

## **DC Electronic Loads & Sources Selector Guide**




# DC Electronic Load & Sources Selector Guide

*Product Selector Guide*



## Regenerative DC Load, Bi-Directional DC Source

	Model	Voltage	Current	Power
	9300	600V & 1200V	up to 8000A	100kW - 2.4MW
	9200	40, 120 & 600V	up to 7200A	12kW - 252kW

## Regenerative Grid Simulator - AC & DC

	Model	Voltage	Current	Power
	9410	200, 400VDC 175, 350VAC	Up to 720A	4kW - 36kW

# 9300 Series High-Voltage Battery Test System

**Modular, Regenerative Battery Pack Test System  
with Power Range from 100kW up to 2.4MW**



## Features

- Wide Operating Envelope at 100kW per cabinet
- Bi-directional DC Source, scalable to 2.4MW/8000A
- Regenerative, > 90% efficiency of discharge power returned to AC mains
- Built-in digital measurements with charting & scope displays
- Current, Voltage & Mode transitions in <2 mSec
- Battery Emulation Mode
- Touch Panel, LabVIEW® & IVI Drivers
- Enerchron® Test Executive

## Advantages

- Designed for testing & emulating all battery chemistries
  - Automatic energy integration (full & 1/2 cycle)
  - Multiple safety layers to protect UUT
- Battery Emulation in hardware (OCV & series resistance)  
Software tools to shorten test development time
  - PC-based Softpanel GUI with charting
  - Supplied LabVIEW & IVI-C/IVI-COM drivers
  - Optional: Enerchron® test sequencer

## Benefits

- Regenerative, returns > 90% of power to the facility, which provides significant electrical savings.
- Dual Range: 1200V/167A & 600V/333A @ 100kW
- Safely simulate and emulate “Real World” conditions
  - Sub-mS voltage, current, & mode transition times
  - Emulate over/under charged batteries
  - Safely emulate BMS & battery failures
- Modular design allows field expansion up to 2.4MW / 8000A



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											
Charge/Discharge Modes	Constant-Voltage (CV), Current (CC), Power (CP), Series Resistance (CR)											
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 12 channels ( 1.2MW)											
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 (Win XP, Win 7)	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											
Safety												
Isolation AC Input	1000VDC Mains to Chassis & UUT - / 1500VDC Mains to UUT +											
Isolation UUT Input	1000VDC UUT - to Chassis / 1500VDC UUT + to Chassis											
Prog. Safety Limits	V Min/Max, I Max, W Min/Max											
Internal Protections	Over-Voltage, Over-Current, Over-Power, Over-Temperature											
Interlocks	External input, emergency stop & rear service door											
Self-Test	Power-up Self-Test reports errors about status of input, output, control & protection mechanisms											
Watchdog Timer	Continuously monitors control communications											
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											
Calibration												
Method	Semi-Automatic with standard lab equipment, Fully-Automatic with HP3458A & NHR Calibrator											

\* Higher power models are available up to 9300-2400 at 2.4MW.  
Specifications apply after 30 minute warm-up. Refer to Users Manual for additional product specifications.

# 9200 Series Battery Module Pack Test System

*Automated Characterization, Cycling, & Emulation  
of Batteries*



## Features

- Modular voltage options 40 or 120V
- Parallels with other 9200 & 9210 systems
- High-resolution waveform capture up to 1.2M Sample/Sec
- Precision voltage, current, power, & energy measurements
- Cycle batteries (charge/discharge) & drive cycles
- Fast dynamic patterns - 1000 step sequence
- State of the art battery emulation mode
- Built-in touch-panel user interface
- Ethernet (LAN)

## Advantages

- Battery emulation using OCV & series resistance
- Designed for testing & emulating all battery chemistries
  - Automatic energy integration (full & 1/2 cycle)
  - Multiple safety layers to protect UUT
- Software tools to shorten test development time
  - PC-based Softpanel GUI with charting
  - Supplied LabVIEW & IVI-C/IVI-COM drivers
  - Optional: Enerchron® test sequencer

## Benefits

- Modular - full function tester per channel design
- Parallels for high power testing (up to 144kW)
- Safely simulate and emulate “Real World” conditions
  - Sub-mS voltage, current, & mode transition times
  - Emulate over/under charged batteries
  - Safely emulate BMS & battery failures
- Flexible configuration (any 3 modules per system)



