

Frequently Asked Questions - Contents

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Calibration Certificate

Question: Do all Power Products ship with a calibration certificate?

Answer: Criteria have been established to determine which products get or do not get a calibration certificate from the factory. A product with a product number does not automatically qualify for a calibration certificate.

Products which meet the following 3 criteria will ship with a calibration certificate.

1. The product must have published specifications.
2. The product must be calibrated: specifications are checked and metrology is in place.
3. There is a likelihood the product will be recalibrated in the field at the recommended calibration intervals to qualify for a calibration certificate.

Currently, four Power Products that are not shipped with a calibration certificate are the 6050A, 6051A, 66000A, and the N3300A. Each of these is a mainframe power unit which houses separate plug-in modules. There are no specifications to be checked on these products, and they do not have a recommended calibration interval in the field. Therefore, there is no need for a calibration certificate for these products.

No Date on Calibration Certificate

Question: Why does Agilent currently ship Power Supplies with calibration certificates that are not dated?

Answer: The calibration date is dated on the Certificate of Calibration next to the signature of Electrical Inspector. And the blank Calibration label (sticker) is stapled with the certificate of calibration.

There are no components used in Power Products which have a specific shelf life. Therefore, the calibration period of this instrument begins on the date that the product is first put into service by the customer. The recommended calibration interval for most Power Products is 12 months. Please check your User's Guide to verify the specific interval for your product. Once the product has been put into service, fill in the appropriate dates for recalibration on the calibration label (sticker).

All Agilent Power Products will meet their published specifications for 1 year after the customer puts the product into service.

Calibration Time Interval

Question: How long is the calibration time interval?

Answer: Agilent recommends 1 year as the calibration interval for all its power supplies.

Line Voltage Options

Question: How do I determine the correct line voltage option to order for my power supply?

Answer: Some power products use lots of power, far beyond the range of typical electronic products with which we are familiar. This makes choosing the correct line voltage option more challenging. Also, power distribution systems, regulations, and connection techniques vary greatly among geographic regions as a result of local electrical standards. Many times, higher powered products require the help of a site electrician to provide the appropriate power distribution, especially for products requiring 3-phase power.

Most Agilent power products have field-changeable line voltages; a few do not, and must be ordered with extra care to avoid mistakes. However, even those that are field changeable may require more than changing the position of a rear panel selector switch. In some cases, internal jumpers must be moved to accomplish the change. Thus, to assure that your power product can be put into service with a minimum of effort on-site, it is important to use care in ordering the product and in preparing the site.

The [Power Products Catalog](#) includes a section on selecting the correct line cord and line voltage for most situations. Also, be sure to consult with your on-site electrician if there is any doubt about the correct method of providing power to your product.

Line Cord Information

Question: Why doesn't my power supply come with the right line cord?

Answer: Some power products use lots of power, far beyond the range of typical electronic products with which we are familiar. This makes it difficult to identify and provide the correct line cord and plug in all situations. Many times, higher powered products require the help of a site electrician to provide the appropriate power distribution. In particular, 3-phase products are typically provided with an unterminated line cord, that is appropriate for the destination country.

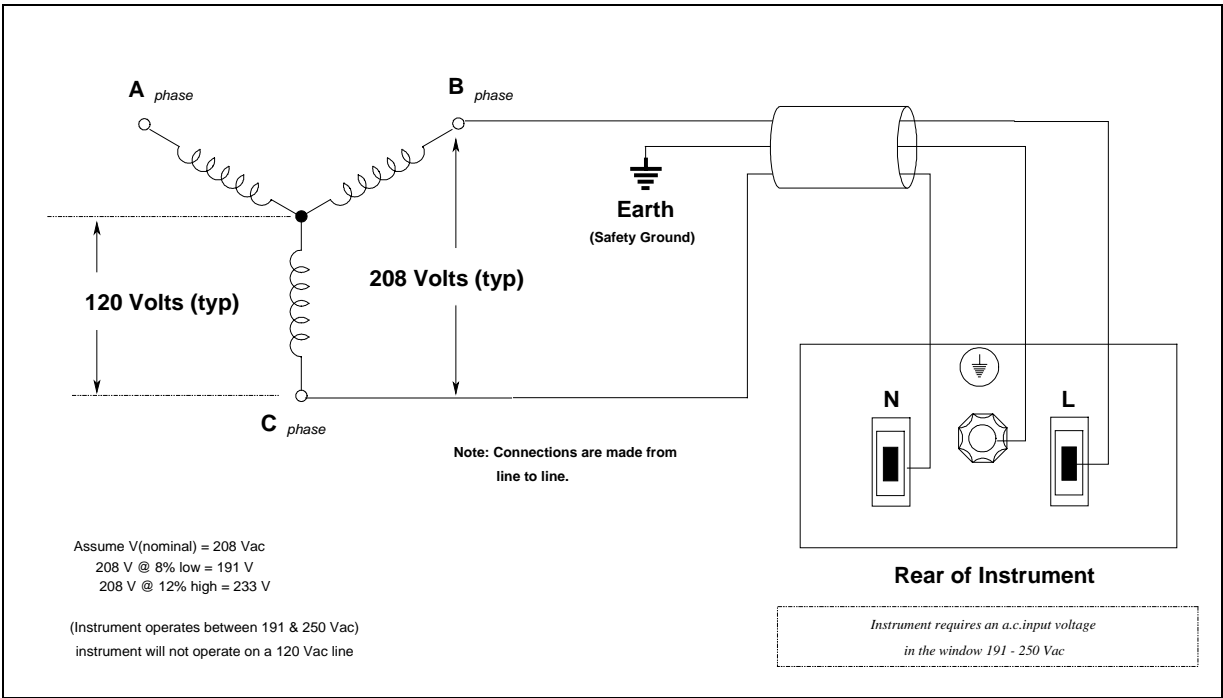
In other cases, the required line voltage and current dictates the line cord that is supplied. For example, the standard voltage for the 2KW 667xA products is 230 Vac. These products can not be powered off a 120 Vac line because of the high current required. Another example is the 601xA and 603xA families of autoranging power supplies. While these can be powered from a 120 Vac circuit, they require currents in excess of 15 A, therefore they are shipped with a line cord intended for operation on a 30 A 120 Vac circuit.

The [Power Products Catalog](#) includes a section on selecting the correct line cord and line voltage for these and many other situations.

Single-Phase Power From a 3-Phase Line

Question: Can I operate a power product that requires 220vac single-phase, from a 208vac 3-phase power line?

Answer: The figure below shows how you can draw close to the required voltage from a 3-phase power line. This will work satisfactorily when the power line is reasonably close to nominal value. However, it is possible that the power product may not be able to produce full power when the 208 Vac line is at the low end of its tolerance. For example if the 208 Vac line were -10%, the resultant input voltage would be 187 Vac. This is below the minimum acceptable voltage for the power product, which would be 191 Vac for a 220 Vac input line setting.



Switching and Linear Power Products

Question: Which power supplies are switchers, and which are linears?

Answer: Some people avoid switching power supplies because they have a poor reputation for performance, specifically high p-p noise on the output, in addition to higher radiated and conducted EMI. However, Agilent pioneered switching supplies such as the 6670 series which offered the performance of linears with the advantages of switchers. Today, all Agilent power supplies offer very low p-p ripple and noise specifications, and very low radiated and conducted EMI. The reputation for superior performance of products such as the Agilent 6670 and 6680 series is well established. The 5kW 6680 series offers peak-peak noise as low as 10 mV and output programming response times as low as 9 ms. In fact, Agilent switchers can be quieter than some linears! Poorly designed linears can have commutating spikes when their bridge rectifier diodes turn off. These spikes occur at two times the power line frequency, but the sharp edges radiate noise in the megahertz range and above. Agilent design engineers have gone to a lot of effort to make both our linear and switching power supplies as noise-free as possible!

However, many switching supplies are still available from other manufacturers that do not offer this level of performance. So as not to unfairly prejudice customers on the performance of these supplies, we have avoided blatantly labeling them as switchers. The list on the following page indicates the type of each model of power supply that Agilent has offered recently.

** Note: The "Hybrid" technology utilizes either primary or secondary 60 Hz SCR phase control switching followed by a Linear regulator on the DC secondary side.

