Agilent Technologies Low-Profile Modular Power System

Series N6700

Service Guide

Agilent Technologies

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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. Agilent Technologies assumes no liability for the customer's failure to comply with these requirements.

General

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 operation instructions.

Before Applying Power

Verify that all safety precautions are taken. Make all connections to the unit before applying power. Note the instrument's external markings described under "Safety Symbols"

Ground the Instrument

This product is a Safety Class 1 instrument (provided with a protective earth terminal). To minimize shock hazard, the instrument chassis and cover must be connected to an electrical ground. The instrument must be connected to the ac power 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 personal injury.

Fuses

The instrument contains an internal fuse, which is not customer accessible.

Do Not Operate in an Explosive Atmosphere

Do not operate the instrument in the presence of flammable gases or fumes.

Do Not Remove the Instrument Cover

Only qualified, service-trained personnel who are aware of the hazards involved should remove instrument covers. Always disconnect the power cable and any external circuits before removing the instrument cover.

Do Not Modify the Instrument

Do not install substitute parts or perform any unauthorized modification to the product. Return the product to an Agilent Sales and Service Office for service and repair to ensure that safety features are maintained.

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.

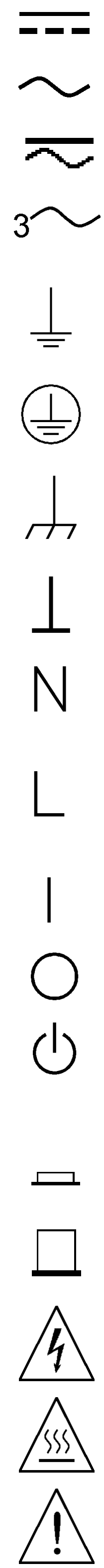
CAUTION

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 are fully understood and met.

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.

Safety Symbols



- Direct current
- Alternating current
- Both direct and alternating current
- Three phase alternating current
- Earth (ground) terminal
- Protective earth ground terminal.
- Frame or chassis terminal
- Terminal is at earth potential.
- Neutral conductor on permanently installed equipment
- Line conductor on permanently installed equipment.
- On supply
- Off supply
- Standby supply. Unit is not completely disconnected from ac mains when switch is off
- In position of a bi-stable push switch
- Out position of a bi-stable push switch
- Caution, risk of electric shock
- Caution, hot surface
- Caution, refer to accompanying description

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Introduction

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This manual discusses the troubleshooting procedures for the N6700B, N6701A, and N6702A MPS mainframes. Troubleshooting procedures are provided to isolate defective assemblies. These procedures do not troubleshoot to the component level.

No procedures are provided for troubleshooting individual modules - other than identifying if a specific module is defective. If you have a defective module, you can return it to Agilent Technologies for repair or replacement. Refer to the following note.

NOTE

You can contact Agilent 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 Agilent in your country or specific location: www.agilent.com/find/assist
Or contact your Agilent Technologies Representative.

The web contains the most up to date version of the manuals. Go to http://www.agilent.com/find/N6700 to get the latest version of the manuals.

Returning an Instrument

Before returning your instrument to Agilent Technologies for service or repair, perform the “Preliminary Checkout” procedures in the beginning of chapter 4.

Warranty Repair

If your instrument fails during the warranty period, Agilent Technologies will replace or repair it free of charge. After your warranty expires, Agilent Technologies will replace or repair it at a competitive price. The standard repair process is “whole unit exchange”. The replacement units are fully refurbished and are shipped with new calibration certificates.

Contact your nearest Agilent Technologies Service Center. They will arrange to have your instrument repaired or replaced.

Repackaging for Shipment

If the unit is to be shipped to Agilent Technologies for service or repair, be sure to:

- Attach a tag to the unit identifying the owner and indicating the required service or repair. Include the model and serial number.
- Place the unit in its original container with the appropriate packaging material and secure the container with strong tape or metal bands.

If the original shipping container is not available, place your unit in a container that will ensure at least 4 inches of compressible packaging material around all sides for the instrument. Use static-free packaging materials to avoid additional damage to your unit.

Agilent Technologies suggests that you always insure shipments.

Instrument Identification

Serial Number

Agilent N6700 MPS mainframes are identified by the serial number located on the interface cover.

The serial number consists of a 10-character number (e.g. MY24D00013) located on the label on the top of the interface board. The first two characters indicate the country of manufacture, and the last five digits are a sequential number assigned to each mainframe.

Additional Information

For Agilent N6700 MPS mainframes, you can query the model number, serial number, firmware revision, backup and active firmware.

For power modules, you can query the model number, serial number, installed options, voltage, current and power rating.

Front Panel:	SCPI Command:

Select **System\About\Frame**.
or
Select **System\About\Module**.
	For mainframe information:
	`*IDN?`
	For information about the power module in channel 1:
	`SYST:CHAN:MOD? (@1)`
	`SYST:CHAN:OPT? (@1)`
	`SYST:CHAN:SER? (@1)`

Firmware Upgrade

You can query the instrument's firmware revision either from the front panel or over the remote interface as previously described under "Additional Information".

To upgrade your instrument with the latest firmware revision, go to http://www.agilent.com/find/N6700firmware. The upgrade procedure consists of the following three steps:

- Download and install the Agilent N6700 Firmware Update Utility from the Web.
- Download and unzip the Agilent N6700 Firmware Update file from the Web.
- Run the Agilent N6700 Firmware Update Utility and update the firmware on your instrument.

NOTE On mainframes with firmware revisions prior to C.00.00, the following functions are not available:

- Support for the 300 W power modules.
- The power allocation function for power modules.
- The ability to reverse the polarity of the output and sense connectors.
- Compliance with LXI class C.

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Performance Verification

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The verification procedures described in this chapter verify that the Agilent N6700 Modular Power System is operating normally and is within published specifications.

NOTE Perform the verification tests before calibrating your power system. If the power system passes the verification tests, the unit is operating within its calibration limits and does not need to be re-calibrated.

Verification Description

Verification procedures perform two primary functions:

Performance Tests These tests verify that the power system is operating normally and meets the specifications published in Appendix A in the User's Guide.

Calibration Tests These tests verify that the power system is operating within its calibration limits.

If the power system fails any of the tests or if abnormal test results are obtained, try calibrating the unit. If calibration is unsuccessful, return the unit to an Agilent Technologies Service Center.

Equipment Required

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.

Type	Specifications	Recommended Model
Digital Multimeter	Resolution: 10 nV @ 1V; Readout: 8 1/2 digits Accuracy: 20 ppm	Agilent 3458A or equivalent
Current Monitor	15 A (0.1 ohm), TC=4ppm/°C (all except N6741B) 50 A (0.05 ohm), TC=4ppm/°C (N6741B, N6754A only) 150 A (0.005 ohm), TC=4ppm/°C (N6753A only)	Guildline 9230A/15R Guildline 9230A/50 Guildline 9230A/150
Load Resistors	25 Ω, 250 W, 1%, TC<100 ppm/°C (calibration) 4 Ω, 250 W, 1%, TC<100 ppm/°C (calibration)	Vishay NH-250-25Ω-1% Vishay NH-250-4Ω-1%
Electronic Load	20 V, 5 A minimum, with transient capability and a slew rate of 833 kA/s or better.	Agilent N3300A mainframe, with N330xA module
GPIB Controller	Full GPIB capabilities	Agilent 82350B or equivalent
Oscilloscope	Sensitivity: 1 mV Bandwidth Limit: 20 MHz Probe: 1:1 with RF tip; 10:1 with RF tip for > 50V	Agilent Infiniium or equivalent
RMS Voltmeter	True RMS Bandwidth: 20 MHz Sensitivity: 100 µV	Rhode and Schwartz Model URE3 or equivalent
Differential Amplifier	Bandwidth: 20 MHz	LaCroy 1855A, DA1850A, or equivalent
Terminations	1 – 50 Ω BNC termination 2 – 50 Ω, 1/8 W termination resistors	
Variable-voltage Transformer or AC source	Adjustable to highest rated input voltage range. Power: 500 VA	Agilent 6813B or equivalent

Measurement Techniques

Voltmeter

To ensure that the values read by the voltmeter during both the verification procedure and the calibration procedure are not affected by the instantaneous measurement of the AC peaks of the output current ripple, several DC measurements should be made and averaged.

If you are using an Agilent 3458A DMM, you can set up the voltmeter to do this automatically. From the instrument's front panel, program 100 power line cycles per measurement.

Press NPLC 100 ENTER.

Current-Monitoring Resistor

The 4-terminal current shunt is used to eliminate output current measurement error caused by voltage drops in the load leads and connections. It has special current-monitoring terminals inside the load connection terminals. Connect the voltmeter directly to these current-monitoring terminals.

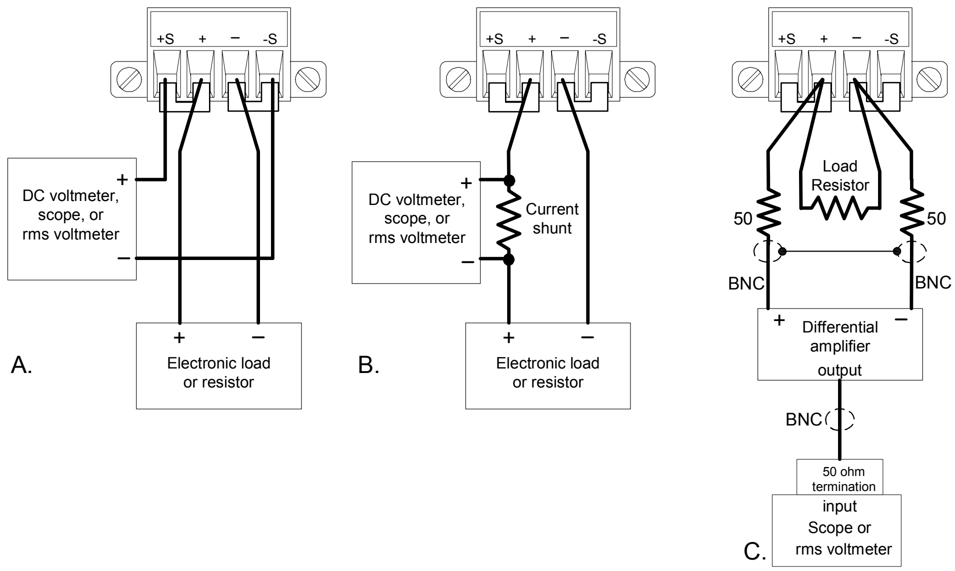
Electronic Load

Many of the test procedures require the use of a variable load capable of dissipating the required power. If a variable resistor is used, switches should be used to connect, disconnect, or short the load resistor. For most tests, an electronic load can be used. The electronic load is considerably easier to use than load resistors, but it may not be fast enough to test transient recovery time and may be too noisy for the noise (PARD) tests.

Fixed load resistors may be used in place of a variable load, with minor changes to the test procedures. Also, if computer controlled test setups are used, the relatively slow (compared to computers and system voltmeters) settling times and slew rates of the power system may have to be taken into account. "Wait" statements can be used in the test program if the test system is faster than the power system.

Verification Test Set-up

The following figures illustrate the test set-ups used for the verification procedures.



Verification Procedure

Constant Voltage Tests

NOTE Test each output channel individually. Refer to the appropriate test record form for the instrument settings of the model you are checking.

Voltage Programming and Readback Accuracy

Test category = performance, calibration

This test verifies that the voltage programming and measurement functions are within specifications.

1. Turn off the power system and connect a DMM directly across the sense terminals (see Test Setup figure A). Do not connect a load.
2. Turn on the power system and program the instrument settings as described in the test record form under “Voltage Programming & Readback, Min Voltage” with the load off. The CV annunciator should be on and the output current should be close to zero.
3. Record the output voltage reading from the DMM and the voltage measured over the interface. The readings should be within the limits specified in the test record form for the appropriate model under “Voltage Programming & Readback, Min Voltage”.
4. Program the instrument settings as described in the test record form under “Voltage Programming & Readback, High Voltage”.
5. Record the output voltage reading from the DMM and the voltage measured over the interface. The readings should be within the limits specified in the test record form for the appropriate model under “Voltage Programming and Readback, High Voltage”.

6 *For Agilent Models N6761A and N6762A only.* Set both the voltage programming and the voltage measurement functions to the low range. Repeat steps 4 - 5 for the low voltage ranges. Program the instrument settings as described in the test record form under “Voltage Programming & Readback, Low Voltage”. The readings should be within the limits specified in the test record form for the appropriate model under “Voltage Programming and Readback, Low Voltage”.

CV Load Effect

Test category = performance

This test measures the change in output voltage resulting from a change in output current from full load to no load.

1 Turn off the power system and connect a DMM and an electronic load (see Test Setup figure A).

2 Turn on the power system and program the instrument settings as described in the test record form under “CV Load Effect”.

3 Set the electronic load for the output channel’s current as described in the test record form under “CV Load Effect”. The CV annunciator on the front panel must be on. If it isn’t, adjust the load so that the output current drops slightly.

4 Record the output voltage reading from the DMM.

5 Open the load. Record the voltage reading from the DMM again. The difference between the DMM readings in steps 4 and 5 is the load effect, which should not exceed the value listed in the test record form for the appropriate model under “CV Load Effect”.

CV Source Effect

Test category = performance

This test measures the change in output voltage that results from a change in AC line voltage from the minimum to maximum value within the line voltage specifications.

1 Turn off the power system and connect the ac power line through a variable voltage transformer or an AC source.

2 Connect a DMM and an electronic load (see Test Setup figure A). Set the variable voltage transformer or AC source to nominal line voltage.

3 Turn on the power system and program the instrument settings as described in the test record form under “CV Source Effect”.

4 Set the electronic load for the output channel’s current as described in the test record form under “CV Source Effect”. The CV annunciator on the front panel must be on. If it isn’t, adjust the load so that the output current drops slightly.

5 Adjust the transformer or AC source to the lowest rated line voltage (86 VAC).

6 Record the output voltage reading from the DMM.

7 Adjust the transformer or AC source to the highest rated line voltage (264 VAC).

8 Record the output voltage reading on the DMM. The difference between the DMM reading in steps 6 and 8 is the source effect, which should not exceed the value listed in the test record form for the appropriate model under “CV Source Effect”.

CV Ripple and Noise

Test category = performance

Periodic and random deviations in the output combine to produce a residual AC voltage superimposed on the DC output voltage. This residual voltage is specified as the rms or peak-to-peak noise in the frequency range specified in Appendix A in the User’s Guide.

1 Turn off the power system and connect the load resistor, differential amplifier, and an oscilloscope (ac coupled) to the output (see Test Setup figure C). Use an appropriate load resistor to keep the power system at the instrument setting specified in the test record form under “CV Ripple and Noise”.

2 As shown in the diagram, use two BNC cables to connect the differential amplifier to the + and – output terminals. Each cable should be terminated by a 50 Ω resistor. The shields of the two BNC cables should be connected together. Connect the output of the differential amplifier to the oscilloscope with a 50 Ω termination at the input of the oscilloscope.

3 Set the differential amplifier to multiply by ten, divide by one, and 1 Megohm input resistance. The positive and negative inputs of the differential amplifier should be set to AC coupling. Set the oscilloscope’s time base to 5 ms/div, and the vertical scale to 10 mV/div. Turn the bandwidth limit on (usually 20 or 30 MHz), and set the sampling mode to peak detect.

4 Program the power system to the settings indicated in the in the test record form for the appropriate model under “CV Ripple and Noise” and enable the output. Let the oscilloscope run for a few seconds to generate enough measurement points. On the Agilent Infiniium scope, the maximum peak-to-peak voltage measurement is indicated at the bottom of the screen on the right side. Divide this value by 10 to get the CV peak-to-peak noise measurement. The result should not exceed the peak-to-peak limits in the test record form for the appropriate model under “CV Ripple and Noise, peak-to-peak”.

   Note: If the measurement contains any question marks, clear the measurement and try again. This means that some of the data received by the scope was questionable.

