Middle Power LED Series
Flip Chip Package

# LM101A

## LM101A opens up a new world of lighting design with its high output and small form factors

### Features & Benefits

- Greater freedom of design with compact package size
- High degree of reliability with plastic-free structure
- Low thermal resistance
- High efficiency providing optimized solution
- Compact footprint (1.15 x 1.15 mm)

SAMSUNG

# Table of Contents



SAMSUNG

# 1. Characteristics

## a) Absolute Maximum Rating

| Item | Symbol | Rating | Unit | Condition |
|---|---|---|---|---|
| Operating Temperature | $T_a$ | -40 ~ +85 | ºC | - |
| Storage Temperature | $T_{stg}$ | -40 ~ +120 | ºC | - |
| LED Junction Temperature | $T_j$ | 125 | ºC | - |
| Forward Current | $I_F$ | 450 | mA | - |
| Assembly Process Temperature | - | 260<br><10 | ℃<br>s | - |
| ESD (HBM) | - | ±2 | kV | - |

## b) Electro-optical Characteristics ($I_F$ = 150 mA, $T_s$ = 85 ºC)

| Item | Unit | Rank | Bin | Min. | Typ. | Max. |
|---|---|---|---|---|---|---|
| Forward Voltage ($V_F$) | V | 6E | 6A | 2.7 | - | 2.9 |
| | | | AE | 2.9 | - | 3.1 |
| Reverse Voltage (@ -10 µA) | V | | | -10.0 | - | - |
| Color Rendering Index ($R_a$) | - | 8 | | 80 | - | - |
| Special CRI (R9) | - | | | 0 | - | - |
| Thermal Resistance (junction to chip point) | K/W | | | - | 2 | - |
| Beam Angle | º | | | - | 150 | - |

**Note:** Samsung maintains measurement tolerance of : Forward voltage = ±0.1 V, Luminous flux = ±5 %, CRI = ±3, R9 = ±6.5

## c) Luminous Flux Characteristics ($I_F$ = 150 mA, $T_s$ = 85 ºC)

| Item | CRI | Nominal CCT (K) | SY | | SZ | | SA | | SB | | SC | | SD | | SE | | SF | | SG | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. |
| | | | 35 | 39 | 39 | 43 | 43 | 47 | 47 | 51 | 51 | 55 | 55 | 59 | 59 | 63 | 63 | 67 | 67 | 71 |
| Luminous Flux (Φv) | 70 | 3000 | | | | | | | | | | | | | | | | | | |
| | | 3500 | | | | | | | | | | | | | | | | | | |
| | | 4000 | | | | | | | | | | | | | | | | | | |
| | | 5000 | | | | | | | | | | | | | | | | | | |
| | | 5700 | | | | | | | | | | | | | | | | | | |
| | | 6500 | | | | | | | | | | | | | | | | | | |
| | 80 | 2200 | | | | | | | | | | | | | | | | | | |
| | | 2700 | | | | | | | | | | | | | | | | | | |
| | | 3000 | | | | | | | | | | | | | | | | | | |
| | | 3500 | | | | | | | | | | | | | | | | | | |
| | | 4000 | | | | | | | | | | | | | | | | | | |
| | | 5000 | | | | | | | | | | | | | | | | | | |
| | | 5700 | | | | | | | | | | | | | | | | | | |
| | | 6500 | | | | | | | | | | | | | | | | | | |
| | 90 | 2700 | | | | | | | | | | | | | | | | | | |
| | | 3000 | | | | | | | | | | | | | | | | | | |
| | | 3500 | | | | | | | | | | | | | | | | | | |
| | | 4000 | | | | | | | | | | | | | | | | | | |

**Note:**

1) The LM101A is tested in pulsed condition at rated test current (10 ms pulse width)
2) Calculated flux values are for reference only
3) Samsung maintains measurement tolerance of: luminous flux = ±5 %

