling Time		10mS							
Current Rise Time (+10%~+90%)		500μS				500μS			

Model		17216M-10-6				17216M-6-12			
Voltage									
Accuracy		± 0.015% of F.S.							
Range		0V~10V, 0V~5V or -5V~5V				0V~6V			
Resolution	Setting	1mV							
	Measurement	0.1mV							
Current									
Accuracy		±0.02% of F.S.				±0.02% of F.S.			
Range		200μA	6mA	200mA	6A	100mA	1A	3A	12A
Resolution	Setting	0.1μA	1μA	0.1mA	1mA	0.1mA	1mA	1mA	10mA
	Measurement	0.01μA	0.2μA	0.01mA	0.2mA	0.01mA	0.1mA	0.1mA	1mA
Power									
Accuracy		±0.035% of F.S.				±0.035% of F.S.			
Range		2mW	60mW	2W	60W	600mW	6W	18W	72W
Resolution	Setting	1μW	10μW	1mW	10mW	0.1mW	1mW	10mW	10mW
	Measurement	0.1μW	2μW	0.1mW	2mW	10μW	0.1mW	1mW	1mW
Minimum Data Sampling Time		10mS							
Current Rise Time (+10%~+90%)		100μS				250μS			

Model		17208M-6-30				17208M-6-60				17212M-6-100S			
Voltage													
Accuracy		±0.015% of F.S.								±0.02% of F.S.			
Range		0V~6V								Charge 0V~6V ; Discharge 1.5V~6V			
Resolution	Setting	1mV								1mV			
	Measurement	0.1mV								0.1mV			
Current													
Accuracy		±0.02% of F.S.				±0.02% of F.S.				±0.05% of F.S. *2			
Range		1mA	100mA	10A	30A	500mA	5A	15A	60A	25A	50A	100A	120A(ST)
Resolution	Setting	1μA	0.1mA	10mA	10mA	0.1mA	1mA	10mA	10mA	1mA	5mA	10mA	10mA
	Measurement	0.1μA	0.01mA	1mA	1mA	0.01mA	0.1mA	1mA	1mA	0.1mA	0.5mA	1mA	1mA
Power													
Accuracy		±0.035% of F.S.				±0.035% of F.S.				±0.07% of F.S. *2			
Range		6mW	600mW	60W	180W	3W	30W	90W	360W	150W	300W	600W	720W
Resolution	Setting	1μW	0.1mW	10mW	10mW	1mW	10mW	10mW	100mW	10mW			
	Measurement	0.1μW	10μW	1mW	1mW	0.1mW	1mW	1mW	10mW	1mW			
Minimum Data Sampling Time		10mS											
Current Rise Time (+10%~+90%)		250μS				500μS				1mS			

Note*1: The accuracy is specified under the condition of 100ms sampling and 23±5℃ , when the A172013 and A172014 modules are used together.
Note*2: Short-term output capability (ST) can output 120% constant current/constant power in a maximum 30S within 60S. Current accuracy ±0.1% of F.S., power accuracy ±0.12% of F.S.
* All specifications are subject to change without notice.

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