ENERGY RECOVERY PRODUCTS™

**EBR010** 6-10 W
**EBR015** 11-15 W
**EBR020** 16-21 W

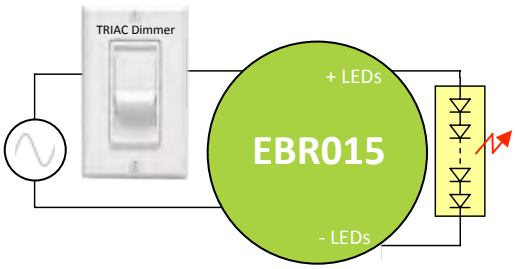
# Constant Current LED Drivers with Deep TRIAC/ELV Dimming (1 - 100%) and with Fast Startup Time

| Input Voltage | Max. Output Power | Output Voltage | Output Current | Efficiency | Max. Case Temperature | THD | Power Factor | Dimming Method | Dimming Range | Startup Time |
|---|---|---|---|---|---|---|---|---|---|---|
| 120 or 230 Vac nominal | 21 W | 16 to 42 Vdc | 200 to 700 mA CC | ≥ 87% | 90°C (measured at the hot spot) | < 20% | > 0.9 | Forward-Phase, Reverse-Phase | 1 - 100% (% of Iout) | 150 ms typical |

CC: Constant Current

## PRODUCT DESCRIPTION

The EBR series of LED drivers is ideally suited for recessed lighting in commercial, architectural and residential LED lighting applications. These devices are compatible with most industry standard phase-cut wall-based dimmers, both forward-phase (leading-edge) and reverse-phase (trailing edge), and offer deep dimming from 100% down to 1%.




APPLICATION DIAGRAM

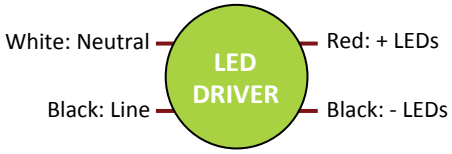
## FEATURES

- 120 Vac or 230 Vac nominal input
- Compatible with industry standard phase-cut dimmers: TRIAC (forward-phase or leading-edge) / ELV (reverse-phase or trailing-edge)
- Lifetime: 112,000 hours at 70°C case hot spot temperature (58°C ambient temperature) for EBR010U-0250-42
- Low acoustic noise of 20 dbA
- Protections: output open load, over-current and short-circuit (hiccup), and over-temperature with auto recovery
- Conducted and radiated EMI: Compliant with FCC CFR Title 47 Part 15 Class B for 120 Vac and EN55015 (CISPR 15) for 220/230/240 Vac
- Enables ENERGY STAR® and DLC (DesignLight Consortium®) luminaire compliance
- IP20-rated case with silicon-based potting
- 94V-0 flammability rating (5VA available upon request)
- 90°C maximum case hot spot temperature
- Class 2 power supply
- Double-insulated power supply between input and output (class II) ⧈
- Worldwide Safety approvals

PLASTIC CASE:
Diameter: 58 mm (2.28 in)
Height: 31.7 mm (1.25 in)

## APPLICATIONS

- Recessed lighting (downlights)
- Commercial & Residential lighting
- Architectural lighting


