HEWLETT hp PACKARD

PRECISION POWER SUPPLIES

MODELS 6104A, 6105A, 6114A, 6115A

TECHNICAL DATA JULY 1972

- **Low-Cost Calibrator**
- **Precision Lab Supply**
- **High Stability Reference**

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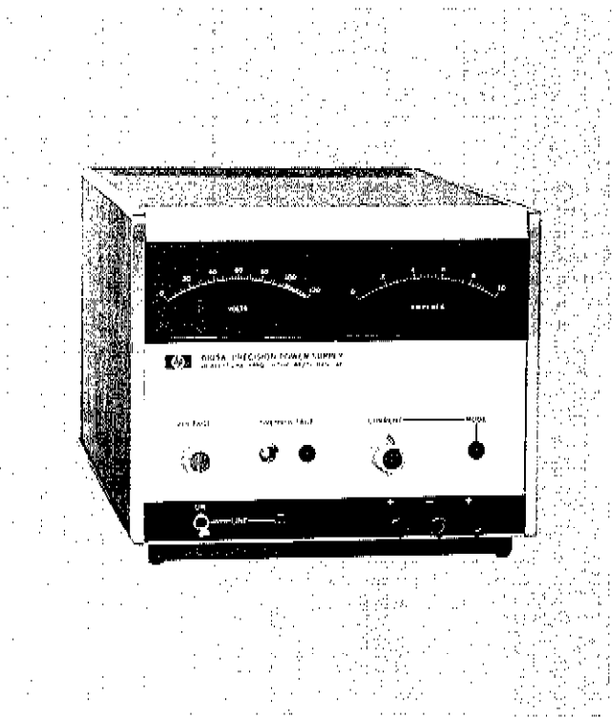
Output voltage accuracy of Models 6114A and 6115A is 0.025% (250ppm) plus 1mV — for example, at 40 volts output, the output voltage of Model 6114A is accurate within ±11mV. This accuracy is attained after only five minutes warmup, thus making these supplies especially suitable for application as portable calibrators.

Models 6104A and 6105A (illustrated below) are intended for applications where the supply is to be primarily remote programmed. The output voltage control on these units is a ten-turn potentiometer; an optional three-digit Decadial is available for improved resettability (Option 013).



Output Current Controls

A front-panel current control allows the maximum output current of these supplies to be set to any desired value within the maximum rating. Using this control, the supplies can be operated as constant current sources with 0.01% current regulation. A current mode indicator (a light-emitting diode) immediately lights when either the supply is operated in the gross current limit region, or the output current level established by the setting of the front panel control is reached. When the indicator is lighted, the output voltage is uncalibrated, but the front panel voltmeter continues to indicate the output voltage with an accuracy of 2%. An optional ten-turn current control with or without a three-digit Decadial is available for increased resolution and resettability (Options 014 and 008, respectively).

The output capacitor can be disconnected to reduce current surges, thereby improving the performance of the supply as a constant current source; this also increases programming speed by approximately one order of magnitude. (Note, however, that the supply may not be stable under all load conditions when the output capacitor is disconnected). This feature is also useful when a specific application requires local load decoupling.

Remote Programming

All four of these supplies can be remote programmed by means of an external voltage or resistance; when remote resistance programmed, output voltage accuracy is 0.01% plus the accuracy of the remote programming resistor, and output current accuracy is 0.25% plus the accuracy of the remote programming resistor. All four models can be also operated in auto-series, auto-parallel, and auto-tracking configurations.

For computer controlled applications, these supplies are designed to be digitally programmed with the HP Model 6940A Multiprogrammer or 6941A Multiprogrammer Extender. The table below indicates the Multiprogrammer output cards required.

Precision Power Supply	Voltage Programming Card	Current Programming Card*
6104A or 6214A	69305A	69312A
6105A or 6115A	69306A	69311A

*One current programming card can program the current outputs of two precision power supplies.

Output Metering

A single meter is provided on the supplies with pushbutton voltage controls; the meter can be switched to read either output voltage or output current. Separate output voltage and current meters are provided on the models with ten-turn voltage controls.

