ARBIN INSTRUMENTS

RBT

Regenerative Battery Testing Systems For Module & Pack Applications

Max Voltage: 1500V

Max Power: scalable up to 1MW

Regenerative Circuitry with >90% Efficiency

Key Features

- Regenerate battery discharge energy to facility grid providing industry-leading energy savings, low heat output, and environmental protection.
- Industry-leading:
  - ✓ 0.05% FS Control Accuracy.
  - ✓ 500ppm Measurement Precision.
  - ✓ 16-bit Measurement Resolution.
  - ✓ >90% Regenerative Efficiency.
  - ✓ <3% THD.
- Parallelable channels.
- Power Ranges up to 300kW/Ch.
- Voltage Ranges from 60V ~ 1000V+.
- Current Range: up to 2000A.
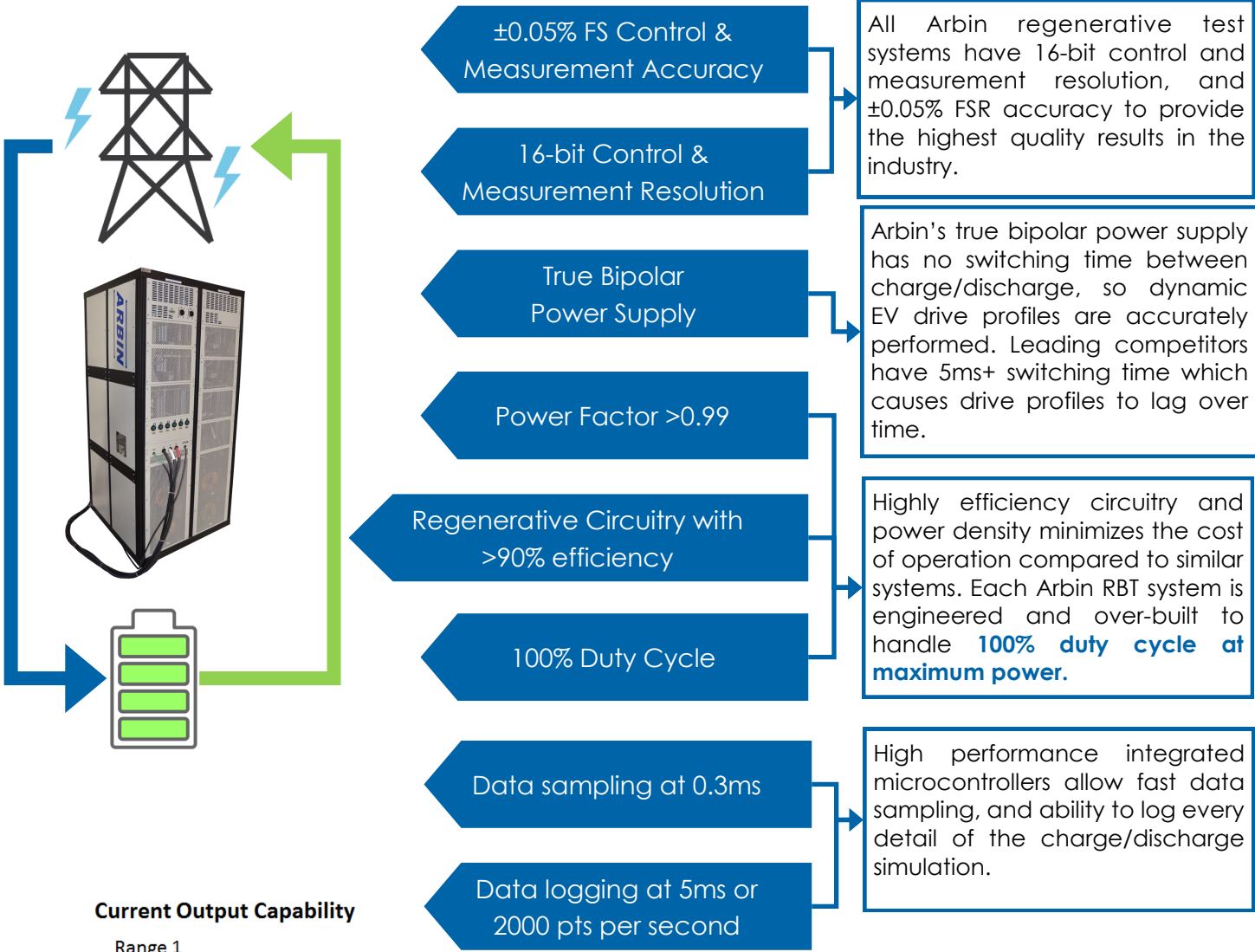- Drive Cycle Simulation using Current or Power profiles.

