9200/9210 Cabinet
DC Power Module
Hardware Reference Manual

Part No. 09-0314

Revision R

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Document History

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	Humidity Spec		
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1. SYSTEM OVERVIEW

1.1 Introduction

This user's manual provides detailed information commonly required for the installation, usage, specifications, and troubleshooting for NHR Model 9210 and NHR Model 9200 Test Systems.

1.2 NHR 9210 Test System Introduction

The 9210 Test System consists of a 28"w x 31"d x 43.5"h cabinet that houses the following:

- Support wiring for one (1) NHR DC Power Module
- A Prominently mounted Key-Locked Emergency Off Button (with expansion connector)
- A PC-Based controller (pre-configured with PowerPanel software)
- Pass through port allowing connection of keyboard, mouse, and monitor
- Line Isolation Transformer
- Logic Power Supply for Internal Interlocks
- An integrated communications switch (LAN)
- A Key-lockable, electrically interlocked rear service door
- Casters for movement of the system

Figure 1 - 9210 System with 4904 Module
(Safety screen removed to show isolation transformer)

1.3 NHR 9200 Test System Introduction

The 9200 Test System consists of a 28”w x 31”d x 72”h cabinet that houses the following:

- Support wiring for one (1), two (2), or three (3) NHR DC Power Modules
- A Prominently mounted Key-Locked Emergency Off Button (with expansion connector)
- A PC-Based controller (pre-configured with PowerPanel software)
- A Touch Screen Interface
- Line Isolation Transformer
- Logic Power Supply for Internal Interlocks
- An integrated communications switch (LAN)
- A Key-lockable, electrically interlocked rear service door
- Casters for movement of the system

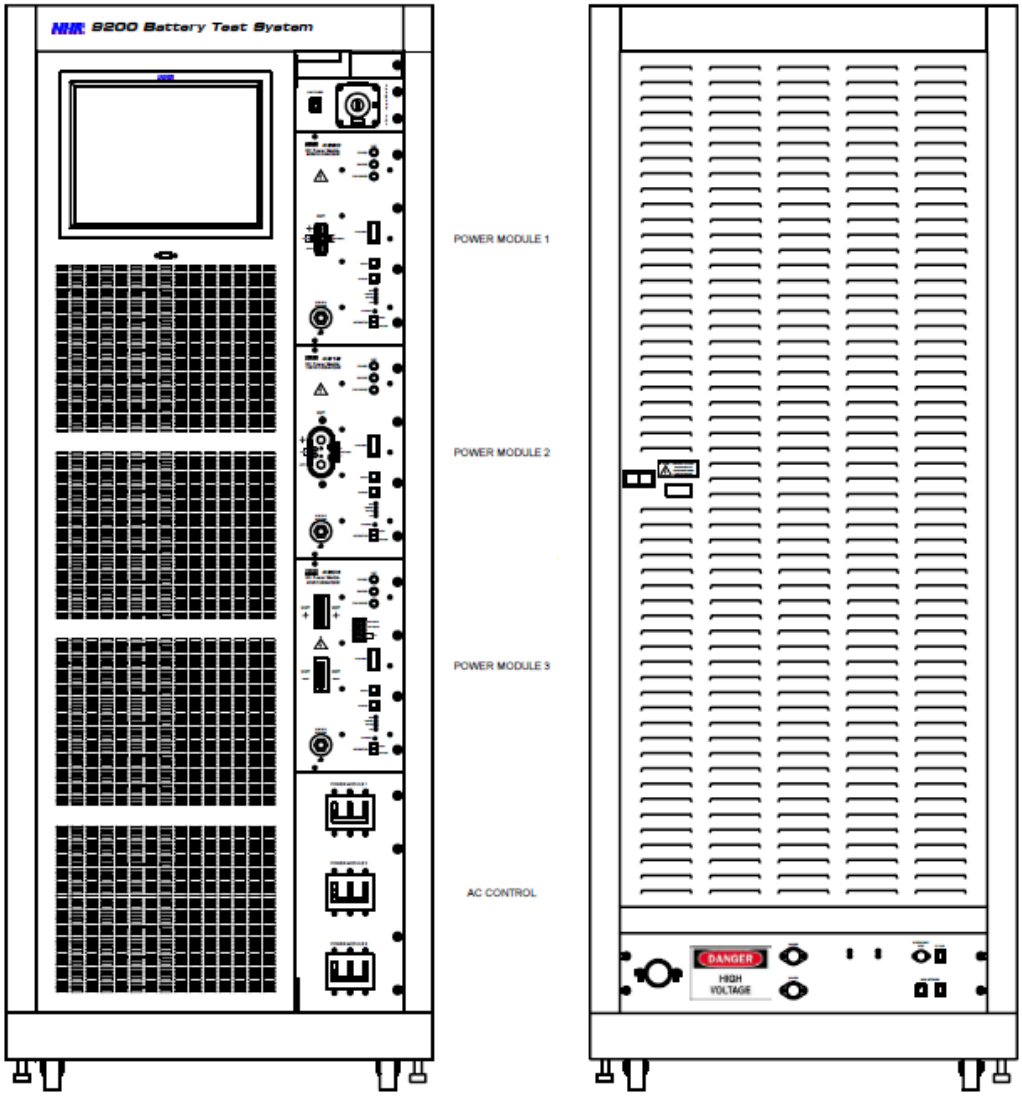

Figure 2 – 9200 System
(With 4960, 4912, and 4904 shown)

1.4 NHR 4900 DC Power Module(s) Introduction

The NHR 4900 DC Power Module family consists of the following model numbers:

- Model 4904 - NHR DC Power Module (40V / 600A / 8kW Source / 12kW Sink)
- Model 4912 - NHR DC Power Module (120V / 200A / 8kW Source / 12kW Sink)
- Model 4960 - NHR DC Power Module (600V / 40A / 8kW Source / 12kW Sink)

Each DC Power Module provides the following user accessible interfaces:

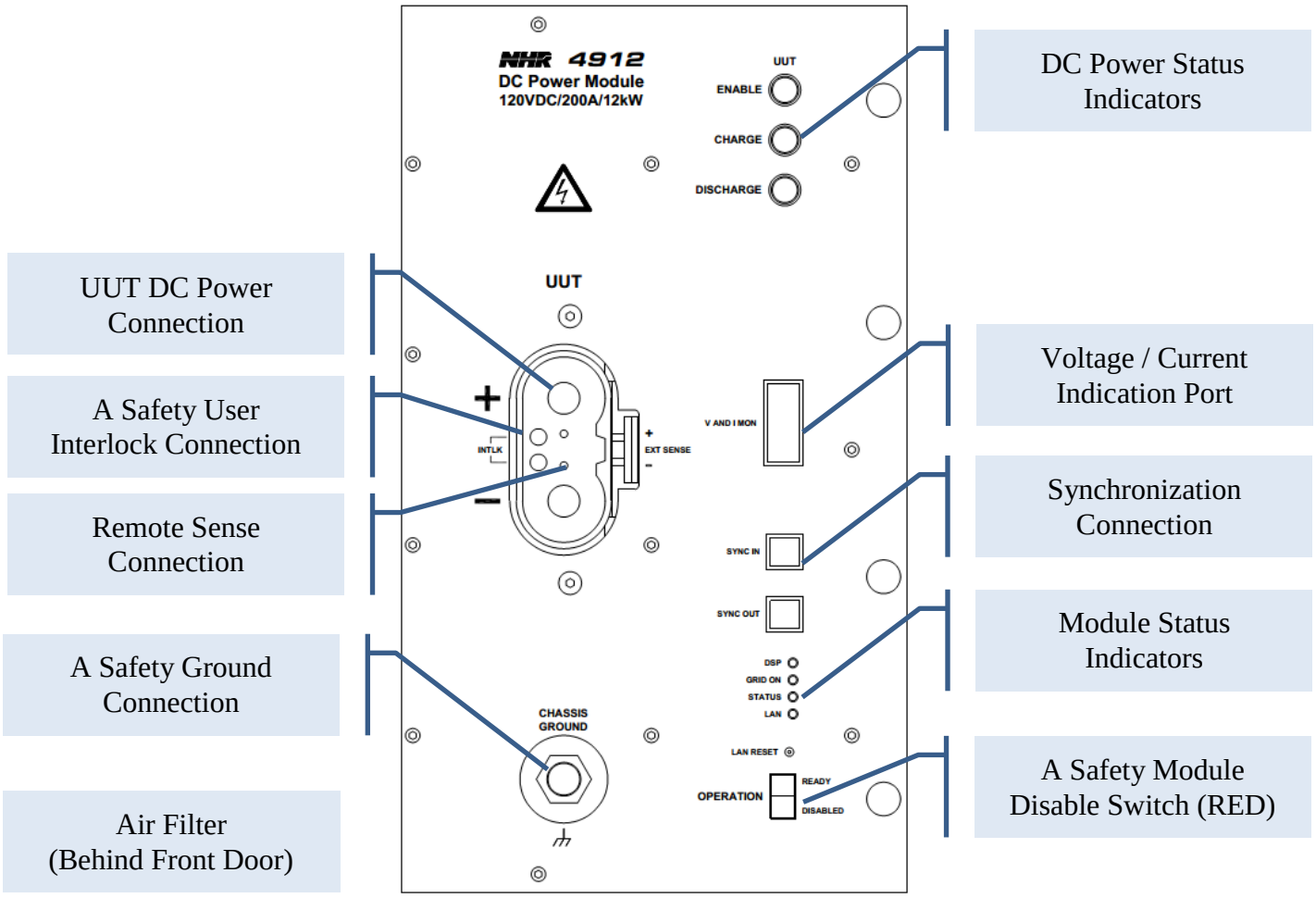

Figure 3 - NHR 4912 User Interface

1.5 WARNING: LIVE CIRCUITS

NO USER SERVICABLE COMPONENTS ARE CONTAINED WITHIN THE POWER MODULE. INTERNAL COMPONETS MAY ONLY BE ACCESSED BY NH RESERCH QUALIFIED TECHNICIANS.

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2. INSTALLATION

2.1 Preparations for Use

The 9200 cabinet requires three (3) phase AC input power. The Line to Line voltage must be within specification per Section 6.3.

2.2 Initial Inspections

Prior to shipment, the system was inspected and found to be free of mechanical or electrical defects. Upon unpacking, inspect for any damage that may have occurred in transit. If damage is detected, file a claim with the carrier immediately and notify NH Research Customer Support Department. Keep all packing material if a need arises to return the system.

2.3 Location Mounting and Cooling

This unit is fan cooled. The air intake is from the front of the cabinet and the exhaust is to the rear of the cabinet.

NHR recommends 30 inches (76cm) unrestricted air space to the rear of the cabinet and 24 inches (60cm) unrestricted air space to the front of the cabinet.

2.4 Modules and Pre-Wired Configurations

The system is delivered with the requested modules pre-installed and configured for use. Unused slots (in the 9200) can be pre-wired for a specific module type thereby allowing them to be easily added in the field. The number and types of modules as well as any pre-wiring must be specified at the time of order.

2.5 Facility Power Requirements

The system can be configured to operate from a nominal 200VL-L to 494VL-L. This must be specified at time of order. The Line to Line voltage must be within specification per Section 6.3. The nominal voltage is specified on the label above the rear door.

2.6 WARNING: LIVE CIRCUITS

INSTALLATION WILL REQUIRE REMOVING SAFETY SCREENS WHICH PROTECT USERS FROM LIVE AC CONNECTIONS. READ THIS SECTION COMPLETELY BEFORE ATTEMPTING INSTALLATION OF THE SYSTEM.

2.7 AC Input Wiring Recommendation

CAUTION
Connection of this system to a three phase AC Line should only be made by an electrician or other qualified personnel.

WARNING
There is a potential shock hazard if the system is not connected to an electrical ground via the safety ground connection at the AC input terminals

WARNING
Connecting the AC Line input to an AC Line that is unable to absorb energy quickly, (i.e., a "soft" source) may result in an increase in voltage on the line during regeneration. If the voltage rises to the maximum allowed, the NHR equipment will shut down. OTHER EQUIPMENT ON THE SAME LINE MAY BE DAMAGED.

The following table is supplied as a general recommendation for the wire gauges and service feed capabilities. The three phase AC Line connects to the system via a terminal block located inside the cabinet on the floor at the rear of the unit. There is a hole with cable strain relief for the cable as per the attached picture. This cable should be three wire and ground.

9210 Single Channel System

Input Voltage Line – Line	**In Cabinet Breaker Rating (Per Module)**	**RECOMMENDED WIRE GAUGE / Per Phase and Ground Current**
		9210-49xx-12
208V	**30A**	**10 AWG / 30A**
240V	**30A**	**10 AWG / 30A**
380V	**20A**	**12 AWG / 20A**
416V	**20A**	**12 AWG / 20A**
480V	**15A**	**12 AWG / 15A**

9200 System

Input Voltage Line – Line	**In Cabinet Breaker Rating (Per Module)**	**RECOMMENDED WIRE GAUGE / Per Phase and Ground Current**		
		9200-49xx-12	**9200-49xx-24**	**9200-49xx-36**
208V	**30A**	**10 AWG / 30A**	**6 AWG / 60A**	**4 AWG / 90A**
240V	**30A**	**10 AWG / 30A**	**6 AWG / 60A**	**4 AWG / 90A**
380V	**20A**	**12 AWG / 20A**	**8 AWG / 40A**	**6 AWG / 60A**
416V	**20A**	**12 AWG / 20A**	**8 AWG / 40A**	**6 AWG / 60A**
480V	**15A**	**12 AWG / 15A**	**10 AWG / 30A**	**8 AWG / 45A**

THE AC INPUT CURRENT AND VOLTAGE RATING ARE MARKED ON THE REAR OF THE UNIT.

THE PROTECTIVE EARTH GROUND MUST BE CONNECTED BEFORE APPLYING AC LINE POWER TO THE DC POWER MODULE.

2.8 Permanent Installation

For permanent installation of cabinet:

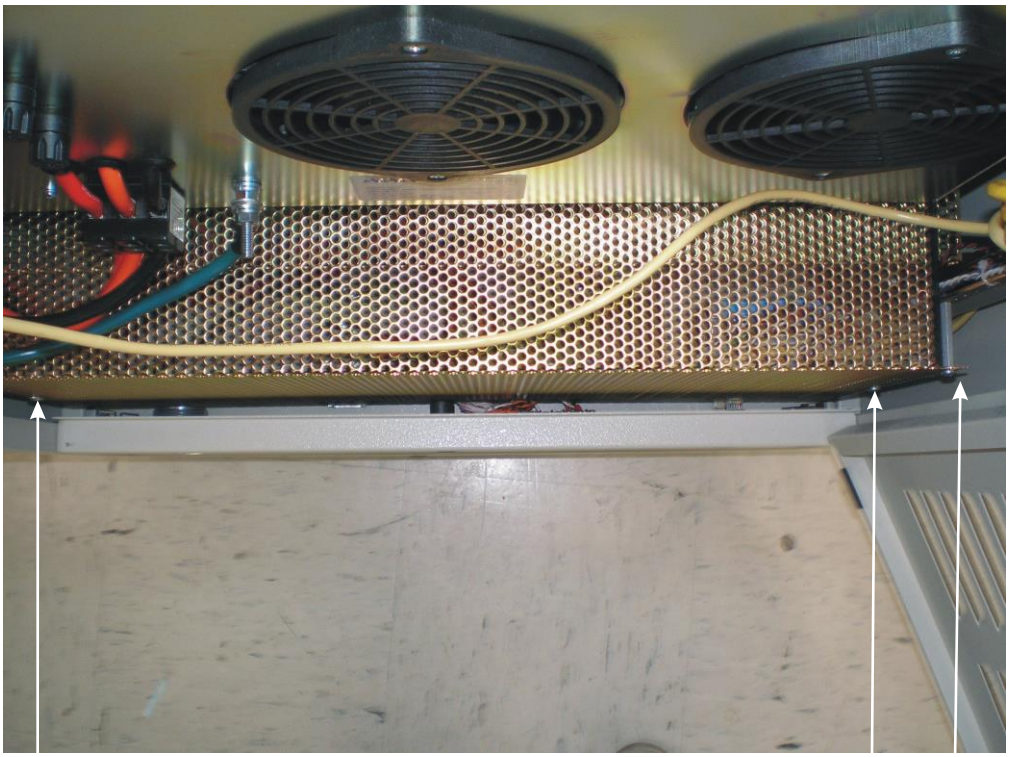
- A switch or circuit breaker must be included in installation.
- It must be suitably located and easily reached.
- It must be marked as the disconnecting device for the equipment.

2.9 Accessing the AC Input Connection

Step 1: Remove the rear door.
The rear door must be unlocked and removed to access the lower protective screen.
Pull down on upper door pin. Once the door pin clears hole the door will fall free.
The door ground strap may also need to be removed to fully remove the rear door.

Figure 4 - Rear Door Release Pin

Step 2: Remove the safety screen by removing the four (4) screws in the corners of the screen.



REMOVE 4 SCREWS RETAINING SCREEN

Step 3: Slide the service cable through the strain relief provided at the rear of the cabinet.
Do not tighten the strain relief until the power connection is made.

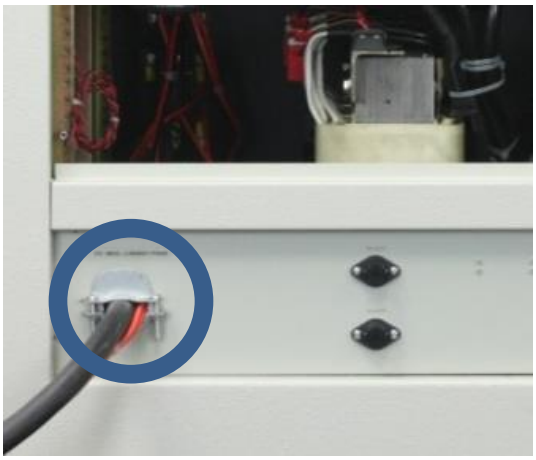
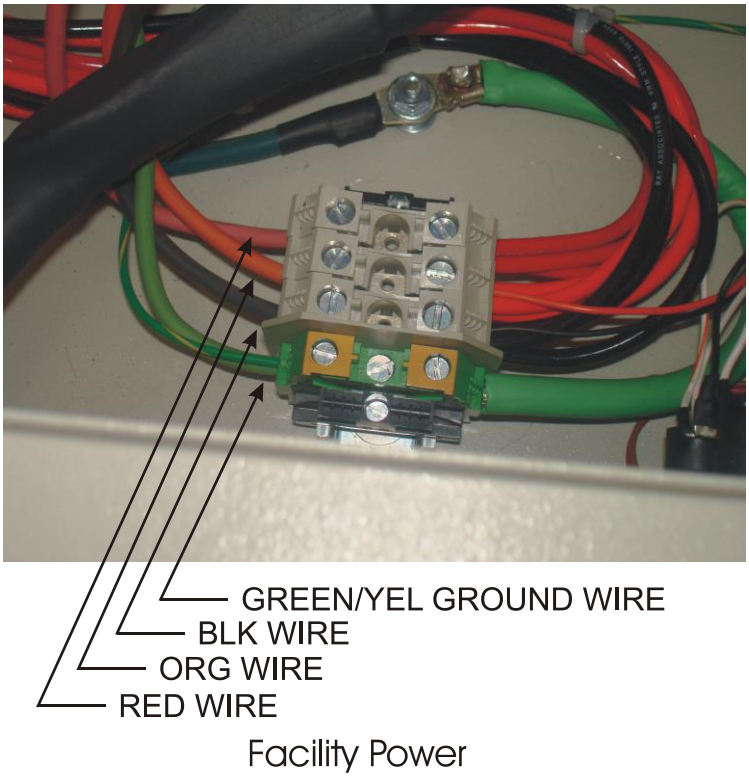


Figure 5 - Strain Relief Location

Step 4: Locate the power input terminal block.
The terminal block is located below the rear door on the left hand side of the cabinet.
There is no phase-rotation requirement when connecting the 3-Phase AC power.
Ensure all connections are tight including the safety ground connection.



Step 5: Tighten the strain relief & replace the safety screen.

Step 6: Replace the rear door.
Ensure the door ground wire is solidly connected to the rear door.
The system will not operate unless the rear door is closed and depresses the interlock switch.
NH Research provides an access key which can be used to lock this service door.

2.10 Ethernet Connection

The 9200 and 9210 cabinet use Ethernet as the primary communication any controller and the NHR DC Power Modules. The internal controller and modules are initially assigned a static IP address in the 192.168.0.xxx sub-domain. Refer to section XXX for information on how to change the IP address for the system.

The back panel provides three (3) standard Ethernet 100BastT RJ45 connections.

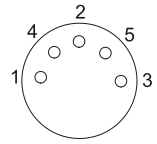
The top connection is directly wired to the internal controller's second LAN port and is provided for to allow IT departments to manage the controller without direct access to the test channels.

The bottom connections are wired to an internal switch which supports auto-MDIX. Auto-MDIX detects the required connection type and eliminates the need for cross over cables. Through this connection, an external system, controller, or PC may communicate with any of the modules, the other Ethernet port, and the internal controller. This connection should be used with an external PC or when connecting multiple cabinets together.

Mating Cable Type:		
Standard Ethernet Cable	Belkin	A3L791-14 (or equivalent)

2.11 Remote E-Stop Expansion Connector

The remote E-Stop expansion connector allows multiple cabinets to be wired where any E-Stop button or a remote stop button will disable the entire group. A jumper plug is supplied and must be installed if this feature is not utilized.

P10 Mating Connector	MFG p/n	Manufacturer
 P10 REAR VIEW	05CL5MX	SwitchCraft
	6355663	NH Research

The supplied plug is preconfigured with PIN 1 and Pin 2 connected. This supplies the interlock voltage potential to both the Emergency Off switch as well as the rear door detect switch.

This plug (or similar connection) must be present when operating a cabinet as a standalone system.

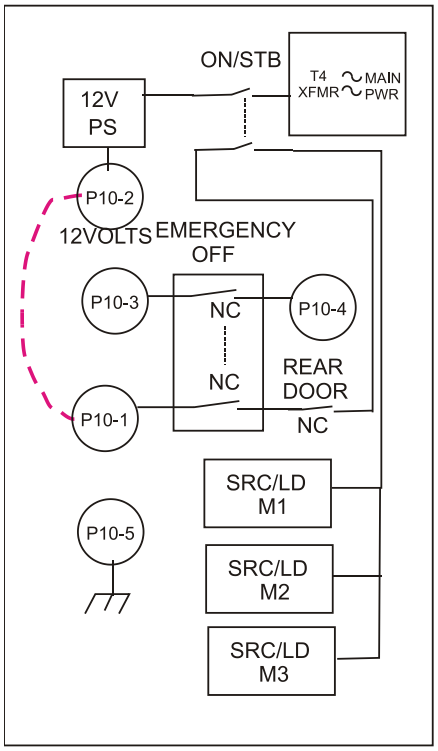


Figure 6 - Wired for single operation

2.11.1 Expanding E-Stop between Multiple Cabinets

The P10 Expansion plug may use the following wiring diagram to expand the Emergency Stop between multiple cabinets. Connections shown as dashed lines.

