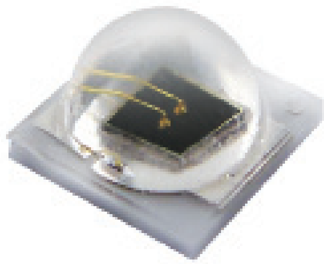
Federal Series Datasheet (EN)

Federal 3535 IR Series

2FX001EX00F02001
2FX001FX00F02002
2FX001IX00F02001



Features:

- High power performance
- Promising power maintenance characteristics
- Level 1 on JEDEC moisture sensitivity analysis
- RoHS compliant

Lighting Design Manufacturing Service

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General Information

Introduction

Federal 3535 IR Series is a smaller and brighter single-chip LED. Federal is a surface mount, compact, high brightness LED that is suitable for various illumination needs such as machine vision.

Order Code Format

2	F	X 0	0 1	x x	0 0	F 0 2	x x x
X1	X2	X3	X4	X5	X6	X7	X8

X1		X2		X3		X4	
Type		Component		Series		Wattage	
2	Emitter	F	Federal	X0	3535	01	1W

X5		X6		X7		X8	
Color		Internal Code		Ceramic Size		Serial Number	
EX	IR 660	-	-	F02	3535	-	-
FX	IR 740						
IX	IR 850						

Package	Radiant Power, Po [mW] I_F = 350mA	Order Code
Federal 3535 1W IR 660	370	2FX001EX00F02001
Federal 3535 1W IR 740	350	2FX001FX00F02002

Package	Radiant Power, Po [mW] I_F = 700mA	Order Code
Federal 3535 1W IR 850	600	2FX001IX00F02001

Absolute Maximum Ratings

(T_J = 25°C)

Parameter	Symbol	Value	Units
DC Forward Current[1]	I_F	IR 660 : 700 IR 740 : 700 IR 850 : 1,000	mA
Reverse Voltage[2]	V_R	Note 2	V
LED Junction Temperature	T_J	125	°C
LED Operating Temperature	-	-40 ~ +85	°C
LED Storage Temperature	-	-40 ~ +125	°C
HBM ESD Sensitivity (class 3B)	-	8	KV
Allowable Reflow Cycles[3]	-	3	Cycles
Soldering Temperature	-	260	°C

Notes:
1. Proper current derating must be observed to maintain junction temperature below the maximum at all time.
2. LEDs are not designed to drive in reverse bias.
3. Allowable reflow cycles are 3 times for each LED.

Characteristics

(IR 660: I_F = 350mA ; T_J = 25°C)
(IR 740: I_F = 350mA ; T_J = 25°C)
(IR 850: I_F = 700mA ; T_J = 25°C)

Parameter		Symbol	Value	Units
Viewing Angle[1]	(typ.)	$2\Theta_{1/2}$	110	Degree
Forward Voltage[2]	(typ.)	V_F	IR 660 : 2.1 IR 740 : 2.1 IR 850 : 1.5	V
Wavelength[3]	(typ.)	W_P	IR 660 : 660 IR 740 : 730 IR 850 : 850	nm
Thermal resistance		-	IR 660 : 4.8 IR 740 : 6.0 IR 850 : 4.9	°C/W
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:
1. Viewing angle is measured with accuracy of ±10%.
2. Forward voltage measurement allowance is ± 0.2V.
3. Edison maintains a tolerance of ±2nm for dominant wavelength.

Radiant Power Bin Codes (IR 660)

(I_F = 350mA ; T_J = 25°C)

Code	(Min.) Radiant Power [mW]	(Max.) Radiant Power [mW]
B1	200	300
B2	300	400
B3	400	500

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

Voltage Bin Codes (IR 660)

(I_F = 350mA ; T_J = 25°C)

Code	(Min.) Voltage V_F [V]	(Max.) Voltage V_F [V]
U02	1.3	1.6
U03	1.6	1.9
U04	1.9	2.2
U05	2.2	2.5

Note:
Forward voltage measurement allowance is ± 0.06V.

Wavelength Bin Code (IR 660)

(I_F = 350mA ; T_J = 25°C)

Code	(Min.) W_P [nm]	(Max.) W_P [nm]
EX0	650	670

Note:
Peak wavelength measurement allowance: ±2nm.

Radiant Power Bin Codes (IR 740)

(I_F = 350mA ; T_J = 25°C)

Code	(Min.) Radiant Power [mW]	(Max.) Radiant Power [mW]
B0	100	200
B1	200	300
B2	300	400

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

Voltage Bin Codes (IR 740)

(I_F = 350mA ; T_J = 25°C)

Code	(Min.) Voltage V_F [V]	(Max.) Voltage V_F [V]
U02	1.3	1.6
U03	1.6	1.9
U04	1.9	2.2
U05	2.2	2.5

Note:
Forward voltage measurement allowance is ± 0.06V.

Wavelength Bin Code (IR 740)

(I_F = 350mA ; T_J = 25°C)

Code	(Min.) W_P [nm]	(Max.) W_P [nm]
FX2	720	745

Note:
Peak wavelength measurement allowance: ±2nm.

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Radiant Power Bin Codes (IR 850)

(I_F = 700mA ; T_J = 25°C)

Code	(Min.) Radiant Power [mW]	(Max.) Radiant Power [mW]
C0	500	600
C1	600	700
C2	700	800

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

Voltage Bin Codes (IR 850)

(I_F = 700mA ; T_J = 25°C)

Code	(Min.) Voltage V_F [V]	(Max.) Voltage V_F [V]
U02	1.3	1.6
U03	1.6	1.9
U04	1.9	2.2
U05	2.2	2.5

Note:
Forward voltage measurement allowance is ± 0.06V.

Wavelength Bin Code (IR 850)

(I_F = 700mA ; T_J = 25°C)

Code	(Min.) W_P [nm]	(Max.) W_P [nm]
IX0	835	870

Note:
Peak wavelength measurement allowance: ±2nm.

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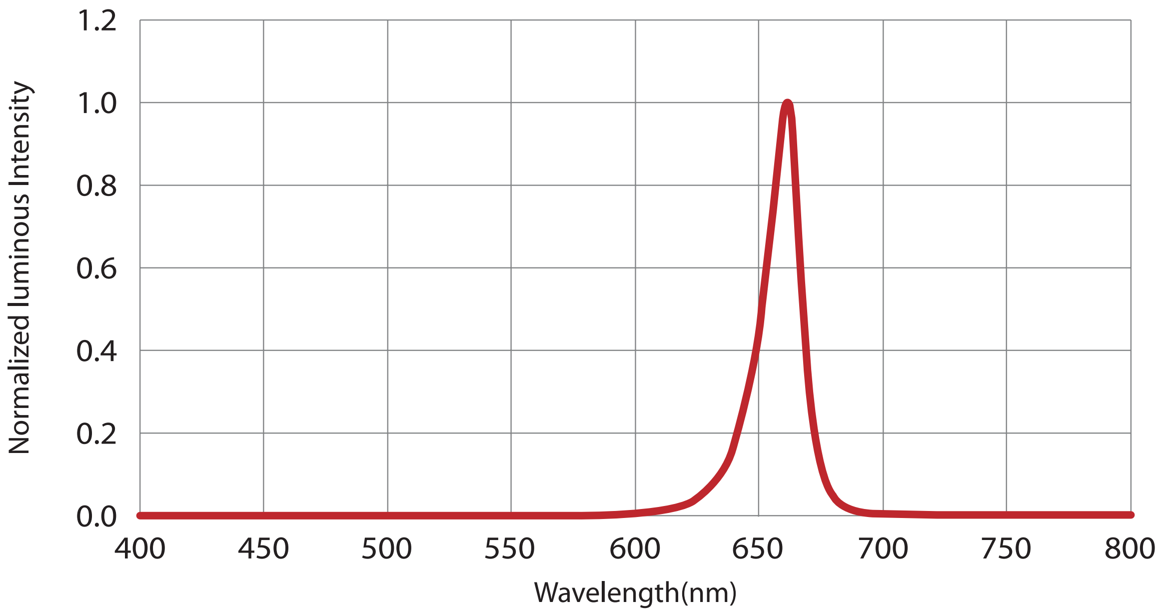
Characteristic Curves

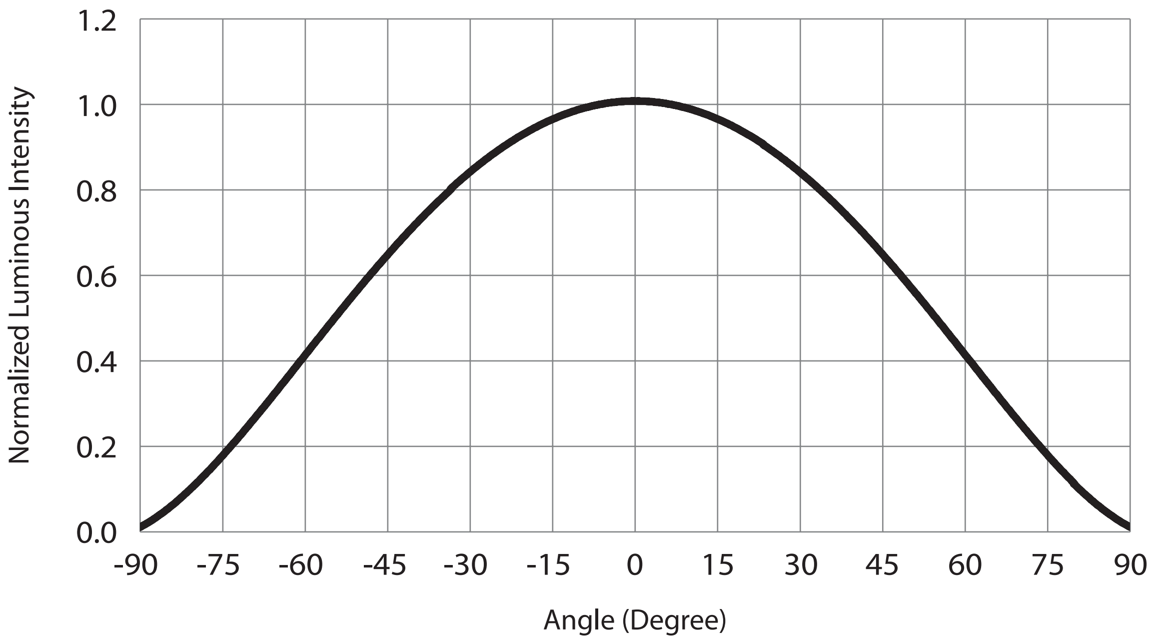
Color Spectrum (IR 660)

(Irel = f(λ) ; I_F = 350mA ; T_J = 25°C)



