## DESIGN GROUP FEATURES CHART

<table>
<thead>
<tr>
<th>Feature</th>
<th>ABC 1000</th>
<th>ABC 1050</th>
<th>BKH</th>
<th>CDT</th>
<th>CK-HS</th>
<th>HB</th>
<th>KG</th>
<th>KO</th>
<th>OPE 12</th>
<th>PAR</th>
<th>PAX</th>
<th>PSX</th>
<th>PAX-67</th>
<th>PR</th>
<th>PRM</th>
<th>PRW</th>
<th>SM</th>
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<td>DC Voltage Regulation</td>
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This chart lists, briefly, the salient features and characteristics of the many different Kepco design groups. In general, each model within a group shares the characteristics of its group and may be identified by its outstanding features.
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INDEX BY OUTPUT VOLTAGE

This index is specially arranged to facilitate the selection of the proper power supply for every job. It complements the design group listings by grouping models according to their voltage swing. Thus, for example, it is easy to determine which groups have models in any desired voltage range — and then to examine their comparative specifications in detail.

DC OUTPUT VOLTS  | DC OUTPUT AMPS  | MODEL  | PAGE
0-2                | 0-1              | ABC 2-1M | 6
0-2                | 0-8              | CK 2-8M  | 10
4-5/4              | 0-11             | PAR-4    | 17
4-5/4              | 0-14             | PWR 4-14 | 23
Dual 4.5           | 0-20             | PRM 2X4.5-20 | 24-25
6.3                | 0-15             | PRM 6-15 | 24-25
Dual 6.3           | 0-20             | PRM 2X6-20 | 24-25
6.3                | 0-25             | PRM 6-25 | 24-25
0-7                | 0-1              | PAX 7-1  | 19
0-7                | 0-2              | PAT 7-2  | 18
0-7                | 0-2              | OPS 7-2  | 16
0-7                | 0-2              | OPS 7-2TA| 21
0-7                | 0-2              | PBX 7-2  | 20
0-7                | 0-2              | PBX 7-2MAT| 21
7-8/4              | 0-10             | PAR-7    | 17
7-8/4              | 0-11             | PRM 7-11 | 23
0-7.5              | 0-2              | ABC 7.5-2M | 6
0-8                | 0-5              | CK 8-5M  | 10
0-8                | 0-5              | CK8-5MHS | 11
0-8                | 0-15             | KS 8-15M | 15
0-8                | 0-25             | KS 8-25M | 15
0-8                | 0-50             | KS 8-50M | 15
0-8                | 0-100            | KS 8-100M| 15
0-10               | 0-7.75           | ABC 10-0.75M | 6
0-12               | 0-100            | KO 12-100M | 14
12-15/4            | 0-7              | PAR-12   | 17
12-15/4            | 0-7              | PWR 12-7 | 23
12                 | 0-10             | PRM 12-10 | 24-25
Dual 12            | 0-12             | PRM 2X12-12 | 24-25
12                 | 0-15             | PRM 12-15 | 24-25
12                 | 0-15             | PRM 12-15F | 24-25
0-14               | 0-7              | SM 14-7AM | 26
0-14               | 0-15             | SM 14-15AM | 26
0-14               | 0-30             | SM 14-30AM | 26
0-15               | 0-7.75           | PAX 15-0.75M | 19
0-15               | 0-1              | ABC 15-1M | 6
0-15               | 0-1.5            | CDT 15-1.5M | 9
0-15               | 0-1.5            | OPS 15-1.5 | 16
0-15               | 0-1.5            | OPS 15-1.5TA| 21
0-15               | 0-1.5            | PAT 15-1.5 | 18
0-15               | 0-1.5            | PBX 15-1.5 | 20
0-15               | 0-1.5            | PBX 15-1.5MAT | 21
15-15/4            | 0-6              | PAR-15   | 17
15-15/4            | 0-6              | PWR 15-6 | 23
0-7.5-15           | 0-10             | PR 15-10M | 22
0-15               | 0-30             | PR 15-30M | 22
Dual 15            | 0-10             | PRM 2X5-10 | 24-25
0-18               | 0-0.5            | ABC 18-0.5M | 6
0-18               | 0-3              | CK 18-3M | 10
ORDERING INFORMATION:

Power supplies are identified by a multipart model number, usually comprising a letter group prefix (identifying the design), a series of numbers that specify the model, and various suffix letters that define the options, meters, control locks, etc. Please use the full Kepco model number when ordering — even if local specification control numbers are assigned by your organization.

Most models are maintained in stock for delivery within two (2) days. Out-of-stock items are usually deliverable within thirty (30) days. Check with your local sales representative, who receives weekly stock reports.

Shipment may be made via motor freight or UPS, at your option. Liaison is also maintained with all New York airports and piers.

WARRANTY:

All Kepco products are backed by a firm one (1) year warranty, covering all parts and labor. The warranty is honored at our factory service department, Flushing, New York, and at field service depots maintained at strategic cities. Service may also be obtained through Kepco’s factory-trained field representatives whose addresses are listed on page 47 of this catalog.

PARTS:

Maintenance parts may be obtained through the field representative or from Kepco directly. When ordering parts, please use the identifying Kepco part number, and give the model and serial number of the instrument for which they are intended. Do not return any parts to Kepco unless authorization tags and instructions are provided.

COMMUNICATIONS:

Address all mail to:
Kepco, Inc., 131-38 Sanford Avenue, Flushing, N.Y. 11352
Telephone: 212-461-7000
TWX Number: 710-582-2631
Telex: 15-6055
Cable Address: KEPCOPOWER NEW YORK

APPLICATIONS ASSISTANCE:

Questions concerning the facilities, features, behavior, and characteristics of any product may be directed to the Kepco Applications Engineering Department. A staff of specialists is happy to provide any assistance in the application of Kepco’s Power Supplies to your requirements.

KEPCO LITERATURE

This catalog is one of a number of Kepco publications designed to assist you in the selection and application of Regulated Power Supplies. Kepco publications include: “Kepco Power Supply Handbook”, reprints of current technical papers and a quarterly newspaper, the Kepco Power Supply News.

KEPCO POWER SUPPLY HANDBOOK

The Handbook covers the subject of Regulated DC Power Supplies in detail with particular emphasis on the operational concept, and its application to systems design.

TECHNICAL PAPERS

Kepco’s engineers are continuously engaged in a research effort to extend the dimensions of the Power Supply art. Their work is regularly published and reprints are available to interested Power Supply users.

KEPCO POWER SUPPLY NEWS

A technical journal published quarterly with articles and news stories reporting developments in the Power Supply field.

For a complimentary copy of the “Kepco Power Supply Handbook”, reprints of technical papers, or a subscription to the Kepco Power Supply News, write: Publications Manager, KEPCO, INC., Dept. 678
131-38 Sanford Ave., Flushing, N.Y. 11352

Copies of these Kepco publications are also available through Kepco’s field representatives.
KEPCO
ALL-TRANSISTOR
POWER SUPPLIES

- voltage and current regulation
- 10-turn voltage control
- operationally programmable

![KEPCO Power Supplies Diagram](image)

<table>
<thead>
<tr>
<th>MODEL</th>
<th>DC OUTPUT RANGE</th>
<th>RIPPLE IMPEDANCE</th>
<th>CURRENT MODE SPECIFICATION VOLTAGE MODE (External Sensing)</th>
<th>OVERSHOOT: (Turn-on/off): None above 25% voltage setting. Negligible below 25% when preloaded to 10% minimum. SERIES/PARALLEL: Series operation to rated isolation; also master/slave capability. Current limiting design permits self-determined parallel load sharing.</th>
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<tbody>
<tr>
<td>ABC 2-1M</td>
<td>0-2</td>
<td>0.25</td>
<td>&lt;0.05% or 1 mV**</td>
<td>&lt;0.05% or 1 mV max.</td>
</tr>
<tr>
<td>ABC 7.5-2M</td>
<td>0-7.5</td>
<td>0.25</td>
<td>&lt;0.05% or 1 mV**</td>
<td>&lt;0.05% or 1 mV max.</td>
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<td>ABC 10-0.75M</td>
<td>0-10</td>
<td>0.25</td>
<td>&lt;0.05% or 1 mV**</td>
<td>&lt;0.05% or 1 mV max.</td>
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<td>ABC 15-1M</td>
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<td>0.25</td>
<td>&lt;0.05% or 1 mV**</td>
<td>&lt;0.05% or 1 mV max.</td>
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<tr>
<td>ABC 18-0.5M</td>
<td>0-18</td>
<td>0.25</td>
<td>&lt;0.05% or 1 mV**</td>
<td>&lt;0.05% or 1 mV max.</td>
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<td>ABC 30-0.3M</td>
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<td>&lt;0.05% or 1 mV**</td>
<td>&lt;0.05% or 1 mV max.</td>
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<tr>
<td>ABC 40-0.5M</td>
<td>0-40</td>
<td>0.25</td>
<td>&lt;0.05% or 1 mV**</td>
<td>&lt;0.05% or 1 mV max.</td>
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*whatever is greater
**-Rated sample is 1V DC across external current sampling resistor, with external current control.

INPUT: 105-125V AC or 210-250V AC (selected), 50-60 cps, single phase.
TEMPERATURE, AMBIENT OPERATING: -20°C to +50°C.
TEMPERATURE, STORAGE: -40°C to +85°C.
COOLING: Convection.
ISOLATION VOLTAGE: 500 volts to chassis.
CONTROL RESOLUTION: 0.05%, 10-turn voltage control.
PROGRAMMING: 1 mA control current, by resistance at 1000 ohms per volt. May be controlled operationally as an amplifier using voltage or current signals; common negative.
VOLTAGE RECOVERY: (for step load current): <50 micro-seCONDS.
CURRENT LIMITING: Single turn panel adjustment sets limit from 25% to 150% of rated full current.
REMOTE ERROR SENSING: Compensates up to 0.5V drop per output lead.

All terms used in the specifications are defined in the Kepco Glossary on Page 33.

Data subject to change without notice.
PATENT NOTICE: Applicable Patent Nos. will be supplied on request.
POWER SUPPLIES

- hybrid tube/transistor regulator
- voltage and current regulation
- 10-turn voltage control
- operationally programmable

### HYBRID MODEL ABC 2500M

**DC OUTPUT RANGE**

<table>
<thead>
<tr>
<th>Model</th>
<th>DC Output Range</th>
<th>Ripple (max.)</th>
<th>Output Impedance</th>
<th>Max Input Amps</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABC 200M</td>
<td>0-200 to 0-100</td>
<td>0.5 mA</td>
<td>10 kΩ + 100 μH</td>
<td>0.3 A</td>
</tr>
<tr>
<td>ABC 425M</td>
<td>0-425 to 0-50</td>
<td>0.5 mA</td>
<td>10 kΩ + 100 μH</td>
<td>0.5 A</td>
</tr>
<tr>
<td>ABC 1000M</td>
<td>0-1000 to 0-100</td>
<td>1.0 mA</td>
<td>10 kΩ + 100 μH</td>
<td>1.0 A</td>
</tr>
<tr>
<td>ABC 1500M</td>
<td>0-1500 to 0-10</td>
<td>1.0 mA</td>
<td>10 kΩ + 100 μH</td>
<td>1.0 A</td>
</tr>
<tr>
<td>ABC 2500M</td>
<td>0-2500 to 0-2</td>
<td>1.0 mA</td>
<td>10 kΩ + 100 μH</td>
<td>2.0 A</td>
</tr>
</tbody>
</table>

### SPECIFICATION

- **Output Range**: 0-100% of rated output
- **Ripple, RMS**: <0.05% or 5 mV
- **Regulation, Line**: <0.05% or 5 mV
- **Regulation, Load**: <0.05% or 5 mV
- **Stability (8 HR.)**: <0.05% or 5 mV
- **Ripple, rms.**: <0.05% per °C
- **Current Mode**: Single turn panel adjustment sets limit from 25% to 150% of rated full current on Models ABC 200M and ABC 425M. A fixed limit set to approximately 150% is provided on Models ABC 1000M, ABC 1500M and ABC 2500M.
- **Overshoot**: (Turn-on/off): None above 25% voltage setting; negligible below 25% when preloaded to 10% minimum.
- **Series/Parallel**: Series operation to rated isolation; also master/slave capability. Current limiting design permits self-determined parallel load sharing.

### INPUT

- 105-125V AC or 210-230V AC, selected, 50-440 cps single phase.

### TEMPERATURE

- Ambient Operating: -20°C to +65°C.
- Storage: -20°C to +85°C.

### COOLING

- Convection.

### ISOLATION VOLTAGE

- 1000 volts to chassis.

### AC OUTPUT

- 6.5V AC, 2A unregulated, available at the rear terminals of Models ABC 200M and ABC 425M.

### CONTROL RESOLUTION

- 0.05%, 10-turn voltage control on Models ABC 200M and ABC 425M. Resolution is 0.005%, with 10-position selector and 10-turn vernier voltage control on Models ABC 1000M, ABC 1500M and ABC 2500M.

### PROGRAMMING

- 1 mA control current, by resistance at 1000 ohms per volt. May be operationally controlled as an amplifier using voltage or current signals; common positive. Model ABC 2500M is restricted to the upper 1/3 of its output range in operational control. Fast slewing models available on special order.

### VOLTAGE RECOVERY

- For step load current: <50 μs, seconds.

### MOUNTING

- Bench style. Rack mounting adapter for single or dual mounting available. See Accessory pages.
**KEPCO**

**HIGH VOLTAGE POWER SUPPLIES**

- Fast slewing capability
- Operationally controlled
- Hybrid design
- 10-turn voltage and current controls

### DC OUTPUT RANGE

<table>
<thead>
<tr>
<th>MODEL</th>
<th>DC OUTPUT RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>BHK 500-0.4M</td>
<td>0-500 0-0.4</td>
</tr>
<tr>
<td>BHK 1000-0.2M</td>
<td>0-1000 0-0.2</td>
</tr>
<tr>
<td>BHK 2000-0.1M</td>
<td>0-2000 0-0.1</td>
</tr>
</tbody>
</table>

### OUTPUT IMPEDANCE

<table>
<thead>
<tr>
<th>MODEL</th>
<th>OUTPUT IMPEDANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>BHK 500-0.4M</td>
<td>DC 1000 ohms</td>
</tr>
<tr>
<td>BHK 1000-0.2M</td>
<td>DC 1000 ohms</td>
</tr>
<tr>
<td>BHK 2000-0.1M</td>
<td>DC 1000 ohms</td>
</tr>
</tbody>
</table>

### DC VOLTAGE GAIN

More than 100 db.

### OUTPUT SLEWING RATE

(Fast slewing connection): Greater than 500,000 volts per second (0.5V/μsec.), measured as the chord to the first time constant on the exponential response.

### SINUSOIDAL FREQUENCY RESPONSE

Fast Slewing Connection: $f_{max} = \frac{1}{4\pi gc}$

Ripple, Fast Slewing Connection:

- Ungrounded: More than 60 db below peak output.
- Grounded: More than 100 db below peak output.

### TRANSIENT RESPONSE

- Voltage Mode, Fast Slewing: For step load current, recovery is exponential with a 50 microsecond time constant.
- Voltage Mode, Normal Speed: For step load current, recovery to regulation band within 50 microseconds.

### OUTPUT IMPEDANCE

- Voltage Mode, Normal Speed: See table.
- Voltage Mode, Fast Slewing: Above 1 kc, add the reactive impedance of 500 microhenries.

### OFFSET NULLING

The initial part of the input offset voltage and input offset current can be nulled with internal controls.

### REFERENCES

Two: +6.2 volts and -6.2 volts; maximum current 1 milliamper.

### PROGRAMMING

1 mA control current, by resistance at 1000 ohms per volt. May be operationally controlled as an amplifier using voltage or current signals. Common positive.

### AUTOMATIC CROSSOVER

Selects voltage regulation or current regulation operating mode automatically.

### VIX® CIRCUIT

Voltage/Current mode indicators display operating conditions: also 115V AC control signal (0.5A max.).

### REMOTE ERROR SENSING

Compensates up to 0.5% drop per output lead.

### TEMPERATURE

- Ambient Operating: -20°C to +55°C.
- Temperature, Storage: -40°C to +85°C.

### COOLING

Convection.

### INPUT

- 105-125 V AC or 210-250V AC (selected), 50-65 cps single phase. Approximately 4 amperes at 125V AC.

### ISOLATION VOLTAGE

1000 volts to chassis.

### CONTROL RESOLUTION

Voltage: 0.01% 10-turn vernier control and 10 position selector. Current: 0.05% 10-turn control.

### OVERSHOOT

(Turn-on/off): None above 10% voltage setting; negligible below 10% when preloaded to 10% minimum.

### SERIES/PARALLEL

Automatic crossover design permits self-determined parallel load sharing, or use of master/slave connections. Series operation to rated isolation.

### METERS

Suffix "M" designates a pair of 2½%, 2 meters. Delete suffix "M" for unmetered unit.

### TERMINALS

Safety (recessed) output connections on front panel; two multi-terminal barrier strips at the rear contain output, sensing and control functions. Fast slewing/normal strapping is internal.

### DIMENSIONS

5¾"H x 19¾"W x 16¾"D (behind panel).

### FINISH

Per FED. STD. 595. Color 26440, (light gray).

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All terms used in the specifications are defined in the Kepco Glossary on page 33.

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**KEPCO**

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**Model BHK 1000-0.2M**
## Complementary Dual Tracking Power Supply

KEPCO CDT

- Complementary or series output
- Single control, adjustable tracking
- Voltage, current and error metering

**Complementary Dual Tracking Power Supplies**

- **IC-pc**, **CMC**, **COT**
- **Model**: COT 100-0.2 M
- **Series Output**: Single control, adjustable tracking voltage, current, and error metering

- **Each Power Supply** contains two sources with a common voltage control, may be used as complementary (plus and minus) supplies or in series for double voltage.

### Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>Twin Outputs*</th>
<th>Individual Supplies</th>
<th>Max. Input</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Complementary</td>
<td>Series</td>
<td>AMPS</td>
</tr>
<tr>
<td></td>
<td>VOLS</td>
<td>AMPS</td>
<td>VOLS</td>
</tr>
<tr>
<td>CDT 15-1.5M</td>
<td>0 to +E0 and 0 to -E0</td>
<td>0 to twice E0</td>
<td>0.001</td>
</tr>
<tr>
<td>CDT 40-0.5M</td>
<td>0 to +E0 and 0 to -E0</td>
<td>0 to twice E0</td>
<td>0.008</td>
</tr>
<tr>
<td>CDT 100-0.2M</td>
<td>0 to +E0 and 0 to -E0</td>
<td>0 to twice E0</td>
<td>0.05</td>
</tr>
</tbody>
</table>

*Each Power Supply contains two sources with a common voltage control, may be used as complementary (plus and minus) supplies or in series for double voltage.

