



**APEX OPTO
CORP**

HIGH POWER LIGHT AOL-EX3LXX 3W Series



APEX are designed by particular package for High Power LED. 3W white has typical 100 lumens @700mA. Unlike most fluorescent sources, APEX contains no mercury and has more energy efficient than other incandescent light source.

Features

- Various colors
- More energy efficient than incandescent and most halogen lamps
- Low voltage operated
- Instant light
- Long operating life

Typical Applications

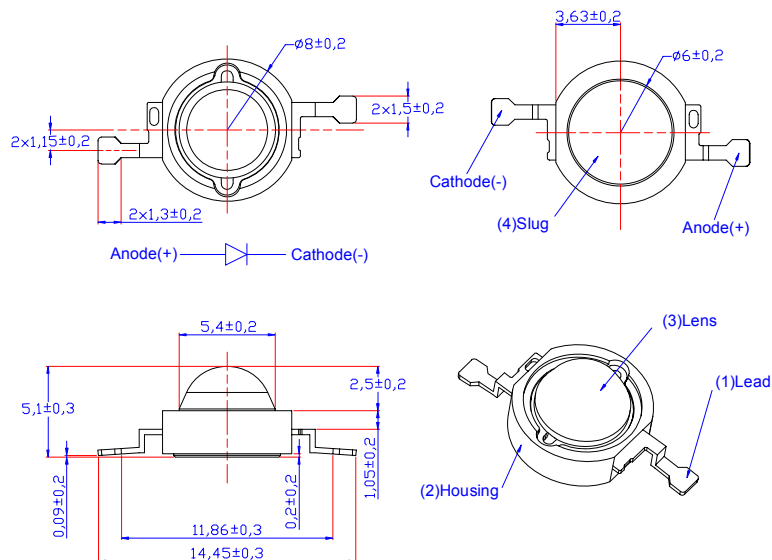
- Reading lights
- Portable flashlight
- Up-lighters and Down-lighters
- LCD Backlights
- General lighting
- Contour lights
- Ceiling lights
- Garden lighting
- Decoration lights
- Architectural lighting
- Beacon lights

APEX-Technology

- $T_{jmax} = 135^{\circ}\text{C}$
- High Lumen performance
- Low thermal resistance $13^{\circ}\text{C}/\text{W}$
- RoHS compliant
- Industrial best lumen maintenance – 50,000hrs life at I_{Fmax} with 70% lumen if T_j is lower than 70°C

Package Outlines

Lambertian



Notes:

1. All dimensions are in mm.
2. It is strongly recommended that the temperature of lead be not higher than 55°C
3. It is important that the slug can't contact aluminum surface, It is strongly recommended that there should coat an uniform electrically isolated heat dissipation film on the aluminum surface.

Absolute Maximum Ratings

Parameter	Symbol	Rating	Units
DC Forward Current	I_F	700	mA
Peak pulse current;(tp \leq 100 μ s, Duty cycle=0.25) ^[1]	I_{pulse}	1000	mA
Peak pulse current;(tp \leq 100 μ s, Duty cycle=0.25) ^[2]	I_{pulse}	1500	mA
Reverse Voltage	V_R	5	V
LED junction Temperature	T_j	135	°C
Forward Contact Voltage	V_{FC}	16	V
Operating Temperature	T_{opr}	-30 ~ +110	°C
Storage Temperature	T_{stg}	-40 ~ +120	°C
ESD Sensitivity	V_B	500	V
Manual Soldering Time at 260°C (Max.)	T_{sol}	5	seconds

Note:

1. There includes: White 、 Warm White 、 True Green 、 Blue
2. There includes: Red 、 Amber 、 Red Orange
3. Proper current derating must be observed to maintain junction temperature below the maximum.
4. LEDs are not designed to be driven in reserve bias.

