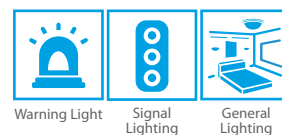
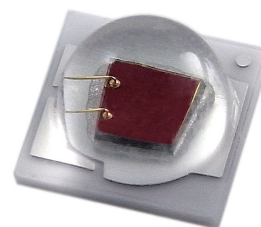


Federal LC Series Datasheet (EN)

Federal 3535 1W Amber

2FX001AX00F02001



Features:

- High lumen performance
- High efficiency package
- Standard 3535 package with existing design
- Level 1 on JEDEC moisture sensitivity analysis
- Maximum drive current: 1,000mA
- RoHS compliant

Typical Applications:

- | | |
|-----------------------|--------------------------------------|
| ■ Wash wall lights | ■ Signaling lights/Traffic signal |
| ■ Warning lights | ■ LCD Backlights |
| ■ Turn signal | ■ Daytime running lights |
| ■ Warm dimming lights | ■ Position lights/Side marker lights |

Table of Contents

| | |
|-------------------------------------|----|
| General Information | 3 |
| Absolute Maximum Ratings | 4 |
| Characteristics | 4 |
| Luminous Flux Bin Codes | 5 |
| Forward Voltage Bin Codes..... | 5 |
| Wavelength Bin Codes | 5 |
| Characteristic Curves | 6 |
| Mechanical Dimensions..... | 11 |
| Reflow Profile..... | 19 |
| Product Packaging Information | 21 |
| Revision History | 23 |
| About Edison Opto | 23 |

General Information

Introduction

Federal 3535 is a surface mount, compact, high brightness LED that is built for various illumination needs. The small physical dimension can free customers from any constraints or limitations in these fields of applications. Furthermore, the reflow-solderable nature of Federal 3535 provides an easy path towards the optimum thermal management to achieve a promising reliability. In conclusion, Federal 3535 offers you an extraordinary LED experience.

Order Code Format

| | | | | | | | | | |
|---------------|-----------|------------|------------|---------------|------------|--------------|--------------|----|-------|
| <u>2</u> | <u>F</u> | <u>X 0</u> | <u>0 1</u> | <u>A X</u> | <u>x x</u> | <u>F 0 2</u> | <u>x x x</u> | | |
| X1 | X2 | X3 | X4 | X5 | X6 | X7 | X8 | | |
| | | | | | | | | | |
| X1 | X2 | X3 | X4 | X5 | | | | | |
| Type | Component | | Series | | Wattage | | Color | | |
| 2 | Emitter | F | Federal | X0 | 3535 | 01 | 1W | AX | Amber |
| | | | | | | | | | |
| X6 | | X7 | | X8 | | | | | |
| Internal code | | PCB Board | | Serial Number | | | | | |
| - | - | F02 | 3535 | - | - | | | | |

Absolute Maximum Ratings

(T_J = 25°C)

| Parameter | Symbol | Value | Units |
|-----------------------------------|----------------|-----------|--------|
| DC Forward Current ^[1] | I _F | 1,000 | mA |
| Reverse Voltage ^[2] | V _R | Note 2 | V |
| LED Junction Temperature | T _J | 125 | °C |
| Operating Temperature | - | -40 ~ +85 | °C |
| Storage Temperature | - | -40 ~ +85 | °C |
| ESD Sensitivity (HBM) | - | 8 | KV |
| Allowable Reflow Cycles | - | 3 | Cycles |
| Soldering Temperature | - | 260 | °C |

Notes:

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

Characteristics

(I_F = 350mA ; T_J = 25°C)

| Parameter | Symbol | Value | Units |
|----------------------------|-------------------|---|--------|
| Viewing Angle (typ.) | 2Θ _{1/2} | 115 | Degree |
| Thermal Resistance (typ.) | R _{th} | 5.8 | °C/W |
| Wavelength | - | 585-595 | nm |
| JEDEC Moisture Sensitivity | - | Level 1 Floor Life Conditions: ≤30°C / 85% RH Soak Requirements(Standard) Time (hours): 168+5/-0 Conditions: 85°C / 85% RH | - |

Notes:

- Edison maintains a tolerance of ±1nm on wavelength measurement.
- Viewing angle is measured with accuracy of ±10%.

Luminous Flux Bin Codes

(T_j = 25°C)

| Color | Code | Luminous Flux @350mA (lm) | | Luminous Flux @700mA (lm) | | Order Code |
|-------|------|------------------------------|------|------------------------------|-------|------------------|
| | | min | max | min | max | |
| Amber | S0 | 51.2 | 66.5 | 91.1 | 118.4 | 2FX001AX00F02001 |
| | T0 | 66.5 | 86.5 | 118.4 | 154.0 | |
| | U0 | 86.5 | 110 | 154.0 | 195.8 | |

Note:

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

Forward Voltage Bin Codes

(I_F = 350mA ; T_j = 25°C)

| Code | (Min.) Forward Voltage (V) | (Max.) Forward Voltage (V) |
|------|----------------------------|----------------------------|
| U03 | 1.6 | 1.9 |
| U04 | 1.9 | 2.2 |
| U05 | 2.2 | 2.5 |
| V00 | 2.5 | 2.8 |

Note:

Forward voltage measurement allowance is ±0.06V.

