



佛山市国星光电股份有限公司

FOSHAN NATIONSTAR OPTOELECTRONICS CO., LTD

# SPECIFICATION

Customer		Product	1210 TOP LED
Customer No.		Type	FM-3528XX

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APPROVED SIGNATURES			



Research & Development Center		
APPROVE	CHECK	DRAW
Release Date : 2010-01-12		

# FM-3528X X Top Light Emitting Diode

## Technical Data Sheet

This product is generally used as indicator and luminary for electronic equipment such as dashboard and signal Led board. And it also be widely used for indoor and outdoor decorative lighting.

### Features:

Color	Material
Red	Red-AlGaInP or AlGaAs
Orange	Orange -AlGaInP
Yellow	Yellow -AlGaInP or GaAsP
Yellow Green	Yellow Green -AlGaInP or GaP
Green	Green-InGaN
Blue	Blue-InGaN
White	Blue-InGaN

- Wide Viewing Angle
- Reflow Solderable
- High Luminous Intensity and Low Power Dissipation
- Good Reliability and Long Life
- Complied With RoHS Directive

## Electrical Characteristics

### ✧ Absolute Maximum Ratings (Temperature=25°C):

Parameter	Symbol	Rating	Unit	
Forward Current	$I_F$	25 Max.	mA	
Pulse Forward Current*	$I_{FP}$	100 Max.	mA	
Reverse Voltage	$V_R$	5 Max.	V	
Operating Temperature	$T_{OPR}$	-30 ~ +85	°C	
Storage Temperature	$T_{stg}$	-40 ~ +100	°C	
Power Dissipation	$P_D$	R	75 MAX	mW
		O		
		Y		
		YG		
		G	120 MAX	
		B		
		W		

● Note: Pulse width  $\leq 0.1ms$ , Duty  $\leq 1/10^*$

**✧ Electro-Optical Characteristics (Temperature=25°C):**

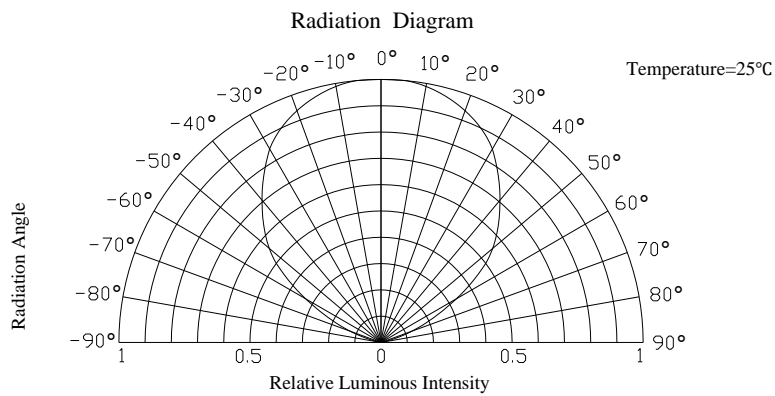
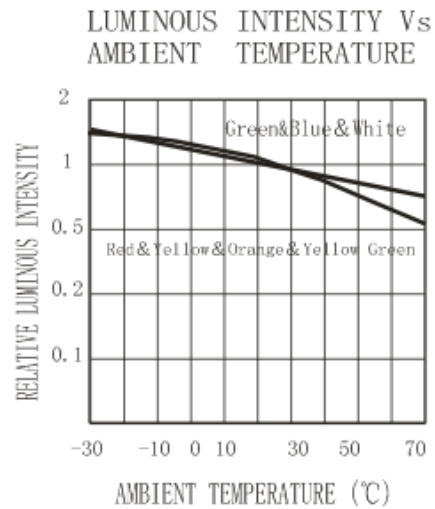
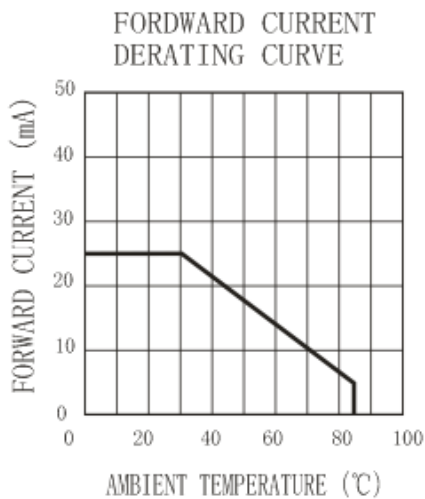
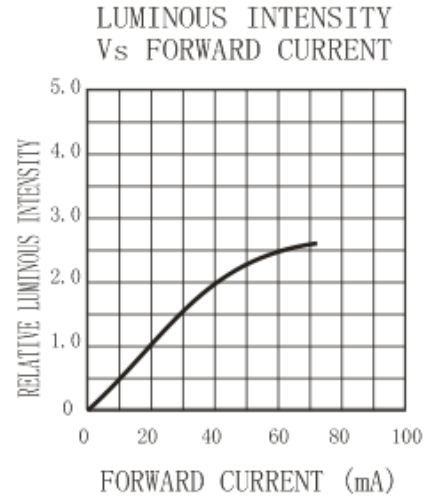
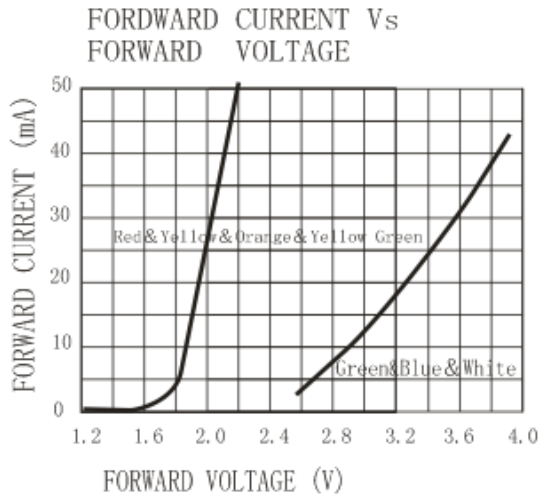
Color	EMITTED COLOR	Lens Color	View Angle 2Θ1/2
FM-3528HRK-660*1	Red	Water Clear	110
FM-3528SXXK-620H08	Super Red		
FM-3528HRK-624O			
FM-3528YOEK-605C	Super Orange		110
FM-3528YOXK-600H08			
FM-3528HYK-585F	Super Yellow		110
FM-3528HYK-589O			
FM-3528PGK	Green		110
FM-3528GHK-570A08	Yellow Green		
FM-3528GEK-572G			
FM-3528UGK-515G	Super Green		
FM-3528UGK-520D			
FM-3528BXX-465D	Super Blue		110
FM-3528BK-470O			
FM-3528WD-460M	Cool White	Yellow diffused	110
FM-3528WDD-460M	Nature White		
FM-3528WLD-460M	Warm White		
FM-3528WS-460T	Cool White		
FM-3528WD-460T	Nature White		
FM-3528WDS-460T	Nature White		
FM-3528WLS-460T	Warm White		
FM-3528SEGEK-1	Bi-Color	Water Clear	110
FM-3528SQGIK			
FM-3528SQGIBIK	Tri-Color	Water Clear	110
FM-P3528WD-460G50	Cool White	Yellow diffused	110
FM-P3528WDD-460G50	Nature White		
FM-P3528WLD-460G50	Warm White		

