

**DC POWER SUPPLY
BENCH SERIES
MODELS 6212C,
6214C, 6216C, 6218C**

**OPERATING AND SERVICE MANUAL
FOR SERIALS:**

**MODEL 6212C, 2715K-00101
MODEL 6214C, 2711K-00101
MODEL 6216C, 2715K-00101
MODEL 6218C, 2715K-00101**

*For instruments with serial
numbers above those listed a
change page may be included.

*For "B" instruments, 6212B, 6214B,
6216B and 6218B refer to Appendix A
Manual Backdating Changes.



**HEWLETT
PACKARD**

Section I
GENERAL INFORMATION

1-1 DESCRIPTION

1-2 This power supply is completely transistorized and suitable for either bench or relay rack operation. It is a compact, well-regulated, Constant Voltage/Constant Current supply that will furnish full rated output voltage at the maximum rated output current or can be continuously adjusted throughout the output range. The front panel CURRENT control can be used to establish the output current limit (overload or short circuit) when the supply is used as a constant voltage source and the VOLTAGE controls can be used to establish the voltage limit (cell-ling) when the supply is used as a constant current source. The supply will automatically crossover from constant voltage to constant current operation and vice versa if the output current or voltage exceeds these preset limits.

1-3 Either the positive or negative output terminal may be grounded or the power supply can be operated floating at up to a maximum of 300 volts off ground.

1-4 A single meter is used to measure either output voltage or output current in volts or mA. The voltage or current range is selected by the METER SELECTION switch on the front panel.

1-5 SPECIFICATIONS

1-6 Detailed specifications for the power supply are given in Table 1-1.

1-7 OPTIONS

1-8 Options are factory modifications of a standard instrument that are requested by the customer. The following options are available for the instrument covered by this manual. Where necessary, detailed coverage of the options is included throughout the manual.

Option No.

Description

028 230 V, 50-400 Hz, Single-Phase Output, Factory modification consists of reconnecting the input transformer for 230 Vac operation. Refer to Section II for further details.

One additional operating and service manual shipped with the power supply.

910

1-9 ACCESSORIES

1-10 The accessories listed in the following chart may be ordered with the power supply or separately from your local Hewlett-Packard field sales office (refer to list at rear of manual for addresses).

Description

HP Part No.

3 1/2" High Rack Kit for mounting up to three BENCH supplies. (Refer to Section II for details.)

14521C

1-11 INSTRUMENT AND MANUAL IDENTIFICATION

1-12 Hewlett-Packard power supplies are identified by a two-part serial number. The first part is the serial number prefix, a number-letter combination that denotes the date of a significant design change and the country of manufacture. The first two digits of the prefix indicate the year (20 = 80, 21 = 81, etc.), the second two digits indicate the week, and the letter "K" designates Korea as the country of manufacture. The second part of the serial number is a different sequential number assigned to each power supply, starting with 00101.

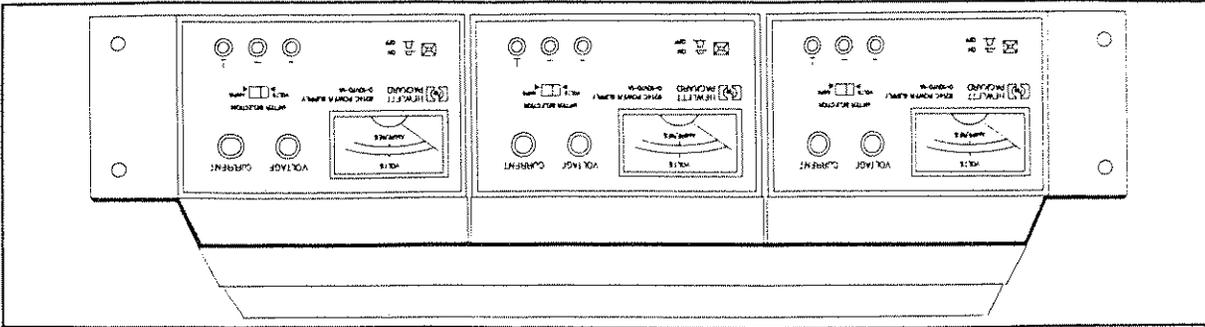
1-13 If the serial number on your instrument does not agree with those on the title page of this manual, a yellow change sheet supplied with the manual defines the difference between your instrument and the instrument described by this manual.

