

EdiPower[®] Series

EdiPower[®] series can provide different operating powers and different colors. They serve as optical engine and can be utilized in general lighting and special lighting applications, such as MR16 and projectors. Furthermore, the high CRI options allow the customers to optimize the effect in various fields such as interior architecture.

Features

- LED light engine
- High power operation
- Instant on
- Long lifetime
- High CRI : 90

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Product Nomenclature

The following table describes the available color, power, and lens type. For more information on luminous flux and forward voltage, please refer to the Multi-chip Bin Group document.

< Table 1 EdiPower® series Nomenclature >

E P 5 W - 2 E 00 - A 1
 X1 X2 X3 X4 X5 X6 X7 X8

X1 LED Item		X2 Power		X3 Emitting Color			X4 Material	X5 Lens Item		X6 Serial No.	X7 Phosphor Type	X8 Type
Code	Type	Code	Type	Code	Type		Code	Type				
EP	EdiPower®	3	3W	W	Cool White	○	E	Emitter				
		4	4W	H	Neutral White	●	S	Star				
		5	5W	X	Warm White	●	H	Housing				
		A	10W	R	Red	●						
		L	15W	A	Amber	●						
		B	20W	T	True Green	●						
				B	Blue	●						
				M	Multi Color							

Environmental Compliance

EdiPower[®] series are compliant to the Restriction of Hazardous Substances Directive or RoHS. The restricted materials including lead, mercury cadmium hexavalent chromium, polybrominated biphenyls (PBB) and polybrominated diphenyl ether (PBDE) are not used in EdiPower[®] to provide an environmentally friendly product to the customers.

Package Dimensions

5W Emitter Dimensions

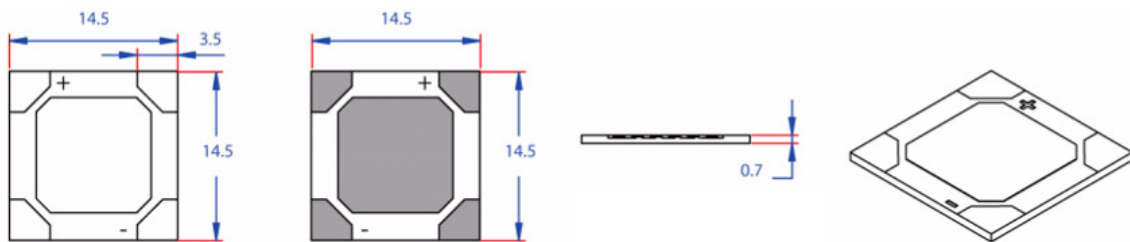


< Figure 1 5W EdiPower® Series Dimensions >

Notes:

1. Unit : mm
2. Tolerance : 0.1 mm
3. Drawings are not to scale

10W/15W/20W Emitter Dimensions

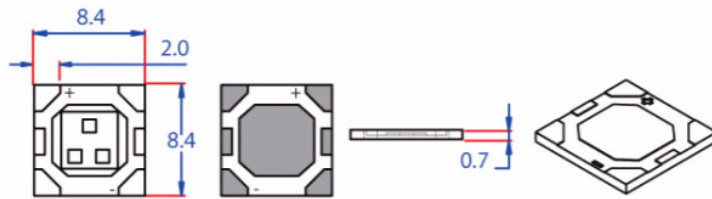


< Figure 2 10W/15W/20W EdiPower® Series Dimensions >

Notes:

1. Unit : mm
2. Tolerance : 0.1 mm
3. Drawings are not to scale

RGB Emitter Dimensions

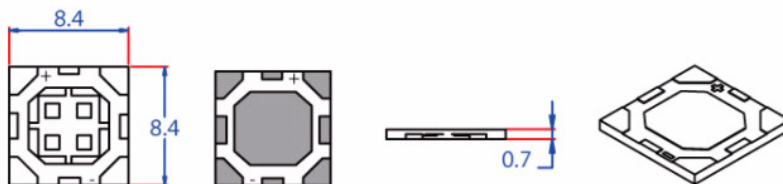


< Figure 3 RGB EdiPower® Series Dimensions >

Notes:

1. Unit : mm
2. Tolerance : 0.1 mm
3. Drawings are not to scale

RGBA Emitter Dimensions

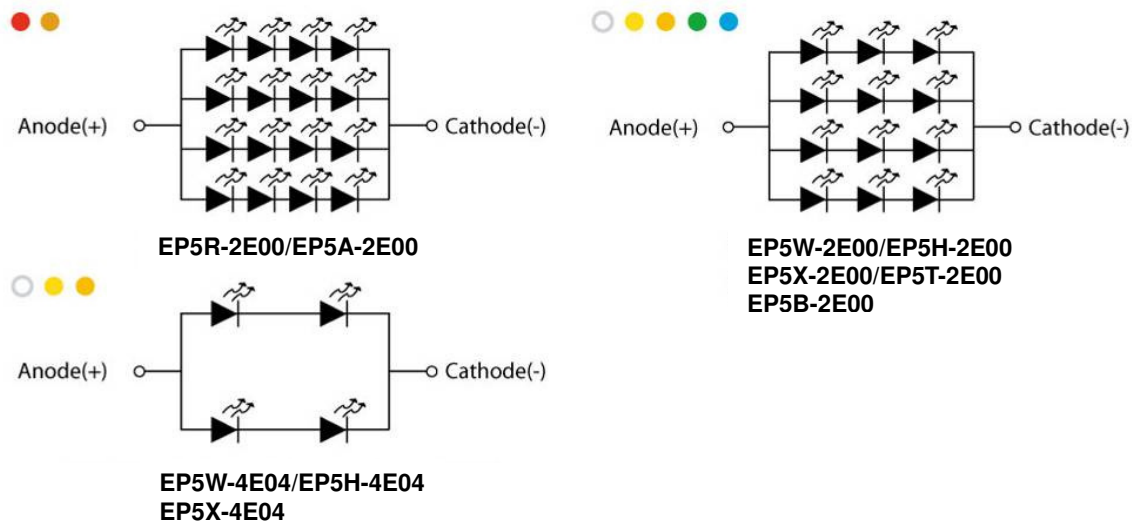


< Figure 4 RGBA EdiPower® Series Dimensions >

Notes:

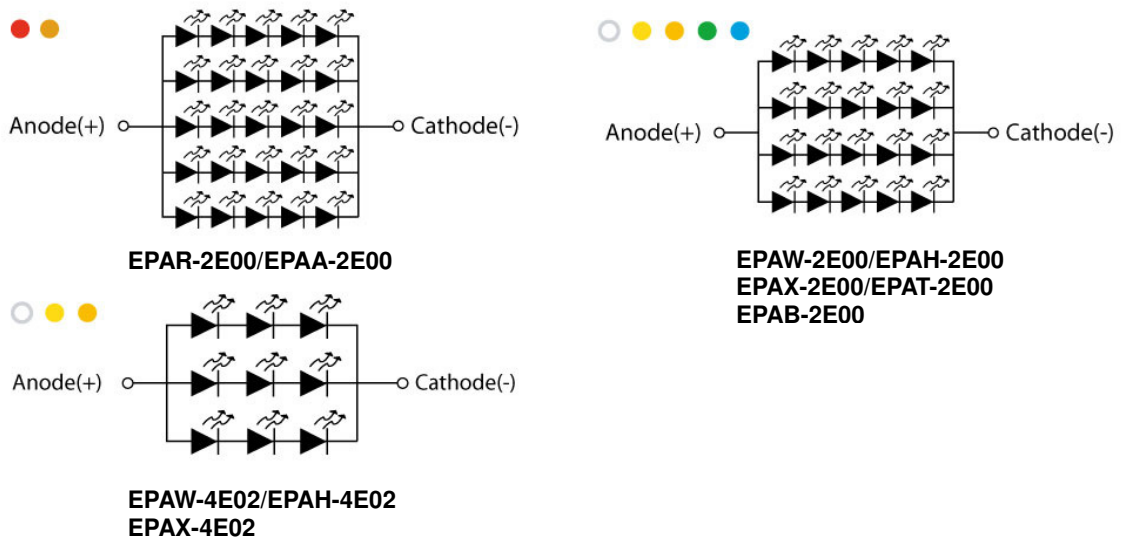
1. Unit : mm
2. Tolerance : 0.1 mm
3. Drawings are not to scale

5W Emitter Circuit Layout



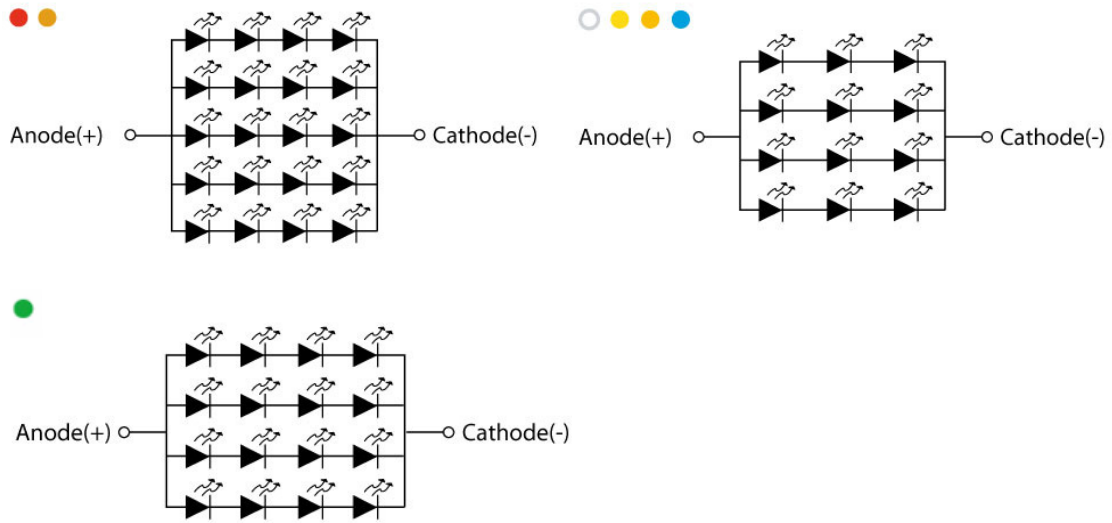
< Figure 5 5W EdiPower® Circuit Layout >

10W Emitter Circuit Layout



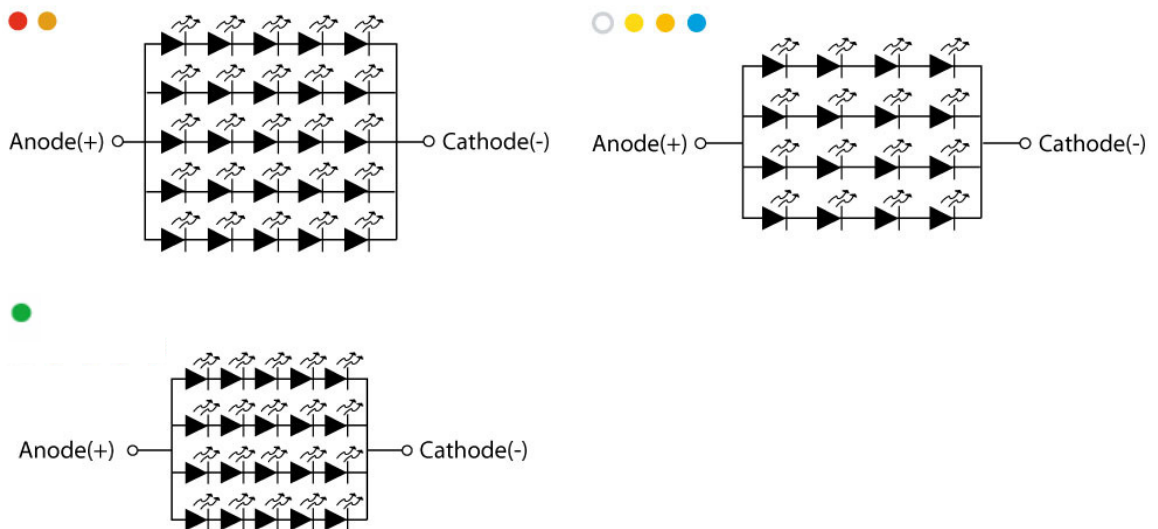
< Figure 6 10W EdiPower® series Circuit Layout >

