

Side-by-Side Comparison: Agilent N5700 System DC Source and Xantrex XFR DC Power Supply

Comparison of an Agilent N5767A (1.5 kW)
with a Xantrex XFR60-20 (1.2 kW)

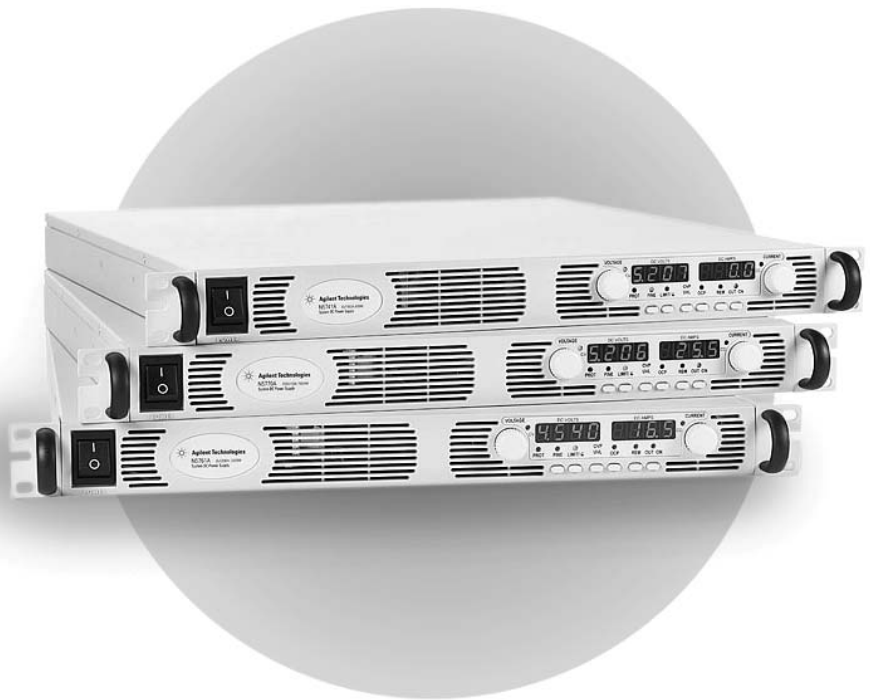
Application Note 1502-2

Introduction

Some power supplies are better suited to system use than others. System-ready power supplies simplify the assembly, programming, debugging and operation of test systems. The key attributes of a system-ready supply go beyond versatile output capabilities to include sensing and measurement functions, a choice of interfaces, compact size and high power density. A system-ready supply will make it easier for you to develop and integrate your test system.

In this guide, we compare two system products: the Agilent N5767A 1.5-kW system DC source and the Xantrex XFR60-20 1.2 kW DC power supply. Agilent has verified or tested all of the features and specifications discussed in this document. Points of comparison include electrical characteristics, programming capabilities, computer interfaces and general features.

Please see page 8 for a list of the other titles in this series as well as relevant product literature.



Throughout this note we use the following shorthand when referring to the various products and product families:

- “N5767A” refers only to the Agilent N5767A 60 V/25 A system DC power supply
- “N5700 Series” refers to the entire Agilent N57xx product family
- “XFR60-20” refers only to the Xantrex XFR60-20 60 V/20 A DC power supply
- “XFR series” refers to the entire Xantrex XFR product family

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Comparing electrical performance

A power supply's voltage, current and power ratings are the key factors that determine its fit with any application. If the available ratings match your needs, then it will be worthwhile to evaluate the other features the supply offers.

Voltage, current and power

Table 1 provides a snapshot of the models available in the Agilent N5700 1.5 kW and Xantrex XFR 1.2 kW product families. It shows that the N5700 Series provides higher current and power ratings than all but the XFR 6-200 model. However, the XFR 6-200 derates 1.5A for every degree Celsius above 30°C.

Key electrical specifications

Output noise and measurement accuracy can affect the DUT and the quality of your measurement results.

Output noise

Comparing specified performance (**Table 2**), we can see that output noise specifications are similar for the two power supplies, except for the specifications for CC_{rms} noise. This discrepancy is partially attributable to the N5767A's extra current capability. The N5767A provides 25 percent more current than the XFR60-20.

