

CERTIFICATION

Agilent Technologies certifies that this product met its published specifications at time of shipment from the factory. Agilent further certifies that its calibration measurements are traceable to the United States National Institute of Standards and Technology (formerly National Bureau of Standards), to the extent allowed by that organization's calibration facility, and to the calibration facilities of other International Standards Organization members.

WARRANTY

This Agilent Technologies hardware product is warranted against defects in material and workmanship for a period of 3 years from date of delivery. Agilent software and firmware products, which are designated by Agilent for use with a hardware product and when properly installed on that hardware product, are warranted not to fail to execute their programming instructions due to defects in material and workmanship for a period of 90 days from date of delivery. During the warranty period, either Agilent or Agilent Technologies will, at its option, either repair or replace products which prove to be defective. Agilent does not warrant that operation the software, firmware, or hardware shall be uninterrupted or error free.

For warranty service, with the exception of warranty options, this product must be returned to the nearest service center designated by Agilent. Customer shall prepay shipping charges by (and shall pay all duty and taxes) for products returned to Agilent for warranty service. Except for the products returned to Customer from another country, Agilent shall pay for return of products to Customer.

Warranty services outside the country of initial purchase are included in Agilent's product price, only if Customer pays Agilent international prices (defined as destination local currency price, or U.S. or Geneva Export price).

If Agilent is unable, within a reasonable time, to repair or replace any product to condition as warranted, the Customer shall be entitled to a refund of the purchase price upon return of the product to Agilent.

The warranty period begins on the date of delivery or on the date of installation if installed by Agilent.

LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by the Customer, Customer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation and maintenance. TO THE EXTENT ALLOWED BY LOCAL LAW, NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. AND AGILENT SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

For consumer transactions in Australia and New Zealand:

The warranty terms contained in this statement, except to the extent lawfully permitted, do not exclude, restrict or modify and are in addition to the mandatory rights applicable to the sale of this product to you.

EXCLUSIVE REMEDIES

TO THE EXTENT ALLOWED BY LOCAL LAW, THE REMEDIES PROVIDED HEREIN ARE THE CUSTOMER'S SOLE AND EXCLUSIVE REMEDIES. AGILENT SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

ASSISTANCE

The above statements apply only to the standard product warranty. Warranty options, extended support contracts, product maintenance agreements and customer assistance agreements are also available. Contact your nearest Agilent Technologies Sales and Service office for further information on Agilent's full line of Support Programs.

Agilent E361XA 30W BENCH SERIES DC POWER SUPPLIES

OPERATING AND SERVICE MANUAL FOR MODELS:

Agilent E3610A
Agilent E3611A
Agilent E3612A

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Declaration of Conformity

The Declaration of Conformity (DoC) for this instrument is available on the Agilent website. You can search the DoC by its product model or description at the web address below.

<http://regulations.corporate.agilent.com/DoC/search.htm>

Note *If you are unable to search for the respective DoC, please contact your local Agilent representative.*

SAFETY SUMMARY

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Agilent Technologies assumes no liability for the customer's failure to comply with these requirements.

Before Applying Power

Verify that the product is set to match the available line voltage.

Ground The Instrument.

This product is a Safety Class I instrument (provided with a protective earth terminal). To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical ground. The instrument must be connected to the ac power supply mains through a three-conductor power cable, with the third wire firmly connected to an electrical ground (safety ground) at the power outlet. Any interruption of the protective(grounding) conductor or disconnection of the protective earth terminal will cause a potential shock hazard that could result in personal injury. If the instrument is to be energized via an external autotransformer for voltage reduction, be certain that the autotransformer common terminal is connected to the neutral (earthed pole) of the ac power lines (supply mains).

Do Not Operate In An Explosive Atmosphere

Do not operate the instrument in the presence of flammable gases or fumes.

Regulatory Information for Canada

This ISM device complies with Canadian ICES-001.
Cet appareil ISM est conforme à la norme NMB-001 du Canada.

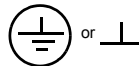
KEEP AWAY FROM LIVE CIRCUITS.

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified service personnel. Do not replace components with power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power, discharge circuits and remove external voltage sources before touching components.

SAFETY SYMBOLS



Instruction manual symbol; the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual.



Indicate earth(ground) terminal.

WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product. Do not proceed beyond CAUTION sign until the indicated conditions are fully understood and met.

GENERAL INFORMATION

Description

This operating and service manual covers three dual range Agilent power supplies, E3610A, E3611A, and E3612A. All models are compact, general purpose bench supplies that are particularly useful for powering developmental IC circuits, both linear and digital. Unless stated otherwise, all information in this manual applies equally to all three models. The desired output range is selected by the front panel RANGE push button. The output can be continuously adjusted for voltage and current throughout either output range.

The front panel VOLTAGE control can be used to establish the voltage limit when the supply is used as a constant current source and the CURRENT control can be used to establish the output current limit when the supply is used as a constant voltage source. The CC SET push button allows the current limit value to be conveniently set using the CURRENT control without shorting the output.

The front panel includes a digital voltmeter/ammeter. A 3 1/2 digit (E3611A 3 digit) voltage display and 3 digit current display accurately show the output voltage and current respectively. The output ratings for each model are shown in the Specifications Table.

