ENERGY RECOVERY PRODUCTS™

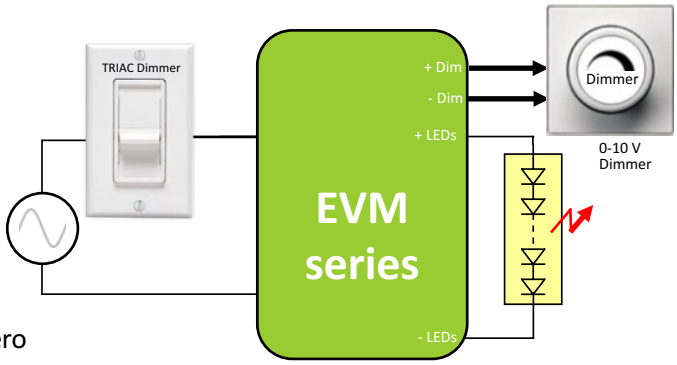
EVM Series

60-120 W

Tri-Mode Dimming (0-10 V & TRIAC/ELV) Constant Current LED Drivers with Deep Dimming

Input Voltage	Max. Output Power	Output Voltage	Output Current	Efficiency	Max. Case Temperature	THD	Power Factor	Dimming Method	Dimming Range	Startup Time
90 to 305 Vac maximum	120 W	30 to 84 Vdc	1.05 to 3 A CC	≥ 87% typical	90°C (measured at the hot spot)	< 20%	> 0.9	Forward-Phase, Reverse-Phase & 0 - 10V	1 - 100% (% of Iout)	400 ms

CC: Constant Current



APPLICATION DIAGRAM

FEATURES

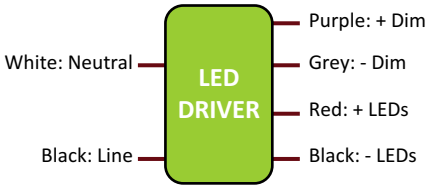
- Compatible with TRIAC (forward-phase or leading-edge) / ELV (reverse-phase or trailing-edge) and 0-10 V dimmers
- Forward-phase and reverse-phase dimming only at 120 Vac
- Outdoor surge protection: 3 kV line to line/6 kV line to earth
- Linear 0-10V dimming transfer function: 10V=100%, 1V=10%, 0.1V=1%
- Optional "remote off" function causes the output current to zero when the dimming wires are shorted with each other.
- 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 (120 Vac)/Class A (277 Vac) and EN55015 (CISPR 15) at 220/230/240 Vac
- Enables ENERGY STAR® and DLC (DesignLight Consortium®) luminaire compliance
- IP20-rated Bottom Leads with Studs metal case with silicone-based potting. Optional IP64 metal case with side leads
- Lifetime: 50,000 hours
- 90° C maximum case hot spot temperature
- Class 2 power supply (only some models)
- Double-insulated power supply between input and output (class II)
- Worldwide safety approvals



METAL CASE
L 144 x W 70 x H 40 mm
(L 5.67 x W 2.76 x H 1.57 in)

APPLICATIONS

- High Bay Lights
- Metal Halide replacement
- Outdoor LED Lighting
- Industrial LED Lighting
- Tunnels and street lighting
- Wide-area downlights
- Suitable for driving high current COB LEDs such as Cree's CXA3050/3070/3590, Bridgelux' Vero series and modules such as Cree's LMH2 6000/8000



WIRING DIAGRAM

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Tri-Mode Dimming (0-10 V & TRIAC/ELV) Constant Current LED Drivers with Deep Dimming

