Agilent N6700 MPS
Low-Profile Modular Power System

Models: N6700B, N6701A, N6702A, N6710B, N6711A, N6712A, N6731B-36B, N6741B-46B, N6751-54A, N6761A-62A, N6773A-76A, N6781A-82A

Technical Overview

New N6780 Series 2-quadrant source/measure units (SMUs) offer productivity gains and insights into power consumption never seen before.

For details, visit
www.agilent.com/find/N6700

- Ideal for ATE systems in R&D, design validation, and manufacturing
- Small size: up to 4 outputs in 1U of rack space
- Flexible, modular system: Can mix and match power levels and performance levels to optimize investment
- Performance modules for critical test requirements
- Value modules for basic DC power requirements
- Fast command processing times to improve throughput
- Connect via GPIB, LAN, or USB
- Fully compliant to LXI Class C specification

For Power Solutions in R&D — See back cover

Agilent Technologies

Small Size and Flexibility for ATE

Power supplies are a fundamental component of every test system in industries including aerospace and defense, consumer electronics, computers and peripherals, communications, semiconductor and automotive electronics. Today's complex automatic test equipment (ATE) systems often require multiple power sources. Test system designers are challenged to keep costs down by reducing rack space occupied by these multiple power supplies and to continually increase test system throughput.

The Agilent N6700 Low-Profile Modular Power System (MPS) is a 1U (rack unit) high, multiple-output programmable DC power supply system that enables test system integrators to optimize performance, power and price to match test needs.

The Agilent N6700 MPS gives test system designers the flexibility to mix and match from over 20 different DC power modules to create a 1- to 4-channel

N6700 System Features

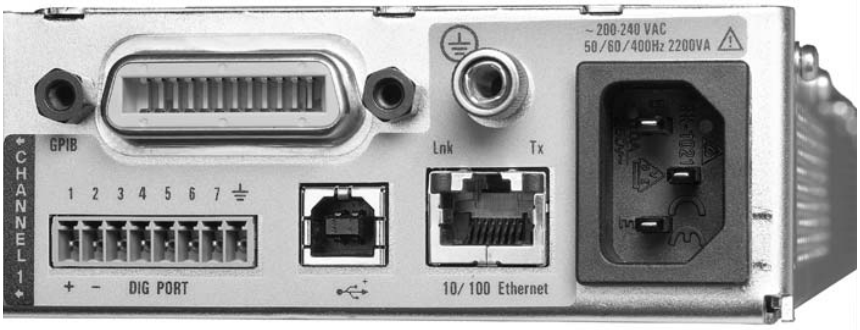


Figure 1. *Connectivity: GPIB, 10/100 Base-T Ethernet, and USB 2.0 all standard*

DC power system optimized to meet specific test requirements. Test system engineers can invest in high-performance outputs where speed and accuracy are needed, or purchase basic performance outputs for simple DC power requirements.

Small size
The Agilent N6700 MPS uses an advanced switching power supply design that fits within 1U of rack space. It has side air vents (no top or bottom air vents) so other instruments can be mounted directly above or below it. (Requires rack mount kit; see Ordering Information.)

Built-in measurement of voltage and current
The N6700 modules come standard with built-in measurement of voltage and current to simplify wiring and design of an ATE system.

Protection features
Each N6700 module is protected against over-voltage, over-current, and over-temperature. A fault condition in one module can be detected within 10 microseconds by other modules so that they can be quickly shut down to avoid hazardous conditions on your device under test (DUT).

Connectivity
The N6700 MPS comes standard with GPIB, USB 2.0, and 10/100 Base-T Ethernet LAN interfaces. While GPIB is best suited for use with existing systems, Agilent offers USB and LAN to allow you to take advantage of the availability, speed, and ease-of-use of common computer industry standard interfaces. The N6700 is fully compliant with the LXI Class C specification.

Security
When used in systems running GPIB, the LAN and/or USB interfaces can be disabled for extra security. Also, all non-volatile RAM data and settings can be cleared from the front panel.

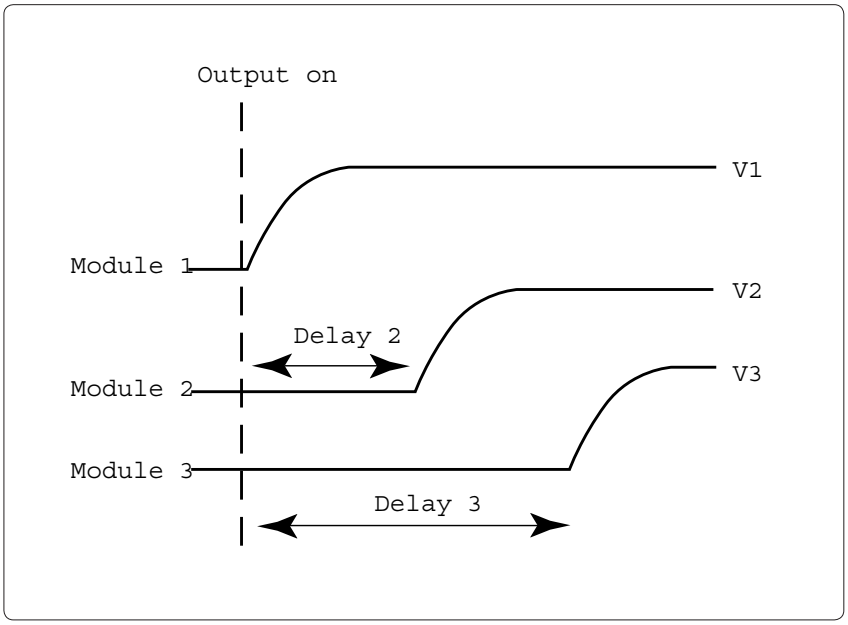


Figure 2. *Output sequencing*

Control from any browser
The N6700 can be controlled via a standard web browser. The N6700 contains a web server that provides web pages for monitor, control, and setup of the MPS.

Output sequencing
Each DC power module can be individually set to turn on or to turn off with a delay. By adjusting the delay times and then commanding the N6700 to turn on, you can set the N6700 modules to sequence on in a particular order. The same sequencing capability is available to shut down the modules in a particular order.

For applications that require more than four DC power modules to be sequenced, this output sequencing can be extended across multiple N6700 mainframes. By wiring together the I/O ports on the rear panel of the mainframes, a pair of synchronization signals are sent between mainframes, allowing the output sequences of each mainframe to be synchronized. This capability is supported on N6700B, N6701A and N6702A mainframes. It is not supported on N6700A mainframes.

Programmable voltage slew
For some applications, like inrush limiting or powering rate-sensitive devices, it is necessary to slow down and control the speed of the power supply to maintain a specific voltage slew rate. The N6700 provides programmable voltage slew rate, so that you can easily control the speed at which the output slews from one voltage to another. You can set the speed of a voltage change anywhere from its maximum up/down programming speed to its slowest change of up to 10 seconds. Programmable voltage slew is available from the front panel when operating the N6700 manually or via computer control.

Series operation
To increase available voltage and power, similarly rated outputs can be operated directly in series.