Agilent N5700 1.5 kW*				Xantrex XFR 1.2 kW Models			
Model	Voltage (V)	Current (A)	Power (W)	Model	Voltage (V)	Current (A)	Power (W)
N5761A	6	180	1080	XFR 6-200	6	200**	1200
N5762A	8	165	1320	XFR 7.5-140	7.5	140	1050
N5763A	12.5	120	1500	XFR 12-100	12	100	1200
N5764A	20	76	1520	XFR 20-60	20	60	1200
N5765A	30	50	1500	XFR 35-35	35	35	1225
N5766A	40	38	1520	XFR 40-30	40	30	1200
N5767A	60	25	1500	XFR 60-20	60	20	1200
N5768A	80	19	1520	N/A	N/A	N/A	N/A
N5769A	100	15	1500	XFR 100-12	100	12	1200
N5770A	150	10	1500	XFR 150-8	150	8	1200
N5771A	300	5	1500	XFR 300-4	300	4	1200
N5772A	600	2.6	1560	XFR 600-2	600	2	1200

* The N5700 Series also includes a family of 750-W power supplies.

** XFR6-200 derates 1.5 A for every degree Celsius above 30°C (example: 170 A at 50°C)

Table 1: Comparison of the voltage, current and power ratings of the N5700 Series and the XFR series

	N5767A	XFR60-20 ¹
CV_{p-p}	60 mV	55 mV
CV_{rms}	8 mV	6 mV
CC_{rms}	75 mA	15 mA

Table 2: Comparison of output noise specifications

¹ From Xantrex XFR Datasheet. Xantrex XFR manual release 3.1 has worse noise specifications for the XFR60-20; CV_{p-p} 150 mV, CV_{rms} 10 mV, CC_{rms} 100 mA

Measurement accuracy

Table 3 shows the accuracy of voltage and current measurements when results are reported via interface bus (not the front panel readout). We can see that the N5767A offers much better measurement accuracy than the XFR60-20. Better power supply measurement accuracy can help you avoid purchasing additional hardware like a DMM and external shunt.

Parallel output for higher current

Connecting two or more power supplies in parallel increases the current available to test a device. Making this capability work properly and predictably, however, requires more than simply wiring the units together. The linked units must be able to communicate and provide the control necessary to ensure safe, accurate operation and easy programming.

Up to four N5700 power supplies with the same voltage and current ratings (identical models) can be connected in a master/slave relationship to provide up to four times the current of a single unit, using

	N5767A	XFR60-20
Voltage	0.1% + 60 mV	0.25% + 150 mV
Current	0.1% + 75 mA	0.1% + 120 mA

Table 3: Comparison of interface measurement accuracy

Agilent's "auto-parallel" capability². With auto-parallel, you simply program the master, and it uses a single insulated wire to control each of the other units.

The XFR series has a similar feature, but it is available only with the GPIB-M optional interface. It provides the ability to auto-parallel up to five power supplies of the same model number for five times the current of a single unit². Setting up auto-parallel capability on the XFR series is more complicated than with the N5700 Series, because the XFR series requires you to set up a special multi-channel mode and use a CANbus 4-wire configuration.

Electrical performance summary

N5700 power supplies typically offer 300 watts more power than the XFR series counterpart models. The extra current gives you more margin and lets you test higher-power devices. The N5767A offers a big advantage in terms of measurement accuracy, which gives you peace of mind that your measurements are within a narrow accuracy band. The XFR60-20 offers slightly better output noise specs. However, the noise specs for the N5767A are adequate for most DUTs that require more than a kilowatt of power. In addition, the Agilent power supply's auto-parallel feature makes it easier to program your system over any interface when you need higher current.

² The N5700 Series provides 25% more current than the XFR. Therefore, when paralleling units although you can only parallel four N5700 power supplies versus five XFR power supplies, you end up with the same amount of current.
(Example: 4 X N5767A = 4 X 25 A = 100 A;
5 X XFR60-20 = 5 X 20 A = 100 A.)

