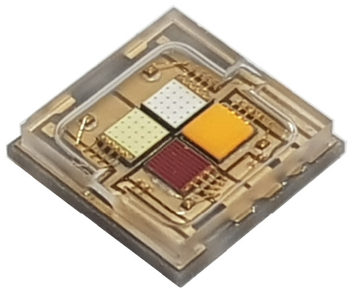
Federal Series Datasheet (EN)

Federal 5050 25W RTBW (Glass)
2FM025M274F03S02



Features:

- Available in Red, True green, Blue and Cool white in a single package
- Maximum driving current per LED die:
  Red : 1,000mA ; True green/Blue : 1,500mA ; Cool white : 2,500mA
- Individually addressable LEDs
- Electrically neutral thermal path
- RoHS compliant
- Flat package with glass covered on top

Typical Applications:

- Stage lighting
- Architectural lighting
- Entertainment lighting
- Filming lighting
- Themed environment lighting
- Mood lighting

Lighting Design Manufacturing Service

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General Information

Introduction

Federal 5050 Series is a smaller and brighter multi-chip LED which provides multi-color packaging flexibility. Federal is a surface mount, compact, high brightness and high power LED that is suitable for various illumination needs such as stage lighting, color-mxining lighting, mood lighting, architectural lighting, as well as entertainment and filming lighting. Federal 5050 multiple colors in one is especially designed for stage lights and wash lights, or any fixtures require high density output. With its compact dimensions, enables a higher flexibility for optical design. All the Edison products are carefully tested in order to achieve high reliability and optimal performance, giving you an extraordinary LED experience.

Order Code Format

2	F	M 0	2 5	M 2	x x	F 0 3	x x x
X1	X2	X3	X4	X5	X6	X7	X8

X1		X2		X3		X4	
Type		Component		Series		Wattage	
2	Emitter	F	Federal	M0	5050	25	25W

X5		X6		X7		X8	
Color		Internal Code		Ceramic Size		Serial Number	
M2	RTBW	-	-	F03	5050	-	-

Package	Luminous Intensity, Iv [lm] I_F = 1,000mA	Order Code
Federal 5050 25W RTBW	Red : 120 True Green : 195 Blue : 43 Cool White : 280	2FM025M274F03S02

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Absolute Maximum Ratings

($T_J = 25°C$)

Parameter	Symbol	Value	Units
DC Forward Current[1]	I_F	Red : 1,000 True Green : 1,500 Blue : 1,500 Cool White : 2,500	mA
Reverse Voltage[2]	V_R	Note 2	V
LED Junction Temperature	T_J	Red : 125 True Green : 150 Blue : 150 Cool White : 150	°C
LED Operating Temperature	-	-40 ~ +65	°C
LED Storage Temperature	-	-40 ~ +125	°C
Soldering Temperature	-	260	°C

Notes:
1. Proper current derating must be observed to maintain junction temperature below the maximum.
2. LEDs are not designed to drive in reverse bias.

Characteristics

($I_F = 1{,}000mA$; $T_J = 25°C$)

Parameter		Symbol	Value	Units
Viewing Angle[1]	(typ.)	$2\Theta_{1/2}$	115	Degree
Forward Voltage[2]	(typ.)	V_F	Red : 2.2 True Green : 3.0 Blue : 3.1 Cool White : 3.1	V
CCT[3]/Wavelength[4]	(typ.)	-	Red : 621 True Green : 522 Blue : 452 Cool White : 6,000	K/nm
CRI (Ra)[5]	(typ.)	-	70	-

Notes:
1. Viewing angle is measured with accuracy of ±10%.
2. Forward voltage measurement allowance is ± 0.5V.
3. CIE_x/y tolerance: ±0.005.
4. Edison maintains a tolerance of ±1nm for dominant wavelength.
5. Tolerance of CRI(Ra): ±2.

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Luminous Flux Bin Codes

(I_F = 1,000mA ; T_J = 25°C)

Color	Code	(Min.) Luminous Intensity Iv [lm]	(Max.) Luminous Intensity Iv [lm]
Red	R	80	130
True Green	T	160	260
Blue	B	25	55
Cool White	W	250	350

Note:
The luminous flux performance is guaranteed within published operating conditions. Edison Opto maintains a tolerance of ±10% on flux measurements.

Wavelength Bin Codes

(I_F = 1,000mA ; T_J = 25°C)

Color	Code	(Min.) Domain Wavelength [nm]	(Max.) Domain Wavelength [nm]
Red	A	619	632
True Green	A	515	521
	B	521	527
Blue	A	449	453
	B	453	457

Note:
Dominant wavelength measurement allowance: ±1nm.

Forward Voltage Bin Codes

(I_F = 1,000mA ; T_J = 25°C)

Color	Code	(Min.) Forward Voltage [V]	(Max.) Forward Voltage [V]
Red	A	2.0	2.6
True Green	A	2.8	3.5
Blue	A	2.8	3.5
Cool White	A	2.8	3.5

Note:
Forward voltage measurement allowance is ± 0.5V.

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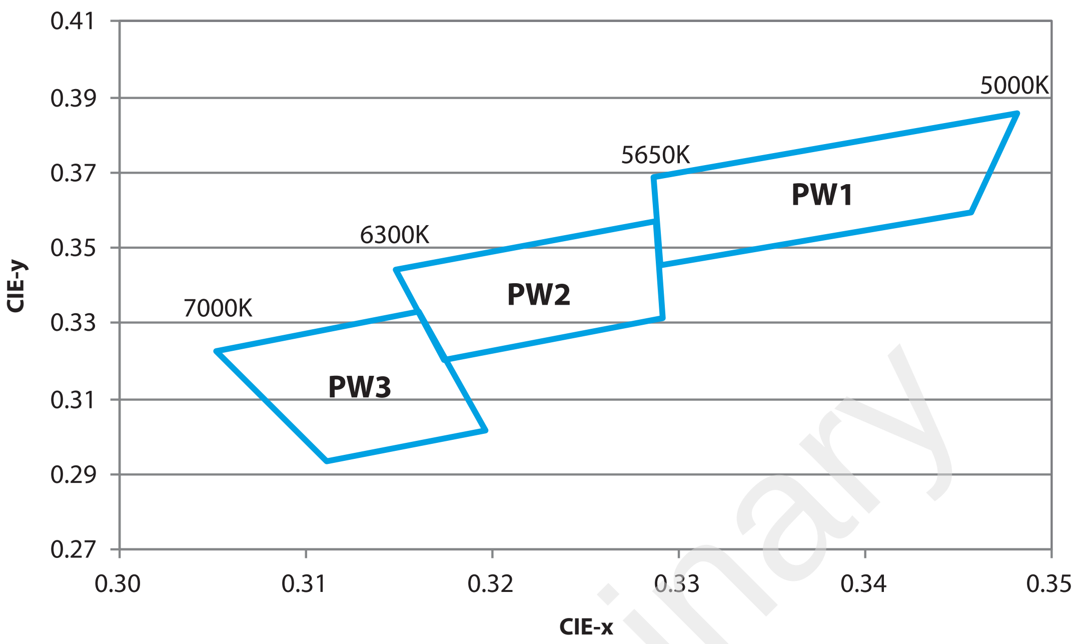
Color Bin Codes

(I_F = 1,000mA ; T_J = 25°C)