Luminous Flux or Radiometric Power^[1] Characteristics at I_F =700mA (T_j=25°C)

Lens Item	Part Name	Color	Flux			Units
			Min.	Typ.	Max.	
Lambertian	AOL-EW3LA1	White	66.5	100	--	lm
	AOL-EX3LA1	Warm White	51.2	80	--	lm
	AOL-ER3LA3	Red	39.4	65	--	lm
	AOL-EO3LA3	Red Orange	51.2	70	--	lm
	AOL-EA3LA3	Amber	39.4	65	--	lm
	AOL-ET3LA1	True Green	51.2	90	--	lm
	AOL-EB3LA1	Blue	13.8	30	--	lm
	AOL-EC3LC1	Royal Blue ^[1]	256.3	350	--	mW

Forward Voltage Characteristics at I_F=700mA(T_j=25°C):

Lens Item	Part Name	Color	V _F			Units
			Min.	Typ.	Max.	
Lambertian	AOL-EW3LA1	White	3.1	--	4.3	V
	AOL-EX3LA1	Warm White	3.1	--	4.3	V
	AOL-ER3LA3	Red	2.0	--	3.0	V
	AOL-EO3LA3	Red Orange	2.0	--	3.0	V
	AOL-EA3LA3	Amber	2.0	--	3.0	V
	AOL-ET3LA1	True Green	2.8	--	4.0	V
	AOL-EB3LA1	Blue	3.1	--	4.3	V
	AOL-EC3LC1	Royal Blue	3.1	--	4.3	V

Dominant Wavelength or Peak Wavelength^[1] or CCT Characteristics at I_F=700mA(T_j=25°C):

Lens Item	Part Name	Color	λ _d /CCT			Units
			Min.	Typ.	Max.	
Lambertian	AOL-EW3LA1	White	4500	--	10000	K
	AOL-EX3LA1	Warm White	2800	--	3800	K
	AOL-ER3LA3	Red	620	--	630	nm
	AOL-EO3LA3	Red Orange	610	--	620	nm
	AOL-EA3LA3	Amber	585	--	595	nm
	AOL-ET3LA1	True Green	515	--	535	nm
	AOL-EB3LA1	Blue	460	--	475	nm
	AOL-EC3LC1	Royal Blue ^[1]	445	--	460	nm

Temperature Coefficient of Forward Voltage & Thermal Resistance Junction to Case Characteristics at $I_F=700\text{mA}(T_j=25^\circ\text{C})$:

Lens Item	Part Name	Color	$\Delta V_F/\Delta T$		$R\theta_{J-B}$	
			Typ.	Units	Typ.	Units
Lambertian	AOL-EW3LA1	White	-2	mV/°C	13	°C/W
	AOL-EX3LA1	Warm White	-2	mV/°C	13	°C/W
	AOL-ER3LA3	Red	-2	mV/°C	13	°C/W
	AOL-EO3LA3	Red Orange	-2	mV/°C	13	°C/W
	AOL-EA3LA3	Amber	-2	mV/°C	13	°C/W
	AOL-ET3LA1	True Green	-2	mV/°C	13	°C/W
	AOL-EB3LA1	Blue	-2	mV/°C	13	°C/W
	AOL-EC3LC1	Royal Blue	-2	mV/°C	10	°C/W

Emission Angle Characteristics at $I_F=700\text{mA}(T_i=25^\circ\text{C})$:

Part Name	Color	$2\theta_{1/2}$			Units
		Max.	Typ.	Min.	
AOL-EW3LA1	White	--	135	--	Degrees
AOL-EX3LA1	Warm White	--	135	--	Degrees
AOL-ER3LA3	Red	--	120	--	Degrees
AOL-EO3LA3	Red Orange	--	120	--	Degrees
AOL-EA3LA3	Amber	--	120	--	Degrees
AOL-ET3LA1	True Green	--	150	--	Degrees
AOL-EB3LA1	Blue	--	150	--	Degrees
AOL-EC3LC1	Royal Blue	--	150	--	Degrees

