



**LEAD THE INDUSTRY USING
ARBIN TECHNOLOGY.**

Testing Systems for Batteries, Supercapacitors, and Fuel Cells

Arbin Instruments



Batteries

Supercapacitors



Fuel Cells



Engineering

Technology

Worldwide Representation

Testing System for Energy Conversion Devices

- Battery
 - Primary Battery
 - Secondary Battery
- Fuel Cell
- Capacitor and Supercapacitor
- Flywheel
- Solar Cell

About Arbin



Arbin Instruments was established in 1991 as a manufacturer of multi-channel potentiostat/galvanostat for Battery, Supercapacitor, and Electrochemical research. In 1997, Arbin Instruments expanded its product line to include Fuel Cell Testing Systems. Today Arbin Instruments is a leading global supplier of testing instrumentation for the energy storage device and energy conversion device markets.

Arbin Instruments innovating leadership includes: first to apply potentiostat/galvanostat circuitry and functionality, first to apply multiple current ranges into a single channel, first to introduce high-speed pulse testing, and first to introduce an integrated humidifier for humidifying fuel cell gas streams.

Arbin Worldwide



Arbin has **sold** approximately **3,000** systems to over 50 countries worldwide.

Battery and Super Capacitor Testing Systems



Applications



- Aerospace
- Consumer Electronics
- Marine
- Medical

- Military
- Telecommunications
- Transportation
- Power Generation

Battery & Super Capacitor Testing



Single Cell: General electronics, toys, hearing aids

Small Batteries Pack: Cellular or cordless telephone, Portable electronics

Medium Batteries Pack: Laptops, Power tools, Electric scooters, Electric wheelchair

Large Batteries Pack: Hybrid Electric Vehicles, Mars Rovers and other space applications

- Completely Independent Channels
- Industry Leading Accuracy
- Potentiostat/Galvanostat Functionality
- Dynamic Data Acquisition
- Three current ranges for higher accuracy testing
- Channel Paralleling
- Systems up to 600V, 4000A
- High power up to 250kW

Types of Battery Testing Systems

Arbin offers BT2000, EVTS, MSTAT, and SCT products to support all different types of battery testing needs.

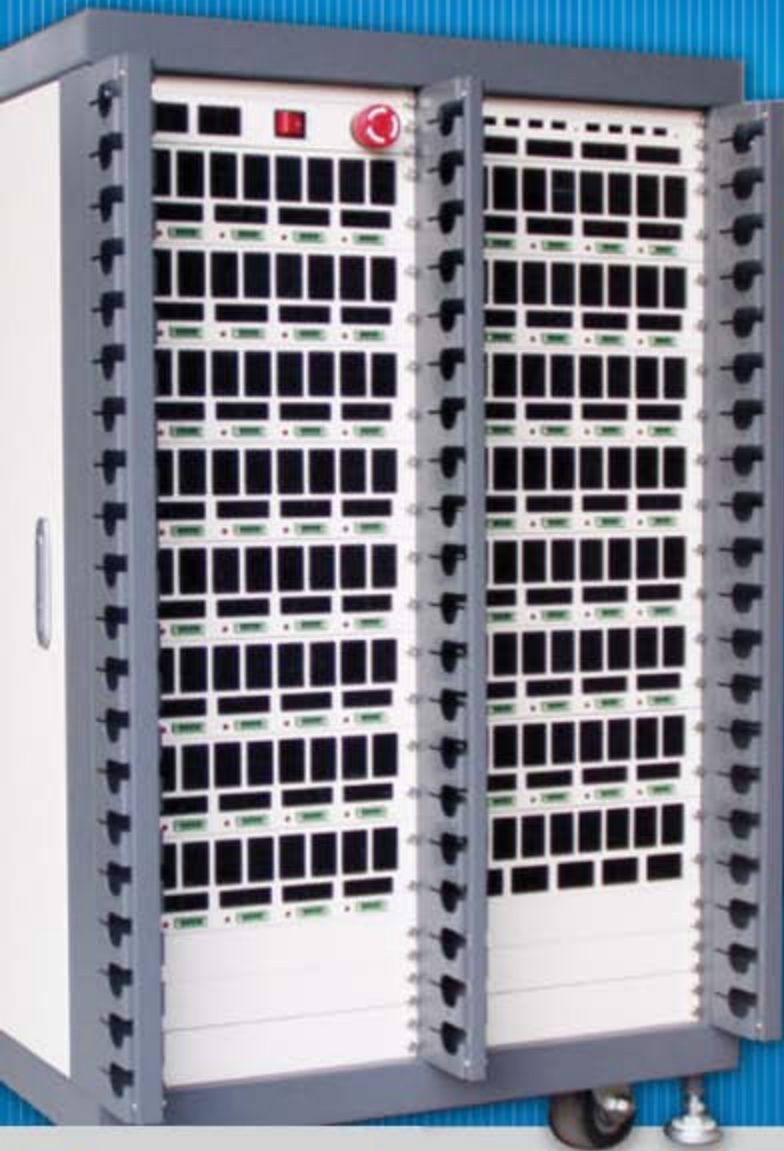
BT2000 A multiple independent-channel testing system designed for Research and Development and/or Production of batteries and other electrochemical energy-storage devices.