15W Emitter Circuit Layout



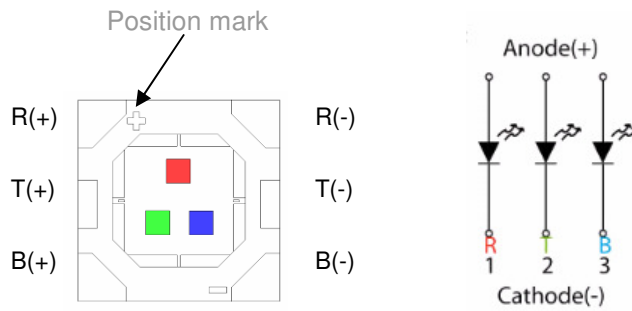
< Figure 7 15W EdiPower[™] series Circuit Layout >

20W Emitter Circuit Layout



< Figure 8 20W EdiPower[®] series Circuit Layout >

RGB Emitter Circuit Layout

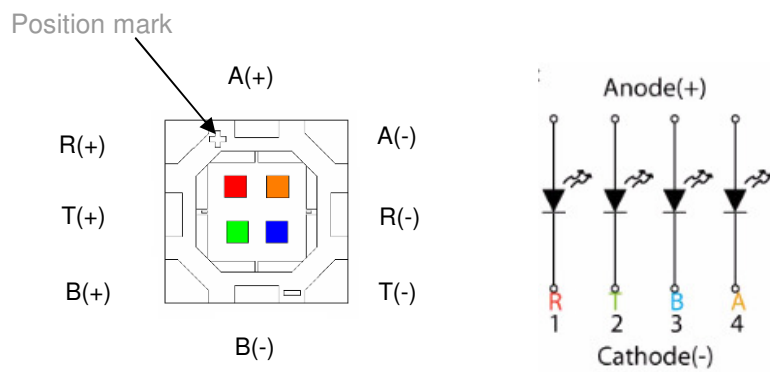


< Figure 9 RGB EdiPower® series Circuit Layout >

Notes:

1. Unit : mm
2. Tolerance : 0.1 mm
3. Drawings are not to scale

RGBA Emitter Circuit Layout



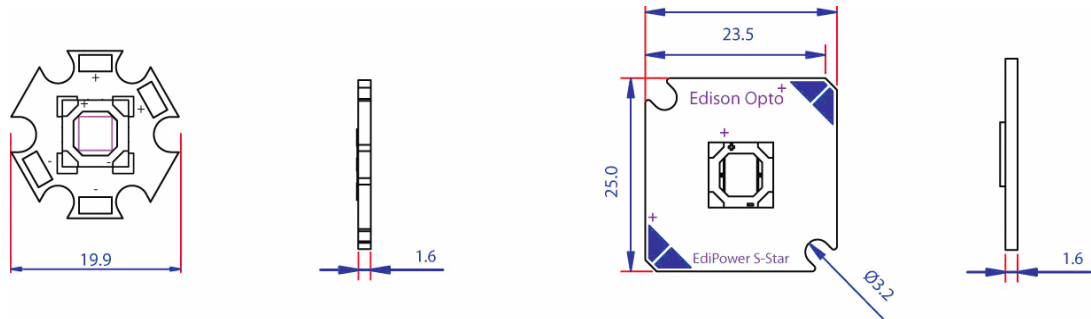
< Figure 10 RGBA EdiPower® series Circuit Layout >

Notes:

1. Unit : mm
2. Tolerance : 0.1 mm
3. Drawings are not to scale

LED Package with Star Dimension and Polarity

5W Star Dimension

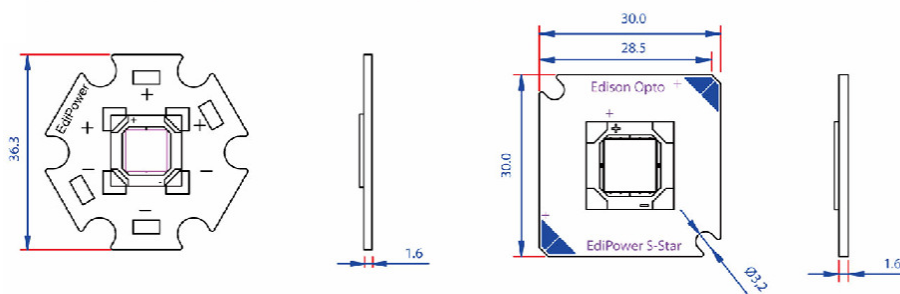


< Figure 11 5W EdiPower[®] Star Dimension >

Notes:

1. Unit : mm
2. Tolerance : 0.2 mm
3. Drawings are not to scale

10W /15W /20W Star Dimension

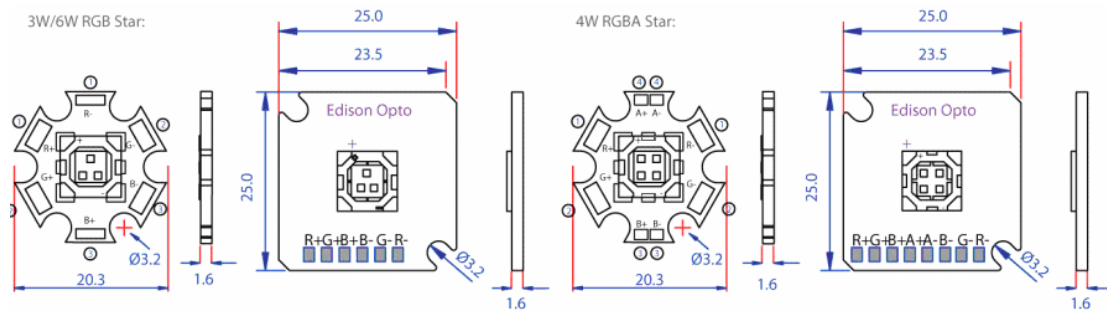


< Figure 12 10W/15W/20W EdiPower[®] Star Dimension >

Notes:

1. Unit : mm
2. Tolerance : 0.2 mm
3. Drawings are not to scale

RGB/RGBA Star Dimensions



< Figure 13 RGB & RGBA EdiPower[®] Star Dimensions >

Notes:

1. Unit : mm
2. Tolerance : 0.1 mm
3. Drawings are not to scale

Absolute Maximum Ratings

The following table describes absolute maximum ratings of EdiPower® series.

< Table 2 Absolute maximum ratings for EdiPower® series >

Parameter	5W	10W	15W	20W	Unit	Symbol
DC Forward Current ¹			Note 1		mA	I _F
Peak pulse current (t _p ≤ 100μs, Duty cycle=0.25)	1,000	1,200	2,000	2,000	mA	I _{Pulse}
Reverse Voltage ²			Note 2		V	V _R
Forward Voltage(W/H/X) ³	12 or 8	20 or 12	12	16	V	V _F
Forward Voltage(T/B)	12	20	16	20	V	V _F
Forward Voltage(R/A)	9	15	12	15	V	V _F
LED junction Temperature ⁴		125			°C	T _J
Operating Temperature		-30 ~ +110			°C	
Storage Temperature		-40 ~ +120			°C	
Soldering Temperature		260			°C	
LED Substrate Temperature		<100			°C	T _s
ESD Sensitivity		2,000			V	V _B
Isolation Voltage(W/H/X/T/B)		1,000			V	
Isolation Voltage(R/A)		50			V	
Thermal grease thickness		≤0.1			mm	

Notes:

1. DC forward current should not exceed LED's operating current; refer to Operating Current and Luminous Flux Characteristics for different values operating current regarding each type of EdiPower®.
2. LEDs are not designed to be driven in reverse bias.
3. Maximum forward voltage is depending on the chips orientation.
4. Proper current derating must be observed to maintain junction temperature below the maximum at all time.

The following tables describe thermal resistance of EdiPower® series on various wattages.

< Table 3 Thermal Resistance Characteristics from Junction to Case >

Part Name	$R_{\theta_{J-C}}$	
	Typ.	Units
EP5x-xxxx	5	°C/W
EPAx-xxxx	2	°C/W
EPLx-xxxx	2	°C/W
EPBx-xxxx	2	°C/W

Operating Current and Luminous Flux Characteristics

The following tables describe luminous flux of EdiPower® series under various current.

< Table 4 Luminous flux characteristics at $T_J=25^{\circ}\text{C}$ for 5W EdiPower® series >

Part Name	Color	Test Current (mA)	Luminous Flux Typ.(lm)	
EP5W-4E04	Cool White	700	250	
EP5H-4E04	Neutral White	700	200	
EP5X-4E04	Warm White	700	150	
EP5W-2E00	Cool White	500	250	
EP5H-2E00	Neutral White	500	200	
EP5X-2E00	Warm White	500	150	
EP5R-2E00	Red	600	80	
EP5A-2E00	Amber	600	80	
EP5T-2E00	True Green	500	150	
EP5B-2E00	Blue	500	70	
EP5W-4E04-Dx	Cool White	700	160	CRI:90
EP5H-4E04-Dx	Neutral White	700	130	CRI:90
EP5X-4E04-Dx	Warm White	700	110	CRI:90

< Table 5 Luminous flux characteristics at $T_J=25^{\circ}\text{C}$ for 10W EdiPower® series >

Part Name	Color	Test Current (mA)	Luminous Flux Typ.(lm)	
EPAW-4E02	Cool White	1,050	450	
EPAH-4E02	Neutral White	1,050	370	
EPAX-4E02	Warm White	1,050	280	
EPAW-2E00	Cool White	645	450	
EPAH-2E00	Neutral White	645	370	
EPAX-2E00	Warm White	645	280	
EPAR-2E00	Red	960	160	
EPAA-2E00	Amber	960	200	
EPAT-2E00	True Green	645	300	
EPAB-2E00	Blue	645	125	
EPAW-4E02-Dx	Cool White	1,050	270	CRI:90
EPAH-4E02-Dx	Neutral White	1,050	220	CRI:90
EPAX-4E02-Dx	Warm White	1,050	200	CRI:90

< Table 6 Luminous flux characteristics at $T_J=25^{\circ}\text{C}$ for 15W EdiPower[®] series >

Part Name	Color	Test Current (mA)	Luminous Flux Typ.(lm)	
EPLW-4E02	Cool White	1,400	675	
EPLH-4E02	Neutral White	1,400	550	
EPLX-4E02	Warm White	1,400	420	
EPLR-4E00	Red	1,500	250	
EPLA-4E00	Amber	1,500	300	
EPLT-4E00	True Green	1,120	630	
EPLB-4E00	Blue	1,400	180	
EPLW-4E02-Dx	Cool White	1,400	405	CRI:90
EPLH-4E02-Dx	Neutral White	1,400	330	CRI:90
EPLX-4E02-Dx	Warm White	1,400	300	CRI:90

< Table 7 Luminous flux characteristics at $T_J=25^{\circ}\text{C}$ for 20W EdiPower[®] series >

Part Name	Color	Test Current (mA)	Luminous Flux Typ.(lm)	
EPBW-4E02	Cool White	1,400	900	
EPBH-4E02	Neutral White	1,400	730	
EPBX-4E02	Warm White	1,400	560	
EPBR-4E00	Red	1,900	350	
EPBA-4E00	Amber	1,900	400	
EPBT-4E00	True Green	1,120	800	
EPBB-4E00	Blue	1,400	240	
EPBW-4E02-Dx	Cool White	1,400	540	CRI:90
EPBH-4E02-Dx	Neutral White	1,400	450	CRI:90
EPBX-4E02-Dx	Warm White	1,400	400	CRI:90

Note:

1. Luminous flux is measured with an accuracy of $\pm 10\%$.

< Table 8 Luminous flux characteristics at $T_J=25^{\circ}\text{C}$ for Multi-Chips EdiPower[®] series >

Part Name	Color	Test Current (mA)	Luminous Flux Typ.(lm)
EP3M-4E00	Red	350	32
EP3M-4E00	True Green	350	45
EP3M-4E00	Blue	350	12
EP4M-4E00	Red	350	32
EP4M-4E00	True Green	350	45
EP4M-4E00	Blue	350	12
EP4M-4E00	Amber	350	35
EP6M-4E00	Red	700	55
EP6M-4E00	True Green	700	80
EP6M-4E00	Blue	700	20

Note:

1. Luminous flux is measured with an accuracy of $\pm 10\%$.

Forward Voltage Characteristics

The following tables describe forward voltage of EdiPower® series.

