

High lumen output and efficacy  
**SPF0BF0A(3535RGBW 4in1)**

S1C0-3535XX0000-00000000-00001



## Product Brief

### Description

- It has a substrate made up of a molded plastic reflector sitting on top of a lead frame.
- The package design coupled with careful selection of component materials allow these products to perform with high reliability.

### Features and Benefits

- Compact Package Size
- 4 Chips in a Package
- Pb-Free Reflow Soldering Application
- RoHS Compliant

### Key Applications

- Architectural
- Entertainment

Reference Code	CRI	Nominal CCT	Part Number
SPF0BF0A	80	3000K	S1C0-3535300000-00000000-00001
		4000K	S1C0-3535400000-00000000-00001
		5000K	S1C0-3535500000-00000000-00001

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## Performance Characteristics

**Table 1. Electro-Optical characteristics at 150mA (Ta=25°C, RH30%)**

Parameter	Color	Symbol	Value			Unit
			Min.	Typ.	Max.	
Luminous Flux <sup>[1]</sup>	Red	$\Phi_V$ <sup>[3]</sup>	18	-	36	lm
	Green		22	-	46	
	Blue		12	-	36	
	White		18	-	51	
Dominant Wavelength <sup>[1]</sup>	Red	$\lambda_d$	618	-	624	nm
	Green		520	-	530	
	Blue		464	-	478	
Forward Voltage <sup>[1]</sup>	Red	$V_F$	1.9	-	2.4	V
	Green		3.0	-	3.6	
	Blue		3.0	-	3.7	
	White		2.9	-	3.7	
Thermal Resistance (J to S) <sup>[2]</sup>	Red	$R\theta_{J-S}$	-	10	-	°C/W
	Green		-	60	-	
	Blue		-	20	-	
	White		-	5	-	
View Angle	Red	$2\theta_{1/2}$	-	134	-	Deg.
	Green		-	144	-	
	Blue		-	143	-	
	White		-	147	-	

**Table 2. Absolute Maximum Ratings**

Parameter	Symbol	Value			Unit
		Min.	Typ.	Max.	
Forward Current	$I_F$	-	-	180	mA
Junction Temperature	$T_j$	-	-	125	°C
Operating Temperature	$T_{op}$	- 40	-	105	°C
Storage Temperature	$T_{stg}$	- 40	-	105	°C
ESD Sensitivity(HBM)			2		kV

**Notes :**

(1) Tolerance :  $V_F \pm 0.1V$ ,  $\Phi_V \pm 7\%$ ,  $\lambda_d \pm 2nm$

(2) Thermal resistance :  $R_{th_{JS}}$  (Junction / solder)

(3)  $\Phi_V$  is the total luminous flux output as measured with an integrating sphere

(4) It is recommended to use it in the condition that the reliability is secured within the max value.

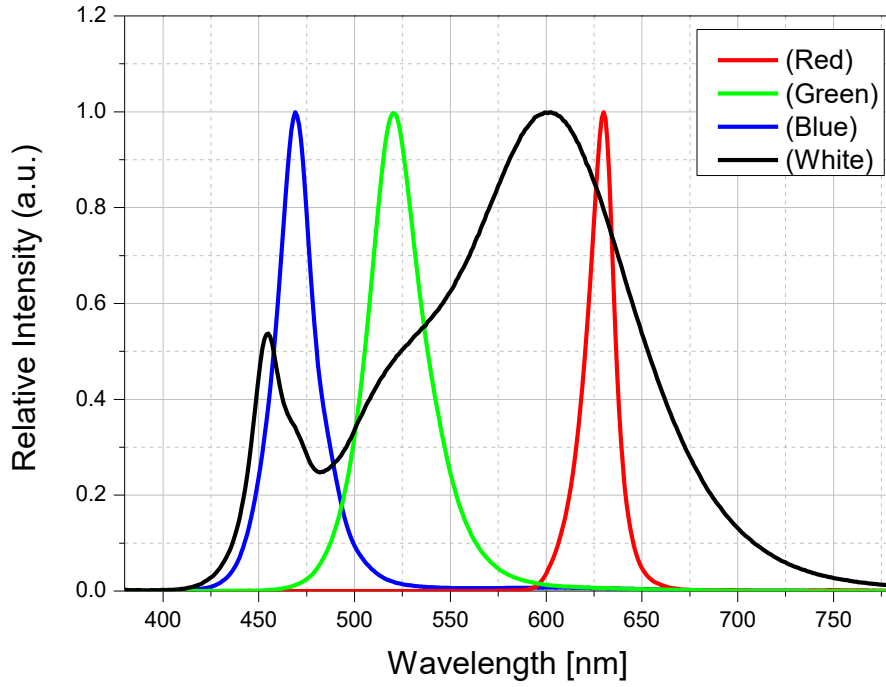
•LED's properties might be different from suggested values like above and below tables if operation condition will be exceeded our parameter range. Care is to be taken that power dissipation does not exceed the absolute maximum rating of the product.

•Thermal resistance can be increased substantially depending on the heat sink design/operating condition, and the maximum possible driving current will decrease accordingly.

•All measurements were made under the standardized environment of Seoul Semiconductor.