Specifications and Supplemental Characteristics

INPUT: 115 Vac \pm 10%, 47-63 Hz, 0.8 A, 70 W
 100 Vec \pm 10%, 47-63 Hz, 0.8 A, 70 W
 230 Vac \pm 10%, 47-63 Hz, 0.4 A, 70 W

OUTPUT: E3610A: 0 to 8 V, 0 to 3 A or 0 to 15 V,
 0 to 2 A
 E3611A: 0 to 20 V, 0 to 1.5 A or 0 to 35 V,
 0 to 0.85 A
 E3612A: 0 to 60 V, 0 to 0.5 A or 0 to 120V,
 to 0.25 A

LOAD REGULATION:

Constant Voltage - Less than 0.01% plus 2 mV for a full load to no load change in output current.

Constant Current - Less than 0.01% plus 1 mA for a zero to maximum change in output voltage.

LINE REGULATION:

Constant Voltage - Less than 0.01% plus 2 mV for any line voltage change within the input rating.

Constant Current - Less than 0.01% plus 1 mA for any line voltage change within the input rating.

RIPPLE AND NOISE:

Constant Voltage - Less than 200 μ V rms and 2 mV peak to peak(20 Hz - 20 MHz)

Constant Current - Less than 200 μ A rms and 1 mA peak to peak(20 Hz - 20 MHz)

TEMPERATURE RANGE: 0 to 40°C for full rated output.
 Derate current 1% per degree C between 40°C-55°C

***TEMPERATURE COEFFICIENT:**

Constant Voltage - Less than 0.02% plus 1 mV per degree C.

Constant Current - Less than 0.02% plus 2 mA per degree C.

TRANSIENT RESPONSE TIME:

Less than 50 usec for output recovery to within 10 mV following a change in output current from full load to half load, or vice versa.

ISOLATION: \pm 240 Vdc

***OUTPUT DRIFT:**

Constant Voltage - Less than 0.1% plus 5 mV total drift for 8 hours after an initial warm-up of 30 minutes.

Constant Current - Less than 0.1% plus 10 mA total drift for 8 hours after an initial warm-up of 30 minutes.

METER ACCURACY: \pm 0.5% + 2 counts at 25°C \pm 5°C

***OVERLOAD PROTECTION:**

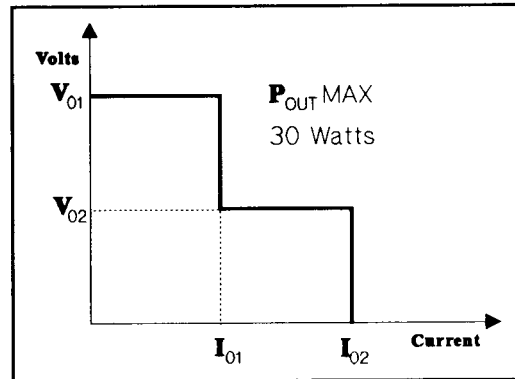
A continuously acting constant current circuit protects the power supply for all overloads including a direct short placed across the terminals. The constant voltage circuit limits the

output voltage in constant current operation.

***OUTPUT TERMINALS:**

Three output terminals are provided on the front panel. They are isolated from the chassis and either the positive or negative terminal may be connected to the ground terminal.

***OUTPUT CHARACTERISTICS**



NOTE: Output voltages higher than V_{02} are possible at low current when the high current range is selected.

E3610A: $V_{01} = 15$ V $V_{02} = 8$ V $I_{01} = 2$ A $I_{02} = 3$ A

E3611A: $V_{01} = 35$ V $V_{02} = 20$ V $I_{01} = 0.85$ A $I_{02} = 1.5$ A

E3612A: $V_{01} = 120$ V $V_{02} = 60$ V $I_{01} = 0.25$ A $I_{02} = 0.5$ A

***METER RESOLUTION**

Voltage: E3610A 10 mV
 E3611A 100 mV
 E3612A 100 mV
 Current: E3610A 10 mA
 E3611A 10 mA
 E3612A 1 mA

***DOWN PROGRAMMING SPEED:** Maximum time for output voltage to change between 100% to 0.1% of maximum rated output voltage at NO LOAD condition.

E3610A: maximum 2.5 sec
 E3611A: maximum 1.0 sec
 E3612A: maximum 1.5 sec

***RESOLUTION:** Minimum output voltage or current change that can be obtained using panel controls.

E3610A: Voltage 10 mV Current 5 mA
 E3611A: Voltage 10 mV Current 5 mA
 E3612A: Voltage 100 mV Current 0.5 mA

COOLING: Convection cooling is employed.

WEIGHT: 8.4 lbs/3.8 Kg net, 9.3 lbs/4.2 Kg shipping.

(NOTE) * SUPPLEMENTAL CHARACTERISTICS

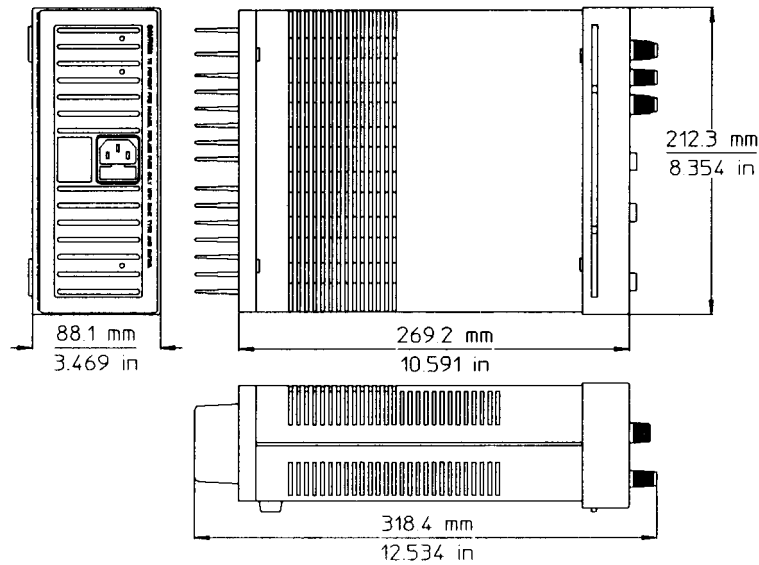


Figure 1: OUTLINE DIAGRAM

Options

The following options are available with this instrument.

