

# Keysight N8900 Series Prewired Rack System

Installation Guide



# Legal Notices

## Copyright Notice

© Keysight Technologies 2015

No part of this manual may be reproduced in any form or by any means (including electronic storage and retrieval, or translation into a foreign language) without prior agreement and written consent from Keysight Technologies, Inc. as governed by United States and international copyright laws.

## Manual Part Number

5991-3411

## Edition

Edition 3, July 2015

## Printed in:

Printed in Germany

## Published by

Keysight Technologies, Inc.  
550 Clark Drive  
Budd Lake, NJ 07828 USA

## Technology Licenses

The hardware and or software described in this document are furnished under a license and may be used or copied only in accordance with the terms of such license.

## Waste Electrical and Electronic Equipment (WEEE) Directive 2002/96/EC

This product complies with the WEEE Directive marketing requirement. The affixed product label (see below) indicates that you must not discard this electrical/electronic product in domestic household waste.

**Product Category:** With reference to the equipment types in the WEEE directive Annex 1, this product is classified as "Monitoring and Control instrumentation" product. Do not dispose in domestic household waste.

To return unwanted products, contact your local Keysight office, or see <http://about.keysight.com/en/company/info/environment/takeback.shtml> for more information.



## U.S. Government Rights

The Software is "commercial computer software," as defined by Federal Acquisition Regulation ("FAR") 2.101. Pursuant to FAR 12.212 and 27.405-3 and Department of Defense FAR Supplement ("DFARS") 227.7202, the U.S. government acquires commercial computer software under the same terms by which the software is customarily provided to the public. Accordingly, Keysight provides the Software to U.S. government customers under its standard commercial license, which is embodied in its End User License Agreement (EULA), a copy of which can be found at [www.keysight.com/find/sweula](http://www.keysight.com/find/sweula). The license set forth in the EULA represents the exclusive authority by which the U.S. government may use, modify, distribute, or disclose the Software. The EULA and the license set forth therein, does not require or permit, among other things, that Keysight: (1) Furnish technical information related to commercial computer software or commercial computer software documentation that is not customarily provided to the public; or (2) Relinquish to, or otherwise provide, the government rights in excess of these rights customarily provided to the public to use, modify, reproduce, release, perform, display, or disclose commercial computer software or commercial computer software documentation. No additional government requirements beyond those set forth in the EULA shall apply, except to the extent that those terms, rights, or licenses are explicitly required from all providers of commercial computer software pursuant to the FAR and the DFARS and are set forth specifically in writing elsewhere in the EULA. Keysight shall be under no obligation to update, revise or otherwise modify the Software. With respect to any technical data as defined by FAR 2.101, pursuant to FAR 12.211 and 27.404.2 and DFARS 227.7102, the U.S. government acquires no greater than Limited Rights as defined in FAR 27.401 or DFAR 227.7103-5 (c), as applicable in any technical data.

This equipment does not contain any software.

## Warranty

THE MATERIAL CONTAINED IN THIS DOCUMENT IS PROVIDED "AS IS," AND IS SUBJECT TO BEING CHANGED, WITHOUT NOTICE, IN FUTURE EDITIONS. FURTHER, TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, KEYSIGHT DISCLAIMS ALL WARRANTIES, EITHER EXPRESS OR IMPLIED, WITH REGARD TO THIS MANUAL AND ANY INFORMATION CONTAINED HEREIN, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. KEYSIGHT SHALL NOT BE LIABLE FOR ERRORS OR FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES IN CONNECTION WITH THE FURNISHING, USE, OR PERFORMANCE OF THIS DOCUMENT OR OF ANY INFORMATION CONTAINED HEREIN. SHOULD KEYSIGHT AND THE USER HAVE A SEPARATE WRITTEN AGREEMENT WITH WARRANTY TERMS COVERING THE MATERIAL IN THIS DOCUMENT THAT CONFLICT WITH THESE TERMS, THE WARRANTY TERMS IN THE SEPARATE AGREEMENT SHALL CONTROL.

## Safety Information

### WARNING

A **WARNING** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a **WARNING** notice until the indicated conditions are fully understood and met.

### CAUTION

A **CAUTION** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a **CAUTION** notice until the indicated conditions.

# Safety Notices

The following general safety precautions must be observed during all phases of operation of this instrument. Failure to comply with these precautions or with specific warnings or instructions elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Keysight Technologies assumes no liability for the customer's failure to comply with these requirements.

## General

The equipment is for industrial use.

Equipment operators are subject to all applicable safety regulations. Along with the warning and safety notices in this manual, all relevant safety, accident prevention, and environmental regulations must also be followed. In particular, the operators of the equipment:

- Must be informed of the relevant safety requirements.
- Must have read and understood the operating manual before using the equipment.
- Must use the designated and recommended safety equipment.

Do not use this product in any manner not specified by the manufacturer. The protective features of this product may be impaired if it is used in a manner not specified in the operating instructions.

## Grounding

### WARNING

This is a Safety Class 1 product and has a protective earth (ground) terminal. To minimize shock hazard, the instrument must be connected to the AC mains through a grounded power cable, with the ground wire firmly connected to an electrical ground (safety ground) at the power outlet. Any interruption of the protective (grounding) conductor or disconnection of the protective earth terminal will cause a potential shock hazard that could result in injury or death.

## Leakage Current

### WARNING

Due to types of products that can be installed in this cabinet, there is a risk of high leakage current. Reliable ground circuit continuity is vital for safe operation of this product. To reduce the risk of electric shock, earth (ground) connection is essential before connecting the power supply. Never operate this cabinet with the ground conductor disconnected.

## Hazardous Voltages

### WARNING

**HAZARDOUS VOLTAGES** All models generate voltages in excess of 60 VDC, with some models rated at up to 1,500 VDC! Ensure that all instrument connections, load wiring, and load connections are either insulated or covered so that no accidental contact with lethal output voltages can occur.

## Cabinet Stability

### WARNING

To reduce the risk of cabinet instability, always install the power supplies starting from the bottom of the rack and continue to the top of the rack. Install a filler panel in any unused instrument trays.

## Before Applying Power

### WARNING

**SHOCK HAZARD** Always turn off the **external disconnect device** before opening the rear door.

Only operate the product at the rated mains voltage and phase as stipulated on the input label.

All connections must be made by qualified personnel who are aware of the hazards involved. Improper actions can cause fatal injury as well as equipment damage.

Never touch cables or connections immediately after turning off the unit. Depending on the model, lethal voltages can remain at the output terminals for up to 10 seconds after turn-off. Verify that there is no dangerous voltage on the output or sense terminals before touching them.

## Environmental Conditions

Do not operate the equipment in the presence of flammable gases or fumes. Environmental conditions are described under **Common Characteristics**.

## Do Not Open Cabinet Doors

Only qualified, service-trained personnel who are aware of the hazards involved should open cabinet doors. Always disconnect external power before opening cabinet doors.

## Do Not Modify the Instrument

Do not install substitute parts or perform any unauthorized modification to the product.

## In Case of Damage

Instruments that appear damaged or defective should be made inoperative and secured against unintended operation until they can be repaired by qualified service personnel.

## Safety Symbols



Direct current



Alternating current



Frame or chassis terminal



Standby supply. Unit is not completely disconnected from ac mains when switch is off



Caution, risk of electric shock



Caution, refer to accompanying description



Protective earth ground terminal.



Contains one or more of the 6 hazardous substances above the maximum concentration value (MCV), 40 Year EPUP.

# Contents

Legal Notices .....	3
Safety Notices.....	4
Contents .....	5
1 - Introduction.....	7
Rack Models .....	8
Rack Characteristics.....	8
Common Characteristics.....	11
2 - Site Preparation .....	13
Site Accessibility.....	14
Site Requirements.....	15
3 - Unpacking .....	17
Items Supplied.....	18
Unpacking Instructions .....	18
Moving the Rack Cabinet.....	20
4 - Assembly.....	21
Connect the AC Mains .....	22
Install the Power Supplies.....	23
Install the Bus Bars .....	24
Connect the AC input.....	27
Connect the Communications Cables .....	28
Connect the Output Cables .....	30
Complete the Installation.....	31
5 - Operation .....	33
Switches and Indicators .....	34
Turn-On Checkout.....	35
Computer Interfaces.....	37
6 - Maintenance .....	39
Lock-Out Tag-Out .....	40
Before Servicing .....	40
Troubleshooting.....	40
Parts List.....	41
Wiring Diagrams.....	42
Index.....	47



# 1

## Introduction

Rack Models .....	8
Rack Characteristics.....	8
Common Characteristics.....	11

The Keysight N8900 Series Rack System is shipped without the Keysight N8900 Series Autoranging DC Power Supplies, which must be ordered separately. You can install up to six 15-kW N8900 power supplies in the prewired rack in parallel – then treat the entire rack as a single-output power system that delivers up to 90 kW. Autoranging capability provides full power output at a wide range of voltages and currents.