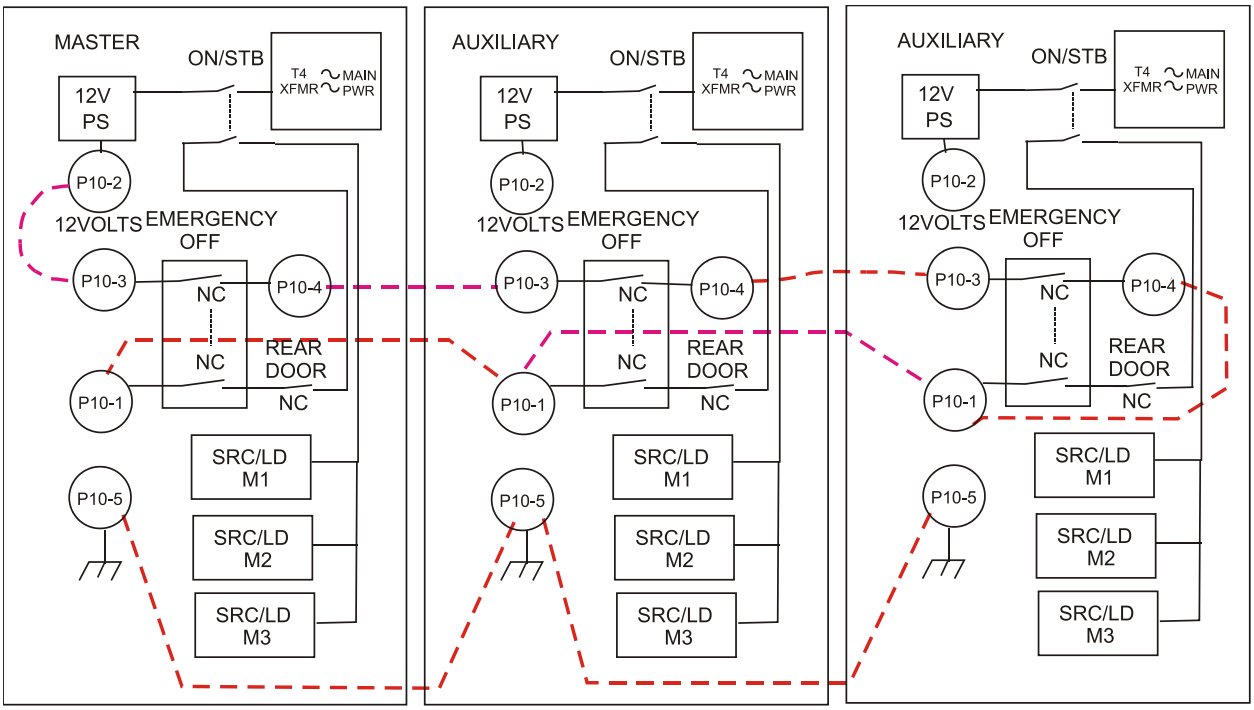


Figure 7 - Wired for Multiple Cabinets (remote Emergency Off)

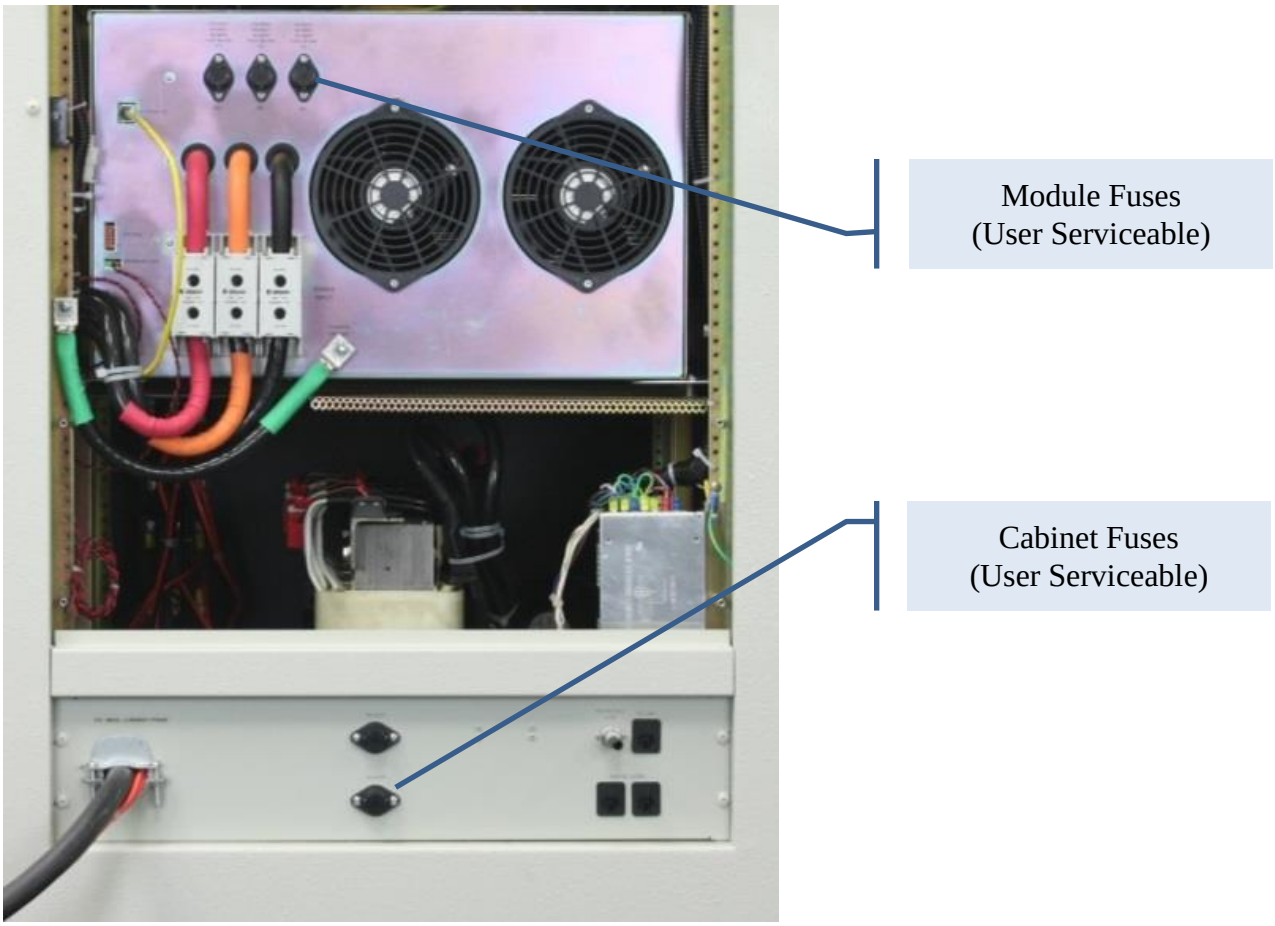
When configured as wired above, the following actions will result in the following:

ACTION	Which Cabinet	RESULT
Push EMERGENCY OFF	Any	All DC Power Modules shut down.
Open rear door	Any	DC Power Modules in this cabinet shut down.
ON/STBY in STBY	Master Only	LAN, PC, & Fans in this cabinet shut down All DC Power Modules shut down.
ON/STBY in STBY	Auxiliary Only	LAN, PC, & Fans in this cabinet shut down DC Power Modules in this cabinet shut down.
Facility Power Loss	Master Only	LAN, PC, & Fans in this cabinet shut down All DC Power Modules shut down.
Facility Power Loss	Auxiliary Only	LAN, PC, & Fans in this cabinet shut down DC Power Modules in this cabinet shut down.

2.12 User Replaceable Fuses

The Module Fuses are used to protect the soft-start current when the module is first turned on. Contact NHR Customer Support if one or more of these fuses fail.

The Cabinet fuses protect the low voltage power supplies, Ethernet switch, and internal controller. Contact NHR Customer Support if one or more of these fuses fail.



	4904	4912	4912 – Version 1	4960
Module Fuse	KTK-15 15A / 600V Fast Acting	KTK-5 5A / 600V Fast Acting	ABC-5 5A / 250V Fast Acting	KTK-2 2A / 600V Fast Acting
Cabinet Fuse	KTK-2 2A / 600V Fast Acting			
Manufacturer	Cooper Bussmann			

3. TURNING THE SYSTEM ON / OFF

3.1 Turning the System ON

Verify the rear door is closed.
Verify the front door is closed.
Verify the Emergency Power Off mushroom switch is not depressed out.
Verify the power switch on the Front Door is in "STAND BY" (Down Position).
Verify the circuit breakers on the front panel are all off.
Turn on facility power breaker (if currently off).

Figure 8 - Current 9200 / 9210 Systems

Figure 9 - Older 9200 Systems

Switch the ON/STANDBY switch to "ON".
Then switch on the front circuit breakers within 10 seconds.

The following will occur when the ON/STANDBY switch is turned to the ON position:

- Network switch turns on within the cabinet.
- Cabinet fans turn on.
- The internal controller turns on (may have high speed fan sound).
- The "ON" light of ON/STANDBY switch will light.

The following will occur after turning on the circuit breakers:

- Module status lights & fans turn on.
- A few audible clicks of relays and contactors (per module).

The PowerPanel software will auto start after the controller has fully started.

3.2 Turning the System OFF

Close the PowerPanel Software (More -> Exit/Shutdown -> Shutdown).
Wait until this software closes before proceeding.
Refer to section 5.9.8 for more information about accessing Shutdown via the PowerPanel.

Switch the circuit breakers to the off position.

Switch the ON/STANDBY switch to “STANDBY” (or the down position).

Facility power does not need to be switched off at this point as each power module is isolated through its own internal contactor.

4. MODEL 9200 / 9210 CABINETS AND DC POWER MODULES

4.1 Introduction

The NHR Model 9210 (single channel) and NHR Model 9200 (multi-channel) cabinets are configured with NHR Model 4900 DC Power Modules, isolation transformers, breakers and safety interfaces, and supporting electronics.

The 9210 and 9200 cabinets are pre-configured and ready for use upon connection to facility power. The main difference between these two systems is the number of modules they can support. The Model 9210 is able to be configured with one (1) module whereas the 9200 is able to be configured with up to three (3) of any of the following modules at the time of ordering.

The NHR Model 4904 DC Power Module is designed to:

Source current up to 40Volts, 600Amps and 8kW.
Sink current up to 40Volts, 600Amps and 12kW.
Emulate a battery up to 40Volts, 600 Amps up to 8kW (sourcing) & 12kW (sinking).

The NHR Model 4912 DC Power Module is designed to:

Source current up to 120Volts, 200Amps and 8kW.
Sink current up to 120Volts, 200Amps and 12kW.
Emulate a battery up to 120Volts, 200 Amps up to 8kW (sourcing) & 12kW (sinking).

The NHR Model 4960 DC Power Module is designed to:

Source current up to 600Volts, 40Amps and 8kW.
Sink current up to 600Volts, 40Amps and 12kW.
Emulate a battery up to 600Volts, 40 Amps up to 8kW (sourcing) & 12kW (sinking).

Common uses for NHR DC Power modules include battery cycling, battery performance testing, DC/DC converter testing, and DC Power supply burn-in. The same electronics is used in both sourcing and sinking current and includes a state-of-the-art battery emulation mode allowing all battery chemistries to be emulated in using simplified programming parameters.

4.2 Facility Power and Safety Features

4.2.1 Near Unity Power Factor Operation

The NHR DC Power Modules operate at a near unity power factor when receiving power from or delivering power to the facility connection. Maintaining near unity power factor prevents disturbance of the Facility power quality regardless of power flow direction. The module does not create frequency but matches the voltage waveform precisely regardless of the direction of current flow.

4.2.2 High Efficiency Regenerative Discharge

The NHR DC Power Modules convert sink (or discharge) power into clean AC power suitable for use within the facility. Traditional loads convert this power into heat which is then exhausted into the surrounding workspace or requires additional cooling facilities. By comparison, regeneration converts the majority of the discharge power to usable AC which significantly reduces the amount of waste heat generated in the surrounding environment.

4.2.3 Fast Acting Internal Relays

Each power module internally supplies fast acting relays on both the Facility AC and a second set of relays for the UUT output. These are used to isolate the module from the facility, UUT, or both depending on the operating state or when a fault is detected during operation.

4.2.4 Active AC Power Monitoring

Each power module independently monitors the facility voltage and frequency. If the voltage or frequency falls outside normal levels, the module takes action by opening both its facility contactors and UUT contactors isolating itself from both the facility and UUT. An error is generated allowing the user to know that the AC power is no longer within acceptable regions.

Additionally, the NHR DC Power Modules actively monitors its internal temperature, internal bus voltage, and limits the current between the internal bus and the facility power. If an error is detected, the power module opens both the facility and UUT contactors isolating itself from both the facility and UUT.

4.2.5 Emergency Stop and Rear Door Interlock

When either the Emergency Stop or Rear Door interlocks are opened, the Power Module opens both the facility and UUT contactors isolating itself from both the facility and UUT. An error is generated allowing the user to know that the AC power is no longer within acceptable regions.

4.2.6 User Interlock

The User Interlock the red safety disable switch is wired in series and control the UUT contactor in hardware. When either is placed into a disabled state, the output relay is opened and cannot be closed until the interlock is placed into a ready condition. This allows for an external temperature limit switch to directly disable the hardware when an external fault condition is observed.

4.2.7 Programmable Safety Limits

The module supports fuse-like programmable safety limits for Min/Max Voltage as well as Min/Max Current and Min/Max Power on a per direction basis. These features are sent to the hardware which actively monitors these conditions separate from any control program execution. When a limit is exceeded in value and delay time, the module opens its UUT relay isolating itself from the UUT.

4.2.8 Additional Built-in Safety Features

In addition to the layers of safety described above there are additional safety features which can be implemented by an end customer. These include software watchdog, regulation settings (such as adding a voltage limit to a discharge or charge), and other programmable features available through the drivers or PowerPanel interface

4.3 Upgrade Features

4.3.1 Firmware Upgradable

The output control is performed by an upgradable, onboard DSP device for fast measurement and command response times. All the micro code for the DSP and the communication microcontroller is stored in FLASH memory so that firmware upgrades can be performed in the field by downloading over the control interface.

4.3.2 Pre-Wired Chassis

The 9200 can be pre-wired to accept a future installation of a power module.
The type of power module must be selected at the time of order.

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5. POWERPANEL BASIC OPERATION

5.1 Introduction

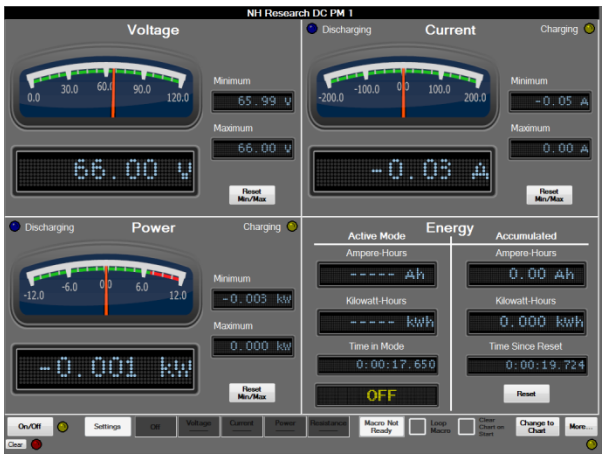
PowerPanel is a software package provided with every NHR 9200 and 9210 system.
This software package is pre-installed and pre-configured for each module within the system.
An additional copy is provided with the driver installation CD allowing one additional laptop or control PC to remotely control up to three (3) power modules.

5.2 Starting PowerPanel

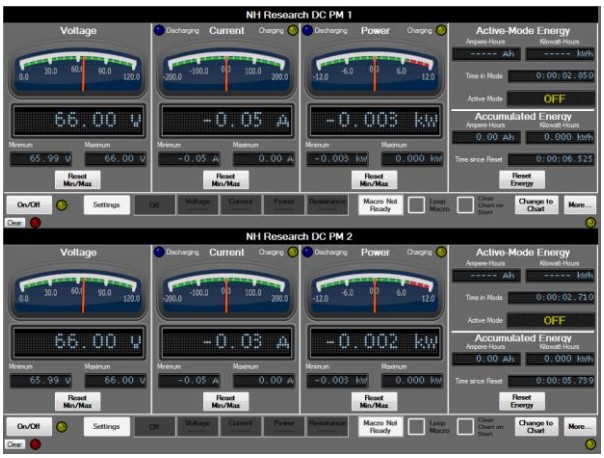
The PowerPanel is configured to start up automatically when the internal controller is started. It can also be launched using an ICON on the desktop.

Upon staring the PowerPanel, the applicatoin attempts to connect with each NHR DC Power Module as described by the configuration file. After connecting, the PowerPanel will display a set of indicators for each of the configured DC Power Module.

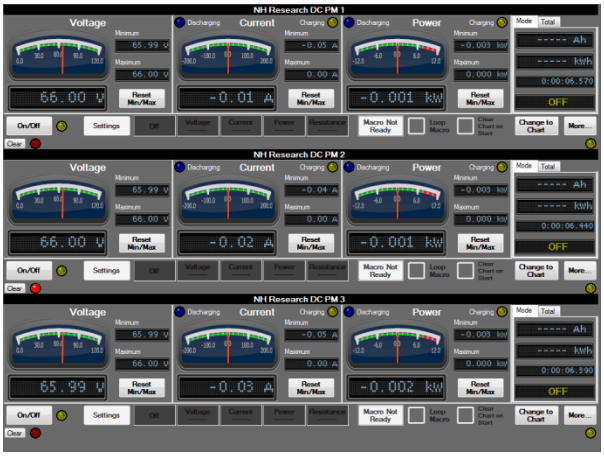
One Module PowerPanel



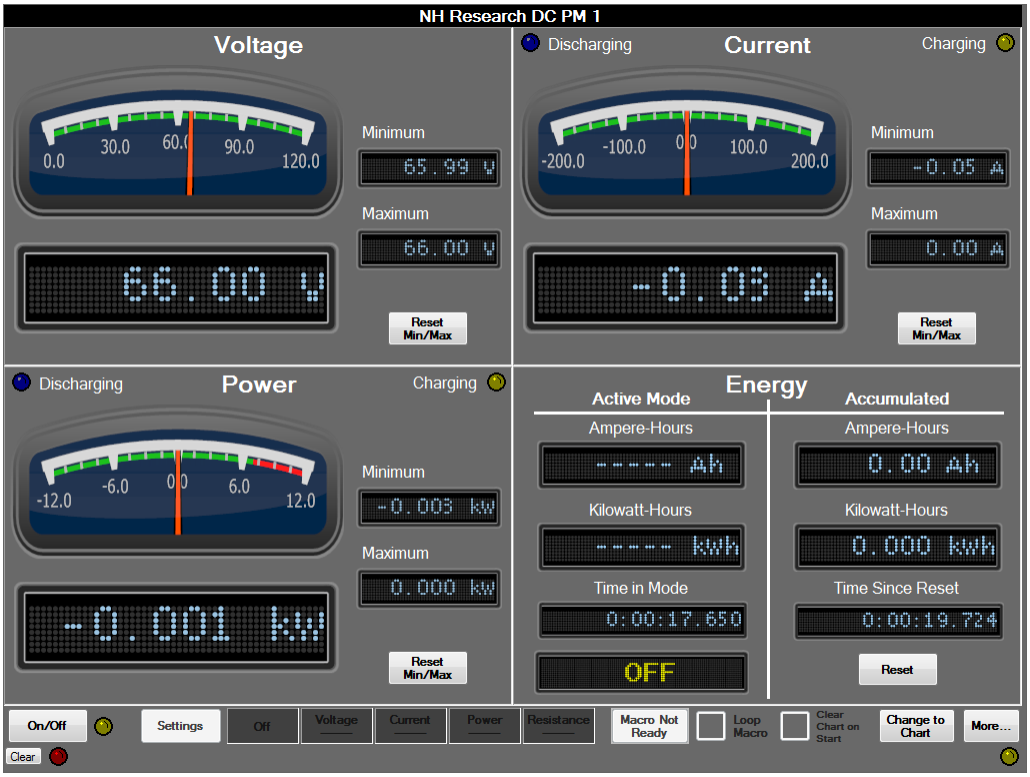
Two Module PowerPanel



Three Module PowerPanel



5.3 Main Screen – Gauges and Meters



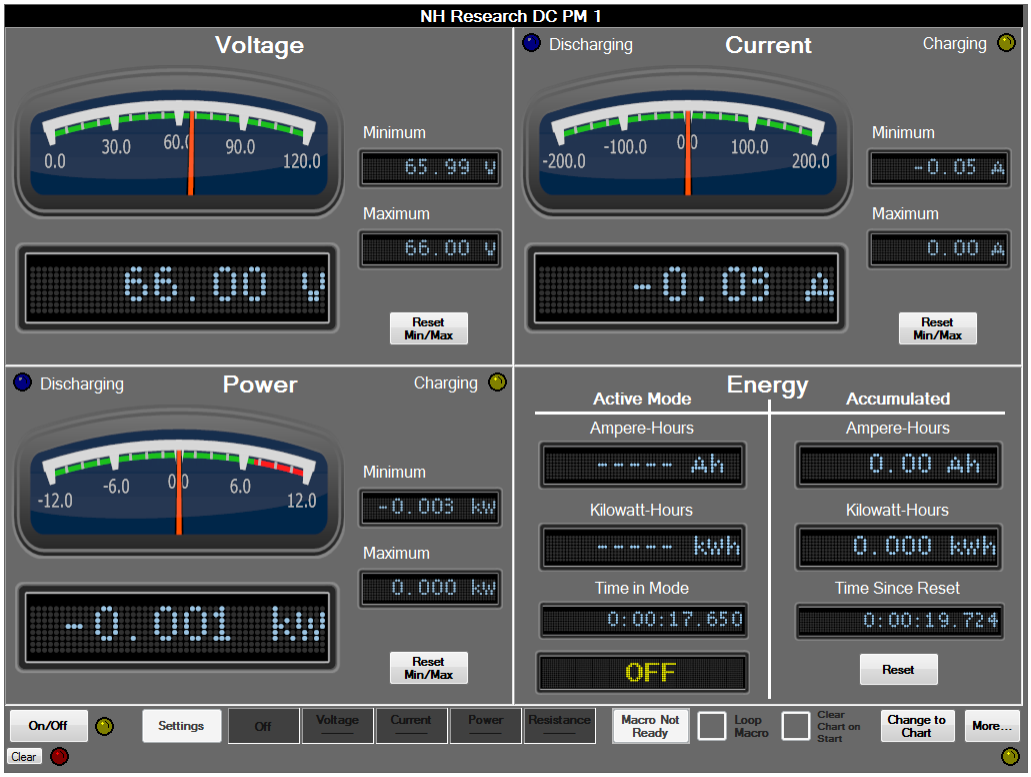
There are a number of gauges / meters on the PowerPanel. Each of these gauges / meters is represented in both digital (numeric) and graphical (Gauge) forms. Both readings are updated every ½ second.

Voltage	This Gauge shows the instantaneous Voltage (Volts).
Current	This Gauge shows the instantaneous Current (Amps). This Gauge will show negative current while discharging by default.
Power	This Gauge shows the instantaneous Power (Watts). This Gauge will show negative Power while discharging by default.

Charging / Discharging Indicators

Current and Power Gauges have these indicators.
When Charging, or sourcing DC current, the Charging (Green Indicator) illuminates.
When Discharging, or sinking DC current, the Discharging (Blue Indicator) illuminates.

5.4 Main Screen – Additional Digital Readouts



The hardware automatically computes a number of measurements. These values are updated on the PowerPanel every ½ second.

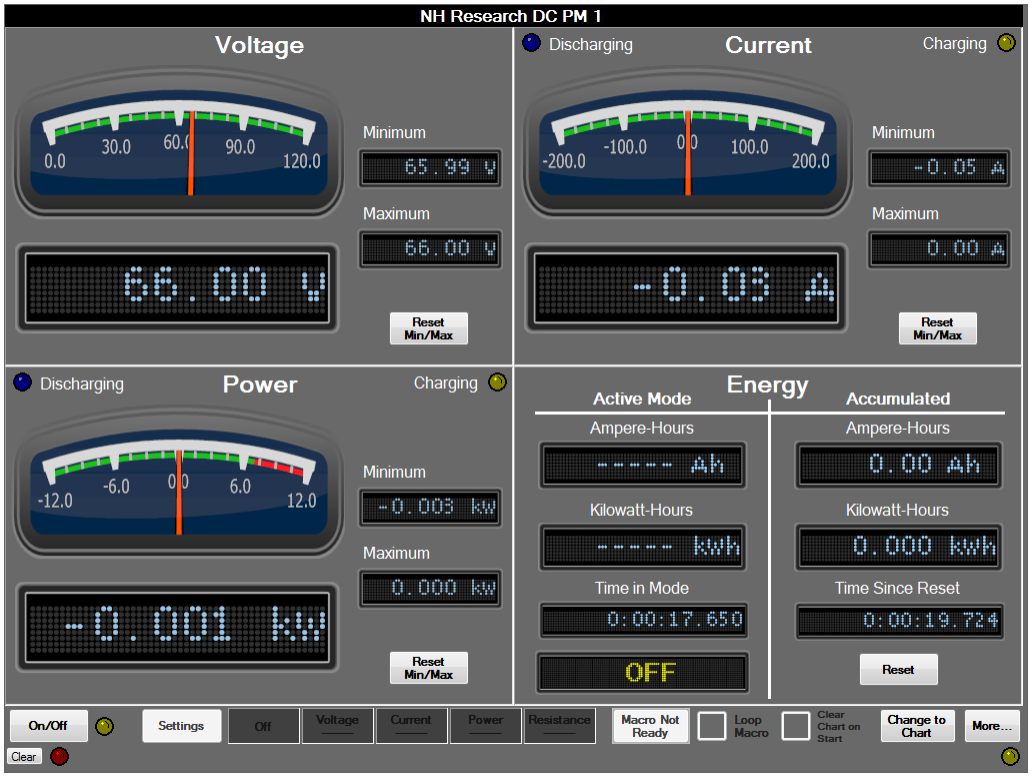
Minimum Voltage, Current, or Power
: these display the Minimum instantaneous readings taken by the PowerPanel since the Reset Min/Max has been pressed.