<u>Option</u>	<u>Description</u>
0EM:	115 Vac ± 10%, 47-63 Hz Input
0E3:	230 Vac ± 10%, 47-63 Hz Input
0E9:	100 Vac ± 10%, 47-63 Hz Input

Instrument Identification

Agilent Technologies power supplies are identified by one serial number. The letter "KR" designates Korea as the country of manufacture, the first digit indicates the year (1 = 91, 2 = 92, etc), the second two digits indicate the week, and the last five digits of the serial number are a different sequential number assigned to each power supply.

If a yellow Change Sheet is supplied with this manual, its purpose is to explain any differences between your instrument and the instrument described in this manual. The Change Sheet may also contain information for correcting errors in the manual.

INSTALLATION

Inspection

When you receive your power supply, inspect it for any obvious damage that may have occurred during shipment. If there is damage, notify the carrier and the nearest Agilent Sales Office immediately. Warranty information is printed on the inside front cover of this manual. Save the shipping carton and packing materials in case the supply has to be returned to Agilent Technologies in the future. If you return the supply for service, attach a tag identifying the owner and model number. Also include a brief description of the problem.

The "Turn-On Checkout Procedure" in this manual can be used as an incoming inspection check to verify that the supply is operational. See the appendix for tests that verify the supply's specifications.

Location And Cooling

Figure 1 shows the outline shape and dimensions of the unit. It is shipped ready for bench operation after connection to an ac power source. The supply is air cooled. Sufficient space should be allotted so that a free flow of cooling air can reach the rear of the instrument when it is in operation. It should be used in an area where the ambient temperature does not exceed 40 degrees C. The current derates 1% per degree C between 40°C-55°C.

Input Power Requirements

Depending on the line voltage option ordered, the supply is ready to be operated from one of the power sources listed in the Specification Table. The input voltage range, and the input current and power at high line voltage and full load is listed for each option.

Power Cord

This instrument is equipped with a three conductor power cable. The third conductor is the ground conductor and when the cable is plugged into an appropriate receptacle, the instrument is grounded. The offset pin on the power cable three prong connector is the ground connection. In no event should this instrument be operated without an adequate cabinet ground connection.

The power supply was shipped with a power cord for the type of outlet used at your location. If the appropriate cord was not included, contact your nearest Agilent Sales Office to obtain the correct cord.

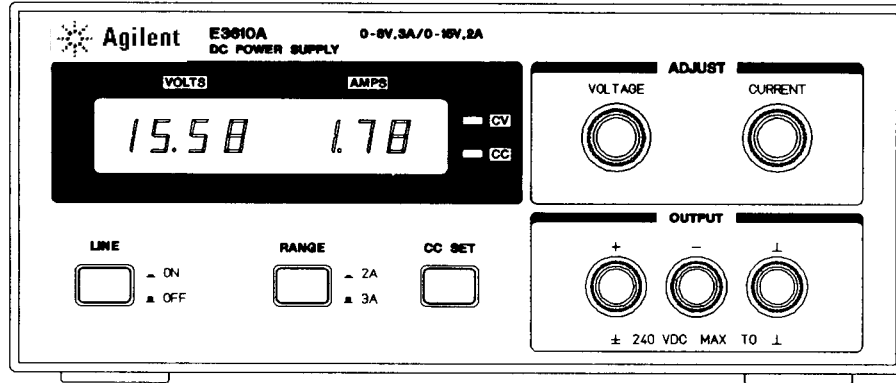


Figure 2: FRONT PANEL CONTROLS AND INDICATORS

OPERATION

Turn-On Checkout Procedure

The following checkout procedure describes the use of the front panel controls and indicators illustrated in Figure 2 and ensures that the supply is operational:

- Push LINE button to ON.
- Set RANGE push button to desired range.
- Turn VOLTAGE control fully counter clockwise to ensure that output decreases to 0 Vdc then fully clockwise to ensure that output voltage increases to the maximum output voltage.
- While depressing CC SET push button, turn the CURRENT control fully counter clockwise and then fully clockwise to ensure that the current limit value can be set from zero to maximum rated value.
- Connect load to output terminals.

WARNING

Shock Hazard

Disconnect ac power before making output terminal connections.

Constant Voltage Operation

To set up a power supply for a constant voltage operation, proceed as follows:

- Turn on power supply and adjust 10-turn VOLTAGE control for desired output voltage (output terminals open). CV LED should light.
- While depressing CC SET push button, adjust 10-turn CURRENT control for maximum output current allowable (current limit). During actual operation, if a load change causes the current limit to be exceeded, the power supply will automatically crossover to constant current mode and output voltage will drop proportionately.

Constant Current Operation

To set up a power supply for a constant current operation, proceed as follows:

- Turn CURRENT control fully counter clockwise to ensure that output decreases to 0 A, and then turn on power supply.
- Adjust VOLTAGE control (no load connected) for maximum output voltage allowable (voltage limit), as determined by load conditions. During actual operation, if a load change causes the voltage limit to be exceeded, the power supply will automatically cross-over to constant voltage operation at the preset voltage limit and output current will drop proportionately.
- Adjust CURRENT control for desired output current while depressing CC SET button (CC LED will not light until the supply is loaded)

Connecting Loads

The output of the supply is isolated from earth ground. Either output terminal may be grounded or the output can be floated up to 240 volts off ground.

