OPS group IX

MODEL	d-c OUTPUT RANGE VOLTS	AMPS	OUTPUT IMPEDANCE VOLTAGE MODE dc OHMS + SERIES L	CURRENT MODE d-c OHMS ‖ SHUNT C		SHIP WGT. lbs.	kg.
OPS 500	0–500	0–0.04	2.2 Ω + 10 mH	50 MΩ + 0.04 μF		19	8.6
OPS 1000	0–1000	0–0.02	9.0 Ω + 10 mH	100 MΩ + 0.02 μF		19	8.6
OPS 2000	0–2000	0–0.01	34.0 Ω + 10 mH	200 MΩ + 0.01 μF		19	8.6

Kepco operational power supplies are a unique concept in power instrumentation. They are d-c power supplies, fully able to stabilize a voltage or current against the effects of load, source or temperature changes, yet able to respond with agility to programming signals requiring swift changes in the output.

The OPS–IX is a bench/system, rack-type, high-voltage instrument, with a single, uncommitted control channel. The OPS–IX uses a hybrid circuit with transistors in the small signal function and a vacuum tube controlling the output voltage. The panel is configured for patch board access to the control functions. See also Kepco's BHK Design in the *High Voltage* section of this catalog.

NOTE: OPS Models are *not* general purpose power supplies. Please see the preface to this section for a discussion of their limits.

INFLUENCE QUANTITY		VOLTAGE CONTROL CHANNEL OFFSET VOLTAGE ΔE_{io}	OFFSET CURRENT ΔI_{io}	CURRENT CONTROL CHANNEL OUTPUT EFFECTS	REFERENCE ±6.2V ±5% NOMINAL
SOURCE: 105–125/210–250V a-c		<0.1 mV	<10 nA	<10 μA	<0.0005%
LOAD: No load – full load		<1.0 mV(1)	<10 nA	<10 μA	–
TIME: 8-hours [drift]		<0.1 mV	<100 nA	<0.01% I_o max.	<0.005%
TEMPERATURE: Per °C		<0.5 mV	<100 nA	<0.01% I_o max.	<0.005%
UNPROGRAMMED OUTPUT DEVIATION:(3) (Ripple and noise)	rms	<0.01% E_o — or 3 mV(2)		<50 μA	–
	p-p(4)	<0.05% E_o — or 15 mV(2)		<250 μA	–

(1) ΔE_{io} for load in current stabilization mode is ΔE_o/open-loop gain. ΔE_o is the compliance voltage change.
(2) Whichever is greater.
(3) One terminal must be grounded or connected so that common-mode current does not flow through the load or through a current-sensing resistor.
(4) 20 Hz to 10 MHz.

VOLTAGE CONTROL CHANNEL

OUTPUT RANGE: OPS–IX are full-range, operationally programmable power supplies. They can be programmed to any level within their rated range and be fully loaded at any output setting.

GAIN: The open-loop d-c gain is in excess of 0.5×10^6 volts/volt.

CONTROL/PROGRAMMING: A built-in, fixed feedback resistor (500 kΩ for OPS 500, 1 MΩ for OPS 1000 and 2 MΩ for OPS 2000) senses the voltage at the negative (-) output/sense terminal. A 0–1 milliampere control current connected to the input summing terminal programs the d-c output throughout the rated range. This current with respect to the plus (+) sense terminal, which is common, may be externally generated–as from a function generator–or may be derived from the built-in +6.2V reference. The internal feedback resistance can be easily disconnected so that feedback can be taken from another point to stabilize various physical phenomena (heat, speed, force, current, electrochemical action . . ., etc.).

OFFSETS: The equivalent offset voltage and current variations for OPS–IX are tabulated for the effect of source changes, load, temperature, and time. Calculate their effect on the output by the relationship:

$$\Delta E_o = \pm \Delta E_r (R_f/R_i) \pm \Delta E_{io} (1 + R_f/R_i) \pm \Delta I_{io} (R_f)$$

where R_f is the feedback resistor and R_i is the input resistor from the reference, E_r.

OFFSET NULLING: The initial or bias part of the voltage control channel's voltage offset (E_{io}) and offset current (I_{io}) can be nulled (zeroed) by built-in trimmers.