## Characteristics Graph

Fig 1. Color Spectrum,  $I_F=150\text{mA}$ ,  $T_j=25^\circ\text{C}$



## Characteristics Graph

Fig 2. Forward Voltage vs. Forward Current,  $T_j=25^\circ\text{C}$

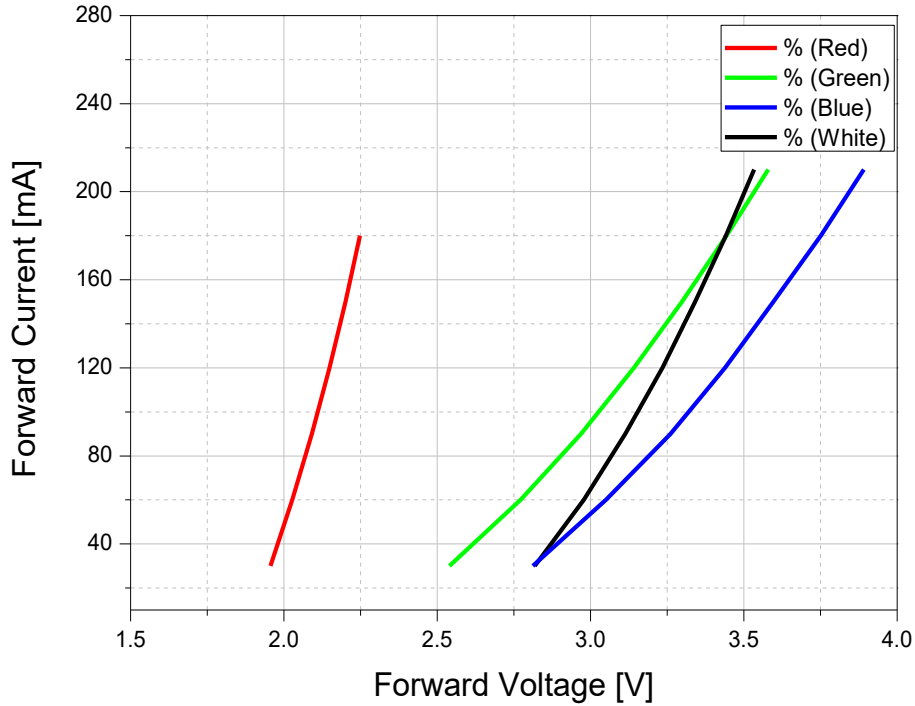
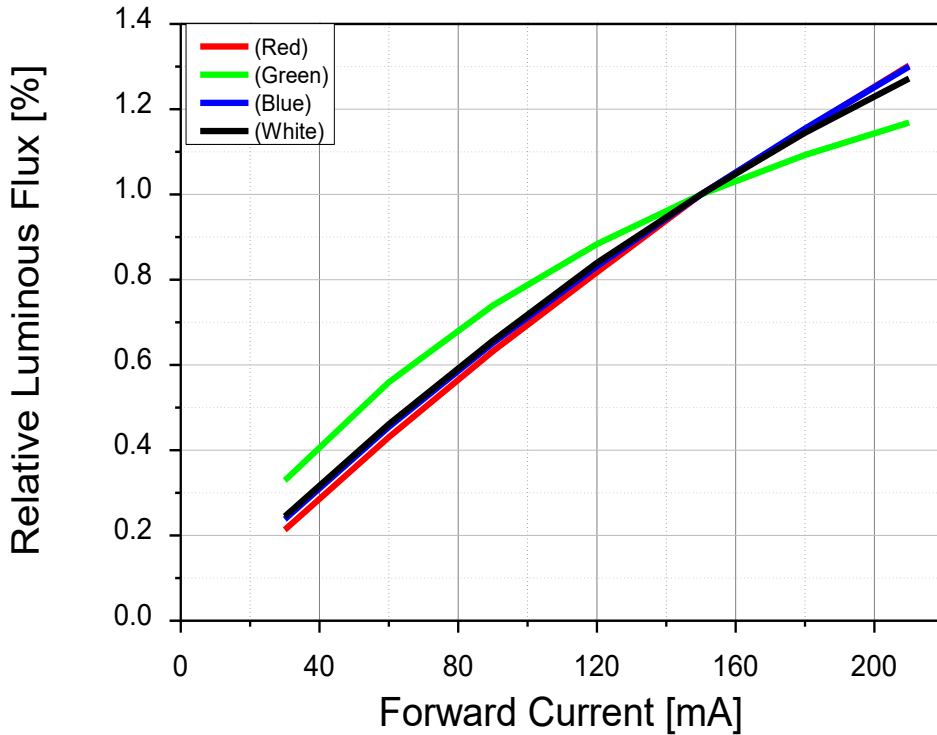


