

Module & Battery Pack Testing Solutions

BT-ML

Powerful, linear-bipolar testing system with comprehensive safety features and a wide range of options designed specially for module and battery pack testing.

SERIES	VOLTAGE	CURRENT
BT-ML-25	2V to 25V	Up to 100A
BT-ML-40	2V to 40V	Up to 100A
BT-ML-60	2V to 60V	Up to 100A



The Arbin BT-ML series is a high precision testing solution designed for testing modules and small packs of batteries and/or supercapacitors. Today's applications like electric vehicles and military technologies demand high-reliability and safe testing environments, so the dependability, accuracy, and safety of these systems are core standards. A full range of optional customizations allow users to create a complete testing package that ideally suits their needs.

Key Features

- Designed for Battery Pack and Modules up to 60 Volts and 100 Amps
- Multiple Independent Potentiostat/Galvanostat Test Channels
- Real-Time Test Monitoring Including Arbin's Integrated Watchdog Circuitry
- Smart Communication Protocols (CAN-Bus / SMBus)
- Drive Cycle Simulation (USABC, FUDS, etc.)
- Temperature Chamber Integration
- Monitor Tests and Plot Data in Real-Time
- On-the-Fly Modifications Allows for Longer Uninterrupted Testing



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Product Description

- Independent hardware-based voltage clamp applied on each channel at user defined value. Voltage clamp may be utilized during a constant current (CC) to constant voltage (CV) transition, which is critically important with Lithium chemistries.
- Arbin is able to provide a Total Package Solution by integrating with 3rd party hardware such as temperature chambers, external chargers, and more. Our open collaboration allows Arbin to work with the 3rd party manufacturer of your choosing.
- Systems arrive pre-calibrated and ready to use. The included PC comes pre-loaded with our software so no installation is required. The color quick-start guide and online library of video tutorials make it easy for new and experienced users to start performing tests on *day one* upon receiving the equipment.
- Each channel features independent programmable control of current, voltage, load, and power with industry leading accuracy at 0.05% FSR and 16 bit resolution.
- Arbin's advanced software package, MITS Pro, provides flexible scheduling, user-friendly interface, distributed system control, and data acquisition.
- Simulate a complex dynamic testing profile directly from a data text file without needing to write a complicated program.

Training & Support

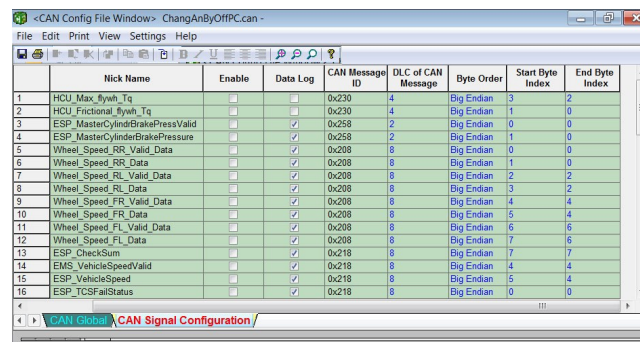
Arbin's knowledgeable customer service team is well-known throughout the industry for their responsiveness and dedication. Application engineers are always available by phone or email, and with equipment running in over 50 countries, Arbin has experienced support technicians nearby to help install equipment, answer questions, and provide any repairs that may be necessary over the life of your system. Additionally, our expansive library of video tutorials make it easy for novice users to learn or experienced users to refresh their knowledge at any time.



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Optional Features

- Arbin offers CAN-Bus Communication for our BT-ML systems that can be used to test battery packs with integrated Battery Management Systems (BMS). The Arbin CAN-Bus device supports reading, writing, and sending CAN messages, logging, monitoring, setting, controlling, and protecting the battery pack. For example, if over-voltage occurs the BMS protects the battery from operating outside of safe limits. The CAN-Bus communicates this valuable information to Arbin's MITS Pro software and the BT-ML tester before causing damage to the battery. CAN-Bus availability depends on system size and specifications.
- Arbin's SMBus option allows users to log data from their smart battery and compare it to the external data provided by the Arbin testing system. Testing procedures can be influenced by the data acquired by the Arbin testing system or by the SMBus register values. Arbin's MITS Pro software is capable of the manipulating SMBus registers during testing. All data specified in the SMBus 2.0 or 1.1 data specifications are stored in a database during testing and can be imported into Excel format for easy manipulation. Data acquisition is synchronized between the SMB board and main I/V test channel.
- The external charger/load input option is useful when qualifying chargers to be used with batteries or studying load profiles. The user connects the battery to the main I/V channel and the charger or load to the External Charge input provided and may program the battery to be charged/discharged by the external charger/load at a predetermined step in the schedule. The system internally and automatically connects the battery to the charger/load. During the External Charge/Load step, the Arbin system collects data about the charger/load performance. The system then disconnects the charger/load once the preset limit conditions are met.



