How to use the Agilent N6700 Series Modular Power System to replace an Agilent 662xA

662xA to N67xx MPS Conversion Guide

Application Note 1467

Introduction

This application note provides a high-level overview of the differences between the Agilent 662xA and the Agilent N67xx in order to help current 662xA owners easily convert from their Agilent 662xA to an Agilent N67xx. This application note has been designed to be used in conjunction with the Agilent 662xA Operation Manuals and datasheets as well as the Agilent N6700 User's Guide and data-sheets[1]. This is not a replacement for any of the manuals and it is recommended that a copy of all the documentation mentioned above be handy for reference when reading this document.

Three areas will be discussed in this document: electrical, programming/interfacing, and mechanical. These sections will cover such topics as the power supply's output power and protections (electrical), command compatibility and calibration (programming/interfacing), as well as size and connector type (mechanical).

A side-by-side comparison of the specifications and other relevant information has been provided in **Appendix A** for convenience.

Throughout this document...

- "N6700A/B" refers to either the N6700A or the N6700B mainframes.
- "N67xx MPS" refers to the entire N67xx family of products.
- "N675xA" refers to both the N6751A (50 W) and N6752A (100 W) High Performance output modules.
- "N676xA" refers to both the N6761A (50 W) and N6762A (100 W) Precision output modules.
- "N67xxA Module" refers only to the features and characteristics of the N6751A, N6752A, N6761A, and N6762A output modules and does not include the N674x, N673x, etc.
- "662xA" refers to the features and characteristics of the 6621A–6629A models.
- "40 W/80 W High/Low Voltage Outputs" refers to the features and characteristics of the specified (40 W and/or 80 W) output(s), which are only present in the 6621A, 6622A, 6623A, 6624A, and 6627A models.
- "25 W/50 W Precision Outputs" refers to the features and characteristics of the specified (25 W and/or 50 W) output(s), which are only present in the 6625A, 6626A, 6628A, and 6629A models.

[1] Please refer to the References section at the end of this document for information on these documents.

Agilent Technologies

The N67xx Modular Power System (MPS)

The N67xx MPS is a module-based power system that consists of a mainframe (N6700A/B) and modules (N673xB–N676xA)[2]. Up to four output modules can be installed in each Agilent N6700A mainframe.

Table 1 at right, as well as the side-by-side comparison chart in **Appendix A**, detail the module combinations that most accurately replace their 662xA counterparts. For example, the 6623A is replaced by an N6700A or N6700B mainframe with three modules: two N6751As and one N6752A. These N67xxA module's voltage, current, and power ratings are a superset of the 662xA's outputs. In most cases the N67xxA module's features and capabilities are also a superset of the 662xA.

[2] A list of all available modules, their model numbers, and characteristics is provided in the N6700 User's Guide in the *At A Glance* section under *Model Differences*. **Table 1** shows only those modules that replace 662xA Outputs.

Model Selection

While they are the best representations of the 662xA power supplies, they are not exact replicas. The following sections discuss the differences.

I own an Agilent ...	My model is replaced by an Agilent ...
6621A **2**—80 W Low Voltage Outputs	**1**—N6700A/B Mainframe with **2**—N6752A 100 W Autoranging Output Modules Previously available as N6721A
6622A **2**—80 W High Voltage Outputs	**1**—N6700A/B Mainframe with **2**—N6752A 100 W Autoranging Output Modules Previously available as N6722A
6623A **1**—40 W Low Voltage Output **1**—40 W High Voltage Output **1**—80 W Low Voltage Output	**1**—N6700A/B Mainframe with **2**—N6751A 50 W Autoranging Output Modules **1**—N6752A 100 W Autoranging Output Module Previously available as N6723A
6624A **2**—40 W Low Voltage Outputs **2**—40 W High Voltage Outputs	**1**—N6700A/B Mainframe with **4**—N6751A 50 W Autoranging Output Modules Previously available as N6724A
6625A Precision **1**—25 W Output **1**—50 W Output	**1**—N6700A/B Mainframe with **1**—N6761A 50 W Precision Output Module **1**—N6762A 100 W Precision Output Module Previously available as N6725A
6626A Precision **2**—25 W Outputs **2**—50 W Outputs	**1**—N6700A/B Mainframe with **2**—N6761A 50 W Precision Output Modules **2**—N6762A 100 W Precision Output Modules Previously available as N6726A
6627A **4**—40 W High Voltage Outputs	**1**—N6700A/B Mainframe with **4**—N6751A 50 W Autoranging Output Modules Previously available as N6727A
6628A Precision **2**—50 W Outputs	**1**—N6700A/B Mainframe with **2**—N6762A 100 W Precision Output Modules Previously available as N6728A
6629A Precision **4**—50 W Outputs	**1**—N6700A/B Mainframe with **4**—N6762A 100 W Precision Output Modules Previously available as N6729A

Table 1. Power Supply Mapping

Option and Accessory Selection

Some features that were options on the 662xA are now standard on the N6700A/B. **Table 2** at right provides a list of options for the 662xA and how they correspond to the N6700A/B. Some options are only partially replaced, meaning some, but not all, of the features provided in the 662xA options are provided in the standard N6700A/B. In the table, multiple features within one option are separated by a dotted line.

Options 100, 120, 220, and 240
The N6700A/B comes standard with a universal input that has a range of 100-240 VAC nominal and 47-63 Hz. For this reason the N6700A/B has no input voltage options. This input range covers all the ranges available on the 662xA. Line voltage conversion and fuse changes are no longer necessary.

662xA Option/Accessory	Description	N6700A/B Option	Description
Voltage Options			
100	87 to 106 Vac, 47 to 66 Hz	None	100 to 240 Vac nominal, 47 to 63 Hz Universal Input Standard on N6700A/B
120	104 to 127 Vac, 47 to 63 Hz	None	
220	191 to 233 Vac, 47 to 66 Hz	None	
240	209 to 250 Vac, 47 to 66 Hz	None	
750	External Relay Control	None	Not implemented in N6700A/B.[3]
	RI/DFI, RI latches	Standard	Use "OUTPut:INHibit:MODE LATChing" command for latching RI. This is the **default** mode.[3]
S50	External Relay Control	None	Not implemented in N6700A/B.[3]
(Similar to Option 750)	RI/DFI, RI does not latch	Standard	Use "OUTPut:INHibit:MODE LIVE" command for non-latching RI.[3]
908	Rack-mount Kit w/o Handles (p/n 5062-3977)	908	Rack Mount Kit (p/n N6700-60009) Handles are standard[4]
909	Rack-mount Kit w/Handles (p/n 5062-3983 or 5063-9221)	908	Rack Mount Kit (p/n N6700-60009) Handles are standard[4]
Part Number 1494-0059	Rack Slide Kit	908	Slide Kit must not be used due to airflow and height restrictions.[4]
E3663AC	Support rails for Agilent rack cabinets	908	Rails must not be used due to airflow and height restrictions.[4]

Table 2. Option Selection Guide

[3] See below for further explanation.
[4] See *Rack Mounting* in the *Mechanical* section.