EVTS An automatic system for testing high power Electric Vehicle (EV) and Hybrid Electric Vehicle (HEV) batteries, packs, and modules.

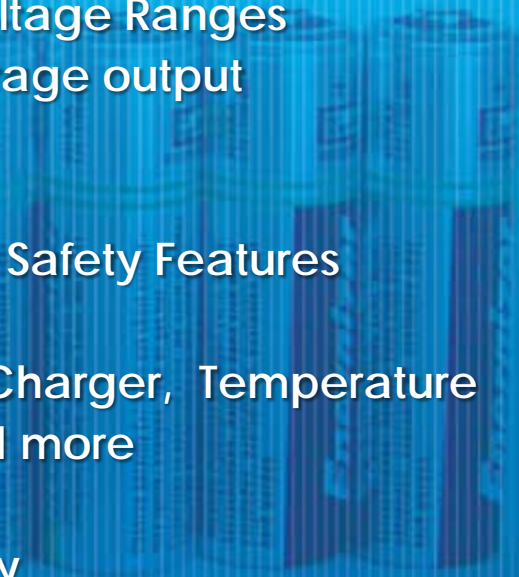
MSTAT A multiple independent-channel testing system designed for pure electrochemical research. Each channel is a true potentiostat and galvanostat which allows independent or combined experiments to run simultaneously.

SCTS Arbin Instruments' SCTS is designed for research and development of capacitors, supercapacitors, and ultracapacitors in a variety of applications.

Battery Testing Systems



- Charge/discharge or discharge cycling only
- Multiple Current and Voltage Ranges
- Bipolar Current and Voltage output
- PST/GST function
- Pulse feature
- Hardware and Software Safety Features
- Plug and Play Modules
- Smart Battery, External Charger, Temperature Chamber Interface, and more
- I/V channel paralleling
- Voltage clamp for safety
- High speed pulse with synchronized data acquisition
- Up to 2000A, 450V, 100kW



Supercapacitor Testing Systems

- Charge/Discharge Cycling
- DC-Equivalent Series Resistance
- DC-Equivalent Parallel Resistance
- Leakage Current Measurement
- Capacitance Testing
- Cyclic Voltammetry
- Fast Response/Rise Time and Low Noise
- Fast Data Collection



Main I/V Features

- **Programmable control** of current, voltage, load and power; providing constant, linear ramp, staircase and other control profiles, generated by a specified formula.
- **Independent control** for each channel.
- **High accuracy.** 0.02 to 0.1% FSR control and reading accuracy of current or voltage on linear circuitry and 0.5% FSR accuracy on PWM circuitry.
- **Multiple current ranges** on every channel provides high accuracy over a wide, dynamic range.
- **Fast current rise time** from 50ms to 2ms on linear circuitry; 10~100ms on PWM circuitry.
- **DC internal resistance.** Online measurement of cell's DC ohmic resistance.
- **Optional high and slow speed pulse with synchronized DAQ.** MITS Pro, can generate high speed (sub-millisecond) bipolar pulses as fast as 500us and synchronized data sampling on linear circuitry
- **Bipolar current/voltage output** guarantees cross zero linearity and accuracy. Enables instant cross zero transition with the speed defined by the rise time.
- **Voltage clamp** to protect from over- or under- charge/discharge.
- **I/V channel paralleling.** This option allows users to parallel several I/V channels to increase current output.