WIRING DIAGRAM

# Constant Current LED Drivers with Deep TRIAC/ELV Dimming (1 - 100%) and with Fast Startup Time

## 1 - INPUT SPECIFICATION (@25°C ambient temperature)

| | Units | Minimum | Typical | Maximum | Notes |
|---|---|---|---|---|---|
| **Input Voltage Range (Vin)**<br>-EBR010/015/020U<br>-EBR010/015/020E | Vac | <br>90<br>180 | <br>120<br>230 | <br>132<br>264 | The rated output current for each model is achieved at Vin ≥ 115 Vac for EBRxxU and at Vin ≥ 209 Vac for EBRxxE. |
| **Input Frequency Range**<br>-EBR010/015/020U<br>-EBR010/015/020E | Hz | <br>57<br>47 | <br>60<br>50 | <br>63<br>53 | |
| **Power Factor (PF)** | | 0.9 | > 0.9 | | At nominal input voltage and with nominal LED voltage |
| **Input Current** | A | - | - | 0.27 A @ 120 Vac<br>0.20 A @ 230 Vac | |
| **Inrush Current** | A | | | 10 A peak | At any point on the sine wave and 25°C |
| **Leakage Current** | µA | | | 250 µA @ 120 Vac<br>500 µA @ 230 Vac | Measured per IEC60950-1 |
| **Input Harmonics** | Complies with IEC61000-3-2 for Class C equipment | | | | |
| **Total Harmonics Distortion (THD)** | | | | 20% | • At nominal input voltage and nominal LED voltage<br>• Complies with DLC (DesignLight Consortium) technical requirements v2.0 |
| **Efficiency** | | - | 85% | - | • Measured with nominal input voltage, a full sinusoidal wave form and without dimmer connected.<br>• Models with power ≤10W have an efficiency of ≥ 83%. |
| **Isolation** | Meets UL60950-1 for class II reinforced/double insulation power supply ☐ | | | | |

## 2 - OUTPUT SPECIFICATION (@25°C ambient temperature)

| | Units | Minimum | Typical | Maximum | Notes |
|---|---|---|---|---|---|
| **Output Voltage (Vout)** | Vdc | 16 | | 42 | See ordering information for details |
| **Output Current (Iout)** | mA | 200 | | 700 | • See ordering information for details<br>• The rated output current for each model is achieved at Vin ≥ 115 Vac for EBRxxU and at Vin ≥ 209 Vac for EBRxxE. |
| **Output Current Regulation** | % | -5 | ±2.5 | 5 | • At nominal AC line voltage<br>• Includes load and current set point variations |
| **Output Current Overshoot** | % | - | - | 10 | The driver does not operate outside of the regulation requirements for more than 2 s during power on with nominal LED load and without dimmer. |
| **Ripple Current** | % | < 25% of rated output current for each model | | | • ≤ 25% of the rated output current for all models with Vout max ≥ 42 V<br>• ≤ 30% of the rated output current for all models with Vout max ≤ 36 V<br>• At nominal LED voltage and nominal input voltage without dimming<br>• In accordance with the IES Lighting Handbook, 9th edition |
| **Dimming Range (% of Iout)** | | 1% | | 100% | The dimming range will be dependent on each specific dimmer. |
| **Start-up Time** | ms | | 150 | | • With nominal LED voltage and without dimmer attached |
| | | | 300 | | • With nominal LED voltage, with an approved dimmer attached (see list of approved dimmers in page 5) and at the full dimming conduction angle |

# Constant Current LED Drivers with Deep TRIAC/ELV Dimming (1 - 100%) and with Fast Startup Time

## 3 - ENVIRONMENTAL CONDITIONS

| | Units | Minimum | Typical | Maximum | Notes |
|---|---|---|---|---|---|
| **Operating Case Temperature (Tc)** | °C | -30 | | +90 | Case temperature measured at the hot spot •tc (see label in page 8) |
| **Storage Temperature** | °C | -40 | | +85 | |
| **Humidity** | % | 5 | - | 95 | Non-condensing |
| **Cooling** | Convection cooled | | | | |
| **Acoustic Noise** | dBA | | | 24 | Measured at a distance of 1 meter, without and with approved dimmers |
| **Mechanical Shock Protection** | per EN60068-2-27 | | | | |
| **Vibration Protection** | per EN60068-2-6 & EN60068-2-64 | | | | |
| **MTBF** | > 300,000 hours when operated at nominal input and output conditions, and at Tc ≤ 70°C | | | | |
| **Lifetime** (See graphs "Lifetime vs. Case and Ambient Temperature" in section 6) | •112,000 hours at Tc = 70°C (Tambient = 58.1°C) for EBR010U-0250-42 (10.5 W) •84,000 hours at Tc = 70°C (Tambient = 58.5°C) for EBR020U-0500-42 (21 W) •Measured at the hot spot (see hot spot •tc on label in page 8) | | | | |