## 2. Product Code Information ($I_F$ = 150 mA, $T_s$ = 85 ºC)

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S | C | P | 8 | W | T | 7 | 8 | H | P | L | 1 | W | L | S | 0 | 6 | E |

| Digit | PKG Information | Code | Specification |
|---|---|---|---|
| 1 2 3 | Samsung Chip | SCP | |
| 4 | CRI | 7 | Min. 70 |
| | | 8 | Min. 80 |
| | | 9 | Min. 90 |
| 5 | CCT (K) | Y | 2200K |
| | | W | 2700K |
| | | V | 3000K |
| | | U | 3500K |
| | | T | 4000K |
| | | R | 5000K |
| | | Q | 5700K |
| | | P | 6500K |
| 6 | Chip Shape | T | Square |
| 7 8 9 | Chip Size (μm) | 78H | 780x780x170μm |
| 10 11 12 | Product Purpose | PL1 | PoC for Lighting |
| 13 | CCT (K) | Y | 2200K |
| | | W | 2700K |
| | | V | 3000K |
| | | U | 3500K |
| | | T | 4000K |
| | | R | 5000K |
| | | Q | 5700K |
| | | P | 6500K |
| 14 | MacAdam Step | L | Single Bin for MacAdam 5-step L(MacAdam 5-step Bin) |
| | | U | Single Bin for MacAdam 3-step U(MacAdam 3-step Bin) |
| 15 16 | Luminous Flux (lm) | S0 | Bin Code: SY, SZ, SA, SB, SC, SD, SE, SF, SG |
| 17 18 | Forward Voltage (V) | 6E | 2.7~3.1 Bin Code: 6A 2.7~2.9; AE 2.9~3.1 |

SAMSUNG

### a) Luminous Flux Bins ($I_F$ = 150 mA, $T_S$ = 85 ºC)

| CRI ($R_a$) Min. | Nominal CCT (K) | Product Code | Flux Bin | Flux Range ($\Phi_v$, lm) |
|---|---|---|---|---|
| 70 | 3000 | SCP7VT78HPL1V☆S06E | SD | 55 ~ 59 |
| | | | SE | 59 ~ 63 |
| | | | SF | 63 ~ 67 |
| | 3500 | SCP7UT78HPL1U☆S06E | SD | 55 ~ 59 |
| | | | SE | 59 ~ 63 |
| | | | SF | 63 ~ 67 |
| | 4000 | SCP7TT78HPL1T☆S06E | SE | 59 ~ 63 |
| | | | SF | 63 ~ 67 |
| | | | SG | 67 ~ 71 |
| | 5000 | SCP7RT78HPL1R☆S06E | SE | 59 ~ 63 |
| | | | SF | 63 ~ 67 |
| | | | SG | 67 ~ 71 |
| | 5700 | SCP7QT78HPL1Q☆S06E | SE | 59 ~ 63 |
| | | | SF | 63 ~ 67 |
| | | | SG | 67 ~ 71 |
| | 6500 | SCP7PT78HPL1P☆S06E | SE | 59 ~ 63 |
| | | | SF | 63 ~ 67 |
| | | | SG | 67 ~ 71 |