Easy parallel operation with virtual channels
To increase available output power and current, identical outputs can be operated in parallel. To simplify parallel operation for applications requiring currents greater than any single output can provide, the N6700 offers virtual channels, a firmware-based feature that allows the N6700 system to treat up to 4 channels as a single, synchronized channel. Once configured, all functions (sourcing, measurements, triggering, protection, and status monitoring) behave as if there is 1 channel of up to 4 times the capacity of a single channel, without writing a single line of code to manage the interaction and synchronization of the paralleled power supplies.

Virtual channel capability is available from the front panel when operating the N6700 manually or via computer control.

Power management feature allows you allocate mainframe power
Often, a DUT requires a single high power DC source and several very low power DC sources. Since the DUT does not require full power to all outputs, you may choose to save money configuring a system where the sum of the power modules installed in a mainframe exceeds the total power available from the mainframe. In this case, the new power management features of the N6700 allow you to allocate mainframe power to the outputs where it's needed, achieving maximum asset utilization and flexibility. This feature provides the safety from unexpected and dangerous shutdowns that can occur with power systems without power management when operated in a similar way.

For example, if your DUT requires 280 W on its main input, and 10 W each on three auxiliary inputs, you can configure a system consisting of one 300 W DC module and three 100 W DC modules. Even though the sum of the module power is 600 W, you can still use the N6700B 400 W MPS mainframe. Thanks to the power management feature, you can allocate the full 300 W to the 300 W module while you allocate only 33 W to each of the 100 W modules.

Plug high power mainframes into standard AC sockets without dedicated high current AC circuits
When you first turn on the N6702A 1200 W MPS mainframe, the mainframe automatically senses the power available from the AC line. If the AC line voltage is such that the resulting current would exceed a standard AC outlet rating, the mainframe automatically scales back the available output power to prevent overloading the AC line. The N6702A will limit the output power to 600 W allowing the high power mainframe to be plugged into any standard outlet. This is very convenient for initial bench checkout of the MPS system. It is also very convenient for test development, which is typically done on the bench when DUT is not yet driven to full power. You can also control this power reduction by manually allocating less than the full available mainframe power among the modules. As a result, the N6702A will draw less power (and less current) from the AC line.

Triggering
The N6700 Low-Profile MPS mainframe has hardware trigger in/trigger out signals which permit the N6700 to be synchronized with external events. For example, a switch closure in the fixture can trigger the N6700 to apply voltage to the DUT or take a measurement.

Drivers
The N6700 comes with both VXI*plug&play* drivers and IVI-COM drivers. LabView drivers are available at NI.COM.

Programming language
The N6700 supports SCPI (Standard Commands for Programmable Instruments).

Firmware updates
The N6700 firmware is stored in FLASH ROM and can be easily updated when new features become available. Firmware can be downloaded into the N6700 over GPIB, LAN, or USB using the supplied firmware update utility program. Firmware updates can be found at **www.agilent.com/find/N6700firmware**.

Output disconnect and polarity reversal relays
Modules in the N6700 can be individually ordered with optional Output Disconnect Relays (option 761) or Output Disconnect/Polarity Reversal Relays (option 760). See table on page 25 for option 760 and 761 availability. All relays are built into the module, so no additional wiring or rack space is needed to get the relay function.

With option 761, Output Disconnect Relays, mechanical relays disconnect both the plus and minus side of the power supply, including the sense leads.

With option 760, Output Disconnect/Polarity Reversal Relays, mechanical relays switch the leads on both the plus and the minus side of the power supply, including the sense leads, resulting in a voltage polarity reversal at the DUT. In addition to polarity reversal, option 760 provides the same output disconnect function as option 761.

Note: Output current is limited on some modules when option 760 Output Disconnect/Polarity Reversal Relays is installed. See the "Available options" tables at the bottom of page 25 and page 27 for more information about maximum current limitations with option 760.

Figure 3. *Front panel with up to 4 channels displayed simultaneously (Picture shows 3 channels installed.)*

Figure 4. *Rear panel (Picture shows 3 channels installed.)*

Front panel
In addition to full control over its three standard interfaces, the N6700 has a full featured front panel to permit easy manual operation for test prototyping, debugging, and troubleshooting when used in an ATE system. You can have confidence that the N6700 is working properly because you can view the settings and actual output values on all four outputs at the same time.

Quieter fans to keep noise down
To reduce acoustic noise, the N6700 mainframes employ fan speed control. When operating at less than full output power, the cooling fans spin slower and generate less noise.

Universal AC input
The N6700 has a universal input that operates from 100-240 Vac, 50/60/400 Hz. There are no switches to set or fuses to change when switching from one voltage standard to another. The AC input employs power factor correction.

Quick disconnects
Each power module has quick disconnects for easy system setup and maintenance.

Rack mount kit
The N6700 is easily rack-mounted using available option 908.
This kit provides all the necessary hardware to rack mount one N6700 mainframe in only 1U of rack space. This rack mount kit includes front rack ears and rear supports which take the place of standard rack rails and/or slides. Note that standard rack rails or slides are not needed and are not compatible with the N6700 because of its 1U size and airflow requirements.

Figure 5. *Quick disconnects for power and sense leads*

Choosing the right DC Power Modules to meet your ATE needs

See detailed specifications on page 13

N6750 Series

For applications where the power supply plays a critical role

The Agilent N6750 Series of high-performance, autoranging DC power modules provides low noise, high accuracy and programming speeds that are up to 10 to 50 times faster than other programmable power supplies. In addition, Agilent has, for the first time, included high-speed test extensions in general-purpose power supplies. The high-speed test extensions offer an oscilloscope-like digitizer that simplifies system configuration and increases measurement accuracy when viewing high-speed transient or pulse events within the DUT. In addition, autoranging output capabilities enable one power supply to do the job of several traditional power supplies.

N6760 Series

For applications where precision is required

The Agilent N6760 Series of precision DC power modules provides precise control and measurements in the milliampere and microampere region with the ability to simultaneously digitize voltage and current, and capture those measurements in an oscilloscope-like data buffer.

N6730/40/70 Series

For basic DC applications

The Agilent N6730, N6740 and N6770 Series of DC power modules provide programmable voltage and current, measurement and protection features at a very economical price, making these modules suitable to power the DUT or to provide power for ATE system resources, such as fixture control.

Figure 6a. *The N6753A and the N6754A 300 W high-performance autoranging DC power modules each occupy 2 module slots within the mainframe. All other modules occupy 1 module slot.*

N6780 Series

For applications where multi-quadrant operation and high-precision are required

For details on these new products and how they can be used for applications including battery drain analysis and function test, visit **www.agilent.com/find/N6780** and download the *N6780 Series Source/Measure Units (SMUs) for the N6700 Modular Power System* data sheet, literature number 5990-5829EN

Figure 6b. *User re-configurable modular system*

The N6750 and N6760 Series: Performance Modules for when the power supply is a critical part of your testing

When your testing requires a power supply to do more than just provide a constant DC level, the N6750 Series of high-performance, autoranging DC power modules and the N6760 Series of precision DC power modules are the perfect fit. These modules combine a fast output with flexible controls and sophisticated measurements. The N6750/60 is more than a power supply; it is a stimulus/response instrument.