	Nick Name	Enable	Data Log	CAN Message ID	DLC of CAN Message	Byte Order	Start Byte Index	End Byte Index
1	HCU_Max_Flywh_Tq	<input type="checkbox"/>	<input type="checkbox"/>	0x230	4	Big Endian	3	2
2	HCU_Frictional_Flywh_Tq	<input type="checkbox"/>	<input type="checkbox"/>	0x230	4	Big Endian	1	0
3	ESP_MasterCylinderBrakePressureValid	<input type="checkbox"/>	<input checked="" type="checkbox"/>	0x258	2	Big Endian	0	0
4	ESP_MasterCylinderBrakePressure	<input type="checkbox"/>	<input checked="" type="checkbox"/>	0x258	2	Big Endian	1	0
5	Wheel_Speed_RR_Valid_Data	<input type="checkbox"/>	<input checked="" type="checkbox"/>	0x208	8	Big Endian	0	0
6	Wheel_Speed_RR_Data	<input type="checkbox"/>	<input checked="" type="checkbox"/>	0x208	8	Big Endian	1	0
7	Wheel_Speed_RL_Valid_Data	<input type="checkbox"/>	<input checked="" type="checkbox"/>	0x208	8	Big Endian	2	2
8	Wheel_Speed_RL_Data	<input type="checkbox"/>	<input checked="" type="checkbox"/>	0x208	8	Big Endian	3	2
9	Wheel_Speed_FR_Valid_Data	<input type="checkbox"/>	<input checked="" type="checkbox"/>	0x208	8	Big Endian	4	4
10	Wheel_Speed_FR_Data	<input type="checkbox"/>	<input checked="" type="checkbox"/>	0x208	8	Big Endian	5	4
11	Wheel_Speed_FL_Valid_Data	<input type="checkbox"/>	<input checked="" type="checkbox"/>	0x208	8	Big Endian	6	6
12	Wheel_Speed_FL_Data	<input type="checkbox"/>	<input checked="" type="checkbox"/>	0x208	8	Big Endian	7	6
13	ESP_CheckSum	<input type="checkbox"/>	<input checked="" type="checkbox"/>	0x218	8	Big Endian	7	7
14	EMS_VehicleSpeedValid	<input type="checkbox"/>	<input checked="" type="checkbox"/>	0x218	8	Big Endian	4	4
15	ESP_VehicleSpeed	<input type="checkbox"/>	<input checked="" type="checkbox"/>	0x218	8	Big Endian	5	4
16	ESP_TCSFailStatus	<input type="checkbox"/>	<input checked="" type="checkbox"/>	0x218	8	Big Endian	0	0

MITS Pro allows users to create custom CAN definitions, monitor CAN data in real-time, and export data for analysis through Arbin's Data Watcher software



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Optional Features (*continued*)



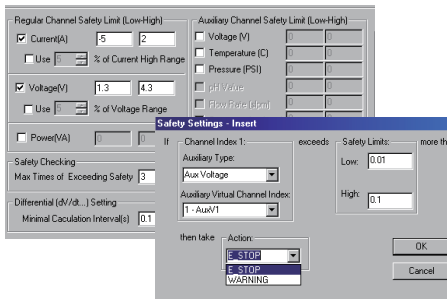
- Digital input/output relay option is commonly used for triggering external conditions such as turning on or off an external charger or providing a trigger for a chamber door or other third party hardware. Available in TTL and Relay.
- Analog input/output module option is designed to measure and control third party devices that use a 0-10V control signal. The Analog I/O board offers control with closed loop (PID) or open loop communication depending on the application.
- Optional auxiliary voltage measurement channels are available to measure cell voltage in a multi-cell battery pack or to measure the reference electrode voltage in a multi-electrode setup. The value of voltage can be recorded in the results file or used to further control the experiment.
- Optional auxiliary temperature measurement channels can measure the temperature at any point in the setup using either a thermocouple module (type E, J, K, or T) or a thermistor module. The value of temperature can be recorded in the results file and/or used to further control the experiment.
- Arbin's temperature chamber interface option (MTCI) allows the system to communicate with a third-party temperature chamber controller during testing. The MTCI module tells the chamber controller what temperature set-point to use during each test step, allowing the user to program automatic temperature profiles in their tests.
- Arbin's Remote Monitoring software can be used to access and view test stations connected to the network. The Remote Desktop connection allows users to connect to all systems in the laboratory and one-by-one view the real time running tests.

