ENERGY RECOVERY PRODUCTS™

ESS010 3-10 W
ESS015 11-15 W
ESS020 16-20 W
ESS030 21-30 W
ESS040 31-40 W

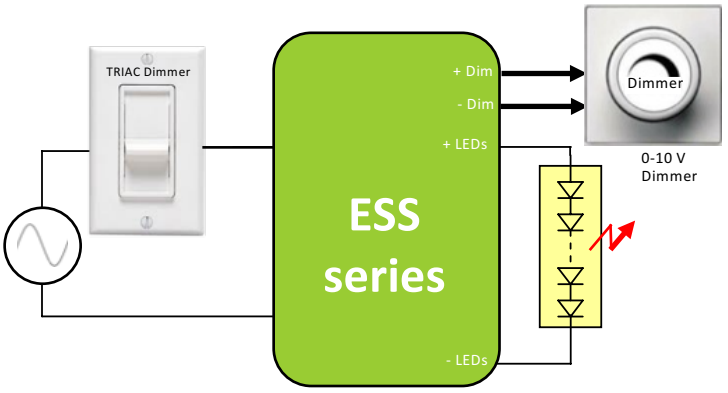
Tri-Mode Dimming (0-10 V & TRIAC/ELV) Constant Current LED Drivers with Fast Startup Time

Nominal Input Voltage	Max. Output Power	Output Voltage	Output Current	Efficiency	Max. Case Temperature	THD	Power Factor	Dimming Method	Dimming Range	Startup Time
120 to 277 Vac, 220 to 240 Vac	40 W	6 to 56 Vdc	250 mA to 2.1 A CC	≥ 87% typical	90°C (measured at the hot spot)	< 20%	> 0.9	Forward-Phase, Reverse-Phase & 0 - 10V	1 - 100% (% of Iout)	300 ms

CC: Constant Current

PRODUCT DESCRIPTION

The ESS series of LED drivers is ideally suited for LED lighting applications in office, commercial and residential. These devices are compatible with most industry standard phase-cut wall-based dimmers, both forward-phase (leading-edge) and reverse-phase (trailing edge), and 0-10V wall-based dimmers and offer deep dimming from 100% down to 1%.



TYPICAL APPLICATION DIAGRAM

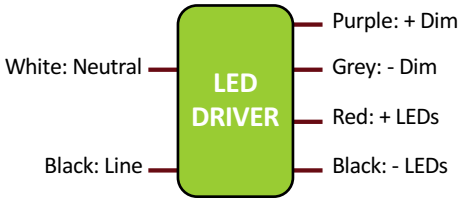
FEATURES

- Compatible with TRIAC (forward-phase or leading-edge), ELV (reverse-phase or trailing-edge) and 0-10 V dimmers
- ESSxxxW models: TRIAC and ELV dimming only at 120 Vac.
- ESSxxxE models: ELV dimming only at 230 Vac.
- Linear 0-10V dimming transfer function: 10V=100%, 1V=10%, 0.1V=1%
- Lifetime: 109,000 hours at 70° C case hot spot temperature (57° C ambient temperature) for ESS030W-0620-42 (26 W)
- 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
- IP64-rated case with silicone-based potting
- 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:
L 84 x W 40 x H 25 mm (L 3.30 x W 1.57 x H 0.99 in)

APPLICATIONS

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



WIRING DIAGRAM

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

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

	Units	Minimum	Typical	Maximum	Notes
Input Voltage Range (Vin) - ESSxxxW models - ESSxxxE models	Vac	90 180	120 230	305 264	•The rated output current for each model is achieved at Vin≥108 Vac & at Vin≥198 Vac for ESSxxxW models, and at Vin≥209 Vac for ESSxxxE models. •At nominal load.
Input Frequency Range - ESSxxxW - ESSxxxE	Hz	47 47	60 50	63 53	
Power Factor (PF)		0.9	> 0.9		•At nominal input voltage and with nominal LED voltage •For derivative models < 10W, PF ≥ 0.8 at 277 Vac only •For derivative models < 5W, PF ≥ 0.7 at 277 Vac only
Inrush Current	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 voltage •Complies with DLC (DesignLight Consortium) technical requirements
Efficiency	%	-	87%	-	Measured with nominal input voltage, a full sinusoidal wave form and without dimmer connected. Models in the ESS010 and ESS015 have a nominal efficiency of 85%.
Isolation	Meets UL60950-1 for class II reinforced/double insulation power supply ☐				