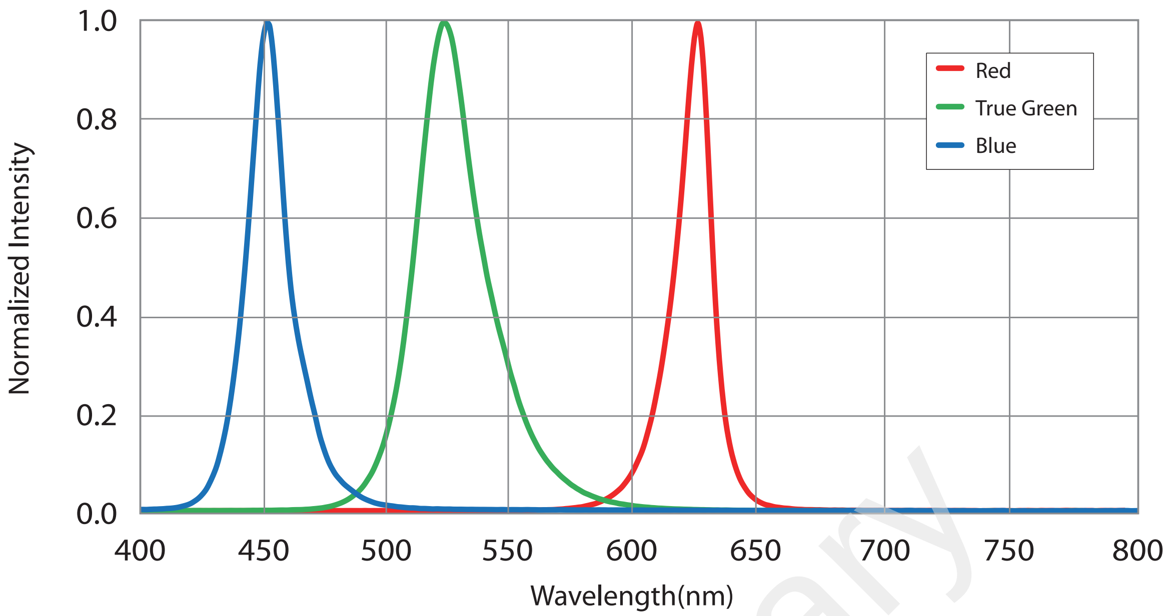
PW1		PW2		PW3	
X	Y	X	Y	X	Y
0.3286	0.3690	0.3148	0.3444	0.3052	0.3224
0.3481	0.3856	0.3288	0.3569	0.3160	0.3332
0.3458	0.3592	0.3292	0.3313	0.3196	0.3013
0.3290	0.3451	0.3175	0.3204	0.3112	0.2932

Note:
CIE_x/y tolerance: ±0.005.

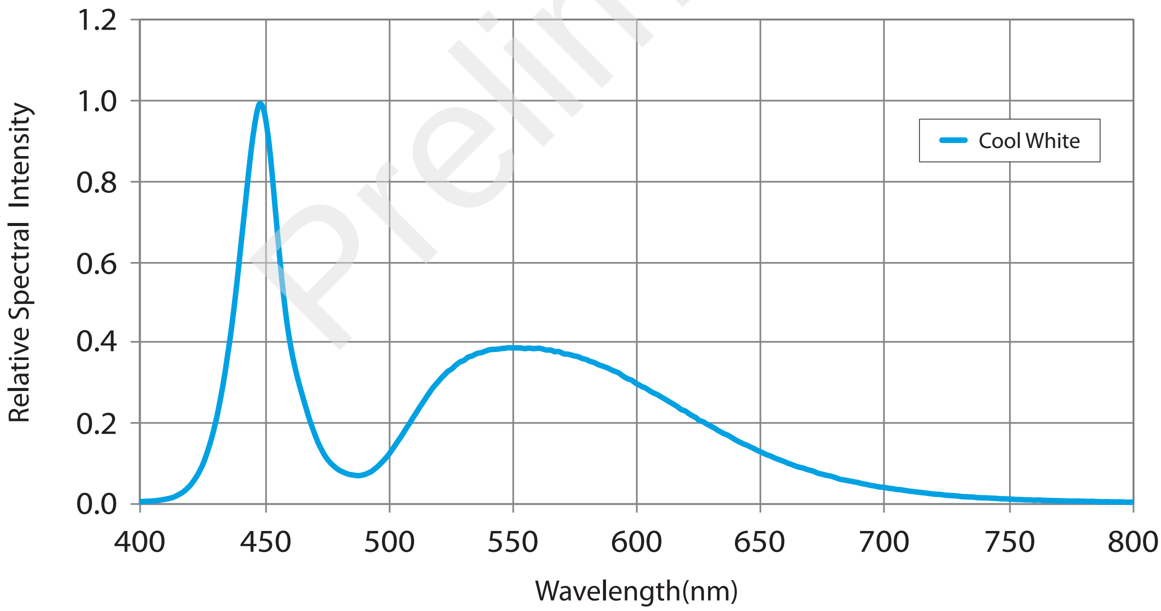
Characteristic Curves

Color Spectrum

(I_{rel}=f(λ) ; I_F = 1,000mA ; T_J = 25°C)



(I_{rel}=f(λ) ; I_F = 1,000mA ; T_J = 25°C)



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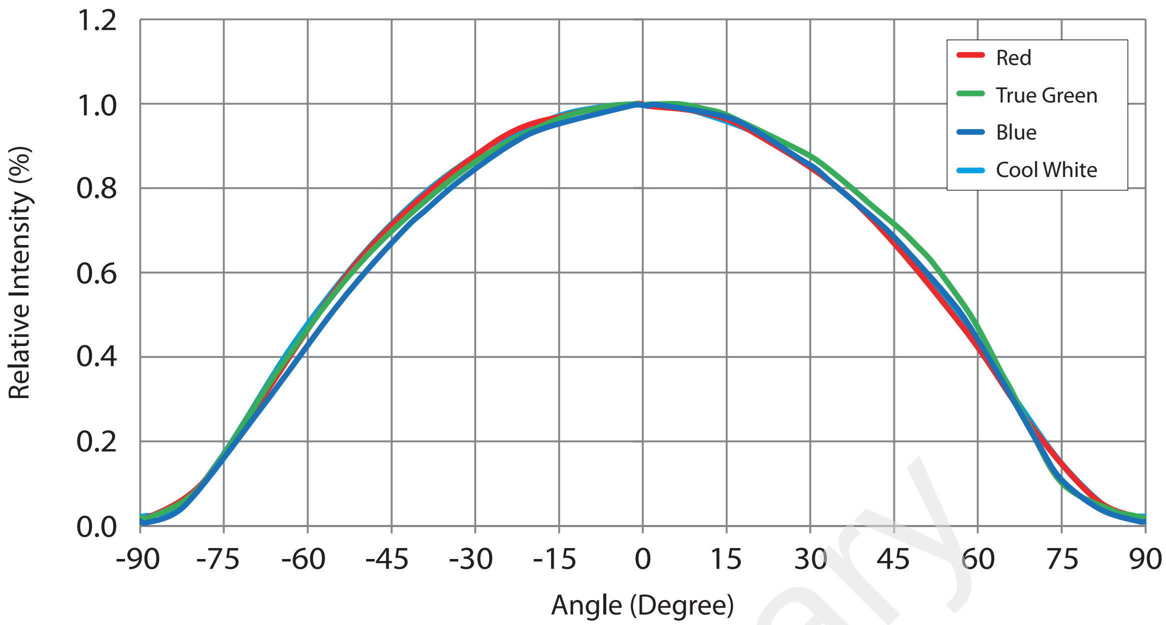
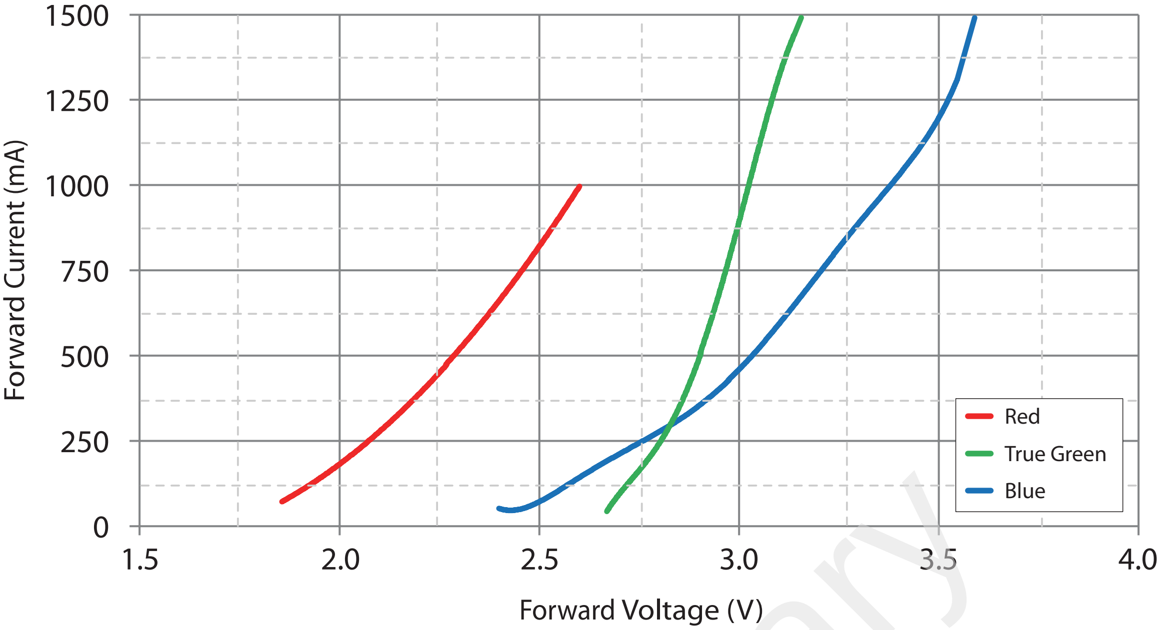
Beam Pattern

