HEWLETT® PACKARD

DUAL OUTPUT POWER SUPPLY
HP MODEL E3620A

OPERATING MANUAL
FOR INSTRUMENTS WITH SERIAL NUMBERS
KR41200101 **AND ABOVE**

For instruments with Serial Numbers above
KR41200101, a change page may be included.

Manual Part No. E3620-90001

August 1999
Edition 6

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. Hewlett-Packard Company 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 and that the correct fuse is installed.

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).

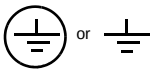
DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE.
Do not operate the instrument in the presence of flammable gases or fumes.

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.

DO NOT SERVICE OR ADJUST ALONE.
Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

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 inpersonal 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.

NOTE

The NOTE sign denotes important information. It calls attention to a procedure, practice, condition or the like, which is essential to highlight.

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT.
Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the instrument. Return the instrument to a Hewlett-Packard Sales and Service Office for service and repair to ensure that safety features are maintained.

Instruments that appear damaged or defective should be made inoperative and secured against unintended operation until they can be repaired by qualified service personnel.

Table of Contents

GENERAL INFORMATION

DESCRIPTION

The Model E3620A Dual Output Power Supply is a compact, constant voltage/current limiting supply that delivers two isolated 0 to 25 V outputs rated at 1 A. It is an ideal power supply for design and breadboard work where single or dual voltages are required. Each output voltage is continuously variable throughout its range and separate current limit circuits protect each output against overload or short circuit damage.

Connections to the outputs are made to binding post type terminals on the front panel. The outputs can be used individually or in combination to satisfy any number of output demands. The positive or negative terminal of each output can be grounded or each output can be left floating. A chassis ground terminal is located on the front panel of the supply.

The front panel also contains a line switch, output voltage controls, an autoranging digital voltmeter and a single-range digital ammeter, and two meter select pushbutton switches. The meter pushbuttons select both voltage and current monitoring for the output V1 and V2. The supply is furnished with a detachable, 3-wire grounding type line cord. The ac line fuse is an extractor type fuseholder on the rear heat sink.

SAFETY CONSIDERATIONS

This product is a Safety Class I instrument, which means that it is provided with a protective earth ground terminal. This terminal must be connected to an ac source that has a 3-wire ground receptacle. Review the instrument rear panel and this manual for safety markings and instructions before operating the instrument. Refer to the Safety Summary page at the beginning of this manual for a summary of general safety information. Specific safety information is located at the appropriate places in this manual.

SAFETY AND EMC REQUIREMENTS

This power supply is designed to comply with the following safety and EMC(Electromagnetic Compatibility) requirements:

- IEC 1010-1(1990)/EN 61010 (1993): Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use
- CSA C22.2 No.231: Safety Requirements for Electrical and Electronic Measuring and Test Equipment
- UL 1244: Electrical and Electronic Measuring and Testing Equipment
- EMC Directive 89/336/EEC: Council Directive entitled Approximation of the Laws of the Member States relating to Electromagnetic Compatibility
- EN 55011(1991) Group 1, Class B/CISPR 11 (1990): Limits and Methods of Radio Interference Characteristics of Industrial, Scientific, and Medical(ISM) Radio-Frequency Equipment
- EN 50082-1(1992) /
  IEC 801-2(1991): Electrostatic Discharge Requirements
  IEC 801-3(1984): Radiated Electromagnetic Field Requirements
  IEC 801-4(1988): Electrical Fast Transient/Burst Requirements

INSTRUMENT AND MANUAL IDENTIFICATION

A serial number identifies your power supply. The serial number encodes the country of manufacture, the week of the latest significant design change, and a unique sequential number. The letter "KR" designates Korea as the country of manufacture, the first one digit indicates the year (4=1994, 5=1995, and so forth), and the second two digits indicate the week. The remaining digits of the serial number are a unique, five-digit number assigned sequentially.

If the serial number on your supply does not agree with those on the title page of the manual, a yellow Change Sheet is supplied with the manual to explain the difference between your instrument and the instrument described by this manual. The Change Sheet may also contain information for correcting errors in the manual.

OPTIONS

Options 0E3 and 0E9 determine which line voltage is selected at the factory. The standard unit is configured for 115 Vac ± 10%, 47-63 Hz input.

Option No.	Description
0E3:	230 Vac ± 10%, 47-63 Hz Input
0E9:	100 Vac ± 10%, 47-63 Hz Input

ACCESSORY

The accessory listed below may be ordered from your local Hewlett-Packard Sales Office either with the power supply or separately. (Refer to the list at the rear of the manual for address.)