1-14 ORDERING ADDITIONAL MANUALS

1-15 One manual is shipped with each power supply. Additional manuals may be purchased from your local Hewlett-Packard field office (see list at rear of this manual for addresses). Specify the model number, serial number prefix, and HP stock number provided on the title page.

<p>STABILITY: Constant Voltage - Less than 0.1% + 5 mV total drift for 8 hours following 30 minutes warm-up at constant ambient, constant line voltage, and constant load. Constant Current - Less than (see table) total drift for 8 hours following 30 minutes warm-up at constant ambient, constant line voltage, and constant load.</p> <p>TRANSIENT RECOVERY TIME: Less than 50 μsec for output voltage recovery in constant voltage operation to within 15 mV of the nominal output voltage following a change in output current from 50% to 100% of the current rating of the supply and vice-versa.</p> <p>OVERLOAD PROTECTION: The current limit circuit protects the power supply for all overloads including a direct short circuit placed across the output terminals. METER: The front panel meter can be used as a voltmeter or an ammeter. OUTPUT CONTROLS: The voltage control and current control set desired output voltage/current. Meter switch selects voltage or current.</p> <p>OUTPUT TERMINALS: Three "five-way" 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 chassis through a separate ground terminal.</p> <p>COOLING: Convection cooling is employed. The supply has no moving parts.</p> <p>SIZE: See Figure 2-1.</p> <p>WEIGHT: 4.75 lbs./2.2 kg. net, 6.75 lbs./3.1 kg. shipping.</p> <p>FINISH: Moss Gray Case, mint front panel</p> <p>POWER CORD: A 3-wire, 5 foot (1.52 cm) power cord is provided with each unit.</p>	<p>INPUT:</p> <table border="1"> <tr> <td>6212C</td> <td>115 Vac, \pm 10%, 48-440 Hz, 0.29A, 28W</td> </tr> <tr> <td>6214C</td> <td>115 Vac, \pm 10%, 48-440 Hz, 0.3A, 28W</td> </tr> <tr> <td>6216C</td> <td>115 Vac, \pm 10%, 48-440 Hz, 0.25A, 26W</td> </tr> <tr> <td>6218C</td> <td>115 Vac, \pm 10%, 48-440 Hz, 0.25A, 26W</td> </tr> </table> <p>OUTPUT:</p> <table border="1"> <tr> <td>6212C</td> <td>0 to 100 Vdc, 0 to 0.1 A</td> </tr> <tr> <td>6214C</td> <td>0 to 10 Vdc, 0 to 1 A</td> </tr> <tr> <td>6216C</td> <td>0 to 25 Vdc, 0 to 0.4 A</td> </tr> <tr> <td>6218C</td> <td>0 to 50 Vdc, 0 to 0.2 A</td> </tr> </table> <p>LOAD REGULATION: Constant Voltage - Less than 4 mV (8 mV, 6212C) for a load current change equal to the current rating of the supply. Constant Current - Less than 500 μA for a load voltage change equal to the voltage rating of the supply.</p> <p>LINE REGULATION: Constant Voltage - Less than 4 mV for \pm 10% change in the nominal line voltage at any output voltage and current within rating. Constant Current - Less than 500 μA for Models 6212C, 16C, 18C and less than 750 μA for Model 6214C for a \pm 10% change in the normal line voltage at any output voltage and current within rating.</p> <p>RIPPLE AND NOISE: Constant Voltage - Less than 200 μV rms/1 mV p-p (dc to 20 Mhz). Constant Current - Less than 150 μA rms/500 μA p-p (dc to 20 Mhz).</p> <p>TEMPERATURE RANGES: Operating: 0° to 55° C. Storage: -40° to +75° C.</p> <p>TEMPERATURE COEFFICIENT: Constant Voltage - Less than 0.02% + 1 mV output change per degree centigrade change in ambient following 30 minutes warm-up. Constant Current - Less than (see table) output change per degree centigrade change in ambient following 30 minutes warm-up.</p> <table border="1"> <tr> <td>6212C</td> <td>-</td> <td>0.5 mA</td> </tr> <tr> <td>6214C</td> <td>-</td> <td>6 mA</td> </tr> <tr> <td>6216C</td> <td>-</td> <td>2 mA</td> </tr> <tr> <td>6218C</td> <td>-</td> <td>1 mA</td> </tr> </table>	6212C	115 Vac, \pm 10%, 48-440 Hz, 0.29A, 28W	6214C	115 Vac, \pm 10%, 48-440 Hz, 0.3A, 28W	6216C	115 Vac, \pm 10%, 48-440 Hz, 0.25A, 26W	6218C	115 Vac, \pm 10%, 48-440 Hz, 0.25A, 26W	6212C	0 to 100 Vdc, 0 to 0.1 A	6214C	0 to 10 Vdc, 0 to 1 A	6216C	0 to 25 Vdc, 0 to 0.4 A	6218C	0 to 50 Vdc, 0 to 0.2 A	6212C	-	0.5 mA	6214C	-	6 mA	6216C	-	2 mA	6218C	-	1 mA
6212C	115 Vac, \pm 10%, 48-440 Hz, 0.29A, 28W																												
6214C	115 Vac, \pm 10%, 48-440 Hz, 0.3A, 28W																												
6216C	115 Vac, \pm 10%, 48-440 Hz, 0.25A, 26W																												
6218C	115 Vac, \pm 10%, 48-440 Hz, 0.25A, 26W																												
6212C	0 to 100 Vdc, 0 to 0.1 A																												
6214C	0 to 10 Vdc, 0 to 1 A																												
6216C	0 to 25 Vdc, 0 to 0.4 A																												
6218C	0 to 50 Vdc, 0 to 0.2 A																												
6212C	-	0.5 mA																											
6214C	-	6 mA																											
6216C	-	2 mA																											
6218C	-	1 mA																											

