QUICK START GUIDE

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CE

KLR

KLR POWER SUPPLY

This guide gives a brief introduction to the KLR Power supply, shows simple load connections, and allows you to verify the power supply is working. The guide also shows you how to use the front panel controls to perform the most commonly used functions.

Refer to the KLR User Manual for full specifications, installation considerations and operating instructions. An Installation/Operation Summary includes hyperlinked references to detailed procedure, but which can be printed as a handy reference.

Refer to the KLR Developer's Guide for a full description of the digital interfaces, their associated drivers, and the SCPI command language.

The User Manual and Developer's Guide can be downloaded from the Kepco web site at www.kepcopower.com/support/. Drivers can downloaded from www.kepcopower.com/drivers/.

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DESCRIPTION. Five KLR Models and five KLR E-Series Models are available, as listed in Table 1. The standard Models are GPIB and RS 232 compatible; the KLR E-Series Models (identified by the E suffix) are GPIB and LAN (ethernet, LAN) compatible. The only difference between standard and E-Series models is that LAN replaces the RS 232 interface on E-Series models. All models allow remote analog programming as well as local control. For each model a multitude of limit models can be configured. Limit models allow the unit to be configured to maximum settings below the rated voltage and/or rated current. When a limit model is established the unit will not accept programming values above the user-defined limits.

OPTIONS. The Rapid Output Discharge Circuit (RODC) option (suffix R) is available on all KLR models. This circuit rapidly discharges the output capacitance, thus significantly reducing response time to reductions in output voltage (see KLR User Manual for details).

TABLE 1. MODEL PARAMETERS

Model number	Rated Voltage Range	Minimum Programmable current	Rated Current Range	Ripple and noise p-p(1)	Efficiency @230 Va-c
KLR 20-120(2)	0-20V	1.5A	0-120A	100 mV	87%
KLR 40-60(2)	0-40V	0.8A	0-60A	80 mV	88%
KLR 75-32(2)	0-75V	0.4A	0-33.3A	80 mV	87%
KLR 150-16(2)	0-150V	0.2A	0-16A	100 mV	88%
KLR 300-8(2)	0-300V	0.1A	0-8A	150 mV	89%

(1) Bandwidth: 20MHz; low frequency ripple may be higher at loads less than 30 Watts.
(2) Specifications apply to both standard and E Series (Suffix E) models.

UNPACKING. 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. If any indication of damage is found, file an immediate claim with the responsible transport service.

EQUIPMENT SUPPLIED. See Table 2.

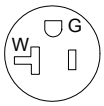
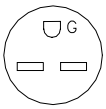
TABLE 2. EQUIPMENT SUPPLIED

ITEM	PART NUMBER	QUANTITY
Jumper (24 AWG or larger bus wire) for local sensing connections	172-0638	2
Analog I/O port mating connector	142-0528	1
Nut with captive lockwasher (on output studs of 20V and 40V models only)	102-0175	2
Quick Start Guide*	228-1689	1

* User Manual and Developer's Guide are available as free downloads from:
www.kepcopower.com/support/opmanls.htm#klr
Drivers are available as free downloads from
www.kepcopower.com/drivers/drivers-dl3.htm#klr

ACCESSORIES. See Table 3.