< Table 9 Forward voltage characteristics at $T_J=25^\circ\text{C}$ for 5W EdiPower® series >

Part Name	Color	Min. Voltage (V)	Typ. Voltage (V)	Max. Voltage (V)	Unit
EP5W-4E04	Cool White	6.0	--	7.8	V
EP5H-4E04	Neutral White	6.0	--	7.8	V
EP5X-4E04	Warm White	6.0	--	7.8	V
EP5W-2E00	Cool White	9.0	--	11.7	V
EP5H-2E00	Neutral White	9.0	--	11.7	V
EP5X-2E00	Warm White	9.0	--	11.7	V
EP5R-2E00	Red	8.0	--	10.8	V
EP5A-2E00	Amber	8.0	--	10.8	V
EP5T-2E00	True Green	9.0	--	11.7	V
EP5B-2E00	Blue	9.0	--	11.7	V

< Table 10 Forward voltage characteristics at $T_J=25^\circ\text{C}$ for 10W EdiPower® series >

Part Name	Color	Min. Voltage (V)	Typ. Voltage (V)	Max. Voltage (V)	Unit
EPAW-4E02	Cool White	9.0	--	11.7	V
EPAH-4E02	Neutral White	9.0	--	11.7	V
EPAX-4E02	Warm White	9.0	--	11.7	V
EPAW-2E00	Cool White	15.0	--	19.5	V
EPAH-2E00	Neutral White	15.0	--	19.5	V
EPAX-2E00	Warm White	15.0	--	19.5	V
EPAR-2E00	Red	9.0	--	14.0	V
EPAA-2E00	Amber	9.0	--	14.0	V
EPAT-2E00	True Green	15.0	--	19.5	V
EPAB-2E00	Blue	15.0	--	19.5	V

< Table 11 Forward voltage characteristics at $T_J=25^{\circ}\text{C}$ for 15W EdiPower[®] series >

Part Name	Color	Min. Voltage (V)	Typ. Voltage (V)	Max. Voltage (V)	Unit
EPLW-4E02	Cool White	9.0	--	11.7	V
EPLH-4E02	Neutral White	9.0	--	11.7	V
EPLX-4E02	Warm White	9.0	--	11.7	V
EPLR-4E00	Red	8.0	--	10.4	V
EPLA-4E00	Amber	8.0	--	10.4	V
EPLT-4E00	True Green	12.0	--	15.6	V
EPLB-4E02	Blue	9.0	--	11.7	V

< Table 12 Forward voltage characteristics at $T_J=25^{\circ}\text{C}$ for 20W EdiPower[®] series >

Part Name	Color	Min. Voltage (V)	Typ. Voltage (V)	Max. Voltage (V)	Unit
EPBW-4E02	Cool White	12.0	--	15.6	V
EPBH-4E02	Neutral White	12.0	--	15.6	V
EPBX-4E02	Warm White	12.0	--	15.6	V
EPBR-4E00	Red	9.0	--	14.0	V
EPBA-4E00	Amber	9.0	--	14.0	V
EPBT-4E00	True Green	15.0	--	19.5	V
EPBB-4E02	Blue	12.0	--	15.6	V

Note:

1. Forward voltage is measured with an accuracy of $\pm 0.1\text{V}$

< Table 13 Forward voltage characteristics at $T_j=25^{\circ}\text{C}$ for Multi-Chips EdiPower[®] series >

Part Name	Color	Min. Voltage (V)	Typ. Voltage (V)	Max. Voltage (V)	Unit
EP3M-4E00	Red	2.0	--	3.0	V
EP3M-4E00	True Green	2.0	--	3.0	V
EP3M-4E00	Blue	3.1	--	4.0	V
EP4M-4E00	Red	2.0	--	3.0	V
EP4M-4E00	True Green	3.1	--	4.0	V
EP4M-4E00	Blue	3.1	--	4.0	V
EP4M-4E00	Amber	2.0	--	3.0	V
EP6M-4E00	Red	2.0	--	3.0	V
EP6M-4E00	True Green	3.1	--	4.0	V
EP6M-4E00	Blue	3.1	--	4.0	V

Note:

1. Forward voltage is measured with an accuracy of $\pm 0.1\text{V}$

JEDEC Information

JEDEC moisture sensitivity classification is used to determine what classification level should be used for initial reliability qualification. Once identified, the LEDs can be properly packaged, stored and handled to avoid subsequent thermal and mechanical damage during the assembly solder reflow attachment and/or repair operation. The present moisture sensitivity standard contains six levels, the lower the level, the longer the devices floor life. EdiPower® series are certified at level 2a. This means EdiPower® series have a floor life of 4 weeks before EdiPower® series need to re-bake.

< Table 14 JEDEC characteristics at $T_J=25^{\circ}\text{C}$ for EdiPower® RC series >

Level	Floor Life		Soak Requirements			
	Time	Conditions	Standard		Accelerated Environment	
			Time (hours)	Conditions	Time (hours)	Conditions
2a	4 weeks	$\leq 30^{\circ}\text{C} / 60\% \text{ RH}$	696 +5/-0	$30^{\circ}\text{C} / 60\% \text{ RH}$	120 +1/-0	$60^{\circ}\text{C} / 60\% \text{ RH}$

Level	Floor Life		Soak Requirements			
			Standard		Accelerated Equivalent	
	Time	Condition	Time(hours)	Condition	Time(hours)	Condition
1	Unlimited	$\leq 30^{\circ}\text{C}/85\% \text{ RH}$	168 +5/-0	$85^{\circ}\text{C}/85\% \text{ RH}$		
2	1 year	$\leq 30^{\circ}\text{C}/60\% \text{ RH}$	168 +5/-0	$85^{\circ}\text{C}/60\% \text{ RH}$		
2a	4 weeks	$\leq 30^{\circ}\text{C}/60\% \text{ RH}$	696 ¹ +5/-0	$30^{\circ}\text{C}/60\% \text{ RH}$	120 +1/-0	$60^{\circ}\text{C}/60\% \text{ RH}$
3	168 hours	$\leq 30^{\circ}\text{C}/60\% \text{ RH}$	192 ¹ +5/-0	$30^{\circ}\text{C}/60\% \text{ RH}$	40 +5/-0	$60^{\circ}\text{C}/60\% \text{ RH}$
4	72 hours	$\leq 30^{\circ}\text{C}/60\% \text{ RH}$	96 ¹ +5/-0	$30^{\circ}\text{C}/60\% \text{ RH}$	20 +5/-0	$60^{\circ}\text{C}/60\% \text{ RH}$
5	48 hours	$\leq 30^{\circ}\text{C}/60\% \text{ RH}$	72 ¹ +5/-0	$30^{\circ}\text{C}/60\% \text{ RH}$	15 +5/-0	$60^{\circ}\text{C}/60\% \text{ RH}$
5a	24 hours	$\leq 30^{\circ}\text{C}/60\% \text{ RH}$	48 ¹ +5/-0	$30^{\circ}\text{C}/60\% \text{ RH}$	10 +5/-0	$60^{\circ}\text{C}/60\% \text{ RH}$
6	Time on label (TOL)	$\leq 30^{\circ}\text{C}/60\% \text{ RH}$	TOL	$30^{\circ}\text{C}/60\% \text{ RH}$		

Notes:

1. The standard soak time includes a default value of 24 hours for semiconductor manufacturer's exposure time (MET) between bake and bag, and includes the maximum time allowed out of the bag at the distributor's facility.
2. Joint Electron Devices Engineering Councils (JEDEC) is the leading developer of standards for the solid-state industry. Almost 3100 participants, appointed by some 290 companies work together in 50 JEDEC committees to meet the needs of every segment of the industry, manufacturers and consumers alike. The publications and standards that they generate are accepted throughout the world.
(<http://www.jedec.org>)

Reliability Items and Failure Measures

Reliability test

The following table describes operating life, mechanical, and environmental tests performed on EdiPower® series package.

< Table 15 Operating life, mechanical, and environmental characteristics and $T_J=25^\circ\text{C}$ for EdiPower® series >

Stress Test	Stress Conditions	Stress Duration	Failure Criteria
Room Temperature Operating Life	25°C , $I_F = I_{F_{\max}}$ (Note 1)	1,000 hours	Note 2
High Temperature High Humidity	85°C / 85%RH	1,000 hours	Note 2
Temperature Cycle	$-40^\circ\text{C}/100^\circ\text{C}$,30 min dwell <5min transfer	500 cycles	Note 2
High Temperature Storage Life	110°C	1,000 hours	Note 2
Low Temperature Storage Life	-40°C	1,000 hours	Note 2
Thermal Shock	$-40 / 125^\circ\text{C}$, 15 min dwell / <10 sec transfer	500 cycles	No catastrophics
Mechanical Shock	1,500 G, 0.5 msec pulse, 5 shocks each 6 axis		No catastrophics
Natural Drop	On concrete from 1.2 m, 3X		No catastrophics
Variable Vibration Frequency	10-2,000-10 Hz, log or linear sweep rate, 20 G about 1 min, 1.5 mm, 3X/axis		No catastrophics
Solder Heat Resistance (SHR)	$260^\circ\text{C} \pm 5^\circ\text{C}$	10 secs	No catastrophics

Notes:

1. Depending on the maximum derating curve.
2. Failure Criteria:
 - Electrical failures
 - V_F shift $\geq 10\%$
 - Light Output Degradation
 - % I_v shift $\geq 30\%$ @1,000hrs or 500 cycle
 - Visual failures
 - Broken or damaged package
 - Solderability < 95% wetting
 - Dimension out of tolerance

Failure Types

Catastrophic failures are failures that result in the LED emitting no light or very little light at normal current levels (e.g. 700 mA). Catastrophic failures are not expected for EdiPower® emitters that are handled and operated within the limits specified in EdiPower® documentation. Please refer to Absolute Maximum Ratings for more information on design limits.