Optional Auxiliaries

- **Auxiliary voltage input:** Usually a floating $\pm 10V$ range with 10GOhm input impedance
- **Thermocouple input:** Type T, K, J, E
- **Thermistor input:** Provides activation signal for the thermistor.
- **Pressure input:** Provides activation signal to the pressure transducer.
- **pH meter:** A BNC connector is provided for input from the pH sensor.
- **External charge/load adapter:** This option is to test a battery under a specific charger/load or to test the charger/load. It connects the battery under test to an external charger or load.



- **Smart battery:** The BT2000 reads information from a smart battery and tests the smart battery accordingly.
- **Flow rate input** for reading data from the gas or liquid flow meter into data file.
- **Programmable digital input/output control.** Input control provides external TTL or relay signal to control the testing while output control provides TTL or isolated relay output to trigger external devices such as valves or alarm.

Optional Utilities

- **AC impedance measurement** to achieve certain accuracy ($\pm 5\sim 6\%$ of value) of the cell's AC impedance.
- **Auto-calibration fixture and software** allow for automatic calibration of the main I/V channels and auxiliary inputs.
- **Uninterruptible power supply (UPS)** protects against computer shutdown in the event of power failure. Arbin recommends a UPS for the system's protection.
- **Multiple temperature chambers** can be added to the system to provide environmental control around tested cell/battery.
- **Temperature chamber or device controller** to control Arbin temperature chamber or other brands of temperature chamber.
- **Mass flow or metering pump controller** to deliver required flow rate set in the testing schedule and record flow rate data in a data file.
- **Combustible or toxic gas detector and alarm.**

Electric Vehicle Testing Systems



- EV/HEV Battery/Module Pack Testing
- High Power Capability
- USABC Standard Tests (FUDS, DST, Partial Charge, SHC, etc.)
- Programmable Automatic Control
- Comprehensive Safety Features
- Advanced Testing Software

Arbin's Fuel Cell Testing Systems

First debuted in 1997, Arbin noticed a growing need for quality fuel cell testing capabilities in the market

Testing Systems

- Batteries
- Supercapacitors
- Fuel Cells**

Combines several proprietary technologies to provide a completely automated solution for fuel cell research in a compact foot print.

We now offer a logical range of FCTS adaptations for each power levels, ranging from 10W – 100kW for **PEM, DM and SOFC** fuel cells.

Fuel Cell Testing Applications

Small Power

- General electronics
- Toys
- Hearing aids
- Cellular/cordless telephone
- Portable electronics

Medium Power

- Laptops
- Power tools
- Electric scooters
- Electric wheelchair

Large Power Mobile

- Hybrid Electric Vehicles
- Fork Lift
- Recreational Vehicles
- Mars Rovers
- Other space applications

Large Power Stationary

- Power generator for home usage
- Back up power for telecommunication /emergency

Fuel Cell Testing Systems



High power electronic Load (patented)

- High power density and efficient cooling
- Programmable control of current, voltage, load and power
- Dual voltage ranges and multiple current ranges for accurate readings
- Up to 240kW

Humidifiers (patent pending)

- Control the gas humidity precisely and reliably
- Controllable temperature up to 150oC
- Operation pressure up to 100psi
- Flow rate up to 6000 standard liter per minute