### Voltage Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Voltage Mode</th>
<th>Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output Range</td>
<td>0 to +E0 and 0 to -E0</td>
<td>0 to twice E0</td>
</tr>
<tr>
<td>Regulation, Line</td>
<td>&lt;0.005%</td>
<td>&lt;0.005%</td>
</tr>
<tr>
<td>Regulation, Load</td>
<td>&lt;0.01% or 1 mV*</td>
<td>&lt;0.01% or 2 mV*</td>
</tr>
<tr>
<td>Stability (8 hr)</td>
<td>&lt;0.01% or 2 mV*</td>
<td>&lt;0.01% or 4 mV*</td>
</tr>
<tr>
<td>Temp. Coefficient</td>
<td>&lt;0.01% per °C</td>
<td>&lt;0.01% per °C</td>
</tr>
<tr>
<td>Ripple, rms</td>
<td>&lt;0.25 mV</td>
<td>&lt;0.5 mV</td>
</tr>
</tbody>
</table>

*Wherever is greater

**Specifications are for the individual supplies. Changes in the master supply (plus output) are repeated 1:1 in the slave supply.**

**INPUT**: 105-135 V AC or 210-250 V AC (selected) 50-440 cps.
**Temperature, Ambient Operating**: −20°C to +65°C.
**Temperature, Storage**: −40°C to +85°C.
**Cooling**: Convection.
**Isolation Voltage**: 500 volts to chassis.
**Output**: The individual power supplies are wired in series, controlled with a single voltage control. They may be loaded in series or separately.
**Control Resolution**: <0.005%, 10 turn voltage control adjusts the output of the positive supply, designated "master"; this voltage in turn controls the negative supply or "slave" in a 1:1 ratio. The two power supplies are connected in series.
**Tracking**: ±5% range of adjustment is controlled by a recessed front panel control. Units can be adjusted to within ±0.5% using panel meter. Closer adjustment with external instrumentation.
**Programming**: 1 milliampere control current, or resistance: 1000 ohms per volt. Common positive.

**Voltage Recovery** (for step load current): <50 milliseconds.

**Current Limiting**: Each supply is individually limited with a 10 to 105% range of adjustment.

**Remote Error Sensing**: Compensates for up to 0.5 volt drop per output lead.

**Meters**: Voltmeter monitors output of MASTER, or the difference between MASTER and SLAVE, displayed as a percentage error (range ±5%). Ammeter monitors current from either supply (selectable).

**Terminals**: Binding posts on the front panel for plus, common and minus outputs, also sensing terminals and separate ground. Barrier strip at the rear has duplicate output, sensing and control terminals.

**Dimensions**: 5½"H x 8½"W x 17¾"D (behind panel).

**Mounting**: Rack Adapters available, see accessory page.

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**Data subject to change without notice**

**Patent Notice**: Applicable Patent Nos. will be supplied on request.
AUTOMATIC CROSSOVER
POWER SUPPLIES

- VIX^ indicators, automatic crossover
- 10-turn voltage and current controls
- operationally programmable

<table>
<thead>
<tr>
<th>SPECIFICATION</th>
<th>VOLTAGE MODE</th>
<th>CURRENT MODE (Internal Sensing)</th>
<th>CURRENT MODE ** (External Sensing)</th>
</tr>
</thead>
<tbody>
<tr>
<td>OUTPUT RANGE</td>
<td>0–100V Eo max.</td>
<td>0.2%–100% Io max.</td>
<td>1 mA–100% Io max.</td>
</tr>
<tr>
<td>REGULATION, LINE</td>
<td>&lt;0.005% or 0.1 mV^</td>
<td>&lt;0.01% or 0.2 mA*</td>
<td>&lt;0.01% at rated sample**</td>
</tr>
<tr>
<td>REGULATION, LOAD</td>
<td>&lt;0.01% or 0.5 mV^</td>
<td>&lt;0.01% or 0.2 mA*</td>
<td>&lt;0.01% at rated sample**</td>
</tr>
<tr>
<td>STABILITY (8 HR.)</td>
<td>&lt;0.01% or 2.0 mV^</td>
<td>&lt;0.05% or 1 mA*</td>
<td>&lt;0.05% or 1 mA*</td>
</tr>
<tr>
<td>TEMP. COEFFICIENT</td>
<td>&lt;0.01% per °C</td>
<td>&lt;0.05% of Io max. per °C</td>
<td>&lt;0.05% per °C at rated sample**</td>
</tr>
<tr>
<td>RIPPLE, rms</td>
<td>&lt;0.5 mV</td>
<td>&lt;0.05% of output setting or 0.01% of Io max.*</td>
<td></td>
</tr>
</tbody>
</table>

REMOTE ERROR SENSING: Compensates up to 0.5V drop per output lead.
OVERSHOOT: (Turn-on/off): None above 25% voltage setting; negligible below 25% when preloaded to 10% minimum.
SERIES/PARALLEL: Automatic crossover design permits self-determined paralleled load-sharing; also master/slave capability. Series operation to rated isolation.
METERS: Suffix “M” designates a pair of 2V, 2% meters. Delete suffix for unmetered unit.
TERMINALS: Binding posts on front panel, plus, minus, and ground. Sixteen (16) terminal barrier strip on rear contains output, sensing and control terminals.
DIMENSIONS: 4¼” H x 8¾” W x 13” D (behind rack adapter), 13½” D (overall).
FINISH: Panel etched aluminum; case, gray hammertone.
MOUNTING: Bench style, single and dual rack mounting adapters available, see accessory pages.

All terms used in the specifications are defined in the Kepco Glossary on Page 32.

INPUT: 105-125V AC or 210-250V AC [selected], 50-65 cps, single phase.
TEMPERATURE, AMBIENT OPERATING: −30°C to +50°C
TEMPERATURE, STORAGE: −40°C to +85°C
ISOLATION VOLTAGE: 500 volts to chassis.
CONTROLS: Independent 10-turn controls for voltage and current. Resolution: 0.01%.
PROGRAMMING: 3 mA control current, by resistance at 1000 ohms per volt. May be operationally controlled as an amplifier, using voltage or current signals; common negative. Voltage and current regulators may be independently programmed.
VOLTAGE RECOVERY, (for step load current): 50 microseconds.
AUTOMATIC CROSSOVER: Selects voltage regulation or current regulation operating mode automatically.
VIX CIRCUIT: Mode indicators display operating condition, a +8V, +1 mA control signal is provided at rear terminals.

Data subject to change without notice.
PATENT NOTICE: Applicable Patent Nos. will be supplied on request.

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PATENT NOTICE: Applicable Patent Nos. will be supplied on request.
UNIPOLAR AMPLIFIER

POWER SUPPLIES

- fast slewing
- automatic crossover
- adjustable offsets

**DC VOLTAGE GAIN:** More than 80 db.

**OUTPUT SLEWING RATE:** >100,000 volts/second (0.1V/μsec.) measured as the slope of the chord to the first time constant on the exponential response.

**SINUSOIDAL FREQUENCY RESPONSE:** $f_{\text{max}} = \frac{32}{E_{\text{pp}}}$ kc.

**MAXIMUM CAPACITANCE LOADING:** 0.001 microfarads. Excess capacitance slows response and causes peaking of response and instability. Adjustable lag networks provide for small range of load reactance.

**RIPPLE:** Voltage Mode: 60 dB below peak output (grounded) Current Mode: 46 dB below peak output (grounded)

**TRANSIENT RESPONSE:** Voltage mode (for step load current) recovery is an exponential with a 50 microsecond time constant. Current Mode (for step load voltage) recovery is at the rate of 0.1 volts per microsecond.

**OUTPUT IMPEDANCE:** At DC $Z_o = \frac{\Delta E_o}{\Delta I_o}$; dynamically, add the reactive impedance of 5 millihenries.

**OFFSET NULLING:** The initial part of the input offset voltage and input offset current can be nulled with internal controls.

**REFERENCES:** Two; +6.2V and -6.2V; maximum current 1 mA.

**VIX® CIRCUIT:** Mode indicators display operating conditions, also produce a ±8V, ±1 mA control signal.

**REMOTE ERROR SENSING:** Compensates up to 0.5V drop per output lead.

**PROGRAMMING:** 1 mA control current by resistance at 1000 ohms per volt. May be operationally controlled as an amplifier using external voltage or current signals; common negative. INPUT: 105-125V AC or 210-250V AC (selectable), 50-65 cps single phase.

**TEMPERATURE, AMBIENT OPERATING:** -20°C to +50°C.

**COOLING:** Forced lateral circulation, built-in blower.

**ISOLATION VOLTAGE:** 500 volts to chassis.

**METERS:** Suffix "M" designates a pair of 2½, 2% meters. Delete the "M" from the suffix to specify an unmetered unit.

**TERMINALS:** Binding posts on front panel, plus, minus, and grounds.

**DIMENSIONS:** 4½"H x 8½"W x 13¾"D. Half-rack. Mounting accessories available, see accessory pages.

**FINISH:** Panel: brushed aluminum; Housing: gray hammer-tone.

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All terms used in the specifications are defined in the Kepec Glossary on page 33.

Data subject to change without notice. PATENT NOTICE: Available Patent Nos. will be supplied on request.
HB
HYBRID
POWER SUPPLIES

- hybrid tube/transistor regulator
- 5-position range, 10-turn voltage control
- operationally programmable

<table>
<thead>
<tr>
<th>SPECIFICATION</th>
<th>VOLTAGE MODE</th>
<th>CURRENT MODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>OUTPUT RANGE</td>
<td>0–100% of I₀, max.</td>
<td>10 mA–100% of I₀, max.</td>
</tr>
<tr>
<td>REGULATION, LINE</td>
<td>&lt;0.01%</td>
<td>&lt;0.01% at rated sample**</td>
</tr>
<tr>
<td>REGULATION, LOAD</td>
<td>&lt;0.01% or 2 mV*</td>
<td>&lt;0.01% at rated sample**</td>
</tr>
<tr>
<td>STABILITY (8 HR.)</td>
<td>&lt;0.01% or 2 mV*</td>
<td>&lt;0.005% or 0.2 mA*</td>
</tr>
<tr>
<td>TEMP. COEFFICIENT</td>
<td>&lt;0.01% per °C</td>
<td>&lt;0.005% per °C at rated sample**</td>
</tr>
<tr>
<td>RIPPLE, rms.</td>
<td>&lt;1 mV</td>
<td>&lt;0.011% of I₀, max.</td>
</tr>
</tbody>
</table>

**whichever is greater

**Rated sample is 10V DC across external current sampling resistor, with external current control.

INPUT: 105-125 V or 210-250V AC (selected), 50-440 cps, single phase
TEMPERATURE, AMBIENT OPERATING: -30°C to +55°C
TEMPERATURE STORAGE: -40°C to +85°C
COOLING: Convection
ISOLATION VOLTAGE: 600 volts to chassis.
AC OUTPUTS: Two unregulated, 6.5V AC, 6A outputs.
CONTROL RESOLUTION: 0.02%, 5 step range selector, 10-turn vernier.
PROGRAMMING: 10 mA control current, by resistance at 100 ohms per volt. May be operationally controlled as an amplifier using voltage or current signals; common positive.
VOLTAGE RECOVERY (for step load current): < 50 micro-seconds.
REMOTE ERROR SENSING: (Models HB 250M and HB 525M only) compensate up to 0.5 volt drop per output lead.
OVERSHOOT (Turn-on/off): None above 25% voltage setting; negligible below 25% when preloaded 10% minimum.
RATING CURVES: Output is designed to deliver 100% of rated current within the span of any one range. When operating outside the selected range, either by remote programming, or as the compliance voltage in current mode, use the graph to determine the maximum current that can be drawn at reduced voltage.

RATING CURVES
Curves represent the volt-ampere rating for range switch positions 1–6. To use, determine which position covers the desired voltage. Read the maximum current for each voltage on the left scale.

METERS: Suffix "M" designates a pair of 2½", 2½ meters. Delete suffix for unmetred unit.
TERMINALS: Binding posts on front panel, plus, minus and ground. Multi-terminal barrier strip at the rear contains output, sensing and control terminals.
DIMENSIONS: ½"H x 19"W x 14½"D (behind front panel).
MOUNTING: Rack or bench.

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Data subject to change without notice
PATENT NOTICE: Applicable Patent Nos. will be supplied on request.
KEPCO

ISOLATED

POWER SUPPLIES

- isolated from power line
- plug-in mount
- 10-turn voltage control

<table>
<thead>
<tr>
<th>MODEL</th>
<th>DC OUTPUT RANGE</th>
<th>OUTPUT IMPEDANCE</th>
<th>MAX INPUT AMPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>KG 25-0.2</td>
<td>0-25</td>
<td>0-0.2</td>
<td>0.006 + 0.01</td>
</tr>
<tr>
<td>KG 100-0.05</td>
<td>0-100</td>
<td>0-0.05</td>
<td>0.1 + 0.01</td>
</tr>
</tbody>
</table>

KG Modules have been especially isolated for minimum common mode signal and least ground coupling to the power line.

**SPECIFICATION**

**VOLTAGE MODE**

<table>
<thead>
<tr>
<th>SPECIFICATION</th>
<th>OUTPUT RANGE</th>
<th>REGULATION, LINE</th>
<th>REGULATION LOAD</th>
<th>STABILITY (8 HR.)</th>
<th>TEMP. COEFFICIENT</th>
<th>RIPPLE, rms.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0-100 %</td>
<td>&lt;0.001%</td>
<td>&lt;0.005% or 0.5 mV*</td>
<td>&lt;0.005% or 1 mV*</td>
<td>&lt;0.005% per C</td>
<td>&lt;0.1 mV</td>
</tr>
<tr>
<td></td>
<td>Eo max.</td>
<td>&lt;0.001%</td>
<td>&lt;0.001% at rated sample**</td>
<td>&lt;0.001% per C at rated sample**</td>
<td>&lt;0.001% per C</td>
<td>0.1 mV</td>
</tr>
<tr>
<td></td>
<td>1 mA-100 %</td>
<td>Iq max.</td>
<td>at rated sample**</td>
<td>at rated sample**</td>
<td>at rated sample**</td>
<td>0.1 mV</td>
</tr>
</tbody>
</table>

**CURRENT MODE**

(External Sensing)

<table>
<thead>
<tr>
<th>CURRENT MODE</th>
<th>OVERSHOOT (Turn-on/off): None above 25% voltage setting; negligible below 25% when preloaded to 10% minimum.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>SERIES/PARALLEL</strong>: Current limiting design permits self-determined parallel load-sharing. Series operation to rated isolation.</td>
</tr>
</tbody>
</table>

**INPUT**: 100-125 VAC, 50-60 cps, single phase.

**TEMPERATURE, AMBIENT OPERATING**: 0°C to +50°C.

**TEMPERATURE, STORAGE**: -40°C to +85°C.

**COOLING**: Convection.

**ISOLATION**: Volts: 500 volts to ground, maximum. Ohms: 10 K megohms to ground, minimum. Capacitance: 200 picofarads to ground, max. Leakage: 50 nA to ground, maximum.

**CONTROL RESOLUTION**: 0.05%, 10-turn voltage control, screwdriver adjustment, with lock.

**PROGRAMMING**: 1 mA control current, by resistance at 1000 ohms per volt.

**VOLTAGE RECOVERY**: (for step load current): < 50 microseconds.

**CURRENT LIMITING**: Recessed panel adjustment from 5% to 100% of rated current.

**OVERSHOOT**: None above 25% voltage setting; negligible below 25% when preloaded to 10% minimum.

**DIMENSIONS**: Panel: 2¾" x 5¾"; PC connector 1¾" behind panel. Single unit housing: (CA-2) 2¾" W x 5¾" H x 14" D includes mounted PC connector, PC-1. Multiunit housing: (RA-19-8) 19" W x 5¾" H x 14" D, includes 8 mounted PC connectors, PC-1.

**MOUNTING**: The unboxed KG Module has no mounting provisions. It must be plugged into either a single or multiunit housing for connections and support.

**FINISH**: Per FED. STD. 590. Color 26440, (light gray).

KEPCO, INC. • 131-38 SANFORD AVENUE • FLUSHING, N.Y. 11352
(212) 461-7000 • TWX # 710-582-2631
Telex 12-6055 • Cable: KEPCOPOWER NEW YORK
KEPCO
SCR
POWER SUPPLIES

- silicon controlled rectifier regulator
- 10-turn voltage and current controls
- automatic crossover

**POWER SUPPLIES**

- **silicon controlled rectifier regulator**
- **10-turn voltage and current controls**
- **automatic crossover**

**SPECIFICATION**

| SPECIFICATION     | VOLTAGE MODE                     | CURRENT MODE**
|-------------------|----------------------------------|---------------------------
| OUTPUT RANGE      | 0–100% Eq max.                  | 10%–100% + Iq max.       |
| REGULATION, LINE  | <1%                              | <2% or 200 mA*            |
| REGULATION, LOAD  | <1% or 20 mV*                    | <2% or 200 mA* **        |
| STABILITY (8 HR.) | <1% or 50 mV*                    | <2% or 200 mA*            |
| TEMP. COEFFICIENT | <0.1% per °C                     | <0.5% of Iq max. per °C   |
| RIPPLE, rms       | See Table                        | <0.5% of Iq max.          |

**VOLTAGE RECOVERY** (for step load current, 0-100% and 100%/100%): <500 milliseconds.

**TERMINALS:** Heavy duty output connectors at rear. A multi-terminal barrier strip contains sensing and control functions.