Parametric failures are failures that cause key characteristics to shift outside of

acceptable bounds. The most common parametric failure, for a high-power LED, is permanent light output degradation over operating life. Most other light sources experience catastrophic failure at the end of their useful life, providing a clear indication that the light source must be replaced. For instance, the filament of an incandescent light bulb breaks and the bulb ceases to create light. In contrast, high-power LEDs generally do not experience catastrophic failure but simply become too dim to be useful in the intended application. Further discussion of this matter can be found in the Long-Term Lumen Maintenance Testing section of this document. Another parametric failure common to white LEDs is a large and permanent shift in the exact color of white light output, called the white point or color point. A shift in white point may not be detectable in one LED by itself, but would be obvious in a side-by-side comparison of multiple LEDs. Since each lighting installation commonly uses many high-power LEDs, white point stability is a point of concern for lighting designers. Typically, white high-power LEDs, created by combining blue LEDs with yellow (and sometimes red) phosphor, will shift towards blue over operational life. This shift can be accelerated by high temperatures and high drive currents. For example, a cool white (e.g., 6500K CCT) LED with a white point failure will typically appear light blue instead of white. In some high-power LEDs, this failure mode can occur after just 1,000 hours of operational life.

Just as with fluorescent light sources, all white high-power LEDs will experience shifts in white point over their operating lives. It is possible for the design of the phosphor and packaging systems to minimize these shifts and contain the shifts to be less than what is detectable by the human eye. As with catastrophic failures, parametric failures can be minimized by adhering to limits specified in EdiPower® documentation.

The MTBF of EdiPower® series

Mean time between failures (MTBF) is the mean (average) time between failures of a system, the reciprocal of the failure rate in the special case when the failure rate is constant. Calculations of MTBF assume that a system is "renewed", i.e. fixed, after each failure, and then returned to service immediately after failure. A related term, mean distance between failures, with a similar and more intuitive sense, is widely used in transport industries such as railways and trucking. The average time between failing and being returned to service is termed mean down time (MDT).

The formula of MTBF for EdiPower® series can be

$$\log(\text{Life}) = \frac{1,600}{T_J(^{\circ}\text{C}) + 273}$$

< Table 16 Relation between Junction Temperature and Life time >

T_J (°C)	Life (hours)	T_J (°C)	Life (hours)
25	234,000	85	29,500
30	191,000	90	25,700
35	157,000	95	22,300
40	129,000	100	19,500
45	107,000	105	17,100
50	90,000	110	15,100
55	75,000	115	13,300
60	64,000	120	11,700
65	54,000	125	10,500
70	46,000	130	9,300
75	39,600	140	7,500
80	34,000	150	6,000

Note:

1. Life means the time when light output decay to 70%

The MTTF of EdiPower® series

An estimate of the average or mean time until a design's or component's first failure, or disruption in the operation of the product, process, procedure, or design occurs.

Mean time until a failure assumes that the product CAN NOT be repaired and the product CAN NOT resume any of its normal operations.

Mean time to failure (MTTF) is related to items such as expected and/or operating life or other items that in general are not fixed or replacement even though it sometimes may be.

MTTF is assumed to be 100,000,000

The failure rates at different hours and different systems (LED quantity) are as below:

if there is 1 failure of 1 emitter in a system

$T_j=75^\circ\text{C}$ is giving 0.01%(100ppm) at 10,000hrs

if there is 1 failure of 10 emitters in a system

$T_j=75^\circ\text{C}$ is giving 0.1%(1,000ppm) at 10,000hrs

if there is 1 failure of 1 emitter in a system

$T_j=75^\circ\text{C}$ is giving 0.05%(500ppm) at 50,000hrs

if there is 1 failure of 10 emitters in a system

$T_j=75^\circ\text{C}$ is giving 0.5%(5,000ppm) at 50,000hrs if there are 10 emitters

ASSIST for High Power LED Reliability

< Table 17 Different Junction Temperature Characteristics for 5W EdiPower[®] series >

	Ts=45°C	Ts=65°C	Ts=85°C
Voltage	7.0V	7.0V	7.0V
Current	700mA	700mA	700mA
Wattage	4.9W	4.9W	4.9W
Heat	3.68W	3.68W	3.68W
Rth	5 °C/W	5 °C/W	5 °C/W
T_J	70 °C	90 °C	110 °C
L_{70%}	46,000hrs	25,700hrs	15,100hrs

< Table 18 Different Junction Temperature Characteristics for 10W EdiPower[®] series >

	Ts=45°C	Ts=65°C	Ts=85°C
Voltage	10.5V	10.5V	10.5V
Current	1,050mA	1,050mA	1,050mA
Wattage	11W	11W	11W
Heat	8.28W	8.28W	8.28W
Rth	2 °C/W	2 °C/W	2 °C/W
T_J	65 °C	85 °C	105 °C
L_{70%}	54,000hrs	29,500hrs	19,500hrs

< Table 19 Different Junction Temperature Characteristics for 15W EdiPower[®] series >

	Ts=45°C	Ts=65°C	Ts=85°C
Voltage	10.5V	10.5V	10.5V
Current	1,400mA	1,400mA	1,400mA
Wattage	14.7W	14.7W	14.7W
Heat	11.04W	11.04W	11.04W
Rth	2 °C/W	2 °C/W	2 °C/W
T_J	75 °C	95 °C	115 °C
L_{70%}	39,600hrs	22,300hrs	13,300hrs

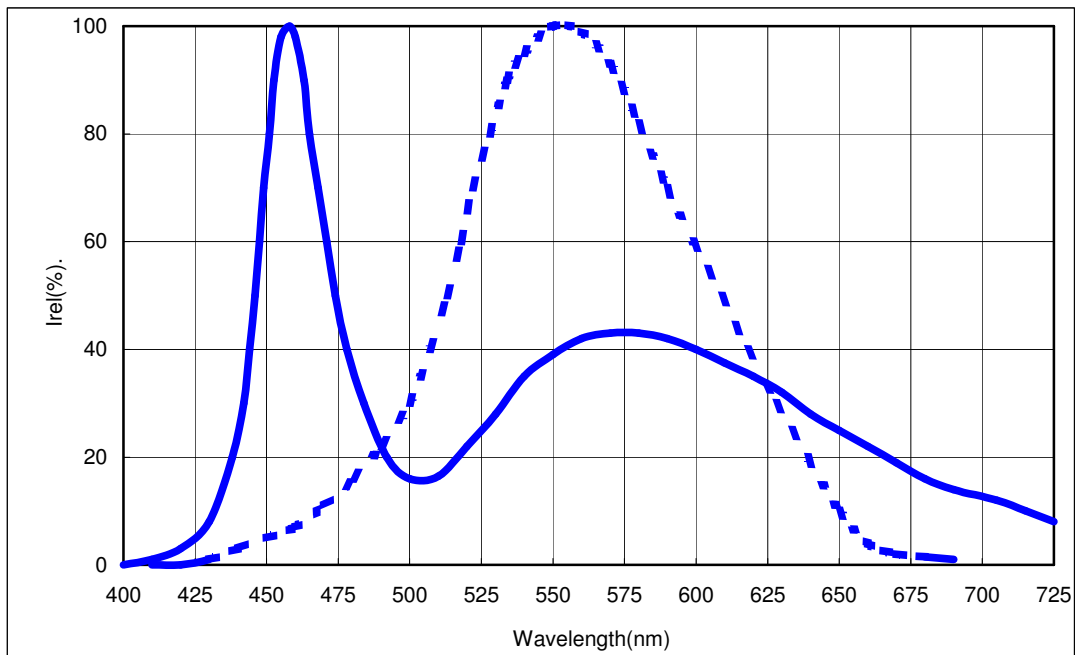
< Table 20 Different Junction Temperature Characteristics for 20W EdiPower® series >

	Ts=45°C	Ts=65°C	Ts=85°C
Voltage	14V	14V	14V
Current	1,400mA	1,400mA	1,400mA
Wattage	19.6W	19.6W	19.6W
Heat	14.72W	14.72W	14.72W
Rth	2 °C/W	2 °C/W	2 °C/W
T_J	85 °C	105 °C	125 °C
L_{70%}	29,500hrs	19,500hrs	10,500hrs

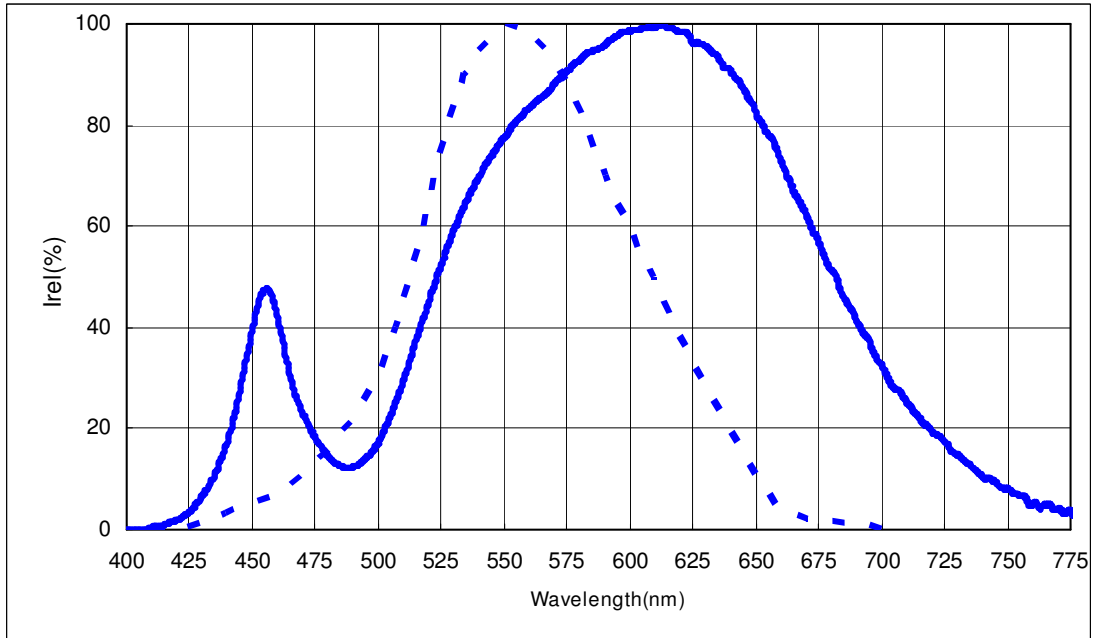
Notes:

1. Ts: substrate temperature
2. ASSIST: Alliance for Solid-State Illumination Systems and Technologies

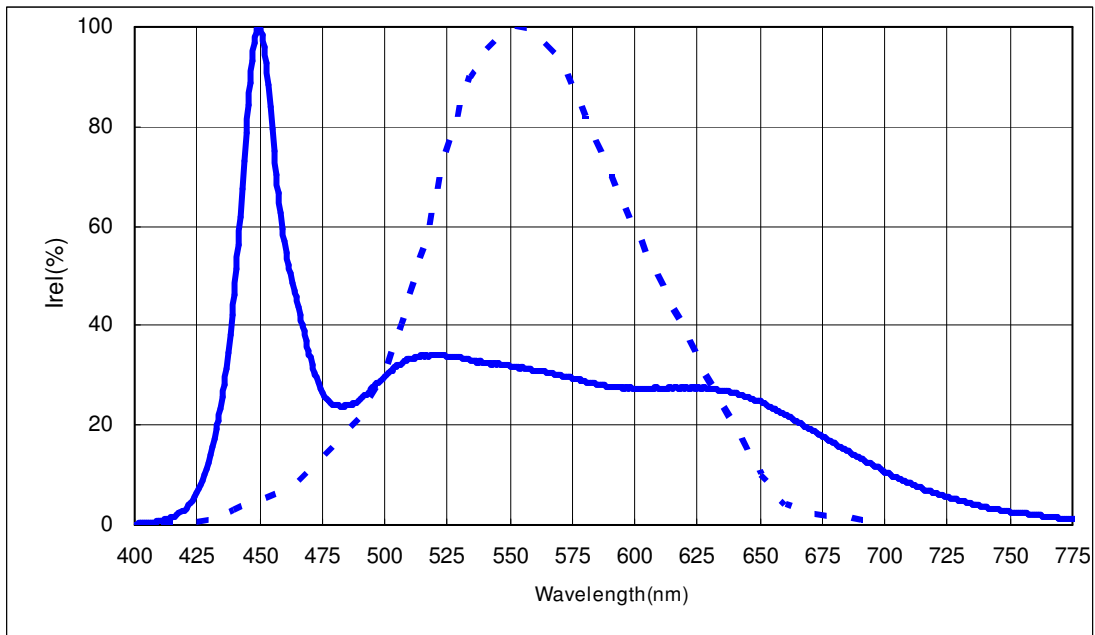
Color Spectrum and Radiation Pattern



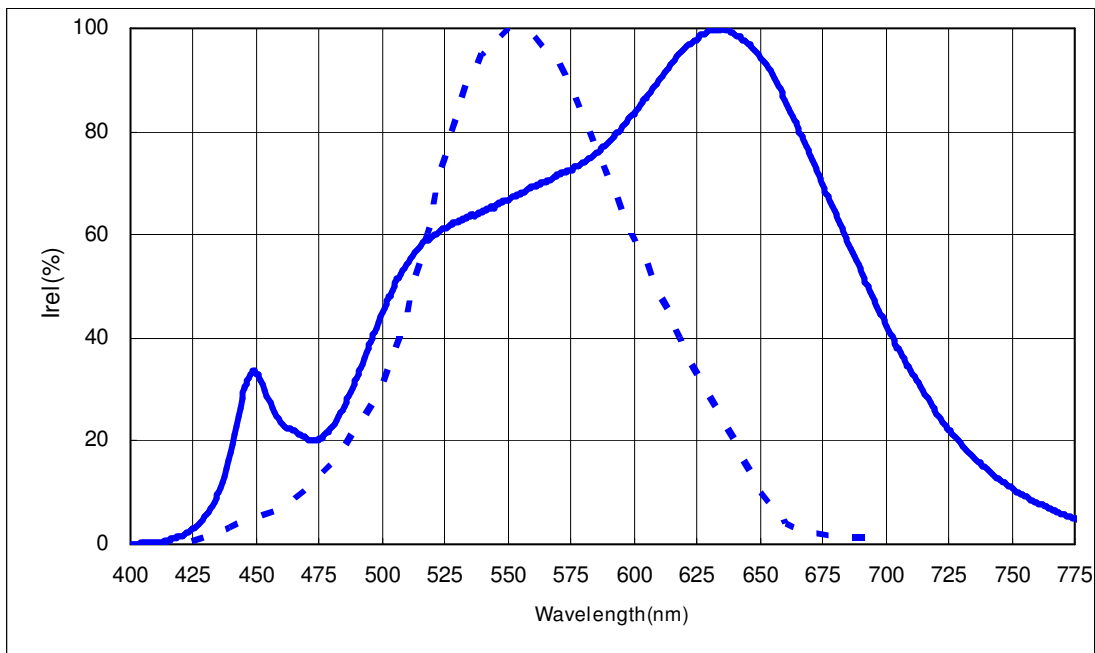
<Figure 14 Color spectrum for EdiPower® cool white>



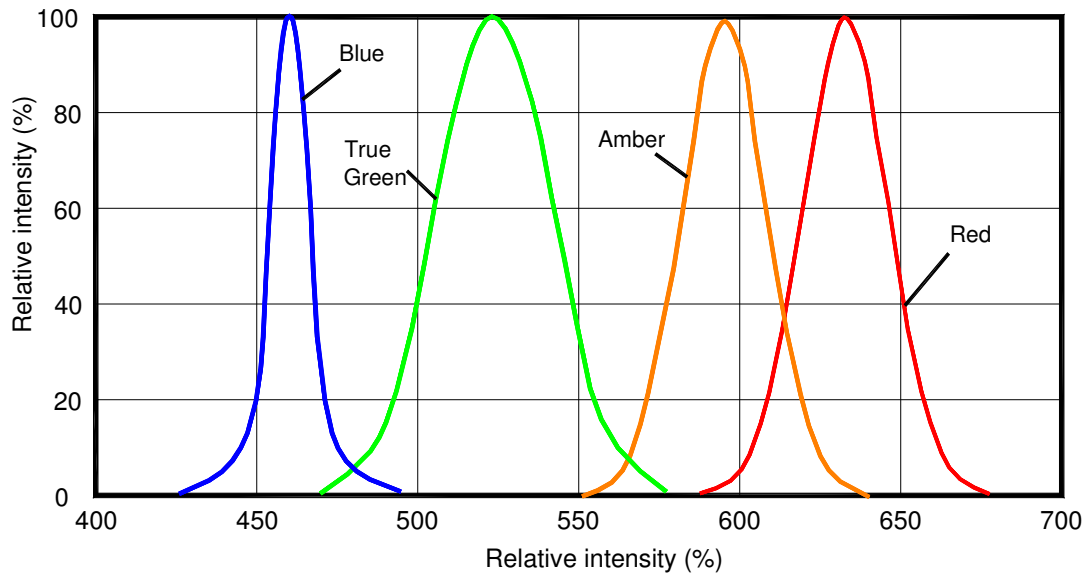
< Figure 15 Color spectrum for EdiPower® warm white and neutral white >



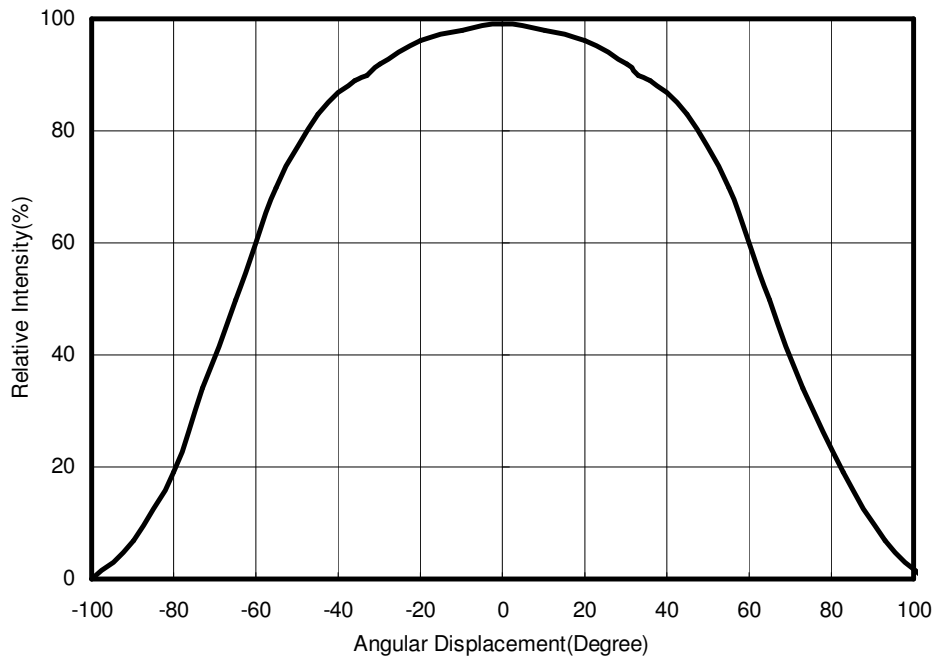
< Figure 16 Color spectrum for EdiPower® cool white with high CRI >



< Figure 17 Color spectrum for EdiPower® warm white and neutral white with high CRI >



< Figure 18 Color spectrum for EdiPower® series red, amber, true Green, blue >



< Figure 19 Lambertian at $T_j=25^\circ\text{C}$ for EdiPower® series.>

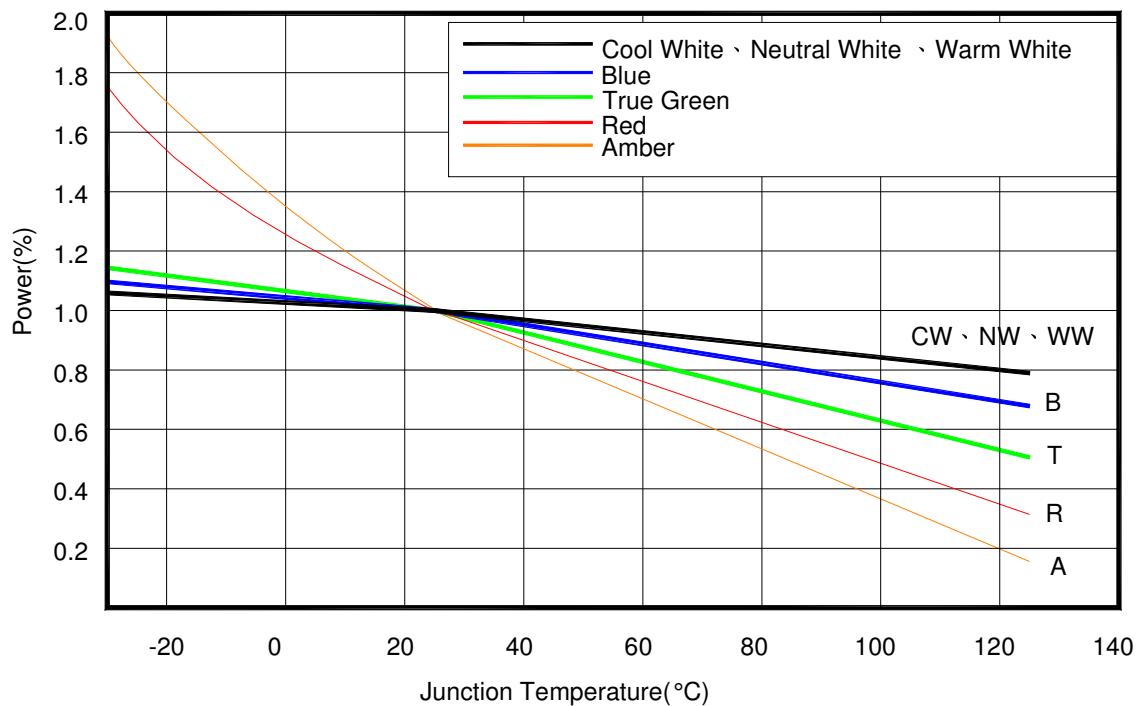
Color Temperature or Dominant Wavelength Characteristics $T_J=25^{\circ}\text{C}$

< Table 21 Dominant Wavelength or Color Temperature Characteristics at $T_J=25^{\circ}\text{C}$ for EdiPower[®] series >

Part Name	Color	λ_d/CCT		Unit
		Min.	Max.	
EPxW-xxxx	Cool White	5,000	10,000	K
EPxX-xxxx	Neutral White	3,800	5,000	K
EPxY-xxxx	Warm White	2,670	3,800	K
EPxR-xE00	Red	620	630	nm
EPxA-xE00	Amber	585	595	nm
EPxT-xE00	True Green	515	535	nm
EPxB-xE00	Blue	460	475	nm

Notes:

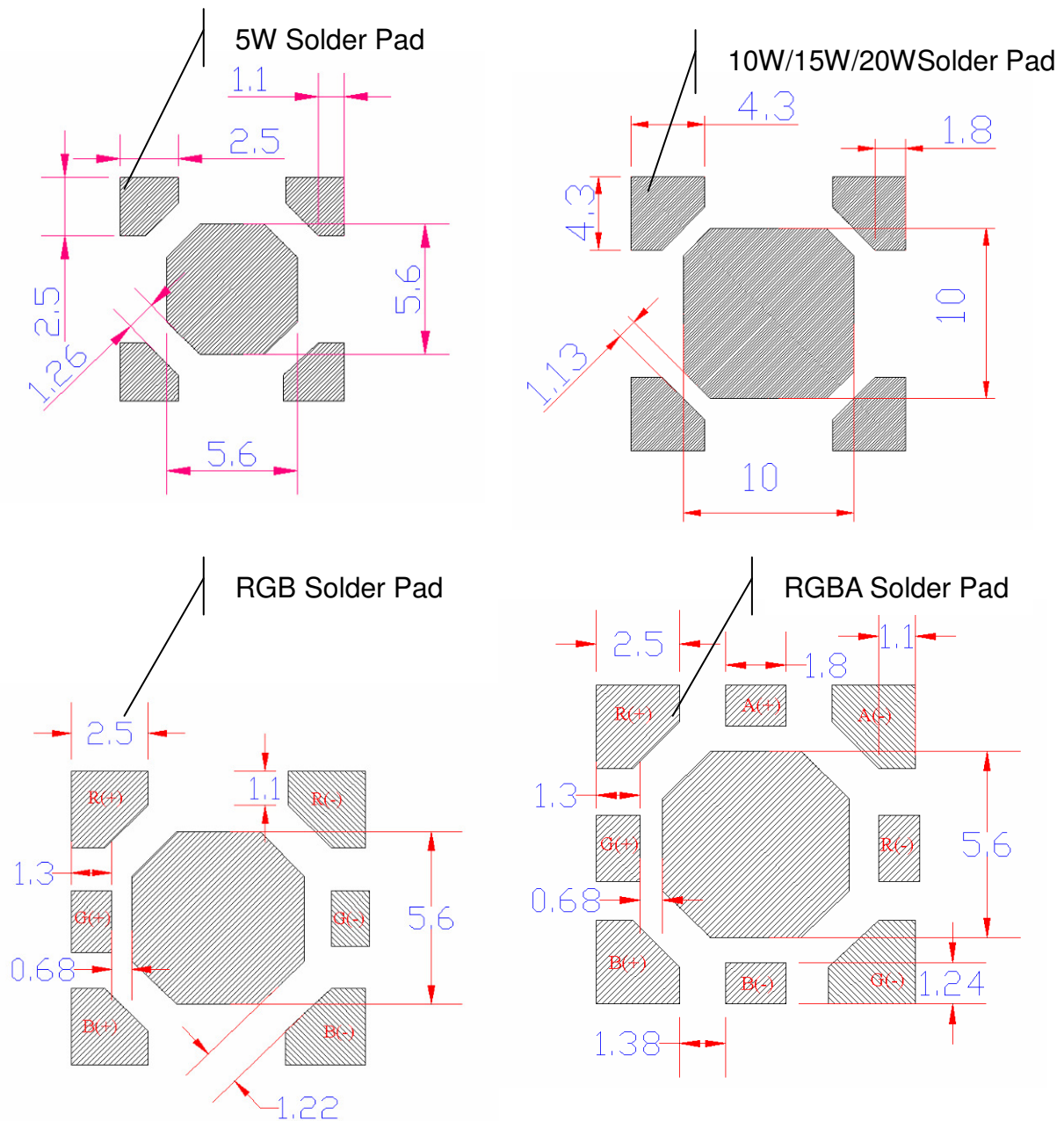
1. CCT is measured with an accuracy of $\pm 200\text{K}$.
2. Wavelength is measured with an accuracy of $\pm 0.5\text{nm}$.



< Figure 20 Junction temperature & power rate for EdiPower[®] series >

Product Soldering Instructions

The central circle pad at the bottom face of the package provides the main path for heat dissipation from the LED to the heat sink (heat sink contact).



< Figure 21 Pad Dimensions >

Notes:

1. All dimensions are measured in mm.
2. The drawings are not to scale
3. Solder pad cannot be connected to slug pad.
4. MCPCB material with a thermal conductivity greater than 3.0 W/mK.

-
5. Please avoid touching the EdiPower® silicone during assembly processes. This may cause pollution or scratch on the surface of silicone.

The choice of solder and the application method will dictate the specific amount of solder. For most consistent results, an automated dispensing system or a solder stencil printer is recommended.

Positive results will be used solder thickness that results in 50µm. The lamp can be placed on the PCB simultaneously with any other required SMD devices and reflow completed in a single step. Automated pick-and-place tools are recommended.

The central slug at the bottom face of the package provides the main path for heat dissipation from the LED to the heat sink (heat sink contact). A key feature of EdiPower® emitter is an electrically neutral heat path that is separate from the LED's electrical contacts. This electrically isolated thermal pad makes EdiPower® emitter perfect for use with either FR4 circuit boards with thermal via or with metal-core printed circuit boards (MCPCB).

Recommend Solder Steps

To prevent mechanical failure of LEDs in the soldering process, a carefully controlled pre-heat and post-cooling sequence is necessary. The heating rate in an IR furnace depends on the absorption coefficients of the material surfaces and on the ratio of the component's mass to its irradiated surface. The temperature of parts in an IR furnace, with a mixture of radiation and convection, cannot be determined in advance.

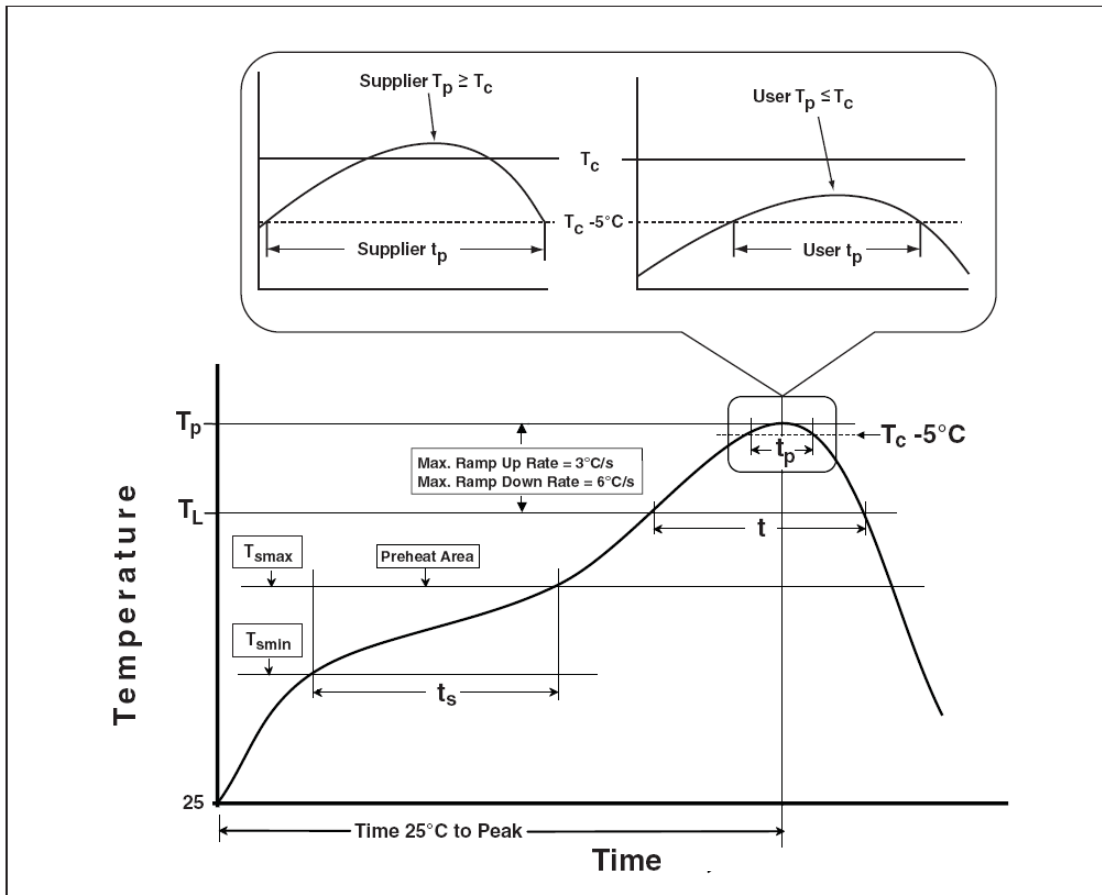
Temperature measurement may be performed by measuring the temperature of a specific component while it is being transported through the furnace. Influencing parameters on the internal temperature of the component are as follows:

- Time and power
- Mass of the component (for EdiPower® emitter on MCPCB this is very important)
- Size of the component
- Size of the printed circuit board
- Absorption coefficient of the surfaces and MCPCB
- Packing density

Peak temperatures can vary greatly across the PC board during IR processes. The variables that contribute to this wide temperature range include the furnace type and the size, mass and relative location of the components on the board. Profiles must be carefully tested to determine the hottest and coolest points on the board. The hottest and coolest points should fall within the recommended temperatures. The profile of the reflow system should be based on design needs, the selected solder system and the solder-paste manufacturer's recommended reflow profile.

Reflow Soldering

The following reflow soldering profiles are provided for reference. Edison recommends that users follow the recommended soldering profile provided by the manufacturer of the solder paste used.