HP Part No.	Description
5063-9240	Rack Kit for mounting one or two 3 1/2" high supplies in a standard 19" rack

The rack mount kit is needed for rack mounting of the E3620A power supply.

ORDERING ADDITIONAL MANUALS

One manual is shipped with each power supply. (Option 910 is ordered for each extra manual.) Additional manuals may also be purchased separately for your local Hewlett-Packard sales office (see the list at the rear of this manual for addresses). Specify the model number, serial prefix, and the HP Part Number provided on the title page.

SPECIFICATIONS

Instrument specifications are listed in Table 1. These specifications are performance standards or limits against which the instrument is tested.

LINE FUSE

The line fuse is located by the ac line receptacle. Check the rating of the line fuse and replace it with the correct fuse if necessary as indicated below. These are slow-blow fuses.

Line Voltage	Fuse	HP Part No.
100/115 Vac	2 A	2110-0702
230 Vac	1 A	2110-0457

Table 1. Specifications

AC INPUT

Standard: 115 Vac ± 10%, 47-63 Hz, 200 VA, 130 W
0E9: 100 Vac ± 10%, 47-63 Hz, 200 VA, 130 W
0E3: 230 Vac ± 10%, 47-63 Hz, 200 VA, 130 W

DC OUTPUT

Voltage span over which output may be varied using front panel controls.
Output V1: 0 to 25 V at 1 A
Output V2: 0 to 25 V at 1 A

LOAD REGULATION

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

LINE REGULATION

Less than 0.01% plus 2 mV for any line voltage change within rating.

RIPPLE AND NOISE

Normal Mode Voltage: Less than 0.35 mV rms/1.5 mV p-p (20 Hz-20 MHz).
Common Mode Current (CMI): Less than 1 μA rms for all outputs (20 Hz-20 kHz).

OPERATING TEMPERATURE RANGE

0 to 40 ^{o}C for full rated output. At higher temperatures, output current is derated linearly to 50% at 55 ^{o}C maximum temperature.

TEMPERATURE COEFFICIENT

Less than 0.02% plus 1 mV voltage change per ^{o}C over the operating range from 0 to 40 ^{o}C after 30 minutes warm-up.

STABILITY (OUTPUT DRIFT)

Less than 0.1% plus 5 mV (dc to 20 Hz) during 8 hours at constant line, load and ambient after an initial warm-up time of 30 minutes.

LOAD TRANSIENT RESPONSE TIME

Less than 50 μsec for output recovery to within 15 mV of nominal output voltage following a load change from full load to half load, or vice versa.

OUTPUT VOLTAGE OVERSHOOT

During turn-on or turn-off of ac power, output plus overshoot will not exceed 1 V if the output control is set for less than 1 V. If the control is set for 1 V or higher, there is no overshoot.

METER ACCURACY: ±(0.5% of output + 2 counts) at 25^{o}C±5^{o}C

METER RESOLUTION

Voltage: 10 mV (0 to 20 V),100 mV (above 20 V)
Current: 1 mA

DIMENSIONS

212.3 mmW x 88.1 mmH x 345.4 mmD
(8.4 inW x 3.5 inH x 13.6 inD)

WEIGHT

5.0 kg(11.0 lbs) net, 6.25 kg(13.8 lbs) shipping

INSTALLATION

INITIAL INSPECTION

Before shipment, this instrument was inspected and found to be free of mechanical and electrical defects. As soon as the instrument is unpacked, inspect for any damage that may have occurred in transit. Save all packing materials until the inspection is completed. If damage is found, a claim should be filed with the carrier. The Hewlett-Packard Sales and Service office should be notified as soon as possible.

Mechanical Check

This check should confirm that there are no broken knobs or connectors, that the cabinet and panel surfaces are free of dents and scratches, and that the meter is not scratched or cracked.

Electrical Check

This instrument should be checked against electrical specifications. Perform the TURN-ON CHECKOUT PROCEDURE in the following paragraph to confirm that the supply is operational. Alternately, check the supply more fully using the PERFORMANCE TEST in the service information section.

INSTALLATION DATA

The instrument is shipped ready for bench operation. Before applying power to the supply, please read the INPUT POWER REQUIREMENTS paragraph.

Location and Cooling

This instrument is air cooled. Sufficient space should be allowed so that a free flow of cooling air can reach the sides and rear of the instrument when it is in operation. It should be used in an area where the ambient temperature does not exceed 40^{o}C.

Outline Diagram
Figure 1 illustrates the outline shape and dimensions of the supply.

