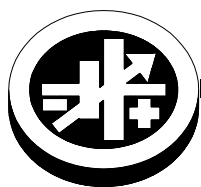


# INSTRUCTION MANUAL



**KEPCO** An ISO 9001 Company.

**RTW  
150W**

## 150 WATT SINGLE OUTPUT, PFC, OPEN FRAME POWER SUPPLIES

### I — INTRODUCTION

**SCOPE OF MANUAL.** This instruction manual covers the installation and operation of the Kepco RTW 150W Series of Open Frame PFC (Power Factor Corrected) RoHS (Reduction of Hazardous Substances) compliant Switching Power Supplies.

**DESCRIPTION.** The Kepco RTW 150W Series consists of seven models of switching power supplies, with a single output as shown in Table 1. Units may be operated with a nominal 100 to 120V a-c and 200 to 240V a-c (input voltage range 85 to 265 Va-c), 50-60 Hz (input frequency range 47-66Hz; units operate up to 440Hz although leakage current, power factor and efficiency specifications may not be met). They will also operate on 120V to 370V d-c input. The RTW 150W Series employs a forward converter with a fixed switching frequency of 145KHz. Power Factor Correction (PFC) is provided by a boost converter. Regulation is provided by pulse width modulation. A thermistor circuit prevents excessive turn-on current surge. Remote on-off and remote programming of output voltage using an external resistance can be implemented. Overvoltage, overcurrent and overtemperature protection is provided. Current limiting with automatic recovery from short circuit is featured. Units are convection cooled L-chassis construction. Models with a factory-installed steel cover are indicated by a C suffix following the model number (e.g., RTW 5-30KC).

Section II contains specifications and operating limits of individual RTW 150W Series models (Table 1) as well as specifications and operating limits common to all RTW 150W Series Models. Section III describes installation and Section IV describes operation

### II — SPECIFICATIONS

The following specifications are at rated input voltages at 25°C unless otherwise specified.

**TABLE 1. OUTPUT RATINGS AND SPECIFICATIONS, RTW 150W SERIES**

MODEL <sup>(8)</sup>	RTW 3.3-35K	RTW 5-30K	RTW 12-12K	RTW 15-10K	RTW 24-6.3K	RTW 28-5.4K	RTW 48-3.2K	
OUTPUT VOLTAGE SETTING, d-c	3.3 ±0.03V	5 ±0.05V	12 ±0.12V	15 ±0.15V	24 ±0.24V	28 ±0.28V	48 ±0.48V	
ADJUSTMENT RANGE, Vd-c	2.85-4.0	4.0-5.8	9.6-13.2	12-16.5	19.2-26.4	22.4-30.8	38.4-52.8	
OUTPUT CURRENT, MAX (AMPS)	35	30	12.5	10	6.3 <sup>(5)</sup>	5.4	3.2	
OUTPUT POWER, MAX <sup>(3)</sup> (WATTS)	115.5	150.0	150.0	150.0	151.2	151.2	153.6	
OVP SETTING <sup>(1)</sup> (VOLTS)	4.2-5.2	6.0-6.9	13.7-15.7	17.0-19.0	27.0-30.5	32.0-35.0	55.0-60.0	
OVERCURRENT SETTING <sup>(2)</sup> (AMPERS)	38.5-45.5	33.0-39.0	13.7-16.3	11.0-13.0	10.5-13.5	5.94-7.02	3.52-4.16	
EFFICIENCY	100 Va-c	80%	83%	84%	84%	86%	86%	86%
	200 Va-c	83%	86%	87%	87%	88%	88%	89%
RIPPLE AND NOISE (mV p-p <sup>(4)</sup> )	Switching ripple (typ)	80	80	100	100	150	150	200
	spike noise (typ) <sup>(6)</sup>	120	120	150	150	200	200	300
External Potentiometer <sup>(7)</sup>	500 Ohms	500 Ohms	750 Ohms	1K Ohms	1.5K Ohms	2K Ohms	5K Ohms	

(1) Overtemperature or overvoltage shuts down the output. Recover by recycling a-c input (30 second delay required before resetting).

(2) Hiccup mode operation. After the cause of overcurrent is removed, output voltage recovers automatically.

(3) See Figure 1 for temperature and input voltage rating.

(4) Bandwidth 100MHz.

(5) Peak current: 10A (useful for motor start applications). Thermal protection (24V model only) cuts off output voltage if overtemperature detected; after sufficient cooling; recover by cycling a-c input.