Remark: “\*1” means reversed polarity

Part Number	Dominant Wavelength (nm)	IV (mcd)		Vf (v) Typ	Test Current (mA)
		Min.	Typ.		
FM-3528HRK-660*1	640	10	16	1.9	20
FM-3528SXX-620H08	620	100	200		
FM-3528HRK-624O	624	600	700		
FM-3528YOEK-605C	605	100	150	2.0	20
FM-3528YOXK-600H08	605	180	250		
FM-3528HYK-585F	585	100	200	2.1	20
FM-3528HYK-589O	589	600	700		
FM-3528PGK	560	7	12	2.1	20
FM-3528GHK-570A08	570	50	80		
FM-3528GEK-572G	572	80	120		
FM-3528UGK-515G	515	750	900	3.2	20
FM-3528UGK-520D	520	900	1100		
FM-3528BXK-465D	465	270	350	3.2	20
FM-3528BK-470O	470	400	500		
FM-3528SEGEK-1	R:624	100	130	2.0	20
	G:572	100	130	2.1	20
FM-3528SQGIK	R:625	150	200	2.0	20
	G:520	600	800	3.2	20
FM-3528SQGIBIK	R:620	180	220	2.0	20
	G:520	600	700	3.2	12
	B:470	120	180	3.2	12

Part Number	Color Temperature (K)	IV (mcd)		Vf (v) Typ.	Test Current (mA)
		Min.	Typ.		
FM-3528WD-460M	7500	1200	1800	3.2	20
FM-3528WDD-460M	4100	1200	1600		
FM-3528WLD-460M	3100	900	1400		
FM-3528WS-460T	7500	1800	2400		
FM-3528WD-460T	6000	2200	2600		
FM-3528WDS-460T	4100	1800	2400		
FM-3528WLS-460T	3100	1500	2000		
FM-P3528WD-460G50	7500	4000	5000	3.0	50
FM-P3528WDD-460G50	4100	3500	4500	3.0	
FM-P3528WLD-460G50	3100	3000	4000	3.0	

# Typical Characteristics Curves



## Reliability Test Items And Conditions

Test Items	Test Conditions	Quantity	Judging Criteria
Solderability	Solder Temperature: 300°C Solder Duration: (3.5±0.5) sec.	15	Solderable Area Over 95%
Thermal Shock Followed by High Temperature And High Humidity Cyclic	-40°C → 10 min. 5 Cycles ↓↑ Shift (2~3) min. 100°C → 10 min. ↓ 25°C~55°C (90%~95%) RH 2 Cycles for 48 hrs., Recover for 2 hrs.	11	C=0 & I**
Resistance For Soldering Heat	Reflow Soldering	15	C=0 & I**
DC Operating Life	1000 hrs. Forward Current: 25mA	22	C=0 & I*
High Temperature Storage	100°C → 1000 hrs.	15	C=0 & I*
High Temperature And High Humidity Cyclic	25°C~55°C (90%~95%) RH 6 Cycles for 144 hrs., Recover for 2 hrs.	11	C=0 & I*

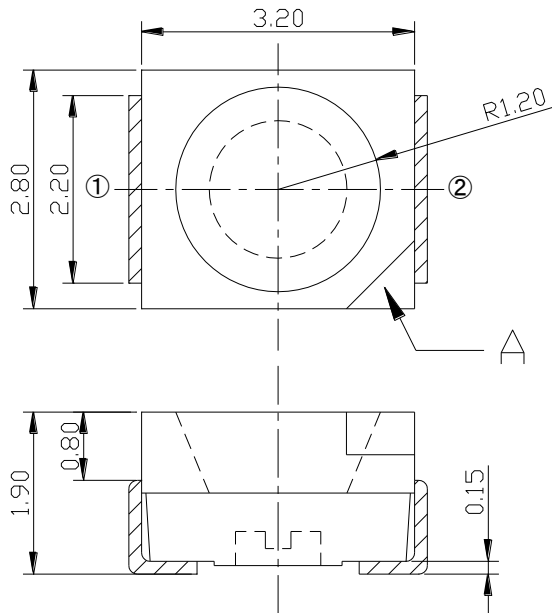
### \*1 Criteria For Judging Damage

Items	Symbol	Test Conditions	Criteria For Judging Damage I*	Criteria For Judging Damage I**
Forward Voltage	V <sub>F</sub>	I <sub>F</sub> =20mA	≥USL×1.2	≥USL
Reverse Current	I <sub>R</sub>	V <sub>R</sub> =5V	≥USL×2.0	≥USL
Luminous Intensity	I <sub>V</sub>	I <sub>F</sub> =20mA	≤LSL×0.5	≤LSL