## 4 - EMC COMPLIANCE AND SAFETY APPROVALS

| EMC Compliance | | | |
|---|---|---|---|
| **Conducted and Radiated EMI** | | FCC CFR Title 47 Part 15 Class B for 120 Vac and EN55015 (CISPR 15) for 220/230/240 Vac | |
| **Harmonic Current Emissions** | | IEC61000-3-2 | For Class C equipment |
| **Voltage Fluctuations & Flicker** | | IEC61000-3-3 | |
| **Immunity Compliance** | **ESD (Electrostatic Discharge)** | IEC61000-4-2 | 6 kV contact discharge, 8 kV air discharge, level 3 |
| | **RF Electromagnetic Field Susceptibility** | IEC61000-4-3 | 3 V/m, 80 - 1000 MHz, 80% modulated at a distance of 3 meters |
| | **Electrical Fast Transient** | IEC61000-4-4 | ± 2 kV on AC power port for 1 minute, ±1 kV on signal/control lines |
| | **Surge** | IEC61000-4-5 | ± 1 kV line to line (differential mode) /± 2 kV line to common mode ground (tested to secondary ground) on AC power port, ±0.5 kV for outdoor cables |
| | **Conducted RF Disturbances** | IEC61000-4-6 | 3V, 0.15-80 MHz, 80% modulated |
| | **Voltage Dips** | IEC61000-4-11 | >95% dip, 0.5 period; 30% dip, 25 periods; 95% reduction, 250 periods |
| **Transient Protection** | **Ring Wave** | | ANSI/IEEE c62.41.1-2002 & c62.41.2-2002 category A, 2.5 kV ring wave |

| Safety Agency Approvals | | |
|---|---|---|
| **UL** | UL8750 recognized | UL60950-1 recognized |
| **cUL** | CSA C22.2 60950-1 | |

| Safety | | | | | |
|---|---|---|---|---|---|
| | **Units** | **Minimum** | **Typical** | **Maximum** | **Notes** |
| **Hi Pot (High Potential)** | Vdc | 4242 | | | •Insulation between the input (AC line and Neutral) and the output •Tested at the RMS voltage equivalent of 3000 Vac |

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## 5 - PROTECTION FEATURES

**Under-Voltage (Brownout)**

The EBR series provides protection circuitry such that an application of an input voltage below the minimum stated in paragraph 1 (Input Specification) shall not cause damage to the driver.

**Short Circuit**

The EBR series is protected against short-circuit such that a short from any output to return shall not result in a fire hazard or shock hazard. The driver shall hiccup as a result of a short circuit or over current fault. Removal of the fault will return the driver to within normal operation. The driver shall recover, with no damage, from a short across the output for an indefinite period of time.

**Internal Over temperature Protection**

The EBR series incorporates circuitry that prevents internal damage due to an over temperature condition. An over temperature condition may be a result of an excessive ambient temperature or as a result of an internal failure. When the over temperature condition is removed, the driver shall automatically recover.

**Output Open Load**

When the LED load is removed, the output voltage of the EBR series is limited to 1.3 times the maximum output voltage of each model.

