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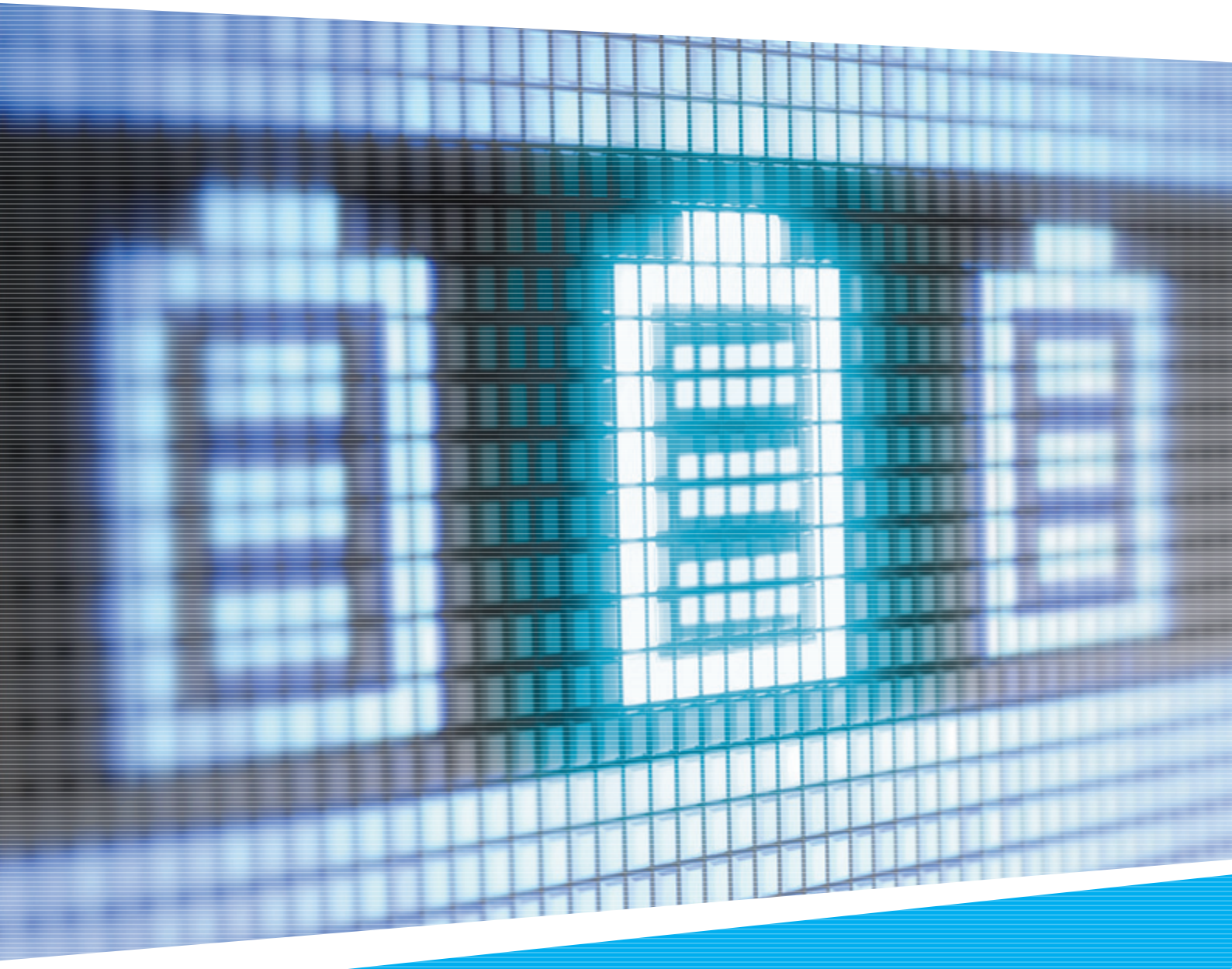
Battery Test Solutions