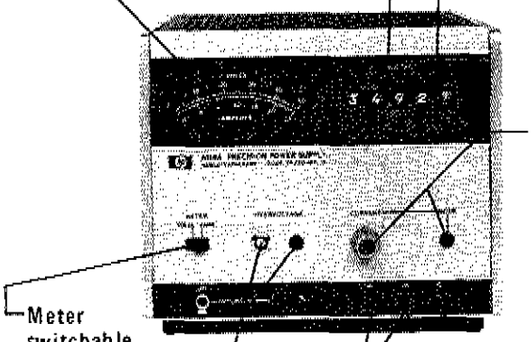
Overvoltage Protection

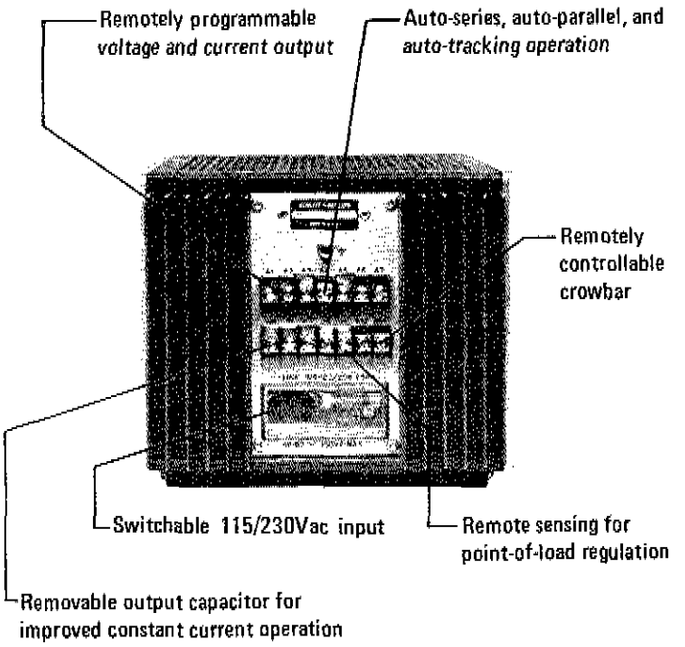
A built-in overvoltage protection circuit (an SCR crowbar) monitors the output and reduces the output voltage and current to zero whenever a preset voltage limit (adjustable from the front panel) is exceeded. This feature provides a convenient method of limiting the maximum output voltage supplied to voltage-sensitive loads.

A new circuit technique used in these supplies permits the output voltage to drop completely to zero once the overvoltage protection circuit has been triggered, rather than to only 1-3V as is typical with other SCR crowbars. This same circuit technique also permits the trip threshold to be set as low as 0.5V, thus providing load protection at very low output voltage levels.

Protection circuit operation is indicated by a light emitting diode located adjacent to the front panel overvoltage control. For systems applications, the overvoltage protection circuits in a group of supplies can be slaved.

Features


Automatic dual-range operation
4-digit pushbutton output voltage adjust
5th digit vernier with 200μV resolution
CV/CC operation with mode indicator
Meter switchable to volts or amps
0.025% output voltage accuracy (at front or rear terminals), available after 5-minute cold-start warm-up.
Overvoltage protection crowbar (with indicator) adjustable down to 0.5V

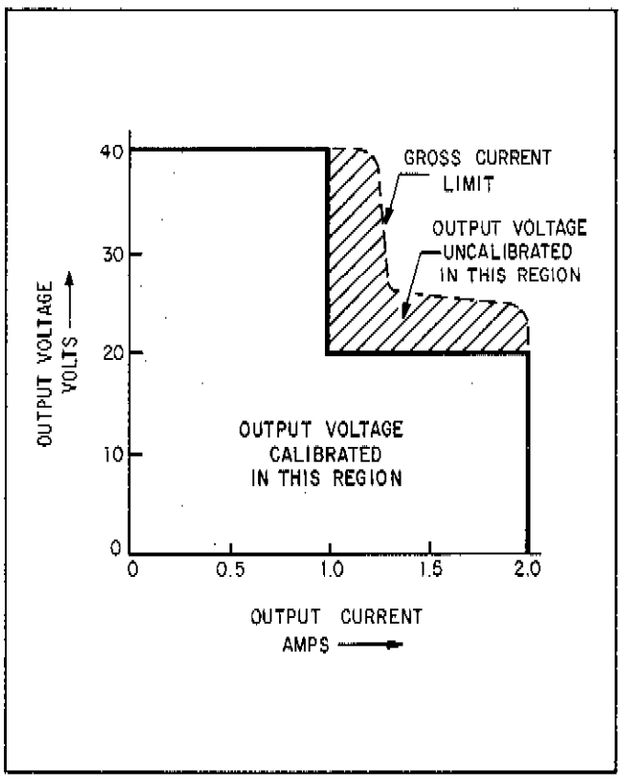

Remotely programmable voltage and current output
Auto-series, auto-parallel, and auto-tracking operation
Remotely controllable crowbar
Switchable 115/230Vac input
Remote sensing for point-of-load regulation
Removable output capacitor for improved constant current operation

Description

These four 40-watt precision power supplies are high-accuracy instruments designed for use as low cost calibrators, working voltage standards, systems reference supplies, or high-performance lab supplies. They are ideal for applications where an accurate, highly stable, easy-to-use source of dc voltage is required. Operating characteristics of these supplies are one or two orders of magnitude better than typical laboratory supplies.

