Ultra-High Precision Battery Testing

HPS Series

Key Features

- 10ppm Precision with industry-leading 24-bit resolution across six current ranges per test channel
- Temperature controlled sampling circuit reduces measurement variation and noise
- Embedded MCU for real-time calculations of battery capacity, power, energy, IR, and efficiency metrics
- Optional integrated MZTC chamber providing a turn-key benchtop testing solution
- Built-in 2nd voltage input, PT100 input, CAN-Bus, and EIS dedicated per test channel

Beyond Precision

Developed in collaboration with industry leaders Ford Motors and Sandia National Lab, and supported by US DOE funding through DOE ARPA-E, Arbin's next-generation High Precision tester (HPS) is an ultra-high precision, low current battery tester. It is specifically designed to detect minute signatures of battery degradation trends early in the testing lifecycle, significantly reducing the battery development cycle.

The HPS enhances battery development for material researchers by utilizing temperature-controlled electronic components and a dedicated microcontroller unit (MCU) per test channel. This advanced system enables researchers to conduct high-precision coulombic efficiency tests on batteries or capacitors with precision reaching below 10 ppm.

Standard Configurations

Voltage Range	Current Range
-6 to 6V	5A/1A/100mA/10mA/1mA/100μA

System Information

System Characteristics			
Channels per Chassis		2	
Current Ranges per Channel		6 (auto switching)	
Channel Parallel		Up to 10 A	
Current Rise Time		<200 µs	
Built-In Auxiliary Inputs			
Temperature PT100		1 input/channel	
2nd Voltage		1 input/channel	
CAN Bus (CAN 2.0, CANFD)		1 /channel	
EIS		10 mHz to 1 kHz	
Control & Measurement Specifications			
Parameter		Voltage	Current
Measurement	Accuracy	±0.002% FSR	±0.004% FSR
	Precision	±0.001% FSR	±0.002% FSR
	Resolution	24 Bit	
Control	Accuracy	±0.005% FSR	
	Precision	±0.004% FSR	
	Resolution	24 Bit	
Time Resolution		100 µs	
Data Acquisition Rate		Up to 1 kHz	
MZTC Chamber Specifications			
Chamber Zone Qty		2 zones with 2 cell fixtures each	
Temperature Range		[Ambient-10℃] to 60℃	
Temperature Uniformity		±1.5℃	
Temperature Control Stability		±0.5℃	
Chassis Specifications			
Cooling		Air-cooled with built-in variable speed fans	
Input Power		110V1P – 240V1P	
Chassis Size		Width: 16" (407 mm) Depth: 27" (686 mm) Height: 5" (127 mm)	

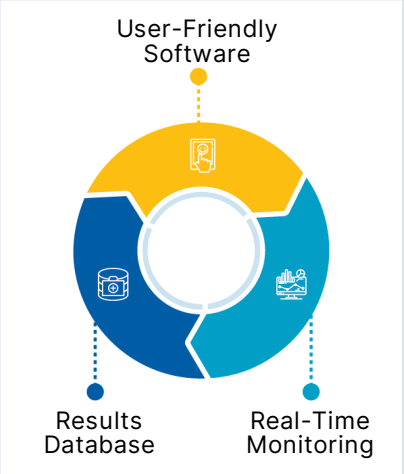
Application Focus

- dQ/dV & High Precision Coulombic Efficiency
- Cyclic & Linear Voltammetry
  PITT/GITT
  Symmetric-Cell Testing
- Dynamic data acquisition based on changes in time, voltage, and current to capture more data when it's needed and maintain efficient file sizes.
- Simulation of Real World Test Profiles
- Data Sampling and Logging: Powerful embedded controllers provide ultra-fast data sampling and logging.
- Comprehensive safety features for lithium-ion battery testing.
- Facility integration to interface with temperature chambers, test facilities, or other third party systems.

Powerful Software Integration

Arbin's HPS system, powered by our latest MITS software, optimizes the battery testing process by simplifying control of the testing process, and integrating the test station into a test facility.

- Create and manage test schedules, monitor real-time testing, and analyze results.
- Integration with third-party hardware and automation software.
- Suitable for both laboratory and production environments.
- Test data securely stored in a range of robust databased formats including MS SQL, PostgreSQL, or utilize Apache Kafka for additional flexibility.