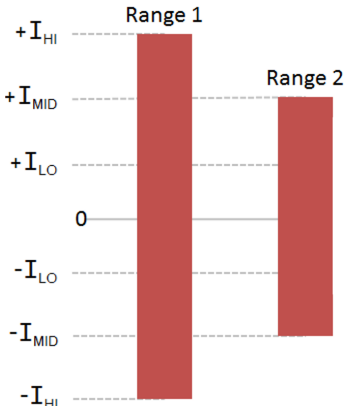|		
Regenerative	**2000 pts/s** Data Logging	**SQL** Results Database
Custom Simulation	Fully Parallelable	**CANBus** Comm. Protocols
User-Friendly Software	Redundant Safety	Real-Time Monitoring

"We did side-by-side comparisons of Arbin and other tester technology. Armed with this data, we moved forward with confidence using Arbin for what is critical to our electrification future [EV]."

— T. Miller, Ford Motors

Primary Applications

- Electric Vehicle Drive Simulations
- Custom Life Cycle Testing
- FUDS, HPPC, DST, WLTP, and more.
- CANBus BMS Validation
- Cranking Amp Tests

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RBT Hardware Performance

±0.05% FS Control & Measurement Accuracy

16-bit Control & Measurement Resolution

All Arbin regenerative test systems have 16-bit control and measurement resolution, and ±0.05% FSR accuracy to provide the highest quality results in the industry.

True Bipolar Power Supply

Power Factor >0.99

Arbin's true bipolar power supply has no switching time between charge/discharge, so dynamic EV drive profiles are accurately performed. Leading competitors have 5ms+ switching time which causes drive profiles to lag over time.

Regenerative Circuitry with >90% efficiency

100% Duty Cycle

Highly efficiency circuitry and power density minimizes the cost of operation compared to similar systems. Each Arbin RBT system is engineered and over-built to handle **100% duty cycle at maximum power.**

Data sampling at 0.3ms

Data logging at 5ms or 2000 pts per second

High performance integrated microcontrollers allow fast data sampling, and ability to log every detail of the charge/discharge simulation.

Current Output Capability

Range 1

Range 2

$+I_{HI}$
$+I_{MID}$
$+I_{LO}$
0
$-I_{LO}$
$-I_{MID}$
$-I_{HI}$

Each RBT system comes standard with **multiple current ranges**, and each current range can be tailored to fit your application.

Current rise time is also excellent, specified at 10ms or less (depending on your system's current specification).
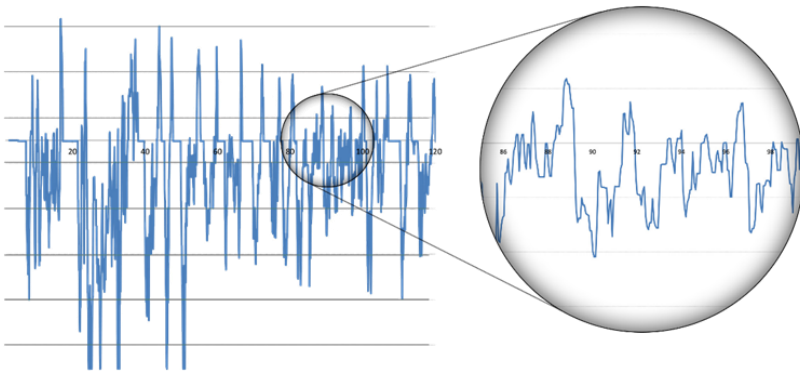
All channels are fully independent, but can also be combined to operate in **parallel for increased current-handling** capacity.

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Simulation

FUDS Power Simulation

Advanced high-speed **simulation** capabilities:

Upload pre-defined data or control simulation dynamically via CAN.

- ✓ Profile Types:
  - Time vs. Current
  - Time vs. Power
  - Time vs. Load
- ✓ Up to 1 million data points.
- ✓ True Bipolar Circuitry so no switching between charge and discharge
- ✓ Data Acquisition Rage: up to 5ms.

Compared to traditional battery cycling that may use exclusively constant current and constant voltage (CC-CV) charge/discharge profiles, EV testing applications require charge/discharge based on various real-world applications. These charge/discharge profiles are highly dynamic and require much greater current demands relative to "traditional" testing.