Wavelength Bin Codes

(T_j = 25°C)

| Color | Code | (Min.) Domain Wavelength [nm] | (Max.) Domain Wavelength [nm] |
|-------|------|----------------------------------|----------------------------------|
| Amber | AX0 | 585.0 | 587.5 |
| | AY0 | 587.5 | 590.0 |
| | AZ1 | 590.0 | 591.5 |
| | AZ2 | 591.5 | 593.0 |
| | AZ3 | 593.0 | 595.0 |

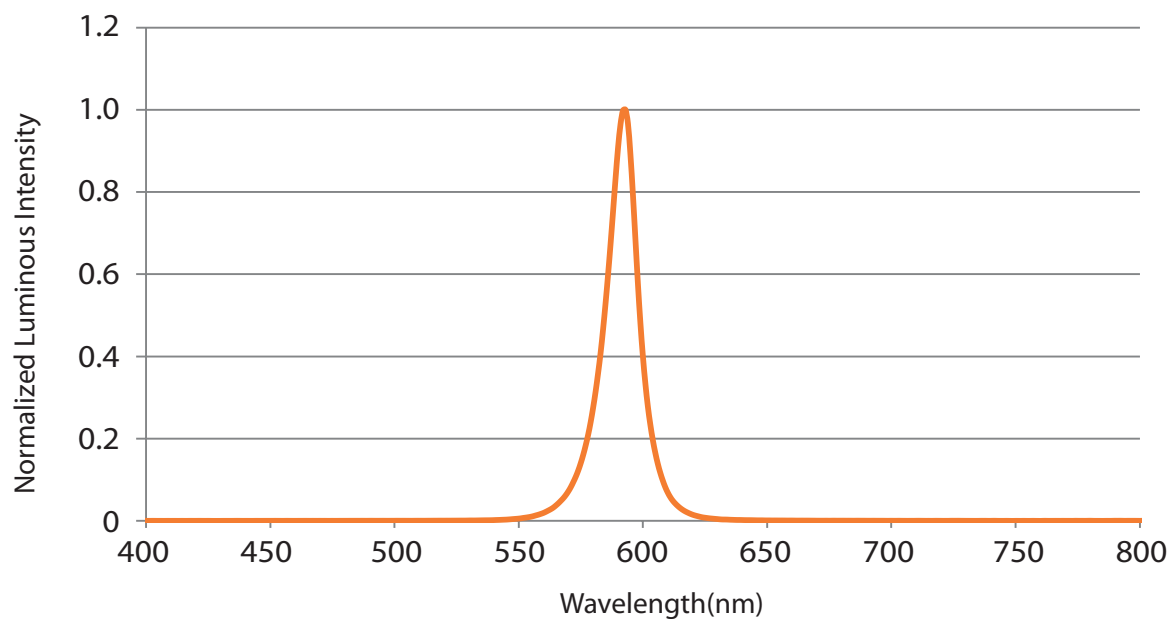
Note:

Dominant wavelength measurement allowance is ±1nm.

Characteristic Curves

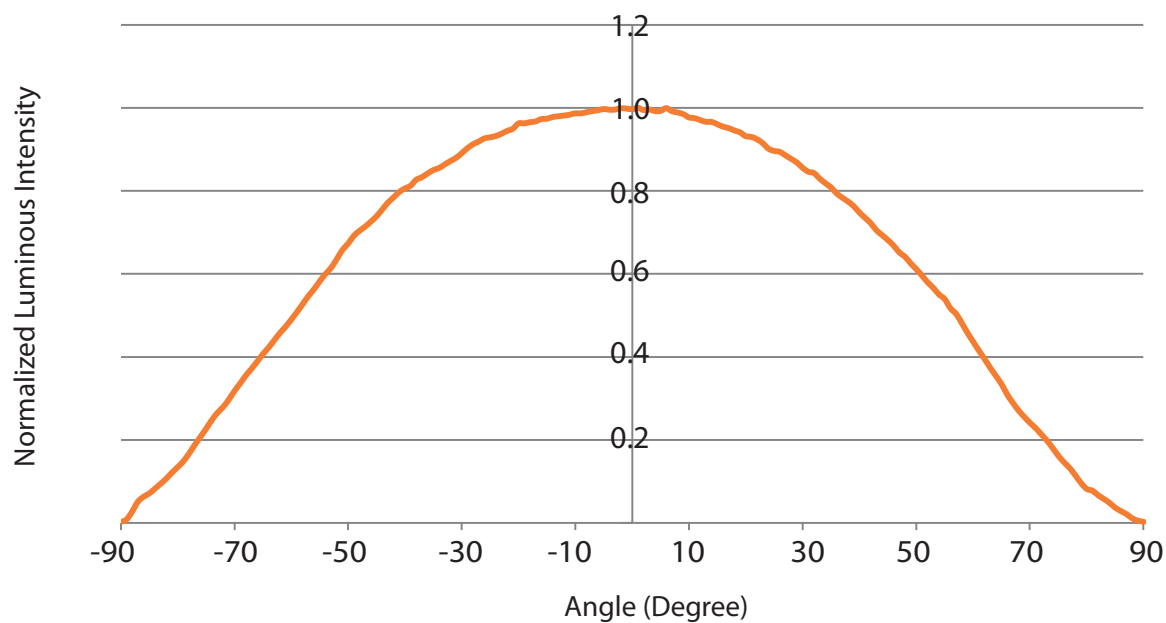
Color Spectrum

($I_{rel}=f(\lambda); I_F = 350\text{mA}; T_J = 25^\circ\text{C}$)