Switcher/Linear Type for Power Supplies

MODEL	WATTS	VOLTS	CURRENT	TYPE	MODEL	WATTS	VOLTS	CURRENT	TYPE
6010A	1000	200	17	Switcher	6612B	40	20	2	Linear
6011A	1000	20	120	Switcher	6621A	160	20/20	10-Oct	Linear
6012B	1000	60	50	Switcher	6622A	160	50/50	4-Apr	Linear
6015A	1000	500	5	Switcher	6623A	160	20/20/50	37386	Linear
6023A	200	20	30	Switcher	6624A	160	20/20/50/50	5/5/2/2	Linear
6028A	200	60	10	Switcher	6625A	75	50/50	0.5/1	Linear
6030A	1000	200	17	Switcher	6626A	150	50/50/50/50	0.5/0.5/1/1	Linear
6031A	1000	20	120	Switcher	6627A	160	50/50/50/50	2/2/2/2	Linear
6032A	1000	60	50	Switcher	6628A	100	50/50	1-Jan	Linear
6033A	200	20	30	Switcher	6629A	200	50/50/50/50	1/1/1/1	Linear
6035A	1000	500	5	Switcher	6632B	100	20	5	Linear
6038A	200	60	10	Switcher	6633B	100	50	2	Linear
6114A	40	40	2	Linear	6634B	100	100	1	Linear
6115A	40	100	0.8	Linear	6641A	200	100	1	Linear
6177C	25	50	0.5	Linear	6642A	200	20	10	Linear
6181C	25	100	0.25	Linear	6643A	200	35	6	Linear
6186C	30	300	0.1	Linear	6644A	200	60	3.5	Linear
6205C	24	40/40	0.6/0.6	Linear	6645A	200	120	1.5	Linear
6209B	32	320	0.1	Hybrid	6651A	500	8	50	Linear
6227B	100	25/25	2-Feb	Linear	6652A	500	20	25	Linear
6228B	100	50/50	1-Jan	Linear	6653A	500	35	15	Linear
6253A	120	20/20	3-Mar	Linear	6654A	500	60	9	Linear
6255A	120	40/40	1.5/1.5	Linear	6655A	500	120	4	Linear
6260B	1000	10	100	Hybrid	6671A	2000	8	220	Switcher
6268B	120	40	30	Hybrid	6672A	2000	20	100	Switcher
6269B	2000	40	50	Hybrid	6673A	2000	35	60	Switcher
6274B	900	60	15	Hybrid	6674A	2000	60	35	Switcher
6281A	38	7.5	5	Linear	6675A	2000	120	18	Switcher
6282A	100	10	10	Hybrid	6680A	5000	5	875	Switcher
6284A	60	20	3	Linear	6681A	5000	8	580	Switcher
6286A	200	20	10	Hybrid	6682A	5000	21	240	Switcher
6289A	60	40	1.5	Linear	6683A	5000	32	160	Switcher
6291A	200	40	5	Hybrid	6684A	5000	40	128	Switcher
6294A	60	60	1	Linear	6612A	750 VA/ 1-ph	300 Vac	6.5	Switcher-AC Source
6296A	180	60	3	Linear	6813A	1750 VA/ 1-ph	300 Vac	13	Switcher-AC Source
6299A	75	100	0.75	Linear	6814B	3000 VA/ 1-ph	150/300 Vac	20/10	Switcher-AC Source
6541A	200	8	20	Linear	6834B	3000 VA/ 3-ph	150/300 Vac	5-Oct	Switcher-AC Source
6542A	200	20	10	Linear	6825A	40	+/-20	+/-2	Linear-Bipolar
6543A	200	35	6	Linear	6826A	50	+/-50	+/-1	Linear-Bipolar
6544A	200	60	3.5	Linear	6827A	50	+/-100	+/-0.5	Linear-Bipolar
6545A	200	120	1.5	Linear	6841A	750 VA/ 1-ph	300 Vac	6.5	Switcher-AC Source

Cooling Requirements

Question: How much cooling do I need for my power supply?

Answer: Users frequently rack power supplies into an enclosure to supply power to some remotely located external load. Under these conditions, to properly determine the cooling requirements, the systems integrator needs thermal data from the manufacturer for the specific enclosure in question. This data is generally in the form of a curve which relates the rise of the enclosure's internal air temperature to the amount of power (or BTU'S) dissipated within the enclosure.

The difference between the maximum power demanded by the external load, and the ac power demanded by the power supply to support the load's needs, is the power dumped into the internal air of the enclosure. Using this number and data for the enclosure, the internal rise can be determined. The internal rise added to the external ambient temperature will determine the temperature of the environment for the power supply. This must be within the ratings of the product or premature failure will occur.

A valuable conversion factor between Watts and BTU's is listed below:

1 BTU/Hr = 0.293 Watt

Internal Memory

Question: How much volatile or non-volatile memory is available in Agilent Power Products?

Answer: The number of store/recall states for power products varies for different series.

DC power supply models:

6030A, 6031A, 6032A, 6033A, 6035A and 6038A have 16 volatile memory storage locations available to the user in either Compatible or SCPI language mode. The user cannot pre-define the power on state.

6632A, 6633A and 6634A have no memory available to the user. The user cannot pre-define the power on state.

66312A, 66332A, 6612B, 6632B, 6633B and 6634B have 4 non-volatile memory storage locations available to the user in SCPI mode including one for power-on state. There is no memory available in COMPability mode. Consult Users Guide or Programming Guide to pre-define the power on state.

664xA, 665xA, 667xA have 5 non-volatile memory storage locations available to the user in SCPI mode including one for power-on state. There are 16 volatile memory locations available to the user in COMPatible mode. Consult Users Guide or Programming Guide to pre-define the power on state.

668xA have 4 non-volatile memory storage locations available to the user in SCPI mode including one for power-on state. There are 16 volatile memory storage locations available in COMPatible mode. Consult Users Guide or Programming Guide to pre-define the power on state.

6610xA modules have 5 non-volatile memory storage locations available to the user including one for power-on state. Consult the Users Guide to pre-define the power on state.

Electronic Loads:

The Electronic Load single input models 6060B and 6063B and module models 60501B, 60502B, 60503B, 60504B and 60507B have 1 non-volatile and 5 volatile memory storage locations available to the user. Consult Programming Guide to change power on state. The Electronic Load mainframe models 6050A and 6051A have no memory available to the user.

AC Sources:

AC power source models 681xA, 681xB, 684xA have 16 non-volatile memory storage locations available to the user including one for power-on state. Consult Users Guide or Programming guide to pre-define the power on state.

Constant Current Operating Mode

Question: How do I put the power supply in the constant current mode?

Answer: The power supply cannot be "put" into the constant current mode. The output settings of the power supply combined with the ohmic value of the particular load determine whether or not the power supply is in constant current.

For example: The power supply inherently resides in the constant voltage mode. If the output voltage were set to 24 volts and a 6Ω load were placed across the output terminals, Ohm's Law would require that 4 amps would flow ($24V/6\Omega$). This presumes that the constant current setting of the power supply were set to a value greater than 4 amps; lets say 5 amps. Now, if the 6Ω load were replaced by a 2Ω load, Ohm's Law would suggest that 12 amps ($24V/2\Omega$) would flow. However, the power supply is set to go into constant current at 5 amps. Therefore, the actual output voltage would be 10 volts ($2\Omega \times 5A$). The power supply will now remain in constant current for values of load = $0 \leq R < 4.8\Omega$. Once the ohmic value of the load becomes greater than 4.8Ω ($24V/5A$), the power supply will again revert to constant voltage operation at the value of 24 volts.

Current Sinking

Question: Can Agilent power supplies sink current?

Answer: Yes! Sinking, or downprogramming, is the ability of a power supply to pull current into the positive power terminal. Sinking is necessary to discharge the power supply's own output capacitor, or the capacitors that are part of an external load.

Sinking is particularly important, for example, in printed circuit board test systems. The relays in test board systems typically must be switched only when the power supplies have discharged to zero volts, to avoid arcing and burn-out of the relay contacts. Sinking allows the power supply outputs to go to zero quickly, thus providing faster test times, an important factor for reducing overall test cost.

The value of the sink current is fixed and is not programmable, with the exception of the 663xB Series, where sink current is set to the same value that is programmed for source current.

In general, sinking is provided to improve a power supply's transition time from a higher to a lower constant voltage operating level, and is not intended to be a steady-state operating condition.

Products	Current Sinking Capability
661x Series 40 Watt	60% of source current rating
6621A, '22A, '23A, '24A, '27A Multiple Output	110% of source current rating
6625A, '26A, '28A, '29A Precision Output	110% of source current rating
663x Series 100 Watt	110% of source current rating
603x Series Autorangers	50 W/actual output voltage in volts or actual output voltage volts/0.05 ohms, whichever is less
664x Series 200 Watt	25% of source current rating
665x Series 500 Watt	20% of source current rating
667x Series 2000 Watt	50 W/actual output voltage in volts or actual output voltage in volts/0.05 ohms, whichever is less
668x Series 5000 Watt	50 W/actual output voltage in volts or actual output voltage in volts/0.05 ohms, whichever is less

Down Programming

Question: What is down programming?

Answer: When a power supply with current sink capability is programmed to a voltage level less than that actually at the output terminals it will automatically begin to sink current. The downprogrammer can be thought of as an internal load across the power supply's output terminals that helps bring the output voltage down quickly.

This is particularly useful in automated test of a device at several voltage or current levels, or in high volume testing. The primary function of the down programmer is to discharge the power supply's output capacitor but in some cases this feature may be used as a load to the device under test. The supply might be used to both charge and discharge a device such as a capacitor or a battery.

Supplies vary in the level and other characteristics of current they sink. Some supplies such as the 603xA, 664xA and 665xA sink a fixed current equal to about 10% of their rated output current while the 667xA series sink a constant power (as the output voltage falls the supply sinks more current). The 662xA series have fixed dual range sink capability similar to their output ranges and the 663xA/B series supplies are programmable. See the Operating manuals to determine the characteristics of each model.

The Difference Between Watts and VA

Question: Why are the required Watts and VA so different?

Answer: Watts is a scalar quantity which is frequently used to measure system efficiency. It is the energy supplied by the utility company over a given period of time and is commonly referred to as power. Except for heavy industrial users, the utility company only bills users for the watts consumed. Watts are directly convertible into mechanical work or BTUs (British Thermal Units) of heat. Wasted power is paid for a second time in terms of additional loading on the user's air-conditioning system. Mathematically, it is a scalar quantity resulting from the vector product of two vector quantities (volts and amps). It is NOT the simple algebraic product of the rms volts times rms current.

VA on the other hand IS the scalar quantity resulting from multiplying the magnitudes (rms) of the vector quantities (volts and amps). This resulting quantity will never be smaller than the watts demanded by an instrument. Uninformed users incorrectly use VA to assess the device's over-all efficiency and power demands. VA is most frequently and correctly used by electricians to determine proper ac mains conductor gage and circuit breaker sizing.

How Watts, VA, Power Factor, and Efficiency are Related

Question: How are Watts, VA, Power Factor, and Efficiency related?

Answer: "Watts" is a scalar quantity, often referred to as power, and is frequently used in conjunction with measuring system efficiency. Watts is the energy supplied by the utility company over a given period of time to accomplish work for the consumer. Except for heavy industrial consumers, the utility company only bills users for the watts consumed (not VA). Watts are directly convertible into mechanical work (horsepower) or BTUs (British Thermal Units) of heat.

1 Horsepower = 746 Watts;

1 BTU/Hr = 0.293 Watts

Mathematically, a watt is a scalar quantity resulting from the vector product of two vector quantities (volts and amps). It is not the simple algebraic product of the rms voltage times the rms current.