Pack/Module/Cell



Chroma

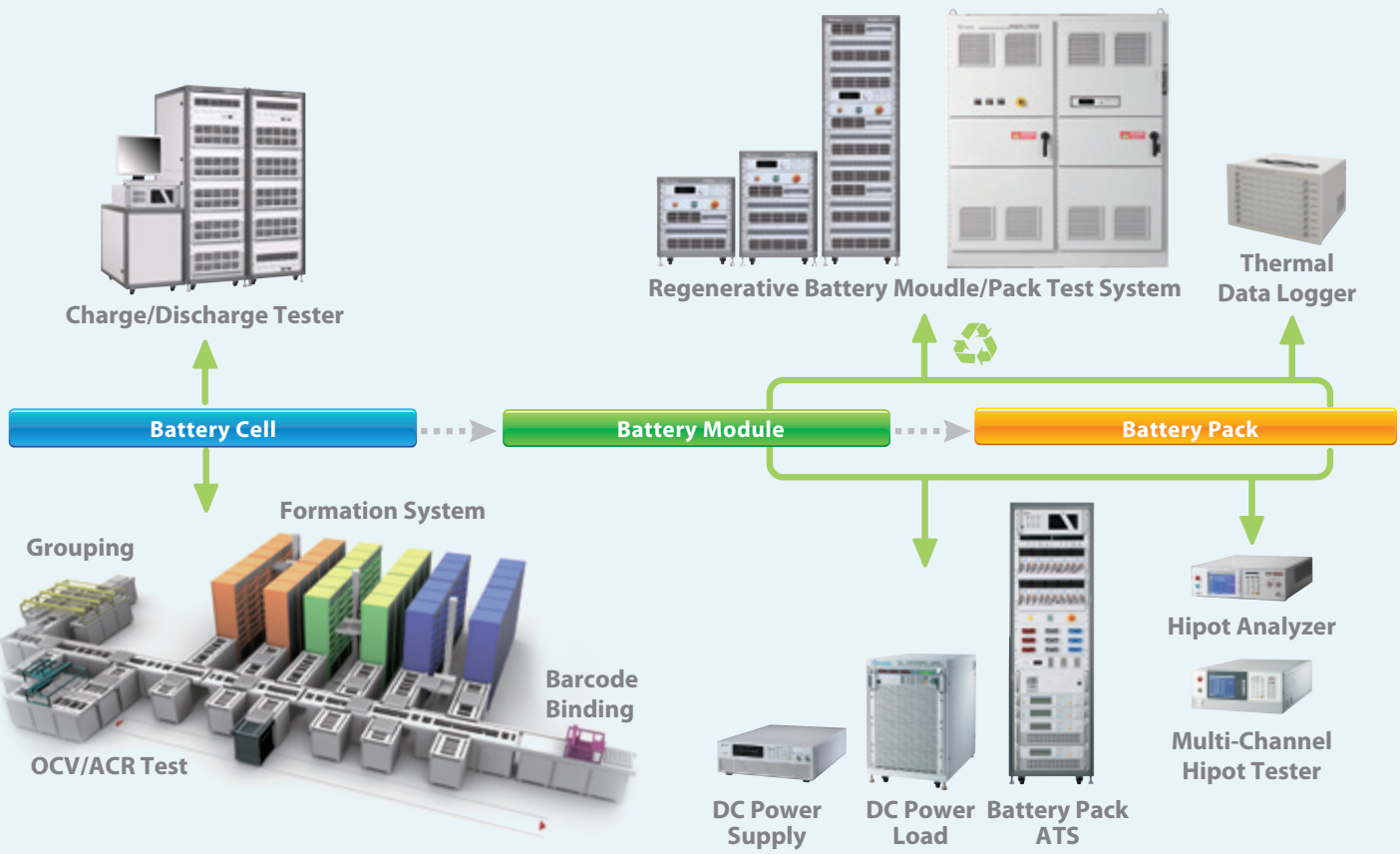
Turnkey Test & Automation Solution Provider

Founded in 1984, Chroma ATE Inc. is a world leading supplier of precision Test and MeasurementInstrumentation, Automated Test Systems, Manufacturing Execution Systems and Turnkey Test and Automation Solutions marketed globally under the brand name "Chroma".

