Features

- Full Power at Wide Output Current Range (Constant Power)
- Adjustable Output Current (AOC) with NFC
- DALI-2 and D4i Certified
- 3-Timer-Modes Dimmable
- Dim-to-Off
- Dimming range: 5%-100%
- Always-on Auxiliary Power: 24Vdc,125mA,3W (Transient Peak Power up to 10W)
- Integrated 16Vdc Bus Power Supply based on DALI-2
- Integrated Power Monitoring with High Accuracy up to ±1%
- Low Inrush Current
- Output Lumen Compensation
- End-of-Life Indicator
- Thermal Sensing and Protection for LED Module
- Input Surge Protection: DM 6kV, CM 10kV
- All-Around Protection: IUVP, IOVP, OVP, SCP, OTP
- IP66/IP67 and UL Dry/Damp/Wet Location
- TYPE HL, for use in a Class I, Division 2 Hazardous (Classified) Location
- 5 Years Warranty

Description

The *ESM-480SxxxBG* series is a 480W, constant-current, NFC programmable and IP66/IP67 rated LED driver that operates from 249-528Vac input with excellent power factor. Created for intra-luminaire solutions and health monitoring applications, this family provides integrated AC power monitoring with an auxiliary voltage and dim-to-off functionality for powering low voltage, wireless controls. The dimming control supports two-way communication via DALI-2 and complies with D4i. The high efficiency of these drivers and compact metal case enables them to run cooler, significantly improving reliability and extending product life. To ensure trouble-free operation, protection is provided against input surge, input under voltage, input over voltage, output over voltage, short circuit, and over temperature.

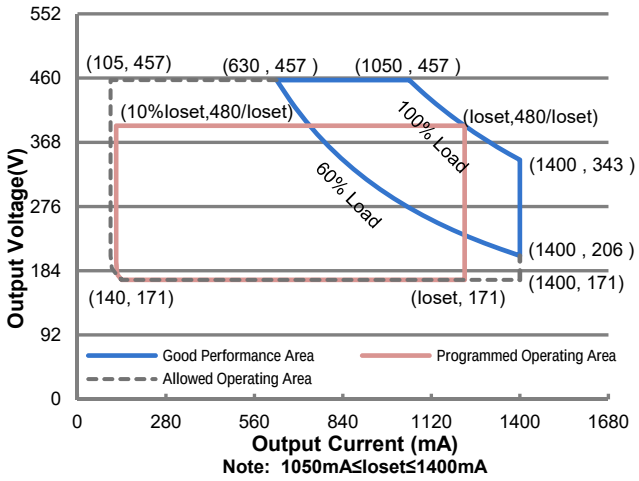
Models

Adjustable Output Current Range	Full-Power Current Range(1)	Default Output Current	Input Voltage Range(2)	Output Voltage Range	Max. Output Power	Typical Efficiency (3)	Typical Power Factor		Model Number
							277Vac	480Vac	
0.105-1.4A	1.05-1.4A	1.4 A	249~528Vac 352~500Vdc	171 ~ 457Vdc	480 W	95.0%	0.99	0.96	ESM-480S140BG
0.21-2.8A	2.1-2.8A	2.8 A	249~528Vac 352~500Vdc	86 ~ 228Vdc	480 W	95.0%	0.99	0.96	ESM-480S280BG
0.315-4.2A	3.15-4.2A	4.2 A	249~528Vac 352~500Vdc	57 ~ 152Vdc	480 W	95.0%	0.99	0.96	ESM-480S420BG
0.435-5.6A	4.35-5.6A	5.6 A	249~528Vac 352~500Vdc	43 ~ 110Vdc	480 W	94.5%	0.99	0.96	ESM-480S560BG(4)
0.86-10A	8.6-10A	10 A	249~528Vac 352~500Vdc	24 ~ 56Vdc	480 W	94.5%	0.99	0.96	ESM-480S10ABG(4)

Notes: (1) Output current range with constant power at 480W.
(2) Certified voltage range: 277-480Vac
(3) Measured at 100% load and 480Vac input (see below “General Specifications” for details).
(4) SELV output.

