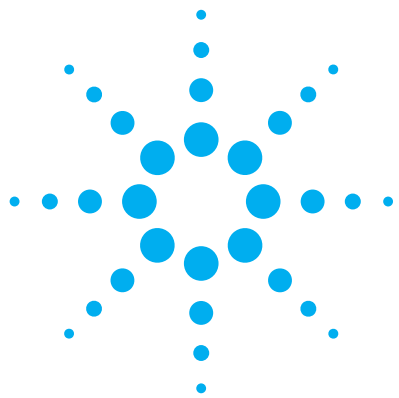




## Trends in Programmable Medium Power ( $\sim 1$ kW) System DC Power Supplies

Application Note 1507

Programmable system DC power supplies in the 500 W to 2 kW power range are used in a variety of industries such as automotive, aerospace/defense, telecom, and component test. Applications using these sources include testing of control modules for cars and aircraft, satellite heaters, and base station amplifiers, as well as burn-in of devices such as laser diodes and memory chips. In an effort to reduce both the cost of test system development and the actual cost of test itself, test engineers in these industries are demanding more power in less space, faster programming and response time, and more flexible power supplies. System DC power supply manufacturers have responded by providing smaller, faster, and more capable sources.



**Figure 1.** Agilent Technologies N5700 750 W or 1500 W power supply

### Smaller size

Let's face it: rack space costs money. Consequently, when evaluating the size of products that will fill the rack, smaller is better. Many power supply manufacturers are packing 500 W, 1000 W, and even 1500 W

power supplies into 1U packages – that's just 1.75 inches (44.45 mm) high! The use of modern switching power supply design techniques makes this possible. This low profile is especially important in burn-in



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**Figure 2.** Stacked “True 1U” design

applications where many, sometimes dozens, of power supplies may be used to provide power to single or multiple test points over long periods of time to weed out early failures.

If you are tasked with selecting one of these compact power-houses, be sure that it is a “true 1U” design with no air vents on the top or bottom. Air vents located on the top or bottom prevent the ability to stack these slim products one directly on top of the other which effectively increases the

“1U” size to something larger when allowing for proper air flow. Blocking air vents can compromise the reliability of the product by causing higher inside-the-box temperatures to occur possibly contributing to premature failure. The Agilent Technologies N5700 Series System DC Power Supplies (see Figure 1) come in a “true 1U”

package that packs 750 W and 1500 W models into this slim design, addressing the need for high power in a small amount of rack space. With no air vents on the top or bottom, these power supplies can be stacked directly on top of other instruments, or directly on top of each other (see Figure 2).

#### **Faster**

As mentioned earlier, programmable medium power DC power supplies are used in a variety of applications. Some of these applications require changing the applied voltage frequently, such as when testing automotive electronic control modules, while others fall into the “set it and forget it” category, as is the case with some burn-in applications. When settings are changed frequently, the time it takes for the power supply to reach its newly programmed value can add significant test

time to the overall test sequence. Conversely, when settings are changed infrequently, this time is much less important.

The time it takes for the output voltage of a programmable power supply to reach the desired voltage is affected by two major contributors: command processing time and output settling time. Consequently, power supply designers have made advances in both of these areas to help reduce test times. For example, N5700 power supplies are able to absorb commands from the controlling bus in as little as 1 ms, thereby freeing up the computer to quickly move on

to other tasks. Once the N5700 absorbs the command from the bus, it can take about 55ms to process the command, followed by the output voltage moving to its final value. The time to complete this process is fast for a power supply in this power range. Aiding the output settling time, the N5700 uses active downprogramming to pull the output voltage down faster than just depending on the external load current alone. All of these features help to shorten overall test time.