TABLE 3. ACCESSORIES

ITEM	FUNCTION	KEPCO PART NUMBER
Line Cord Set (250V/20A)	2.5m long cord set, provides for source power connection. Mates with NEMA 6-20R receptacle (see adjacent figure). Supports rated load power over mains voltage range of 180-265V a-c. NEMA 6-20R 	118-1235
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
Source power connector	Mates with a-c input connector J1 (see Figure 1-2) for user-wired source power connection. Supports rated load power over mains voltage range of 180-265V a-c.	142-0381
IEEE 488 (GPIB) Cable, 1m long	Connect KLR Power Supply to GPIB bus.	SNC 488-1
IEEE 488 (GPIB) Cable, 2m long	Connect KLR Power Supply to GPIB bus.	SNC 488-2
IEEE 488 (GPIB) Cable, 4m long	Connect KLR 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 KLR via jackscrews.	108-0204
Loop Back Test Connector	Used for verification of RS 232 operation.	195-0112
Null Modem Cable, 10 ft.	Connect RS 232 port with controlling computer, DB9F to DB9F, 10 feet long.	118-1176
Null Modem Cable, 1 ft.	Used for Master/Slave connections. Connects RS 232 ports of stacked power supplies, DB9F to DB9F, one foot long.	118-1220
LAN Patch cable	Connects KLR 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 4, sheet 1, Detail “C” for requirements.	128-2306

SAFETY. See Table 4

TABLE 4. 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.

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.

NOTE: This test must be performed with all I/O ports disconnected, and ANALOG I/O SETTINGS switch positions 3, 4 and 5 set to OFF (up).

1 With POWER circuit breaker set to OFF position, connect the power supply to source power (see See “Input Connections.” on page 5.).

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 (see “Turning The Power Supply On.” on page 7). After the test has been successfully completed, the status display reads SET (setpoint mode), the DC VOLTS display reads 0 Volts and 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 User Manual 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 4 and 5 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.

12 Set POWER ON/OFF circuit breaker to OFF and disconnect from source power, load and test equipment.

INSTALLATION. Install units in a 19 inch-wide rack. Optional slides may be used. Leave the front and rear panels clear of obstructions to ensure adequate cooling. For parallel, series and master-slave configurations, refer to the User Manual.

INPUT CONNECTIONS. Operation at rated load power (2400W) over the full rated source voltage range (180 - 265V a-c) requires a branch service rating of 20 Amperes; Kepco recommends use of #12 AWG (2,0 mm^2) for primary wiring. For operation at output power of 2000W or less, or with source voltage not less than 200V a-c, branch service may be reduced to 15 Amperes using #14 AWG (1,6 mm^2) wiring. Line cords and a user-wireable source power connector are available as accessories (see Table 3). Plug the (wired) source power connector or line cord into the source power inlet connector at the rear panel.

LOAD CONNECTIONS. Connect the load to the (+) and (–) DC OUTPUT terminals on the rear panel (Figure 2). (+M) and (–M) outputs are for local connection of error sense leads.

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

NOTE: Output Sense lines must be connected for proper operation, either locally, or at the load (remote).