Output Ratings

All four models feature automatic dual-range operation. For example, Models 6104A and 6114A can supply 0-20V at 0-2A, and 20-40V at 0-1A, without manual range switching. Automatic output current range crossover occurs when the supply is providing greater than one-half of the maximum rated output voltage. As shown in the sketch below, each supply will deliver full rated output current while operated in the lower half of the calibrated output voltage range, and one half the rated output current while operated in the upper half of the calibrated output voltage range.



Output Voltage Controls

Pushbutton voltage controls on Models 6114A and 6115A allow the output voltage to be set rapidly and accurately. The setting is displayed in large, easy-to-read numerals. A four-digit pushbutton switch increases or decreases the output voltage in unit steps, and the switches go directly from "9" to "0" without backing down. A fifth digit, set via a thumbwheel on the switch assembly, provides output voltage resolution of 200μV.

Specifications

			TEN-TURN VOLTAGE ADJUST		CALIBRATED PUSHBUTTON VOLTAGE ADJUST		TEN-TURN VOLTAGE ADJUST		CALIBRATED PUSHBUTTON VOLTAGE ADJUST	
RATING	DC Output: Voltage and current spans indicate range over which output may be varied using front panel controls.	Volts	0-20	20-40	0-20	20-40	0-50	50-100	0-50	50-100
		Amps	0-2.0	0-1.0	0-2.0	0-1.0	0-0.8	0-0.4	0-0.8	0-0.4
	Model		6104A		6114A		6105A		6115A	
PERFORMANCE	Load Regulation: Voltage Load Regulation is given for a load current change equal to the current rating of the supply, and is measured at the rear terminals. Current Load Regulation is given for a load voltage change equal to the voltage rating of the supply.	Voltage	0.0005% + 100μV		0.0005% + 100μV		0.0005% + 50μV		0.0005% + 50μV	
		Current	0.01% + 500μA		0.01% + 500μA		0.01% + 500μA		0.01% + 500μA	
	Line Regulation: For a change in line voltage between 104 and 127Vac or 208 and 254Vac at any output voltage and current within rating.	Voltage	0.0005% + 40μV		0.0005% + 40μV		0.0005% + 100μV		0.0005% + 100μV	
		Current	0.005% + 40μA		0.005% + 40μA		0.005% + 20μA		0.005% + 20μA	
	Ripple and Noise: Rms/p-p (20Hz to 20MHz), at any line voltage and under any load condition within rating.	Voltage	40μV/100μV ☆		40μV/100μV ☆		40μV/100μV ☆		40μV/100μV ☆	
		Current	200μA/1mA		200μA/1mA		200μA/1mA		200μA/1mA	
	Temperature Coefficient: Output change per degree Celsius change in ambient following 30 minutes warm-up.	Voltage	0.005% + 25μV		0.001% + 15μV		0.005% + 50μV		0.001% + 15μV	
		Current	0.02% + 50μA		0.02% + 50μA		0.02% + 25μA		0.02% + 25μA	
	Drift: Total drift in output (dc to 20Hz) over specified interval, under constant line, load, and ambient temperature, and following 30-minutes warm-up under same conditions.	Voltage, 8-hour	0.005% + 50μV †		0.0015% + 15μV *		0.005% + 50μV †		0.0015% + 15μV *	
		△ Voltage, 90-day	0.01% + 100μV †		0.0075% + 30μV *		0.01% + 100μV †		0.0075% + 30μV *	
		Current, 8-hour	0.25% + 7mA ‡		0.25% + 7mA ‡		0.25% + 4mA ‡		0.25% + 4mA ‡	
	Output Voltage Accuracy: Output voltage accuracy obtainable from the front panel controls at 23 ±3°C, at any line voltage and load current within rating, and following 5 minutes warm-up.		Not Applicable		0.025% + 1.0mV		Not Applicable		0.025% + 1.0mV	