This document includes installation and operating information for the Keysight N8900 Series Rack System. For feedback on this document, please contact Keysight at [www.keysight.com/find/n8900-docfeedback](http://www.keysight.com/find/n8900-docfeedback).

### NOTE

You can contact Keysight Technologies at one of the following telephone numbers for warranty, service, or technical support information.

In the United States: (800) 829-4444

In Europe: 31 20 547 2111

In Japan: 0120-421-345

Or use our Web link for information on contacting Keysight in your country or specific location: [www.keysight.com/find/assist](http://www.keysight.com/find/assist)

Or contact your Keysight Technologies Representative.

The web contains the most up to date version of this manual. Go to [www.keysight.com/find/n8900](http://www.keysight.com/find/n8900) to get the latest version of the manual.

## Rack Models

Rack Models	AC Input	Supported Models	Maximum Voltage	Maximum Current (with 6 units)
Keysight N89201A	208 VAC 3 phase	Up to 6 - N8931A Up to 6 - N8932A	80 V 200 V	3060 A 1260 A
Keysight N89202A	208 VAC 3 phase	Up to 6 - N8934A Up to 6 - N8935A Up to 6 - N8937A	500 V 750 V 1,500 V	540 A 360 A 180 A
Keysight N89401A	400 VAC 3 phase	Up to 6 - N8951A Up to 6 - N8952A	80 V 200 V	3060 A 1260 A
Keysight N89402A	400 VAC 3 phase	Up to 6 - N8954A Up to 6 - N8955A Up to 6 - N8957A	500 V 750 V 1,500 V	540 A 360 A 180 A

## Rack Characteristics

Characteristics are not warranted but are descriptions of performance determined either by design or by type testing. All characteristics are typical unless otherwise noted.

This information is subject to change without notice.

Characteristics	Number of Units in Parallel				
N8931A/N8951A	2	3	4	5	6
Output ripple & noise CV peak-to-peak:	640 mV				
Load Effect					
Voltage:	40 mV	40 mV	40 mV	40 mV	40 mV
Current:	1.53 A	2.30 A	3.06 A	3.83 A	4.60 A
Current programming & measurement accuracy:	≤ 2.2 A	≤ 3.3 A	≤ 4.4 A	≤ 5.5 A	≤ 6.6 A
Voltage programming & measurement accuracy:	≤ 80 mV				
Transient response					
Recovery Time:	≤ 3 ms				
Settling band:	0.80 V				
Output response time					
Up, full load:	≤ 30 ms				
Down, full load:	≤ 80 ms				
Down, no load:	≤ 30 s				



Characteristics	Number of Units in Parallel				
N8932A/N8952A	2	3	4	5	6
Output ripple & noise CV peak-to-peak:	740/600 mV				
Load Effect					
Voltage:	100 mV	100 mV	100 mV	100 mV	100 mV
Current:	0.063 A	0.945 A	1.26 A	1.58 A	1.89 A
Current programming & measurement accuracy:	$\leq 0.840$ A	$\leq 1.26$ A	$\leq 1.68$ A	$\leq 2.1$ A	$\leq 2.52$ A
Voltage programming & measurement accuracy:	$\leq 200$ mV				
Transient response					
Recovery Time:	$\leq 3$ ms				
Settling band:	2.0 V				
Output response time					
Up, full load:	$\leq 30$ ms				
Down, full load:	$\leq 80$ ms				
Down, no load:	$\leq 10$ s				

Characteristics	Number of Units in Parallel				
N8934A/N8954A	2	3	4	5	6
Output ripple & noise CV peak-to-peak:	700 mV				
Load Effect					
Voltage:	250 mV	250 mV	250 mV	250 mV	250 mV
Current:	270 mA	405 mA	540 mA	675 mA	810 mA
Current programming & measurement accuracy:	$\leq 0.36$ A	$\leq 0.54$ A	$\leq 0.72$ A	$\leq 0.90$ A	$\leq 1.08$ A
Voltage programming & measurement accuracy:	$\leq 500$ mV				
Transient response					
Recovery Time:	$\leq 3$ ms				
Settling band:	5.0 V				
Output response time					
Up, full load:	$\leq 30$ ms				
Down, full load:	$\leq 80$ ms				
Down, no load:	$\leq 10$ s				

## 1 Introduction

Characteristics	Number of Units in Parallel				
N8935A/N8955A	2	3	4	5	6
Output ripple & noise CV peak-to-peak:			1.6 V		
Load Effect					
Voltage:	375 mV	375 mV	375 mV	375 mV	375 mV
Current:	190 mA	270 mA	360 mA	450 mA	540 mA
Current programming & measurement accuracy:	$\leq 240$ mA	$\leq 360$ mA	$\leq 480$ mA	$\leq 600$ mA	$\leq 720$ mA
Voltage programming & measurement accuracy:			$\leq 750$ mV		
Transient response					
Recovery Time:			$\leq 3$ ms		
Settling band:			7.5 V		
Output response time					
Up, full load:			$\leq 30$ ms		
Down, full load:			$\leq 80$ ms		
Down, no load:			$\leq 10$ s		

Characteristics	Number of Units in Parallel				
N8937A/N8957A	2	3	4	5	6
Output ripple & noise CV peak-to-peak:			4.8 V		
Load Effect					
Voltage:	750 mV	750 mV	750 mV	750 mV	750 mV
Current:	106/90 mA	159/135 mA	212/180 mA	265/225 mA	318/270 mA
Current programming & measurement accuracy:	$\leq 120$ mA	$\leq 180$ mA	$\leq 240$ mA	$\leq 300$ mA	$\leq 360$ mA
Voltage programming & measurement accuracy:			$\leq 1.5$ V		
Transient response					
Recovery Time:			$\leq 3$ ms		
Settling band:			15 V		
Output response time					
Up, full load:			$\leq 30$ ms		
Down, full load:			$\leq 80$ ms		
Down, no load:			$\leq 10$ s		

## Common Characteristics

Characteristics	All Models
Computer Interfaces	
LXI Core 201:	10/100 Base-T Ethernet (Sockets, VXI-11 protocol, Web user interface)
USB:	USB 2.0 (USB-TMC488)
GPIB:	GPIB IEEE 488
Language:	SCPI - 1993, IEEE 488.2 compliant
Environmental Conditions	
Operating environment:	Indoor use, installation category II (for AC input), pollution degree 2
Temperature range:	0°C to 45°C
Relative humidity:	80% or less (non-condensing)
Altitude:	Up to 2000 meters
Regulatory Compliance	
EMC:	European EMC Directive for test and measurement products Australian standard and carries C-Tick mark
Safety:	European Low Voltage Directive and carries the CE marking
Weight	
N89201A:	348 lbs (158.2 kg) empty; estimated at 738 lbs (336 kg) fully loaded
N89202A:	298 lbs (135.5 kg) empty; estimated at 688 lbs (313 kg) fully loaded
N89401A:	320 lbs (145.5 kg) empty; estimated at 670 lbs (306 kg) fully loaded
N89402A:	270 lbs (122.7 kg) empty; estimated at 620 lbs (283 kg) fully loaded
Dimensions	
All Models:	600 mm x 1,060 mm x 1,540 mm Depth includes front and rear handles Height includes casters and emergency stop switch.



## 2

# Site Preparation

Site Accessibility.....	14
Site Requirements.....	15

# Site Accessibility

## Customer's Responsibility

It is the customer's responsibility to:

1. Prepare the installation site in accordance with the instructions in this guide (see [Site Requirements](#)).
2. Move all of the equipment from the receiving area to the installation site.
3. Move any other equipment and furniture that will be used with the test system to the installation site.

To determine the accessibility of your installation site, you must consider the physical characteristics of the test system and whether the route from the receiving area to the installation site will accommodate the system.

The equipment listed in the following table, or the equivalent to this equipment, is required for the performance tests and for calibration. Test record sheets are included at the back of this section.

## Installation Route

Inspect all doorways, corridors, and rooms enroute to the installation site. Make sure that there is enough clearance for the height of the cabinet along the entire route. Also make sure that there is enough clearance for the cabinet to go around all corners.

