

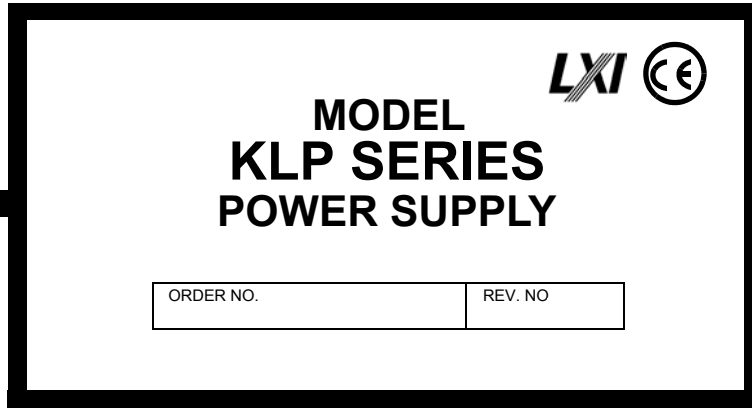
# USER MANUAL

## KLP SERIES

### POWER SUPPLY

#### 1200 WATT PROGRAMMABLE POWER SUPPLY

KEPCO INC.  
An ISO 9001 Company.



#### IMPORTANT NOTES:

- This manual is valid for the following Model and associated serial numbers:

MODEL	SERIAL NO.	REV. NO.	MODEL	SERIAL NO.	REV. NO.
KLP 10-150-1200		REV.1	KLP 10-150-1.2K		REV.1
KLP 20-120-1200		REV.12	KLP 20-120-1.2K		REV.1
KLP 36-60-1200		REV.12	KLP 36-60-1.2K		REV.1
KLP 75-33-1200		REV.25	KLP 75-33-1.2K		REV.1
KLP 150-16-1200		REV.22	KLP 150-16-1.2K		REV.1
KLP 300-8-1200		REV.14	KLP 300-8-1.2K		REV.1
KLP 600-4-1200		REV.3	KLP 600-4-1.2K		REV.1
- A Change Page may be included at the end of the manual. All applicable changes and revision number changes are documented with reference to the equipment serial numbers. Before using this Instruction Manual, check your equipment serial number to identify your model. If in doubt, contact your nearest Kepco Representative, or the Kepco Documentation Office in New York, (718) 461-7000, requesting the correct revision for your particular model and serial number.
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## Declaration of Conformity

Application of Council directives: **73/23/EEC (LVD)**  
**93/68/EEC (CE mark)**

Standard to which Conformity is declared:

**EN61010-1:2001 (Safety requirements for electrical equipment for measurement, control and laboratory use - Part 1)**

Manufacturer's Name and Address: **KEPCO INC.**  
**131-38 SANFORD AVENUE**  
**FLUSHING, N.Y. 11352 USA**

Importer's Name and Address:

**REPRESENTATIVE COPY**

Type of Equipment: **Component Power Supply**

Model No.: *[PRODUCT MODEL NUMBER]*

Year of Manufacture:

I, the undersigned, declare that the product specified above, when used in conjunction with the conditions of conformance set forth in the product instruction manual, complies with the requirements of the Low Voltage Directive 73/23/EEC, which forms the basis for application of the CE Mark to this product.

Place: **KEPCO Inc.**  
**131-38 Sanford Ave.**  
**Flushing, N.Y.11352 USA**

Saul Kupferberg  
(Full Name)

Date: \_\_\_\_\_

VP OF SALES  
(position)

## Conditions of Conformance

When this product is used in applications governed by the requirements of the EEC, the following restrictions and conditions apply:

1. For European applications, requiring compliance to the Low Voltage Directive, 73/23/EEC, this power supply is considered a component product, designed for "built in" applications. Because it is incomplete in construction, the end product enclosure must provide for compliance to any remaining electrical safety requirements and act as a fire enclosure. (EN61010-1:2001, Cl. 6, Cl. 7, Cl.8, and Cl. 9)
2. This power supply is designed for stationary installation, with mains power applied via a detachable power supply cord or via direct wiring to the source power terminal block.
3. This power supply is considered a Class 1 (earthed) product. It is intended for use as part of equipment meant for test, measurement and laboratory use, and is designed to operate from single phase, three wire power systems. This equipment must be installed within a suitably wired equipment rack, utilizing a three wire (grounded) mains connection. See wiring section of this manual for complete electrical wiring instructions. (EN61010-1:2001, Cl.6.10.1)
4. This power supply has secondary output circuits that are considered hazardous, and which exceed 240 VA at a potential of 2V or more.
5. The output wiring terminals of this power supply has not been evaluated for field wiring and, therefore, must be properly configured by the end product manufacturer prior to use.
6. This power supply employs a supplementary circuit protector in the form of a circuit breaker mounted on the front panel. This circuit breaker protects the power supply itself from damage in the event of a fault condition. For complete circuit protection of the end product, as well as the building wiring, it is required that a primary circuit protection device be fitted to the branch circuit wiring. (EN61010-1:2001, Cl. 9.5)
7. Hazardous voltages are present within this power supply during normal operation. All operator adjustments to the product are made via externally accessible switches, controls and signal lines as specified within the product operating instructions. There are no user or operator serviceable parts within the product enclosure. Refer all servicing to qualified and trained Kepco service technicians.

# SAFETY INSTRUCTIONS

## 1. Installation, Operation and Service Precautions

This product is designed for use in accordance with EN 61010-1 and UL 3101 for Installation Category 2, Pollution Degree 2. Hazardous voltages are present within this product during normal operation. The product should never be operated with the cover removed unless equivalent protection of the operator from accidental contact with hazardous internal voltages is provided:



There are no operator serviceable parts or adjustments within the product enclosure. Refer all servicing to trained service technician.



Source power must be removed from the product prior to performing any servicing.

## 2. Grounding

This product is a Class 1 device which utilizes protective earthing to ensure operator safety.



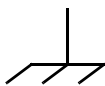
The PROTECTIVE EARTHING CONDUCTOR TERMINAL must be properly connected prior to application of source power to the product (see instructions on installation herein) in order to ensure safety from electric shock.



PROTECTIVE EARTHING CONDUCTOR TERMINAL - This symbol indicates the point on the product to which the protective earthing conductor must be attached.



EARTH (GROUND) TERMINAL - This symbol is used to indicate a point which is connected to the PROTECTIVE EARTHING TERMINAL. The component installer/ assembler must ensure that this point is connected to the PROTECTIVE EARTHING TERMINAL.



CHASSIS TERMINAL - This symbol indicates frame (chassis) connection, which is supplied as a point of convenience for performance purposes (see instructions on grounding herein). This is not to be confused with the protective earthing point, and may not be used in place of it.

## 3. Electric Shock Hazards

This product outputs hazardous voltage and energy levels as a function of normal operation. Operators must be trained in its use and exercise caution as well as common sense during use to prevent accidental shock.



This symbol appears adjacent to any external terminals at which hazardous voltage levels as high as 600V d-c may exist in the course of normal or single fault conditions.



This symbol appears adjacent to any external terminals at which hazardous voltage levels in excess of 600V d-c may exist in the course of normal or single fault conditions.



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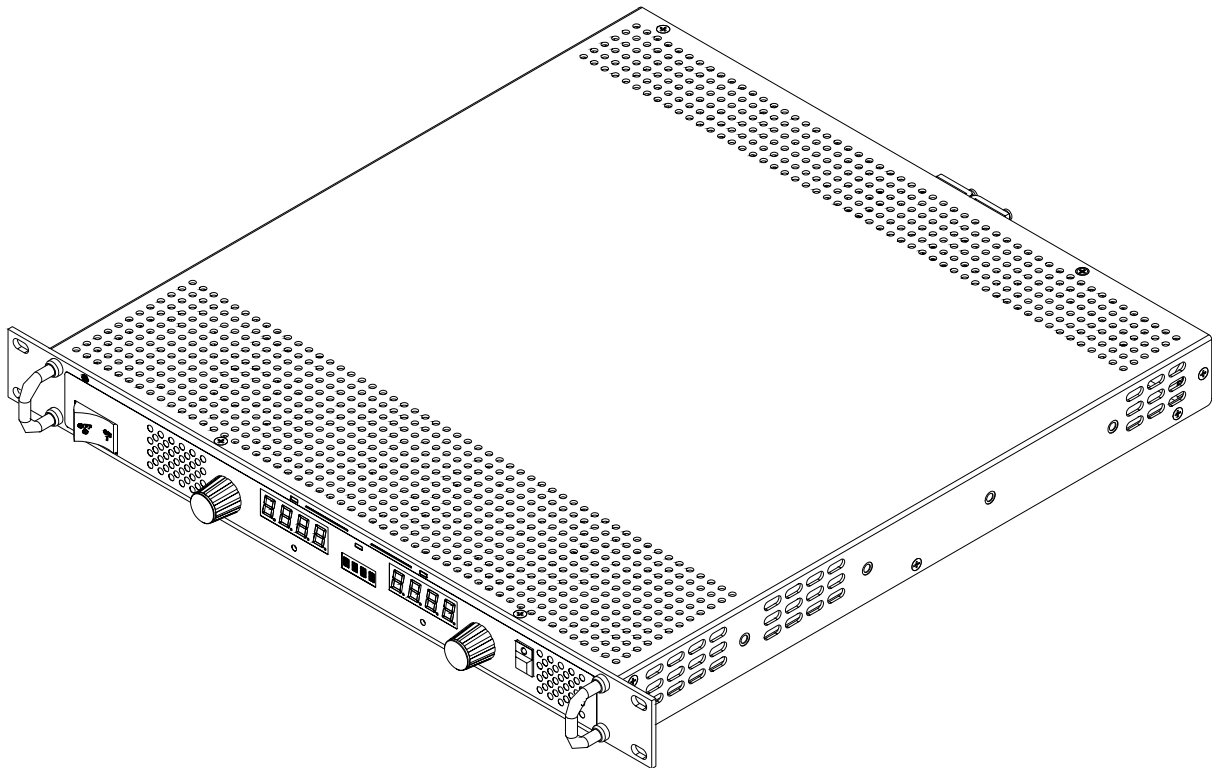
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**FIGURE 1-1. KLP SERIES POWER SUPPLY**

## SECTION 1 - INTRODUCTION

### 1.1 SCOPE OF MANUAL

This manual contains instructions for the installation, operation and service of the KLP series of 1200W output power, stabilized voltage or current, d-c power supplies manufactured by KEPCO, Inc., Flushing, New York, U.S.A.



### WARNING

DANGEROUS AND LETHAL POTENTIALS ARE PRESENT,  
BOTH WITHIN THIS POWER SUPPLY, AND AT THE OUTPUT!

Before proceeding to use the power supply, read this manual very carefully. Caution must be used when working with, and making connections to, this power supply. Use only wires with the proper voltage rating for high voltage connections.

### 1.2 GENERAL DESCRIPTION

The KLP Power Supply Series (Figure 1-1) are universal input, automatic crossover, 1200-watt constant power, voltage/current stabilizers with a full rectangular output characteristic within the voltage and current ranges listed in Table 1-1.

Six KLP -1200 Models and six KLP -1.2K Models are available, as listed in Table 1-1. The -1200 Models are GPIB and RS 232 compatible; the KLP -1.2K Models are GPIB and LAN compatible. All models allow remote analog programming.

For each model a multitude of virtual models can be configured. The "rated voltage, maximum current at rated voltage" and "rated current and maximum voltage at rated current" parameters define the virtual models available within the limit of 1200 Watts of output power (see Figure 1-2).

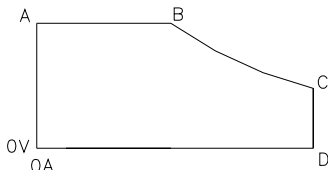
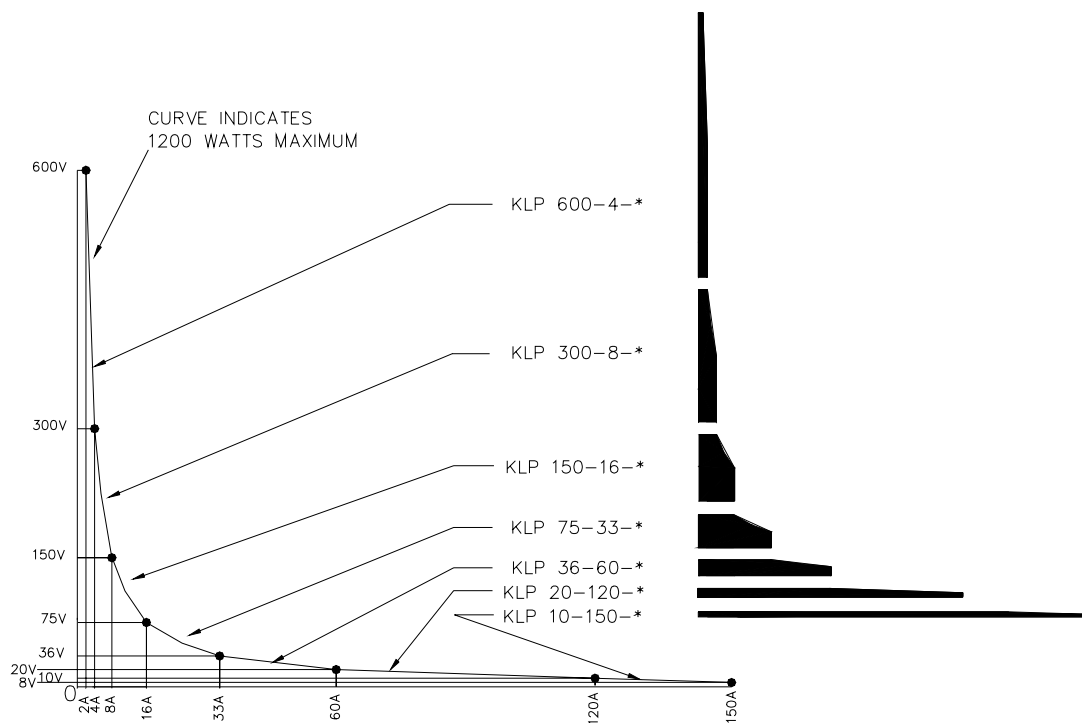
KLP power supplies operate from wide range 100-255V a-c, 45-66 Hz or 125-420V d-c input source power. Since there are no internal adjustments, KLP Power Supplies offer excellent output voltage/current stability and easy calibration.

Output voltage and current are displayed on independent LED displays. Control of the KLP can be either local, via the front panel controls and displays, or remote, using 1) either analog signals (applied to the Analog I/O Port), or 2) digital programming via either a) IEEE 488.2 (GPIB) bus, b) RS 232 communication bus [-1200 Models only]. The -1.2K Models also offer direct or web page control via the LAN port. Digital control is done with 12 bits of resolution over the entire voltage/current range.

The full-rack cross section permits mounting in a standard 19-inch wide rack (for optional chassis slides); see Table 1-4. Load connections are made at the rear panel. Sensing, monitor, and current share terminals are also available at the rear panel. Outline dimensions are provided in Figure 1-3.

### 1.3 SPECIFICATIONS

Table 1-1 lists the parameters applicable to individual models. Table 1-2 lists general specifications applicable to all models except where otherwise noted.



OPERATING REGION FOR EACH MODEL DEFINED BY POINTS A, B, C AND D. FROM POINT B TO POINT C, OPERATING REGION IS DEFINED BY 1200W MAXIMUM.

MODEL*	A	B	C	D
KLP 600-4	600V	2A	300V	4A
KLP 300-8	300V	4A	150V	8A
KLP 150-4	150V	8A	75V	16A
KLP 75.33	75V	16A	36V	33.3A
KLP 36-60	36V	33.3A	20V	60A
KLP 20-120	20V	60A	10V	120A
KLP 10-150	10V	120A	8V	150A

\* APPLIES TO BOTH -1200 AND -1.2K MODELS.

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FIGURE 1-2. KLP OPERATING REGIONS

TABLE 1-1. MODEL PARAMETERS

Model number	Rated Voltage Range <sup>(1)</sup>	Maximum current for rated voltage	Minimum programmable current	Rated Current Range <sup>(1)</sup>	Maximum voltage for rated current	Ripple and noise p-p <sup>(2)</sup>	Efficiency @115 Va-c
KLP 10-150- <sup>(3)</sup>	0-10V	120A@10V	3.2A	0-150A	8V@150A	75 mV	80%
KLP 20-120- <sup>(3)</sup>	0-20V	60A@20V	1.6A	0-120A	10V@120A	75 mV	82%
KLP 36-60- <sup>(3)</sup>	0-36V	33.3A@36V	0.8A	0-60A	20V@60A	125 mV	83%
KLP 75-33- <sup>(3)</sup>	0-75V	16A@75V	0.4A	0-33.3A	36V@33.3A	125 mV	84%
KLP 150-16- <sup>(3)</sup>	0-150V	8A@150V	0.2A	0-16A	75V@16A	125 mV	86%
KLP 300-8- <sup>(3)</sup>	0-300V	4A@300V	0.1A	0-8A	150V@8A	300 mV	87%
KLP 600-4- <sup>(3)</sup>	0-600V	2A@600V	0.05A	0-4A	300V@4A	400 mV	88%

(1) The maximum current and voltage are constrained by the 1200 watt power limitation, see Figure 1-2.

(2) Bandwidth: 20MHz; low frequency ripple may be higher at loads less than 30 Watts.

(3) Specifications listed apply to both -1200 and -1.2K Models.

**TABLE 1-2. KLP SPECIFICATIONS**

SPECIFICATION		RATING/DESCRIPTION	CONDITION/COMMENT
<b>INPUT CHARACTERISTICS</b>			
a-c voltage	nominal	110-240 Va-c	Single Phase.
	range	100-255 Va-c	Wide Range; contact factory for operation to 265V a-c.
d-c voltage	range	125-420 Vd-c	No regulatory agency approval.
Frequency	nominal range	50-60 Hz	
	maximum	45-440 Hz	Increased Leakage above 66 Hz.
Power Factor	typical	0.99	Meets EN 61000-3-2.
Maximum Input Current	120 Va-c	13A rms	Rated load (1200W).
	240 Va-c	6.5A rms	Rated load (1200W).
Inrush Current	265 Va-c	40A	Peak
	132 Va-c	20A	Peak
Input Fusing		Circuit Breaker	2-line
Low a-c Protection		Self protected	No fixed limits.
Output hold up	typical	10 milliseconds	Ride through.
Leakage Current	115 Va-c, 60Hz	5mA max	
	230 Va-c 50Hz	10mA max	
<b>OUTPUT CHARACTERISTICS</b>			
Type of stabilizer		CV/CC	Voltage/Current
Adjustment range	voltage	0-100% of rated voltage	No minimum load required.
	current	minimum to 100% of rated current	No minimum load required. See Table 1-1 for minimum programmable current.
Source effect	voltage	0.01% $E_{max}$	Over full source range.
	current	0.01% $I_{max}$	
Load effect	voltage	0.01% $E_{max}$	Over full load current range.
	current	0.02% $I_{max}$	
Temperature effect	voltage	0.02%/deg C	0-50 deg C
	current	0.05%/deg C	
Time effect (drift)	voltage	0.05%/24hr	After 30 min warmup.
	current	0.05%/24hr	
Error sensing		0.25 volts per wire	Above rated output. Contact factory for larger margins.
Isolation voltage		600 Vd-c or peak	Either output terminal to ground.
Transient recovery for load change	excursion	1% of $E_{max}$	50% load step 2A/microsecond max.
	recovery	2 msec	Return to 0.1% of setting.
Turnon/turnoff overshoot		same as load transient response limits	
Overvoltage protection	voltage	20-120% of $E_{max}$	Programmable; see PAR. 3.2.13.5.2.
Overcurrent protection	current	72-120% of $I_{max}$	Programmable; see PAR. 3.2.13.5.2.
Overtemperature protection		Shutdown	See PAR. 3.2.13.5.2.
Open Load wire protection		Shutdown	See PAR. 3.2.13.5.2.
Parallel operation		Active load sharing within 5% of $I_o$ rated	Up to 5 units, maximum.

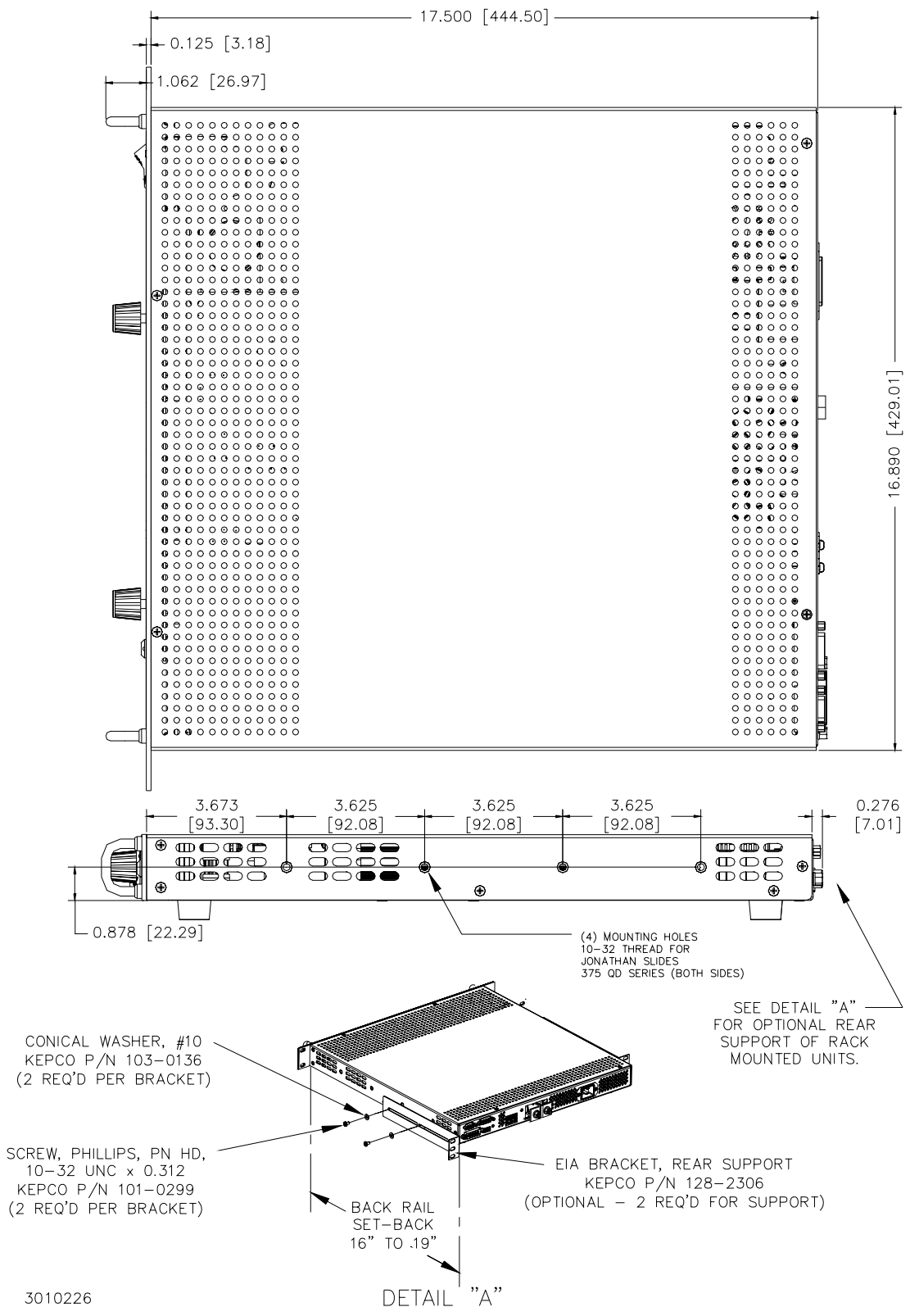
**TABLE 1-2. KLP SPECIFICATIONS (Continued)**

SPECIFICATION	RATING/DESCRIPTION	CONDITION/COMMENT	
<b>GENERAL (ENVIRONMENTAL) SPECIFICATIONS</b>			
Temperature	operating	-20 to +50 deg C	Rated load. Derate at 25W per °C between 50 and 70°C.
	storage	-40 to +85 deg C	
Cooling	3 internal d-c fans	exhaust to the rear	
Humidity	0 to 95% RH	non-condensing	
Shock	20g, 11msec +/- 50% half sine	non-operating	
Vibration	5 -10 Hz	10mm double amplitude	3-axes, non-operating
	10-55 Hz	2g	3-axes, non-operating
Altitude	sea level to 10000 ft.	0-3,000 ft: 100%, linear derating to 70% of power at 10,000ft.	
<b>PHYSICAL CHARACTERISTICS</b>			
Dimensions	English	1.735"H x 19"W x 17.5"D	Depth excluding connectors and terminal blocks (see Figure 1-3).
	metric	44.45 x 482.6 x 443.7 mm	
Weight	English	15 lbs	
	metric	6.82kg	
Source power connector	IEC 320-C19 appliance inlet	250 Va-c, 16A (VDE); 125V a-c, 20A (UL)	
Load connections	8-36V models	Nickel plated copper busbars	Provision for safety covers.
	75-600V models	Shocksafe Euroblock	
Analog programming port.	15 pin D-sub		
Digital programming ports	primary	Standard GPIB connector	IEEE 488.2 (GPIB)
	secondary	9 pin D-sub	RS 232 (-1200 Models only)
	secondary	RJ 45	LAN (-1.2K Models Only)
Feedback/Control Input	5 position low profile Euroblocks		
<b>PROGRAMMING CHARACTERISTICS - LOCAL</b>			
Local control	rotary encoders	Panel mounted.	
Local control resolution	Coarse	~100 LSB/step	Depress control for Fine resolution
	Fine	1 LSB/step	
Setting range	0-100% of rating	KLP will automatically adjust limit to maintain 1200 W maximum,	
Power up settings	voltage	defaults to zero	See PAR. 3.2.7.3.
	current	defaults to min. value (See Table 1-1)	
Protection Limits	Overvoltage	20-120% of Emax	Programmable; accessed via front panel protect switch or SCPI command over digital bus.
	Overcurrent	72-120% of Imax	

