

SECTION I GENERAL INFORMATION

1-1 DESCRIPTION

1-2 This instruction manual contains operating and service instructions for four Hewlett-Packard precision power supplies. The four models (designated 6104A, 6105A, 6114A, and 6115A) are ideal for applications requiring an accurate, highly stable, and easily settable source of dc voltage or current. All models are completely solid-state and feature constant voltage/constant current operation, automatic dual-range operation, overvoltage crowbar protection, front-panel voltage and current metering, and provisions for remote voltage and current programming. In addition, all models are capable of auto-series, auto-parallel, and auto-tracking operation. Front-panel mounted controls allow current limit and overvoltage trip points to be conveniently set, while OVERVOLTAGE and CURRENT MODE light emitting diodes indicate when the corresponding condition is in effect.

1-3 Additional features and characteristics applicable to specific models are described in the following paragraphs. Section III of this manual covers the use of all controls and indicators and gives procedures for implementing the various operating modes.

1-4 MODELS 6104A and 6105A

1-5 These models employ individual voltage and current meters, and a 10-turn potentiometer for setting output voltage levels. With the exception of some component values and meter scale markings, the two models are physically identical. For improved settability, an optional three-digit decimal voltage control (option 013) is available.

1-6 Model 6104A Output Ratings. The Model 6104A can be operated in either of two ranges: 0 to 20V at 0 to 2A; or 20 to 40V at 0 to 1A. Automatic voltage range crossover occurs if the load current exceeds approximately 1A and the output voltage has been set above 20V.

1-7 The front panel CURRENT control allows the maximum output current to be set to any desired value from 0 amps up to the maximum current rating for the range. Using this control, the power supply can be operated as a constant current source with 0.01% current regulation. The front panel CURRENT MODE indicator lights when either the maximum (gross) current limit is reached, or when the current limit established by the front panel control is

reached. When the indicator is lighted, the output voltage is uncalibrated. However, the front panel voltmeter continues to indicate the output voltage with an accuracy of 2%.

1-8 Model 6105A Output Ratings. The Model 6105A can be operated in either of two ranges: 0 to 50V at 0 to 0.8A; or 50 to 100V at 0 to 0.4A. Automatic voltage range crossover occurs if the load current exceeds approximately 0.4A and the output voltage has been set above 50V.

1-9 The Model 6105A can also be used as a current source, as described in paragraph 1-7.

1-10 MODELS 6114A and 6115A

1-11 These models make use of a front-panel mounted four-digit pushbutton control to increase and decrease output voltage in unit steps. A thumbwheel control is used to set the fifth (or least significant) digit for output voltage accuracy in the fractional millivolt range. A single meter, combining both voltage and current functions, is also located on the front panel. A METER slide switch selects the function to be indicated on the meter. With the exception of some component values and meter scale markings, the 6114A and 6115A are physically identical.

1-12 Model 6114A Output Ratings. The Model 6114A can be operated in either of two ranges: 0 to 20V at 0 to 2A; or 20 to 40V at 0 to 1A. Automatic voltage range crossover occurs if the load current exceeds approximately 1A and the output voltage has been set above 20V.

1-13 The Model 6114A can also be used as a current source, as described in paragraph 1-7.

1-14 Model 6115A Output Ratings. The Model 6115A can be operated in either of two ranges: 0 to 50V at 0 to 0.8A; or 50 to 100V at 0 to 0.4A. Automatic voltage range crossover occurs if the load current exceeds approximately 0.4A and the output voltage has been set above 50V.

1-15 The Model 6115A can also be used as a current source, as described in paragraph 1-7.

1-16 SPECIFICATIONS

1-17 Detailed specifications for all four models are given in Table 1-1.

Table 1-1. Specifications, Models 6104A, 6105A, 6114A, 6115A

NOTE

Specifications apply to all models, unless otherwise indicated.

GENERAL

INPUT POWER:

104-127 Vac, 48-440Hz, 150VA maximum (Standard)
208-254 Vac, 48-440Hz, 150VA maximum (Switch Selected)

DC OUTPUT:

Single output, dual range with automatic cross-over between ranges.

Models 6104A & 6114A: 0-20V, 2A/20-40V, 1A

Models 6105A & 6115A: 0-50V, 0.8A/50-100V, 0.4A

METERS:

Models 6104A and 6105A: Individual voltage and current meters, with $\pm 2\%$ full scale accuracy.