Significant markets Chroma serves include LED, photovoltaic, Li-battery, electric vehicle (EV/EVSE), semiconductor/IC, laser diode, flat panel display, video and color, power electronics, passive component,electrical safety, and thermoelectric test, as well as automated optical inspection and manufacturing execution systems.

Chroma has worldwide operation sites in the United States, Europe, Japan and mainland China chartered to deliver innovative technologies with high value-added product and service to satisfy our global customers' demands.

Battery Test and Automation Solutions



Battery Pack Test Solutions

Regenerative Battery Pack Test System

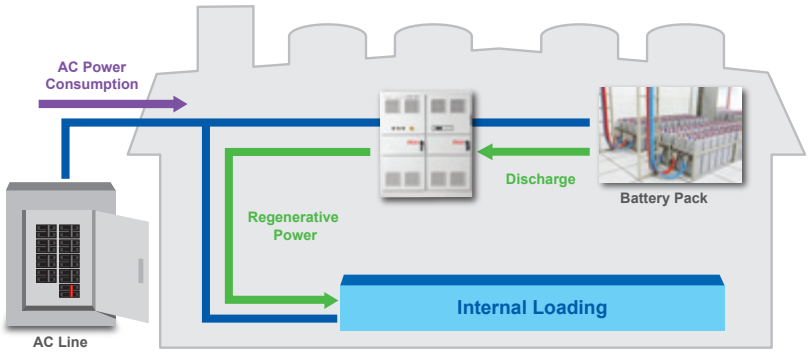
Model 17030 Series

Regenerative Function

The 17030 Regenerative Battery Test System is a, single or dual output, high precision integrated solution specifically designed for high power battery pack testing. Highly accurate sources and measurements capability ensure testing quality suitable for battery pack incoming or outgoing inspections, as well as capacity, performance, production and qualification testing.

Key Features

- ☑ Charge/discharge mode : CC/CV/CP/Waveform
- ☑ Measurement accuracy
  - Voltage : 0.05% rdg.+0.05% F.S.
  - Current : ±0.1%F.S.
- ☑ Regenerative battery energy discharge
- ☑ Customized power levels
  - Voltage range : 10~1200V
  - Current range : 0~1000A
  - Power range : 90~350kW (Up to 2 units can be used in parallel)
  - Like channels can be easily paralleled for higher power/current requirements. This feature provides ultimate flexibility between high channel count and high current testing.
  - Dual output in one system, independent control

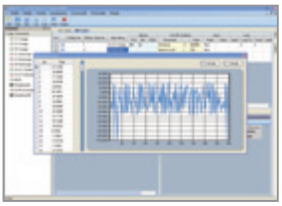


Regenerative Function

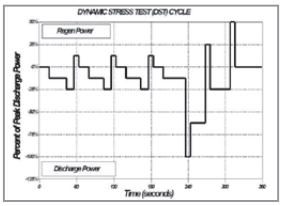
Driving Cycle Simulation (Power/ Current Waveform Mode)

Simulate real automotive working conditions by defining quick and irregular charging and discharging profile

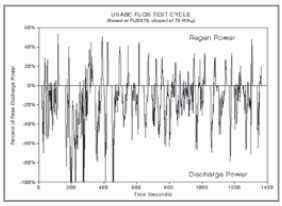
- ☑ Import dynamic charge/discharge waveforms to simulate DRIVE CYCLES or other actual charge/discharge profiles via .xls file formats
- ☑ Supports up to 720,000 points within driving profile memory
- ☑ Data point resolution (Δt) : 10ms~999s