The floor under the cabinet along the installation route and at the installation site must be capable of supporting a concentrated load of approximately 250 pounds-force per square inch (18 kilograms-force per square centimeter) for a fully loaded rack system.

Any horizontal gaps in the floor (such as between the floor and an elevator) cannot exceed 2.5 cm (1 in.). Any vertical obstructions that are at a right angle to the floor (such as the lip of an elevator threshold) cannot exceed 1 cm (0.4 in.) in height.

### **WARNING**

The maximum recommended angle of any ramp on which the cabinet will be moved is 10 degrees and cannot exceed 15 degrees.

---

## Site Requirements

### Floor Loading

Observe floor loading requirements (especially raised floors) and ensure adequate space before moving your rack system, and all safety items while moving.

At the maximum gross weight for a fully loaded rack system, the floor must be able to support 250 pounds-force per square inch (18 kilograms-force per square centimeter).

#### **WARNING**

It is the customer's responsibility to determine the floor loading capacity at the installation site, and for the entire route when moving. Failure to do so could result in personal injury and/or equipment damage.

Because the weight is concentrated on the four casters, Keysight Technologies recommends removing the components and moving them separately when moving a rack system over a floor (especially a raised floor) of unknown capacity.

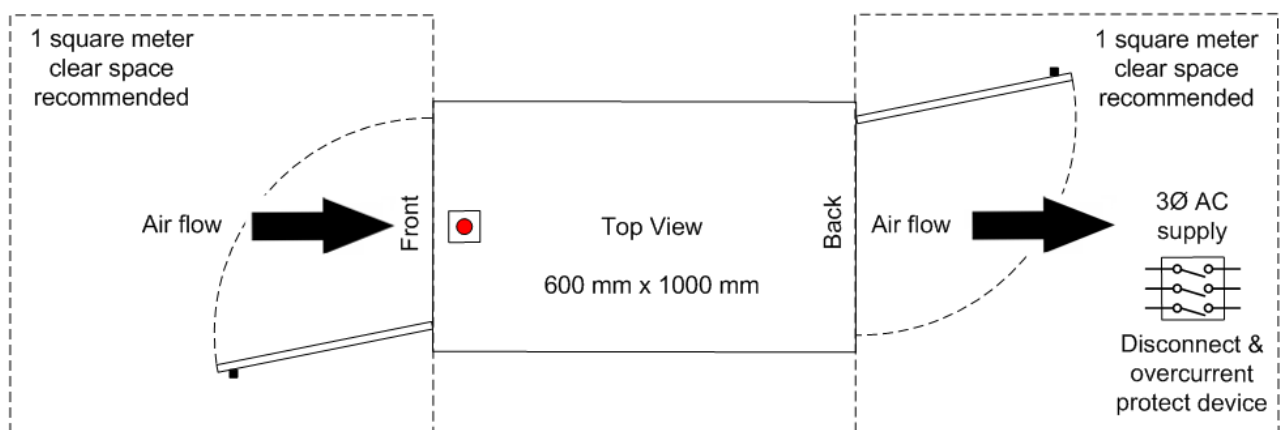
### Floor Space

The dimensions of your rack system, an outline diagram, and airflow direction are shown below. Fans cool the instruments by drawing air through the front and exhausting it out the back. Allow at least 1 meter (36 inches) of space at the front and back of the cabinet for adequate air circulation.

#### **NOTE**

Keysight N8900 Series Rack Systems generate up to 90 kW of power, which is consumed by the DUT. Ensure that there is enough air circulation or air conditioning at the installation site to remove any excess heat generated by the DUT. By itself, a fully loaded rack system generates up to 9 kW of heat.

Approximately one to two square meters (one to two square yards) of space are recommended in front and behind the cabinet for accessibility and servicing. Since there may be occasions when several people may be gathered in front of the rack system, additional space may be considered.



## Power Requirements

This section indicates the electrical requirements of your rack system.

### NOTE

It is assumed that you have conducted tests to determine that the voltage fluctuations throughout the day are within the range indicated for your rack system. If there is greater voltage fluctuation than what is indicated in the table, provisions must be made for voltage regulation.

	Requirements for US	Requirements for Europe	Requirements for Asia
Nominal Rating:	208 VAC line-to-line	400 VAC line-to-line	208 VAC line-to-line
Input Range:	± 10% of nominal	± 10% of nominal	± 10% of nominal
Phase:	3 phase	3 phase	3 phase
Input Current (with 6 units):	336 A	168 A	336 A
kW per Phase (with 6 units):	33.6 kW	33.6 kW	33.6 kW
Frequency Range:	45-65 Hz	45-65 Hz	45-65 Hz
Maximum Short-circuit Current:	10 kA	10 kA	10 kA

## External System Disconnect

### WARNING

Although the rack system has an emergency stop switch at the top, door interlock switches on the back door, and individual circuit breakers on the front, these switches do not completely disconnect the AC mains from all components and connections inside the rack. AC voltage is still present at the main terminal block, the line side of K1 (K2), circuit breaker F7, and the auxiliary power supply.

It is the customer's responsibility to provide an adequate disconnecting means in accordance to clause 5.3.2 (NFPA79 or EN 60204-1) at the final installation location in order to de-energize the entire rack system completely. The following requirements apply:

- An additional disconnect method, either a disconnect switch or circuit breaker, must be provided to completely disconnect the AC mains from the cabinet. The AC mains cables must be connected to this external system disconnect device.
- Additionally, customers must also provide an overcurrent protection device.
- A licensed electrician must select and install this disconnect device and protection device in accordance all applicable local electrical codes and the ratings nameplate on the cabinet.
- The cabinet must be labeled to indicate the location of the external disconnect device. The disconnect device must also be labeled to indicate the cabinet that it supplies.



# 3

## Unpacking

Items Supplied.....	18
Unpacking Instructions .....	18
Moving the Rack Cabinet .....	20

When you receive your N8900 Series Rack System, inspect it for any obvious damage that may have occurred during shipment. If there is damage, notify the shipping carrier and nearest Keysight Sales and Support Office immediately. Refer to [www.keysight.com/find/assist](http://www.keysight.com/find/assist).

Check the Items Supplied list and verify that you have received these items with your unit. If anything is missing, please contact your nearest Keysight Sales and Support Office.

### NOTE

The power supplies for the N8900 Rack System are shipped separately.

---

## Items Supplied

After you have unpacked the rack system, check that you have received the following items. These should be packed inside the cabinet.

Item	Description	Part Number
<b>Installation Guide</b>	This document	5991-3411
<b>Other Documentation</b>	Functional test certificate China RoHS addendum Safety information booklet Rack packing List	
<b>Hardware kit - High voltage</b>	12 front-panel screws* 12 front washers* 5 - CAT5 patch cables	5067-6071
<b>Hardware kit - High current</b>	12 front-panel screws* 12 front washers* 18 M8x30 mm screws 18 M8x40 mm screws 36 spring washers 36 M8 nuts 72 flat washers 5 - CAT5 patch cables	5067-6070

\*There are enough front panel screws and washers for three power supplies. If you are installing more than three supplies, use the front panel screws and washers that are installed in the blank front panels.

## Unpacking Instructions

**WARNING** Wear safety goggles and gloves when unpacking the rack system.

---

Complete unpacking instructions are provided in a separate document that is attached to the shipping crate. Briefly, unpacking involves the following steps:

1. Use the appropriate tools to disassemble the shipping crate.
2. Remove the top cover and side panels from the pallet.
3. Remove the ramp and the blocking to which the ramp is attached.
4. Cut the strapping.
5. Slide the ramp under the pallet.
6. Carefully roll the cabinet down from off the pallet.

## Moving the Rack Cabinet

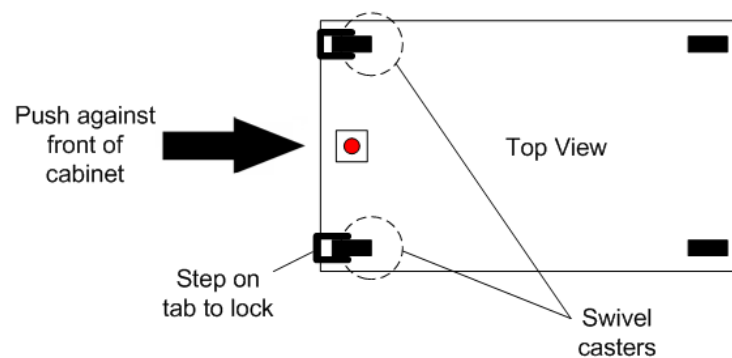
The rack system includes casters that pivot so that the cabinet can easily be maneuvered into position.