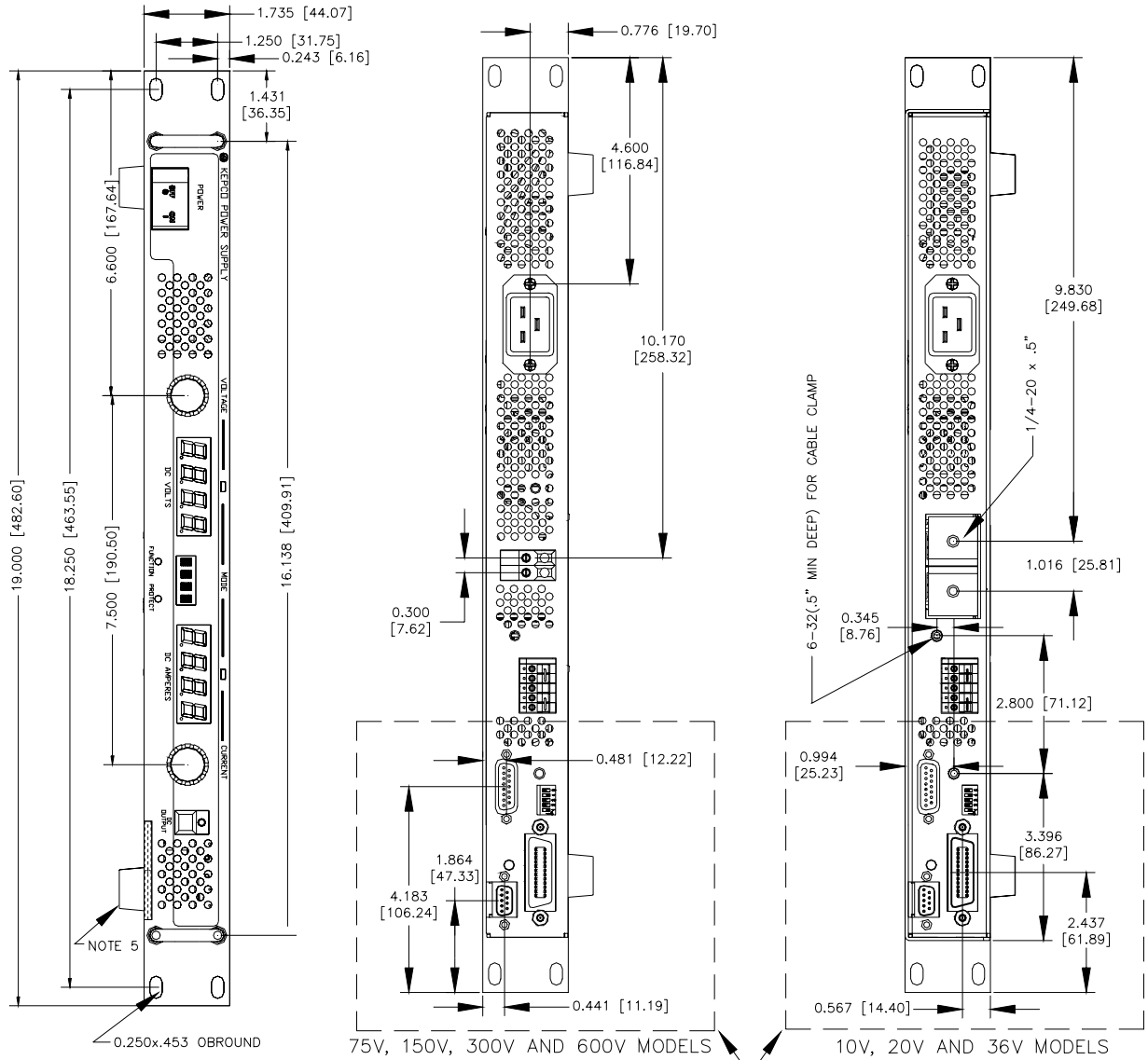


**TABLE 1-2. KLP SPECIFICATIONS (Continued)**

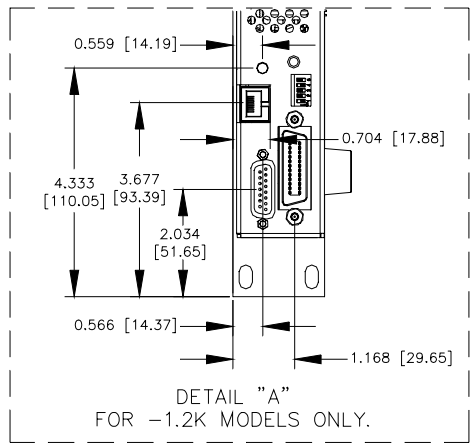
SPECIFICATION		RATING/DESCRIPTION	CONDITION/COMMENT
<b>PROGRAMMING CHARACTERISTICS - ANALOG</b>			
Analog remote control	selection	Activate with jumper at analog programming connector	Recognized during power up.
	isolation	Safety Extra Low Voltage (SELV)	
Analog Input Update Rate		2Hz (0.5 Second) Applies to programming by voltage/ resistance and readback specifications.	Analog input voltage digitized (12-bit resolution), optically isolated, then processed by digital section.
Programming by voltage	voltage	0-10V	See PAR. 4.3.3 to reduce Full Scale voltage.
	current	0-10V	Min. programming limit; see Table 1-1. See PAR. 4.3.3 to reduce Full Scale voltage.
Programming by resistance	voltage	0-10K ohms	See PAR. 4.3.3 to reduce Full Scale resistance.
	current	0-10K ohms	Min. programming limit; see Table 1-1. See PAR. 4.3.3 to reduce Full Scale resistance.
Readback		0-10V proportional signal	Proportional to analog control voltage/resistance.
Remote inhibit		TTL compatible	Dual polarity; see PAR. 3.2.13.5.1.
Composite status flag		Isolated form C contacts	Programmable functions (PAR. 3.2.13.3).
<b>PROGRAMMING CHARACTERISTICS - DIGITAL</b>			
Supported Interfaces	-1200 Models	GPIO and RS 232	SCPI command set for GPIO and RS 232 (see KLP Developer's Guide).
	-1.2K Models	GPIO and LAN	Support SCPI command set (see KLP Developer's Guide) for GPIO and LAN; Support four interfaces for LAN: 1. Web interface, port 80 (LXI Class C, Version 1.2) 2. SCPI Telnet, port 5024 3. SCPI Sockets, port 5025 4. VXI 11, port 1024
GPIO		GPIO address range: 1 to 31	Factory default is 6.
RS 232	-1200 Models	Baud Rate range: 2400, 4800, 9600, 19,200 or 38,400	Factory default is 38,400.
Digital remote control	isolation	Safety Extra Low Voltage (SELV)	
	format	compatible with SCPI protocols	W98 SE and later operating systems.
Programming resolution		0.024% of Emax and Imax	
Programming accuracy		0.05% of Emax and Imax	
Readback resolution		0.024% of Emax and Imax	
Readback accuracy		0.1% of Emax and Imax	
Status reporting		OVP, OCP, OTP, output lead fault (OLF), fan failure, power loss	See PAR. 1.4.4 and 1.4.9.



**FIGURE 1-3. KLP SERIES POWER SUPPLY, MECHANICAL OUTLINE DRAWING (SHEET 1 OF 2)**



- NOTES:
- MATERIAL:
    - CHASSIS: 0.064 THK. ALUM. 5052-H32
    - COVER: 0.064 THK. ALUM. 5052-H32
    - FRONT PANEL: 0.125 THK. ALUM. 6061-T6
  - FINISH:
    - CHASSIS, COVER AND BACKPLATE: YELLOW IRIDITE
    - FRONT PANEL: KEPKO GREY,
  - DIMENSIONS IN PARENTHESES ARE IN MILLIMETERS.
  - TOLERANCES:
    - BETWEEN MOUNTING HOLES:  $\pm 1/64$  ( $\pm 0.4$ ).
    - ALL OTHER DIMENSIONS:  $\pm 1/32$  ( $\pm 0.8$ ) EXCEPT AS NOTED.
  - REMOVE 4 PLASTIC FEET BEFORE RACK INSTALLATION  
 CAUTION: IF REINSTALLATION OF FEET IS NECESSARY, FAILURE TO REINSTALL FEET USING ALL HARDWARE SPECIFIED OR LONGER SCREW CAN RESULT IN DAMAGE TO THE UNIT.  
 SCREW: 6-32 X 0.50 IN. (MAX), BHPH (P/N 101-0019)  
 LOCKWASHER, #6, 0.018 IN. THK (P/N 103-0015)  
 FLAT WASHER, #6, 0.028 IN. THK (P/N 103-0100)



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FIGURE 1-3. KLP SERIES POWER SUPPLY, MECHANICAL OUTLINE DRAWING (SHEET 2 OF 2)

## **1.4 FEATURES**

### **1.4.1 LOCAL CONTROL**

Two front panel rotary encoders allow adjustment of voltage and current setpoints and limits. Operating mode of the power supply is indicated by lighting either a green (Constant Voltage) or amber (Constant Current) LED. The output can be enabled or disabled by the front panel DC OUTPUT switch; an associated indicator lights when the output is enabled (applied to the load). Two 4-character LEDs normally display actual output voltage and current, or programmed voltage and current limits in setpoint mode.

The voltage and current controls and their associated LED displays are also used with the FUNCTION and PROTECT switches and the 4-character status display for various other functions described in PAR. 3.2. A local lockout feature (see PAR. 3.2.2.1) prevents alteration of the power supply settings from the front panel when the power supply is operating in remote mode.

### **1.4.2 REMOTE CONTROL**

Remote control of the KLP Power Supply can be accomplished either through digital or analog programming.

#### **1.4.2.1 DIGITAL PROGRAMMING**

Digital control for -1200 Models is available directly via either the IEEE 488.2 (GPIB) or RS232 ports using SCPI commands. Digital control for -1.2K Models is available directly via either the IEEE 488.2 (GPIB) port using SCPI commands or via the LAN port using SCPI commands or web pages. Most features available in local mode can be accessed in remote mode through digital programming, as well as some that are only available via digital remote programming (PAR. 3.3.2). Front panel indicators showing operating mode and output voltage and current are active when digital programming is used. Refer to the KLP Developer's Guide for more information about digital programming.

#### **1.4.2.2 ANALOG PROGRAMMING**

KLP Power Supplies can also be controlled remotely using switch selectable voltage or resistance. Analog programming functions include voltage and current programming, enabling/disabling the output, and voltage and current readback (see PAR. 3.4).

Full scale programming/readback can be programmed using either an input analog voltage or by an input analog resistance. See PAR. 3.4 for more information.

### **1.4.3 DIGITAL CALIBRATION**

Internal adjustments of the KLP Power Supply are automatic. Calibration can be performed in either local or remote (using the VXI *plug&play* demo program) digital mode, using a calibrated DVM and a corresponding precision shunt resistor.

Calibration constants for programming and read-back activities are calculated by the microcontroller and stored in the non-volatile memory. No internal adjustments are necessary. The previous calibration is saved and can be restored if desired. The original factory calibration can also be restored. Calibration is password-protected. Refer to Section 4 for more information.

#### **1.4.4 OVERVOLTAGE/OVERCURRENT PROTECTION**

Overvoltage and Overcurrent protection values can be individually programmed. If the output voltage/current exceeds the overvoltage/overcurrent protection value, the protection circuit latches the output off, flashes an overvoltage (OVP) or overcurrent (OCP) error message on the status display and sets a status bit that can be retrieved through the RS 232 [-1200 Models only], LAN [-1.2K Models only], or GPIB port. The N.O. and N.C. contacts of the relay provide status flags via the Analog I/O port connector. Refer to PAR. 3.2.13.3 for more information.

#### **1.4.5 USER-DEFINED VOLTAGE/CURRENT LIMITS (VIRTUAL MODELS)**

The KLP Power Supply can be programmed to user-defined values that can be lower than the maximum values. For example, the KLP 36-60-1200, will automatically be limited to 1200 Watts as illustrated in Figure 1-2, however arbitrary limits, e.g., 40A@30V or 30A@35V can be established. Once the limits are set, setting values exceeding the limit values will not be accepted. Refer to PAR. 3.2.6 for more information.

#### **1.4.6 STORAGE OF USER-PROGRAMMED ACTIVE SETTINGS**

The KLP Power Supply contains 40 memory locations that can be used to store active settings. This feature is only available via digital remote programming. Values are stored in the nonvolatile memory, and are retained when the unit is turned off (refer to PAR 3.3.2 for more information).

#### **1.4.7 USER-PROGRAMMED SEQUENCES**

The KLP Power Supply contains 100 memory locations for programming sequences that can program the KLP to produce a variety of sequential output operations. Each memory location accommodates a value for voltage and current and a dwell time (how long the parameter is to be in effect). Values are stored in the volatile memory, and are lost when the unit is turned off (refer to PAR 3.3.2 for more information).

#### **1.4.8 LAST SETTING RECALL**

The KLP Power supply has the ability to retain the last voltage and current setpoints programmed before the unit is shut off. A DIP switch selection (position 3) allows the user to determine whether the power supply is set to 0V, minimum current or the retained PAR voltage and current setpoints upon the next power-up sequence. Refer to Table 2-2 and PAR. 3.2.7.3 for more information.

#### **1.4.9 BUILT-IN PROTECTION**

KLP Series Power Supplies provide built-in protection against the system faults listed below. In each case, a detected fault results in immediate latched shutdown of the power supply output. In addition, the status display flashes the appropriate indication and the status bit is set for retrieval through either of the digital programming ports. If the internal relay is configured for FAULT mode (factory default setting, see PAR. 3.2.13.3) the relay will toggle to provide a composite fault indication at the analog programming port. The indication time is limited by internal hold-up capacity for PWR faults (as the unit shuts down, when power is no longer sufficient to power the relay it de-energizes).

- a. **Overtemperature (OTP).** Monitors heatsink temperature; trips if it exceeds factory set limit.
- b. **Overvoltage (OVP) or overcurrent (OCP) at the output.** (See PAR. 3.2.8)

- c. **Fan failure (FAN).** Monitors all three internal cooling fans; trips if failure of any fan.
- d. **Output Lead Fault (OLF).** Monitors output power and sense leads; trips if any discontinuity (open circuit) is detected in load connections.
- e. **Source Power Loss (PWR).** Monitors internal d-c bus voltage at output of PFC; trips if low a-c input or PFC failure occurs.

**1.4.10 INTERNAL RELAY**

An internal relay provides common, normally open and normally closed contacts available to the user via the analog I/O connector. This relay is normally programmed (factory default) to energize upon detection of a system fault (FLT mode); see PAR. 1.4.9 for a list of faults. The relay may also be programmed to be energized at the user's discretion from the front panel (MAN mode), or as part of a user-specified program using LIST commands (LIST mode). Refer to PAR. 3.2.13.3 for details.)

**1.4.11 MASTER/SLAVE CONTROL [-1200 MODELS ONLY]**

For applications that require the use of multiple KLP -1200 Model power supplies in either series (for higher voltage) or parallel (for redundancy or higher current) the master/slave feature allows a single power supply (the master) to automatically control both outputs to achieve the desired output. Refer to PAR. 2.7.8 and 3.2.11 for details.

**1.5 EQUIPMENT SUPPLIED**

Equipment supplied with the unit is listed in Table 1-3.

**TABLE 1-3. EQUIPMENT SUPPLIED**

ITEM	PART NUMBER	QUANTITY
Source power connector	142-0381	1
Jumper (24 AWG or larger bus wire) for local sensing connections	172-0585	2
Analog I/O port mating connector	142-0528	1
Documentation CD (includes Documentation and Drivers)	254-0033	1

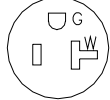
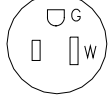
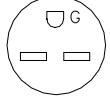
**1.6 ACCESSORIES**

Accessories for the KLP Power Supply are listed in Table 1-4.



**1.7 SAFETY**

There are no operator serviceable parts inside the case. Service must be referred to authorized personnel. Using the power supply in a manner not specified by Kepco, Inc. may impair the protection provided by the power supply. Observe all safety precautions noted throughout this manual. Table 1-5 lists symbols used on the power supply or in this manual where applicable.

**TABLE 1-4. ACCESSORIES**

ITEM	FUNCTION		KEPCO PART NUMBER
Line Cord Set (125V/20A)	2.5m long cord set, provides for source power connection. Mates with NEMA 5-20R receptacle (see adjacent figure). Supports rated load power over mains voltage range of 100-136V a-c.	NEMA 5-20R 	118-0776
Line Cord Set (125V/15A)	2.5m long cord set, provides for source power connection. Mates with NEMA 5-15R receptacle (see adjacent figure). Supports restricted load power over mains voltage range of 100-136V a-c (contact Kepco Sales Engineering for details).	NEMA 5-15R 	118-1136
Line Cord Set (250V/15A)	2.5m long cord set, provides for source power connection. Mates with NEMA 6-15R receptacle (see adjacent figure). Supports rated load power over mains voltage range of 180-265V a-c.	NEMA 6-15R 	118-1137
IEEE 488 (GPIB) Cable, 1m long	Connect KLP Power Supply to GPIB bus.		SNC 488-1
IEEE 488 (GPIB) Cable, 2m long	Connect KLP Power Supply to GPIB bus.		SNC 488-2
IEEE 488 (GPIB) Cable, 4m long	Connect KLP Power Supply to GPIB bus.		SNC 488-4
Chassis Slide (2 required per power supply)	Allows rack-mounted units to slide in and out.		108-0239 (Jonathan 375-QD Series)
Analog Connector Backshell	Locks analog port mating connector to KLP via jackscrews.		108-0204
Loop Back Test Connector	Used for verification of RS 232 operation.		195-0112
Null Modem Cable	Connect RS 232 port with controlling computer, DB9F to DB9F, 10 ft long.		118-1176
LAN Patch cable	Connects KLP LAN port to LAN, 10 ft long.		118-1115
Support bracket, rear	Provides extra support to rear of rack-mounted unit if needed. Two brackets required per unit. Each bracket requires 2 screws and 2 washers. See Figure 1-3, sheet 1, Detail "A" for requirements.		128-2306

**TABLE 1-5. SAFETY SYMBOLS**

SYMBOL	MEANING
	CAUTION: RISK OF ELECTRIC SHOCK.
	CAUTION: REFER TO REFERENCED PROCEDURE.
WARNING	INDICATES THE POSSIBILITY OF BODILY INJURY OR DEATH.
CAUTION	INDICATES THE POSSIBILITY OF EQUIPMENT DAMAGE.





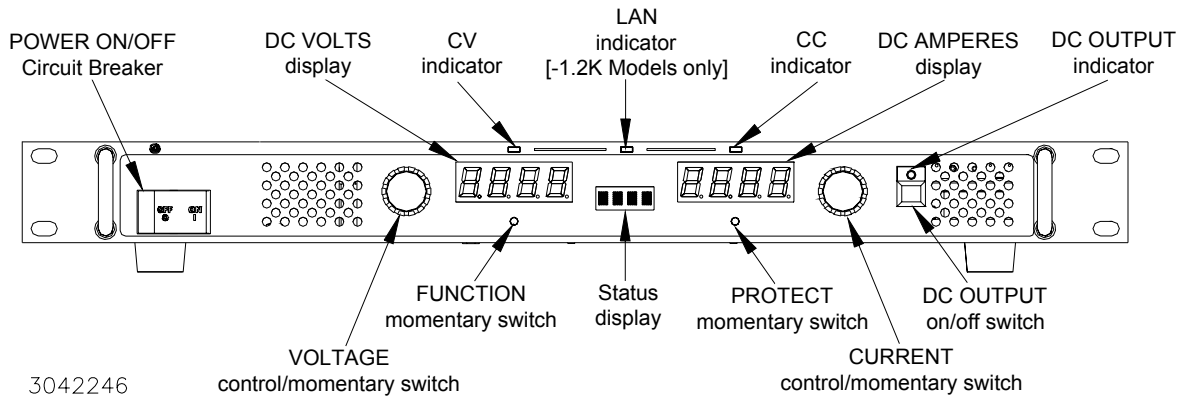
## SECTION 2 - INSTALLATION

### 2.1 UNPACKING AND INSPECTION

This instrument has been thoroughly inspected and tested prior to packing and is ready for operation. After careful unpacking, inspect for shipping damage before attempting to operate. Perform the preliminary operational check as outlined in PAR 2.5. If any indication of damage is found, file an immediate claim with the responsible transport service.

### 2.2 TERMINATIONS AND CONTROLS

#### 2.2.1 FRONT PANEL CONTROLS AND INDICATORS. Refer to Figure 2-1 and Table 2-1.



**FIGURE 2-1. KLP SERIES, FRONT PANEL CONTROLS AND INDICATORS**

#### 2.2.2 REAR PANEL CONNECTORS AND SWITCHES. Refer to Figure 2-2 and Tables 2-2 through 2-7.

**TABLE 2-1. CONTROLS, AND INDICATORS**

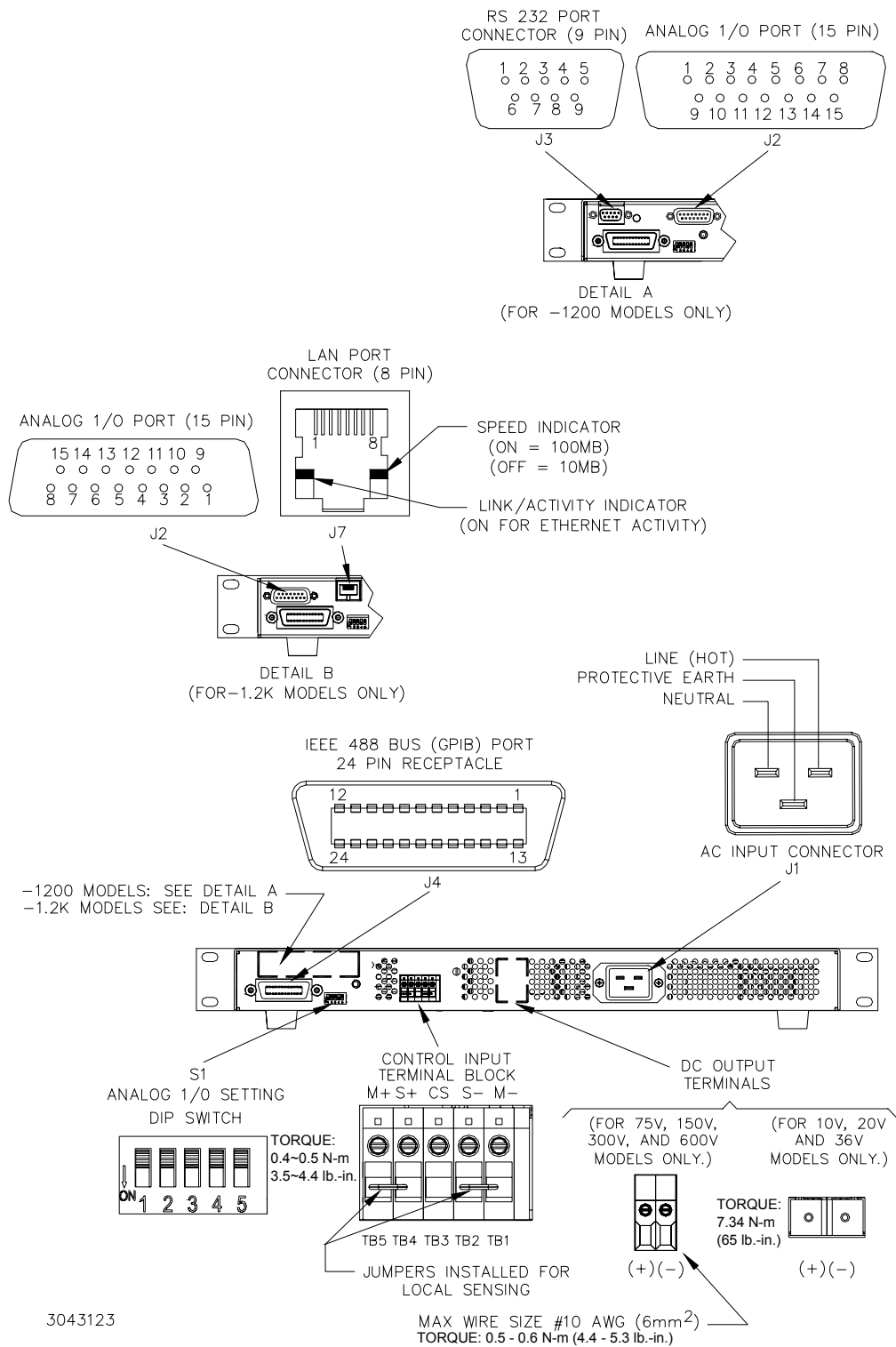
CONTROL OR INDICATOR	FUNCTION
POWER ON/OFF Circuit Breaker	Turns the power supply on or off. Applies input power to power supply internal circuits. Circuit breaker provides input overload protection.
VOLTAGE control/switch	Multifunction rotary encoder with momentary-contact pushbutton switch. Rotate to set output voltage (PAR. 3.2.7) and overvoltage limit (PAR. 3.2.8). Also used to enter SET mode of voltage programming (PAR. 3.2.7.2), change GPIB address (PAR. 3.2.9), change RS232 baud rate (PAR. 3.2.10), enter Virtual Model password (PAR. 3.2.6), and enter calibration password and perform calibration (PAR. 4.3).
DC VOLTS display	Four-digit LED display that shows voltage settings: a. Shows actual output voltage (default). b. Shows voltage set point (PAR. 3.2.7.2) or overvoltage limit when function selected (PAR. 3.2.8).
CV indicator	Green LED lights to indicate power supply is operating in constant voltage mode (see PAR. 3.2.7).
Status 4 character display	Displays active function or blinks for error messages. Normally blank (VOLTAGE and CURRENT LEDs display actual voltage and current).
CC indicator	Amber LED lights to indicate power supply is operating in constant current mode (see PAR. 3.2.7).

**TABLE 2-1. CONTROLS, AND INDICATORS (CONTINUED)**

CONTROL OR INDICATOR	FUNCTION
DC AMPERES display	Four-digit LED display that shows current settings: a. Shows actual output current (PAR.3.2.7). b. Shows current set point or overcurrent limit when function selected (PAR. 3.2.7.2). c. Shows GPIB address (PAR. 3.2.9), baud rate (PAR. 3.2.10). d. Shows unit password (PAR. 3.2.6 and PAR. 4.3).
CURRENT control/ momentary switch	Multifunction rotary encoder with momentary-contact pushbutton switch. Rotate to set output current (PAR. 3.2.7) and overcurrent limit (PAR. 3.2.8). Also used to enter SET mode of current programming (PAR. 3.2.7.2), change GPIB address (PAR. 3.2.9), change RS232 baud rate (PAR. 3.2.10), enter Virtual Model password (PAR. 3.2.6), and enter calibration password and perform calibration (PAR. 4.3).
DC OUTPUT indicator	Green LED lights when DC output is enabled. LED is off when output is disabled.
DC OUTPUT on/off switch	Enables or disables the DC Output. When output is disabled, current and voltage are programmed to minimal value and zero, respectively (PAR. 3.2.3). Also used to accept front panel inputs.
PROTECT momentary switch	Used to set overvoltage and overcurrent (PAR. 3.2.8) protection limits. NOTE: Requires a thin tool (e.g., end of paper clip) to press switch.
LAN Indicator [-1.2K Models only]	Green LED indicates when LAN interface is installed and valid IP address found. Can be intentionally blinked using the web-based interface to identify which unit is being accessed in a multi-unit environment. During initialization the LED blinks rapidly while attempting to locate a valid IP address. If successful, LED stays on without blinking; LED not lit indicates failure.
FUNCTION momentary switch	Used to set user-determined limits on voltage and current (virtual model) (PAR. 3.2.6) , change GPIB address (PAR. 3.2.9), change RS232 baud rate (-1200 Models only, PAR. 3.2.10), set up master/slave operation (-1200 Models only, PAR. 3.2.11), set up LAN interface (-1.2K Models only, PAR. 3.2.12), and enter the Utility menu (PAR. 3.2.13). The utility menu is used display Firmware Version (PAR. 3.2.13.1), display Model (PAR. 3.2.13.2), configure the internal relay (PAR. 3.2.13.3), configure quick-boot (PAR. 3.2.13.4), configure Remote Inhibit (high or low) and determine how the unit responds to faults (PAR. 3.2.13.5), calibrate analog inputs (PAR. 3.2.13.6), and enter calibration (PAR. 4.3). NOTE: Requires a thin tool (e.g., end of paper clip) to press switch.