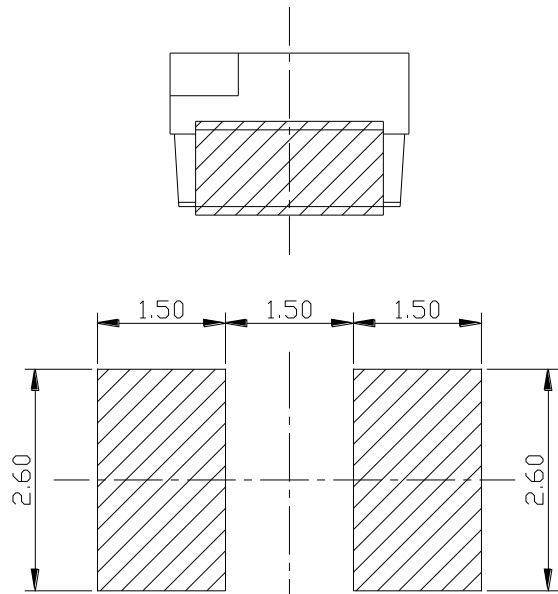
\* USL: Upper Standard Level, LSL: Lower Standard Level \*



# Outline Dimensions



Single Color



Recommended Soldering Pad



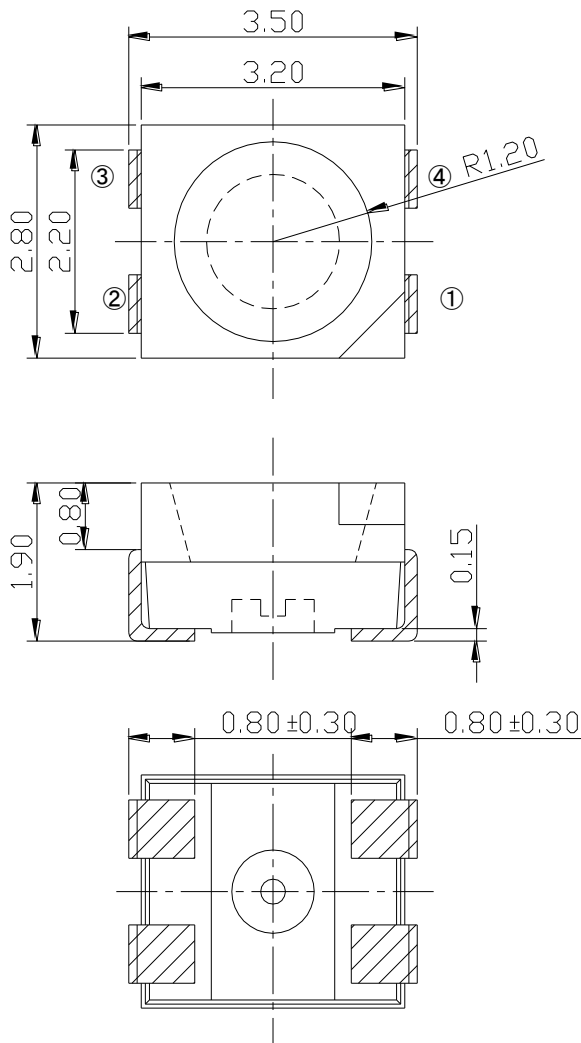
Polarity

Note:

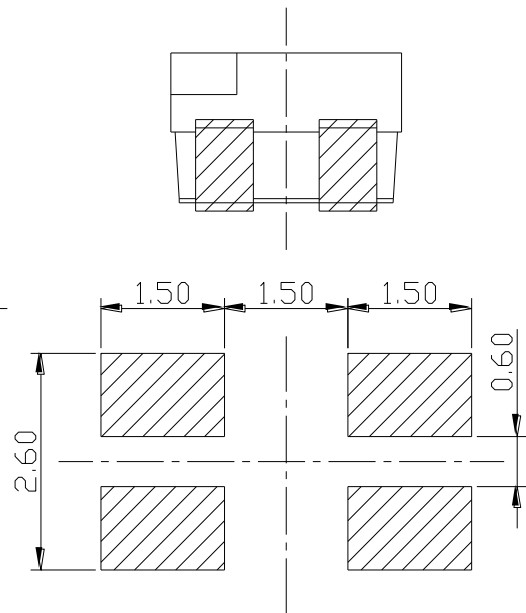
A: Cathode Mark

All dimensions in mm.

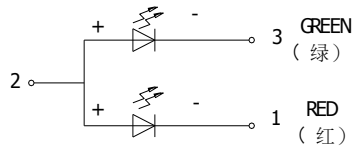
Tolerances unless mentioned is  $\pm 0.1$  mm.