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

	Units	Minimum	Typical	Maximum	Notes
AC Line Input Voltage Range (Vin)	Vac	90	120/220/230/ 240/277	305	The rated output current for each model is achieved at Vin ≥ 108 Vac and at Vin ≥ 198 Vac, at nominal load.
Input Frequency Range	Hz	47	60 / 50	63	
Power Factor (PF)		0.9	> 0.9		At nominal input voltage
Inrush Current	A	Meets NEMA-410 requirements			At any point on the sine wave and 25°C
Leakage Current	µA			250 µA @ 120 Vac 500 µA @ 230 Vac 600 µA @ 277 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 load •Complies with DLC (DesignLight Consortium) technical requirements
Efficiency			87% 89%	-	•At 120 Vac •At 277 Vac
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	30		84.0	See ordering information for details
Output Current (Iout)	A	1.05		3	•See ordering information for details •The rated output current for each model is achieved at Vin ≥ 108 Vac and at Vin ≥ 198 Vac, at nominal load.
Output Current Regulation	%	-5	±2.5	+5	Includes AC line voltage, load, and current set point variations
Output Current Overshoot	%	-	-	10	The driver does not operate outside of the regulation requirements for more than 500 ms during power on with nominal LED load and without dimmer.
Ripple Current	< 25% peak-to-peak of rated output current				•Measured at nominal LED voltage and nominal input voltage without dimming. •Calculated 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		400		With nominal LED voltage and without dimmer attached
			500		With nominal LED voltage, with an approved dimmer attached (see list of approved dimmers in page 5) and at the full dimming conduction angle

Output Controls	
+Dim, -Dim	A dimming input can be used to adjust the output setting via a standard commercial wall dimmer, an external control voltage source (0 to 10 Vdc), or a variable resistor when using the recommended number of LEDs. The dimming input permits 1% to 100% dimming.

Tri-Mode Dimming (0-10 V & TRIAC/ELV) Constant Current LED Drivers with Deep Dimming

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 11)
Storage Temperature	°C	-40		85	
Humidity	%	5	-	95	Non-condensing
Cooling	Convection cooled				
Acoustic Noise	dBA			22	Measured at a distance of 1 foot (30 cm) 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)	50,000 hours at 70°C maximum case hot spot temperature (see hot spot •tc on label in page 11)				

4 - EMC COMPLIANCE AND SAFETY

EMC Compliance			
Conducted and Radiated EMI		•FCC CFR Title 47 Part 15 Class B at 120 Vac and Class A at 277 Vac, •EN55015 (CISPR 15) compliant at 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	± 3 kV line to line (differential mode) /± 6 kV line to common mode ground (tested to secondary ground) on on AC power port, ±0.5 kV for outdoor cables
	Conducted RF Disturbances	IEC61000-4-6	3 V, 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	
CE	IEC61347-2-13 electronic control gear for LED Modules	

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

Tri-Mode Dimming (0-10 V & TRIAC/ELV) Constant Current LED Drivers with Deep Dimming

5 - PROTECTION FEATURES

Under-Voltage (Brownout)
The EVM 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 EVM 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 EVM 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.

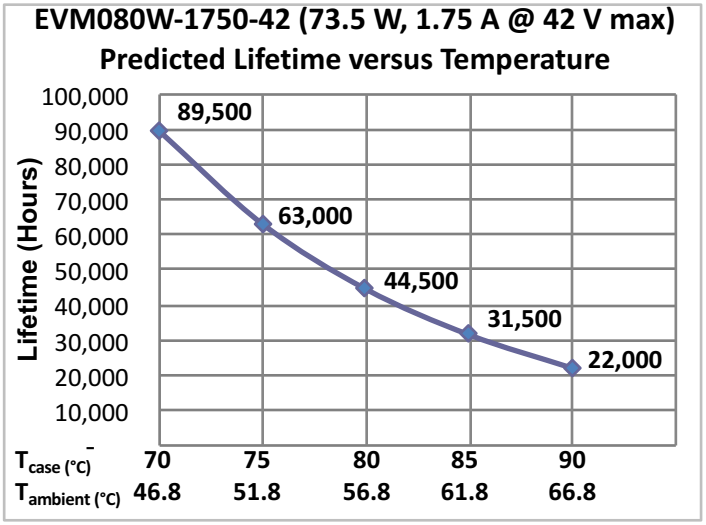
Output Open Load
When the LED load is removed, the output voltage of the EVM series is limited to 1.3 times the maximum output voltage of each model.