Maximum Voltage, Current, or Power
: these display the Maximum instantaneous readings taken by the PowerPanel since the Reset Min/Max has been pressed.

Active Mode Measurements
: Ampere-Hours, Kilowatt-Hours, and Time in Mode are the accumulated values while in this programmed mode.

Accumulated (Total Values)
: Ampere-Hours, Kilowatt-Hours, and Total time since reset are displayed.

5.5 Main Screen – Indicators



On/Off (Next to the On/Off button)

Off means the DC Power Module is in the “OFF” state.
Illuminated means the Module is in an active state (Including Standby).

Communication Indicator (Lower Right hand corner)

Blinking Indicates normal communication with the DC Power Module.

Error – Red Indicator next to clear button

Off indicates there is no error.
Red indicates an error and an error message is displayed.

5.6 Main Screen – Condition specific Indicators

Remote Mode / Locked –

User controls are locked because another test stand is controlling the hardware.

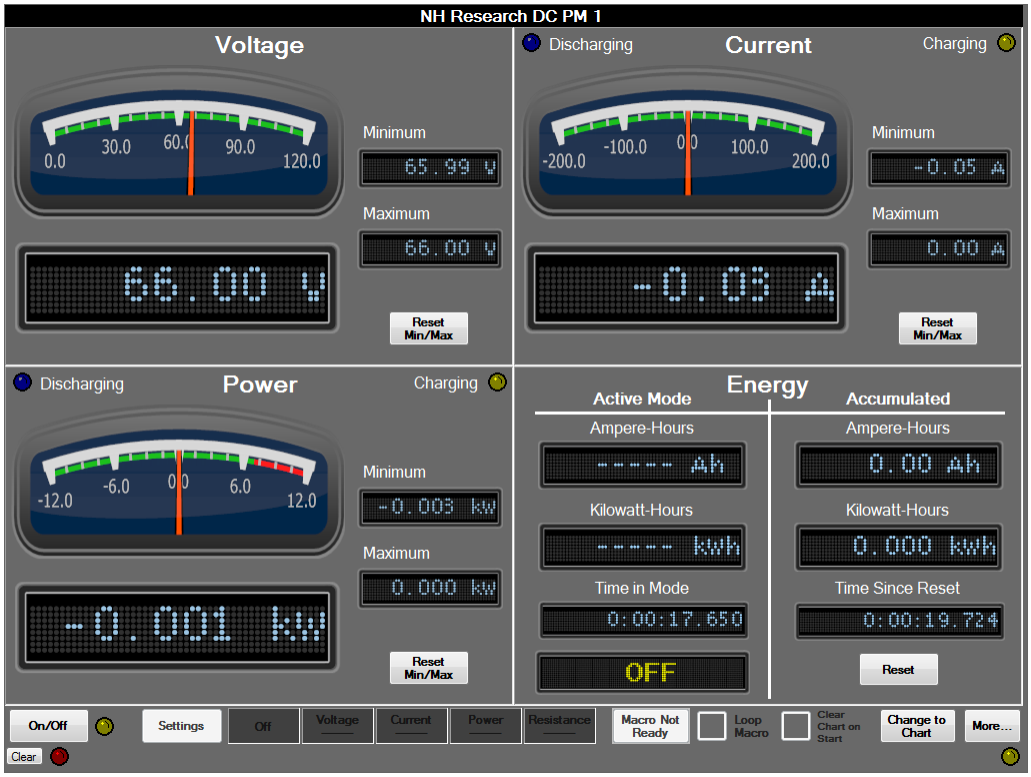
 Busy (Lower right hand corner next to status light)

When this ICON appears the DC Power Module is waiting for a task to complete.

Trigger (Lower right hand corner next to status light)

When this ICON appears the DC Power Module is waiting for a trigger from a valid trigger source.

5.7 Main Screen – Buttons



These buttons are enabled when the module is not being externally controlled.

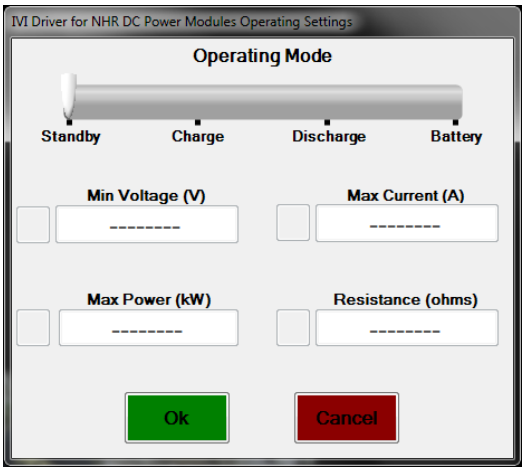
ON/OFF	Enables the DC Power Module in Operational State Standby Or, Forces the DC Power Module to OFF state (if enabled).
Settings	Sets the operational mode for the DC Power Module.
Macro Not Ready	Shows the current state of a MACRO.
Loop Macro	When checked, an executed macro will loop until manually stopped.
Clear Chart on Start	When checked, the chart screen will be cleared upon macro start.
Change to Chart	Changes the Main Screen to a Chart Screen.
More…	Additional Configuration Options.
Clear	Clears any Status Errors.
Reset Min/Max	Resets the digital readout for minimum and maximum values Voltage, Current, Power.
Reset Energy	Resets the Accumulated Energy Counters.

Note: Many of these buttons are disabled or removed when the DC Power Module is being controlled externally. See the remote mode section for more information.

Warning when using Inductive Loads or Sources: Pressing the ON/OFF disconnects the DC Power Module output and may cause a very DI(t)/Dt. This abrupt current change can result in very high terminal voltage.

5.8 Settings

This window allows the user to manually set an operational state (Standby, Charge, Discharge, or Battery) and limiting mode including Constant Voltage (CV), Constant Current (CC), Constant Power (CP), and Constant Resistance (CR). The DC Power Module will immediately enter the mode requested with the settings requested when OK is pressed.



Operational States:

Standby: The DC Power Module will not source or sink DC Current (Idle State).
Charge: The DC Power Module sources DC Current up to the limiting values.
Discharge: The DC Power Module sinks DC Current up to the limiting values.
Battery: The DC Power Module will act as a voltage source and sink current as necessary up to the limiting values.

Limiting Values:

More than one limiting value can be set at the same time. When selected these limiting values determine the DC Power Modules functional behavior. When not enabled the module will assume these are uncontrolled limits and will use the maximum hardware capability.

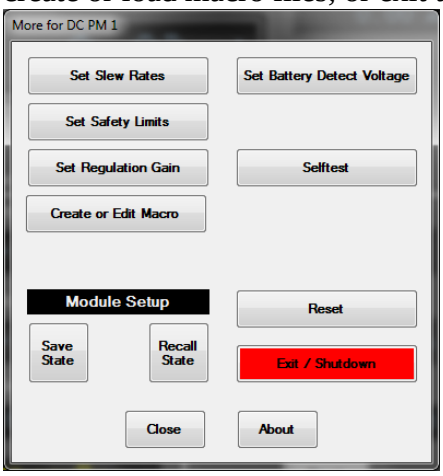
(Min/Max) Voltage: The DC Power Module will increase or decrease current flow to maintain this Programmed Voltage.
Max Current: The DC Power Module will not allow Currents above this value.
Max Power: The DC Power Module will not allow Power above this value.
Resistance: Acts as current dependent voltage offset between measured voltage and set voltage (a functional series resistance).

Example: A DC Power Module set for Charge and with a programmed voltage of Voltage = 48V, and Current = 100A will result in a supply acting as a 48V/100A supply.

In the above example it is easy to see that producing a CCCV (Constant Current, Constant Voltage) profile is easy to accomplish. This can be additionally limited with resistance and power terms as well.

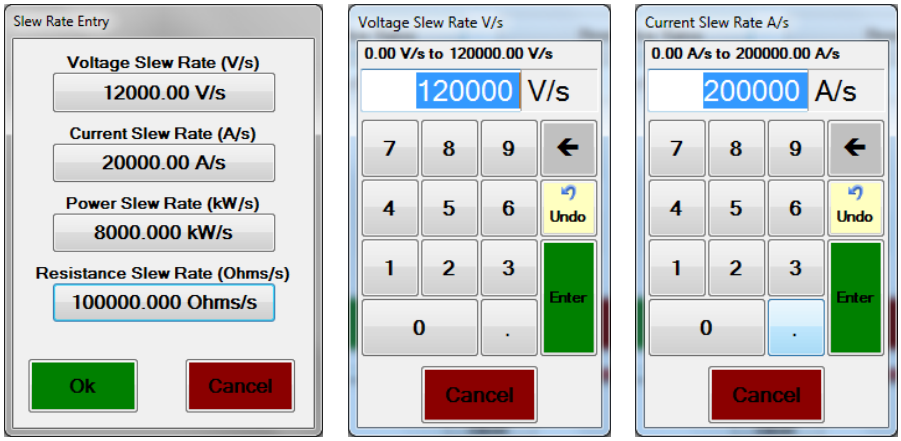
5.9 More…

This window allows the user to set more advanced controls such as slew rates, safety limits, create or load macro files, or exit to windows.



5.9.1 More… → Set Slew Rates

The DC Power Module has the ability to set slew rates for voltage, current, power, and/or resistance. This allows the module to "Ramp" the voltage and/or current at a defined rate.



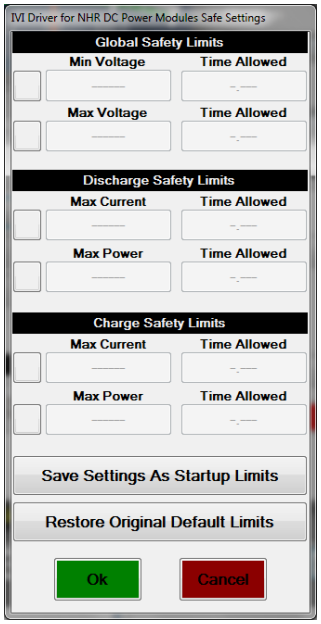
Note: Slew rate applies to new settings in the same operational mode. Changing Modes (Charge to Discharge, etc.) will result in the fastest transition possible.

5.9.2 More… → Reset

This button on the "More…" page sends a reset to the DC Power Module.
When a DC Power Module is reset it will disable the module (Similar to pressing ON/OFF button), Reset the Slew Rate to Maximum, reloads startup safety limits, and resets regulation gain.

5.9.3 More… → Safety Limits

Safety limits provide a secondary mechanism to prevent damage to the UUT due to operator or programmatic error. If an average value of any safety limit setting is exceeded for the time allowed the DC Power Module will enter an "OFF" state and disconnect from the UUT. If the safety limits are tripped the DC Power Module will require a reset.



There are three (3) groups of safety limits.
Global safety limits (Voltage) apply in all states including standby.

Discharge safety limits apply when the unit is sinking current either in discharge or battery emulation.

Charge Safety limits apply when the unit is sourcing current either in charge or battery emulation.

The Time Allowed is modeled after a circuit breaker or slow blow fuse. This time function allows very short pulses above the limit setting to occur without tripping a safety limit.

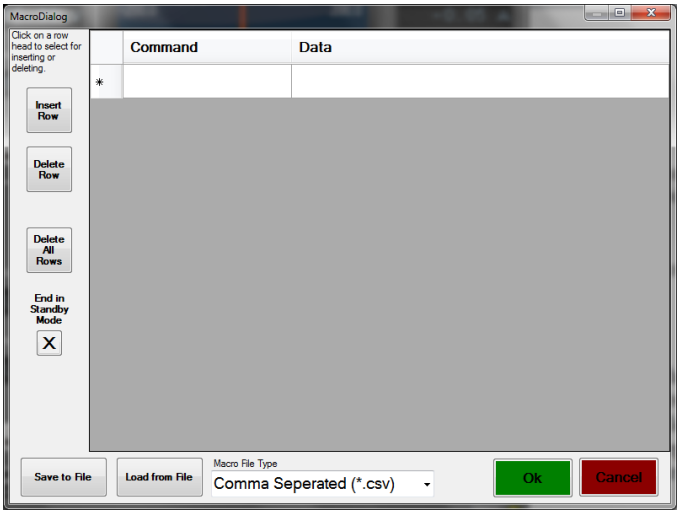
Time Allowed typical values
Time Allowed = 0.1 – Similar to a fast blow fuse.
Time Allowed = 0.5 – Similar to a slow blow fuse.
Time Allowed = 1.0 – Acts as a very slow blow fuse.
Time Allowed = 0.0 – Instant Fuse (A single reading will cause a safety limit trip).

Warning when using Inductive Loads or Sources: A safety limit trip disconnects the DC Power Module output and may cause a very DI/Dt. This abrupt current change can result in very high terminal voltage.

5.9.4 More… → Create or Edit Macro

Macros, up to 1000 steps, are downloaded to and execute locally to a single DC Power Module. Macros can adjust slew rates, apply settings, wait for a slew to finish, wait for time, or wait until a specific voltage, current, or power level is reached. This functionally is provided at the touch panel to allow automation of simple test protocols.

Macros are intended to provide high speed setting capability or when for very simple test patterns. Macros should not be considered a sequencer since only basic controls are provided for use on a single DC Power Module.

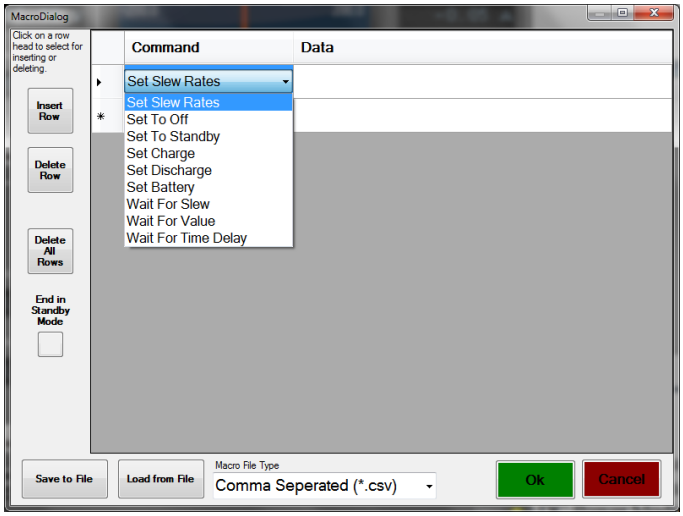


This screen appears when the Create or Edit Macro button is pressed and allows the operator to load a macro from a file, generate a new step based macro, or save the macro to a file for later use.

The macro can be loaded from or saved in the following file formats:

- Comma separated (.NHR or .CSV)
- Tab delimitated (.TXT)
- Space delimitated (.prn)

To create a new macro simply touch the "Command" column for the desired step and select the Operational State and limiting values desired.



5.9.5 More… → Save State / Recall State

Save and Recall states provide a allowing the user to save the previous setup including operating state, safety limits, regulation gain, slew rates, etc.

5.9.6 More… → Set Battery Detect Voltage

Battery Detect protects against high currents or high voltages for the following conditions:

1) A battery has been wired to the power leads with reverse polarity.
2) Charge mode is activated with a potential open circuit.

The module will accept or error switching from OFF to any operating state (including standby):

- ALLOWED – Battery Detect is set to Zero (disabled).
- ALLOWED – Battery Detect is Non-Zero and Power Leads have slightly positive voltage.
- ERROR – Battery Detect is Non-Zero and Power Leads are Zero or Negative.

The module will accept or error when entering Charge from any state other than charge:

- ALLOWED – Battery Detect is set to Zero (disabled).
- ALLOWED – Battery Detect is Non-Zero and sense leads measure a higher voltage value.
- ERROR – Battery Detect is Non-Zero and sense leads measure a lower voltage value.

If an Error is detected, the Module is placed into an OFF state and a battery detect error message is provided.

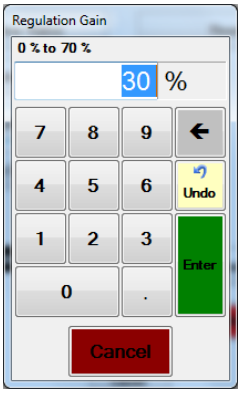
Note: If the module is turned off for any reason (including error) and the battery detect voltage is set to disabled (0), The Module will automatically re-enable this safety feature with default values.

Default value is 5% of Module Voltage

5.9.7 More… → Set Regulation Gain

The DC Power Module uses a Digital Signal Processor (DSP) to maintain tight regulation of the hardware. Regulation gain provides a programmable adjustment for the loop gain and can be used to de-tune or speed up the power module.

Please consult NH Research before making adjustments to this value.

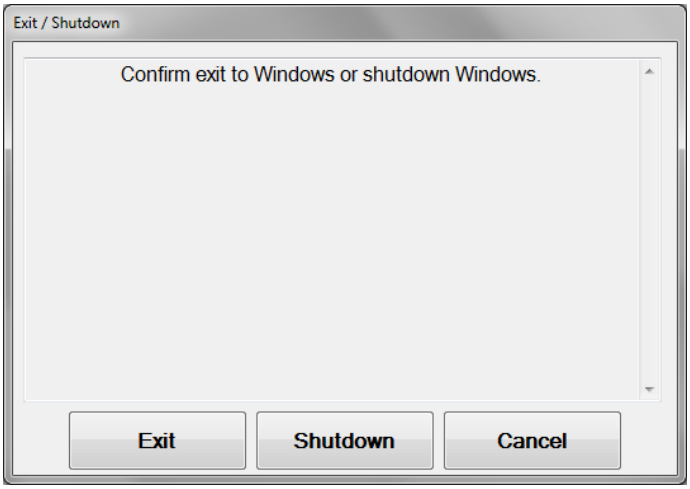


Default value is 30%

5.9.8 More… → Exit / Shutdown

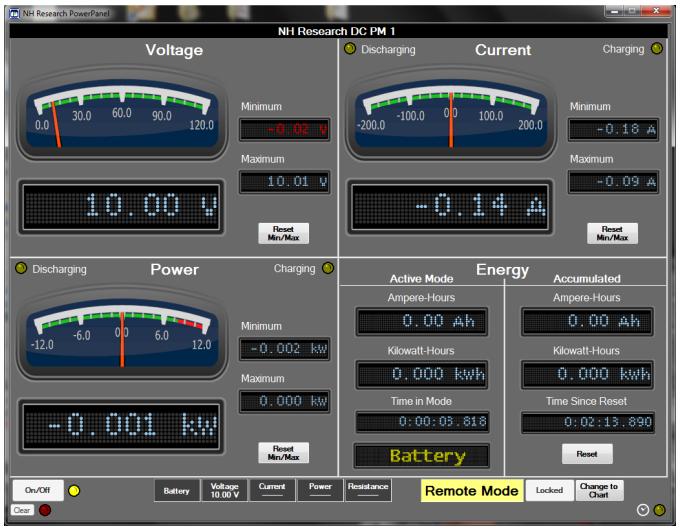
The PowerPanel can exit to a Windows 7 Desktop or start the shutdown process for the controller. These functions are found by pressing more than Exit / Shutdown and the following window appears.

Exit is generally used when local controller administration functions are needed (such as changing the IP address) whereas Shutdown is typically used to turn off the system.



5.10 Remote Lockout

An External PC can send a lockout command which will disable the control of a DC Power Module through the PowerPanel. When this occurs the PowerPanel will show “Remote Mode” and will prevent access to the controls that could affect the test.

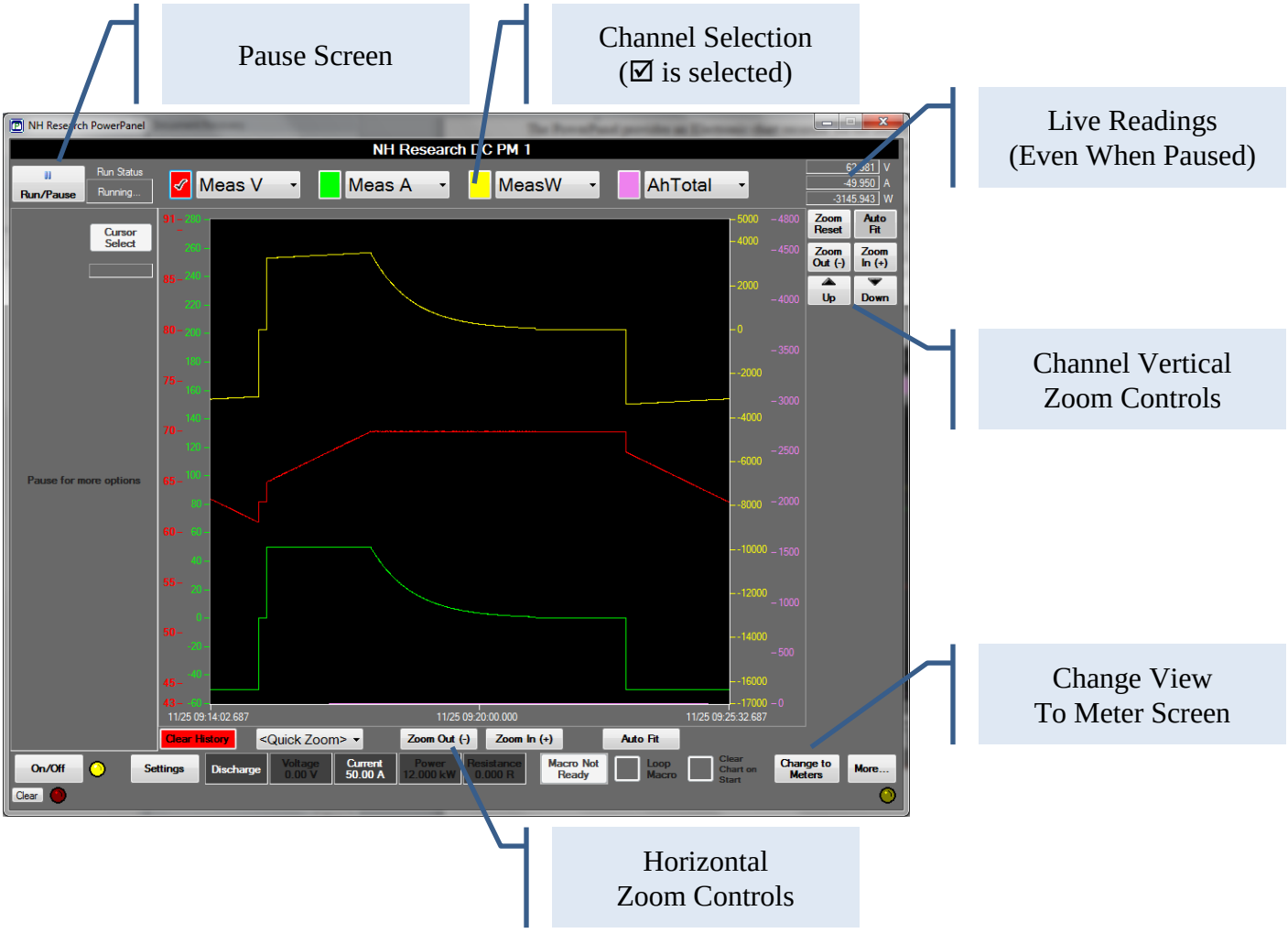


5.11 Change to Chart

The PowerPanel provides an Electronic chart recorder for the DC Power Module. Pressing the Change to Chart button converts the displayed screen from meters to the chart recorder screen. Changing to this screen does not affect normal operation of the DC Power Module. The chart recorder will collect measurements at ½ second (500mS) intervals when the module is enabled.

Tip: In a Macro, the DC Power Module can be set to an Operation State: OFF. Doing so will also stop collection of data on the chart recorder until the module is enabled again.

On this screen, Pressing Run/Pause button will provide the user with all recorded data, Allow Zoom and cursor controls for the data, and provides a generate report button allowing a copy of the data to be saved. Pressing the Run/Pause button does not affect the operational mode, continued data collection, or macro execution of the DC Power Module.

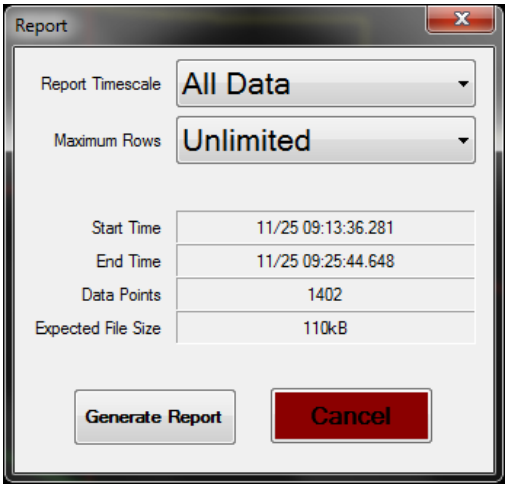


5.11.1 Pausing Chart Recorder

The chart recorder may be paused. This application continues to collect measurements in the background so no data is lost. When paused, all data (up to 18 hours) is displayed on the screen along with additional zoom, cursor, and reporting controls.