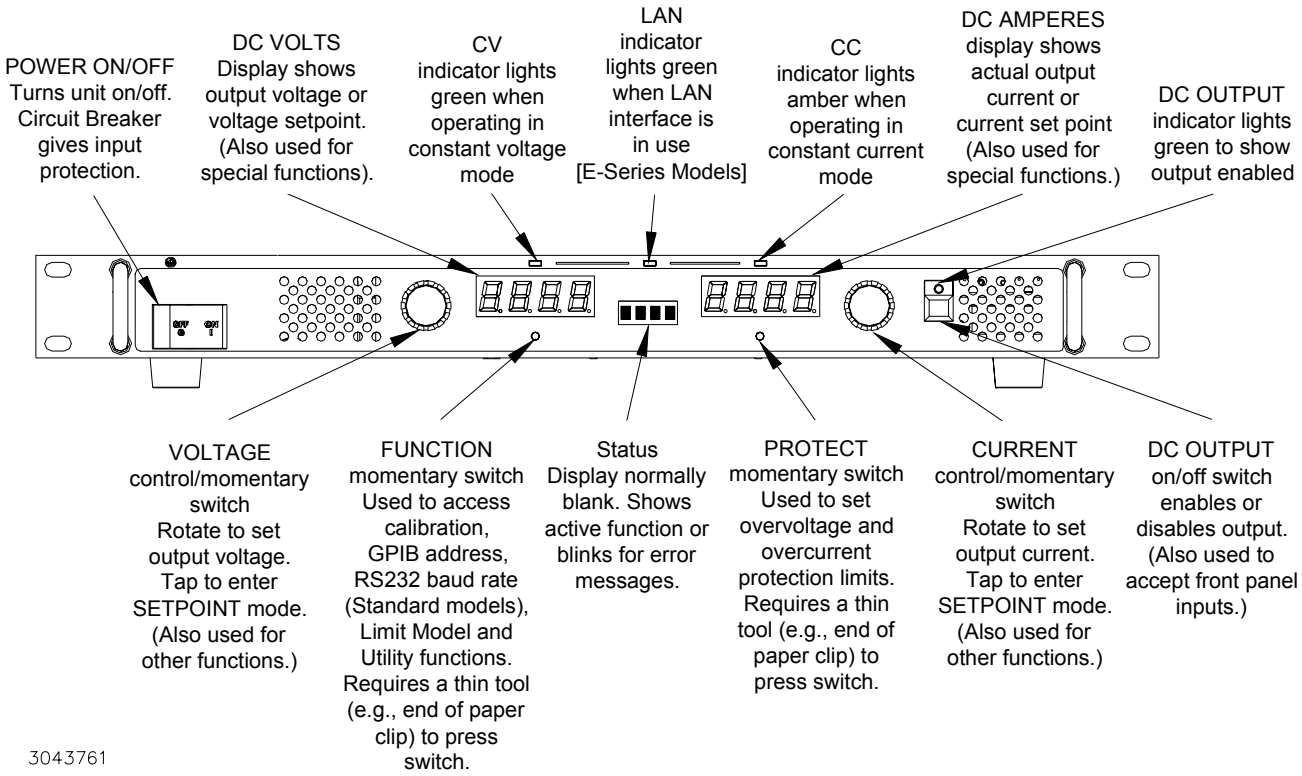


FIGURE 1. KLR SERIES, FRONT PANEL CONTROLS AND INDICATORS

LOCAL SENSING (FACTORY DEFAULT). Unit is shipped with local sensing jumpers installed: +S connected to +M and –M connected to –S (see Figure 2).