**TABLE 2-2. ANALOG I/O SWITCH FUNCTIONS**

DIP SWITCH POSITION	FUNCTION	SETTINGS
1	Allows analog programming commands for <b>voltage</b> to be provided by either variable voltage (PAR. 3.4.3) or resistance (PAR. 3.4.2).	ON: Selects Resistance OFF: Selects Voltage (factory default)
2	Allows analog programming commands for <b>current</b> to be provided by either variable voltage (PAR. 3.4.3) or resistance (PAR. 3.4.2).	ON: Selects Resistance OFF: Selects Voltage (factory default)
3	Allows retention of the last entered setpoint values for voltage and current in non-volatile memory for recall at the next power-up sequence. (see PAR. 3.2.7.3).	ON: Save and recall previous setpoint values upon power-up. OFF: Power-up set to 0 Volts and minimum current (factory default).
4	Reserved - Do not use.	
5	Allows locking of the front panel controls. (see PAR. 3.2.2.1)	ON: Local controls locked. OFF: Local controls enabled (factory default).



**FIGURE 2-2. KLP SERIES, REAR PANEL SWITCH AND CONNECTORS**

**TABLE 2-3. IEEE 488 PORT CONNECTOR (J4) PIN ASSIGNMENTS**

PIN	SIGNAL NAME	FUNCTION
1	DI01	I/O Line
2	DI02	I/O Line
3	DI03	I/O Line
4	DI04	I/O Line
5	EOI	End or Identify
6	DAV	Data Valid
7	NRFD	Not Ready for Data
8	NDAC	Not Data Accepted
9	IFC	Interface Clear
10	SRQ	Service Request
11	ATN	Attention
12	SHIELD	Shield
13	DI05	I/O Line
14	DI06	I/O Line
15	DI07	I/O Line
16	DI08	I/O Line
17	REN	Remote Enable
18	GND	Ground (signal common)
19	GND	Ground (signal common)
20	GND	Ground (signal common)
21	GND	Ground (signal common)
22	GND	Ground (signal common)
23	GND	Ground (signal common)
24	LOGIC GND	Logic Ground

**TABLE 2-4. RS232 PORT CONNECTOR (J3) PIN ASSIGNMENTS [-1200 MODELS ONLY]**

PIN	SIGNAL NAME	FUNCTION
NOTE: A null modem cable (see Table 1-4) is required for nearly all applications, with the exception of those in which RXD and TXD line transposition is accomplished via external hardware (e.g. older Apple MAC computers with D-sub serial port).		
1	DCD	Data Carrier Detect (protocol not used)
2	RXD	Receive Data
3	TXD	Transmit Data
4	DTR	Data Terminal Ready (protocol not used)
5	SGND	Signal Ground
6	DSR	Data Set Ready (protocol not used)
7	RTS	Request To Send (protocol not used)
8	CTS	Clear To Send (protocol not used)
9	RI	Ringer Indicator (protocol not used)

**TABLE 2-5. LAN PORT CONNECTOR (J7) PIN ASSIGNMENTS [-1.2K MODELS ONLY]**

PIN	SIGNAL NAME	FUNCTION
1	TX+	Transmit +
2	TX-	Transmit -
3	NOT USED	
4	NOT USED	
5	NOT USED	
6	NOT USED	
7	RX+	Receive +
8	RX-	Receive -

**TABLE 2-6. CONTROL INPUT TERMINAL BLOCK ASSIGNMENTS**

TERMINAL	FUNCTION
M+	Positive output monitor connection (TB5) (see PAR. 2.7.5.1)
S+	Positive sense connection (TB4) (see PAR. 2.7.5.1)
CS	Current Share bus (TB3) (see PAR. 2.7.7.1)
S-	Negative sense connection (TB2) (see PAR. 2.7.5.1)
M-	Negative output monitor connection (TB1) (see PAR. 2.7.5.1)

**TABLE 2-7. ANALOG I/O CONNECTOR (J2) PIN ASSIGNMENTS**

PIN	SIGNAL NAME	FUNCTION
1	Cref	Analog signal which programs output current from zero to full scale. Voltage or resistance programming is selected via DIP switch position 2 (See Table 2-2). Refer to PAR. 3.4.3 for voltage programming and 3.4.2 for resistance programming.
2	RELAY_NO	Connected to RELAY_COM (pin 4) for relay energized condition. <sup>(1)</sup>
3	Vref	Analog signal which programs output voltage from zero to full scale. Voltage or resistance programming is selected via DIP switch position 1 (See Table 2-2). Refer to PAR. 3.4.3 for voltage programming and 3.4.2 for resistance programming.
4	RELAY_COM	Relay common. <sup>(1)</sup>
5		Reserved.
6	VOLT_RBACK	Analog signal which represents output voltage from zero to full scale. The full scale programming level sets the full scale readback level (see PAR. 4.3.3).
7	CURR_RBACK	Analog signal which represents output current from zero to full scale. The full scale programming level sets the full scale readback level (see PAR. 4.3.3).
8	REM_INH	Allows single signal to control output on/off. See PAR. 3.4.1.
9	GND	Ground <sup>(2)</sup>
10	RELAY_NC	Connected to RELAY_COM (pin 4) for relay not energized condition <sup>(1)</sup>
11	GND	Ground
12	ANALOG_CTRL	Enables or disables analog programming (see PAR. 3.4). 1 = Analog programming disabled (default, no connection) 0 = Analog programming accepted (use jumper on mating connector to connect to pin 9, 11, 13 or 15 (ground)).
13	GND	Ground
14	EXT_TRG	Performs same function as SCPI *TRG command if unit is programmed for external triggering via digital remote mode. Transition from 1 (+5V) to 0 (ground) causes values established by VTRIG and CTRIG commands to become VSET and CSET (see PAR 3.3.2, External Triggering).
15	GND	Ground
<sup>(1)</sup> Refer to PAR. 3.2.13.3 to configure internal relay. <sup>(2)</sup> All GND connections are common.		

## 2.3 SOURCE POWER REQUIREMENTS

This power supply operates with the installed circuit breaker from either d-c or single phase a-c mains power over the voltage and frequency ranges specified in Table 1-2 without adjustment or modification.

## 2.4 COOLING

The power devices used within the power supply are maintained within their operating temperature range by means of internal heat sink assemblies cooled by three internal (d-c type) cooling fans.

ALL INLET AND EXHAUST OPENINGS AT THE FRONT AND REAR OF THE POWER SUPPLY CASE MUST BE KEPT CLEAR OF OBSTRUCTION TO ENSURE PROPER AIR ENTRY AND EXHAUST. Although not a requirement, it is recommended that side and top vent openings be clear of obstruction for more efficient cooling. Periodic cleaning of the power supply interior is recommended by authorized service personnel only (see KLP Service Manual for instructions).

If the power supply is rack mounted, or installed within a confined space, care must be taken that the ambient temperature, which is the temperature of the air immediately surrounding the power supply, does not rise above the specified limits (see Table 1-2).

## 2.5 PRELIMINARY OPERATIONAL CHECK

A simple operational check after unpacking and before equipment installation is advisable to ascertain whether the power supply has suffered damage resulting from shipping.

Refer to Figures 2-1 and 2-2 for location of operating controls and electrical connections. Table 2-1 explains the functions of operating controls and indicators.

NOTE: This test must be performed with IEEE 488, RS232 [-1200 Models], LAN [-1.2K Models] and ANALOG I/O ports disconnected, and ANALOG I/O SETTINGS switch positions 3 and 5 set to OFF.

1. With **POWER** circuit breaker set to OFF position, connect the power supply to source power (see PAR. 2.7.2).
2. With no load connected, set **POWER** circuit breaker to the ON position. Each time the unit is turned on an internal self-test is performed. After the test has been successfully completed, the unit displays the following:
  - The status display flashes **MODL** (model) for two seconds while the **DC VOLTS** display shows  $E_{O_{MAX}}$  and the **DC AMPERES** display shows  $I_{O_{MAX}}$ . (E.g. for model 75-33-1200, **DC VOLTS** reads 75 and **DC AMPERES** reads 33.)
  - Then the status display flashes **VIRT** (Virtual model) for two seconds while the **DC VOLTS** display shows  $E_{O_{MAX}}$  and the **DC AMPERES** display shows the current corresponding to 1200W. (E.g. for model 75-33-1200, **DC VOLTS** reads 75 and **DC AMPERES** reads 16.)
  - Then the status display flashes **PROT** (protection limits) for two seconds while the **DC VOLTS** display shows 120% of  $E_{O_{MAX}}$  and the **DC AMPERES** display shows 120% of current corresponding to 1200W. (E.g. for model 75-33-1200, **DC VOLTS** reads 90.0)

and **DC AMPERES** reads 19.2.)

- Then the status display reads **SET** (setpoint mode), the **DC VOLTS** display reads 0 Volts, the **DC AMPERES** display reads minimum Amperes (see Note 1, below).

NOTES: 1. A minimum programmed current (actual value depends on model) is required to ensure proper operation of the power supply under all load conditions. Programmed current is automatically set to be at least the minimum current.

2. If an error indication is blinking in the Status display, refer to Table 3-1 for an explanation of error codes.
3. Rotate **VOLTAGE** adjust knob clockwise. Verify that **DC VOLTS** display increases in large (X 100) increments.
4. Press and rotate **VOLTAGE** adjust knob clockwise. Verify the **DC VOLTS** display increases in finer increments than step 3, then release knob.
5. Adjust **VOLTAGE** adjust knob clockwise until Status display reads **>MAX**. Tap either **VOLTAGE** or **CURRENT** adjust knob once to enter values. Verify Status display is blank
6. Connect a digital voltmeter (DVM) to the (M+) and (M-) terminals on the rear panel.
7. Press and release **DC OUTPUT** switch to enable the output. Verify **DC OUTPUT** indicator lights.
8. Compare the programmed output voltage value (step 5) with the voltage reading of the DVM; the difference between the two should not exceed 0.05% of the maximum voltage of the unit.
9. Compare the voltage reading of the **DC VOLTS** display with that of the DVM; the difference between the two should not exceed 0.1% of the maximum voltage of the unit.
10. Enter different value for output voltage, then repeat steps 8 and 9 using different values for programmed voltage.
11. Disable the output by pressing and releasing **DC OUTPUT** switch; verify front panel **DC VOLTS** and **DC AMPERES** displays read 0.0V and minimal current and the DC OUTPUT indicator is off.

## 2.6 INSTALLATION

### 2.6.1 RACK MOUNTING

The unit is intended to be mounted directly in a 19-inch wide rack. Optional slides (see Table 1-4) can be used.

## 2.7 WIRING INSTRUCTIONS

Interconnections between an a-c power source and the power supply, and between the power supply and its load are as critical as the interface between other types of electronic equipment. If optimum performance is expected, certain rules for the interconnection of source, power supply and load must be observed by the user. These rules are described in detail in the following paragraphs.

## 2.7.1 SAFETY GROUNDING

Local, national and international safety rules dictate the earth grounding of the metal cover and case of any instrument connected to the a-c power source, when such grounding is an intrinsic part of the safety aspect of the instrument.

KLP is provided with a three-terminal IEC appliance coupler for connection of the mains supply source, one terminal of which is dedicated for the protective earthing conductor; no other ground or earth connection is required, although the chassis may be separately connected to earth ground for noise or other performance considerations (frame grounding).

The instructions below suggest wiring methods which comply with these safety requirements; however, in the event that the specific installation for the power system is different from the recommended wiring, it is the customer's responsibility to ensure that all applicable electric codes for safety grounding requirements are met.

## 2.7.2 SOURCE POWER

### 2.7.2.1 CURRENT RATING

All switchmode power supplies, including the KLP series, present a constant power characteristic to the input power source. Consequently, the power supply draws maximum input current for a given load power at low input voltage, and proportionately less as source voltage is raised according to the formula

$$\text{Input Current} = \text{Output Power} / (\text{Efficiency} \times \text{Input Voltage})$$

The input power circuit breaker of the power supply is rated to support rated load power under worst-case efficiency conditions at the lowest rated source voltage (100V a-c), and provides the necessary overload protection to the power supply's internal circuitry. The user must provide a properly sized and rated mains lead (line cord) and service with a current rating compatible with the anticipated input current. The Table 2-8 provides recommendations for service current rating and mains lead wire size for common a-c mains voltages. Table 1-4 lists line cords currently available as accessories.

**TABLE 2-8. INPUT CURRENT SERVICE RATING AND CONDUCTOR SIZES**

MAINS VOLTAGE RANGE	CURRENT SERVICE RATING	CONDUCTOR SIZE
100 - 132V a-c, 50/60Hz	20 Amp	#12AWG [2,0 mm <sup>2</sup> ]
180 - 265V a-c, 50/60Hz	15 Amp	#14AWG [3,0 mm <sup>2</sup> ]

For continuous operation at output power levels lower than 1000 watts, or for other line cord styles, contact Kepco Applications Engineering for additional options.

### 2.7.2.2 CONNECTIONS

Source power is connected at the rear panel of the KLP power supply (see Figure 2-2) via the IEC 320-style recessed power inlet connector, which provides interface to a three-wire safety line cord via a polarized mating plug. A user-wirable mating connector is provided. Terminal assignment follows internationally accepted conventions. It is the user's responsibility to ensure that all applicable local codes for source power wiring are met. Kepco also makes a variety of prefabricated safety line cord sets available for connecting KLP to source power via conventional box-mounted receptacles. Table 1-4 lists three popular cord set variants for North American applications. For other options please contact Kepco Sales Engineering with specific requirements.



## WARNING



IT IS IMPERATIVE THAT THE USER PROVIDE ALL THREE SOURCE WIRE CONNECTIONS, AS THIS CONNECTION IS THE SAFETY GROUND PROVISION!

### 2.7.3 D-C OUTPUT GROUNDING

Connections between the power supply and the load and sensing connections may, despite precautions such as shielding, twisting of wire pairs, etc., be influenced by radiated noise, or “pick-up”. To minimize the effects of this radiated noise the user should consider grounding one side of the power supply/load circuit. The success of d-c grounding requires careful analysis of each specific application, however, and this recommendation can only serve as a general guideline.

One of the most important considerations in establishing a successful grounding scheme is to avoid GROUND LOOPS. Ground loops are created when two or more points are grounded at different physical locations along the output circuit. Due to the interconnection impedance between the separated grounding points, a difference voltage and resultant current flow is superimposed on the load. The effect of this ground loop can be anything from an undesirable increase in output noise to disruption of power supply and/or load operation. The only way to avoid ground loops is to ensure that the entire output/load circuit is fully isolated from ground, and only then establish a single point along the output/load circuit as the single-wire ground point.

The exact location of the “best” d-c ground point is entirely dependent upon the specific application, and its selection requires a combination of analysis, good judgement and some amount of empirical testing. If there is a choice in selecting either the positive or negative output of the power supply for the d-c ground point, both sides should be tried, and preference given to the ground point producing the least noise. For single, isolated loads the d-c ground point is often best located directly at one of the output terminals of the power supply; when remote error sensing is employed, d-c ground may be established at the point of sense lead attachment. In the specific case of an internally-grounded load, the d-c ground point is automatically established at the load.

The power supply output terminals (located on the rear panel) for KLP Power Supplies are d-c isolated (“floating”) from the chassis in order to permit the user maximum flexibility in selecting the best single point ground location. Output ripple specifications as measured at the output are equally valid for either side grounded. Care must be taken in measuring the ripple and noise at the power supply: measuring devices which are a-c line operated can often introduce additional ripple and noise into the circuit.

There is, unfortunately, no “best” method for interconnecting the load and power supply. Individual applications, location and nature of the load require careful analysis in each case. It is hoped that the preceding paragraphs will be of some assistance in most cases. For help in special applications or difficult problems, consult directly with Kepco's Application Engineering Department.

## **2.7.4 POWER SUPPLY/LOAD INTERFACE**

The general function of a voltage or current stabilized power supply is to deliver the rated output quantities to the connected load. The load may have any conceivable characteristic: it may be fixed or variable, it may have predominantly resistive, capacitive or inductive parameters; it may be located very close to the power supply output terminals or it may be a considerable distance away. The perfect interface between a power supply and its load would mean that the specified performance at the output terminals would be transferred without impairment to any load, regardless of electrical characteristics or proximity to each other.

The stabilized d-c power supply is definitely not an ideal voltage or current source, and practical interfaces definitely fall short of the ideal. All voltage-stabilized power supplies have a finite source impedance which increases with frequency, and all current-stabilized power supplies have a finite shunt impedance which decreases with frequency. The method of interface between the power supply output and the load must, therefore, take into account not only the size with regard to minimum voltage drop, but the configuration with regard to minimizing the impedance introduced by practical interconnection techniques (wire, bus bars, etc.). The series inductance of the load wire must be as small as possible as compared to the source inductance of the power supply: although the error sensing connection to the load compensates for the d-c voltage drop in the power leads, it cannot completely compensate for the undesirable output effects of the power lead inductance. These lead impedances (both power and sensing leads) are especially important if the load is a) constantly modulated or step-programmed, b) has primarily reactive characteristics, or c) where the dynamic output response of the power supply is critical to load performance.

## **2.7.5 LOAD CONNECTION - GENERAL**

Load connections to the KLP power supply are achieved via the (+) and (–) DC OUTPUT terminals located on the rear panel; (+M) and (–M) outputs are also available at terminal blocks (TB5 and TB1, respectively) located on the panel for connection of external monitoring equipment such as a DVM, oscilloscope, etc.

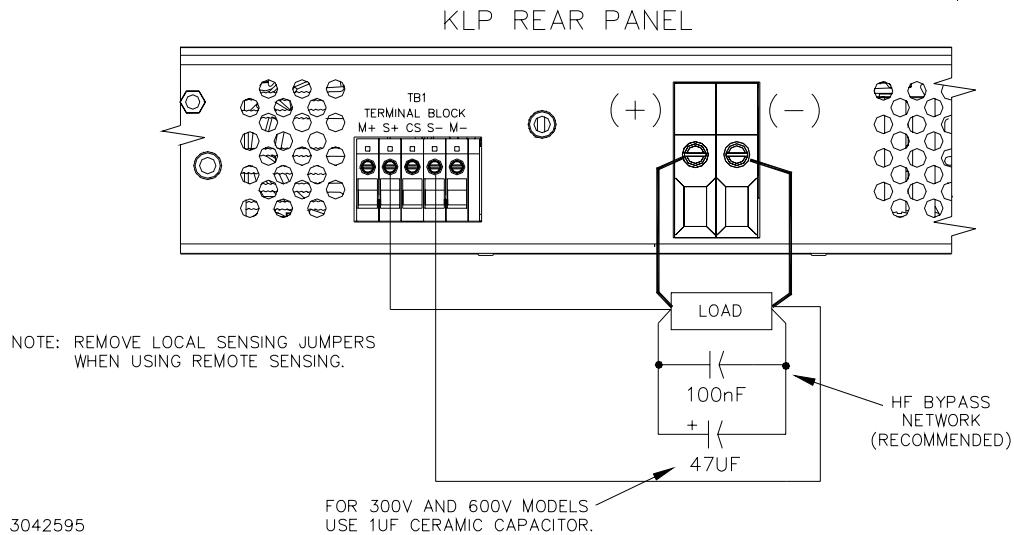
Configuration of local or remote sensing is facilitated by pre-installed jumpers which configure the unit for local sensing as shown in Figure 2-2.

**NOTE: REGARDLESS OF OUTPUT CONFIGURATION, OUTPUT SENSE LINES MUST BE CONNECTED FOR PROPER OPERATION, EITHER LOCALLY, OR AT THE LOAD (REMOTE). OBSERVE POLARITIES: THE +S TERMINAL MUST BE CONNECTED TO EITHER +M (LOCAL) OR +LOAD (REMOTE), AND THE –S TERMINAL MUST BE CONNECTED TO EITHER –M (LOCAL) OR –LOAD (REMOTE).**

### **2.7.5.1 LOCAL SENSING/REMOTE SENSING SELECT**

Local sensing (factory default configuration) is established by connecting terminal TB4 (+S) to TB5 (+M) and TB1 (–M) to TB2 (–S) (see Figure 2-2). The power supply is shipped with two jumpers installed to obtain local sensing.

Remote sensing is established by first removing the factory-installed local sensing jumpers between +S and +M and between –M and –S. The +S and –S lines must be connected at the load (see Figure 2-3). A high frequency bypass network consisting of two capacitors connected across the load as shown in Figure 2-3 is recommended to reduce noise in the sense loop.



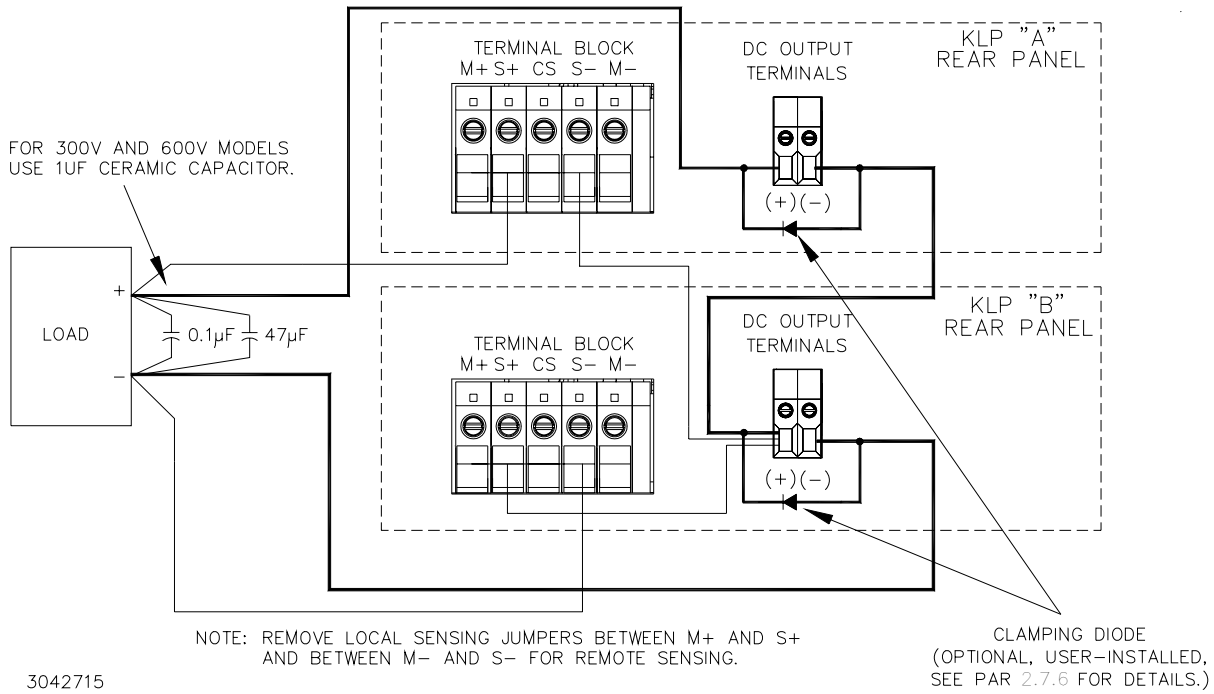
**FIGURE 2-3. REMOTE SENSING**

### 2.7.6 SERIES OPERATION

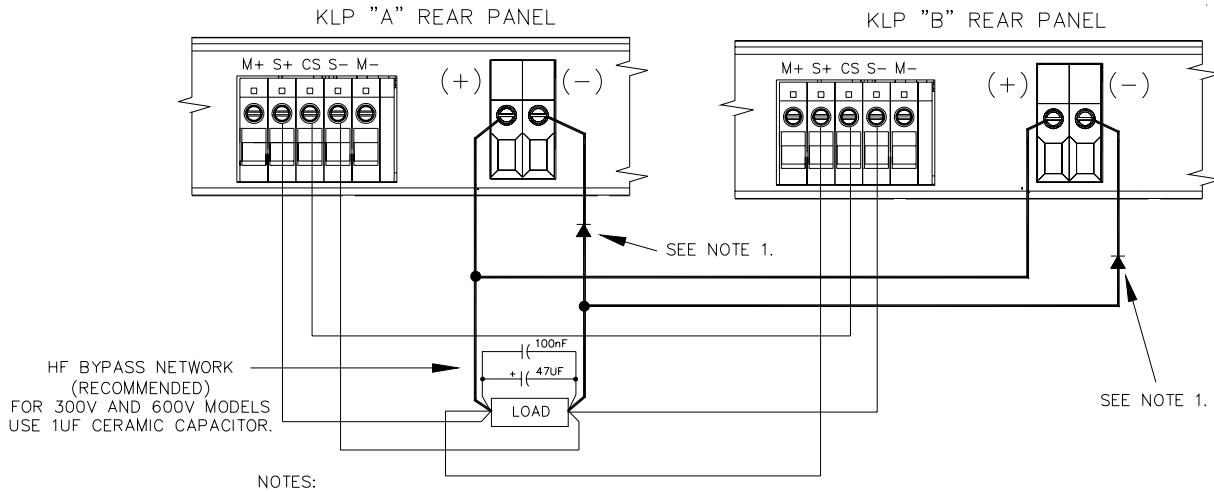
Units may be connected in series to obtain higher output voltages. Each power supply in the series may be protected by a clamping diode connected in its non-conducting direction in parallel with the output. This diode protects the power supply outputs against secondary effects in the event of a load short. (Note that this is NOT the same as the blocking diode used for parallel/redundant operation.) Selection of the clamping diode is entirely dependent upon output voltage/current parameters. The clamping diode must be rated for the maximum voltage and current of the series connection. Several clamping diodes in parallel may be required to meet the total current rating. The user must also respect the  $\pm 600V$  d-c maximum isolation from output to chassis when determining the maximum series voltage. Figure 2-4 shows a series connection of two KLP power supplies using remote sensing. Kepco strongly recommends that series applications employ master/slave control (available on -1200 Models only) as described in PAR's. 2.7.8 and 3.2.11.

### 2.7.7 PARALLEL/REDUNDANT OPERATION

Identical KLP power supply models may be connected in parallel in order to provide increased output current to a common load (see Figure 2-5). This permits the user to obtain significantly higher load ratings than for a single KLP power supply. The number of power supplies required is determined by dividing the required load current by the current rating of the applicable KLP model, and rounding up to the next whole number when necessary. KLP power supplies utilize active current sharing circuitry to distribute the load current equally among the paralleled units. Redundant operation is achieved by paralleling one or more power supplies than the minimum number required to support the load; in this way, system operation is not compromised by the failure of a single power supply. Any number of KLP power supplies (N+M) can be wired for redundant operation as long as (N) power supplies can support the load, M representing the total number of failed power supplies. When operating KLP power supplies in any parallel configuration, load sharing **must** be implemented among the paralleled modules. Kepco strongly recommends that parallel/redundant applications employ master/slave control (available on -1200 Models only) as described in PAR's. 2.7.8 and 3.2.11.



**FIGURE 2-4. SERIES CONNECTION USING REMOTE SENSING**



1. BLOCKING DIODES ARE OPTIONAL, USER-INSTALLED. THESE DIODES MAY BE LOCATED IN EITHER POSITIVE OR NEGATIVE POWER LEAD. OBSERVE PROPER DIODE POLARITY AND ALL APPROPRIATE SAFETY AND HEAT DISSIPATION REQUIREMENTS.

2. REMOVE LOCAL SENSING JUMPERS.

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**FIGURE 2-5. PARALLEL CONNECTIONS USING REMOTE SENSING**

### 2.7.7.1 LOAD SHARING

When operating two or more power supplies in parallel, either for capacity or redundancy, it is desirable to distribute the load equally among all of the power supplies in order to improve performance, reduce stress and increase reliability. KLP power supplies incorporate active circuitry which forces multiple power supplies wired in parallel to share load current, both in voltage- and current-mode regulation. The KLP employs a single wire connection between paralleled power supplies, forming a master-slave relationship as follows: the highest voltage unit becomes the master, and all of the remaining units are slaved to it via the current share signal (CS, available at the rear panel terminal A3TB3, Figure 2-2), which boosts the slave outputs in order to increase load share. A maximum boost limit prevents the slave units from following a defective master into an overvoltage condition, or from creating a load hazard if either the slave itself or the load sharing system is defective.