Fuel Cell Testing Systems



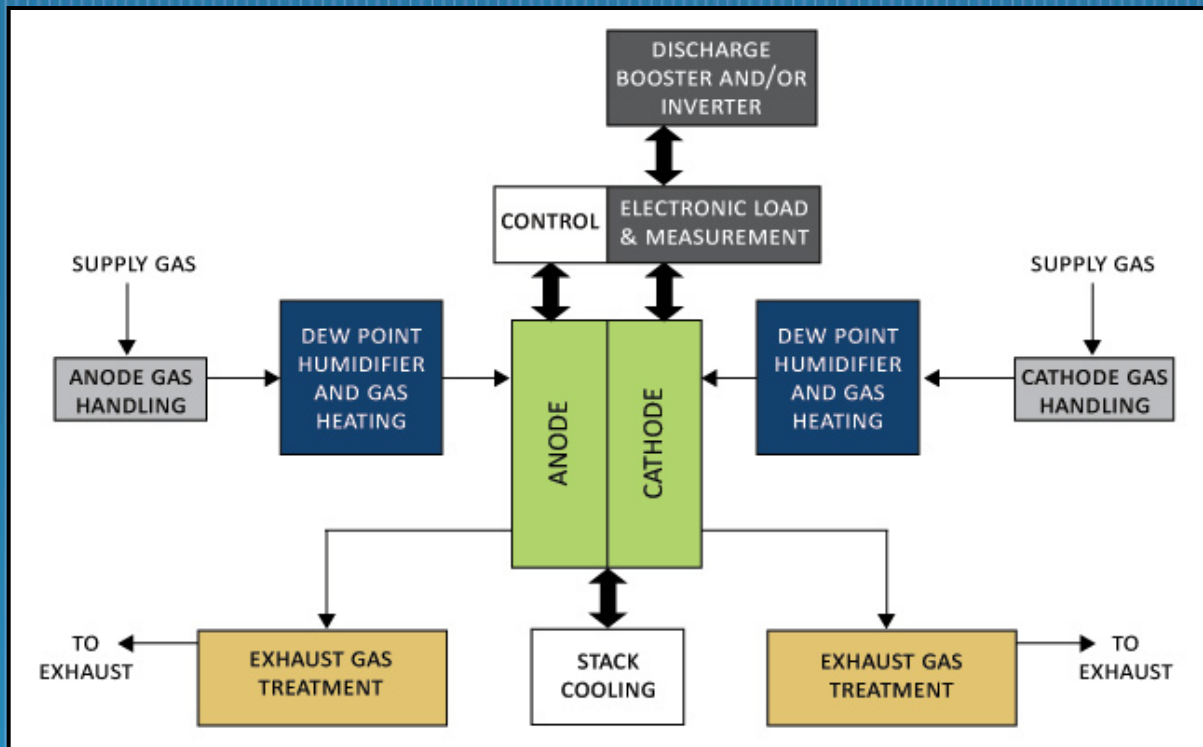
Gas/Liquid Handling & Flow Rate Control Units

- Multiple fuel/oxidant inlets
- Automatic/dynamic control of flow rate
- Fuel cell pressure monitor and control
- Optional gas mixing and heating/cooling units

Other Important Features

- Complete material handling and thermal management
- Advanced testing software and data acquisition
- Comprehensive safety features

Fuel Cell Testing Systems



- Input Gas Handling
- Liquid Reactant Handling
- Dew Point Humidifier
- Exhaust Gas Treatment
- Stack Cooling/Heating
- Electronic Load
- Software, Control and DAQ

Arbin's FCTS incorporates a two level safety system

Module level & Overall system level

The two levels work together to make FCTS extremely safe to operate both to the user and to the system

Types of Fuel Cell Testing Systems



Proton Exchange Membrane

Arbin's FCTS "H Series" of systems is designed specifically for the testing of proton exchange membrane (PEM) or solid polymer fuel cells.

