APEX OPTO CORP

HIGH POWER LIGHT

AOL-EX1XAX

1W Series

APEX are designed by particular package for High Power LED. 1W white has typical 55 lumens @350mA. 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

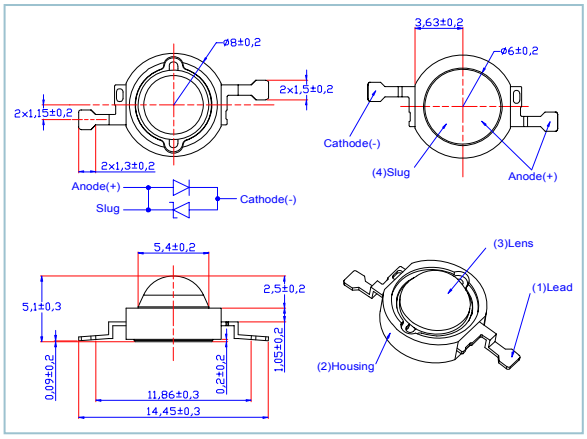
- Reading lights
- Portable flashlight
- Up-lighters and Down -lighters
- LCD Backlights
- General lighting
- Contour lights
- Ceiling lights
- Garden lighting
- Decoration lights
- Architectural lighting
- Beacon lights

APEX Technology

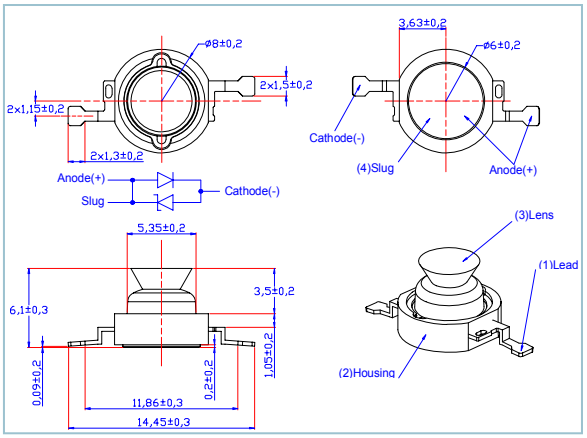
- Tjmax = 125℃
- High Lumen performance
- Low thermal resistance 15-18℃/W
- ROHS compliant
- Industrial best lumen maintenance -- 50,000hrs life at I_{Fmax} with 70% lumen If T_j is lower than70℃

Package Outlines

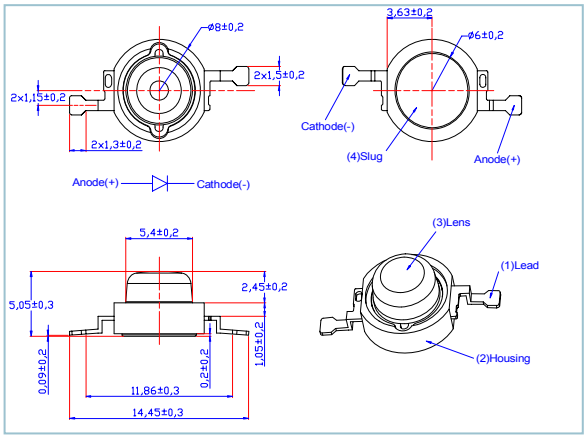
Lambertian



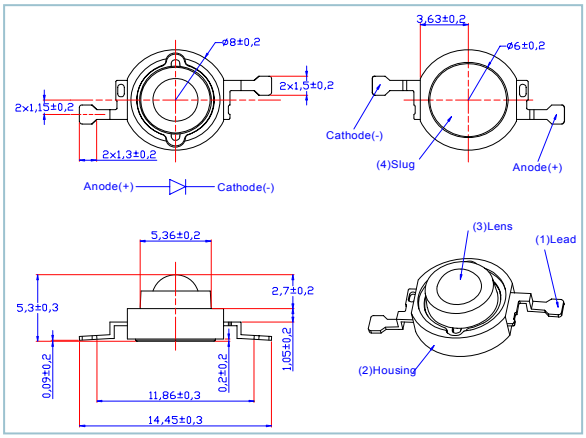
Side Emitting



Batwing



Focusing



Notes:

- **All dimensions are in mm.**
- **Drawings are not to scale.**
- **It is strongly recommended that the temperature of lead be not higher than 55℃.**
- **Lambertian and side emitting series slug has polarity as anode.**
- **It is important that the slug can't contact aluminum surface, It is strongly recommended that there should coat a uniform electrically isolated heat dissipation film on the aluminum surface.**

Absolute Maximum Ratings

Parameter	Symbol	Rating	Units
DC Forward Current	I_F	**350**	mA
Peak pulse current;(tp≦100μs, Duty cycle=0.25)	I_{pulse}	**500**	mA
Reverse Voltage	V_R	**5**	V
Forward Contact Voltage	V_{FC}	**16**	V
LED junction Temperature	T_j	**125**	℃
Operating Temperature	T_{opr}	**-30 ~ +110**	℃
Storage Temperature	T_{stg}	**-40 ~ +120**	℃
ESD Sensitivity (Lambertian and Side emitting)	V_B	**4,000**	V
ESD Sensitivity (Batwing and Focusing)	V_B	**500**	V
Manual Soldering Time at 260℃(Max.)	T_{sol}	**5**	*seconds*