When implementing load sharing, the user must ensure that all power supplies are attempting to regulate to the same voltage at the same location, and must minimize the possibility of load share signal corruption; the power supplies should, as nearly as possible, emulate a single large power supply. To this end, the following rules apply:

- a. If possible, remote error sensing should be employed, with all error sensing connections terminated at the same physical point, and as close to the power supplies as possible; if local error sensing is required, power lead voltage drops must be minimized. Provide local noise decoupling capacitors across all sense wire termination points.
- b. The power supplies should be located as near to each other as possible, with power terminations bussed together using adequately sized interconnections; the power supply/load interconnections should be distributed evenly along the power supply output interconnection buses. This is especially important in high-current systems employing several power supply modules in parallel, where voltage drops in the interface connections can be significant in comparison to the load share signal voltage and introduce both d-c and a-c errors.
- c. All power supply output voltages should be adjusted as closely as possible, and in any case within a 1% error band. Additionally, the current limit setpoints should be identical and high enough to support the load requirements; for (N+M) systems, this means setting the current limits high enough to tolerate loss of M power supplies and still support the load.
- d. Minimize the current share signal wire interconnection lengths to reduce risk of noise influence.

### 2.7.8 MASTER/SLAVE CONFIGURATIONS [-1200 MODELS ONLY]

Master/slave configurations of power supply pairs can be used to allow changes to output voltage/current of one supply (master) to affect the output of the other (slave). Both units of a master/slave configuration must be identical models. Master/slave control is implemented using the RS 232 ports. After connecting the series or parallel pair (see PAR. 2.7.6 or 2.7.7, respectively), use a null modem cable, minimum length 0.5 foot, DB9F-DB9F, to connect the RS 232 ports of both power supplies. Then refer to PAR. 3.2.11 to complete the setup of each power supply in the master/slave configuration.

## 2.7.9 ANALOG I/O CONNECTIONS

The Analog I/O Port connector, located on the rear panel of the KLP power supply (see Figure 2-2), provides access for all analog programming inputs and status signal outputs. In addition, an external trigger input is available for use with SCPI \*TRG and TRIG commands. Refer to Table 2-7 for analog I/O programming signal pin assignments and descriptions.

These signals must be protected from radiated and conducted noise as well as from physical contact with non-valid driving sources. The following subsections address specific programming signal applications; in general, however, when accessing this connector from distant locations or high-noise environments, it is recommended that a shielded cable be used, with the shield terminated to the system's single point ground.

### a. Analog Programming Enable (ANALOG\_CTRL)

Connect pin 12 (Analog Control) to pin 9, 11, 13, or 15 (ground) to enable analog I/O programming.

### b. External Voltage and Current Programming (V\_Ref and C\_Ref)

Twist the voltage programming signal V\_Ref (pin 3), Current Programming signal C\_Ref (pin 1) and ground (pin 9, 11, 13, or 15). Configure Analog I/O switch positions 1 and 2 to use either voltage or resistance as the programming source. Factory default for full scale output is 10V or 10 Kohms (see par. 4.3.3 to set lower values for full scale output).

### c. Voltage and Current Readback (VOLT\_RBACK and CURR\_RBACK)

Twist the voltage readback signal VOLT\_RBACK (pin 6), Current readback signal CURR\_RBACK (pin 7) together with ground (pin 9, 11, 13, or 15). Full scale readback voltages are identical to selected full scale programming voltages (see PAR. 4.3.3).

### d. Remote Inhibit (REM\_INH)

Twist remote inhibit (pin 8) together with ground (pin 9, 11, 13, or 15). See PAR. 3.2.13.5.1 to configure active high or low and PAR. 3.4.1 to enable/disable the output using remote inhibit.

### e. Fault Connections (RELAY\_NC, RELAY\_COM, RELAY\_NO)

It is recommended that normally open and normally closed relay signals RELAY\_NC (pin 10) and/or RELAY\_NO (pin 2), respectively, be twisted together with RELAY\_COM (pin 4) as needed to eliminate noise pickup. See PAR. 3.2.13.3 to configure internal relay.

### f. External Trigger (EXT\_TRIG)

External Trigger may be used with the SCPI TRIG commands (see KLP Developer's Guide) during digital remote operation. For noise suppression it is recommended that wires from EXT\_TRIG, pin 14 and ground (pin 9, 11, 13, or 15) be twisted together.

## 2.8 DIGITAL CONNECTIONS

The following paragraphs describe the connections required to use the GPIB, RS 232 [-1200 Models only] or LAN [-1.2K models only] ports for remote control of the unit.

### 2.8.1 GPIB CONNECTIONS

Your computer must have a GPIB interface card installed. Connect the power supply to the computer's GPIB interface card. Use a standard GPIB interface cable at the GPIB port on the rear panel (See Figure 2-2). Refer to Table 2-3 for GPIB port pin assignments. Refer to PAR. 3.2.9 to change the default GPIB address (6) from the front panel.

## **2.8.2 RS 232 CONNECTIONS [-1200 MODELS ONLY]**

Communications between KLP, considered data terminal equipment (DTE), and data communications equipment (DCE), e.g. a modem, requires a patch cable, or one with a pin-for-pin relationship between terminating connectors. A null modem cable is necessary for nearly all applications, with the exception of those in which the RXD and TXD line transposition is accomplished via external hardware (e.g. older Apple MAC computers with D-sub serial port). See Table 2-4 for RS 232 port pin assignments. Connect the cable to the KLP at the RS 232 port located on the rear panel (See Figure 2-2). Refer to PAR. 3.2.10 to change the default baud rate (38400) from the front panel.

## **2.8.3 LAN CONNECTIONS [-1.2K MODELS ONLY]**

Connect the KLP to the LAN via the RJ 45 LAN port located at the rear panel (See Figure 2-2). Refer to Table 2-5 for LAN port pin assignments. Refer to PAR 3.2.12 to configure the LAN interface from the front panel. Some configuration can also be done through the web interface (see PAR. 3.3.6.3). Refer to the KLP Developer's Guide for the associated SCPI commands





## SECTION 3 - OPERATION

### 3.1 GENERAL

This section explains how to operate the KLP Power Supply. Series KLP feature three modes of operation:

- Local Mode: This is the default operating mode, providing full access to all programming and readback functions via front panel displays, controls, and indicators (see PAR. 3.2).
- Digital Remote Mode (see PAR. 3.3): This mode is selected via commands transmitted through one of the two digital ports. One port is configured for IEEE-488 (GPIB), The second port is either an RS 232 port [-1200 Models] or a LAN port [-1.2K models]. The digital ports are described in the KLP Developer's Guide. The power supply automatically goes into digital remote mode when commands are accepted via one of the digital ports.
- Analog Remote Mode: This mode is selected via a jumper wire at the analog programming port prior to initial turn-on, and provides limited access to programming and readback functions (see PAR. 3.4).

### 3.2 LOCAL MODE OPERATION

Local operation of the KLP Power Supply is accomplished via the front panel switches and controls illustrated in Figure 2-1 and described in detail in Table 2-1. Separate 4-digit LEDs display actual output voltage and current; these same displays show set points and limits as well. Status and fault indications are provided by a 4-character alpha-numeric display.

#### 3.2.1 TURNING THE POWER SUPPLY ON

1. To turn the power supply on, set **POWER ON/OFF** circuit breaker (1, Figure 2-1) to ON. Apply firm, continuous pressure to rocker actuator until fully engaged (right side of rocker actuator locked parallel to front panel). If actuator does not lock when released, allow actuator to return to starting position, then wait a few seconds before repeating turn-on sequence. DO NOT attempt to "tease" the switch contacts closed by repetitive press-and-release action. The circuit breaker is "trip-free" design; if overload exists, contacts cannot be held closed by actuator.
2. When the power supply is turned on, it performs a self-test and displays the following information:
  - status display flashes **MODL** for 2 seconds while **DC VOLTS** and **DC AMPERES** displays show the maximum voltage and current capability of the unit.
  - status display flashes **VIRT** for 2 seconds while **DC VOLTS** and **DC AMPERES** displays show the maximum voltage and current allowed for a previously programmed virtual model. To reprogram the maximum allowable voltage and/or current, refer to PAR. 3.2.6 to define a virtual model.
  - Status display flashes **PROT** for 2 seconds while **DC VOLTS** and **DC AMPERES** displays show previously stored OVP and OCP trigger levels. NOTE: to reprogram OVP or OVC, refer to PAR. 3.2.8.

NOTE: To eliminate the display of model, virtual model, and protection levels on power-up, refer to PAR. 3.2.13.4 for quick boot.

- For -1.2K Models, the LAN indicator blinks rapidly during initialization. If an IP address is found, it stays on without blinking. If an IP address is not found, the LAN indicator stays off.
- If any fault is configured for AUTO recovery (see PAR. 3.2.13.5.2), the status display flashes **AUTO** for one second.
- If remote inhibit is active (see PAR. 3.4.1) upon power-up, the status display flashes **rINH** for one second.
- If an error occurs, an error code is displayed in the status display (see Table 3-1).

3. After a successful self test, the default conditions upon power up are as follows:

- Status display shows **SET**,
- output is disabled (green **DC OUTPUT** indicator is off). If remote analog mode is selected (PAR. 3.4), output is enabled unless Remote Inhibit, pin 8 of the Analog I/O Connector (see Figure 2-2 and Table 2-7) is grounded.
- **DC VOLTS** and **DC AMPERES** displays show programmed output conditions: either 0 Volts, minimum Amperes (see NOTE, PAR. 3.2.1) or, if DIP switch position 3 enabled (see Table 2-2), previously saved setpoint values in effect upon power off.

NOTE: A minimum programmed current is required to ensure proper operation of the power supply under all load conditions. Programmed current is automatically set to be at least the minimum current (actual value depends on model, see Table 1-1).

- Since the output is off, Constant Voltage (**CV**) mode indicator (green LED) and Constant Current (**CC**) indicator (amber LED) are off.

**TABLE 3-1. POWER-UP BUILT-IN TEST ERROR CODES**

ERROR CODE	MEANING
<b>E310</b>	System Error
<b>E313</b>	Calibration Memory Error
<b>E315</b>	Configuration Memory Error
<b>E341</b>	Memory Error (CRC)
<b>E330</b>	Self Test Error
<b>Ecal</b>	Calibration Error - The unit will try to restore the previous calibration.
<b>Eclp</b>	Previous Calibration Error - After detecting a Calibration Error (Ecal) and trying to use the previous calibration, an error was detected, and the unit will attempt to restore the factory calibration.
<b>Eclf</b>	Factory Calibration Error - The unit has failed to restore the factory calibration after failing to restore the previous calibration. The unit will not operate after this error has been displayed and must be referred for service.

NOTE: During power-up the power supply performs detailed software check sequences. If a failure is detected during power-up, the DC VOLTS and DC AMPERES displays are blanked and the Status display shows an error code. For errors that occur after power-up, refer to the Developer's Guide for typical error codes and possible causes. For these and all other error codes, refer to authorized service personnel if corrective action is required.

### 3.2.2 SETTING LOCAL/REMOTE MODE

LOCAL MODE. When the power supply is turned on, it is automatically set to Local mode as long as Analog I/O port pin 12 is not grounded. In local mode the Status display is normally blank.

DIGITAL REMOTE MODE. The power supply will automatically go into digital remote mode when digital remote commands are accepted via the GPIB, RS232, or LAN ports. In digital remote mode the power supply normally shows **dRem** in the status display. The LAN indicator [-1.2K models only] is on when a valid IP address has been found. When in digital remote mode, all front panel controls are disabled. If desired, local mode can be restored by pressing both **VOLTAGE** and **CURRENT** controls simultaneously; the power supply will then remain in local mode until another digital command is received, causing the unit to return to remote digital mode. The OPERATE INSTRUMENT web page [-1.2K Models only] must not be active when restoring local mode. To disable local mode entirely, see PAR. 3.2.2.1 for front panel lockout.

NOTE: During both LOCAL and DIGITAL REMOTE operation, the analog readback signals (voltage and current) remain available, as does the remote inhibit signal; only programming signals are disregarded.

ANALOG REMOTE: With power supply turned off, ground Analog I/O port pin 12. Refer to PAR. 2.7.9 to configure the Analog I/O Port; refer to Table 2-2 to configure the Analog I/O switch. When the power supply is turned on, the status display shows **aRem** (Analog Remote programming selected). The unit will accept Analog Remote commands (see PAR. 3.4) and front panel controls are disabled, except that the **DC OUTPUT ON/OFF** switch is operational. Local mode can be restored by pressing the **VOLTAGE** and **CURRENT** controls at the same time. Once local mode has been restored, analog remote programming is disabled until the unit is powered off, then on again.

NOTE While Analog Remote programming is active, the unit will respond to digital queries, but will not respond to most digital commands, except for the front panel unlock command (see PAR. 3.2.2.1). Note that digital commands that conflict with the analog programming settings must not be issued, as these can cause momentary unpredictability at the output until analog control is reasserted.

#### 3.2.2.1 REMOTE WITH LOCAL (FRONT PANEL) LOCKOUT

To prevent unauthorized setting of the power supply to Local mode, a local lockout mode can be enabled which prevents the power supply from being restored to local mode via the front panel.

With the power supply turned off, set the ANALOG I/O DIP switch, position 5 (see Table 2-2) to ON. Now when the power supply is turned on the status display will read one of the following:

**LOCK** - front panel controls locked, analog mode not enabled and no digital commands received.

**aRw1** (analog Remote with local lockout) - front panel controls locked, analog mode enabled

**dRw1** (digital Remote with local lockout) - front panel controls locked, analog mode disabled and a digital command received.

Once the front panel is locked, it can only be unlocked by either of the following:

- turn the power supply off, set ANALOG I/O DIP switch position 5 to OFF, and then power up again.
- send the following SCPI command via GPIB, RS232 or LAN port:  
**SYST:KLOC OFF**

NOTE: If the front panel is unlocked by SCPI command, the unit will be set to Remote with Local Lockout when it is turned on again. Set ANALOG I/O DIP switch position 5 to OFF to disable Remote with Local Lockout.

### 3.2.3 ENABLING/DISABLING OUTPUT POWER

When the power supply is turned on, the output is automatically disabled (**DC OUTPUT** LED is off) and the **DC VOLTS** and **DC AMPERES** displays show the programmed output voltage and current set points and the status display reads **SET**.

To disable the output, press and release the **DC OUTPUT** switch again. The **DC OUTPUT** indicator goes off.

While in the setpoint mode (Status display reads **SET**) the output cannot be turned on (pressing **DC OUTPUT** has no effect). If output was on while setpoint mode was entered, pressing **DC OUTPUT** will disable the output.

For setpoint adjustment refer to PAR. 3.2.7.2. To enable/disable the output using analog control, refer to PAR. 3.4.1.

### 3.2.4 CHECKING VOLTAGE/CURRENT SETPOINTS

**CAUTION: WHEN THE OUTPUT IS DISABLED, THE DC VOLTS AND DC AMPERES DISPLAYS SHOW THE ACTUAL OUTPUT VOLTAGE AND CURRENT. BEFORE ENABLING THE OUTPUT ALWAYS CHECK THE SETPOINTS TO AVOID POSSIBLE DAMAGE TO THE LOAD.**

Check the voltage and current set points by tapping either the **VOLTAGE** or **CURRENT** control. The status display reads **SET**, and the **DC VOLTS** and **DC AMPERES** displays show the stored setpoints.

To accept the displayed value, tap the associated adjustment control again. To change the value, rotate the control (press the control in while rotating for fine adjustment), then tap the adjustment control again to accept the new setting. If you decide not to change the value after rotating the control, the previous setpoint value will be restored after about 20 seconds of inactivity, then tap either adjustment control to accept. If a fault has been configured for AUTO recovery, the status display flashes **>AUTO** for one second upon leaving Setpoint mode (see PAR 3.2.13.5.2).

### 3.2.5 PASSWORD PROTECTED FUNCTIONS

Certain functions, such as defining virtual model, system configuration, and calibration can only be changed from the front panel after entering the unit password. Refer to PAR. 4 to change the password. Table 4-1 shows the factory default password for each model.

1. The status display shows **PASS** (password) and the display shows **0000** with the left-most character blinking. Rotate **CURRENT** control to select a number from 0-9. Tap **CURRENT** control to advance to next digit.
2. Repeat this process until all four digits have been selected. Tap **DC OUTPUT** switch to accept the number. If password is incorrect, the status display reads **"ERR"**. Repeat this step to enter the correct password, or press the **FUNCTION** switch to exit.

### 3.2.6 DEFINING A VIRTUAL MODEL

The virtual model is defined by establishing a maximum programmable voltage and current for the unit within the 1200W power limitation and the maximum voltage and current ratings listed in Table 1-1. Once established, the unit will not accept programmed values beyond these values whether from the front panel in local mode, or from the digital (GPIB, RS232, or LAN) or analog input ports in remote mode. The virtual model settings are password-protected (see PAR. 3.2.5).

A multitude of possible 1200W power supplies may be emulated by defining the maximum voltage and current. For example, some of the possible power supplies that a KLP 36-60-1200 can emulate are: 36V, 33A (1200W), 20V, 60A (1200W), 30V, 40A (1200W) and 35V, 30A (1050W). Refer to Table 1-1 and Figure 1-2 for the acceptable operating regions for each model.

NOTE: Decreasing full scale voltage and/or current does not improve programming resolution.

Whenever a virtual model is set, overvoltage and overcurrent protect limits (see PAR. 3.2.8) are reset to 120% of the new maximum value (except where necessary to maintain minimum values as noted in PAR. 3.2.8). Also, if position 3 of the Analog I/O DIP switch is set to recall previous setpoint values upon power-up (see Table 2-2 and PAR. 3.2.7.3), the previous setpoint value is cleared so that after changing the virtual model the initial powerup will be at 0 Volts, minimum current. In addition, the following parameters which are not accessible from the front panel (see PAR. 3.3.2) should be checked to ensure that there are no settings outside the range permitted by the new maximum programmable voltage and current.

- Storage of User-programmed Active Settings (Save/Recall).
- User-determined output Sequences.
- External Triggers: VOLT:TRIG and CURR:TRIG values
- Sequences programmed using LIST commands.

To define a virtual model, proceed as follows.

1. If the status display shows **SET**, tap either the **CURRENT** or **VOLTAGE** controls to take the unit out of setpoint mode (status display goes from **SET** to blank)
2. Using a thin tool (e.g., a paper clip), press the **FUNCTION** switch once so that the status display reads **VRT**. The **DC VOLTS** and **DC AMPERES** displays show the programmed maximum voltage and current of the virtual model. To exit without changing the virtual model, rotate either **VOLTAGE** or **CURRENT** control until Status display reads **EXIT**, then tap **DC OUTPUT** switch. To change the virtual model limits proceed to step 3.
3. Press the **DC OUTPUT** switch once. The status display shows **PASS**. Enter the unit password (see PAR. 3.2.5) and tap **DC OUTPUT** switch to accept the number. When the password is accepted, the virtual model settings in the **DC VOLTS** and **DC AMPERES** displays begin blinking.
4. Rotate **VOLTAGE** and **CURRENT** controls until desired values appear in **DC VOLTS** and **DC AMPERES** displays. Pressing and holding the control in while turning provides a finer adjustment resolution. Under no conditions will the power supply accept limits beyond its maximum ratings of voltage and current. As the primary parameter is increased, the power supply will automatically decrement the secondary parameter as necessary to maintain max-

imum output power at 1200 Watts. Maximum current shown on **DC AMPERES** display is automatically limited to 1200W maximum.

5. Press **DC OUTPUT** switch to accept virtual model settings. The unit displays **done**, then resets and repeats the power on sequence (see PAR. 3.2.1).

NOTE: Accepting a new virtual model resets the setpoints to zero Volts and minimum Amperes, resets the OVP and OCP values and, if DIP switch position 3 is enabled, clears stored setpoints of voltage and current as described above.

### 3.2.7 SETTING VOLTAGE OR CURRENT

The **VOLTAGE** and **CURRENT** controls adjust output voltage and current limit, respectively, when the unit is in constant voltage (CV) mode and adjust voltage limit and output current, respectively, when the unit is in constant current (CC) mode. The mode (CV or CC) is determined by the load together with the programmed settings. As long as the voltage across the load produces a current that is less than the programmed Current setpoint, the unit operates in CV mode (voltage programmed to voltage setpoint, current limited by current setpoint). If the load changes to the point that current through the load reaches the current setpoint, the unit automatically enters CC mode (current programmed to current setpoint, voltage limited by voltage setpoint).

Output voltage or current can be set at the front panel in two ways: Real-time adjustment (PAR 3.2.7.1) or Setpoint adjustment (PAR. 3.2.7.2).

#### 3.2.7.1 REAL-TIME VOLTAGE/CURRENT ADJUSTMENT

Rotating the associated control will change the output voltage or current in real-time only if the output is enabled. If the unit is in constant voltage mode (**CV** indicator lit) the **DC VOLTS** display shows the actual output voltage as the **VOLTAGE** control is rotated. Similarly, if the unit is in constant current mode (**CC** indicator lit) the **DC AMPERES** display shows the actual output current as the **CURRENT** control is rotated.

NOTE: If the unit is in CV mode, rotating the **CURRENT** control will affect the current limit even though the **DC AMPERES** display does not change since it is showing actual output current. Similarly, rotating the **VOLTAGE** control while in CC mode affects the voltage limit. To change the limits to a precise value, refer to PAR. 3.2.7.2, Setpoint Adjustment.

Voltage and current settings are not allowed to exceed either a) the virtual model setting or b) 80% of the protection value. Attempts to set voltage or current beyond these limits will not be accepted. The status display shows either **>MAX** for virtual model limits, **>OVP** for voltage protection, or **>OCP** for current protection to indicate which limit is being exceeded.

#### 3.2.7.2 SETPOINT ADJUSTMENT

Tap either the **VOLTAGE** or **CURRENT** control to initiate setpoint adjustment (status display reads SET). The previous setpoint is visible on the corresponding **DC VOLTS** or **DC AMPERES** display.

1. Rotate the corresponding control to change the setpoint as viewed on the corresponding LED display. If you decide not to change the setting after rotating the control, the previous setpoint value is restored after approximately 20 seconds. Tap either adjustment control again to accept the displayed setting.

2. In the setpoint mode, both coarse (rotate the control) and fine (rotate while pressing control in) adjustment is available. The coarse adjustment is approximately 100X the fine adjustment resolution.

Setpoint adjust can be done with output either on or off, however the output can not be enabled while setpoint is active (See PAR. 3.2.3).

Voltage and current settings are not allowed to exceed either a) the virtual model setting or b) 80% of the protection value. Attempts to set voltage or current beyond these limits will not be accepted. The status display shows either **>MAX** for virtual model, **>OVP** for voltage protection, or **>OCP** for current protection to indicate which limit is being exceeded. If a fault has been configured for AUTO recovery, the status display flashes **>AUTO** for one second upon leaving Setpoint mode (see PAR 3.2.13.5.2).

### 3.2.7.3 LAST SETTING RECALL

KLP is capable of saving the last setpoint values for voltage and current prior to unit shutdown, and recalling them when the unit is next turned on. Enable this function prior to power-up by setting Analog I/O Switch 3 to the ON (down) position (see Table 2-2 and Figure 2-2). Upon next power-up, each setpoint entry for voltage and current is stored in non-volatile memory, with latest settings displacing prior ones. When the power supply is turned off, the last settings are saved and automatically retrieved at next power-up as the starting setpoints. Note that this function applies to setpoint entries only (PAR 3.2.7.2); output changes entered in real-time mode (PAR 3.2.7.1) are not saved. To disable this function, turn the unit off and set Analog I/O Switch 3 to the OFF (up) position; at next power-up, the stored value buffer is cleared and setpoints will default to zero volts and minimum current.

NOTE: If the virtual model for the power supply is altered, the last settings are reset to zero volts and minimum current.

### 3.2.8 VIEWING/CHANGING OVERVOLTAGE OR OVERCURRENT PROTECTION VALUES

Overvoltage and Overcurrent protection values can be individually programmed. The range for overvoltage and overcurrent values are 0.2 to 1.2 x  $E_{Omax}$  and 0.72 to 1.2 x  $I_{Omax}$ . If the output voltage/current exceeds the overvoltage/overcurrent protection value, the protection circuit latches the output off, flashes an overvoltage (OVP) or overcurrent (OCP) protection error message on the status display and sets a status bit that can be retrieved through the RS 232, GPIB or LAN port. The unit must be cycled on and off to restore the output. If the internal relay is programmed to FAULT mode (see PAR. 3.2.13.3), the N.O. and N.C. contacts of the relay provide status flags via the Analog I/O port connector. The maximum values are 1.2 x  $E_{Omax}$  for overvoltage protection, and 1.2 x  $I_{Omax}$  for overcurrent protection.

A built-in feature prevents the unit from being programmed within 20% of OVP or 20% of OVC. For example, if OVP and OVC are set to 12V and 72A, respectively, programming of the output is automatically limited to 10V and 60A.

NOTE: When a virtual model is defined (PAR. 3.2.6), OVP and OVC are automatically set 20% and 20%, respectively, above the maximum programmable values established by the virtual model. If OVP or OVC are lowered by the user, valid settings will actually be lower than the virtual model limits because values within 20% of OVP or 20% of OVC are prohibited.

The OVP and/or OVC limits can be changed as follows:

1. Using a thin tool (e.g., end of paper clip), press and hold the **PROTECT** switch. The output is switched off, setting voltage to zero Volts, and current to a minimal value, and the status dis-

play shows **PROT**. The **DC VOLTS** and **DC AMPERES** displays show the corresponding overvoltage and overcurrent protection setpoints while the **PROTECT** switch is held in.

2. To change the values, operate the corresponding adjustment control while holding the **PROTECT** switch in. When the **PROTECT** switch is released, the protection values showing in the **DC VOLTS** and **DC AMPERES** displays are entered as the new protection values.

### 3.2.9 CHANGING GPIB ADDRESS

The factory default GPIB address is 6. To change the address from the front panel proceed as follows:

1. If the status display shows **SET**, tap either the **CURRENT** or **VOLTAGE** controls to take the unit out of setpoint mode (status display goes from **SET** to blank)
2. Using a thin tool (e.g., a paper clip), press the **FUNCTION** switch once until the status display reads **VIRT**. Rotate either the **CURRENT** or **VOLTAGE** control until the display reads **ADDR**; the active GPIB address is visible in the **DC AMPERES** display. To change the address, proceed to step 3.
3. Tap the **DC OUTPUT** switch once. The GPIB address visible in the **DC AMPERES** display begins blinking.
4. Rotate the **CURRENT** control to change the GPIB address, then tap the **DC OUTPUT** switch to accept the displayed GPIB address. The display briefly reads **DONE**, then returns to **ADDR**.
5. Rotate the **VOLTAGE** control until display reads **EXIT**, then tap the **DC OUTPUT** switch to exit

### 3.2.10 CHANGING RS232 BAUD RATE [-1200 MODELS ONLY]

The factory default RS232 baud rate is 38400. To change the baud rate from the front panel proceed as follows:

1. If the status display shows **SET**, tap either the **CURRENT** or **VOLTAGE** controls to take the unit out of setpoint mode (status display goes from **SET** to blank)
2. Using a thin tool (e.g., a paper clip), press the **FUNCTION** switch once until the status display reads **VIRT**. Rotate either the **CURRENT** or **VOLTAGE** control until the display reads **BAUD**; the active baud rate x 1000 is visible in the **DC AMPERES** display (e.g., 38400 is displayed as 38.4). To change the baud rate, proceed to step 3.
3. Tap the **DC OUTPUT** switch once. The baud rate visible in the **DC AMPERES** display begins blinking.
4. Rotate the **CURRENT** control to change the baud rate, then tap the **DC OUTPUT** switch to accept the displayed baud rate. The display briefly reads **DONE**, then returns to **BAUD**.
5. Rotate the **VOLTAGE** control until display reads **EXIT**, then tap the **DC OUTPUT** switch to exit

### 3.2.11 SETTING UP MASTER/SLAVE CONFIGURATIONS [-1200 MODELS ONLY]

Both units of a master/slave pair must be identical models. After connecting the RS 232 ports (see PAR. 2.7.8), proceed as follows to configure the individual units to be master or slave.



