Advanced Power System

N6900 and N7900 series power supplies

Introduction

Introducing the Keysight Technologies' Advanced Power System (APS) 1 kW and 2 kW system power supplies, the ultimate solution for advanced ATE power testing. Equipped with VersaPower architecture, the APS family offers unparalleled performance and innovative features to tackle your toughest power test challenges.

KEYSIGHT

Advanced Power System (APS) Overview

Overcome your power test challenges with the Advanced Power System family

With the Keysight Technologies, Advanced Power System (APS) 1 kW and 2 kW system power supplies, you get a new level of power supply performance. The Advanced Power System (APS) family was designed with VersaPower architecture to help you overcome your toughest power test challenges by delivering industry-leading specifications and innovative features in an integrated solution for today's advanced ATE power testing needs.

VersaPower architecture delivers the fastest, most accurate, integrated power system

- Accelerate test-system throughput with industry-leading speed
- Capture your DUT's current profile with accurate measurements
- Reduce your ATE development time and cost with highly integrated capabilities

Get lots of power in a small test-system footprint

Two power ranges deliver a large amount of power in a small test-system footprint:

- 1 kW models have a 1U full-rack footprint
- 2 kW models have a 2U full-rack footprint
- Both power ranges have built-in paralleling capability up to 10 kW

Choose the right APS performance class to meet your needs

Keysight N6900 Series DC power supplies	Designed for ATE applications where high performance is critical. Add performance options to get the dynamic test capabilities of the N7900
Keysight N7900 Series dynamic DC power supplies	Designed for ATE applications where high-speed dynamic sourcing and measurement is needed

Choose the APS model with the voltage and current you need

Both the N6900 Series DC power supplies and the N7900 Series dynamic DC power supplies provide five voltage and current combinations at the 1 kW power range and seven voltage and current combinations at the 2 kW power range.

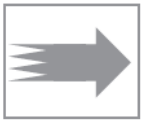
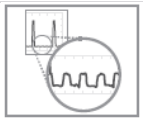
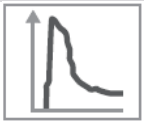
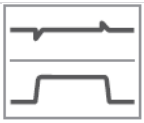
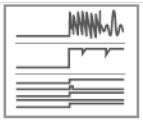
Table 1. List of APS power supplies

Series	1 kW models	2 kW models
Keysight N6900 Series DC power supplies	• N6950A 9 V, 100 A • N6951A 20 V, 50 A • N6952A 40 V, 25 A • N6953A 60 V, 16.7 A • N6954A 80 V, 12.5 A	• N6970A 9 V, 200 A • N6971A 20 V, 100 A • N6972A 40 V, 50 A • N6973A 60 V, 33 A • N6974A 80 V, 25 A • N6976A 120 V, 16.7 A • N6977A 160 V, 12.5 A
Keysight N7900 Series dynamic DC power supplies	• N7950A 9 V, 100 A • N7951A 20 V, 50 A • N7952A 40 V, 25 A • N7953A 60 V, 16.7 A • N7954A 80 V, 12.5 A	• N7970A 9 V, 200 A • N7971A 20 V, 100 A • N7972A 40 V, 50 A • N7973A 60 V, 33 A • N7974A 80 V, 25 A • N7976A 120 V, 16.7 A • N7977A 160 V, 12.5 A

Test challenges and how the APS helps you overcome them

The APS, with Keysight's exclusive VersaPower architecture, helps you overcome a wide variety of power test challenges

Table 2. Test challenges and how the APS helps you overcome them

	Power related test challenge	How the APS helps you overcome the challenge
	Increasing test system throughput Reducing test time can mean big savings, so achieving throughput gains is a never-ending quest.	• Fast up and down programming speeds (up to 500 µs) • Fast command processing (< 2 ms) • List capability to step through a list of voltage or current levels • Seamless ranging capability for fast current measurements without sacrificing accuracy
	Building a continuous source and load You need a continuous source and load solution for testing power storage DUTs.	• Full two-quadrant glitch-free operation across quadrants • Voltage and current limit settings to keep your device within its operating range
	Protecting against power related damage When testing expensive DUTs, designing protection from power damage in the test system is critical.	• Smart triggering • Fast output response • Output disconnect relays • Watchdog timer
	Characterizing dynamic current profiles Your DUT has a current profile with a large dynamic range that you need to characterize.	• 18-bit high resolution current digitizer • Adjustable measurement sample rate • External logging capability • Peak triggering and measurements
	Generating power transients In harsh real-world environments, DUTs can face power transients, such as surges and interrupts. To ensure proper operation of a design in the real world, these transients need to be simulated in testing.	• AWG capability • Step function capability • High bandwidth mode
	Characterizing inrush current You need to capture the large current surge that occurs when you first turn on power to your DUT with reactive elements at the input.	• High resolution current and voltage digitizers • Pre- and post-triggering for capturing measurement data • Large current range that is over 2x the rated output of the power supply
	Maintaining output integrity under dynamic load conditions Maintaining a stable output voltage free of oscillations and voltage droop can be a challenge under a very dynamic load, especially when working with long cable runs.	• Fast transient response to ensure minimal voltage droop to load transients • High and low output bandwidth settings for tuning the output to your load
	Tracking power events for root-cause analysis You want to track power events during root-cause analysis testing to see why or if you're DUT was damaged during test.	• Built-in Black Box Recorder • Records voltage, current, power, trigger events, mode changes, and more in non-volatile memory
	Properly powering on/off a DUT To prevent damage at turn-on or turn-off, you need to properly sequence multiple supplies on/off or tune their slew rates.	• Sequencing capability across multiple APS supplies • Sequencing capability with Keysight's N6700 modular power supply family • Adjustable slew rate control

A Deeper Look at How the APS Can Help You Overcome Your Power Test Challenges

Accelerate test throughput with industry-leading specifications

Shaving seconds or even milliseconds off a test time can lead to significant savings for high-volume manufacturers, making throughput gains a never-ending quest for test system designers. The APS is a valuable tool for increasing throughput. It provides a number of industry-leading specifications and innovative features that can help you achieve significant throughput gains in your testing. Some examples:

- Industry-leading command processing time (<2 ms)
- Fast up and down programming speeds (up to 500 µs)
- Adjustable measurement times for optimum measurements in minimum time
- Seamless ranging capability for fast current measurements without sacrificing accuracy
- Output lists that allow you to step through timed or triggered voltage or current levels that can also generate triggers for tightly synchronized measurement