Figure 2-2. Rack Kit with three BENCH supplies.



2-4 This check should confirm that there are no
 2-3 Mechanical Check
 2-14 This instrument may be rack mounted separately
 as shown in Figure 2-2. The units are placed in the Rack
 Mounting Frame. The Rack Mounting Frame is then
 fastened to the rack frame.

2-13 Rack Mounting
 2-12 Figure 2-1 illustrates the outline shape and
 dimensions of Models 6211C through 6218C.
 2-11 Outline Diagram

2-10 This instrument 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 55° C.

2-9 Location
 2-8 The instrument is shipped ready for bench opera-
 tion. It is necessary only to connect the instrument to
 a source of power and it is ready operation.

2-7 INSTALLATION DATA

2-6 The instrument should be checked against its
 electrical specifications. Section V includes an "in-
 cabinet" performance check to verify proper instrument
 operation.

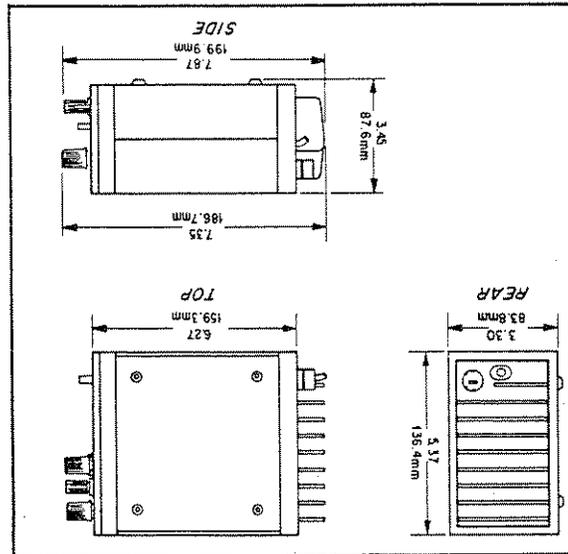
2-5 Electrical Check

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.

2-2 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 pack-
 ing materials until the inspection is completed. If damage
 is found, file claim with carrier immediately. Hewlett-
 Packard Sales and Service office should be notified as
 soon as possible.