Model 9200 Individual Power Module Specifications

MODEL NUMBER	4904			4912		
Functional Capability						
Operating States	Charge (Source), Discharge (Load), Standby, Battery					
Charge/Discharge Modes	Constant-Voltage(CV), Current (CC), Power (CP), Resistance (CR)					
Charging Envelope	0 - 40V, 8kW, 600A			0-120V, 8kW, 200A		
Discharging Envelope	1 - 40 V, 12kW, 600A			4-120 V, 12kW, 200A		
Slew Rate	0.011V/S - 40kV/S, 0.0165A - 600kA/S			0.033V/S - 120kV/S, 0.055A - 200kA/S		
Current Change Time	Less than 5mS					
Current Reverse Time	Less than 10mS					
Parallelability	Synchronous control for up to 12 channels (144kW)					
Macros						
Development Source	Touch-Panel, Import from Excel or User's System Controller					
Maximum Steps	1000					
Minimum Time Delay	50uS					
Maximum Step Delay	1mS - 7 Days					
Programming	Range	Accuracy <sup>1</sup>	Res. <sup>1</sup>	Range	Accuracy <sup>1</sup>	Res. <sup>1</sup>
Voltage	0-40V	0.025% + 0.025%	0.005%	0-120V	0.025% + 0.025%	0.005%
Current	±600A	0.1% + 0.1%	0.005%	±200A	0.1% + 0.1%	0.005%
Power	+8/-12kW	0.12% + 0.12%	0.005%	+8/-12kW	0.12% + 0.12%	0.005%
Resistance	0 - 34Ω	2%	0.005%	0 - 100Ω	2%	0.005%
Slew Rate						
Voltage	0.011V/s – 80V/ms			0.033V/s – 240V/ms		
Current	0.17A/s – 3000A/ms			0.055A/s – 1000A/ms		
Resistance	0.01Ω/s – 34Ω/ms			0.028Ω/s – 100Ω/m		
Power	2W/s – 8kW/s			2W/s – 8kW/s		
Test Measurement (4-Wire)	Range	Accuracy <sup>1</sup>	Res. <sup>1</sup>	Range	Accuracy <sup>1</sup>	Res. <sup>1</sup>
Voltage, DC Average	0 -40V	0.025% + 0.025%	0.005%	0 -120V	0.025% + 0.025%	0.005%
Current, DC Average, Amp-Hr	0 - 600A	0.1% + 0.1%	0.005%	0 - 200A	0.1% + 0.1%	0.005%
Power, Ah, kWh	± 12kW	0.12% + 0.12%	0.005%	± 12kW	0.12% + 0.12%	0.005%
Time	1ms - 1Yr	0.1%	0.005%	1ms - 1Yr	0.1%	0.005%
Control						
Local User Interface	Touch-Panel with graphic meters and controls plus Macro development/execution screens					
Ext. System Communication	LAN (Ethernet)					
Drivers (Win XP or Win 7)	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					
Safety						
Isolation AC Input	1000V AC to DC Output / 1000V AC Input to chassis					
Isolation UUT Input	600V UUT to chassis	1000V UUT to chassis	1000V UUT to chassis	1000V UUT to chassis		
Programmable Safety Limits	Over-Voltage (OV) / Under-Voltage (UV), Over-Current (OC), Over-Power (OP)					
Internal Protection	Over/Under-Voltage, Over-Current, Over-Power, Internal Over-Temperature					
Interlocks	External user input, emergency stop, and rear service door					
Watchdog Timer	Continuously monitors control communications					
Physical						
Test Channel Connectors	Buss Bars	Anderson EBC A32	Anderson EBC A32	Anderson EBC A32		
Cabinet² Dim. (HxWxD)	72 x 28 x 31"/1829 x 711 x 787mm					
Cabinet Weight (3 Channels)	1475lbs/669kg					
Operating Temperature	0 - 35°C full power					
Input Power³ per Module	3 Ø, 50 - 60Hz, 200VAC/30A, 208VAC/29A, 220VAC/27A, 380VAC/16.5A or 480VAC/13A					
Calibration	Semi-Automatic , closed cover with standard lab equipment					

Specifications apply after 30 minute warm-up. Refer to User's Manual for additional product specifications. <sup>2</sup> Standard cabinet contains 1, 2 or 3 Modules, <sup>3</sup> Input Voltage set at placement of order