Notes:

- **Proper current derating must be observed to maintain junction temperature below the maximum.**
- **LEDs are not designed to be driven in reserve bias.**

Luminous Flux & Radiometric Power[1] Characteristics at I_F=350mA(Tj=25℃):

Lens Item	Part Name	Color	Flux			Units
			Min.	Typ.	Max.	
Lambertian Side Emitting	AOL-EW1xA1	White	30.3	55.0	--	lm
	AOL-EW1xA6	White	30.3	45.0	--	lm
	AOL-EW1xA7	White	30.3	60.0	--	lm
	AOL-EX1xAx	Warm White	17.9	40.0	--	lm
	AOL-ER1xAx	Red	23.3	45.0	--	lm
	AOL-EO1xAx	Red Orange	23.3	45.0	--	lm
	AOL-EA1xAx	Amber	23.3	40.0	--	lm
	AOL-ET1xAx	True Green	30.3	60.0	--	lm
	AOL-EB1xAx	Blue	8.2	15.0	--	lm
	AOL-EC1xAx	Royal Blue[1]	113.9	220	--	mW
Lens Item	Part Name	Color	Flux			Units
			Min.	Typ.	Max.	
Batwing Focusing	AOL-EW1xAx	White	30.3	45.0	--	lm
	AOL-EX1xAx	Warm White	17.9	40.0	--	lm
	AOL-ER1xAx	Red	23.3	40.0	--	lm
	AOL-EO1xAx	Red Orange	23.3	40.0	--	lm
	AOL-EA1xAx	Amber	23.3	38.0	--	lm
	AOL-ET1xAx	True Green	30.3	50.0	--	lm
	AOL-EB1xAx	Blue	8.2	13.0	--	lm
	AOL-EC1xAx	Royal Blue[1]	113.9	200	--	mW

Forward Voltage Characteristics at I_F=350mA(Tj=25℃):

Lens Item	Part Name	Color	V_F			Units
			Min.	Typ.	Max.	
Lambertian Side Emitting Batwing Focusing	AOL-EW1xAx	White	3.1	--	4.0	V
	AOL-EW1xA6	White	3.1	--	4.3	V
	AOL-EW1xA7	White	2.8	--	3.7	V
	AOL-EX1xAx	Warm White	2.8	--	4.3	V
	AOL-ER1xAx	Red	2.0	--	3.0	V
	AOL-EO1xAx	Red Orange	2.0	--	3.0	V
	AOL-EA1xAx	Amber	2.0	--	3.0	V
	AOL-ET1xAx	True Green	2.8	--	4.0	V
	AOL-EB1xAx	Blue	3.1	--	4.3	V
	AOL-EC1xAx	Royal Blue	3.1	--	4.3	V

Dominant Wavelength or Peak Wavelength[1] or Color Temperature Characteristics at I_F=350mA(Tj=25℃):

Lens Item	Part Name	Color	λd/λp[1]/CCT			Units
			Min.	Typ.	Max.	
Lambertian Side Emitting Batwing Focusing	AOL-EW1xAx	White	4500	--	10000	K
	AOL-EX1xAx	Warm White	2800	--	3800	K
	AOL-ER1xAx	Red	620	--	630	nm
	AOL-EO1xAx	Red Orange	610	--	620	nm
	AOL-EA1xAx	Amber	585	--	595	nm
	AOL-ET1xAx	True Green	515	--	535	nm
	AOL-EB1xAx	Blue	460	--	475	nm
	AOL-EC1xAx	Royal Blue[1]	440	--	460	nm

Temperature Coefficient of Forward Voltage & Thermal Resistance Junction to Case Characteristics at I_F=350mA(Tj=25℃) : $R\theta_{J-B}$

Lens Item	Part Name	Color	△V_F/△T		Typ.	Units
			Typ.	Units		
Lambertian Side Emitting Batwing Focusing	AOL-EW1xAx	White	-2	mV/℃	15	℃/W
	AOL-EX1xAx	Warm White	-2	mV/℃	15	℃/W
	AOL-ER1xAx	Red	-2	mV/℃	18	℃/W
	AOL-EO1xAx	Red Orange	-2	mV/℃	18	℃/W
	AOL-EA1xAx	Amber	-2	mV/℃	18	℃/W
	AOL-ET1xAx	True Green	-2	mV/℃	15	℃/W
	AOL-EB1xAx	Blue	-2	mV/℃	15	℃/W
	AOL-EC1xAx	Royal Blue	-2	mV/℃	15	℃/W

Emission Angle Characteristics at I_F=350mA(Tj=25℃):