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Safety Features

All Arbin test stations are designed and manufactured based on industry regulations and arrive CE certified. The Arbin system includes an array of safety features that protect the user, the devices under test, and the test station.

- The system itself is secure internally to protect from unintentional misuse. The system is equipped with an emergency stop button and multiple levels of fusing are provided inside the system for protections at the channel/board and power supply level. Arbin's Watchdog circuit monitors the machine's internal communication between the PC and onboard microcontrollers and will stop all tests if there is a failure that poses a risk. A light tower array is used to visually alert the user to potential problems and the PC can be programmed to sound an audible alarm.



- The user is able to implement safety limits in the software for current, voltage, total power, as well as temperature or other auxiliary readings. These values can be programmed to send the system into a rest state for a period of time, or simply stop the test and disconnect the charge/discharge circuitry. There are separate limits available for each test schedule as a whole, and individual steps within the test schedule.

- A Redundant Safety System can be provided to independently monitor the devices under test, and can disconnect the device if a safety setting has been exceeded. Safety is the highest priority when testing high power devices, and Arbin's Redundant Safety System provides an additional safety system, independent of the Arbin hardware and software, to ensure a safe testing environment. The system has the ability to monitor current, voltage, and temperature. If any user-defined safety settings are reached, the device under test will be disconnected from the Arbin test channel. A hardware interlock can also be provided with this system to completely power off the Arbin test station.
- The reliability of testing can be increased even further by adding a smart UPS to the controlling PC. This will allow tests to automatically resume after a brief power failure if they are in a safe condition and permits user intervention in the process. There is provision for the user to intervene if desired before the channels resume. This is an essential component for any user with an unreliable power source unless the entire facility is on backup power.



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Hardware Specifications

MODEL NUMBER	25V - 10A	25V - 50A	25V - 100A
Voltage Range (max/min)	2V to 25V		
Voltage Accuracy (0.05% FSR)	$\pm 25\text{mV}$		
Voltage and Current Resolution	16 bit		
Current Ranges Provided	High: 10A \pm 10mA	High: 50A \pm 50mA	High: 100A \pm 100mA
0.05% Full Scale Accuracy	Medium: 1A \pm 1mA	Medium: 5A \pm 5mA	Medium: 10A \pm 10mA
	Low: 100mA \pm 100 μ A	Low: 500mA \pm 0.5mA	Low: 1A \pm 1mA
Minimum V at Maximum Current	2V @ 10A	2V @ 50A	2V @ 100A
Voltage Input Impedance	$\sim 10\text{G}\Omega$		
Current Rise Time	$\sim 100\mu\text{S}$	$\sim 200\mu\text{S}$	$\sim 500\mu\text{S}$
Voltage Clamp	Individual / Channel Based Voltage Clamp		
Max Continuous Power per Channel	250W	1250W	2500W
Internal Board Circuitry	Arbin 2243-2	Arbin SCT200	Arbin SCT200
Ventilation Method	Air cooled		
Room Operating Temperature	10 to 35 degrees C		
Connection to Computer	TCP/IP		
Computer Specifications	PC with 22" flat-screen monitor is included, preloaded with our MITS Pro testing software		

CHASSIS SIZE OPTIONS	Number of Channels		
30" X 30" X 45"	12	4	2
30" X 40" X 77"	30	8	5

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Hardware Specifications

MODEL NUMBER	40V - 20A	40V - 50A	40V - 100A
Voltage Range (max/min)	2V to 40V		
Voltage Accuracy (0.05% FSR)	±40mV		
Voltage and Current Resolution	16 bit		
Current Ranges Provided	High: 20A ± 20mA	High: 50A ± 50mA	High: 100A ± 100mA
0.05% Full Scale Accuracy	Medium: 5A ± 5mA	Medium: 5A ± 5mA	Medium: 10A ± 10mA
	Low: 500mA ± 0.5mA	Low: 500mA ± 0.5mA	Low: 1A ± 1mA
Minimum V at Maximum Current	2V @ 20A	2V @ 50A	2V @ 100A
Voltage Input Impedance	~10GΩ		
Current Rise Time	~100μS	~200μS	~500μS
Voltage Clamp	Individual / Channel Based Voltage Clamp		
Max Continuous Power per Channel	800W	2000W	4000W
Internal Board Circuitry	Arbin HVL	Arbin HVL	Arbin HVL
Ventilation Method	Air cooled		
Room Operating Temperature	10 to 35 degrees C		
Connection to Computer	TCP/IP		
Computer Specifications	PC with 22" flat-screen monitor is included, preloaded with our MITS Pro testing software		