	Resolution: Minimum output voltage or current change that can be obtained using front panel controls.	Voltage	8mV		200μV		16mV		200μV	
		Current	15mA		15mA		8mA		8mA	
	Output Impedance (Typical): Represented by a resistance in series with an inductance.		0.05mΩ + 3μH		0.05mΩ + 3μH		0.05mΩ + 3μH		0.05mΩ + 3μH	
	Load Transient Recovery: Time required for output voltage recovery to within the given level of the nominal output voltage following a change in output current equal to the current rating of the supply.	Time	<50μs		<50μs		<50μs		<50μs	
		Level	10mV		10mV		10mV		10mV	
FEATURES	Output Mode: Constant Voltage/Constant Current, or Constant Voltage/Current Limited.		CV/CC		CV/CC		CV/CC		CV/CC	
	Auto-Series, Auto-Parallel, and Auto-Tracking:		Yes		Yes		Yes		Yes	
	Remote Sensing:		Yes		Yes		Yes		Yes	
	Remote Programming: Resistance Programming Coefficient	Voltage	2000Ω/V ± 0.01%		2000Ω/V ± 0.01%		2000Ω/V ± 0.01%		2000Ω/V ± 0.01%	
		Current	500Ω/A ± 0.25%		500Ω/A ± 0.25%		1000Ω/A ± 0.25%		1000Ω/A ± 0.25%	
	Voltage Programming Coefficient	Voltage	1V/V §		1V/V §		1V/V §		1V/V §	
		Current	0.5V/A ± 1.0%		0.5V/A ± 1.0%		1V/A ± 1.0%		1V/A ± 1.0%	
	Speed: Maximum time required to non-repetitively program from zero to within 99.9% of the maximum rated output voltage, or from the maximum rated output voltage to within 0.1% of that voltage above zero.	Up Programming: No Load	60ms		60ms		150ms		150ms	
		Up Programming: Full Load	200ms		200ms		500ms		500ms	
		Down Programming: No Load	600ms		600ms		1.5s		1.5s	
		Down Programming: Full Load	100ms		100ms		175ms		175ms	
	Overvoltage Protection Crowbar: Trip Voltage Range: (approximate).		0.5V to 45V		0.5V to 45V		0.5V to 110V		0.5V to 110V	
	Margin: Minimum setting above output voltage to prevent false tripping.		2% + 0.5V		2% + 0.5V		2% + 0.5V		2% + 0.5V	
	DC Output Isolation: Supply may be floated at up to the given level above ground.		300V		300V		300V		300V	
	Meter Ranges: (Accuracy is specified as % of full scale.)		0-50V ± 2% Two 0-2.4A ± 2% Meters		0-50V ± 2% One 0-2.4A ± 2% Meter		0-120V ± 2% Two 0-1.0A ± 2% Meters		0-120V ± 2% One 0-1.0A ± 2% Meter	
GENERAL	Power:		104-127 or 208-254 Vac (switchable), 48-440Hz, 150VA max.		104-127 or 208-254 Vac (switchable), 48-440Hz, 150VA max.		104-127 or 208-254 Vac (switchable), 48-440Hz, 150VA max.		104-127 or 208-254 Vac (switchable), 48-440Hz, 150VA max.	
		Connections	3-Wire, 5-Ft. Cord		3-Wire, 5-Ft. Cord		3-Wire, 5-Ft. Cord		3-Wire, 5-Ft. Cord	
	Temperature Ratings: Operating 0 to 55°C. Storage -40 to +75°C.	Cooling	Convection		Convection		Convection		Convection	
	Overall Dimensions:	Inches	7¾W x 6½H x 13¼D		7¾W x 6½H x 13¼D		7¾W x 6½H x 13¼D		7¾W x 6½H x 13¼D	
		Millimeters	197W x 166H x 336D		197W x 166H x 336D		197W x 166H x 336D		197W x 166H x 336D	
	Weight:	Net	17 lbs; 7,7 kg.		17 lbs; 7,7 kg.		17 lbs; 7,7 kg.		17 lbs; 7,7 kg.	
		Shipping	21 lbs. 9,5 kg.		21 lbs. 9,5 kg.		21 lbs. 9,5 kg.		21 lbs. 9,5 kg.	
	Options Available: (For complete description, refer to page 4.)		008,013,014		008,014		008,013,014		008,014	

* Specified with final decade pot set to zero. If pot is set to value other than zero, pot wiper jump effect may cause drift of 0.0015% + 200μV (8-hour) or 0.0075% + 200μV (90-day).

† Pot wiper jump effect may add 5mV (6104A) or 10mV (6105A). When remote programmed, drift is 0.001% + 15μV (8-hour) or 0.0075% + 30μV (90-day) plus stability of remote programming device.