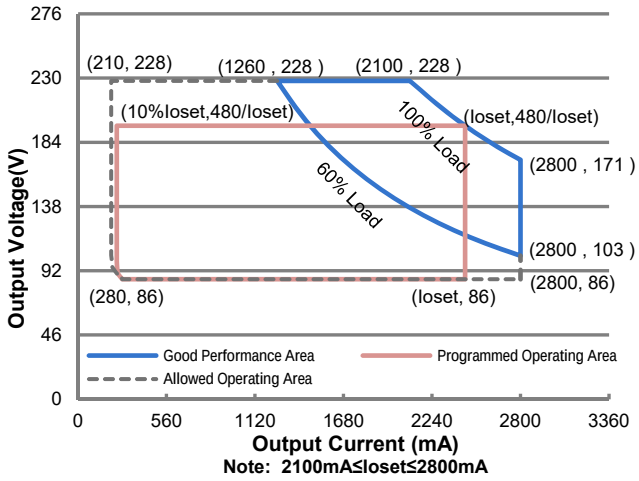
I-V Operating Area

ESM-480S140BG



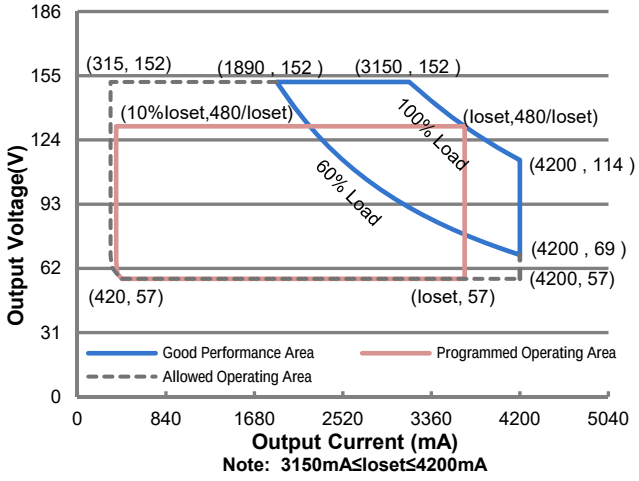
Note: 1050mA≤Ioset≤1400mA

ESM-480S280BG



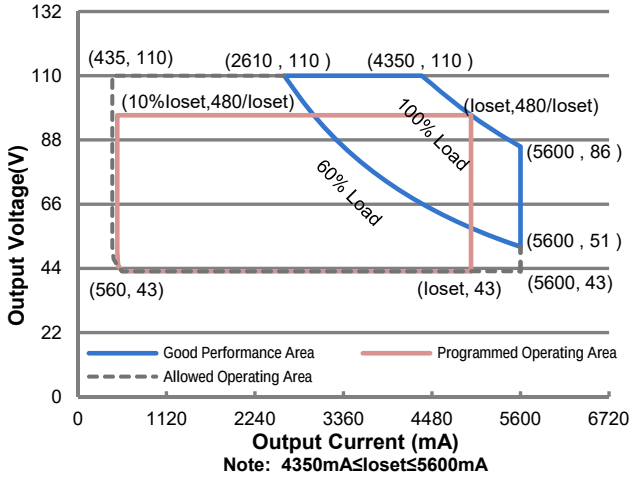
Note: 2100mA≤Ioset≤2800mA

ESM-480S420BG



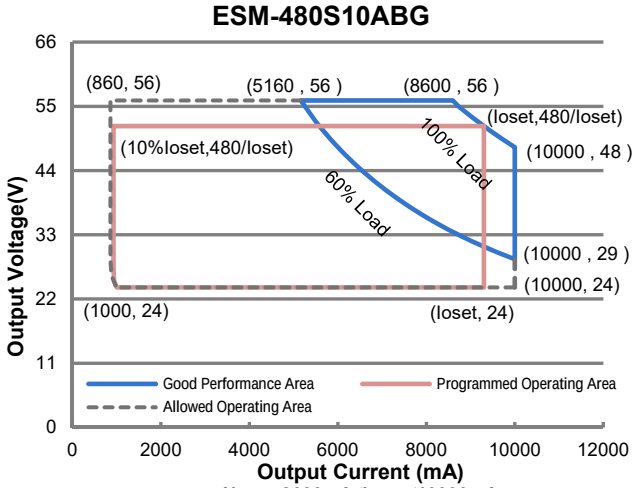
Note: 3150mA≤Ioset≤4200mA

ESM-480S560BG



Note: 4350mA≤Ioset≤5600mA

ESM-480S10ABG



Note: 8600mA≤Ioset≤10000mA

Input Specifications

Parameter	Min.	Typ.	Max.	Notes
Input AC Voltage	249 Vac	-	528 Vac	
Input DC Voltage	352 Vdc	-	500 Vdc	
Input Frequency	47Hz	-	63Hz	
Leakage Current	-	-	0.75 MIU	UL 8750; 480Vac/ 60Hz
	-	-	0.70 mA	IEC 60598-1; 480Vac/ 60Hz, grounding effectively
Input AC Current	-	-	2.07 A	Measured at 100% load and 277 Vac input.
	-	-	1.19 A	Measured at 100% load and 480 Vac input.
Inrush Current(I^2t)	-	-	1.07 A^2s	At 480Vac input, 25°C cold start, duration =4.12 ms, 10%Ipk-10%Ipk. See Inrush Current Waveform for the details.
PF	0.90	-	-	At 277-480Vac,50-60Hz,60%-100% Load (288- 480W)
THD		-	20%	

Output Specifications

Parameter	Min.	Typ.	Max.	Notes
Output Current Tolerance	-5%Ioset	-	5%Ioset	100% load
Output Current Setting (Ioset) Range				
ESM-480S140BG	105 mA	-	1400 mA	
ESM-480S280BG	210 mA	-	2800 mA	
ESM-480S420BG	315 mA	-	4200 mA	
ESM-480S560BG	435 mA	-	5600 mA	
ESM-480S10ABG	860 mA	-	10000 mA	
Output Current Setting Range with Constant Power				
ESM-480S140BG	1050 mA	-	1400 mA	
ESM-480S280BG	2100 mA	-	2800 mA	
ESM-480S420BG	3150 mA	-	4200 mA	
ESM-480S560BG	4350 mA	-	5600 mA	
ESM-480S10ABG	8600 mA	-	10000 mA	
Total Output Current Ripple (pk-pk)	-	5%Iomax	10%Iomax	100% load, 20 MHz BW
Output Current Ripple at < 200 Hz (pk-pk)	-	2%Iomax	-	100% load
Startup Overshoot Current	-	-	10%Iomax	100% load
No Load Output Voltage				
ESM-480S140BG	-	-	500 V	
ESM-480S280BG	-	-	280 V	
ESM-480S420BG	-	-	190 V	
ESM-480S560BG	-	-	120 V	
ESM-480S10ABG	-	-	60 V	
Line Regulation	-	-	±0.5%	100% load
Load Regulation	-	-	±1.5%	

Output Specifications (Continued)

Parameter	Min.	Typ.	Max.	Notes
Turn-on Delay Time	-	-	0.5 s	Measured at all dimming modes except DALI-2,and 277-480Vac input,60%-100%Load
			1.0 s	Measured at DALI-2 dimming mode, and 277-480Vac input, 60%-100% Load
Temperature Coefficient of Ioset	-	0.03%/°C	-	Case temperature = 0°C ~Tc max
24V Auxiliary Output Voltage	21.6 V	24 V	26.4 V	
24V Auxiliary Output Source Current	0 mA	-	125 mA	Return terminal is “DA−“
24V Auxiliary Output Transient Peak Current @6W	-	-	250 mA	250mA peak for a maximum duration of 2.2ms in a 6.0ms period during which time the average should not exceed 125mA.
24V Auxiliary Output Transient Peak Current @10W	-	-	425 mA	425mA peak for a maximum duration of 1.3ms in a 5.2ms period during which time the average should not exceed 125mA.
Integrated DALI-2 Bus Power Supply Voltage	12 Vdc	16 Vdc	20 Vdc	Voltage is depending on loading.
Integrated DALI-2 Bus Power Maximum Supply Current	60 mA			
Integrated DALI-2 Bus Power Guaranteed Supply Current	50 mA			DALI-2 Bus Power Supply Voltage ≥12V

Notes: (1) DALI-2 bus power supply is enabled by default and can be disabled via programming interface.
(2) DALI-2 bus power supply supports automatic shut-down and restart after short-circuit.

General Specifications

Parameter	Min.	Typ.	Max.	Notes
Efficiency at 277 Vac input:				Measured at 100% load and steady-state temperature in 25°C ambient; (Efficiency will be about 2.0% lower if measured immediately after startup.)
ESM-480S140BG				
Io= 1050 mA	91.5%	93.5%	-	
Io= 1400 mA	92.0%	94.0%	-	
ESM-480S280BG				
Io= 2100 mA	92.0%	94.0%	-	
Io= 2800 mA	92.0%	94.0%	-	
ESM-480S420BG				
Io= 3150 mA	92.0%	94.0%	-	
Io= 4200 mA	91.5%	93.5%	-	
ESM-480S560BG				
Io= 4350 mA	91.5%	93.5%	-	
Io= 5600 mA	91.5%	93.5%	-	
ESM-480S10ABG				
Io= 8600 mA	91.5%	93.5%	-	
Io= 10000 mA	91.5%	93.5%	-	

General Specifications (Continued)