"VA" on the other hand is the scalar quantity resulting from multiplying the rms magnitude of the vector quantities, volts and amps. This resulting quantity will never be smaller than the watts demanded by an instrument. Uninformed individuals incorrectly use VA to assess a product's over-all efficiency and power demands. Correctly applied, VA is used to determine proper ac mains conductor gage and circuit breaker sizing as well as "power factor".

"Power factor" is, for a given set of conditions, the watts consumed by a product divided by the VA necessary to deliver that power. The power factor will only equal 1.0 when the load is purely resistive; i.e., watts consumed equals the VA necessary. In real life this happens infrequently. More times than not, the power factor is a number less than 1.0.

As the load becomes more reactive, a greater number of VA is required to deliver the same number of watts to the load. Assuming the rms mains voltage remains fixed, the decreased power factor necessitates a larger rms current be available to supply the same nominal number of watts to the load. The power utility and distribution grid must be capable of generating and distributing this disproportionately high level of current. This is why the utility companies are desirous of power factors near 1.0 for products.

"Efficiency", is simply the work done by a system divided by the work supplied to the system. For an electrical load under a given set of conditions, this is usually the output power divided by the input power. The resulting number is always less than 1.0. The difference between the output power and the input power is the number of watts lost from the system in the form of heat. Lost watts can be converted into BTU's/Hr and equates to the amount of heat which is released into the ambient surroundings.

The Difference Between P-P Voltage Noise and RMS Noise

Question: What is the difference between voltage P-P noise and RMS noise specifications?

Answer: Both V_{p-p} and V_{rms} are measures for the unwanted ac components of a dc power supplies output. Peak-to-peak noise is measured from the maximum positive point on the waveform to the most negative voltage point. This measurement is particularly important for applications where noise spikes could be detrimental to accurate measurements on a sensitive load, such as r.f. circuitry.

RMS is an abbreviation for root mean square, and it's accurate measurement requires a true-RMS responding voltmeter. This measurement is not an ideal representation of dc power supply noise, since fairly high output noise spikes of short duration could be present in the ripple, and not appreciably increase the RMS value.

Current Overshoots Above the Current Limit Setting

Question: Why does the power supply allow transient current overshoots above the current limit setting?

Answer: Agilent power supplies can operate in either constant voltage (CV) or constant current (CC) over the rated output voltage and current. However, most are designed as constant voltage sources. This means that these units turn on in constant voltage mode. There is no command for constant current operation. Whether you set the current (Iset) to 0 or any other value, the dc source operates in the CV mode first, and will generate maximum voltage set by voltage (Vset) until the operating mode of the unit is determined by the voltage setting, the current setting, and the load resistance. Thereafter, the power supply will automatically transition back and forth between CV and CC mode as necessary based on changes in the load resistance, the voltage setting, or the current setting.

Furthermore, the transition from CV to CC is not instantaneous. The power supply's internal control loop has a finite slew rate characteristic, which introduces a time delay in mode crossover. Switching power supplies respond more slowly (typically 100's of milli-seconds) than linear supplies (typically 100's of micro-seconds). During this transition period, the current can exceed the current limit by a significant amount.

This should not be surprising. The output capacitor, present on every power supply, is outside the control loop, and is capable of supplying *very large* currents into the load as a result of resistance changes. This type of situation is possible with most power supplies to a greater or lesser extent. To prevent this characteristic from becoming a problem, there are a few precautions you should observe.

First choose the smallest power supply that will reasonably do the job. If possible, use a linear rather than a switcher. Choosing a larger supply than necessary may provide flexibility, but it also increase the potential for problems.

Next, don't "hot switch" the device under test (DUT) onto a power supply output that is already at working voltage, *especially* if the DUT represents a capacitive load. Instead, first program the power supply to 0.0amps, then connect the DUT, then re-program the supply to the desired current limit.

Lastly, don't turn the power supply output on with a sensitive load connected. The power supply will initially turn on in the CV mode. The only way to turn the unit on in CC mode is by placing a short across the output and then enabling or turning the output on, and finally removing the short.

Driving Inductive Loads

Question: How can I drive an inductive load or a large electro-magnet with a power supply?

Answer: One of the popular uses of Agilent power supplies is driving large magnets. Magnets are commonly used in several industries including nuclear fusion research and magnetic resonance imaging. However, there are a couple of problems that can arise in these applications.

Power supply oscillation can occur when driving an inductive load or magnet.

It may be difficult to ramp the current through the magnet fast enough (especially with cryogenic magnets).

Since a magnet is basically a large inductor, the power supply must be stable when driving a large inductive load. Inductive loads present no stability problems in the CV mode, however, in the CC mode a parallel resonant network is formed by the inductance of the load and the output capacitance of the power supply. This can cause ringing, or even oscillation at a frequency given by the formula:

$$\text{Frequency of oscillation} = 1 / [(2)(3.1416)(LC)^{.5}]$$

Also, the rate of current flow through a magnet is determined by the formula: $di/dt = L/V$

The larger the magnet, the higher the voltage must be to drive it at a given ramp rate. The power supplies maximum voltage ratings may be insufficient for these applications. In other cases, a higher current may be needed than one power supply can provide. Paralleling power supplies to get more current for driving magnets increases the possibility of oscillation problems, which can destroy the DUT (Device Under Test).

The solution to these problems is to use a power supply that has stability for inductive loads either built-in, or provided as a special option. Here are some examples:

6680A and 6681A (5 kW): have internal stabilization for loads up to 7 Henrys

6010A, 6011A, 6012B*, 6030A, 6031A, 6632A and 6038A** have special options available:

Option J01 - stabilization for loads up to 10 Henrys

Option J02 - stabilization for loads of 10 to 25 Henrys (* = J02 not available for these supplies)

For driving inductive loads when using the 664x, 665x, 667x and 668x supplies, refer to their Operating Manuals to understand power supply stability. Contact your local Sales Office for information about specials for these and/or other Agilent power supplies.

Remote Sensing

Question: How can I offset the voltage drop caused by long cable lengths from my dc power supply to the device under test (DUT)? What is remote (error) sensing? When is it needed?

Answer: Normally, Agilent power supplies are delivered configured to deliver their full specs at the output terminals. In some application, where long lead lengths to the DUT are unavoidable, the regulation of the power supply at the DUT can be significantly improved by using remote sensing. The sense leads effectively connect the inputs to the power supply control loop directly to the DUT. Since there is negligible current in these sense leads, the exact voltage at the DUT is communicated back to the power supply. Now any resistance in the load leads is essentially brought inside the power supply control loop, and is effectively “eliminated”.

The amount of drop in the load leads that the sense leads can correct for is limited. In general, most Agilent dc power supplies can handle up to 2 volts in each load lead. Some power supplies are available which can drop up to half the rated output in each lead. Of course, the total drop in the load leads subtracts from the rated voltage available for the DUT. Refer to the [Power Products Catalog](#) for the remote sensing specifications for the power supply of interest.

PROCEDURE:

For the 661xB/C, 663xB, 664xA, 665xA, Electronic Loads, 66111A, 66311A, 66312A, 66332A, 6610xA, E3614A, E3615A, E3616A, E3617A:

Make the sense wire connections (+S to +; -S to the -)

Ensure that the Remote/Local switch on the back of the unit is set to “Remote”

Note: front panel binding posts *do not* have remote sense capability

For the 667xA, 668xA, E3632A (no Remote/Local switch):

Remove the jumpers connecting +S and +, and connecting -S and -

Make the sense wire connections (+S to +; -S to the -)

For 681xA, 6814B, 6834B and 6843A ac sources (no Remote/Local switch):

ALWAYS make the sense wire connections (+S to +; -S to the -)

Also, in applications requiring relays, the 59510A/11A Relays automatically switch and sequence both load and sense leads. When used with Agilent system power supplies that have been configured appropriately, the relays can be controlled through the power supply GPIB port. Please refer to the Operating Manuals elsewhere on this website for more complete information on remote sensing .

Floating the Output Above Ground

Question: Can I “float” the power supply above ground?

Answer: The chassis of the power product must *always* be referenced to earth ground, for safety reasons. However, the output is isolated and may be connected to a point other than ground. It is most common for the output to be connected to circuit common, but in some applications it is advantageous to have the power supply output referenced to some voltage above (or below) ground.

For most Agilent Power Products, the maximum floating voltage is +/- 240 volts from chassis ground. However, the following products have different isolation voltages as indicated:

6015A/6035A: +/-550 volts

68xxA: 300 vrms

66312A: +/- 50 volts

E3631A 6 volt output: +/-25 volts

Floating a power supply can represent a hazard to people and equipment. Be aware of the following considerations when floating a power product.

Digital I/O ports are referenced to ground, regardless of where the power product output is referenced.

A grounded analog programming source may short out the current sense resistor causing uncontrolled output currents or blown tracks on the power supply circuit board. Be sure the programming source is fully isolated. Think through all connections carefully.

Multiple grounds in the system can cause ground loops resulting in extra noise, and possible dc measurement errors.

Be sure to consult the Application Information section of the [Power Products Catalog](#) for more information on these and other applications.

Series/Parallel Output Connections

Question: Can I connect dc power supplies in series or in parallel to obtain higher currents or voltages?

Answer: Yes, in many cases this can be done, however there are some specific cautions. The resultant voltage for series connections cannot exceed the maximum floating voltage allowed for any of the component power supplies. While this is typically +/-240 volts dc, there are some supplies as low as +/-25 volts dc, and others as high as +/-550 volts dc. For best results, only supplies of equal output voltage ratings should be paralleled and only supplies of equal current ratings should be placed in series.

Some Agilent dc power supplies have the capability for auto-parallel operation, which increases the convenience of controlling the resultant configuration. In this case, only one unit has to be controlled (manually or by computer control) to take advantage of the full power of all supplies. For more information, refer to the [Power Products Catalog](#).

Remote Inhibit Capability

Question: I want to put a microswitch on the safety cover so that lifting the cover will program my ATE power supplies to zero volts. Do Agilent power supplies have this capability?