Make sure that the two casters located at the front of the cabinet are unlocked.

**WARNING**

When moving the cabinet, move slowly and use extreme care to prevent the casters jamming on debris, in seams, or in cracks in the floor surface. The cabinet's high center of gravity could cause it to tip if a caster jammed.

---



Once the cabinet is placed in its final location, lock the front casters by stepping on the locking tab. This will prevent the cabinet from moving.

## 4 Assembly

Connect the AC Mains .....	22
Install the Power Supplies.....	23
Install the Bus Bars .....	24
Connect the AC input.....	27
Connect the Communications Cables .....	28
Connect the Output Cables .....	30
Complete the Installation .....	31



This section describes the steps required to assemble your Keysight N8900 Series Rack System. Please observe all relevant Warnings and Cautions.



## Connect the AC Mains

### WARNING

**SHOCK HAZARD.** Make sure that the AC mains cables are NOT connected to the AC mains. Only connect the AC mains cables to the AC mains as the final step in the installation procedure.

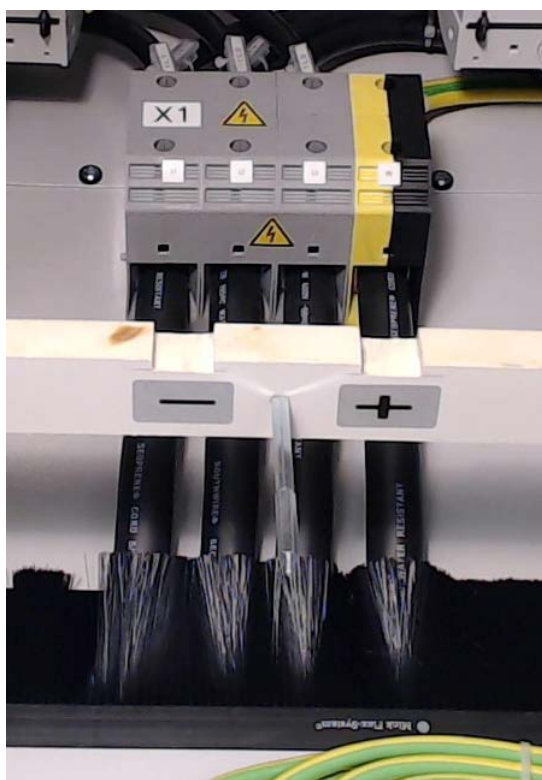
Install the AC mains cables into the cabinet first - before you install the power supplies or make any other connections. This is because it is easier to install and tighten the cables while the cabinet is empty.

1. Remove the plastic safety cover from the center of the rack and put it aside until later.
2. Route the cables up through the opening in the floor of the cabinet. Connect the cables to the terminal blocks. Terminal block connection specifications are as follows:

	208 VAC Specifications	400 VAC Specifications
Cross section AWG:	AWG 4/0 to 500 mcm	AWG 1/0 to AWG 3/0
Cross section Metric:	120 mm <sup>2</sup> to 240 mm <sup>2</sup>	50 mm <sup>2</sup> to 95 mm <sup>2</sup>
Stripping length:	40 mm (1.6 inches)	33 mm (1.3 inches)
Tightening torque:	25 Nm to 30 Nm (18.5 lb-ft to 22 lb-ft)	15 Nm to 20 Nm (11 lb-ft to 14 lb-ft)
Connection method:	Screw connection with hexagonal socket	Screw connection with hexagonal socket

### NOTE

For heavier cables (up to 500 mcm), remove the cover plate from the bottom skirt of the cabinet, and route the cables through this opening.



## Install the Power Supplies

Use caution when installing power supplies.



### CAUTION

Power supplies weigh as much as 78 lbs. (35.5 kg). Two people are required when installing power supplies. Because of the unit's weight, do not lift or move it alone. Moving by hand should be avoided where possible. If unavoidable, lift only the instrument's chassis; do not lift the unit using the exterior handles, knobs, or output terminals.

1. Install each power supply by sliding the unit into the rack from the front.

### CAUTION

Because of a tipping hazard, always install the power supplies starting from the bottom instrument location and continuing to the top rack location.

2. Attach the supplied dress screws to the front panel of the unit. Do NOT tighten the screws all the way. There are enough screws and washers in the hardware kits for three power supplies. If you are installing more than three power supplies, use the front panel hardware from the bank front panels.

### NOTE

Install the supplied blank front panels in front of any empty instrument openings.



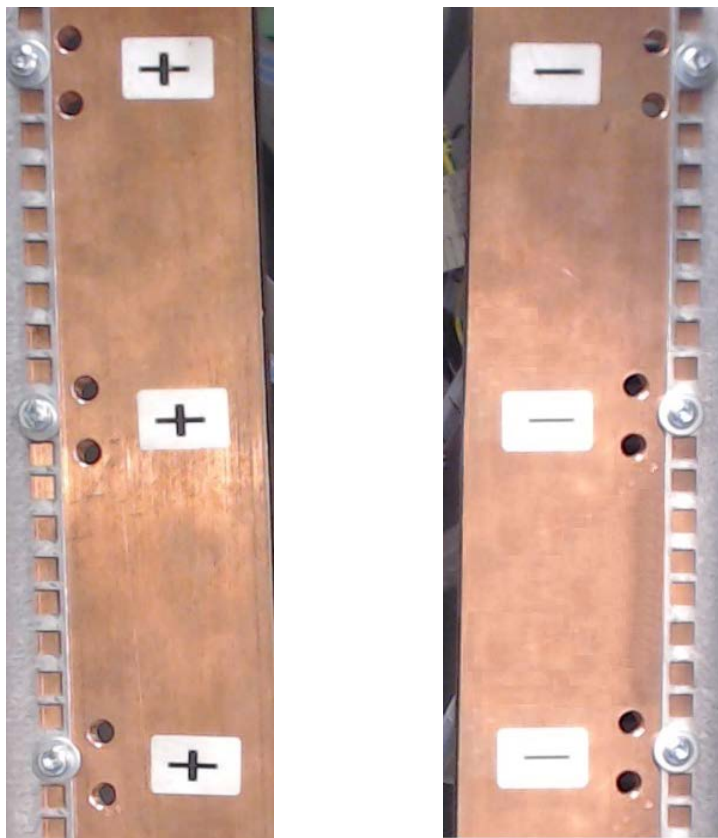
## Install the Bus Bars

### Remove the bus bars from their storage locations

**CAUTION**

High current bus bars weigh up to 28 lbs. (13 kg) each. Use caution when lifting and moving the bus bars. Lay them down so that they do not fall.

1. Remove the screws that attach the bus bars to the corner brackets.
2. Carefully remove the bus bars.



### Position and connect each bus bar to the output terminals

Both high-current and high-voltage bus bars install in the same manner. The connection hardware is included in the accessory box shipped with the cabinet. Refer to Items Supplied for details.

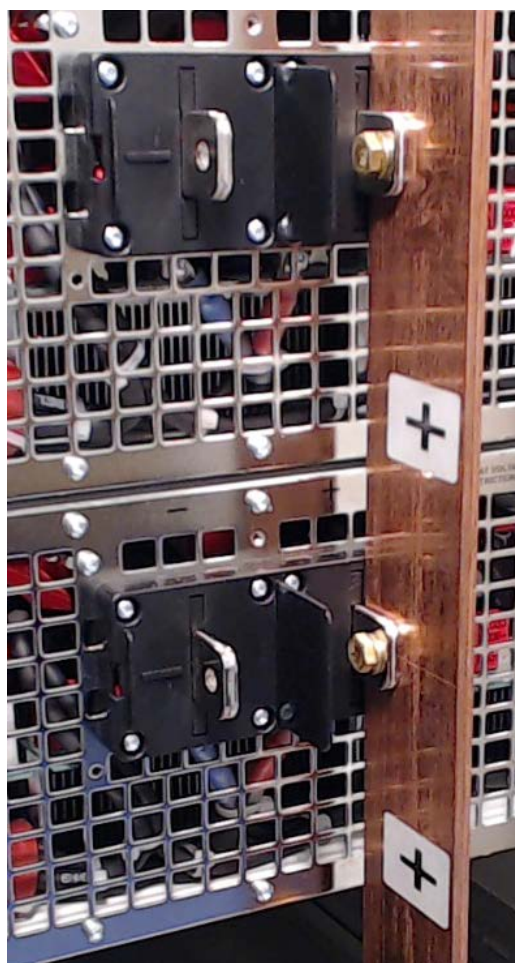
1. Start with the positive bus bar. Place the positive bus bar on the bottom support bracket. Position the bus bar on the *right* side of the positive output terminals. For the high-current bus bars, you may need to remove the single screw in the middle that connects the short bar to the long bar.
2. Attach the bus bar to the output terminal of each unit using the single connection hole that is closest to the rear panel of the unit. Note the screw heads are on the outside of the bus bars; the washer, lock washer, and nut are mounted on the inside of the bus bars. Do NOT tighten the screws completely.