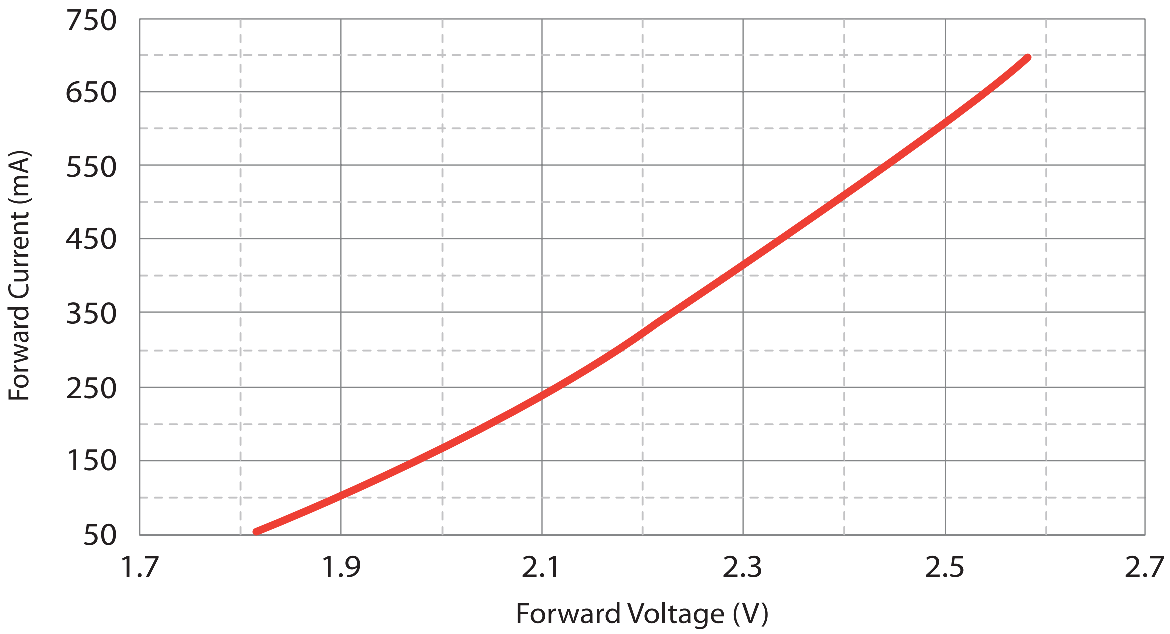
Beam Pattern (IR 660)

(I_F = 350mA ; T_J = 25°C)



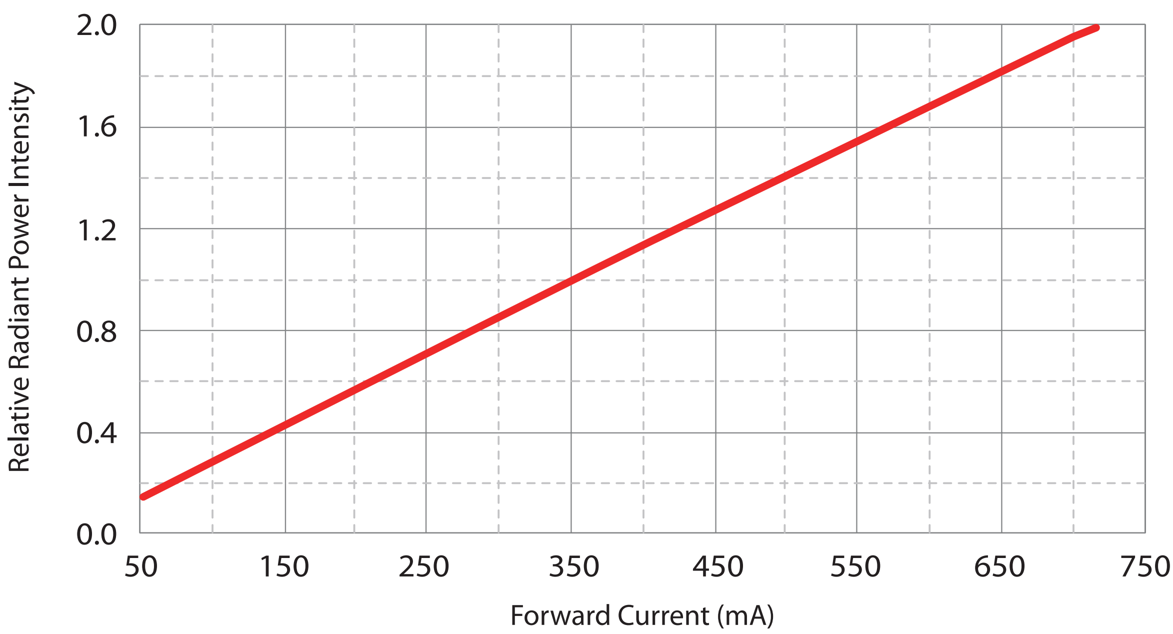
Forward Current vs. Forward Voltage (IR 660)

($I_F = f(V_F)$; $T_J = 25°C$)



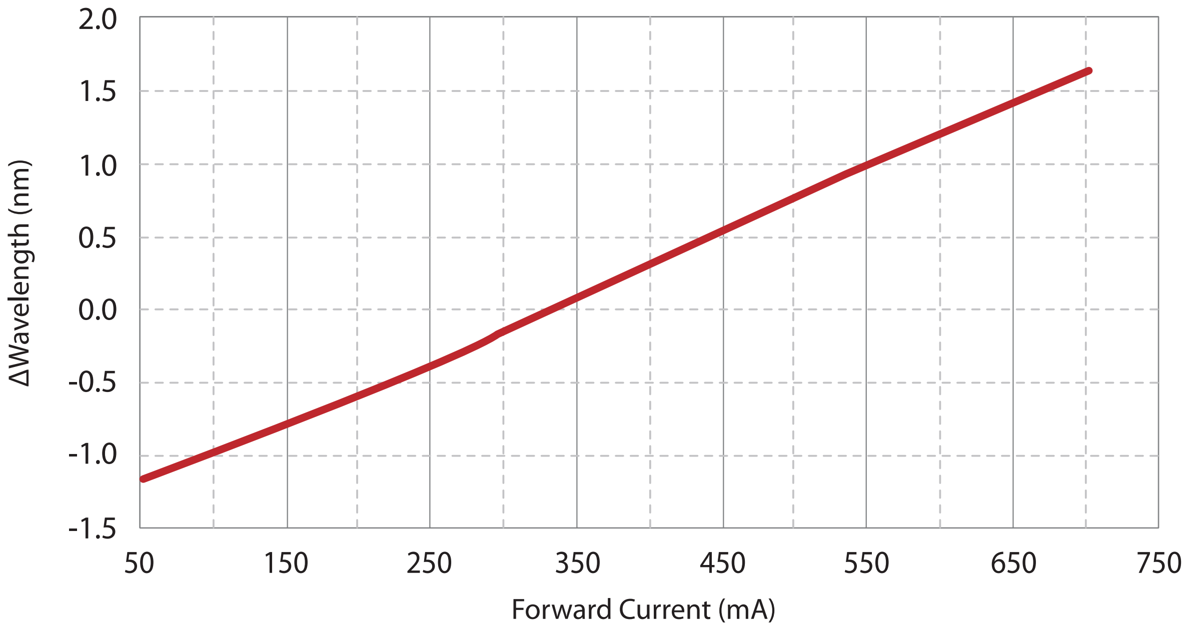
Relative Radiant Power Intensity vs. Forward Current (IR 660)

(Po/Po (350mA) = $f(I_F)$; $T_J = 25°C$)



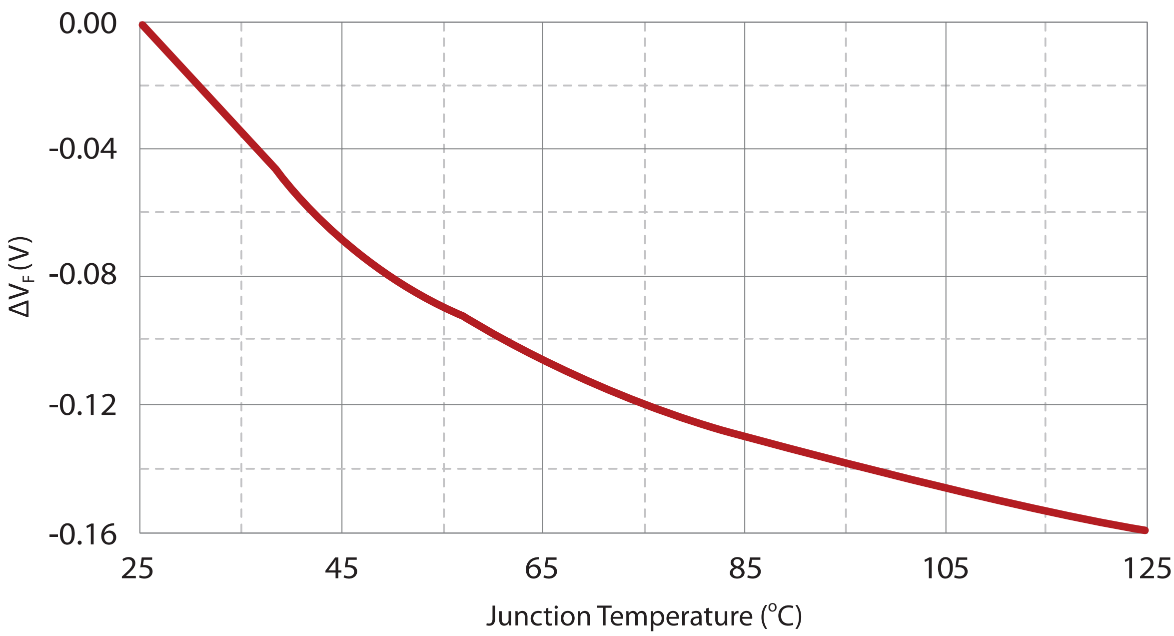
Wavelength vs. Forward Current (IR 660)

(ΔWavelength=Wavelength-Wavelength(350mA) ; T_J = 25°C)



Forward Voltage vs. Junction Temperature (IR 660)

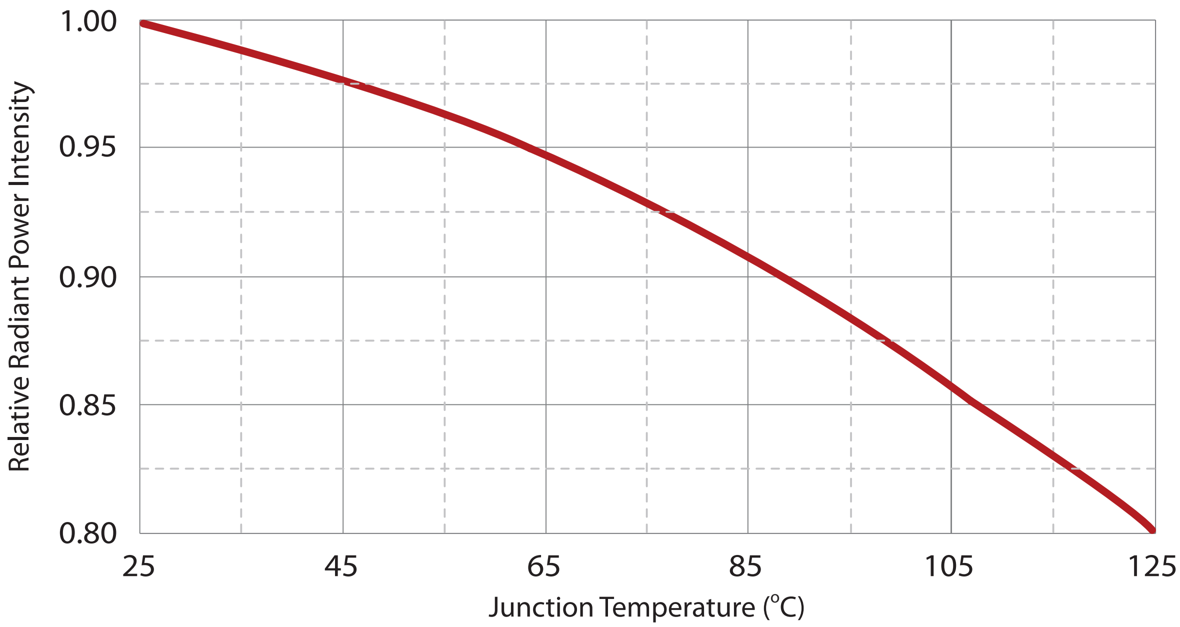
($\Delta V_F = V_F - V_F(25°C) = f(T_J)$; I_F = 350mA)