**DIMENSIONS:** 8½"H x 19"W x 20"D (behind panel). Side handles and skids removable for rack mounting.

**FUTHER:** For FED. STD. 595, Color 26440, (light gray).

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**TELEPHONE:** (212) 461-7000 • **TWX#** 710-582-2631

**TELEX:** 12-6055 • **CABLE:** KEPCOPW PK NEW YORK

**MODEL KO 45-30M**
# KEPCO KS

## AUTOMATIC CROSSOVER

**POWER SUPPLIES**

- VIX™ indicators, automatic crossover
- 10-turn voltage and current controls
- operationally programmable

### Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Voltage Mode</th>
<th>Current Mode (Internal Sensing)</th>
<th>Current Mode (External Sensing)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output Range</td>
<td></td>
<td>0-100% Eo max.</td>
<td>10 mA—100% Io max.</td>
</tr>
<tr>
<td>Regulation, Line</td>
<td>&lt;0.005%</td>
<td>&lt;0.01% or 1 mA*</td>
<td>&lt;0.01% at rated sample**</td>
</tr>
<tr>
<td>Regulation, Load</td>
<td>&lt;0.01% or 0.5 mV*</td>
<td>&lt;0.01% or 1 mA*</td>
<td>&lt;0.01% at rated sample**</td>
</tr>
<tr>
<td>Stability (8 HR.)</td>
<td>&lt;0.01% or 3 mV*</td>
<td>&lt;0.05% or 5 mA*</td>
<td>&lt;0.05% per °C at rated sample**</td>
</tr>
<tr>
<td>Temp. Coefficient</td>
<td>&lt;0.01% per °C</td>
<td>&lt;0.05% of Io max. per °C</td>
<td>&lt;0.05% per °C at rated sample**</td>
</tr>
<tr>
<td>Ripple, mV</td>
<td>&lt;1 mV</td>
<td>&lt;0.1% of setting or 0.05% of Io max.*</td>
<td></td>
</tr>
</tbody>
</table>

**Input:** 115±10%V AC or 230±15%V AC [selected] 50-65 cps, 10. Size D has additional 194±9%V AC and 286±18%V AC inputs.

**Temperature, Ambient Operating:** -20°C to +60°C

**Temperature, Storage:** -40°C to +85°C

**Cooling:** Forced air, lateral circulation. Built-in blower.

**Isolation Voltage:** 1000V DC across external current sensing resistor, with external current control.

**REMOTE ERROR SENSING:** Compensates up to 0.5V drop per output lead.

**OVERLOADS:** (Turn-on/off): None above 25% of voltage setting; negligible below 25% when preloaded to 100% minimum.

**Series/Parallel:** Automatic crossover design permits self-determined parallel load sharing; also master/slave capability. Series operation to rated isolation.

**Meters:** Suffix "M" designates a pair of 2½" 2½% meters.

**Dimensions:** See table for sizes. Removable side handles and skids included on D size.

**Finish:** Per FED. STD. 595. Color 24040, (light gray).

---

**MODEL KS 38-5M**

<table>
<thead>
<tr>
<th>Model</th>
<th>DC Output Range (V)</th>
<th>Output Impedance (Ω)</th>
<th>Max. Input (V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>KS 8-15</td>
<td>0-8</td>
<td>0-15</td>
<td>0.05 ±10</td>
</tr>
<tr>
<td>KS 8-35</td>
<td>0-8</td>
<td>0-35</td>
<td>0.05 ±10</td>
</tr>
<tr>
<td>KS 8-100</td>
<td>0-8</td>
<td>0-100</td>
<td>0.05 ±10</td>
</tr>
<tr>
<td>KS 18-15</td>
<td>0-18</td>
<td>0-15</td>
<td>0.10 ±10</td>
</tr>
<tr>
<td>KS 18-15</td>
<td>0-18</td>
<td>0-15</td>
<td>0.12 ±10</td>
</tr>
<tr>
<td>KS 18-35</td>
<td>0-18</td>
<td>0-35</td>
<td>0.12 ±10</td>
</tr>
<tr>
<td>KS 18-100</td>
<td>0-18</td>
<td>0-100</td>
<td>0.12 ±10</td>
</tr>
<tr>
<td>KS 36-5</td>
<td>0-36</td>
<td>0-5</td>
<td>0.10 ±10</td>
</tr>
<tr>
<td>KS 36-10</td>
<td>0-36</td>
<td>0-10</td>
<td>0.12 ±10</td>
</tr>
<tr>
<td>KS 36-10</td>
<td>0-36</td>
<td>0-10</td>
<td>0.12 ±10</td>
</tr>
<tr>
<td>KS 36-60</td>
<td>0-36</td>
<td>0-60</td>
<td>0.12 ±10</td>
</tr>
<tr>
<td>KS 60-10</td>
<td>0-60</td>
<td>0-10</td>
<td>0.12 ±10</td>
</tr>
<tr>
<td>KS 60-5</td>
<td>0-60</td>
<td>0-5</td>
<td>0.12 ±10</td>
</tr>
<tr>
<td>KS 60-15</td>
<td>0-60</td>
<td>0-15</td>
<td>0.12 ±10</td>
</tr>
<tr>
<td>KS 60-15</td>
<td>0-60</td>
<td>0-15</td>
<td>0.12 ±10</td>
</tr>
<tr>
<td>KS 120</td>
<td>0-120</td>
<td>0-5</td>
<td>0.12 ±10</td>
</tr>
<tr>
<td>KS 120-5M</td>
<td>0-120</td>
<td>0-5</td>
<td>0.12 ±10</td>
</tr>
<tr>
<td>KS 120-5M</td>
<td>0-120</td>
<td>0-5</td>
<td>0.12 ±10</td>
</tr>
<tr>
<td>KS 120-5M</td>
<td>0-120</td>
<td>0-5</td>
<td>0.12 ±10</td>
</tr>
</tbody>
</table>

**Dimensions:**

- **A:** 2½" 19 14½
- **B:** 5½" 19 16
- **C:** 7" 19 16
- **D:** 8½" 19 20

---

All terms used in the specifications are defined in the Kepco Glossary on Page 33.

Data subject to change without notice. Patent notice: Applicable Patent Nos. will be supplied on request.
KEPCO

OPERATIONAL

POWER SUPPLIES

- high gain dc amplifier
- high speed slewing
- offset voltage and current nulling

<table>
<thead>
<tr>
<th>Model</th>
<th>DC Output Range</th>
<th>Output Impedance</th>
<th>Common</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPS-1A</td>
<td>0–20 0–0.05</td>
<td>0.04 +15 Ω</td>
<td>Minus</td>
</tr>
<tr>
<td>OPS 7–2</td>
<td>0–7 0–2</td>
<td>0.0005 +15 Ω</td>
<td>Plus</td>
</tr>
<tr>
<td>OPS 16–1.5</td>
<td>0–15 0–1.5</td>
<td>0.001 +15 Ω</td>
<td>Plus</td>
</tr>
<tr>
<td>OPS 21–1</td>
<td>0–21 0–1</td>
<td>0.0025 +15 Ω</td>
<td>Plus</td>
</tr>
<tr>
<td>OPS 40–0.5</td>
<td>0–40 0–0.5</td>
<td>0.0068 +15 Ω</td>
<td>Plus</td>
</tr>
<tr>
<td>OPS 72–0.3</td>
<td>0–72 0–0.3</td>
<td>0.025 +15 Ω</td>
<td>Plus</td>
</tr>
<tr>
<td>OPS 100–0.2</td>
<td>0–100 0–0.2</td>
<td>0.050 +15 Ω</td>
<td>Plus</td>
</tr>
<tr>
<td>OPS-2000</td>
<td>0–2000 0–0.01</td>
<td>20.0 +25 Ω</td>
<td>Plus</td>
</tr>
</tbody>
</table>

**VOLTAGE AMPLIFIER OFFSETS**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Voltage Amplifier Offset</th>
<th>Output Current Offset</th>
<th>Offset Voltage</th>
<th>Offset Current</th>
<th>Offset Voltage</th>
<th>Offset Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>LINE: 105-125/210-250V AC</td>
<td>&lt;0.1 mV</td>
<td>&lt;10 nA</td>
<td>&lt;10 μA</td>
<td>&lt;0.01%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOAD: No load/full load</td>
<td>&lt;1.0 mV</td>
<td>&lt;10 nA</td>
<td>&lt;10 μA</td>
<td>&lt;0.01%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TIME: 1 μs (Stability)</td>
<td>&lt;0.1 mV</td>
<td>&lt;50 nA</td>
<td>&lt;0.07%</td>
<td>&lt;0.01%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TEMP: Per °C (Coefficient)</td>
<td>&lt;0.5 mV</td>
<td>&lt;10 nA</td>
<td>&lt;0.03%</td>
<td>&lt;0.01%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**OPERATIONAL AMPLIFIER SPECIFICATIONS**

- DC Voltage Gain: More than 80 dB.
- Output Slew Rate: >800,000 volts/second [80V/(V/μsec.)] measured at half the first time constant on the exponential response. Model OPS-2000. >1,000,000 volts/second. [1V/(V/sec)].
- Sinusoidal Frequency Response: $f_{\text{max}} = 160/E_{\text{pp}}$ kHz. Model OPS-2000: Maximum Frequency = 320/E_{\text{pp}}$ kHz.
- Ripple: >80 dB below peak output or 3 mV rms, whichever is greater.
- Maximum Capacitive Loading: 0.001 microfarads. Excess capacitance slows response and causes peaking of response and instability. Adjustable lag networks provide for small range of load reactance.
- Transient Response: Voltage Mode (for step load current) recovery is an exponential with 50 microsecond time constant. Current Mode (for step load voltage) recovery is at the rate of 0.5 volts per microsecond.
- Offset Nulling: Fixed part of input offset voltage and input offset currents can be nulled.
- References: Two at +6.2V and -6.2V; maximum 1 milliampere.
- Programming: May be controlled by external voltage or current signals, common positive (OPS-1A common negative).

Data subject to change without notice.

TEMPERATURE, AMBIENT OPERATING: -20°C to +60°C.
TEMPERATURE, STORAGE: -40°C to +85°C.
COOLING: Convection.
ISOLATION VOLTAGE: 500 volts to chassis.
CURRENT LIMITING: Adjustable from 10% to 110% of rated current. Model OPS-2000 is an automatic-crossover current regulator, see table for performance specifications.
TERMINALS: Connectors via a rear mounted barrier strip. Plug-in Modules include a PC connector. Bench models have front panel terminal pattern (OPS 1A front terminals only).
DIMENSIONS: Uncased: 21/2" H x 31/8" W x 12 3/4" D. D, Covered: (Suffix C) 2 5/8" H x 4 1/2" W x 13 5/8" D. Models OPS-1A and OPS-2000 are available in bench style case only. OPS-1A: 4 1/4" H x 8 1/4" W x 5 1/4" D. OPS-2000: 5 1/8" H x 8 3/4" W x 14 1/4" D.
MOUNTING AND ACCESSORIES: See accessory pages for choice of mounting panels and housings. OPS-TA: equipped with plug-in slide guide and panel with adjustments. OPS-CCM: equipped with plug-in slide guide and current regulator controls, voltmeter and ammeter.

*All terms used in the specifications are defined in the Kepco Glossary on Page 33.*
**KEPCO PAR MODULAR POWER SUPPLIES**

- overload current cutoff
- out-of-band programming
- precision regulator
- conventional transformer

### OUTPUT CURRENT @ ambient temp

| MODEL | Voltage | Current
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PAR-4</td>
<td>4 ± 5%</td>
<td>0.9 - 0.110</td>
</tr>
<tr>
<td>PAR-7</td>
<td>7 ± 5%</td>
<td>0.9 - 0.100</td>
</tr>
<tr>
<td>PAR-12</td>
<td>12 ± 5%</td>
<td>0.9 - 0.70</td>
</tr>
<tr>
<td>PAR-15</td>
<td>15 ± 5%</td>
<td>0.4 - 0.60</td>
</tr>
<tr>
<td>PAR-24</td>
<td>24 ± 5%</td>
<td>0.3 - 0.40</td>
</tr>
<tr>
<td>PAR-28</td>
<td>28 ± 5%</td>
<td>0.3 - 0.37</td>
</tr>
<tr>
<td>PAR-36</td>
<td>36 ± 5%</td>
<td>0.23 - 0.28</td>
</tr>
<tr>
<td>PAR-48</td>
<td>48 ± 5%</td>
<td>0.18 - 0.23</td>
</tr>
<tr>
<td>PAR-60</td>
<td>60 ± 5%</td>
<td>0.13 - 0.20</td>
</tr>
</tbody>
</table>

**INPUT:** 105-125V AC or 210-250V AC (selected), 50-400 cps single phase; approximately 2 amperes, 200 watts.

**TEMPERATURE, AMBIENT OPERATING:** Uncased: -20° to + 65°C maximum (see rating chart). Cased: -20°C to + 55°C maximum (see rating chart).

**TEMPERATURE, STORAGE:** -40°C to + 85°C.

**SERIES/PARALLEL:** Connections are provided for parallel operation of identical units.

**COOLING:** Convection.

**ISOLATION VOLTAGE:** 500 volts to chassis.

**OVERVOLTAGE PROTECTOR:** Provision is made for attachment of an optional crowbar overvoltage protector, type VP-PAR. See accessory listing for detailed description of protector.

**TERMINALS:** All input, output, sense and control connections are made via a single multiterminal barrier strip.

**VOLTAGE RECOVERY:** For step load current: <500 milliseconds.

**OVERLOAD CURRENT CUTOFF:** Adjusted cutoff locus points about the Eo = 0, Io = 5% point, reducing the output current into an overload. Note: Nonlinear loads drawing a high starting current may be locked out by the cutoff locus, and require a starting resistance to be contained within the shaded regions of the operating region graph.

**REMOTE ERROR SENSING:** Compares a 0.5 volt drop to output lead.

**OVERSHOOT:** (Turn-off): None in ±5% operating band. When output is set below 25%, load to approximately 10% for negligible overshoot.

**SERIES-PARALLEL:** Connections are provided for parallel operation of identical units. Series operation to rated isolation.

**TERMINALS:** All input, output, sense and control connections are made via a single multiterminal barrier strip.

**DIMENSIONS:** Uncased: 6" H x 4" W x 10" D. Cased: 6.5" H x 5.5" W x 10.5" D.

**FINISH:** Rigid Blue epoxy.

**MOUNTING:** Rack mounting panel adapters available. See accessory pages.

**OPERATING REGION GRAPH**

**SPECIFICATION**

<table>
<thead>
<tr>
<th>Voltage Mode</th>
<th>Current Mode** (External Sensing)</th>
</tr>
</thead>
<tbody>
<tr>
<td>OUTPUT RANGE</td>
<td>±5% at I</td>
</tr>
<tr>
<td>REGULATION, LINE</td>
<td>&lt;0.005% at rated sample**</td>
</tr>
<tr>
<td>REGULATION, LOAD</td>
<td>&lt;0.01% or 0.5 mV** at rated sample**</td>
</tr>
<tr>
<td>TEMP. COEFFICIENT</td>
<td>&lt;0.05% per °C at rated sample**</td>
</tr>
<tr>
<td>RIPPLE, rms</td>
<td>&lt;0.05 mV at 10°C</td>
</tr>
</tbody>
</table>

**All terms used in the specifications are defined in the Kepco Glossary on Page 33.
KEPCO

MODULAR
POWER SUPPLIES

- voltage/current regulation
- full range operationally programmable
- all silicon design

<table>
<thead>
<tr>
<th>MODEL</th>
<th>DC OUTPUT RANGE VOLS</th>
<th>OUTPUT IMPEDANCE Ohms + Microhenries</th>
<th>MAX INPUT AMPS</th>
<th>DC OUTPUT RANGE AMPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAT 7-2</td>
<td>0-7</td>
<td>0.0005</td>
<td>0.02</td>
<td>0.1-1</td>
</tr>
<tr>
<td>PAT 15-1.5</td>
<td>0-15</td>
<td>0.001</td>
<td>0.02</td>
<td>0.1-1</td>
</tr>
<tr>
<td>PAT 21-1</td>
<td>0-21</td>
<td>0.0025</td>
<td>0.02</td>
<td>0.1-1</td>
</tr>
<tr>
<td>PAT 40-0.5</td>
<td>0-40</td>
<td>0.008</td>
<td>0.02</td>
<td>0.1-1</td>
</tr>
<tr>
<td>PAT 72-0.3</td>
<td>0-72</td>
<td>0.025</td>
<td>0.02</td>
<td>0.1-1</td>
</tr>
<tr>
<td>PAT 100-0.2</td>
<td>0-100</td>
<td>0.050</td>
<td>0.02</td>
<td>0.1-1</td>
</tr>
</tbody>
</table>

**SPECIFICATIONS**

VOLTAGE MODE (External Sensing)

Output Range: 0-100% Eo max., 1mA-100% I0 max.

Regulation, Line:<0.01%<0.01% at rated sample

Regulation, Load:<0.01% or 1 mA*<0.02% at rated sample

Stability (8 HR):<0.01% or 2 mA*<0.05% or 1 mA

Temp. Coefficient:<0.01% per °C<0.05% per °C

Ripple, rms:<0.1 mV<0.02% of I0 max.

Remote Error Sensing: Compensates up to 0.5 volts across external current sampling resistor with external current control.

**CURRENT LIMITING**: Adjustable from 10% to 105% of rated full current.

**OVERSHOOT**: (Turn-on/off): None above 25% voltage setting; negligible below 25% when preloaded to 10% minimum.

**SERIES/PARALLEL**: Series operation to rated isolation; also master/slave capability. Current limiting design permits self-determined parallel load sharing.

**TERMINALS**: All input, output and control connections are made via a multi-terminal barrier strip.

**DIMENSIONS**: Cased: 3½"H x 6½"W x 4¾"D.

**FINISH**: Black anodized aluminum.

**MOUNTING**: Rack Adapters available. See accessory pages.

All terms used in the specifications are defined in the Kepco Glossary on Page 33.

INPUT: 100-125V AC or 210-250V AC (selected), 50-440 cps single phase.

TEMPERATURE, AMBIENT OPERATING: Cased: -20°C to +71°C.

TEMPERATURE, STORAGE: -40°C to +85°C.

COOLING: Convection.

ISOLATION VOLTAGE: 500 volts to chassis.

PROGRAMMING: Approximately 1 mA control current, externally adjustable by resistance at <1000 ohms per volt. Specify suffix "R" to obtain model with integral ±10% control current adjustment. May be operationally controlled as an amplifier using voltage or current signals: common positive.

VOLTAGE RECOVERY, (for step load current): <50 seconds.

CURRENT LIMITING: Adjustable from 10% to 105% of rated full current.

REMOTE ERROR SENSING: Compensates up to 0.5 volt drop per output lead.

OVERSHOOT: (Turn-on/off): None above 25% voltage setting; negligible below 25% when preloaded to 10% minimum.

SERIES/PARALLEL: Series operation to rated isolation; also master/slave capability. Current limiting design permits self-determined parallel load sharing.

TERMINALS: All input, output and control connections are made via a multi-terminal barrier strip.

DIMENSIONS: Cased: 3½"H x 6½"W x 4¾"D.

FINISH: Black anodized aluminum.

MOUNTING: Rack Adapters available. See accessory pages.

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Data subject to change without notice.

PATENT NOTICE: Applicable Patent Nos. will be supplied on request.