Tri-Mode Dimming (0-10 V & TRIAC/ELV) Constant Current LED Drivers with Deep Dimming

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 graphs in figure 1 are determined by the electrolytic capacitor with the shortest lifetime, among all electrolytic capacitors. They represent a worst case scenario in which the LED driver is powered 24 hours/day, 7 days/week. 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



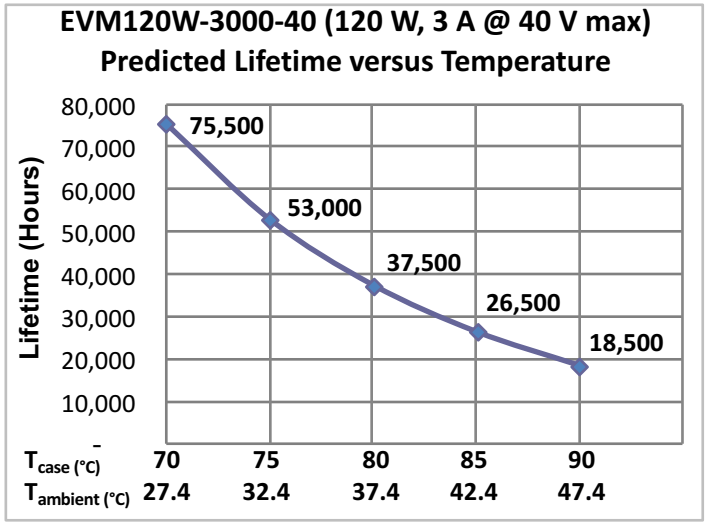
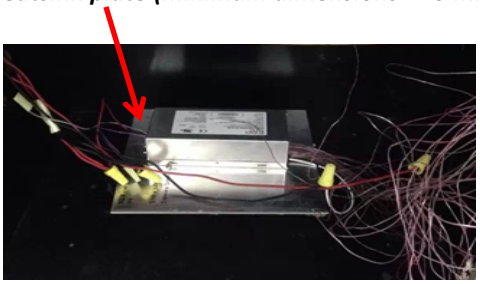


Figure 1

Notes:

- *The ambient temperature $T_{ambient}$ and the differential between $T_{ambient}$ and T_{case} mentioned in the above graphs are relevant only as long as both the driver and the light fixture are exposed to the same ambient room temperature. If the LED driver is used in an enclosure or covered by insulation material, then the ambient room temperature is no longer valid. In this situation, please refer only to the case temperature T_{case}.*
- *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.*
- ***For EVM models ≥ 90 W, the driver must be mounted flush on a flat aluminum heatsink plate (minimum dimensions 210 mm x 200 mm x 2 mm) to ensure adequate thermal derating and life performance.***



Tri-Mode Dimming (0-10 V & TRIAC/ELV) Constant Current LED Drivers with Deep Dimming

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 2, 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 3 shows the typical output current versus conduction angle at nominal input voltage.

Forward-phase (TRIAC) and reverse-phase (ELV) dimming are only working at 120 Vac.

The EVM series offers dual dimming compatibility with both phase-cut (reverse-phase and forward-phase) and 0–10V dimmers. Phase-cut dimming always has priority over 0-10 V dimming.