(6) Ripple and noise will be approximately 1.5 times these values in the operating temperature range -10 ~ 0°C. The ripple and noise values tabulated are valid when the output is derated as shown in Figure 1 from 40 ~ 71°C.

(7) Used for remote programming of output voltage. See Section IV OPERATION, REMOTE VOLTAGE PROGRAMMING.

(8) Specifications apply to models with K (no cover) and KC (cover installed) suffixes.

**INPUT VOLTAGE:** Operation at input voltage outside the recommended range may result in component degradation.

Nominal 100-120V a-c, 200-240V a-c, range: 85-265V a-c (0 to 100% load, -10 to 71°C).

d-c range: 120 -370V d-c.; polarity insensitive. Safety agency approval applies only to a-c input operation.

**INPUT SOURCE FREQUENCY:**

Nominal 50/60 Hz; Range 47-440 Hz (0 to 100% load, -10 to 71°C). (Units operate up to 440 Hz, however the leakage current exceeds the UL leakage safety specification limit, and power factor and efficiency specifications may not be met.)

**INPUT CURRENT:**

5V-48V models: 1.9A rms max. (100-120 Va-c input, 100% load); 1.0A rms max. (200-240 Va-c input, 100% load).

24V model at peak output: 2.7A rms typ. (100 Va-c input); 1.1A rms typ. (240 Va-c input).

3.3V model: 1.6 rms max. (100-120 Va-c input, 100% load); 0.85A rms max. (200-240 Va-c input, 100% load).

**INPUT PROTECTION AND SOFT START:** A thermistor circuit reduces start-up surge. Units are protected against shorts by an input fuse. Fuse value 5A, 250V.

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**INPUT SURGE:** cold start 25 °C (First surge only, not including the current flow into the EMI filter) 14A typ. (100 V a-c, 100% load); 28A typ. (200 Va-c, 100% load).

**LEAKAGE CURRENT:**

0.29mA typ, 0.45mA max at 100V a-c and 60 Hz (operating in conformance with Den-An),  
 0.40mA typ, 0.65mA max at 240V d-c and 60 Hz (operating in conformance with IEC 950 and UL1950).

**POWER FACTOR:** 0.99 typ. at 100 Va-c, 0.96 typ. at 240 Va-c.

**STABILIZATION:**

Source Effect: (85 to 132Va-c, 170-265 Va-c) 0.1% typ., 0.2% max.  
 Load Effect: (0% - 100% of rated output current) 0.2% typ., 0.4% max.  
 Temperature effect: (-10 to 71°C) 0.5% typ., 1.0% max.  
 Combined effect (source, load, temperature): 0.9% typ., 1.8% max.  
 Time effect (drift): (1/2 to 8 hr. at 25°C) 0.2% typ., 0.5% max.

**TRANSIENT RECOVERY:** A step load change from 50% to 100% of rated output current in 50 microseconds or more, produces no more than 4% output voltage excursion. Recovery time is 1ms maximum.

**ACCEPTABLE LOAD CAPACITANCE:** (start-up time is affected)

3.3V-28V models: 100,000µF max; 48V model: 50,000µF max.

**OUTPUT HOLDING TIME:** Upon input interruption the output is maintained for:

35mS typ. (3.3V model: 50mS typ.), 20mS min. at 100 Va-c;  
 40mS typ. (3.3V model: 55mS typ.), 25mS min. at 240 Va-c

**START UP TIME:** 220mS typ., 300mS max. at 100 Va-c; 120mS typ., 200mS max., at 240 Va-c. Between 0 and 71° C.

**OVERVOLTAGE PROTECTION:** Fixed, factory set. See Table 1.

**OVERCURRENT:** Hiccup type, output voltage returns to rated level upon removal of cause of overcurrent.

**OPERATING TEMPERATURE:** -10 to 71°C (start up -20 to -10°C). See the derating, Figure 1. See Table 1, Note (1) for overtemperature protection recovery.

**STORAGE TEMPERATURE:** -30°C to + 75°C.

**COOLING:** Natural convection.

**ORIENTATION:** Vertical or horizontal (see Figure 5).

**HUMIDITY:** Operating and Storage: 10% to 95% relative humidity, noncondensing, wet bulb temperature ≤ 35°C.

**WITHSTAND VOLTAGE:**

(at 15 to 35°C ambient, 10 to 85% relative humidity):  
 Between input and output terminals, 3.0 KV a-c for 1 minute, cutout current 10 ma.  
 Between input terminals and ground, 2.0 KV a-c for 1 minute, cutout current 10 ma.  
 Between output terminals and ground, 500V a-c for 1 minute, cutout current 20 ma.