Note

1. Flux is measured with an accuracy of $\pm 10\%$.
2. CCT selection acc. to CCT groups and an accuracy of $\pm 200\text{K}$
3. Forward Voltage is measured with an accuracy of $\pm 0.1\text{V}$
4. Wavelength is measured with an accuracy of $\pm 0.5\text{nm}$
5. All white, warm white and blue emitters are built with InGaN
6. All red, red-orange and amber emitters are built with AlGaInP

JEDEC Moisture Sensitivity:

Level	Floor Life		Soak Requirements			
	Time	Conditions	Standard		Accelerated Environment	
			Time (hours)	Conditions	Time (hours)	Conditions
4	72hours	≤ 30°C / 60% RH	96 +2/-0	30°C / 60% RH	20 +0.5/-0	60°C / 60% RH

LEVEL	FLOOR LIFE		SOAK REQUIREMENTS			
			STANDARD		ACCELERATED EQUIVALENT ¹	
	TIME	CONDITIONS	TIME (hours)	CONDITIONS	TIME (hours)	CONDITIONS
1	Unlimited	≤30°C/85% RH	168 +5/-0	85°C/85% RH		
2	1 year	≤30°C/80% RH	168 +5/-0	85°C/80% RH		
2a	4 weeks	≤30°C/80% RH	600 ² +5/-0	30°C/80% RH	120 +1/-0	60°C/80% RH
3	168 hours	≤30°C/80% RH	192 ² +5/-0	30°C/80% RH	40 +1/-0	60°C/80% RH
4	72 hours	≤30°C/80% RH	96 ² +2/-0	30°C/80% RH	20 +0.5/-0	60°C/80% RH
5	48 hours	≤30°C/80% RH	72 ² +2/-0	30°C/80% RH	15 +0.5/-0	60°C/80% RH
5a	24 hours	≤30°C/80% RH	48 ² +2/-0	30°C/80% RH	10 +0.5/-0	60°C/80% RH
6	Time on Label (TOL)	≤30°C/80% RH	TOL	30°C/80% RH		

Note

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.

Operating life, mechanical, and environmental tests performed on APEX package:

Stress Test	Stress Conditions	Stress Duration	Failure Criteria
Room Temperature Operating Life	25°C, I _F = max DC (Note 1)	1000 hours	Note 2
High Temperature High Humidity	85°C / 85%RH	1000 hours	Note 2
Temperature Cycle	-40°C/100°C ,30 min dwell / <5min transfer	200 cycles	Note 2
High Temperature Storage Life	110°C	1000 hours	Note 2
Low Temperature Storage Life	-55°C	1000 hours	Note 2
Thermal Shock	-40 / 120°C, 20 min dwell / <20 sec transfer	200 cycles	No catastrophics
Mechanical Shock	1500 G, 0.5 msec pulse, 5 shocks each		No catastrophics
Natural Drop	axis		No catastrophics
Variable Vibration Frequency	On concrete from 1.2 m, 3X		No catastrophics
Solder Heat Resistance (SHR)	10-2000-10 Hz, log or linear sweep rate, 20 G about 1 min, 1.5 mm, 3X/axis		No catastrophics
Solderability	260°C ± 5°C, 10 sec		Solder coverage on lead
	Steam age for 16 hr, then solder dip at 260°C for 5 sec		