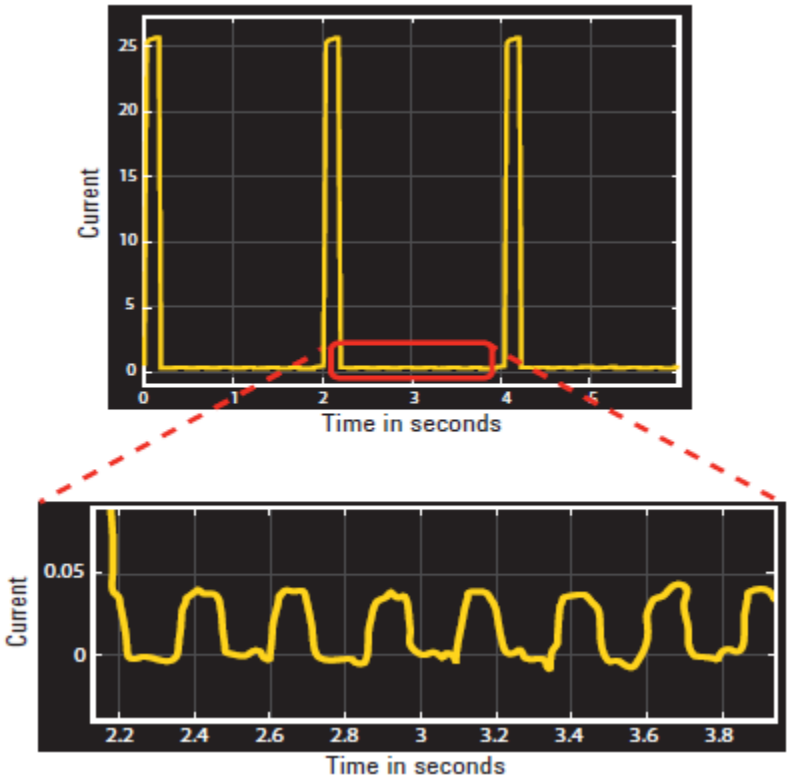


Figure 1. Dynamic current measurement

Accurately characterize your DUT’s power profile with advanced measurements

The APS provides simultaneous voltage and current measurement capabilities that deliver high accuracy and resolution. Make measurements using two main modes: averaged or digitized. In average mode, the APS delivers high-accuracy DMM-quality voltage and current measurements. The digitizing capability allows you to capture dynamic current or voltage profiles at much higher resolution than an oscilloscope.

- Capture inrush current: APS provides an 18-bit current digitizer with a sample rate up to 200 kS/s, level triggers, and a current measurement range that is 2.25x as high as the max output current range of the power supply.
- Accurately capture dynamic current profiles: APS has two current measurement ranges that allow it to measure micro-amps to amps. The APS uses seamless ranging technology to transition from one measurement range to the other without discontinuities in the output power or in measurement data (see Figure 1).
- Accurately measure power storage and efficiency: In addition to high-accuracy voltage and current measurement capabilities, APS power supplies offer built-in power, peak power, amp-hour, and watt-hour calculations. These measurements help simplify your power efficiency and storage calculations.
- Additional APS measurement capabilities:
- Adjustable measurement intervals for both average and digitized measurements
- External logging capability, which simplifies data logging in ATE software
- Pre-, post-, and level-triggering for pinpointing exactly where and when to measure

Reduce ATE development time and support costs with integrated features

Continuously source and sink current for power storage test applications

When operated as standalone units, APS power supplies can continuously sink up to 10% of their rated output current for an indefinite time. With the addition of APS N7909A power dissipater units, APS power supplies can continuously sink up to 100% of their rated output current. This means you can sink the power supply's full rated output power for an indefinite time. Note that the two-quadrant sourcing and sinking capability of the DC power supply allows for continuous transitions between sourcing and sinking current without changing the power supply's output characteristics or introducing any disruptive behavior. These capabilities make the APS an ideal solution for continuous source and sink testing needs in power storage applications. For more information on the APS N7909A, see page 12.

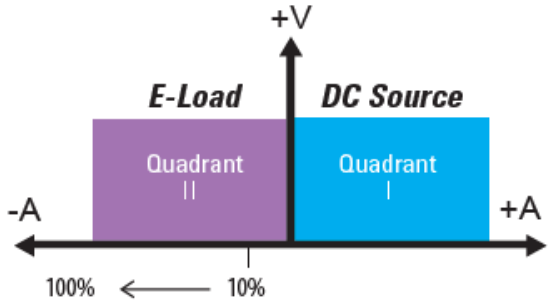


Figure 2. When you add N7909A power dissipater units to an APS supply, you extend its ability to sink current from 10% to 100% of its rated current

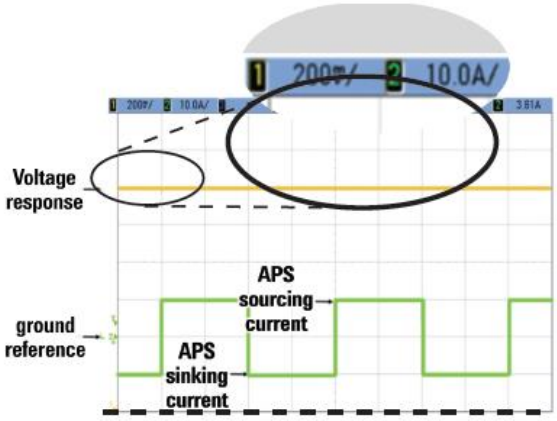


Figure 3. Shows an example of an APS power supply smoothly pulsing back and forth from sinking current at -10 A to sourcing current at 10 A. Notice that the voltage level captured at high resolution on the top trace remains constant with no glitches.

To complement the two quadrant operation, all APS power supplies have built-in programmable output resistance capability. This capability allows an APS power supply to simulate the internal resistance of a battery.

Smart triggering: Increase throughput, protect your DUT, and reduce test complexity

The APS's smart triggering system provides trigger capabilities never before seen in a power supply. The APS's smart triggering can accelerate your test throughput, better protect your DUT, and reduce the complexity of your test system. The smart triggering system includes all the basic triggering functionality you would expect in a system power supply, but it goes well beyond with capabilities such as:

- Level triggering allows you to execute a trigger from five different APS measurement parameters: voltage, current, power, amp-hour, and watt-hour.
- Logical triggering gives you the ability to create logical "and," "or," and "not" trigger expressions using various trigger conditions such as digital input pins, level triggers, status bits, and more.
- Triggers can be used to transition through a list of voltage or current levels as well as through the points of a voltage or current waveform.
- Triggers with precision delays can be sent out from the APS after a voltage or current level change/transient. These triggers can be used to signal another instrument in the test system to do something after a voltage or current change.