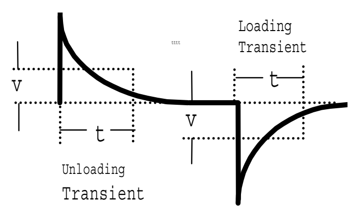
5 Disconnect the oscilloscope and connect an rms voltmeter in its place. Do not disconnect the 50 ohm termination. Divide the reading of the rms voltmeter by 10. The result should not exceed the rms limits in the test record form for the appropriate model under “CV Ripple and Noise, rms”.

Transient Recovery Time

Test category = performance

This test measures the time for the output voltage to recover to within the specified value following a 50% change in the load current.

1. Turn off the power system and connect the output as in Test Setup figure A, with the oscilloscope across the sense terminals.
2. Turn on the power system and program the program the instrument settings as described in the test record form under “Transient Response”.
3. Set the electronic load to operate in constant current mode. Program its load current to the lower current value indicated in the test record form under “Transient Response”.
4. Set the electronic load's transient generator frequency to 100 Hz and its duty cycle to 50%.
5. Program the load's transient current level to the higher current value indicated in the test record form under “Transient Response”, and turn the transient generator on.
6. Adjust the oscilloscope for a waveform similar to that shown in the following figure.
7. The output voltage should return to within the specified voltage at the specified time following the 50% load change. Check both loading and unloading transients by triggering on the positive and negative slope. Record the voltage at time “t” in the performance test record form under “Transient Response”.



Constant Current Tests

NOTE Test each output channel individually. Refer to the appropriate test record form for the instrument settings of the model you are checking.

Current Programming and Readback Accuracy

Test category = performance, calibration

This test verifies that the current programming and measurement functions are within specifications.

1. Turn off the power system and connect the current shunt directly across the output terminals. Connect the DMM directly across the current shunt (see Test Setup figure B). Note that the electronic load is not used in this portion of the test.

2 Turn on the power system and program the instrument settings as described in the test record form under “Current Programming & Readback, Min Current”. The CC annunciator should be on and the output voltage reading should be about zero.

3 Divide the voltage drop (DMM reading) across the current shunt by the shunt resistance to convert to amps and record this value (Iout). Also, record the current measured over the interface. The readings should be within the limits specified in the test record form for the appropriate model under “Current Programming and Readback, Min Current”.

4 Program the instrument settings as described in the test record form under “Current Programming & Readback, High Current”.

5 Divide the voltage drop (DMM reading) across the current shunt by the shunt resistance to convert to amps and record this value (Iout). Also, record the current reading measured over the interface. The readings should be within the limits specified in the test record form for the appropriate model under “Current Programming and Readback, High Current”.

6 *For Agilent Models N6761A and N6762A only.* Set both the current programming and the current measurement functions to the low range. Repeat steps 4 - 5 for the low current ranges. Program the instrument settings as described in the test record form under “Current Programming & Readback, Low Current”. The readings should be within the limits specified in the test record form for the appropriate model under “Current Programming and Readback, Low Current”.

CC Load Effect

Test category = performance

This test measures the change in output current resulting from a change in output voltage from full scale to short circuit.

1 Turn off the power system and connect the current shunt, DMM, and electronic load (see Test Setup figure B). Connect the DMM directly across the current shunt.

2 Turn on the power system and program the instrument settings as described in the test record form under “CC Load Effect”.

3 Set the electronic load for CV mode and program it to the output channel’s voltage as described in the test record form under “CC Load Effect”. The CC annunciator on the front panel must be on. If it isn’t, adjust the load so that the output voltage drops slightly.

4 Divide the voltage drop (DMM reading) across the current monitoring resistor by its resistance to convert to amps and record this value (Iout).

5 Short the electronic load. Divide the voltage drop (DMM reading) across the current monitoring resistor by its resistance to convert to amps and record this value (Iout). The difference in the current readings in steps 4 and 5 is the load effect, which should

not exceed the value listed in the test record form for the appropriate model under “CC Load Effect”.

CC Source Effect

Test category = performance

This test measures the change in output current that results from a change in AC line voltage from the minimum to maximum value within the line voltage specifications.

1. Turn off the power system and connect the ac power line through a variable voltage transformer or AC source.
2. Connect the current shunt, DMM, and electronic load (see Test Setup figure B). Connect the DMM directly across the current shunt. Set the variable voltage transformer or AC source to nominal line voltage.
3. Turn on the power system and program the instrument settings as described in the test record form under “CC Source Effect”.
4. Set the electronic load for the output channel’s voltage under “CC Source Effect”. The CC annunciator on the front panel must be on. If it isn’t, adjust the load so that the output voltage drops slightly.
5. Adjust the transformer or AC source to the lowest rated line voltage (86 VAC).
6. Divide the voltage drop (DMM reading) across the current monitoring resistor by its resistance to convert to amps and record this value (Iout).
7. Adjust the transformer or AC source to the highest rated line voltage (264 VAC).
8. Divide the voltage drop (DMM reading) across the current monitoring resistor by its resistance to convert to amps and record this value (Iout). The difference between the DMM reading in steps 6 and 8 is the source effect, which should not exceed the value listed in the test record form for the appropriate model under “CC Source Effect”.

Test Record Forms

Test Record Form – Agilent N6751A and N6752A

Agilent N6751A and N6752A	Report No ______________		Date ________________	
Description	**Model**	**Minimum Specs.**	**Results**	**Maximum Specs.**
		Constant Voltage Tests		
Voltage Programming & Readback				
Minimum Voltage Vout	Both	+ 1 mV	__________	+ 39 mV
Voltage measured over interface	Both	Vout – 20 mV	__________	Vout + 20 mV
High Voltage Vout	Both	49.951 V	__________	50.049 V
Voltage measured over interface	Both	Vout – 45 mV	__________	Vout + 45 mV
CV Load Effect				
	Both	– 2 mV	__________	+ 2 mV
CV Source Effect				
	Both	– 1 mV	__________	+ 1 mV
CV Ripple and Noise				
peak-to-peak	Both	N/A	__________	+ 4.5 mV
rms	Both	N/A	__________	+ 0.35 mV
Transient Response				
Voltage at 100 µs	Both	– 75 mV	__________	+ 75 mV
Voltage at 100 µs with Option 761	N6752A	– 125 mV	__________	+ 125 mV
		Constant Current Tests		
Current Programming & Readback				
Minimum Current Iout	Both	– 10 mA	__________	+ 30 mA
Current measured over interface	Both	Iout – 4 mA	__________	Iout + 4 mA
High Current Iout	N6751A	4.975 A	__________	5.025 A
	N6752A	9.970 A	__________	10.030 A
Current measured over interface	N6751A	Iout – 9 mA	__________	Iout + 9 mA
	N6752A	Iout – 14 mA	__________	Iout + 14 mA
CC Load Effect				
	Both	– 2 mA	__________	+ 2 mA
CC Source Effect				
	Both	– 1 mA	__________	+ 1 mA

	Instrument Settings	
Test Description	**N6751A**	**N6752A**
Voltage Programming & Readback, Min Voltage	20 mV, 5 A	20 mV, 10 A
Voltage Programming & Readback, High Voltage	50 V, 1 A	50 V, 2 A
CV Load Effect, Source Effect, Ripple and Noise	50 V, 1 A	50 V, 2 A
Transient Response	50 V, from 0.5 A to 1 A	50 V, from 1 A to 2 A
Current Programming & Readback, Min Current	10 mA, 50 V	10 mA, 50 V
Current Programming & Readback, High Current	5 A, 10 V	10 A, 8.5 V
CC Load Effect, Source Effect	5 A, 10 V	10 A, 8.5 V

Test Record Form – Agilent N6753A

Agilent N6753A	Report No ______________		Date ________________	
Description	**Model**	**Minimum Specs.**	**Results**	**Maximum Specs.**
		Constant Voltage Tests		
Voltage Programming & Readback				
Minimum Voltage Vout		0 mV	_________	+ 20 mV
Voltage measured over interface		Vout – 10 mV	_________	Vout + 10 mV
High Voltage Vout		19.978 V	_________	20.022 V
Voltage measured over interface		Vout –20 mV	_________	Vout + 20 mV
CV Load Effect				
		– 2 mV	_________	+ 2 mV
CV Source Effect				
		– 0.5 mV	_________	+ 0.5 mV
CV Ripple and Noise				
peak-to-peak		N/A	_________	+ 5 mV
rms		N/A	_________	+ 1 mV
Transient Response				
Voltage at 100 µs		– 30 mV	_________	+ 30 mV
Voltage at 100 µs w/Option 760/761		– 200 mV	_________	+ 200 mV
		Constant Current Tests		
Current Programming & Readback				
Minimum Current Iout		+ 20 mA	_________	+ 80 mA
Current measured over interface		Iout – 30 mA	_________	Iout + 30 mA
High Current Iout		49.920 A	_________	50.080 A
Current measured over interface		Iout – 80 mA	_________	Iout + 80 mA
CC Load Effect				
		– 12 mA	_________	+ 12 mA
CC Source Effect				
		– 5 mA	_________	+ 5 mA

Test Description	N6753A Setting
Voltage Programming & Readback, Min Voltage	10 mV, 50 A
Voltage Programming & Readback, High Voltage	20 V, 50 A
CV Load Effect, Source Effect, Ripple and Noise	20 V, 50 A
Transient Response	20 V, from 25 A to 50 A
Current Programming & Readback, Min Current	50 mA, 20 V
Current Programming & Readback, High Current	50 A, 20 V
CC Load Effect, Source Effect	50 A, 20 V

Test Record Form – Agilent N6754A

Agilent N6754A	Report No ______________		Date ________________	
Description	**Model**	**Minimum Specs.**	**Results**	**Maximum Specs.**
		Constant Voltage Tests		
Voltage Programming & Readback				
Minimum Voltage Vout		0 mV	_________	+ 50 mV
Voltage measured over interface		Vout – 25 mV	_________	Vout + 25 mV
High Voltage Vout		59.939 V	_________	60.061 V
Voltage measured over interface		Vout – 55 mV	_________	Vout + 55 mV
CV Load Effect				
		– 2 mV	_________	+ 2 mV
CV Source Effect				
		– 1 mV	_________	+ 1 mV
CV Ripple and Noise				
peak-to-peak		N/A	_________	+ 6 mV
rms		N/A	_________	+ 1 mV
Transient Response				
Voltage at 100 µs		– 90 mV	_________	+ 90 mV
Voltage at 100 µs w/Option 760/761		– 350 mV	_________	+ 350 mV
		Constant Current Tests		
Current Programming & Readback				
Minimum Current Iout		+ 8 mA	_________	+ 32 mA
Current measured over interface		Iout – 8 mA	_________	Iout + 8 mA
High Current Iout		19.968 A	_________	20.032 A
Current measured over interface		Iout – 28 mA	_________	Iout + 28 mA
CC Load Effect				
		– 5 mA	_________	+ 5 mA
CC Source Effect				
		– 2 mA	_________	+ 2 mA

Test Description	N6754A Setting
Voltage Programming & Readback, Min Voltage	25 mV, 20 A
Voltage Programming & Readback, High Voltage	60 V, 20 A
CV Load Effect, Source Effect, Ripple and Noise	60 V, 20 A
Transient Response	60 V, from 10 A to 20 A
Current Programming & Readback, Min Current	20 mA, 60 V
Current Programming & Readback, High Current	20 A, 60 V
CC Load Effect, Source Effect	20 A, 60 V

Test Record Form – Agilent N6761A and N6762A

Agilent N6761A and N6762A	Report No _______________		Date _________________	
Description	**Model**	**Minimum Specs.**	**Results**	**Maximum Specs.**
	Constant Voltage Tests			
High Range Voltage Prog. & Readback				
Minimum Voltage Vout	Both	+ 9 mV	_________	+ 21 mV
Voltage measured over interface	Both	Vout – 6 mV	_________	Vout + 6 mV
High Voltage Vout	Both	49.986 V	_________	50.014 V
Voltage measured over interface	Both	Vout – 14 mV	_________	Vout + 14 mV
Low Range Voltage Prog. & Readback				
Low Voltage Vout	Both	5.4976 V	_________	5.5024 V
Voltage measured over interface	Both	Vout – 2.4 mV	_________	Vout + 2.4 mV
CV Load Effect				
	Both	– 0.5 mV	_________	+ 0.5 mV
CV Source Effect				
	Both	– 0.5 mV	_________	+ 0.5 mV
CV Ripple and Noise				
peak-to-peak	Both	N/A	_________	+ 4.5 mV
rms	Both	N/A	_________	+ 0.35 mV
Transient Response				
Voltage at 150 µs	Both	– 75 mV	_________	+ 75 mV
	Constant Current Tests			
High Range Current Prog. & Readback				
Minimum Current Iout	Both	+ 0.8 mA	_________	+ 1.2 mA
Current measured over interface	Both	Iout – 160 µA	_________	Iout + 160 µA
High Current Iout	N6761A	1.4992 A	_________	1.5008 A
	N6762A	2.9986 A	_________	3.0014 A
Current measured over interface	N6761A	Iout – 0.76 mA	_________	Iout + 0.76 mA
	N6762A	Iout – 1.36 mA	_________	Iout + 1.36 mA
Low Range Current Prog. & Readback				
Low Current (Full Scale) Iout	Both	0.099945 A	_________	0.100055 A
Current measured over interface	Both	Iout – 45 µA	_________	Iout + 45 µA
CC Load Effect				
	Both	– 65 µA	_________	+ 65 µA
CC Source Effect				
	Both	– 30 µA	_________	+ 30 µA

	Instrument Settings	
Test Description	**N6761A**	**N6762A.**
Voltage Programming & Readback, Min Voltage	15 mV, 1.5 A	15 mV, 3 A
Voltage Programming & Readback, High Voltage	50 V, 1 A	50 V, 2 A
Voltage Programming & Readback, Low Voltage	5.5 V, 1.5 A	5.5 V, 3 A
CV Load Effect, Source Effect, Ripple and Noise	50 V, 1 A	50 V, 2 A
Transient Response	50 V, from 0.5 A to 1 A	50 V, from 1 A to 2 A
Current Programming & Readback, Min Current	1 mA, 50 V	1 mA, 50 V
Current Programming & Readback, High Current	1.5 A, 33 V	3 A, 33 V
Current Programming & Readback, Low Current	0.1 A, 50 V	0.1 A, 50 V
CC Load Effect, Source Effect	1.5 A, 33 V	3 A, 33 V

Test Record Form – Agilent N6731B and N6741B

Agilent N6731B and N6741B	Report No ______________		Date ________________	
Description	**Model**	**Minimum Specs.**	**Results**	**Maximum Specs.**
		Constant Voltage Tests		
Voltage Programming & Readback				
Minimum Voltage Vout	Both	– 4 mV	_________	+ 34 mV
Voltage measured over interface	Both	Vout – 20 mV	_________	Vout + 20 mV
High Voltage Vout	Both	4.976 V	_________	5.024 V
Voltage measured over interface	Both	Vout – 25 mV	_________	Vout + 25 mV
CV Load Effect				
	Both	– 5 mV	_________	+ 5 mV
CV Source Effect				
	Both	– 1 mV	_________	+ 1 mV
CV Ripple and Noise				
peak-to-peak	N6731B	N/A	_________	+ 10 mV
	N6741B	N/A	_________	+ 11 mV
rms	Both	N/A	_________	+ 2 mV
Transient Response				
Voltage at 200 μs	N6731B	– 80 mV	_________	+ 80 mV
	N6741B	– 100 mV	_________	+ 100 mV
		Constant Current Tests		
Current Programming & Readback				
Minimum Current Iout	Both	+ 40 mA	_________	+ 80 mA
Current measured over interface	Both	Iout – 20 mA	_________	Iout + 20 mA
High Current Iout	N6731B	9.965 A	_________	10.035 A
	N6741B	19.95 A	_________	20.05 A
Current measured over interface	N6731B	Iout – 35 mA	_________	Iout + 35 mA
	N6741B	Iout – 50 mA	_________	Iout + 50 mA
CC Load Effect				
	Both	– 2 mA	_________	+ 2 mA
CC Source Effect				
	Both	– 1 mA	_________	+ 1 mA