Fig 3. Forward Current vs. Relative Luminous Flux,  $T_j=25^\circ\text{C}$



## Characteristics Graph

Fig 4. Forward Current vs. CIE x,y Shift,  $T_j=25^{\circ}\text{C}$

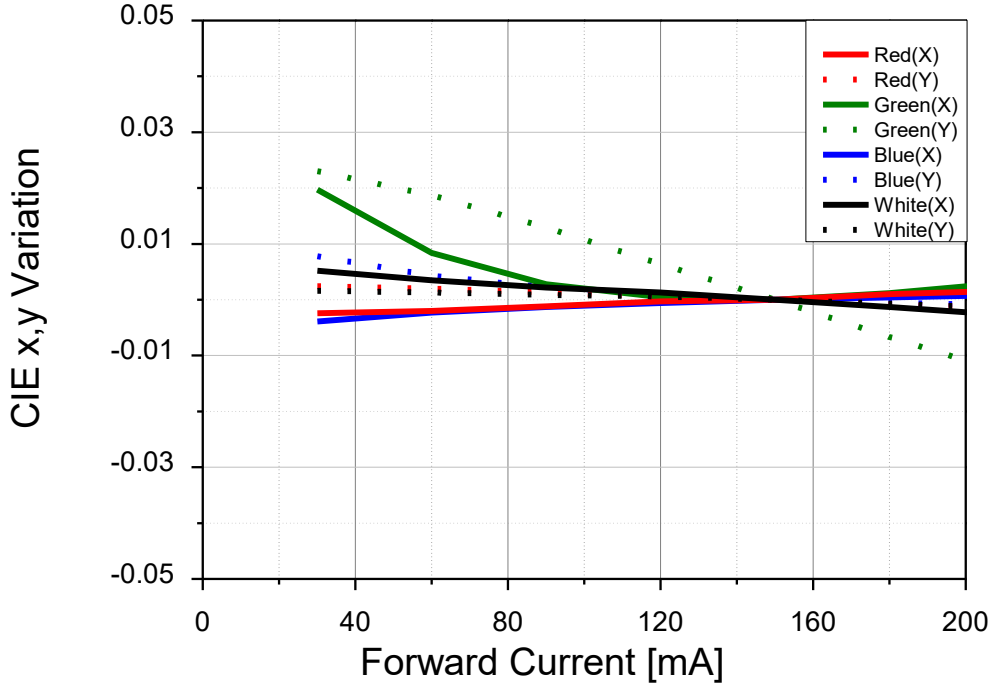
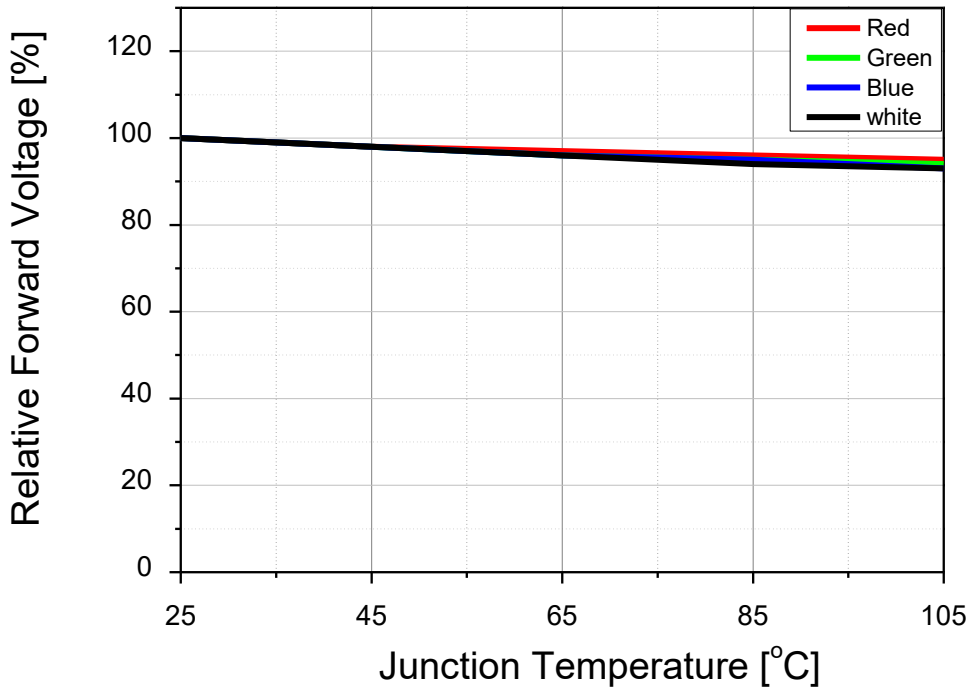
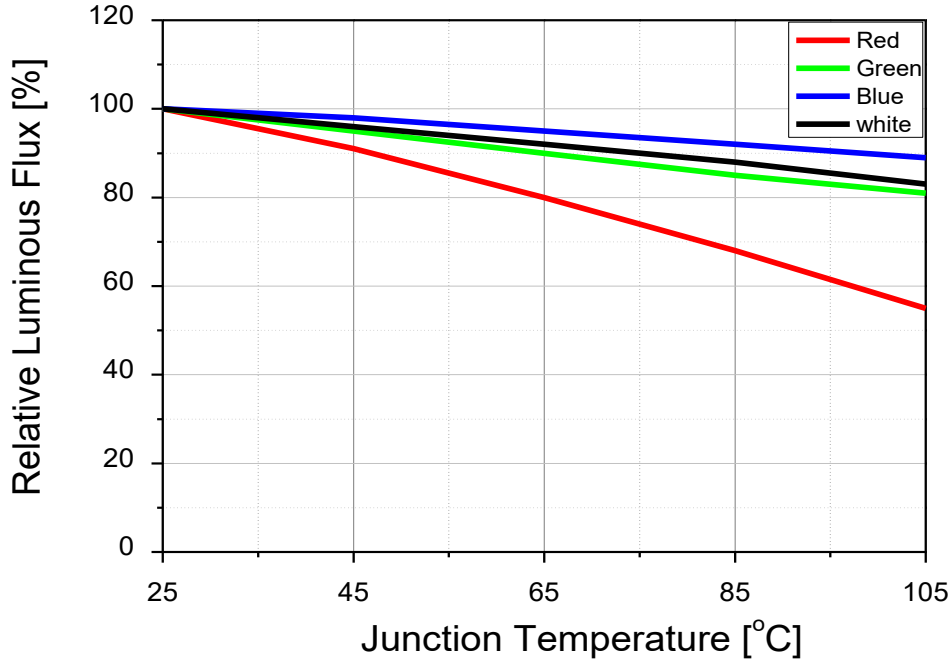
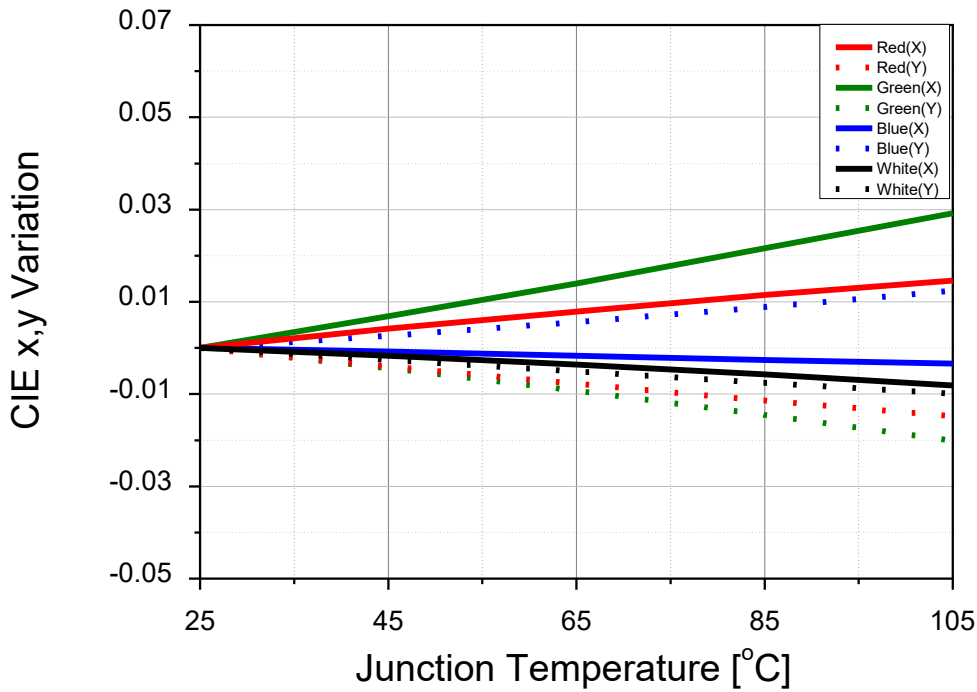