Parameter	Min.	Typ.	Max.	Notes
Efficiency at 400 Vac input: ESM-480S140BG Io= 1050 mA Io= 1400 mA ESM-480S280BG Io= 2100 mA Io= 2800 mA ESM-480S420BG Io= 3150 mA Io= 4200 mA ESM-480S560BG Io= 4350 mA Io= 5600 mA ESM-480S10ABG Io= 8600 mA Io= 10000 mA	 93.0% 93.0% 93.0% 93.0% 92.5% 92.5% 92.0% 92.0% 92.5% 92.5%	 95.0% 95.0% 95.0% 95.0% 94.5% 94.5% 94.0% 94.0% 94.5% 94.5%	 - - - - - - - - - -	Measured at 100% load and steady-state temperature in 25°C ambient; (Efficiency will be about 2.0% lower if measured immediately after startup.)
Efficiency at 480 Vac input: ESM-480S140BG Io= 1050 mA Io= 1400 mA ESM-480S280BG Io= 2100 mA Io= 2800 mA ESM-480S420BG Io= 3150 mA Io= 4200 mA ESM-480S560BG Io= 4350 mA Io= 5600 mA ESM-480S10ABG Io= 8600 mA Io= 10000 mA	 93.0% 93.0% 93.0% 93.0% 93.0% 92.5% 92.5% 92.5% 92.5% 92.5%	 95.0% 95.0% 95.0% 95.0% 95.0% 94.5% 94.5% 94.5% 94.5% 94.5%	 - - - - - - - - - -	Measured at 100% load and steady-state temperature in 25°C ambient; (Efficiency will be about 2.0% lower if measured immediately after startup.)
Power Monitoring Accuracy	-1%	-	1%	Measured at 480Vac input and 100% Load
Standby Power	-	1.5 W	-	Measured at 480Vac/50Hz; Dimming off
MTBF	-	300,000 Hours	-	Measured at 480Vac input, 80%Load and 25°C ambient temperature (MIL-HDBK-217F)
Lifetime	-	100,000 Hours	-	Measured at 480Vac input, 80%Load and 70°C case temperature; See lifetime vs. Tc curve for the details
	-	50,000 Hours	-	Measured at 277Vac input, 100% Load and 40°C ambient temperature
Operating Case Temperature for Safety Tc_s	-40°C	-	+90°C	
Operating Case Temperature for Warranty Tc_w	-40°C	-	+80°C	Case temperature for 5 years warranty Humidity: 10%RH to 95%RH
Storage Temperature	-40°C	-	+85°C	Humidity: 5%RH to 95%RH
Dimensions Inches (L × W × H) Millimeters (L × W × H)	9.57 × 3.54 × 1.71 243 × 90 × 43.5			With mounting ear 10.31 × 3.54 × 1.71 262 × 90 × 43.5
Net Weight	-	2200 g	-	

Dimming Specifications

Parameter		Min.	Typ.	Max.	Notes
DA+, DA- High Level		9.5 V	16 V	22.5 V	
DA+, DA- Low Level		-6.5 V	0 V	6.5 V	
DA+, DA- Current		0 mA	-	2 mA	
Dimming Output Range with 5%-100%	ESM-480S140BG ESM-480S280BG ESM-480S420BG ESM-480S560BG ESM-480S10ABG	5%Ioset	-	Ioset	1050 mA ≤ Ioset ≤ 1400 mA 2100 mA ≤ Ioset ≤ 2800 mA 3150 mA ≤ Ioset ≤ 4200 mA 4350 mA ≤ Ioset ≤ 5600 mA 8600 mA ≤ Ioset ≤ 10000 mA
	ESM-480S140BG ESM-480S280BG ESM-480S420BG ESM-480S560BG ESM-480S10ABG	53 mA 105 mA 168 mA 218 mA 430 mA	-	Ioset	105 mA ≤ Ioset ＜ 1050 mA 210 mA ≤ Ioset ＜ 2100 mA 315 mA ≤ Ioset ＜ 3150 mA 435 mA ≤ Ioset ＜ 4350 mA 860 mA ≤ Ioset ＜ 8600 mA

Safety &EMC Compliance

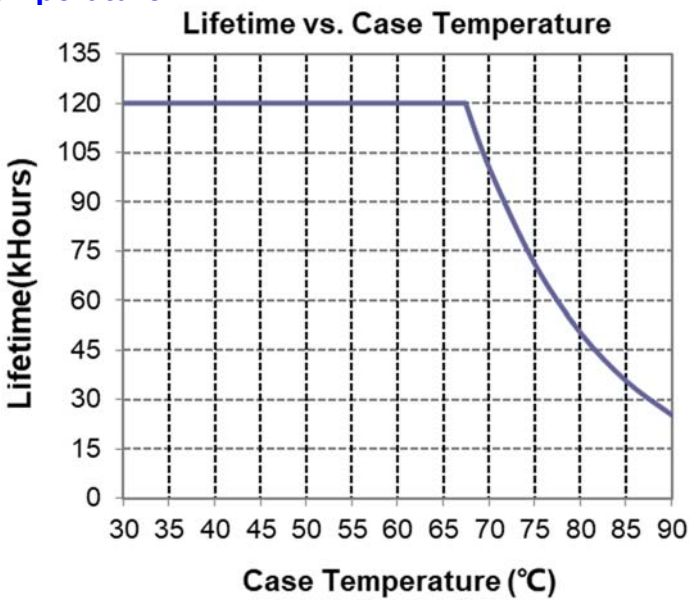
Safety Category	Standard
UL/CUL	UL 8750,CAN/CSA-C22.2 No. 250.13
ENEC	EN 61347-1, EN 61347-2-13
UKCA	BS EN 61347-1, BS EN 61347-2-13 BS EN 301 489-1 BS EN 301 489-3 BS EN 300 330 BS EN 62479/BS EN 50663/BS EN 50665/BS EN 50364
CE	EN 61347-1, EN 61347-2-13 EN 301 489-1 EN 301 489-3 EN 300 330 EN 62479/EN 50663/EN 50665/EN 50364
CB	IEC 61347-1, IEC 61347-2-13
global-mark	AS/NZS 61347.1, AS/NZS 61347.2.13
Performance	**Standard**
ENEC	EN 62384
EMI Standards	**Notes**
BS EN/EN IEC 55015(1)	Conducted emission Test &Radiated emission Test
BS EN/EN IEC 61000-3-2	Harmonic current emissions
BS EN/EN 61000-3-3	Voltage fluctuations & flicker
FCC Part 15(1)	ANSI C63.4 Class B
	This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: [1] this device may not cause harmful interference, and [2] this device must accept any interference received, including interference that may cause undesired Operation.

Safety &EMC Compliance (Continued)

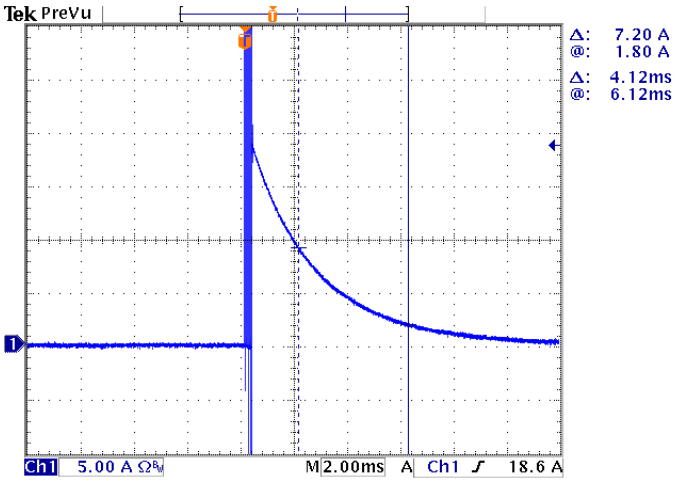
EMS Standards	Notes
BS EN/EN 61000-4-2	Electrostatic Discharge (ESD): 8 kV air discharge, 4 kV contact discharge
BS EN/EN 61000-4-3	Radio-Frequency Electromagnetic Field Susceptibility Test-RS
BS EN/EN 61000-4-4	Electrical Fast Transient / Burst-EFT
BS EN/EN 61000-4-5	Surge Immunity Test: AC Power Line: Differential Mode 6 kV, Common Mode 10 kV
BS EN/EN 61000-4-6	Conducted Radio Frequency Disturbances Test-CS
BS EN/EN 61000-4-8	Power Frequency Magnetic Field Test
BS EN/EN 61000-4-11	Voltage Dips
BS EN/EN 61547	Electromagnetic Immunity Requirements Applies To Lighting Equipment
DALI-2 Standards	**Notes**
DALI-2(2)	IEC 62386-101, -102 & -207