	Instrument Settings	
Test Description	**N6731B**	**N6741B**
Voltage Programming & Readback, Zero Voltage	15 mV, 10 A	15 mV, 20 A
Voltage Programming & Readback, High Voltage	5 V, 10 A	5 V, 20 A
CV Load Effect, Source Effect, Ripple and Noise	5 V, 10 A	5 V, 20 A
Transient Response	5 V, from 5 A to 10 A	5 V, from 10 A to 20 A
Current Programming & Readback, Zero Current	60 mA, 5 V	60 mA, 5 V
Current Programming & Readback, High Current	10 A, 5 V	20 A, 5 V
CC Load Effect, Source Effect	10 A, 5 V	20 A, 5 V

Test Record Form – Agilent N6732B and N6742B

Agilent N6732B and N6742B	Report No _______________		Date _________________	
Description	**Model**	**Minimum Specs.**	**Results**	**Maximum Specs.**
	Constant Voltage Tests			
Voltage Programming & Readback				
Minimum Voltage Vout	Both	– 4 mV	__________	+ 34 mV
Voltage measured over interface	Both	Vout – 20 mV	__________	Vout + 20 mV
High Voltage Vout	Both	7.973 V	__________	8.027 V
Voltage measured over interface	Both	Vout – 28 mV	__________	Vout + 28 mV
CV Load Effect				
	Both	– 6 mV	__________	+ 6 mV
CV Source Effect				
	Both	– 2 mV	__________	+ 2 mV
CV Ripple and Noise				
peak-to-peak	Both	N/A	__________	+ 12 mV
rms	Both	N/A	__________	+ 2 mV
Transient Response				
Voltage at 200 µs	N6732B	– 80 mV	__________	+ 80 mV
	N6742B	– 100 mV	__________	+ 100 mV
	Constant Current Tests			
Current Programming & Readback				
Minimum Current Iout	Both	– 20 mA	__________	+ 60 mA
Current measured over interface	Both	Iout – 10 mA	__________	Iout + 10 mA
High Current Iout	N6732B	6.2206 A	__________	6.2794 A
	N6742B	12.46 A	__________	12.54 A
Current measured over interface	N6732B	Iout – 19.37 mA	__________	Iout + 19.37 mA
	N6742B	Iout – 29 mA	__________	Iout + 29 mA
CC Load Effect				
	Both	– 2 mA	__________	+ 2 mA
CC Source Effect				
	Both	– 1 mA	__________	+ 1 mA

	Instrument Settings	
Test Description	**N6732B**	**N6742B**
Voltage Programming & Readback, Zero Voltage	15 mV, 6.25 A	15 mV, 12.5 A
Voltage Programming & Readback, High Voltage	8 V, 6.25 A	8 V, 12.5 A
CV Load Effect, Source Effect, Ripple and Noise	8 V, 6.25 A	8 V, 12.5 A
Transient Response	8 V, from 3.125 A to 6.25 A	8V, from 6.25A to 12.5A
Current Programming & Readback, Zero Current	40 mA, 8 V	40 mA, 8 V
Current Programming & Readback, High Current	6.25 A, 8 V	12.5 A, 8 V
CC Load Effect, Source Effect	6.25 A, 8 V	12.5 A, 8 V

Test Record Form – Agilent N6733B and N6743B

Agilent N6733B and N6743B	Report No ______________		Date ________________	
Description	**Model**	**Minimum Specs.**	**Results**	**Maximum Specs.**
	Constant Voltage Tests			
Voltage Programming & Readback				
Minimum Voltage Vout	Both	+ 10 mV	__________	+ 50 mV
Voltage measured over interface	Both	Vout – 20 mV	__________	Vout + 20 mV
High Voltage Vout	Both	19.96 V	__________	20.04 V
Voltage measured over interface	Both	Vout – 40 mV	__________	Vout + 40 mV
CV Load Effect				
	Both	– 9 mV	__________	+ 9 mV
CV Source Effect				
	Both	– 2 mV	__________	+ 2 mV
CV Ripple and Noise				
peak-to-peak	Both	N/A	__________	+ 14 mV
rms	Both	N/A	__________	+ 3 mV
Transient Response				
Voltage at 200 µs	N6733B	– 200 mV	__________	+ 200 mV
	N6743B	– 300 mV	__________	+ 300 mV
	Constant Current Tests			
Current Programming & Readback				
Minimum Current Iout	Both	– 10 mA	__________	+ 30 mA
Current measured over interface	Both	Iout – 5 mA	__________	Iout + 5 mA
High Current Iout	N6733B	2.4762 A	__________	2.5237 A
	N6743B	4.9725 A	__________	5.0275 A
Current measured over interface	N6733B	Iout – 8.75 mA	__________	Iout + 8.75 mA
	N6743B	Iout – 12.5 mA	__________	Iout + 12.5 mA
CC Load Effect				
	Both	– 2 mA	__________	+ 2 mA
CC Source Effect				
	Both	– 1 mA	__________	+ 1 mA

	Instrument Settings	
Test Description	**N6733B**	**N6743B**
Voltage Programming & Readback, Zero Voltage	30 mV, 2.5 A	30 mV, 5 A
Voltage Programming & Readback, High Voltage	20 V, 2.5 A	20 V, 5 A
CV Load Effect, Source Effect, Ripple and Noise	20 V, 2.5 A	20 V, 5 A
Transient Response	20 V, from 1.25 A to 2.5 A	20 V, from 2.5 A to 5 A
Current Programming & Readback, Zero Current	10 mA, 20 V	10 mA, 20 V
Current Programming & Readback, High Current	2.5 A, 20 V	5 A, 20 V
CC Load Effect, Source Effect	2.5 A, 20 V	5 A, 20 V

Test Record Form – Agilent N6734B and N6744B

Agilent N6734B and N6744B	Report No ______________		Date ________________	
Description	**Model**	**Minimum Specs.**	**Results**	**Maximum Specs.**
		Constant Voltage Tests		
Voltage Programming & Readback				
Minimum Voltage Vout	Both	+ 5 mV	_________	+ 75 mV
Voltage measured over interface k	Both	Vout – 35 mV	_________	Vout + 35 mV
High Voltage Vout	Both	34.93 V	_________	35.07 V
Voltage measured over interface	Both	Vout – 70 mV	_________	Vout + 70 mV
CV Load Effect				
	Both	– 11 mV	_________	+ 11 mV
CV Source Effect				
	Both	– 4 mV	_________	+ 4 mV
CV Ripple and Noise				
peak-to-peak	Both	N/A	_________	+ 15 mV
rms	Both	N/A	_________	+ 5 mV
Transient Response				
Voltage at 200 µs	N6734B	– 200 mV	_________	+ 200 mV
	N6744B	– 300 mV	_________	+ 300 mV
		Constant Current Tests		
Current Programming & Readback				
Minimum Current Iout	Both	– 15 mA	_________	+ 25 mA
Current measured over interface	Both	Iout – 4 mA	_________	Iout + 4 mA
High Current Iout	N6734B	1.47775 A	_________	1.52225 A
	N6744B	2.9755 A	_________	3.0245 A
Current measured over interface	N6734B	Iout – 6.25 mA	_________	Iout + 6.25 mA
	N6744B	Iout – 8.5 mA	_________	Iout + 8.5 mA
CC Load Effect				
	Both	– 2 mA	_________	+ 2 mA
CC Source Effect				
	Both	– 1 mA	_________	+ 1 mA

	Instrument Settings	
Test Description	**N6734B**	**N6744B**
Voltage Programming & Readback, Zero Voltage	40 mV, 1.5 A	40 mV, 3 A
Voltage Programming & Readback, High Voltage	35 V, 1.5 A	35 V, 3 A
CV Load Effect, Source Effect, Ripple and Noise	35 V, 1.5 A	35 V, 3 A
Transient Response	35 V, from 0.75 A to 1.5 A	35 V, from 1.5 A to 3 A
Current Programming & Readback, Zero Current	5 mA, 35 V	5 mA, 35 V
Current Programming & Readback, High Current	1.5 A, 35 V	3 A, 35 V
CC Load Effect, Source Effect	1.5 A, 35 V	3 A, 35 V

Test Record Form – Agilent N6735B and N6745B

Agilent N6735B and N6745B	Report No ______________		Date ________________	
Description	**Model**	**Minimum Specs.**	**Results**	**Maximum Specs.**
		Constant Voltage Tests		
Voltage Programming & Readback				
Minimum Voltage Vout	Both	+ 10 mV	________	+ 130 mV
Voltage measured over interface	Both	Vout – 60 mV	________	Vout + 60 mV
High Voltage Vout	Both	59.88 V	________	60.12 V
Voltage measured over interface	Both	Vout – 120 mV	________	Vout + 120 mV
CV Load Effect				
	N6735B	– 13 mV	________	+ 13 mV
	N6745B	– 16 mV	________	+ 16 mV
CV Source Effect				
	Both	– 6 mV	________	+ 6 mV
CV Ripple and Noise				
peak-to-peak	Both	N/A	________	+ 25 mV
rms	Both	N/A	________	+ 9 mV
Transient Response				
Voltage at 200 µs	N6735B	– 400 mV	________	+ 400 mV
	N6745B	– 500 mV	________	+ 500 mV
		Constant Current Tests		
Current Programming & Readback				
Minimum Current Iout	Both	– 17.5 mA	________	+ 22.5 mA
Current measured over interface	Both	Iout – 4 mA	________	Iout + 4 mA
High Current Iout	N6735B	0.7788 A	________	0.8212 A
	N6745B	1.5776 A	________	1.6224 A
Current measured over interface	N6735B	Iout – 5.2 mA	________	Iout + 5.2 mA
	N6745B	Iout – 6.4 mA	________	Iout + 6.4 mA
CC Load Effect				
	Both	– 2 mA	________	+ 2 mA
CC Source Effect				
	Both	– 1 mA	________	+ 1 mA

	Instrument Settings	
Test Description	**N6735B**	**N6745B**
Voltage Programming & Readback, Zero Voltage	70 mV, 0.8 A	70 mV, 1.6 A
Voltage Programming & Readback, High Voltage	60 V, 0.8 A	60 V, 1.6 A
CV Load Effect, Source Effect, Ripple and Noise	60 V, 0.8 A	60 V, 1.6 A
Transient Response	60 V, from 0.4 A to 0.8 A	60 V, from 0.8 A to 1.6 A
Current Programming & Readback, Zero Current	2.5 mA, 60 V	2.5 mA, 60 V
Current Programming & Readback, High Current	0.8 A, 60 V	1.6 A, 60 V
CC Load Effect, Source Effect	0.8 A, 60 V	1.6 A, 60 V

Test Record Form – Agilent N6736B and N6746B

Agilent N6736B and N6746B	Report No _____________		Date _______________	
Description	**Model**	**Minimum Specs.**	**Results**	**Maximum Specs.**
		Constant Voltage Tests		
Voltage Programming & Readback				
Minimum Voltage Vout	Both	0 mV	_________	+ 200 mV
Voltage measured over interface	Both	Vout – 100 mV	_________	Vout + 100 mV
High Voltage Vout	Both	99.8 V	_________	100.2 V
Voltage measured over interface	Both	Vout – 200 mV	_________	Vout + 200 mV
CV Load Effect				
	N6736B	– 20 mV	_________	+ 20 mV
	N6746B	– 30 mV	_________	+ 30 mV
CV Source Effect				
	Both	– 10 mV	_________	+ 10 mV
CV Ripple and Noise				
peak-to-peak	Both	N/A	_________	+ 30 mV
rms	Both	N/A	_________	+ 18 mV
Transient Response				
Voltage at 200 µs	N6736B	– 500 mV	_________	+ 500 mV
	N6746B	– 1000 mV	_________	+ 1000 mV
		Constant Current Tests		
Current Programming & Readback				
Minimum Current Iout	Both	– 8.5 mA	_________	+ 11.5 mA
Current measured over interface	Both	Iout – 2 mA	_________	Iout + 2 mA
High Current Iout	N6736B	0.4893 A	_________	0.5107 A
	N6746B	0.9885 A	_________	1.0115 A
Current measured over interface	N6736B	Iout – 2.75 mA	_________	Iout + 2.75 mA
	N6746B	Iout – 3.5 mA	_________	Iout + 3.5 mA
CC Load Effect				
	Both	– 2 mA	_________	+ 2 mA
CC Source Effect				
	Both	– 1 mA	_________	+ 1 mA

	Instrument Settings	
Test Description	**N6736B**	**N6746B**
Voltage Programming & Readback, Zero Voltage	100 mV, 0.5 A	100 mV, 1 A
Voltage Programming & Readback, High Voltage	100 V, 0.5 A	100 V, 1 A
CV Load Effect, Source Effect, Ripple and Noise	100 V, 0.5 A	100 V, 1 A
Transient Response	100 V, from 0.25 A to 0.5 A	100 V, from 0.5 A to 1 A
Current Programming & Readback, Zero Current	1.5 mA, 100 V	1.5 mA, 100 V
Current Programming & Readback, High Current	0.5 A, 100 V	1 A, 100 V
CC Load Effect, Source Effect	0.5 A, 100 V	1 A, 100 V

Test Record Form – Agilent N6773A

Agilent Model N6773A	Report No ______________		Date ________________	
Description	**Model**	**Minimum Specs.**	**Results**	**Maximum Specs.**
		Constant Voltage Tests		
Voltage Programming & Readback				
Minimum Voltage Vout		+ 10 mV	__________	+ 50 mV
Voltage measured over interface		Vout – 20 mV	__________	Vout + 20 mV
High Voltage Vout		19.96 V	__________	20.04 V
Voltage measured over interface		Vout – 40 mV	__________	Vout + 40 mV
CV Load Effect				
		– 13 mV	__________	+ 13 mV
CV Source Effect				
		– 2 mV	__________	+ 2 mV
CV Ripple and Noise				
peak-to-peak		N/A	__________	+ 20 mV
rms		N/A	__________	+ 3 mV
Transient Response				
Voltage at 250 µs		– 300 mV	__________	+ 300 mV
		Constant Current Tests		
Current Programming & Readback				
Minimum Current Iout		– 30 mA	__________	+ 90 mA
Current measured over interface		Iout – 15 mA	__________	Iout + 15 mA
High Current Iout		14.9175 A	__________	15.0825 A
Current measured over interface		Iout – 37.5 mA	__________	Iout + 37.5 mA
CC Load Effect				
		– 6 mA	__________	+ 6 mA
CC Source Effect				
		– 1 mA	__________	+ 1 mA

Test Description	N6773A Setting
Voltage Programming & Readback, Min	30 mV, 15 A
Voltage Programming & Readback, High	20 V, 15 A
CV Load Effect, Source Effect, Ripple and Noise	20 V, 15 A
Transient Response	20 V, from 7.5 A to 15 A
Current Programming & Readback, Min	30 mA, 20 V
Current Programming & Readback, High	15 A, 20 V
CC Load Effect, Source Effect	15 A, 20 V

Test Record Form – Agilent N6774A

Agilent Model N6774A	Report No _______________		Date _________________	
Description	**Model**	**Minimum Specs.**	**Results**	**Maximum Specs.**
		Constant Voltage Tests		
Voltage Programming & Readback				
Minimum Voltage Vout		+ 5 mV	__________	+ 75 mV
Voltage measured over interface		Vout – 35 mV	__________	Vout + 35 mV
High Voltage Vout		34.93 V	__________	35.07 V
Voltage measured over interface		Vout – 70 mV	__________	Vout + 70 mV
CV Load Effect				
		– 16 mV	__________	+ 16 mV
CV Source Effect				
		– 4 mV	__________	+ 4 mV
CV Ripple and Noise				
peak-to-peak		N/A	__________	+ 22 mV
rms		N/A	__________	+ 5 mV
Transient Response				
Voltage at 250 µs		– 300 mV	__________	+ 300 mV
		Constant Current Tests		
Current Programming & Readback				
Minimum Current Iout		– 45 mA	__________	+ 75 mA
Current measured over interface		Iout – 12 mA	__________	Iout + 12 mA
High Current Iout		8.42725 A	__________	8.57275 A
Current measured over interface		Iout – 24.75 mA	__________	Iout + 24.75 mA
CC Load Effect				
		– 6 mA	__________	+ 6 mA
CC Source Effect				
		– 1 mA	__________	+ 1 mA