Lighting Design Manufacturing Service

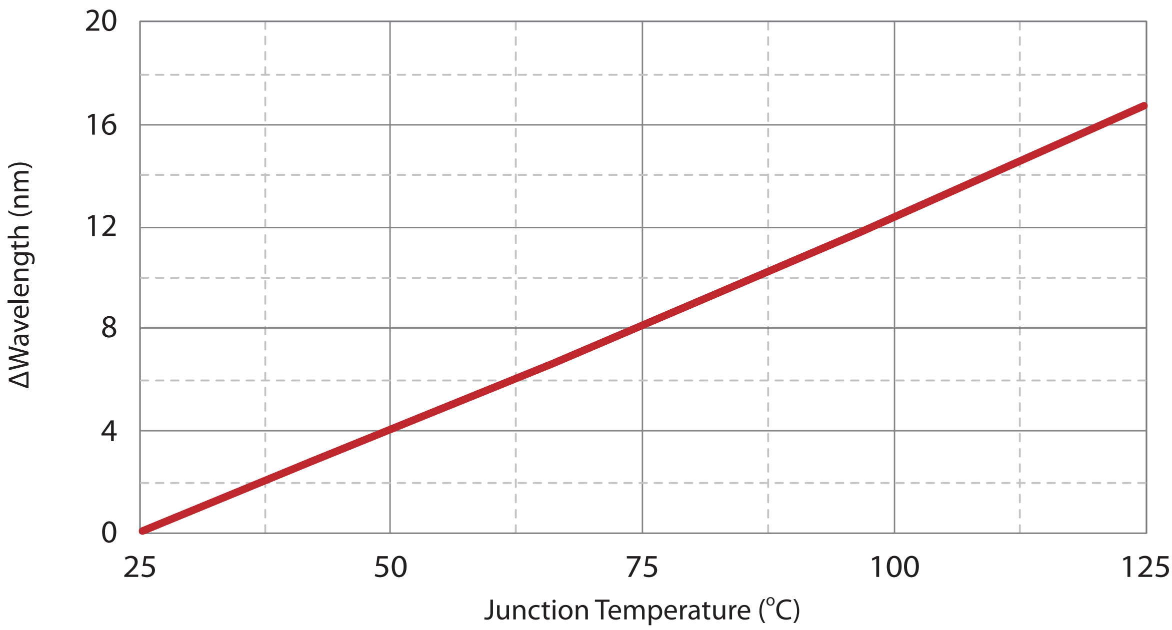
Relative Radiant Power Intensity vs. Junction Temperature (IR 660)

(Po/Po(25°C) = f(T_J) ; I_F = 350mA)



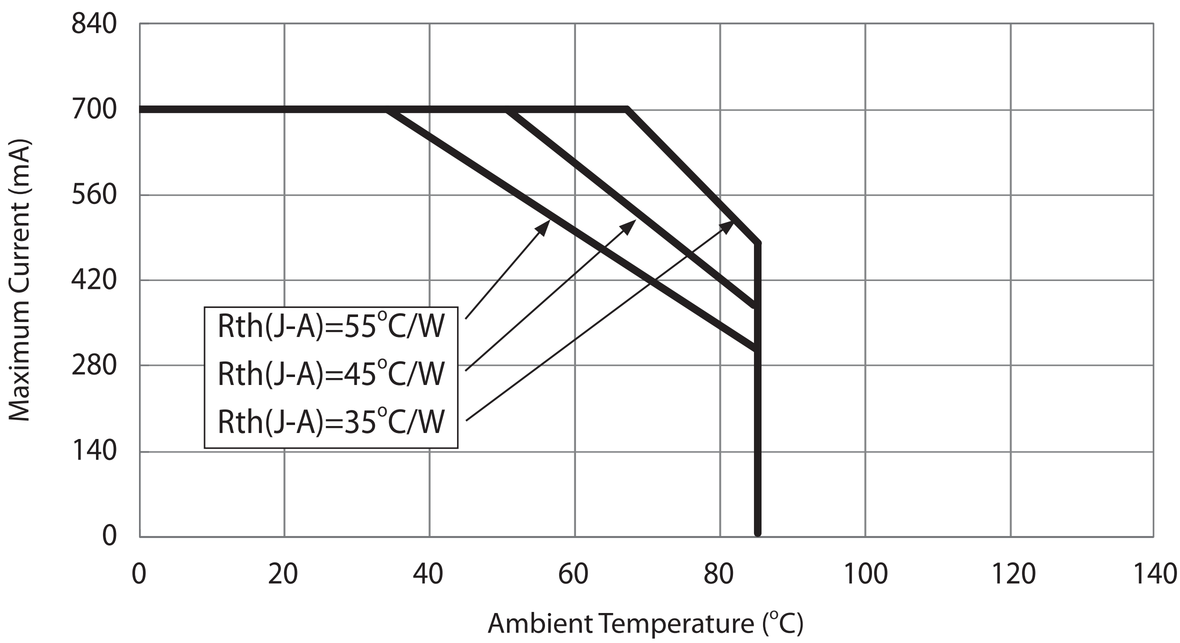
Wavelength vs. Junction Temperature (IR 660)

(ΔWavelength=Wavelength-Wavelength(25°C) ; I_F = 350mA)



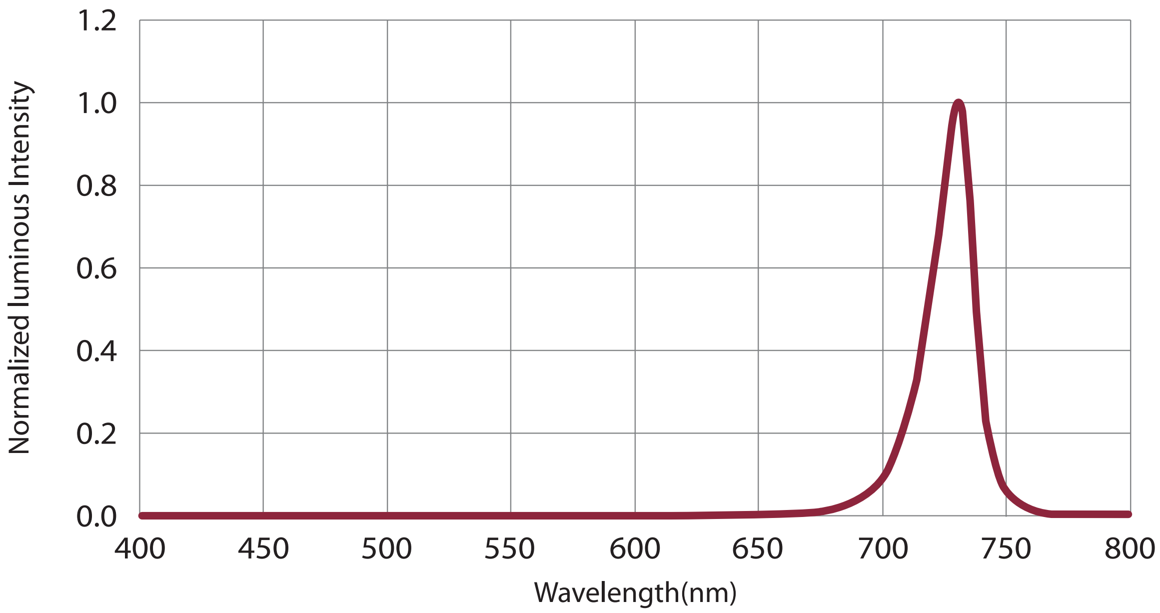
Lighting Design Manufacturing Service

Maximum Current vs. Ambient Temperature (IR 660)



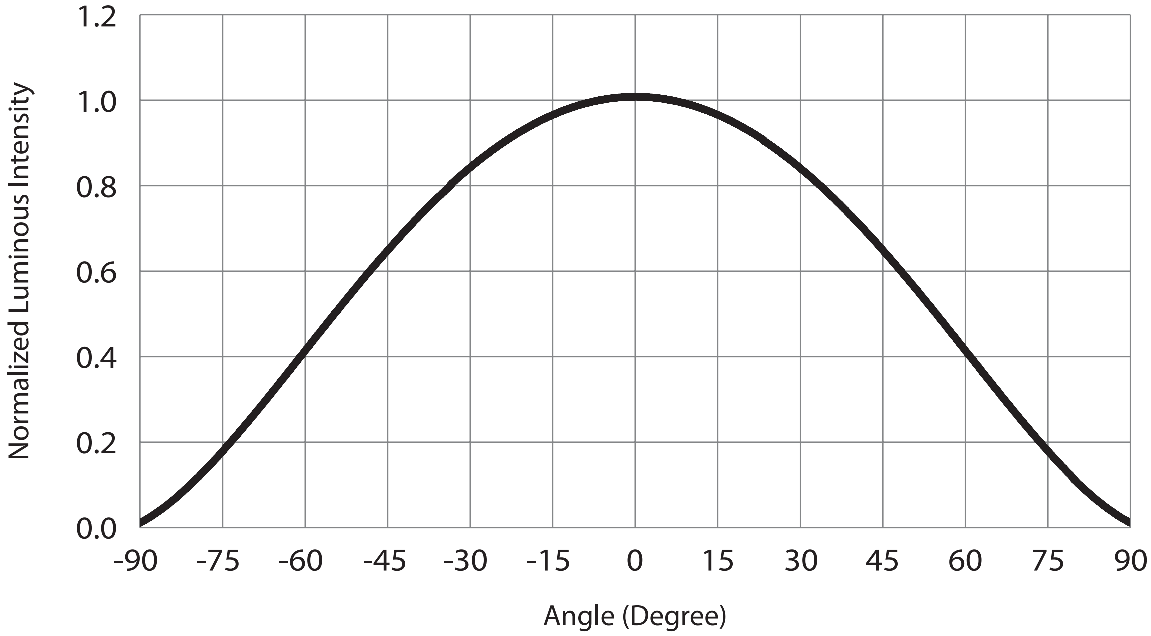
Color Spectrum (IR 740)

(Irel = f(λ) ; I_F = 350mA ; T_J = 25°C)



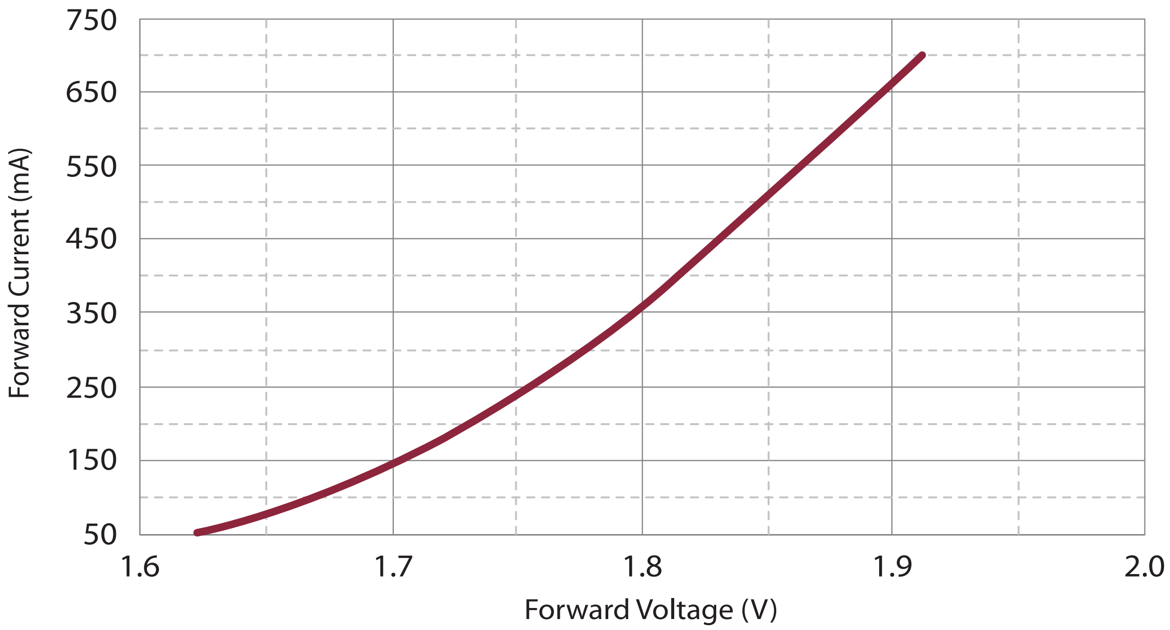
Beam Pattern (IR 740)