Notes: (1) This LED driver meets the EMI specifications above, but EMI performance of a luminaire that contains it depends also on the other devices connected to the driver and on the fixture itself.
(2) DALI parts: 101, 102, 150, 207, 250, 251, 252, 253.

Lifetime vs. Case Temperature

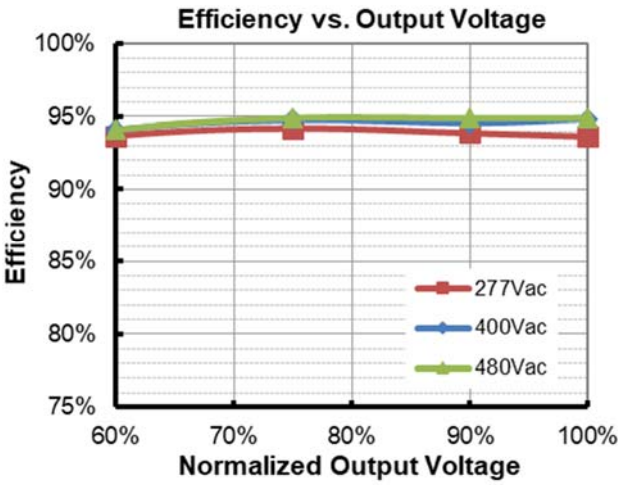


Inrush Current Waveform

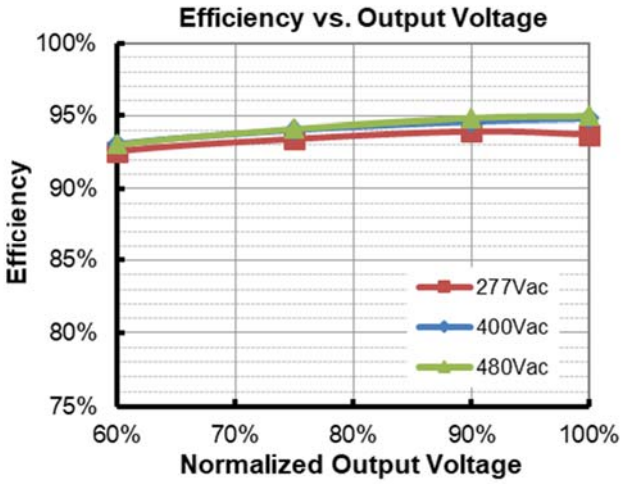


Efficiency vs. Load

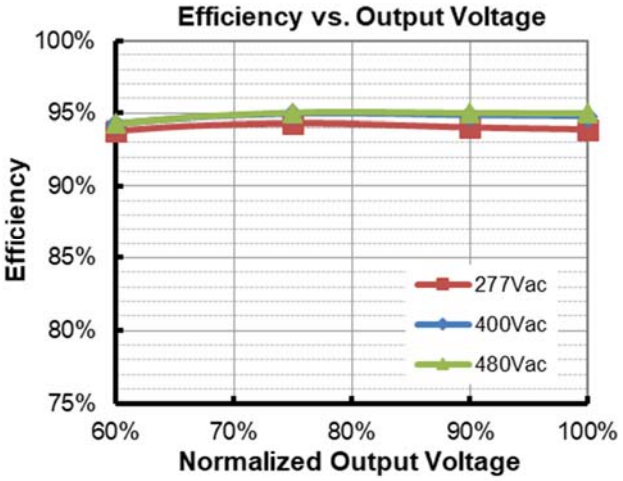
ESM-480S140BG(Io=1050mA)



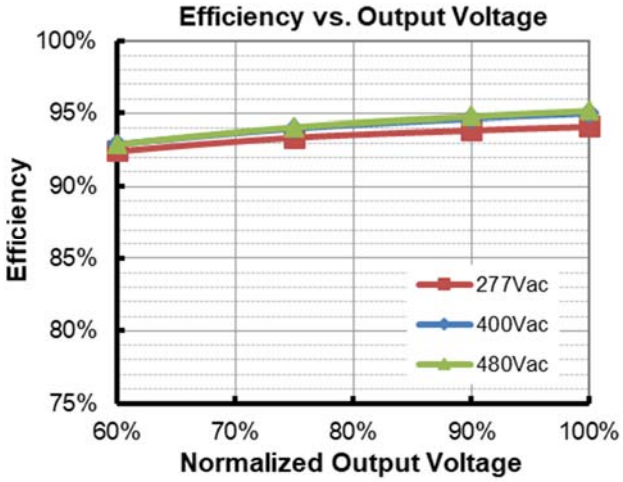
ESM-480S140BG(Io=1400mA)



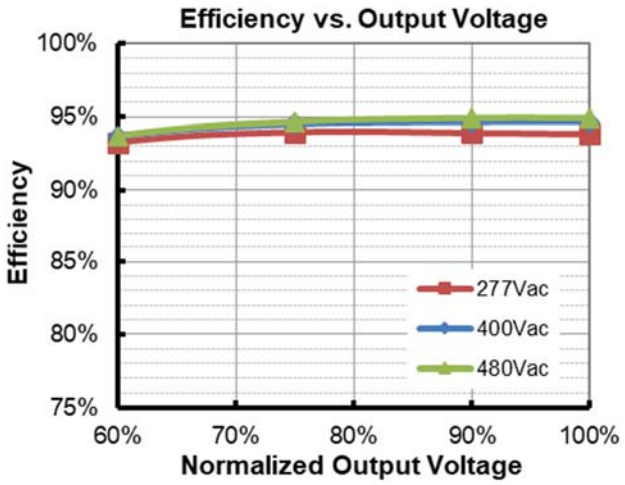
ESM-480S280BG(Io=2100mA)



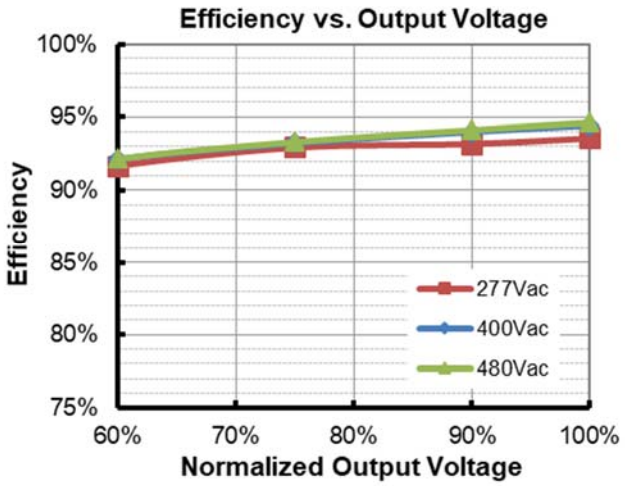
ESM-480S280BG(Io=2800mA)