Each load should be connected to the power supply output terminals using separate pairs of connecting wires. This will minimize mutual coupling effects between loads and will retain full advantage of the low output impedance of the power supply. Each pair of connecting wires should be as short as possible and twisted or shielded to reduce noise pickup (If a shield is used, connect one end to the power supply ground terminal and leave the other end unconnected.)

Operation Beyond Rated Output

The output controls can adjust the voltage or current to values above (up to 5%) the rated output as indicated on the front panel display. Although the supply can be operated in the 5% overrange region without being damaged, it can not be guaranteed to meet all of its performance specifications in this region.

Pulse Loading Considerations

The power supply will automatically cross over from constant-voltage to constant-current operation in response to an increase (over the preset limit) in the output current. Although the preset limit may be set higher than the average output current, high peak currents (as occur in pulse loading) may exceed the preset current limit and cause crossover to occur. If this crossover limiting is not desired, set the preset limit for the peak requirement and not the average.

Capacitive Loads

An internal capacitor, across the output terminals of the power supply, helps to supply high-current pulses of short duration during constant voltage operation. Any capacitance added externally will improve the pulse current capability,

but will decrease the safety provided by the current limiting circuit. A high-current pulse may damage load components before the average output current is large enough to cause the current limiting circuit to operate.

Reverse Current Loading

Active loads connected to the power supply may actually deliver a reverse current to the power supply during a portion of its operating cycle. An external source can not be allowed to pump current into the supply without loss of regulation and possible damage to the output capacitor. To avoid these effects, it is necessary to preload the supply with a dummy load resistor so that the power supply delivers current through the entire operating cycle of the load devices.

APPENDIX

SERVICE INFORMATION

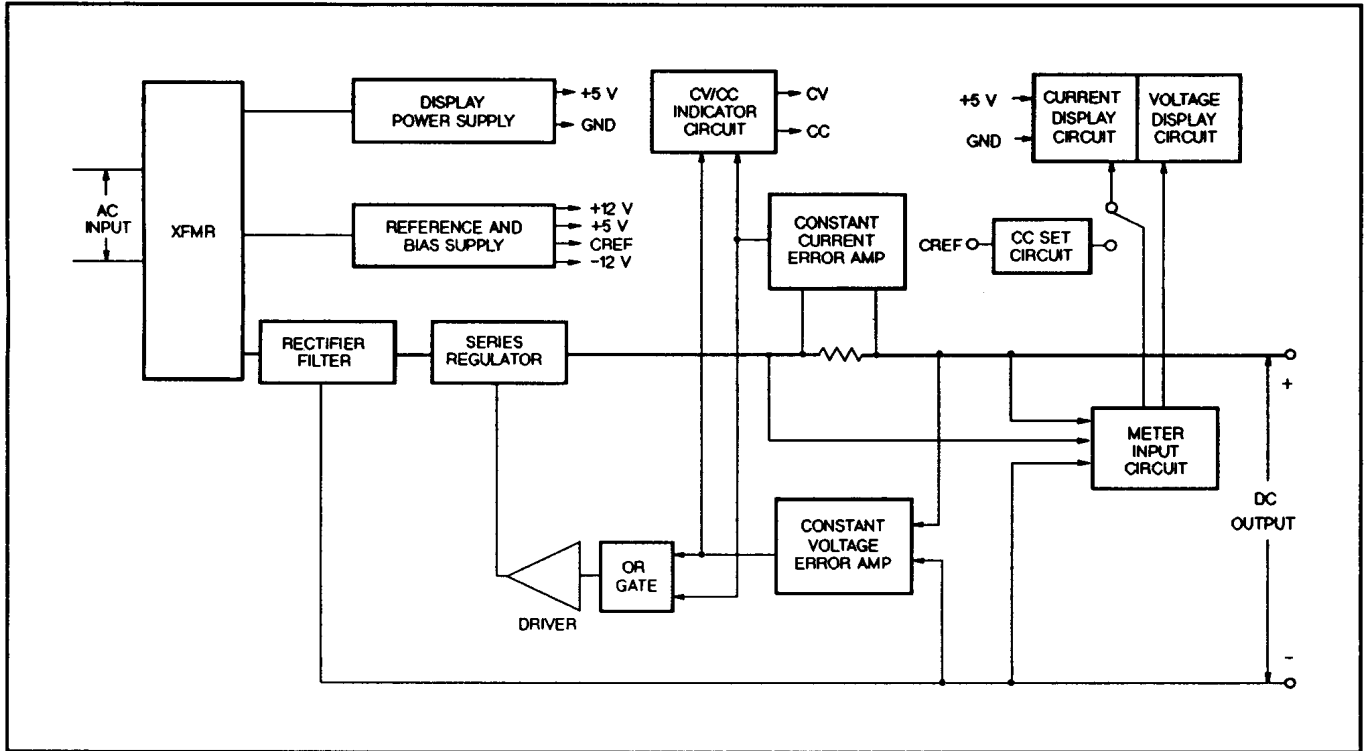


Figure A-1. Block Diagram

PRINCIPLES OF OPERATION

Throughout this discussion, refer to both the block diagram of Figure A-1 and the schematic diagram at the rear of the manual. The input AC line voltage is stepped down by the power transformer and applied to the rectifier and filter. The rectifier-filter converts the AC input to raw DC which is fed to the positive output terminal via parallel series regulator(Q1 and Q3) and current sampling resistor(R2). The regulator, part of the feedback loop, is made to alter its conduction to maintain a constant output voltage or current. The voltage developed across the current sampling resistor is the input to the constant current error amplifier. The constant voltage error amplifier obtains its input by sampling the output voltage of the supply.