**INSULATION RESISTANCE:** Between input and output, input and ground, output and ground, ±RC and output, ±RC and input, 100 megohms minimum (500V d-c, 15 to 35°C ambient, 10 to 85% relative humidity).

**VIBRATION:** Three axes, one hour each, sweep time 10 min.; nonoperating 5-10 Hz., 10 mm amplitude.

10-200 Hz., 2G (19.6m/S<sup>2</sup>) acceleration.

**SHOCK:** Three axes, 20G (196m/S<sup>2</sup>) when installed per Figure 5, method A, 60G

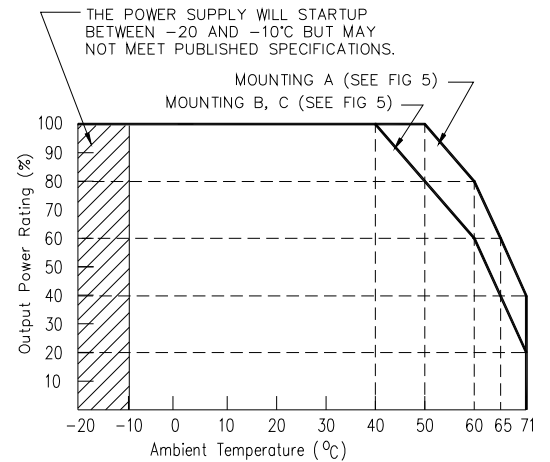
(588m/S<sup>2</sup>) when installed per Figure 5, method B or C, 11ms ±5 msec pulse duration, three shocks each axis, nonoperating, 1/2 sine pulse.

**EMC - EMISSIONS:**

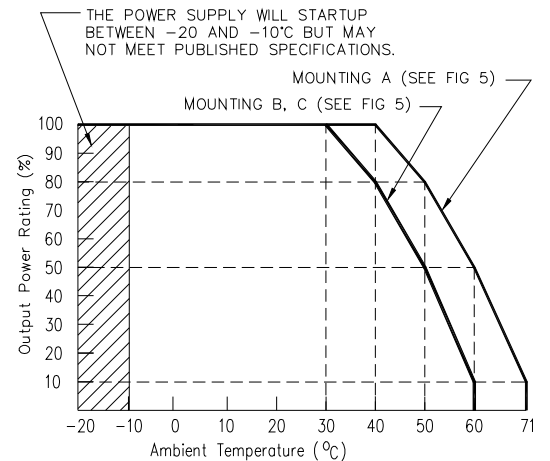
Radiated Noise 30MHZ to 1GHz: FCC Class B, VCCI-B, EN55011-B, EN55022-B  
 Conducted Noise 0.15MHz to 30MHz: FCC Class B, VCCI-B, EN55011-B, EN55022-B  
 Input Harmonics (on AC Mains) 0 to 2KHZ: EN 61000-3-2.

**EMC - IMMUNITY:** Designed to meet EN 50082-2.

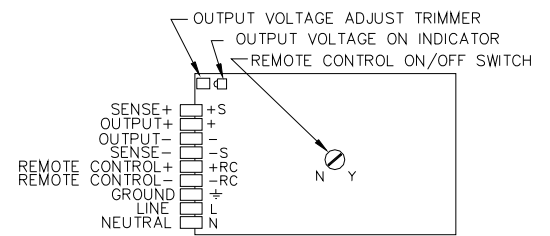
ESD: EN 61000-4-2 Level 4, Normal operation.  
 Radiated Field Noise: EN 61000-4-3 Level 3, Normal operation.  
 Electrical Fast Transient/Burst (EFT): EN 61000-4-4 Level 3, Normal operation.  
 Surge: EN 61000-4-5 Level 4, no damage.  
 Conducted Noise: EN 61000-4-6 Level 3, Normal operation.  
 Power Frequency Magnetic Field: EN 61000-4-8 Level 4, Normal operation.  
 Voltage Dips, Short Interruptions, Voltage Variation: EN 61000-4-11, Normal operation.