Answer: Yes, all of the GPIB programmable supplies in the 603xA, 664xA, 665xA, 667xA and 668xA series as well as the 68xxA series ac sources have this capability called remote inhibit built-in at no extra cost. Remote Inhibit is available as an option at extra cost on the 662xA and 663xA series. A contact closure or TTL low signal applied to the INH line programs the output of the supply to zero volts. The power supply can also be programmed to generate a service request (SRQ) via the GPIB in the event that the INH line is pulled low.

Remote Inhibit is Pulled Low

Question: Why is INH pulled low to disable the 66xxA power supply or 68xxA ac source?

Answer: It might appear more logical to have a contact opening represent the disabled state in a "fail-safe" manner than contact closure. That way, the source would go into the disabled state in the event that the connector falls off or a wire breaks, or a micro-switch opens. However, the disadvantage of this approach is that it complicates communication between multiple supplies in a system.

Pulling the INH line low to disable the source makes it possible to "wire-or" together the FLT (fault) output signals for a group of power supplies and ac sources. Thus, an INH input signal (remote inhibit) to any of the units can be used to shut down all others in the system. Internal circuitry latches the INH line low until, keeping all supplies disabled until they are deliberately reset.

An additional reason for choosing the low state to disable the output is that it simplifies normal operation for users who do not need to use the disable capability. Thus, those users who are not using this capability do not have to remember to connect the required jumper wire, or plug in a connector with the shorting jumper. Otherwise, where a positive connection is required to establish normal operation, users frequently mistakenly conclude that the unit has failed, and that the output is dead.

Voltage Programming With an External Signal Source

Question: Can Agilent power supplies be programmed from 0 to full output voltage using a 0 to 10V signal source?

Answer: Yes, many Agilent power supplies feature remote voltage programming or analog programming capability. However, there is a potential danger in analog programming any power supply, especially a high voltage supply. If the 0 to 10 V programming source is a typical, non-isolated, low-cost, digital-to-analog converter (DAC), it is probably grounded through its digital inputs and/or through the computer's internal power supplies, which are grounded through the computer's power cord. It's easy to overlook this, and the mistake can be very expensive.

If the DAC is non-isolated, (or isolated only up to 42 V above ground), and one of the output terminals of the power supply is grounded, either directly or through the UUT, the output capacitor of the power supply can discharge through the computer backplane, motherboard, and the I/O common through the computer power cord ground. The resulting high current may even last long enough to vaporize the thin ground tracks on some or all of the printed circuit boards in the PC.

Be sure the programming source is electrically isolated, is operated from isolated power supplies, and is rated for floating voltages up to the full output voltage of the programmed supply. This is necessary so no one is hurt, and no equipment is damaged, no matter which output terminal of the power supply or UUT is grounded.

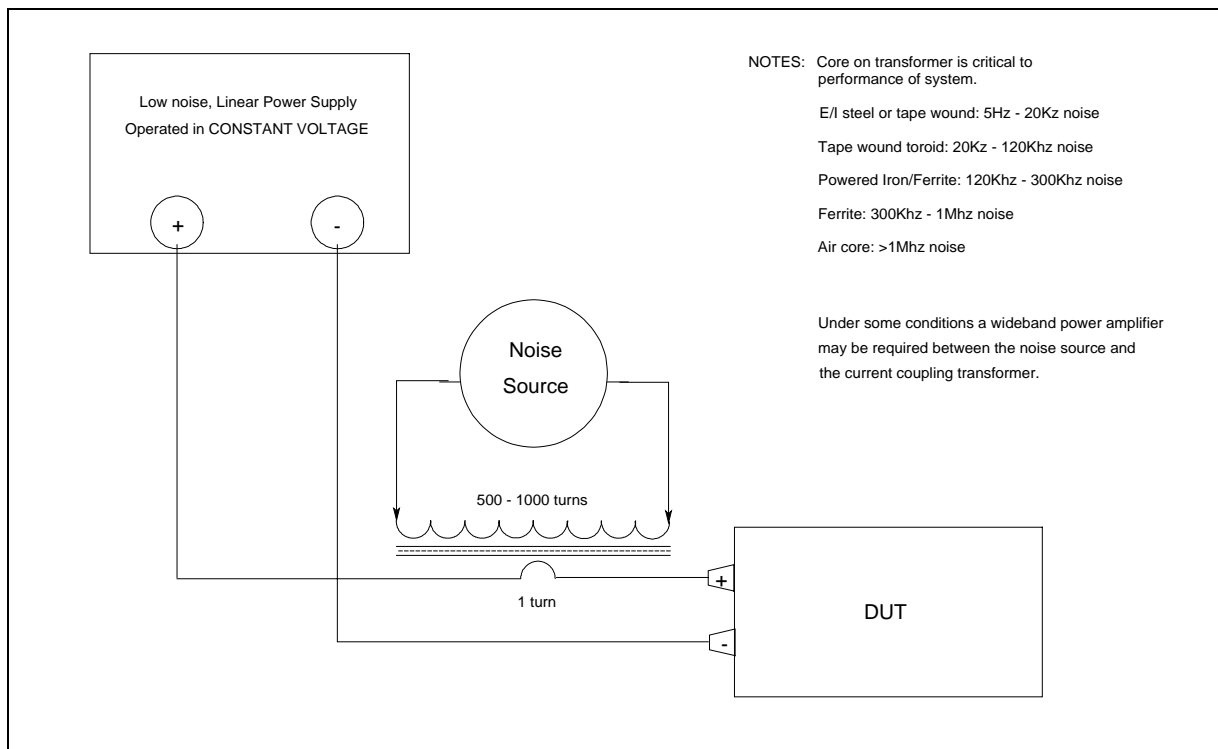
Refer to the topic on Constant Voltage Programming with Variable Voltage Gain in the application section of the [Power Products Catalog](#) for more detailed information.

Superimposing Noise On the Output

Question: How can I superimpose noise on the output of a dc power supply?

Answer: Agilent power supplies are designed to have the lowest noise that is practically possible. For some application it is desirable to simulate the effect of noise on the output, for example to test system immunity to power line disturbances. Many Agilent power supplies have an analog programming input which can be used to modulate the output with a signal typically 0.0 to 5.0 volts. This can provide a satisfactory solution for some cases, however, the bandwidth is limited with this approach, generally to less than 10KHz.

For applications where it is necessary to simulate higher frequency noise, the solution involves using a current coupling transformer in series with the output. The desired signal, presumably from a suitable signal generator, is connected to primary of the transformer (refer to the figure below). Information on the specifications of a suitable transformer are included. Note that for some applications a wideband power amplifier may be necessary to avoid excessive loading on the noise source.



Synchronizing Output Turn-On and Turn-Off

Question: How can I synchronize different power supply outputs to turn on and off at the same time?

Answer: This can be a challenging problem because the products that could potentially be grouped together have been designed over a period of 20 years. The availability of “hooks and handles” varies somewhat by series of products. Also, there are some inherent limits as to how “simultaneously” products can react due to different power supply topologies have different slew rates (i.e. the speed with which the output can change). Linear supplies typically have slew rates in the 100’s of microseconds, while switching supplies respond in 100’s of milliseconds.

In the most general case, the majority of Agilent power products offer RI/DFI (remote inhibit/discrete fault interrupt). This feature can be used to turn products off simultaneously, either as a result of a specific power supply fault, using the DFI signal, or due to some external event, by pulling the RI contact low. Refer to the manual for your product for additional information on how to accomplish this. On most products, the RI contact is a latching function. Therefore to turn the products on, once RI has been activated, RI needs to be converted to non-latching. While this capability is standard on the 661xA and 663xB products, it requires a special option, S50, on other series. Contact your Field Engineer to find out about the availability of this option for your product. External components such as relays, or FET switches are also required to control multiple power supplies.

For groups of products which all have SCPI command language, the group execute trigger (GET) command can be used. However, timing accuracy is limited by command processing time which can be up to 50 milliseconds. Furthermore, this approach cannot be used with power products that offer sub-addressing. See the programming guide for your product family (available elsewhere on this website) for more information on <*TRG> and commands. Also, refer to “IEEE Standard Codes, Formats, Protocols, and Common Commands”, IEEE STD 488.2-1992 available from the IEEE.

One more alternative is available for systems composed of 66000 modular power system modules and 68xxB ac sources. These products have expanded feature sets, which include “list and trigger” capabilities. These features make it easier to synchronize or sequence power products. For more information, refer to Product Notes 5091-2497 and 5963-7044 for 66000 and 68xxA products respectively, which can be found using the search button in the upper left corner of this website.

Software Driver Information

Question: Where can I find a software driver for my Agilent power product?

Answer: The VXI *plug&play* drivers can be found at < <http://www.tm.agilent.com/tmo/software/English/PowerSupplyDrivers.html> >. Copy this URL into your browser. From this page you may select the driver for the specific product of interest.

The plug&play drivers found here will work in the LabView environment, however, if you are also using a National Instruments GPIB card, you will need the VISA library. This VISA library must be installed with the plug&play driver, and it can be located on National Instruments website. Copy this URL into your browser: < <ftp://ftp.natinst.com/support/visa/drivers/win32/2.0/> >. Then select the file named visa20.zip.

National Instruments also has a library of drivers for many different products, both those developed by National Instruments, and those contributed by third parties. Note: **These drivers are not supported by Agilent.** The library can be found at < <http://www.natinst.com/idnet/idl.htm> >.

Errors When Programming Over the GPIB

Question: Why doesn't my system power supply accept commands over the GPIB? Why do I keep getting an error when I try to communicate with my system power supply over the GPIB?

Answer: If you are getting either error 11 or error 113 when you try to send GPIB commands to your system supply, it may be that you are using the wrong command language. Many Agilent power supplies have two different sets of programmable commands, especially if they were introduced prior to 1989 when SCPI (Standard Commands for Programmable Instruments) became available. The reason for this feature is to offer customers the choice of preserving compatibility with existing software programs written for these products some time ago, or allowing new software programs to be written using the industry standard SCPI codes and formats. Because the supplies can accept commands only in the language they are set for, sending a command in the "inactive" language will cause an error.