Part Name	Color	2Θ½(Typ.)			Units
		Lambertian	Batwing	Focusing	
AOL-EW1xAx	White	***130***	***110***	***80***	Degrees
AOL-EW1LA6	White	***130***	***--***	***--***	Degrees
AOL-EW1LA7	White	***120***	***--***	***--***	Degrees
AOL-EX1xAx	Warm White	***130***	***110***	***80***	Degrees
AOL-ER1xAx	Red	***120***	***100***	***35***	Degrees
AOL-EO1xAx	Red Orange	***120***	***100***	***35***	Degrees
AOL-EA1xAx	Amber	***120***	***100***	***35***	Degrees
AOL-ET1xAx	True Green	***150***	***110***	***40***	Degrees
AOL-EB1xAx	Blue	***150***	***110***	***40***	Degrees
AOL-EC1xAx	Royal Blue	***150***	***110***	***40***	Degrees

Part Name	Color	Θ_{PEAK}(Typ.)		Units
		Batwing	Side emitting	
AOL-EW1xAx	White	***±40***	***±80***	Degrees
AOL-EW1SA6	White	***--***	***±80***	Degrees
AOL-EW1SA7	White	***--***	***±80***	Degrees
AOL-EX1xAx	Warm White	***±40***	***±80***	Degrees
AOL-ER1xAx	Red	***±35***	***±80***	Degrees
AOL-EO1xAx	Red Orange	***±35***	***±80***	Degrees
AOL-EA1xAx	Amber	***±35***	***±80***	Degrees
AOL-ET1xAx	True Green	***±40***	***±80***	Degrees
AOL-EB1xAx	Blue	***±40***	***±80***	Degrees
AOL-EC1xAx	Royal Blue	***±40***	***±80***	Degrees

Note

1. **Flux is measured with an accuracy of ± 10%.**
2. **CCT selection acc. to CCT groups and an accuracy of ± 200K**
3. **Forward Voltage is measured with an accuracy of ± 0.1V**
4. **Wavelength is measured with an accuracy of ± 0.5nm**
5. **All white、warm white 、True green 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			
			Standard		Accelerated Environment	
	Time	Conditions	Time (hours)	Conditions	Time (hours)	Conditions
4	**72hours**	**≦30℃ / 60% RH**	**96 +2/-0**	**30℃ / 60% RH**	**20 +0.5/-0**	**60℃ / 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/60% RH	168 +5/-0	85°C/60% RH		
2a	4 weeks	≤30°C/60% RH	696[2] +5/-0	30°C/60% RH	120 +1/-0	60°C/60% RH
3	168 hours	≤30°C/60% RH	192[2] +5/-0	30°C/60% RH	40 +1/-0	60°C/60% RH
4	72 hours	≤30°C/60% RH	96[2] +2/-0	30°C/60% RH	20 +0.5/-0	60°C/60% RH
5	48 hours	≤30°C/60% RH	72[2] +2/-0	30°C/60% RH	15 +0.5/-0	60°C/60% RH
5a	24 hours	≤30°C/60% RH	48[2] +2/-0	30°C/60% RH	10 +0.5/-0	60°C/60% RH
6	Time on Label (TOL)	≤30°C/60% RH	TOL	30°C/60% 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℃, I_F = max DC (Note 1)	1000 hours	Note 2
High Temperature High Humidity	85℃ / 85%RH	1000 hours	Note 2
Temperature Cycle	-40℃/100℃ ,30 min dwell /＜5min transfer	200 cycles	Note 2
High Temperature Storage Life	110℃	1000 hours	Note 2
Low Temperature Storage Life	-55℃	1000 hours	Note 2
Thermal Shock	-40 / 120℃, 20 min dwell /＜20 sec transfer	200 cycles	No catastrophics
Mechanical Shock	1500 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	10-2000-10 Hz, log or linear sweep rate, 20 G about 1 min, 1.5 mm, 3X/axis		No catastrophics
Solder Heat Resistance (SHR)	260℃ ± 5℃, 10 sec		No catastrophics
Solderability	Steam age for 16 hr, then solder dip at 260℃ for 5 sec		Solder coverage on lead

Note

1. Depending on the maximum derating curve.

2. Failure Criteria:

Electrical failures

V_F shift >=10%

I_R<50uA @Vr=5V

Light Output Degradation

% Iv shift >= 30% @1,000hrs or 200cycle

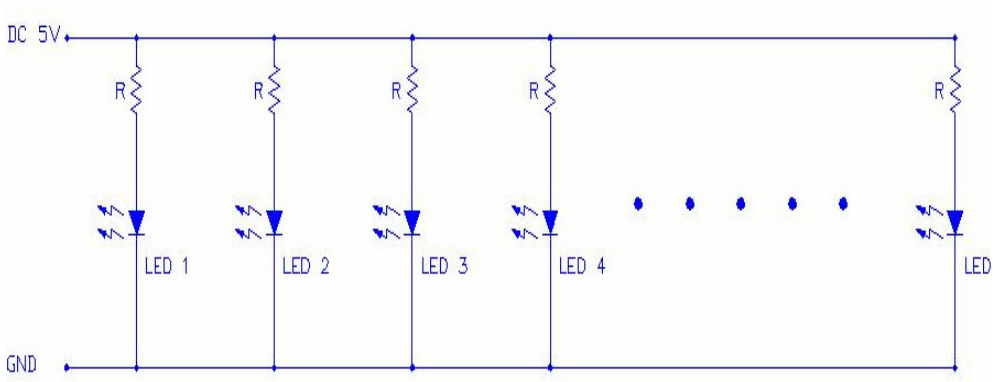
Visual failures

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.