Any changes in output voltage or current are detected, amplified by the error amplifier and driver and applied to the series regulator in the correct phase and amplitude to counteract the change in output voltage or current.

Two error amplifiers are included in a CV/CC supply, one for controlling output voltage, the other for controlling output current. Since the constant voltage amplifier tends to achieve zero output impedance and alters the output current whenever the load resistance changes, while the constant current amplifier causes the output impedance to be infinite and changes the output voltage in response to any load resistance change, it is obvious that the two amplifiers can not operate simultaneously. For any given value of load resistance, the power supply must act either as a constant voltage source or as a constant

current source - it can not be both; transfer between these two modes is accomplished at a value of load resistance equal to the ratio of the output voltage control setting to the output current control setting.

The reference and bias circuit provides stable reference voltages which are used by the constant voltage/current error amplifier circuits for comparison purpose. The digital meter circuit provides an indication of output voltage and current for constant voltage or constant current operating modes.

The display power circuit provides voltage which is used by A/D converter and LED drive.

Diode CR3 is connected across the output terminals in reverse polarity. It protects the output electrolytic capacitor and the series regulator transistor from the effects of a reverse voltage applied across the output terminals.

PERFORMANCE TEST

The following provides the test procedure in high current range for verifying the unit's compliance with the specifications and characteristics of Table in page 1-3. The same test procedure may be applied to low current range.

Test Equipment Required

The following Table lists the equipment required to perform the tests and adjustments. You can separately identify the equipment for performance tests, or calibration in the USE column of the Table.

Table A-1. Test Equipment Required

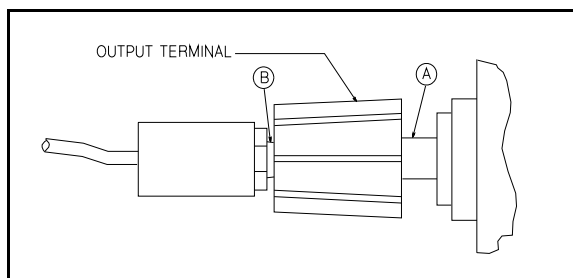
TYPE	REQUIRED CHARACTERISTICS	USE	RECOMMENDED MODEL
Oscilloscope	Sensitivity: 1 mV Bandwidth: 20 MHz/100 MHz	P	Agilent 54602A
RMS Voltmeter	True rms, 10 MHz bandwidth	P	
Multimeter	Resolution: 0.1 mV Accuracy: 0.01%	P, A	Agilent 34401A
Electronic Load	Voltage Range : 240 Vdc Current Range : 10 Adc Open and short switches Transient on/off	P, A	Agilent 6063B
Load Resistor(For high current range)	2.6 ohm 50 W, 13.3 ohm 50 W, 120 ohm 50 W	P	
Current Sampling Resistor	0.1 ohm 0.1% 10 W, 1 ohm 1% 10 W	P, A	

* P = Performance testing A = Calibration adjustments.

Constant Voltage(CV) Test

The measuring device must be connected as close to the output terminals as possible when measuring the output impedance, transient response, regulation, or ripple of the power supply in order to achieve valid measurements. A measurement made across the load includes the impedance of the leads to the load and such lead lengths can have an impedance several orders of magnitude greater than the supply output impedance, thus invalidating the measurement.

When performance measurements are made at the front terminals, the load should be plugged into the front of the terminals at (B), while the monitoring device is connected to a small lead or bus wire inserted through the hole in the neck of the binding post at (A).



Load Effect(Load Regulation)

Definition: CV Load Effect is the immediate change in dc output voltage when load resistance changes from open circuit to full load or from full load to open circuit.

Test Parameters:

Measured Variable: Output Voltage

Expected Results: Less than 0.01% plus 2 mV

Test Procedure:

- Connect the test equipment as shown in Figure A-2. Operate the electronic load in constant current mode and set its current to the full rated value of the power supply (E3610A: 3.0 A, E3611A: 1.5 A, E3612A: 0.5 A). Input off the electronic load.
- Turn the unit's power on and turn CURRENT control fully clockwise.

- Turn up output voltage to the full rated value (E3610A: 8.0 V, E3611A: 20 V, E3612A: 60 V) as read on the digital voltmeter. Then input on the electronic load.
- Record the output voltage at the digital voltmeter.
- Operate the electronic load in Open(Input Off) mode.
- Record the output voltage again immediately. The readings' difference during the immediate change should not more than 0.01% of output voltage plus 2 mV.

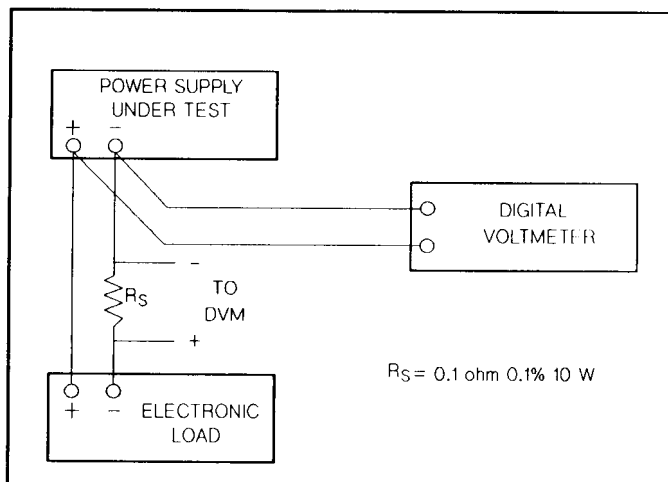


Figure A-2. Basic Test Setup

Source Effect(Line Regulation)

Definition: Source effect is the immediate change in dc output voltage when the ac input voltage changes from a minimum to maximum value ($\pm 10\%$ of nominal voltage).