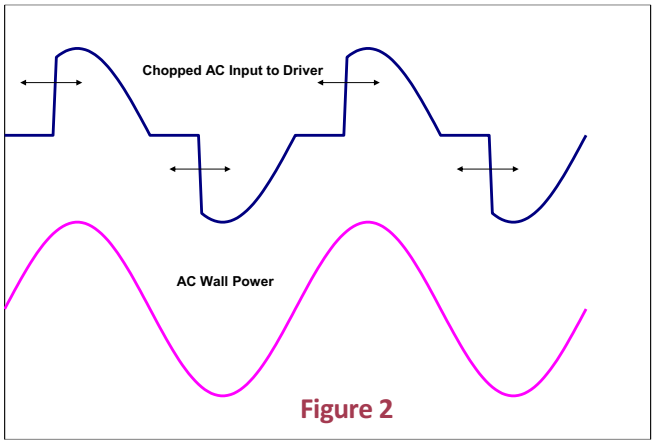


Figure 2

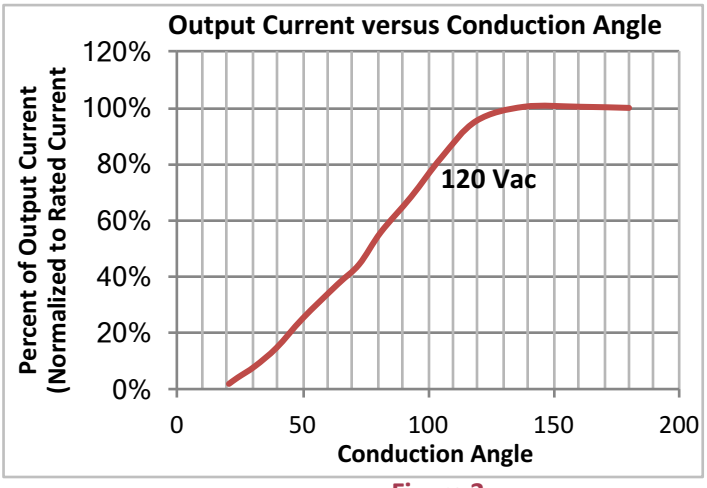


Figure 3

8 - COMPATIBLE PHASE-CUT DIMMERS & DIMMING RANGE

120Vac Dimmers					
Mfg.	**Model**	**Mfg.**	**Model**	**Mfg.**	**Model**
Lutron	S-603PG	**Lutron**	DVELV-303P	**Lutron**	CT-103P
Leviton	IPI06-1LZ	**Lutron**	SELV-300P	**Cooper**	SLC03P
Leviton	6631-2	**Leviton**	6683-IW	**Leviton**	IPE04
Lutron	DVCL-153P	**Leviton**	6161	**Lutron**	MAELV-600
Lutron	DV-600P	**Leviton**	6633-P	**Lutron**	FAELV-500
Lutron	TGCL-153P	**Lutron**	TG-600P	**Lightolier**	ZP260QEW
Lutron	S-600P	**Cooper**	DLC03P	**Cooper**	DAL06P
Leviton	VPE06	**Lutron**	LG-600P		

Dimming compatibility charts are available for each model in the EVM series. Please contact your sales representative or send an email to: SaveEnergy@ERPPowerLLC.com.

Tri-Mode Dimming (0-10 V & TRIAC/ELV) Constant Current LED Drivers with Deep Dimming

9 - 0-10 V DIMMING

The EVM drivers operate only with 0-10V dimmers that sink current. They are not designed to operate with 0-10V control systems that source current, as used in theatrical/entertainment systems. Developed in the 1980's, the 0-10V sinking current control method is adopted by the International Electrotechnical Commission (IEC) as apart of their IEC Standard 60929 Annex E.

The method to dim the output current of the driver is done via the +Dim/-Dim Signal pins. The +Dim/-Dim Signal pins respond to a 0 to 10 V signal, delivering 1% to 100% of the output current based on rated current for each model. A pull-up resistor is included internal to the driver. When the +Dim input (purple) is short circuited to the –Dim wire (grey) or to the –LED wire (black), there is no output current. When the +Dim input (purple) is ≤ 1 V, the output current is programmed to ≤ 10% of rated current. If the +Dim input is >10V or open circuited, the output current is programmed to 100% of the rated current.
When not used, the –Dim wire (grey) and to the +Dim wire (purple) can be capped or cut off. In this configuration, no dimming is possible and the driver delivers 100% of its rated output current.

The maximum source current (flowing from the driver to the 0-10V dimmer) supplied by the +Dim Signal pin is < 1 mA. The tolerance of the output current while being dimmed shall be +/-8% typical until down to 2V.