Track power events with a black box recorder

If you are testing expensive prototypes and a power-related problem damages or destroys your DUT, you need to figure out what went wrong to ensure it does not happen again. The APS's optional N7908A black box recorder (BBR) overcomes this test challenge by creating a power event record inside the power supply. Much like an airplane flight data recorder, the APS black box recorder is always recording events. When the power supply is on, it is always running, recording power events and making measurements in non-volatile memory regardless of what the power supply is doing or how it is being used.

Examples of what it records:

- Voltage (min, max, and avg), current (min, max, and avg), and power (min, max, and avg)
- Trigger events
- Status bits
- Front panel and command events
- User-defined tags

See page 12 for more information on the APS N7908A BBR.

Avoid damage to your DUT with APS protection

When you are testing costly DUTs, integrating power protection measures into the test system is critical. Using instrumentation with built-in protection features provides a huge benefit when DUT protection is required. Here's why:

- Built-in protection features, such as broken sense line de- tection, reduce the amount of protection hardware needed in the test system, reducing complexity and development time.
- With protection features integrated into the instrumenta- tion, the amount of hardware needed for the test system is reduced, which in turn lowers test system support costs.
- With protection measures implemented in hardware rather than test system software, error conditions can be detected and handled much faster, reducing the likelihood of the DUT sustaining major damage.

The APS power supplies feature advanced and fast protection capabilities fully integrated

These protection capabilities include:

- Fast CC/CV mode crossover as well as user-settable voltage and current priority modes to reduce unwanted voltage or current overshoots
- Smart triggering
- Over- and under-voltage and current protection
- Fast reaction to error conditions
- Output disconnect relays
- User-configurable watchdog timer
- Broken and shorted sense line detection

Generate voltage and current transients

DUTs that are operated in rugged environments, such as automotive electronics and avionics, can often experience transient behavior from the power source, such as voltage dropouts or surges. To ensure your DUT can stand up to these real-world transients, you must simulate worst-case power transient conditions in the test process. The APS power supplies provide three different functionalities for simulating either voltage or current transients for testing:

A one-time event that steps the output voltage or current up or down in response to a triggered event.

Arbitrary waveforms: An arbitrary waveform generator (arb) allows you to generate complex user-defined voltage or current waveforms of up to 65,535 data points.

List: A list can consist of up to 512 steps. Each step in the list can have a unique dwell time associated with it, which specifies the time in seconds that the list will remain at that step before moving on to the next step. Lists can also be trigger-paced, in which case the list advances one step for each trigger received.

For a demonstration of the APS's arb capability, an example "interrupt" pulse was generated with the N7951A into a resistive load. The interrupt pulse goes from 20 V to 2 V for 10 ms and then returns to 20 V. The resulting interrupt pulse was captured (Figure 4) and its fall time was measured to be < 200 µs (Figure 5). For more information on the APS's output bandwidth and speed for generating voltage and current transients, refer to the specifications section in this document or the APS user manual.

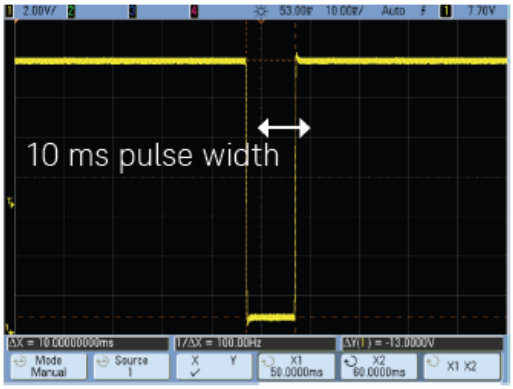


Figure 4. Voltage interrupt pulse generated by N7951A

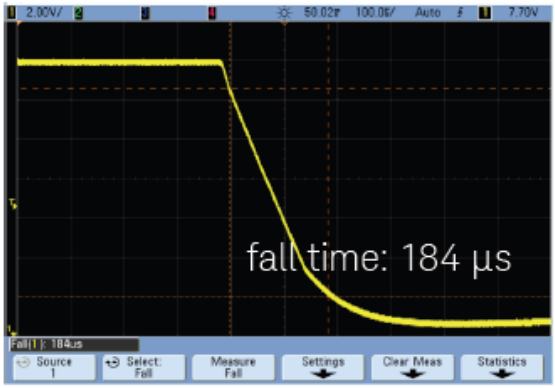


Figure 5. Interrupt pulse fall time measurement of < 200 us

Properly powering on and off your DUT with the APS

If you work with DUTs that have multiple power supply inputs, such as satellite payloads, you often need to properly sequence on or off each power supply at strictly repeatable times to prevent current surges and latch-up conditions. In addition to sequencing on or off each supply, you may need to set the ramp rate of each supply at turn-on or turn-off to a particular rate. These requirements add significant complexity to an ATE test system, both in hardware and software.

The APS power supplies can help you overcome this test challenge by providing built-in sequencing capability across APS mainframes or with Keysight's popular N6700 family of modular system power supplies. Also, the APS power supplies provide adjustable slew rate control at turn-on or turn-off. These built-in capabilities provide a clean low-complexity way to properly power-on or off your DUT during test.

Add power flexibility to your test system by paralleling multiple APS supplies

Paralleling multiple power supplies together is a great way to add power flexibility to your test system. The down side of paralleling power supplies together is typically you cannot get all the supplies to operate in the desired constant voltage (CV) or constant current (CC) mode. For instance, when trying to operate in CV mode with two parallel supplies, one will typically source the bulk of the current and operate in CC mode and the other supply will source only a fraction of the current and operate in CV mode. This condition can highly degrade certain power supply performance specifications such as transient response.

With the APS you do not have to worry about this since it has built-in paralleling capability that ensures each supply equally shares the load current so they all remain in the desired mode, whether it is CV or CC. Note that paralleling works whether the APS power supplies are sourcing or sinking current from the DUT.

To take advantage of the APS paralleling capability, you need only a simple three-wire connection in the rear of the supplies in the parallel configuration (see Figure 6). With this capability, you can parallel up to five APS power supplies (recommended), which provides a max power of 10 kW.