**Note:** “☆” can be “L” (Single bin for MacAdam 5-step), “U” (Single bin for MacAdam 3-step)

### a) Luminous Flux Bins ($I_F$ = 150 mA, $T_S$ = 85 ºC)

| CRI ($R_a$) Min. | Nominal CCT (K) | Product Code | Flux Bin | Flux Range ($\Phi_v$, lm) |
|---|---|---|---|---|
| 80 | 2200 | SCP8YT78HPL1Y☆S06E | SZ | 39 - 43 |
| | | | SA | 43 - 47 |
| | | | SB | 47 - 51 |
| | 2700 | SCP8WT78HPL1W☆S06E | SB | 47 ~ 51 |
| | | | SC | 51 ~ 55 |
| | | | SD | 55 ~ 59 |
| | 3000 | SCP8VT78HPL1V☆S06E | SC | 51 ~ 55 |
| | | | SD | 55 ~ 59 |
| | | | SE | 59 ~ 63 |
| | 3500 | SCP8UT78HPL1U☆S06E | SC | 51 ~ 55 |
| | | | SD | 55 ~ 59 |
| | | | SE | 59 ~ 63 |
| | 4000 | SCP8TT78HPL1T☆S06E | SD | 55 ~ 59 |
| | | | SE | 59 ~ 63 |
| | | | SF | 63 ~ 67 |
| | 5000 | SCP8RT78HPL1R☆S06E | SD | 55 ~ 59 |
| | | | SE | 59 ~ 63 |
| | | | SF | 63 ~ 67 |
| | 5700 | SCP8QT78HPL1Q☆S06E | SC | 51 ~ 55 |
| | | | SD | 55 ~ 59 |
| | | | SE | 59 ~ 63 |
| | 6500 | SCP8PT78HPL1P☆S06E | SC | 51 ~ 55 |
| | | | SD | 55 ~ 59 |
| | | | SE | 59 ~ 63 |

**Note:** "☆" can be "L" (Single bin for MacAdam 5-step) "U" (Single bin for MacAdam 3-step)

## a) Luminous Flux Bins ($I_F$ = 150 mA, $T_S$ = 85 ºC)

| CRI ($R_a$) Min. | Nominal CCT (K) | Product Code | Flux Bin | Flux Range ($\Phi_v$, lm) |
|---|---|---|---|---|
| 90 | 2700 | SCP9WT78HPL1W☆S06E | SY | 35 ~ 39 |
| | | | SZ | 39 ~ 43 |
| | | | SA | 43 ~ 47 |
| | 3000 | SCP9VT78HPL1V☆S06E | SY | 35 ~ 39 |
| | | | SZ | 39 ~ 43 |
| | | | SA | 43 ~ 47 |
| | 3500 | SCP9UT78HPL1U☆S06E | SZ | 39 ~ 43 |
| | | | SA | 43 ~ 47 |
| | | | SB | 47 ~ 51 |
| | 4000 | SCP9TT78HPL1T☆S06E | SZ | 39 ~ 43 |
| | | | SA | 43 ~ 47 |
| | | | SB | 47 ~ 51 |