Test Parameter:

Measured Variable: Output Voltage

Expected Results: Less than 0.01% plus 2 mV

Test Procedure:

- Connect the test equipment as shown in Figure A-2. Operate the electronic load in constant current mode and set its current

- to the full rated value of power supply. Input off the electronic load.
- b. Connect the unit to the ac power line through a variable autotransformer which is set for low line voltage (104 Vac for 115 Vac).
- c. Turn the unit's power on and turn CURRENT control fully clock-wise.
- d. Turn up output voltage to the full rated values as read on the digital voltmeter. Then input on the electronic load.
- e. Record the output voltage at the digital voltmeter.
- f. Adjust autotransformer to high line voltage (127 Vac for 115 Vac).
- g. Record the output voltage again immediately. The readings' difference during the immediate change should not more than 0.01% of output voltage plus 2 mV.

Load Transient Recovery Time

Definition: This is the time for the output voltage to return to within a specified bend around its voltage following a step change in load.

Test Parameters:

Measured Variable: Output Voltage Transients

Expected Results: Less than 50 usec (at 10 mV from base line)

Test Procedure:

- a. Connect the test equipment as shown in Figure A-2, but replace the DVM with the oscilloscope. Operate the electronic load in constant current mode.
- b. Turn the unit's power on and turn CURRENT control fully clock-wise.
- c. Turn up output voltage to the full rated value.
- d. Set the electronic load to transient operation mode between one half of unit's full rated value and unit's full rated value at a 1 KHz rate with 50% duty cycle.

- e. Set the oscilloscope for ac coupling, internal sync and lock on either the positive or negative load transient.
- f. Adjust the oscilloscope to display transients as in Figure A-3.
- g. Check that the pulse width of the transients at 10 mV from the base line is no more than 50 usec as shown.

PARD(Ripple and Noise)

Definition: Periodic and random deviation(PARD) in the unit's output ripple and noise combine to produce a residual ac voltage superimposed on the dc output voltage. Constant voltage PARD is specified as the root-mean-square(rms) or peak-to-peak(pp) output voltage in a frequency range of 20 Hz to 20 MHz.

PARD(RMS) Measurement

Test Parameter:

Measured Variable: Output Voltage(rms)

Expected Results: Less than 200 uV rms

Test Procedure:

- a. Connect the test equipment as shown in Figure A-4.
- b. Turn the unit's power on and turn CURRENT control fully clock-wise.
- c. Turn up output voltage to the full rated value. Check that the unit's CV indicator remains lighted. Reduce VOLTAGE control if not lighted.
- d. Check that the rms noise voltage at the true rms voltmeter is no more than 200 uV.