Fig 5. Junction Temperature vs. Relative Forward Voltage,  $I_F=150\text{mA}$

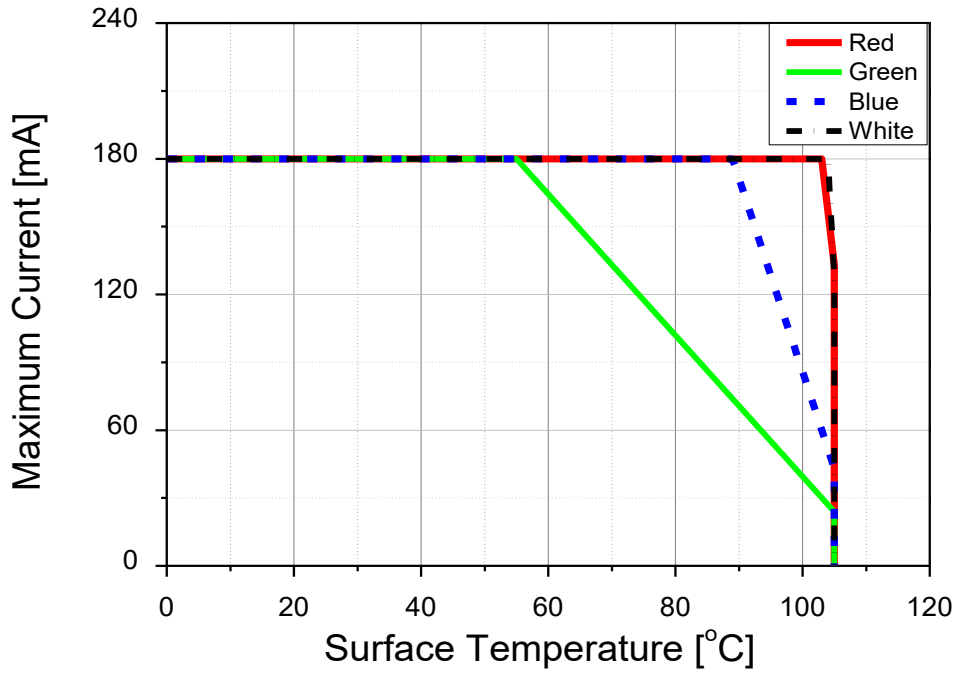


## Characteristics Graph

**Fig 6. Junction Temperature vs. Relative Luminous Flux,  $I_F=150\text{mA}$** 

**Fig 7. Junction Temperature vs. vs. CIE x,y Shift,  $I_F=150\text{mA}$** 


## Characteristics Graph

Fig 8. Surface Temperature vs. Maximum Forward Current,  $T_j(\text{max.})=125^\circ\text{C}$





## Color Bin Structure

**Table 3. Bin Code description,  $I_F=150\text{mA}$ ,  $T_a=25^\circ\text{C}$** 

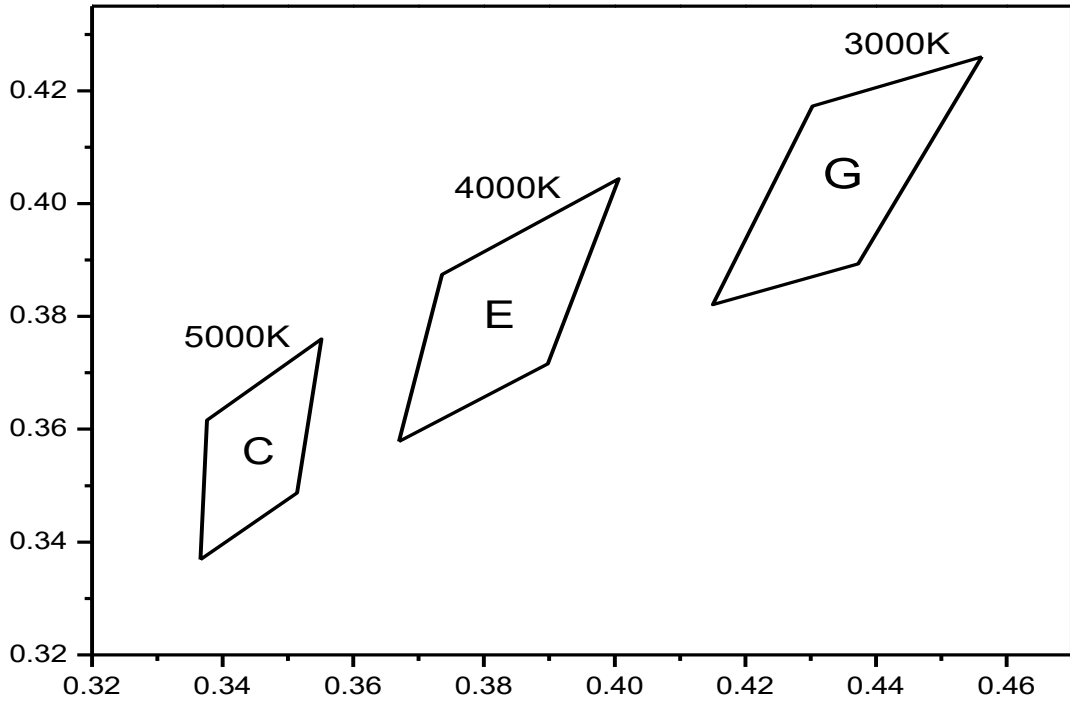
Color	Luminous Flux, $\Phi_V$			Dominant Wavelength, $\lambda_d$			Forward Voltage, $V_F$		
	Bin Code	[lm]		Bin Code	[nm]		Bin Code	[V]	
		Min.	Max.		Min.	Max.		Min.	Max.
Red	RL1	18	27	RD	618	624	RV	1.9	2.4
	RL2	27	36						
Green	GL1	22	34	GD1	520	525	GV	3.0	3.6
	GL2	34	46	GD2	525	530			
Blue	BL1	12	24	BD1	464	471	BV	3.0	3.7
	BL2	24	36	BD2	471	478			
White	WL1	18	32	3000K(G)			WV	2.9	3.7
	WL2	32	46						
	WM1	21	35	4000K(E)					
	WM2	35	49						
	WN1	23	37	5000K(C)					
	WN2	37	51						