2 - OUTPUT SPECIFICATION (@25° C ambient

	Units	Minimum	Typical	Maximum	Notes
Output Voltage (Vout)	Vdc	6		56	See ordering information for details
Output Current (Iout)	mA	250		1100	•See ordering information for details •The rated output current for each model is achieved at Vin≥108 Vac & at Vin≥198 Vac for ESSxxxW models, and at Vin≥209 Vac for ESSxxxE models.
Output Current Regulation	%	-5	±2.5	5	• At nominal AC line voltage • Includes 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	≤ 40% of rated output current for each model				•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		300		With nominal LED voltage and without dimmer attached
			400		With nominal LED voltage, with an approved dimmer attached (see list of approved dimmers in page 7) and at the full dimming conduction angle

Output Controls	
+Dim Signal, -Dim Signal	The +Dim/-Dim signal pins 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 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 12)
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	109,000 hours for ESS030W-0620-42 (26 W) at 70°C maximum case hot spot temperature (see hot spot •tc on label in page 12). See details in section 6.				

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	± 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, Class 2	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 Fast Startup Time

5 - PROTECTION FEATURES

Under-Voltage (Brownout)

The ESS 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 ESS 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 ESS 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

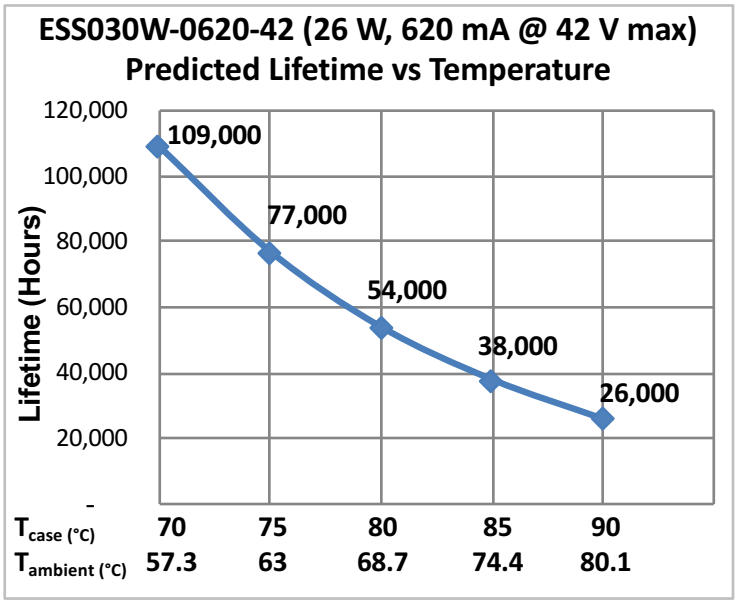
When the LED load is removed, the output voltage of the ESS series is limited to 1.3 times the maximum output voltage of each model.

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

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 & 1bis are determined by the electrolytic capacitor with the shortest lifetime, among all electrolytic capacitors. It represents 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



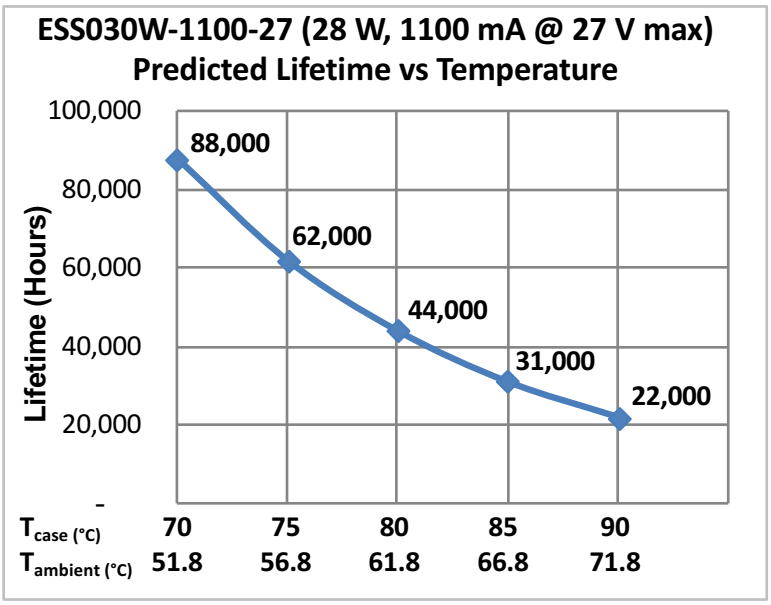


Figure 1

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 housed 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.*