2-1 INITIAL INSPECTION

Figure 2-1. Outline Diagram



Section II
 INSTALLATION

2-15 INPUT POWER REQUIREMENTS

2-16 This power supply may be operated continuously from either a nominal 115 volt or 230 volt 50-400 Hz power source. The unit as shipped from the factory, is wired for 115 volt operation. The input power required when operated from a 115 volt power source at full load is:

Model	Input Current	Input Power
6212C	0.29A	28W
6214C	0.29A	28W
6217C	0.25A	26W
6218C	0.25A	26W

2-17 Connections for 230 Volt Operation (Figure 2-3)

2-18 Normally, the two primary windings of the input transformer are connected in parallel for operation from 115 volt source. To convert the power supply to operation from a 230 volt source, the power transformer windings are connected in series as follows:

- a. Unplug the line cord and remove the top cover as described in Paragraph 5-3.
- b. Remove the jumpers between taps 4-2 and 3-1. Solder a jumper between taps 3-2 on the input power transformer T1, see Figure 2-3.
- c. Replace existing fuse with 0.25 ampere, 250 volt fuse.
- d. Replace existing line cord plug with a standard 230 volt plug.

2-19 Power Cable

2-20 To protect operating personnel, the National Electrical Manufacturers Association (NEMA) recommends that the instrument panel and cabinet be grounded. This instrument is equipped with a three conductor power cable. The third conductor is the ground conduc-

tor 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.

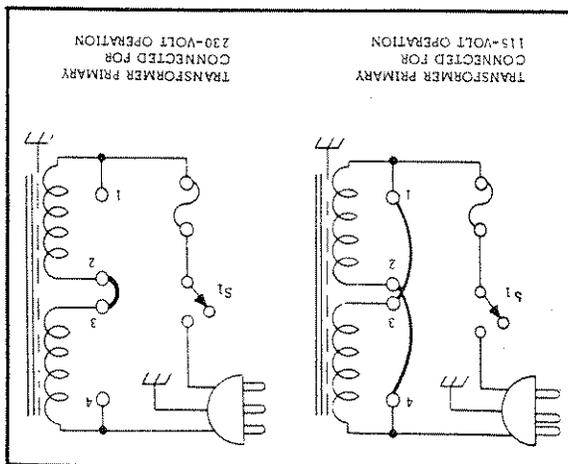


Figure 2-3. Input Power Transformer, Connections

2-21 To preserve the protection feature when operating the instrument from a two-contact outlet, use a three-prong to two-prong adapter and connect the green lead on the adapter to ground.

2-22 REPACKAGING FOR SHIPMENT

2-23 To insure safe shipment of the instrument, it is recommended that the package designed for the instrument be used. The original packaging material is reusable. If it is not available, contact your local Hewlett-Packard field office to obtain the materials. This office will also furnish the address of the nearest service office to which the instrument can be shipped. Be sure to attach a tag to the instrument which specifies the owner, model number, full serial number, and service required, or a brief description of the trouble.

Section III OPERATING INSTRUCTIONS

3-1 TURN-ON CHECKOUT PROCEDURE

3-2 The following checkout procedure describes the use of the front panel control and indicators illustrated in Figure 3-1 and ensures that the supply is operational:

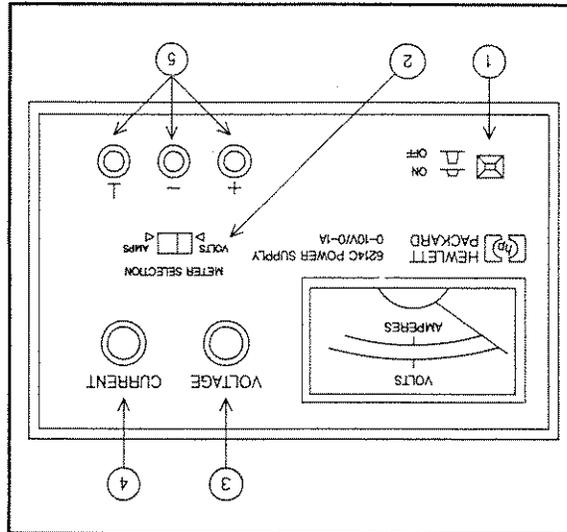


Figure 3-1. Front Panel Controls and Indicators.