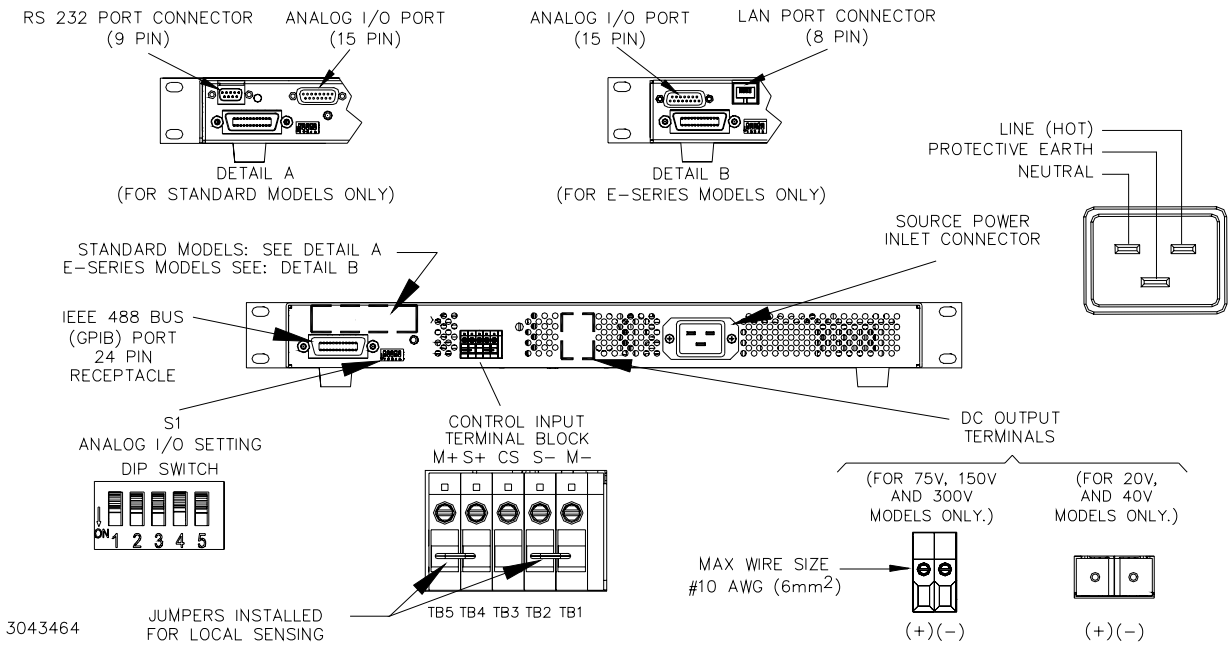


FIGURE 2. KLR SERIES, REAR PANEL VIEW, JUMPERS INSTALLED FOR LOCAL SENSING

REMOTE SENSING SELECT. First remove the factory-installed local sensing jumpers between +S and +M and between –M and –S. Then connect the +S and –S lines at the load, observing proper polarity (see Figure 3). A high frequency bypass network consisting of two capacitors connected across the error sensing point as shown in Figure 3 is recommended to reduce noise in the sense loop.

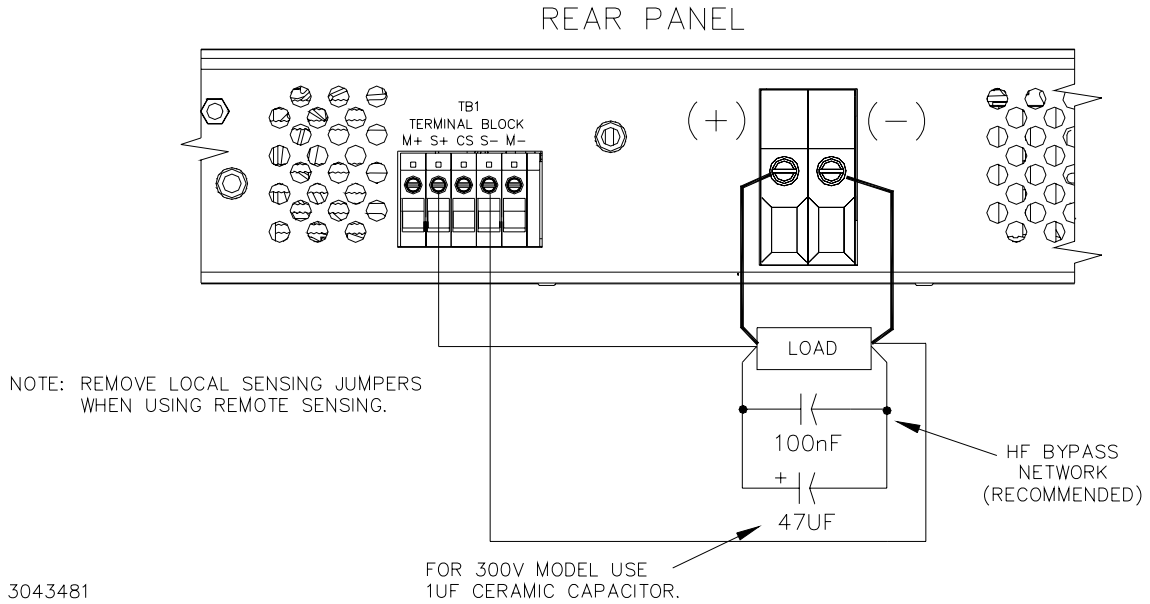


FIGURE 3. REMOTE SENSING

ANALOG I/O CONNECTIONS. The Analog I/O Port connector, located on the rear panel of the KLR power supply (see Figure 2), provides access to analog programming inputs, status signal outputs and an external trigger input available for use with SCPI *TRG and TRIG commands.