Bi-Color



Recommended Soldering Pad

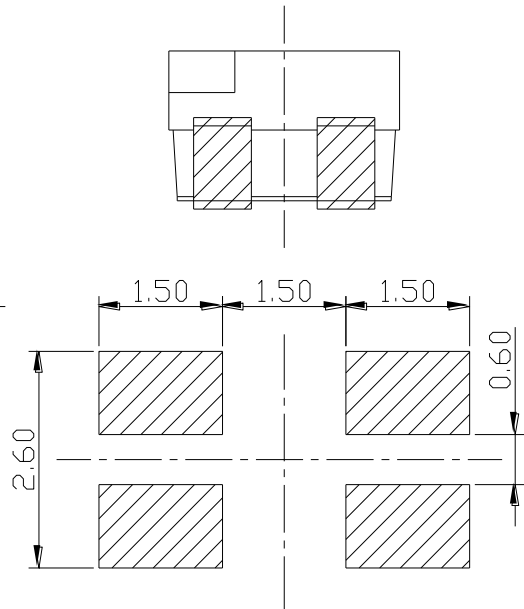
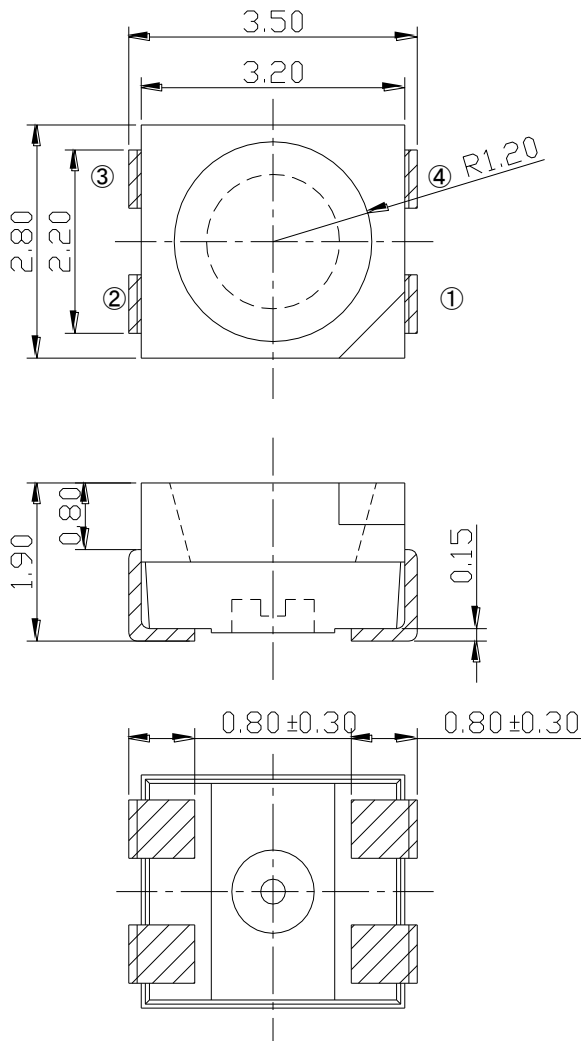


Polarity

Note:

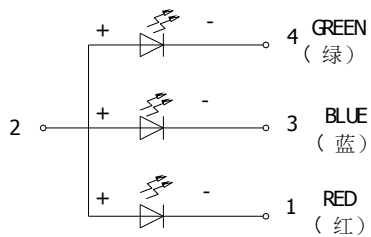
All dimensions in mm.

Tolerances unless mentioned is  $\pm 0.1$  mm.



Tri-Color

Recommended Soldering Pad

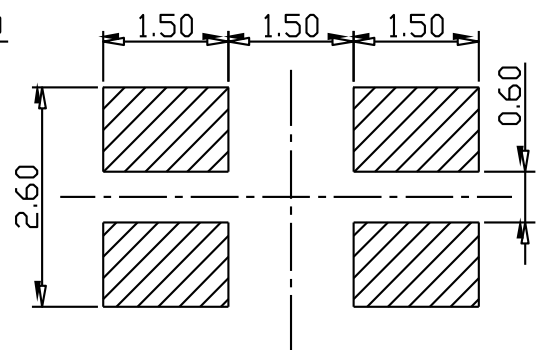
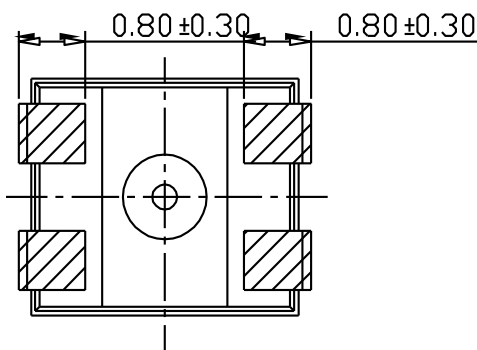
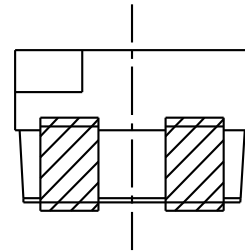
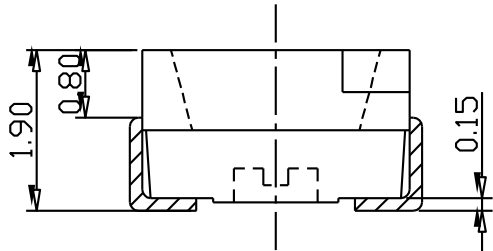
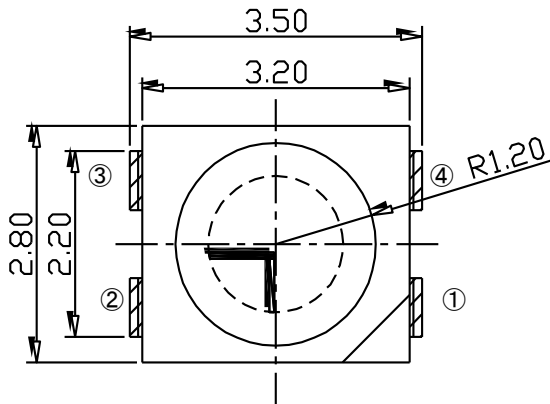


Polarity

Note:

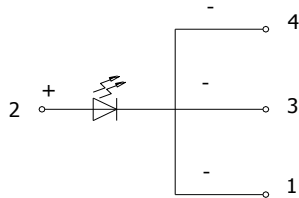
All dimensions in mm.