KEPCO MODULAR POWER SUPPLIES

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18
KEPCO PAX
MODULAR
POWER SUPPLIES
- voltage/current regulation
- full range operationally programmable
- high speed models

<table>
<thead>
<tr>
<th>SPECIFICATION</th>
<th>VOLTAGE MODE</th>
<th>CURRENT MODE** (External Sensing)</th>
</tr>
</thead>
<tbody>
<tr>
<td>OUTPUT RANGE</td>
<td>0–100% Eo max.</td>
<td>1 mA to 100% Io</td>
</tr>
<tr>
<td>REGULATION, LINE</td>
<td>&lt;0.05% or 1 mV*</td>
<td>&lt;0.1% at rated sample**</td>
</tr>
<tr>
<td>REGULATION, LOAD</td>
<td>&lt;0.05% or 1 mV*</td>
<td>&lt;0.1% at rated sample**</td>
</tr>
<tr>
<td>STABILITY (8 HR.)</td>
<td>&lt;0.05%/or 3 mV*</td>
<td>&lt;0.3% or 1 mA*</td>
</tr>
<tr>
<td>TEMP. COEFFICIENT</td>
<td>&lt;0.05%/per °C</td>
<td>&lt;0.1%/per °C at rated sample**</td>
</tr>
<tr>
<td>RIPPLE, (Standard Speed)</td>
<td>&lt;0.25 mV, rms.</td>
<td>&lt;0.1%/Io max.</td>
</tr>
<tr>
<td>RIPPLE, (High Speed)</td>
<td>&lt;60 dB below peak output (grounded)</td>
<td>&lt;60 dB below peak output (grounded)</td>
</tr>
</tbody>
</table>

**whichever is greater

*Rated sample is 1V DC across external current sampling resistor, with external current control.

Sinusoidal Frequency Response: \( f_{\text{max}} = \frac{E_p}{\Delta E} \) kC

(Ep is the peak-to-peak voltage excursion.)

Maximum Capacitive Loading: 0.001 microfarad.

Transients:
- Voltage Mode: To a step load current, excursion is \( I_{\text{di}} \)
- Series/Parallel: Series operation to rated isolation; also master/slave capability. Current limiting design permits self-determined parallel load sharing.

TERMINALS: All input, output and control connections are made via a multi-terminal barrier strip and printed circuit connector.

DIMENSIONS: Unenclosed: 2W x 3½H x 12D. Enclosed: 2W x 3½H x 13D. Color 26440 (light gray).


MOUNTING: See Accessory page for choice of mounting panels and housings.
KEPCO

MODULAR POWER SUPPLIES

- voltage/current regulation
- full range operationally programmable
- all silicon design

**SPECIFICATION**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>DC OUTPUT RANGE</th>
<th>OUTPUT IMPEDANCE</th>
<th>MAX INPUT AMPS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>VOLTS</td>
<td>AMPS</td>
<td>OHMS</td>
</tr>
<tr>
<td>PBX 7-2</td>
<td>0-7</td>
<td>0-2</td>
<td>0,0004</td>
</tr>
<tr>
<td>PBX 15-1.5</td>
<td>0-15</td>
<td>0-1,5</td>
<td>0,001</td>
</tr>
<tr>
<td>PBX 21-1</td>
<td>0-21</td>
<td>0-1</td>
<td>0,0025</td>
</tr>
<tr>
<td>PBX 40-0.5</td>
<td>0-40</td>
<td>0-0.5</td>
<td>0,008</td>
</tr>
<tr>
<td>PBX 72-0.3</td>
<td>0-72</td>
<td>0-0,3</td>
<td>0,025</td>
</tr>
<tr>
<td>PBX 100-0.2</td>
<td>0-100</td>
<td>0-0,2</td>
<td>0,050</td>
</tr>
</tbody>
</table>

**INPUT:** 105-125V AC or 210-250V AC (selected), 50-440 cps single phase.

**TEMPERATURE, AMBIENT OPERATING:** Cased: -20 C to +65 C. Uncased: -30 C to +71 C.

**TEMPERATURE, STORAGE:** -40 C to +85 C.

**ISOLATION VOLTAGE:** 500 volts to chassis.

**PROGRAMMING:** Approximately 1mA control current. Externally adjustable, by resistance at =1000 ohms per volt. Specify suffix "R" to obtain model with integral +10% control current adjustment. May be operationally controlled as an amplifier using voltage or current signals; common positive.

**VOLTAGE RECOVERY:** (for step load current): <0.5 sec.

**CURRENT LIMITING:** Adjustable from 10% to 100% of rated full current.

**REMOTE ERROR SENSING:** Compensates up to 0.5 volt drop per output lead.

All terms used in the specifications are defined in the Kepec Glossary on Page 33.

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KEPCO
PBX-MAT
AND
OPS-TA
MODULAR
POWER SUPPLIES

Six slot rack mountable housing — Model RA 22-6

Model PBX 21-MAT Panel
The MAT attachment to Kepco's PBX models provides meters (two, for voltage and current); adjustment, (a multi-turn voltage control); and terminals (pin jacks).

<table>
<thead>
<tr>
<th>MODEL</th>
<th>DC OUTPUT RANGE</th>
<th>MAX. INPUT AMPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBX 7-2MAT</td>
<td>0-7</td>
<td>0-2</td>
</tr>
<tr>
<td>PBX 15-1.5MAT</td>
<td>0-15</td>
<td>0-1.5</td>
</tr>
<tr>
<td>PBX 21-1MAT</td>
<td>0-21</td>
<td>0.45</td>
</tr>
<tr>
<td>PBX 40-0.5MAT</td>
<td>0-40</td>
<td>0-0.5</td>
</tr>
<tr>
<td>PBX 72-0.3MAT</td>
<td>0-72</td>
<td>0.45</td>
</tr>
<tr>
<td>PBX 100-0.2MAT</td>
<td>0-100</td>
<td>0-0.2</td>
</tr>
</tbody>
</table>

Model OPS 40-0.5TA Panel
The TA attachment to Kepco's OPS models provides terminals (a 10-pin jack patch panel) and adjustments (offset nulling, AC legs and current limiting).

<table>
<thead>
<tr>
<th>MODEL</th>
<th>DC OUTPUT RANGE</th>
<th>MAX. INPUT AMPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPS 7-2TA</td>
<td>0-7</td>
<td>0-2</td>
</tr>
<tr>
<td>OPS 15-1.5TA</td>
<td>0-15</td>
<td>0-1.5</td>
</tr>
<tr>
<td>OPS 21-1TA</td>
<td>0-21</td>
<td>0.45</td>
</tr>
<tr>
<td>OPS 40-0.5TA</td>
<td>0-40</td>
<td>0-0.5</td>
</tr>
<tr>
<td>OPS 72-0.3TA</td>
<td>0-72</td>
<td>0.45</td>
</tr>
<tr>
<td>OPS 100-0.2TA</td>
<td>0-100</td>
<td>0-0.2</td>
</tr>
</tbody>
</table>

SPECIFICATIONS: Same as for regular PBX and OPS models; see specifications pages.

HARDWARE, ADAPTERS and ACCESSORY ITEMS
Panels finished per Fed. STD. 996. Color 36440 (light gray).

CABINETS:
PBX-MAT (Assembly) 5 3/4" X 2 9/16" X 15"
OPS-TA (Assembly) 5 3/4" X 2 9/16" X 15"
RA-22-6—Six slot housing w/ plug board 5 3/4" X 19" X 16 1/2"* BPA-22—Blank panel assy. w/ slide plate 5 3/4" X 2 9/16" X 14 1/2"*

ADAPTER:
PC-1 Connector, for use with uncased models.
PC-2—Plug-in adapter* 5 3/4" X 2 9/16"* — For plug-in convenience in the RA-22-6, use (1) PC-2 per slot.

FILLER PANELS:
RFP 22-1—Single filler panel for RA 22-6 5 3/4" x 2 9/16" x 16 1/2" RFP 22-2—Double filler panel for RA 22-6 5 3/4" x 5 3/4" x 16 1/2" RFP 22-3—Triple filler panel for RA 22-6 5 3/4" x 8 1/4" x 16 1/2"

CASES:
CA-3—Single slot housing w/ plug board 5 3/4" x 2 9/16" x 16 1/2" CA-4—Double slot housing w/ plug board 5 3/4" x 5 3/4" x 16 1/2" CA-5—Triple slot housing w/ plug board 5 3/4" x 8 1/4" x 16 1/2"

DIMENSIONS
H W D
PBX-MAT (Assembly) 5 3/4" x 2 9/16" x 15"
OPS-TA (Assembly) 5 3/4" x 2 9/16" x 15"
RA-22-6—Six slot housing w/ plug board 5 3/4" X 19" X 16 1/2"* BPA-22—Blank panel assy. w/ slide plate 5 3/4" X 2 9/16" X 14 1/2"*

ADAPTER:
PC-1 Connector, for use with uncased models.
PC-2—Plug-in adapter* 5 3/4" X 2 9/16"* — For plug-in convenience in the RA-22-6, use (1) PC-2 per slot.

FILLER PANELS:
RFP 22-1—Single filler panel for RA 22-6 5 3/4" x 2 9/16" x 16 1/2" RFP 22-2—Double filler panel for RA 22-6 5 3/4" x 5 3/4" x 16 1/2" RFP 22-3—Triple filler panel for RA 22-6 5 3/4" x 8 1/4" x 16 1/2"

CASES:
CA-3—Single slot housing w/ plug board 5 3/4" x 2 9/16" x 16 1/2" CA-4—Double slot housing w/ plug board 5 3/4" x 5 3/4" x 16 1/2" CA-5—Triple slot housing w/ plug board 5 3/4" x 8 1/4" x 16 1/2"

DIMENSIONS
H W D
PBX-MAT (Assembly) 5 3/4" x 2 9/16" x 15"
OPS-TA (Assembly) 5 3/4" x 2 9/16" x 15"
RA-22-6—Six slot housing w/ plug board 5 3/4" X 19" X 16 1/2"* BPA-22—Blank panel assy. w/ slide plate 5 3/4" X 2 9/16" X 14 1/2"*

ADAPTER:
PC-1 Connector, for use with uncased models.
PC-2—Plug-in adapter* 5 3/4" X 2 9/16"* — For plug-in convenience in the RA-22-6, use (1) PC-2 per slot.

FILLER PANELS:
RFP 22-1—Single filler panel for RA 22-6 5 3/4" x 2 9/16" x 16 1/2" RFP 22-2—Double filler panel for RA 22-6 5 3/4" x 5 3/4" x 16 1/2" RFP 22-3—Triple filler panel for RA 22-6 5 3/4" x 8 1/4" x 16 1/2"

CASES:
CA-3—Single slot housing w/ plug board 5 3/4" x 2 9/16" x 16 1/2" CA-4—Double slot housing w/ plug board 5 3/4" x 5 3/4" x 16 1/2" CA-5—Triple slot housing w/ plug board 5 3/4" x 8 1/4" x 16 1/2"

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PATENT NOTICE: Applies Patent Nos. will be supplied on request.

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21
FIGURE 1

FIGURE 2: TYPICAL RIPPLE CHARACTERISTICS

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FIGURE 3: TYPICAL LOAD REGULATION

FIGURE 4: LINE REGULATION (GROUP II) AS A FUNCTION OF OUTPUT VOLTAGE AND LINE CURRENT

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**KEPCO PWR MODULAR POWER SUPPLIES**

- overload current cutoff
- out-of-band programming
- precision regulator
- flux oscillating transformer

**SPECIFICATION**

<table>
<thead>
<tr>
<th>VOLTAGE MODE</th>
<th>CURRENT MODE** (External Sensing)</th>
</tr>
</thead>
<tbody>
<tr>
<td>OUTPUT RANGE</td>
<td>±5% Eo*</td>
</tr>
<tr>
<td>REGULATION, LINE</td>
<td>&lt; 0.005% (Eo)</td>
</tr>
<tr>
<td>REGULATION, LOAD</td>
<td>&lt; 0.05% or 1 mA**</td>
</tr>
<tr>
<td>STABILITY (8 HR.)</td>
<td>&lt; 0.005% or 3 mA**</td>
</tr>
<tr>
<td>TEMP. COEFFICIENT</td>
<td>&lt; 0.05% per °C</td>
</tr>
<tr>
<td>RIPPLE, rms.*</td>
<td>&lt; 0.25 mV</td>
</tr>
</tbody>
</table>

*wherever is greater

**INPUT:** 100-130V AC, 60 cps ± 1 cps single phase; approximately 2 amperes, 200 watts.
**Overseas Units:** Specify suffix "-50" for selectable 104 =13.5V AC, 115 =15V AC, 208 =27V AC, or 230 =30V AC, 50 cps ± 1 cps. Derate output current by 20% when ordering with "-50" option.
**TEMPERATURE AMBIENT OPERATING:** Uncased: -20°C to 65°C. Cased: -20°C to 85°C.
**TEMPERATURE, STORAGE:** -40°C to +85°C.
**ISOLATION VOLTAGE:** 500 volts to chassis.
**CONTROL/PROGRAMMING:** ±5% by internal trimmer for voltage or current. External resistance programming ratio is 1000 ohms per volt, 1 mA control current. A 1% fixed resistor is supplied to program the tabulated nominal voltage. When programmed below ±5% output band, derate current per operating region graph.
**VOLTAGE RECOVERY:** (for step load current): <30 microseconds.

**OPERATING REGION GRAPH**

<table>
<thead>
<tr>
<th>MODEL</th>
<th>DC OUTPUT RANGE</th>
<th>OUTPUT IMPEDANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>VOLTS</td>
<td>AMPS</td>
</tr>
<tr>
<td>PWR 4-14</td>
<td>4.5V</td>
<td>0-14</td>
</tr>
<tr>
<td>PWR 7-11</td>
<td>7.5V</td>
<td>0-71</td>
</tr>
<tr>
<td>PWR 12-7</td>
<td>12.5V</td>
<td>0-7</td>
</tr>
<tr>
<td>PWR 15-6</td>
<td>15.5V</td>
<td>0-6</td>
</tr>
<tr>
<td>PWR 24-4</td>
<td>24.5V</td>
<td>0-4</td>
</tr>
<tr>
<td>PWR 28-3</td>
<td>28.5V</td>
<td>0-3</td>
</tr>
<tr>
<td>PWR 36-2</td>
<td>36.5V</td>
<td>0-2</td>
</tr>
<tr>
<td>PWR 48-2</td>
<td>48.5V</td>
<td>0-2</td>
</tr>
<tr>
<td>PWR 60-1.5</td>
<td>60.5V</td>
<td>0-1.5</td>
</tr>
</tbody>
</table>

**WARRANTY:**

All terms used in this specification are defined in the Kepco Glossary on Page 32.

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**PATENT NOTICE:** Applicable Patent Nos. will be supplied on request.

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**DIMENSIONS:**

Uncased: 6 3/4"H x 5"W x 10 1/2"D. Cased: 6 3/4"H x 5"W x 10 1/2"D.

**MOUNTING:** Rack Adapters available, see accessory page.
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Telex 12 6055 • Cable: KEPCOPOWER NEWYORK

MODULAR POWER SUPPLIES

- fixed voltage
- economical
- high reliability

FIGURE 1:
TYPICAL LOAD REGULATION FOR ALL PRM MODELS

FIGURE 2:
TYPICAL RIPPLE AS A FUNCTION OF LOAD FOR ALL PRM MODELS EXCEPT EXTRA FILTERED MODELS

FIGURE 3:
TYPICAL RIPPLE AS A FUNCTION OF LOAD FOR ALL EXTRA FILTERED MODELS

INPUT: 115V AC ± 15 V AC, 60 cps ± 5% single phase.
Overseas Models: For 50 cps, ±3%, specify suffix "-50". Inputs: selectable 108 ±13.5 V AC, 115 V AC, 208 ±27 V AC or 230 ±30 V AC. Output current rating is denoted 20% in 50 cps version.
NOTE: Input frequency variations produce an approximate equal percentage output voltage change.
TEMPERATURE, AMBIENT OPERATING: -20°C to +55°C
TEMPERATURE STORAGE: -40°C to +85°C
COOLING: Convection.
OUTPUT IMPEDANCE: 1 kΩ to 10 kΩ: 0.05 ohms, 10 kΩ to 100 kΩ: 0.05 ohms ± 0.5 microhenries. Below 1000 cps impedance is a function of a load current and may be derived from the slope of load regulation curve ΔEL/ΔI.

All terms used in the specifications are defined in the KEPCO Glossary on Page 33.

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PATENT NOTICE: Applicable Patent Nos. will be supplied on request.

VOLTAGE RECOVERY: (50-100% current): < 400 milliseconds.
OVERLOAD PROTECTION: Current limiting transformer restricts short circuit current to safe value. A thermal circuit breaker is employed in dual models.
ISOLATION VOLTAGE: 600 volts to chassis (or between the outputs of dual models).
SERIES/PARALLEL OPERATION: Identical models, or halves of a dual supply can be paralleled for approximately double current (allow for 10% imbalance). Series operation to rated isolation.
ACCESSORIES: Various rack adapters available, see accessory page. Cases: Size A uses CA-200
Size C uses CA-300
Size B has non-removable integral enclosure. Add suffix "c" for cases Size A & C models.

FINISH: Cases: royal blue.
### SIZE "A" - 180 SERIES

<table>
<thead>
<tr>
<th>MODEL</th>
<th>DC OUTPUT VOLTS</th>
<th>LOAD REGULATION*</th>
<th>DC OUTPUT AMPS</th>
<th>LOAD REG. CURVE (Fig. 1)</th>
<th>RIPPLE (MAX.) (RMS) VOLTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRM 6-25</td>
<td>6.3 0-25</td>
<td>0.5</td>
<td>0.6</td>
<td>1</td>
<td>0.4</td>
</tr>
<tr>
<td>PRM 12-15</td>
<td>12 0-15</td>
<td>0.6</td>
<td>1.0</td>
<td>1</td>
<td>0.4</td>
</tr>
<tr>
<td>PRM 18-10</td>
<td>18 0-10</td>
<td>0.6</td>
<td>1.0</td>
<td>2</td>
<td>0.3</td>
</tr>
<tr>
<td>PRM 24-8</td>
<td>24 0-8</td>
<td>0.7</td>
<td>1.2</td>
<td>2</td>
<td>0.3</td>
</tr>
<tr>
<td>PRM 36-5</td>
<td>36 0-5</td>
<td>0.8</td>
<td>1.3</td>
<td>3</td>
<td>0.4</td>
</tr>
<tr>
<td>PRM 48-4</td>
<td>48 0-4</td>
<td>1.0</td>
<td>1.8</td>
<td>4</td>
<td>0.3</td>
</tr>
<tr>
<td>PRM 60-3</td>
<td>60 0-3</td>
<td>1.1</td>
<td>1.9</td>
<td>5</td>
<td>0.3</td>
</tr>
<tr>
<td>PRM 120-15</td>
<td>120 0-15</td>
<td>2.2</td>
<td>3.6</td>
<td>7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

*Measured at 115V AC Line.