There are two 0-10V dimming transfer functions available, a linear curve where 10V = 100% of the output current and 1V = 10% of the output current (seen in figure 4) or a non-linear curve where the 9V = 100% of the output current and 1V = 1% of the output current (seen in figure 5). The linear curve is used across all the models of the EVM series. The non-linear curve is available as an option.
The non-linear curve is recommended when using standard in wall 0-10V logarithmic dimmers to avoid having insufficient source current available to pull the dimmer up to 10V and to account for the inability of the dimmer to pull below approximately 0.9V. In these types of installations, the modified transfer function will ensure 100% light output and dimming to 1%, regardless of the number of drivers on the 0-10V dimming line. Please contact your sales representative or send an email to SaveEnergy@ERPPowerLLC.com for additional information on the non-linear curve.

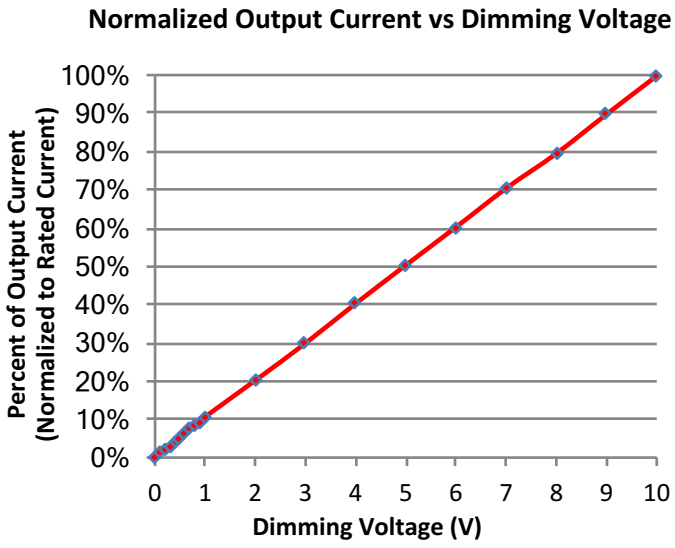


Figure 4

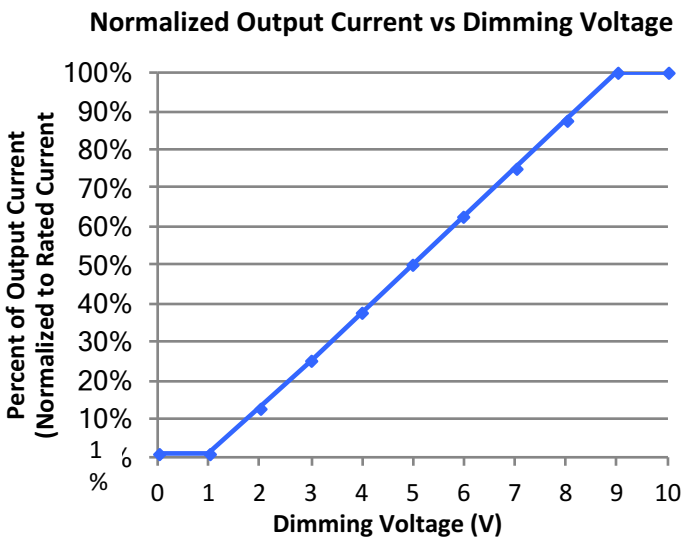


Figure 5

Tri-Mode Dimming (0-10 V & TRIAC/ELV) Constant Current LED Drivers with Deep Dimming

9 - 0-10 V DIMMING (CONTINUED)

A fixed or variable resistor can be also used from the dimming input to the return to adjust the output current. Figure 6 show the relationship of the output current to a resistor connected across the 0-10V dimming input