(I_F = 1,000mA ; T_J = 25°C)



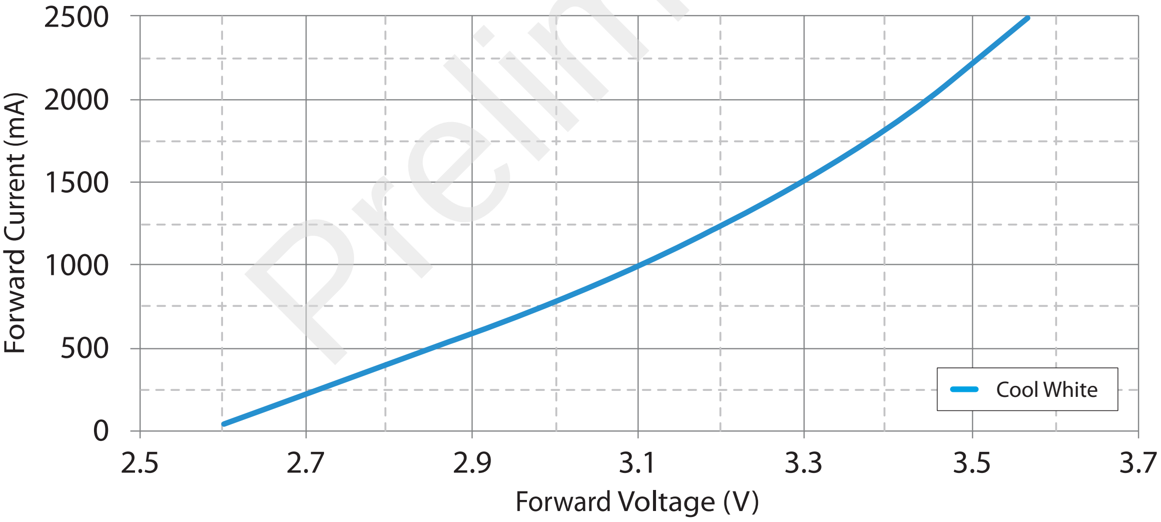
Forward Current vs. Forward Voltage

($I_F = f(V_F)$; $T_J = 25°C$)



Forward Current vs. Forward Voltage

($I_F = f(V_F)$; $T_J = 25°C$)



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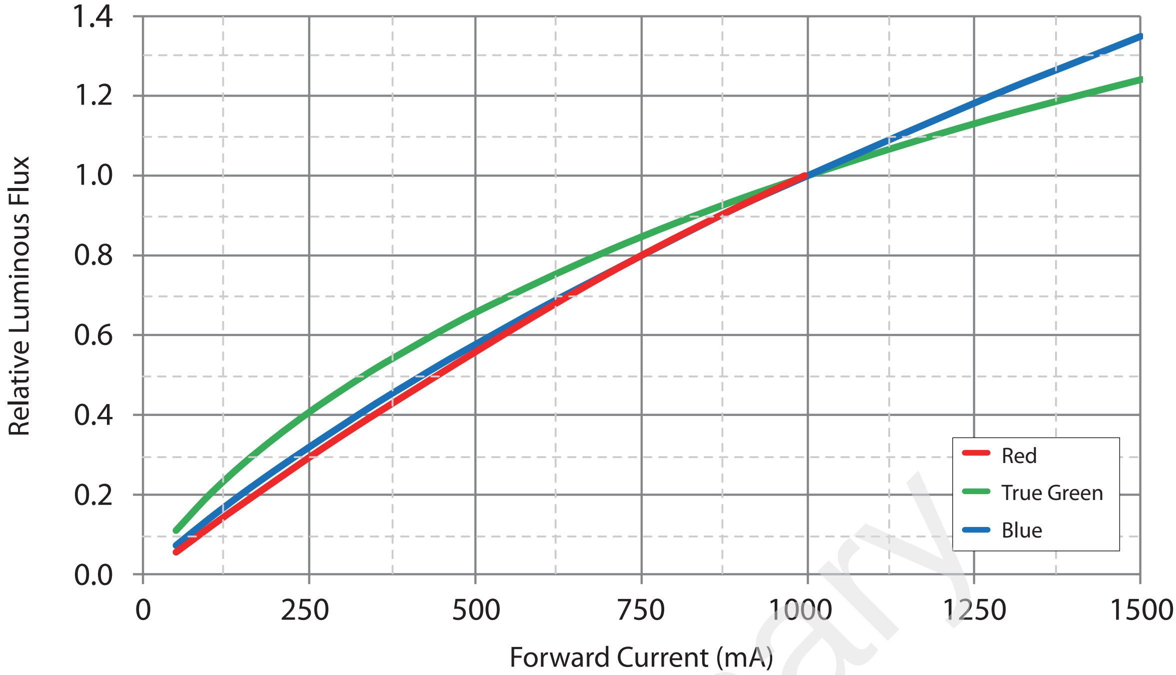
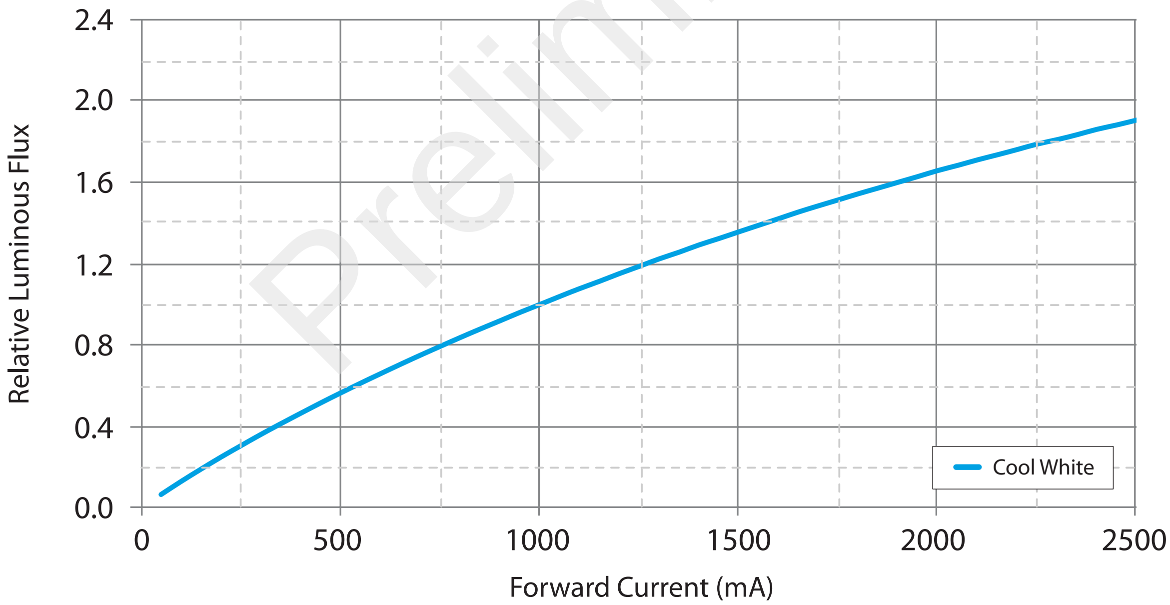
Relative Luminous Flux vs. Forward Current

(IV/IV (1000mA) = f(I_F) ; T_J = 25°C)