Figure 6. An APS supply's three-wire connection for paralleling multiple supplies

For more information

On how the APS can help you overcome your power-related test challenges, including videos, application notes, and example code, visit www.keysight.com/find/TestChallenges

APS Hardware Accessories and Software

APS N7909A power dissipater unit

The optional N7909A power dissipater unit adds current sinking or two-quadrant operation to any N6900 or N7900 power supply. Each N7909A provides up to 1 kW of current sinking capability to an APS power supply, so you will need two N7909As to achieve full two-quadrant operation of a 2 kW APS supply. You can use a single N7909A with a 2 kW APS power supply to achieve 50% current sinking capability. The N7909A form factor is 1U and full rack width. N7909A connects to an APS power supply via a two-wire power connection and a communication connection to provide continuous two-quadrant operation. The connections are located on the rear panel of both the N7909A and the supply, as shown in Figure 7.

Figure 7. N7909A power dissipater unit rear connections to a 1 kW APS power supply

The N7909A does not operate as a standalone instrument. It only works with an APS power supply. Additional information on the APS's 2-quadrant operation:

- The APS provides programmable ± current waveform capability to fully utilize the two-quadrant operation
- The APS provides ± current limit settings to ensure your device is operated in its allowable range
- By default, the APS's current sink capability will perform down programming for pulling down voltage levels when it is connected to loads with stored energy, for instance loads with a large amount of parallel capacitance at their input.
- All these capabilities are also available when you use a standalone APS power supply's 10% rated output current sinking capability without the N7909A power dissipater unit.

2. Note: Even though the APS's two-quadrant operation gives it much of the same functionality as a DC electronic load, it cannot simulate current transients as fast as an electronic load. For instance, the APS can simulate full range -/+ current transients at ~ 5 ms, where a high-performance electronic load can achieve current transients < 1 ms. See the specifications and user guide at for more information at www.keysight.com/find/APS-doc

APS black box recorder (option BBR)

Much like a flight data recorder, the N7908A black box recorder (BBR) runs continually in the background, independent of what the power supply is doing. When the power supply is on, the BBR is recording power events and storing measurements in non-volatile memory. The BBR can be set for either a 24- hour record or a 10-day record period. In the 24-hour mode, measurements are made at a rate of 100 per second, and in the 10-day mode they are made at a rate of 10 per second. The BBR data can be accessed via the free APS power assistant software (see Figure 8 on page 13). The BBR option works on all APS N6900 and N7900 power supplies. It is a factory installed option available only at the time of purchase.

APS N7910A rack mount kit

The N7910A rack mount kit can be used for all N6900 and N7900 power supplies, regardless of if they are 1 kW or 2 kW form factors. It can also be used for mounting the N7909A. N7910A APS rack mount kit is needed for every APS power supply or N7909A dissipater that you would like to mount.

The N7910A is intended for use in a 19-inch EIA rack cabinet. APS power supplies and power dissipater units can be mounted directly above or below each other without any worry of heat problems. For installation instructions and other rack-mounting options, refer to the APS user manual at www.keysight.com/find/APS-doc

N7906A power assistant software

The APS N7906A power assistant software is a free application that works with the APS power supplies. The power assistant software provides three main capabilities for working with the APS power supplies:

- Control an APS power supply using the Power assistant software's intuitive graphical user interface
- Retrieve and view data from the optional APS power supply black box recorder (see Figure 8)
- Perform trigger routing and configure logical trigger expressions (see Figure 9)

The power assistant software is available for download at www.keysight.com/find/powerassistant. For more information on the APS power assistant software, refer to the APS user manual at www.keysight.com/find/APS-doc

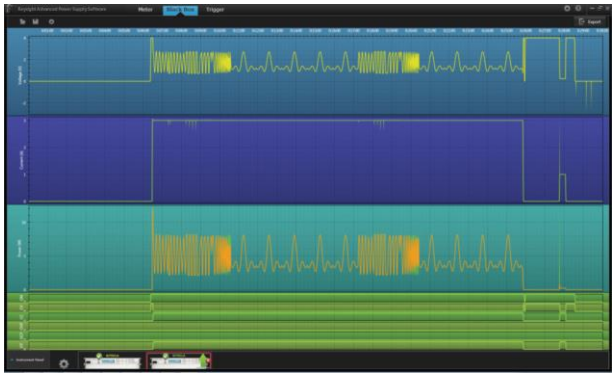


Figure 8. Black box recorder data displayed within the N7906A Power Assistant software

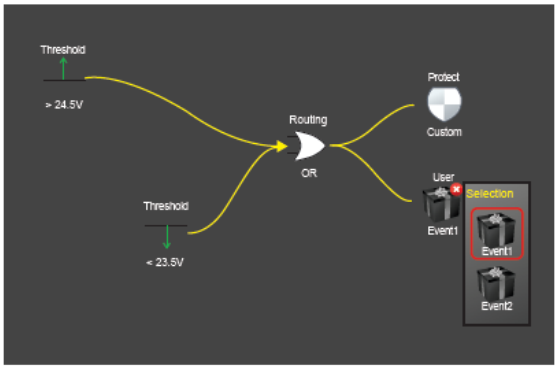


Figure 9. Configuring a trigger expression with the N7906A Power Assistant software

Differences Between the APS N6900 Series and N7900 Series

Table 3. This table compares performance specifications and features of the N6900 DC Series power supplies and the N7900 Series dynamic DC power supplies.

Feature	N6900 1 kW and 2 kW models	N7900 1 kW and 2 kW models
Voltage and current programming	14-bit precision (16-bit with option 303)	16-bit precision
Voltage and current measurements	18-bit precision	18-bit precision
Voltage up / down programming time[1]	3 ms / 3 ms 0.5 ms / 0.35 ms with option 303	0.5 ms / .35 ms
Transient response time (recovery time)[1]	100 us	100 us
Two-quadrant operation (10% standard, 100% optional)	Yes	Yes
Smart triggering	Yes	Yes
Power storage and efficiency measurements	Yes	Yes
Output sequencing / adjustable slew rate	Yes	Yes
Parallel operation	Yes	Yes
Low current measurement range	Yes with option 301	Yes
Seamless current measurements	Yes with option 301	Yes
V and I digitizers with programmable sample rates	Yes with option 302	Yes
External logging capability	Yes with option 302	Yes
Output list capability	Yes with option 303	Yes
Arbitrary waveform generation	Yes with option 303	Yes
Output relays (disconnect and polarity reversal)	(Yes[2] with option 760/761)	Yes[2]

1. For detailed specifications, see APS user manual.
2. N6950A/N7950A and N6970A/N7970A only have output disconnect relays, no polarity reversal relays.