Tolerances unless mentioned is  $\pm 0.1$  mm.



P3528

Recommended Soldering Pad



Polarity

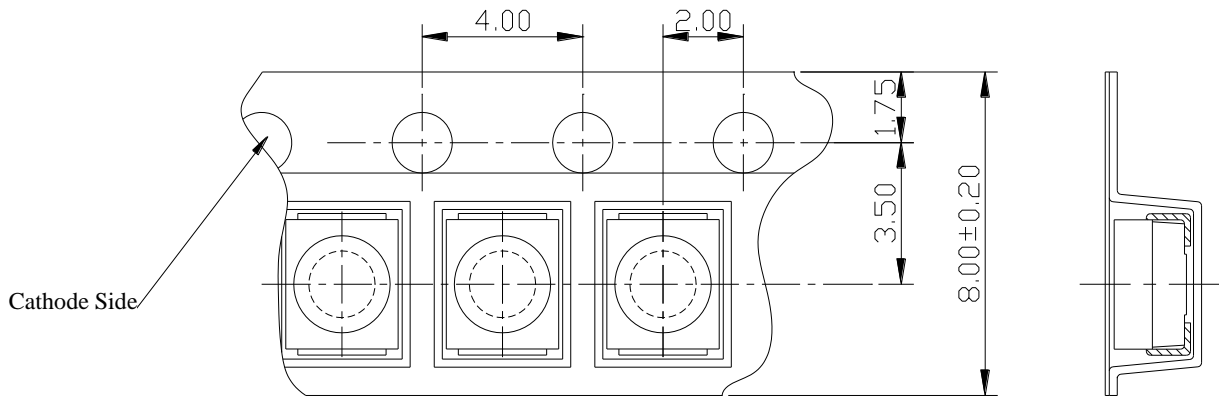
Note:

All dimensions in mm.

Tolerances unless mentioned is  $\pm 0.1$  mm.

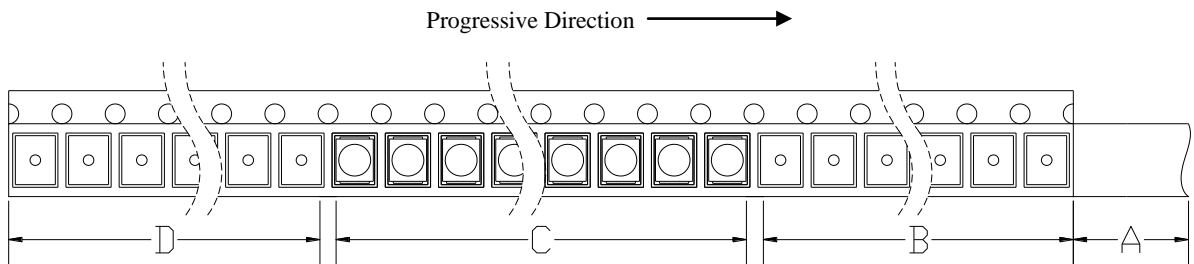
## Packaging (1)

### ✧ Carrier Tape



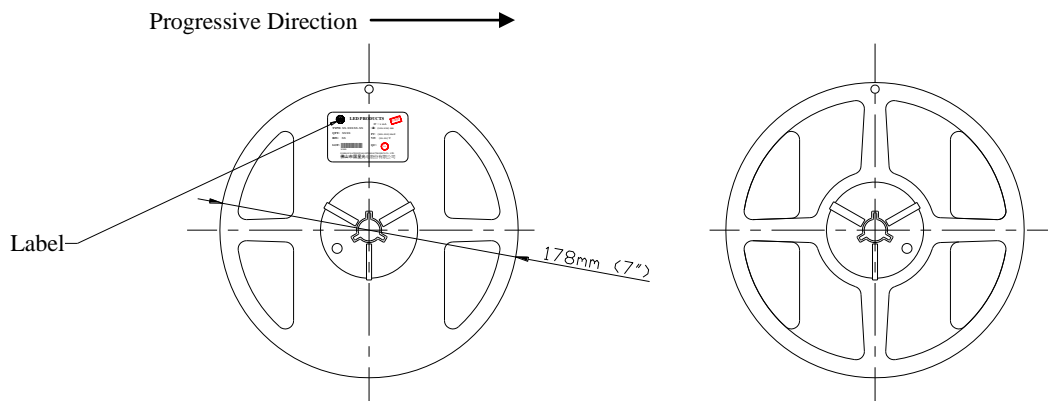
All dimensions in mm, tolerances unless mentioned is  $\pm 0.1$  mm.

### ✧ Details Of Carrier Tape



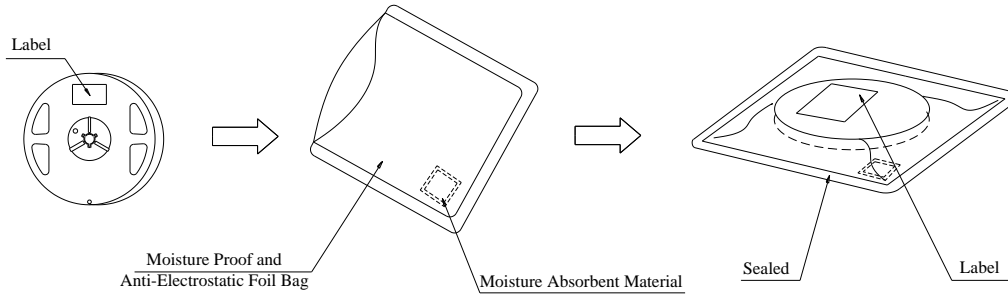
A: Top Cover Tape, 300mm; B: Leader, Empty, 200mm; C: 2000 Lamps Loaded; D: Trailer, Empty, 200mm.