Test Description	N6774A Setting
Voltage Programming & Readback, Min	40 mV, 8.5 A
Voltage Programming & Readback, High	35 V, 8.5 A
CV Load Effect, Source Effect, Ripple and Noise	35 V, 8.5 A
Transient Response	35 V, from 4.25 A to 8.5 A
Current Programming & Readback, Min	15 mA, 35 V
Current Programming & Readback, High	8.5 A, 35 V
CC Load Effect, Source Effect	8.5 A, 35 V

Test Record Form – Agilent N6775A

Agilent Model N6775A		Report No ______________		Date ________________
Description	**Model**	**Minimum Specs.**	**Results**	**Maximum Specs.**
		Constant Voltage Tests		
Voltage Programming & Readback				
Minimum Voltage Vout		+ 10 mV	__________	+ 130 mV
Voltage measured over interface		Vout – 60 mV	__________	Vout + 60 mV
High Voltage Vout		59.88 V	__________	60.12 V
Voltage measured over interface		Vout – 120 mV	__________	Vout + 120 mV
CV Load Effect				
		– 24 mV	__________	+ 24 mV
CV Source Effect				
		– 6 mV	__________	+ 6 mV
CV Ripple and Noise				
peak-to-peak		N/A	__________	+ 35 mV
rms		N/A	__________	+ 9 mV
Transient Response				
Voltage at 250 µs		– 500 mV	__________	+ 500 mV
		Constant Current Tests		
Current Programming & Readback				
Minimum Current Iout		– 52.5 mA	__________	+ 67.5 mA
Current measured over interface		Iout – 12 mA	__________	Iout + 12 mA
High Current Iout		4.9325 A	__________	5.0675 A
Current measured over interface		Iout – 19.5 mA	__________	Iout + 19.5 mA
CC Load Effect				
		– 6 mA	__________	+ 6 mA
CC Source Effect				
		– 1 mA	__________	+ 1 mA

Test Description	N6775A Setting
Voltage Programming & Readback, Min	70 mV, 5 A
Voltage Programming & Readback, High	60 V, 5 A
CV Load Effect, Source Effect, Ripple and Noise	60 V, 5 A
Transient Response	60 V, from 2.5 A to 5 A
Current Programming & Readback, Min	7.5 mA, 60 V
Current Programming & Readback, High	5 A, 60 V
CC Load Effect, Source Effect	5 A, 60 V

Test Record Form – Agilent N6776A

Agilent Model N6776A	Report No _______________		Date _________________	
Description	**Model**	**Minimum Specs.**	**Results**	**Maximum Specs.**
		Constant Voltage Tests		
Voltage Programming & Readback				
Minimum Voltage Vout		0 mV	_________	+ 200 mV
Voltage measured over interface		Vout – 100 mV	_________	Vout + 100 mV
High Voltage Vout		99.8 V	_________	100.2 V
Voltage measured over interface		Vout – 200 mV	_________	Vout + 200 mV
CV Load Effect				
		– 45 mV	_________	+ 45 mV
CV Source Effect				
		– 10 mV	_________	+ 10 mV
CV Ripple and Noise				
peak-to-peak		N/A	_________	+ 45 mV
rms		N/A	_________	+ 18 mV
Transient Response				
Voltage at 250 µs		– 1000 mV	_________	+ 1000 mV
		Constant Current Tests		
Current Programming & Readback				
Minimum Current Iout		– 25.5 mA	_________	+ 34.5 mA
Current measured over interface		Iout – 6 mA	_________	Iout + 6 mA
High Current Iout		2.9655 A	_________	3.0345 A
Current measured over interface		Iout – 10.5 mA	_________	Iout + 10.5 mA
CC Load Effect				
		– 6 mA	_________	+ 6 mA
CC Source Effect				
		– 1 mA	_________	+ 1 mA

Test Description	N6776A Setting
Voltage Programming & Readback, Min	100 mV, 3 A
Voltage Programming & Readback, High	100 V, 3 A
CV Load Effect, Source Effect, Ripple and Noise	100 V, 3 A
Transient Response	100 V, from 1.5 A to 3 A
Current Programming & Readback, Min	4.5 mA, 100 V
Current Programming & Readback, High	3 A, 100 V
CC Load Effect, Source Effect	3 A, 100 V

3
Calibration

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Calibration Procedure ... 35

This chapter includes calibration procedures for the Agilent N6700 Modular Power System. Instructions are given for performing the procedures from either the front panel or a controller over the GPIB.

Refer to the “Equipment Required” section in chapter 2 for a list of the equipment required for calibration. Also refer to “Measurement Techniques” for information about connecting the voltmeter and current shunt.

NOTE Perform the verification tests before calibrating your power system. If the power system passes the verification tests, the unit is operating within its calibration limits and does not need to be re-calibrated.

Calibration Interval

The recommended calibration interval for Agilent N67xxA/B power modules is one year. Agilent N6700A/B, N6701A, and N6702A MPS mainframes do not require calibration.

Calibration Description

Refer to the “Equipment Required” section in chapter 2 for a list of the equipment required for calibration. Also refer to “Measurement Techniques” for information about connecting the voltmeter and current shunt. A general outline of the calibration procedure is as follows:

- Enter the calibration mode by providing the correct password. The password is factory-set to 0 (zero). You can change the password once calibration mode is entered to prevent unauthorized access to the calibration mode. Refer to “Change the Calibration Password” at the end of this section.
- Calibrate only ONE channel at a time. The calibration commands accept only a single channel number for the channel parameter. Calibration cannot be performed on channels that have been grouped. If any channels have been grouped, they must be ungrouped before they can be calibrated.
- When calibrating the unit using SCPI commands, most steps involve sending a *OPC? query to synchronize with the power system’s command completion before proceeding. The response from the instrument must be read each time *OPC? is given.
- **Once started, you must perform the complete calibration procedure in its entirety.** As each calibration section is completed, the instrument calculates new calibration constants and begins using them. However, these constants are not saved in nonvolatile memory until a SAVE command is explicitly given.
- Exit the calibration mode either by logging out of the front panel menu or by sending CAL:STAT OFF. Note that any channels that were calibrated but not saved will revert to their previous calibration constants.

Calibration Switches

Two switches control the access to calibration commands. The switches are on the interface board and are accessible by removing the top cover. Refer to “Accessing the Calibration switch” in chapter 4. Switches 1 and 2 set the calibration configuration as follows:

	Sw 1	Sw 2	Description
Normal	ON	ON	This is the default or as-shipped switch setting. The calibration functions are accessible after entering a numeric password. The default password is 0 (zero).
Clear password	OFF	ON	The admin/calibration password is reset to 0 when the instrument is first powered on. Use this setting if you have forgotten the password.
Inhibit calibration	OFF	OFF	All calibration commands are disabled. This is useful where calibration access is guarded by instrument seals.

Calibration Procedure

Unless instructed otherwise, connect the +sense terminal to the +output, and the -sense terminal to the -output.

Warm-up Period for Agilent Models N6761A and N6762A

Agilent Models N6761A and N6762A require a warm-up period of 30 minutes in the reset (*RST) state before starting the calibration procedure.

Enter Calibration mode

Front Panel:	SCPI Command:
Select **System\Admin\Login**. Enter your password in the Password field and press Select.	`CAL:STAT ON, <password>`

Voltage Programming and Measurement Calibration

Step 1. Connect the DMM's voltage input to an output channel.

Step 2. Select the full-scale voltage programming and measurement range. The following example selects the 50 volt full-scale range of channel 1. The value entered must be the maximum voltage of the range.

Front Panel:	SCPI Command:
Select **System\Admin\Cal\Function\Vprog**. Then select the High range.	`CAL:VOLT 50, (@1)`

Step 3. Select the first voltage calibration point.

Front Panel:	SCPI Command:
Select Next. The information field should indicate: Enter P1 data	`CAL:LEV P1` `*OPC?`

Step 4. Measure the output voltage with the DMM and enter the data.

Front Panel:	SCPI Command:
Select the Measured Data field. Enter the data from the external DMM. Press Select when done.	`CAL:DATA <data>`

Step 5. Select the second voltage calibration point.

Front Panel:	SCPI Command:
Select Next. The information field should indicate: Enter P2 data	`CAL:LEV P2` `*OPC?`

Step 6. Measure the output voltage with the DMM and enter the data.

Front Panel:	SCPI Command:
Select the Measured Data field. Enter the data from the external DMM. Press Select when done. Press Next to finish calibration.	`CAL:DATA <data>`

Low Range Voltage Programming Calibration

This only applies to Agilent Models N6761A and N6762A.

Step 7. Select the low-voltage programming range. This example selects the 5 volt programming range of channel 1. The value to program a range must be the maximum voltage of the range.

Front Panel:	SCPI Command:
Select **System\Admin\Cal\Function\Vprog**. Then select the Low range.	`CAL:VOLT 5, (@1)`

Step 8. Select the first voltage calibration point.

Front Panel:	SCPI Command:
Select Next. The information field should indicate: Enter P1 data	`CAL:LEV P1` `*OPC?`

Step 9. Measure the output voltage with the DMM and enter the data.

Front Panel:	SCPI Command:
Select the Measured Data field. Enter the data from the external DMM. Press Select when done.	`CAL:DATA <data>`

Step 10. Select the second voltage calibration point.

Front Panel:	SCPI Command:
Select Next. The information field should indicate: Enter P2 data	`CAL:LEV P2` `*OPC?`

Step 11. Measure the output voltage with the DMM and enter the data.

Front Panel:	SCPI Command:
Select the Measured Data field. Enter the data from the external DMM. Press Select when done. Press Next to finish calibration.	`CAL:DATA <data>`

Low Range Voltage Measurement Calibration

This only applies to Agilent Models N6761A and N6762A.

Step 12. Select the low-voltage measurement range. This example selects the 5 volt measurement range of channel 1. The value to program a range must be the maximum voltage of the range.

Front Panel:	SCPI Command:
Select **System\Admin\Cal\Function\Vmeas**.	`CAL:VOLT:MEAS 5, (@1)`

Step 13. Select the first voltage calibration point.

Front Panel:	SCPI Command:
Select Next. The information field should indicate: Enter P1 data	`CAL:LEV P1` `*OPC?`

Step 14. Measure the output voltage with the DMM and enter the data.

Front Panel:	SCPI Command:
Select the Measured Data field. Enter the data from the external DMM. Press Select when done.	`CAL:DATA <data>`

Step 15. Select the second voltage calibration point.

Front Panel:	SCPI Command:
Select Next. The information field should indicate: Enter P2 data	`CAL:LEV P2` `*OPC?`

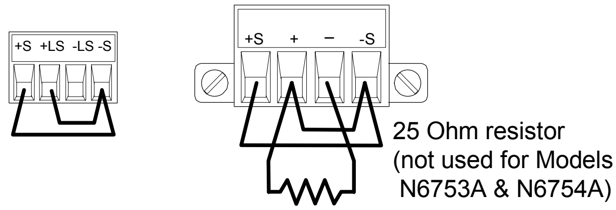
Step 16. Measure the output voltage with the DMM and enter the data.

Front Panel:	SCPI Command:
Select the Measured Data field. Enter the data from the external DMM. Press Select when done. Press Next to finish calibration.	`CAL:DATA <data>`

Voltage Common Mode Rejection Ratio Calibration

This only applies to Agilent Models N6751A, N6752A, N6753A, N6754A, N6761A and N6762A.

Step 17. For this step only, refer to the following figure and connect a jumper between the +sense and the –sense terminals. Connect a second jumper from the +output to the –sense terminal. Connect a 25 ohm load resistor across the +output and –output terminals (the resistor is not needed for Models N6753A and N6754A). This procedure is automatic and takes a few seconds.



Front Panel:	SCPI Command:
Select **System\Admin\Cal\Function\CMRR**. Then select Next.	`CAL:VOLT:CMRR (@1)` `*OPC?`

Current Programming and Measurement Calibration

The output voltage may go negative at some point during this procedure on units that have polarity reversal relays (option 760).

Step 18. Connect the +sense terminal to the +output, and the -sense terminal to the –output. Connect a precision shunt resistor to the output. The shunt resistor should be able to measure at least 120% of the output's rated full-scale current. Connect the DMM across the shunt resistor.

Step 19. Select the full-scale current programming range. The following example selects the 10 amp full-scale current programming and measurement range of channel 1. The value to program a range must be the maximum current of the range.

Front Panel:	SCPI Command:
Select **System\Admin\Cal\Function\Iprog** Then select the High range.	`CAL:CURR 10, (@1)`

Step 20. Select the first current calibration point.

Front Panel:	SCPI Command:
Select Next. The information field should indicate: Enter P1 data	`CAL:LEV P1` `*OPC?`

Step 21. Calculate the shunt current (I=V/R) and enter the data.

Front Panel:	SCPI Command:
Select the Measured Data field. Enter the data from the external DMM. Press Select when done.	`CAL:DATA <data>`

Step 22. Select the second current calibration point.

Front Panel:	SCPI Command:
Select Next. The information field should indicate: Enter P2 data	`CAL:LEV P2` `*OPC?`

Step 23. Calculate the shunt current (I=V/R) and enter the data.

Front Panel:	SCPI Command:
Select the Measured Data field. Enter the data from the external DMM. Press Select when done. Press Next to finish calibration.	`CAL:DATA <data>`

Downprogrammer Calibration

Step 24. Remove all loads from the output. This procedure is automatic and takes a few seconds.

Front Panel:	SCPI Command:
Select **System\Admin\Cal\Function\DPprog**. Then select Next.	`CAL:DPRog (@1)` `*OPC?`

Low Range Current Measurement Calibration

This only applies to Agilent Models N6761A and N6762 with Firmware revisions B.00.00 and up. For calibrating units with previous firmware revisions, refer to Appendix B.

Step 25. Connect only the current measurement terminals of the Agilent 3458A to the output terminals.

Step 26. Select the low-current measurement range. The following example selects the 0.1 amp low-current measurement range of channel 1. The value to program a range must be the maximum current of the range.

Front Panel:	SCPI Command:
Select **System\Admin\Cal\Function\Imeas**.	`CAL:CURR:MEAS 0.1, (@1)`

Step 27. Select the first current calibration point. Then wait a minimum of 5 minutes for the internal temperature to stabilize.

Front Panel:	SCPI Command:
Select Next. The information field should indicate: Enter P1 data	`CAL:LEV P1`

Step 28. Measure the current with the Agilent 3458A and enter the value.

Front Panel:	SCPI Command:
Select the Measured Data field. Enter the data from the external DMM. Press Select when done. Press Next to finish calibration.	`CAL:DATA <data>` `*OPC?`

Step 29. Disconnect the Agilent 3458A from the output terminals. Then select the second current calibration point. Wait a minimum of 5 minutes for the internal temperature to stabilize.

Front Panel:	SCPI Command:
Select Next. The information field should indicate: Enter P2 data	`CAL:LEV P2`

Step 30. Then select the third current calibration point.

Front Panel:	SCPI Command:
Select Next. The information field should indicate: Enter P3 data	`CAL:LEV P3` `*OPC?`

Low Range Current Programming Calibration

This only applies to Agilent Models N6761A and N6762A.

Step 31. Connect only the current measurement terminals of the Agilent 3458A to the output terminals.