When shipped from the factory, the default language differs depending on the model, as follows :

Compatibility mode for: 6632B, 6633B, 6634B, 603xA

SCPI mode for : 6631B, 661xB, 664xA, 665xA, 667xA, 668xA, 6631xA, 66332A

The procedure for changing command language mode varies depending on the specific product involved. In general, to change to a different command language mode, enter the following command:

To change to the SCPI command language:

If the customer has: 661xB, 663xxA, 663xB

Enter the command: SYST:LANG SCPI

If the customer has: 664xA, 665xA, 667xA, 668xA, 603xA

Enter the command: SYST:LANG TMSL

To change to the compatibility language:

For all products

Enter the command: SYST:LANG COMP

Note that the current active language setting is stored in non-volatile memory. This mode is retained when the power supply is shut off. When the power supply is subsequently powered on, it will be set for whichever language was used last.

For more complete information on changing the command language mode, please refer to the operating manual for your product. For the 603xA Series products, see also the FAQ entitled: "603xA: How do I change the programming language?".

Readback is Intermittently Corrupted or Empty

Question: Why is the readback from my power supply intermittently corrupted or empty?

Answer: This problem frequently occurs on the second of two queries. While this is most common with the 662xA family of supplies, it can occur on other system power products, but generally only if they are being used in compatible language mode. This may occur with a recent purchased supply while others of the same type which have been in the system for some time operate satisfactorily.

This problem arises from an internal difference in GPIB chips from certain suppliers. The problem is that the newer design GPIB chip may cause a line feed character to remain in the output buffer after the readback query. Normally, the power product firmware will clear the leftover bit out of the buffer when it prepares a response to the next query. However, if the second query comes in too quickly, the leftover "line feed" is returned and may appear as a null string.

For a temporary workaround, make sure every query is terminated with a or EOI . Make sure that all characters in the buffer are read back before initiating another query. To accomplish this, insert a wait statement of at least 200 ms after any query before beginning to read back the characters.

For products which display this problem, there is a firmware fix that can be implemented at the Service Center. Contact your local Sales Office or Call Center, for more information. Click on the "Assistance" button in the upper left corner to obtain the number of the office nearest you.

603xA: Secondary Address

Question: How can you change or view the secondary address in the 6030A, 6031A, 6032A, 6033A, 6035A, or 6038A power supplies?

Answer: These products have been retrofitted with SCPI language capability, in addition to the original or compatibility mode. Secondary addressing of these products is only available in SCPI mode. These products are shipped from the factory in the COMPAtible Language Mode with their hardware address set to "Adr 5". Secondary addressing is NOT available in COMPAtible mode.

To change the programming language to SCPI Mode send string "SYST:LANGTMSL" using an GPIB controller. In the SCPI Mode, either by cycling the ac line or by holding in the [LCL] front panel button. The display will first show "Adr 5", the primary address, for 2 seconds, then "SEC xxx" the secondary address until the [LCL] button is released. The primary Address is set using the rear panel address switch. All instruments connected directly to the GPIB interface must have a unique primary address. With the [LCL] button depressed, and the display showing "SEC xxx", the rotary pulse generator can be used to change the xxx portion from "---" (null) to an integer number between "0" and "15".

A display of "Adr 5" followed by "SEC ---" designates the the instrument to be a stand alone instrument and must be talked to by using address 705. A display of "Adr 5" followed by "SEC 0" designates the instrument as the direct instrument in a possible chain of instruments and must be talked to by using address 70500. (This instrument must be the instrument connected to the controller via the GPIB cable). In either case ("SEC ---", or "SEC 0"), the display "Adr 5" is still viewable when the ac power is cycled or when the [LCL] button is initially depressed. A display of "Adr ---", primary address a null, followed by "SEC 1", "SEC 2", or "SEC nn" when the ac line is cycled or the [LCL] button is depressed is a linked instrument. Instruments where the "SEC nn" is a number = or > 1 are linked instruments, and can only be talked to by a direct instrument. Linked instruments can never be talked to directly from the controller.

If a unit is in the SLAVE or LINK mode and you wish to convert it to a MASTER, follow this procedure:

Set the GPIB address to a reserved address "31".

Turn the unit off, then turn it on again.

Set the address to "5" or any valid address number.

Cycle the power again and the unit will now be set as a MASTER.

NOTE: The choice of programming language is stored in the instrument's nonvolatile ROM and remains the language of choice until deliberately changed by the user. Reference the 603xA family Operating Manual, p/n 5959-3342. Errors reported as "8" or "-113" are characteristic of using a programming syntax which is inconsistent with the product's setting/expectations.

603xA: Programming Language

Question: How do you change the programming language expected by the the 6030A, 6031A, 6032A, 6033A, 6035A, or 6038A power supplies?

Answer: These products are shipped from the factory in their native language (called Compatible Language Mode) with their hardware address set to "Adr 5". The programming language can only be changed to SCPI Mode via a controller by sending the string "SYST:LANGTMSL". The programming language can be returned to COMPAtible language mode via a controller by sending string "SYST:LANGCOMP" or by Setting the rear panel address switch to "31". Cycle the AC power and observe that the display will read "ERR 8". Reset the rear panel address switch to "5" Cycle the AC power again and observe that the display will read "Adr 5". The instrument is now in its native (COMPAtible) language.

Here's how to determine which language the power supply is set to. From a controller send command string "SYST:LANG?" Alternatively, from the front panel press and hold [LCL] button. (For the following, x is a number greater than or equal to 1). If the front panel display reads "Adr x" for 2 seconds, then returns to a volt/amp meter display the instrument is in COMPAtible language mode. If the front panel display reads "Adr x", then "SEC xxx", the instrument is in SCPI language mode. "SEC xx" is a secondary address available only in the SCPI mode.

Note that the choice of programming language is stored in the instrument's nonvolatile memory and remains the language of choice until deliberately changed by the user. Refer to the 603xA Family Operating Manual, p/n 5959-3342 Appendix C, paragraph titled LANGUAGE SWITCHING.

605xA and 606xB: Electronic Loads in Series/Parallel

Question: Can I use Agilent Electronic Loads in series and in parallel?

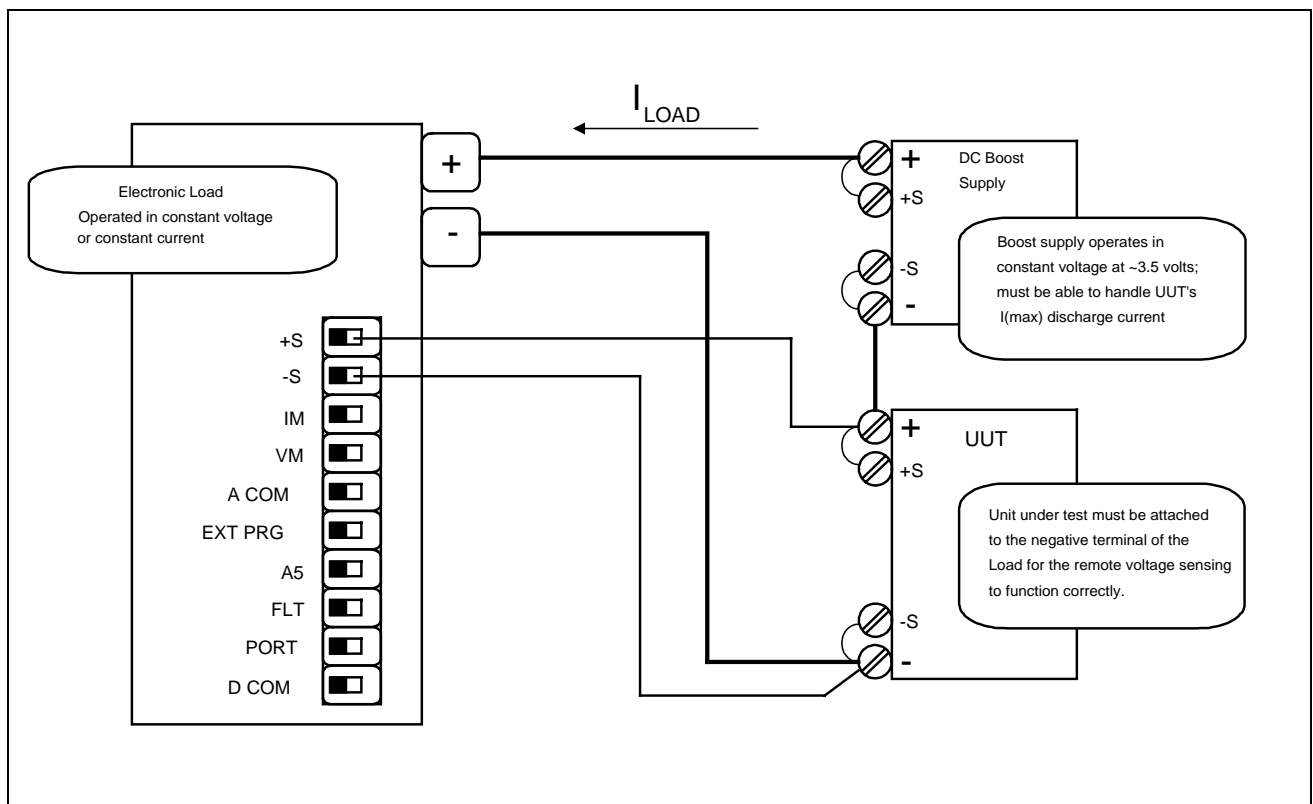
Answer: Agilent electronic loads ARE designed to be operated in parallel for more current, but NOT in series for more voltage. Loads are fully protected against damage from current overloads, but will be damaged by voltage above the maximum voltage rating.

605xA and 606xB: Electronic Loads Below 3 Volts

Question: Is there a way I can use an 606xB or 605xA Electronic load below 3 volts without derating?