**Notes :**

- Tolerance :  $V_F \pm 0.1\text{V}$ ,  $\Phi_V \pm 7\%$ ,  $\lambda_d \pm 2\text{nm}$
- All measurements were made under the standardized environment of Seoul Semiconductor.

## Color Bin Structure

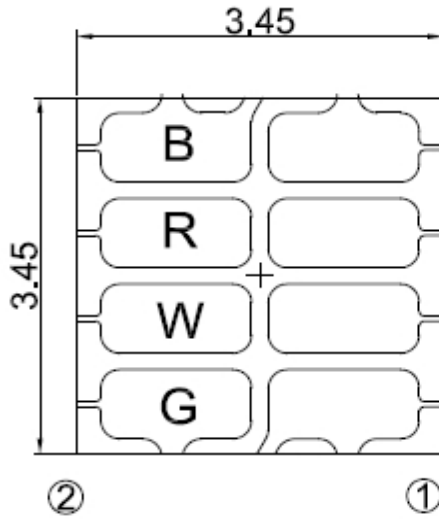
CIE Chromaticity Diagram  $I_F=150\text{mA}$ ,  $T_J=25^\circ\text{C}$



3000K G		4000K E		5000K C	
CIE X	CIE Y	CIE X	CIE Y	CIE X	CIE Y
0.4562	0.4260	0.3670	0.3578	0.3366	0.3369
0.4303	0.4173	0.3736	0.3874	0.3376	0.3616
0.4150	0.3821	0.4006	0.4044	0.3551	0.376
0.4373	0.3893	0.3898	0.3716	0.3514	0.3487