### SIZE "B" - 120 SERIES

<table>
<thead>
<tr>
<th>MODEL</th>
<th>DC OUTPUT VOLTS</th>
<th>LOAD REGULATION*</th>
<th>DC OUTPUT AMPS</th>
<th>LOAD REG. CURVE (Fig. 1)</th>
<th>RIPPLE (MAX.) (RMS) VOLTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRM 6-15</td>
<td>6.3 0-15</td>
<td>0.5</td>
<td>0.8</td>
<td>1</td>
<td>0.4</td>
</tr>
<tr>
<td>PRM 12-10</td>
<td>12 0-10</td>
<td>0.6</td>
<td>1.0</td>
<td>2</td>
<td>0.4</td>
</tr>
<tr>
<td>PRM 18-6.7</td>
<td>18 0-6.7</td>
<td>0.8</td>
<td>1.3</td>
<td>3</td>
<td>0.3</td>
</tr>
<tr>
<td>PRM 24-5</td>
<td>24 0-5</td>
<td>1.0</td>
<td>1.7</td>
<td>3</td>
<td>0.3</td>
</tr>
<tr>
<td>PRM 28-4.3</td>
<td>28 0-4.3</td>
<td>1.2</td>
<td>2.0</td>
<td>4</td>
<td>0.3</td>
</tr>
<tr>
<td>PRM 36-3.3</td>
<td>36 0-3.3</td>
<td>1.5</td>
<td>2.4</td>
<td>5</td>
<td>0.3</td>
</tr>
<tr>
<td>PRM 48-2.5</td>
<td>48 0-2.5</td>
<td>2.0</td>
<td>3.4</td>
<td>6</td>
<td>0.3</td>
</tr>
<tr>
<td>PRM 60-2</td>
<td>60 0-2</td>
<td>2.3</td>
<td>3.8</td>
<td>7</td>
<td>0.3</td>
</tr>
<tr>
<td>PRM 120-1</td>
<td>120 0-1</td>
<td>4.6</td>
<td>7.6</td>
<td>9</td>
<td>0.3</td>
</tr>
</tbody>
</table>

*Measured at 115V AC Line.

### SIZE "C" - 300 SERIES DUAL OUTPUT

<table>
<thead>
<tr>
<th>MODEL</th>
<th>DC OUTPUT VOLTS</th>
<th>LOAD REGULATION*</th>
<th>DC OUTPUT AMPS</th>
<th>LOAD REG. CURVE (Fig. 1)</th>
<th>RIPPLE (MAX.) (RMS) VOLTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRM 2X 4.5-20</td>
<td>4.5 0-20</td>
<td>0.5</td>
<td>0.7</td>
<td>1</td>
<td>0.3</td>
</tr>
<tr>
<td>PRM 2X 6-20</td>
<td>6.3 0-20</td>
<td>0.5</td>
<td>0.7</td>
<td>1</td>
<td>0.3</td>
</tr>
<tr>
<td>PRM 2X 12-12</td>
<td>12 0-12</td>
<td>0.5</td>
<td>0.7</td>
<td>1</td>
<td>0.3</td>
</tr>
<tr>
<td>PRM 2X 15-10</td>
<td>15 0-10</td>
<td>0.5</td>
<td>1.0</td>
<td>1</td>
<td>0.3</td>
</tr>
<tr>
<td>PRM 2X 18-8</td>
<td>18 0-8</td>
<td>0.6</td>
<td>1.6</td>
<td>1</td>
<td>0.3</td>
</tr>
<tr>
<td>PRM 2X 24-6</td>
<td>24 0-6</td>
<td>0.6</td>
<td>1.0</td>
<td>2</td>
<td>0.3</td>
</tr>
<tr>
<td>PRM 2X 28-6</td>
<td>28 0-5</td>
<td>0.7</td>
<td>1.2</td>
<td>2</td>
<td>0.3</td>
</tr>
<tr>
<td>PRM 2X 36-4</td>
<td>36 0-4</td>
<td>0.7</td>
<td>1.2</td>
<td>3</td>
<td>0.3</td>
</tr>
<tr>
<td>PRM 2X 48-3</td>
<td>48 0-3</td>
<td>0.8</td>
<td>1.4</td>
<td>3</td>
<td>0.3</td>
</tr>
<tr>
<td>PRM 2X 60-2.5</td>
<td>60 0-2.5</td>
<td>1.0</td>
<td>1.7</td>
<td>3</td>
<td>0.3</td>
</tr>
</tbody>
</table>

*Measured at 115V AC Line.

### SIZE "C" - 180F SERIES EXTRA-FILTERED

<table>
<thead>
<tr>
<th>MODEL</th>
<th>DC OUTPUT VOLTS</th>
<th>LOAD REGULATION*</th>
<th>DC OUTPUT AMPS</th>
<th>LOAD REG. CURVE (Fig. 1)</th>
<th>RIPPLE (MAX.) (RMS) VOLTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRM 6-25F</td>
<td>6.3 0-25</td>
<td>0.7</td>
<td>1.2</td>
<td>1</td>
<td>0.4</td>
</tr>
<tr>
<td>PRM 12-15F</td>
<td>12 0-15</td>
<td>0.9</td>
<td>1.4</td>
<td>2</td>
<td>0.3</td>
</tr>
<tr>
<td>PRM 18-10F</td>
<td>18 0-10</td>
<td>0.9</td>
<td>1.5</td>
<td>3</td>
<td>0.3</td>
</tr>
<tr>
<td>PRM 24-8F</td>
<td>24 0-8</td>
<td>1.2</td>
<td>2.0</td>
<td>3</td>
<td>0.3</td>
</tr>
<tr>
<td>PRM 36-5F</td>
<td>36 0-5</td>
<td>1.3</td>
<td>2.1</td>
<td>3</td>
<td>0.3</td>
</tr>
<tr>
<td>PRM 48-4F</td>
<td>48 0-4</td>
<td>1.7</td>
<td>2.9</td>
<td>5</td>
<td>0.3</td>
</tr>
<tr>
<td>PRM 60-3F</td>
<td>60 0-3</td>
<td>2.3</td>
<td>3.8</td>
<td>6</td>
<td>0.3</td>
</tr>
<tr>
<td>PRM 120-1.5F</td>
<td>120 0-1.5</td>
<td>3.8</td>
<td>6.8</td>
<td>8</td>
<td>0.03</td>
</tr>
</tbody>
</table>

*Measured at 115V AC Line. **Less 2% filter drop (See ACCURACY)
KEPCO

TRANSISTORIZED

POWER SUPPLIES

- wide voltage range
- high current
- dual regulator
- minimum regulator dissipation

<table>
<thead>
<tr>
<th>MODEL</th>
<th>DC OUTPUT RANGE</th>
<th>OUTPUT IMPEDANCE</th>
<th>MAX. INPUT</th>
<th>DIMENSIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DC to 100cps</td>
<td>100cps</td>
<td>1kc to 10kc</td>
<td>1kc to 10kc</td>
</tr>
<tr>
<td>SM 14-7AM</td>
<td>0-14 to 0-7</td>
<td>0.001</td>
<td>0.005</td>
<td>0.1</td>
</tr>
<tr>
<td>SM 14-15AM</td>
<td>0-14 to 0-15</td>
<td>0.0005</td>
<td>0.005</td>
<td>0.02</td>
</tr>
<tr>
<td>SM 14-30AM</td>
<td>0-14 to 0-30</td>
<td>0.0003</td>
<td>0.005</td>
<td>0.02</td>
</tr>
<tr>
<td>SM 36-7AM</td>
<td>0-36 to 0-7</td>
<td>0.005</td>
<td>0.005</td>
<td>0.03</td>
</tr>
<tr>
<td>SM 36-10AM</td>
<td>0-36 to 0-10</td>
<td>0.003</td>
<td>0.005</td>
<td>0.03</td>
</tr>
<tr>
<td>SM 36-15AM</td>
<td>0-36 to 0-15</td>
<td>0.002</td>
<td>0.005</td>
<td>0.03</td>
</tr>
<tr>
<td>SM 75-7AM</td>
<td>0-75 to 0-7</td>
<td>0.002</td>
<td>0.005</td>
<td>0.04</td>
</tr>
<tr>
<td>SM 75-5AM</td>
<td>0-75 to 0-5</td>
<td>0.01</td>
<td>0.005</td>
<td>0.02</td>
</tr>
<tr>
<td>SM 75-8AM</td>
<td>0-75 to 0-8</td>
<td>0.005</td>
<td>0.005</td>
<td>0.06</td>
</tr>
<tr>
<td>SM 160-1AM</td>
<td>0-160 to 0-1</td>
<td>0.1</td>
<td>0.005</td>
<td>0.04</td>
</tr>
<tr>
<td>SM 160-2AM</td>
<td>0-160 to 0-2</td>
<td>0.05</td>
<td>0.005</td>
<td>0.04</td>
</tr>
<tr>
<td>SM 160-4AM</td>
<td>0-160 to 0-4</td>
<td>0.02</td>
<td>0.005</td>
<td>0.06</td>
</tr>
<tr>
<td>SM 325-0.5AM</td>
<td>0-165 to 0-2.5</td>
<td>0.4</td>
<td>0.005</td>
<td>0.1</td>
</tr>
<tr>
<td>SM 325-1AM</td>
<td>0-325 to 0-1</td>
<td>0.2</td>
<td>0.005</td>
<td>0.1</td>
</tr>
<tr>
<td>SM 325-2AM</td>
<td>0-325 to 0-2</td>
<td>0.1</td>
<td>0.005</td>
<td>0.1</td>
</tr>
</tbody>
</table>


ISOLATION VOLTAGE: 400 volts to chassis.

CONTROL RESOLUTION: 0.1%, 10-turn voltage control.

VOLTAGE RECOVERY: (for step load current): 50 microseconds.

REMOTE ERROR SENSING: Compensates up to 0.5 volt drop per output lead.

OVERSHOOT: (Turn-on/off): None above 25% voltage setting; negligible below 25% when preloaded to 10% minimum.

METERS: Suffix “M” designates a pair of 2½”, 2½” meters.

SERIES OPERATION: To rated isolation.

TERMINALS: Binding posts front and rear for plus, minus and ground.

DIMENSIONS: See table for sizes.

FINISH: Per FED. STD. 506, Color 26440, light gray.

SPECIFICATION

- VOLTAGE MODE
- OUTPUT RANGE: 0−100% Vo max.
- REGULATION, LINE: <0.01%
- REGULATION, LOAD: <0.05% or 1 mV
- STABILITY (8 HR.): <0.05% or 3 mV
- TEMP. COEFFICIENT: <0.05%/C
- RIPPLE, rms.: <1 mV

INPUT: 105-123V AC, 60 ± 1 cps single phase.

Overseas Models: Specify suffix “−50” for selectable 104 ±9V, AC; 115 ±10V AC; 208 ±11V AC; 230 ±20V AC, 50 cps ±1 cps. Denote output voltage range by 20% when ordering with “50” option.

TEMPERATURE, AMBIENT OPERATING: −20°C to +50°C.

TEMPERATURE, STORAGE: −40°C to +85°C.

All terms used in the specifications are defined in the Kepco Glossary on Page 33.
**POWER SUPPLIES**

- time tested vacuum tube design
- multi-output laboratory units

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**MODEL**  
**DC OUTPUT RANGE**  
**VOLTS**  | **mA**  | **VOLTAGE REGULATION**  
KEPCO
ACCESSORY EQUIPMENT

HARDWARE, ADAPTERS and ACCESSORY ITEMS
for OPS, OPS-TA, PAX, PBX and PBX-MAT MODULES

<table>
<thead>
<tr>
<th>MODEL</th>
<th>DESCRIPTION</th>
<th>SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>RA 22-6</td>
<td>Six-slot rack housing w/o plug boards*</td>
<td>5½&quot; H x 19&quot; W x 16½&quot; D</td>
</tr>
<tr>
<td>BPA-22</td>
<td>Blank panel assembly w/ slide plate</td>
<td>5½&quot; H x 2¾&quot; W x 14½&quot; D</td>
</tr>
<tr>
<td>RFP 22-1</td>
<td>Single filler panel for RA 22-6</td>
<td>5½&quot; H x 2¾&quot; W</td>
</tr>
<tr>
<td>RFP 22-2</td>
<td>Double filler panel for RA 22-6</td>
<td>5½&quot; H x 5½&quot; W</td>
</tr>
<tr>
<td>RFP 22-3</td>
<td>Triple filler panel for RA 22-6</td>
<td>5½&quot; H x 8½&quot; W</td>
</tr>
<tr>
<td>CA-1</td>
<td>Chassis mounting case (single)</td>
<td>2½&quot; H x 4½&quot; W x 13½&quot; D</td>
</tr>
<tr>
<td>CA-3</td>
<td>Single-slot housing w/plug board</td>
<td>5½&quot; H x 2½&quot; W x 16&quot; D</td>
</tr>
<tr>
<td>CA-4</td>
<td>Double-slot housing w/plug board</td>
<td>5½&quot; H x 5½&quot; W x 16&quot; D</td>
</tr>
<tr>
<td>CA-5</td>
<td>Triple-slot housing w/plug board</td>
<td>5½&quot; H x 8½&quot; W x 16&quot; D</td>
</tr>
<tr>
<td>RA 12-1</td>
<td>1 unit Rack Adapter (cased)</td>
<td>3½&quot; H x 19&quot; W</td>
</tr>
<tr>
<td>RA 13-4</td>
<td>4 unit Rack Adapter (cased)</td>
<td>3½&quot; H x 19&quot; W</td>
</tr>
<tr>
<td>RA 11-6</td>
<td>6 unit Rack Adapter (cased)</td>
<td>5½&quot; H x 19&quot; W</td>
</tr>
<tr>
<td>PC-1</td>
<td>Printed circuit board connector</td>
<td></td>
</tr>
<tr>
<td>PC-2</td>
<td>Plug-in adapter*</td>
<td>5½&quot; H x 2½&quot; W</td>
</tr>
</tbody>
</table>

*For plug-in convenience in the RA 22-6, use (1) PC-2 per slot.

METER, ADJUSTMENT and TERMINAL ASSEMBLIES for PBX MODULES

<table>
<thead>
<tr>
<th>MODEL</th>
<th>FOR USE WITH</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAT-7</td>
<td>Model PBX 7-2</td>
</tr>
<tr>
<td>MAT-15</td>
<td>Model PBX 15-1.5</td>
</tr>
<tr>
<td>MAT-21</td>
<td>Model PBX 21-1</td>
</tr>
<tr>
<td>MAT-40</td>
<td>Model PBX 40-0.5</td>
</tr>
<tr>
<td>MAT-72</td>
<td>Model PBX 72-0.2</td>
</tr>
<tr>
<td>MAT-100</td>
<td>Model PBX 100-0.2</td>
</tr>
</tbody>
</table>

TERMINAL/ADJUSTMENT ASSEMBLIES for OPS MODULES

<table>
<thead>
<tr>
<th>MODEL</th>
<th>FOR USE WITH</th>
</tr>
</thead>
<tbody>
<tr>
<td>TA-7</td>
<td>Model OPS 7-2</td>
</tr>
<tr>
<td>TA-15</td>
<td>Model OPS 15-1.5</td>
</tr>
<tr>
<td>TA-21</td>
<td>Model OPS 21-1</td>
</tr>
<tr>
<td>TA-40</td>
<td>Model OPS 40-0.5</td>
</tr>
<tr>
<td>TA-72</td>
<td>Model OPS 72-0.3</td>
</tr>
<tr>
<td>TA-100</td>
<td>Model OPS 100-0.2</td>
</tr>
</tbody>
</table>

VARIABLE RESISTIVE LOAD

The Model KT 6212 is a multiganged, eight-section group of dual-wound power rheostats used in the testing of regulated power supplies. Model KT 6212 consists of two independent gangs of four rheostats apiece, 0-64 ohms and 0-1000 ohms. The rheostats can be switched for parallel, series parallel and series operation. Each rheostat has heavy and light windings so that the maximum load current changes at approximately each third rotation point around the dial.

CONTROLS:
Switches select series and parallel combinations of the four ganged rheostats with the corresponding resistance and current rating designated by concentric bands. Each band defines the resistance range for its particular connection with zero ohms (maximum current) in the clockwise position. The bands are divided into three sections that correspond to the position of the heavy and light windings, respectively. The maximum current in each section is shown on the corresponding portion of the band.

FUSING:
Each rheostat in the 0-64 ohm gang is fused at 7 amperes. Each rheostat of the 0-1000 ohm gang is fused for 2 amperes.

EXTERNAL POWER REQUIREMENTS:
None. The Model KT 6212 is a passive device.

DIMENSIONS:
8¼" H x 19" W x 13¼" D. The Model KT 6212 resistive load is designed for mounting in standard 19" equipment racks.

Panels finished per FED. STD. 595 Color 26440 (light gray).
KEPCO

RACK ADAPTERS

Rack Adapters are manufactured by Kepco to adapt bench style, modular and half-rack Power Supplies to the standard 19" wide equipment rack or cabinet. Panels and Rack Adapters are finished per FED. STD. 595. Color 26440, (light gray).

Model RA-1

Model RA-4

Model RA-5

RACK ADAPTERS for ABC, CK, FG-100, KP-1, MP-1, MP-10, OPS-1A and VIX 1-5.