5.11.2 Reporting Data from the Chart Recorder

Pressing Pause followed by Report opens a report generation window.



All reports are generated as CSV files and may contain All Data (Currently selected), Just data shown on the screen's current view, or the data between the cursors.

Additionally, the data can be decimated (or limited) to 100, 1000, 10k, 50k, or all rows of data.

Selecting Generate report will open a filename entry. The data can be saved to the local controller drive, USB drive, or any network attached storage (share drive) if configured.

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6. 9200 & 9210 SPECIFICATIONS

6.1 Cabinet Options

NHR 9200 System Cabinet may be configured with up to three (3) DC Power Module Models. Mixed cabinet configurations are available upon request. Any unused slot(s) may be optionally ordered as pre-wired to allow a future field upgrade. This option and module type must be selected at the time of order.

NHR 9210 System Cabinet may be configured with one (1) DC Power Module.

Refer to the product brochure for ordering information.

6.2 Input Power

Three Phase AC Facility Connection at 50 / 60Hz.
Power Factor exceeding 0.9.
Typical efficiency exceeding 85%.

6.3 Input Voltage

The input voltage desired must be specified at time of order.

Typical values are 200VAC, 220VAC, 380VAC, 400, 440, and 480VAC line to line ±10%. Operation up to –15% is allowed at reduced power.

6.4 Input Current

Each power module is designed for 10kW AC Facility Power. The following table provides the expected power usage of a fully loaded power system where all modules are at maximum power in either charge or discharge.

Line-Line V	Maximum Per Phase Current		
	9210-49xx-12 9200-49xx-12	9200-49xx-24	9200-49xx-36
200VAC	30 A	60 A	90 A
208VAC	30 A	59 A	88 A
220VAC	29 A	56 A	83 A
380VAC	17 A	33 A	48 A
400VAC	16 A	31 A	46 A
480VAC	13 A	26 A	38 A

Contact NHR for other voltages / current combinations.

6.5 Physical

Model	4904	4912	4960
Test Chan Connectors	Bus Bars	Anderson EBC A32	Anderson SBS75X
Cabinet Dimensions	72” H x 28” W 31” D		
Cabinet Weight 3 CH	1475 Lbs/600Kg		
Operating Temp	0 - 35°C Full Power		
Input Power /Module	3 Ø,50–60Hz, 200. 208, 380, 400, 440, 480 +/- 10%		

6.6 Isolation and Safety

Model	4904	4912	4960
Isolation AC Inputs	1000VAC Inputs to DC Outputs / 1000VAC Inputs to chassis		
Isolation UUT Inputs	600V UUT to chassis	1000V UUT to chassis	1000V UUT to chassis
Prog Safety Limits	Over-Voltage, Under-Voltage, Over Current, Over Power		
Internal Protection	Over-Voltage, Under-Voltage, Over Current, Over Power, Over-Temp		
Interlocks	External user input, emergency stop, and rear service door		
Watch Dog Timer	Continuously monitors control communications		

7. POWER MODULE INDICATORS

LED devices are used for long life; however failure is always a possibility. When the ENABLE or CHARGE lights are on, output voltage may be present, however voltage cannot be guaranteed to be absent if the lights are off, since it may be due to failure of the LEDs.

7.1 Enable

This indicator will light whenever the output relay is closed, enabling voltage to the output connector pins.

7.2 Charge

This indicator will light when sourcing voltage and current to charge a battery.

7.3 Discharge

This indicator will light when sinking current to discharge a battery.

7.4 DSP

This indicator will blink green about once per second while powered on to indicate normal operation of the DSP.
This indicator will blink yellow about once per second indicating a nonfatal error.
This indicator will blink red about once per second indicating a fatal error, the output is off.
If this indicator stops blinking, the DSP is not running correctly and a reset will be required.

7.5 Grid On

This indicator on the front panel will light when internal power supply voltage is present.

7.6 Status

This indicator will blink yellow about once per second while powered on to indicate normal operation of the microcontroller.
If this LED stops blinking, the microcontroller is not running correctly and a power on reset will be required.
This indicator will alternately blink yellow/red when the microcontroller detects any of several errors, either in hardware, DSP communication, or command execution.
This indicator will indicate it is communicating with the network controller PC with an alternating green/yellow or non-steady yellow blinking pattern.

7.7 LAN

This indicator will be on when a good network connection is established. It will turn off if the network cable is unplugged, or a network IP conflict is detected. It can be set to blink in response to a control button available on the web page served by the instrument.

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8. POWER MODULE CONNECTORS

8.1 Input Power Terminal Block

A terminal block on the rear panel is used to supply input power to the Power Module. Chassis ground must be returned to earth ground for safety. Input power must be connected to the three phase transformer in the base of the cabinet. ∅A is connected to A1, ∅B is connected to B1, ∅C is connected to C1. (Refer to DC Power Module Rear Panel Configurations Section 1.7).

8.2 Network in Modular Jack Connector

Standard 100BaseT Ethernet connection is mounted on the rear panel. Auto MDIX is implemented so no cross-over cables are required. All network instrument connections should remain on a private network, behind a router or connected to a second NIC card in a computer.
NOTE: NH Instruments should not be connected directly to a company network or Wide Area Network through a network switch.

Mating connector is a standard RJ45 8P/8C type.

8.3 Emergency off Terminal Block

This terminal block located on the back panel must have 12VDC applied to pin 1 referenced to (pin 2 chassis). If no voltage is applied the DC Power Module will turn off.

8.4 UUT

These large front panel connectors are the main power connection to the battery.

8.5 EXT SENSE (4912 Version 1/2 only)

If the sense select switch is set to ext., the external sense in must be connected. They should be connected to the supply outputs at the load connection terminals to compensate for voltage drop over fixture wiring.

The internal sense feature was removed for power modules.

8.6 Interlock

This interlock input must be shorted for normal operation. If left open the DC Power Module will turn off.

8.7 Chassis Ground

This large front panel bolt must be returned to earth ground for safety.

8.8 Sync In / Out Modular Jack Connectors

Front panel connectors RJ22 type modular connectors that carry a synchronization signal for paralleling. There are two connectors to facilitate a daisy-chain type connection between multiple instruments using inexpensive commercial cables.

Mating connector is a modular RJ22 4P/4C type.

8.9 Voltage and Current Monitor Connector

This DB9 connector located on the front panel is used to monitor voltage and current.

Pin	Description	Model 4904	Model 4912	Model 4960
1	Voltage monitor, Full Scale = +5V	40 V	120 V	600 V
2	Ground			
3	Voltage monitor, Full Scale = -5V	40 V	120 V	600 V
4	Current monitor, Full Scale = +5V	600 A	200 A	40 A
5	Ground			
6	Current monitor, Full Scale = -5V	600 A	200 A	40 A
7	No connection			
8	No connection			
9	No connection			

Mating Connector type is:

NH Part #	Description	Commercial Part #	Manufacturer
6202014	DSUB 9 Plug	DE9P	ITT CANNON
6201698	DSUB Shell	DE24657	ITT CANNON
6201309	DSUB Screw Lock	D20419-21	ITT CANNON

Mating cable type is:

NH Part #	Description	Commercial Part #	Manufacturer
8030596	CABLE, RS232, DB9 M/F 10' MOLDED	F2N209-10-T	BELKIN

9. POWER MODULE CONFIGURATION OPTIONS

9.1 Options Dipswitch

These switches located on the rear panel are used for factory test and debug.
The operating position is shown below when facing the rear of the unit.

Switch 1 - Position Left, Normal Network Operation
Position Right, Force LAN to fixed IP address 192.168.0.2
Switch 2 - Position Left, Default
Switch 3 - Position Left, Normal Configuration Parameters
Position Right, Ignored Flash Configuration Parameters
Switch 4 - Position Left, Default
Switch 5 - Position Left, Default
Switch 6 - Position Left, Default
Position Right, DEBUG/NHR USE ONLY
Switch 7 - Position Left, Default
Switch 8 - Position Right, Normal DSP Operation

9.2 LAN Reset Switch

The recessed switch on the front panel is used to reset network settings to known values to enable re-establishing a lost network connection. A small object must press the push button through the hole in the panel for 6 seconds to reset. After the reset operation, the Instrument will first attempt for 30 seconds to obtain an IP address using the DHCP protocol, then self-assign an address in the range 169.254.x.x as required by the Dynamic Configuration IP Protocol. The reset operation will also turn off the Instrument and return it to a reset state.

9.3 Operation Rocker Switch

Located on the front panel allows the user to set a disabled mode where the output contactor will not engage. When set to ready the DC Power Module is allowed to operate.

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10. MODEL 4904 SPECIFICATIONS

10.1 Configuration

Each DC Power Module acts as an independent, isolated, bi-directional power source or sink. Up to 12 Model 4904s may be controlled in parallel for a large range of current and power needs.

10.2 Power

Charge (Sourcing DC Current)	0 – 8kW
Discharge (Sinking DC Current)	0 – 12kW
Battery Emulation (Sourcing)	0 – 8kW
Battery Emulation (Sinking)	0 – 12kW

10.3 Operating Voltage Ranges

Charge 0 – 40V
Discharge 0 – 40V
Battery Emulation 0 – 40V

Note: Below 1V the allowable discharge (Sink) current is reduced approaching 0A at 0V. Refer to the operating envelope in section 10.25.

10.4 Operating Current Ranges

0 – ±600ADC continuous

Settings change within same operating mode:	less than 5 milliseconds.
Settings change when changing operating mode:	less than 10 milliseconds.

10.5 Voltage Noise

Less than 500mVrms

10.6 Current Noise

Less than 1.5Arms

10.7 Parallel Operation

Model 4904s may be paralleled up to 12 Modules for higher current and power.

10.8 Protection

Over voltage, current, power, and temperature protection is provided.

10.9 Communication

The PowerPanel communicates to each DC Power Module through an Ethernet port.

10.10 Self-test

Power-up self-test is implemented in firmware and reports comprehensive error messages about the status of the input, output, control and protection mechanism.

10.11 Performance Monitoring

Performance is monitored continuously. In case of measurement ambiguities, under over range conditions, heat sink temperature limits reached, etc. an appropriate error or warning is sent to the controlling device.

Each Model 4904 has its own front panel LED's indicating operating mode, status, communication and errors.

10.12 Current Monitor

An analog output current monitor is provided. -10 to +10V corresponds to full scale discharge to full scale charge current. This signal is differential referenced to chassis ground. This output is not calibrated.
Accuracy is ±15%, repeatability is ±1%.

10.13 Voltage Monitor

An analog output voltage monitor is provided. 0 to +10V corresponds to 0V to full scale voltage. This signal is differential referenced to chassis ground. This output is not calibrated.
Accuracy is ±15%, repeatability is ±1%.

10.14 Temperature

Operational from 0 to 35°C at full power, 35°C to 50°C at reduced power.
Noncondensing humidity < 75% R.H.
Specifications apply at 25°C ±5°C after 10-minute warm-up.

10.15 Isolation

Three phase (3∅) Line and Chassis Ground	1000 Volts DC
Three phase (3∅) Line and DC Output	1000 Volts DC
DC Output and Chassis Ground	600 Volts DC

10.16 Size

14H x 24W x 23D inches

10.17 Weight

Per Power Module: 100Lbs / 45.5kG
Three (3) Power Module configurations: 1320Lbs / 600kG

10.18 Output Relay

An output relay is provided to disconnect from the UUT.

10.19 Calibration

All adjustments are done in software and stored in FLASH.
Equipment Required:

Multi-meter, Hewlett Packard Model 3458A or equivalent
NHR Calibrator or third party current measurement device.

10.20 Leakage Current

When not enabled, the leakage current does not exceed 250uA + 10uA/V @27deg C.

10.21 Cooling

Air cooled – front intake rear exhaust.

10.22 Programming Accuracy

Voltage	Range Accuracy Resolution	0 to 40V 0.1% of set +0.1% range 0.005% of range
Current	Range Accuracy Resolution	0 to 600A 0.2% of set +0.2% of range 0.005% of range

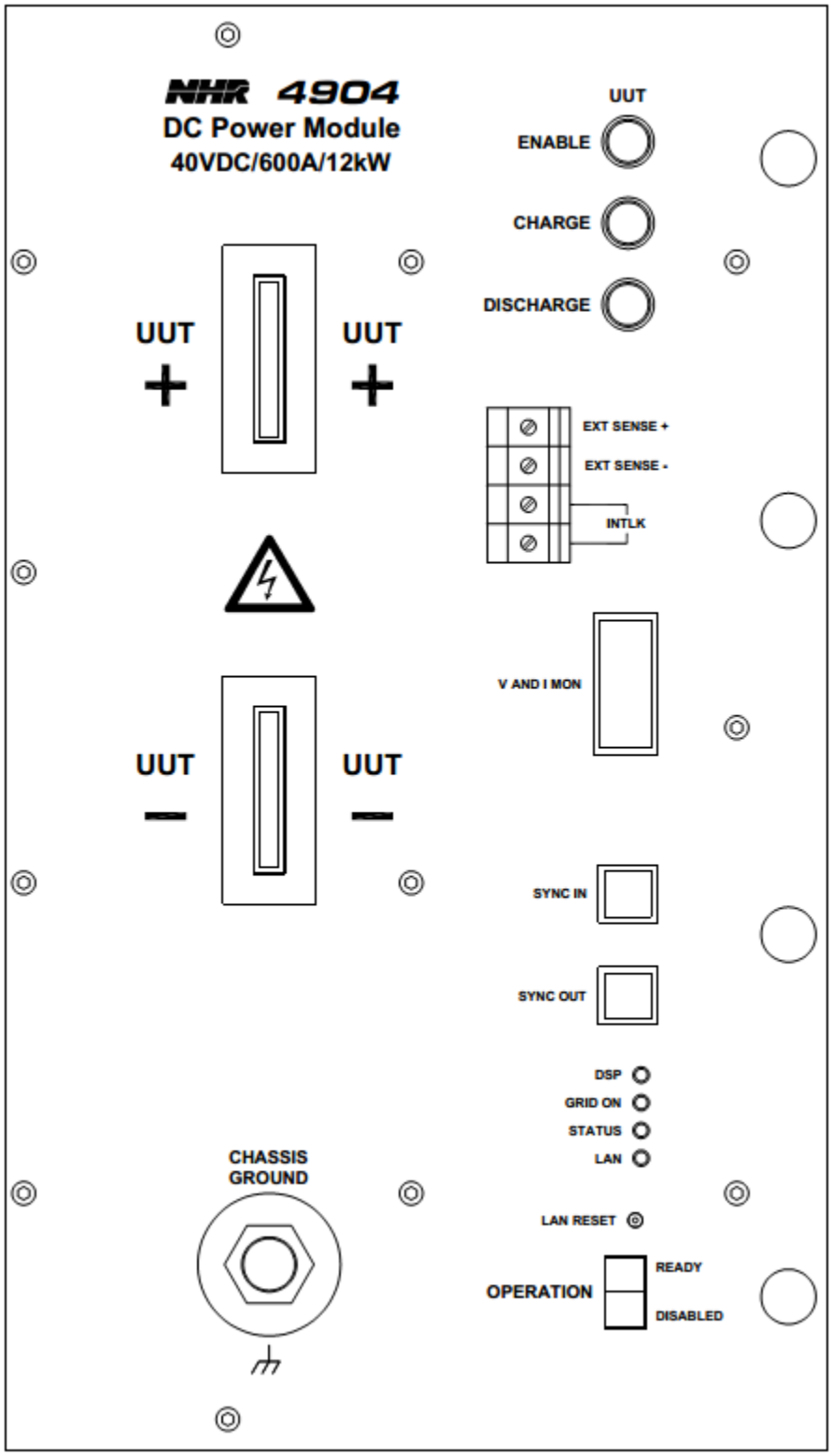
Accuracies apply when the setting is greater than 10% of the range.

10.23 Measurement Accuracy

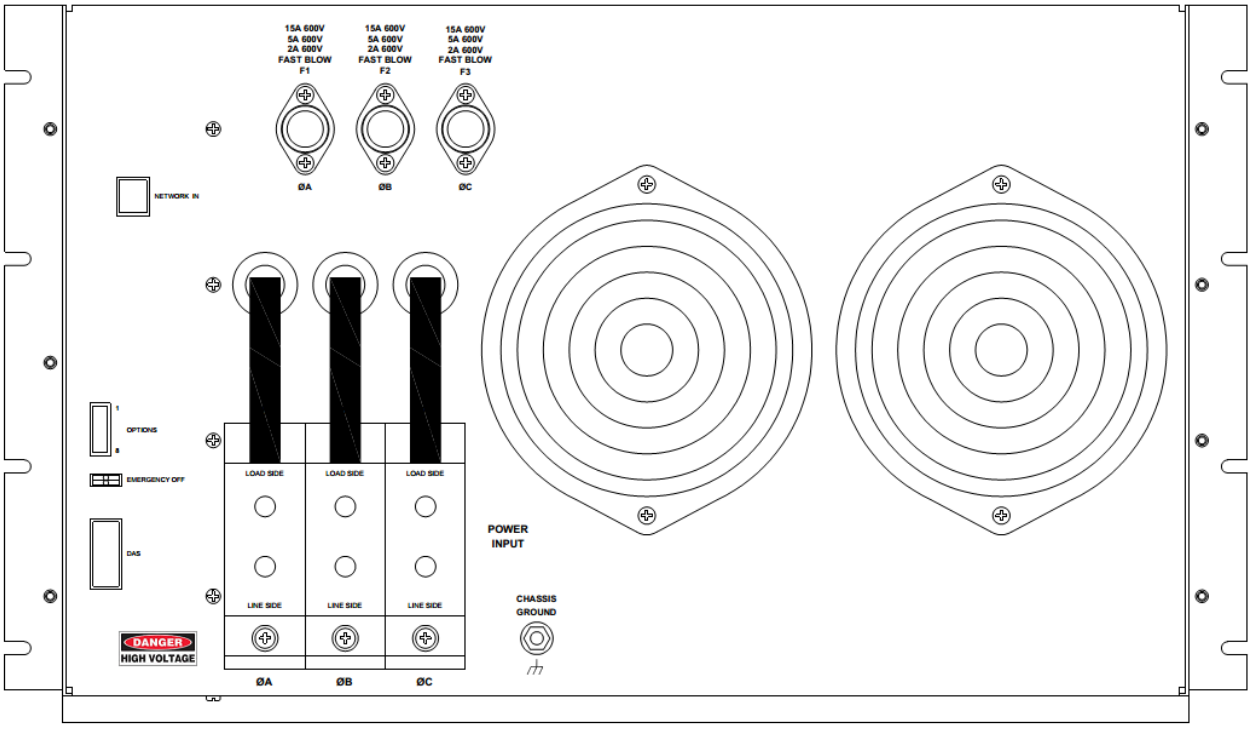
Voltage DC average	Range Accuracy Resolution	0 to 40V 0.05% of reading, + 0.05% range 0.005% of range
Current DC average, Ampere hour	Range Accuracy Resolution	0 to 600A 0.1% of reading, + 0.1% range 0.005% of range
Power, Watt-hour	Range Accuracy Resolution	Voltage Range times Current Range 0.12% of reading, + 0.12% of range 0.005% of range
Time	Range Accuracy Resolution	1millisecond to 1Year 0.1% of reading 0.005% of range

Accuracies apply when the measurement is greater than 10% of the range.

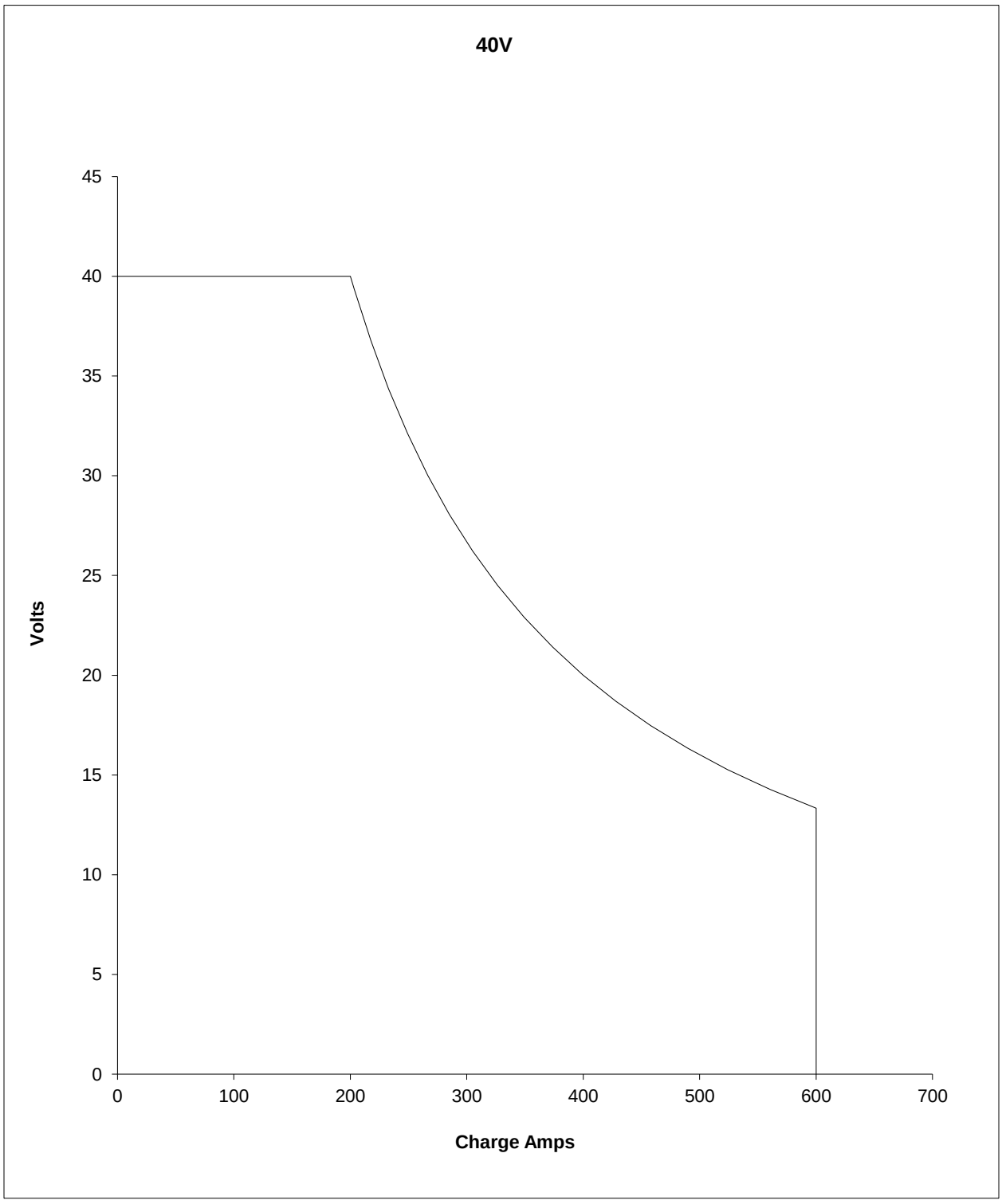
10.23.1 Model 4904 DC Power Module – Front View



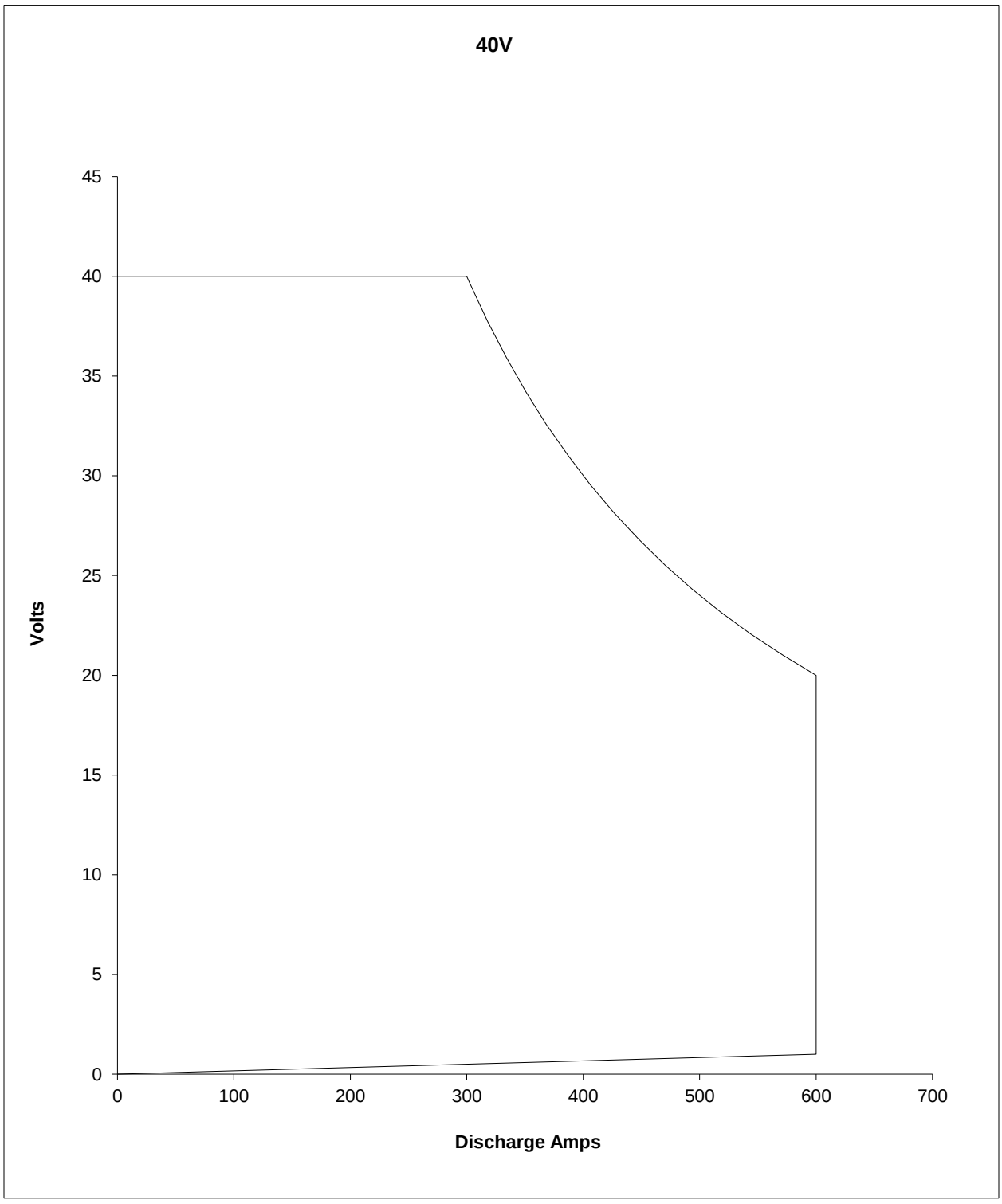
10.23.2 Model 4904 DC Power Module – Rear View



10.24 Operating Envelope Charging (Sourcing Current)



10.25 Operating Envelope Discharging (Sinking Current)



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11. MODEL 4912 SPECIFICATIONS

11.1 Configuration

Each DC Power Module acts as an independent, isolated, bi-directional power source or sink. Up to 12 Model 4912s may be controlled in parallel for a large range of current and power needs.