## 6 - PREDICTED LIFETIME VERSUS CASE AND AMBIENT TEMPERATURE

Lifetime is defined by the measurement of the temperatures of all the electrolytic capacitors whose failure would affect light output under the nominal LED load and worst case AC line voltage. The graph in figure 1 is determined by the electrolytic capacitor with the shortest lifetime, among all electrolytic capacitors. The lifetime of an electrolytic capacitor is measured when any of the following changes in performance are observed:

*1) Capacitance changes more than 20% of initial value*
*2) Dissipation Factor (tan δ): 150% or less of initial specified value*
*3) Equivalent Series Resistance (ESR): 150% or less of initial specified value*
*4) Leakage current: less of initial specified value*

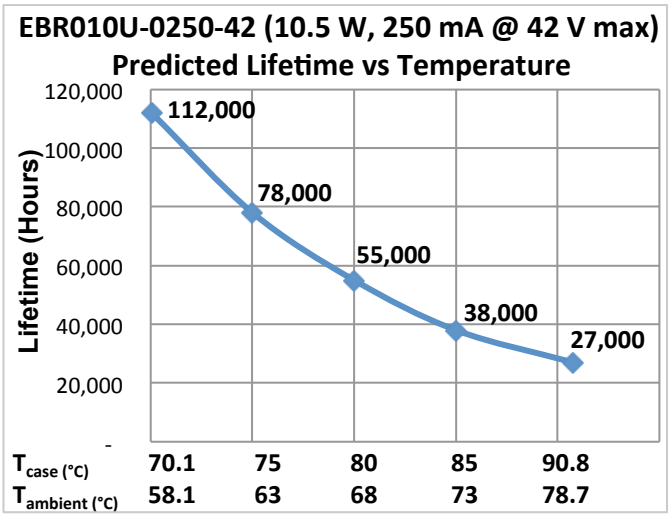


Figure 1

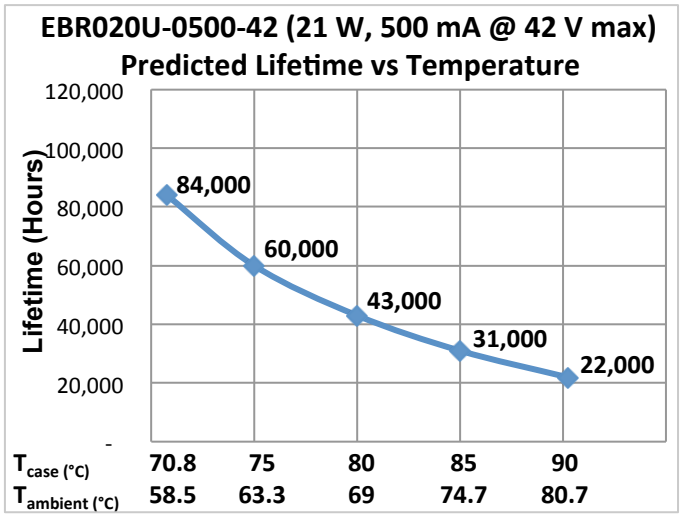


Figure 2

*It should be noted the graph "Lifetime vs. Ambient Temperature" may have an error induced in the final application if the mounting has restricted convection flow around the case. For applications where this is evident, the actual case temperature measured at the Tc point in the application should be used for reliability calculations.*

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## 7 - PHASE-CUT DIMMING

Dimming of the driver is possible with standard TRIAC-based incandescent dimmers that chop the AC voltage as shown in Figure 3, or with ELV dimmers. During the rapid rise time of the AC voltage when the dimmer turns on, the driver does not generate any voltage or current oscillations, and inrush current is controlled. During the on-time of the AC input, the driver regulates the output current based upon the conduction angle. The RMS value of the driver output current is proportional to the on-time of the AC input voltage. When operating with an incandescent dimmer, the RMS output current varies depending upon the conduction angle and RMS value of the applied AC input voltage. Figure 4 shows the typical output current versus conduction angle at nominal input voltage.

When using low power EBR models (specifically < 10 W) with a reverse-phase or forward-phase dimmer, always make sure the minimum required load is applied to the dimmer. Check the dimmer documentation for minimum load requirements.