<table>
<thead>
<tr>
<th>MODEL</th>
<th>FOR USE WITH</th>
</tr>
</thead>
<tbody>
<tr>
<td>RA 1 (Single)</td>
<td>Model 103 only</td>
</tr>
<tr>
<td>RA 4 (Dual)</td>
<td>Above Listed Models</td>
</tr>
<tr>
<td>RA 5 (Single)</td>
<td>Above Listed Models</td>
</tr>
<tr>
<td>FPI</td>
<td>Filler Panel for RA 4</td>
</tr>
</tbody>
</table>

HARDWARE, ADAPTERS and ACCESSORY ITEMS

PAR, PRM Size "A" - 180 Series and PWR GROUPS

<table>
<thead>
<tr>
<th>MODEL</th>
<th>DESCRIPTION</th>
<th>DIMENSIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA-200</td>
<td>Case</td>
<td>6&quot;¹   5&quot; 10&quot;²</td>
</tr>
<tr>
<td>RA 1-2</td>
<td>2 Unit Rack Adapter</td>
<td>5&quot;²  19&quot;¹</td>
</tr>
<tr>
<td>RA 3-3</td>
<td>3 Unit Rack Adapter</td>
<td>6&quot;²  19&quot;¹</td>
</tr>
<tr>
<td>RA 5-1</td>
<td>1 PRM Unit Rack Adapter</td>
<td>5&quot;²  19&quot;¹</td>
</tr>
<tr>
<td>RA 2-1</td>
<td>1 PWR Unit Rack Adapter</td>
<td>5&quot;²  19&quot;¹</td>
</tr>
<tr>
<td>RA 25-1</td>
<td>1 PAR Unit Rack Adapter</td>
<td>5&quot;²  19&quot;¹</td>
</tr>
</tbody>
</table>

PRM Size "B" - 120 Series Group

| RA 14-3 | 3 Unit Rack Adapter | 3"²  19"¹ |
| RA 15-1 | 1 Unit Rack Adapter | 3"²  19"¹ |
| RA 16-4 | 4 Unit Rack Adapter | 5"²  19"¹ |
| RA 17-5 | 5 Unit Rack Adapter | 5"²  19"¹ |

PRM Size "C" - Dual Output and Extra-Filtered GROUPS

| CA-300 | Case | 6"²   5" 14"² |
| RA 2-2 | 2 Unit Rack Adapter | 5"²  19"¹ |
| RA 3-3 | 3 Unit Rack Adapter | 5"²  19"¹ |
| RA 4-1 | 1 Unit Rack Adapter | 5"²  19"¹ |

PLUG-IN CABINETS for PRM Size "A", "B" & "C"

| RA 20-3 | 3 Unit Housing | 8"²  19"¹ 18"¹ |
| RAP 20-1 | 1 Unit Panel Adapter | 8"²  5½" |
| RFP 20-1 | Rack Filler Panel | 8"²  5½" |

PLUG-IN CABINETS for PAR and PWR GROUPS

| RA 21-3 | 3 Unit Housing | 8½"²  19"¹ 13"¹ |
| RAP 21-1 | 1 Unit Panel Adapter | 8½"²  5½" |
| RFP 21-1 | Rack Filler Panel | 8½"²  5½" |

KG GROUP

| CA-2 | Single Unit Housing | 5½"²  2½" 14"¹ |
| RFP 19 | Single filler panel | 5½"²  2½" |
| RFP 19 | Double filler panel | 5½"²  4½" |
| RFP 19 | Triple filler panel | 5½"²  6½" |

CDT and OPS-2000

| RA 24 | Double 5½" half-rack | 5½"²  19"¹ 17½"¹ |
| RFP 24 | Filler panel for RA 24 | 5½"²  8½"² |

PAT GROUP

| RA 25-1 | 1 Unit Rack Adapter | 3½"²  19"¹ |
| RA 27-2 | 2 Unit Rack Adapter | 3½"²  19"¹ |
| RA 28-4 | 4 Unit Rack Adapter | 6½"²  19"¹ |
ACCESSORY EQUIPMENT

VIX RELAY

Model VIX-IC translates the VIX REMOTE SIGNAL available on all CK and KS VIX-equipped power supplies into a heavy duty relay closure for external control or signal applications.

SPECIFICATIONS

INPUT: ±8V DC at 1 mA (from VIX signal).

OUTPUT: Three pole, double throw relay contacts; each rated to carry 10 amperes at 115V AC or 5 amperes at 230V AC.

POWER REQUIREMENTS: 105-125V or 210-250V AC

SIZE: 4½" H x 8½" W x 5" D (5¾" D overall) Standard half-rack configuration.

MOUNTING: In the half-rack enclosure VIX-IC can be mounted in either RA-4 or RA-5 rack adaptors. The enclosure is removable so that the circuit board, which is complete by itself, can be mounted within other equipment or chassis. To designate model without enclosure, delete the suffix "C", e.g., Model VIX-I, for unenclosed circuit board for "built-in" mounting.

KEPCO MOTORIZED PROGRAMMERS

MECHANICAL FUNCTION GENERATOR

Models MP-1 and MP-10 are mechanical drives for a 10-turn servo-mount potentiometer installed within. A synchronous motor drives the shaft through an 8-speed gear-box with adjustable limits.

<table>
<thead>
<tr>
<th>MODELS</th>
<th>SECONDS PER REVOLUTION (MAXIMUM: 10 REVOLUTIONS, 360°)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MP-1</td>
<td>0.1 0.3 1.0 3.0 10.0 30.0 100.0 300.0</td>
</tr>
<tr>
<td>MP-10</td>
<td>1.0 3.0 10.0 30.0 100.0 300.0 1000.0 3000.0</td>
</tr>
</tbody>
</table>

TIMING ACCURACY: ±0.5% referenced to 60 cps line frequency.

LIMITS, (Mechanically Adjustable):

- Low Limit: Range from 0-9½ turns.
- High Limit: Range from ½ to 10-turns.
- Minimum Sweep Range: ½ turn (120°)

OVERIDE: Manual override buttons reverse the sweep at any desired point—or manually stop the programmer.

DIRECTION SIGNALS: Pilot lights signal the direction of sweep up and down. With dwell and retrace off, sweep cycles symmetrically between limits.

DWELL: Stops the sweep at either the high or low limit, (selectable).

All terms used in the specifications are defined in the Kepco Glossary on Page 33.

Data subject to change without notice.

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(212) 461-7000 • TWX #710-582-2631
Telex: 12-6055 • Cable: KEPCOPower Newyork

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**KEPCO**

**PROGRAMMER, FUNCTION GENERATOR**

**MODEL FG-100**

Model FG-100 is a precision, slow speed, triangular waveform generator capable of generating any repetitive ramp function. Separately adjustable, high and low limits, are provided which periodically reverse the direction of the integration. The rising rate and falling rate are separately adjustable or can be controlled symmetrically with a single control.

**SPECIFICATIONS**

**OUTPUTS:**
- #1 — 0.20V DC, 0-20 ma.
- #2 — 0-10 ma to program 100 ohm/volt power supply.
- #3 — 0-1 ma to program 1000 ohm/volt power supply.
  
All outputs available simultaneously.

**INPUT:**
- 105-125V or 210-250V AC, 50-440 cps.

**TIMING:**
- 4 ranges: 0.1V/sec., 1.0V/sec., 10V/sec., 100V/sec. Rising and falling slopes continuously adjustable between ranges either separately or symmetrically. For outputs #2 and #3, divide the above timing by 2000 and 20,000 respectively to obtain milliamperes per second.

**LIMITS:** Separately adjustable high limit and low limit permits operation between any two pre-set voltages or currents.

**REVERSING SWITCHES:** Programming direction is automatically reversed at the high and low limits. In addition, a pair of push buttons are provided which permit the direction to be reversed at any point in the operating span.

A pair of directional lamps are provided to show the direction of the ramp.

**METER:** 2½" edgewise meter monitors output in volts (0-20V DC) and in percent of maximum output, 0-100%.

**PROGRAMMING:** Model FG-100 may be used by itself to generate a wide variety of very low speed triangular or sawtooth functions, or it can be used diversely with any programmable DC power supply. When connected to a programmable power supply, the Model FG-100 Function Generator programs the power supply throughout all or part of its rated voltage or current range as set by the power supply's controls and the function generator's limit settings. NOTE: Function speed is converted to programming speed by multiplying the driving current rate (ma/sec.) by the resistance setting of the voltage control of the power supply being programmed. This gives the programming speed of the power supply's output in volts per second.

**REMOTE CONTROLS:** Timing and limit setting controls are brought to a multi-terminal barrier strip at the rear of the unit for remote operation. A sync output is also provided as is provision for remote directional signals.

**SIZE:** 4½" H x 8½" W x 10" D (13¼" D overall); standard half-rack configuration, fits Rack Adapters RA-4 and RA-5.

---

**KEPCO**

**PROGRAMMING PANELS**

**MODEL KP-1** for use with any Kepco programmable power supply using a 1 mA control current.

**SPECIFICATIONS:** **MODEL KP-1**

**DECADERS:** 6-digit voltage programming, 3-digit current programming.

**RANGE:** 0-1,011.110 ohms in 1 ohm steps (0 to 1,011.110V in 1 millivolt steps at 1000V/V).

**ACCURACY:** Decades contain 0.1% resistor except units decade (millivolts) which contain 1% resistors.

**SIZE:** Half-rack, 4¼" H x 19" W x 9½" D. Standard rack mount configurations.

Both decade programmers contain provision for current programming using the first three digits. This assumes a 1 volt sensing drop (internal or external). If the recommended 10 volt sample is employed for HB and ABC high voltage hybrids, then a fourth digit can be used for higher resolution.

When substituted in place of a power supply's normal voltage control and calibrated, the KP-1/KP-10 digital decade programmer converts that supply to a highly accurate voltage or current source.

Both programmers contain zero trimming controls which, in conjunction with the power supplies own bridge current adjustment, allow precise calibration of the output at minimum and maximum output. The programming function of the Kepco bridge is inherently linear to an accuracy determined by the load/line regulation of the power supply. This means that the circuit accuracy is, for all intents and purposes, limited solely by the resistors used in the programmer.
Model VIP–1 OVER-VOLTAGE/OVER-CURRENT

Model VIP–3 OVER and UNDER-VOLTAGE
OVER and UNDER-CURRENT

Model VIP–4 200 AMPERES OVER-VOLTAGE
CROWBAR. Range: 0–50 volts

The VIP consists of a sensing circuit capable of detecting a voltage 1% or 0.1 volts different than any preset voltage limit in the range 5–200 volts. Should such an over or under-voltage occur, a fast-acting silicon controlled rectifier (SCR) “crowbar” short circuits the power supply’s output within 50 microseconds. Simultaneously a power interlock relay is tripped which removes the primary AC power within approximately 50 milliseconds. The SCR discharges the power supply’s output filter capacitor and the voltage is reduced to zero.

Operation in the internal reference mode allows the operator to pro-set any voltage as a limit above or below which crowbar/turn-off action is precipitated. In its tracking mode, the VIP is interconnected with the voltage control circuit of the power supply with which it is used and will sense a voltage differential between the output of the supply and the programmed voltage. Terminals are provided for the addition of a sensing resistor to convert VIP into an over-current or under-current protector depending on model. The current sensing resistor is chosen to drop 1 volt at the operating current. The sensitivity control then adjusts the firing threshold from 0 to the operating current, maximum 30 amperes.

SPECIFICATIONS:

VOLTAGE
SENSITIVITY: Minimum threshold 1% of operating voltage or 0.1 volts whichever is greater (adjustable). RANGE: 0–60V*, 50–100V, 100–150V, 150–300V.

CURRENT
SENSITIVITY: 5% of operating current producing a 1 volt drop across external sensing resistor.
RANGE: 0–30 amperes. Model VIP 4 has a 0–200 amperes crowbar range.

POWER INTERLOCK RELAY
CONTACT RATING: 10 amperes at 115V AC.

Operation of the VIP is in two stages. The output crowbar is immediately followed by an AC power interruption to the crowbarred power supply. High power supplies (such as might require a VIP 4) may require either an auxiliary contactor to turn them off, or, in the case of the large KS and KO models, a connection may be made to the trip coil of the power supply’s circuit breaker to accomplish the turn-off action.

DIMENSIONS
3½” high x 19” wide x 8” deep.
Standard EIA rack dimensions.

FINISH: Per FED. STD. 595. Color 26440 (light gray).

NOTE: When a VIP is to be used in its “Tracking Mode” be sure to specify (when ordering) whether it is to be used with a plus common or minus common power supply.

Data subject to change without notice

PATENT NOTICE: Applicable Patent Nos. will be supplied on request.

OVER-VOLTAGE PROTECTORS
Independently powered overvoltage crowbar prevents the output voltage from exceeding a preset voltage under any failure condition. The crowbar shorts the output through a Silicon Controlled Rectifier (SCR).

MODELS USE WITH

<table>
<thead>
<tr>
<th>MODEL</th>
<th>POWER</th>
<th>USE WITH</th>
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<tbody>
<tr>
<td>VP–PAR</td>
<td>ALL KEPCO PAR MODELS, 3–80V DC</td>
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<tr>
<td>VP–PWR</td>
<td>ALL KEPCO PWR MODELS, 3–80V DC</td>
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<tr>
<td>VP–PX–1</td>
<td>KEPCO PAX &amp; PBX MODELS, 3–80V DC</td>
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<tr>
<td>VP–PX–2</td>
<td>KEPCO PAX &amp; PBX MODELS 3–160V DC</td>
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</table>

SPECIFICATIONS:

OPERATING LEVEL:
The trigger point may be set within 5% or 0.25V (whichever is greater) of power supply setting.

TEMPERATURE COEFFICIENT:
0.1% or 0.1V (whichever is greater) per °C.

REMOTE ERROR SENSING:
Compensates up to 1 volt per output lead.

TRIGGERING TIME, (adjustable delay):
- RANGE OF ADJUSTMENT
- AMOUNT OF OVERVOLTAGE
  - 5 to 16 microseconds 20% or 1 volt
  - 8 to 16 microseconds 10% or 0.5 volt
  - 12 to 24 microseconds 5% or 0.25 volt

AUTOTRANSFORMERS

MODEL POWER L * SIZE W D
<table>
<thead>
<tr>
<th>MODEL</th>
<th>POWER</th>
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<th>SIZE *</th>
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<td>9½&quot;</td>
<td>5½&quot;</td>
<td>6½&quot;</td>
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</table>

*Overall case dimensions (not including handle and feet)
GLOSSARY OF POWER SUPPLY TERMS

accuracy—Accuracy, used as a specification for the output voltage of fixed voltage power supplies, refers to the absolute voltage tolerance with respect to the stated nominal output.

bipolar—Having two poles, polarities or directions. Applied to amplifiers or power supplies, it means that the output may vary in either polarity from zero; as a symmetrical program, it need not contain a d-c component. (See Unipolar)

bridge current—A current derived from the quotient of reference voltage by reference resistor (input resistor) circulating around the loop formed by the output elements and voltage control resistance (feedback resistor). The passage of this current through the voltage control resistance develops the voltage that programs the output of a power supply; 1 mA for 1000 ohms per volt, 10 mA for 100 ohms per volt, etc. (See Figure 1)

calibration, programming—Calibration with reference to power supply programming describes the adjustment of the control bridge current to calibrate the programming ratio in ohms per volt. Many programmable supplies incorporate a "calibrate" control as part of the reference resistor which performs this adjustment. (See Figure 1)

closed-loop gain (operational gain)—The gain measured with feedback, is the ratio of the voltage appearing across the output terminal pair to the causative voltage required at the input resistor. The closed-loop (operational) gain is denoted by the symbol (G) in diagrams and equations. If the open-loop gain (A) is sufficiently large, the closed-loop gain can be satisfactorily approximated by the ratio of the feedback resistor Rf to the input resistor Ri. (See Open-loop, Loop Gain)

command reference—In a servo or control system, the voltage or current to which the feedback signal is compared. As an independent variable, the command reference exercises complete control over the system output. (See Operational Programming)

common point—the terminal which is common between the programming input (inverting connection) and the output of an operationally controlled power supply. The common point may be either the plus (+) error-sensing terminal or the minus (−) error-sensing terminal, depending on the design. (See Figure 1)

comparison amplifier—A high gain, non-inverting d-c amplifier which, in a bridge-regulated power supply, has as its input the voltage between the null junction and the common terminal. The output of the comparison amplifier drives the series pass elements. (See Figure 1)

complementarity tracking—A system of interconnection of two regulated supplies in which one (the master) is operated to control the other (the slave). The slave supply voltage is made equal (or proportional) to the master supply voltage and of opposite polarity with respect to a common point. (See Figure 2)

compliance extension—A form of master/slave interconnection of two or more current regulated power supplies to increase their compliance voltage range through series connection.

compliance voltage—The output voltage of a d-c power supply operating in constant current mode. The compliance range is the range of voltages needed to sustain a given value of current constant throughout a range of load resistances.

constant current power supply (current regulaator)—A power supply capable of maintaining a preset current through a variable load resistance. This is achieved by automatically varying the output current in order to maintain the ratio Eout/Rload constant.

constant voltage power supply (voltage regulaator)—A power supply that is capable of maintaining a preset voltage across a variable load resistance. This is achieved by automatically varying the output current in order to maintain the product of load voltage times load resistance constant.

control ratio—The required change in control resistance to produce a one volt change in the output voltage of a power supply. The control ratio is expressed in ohms per volt and is the reciprocal of the bridge current. (See Figure 1).

control range—The range of voltage or current over which a controlled parameter may be adjusted.

cooling—The process of removing heat. Power supplies are cooled by transferring their heat of dissipation to the air. Methods include convection and forced-air circulation. Heat removal by direct radiation and by conduction also occurs.

Figure 1—Kepco comparison bridge connected as a voltage regulator.
crossover, automatic—The form of an output locus on the E/I plane consisting of independently adjustable, perpendicular voltage and current lines intersecting at the "crossover point." Power supplies having an automatic crossover characteristic operate equally well as voltage or current sources, the mode of operation being a function of the intersection between the load line and the E/I locus. (See Figure 3.)

current compensation—A means of compensating the inevitable shunt conductance in circuits connected across the terminals of a current regulator, similar to the error sensing provisions of a voltage regulator.

current cutoff — An overload protective mechanism which resembles automatic crossover except that the current locus is not so tightly regulated and is intended for protection rather than constant current operation. (See Figure 5.)

current limiting—An overload protective mechanism which resembles automatic crossover except that the current locus is not so tightly regulated and is intended for protection rather than constant current operation. (See Figure 5.)

current sensing resistor—A resistor placed in series with the load to develop a voltage proportional to load current. A current regulated d-c power supply regulates the current in the load by regulating the voltage across the sensing resistor.

drift—(See Stability)

error signal — The error signal is the difference between the output voltage and a fixed reference voltage compared in ratio by the resistors at the null junction of a comparison bridge. \( E = E_0 - E_1 \) (See Figure 1) The error signal is amplified to drive the series pass elements and correct the output.

feedback—The process of returning part of the output from a system to its input. If out of phase, this has the effect of cancelling part of the output, reducing the input/output gain. The use of feedback is fundamental to all control systems, including power supplies. The feedback attenuates the errors in proportion to the amount of feedback and provides the regulation necessary to control a d-c output.

feedback capacitor—A capacitor placed in the feedback path to alter the a-c feedback characteristic. The capacitor may be used for either lead or lag phase compensation.

feedback resistor—in an inverting amplifier, the resistor that couples output to input is called the feedback resistor, \( R_f \). In a power supply employing the operational design concept, the feedback resistor corresponds to the voltage control. (See Figure 6).

filters—Filters are RC or LC networks arranged as low pass to attenuate the varying components that remain when an a-c voltage is rectified. In power supplies without subsequent active series regulators, the filter determines the amount of "ripple" that will remain in the d-c output. In supplies with active feedback, series regulators, the regulator mainly controls the ripple with output filtering serving chiefly for phase-gain control as a lag element and as an energy storage to minimize output voltage transients.