Note

1. Depending on the maximum derating curve.

2. Failure Criteria:

Electrical failures

V_F shift >=10%

I_R<50uA @V_R=5V

Light Output Degradation

% I_v shift >= 30% @1000hrs or 200cycle

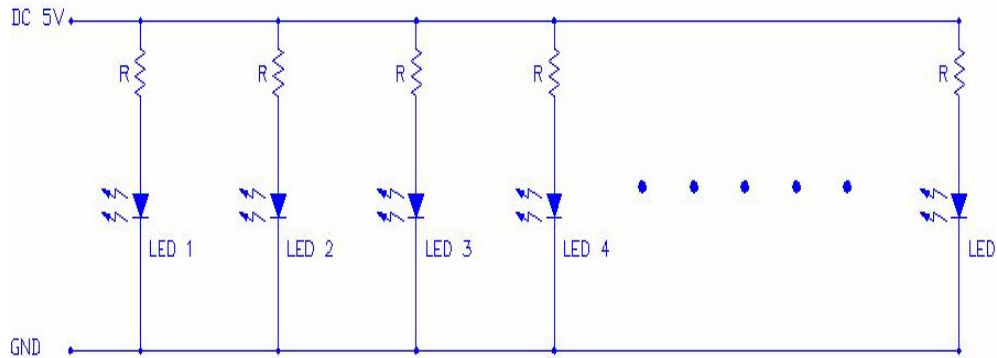
Visual failures

Broken or damaged package or lead

Solderability < 95% wetting

Dimension out of tolerance

Burn-in Condition APEX Reliability



When we talk about MTBF of APEX, we can provide a formula for customers.

$$\log(\text{Life}) = \frac{1600}{T_j(^{\circ}\text{C}) + 273}$$

Life means the time light output becomes 70%.

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

When we talk about MTBF of APEX, we can provide a formula for customers

MTBF 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

Tj=75°C is giving 0.01%(100ppm) at 10,000hrs if there is 1 failure of 10 emitters in a system

Tj=75°C is giving 0.1%(1,000ppm) at 10,000hrs

if there is 1 failure of 1 emitter in a system

Tj=75°C is giving 0.05%(500ppm) at 50,000hrs if there is 1 failure of 10 emitters in a system

Tj=75°C is giving 0.5%(5,000ppm) at 50,000hrs if there are 10 emitters

How to Know Tj in Your Application?

Rth(junction to case)=13°C/W

The thermal grease is 200um.

K(Aluminum PCB)=2.6 W/mk

Then Rth(case to board)= $\frac{200}{2.6 \times (6.4/2)^2 \pi} = 2.4 \text{ } ^\circ\text{C/W}$

The Rth between board and air is mainly dependent on the total surface air.