- a. Push AC switch (1) in to on position.
- b. Set METER SELECTION switch (2) to VOLTS position.
- c. Turn VOLTAGE control (3) fully cw to ensure that output decreases to 0V, then the VOLTAGE control fully cw to ensure that output voltage increases to the maximum rated output voltage.
- d. Turn off and set METER SELECTION switch (2) to AMPS position and short circuit (+) and (-) output terminals.
- e. Turn off and turn the CURRENT control fully ccw and then fully cw to ensure that the output current reaches zero and maximum rated output.
- f. Remove short and connect load to output terminals.

3-3 OPERATION

3-4 The power supply can be operated as a single unit (normal operation), in parallel, or in series. The output of the supply can be floated up to 130 volts off ground.

3-5 Constant Voltage

- 3-6 To select a constant voltage output, proceed as follows:
 - a. Turn-on power supply and adjust VOLTAGE control for desired output voltage (output terminals open).

3-7 CONSTANT CURRENT

- b. With supply off short output terminals and adjust CURRENT control for maximum output current allowable (current limit), as determined by load conditions. If a load change causes the current limit to be exceeded, the power supply will automatically crossover to constant current output at the present current limit and the output voltage will drop proportionately. In setting the current limit, allowance must be made for high peak current which can cause unwanted cross-over. (Refer to paragraph 3-20).
- 3-8 To select a constant current output, proceed as follows:
 - a. With supply off short output terminals, turn on current.
 - b. Open output terminals and adjust VOLTAGE control for maximum output voltage allowable (voltage limit), as determined by load conditions. If a load change causes the voltage limit to be exceeded, the power supply will automatically crossover to constant voltage output at the preset voltage limit and the output current will drop proportionately. In setting the voltage limit, allowance must be made for high peak voltages which can cause unwanted crossover. (Refer to paragraph 3-20).

3-9 CONNECTING LOADS

- 3-10 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 shield is used, connect one end to power supply ground terminal and leave the other end unconnected.)

3-19 SPECIAL OPERATING CONSIDERATIONS

3-20 Pulse Loading
 3-21 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.

3-22 Output Capacitance

3-23 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.

3-24 Reverse Current Loading

3-25 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 cannot 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 device.

3-26 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. For example, in series operation of two supplies, if the AC is removed from one supply, the diode prevents damage to the unenergized supply which would otherwise result from a reverse polarity voltage.

3-27 Since series regulator transistors or driver transistors cannot withstand reverse voltage, another diode is connected across the series transistor. This diode protects the series transistors in parallel or Auto-Parallel operation if one supply of the parallel combination is turned on before the other.

3-11 If load considerations require that the output power distribution terminals be remotely located from the power supply, then the power supply output terminals should be connected to the remote distribution terminals via a pair of twisted or shielded wires and each load separately connected to the remote distribution terminals.

3-12 Operation of Supply Beyond Rated Output.

3-13 The shaded area on the front panel meter face indicates the amount of output voltage or current that is available in excess of the normal rated output. Although the supply can be operated in this shaded region without being damaged, it cannot be guaranteed to meet all of its performance specifications. However, if the line voltage is maintained above 115 Vac, the supply will probably operate within its specifications.

3-14 OPTIONAL OPERATING MODES

3-15 Series Operation

3-16 Normal Series Connections. These power supplies may be operated in series to obtain a higher voltage than available from a single supply as long as neither output terminal is floated more than 130 Vdc off ground measured at the front panel terminals. When this connection is used, the output voltage is the sum of the voltages of the individual supplies. Each of the individual supplies must be adjusted in order to obtain the total output voltage. The power supply contains a protective diode connected internally across the output which protects the supply if one power supply is turned off while its series partner(s) is on.

3-17 Parallel Operation

3-18 Two or more power supplies can be connected in parallel to obtain a total output current greater than that available from one power supply. The total output current is the sum of the output currents of the individual power supplies. The output of each power supply can be set separately. The output voltage controls of one power supply should be set to the desired output voltage; the other power supply should be set for a slightly larger output voltage. The supply set to the lower output voltage will act as a constant voltage source; the supply set to the higher output will act as a current limit source, dropping its output voltage until it equals that of the other supply. The constant voltage source will deliver only that fraction of its total rated output current which is necessary to fulfill the total current demand.