APS Specifications

For more detailed specifications refer to the APS user manual at www.keysight.com/find/APS-doc

N6900 specifications 1 kW / 2 kW

Table 4. N6900 specifications 1 kW / 2 kW

	N6950A / 70A	N6951A / 71A	N6952A / 72A	N6953A / 73A	N6954A / 74A	N6976A	N6977A
DC ratings Voltage range Current max Current sink @10% Current sink @100%1 Power	 0 to 9 V 100 A / 200 A -10 A / -20 A -100 A / -200 A 900 W / 1.8 kW	 0 to 20 V 50 A / 100 A -5 A / -10 A -50 A / -100 A 1 kW / 2 kW	 0 to 40 V 25 A / 50 A -2.5 A / -5 A -25 A / -50 A 1 kW / 2 kW	 0 to 60 V 16.7 A / 33.3 A -1.67 A / -3.33A -16.7 A / -33.3 A 1 kW / 2 kW	 0 to 80 V 12.5 A / 25 A -1.25 A / -2.5 A -12.5 A / -25 A 1 kW / 2 kW	 0 to 120 V 16.7 A -1.67 A -16.7 A 2 kW	 0 to 160 V 12.5 A -1.25 A -12.5 A 2 kW
Output ripple & noise2 CV rms CV peak-to-peak	 1 mV 9 mV	 1 mV 9 mV	 1 mV 9 mV	 1 mV 9 mV	 1 mV 9 mV	 2 mV 30 mV	 3 mV 30 mV
Load regulation Voltage Current	 0.5 mV 8 mA / 15 mA	 0.75 mV 3 mA / 6 mA	 1.5 mV 1 mA / 2 mA	 2 mV 1 mA / 1.5 mA	 2 mV 0.8 mA / 1.5 mA	 4 mV 1 mA	 4 mV 0.8 mA
Volt programming & meas. accuracy3 Lead drop ≤1 V max Lead drop ≤25% of V rating with option 301	 0.03% +1.5 mV 0.03% +1.9 mV 0.03% +1 mV 0.03% +1.4 mV	 0.03% +3 mV 0.03% +4 mV 0.03% +2 mV 0.03% +3 mV	 0.03% +6 mV 0.03% +7.9 mV 0.03% +4 mV 0.03% +5.9 mV	 0.03% +9 mV 0.03% +12 mV 0.03% +6 mV 0.03% +9 mV	 0.03% +12 mV 0.03% +16 mV 0.03% +8 mV 0.03% +12 mV	 0.03% +17 mV 0.03% +23 mV 0.03% +11 mV 0.03% +17 mV	 0.03% +24 mV 0.03% +32 mV 0.03% +14 mV 0.03% +22 mV
Curr programming and measurement accuracy3 with Option 301	0.1% +30 / 60 mA 0.04%+15/30mA	0.1% +15 / 30 mA 0.04% +8 / 15 mA	0.1% +8 / 15 mA 0.04% +4 / 8 mA	0.1% +5 / 10 mA 0.04%+2.5/5mA	0.1% +4 / 8 mA 0.04% +2 / 4 mA	0.1% +5 mA 0.04% +2.5 mA	0.1% +4 mA 0.04% +2 mA
Curr. Measurement ranges5 (with Option 301) High range N695x High range N697x Low range N695x Low range N697x	 -225 A to 225 A -450 A to 450 A -11 A to 11 A -22 A to 22 A	 -112.5Ato112.5A -225 A to 225 A -5.5 A to 5.5 A -11 A to 11 A	 -56.2 A to 56.2 A -112.5 A to 112.5A -2.75 A to 2.75 A -5.5 A to 5.5 A	 -37.6 A to 37.6 A -74.9 A to -74.9 A -1.84 A to 1.84 A -3.67 A to 3.67 A	 -28.1 A to 28.1 A -56.2 A to 56.2 A -1.37 A to 1.37 A -2.75 A to 2.75 A	 N/A -37.6 A to 37.6 A N/A -1.84 A to 1.84 A	 N/A -28.1 A to 28.1 A N/A -1.37 A to 1.37 A
Transient response4 Recovery time Settling band	 100 us 150 mV	 100 us 150 mV	 100 us 100 mV	 100 us 150 mV	 100 us 200 mV	 100 us 300 mV	 100 us 400 mV
Volt up & down programming time6 10% to 90% and 90% to 10% Settling time	 3 ms 10 ms	 3 ms 10 ms	 3 ms 10 ms	 3 ms 10 ms	 3 ms 10 ms	 3 ms 10 ms	 3 ms 10 ms
(w/Option 303) Volt up programming Time	 O,5 ms 1 ms	 O,5 ms 1 ms	 O,5 ms 1 ms	 O,5 ms 1 ms	 O,5 ms 1 ms	 O,5 ms 1 ms	 O,5 ms 1 ms
Resistance programming6 Range Accuracy Resolution	 0 to 0.1 / 0.05 Ω 0.12% +1.6 mΩ*A 0.8 µΩ / 0.4 µΩ	 0 to 0.4 / 0.2 Ω 0.12% +3.2 mΩ*A 3.4 µΩ / 1.7 µΩ	 0 to 1.6 / 0.8 Ω 0.12% +6.4 mΩ*A 13 µΩ / 7 µΩ	 0 to 3.4 / 1.7 Ω 0.12% +8.8 mΩ*A 30 µΩ / 15 µΩ	 0 to 6.4 / 3.2 Ω 0.12% +12.8 mΩ*A 54 µΩ / 27 µΩ	 0 to 6.8 Ω 0.12% +17.7 mΩ*A 60 µΩ	 0 to 12.8 Ω 0.12% +25.6 mΩ*A 108 µΩ