11.2 Power

Charge (Sourcing DC Current)	0 – 8kW
Discharge (Sinking DC Current)	0 – 12kW
Battery Emulation (Sourcing)	0 – 8kW
Battery Emulation (Sinking)	0 – 12kW

11.3 Operating Voltage Ranges

Charge 0 – 120V
Discharge 0 – 120V
Battery Emulation 0 – 120V

Note: Below 4V the allowable discharge (Sink) current is reduced approaching 0A at 0V. Refer to the operating envelope in section 11.25

11.4 Operating Current Ranges

0 – ±200ADC continuous

Settings change within same operating mode:	less than 5 milliseconds.
Settings change when changing operating mode:	less than 10 milliseconds.

11.5 Voltage Noise

Less than 500mVrms

11.6 Current Noise

Less than 500mArms

11.7 Parallel Operation

Model 4912s may be paralleled up to 12 Modules for higher current and power.

11.8 Protection

Over voltage, current, power, and temperature protection is provided.

11.9 Communication

The PowerPanel communicates to each DC Power Module through an Ethernet port.

11.10 Self-test

Power-up self-test is implemented in firmware and reports comprehensive error messages about the status of the input, output, control and protection mechanism.

11.11 Performance Monitoring

Performance is monitored continuously. In case of measurement ambiguities, under over range conditions, heat sink temperature limits reached, etc. an appropriate error or warning is sent to the controlling device.

Each Model 4912 has its own front panel LED's indicating operating mode, status, communication and errors.

11.12 Current Monitor

An analog output current monitor is provided. -10 to +10V corresponds to full scale discharge to full scale charge current. This signal is differential referenced to chassis ground. This output is not calibrated.
Accuracy is ±15%, repeatability is ±1%.

11.13 Voltage Monitor

An analog output voltage monitor is provided. 0 to +10V corresponds to 0V to full scale voltage. This signal is differential referenced to chassis ground. This output is not calibrated.
Accuracy is ±15%, repeatability is ±1%.

11.14 Temperature

Operational from 0 to 35°C at full power, 35°C to 50°C at reduced power.
Noncondensing humidity < 75% R.H.
Specifications apply at 25°C ±5°C after 10-minute warm-up.

11.15 Isolation

Three phase (3∅) Line and Chassis Ground	1000 Volts DC
Three phase (3∅) Line and DC Output	1000 Volts DC
DC Output and Chassis Ground	600 Volts DC

11.16 Size

14H x 24W x 23D inches

11.17 Weight

Per Power Module: 100Lbs / 45.5kG
Three (3) Power Module configurations: 1320Lbs / 600kG

11.18 Output Relay

An output relay is provided to disconnect from the UUT.

11.19 Calibration

All adjustments are done in software and stored in FLASH.
Equipment Required:

Multi-meter, Hewlett Packard Model 3458A or equivalent
NHR Calibrator or third party current measurement device.

11.20 Leakage Current

When not enabled, the leakage current does not exceed 250uA + 10uA/V @27deg C.

11.21 Cooling

Air cooled – front intake rear exhaust.

11.22 Programming Accuracy

Voltage	Range Accuracy Resolution	0 to 120V 0.1% of set +0.1% range 0.005% of range
Current	Range Accuracy Resolution	0 to 200A 0.2% of set +0.2% of range 0.005% of range

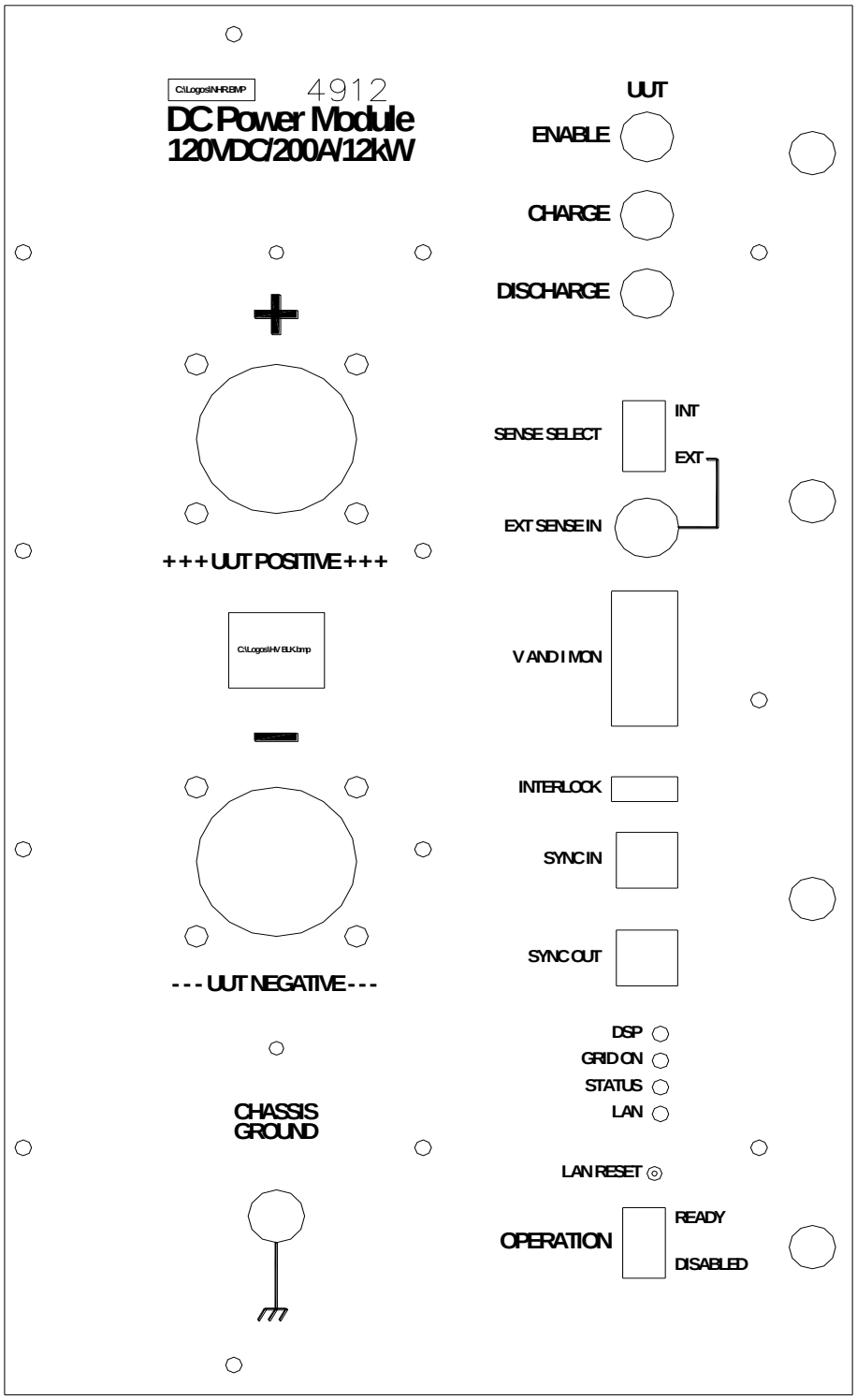
Accuracies apply when the setting is greater than 10% of the range.

11.23 Measurement Accuracy

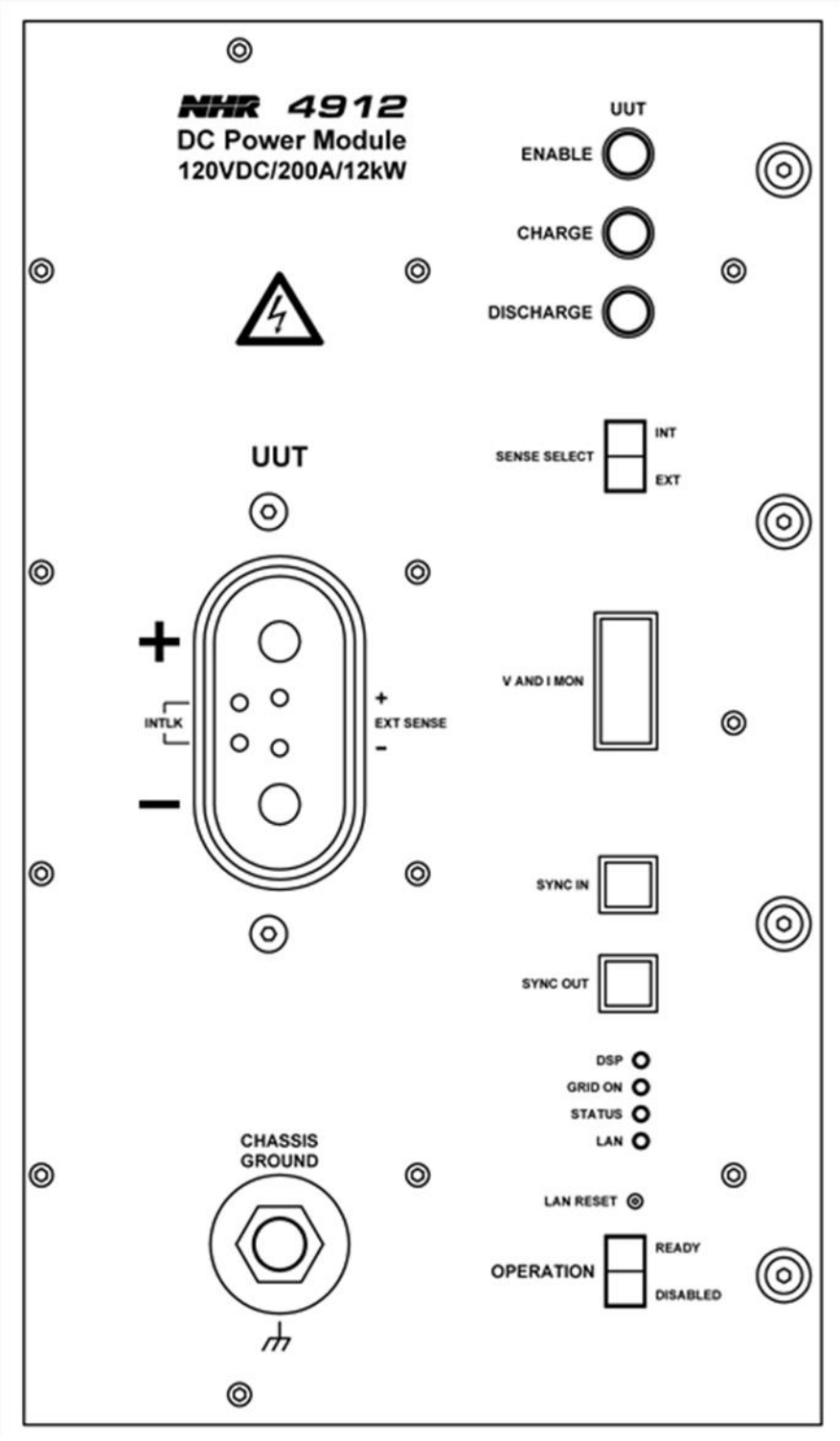
Voltage DC average	Range Accuracy Resolution	0 to 120V 0.05% of reading, + 0.05% range 0.005% of range
Current DC average, Ampere hour	Range Accuracy Resolution	0 to 200A 0.1% of reading, + 0.1% range 0.005% of range
Power, Watt-hour	Range Accuracy Resolution	Voltage Range times Current Range 0.12% of reading, + 0.12% of range 0.005% of range
Time	Range Accuracy Resolution	1millisecond to 1Year 0.1% of reading 0.005% of range

Accuracies apply when the measurement is greater than 10% of the range.

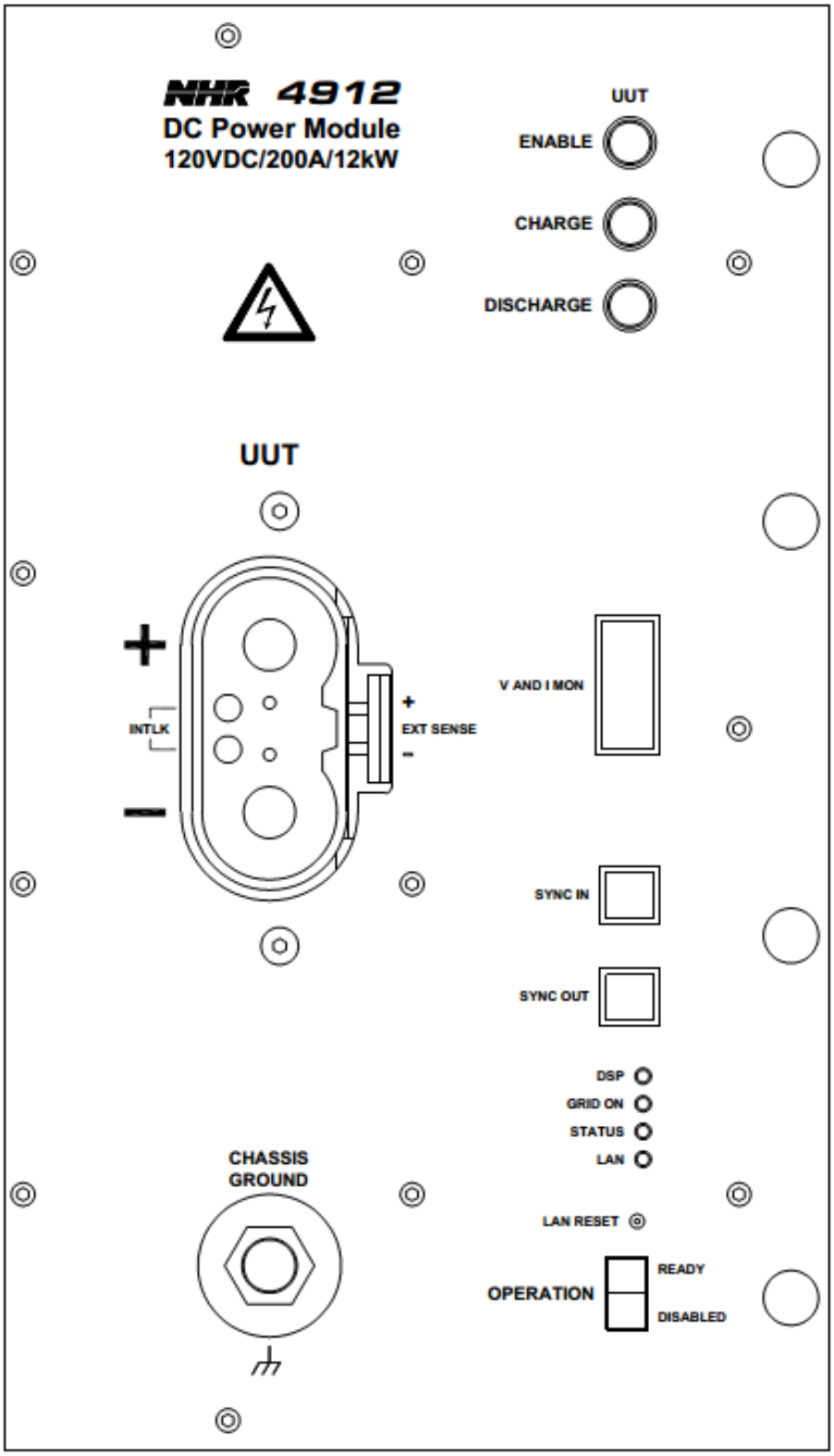
11.23.1 Model 4912 DC Power Module Version 1 – Front View



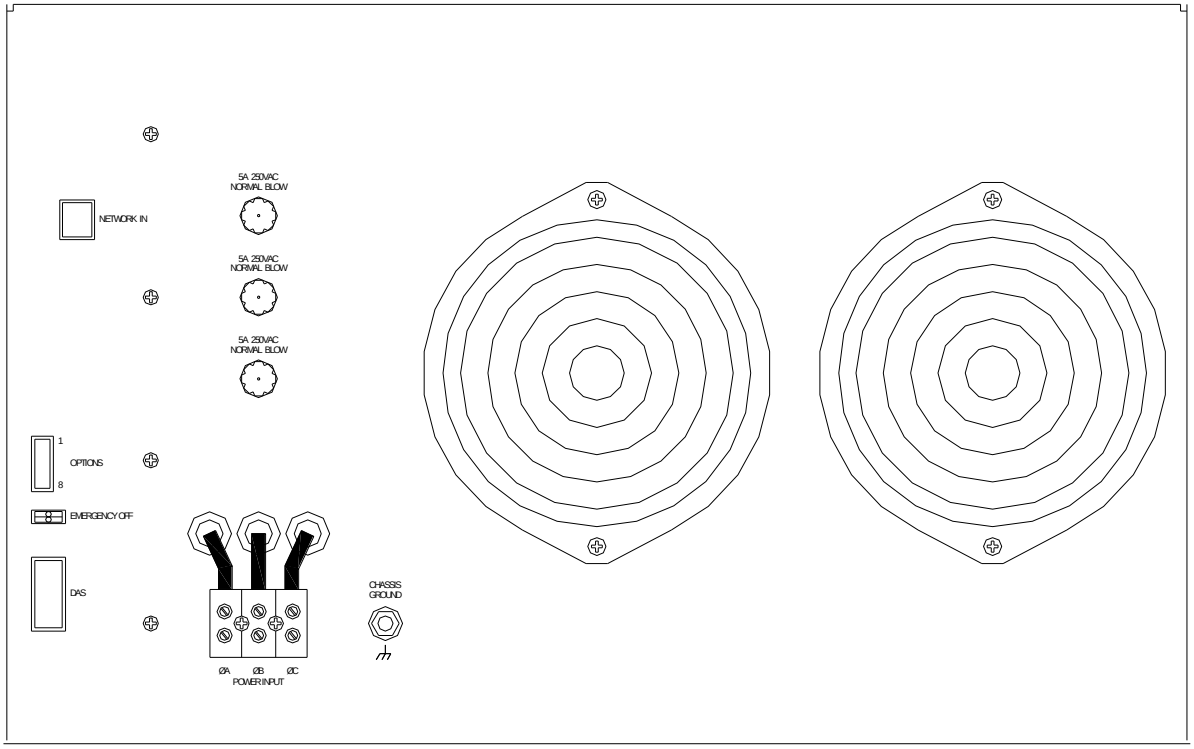
11.23.2 Model 4912 DC Power Module Version 2 – Front View



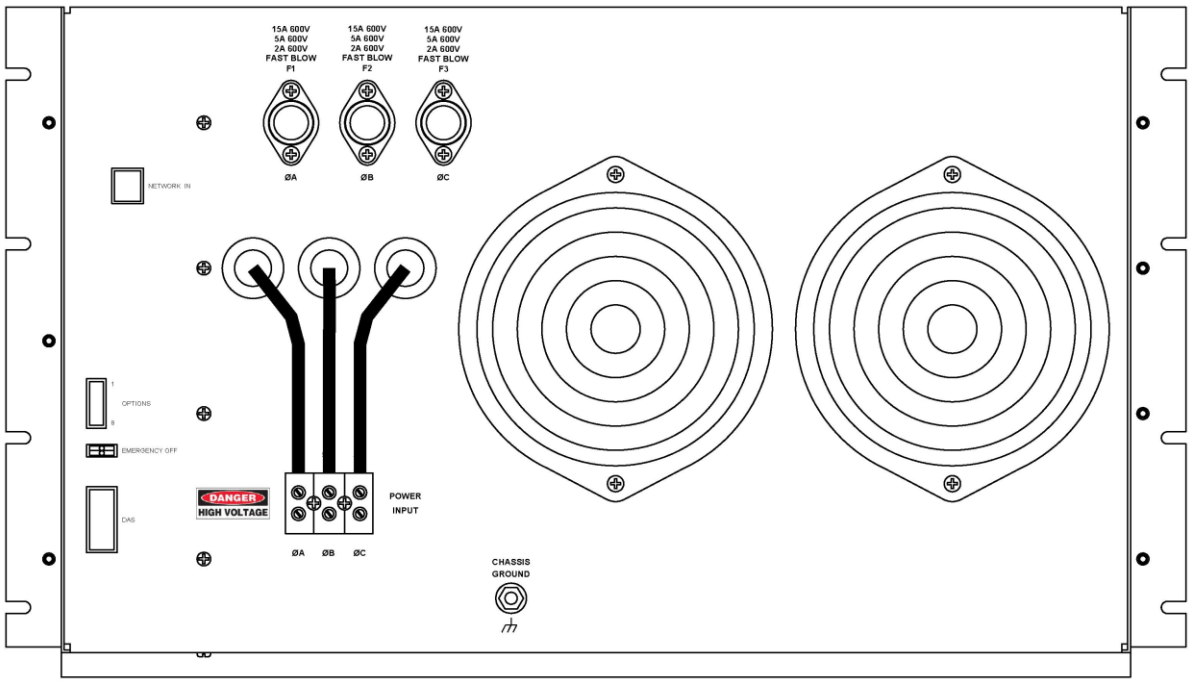
11.23.3 Model 4912 DC Power Module Version 3 – Front View