Step 32. Select the low-current programming range. The following example selects the 0.1 amp low-current programming range of channel 1. The value to program a range must be the maximum current of the range.

Front Panel:	SCPI Command:
Select **System\Admin\Cal\Function\Iprog**. Then select the Low range.	`CAL:CURR 0.1, (@1)`

Step 33. Select the first current calibration point. Wait a minimum of 5 minutes for the output current to stabilize.

Front Panel:	SCPI Command:
Select Next. The information field should indicate: Enter P1 data	`CAL:LEV P1` `*OPC?`

Step 34. Measure the current with the Agilent 3458A and enter the value.

Front Panel:	SCPI Command:
Select the Measured Data field. Enter the data from the external DMM. Press Select when done.	`CAL:DATA <data>`

Step 35. Select the second current calibration point. Then wait 30 seconds for the output current to stabilize.

Front Panel:	SCPI Command:
Select Next. The information field should indicate: Enter P2 data	`CAL:LEV P2` `*OPC?`

Step 36. Measure the current with the Agilent 3458A and enter the value.

Front Panel:	SCPI Command:
Select the Measured Data field. Enter the data from the external DMM. Press Select when done. Press Next to finish calibration.	`CAL:DATA <data>`

Peak Current Limit Calibration

Steps 37 through 41 only apply to Agilent Models N6751A, N6752A, N6753A, N6754A, N6761A, and N6762A. Note for Models N6753A and N6754A, the peak current limit calibration is valid for 5 years.

Step 37. Connect the appropriate load resistor or electronic load across the output terminals.

N675xA and N676xA:	25 ohm resistor (see equipment list in chapter 2)
N6753A:	Electronic load set to 26.25A in constant current mode, or 0.6 ohm load resistor (resistance includes load leads)
N6754A:	Electronic load set to 10.5A in constant current mode, or 3.8 ohm load resistor (resistance includes load leads)

Step 38. Select peak current limit calibration.

Front Panel:	SCPI Command:
Select **System\Admin\Cal\Function\IPeak**.	`CAL:CURR:PEAK (@1)`

Step 39. Select the first current calibration point.

Front Panel:	SCPI Command:
Select Next. The calibration is automatic.	`CAL:LEV P1` `*OPC?`

Step 40. Replace the load resistor or change the electronic load as follows:

N675xA and N676xA:	4 ohm resistor (see equipment list in chapter 2)
N6753A:	Electronic load set to 13.125A in constant current mode, or 1.2 ohm load resistor (resistance includes load leads)
N6754A:	Electronic load set to 5.25A in constant current mode, or 7.6 ohm load resistor (resistance includes load leads)

Step 41. Select the second current calibration point.

Front Panel:	SCPI Command:
Select Next. The calibration is automatic.	`CAL:LEV P2` `*OPC?`

Steps 42 through 44 apply to Agilent Models N6731A through N6735A, and N6742A through N6745A.

Step 42. Connect the 4 ohm load resistor across the output terminals (see the equipment list in chapter 2).

Step 43. Select peak current limit calibration.

Front Panel:	SCPI Command:
Select **System\Admin\Cal\Function\IPeak**.	`CAL:CURR:PEAK (@1)`

Step 44. Select the first current calibration point.

Front Panel:	SCPI Command:
Select Next. The calibration is automatic.	`CAL:LEV P1` `*OPC?`

Save and Exit Calibration Mode

CAUTION Storing calibration constants overwrites the existing ones in non-volatile memory. If you are not sure you want to permanently store the new constants, do not Save the data when you exit the calibration mode. The calibration will then remain unchanged.

Front Panel:	SCPI Command:

Select **System\Admin\Cal\Date**. Enter the calibration date in the Date field. If desired, you can enter alphanumeric data in this field.
Select **System\Admin\Cal\Save**. Select Save to save all calibration data.
Select **System\Admin\Logout** to exit calibration mode.
	To enter a calibration date:
	`CAL:DATE "<date>", (@1)`
	To save calibration data:
	`CAL:SAVE`
	To exit calibration mode:
	`CAL:STAT OFF`

Change the Admin/Calibration Password

The password must be numeric, and can be up to 15 digits in length. After it has been changed, you can only enter the calibration mode by providing the correct password.

If the password is lost or forgotten, access can be restored by setting an internal switch that resets the password to zero (refer to "Accessing the Calibration switch" in chapter 4). Once you have set the password to zero with the switch, you can enter a new password using the Admin menu or using the CAL:PASS command. The new password will become active when you log out of the Admin Menu or send CAL STAT OFF. After you have returned the switches to the normal position, you can assess the Admin menu with the new password.

Front Panel:	SCPI Command:

Select **System\Admin\Login**.
Enter the original password in the Password field and press Select.
Select **System\Admin\Password**. Enter a new password in the Password field.
Logout of the Admin menu to activate the password.
	Enter calibration mode using the original password
	`CAL:STAT ON, <password>`
	To change the password:
	`CAL:PASS <NRf>`
	To exit calibration mode and activate the password:
	`CAL:STAT OFF`

NOTE If the message "Locked out by internal switch setting" or "Calibration is inhibited by switch setting" appears, the internal switch is set to prevent the password from being changed (refer to "Accessing the Calibration switch" in chapter 4).

4
Disassembly

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Disassembly Procedures 46
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This chapter discusses the disassembly procedures for troubleshooting and repairing Agilent N6700B, N6701A, and N6702A MPS mainframes.

Electrostatic Discharge (ESD) Precautions

Almost all electrical components can be damaged by electrostatic discharge (ESD) during handling. Component damage can occur at electrostatic discharge voltages as low as 50 volts. The following guidelines will help prevent ESD damage when servicing the instrument or any electronic device.

- Disassemble instruments *only* in a static-free work area.
- Use a conductive work area to reduce static charges.
- Use a conductive wrist strap to reduce static accumulation.
- Minimize handling.
- Keep replacement parts in original static-free packaging.
- Remove all plastic, foam, vinyl, paper, and other static-generating materials from the immediate work area.

Disassembly Procedures

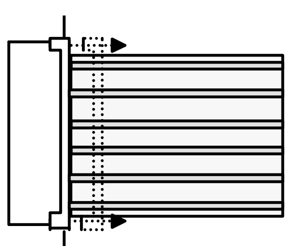
WARNING **SHOCK HAZARD. FAN HAZARD. Turn off the mainframe and disconnect its power cord before attempting any of the following procedures.**

Required Disassembly Tools

Tool	Use
9/32 Hex driver	Removing GPIB connector
5/16 Hex driver	Removing DC cable assembly from bias supply
T20 Torx driver	Removing bias board, handles, and bulk supply
T10 Torx driver	Removing covers and board assemblies

Ribbon Cables

- Note the position of the conductive side of the cable for re-installation. (The blue tab is on the non-conductive side.)
- Release the ribbon cable by pulling up on the locking tab as shown by the arrows in the following figure.



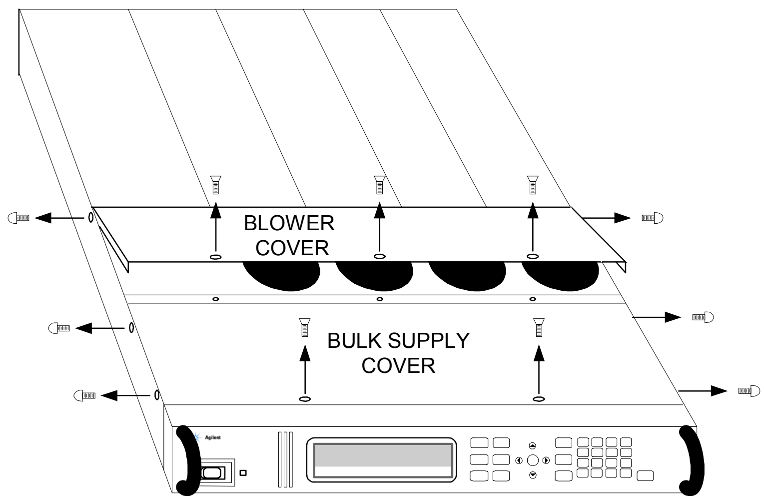
- To replace the cable, fully insert the cable into the connector; then push down on the locking tab to secure the cable.

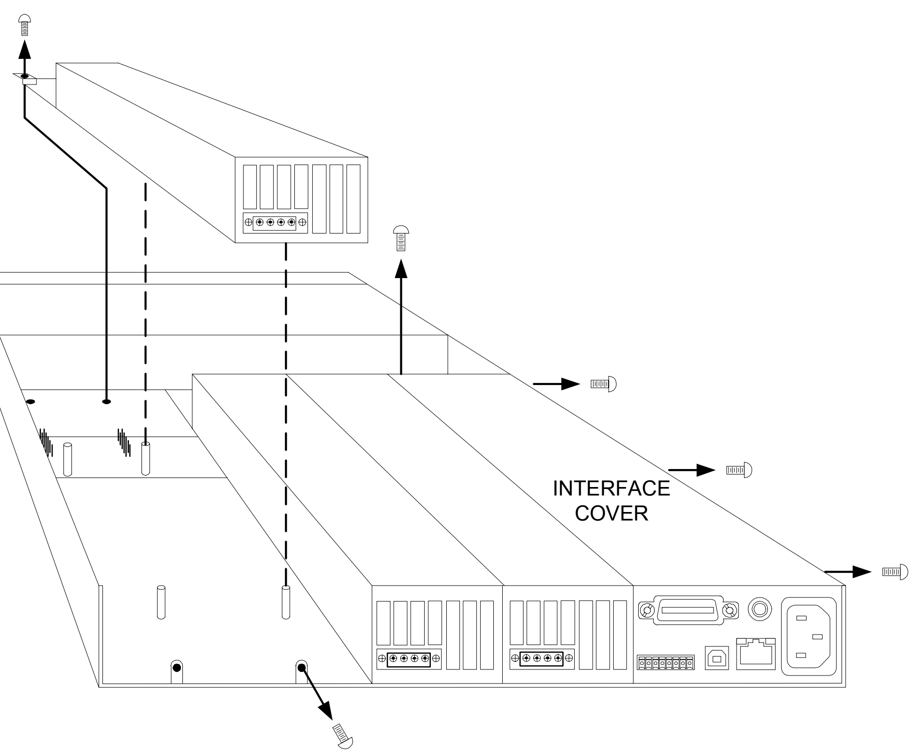
Removing/Installing Modules

CAUTION Modules must be installed next to one another, starting with slot 1. Do not leave any empty slots *between* modules, otherwise the power system will not operate. Any remaining unused slots must have a filler module installed to ensure proper cooling. Do not install filler modules *between* power modules.

Step 1. Remove the blower cover. Remove three screws from the top of the cover and two screws on the sides. Tilt the cover up and slide it out.

Step 2. To remove a module, first remove the two fastening screws at either end of the module. Grasp the module at the ends (near the fan and the output connector), and lift it straight up out of the mainframe.





Step 3. To install a module, align the module over the alignment pins, and push it down onto the mainframe connector.

Step 4. Fasten the module to the mainframe. Install the two screws from the power module or filler module at either end of the module. Because the RFI strips are applying upward pressure, continue pushing down on the module until the screws are fully tightened.

Step 5. Replace the blower cover when finished.

Accessing the Calibration switch

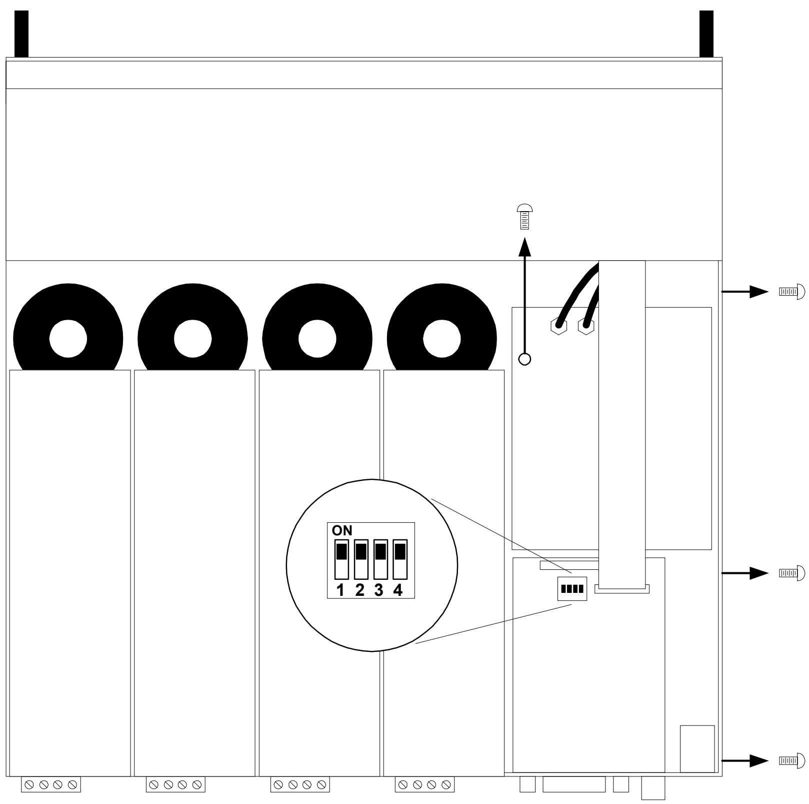
Step 1. Remove the blower cover. Remove three screws from the top of the cover and two screws on the sides. Tilt the cover up and slide it out.

Step 2. Remove the interface cover. Remove the three screws along the left side of the unit. Then remove the screw at the front of the cover. Lift off the cover.

Step 3. The calibration switch is on the interface board near the ribbon cable. To change the calibration switch settings, use a small screwdriver to move the switches. Refer to chapter 3 for settings information.

CAUTION Do not use a pencil to move the switches. Any graphite dust that gets on the switches will conduct electricity.

Step 4. Replace all covers when finished.



Removing/Installing the Interface (PPMC) board

Step 1. Remove the blower cover. Remove three screws from the top of the cover and two screws on the sides. Tilt the cover up and slide it out.

Step 2. Remove the interface cover. Remove the three screws along the left side of the unit. Then remove the screw at the front of the cover. Lift off the cover.

Step 3. Use a hex wrench to remove the GPIB connector from the rear of the mainframe Disconnect all cable assemblies from the interface board.

Step 4. Disconnect the 3 cable assemblies located along the front edge of the board. Use a T10 driver and remove the screws that attach the board to the chassis. Lift the board out.

Step 5. To reinstall the interface board, perform the above steps in reverse order. Replace all covers when finished.

Removing/Installing the Bias board

Step 1. Remove the blower and interface covers as previously described.

Step 2. Disconnect all cable assemblies from the bias board.

Step 3. Use a T10 driver and remove the screws that attach the bias board to the chassis. Use a T20 driver and remove the 4 screws that attach the board to the backplane assembly. Lift the board out.

Step 4. To reinstall the bias board, perform the above steps in reverse order. Replace all covers when finished.

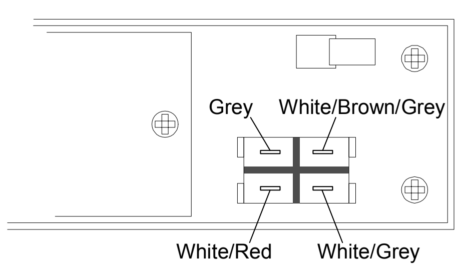
Removing/Installing the Front Panel Assembly

Step 1. Remove the two screws along the front of the bulk supply cover as well as the four screws on each side of the front panel assembly that attach the front panel assembly to the chassis.

Step 2. Slide the front panel assembly forward and away from the chassis to access the test points for troubleshooting.

Step 3. To completely remove the front panel assembly, disconnect the ribbon cable between the front panel board and the interface board at the front panel board.

Step 4. Disconnect the wires going to the S1 switch assembly. For reassembly, make a note of the color coding of the wires and the pins to which they are connected.



Step 5. To remove the front panel board, remove the six screws that secure the board to the front frame assembly.