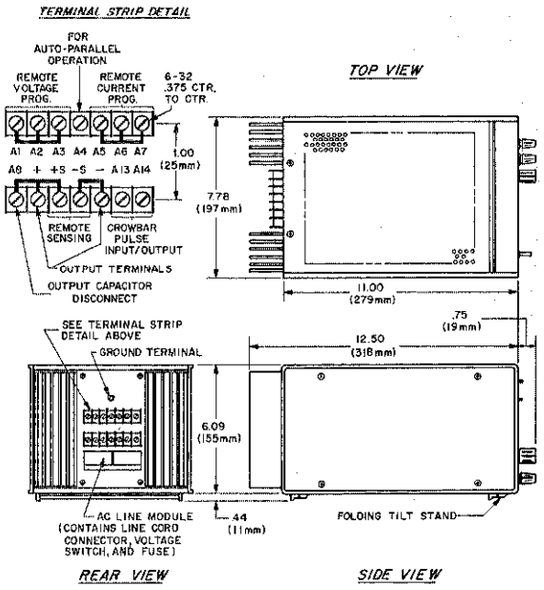
‡ When remote programmed, drift is 0.25% + 500μA plus stability of remote programming device.

^ Indicates tentative specification.

§ Accuracy is equal to accuracy of remote programming device ±200μV.

☆ When operated with a 400Hz input, peak-to-peak ripple and noise is 10mV.

Dimensions

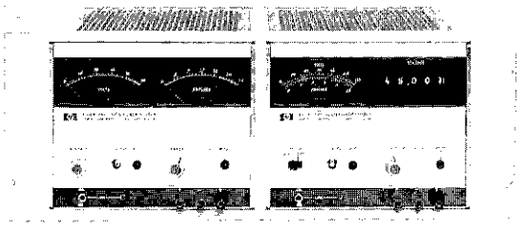


Options

No.	Description
008	Ten-turn output current control. Replaces the standard single-turn current control to allow greater resolution in setting the output current of the supply.
013	Three-digit graduated decadial voltage control. Attaches to the standard ten-turn voltage control of Models 6104A and 6105A; allows accurate resetting of the output voltage.
014	Three digit graduated decadial current control. Includes a ten-turn control replacing the standard single-turn current control; allows both greater resolution and accurate resetting of the output current.

Accessories

Rack Adapter Frame, HP Part No. 5060-8762: For permanently or semi-permanently mounting one or two Precision Power Supplies in a standard 19-inch rack.



Blank Panel, HP Part No. 5060-8760: Filler panel for blocking unused half of rack frame (or combining case below) when rack mounting only one Precision Power Supply.

Carrying Handle, Model 11057A: Easily attached handle for added portability and handling convenience.

Combining Case, Model 1052A: For mounting one or two Precision Power Supplies in a standard 19-inch rack where quick and easy removal and reinstallation of instruments is desirable. A cooling kit (listed below) must be installed at the rear of the combining case when one or two Precision Power Supplies are operated in the case.

Combining Case Cooling Kit, HP Part No. 5060-0789: For 115Vac, 50-60Hz input.

Combining Case Cooling Kit, HP Part No. 5060-0796: For 230Vac, 50-60Hz input.

Prices*

Precision Power Supplies:

6104A	$440.
6105A	$455.
6114A	$525.
6115A	$540.

Options:

008, Ten-turn Output Current Control	$25.
013, Three Digit Graduated Decadial Voltage Control	$35.
014, Three Digit Graduated Decadial Current Control	$60.

Accessories:

Rack Adapter Frame, HP Part No. 5060-8762	$25.
Blank Panel, HP Part No. 5060-8760	$7.
Carrying Handle, Model 11057A	$5.
Combining Case, Model 1052A	$150.
Combining Case Cooling Kit (115Vac), HP Part No. 5060-0789	$35.
Combining Case Cooling Kit (230Vac), HP Part No. 5060-0796	$36.50

* Prices apply to domestic U.S.A. customers only. For price information in other countries, contact your local HP Field Engineer.

For more information, call your local HP Sales Office or East (201) 265-5000 • Midwest (312) 677-0400 • South (404) 436-6181 • West (213) 877-1282. Or, write: Hewlett-Packard, 1501 Page Mill Road, Palo Alto, California 94304. In Europe, Post Office Box 85, CH-1217 Meyrin 2, Geneva, Switzerland. In Japan, YHP, 1-59-1, Yoyogi, Shibuya-Ku, Tokyo, 151.

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