The US Council for Automotive Research, Environmental Protection Agency, and local state governments have all developed and published testing standards for bench-marking batteries and electric vehicle performance.

Federal Urban Drive Schedule (FUDS)

Hybrid Pulse Power Characterization (HPPC)

Dynamic Stress Test (DST)

Peak Power Test

US06, FTP EPA75, HWFET, NYCC, LA92

...and many more.
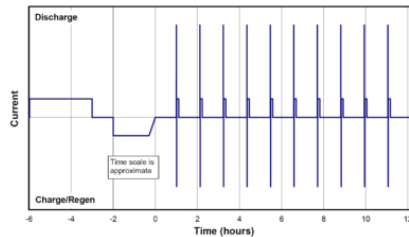
HPPC Profile
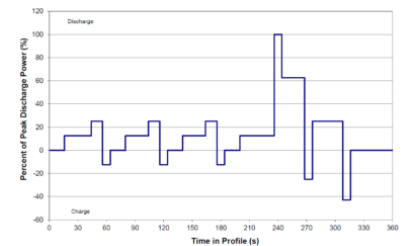
DST Profile

The UN Economic Commission has developed the Worldwide Harmonized Light Vehicles Test Procedures (WLTP) standards for electric vehicle battery testing that is now followed by Europe and most Asian counties (India, Japan, Malaysia, S.Korea, Thailand, Vietnam, etc.)

WLTP is divided into three classes of vehicle based on the ratio of power to mass after reducing by 75kg, and is divided based on vehicle maximum velocity.

Class 1 vehicles have a power to mass ratio (-75kg) ≤ 22 W/kg. [Low, Medium]

Class 2 vehicles have a power to mass ratio (-75kg) 22 ≤ 34 W/kg. [Low, Med, High, XHigh]

Class 3 vehicles have a power to mass ratio (-75kg) > 34 W/kg. [Low, Med, High, XHigh]

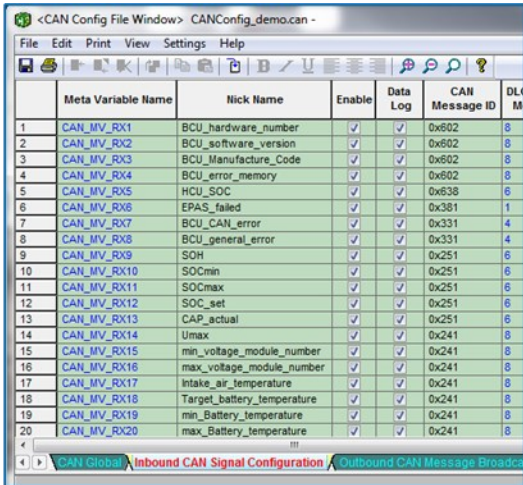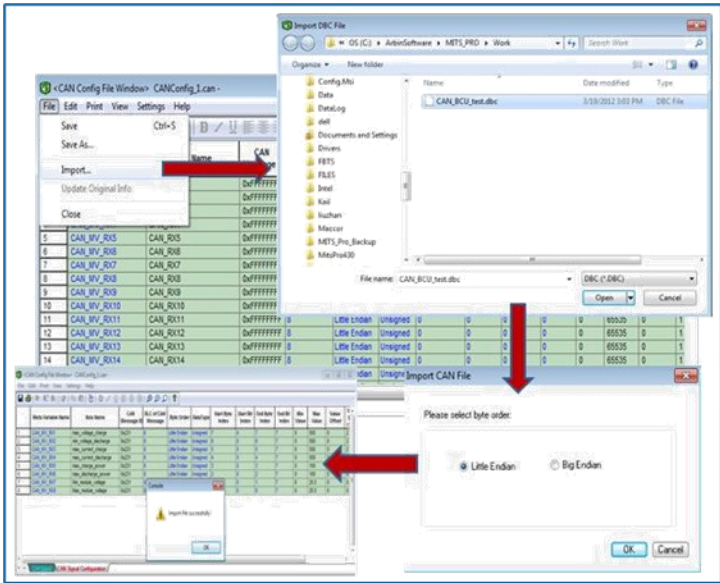**Contact Us: +1 (979) 690 2751 / sales@arbin.com**

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CANBus Communication
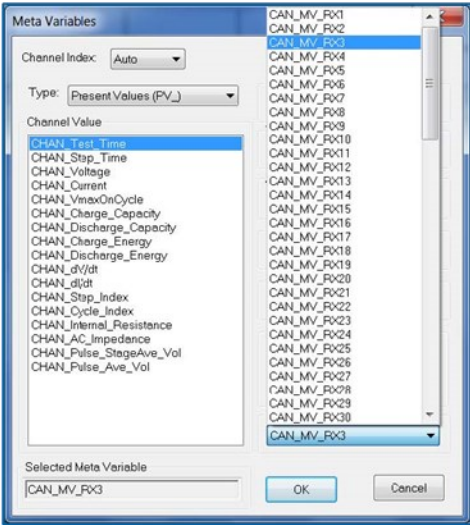
Advanced **CANBus** features:

Arbin's RBT is the **only** tester which allows dynamic control of the charge/discharge via CAN protocol which enable the BMS to control the Arbin tester.