Step 6. To remove the display module, first disconnect the cable at the P1 connector and the ribbon cable at the J2 connector. Then untwist the tabs that hold the display module to the front panel board.

Step 7. To reinstall the front panel assembly, perform the above steps in reverse order.

Removing/Installing the Bulk Supply

Step 1. Remove the blower cover, bulk supply cover, and interface cover as previously described.

Step 2. Remove the power module from slot #3 in the mainframe. You now have access to two of the screws that install the bulk supply.

Step 3. Remove the four screws on each side of the front panel assembly that attach the front panel assembly to the chassis. Slide the front panel assembly forward and away from the chassis. You now have access to the remaining screws that install the bulk supply.

Step 4. Use a T20 driver and remove all screws that fasten the bulk supply to the chassis.

Step 5. **For N6700B and N6701A mainframes**, slide the bulk supply over so that you can access the AC and DC cable assembly connectors.
For N6702A mainframes, which have two paralleled bulk supplies, disconnect the ribbon cable that connects the interface board to the front panel by gently lifting up on the interface board connector. Slide the ribbon cable out so that you can access the AC and DC cable assembly connectors.

Step 6 Disconnect the DC and AC cable assemblies and lift the bulk supply out of the unit. For reassembly, make a note of the color-coding of the wires and the pins to which they are connected.

Cable assembly	Connected to Pin
Red (DC)	+48 V
Black (DC)	–48 V
Grey (AC)	AC
Red/white (AC)	ACC
Green/yellow (AC)	ground

Step 7. To reinstall the bulk supply, perform the above steps in reverse.

Installing a Redundant Ground for 400 Hz Operation

Operation at 400 Hz requires the installation of a redundant ground from the instrument chassis to earth ground. The redundant ground must be permanently attached to the unit as well as to the earth ground point.

The following procedure only describes how to make the permanent connection at the unit. The user must ensure the integrity and permanence of the connection at the earth ground point.

The following customer-supplied hardware is required:

- Ground wire (14/16 AWG)
- Uninsulated ring terminal for attaching wire to unit (Tyco p/n 34124 or equivalent)
- Hardware for attaching wire to earth ground point

The following tools are required for installing the redundant ground:

- 3/8 inch hex wrench

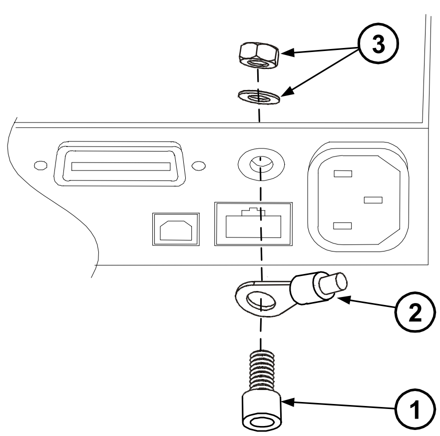
Step 1. Remove the top cover of the GPIB board as previously described under “Accessing the Calibration switch”.

Step 2. Use the wrench and remove the binding post (1) from the rear of the chassis. The binding post is located between the AC input connector and the GPIB connector.

Step 3. Crimp the appropriate ring terminal (2) onto the end of the ground wire.

Step 4. Place the ring terminal onto the threaded end of the binding post. Re-install the binding post on the chassis with the washer and nut (3).

Step 5. Rotate the ring terminal so that the ground wire does not interfere with any other connectors on the back of the unit. Use the wrench and tighten the binding post to the chassis (Torque = 20 – 25 in-lb.).



5
Troubleshooting

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Before performing the Overall Troubleshooting procedures, perform the Preliminary Checkout procedure in the beginning of this chapter.

If the power system passes selftest and there are no obvious faults, perform the verification procedures in chapter 2 to determine if any power modules are not calibrated, or are not operating properly. This will help isolate a problem to a specific power module.

The following table documents the test equipment required for troubleshooting Agilent N6700 MPS mainframes.

Model	Description
Agilent 34401A or equivalent	Digital multimeter (for measuring voltage and resistance)

Preliminary Checkout

Is the instrument inoperative?

- Verify that the AC power cord is connected to the instrument.
- Verify that the front-panel On/Standby switch has been pushed.

Is the display working?

- If the display is hard to read, but front-panel LED is lit and the fans are working, the display contrast setting may be too light or too dark. Use the front panel menu to set the display contrast.

Does the instrument fail selftest?

- Remove all external connections to the instrument.
- Check that modules are installed next to each other, starting with slot 1. If there are any empty slots (or filler modules) *between* the power modules, the power system will not operate.
- Check that the mainframe has the latest firmware installed.
- Turn off the unit and cycle power to run selftest again.

If the supply passes selftest and there are no obvious faults, perform the verification procedures in chapter 2 to determine if any functions are not calibrated, or are not operating properly.

Self-test Error List

The following table documents the self-test error messages. Refer to Appendix A for other error messages.

	Selftest Errors (these errors set Standard Event Status register bit #3)
202	**Selftest Fail Aux Adc 0 expected <n1> to <n2>, measured <n3>, chan <n4>** Auxiliary ADC failed. n1 and n2 are the expected limits. n3 is the measured value. n4 is the channel location of the failed module.
202	**Selftest Fail DACs 0 expected <n1> to <n2>, measured <n3>, chan <n4>** Both voltage and current DACs are at zero. n1 and n2 are the expected limits. n3 is the measured value. n4 is the channel location of the failed module.
202	**Selftest Fail DACs 1 expected <n1> to <n2>, measured <n3>, chan <n4>** Voltage DAC is at zero; current DAC is at full scale. n1 and n2 are the expected limits. n3 is the measured value. n4 is the channel location of the failed module.
202	**Selftest Fail DACs 2 expected <n1> to <n2>, measured <n3>, chan <n4>** Voltage DAC is at full scale; current DAC is at zero. n1 and n2 are the expected limits. n3 is the measured value. n4 is the channel location of the failed module.
202	**Selftest Fail DACs 3 expected <n1> to <n2>, measured <n3>, chan <n4>** Both voltage and current DACs are at full scale. n1 and n2 are the expected limits. n3 is the measured value. n4 is the channel location of the failed module.

Overall Troubleshooting

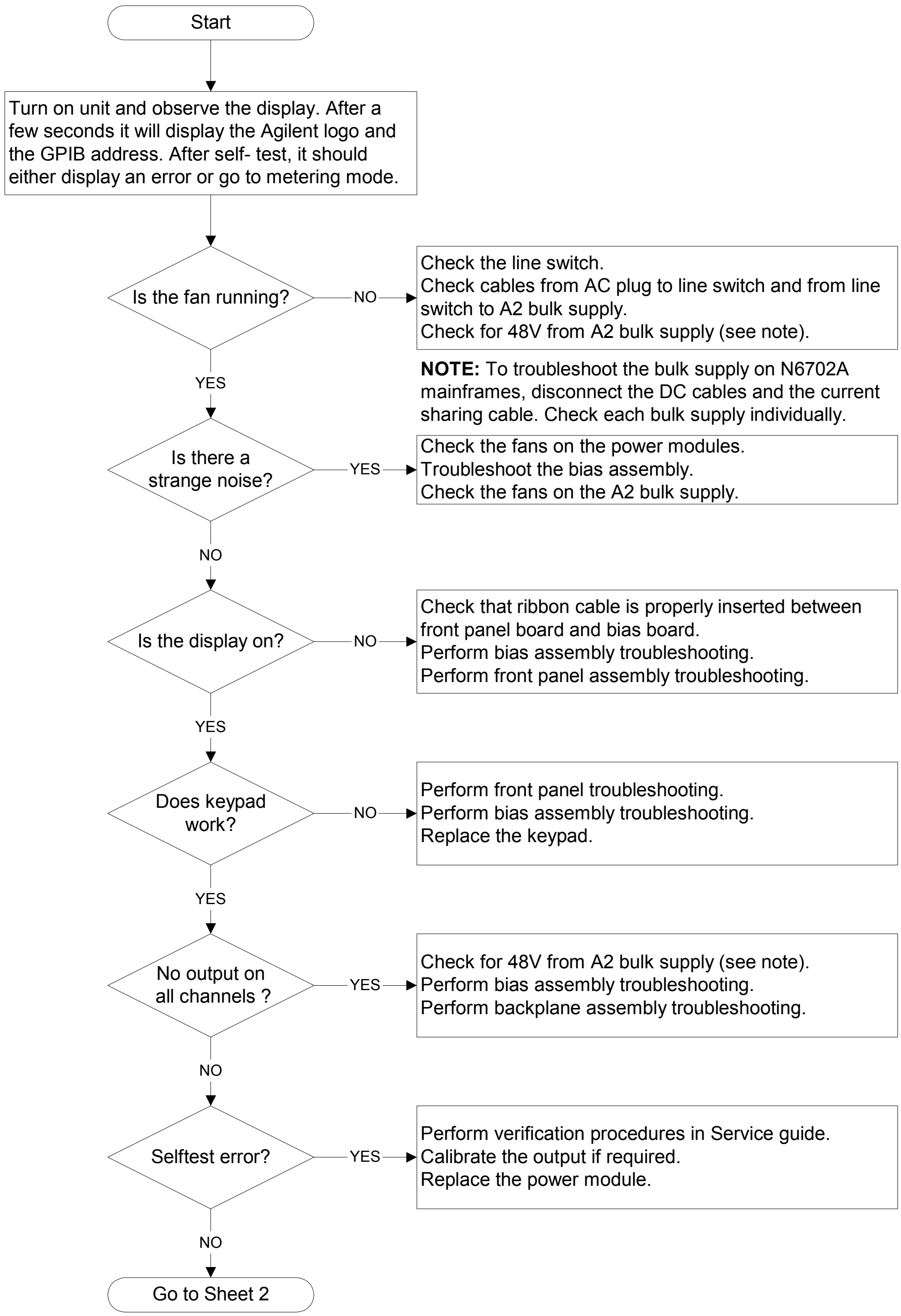


Figure 3-1. Overall Troubleshooting Sheet 1

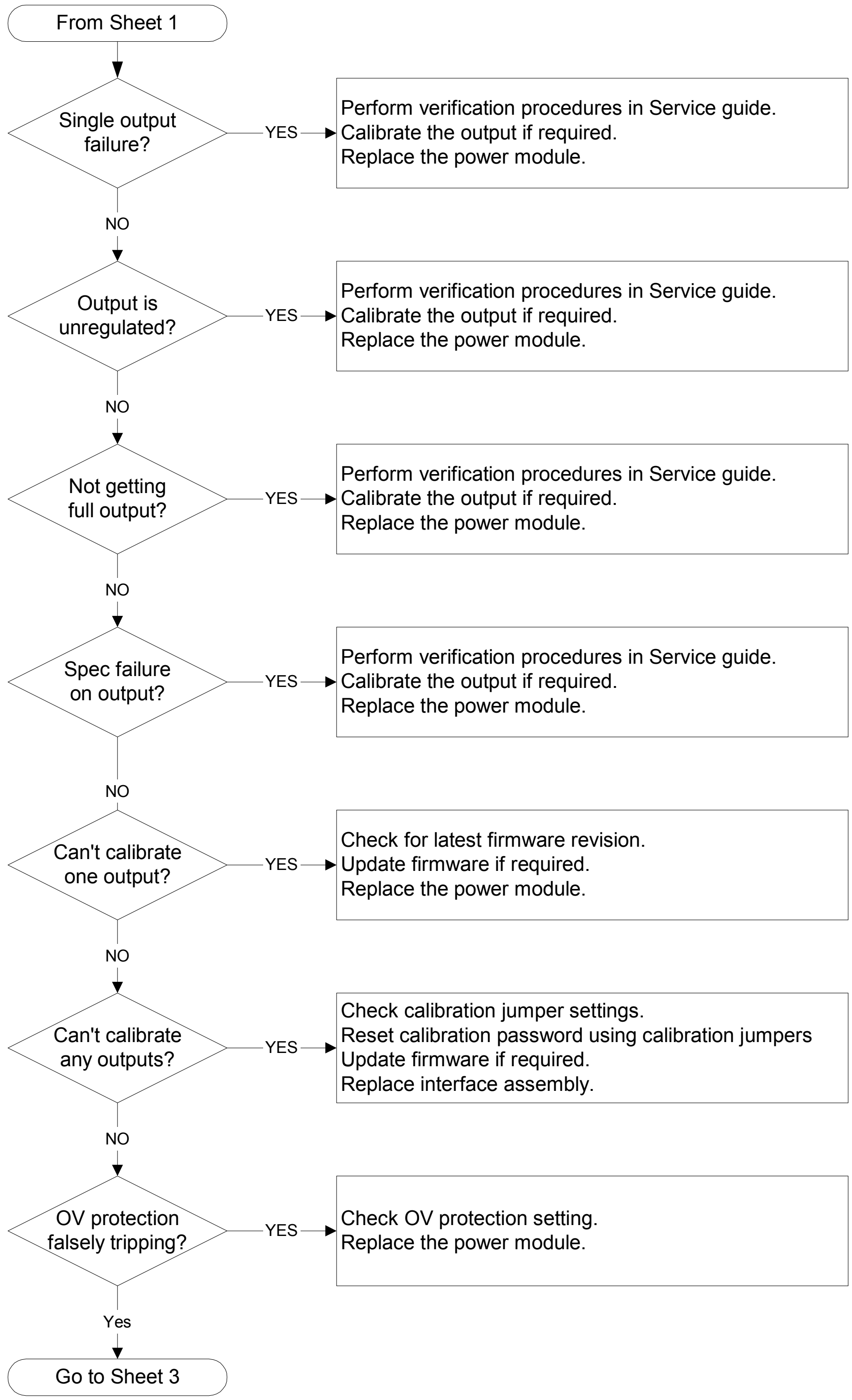


Figure 3-1. Overall Troubleshooting Sheet 2

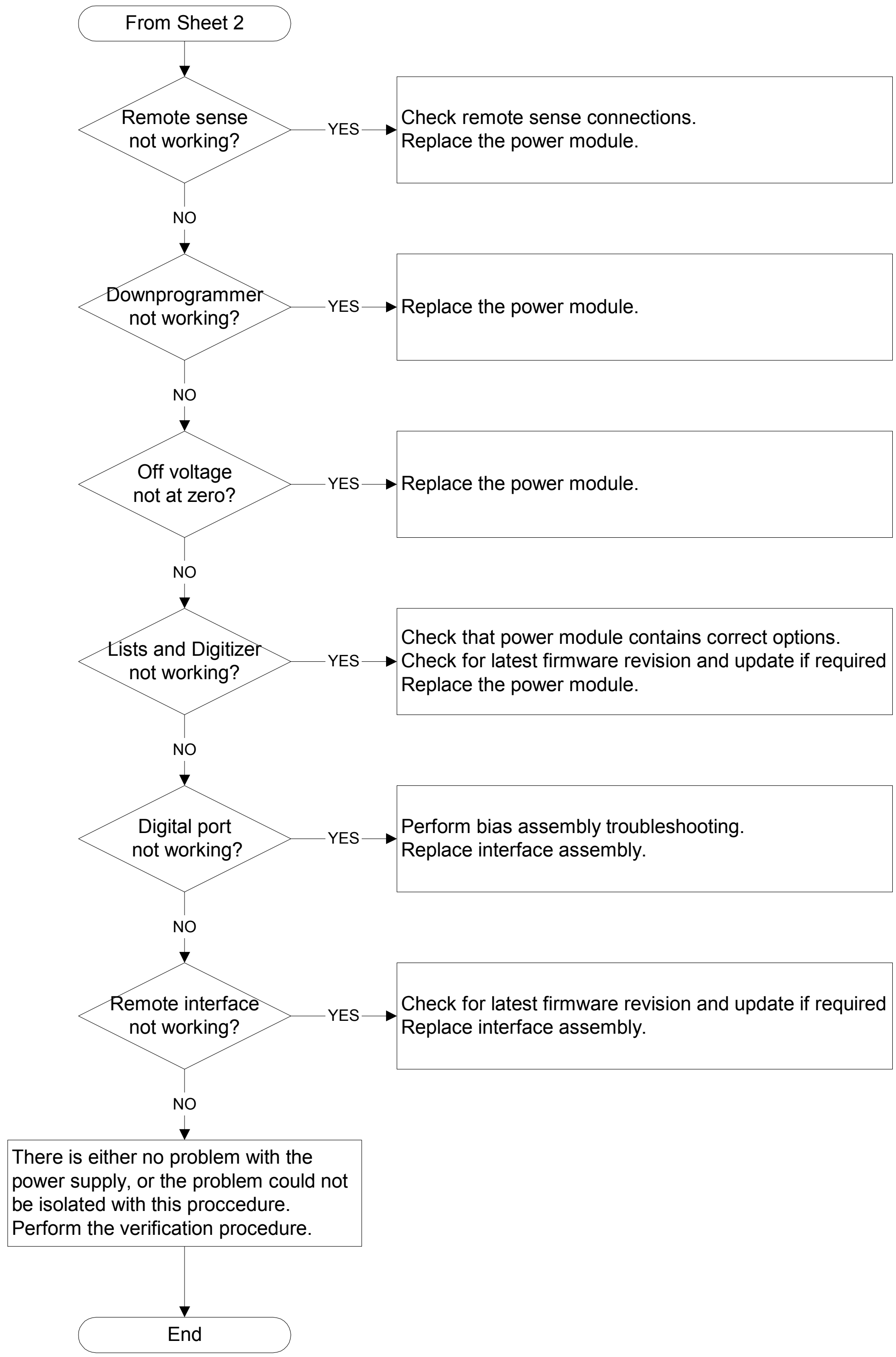


Figure 3-1. Overall Troubleshooting Sheet 3

Front Panel Troubleshooting

Troubleshooting the front panel board involves checking for the presence of the correct bias voltages on the board. Refer to the following table and figure.