Because of the difference in thickness of the high-current bus bars, use the longer (40 mm) screws to connect the bottom three units. Use the shorter (30 mm) screws to connect the top three units. Once the single screws are installed, install the remaining two screws on each rear terminal.

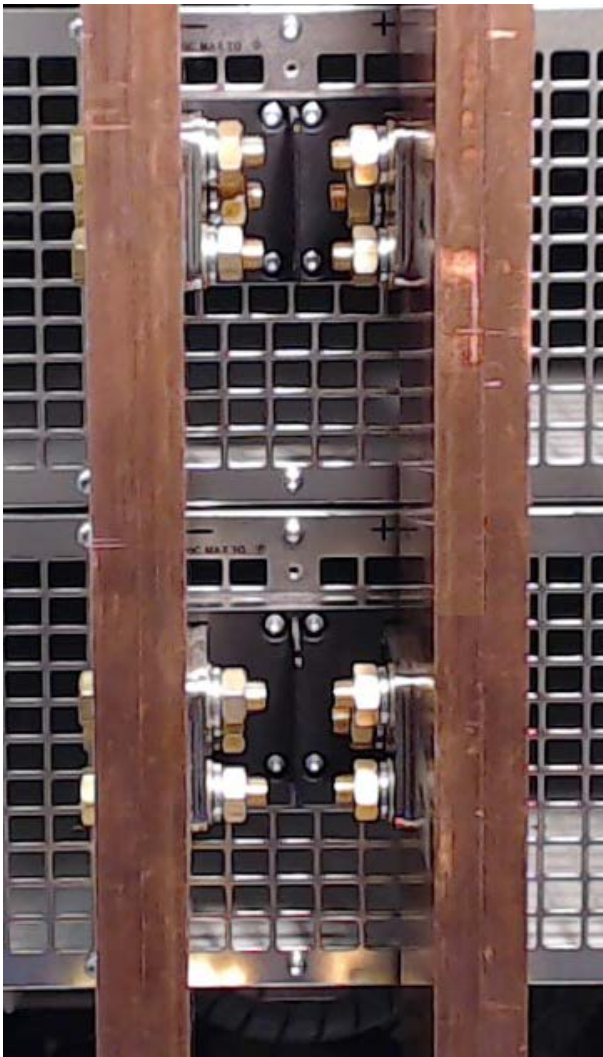
**IMPORTANT****For high-current bus bars only.**

After you have installed the positive bus bar, remove the four output bolts located at the bottom of the bus bar. Do this **before** you install the negative bus bar. Otherwise you may not be able to remove the output bolts when both positive and negative bus bars have been installed.



3. Continue with the negative bus bar. Place the negative bus bar on the bottom support bracket. Position the bus bar on the *left* side of the negative output terminals. Repeat step 2 for the negative bus bar.

4. Once all connection screws are installed as shown in the following figures, tighten the screws according to the following torque settings.
  - For the high-current bus bars, maximum torque is 9.2 lb-ft (12.4 Nm).
  - For the high-voltage bus bars, maximum torque is 5.4 lb-ft (7.3 Nm).



## Connect the AC input

Connect the closest AC input harness to the unit. AC input harnesses are connected to circuit breakers on the front of the cabinet. Refer to [Switched and Indicators](#) to see the breaker assignment for each AC input harness.

1. First remove the strain relief and the AC connector plug that came with the power supply – then install the AC cable harness.
2. Make sure the connector plug is fully inserted – then Install the strain relief bracket as shown, using the four hex nuts. Fasten the AC cable harness to the strain relief using the tie wrap provided with the power supply. Keep the wire harness away from the adjacent bus bar.





## Connect the Communications Cables

### Connect the Sharebus and Group cables

1. Connect the **Sharing** terminals for parallel operation using the blue sharing cables. This allows current sharing among the units.



2. Install the **Group** (Master/Slave) cables. These grey CAT5 cables are included in the accessory box shipped with the rack cabinet.
3. Set the Group switches. The following figure describes the group switch settings for the instrument stack. Only the first and last units in the instrument stack need to have the switches set down (unterminated).

Switches	Description
	<p>Switches up – for units between the top and bottom units.</p> <p>Switches down – only for top and bottom units of the instrument stack ("unterminated").</p>

#### CAUTION

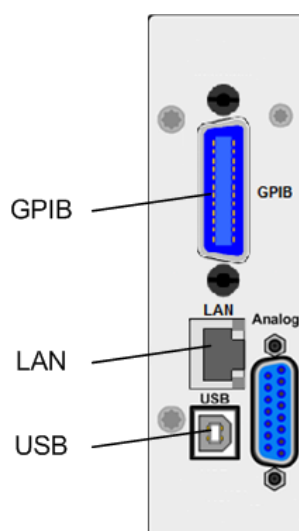
**Equipment Damage** Never insert a network cable that is connected to the Ethernet or its components to the Master/Slave terminals. The LAN and Master/Slave terminals are NOT compatible.

## Connect the computer interface cable

1. Designate which power supply will be the “master” control unit. You can designate any of the power supplies in the instrument stack as the master control unit.
2. Connect the appropriate computer interface to the power supply that will be the master control unit of the instrument stack. The computer interface cable is customer-supplied.

**NOTE**

You may wish to connect the interface cable to the top unit in the stack, thereby making it easy to view and access its front panel from the front of the cabinet.



The front panel of the master control unit will display the aggregate output current of all instruments in the stack. The front panel of the master unit is also enabled for instrument control. The slave units have their front panel controls disabled.

## Connect the Output Cables

### WARNING

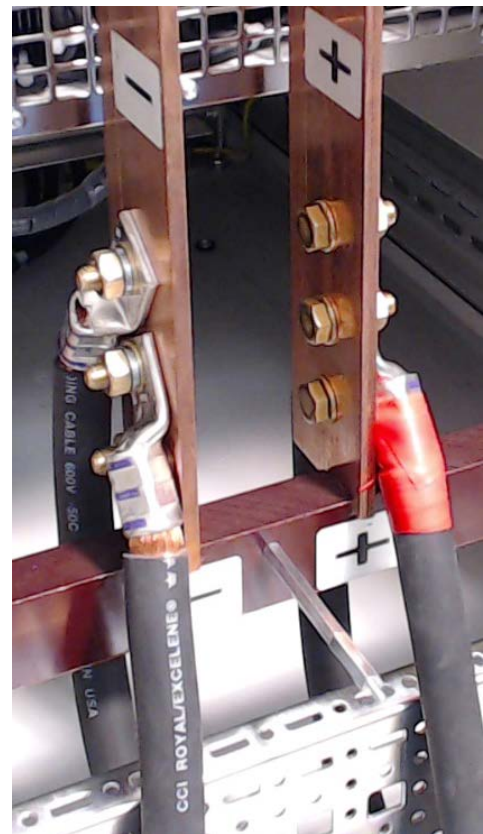
**SHOCK HAZARD** All output connections must be made with the **external system disconnect** off, and must be performed by qualified personnel who are aware of the hazards involved. Improper actions can cause fatal injury as well as equipment damage.

Ensure that the insulation rating of the output cables is greater than the voltage rating of the rack system, which may be rated up to 1,500 VDC!

Attach the output cables to the attachment bolts provided at the bottom of the output bus bars. High-current bus bars provide four attachment bolts per bar. High-voltage bus bars provide three attachment bolts per bar.

Depending on the current ratings of the system, it may be necessary to connect the output cables to both sides of the bus bars

Route the cables out of the opening at the bottom of the cabinet.



Always use wire lugs to connect the output cables to the bus bars. The above figures show the proper placement of the hardware against the bus bars.

The output lugs should always have direct contact with the bus bars. Place the flat washers on the outside surface of the wire lugs. Place the split washer between the flat washer and the nut.

Note that when connecting cables to both sides of the bus bars, you do not need to place a flat washer under the bolt head.