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

Life means the time light output becomes 70%

Tj (^{o}C)	Life (hours)	Tj (^{o}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℃ is giving 0.01%(100ppm) at 10,000hrs

if there is 1 failure of 10 emitters in a system

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

if there is 1 failure of 1 emitter in a system

Tj=75℃ is giving 0.05%(500ppm) at 50,000hrs

if there is 1 failure of 10 emitters in a system

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

How to Know Tj in Your Application?

If it is white APEX, Rth(junction to case)=15°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 °C/W**

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

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

If Area is 30cm²	**Rth=16.7**	**ΔT(junction-air)=(15+2.4+16.7)x1=34.1 °C**
If Area is 60cm²	**Rth=8.3**	**ΔT (junction-air)=(15+2.4+8.3)x1=25.7 °C**
If Area is 90cm²	**Rth=5.5**	**ΔT (junction-air)=(15+2.4+5.5)x1=22.9 °C**

ASSIST FORM about High Power LED Reliability(White APEX)

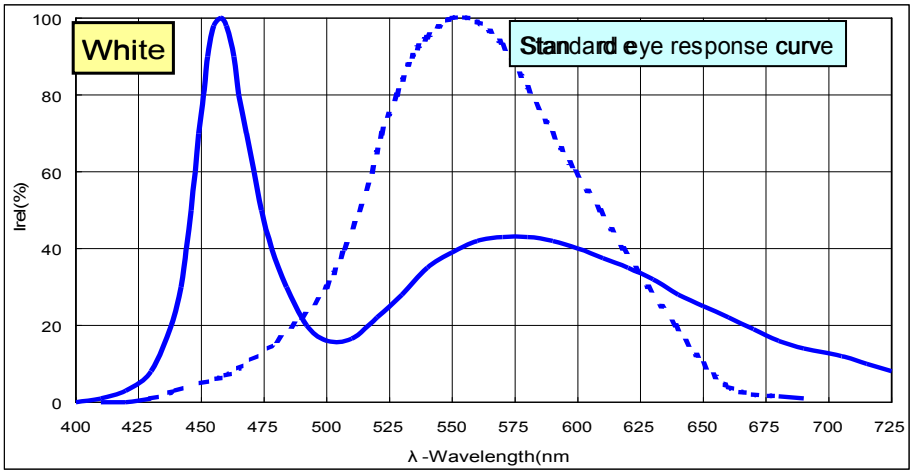
	Ts=45°C	Ts=65°C	Ts=85°C
Voltage	3.5V	3.5V	3.5V
Current	350mA	350mA	350mA
Wattage	1.2W	1.2W	1.2W
Heat	1.0W	1.0W	1.0W
Rth	15°C/W	15°C/W	15°C/W
Tj	60°C	80°C	100°C
$L_{70\%}$	64,000hrs	34,000hrs	19,500hrs

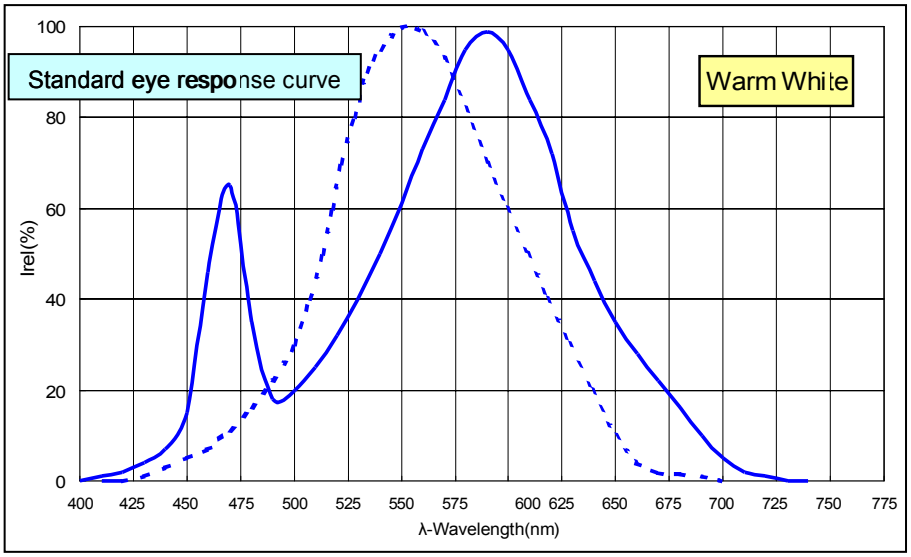
ESD Sensitivity test:

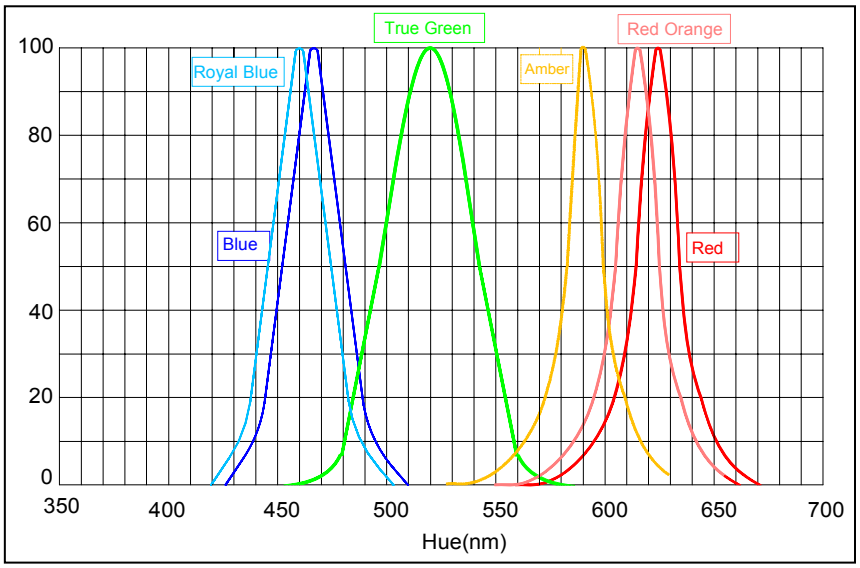
Part No.	***AOL-Ex1xAx***
Test Quantity	*Each 10 pcs*
Test Item	*ESD-HBM*
Test Method	*MIL-STD-883E Method 3015.7*
Class Ⅰ	*0V ~ 1,999V*
Class Ⅱ	*2,000V ~ 3,999V*
Class Ⅲ	*4,000V ~ to above*
Failure Criteria	*IR>5μA@V_R=5V*
Test Voltage	*-100 ~ -500V ,Step: -100V* *-500 ~ -8,000V ,Step: -500V*
Test Date	*18-Mar-05*
Test Equipment	*Keytek Zapmaster*
Test Environmental	*25℃±5℃,55%±10%RH*

Sample	Voltage(V)		MIL-STD
	Forward	Reverse	
Lambertian	***Pass***	***Pass***	**Class**Ⅲ
Side emitting	***Pass***	***Pass***	**Class**Ⅲ
Batwing	***Pass***	***>500***	**--**
Focusing	***Pass***	***>500***	**--**

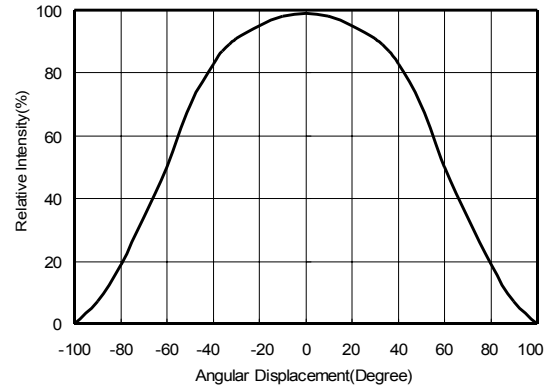
Electrical & Optical Curves-Spectrum



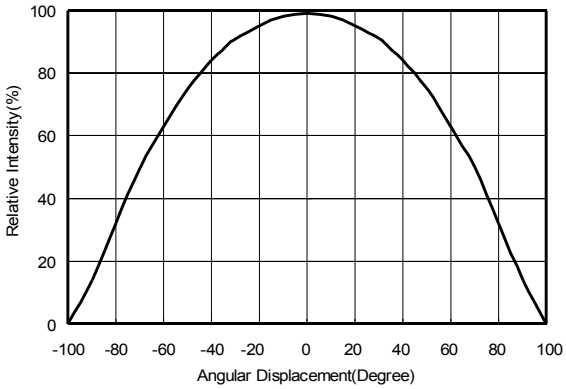




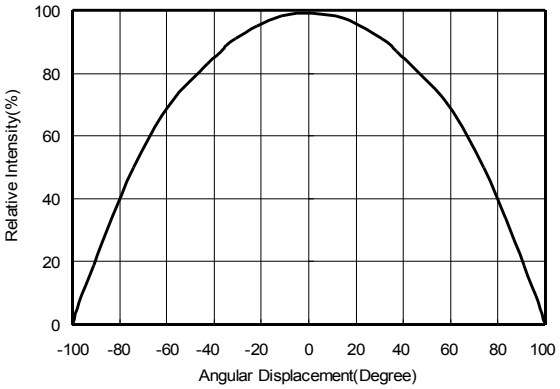
Typical Radiation Pattern for Lambertian