### ✧ Reel Dimension

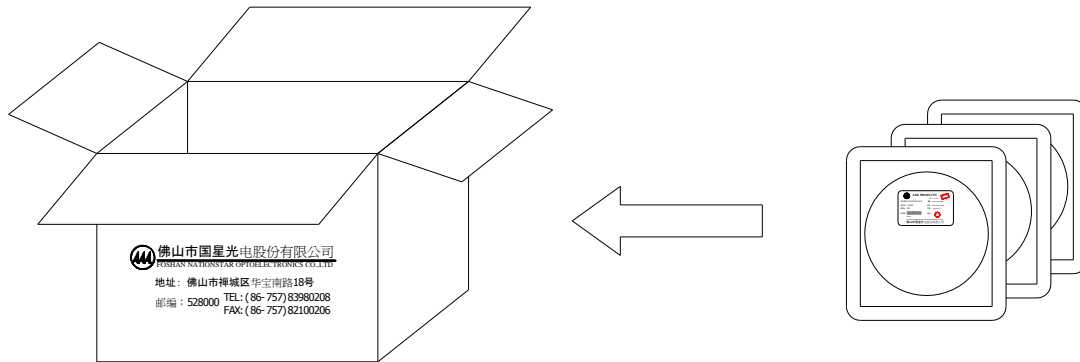


## Packaging (2)

### ✧ Moisture Proof and Anti-Electrostatic Foil Bag



### ✧ Cardboard Box



### ✧ Label Explanation

QTY: Quantity

BIN: Rank

LOT: Lot Number

$\lambda$ d: Wavelength Range or (Xx-x)

IV: Luminous Intensity Range

VF: Forward Voltage Range

IF: Testing Current




**AAA** **TOP LEDS** **RoHS**

IF = x mA

TYPE: XX-XXXXXX-XX ;  $\lambda$ : (xxx-xxx) nm

QTY: XXXX IV: (xxx-xxx) mcd

BIN: XX VF: (xx-xx) V

LOT:  QC:   
XXXX

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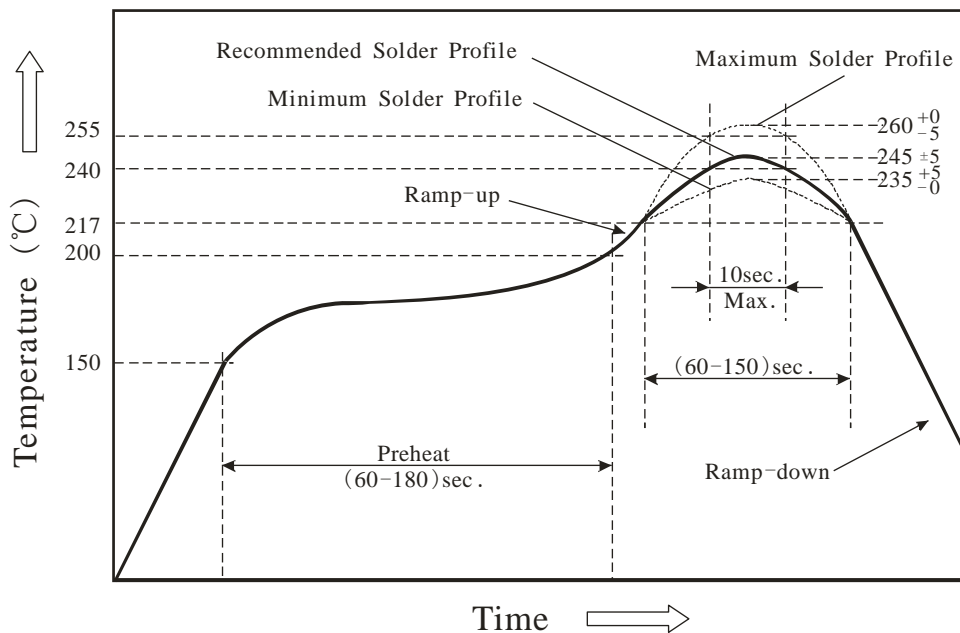
## Guideline for Soldering

### 1. Hand Soldering

A soldering iron of less than 20W is recommended to be used in Hand Soldering. Please keep the temperature of the soldering iron under 300°C while soldering. Each terminal of the LED is to go for less than 3 second and for one time only.

Be careful because the damage of the product is often started at the time of the hand soldering.

### 2. Reflow Soldering: Use the conditions shown in the under Profile of Pb-Free Reflow Soldering.



- Reflow soldering should not be done more than two times.
- Stress on the LEDs should be avoided during heating in soldering process.
- After soldering, do not deal with the product before its temperature drop down to room temperature.

### 3. Cleaning

It is recommended that alcohol be used as a solvent for cleaning after soldering. Cleaning is to go under 30°C for 3 minutes or 50°C for 30 seconds. When using other solvents, it should be confirmed beforehand whether the solvents will dissolve the package and the resin or not.

Ultrasonic cleaning is also an effective way for cleaning. But the influence of Ultrasonic cleaning on LED depends on factors such as ultrasonic power. Generally, the ultrasonic power should not be higher than 300W. Before cleaning, a pre-test should be done to confirm whether any damage to LEDs will occur.

