NH Research (NHR)
Introduction & Product Overview

Test solutions for today’s technologies & tomorrow’s innovations.

Your Partner in Test
Enabling Electrification

*NHR enables electrification by accelerating innovation, validation & functional test of today’s & tomorrow’s technologies*

Backed by **over 50 years of experience** in power conversion and power supply test systems we provide world-class test instruments and systems. Our solutions provide the performance, simplicity, and safety that engineers and researchers desire.

- Best-in-class performance
- Ease of use
- Modular & scalable solutions
- Reduced testing time
- Improved safety
- Energy savings

Our Products

NHR’s product portfolio ranges from power instruments to complete test system solutions.

- AC & DC Electronic Loads
- Grid Simulators
- Bi-directional Sources
- Battery Test & Battery Emulation Systems
- Power Supply Test Systems
- AC & DC Power Sources
Our Value

**Simplified Testing**
- Easy set up, intuitive GUI and simple variable-based inputs
- Reduce test development time & increase engineering productivity
- Multiple ways to control instrument including third-party software
- Built-in measurements & features eliminate additional test equipment

**Flexible & Scalable Configuration**
- Flexible voltage & current combinations for optimized testing
- Scalable power, multi-channel capability & wide operating envelopes
- Highly modular configuration of power to address specific test requirements
- Address evolving test needs

**Bi-directional AC & DC**
- Bi-directional test solutions to emulate today’s real world conditions
- Battery emulation & grid simulation are crucial for validating an entire product or system
- Accepts back EMF & eliminates safety hazards
- Speed up development time, reduce complexity & costs

**Regenerative AC & DC**
- Energy is recycled for re-use back into your test system or facility
- Typically > 90% energy efficiency
- Reduced heat dissipation in the work space improves work conditions & increases productivity
- Reduce energy usage & operating costs

**Speed & Accuracy**
- Fast transient response times to meet today’s technologies & tomorrow’s innovations
- Accurate data & high performance test solutions
- Reduce testing time & risk of error
- Provides confidence in today’s & tomorrow’s testing

**Integrated Safety**
- Safety features designed into all products
- Integrated safety relays & isolated inputs
- No hidden costs or additional safety accessories required
- Eliminate safety risks & confidently push the boundaries of test
# Table of Contents

## Industry Overview | 5 – 8
- Electric Vehicles ............................................. 5
- Aerospace & Defense ................................. 6
- Energy Storage & Battery Test ......................... 7
- Renewable Energy & Microgrid ....................... 8

## Product Overview | 9 – 19

### NHR 9200 & 9300 Series | 9 – 11

- **Bi-directional DC Source**
- **Battery Test Systems**
- **Battery Emulation**
- **Regenerative DC Electronic Loads**
  - 9200 Series - Low to Medium Voltage .......... 10
  - 9300 Series - Medium to High Voltage .......... 11

### AC Loads | 12 – 13
- 9430 Regenerative 4-Quadrant AC Load .......... 12
- 4600 Series 2-Quadrant AC Load .................. 13

### AC Sources/Grid Simulator | 14 – 15
- 9410 Regenerative AC Grid Simulator ............. 14
- 9420 AC Power Source .................................. 15

### DC Electronic Loads | 16 – 17
- 4300 Series Modular DC Load - up to 120 V, 500 V .. 16
- 4700 Series Benchtop DC Load - up to 120 V ........ 17
- 4760 Series Benchtop DC Load - up to 600 V .......... 17

### DC Regenerative Loads

**Regenerative DC Electronic Loads** (9 – 11)

### Energy Test System Software Solutions | 18
- Enerchron® Test Executive Software ............... 18

### Power Supply Test Systems | 19
- EmPower® Software ..................................... 19
- 5600 - Universal Tester ................................ 19
- 5710 - Engineering Characterization Test System .. 19
- S600 - Multi-channel Test System .................. 19

## Worldwide Service & Customer Support | 20
Automotive | Electric Vehicles
EV test solutions for powertrain, battery test, DC fast charger & power electronics

Example Applications

DC Fast Charger Test
- Battery emulation
- V2L, V2G
- High power wireless

Powertrain Test
- Motor drive performance
- Dynamometer, alternator
- Battery emulation
- Start - stop testing

Battery Test
- Drive cycle & performance
- Charge/discharge
- BMS development

Power Conversion
- DC to DC converter
- EVSE, Onboard charger
- In-vehicle electronics

Learn More
Aerospace | Defense
ATE friendly & next generation power test solutions from R&D to sustainment

Complete Avionics Test Solutions
1. Batteries, capacitors
2. Propulsion system
3. AC-DC, DC-DC converters
4. AC generators
5. Auxiliary loads, switches, electric actuators, etc.