Ordering Information

Typical Configurations	9200-4904-36	9200-4912-36-2
Number of Test Channels <sup>3</sup> Maximum Test Power	3 @ 12kW 36kW	6 @ 12kW 72kW
Power Modules Voltage Maximum Current	4904 40V 1800A	4912 120V 1200A
Number of Cabinets Floor Space Req'd (WxD) Cabinet Height	One 28 x 31"/711 x 787mm 72"/1829mm	Two 56 x 31"/1422 x 787mm 72"/1829mm
Part Number Construction	9200-4912-36-2 4912 – Power Module Selection 36 – kW per cabinet (1 module = 12kW, 2 modules = 24kW, 3 modules = 36kW) 2 – Number of Cabinets	



# 9410 Series Regenerative Grid Simulator

AC/DC Grid Simulator with HiVAR™



## Features

- 8 models - 12kW to 96kW
- Two AC Voltage ranges 175, 350VRMS (I-n)
- Two DC Voltage ranges 200, 400VDC
- Two high-accuracy current measurement ranges
- Operating frequency – DC, 30 to 100Hz
- Precision voltage, current, power & energy measurements
- Waveform digitization (capture) up to 125kSamples/sec
- Powerful line disturbance creation tools
- Sink power regenerated back to facility
- Built-in 9" Touch-Panel user Interface
- Programmable via SCPI & NI LabVIEW compliant drivers

## Advantages

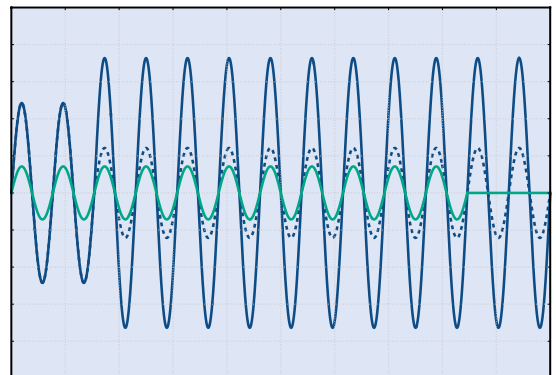
- Voltage Ranges matched to Interconnection Standards
  - 175VRMS (I-n) ideal for 120VAC (1Φ) & 240VAC (2Φ)
  - 350VRMS (I-n) ideal for 380 - 480VAC (3Φ)
- Fully programmable & Bi-Directional AC/DC
  - Independent phase voltage & phase angle relationships
  - Phase angle & timed triggerable set controls
  - Sinusoidal or arbitrary voltage waveshapes (harmonics)
- HiVAR: More Reactive Power & current per kW
  - Additional VAR capability supports Volt-VAR testing
  - Crest factor support upto 3x Max IRMS
- Software selectable for 1, 2 or 3 phase operation
- Built-in SW watchdog & safety limits

## Benefits

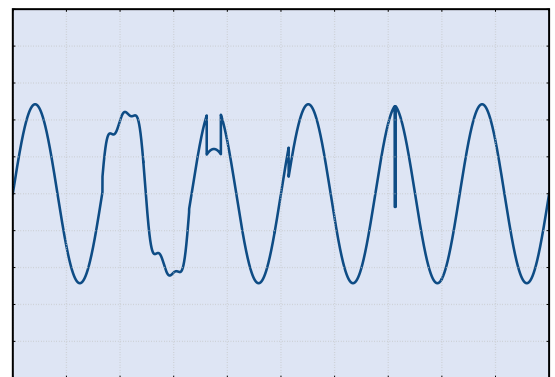
- Field upgradeable to higher power
- Fully emulate any utility/grid condition
- Simulate non-ideal Phase angle relationship (A-B & A-C)



