9300 Series
High-Voltage Battery Test System

Testing and Validation of High Voltage Batteries, Fuel Cells, and Energy Storage Systems

Key Features

- Dual voltage range design: 600V, 1200V
- Modular & scalable power up to 2.4MW
  - 100kW per cabinet (parallel up to 24 cabinets)
  - Current 333A per cabinet (up to 8,000A)
- Regenerative power > 95% (Typical)
- 100% SiC-based technology
- Fast transient speeds: Slew Rate < 2mS
- Fully integrated battery cycler: built-in isolation contactor relays, pre-charge circuit, reverse polarity checker
- Modes: Charge/Discharge, Load, and Battery Emulation
- High insulation resistance to ensure product safety
- Air-cooled (no liquid cooling) provides simplified maintenance
- Advanced digital measurements with charting
- Multiple control options: touch panel, LabVIEW®, IVI Drivers, & SCPI
- Battery Test Software: Enerchron® or NI BTS Software
- Drive cycle simulation testing including FUDS, SFUDS, GSFUDS, WLDC, JC08, & ECE-15L

Applications

Model 9300 *100kW Test System*

The Industry's Most Flexible Battery Cycler for Battery Module and Pack Testing

The 9300 High Voltage Battery Test System is the industry's leading test solution for automotive, aerospace, energy, and industrial markets. The 9300 is used by well-recognized OEMs, Tier 1, 2, 3 manufacturers and suppliers, universities, government, and test labs, worldwide. Our flexible 9300 platform allows you to evolve with your test requirements from R&D and validation to production and end-of life.

The 9300 provides modular and scalable power from 100kW up to 2.4MW. Its dual voltage range of 600V and 1,200V covers both lower and higher power applications within a single product. Unlike custom built solutions, the 9300 provides maximum flexibility in voltage and power, providing full power from 300 V – 1,200 V +.

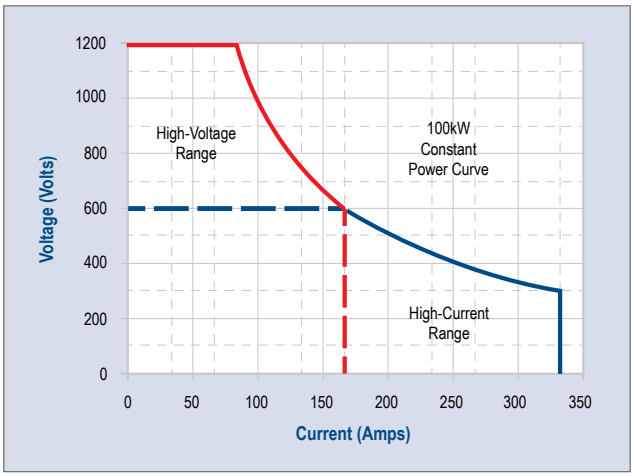

Figure 1 *- Wide Constant Power Operating Envelope*

Modular and Scalable Power Provides Future-Proofing

NHR's Battery Test Systems are designed for fully independent operation. Additional 100kW cabinets can be run synchronously in parallel up to 2.4MW/8000A, increasing the maximum power and current capability to the level required. This modular expansion allows you to scale power as needed ***(Fig. 2)***.

Figure 2 *- Modular and Scalable Power up to 2.4MW*

Built-In Comprehensive Measurement Capability

A wide range of precision measurement information is provided by the 1-MS/S digitization of analog measurement signals within each cabinet. For example, the simultaneous measurements of voltage, current, amp-hours and watt- hours are continuously available. Data can be accessed or downloaded to provide high-resolution, synchronized samples of voltage and current for advanced measurements such as battery condition ***(Fig. 3)***.

Figure 3 *- Chart Recorder*

Monitor Performance, Parameters and Status During Test to Minimize Hazards

The 9300 performance is monitored continuously. Items such as measurement ambiguities, under/over-range conditions, heat- sink temperature limits, and grid frequency limits trigger an appropriate warning message to the controlling device. Each tester provides programmable trip limits to continuously double check the operator requested setting ***(Fig. 5)***; an interlock input that can be connected to an external test fixture; an emergency manual switch; and remote power-off input. When the trip limits, interlock, or emergency power-off is detected, the tester halts power flow and follows an internal power-off sequence which includes opening the contactors and isolating itself from the UUT.