(I_F = 350mA ; T_J = 25°C)



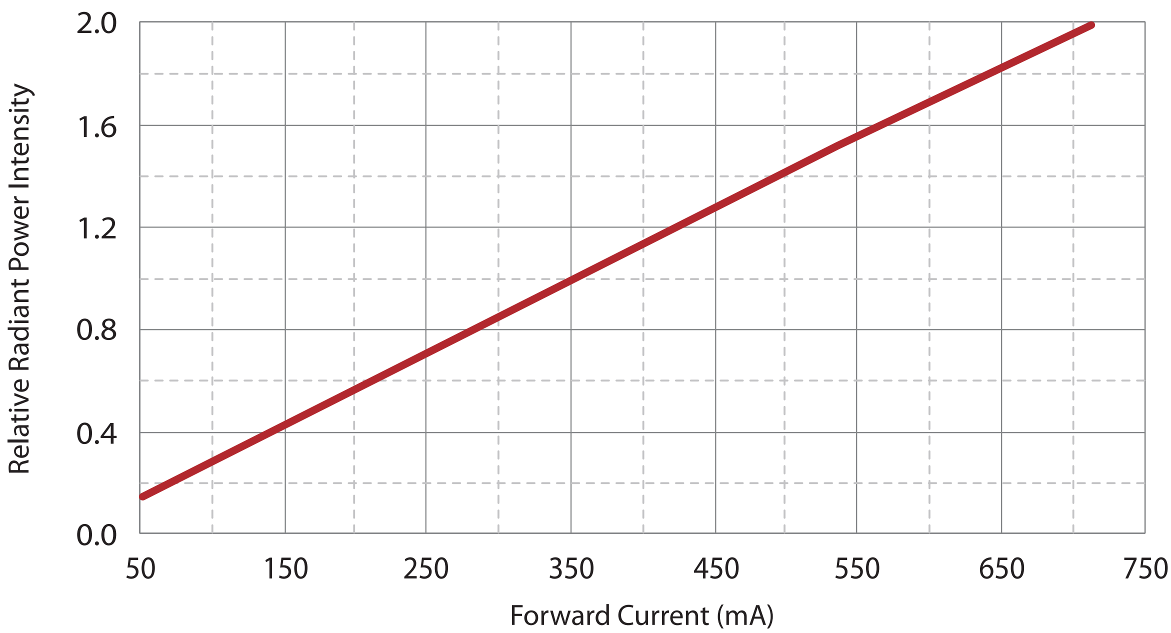
Forward Current vs. Forward Voltage (IR 740)

($I_F = f(V_F)$; T_J = 25°C)



Relative Radiant Power Intensity vs. Forward Current (IR 740)

(Po/Po (350mA) = $f(I_F)$; T_J = 25°C)



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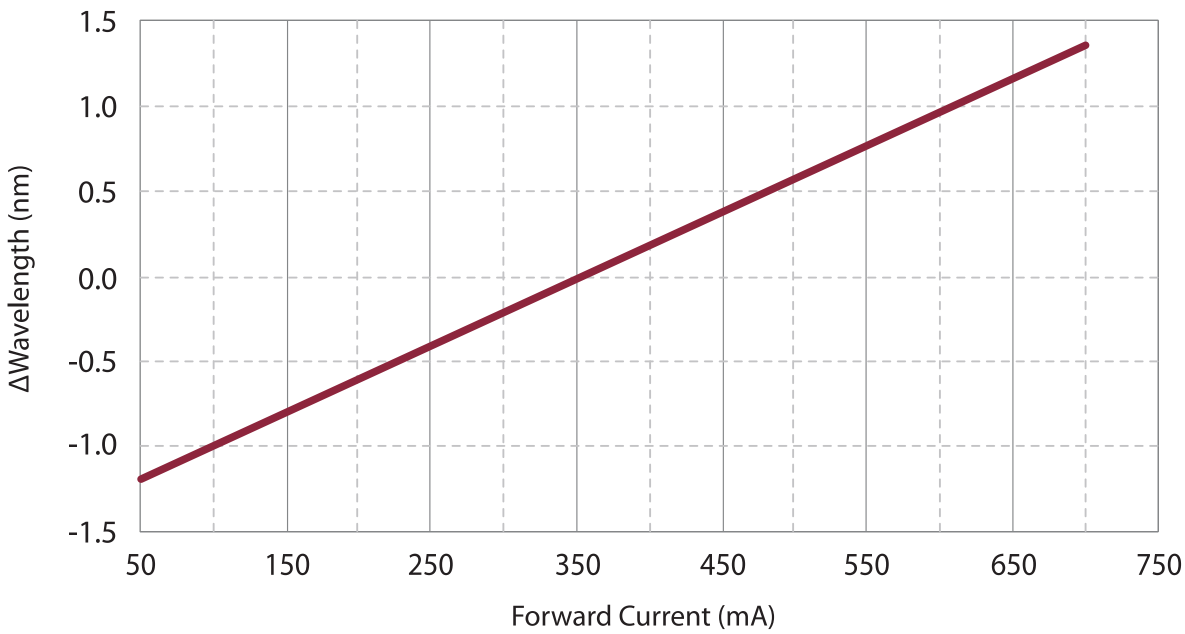
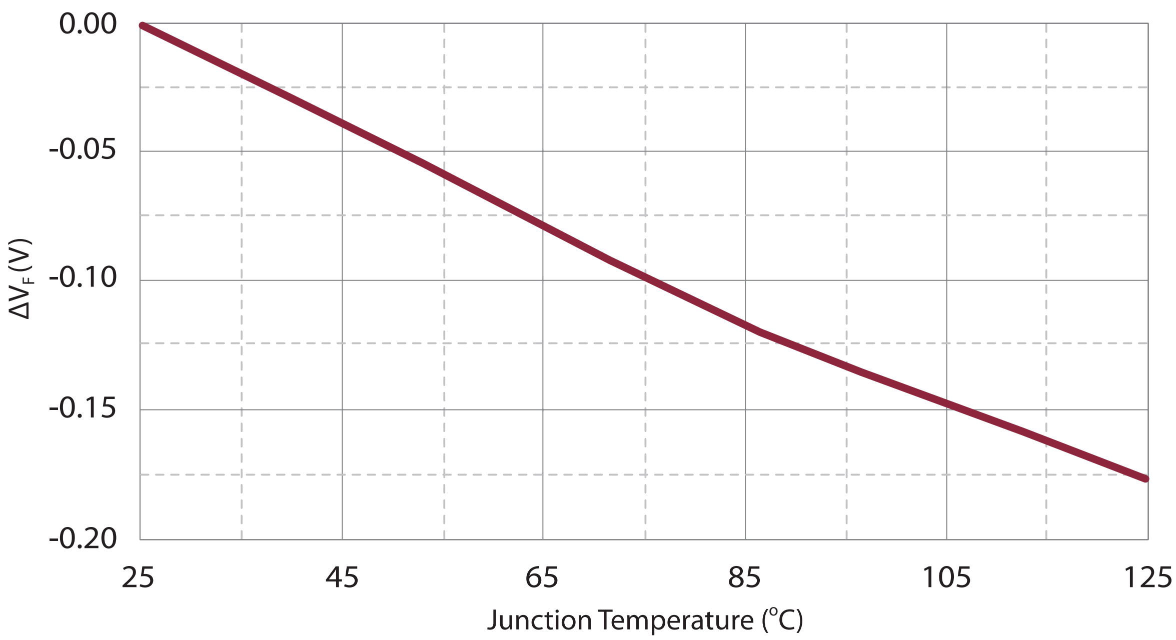
Wavelength vs. Forward Current (IR 740)

(ΔWavelength=Wavelength-Wavelength(350mA) ; T_J = 25°C)



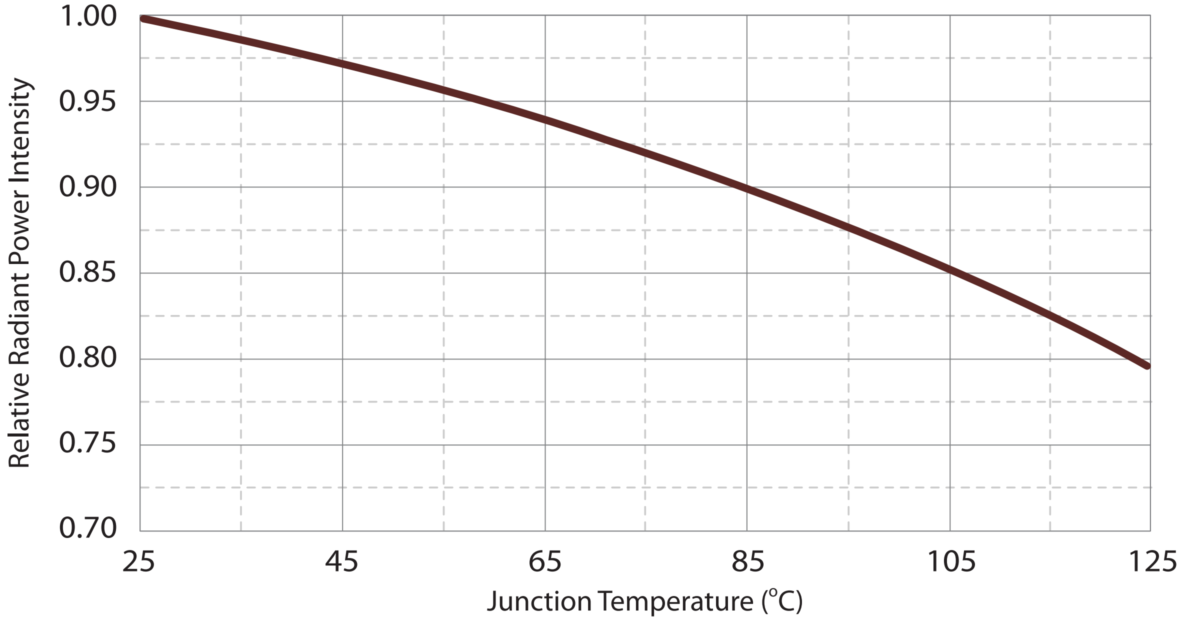
Forward Voltage vs. Junction Temperature (IR 740)

($\Delta V_F = V_F - V_F(25°C) = f(T_J)$; I_F = 350mA)