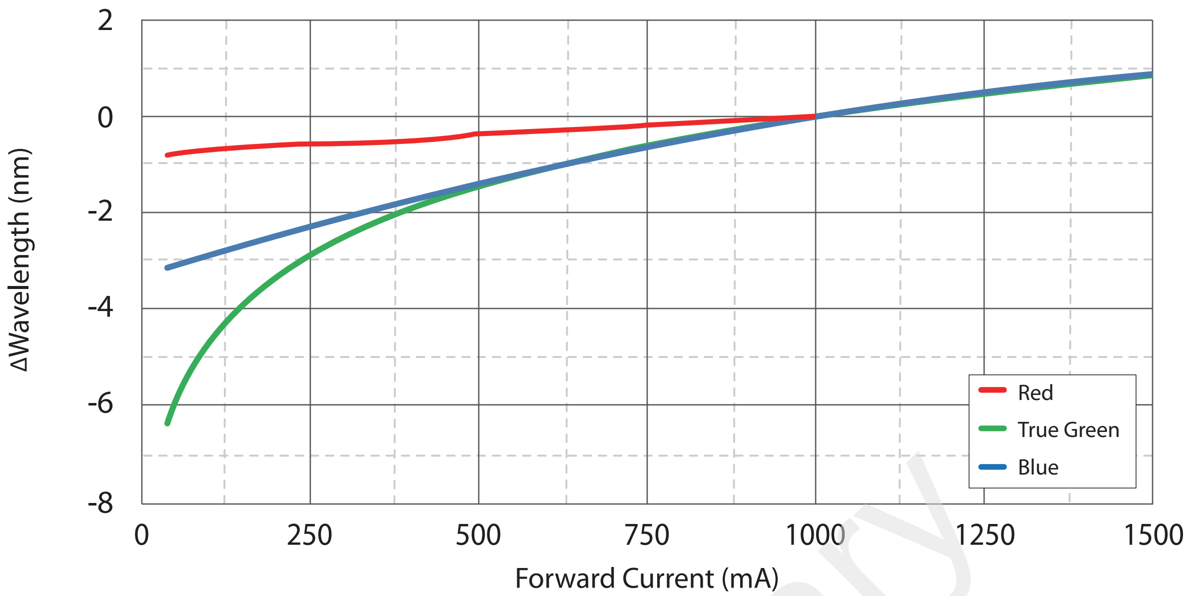
Relative Luminous Flux vs. Forward Current

(IV/IV (1000mA) = f(I_F) ; T_J = 25°C)



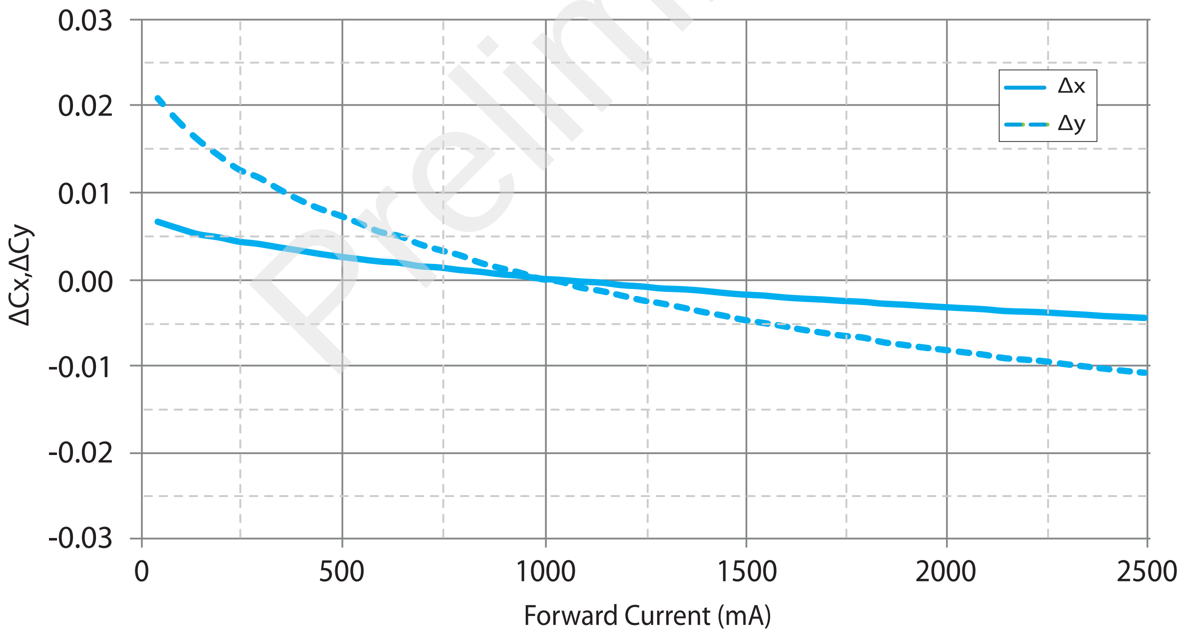
Wavelength vs. Forward Current

(ΔWavelength=Wavelength-Wavelength(1,000mA) ; T_J = 25°C)



ΔCx,ΔCy vs. Forward Current (Cool White)

(ΔCx,ΔCy=f(I_F) ; T_J = 25°C)



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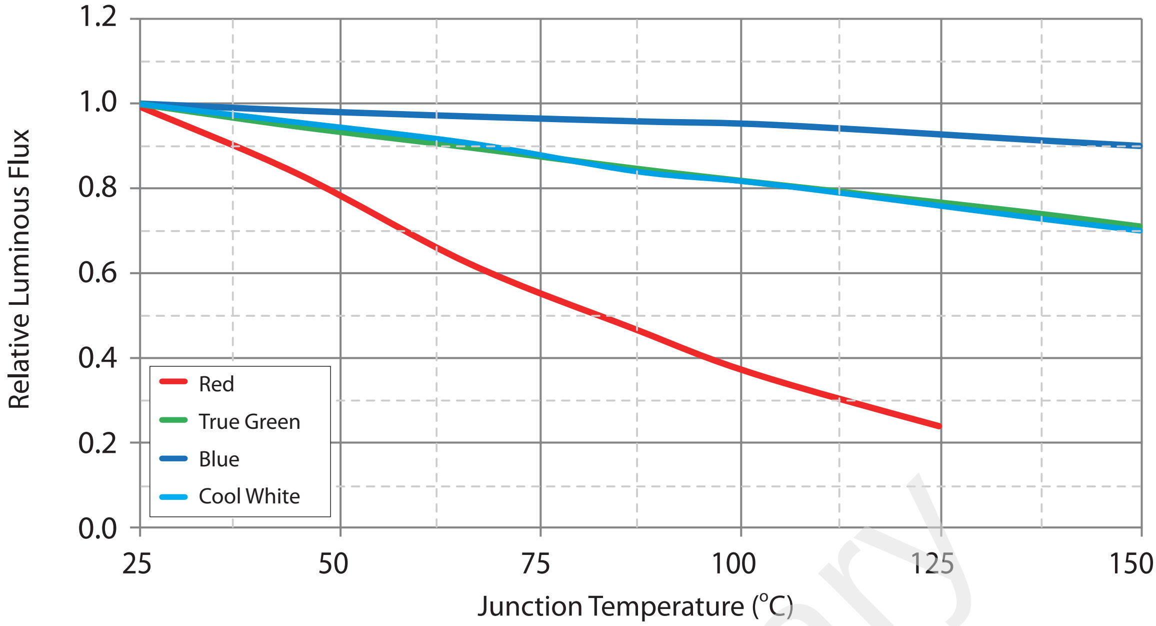
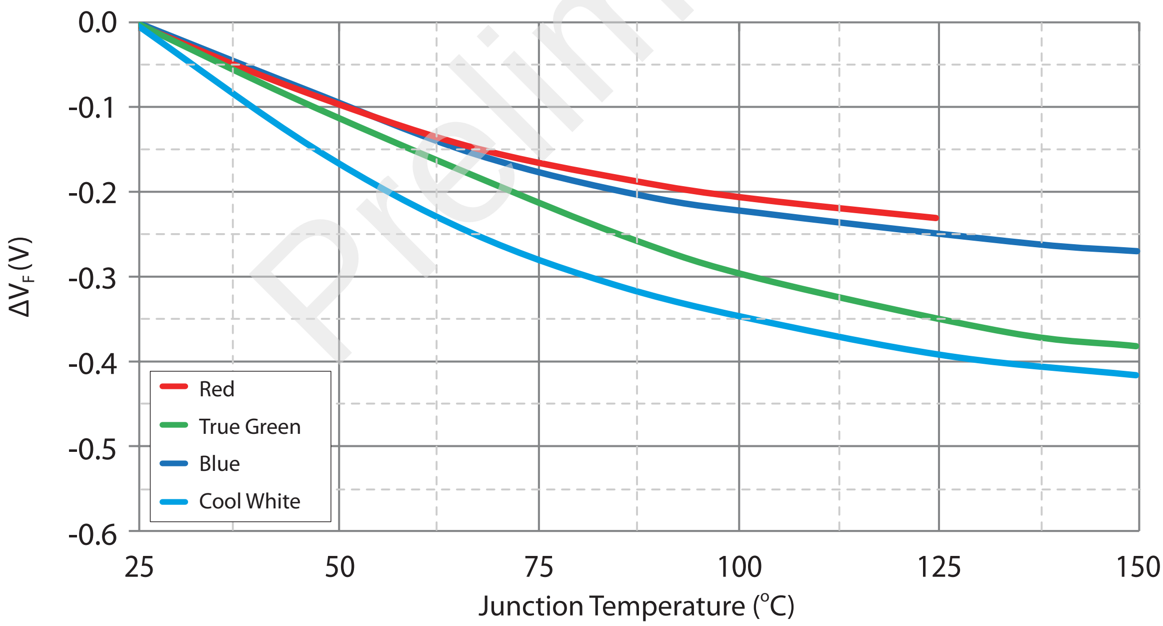
Relative Luminous Flux vs. Junction Temperature