Loading Dynamic Power/Current Profile



DST Power Profile

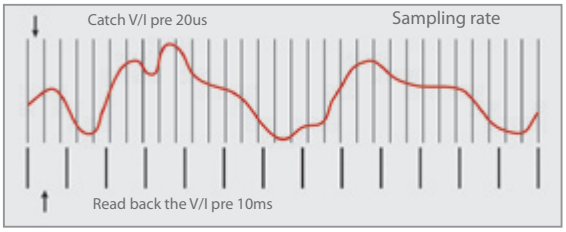


Support FUDS Test

Capacity Calculation

High frequency sampling rate used for calculating dynamic charge/discharge capacity ratings in waveform mode

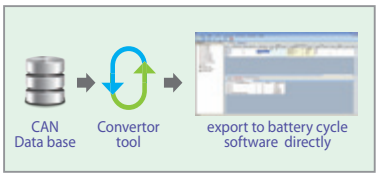
- ☑ Voltage/current sampling rate : 50KHz
- ☑ Minimum data acquisition: 10ms
- ☑ Supported integration methods e calculation
  - I : Capacity
  - V x I : Energy



Capacity Calculation with Double Integrating Method

Software integration supports BMS communication integration (CANbus), thermal data loggers (Chroma 51101-64 for measuring the voltage and temperature), and thermal chamber control (Option)

- ☑ User defines in the CANbus massage
- ☑ Convert DBC to Battery Cycler using provided software tools
- ☑ Collect BMS data, such as voltage, Current, temperature, battery states, and etc.
- ☑ Data test steps for cut-off or protection testing and limits



Convert DB Tools

CANbus Messaging Dialog Box

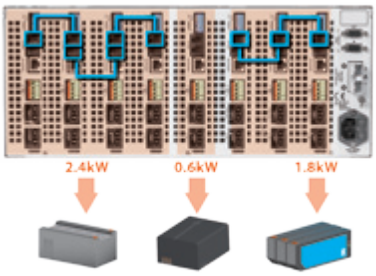
BMS Status Browse

Battery Pack/Module Test Solutions

Regenerative Battery Pack Test System

Model 17020 Series

Chroma's 17020 regenerative batter test systems provide multiple independent channels to support dedicated charge/ discharge testing on multiple battery modules or packs. Channels can easily be connected in parallel to support higher current requirements. This feature provides flexibility between high channel count (max 60 channels) and high current testing.



Channels parallelable for higher current

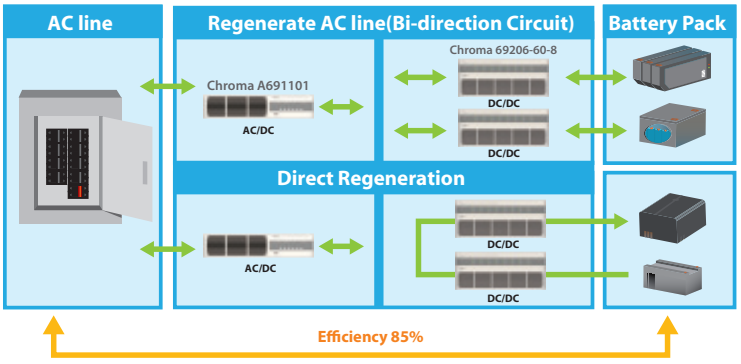
Flexible system configuration

Key Features

- ☑ Charge / discharge mode : CC/CV/CP/Waveform
  Voltage Range : 20V/ 60V/ 100V
  Current Range : 12A/ 50A/ 60A
  Power Range : : 600W/ 1250W/ 2500W for one channel
  (Max of 60 channels (40kW) maybe connected in parallel)
- ☑ High precision measurement accuracy
  Voltage : 0.02% rdg.+0.02% F.S./ 0.1% rdg.+0.05% F.S.
  Current : 0.05% rdg+0.05% rng/ 0.1% rdg. + 0.05% rng.
- ☑ Voltage / Current sampling rate :
  50kHz for calculating dynamic charge / discharge capacity
- ☑ DCIR function (IEC 61960-2003)