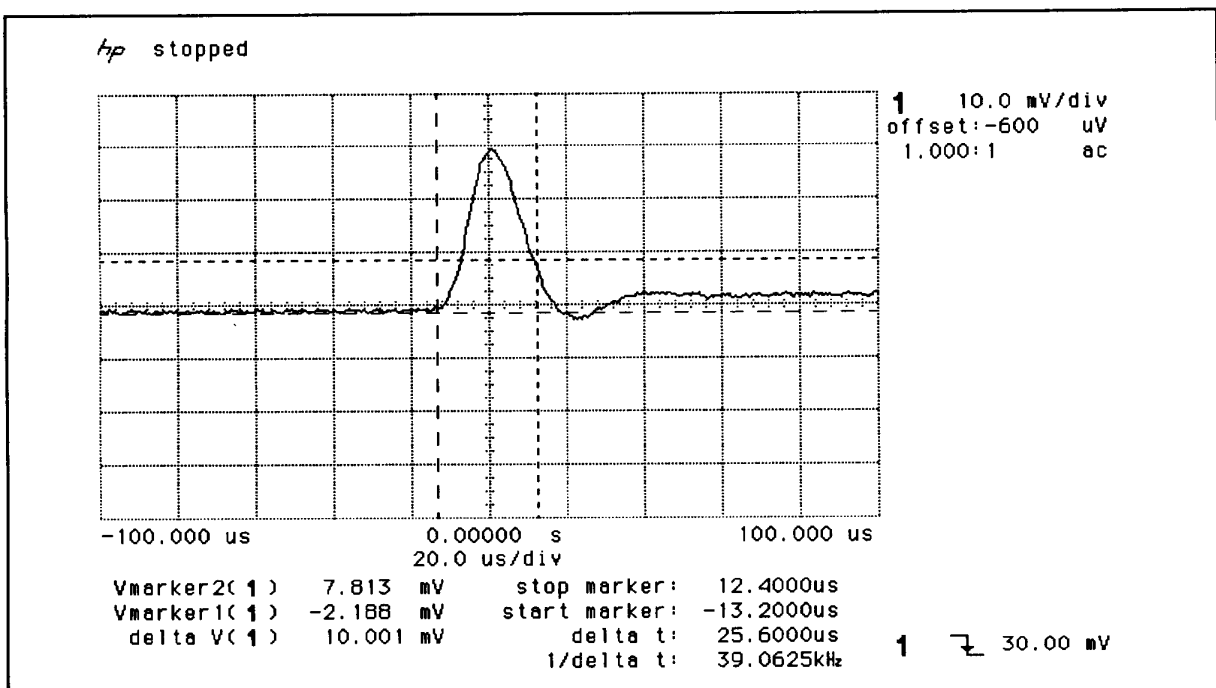


Figure A-3. Load Transient Recovery Waveform

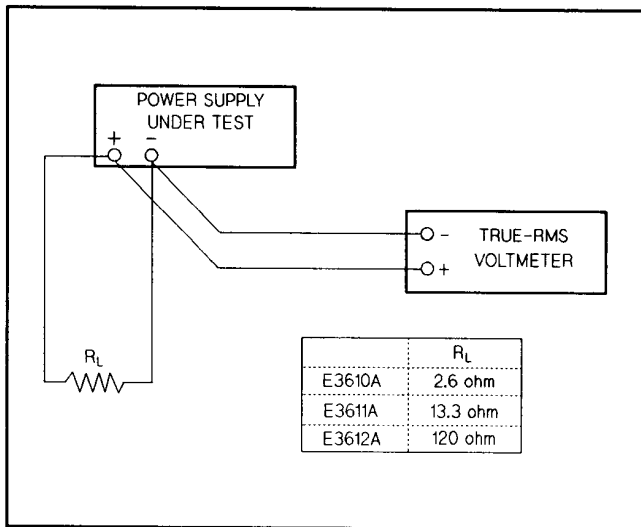


Figure A-4. RMS Measurement Test Setup

PARD(Peak-to-Peak) Measurement

Test Parameter:

Measured Variable: Output voltage(peak-to-peak)

Expected Results: Less than 2 mV p-p

Test Procedure:

- Connect the test equipment as shown in Figure A-5.
- Turn the unit's power on and turn CURRENT control fully clockwise.
- Turn up output voltage to the full rated value. Check that the unit's CV Indicator remains lighted. Reduce VOLTAGE control if not lighted.
- Set the oscilloscope to AC mode and bandwidth to 20 MHz.
- Check that the peak-to-peak noise is no more than 2 mV.

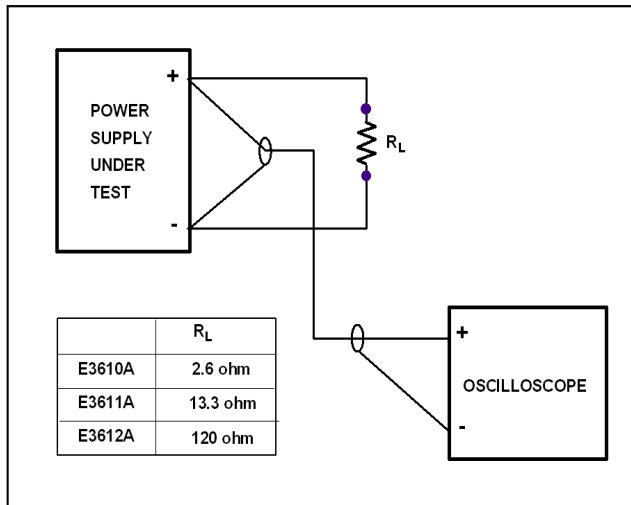


Figure A-5. Peak-to-Peak Measurement Test Setup

Constant Current(CC) Tests

For output current measurements the current sampling resistor must be treated as a four terminal device. In the manner of a meter shunt,

the load current is fed to the extremes of the wire leading to the resistor while the sampling terminals are located as close as possible to the resistance portion itself. Generally, any current sampling resistor should be of the low noise, low temperature coefficient type and should be used at no more than 5% of its rated power so that its temperature rise will be minimized.

Load Effect(Load Regulation)

Definition: CC Load Effect is the immediate change in dc output current when load resistance changes from short circuit to full load or from full load to short circuit.

Test Parameter:

Measured Variable: Output Current

Expected Results: Less than 0.01% plus 1 mA

Test Procedure:

- Connect the DVM across R_s in Figure A-2. Operate the electronic load in constant voltage mode and set its voltage to the full rated value of power supply. Input off the electronic load.
- Turn the unit's power on and turn VOLTAGE control fully clockwise and current control to the full rated value. Then input on the electronic load.
- Check that the AMPS display reads full rated values and CC indicator remains lighted. Reduce CURRENT control if not lighted.
- Record the voltage across R_s and convert it to current through dividing by R_s .
- Operate the electronic load in short(input short mode).
- Record voltage across R_s again immediately. The readings' difference during the immediate change should not more than 0.01% of output current plus 1 mA.

Source Effect(Line Regulation)

Definition: Source Effect is the immediate change in dc output current when the ac input voltage changes from the minimum to maximum value($\pm 10\%$ of nominal voltage).

Test Parameter:

Measured Variable: Output Current

Expected Results: Less than 0.01% plus 1 mA

Test Procedure:

- Connect the DVM across R_s in Figure A-2. Operate the electronic load in constant voltage mode and set its voltage to the full rated value of power supply.
- Connect the unit to the ac power line through a variable autotransformer that set for low line voltage(104 Vac for 115 Vec). Input off the electronic load.
- Turn the unit's power on and turn VOLTAGE control fully clockwise and output current to the full rated value. Then input on the electronic load.
- Check that the AMPS display reads full rated values and CC indicator remains lighted. Reduce CURRENT control if not lighted.
- Record output voltage across R_s and convert it to current through dividing by R_s .
- Adjust autotransformer to the high line voltage(127 Vac for 115 Vac).
- Record the voltage across R_s again immediately. The readings' difference during the immediate change should not more than 0.01% of output current plus 1 mA.