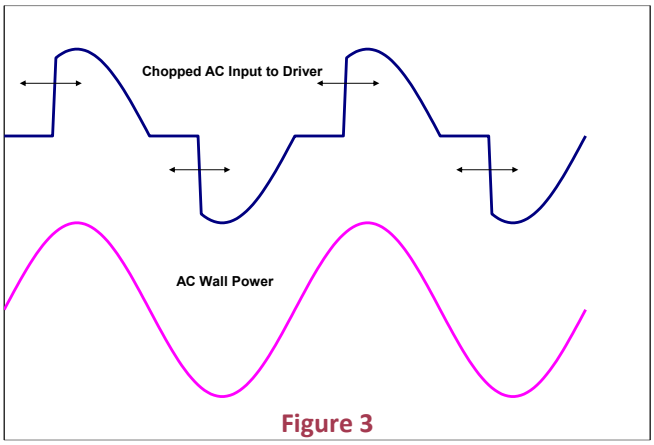



Figure 3

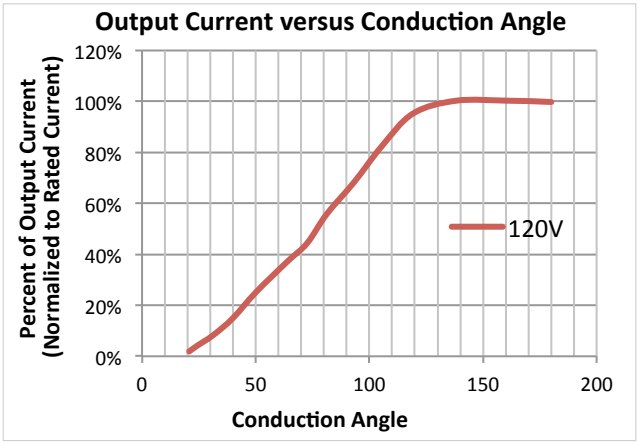



Figure 4

## 8 - COMPATIBLE PHASE-CUT DIMMERS & DIMMING RANGE

*The dimming range represents typical values and may vary for the same dimmer model number when installed.*

**Model EBR020U-0500-42 (21 W, 500 mA @ 42 V max)**

| Dimmer List | | | Dimming Range (% Iout) | | |
|---|---|---|---|---|---|
| Manufacturer | Series | Model Number | Max | Min | Flicker Result |
| Cooper | Aspire | 9573WS | 100 | 24.2 | PASS |
| Cooper | Devine | DI06P-A-K | 100 | 9.5 | PASS |
| Legrand | Paddle | ADPD453L-W2 | 100 | 22 | PASS |
| Leviton | Illumatech | IPI06 | 100 | 4.1 | PASS |
| Leviton | Sureslide | 6631-LW | 100 | 0.6 | PASS |
| Leviton | Sureslide | 6613-PL | 100 | 7.1 | PASS |
| Lutron | Skylark | S-603PG (1) | 81 | 6 | PASS |
| Lutron | Diva | DVCL-153PR | 95.4 | 1.2 | PASS |
| Lutron | Ariadni | AY-600P-AL | 100 | 10.7 | PASS |
| Lutron | Maestro | MRF2-600M-WH | 96.2 | 3 | PASS |
| Lutron | Skylark | S-600P-AL | 98.2 | 4.5 | PASS |
| Lutron | Diva | DV-600P-WH | 98.2 | 5.8 | PASS |
| Lutron | Nova | N-600 | 100 | 5.6 | PASS |
| Lutron | Skylark | SLV-600-WH | 100 | 8 | PASS |
| Lutron | Glyder | GLV-600-WH | 100 | 3.8 | PASS |