Contact Us

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HPS

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High Precision Testing Systems

Why Does Precision Matter?

Measurement precision is more critical for long-term testing and long-term projections than control accuracy alone. Most other battery testing systems do not correctly specify their precision and/or have relatively poor precision, which hinder the conclusions drawn from results data. Important trends and electrochemical indicators may remain unnoticed; lost in the measurement noise.

Arbin offers ultra-high precision testing systems for meaningful battery research. The new SHPS system enables users to get comprehensive and precise battery data with high confidence under real-world conditions.

High Precision Benefits:

- Early detection of battery degradation trends
- Precisely measurement of battery's coulombic efficiency
- Fast measurement of battery self-discharge current
- Precisely grade battery's capacity
- Reveal slight difference among similar batteries for material research

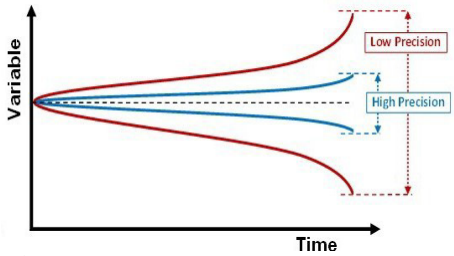

Diagram 1

Product Description

Arbin High Precision Testing System

Arbin offers +/-6V5A SHPS system, with integrated temperature chamber option available.

Figure 1: Configuration 1

Configuration 1: Desktop system without integrated temperature chamber

Configuration 2: Desktop system with integrated temperature chamber

Figure 2: Configuration 2

Voltage Range	Voltage Range	Current Ranges
HPS21024	-6V ~ 6v	5A/1A/100mA/10mA/1mA/100uA

PRECISION
POWERED BY ARBIN

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HPS

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Product Highlights

- 6 current ranges covering wide application needs
- Sampling circuit under controlled temperature environment to reduce variation and noise
- High Precision measurement and control
- Dynamic sample speed mechanism adapting both high-precision and high-speed test
- Data log as fast as 200 us per point
- 24 bit high resolution ADC to capture minute signal change
- 24 bit high resolution DAC to realize precise output value and smooth & fine output transition
- 100 us Time resolution with 20 ppm accuracy
- Built-in 2nd voltage per channel for three electrode test
- Built-in PT 100 temperature per channel
- Built-in CAN Bus support per channel for easy communication and system integration
- Integrated temperature chamber per channel available as a turn-key testing solution
- Each channel has a dedicated MCU for full functionality and non-disturbe performance

Product Features

- Patent-pending Self Discharge Current Measurement (SDCM) feature to precisely measure battery current leakage in a relatively short time for Battery Research, Battery Formation, or Battery QC.
- Built-in EIS/ACIM feature for battery research and QC without investing in additional EIS equipment.
- Built-in DCIM (DC method to measure EIS) feature serves as an alternative method of ACIM to get EIS data without disturbing regular battery test.
- Simulation feature for current, power, load downloaded in the microcontroller to perform user-defined time-defined functions that may be inputted from external sources and used as control parameter with ability to hold up to 1.2 million data points with as low as 10 ms time interval.
- Designed for Coulombic efficiency and Cyclic Voltammetry test with smooth control and true results.
- Multi-layer protection mechanism + Comprehensive variable monitoring to ensure load and user safety.

Safety Features

- Multiple levels of internal fusing and over-temperature control measures
- System watchdog and over-charging / over-discharging protection.
- Testing schedules can have layers of global and step-driven safety limits for voltage, current and power.
- Logic-driven scheduling interface allows for additional safety layers based on testing inputs, including Tests begin with a built-in logic check of all control values.
- Tests begin with a built-in logic check of all control values