Rack Mounting
This supply may be rack mounted in a standard 19-inch rack panel either by itself or alongside a similar unit. Please see the ACCESSORY, page 1-4, for available rack mounting accessory. The rack-mounting kit includes complete installation instructions.

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 Table 1. A label on the rear heat sink shows the nominal input voltage set for the supply at the factory.

Power Cable
To protect operating personnel, the supply should be grounded. This supply 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 supply is grounded. The power supply is equipped at the factory with a power cord plug appropriate for the user's location. Notify the nearest HP Sales and Service Office if the appropriate power cord is not included with the supply.

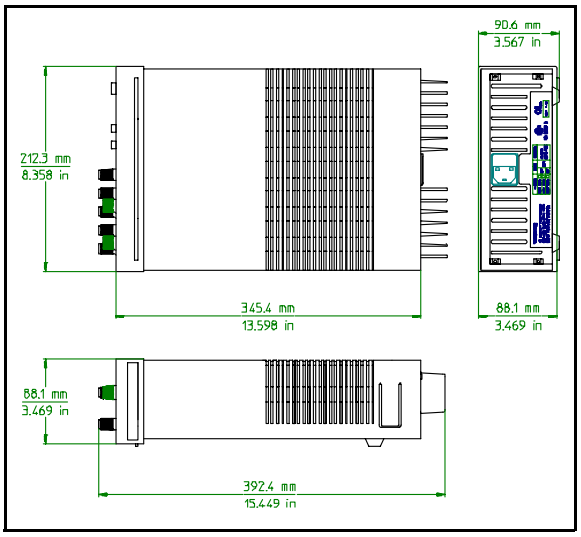


Figure 1. Outline Diagram

OPERATING INSTRUCTIONS

INTRODUCTION
This section describes the operating controls and indicators, turn-on checkout procedures, and other operating considerations for the Model E3620A Dual Output Power Supply.

CAUTION

Before applying power to the supply, check the label on the heat sink to make certain that the supply's line voltage option agrees with the line voltage to be used. If the option does not correspond to your line voltage, refer to paragraph "LINE VOLTAGE OPTION CONVERSION" in the service section before applying power.

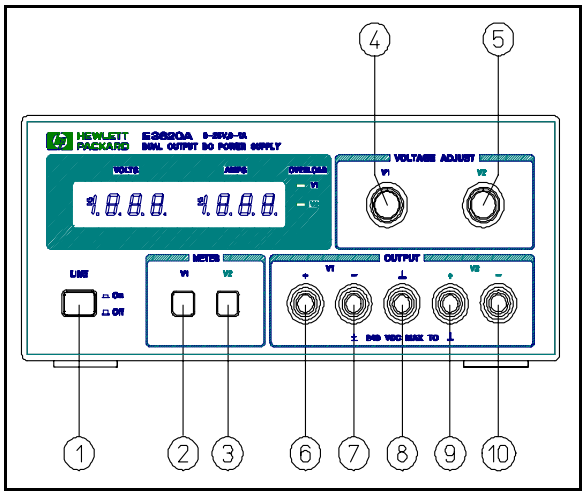


Figure 2. Front-Panel Controls and Indicators

CONTROLS

Line Switch
The LINE pushbutton switch (1, Figure 2) is pushed-in to turn the supply ON and released (out position) to turn the supply OFF.

Voltage and Current Metering
Two meter select pushbutton switches (2 and 3) permit the output voltage and current of either output (V1 or V2) to be monitored on the VOLTS/AMPS meter. The V1 and V2 output select pushbuttons connect the desired output to the metering circuit when the applicable button is pushed in.

NOTE

Be careful that both METER pushbuttons are not released (out-position) or pushed in simultaneously.

Voltage Controls
The V1 and V2 voltage controls (4 and 5) set the voltage level of the corresponding output. The voltage controls are 10 turn potentiometers.

TURN-ON CHECKOUT PROCEDURE

The following steps describe the use of the Model E3620A front panel controls illustrated in Figure 2 and serve as a brief check that the supply is operational. Follow this checkout procedure or the more detailed performance test of service information section when the instrument is received and before it is connected to any load equipment. Proceed to the more detailed performance test beginning in service information section if any difficulties are encountered.

a. Connect line cord to power source and push LINE switch (①) in.

b. Push the V1 meter select pushbutton switch (②) to in-position to monitor supply's V1 output voltage. With no load connected, vary the V1 voltage control (④) over its range and check that the voltmeter responds to the con trol setting and the ammeter indicates zero.

c. Turn the V1 voltage control (④) fully clockwise and short the +V1 output terminal (⑥) to -V1 terminal (⑦) with an insulated test lead. The ammeter should indicate a short-circuit output current of minimum 1.0 A + 5% at 25 ^{o}C. Remove the short from the output terminals.

d. Push the V2 meter select pushbutton switch to in-position and repeat steps (b) and (c) for V2 output.