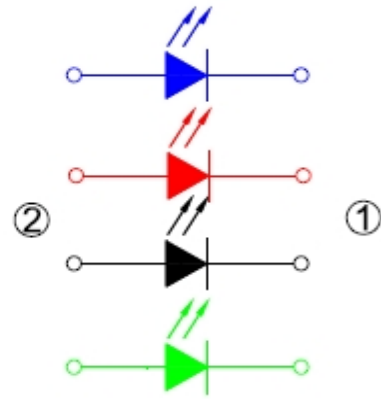
# Mechanical Dimensions

## Package Dimensions

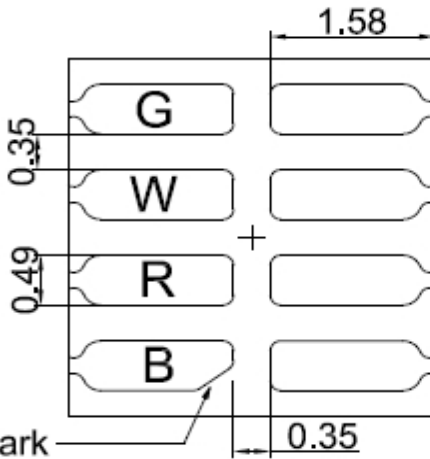


Anode

Cathode

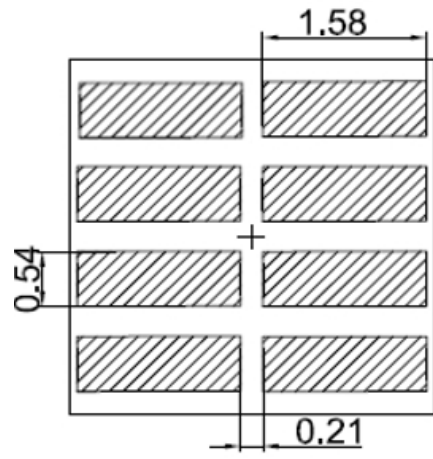


Polarity



Anode Mark

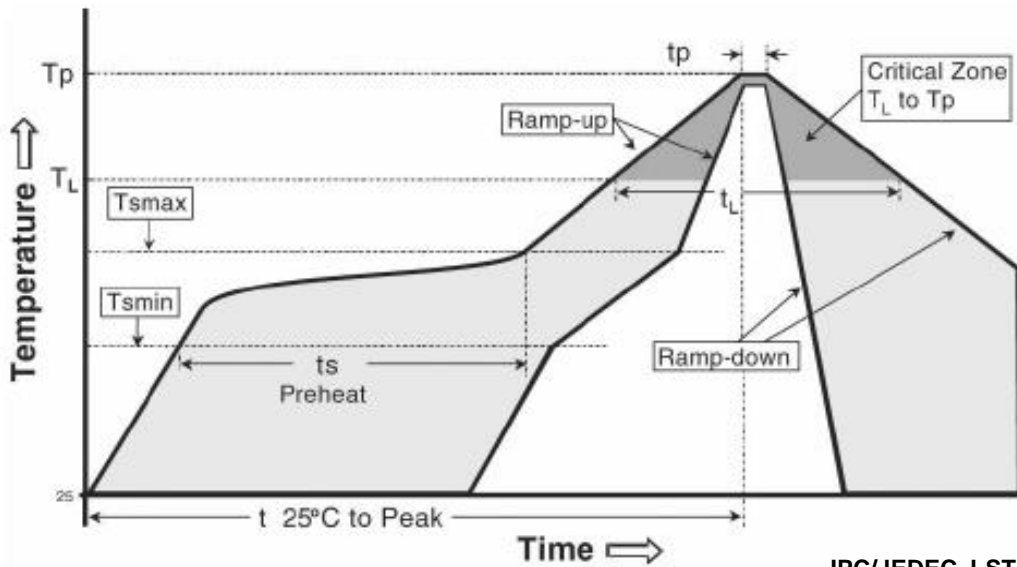
BOT VIEW



SOLDERING PATTERNS

- (1) All dimensions are in millimeters.
- (2) Scale : none
- (3) Undefined tolerance is  $\pm 0.1\text{mm}$

## Reflow Soldering Characteristics

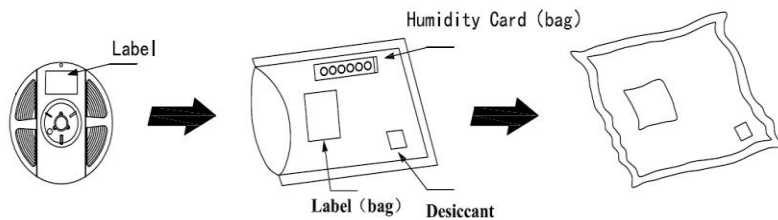
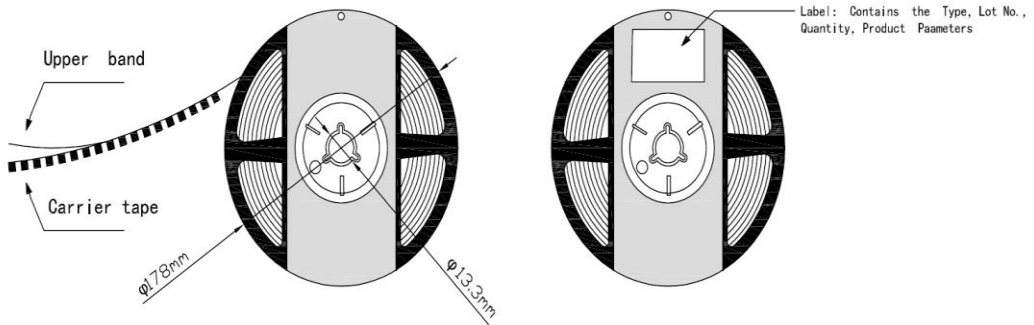
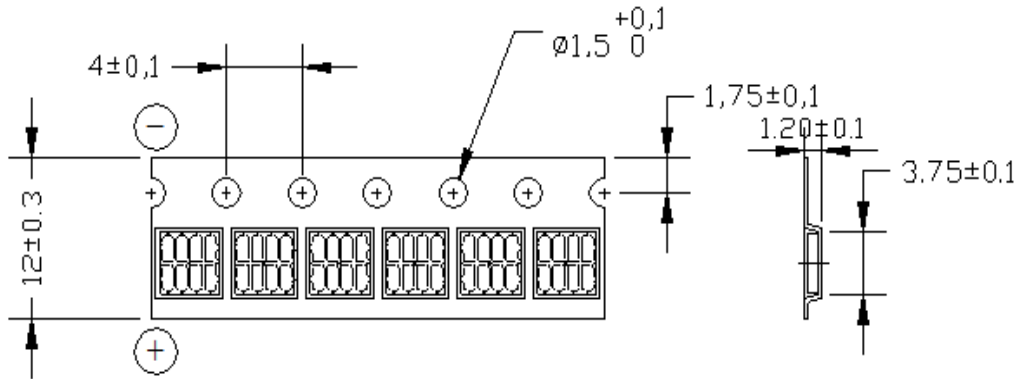

**IPC/JEDEC J-STD-020**

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Average ramp-up rate (T <sub>max</sub> to T <sub>p</sub> )	3° C/second max.	3° C/second max.
Preheat		
- Temperature Min (T <sub>min</sub> )	100 °C	150 °C
- Temperature Max (T <sub>max</sub> )	150 °C	200 °C
- Time (T <sub>min</sub> to T <sub>max</sub> ) (ts)	60-120 seconds	60-180 seconds
Time maintained above:		
- Temperature (T <sub>L</sub> )	183 °C	217 °C
- Time (t <sub>L</sub> )	60-150 seconds	60-150 seconds
Peak Temperature (T <sub>p</sub> )	215°C	260°C
Time within 5°C of actual Peak Temperature (tp) <sup>2</sup>	10-30 seconds	20-40 seconds
Ramp-down Rate	6 °C/second max.	6 °C/second max.
Time 25°C to Peak Temperature	6 minutes max.	8 minutes max.