REFERENCES: A pair of ±6.2V ±5%, 1 milliampere references referred to the plus (+) output/sense terminal are provided for offsetting or biasing purposes.

REMOTE ERROR SENSING: Provision is made for a 4-terminal connection to a load, able to compensate for static voltage drops up to 0.5 volt per lead.

CURRENT CONTROL CHANNEL

Output current is controlled by a built-in current sensing and feedback circuit, compensated to account for the shunting effect of the voltage feedback circuit. The stabilization of this channel against the four major influences is tabulated.

OUTPUT RANGE: Current is controlled by a recessed trimmer accessible through the front panel. The range of this control is 2% I_o max to 100% I_o max. For a wider current control range, the voltage control channel may be connected so as to sample the drop across an external current-sensing resistor to obtain current feedback. Based on a 10-volt sample, control can be exercised from approximately 100 microamperes to the maximum output current.

DYNAMICS

MAXIMUM SLEWING RATE (the fastest rate of change that can be obtained by overdriving or forcing): More than 1 volt per μsec.

PROGRAMMING TIME CONSTANT: The programming time constant is controlled by the RC product of the selected feedback resistance and the selected feedback capacitance. The nominal feedback resistance is 1000 ohms per volt of output. The range of capacitance available internally is: 200 pF to 1900 pF.

FREQUENCY RESPONSE: The maximum output frequency is given by the expression: f max. $= 10^6/\pi E_{pp}$, where E_{pp} is the peak-to-peak modulation voltage. The -3 dB response is given by the programming time constant. ($f = 1/2\pi\tau$, $\tau = R_f C_f$).

VOLTAGE RECOVERY FOR A STEP-LOAD CURRENT: Voltage recovers as an exponential with a time constant less than 100 microseconds.

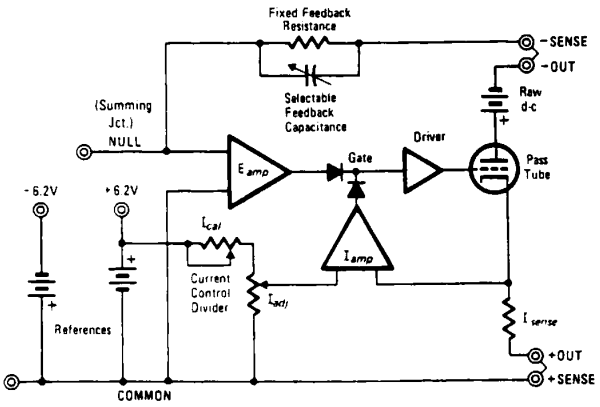
CURRENT RECOVERY FOR A STEP-LOAD VOLTAGE: The current recovery time constant is the same as the programming time constant or the ratio of current setting to the tabulated output capacitance, whichever is longer.

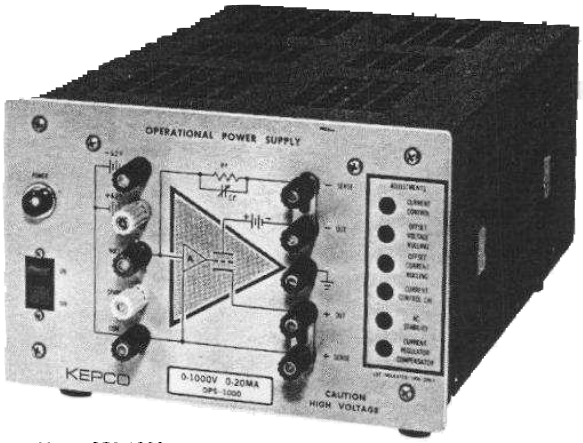
OUTPUT IMPEDANCE: Expressed as a function of frequency, the output impedance is a measure of dynamic stabilization. The d-c and low frequency value is given by the load effect. As a voltage stabilizer, the impedance increase above the stabilizer's cutoff frequency becomes asymptotic to a characteristic series inductance. As a current stabilizer, the impedance decrease above the stabilizer's cutoff frequency becomes asymptotic to a characteristic shunt capacitance. The model table gives these values for each OPS–IX model.