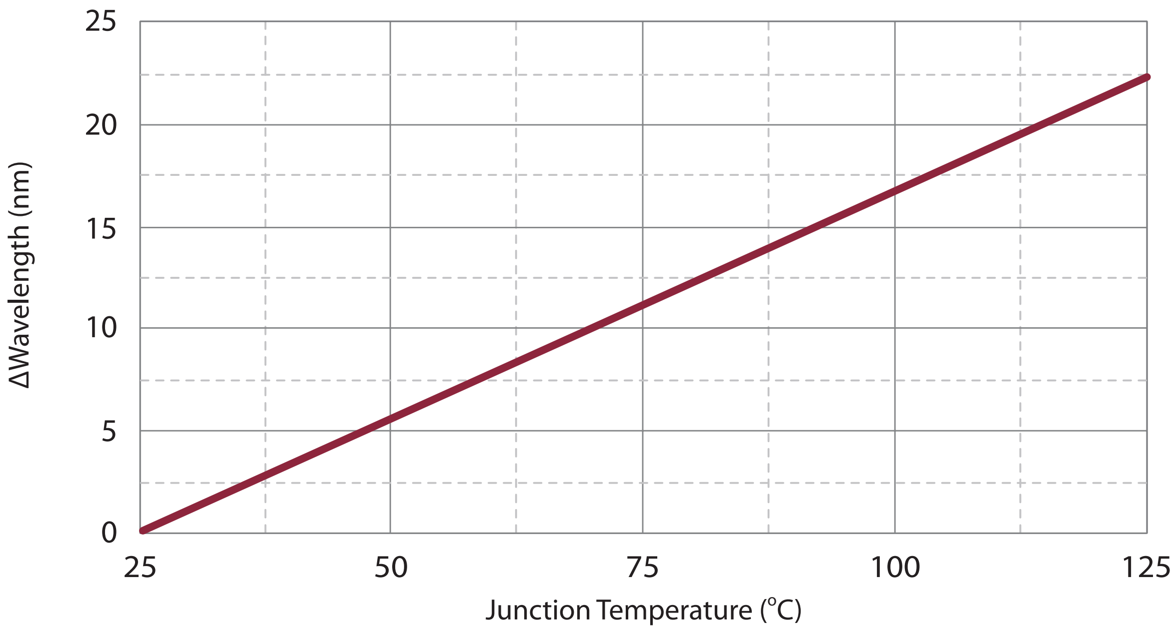
Relative Radiant Power Intensity vs. Junction Temperature (IR 740)

(Po/Po(25°C) = f(T_J) ; I_F = 350mA)

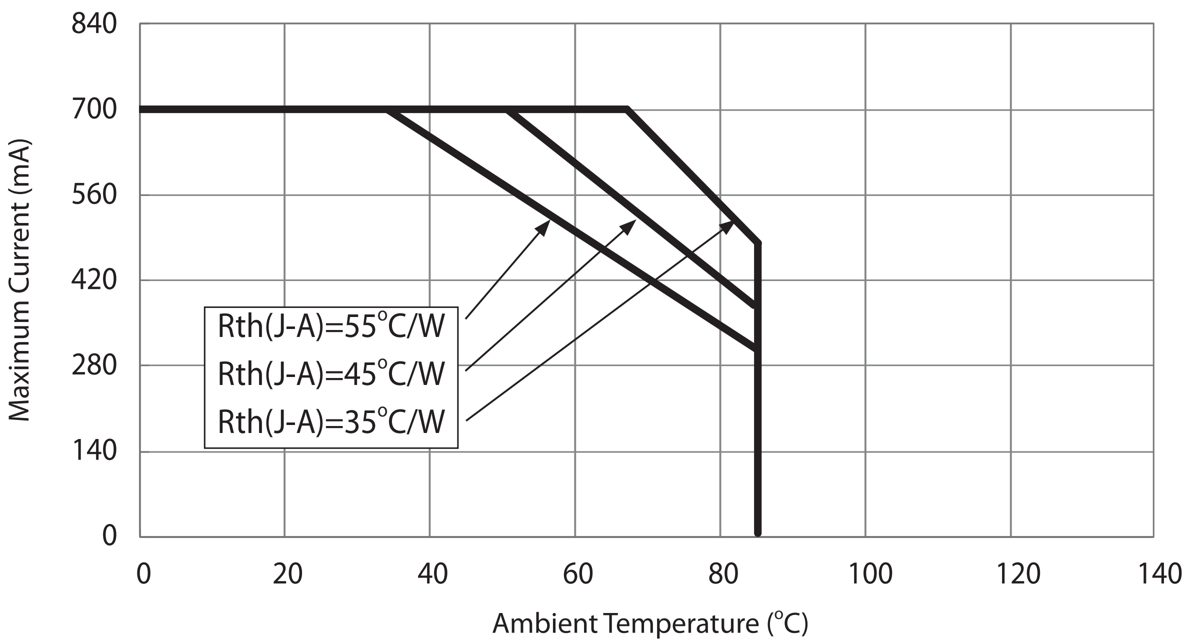


Wavelength vs. Junction Temperature (IR 740)

(ΔWavelength=Wavelength-Wavelength(25°C) ; I_F = 350mA)

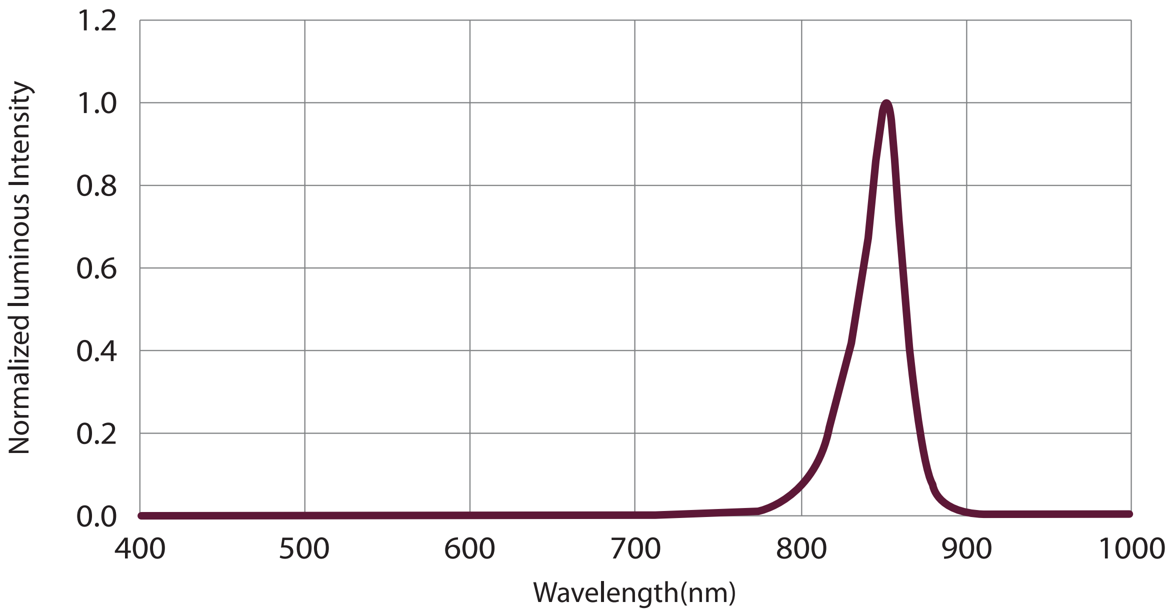


Maximum Current vs. Ambient Temperature (IR 740)



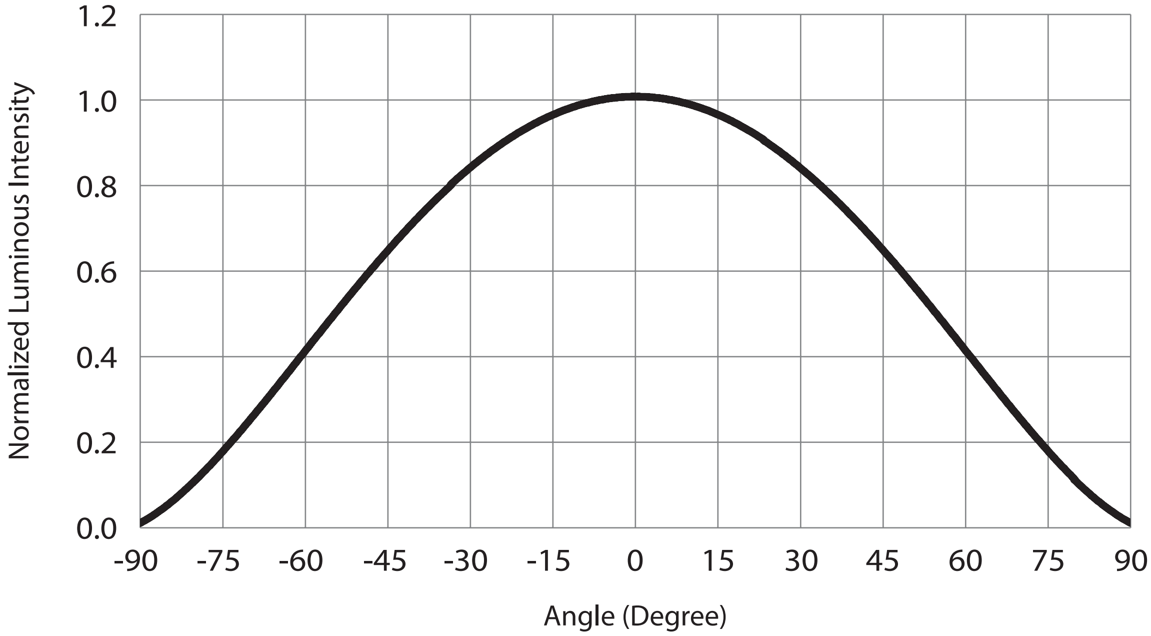
Color Spectrum (IR 850)

(Irel = f(λ) ; I_F = 700mA ; T_J = 25°C)



Beam Pattern (IR 850)

(I_F = 700mA ; T_J = 25°C)