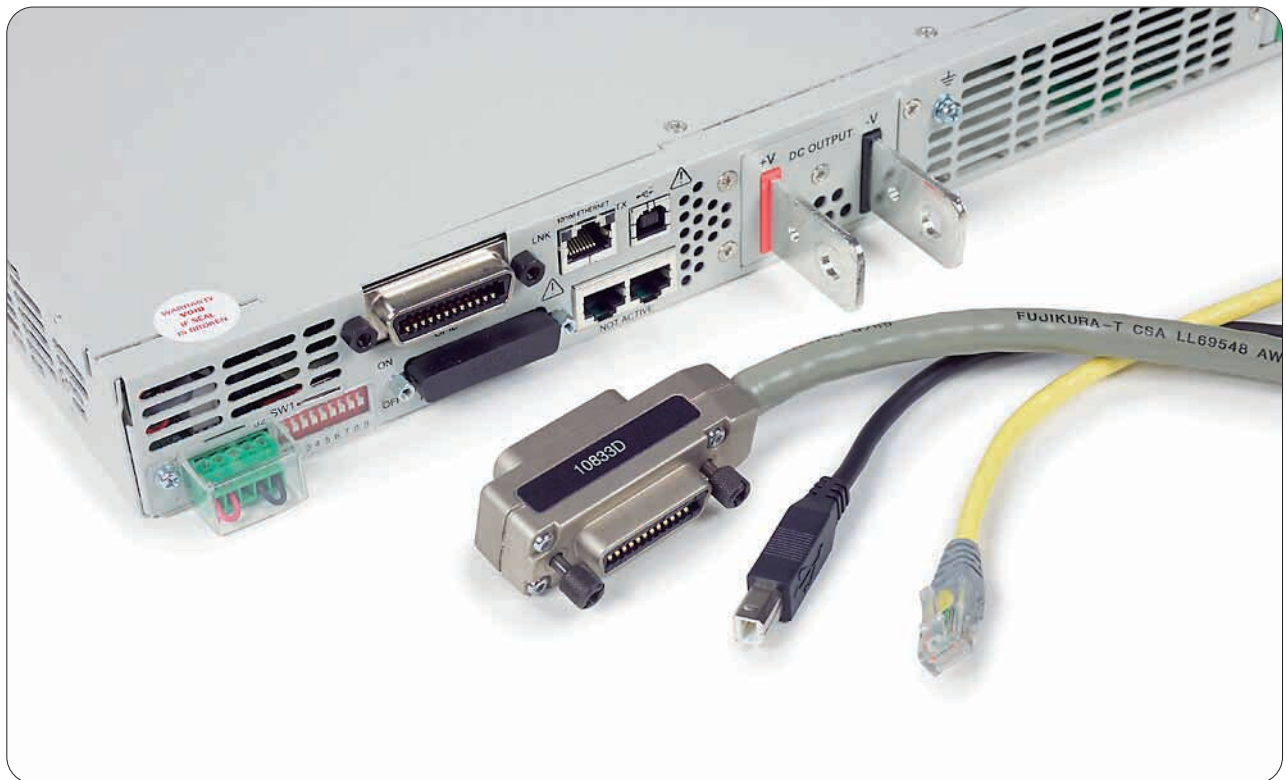
**Connectivity**

Another trend in the power supply industry, affecting other instrumentation as well, is in the area of the programming interface. LAN and USB ports are beginning to appear on the back of power supplies in addition to the familiar GPIB port. GPIB has been around for many years, adeptly serving as the interface between the controlling computer and the instrument. However, with the proliferation of the World Wide Web and continuing pressure for easier, less expensive

connectivity for instrumentation, LAN connections were inevitable. A LAN connection on a power supply offers remote access to the control and monitoring of the power supply. This can be convenient when the device under test and power supplies need to be located in a hazardous environment, or there is a need to monitor status of a power product from a distant office location, or even from a different part of the world! Power supplies are available today with built-in servers providing Web access to a graphical user interface that can be used to control and monitor the supply. The N5700 series has this capability.

USB is a useful interface for fast, simple connections from a PC to an instrument. USB ports are now common on most computers and provide a quick way to connect to an instrument without having to install any extra hardware in the PC, as is needed for GPIB since installation of a GPIB card is required. For connections to multiple instruments with LAN or USB, a hub needs to be used.

Since LAN and USB ports are typically found on most PCs, you can simply connect the instrument directly when using LAN and USB enabled instruments, like the N5700 series of power supplies. This reduces setup time and cost. Further reductions in cost are realized with the low cost of LAN and USB cables relative to the cost of GPIB cables.



**Figure 3.** GPIB, USB, and LAN interfaces are all standard on Agilent's N5700 power supplies

Figure 3 shows the connectivity ports, namely GPIB, USB, and LAN, included standard on all N5700 products, giving the user the flexibility of freedom of choice for the interface to be used.

#### **Universal input and PFC**

Changes to the AC input front-end reveals yet another trend in power supply design: the use of active power factor correction (PFC). PFC front-ends can improve power supply

efficiency and will greatly reduce harmonic current emissions. But even more important to the power supply user, an additional consequence of this trend is that these power supplies will run off of a wide range of AC

input voltages (universal input) eliminating the need for the user to change jumpers or settings to accommodate different line voltages in different countries throughout the world. For example, AC input voltages from 85 Vac to 265 Vac can power the N5700 series without the need to change anything other than the line cord in order to accommodate different AC receptacles.

#### **Don't forget the basics (standard features)**

While there are a variety of trends affecting medium power DC power supplies, some features remain constant through time. Remote sensing, or the ability to compensate for voltage drop in load wires, is an essential feature. Equally important is protection for both the device under test (DUT) and the power supply itself, which comes from features like over-voltage protection, over-current protection, and over-temperature shutdown. While the hope is that these protection features are not utilized regularly (or at all), they act as an insurance policy to protect expensive DUTs. All are present in the N5700 design.

Of course, protection for the operators of test equipment is also important. Some high voltage power supplies can deliver quite a shock to an unsuspecting operator. A feature called remote inhibit, or output shut-off, can be used in an interlocking scheme to eliminate this hazard. A cover can be used to protect the user from access to the hazardous voltages in a test system or in any fixtures used to connect the power supply to the DUT. If the cover is lifted, a micro-switch can be activated that is connected to the power supply's remote inhibit input that automatically disables its output, thereby protecting the user from any exposed hazardous voltages. N5700 power supplies have this remote inhibit feature.

The ability to increase power by putting power supplies in parallel or series is also quite a useful feature typically available on many medium power

DC power supplies. Up to four N5700 series power supplies can be put in parallel to increase output current capability, while up to two N5700 supplies can be put in series to increase output voltage capability.

Finally, with respect to standard features, having the ability to measure output voltage and output current built into the power supply is essential in many of the medium power applications. For example, monitoring power supply output current is a standard practice when burning in devices to ensure that none of the devices have failed in a shorted condition. The N5700 series power supplies have built-in voltage and current readback.

### **Conclusion**

The trend toward smaller, faster products with more flexible interface choices becomes evident when examining today's medium power system DC power supplies. 1U high power supply packages are available to help fit more power in less space. Faster command processing times are lowering the cost of test by reducing test time. LAN and USB interface use is replacing GPIB use to help reduce the time and cost associated with adding GPIB to a PC, in addition to providing remote programming access to the instrumentation. The new Agilent Technologies N5700 Series System DC Power Supplies are setting new standards in medium power DC supplies, providing up to 1500 W in a 1U package with LAN, USB, and GPIB included standard. With voltages from 6 V to 600 V, and currents from 1.3 A to 180 A, these new products address medium power requirements in many application areas.

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