PARD(Ripple and Noise)

Definition: Periodic and random deviation(PARD) in the unit's output ripple and noise combine to produce a residual ac current as well as

an ac voltage superimposed on the dc output. Constant Current PARD is specified as the root-mean-square(rms) output current in e frequency range of 20 Hz to 20 MHz with the unit in CC operation.

PARD(RMS) Measurement

Test Parameter:

Measured Variable: Output Current(rms)

Expected Results: Less than 200 uA rms

Test Procedure:

- a. Connect the test equipment as shown in Figure A-6.
- b. Turn the unit's power on and turn the VOLTAGE control fully clockwise.
- c. Turn up output current to the full rated value. Check that the CC indicator remains lighted. Reduce CURRENT control if not lighted.
- d. Record rms voltage across R_s and convert it to current through dividing by R_s .
- e. Check that the rms noise current is no more than 200 uA.

PARD(Peak-to-Peak) Measurement

Test Parameter:

Measured Variable: Output Current(peak-to-peak)

Expected Results: Less than 1 mA p-p

Test Procedure:

- a. Connect the test equipment as shown in Figure A-6, but replace the RMS voltmeter with oscilloscope.
- b. Set the oscilloscope to AC mode and bandwidth to 20 MHz.
- c. Turn the unit's power on and turn the VOLTAGE control fully clockwise.
- d. Turn up output current to the full rated value. Check that the CC indicator remains lighted. Reduce CURRENT control if not lighted.
- e. Record peak-to-peak voltage across R_s and convert it to current through dividing by R_s . Check that the peak-to-peak noise current is no more than 1 mA.

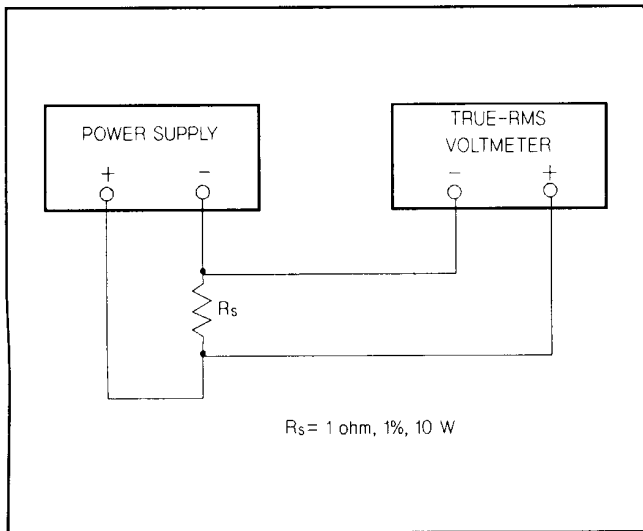


Figure A-6. RMS Measurement Test setup

CALIBRATION PROCEDURE

To calibrate ammeter and full scale current, connect test equipments as shown in Figure A-7.

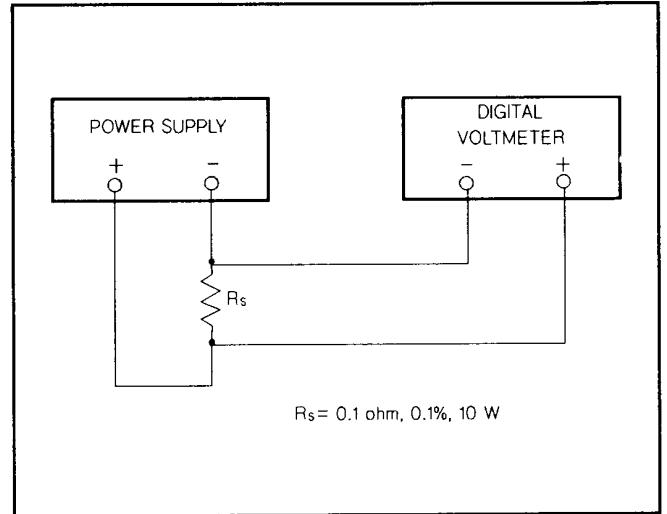


Figure A-7. Calibration in High Current Range

Calibration in High Current Range

- a. Turn VOLTAGE and CURRENT control fully clockwise.
- b. Set RANGE push button to high current range.
- c. Turn on power supply and adjust R31 so that DVM indicates exactly as follows (5% over rated current):
E3610A: 0.315 V E3611A: 0.158 V E3612A: 0.053 V
- d. Adjust R3 on the display board so that the displayed value on the front panel is equal to DVM value divided by R_s .
- e. While depressing CC SET push button, adjust R20 so that the displayed value on the front panel is equal to DVM value divided by R_s .

Calibration in Low Current Range

- a. Set RANGE push button to low current range.
- b. Adjust R32 so that DVM indicates exactly as follows (5% over rated current).
E3610A: 0.21 V E3611A: 0.089 V E3612A: 0.026 V

Calibration of VOLTS Meter

- a. Disconnect the current shunt(R_s) and connect DVM across output of supply.
- b. Set RANGE push button to low current range at no load.
- c. Adjust VOLTAGE control till DVM indicates exactly as follows (full rated voltage):
E3610A: 15 V E3611A: 35 V E3612A: 120 V
- d. Adjust R10 on the display board so that the value of the front panel display is the same as the value of DVM.

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