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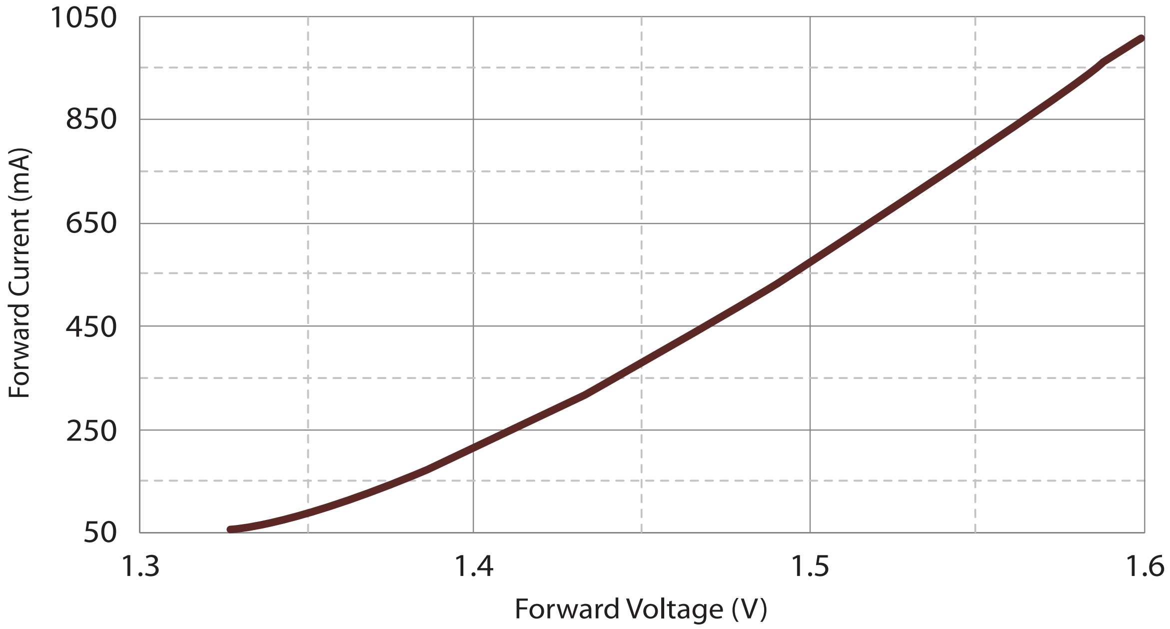
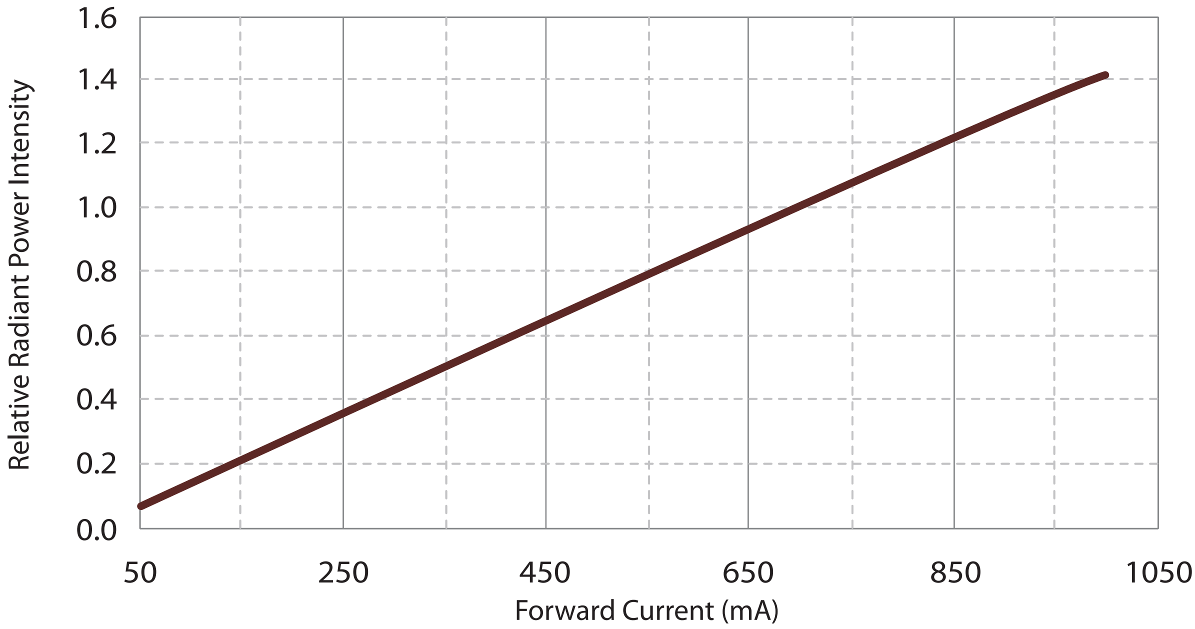
Forward Current vs. Forward Voltage (IR 850)

($I_F = f(V_F)$; $T_J = 25°C$)



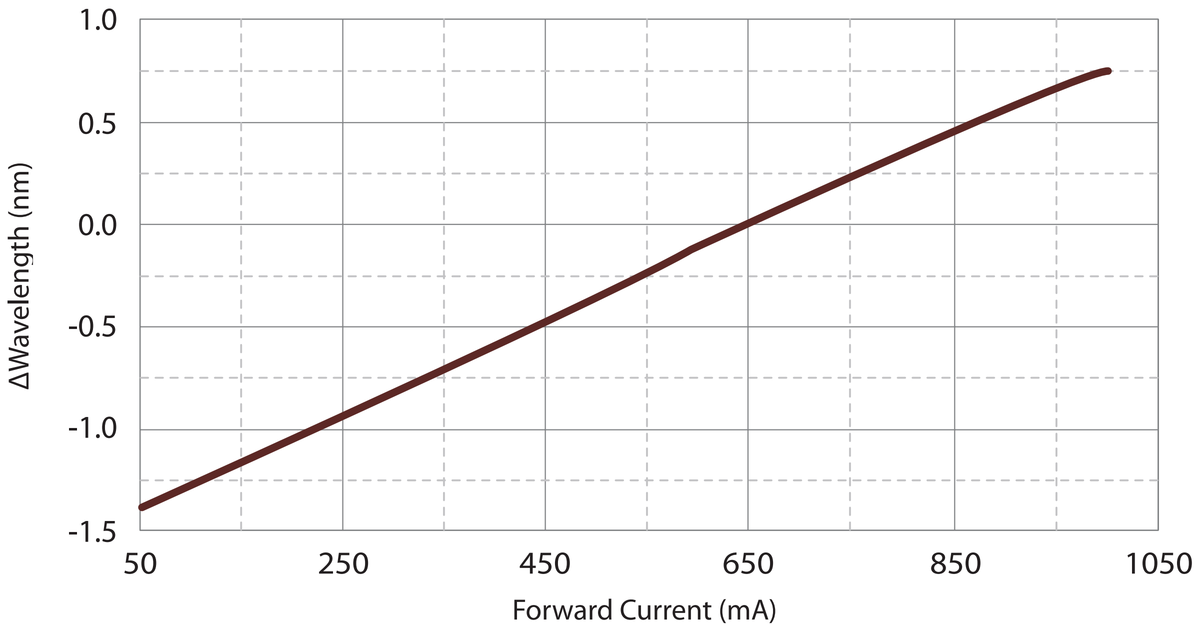
Relative Radiant Power Intensity vs. Forward Current (IR 850)

(Po/Po (700mA) = $f(I_F)$; $T_J = 25°C$)



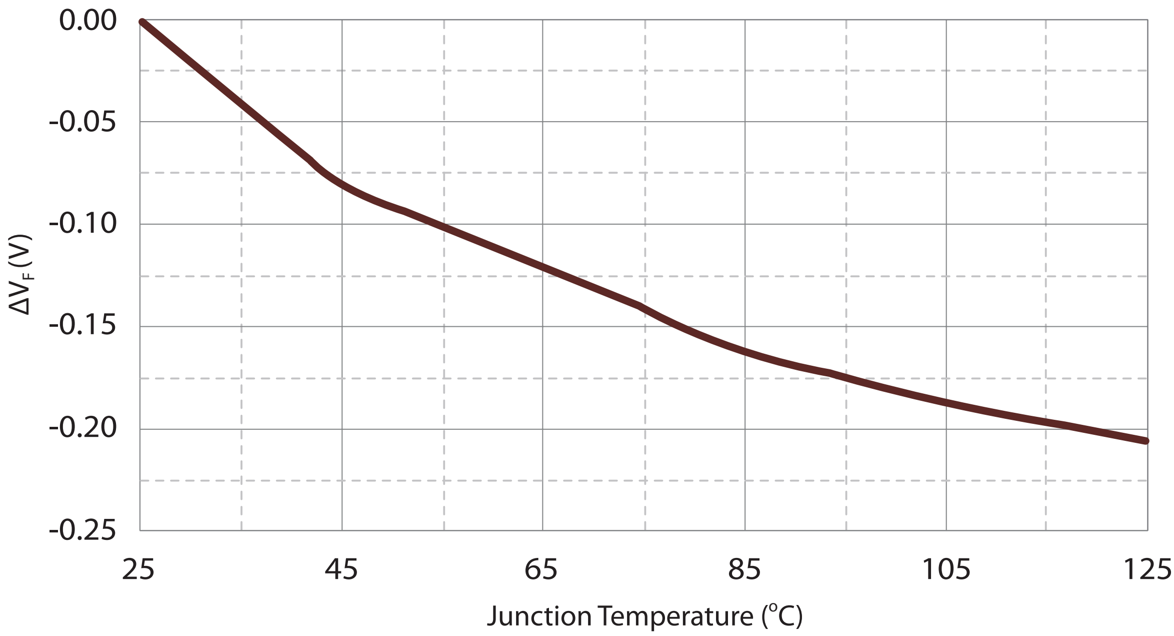
Wavelength vs. Forward Current (IR 850)

(ΔWavelength=Wavelength-Wavelength(700mA) ; T_J = 25°C)



Forward Voltage vs. Junction Temperature (IR 850)

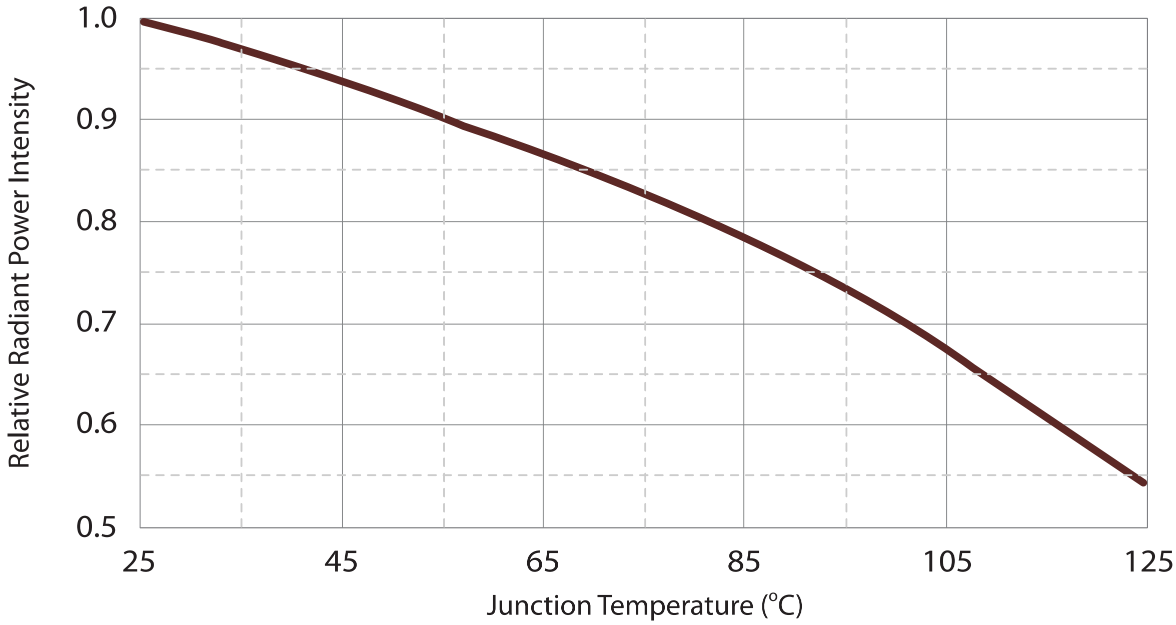
($\Delta V_F = V_F - V_F(25°C) = f(T_J)$; I_F = 700mA)



Lighting Design Manufacturing Service

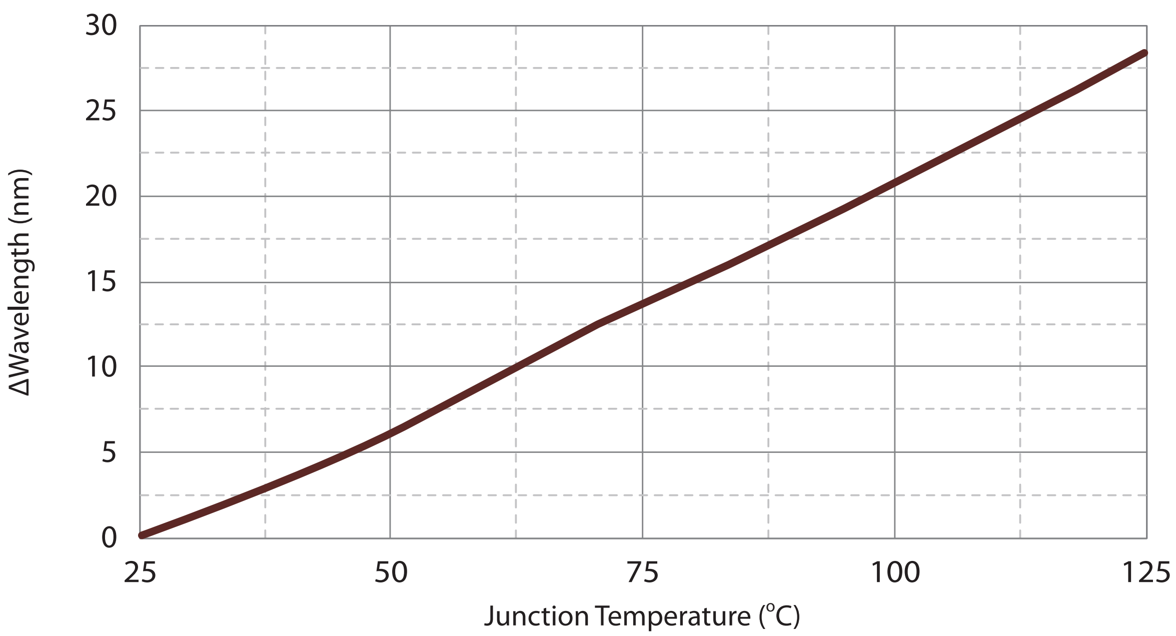
Relative Radiant Power Intensity vs. Junction Temperature (IR 850)