### 3.2.11.1 CONFIGURE POWER SUPPLY AS MASTER [-1200 MODELS ONLY]

1. Turn power on. If the unit comes up in setpoint mode (see PAR. 3.2.4), tap either the **CURRENT** or **VOLTAGE** controls to take the unit out of setpoint mode (status display goes from **SET** to blank).
2. Using a thin tool (e.g., a paper clip), press the **FUNCTION** switch once until the status display reads **VRT**. Rotate either the **CURRENT** or **VOLTAGE** control until the display reads **M/S**.
3. Tap the **DC OUTPUT** switch once.
  - The status display reads either **SERI** (series) or **PARA** (parallel).
  - The **DC VOLTS** display shows the number assigned to the unit (1 = master, 2 or above = slave).
  - The **DC AMPERES** display shows the maximum number of units in the configuration.
  - The factory default is standalone operation (**DC VOLTS** and **DC AMPERES** show 1).
4. To change the configuration tap the **DC OUTPUT** switch once. The **DC VOLTS** and **DC AMPERES** start blinking.
  - Specify either **SERI** (series configuration for higher voltage) or **PARA** (parallel configuration for higher current) using either the **VOLTAGE** or **CURRENT** control by *holding in* and rotating the control. Both connected units must be set the same, either **SERI** or **PARA**.
  - Specify the total number of units in the configuration to 2 by rotating the **CURRENT** control.
  - Specify the unit number to be assigned (1 = master) by rotating the **VOLTAGE** control.
5. Press **DC OUTPUT** to accept the displayed settings. The unit briefly flashes **WAIT**, then restarts with the new settings; press **FUNCTION** to abort without changing the settings.

NOTE: Until both units are configured properly, the displays will cycle as follows: status display will flash **E241** (hardware error), then **DC VOLTS**, status display and **DC AMPERES** flash **x OF y** where **x** = unit number and **y** = total number of units, the status display flashes the type of connection **SERI** (series) or **PARA** (parallel).

### 3.2.11.2 CONFIGURE POWER SUPPLY AS SLAVE [-1200 MODELS ONLY]

1. Turn power on. If the unit comes up in setpoint mode (see PAR. 3.2.4), tap either the **CURRENT** or **VOLTAGE** control to take the unit out of setpoint mode (status display goes from **SET** to blank).
2. Using a thin tool (e.g., a paper clip), press the **FUNCTION** switch once until the status display reads **VRT**. Rotate either the **CURRENT** or **VOLTAGE** control until the display reads **M/S**.
3. Tap the **DC OUTPUT** switch once.
  - The status display reads either **SERI** (series) or **PARA** (parallel).

- The **DC VOLTS** display shows the number assigned to the unit (1 = master, 2 or above = slave).
  - The **DC AMPERES** display shows the maximum number of units in the configuration.
  - The factory default is standalone operation (**DC VOLTS** and **DC AMPERES** show 1).
4. To change the configuration tap the **DC OUTPUT** switch once. The **DC VOLTS** and **DC AMPERES** start blinking.
- Specify either **SERI** (series configuration for higher voltage) or **PARA** (parallel configuration for higher current) using either the **VOLTAGE** or **CURRENT** control by *holding in* and rotating the control. Both connected units must be set the same, either **SERI** or **PARA**.
  - Specify the total number of units in the configuration to 2 by rotating the **CURRENT** control.
  - Specify the unit number to be assigned (2 = slave) by rotating the **VOLTAGE** control.
5. Press **DC OUTPUT** to accept the displayed settings. The unit briefly flashes wait, then restarts with the new settings; press **FUNCTION** to abort without changing the settings.

NOTE: Until both units are configured properly, the displays will cycle as follows: status display will flash **E241** (hardware error), then **DC VOLTS**, status display and **DC AMPERES** flash **x OF y** where **x** = unit number and **y** = total number of units, the status display flashes the type of connection **SERI** (series) or **PARA** (parallel).

### 3.2.11.3 OPERATING THE MASTER/SLAVE CONFIGURATION [-1200 MODELS ONLY]

Once the master is configured, it searches for the slave specified. Until the slave is set up properly, the master status display will cycle as follows: status display will flash **E241** (hardware error), then **DC VOLTS**, status display and **DC AMPERES** flash **x OF y** where **x** = unit number and **y** = total number of units, the status display flashes the type of connection **SERI** (series) or **PARA** (parallel). When the slave is found, the status display of the slave reads **SLVE** and the **DC VOLTS** and **DC AMPERES** displays on the slave go blank. For the master/slave combination to work properly the number of slave units specified in the master (PAR. 3.2.11.1, step 4) must be found.

When the slave has been found, the master proceeds with the normal turn-on sequence and the unit proceeds to **SET** mode. The master front panel readouts show the total values for set point, voltage and current readback, virtual model (the virtual model and protection settings of the slave are automatically programmed to be the same as the master) and protection settings for the master/slave configuration. All controls on the slave are disabled. The parallel or series combination is controlled from the master using either the front panel, SCPI commands, or analog control.

- If analog control is used, only the master is configured for analog control (the slave is controlled digitally by the master).
- If Remote Inhibit is used, it should only be connected to the master.

- If **E241** (hardware error) is showing in the status display, check the master and/or slave setup. If necessary, use **FUNCTION** switch to enter the M/S menu to change the configuration as described above.
- If there is no communication between units for approximately 10 seconds, all units will turn off their output and the status display will flash **E241** (hardware error), then **xOFy** where **x** = unit number and **y** = total number of units, and finally the serial/parallel configuration setting **SERI** or **PARA**.

### 3.2.12 LAN INTERFACE CONFIGURATION [-1.2K MODELS ONLY]

Using a thin tool (e.g. end of paper clip), press **FUNCTION** switch once until status display reads **VIRT**, then rotate either **VOLTAGE** or **CURRENT** control until status display reads **LAN**. Press **DC OUTPUT** switch to enter the LAN Interface configuration menu. Rotate either **VOLTAGE** or **CURRENT** control to see the available functions.

- **LRST** - LAN Reset. To restore the LAN interface configuration to the factory default, rotate either **VOLTAGE** or **CURRENT** control to show **YES** in the **DC VOLTS** display, then press **DC OUTPUT** switch. The factory default settings are listed in PAR. 3.3.1.3.
- **DHCP** - DHCP status is displayed in the **DC VOLTS** display. To change the setting press **DC OUTPUT** switch, then rotate either **VOLTAGE** or **CURRENT** control to see desired setting and press **DC OUTPUT** switch to save.
  - ON - The KLP requests an IP address from the DHCP server. (AUTOIP set to OFF.)
  - OFF - The KLP uses the IP, MASK, GATE and DNS addresses established by the user using either the UTIL - LAN menus at the front panel, the web interface (see PAR. 3.3.6) or via SCPI commands over one of the digital interfaces. (AUTO IP also set to OFF.)
- **AUTO** - AUTO IP status is displayed in the **DC VOLTS** display.
  - ON - The KLP obtains an IP address automatically. (Both DHCP and AUTO IP set to ON.)
  - OFF - The KLP uses the IP, MASK, GATE and DNS addresses established by the user using either the UTIL - LAN menus at the front panel or via SCPI commands. (AUTOIP set to OFF.)
- **MAC1** - Shows first pair of hex digits of the MAC address (e.g., for MAC address 01-23-45-67-89-AB the **DC VOLTS** display shows **01-** and the **DC AMPERES** display shows **23-**). Cannot be changed by the user.
- **MAC2** - Shows second of two hex digits of the MAC address (e.g., for MAC address 01-23-45-67-89-AB the **DC VOLTS** display shows **45-** and the **DC AMPERES** display shows **67-**). Cannot be changed by the user.
- **MAC3** - Shows third pair of hex digits of the MAC address (e.g., for MAC address 01-23-45-67-89-AB the **DC VOLTS** display shows **89-** and the **DC AMPERES** display shows **AB**). Cannot be changed by the user.
- **IP1** - Shows first half of IP address (e.g., for IP address 192.168.000.200 the **DC VOLTS** display shows **192.** and the **DC AMPERES** display shows **168.**). To change

the address, press **DC OUTPUT** switch, then rotate **VOLTAGE** control to change **192.** or **CURRENT** control to change **168.**, then press **DC OUTPUT** switch to save.

- **IP2** - Shows second half of IP address (e.g., for IP address 192.168.000.200 the **DC VOLTS** display shows **\_000.** and the **DC AMPERES** display shows **\_200.**). To change the address, press **DC OUTPUT** switch, then rotate **VOLTAGE** control to change **\_000.** or **CURRENT** control to change **\_200.**, then press **DC OUTPUT** switch to save.
- **MSK1** - Shows first half of SUBNET MASK address (see IP1 described above). Default is 255.255.
- **MSK2** - Shows second half of SUBNET MASK address (see IP2 described above). Default is 0.0
- **GTE1** - Shows first half of GATE address (see IP1 described above).
- **GTE2** - Shows second half of GATE address (see IP2 described above).
- **DNS1** - Shows first half of DNS address (see IP2 described above).
- **DNS2** - Shows second half of DNS address (see IP2 described above).
- **RTN** - Return to **LAN** menu.

### 3.2.13 UTILITY FUNCTION

The Utility Function provides additional system information or access to special functions. These are described below.

1. If the status display shows **SET**, tap either the **CURRENT** or **VOLTAGE** controls to take the unit out of setpoint mode (status display goes from **SET** to blank)
2. Using a thin tool (e.g., a paper clip), press the **FUNCTION** switch once until the status display reads **VIRT**, then rotate either the **VOLTAGE** or **CURRENT** control in either direction until status display reads **UTIL**.
3. Tap the **DC OUTPUT** switch once, then rotate either the **VOLTAGE** or **CURRENT** control in either direction to select the function identified in the status display (see below).
  - **VERS** - Display System Firmware Version (see PAR. 3.2.13.1)
  - **MODL** - Display Model (see PAR. 3.2.13.2)
  - **RELY** - Relay Control (see PAR. 3.2.13.3)
  - **QKBT** - Quick Boot (see PAR. 3.2.13.4)
  - **SYST** - System Configuration (see PAR. 3.2.13.5)
  - **INVC** - Analog Input Voltage and Current A to D calibration voltages (see PAR. 3.2.13.6)
  - **LBT** - [-1200 Models only] Loop Back Test used to isolate RS 232 communication prob-

lems (see KLP Developer's Guide).

- **CAL** - Display last calibration date and/or begin Calibration (see PAR. 3.2.13.7)
- **RTN** - Exit any submenu and return to previous menu

### 3.2.13.1 DISPLAY SYSTEM FIRMWARE VERSION

Enter **UTIL** menu (see PAR. 3.2.13, steps 1 through 3) and rotate either **VOLTAGE** or **CURRENT** control until status display reads **VERS**.

- The **DC VOLTS** display identifies whether the firmware is the factory shipped firmware (**Pr**i displayed) or field updated firmware (**SEC** displayed).
- The **DC AMPS** display shows the firmware version. This information can not be changed directly by the user.

### 3.2.13.2 DISPLAY MODEL

Enter **UTIL** menu (see PAR. 3.2.13, steps 1 through 3) and rotate either **VOLTAGE** or **CURRENT** control until status display reads **MODL**.

- The **DC VOLTS** display shows the model voltage rating (e.g, 75.00 for KLP 75-33-1200).
- The **DC AMPS** display shows the model current rating (e.g, 33.34 for KLP 75-33-1200). This information can not be changed by the user.

### 3.2.13.3 INTERNAL RELAY CONTROL

The internal relay contacts available at pins 6, 7 and 8 of the Analog I/O connector can be configured from the front panel to operate in either Fault, Manual or List mode. If FAULT mode (the factory default) is selected, the relay energizes automatically upon detection of a user-selected condition. The selections are a) **NORM** (normal), a system fault (see PAR. 1.4.9), b) **v->c**, when the unit transitions from Constant Voltage (CV) to Constant Current (CC) mode, or c) **c->v**, when the unit transitions from CC to CV mode. If **v->c** (or **c->v**) is selected, the amount of time the unit must be in CC (or CV) mode before the relay energizes may be programmed from the front panel (see step 2a) or using the SCPI command **OUTP:PROT:DEL** (see KLP Developer's Guide).

1. Enter **UTIL** menu (see PAR. 3.2.13, steps 1 through 3) and rotate either **VOLTAGE** or **CURRENT** control until status display reads **RELY**. The **DC VOLTS** display indicates whether the relay is currently **ON** (energized) or **OFF** (deenergized). Tap **DC OUTPUT** switch to enter Relay Control menu.
  - Rotate either **VOLTAGE** or **CURRENT** control to see the available relay control modes in the status display. The modes are:  
**FLT** (factory default) - Relay is set to energize automatically upon detection of one of three preselected conditions:
    - NORM**: (factory default) relay energizes immediately upon detection of a system (fatal) error:
    - v->c**: relay energizes immediately upon detection of a system (fatal) error and,

after a user-programmable delay, the relay energizes upon a transition from constant voltage (CV) to constant current (CC) mode.

**C->V:** relay energizes immediately upon detection of a system (fatal) error and, after a user-programmable delay, the relay energizes upon a transition from constant current (CC) to constant voltage (CV) mode.

**RTN:** Return to **FLT** menu.

**MAN** - Relay on/off is controlled manually, directly from the front panel (see below). Relay state is not retained; relay will be off when unit is turned on

**LIST** - Relay on/off is controlled remotely using LIST commands via GPIB or RS 232 interface (see KLP Developer's Guide).

**RTN** - Return to **RELY** menu.

2. To select mode rotate either **VOLTAGE** or **CURRENT** control until status display reads **FLT** (factory), **MAN** (manual), or **LIST**. Then press **DC OUTPUT** switch to save selection.

a. If **FLT** is selected, rotate **VOLTAGE** or **CURRENT** control to select **NORM**, **V->C**, or **C->V**. in the status display.

(1) To select **NORM**, tap the **DC OUTPUT** switch to save selection; unit returns to **RELY** menu.

(2) To select **V->C** or **C->V**, first set the delay. While **V->C** or **C->V** is in the status display, the **DC AMPERES** display shows the delay in seconds, from 000.5 to 128.0: **NNND**, where **NNN** is an integer from 0 to 128 and **D** will be either .0 or .5 (000.0 is not permitted). The delay determines the length of time that the unit must be operating in the new mode before energizing the relay.

The factory default delay time is set to 1.0 seconds to prevent false tripping of the relay during application of output power to low impedance or highly reactive loads. If false tripping occurs, this delay may be increased as needed.

To change the delay, press in and rotate either the **VOLTAGE** or **CURRENT** control; release the control when the **DC AMPERES** display shows the desired delay. Tap the **DC OUTPUT** switch to save selection; unit returns to **RELY** menu.

NOTE: Once the relay turns on in **V->C** or **C->V** mode, the relay will go off again when the unit transitions back to the original mode, or when the output is turned off.

b. To select **MAN**, tap the **DC OUTPUT** switch to save selection. If **MAN** is selected, the **DC VOLTS** display shows whether the relay is **ON** or **OFF**. To change the state of the relay press in and rotate either **VOLTAGE** or **CURRENT** control until the desired relay state is displayed, then release the control. Tap the **DC OUTPUT** switch to immediately set the relay to the selected state and return to the **RELY** menu.

c. To select **LIST**, tap the **DC OUTPUT** switch to save selection; unit returns to the **RELY** menu

3. Rotate either **VOLTAGE** or **CURRENT** control until status display shows **RTN** and press **DC OUTPUT** switch to exit **UTIL** menu, then rotate either **VOLTAGE** or **CURRENT** control until status display shows **EXIT** and press **DC OUTPUT** switch to exit **FUNCTION** control.

NOTE: If a **SYSTEM:SECurity:IMMediate** command is issued, the above relay control settings are reset to the factory default: **FLT - NORM**.

#### 3.2.13.4 QUICK BOOT

Enter **UTIL** menu (see PAR. 3.2.13, steps 1 through 3) and rotate either **VOLTAGE** or **CURRENT** control until status display reads **QkBT** - Quick Boot. If Quick boot is ON, then the next time the unit is powered up it will go directly to setpoint mode (status display reads **SET**, see PAR. 3.2.7) without displaying **MODL**, **VIRT**, and **PROT** settings.

- The **DC VOLTS** display indicates whether quick boot is **ON** or **OFF**.
1. Tap the **DC OUTPUT** switch to change the setting. The **DC VOLTS** display begins to blink.
  2. Rotate either **VOLTAGE** or **CURRENT** control until the desired quick boot state is displayed, then tap the **DC OUTPUT** switch to save the setting; the blinking stops.
  3. To exit, rotate either **VOLTAGE** or **CURRENT** control until the status display reads **RTN**, then tap the **DC OUTPUT** switch. To exit the **UTIL** menu rotate either **VOLTAGE** or **CURRENT** control until the status display reads **EXIT**, then tap the **DC OUTPUT** switch.

#### 3.2.13.5 SYSTEM CONFIGURATION FUNCTIONS

The system configuration functions allow the user to determine 1) whether the Remote Inhibit signal is an active TTL high or low and 2) how the unit recovers from a fault. The unit password is required to change these functions.

1. Enter **UTIL** menu (see PAR. 3.2.13, steps 1 through 3) and rotate either **VOLTAGE** or **CURRENT** control until status display reads **SYST**.
2. Tap the **DC OUTPUT** switch to enter the System Configuration Functions menu.

##### 3.2.13.5.1 REMOTE INHIBIT CONFIGURATION

The Remote Inhibit signal **REM\_INH** is applied to analog I/O port, pin 8 (see PAR's. 2.7.9 and 3.4.1). This signal can be configured to be active (inhibit the output) for either a TTL high or low.

1. Enter **UTIL** menu (see PAR. 3.2.13, steps 1 through 3) and rotate either **VOLTAGE** or **CURRENT** control until status display reads **SYST**, then tap **DC OUTPUT** switch. Rotate either **VOLTAGE** or **CURRENT** control until the status display reads **rINH** and the **DC VOLTS** display reads either **Hi** or **Lo**.
2. To change the remote inhibit setting, tap the **DC OUTPUT** switch. The status display shows **PASS**. Enter the unit password (see PAR. 3.2.5) and tap **DC OUTPUT** switch to accept the number. When the password is accepted, the status display reads **rINH** and **DC VOLTS** display is blinking.
3. Rotate either **VOLTAGE** or **CURRENT** control until **DC VOLTS** display reads desired setting, then tap **DC OUTPUT** switch to accept.
4. Tap **FUNCTION** switch to exit or rotate **VOLTAGE** or **CURRENT** control until status display reads **RTN**, then tap **DC OUTPUT** switch to return to next highest menu.

### 3.2.13.5.2 FAULT RECOVERY CONFIGURATION

The KLP allows the user to control how the unit recovers from faults, and allows different responses for different faults. This function is password-protected. The three recovery options are PROT, SAFE and AUTO.

- **PROTECTED** - When a fault configured as PROT is detected, the output is disabled. Recovery requires that the user turn the unit off and wait five seconds before turning the unit on. After initializing, the output is disabled and the unit is in Setpoint mode, programmed to 0 Volts, minimum current, except that if last setting recall (PAR. 3.2.7.3) is enabled, the Setpoint values are from the last setting. This is the safest recovery option, forcing the operator to reboot the power supply before programming and re-enabling the output, hopefully after eliminating the cause of the fault. PROT is the factory default setting for all fault recoveries.
- **SAFE** - When a fault configured as SAFE is detected, the output is disabled and the unit is returned to Setpoint mode (programmed to zero volts, minimum current); if last setting recall (PAR. 3.2.7.3) is enabled, the Setpoint values are from the last setting. Recovery requires that the user exit Setpoint mode and re-enable the output, either from the front panel or via one of the digital programming ports. Recovery cannot be initiated by toggling the remote inhibit line at the analog programming port. This option provides greater operator convenience by eliminating the need to reboot the power supply while preserving a safe response (output off), but it is the user's responsibility to NOT attempt multiple consecutive restarts without eliminating the fault condition.
- **AUTOMATIC** - When a fault configured as AUTO is detected, the output is disabled as long as the fault condition exists. When the fault condition is no longer present (e.g., the unit has cooled after an OTP overtemperature fault) the output returns to its last state (OFF or ON) and the unit is programmed to zero volts, minimum current, except if last setting recall (PAR. 3.2.7.3) is enabled, the unit is programmed to match the last setting. While offering the greatest convenience to the user, this option represents the highest risk because the output can reappear without warning when the fault condition clears. To alert the user to this risk, if any fault is set to AUTO recovery, the status display briefly shows **AUTO** after a) any fault recovery, b) any output enable action or c) upon leaving Setpoint mode. In addition, if AUTO recovery is selected for source power failure (PWR) faults, the status display flashes **AUTO** for one second as part of the power-up sequence.

If more than one fault occurs, the fault with the lowest risk level determines the unit's response, however multiple faults will cause the output to be off upon recovery, even if set to AUTO.

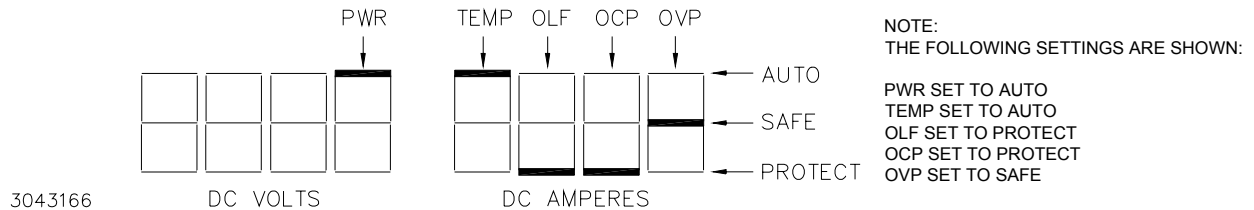
The factory default configuration is PROTECT for all faults. Note that some faults have limited options. The recovery options for each fault are:

- OVP (Overvoltage Protection fault) PROTECT or SAFE
- OCP (Overcurrent Protection fault) PROTECT or SAFE
- OLF (Output Lead Fault) PROTECT or SAFE
- TEMP (Temperature fault) PROTECT, SAFE or AUTO
- PWR (Loss of source power fault) PROTECT, SAFE or AUTO
- FAN (Fan failure fault) PROTECT (not configurable)



1. Enter **UTIL** menu (see PAR. 3.2.13, steps 1 through 3) and rotate either **VOLTAGE** or **CURRENT** control until status display reads **SYST**, then tap **DC OUTPUT** switch. Rotate either **VOLTAGE** or **CURRENT** control to until the status display reads **RCOV**.

The **DC VOLTS** and **DC AMPERES** displays show a series of bars that give a snapshot picture of the recovery configuration as defined in Figure 3-1. The location of the bar (top, middle, or bottom) corresponds to the risk level (high for AUTO, middle for SAFE, and low for PROTECT). The character positions are assigned to the configurable faults as shown.



**FIGURE 3-1. FAULT RECOVERY CONFIGURATION DISPLAY**

2. To change a fault recovery setting, tap the **DC OUTPUT** switch to enter the Recovery menu.
3. The status display shows **PASS**. Enter the unit password (see PAR. 3.2.5) and tap **DC OUTPUT** switch to accept the number. When the password is accepted, status display reads **OVF** and the **DC VOLTS** display shows the present fault recovery status (**PROT** or **SAFE**) for **OVF**. Rotate either **VOLTAGE** or **CURRENT** control to cycle through **OVF**, **OCP**, **OLF**, **TEMP**, and **PWR** settings. To exit tap the **DC OUTPUT** switch while the status display shows **RTN**.
4. To change a setting, tap the **DC OUTPUT** switch while the status display shows the fault. The setting in the **DC VOLTS** display begins to blink. Rotate either **VOLTAGE** or **CURRENT** control to cycle through the allowable settings. Tap the **DC OUTPUT** switch to accept the setting shown in the **DC VOLTS** display.
5. To continue, rotate either **VOLTAGE** or **CURRENT** control to select another fault. To exit, either select **RTN** and tap the **DC OUTPUT** switch to go to the next highest menu, or tap the **FUNCTION** switch to exit function mode.

### 3.2.13.6 ANALOG INPUT FULL SCALE CALIBRATION

Enter **UTIL** menu (see PAR. 3.2.13, steps 1 through 3) and rotate either **VOLTAGE** or **CURRENT** control until status display reads **INVC**.

- The **DC VOLTS** display shows the analog input voltage value that produces the full scale output voltage established by the virtual model.
- The **DC AMPS** display shows the analog input voltage value that produces the full scale output current established by the virtual model.

1. To change the settings tap the **DC OUTPUT** switch.
2. Rotate **VOLTAGE** control to set the analog voltage value required to produce the full scale output voltage (for fine adjustment press in **VOLTAGE** control and hold while rotating).
3. Rotate the **CURRENT** control to set the analog voltage value required to produce the full scale output current (for fine adjustment press in **CURRENT** control and hold while rotating).

4. Tap the **DC OUTPUT** switch to accept the new settings (blinking stops) or use a thin tool (e.g., a paper clip) to press the **FUNCTION** switch to cancel the operation.
5. To exit, rotate either **VOLTAGE** or **CURRENT** control until the status display reads **RTN**, then tap the **DC OUTPUT** switch. To exit the **UTIL** menu rotate either **VOLTAGE** or **CURRENT** control until the status display reads **EXIT**, then tap the **DC OUTPUT** switch.

### 3.2.13.7 CALIBRATION

Refer to PAR 4.3.

## 3.3 REMOTE MODE PROGRAMMING USING DIGITAL INTERFACES

For digital remote programming refer to the KLP Developer's Guide.

### 3.3.1 FACTORY DEFAULT SETTINGS

#### 3.3.1.1 GPIB FACTORY DEFAULTS

The factory default GPIB address is 6; refer to PAR. 3.2.9 to change the GPIB address.

#### 3.3.1.2 RS 232 FACTORY DEFAULTS [-1200 MODELS ONLY]

The factory default RS 232 settings are as follows; refer to PAR. 3.2.10 to change the RS 232 baud rate (-1200 Models only):

- Baud rate: 38400
- Parity: None
- Data Bits 8
- Stop Bits 1
- Echo OFF
- XON ON (enabled) NOTE: Kepco strongly recommends the XON XOFF method for data transfer via RS 232 protocol for all Kepco products. If this method is not selected, it is the user's responsibility to ensure completion of any response by the power supply prior to issuance of subsequent commands.

