

Advanced Power System N6900 Series Power Supplies

Versatility was never faster

Achieve the optimum balance of test coverage,
quality and time



Advanced Power System (APS) Overview

Versatility was never faster

There's an art to the tradeoffs you make when you need to integrate your test system fast, test your products faster and stay within budget. Keysight's small, flexible and market-leading-fast Advanced Power System (APS) N6900 Series DC power supplies with VersaPower architecture can make those tradeoffs easier and help you achieve the optimum balance of test coverage, quality and time in your ATE system

Overcome your toughest measurement challenges with VersaPower architecture

VersaPower uses cutting- edge technology to deliver industry-leading performance and innovative capabilities you don't typically find in a switching power supply design.

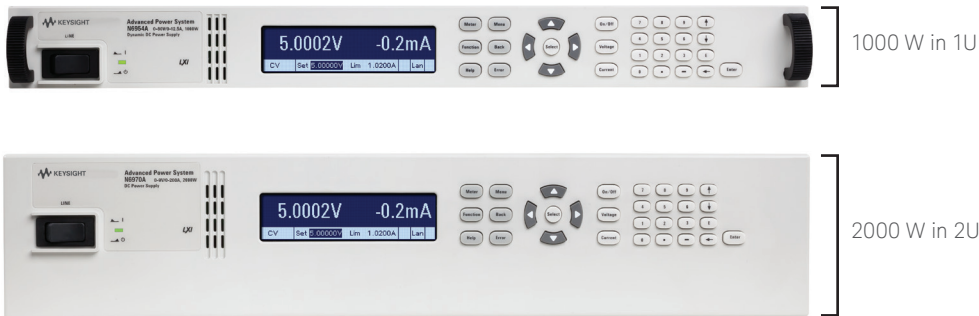
VersaPower architecture delivers the fastest, most accurate, integrated power system

- 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
- Create the configuration you need: easily add optional and advanced 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 APS N6900 model with the voltage and current you need

The N6900 Series DC power supply family offers five voltage and current combinations at the 1 kW power range and seven voltage and current combinations at the 2 kW power range.

Keysight N6900 Series DC power supplies	
1 kW models	2 kW models
N6950A 9 V, 100 A	N6970A 9 V, 200 A
N6951A 20 V, 50 A	N6971A 20 V, 100 A
N6952A 40 V, 25 A	N6972A 40 V, 50 A
N6953A 60 V, 16.7 A	N6973A 60 V, 33 A
N6954A 80 V, 12.5 A	N6974A 80 V, 25 A
	N6976A 120 V, 16.7 A
	N6977A 160 V, 12.5 A

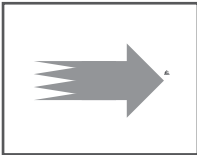
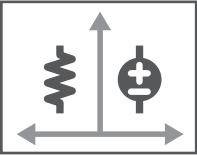

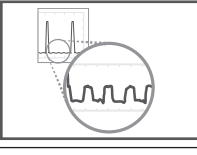
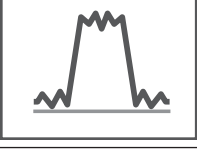
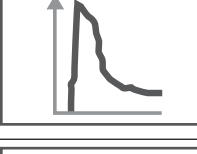
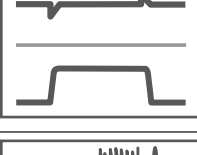
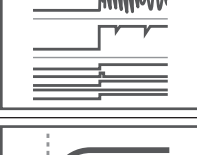

Meet your ATE testing needs without paying for more capability than you need

When you purchase an N6900 DC power supply, you can add optional capability to boost your test-system versatility. Now you can tune your power supply capability to meet your specific needs.

Option	Number	Capability	Use for
Accuracy package	Option 301	Adds higher current and voltage resolution and a second seamless measurement range for current with full factory calibration.	Accurately measure power storage and efficiency. Make DMM-quality voltage and current measurements.
Measurement enhancements	Option 302	Adds external data logging and voltage and current digitizers with programmable sample rates.	Capture inrush current and other dynamic current and voltage profiles at a much higher resolution than an oscilloscope.
Source and speed enhancements	Option 303	Add constant-dwell arbitrary waveforms and output list capability and provide improvement in up/down programming time.	Increase test throughput in high-volume manufacturing. Step through timed or triggered voltage or current levels that can also generate triggers for tightly synchronized measurements.
Disconnect and polarity-reversal relays	Options 760 and 761	Allows you to switch voltages between positive and negative values.	When testing high-value DUTs, the disconnect relays will further protect the DUT from power damage.