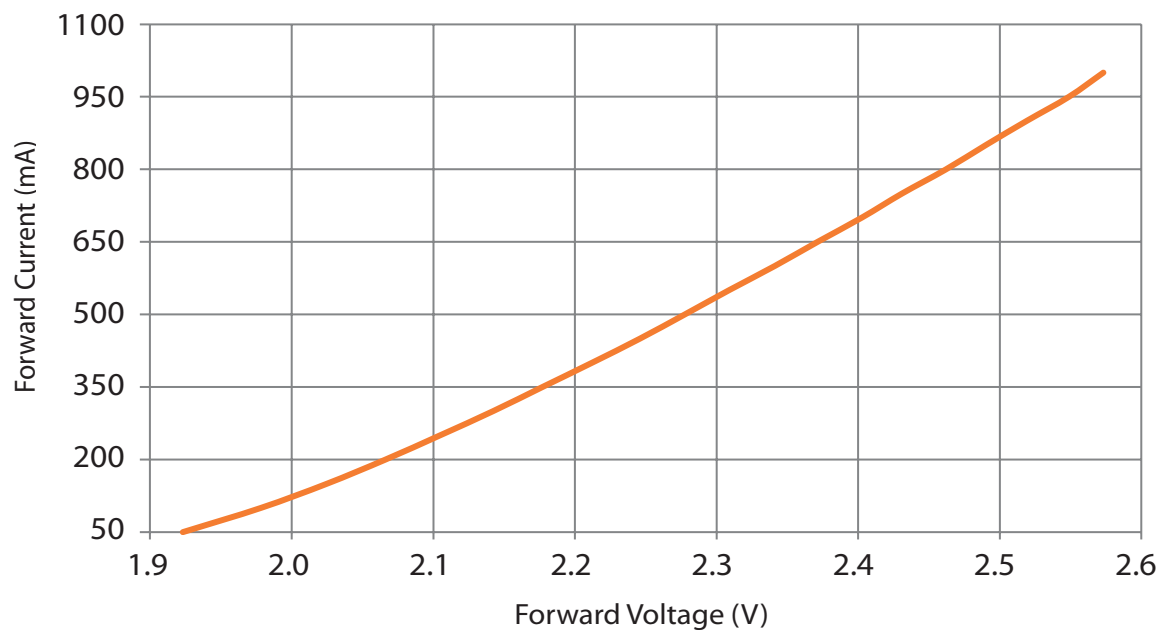
Beam Pattern

($I_F = 350\text{mA}; T_J = 25^\circ\text{C}$)



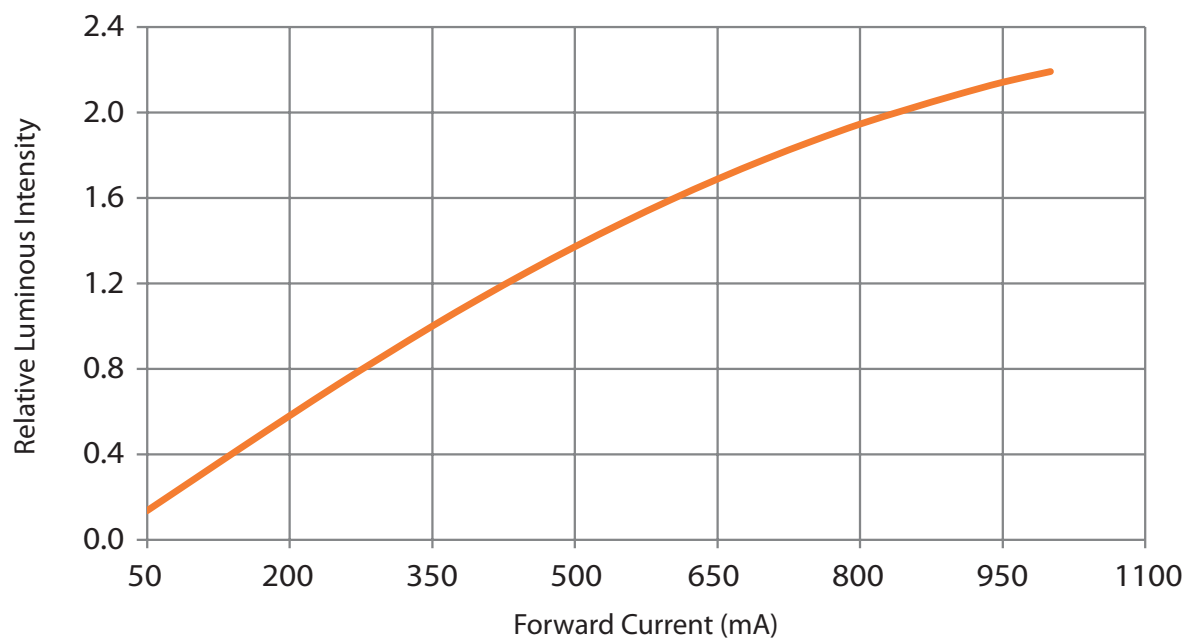
Forward Current vs. Forward Voltage

($I_F = f(V_F)$; $T_J = 25^\circ\text{C}$)



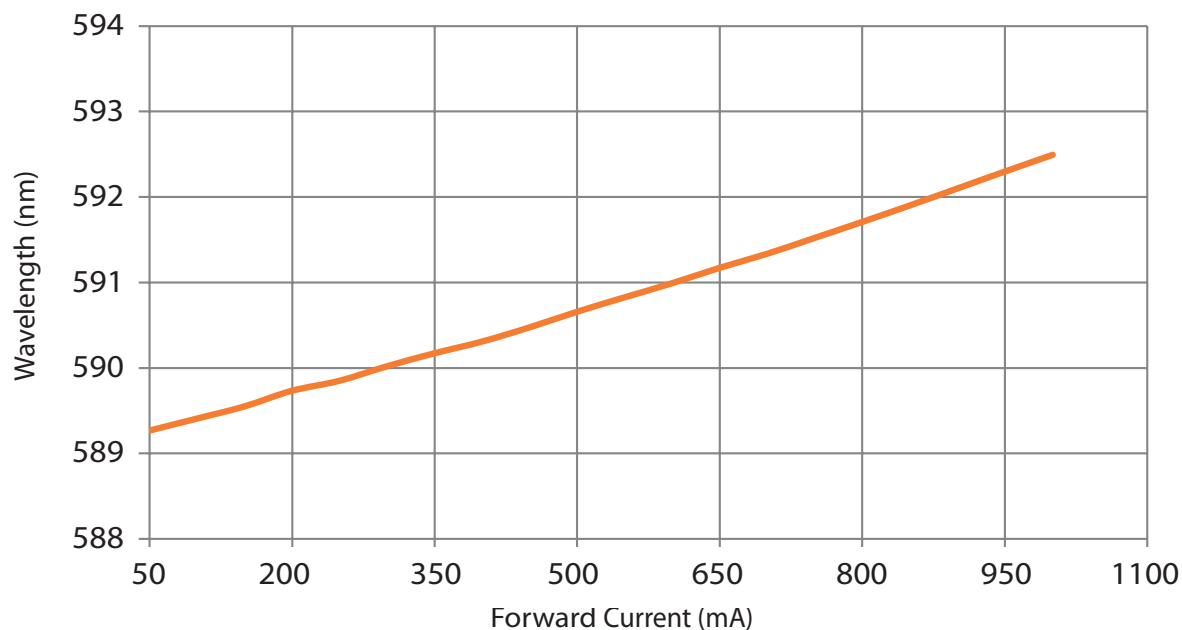
Relative Luminous Intensity vs. Forward Current