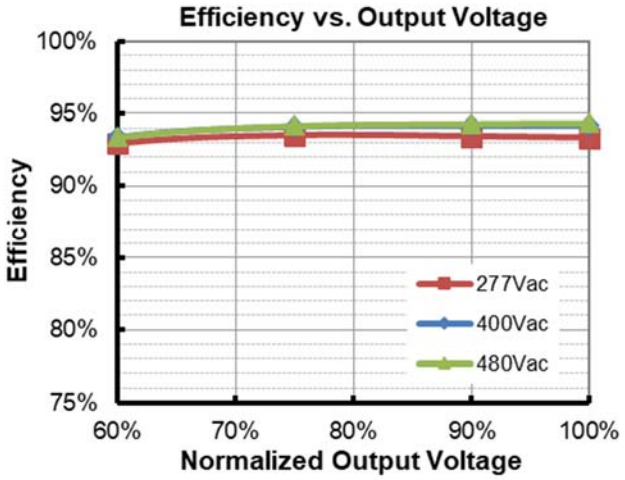
ESM-480S420BG(Io=3150mA)



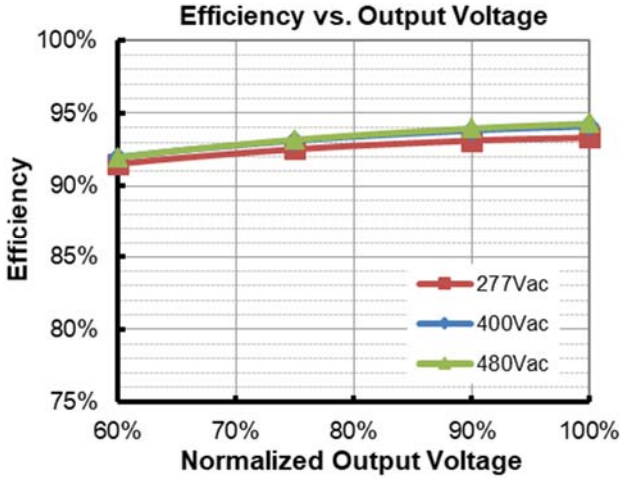
ESM-480S420BG(Io=4200mA)



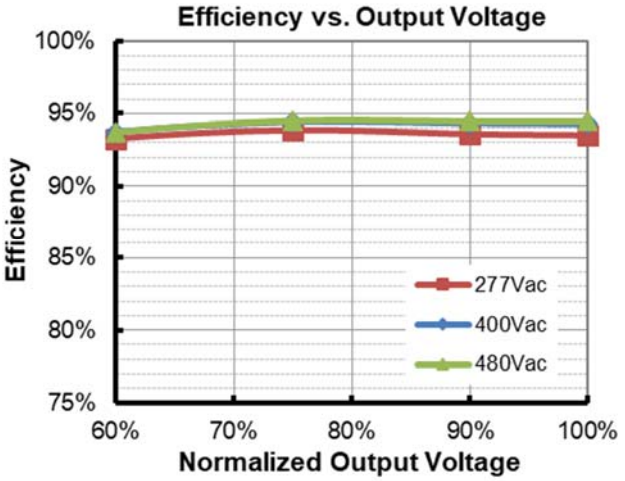
ESM-480S560BG(Io=4350mA)



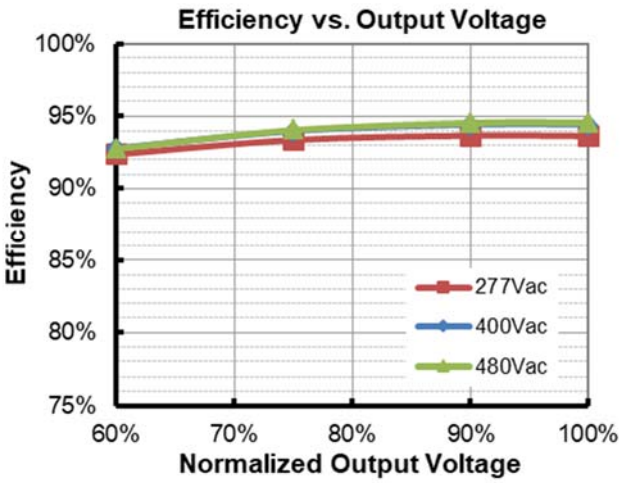
ESM-480S560BG(Io=5600mA)



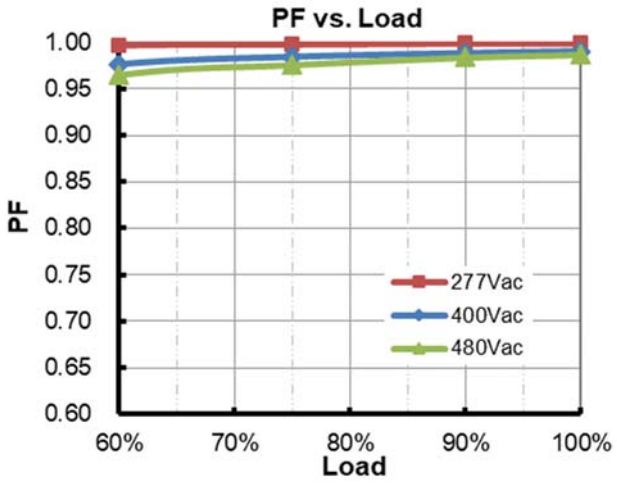
ESM-480S10ABG(Io=8600mA)



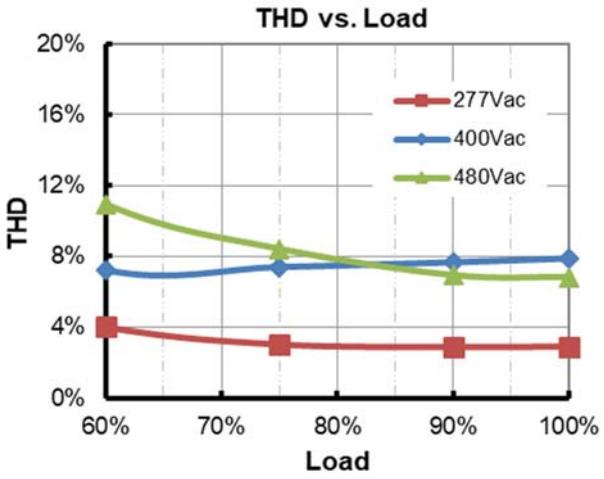
ESM-480S10ABG(Io=10000mA)