#### 3.3.1.3 LAN FACTORY DEFAULTS [-1.2K MODELS ONLY]

The factory default LAN interface settings are listed below. Factory default setting can be restored using the LAN Reset function (front panel only) or configured as desired from either the front panel (see PAR. 3.2.12) or the web interface (see PAR. 3.3.6.3 )

- DHCP: ON
- AUTOIP: ON
- PING: ON (can only be changed through web interface)
- IP Address: Undefined
- MASK Address: 255.255.0.0
- GATE Address: 0.0.0.0
- DNS Address: 0.0.0.0

### 3.3.2 ADDITIONAL FUNCTIONS NOT AVAILABLE FROM THE FRONT PANEL

Some additional functions are described in the KLP Developer's Guide that are not available from the front panel:

- Storage of User-programmed Active Settings - 40 memory locations are available to store and recall active settings of the power supply. The active settings include voltage, current, protection limits, and output state (ON or OFF). This feature may be also accessed using the web interface (-1.2K models only, see PAR. 3.3.6.5.3).
- User-determined output Sequences - Up to 100 memory locations are available for programming the KLP output using multiple command sequences that can be initiated by a single LIST command (see KLP Developer's Guide). This feature may be also accessed using the web interface (-1.2K models only, see PAR. 3.3.6.5.5).
- External Triggering - If external trigger mode is selected, grounding the EXT\_TRG line (J2 pin 14 to pin 9, 11, 13 or 15) allows SCPI commands to change the output of the power supply. Refer to the KLP Developer's Guide for details on the use of triggering.

Kepeco provides three instrument drivers, IVI-COM, LabView G and VXI *plug&play* which simplify programming of the KLP power supply via the digital interfaces. These drivers are described in the KLP Developer's Guide and can be downloaded from the Kepeco web site at: <http://www.kepecopower.com/drivers/>

### 3.3.3 REMOTE PROGRAMMING USING THE IVI-COM INSTRUMENT DRIVER

The IVI-COM driver for KLP is available for download at the Kepeco web site [www.kepecopower.com/drivers](http://www.kepecopower.com/drivers). Examples are provided in the KLP Developer's Guide.

### 3.3.4 REMOTE PROGRAMMING USING THE LABVIEW G INSTRUMENT DRIVER

The LabView G driver for KLP, available for download at the Kepeco web site [www.kepecopower.com/drivers](http://www.kepecopower.com/drivers), includes a LabView G demonstration program that greatly simplifies programming the unit with a Windows™ compatible computer. After running a setup, a "soft" front panel is visible on the computer monitor that allows all the functionality of the local front panel. The LabView G soft front panel controls are explained in the KLP Developer's Guide.

### 3.3.5 REMOTE PROGRAMMING USING THE VXI *plug&play* INSTRUMENT DRIVER

The VXI *plug&play* driver for KLP, available for download at the Kepeco web site [www.kepecopower.com](http://www.kepecopower.com), includes a demonstration program that greatly simplifies programming the unit via the GPIB or RS 232 ports with a Windows™ compatible computer. After running a setup, a "soft" front panel is visible on the computer monitor that allows all the functionality of the local front panel. The VXI *plug&play* soft front panel controls are explained in the KLP Developer's Guide.

### 3.3.6 REMOTE PROGRAMMING USING THE WEB INTERFACE [-1.2K MODELS ONLY]

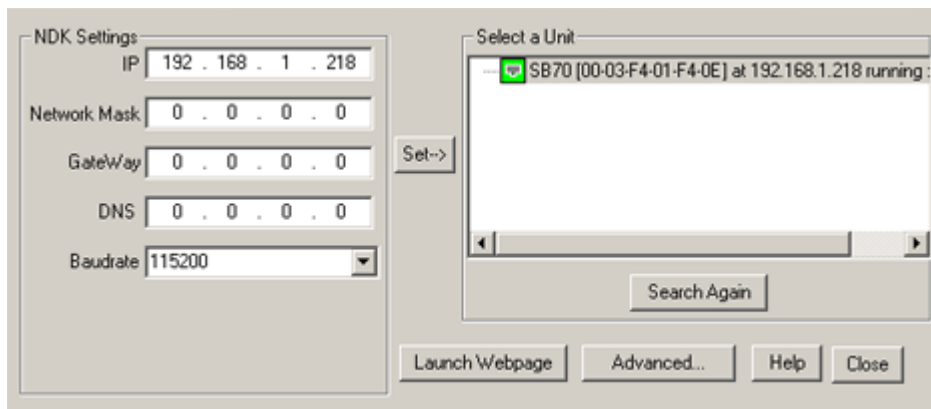
Remote programming of the KLP via the LAN port can be accomplished using a standard web browser connected to the internet.

The factory default LAN settings of the KLP are DHCP on, AUTOIP on. When the power supply is turned on, it tries to find a DHCP server and get an IP address while the LAN indicator blinks rapidly. If the server is not found after 10 seconds, the unit will use AUTOIP to get an address. If an IP address is found, the LAN indicator stays on without blinking. If an IP address is not found,

the LAN indicator stays off. The FUNCTION/LAN menu (see PAR. 3.2.12) can be used to view the IP address that was found, or change it if desired.

### 3.3.6.1 FINDING KEPKO POWER SUPPLIES ON THE LAN [-1.2K MODELS ONLY]

The PSfind utility is supplied on the CD that comes with the unit, or can be downloaded from the Kepco web site at [www.kepcopower.com/drivers](http://www.kepcopower.com/drivers). This utility finds all operational Kepco power supplies connected to the LAN and then shows the pertinent addresses of the models found. To run the utility from your PC go to \utilities on the CD. This directory only contains one file psfind.exe. Copy the file to your computer or run it directly from the CD itself. A separate window opens as shown on Figure 3-2.



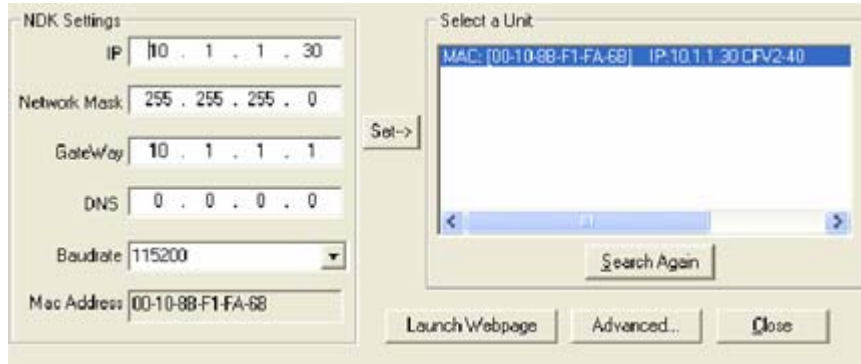
**FIGURE 3-2. PS FIND SCREEN**

Once the search is completed, all found units are displayed in the Select a Unit window (the MAC address appears in parentheses); highlighting one of the units found will load that unit's IP, Network Mask, Gateway and DNS addresses in the NDK Settings on the left side of the window. If you do not see your device in the Select a Unit window, make sure it is turned on and connected to the network, then click the Search Again button.

**NOTE:** The MAC address appears as all zeros at initial startup and before establishing an active LAN connection. This condition may occur for several minutes if the unit in question is not connected to an active LAN.

- To set a static IP address, enter the static address in the IP ADDRESS field and the Mask address in the Network Mask field (Figure 3-3 shows a the IP Address, Network Mask and Gateway changed from that shown in Figure 3-2), then highlight the desired unit and click the Set button. There will be a short pause while parameters are updated. If you do not see your device in the "Select a Unit" window, make sure it is turned on and connected to the network, then click the Search Again button.
- To set DHCP to ON, enter an IP ADDRESS of 0.0.0.0, then highlight the desired unit and click the Set button. After a few seconds, click Search Again, highlight the desired unit and click the Set button.

The Baudrate pull-down menu and Advanced button are provided for debug of the unit, providing access to some internal registers of the interface. Changes in these registers may cause the unit to become inoperative until power up of the unit occurs. These changes are only temporary, and are overwritten when the next time the KLP is powered up.



**FIGURE 3-3. SETTING A STATIC IP ADDRESS**

**3.3.6.2 LAUNCH WEB INTERFACE [-1.2K MODELS ONLY]**

Click the Launch Webpage button to open the KLP Instrument HOME PAGE (UNIT DESCRIPTION) in your default browser (see Figure 3-4). You can also launch the web page in any browser by entering the IP address as the URL.

NOTE: If source power to the KLP is removed or lost while a browser window is open, communication with the KLP can not be restored until the present browser window is closed and a new window is opened.

Although most current browsers will work, Kepeco recommends the following as fully supported: IE 5.5 and higher, Netscape 6 and higher and Firefox 1.0 and higher. Popup blocking must be disabled and Javascript must be enabled for proper operation. If Popup blocking is enabled, it may prevent viewing of the help screens.



**FIGURE 3-4. WEB INTERFACE HOME PAGE (UNIT DESCRIPTION)**

The KLP Instrument Home page identifies the unit which has been accessed, including Manufacturer, Instrument, Description, Serial Number, Calibration Date, LXI Software Revision, LXI Class, LXI Version, Hostname, MAC Address and TCP/IP Address. Click the HELP box at the left of the screen for detailed explanations of each. These parameters can not be changed by the user. Fault alerts are not available from this page

Clicking the ID INSTRUMENT box at the left of the screen, causes the physical front panel LAN indicator on the selected unit to blink, allowing visual confirmation as to which unit is selected. This is especially important if more than one unit is found on the LAN.

### 3.3.6.3 INSTRUMENT CONFIGURATION USING WEB INTERFACE [-1.2K MODELS ONLY]

Click on CONFIGURE INSTRUMENT at the left to view the INSTRUMENT Configuration page (Figure 3-5). The parameters that can be configured from this page are arranged in two groups.

The top group requires the unit password to change the parameter and includes:

- Whether the polarity of the Remote Inhibit signal is active (inhibit) for low or high (see PAR. 3.2.13.5.1 for details).
- How the unit recovers from faults (see PAR. 3.2.13.5.2 for details).

The second group does not require a password, and includes

- GPIB address.
- Quick boot (see PAR. 3.2.13.4 for details).
- Assignment of the internal relay (see PAR. 3.2.13.3 for details).

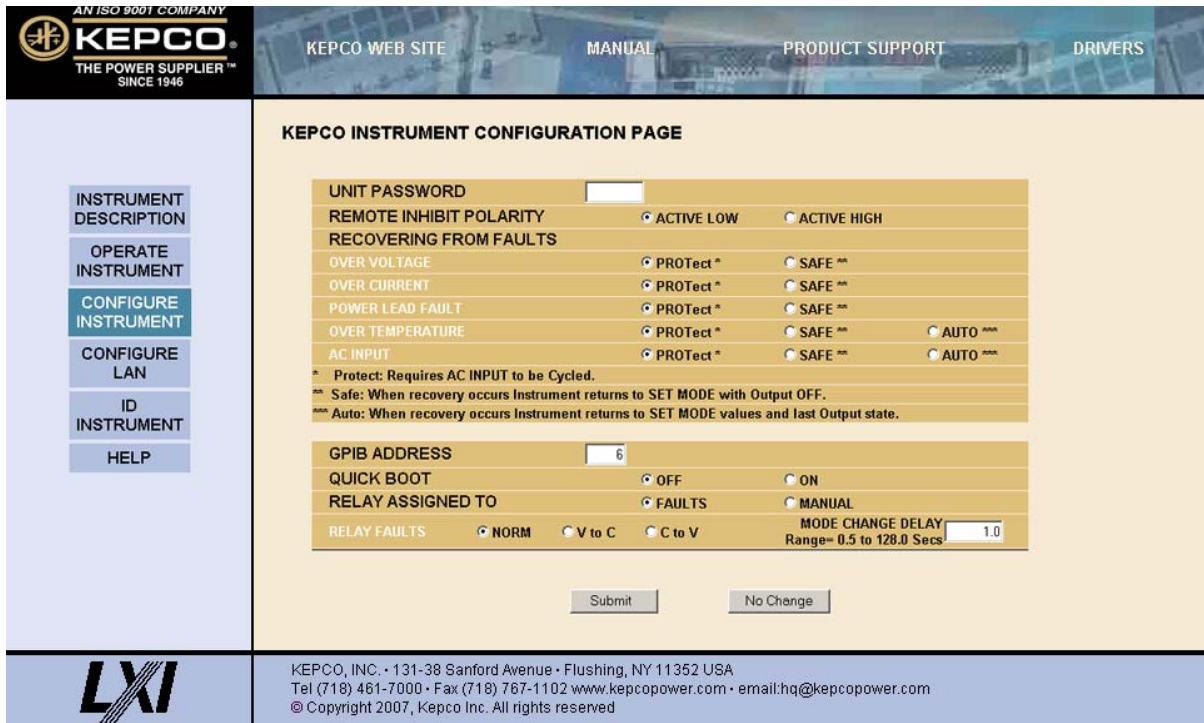


FIGURE 3-5. WEB INTERFACE CONFIGURE INSTRUMENT PAGE

### 3.3.6.4 LAN CONFIGURATION USING WEB INTERFACE [-1.2K MODELS ONLY]

Click on CONFIGURE LAN at the left to view the LAN Configuration page (Figure 3-6). The parameters that can be configured from this page are Host Name (DHCP), Description, IP Address, Subnet Mask address, Default Gateway Address, and DNS Server Address. Separate checkboxes allow enabling of DHCP, AUTOIP and PING. Descriptions of these terms can be viewed by clicking the HELP box at the left. If a fault condition exists, an alert window indicates the type of fault. Click OK to close the window; the SUBMIT button is disabled until the fault is corrected.

There are three passwords shown on this page which control access to the web pages only (not to be confused with the unit password (see PAR. 3.2.5) which is needed for calibration, changing virtual model, etc.).

NOTE: In cases where multiple users are expected to have access to the units, it is recommended that password access be used to restrict *control* of the unit to one user (functioning as a bus controller), while allowing other users viewing access. Allowing multiple users to issue commands to a single unit can cause unpredictable results and may cause the unit to lock up.

- The OPERATE INSTRUMENT password restricts the ability to view the OPERATE INSTRUMENT page.
- The CONFIGURE INSTRUMENT password restricts the ability to change some INSTRUMENT configuration parameters shown on the CONFIGURE INSTRUMENT page.
- The CONFIGURE LAN password restricts the ability to change the LAN configuration parameters shown on the CONFIGURE LAN page (Figure 3-6.)

The factory default is that passwords are not needed to access password-protected areas and none of the three passwords have been established. To set a password for the first time, leave the CURRENT field blank, enter the new password in the NEW and REPEAT fields, then click SUBMIT. Subsequent changes require the current password to be entered in the CURRENT field. If a password is lost or forgotten, the factory default state (no password required) can be restored from the front panel using the LAN Reset function (see PAR. 3.2.12).

To change a parameter, enter the correct data and click the appropriate checkboxes, then click SUBMIT. If the data is not entered within 20 seconds after the last keystroke, the data will revert to the previous value. If the LAN CONFIGURATION password was set, you will be prompted to enter the password before the changes are accepted.

When SUBMIT is clicked after new IP address information is entered, the front panel LAN indicator blinks rapidly while the unit validates the IP address. If the address is valid, the browser returns to the INSTRUMENT DESCRIPTION page. If the address entered is already in use, the following note appears towards the top of the page:

NOTE: IP Address is in use.  
Click CONFIGURE LAN and choose another IP to correct.

An IP address that is not already in use must be entered and submitted, otherwise the browser will lock, requiring the browser to be closed and reopened.

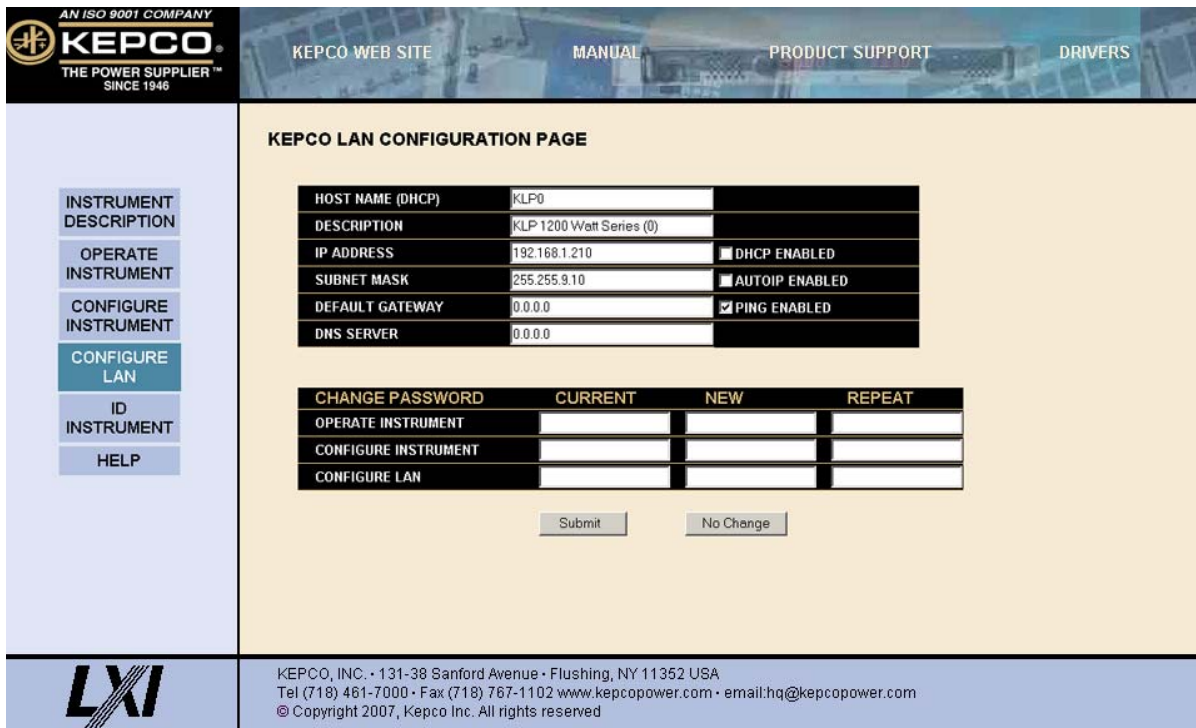


FIGURE 3-6. WEB INTERFACE CONFIGURE LAN PAGE

### 3.3.6.5 OPERATING THE UNIT USING WEB INTERFACE [-1.2K MODELS ONLY]

To operate the unit, click the OPERATE INSTRUMENT box at the left. A simulated front panel at the top of the screen shows 1) output voltage and current, 2) CV or CC if the unit is in constant voltage or constant current mode, respectively (\*\* is displayed if the output is off, meaning the unit is in neither CV nor CC mode), and 3) whether the output is on or off. An ON/OFF button can be clicked to turn the output on or off. A small white dot below the voltage display flashes to indicate the web page is communicating with the unit. If a fault condition exists, an alert window indicates the type of fault, and operation via the web is disabled. When the fault is corrected, click OK to close the alert window and resume operation via the web.

NOTE: If the OPERATE INSTRUMENT password has been set (see PAR. 3.3.6.3), you will be prompted to enter the password before the OPERATE INSTRUMENT page can be viewed.

If the unit has been set to Analog control mode, the OPERATE INSTRUMENT page displays only voltage, current, CV or CC mode, and output state. The unit can not be controlled via the LAN interface and the message "Analog Remote Control" is displayed on the open web page.

The functions that the user can modify are listed on the black menu bar below the representation of the front panel: Output, Protection, Save/Recall, Reset, List, and Virtual Model, and are described in the following paragraphs.

NOTE: Once data in a field has been changed, if the data is not entered within 20 seconds, the data will revert to the previous value.



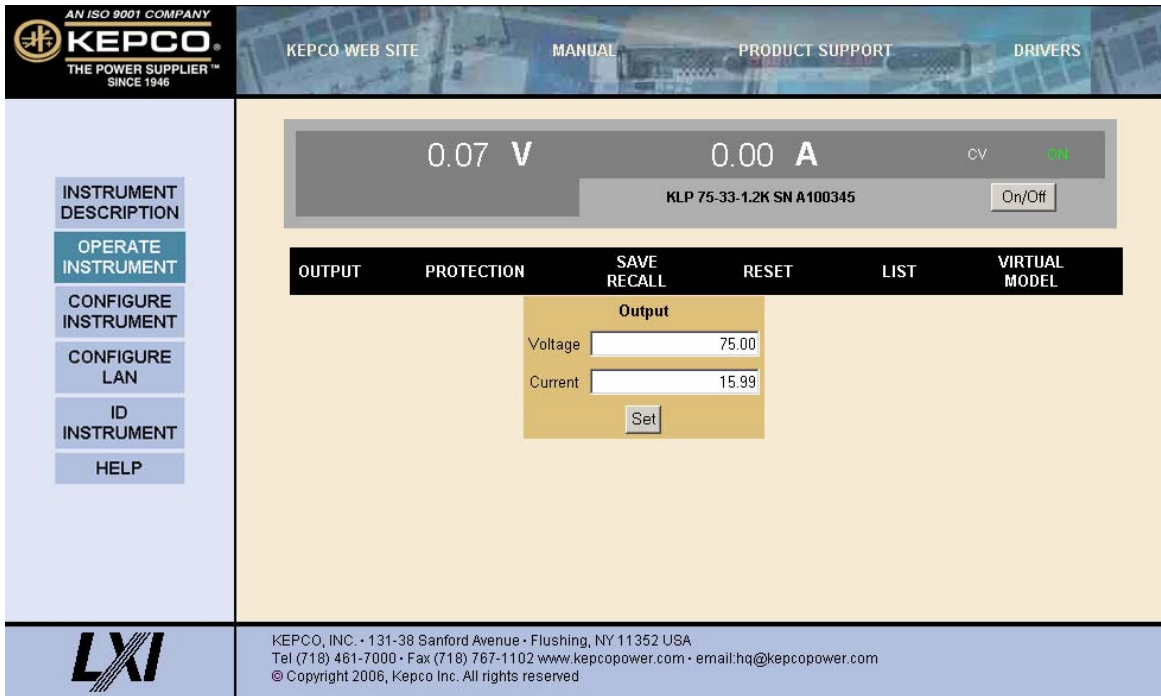


FIGURE 3-7. WEB INTERFACE OPERATE INSTRUMENT PAGE

### 3.3.6.5.1 CHANGING THE OUTPUT [-1.2K MODELS ONLY]

The Output dialog box opens when the OPERATE INSTRUMENT page is first opened, or when **OUTPUT** is clicked (see Figure 3-7). To set output voltage or current, enter the values and click SET. Voltage and current settings are not allowed to exceed either a) the virtual model setting or b) 80% of the protection value. Attempts to set voltage or current beyond these limits will not be accepted. To turn the output on or off, click the ON/OFF button within the simulated front panel.

### 3.3.6.5.2 CHANGING PROTECTION [-1.2K MODELS ONLY]

Click **PROTECTION** to open the Protection dialog box (Figure 3-8). To set the overvoltage and overcurrent protection values, enter the values and click **Set**. See PAR. 3.2.8 for details about how overvoltage and overcurrent protection function in the KLP power supply.

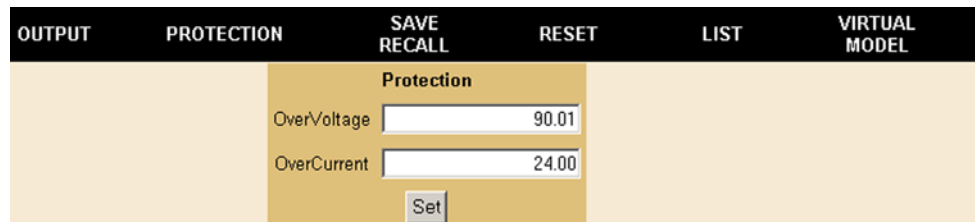


FIGURE 3-8. PROTECTION DIALOG BOX

### 3.3.6.5.3 USING SAVE AND RECALL [-1.2K MODELS ONLY]

The KLP Power Supply contains 40 memory locations that can be used to store either active settings or a set of user-determined settings. Values are stored in the nonvolatile memory and are retained when the unit is turned off. The stored settings can then be recalled using this fea-

ture. These settings are cleared when a calibration is performed. Click **SAVE/RECALL** to open the Save/Recall Dialog Box (Figure 3-9).

**FIGURE 3-9. SAVE/RECALL DIALOG BOX**

**NOTE:** When the SAVE/RECALL tab is initially selected, parameters for all locations appear as empty even when there are values stored from previous sessions. Click the **Preview** button first to avoid overwriting existing data.

- **To view currently stored settings:** Enter a location (1 to 40) in the box between **Save @** and **Preview** buttons, then click **Preview** button.
- **To change currently stored settings:** Enter a location (1 to 40) in the box between **Save @** and **Preview** buttons, then click **Preview** button. Modify the settings and click **Save @** button to save the modified settings.
- **To save the active settings:** Enter the desired location (1 to 40) in the **LOCATION** box and click **Save State** button to save the active settings. Only the parameters shown in Figure 3-7 can be saved.
- **To save user-determined settings:** Enter location (1 to 40) in the box between **Save @** and **Preview** buttons. Enter desired values for Voltage, Current, Overvoltage Protection and Overcurrent protection. Select whether the output is to be on or off, then click **Save @** button to save the settings
- **To Recall settings:** Enter the desired location in the **LOCATION** field and click **Recall State** to set previously stored settings as the active settings.

If a virtual model setting is changed, and a stored setting is outside the range established by the new virtual model, the data set is not loaded; although there is no indication on the web page, the Status Display of the power supply will flash E221, "Settings conflict."

### 3.3.6.5.4 RESETTING THE UNIT (\*RST) [-1.2K MODELS ONLY]

Click **\*RST** button to reset power supply to the power on default state: setpoints to zero Volts and minimum Amperes (see NOTE, PAR. 3.2.1, step 3, and Table 1-2), and output set to OFF, except that if last setting recall (PAR. 3.2.7.3) is enabled, the Setpoint values are from the last setting. **\*RST** also clears all LIST entries.

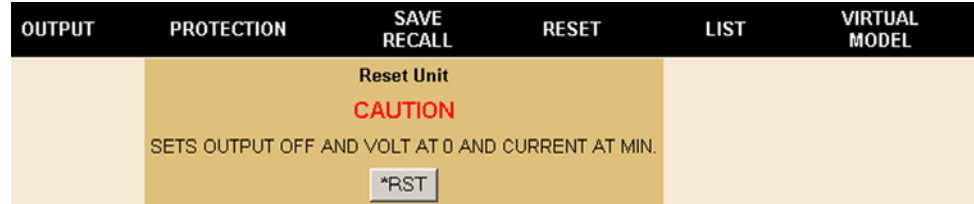


FIGURE 3-10. RESET DIALOG BOX

### 3.3.6.5.5 USING A LIST (USER-PROGRAMMED SEQUENCES) [-1.2K MODELS ONLY]

Using the LIST feature, up to 100 locations are available for programming the KLP output. These locations enable the user to program the output using sequential steps which may be initiated by a single command. The repeatable user-determined sequences are stored in volatile memory and are retained until reprogrammed, the power supply is turned off, a calibration is performed, or a **LIST:CLear** command is received. If a virtual model setting is changed, and a programmed value is outside the range established by the new virtual model, that step is executed as the default minimum (zero V, minimum A) although the location contents are not changed.

**Create the List.** Click **LIST** to open the List dialog box (Figure 3-11). Each location defines the values for one step: voltage and current, and a dwell time duration (between 0.5 and 655.36 seconds); dwell times down to 0.01 second can be obtained using SCPI commands to generate the list). (Note the state of the internal relay can be stored using the VXI *plug&play* driver or SCPI LIST commands, but can not be controlled from the web interface). Click **Add to List** button to add a step (the information in the Voltage, Current and Dwell boxes) to the List steps shown to the right.