Rth(board-air) = $\frac{500}{\text{Area}(\text{cm}^2)}$

If Area is 30cm² Rth=16.7 ΔT(junction-air)=(13+2.4+16.7)x3=96.3 °C

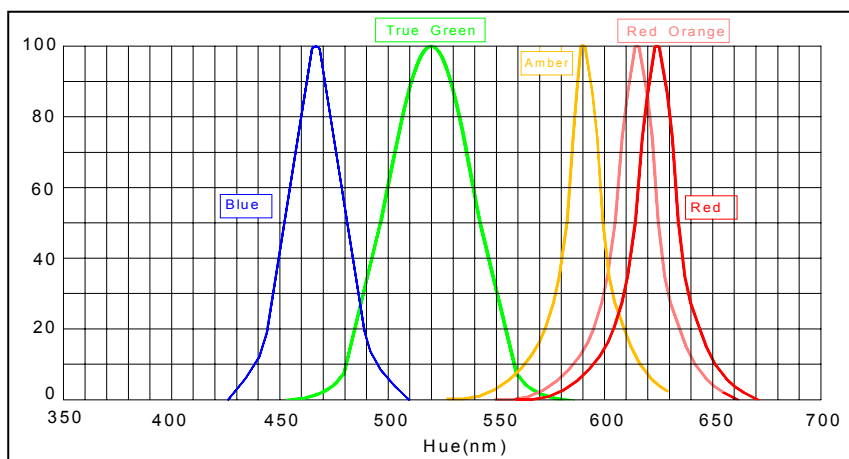
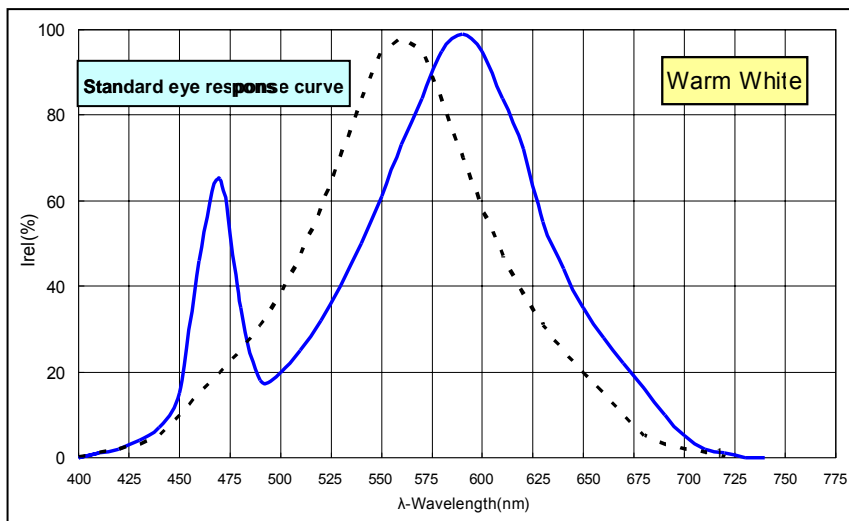
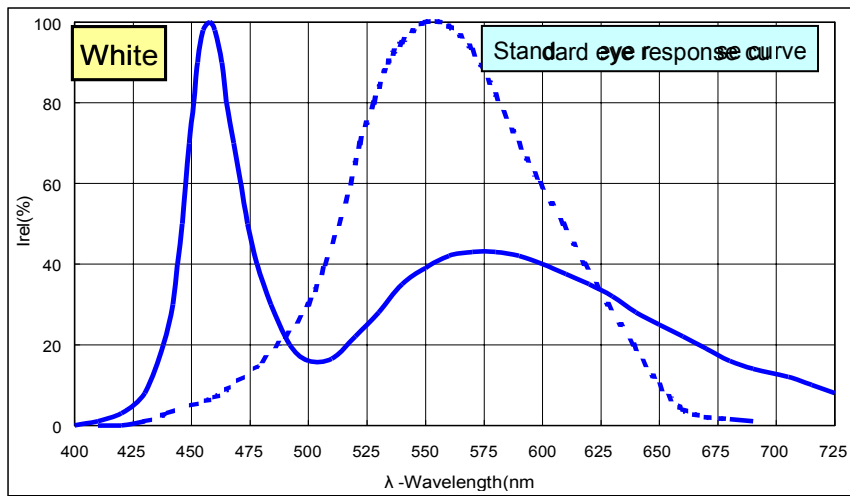
If Area is 60cm² Rth=8.3 ΔT(junction-air)=(13+2.4+8.3)x3=71.1 °C

If Area is 90cm² Rth=5.5 ΔT(junction-air)=(13+2.4+5.5)x3=62.7 °C

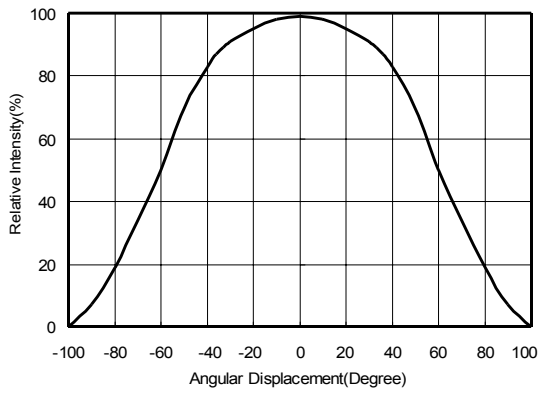
ASSIST FORM about High Power LED Reliability (White APEX)

	<u>Ts=45°C</u>	<u>Ts=65°C</u>	<u>Ts=85°C</u>
Voltage	3.6V	3.6V	3.6V
Current	700mA	700mA	700mA
Wattage	2.5W	2.5W	2.5W
Heat	2.0W	2.0W	2.0W
Rth	13 °C/W	13 °C/W	13 °C/W
Tj	71 °C	91 °C	111 °C
L_{70%}	46,000hrs	25,700hrs	15,100hrs