(IV/IV(25°C) = f(T_J) ; I_F = 1000mA)



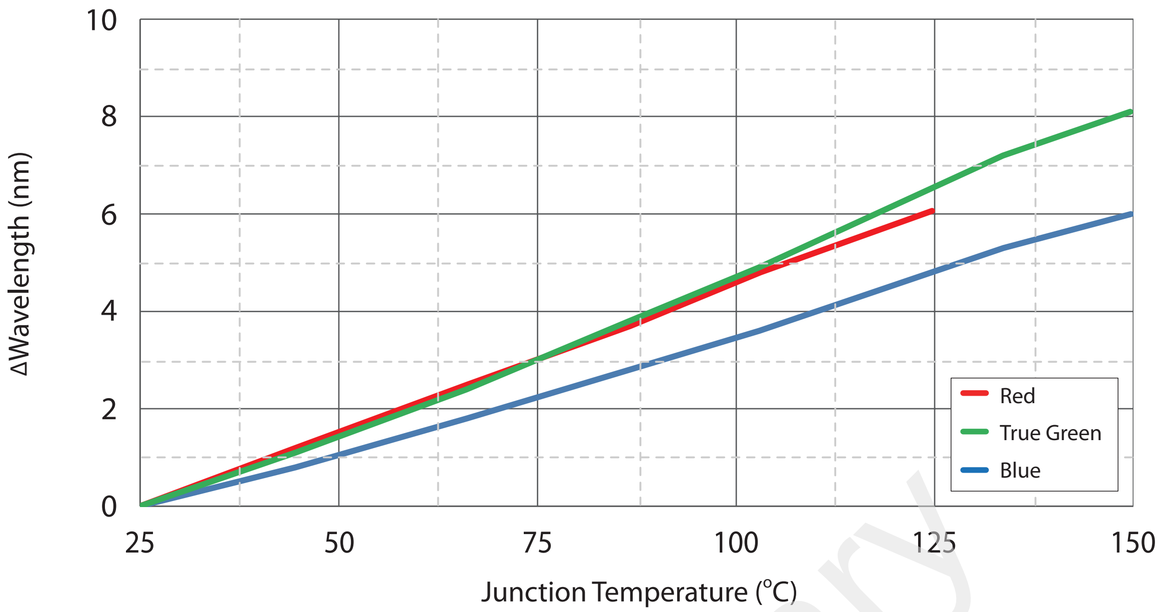
Forward Voltage vs. Junction Temperature

(ΔV_F=V_F-V_F(25°C)= f(T_J) ; I_F = 1,000mA)



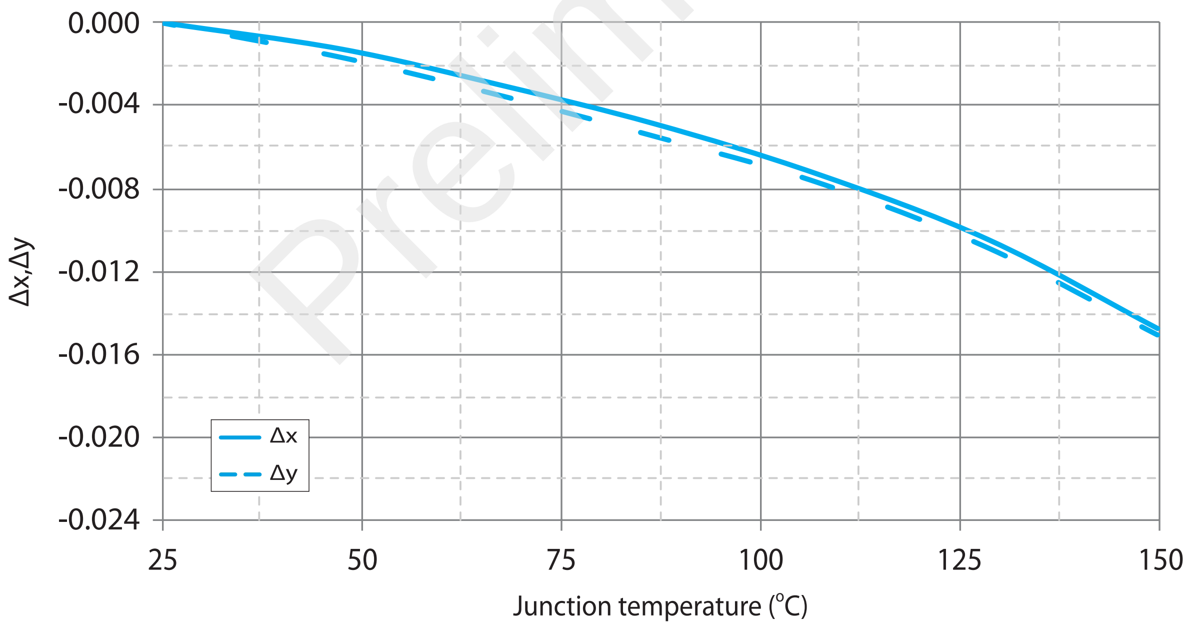
Wavelength vs. Junction Temperature

(ΔWavelength=Wavelength - Wavelength (25°C) ; I_F = 1,000mA)



ΔCx,ΔCy vs. Junction Temperature (Cool White)

(ΔCx,ΔCy=f(T_J) ; I_F=1000mA)



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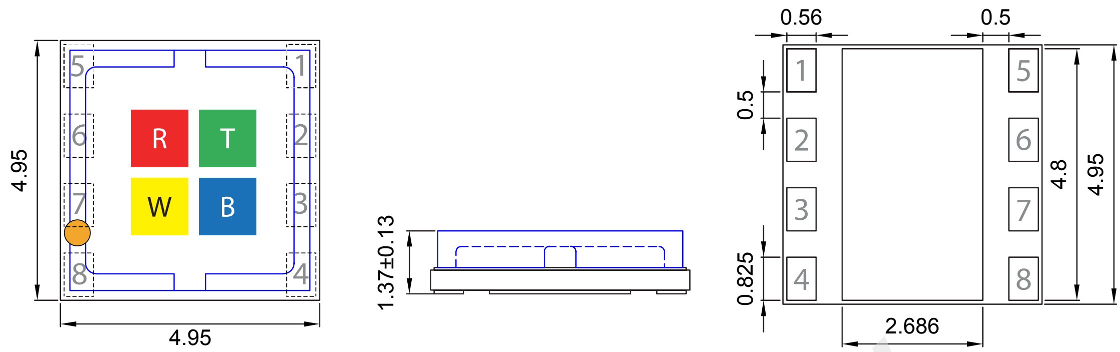
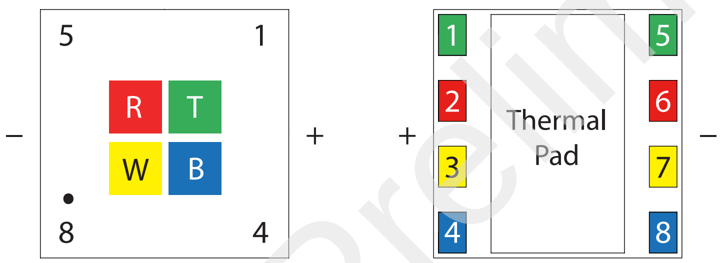
Mechanical Dimensions

Emitter Type Dimension

Notes:
1. Unless otherwise specified tolerance : ±0.1.
2. Unit: mm.
3. Drawings are not to scale.