Answer: Yes. Use a boost supply in series with the UUT. The load will now meet all its specs with no derating, because it always operates above 3 volts (refer to the figure below).

The boost supply can be a low-cost fixed output 3 V or 5 V supply with a current rating at least as high as the maximum peak load current needed. The 6641A (8 V, 20 A), 6651A (8 V, 50 A), 6671A (8 V, 220 A), or 6681A (8 V, 580 A) are all excellent choices. The voltage setting of a programmable boost supply should be set to 3 volts, and the current limit set to full scale. Select a boost power supply with low peak-peak (p-p) ripple and noise. The constant current load will compensate for low frequency p-p ripple and noise below a few kHz, but high frequency ripple and noise from the boost will appear across the UUT.



605xA and 606xB: Electronic Load Power-On State

Question: When powered on, what is the wake-up voltage and current setting of the 606xB and the modules installed in the Agilent 605xB Series electronic loads?

Answer: The 606xB and the modules installed in the 605xA mainframe have 7 user-definable recall states which allow saving the settings of the load for later recall. One of these states, location 0 is non-volatile; this is called the wake-up state. The 606xB and the modules installed in the 605xA will be set to the state stored in location 0 at power turn-on. If no state has been saved to location 0, then it will still contain the factory-default state. The factory default state normally would be 0 V and 0 A. See *SAV in Programming Manual 06060-90005.

605xA and 606xB: Electronic Load Resistance Accuracy

Question: How do I determine Resistance Accuracy in the Electronic Load Family?

Answer: The 6060B specifications will be used for this example. The resistance accuracy of other models can be determined by substituting the accuracy specifications of the other model in the example below.

For the 6060B low range and a desired resistance of 1 ohm, the calculations are:

Low range accuracy specification is +/-0.8% + 0.008 ohms

Ohms + [(Ohms * accuracy percentage) + offset] = high specification point $1 + ((1 * 0.008) + 0.008) = 1.016$ ohms

Ohms - [(Ohms * accuracy percentage) + offset] = low specification point $1 - ((1 * 0.008) + 0.008) = 0.984$ ohms

For the 6060B middle and high ranges, and a desired resistance of 50 ohms the calculations are:

Middle and high range accuracy specification is +/-0.3% + 0.008 Seimens.

The middle and high range specifications are in Seimens so the ohmic value must be changed to Seimens before the calculations are performed, then changed back to ohms. Seimens = 1 / Ohms

Seimens + [(Seimens * accuracy percentage) + offset] = high Seimens point

1 / high Seimens point = low resistance specification point

$1/50 + ((1/50 * 0.003) + 0.008) = 0.028$ Seimens

$1/0.028 = 35.6$ ohms Seimens - [(Seimens * accuracy percentage) + offset] = low Seimens point

1 / low Seimens point = high resistance specification point

$1/50 - ((1/50 * 0.003) + 0.008) = 0.0119$ Seimens

$1/0.0119 = 83.75$ ohms

For more detailed information, read Appendix A in the 606xB Operating Manual or 605xA Operating Manual, which can be found on this CD-ROM.

605xA and 606xB: Electronic Load Constant Resistance Resolution

Question: Why are Agilent Electronic Loads constant resistance resolution specified in ohms on the low resistance range, but in mSiemens on the two higher ranges?

Answer: In general, Agilent Electronic Loads are not a conventional "resistor". The loads consist of IC's, capacitors, resistors, FETs, etc. They were designed with two major circuits, a cv and cc circuit. These circuits are used to simulate resistance on the two upper ranges.

First, it is necessary to understand why there is a difference in the way in which the ranges are specified (mohms or mS). The constant resistance (CR) mode in the load actually operates using either the constant current (CC) or constant voltage (CV) circuits inside the load. The lowest CR range uses the CV regulating circuits, while the two higher ranges use the CC regulating circuits. It is because of these differences in the circuits used to regulate the load input that the specifications need to be different.

When the CV circuits are used, the load can be viewed as many resistors, all the same value (the resolution), in series to produce the desired resistance. Then, changing the resistance is like changing the number of discrete resistors in series. Therefore, the resolution is the value of one of these series resistors, and putting resistors in series changes the resistance measured in ohms. For the 60501B, the "discrete resistor" or resolution that can be programmed is 0.54 mohms in the 2 ohm range.

When the CC circuits are used, the load can be viewed as many resistors, all the same value (the resolution), in parallel to produce the desired resistance. Then, changing the resistance is like changing the number of discrete resistors in parallel. Therefore, the resolution is the value of one of these parallel resistors, and putting resistors in parallel changes the conductance measured in siemens. For the 60501B, the "discrete resistor" or resolution that can be programmed is 0.14 mS (=7.14 kohms).

For example, in the 2 kohm range, you can program the load input from 2 ohms to 2 kohms (0.5 S to 0.5 mS) with a resolution of 0.14 mS. This would be the equivalent of starting with about 3568 7.143 kohm resistors in parallel with each other, and in parallel with a 2 kohm resistor, and removing one at a time until you had only the 2 kohm resistor left.

Note that the resolution of the conductance is constant at 0.14 mS, however, the resolution of the total parallel resistance is not constant. It depends on how many resistors you have in parallel.

If you have two 7.143 kohm resistors in parallel and remove one, the resolution looks like 3571.5 ohms. If you have 3568 7.143 kohm resistors in parallel and remove one, the resolution looks like $(7143/3567) - (7143/3568) = 0.561$ mohms. But the conductance resolution is constant at 0.14 mS.

605xA and 606xB: Electronic Load Slew Rate

Question: What are the units used when setting the slew rate on the electronic loads?

Answer: When setting the slew rate from the front panel of the load, the units used are A/us. When setting the slew rate over the GPIB, the units used are also A/s.

The range of slew rate that can be programmed varies depending on which output range (high or low input current), and the model. As an example for the 6060B, on the low range (0-6A), slew rate can be programmed from 1A/ms (0.001A/us) to 5A/us. On the high range (0-60A), slew rate can be programmed from 0.1A/ms (0.0001A/us) to 0.5A/us. The ranges of slew rate for all electronic load products can be found in the Supplemental Characteristics section of the electronic load pages of the [Power Products Catalog](#).

6612C: Compatibility With the 6612B

Question: Does the 6612C have the same programming language as the 6612B version, SCPI or VXI plug&play drivers? Will it interface to other products? How compatible are these?

Answer: The short answer is yes! All of the models in this family (661xC) have two command sets: SCPI; and Compatibility (663xA-type). The language format can be changed either by s/w command or from the front panel. When the unit is turned off, the current language mode is stored in non-volatile memory. As a result, the unit will wake up in whatever language was used last. This makes it easy to replace a B-version with the new C-version. The same application program that was used with the B-version will work for the C-version.

661xC and 663xB: Current Measurement Ranges

Question: Do the 661xC and 663xB Series power supplies have more than one current measurement range? What is the current measurement resolution? How do I switch between them?

Answer: Yes, these models feature TWO 16-bit current measurement ranges. The high range covers the full output, with an LSB ranging from approximately 20 uA for 1A output to 436 uA for the 10A output.

Model	Max Current	Resolution
6611C	5 A	213 uA
6612C	2 A	74 uA
6613C	1 A	37 uA
6614C	0.5 A	20 uA
6631B	10 A	436 uA
6632B	5 A	213 uA
6633B	2 A	74 uA
6634B	1 A	20 uA

All models have a low range of 20.0 mA full scale, with an LSB of 0.6 uA. You can select either the high or low range, or autoranging between the two. With autoranging, range switching is triggered whenever the current crosses above/below 20.0 mA.

661xC and 663xB: Output Transition Time

Question: How fast can the 661xC and 663xB Series supplies respond to a command and generate a full scale output?

Answer: The output transition time is comprised of two parts: command processing time (before the output starts to change voltage), and the output programming response time (essentially the time it takes the output to go from 10% of the voltage to 90%). Adding both figures will give a good estimate of the output transition time.

For both series of products, the command processing time has been reduced to <4ms.

The 663xB Series products have two operating modes, with a fast/normal mode switch on the rear panel. In the fast mode, the output can slew from 10% to 90% within 400 us. In the normal mode the output slews in 2 ms. Note, use of the fast mode will degrade noise performance somewhat (from 3 mV to 10 mV on the 6632B).

The 661xC models do not offer a fast/normal mode switch, however their output programming response time is approximately 2 ms.

663xB: Programmable Current Sinking

Question: Can the current sinking limit be programmed on Agilent power supplies?

Answer: In general, current sinking is a fixed value at some percentage of the full scale current output.

However, there is an exception for one series of Agilent power supplies. On the 663xB series, the maximum negative current tracks the value programmed for the positive current limit. This capability allows the 663xB units to function as a constant current load in some applications, such as battery cycling and test.

663xB: Compatibility With the "A" Version Units

Question: Do the 6632B, 6633B and 6634B have the same programming language as the A version, SCPI or VXI *plug&play* drivers? Will it interface to other products? How compatible are these?

Answer: All of the models in this family have two command sets: SCPI; and Compatibility (663xA-type). The language format can be changed either by s/w command or from the front panel. When the unit is turned off, the current language mode is stored in non-volatile memory. As a result, the unit will wake up in whatever language was used last. This makes it easy to replace an A-version 663x Series with the B-version 663x Series. Software written for the A-version will work with the B-version if the B-version's language format is set for Compatibility mode.

668xA: Sharing Current at Low Output in Auto-Parallel Mode

Question: Why don't my 668xA 5 kW power supplies share current at low output current when operated in auto-parallel?

Answer: It's normal. They will share current at full load. Here's a complete explanation. Using 668xA Series power supplies in auto-parallel, a maximum of five 668xA Series power supplies, with the same model number, may be configured for auto-parallel operation. The 668xA power supplies were designed with a deliberate external programming offset so the master will output current before the slaves output current. Therefore, slave(s) supplies will always sink current when low output current values are desired.

Auto-parallel procedure:

Connect the 668xA power supplies with Im from the master going to +Ip of each slave and comP going to -Ip of each slave (refer to the figure on the next page).