*Note (1): All models exhibit limited range with this dimmer*

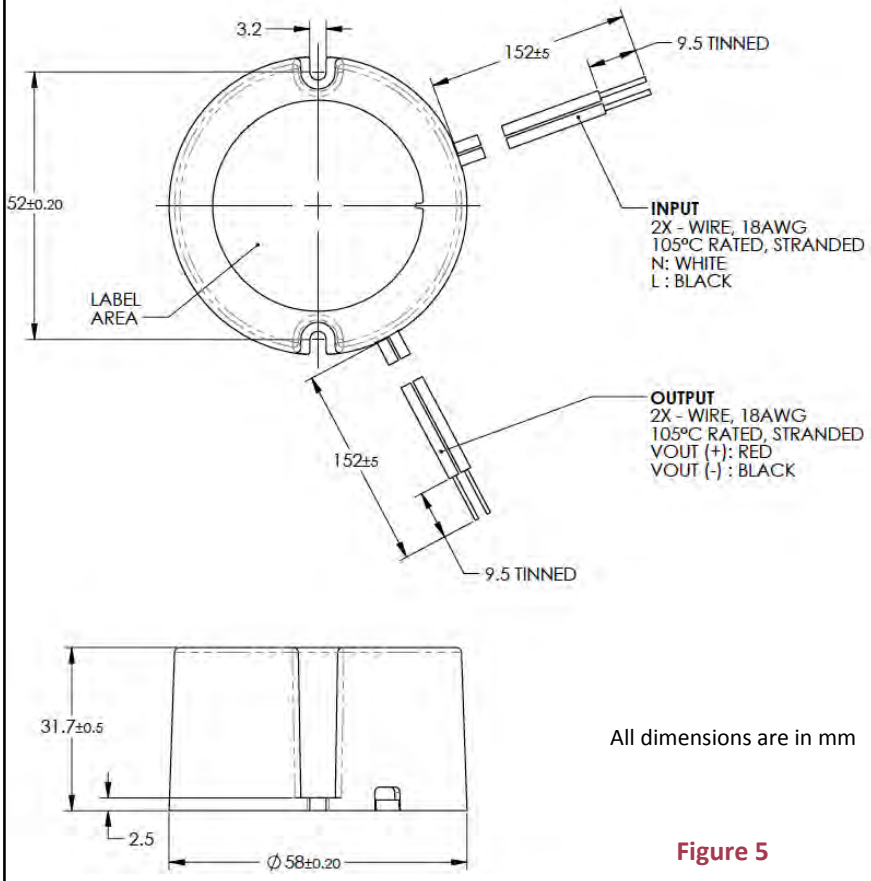
# Constant Current LED Drivers with Deep TRIAC/ELV Dimming (1 - 100%) and with Fast Startup Time

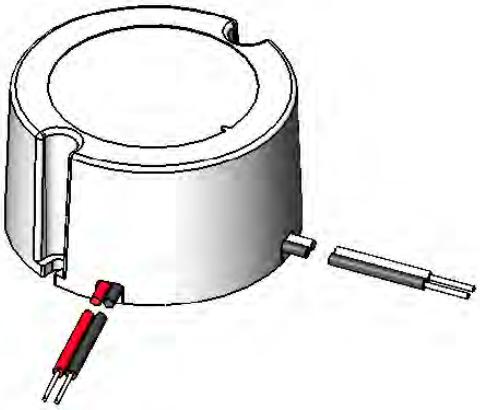
## 9 - MECHANICAL DETAILS

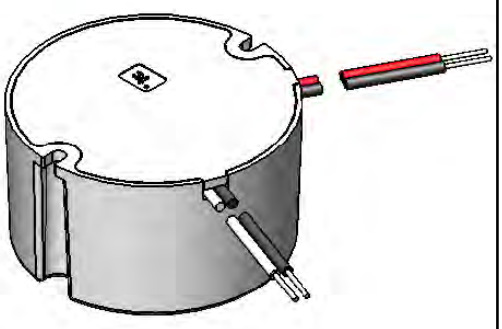
**Packaging Options:** Plastic case
**I/O Connections:** Flying leads, 18 AWG on power leads, 152 mm (6 in) long, 105°C rated, stranded, stripped by approximately 9.5mm, and tinned. All the wires, on both input and output, have a 300 V insulation rating.
**Ingress Protection:** IP20 rated. Only models in the EBR020 (16-20 W power range) have potting.
**Flammability Rating:** UL94 V-0 (5VA available upon request)