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). The default GPIB address is 6. Refer to the User manual to change it from the front panel, or to the Developer's Guide to change it using SCPI commands.

RS 232 CONNECTIONS (STANDARD MODELS). Connect the KLR to a modem using a Null Modem patch cable at the RS 232 port located on the rear panel (See Figure 2). A Null Modem cable is not required for older MAC computers with D-sub serial port in which the RXD and TXD line transposition is accomplished via external hardware. The default baud rate is 38400. Refer to the User manual to change it from the front panel, or to the Developer's Guide to change it using SCPI commands.

LAN CONNECTIONS (E-SERIES MODELS). The LAN interface allows the KLR to communicate via a built-in web port (using web pages from a standard browser), as well as through other built-in LAN ports. Connect the KLR to the LAN via the RJ 45 LAN port located at the rear panel (See Figure 2). Refer to the User manual to configure the LAN interface from the front panel or through the web interface. Refer to the Developer's Guide for the associated SCPI commands

OPERATION. Additional features covered in the User Manual are: Quick Boot (eliminating the power-up displays), use of the internal relay, operation via the LAN interface or analog signals and setting coarse/fine adjustment preference of the VOLTAGE and CURRENT controls. An Installation/Operation Summary is also included in the User manual. The Developer's Guide covers the GPIB and RS 232 and LAN interfaces, including the use of the drivers available from www.kepcopower.com/drivers/.

TURNING THE POWER SUPPLY ON. To turn the power supply on, set POWER ON/OFF circuit breaker (Figure 1) to ON. If an error occurs, an error code is displayed in the status display (see User Manual.)

1 When the power supply is turned on, it performs a self-test and displays the following information:
   - Status display flashes **KLR** for 2 seconds while **DC VOLTS** and **DC AMPERES** displays show the maximum voltage and current capability of the unit.
   - Status display flashes **LAN** for 2 seconds if unit is an E-Series model
   - Status display flashes **RODC** for 2 seconds if unit has the Rapid Output Discharge Circuit option installed.
   - Status display flashes **LMT** for 2 seconds while **DC VOLTS** and **DC AMPERES** displays show the maximum voltage and current allowed for a previously programmed Limit model.
   - Status display flashes **PROT** for 2 seconds while **DC VOLTS** and **DC AMPERES** displays show previously stored OVP and OCP trigger levels.

2 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).
   - **DC VOLTS** and **DC AMPERES** displays show programmed output conditions: 0 Volts, minimum Amperes (if DIP switch position 3 was ON when the unit was turned off, previously saved setpoint values are displayed).

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

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

1 To enable the output, first exit SET mode by tapping either the **VOLTAGE** or **CURRENT** control, then press and release the **DC OUTPUT** switch. The associated green LED lights to indicate output power is applied to the load. Each time you exit SET mode, the setpoint values are stored for possible recall if the power supply is turned off or the output is disabled.

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

NOTE: 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.

CHECKING OR CHANGING 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.

1 Tap either the **VOLTAGE** or **CURRENT** control. The status display reads SET, and the **DC VOLTS** and **DC AMPERES** displays show the stored setpoints.

2 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; or see User Manual to set coarse/fine preference), then tap the adjustment control again to accept the new setting.

NOTE: Before changing the setpoint, note the displayed setpoint. If you decide not to change the value after rotating the control, you must rotate the control to the value noted, then tap the adjustment control to accept.

LIMIT MODEL SETTING. The limit model establishes a maximum programmable voltage and current for the unit within the maximum voltage and current ratings listed in Table 1. The unit will not accept programmed values beyond these values.

1 Using a thin tool (e.g., a paper clip), press the **FUNCTION** switch until the status display reads LMT. The **DC VOLTS** and **DC AMPERES** displays show the programmed maximum voltage and current of the limit model.