Each load lead (wire) should be same wire gauge and length.

Turn on all power supplies.

Program each slave supply for zero output current either by pressing [CURRENT] [0] [ENTER] from the front panel keypad or sending the command "CURR:LEV 0" via the GPIB. See note 2 and 3.

Program each slave supply's output voltage to a value at least 2 volts greater than the programmed output voltage of the master supply.

Program the master supply's output current to one-half the total output current if there is one slave supply or one-third the total output current if there are two slave supplies.

Enable all power supplies by pressing [Output On/Off] key.

Increase the master supplies output voltage. At low output currents the slave(s) will sink current. This is normal. At low output current the master will be supplying all the load current and sink current to the slave(s). At maximum output current each supply will be delivering an equal amount of current. It is normal when operating at less than maximum current to have unequal current sharing between the master and slave supplies. The master supply provides more current at low output currents but current sharing will become equal when they reach maximum output current.

If remote sensing, only the master supply +S/-S lines are connected remotely. The slave supplies should be connected for local sensing, connected at the rear of their respective output terminals.

Notes:

The current division between the master and slave(s) can be determined from the following formula:

$$I_{out} = I_m [1 + N_s (1 + 0.127V / 5V)] - N_s I_{fs} (0.127V / 5V)$$

The amount of current the master must output before the slave(s) outputs current can be determined from the following formula.

$$N_s * I_{fs} (0.127V / 5V)$$

where

Im = master current

Ns = number of slaves

Ifs = full scale current

Example: 1 master 2 slaves Model hp6680A 5V 875A

$$I_{out} = I_m (3.0508) - 44.4A$$

Master current limit must be set above $44.4A / 3.0508 = 14.55A$ to obtain any output current.

For no-load condition:

68xxA: Programming DC Output Voltage

Question: How do I program a DC voltage from an AC power source?

Answer: DC voltage can only be programmed from AC source models 6811A, 6811B, 6812A, 6812B, 6813A, 6813B, 6841A and 6842A. To program a DC voltage perform the following steps using the front panel keypad.

Press [Shift] key then [Output] key. Display will read "OUTP:COUP AC".

Press down triangle on function keypad once, display reads "*RST". press [Enter]. AC power source is now in a known factory default power on state.

The right side of the front panel display should now be: METER This means the metering circuit will readback both AC AC+DC and DC components of the AC source output signal. OUTPUT This signifies the output of the AC source will only AC contain an AC component.

Press [Shift] [Output] key, display reads "OUTP:COUP AC".

Press down arrow on the Entry keypad until the display reads "OUPT:COUP DC", press [Enter].

The right side of the front panel display under the OUTPUT annunciator should now read: OUTPUT This signifies the output of the AC source will contain AC+DC both an AC and DC component.

Press [VOLT] display reads "VOLT 0.00" Note: VOLT determines magnitude of AC rms output voltage programmed, OFFSET determines magnitude of DC output voltage programmed. If no AC component is desired leave VOLT set to 0.00.

Press down or up triangle on function keypad until display reads "OFFSET 0.00".

Enter desired DC output voltage from entry keypad, ie: if 25 Vdc is desired press [2] [5]. Display now reads "OFFSET 25", press [Enter].

Press [Output On/Off] key, output terminals will now have 25 Vdc present.

The DC voltage on the phase 1 output terminal can be programmed either positive or negative with respect to the COM output terminal. To program a negative DC output voltage press [Shift] then the decimal key on the entry keypad. Note the minus sign is the shifted decimal key.

68xxA: Creating a Trigger Out Signal

Question: How do I create a trigger out signal on the rear of an AC source?

Answer: To generate a SINGLE "Trig OUT", use the following key sequences:

Press [shift] [Output] keys;

Use the function and entry scroll keys to pick {TTLT:STATE "ON"} then press [ENTER] ;

Press [Trigger Control] key;

Use scroll keys to pick {INIT:IMMED} then press [ENTER];

Press [shift] [Trigger] keys.

This initiates a one-time trigger from the Trigger Out BNC connector on the rear panel of the instrument (refer to the following figure). In order to initiate subsequent triggers, {INIT:IMMED} must first be re-entered each time. Then pressing [shift][Trigger] will initiate a trigger.

To generate a "Trig OUT" each time the [shift][Trigger] is pressed:

Press [shift] [Output] key;

Use the function and entry scroll keys to pick {TTLT:STATE "ON"} then press [ENTER];

Press [Trigger Control] key;

Use scroll keys to pick {INIT:CONT ON} then press [ENTER];

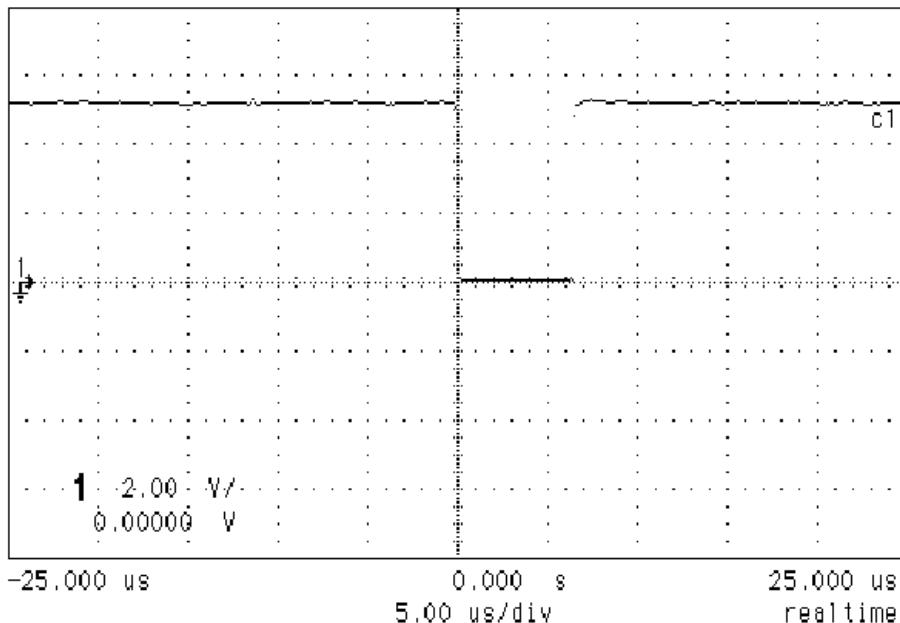
Press [shift] [Trigger] keys.

This initiates a trigger from the Trigger Out BNC connector on the rear panel of the instrument each time [shift] [Trigger] is pushed.

Sample program for generating
a trigger over the GPIB:

```
10 OUTPUT 705; "OUTP ON"  
20 OUTPUT 705; "OUTP:TTLT ON"  
30 OUTPUT 705; "INIT:IMM:NAME TRAN"  
40 OUTPUT 705; "TRIG:TRAN:SOUR BUS"  
50 OUTPUT 705; "TRIG:IMM"  
60 END
```

hp running



66000A: Setting the Dwell Time in List Mode

Question: How do I set the dwell time in the List mode on the 66000A series power supplies?

Answer: The List mode can contain up to 20 Voltage, Current or Dwell steps if controlled over the GPIB, or up to 8 steps if controlled from the optional keyboard. Each dwell point specifies the time, in seconds, that the output will remain at the corresponding voltage/current combination in the list. The dwell time can be set any value from 10 msec to 65 sec, however due to the clock frequency the time will be resolved to the nearest 1 msec increments.

The command is LIST:DWEL 1,1.5,3,1.5
(where each number is an example of time expressed in seconds)

More detailed info can be found on p. 38 of the 661xxA Programming Guide, p/n 5959-3362. Some programming examples can be found in the Product Note, p/n 5091-2497E.

E36xxA: Rack Mounting

Question: How do I rack mount the E36XXA manual and programmable power supply?

Answer: The following rack mount kits are available (select the appropriate model number):

For the E3610A, E3611A, and E3612A: These are three inch manual DC Power Supplies, which were not originally intended to be rack mounted. If you have a need to install one or more in a rack, order rack mount kit 5063-9767. This kit contains a support shelf, a half-width filler panel, a full-width blank panel, mounting hardware and left and right flanges.

For the E3614A, E3615A, E3616A, E3617A and E3620A, E3630A: Three inch manual DC Power Supplies.

For the E3640A, E3641A, E3642A, E3643A, E3644A, E3645A: Three inch programmable DC Power Supplies.

To rack mount one instrument, order adapter kit 5063-9240.

To rack mount two instruments side-by-side, order lock-link kit 5061-9694 and flange kit 5063-9212.

To rack mount one or two instruments in a sliding support shelf, order shelf 5063-9255 and slide kit 1494-0015 (for a single instrument, also order filler panel 5002-3999).

For the E3631A, E3632A, E3633A, E3634A, E3646A, E3647A, E3648A, E3649A: Five inch programmable DC Power Supplies.

To rack mount a single instrument, order adapter kit 5063-9243.

To rack mount two instruments side-by-side, order lock-link kit 5061-9694 and flange kit 5063-9214.

To rack mount one or two instruments in a sliding support shelf, order shelf 5063-9256 and slide kit 1494-0015 (for a single instrument, also order filler panel 5002-4002).

Support rails are required for all of the above models except for the manual models: E3610A, E3611A, E3612A only. These support rails are required when mounting one or two instruments. Support rail : E3663AC.

E36xxA: Setting the Line Voltage

Question: How do I change the power-line voltage setting for an E36xxA Series power supply?

Answer: Certain model families have different methods for changing the line voltage as listed below. Always make sure that the correct fuse is installed before powering up after changing the line voltage. For more information, see "Line Voltage conversion" in the manual. Also check the manual for the correct fuse values. Before attempting to change the line voltage value, always make sure that the unit is unplugged first.

For the E3610A, E3611A, and E3612A:

It is not possible to change the line voltage setting on these supplies.