Power Factor



Total Harmonic Distortion



Protection Functions

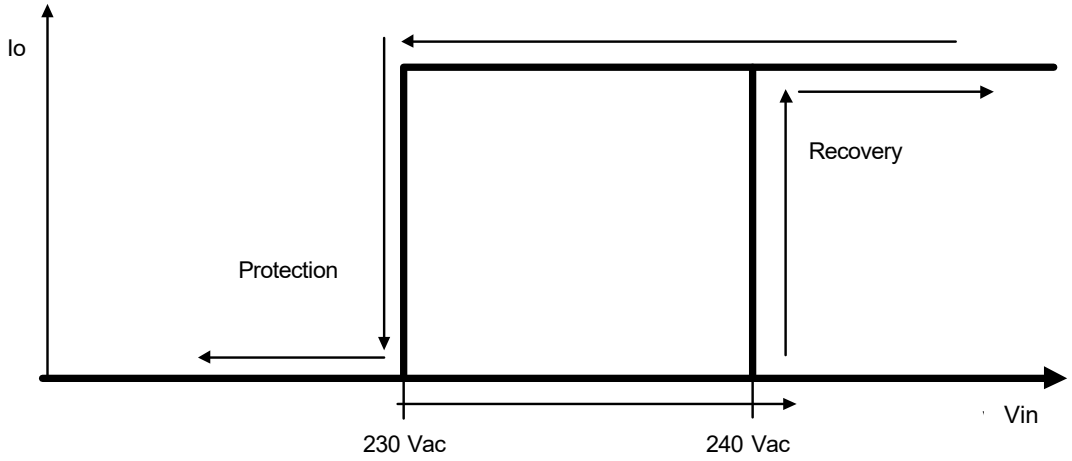
Parameter		Min.	Typ.	Max.	Notes
External Thermal Protection	R1 (Start derating)	-	1.67 kΩ	-	The output current starts to decrease linearly when the actual NTC resistance value is lower than R1, until R2 is reached.
	R2 (Stop derating)	-	1.27 kΩ	-	When the actual NTC resistance value is lower than R2, the output current will stay at the programmed Protection Current Floor.
	Protection Current Setting Range	10%Ioset	20%Ioset	100%Ioset	10%Ioset > Iomin (default setting is 20%)
		Iomin	20%Ioset	100%Ioset	10%Ioset ≤ Iomin (default setting is 20%)
Over Temperature Protection		Decreases output current, returning to normal after over temperature is removed.			
Short Circuit Protection		Auto Recovery. No damage will occur when any output is short circuited. The output shall return to normal when the fault condition is removed.			
Over Voltage Protection		Limits output voltage at no load and in case the normal voltage limit fails.			

Protection Functions (Continued)

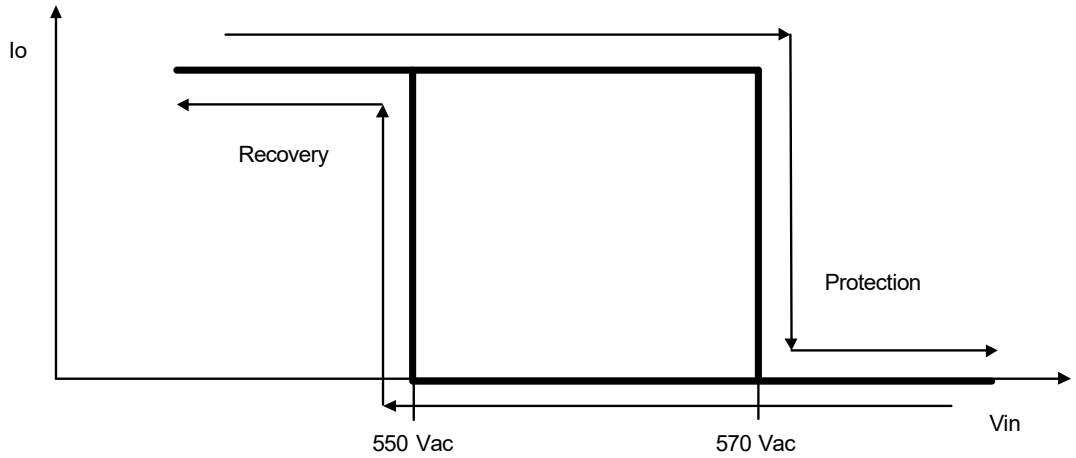
Parameter		Min.	Typ.	Max.	Notes
Input Under Voltage Protection (IUVP)	Input Protection Voltage	220 Vac	230 Vac	240 Vac	Turn off the output when the input voltage falls below protection voltage.
	Input Recovery Voltage	230 Vac	240 Vac	250 Vac	Auto Recovery. The driver will restart when the input voltage exceeds recovery voltage.
Input Over Voltage Protection (IOVP)	Input Over Voltage Protection	550 Vac	570 Vac	590 Vac	Turn off the output when the input voltage exceeds protection voltage.
	Input Over Voltage Recovery	530 Vac	550 Vac	570 Vac	Auto Recovery. The driver will restart when the input voltage falls below recovery voltage.
	Max. of Input Over Voltage	-	-	590 Vac	The driver can survive for 8 hours with a stable input voltage stress of 590Vac.

Note: (1) The recommended NTC type is 10kΩ NTC, Murata NCP18XH103J03RB.

- **Input Under Voltage Protection Diagram**



- **Input Over Voltage Protection Diagram**

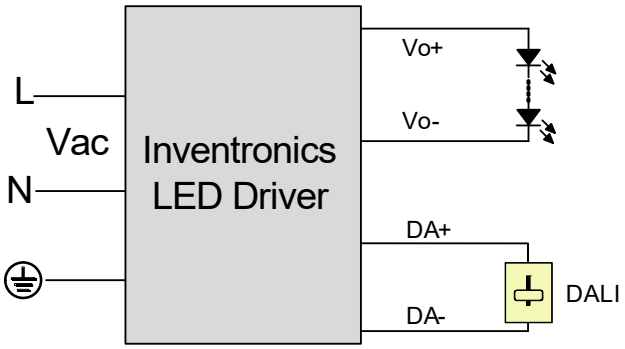


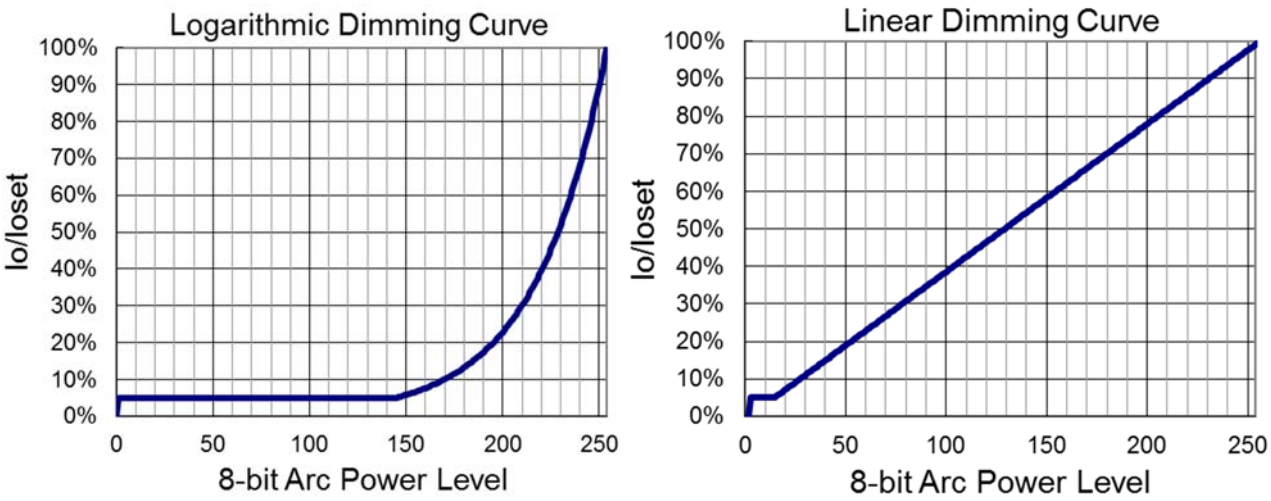
www.inventronics-co.com Tel: 86-571-56565800 Fax: 86-571-86601139 sales@inventronics-co.com