Evaluating programming capabilities

In this section, we consider several aspects of instrument programming that can affect development time, system performance, software reuse and more.

Choice of interfaces

GPIB has been the *de facto* standard for test system input/output (I/O) for many years. In the computer world, cost-effective, easy-to-use LAN and USB interfaces have become pervasive, and most current-generation PCs include both types of ports. LAN and USB ports are becoming more common in test equipment³ and they offer test-system developers distinct advantages.

Every model in the N5700 Series includes GPIB, LAN and USB interfaces as standard equipment. All three are active at all times and may be used simultaneously, though not for the same task (for example, only one can be used for instrument control). With all three built in, you can choose the best interface for today's requirements and easily switch in the future—with no additional cost. All of the interfaces support Standard Commands for Programmable Instruments (SCPI) and are compatible with the Agilent 603x series and Xantrex's proprietary language.

The XFR series also offers GPIB, RS-232, and LAN interfaces, but no USB interface. However, the LAN interface employs an RS-232-to-LAN converter, which acts like an RS-232 port and operates at slower RS-232 speeds. You may experience difficulty when you try to program your instrument using this LAN-like interface in most programming environments, as it does not use the standard libraries. Also, the XFR series limits your flexibility, because it allows you to install only one interface in a unit at a time—either GPIB, RS-232 or LAN/RS-232. In addition, each interface has its own associated programming language. For example, there are two programming options for GPIB, one with a proprietary command set and one with a SCPI command set. The LAN/RS-232 interface only accepts the proprietary command set. This limitation makes it difficult to choose which interface to use, and it makes it difficult and costly to change from one interface to the next, as your needs change.

Single-command configuration

In a test system, the ability to store and recall frequently used configurations with a single command reduces setup time and makes testing more efficient. The N5700 Series can store and recall up to 16 different instrument states, each with just one command. The XFR series doesn't offer this capability, meaning it could take hundreds of milliseconds to set up a complex configuration via GPIB.

Graphical user interface

The N5700 Series has a built-in Web server that provides a Web-browser-based graphical user interface (GUI) that gives you the ability to configure, control and monitor your power supply (Figure 1). You access this capability through the LAN interface; because all three interfaces are active at the same time, you can control a unit via GPIB or USB and monitor it via the LAN port. This can be very useful when debugging or monitoring a test program.

XFR models with the M9B interface have a GUI that provides monitoring and control of basic power supply functions. XFR models with the LAN/RS-232 interface have a built-in Web browser, but it offers no way to interact with or program the power supply's functions.

³ Agilent is a leader in offering LAN and USB in instruments. To ensure easy connectivity to legacy equipment, Agilent also offers converters such as the E5810A LAN/GPIB gateway and the 82357A USB/GPIB interface. For more information about these devices, go to www.agilent.com/find/gpib.

Emergency shut down

When a fault or emergency occurs, the ability to inhibit or shut down the power supply via external control is an important safety feature. The N5700 Series provides this capability through its shutdown feature, which is triggered by an external signal. The N5700 Series can also provide a shutdown signal for other devices that support this feature. You can configure multiple N5700 power supplies to shut down when a fault occurs in any one of the power supplies.

XFR series power supplies can shut down their output when they are triggered by an external signal, but they do not have the ability to source that signal to other devices.

Total programming time

For test system applications, we define total programming time as the time it takes for the power supply to receive a command, process it, and raise the output from 10% to 90% of the programmed value. We tested the digital interfaces on both units by commanding them to output their maximum voltage (60 V). As summarized in **Table 4**, the N5767A is more than twice as fast in a typical programming situation. The Xantrex LAN port showed inconsistent command processing time but seemed to process the command at approximately 100 ms.