FLUX-O-TRAN®—A registered trademark of Kepco, Inc., applied to ferro-resonant voltage regulating transformers of a special design, which are used in many power supply designs. The Flux-O-Tran, with its resonating capacitor, provides a squared-wave output (for high rectifier and filter efficiency) whose magnitude is largely independent of the primary voltage amplitude. (See Figure 7.)

frequency response—The measure of an amplifier or a power supply's ability to respond to a sinusoidal program. The frequency response measures the maximum frequency for undistorted full output voltage excursions.

heat rise—The temperature increase due to self-heating in power supplies, as in all dissipative devices. Good design must allow for the anticipated heat rise internally in addition to the external environmental temperature.

heat sink—A thermal sink used to enhance the transfer of heat from its dissipative sources (pass transistors, rectifiers, etc.) to the external environment. A heat sink is ordinarily a relatively large metallic (usually copper or aluminum) structure to which the heat sources are fastened, and which is, in turn, ar-
ranged to transfer the heat to an exchange medium (water, air, etc.)

high speed regulator (fast slewing)—A power-supply regulator which, by the elimination of capacitors from its output filter, is capable of rapid programming of output voltage and/or quick response as a current source.

hybrid—A combination of disparate elements to form a common circuit. In Kepco power supplies, hybrid refers to the combination of vacuum tubes and transistors in a regulating circuit used for the control of high-voltage operation.

impedance transformer—An operationally controlled power supply functions as a voltage follower having high input impedance and low output impedance in a noninverting amplifier configuration, with unity voltage gain.

inverting amplifier—An amplifier whose output polarity is reversed as compared to its input. (See Phase Shift.) Such an amplifier is negative feedback by a connection from output to input, and, with high gain, is widely used as an operational amplifier. An operational dc power supply can also be described as a high gain inverting amplifier. (See Figure 8).

isolation voltage—A rating for a power supply which specifies the amount of external voltage that can be connected between any output terminal and ground (the chassis). This rating is important when power supplies are connected in series.

lag networks—Resistive-reactive components, arranged to control phase-gain roll off versus frequency. Used to assure the dynamic stability of a power-supply's comparison amplifier. The main effect of a lag network is a reduction of gain at relatively low frequencies.

lead networks—Resistive-reactive components, arranged to control phase-gain roll off versus frequency. Used to assure the dynamic stability of a power-supply's comparison amplifier. The main effect of a lead network is to introduce a phase lead at the higher frequencies, near the unity gain frequency.

linearity, programming—The linearity of a programming function refers to the correspondence between incremental changes in the input signal (resistance, voltage or current) and the consequent incremental changes in power supply output. Direct programming functions are inherently linear for the Kepco bridge regulator, and are accurate to within a percentage equal to the supply's regulating ability.

loop gain—A measure of the feedback in a closed-loop system, being equal to the ratio of the open-loop to the closed-loop gains. (in dB, A-G). The magnitude of the loop gain determines the error attenuation and, therefore, the performance of an amplifier used as a voltage regulator. (See Open-loop and Closed-loop Gain).

loop (leakage) current—(See Offset Current.)

master-slave operation—A system of interconnection of the regulated power supplies in which one (the master) operates to control the other (the slave). Specialized forms of the master-slave configuration are used for: Complementary Tracking (plus and minus tracking around a common point); Parallel Operation, to obtain increased current output for voltage regulation; Compliance Extension, to obtain increased voltage output for current regulation. (See Figure 2).

modular—The term "modular" is used to describe a type of power supply designed to be built into other equipment, either chassis or rack mount. It is usually distinguished from laboratory bench equipment by a lack of meters and controls.

MTBF (mean time between (or before) failure)—A measure of reliability giving the time before first failure or, for repairable equipment, the average time between repairs. MTBF may be approximated or predicted by summing the reciprocal failure rates of individual components in an assembly.

null junction—The input terminal of the voltage amplifier to which the input or reference is connected together with the feedback. The null junction supports a virtual ground because of its large voltage gain to the output, and is the terminal for which the input offset voltage (E_o) and input offset current (I_o) are measured. Also called the summing junction. (See Figure 6).

offset current—A dc current flowing into an amplifier's input terminal (null junction) when the input or reference source of current is disconnected. The fixed or initial part of the offset current (termed I_{o}) may be adjusted to zero by summing a current of opposite direction. The variations in offset current (I_{o}) can be specified as a function of line, load, time and temperature variations. (See Operational Equation and Figure 8).

offset voltage—A dc potential remaining across an amplifier's input terminals (from null junction to common) when the output voltage is zero. The fixed or initial part of the offset voltage (termed E_{o}) may be adjusted to zero on some models, on others it is fixed with a negative polarity. The variation of the offset voltage (E_{o}) can be specified as a function of line load, time and temperature variations. (See Operational Equation and Figure 8).

open-loop gain—The gain, measured without feedback, is the ratio of the voltage appearing across the output term (or pair) to the causative voltage required at the (input) null junction. The open-loop gain is denoted by the Symbol (A) in diagrams and equations. (See Closed-loop and Loop Gain).

operational equation—The output (E_o) of a power supply can be related to its input reference (E_r) by an equation which includes the operational gain G. For an inverting amplifier, G = -R_o/R_i. The ratio of feedback to input resistance.

Omitting the effect of input offsets:

\[ E_{o} = G \cdot E_{r} (R_{o}/R_{i}) + E_{o} (1 + R_{o}/R_{i}) + L/R_{i} \]

Including the effect of input offsets:

\[ E_{o} = G \cdot E_{r} (R_{o}/R_{i}) + E_{o} (1 + R_{o}/R_{i}) + \Delta E_{o} (R_{i}) \]

(assuming \( \Delta R_{o} \) and \( \Delta E_{o} \) are negligible for line, load, time or temperature).

operational power supply—A power supply whose control amplifier has been optimized for signal processing applications rather than the supply of steady-state power to a load. A self-contained combination of operational amplifier, power amplifier and power supplies for higher power operational applications.

\[ E_{o} = G \cdot E_{r} (R_{o}/R_{i}) + E_{o} (1 + R_{o}/R_{i}) + \Delta E_{o} (R_{i}) \]

(assuming \( \Delta R_{o} \) and \( \Delta E_{o} \) are negligible for line, load, time or temperature).
operational programming—The process of controlling the output voltage of a regulated power supply by means of signals (which may be voltage, current, resistance or conductance) which are operated on by the power supply in a predetermined fashion. Operations may include algebraic manipulations, multiplication, summation, integration, scaling and differentiation. (See Figure 6).

output impedance—The effective dynamic output impedance of a power supply is derived from the ratio of the measured peak-to-peak change in output voltage to a measured peak-to-peak change in alternating load current. Output impedance is usually specified throughout the frequency range d-c to 100 kc. (See Figure 6).

overshoot—A transient rise beyond regulated output limits, occurring when the a-c power input is turned on or off, and for line or load step changes.

parallel operation—The connection of two or more elements or supplies such that corresponding polarity terminals are connected together, and their currents sum in a load.

pass element—An active circuit element used to control the output of a series regulated power supply by varying its conduction. The pass element (commonly a transistor or tube) is arranged between the raw d-c source and the output terminals, controlled by an amplifier to produce a voltage drop across its own terminals.

phase margin—The amount of phase shift, subtracted from 180°, found in a feedback system at the frequency for which its gain reaches unity. The margin from 180° represents the degree of dynamic stability.

phase shift—The time difference between corresponding points of a waveform at different places in a circuit. (Example: input and output). Based on 360° for a single cycle, the time lead or lag is expressed in degrees. An inverting amplifier, for example, ideally exhibits 180° phase shift.

power factor—The ratio of real to reactive power at a single cycle, the time lead or lag is expressed in degrees. An inverting amplifier, for example, ideally exhibits 180° phase shift.

power supply (a-c to d-c)—Generally, a device consisting of transformer, rectifier and filter for converting available a-c to a prescribed d-c voltage or current.

programming—The control of any power supply functions, such as output voltage or current, by means of an external or remotely located variable control element. Control elements may be variable resistances, conductances, or variable voltage or current sources. (See Figure 10).

programming ratio—The ratio of command signal to output. For a voltage regulator, resistance controlled, the programming ratio is expressed in ohms per volt, and is a reciprocal function of the power supply's control current. (Example: a 1 mA control current corresponds to 1000 ohms per volt. 10 mA corresponds to 100 ohms per volt.)

programming speed—The rate of change of output voltage following a step command measured as the chord of the exponential from the origin to the first time constant. The programming speed also governs the response time of the power supply when it functions as a current regulator. (See Figure 11).

recovery time—A measure of the transient response to a step load change, recovery time signifies the time required for the controlled parameter to return to within a specified level. In Kepco power supplies, the specified level is the d-c load regulation specification. Recovery time is used for conventionally filtered voltage regulators to describe the recovery for a step change in load current.

rectifier—A device used to convert an alternating waveform to a direct current (d-c); part of the raw supply in all a-c/d-c power supplies. Half wave rectifier: produces d-c from a-c by passing alternate half cycles of the same polarity. Full wave rectifier: produces d-c from a-c by reversing alternate half cycles so they are of the same polarity. (See Figure 12a and b).

regulated power supply—An energy converter containing rectifiers or elements designed to make its output resemble the ideal of either a voltage source (low impedance) or a current source (high impedance). Usually also containing elements intended to make the output insensitive to changes in the source or line.

regulation—(v) The process of controlling a parameter (voltage or current) for the purpose of maintaining it constant. (n) The amount of change observed in the controlled parameter versus the causative variation in line, load, temperature or time. Variations for each cause are usually specified separately.

regulation, line—(v) The process of regulating against changes in primary (line) voltage. (n) The amount of output change experienced when the line varies through a prescribed amount.

regulation, load—(v) The process of regulating against changes in load. (n) The amount of output change experienced when the load varies through prescribed limits.
remote error sensing—A means by which a regulator circuit senses the potential at a remote point (usually the load) and causes the power supply to control that voltage. This connection is used to compensate for the voltage drops in connecting wires.

resolution (control)—The minimum increment that can be spanned with a manual control. For continuous elements, the minimum increment is taken to be 1° of shaft rotation.

response time—A measure of the transient response to a step load change, response time signifies the time corresponding to a single time constant on an exponential. Response time is normally used for fast slew power supplies and current regulators for which other dynamic have been defined in terms of the time constant. (See Figure 13)

return supply—An auxiliary source used within a power supply to enable it to operate at zero output. The return supply provides a current path to generate the pass voltage drop for an unloaded supply.

ripple—An unwanted a-c component on the output of a d-c supply. May be composed of line harmonically related components, plus noise induced from other sources.

series operation—The connection of two or more elements or supplies such that alternate polarity terminals are connected together and their voltages sum in a load. Load current is equal and common through any output terminal and ground. (See Isolation Voltage.) For series connection of current regulators, master/slave (compliance extension) or automatic crossover is used.

series regulator—a form of control employing the active regulating element in series with the output (between the d-c source and the regulated output terminals).

shunt regulator—a form of control employing the active regulating element in shunt (parallel) with the output.

slaved tracking—a system of interconnection of two or more regulated supplies in which one (the master) operates to control the others (the slaves). The output voltages of the slave units may be equal or proportional to the output voltage of the master unit. (See Slaved output voltages track the master output voltage in a constant ratio.) (See Complementary Tracking and Master/Slave). (See Figure 2).

slew rate—See Programming Speed.

spoilerv resistors—A means of raising the source impedance of a voltage regulator, sufficiently to permit parallel operation, used where other means of parallel operation are not provided.

stability, long term (LTS)—The change in output or offset parameter as a function of time, at constant line voltage, load and ambient temperature (sometimes referred to as drift). Kepco specifies stability as the change experienced per 8-hour period of time.

step line voltage change—An instantaneous change in line voltage (e.g., 105-125V a-c) for measuring line regulation and recovery time.

step load change—An instantaneous change in load current (e.g., zero to full load); for measuring the load regulation and recovery time.

summing point—See Null junction.

temperature, ambient—The temperature of the environment in which operation takes place. Ambient temperature may be influenced by the dissipation of heat generating equipment in confined areas. For example, the interior of a crowded equipment enclosure may be significantly warmer than outside. However, the local environment of the component equipment, is the ambient temperature.

temperature coefficient—A measure of an instrument's response to a variation in its environmental temperature; normally expressed in a percentage of change per degree temperature variation.

temperature, operating—The range of environmental temperatures between which specified operations can be obtained. For power supplies, the temperature is measured exclusive of the heat rise, below the equipment or at the air intake.

temperature, storage—The range of environmental temperatures through which safe storage is possible without deterioration of any physical or operating parameter, and so that the unit will reliably function when returned to a temperature within its operating temperature range.

unipolar—Having but one pole, polarity or direction. Applied to amplifiers or power supplies, it means that the output can vary in only one direction from zero and, therefore, will always contain a d-c component. (See Bipolar).

unity gain bandwidth—A measure of a gain-frequency product of a transistor. Unity gain bandwidth is the frequency at which the open-loop gain becomes unity, based on a 6 db per octave crossing. (See Figure 14). Typical Gain-Frequency (Bode) Plot.

virtual ground—The condition existing at the input terminals of a high gain voltage amplifier. If this gain is large, the input is small and may be assumed "virtually zero", thus the input terminal is at virtually ground potential.

VIX—A Kepco designation for a visual hosts the various classifications to indicate the mode of operation—voltage or current.

voltage reference—A source of potential employed as the comparison reference for a power supply. The reference is usually based on a temperature-compensated zener diode energized from a separate regulated source. In the operational sense, the voltage reference forms the input to the amplifier.

warmup time—The time (after power turn-on) required for the output voltage or current, to reach an equilibrium value within the stability specification. The time is typically a function of power supply loading and size and will vary from 15 to 45 minutes.
The modern regulated power supply is a versatile instrument, capable of performing a wide range of signal and power control functions. To get the most from such equipment, a clear understanding of the fundamentals is essential. These notes seek to provide a basis for this understanding, using Kepco's operational notation as the basis for describing power supply performance.

For an expanded treatment of the subject, the Kepco Power Supply Handbook can be obtained by writing to the Publications Manager, Kepco, Inc., 391-38 Sanford Avenue, Flushing, N.Y. 11352. Additional text material is listed in the bibliography.

GENERAL

Power supplies, as manufactured by Kepco, have two fundamental tasks, "regulating" (or the maintaining constant) of voltages and currents, or control, meaning the ability to adjust — or modulate the output voltages and currents. These two seemingly opposite tasks are performed by the same feedback circuit in essentially the same way, and may even occur simultaneously. For example, voltage may be regulated against primary (AC) power variations yet controlled (varied) by an external modulating signal. As a matter of convenience, somewhat different language is used to describe the behavior of a power supply when it is asked to regulate than when it is called upon to control. But because they depend on the same physical circuits, it is possible to translate easily from one set of terms to another. Users will find it convenient to use whichever language best fits the circumstances at hand.

Those power supplies which by their design are especially suited for control purposes are termed "operationally programmable," and have their performance specified two ways. In terms of their regulator performance (as a power supply) and in terms of their control ability (as if they were DC amplifiers). Indeed, viewed operationally, programmable power supplies do resemble unipolar, high power DC inverting amplifiers, and the language used to describe their performance is similar to the operational amplifier lexicon.

The Kepco "OPS" series power supplies carry the amplifier identification one step further by substituting amplifier-type controls (gain, offset, patch panels, etc.) for power supply controls, meters, voltage/current adjustments, etc. These models are identified by their "OPS" prefix.

This catalog also lists power supplies with a unique special characteristic, "operationally programmable," and have their performance specified two ways. In terms of their regulator performance (as a power supply) and in terms of their control ability (as if they were DC amplifiers). Indeed, viewed operationally, programmable power supplies do resemble unipolar, high power DC inverting amplifiers, and the language used to describe their performance is similar to the operational amplifier lexicon.

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The paragraphs that follow detail these special characteristics.

THE POWER SUPPLY—AMPLIFIER ANALOG

In terms of its ability to control voltage or current, a power supply may be viewed as a special form of operational amplifier. That is, it has an "input" or null junction, an output, and a terminal common between them. The amplifier used in a power supply's regulator exhibits from 80 to 120 db of open-loop gain so that with feedback, the simplifying assumptions of operational analysis may be applied.

Drawing the power supply symbolically as an amplifier, the terminals corresponding to input/output and common are easily identified. In fact, it is not really necessary to show the amplifier and pass elements and raw DC supply as separate elements, if we are merely interested in their external behavior, the simplified diagram of Figure 2 may be substituted.

Assuming large gain A, the amount of signal ε required to produce Eo, the output, is small. If ε is sufficiently small, it can be considered zero for the purposes of this analysis, and the equation of balance becomes:

\[ E_o / R_1 = \varepsilon / R_1 \]

where \( E_o \) is the output voltage, \( R_1 \) is the feedback resistance, and \( R_1 \) is the gain.

The use of the analog model enables a designer to visualize the effects of various control modes and their inter-relationships. For example, the conventional power supply voltage control adjustment (Rf) is seen to operate the equipment as a variable gain amplifier with a fixed input (called the reference). Or, fixing \( R_1 \) and \( R_1 \), a variable voltage may be substituted for the reference to drive a fixed gain amplifier. This we call programming by external voltage.

If \( R_1 \) is varied instead of \( E_o \) or \( R_1 \), inverse programming results because \( R_1 \) is in the denominator of the equation:

\[ E_o = \varepsilon / (R_1/R_1) \]

As an inverting amplifier, the input is applied through \( R_1 \) to a terminal pair supporting a null. The input impedance is, therefore, \( R_1 \). A power supply may, however, be driven between the output and null junction, in which case it becomes a noninverting amplifier with high input impedance and unity gain, a "voltage follower" or "impedance transformer." (See Figure 3).

Because of the power supply's ability to successfully emulate its operational model, there are many jobs which may be undertaken by operational power supplies which
combine the characteristics of an amplifier (high gain, fast slewing, low offset) with the advantages of a power supply (high power, self-contained sources, self-regulating).

OFFSET RATINGS

The operationally programmable and OPS model Kepco Power Supplies are extraordinarily versatile in their application to complex control problems. No longer are the traditional line and load regulation specifications sufficient to define the performance.