Models 6114A and 6115A: Single, dual-function (voltage and current) meter, with $\pm 2\%$ full scale accuracy.

TEMPERATURE RATINGS:

Operating: 0 to 55°C. Storage: -40 to +75°C.

COOLING:

Convection cooling is employed. The supplies have no moving parts.

DIMENSIONS:

See outline diagram, Figure 2-1.

WEIGHT:

17 lbs. (7,7kg.) net. 21 lbs. (9,5kg.) shipping.

CONSTANT VOLTAGE OUTPUT

LOAD REGULATION:

For load current change equal to current rating of supply (measured at rear terminals).

Models 6104A & 6114A: 0.0005% + 100 μ V

Models 6105A & 6115A: 0.0005% + 50 μ V

LINE REGULATION:

For a $\pm 10\%$ change in line voltage from nominal value (115 Vac or 230 Vac).

Models 6104A & 6114A: 0.0005% + 40 μ V

Models 6105A & 6115A: 0.0005% + 100 μ V

RIPPLE AND NOISE:

40 μ Vrms/100 μ V p-p (up to 20MHz) at any line voltage and under any load condition within rating.

TEMPERATURE COEFFICIENT:

Output voltage change per degree Centigrade change in ambient following 30-minute warm up.

Model 6104A: 0.005% + 25 μ V

Model 6105A: 0.005% + 50 μ V

Model 6114A: 0.001% + 15 μ V

Model 6115A: 0.001% + 15 μ V

DRIFT:

Total voltage drift over 8-hour interval under constant line, load, and ambient following a 30-minute warm up. Conditions must be held constant during warm up.

Models 6104A & 6105A: 0.005% + 50 μ V **

Models 6114A & 6115A: 0.0015% + 15 μ V *

TRANSIENT RECOVERY TIME:

Less than 50 μ sec is required for output voltage recovery to within 10mV of the nominal output voltage following a change in output current equal to the current rating of the supply.

OUTPUT IMPEDANCE (typical):

Equivalent to a .05m Ω resistor in series with a 3 μ H inductor.

RESOLUTION:

Minimum output voltage change obtainable using front panel voltage controls.

Model 6104A: 8mV Model 6114A: 200 μ V

Model 6105A: 16mV Model 6115A: 200 μ V

OUTPUT VOLTAGE ACCURACY:

0.025%+1mV, at 23°C $\pm 3^\circ$ C, at any line vol. and load cur. within rating, after 5-min. warm up.

REMOTE RESISTANCE PROGRAMMING:

2000 Ω /V \pm 0.01% Programming Coefficient.

REMOTE VOLTAGE PROGRAMMING:

Programming Coefficient: 1V/V

Programming Accuracy: Accuracy of remote source, \pm 0.2mV

REMOTE PROGRAMMING SPEED:

The maximum time required to non-repetitively program from 0V to within 99.9% of the maximum rated output voltage (up programming), or from the maximum rated output voltage to within 0.1% of that voltage above 0V (down programming).

	6104A/6114A	6105A/6115A
up	60msec (no load)	150msec (no load)
prog.	30msec (full load)	75msec (full load)
down	600msec (no load)	1.5sec (no load)
prog.	30msec (full load)	75msec (full load)

Table 1-1. Specifications, Models 6104A, 6105A, 6114A, 6115A (continued)