**FIGURE 1. OUTPUT POWER VS. TEMPERATURE, K MODELS (WITHOUT COVER)**



**FIGURE 2. OUTPUT POWER VS. TEMPERATURE, KC MODELS (WITH COVER)**



**FIGURE 3. COMPONENT LOCATIONS**

**SAFETY:** EN 60950:2001 Assistance for DEN-AN. U.S. UL 60950-1 First Edition.; Canada: CSA-22.2 No. 60950-1. (ambient temp. 50°C). Meets creepage and clearance requirements of DEN-AN Appendix at 100V a-c input. RTW 150W units are CE marked per the Low Voltage Directive (LVD), EN60950 73/23/EEC AND 93/68/EEC. [The standards do not apply with DC input operation.]

**WEIGHT:** K models (without cover): 1.15 lbs. (520 grams) max.; KC models (with cover): 1.32 lbs. (600 grams) max.

**WARRANTY:** One year.

### III — INSTALLATION

**MOUNTING THE POWER SUPPLY:** Refer to Figures 5 and 6. The unit may be mounted on one mounting surface. Note the restrictions for maximum penetration of mounting screws. The air temperature surrounding the power supply must not exceed the ambient values given in the graph in Figure 1.

**CONNECTIONS:** Connect the load to the power supply as shown in Figure 4A, B, or C. The unit is shipped with shorting links in place for Local sensing. The AC input power is applied via the terminal block. Make sure to connect the AC input Neutral, Line and Ground wires to the respective terminals of the terminal block (see Figure 3). **Sensing (either Local or Remote) MUST be used.**

**LOCAL/REMOTE SENSING:** Figure 4 shows proper connection of multiple loads using either remote or local sensing. **If local or remote sensing is not configured, the unit will not work properly.** The unit is shipped with shorting links in place for Local sensing. For remote sensing, remove the shorting links and connect the +S and -S terminals to the load. Remote sensing compensation is up to 0.4V per load wire (0.15V for RTW 3.3-35K, 0.25V for RTW 5-30K). Load wire length should not be more than 16.4ft. (5m). Transient recovery specs may not be met when remote sensing is used. To prevent oscillations and premature tripping of overvoltage protection, install one electrolytic (not tantalum) capacitor (470mF min) between +S and + and one between - and -S terminals.