(Po/Po (25°C) = f(TJ) ; I_F = 700mA)



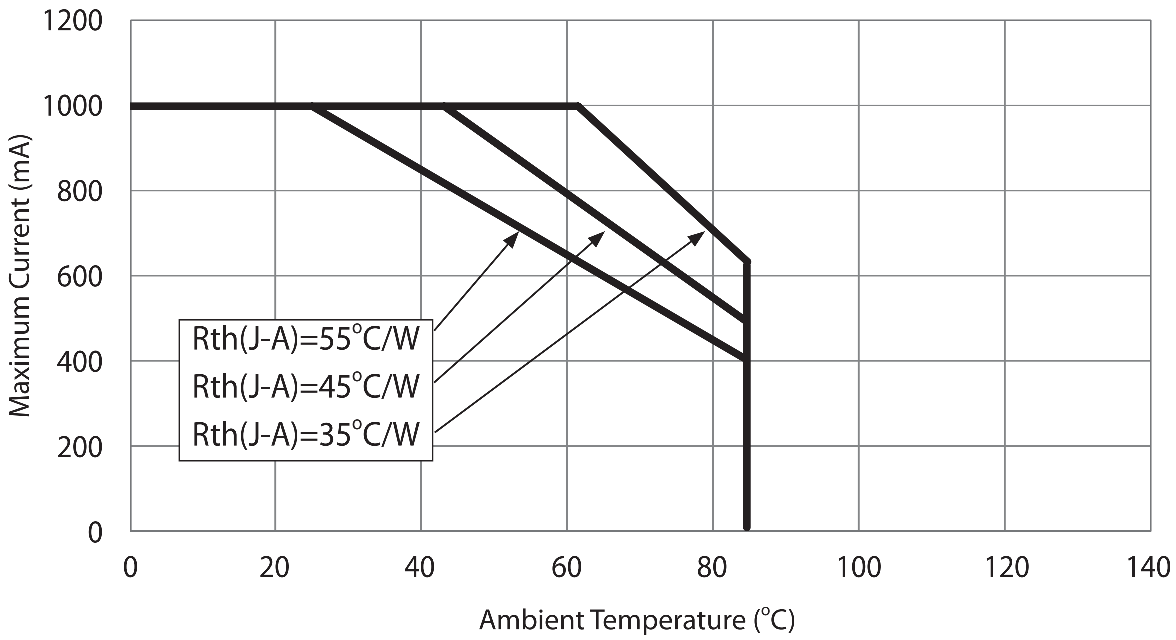
Wavelength vs. Junction Temperature (IR 850)

(ΔWavelength=Wavelength-Wavelength(25°C) ; I_F = 700mA)



Lighting Design Manufacturing Service

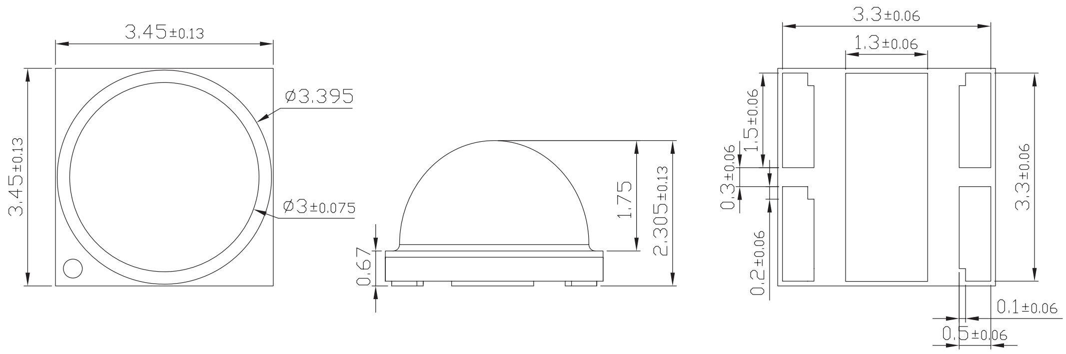
Maximum Current vs. Ambient Temperature (IR 850)



Lighting Design Manufacturing Service

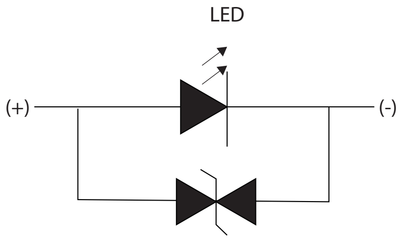
Mechanical Dimensions

Component



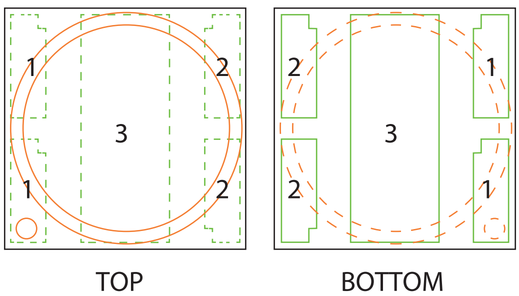
Notes:
1. Unit: mm.
2. Tolerance (unless otherwise specified): ±0.10mm.
3. Drawings are not to scale.

Circuit



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

Ceramic Layout



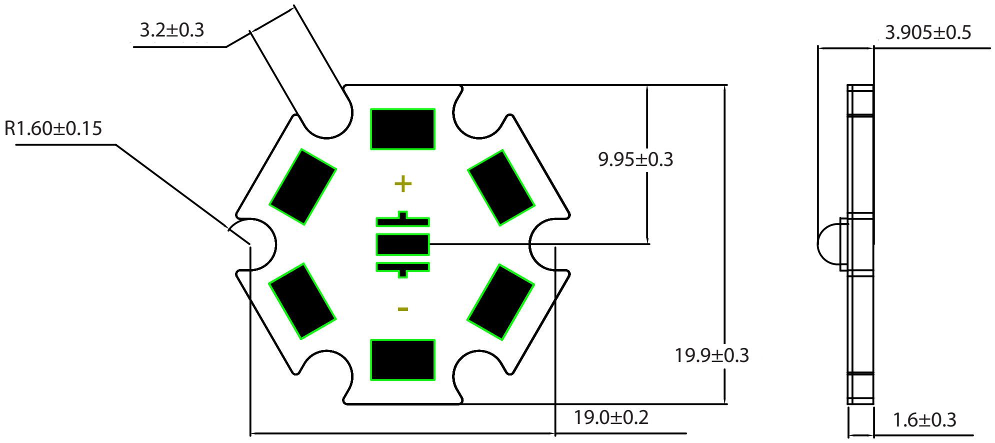
Pad Configuration

Pad	Function
1	Anode
2	Cathode
3	Thermal

Lighting Design Manufacturing Service

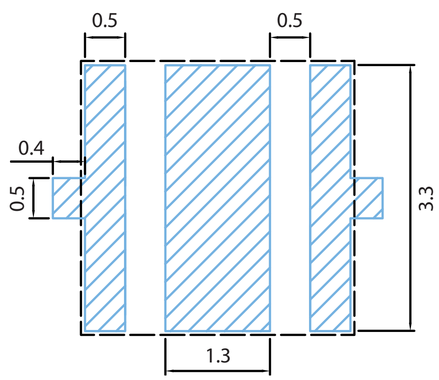
Recommended PCB

Recommended Star



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

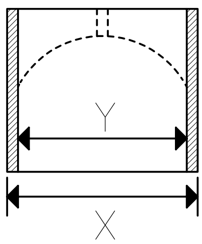
Recommended Solder Pad



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.

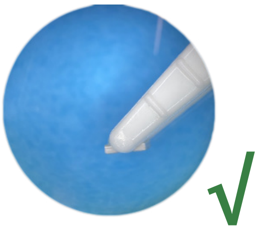
3. When manually handling the LED, please use the plastic tweezers instead of the metal one. Avoid contacting to the silicon lens structure which will cause damage to the package.

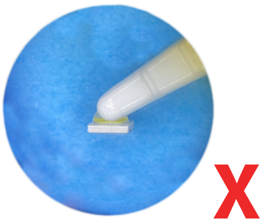
4. Do not use adhesives or dissipation paste to attach the LED that outgas organic vapor.

5. Do not use any product with materials containing sulfur.

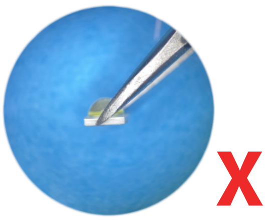
6. Do not assemble in humid environment or the conditions of containing oxidizing gas such as Cl, H2S, NH3, SO2, NOX, etc.

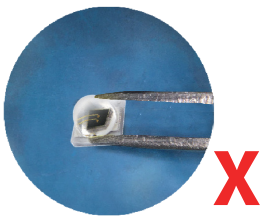
• Plastic Tweezers





• 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.

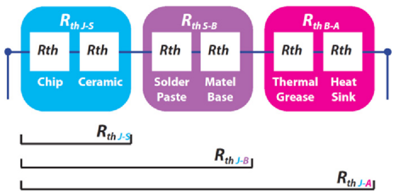
The following paragraphs describe how to determine the junction temperature and a simple ideal to heat sink design.

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

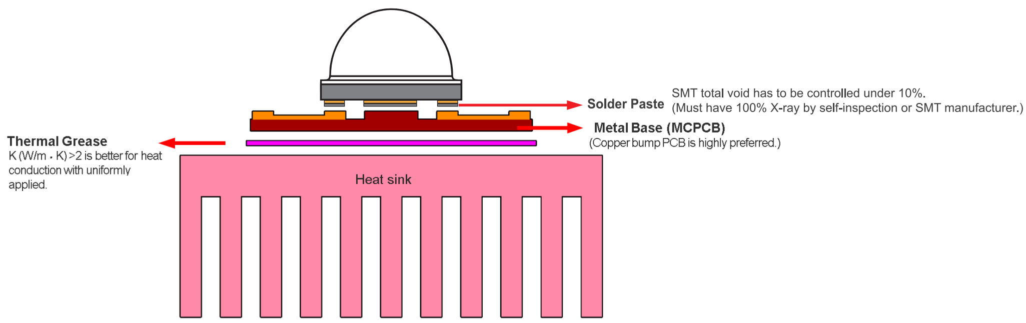


which,

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 = $Rth_{(J\text{-}S)} + Rth_{(S\text{-}B)} + Rth_{(B\text{-}A)}$



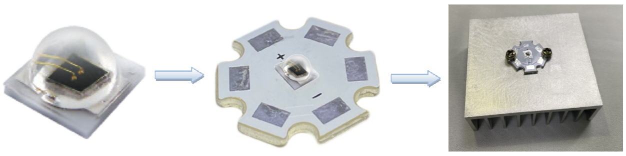
*During lighting design, the temperature T_J upon overall thermal stability shall be ensured not to exceed 125°C and the operating current may not exceed the nominal value.