Test Point	Location	Voltage	Action
TP 1	BKL_VCC	+12 V	If bias not present, troubleshoot the bias board or replace the front panel board.
TP 2	P1 pin 3	+12 V	If backlight voltage not present, replace the front panel board. If voltage is present and the display is not lit, replace the display.
Common	GNDB	Common	

Bias Board Troubleshooting

Troubleshooting the bias board involves checking for the presence of the correct bias voltages on the board. Refer to the following table and figures.

Note that if the bias voltages at test points 2 - 4 in the following table are not present, it could be caused by a defect in the power module or interface board that is pulling the bias voltage low.

Test Point	Location	Voltage	Action
TP 1	+ RED	+48 V	Output of bulk supply. If not present, replace the bulk supply.
TP 2	+ C4	+12 V	If biases at TP 2, TP 3, or TP 4 are not present, disconnect the backplane and interface board cable assemblies and recheck. If biases are still not present, replace the bias board.
TP 3	U9 - 2	+5 V	Same as above.
TP 4	+ C3	+3.3 V	Same as above.
Common	– BLK	Common	

Backplane Board Troubleshooting

Troubleshooting the backplane board consists of visually inspecting the pins and pin connections.

If there are missing or broken pins, replace the board.

If there are bent pins, carefully try to straighten the pin. If you are unsuccessful, replace the board.

Closely examine the solder connections at the pins. If there are cracks in the solder, carefully re-solder the connector. If unsuccessful, replace the board.

Calibration and Passwords

Calibration is not required after the mainframe has been repaired. All calibration information is module-specific and resides in each power module.

However, if the A5 board that contains the calibration switches has been replaced, any calibration password that has been set will be lost. Passwords that are used to prevent access to the front panel Admin menu will also be lost.

The calibration password will automatically be reset to the factory default, which is zero (0). Front panel access to the Admin menu will be unrestricted unless a password is set.

Refer to the User's Guide for information on setting the calibration password as well as the Admin menu password.

Initialization

The power system's model number, serial number, and other constants that are required to program the instrument are stored in an EEPROM on the A5 board. If this board is replaced, the instrument must be re-initialized.

To initialize the power system, you must send the following information to the power system over the interface:

```
DIAGnostic:FRAMe:ATTRibute "ModelNumber", "value"
```

where "value" is the model number, e.g. N6700B.

```
DIAGnostic:FRAMe:ATTRibute "SerialNumber", "value"
```

where "value" is the serial number located on top of the interface cover.

At power-up, the power system will go through the turn-on self test sequence. All other parameters will be set to the factory defaults. The mainframe is now initialized.

6
Replaceable Parts

Parts List 62
Parts Location Diagrams 63

The following table documents the replaceable parts assembles. The diagrams show the location of the parts

Parts List

Reference Designator	N6700B Part number	N6701A Part number	N6702A Part number	Description
		Electrical Assemblies		
A1	N6700-61001	N6700-61001	N6700-61001	A1 Front Panel PCA (tested)
A2	0950-4655	0950-4687	0950-4687 (qty. 2)	A2 Bulk Supply
A3	5065-6981	5065-6981	5065-6981	A3 Backplane PCA
A4	N6700-60101	N6700-60101	N6700-60101	A4 Bias PCA (tested)
A5	N6700-60102	N6701-60102	N6702-60102	A5 Interface PCA (tested)
		Individual Parts		
1	5002-2817	5002-2817	5002-2828	Chassis frame
2	5002-2808	5002-2808	5002-2808	Front frame
3	1390-1079	1390-1079	1390-1079	Handles
4	N6700-40001	N6700-40001	N6700-40001	Keypad
5	2090-0886	2090-0886	2090-0886	Display
6	4040-2556	4040-2556	4040-2556	Window
7	N6700-00001	N6700-00001	N6700-00001	Front panel
8	3101-4019	3101-4019	3101-4019	Line switch
9	5185-1358	5185-1358	5185-1358 (qty. 2)	Cable, bulk supply to ground
10	5185-1357	5185-1357	5188-4205	AC cable, bulk supply to switch
11	5185-1362	5185-1362	5185-1362	DC power cable
12	5185-1354	5185-1354	5185-1354	Ribbon cable, to front panel
13	5185-1382	5185-1382	5185-1382	Ribbon cable, to backplane
14	5185-1352	5185-1352	5185-1352	Insulator, under backplane
15	5185-1384	5188-4210	5188-4210	Bias cable assembly
16	5185-1397	5185-1397	5185-1397	AC cable with socket
17	1510-0038	1510-0038	1510-0038	Binding post
18	E5810-61605	E5810-61605	E5810-61605	GPIB connector with cable
19	1253-6408	1253-6408	1253-6408	Digital plug
20	N.A.	5002-2830	N.A.	Bulk supply bracket
21	N.A.	N.A.	5188-4207	Current share cable
22	N.A.	N.A.	5188-4206	DC power cable for 2nd bulk supply
		Covers and Labels		
	5002-2809	5002-2809	5002-2829	Bulk supply cover
	5002-2810	5002-2810	5002-2810	Blower cover
	5002-2807	5002-2807	5002-2807	Interface cover
	N6700-80006	N6701-80006	N6702-80006	Front/Rear/Interface labels
	5185-1387	5185-1387	5185-1387	Blower cover label (caution)

Parts Location Diagrams

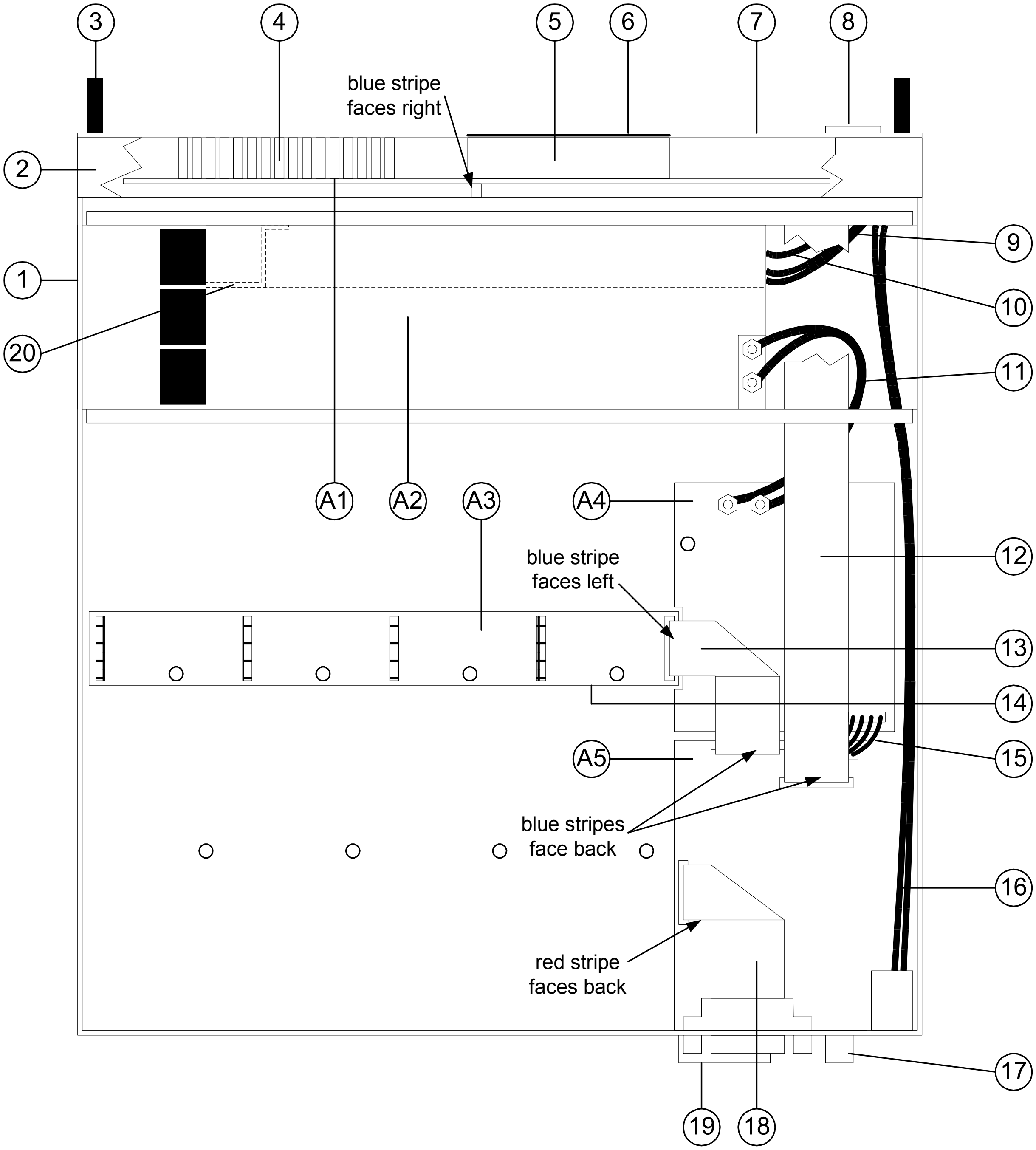


Figure 4-1. N6700B/N6701A Mainframe Part Locations

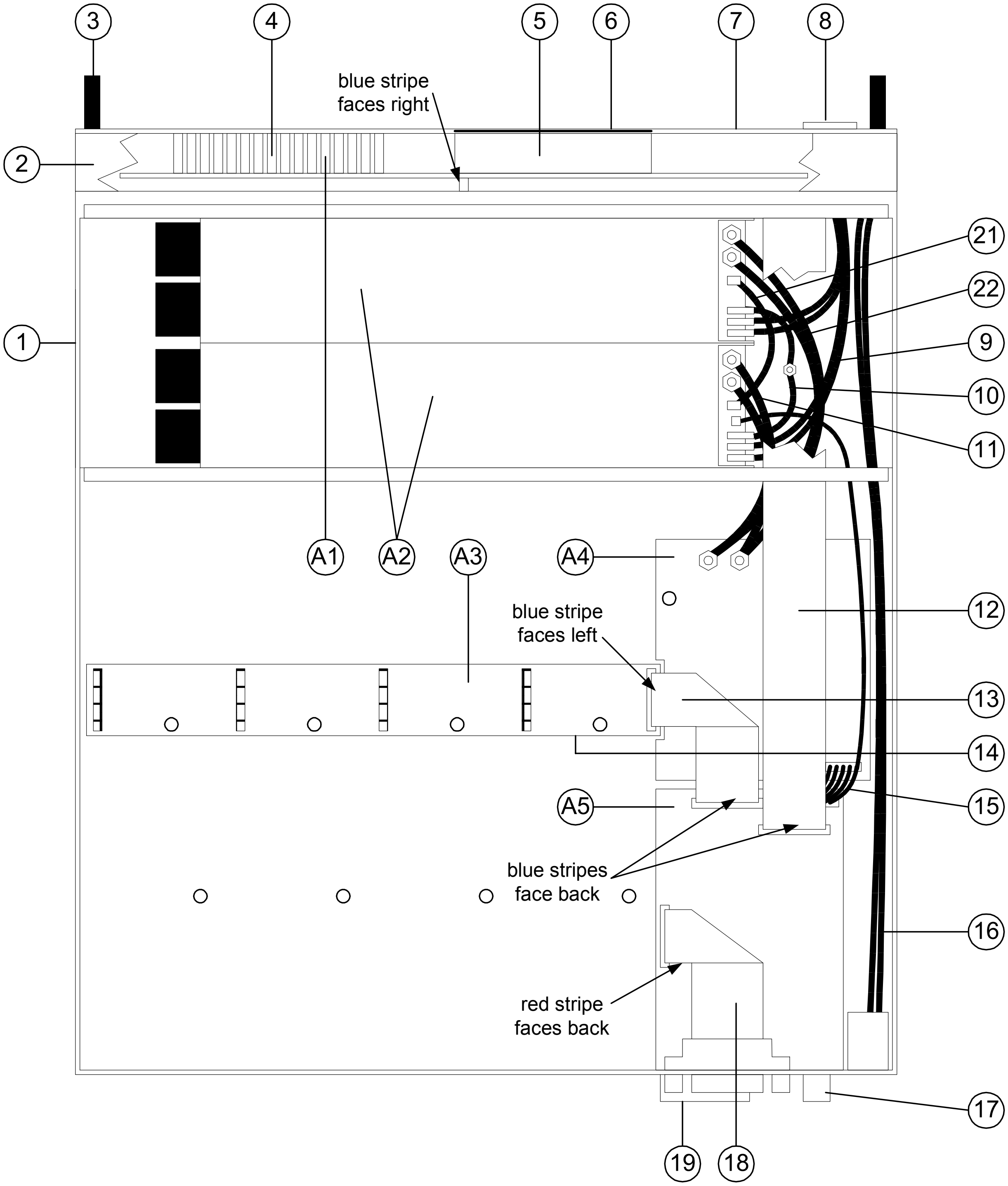


Figure 4-2. N6702A Mainframe Part Locations

Appendix A
Error Messages

Displaying Error Messages 66
Error List 66

This appendix gives the error numbers and descriptions that are returned by the Agilent N6700 Modular Power System.

Error messages can be displayed on the front panel and also read back programmatically.

Displaying Error Messages

The instrument beeps each time a command syntax or hardware error is generated. The front-panel **ERR** annunciator turns on when one or more errors are currently stored in the SCPI error queue.

Front Panel:	SCPI Command:
Press the Error key. If errors appear, use the navigation keys to scroll though the list.	SYST:ERR?

Errors are cleared as they are read. When all errors have been read, the **ERR** annunciator turns off and the error queue is cleared.