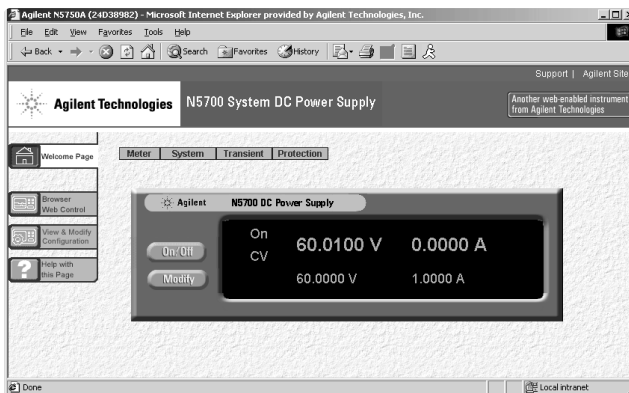


Figure 1. Browser-based GUI for remote access and control of the N5700 Series

Command compatibility

Command compatibility increases software reuse, simplifies instrument interchange and reduces system development time. The N5700 Series is compatible with the widely used Agilent 603x series power supplies. It is also compatible with the most frequently used functions of the XFR series, making it easy for XFR users to switch to Agilent supplies that offer greater power and current. The main compatibility gap is in the calibration procedure, which must be performed as described in the N5700 user's guide.

Programming capabilities summary

The system-ready N5700 Series provides a complete package, offering multiple interfaces, rapid configuration capabilities, browser-based monitoring and control, faster programming time, command compatibility with other products, and more. The N5700 Series power supplies' PC-standard interfaces give you a significant advantage over the XFR series, which offers only GPIB/RS-232 (with limited LAN capability) or analog programming interfaces. The more flexible browser interface on the N5700 also contributes to faster system programming and debugging, while the ability to recall setups with a single command allows faster system operation.

	N5767A			XFR60-20		
	GPIB	LAN	USB	GPIB	LAN*	USB
Command processing time	45 ms	45 ms	45 ms	70 ms	100 ms	N/A
Output voltage rise time	25 ms	25 ms	25 ms	72 ms	72 ms	N/A
Total programming time	70 ms	70 ms	70 ms	142 ms	172 ms	N/A

*Not a true LAN port, LAN/RS-232 converter

Table 4: Comparison of total programming time when commanded to output maximum voltage

Reviewing general attributes

Mechanical attributes such as power per unit volume, airflow and physical size are good measures of a power supply’s suitability for system applications.

Power density and airflow

When you put more power into a smaller package, you open up space in the system rack for other instruments. For example, the N5767A can source up to 1500 W in a true 1U, full-rack package. “True 1U” means that other instruments can be mounted directly above and below the unit without affecting the cooling or operation of the stacked instruments. All models in the N5700 family draw air from the front and exhaust it through the rear panel, avoiding interference with adjacent instruments. This capability allows you, for example, to mount three N5767A power supplies within a 3U rack space, so you can simultaneously source 60 V and 75 A without affecting airflow.

In contrast, the XFR60-20 can source up to 1200 W in a 1U, full-rack package. The XFR60-20 draws air from the side and top for ventilation. Air vents on the top of the XFR60-20 supply would be blocked if you mounted other instruments or other XFR60-20 units directly above it. Blocking the top air vents would raise the operating temperature inside the power supply.

Price per watt

Price is always a factor when evaluating different instruments, but a simple cost comparison may not capture the value per unit price. A normalized figure such as “price per watt” can provide a more meaningful comparison (shown in **Table 5** below).

While the XFR60-20’s price per watt is slightly lower in models with GPIB and RS-232 interfaces, the N5767A offers many advantages—such as all three interfaces standard, compatibility with Xantrex code, and more power in the same size package—that makes it a better value.

Universal AC input

Advances in product design make it possible to connect test instruments to a wide range of AC input voltages without the inconvenience of changing jumpers and fuses or selecting

region-specific product options. However, clean, efficient operation with this type of universal AC input depends on the power factor rating of the device’s internal power supply.

The N5700 Series’ active power factor correction (PFC) allows operation to its full specifications across a continuous range of voltage that spans 85 to 265 Vac. With PFC, the N5700 Series has a power factor of 0.99, which indicates efficient power consumption and minimal emission of current harmonics onto the power line.