Methanol/Liquid

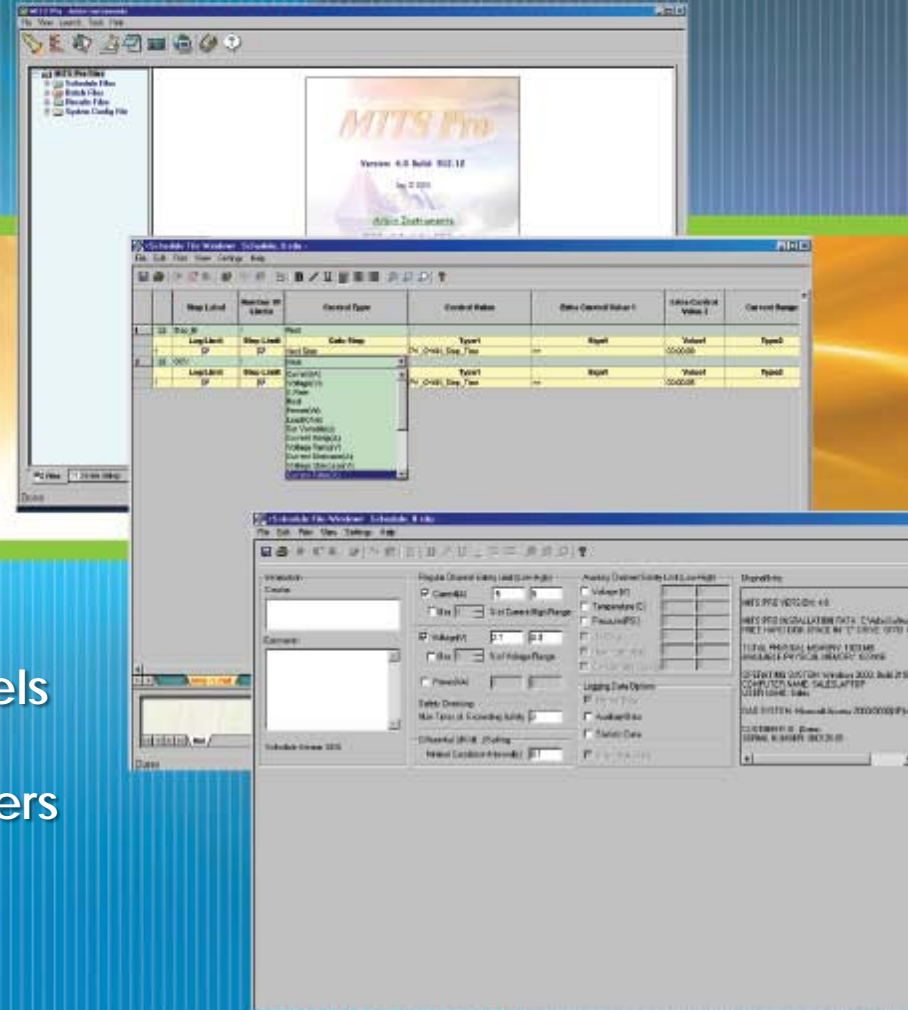
Arbin's "L-Series" FCTS are designed specifically for the testing of direct methanol (DM) and other liquid fuel cells.

Combination PEM/Liquid

Arbin's FCTS HL Series systems are designed specifically for testing both proton exchange membrane (PEM) and Direct Methanol (DM) or liquid fuel cells.

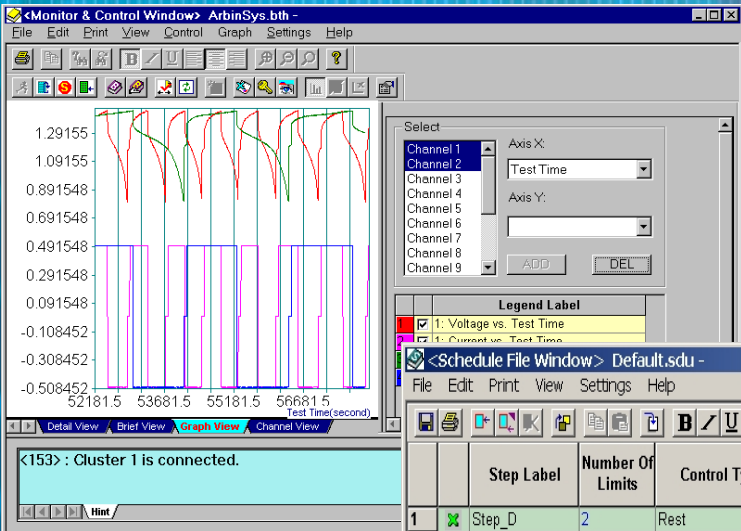
MITS Pro Software

- Flexible scheduling
- Independent testing on multiple channels
- Boolean controls of test parameters
- On-the-fly modification of test parameters in real time
- Interface with third-party devices
- User-friendly interface
- Complete data management utility