($I_V/I_V(350\text{mA}) = f(I_F)$; $T_J = 25^\circ\text{C}$)



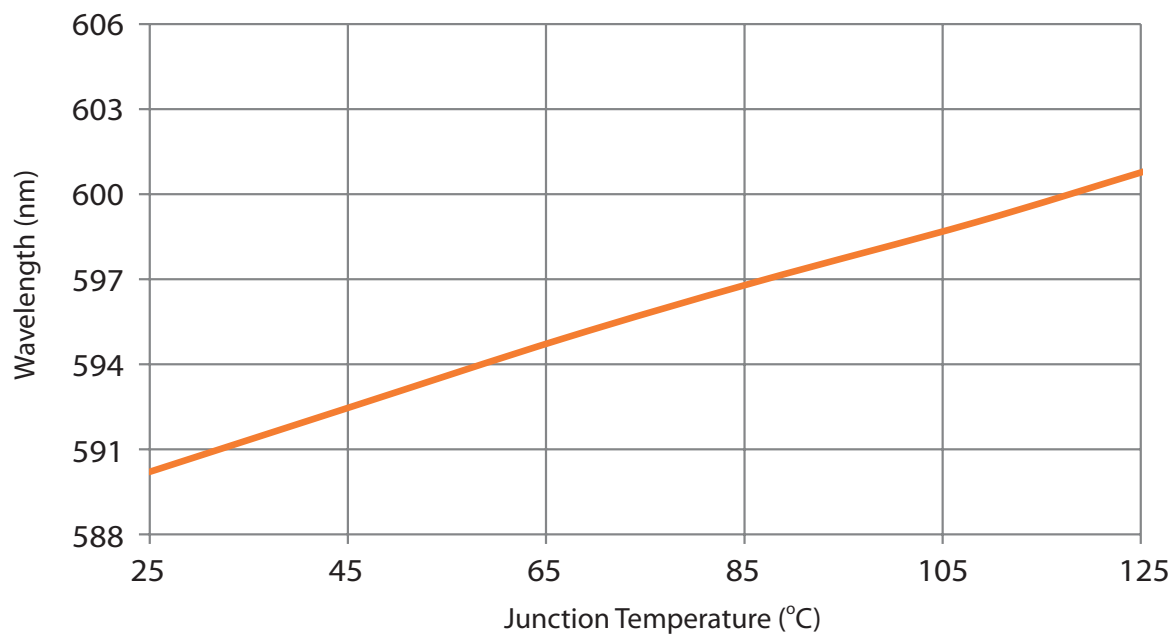
Wavelength vs. Forward Current

($T_j = 25^\circ\text{C}$)



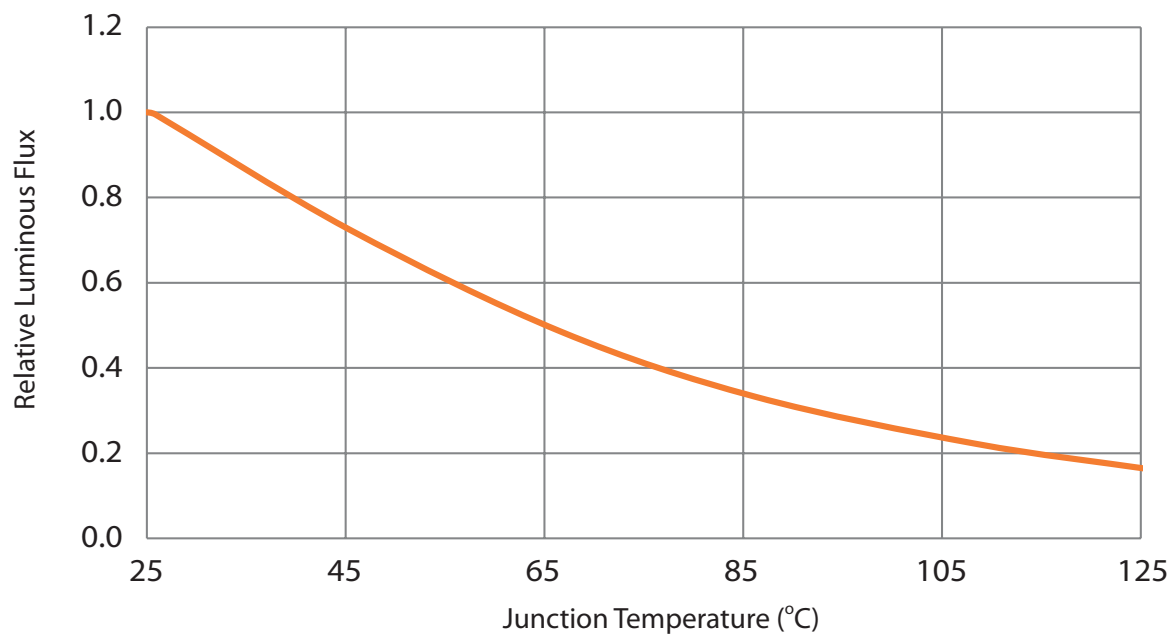
Wavelength vs. Junction Temperature

($I_F = 350\text{mA}$)