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

6 - PREDICTED LIFETIME VERSUS CASE AND AMBIENT TEMPERATURE (CONTINUED)

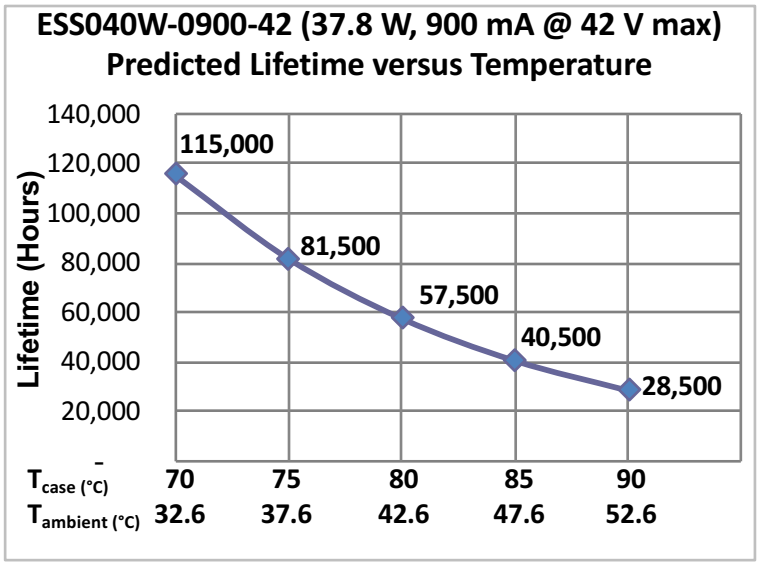


Figure 1 bis

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 housed 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.*

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

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 working only at 120 Vac.

The ESS series offers 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.

When using low power ESS 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.

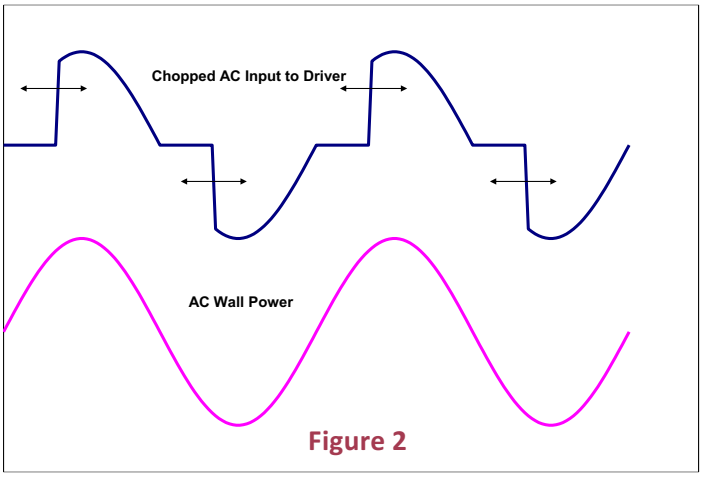


Figure 2

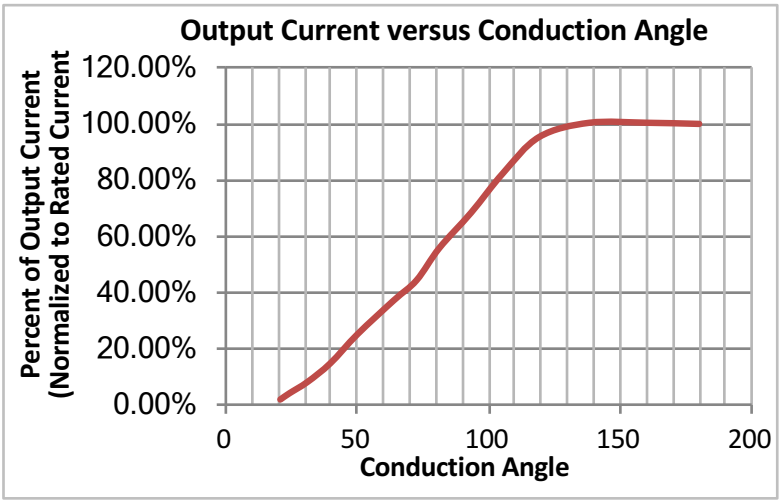


Figure 3

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 ESS 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 Fast Startup Time