Option 750, External Relay Control and RI/DFI (RI latches)

The 662xA with Option 750 has an 8-pin port dedicated to the control of up to four external relays and a 4-pin port dedicated to RI/DFI. The N6700A mainframe comes standard (no option required) with a 4-pin port and the N6700B mainframe comes standard with an 8-pin port that are user programmable to one of three functions— RI/DFI, digital I/O, or triggering. Digital I/O and triggering are not available in the 662xA.

External Relay Control

External relay control as provided in the 662xA with Option 750 is not supported by the N6700A/B. The 4-pin digital port on the N6700A, when configured for digital I/O, can support control of up to 3 external relays, not 4 as in the 662xA. The 8-pin digital port on the N6700B, when configured for digital I/O, can support control of up to 7 external relays. The compatibility commands associated with external relay control are not implemented and will produce an error. If you would like to control EXTERNAL relays through the digital port, the Standard Commands for Programmable Instruments (SCPI) language must be used. Refer to the N6700 User's Guide for information on how to configure the digital I/O port for this use. If interested in INTERNAL relays for the N675xA and N676xA modules, Option 761, INTERNAL output disconnect relays, may meet your needs. Also, Option 054, high-speed test extensions, which provides digitized output measurements and output list capability, is available for these modules. Option 054 is standard on the N676xA modules.

RI/DFI

When the N6700A/B's digital I/O port is configured for RI/DFI, the operation is the same as in the 662xA with Option 750. Please see the N6700 User's Guide for information on how to configure the digital I/O port for RI/DFI.

Option S50, Relay Control and RI/DFI (RI does not latch)

The 662xA with Option S50 is the same as Option 750 shown above, but the Remote Inhibit (RI) does not latch.

External Relay Control

External Relay Control is the same as described in Option 750.

RI/DFI

When the N6700A/B's digital I/O port is configured for RI/DFI, the non-latching RI functionality provided in the 662xA with Option S50 can be enabled on the N6700A/B by using the "OUTPut:INHibit:MODE LIVE" command. This functionality has been made available in the N6700A/B firmware. The default mode for RI is "OUTPut: INHibit:MODE LATChing".

Electrical

Safety Certification
662xA: These products are Safety Class 1 instruments. They comply with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC and carry the CE-marking accordingly.

N67xxA Modules: These products are Safety Class 1 instruments. They comply with the European Low Voltage Directive 73/23/EEC and carry the CE-marking. This product also complies with the US and Canadian safety standards for test and measurement products.

Voltage, Current, and Power
The N67xxA modules can produce all combinations of voltage and current that the 662xA is capable of producing. If you follow **Table 1**, the N67xxA module's voltage, current, and power specifications are a superset of the 662xA's and in most cases can produce up to 25% more power.

Output Ranges and Autoranging
The 662xA's outputs are limited to two ranges of voltage and current. For example, the 40 W Low Voltage output is limited to 40 Watts or less within the two "rectangular" ranges of 0-7 V/0-5 A and 0-20 V/0-2 A. The N67xxA modules, however, can produce any combination of voltage and current within their maximum voltage and current specification as long as it falls at or below its maximum power rating[5]. For example, the 50 W High Performance Autoranging DC Power Module (N6751A), which replaces the 40 W Low and High Voltage outputs in the 662xAs, can output any combination of 50 Watts or less within 0-50 V/ 0-5 A. Therefore, this module, at its maximum voltage of 50 V can output up to 1 A and at its maximum current of 5 A can output up to 10 V. This type of operation is known as "autoranging." Please see **Appendix A** for a graphical representation of this example.

Protection Features
Overvoltage Protection (OV or OVP)
On the 662xA models, the OV trip point can be programmed up to 23 V on any 40 W or 80 W Low Voltage Output and up to 55 V on any 40 W or 80 W High Voltage Output as well as the 25 W and 50 W precision outputs. The overvoltage protection shorts the output by firing an SCR crowbar and sets zero volts and minimal current on the output. The 662xA also has a fixed overvoltage threshold of approximately 120% of the maximum rated output voltage built into each output. When an overvoltage occurs, the word OVERVOLTAGE appears in the front panel display and the OV status bit is set for that output.

[5] The N6752A is the only exception to this rule. It can produce 100 W from 12 V/8.33 A to 50 V/2 A. Between 8.33 A and 10 A, the N6752A's output power derates from 100 W to 85 W. Please see the 100 W Comparison Graph in **Appendix A** for a graphical representation of this.

On the N67xxA modules, the OV trip point can be programmed up to 60 V on all 50 W and 100 W output modules. When overvoltage protection is enabled, the power supply will turn off its output if the output voltage reaches the programmed overvoltage limit. The voltage is measured at the output terminals. There is no SCR crowbar nor is there a fixed overvoltage threshold in any of the N67xxA modules. When an overvoltage occurs, the OV enunciator will appear next to the channel number in the bottom left corner of the display and the OV status bit is set for that output.

662xA OV Trigger Connections
Each output of the 662xA power supplies has two OV terminals on its rear panel terminal block labeled +OV and –OV. By connecting these terminals in parallel, an overvoltage shutdown on any one output will also trigger the overvoltage on the remaining outputs. Up to eight terminals can be strapped together.

The N67xxA Modules lack these OV terminals, but not the functionality. The functionality is achieved in firmware by using the "OUTPut:PROTection: COUPle <on, off, 0, 1>" command. This command enables/disables output coupling for protection faults. When enabled, ALL output channels are disabled when a protection fault is triggered. When disabled, only the affected output channel is disabled when a protection fault is triggered. This eliminates the need for physical OV terminals. The standard RI/DFI on each N6700A/B mainframe extends this functionality to more than one mainframe. Please refer to the *Digital Control Connections* section of the N6700 User's Guide for more information on configuring the digital port for RI/DFI.

Overcurrent Protection
662xA: When the Overcurrent protection feature is enabled, and the output is sourcing current and enters +CC operating mode, the output will be disabled (set to zero volts and minimal current) and the word OVERCURRENT will appear on the front panel display. The OC status bit is set for that output.

N67xxA Modules: When overcurrent protection is enabled, the power supply will turn off its output (set minimum voltage, minimum current, and goes into a high-impedance state) if the output current reaches the programmed current limit. The output current is measured across a current shunt resistor on the inboard side of the output terminals. When an overcurrent condition occurs, the OC enunciator will appear next to the channel number in the bottom left corner of the display and the OC status bit is set for that output.

Unregulated Output, Overtemperature, and Errors
Operation and handling is the same between the 662xA and the N67xxA modules.