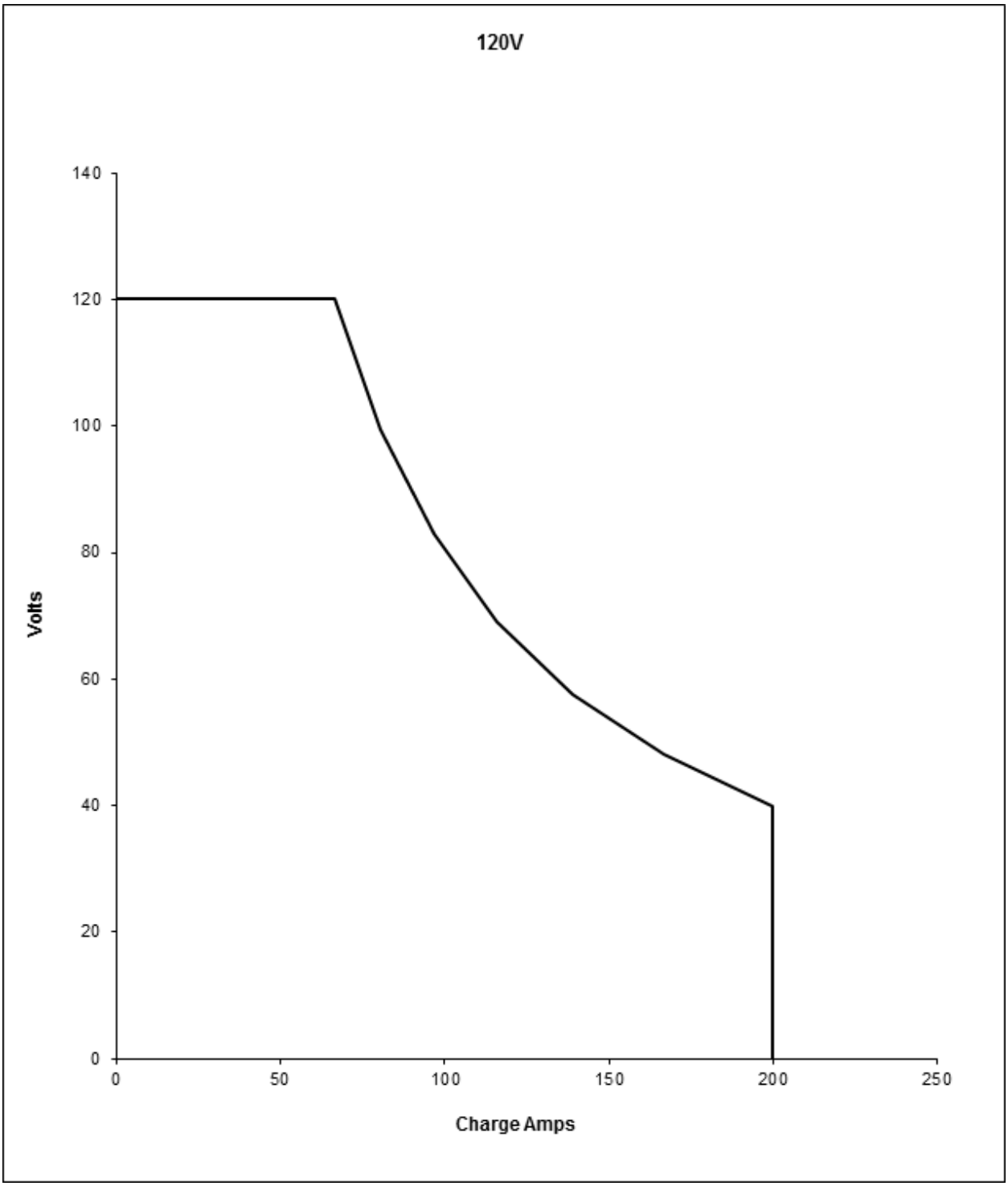
11.23.4 Model 4912 DC Power Module Version 1 – Rear View



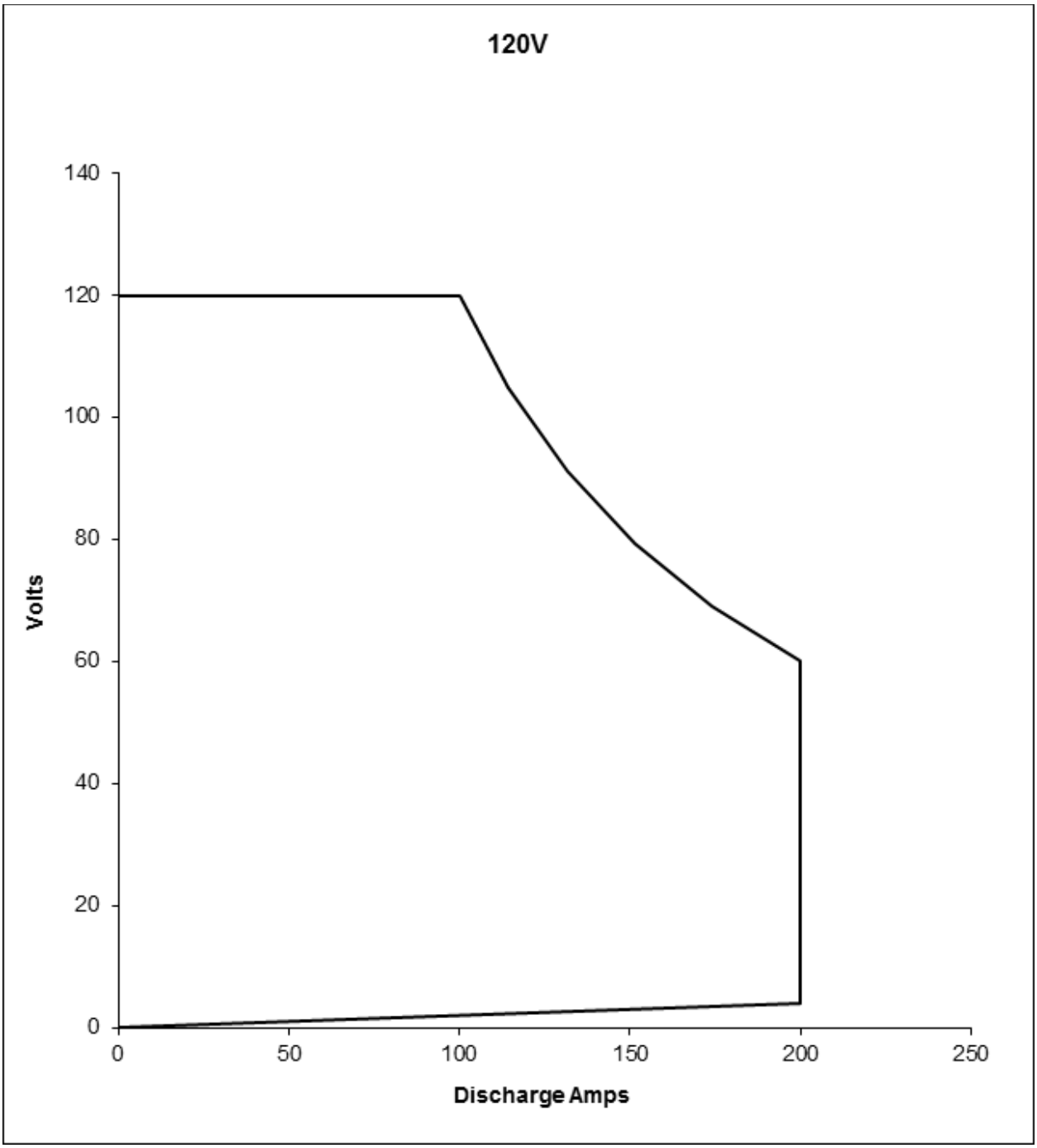
11.23.5 Model 4912 DC Power Module Version 2 – Rear View



11.24 Operating Envelope Charging (Sourcing Current)



11.25 Operating Envelope Discharging (Sinking Current)



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12. MODEL 4960 SPECIFICATIONS

12.1 Configuration

Each DC Power Module acts as an independent, isolated, bi-directional power source or sink. Up to 12 Model 4960s may be controlled in parallel for a large range of current and power needs.

12.2 Power

Charge (Sourcing DC Current)	0 – 8kW
Discharge (Sinking DC Current)	0 – 12kW
Battery Emulation (Sourcing)	0 – 8kW
Battery Emulation (Sinking)	0 – 12kW

12.3 Operating Voltage Ranges

Charge 0 – 600V
Discharge 0 – 600V
Battery Emulation 0 – 600V

Note: Below 10V the allowable discharge (Sink) current is reduced approaching 0A at 0V. Refer to the operating envelope in section 12.25.

12.4 Operating Current Ranges

0 – ±40ADC continuous

Settings change within same operating mode:	less than 5 milliseconds.
Settings change when changing operating mode:	less than 10 milliseconds.

12.5 Voltage Noise

Less than 500mVrms

12.6 Current Noise

Less than 500mArms

12.7 Parallel Operation

Model 4960s may be paralleled up to 12 Modules for higher current and power.

12.8 Protection

Over voltage, current, power, and temperature protection is provided.

12.9 Communication

The PowerPanel communicates to each DC Power Module through an Ethernet port.

12.10 Self-test

Power-up self-test is implemented in firmware and reports comprehensive error messages about the status of the input, output, control and protection mechanism.

12.11 Performance Monitoring

Performance is monitored continuously. In case of measurement ambiguities, under over range conditions, heat sink temperature limits reached, etc. an appropriate error or warning is sent to the controlling device.

Each Model 4960 has its own front panel LED's indicating operating mode, status, communication and errors.

12.12 Current Monitor

An analog output current monitor is provided. -10 to +10V corresponds to full scale discharge to full scale charge current. This signal is differential referenced to chassis ground. This output is not calibrated.
Accuracy is ±15%, repeatability is ±1%.

12.13 Voltage Monitor

An analog output voltage monitor is provided. 0 to +10V corresponds to 0V to full scale voltage. This signal is differential referenced to chassis ground. This output is not calibrated.
Accuracy is ±15%, repeatability is ±1%.

12.14 Temperature

Operational from 0 to 35°C at full power, 35°C to 50°C at reduced power.
Noncondensing humidity < 75% R.H.
Specifications apply at 25°C ±5°C after 10-minute warm-up.

12.15 Isolation

Three phase (3∅) Line and Chassis Ground	1000 Volts DC
Three phase (3∅) Line and DC Output	1000 Volts DC
DC Output and Chassis Ground	1000 Volts DC

12.16 Size

14H x 24W x 23D inches

12.17 Weight

Per Power Module: 100Lbs / 45.5kG
Three (3) Power Module configurations: 1320Lbs / 600kG

12.18 Output Relay

An output relay is provided to disconnect from the UUT.

12.19 Calibration

All adjustments are done in software and stored in FLASH.
Equipment Required:

Multi-meter, Hewlett Packard Model 3458A or equivalent
NHR Calibrator or third party current measurement device.

12.20 Leakage Current

When not enabled, the leakage current does not exceed 250uA + 10uA/V @27deg C.

12.21 Cooling

Air cooled – front intake rear exhaust.

12.22 Programming Accuracy

Voltage	Range Accuracy Resolution	0 to 600V 0.1% of set +0.1% range 0.005% of range
Current	Range Accuracy Resolution	0 to 40A 0.2% of set +0.2% of range 0.005% of range

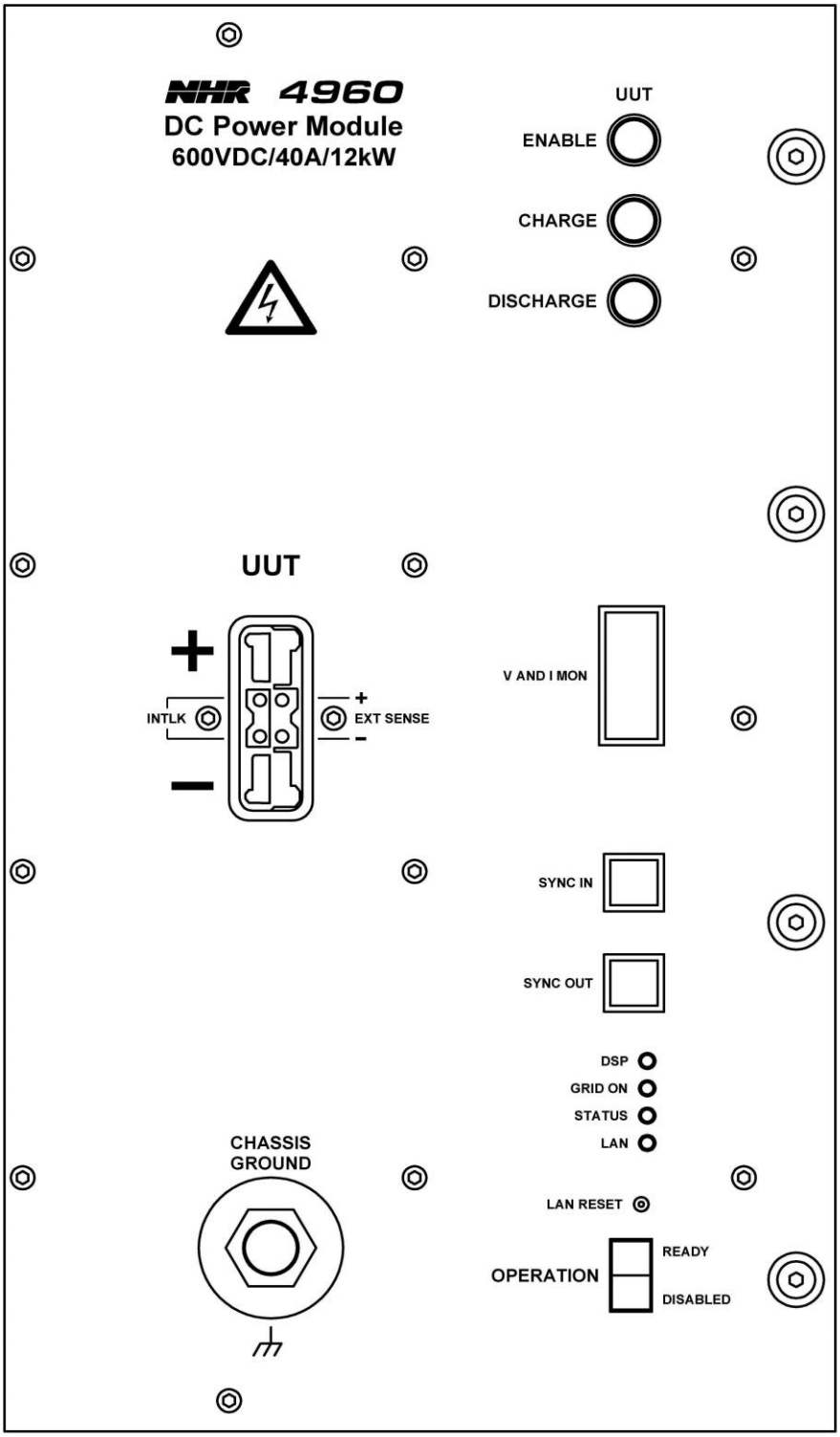
Accuracies apply when the setting is greater than 10% of the range.

12.23 Measurement Accuracy

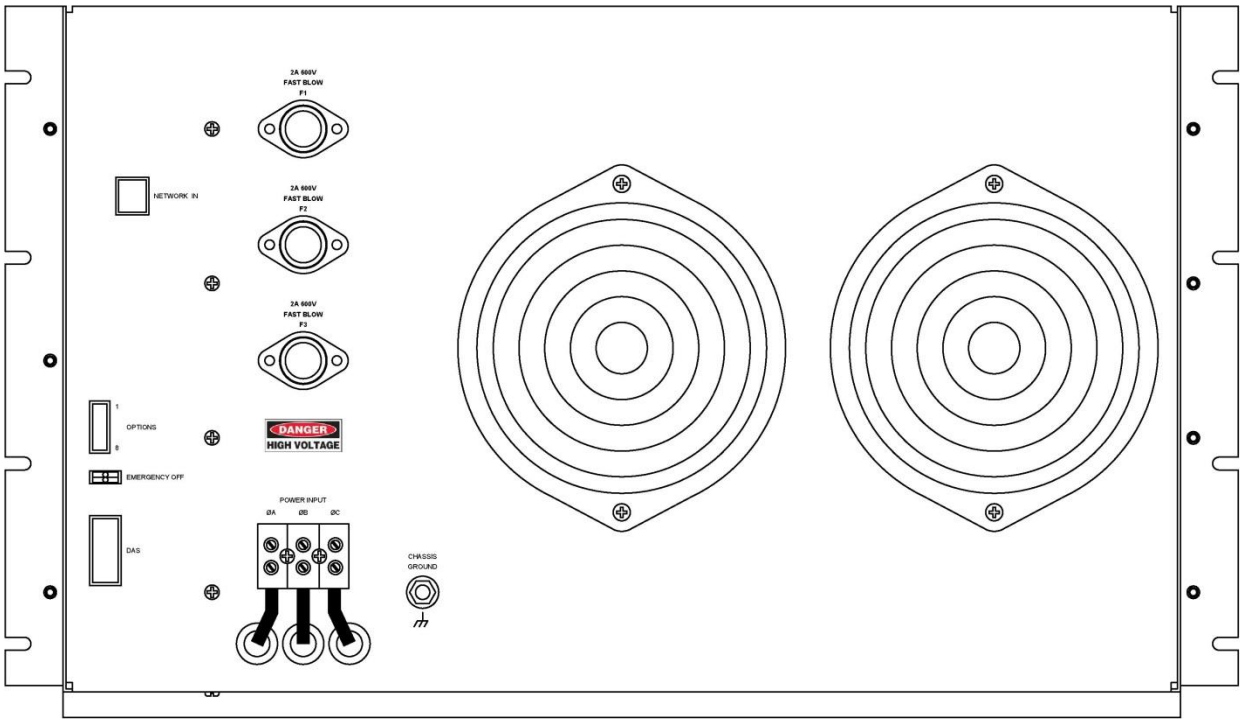
Voltage DC average	Range Accuracy Resolution	0 to 600V 0.05% of reading, + 0.05% range 0.005% of range
Current DC average, Ampere hour	Range Accuracy Resolution	0 to 40A 0.1% of reading, + 0.1% range 0.005% of range
Power, Watt-hour	Range Accuracy Resolution	Voltage Range times Current Range 0.12% of reading, + 0.12% of range 0.005% of range
Time	Range Accuracy Resolution	1millisecond to 1Year 0.1% of reading 0.005% of range

Accuracies apply when the measurement is greater than 10% of the range.

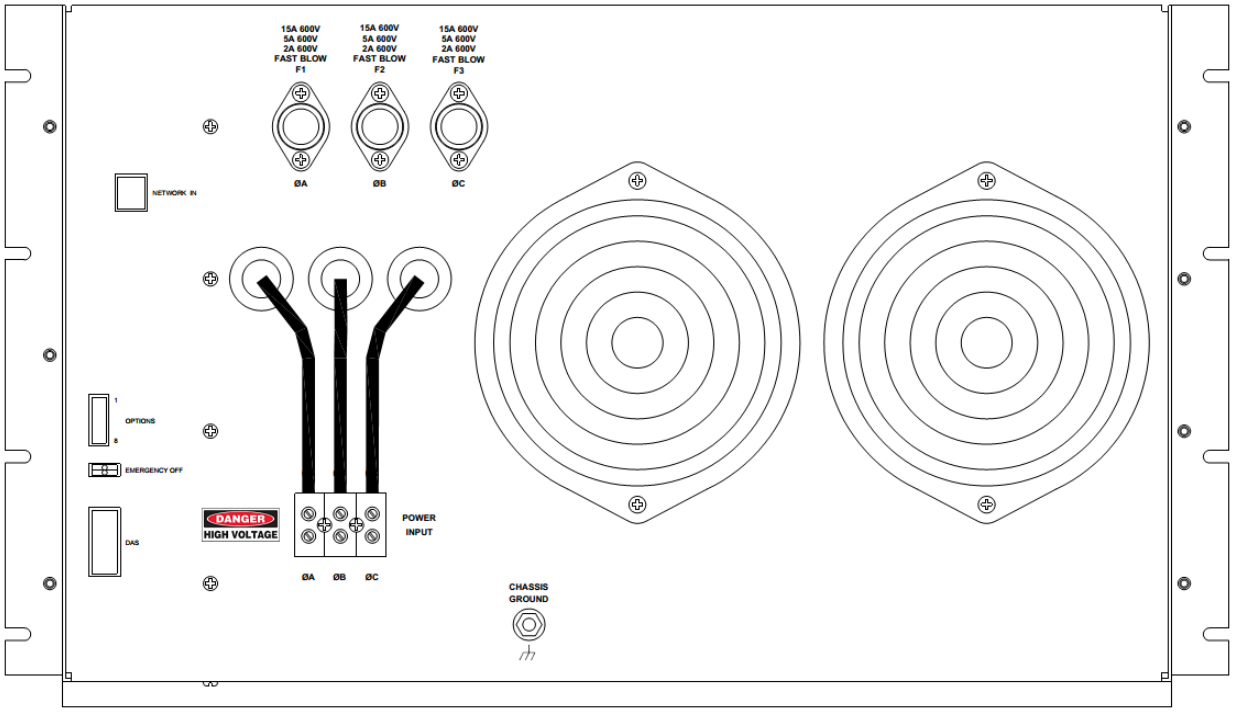
12.23.1 Model 4960 DC Power Module – Front View



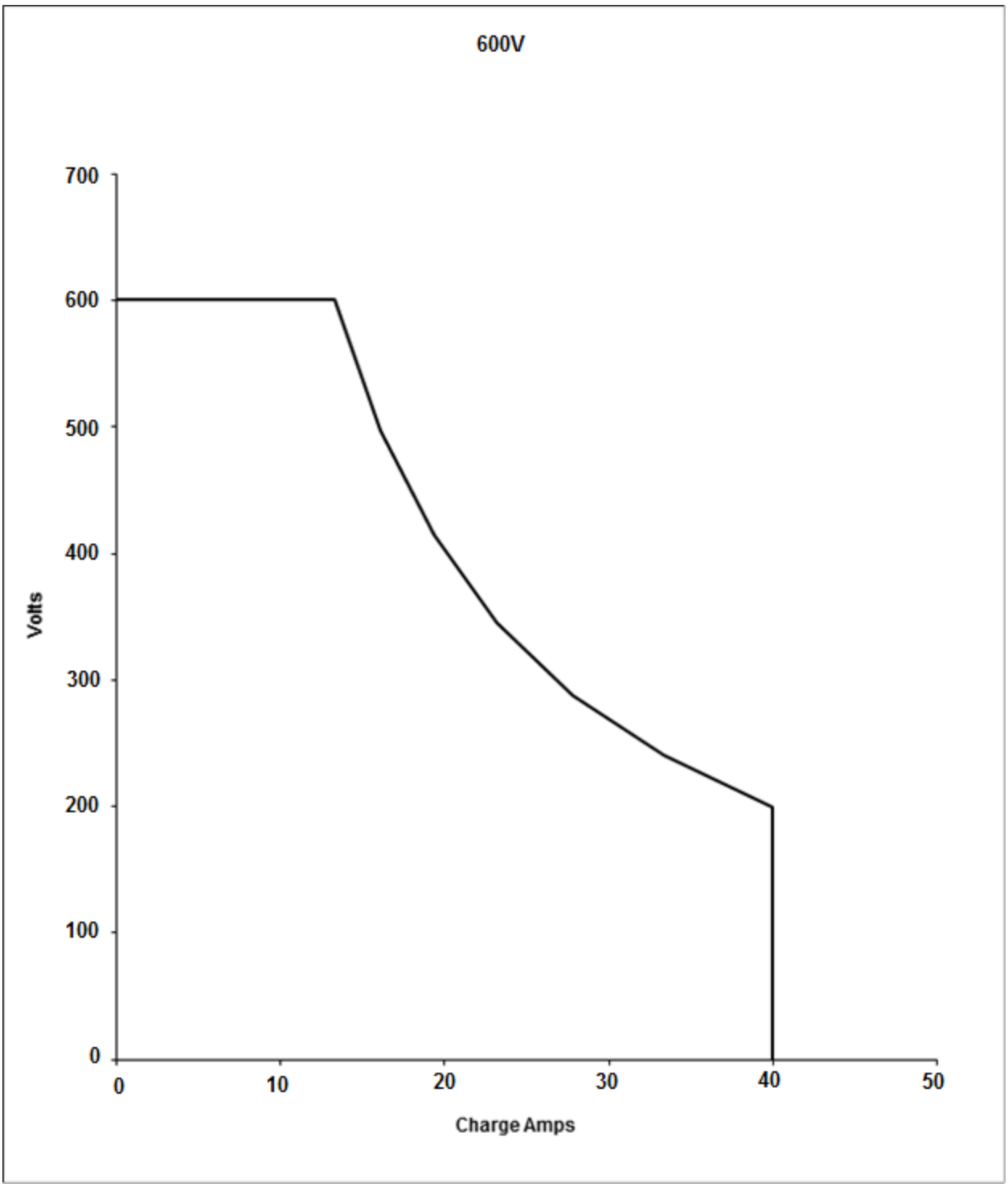
12.23.2 Model 4960 DC Power Module Version 1 – Rear View