Example Applications

Traditional ATE
- Power supply
- Power conversion
- Chargers

Avionics, Tanks, Ships
- Propulsion systems, drive train
- Motor emulator
- Inverter test
- High voltage battery test
- DC fast charger, charger

Radar, Electronic Warfare
- Power electronics test

Solar PV & Grid Tied
- DG, V2G, ESS, micro-grid simulation
- PV emulation, PV inverter test

Learn More
Battery Test | Energy Storage
Test solutions for all battery chemistries, fuel-cells, supercapacitors & energy storage devices

Example Applications

Battery Test
- EV/ESS battery module/pack
- Charge/discharge
- BMS development
- Battery characterization
- Life-cycle
- Fuel cell test (module, stack)

Battery Emulation
- EV powertrain
- Avionics propulsion systems
- DC fast charger
- Micro-grid simulation
- Solar PV emulation

Power Conversion
- Grid-tied inverters
- DC-DC converters
- Power Distribution Units
- UPS
Renewable Energy | Microgrid

Renewable energy test solutions for solar PV, grid-tied technologies & energy storage systems

Example Test Applications

Grid-tied Technologies
- Distributed generation (DG)
- V2G, ESS
- High power wireless
- EV load testing

Grid Simulation
- ESS
- Microgrid

Solar PV
- Solar PV emulation
- Battery emulation
- PV Inverter

Energy Storage System
- Battery, fuel cell test

Power Conversion
- AC-DC, DC-DC converter
- UPS - Power Distribution Unit

Learn More
NHR 9200 & 9300 Series

- Bi-directional DC Source
- Battery Test System
- Battery Emulation
- Regenerative DC Load
9200 Series — Low to Medium Voltage

Modular, Regenerative, Bi-directional DC Source for Automated Characterization, Battery Cycling & Battery Emulation

- Module options to fit your voltage needs - 40, 120, 240 & 600 V
- Up to three 12 kW modules/cabinet, scalable to 144 kW
- Mix, match & parallel modules & cabinets
- Regenerative discharge (load)
- High efficiency > 87%
- Sub millisecond current transients for simulating ultra-fast step changes seen in Battery Test, Interruptible Current Devices, EV Powertrain Testing, & more.
- Very low noise
- Built-in safety features including pre-charge circuit, isolation relays, etc.
- CAN, BMS, DAQ options

Battery Test:
- EV/ESS Battery Module/Pack Test
- Start - Stop Test
- Battery Characterization
- Cycling, Life-cycle
- Charge, Discharge
- Fuel Cell Test – Cell, Module, Stack

Battery Emulation:
- EV Powertrain, Avionics Propulsion Systems
- DC Charger
- Power Conversion: DC/DC Converters, Inverters
- On-board Charger, UPS, Power Distribution Unit (PDU)
- Microgrid, ESS, PV Emulation
9300 Series — Medium to High Voltage

High Voltage, Regenerative Bi-directional DC Source for Automated Characterization, Battery Cycling & Battery Emulation

- Dual voltage range – 600 V & 1200 V
- Modular 100 kW per cabinet
- Scalable up to 2.4 MW
- Regenerative discharge (load)
- High efficiency > 90%
- Sub millisecond current transients for simulating ultra-fast step changes seen in Battery Test, Interruptible Current Devices, EV Powertrain Testing, & more.
- Very low noise
- Built-in safety features including pre-charge circuit, isolation relays, etc.
- CAN, BMS, DAQ options

Battery Test:
- EV/ESS Battery Module/Pack Test
- Battery Characterization
- Cycling, Life-cycle
- Charge, Discharge
- Fuel Cell Test-Module, Stack

Battery Emulation:
- EV Powertrain, Avionics Propulsion Systems
- DC Fast Charger
- Power Conversion: DC/DC Converters, Inverters
- On-board Charger, UPS, Power Distribution Unit (PDU)
- Microgrid, ESS, PV Emulation
9430 Regenerative 4-Quadrant AC Load

Linear & Non-Linear AC Loading in Several Emulation Modes

- 8 power ratings – 4 to 96 kW
- Programmable 1, 2 or 3-Phase
- AC voltage range – 10 to 350 VAC
- Frequencies – 30 to 880 Hz
- DC voltage range – 10 to 400 VDC
- Reactive power capability 2.6 x real power
- High efficiency > 90%
- Power factor range: -1 to +1
- Crest factor range: 1.414 to 4.000

Applications:
- Full Line Disturbances at Any Power Factor
- Grid Utility Test, Inverter Test, UPS Test
- EV Load Testing
- Switch, Fuse Test
- Linear & Non-linear Loading, Inductive & Capacitive Loading Requirements.