Current Sink (Downprogramming) Capability

- 40 W/80 W High/Low Voltage Outputs current sink limits are fixed approximately 10% higher than the maximum current source limits for a given operating voltage at any voltage above 2.5 V.
- 25 W Precision Outputs can sink up to 0.5 A.
- 50 W Precision Outputs can sink 1 A above 16 V and 2 A below 16 V.
- All 662xA Outputs, when the negative current limit is reached, go into –CC mode and the –CC status bit is set.
- N67xxA Modules: Current sink is limited by power. The downprogrammer can dissipate approximately 7 W continuously. For example, if the voltage at the output terminals is 10 V the power supply will limit the negative current to approximately 0.7 A. When the voltage and negative current combination exceeds approximately 7 W the power supply goes into CP- mode and the CP- status bit is set. The N675xA modules can sink 7 A peak. The N676xA modules can sink 3 A peak.

Positive and Negative Voltages

The 662xA are capable of producing either positive or negative voltages by grounding, or "commoning", one of the output terminals. The supply can be operated with any output terminal ±240 Vdc (including output voltage) from ground.

The N67xxA Modules have the same capabilities.

Remote Voltage Sensing

40 W/80 W High/Low Voltage Outputs:
The maximum voltage available at the output terminals during remote sensing is the maximum voltage rating plus one volt. This allows a voltage drop of 0.5 V per load lead, or 1 V total, when the maximum voltage is set.

25 W and 50 W Precision Outputs:
The maximum voltage available at the output terminals during remote sensing is 50.5 V. This allows a voltage drop of 0.25 V per load lead, or 0.5 V total when the maximum voltage is set. The maximum voltage drop in both leads cannot exceed 10 volts total or the overvoltage protection circuit will shutdown the power supply.

N67xxA Modules: The maximum voltage available at the output terminals during remote sensing is the maximum voltage rating plus 5 volts. This allows a voltage drop of 2.5 V per load lead, or 5 V total, when the maximum voltage is set.

Parallel Operation

662xA: Each output contains an active downprogrammer that is capable of sinking current from only ONE identical output, therefore, you can parallel no more than two outputs.

N67xxA Modules: Each output contains an active downprogrammer, which limits the input current (negative) to approximately 7 W depending on the voltage at the output. Up to four modules (same model numbers only) can be paralleled for more current. For example, four N6751A modules can all be paralleled for a maximum current of 20 A.

Series Operation

662xA: The outputs can be connected in series to obtain greater voltage capability. Outputs connected in series must have equivalent current ratings. If the current ratings are not equivalent, the higher rated output could potentially damage the lower rated output by forcing excessive current through it under certain load conditions. Floating voltages must not exceed 240 Vdc. Therefore, no output terminal may be more than 240 Vdc from chassis ground.

N67xxA Modules: The outputs have the same capabilities when used in series.

Transient Response

- 40 W/80 W High/Low Voltage Outputs: 75 µs maximum to recover to within 75 mV of nominal value following a load change within the range 300 mA to full load for low voltage units, and 150 mA to full load for high voltage units.
- 25 W and 50 W Precision Outputs: 75 µs maximum to recover to within 75 mV of nominal value following a load change from 0.1 A to 100% of the maximum rated current.
- N675xA Output Modules: Less than 100 µs for the output to recover to within 75 mV of nominal value following a load change from 50% to 100% of the maximum rated current.
- N676xA Output Modules: Less than 150 µs for the output to recover to within 75 mV of nominal value following a load change from 50% to 100% of the maximum rated current.

Noise

Please see the comparison chart in Appendix A for the noise specifications.

The 662xA uses unique commands that do not follow the SCPI (Standard Commands for Programmable Instruments) standard. These commands (compatibility commands) have been built into the N6700A/B's firmware to provide backwards compatibility and convenience. The N675xA and N676xA modules are capable of accepting both compatibility and SCPI commands. However, mixing commands may produce unexpected results. Please see **Appendix E** of the N6700A User's Guide for the complete list of compatibility commands.

Possible Pitfalls When Mixing SCPI and Compatibility Commands

As mentioned at left, mixing compatibility and SCPI commands may produce unexpected results. This section will explain one of the possible pitfalls of mixing the commands to help avoid the unexpected.

Measurements

The N675xA Modules with Option 054 and the N676xA modules have a high-speed digitizer that take voltage and current measurements. This digitizer is programmable and the sampling rate, number of points, and measurement windowing, as well as other measurement parameters listed in **Table 3** below, can all be set using SCPI commands. Any change to these parameters will affect the "VOUT?" and "IOUT?" query responses.

Interfaces

Remote (GPIB)

The 662xA comes standard with a GPIB interface. The N6700A/B mainframe also comes standard with a GPIB interface (LAN and USB are also standard on the N6700A/B). The ability to lock the front panel, such as the 662xA did when in remote mode, is not automatic in the N6700A/B. The command

Table 3.
Default Measurement Settings for N675xA with Option 054 and N676xA

SCPI Command	Description	Default
SENSe:CURRent:RANGe	Sets the DC current measurement range on models that have multiple ranges	<max>
SENSe:VOLTage:RANGe	Sets the DC voltage measurement range on models that have multiple ranges	<max>
SENSe:FUNCtion	Sets the function for modules without simultaneous voltage and current measurement capability	"VOLTage"
SENSe:SWEep:POINts	Defines the number of points in a measurement	1024
SENSe:SWEep:OFFSet:POINts	Defines the number of offset points in a measurement	0
SENSe:SWEep:TINTerval	Defines the time period, in seconds, between measurements	20.48usec
SENSe:WINDow	Sets the window function used in DC measurement calculations	RECTangular

"SYSTem:COMMunicate:RLState RWLock" must be used to lock out the front panel. Please see the N6700 User's Guide for more details.

Local (Front Panel)
Both the 662xA and N6700A/B have front panel controls and display. The 662xA's front panel control has individual buttons for each feature along with a numerical keypad. The N6700A/B eliminates most of these buttons, but has much more capable control from the front panel. It has an extensive menu system with a few keys for quick, one-button access as well as navigational keys and a numerical keypad. The N6700A/B is also capable of displaying all four channels voltage and current at the same time, while the 662xA can only show one channel at a time.

Comparison of 662xA Commands and N675xA and N676xA Modules Compatibility Commands

There are three general areas of differences between the 662xA's commands and the N67xxA modules compatibility commands—IEEE 488.2 Syntax, Status Reporting, and Model Specific Limits. In addition, there are specific functions that are not implemented or are different.

IEEE 488.2 Syntax

Space Separator I
The N67xxA Modules will not allow a space separator between numbers.

Example:
"ISET 1 0.5" and "ISET 1, 0.5"

662xA: Both commands are accepted and processed with the same results.