< Figure 22 Reflow Profiles >

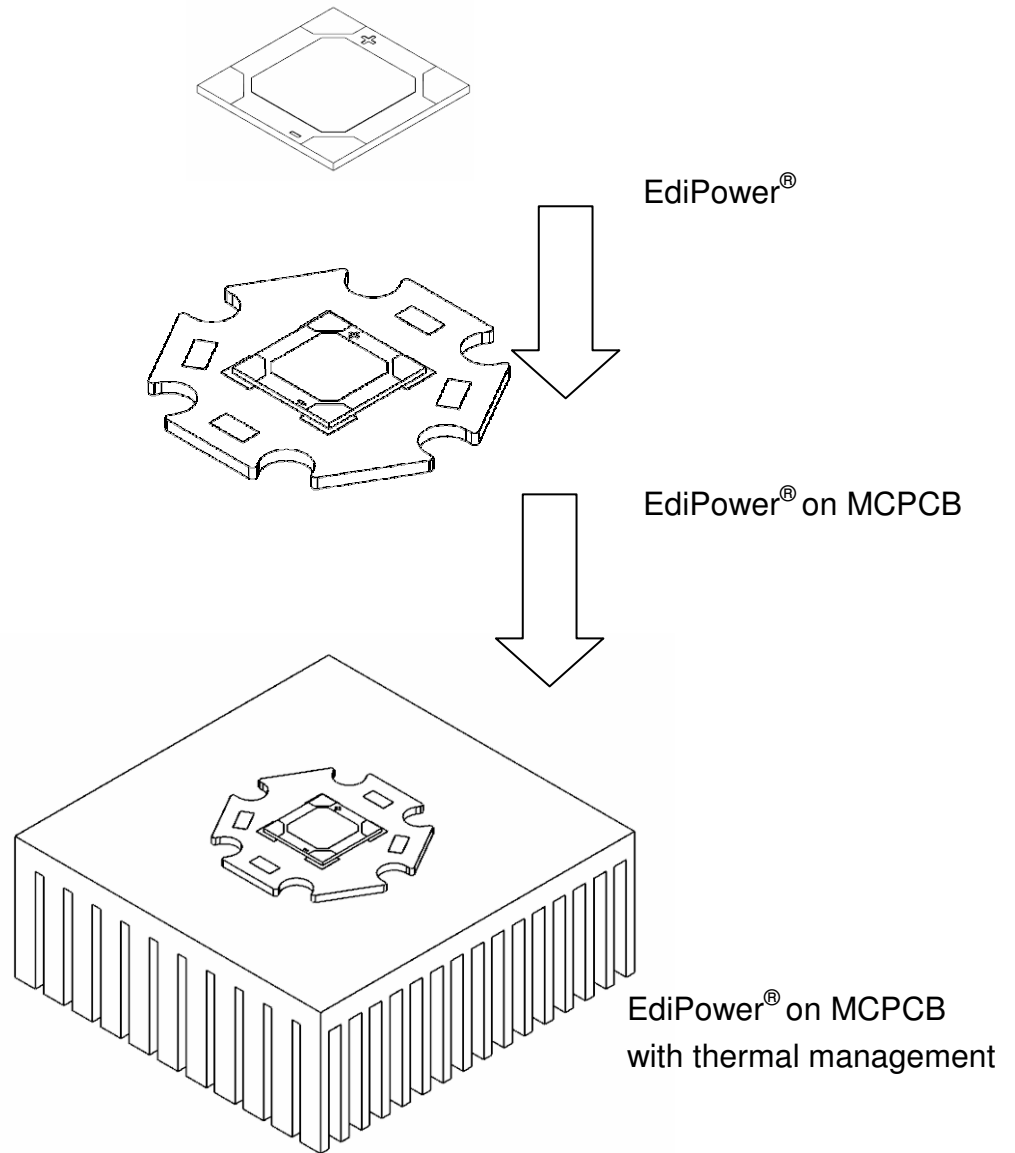
Table of Classification Reflow Profiles

< Table 22 Reflow Profiles >

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Preheat & Soak		
Temperature min (T _{min})	100 °C	150 °C
Temperature max (T _{max})	150 °C	200 °C
Time (T _{min} to T _{max}) (ts)	60-120 Sec.	60-120 Sec.
Average ramp-up rate (T _{max} to T _p)	3 °C/Sec max.	3 °C/Sec max.
Liquidous temperature (TL)	183 °C	217 °C
Time at liquidous (tL)	60-150 Sec.	60-150 Sec.
Peak package body temperature (T _p)*	230 °C ~235 °C *	255 °C ~260 °C *
Classification temperature (T _c)	235 °C	260 °C
Time (tp)** within 5 °C of the specified classification temperature (T _c)	20** Sec	30** Sec
Average ramp-down rate (T _p to T _{max})	6 °C/Sec max.	6 °C/Sec max.
Time 25 °C to peak temperature	6 min max.	8 min max.
* Tolerance for peak profile temperature (T _p) is defined as a supplier minimum and a user maximum.		
** Tolerance for time at peak profile temperature (tp) is defined as a supplier minimum and a user maximum.		

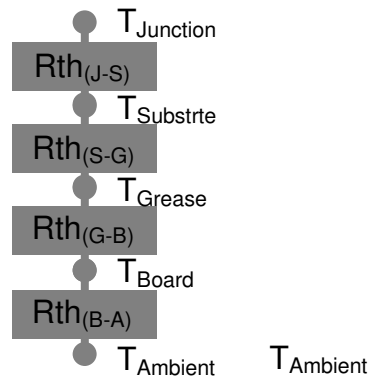
Product Thermal Application Information

Thermal grease should be evenly spread with a thickness <math>< 100\mu\text{m}</math> when assembling on MCPCB or heatsink carrier.



< Figure 23 EdiPower[®] Heatsink Application >

Thermal Resistance Application



$$R_{th(J-A)} = R_{th(J-S)} + R_{th(S-G)} + R_{th(G-B)} + R_{th(B-A)}$$

$$T_{Junction} = T_{Ambient} + R_{th(J-A)} \times P_{Dissipation}$$

$$(T_J = T_A + R_{th(J-A)} \times P_D)$$

< Figure 24 Rth and T_J for EdiPower[®] >

Suggested Adhesive for Selection(such as thermal grease)

- Ease of use
 - Non-solvent, One-part
- Fast tack free
 - 3 minutes at 25°C
- No corrosion
 - Alcohol type of room temperature vulcanization (RTV)
- Low volatility
 - Low weight loss of silicone volatiles
- Adhesion
 - Excellent adhesion to most materials without use of a primer
- Dielectric properties
 - Cured rubber exhibits good dielectric properties
- Excellent thermal stability and cold resistance
 - Cured rubber provides wide service temperature range

< Table 23 Specification for Adhesive properties >

Specification	Suggested Properties
Take-free time	3~10 mins
Specific gravity	< 3 g/cm ²
Thermal conductivity	> 2.5 W/mK
Rth in using	< 1.8 °C/W
Volume resistance	> 1x10 ¹⁴
Lap shear adhesion strength	> 200 N/ cm ²
Tensile strength	> 4 Mpa

Thermal Resistance Calculation

The thermal resistance between two points is defined as the ratio of the difference in temperature to the power dissipated. For calculations in the following units used are °C/W. In the case of LEDs, the resistance of two important thermal paths affects the junction temperature:

From the LED junction to the thermal contact at the bottom of the package, this thermal resistance is governed by the package design. It is referred to as the thermal resistance between junction and slug ($R_{th (J-S)}$)

From the thermal contact to ambient conditions, this thermal resistance is defined by the path between the slug, board, and ambient. It is referred to as the thermal resistance between slug and board ($R_{th (S-B)}$) and between board and ambient ($R_{th (B-A)}$).

The overall thermal resistance between the LED junction and ambient ($R_{th (J-A)}$) can be modeled as the sum of the series resistances $R_{th (J-S)}$, $R_{th (S-B)}$, and $R_{th (B-A)}$.

The following will show how to calculate R_{th} for each part of LED module.

1. $R_{th (J-S)}$

EdiPower® series $R_{th (J-S)}=5\text{ °C/W}$

2. $R_{th (S-G)}$

If the thickness of thermal grease is 100um and area is 8.4x8.4 mm².

Thermal conductivity of thermal grease is 2.6 W/mK.

The Formula of R_{th} is
$$\frac{\text{Thickness(um)}}{\text{Thermal Conductivity (W/mK) x Area(mm}^2)}$$

$$\text{Therefore } R_{th(S-G)} = \frac{100}{2.6 \times 8.4 \times 8.4} = 0.54 \text{ } ^\circ\text{C/W}$$

3. $R_{th(G-B)}$

Assume R_{th} of standard MCPCB is $1.5 \text{ } ^\circ\text{C/W}$

4. $R_{th(B-A)}$

The R_{th} between board and air is mainly dependent on the total surface area.

$$\text{Therefore } R_{th(B-A)} \doteq \frac{500}{\text{Area}(\text{cm})^2}$$

$$\text{If Area is } 30\text{cm}^2 \quad R_{th}=16.7 \quad R_{th(J-A)} = 5+0.54+1.5+16.7 = 23.74 \text{ } ^\circ\text{C/W}$$

$$\text{If Area is } 60\text{cm}^2 \quad R_{th}=8.3 \quad R_{th(J-A)} = 5+0.54+1.5+8.3 = 15.34 \text{ } ^\circ\text{C/W}$$

$$\text{If Area is } 90\text{cm}^2 \quad R_{th}=5.5 \quad R_{th(J-A)} = 5+0.54+1.5+5.5 = 12.54 \text{ } ^\circ\text{C/W}$$

Junction Temperature Calculation

The total power dissipated by the LED is the product of the forward voltage (V_F) and the forward current (I_F) of the LED.

The temperature of the LED junction is the sum of the ambient temperature and the product of the thermal resistance from junction to ambient and the power dissipated.

$$T_{\text{Junction}} = T_{\text{Air}} + R_{th(J-A)} \times P_{\text{Dissipation}}$$

If one white EdiPower[®] in room temperature (25°C) operated 500mA and $V_F = 7\text{V}$, the $P_{\text{Dissipation}} = 0.7 \times 7 = 4.9\text{W}$

And junction temperature is

$$T_{\text{Junction}} = 25^\circ\text{C} + 23.74 \times 4.9 = 141 \text{ } ^\circ\text{C} \text{ (total surface area } = 90\text{cm}^2)$$

$$T_{\text{Junction}} = 25^\circ\text{C} + 27.5 \times 4.9 = 160 \text{ } ^\circ\text{C} \text{ (total surface area } = 60\text{cm}^2)$$

$$T_{\text{Junction}} = 25^\circ\text{C} + 35.9 \times 4.9 = 200 \text{ } ^\circ\text{C} \text{ (total surface area } = 30\text{cm}^2)$$

Example : Junction Temperature Calculation

One white LED is used under ambient temperature (T_{Ambient}) of 30°C . This LED is attach on Heatsink (Area= 100cm^2). Calculate junction temperature.

Assuming a forward voltage of $V_F = 10.2\text{V}$ at 500mA and total power dissipated is

$$P_{\text{Dissipation}} = 1 \times 0.5 \times 10.2 = 5.1 \text{ W.}$$

$$\text{EdiPower}^{\text{®}} \quad R_{th(J-S)} = 5 \text{ } ^\circ\text{C/W.}$$

With good design, $R_{th(S-G)}$ can be minimized to $1 \text{ } ^\circ\text{C/W}$.

$R_{th(G-B)}$ of a standard MCPCB can be $1.5 \text{ } ^\circ\text{C/W}$.

The R_{th} between board and air is mainly dependent on the total surface area.

Therefore it can be calculated in formula $\frac{500}{\text{Area}(\text{cm})^2}$

$$R_{th(B-A)} = \frac{500}{100} = 5 \text{ } ^\circ\text{C/W}.$$

Following the formula $T_{\text{Junction}} = T_{\text{Ambient}} + R_{th(J-A)} \times P_{\text{Dissipation}}$

$$T_{\text{Junction}} = 30 \text{ } ^\circ\text{C} + (5 \text{ } ^\circ\text{C/W} + 1 \text{ } ^\circ\text{C/W} + 1.5 \text{ } ^\circ\text{C/W} + 5 \text{ } ^\circ\text{C/W}) \times 5\text{W}$$
$$= 92.5 \text{ } ^\circ\text{C}$$

That means this LED is operated under good condition ($T_{\text{Junction}} < 125 \text{ } ^\circ\text{C}$).

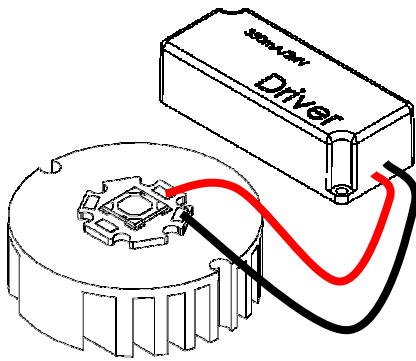
It's strongly recommended to keep the junction temperature under $125 \text{ } ^\circ\text{C}$

Or keep the substrate temperature of emitter not exceed $55 \text{ } ^\circ\text{C}$

Product Electrical Application Information

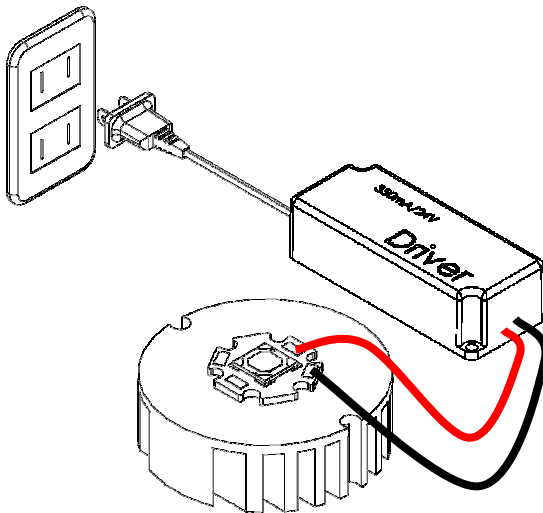
Following graphs and descriptions show how to connect LED or LED module and plug to AC outlet.