**Note:** This general guideline may not apply to all PCB designs and configurations of all soldering equipment. The techniques in practice is influenced by many factors, it should be specialized base on the PCB designs and configurations of the soldering equipment.

## Precautions (1)

### 1. Storage

- Moisture proof and anti-electrostatic package with moisture absorbent material is used, to keep moisture to a minimum.
- Before opening the package, the product should be kept at 30°C or less and humidity less than 60% RH, and be used within a year.
- After opening the package, the product should be stored at 30°C or less and humidity less than 10%RH, and be soldered within 24 hours (1 days). It is recommended that the product be operated at the workshop condition of 30°C or less and humidity less than 60%RH.
- If the moisture absorbent material has fade away or the LEDs have exceeded the storage time, baking treatment should be performed based on the following condition:  $(80 \pm 5)^\circ\text{C}$  for 24 hours.

### 2. Static Electricity

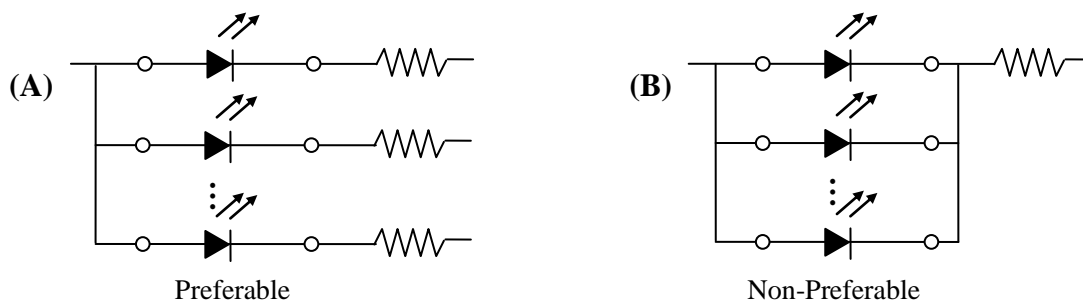
Static electricity or surge voltage damages the LEDs. Damaged LEDs will show some unusual characteristics such as the forward voltage becomes lower, or the LEDs do not light at the low current., even not light.

All devices, equipment and machinery must be properly grounded. At the same time, it is recommended that wrist bands or anti-electrostatic gloves, anti-electrostatic containers be used when dealing with the LEDs.

### 3. Design Consideration

In designing a circuit, the current through each LED must not exceed the absolute maximum rating specified for each LED. In the meanwhile, resistors for protection should be applied, otherwise slight voltage shift will cause big current change, burn out may happen.

It is recommended to use Circuit A which regulates the current flowing through each LED rather than Circuit B. When driving LEDs with a constant voltage in Circuit B, the current through the LEDs may vary due to the variation in Forward Voltage ( $V_F$ ) of the LEDs. In the worst case, some LED may be subjected to stresses in excess of the Absolute Maximum Rating.



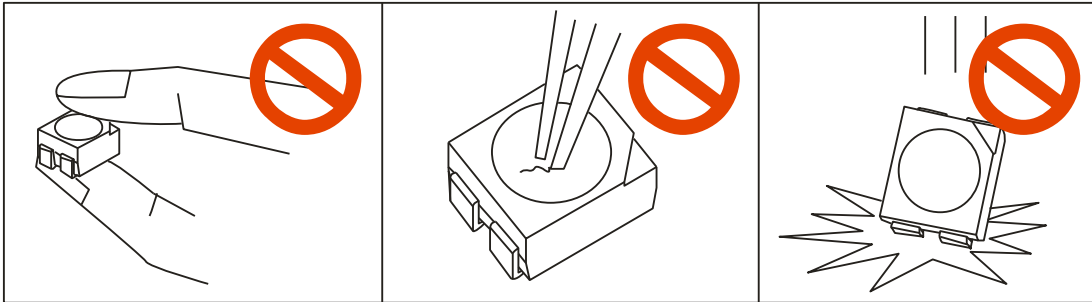
Thermal Design is paramount importance because heat generation may result in the Characteristics decline, such as brightness decreased, Color changed and so on. Please consider the heat generation of the LEDs when making the system design.



## Precautions (2)

### 4. Others

When handling the product, touching the encapsulant with bare hands will not only contaminate its surface, but also affect on its optical characteristics. Excessive force to the encapsulant might result in catastrophic failure of the LEDs due to die breakage or wire deformation. For this reason, please do not put excessive stress on LEDs, especially when the LEDs are heated such as during Reflow Soldering.



The epoxy resin of encapsulant is fragile, so please avoid scratch or friction over the epoxy resin surface. While handling the product with tweezers, do not hold by the epoxy resin, be careful.

### 5. Safety Advice For Human Eyes

Viewing direct to the light emitting center of the LEDs, especially those of great Luminous Intensity, will cause great hazard to human eyes. Please be careful.