for Red、Amber、Red Orange、EDEW-1LA7

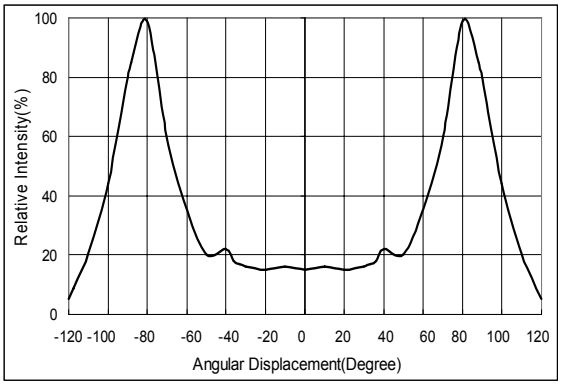


for White、Warm white

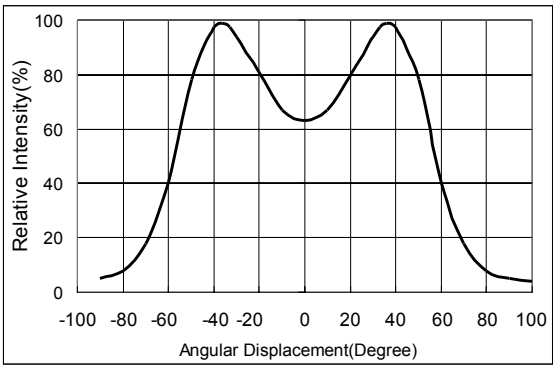


for Blue、Royal Blue、True Green

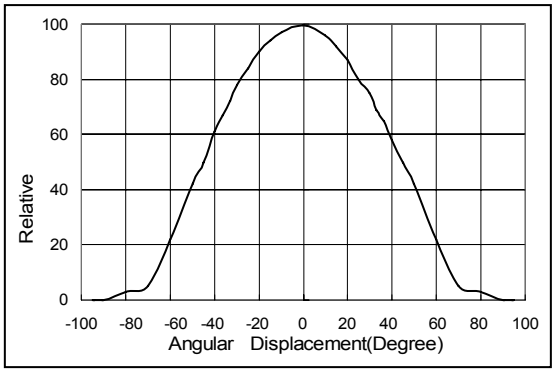
Side Emitting (for all colors)



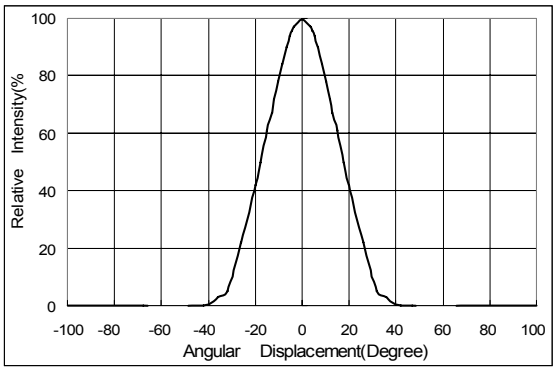
Batwing (for all colors)



Focusing



for White、Warm White



for Blue、Royal Blue、True Green
Red、Red Orange、Amber

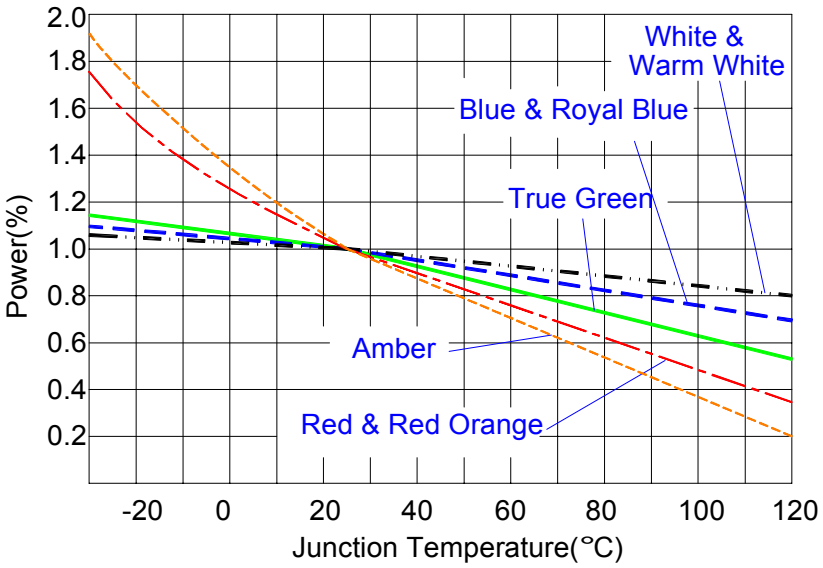
Available Ray Data List

1W APEX	Provide Ray source file type	Red	Blue	True Green	White
Lambertian	From ASAP (*.DIS)	◎	△	△	△
	From Trace Pro (*.DAT)	◎	◎	◎	◎
	From Radiant Image (*.RSM)	◎	△	△	△
Batwing	From ASAP (*.DIS)	◎	◎	△	△
	From Trace Pro (*.DAT)	◎	◎	◎	◎
	From Radiant Image (*.RSM)	△	△	△	△
Side emitting	From ASAP (*.DIS)	△	△	△	△
	From Trace Pro (*.DAT)	◎	◎	◎	◎
	From Radiant Image (*.RSM)	△	△	△	△
Focusing	From ASAP (*.DIS)	△	△	△	△
	From Trace Pro (*.DAT)	△	△	△	△
	From Radiant Image (*.RSM)	△	△	△	△