4-Quadrant Operation

Inductive Load waveform showing bi-directional power flows.
Programmable Power & Crest-Factor Control of AC Loading

- 6 power ratings – 3 to 36 kW
- Programmable 1 & 3-phase
- User-defined waveforms
- PC control using LabVIEW & IVI drivers
- 100-step macro per cycle loading changes
- CC, CR, CV, CP, SC, UPF & CNL emulation modes

Applications:
- UUT Reliability Testing, UPS Testing, V2G
- Grid Utility Test, Inverter Test
- Linear & Non-linear Loading, Inductive & Capacitive Loading Requirements
- True Short Circuit Test

The 4600 can simulate a resistor, constant load (CC or CP), or non-linear rectified loading and shifting rectified loading (capacitive or inductive).
9410 Regenerative Grid Simulator

Testing of PV Inverters, Grid-Tied Technologies AC Power & Frequency Conversion Products

- 8 power ratings – scalable from 4 to 96 kW
- Dual AC voltage range – 175, 350 VAC at 30 to 100 Hz AC
- Dual DC voltage range – 200, 400 VDC
- Programmable 1, 2 or 3-Phase
- Regenerative discharge (load)
- High efficiency > 90%
- Mix AC & DC on separate output channels
- Built-in safety isolation relays

Applications:
- Grid Simulation: Microgrid systems
- V2G, ESS
- On-board Chargers, Grid-aware Chargers
- Grid Utility Test
- PV/Grid Tied Inverter Test
- UPS, Power Distribution Unit (PDU) Test

Compliant with UL1741, IEEE1547 and similar grid-tied standards world-wide.

Multiple Configuration Possibilities

Channel 1 | Channel 2 | Channel 3
---|---|---
1-Phase | 1-Phase | 1-Phase
1-Phase | 1-Phase | 1-Phase
Split-Phase | 1-Phase | 1-Phase
3-Phase | 1-Phase | 1-Phase

9410 & 9420 Series
Programmable 1, 2 or 3-phase configuration
9420 AC Power Source

General Purpose AC Stimulus
- 7 power ratings – scalable from 8 to 96 kW
- Dual range – 175, 350 VAC at 30 to 880 Hz AC
- Dual range – 200, 400 VDC
- Programmable 1, 2 or 3-Phase
- Ultra-low current Energy Star measurement ranges
- DC output & bi-directional DC operating option
- Mix AC & DC on separate output channels
- Built-in safety isolation relays

Applications:
- ATE Applications: Regulatory Test
- Power-line Disturbance
- Power Conversion: AC/DC Converter Test
- Charger, UPS, Power Distribution Unit Test
- Data Center/Service
- Energy Star - Low Current Range

HIVAR® Offers 2 x Reactive Power Capability per kW

The 9420 12kW in single-phase mode has an extended operating envelope with more usable true power.
4300 Series Modular DC Load

Mix & Match up to 16 Loads with Independent Measurement Capability in a Single 5U / 8 ¾” Chassis

- Voltage rating – 120 V or 500 V
- 3 Power ratings – 150, 300 & 600 W
- Advanced built-in scope measurements, waveform capture & analysis
- Drastically reduces muxing channel count
- High functionality reduces ATE footprint
- Power Analyzer & OVP source available
- Mix & match loads for maximum configuration flexibility
- Isolated digital inputs & outputs for test fixture support
- PC/LAN control with LabVIEW & IVI drivers

Applications:

- Power Devices: Chargers, Adapters, DC Supplies, LED Drivers, Telecom Rectifiers
- Fuel Cell Test, Super Capacitor Test
- Power Conversion
- EV Subsystem Test: OBC, V2G, APM, DC/DC Converter
- Highly Modular, Flexible & Compact Test Requirements

Precision in Digitally Controlled DC Loading

4300 & 4700 Series:

- High accuracy in both set & measurement
- Ultra-fast slew-rate controls for all loading modes
- Fast transients, sub-millisecond pulse
4700 & 4760 Series DC Load - Bench Top

Fast-Transient, High-Current Linear Loads for Bench-Top or Automated Test Station Use

- 8 power ratings
  - 4700 Series - 1 kW / 200 A / 120 V to 36 kW / 7200 A / 120 V
  - 4760 Series - 1 kW / 50 A / 600 V to 36 kW / 1800 A / 600 V
- High accuracy 1 kW low power range
- Built-in advanced measurements, waveform capture & analysis
- PC control using LabVIEW & IVI drivers
- Optional touch-panel graphical user interface

Applications:

- Power Devices: Chargers, Adapters, DC Supplies, LED Drivers, Telecom Rectifiers
- Fuel Cell Test, Super Capacitor Test
- Power Conversion
- EV Subsystem Test: OBC, V2G, APM, DC/DC Converter
- Ideal for Fast Transients, Ultra-low Voltage Loading (down to .01 VDC)

High-Speed / Real World Transient Simulation

4300 & 4700 Series
Inrush simulation, step changes (20µS), noise simulation
The Power of Choice (NHR Advantage)

Write your own software - Enerchron Test Executive - Work with your favorite Integrator

Flexible Data Control Options

Enerchron Test Executive Software

Test Executive with Advanced Test Creation, Execution, & Reporting Capabilities for Battery Cycling & Other Energy Product Testing

- Powerful test sequencer editor that is flexible & intuitive
- Reduces test development time with simple graphical sequence programming so engineers can focus on UUT
- Unique variable-based programming
  - Save key data & perform calculations
  - Dynamically control the test during test
  - Import or create drive cycles
- Implementing drive/grid cycles is easy as 1-2-3
- Programmable remapping capability
- Integrate with third-party communication tools

Test System Solutions

Products Supported:

- 9200 Series, 9300 Series
- 4312, 4350, 4700, 4760 Series DC Loads
- 9410 Regenerative AC Grid Simulator
- 9420 AC Power Source
- 9430 Regenerative 4-Quadrant AC Load

Touch I/F

Remote

Enerchron

LabVIEW

Battery

Battery Cycler

(In Chamber)

Chamber

Relay, I/O, & PWM

DAQ (Volt & Temp.)

422/485

MODBUS

CAN

ETHERNET

Enerchron®

A complete solution for DC, DC/DC, DC/AC, & AC/AC applications

DC Loads & DC Supplies

Relay, I/O, & PWM

DAQ (Volt & Temp.)
Power Supply Test Systems

5600 - Universal Test System (AC-DC, DC-DC)
Universal tester for testing power supplies with DC outputs
- Maximum configuration flexibility with multi-bay capacity
- Digitizer replaces several single-function instruments 2 waveform digitizers, 2 x 16, 100 Mhz multiplexer
- Expandable input measurement channels
- Common interface panel

5710 - Engineering Characterization Test System (AC-DC, DC-DC)
Characterization/Design Verification, Power Supplies/ATE Testing
- Tektronix MDO-Series Mixed Signal Oscilloscope
- Unlimited voltage, current & timing measurements
- Library of design verification test routines reduces program development time
- Wide configuration flexibility

emPower™ Test Executive Software
Simplified Test Creation, Execution & Reporting for Power Supply Functional Tests
- Ideal for matrix & high volume testing
- Zero post-development using automatic report generator
- Sequencer with built in features
- Reduces software development time & risk
- Easy data entry environment
- Complete library of design verification test routines
- Speeds up test & increases productivity

S600 - Multi-Channel Power Supply Test System (AC-DC)
High Speed, Parallel Testing of High Volume Power Conversion Devices
- Configurable up to 16 devices in parallel at different outputs
- Easy configuration through front-loading, card-based instruments
- Built-in waveform digitizers on all instruments
- Time-synchronized multi-output UUT testing
- Space savings
Worldwide Service & Customer Support

Need help? Contact us for more info.

Contact Us  Technical Support  Training

“At NHR, we consider every customer a partner.”

We help you achieve your goals.

- **Expertise** – application, product design, engineering specialists on stand-by
- **Access** – rapid response times by phone, email & site-visits
- **Support** – technical experts, training, diagnostic tools, calibration tools & replacement parts to resolve problems quickly

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