**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.

Lighting Design Manufacturing Service

Tips for Thermal Management

Federal products are not recommended to be operating without a heat sink. Through MCPCB, users may realize better performance.



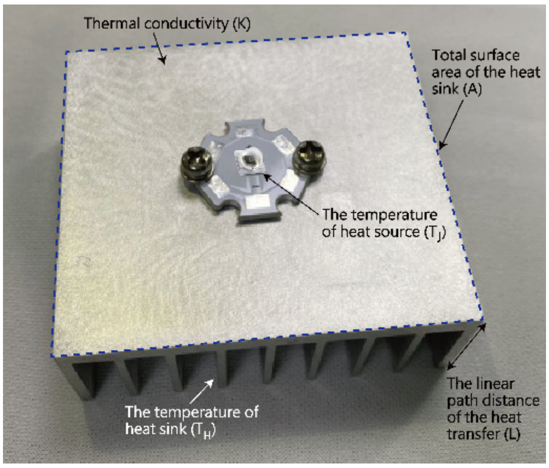
For LEDs, choose an appropriate operation environment and conduct the heat to the air after light on LEDs may maintain the better performance and lifetime. Four major thermal path are as follow:
From heat source (component) to heat sink. (By conduction)
Conduction within the heat sink to its surface. (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

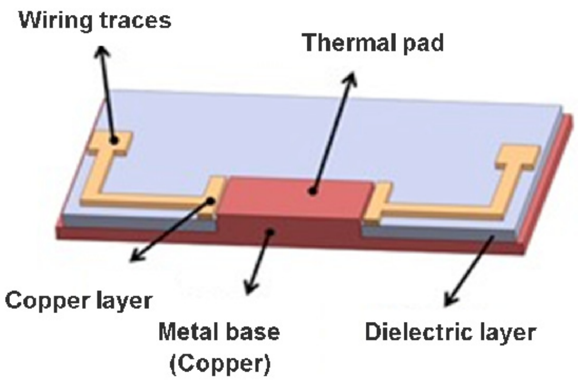
Path3 : Heat dissipation includes convection and radiation. Those two types of transfer are proportional to the surface area of the heat sink. Adding the number of fin may increase the total surface area. However, too many fins may cause inhabitation of convection. There are many other thermal management 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.



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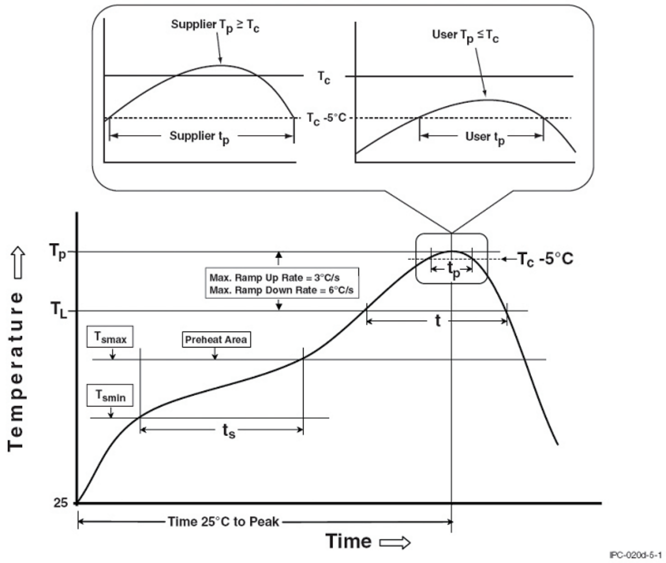
Reflow Profile

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. 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.

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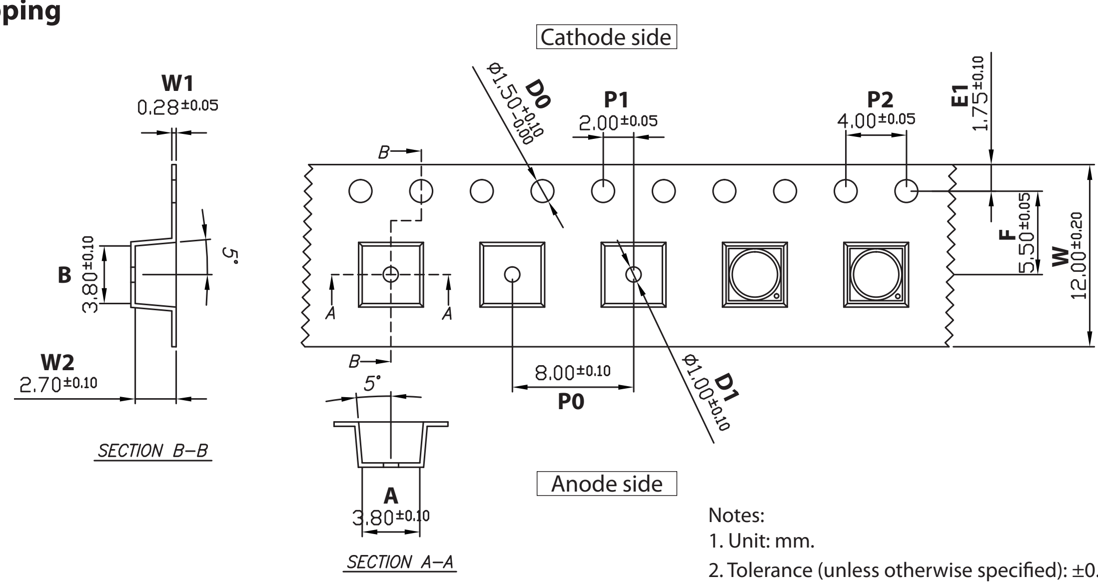
Product Packaging Information

Tapping

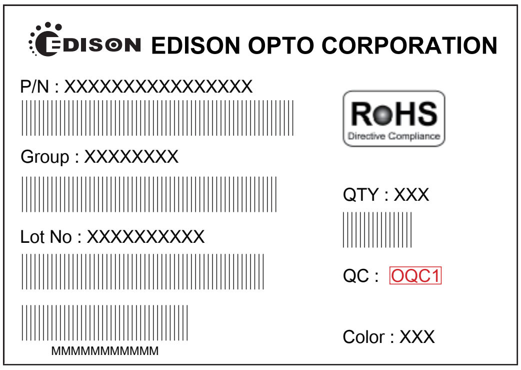


Notes:
1. Unit: mm.
2. Tolerance (unless otherwise specified): ±0.10mm.
3. Drawings are not to scale.

A	B	D0	D1	E1	F
3.80± 0.10	3.80±0.10	Φ1.50+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



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
Radiant Power Bin Code	Voltage Bin Code	Wavelength Bin Code

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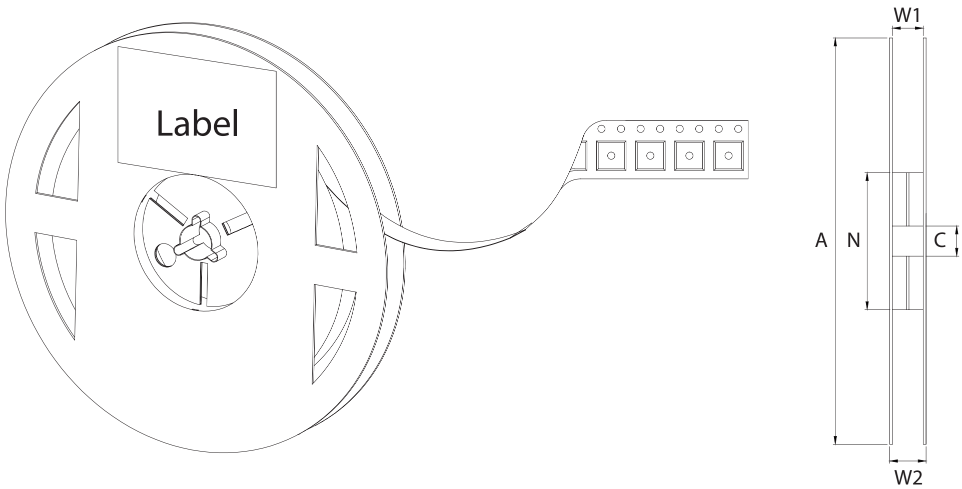
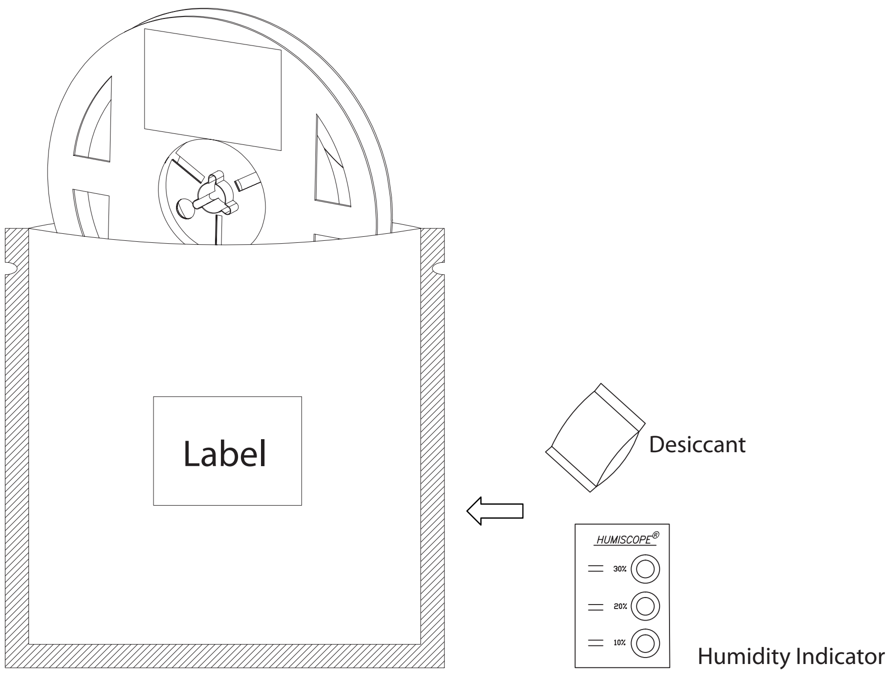
Tape and Reel

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



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Revision History

Versions	Description	Release Date
1	Establish order code information	2012/12/18
2	1. Add the Characteristic curve 2. Add the Emitter on Star ordering code	2013/02/26
3	1. Add Cherry Red information 2. Add Reliability & Reflow Profile	2014/09/15
4	1. Add color BIN of IR850 2. Revise all the characteristic curve 3. Add Voltage BIN Structure 4. Add Color BIN Code	2015/01/20
5	1. Revise Deep Red characteristic 2. Delete Cherry Red information	2015/10/05
6	Revise Luminous flux characteristic	2015/12/10
7	Update Luminous flux characteristic	2016/02/17
8	1. Update UV Luminous flux characteristic 2. Revise Characteristic curve 3. Add the cautions of reliability	2017/05/26
9	1. Add Indigo&Cheery Red information 2. Update Peak Pulsed Current & viewing angle 3. Revise all the characteristic curve	2018/02/06
10	1. Format revision 2. Add HBM ESD sensitivity (class 3B) of absolute maximum ratings 3. Revise characteristics of thermal resistance 4. Modify the table of bin codes 5. Revise the characteristic curves 6. Add application notes	2024/01/29

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

www.edison-opto.com

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