Dimming

- **DALI-2 Dimming**

The recommended implementation of the dimming control is provided below.





Implementation: DALI-2 Dimming

- **Time Dimming**

Time dimming control includes 3 kinds of modes, they are Self Adapting-Midnight, Self Adapting-Percentage and Traditional Timer.

- **Self Adapting-Midnight**: Automatically adjusts the dimming curve based on the on-time of past two days (if difference <15 minutes), assuming that the center point of the dimming curve is midnight local time.
- **Self Adapting-Percentage**: Automatically adjusts the on-time of each step by a constant percentage = (actual on-time for the past 2 days if difference <15 min) / (programmed on-time from the dimming curve).
- **Traditional Timer**: Follows the programmed timing curve after power on with no changes.

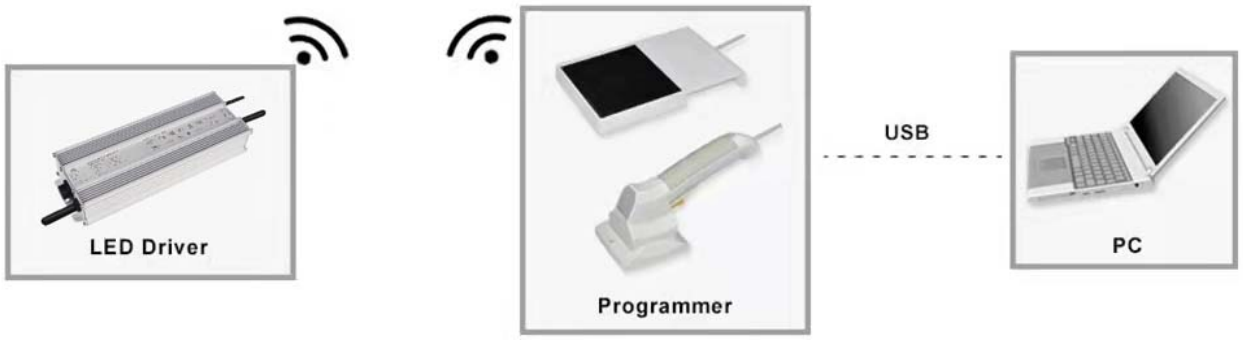
- **Output Lumen Compensation**

Output Lumen Compensation (OLC) may be used to maintain constant light output over the life of the LEDs by driving them at a reduced current when new, then gradually increasing the drive current over time to counteract LED lumen degradation.

- **End Of Life**

End-of-Life (EOL) is providing a visual notification to a user that the LED module has reached the end of manufacturer-specified life and that the replacement is recommended. Once active, an indication is given at each power-up of the driver, which the driver indicates this through a lower light output during the first 1 minute before normal operation is continued.

Programming Connection Diagram

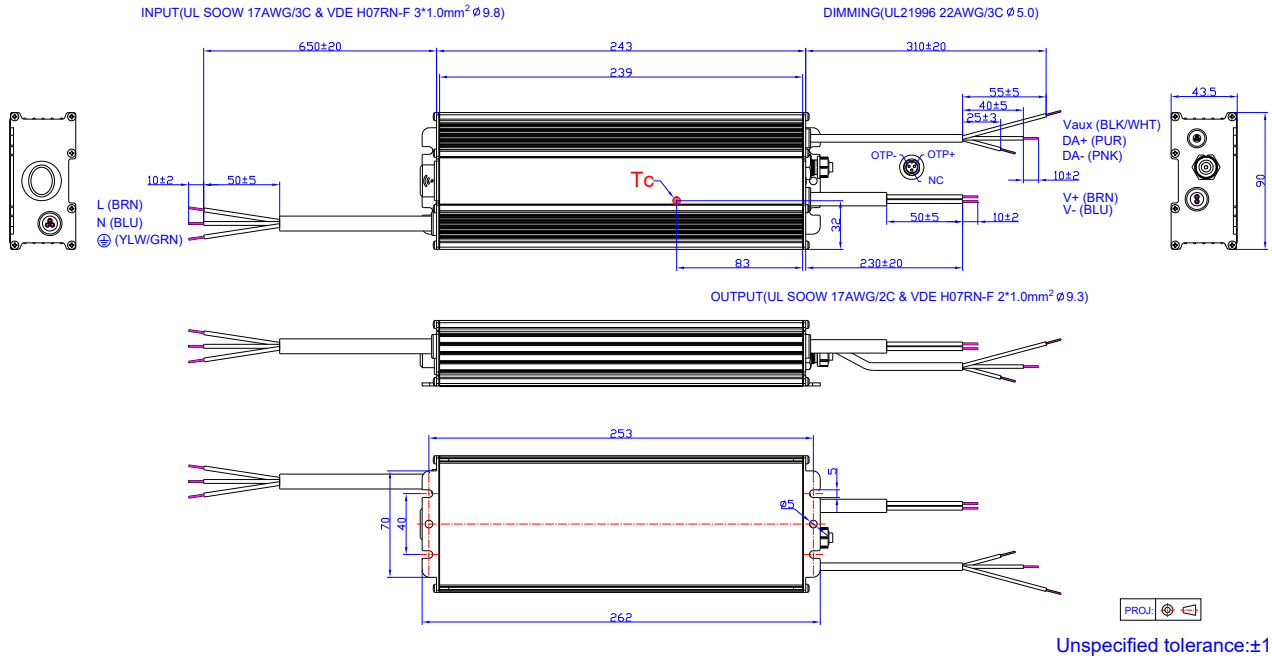


Note: The driver does not need to be powered on during the programming process.