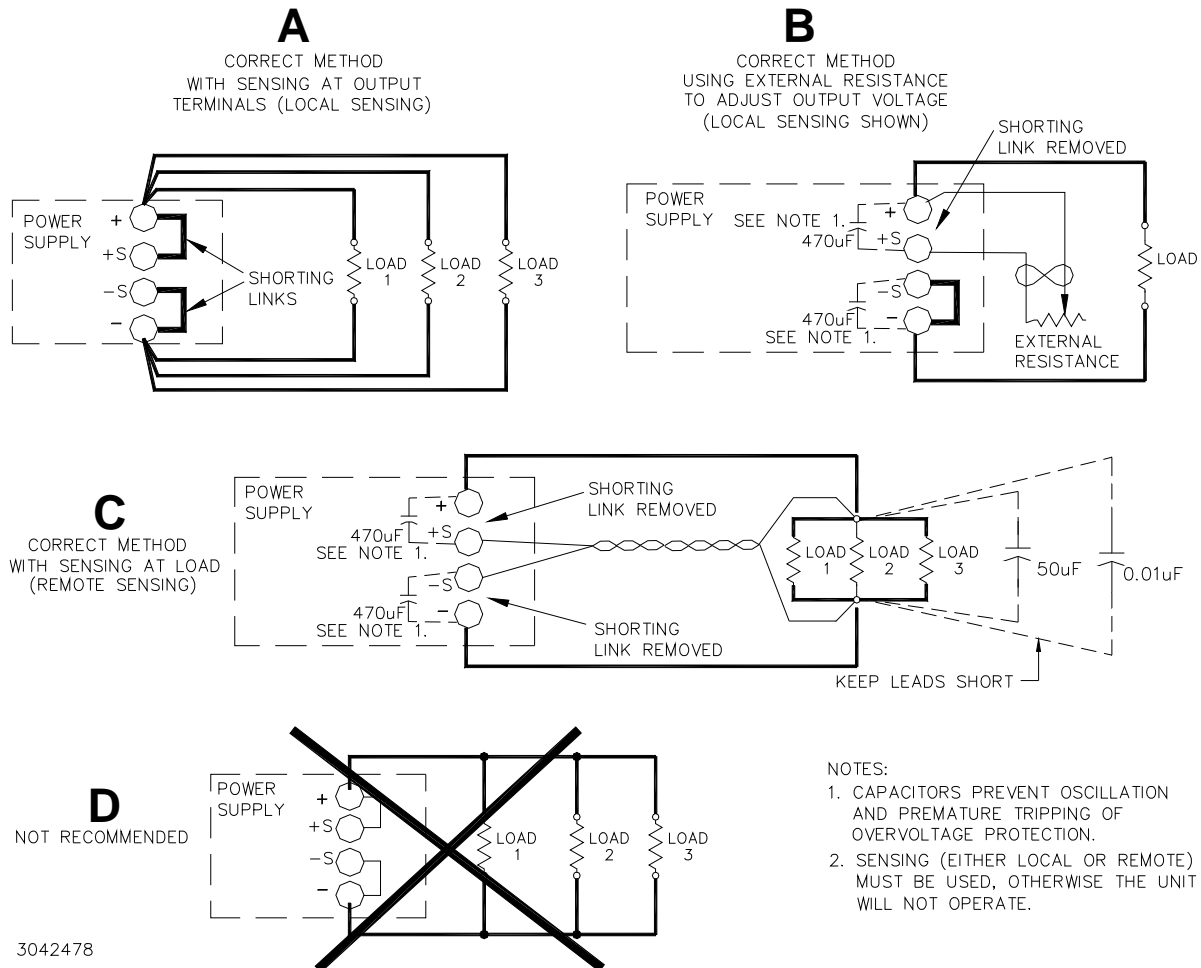
### IV — OPERATION

When output voltage is available, the green LED is on. The Output Voltage Adjust trimmer (see Figure 3) allows adjustment of the output voltage within the range specified in Table 1.

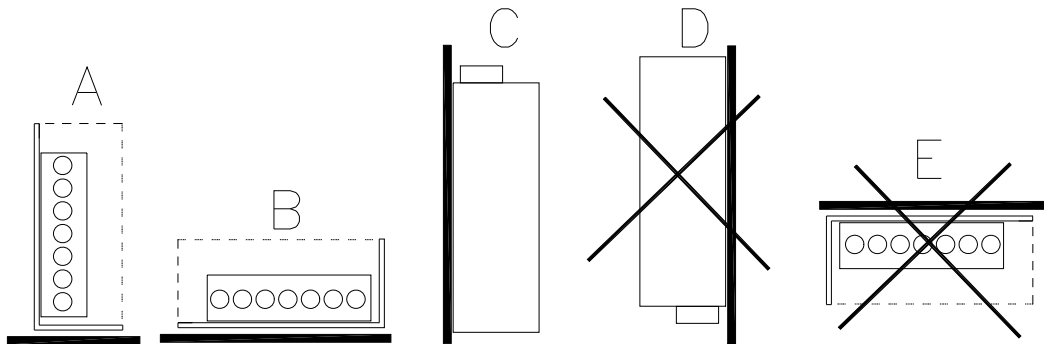
**REMOTE ON OFF:** Use  $\pm$ RC terminals to set output on or off after setting the Remote On/Off switch to Y (see Figure 3). Output OFF requires no voltage, or short circuit, or 0 to 0.8V d-c across  $\pm$ RC terminals; Output ON requires 4.5 to 12.5V d-c (or 12.5 to 24.5V d-c through 1.5K Ohms) across  $\pm$ RC terminals.  $\pm$ RC terminals are isolated from AC input and DC output terminals.

**REMOTE VOLTAGE PROGRAMMING:** In addition to the integral trimmer, output voltage can be also be adjusted via an external variable resistance (see Figure 4B). The variable resistance specified in Table 1 must be substituted for the shorting link between + and +S terminals. Note that load effect for RTW 150W is increased using this technique, and may exceed values listed above under STABILIZATION.

**SERIES OPERATION:** When a number of power supplies are operating in series, the current rating is to be limited to the rating of the power supply with the lowest rating. A diode ( $V_r > 2\sum V_o$ ,  $I_f > 2I_o$ ,  $V_f \ll \text{low}$ ) must be connected to the power supply output terminals to protect the unit from reverse voltage.



