Renewable Energy & Micro-Grid Test Solutions

NH Research (NHR)
Enabling Electrification
Enabling Electrification

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

Backed by over 50 years of experience

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

Flexible, Modular Hardware AND Software

Product Portfolio
- Battery/Fuel Cell Test Systems
- Bi-directional DC Source
- Grid Simulators
- AC & DC Electronic Loads
- AC & DC Power Sources
- Power Supply Test Systems

...Your Partner in Test
Bi-Directional Power is the New Normal

The Grid

Charger

Electric Car

Battery

Grid Simulators (Bi-Directional AC)

Battery Emulators (Bi-Directional DC)
Microgrid Test Solutions

**Tech Trends**
- Bi-Directional Sources
- Battery & Fuel Cell Emulation
- AC/DC Source & Loads
- Regenerative Grid Simulators

**Applications**
- Vehicle to Grid (V2G)
- Solar PV Inverters
- Energy Storage
- Distributed Grid (DG) Inverters
Microgrid Test Solutions

- **Solar**: 9200/9300 Solar Emulator
- **ESS**: 9200/9300 Battery Test
- **Wind**: 9200/9300 Wind Emulator
- **V2G**: 9430 Regen Load
- **Generator**: 9420 AC Source
- **Loads**: 9430 Regen Load

Regenerative, Bidirectional Source Simulation
- 9200 & 9300 DC Source
- 9410 Regenerative Grid Simulator
- 9420 AC Source with HIVAR

Load Simulation
- 9430 AC 4-Quadrant Source
- 4600 AC Electronic Load
Utility Grid Load Testing

Utility Grid

Test effects of energy to & from the grid

9410/9420
Regen Grid Simulator/
AC Source

9430
Regen 4 Quadrant
AC Load
Solar PV to Grid Testing

Residential Solar PV

Test effects of energy to the grid
ESS/Battery Test or Emulation

Residential or Large Scale Energy Storage

Test the battery or effects of energy to the grid

9200/9300 Battery Test or Battery Emulator

9410/9420 Regen Grid Simulator/AC Source
Wind to Grid Testing

Wind Sources (DG)

Test effects of energy to the grid

Wind DG

9430 Regen 4 Quadrant AC Load
Generator Testing

Generator

Test effects of energy to & from the grid

9410/9420
Regen Grid Simulator/
AC Source

9430
Regen 4 Quadrant
AC Load
Facility Load Testing

Facility Loads

Test effects of energy to & from the grid

9410/9420 Regen Grid Simulator/AC Source

9430 Regen 4 Quadrant AC Load

Loads
EV Onboard Charger

Electric Vehicles

Test effects of energy to the grid

On-board Charger

9410/9420 Regen Grid Simulator/AC Source

9200/9300 Battery Emulator
Vehicle 2 Grid Testing

Electric Vehicles

Test effects of energy to the grid

9410/9420
Regen Grid Simulator/
AC Source

9430
Regen 4 Quadrant
AC Load

EVSE
Traditional Loads Vs. Regenerative

Traditional Loads
- Heat Loss
- Poor Working Conditions
- Operating Costs
The Benefits of Regenerative Loads

Regenerative Loads

- Reduce Waste Heat
- Recycle Energy >90% back to UUT or facility
- Huge Cost Savings
9200/9300 Battery/Energy Storage Test Systems

Flexible Hardware & Software

Key Features

- Modular & scalable power
- Flexible configuration – mix & match
- Fast response times
- Regenerative > 90% energy efficiency
- All modes - CC, CV, CP, and/or CR
- Battery Emulation Mode
- Multiple layers of Safety
- Flexible & easy integration (CAN, BMS, DAQ, chambers, etc.)

12 kW up to 21 Channels

100 kW up to 2.4 MW
9400 Series Regenerative Loads & Sources

Key Features

- Scalable from 4 to 96 kW
- 8 power ratings
- Multiple Ranges 175 & 350Vrms(l-n)
- Up to 880Hz
- Regenerative > 90% energy efficiency
- Programmable 1, 2 or 3-Phase mode
- Mix AC & DC on separate outputs
- Built-in safety isolation relays

- 9410 – Grid Simulator
- 9420 – AC Source HIVAR
- 9430 – AC 4 Quadrant Load
9410 Regenerative Grid Simulator

The Right Tool for Simulating AC Voltage Disturbances

NHR 9410 Grid Simulator

Dips & Swells

Harmonics

Immunity

Phase Jump

Imbalance
9430 Regenerative 4-Quadrant Loading

Simulate Any Power Factor/Current Control

Simulate Any Combination of Load Profiles

Power Factor

Crest Factor

Asymmetrical

I Harmonics

Inrush
Renewable Energy & Micro Grid Test Solutions

- **9430 Regen 4 Quadrant Load**
  - up to 96kW

- **4600 AC Load**
  - up to 36kW

- **9410 Grid Sim**
  - up to 96kW

- **9420 AC Source**
  - up to 96kW

- **9200 Series**
  - 12 kW, 21 channels

- **9300 Series**
  - 100 kW to 2.4 MW

- **4700 & 4760**
  - 1 kW to 36 kW

- **4300 Chassis**
  - 150W, 300W, 600W

- **4600 AC Load**
  - up to 36 kW

- **9430 Regen**
  - 4 Quadrant Load

- **9410 Grid Sim**
  - up to 96 kW

- **9420 AC Source**
  - up to 96 kW

- **9200 Series**
  - 12 kW, 21 channels

- **9300 Series**
  - 100 kW to 2.4 MW

- **4700 & 4760**
  - 1 kW to 36 kW

- **4300 Chassis**
  - 150W, 300W, 600W

---

### AC Grid Sim
- **9410**
- **9420**

### AC Loads
- **9430**
- **4600**

### Bi-directional DC Source
- **9200 Series**
- **9300 Series**

### Battery Emulators
- **9200 Series**
- **9300 Series**

### Battery Test
- **9200 Series**
- **9300 Series**

### DC Loads
- **4300**
- **4700/4760**

### DC Regenerative Loads
- **9200 Series**
- **9300 Series**
Access Resource Library

- Download Application Notes
  - Microgrid Test Solutions Diagram
  - Regenerative Loads and Sources Application Note
  - Battery Emulation: Testing without Batteries

- On-Demand Webinars

- Schedule a Consultation

- Renewable Energy & Microgrid Webpage

- Visit us at http://nhresearch.com
Worldwide Service & Customer Support

Need help? **Contact us**

We help you achieve your goals.

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

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

Phone: 949-474-3900  
Email: sales@nhresearch.com  
Website: [www.nhresearch.com](http://www.nhresearch.com)

...Your Partner in Test