**Note:** "☆" can be "L" (Single bin for MacAdam 5-step), "U" (Single bin for MacAdam 3-step)

## b) Color Bins ($I_F$ = 150 mA, $T_s$ = 85 ºC)

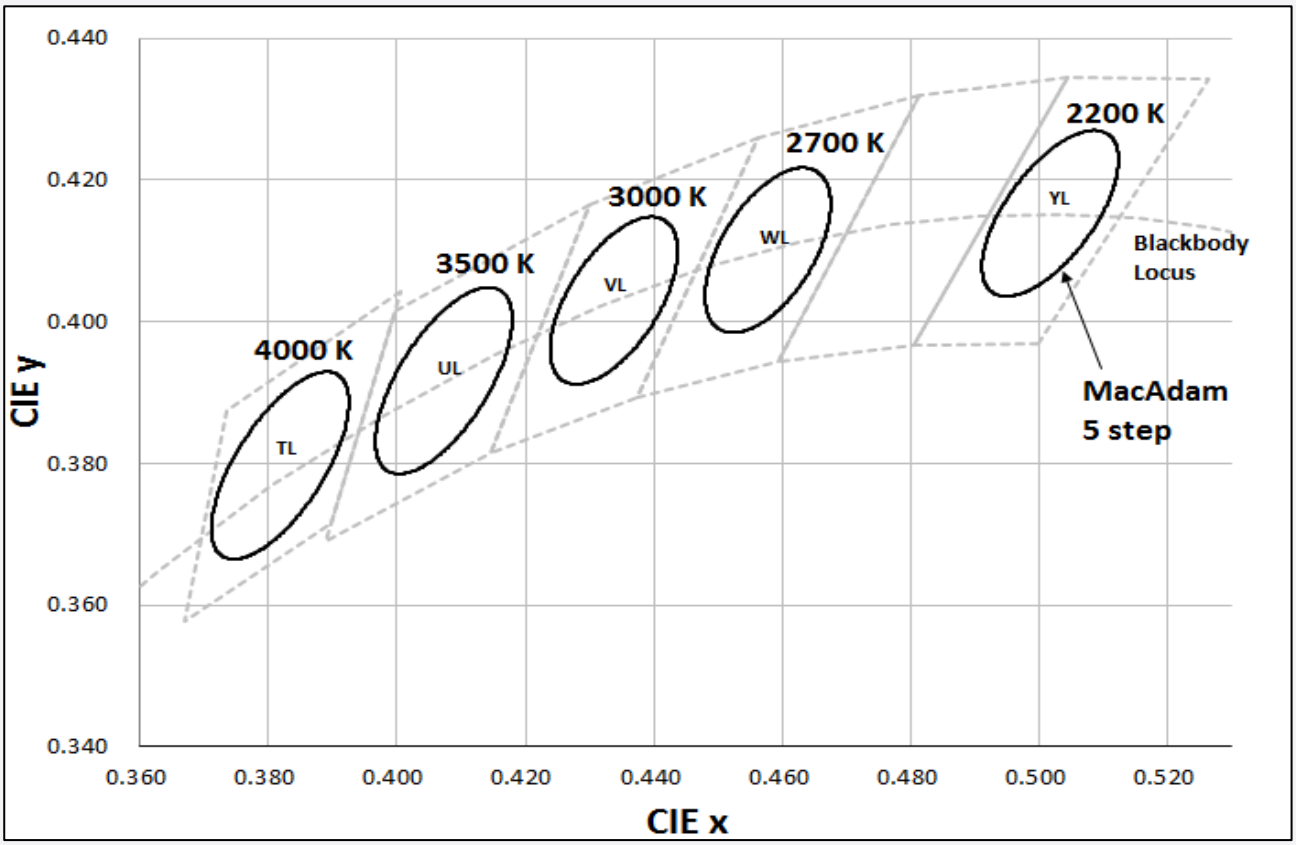
| CRI Min. | Nominal CCT (K) | Product Code | Color Rank | Chromaticity Bins |
|---|---|---|---|---|
| 70 | 3000 | SCP7VT78HPL1V☆S06E | VL | VL |
| | | | VU | VU |
| | 3500 | SCP7UT78HPL1U☆S06E | UL | UL |
| | | | UU | UU |
| | 4000 | SCP7TT78HPL1T☆S06E | TL | TL |
| | | | TU | TU |
| | 5000 | SCP7RT78HPL1R☆S06E | RL | RL |
| | | | RU | RU |
| | 5700 | SCP7QT78HPL1Q☆S06E | QL | QL |
| | | | QU | QU |
| | 6500 | SCP7PT78HPL1P☆S06E | PL | PL |
| | | | PU | PU |
| 80 | 2200 | SCP8YT78HPL1Y☆S06E | YL | YL |
| | | | YU | YU |
| | 2700 | SCP8WT78HPL1W☆S06E | WL | WL |
| | | | WU | WU |
| | 3000 | SCP8VT78HPL1V☆S06E | VL | VL |
| | | | VU | VU |
| | 3500 | SCP8UT78HPL1U☆S06E | UL | UL |
| | | | UU | UU |
| | 4000 | SCP8TT78HPL1T☆S06E | TL | TL |
| | | | TU | TU |
| | 5000 | SCP8RT78HPL1R☆S06E | RL | RL |
| | | | RU | RU |
| | 5700 | SCP8QT78HPL1Q☆S06E | QL | QL |
| | | | QU | QU |
| | 6500 | SCP8PT78HPL1P☆S06E | PL | PL |
| | | | PU | PU |
| 90 | 2700 | SCP9WT78HPL1W☆S06E | WL | WL |
| | | | WU | WU |
| | 3000 | SCP9VT78HPL1V☆S06E | VL | VL |
| | | | VU | VU |
| | 3500 | SCP9UT78HPL1U☆S06E | UL | UL |
| | | | UU | UU |
| | 4000 | SCP9TT78HPL1T☆S06E | TL | TL |
| | | | TU | TU |