- ✓ Allow BMS to fully control RBT charge/discharge.
- ✓ Easily import CAN database and customize.
- ✓ Read/write integration with battery management system.
- ✓ Offers easy-to-navigate drop-down menu selections.
- ✓ Create customized CAN report to compare BMS data.
- ✓ No 3rd party equipment, DLL package, or license is needed.
- ✓ Extended or Standard Frame Type.

RBT

Powerful and Safe

Arbin offers complete regenerative testing solutions for high power battery modules & packs. Each Arbin system is designed with core focuses on safety and reliability.
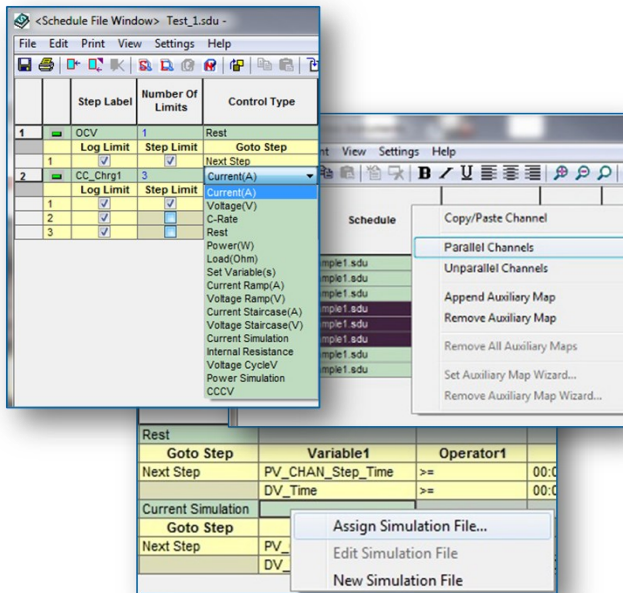
Arbin's **powerful software package**, MITS, provides flexible scheduling, a user-friendly interface, and real-time test monitoring.   Our software provides easy data analysis and plotting tools based in Data Watcher and Microsoft Excel.

User-defined **software safety limits** 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.

Each system is equipped with an **emergency stop button** and **multiple levels of fusing** inside the system for protections at the channel/board and power supply level in order to protect from unintentional misuse.

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. An optional light tower array can be used to visually alert the user to potential problems and the PC can be programmed to sound an audible alarm.

Each RBT system is manufactured with an **uninterruptible power supply (UPS)** that can safely shut down the RBT system in the event of facility power failure. This is an essential feature for high power testing system that may be operated on an unreliable power source (unless the entire facility is on backup power).

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System Configuration Options

System Options	
Max Voltage per Channel	60V, 100V, 150V… up to 1500V per channel; increments of 50V
Max Current Options	±25A up to 2000A per channel; increments of 25A
Power Options	±3kW, 5kW, 10kW… up to 300kW per channel; increments of 10kW

Specification		Accuracy	Resolution
Control	Voltage	< ±0.05% FSR	16-bit, 0.0015% FSR
	Current	< ±0.05% FSR	
	Power	< ±0.1% FSR	
Measurement	Voltage	< ±0.05% FSR	16-bit, 0.0015% FSR
	Current	< ±0.05% FSR	
	Power	< ±0.1% FSR	
Time	Rise Time	~5ms (Time required for current output to get from 10-90% of setpoint value)	
	Minimum Step Time	50mS	
	Data Logging Rate	2000 points per second, per system up to 10mS	
	Measurement Precision	0.1mS	
Regenerative Power	Efficiency	~90%	
	THD	<5%	
	Power Factor	>99%	
	Current Ripple	0.1% FS	
Connection for PC		TCP/IP (Ethernet)	
Ventilation Method		Air cooled, *variable speed fans*	

Note:

*FSR: Full Scale Range.