N67xxA Modules: Only "ISET 1, 0.5" is accepted. "ISET 1 0.5" will result in an error (-103, "Invalid separator").

Space Separator II
A space is needed between the command and the channel number.

Example:
"ISET1,0.5" and "ISET 1,0.5"

662xA: Both commands are accepted and processed with the same results.

N67xxA Modules: Only "ISET 1,0.5" is accepted. ISET1,0.5 will result in an error (-103. "Invalid separator").

Queries and Readback
Multiple Queries without Continuous Readback
Sending a second query to an N67xxA module without reading the response to the first will generate an error.

Example:
```
ISET? 1
VSET? 1
<readback>
```

662xA: Readback will return the value of the "VSET? 1" query without an error.

N67xxA Modules: Readback will return the value of the "VSET? 1" query and will error (-410, "Query INTERRUPTED").

Multiple Queries with Partial Readback
An N67xxA Module will not allow a user to query information, read back only a portion of the information (a few characters), send another command, and finish reading back the remaining information from the original query.

Example:
```
ISET 1, 1
ISET? 1
<partial readback>
ISET 1, 0.5
<readback remaining>
```

662xA: Partial readback will return a few characters. Remaining readback will return the remaining characters along with the value "1", from the "ISET? 1" query, without error.

N67xxA Modules:
Readback will not return any information and errors, such as -410,"Query INTERRUPTED" and -420, "Query UNTERMINATED" will be reported.

Multiple, Semicolon-Separated Queries
The 662xA overwrites any previous unread query responses. The N6700A, however, can respond to multiple queries.

Example:
VOUT? 1; VOUT? 2; VOUT? 3
<readback>

662xA: Readback returns only the information for the last (VOUT? 3) query.

N67xxA Modules: Readback returns values for all the queries, separated by semicolons.

Numeric Data
662xA: The power supply will return numeric data (ASCII characters) in a format that is dependent on the type of data requested. Please refer to the *Numeric Data* section in the *Remote Operation* chapter of the 662xA Operating Manuals.

N67xxA Modules: Floating-point numbers returned by the instrument may not have exactly the same syntax or number of digits.

Initial Conditions
If the power supply is not programmed to recall the values in the 0 (zero) register (RCL0), immediately after power on, the power supply sets all parameters to their initial, or "CLR", values. These are the values that result from the "CLR" command. **Table 4** below lists these parameters and their initial values.

Parameter	40 W/80 W High/Low Voltage Outputs	25 W/50 W Precision Outputs	N67xxA Modules
Voltage	0 V	0 V High Range	Minimum Voltage
Current	Minimum current limit	10 mA High Range	Minimum Current
Reprogramming Delay	20 ms	20 ms	20 ms
Store/Recall Registers	0 volts and min. current limit	0 V High Range and 10 mA High Range	Minimum voltage and minimum current
Overvoltage (OV)	23 V on low voltage outputs and 55 V on high voltage outputs	55 V (High Range)	55 V
Output Channels	On	On	Off
OCP Enabled	Off	Off	0 (off)
UNMASK Register	0 (cleared)	0 (cleared)	0 (cleared)
SRQ	0 (off)	0 (off)	0 (n/a)
Front Panel Metering	Output #1	Output #1	Output #1
Power Supply Address	Last stored value (Factory set to 5)	Last stored value (Factory set to 5)	Last stored value (Factory set to 5)
Local Control	On (enabled)	On (enabled)	On (enabled)
PON Bit	On	On	0 (n/a)
PON SRQ	Last stored value (Factory set to 0)	0 (off)	0 (n/a)
Cal Mode	Off	Off	0 (off)

Table 4. Initial Conditions

Status Reporting

Status, Accumulated Status, Mask, and Fault Registers

Table 5 below lists the bit assignments for the Status, Accumulated Status, Mask, and Fault Registers and how they translate between the 662xA and the N67xxA modules. The "-CC" bit will never be set because negative current cannot be regulated in the N67xxA modules[6]. Please see *Current Sink Capabilities* in the *Electrical Section* for more details.

The "CP+" and "CP-" bits in the N67xxA output modules correspond to the output being in the positive or negative constant power limit mode respectively and should not be confused with the "coupled parameter" (CP) bit in the 662xA, which indicates range changes or switching.

Bit Position	Bit Weight	662xA Meaning	N67xxA Meaning
7	128	CP[7]	CP[7]
6	64	OC	OC
5	32	UNR	UNR or CP[7]
4	16	OT	OT
3	8	OV	OV
2	4	-CC	Never Set[6]
1	2	+CC	+CC
0	1	CV	CV

Table 5. Bit Assignment and Translation for Status, A Status, Mask, and Fault Registers

[6] The –CC condition does not exist in the N67xxA.

[7] Not set on the N675xA modules, see *Range Switching* at right for more details.

Serial Poll and Service Requests (SRQ)

Serial Poll and Service Requests (SRQ) will be controlled according to the SCPI status model and will not act like a 662xA. Please refer to the *Status Subsystem* section in the *Language Dictionary* Chapter of the N6700 User's Guide.

Parallel Poll

Parallel Poll will not work with the N67xxA modules.

Model Specific Differences

Full-Scale Limits

All full-scale limits, such as voltage, current, and power, will match N67xxA output module full-scale limits, not 662xA output limits.

Range Switching

40 W/80 W High/Low Voltage Outputs:
Each output operates within the specified boundaries of either the low or high range. The range is selected based on the programmed parameters. If the last parameter (voltage or current) programmed is outside of the existing range, the supply will automatically switch ranges. When the range is automatically switched the "coupled parameter" (CP) bit in the status register is set to indicate that range switching occurred.

N675xA Modules:
The automatic setting adjustment done in the 662xA when the range changes will not occur because it is no longer necessary due to the autoranging capability of the N675xA. Since there is no range switching, the "coupled parameter" (CP) bit is never set.

Range Programming
25 W and 50 W
Precision Outputs:
The range can be set by using the "VRSET" or "IRSET" commands. The power supply will automatically pick the range that the value sent fits into. If the value sent requires a range change (high to low or low to high) the "coupled parameter" (CP) bit is set.

N676xA Modules:
The functionality is the same as above, but the ranges are different. **Table 6** below shows the ranges for the different outputs.

Functions that operate differently or are missing
For compatibility, most commands from the 662xA language are accepted, however, some commands do nothing. Commands that "do nothing" are accepted and do not produce an error, but no function is performed. The commands that are not accepted will return "Error 203, Compatibility function not implemented".

ID? Query
The "ID?" query, when sent to the N6700A/B will always return the model number of the mainframe, which will be either "N6700A" or "N6700B".

OCRST and OVRST
662xA: "OCRST <ch>" returns the specified channel to the settings it had prior to being turned off by the overcurrent protection circuit, clearing ONLY the OC condition. "OVRST <ch>" attempts to reset the overvoltage crowbar circuit in the specified output channel, clearing only the OV condition.