Hardware Specifications

MZTC All-in-one Specification		HPS21026-6V5A-2CH
Voltage	Number of Channels	2
	Voltage Ranges	(-6V) ~ 6V
	Measurement Precision(10ppm)	120uV
	Control Precision(40ppm)	480uV
	Measurement & Control Resolution	24bit
	Input Impedance	100G Ohm
Current	Current Ranges	5A /1A / 100mA / 10mA / 1mA / 100μA
	Measurement Precision (20ppm)	200μA / 40μA / 4μA / 400nA / 40nA / 4nA
	Control Precision (40ppm)	400μA / 80μA / 8μA / 800nA / 8nA
	Measurement & Control Resolution	24bit
	Rise Time (10%-90%)	<=100μs
Built-in Temperature	Number of Channels	2
	Temperature Type	PT100
	Temperature Measurement Range	-80 ℃ ~ 200 ℃
	Temperature Measurement Accuracy	+/-0.5 ℃
Built-in Voltage	Number of Channels	2
	Built-in Voltage Range	-5V ~ 5V
	Built-in Voltage Accuracy	200uV / 20ppm
	Built-in Voltage Input Impedance	100G Ohm
Built-in CAN	Number of Channels	2
	Supported Protocol	CAN 2.0, CAN FD
Integrated Chamber (if equipped)	Chamber Quantity	2
	Temperature Space Variation	+/-1.5 ℃
	Temperature Control Stability	+/-0.5 ℃
	Temperature Range	10 ℃ ~ 60 ℃
EIS	Built-in	Equipped, dedicated per channel
	Range	10mHz ~ 1kHz
Time	Data Acquisition Rate	up to 200us per point
	Data Sample Rate	up to 200us per point
	Time Resolution	100us
	Time Accuracy	<20ppm, accumulated error less than 1.7s
General	Input Voltage	110~240VAC
	Size(W x D x H)	with chamber: 16" x 17" x 16"
		without chamber: 16" x 27" x 5"

Our product is always improving, and specifications are subject to change.

HPS

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Auxiliary Options & Accessories

Select from the options below to expand the capability of your HPS system.

Multi-Zone Temperature Chamber	Temperature chamber equipped with RTD to provide constant temperature from 10 to 60 degree Celsius. Allow the usage of battery tray for coin cells, 18650 cylindrical cells or universal battery tray for any type of battery. Eight isolated temperature zones per chamber.
Auxiliary Voltage	Used as additional reference electrodes to measure voltage.
Auxiliary Temperature	Thermocouple/Thermistor used to record temperature as well as control the test schedule.
MTCI (Chamber Interface)	Interface with a 3rd party temperature chamber so Arbin software can turn chamber on/off and adjust temperature.
EIS Module	An EIS module can be shared across 4 to 32 channels. **G-1010E** 1A max 10μHz to 2MHz **Arbin EIS 20P** 1A max 0.01Hz to 10kHz **Arbin EIS 40P** 0.5A max 0.01Hz to 10kHz *Recommended
For more information please visit: www.arbin.com/products/accessories/auxiliaries.htm	

Multi-Zone Temperature Chamber (MZTC)

1. Digital Temperature Display with Push Button Control
2. Communication: TCP/IP

# Independent Chambers	8 Isolated Chambers
Total # of Cells Allowed	8~32* (For more information on battery trays, refer to the MZTC sheet.
Connection	I/V measurements to battery tray with build in RTD temperature sensors
Temperature Range	10 to 60 degree Celsius
Accuracy	±0.5 degree Celsius
Point of Stability	±0.5 degree Celsius
Controller and Display	Display chamber temperature, control though software or manual setting
Modular External Size (WxDxH)	12.5" x 16" x 22"
Chamber Internal Size (WxDxH)	4.5" x 7" x 3"
Maximum Current Allowed	Up to 60A*

*Determined by tray type used to interface with cells.

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 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.
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.	**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.
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.	**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.
Rest† The battery is disconnected from the charge/discharge circuit but remains connected to the voltage measurement circuit to enable open-circuit voltage measurement.	**Formula†** Equips the user to control and limit schedule steps according to dynamic mathematical equations in addition to constants or instantaneous channel data.
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.	**End Conditions** Time, Voltage, Current, Capacity, Energy, ΔV, DV/dt, formula, meta-variables, and other combinations.
Load† (Ohm) Applies a constant resistance load to the battery at the value specified. The load control type will always produce a negative current.	**Current Staircase†/Voltage Staircase** Generates a current/voltage staircase with increasing current/voltage, and negative decreasing current/voltage staircase with adjustable step amplitude.
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.	**Safety Check** Includes control value check (Current, Voltage, Power), abnormal behavior check (Step Time, Capacity/Energy), and irregular impedance check.
Set Variables† Change test related variables including channel capacity, energy and all test counter variables.	**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.

Control types marked with (†) are available in parallel mode

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 maintenance 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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