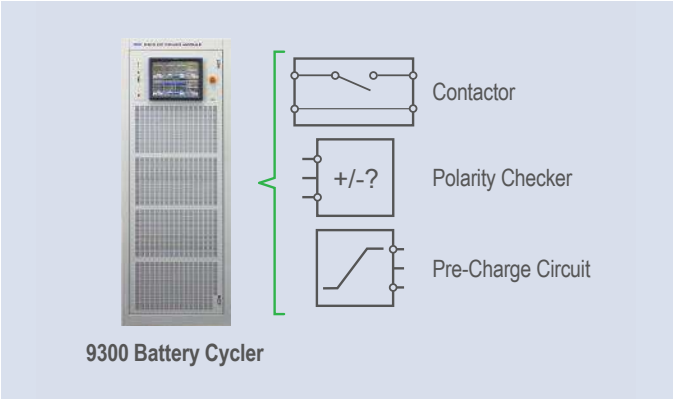

Figure 4 *- Functional representation of the 9300. Bidirectional power supplies and other cyclers may not include isolation contactor relays, polarity checker and pre-charge circuits.*

Figure 5 *- Enter Programmable Trip Limits*

The Power of Choice: Multiple Control & Automation Options

NHR Battery Test Systems are designed with multiple control options so that you can: write your own software (IVI or SCPI); program with NI tools (LabVIEW or VeriStand); work with a solution provider; or select a battery test software package such as NHR's Enerchron or NI's BTS for a fully integrated solution.

The 9300 has a large visual Touch-Panel that controls and displays voltage, current, power along with other settings, limits, and test status. The Touch-Panel allows you to create, run, monitor, chart, and report UUT charge/discharge profiles without writing any code.

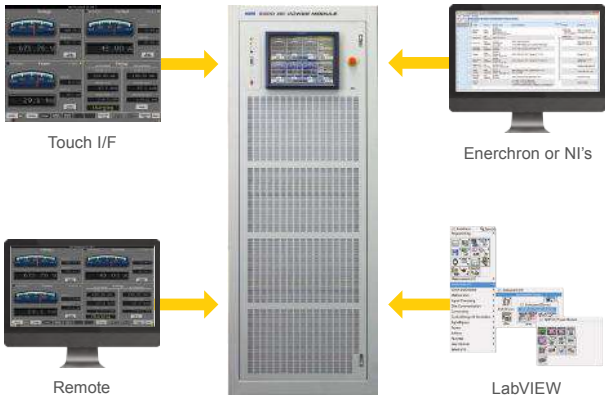

***Figure 6** - Multiple Control Options for Flexible and Easy Integration*

Simplify and Accelerate Battery Test

The Enerchron® Advantage

Enerchron is a powerful but easy to use Test Executive created specifically to simplify and accelerate your test automation. It provides a comprehensive battery test environment that includes integration with HW and SW tools. This software solution that provides the sequence control and integration of hardware I/O, CAN, chambers/ chillers, and safety elements of the test station. A key differentiator from other test software is the use of variables instead of hard-coded values. Test sequences can be easily scaled and adjusted for any UUT.

***Figure 7** - An Example Battery Test Environment*

Accelerate & Scale Battery Test

The NI BTS Advantage

Together, NHR and NI offer more complete and open electrification solutions to optimize test workflows and accelerate time to market for our customers. If required, we also have a reliable partner network of solution providers. The NI Battery Test System (BTS) Software provides additional systems capability:

- System architecture effectively scales to large, distributed battery labs.
- Powerful data and system management that optimizes OpEx and reduces the overall CO_2 footprint of your test facility
- Agile test plan development improves utilization and efficiency
- Workflow, scheduling, data management, and data analytics delivers higher-performance batteries, faster, and within budget.