For the E3614A, E3615A, E3616A, E3617A, E3620A, and E3630A:

The power line voltage selection switch is located on the inside of the unit. First open the top cover of the power supply. Then change the voltage setting using the selection switch located on the PC board.

For the E3631A and E3632A:

The power line voltage selector is located on the rear panel of the instrument. Remove the power line module from the rear panel (located near the ac receptacle). Rotate the power line voltage selector until the correct voltage appears. Replace the power line module in the rear panel.

For the E364x:

The line selection switch located inside the unit allows the line voltage to be changed. To change the line voltage, open the top cover of the instrument and configure the selection switch located on the PC board.

E36xxA: Output Control Using Resistors

Question: How can I control the output from the E3614A/15A/16A/17A power supplies using resistors?

Answer: Remote programming with resistors allows you to control the E3614A/15A/16A/17A output voltage or current by means of remotely varying resistors. The sum of the two programming resistors should be greater than 40 kohms. This disables the voltage control on the front panel. The switches on the rear must be in the proper sequence and the resistors must be connected to the proper terminals in the back for this feature to work correctly. There are more details in the manual.

E36xxA: Making Adjustments With the Output Disabled

Question: How do I adjust the voltage or current settings when the Output is disabled on an E36xxA-Series power supply?

Answer: When the Output is disabled, press the 'Display Limit' button on the front panel to place the power supply in the limit mode. Then, set the desired limit values for the output voltage and/or current. Press the 'Output Off' button again to enable the power supply's output.

E36xxA: Remote Programming

Question: Which of the E36xxA power supplies can be controlled from the remote interface?

Answer: The E3631A and E3632A power supplies are fully programmable and you can program them from the RS-232 or GPIB (IEEE-488) interface. Both remote interfaces are included standard with these two power supplies.

The Agilent E3614A, E3615A, E3616A, and E3617A power supplies have voltage programming capability. A dc voltage (0V to 10V) can be placed on the appropriate rear-panel terminal connectors. As the applied dc voltage changes, a proportional change is made in the power supply output.

You can perform remote-voltage programming in both the constant voltage and constant current modes with these power supplies.

E36xxA: Software Drivers

Question: Are there software drivers available for the E36xxA power supplies?

Answer: Yes! There are VXI plug and play drivers that support Agilent VEE, NI Labview, and Labwindows for the E363xA and E364xA families of power supplies. Users of Windows 98 and Windows Millennium Edition should use the Windows 95 drivers.

The drivers are located as follows:

E3631A driver:

Win 3.x : <http://ftp.agilent.com/pub/mpusup/vxipnp/win/supported/e3631a.exe>

Win 95, NT: <http://ftp.agilent.com/pub/mpusup/vxipnp/winnt/supported/e3631a.exe>

E3632A, E3633A, E3634A driver:

Win 95, NT: <http://ftp.agilent.com/pub/mpusup/vxipnp/winnt/supported/e363xa.exe>

E364xA driver:

Win 95, NT: <http://ftp.agilent.com/pub/mpusup/vxipnp/winnt/supported/e364xa.exe>

E36xxA: Internal Memory

Question: How much internal memory is available to the user in the E363xA and E364xA power supplies?

Answer: The E3631A, E3632A, E3633A, and E3634A have 3 non-volatile recall states for the output parameters, each of which can store the voltage, current limit, and over-voltage protection setting .

The E364xA series supplies have similar capabilities. The only difference is that they have 5 non-volatile recall states instead of 3.

E36xxA: Clearing the Contents of Power Supply Memory

Question: How can I clear the content of power supply memory for programmable E36xxA power supplies?

Answer: There is no way to clear the contents of the store/recall states. They can be overwritten as many times as desired but there is not an explicit way to delete a saved state.

The specific details of store/recall operations will differ according to the series of product. For additional details refer to the Users Guide for your specific product. The information can be found in Chapter 3 Front-Panel Operation and Features, under “Storing and Recalling Operating States”.

E36xxA: Reading the Calibration Date

Question: How can I read the calibration date for an E363xA or an E364xA power supply?

Answer: The calibration message containing the factory calibration date can be retrieved by using the "CALibration:STRing?" command. After the calibration is completed, the date can be changed with the "CALibration:STRing <string>" command.

The E364xA family has a way to read the calibration string through the front panel. Press the view button, rotate the knob until "CAL STRING" is displayed, and then press view again. The calibration string will appear on the front panel.

The user must use the " CALibration:STRing <string>" command to modify the calibration message, or else the factory calibration date will be returned when it is queried.

E36xxA: Instrument Repair Procedures

Question: My E36xxA DC Power Supply is broken; How can I get it fixed?

Answer: If your E36xxA fails within three years of the original purchase, Agilent will repair or replace it free of charge. If the instrument fails after the three-year warranty has expired, Agilent will provide a quote to repair or replace it at customer's expense. The decision to repair or replace the instrument will be made locally by Agilent.

In the United States, there are two separate repair strategies that you can use, depending on your individual circumstances.

Agilent Express. With this option, you simply call a toll-free telephone number (800-258-5165) to arrange for immediate replacement of your failed unit with a new unit. For more details, refer to Chapter 6 in the Agilent E36xxA Service Guide. Please note that with this procedure the

replacement instrument will have a different serial number than your original instrument. If you are required to retain your original serial number, you should use the Standard Repair Service described below.

Standard Repair Service. With this option, you can return your failed instrument to the nearest Agilent Service Center. Depending on the nature of the failure, the Service Center will arrange to either repair or replace the instrument.

Outside of the United States, the Standard Repair Service option is the only solution currently available; Contact your nearest Agilent Service Center for the most current information.

E3631A and E3632A: Disabling the Control Knob

Question: How do I disable the control knob on the Agilent E3631A/32A power supplies?

Answer: To disable the front-panel control knob, scroll the flashing digit on the front-panel display to the right or left using the selection keys (<) or (>) until the flashing digit disappears.; Notice that the control knob and all front-panel keys are now disabled while in the remote interface mode. The disabled state of the control knob is NOT stored with a 'store/recall' operation.;

E3631A and E3632A: Output 'OFF' State

Question: What is the voltage/current level when the 3631A is in the output off state?

Answer: The answer to this question varies depending on the firmware version installed in the power supply. The firmware revision can be viewed by using the "*IDN?" command. The query returns in the format:

"HEWLETT-PACKARD,E3631A,0,1.1-X.X-X.X" (1.1 is the firmware revision)

For units with firmware revision 1.4 or less in the output off state, values of less than 0.6 V of opposite polarity with no load or less than 60 mA of opposite direction with a short circuit may appear at the output. To get zero volts, the power supply must be programmed to zero volts.

For units with firmware revisions greater than 1.4 in the output off state, the power supply will output values of voltage and current of zero (within the programming accuracy specification of the DC Power Supply).

E363xA and E364xA: Compatibility With National GPIB I/F Card

Question: Will the E363xA and E364xA series supplies work with National Instruments GPIB I/F card for PCs?

Answer: Yes, the National Instruments GPIB board is very configurable. However, this can cause some problems.

The National Instruments card comes set up with EOI as the termination character. This can cause problems with instruments that use a line feed as the termination character. Commands sent to the instrument are fine, however a timeout can occur during read-back of data. This can be fixed by changing the termination character to a line feed character, which is the IEEE488 standard.

Another possible problem occurs with REN (Remote ENable). It does not send REN, when it talks to an instrument. With some commands, you may get an error that says the instrument must be in remote before you can send the command. This error will normally happen only in when using RS232, since RS232 requires a command to put the instrument in remote. This problem can be fixed by using the National configuration software utility (ibconf), and placing a check in the box called "assert REN when SC". For more information about this issue, please contact National instruments.

If you are using the pci-gpib card, bus mastering must be enabled on that slot. If you do not enable bus mastering, the handshake will not work on GPIB communications.

E364xA: Fan Cooling

Question: Do the E364xA power supplies have fan cooling?

Answer: Yes. The fan speed in the E364xA series supplies is controlled automatically for reduced acoustic noise when the ambient temperature and power supply load is such that the full cooling capability is not required.

E364xA: Flashing Digit on the Display

Question: How can I eliminate the flashing single digit in the front-panel display?

Answer: The flashing digit indicates the digit of the output parameter displayed that can be changed by turning the front panel knob. Use the resolution selection key (<) or (>) to move the flashing digit to the left or right until the flashing stops. Note that the knob, the flashing digit, and the resolution selection are disabled while in the remote interface mode. The position associated with the resolution selection key is not stored/recalled with the 'store/recall' functions.

E364xA: Settling Time

Question: What is the settling time for the E364xA power supplies?

Answer: For the E364xA series, Settling Time is defined as the maximum time required for the output voltage to change from 1% to 99% (or vice versa) following receipt of a VOLTage or APPLy command from the GPIB or RS-232 interface. The settling time is <90 msec for Agilent E364xA instruments.

E364xA: Bench-Top/System Applications

Question: Are these power supplies targeted for bench-top or system applications?

Answer: These power supplies have all the features and performance necessary for both bench-top and system ATE applications where throughput is not critical, at a surprisingly low price. These units provide useful features for bench users such as front panel control of all power supply settings, front panel binding posts and small footprints. In addition, they have features such as rear terminal output, standard GPIB and RS-232 interfaces to provide superior convenience for system operation as well.

E364xA: Returning the Unit to the State it was in Before Power was Removed

Question: Can the E364xA be configured to return to the state it was in before line power was removed?

Answer: No. The E364xA is NOT capable of recalling the power-down settings. These power supplies are designed to conform to SCPI (*Standard Commands for Programmable Instruments*). The SCPI standard states that every source instrument, including power supplies, should be powered on with the output OFF state. To avoid the accidental loss of setting values, it is recommended that you use 'store and recall' for frequently-used operating states. The instrument has five non-volatile memory locations reserved for storing and recalling the power supply settings.

E364xA: Alternative Programming Language

Question: Does the E364xA offer any alternative programming languages?

Answer: The E364xA's programming language is compatible with SCPI (1998) and IEEE 488.2. No other programming languages are available.