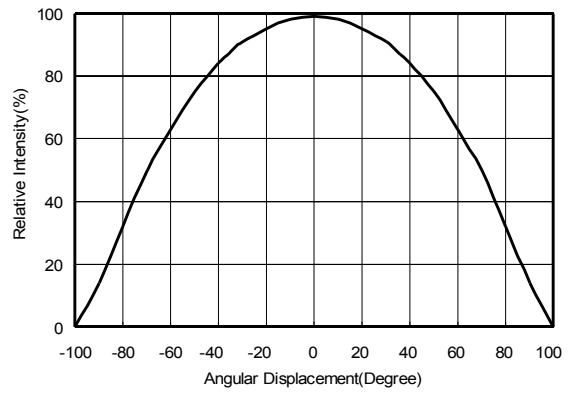
Electrical & Optical Curves-Spectrum



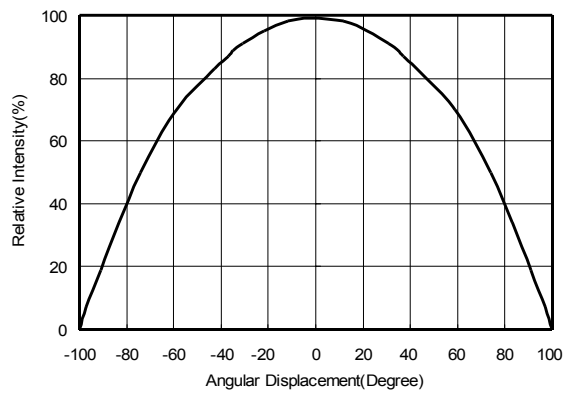
**Typical Radiation Pattern for
Lambertian**