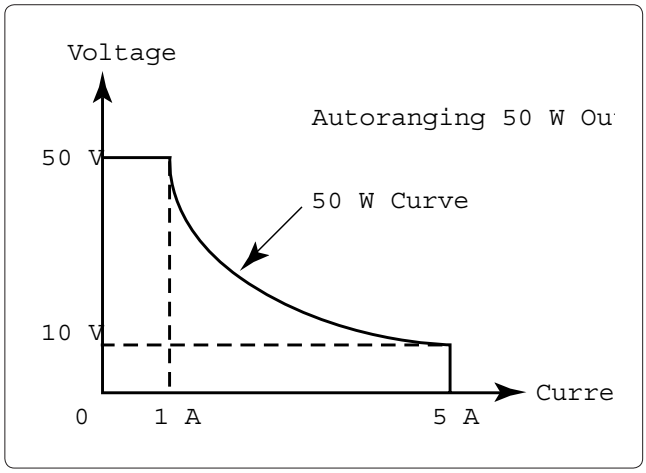
To fit in 1U, the N6750/60 use an advanced switch-mode design that offers the low output noise and fast output speed typically found on linear power supplies.

Low noise outputs
Careful attention has been paid to this design to ensure low normal mode noise (ripple and peak-peak) as well as low common mode noise. This switching power supply outperforms most linear power supplies on the market.

Output programming speed
When it comes to speed, the N6750/60 achieves performance unlike a typical DC power supply. Thanks to an active down-programming circuit to rapidly pull down the output when lowering the module's output voltage, the N6750/60 can rapidly program both up and down in voltage. Changing voltage from 0 V to 50 V, or 50 V to 0 V, can be accomplished in less than 1.5 milliseconds. And for smaller voltage changes, for example from 0 V to 5 V or 5 V to 0 V, the programming speed is less than 200 microseconds. These output speeds allow the N6750/60 to give maximum system throughput when your test calls for frequent changes in power supply voltage settings.

Autoranging for flexibility
The N6750/60 gives test system designers even more flexibility by providing autoranging outputs. This autoranging capability provides maximum output power at any output voltage up to 50 V. This allows one power supply to do the job of several power supplies because its operating range covers low voltage, high current as well as high voltage, low current operating points.

For example, the N6751A high-performance, autoranging DC module, rated at 50 V, 5 A, and 50 W can provide full power at
10 V @ 5 A (=50 W),
20 V @ 2.5 A (= 50 W),
33.3 V @ 1.5 A (= 50 W),
50 V @ 1 A (= 50 W)
or anywhere in between.



Therefore, this 50 W autoranging power supply, due to its extended voltage and current range, can produce voltage and current combinations in the range of a 250 W non-autoranging power supply.

The flexibility of autoranging is useful when the DUT operates over a wide range of voltages, when the ATE system needs to test a wide range of DUTs, or when margin is needed because the ATE power supply must be selected before final DUT power requirements are determined.

See page 22 for a diagram describing the details of the autoranging output characteristics of the N6750 and N6760 Series of DC power modules.

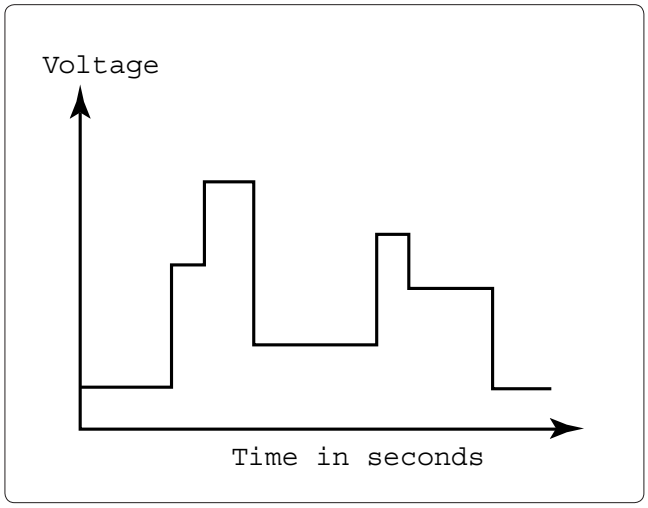


Figure 7. *High speed test extensions LIST mode provides "power ARB" capability*

High-speed test extensions
To make your testing go even faster, the N6750/60 offer High-Speed Test Extensions (HSTE). This enhancement to the N6750/60 DC power modules extends the capabilities to include features similar to a built-in arbitrary waveform generator and a built-in oscilloscope. HSTE is optional on the N6750 DC power modules. HSTE is standard on the N6760 DC power modules.

Through the LIST mode of HSTE, you can download up to 512 setpoints of voltage and current. In LIST mode, you can program the output to execute a LIST of voltage and current setpoints. For each setpoint, a dwell time can be specified and the power supply will stay (i.e., dwell) at that setpoint for the programmed dwell time value. For each setpoint in the LIST, you can have a different dwell time from 0 to 262 seconds with 1 microsecond resolution.* Then, you can trigger the module to begin executing the list. The module will step thru the list, staying at each setpoint for the programmed dwell time, and then it will move on to the next point. This speeds up execution by removing the computer I/O from the process. The result is an output that automatically changes according to the programmed list, just like an arbitrary waveform generator.

* *Note that the output response time is less than 5 milliseconds per voltage change, so steps of less than 5 milliseconds will not achieve their final output voltage value before moving on to the next step. This is useful when trying to create a smooth waveform.*

HSTE also provides an oscilloscope-like digitizer built into the power module to capture voltage and current measurements of up to 4096 points at up to 50,000 measurements per second.

For applications such as design validation of battery powered digital devices, the ability to capture dynamic information about the current flowing into the DUT allows designers to better understand the current drain on DUT batteries and optimize DUT power management during normal DUT operation and in DUT standby mode.

The digitizer can also be synchronized with changes in the output. For example, the digitizer can make measurements in response to a trigger generated by a change in output voltage caused by LIST mode. In this configuration, you can ensure that measurements are made at the right moment during each step of an executing LIST. This is particularly useful if you are trying to measure current consumption during a rapidly changing voltage stimulus, such as current drawn during a pulsed output voltage.

Precision low-level performance
The N6760 Series of Precision DC Power Modules additionally provide dual ranges on both programming and measurement. In the low range, these power supplies provide precision in the milliampere and microampere regions. They are ideally suited for semiconductor and passive device testing, or where a precisely controlled output and highly accurate, precise measurements are needed during test.

New source/measure unit modules for the most demanding applications
The N6780 Series of Source/Measure Units offer the highest level of performance in the N6700 Series. These SMUs feature highly accurate measurements down to nanoamperes while providing operation as a DC voltage source, DC current source, and electronic load. For details on these new products and how they can be used for applications including battery drain analysis and functional test, visit **www.agilent.com/find/N6780** and download the *N6780 Series Source/Measure Units (SMUs) for the N6700 Modular Power System* Data Sheet, literature number 5990-5829EN.