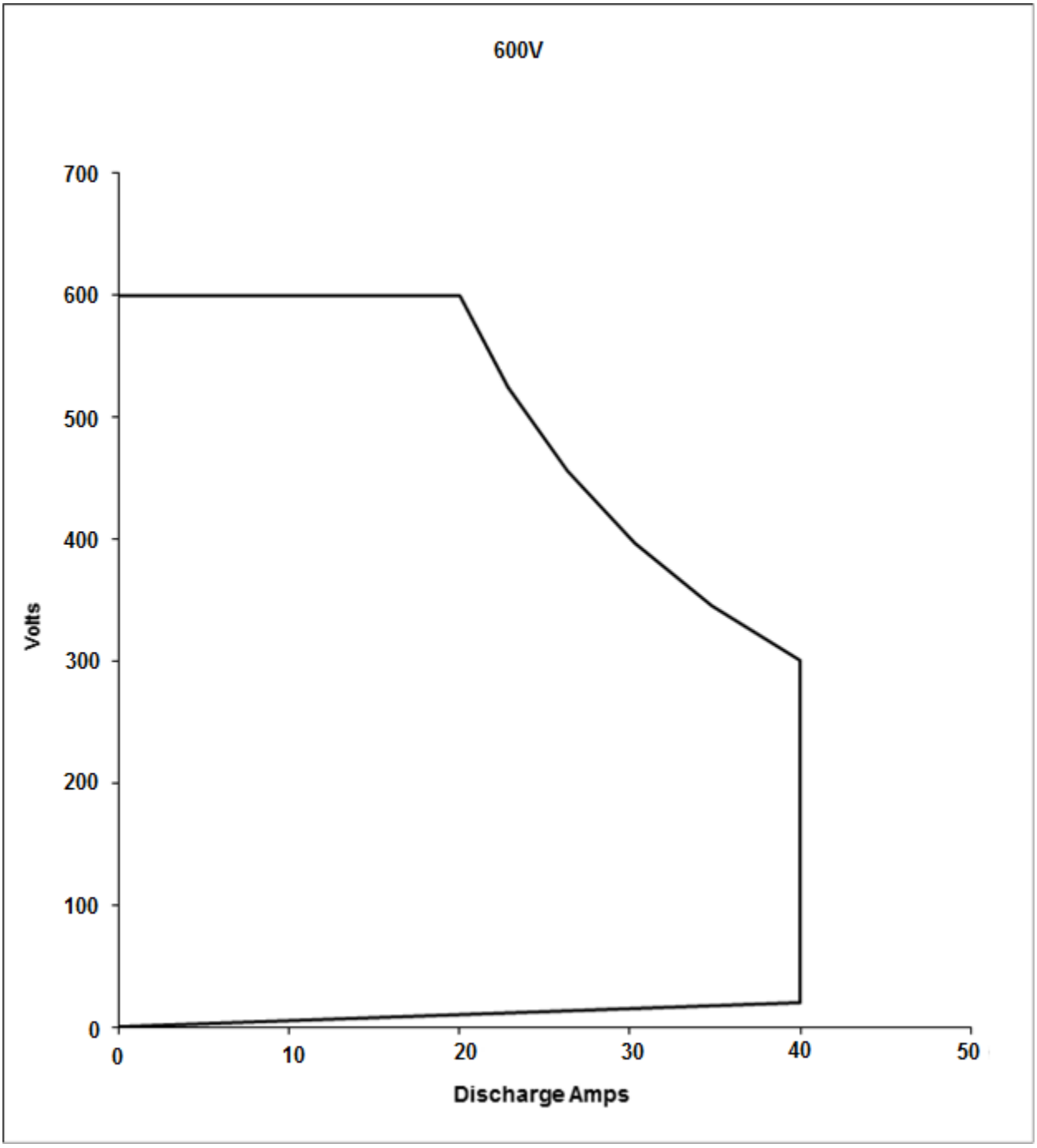
12.23.3 Model 4960 DC Power Module Version 2 – Rear View



12.24 Operating Envelope Charging (Sourcing Current)



12.25 Operating Envelope Discharging (Sinking Current)



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13. TROUBLE SHOOTING

13.1 Common error messages which require a Reset

Below are error messages that include the words “Reset is required to clear”.
The cause that generated the error must first be corrected then a “Reset” command must be issued to the power module.
This can be accomplished using the front panel “More” button or through an IVI command.

Error Message	*Possible Cause*	*Solution*
"Emergency Stop, Output Relay is open. RESET is REQUIRED to clear."	E-Stop button is pressed	Unlock E-Stop button
	Front access door is open (Version 1 9200/4912 only)	Close and latch the front door
	Rear access door is open	Close and latch the rear door
	Faulty door interlock switch	Check door interlock switches close when doors are closed.
	Rear 9200 cabinet fuse is open	Close all software programs, Power off system and check fuses at rear of 9200 system.
	Interlock control wire is not connected to Power Module	Open rear door and check interlock wire is properly connected to the power module.
"Grid over (under)-voltage, (Grid under-voltage,) Output Relay is open. RESET is REQUIRED to clear."	Grid voltage exceeded upper (or lower) voltage limits for a short time	Issue a reset command, If the error returns then check AC input voltage connection.
	System connected not wired for current AC input voltage	Check rear label for input voltage requirements and connect to proper AC connection.
"Interlock was/is open, Output Relay is open. RESET is REQUIRED to clear."	Version 1 9200/4912 only – Interlock jumper on front panel is not shorted	Correct issue with interlock jumper on front panel.
“Internal over (under)-voltage, Output Relay is Open. RESET is REQUIRED to clear.”	Internal voltage issue generally caused by a grid voltage issue.	See “Grid over (under) – voltage” above

Common error messages which require a reset continued:

Error Message	*Possible Cause*	*Solution*
"Internal over-temperature, Output Relay is open. RESET is REQUIRED to clear."	Dirty filters (if equipped)	Replace dirty filters
	Insufficient intake airflow	Remove obstruction from front of 9200 test system
	Insufficient exhaust airflow	Remove obstruction from rear of 9200 test system
	Ambient temperature too high	Increase air conditioning in workspace
"Safety trip: Current too high, Output Relay is open. RESET is REQUIRED to clear."	Measured current was above either the charge or discharge current safety limit for the programmed time allowed.	Increase safety limit value, increase time allowed, or disable safety limit. (see note)
"Safety trip: Power too high, Output Relay is open. RESET is REQUIRED to clear."	Measured power was above either the charge or discharge current safety limit for the programmed time allowed.	Increase safety limit value, increase time allowed, or disable safety limit. (see note)
"Safety trip: Voltage too high, Output Relay is open. RESET is REQUIRED to clear."	Measured voltage was above the maximum voltage safety limit for time allowed.	Increase maximum voltage safety limit value, increase time allowed, or disable safety limit. (see note)
"Safety trip: Voltage too low, Output Relay is open. RESET is REQUIRED to clear."	Measured voltage was below the minimum voltage safety limit for time allowed.	Decrease minimum voltage safety limit value, increase time allowed value, or disable safety limit. (see note)
	UUT was not connected before entering standby.	Connect UUT before placing Power Module in standby
"The turn on sequence failed, Output Relay is open. RESET is REQUIRED to clear."	Fuses at rear of Power Module are open	Close all programs, open 9200 rear door and check fuses on the power module giving the error.

Note: Safety limits are intended to prevent operator error and should be set between maximum test values and maximum specification values. The Power Modules will automatically limit to the maximum specification values for the power modules.

13.2 Error messages – When turning on Power Module

These error messages occur when pressing the ON/OFF button on the power panel or when a program using the IVI driver switches the power module state from "OFF" to something other than off.
These errors prevent further use of the Power Panel software until the error has been acknowledged.
Press the "clear" to review and clear the error on the Power Panel Software.

Error Message	*Possible Cause*	*Solution*
"Battery not detected. Output Relay is open."	Main power leads are reversed	Verify main power leads to UUT are not reversed, Clear error
	No voltage at main power leads	Battery Detect Voltage is non-zero and no voltage is present (See note for more information)
"Enable Switch was/is open, Output Relay is open."	Red enable switch is set to "Disabled"	Switch power module to enabled
	User interlock pins are not shorted	Ensure the user interlock pins are shorted
"Mode prerequisite is not met."	The Power Module was being activated before the reset sequence finished.	Wait for 60 seconds or until a large contactor closure is heard. The power module is ready for use.
"Voltage sense leads error. Output Relay is open."	External sense is not connected to UUT	Connect external sense to UUT

Note: Only for power modules that do NOT have an internal/external sense select switch, the following apply:
This version of the control card looks for a small positive voltage on the main power leads in order to protect against a reverse connected battery. This feature can be overridden by setting the battery detect voltage to a zero (0) value. When over-ridden the safety feature is re-engaged automatically when the power module is turned off for any reason.

Disabling this detection feature can be accomplished under the "More" button or through an IVI command.

13.3 Error messages – Other

These error messages may seem to occur at any time.
These errors prevent further use of the Power Panel software until the error has been acknowledged.
Press the “clear” to review and clear the error on the Power Panel Software.

Error Message	*Possible Cause*	*Solution*
"A hardware reset occurred, Output Relay is open."	Communications timeout	Check network for reliable communications
	System reset occurred	Non-standard operation has occurred
"Battery not detected. Output Relay is open." Is displayed when attempting to “Charge”	Measured voltage is less than “battery detect” voltage setting.	Correct battery detect voltage setting (see note 1)
	See previous section for additional causes	See previous section for additional solutions
"Command not recognized."	Controlling PC has older driver	Update driver on all controllers
	Firmware on Power Module is not the latest released version	Update Power Module firmware
"Set parameter is out of range."	One of the settings for the command is outside limits allowed for that command.	Using Power Panel: Check system configuration Using IVI: Refer to programmers reference
"The number of queued macro commands is too large."	More than 1000 Steps in macro	Reduce macro to a maximum of 1000 Steps
"Voltage sense leads error. Output Relay is open."	See previous section	See previous section

Note 1 – Battery detect is used to prevent the power module from entering “charge” which may result in high current being sourced into an open circuit. It accomplishes this protection by first measuring the UUT voltage and comparing it with the programmed “battery detect” voltage level. There is no similar protection required for “discharge” or “battery” modes.
There is a special meeting for a zero (0) “battery detect” voltage setting which is described in the previous section.

14. SERVICE

14.1 Cleaning

The exterior of the 9200 may be cleaned with a cloth dampened with a mild detergent and wrung out. Disconnect mains power to the 9200 before cleaning. Do not spray water or other cleaning agents directly on the unit.

14.2 Filter replacement.

This filter is 12" X 12" X 1" and is available at any Building Supply Store. For example Purolator F312.
Install with ARROW pointed in.

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15. CE CERTIFICATIONS

Declaration of Conformity

Application of Council Directive: 2004/108/EC

Standards To Which Conformity Is Declared:	**EN61326: 2006** **EN55011 Class A Group 1** **EN61000-4-2** **EN61000-4-3** **EN61000-4-4** **EN61000-4-5** **EN61000-4-6** **EN61000-4-8** **EN61000-4-11**
Manufacturer's Name:	**NH Research, Inc.**
Manufacturer's Address:	**16601 Hale Avenue** **Irvine, CA 92606** **949-474-3900**
Equipment Description:	**Regenerative DC Load**
Equipment Class:	**Laboratory, Measurement, & Process Control Equipment: Industrial Environment**
Model Numbers:	**4904/4912/4960/9200**

I the undersigned, hereby declare that the equipment specified above, conforms to the above Directive(s) and Standard(s).

Place:	NH Research
Signature:	Thomas C. Fairburn
Full Name:	Thomas C. Fairburn
Position:	Sustaining Engineering MGR

DECLARATION OF CONFORMITY

Application of Council Directive: 2006/95/EC

Standards to which conformity is declared:	EN61010-1: 2010
Manufacturer's Name:	NH Research, Inc.
Manufacturer's Address:	16601 Hale Avenue Irvine, CA 92606 949-474-3900
Equipment Description:	Regenerative Load
Equipment Class:	Class I
Model Number:	4904/4912/4960/9200

I the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s) and Standard(s).

Place:	NH RESEARCH
Signature:	Thomas C. Fairburn
Full Name:	Thomas C. Fairburn
Position:	Sustaining Engr. Mgr

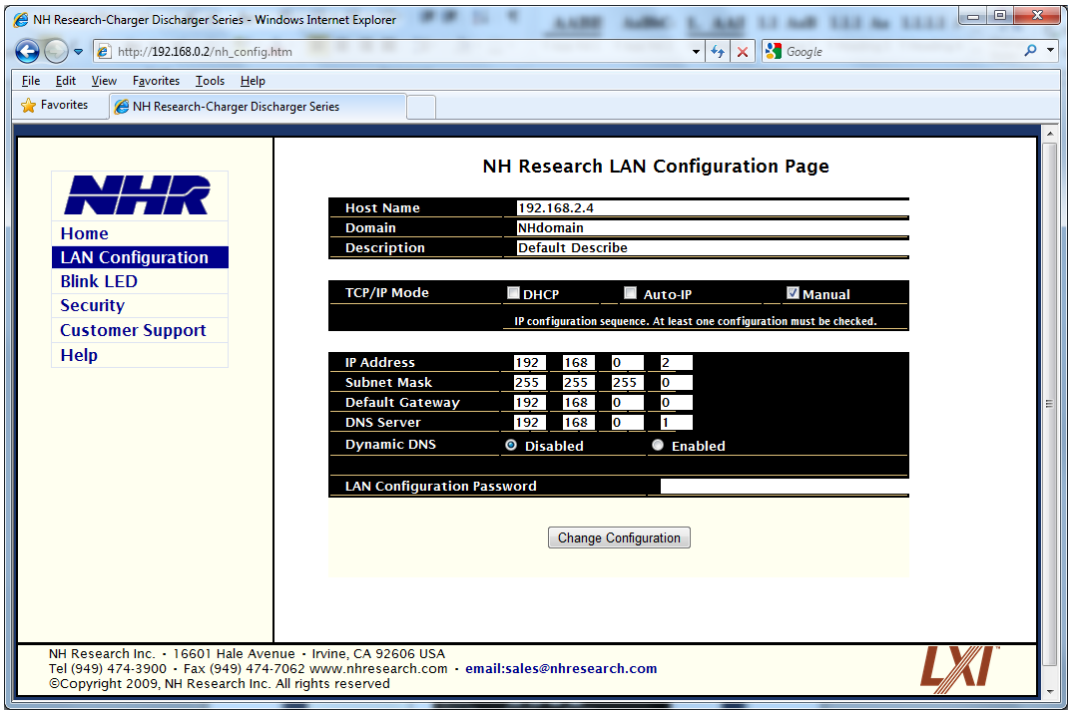
APPENDIX A - ETHERNET CONFIGURATION

If the IP address is not known:
The IP address can be forced to 192.168.0.2 by switching the top dip switch on the rear of the DC Power Module. Note this should be done one module at a time to prevent an IP address conflict.
The DIP switches located on the rear panel of each module.
The operating position is shown below when facing the rear of the unit.

Switch 1 - Position Left, Normal Network Operation
Position Right, Force LAN to fixed IP address 192.168.0.2
Switch 2 - Position Left, Default
Switch 3 - Position Left, Normal Configuration Parameters
Position Right, Ignored Flash Configuration Parameters
Switch 4 - Position Left, Default
Switch 5 - Position Left, Default
Switch 6 - Position Left, Default
Switch 7 - Position Left, Default
Switch 8 - Position Right, Normal DSP Operation

If the IP address is known:
Connect a PC with the same Ethernet domain as the module. I.e. if the module is at 192.168.0.2 then the PC will need to be configured for 192.168.0.x where x is from 0-254 except for 2.

Open a web browser and type the modules IP address: e.g. http://192.168.0.2



The Left Selection Menu Contains:
LAN CONFIGURATION: Update the LAN (Ethernet) configuration
BLINK LED: Blinks the LAN LED on the Module
SECURITY: Allows a custom password to be set
CUSTOMER SUPPORT: Takes you to NH Research Site
HELP: Help

Select Blink LED and ensure you are connected to the correct DC Power Module looking at the LAN LED on the module front panel.

Select LAN Configuration and update to your desired settings:

DHCP – When Selected the Module will attempt to get an address from a DHCP Server
Auto IP – The Module will self-assign an address as 169.XXX.XXX.XXX
Manual – For Static IP setting

Enter the LAN Configuration password to approve the change. The default password is 'password'

Click Change Configuration

Note: If you set the switch on the rear panel to force 192.168.0.2 address please turn this switch off before cycling power.

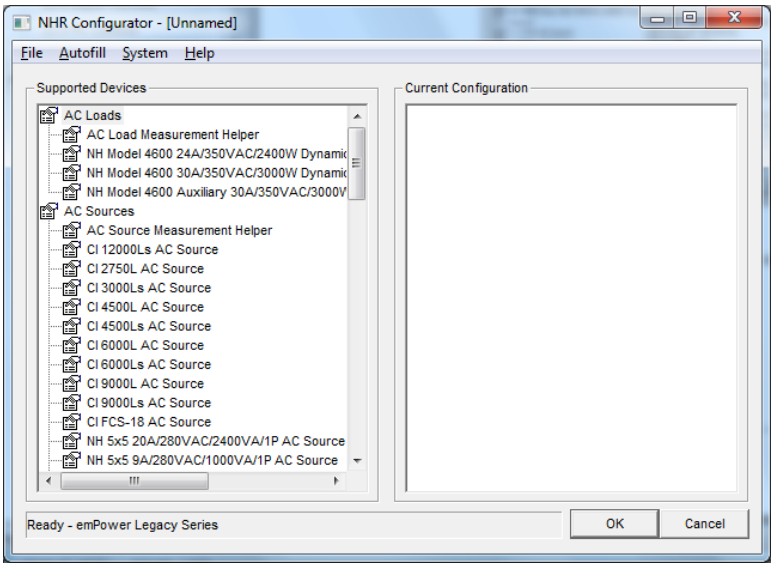
APPENDIX B - SOFTWARE CONFIGURATION

Labview and PowerPanel use the **NHR Configurator** tool to define the resource name.

NHR Configurator can be found under Programs → NH Research → System Configurator.

When Launched, The NHR Configurator dialog window displays two frames, the Supported Devices frame, and the Current Configuration frame.

The Title block shows the name of the configuration file loaded. This allows multiple configurations to be loaded quickly by the operator changing the configuration of the hardware.



The Supported Devices Frame
The Supported Devices frame contains the list of all hardware drivers on your Test System. Your Test System came with the standard set of NH Research hardware device.

The Current Configuration Frame
NHR has always listed hardware devices in this frame by grouping the functional modes of the device. In this way Sources, Loads, measurement devices, and now DC Power Modules (PM) can be shown as configured test equipment by functional type.

We will be focusing on the PM (or DC Power Module) section since this is the actual hardware device being configured.

Un-configured hardware devices
A DC Power Module is not configured using NHR Configurator will not be directly communicated to by Labview drivers or other NHR software. Communication will only occur when a module is known and has been configured with this tool.

Non-existent/Non-functioning hardware devices
If a hardware device referred to in the Current Configuration file is either Non-existent (because it has been removed, or disconnected), or Non-functioning (because it is damaged), NHR Configurator will display a non-communication fault message.

IP Address Changes
Are automatically updated in NHR Configurator as long as the device exist and is able to be communicated with. NHR Configurator uses the MAC address of the DC Power Module to ensure it is still operating and not the assigned IP address.

Using NHR Configurator
What you can do in the NHR Configurator dialog window?
The Current Configuration file contains **ALL** the information about **ALL** the hardware devices that NHR Software will communicate with.

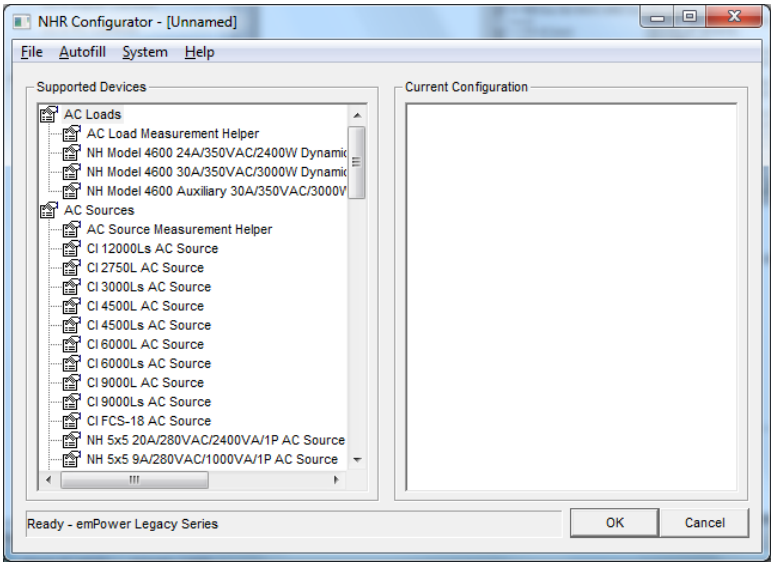
There are 11 tasks you can do in the NHR Configurator, they are:
The NHR Configurator – File menu
- Task 1 - Create a new Configuration file.
- Task 2 - Open an existing Configuration file.
- Task 3 - Save the Current Configuration file.
- Task 4 - View, Save, and Print the Current Configuration file.

The NHR Configurator – Autofill menu
- Task 5 - Add a new Device Driver (Automatically).

The NHR Configurator – Supported Devices frame
- Task 6 - Add a new Device Driver (Manually).

The NHR Configurator – Current Configuration frame (right-click menu)
- Task 7 - Creating a Parallel Configuration
- Task 8 - Rename a hardware device.
- Task 9 - Removing a hardware device.
- Task 10 - Dump the configuration of a hardware device.
- Task 11 - Update the Firmware of a hardware device.

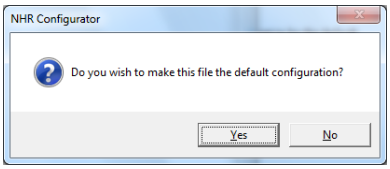
Task 1– Create a new Configuration file.
Open the NHR Configurator dialog window.



Click File – the File menu opens.
Select the New option – a new, un-named, Configuration file is created with no hardware devices in the Current Configuration frame.

Before you go any further, it's a good idea to save this new Configuration file, so:
Select the Save As… option from the file menu – a standard windows dialog window opens.

Enter an appropriate name for the Configuration file in the File Name: field.
Click the Save button – a NHR Configuration dialog window opens.



Click the Yes button – the new Configuration file is saved, and is set to be the default Configuration file.

Task 2 – Open an existing Configuration file.
The easy way to change Configuration files is to just open the Configuration file you want to be your Current Configuration file. To do so:

Open the NHR Configurator dialog window
Select the Open… option from the File Menu. – A standard windows dialog window opens.
Select the Configuration file you want to open.
Click the Open button - You will be asked if this is to be the default configuration.
Click the Yes button – the Opened Configuration file is set to be the default Configuration file.

Task 3 – Save the Current Configuration file.
Select the Save option from the File Menu – the Current Configuration file is saved.
In the NHR Configurator dialog window, click the OK button.

Task 4 – View, Save, and Print the Current Configuration file.
Click File – the File menu opens.
Select the Print… option – the Print Configuration dialog window. This allows the configuration to be printed or saved as an .rtf (Rich Text Format) file for documentation purposes.

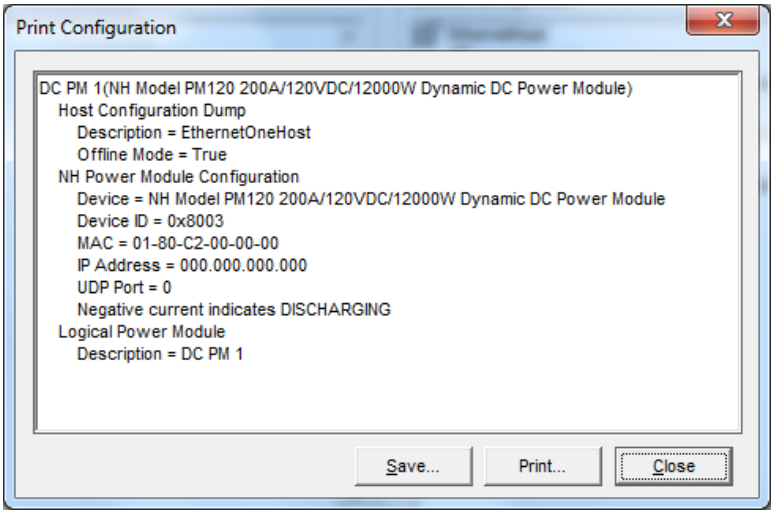
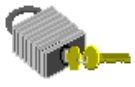


Figure 10 – The Print Configuration dialog window

Scroll down to view the details of each hardware device in the Current Configuration file.