## 10 - OUTLINE DRAWINGS

**Dimensions:** Diameter: 58 mm (2.6 in), Height: 31.7 mm (1.25 in)
**Volume:** 83.7 $cm^3$ (5.1 $in^3$)
**Weight:** 170.5 g (6 oz)








All dimensions are in mm

**Figure 5**

# Constant Current LED Drivers with Deep TRIAC/ELV Dimming (1 - 100%) and with Fast Startup Time

## 11 - ORDERING INFORMATION - MODEL DESCRIPTION

EBR□□□□-□□□□-□□

**Series**
- 010 (6 - 10 W)
- 015 (11 - 15 W)
- 020 (16 - 21 W)

**Nominal Vin**
- U (120 Vac)
- E (230 Vac)

**Iout**

**Vout Max.**

| | ERP Part Number | Nominal Input Voltage (Vac) | Iout (mA) | Max Output Power (W) | Vout Min (Vdc) | Vout Nom (Vdc) | Vout Max (Vdc) | No Load Voltage (Vdc) |
|---|---|---|---|---|---|---|---|---|
| 120 VAC NOMINAL INPUT VOLTAGE | **EBR010U: 8 to 10 W** | | | | | | | |
| | EBR010U-0200-42 | 120 | 200 | 8.4 | 30 | 37.8 | 42 | 50 |
| | EBR010U-0250-42 | 120 | 250 | 10.5 | 30 | 37.8 | 42 | 50 |
| | EBR010U-0440-24 | 120 | 440 | 10.6 | 16 | 21.6 | 24 | 31.2 |
| | **EBR015U: 11 to 15 W** | | | | | | | |
| | EBR015U-0285-42 | 120 | 285 | 12.0 | 30 | 37.8 | 42 | 50 |
| | EBR015U-0300-42 | 120 | 300 | 12.6 | 30 | 37.8 | 42 | 50 |
| | EBR015U-0350-32 | 120 | 350 | 11.2 | 21 | 28.8 | 32 | 41.6 |
| | EBR015U-0350-42 | 120 | 350 | 14.7 | 30 | 37.8 | 42 | 50 |
| | EBR015U-0400-32 | 120 | 400 | 12.8 | 21 | 28.8 | 32 | 41.6 |
| | EBR015U-0440-36 | 120 | 440 | 15.8 | 24 | 32.4 | 36 | 46.8 |
| | **EBR020U: 16 to 21 W** | | | | | | | |
| | EBR020U-0400-42 | 120 | 400 | 16.8 | 30 | 37.8 | 42 | 50 |
| | EBR020U-0460-42 | 120 | 460 | 19.3 | 30 | 37.8 | 42 | 50 |
| | EBR020U-0500-32 | 120 | 500 | 16.0 | 21 | 28.8 | 32 | 41.6 |
| | EBR020U-0500-37 | 120 | 500 | 18.5 | 25 | 32.4 | 37 | 46.8 |
| | EBR020U-0500-42 | 120 | 500 | 21.0 | 30 | 37.8 | 42 | 50 |
| | EBR020U-0700-24 | 120 | 700 | 16.8 | 16 | 21.6 | 24 | 31.2 |
| | EBR020U-0700-30 | 120 | 700 | 21.0 | 20 | 27.0 | 30 | 35 |
| 230 VAC NOMINAL INPUT VOLTAGE | **EBR010E: 8 to 10 W** | | | | | | | |
| | EBR010E-0200-42 | 220/230/240 | 200 | 8.4 | 30 | 37.8 | 42 | 50 |
| | EBR010E-0250-42 | 220/230/240 | 250 | 10.5 | 30 | 37.8 | 42 | 50 |
| | EBR010E-0440-24 | 220/230/240 | 440 | 10.6 | 16 | 21.6 | 24 | 31.2 |
| | **EBR015E: 11 to 15 W** | | | | | | | |
| | EBR015E-0285-42 | 220/230/240 | 285 | 12.0 | 30 | 37.8 | 42 | 50 |
| | EBR015E-0300-42 | 220/230/240 | 300 | 12.6 | 30 | 37.8 | 42 | 50 |
| | EBR015E-0350-42 | 220/230/240 | 350 | 14.7 | 30 | 37.8 | 42 | 50 |
| | EBR015E-0350-32 | 220/230/240 | 350 | 11.2 | 21 | 28.8 | 32 | 41.6 |
| | EBR015E-0440-36 | 220/230/240 | 440 | 15.8 | 24 | 32.4 | 36 | 46.8 |
| | **EBR020E: 16 to 21 W** | | | | | | | |
| | EBR020E-0380-42 | 220/230/240 | 380 | 16.0 | 30 | 37.8 | 42 | 50 |
| | EBR020E-0400-42 | 220/230/240 | 400 | 16.8 | 30 | 37.8 | 42 | 50 |
| | EBR020E-0500-32 | 220/230/240 | 500 | 16.0 | 21 | 28.8 | 32 | 41.6 |
| | EBR020E-0500-37 | 220/230/240 | 500 | 18.5 | 25 | 33.3 | 37 | 48 |
| | EBR020E-0500-42 | 220/230/240 | 500 | 21.0 | 30 | 37.8 | 42 | 50 |
| | EBR020E-0700-24 | 220/230/240 | 700 | 16.8 | 16 | 21.6 | 24 | 31.2 |
| | EBR020E-0700-30 | 220/230/240 | 700 | 21.0 | 20 | 27.0 | 30 | 35 |