If you are using Agilent multiple-output system DC power supplies now

Models
6621A, 6622A, 6623A,
6624A, 6625A, 6626A,
6627A, 6628A, 6629A

If you would like to take advantage of the size and speed of the N6700, and need assistance in converting from Agilent 662x to the N6700, please refer to *Application Note 1467 – How to use the Agilent N6700 Series modular power system to replace an Agilent 662xA*. Look for literature part number 5989-0466EN at **www.agilent.com/find/N6700**

The N6730, N6740 and N6770 Series: Basic modules when you just need a simple power supply

Not all applications require high performance power supplies. When your budget is tight, and when speed and accuracy are a low consideration, the Agilent N6700 Low-Profile MPS supports basic DC power modules that provide an economical solution. The N6730, N6740 and N6770 Series give you clean, reliable DC power without advanced features.

The Agilent N6730 Series of 50 W DC power modules, the N6740 Series of 100 W DC power modules, and the N6770 Series of 300 W DC power modules provide the following:

- Fully programmable constant voltage/constant current DC source
- Remote sensing for accurate control of output voltage when voltage drops in the leads are present
- Built-in measurements of voltage and current
- Protection (over-voltage over-current, and over-temperature) against damage to your DUT or to the power module
- Performance (programming accuracy, measurement accuracy, noise) suitable for most common DC power applications
- Built-in optional output disconnect and polarity reversal relays, which break both the power and the sense leads, to simplify system wiring

Use the N6730/40/70 in place of fixed-output DC power supplies
Many ATE systems have complex fixtures that contain indicator lights, relays or active circuits (like sensors, triggers, amplifiers) to facilitate testing of the DUT. These circuits need DC power, too. One solution for powering these ATE system resources would be to purchase a fixed-output DC source. However, there are considerations when integrating a fixed output DC source into an ATE system.

The table to the right illustrates these points and how it may be easier, faster, and more economical to purchase an N6730/40/70 programmable DC power module in place of a fixed-output DC power supply.

All the benefits of the N6700 MPS at a low price
While the N6730/40/70 are economical solutions to basic DC power requirements, they are also part of the N6700 MPS. Therefore, while saving, you still have the benefits of:

- Small size (true 1U)
- Mix-and-match with other N6700 DC power modules when you need performance along with basic DC outputs
- Connectivity via LAN, USB, and GPIB
- Fast command processing time of less than 1 ms
- Remote control over internet via standard web browser
- Friendly front panel
- Optional output disconnect and polarity reversal relays

Factor	Consideration when using a fixed-output DC power supply	Solution using N6730/40/70 DC power modules in N6700 MPS
Control the output	You may want some limited control over this DC source (on/off).	The N6730/40/70 is fully controllable over LAN, USB, GPIB
Monitor the output	You may want to be able to monitor the voltage or current to ensure proper operation, which would require wiring to a system DMM.	The N6730/40/70 has built-in measurements of voltage and current, eliminating the need for wiring to a system DMM.
Mounting the power supply	You will need to mount the power supply in the ATE system. Finding a safe location can be a challenge. Some system designers will build a "drawer" or "tray" for holding power supplies. However, this adds extra design time, fabrication costs, installation costs, and occupies rack space.	The N6730/40/70 are compact modules integrated into a 1U rack mountable mainframe. There is no need to design or build any custom mounting hardware.
Safety	You may want to provide a safety interlock to this DC source. This would require control (on/off) and a means to detect the interlock condition.	The N6730/40/70 have hardware inputs for remote on/off that can be directly connected to a safety interlock system.

Agilent N6751A/N6752A, N6753A, N6754A and N6761A/N6762A Performance Specifications

Unless otherwise noted, specifications are warranted over the ambient temperature range of 0 to 55°C after a 30-minute warm-up period, with each module's sense terminals externally jumpered directly to their respective output terminals (local sensing).

Note: Performance specifications for the N6780 SMU modules can be found at **www.agilent.com/find/N6780**. *See the N6780 Series Source/ Measure Units (SMUs) for the N6700 Modular Power System Data Sheet, literature number 5990-5829EN.*

		N6751A/ N6752A	N6753A	N6754A	N6761A/ N6762A
DC output ratings					
	Voltage	50 V	20 V	60 V	50 V
	Current (derated 1% per °C above 40°C)	5 A / 10 A	50 A	20 A	1.5 A / 3 A
	Power	50 W / 100 W	300 W	300 W	50 W / 100 W
Output ripple and noise (PARD)					
(from 20 Hz – 20 MHz)	CV peak-to-peak	4.5 mV	5 mV	6 mV	4.5 mV
	CV rms	350 µV	1 mV	1 mV	350 µV
Load effect (Regulation)					
(for any output load change,	Voltage	2 mV	2 mV	2 mV	0.5 mV
with a maximum load-lead	Current (@ 0 - 7 V)	2 mA	12 mA	5 mA	30 µA
drop of 1 V per lead)	(@ 0 - 50 V)	2 mA	12 mA	5 mA	65 µA
Source effect (Regulation)	Voltage	1 mV	0.5 mV	1.2 mV	0.5 mV
	Current1 mA	5 mA	2 mA	30 µA	
Programming accuracy					
(at 23°C ±5°C	Voltage high range	0.06% + 19 mV	0.06% + 10 mV	0.06% + 25 mV	0.016% + 6 mV
after 30 minute	Voltage low range (≤ 5.5 V)	N/A	N/A	N/A	0.016% + 1.5 mV
warm-up. Applies	Current high range	0.1% + 20 mA	0.10% + 30 mA	0.10% + 8 mA	0.04% + 200 µA
from min. to max.	Current low range (≤ 100 mA, @ 0 - 7 V)	N/A	N/A	N/A	0.04% + 15 µA
programming range)	(≤ 100 mA, @ 0 - 50 V)	N/A	N/A	N/A	0.04% + 55 µA
Measurement accuracy					
(at 23°C ±5°C)	Voltage high range	0.05% + 20 mV	0.05% + 10 mV	0.05% + 25 mV	0.016% + 6 mV
	Voltage low range (≤ 5.5 V)	N/A	N/A	N/A	0.016% + 1.5 mV
	Current high range	0.1% + 4 mA	0.10% + 30 mA	0.10% + 8 mA	0.04% + 160 µA
	Current low range (≤ 100 mA, @ 0 - 7 V) [NOTE 1]	N/A	N/A	N/A	0.03% + 15 µA [NOTE 2]
	(≤ 100 mA, @ 0 - 50 V)	N/A	N/A	N/A	0.03% + 55 µA
Load transient recovery time					
(time to recover to within the settling band following a load change)					
• from 60% to 100% and from 100% to 60% of full load for models N6751A & N6761A					
• from 50% to 100% and from 100% to 50% of full load for models N6752A-N6754A & N6762A.					
	Voltage settling band	± 75 mV [NOTE 2]	± 30 mV	± 90 mV [NOTE 3]	± 75 mV
	Time	< 100 µs	< 100 µs	< 100 µs	< 100 µs

[1] Applies when measuring 4096 data points (SENSe:SWEep:POINts = 4096).

[2] Settling band is ±125 mV for Model N6752A when relay option 761 is installed.

[3] Settling band is ±350 mV for Model N6754A when relay option 760 or 761 is installed.