Supported Models	Maximum Voltage	Maximum Current (with 6 units)	Number of Output Cables per Bus Bar	Maximum Current per Cable
Up to 6 - N8931A	80 V	3060 A	8 x 300 mcm	383 A
Up to 6 - N8932A	200 V	1260 A	4 x 4.0 AWG	315 A
Up to 6 - N8934A	500 V	540 A	3 x 2.0 AWG	180 A
Up to 6 - N8935A	750 V	360 A	2 x 2.0 AWG	180 A
Up to 6 - N8937A	1,500 V	180 A	1 x 2.0 AWG	180 A
Up to 6 - N8951A	80 V	3060 A	8 x 150 mm <sup>2</sup>	383 A
Up to 6 - N8952A	200 V	1260 A	4 x 120 mm <sup>2</sup>	315 A
Up to 6 - N8954A	500 V	540 A	3 x 70 mm <sup>2</sup>	180 A
Up to 6 - N8955A	750 V	360 A	2 x 70 mm <sup>2</sup>	180 A
Up to 6 - N8957A	1,500 V	180 A	1 x 70 mm <sup>2</sup>	180 A

## Complete the Installation

1. Install the safety cover



2. Tighten all dress screws on the front panels



## Connect the AC input cables to the AC mains disconnect device

### **WARNING**

You must have an additional disconnect device installed between the AC mains and the AC input cables of the rack system. Installation of this additional disconnect device must be done by a qualified electrician in accordance with all local electrical codes. Refer to **External System Disconnect**.

---

1. Connect the AC input cables to the AC mains.
2. Close the rear door of the rack.
3. Energize the AC mains.
4. Energize the equipment in the rack using the circuit breakers located on the front of the rack.



# 5

## Operation

Switches and Indicators.....	34
Turn-On Checkout.....	35
Computer Interfaces.....	37

This section describes how to initially turn on the Keysight N8900 Series Rack System.

This procedure can be used to provide an assurance check that all equipment is operating normally.

## Switches and Indicators

This section describes the front panel controls and indicators as identified in the figure below.

**Emergency Stop switch** - disconnects AC to all power supplies. Does not disconnect the rack system from AC mains. Pull up on the emergency stop switch to reset the switch after an emergency stop.

**Power switch** - front-panel on/off switch.

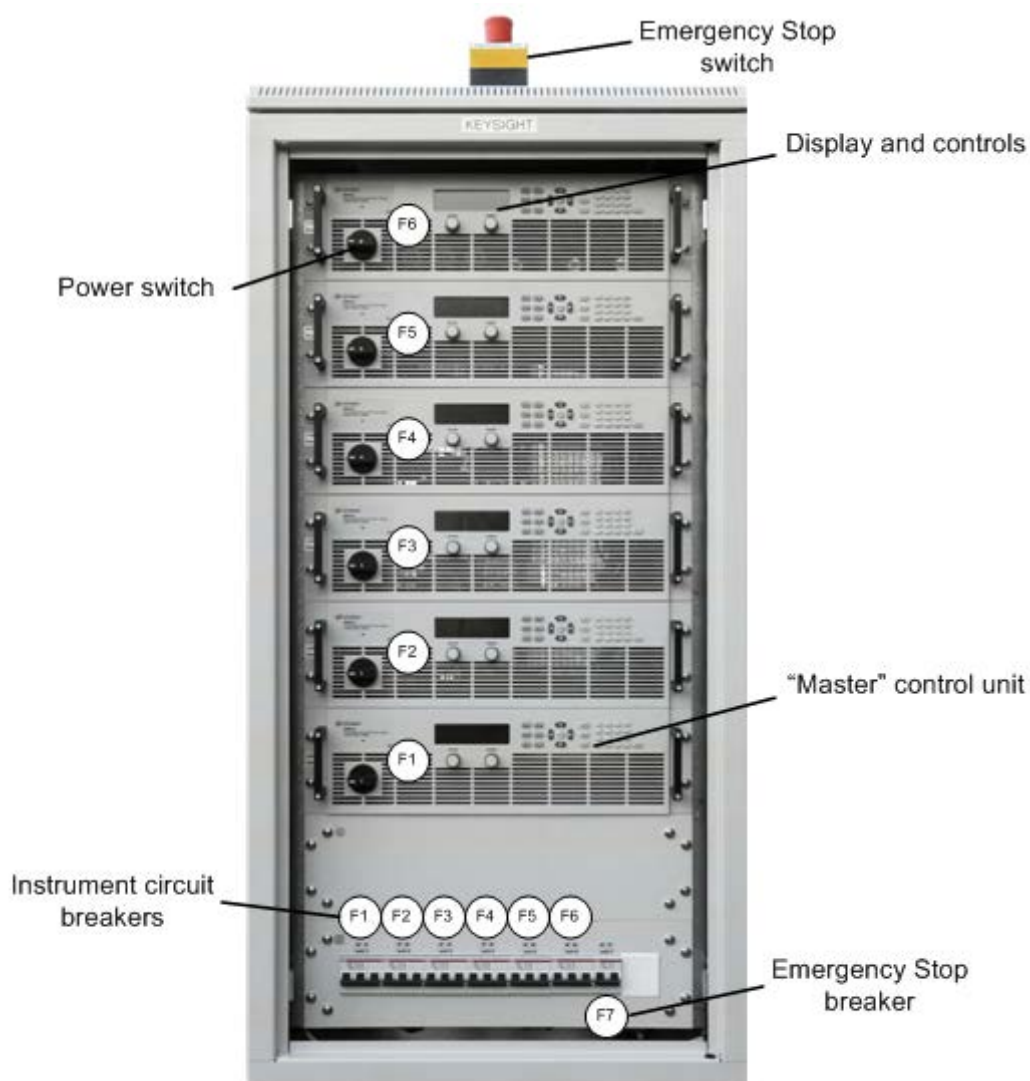
**Instrument circuit breakers** - disconnects power to individual units.

**Master control unit** - controls all slave units in the instrument stack. Note that the master control unit displays the aggregate output current of the stack.

**Display and controls** - the individual instrument front-panel displays and controls. The controls are disabled on all slave units.

**Emergency Stop breaker** - disconnects power to the safety interlock circuits.

**F1 - F7** - identifies the front-panel circuit breaker assignments. These correspond to the wiring diagrams at the end of this document.



## Turn-On Checkout

### Turn the Rack On

**WARNING**

**HAZARDOUS VOLTAGES** All power supplies generate voltages in excess of 60 VDC, with some models rated at up to 1,500 VDC! Ensure that all output connections are either insulated or covered so that no accidental contact with lethal output voltages can occur.

---

Turn on the rack by setting the following switches and breakers:

1. Check that the rear cabinet door is closed.
2. Check that the emergency stop switch is pulled up.
3. Check that all of the front circuit breakers are up (on).
4. Turn on the external AC mains disconnect switch.

Check the operation of the safety disconnect circuits:

1. Open, then close the rear door. When the door is opened you should hear the AC contactor in the rack disconnect the AC mains to the power supplies. When the door is closed, you should hear the AC contactor in the rack re-connect the AC mains to the power supplies.
2. Push down, then pull up the Emergency Stop switch located on the top of the rack. When the switch is down you should hear the AC contactor in the rack disconnect the AC mains to the power supplies. When the switch is pulled up, you should hear the AC contactor in the rack re-connect the AC mains to the power supplies.

### Turn Each Unit On

1. Turn each unit on with the front-panel power switch. Rotate the knob from 0 to 1. The front-panel display will light up after a few seconds. A power-on self-test occurs automatically, which assures you that the instrument is operational.

**NOTE**

It may take about 30 seconds or so for the power supply to initialize before it is ready for use.

---

2. Set the output voltage. Turn the Voltage knob to set the output voltage. The setting value appears in the Set field on the bottom of the display.
3. Set the Output Current. Turn the Current knob to set the output current. The setting value appears in the Set field on the bottom of the display.

4. Enable the Output. Push the **On/Off** key to enable the output. If a load is connected to the output, the front-panel display will indicate that it is drawing current. Otherwise, the current reading will be zero. The status indicator shows the output's status. For example, "CV" indicates the output is in constant voltage mode.

**NOTE**

If the output current is set to zero, the output voltage may remain as zero when the output is enabled, and a UNR status may appear in the display. You must program a minimum current value for the output voltage to rise to its programmed setting.

---

## Configure the Units for Master or Slave Operation

1. Configure the unit for master or slave operation. Use the front panel menu as follows. Note that the master unit is the power supply to which the computer interface cable is connected.

Front Panel Menu	Action
Select <b>System\Group\Function</b>	In the dialog box, select either Master or Slave. Then press <b>Select</b> .