If this brief checkout procedure or later use of the supply reveals a possible malfunction, see the service information section for detailed test, troubleshooting, and adjustment procedures.

OPERATION

The dual outputs of the E3620A can be used individually, in series, or in parallel. Each output can be floated (up to 240 volts off ground) or, the + or - terminal of either output can be grounded to the chassis ground terminal which is located on the supply's front panel.

Overload Protection Circuits

The outputs are individually protected against overload or short circuit damage by separate current limiting circuits. The circuits are factory adjusted to limit the output current to minimum 1 A + 5%. The current limits are set by adjusting R63 in the V1 supply and R34 in the V2 supply (see the schematic diagram). No deterioration of supply performance occurs if the output current remains below the current limit setting.

NOTE

During the actual operation of the V1 and V2 outputs, if a load change causes the current limit to be exceeded, the OVERLOAD LED is lighted. If overload conditions occur, the V1 and V2 supplies will protect the load by limiting the current to minimum 1 A + 5%. The V1 and V2 supplies are self restoring; that is, when the overload is removed or corrected, the output voltage is automatically restored to the previously set value.

Operation Beyond Rated Output

The supply may be able to provide voltages and currents greater than its rated maximum outputs if the line voltage is at or above its nominal value. Operation can be extended up to 5% over the rated output without damage to the supply, but performance can not be guaranteed to meet specifications above the rated output of 0 to 25 V at 1 A.

Connecting Load

Connect each load to the power supply output terminals using separate pairs of connecting wires. This will minimize mutual coupling effects between loads and takes full advantage of the low output impedance of the supply. Load wires must be of adequately heavy gauge to maintain satisfactory regulation at the load.

Make each pair of connecting wires as short as possible and twist or shield them to reduce noise pick-up. If a shield is used, connect one end of the shield to the power supply ground terminal and leave the other end unconnected.

If load considerations require locating output power distribution terminals at a distance from the power supply, then the power supply output terminals should be connected to the remote distribution terminals by a pair of twisted or shielded wires and each load should be connected to the remote distribution terminals separately.

Series Operation

The two outputs (V1 and V2) can be connected in series to obtain a voltage (up to 50 V) higher than that available from a single output. Each output control (V1 and V2) must be adjusted in order to obtain the total output voltage. Diodes connected internally across each output protect the supply's output filter capacitors against reverse voltages. This could occur if the supplies are connected in series and the output is shorted.

Parallel Operation

The V1 and V2 supplies can be connected in parallel to obtain a total output current greater than that available from one supply. The total output current is the sum of the output currents of the individual supplies. The output voltage controls of one power supply should be set to the desired output voltage, and the other supply set for a slightly larger output voltage. The supply set to the lower output voltage will act as a constant voltage source, while the supply set to the higher output will act as a current-limited source, dropping its output voltage until it equals that of the other supply. The constant voltage source will deliver only that fraction of its rated output current necessary to fulfill the total current demand.

LOAD CONSIDERATIONS

This section provides information on operating your supply with various types of loads connected to its output.

PULSE LOADING

The power supply will automatically cross over from constant-voltage to current-limit operation in response to an increase in the output current over the preset limit. 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 and degrade performance.

REVERSE CURRENT LOADING

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

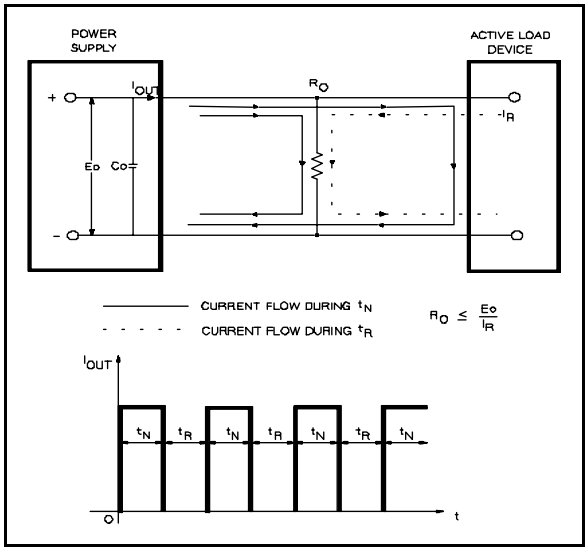


Figure 3. Reverse Current Loading Solution

OUTPUT CAPACITANCE

An internal capacitor across the output terminals of the 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 load protection 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 VOLTAGE PROTECTION

A diode is connected across the output terminals with reverse polarity. This diode protects the output electrolytic capacitors and the series regulator transistors from the effects of a reverse voltage applied across the output terminals. Since series regulator transistors can not withstand reverse voltage either, diodes are also connected across them. When operating supplies in parallel, these diodes protect an unenergized supply that is in parallel with an energized supply.