Agilent N6751A/N6752A, N6753A, N6754A and N6761A/N6762A Supplemental Characteristics

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

		N6751A/ N6752A	N6753A	N6754A	N6761A/ N6762A
Programming ranges					
	Voltage high range	20 mV – 51 V	10 mV – 24.48 V	25 mV – 61.2 V	15 mV – 51 V
	Voltage low range (≤ 5.5 V)	N/A	N/A	N/A	12 mV – 5.5 V
	Current high range	10 mA – 5.1 A/ 10 mA – 10.2 A	50 mA – 51 A	20 mA – 20.4 A	1 mA – 1.53 A/ 1 mA – 3.06 A
	Current low range (≤ 0.1 A)	N/A	N/A	N/A	0.1 mA – 0.1 A NOTE 1
Programming resolution					
	Voltage high range	3.5 mV NOTE 2	1.5 mV NOTE 2	4.2 mV NOTE 2	880 µV NOTE 3
	Voltage low range (≤ 5.5 V)	N/A	N/A	N/A	90 µV
	Current high range	3.25 mA NOTE 4	16.3 mA NOTE 4	6.5 mA NOTE 4	60 µA
	Current low range (≤ 0.1 A)	N/A	N/A	N/A	2 µA
Measurement resolution					
	Voltage high range	1.8 mV NOTE 5	0.8 mV NOTE 5	2.2 mV NOTE 5	440 µV NOTE 6
	Voltage low range (≤ 5.5 V)	N/A	N/A	N/A	44 µV
	Current high range	410 µA	2.05 mA	820 µA	30 µA
	Current low range (≤ 0.1 A)	N/A	N/A	N/A	1 µA
Programming temperature coefficient per °C					
	Voltage high range	18 ppm + 160 µV	20 ppm + 20 µV	20 ppm + 50 µV	18 ppm + 140 µV
	Voltage low range (≤ 5.5 V)	N/A	N/A	N/A	40 ppm + 70 µV
	Current high range	100 ppm + 45 µA	60 ppm + 500 µA	60 ppm + 200 µA	33 ppm + 10 µA
	Current low range (≤ 0.1 A)	N/A	N/A	N/A	60 ppm + 1.5 µA
Measurement temperature coefficient per °C					
	Voltage high range	25 ppm + 35 µV	20 ppm + 20 µV	20 ppm + 50 µV	23 ppm + 40 µV
	Voltage low range (≤ 5.5 V)	N/A	N/A	N/A	30 ppm + 40 µV
	Current high range	60 ppm + 3 µA	60 ppm + 30 µA	60 ppm + 12 µA	40 ppm + 0.3 µA
	Current low range (≤ 0.1 A)	N/A	N/A	N/A	50 ppm + 0.3 µA
Output ripple and noise (PARD)					
	CC rms	2 mA	10 mA	4 mA	2 mA
Common mode noise					
(from 20 Hz – 20 MHz;	rms	500 µA	500 µA	750 µA	500 µA
from either output to chassis)	peak-to-peak	< 2 mA	2 mA	3 mA	< 2 mA
Over-voltage protection					
	Accuracy	0.25% + 250 mV	0.25% ±150 mV	0.25% ±300 mV	0.25% + 250 mV
	Maximum setting	55 V	22 V	66 V	55 V
	Response time	50 µs from occurrence of over-voltage condition to start of output shutdown			

[1] If you are operating the unit below 255 µA in constant current mode, the output may become unregulated with the following load conditions: The load resistance is <175 mΩ **and** the load inductance is >20 µH. If this occurs, an UNRegulated flag will be generated and the output current may rise above the programmed value but will remain less than 255 µA.
[2] Based on 14-bit DAC, with DAC range adjusted by software calibration
[3] Based on 16-bit DAC, with DAC range adjusted by software calibration
[4] Based on 12-bit DAC, with DAC range adjusted by software calibration
[5] Based on 16-bit ADC (15 bits plus sign), with ADC range adjusted by software calibration
[6] Based on 18-bit ADC (17 bits plus sign), with ADC range adjusted by software calibration

Agilent N6751A/N6752A, N6753A, N6754A and N6761A/N6762A Supplemental Characteristics

(Continued)

		N6751A/ N6752A	N6753A	N6754A	N6761A/ N6762A
Maximum up-programming time with full resistive load (time from 10% to 90% of total voltage excursion)	For voltage change of	0 to 10 V	0 to 6 V	0 to 15 V	0 to 10 V
	Up-programming time	0.2 ms	0.3 ms	0.3 ms	0.6 ms
	For voltage change of	0 to 50 V	0 to 20 V	0 to 60 V	0 to 50 V
	Up-programming time	1.5 ms	1.5 ms	2.0 ms	2.2 ms
Maximum up-programming settling time with full resistive load (time from start of voltage change to within 50 mV of final value)	For voltage change of	0 to 10 V	0 to 6 V	0 to 15 V	0 to 10 V
	Up-programming settling time	0.5 ms	2.0 ms	2.0 ms	0.9 ms
	For voltage change of	0 to 50 V	0 to 20 V	0 to 60 V	0 to 50 V
	Up-programming settling time	4.0 ms	3.0 ms	4.0 ms	4.0 ms
Maximum down-programming time with no load (time from start of voltage change to output voltage < 0.5 V)	For voltage change of	10 to 0 V	6 to 0 V	15 to 0 V	10 to 0 V
	Down-programming time	0.3 ms	0.5 ms	0.6 ms	0.3 ms
	For voltage change of	50 to 0 V	20 to 0 V	60 to 0 V	50 to 0 V
	Down-programming time	1.3 ms	1.6 ms	2.0 ms	1.3 ms
Maximum down-programming settling time with no load (time from start of voltage change to output voltage within 50 mV of final value)	For voltage change of	10 to 0 V	6 to 0 V	15 to 0 V	10 to 0 V
	Down-programming settling time	0.45 ms	0.7 ms	0.7 ms	0.45 ms
	For voltage change of	50 to 0 V	20 to 0 V	60 to 0 V	50 to 0 V
	Down-programming settling time	1.4 ms	3.0 ms	3.0 ms	1.4 ms
Down-programming time with capacitive load [NOTE 1] (time from start of voltage change to output voltage < 0.5 V)	Capacitive load	1000 µF [NOTE 1]	4700 µF [NOTE 2]	680 µF [NOTE 3]	1000 µF [NOTE 1]
	For voltage change of	10 to 0 V	6 to 0 V	15 to 0 V	10 to 0 V
	Down-programming time	0.3 ms	0.5 ms	0.6 ms	0.3 ms
	For voltage change of	50 to 0 V	20 to 0 V	60 to 0 V	50 to 0 V
	Down-programming time	1.3 ms	1.6 ms	2.0 ms	1.3 ms
Down-programming capability	Continuous power	7 W	12.5 W	12.5 W	7 W
	Peak current	7 A	15 A	6 A	3.8 A
Remote sense capability		Outputs can maintain specifications with up to a 1-volt drop per load lead.			
Series and parallel operation		Identically rated outputs can be operated directly in parallel or can be connected for straight series operation. Auto-series and auto-parallel operation is not available.			