<p>OVERVOLTAGE CROWBAR PROTECTION: Trip Voltage Range (approximate): 0.5V to 10% above rated output voltage of supply. Margin: Minimum 2% + 0.5V above output voltage to prevent false activation.</p> <p>DC OUTPUT ISOLATION: Supply may be floated at up to 300V above ground.</p> <hr/> <p style="text-align: center;">CONSTANT CURRENT OUTPUT</p> <hr/> <p>LOAD REGULATION: 0.01% + 500μA for load voltage change equal to the voltage rating of the supply.</p> <p>LINE REGULATION: For a $\pm 10\%$ change in line voltage from nominal value (115 Vac or 230 Vac). <u>Models 6104A & 6114A:</u> 0.005% + 40μA <u>Models 6105A & 6115A:</u> 0.005% + 20μA</p> <p>RIPPLE AND NOISE: 200μA rms/1mA p-p at any line voltage and under any load condition within rating.</p>	<p>TEMPERATURE COEFFICIENT: Output change per degree Centigrade change in ambient following 30-minute warm up. <u>Models 6104A & 6114A:</u> 0.02% + 50μA <u>Models 6105A & 6115A:</u> 0.02% + 25μA</p> <p>DRIFT: Total current drift in output over 8-hour interval under constant line, load, and ambient following 30-minute warm up. Conditions must be held constant during warm up. <u>Models 6104A & 6114A:</u> 0.25% + 7mA \ddagger <u>Models 6105A & 6115A:</u> 0.25% + 4mA \ddagger</p> <p>RESOLUTION: Minimum output current change obtainable using front panel current control. <u>Models 6104A & 6114A:</u> 15mA <u>Models 6105A & 6115A:</u> 8mA</p> <p>REMOTE RESISTANCE PROGRAMMING: <u>Models 6104A & 6114A:</u> 500Ω/A \pm 0.5% <u>Models 6105A & 6115A:</u> 1000Ω/A \pm 0.25%</p> <p>REMOTE VOLTAGE PROGRAMMING: <u>Models 6104A & 6114A:</u> 0.5V/A \pm 1% <u>Models 6105A & 6115A:</u> 1V/A \pm 1%</p>
<p>* Specified with final decade potentiometer set to zero. If potentiometer is set to value other than zero thermally induced resistance shifts may cause drift of 0.0015% + 200μV.</p> <p>** Potentiometer wiper jump effect may add 5mV (6104A) or 10mV (6105A). When remote programmed, drift is 0.001% + 15μV plus stability of remote programming device.</p> <p>\ddagger When remote programmed, drift is 0.25% + 500μA plus stability of remote programming device.</p>	

1-18 OPTIONS

1-19 Options are customer-requested factory modifications of a standard instrument. All of the options described below apply to Models 6104A and 6105A. All except option 013 apply to Models 6114A and 6115A.

<u>Option No.</u>	<u>Description</u>
008	<u>Ten-turn Output Current Control:</u> Replaces standard single-turn current control to allow greater resolution in setting the output current of supply.
013	<u>Three Digit Graduated Decadal Voltage Control:</u> Replaces standard 10-turn voltage control of Models 6104A and 6105A for improved output voltage settability.

<u>Option No.</u>	<u>Description</u>
014	<u>Three Digit Graduated Decadal Current Control:</u> Includes 10-turn control, replacing standard single-turn current control for greater resolution in setting the output current of supply.
040	<u>Interfacing for Multiprogrammer Operation:</u> Prepares standard HP power supplies for resistance programming by the 6940A Multiprogrammer or 6941A Multiprogrammer Extender. Operation with either of these instruments requires that the power supply be subjected to (1) Special Calibration, and (2) Protection Checkout. The former procedure insures that the power supply can be accurately set to zero and

the maximum rated output voltage or current when programmed by the Multiprogrammer; the latter procedure insures that the power supply will not be damaged by the rapid, repetitive programming possible with the Multiprogrammer.

1-20 ACCESSORIES

1-21 The accessories listed in the following chart may be ordered with the instrument or separately from your local Hewlett-Packard sales office (refer to list at rear of manual for addresses).

<u>HP Part No.</u>	<u>Description</u>
5060-8762	Dual Rack Adapter: Kit for rack mounting one or two supplies in standard 19-inch rack.
5060-8760	Blank Panel: Filler panel to block unused half of rack when mounting only one supply.
1052A	Combining Case for mounting one or two units in standard 19" rack.
5060-0789	Cooling kit for above combining case, 115Vac, 50-60Hz.
5060-0796	Cooling kit for above combining case, 230Vac, 50-60Hz.

1-22 INSTRUMENT IDENTIFICATION

1-23 Hewlett-Packard power supplies are identified by a three-part serial number. The first part is the power supply model number. The second part is the serial number prefix, consisting of a number-letter combination denoting the date of a significant design change and the country of manufacture. The first two digits indicate the year (12 = 1972, 13 = 1973, 20 = 1980, etc); the second two digits indicate the week (01 through 52); and the letter "A", "G", "J", or "U" designates the U.S.A., West Germany, Japan, or the United Kingdom, respectively, as the country of manufacture. The third part is the power supply serial number; a different 5-digit sequential number is assigned to each power supply, starting with 00101.

1-24 If the serial number prefix on your unit does not agree with the prefix on the title page of this manual, change sheets supplied with the manual or manual backdating changes in Appendix A define the differences between your instrument and the instrument described by this manual.

1-25 ORDERING ADDITIONAL MANUALS

1-26 One manual is shipped with each instrument. 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 part number shown on the title page.