DECLARATION OF CONFORMITY

according to ISO/IEC Guide 22 and EN 45014

Manufacturer's Name:	Hewlett-Packard Company Korea Instrument Operation
Manufacturer's Address:	345-15, Kasan-dong Kumchon-ku, Seoul 153-023 Korea

declares, the product

Product Name:	Dual Output DC Power Supply
Model Number:	HP E3620A
Product Options:	All Options

conforms to the following Product Specifications

Safety:	IEC 1010-1 (1990) / EN 61010-1 (1993)
EMC:	CISPR 11:1990/EN 55011 (1991) - Group 1 Class A[1)] IEC 801-2:1991/EN 50082-1 (1992): 4 kV CD, 8 kV AD IEC 801-3:1984/EN 50082-1 (1992): 3 V/m IEC 801-4:1988/EN 50082-1 (1992): 1 kV Power Lines 0.5 kV Signal Lines

Supplementary Information: The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC (inclusive 93/68/ EEC) and carries the "CE" mark accordingly.

[1)]The product was tested in a typical configuration with Hewlett-Packard Test Systems.

Seoul, Korea May 10, 1996

Young Sook Lee, Quality Manager

European Contact: Your local Hewlett-Packard Sales and Service Office or Hewlett-Packard GmbH, Department ZQ / Standards Europe, Herrenberger Straße 130, D-71034 Böblingen (FAX: +49-7031-143143).

HEWLETT® PACKARD

CERTIFICATION

Hewlett-Packard (HP) Company certifies that this product met its published specifications at time of shipment from the factory. Hewlett-Packard 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 Hewlett-Packard hardware product is warranted against defects in material and workmanship for a period of three years from date of delivery. HP software and firmware products, which are designated by HP 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 HP or Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective. HP 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 a service facility designated by HP. Return to Englewood Colorado Service Center for repair in United States(1-800-258-5165). Customer shall prepay shipping charges by (and shall pay all duty and taxes) for products returned to HP for warranty service. Except for the products returned to Customer from another country, HP shall pay for return of products to Customer.

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

If HP 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 HP.

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

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 HP 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. HP 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 contacts, product maintenance agreements and customer assistance agreements are also available. Contact your nearest Hewlett-Packard Sales and Service office for further information on HP's full line of Support Programs.

Manual Update

In order to maintain a consistent appearance across all Hewlett-Packard products, the colors on the following instruments have been changed. This update lists the changes as a result of the color change. This update also provide information to correct manual errors or changes. Refer to this update when ordering replacement parts.

Manual Identification
This update is used with the Operating and Service Guide of the **HP E3620A Dual Output Lab Bench DC Power Supply**. Manual Part Number: E3620-90001. Manual Print Date: August 1997 (Edition 5).

For Instruments with Serial Numbers > KR41200101

Change 1: On page 1-5, Meter Accuracy Specification at the Table 1, change as follows:

From: ± 0.5 % of full scale + 2 counts at 25 °C ± 5 °C
To: ± (0.5 % of output + 2 counts) at 25 °C ± 5 °C

Change 2: Make the following changes to the Replaceable Parts List on page A-12 to A-13.

Old HP Part Number	New HP Part Number	Part Description
8120-1378	8120-8767	Power cord for STD, 0E9
8120-1689	8120-8768	Power cord for 0E3
1853-0950	1853-0590	TRANSISTOR 2N4036 SI TO-5 PD=1W

Rack Mounting Kits

The part numbers for the new rack mounting kits for the E3620A are listed below.

- To rack mount a single instrument, order:
  Adapter Kit : 5063-9240
- To rack mount two instruments side by side, order:
  Lock-Link Kit : 5061-9694
  Flange Kit : 5063-9212
- To rack mount one or two instruments in a sliding support shelf, order:
  Shelf : 5063-9255
  Slide Kit : 1494-0015
  (for a single instrument, also order filler panel 5002-3999)

Printed in Korea August 1999 E0899

E3620-90092