2 To exit, rotate either **VOLTAGE** or **CURRENT** control until Status display reads EXIT, then tap **DC OUTPUT** switch. To change the limit model settings refer to the User Manual.

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 or Setpoint adjustment.

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.

- 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 SETPOINT ADJUSTMENT.
- Voltage and current settings are not allowed to exceed either a) the limit 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 limit model, >OVP for voltage protection, or >OCP for current protection to indicate which limit is being exceeded.

Setpoint Voltage/Current Adjustment.

1 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.

2 Rotate the corresponding control to change the setpoint as viewed on the corresponding LED display. Tap the adjustment control again to accept the new setting.

- In the setpoint mode, both coarse and fine adjustment (depending on whether the control is pressed in while rotating) is available. The coarse adjustment is approximately 100X the fine adjustment resolution. Refer to User Manual to set coarse/fine preference.
- Setpoint adjust can be done with output either on or off, however the output can not be enabled while setpoint is active.
- Voltage and current settings are not allowed to exceed either a) the limit 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 limit model, `>OVP` for voltage protection, or `>OCP` for current protection to indicate which limit is being exceeded.
- 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.

LAST SETTING RECALL. KLR 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 Figure 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.

- Recall is for SETPOINT ADJUSTMENTS only; output changes entered as REALTIME ADJUSTMENTS 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.
- If the limit model for the power supply is altered, the last settings are reset to zero volts and minimum current.

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 $E_O$max and 0.72 to 1.2 x $I_O$max.

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.

- The maximum values are 1.2 x $E_O$max for overvoltage protection (OVP), and 1.2 x $I_O$max for overcurrent protection (OCP).
- A built-in feature prevents the unit from encroaching upon the above margins for OVP and OCP. For example, if OVP and OCP are set to 12V and 72A, respectively, programming of the output is automatically limited to 10V and 60A.
- When a limit model is defined, OVP and OCP are automatically set 20% and 20%, respectively, above the maximum programmable values established by the limit model. If OVP or OCP are lowered by the user, valid settings will actually be lower than the limit model limits because values within 20% of OVP or 20% of OCP are prohibited.
- If either adjustment exceeds maximum programmable volts or amps, or if the adjustment is within 20% of OVP or 20% of OCP, the status display will show `>MAX`.

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 display 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.