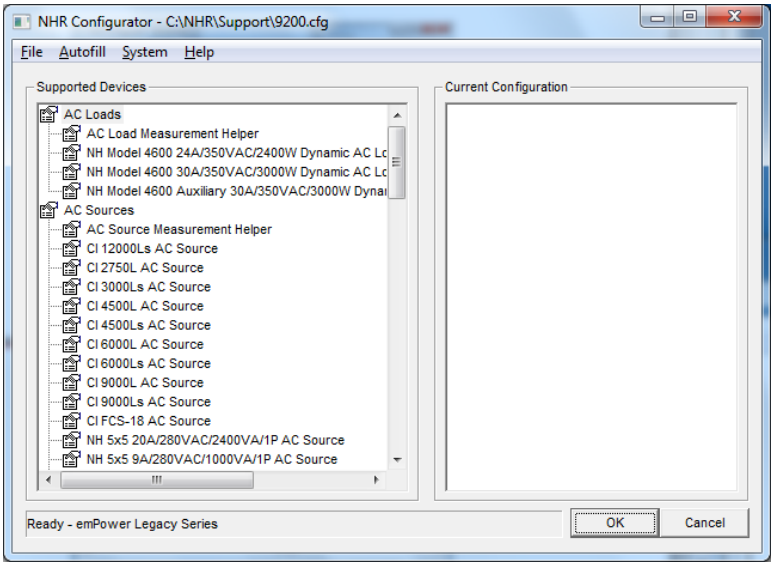


The Print Configuration dialog window
The details listed in the Print Configuration dialog window contains the configuration details of all hardware devices in the Current Configuration file.

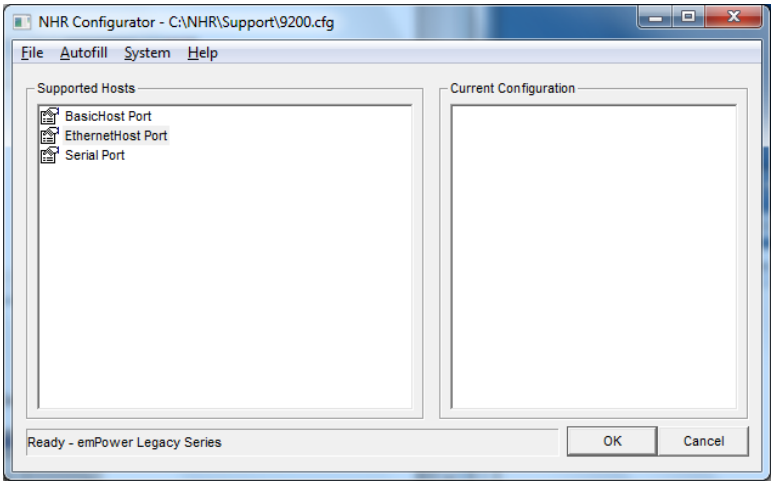
Task 5– Add a new Device Driver (Automatically).
Using the Search for Devices option in the Autofill menu of NHR Configurator is the recommended method for adding new hardware device drivers to the Configuration file.

Autofill – Online mode only
The Search for Devices option **only** works on NHR hardware devices connected to the communication ports; and only when is in Online mode. Using this method Configurator does most of the work for you; it "autofills" much of the setup information that would otherwise need to be entered manually.

Open the NHR Configurator dialog window.

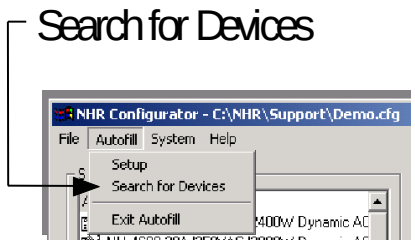


Select Autofill →Setup



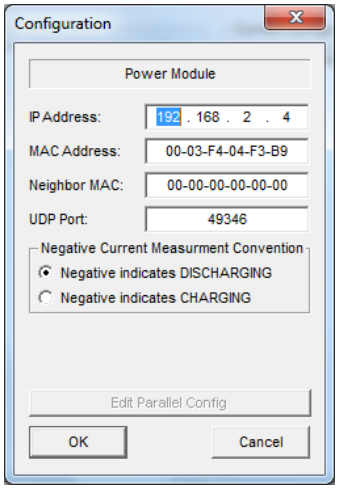
When starting from a blank configuration it will look like above. We will need to select Ethernet Host so NHR Configurator knows where to look for devices. This can be done by double clicking EthernetHost Port or dragging it to the Current Configuration.

Once this is done then Search for devices can be selected from the Autofill menu.



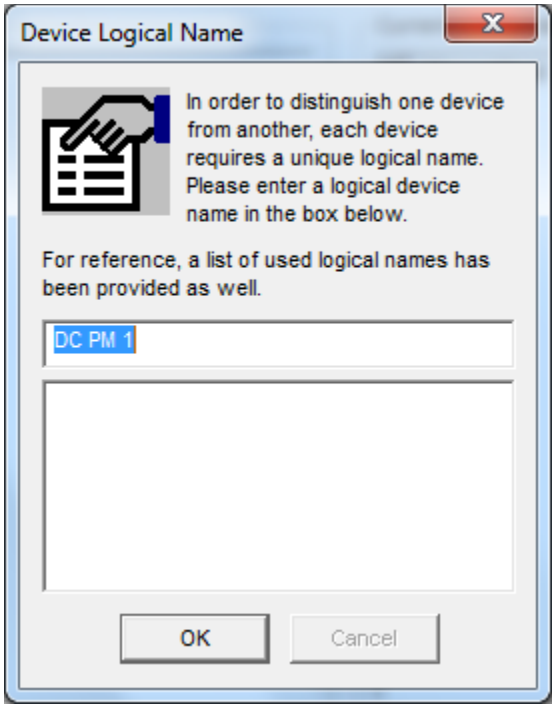
Search for devices will look on the Ethernet using Broadcast packets and identify any DC Power Modules found on the network.

After pressing the "OK" button a set of configuration windows will appear for each DC Power Module found. The first of these is the Ethernet Configuration Window.



Negative Current Measurement Convention
The Configurator allows the operator to select the preferred sign for current direction. When communicating to the DC Power Module in Labview or PowerPanel a negative current value would indicate Charging or Discharging based on this selection.

Next is the Logical Device Name. This is the Resource Identification name that will be used by Labview programs. If running the Configurator on the PowerPanel it is recommended to allow the default naming convention to be used (i.e. DC PM x where x is unit 1,2, or 3).



Logical Name
The Logical Name allows the user to have a more intuitive name for the DC Power Module or parallel group of DC Power Modules. Later sections will show how to parallel the DC Power Modules.

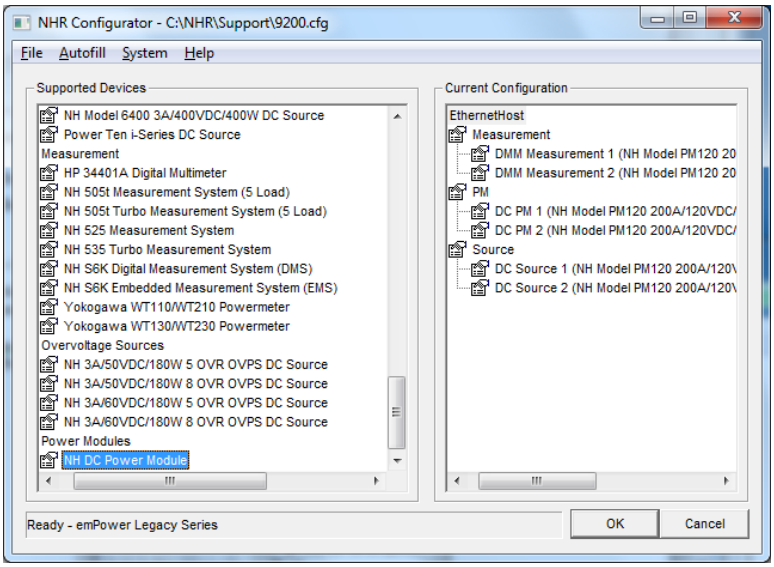
After this first name is assigned NHR Configurator may request more names or configuration information. It is recommended to select OK and allow the default values for each of the following windows. These addition al configuration items are related to NHR Configurators preference in grouping hardware by Logical Type. A DC Power Module is inherently a DC Power Module, Measurement Device, and a Source. It is recommended to leave these names as default values.

Task 6 – Add a new DC Power Module (Manually).
To add a new DC Power Module manually, you either:

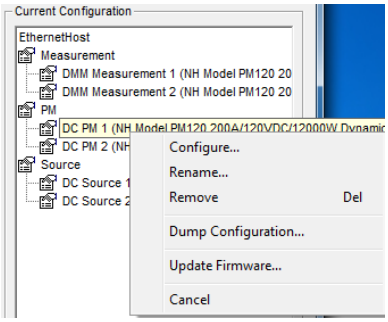
1. Double-click the named device in the Supported Devices frame
2. Drag the device in the Supported Devices frame, into the Current Configuration frame.

Task 7 – Creating a Parallel Configuration
This section shows how to establish a Parallel configuration through NHR Configurator. Parallel configurations can also easily be established in Labview programs as well.

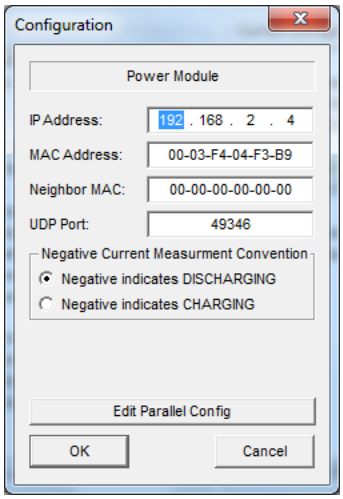
To create a parallel configuration it is recommended to first create a configuration file with the desired DC Power Modules described as individual modules.



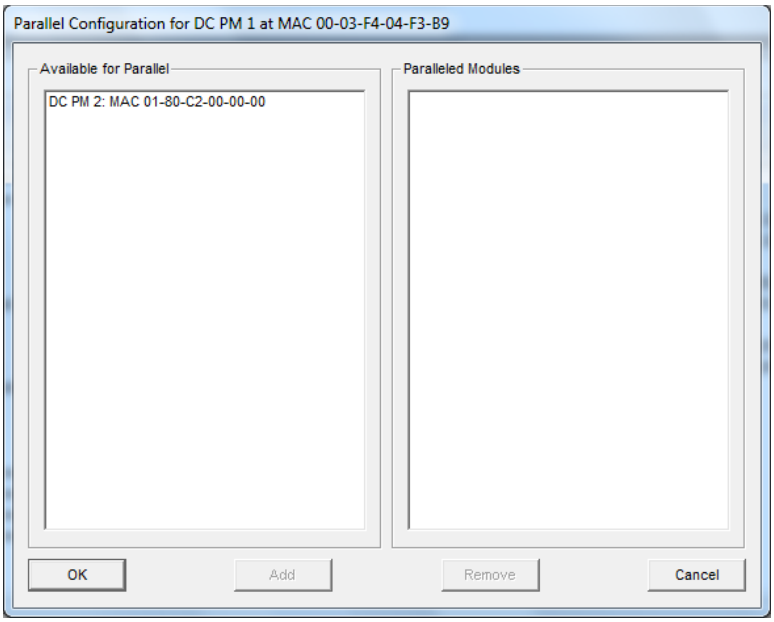
Select a DC Power Module that will be the master by Right Clicking on that DC Power Module and select Configure.



This will bring up that modules configuration information again. Notice this time that Edit Parallel Config button is available since NHR Configurator knows about more than one DC Power Module.

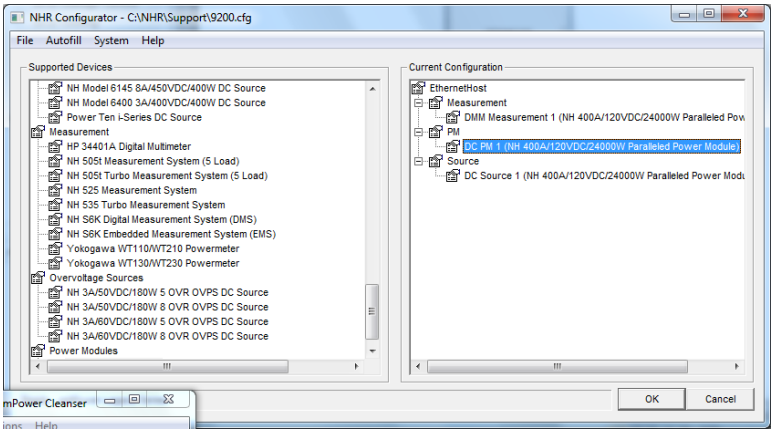


Selecting Edit Parallel Config button will open a new window. This window allows the additional DC Power Modules to be connected together as slaves to the first DC Power Module selected.

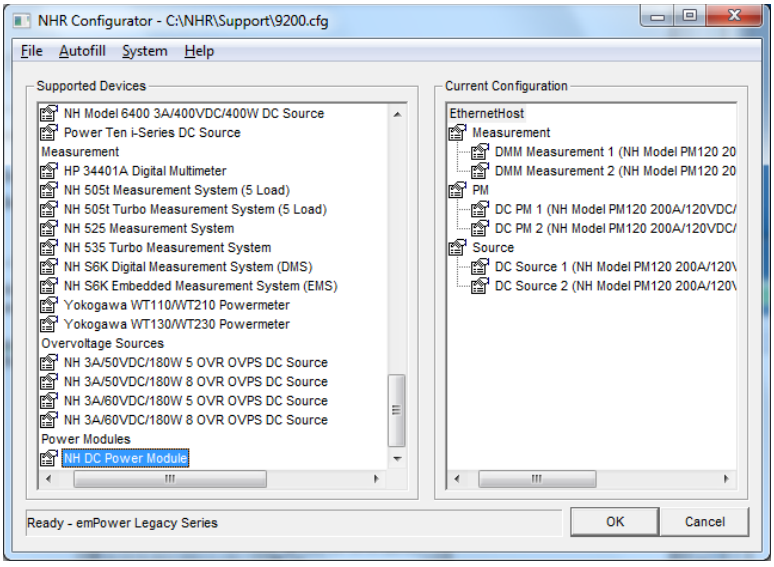


Once the DC Power Modules have been added or removed press OK to return to the main configuration window.

Notice that PM2 is now no longer in the configuration main window and PM1 is now listed as having twice its functional capabilities. DC PM 1 is therefore now a parallel module comprised of two (or more) physical modules.

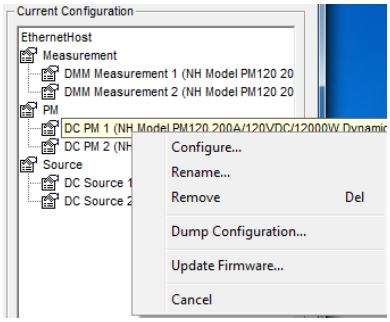


Task 8 – Rename a hardware device.
This section tells you how to change the Logical Name of a hardware device.
Open the NHR Configurator.

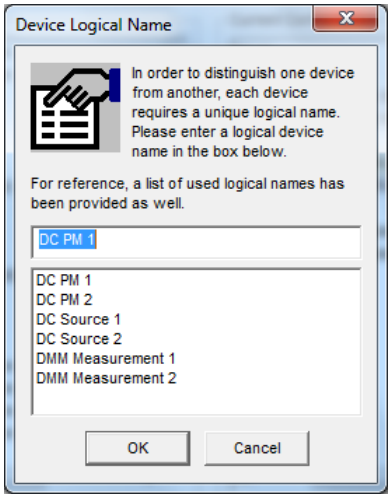


In the Current Configuration frame:

Right-click on the hardware device you want to rename.



Select the Rename option – the Device Logical Name dialog window opens.

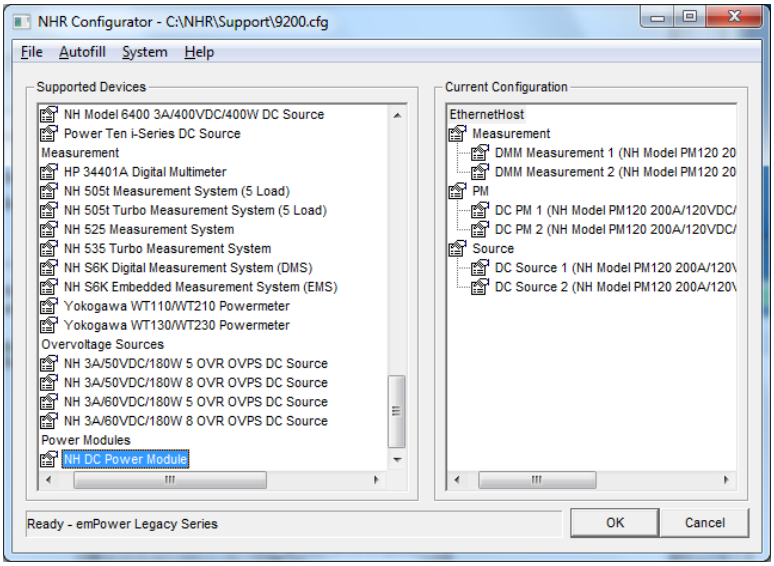


Enter a new Logical Name for the hardware device, click the OK button.

Logical Name
The Logical Name allows the user to have a more intuitive name for the DC Power Module or parallel group of DC Power Modules. It is recommended to use the DC PM x where x is the modules location in the cabinet when creating a configuration on the PowerPanel.

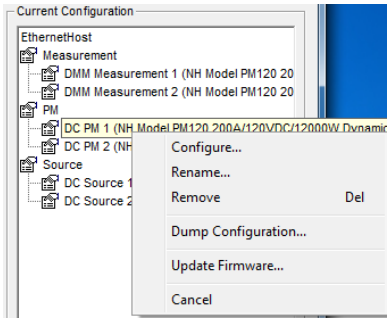
Task 9 – Removing a hardware device.

Open the NHR Configurator.



In the Current Configuration frame:

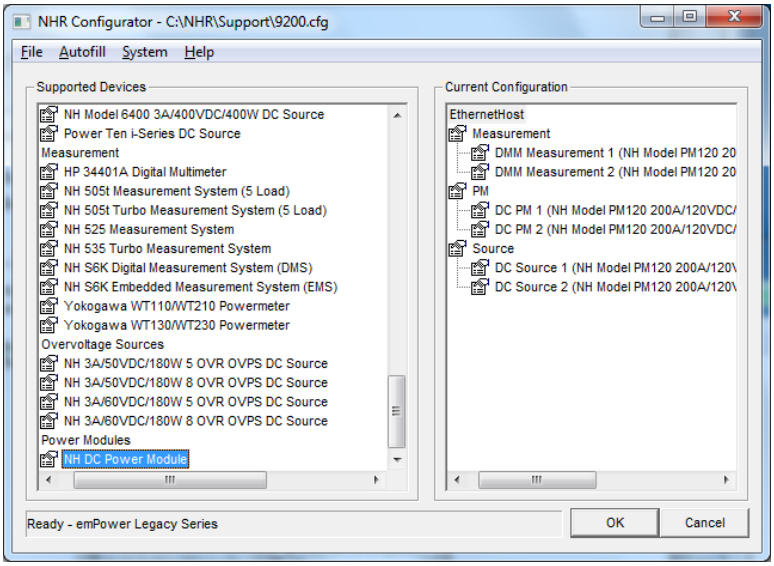
Right-click on the hardware device you want to remove.



Click the Remove option.

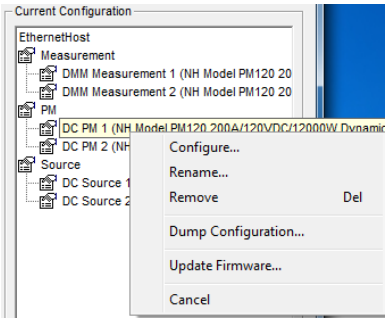
Task 10 – Dump the configuration of a hardware device.

Open the NHR Configurator.

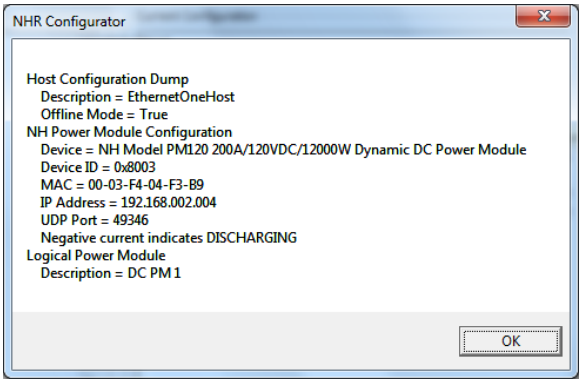


In the Current Configuration frame:

Right-click the name of hardware device you want the configuration details of.



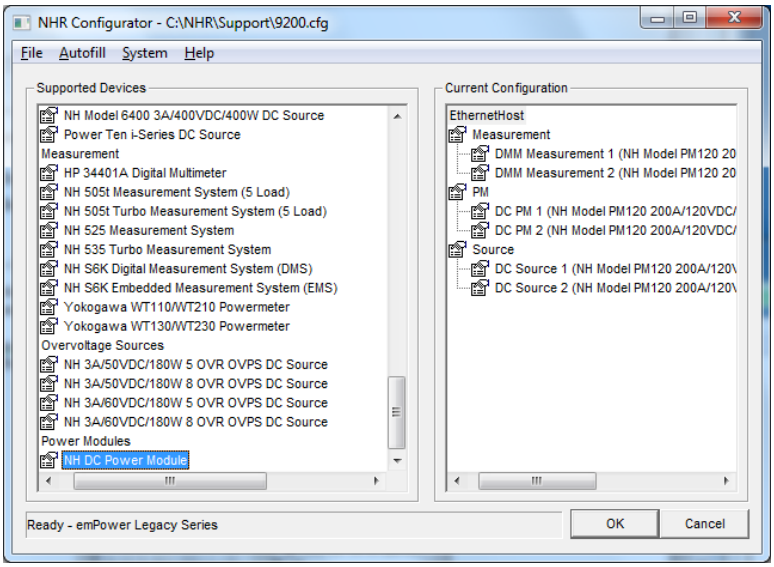
Select the Dump Configuration option and a window will open with the device configuration information.



Task 11 – Update the Firmware of a hardware device.

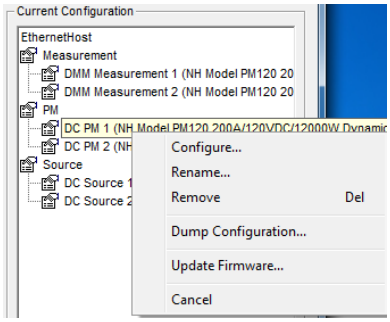
The Firmware is software that is embedded into an NH Research DC Power Module. NHR occasionally releases new firmware for the DSP or Network Micro to improve functional performance of the DC Power Module.

To update firmware, first open the NHR Configurator.

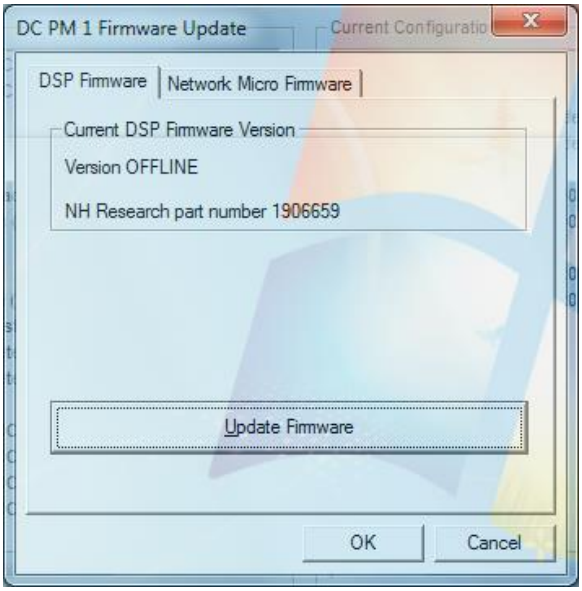


In the Current Configuration frame:

Right-click the name of hardware device you want to update.



Select Update Firmware.



There are two tabs … One for DSP Firmware and one for Network Micro Firmware.

Select the correct tab for the Firmware to be updated and then Update Firmware.

Firmware
The DSP Firmware generally is released as a *.HEX file
The Network Micro Firmware is generally released as a *.S19 File

A dialog will open allowing the firmware update file to be selected. Once firmware is updated the DC Power Module will need to be power cycled. Close PowerPanel and Configurator before turning off power to the DC Power Module.

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