N67xxA Modules: Both OVRST and OCRST will reset ALL latched protection functions for the specified channel.

Calibration
None of the 662xA calibration commands are provided in the compatibility language of the N67xxA modules. Calibration must be done exclusively in the SCPI language format. Use of any of the 662xA's calibration command set will result in an error message. Please refer to *Calibration* in the N6700 User's Guide for the calibration procedure.

Multiple Output Storage & Recall
6621A, 6622A, 6623A,
6624A, 6627A:
These models have 10 internal registers, which have the following characteristics:

- All registers (1-10) can store the voltage (VSET) and current (ISET) settings for all the outputs.
- When a register is recalled "RCL <reg>", the outputs are set sequentially (1,2,3,4).
- At power-on, all registers (1-10), because they are all volatile, are reset to zero volts and minimum current.

Range	25 W Precision	50 W Precision	N6761A	N6762A
High	0-50 V/0-500 mA	0-50 V/0-2 A	0-50 V/0-1.5 A	0-50 V/0-3 A
Low	0-7 V/0-15 mA	0-16 V/0-200 mA	0-5.5 V/0-100 mA	0-5.5 V/0-100 mA

Table 6. Output/Measurement Ranges

6625A, 6626A, 6628A, 6629A:
These models have 11 internal registers, which have the following characteristics:

- Register 0 is recalled automatically at power-on.
- Register 0 stores: VSET, VRSET, ISET, IRSET, OVSET, OCP, DLY, and MASK for all outputs.
- Registers 1-10 save: VSET, VRSET, ISET, IRSET, and OVSET for all outputs.
- At power-on, registers 4-10 are reset to 0 V and minimum current.
- Registers 0-3 can only be saved once per power-on. Power needs to be cycled to re-enable writing to these non-volatile registers.
- If registers 0-3 are written to more than once per power-on cycle, Error 30 "STORE LIMIT" will result.
- When a register is recalled, the outputs are set sequentially (1,2,3,4).

N6700A/B Mainframe:
The N6700A has 11 internal registers, which have the following characteristics:

- Register 0 is recalled automatically at power-on ONLY if the power-on state is set to RCL0 by sending the command "OUTPut: PON:STATe RCL0".
- All registers (0-10) store: VSET, VRSET, ISET, IRSET, OVSET, OCP, and DLY. The state of the MASK register is not stored.
- At power-on registers 2-10 are reset to minimum voltage and minimum current.
- The non-volatile registers (0-1) can be written to more than once per power-on cycle.
- When a register is recalled, the outputs are set sequentially (1,2,3,4).

Table 7 below shows the differences between the 662xA and the N6700A/B mainframes memory states.

	Non-Volatile Registers	Volatile Registers
6621A, 6622A, 6623A, 6624A, 6627A	0	10—Registers 1-10
6625A, 6626A, 6628A, 6629A	4—Registers 0-3	7—Registers 4-10
N6700A/B	2—Registers 0-1	9—Registers 2-10

Table 7. Memory STO/RCL States

Clear Command (CLR)
The Clear "CLR" command is typically used in systems to send all devices in the system to a known state with a single command. Please see **Table 4** in the *Initial Conditions* section for the "CLR" values.

Mechanical/Physical

Size

The overall physical size of the N6700A/B mainframe is much smaller than the 662xA power supply. Please see **Table 8** at right. Positive deltas indicate smaller or lighter.

Color

The 662xA's front panel color was Mint Gray prior to 1988 and Parchment White from 1988 to the present. The case color was French Gray prior to 1988 and Dove Gray from 1988 to the present.

The N6700A/B front panel color is Quartz Grey and the case is unpainted, zinc-plated steel.

Location and Cooling

The 662xA series power supplies can operate without loss of performance within the temperature range of 0° to 55°C (measured at the fan intake). The fan, located at the rear of the unit, cools the supply by drawing air in through the openings on the rear panel and exhausting it through openings on the sides. Please refer to the gray arrows in **Figure 1a** in **Appendix B**.

	662xA	N6700A/B	Delta
Height	132.6 mm (5.22 in)	44.45 mm (1.75 in)	88.15 mm (3.47 in)
Width	425.5 mm (16.75 in)	432.5 mm (17.03 in)	-7.0 mm (-0.28 in)
Depth	497.8 mm (19.6 in)	571.5 mm (22.5 in)	-73.7 mm (-2.9 in)
Weight	17.4–23 kg (38–51 lbs)	11–12.7 kg (24.4–28 lbs)	6.4–10.3 kg (13.6–23 lbs)

Table 8. Dimensions and Weight

The N6700 series power supplies can operate without loss of performance within the temperature range of 0° to 55°C (ambient). Three fans that draw air in from the right side of the unit and exhaust it out the left side cool the front one-third of the mainframe. Each module also has a fan which provide cooling for the rear two-thirds of the mainframe as well as the module itself by drawing in air from the sides and exhausting it out the rear. Please refer to the gray arrows in **Figure 1b** in **Appendix B**.

Rack Mounting

NOTE: The N6700A/B mainframe comes standard with handles mounted on the front panel and does not require a rack mounting option if handles are all that are required.

The N6700A/B has only one rack mount option (Option 908). This option replaces ALL 662xA rack mount options as well as the rack mounting accessories, such as the Rack Slide Kit (p/n 1494-0059) and support rails (E3663AC). A Rack Slide Kit and support

rails are neither required nor available to rack mount an N6700A/B mainframe. The N6700A/B can only be rack mounted using Option 908 (p/n N6700-60009). No other means of rack mounting should be used due to airflow and height restrictions. For more information please see the *Installing the Unit* section in the *Installation* chapter of the N6700 User's Guide.

Output Connectors

Pin-outs

The 662xA series output connector is a 6-pin terminal block that consists of +S, +V, -V, -S, +OV, and -OV. The orientation of the connector depends on the output.

Output 2 & 3:
-OV, +OV, -S, -V, +V, +S

Output 1 & 4:
+S, +V, -V, -S, +OV, -OV
See **Figure 2a** in **Appendix B**.

The N67xxA modules output connector is a 4-pin (phoenix) connector that consists of +S, +, -, and –S from left to right (when looking at the rear of the unit). There are no OV terminals. See **Figure 2b** in **Appendix B**.

Placement

Please see **Figures 1a** and **1b** in **Appendix B** for output connector placement.

Power Cord, GPIB, and Other Connectors

Please see **Figures 1a** and **1b** in **Appendix B** for placement details.