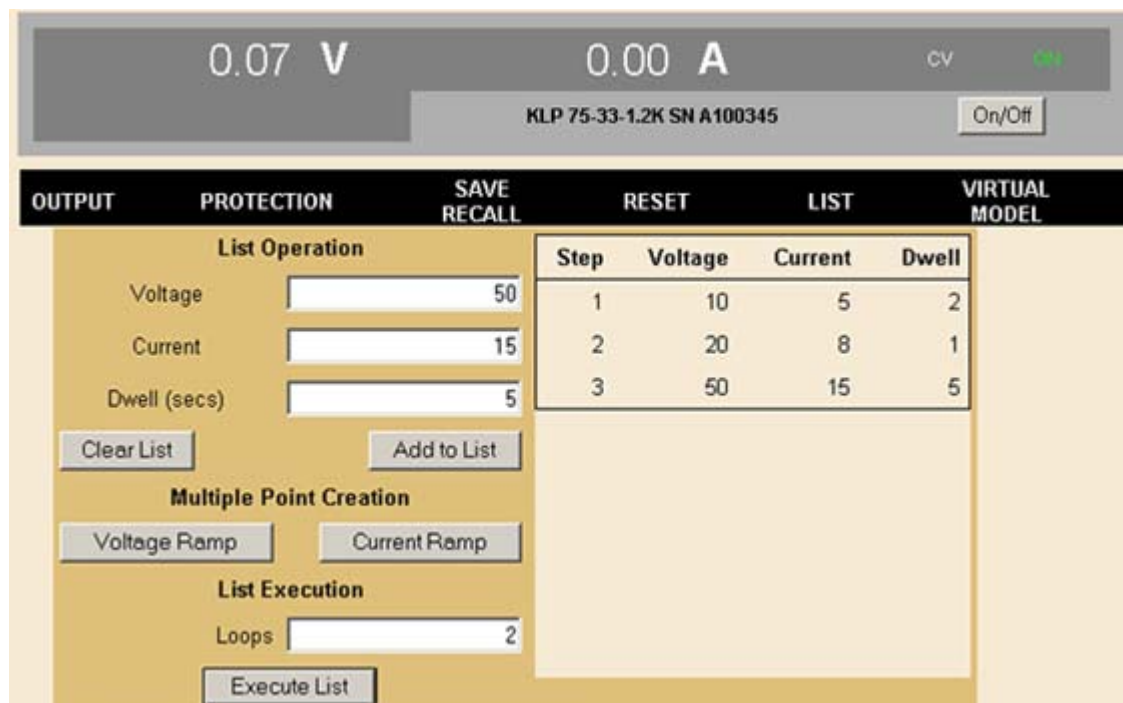


FIGURE 3-11. LIST DIALOG BOX

**Clearing the List.** Once a step has been added, it can not be changed and can only be deleted by pressing the **Clear List** button to start over. In addition, performing any of the following operations will also clear the list: changing overcurrent or overvoltage PROTECTION settings, unit RESET (clicking \*RST), changing VIRTUAL MODEL settings and exiting the OPERATE INSTRUMENT page.

**Create Voltage or Current Ramps.** In addition to adding single steps, the user may add multiple steps to produce voltage or current ramps. Clicking the **Voltage Ramp** or **Current Ramp** button opens similar dialog boxes (see Figure 3-12). Enter the starting and ending ramp values, the number of intermediate steps (including start and end), the total time (in seconds) to go from the start to the end of the ramp, and a constant current (for voltage ramp) or voltage (for current ramp) for each step of the ramp. Clicking the **Create Ramp** button adds the steps to the list as the firmware calculates the intermediate voltage values and dwell times required to produce the desired ramp (calculated dwell times for each step must be greater than 0.5 second). Ramps with many total steps may take a few seconds to process; the percentage complete is indicated below the **Create Ramp** button.

OUTPUT	PROTECTION	SAVE RECALL	RESET	LIST	VIRTUAL MODEL
<b>Voltage RAMP</b>			<b>Current RAMP</b>		
Start Voltage	<input type="text" value="0"/>		Start Current	<input type="text" value="20"/>	
End Voltage	<input type="text" value="10"/>		End Current	<input type="text" value="10"/>	
Steps	<input type="text" value="10"/>		Steps	<input type="text" value="10"/>	
Total Time (secs)	<input type="text" value="10"/>		Total Time (secs)	<input type="text" value="10"/>	
Current	<input type="text" value="20"/>		Voltage	<input type="text" value="35"/>	
<input type="button" value="Create Ramp"/>			<input type="button" value="Create Ramp"/>		

**FIGURE 3-12. ADDING MULTIPLE STEPS (RAMPS) TO LIST**

**Execute the List.** Steps may be added to a list using Add to List, Current Ramp or Voltage Ramp buttons, however the total number of steps can not exceed 100. To execute the list, enter the number of times the list is to be executed in the **Loops** box (0 is continuous), set the output on (click the **On/Off** button if necessary) and click the **Execute List** button. While the list is running, the title of the **Execute List** button changes to **Stop Execution**.

**Stop the List.** If the **Stop Execution** button is clicked to stop the list, the output stays on and the voltage/current are returned to the previously set values for **Output**. If the list is stopped by clicking the \*RST button, the output turns off and **Output** setpoints are reset to 0V, minimum current, except that if last setting recall (PAR. 3.2.7.3) is enabled, the Setpoint values are from the last setting.

### 3.3.6.5.6 SETTING VIRTUAL MODEL [-1.2K MODELS ONLY]

Refer to PAR. 3.2.6 for details about what Virtual Model means for KLP and how the virtual model affects other parameters. Click **Virtual Model** to open the Virtual Model dialog box (Figure 3-13). The current virtual model settings (gray) are displayed. To change the settings enter the Unit Password (see PAR. 4) and press ENTER key on the computer keyboard. After the password is accepted, the Unit Password field is inaccessible (gray) and the Maximum Voltage and Maximum Current fields can be changed. Enter either maximum voltage or maximum current; the other field will be filled in automatically for a maximum of 1200 Watts, then press ENTER key; all fields are gray for a second or two while the power supply accepts each entry. The Password field is reset after leaving the Virtual Model dialog box

Setting a new virtual model resets the setpoints to zero Volts and minimum Amperes and resets the OVP and OCP values to 120% of virtual model maximum. A minimum programmed current is required to ensure proper operation of the power supply under all load conditions. Programmed current is automatically set to be at least the minimum current (actual value depends on model, see Table 1-1). If DIP switch position 3 is enabled (see Table 2-2), stored setpoints for voltage and current are cleared when the virtual model settings are saved.

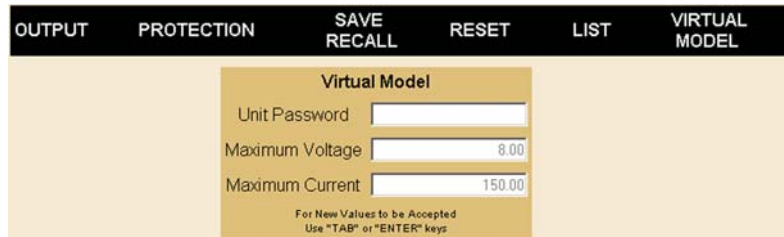


FIGURE 3-13. VIRTUAL MODEL DIALOG BOX

### 3.4 REMOTE PROGRAMMING USING ANALOG SIGNALS

The voltage and current inputs ( $V_{ref}$  and  $C_{ref}$ , respectively) of the Analog I/O Port (see J2, Figure 2-2 and Table 2-2) are normally inactive. These are activated by connecting pin 12 of J2 to one of the four GND pins: J2 pin 9, 11, 13 or 15 before turning the power supply on. Once the power supply is turned on the status display reads **aRem**. While the power supply is in analog remote mode, digital queries related to status and readback will be accepted and executed. The following paragraphs provide detailed information for using analog programming signals.

NOTE: Optimum resolution is achieved with 10V programming input which is equivalent to full scale. Decreasing the analog voltage equivalent to full scale (see PAR. 4.3.3) will cause a corresponding decrease in programming resolution.

With the exception of  $V_{ref}$  and  $C_{ref}$ , all the other Analog I/O Port functions are active regardless of the status of the analog control signal applied to J2 pin 12. These include internal relay: RELAY\_NO (pin 2), RELAY\_COM (pin 4), RELAY\_NC (pin 10); voltage and current readbacks: VOLT\_RBACK (pin 6) and CURR\_RBACK (pin 7); external trigger: EXT\_TRG (pin 14) and remote inhibit: REM\_INH (pin 8).

#### 3.4.1 ENABLING/DISABLING THE OUTPUT USING ANALOG CONTROL

If the output has previously been enabled, the Remote Inhibit (**rINH**) signal applied to analog I/O port pin 8 (see PAR. 2.7.9) allows the output to be enabled/disabled remotely. If the output is already off, this signal has no effect; however if it is active, and an attempt is made to turn the output on, the output will stay off and **rINH** will appear in the status display.

This signal is a TTL signal that can be programmed to be active (turn the output off) for either a TTL high (logic 1) or TTL low (logic 0) (see PAR. 3.2.13.5.1).

If **rINH** is set to be active for low, an open condition at pin 8 causes the output state to default to ON and the output will go to the levels programmed on **Vref** and **Cref** without warning.

If **rINH** is set to be active for high, an open condition at pin 8 causes the output to remain off. If quick-boot (see PAR. 3.2.13.4) is off and **rINH** is set to high, upon power-up the status display will flash **rINH** at the end of the start-up sequence to remind the user of this condition (see PAR. 3.2.1).

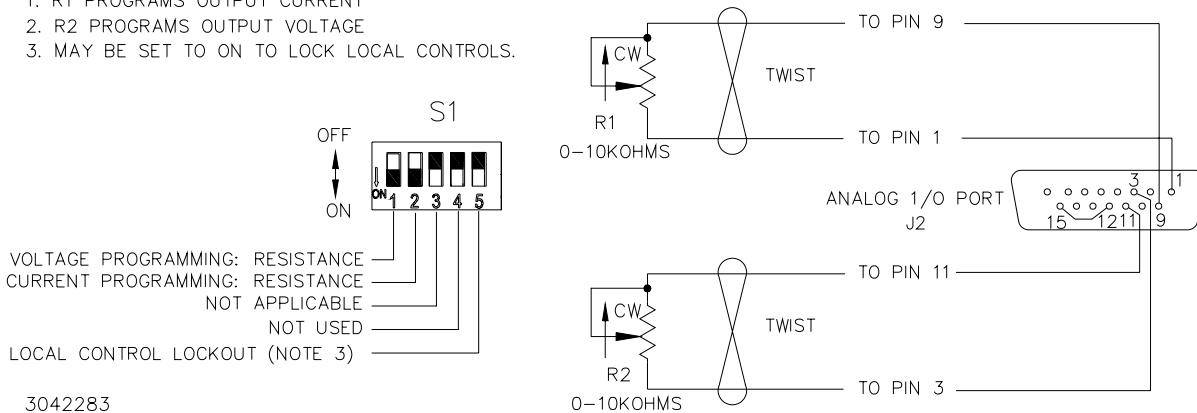
### 3.4.2 PROGRAMMING WITH EXTERNAL RESISTANCE

Figure 3-14 is a simplified diagrams of the KLP showing the switch configuration and external connections required for analog programming using an external resistance.

1. Overvoltage and Overcurrent settings must be established via either local programming or digital remote programming prior to initiating Analog Remote programming. (see PAR. 3.4.4.)
2. Turn off power and configure the Analog I/O DIP switch (Figure 2-2) as follows:
  - SW1: ON (Program output voltage via resistance)
  - SW2: ON (Program output current via resistance)
  - SW3: either OFF or ON (disabled when in remote analog programming mode; see Table 2-2)
  - SW4: Reserved - Do not use.
  - SW5: Either OFF (Local controls enabled) or ON (Local controls locked)
3. Configure Analog I/O Port J2 (Figure 2-2) by referring to Table 2-7 and Figure 3-14 (grounding J1 pin 12 enables analog programming).

NOTES:

1. R1 PROGRAMS OUTPUT CURRENT
2. R2 PROGRAMS OUTPUT VOLTAGE
3. MAY BE SET TO ON TO LOCK LOCAL CONTROLS.



**FIGURE 3-14. ANALOG PROGRAMMING OF OUTPUT VOLTAGE OR CURRENT USING RESISTANCE**

With the power supply configured as shown in Figure 3-14 and assuming the load causes the power supply to operate in voltage mode, varying external resistor R2 from 0 to 10K causes the output voltage of the power supply to vary linearly from 0 to full scale, while R1 can be used to adjust the current limit. When the power supply operates in current mode, R2 will adjust the voltage limit and R1 will adjust output current.

Factory default full scale (F.S.) resistance programming is 10K ohms based on F.S. programming voltage of 10V. To set full scale resistance to a lower value, see PAR. 4.3.3 to change the F.S. programming voltage to a lower value, then adjust based on 1000 ohms/Volt.

### 3.4.3 PROGRAMMING WITH EXTERNAL VOLTAGE

Figure 3-15 is a simplified diagrams of the KLP showing the switch configuration and external connections required for analog programming using an external voltage.

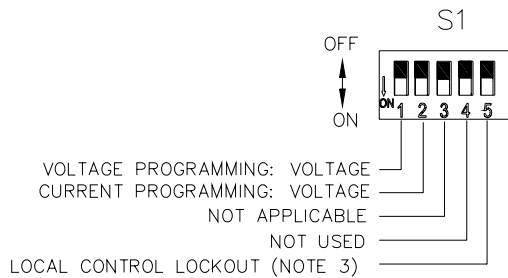
1. Virtual Model (PAR. 3.2.6) and Overvoltage and Overcurrent settings (PAR. 3.4.4) must be established via either local programming or digital remote programming prior to initiating Analog Remote programming.
2. Turn off power and configure the Analog I/O DIP switch (Figure 2-2) as follows:
  - SW1: OFF (Program output voltage via voltage)
  - SW2: OFF (Program output current via voltage)
  - SW3: either OFF or ON (disabled when in remote analog programming mode; see Table 2-2)
  - SW4: Reserved - Do not use
  - SW5: Either OFF (Local controls enabled) or ON (Local controls locked)
3. Configure Analog I/O Port J2 (Figure 2-2) by referring to Table 2-7 and Figure 3-15 (grounding J1 pin 12 enables analog programming).
4. Refer to PAR. 3.4.4 to change overvoltage or overcurrent setting in analog programming mode.

With the power supply configured as shown in Figure 3-15 and assuming the load causes the power supply to operate in voltage mode, varying source voltage V2 from 0 to maximum causes the output voltage of the power supply to vary linearly from 0 to full scale, while V1 can be used to adjust the current limit. When the power supply operates in current mode, V2 will adjust the voltage limit and V1 will adjust output current.

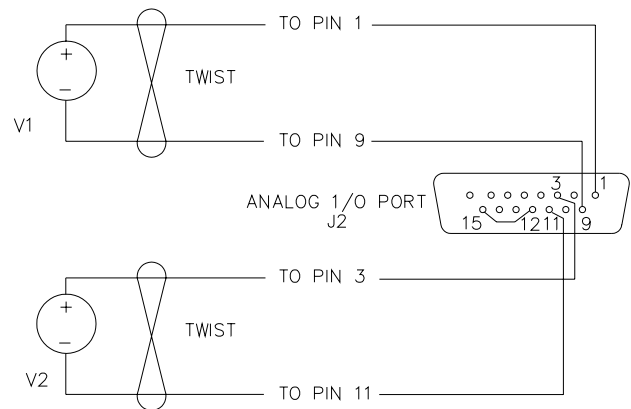
Factory default full scale (F.S.) voltage programming is 10V. To set full scale voltage programming to a lower value, see PAR. 4.3.3

NOTES:

1. V1 PROGRAMS OUTPUT CURRENT.
2. V2 PROGRAMS OUTPUT VOLTAGE.
3. MAY BE SET TO ON TO LOCK LOCAL CONTROLS.



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**FIGURE 3-15. ANALOG PROGRAMMING OF OUTPUT VOLTAGE OR CURRENT USING VOLTAGE**

#### **3.4.4 CHANGING OVERVOLTAGE OR OVERCURRENT PROTECTION VALUES IN ANALOG PROGRAMMING MODE**

Overvoltage and overcurrent values can not be changed using analog remote programming; this can only be done by issuing a command via the GPIB or RS232 port, or via local mode from the front panel (enter local mode by pressing the VOLTAGE and CURRENT adjustment controls at the same time, then see PAR. 3.2.8).

If the panel is locked and RS 232 or GPIB access is not possible, turn the power supply off, set ANALOG I/O DIP switch position 5 to OFF, and then power up again to unlock the panel (PAR.3.2.2.1). After the settings have been changed, turn the power supply off, set ANALOG I/O DIP switch position 5 to ON to relock the panel, then turn on the power supply to restore Analog Remote Programming (status display reads aRem).



## SECTION 4 - CALIBRATION

### 4.1 GENERAL

This section contains the calibration instructions for the Power Supply. It is recommended that the user be familiar with Local Mode operation (PAR.3.2) before calibrating the unit.

A full calibration consist of a voltage calibration and a current calibration. Both voltage and current calibrations consist of a zero and a full scale calibration.

External calibration calibrates the precise user-defined reference voltages used that will be equivalent to full scale output when external analog programming is used.

NOTE: Calibrating the unit resets all internal memory locations used for saving active settings (\*SAV, \*RCL), programmed sequences using the LIST commands, and trigger levels established by CURR:TRIG and VOLT:TRIG. These parameters are returned to the default minimum (0V, minimum A).

In order to enter the calibration mode the correct unit password must be entered. If the password has been forgotten, call the factory and a special password (which has been assigned to your power supply) will be provided. During the calibration, new calibration data is computed which is then stored in the nonvolatile memory either when EXIT is executed (local mode, PAR. 4.3.4) or SAVE Calibration is executed (remote mode, PAR 4.4.4).

Calibration of the KLP is performed in one of two ways: locally using the front panel controls (PAR. 4.3), or remotely using the graphical interface supplied with the VXI *plug&play* instrument driver available at [www.kepcopower.com/drivers/](http://www.kepcopower.com/drivers/). The VISA compliant VXI *plug&play* driver works with many GPIB cards from suppliers such as National Instruments and Hewlett-Packard. These two ways cannot be combined.

### 4.2 EQUIPMENT REQUIRED

The following equipment is required to calibrate the KLP Power Supply.

- Digital Voltmeter (DVM) with 6 digits resolution and at least 0.002% accuracy for d-c measurements.

NOTE: Because the voltage measured will be used as a reference for calibration, the DVM used must be accurately calibrated prior to calibrating the power supply.

- Precision Shunt Resistor (with a tolerance of 0.01%, power rating of at least 10 times larger than the maximum stress, and a temperature coefficient equal to or better than 20 ppm per degree C).
- A stable, clean d-c power source capable of supplying 10.0000V (or other desired full scale analog voltage) at 10mA minimum (a linear power supply or reference voltage I.C. is recommended).

NOTE: Proper cooling of the external precision shunt resistor ensures the accuracy of the calibration.

### 4.3 CALIBRATION USING FRONT PANEL CONTROLS IN LOCAL MODE

For voltage calibration all loads must be disconnected and the sense terminals connected to the corresponding output terminals. The digital voltmeter will be connected to the output of the power supply. For current calibration after disconnecting all loads an appropriate shunt resistor will be connected across the output terminals and the digital voltmeter will be connected across the sense terminals of the shunt resistor.

1. Turn off power supply and disconnect load from output terminals at the rear of the unit.
2. Verify that power supply is configured for local error sensing (PAR. 2.7.5.1).
3. For voltage calibration connect DVM to (M+, S+) and (M-, S-) of terminal block at the rear of power supply.
4. For current calibration connect an appropriate shunt resistor (see PAR 4.2) across the output terminals and connect DVM to shunt resistor terminals.
5. Turn on power supply, exit **SET** mode by tapping either **VOLTAGE** or **CURRENT** control and using a thin tool (e.g., a paper clip), press the **FUNCTION** switch once until the status display reads **VIRT**, then rotate either the **VOLTAGE** or **CURRENT** control in either direction until status display reads **UTIL**.
6. Tap the **DC OUTPUT** switch once, then rotate either the **VOLTAGE** or **CURRENT** control in either direction until status display reads **CAL**.
7. Tap **DC OUTPUT** switch to enter calibration mode. The status display shows **PASS**. Enter the password (see PAR. 3.2.5) and tap **DC OUTPUT** switch to accept the number.
8. When the password is accepted, status display reads **v ?**. Tapping either **VOLTAGE** or **CURRENT** control continuously cycles through all the calibration choices. The status display reads: **v ?** for voltage calibration **c ?** for current calibration, **EXT?** for remote analog calibration, and **EXIT** to save the calibrated results. Tap the **FUNCTION** switch to exit calibration WITHOUT saving any calibration data (see PAR. 4.3.4). Tap the **DC OUTPUT** switch to select the displayed choice.

NOTE: Calibrations may be done in any order.

9. Proceed to PAR. 4.3.1 for voltage calibration, PAR 4.3.2 for current calibration, PAR. 4.3.3 for external calibration or PAR. 4.3.4 to exit calibration

#### 4.3.1 VOLTAGE CALIBRATION (LOCAL)

During voltage calibration, the voltage, voltage readback and remote analog voltage readback are calibrated.

1. Minimum voltage is first; the status display reads **v\_0**. Monitor DVM and rotate the **VOLTAGE** control to increase or decrease the output voltage until the DVM reads as close as possible to minimum rated voltage.
2. Tap the **DC OUTPUT** switch to accept the value. The status display then reads **vMAX**. Monitor DVM and rotate the **VOLTAGE** control to increase or decrease the output voltage until the DVM reads as close as possible to maximum rated voltage.

3. Tap the **DC OUTPUT** switch to accept the value. The status display then reads **OUTV**. Connect the DVM to ANALOG I/O PORT J2, pin 13 (M–) and pin 6 (M+). Rotate the **VOLTAGE** control to increase or decrease the output voltage until the DVM reads as close as possible to 10V.
4. Tap the **DC OUTPUT** switch to accept the value. The status display reads **c ?**. Tap the **DC OUTPUT** switch to proceed to Current Calibration (see PAR. 4.3.2), or tap either **VOLTAGE** or **CURRENT** control to advance to next choice

#### 4.3.2 CURRENT CALIBRATION (LOCAL)

During current calibration, the current, current readback and analog current readback are calibrated.

1. The status display reads **LOAD**. When the shunt and DVM are connected per PAR. 4.3, step 4, tap the **DC OUTPUT** switch. The status display reads **C<sub>MAX</sub>**.
2. Rotate the **CURRENT** control to increase or decrease the DVM reading until the DVM reading corresponds as close as possible to maximum rated current (Calculate current as follows:  
 $I \text{ (Amperes)} = \text{DVM reading (Volts)} / \text{Shunt Resistance (Ohms)}$ ).
3. Tap the **DC OUTPUT** switch to accept the value. The status display reads **c\_0**. Rotate the **CURRENT** control to increase or decrease the DVM reading until the DVM reading corresponds to minimum positive or zero current (Calculate current as follows:  
 $I \text{ (Amperes)} = \text{DVM reading (Volts)} / \text{Shunt Resistance (Ohms)}$ ).
4. Tap the **DC OUTPUT** switch to accept the value. The status display reads **C<sub>MAX</sub>**. Rotate the **CURRENT** control to increase or decrease the DVM reading until the DVM reading corresponds as close as possible to maximum rated current (Calculate current as follows:  
 $I \text{ (Amperes)} = \text{DVM reading (Volts)} / \text{Shunt Resistance (Ohms)}$ ).
5. Tap the **DC OUTPUT** switch to accept the value. The status display reads **OUTC**. Connect the DVM to ANALOG I/O PORT J2, pin 13 (M–) and pin 7 (M+). Rotate the **CURRENT** control to increase or decrease the output voltage until the DVM reads as close as possible to 10V.
6. Tap the **DC OUTPUT** switch to accept the value. The status display reads **EXT?**. Tap the **DC OUTPUT** switch to proceed to External Calibration (see PAR. 4.3.2), or tap either **VOLTAGE** or **CURRENT** control to advance to next choice

#### 4.3.3 EXTERNAL CALIBRATION (LOCAL)

During external calibration the external analog reference voltages used to establish full scale output current and voltage are calibrated and defined. The factory default calibration is 10V programs full scale output, however the following procedure allows any d-c value up to 10V to program full scale, while a voltage proportionately less programs a corresponding decrease in the output.

NOTE: The full scale programming voltage has a 1:1 correspondence with the external readback; i.e., 10V full scale programming voltage results in a 10V full scale readback. If the full scale programming voltage is changed to a value other than 10V, the full scale readback voltage is changed accordingly.

1. The status display reads **INPV**. Refer to PAR 3.4 to connect the reference voltage used to define full scale output voltage. as the source as described in PAR 3.4.
2. When the reference voltage is at the desired value, tap the **DC OUTPUT** switch to accept the value. When the calibration is saved, this analog voltage will be equivalent to full scale output voltage. **The full scale output voltage is determined by the virtual settings in effect.**
3. The status display reads **INPC**. Connect the reference voltage used to define full scale output current as described in PAR 3.4.
4. When the reference voltage is at the desired value, tap the **DC OUTPUT** switch to accept the value. When the calibration is saved, this voltage value will be equivalent to full scale output current. **The full scale output current is determined by the virtual settings in effect.**
5. The status display reads **EXIT**. Proceed to PAR. 4.3.4 to exit calibration.

#### 4.3.4 CALIBRATION EXIT (LOCAL)

NOTE: using a thin tool (e.g., a paper clip), tap the **FUNCTION** switch to exit calibration WITHOUT saving any calibration data. If no calibrations were completed, then the unit advances to the next function as if the **FUNCTION** switch was pressed.

1. When the status display reads **EXIT**, tap the **DC OUTPUT** switch to save the calibration.
2. The status display reads **DATE**. The **DC VOLTS** display represents MMDD (month, day) and the **DC AMPS** display represents YYYY (year). The factory calibration date is displayed with the first digit blinking as a starting point to enter the current date. Rotate either the **VOLTAGE** or **CURRENT** controls to change the digit, then tap either control to move to the next digit.

NOTE: For purposes of traceability the user is strongly urged to enter the calibration date upon completion of calibration. If a date is not entered, no date is saved.

3. Tap **DC OUTPUT** switch to accept date. If any calibration (voltage, current or external) was completed, the unit will save the new calibration. The status display reads "DONE" while calibration is being saved.
4. Once saved the unit enters Virtual Model mode. Follow the procedure in PAR 3.2.6 to set the virtual model.

NOTE: The virtual model is always reset following calibration. If voltage calibration is completed (regardless of whether or not current calibration is completed), the virtual model voltage is set for maximum rated voltage, and current is set to the value corresponding to 1200 Watts. If ONLY current calibration is completed, the virtual model current will be set for maximum rated current and voltage is set to the value corresponding to 1200 Watts.

#### 4.4 CALIBRATION USING VXI *plug&play* DRIVER

Calibration of the KLP can be performed using SCPI commands implemented through the VXI *plug&play* Instrument driver. The driver provides a graphical interface with informational displays and prompts which lead you through the calibration of the KLP. This VISA compliant driver works with many GPIB cards from suppliers such as National Instruments and Hewlett-Packard.

The following calibration procedure uses the "soft" front panel which is part of the VXI *plug&play* driver for the KLP which can be downloaded from the Kepco website at: [www.kepcopower.com/drivers/](http://www.kepcopower.com/drivers/) or from the supplied CD.

Unzip the files and doubleclick on setup.exe to install the driver. The Kepco\klp folder will be added to the Start - Programs folder. Doubleclick KLPCTRL.exe to run the program, and refer to the KLP Developer's Guide in the Kepco\klp folder for details about using the soft front panel.