N7900 specifications 1 kW / 2 Kw

Table 5. N7900 specifications 1 kW / 2 kW

	N7950A / 70A	N7951A / 71A	N7952A / 72A	N7953A / 73A	N7954A / 74A	N7976A	N7977A
DC ratings							
Voltage range	0 to 9 V	0 to 20 V	0 to 40 V	0 to 60 V	0 to 80 V	0 to 120 V	0 to 160 V
Current max	100 A / 200 A	50 A / 100 A	25 A / 50 A	16.7 A / 33.3 A	12.5 A / 25 A	16.7 A	12.5 A
Current sink @10%	-10 A / -20 A	-5 A / -10 A	-2.5 A / -5 A	-1.67 A / -3.33 A	-1.25 A / -2.5 A	-1.67 A	-1.25 A
Current sink @100%[1]	-100 A / -200 A	-50 A / -100 A	-25 A / -50 A	-16.7 A / -33.3 A	-12.5 A / -25 A	-16.7 A	-12.5 A
Power	900 W / 1.8 kW	1 kW / 2 kW	1 kW / 2 kW	1 kW / 2 kW	1 kW / 2 kW	2 kW	2 kW
Output ripple & noise[2]							
CV rms	1 mV	1 mV	1 mV	1 mV	1 mV	2 mV	3 mV
CV peak-to-peak	9 mV	9 mV	9 mV	9 mV	9 mV	30 mV	30 mV
Load regulation							
Voltage	0.5 mV	0.75 mV	1.5 mV	2 mV	2 mV	4 mV	w4 mV
Current	8 mA / 15 mA	3 mA / 6 mA	1 mA / 2 mA	1 mA / 1.5 mA	0.8 mA / 1.5 mA	1 mA	0.8 mA
Volt programming and measurement accuracy[3] Lead drop ≤1 V maxLead drop ≤25% of V rating	0.03% +1 mV 0.03% +1.4 mV	0.03% +2 mV 0.03% +3 mV	0.03% +4 mV 0.03% +5.9 mV	0.03% +6 mV 0.03% +9 mV	0.03% +8 mV 0.03% +12 mV	0.03% +11 mV 0.03% +17 mV	0.03% +14 mV 0.03% +22 mV
Curr. programming and measurement accuracy[3]	0.04% +15 / 30 mA	0.04% +8 / 15 mA	0.04% +4 / 8 mA	0.04% +2.5 / 5 mA	0.04% +2 / 4 mA	0.04% +2.5 mA	0.04% +2 mA
Current measurement low-range accuracy[3]	0.05% +3/6 mA	0.05% +1/2 mA	0.05% +0.6/1.2 mA	0.05% +0.3/0.6 mA	0.05% +0.25/0.5 mA	0.05% +0.4 mA	0.05% +0.25 mA
Curr. Measurement ranges[5]							
High range N795x	-225 A to 225 A	-112.5 A to 112.5A	-56.2 A to 56.2 A	-37.6 A to 37.6 A	-28.1 A to 28.1 A	N/A	N/A
High range N797x	-450 A to 450 A	-225 A to 225 A	-112.5 A to 112.5A	-74.9 A to -74.9 A	-56.2 A to 56.2 A	-37.6 A to 37.6 A	-28.1 A to 28.1 A
Low range N795x	-11 A to 11 A	-5.5 A to 5.5 A	-2.75 A to 2.75 A	-1.84 A to 1.84 A	-1.37 A to 1.37 A	N/A	N/A
Low range N797x	-22 A to 22 A	-11 A to 11 A	-5.5 A to 5.5 A	-3.67 A to 3.67 A	-2.75 A to 2.75 A	-1.84 A to 1.84 A	-1.37 A to 1.37 A
Transient response4							
Recovery time	100 µs	100 µs	100 µs	100 µs	100 µs	100 µs	100 µs
Settling and	150 mV	150 mV	100 mV	150 mV	200 mV	300 mV	400 mV
Volt up programming time[6]							
10% to 90%	0.5 ms	0.5 ms	0.5 ms	0.5 ms	0.5 ms	0.5 ms	0.5 ms
Settling time	1 ms	1 ms	1 ms	1 ms	1 ms	1 ms	1 ms
Volt down programming time[6]							
90% to 10%	0.35 ms	0.35 ms	0.35 ms	0.35 ms	0.35 ms	0.35 ms	0.35 ms
Settling time	0.8 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms
Voltage programming bandwidth (no load)[6]							
-3 dB point	2 kHz	2 kHz	2 kHz	2 kHz	2 kHz	2 kHz	2 kHz
-1 dB point	1 kHz	1 kHz	1 kHz	1 kHz	1 kHz	1 kHz	1 kHz
Curr. up-programming time[6]10% to 90%	2.5 ms	2.5 ms	2.5 ms	2.5 ms	2.5 ms	2.5 ms	2.5 ms
Current programming bandwidth (resistive load)[6]							
-3 dB point	160 Hz	160 Hz	160 Hz	160 Hz	160 Hz	160 Hz	160 Hz
-1 dB point	70 Hz	70 Hz	70 Hz	70 Hz	70 Hz	70 Hz	70 Hz
Resistance programming[6]							
Range	0 to 0.1 / 0.05 Ω	0 to 0.4 / 0.2 Ω	0 to 1.6 / 0.8 Ω	0 to 3.4 / 1.7 Ω	0 to 6.4 / 3.2 Ω	0 to 6.8 Ω	0 to 12.8 Ω
Accuracy	0.06% +1.6 mΩ*A	0.06% +3.2 mΩ*A	0.06% +6.4 mΩ*A	0.06% +8.8 mΩ*A	0.06% +12.8 mΩ*A	0.12% +17.7 mΩ*A	0.06% +25.6 mΩ*A
Resolution	0.8 µΩ / 0.4 µΩ	3.4 µΩ / 1.7 µΩ	13 µΩ / 7 µΩ	30 µΩ / 15 µΩ	54 µΩ / 27 µΩ	60 µΩ	108 µΩ

1. Current sinking up to 100% of rated current requires one N7909A power dissipater for 1 kW models and two N7909A power dissipaters for 2 kW models. 2 kW models with one power dissipater can sink 50% of their rated current.
2. From 20 Hz to 20 MHz
3. Expressed as % of setting (or % of measurement) + offset. At 23 °C ±5 °C after a 30-minute warm-up; measurement. NPLC=1; valid for 1 year.
4. Time to recover within the settling band following a load change from 50% to 100% of full load.
5. When sinking current, the negative current measurement ranges match the positive current measurement ranges.
6. These are supplemental characteristics