Appendix A

662xA to N67xx Comparison Sheet

Current Model

Specifications (at 0° to 55°C unless otherwise specified)		40 W Low Voltage Output	40 W High Voltage Output	80 W Low Voltage Output	80 W High Voltage Output	25 W Precision Output	50 W Precision Output
Output Power	Low range volts, amps	0 to 7 V, 0 to 5 A	0 to 20 V, 0 to 2 A	0 to 7 V, 0 to 10 A	0 to 20 V, 0 to 4 A	0 to 7 V, 0 to 15 mA	0 to 16 V, 0 to 200 mA
	High range volts, amps	0 to 20 V 0 to 2 A	0 to 50 V 0 to 0.8 A	0 to 20 V 0 to 4 A	0 to 50 V 0 to 2 A	0 to 50 V, 0 to 500 mA	0 to 50 V, 0 to 1 A or 0 to 16 V, 0 to 2 A
Output Combination for each model (total number of outputs)	6621A (2)	—	—	2	—	—	—
	6622A (2)	—	—	—	2	—	—
	6623A (3)	1	1	1	—	—	—
	6624A (4)	2	2	—	—	—	—
	6625A (2) Precision	—	—	—	—	1	1
	6626A (4) Precision	—	—	—	—	2	2
	6627A (4)	—	4	—	—	—	—
	6628A (2) Precision	—	—	—	—	—	2
	6629A (4) Precision	—	—	—	—	—	4
Programming Accuracy (at 25°C ±5°C)	Voltage	19 mV + 0.06%	50 mV + 0.06%	19 mV + 0.06%	50 mV + 0.06%	1.5 mV + 0.016% (low) 10 mV + 0.016% (high)	3 mV + 0.016% (low) 10 mV + 0.016% (high)
	Current	50 mA + 0.16%	20 mA + 0.16%	100 mA + 0.16%	40 mA + 0.16%	15 µA + 0.04% (low) 100 µA + 0.04% (high)	185 µA + 0.04% (low) 500 µA + 0.04% (high)
Readback Accuracy (at 25°C ±5°C)	Voltage	20 mV + 0.05%	50 mV + 0.05%	20 mV + 0.05%	50 mV + 0.05%	2 mV + 0.016% (low) 10 mv + 0.016% (high)	3.5 mV + 0.016% (low) 10 mv + 0.016% (high)
	+ Current	10 mA + 0.1%	4 mA + 0.1%	20 mA + 0.1%	8 mA + 0.1%	15 µA + 0.03% (low) 130 µA + 0.03% (high)	250 µA + 0.04% (low) 550 µA + 0.04% (high)
	- Current	25 mA + 0.2%	8 mA + 0.2%	50 mA + 0.2%	20 mA + 0.2%	15 µA + 0.03% (low) 130 µA + 0.03% (high)	250 µA + 0.04% (low) 550 µA + 0.04% (high)
Ripple and noise (rms, 20 Hz to 10 MHz; peak-to-peak, 20 Hz to 20 MHz)	Constant Voltage rms	500 µV	500 µV	500 µV	500 µV	500 µV	500 µV
	peak-to-peak	3 mV	3 mV	3 mV	3 mV	3 mV	3 mV
	Constant Current rms	1 mA	1 mA	1 mA	1 mA	0.1 mA	0.1 mA
Load regulation	Voltage	2 mV	2 mV	2 mV	2 mV	0.5 mV	0.5 mV
	Current	1 mA	0.5 mA	2 mA	1 mA	0.005 mA	0.01 mA
Load cross regulation	Voltage	1 mV	2.5 mV	1 mV	2.5 mV	0.25 mV	0.25 mV
	Current	1 mA	0.5 mA	2 mA	1 mA	0.005 mA	0.01 mA
Line regulation	Voltage	0.01% + 1 mV	0.01% + 1 mV	0.01% + 1 mV	0.01% + 1 mV	0.5 mV	0.5 mV
	Current	0.06% + 1 mA	0.06% + 1 mA	0.06% + 1 mA	0.06% + 1 mA	0.005 mA	0.01 mA
Transient response time Time for the output to recover to within 75 mV of nominal value following a load change within specifications		<75 µs	< 75 µs	<75 µs	<75 µs	<75 µs	<75 µs
Supplemental Characteristics		(Non-warranted characteristics determined by design and useful in applying the product)					
Average programming resolution	Voltage	6 mV	15 mV	6 mV 20 mV(high)	6 mV 20 mV(high)	460 µV (low) 3.2 mV (high)	1 mV (low) 3.2 mV (high)
	Current	25mV	10 mA	50 mA 20 mA(high)	50 mA 20 mA(high)	1 µA (low) 33 µA (high)	13 µA (low) 131 µA (high)
OVP Programming Accuracy		100 mV	250 mV	100 mV	50 mV	230 mV	230 mV
Command Processing Time (over GPIB)		7ms	7 ms	7 ms	7 ms	7 ms	7 ms
Interfaces		GPIB					
Size		425.5 mm Width x 132.6 mm Height x 497.8 mm Depth					

New Enhanced Model[8]