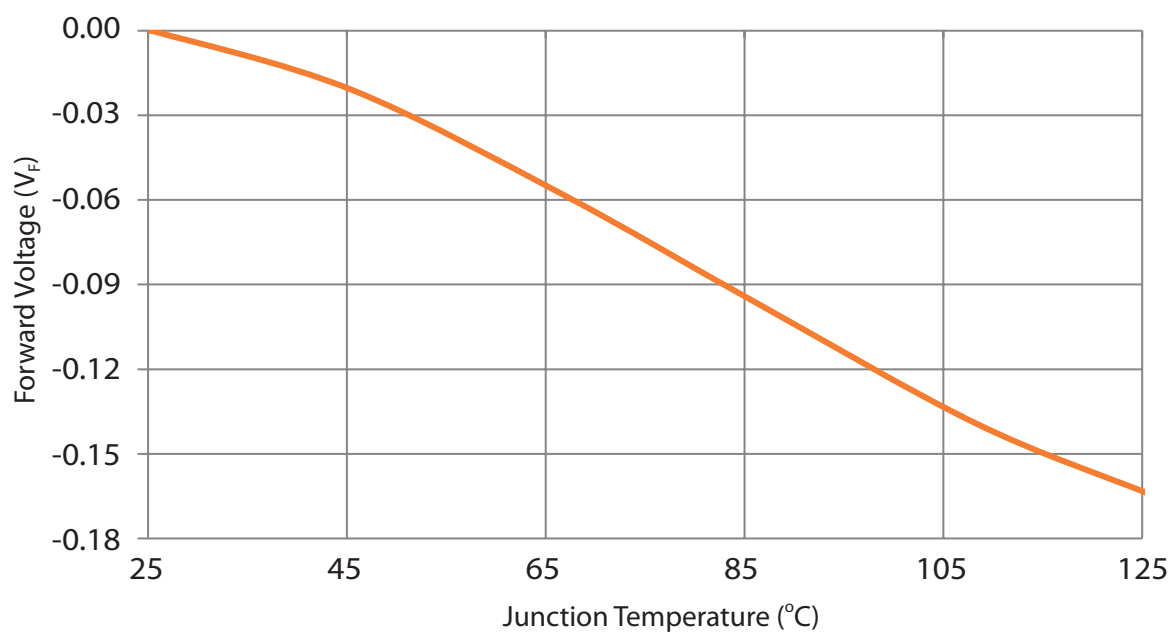
Relative Luminous Flux vs. Junction Temperature

$(I_V/I_V(25^\circ\text{C}) = f(T_J); I_F = 350\text{mA})$



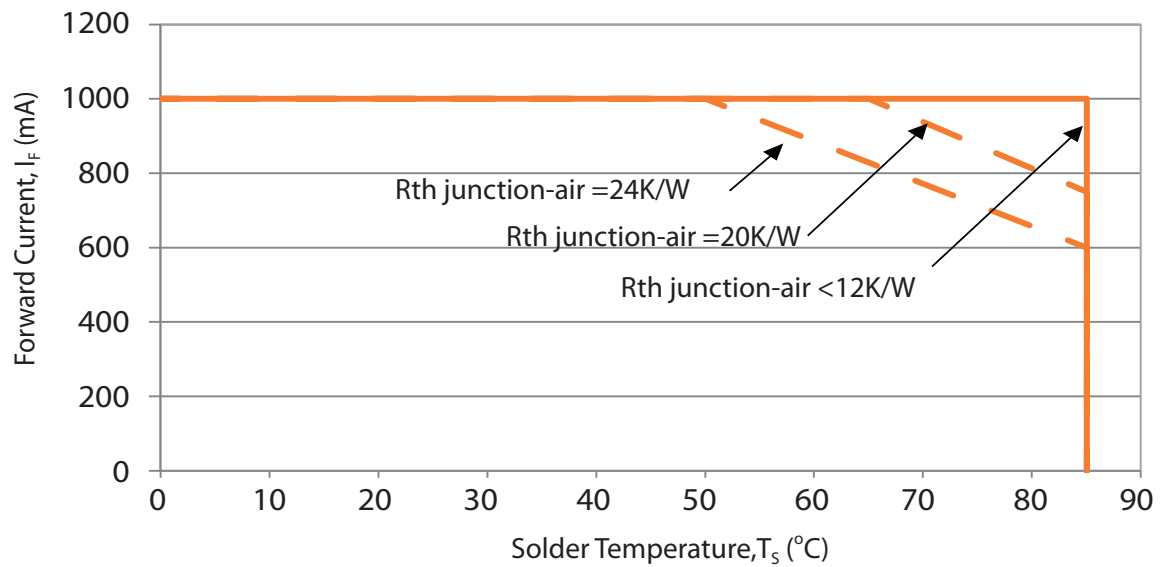
Forward Voltage vs. Junction Temperature

$(\Delta V_F = V_F - V_F(25^\circ\text{C}) = f(T_J); I_F = 350\text{mA})$



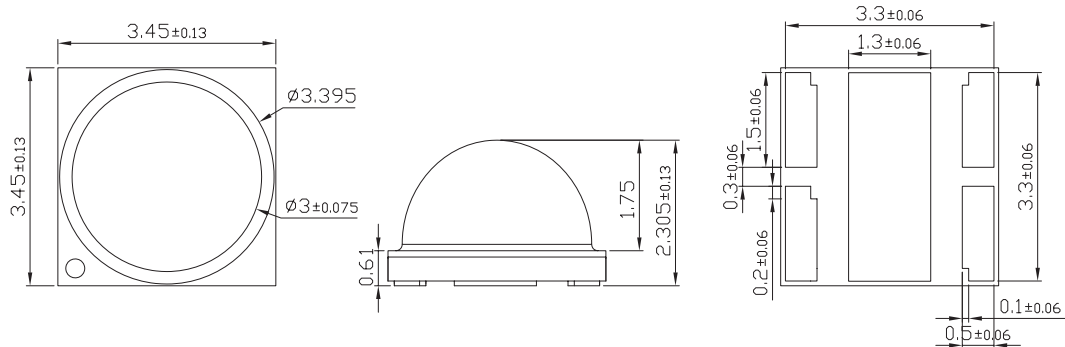
Forward Current vs. Solder Temperature

$$I_F = f(T)$$



Mechanical Dimensions

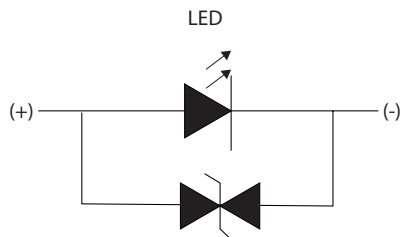
Component



Notes:

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

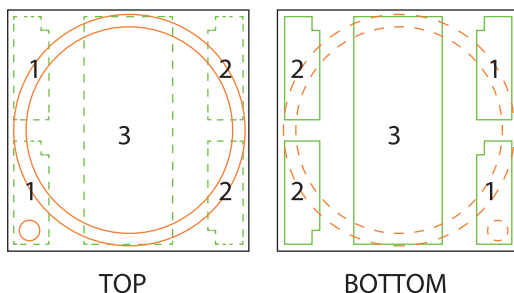
Circuit



Note:

The thermal pad is electrically isolated from anode and cathode.