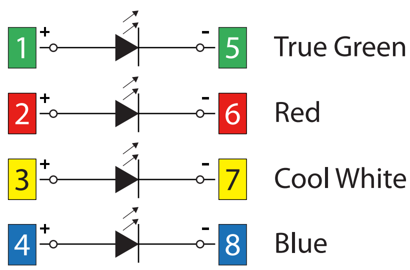
PCB Layout



Top

Bottom

Circuit



Note:
The thermal pad is electrically isolated from anode and cathode.

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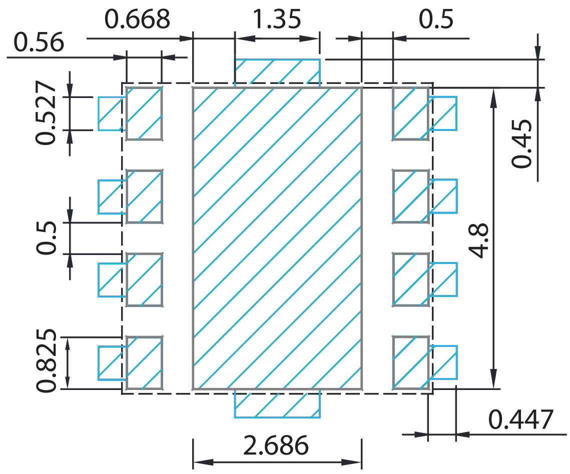
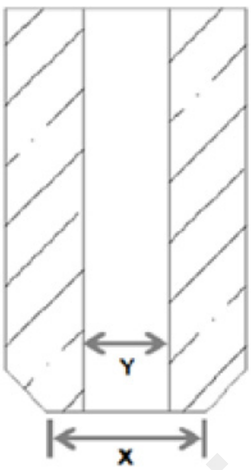
Recommended PCB Solder Pad



Notes:
1. Unit: mm.
2. Drawings are not to scale.

Pick and Place

1. Federal series is compatible for all kind of SMT instrument.
2. Using the recommended nozzle design can be more accurate during the SMT process.
3. The use of following specifications for designing the pick and place are recommended, which can pick and place the LED component more accurately.
4. The specifications and process parameters for pick and place shall be selected with caution, so that crack/scratch/deformation of the LED component that further affects the (shift of wavelength and color temperature/insufficient brightness) and reliability of the LED component can be prevented.



Recommended Nozzle Specification

Parameter	Spec.
Outside Diameter (x)	Φ 3.6
Inside Diameter (y)	Φ 2.2
Material	Ceramic

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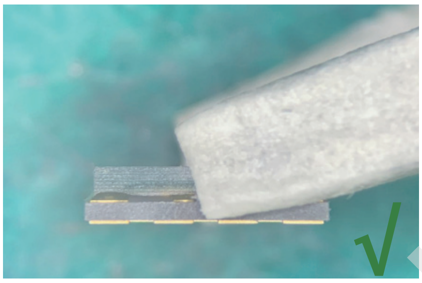
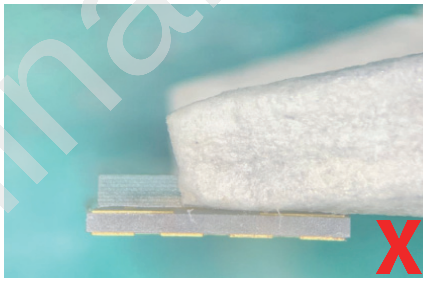
Handling Manual

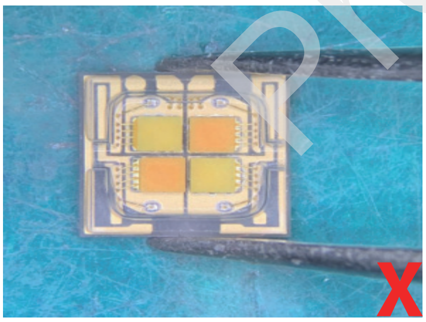
1. Do not press the product; even a slight pressure may damage the product.
2. Should flock, dirt and flux appear on the surface of LED component (glass), cotton swabs dipped in a slight amount of IPA can be used to clean the component surface (no water, oil, organic solvent can be used) and awareness must be implemented on whether or not there is residual flock. In addition, no ultrasonic wave can be used to clean the component, so internal damage to the component can be prevented.
3. When manually handling the LED, please use the plastic tweezers instead of the metal one. Avoid contacting to the silicon lens structure which will cause damage to the package.
4. Do not use adhesives or dissipation paste to attach the LED that outgas organic vapor.
5. Do not use any product with materials containing sulfur.
6. Do not assemble in humid environment or the conditions of containing oxidizing gas such as Cl, H2S, NH3, SO2, NOX, etc.

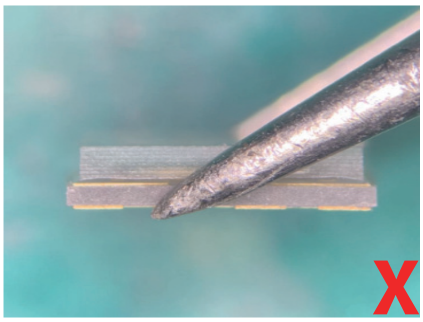
• Plastic Tweezers





• Metal Tweezers





Thermal Management

A high temperature operation condition always easily causes the decrease of flux and the decay of LED dies. The highest operation temperature of a component is able to be found by the indication of junction temperature in its datasheet. The power dissipation ability, the ambient temperature of LED junction, environment, thermal path and its thermal resistance are the main parameters which affect the performance of a LED device. Therefore, the limitation of junction temperature has become an important issue when designing a LED product.

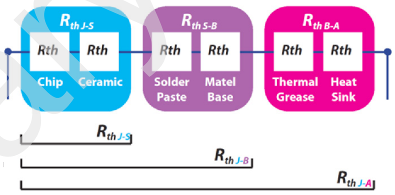
The following paragraphs describe how to determine the junction temperature and a simple ideal to heat sink design.

Thermal resistance is the temperature difference across a structure when a unit of heat energy flows through in unit time. For LEDs, temperature difference presents the temperature between a die's PN junction and package substrate. For the same package structure and operating condition, the smaller thermal resistance a LED has, the lower temperature of this LED. With lower operation temperature, a LED would keep its original performance for longer.

By estimating the PN junction temperature, users may be aware that the thermal management had been well designed.

From basic thermal equation for thermal resistance : $Rth_{(J\text{-}A)} = \frac{\Delta T_{(J-A)}}{P_D}$

Therefore the junction temperature (T_J) is : $T_J = T_A + Rth_{(J\text{-}A)}$ x PD

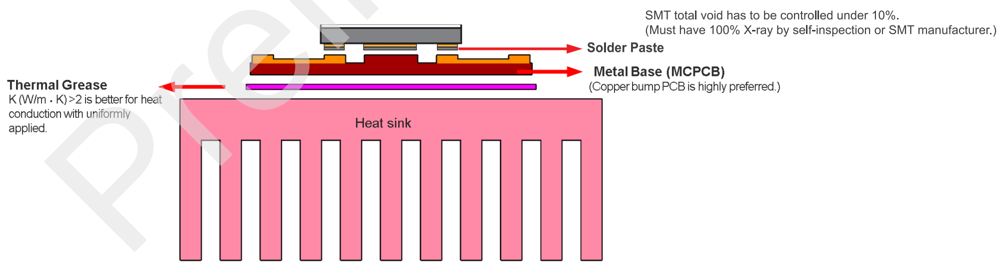


which,

P_D : Power Dissipation = Forward Voltage (V_F) x Forward Current (I_F)

T_A : Ambient Temperature (assume 25°C)

$Rth_{(J\text{-}A)}$: Total Thermal Resistance = $Rth_{(J\text{-}S)} + Rth_{(S\text{-}B)} + Rth_{(B\text{-}A)}$

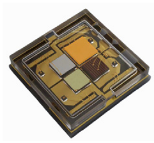


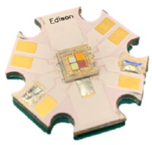
*During lighting design, the temperature T_J upon overall thermal stability shall be ensured not to exceed each chip's allowable temperature limit and the operating current may not exceed the nominal value.

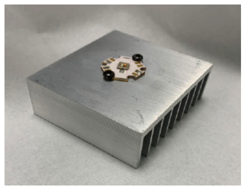
**While using the LED product, the overall structure for thermal conductivity shall be considered, so uneven paths for thermal conduction or radiator temperature that speeds up product failure can be prevented.

Tips for Thermal Management

Federal products (e.g: 25W) are not recommended to be operating without a heat sink. Through MCPCB, users may realize better performance.