for Red、Amber、Red Orange

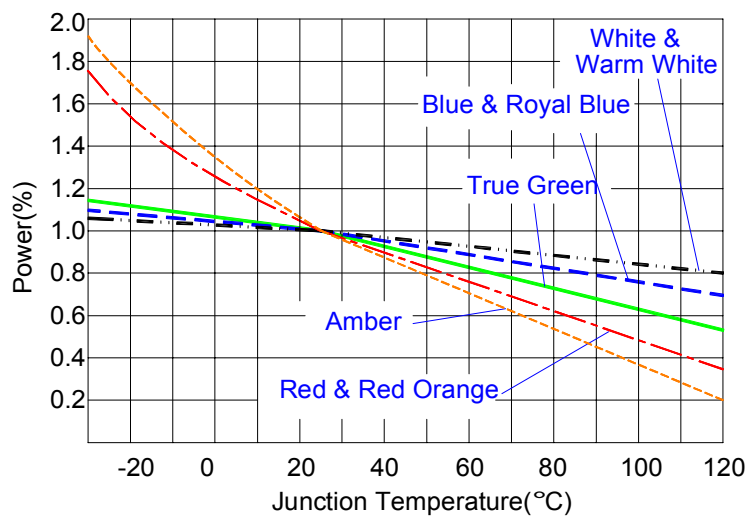


for White、Warm white

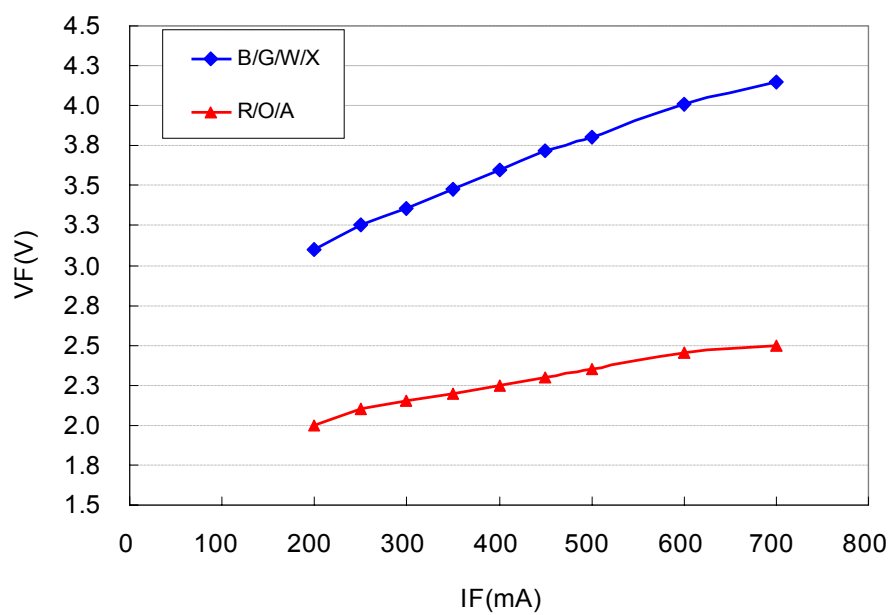


for Blue、True Green

Typical Optical and Electrical Curves

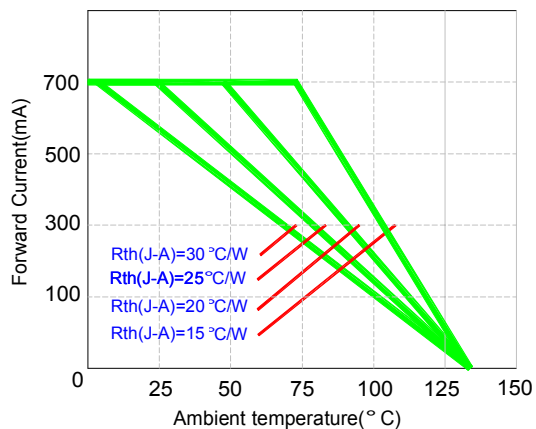


Junction Temperature & Forward Voltage

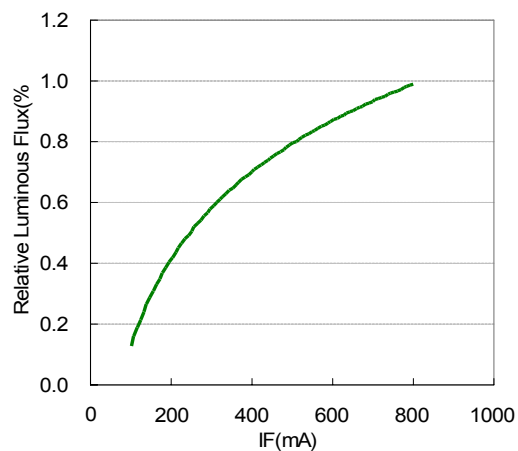


Operating Current & Forward Voltage

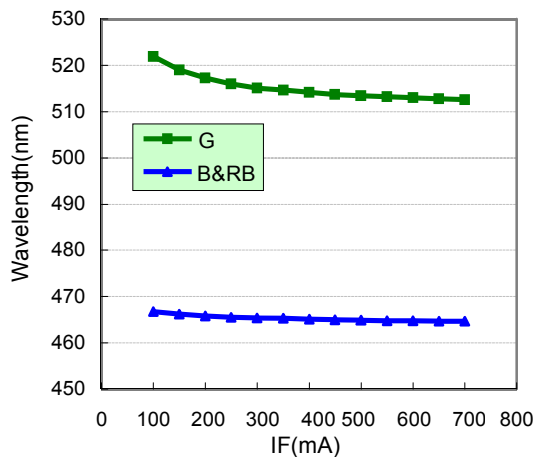
Typical Optical and Electrical Curves



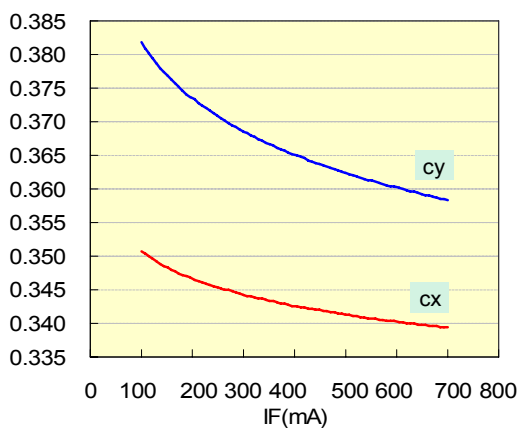
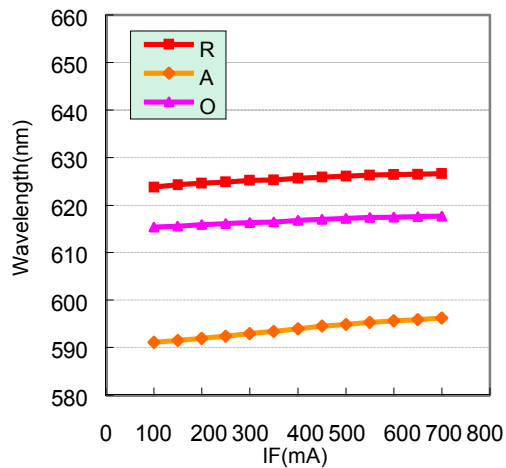
Operating Current & Ambient Temperature



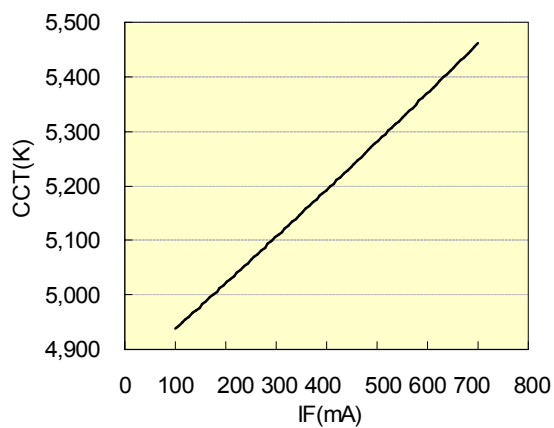
Forward Current & Luminous Flux



Forward Current & Wavelength



Forward Current & chromaticity coordinate



Forward Current & CCT

Adhesive for Emitter to Aluminum PCB

Suggestion:

- **Ease of use**
Non-solvent, One-part
- **Fast tack free**