Specifications (at 0° to 55°C unless otherwise specified)		50 W High Performance Autoranging DC Power Module	100 W High Performance Autoranging DC Power Module	50 W Precision DC Power Module	100 W Precision DC Power Module
Output Power	Autoranging[9]	0 to 50 V, 0 to 5 A	0 to 50 V, 0 to 10 A	0 to 50 V, 0 to 1.5 A	0 to 50 V, 0 to 3 A
	Autoranging[9]	50 W	100 W[10]	50 W	100 W
Output Combination	Module Model Number	N6751A	N6752A	N6761A	N6762A
	N6700A/B +	—	2	—	—
	N6700A/B +	—	2	—	—
	N6700A/B +	2	1	—	—
	N6700A/B +	4	—	—	—
	N6700A/B +	—	—	1	1
	N6700A/B +	—	—	2	2
	N6700A/B +	4	—	—	—
	N6700A/B +	—	—	—	2
	N6700A/B +	—	—	—	4
Programming Accuracy (at 25°C ±5°C)	Voltage	19 mV + 0.06%	19 mV + 0.06%	1.5 mV + 0.016% (low) 6 mV + 0.016% (high)	1.5 mV + 0.016% (low) 6 mV + 0.016% (high)
	Current	20 mA + 0.1%	20 mA + 0.1%	15 µA + 0.04% (low) 200 µA + 0.04% (high)	15 µA + 0.04% (low) 200 µA + 0.04% (high)
Readback Accuracy (at 25°C ±5°C)	Voltage	20 mV + 0.05%	20 mV + 0.05%	1.5 mV + 0.016% (low) 6mV + 0.016% (high)	1.5 mV + 0.016% (low) 6mV + 0.016% (high)
	+ Current	4 mA + 0.1%	4 mA + 0.1%	15 µA + 0.03% (low) 200 µA + 0.03% (high)	15 µA + 0.03% (low) 200 µA + 0.03% (high)
	- Current	4 mA + 0.1%	4 mA + 0.1%	15 µA + 0.03% (low) 200 µA + 0.03% (high)	15 µA + 0.03% (low) 200 µA + 0.03% (high)
Ripple and noise (rms, 20 Hz to 10 MHz; peak-to-peak, 20 Hz to 20 MHz)	Constant Voltage rms	1 mV	1 mV	1 mV	1 mV
	peak-to-peak	6 mV max, 4 mV typical	6 mV max, 4 mV typical	6 mV max, 4 mV typical	6 mV max, 4 mV typical
	Constant Current rms	See Supplemental Characteristics below.			
Load regulation	Voltage	2 mV	2 mV	0.5 mV	0.5 mV
	Current	2 mA	2 mA	0.03 mA	0.03 mA
Load cross regulation	Voltage	1 mV	1 mV	0.5 mV	0.5 mV
	Current	1 mA	1 mA	0.005 mA	0.005 mA
Line regulation	Voltage	1 mV	1 mV	1 mV	1 mV
	Current	1 mA	1 mA	0.03 mA	0.03 mA
Transient response time Time for the output to recover to within 75 mV of nominal value following a load change from 50% to 100% of rating		<100 µs	<100 µs	<150 µs	<150 µs
Supplemental Characteristics		(Non-warranted characteristics determined by design and useful in applying the product)			
Average programming resolution	Voltage	3.5 mV	3.5 mV	90 µV (low) 880 µV (high)	90 µV (low) 880 µV (high)
	Current	3.25 mA	3.25 mA	2 µA (low) 60 µA (high)	2 µA (low) 60 µA (high)
Ripple and noise	Constant Current rms	2 mA	2 mA	2 mA	2 mA
OVP Programming Accuracy		0.25 V ±0.25%	0.25 V ±0.25%	0.25 V ±0.25%	0.25 V ±0.25%
Command Processing Time (over GPIB)		<1 ms	<1 ms	<1 ms	<1 ms
Interfaces		GPIB, USB, LAN			
Size		432.5 mm Width x 44.45 mm Height x 596.9 mm Depth			

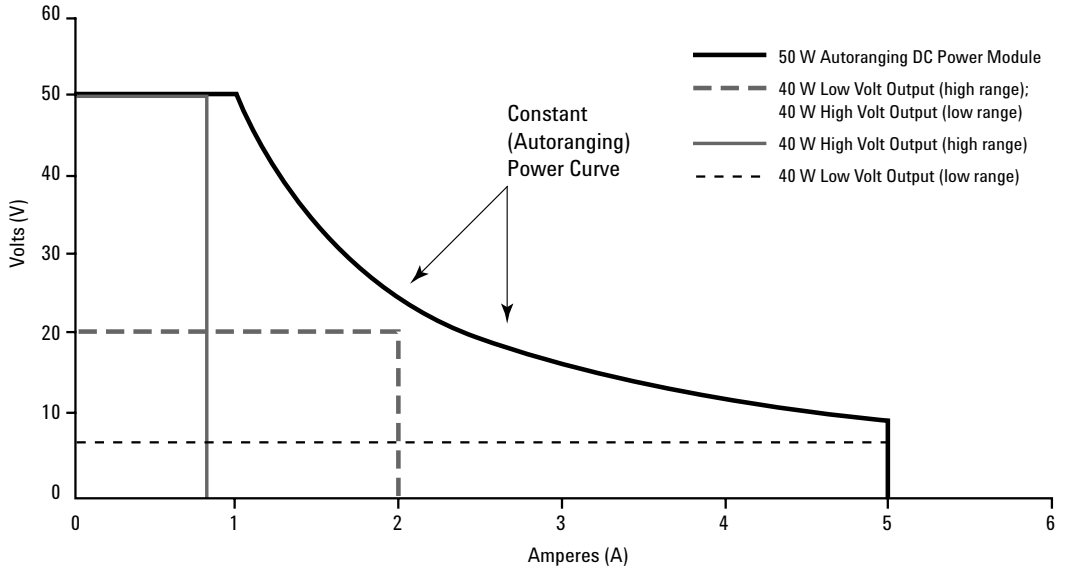
[8] These products are closest in configuration and ratings to your current model, but are not identical.

[9] Any combination of the specified Voltage and Current that is less than or equal to the specified power rating. Please see 50 W and 100 W Comparison Graphs for graphical representations of this.

[10] 100 W from 12 V/8.33 A to 50 V/2 A. Between 8.33 A and 10 A, the N6752A's output power derates from 100 W @ 8.33 A to 85 W @ 10 A. Please see 100 W Comparison Graph for a graphical representation of this.

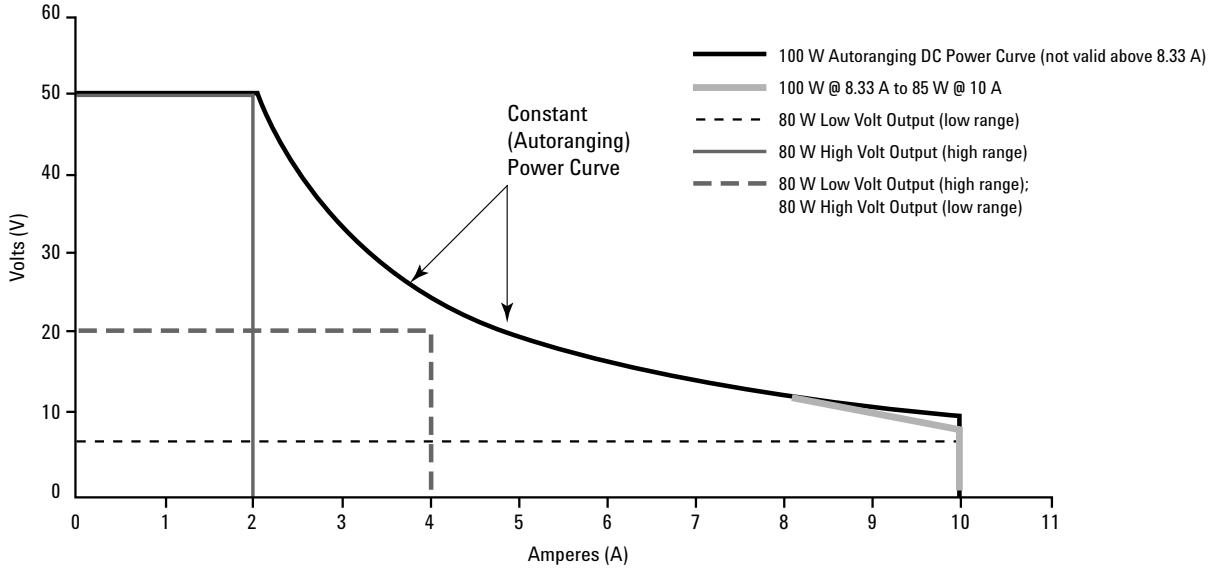
Rectangular Output vs. Autoranging Output Graph (50 W Comparison Graph):