Two-quadrant specifications

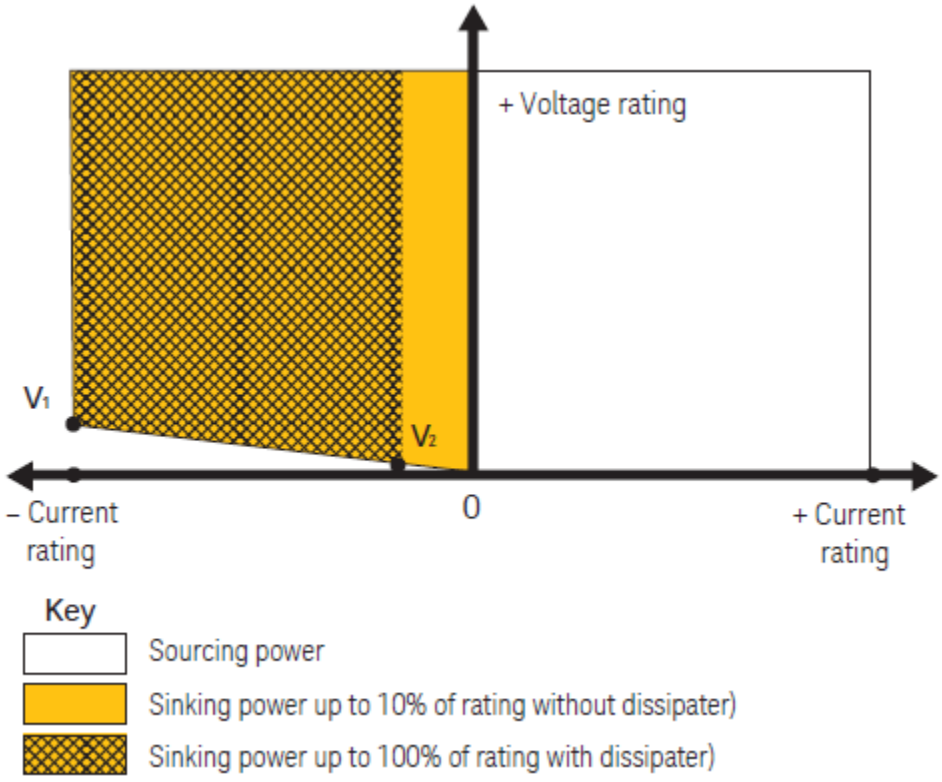


Table 6. Two-quadrant specifications

	N6950A/70A N7950A/70A	N6951A/71A N7951A/71A	N6952A/72A N7952A/72A	N6953A/73A N7953A/73A	N6954A/74A N7954A/74A	N6976A N7976A	N6977A N7977A
+ Voltage rating	9 V	20 V	40 V	60 V	80 V	120 V	160 V
+Current rating	100 A/200 A	50 A/100 A	25 A/50 A	16.7 A/33.3 A	12.5 A/25 A	16.7 A	12.5 A
-Curr rating (w/dissipater)	-100 A/-200 A	-50 A/-100 A	-25 A/-50 A	-16.7 A/-33.3 A	-12.5 A/-25 A	-16.7 A	-12.5 A
V1	0.68 V	0.525 V	1.9 V	1.47 V	2.0 V	3 V	4 V
V2	0.068 V	0.0525 V	.19 V	.147 V	0.2 V	0.3 V	0.4 V

APS General Information

APS N6900 Series and N7900 Series power supply power requirements

Connect the power cord that was supplied with your unit to the AC mains connector on the rear of the unit. Note that these cords are standard and are specially rated to handle the power needs of the APS supply they are shipped with. The AC input on the back of your unit is a universal AC input. It accepts nominal line voltages in the range of 100 VAC to 240 VAC. The frequency can be 50 Hz, 60 Hz, or 400 Hz. AC mains rated below 180 VAC cannot supply enough current to power either the 1 kW or the 2 kW N6900 and N7900 models to their full rated output power. In such cases, when a 1 kW or 2 kW APS power supply is connected to below 180 VAC AC mains, the power supply will still operate normally, but its maximum output power will be limited to 700 W. In this condition, if the power supply exceeds 700 W of output power the instrument turns off the output and sets the CP+ status bit.

APS power supply connectivity

All APS power supplies come standard with GPIB (IEEE-488), LAN (LXI-Core), and USB remote programming interfaces. GPIB and LAN parameters can be set via the front panel. The APS is LXI Core 2011 compliant and includes a built-in Web interface. This means you can control the APS remotely using a Web browser and a LAN connection.

APS weight and dimensions

Weight and dimensions are the same for the N6900 Series and N7900 Series APS power supplies:

- 1 kW power supplies
- Weight: 24 lbs. (10.9 kg.)
- Dimensions: L 22.39 in / 568.7 mm, W 16.81 in / 426.9 mm, H 1.75 in / 44.45 mm
- 2 kW power supplies
- Weight: 34 lbs. (15.5 kg.)
- Dimensions: L 24.928 in / 633.2 mm, W 16.81 in / 426.9 mm, H 3.468 in / 88.1 mm
- Power dissipater unit
- Weight: 18 lbs. (8.2 kg.)
- Dimensions: L 19.81 in / 503.3 mm, W 16.81 in / 426.9 mm, H 1.75 in / 44.45 mm

APS digital control port

On the rear panel of every APS power supply is a digital control port that consists of seven I/O pins that provide access to various control functions, as shown in Figure 10. Each pin is user configurable. Table 7 describes the possible pin configuration for the digital port functions.

For more information on the digital control port and how to configure it refer to the Advanced Power System user guide at www.keysight.com/find/APS-doc

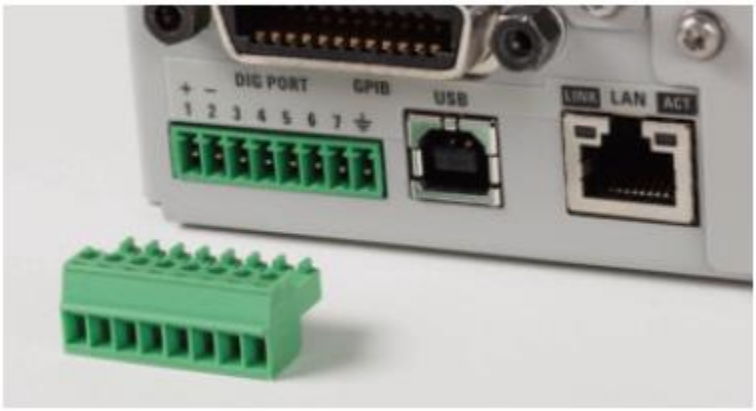


Figure 10. Digital control port on rear panel

Table 7. Digital control port description

Pin function	Available configurable pins
Digital I/O and digital in	Pins 1 through 7
External trigger in/out	Pins 1 through 7
Fault out	Pins 1 through 2
Inhibit in	Pins 3
Output couple	Pins 4 through 7
Common (connected to ground)	Pins 8