Regenerative Energy

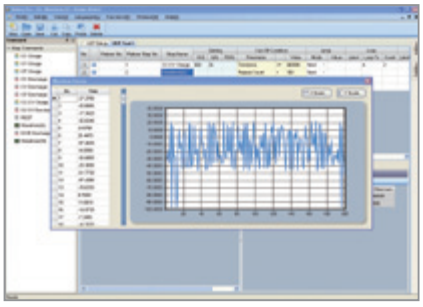
- ☑ Regenerative battery energy discharge
  - Direct recycling back to grid or for charging pack
- ☑ Regenerative battery energy discharge efficiency :
  About 85% at >20% of rated power
- ☑ Low heat output to reduce air-conditioner and power consumption
- ☑ AC line current THD < 5% at rated power
- ☑ AC line PF is > 0.9 at rated power



Driving Cycle Simulation (Power/ Current Waveform Mode)

Simulate real automotive working conditions by defining quick and irregular charging and discharging profile

- ☑ Import dynamic charge/discharge waveforms designed to simulate DRIVE CYCLES or other actual charge/discharge profiles via .xls file formats
- ☑ Supports 720,000 points within driving profile memory
- ☑ Data point resolution (△t) : 10ms~999s



Loading Dynamic Power/current profile

Low Cost Temperature Measurement

- ☑ Battery surface temperature measurement within the range of 0~90˚C ±2˚C
- ☑ 4 measurement sensors supported for each channel

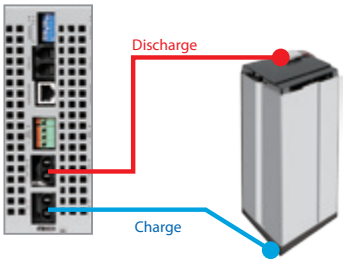
Temperature Sensor

Independent Battery Connections

For batteries with separate charge and discharge connections, user may set 17020's channels to independent charge/ discharge via software.

Support

- ☑ Software integration supports BMS Communication Integration (CANbus)
- ☑ Thermal data loggers (Chroma 51101-64 for measuring the voltage and temperature) and thermal chamber control (optional)
- ☑ Flexible system configuration
- ☑ Channels parallelable for higher current
- ☑ Temperature Sensor



Battery Cell Test Solutions

Battery Cell Charge/Discharge Test System

Model 17011

17011 Charge/Discharge Test System

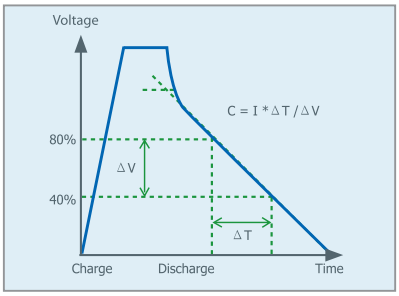
Chroma's 17011 Charge/Discharge test system is high precision automated test system designed specifically for testing Lithium-ion secondary batteries and Electrical Double Layer Capacitor (EDLC). It's suitable for cycle life test, incoming and out-going inspection, production, and reliability test. Test channels support parallel operation for maximum flexibility between high channel count and large currents. This system supports charge and discharge tests in CC-CV, CV and CP modes as well as supports battery DCIR test, and also capacitance and DCIR tests for EDLC.

Key Features

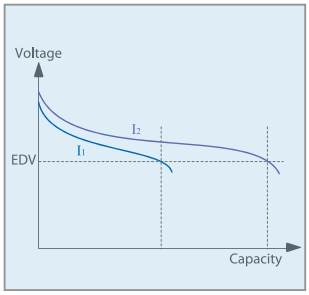
- ☑ High precision output and measurement, maximum ± (0.02% of F.S.)
  Voltage Range : 0~5V / 1.8V~5V
  Current Range : 0~20A / 0~30A / 0~100A
- ☑ Independent test channel control and execution
- ☑ Channels parallel output function (17202-5-30 maximum parallel current 300A, 17212R-5-100 maximum parallel current 600A)
- ☑ High sampling rate maximum 10mS
- ☑ Flexible data acquisition (Δt, ΔV, ΔI, ΔQ)
- ☑ Real-time data acquisition (Q, Vt, It, time) and step termination status (Q, V_end, I_end, time)
- ☑ Build-in two battery DCIR test mode to get DCIR values rapidly and accurately (DCIR=R0+Rp , ACIR≅R0)
- ☑ Build-in EDLC capacitance (F) and DCIR test functions to provide prompt and accurate test results (17202-5-20 and 17202-5-30 only)
- ☑ Real-time outer-loop resistance check
- ☑ Discharge energy recycle function (A691103 only)