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.

Power related test challenge	How the APS helps you overcome the challenge
 <p>Increasing test system throughput Reducing test time can mean big savings, so achieving throughput gains is a never-ending quest.</p>	<ul style="list-style-type: none"> – 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
 <p>Building a continuous source and load You need a continuous source and load solution for testing power storage DUTs.</p>	<ul style="list-style-type: none"> – Full two-quadrant glitch-free operation across quadrants – Voltage and current limit settings to keep your device within its operating range
 <p>Protecting against power related damage When testing expensive DUTs, designing protection from power damage in the test system is critical.</p>	<ul style="list-style-type: none"> – Smart triggering – Fast output response – Output disconnect relays – Watchdog timer
 <p>Characterizing dynamic current profiles Your DUT has a current profile with a large dynamic range that you need to characterize.</p>	<ul style="list-style-type: none"> – 18-bit high resolution current digitizer – Adjustable measurement sample rate – External logging capability – Peak triggering and measurements
 <p>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.</p>	<ul style="list-style-type: none"> – AWG capability – Step function capability – High bandwidth mode
 <p>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.</p>	<ul style="list-style-type: none"> – 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
 <p>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.</p>	<ul style="list-style-type: none"> – Fast transient response to ensure minimal voltage droop to load transients – High and low output bandwidth settings for tuning the output to your load
 <p>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.</p>	<ul style="list-style-type: none"> – Built-in Black Box Recorder – Records voltage, current, power, trigger events, mode changes, and more in non-volatile memory
 <p>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.</p>	<ul style="list-style-type: none"> – Sequencing capability across multiple APS supplies – Sequencing capability with Keysight's N6700 modular power supply family – Adjustable slew rate control

Faster Test Speeds, Faster System Integration and Deployment

Accelerate test throughput with industry-leading specifications

- Achieve test speeds that are up to 100x faster than standard system power supplies
- Enhance program execution with command processing speed of less than 1 ms
- Optimize test speed and ensure DUT safety with up/down programming speed as fast as 500 μ s
- Balance speed and accuracy with adjustable measurement rates (Options 301 and 303)

Faster system integration

Reduce test complexity and protect your DUT with integrated smart triggering

- Initiate instrument action with level triggering from five different measurements
- Create logical triggering “and,” “or,” “not” based on multiple trigger sources
- Use triggers to transition through a list of voltage or current levels

Faster deployment

Easily replicate and support systems at multiple sites around the world

- The high degree of integration dramatically reduces system development time and makes replication easy
- Complement your in-house test expertise with Keysight's local application engineering resources
- Simplify calibration and repair with our global service network

Add additional flexibility to your system with built-in paralleling capability

- Automatically ensure equal current sharing among paralleled supplies
- Connect multiple N6900 power supplies using the three-wire connection on the rear panel of each unit
- Use each paralleled supply in its intended mode, either constant voltage (CV) or constant current (CC)

Simplify battery and power-storage testing with full two-quadrant operation

- Get smooth, continuous operation between positive and negative current transitions
- Use positive and negative programmable current limits and current waveforms, plus automatic down-programming
- Utilize the built-in 10% load
- Note: Full two-quadrant operation requires addition of N7909A power dissipater accessories



Figure 1. 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 N6900 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 2.



Figure 2. 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 \pm current waveform capability to fully utilize the two-quadrant operation.
- The APS provides \pm 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.

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 \pm current transients at ~ 5 ms, where a highperformance 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 optional 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 3). 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.

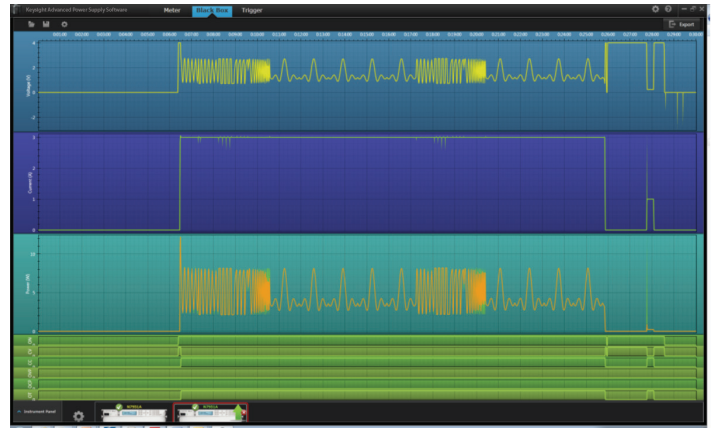


Figure 3. Black box recorder data displayed within the N7906A Power Assistant software.