- **Please refer to PRG-NFC-H or PRG-NFC-D2 (Programmer) datasheet for details.**

Mechanical Outline

ESM-480S140BG



Unspecified tolerance:±1

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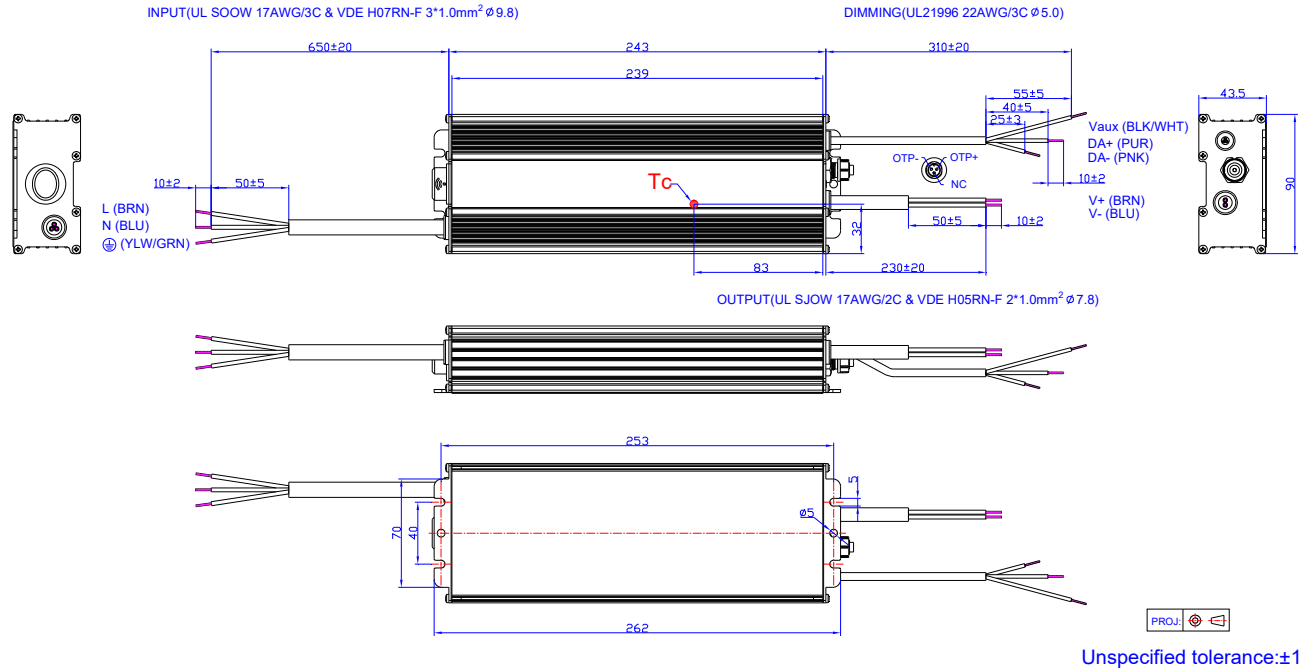
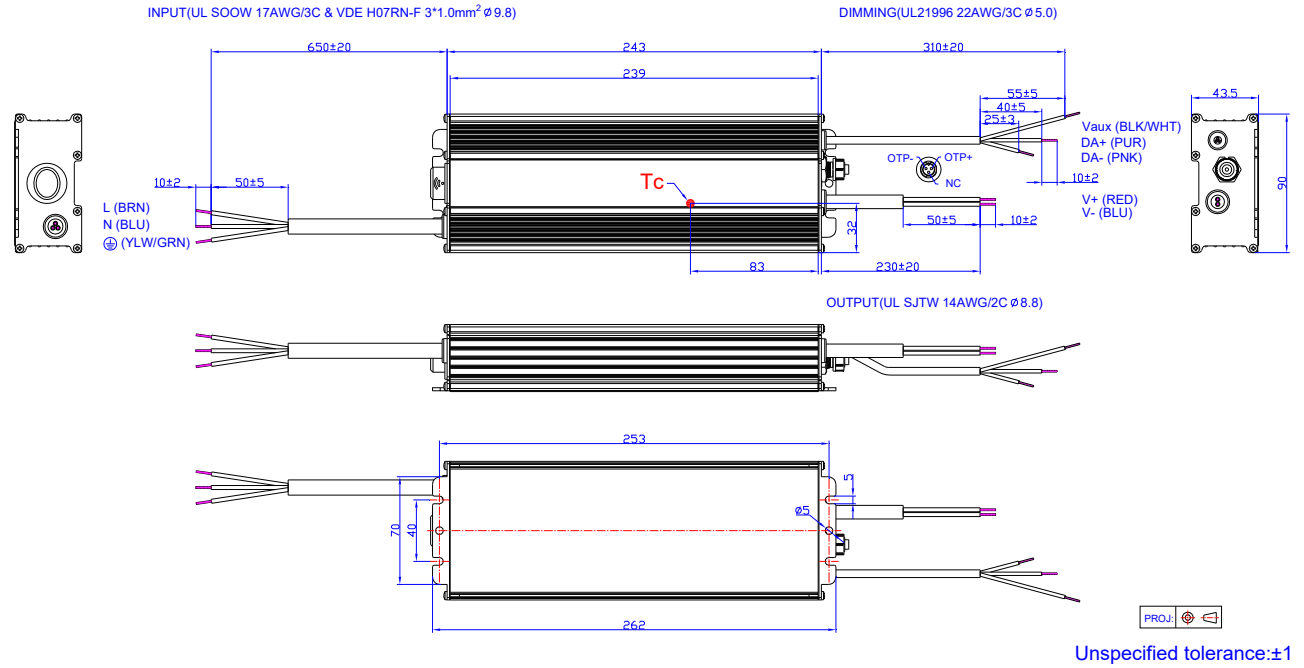
ESM-480S280BG/ESM-480S420BG/ESM-480S560BG



Unspecified tolerance:±1

ESM-480S10ABG



Unspecified tolerance:±1

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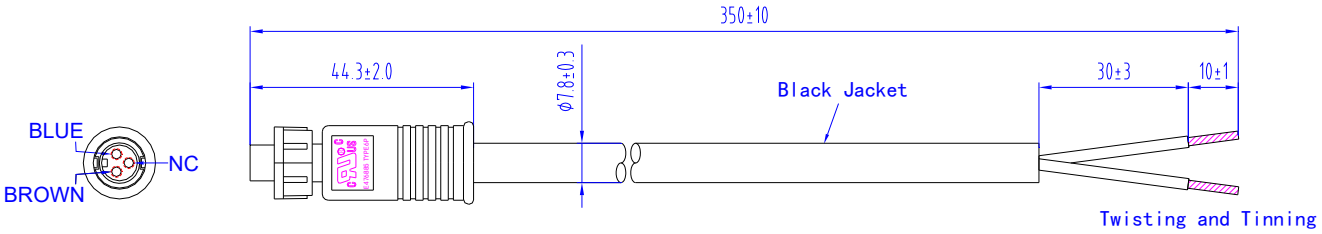
Optional Cable Parts

CAB-OTPG



- **The external thermal protection cable used for the ESM series drivers can be supplied by Inventronics, please contact the sales for ordering if necessary. For the details of cable, please refer to CAB-OTPG (Cable) datasheet.**

RoHS Compliance

Our products comply with reference to RoHS Directive (EU) 2015/863 amending 2011/65/EU, calling for the elimination of lead and other hazardous substances from electronic products.

Revision History

Change Date	Rev.	Description of Change		
		Item	From	To
2023-03-13	A	Datasheet Release		/
2023-05-12	B	Safety &EMC Compliance	/	Updated
		Mechanical Outline	/	Updated