Hot Swappable & Redundant DC Power Supply

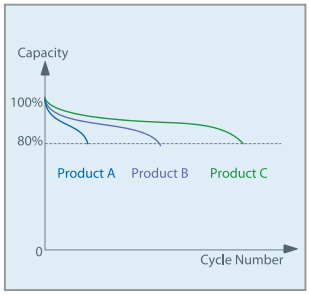
AC/DC Bi-Directional Converter



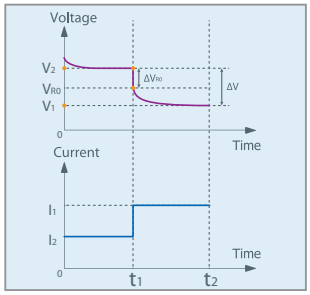
EDLC Capacitance Testing Curve



Capacity Measurement



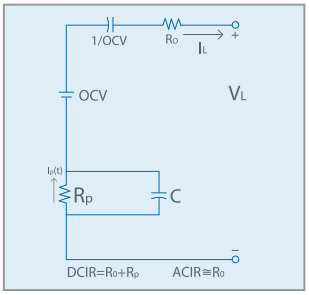
Cycle Life Testing



DCIR Test

$$DCIR = R_O + R_P = \frac{\Delta V}{\Delta I} = \frac{|V_2 - V_1|}{|I_1 - I_2|}$$

$$ACIR \cong R_O = \frac{\Delta V_{RO}}{\Delta I} = \frac{|V_2 - V_{RO}|}{|I_1 - I_2|}$$



Lumped Parameter Model Circuit Diagram

Recycling Li-ion Cell Formation System

Model 17000

Chroma's 17000 series is specifically designed for the formation of Lithium-ion secondary batteries. It's a complete turn-key system, including carrier trays, robust battery probe contacts, high quality/charge/discharge modules and intuitive software all under computer control. The included MES software allows users to create a Formation Management System which is specially designed for battery formation processes. In many cases the 17000 MES software can control the entire formation process including FMS features.

Key Features

- ☑ BVT (Battery Voltage Tracking) reduces power consumption while battery charging
- ☑ ERM (Energy Recycling Module) recycles discharged energy
- ☑ Energy recycle to AC grid function improves the energy recycle efficiency of high discharge power
- ☑ Energy savings monitor : tracks kW, kWh, reduced CO2 or plated-tree display
- ☑ Real-time outer-loop resistance check
- ☑ System safety/test reliability through PLC/IPC monitoring of all sensors (temperature, smoke, device type and battery tray position)
- ☑ System are linked as a LAN offering remote monitoring and control with FMS (Formation Management System)
- ☑ Automated handling and sorting are available

Software Platform

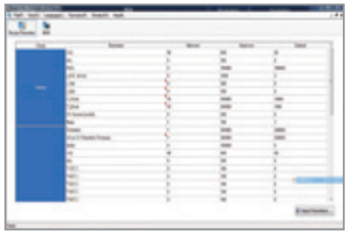
Battery Pro (for Model 17030/17020/17011)

Chroma's Battery Pro test environment supports 17030, 17020 and 17011 using common software platform. Battery Pro is specifically designed to meet the various requirements of secondary battery packs with high safety and stability. Charge and discharge protection aborts tests when abnormal conditions are detected. Data loss, storage and recovery are protected against power failure.