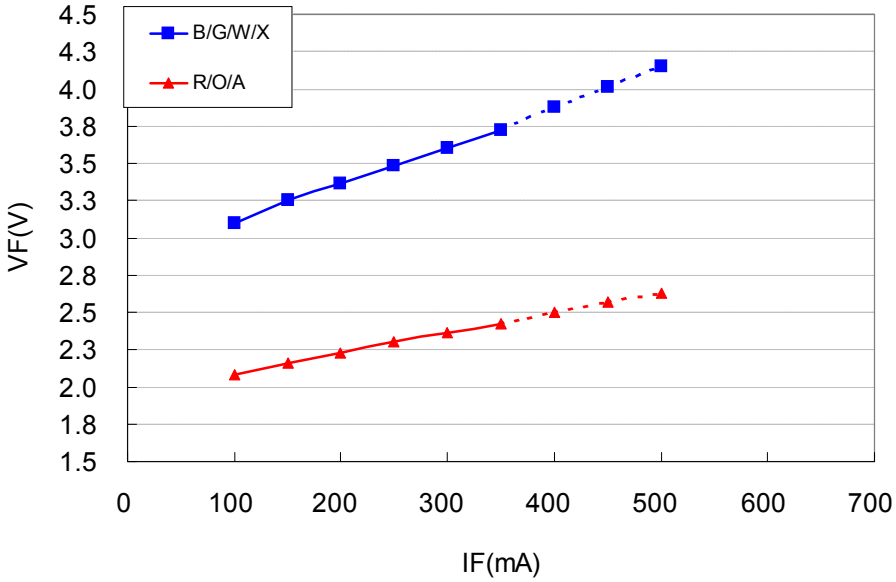
Note:

1. "◎" Ready
2. "△" Not

Typical Optical and Electrical Curves

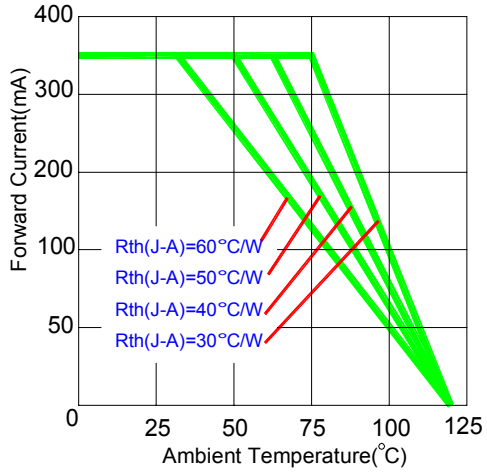


Junction Temperature & Forward Voltage

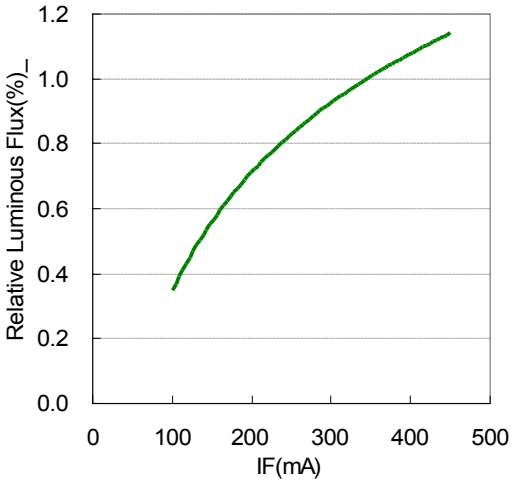


Operating Current & Forward Voltage

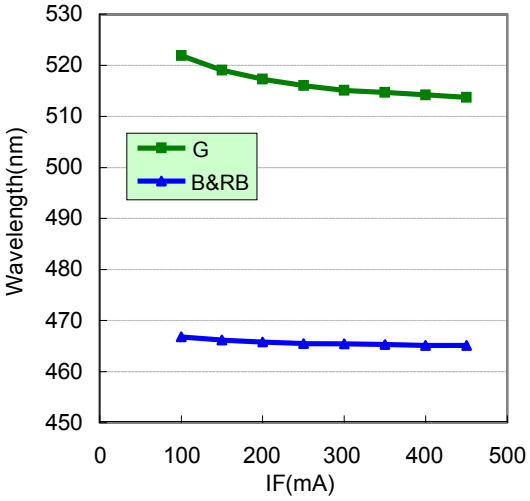
Typical Optical and Electrical Curves

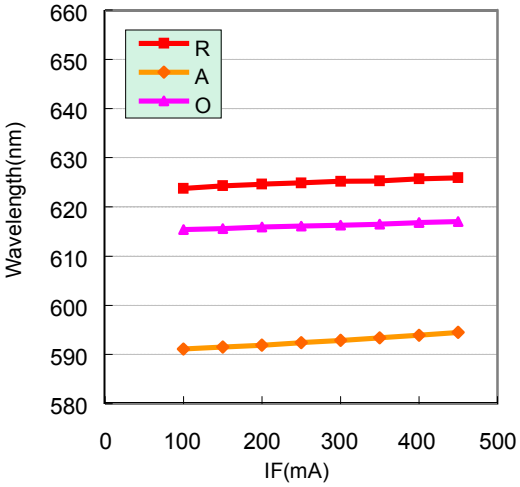


Operating Current & Ambient Temperature

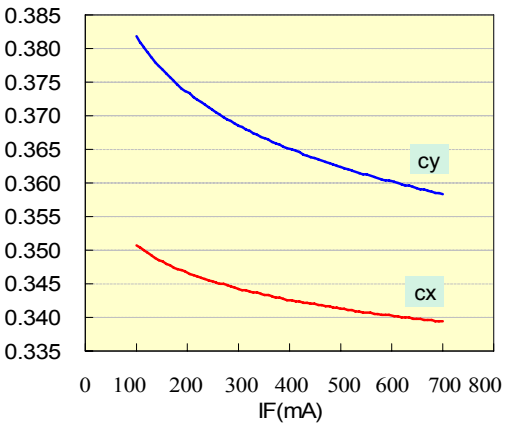


Forward Current & Luminous Flux

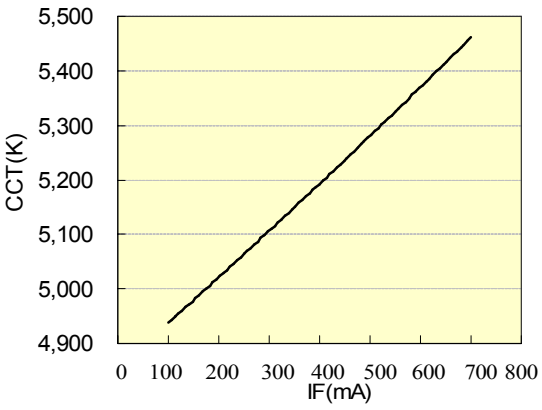




Forward Current & Wavelength



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

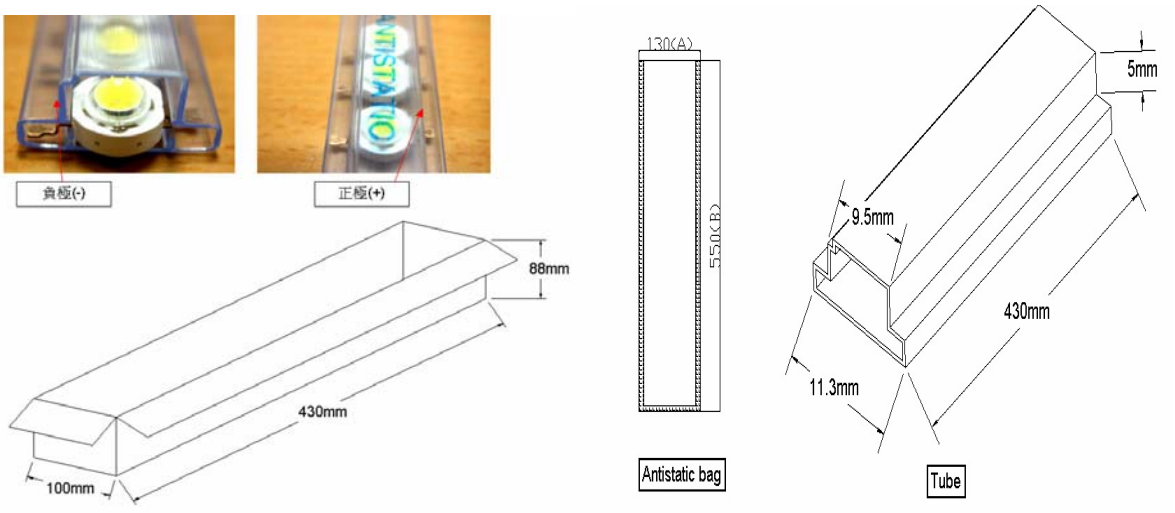
Typical Properties:

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
Batwing Lens	2 kgf
Side Emitting Lens	2 kgf
Focusing Lens	2 kgf

Package Specifications:



Notes:

1. **Inner antistatic bag standard.**
2. **A bag contains one humidity indicator card and drying agent.**
3. **50pcs emitters per tube.**
4. **20 tubes per bag, 1 K pcs per bag.**
5. **2 bags per inner box, 2 K pcs per inner box.**

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