Model 9410-12 Regenerative Grid Simulator



Easily Test to UL 1741 - Abnormal Voltage Test



Easily produce harmonics, Notches, Phase Jumps & more

# Model 9410 Regenerative Grid Simulator Specifications

MODEL NUMBER		9410-12	9410-24	9410-36	9410-48	9410-72	9410-96
AC Output Ratings							
Phases/Output Channels	1, 2, or 3						
Power, Max (1Φ or 3Φ)	12kW/31.5kVA	24kW/63kVA	36kW/94.5kVA	48kW/126kVA	72kW/189kVA	96kW/252kVA	
Current Ranges (RMS per Φ)	6, 30A/Φ	12, 60A/Φ	18, 90A/Φ	24, 120A/Φ	36,180A/Φ	48, 240A/Φ	
Current Ranges (RMS 1Φ)	18, 90A	36, 180A	54, 270A	72, 360A	108, 540A	144, 720A	
Peak Current	3 X Max RMS						
Frequency	30 – 100Hz (option up to 880Hz)						
Voltage Ranges, L-N	10 - 175, 350VRMS L-N (Split Phase 250V Max)						
Accuracy	0.2% Set + 0.2% Rng						
Resolution	0.005% Rng						
Distortion (THD)	<1% @ 50/60Hz (Full power into resistive load at 480VRMS (L-L) )						
Response Rate	1V/μS (10% to 90% measured at 90 degree turn-on into resistive load)						
Custom Waveforms	Sine, n-Step Sine, Triangle, Clipped-Sine, Arbitrary (user defined)						
Phase Angle Control	0 to 359 degrees / 1 degree resolution						
DC Output Ratings							
Power Max ( 1ch or 3ch)	12kW	24kW	36kW	48kW	72kW	96kW96kW	
Current Ranges (Per Ch.)	6, 30A/CH	12, 60A/CH	18, 90A/CH	24, 120A/CH	36, 180A/CH	48, 240A/CH	
Current Ranges (Per System)	18, 90A	36, 180A	54, 270A	72, 360A	108, 540A	144, 720A	
Voltage Ranges	10 - 200, 400VDC						
Accuracy	0.2% Set + 0.2% Rng						
Ripple	< 800mV RMS						
AC & DC Measurements							
Voltage Range (LR, HR)	260, 520V Pk						
Accuracy (AC RMS)	0.1% Rdg + 0.06% Rng						
Accuracy (DC)	0.1% Rdg + 0.1% Rng						
Accuracy (Peak)	0.5% Rdg + 0.2% Rng						
Resolution	0.005% Rng						
Current per Phase (LR, HR)	20, 100A	40, 200A	60, 300A	80, 400A	120, 600A	180, 800A	
Accuracy (AC RMS)	0.1% Rdg + 0.1% Rng						
Accuracy (DC)	0.2% Rdg + 0.1% Rng High Range, 0.2% Rdg + 0.3% Rng Low Range						
Accuracy (Peak)	0.5% Rdg + 0.2% Rng						
Resolution	0.005% Rng						
Power	Voltage Range x Current Range						
Accuracy (kW or kVA)	0.2% Rdg + 0.1% Rng						
Resolution	0.005% Rng						
Additional Measurements	Energy (Ah, kWh, kVAh), AC Crest Factor, AC Power Factor, Waveform Capture						
Waveform Digitizer							
Data Acquisition	Output Voltage and Current			Aperture Time		1 cycle to 64s	
Sample Rate	125kSamples / sec			Accuracy/Resolution		0.5% Rng / 0.05%	
Memory Depth	64kSamples						
Control							
Local User Interface	Built-in Touch-Panel and PC-Based software tools including graphical user interface						
External System Comm	LAN (Ethernet) supporting SCPI or VXI-11						
Drivers	Ni-Compliant LabVIEW Drivers, Enerchron (opt.)						
Safety							
Module Protection	Self-protecting for over-voltage, over-current, over-power, and over-temperature						
Physical	Emergency Stop and remote E-Stop connection						
Programmable Limits	Min/Max Voltage, Current (per direction), and Power (per direction) with separate limits and time delay values						
Software Watchdog	Programmable						
Physical							
Connectors	Phoenix Contact	Bus Bars					
Form	Chassis	Single Cabinet				Double Cabinet	
Dimensions (HxWxD)	15¼ x 19 x 24" 400 x 483 x 610mm	49x23x30" 1244x584x762mm	61x23x30" 1549x584x762mm	78x23x30" 1981x584x762mm	78 x 46 x 30" 1981 x 1168 x 762mm		
Weight	155lbs/70kg	480lbs/218kg	640lbs/290kg	780lbs/354kg	1280lbs/581kg	1560lbs/708kg	
Operating Temp	35°C						
Isolation	Facility to Chassis – 1,000V, Output to Chassis – 500 V, Facility to Output Internal Isolation – 2,000 V						
Input Power							
Voltage	Universal Input – 380V to 480V ± 10% (L-L, 3 Phase, 50/60Hz)						
Efficiency/Power Factor	> 85% / > 0.95						
Current per Φ @ 380 V	25A	49A	73A	97A	144A	192A	
Current per Φ @ 400 V	24A	47A	69A	92A	137A	183A	
Current per Φ @ 480 V	20A	39A	58A	77A	114A	152A	
ORDERING INFORMATION		MODEL	KW RATING				
Grid Emulator P/N		9410	-12				



# Enabling Electrification

*Your Partner in Test*