The XFR series lacks PFC and therefore does not have a universal input. The XFR must operate in one of two separate ranges; 85 to 130 Vac and 190 to 264 Vac. The power supply will automatically choose the appropriate range, however, problems can arise, for example,

	N5767A			XFR60-20		
	GPIB	LAN	USB	GPIB	RS-232	LAN*
Cost	\$2700** for an instrument with all three interfaces			[\$1420 + \$625]** (single interface)	[\$1420 + \$495]** (single interface)	[\$1420 + \$775]** (single interface)
Cost per watt	\$1.80/watt			\$1.70/watt	\$1.60/watt	\$1.83/watt

* Not a true LAN port, LAN/RS-232 converter

**As of the printing of this document

Table 5: Comparison of the price per watt of the N5767A and the Xantrex XFR60-20

if the power supply is operating in the higher range and there is an AC line voltage drop. Also, the XFR's power factor is 0.65, which means it has higher input currents, which may cause problems with the AC input line.

Customer-downloadable firmware

To help minimize product downtime, you can download firmware updates for the N5700 Series from the Agilent Web site. To ensure a successful update, the N5700 Series utilizes primary and backup copies of the firmware. If problems occur during the update process, such as power outages or installation errors, the unit reverts to the backup version and continues to function properly.

The XFR also supports downloadable firmware, but only for models with the LAN/RS-232 interface. Updates are not available on the Web, as of the printing of this document. No backup firmware exists, and you must return the power supply to the factory if an upgrade is not successful.

General attributes summary

The N5700 Series offers more value and flexibility than the XFR series. The economical N5700 Series supplies can operate from any AC mains input voltage in the world—no switch or fuse changes. You can download firmware updates from www.agilent.com, and when you need service and support, Agilent's global network of service centers makes it easy for you to get the help you need, anywhere in the world.

Conclusion

In our comparison of the two individual products—the N5767A and the XFR60-20 the N5767A showed advantages over the XFR60-20 in three key areas: output power and performance; programming capabilities and I/O interfaces; and value.

- **Output:** The N5700 Series offers higher current and power ratings.
- **Flexible I/O:** N5700 Series supplies include GPIB, LAN, and USB interfaces, all available simultaneously on a single instrument. XFR units include either GPIB, RS-232 or LAN/RS-232 interfaces—USB is not available—and you are limited to a single interface.

- **Value:** The N5767A provides greater functionality for a similar price, making it a better value (XFR prices vary depending on the interface you choose). Agilent's quality and worldwide service and support strengthens the value advantage.

The N5700 Series embodies our commitment to making system integration faster and easier. Agilent's system-ready instruments, open software, PC-standard I/O and global support can truly help you simplify and accelerate test system development. Our worldwide resources let you access the startup assistance, training classes and update services you need to develop and maintain your test systems—virtually anywhere they may be deployed.

To discover more ways to simplify system integration, accelerate system development and apply the advantages of open connectivity, please visit our Web site at www.agilent.com/find/systemcomponents.

Related literature

The other notes in this series will help you compare Agilent system DC sources with power supplies from other manufacturers:

- Side-by-Side Comparison: Agilent N5700 Series System DC Source and Sorensen DLM DC Power Supply, AN 1502-1 5989-1628EN
<http://cp.literature.agilent.com/litweb/pdf/5989-1628EN.pdf>
- How to Convert from a Sorensen DLM to an Agilent N5700, AN 1503-1 5989-1629EN
<http://cp.literature.agilent.com/litweb/pdf/5989-1629EN.pdf>
- How to Convert from a Xantrex XFR to an Agilent N5700, AN 1503-2 5989-1631EN
<http://cp.literature.agilent.com/litweb/pdf/5989-1631EN.pdf>

Agilent product literature can help you select the best system DC source for your application:

- Agilent N5700 Series Data Sheet, 5989-1330EN
<http://cp.literature.agilent.com/litweb/pdf/5989-1330EN.pdf>
- Trends in Medium Power (~1 kW) DC Power Supplies, 5989-1331EN
<http://cp.literature.agilent.com/litweb/pdf/5989-1331EN.pdf>
- Agilent N5700 System DC Power Supply User's Guide, 5969-2917EN
- Agilent N5700 Product Reference CD-ROM, 5969-2918EN

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Printed in USA, May 24, 2005

5989-1630EN



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