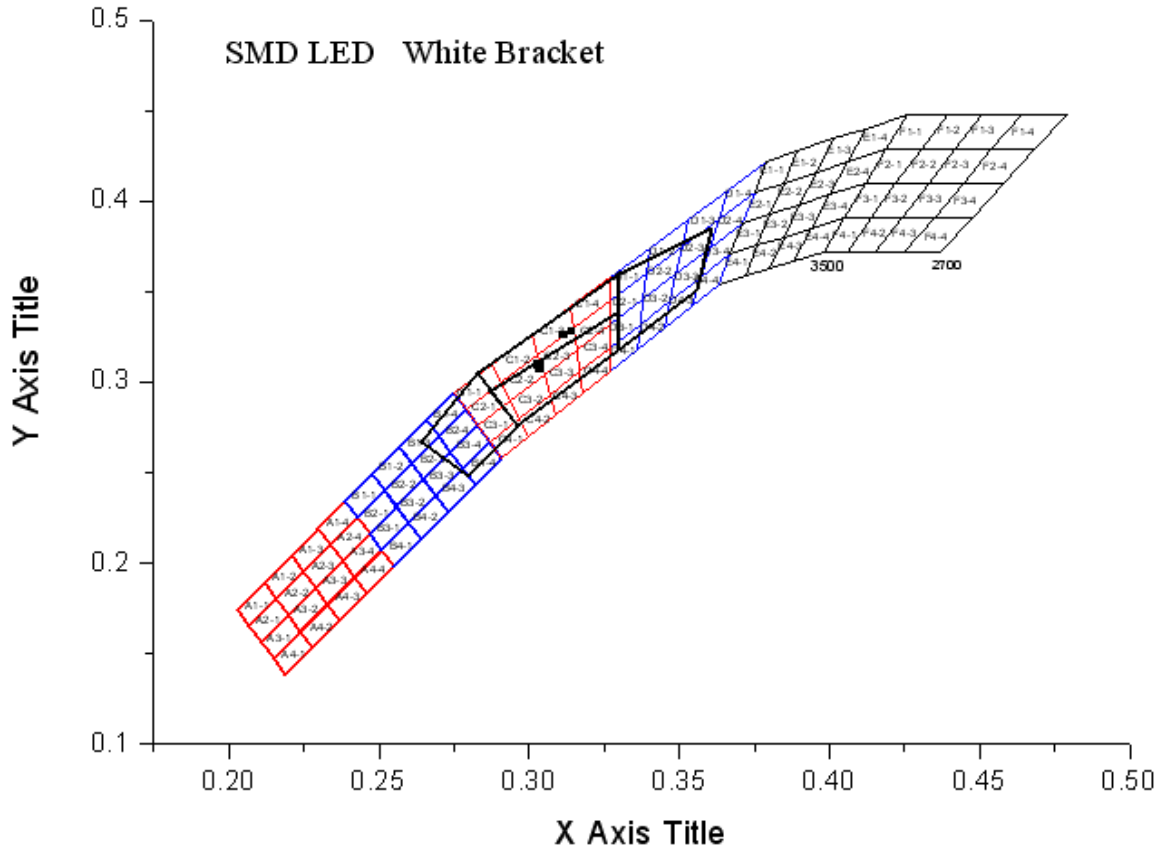
## Appendix

<b>IV(mcd) BINS:</b>		Detailed Bracket			
<b>IV(mcd)</b>	<b>IV(mcd)</b>	<b>IV(mcd)</b>	<b>IV(mcd)</b>	<b>IV(mcd)</b>	<b>IV(mcd)</b>
7-9	24-30	80-100	270-330	900-1200	3300-4000
9-11	30-36	100-120	330-400	1200-1500	4000-5000
11-13	36-45	120-150	400-500	1500-1800	5000-6000
13-16	45-55	150-180	500-600	1800-2200	6000-7500
16-20	55-65	180-220	600-750	2200-2700	
20-24	65-80	220-270	750-900	2700-3300	

<b>VF(V) BINS:</b>		Detailed Bracket	
<b>VF(V)</b>	<b>VF(V)</b>	<b>VF(V)</b>	<b>VF(V)</b>
1.6-1.7	2.1-2.2	2.6-2.7	3.1-3.2
1.7-1.8	2.2-2.3	2.7-2.8	3.2-3.3
1.8-1.9	2.3-2.4	2.8-2.9	3.3-3.4
1.9-2.0	2.4-2.5	2.9-3.0	3.4-3.5
2.0-2.1	2.5-2.6	3.0-3.1	3.5-3.6

### $\lambda_D$ (nm) BINS

	$\lambda_D$ (nm)		$\lambda_D$ (nm)		
Blue	463-466	Green	515-517.5	527.5-530	554-556
	466-469		517.5-520	530-532.5	556-558
	469-472		520-522.5	532.5-535	558-560
	472-475		522.5-525		560-562
Yellow Green	568-570		525-527.5		562-564
	570-572	Yellow	580-582.5	590-592.5	
	572-574		582.5-585	592.5-595	
	574-576		585-587.5		
	587.5-590				
Orange	598~601	Red	620~625		
	601~604		625-635		
	604~607		635-650		
	607~610				

**White (X,Y) BINS:**


		Bottom	Left	Top	Right			Bottom	Left	Top	Right
<b>A ☒</b> <b>X:0.229</b> <b>Y:0.186</b>	X	0.219	0.203	0.239	0.255	<b>B ☒</b> <b>X:0.265</b> <b>Y:0.246</b>	X	0.255	0.239	0.275	0.291
	Y	0.138	0.174	0.234	0.198		Y	0.198	0.234	0.294	0.258
<b>C ☒</b> <b>X:0.305</b> <b>Y:0.304</b>	X	0.291	0.275	0.327	0.327	<b>D ☒</b> <b>X:0.349</b> <b>Y:0.36</b>	X	0.327	0.327	0.379	0.363
	Y	0.258	0.294	0.358	0.306		Y	0.306	0.358	0.422	0.354
<b>E ☒</b> <b>X:0.39</b> <b>Y:0.398</b>	X	0.363	0.379	0.426	0.398	<b>F ☒</b> <b>X:0.433</b> <b>Y:0.41</b>	X	0.398	0.426	0.479	0.437
	Y	0.354	0.422	0.448	0.372		Y	0.372	0.448	0.448	0.372
When the Label is printing Please give clear indication of color coordinate area (as: A1-2)											