APS N7907A rack mount kit

The N7907A rack mount kit can be used for all N6900 and N7900 power supplies, regardless if they are 1 kW or 2 kW form factors. It can also be used for mounting the N7909A. N7907A APS rack mount kit is needed for every APS power supply or N7909A dissipater that you would like to mount.

The N7907A 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.

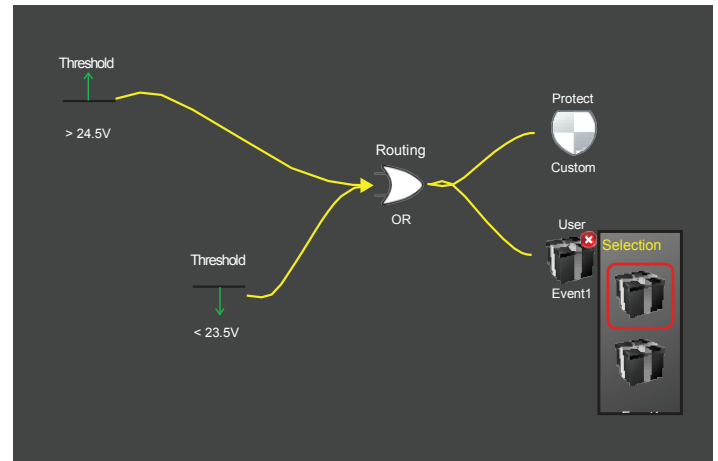


Figure 4. Configuring a trigger expression with the N7906A Power Assistant software.

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 3)
- Perform trigger routing and configure logical trigger expressions (see Figure 4)

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.

APS Specifications

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

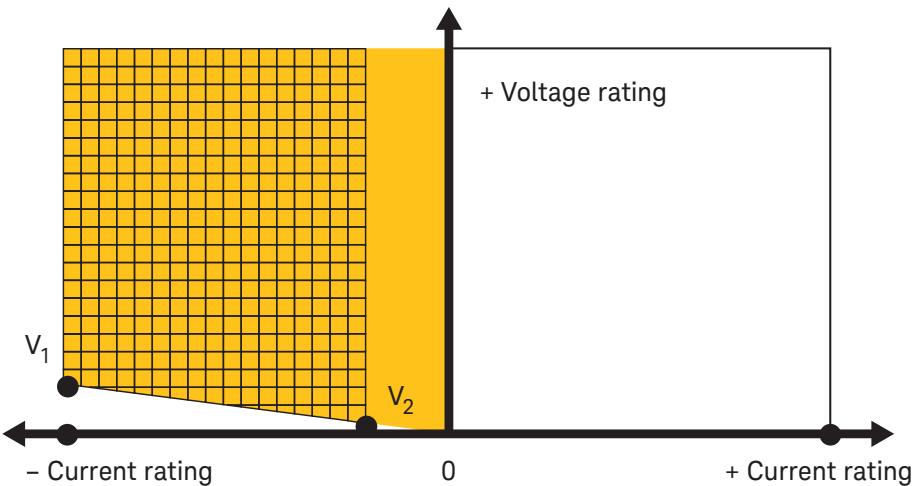
N6900 specifications 1 kW / 2 kW

Table 2.