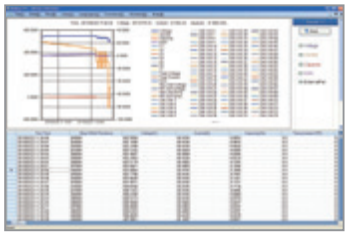
Key Features

- ☑ Real-time multi channel battery pack status browse
- ☑ Icon Manager : Test status of each channel is managed through different icons, easy to read and understand
- ☑ Authority management: Sets the user's authority for operation
- ☑ Fault record tracking: It records the abnormal state of each channel independently
- ☑ 3000 charge/discharge conditions
- ☑ Sets dual layer loops (cycle & loop) with 9999 loops per layer
- ☑ Cut-off condition
  - Time/ Capacity/ Voltage/ Current/ Temperature
  - Data Acquisition from data logger (option)
  - Data Acquisition from BMS (option)
- ☑ Protection
  - OVP/UVP/OCP/OTP/OQP
  - Data Acquisition from data logger (option)
  - Data Acquisition from BMS (option)
  - Turn the main loop off for safety issues of AC line
  - ΔV protection / ΔI protection for internal short of battery pack
  - ΔV period protection / ΔI period protection
  - CC-CV transition time

Battery Pro Main Page (English)

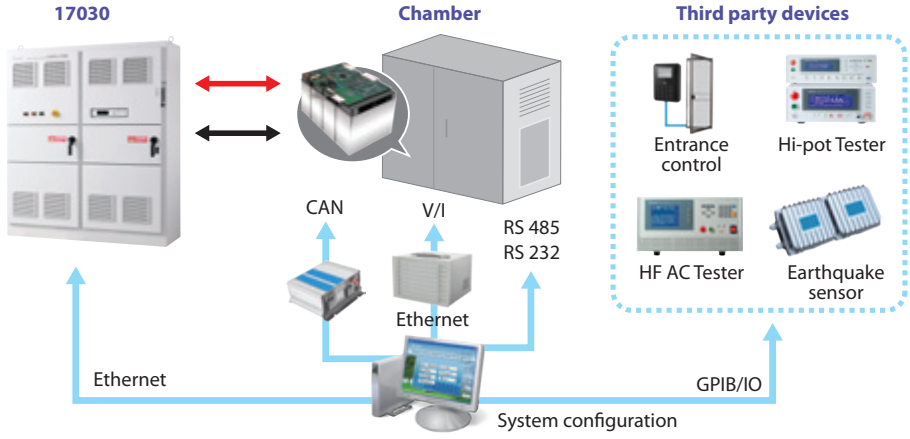

UUT Specifications

Status browser (1)


Status browser (2)

Software Integration Option

- ☑ Data logger :
  data logger integration allows for detailed collection of voltage, current and temperature data during charge/discharge profiling
- ☑ Battery Pro can communicate to most thermal chambers for life cycle and temperature testing
- ☑ Third party devices can be integrated into the 17030 via standard interface protocols (discrete I/O interface, GPIB, and etc.)

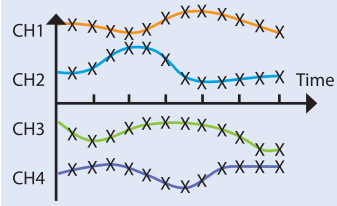


Cell Voltage and Temperature Measurement

Thermal/Multi-Function Data Logger

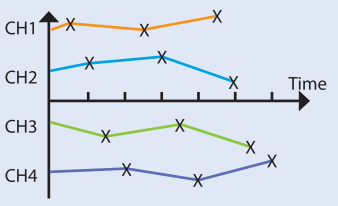
Model 51101 Series

- ☑ Support B, E, J, K, N, R, S, and T type thermal couples with ITS-90 defined temperature range
- ☑ Temperature resolution : 0.01˚C
  Accuracy : (0.01% of reading+0.3˚C)
- ☑ Cell Voltage measurement
  - Range : ±10VDC
  - Rsolution : 10uV
  - Accuracy : 0.015% of reading+100uV
- ☑ Synchronized and constant sampling rate for all channels, min sampling rate : 200ms
- ☑ 1000VDC channel to channel isolation