9 - 0-10 V DIMMING

The ESS 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), a small amount of current may be present on the output and, in that condition, shimmering may be observed. If the +Dim input is ≤ 1 V and ≥ 0.6 V, the output current is still present, as shown in figure 4.
If the +Dim input is > 10 V 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 individually 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 2 V.

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 the all the models of the ESS series. The non-linear curve is available as an option.
The non-linear curve is recommended when using standard in wall 0-10 V 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 type 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.

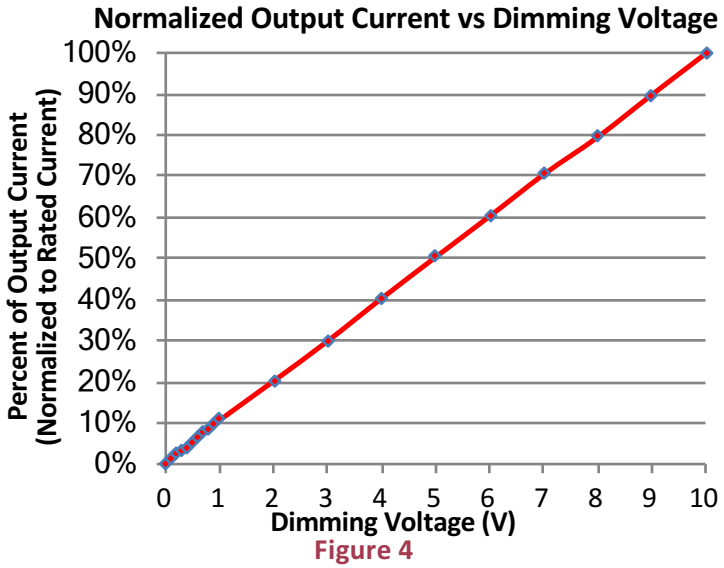


Figure 4

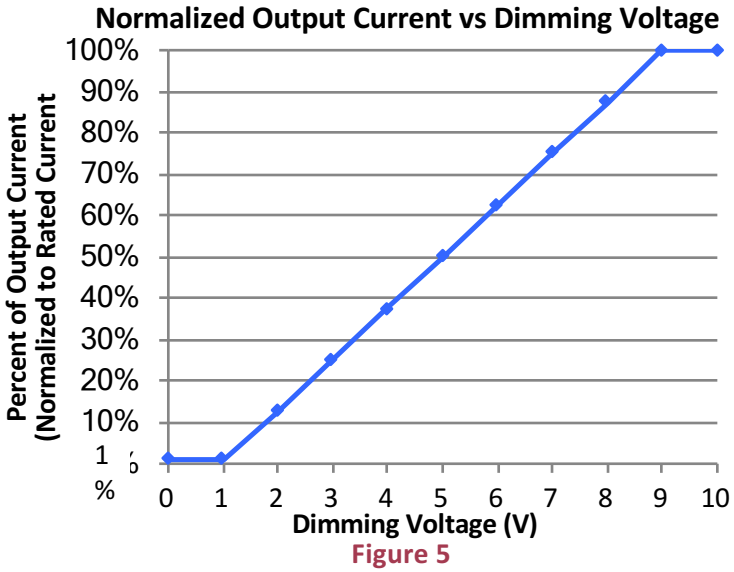


Figure 5

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

9 - 0-10 V DIMMING (CONTINUED)