### Caution

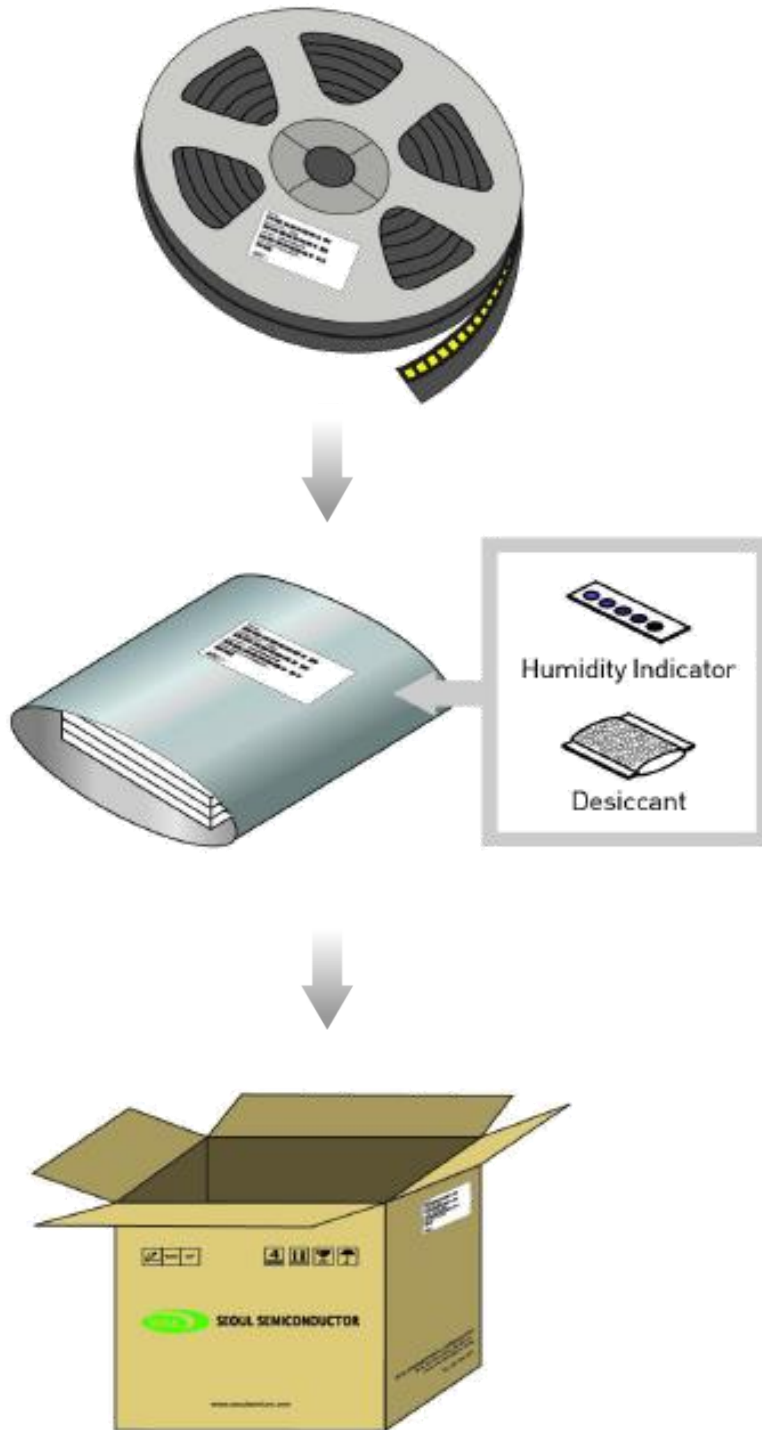
- (1) Reflow soldering is recommended not to be done more than two times. In the case of more than 24 hours passed soldering after first, LED will be damaged.
- (2) Repairs should not be done after the LED have been soldered. When repair is unavoidable, suitable tools must be used.
- (3) Die slug is to be soldered.
- (4) When soldering, do not put stress on the LED during heating.
- (5) After soldering, do not warp the circuit board.

## Emitter Tape & Reel Packaging



1. Quantity : 1000pcs/Reel
2. Cumulative Tolerance : Cumulative Tolerance/10 pitches to be  $\pm 0.2$ mm
3. Package : P/N, Manufacturing data Code No. and quantity to be indicated on a damp proof Package
4. unit = mm

## Packaging Information



## Product Nomenclature

**Table 4. Part Numbering System : X<sub>1</sub>X<sub>2</sub>X<sub>3</sub>X<sub>4</sub>X<sub>5</sub>X<sub>6</sub>X<sub>7</sub>X<sub>8</sub>**

Part Number Code	Description	Part Number	Value
X <sub>1</sub>	Company	S	SSC
X <sub>2</sub>	LED series	P	Power
X <sub>3</sub> X <sub>4</sub>	Color Specification	F0	Full Color
X <sub>5</sub>	Package series	B	3535 series
X <sub>6</sub>	Lens Type	F	Flat
X <sub>7</sub>	PCB type	0	Emitter
X <sub>8</sub>	Revision	A	

**Table 5. Lot Numbering System : Y<sub>1</sub>Y<sub>2</sub>Y<sub>3</sub>Y<sub>4</sub>Y<sub>5</sub>Y<sub>6</sub>Y<sub>8</sub>Y<sub>9</sub>Y<sub>10</sub> - Y<sub>11</sub>Y<sub>12</sub>Y<sub>13</sub> - Y<sub>14</sub>Y<sub>15</sub>Y<sub>16</sub> - Y<sub>17</sub>Y<sub>18</sub>Y<sub>19</sub>Y<sub>20</sub>Y<sub>21</sub>Y<sub>22</sub>Y<sub>23</sub>**

Lot Number Code	Description
Y <sub>1</sub> Y <sub>2</sub> Y <sub>3</sub> Y <sub>4</sub> Y <sub>5</sub> Y <sub>6</sub> Y <sub>7</sub> Y <sub>8</sub> Y <sub>9</sub> Y <sub>10</sub>	Date of box packing
Y <sub>11</sub> Y <sub>12</sub> Y <sub>13</sub> - Y <sub>14</sub> Y <sub>15</sub> Y <sub>16</sub>	Date of label order
Y <sub>17</sub> Y <sub>18</sub> Y <sub>19</sub> Y <sub>20</sub> Y <sub>21</sub> Y <sub>22</sub> Y <sub>23</sub>	Item code

## Handling of Silicone Resin for LED

- (1) During processing, mechanical stress on the surface should be minimized as much as possible. Sharp objects of all types should not be used to pierce the sealing compound.
- (2) In general, LED should only be handled from the side. By the way, this also applies to LED without a silicone sealant, since the surface can also become scratched.
- (3) When populating boards in SMT production, there are basically no restrictions regarding the form of the pick and place nozzle, except that mechanical pressure on the surface of the resin must be prevented. This is assured by choosing a pick and place nozzle which is larger than the LED's reflector area.
- (4) Silicone differs from materials conventionally used for the manufacturing of LEDs. These conditions must be considered during the handling of such devices. Compared to standard encapsulants, silicone is generally softer, and the surface is more likely to attract dust. As mentioned previously, the increased sensitivity to dust requires special care during processing. In cases where a minimal level of dirt and dust particles cannot be guaranteed, a suitable cleaning solution must be applied to the surface after the soldering of components.
- (5) Seoul Semiconductor suggests using isopropyl alcohol for cleaning. In case other solvents are used, it must be assured that these solvents do not dissolve the package or resin. Ultrasonic cleaning is not recommended. Ultrasonic cleaning may cause damage to the LED.
- (6) Please do not mold this product into another resin (epoxy, urethane, etc) and do not handle this product with acid or sulfur material in sealed space.
- (7) Avoid leaving fingerprints on silicone resin parts.