What CHROMA data loggers see, constant rate each channel

Sample rate per channel = constant



What other data loggers see, more channels, slower rate each channel

Sample rate per channel = $\frac{\text{bandwidth}}{\text{number of channels}}$

Electrical Safety Test Solutions

Hipot Analyzer

Model 19055-C

- ☑ ACW/DCW/IR/HFCC/OSC
- ☑ Corona Discharge Detection/Discharge Level Analysis (DLA)

Multi-Channel Hipot Tester

Model 19020

- ☑ ACW/DCW/IR/OSC
- ☑ 10 channels in one design

Hipot Scanner Series

Model 19035

- ☑ ACW/DCW/IR/OSC
- ☑ 8 ports scanner

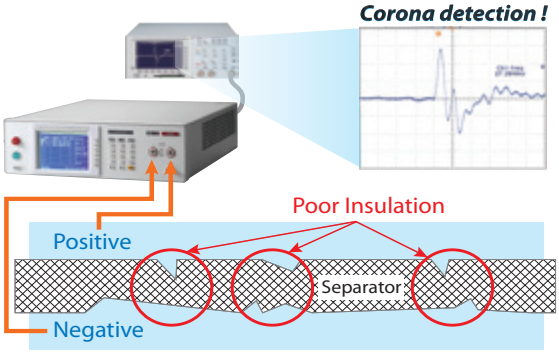
One Channel Hipot Tester

Model 19073

- ☑ ACW/DCW/IR/OSC

Jelly Roll

The distance between positive & negative electrodes is one of key performance indicators of battery cells since the electric field intensity is related to distance (E=V/d). The distance is usually defined by a separator. During jelly roll producing process, the distance may be shorter than specified due to the deckle edge of cutting and due to metal particle introduced during rolling. Charging and discharging the cell under this condition could result in the dendritic crystal being produced on both sides of the separator which affects the quality of battery cell. Hi-pot test implement can inspect the distance between positive & negative electrodes. Beyond general hipot inspection, Chroma 19055-C can detect the corona discharge within a miniature distance. This function helps to improve the battery cell reliability and quality which cannot be detected by most IR meters.



Battery Cell

Electrical safety test is the most important for battery cell. If battery cells are connected with a module with inadequate insulation, the battery cell or module might be damaged due to the insulation casing failure. Chroma's 19055-C hipot can support high voltage testing to ensure the quality and safety of battery cell products prior to module level testing.

Battery Pack

Electrical safety test is the most important for battery packing error of cell, or insulation clearances not enough leads to insulation failure. (Related standard IEC 62133)

Automatic Test System

Model 8000

BMS Board Function Test

- ☑ Battery cells voltage unbalance test/OVP test/UVP test/OCP test/Output resister test/ BMS data compare/BMS accuracy test/Others

Pre-test and Final Test (End of Line Test)

- ☑ Charge and discharge test/OCP test/DCIR test/ACIR test/Output resister test/Short test/Others

Battery Module Maintenance and Certification Test

- ☑ Regulate battery cells voltage to balance/ DCIR test
- ☑ Create unbalance condition for certification test

DC Electronic Load

Model 63200 Series

- ☑ 2.6kW~15.6kW/ 0~80V/ 0~1000V/ 0~1000A
- ☑ Master/Slave parallel operation up to a max of 5 units

DC Power Supply

Model 62000H/62000P Series

- ☑ 600W~15kW/ 0~1000V/ 0~375A
- ☑ High power density (15kW in 3U)
- ☑ Master/Slave parallel operation up to a max of 5 units

Application

- ☑ Battery Module & Pack Charge/Discharge Test : Chroma provides Battery Charge/Discharge Test Software to perform battery pack simulation testing
- ☑ DC source & DC Load for Safety Test: Users can use the Chroma's box equipment to test the safety test of Battery such as OVP, UVP, OCP, Short test and force discharge

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