	N6950A / 70A	N6951A / 71A	N6952A / 72A	N6953A / 73A	N6954A / 74A	N6976A	N6977A
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 at 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 at 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 and 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	4 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 meas. accuracy ³	0.03% +1.5 mV	0.03% +3 mV	0.03% +6 mV	0.03% +9 mV	0.03% +12 mV	0.03% +17 mV	0.03% +24 mV
Lead drop ≤ 1 V max	0.03% +1.9 mV	0.03% +4 mV	0.03% +7.9 mV	0.03% +12 mV	0.03% +16 mV	0.03% +23 mV	0.03% +32 mV
Lead drop $\leq 25\%$ of V	0.03% +1 mV	0.03% +2 mV	0.03% +4 mV	0.03% +6 mV	0.03% +8 mV	0.03% +11 mV	0.03% +14 mV
Rating with option 301	0.03% +1.4 mV	0.03% +3 mV	0.03% +5.9 mV	0.03% +9 mV	0.03% +12 mV	0.03% +17 mV	0.03% +22 mV
Curr programming and measurement accuracy ³	0.1% +30 / 60 mA	0.1% +15 / 30 mA	0.1% +8 / 15 mA	0.1% +5 / 10 mA	0.1% +4 / 8 mA	0.1% +5 mA	0.1% +4 mA
With Option 301	0.04% +15/30mA	0.04% +8 / 15 mA	0.04% +4 / 8 mA	0.04% +2.5/5mA	0.04% +2 / 4 mA	0.04% +2.5 mA	0.04% +2 mA
Curr. measurement ranges ⁵ (with Option 301)							
High range N695x	-225 A to 225 A	-112.5A 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 N697x	-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 37.6A	-28.1 A to 28.1 A
Low range N695x	-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 N697x	-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 response ⁴							
Recovery time	100 μ s	100 μ s	100 μ s	100 μ s	100 μ s	100 μ s	100 μ s
Settling band	150 mV	150 mV	100 mV	150 mV	200 mV	300 mV	400 mV
Volt up and down programming time ⁶							
10% to 90% settling time	3 ms	3 ms	3 ms	3 ms	3 ms	3 ms	3 ms
90% to 10% settling time	10 ms	10 ms	10 ms	10 ms	10 ms	10 ms	10 ms
With Option 302							
Volt up programming	0,5 ms	0,5 ms	0,5 ms	0,5 ms	0,5 ms	0,5 ms	0,5 ms
Time	1 ms	1 ms	1 ms	1 ms	1 ms	1 ms	1 ms
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	0.12% +1.6 m Ω *A	0.12% +3.2 m Ω *A	0.12% +6.4 m Ω *A	0.12% +8.8 m Ω *A	0.12% +12.8 m Ω *A	0.12% +17.7 m Ω *A	0.12% +25.6 m Ω *A
Resolution	0.8 $\mu\Omega$ / 0.4 $\mu\Omega$	3.4 $\mu\Omega$ / 1.7 $\mu\Omega$	13 $\mu\Omega$ / 7 $\mu\Omega$	30 $\mu\Omega$ / 15 $\mu\Omega$	54 $\mu\Omega$ / 27 $\mu\Omega$	60 $\mu\Omega$	108 $\mu\Omega$

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 \pm 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



Key




-  Sourcing power
-  Sinking power up to 10% of rating without dissipater
-  Sinking power up to 100% of rating with dissipater

Table 3.

	N6950A / 70A	N6951A / 71A	N6952A / 72A	N6953A / 73A	N6954A / 74A	N6976A	N6977A
+ 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
- Current 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 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 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

- 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 5. Each pin is user configurable. Table 4 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 5. Digital control port on rear panel.

Table 4. Digital control port

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

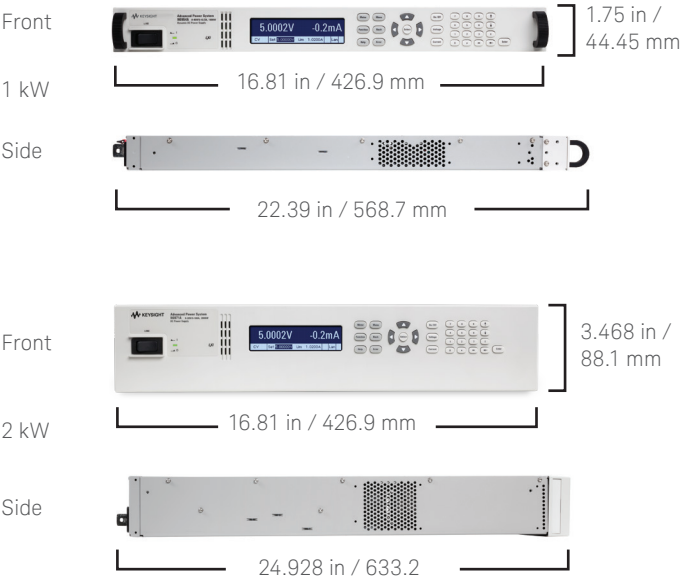


Figure 6. 1 KW and 2 KW power supplies, front and side dimensions.

APS Ordering Information

Step 1. Choose performance options from Table 5.

Table 5. APS N6900 Performance Options

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

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 2 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 power supply: APS N7909A power dissipater unit and the APS N7908A 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 power supply or the N7909A dissipater, use the N7907A APS rack mount kit. The N7907A will work with both 1 kW and 2 kW APS power supplies. A N7907A 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 6. APS N6900 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 120 V 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



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