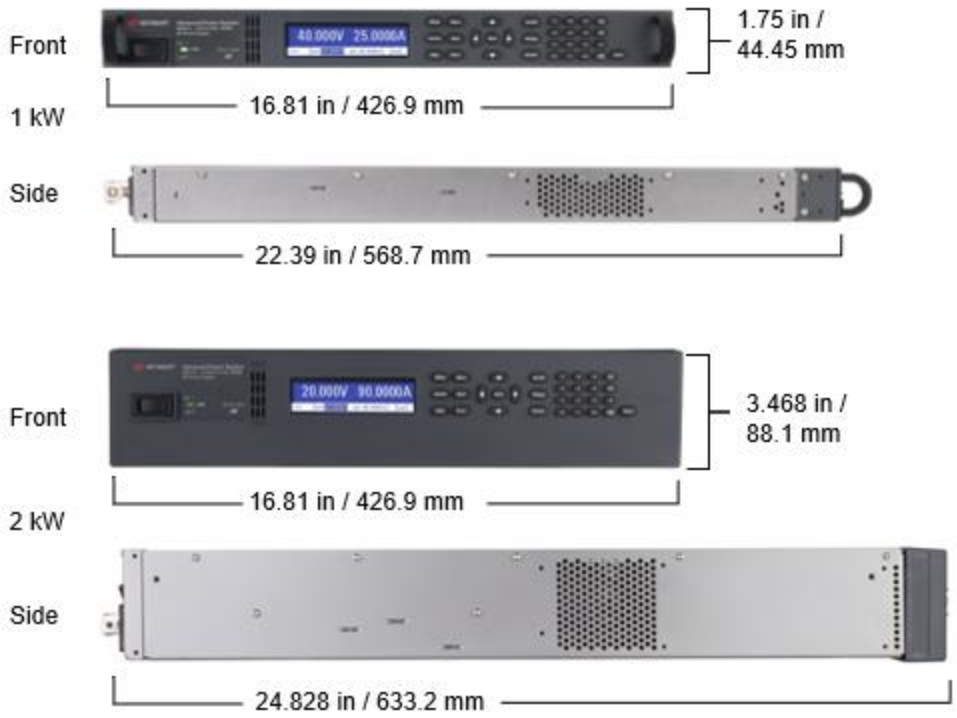


Figure 11. 1 kW and 2 kW power supplies, front and side dimensions

APS Ordering Information

Step 1 Determine performance level

Choose the right APS power supply performance level to meet your power test needs:

- N6900 Series DC power supplies: Designed for ATE applications where high performance is critical
- N7900 Series dynamic DC power supplies: Designed for ATE applications where high-speed dynamic sourcing and measurement is needed

Refer to Table 3 on page 14 for an in-depth performance and feature comparison of the N6900 Series and the N7900 Series.

For N6900, choose performance options from Table 8.

Option number	Description
301	Accuracy Package
302	Measurement Enhancements
303	Source and Speed Enhancements
760/761	Disconnect and Polarity Reversal Relays

Table 8. APS N6900 Performance Options

Step 2 Choose the right power, voltage, and current level

Choose the right APS power supply model based on your power, voltage, and current needs. Refer to Table 1 on page 3 for a full list of APS power supplies.

Step 3 Select the right optional hardware accessories

The APS includes two user-configurable hardware accessories for increasing the capability of an N6900 Series or N7900 Series power supply: APS N7909A power dissipater unit and the APS black box recorder.

The APS black box recorder is a factory installed option (option BBR) for new APS power supplies. For older models with serial numbers prior to MY59000000, the black box recorder is a user-installable hardware option that can be purchased by ordering the N7908A BBR accessory.

If you want to have full two-quadrant operation for your APS power supply, you will need one or two APS N7909A power dissipater units. Each N7909A adds 1 kW current sinking capability to an APS power supply, so for 1 kW APS power supplies you need one N7909A for full two-quadrant operation and for 2 kW APS power supplies you need two N7909As for full two- quadrant operation. Note that you can use a single N7909A with a 2 kW APS power supply to achieve 50% current sink capability. The N7909A is a separate user-configurable hardware accessory. You can order it at any time and connect it to your APS power supply.

Step 4 Order hardware for mounting the APS in an ATE system

To mount any N6900 Series or N7900 Series power supply or the N7909A dissipater, use the N7910A APS rack mount kit. The N7910A will work with both 1 kW and 2 kW APS power supplies. A N7910A APS rack mount kit is needed for every APS power supply or N7909A dissipater that you would like to mount. For other rack mount options and for product dimensions, refer to the user manual at www.keysight.com/find/APS-doc

Step 5 Choose calibration and power cord options

These options only apply to APS power supplies since they are the only units in the APS family that need to be calibrated or plugged into AC power. When ordering, to specify a particular option with an APS supply, simply append the option number to the power supply model number. For instance, to order a power cord that works in Switzerland for your 40-V 1 kW dynamic DC power supply, you would specify “N7952A-906” for your order.

Table 9. APS N6900 Series and N7900 Series options

Option number	Description
1A7	ISO 17025 cal certificate
BBR	Black Box Recorder
UK6	Commercial calibration with test results data
900	Power cord - United Kingdom
901	Power cord - Australia and New Zealand
902	Power cord - Continental Europe
904	Power cord - United States and Canada - 240 V (To add a 120V power cord, order part number 8120-5337 for the N695xA and N795xA products or part number 8121-2355 for the N697xA and N797xA products. Output power limited to 700 W at 120 VAC.)
906	Power cord - Switzerland
912	Power cord - Denmark
917	Power cord - India
918	Power cord - Japan - 100 V
919	Power cord - Israel
920	Power cord - Argentina
921	Power cord - Chile
922	Power cord - China - 250 V
923	Power cord - South Africa
927	Power cord - Thailand and Philippines
929	Power cord - Japan - 250 V
930	Power cord - Brazil
931	Power cord - Taiwan
932	Power cord - Cambodia
PLG	Continental European power cord - only for EU DISTR W MULT PWR CORD standards