Ceramic Layout

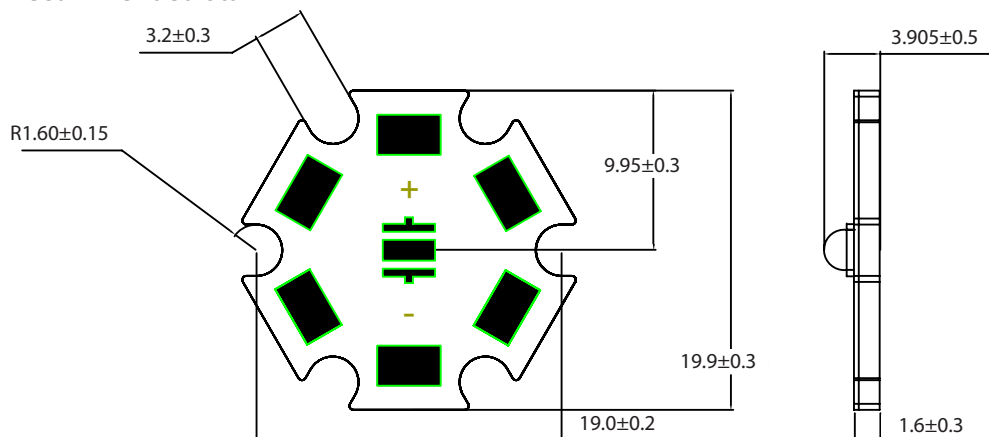


Pad Configuration

| Pad | Function |
|-----|----------|
| 1 | Anode |
| 2 | Cathode |
| 3 | Thermal |

Recommended PCB

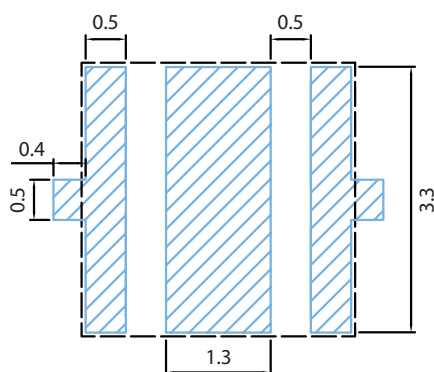
Recommended Star



Notes :

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

Recommended Solder Pad

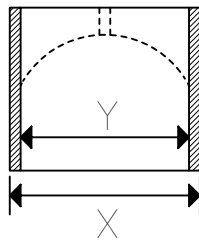


Notes:

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 emitting surface of the LED component is a piece of silicone, thus the specifications and process.



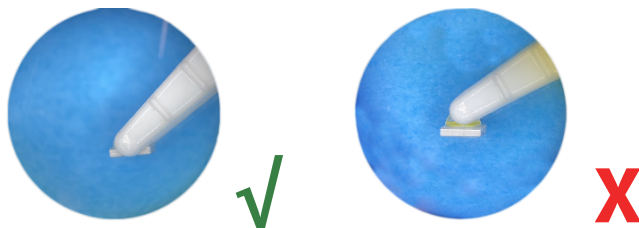
Recommended Nozzle Specification

| Parameter | Spec. |
|----------------------|---------|
| Outside Diameter (x) | Φ 3.5 |
| Inside Diameter (y) | Φ 3.1 |
| Material | Ceramic |

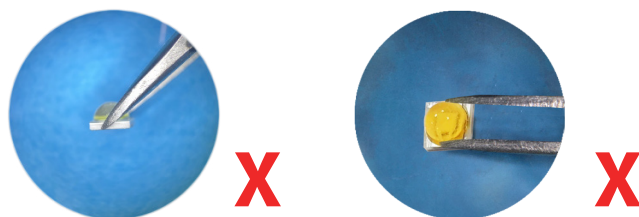
Handling Manual

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 (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.
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, NO_x, 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 : $R_{th(J-A)} = \frac{\Delta T_{(J-A)}}{P_D}$

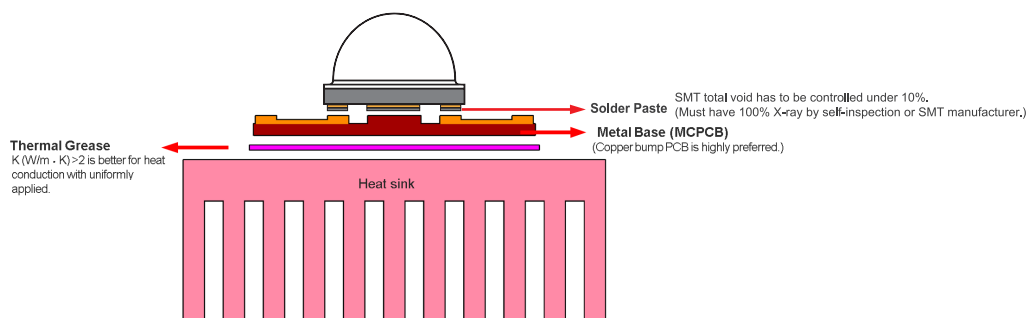
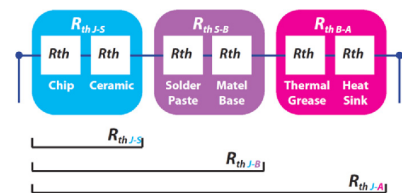
Therefore the junction temperature (T_J) is : $T_J = T_A + R_{th(J-A)} \times P_D$

which,

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

T_A : Ambient Temperature (assume 25°C)

$R_{th(J-A)}$: Total Thermal Resistance = $R_{th(J-S)} + R_{th(S-B)} + R_{th(B-A)}$



*During lighting design, the temperature T_J upon overall thermal stability shall be ensured not to exceed 125°C 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: 1W) 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)

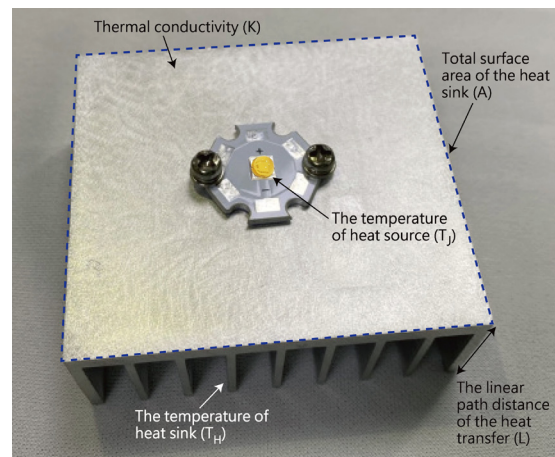
Path1 : The contact surface of the MCPCB and heat sink are not perfectly flat, they are not able to meet each other completely. Air between these two materials will result in high thermal resistance and reduce the effect of heat transfer. To enhance the ability of thermal conduction, one common method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

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.