[1] Modules can discharge a 1000 µF capacitor from 50 V to 0 V at a rate of 4 times/second.
[2] Modules can discharge a 4700 µF capacitor from 20 V to 0 V at a rate of 4 times/second.
[3] Modules can discharge a 680 µF capacitor from 60 V to 0 V at a rate of 4 times/second.

Agilent N6731B – N6736B and N6741B – N6746B Performance Specifications

Unless otherwise noted, specifications are warranted over the ambient temperature range of 0 to 55°C after a 30-minute warm-up period, with each module's sense terminals externally jumpered directly to their respective output terminals (local sensing)

		N6731B/ N6741B	N6732B/ N6742B	N6733B/ N6743B	N6734B/ N6744B	N6735B/ N6745B	N6736B/ N6746B
DC output ratings:							
	Voltage	5 V	8 V	20 V	35 V	60 V	100 V
	Current [NOTE 1]	10 A / 20 A	6.25 A / 12.5 A [NOTE 3]	2.5 A / 5 A	1.5 A / 3 A	0.8 A / 1.6 A	0.5 A / 1 A
	Power	50 W / 100 W	50 W / 100 W	50 W / 100 W	52.5 W / 105 W	50 W / 100 W	50 W / 100 W
Output ripple and noise (PARD) (from 20 Hz – 20 MHz)	CV peak-to- peak	10 mV / 11 mV	12 mV	14 mV	15 mV	25 mV	30 mV
	CV rms	2 mV	2 mV	3 mV	5 mV	9 mV	18 mV
Load effect (Regulation) (with output change from no load to full load, up to a maximum load-lead drop of 1 V/lead)	Voltage	5 mV	6 mV	9 mV	11 mV	13 mV / 16 mV	20 mV / 30 mV
	Current	2 mA	2 mA	2 mA	2 mA	2 mA	2 mA
Source effect (Regulation)	Voltage	1 mV	2 mV	2 mV	4 mV	6 mV	10 mV
	Current	1 mA	1 mA	1 mA	1 mA	1 mA	1 mA
Programming accuracy (@ 23 °C ±5°C after 30 minute warm-up. Applies from minimum to maximum programming range)	Voltage	0.1% + 19 mV	0.1% + 19 mV	0.1% + 20 mV	0.1% + 35 mV	0.1% + 60 mV	0.1% + 100 mV
	Current	0.15% + 20 mA	0.15% + 20 mA	0.15% + 20 mA	0.15% + 20 mA	0.15% + 20 mA	0.15% + 10 mA
Measurement accuracy (at 23°C ±5°C)	Voltage	0.1% + 20 mV	0.1% + 20 mV	0.1% + 20 mV	0.1% + 35 mV	0.1% + 60 mV	0.1% + 100 mV
	Current	0.15% + 20 mA	0.15% + 10 mA	0.15% + 5 mA	0.15% + 4 mA	0.15% + 4 mA	0.15% + 2 mA
Load transient recovery time (time to recover to within the settling band following a load change from 50% to 100% and from 100% to 50% of full load.)							
	Voltage settling band	±0.08 V / 0.1 V [NOTE 2]	±0.08 V / 0.1 V [NOTE 2]	± 0.2 V / 0.3 V	± 0.2 V / 0.3 V	± 0.4 V / 0.5 V	± 0.5 V / 1.0 V
	Time	< 200 µs	< 200 µs	< 200 µs	< 200 µs	< 200 µs	< 200 µs

[1] Output current is derated 1% per °C above 40°C.
[2] Settling band is ±0.10 V/0.125 V for 5 V and 8 V models when relay options 760 and 761 are installed.
[3] For N6742B, output current is limited to 10 A when option 760 Output Disconnect/Polarity Reversal Relays is installed.

Agilent N6731B – N6736B and N6741B – N6746B Supplemental Characteristics

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

		N6731B/ N6741B	N6732B/ N6742B	N6733B/ N6743B	N6734B/ N6744B	N6735B/ N6745B	N6736B/ N6746B
Programming ranges	Voltage	15 mV – 5 .1 V	15 mV – 8 .16 V	30 mV – 20.4 V	40 mV – 35.7 V	70 mV – 61.2 V	100 mV – 102 V
	Current	60 mA – 10.2 A/ 60 mA – 20.4 A	40 mA –6.375 A/ 40 mA – 12.75 A	10 mA – 2.55 A/ 10 mA – 5.1 A	5 mA – 1.53 A/ 5 mA – 3.06 A	2.5 mA – 0.85 A/ 2.5 mA – 1.7 A	1.5 mA – 0.51 A/ 1.5 mA – 1.02 A
Programming resolution NOTE 1							
	Voltage	3.5 mV	4 mV	7 mV	10 mV	18 mV	28 mV
	Current	7 mA	4 mA	3 mA	2 mA	1 mA	0.5 mA
Measurement resolution NOTE 2							
	Voltage	3 mV	4 mV	10 mV	18 mV	30 mV	50 mV
	Current	10 mA	7 mA	3 mA	2 mA	1 mA	0.5 mA
Programming temperature coefficient per °C	Voltage	0.005% + 0.1 mV	0.005% + 0.1 mV	0.005% + 0.2 mV	0.005% + 0.5 mV	0.005% + 0.5 mV	0.005% + 1 mV
	Current	0.005% + 1 mA	0.005% + 0.5 mA	0.005% + 0.1 mA	0.005% + 0.05 mA	0.005% + 0.02 mA	0.005% + 0.02 mA
Measurement temperature coefficient per °C	Voltage	0.01% + 0.1 mV	0.01% + 0.1 mV	0.01% + 0.2 mV	0.01% + 0.2 mV	0.01% + 0.5 mV	0.01% + 0.5 mV
	Current	0.01% + 1 mA	0.01% + 0.5 mA	0.01% + 0.1 mA	0.01% + 0.05 mA	0.01% + 0.02 mA	0.01% + 0.02 mA
Output ripple and noise (PARD)	CC rms	8 mA	4 mA	2 mA	2 mA	2 mA	2 mA
Common mode noise (from 20 Hz – 20 MHz; from either output to chassis)	rms	1 mA	1 mA	1 mA	1 mA	1 mA	1 mA
	peak-to-peak	< 15 mA	< 10 mA	< 10 mA	< 10 mA	< 10 mA	< 10 mA
Over-voltage protection							
	Accuracy	0.25% + 50 mV	0.25% + 50 mV	0.25% + 75 mV	0.25% + 100 mV	0.25% + 200 mV	0.25% + 250 mV
	Accuracy w/opt 760	0.25% + 600 mV	0.25% + 600 mV	0.25% + 350 mV	0.25% + 250 mV	0.25% + 300 mV	0.25% + 300 mV
	Accuracy w/opt 761	0.25% + 600 mV	0.25% + 600 mV	0.25% + 350 mV	0.25% + 250 mV	0.25% + 300 mV	0.25% + 300 mV
	Maximum setting	7.5 V	10 V	22 V	38.5 V	66 V	110 V
	Response time	50 µs from occurrence of over-voltage condition to start of output shutdown					
Maximum up-programming and down-programming Time with full resistive load (time from 10% to 90% of total voltage excursion)							
Voltage setting from 0 V to full scale and full scale to 0 V		20 ms	20 ms	20 ms	20 ms	20 ms	20 ms
Maximum up-programming and down-programming settling tme with full resistive load (time from start of voltage change until voltage settles within 0.1% of the full-scale voltage of its final value)							
Voltage setting from 0 V to full scale and full scale to 0 V		100 ms	100 ms	100 ms	100 ms	100 ms	100 ms
Remote sense capability		Outputs can maintain specifications with up to a 1-volt drop per load lead.					
Series and parallel operation		Identically rated outputs can be operated directly in parallel or can be connected for straight series operation. Auto-series and auto-parallel operation is not available.					