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

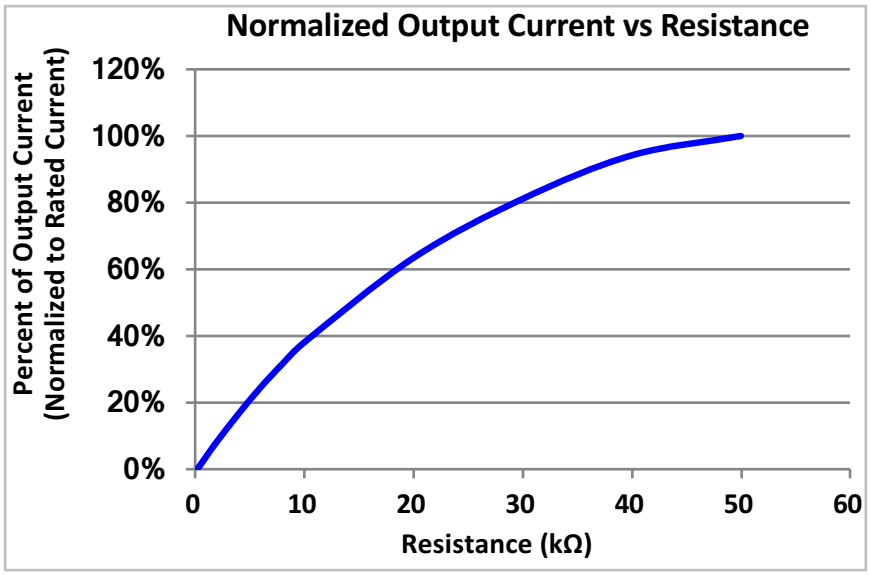


Figure 6

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)

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

11 - MECHANICAL DETAILS

Packaging Options: Plastic case

I/O Connections: Flying leads, 18 AWG on power leads, 22 AWG on 0-10V dimming wires, 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: IP64 rated

Flammability Rating: UL94 V-0 (5VA available upon request. Please contact your sales representative or send an email to: SaveEnergy@ERPPowerLLC.com).

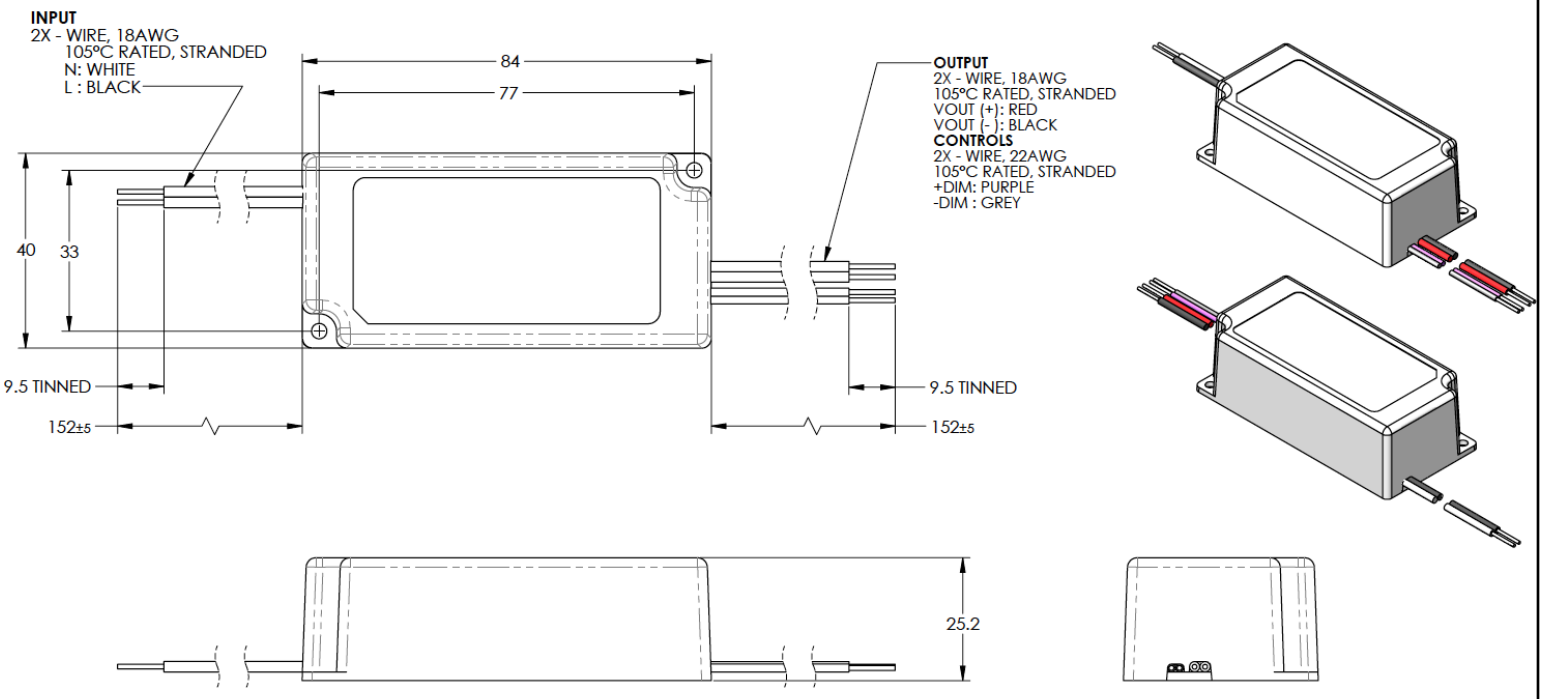
Mounting Instructions: The ESS driver case must be secured on a flat surface through the two mounting tabs, shown here below in the case outline drawings.