Error List

Error	**Device-dependent Errors** (these errors set Standard Event Status register bit #3)
0	**No error** This is the response to the ERR? query when there are no errors.
100	**Too many channels** You have specified more channels than are installed in the mainframe.
101	**Calibration state is off** Calibration is not enabled. The instrument will not accept calibration commands.
102	**Calibration password is incorrect** The calibration password is incorrect.
103	**Calibration is inhibited by switch setting** Calibration mode is locked out by the calibration switch.
104	**Bad sequence of calibration commands** Calibration commands have not been entered in the proper sequence.
105	**Unexpected output current** The measured output current is outside the acceptable range.
106	**Zero measurement out of range error** The “zero” measurement value is outside the acceptable range.
107	**Programming cal constants out of range** The programmed calibration constant is outside the acceptable range.
108	**Measurement cal constants out of range** The measurement calibration constant is outside the acceptable range.
109	**Over voltage cal constants out of range** The over voltage calibration constant is outside the acceptable range.
110	**Wrong V+I** The instrument was unable to set the correct voltage or current value.
111	**Aux vloc cal constants out of range** Calibration constants on the internal auxiliary local ADC are outside the acceptable range.
112	**Aux vrem cal constants out of range** Calibration constants on the internal auxiliary remote ADC are outside the acceptable range.
113	**Aux imon cal constants out of range** Calibration constants on the internal auxiliary imon ADC are outside the acceptable range.

	Device-dependent Errors (continued)
200	**Hardware error channel <channel>** A hardware error has occurred on the specified channel.
201	**Invalid configuration, empty slots** There is an empty slot between modules. This configuration is not allowed.
202	**Selftest Fail** A selftest failure has occurred. See selftest failure list for details.
203	**Compatibility function not implemented** The requested compatibility function is not available.
204	**NVRAM checksum error** A checksum error has occurred in the instrument's nonvolatile random access memory.
205	**NVRAM full** The nonvolatile random access memory of the instrument is full.
206	**File not found** The internal calibration file or the internal channel attribute file was not found in NVRAM.
207	**Cal file version error** The calibration file was written or read using old firmware. Firmware must be updated.
302	**Option not installed** The option that is programmed by this command is not installed.
303	**There is not a valid acquisition to fetch from** There is no valid data in the measurement buffer.
304	**Volt and curr in incompatible transient modes** Voltage and current cannot be in Step and List mode at the same time.
305	**A triggered value is on a different range** A triggered value is on a different range than the one that is presently set.
306	**Too many list points** Too many list points have been specified.
307	**List lengths are not equivalent** One or more lists are not the same length.
308	**This setting cannot be changed while transient trigger is initiated** Setting cannot be changed while the instrument is waiting for or executing a trigger sequence.
309	**Cannot initiate, voltage and current in fixed mode** Cannot initiate the transient generator because either the voltage or the current function is set to Fixed mode.

	Command Errors (these errors set Standard Event Status register bit #5)
–100	**Command error** Generic syntax error.
–101	**Invalid character** An invalid character was found in the command string.
–102	**Syntax error** Invalid syntax was found in the command string. Check for blank spaces.
–103	**Invalid separator** An invalid separator was found in the command string. Check for proper use of , ; :
–104	**Data type error** A different data type than the one allowed was found in the command string.
–105	**GET not allowed** A group execute trigger is not allowed in a command string.

	Command Errors (continued)
–108	**Parameter not allowed** More parameters were received than were expected.
–109	**Missing parameter** Fewer parameters were received than were expected.
–110	**Command header error** An error was detected in the header.
–111	**Header separator error** A character that was not a valid header separator was found in the command string.
–112	**Program mnemonic too long** The header contains more than 12 characters.
–113	**Undefined header** A command was received that was not valid for this instrument.
–114	**Header suffix out of range** The value of the numeric suffix is not valid.
–120	**Numeric data error** Generic numeric data error.
–121	**Invalid character in number** An invalid character for the data type was found in the command string.
–123	**Exponent too large** The magnitude of the exponent was larger than 32000.
–124	**Too many digits** The mantissa of a numeric parameter contained more than 255 digits, excluding leading zeros.
–128	**Numeric data not allowed** A numeric parameter was received but a character string was expected.
–130	**Suffix error** Generic suffix error
–131	**Invalid suffix** A suffix was incorrectly specified for a numeric parameter.
–134	**Suffix too long** The suffix contains more than 12 characters.
–138	**Suffix not allowed** A suffix is not supported for this command.
–140	**Character data error** Generic character data error
–141	**Invalid character data** Either the character data element contains an invalid character, or the element is not valid.
–144	**Character data too long** The character data element contains more than 12 characters.
–148	**Character data not allowed** A discrete parameter was received, but a string or numeric parameter was expected.
–150	**String data error** Generic string data error
–151	**Invalid string data** An invalid character string was received. Check that the string is enclosed in quotation marks.
–158	**String data not allowed** A character string was received, but is not allowed for this command.

	Command Errors (continued)
–160	**Block data error** Generic block data error
–161	**Invalid block data** The number of data bytes sent does not match the number of bytes specified in the header.
–168	**Block data not allowed** Data was sent in arbitrary block format but is not allowed for this command.
–170	**Expression error** Generic expression error
–171	**Invalid expression data** The expression data element was invalid.
–178	**Expression data not allowed** Expression data element was sent but is not allowed for this command.

	Execution Errors (these errors set Standard Event Status register bit #4)
–200	**Execution error** Generic syntax error
–220	**Parameter error** A data element related error occurred.
–221	**Settings conflict** A data element could not be executed because of the present instrument state.
–222	**Data out of range** A data element could not be executed because the value was outside the valid range.
–223	**Too much data** A data element was received that contains more data than the instrument can handle.
–224	**Illegal parameter value** An exact value was expected but not received.
–225	**Out of memory** The device has insufficient memory to perform the requested operation.
–226	**Lists not same length** One or more lists are not the same length.
–230	**Data corrupt or stale** Possible invalid data. A new reading was started but not completed.
–231	**Data questionable** The measurement accuracy is suspect.
–232	**Invalid format** The data format or structure is inappropriate.
–233	**Invalid version** The version of the data format is incorrect to the instrument.
–240	**Hardware error** The command could not be executed because of a hardware problem with the instrument.
–241	**Hardware missing** The command could not be executed because of missing hardware, such as an option.
–260	**Expression error** An expression program data element related error occurred.
–261	**Math error in expression** An expression program data element could not be executed due to a math error.

	Query Errors (these errors set Standard Event Status register bit #2)
–400	**Query Error** Generic error query
–410	**Query INTERRUPTED** A condition causing an interrupted query error occurred.
–420	**Query UNTERMINATED** A condition causing an unterminated query error occurred.
–430	**Query DEADLOCKED** A condition causing a deadlocked query error occurred.
–440	**Query UNTERMINATED after indefinite response** A query was received in the same program message after a query indicating an indefinite response was executed.

	Selftest Errors (these errors set Standard Event Status register bit #3)
202	**Selftest Fail Aux Adc 0 expected <n1> to <n2>, measured <n3>, chan <n4>** Auxiliary ADC failed. n1 and n2 are the expected limits. n3 is the measured value. n4 is the channel location of the failed module.
202	**Selftest Fail DACs 0 expected <n1> to <n2>, measured <n3>, chan <n4>** Both voltage and current DACs are at zero. n1 and n2 are the expected limits. n3 is the measured value. n4 is the channel location of the failed module.
202	**Selftest Fail DACs 1 expected <n1> to <n2>, measured <n3>, chan <n4>** Voltage DAC is at zero; current DAC is at full scale. n1 and n2 are the expected limits. n3 is the measured value. n4 is the channel location of the failed module.
202	**Selftest Fail DACs 2 expected <n1> to <n2>, measured <n3>, chan <n4>** Voltage DAC is at full scale; current DAC is at zero. n1 and n2 are the expected limits. n3 is the measured value. n4 is the channel location of the failed module.
202	**Selftest Fail DACs 3 expected <n1> to <n2>, measured <n3>, chan <n4>** Both voltage and current DACs are at full scale. n1 and n2 are the expected limits. n3 is the measured value. n4 is the channel location of the failed module.

Appendix B
Backdating

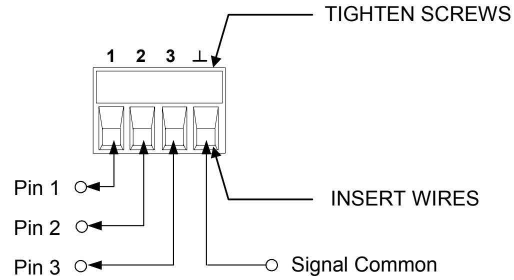
Differences in Earlier Agilent N6700A Mainframes 72
Firmware Differences.. 72

This appendix describes how the earlier Agilent N6700A mainframes are different from the Agilent N6700B, N6701A, and N6702A mainframes, which are the primary focus of this Service Guide.

It also discusses differences in firmware revisions prior to revision 3.00.00.

Differences in Earlier Agilent N6700A Mainframes

- **Digital Control Port -** Agilent N6700A mainframes use a 4-pin connector (p/n 1253-5830) instead of the 8-pin connector available on Agilent N6700B mainframes.



Pin functionality on the 4-pin connector is the same as the first 3 pins and the common pin on the 8-pin connector. The following chart describes the pin functions.

Pin	External Trigger	Fault/Inhibit	Digital I/O
1	Trigger In/Out	FLT Output	Input/Output 0
2	Trigger In/Out	FLT Common	Input/Output 1
3	Trigger In/Out	INH Input	Input/Output 2
⊥	Trigger Common	INH Common	Signal Common

- **LAN Connector -** Agilent N6700A mainframes use “mini-B” USB connector.
- **Binding Post -** Agilent N6700A mainframes use a longer, hex shaped chassis ground binding post on the rear panel.

Firmware Differences

Firmware Revisions Prior to C.00.00

The following features and capabilities are **not** available on mainframes with firmware revisions prior to C.00.00.

- Support for the 300 W power modules.
- The power allocation function for power modules.
- The ability to reverse the polarity of the output and sense connectors.
- Compliance with LXI class C.

NOTE To upgrade your instrument with the latest firmware revision, go to http://www.agilent.com/find/N6700firmware.

Firmware Revisions Prior to B.00.00

The following features and capabilities are **not** available on mainframes with firmware revisions prior to B.00.00.

- Support for the “B” version power modules.
- The ability to group output channels together in parallel.
- The ability to program a voltage slew rate.
- The ability to lock out the front panel from the front panel.
- The ability to password-secure the LAN and USB interface and the non-volatile RAM settings.
- The ability to select 1-channel or 4-channel view at turn-on.
- The low range current measurement calibration is different.

Front Panel Menu Commands for Firmware Revisions prior to B.00.00

Menu Command			Control Description
Output	**Voltage**		Programs voltage setting and range.
	Current		Programs current setting and range.
	Delay		Program Turn-on /Turn Off delay.
Measure	**Range**		Selects voltage and current measurement range.
	Sweep		Specifies measurement points, time interval, and trigger offset.
	Window		Selects measurement window (Rectangular/Hanning).
	Control		Lets you abort a measurement in progress.
Transient	**Mode**	**Voltage**	Selects voltage mode (Fixed, Step, or List).
		Current	Selects current mode (Fixed, Step, or List).
	Step		Programs voltage and current steps. Enables step trigger signals.
	List	**Pace**	Specifies Dwell or Trigger paced list.
		Repeat	Specifies number of list repetitions, or specifies continuous list.
		Terminate	Specifies list settings when the list terminates.
		Config	Configures the list steps. Specify voltage, current, and dwell values. Also specifies trigger output signal states.
		Reset	Aborts the list and resets all list parameters.
	TrigSource		Specify the trigger source: bus, tran 1-4, pin 1-3.
	Control		Initiate, Trigger, or Abort output triggers.
Protect	**OVP**		Configures over-voltage protections function.
	OCP		Configures over-current protections function.
	Inhibit		Configures the external inhibit signal.
	Coupling		Disables ALL output channels when a protection fault occurs.
	Clear		Clears output protection.
States	**Reset**		Resets the instrument to its reset (*RST) state.
	Save/Recall		Saves or recalls an instrument state.
	PowerOn		Selects the power on state.

Menu Command				Control Description
System	**Interface**	**LAN**	**Status**	Displays interface status information.
			IP	Enables/disables DHCP and Auto IP Also sets the IP Address, Subnet Mask, and Default Gateway.
			DNS	Configures the DNS server.
			Name	Configures the Dynamic DNS and NetBIOS naming service.
			Domain	Configures the Domain Name.
			TCP	Configures the TCP keepalive function.
			Enable	Enables/disables the LAN interface and the built-in Web server.
		USB	**Status**	Displays status, speed, packets received, and packets sent.
			Identification	USB connect string - the instrument's unique USB identifier
			Enable	Enables/disables the USB interface.
		GPIB		Selects the GPIB address.
		Reset		Resets the interface settings to the factory-shipped state.
	DigPort	**Pin 1**	**Function**	Specifies the pin function: DigIO, TrigIn, TrigOut, DigIn, or FaultOut..
			Polarity	Specifies the pin polarity.
		Pin 2	**Function**	Specifies the pin function: DigIO, TrigIn, TrigOut, or DigIn.
			Polarity	Specifies the pin polarity.
		Pin 3	**Function**	Specifies the pin function: DigIO, TrigIn, TrigOut, DigIn, or InhibitIn.
			Polarity	Specifies the pin polarity.
		Data		Sends/reads data from the digital I/O port function
	Preferences	**Display**		Configures Screen saver, Wake-on I/O, and Display contrast.
		Keys		Enables/disables key clicks and configures the On/Off key.
		Security	**ResetNVRam**	Resets all non-volatile RAM settings to their factory defaults.
	Error			Displays the Error log.
	Calibrate	**State**		Enables/disables calibration. You must supply a password to enable.
		Sequence	**VProg**	**High** Enters measured data for high calibration point. **Low** Enters measured data for low calibration point.
			VMeas	Enters measured data.
			CMRR	Calibrates common mode rejection ratio.
			IProg	**High** Enters measured data for high calibration point. **Low** Enters measured data for low calibration point.
			IMeas	Enters Measured data.
			DPRog	Calibrates the downprogrammer.
			IPeak	Calibrates I peak.
		Date		Saves the calibration date for each channel.
		Save		Saves the calibration data.
		Password		Changes the password.
	About	**Frame**		Displays model, serial number, firmware revision, backup revision, and active firmware.
		Module		Displays model, serial number, options, voltage, current, and power.

Low Range Current Measurement Calibration for Units with Firmware Revisions Prior to B.00.00

This only applies to Agilent Models N6761A and N6762A with Firmware revisions prior to B.00.00. Replace steps 25 through 30 of the previously documented procedure with the following steps.

Step 25. Remove all loads from the output and turn the output off. Wait a minimum of 3 minutes with the output off before proceeding.

Step 26. Select the low-current measurement range. The following example selects the 0.1 amp low-current measurement range of channel 1. The value to program a range must be the maximum current of the range.

Front Panel:	SCPI Command:
Select **System\Cal\Sequences\Imeas**.	`CAL:CURR:MEAS 0.1, (@1)`

Step 27. Steps 27 and 28 only apply to units with firmware revision A.01.04. If your unit has firmware revision A.01.03 or below, skip these steps and go to step 29.
Wait a minimum of 4 minutes for the internal temperature to stabilize. Then select the first current calibration point.

Front Panel:	SCPI Command:
Select Next. The information field should indicate: Enter P1 data	`CAL:LEV P1` `*OPC?`

Step 28. Re-connect the precision shunt resistor to the output and connect the DMM across the shunt. Select the second current calibration point.

Front Panel:	SCPI Command:
Select Next. The information field should indicate: Enter P2 data	`CAL:LEV P2` `*OPC?`

Step 29. This step only applies to units with firmware revision A.01.03 or below. If your unit has firmware revision A.01.04, skip this step.
Re-connect the precision shunt resistor to the output and connect the DMM across the shunt. Select the second current calibration point.

Front Panel:	SCPI Command:
Select Next. The information field should indicate: Enter P1 data	`CAL:LEV P1` `*OPC?`

Step 30. Calculate the shunt current (I=V/R) and enter the data.

Front Panel:	SCPI Command:
Select the Measured Data field. Enter the data from the external DMM. Press Select when done. Press Next to finish calibration.	`CAL:DATA <data>`

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