For LEDs, choose an appropriate operation environment and conduct the heat to the air after light on LEDs may maintain the better performance and lifetime. Four major thermal path are as follow:

From heat source (component) to heat sink. (By conduction)

Conduction within the heat sink to its surface. (By conduction)

Transfer from the surface to the surrounding air. (By convection)

Emit heat from the heat sink surface. (By radiation)

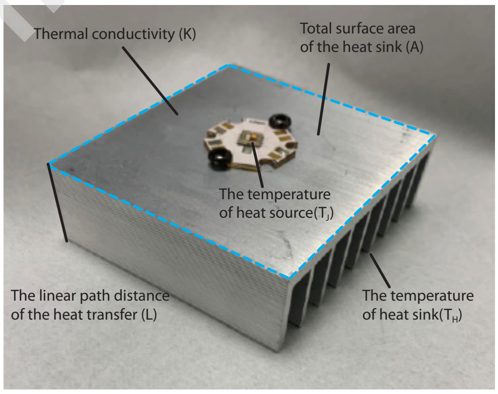
Path1 : The contact surface of the MCPCB and heat sink are not perfectly flat, they are not able to meet each other completely. Air between these two materials will result in high thermal resistance and reduce the effect of heat transfer. To enhance the ability of thermal conduction, one common method is applying thermal grease between the two interfaces and uses the screws to enforce the adhesion between two surfaces.

Path2 : Temperature gradient depends on the time of a heat sink. The total heat flux (Q) consists of:

1. The temperature difference between heat source (T_J) and heat sink (T_H)
2. Thermal conductivity (K) of the heat sink
3. Total surface area of the heat sink (A)
4. The linear path distance of the heat transfer (L)

This is represented by the Fourier's Law as follow:

$$Q = K \times A \times \frac{\Delta T}{L}$$



By choosing a higher thermal conductivity, increasing the surface area of the heat sink (add the number of fins) or shorten the distance of the linear path of heat dissipation may improve the loss of heat flux per unit time. Among all materials, metal is the best choice because of its high thermal conductivity.

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List of thermal conductivity for some usual materials

Material	K(W/m·K)
Copper	391
C1100	384
Aluminum	230
5000 Series	225
ADC-12	96.2
Magnesium	156
Air	0.024

Path3 : Heat dissipation includes convection and radiation. Those two types of transfer are proportional to the surface area of the heat sink. Adding the number of fin may increase the total surface area. However, too many fins may cause inhabitation of convection. There are many other thermal management methods such as install a fan to reach obliged convection. But this design may cause the issues such as noise or circuit design problem.

Path4 : Compare with an unfinished heat sink, the one that covered by high emissivity material, such as ceramic powder or deep color paint, usually has better radiation ability. Both anodizing and etching are also effective to increase the thermal dissipation.

Key points for thermal management:
1. The contact surface's flatness and smoothness of the component and heat sink.
2. The total surface area of heat sink.
3. The selection of heat sink material.
4. Optimum number of fins. (Aerodynamic optimization)

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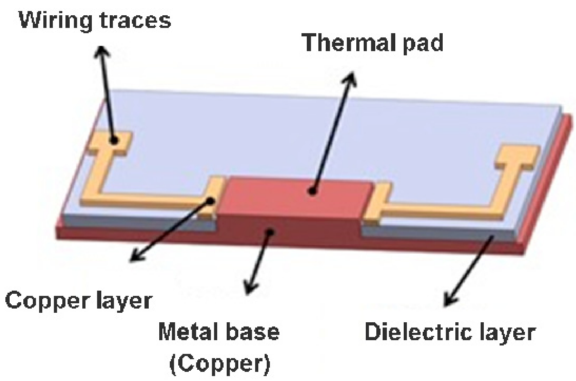
Recommended PCB Design

The PCB design can affect the thermal performance of the end product. In order to reduce the thermal resistance of PCB, heat must transfer through metal without dielectric layer. The figure below shows the cross-section of PCB.



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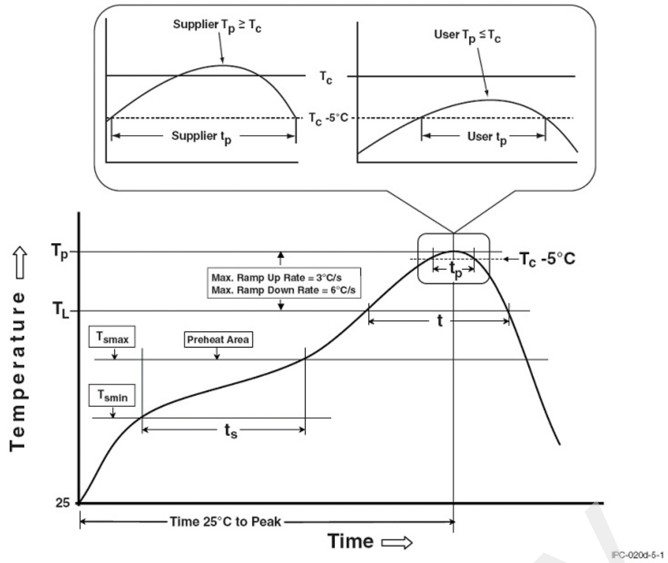
Reflow Profile

The following reflow profile is from IPC/JEDEC J-STD-020D which provided here for reference.



Reflow Profiles

Classification Reflow Profiles

Profile Feature	Pb-Free Assembly
Preheat & Soak Temperature min (Tsmin) Temperature max (Tsmax) Time (Tsmin to Tsmax) (ts)	150 °C 200 °C 60-120 seconds
Average ramp-up rate (Tsmax to Tp)	3 °C/second max.
Liquidous temperature (TL) Time at liquidous (tL)	217 °C 60-150 seconds
Peak package body temperature (Tp)*	255 °C ~260 °C *
Classification temperature (Tc)	260 °C
Time (tp)** within 5 °C of the specified classification temperature (Tc)	30** seconds
Average ramp-down rate (Tp to Tsmax)	6°C/second max.
Time 25°C to peak temperature	8 minutes max.

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Notes:

1. Tolerance for time at peak profile temperature (Tp) is defined as a supplier minimum and a user maximum.

2. Tolerance for peak profile temperature (tp) is defined as a supplier minimum and a user maximum.

3. Prior to the SMT process, the LED component shall be confirmed whether or not there is damping, so that any product failure caused during the SMT process can be prevented. (For more conditions and details of product storage, please refer to the information of product storage).

4. This LED component is applicable for reflow profile onto the PCB board. We will not guarantee the reliability if other methods are implemented.

5. The reflow process of LED component shall not exceed three times.

6. Should the LED product require second soldering, the re-work must be implemented with a hot plate. Moreover, the LED product shall be confirmed with well characteristics prior to usage.

7. Should flock, dirt and flux appear on the surface of LED component (silicone lens), cotton swabs dipped in a slight amount of IPA can be used to clean the component surface (no water, oil, organic solvent can be used) and awareness must be implemented on whether or not there is residual flock. In addition, no ultrasonic wave can be used to clean the component, so internal damage to the component can be prevented.

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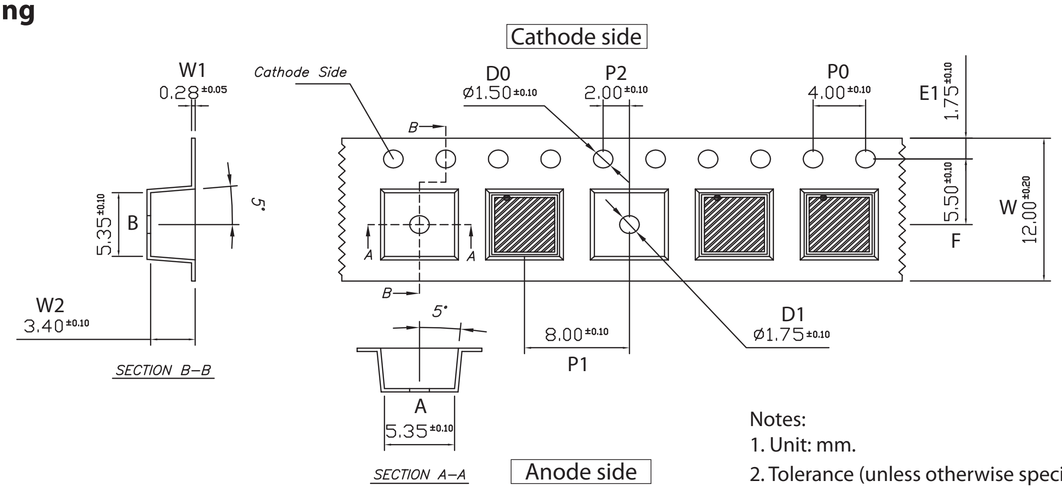
Product Packaging Information

Tapping

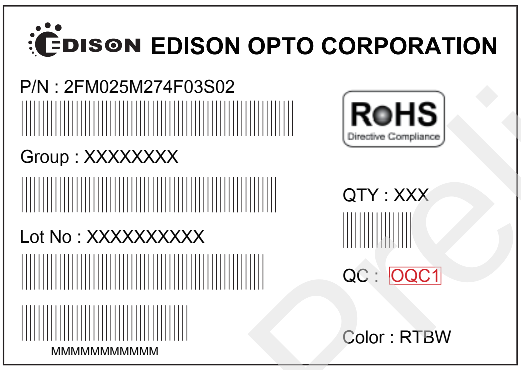


Notes:
1. Unit: mm.
2. Tolerance (unless otherwise specified): ±0.10mm.
3. Drawings are not to scale.