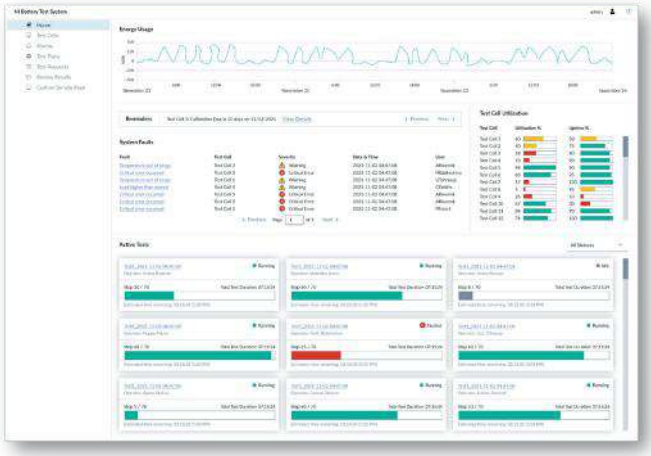

***Figure 8** - NI BTS 3.0 Example Dashboard*

Model 9300 High-Voltage Battery Test System

MODEL NUMBER*	9300-100	9300-200	9300-300	9300-400	9300-500	9300-600	9300-700	9300-800	9300-900	9300-1000	9300-1100	9300-1200
Rating	100kW	200kW	300kW	400kW	500kW	600kW	700kW	800kW	900kW	1000kW	1100kW	1200kW
Max Current @ 600V	333A	666A	999A	1332A	1665A	1998A	2331A	2664A	2997A	3330A	3663A	3996A
Current @ 1200V	±167A	±334A	±501A	±668A	±835A	±1002A	±1169A	±1336A	±1503A	±1670A	±1837A	±2001A
Programming Capability												
Operating States	Charge (Source), Discharge (Load), Standby, Battery Emulation											
Set Point Limits	Constant-Voltage (CV), Current (CC), Power (CP), Series Resistance (CR)											
Trip Point Limits	Min/Max Voltage, Current (per direction), and Power (per direction) with time delay values											
Charging Envelope	0 - 600V/±333A, 0 -1200V/±167A											
Discharging Envelope	30 - 600V/±333A, 60 - 1200V/±167A											
Voltage Accuracy	0.025% Set + 0.025% Range											
Current Accuracy	0.1% Set + 0.1% Range											
Slew Rate	Same polarity 10 - 90% < 2mS Low Range, < 3mS High Range											
Current Change Time	< 5mS											
Current Reverse Time	< 10mS											
Parallelability	Synchronous control for up to 24 channels (2.4MW)											
Macro Test Profiles												
Development Source	Touch-Panel, Import from Excel or User's System Controller											
Max. Steps	1000											
Min.Time Delay	50µS											
Max. Step Delay	1mS - 7 days											
Test Meas. (4-wire)	Range				Accuracy				Resolution			
Voltage, DC Avg.	0 - 600V/0 - 1200V				0.025% Reading + 0.025% Range				0.005% Range			
Current, DC Avg. Amp Hr	0 - 333A/0 - 167A				0.1% Reading + 0.1% Range				0.005% Range			
Power, Watt Hr	I Range x V Range				0.12% Reading + 0.12% Range				0.005% Range			
Time	1mS - 1 Yr				0.1% Reading				0.005% Range			
Temperature	0 - 150 °C											
Control												
Local User Interface	Touch-Panel with graphic meters & controls plus Macro screens											
Ext. Sys. Communication	LAN (Ethernet)											
Drivers	LabVIEW, IVI-COM, IVI-C											
Analog Current Monitor	0 to +10V charge/0 to -10V discharge											
Analog Voltage Monitor	0 to +10V full scale voltage											
External Inputs	Interlock input & power-off (eOff) input											
Software Watchdog	Programmable											
Physical (Single 100kW Cabinet)												
Connectors	Main power through buss bars											
Cabinet Dim. (HxWxD)	78 x 28 x 39"/1981 x 711 x 991mm											
Cabinet Weight	1200lbs/544kg											
Operating Temperature	0 - 35°C full power											
Input Power	3ø, 50 - 60Hz, 380VAC/200A or 480VAC/160A. Output Power reduced to 90kW below 360VAC input											
Input Power Factor	PF >0.997											
Isolation AC Input	800VDC Mains to Chassis & UUT - / 1500VDC Mains to UUT +											
Isolation UUT Input	800VDC UUT - to Chassis / 1500VDC UUT + to Chassis											
Internal Monitoring	Over-Voltage, Over-Current, Over-Power, Over-Temperature											

* Higher power models are available up to 9300-2400 at 2.4MW.

NHR from ni

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