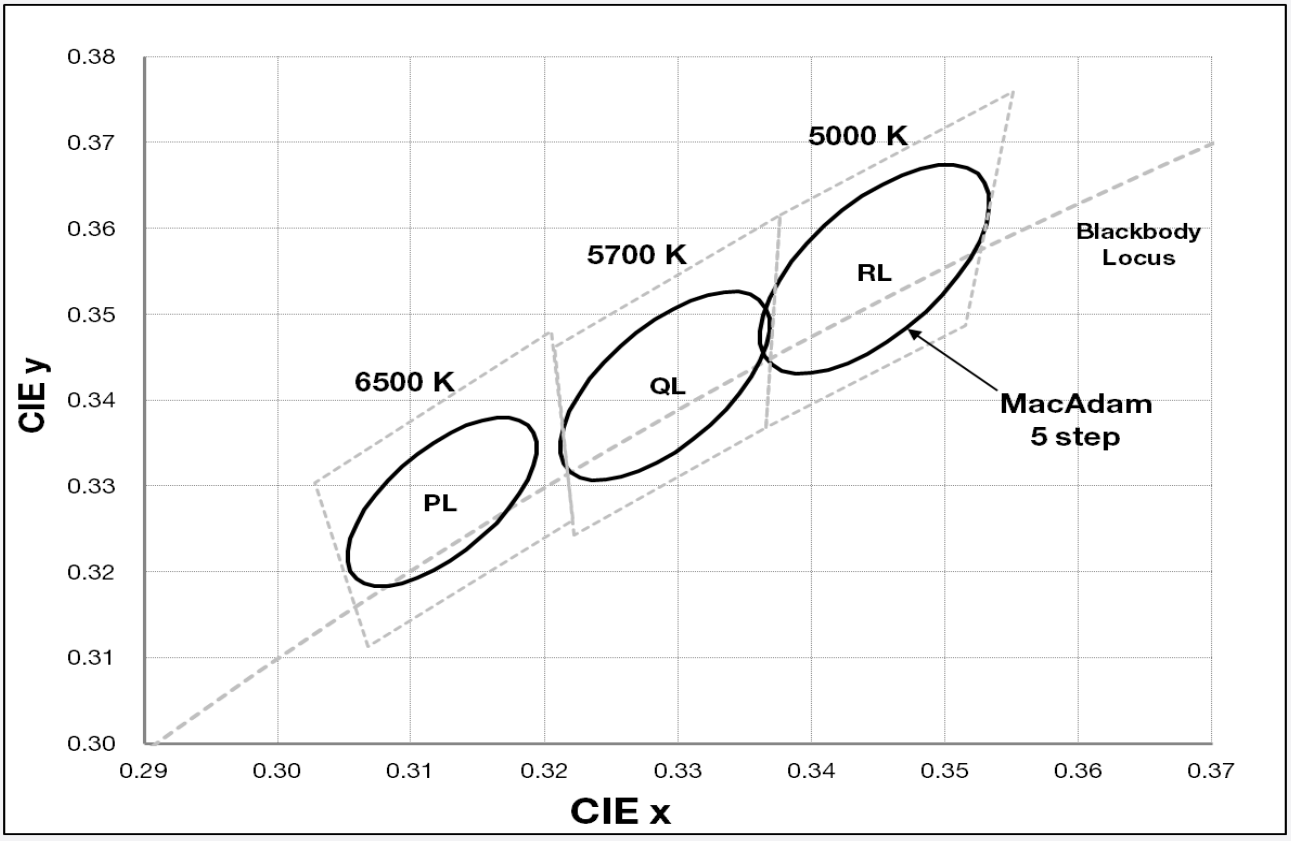
**Note:** “☆” can be “L” (Single bin for MacAdam 5-step), “U” (Single bin for MacAdam 3-step)