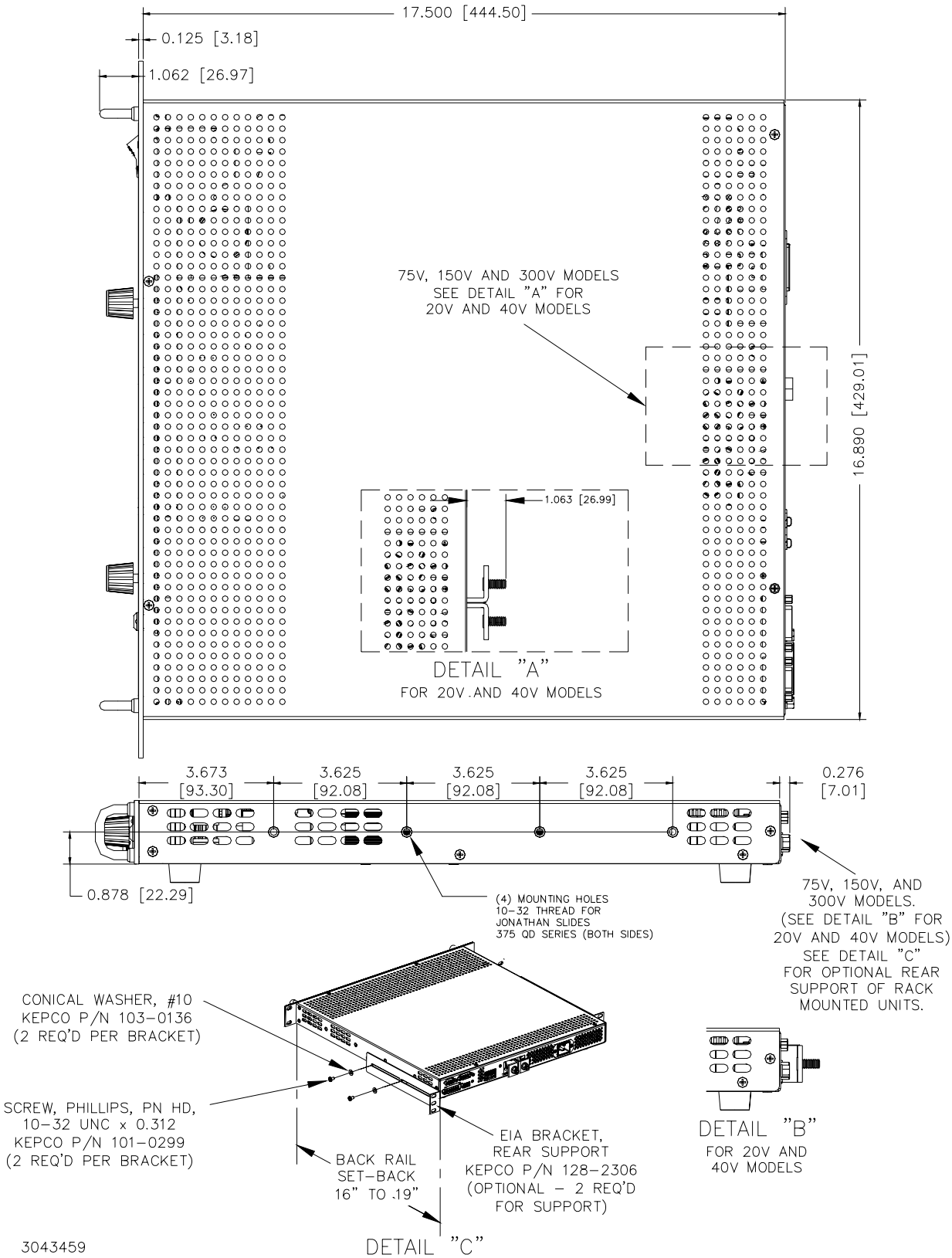
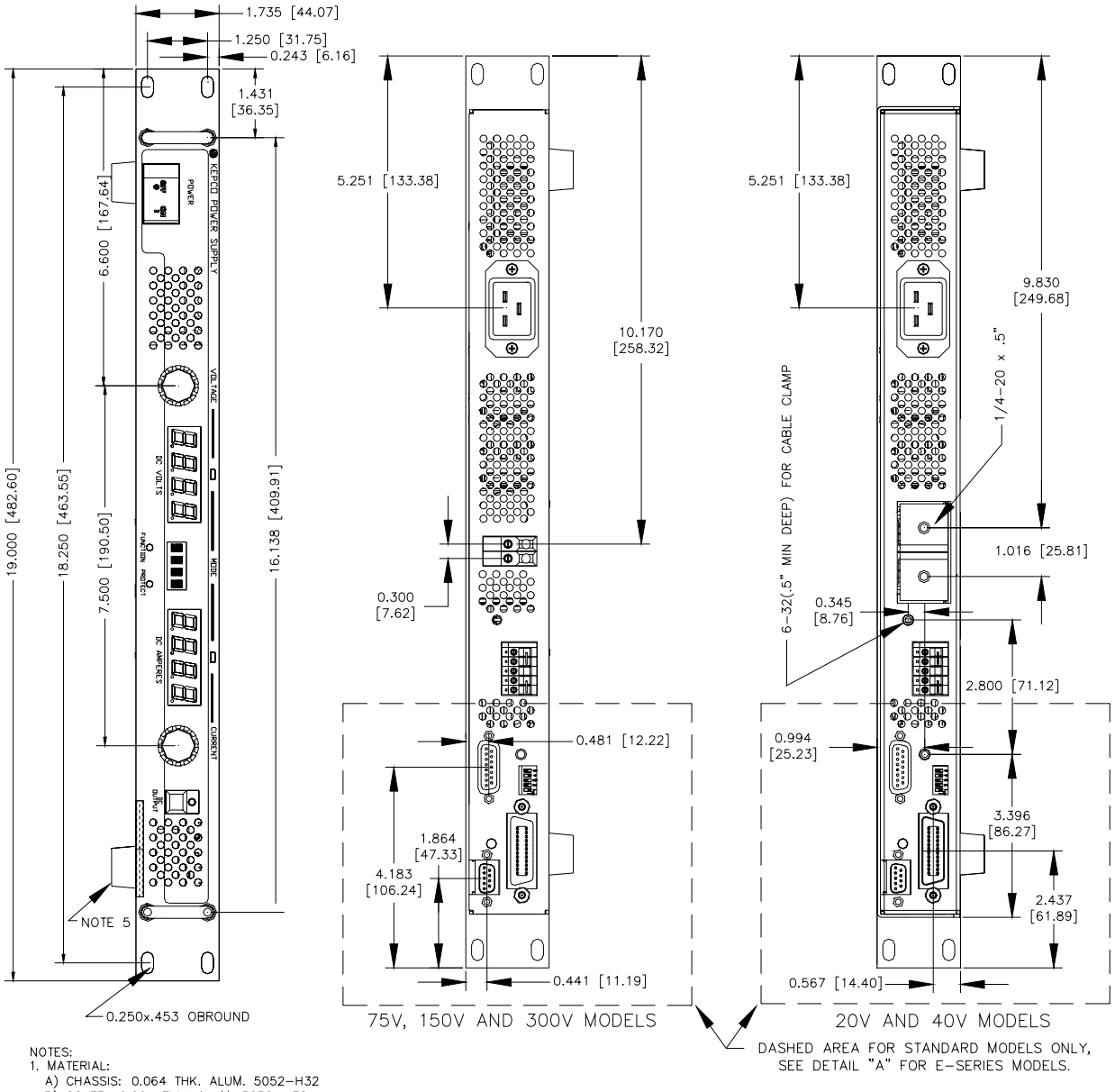