Kepco has adopted the input referred offset form of specification writing for these units to obtain a more generalized form of rating, one that is independent of the associated input and feedback elements. For convenience, the offsets are divided into two parts, offset voltage and offset current. They are specified separately as variables for line, load, temperature and time changes. The offset voltage and offset current also have a fixed or initial part which does not contribute to an output change, and can be adjusted at will, or nulled, as desired.

In this catalog, the symbol $E_{io}$ is used to represent the input offset voltage, and $\Delta E_{io}$ its variable part. $I_{io}$ is the input offset current and $\Delta I_{io}$ is the variable part.

![Figure 3](image)

**Figure 3—Power supply/amplifier drawn as a non-inverting unity gain follower with high input impedance.**

To compute the effect of a particular parameter change (line, load, temperature or time) on the output of the amplifier/pVECTOR supply, it is only necessary to know the input and feedback impedance, and the reference.

REMOTE ERROR SENSING:

Precision voltage regulators with substantial current ratings are always equipped with error-sensing terminals that are separate from the output terminals. The sensing terminals correspond to the common point and feedback point, respectively, and are the terminals across which the power supply actually controls its voltage. To regulate voltage at any point remote from the power supply, separate wires should be run from the respective sensing terminals to the desired sensing point. The power supply will thereupon regulate or control the voltage at that point. There is provision for as much as 0.5 V drop per output power lead in Kepco power supply designs. For a change in load current, the output terminal voltage will alter automatically to compensate for this much line loss to regulate the remote sensing point.

To preserve the step-load current transient response (recovery time), a power supply’s output filter-capacitor is not connected to the output terminals (where it would have to charge and discharge as the output compensated for a varying line drop). Instead, the filter is connected directly to the error-sensing terminals where it limits the transient excursion by acting as a local energy source during the recovery interval.

There is a special diode connected across each error-sensing link (to the respective output terminal), whose function is to conduct should the connections be inadvertently omitted. These diodes prevent an uncontrolled response when the links are open and a remote connection is missing.

In laboratory supplies, the output and error-sensing wires are routed first to the front panel terminals and thence to the output/sensing pair normally located at the rear. This has the effect of being an automatic sensing selector placing the sensing point effectively at whichever output terminal pair (front or rear) happens to be in use.

DYNAMICS

The time and frequency domain characteristics of a power supply are specified in terms of its response to a step or sinusoidal variation of either voltage or current.

As a voltage regulator, load variations manifest themselves as a change in current. In the time domain (step response), the dynamics are usually expressed as a "response time" or "recovery time": while in the frequency domain, the dynamics are expressed in a plot of the output impedance vs. frequency.
As a current regulator, load variations manifest themselves as a change in the compliance voltage. The rate of change of the compliance voltage, the voltage slew rate, governs the time response (recovery) and frequency characteristics ([output impedance]). For conventionally filtered equipment, it is functionally dependent on the ratio of the output current limit to output capacitance:

\[
\frac{\Delta V}{\Delta t} = I_{\text{lim}} C_o
\]

This will vary widely, having a mean value of a few hundred volts per second for most supplies. Because the slew rate \(\frac{\Delta V}{\Delta t}\) varies as a function of the current limit setting, and as a function of the value of an electrolytic capacitor, it is usually not specified for a conventional power supply.

High-speed power supplies, operational power supplies (OPS) and models offering normal/high-speed convertibility have much faster slew rate abilities, ranging from 50,000 to 1,000,000 volts per second. For these models, a response time for step load variations in current mode can be specified in terms of volts per microsecond. A 100,000 volt per second slew rate means 0.1 volt per microsecond transient response as a current regulator.

Because the slew rate is defined as the slope to the first time constant (63%), the response time rather than recovery time is used to describe the transient behavior of a current regulator. Response time refers to 63% recovery, while recovery time usually refers to a specific level—the DC load regulation level for all Kepco voltage regulators.

The slew rate of a power supply also governs the sinusoidal bandwidth that the circuit will pass, undistorted, as a linear function of amplitude. Figure 27 plots several slew rates vs. peak-to-peak sinusoidal amplitude to help determine the maximum frequency. For example, a model having a programming speed of 500,000 V/sec and programmed (commanded) to produce a 10 V peak-to-peak output sinusoid will have a 16 kc. band pass.

### Output Impedance

As the time domain expression of a power supply's dynamics, the output impedance represents the "dynamic regulation" and is usually measured and specified.

For a voltage regulator, the output impedance \(Z_o\) is the incremental impedance obtained by varying the load current \(I_o\) and observing the small resulting voltage swing \(E_o\):

\[
Z_o = \frac{E_o}{I_o}
\]

\(Z_o\) is ordinarily expressed as a function of frequency. Of primary importance, however, is not the magnitude of the impedance at any arbitrary frequency, but rather the shape of the plot \(Z_o\) vs. frequency.

Above 10 to 20 kc, the impedance is mostly reactive (inductive) and can be specified by stating the equivalent inductance in microhenries. From the reactance chart, a 1 microhenry inductance is about 0.6 ohms at 100 kc. Connecting wires also contribute a series inductance, usually substantially larger than the equivalent inductance of the supply itself and should be accounted for when estimating the high frequency impedance presented by the supply and its wires to a load.

Plotted vs. log frequency, the impedance should show a smooth curve similar to Figure 6. Any peaks or pronounced dips, particularly in the region of the breakpoint near 1 to 10 kc, indicate a misadjustment of the AC stability controls (lag networks) or a marginal output filter capacitor.

![Figure 6- Typical power supply output impedance plot on log-log paper.](Image)

Since many load circuits depend upon the decoupling effect of a power supply's low source impedance, the following procedures are recommended to minimize the effect of wiring inductance: load wires should be twisted together and should be of the heaviest possible gauge. Remote error sensing wires should be twisted together, and, in addition, a capacitive bypass directly at the load terminals is very useful. Such a capacitor acts at a local energy source, compensating for the load wiring inductance. When particularly long sensing leads are used, it is sometimes helpful to connect local sensing bypass capacitors to the power supply. These would be placed between the individual plus and minus output terminal and their respective error sensing terminal. They serve to bypass the combination of load wire and sense-wire inductance and prevent transient instability.

### CURRENT REGULATION

Power supplies regulate current by controlling the voltage drop across a sensing resistance placed in series with the load. By regulating the voltage across a fixed resistor, the current through it, and the load, is regulated.

The features chart on Page 2 lists models designated as "automatic crossover" designs. This means that a current sensing circuit, with a built-in sampling resistor, amplifier, and gate, is included as part of the supply. Such supplies have two independent sensing and control circuits: one for voltage, the other for current.

Other models, designated as being suitable for "current regulation"—but not automatic crossover designs—have a single sensing and control amplifier which is normally used to sense voltage. In these designs, access terminals are provided, together with instructions for conversion to current sensing and control using the external components.

![Figure 7- Current regulating configuration.](Image)

For most models, a minimum current level is specified. Special techniques can be employed to alter and even eliminate this minimum level. Please refer to Chapter 4, Current Regulation, in the Kepco Power Supply Handbook.
AUTOMATIC CROSSOVER

Power supplies featuring the twin regulator circuit, for voltage and current, have what is known as an automatic crossover output characteristic. Such power supplies operate either as voltage regulators or current regulators, crossing over automatically, from one mode to the other as determined by the voltage and current level settings, and the load resistance.

Figure 8—Kepco twin-bridge automatic crossover circuit.

On the E/I plane, the locus of a voltage regulator is a horizontal line, adjustable vertically. The locus of a current regulator is a vertical line, adjustable horizontally. Their intersection, for any given pair of adjustments, is the crossover point. A power supply with these adjustments operates at a point determined by the intersection of the locus lines with a radial load line representing a resistance.

Figure 9—Typical characteristic automatic voltage/current crossover.

Power supplies equipped to operate this way are self-determining, able to drive any load from zero to infinity without difficulty, and incapable of overload.

Figure 10—The locus of a variable load resistance is a plane corresponding to the first quadrant. An infinite resistance (open circuit) corresponds to the voltage (vertical) axis. A zero resistance (short circuit) corresponds to the current (horizontal) axis. Resistors from 0 to \( R_{L_{max}} \) span the first quadrant.

Automatic crossover power supplies operate equally well as voltage and current regulators. They are provided with two controls for the purpose of setting levels. Kepco reserves the use of the term “automatic crossover” to those supplies in which the internal current regulator is comparable to the voltage regulator.

If immunity to overload is the prime objective, then a less sophisticated sort of circuit might be chosen. This is called current limiting, which provides a locus similar to that of an automatic crossover supply, but lacking the sharp precision in current mode that characterizes a true current regulator.

Figure 11—Current limiting curves. Note that \( I_{lim} \) is always greater than the current at which limiting begins, \( I_{lim} \).

Current limited power supplies are intended for operation only along the horizontal (voltage mode) part of its output locus. The vertical part serves only to prevent overload damage.

VIX®

As a convenience, some automatic crossover models are equipped with a pair of indicator lights, and an output signal jack, to signal the mode of the equipment. The VIX (Voltage/Current Crossover) circuit is connected to the power supply's decision gate, and by lighting one lamp or the other, enables a user to know the mode chosen by his power supply equipment. There is a ±8V DC signal, isolated, whose polarity reverses at crossover and which may be used to activate alarm signal devices or automatic machinery. An accessory, Model VIX-1C operates on 3PDT, 115V AC, 10A relay at crossover to power external apparatus. BHK models provide a relay contact closure directly as an external VIX signal.

CURRENT CUTOFF:

The Kepco PWR and PAR designs employ a current cutoff form of overload protection in which both voltage and...
current diminish simultaneously when the load exceeds the limit setting plotted on the EZI plane. The cut off locus has a form of Figure 12. Operation occurs at the intersection of the radial load line with the operating characteristic. As the load resistor is made smaller, the load line rotates clockwise. At the limit point, it can be seen that the operating point migrates rapidly back toward the origin. This design allows for some degree of remote programmability with the proviso that the current rating denotes linearly with voltage setting, i.e., at half voltage, approximately half current can be drawn.

**FLUX-O-TRAN®**

Kepco's PR, PRM, SM and PWR Power Supplies use a special regulating power transformer that operates on the flux-oscillating, resonant tank principle. Briefly, the Flux-O-Tran secondary is wound on a separate magnetic structure, separated from the primary by a special magnetic shunt. It is connected to a tank capacitor to form a resonant circuit at the line frequency. When excited, the resonant circuit builds up sufficient flux to saturate the iron core on each half-cycle. The output waveform is as shown in Figure 14, having a generally rectangular shape which, when rectified, offers a lower peak-to-average ratio for better load regulation and smaller ripple. Power supplies employing the Flux-O-Tran have the advantage of line regulation, line isolation (transients and spikes do not get through a Flux-O-Tran), load regulation, low ripple, and overload protection. When shorted, the Q of the resonant tank won't support oscillation, all within a very simple, extremely rugged high voltage series pass tube to regulate the high voltage. These designs are used from 200V DC to 2500V DC in power ratings from 20 watts to 200 watts.

**HYBRID DESIGN**

High voltage power supplies in the Kepco HB, BHK, and ABC design classifications employ a unique combination of solid state reference and amplifier circuits with rugged, high voltage series pass tubes to regulate the high voltage. These designs are used from 200V DC to 2500V DC in power ratings from 20 watts to 200 watts.

**SERIES AND PARALLEL:**

Voltage regulators are easily connected in series, and current regulators are easily paralleled. On some supplies, special provisions are made for paralleling voltage regulators, and most current regulators have provision for series compliance extension. Automatic crossover supplies, since they are free to choose their mode automatically, may be series or parallel connected without concern. However the arrangement for interconnecting power supplies in series or parallel, an isolating diode is recommended to prevent damage to one supply by another. For parallel current regulators, this takes the form of a diode in series with each source.

![Figure 16](image)

Figure 16—Diodes protect parallel current regulators.

For series voltage regulators, a shunt diode across each power supply is the recommended precaution.

![Figure 17](image)

Figure 17—Reverse diodes protect a series string of voltage regulators.

**MEASUREMENTS:**

The following circuits and techniques can be employed to verify power supply performance characteristics. Depending on the type of power supply, measurements may be made for voltage regulation vs. primary power (line), current (load), environment (temperature) and time (stability). Similar measurements are also performed for current regulation in those supplies possessing two control terminals. Of course, to drive a real load with equivalent parameters, the remote-sensing connection would be used to compensate for the inevitable series resistance of the load-connecting wires.
Current regulators require the precaution of eliminating shunt conductance paths if accurate results are to be obtained. The most obvious example of a shunt conductance is a voltmeter or similar instrument, which may remain connected after the voltage-measuring procedures are completed. Current regulation is usually evaluated by inserting a sensing resistor in the current flow path, and proceeding to monitor its voltage drop as a measure of the current. In general, a separate resistor should be used for this purpose, not the same resistor that the power supply employs for its own current sensing. The sensitivity of measurement will depend on the size of the sample, with larger voltages yielding greater sensitivity. The limit in this regard is simply the amount of voltage compliance range that can be devoted to the measuring resistor rather than the load.

Ripple, measured in either voltage or current modes, should be expressed in the correct units for the mode. Current ripple in amperes; voltage ripple in volts. Specifications are written in terms of rms volts, but observations of the peak-to-peak ripple should also be made to ensure that the ratio not exceed 3:1 to 5:1. The oscilloscope monitor should always be used to ascertain that there are no nonharmonic frequency components, particularly at high frequencies, and that there is not an excessive 60-cycle component (indicative of pickup/grounding problems in the measurements setup).

LOAD REGULATION:

Vary the load voltage or current in a step fashion and observe the resulting change in the measured parameter at its sensing terminals. For voltage load regulation, measure at the power supply's error-sensing terminals; for current load regulation, measure at the signal terminals of the current-sensing resistor. To express regulation as a percentage, divide the observed change by the output setting or sample magnitude and multiply by 100. Be certain that the means used to vary the primary voltage is capable of withstanding the AC component (indicative of pickup/grounding problems in the measurements setup).

OFFSET VOLTAGE:

To measure line regulation, vary the primary power to its rated limits and observe the corresponding change in output voltage or current at their respective sensing points. To obtain the percentage, divide by the magnitude of the output — or the sample — and multiply by 100. Be certain that the means used to vary the primary voltage is capable of withstanding the load imposed by the power supply and measure the AC voltage at the AC terminals or line cord of the supply to avoid including the line drop in the calculations.

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To measure \( E_{\text{Io}} \) vs. load with the output at zero, will require an auxiliary power source to pass current through the output loop — to overcome the ohmic loss in the circuit wires. Alternatively, the feedback resistor [voltage control] can be set to produce a small output voltage, sufficient to pass the rated current in a load. This procedure adds the effect of internal reference voltage variation and. \( I_{\text{Io}} \) changes to the \( E_{\text{Io}} \) measurement, but if the output voltage is kept small, the errors are negligible and can be ignored.

For line variation effects, temperature coefficient and stability measurements monitor \( \Delta E_{\text{Io}} \) as the respective parameter is varied through known limits.

**OFFSET CURRENT: \( I_{\text{Io}} \)**

\( I_{\text{Io}} \) is measured by monitoring the output voltage when the reference source of control current is disconnected. Because there is no way to eliminate \( E_{\text{Io}} \) from the output of a power supply, \( I_{\text{Io}} \) is isolated for the purpose of measurement by making its effect very large with respect to other contributions. This is done by disconnecting the power supply’s reference \( E_{\text{R}} \) and substituting for \( R_{\text{f}} \) a large resistance in the feedback path. Resistances of 100K to 1 meg are commonly used, together with capacitors of between 0.1 and 1 microfarad (\( C_{\text{f}} \)), to minimize ripple interference with the measurement: \( I_{\text{Io}} = E_{\text{Io}} / R_{\text{f}} \) with \( R_{\text{f}} = 1 \) megohm; 1 mV at the output \( (E_{\text{R}}) \) corresponds to 1 nanocoulomb \( I_{\text{Io}} \).

For line, load, temperature and time variations of \( I_{\text{Io}} \), measurements are made by observing the output while selectively varying the respective parameters, as in the previous procedures.

**OUTPUT IMPEDANCE:**

Voltage load regulation can be expressed as the change of output voltage for a given change in load current \( \Delta E / \Delta I \); it can be seen to have the units of an impedance. A plot of this impedance vs. frequency of load change will define the dynamic regulation of a power supply. To measure impedance vs. frequency, a means of sinusoidally modulating a load is required. Since the impedance is a ratio, the amount of modulation required is not great.

Figure 23 illustrates one way to accomplish load modulation using a power amplifier in parallel with a fixed load resistor. \( Z_{\text{Lo}} = \Delta E / \Delta I \)

Soldered

Voltage pick off lugs

Figure 22—Minimum inductance construction for a sensing resistor to measure a-c impedance.

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Figure 25—Slewing rate test circuit. Power supply drawn operationally.

Figure 26—Exponential response to a step program showing method of measuring slew rate.

Figure 27—Slewing rate chart.

SLEWING RATE CHART

Slope limited power supplies have their sinusoidal bandwidth limited by the product of frequency (f) and the peak-to-peak signal amplitude (E_{pp}) in the equation:

\[
\text{Slewing rate} = \pi f E_{pp}
\]

The chart above, plots E_{pp} vs. (f) for several values of the slewing rate from 10,000 volts per second to 5,000,000 volts per second.

These speeds are typical of the Kepco OPS, or high speed power supplies. Such supplies are designed either without an output filter-capacitor, or with a removable capacitor for convertible high-speed/slow-speed operation.

When the capacitor is eliminated in a power supply, its programming speed is greatly enhanced, as is its recovery time as a current source. On the other hand, its margin of AC stability is considerably reduced, necessitating the use of special phase-adjusting circuits to stabilize the feedback.

Lacking the field phase relationship imposed by a large output capacitor, stable operation demands that the power supply see a purely resistive load, or a maximum capacitance of 0.001 microfarad.

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NOMOGRAPH OF VOLTAGE DROP ACROSS LOAD SUPPLY LEADS
(as a function of wire size and load current)

THIS NOMOGRAPH CAN BE USED TO FIND:

1) Maximum current carrying capacity recommended for any standard wire size.*
2) Voltage drop in millivolts per foot for known wire size and operating current.
3) Wire size required for known operating current and known maximum tolerable voltage drop across supply leads.

*Based on an arbitrary minimum 500 circular mils per ampere. Higher-temperature wire class insulation will safely allow higher currents.

NOTE: A voltage regulated Power Supply controls the voltage across its output terminals. Hence the wire conductors used to connect the load must be considered as part of the load. At high load currents the voltage drop across the supply leads may appreciably degrade regulation at the load. Kepco models equipped with the remote error sensing feature can automatically compensate for voltage drops of up to 500 mv across each load supply lead.