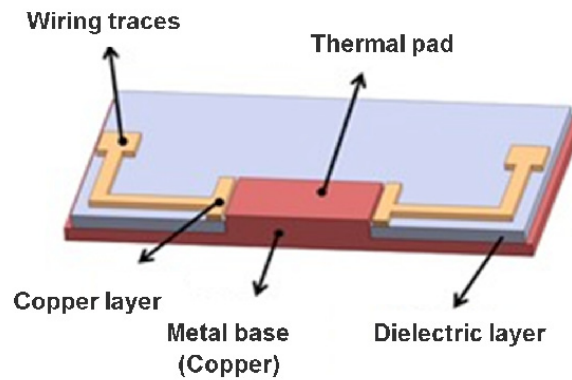
Path4 : Compare with an unfinished heat sink, the one that covered by high emissivity material, such as ceramic powder or deep color paint, usually has better radiation ability. Both anodizing and etching are also effective to increase the thermal dissipation.

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)

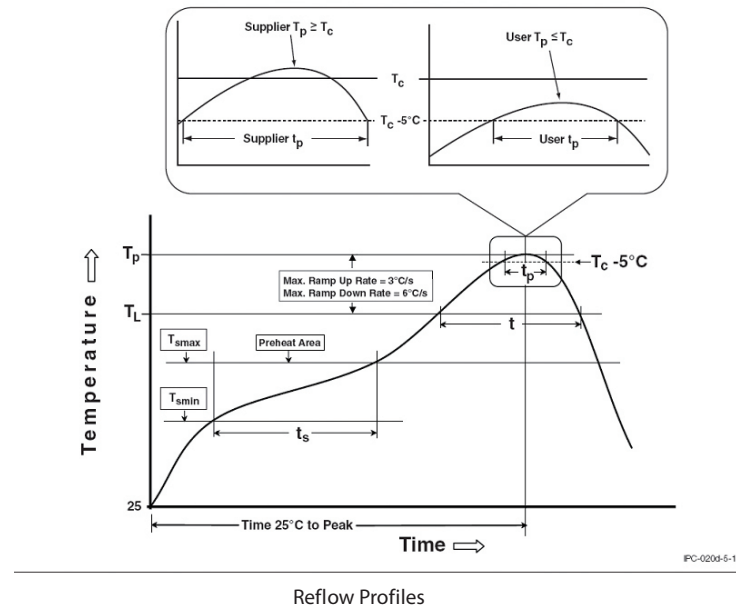
Recommended PCB Design

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.



Reflow Profile

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



Classification Reflow Profiles

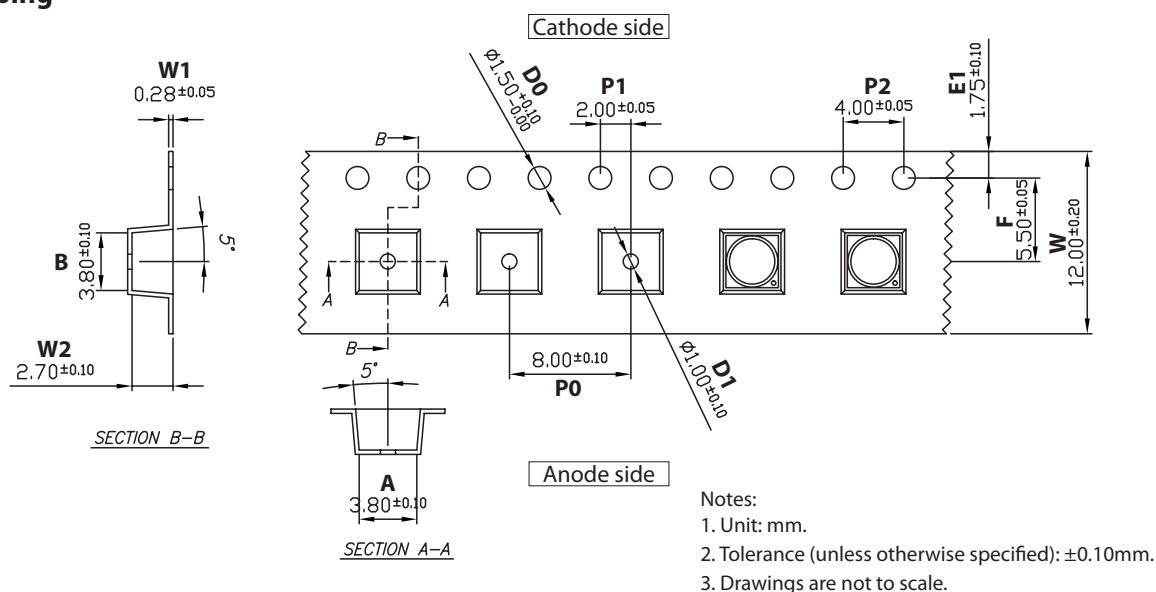
| Profile Feature | Pb-Free Assembly |
|---|--|
| Preheat & Soak | 150°C |
| Temperature min (T_{smin}) | 200°C |
| Temperature max (T_{smax}) | 60-120 seconds |
| Time (T_{smin} to T_{smax}) (t_s) | |
| Average ramp-up rate (T_{smax} to T_p) | $3^\circ\text{C/second max.}$ |
| Liquidous temperature (T_L) | 217°C |
| Time at liquidous (t_L) | 60-150 seconds |
| Peak package body temperature (T_p)* | $255^\circ\text{C} \sim 260^\circ\text{C} *$ |
| Classification temperature (T_c) | 260°C |
| Time (t_p)** within 5°C of the specified classification temperature (T_c) | 30^{**} seconds |
| Average ramp-down rate (T_p to T_{smax}) | $6^\circ\text{C/second max.}$ |
| Time 25°C to peak temperature | 8 minutes max. |

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. Maximum temperature of SMT process must be under 300°C, and the duration at 300°C must be within 10 seconds.
4. 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).
5. This LED component is applicable for reflow profile onto the PCB board. We will not guarantee the reliability if other methods are implemented.
6. The reflow process of LED component shall not exceed three times.
7. 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.
8. 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.