**FIGURE 4. LOAD CONNECTIONS**

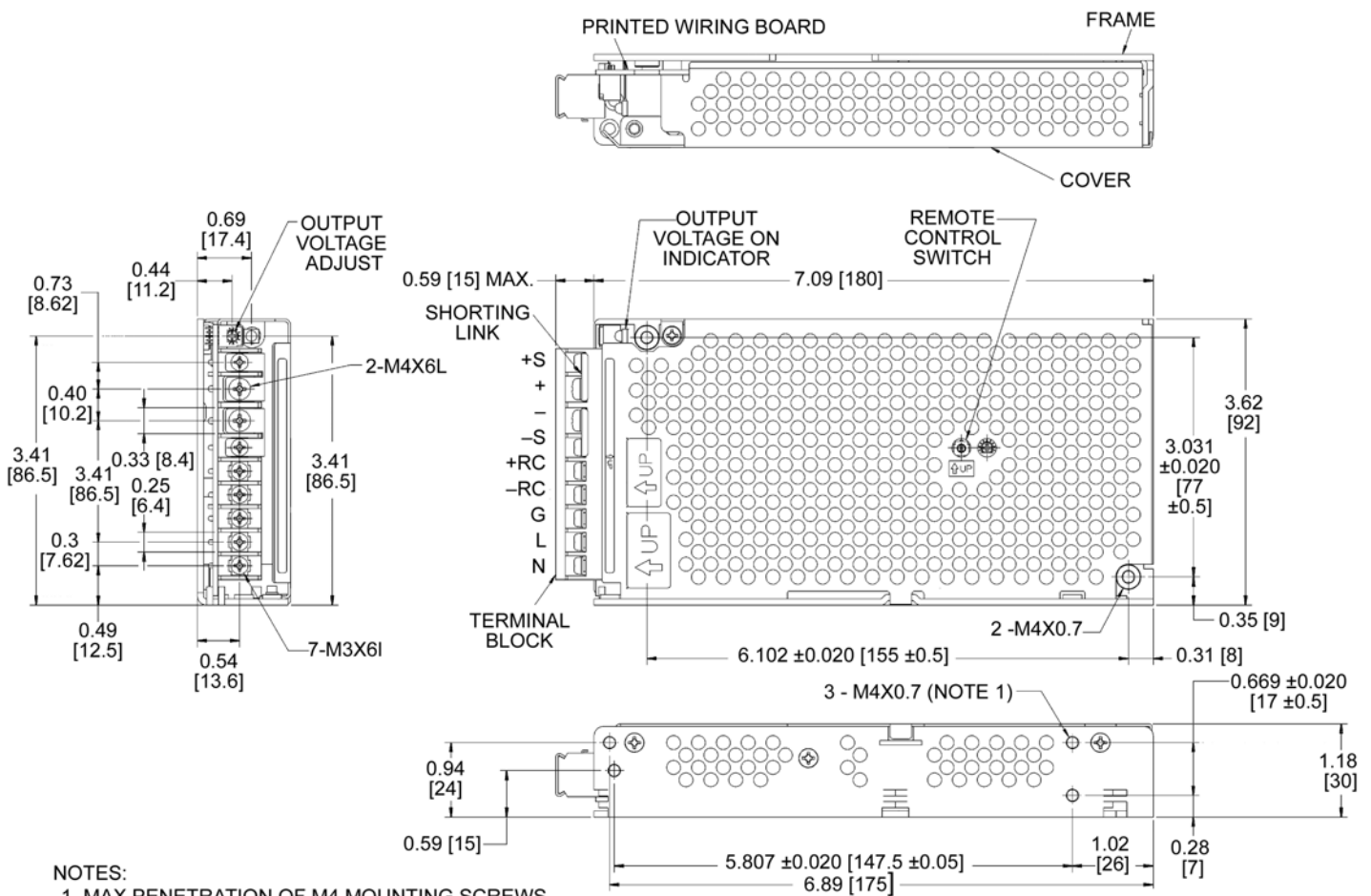


NOTES:

1. METHODS D AND E ARE NOT RECOMMENDED DUE TO INSUFFICIENT VENTILATION.
2. REFER TO FIGURE 1 FOR OUTPUT POWER VS. TEMPERATURE FOR MOUNTING METHOD SELECTED.

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**FIGURE 5. POWER SUPPLY MOUNTING**



NOTES:

1. MAX PENETRATION OF M4 MOUNTING SCREWS IS 0.24 IN. (6 MM) FROM CASE SURFACE.
2. DIMENSIONS ARE IN INCHES, DIMENSIONS IN BRACKETS ARE IN MILLIMETERS.
3. TOLERANCES:  $\pm 0.04$  IN. [ $\pm 1.0$  MM] UNLESS OTHERWISE SPECIFIED.
4. WEIGHT: 1.32 LBS. (600 GR.) MAX. WITH COVER, 1.15 LBS. (520 GR.) WITHOUT COVER

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**FIGURE 6. RTW 150W MECHANICAL OUTLINE DIAGRAM (WITH COVER)**