*All systems have dual current ranges. The second current range is 0.5 * Max Current.
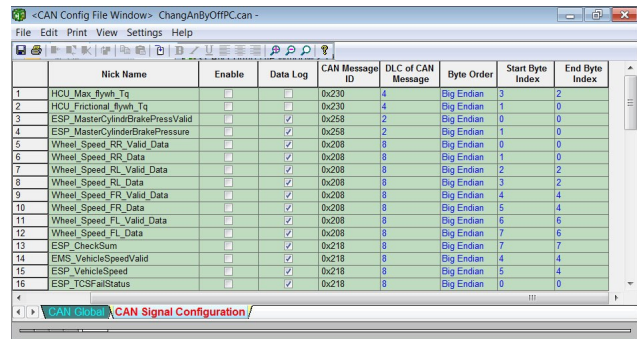
*Discharge voltage down to 0V, or negative, is optional.

*Additional voltage, current, and power options available upon request.

*Arbin RBT systems have the ability to continuously output 100% * (Max Voltage * Max Current) if specified.

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Available Auxiliary Options

■ **CAN-Bus Communication** for our RBT systems that can be used to test battery packs with integrated Battery Management Systems (BMS). MITS Pro can allow users to create custom CAN definitions, monitor CAN data in real-time, and export data for analysis through Arbin's Data Watcher software. 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 EVTS tester before causing damage to the battery. Arbin follows the standard CAN-Bus specification such as SAE J1939 protocol, CANopen or even user-defined protocols, With Arbin's CAN-Bus, there is no third party equipment, 3rd party DLL package or 3rd party licenses' needed to operate.

■ **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.

■ **Auxiliary voltage measurement** channels are available to measure cell voltage in a multi-cell battery pack. The value of voltage can be recorded in the results file or used to further control the experiment.

Above is an example of an auxiliary chassis, populated with temperature and voltage measurement auxiliaries.

■ **Temperature measurement** channels can measure the temperature at any point in the setup using either a thermocouple module (type T or K) or a thermistor module. The value of temperature can be recorded in the results file and/or used to further control the experiment.

■ **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.

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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.	**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.
Voltage† (V) Outputs constant voltage to the cell or battery at the value specified. Outputs constant voltage to the cell or battery at the value specified.	**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.
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.	**Formula†** Equips the user to control and limit schedule steps according to dynamic mathematical equations in addition to constants or instantaneous channel data.
Rest† The battery is disconnected from the charge/discharge circuit but remains connected to the voltage measurement circuit to enable open-circuit voltage measurement.	**End Conditions** Time, Voltage, Current, Capacity, Energy, ΔV, DV/dt, formula, meta-variables, and other combinations.
Power† (W) Outputs constant power to the cell of battery at the value specified. Outputs constant power to the cell of battery at the value specified.	**Current Staircase†/Voltage Staircase** Generates a current/voltage staircase with increasing current/voltage, and negative decreasing current/voltage staircase with adjustable step amplitude.
Load† (Ohm) Applies a constant resistance load to the battery at the value specified. The load control type will always produce a negative current.	**Safety Check** Includes control value check (Current, Voltage, Power), abnormal behavior check (Step Time, Capacity/Energy), and irregular impedance check.
Current Ramp†/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.	**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 number, cycle capacity/energy, max voltage, etc.
Set Variables† Change test related variables including channel capacity, energy and all test counter variables.	**Network Capabilities** Provide TCP/IP access for networking.
Channel Paralleling Channels may be operated in parallel for increased current-handling capabilities.	*Control types marked with (†) are available in parallel mode*

RBT

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Configuring Your System

Arbin Instruments can configure and engineer a RBT system for your applications demands. We may use existing standardized voltage and current ranges or build an entirely new combination — depending on your need. Multiple chassis sizes are available.

Dimensions
21.5" x 62.5" x 62"
37.5" x 62.5" x 73"
37.5" x 62.5" x 81"
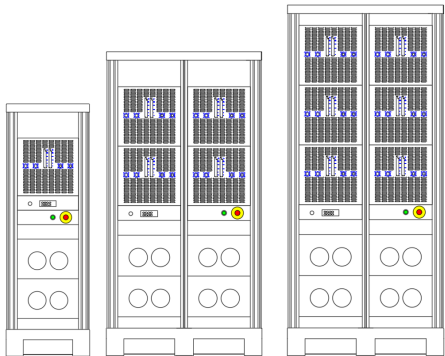
Training & Support

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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- Hong Kong
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- Vietnam

We stand by our products — offering the best warranty in the industry, a **2-year warranty** for every system.

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