40 W High and Low Voltage Output vs. 50 W N6751A High Performance Autoranging DC Power Module



Rectangular Output vs. Autoranging Output Graph (100 W Comparison Graph):

80 W High and Low Voltage Output vs. N6752A 100 W High Performance Autoranging DC Power Module



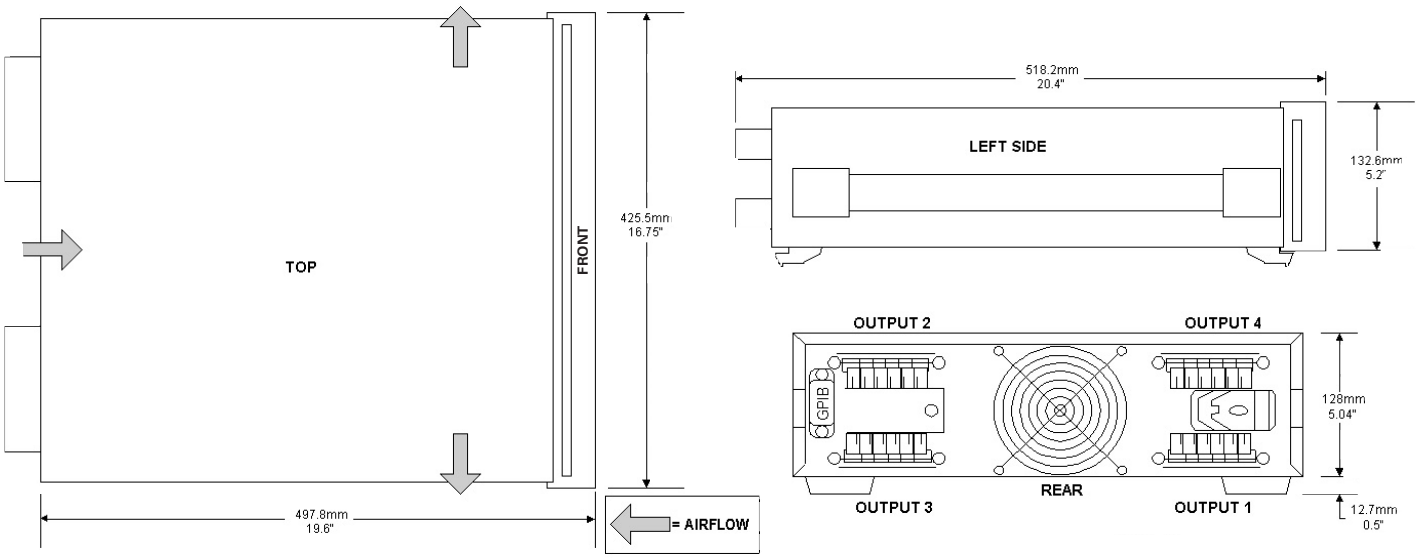


Figure 1a. 662xA Dimensions and Airflow

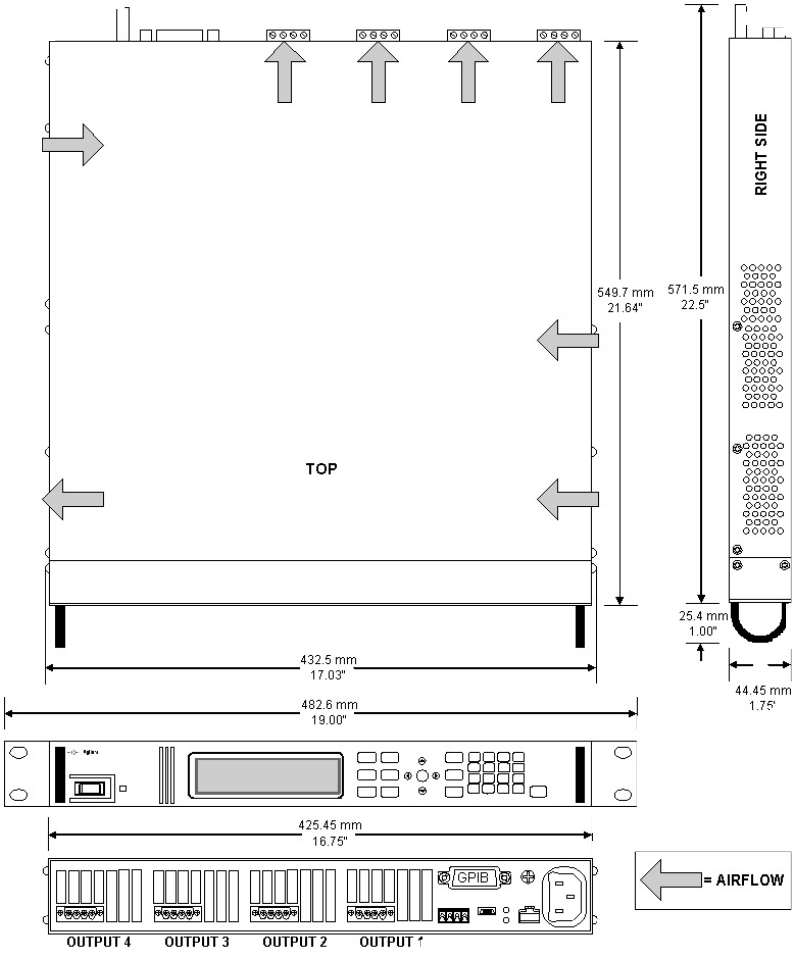


Figure 1b. N6700A/B Dimensions and Airflow

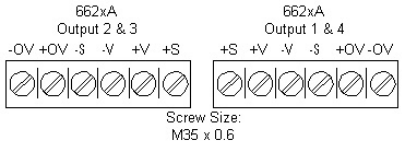


Figure 2a. 662xA Output Connectors

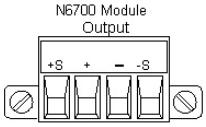


Figure 2b. N67xxA Module Output Connectors

References

Other Agilent Literature

Data Sheets

- 662xA Performance DC Power Supplies
  http://www.agilent.com/find/662xdatasheet

- N6700 Series Low-Profile Modular Power System
  http://www.agilent.com/find/n6700
  Agilent p/n 5989-1411EN

Operation Manuals and User's Guides

- 6621A, 6622A, 6623A, 6624A, and 6627A
  Agilent p/n 5957-6377

- 6625A, 6626A, 6628A, and 6629A
  Agilent p/n 006626-90001

- N6700 Series
  Agilent p/n 5969-2908EN

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For the latest and complete specifications, refer to the N6700 User's Guide. Go to **http://www.agilent.com/find/N6700** for the most up-to-date version.

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