[1] Based on 12-bit DAC, with DAC range adjusted by software calibration
[2] Based on 12-bit ADC (11 bits plus sign), with ADC range adjusted by software calibration

Agilent N6773A – N6776A Performance Specifications

Unless otherwise noted, specifications are warranted over the ambient temperature range of 0 to 55°C after a 30-minute warm-up period, with each module's sense terminals externally jumpered directly to their respective output terminals (local sensing).

		N6773A	N6774A	N6775A	N6776A
DC output ratings					
	Voltage	20 V	35 V	60 V	100 V
	Current NOTE 1	15 A NOTE 3	8.5 A	5 A	3 A
	Power	300 W	300 W	300 W	300 W
Output ripple and noise (PARD)					
(from 20 Hz – 20 MHz)	CV peak-to- peak	20 mV	22 mV	35 mV	45 mV
	CV rms	3 mV	5 mV	9 mV	18 mV
Load effect (Regulation)					
(with output change from no load to full load, up to a maximum load-lead drop of 1 V/lead)	Voltage	13 mV	16 mV	24 mV	45 mV
	Current	6 mA	6 mA	6 mA	6 mA
Source effect (Regulation)					
	Voltage	2 mV	4 mV	6 mV	10 mV
	Current	1 mA	1 mA	1 mA	1 mA
Programming accuracy:					
(@ 23°C ±5°C after 30 minute warm-up. Applies from minimum to maximum programming range)	Voltage	0.1% + 20 mV	0.1% + 35 mV	0.1% + 60 mV	0.1% +100 mV
	Current	0.15% + 60 mA	0.15% + 60 mA	0.15% + 60 mA	0.15% + 30 mA
Measurement accuracy					
(at 23°C ±5°C)	Voltage	0.1% + 20 mV	0.1% + 35 mV	0.1% + 60 mV	0.1% +100 mV
	Current	0.15% + 15 mA	0.15% + 12 mA	0.15% + 12 mA	0.15% + 6 mA
Load transient recovery time					
(time to recover to within the settling band following a load change from 50% to 100% and from 100% to 50% of full load.)					
	Voltage settling band	± 0.3 V NOTE 2	± 0.3 V NOTE 2	± 0.5 V	± 1.0 V
	Time	< 250 µs	< 250 µs	< 250 µs	< 250 µs

[1] Output current is derated 1% per °C above 40°C.

[2] Settling band is ±0.35 V for 20 V and 35 V Models when relay options 760 and 761 are installed.

[3] For N6773A, output current is limited to 10 A when option 760 Output Disconnect/Polarity Reversal Relays is installed.

Agilent N6773A – N6776A Supplemental Characteristics

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

		N6773A	N6774A	N6775A	N6776A
Programming ranges	Voltage	30 mV – 20.4 V	40 mV – 35.7 V	70 mV – 61.2 V	100 mV – 102 V
	Current	30 mA – 15.3 A	15 mA – 8.67 A	7.5 mA – 5.1 A	4.5 mA – 3.06 A
Programming resolution NOTE 1	Voltage	7 mV	10 mV	18 mV	28 mV
	Current	9 mA	6 mA	3 mA	1.5 mA
Measurement resolution NOTE 2	Voltage	10 mV	18 mV	30 mV	50 mV
	Current	9 mA	6 mA	3 mA	1.5 mA
Programming temperature coefficient per °C	Voltage	0.01% + 0.2 mV	0.01% + 0.5 mV	0.01% + 0.5 mV	0.01% + 1 mV
	Current	0.01% + 0.5 mA	0.01% + 0.5 mA	0.01% + 0.1 mA	0.01% + 0.1 mA
Measurement temperature coefficient per °C	Voltage	0.01% + 0.2 mV	0.01% + 0.2 mV	0.01% + 0.5 mV	0.01% + 0.5 mV
	Current	0.01% + 0.5 mA	0.01% + 0.5 mA	0.01% + 0.05 mA	0.01% + 0.05 mA
Output ripple and noise (PARD)	CC rms	6 mA	6 mA	6 mA	6 mA
Common mode noise (from 20 Hz – 20 MHz; from either output to chassis)	Rms	2 mA	2 mA	2 mA	2 mA
	Peak-to- peak	< 20 mA	< 20 mA	< 20 mA	< 20 mA
Over-voltage Protection	Accuracy	0.25% +100 mV	0.25% + 130 mV	0.25% + 260 mV	0.25% + 650 mV
	Accuracy w/opt 760	0.25% + 700 mV	0.25% + 700 mV	0.25% + 400 mV	0.25% + 650 mV
	Accuracy w/opt 761	0.25% + 500 mV	0.25% + 350 mV	0.25% + 350 mV	0.25% + 650 mV
	Maximum setting	22 V	38.5 V	66 V	110 V
	Response time	50 µs from occurrence of over-voltage condition to start of output shutdown			
Maximum up-programming and down-programming time with full resistive load (time from 10% to 90% of total voltage excursion)	Voltage setting from 0 V to full scale and full scale to 0 V	20 ms	20 ms	20 ms	20 ms
Maximum up-programming and down-programming settling time with full resistive load (time from start of voltage change until voltage settles within 0.1% of the full-scale voltage of its final value)	Voltage setting from 0 V to full scale and full scale to 0 V	100 ms	100 ms	100 ms	100 ms
Remote sense capability		Outputs can maintain specifications with up to a 1-volt drop per load lead.			
Series and parallel operation		Identically rated outputs can be operated directly in parallel or can be connected for straight series operation. Auto-series and auto-parallel operation is not available.			