A	B	D0	D1	E1	F
5.35± 0.10	5.35±0.10	ø1.50±0.10	ø1.75±0.10	1.75±0.10	5.50±0.10

P0	P1	P2	W	W1	W2
4.00±0.10	8.00±0.10	2.00±0.10	12.00±0.10	0.28±0.05	3.40±0.10

Product Label



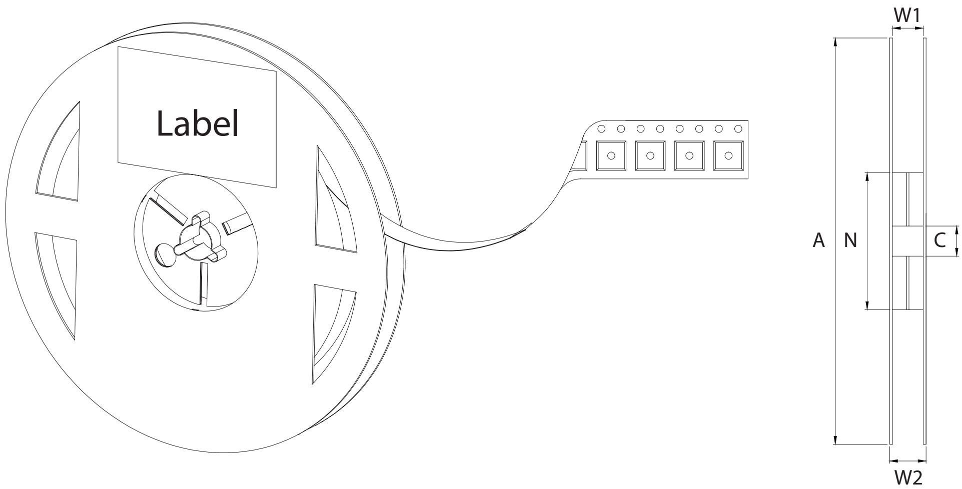
Label information
P/N: Order Code
Group: Bin Group
Lot No: Lot Number
QTY: Packing Quantity
LED: LED Color

Bin Group Format

X	X	X	X	X	X	X	XXX
X1	X2	X3	X4	X5	X6	X7	X8-X10
Red		True Green		Blue		Cool White	
LuminousFlux (lm)	Wavelength (nm)	LuminousFlux (lm)	Wavelength (nm)	LuminousFlux (lm)	Wavelength (nm)	LuminousFlux (lm)	Color Bin

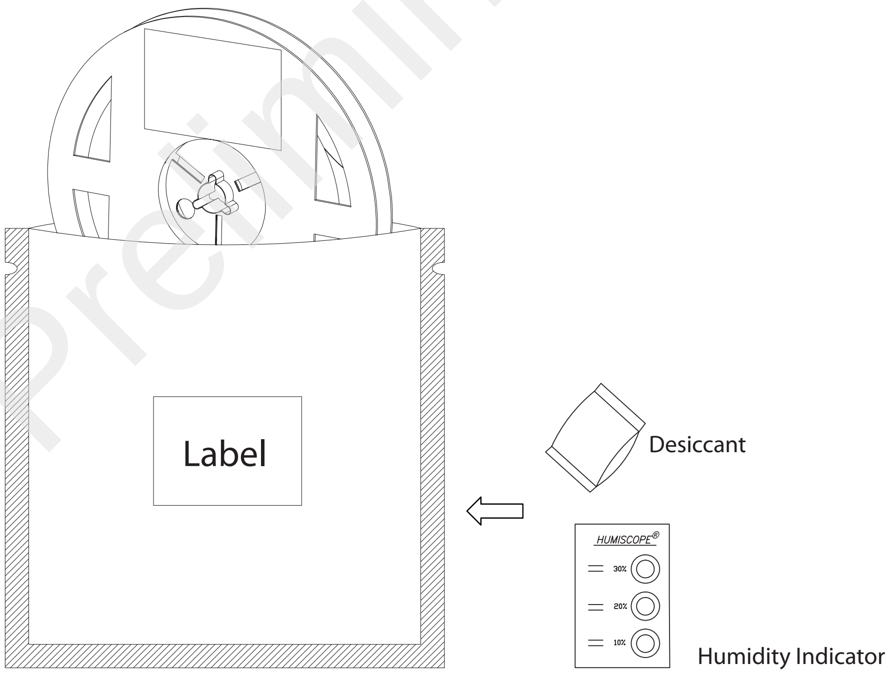
Tape and Reel

Notes:
1. Unit: mm.
2. Drawings are not to scale.



A	C	N	W1	W2	Pieces per Reel
178±1.0	13.3±0.3	59±1.0	13.5±1.0	16.1+0.5/-0	≦ 500
Starting with 50pcs empty, and 50pcs empty at the last.					

Static Bag



Lighting Design Manufacturing Service

Storage Information

Conditions	Temperature	Humidity	Time	Remarks
Aluminum foil bag (sealed)	5~30°C	≤90%	Within 1 year from delivery date	The aluminum foil bag is sealed with maintained integrity and there is no sign of vacuum relief.
Aluminum foil bag (unsealed)	5~30°C	≤60%		The environmental conditions for storage shall be monitored.

1. After the aluminum foil bag gets unsealed over a year or discoloration of the drying agents occurs, re-baking is required (preventing ambient temperature and moisture from affecting quality of the components and mounted piece). The entire roll of carrier tape shall be placed into the oven horizontally.
2. The storage environment shall be kept tidy and the environmental conditions for storage shall be monitored.
3. Long time exposure to sunlight or UV should be avoided; otherwise, it may cause the discoloration of materials.
4. The assembled PCB modules may not be stacked together, so broken packaging seal or internal failure of LED can be prevented.
5. Should the moisture card discolor after unsealing (possible vacuum relief to the packaging), the baking of the component is required for preventing impact on the product quality. (With reference to the baking treatment should be performed after unsealing and based on the following condition: 65±5°C for 24 hours or above).
6. Be aware of the storage equipment (i.e., damp-proof cabinet), production environment or ESD protection for the operator. Prevent the component from ESD shock that may cause product failure.

   A. The personnel acquiring the LED component shall be equipped with anti-static bracelet, anti-static shoes, clean-room clothing (bracelet) and earth connection.
   B. The storage equipment (i.e., damp-proof cabinet) where the LED component is placed shall be ensured with an earth connection.
   C. The working area shall be provided with an anti-static desk (earth connection required) and anti-static fans.
   D. After suffering ESD damage, the LED component would cause quality abnormalities such as electrical leakage of the product (Ir), reduction in starting voltage or abnormal lumen decay.

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Revision History

Versions	Description	Release Date
0.1	Preliminary	2022/10/07
0.2	1. Revise the cover format 2. Revise forward voltage measurement allowance 3. Add forward voltage bin codes 4. Modify characteristic curves for wavelength shift 5. Optimize circuit schematic 6. Add application notes	2024/01/17

About Edison Opto

Edison Opto is a leading manufacturer of high power LED and a solution provider experienced in LDMS. LDMS is an integrated program derived from the four essential technologies in LED lighting applications- Thermal Management, Electrical Scheme, Mechanical Refinement, Optical Optimization, to provide customer with various LED components and modules. More Information about the company and our products can be found at www.edison-opto.com

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