## Precaution for Use

### (1) Storage

To avoid the moisture penetration, we recommend storing Z5 Series LED in a dry box with a desiccant. The recommended storage temperature range is 5°C to 30°C and a maximum humidity of RH50%.

### (2) Use Precaution after Opening the Packaging

Use SMT techniques properly when you solder the LED as separation of the lens may affect the light output efficiency.

Pay attention to the following:

#### a. Recommend conditions after opening the package

- Sealing / Temperature : 5 ~ 40°C Humidity : less than RH30%

#### b. If the package has been opened more than 7 days (MSL\_3) or the color of the desiccant changes, components should be dried for 10-24hr at 60±5°C

(3) Do not apply mechanical force or excess vibration during the cooling process to normal temperature after soldering.

(4) Do not rapidly cool device after soldering.

(5) Components should not be mounted on warped (non coplanar) portion of PCB.

(6) Radioactive exposure is not considered for the products listed here in.

(7) Gallium arsenide is used in some of the products listed in this publication. These products are dangerous if they are burned or shredded in the process of disposal. It is also dangerous to drink the liquid or inhale the gas generated by such products when chemically disposed of.

(8) This device should not be used in any type of fluid such as water, oil, organic solvent and etc. When washing is required, IPA (Isopropyl Alcohol) should be used.

(9) When the LED are in operation the maximum current should be decided after measuring the package temperature.

(10) The appearance and specifications of the product may be modified for improvement without notice.

(11) Long time exposure of sunlight or occasional UV exposure will cause lens discoloration.

## Precaution for Use

(12) VOCs (Volatile organic compounds) emitted from materials used in the construction of fixtures can penetrate silicone encapsulants of LED and discolor when exposed to heat and photonic energy. The result can be a significant loss of light output from the fixture. Knowledge of the properties of the materials selected to be used in the construction of fixtures can help prevent these issues.

(13) Attaching LEDs, do not use adhesives that outgas organic vapor.

(14) The driving circuit must be designed to allow forward voltage only when it is ON or OFF. If the reverse voltage is applied to LED, migration can be generated resulting in LED damage.

(15) LED is sensitive to Electro-Static Discharge (ESD) and Electrical Over Stress (EOS). Below is a list of suggestions that Seoul Semiconductor purposes to minimize these effects.

### a. ESD (Electro Static Discharge)

Electrostatic discharge (ESD) is defined as the release of static electricity when two objects come into contact. While most ESD events are considered harmless, it can be an expensive problem in many industrial environments during production and storage. The damage from ESD to an LED may cause the product to demonstrate unusual characteristics such as:

- Increase in reverse leakage current lowered turn-on voltage
- Abnormal emissions from the LED at low current

The following recommendations are suggested to help minimize the potential for an ESD event. One or more recommended work area suggestions:

- Ionizing fan setup
- ESD table/shelf mat made of conductive materials
- ESD safe storage containers

One or more personnel suggestion options:

- Antistatic wrist-strap
- Antistatic material shoes
- Antistatic clothes

Environmental controls:

- Humidity control (ESD gets worse in a dry environment)

## Precaution for Use

### b. EOS (Electrical Over Stress)

Electrical Over-Stress (EOS) is defined as damage that may occur when an electronic device is subjected to a current or voltage that is beyond the maximum specification limits of the device. The effects from an EOS event can be noticed through product performance like:

- Changes to the performance of the LED package  
(If the damage is around the bond pad area and since the package is completely encapsulated the package may turn on but flicker show severe performance degradation.)
- Changes to the light output of the luminaire from component failure
- Components on the board not operating at determined drive power

Failure of performance from entire fixture due to changes in circuit voltage and current across total circuit causing trickle down failures. It is impossible to predict the failure mode of every LED exposed to electrical overstress as the failure modes have been investigated to vary, but there are some common signs that will indicate an EOS event has occurred:

- Damaged may be noticed to the bond wires (appearing similar to a blown fuse)
- Damage to the bond pads located on the emission surface of the LED package  
(shadowing can be noticed around the bond pads while viewing through a microscope)
- Anomalies noticed in the encapsulation and phosphor around the bond wires.
- This damage usually appears due to the thermal stress produced during the EOS event.

### c. To help minimize the damage from an EOS event Seoul Semiconductor recommends utilizing:

- A surge protection circuit
- An appropriately rated over voltage protection device
- A current limiting device

## Company Information

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### **Company Information**

Seoul Semiconductor ([www.SeoulSemicon.com](http://www.SeoulSemicon.com)) manufactures and packages a wide selection of light emitting diodes (LEDs) for the automotive, general illumination/lighting, Home appliance, signage and back lighting markets. The company is the world's fifth largest LED supplier, holding more than 10,000 patents globally, while offering a wide range of LED technology and production capacity in areas such as "nPola", "Acrich", the world's first commercially produced AC LED, and "Acrich MJT - Multi-Junction Technology" a proprietary family of high-voltage LEDs.

The company's broad product portfolio includes a wide array of package and device choices such as Acrich and Acirch2, high-brightness LEDs, mid-power LEDs, side-view LEDs, and through-hole type LED as well as custom modules, displays, and sensors.

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