LOAD REACTANCE: Operational power supplies are restricted to capacitive loads no greater than 0.001 microfarad. Built-in rolloff control (lag) networks will allow the OPS to drive most cable or harness capacitances up to this limit. When driving inductive loads, diode protection is required for the back emf generated by a programmed di/dt.

TM

SIMPLIFIED SCHEMATIC DIAGRAM





Model OPS 1000

GENERAL

SOURCE POWER INPUT: Units are factory-wired for 105–125' a-c, 50–65 Hz. A simple jumper change will reconfigure the inpu for 210–250V a-c, 50–65 Hz. Power consumption approximatel 75 watts; power factor 0.9, protected by a built-in fuse. A 3-wir line cord is provided, terminated in plug Pattern No. 1. See pg. 111

ISOLATION FROM GROUND: The circuit and output terminal have no d-c connection to ground and may be floated up t 1000 volts (d-c or peak) off ground. The common mode curren from output to ground is less than 30 microamperes rms 300 microamperes peak-to-peak at 115V a-c, 60 Hz.

TEMPERATURE RATINGS

Storage: -40°C to +85°C.

Operating: -20°C to +65°C. Cooling is by natural convection. Full output current is delivered at +65°C; no derating or external heat sink is required.

STANDARDS: OPS–IX models are designed and tested in accord with the NEMA standard for stabilized power supplies, d-c output, Publication No. PY-1-1972.

TERMINALS: A front panel patch board of 10 binding posts provide access to the voltage control channel's summing input (null junction), the ±6.2V references, the two output connections and ground. They are arranged for ease in setting up operational manipulations. All connections are duplicated on a barrier-strip mounted at the rear.

MOUNTING: OPS Group IX models are "half-rack" sized for bench-top use or rack mounting in either the RA–24, or RA–32 hardware systems. Please refer to the *Hardware* section of this catalog for description.

Model RA–24 Rack Adapter Price: $25.00.
Model RA–32 Rack Adapter Price: $75.00
RA–24 and RA–32 are predrilled for Jonathan slides, type 110 QD 20-2, 22-2, 24-2.

DIMENSIONS

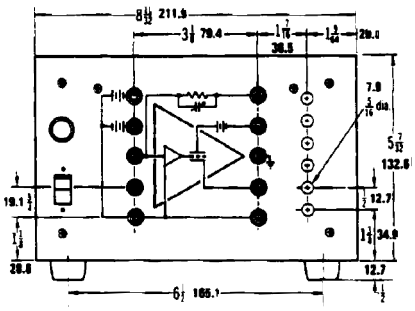
English measure: 5 3/32"H x 8 1/32"W x 12 7/8"D. (behind panel)
Metric measure: 132.6 H x 211.9 W x 327.0 D mm.
See outline drawings.

FINISH: *Panel:* Gray Color 26440, Fed. Std. 595.
Case: Textured dark charcoal gray.

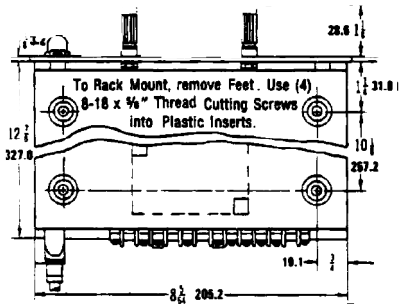
OUTLINE DIMENSIONAL DRAWINGS

Fractional dimensions in light face type are in inches, dimensions in bold face type are in millimeters.
Tolerance: ± 1/64" (0.4) between mounting holes.
± 1/32" (0.8) other dimensions.
Panels: Per Mil. Std. 189

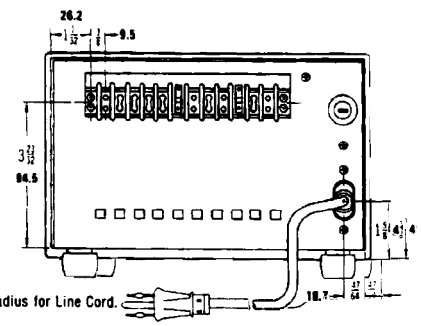
FRONT VIEW



BOTTOM VIEW



REAR VIEW



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