FIGURE 4. KLR OUTLINE DIMENSIONS (SHEET 1 OF 2)



NOTES:
1. MATERIAL:
   A) CHASSIS: 0.064 THK. ALUM. 5052-H32
   B) COVER: 0.064 THK. ALUM. 5052-H32
   C) FRONT PANEL: 0.125 THK. ALUM. 6061-T6
2. FINISH:
   A) CHASSIS, COVER AND BACKPLATE: YELLOW IRIDITE
   B) FRONT PANEL: KEPCO GREY,
3. DIMENSIONS IN PARENTHESES ARE IN MILLIMETERS.
4. TOLERANCES:
   A) BETWEEN MOUNTING HOLES: ±1/64 (±0.4).
   B) ALL OTHER DIMENSIONS: ±1/32 (±0.8) EXCEPT AS NOTED.
5. 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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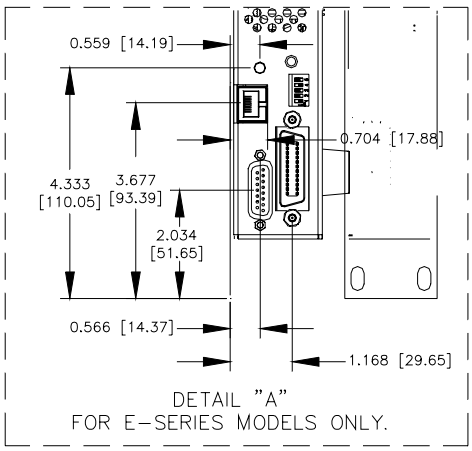

FIGURE 4. KLR OUTLINE DIMENSIONS (SHEET 2 OF 2)