2. Assign an address for the units that are configured slaves. Use the front panel menu as follows.

Front Panel Menu	Action
Select <b>System\Group\Slave</b>	In the dialog box, select the address of the slave unit. Values can range from 1 - 5. Then press <b>Select</b> .

## Computer Interfaces

This section describes how to connect to the various communication interfaces on your rack system. All interface connections must be made to the power supply that has been designated as the "master" controller of all the power supplies in the rack (see Connect the Communications Cables).

If you have not already done so, install the Keysight IO Libraries Suite, which can be found at [www.keysight.com/find/iolib](http://www.keysight.com/find/iolib).

### NOTE

For detailed information about GPIB, USB, and LAN interface connections, refer to the documentation included with the Keysight IO Libraries Suite.

## GPIB Connections

1. Connect the power supply that has been designated as the master control unit to the GPIB interface card in your computer.
2. Use the Connection Expert utility of the Keysight IO Libraries Suite to configure the GPIB card's parameters.
3. You can now use Interactive IO within the Connection Expert to communicate with the master controller, or you can program your instrument using various programming environments.

## USB Connections

1. Connect the power supply that has been designated as the master control unit to the USB port on your computer.
2. With the Connection Expert utility of the Keysight IO Libraries Suite running, the computer will automatically recognize the instrument. This may take several seconds. When the instrument is recognized, your computer will display the VISA alias, IDN string, and VISA address. This information is located in the USB folder.
3. You can now use Interactive IO within the Connection Expert to communicate with the master controller, or you can program your instrument using various programming environments.

## LAN Connections

### CAUTION

**Equipment Damage** Never insert a network cable that is connected to the Ethernet or its components to the Master/Slave terminals. The LAN and Master/Slave terminals are NOT compatible.

1. Connect the power supply that is designated as the master control unit to the LAN. The as-shipped master controller LAN settings are configured to automatically obtain an IP address from the network using a DHCP server (DHCP is set On). The DHCP server will register the master controller's hostname with the dynamic DNS server. The hostname as well as the IP address can then be used to communicate with the master controller.

If you are using a private LAN, you can leave all LAN settings as they are. Most Keysight products and most computers will automatically choose an IP address using auto-IP if a DHCP server is not present. Each assigns itself an IP address from the block 169.254.nnn. The front-panel Lan indicator will come on when the LAN port has been configured.

2. Use the Connection Expert utility of the Keysight IO Libraries Suite to add the master controller and verify a connection. To add the instrument, you can request the Connection Expert to discover the instrument. If the instrument cannot be found, add the instrument using the instrument's hostname or IP address.
3. You can now use Interactive IO within the Connection Expert to communicate with the master controller, or you can program your instrument using various programming environments.

# 6

## Maintenance

Lock-Out Tag-Out .....	40
Before Servicing .....	40
Troubleshooting.....	40
Parts List.....	41
Wiring Diagrams.....	42

The Keysight N8900 Series Rack System is designed to be self-serviced. Part numbers and wiring diagrams are included in this section.

If you need additional troubleshooting or parts information, contact [www.keysight.com/find/assist](http://www.keysight.com/find/assist).

## Lock-Out Tag-Out

The Keysight N8900 Series Rack System has locks on the front and back doors. Only authorized persons should have access to the keys.

**Front Door lock** – The lock on the front door is designed to prevent unauthorized access to the front panel controls. Access to the front panel controls may be necessary during normal operation. Opening the front door does not present a safety hazard.

**Back Door lock** – The lock on the back door is designed to prevent unauthorized access to the cabinet during operation. If the back door is opened during operation, a safety switch shuts disconnects AC to all power supplies.

**WARNING**

The interlock switches on the back door do not completely disconnect the AC mains from all components and connections inside the rack. AC voltage is still present at the main terminal block, the line side of K1 and K2, circuit breaker F7, and the auxiliary power supply.

---

## Before Servicing

**WARNING**

Switch off the disconnect device before servicing.

---

To service the rack system you must turn off the external disconnect device to completely disconnect the AC mains from the rack system. This disconnect device must be installed by the customer. Refer to External System Disconnect.

Attach a tag to the rack system to indicate that the cabinet has been disconnected from the AC mains for servicing.

## Troubleshooting

**WARNING**

**All troubleshooting must be made by qualified personnel who are aware of the hazards involved. Improper actions can cause fatal injury as well as equipment damage. Refer to the Warning under Lock-Out Tag-Out.**

---

If there is no power to one or of more of the power supplies:

1. Check that there is power available at the AC mains.
2. Check that the external disconnect device is on.
3. Check that the rear cabinet door is closed.
4. Check that the emergency stop switch is pulled up.
5. Check that all of the front circuit breakers are up (on).
6. Open the rear door and check that there is 24 VDC at the output of the auxiliary supply. This supply powers the main K1 relays.
7. Troubleshoot the AC portion and the interlock portion (orange) of the rack system according to the wiring diagrams provided.



## Parts List

The following table documents the replaceable parts. The reference designators refer to the location of the electrical parts in the wiring diagrams.

### Common Parts for All Rack Systems

Reference Designator	Description	Quantity	Part number
K1, K2	Emergency stop contactor	1 or 2*	5067-6535
S1	Emergency stop switch	1	5067-6539
S2, S3	Door contact switch	2	5067-6538
X2	Emergency stop bridge (4 position)	1	5188-9210
	Mounting bracket for door contact switch	2	5003-2175
	Transparent bus bar safety cover	1	5003-2185
	Top/bottom holders for output bus bars	2	5003-2337
	Blank front panels	3	5003-2338
	Cover washers for blank front panels	12	5003-2164
	Dress screws for blank front panels	12	5003-2170
	Heavy duty wheels (set of 4)	1	5067-6540

\* 1 used in 400 VAC systems; 2 used in 208 VAC systems

### Parts for 400 VAC Systems (N89401A, N89402A)

Reference Designator	Description	Quantity	Part number
MWR-WDR-120-24	Auxiliary supply for emergency stop	1	5067-6534
F1-F6	Circuit breakers for power supplies	6	5067-6536
F7	Circuit breaker for auxiliary power supply	1	5067-6537
X1, (L1- L3)	AC mains terminal block	1	5067-6558
X1, (PE)	AC mains terminal block	1	5188-9209

### Parts for 208 VAC Systems (N89201A, N89202A)

Reference Designator	Description	Quantity	Part number
MWR-WDR-240-24	Auxiliary supply for emergency stop	1	5067-6556
F1-F6	Circuit breakers for power supplies	6	5188-9207
F7	Circuit breaker for auxiliary power supply	1	5188-9208
X1, (L1- L3, PE)	AC mains terminal block	1	5067-6557
X2	Emergency stop bridge (4 position)	1	5188-9210

## Parts for High Current Systems (N89201A, N89401A)

Reference Designator	Description	Quantity	Part number
	High Current Hardware kit (includes set of patch cables, screws and nuts for high-current bus bars, and front panel fixation)	1	5067-6070
	Screw M12 x 45mm brass - for output connections	8	5003-2169
	Nut M12 brass - for output connections	8	5003-2166
	Spring ring M12 - for output connections	8	5003-2167
	Washer M12 brass - for output connections	16	5003-2168