12 - OUTLINE DRAWINGS

Dimensions: L 84 x W 40 x H 25.2 mm (L 3.30 x W 1.57 x H 0.99 in)

Volume: 84.7 cm^3 (5.16 in^3)

Weight: 154 g (5.4 oz)



All dimensions are in mm

Figure 7

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

13 - ORDERING INFORMATION, MODEL DESCRIPTION

ESS□□□□-□□□□-□□

Series
- 010 (3 - 10 W)
- 015 (11 - 15 W)
- 020 (16 - 20 W)
- 030 (21 - 30 W)
- 040 (31 - 40 W)

Nominal Vin
- W (120 to 277 Vac)

Iout (mA)

Vout Max. (Vdc)

120-277 VAC NOMINAL INPUT VOLTAGE

Ordering Part Number	Input Voltage Range (Vac)	Iout (mA)	Max Output Power (W)	Vout min (Vdc)	Vout Nom (Vdc)	Vout Max (Vdc)	No Load Voltage (Vdc)
ESS010W: up to 10 W							
ESS010W-0180-42	120 to 277	180	7.6	28	37.8	42	50
ESS010W-0200-42	120 to 277	200	8.4	28	37.8	42	50
ESS010W-0250-42	120 to 277	250	10.5	28	37.8	42	50
ESS010W-0350-24	120 to 277	350	8.4	14	22	24	31.2
ESS010W-0500-12	120 to 277	500	6.0	6	10.8	12	16
ESS010W-0750-12	120 to 277	750	9.0	6	10.8	12	16
ESS015W: 11 to 15 W							
ESS015W-0300-42	120 to 277	300	12.6	28	37.8	42	50
ESS015W-0350-32	120 to 277	350	11.2	21	28.8	32	41.6
ESS015W-0400-32	120 to 277	400	12.8	21	28.8	32	41.6
ESS015W-0350-42	120 to 277	350	14.7	28	37.8	42	50
ESS015W-0440-25	120 to 277	440	11.0	19	22.5	25	32.5
ESS015W-0440-34	120 to 277	440	15.0	24	30.6	34	44.2
ESS015W-0700-18	120 to 277	700	12.6	10	16.2	18	25
ESS015W-1000-12	120 to 277	1000	12.0	6	10.8	12	16
ESS015W-1050-14	120 to 277	1050	14.7	8	12.6	14	18.2
ESS020W: 16 to 20 W							
ESS020W-0350-56	120 to 277	350	19.6	40	50	56	60
ESS020W-0400-42	120 to 277	400	16.8	28	37.8	42	50
ESS020W-0450-42	120 to 277	450	18.9	28	37.8	42	50
ESS020W-0500-32	120 to 277	500	16.0	21	28.8	32	41.6
ESS020W-0600-27	120 to 277	600	16.2	20	24.3	27	35
ESS020W-0700-24	120 to 277	700	16.8	14	22	24	31.2
ESS020W-1400-14	120 to 277	1400	19.6	8	12.6	14	18.2
ESS030W: 21 to 30 W							
ESS030W-0500-42	120 to 277	500	21.0	28	37.8	42	50
ESS030W-0550-42	120 to 277	550	23.1	28	37.8	42	50
ESS030W-0620-42	120 to 277	620	26.0	28	37.8	42	50
ESS030W-0700-32	120 to 277	700	22.4	21	28.8	32	41.6
ESS030W-0700-42	120 to 277	700	29.4	28	37.8	42	50
ESS030W-0900-27	120 to 277	900	24.3	20	24.3	27	35
ESS030W-0900-32	120 to 277	900	28.8	21	28.8	32	41.6
ESS030W-1050-27	120 to 277	1050	28.4	20	24.3	27	35
ESS030W-1100-27	120 to 277	1100	29.7	20	24.3	27	35
ESS030W-1750-14	120 to 277	1750	24.5	8	12.6	14	18.2
ESS030W-2100-14	120 to 277	2100	29.4	8	12.6	14	18.2
ESS040W: 31 to 40 W							
ESS040W-0800-42	120 to 277	800	33.6	28	37.8	42	50
ESS040W-0900-42	120 to 277	900	37.8	28	37.8	42	50
ESS040W-1400-24	120 to 277	1400	33.6	14	22	24	31.2
ESS040W-1400-27	120 to 277	1400	37.8	20	24.3	27	35