Step1: Connect the wires of LED Module to the DC output of the driver.



< Figure 25 LED Module connect to the DC output of the driver >

Step2 : Plug the driver to AC outlet.



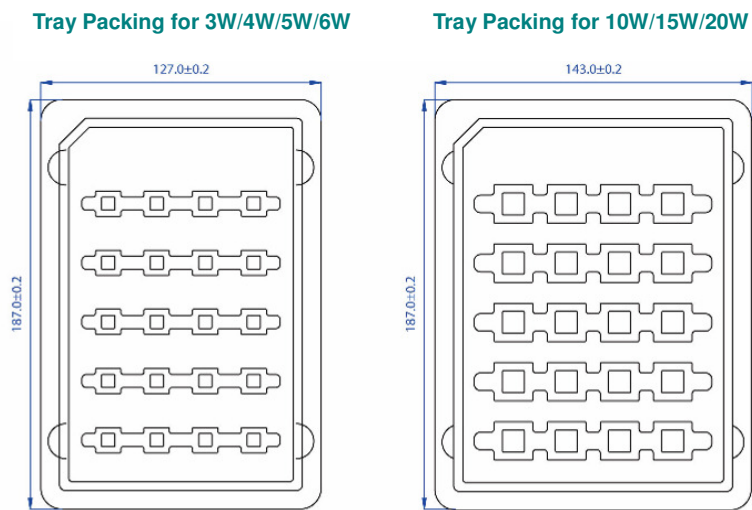
< Figure 26 Plug the AC output of the driver to AC outlet >

Caution: Never plug the driver to AC outlet before the LED Module is properly connected to the driver as this may generate transient voltage and damage the LEDs permanently.

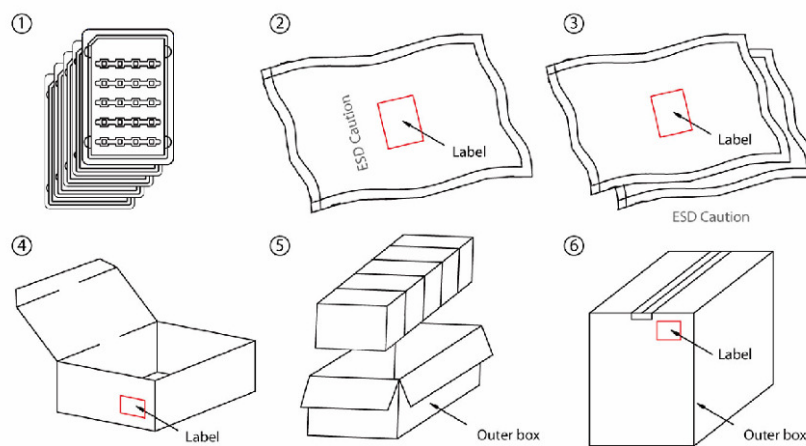
Simple Test Method

A constant current circuit is strongly recommended. The constant voltage circuit as below is not a good method to use though it is simple. Heat dissipation must be cared even testing pulse is short, otherwise some interface will be damaged.

EdiPower® Packaging Information



< Figure 27 Tray package dimension >



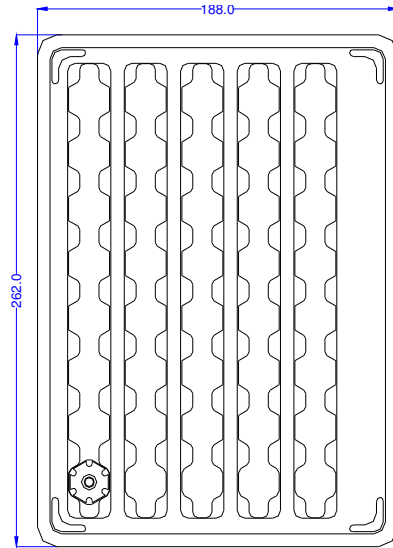
< Figure 28 Packaging steps >

Notes:

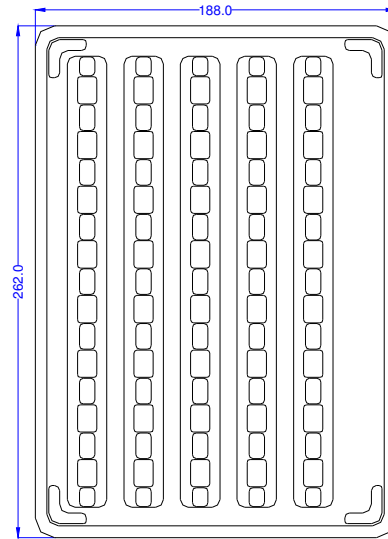
1. All dimensions are in mm.
2. There are 25pcs emitters in a full tray.
3. There are 5 trays in a bag.
4. There are 5 bags in an inner box.
5. There are 5 inner boxes in an outer box.
6. A bag contains one humidity indicator card and drying agent.

EdiPower® with Star Package Specifications

Star Tray Packaging for 3W/4W/5W/6W

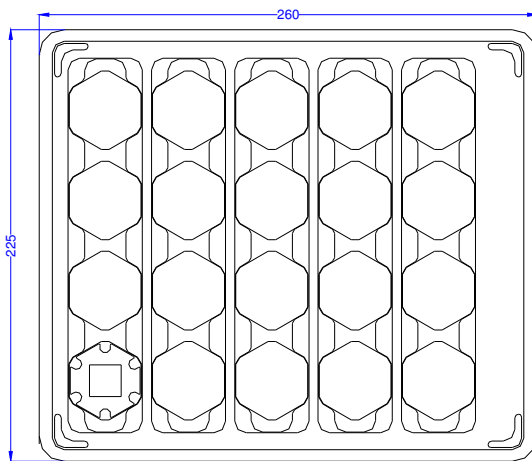


Tray

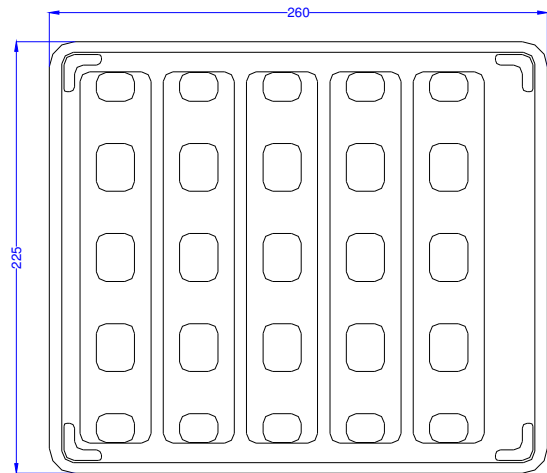


Cover

Star Tray Packaging for 10W/15W/20W

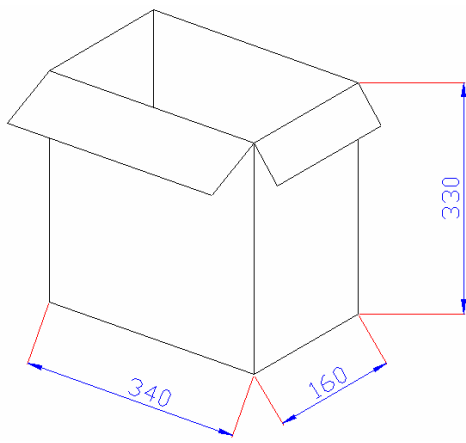


Tray

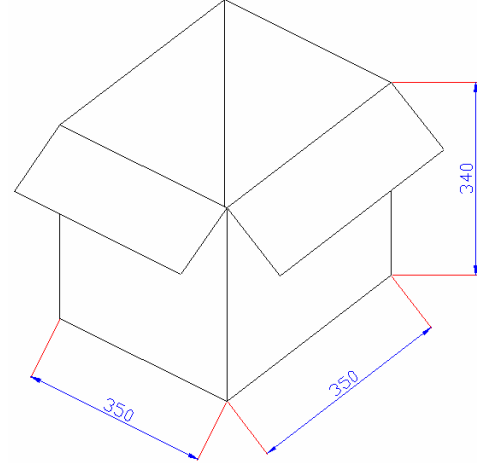


Cover

< Figure 29 Star tray package dimensions >



< Figure 30 Inner box >

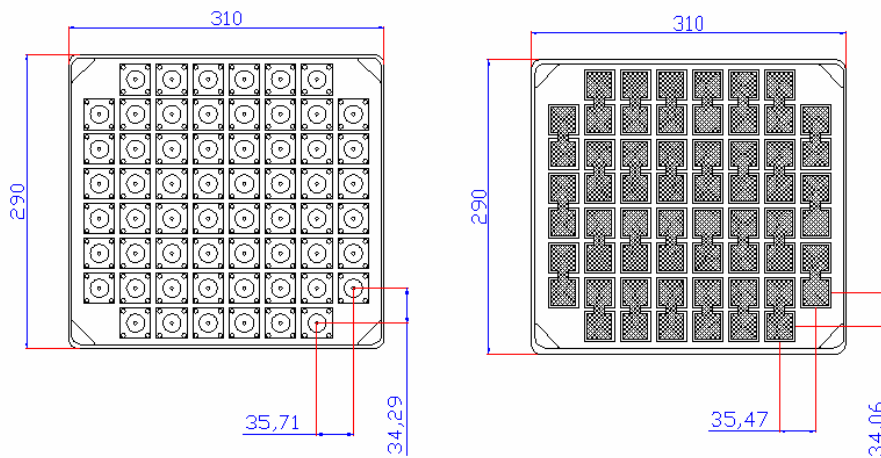


< Figure 31 Outer box >

Notes:

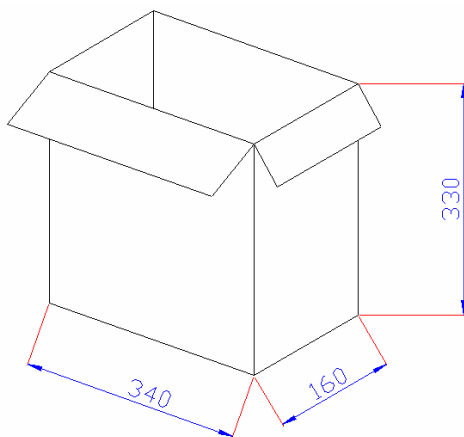
1. All dimensions are in mm.
2. There are 80pcs stars in a 5W star tray and 40pcs stars in a 10W/15W/20W star tray.
3. There are 10 trays in an inner box.
4. There are 2 inner boxes in an outer box.

Square Star Tray Packaging

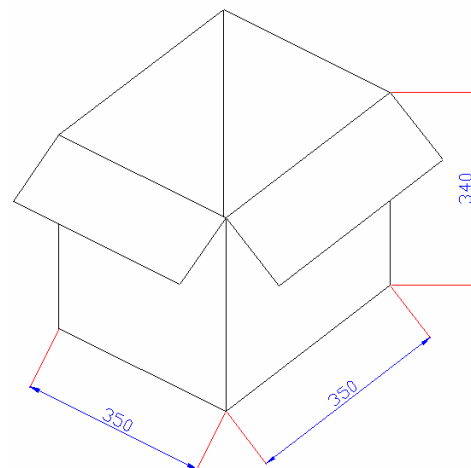


< Figure 32 Square Star Tray >

V



< Figure 33 Inner box >



< Figure 34 Outer box >

Notes:

1. All dimensions are in mm.
2. There are 60 pcs stars in a tray.
3. There are 10 trays in an inner box.
4. There are 2 inner boxes in an outer box.