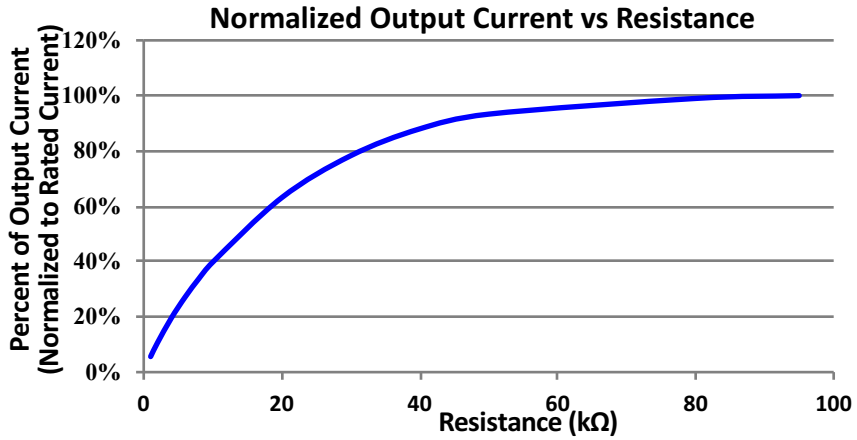


Figure 6

10 - COMPATIBLE 0-10 V DIMMERS

- Lutron, Nova series (part number NFTV)
- Lutron, Diva series (part number DVTV)
- Leviton, IllumaTech series (part number IP710-DL)

11 – REMOTE OFF FUNCTION

The EVM series includes an optional ”remote off” function which enables to switch off the output current and output voltage when the purple and grey 0-10V dimming wires are shorted with each other.

Tri-Mode Dimming (0-10 V & TRIAC/ELV) Constant Current LED Drivers with Deep Dimming

12 - MECHANICAL DETAILS

Packaging Options: Metal case

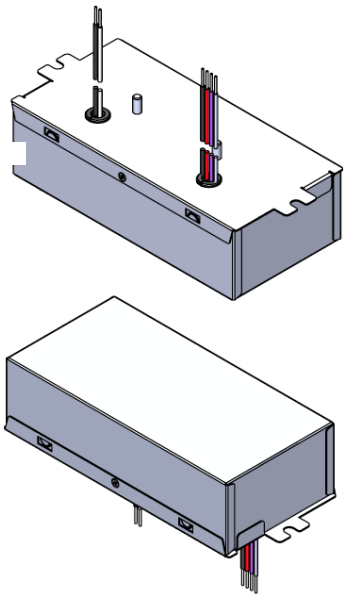
I/O Connections: Flying leads, 18 AWG on power leads, 22 AWG on 0-10V dimming wires, 203 mm (8") long, 105°C rated, double insulated stranded, stripped by approximately 9.5mm and tinned. All the wires, on both input and output, have a 300 V insulation rating. Input wires have double insulation.

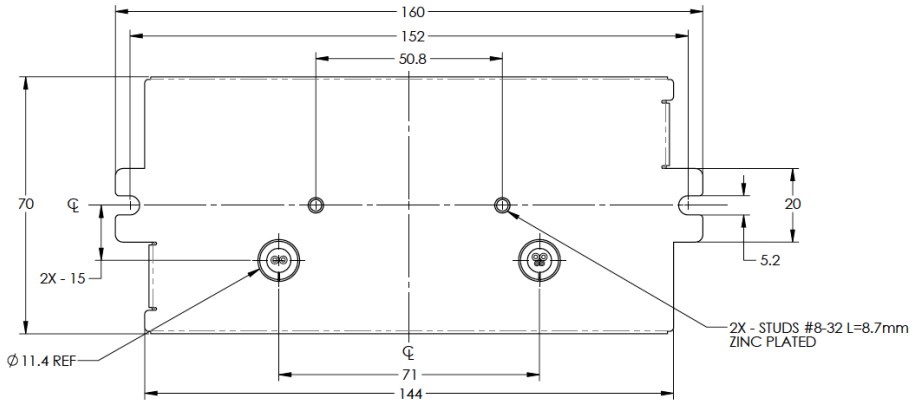
Ingress Protection: IP20 rated (IP64 for optional metal case with side leads)

13 - OUTLINE DRAWINGS

Dimensions: L 144 x W 70 x H 40 mm (L 5.66 x W 2.76 x H 1.57 in)