220-240 VAC NOMINAL INPUT VOLTAGE

Ordering Part Number	Input Voltage Range (Vac)	Iout (mA)	Max Output Power (W)	Vout min (Vdc)	Vout Nom (Vdc)	Vout Max (Vdc)	No Load Voltage (Vdc)
ESS010E: 11 to 10 W							
ESS010E-0250-42	220/230/240	250	10.5	24	37.8	42	50
ESS015E: 11 to 15 W							
ESS015E-0350-42	220/230/240	350	14.7	24	37.8	42	50
ESS020E: 16 to 20 W							
ESS020E-0400-42	220/230/240	400	16.8	24	37.8	42	50
ESS020E-0450-42	220/230/240	450	18.9	24	37.8	42	50
ESS030E: 21 to 30 W							
ESS030E-0500-42	220/230/240	500	21.0	24	37.8	42	50
ESS030E-0620-42	220/230/240	620	26.0	24	37.8	42	50
ESS030E-0700-42	220/230/240	700	29.4	24	37.8	42	50
ESS040E: 31 to 40 W							
ESS040E-0800-42	220/230/240	800	33.6	24	37.8	42	50
ESS040E-0900-42	220/230/240	900	37.8	24	37.8	42	50

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 Fast Startup Time

14 - LABELING

The ESS030W-0500-42 is used in figure 8 as an example to illustrate a typical label.

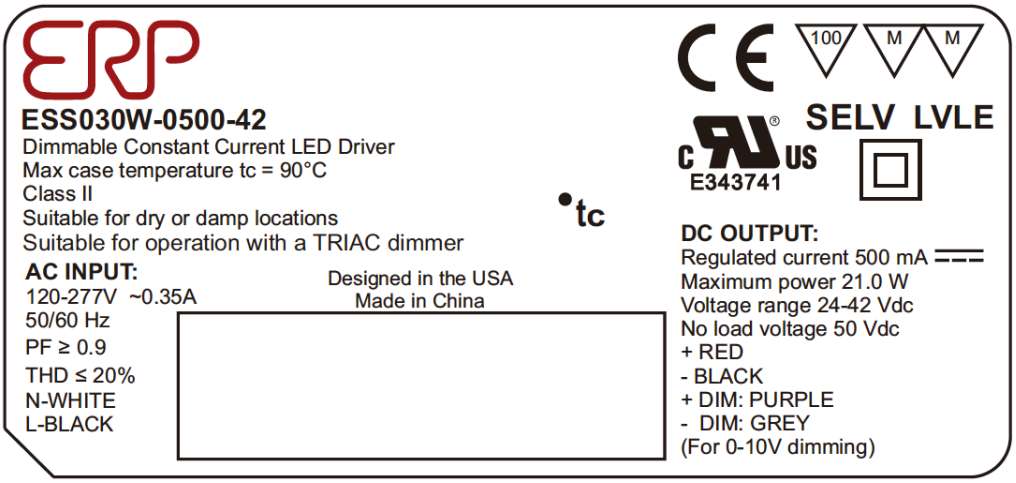


Figure 8

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Moorpark, CA 93021, USA

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