[1] Based on 12-bit DAC, with DAC range adjusted by software calibration

[2] Based on 12-bit ADC (11 bits plus sign), with ADC range adjusted by software calibration

Agilent N6700B, N6701A, N6702A MPS Mainframes

N6700B, N6701A, N6702A

Maximum total output power (= sum of total module output power)	N6700B	400 W	when operating from 100 – 240 VAC input
	N6701A	600 W	when operating from 100 – 240 VAC input
	N6702A	1200 W	when operating from 200 – 240 VAC input
		600 W	when operating from 100 – 120 VAC input
Command processing time	From receipt of command to start of the output change	≤ 1 ms	
Protection response characteristics	INH input	5 µs from receipt of inhibit to start of shutdown	
	Fault on coupled outputs	< 10 µs (from receipt of fault to start of shutdown)	
Digital control characteristics	Maximum voltage ratings	16.5 VDC/- 5 VDC between pins (pin 8 is internally connected to chassis ground).	
	Pins 1 and 2 as FLT output	Maximum low-level output voltage = 0.5 V @ 4 mA Maximum low-level sink current = 4 mA Typical high-level leakage current = 0.14 mA @ 16.5 VDC	
	Pins 1 - 7 as digital/trigger outputs (pin 8 = common)	Maximum low-level output voltage = 0.5 V @ 4 mA; 1 V @ 50 mA; 1.75 V @ 100 mA Maximum low-level sink current = 100 mA Typical high-level leakage current = 0.12 mA @ 16.5 VDC	
	Pins 1 - 7 as digital/trigger inputs and pin 3 as INH input (pin 8 = common)	Maximum low-level input voltage = 0.8 V Minimum high-level input voltage = 2 V Typical low-level current = 2 mA @ 0 V (internal 2.2 k pull-up) Typical high-level leakage current = 0.12 mA @ 16.5 VDC	
Interface capabilities	GPIB:	SCPI - 1993, IEEE 488.2 compliant interface	
	LXI compliance	Class C (applies to mainframes with firmware revision C.00.02 and up)	
	USB 2.0	Requires Agilent IO Library version M.01.01 and up, or 14.0 and up	
	10/100 LAN	Requires Agilent IO Library version L.01.01 and up, or 14.0 and up	
	Built-in web server	Requires Internet Explorer 5+ or Netscape 6.2+	
Environmental conditions	Operating environment	Indoor use, installation category II (for AC input), pollution degree 2	
	Temperature range	0°C to 55°C (current is derated 1% per °C above 40°C ambient temperature)	
	Relative humidity	Up to 95%	
	Altitude	Up to 2000 meters	
	Storage temperature	-30°C to 70°C	
	LED statement	Any LEDs used in this product are Class 1 LEDs as per IEC 825-1	

Agilent N6700B, N6701A, N6702A MPS Mainframes (Continued)

		N6700B, N6701A, N6702A
Regulatory compliance	EMC	Complies with the European EMC directive 89/336/EEC for Class A test and measurement products.
		Complies with the Australian standard and carries the C-Tick mark.
		This ISM device complies with Canadian ICES-001.
		Cet appareil ISM est conforme à la norme NMB-001 du Canada.
		Electrostatic discharges greater than 1 kV near the I/O connectors may cause the unit to reset and require operator intervention.
	Safety	Complies with the European Low Voltage Directive 73/23/EEC and carries the CE-marking. This product also complies with the US and Canadian safety standards for test and measurement products.
Acoustic noise declaration	This statement is provided to comply with the requirements of the German Sound Emission Directive, from 18 January 1991.	Sound Pressure Lp < 70 dB(A), *At Operator Position, *Normal Operation, *According to EN 27779 (Type Test). Schalldruckpegel Lp <70 dB(A) *Am Arbeitsplatz, *Normaler Betrieb, *Nach EN 27779 (Typprüfung).
Output terminal isolation	Maximum Rating	No output terminal may be more than 240 VDC from any other terminal or chassis ground.
AC input	Nominal input ratings	100 VAC – 240 VAC; 50/60 Hz/400 Hz
	Input range	86 VAC – 264 VAC
	Power consumption	1000 VA typical (N6700B mainframes) 1500 VA typical (N6701A mainframes) 3000 VA typical (N6702A mainframes)
	Fuse	Internal fuse (not customer accessible)
Dimensions	Height	44.45 mm; 1.75 in.
	Width	432.5 mm; 17.03 in.
	Depth (including handles)	585.6 mm; 23.06 in. (N6700B/N6701A mainframes) 633.9 mm; 24.96 in. (N6702A mainframes)
Weight	N6700B with 4 installed modules	Net: 12.73 kg; 28 lbs.
	N6701A with 4 installed modules	Net: 11.82 kg; 26 lbs.
	N6702A with 4 installed modules	Net: 14.09 kg; 31 lbs.
	Single-wide power module	Net: 1.23 kg; 2.71 lbs
	Double-wide power module	Net: 2.18 kg; 4.8 lbs

Power Module Option Characteristics

Output relays (Option 760/761)

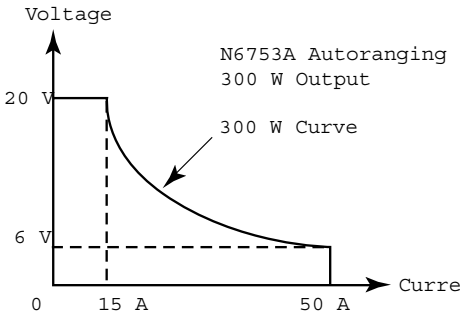
- **Type**
  Double-pole, double-throw
- **Location**
  output & sense terminals

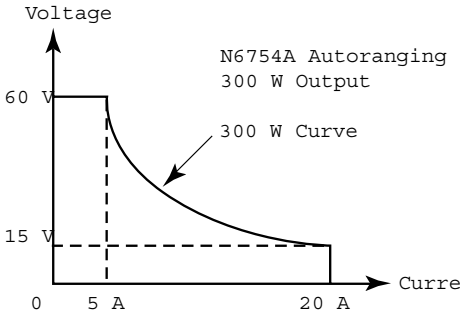
Output lists (Option 054):

- Maximum number of steps = 512
- Maximum dwell time in seconds = 262
- Maximum list repetitions = 256, or infinite

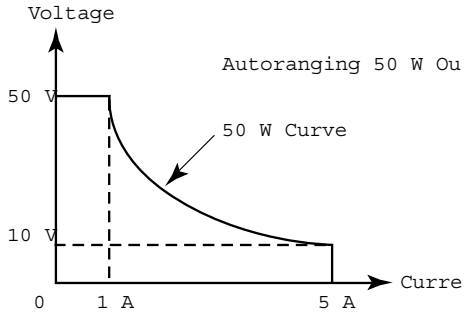
Digitized measurements (Option 054)

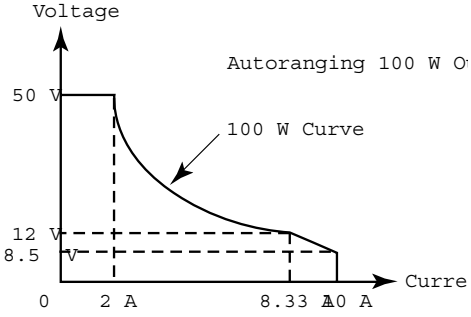
- Maximum measurement points = 4096
- Maximum sample rate = 50 kHz

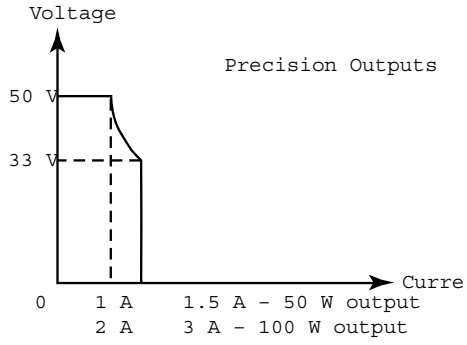




Autoranging Characteristic







Outline Diagram