## Parts for High Voltage Systems (N89202A, N89402A)

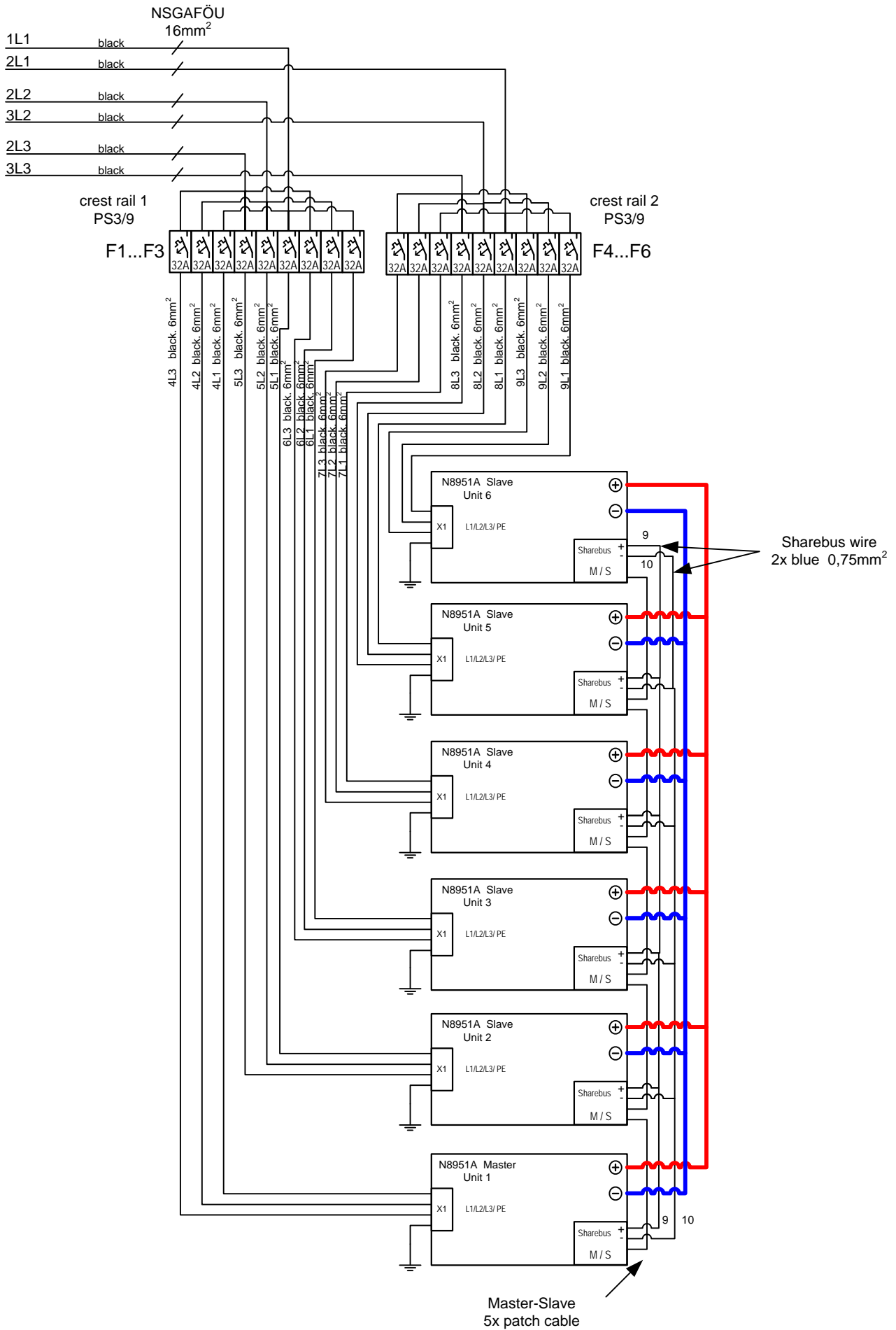
Reference Designator	Description	Quantity	Part number
	High Voltage Hardware kit (includes set of patch cables, screws and washers front panel fixation)	1	5067-6071
	Screw M8 x 25mm brass - for output connections	6	5003-1144
	Nut M8 brass - for output connections	6	5003-1147
	Spring ring M8 - for output connections	6	5003-1148
	Washer M8 brass - for output connections	12	5003-2036

## Wiring Diagrams

Replaceable electrical parts are identified by reference designators in the parts list. Individual wires are identified by diameter and color code. Wires and wire connections are identified by colored labels placed at the ends of each wire.

For example: wires labeled 4L1, 4L2, and 4L3 refer to the wiring harness that connects the AC mains connector for Unit 1 (the master) to the front-panel circuit breaker labeled F1. L1, L2, and L3 refer to the phase to which the individual wire is connected. The PE (protective earth) designation refers to the ground connections for all yellow/green (ye/gn) wires inside the cabinet.

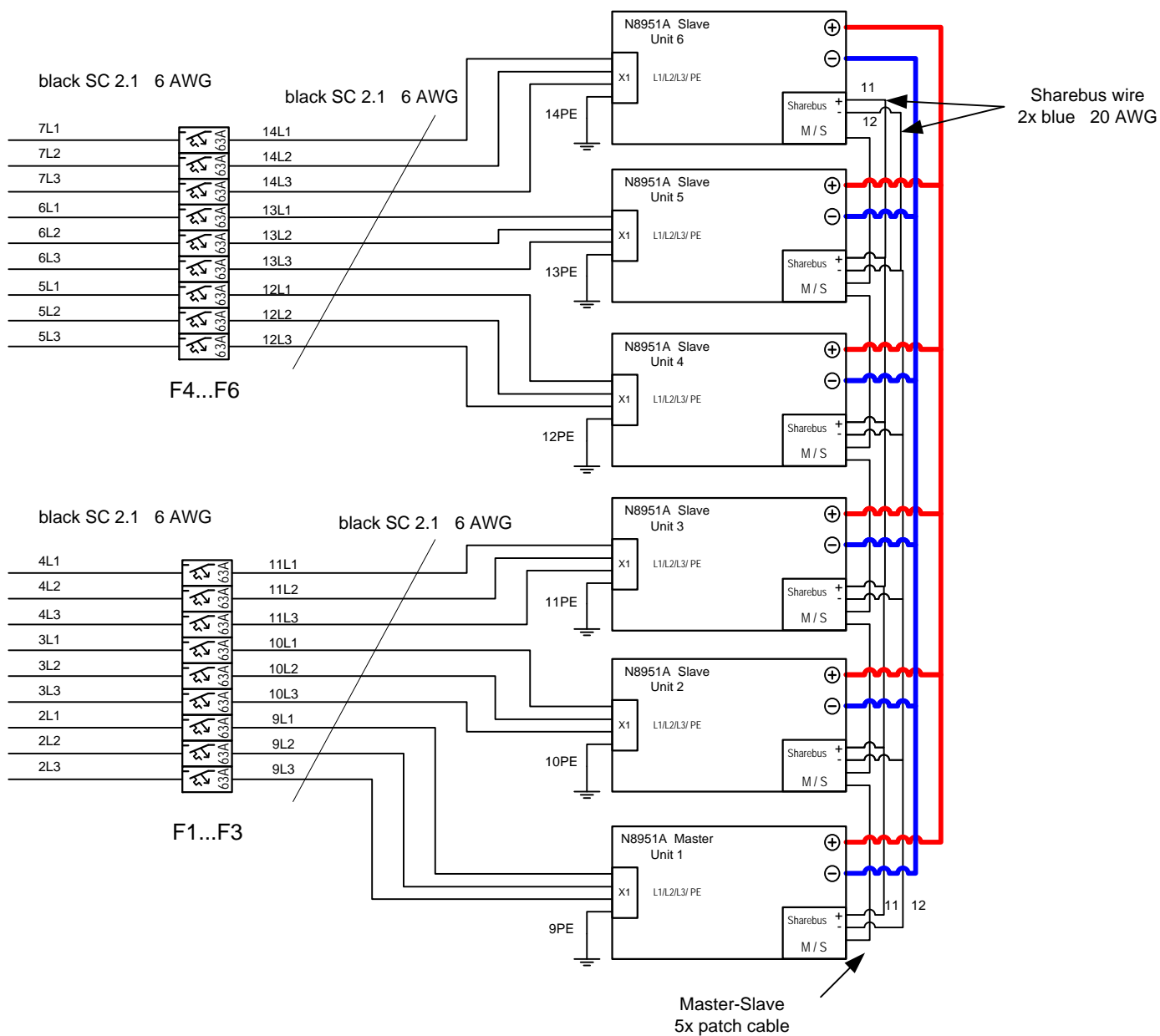






Contactor K2

Contactor K1



# Index

A		L	
AC mains		LAN connections .....	37
disconnect .....	16, 40	lock-out tag-out .....	40
assemblies		M	
replaceable .....	41	models .....	8
C		moving .....	20
characteristics .....	8	O	
common .....	11	operation	
connections		master/slave .....	36
AC input .....	27	P	
computer interface .....	29	power	
DC output .....	30	requirements .....	16
group cables .....	28	power supply cautions .....	23
interface .....	37	R	
sharebus .....	28	replaceable parts	
contact Keysight .....	7	list .....	41
customer		S	
responsibility .....	14	safety .....	4
D		site	
dimensions .....	11	accessibility .....	14
diagram .....	15	requirements .....	15
E		system	
external		disconnect .....	16, 40
disconnect .....	16, 40	T	
F		turn-on	
floor		checkout .....	35
loading .....	15	U	
space .....	15	unpacking .....	19
front panel		USB connections .....	37
switches .....	34	W	
indicators .....	34	Warning .....	3
G		web URL's .....	7
GPIB connections .....	37	wiring diagrams	
I		208 VAC rack .....	45
installation		400 VAC rack .....	43
AC mains .....	22		
bus bars .....	24		
power supplies .....	23		
route .....	14		
items supplied .....	18		