3 minutes at 25°C
- **No corrosion**
Alcohol type of 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

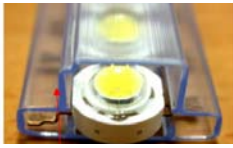
Typical Properties

Specification	Suggested Properties
Take-free time	3~10 minutes
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

Thrust for APEX Lens

Lens Type	Typical Thrust
Lambertian Lens	5 kgf

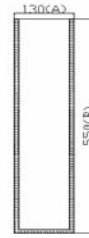
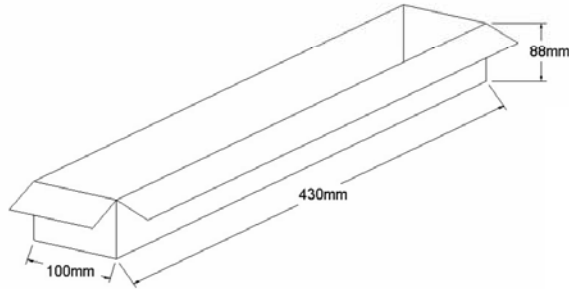
Package Specifications



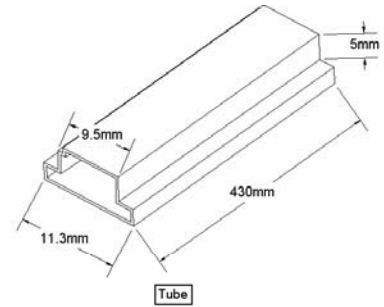
Cathode



Anode



Antistatic bag



Tube

Notes

1. There are 50pcs emitters in a tube
2. There are 20 tubes in a bag
3. There are 2 bags in an inner box
4. A bag contains one humidity indicator card and drying agent

Packing Step	Type	Dimension(mm)	Emitter Q'ty(Max.)
1	Tube	430*13	50
2	Inner Box	430*100*88	1,000
3	Outer Box	460*196*135	2,000