CHASSIS SIZE OPTIONS	Number of Channels		
30" x 30" x 45"	4	n/a	n/a
30" X 30" X 65"	8	4	2
30" X 30" X 77"	12	8	4
30" X 40" X 77"	16	12	6

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Hardware Specifications

MODEL NUMBER	60V - 20A	60V - 50A	60V - 100A
Voltage Range (max/min)	2V to 60V		
Voltage Accuracy (0.05% FSR)	$\pm 60\text{mV}$		
Voltage and Current Resolution	16 bit		
Current Ranges Provided	High: 20A \pm 20mA	High: 50A \pm 50mA	High: 100A \pm 100mA
0.05% Full Scale Accuracy	Medium: 5A \pm 5mA	Medium: 10A \pm 10mA	Medium: 50A \pm 50mA
	Low: 500mA \pm 0.5mA	Low: 1A \pm 1mA	Low: 5A \pm 5mA
Minimum V at Maximum Current	2V @ 20A	2V @ 50A	2V @ 100A
Voltage Input Impedance	$\sim 10\text{G}\Omega$		
Current Rise Time	$\sim 1\text{ mS}$	$\sim 3\text{ mS}$	$\sim 3\text{ mS}$
Voltage Clamp	Individual / Channel Based Voltage Clamp		
Max Continuous Power per Channel	1200 W	3000 W	6000 W
Internal Board Circuitry	Arbin HVL	Arbin HVL	Arbin HVL
Ventilation Method	Air cooled		
Room Operating Temperature	10 to 35 degrees C		
Connection to Computer	TCP/IP		
Computer Specifications	PC with 22" flat-screen monitor is included, preloaded with our MITS Pro testing software		

CHASSIS SIZE OPTIONS	Number of Channels		
30" X 30" X 65"	6	n/a	n/a
30" x 30" x 77"	10	6	2
40" X 40" X 77"	16	8	5

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Software Control Specifications

Current (A)	Outputs constant current to the cell or battery at the value specified Positive current refers to charge and negative current refers to discharge
Voltage (V)	Outputs constant voltage to the cell or battery at the value specified
C-Rate	C-Rate is a method for indicating the discharge as well as the charge current of a battery. It can be expressed as $I = M * C$ where I = current A; C = battery capacity; M is the C-rate value.
Rest	The battery is disconnected from the charge/discharge circuit but remains connected to the voltage measurement circuit to enable open-circuit voltage measurement
Power (W)	Outputs constant power to the cell of battery at the value specified.
Load (Ohm)	Applies a constant resistance load to the battery at the value specified. The load control type will always produce a negative current.
Set Variable (s)	Change test related variables including channel capacity, energy and all test counter variables.
Current/Voltage Ramp	Generates a current/voltage ramp with a positive scan rate for increasing current/voltage, and negative scan rate generates decreasing current/voltage ramp.
Current/Voltage Staircase	Generates a current/voltage staircase with increasing current/voltage, and negative decreasing current/voltage staircase with adjustable step amplitude.
Voltage Cycle V	This mode, commonly called Cyclic Voltammetry, permits the user to create linear sweeps in one step, eliminating the need to jump steps to reverse sweep directions
Current and Power Simulation	Non-standard time-domain functions may be inputted from external sources such as ASCII data streams and used as control parameters for repetitive tests
DC Internal Resistance	This function applies a 10-pulse train with 1ms pulse width of the specified magnitude following a constant-current charge or discharge step
CCCV	Allows users to implement a constant current-constant voltage charge regime in one step. Users specify the charge rate (CC) and the voltage limit (CV); with a specified current or time limit termination value.
Formula	Equips the user to control and limit schedule steps according to dynamic mathematical equations in addition to constants or instantaneous channel data
End Conditions	Time, Voltage, Current, Capacity, Energy, ΔV , DV/dt , formula, meta-variables, and other combinations
Data Logging Rate	During a standard step: 40-150 data points per second, per PC
Network Capabilities	Provide TCP/IP access for networking
Data Result File	Imported into Microsoft Excel; Arbin's Excel Data Pro macro included for easy data manipulation
Data File Content	Channel data; test time, step time, voltage, current, capacity, energy, first/second derivative of I or V , auxiliary input data (optional). Statistical data: cycle #, cycle capacity/energy, max voltage, etc.

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