Product Packaging Information


Tapping



| A | B | D0 | D1 | E1 | F |
|-----------------|-----------------|-----------------------------|-----------------|-----------------|-----------------|
| 3.80 ± 0.10 | 3.80 ± 0.10 | $\Phi 1.50 + 0.10 / - 0.00$ | 1.00 ± 0.10 | 1.75 ± 0.10 | 5.50 ± 0.05 |

| P0 | P1 | P2 | W | W1 | W2 |
|-----------------|-----------------|-----------------|------------------|-----------------|----------------|
| 8.00 ± 0.10 | 2.00 ± 0.05 | 4.00 ± 0.05 | 12.00 ± 0.20 | 0.28 ± 0.05 | 2.7 ± 0.10 |

Product Label

| | |
|--|--|
|  EDISON OPTO CORPORATION | |
| P/N : 2FX001AX00F02001 | |
| Group : XXXXXXXX | |
| Lot No : XXXXXXXXXX | |
| Color : Amber | |
| QC : OQC1 | |
| QTY : XXX | |
| Color : Amber | |

Label information

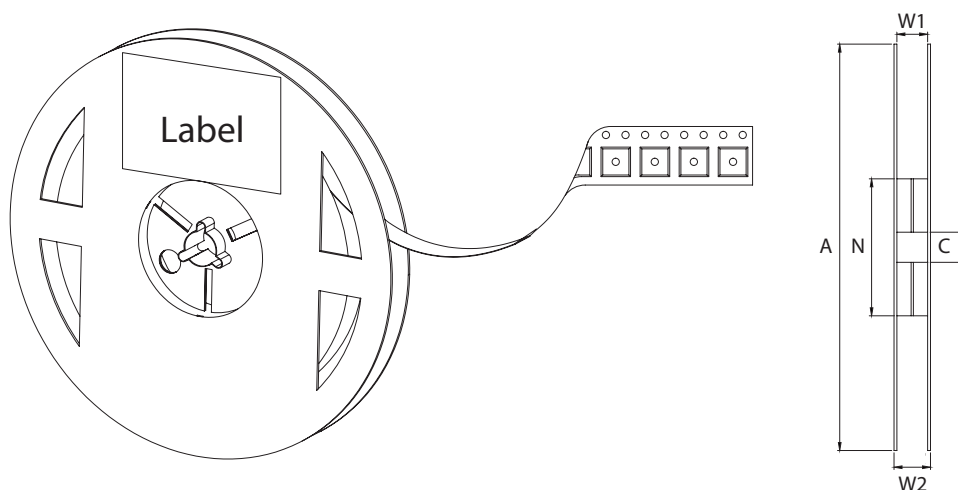
P/N : Order Code
Group : Bin Code
Serial No : LOT Number
QTY : Packing Quantity
Color : LED Color

Bin Group Format

| XX | XXX | XXX |
|------------------------|---------------------|--------------------------|
| X1-X2 | X3-X5 | X6-X8 |
| Luminous Flux Bin Code | Wavelength Bin Code | Forward Voltage Bin Code |

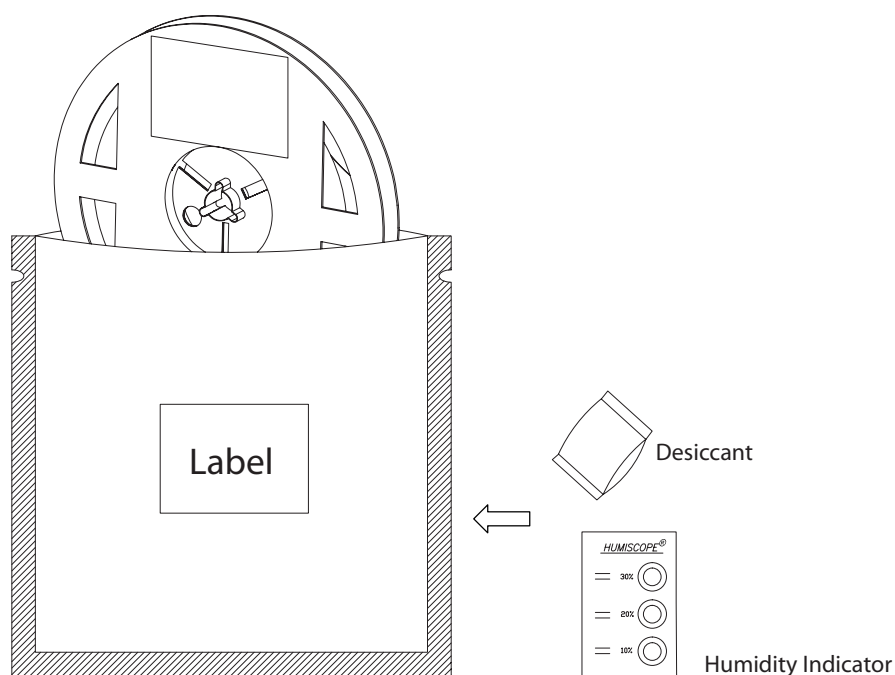
Tape and Reel

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



Revision History

| Versions | Description | Release Date |
|----------|---|--------------|
| 1 | Establish order code information | 2020/10/21 |
| 2 | 1. Format revision 2. Add application notes 3. Revise product packaging information 4. Add bin group format of label | 2024/03/28 |

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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