For voltage calibration all loads must be disconnected and the sense terminals connected to the corresponding output terminals. The digital voltmeter will be connected to the output of the power supply. For current calibration after disconnecting all loads an appropriate shunt resistor will be connected across the output terminals and the digital voltmeter will be connected across the sense terminals of the shunt resistor.

1. Turn off power supply and disconnect load from output bus bar at the rear of the unit.
2. Verify that power supply is configured for local error sensing (See PAR. 2.7.5.1).
3. For voltage calibration connect DVM to (M+, S+) and (M-, S-) of terminal block at the rear of power supply.
4. For current calibration connect an appropriate shunt resistor (see PAR 4.2) across the output terminals and connect DVM to shunt resistor terminals.
5. Turn on power supply, and after the status display shows **SET**, start the KLP VXI *plug&play* demo program.
6. Click the **Calibrate Access** button on the VXI plug&play demo main panel: the button label changes to **Calibrate Close** and the Calibration Window (Figure 4-1) opens with all buttons disabled (grayed out) and PASSWORD appears in the text box near the top of the window.

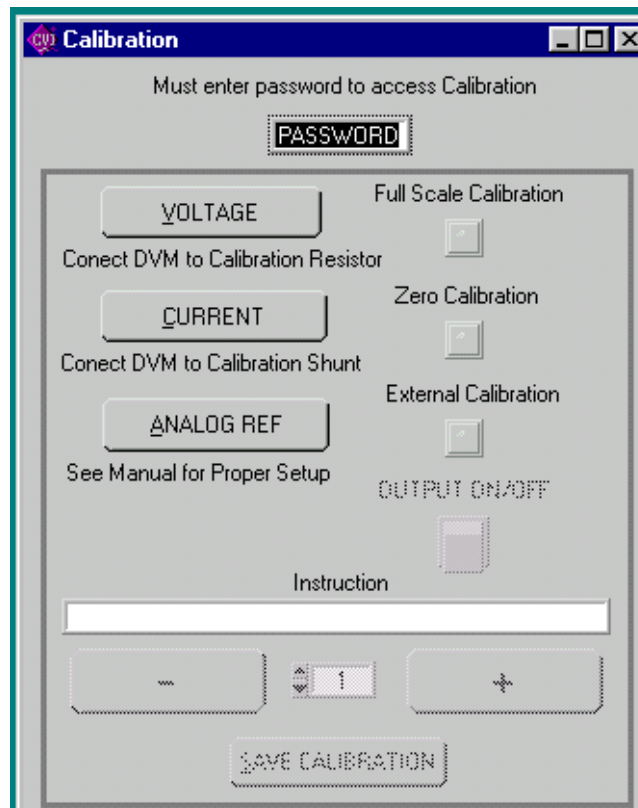


FIGURE 4-1. CALIBRATION WINDOW

7. Use the computer keyboard to enter the password in the text box displaying the word PASSWORD, then press the ENTER key.
8. If password is correct, the status display on the VXI main panel reads CAL and the buttons on Calibration Screen (Figure 4-1) are enabled (highlighted). If the password is incorrect, the password text box displays "WRONG #". Repeat step 7 to enter the correct password, or click the **Calibrate Close** button on the VXI main panel to exit calibration.

NOTE: Calibrations may be done in any order.

9. Proceed to PAR. 4.4.1 for voltage calibration, PAR 4.4.2 for current calibration., PAR. 4.4.3 for external calibration or PAR. 4.4.4 to exit calibration

#### 4.4.1 VOLTAGE CALIBRATION (VXI *plug&play* DRIVER DEMO)

During voltage calibration, the voltage, voltage readback and remote analog voltage readback are calibrated.

1. Click the **VOLTAGE** button on the Calibration window to start voltage calibration: the Voltage Calibration Window (Figure 4-2) appears. Minimum voltage is first; the status display (on the VXI main panel) reads **V\_0**. Monitor DVM and click the "+" button to increase and the "-" to decrease the output voltage until the DVM reads as close as possible to minimum rated POSITIVE voltage.

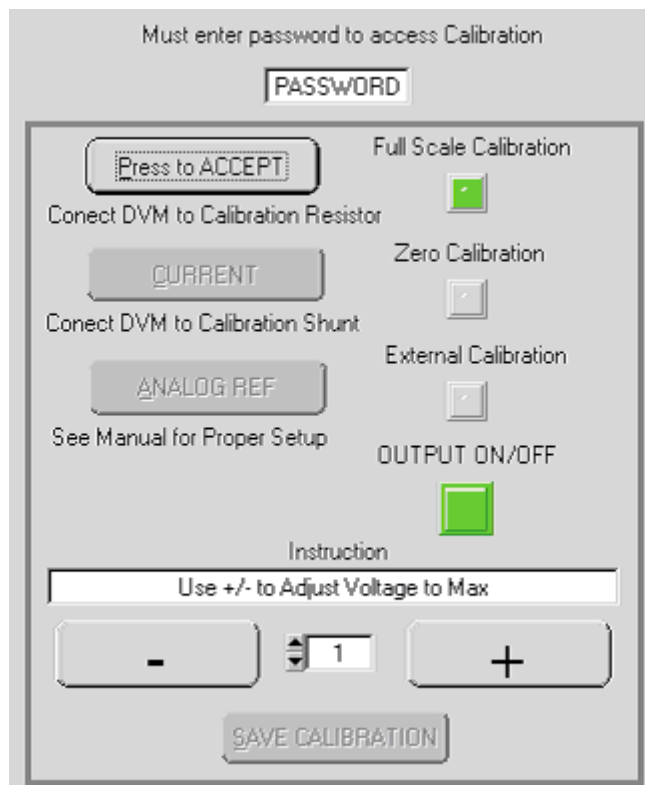


FIGURE 4-2. VOLTAGE CALIBRATION WINDOW

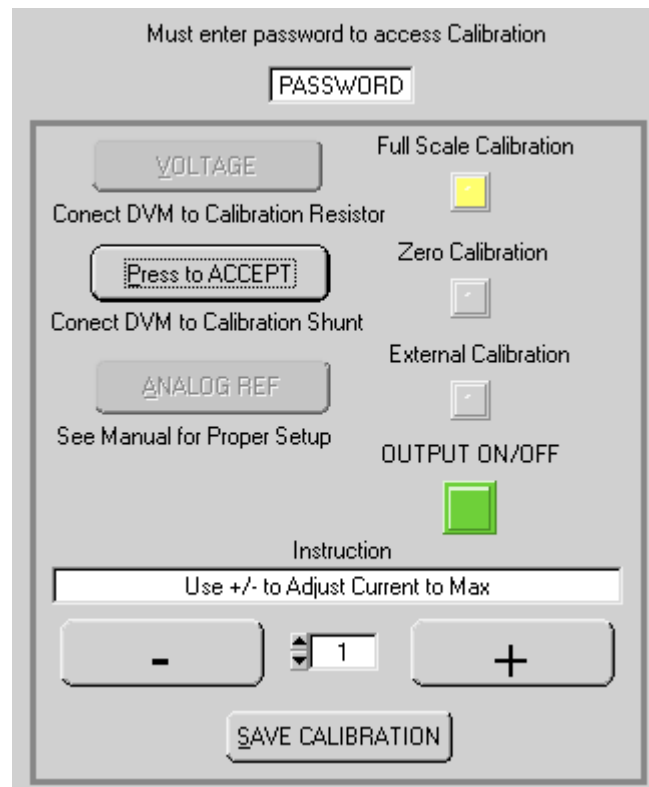
2. Click the **PRESS TO ACCEPT** button to accept the value. The status display then reads **VMAX**. Monitor DVM and click the "+" button to increase and the "-" to decrease the output voltage until the DVM reads as close as possible to maximum rated voltage.

3. Click the **PRESS TO ACCEPT** button to accept the value. The status display then reads **OUTV**. Connect to DVM (+) to Analog I/O Port J2, pin 6 and DVM (-) to pin 13. Click the “+” button to increase and the “-” button to decrease the output voltage until the DVM reads as close as possible to 10V.
4. Click the **PRESS TO ACCEPT** button to accept the value. The status display will not change. At the calibration window, click the **CURRENT** Button to proceed to current calibration (see PAR. 4.4.2).

#### 4.4.2 CURRENT CALIBRATION (VXI *plug&play* DEMO)

During current calibration, the current, current readback and analog current readback are calibrated.

1. Click the **CURRENT** button on the Calibration Window to start current calibration; the Current Calibration Window (Figure 4-3) appears and the status display on the VXI main panel reads **C MAX**.



**FIGURE 4-3. CURRENT CALIBRATION WINDOW**

2. Monitor DVM and click the “+” button to increase and the “-” to decrease the output current until the DVM reads as close as possible to maximum rated current (Calculate current as follows:
 
$$I \text{ (Amperes)} = \text{DVM reading (Volts)} / \text{Shunt Resistance (Ohms)}.$$
3. Click the **PRESS TO ACCEPT** button to accept the value. The status display reads **C\_0**. Click the “+” button to increase and the “-” to decrease the output current until the DVM reads as close as possible to minimum positive or zero current (Calculate current as follows:
 
$$\text{(Amperes)} = \text{DVM reading (Volts)} / \text{Shunt Resistance (Ohms)}.$$

4. Click the **PRESS TO ACCEPT** button to accept the value. The status display reads **CMAX**. Click the “+” button to increase and the “-” to decrease the output current until the DVM reads as close as possible to maximum rated current (Calculate current as follows:  

$$I \text{ (Amperes)} = \text{DVM reading (Volts)} / \text{Shunt Resistance (Ohms)}$$
5. Click the **PRESS TO ACCEPT** button to accept the value. The status display reads **OUTC**. Connect to DVM (+) to Analog I/O Port J2, pin 7 and DVM (-) to pin 13. Click the “+” button to increase and the “-” to decrease the output current until the DVM reads as close as possible to 10V.
6. Click the **PRESS TO ACCEPT** button to accept the value. The status display will not change. Click the **ANALOG REF** button on the calibration window to proceed to external calibration (see PAR. 4.4.3).

#### 4.4.3 ANALOG REFERENCE CALIBRATION (VXI *plug&play* DEMO)

During analog reference calibration the external analog reference voltages used to establish full scale output current and voltage are defined. The factory default calibration of 10V programs full scale output, however the following procedure allows any d-c value up to 10V to program full scale, while a voltage proportionately less programs a corresponding decrease in the output.

NOTE: The full scale programming voltage has a 1:1 correspondence with the external readback; i.e., 10V full scale programming voltage results in a 10V full scale readback. If the full scale programming voltage is changed to a value other than 10V, the full scale readback voltage is changed accordingly.

1. Click the **ANALOG REF** button on the Calibration Window; the Analog Reference Calibration Window (Figure 4-4) appears and the status display on the VXI main panel reads **INPV**. When the reference voltage is at the desired value, click the **PRESS TO ACCEPT** button to accept the value. When the calibration is saved, this analog voltage will be equivalent to full scale output voltage. NOTE: **The full scale output voltage is determined by the virtual settings in effect.**

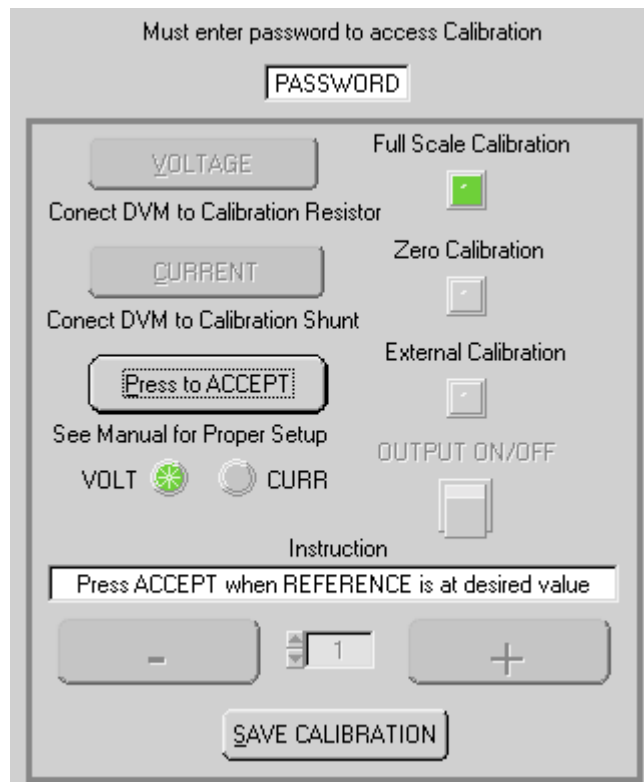


FIGURE 4-4. ANALOG REFERENCE CALIBRATION WINDOW



2. The status display reads **INPC**. Connect the reference voltage used to define full scale output current as described in PAR 3.4.
3. When the reference voltage is at the desired value, click the **PRESS TO ACCEPT** button to accept the value. When the calibration is saved, this voltage value will be equivalent to full scale output current. **NOTE: The full scale output current is determined by the virtual settings in effect.**
4. The status display will not change. Proceed to PAR. 4.4.4 to exit calibration.

#### 4.4.4 CALIBRATION EXIT (VXI *plug&play* DEMO)

NOTE: Clicking the Calibrate **Close** button on the VXI main panel will exit calibration WITHOUT saving any calibration data.

1. Click the **SAVE CALIBRATION** button on the calibration window to save this calibration.
2. The Calibration window automatically closes and the Virtual Model window automatically opens.
3. The virtual model settings can be changed after the password has been properly entered.
4. NOTE: The virtual model is always reset following calibration. If voltage calibration is completed (regardless of whether or not current calibration is completed), the virtual model voltage is set for maximum rated voltage, and current is set to the value corresponding to 1200 Watts. If a current calibration is completed, but no Voltage calibration, the virtual model current will be set for maximum rated current and voltage is set to the value corresponding to 1200 Watts.

#### 4.5 CHANGING THE CALIBRATION PASSWORD

The 4-digit Unit password is required for to enter calibration mode. The factory default Unit password is listed in Table 4-1. To change the password from the front panel proceed as follows:

1. If the status display shows **SET**, tap either the **CURRENT** or **VOLTAGE** controls to take the unit out of setpoint mode (status display goes from **SET** to blank)
2. Hold the **PROTECT** switch in and use a thin tool (e.g., a paper clip), to press the **FUNCTION** switch. Status display reads **PASS**.

NOTE: To exit this procedure without changing the password, rotate the **VOLTAGE** control.

3. Tap the **DC OUTPUT** switch. Status display reads **OLD?**.
4. Rotate the **CURRENT** control until **DC AMPERES** display shows old password. Tap the **DC OUTPUT** switch to enter. Status display shows **NEW?**.
5. Rotate the **CURRENT** control until **DC AMPERES** display shows new password. Tap the **DC OUTPUT** switch to enter. Status display shows **RPT?**.
6. Rotate the **CURRENT** control until **DC AMPERES** display reads new password. Tap the **DC OUTPUT** switch to enter. Status display reads **DONE** and the unit returns to setpoint mode.

**TABLE 4-1.FACTORY DEFAULT UNIT PASSWORDS**

MODEL (-1200 OR -1.2K)	UNIT PASSWORD
KLP 10-150	1015
KLP 20-120	2012
KLP 36-60	3660
KLP 75-33	7533
KLP 150-16	1516
KLP 300-8	3008
KLP 600-4	6004

**4.6 RESTORING PRIOR CALIBRATION VALUES**

Calibration values for KLP are stored in three separate locations designated: Factory, Previous and Working. Each time the unit is calibrated, the Working values are moved to Previous, and the new calibration values are stored in Working. It is possible to replace the Working calibration values with either the Previous or the Factory calibration values; contact Kepeco Sales Engineering for details.

## KLP INSTALLATION/OPERATION SUMMARY

This summary can be printed as a handy overview to common tasks covered in the KLP User Manual, and includes hyperlinked references to appropriate paragraphs, Tables and Figures and Kepco website pages for more details.

### INITIAL SETUP INSTRUCTIONS

1. **Location:** Do not obstruct front and rear panel vents; additional clearance at side, top and bottom vents is recommended.
2. **Connect power supply output to load:**
  - Voltage drop must be less than 0.25V per conductor (see Nomograph1 at <http://www.kepcopower.com/nomomax.htm>)
  - Local error sense operation is factory default; for remote error sense operation see PAR. 2.7.5.1.
  - For parallel or series operation of two or more power supplies see PAR. 2.7.7 and 2.7.6, respectively.
3. **Connect remote programming cables (if applicable):** Only one remote programming input may be active at a time.
  - **Remote analog programming:** Connect programming cable between programming source and J2; see Table 2-7 and PAR. 2.7.9.
  - **Digital programming using GPIB:** Connect programming cable between host computer and J4; see Table 2-3 and PAR. 2.8.1.
  - **Digital programming using RS 232 [-1200 Models only]:** Connect programming cable between host computer and J3; see PAR. 2.8.2 and Table 2-4.
  - **Digital programming using LAN [-1.2K Models only]:** Connect LAN cable between host computer and J3; see PAR. 2.8.3 and Table 2-5.
4. **Connect power supply to power source using one of the following:** See PAR. 2.7.2 for additional information.
  - Use standard NEMA line cord set from Kepco (see Table 1-4) or customized line cord using user-wireable mating connector (supplied) in conjunction with user-selected line cord or discrete wiring as applicable.
  - See Table 2-8 for source power branch current rating and overload protection recommendations.
5. **Apply source power:** Set Power ON/OFF circuit breaker/switch on front panel to ON. Apply firm, continuous pressure to rocker actuator until fully engaged (right side of rocker actuator locked parallel to front panel). If actuator does not lock when released, allow actuator to return to starting position, then wait a few seconds before repeating turn-on sequence. DO NOT attempt to "tease" the switch contacts closed by repetitive press-and-release action. The circuit breaker is "trip-free" design; if overload exists, contacts cannot be held closed by actuator.

### LOCAL OPERATING MODE INSTRUCTIONS

**How do I enable/disable the output?** Press DC OUTPUT to toggle output on and off. *The output cannot be enabled while SET appears in the status display; tap either knob to exit setpoint mode.* The output can be disabled at any time. VOLTS and AMPS displays show actual output parameters as determined by the load (see PAR. 3.2.3).

**How do I establish the operating mode?** Operating mode is determined automatically by the programmed voltage ( $V_p$ ) and current ( $I_p$ ) settings and the load. If the load impedance is greater than  $V_p/I_p$ , the unit operates in CV mode (voltage stabilized to voltage setpoint). If the load impedance is less than  $V_p/I_p$ , the unit operates in CC mode (current stabilized to current setpoint) (see PAR. 3.2.7). Crossover between operating modes is seamless and automatic. CV and CC indicators show present mode.

**How do I adjust output voltage or current (real-time)?** Enable the output. If in CV mode (indicator lit), rotate Voltage knob until VOLTS display shows desired output voltage. If in CC mode (indicator lit), rotate Current knob until AMPS display shows desired output current. Pressing and holding control knob in while turning provides fine adjustment. Rotating knob controlling limit parameter (Voltage in CC mode, Current in CV mode) changes limit setting, however change is invisible since actual outputs are displayed on VOLTS and AMPS displays (see PAR. 3.2.7.1).

**How can I see what the voltage and current setpoints are?** Tap (press and release) either Voltage or Current knob once to enter setpoint mode (status reads SET). VOLTS and AMPS displays show the setpoints. Tap either knob once to exit setpoint mode (SET disappears) (see PAR. 3.2.7.2).

**How do I change voltage and current setpoints (enter and exit setpoint mode)?** *Setpoint mode can be entered with output enabled or disabled, but output CAN NOT be enabled while setpoint mode is active.* Tap (press and release) either Voltage or Current knob once to enter setpoint mode (status reads SET). Rotate Voltage and Current knobs until desired values appear in VOLTS and AMPS displays; pressing and holding control knob in while turning provides fine adjustment. Tap either knob once to exit setpoint mode (SET disappears) (see PAR. 3.2.7.2).

**What happens when setpoint mode is exited?** If the output is enabled, exiting setpoint causes output to jump to new setpoints. If the output was disabled prior to or while in setpoint, exiting setpoint stores the new settings in memory; when output is enabled, output jumps to programmed setpoints. When setpoint is exited, VOLTS and AMPS revert to actual output values as determined by the load.

**How do I enter a Password?** Password is required to set Virtual Model or calibrate the unit. Status shows PASS (password) and Current Display shows 0000. Rotate Current knob to select a number from 0-9. Tap Current knob to advance to next digit. Repeat until all four digits have been selected. Tap DC OUTPUT to accept the number. See Table 4-1 for default passwords.

**How do I enter/exit Function mode?** To enter a function, press FUNCTION using a thin tool once so status reads VIRT (virtual model, see below); rotate Voltage or Current knobs for ADDR (set GPIB address, PAR. 3.2.9), BAUD (1200 models only, set RS 232 baud rate, PAR. 3.2.10), LAN (-1.2K models only, configure LAN parameters. see PAR. 3.2.12), M/S (-1200 models only, Master/Slave, PAR. 3.2.11), UTIL (utility, PAR. 3.2.13). or EXIT. To select a function, tap DC OUTPUT.

**How do I view/change the virtual model settings?** See PAR. 3.2.6 for description of virtual model. *If status shows SET, exit setpoint mode (tap either knob once).* Use thin tool to press FUNCTION once; status reads VIRT. VOLTS and AMPS displays show the maximum voltage and current of the present virtual model. *If no change, exit function mode (see above).* To change, press DC OUTPUT once. Status shows PASS (password). Enter password (*see above*) and tap DC OUTPUT to accept. When password is accepted, status reads VIRT, VOLTS and AMPS displays blink. To change setting rotate Voltage and Current knobs until VOLTS and AMPS displays show desired virtual model settings. (Press and hold knob in while turning for fine adjustment.) Press DC OUTPUT to accept virtual model settings. Unit displays DONE, then resets and repeats power on sequence.

**How do I view/change overvoltage and overcurrent protection limits?** See PAR.3.2.6 for description of protection limits. *If status reads SET, tap either knob to exit setpoint mode.* To view protection limits, use a thin tool to press and hold PROTECT until status reads PROT, VOLTS and AMPS displays show the protection limits; to change limits, while continuing to hold PROTECT in, adjust OVP and OCP limits using the Voltage and Current knobs. When PROTECT released, values showing in VOLTS and AMPS displays are the new protection limits.

## REMOTE ANALOG OPERATING MODE INSTRUCTIONS

**How do I enable analog operating mode?** Connect ANALOG\_CTRL (pin 12) to GROUND (pin 9, 11, 13, or 15) of analog port prior to power-up to enable remote analog programming for that session. Remote analog control is indicated by "aREM" in status display. *The status of ANALOG\_CTRL is sensed at power-up only.* Enabling analog operating mode disables the local operating controls on the front panel. (see PAR. 3.4).

**How do I enable or disable the output?** Connect REM\_INH (pin 8) to GROUND (pin 9, 11, 13, or 15) of analog port to disable power supply output, open the connection to enable the output (see PAR. 3.4.1). The DC OUTPUT control on the front panel remains active in remote analog programming mode.

**How do I adjust voltage and current setpoints using an external voltage source?** Set analog I/O DIP switch positions 1 and 2 up (factory default position) to use external voltage control of voltage and current, respectively. Full-scale programming voltage is factory set at 10V; to alter full-scale value see PAR. 3.2.13.6. Apply a 0-10V signal from Vref (pin 1) and Cref (pin 3) to GROUND (pin 9, 11, 13, or 15) of analog port to adjust the setpoint values for output voltage and current proportionally between minimum and maximum virtual model limits. *Programming input pins are only active when analog port is enabled.* (See PAR. 3.4.3 for details.)

**How do I adjust voltage and current setpoints using an external resistance?** Set analog I/O DIP switch positions 1 and 2 down to use external resistance for remote analog programming of voltage and current, respectively. Full-scale programming resistance is factory set at 10KOhms; to alter full-scale value see PAR. 3.2.13.6 and use 1000 ohms per volt scale factor. Apply a 0-10KOhm resistance from Vref (pin 1) and Cref (pin 3) to GROUND (pin 9, 11, 13, or 15) of analog port to adjust the setpoint values for output voltage and current proportionally between minimum and maximum virtual model limits. *Programming inputs are only active when analog port is enabled.* (See PAR. 3.4.2 for details.)

**How do I Read back operating voltage and current?** Analog signals proportional to actual output voltage and current levels are available at VOLT\_RBACK (pin 6) and CURR\_RBACK (pin 7) of analog I/O port. Full-scale signal level is the same as that for full scale programming. Readback signals are always available at analog port, even if analog programming is not enabled.

**How do I exit remote analog programming mode?** Simultaneously depressing and releasing both Voltage and Current knobs forces the unit to exit remote analog programming mode and return to local operating mode; this can also be done by sending any command or query via the remote digital inputs. To restore remote analog control cycle source power OFF for five seconds then restart.

## REMOTE DIGITAL OPERATING MODE INSTRUCTIONS

**How do I enable digital operating mode?** Sending any digital command or query via either the GPIB, LAN or RS 232 port immediately sets the unit in remote digital operating mode and disables the local operating controls on the front panel. For details on command formatting and communication protocols see PAR. 3.3.

**How do I exit remote digital programming mode?** Simultaneously depressing and releasing both Voltage and Current knobs will force the unit to exit remote digital programming mode and return to local operating mode. Remote digital control is reactivated upon transmission of any digital command or query by the control (host) computer.

**How do I view/change the GPIB address?** The factory default GPIB address is 6. Using a thin tool, press FUNCTION once; status reads VIRT. Rotate Voltage or Current knob until status reads ADDR; the active GPIB address shows in AMPS display. To exit, rotate Voltage or Current knob till status reads EXIT then tap DC OUTPUT. To change, tap DC OUTPUT: AMPS display blinks. Rotate Current knob to change address and tap DC OUTPUT to accept; display flashes DONE then ADDR. See above to exit.

**How do I view/change RS 232 baud rate? [-1200 Models Only]** The factory default RS 232 baud rate is 38400. Using a thin tool, press FUNCTION once; status reads VIRT. Rotate Voltage or Current knob until status reads BAUD; AMPS display shows active baud rate x 1000 (e.g., 38400 is displayed as 38.4). To exit, rotate Voltage or Current knob till status reads EXIT then tap DC OUTPUT. To change, tap DC OUTPUT: AMPS display blinks. Rotate Current knob to change baud rate and tap DC OUTPUT to accept; display flashes DONE then BAUD. See above to exit. See PAR. 3.3.1.2 for additional RS 232 parameters.

**How do I set up the LAN interface? [-1.2K Models Only]** See PAR. 3.2.12 and refer to KLP Developer's Guide.

**How do I operate the KLP using web pages via the LAN interface? [-1.2K Models Only]** See PAR. 3.3.6 and refer to KLP Developer's Guide. Use the PSfind program (on CD supplied) to locate KLP(s) functioning on the LAN. Highlight the unit and click Launch Web Page. Click OPERATE INSTRUMENT. Simulated front panel shows status of voltage, current, output on/off, and operating mode (CV or CC). Operating functions supported from Operate Instrument page: Set output on/off and output voltage/current (PAR. 3.3.6.5.1), overvoltage/overcurrent protection (PAR. 3.3.6.5.2), save/recall (PAR. 3.3.6.5.3), reset (PAR. 3.3.6.5.4), list (PAR. 3.3.6.5.5) and virtual model (PAR. 3.3.6.5.6). Click CONFIGURE LAN to change LAN addresses or set up LAN passwords (PAR. 3.3.6.3). Click ID INSTRUMENT to flash physical LAN indicator on KLP.