Volume: 403.2 cm^3 (24.6 in^3)





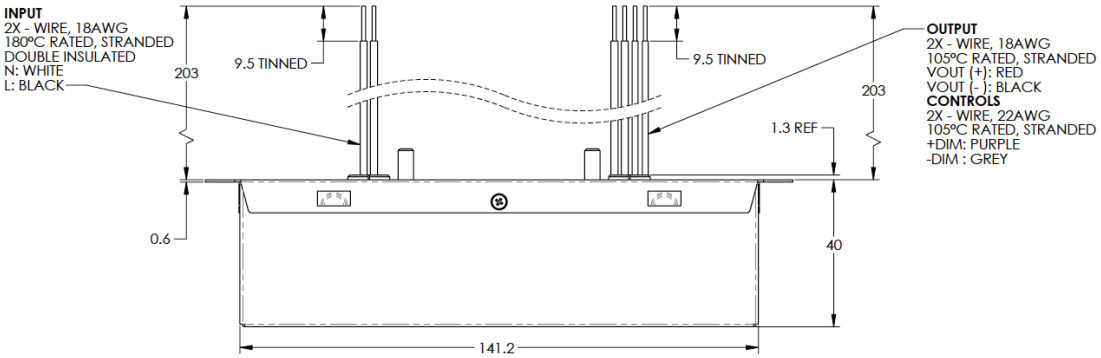


Figure 7

All dimensions are in mm

Tri-Mode Dimming (0-10 V & TRIAC/ELV) Constant Current LED Drivers with Deep Dimming

14 - ORDERING INFORMATION - MODEL DESCRIPTION

EVM□□□□–□□□□–□□–□□□

Series	Nominal Vin	Iout	Vout Max.	Optional features
• 080 (70 - 80 W) • 090 (81 - 90 W) • etc…	• W (120 to 277 Vac)			

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)	Comments
EVM060W: up to 60W								
EVM060W-1400-42-C0B	120 - 277	1400	58.8	30	37.8	42	50	Non-linear 0-10V dimming profile (10V to 8.1V=100%, 1V to 0.08V=1%)
EVM080W: 71-80W								
EVM080W-1750-42	120 - 277	1750	73.5	30	37.8	42	50	
EVM080W-1900-42	120 - 277	1900	79.8	30	37.8	42	50	
EVM090W: 81-90W								
EVM090W-1050-84[1]	120 - 277	1050	88.2	70	75.6	84	100	
EVM090W-1700-48-N1B[2]	120 - 277	1700	81.6	37	43.2	48	60	Customized 0-10V dimming profile (10V=100%, 1V=1%) and Remote Off function (Iout=0 when 0-10V dimming wires are shorted)
EVM090W-2000-42	120 - 277	2000	84.0	30	37.8	42	50	
EVM100W: 91-100W								
EVM100W-1200-80[1]	120 - 277	1200	96.0	66	72	80	104	
EVM100W-1200-84[1]	120 - 277	1200	100.8	70	75.6	84	100	
EVM100W-2100-45	120 - 277	2100	94.5	32	40.5	45	58.5	
EVM110W: 101-110W								
EVM110W-2000-52-N1B[1][3]	120 - 277	2000	104.0	40	46.8	52	60	Customized 0-10V dimming profile (10V=100%, 1V=1%) and Remote Off function (Iout=0 when 0-10V dimming wires are shorted)
EVM110W-2500-42[1]	120 - 277	2500	105.0	30	37.8	42	50	
EVM120W: 111-120W								
EVM120W-2700-42[1]	120 - 277	2700	113.4	30	37.8	42	50	
EVM120W-3000-40[1]	120 - 277	3000	120.0	30	37.8	40	50	

Notes:

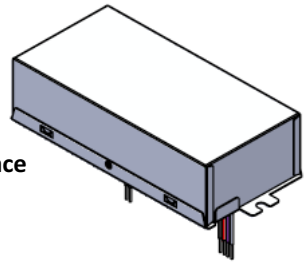
- *(1) Not class 2.*
- *(2)The EVM090W-1700-48-N1B is specifically intended to drive the Cree LMH2 6000 module and exhibits a customized 0-10V dimming transfer function.*
- *(3) The EVM110W-2000-52-N1B is specifically intended to drive the Cree LMH2 8000 module and exhibits a customized 0-10V dimming transfer function.*
- *For additional options of output current and output voltage, contact your sales representative or send an email to: SaveEnergy@ERPPowerLLC.com*

Tri-Mode Dimming (0-10 V & TRIAC/ELV) Constant Current LED Drivers with Deep Dimming

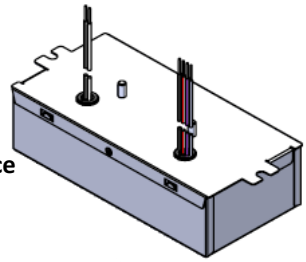
15 - LABELING

The EVM090W-1700-48 is used in figures 8 & 9 as an example to illustrate a typical label.

Top Face



Bottom Face



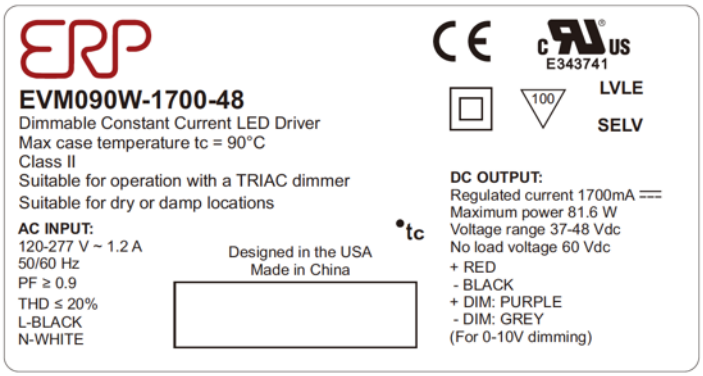


Figure 8

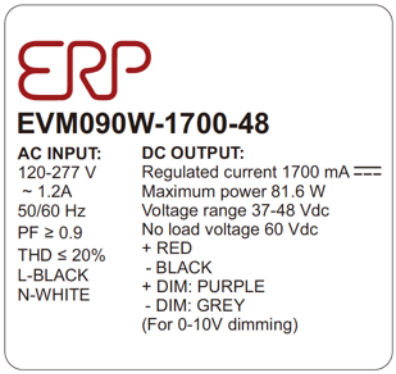


Figure 9

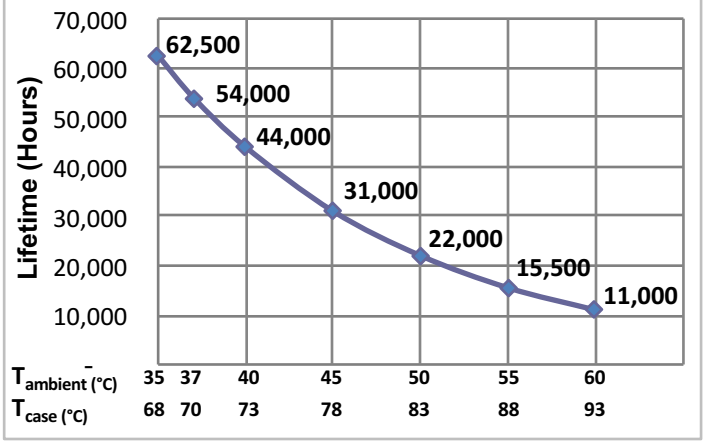
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Tri-Mode Dimming (0-10 V & TRIAC/ELV) Constant Current LED Drivers with Deep Dimming

EVM110W-2000-52-N1B (104 W, 2 A @ 52 V max)
Predicted Lifetime versus Temperature



EVM110W-2500-42 (105 W, 2.5 A @ 42 V max)
Predicted Lifetime versus Temperature