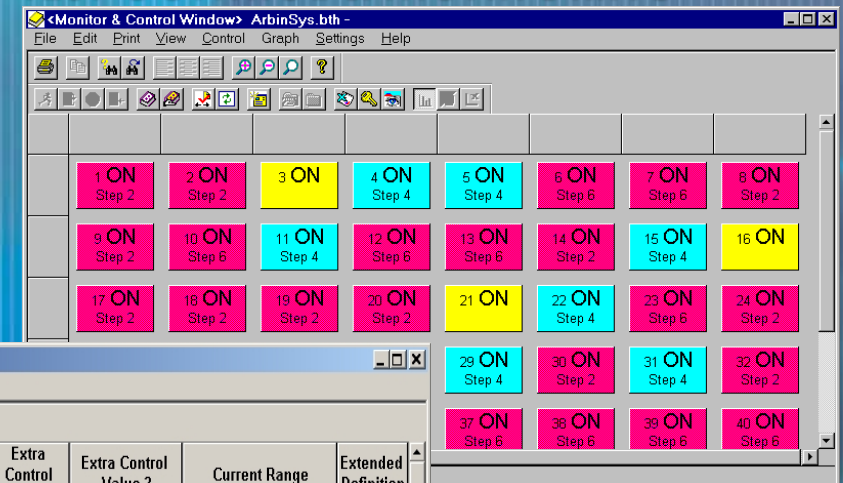


MITs Pro Software - Examples

TEST RESULTS & DATA PRESENTATION



TEST CONTROL & MONITORING



| | Step Label | Number Of Limits | Control Type | Control Value | Extra Control Value 1 | Extra Control Value 2 | Current Range | Extended Definition |
|---|-------------------------------------|-------------------------------------|--------------|-------------------|-----------------------|-----------------------|---------------|---------------------|
| 1 | ✘ Step_D | 2 | Rest | | | | | |
| | Log Limit | Step Limit | Goto Step | Type1 | Sign1 | Value1 | Type2 | Sign2 |
| 1 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | Next Step | PV_CHAN_Step_Time | >= | 00:00:10 | | |
| 2 | <input checked="" type="checkbox"/> | <input type="checkbox"/> | | DV_Time | >= | 00:00:01 | | |
| 2 | ✘ Step_B | 2 | Current(A) | 1 | | | High | |
| | Log Limit | Step Limit | Goto Step | Type1 | Sign1 | Value1 | Type2 | Sign2 |
| 1 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | Next Step | PV_CHAN_Step_Time | >= | 00:00:30 | | |
| 2 | <input checked="" type="checkbox"/> | <input type="checkbox"/> | | DV_Time | >= | 00:00:10 | | |
| 3 | ✘ Step_C | 2 | Current(A) | -1 | | | High | |
| | Log Limit | Step Limit | Goto Step | Type1 | Sign1 | Value1 | Type2 | Sign2 |
| 1 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | Next Step | PV_CHAN_Step_Time | >= | 00:00:30 | | |
| 2 | <input checked="" type="checkbox"/> | <input type="checkbox"/> | | DV_Time | >= | 00:00:10 | | |

TEST CONFIGURATION & SCHEDULING

MITS Pro Software

Data Export & Handling

The screenshot displays the MITS Pro Software interface with several key components:

- Microsoft Excel - Book1:** Shows a menu with options like 'Import MITS Results Data...', 'Import ABT5.0 Results Data...', and 'Options...'. The 'Arbin Data' menu is open, showing 'Arbin Plot' and 'Arbin Toolbar'.
- Microsoft Excel - GSM-5A:** Displays a spreadsheet with columns for 'Data_Point', 'Test_Time(s)', 'Date_Time', 'Step_Time(s)', 'Step_Index', 'Cycle_Index', 'Current(A)', 'Voltage(V)', 'Charge_Capacity (Ah)', 'Discharge_Capacity (Ah)', 'Charge_Energy (Wh)', 'Discharge_Energy (Wh)', 'dV/dt (V/s)', 'Internal_Resistance (Ohm)', and 'AC_Impedance (Ohm)'. The data is organized into steps and cycles.
- Import Data Dialog:** Allows for importing data from a file. It includes fields for 'Import File Name' (C:\ArbinSoftware\MITS_PRO\Data\GSM-5A.res) and 'Output File Name' (C:\ArbinSoftware\DataPro\GSM-5A.xls). It also has options to 'Apply Filter to Normal Channel Data' (All, First, Cycle No., From Step, From Cycle, From Point) and 'Import Data Options' (Normal Channel Data, Auxiliary Channel Data, Statistics Channel Data, SmartBattery Data).
- Simple Plot Dialog:** Configures a 'Channel Plot'. It allows selecting axes (X: Data_Point, Test_Time(s), Date_Time, Step_Time(s); Y1: Data_Point, Test_Time(s), Date_Time, Step_Time(s), Step_Index, Cycle_Index, Current(A); Y2: Date_Time, Step_Time(s), Step_Index, Cycle_Index, Current(A), Voltage(V), Charge_Capacity(Ah)). It also lets users select channels and cycle indices, choose a plot style (ScatterLinesNoMarkers), and select a chart type (Default chart, Chart Per Channel, New chart, Add to the chart plotted last time).



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Para consultas sobre nuestros productos, por favor póngase en contacto con:

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