*For additional options of output current and output voltage, contact your sales representative or send an email to: SaveEnergy@ERPPowerLLC.com*

# Constant Current LED Drivers with Deep TRIAC/ELV Dimming (1 - 100%) and with Fast Startup Time

## 12 - LABELING

The EBR020E-0700-30 is used in figure 6 as an example to illustrate a typical label.

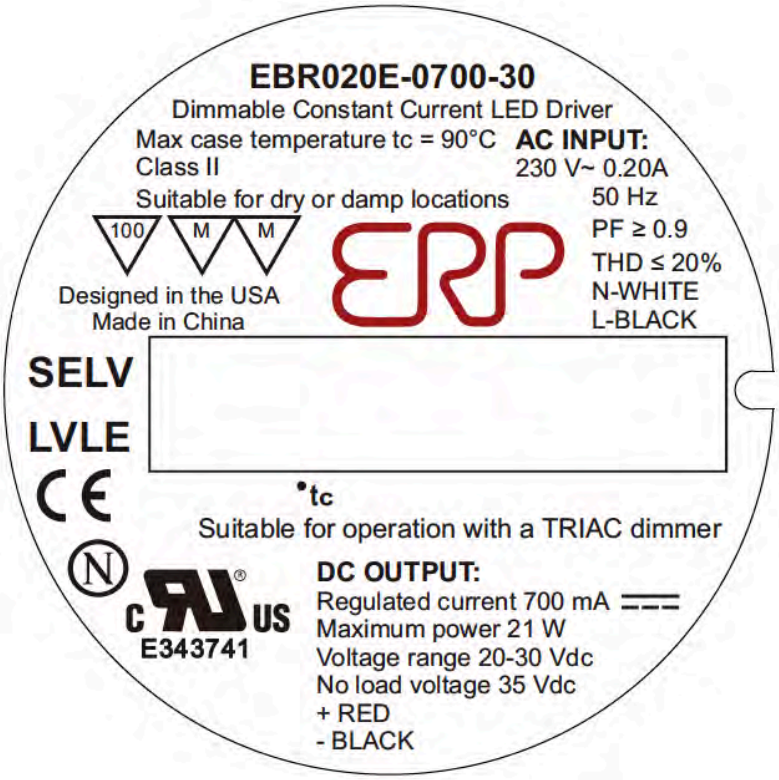



Figure 6

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