## c) Voltage Bins ($I_F$ = 150 mA, $T_S$ = 85 ºC)

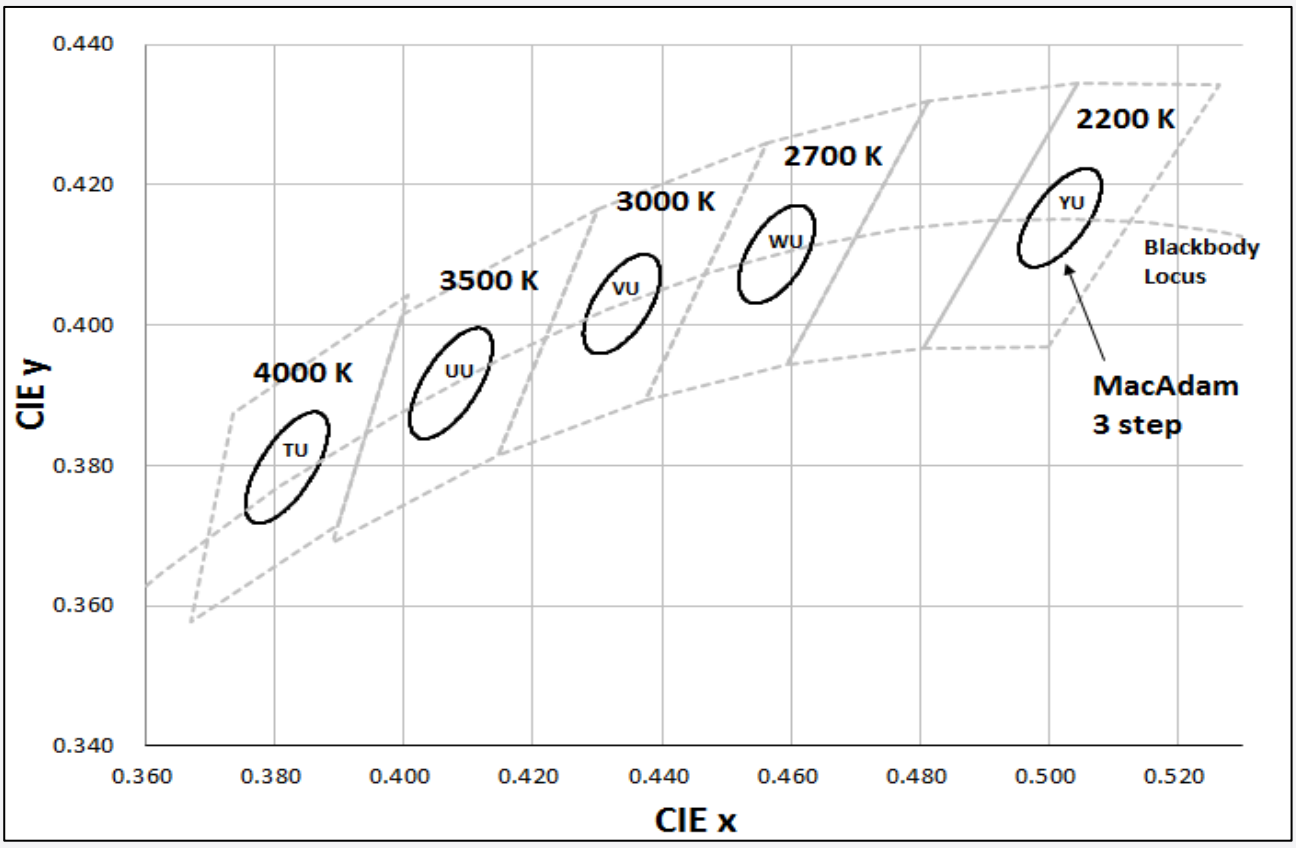
| Nominal CCT (K) | CRI Min. | Product Code | Voltage Rank | Voltage Bin | Voltage Range (V) |
|---|---|---|---|---|---|
| | | | 6E | 6A | 2.7 ~ 2.9 |
| | | | | AE | 2.9 ~ 3.1 |

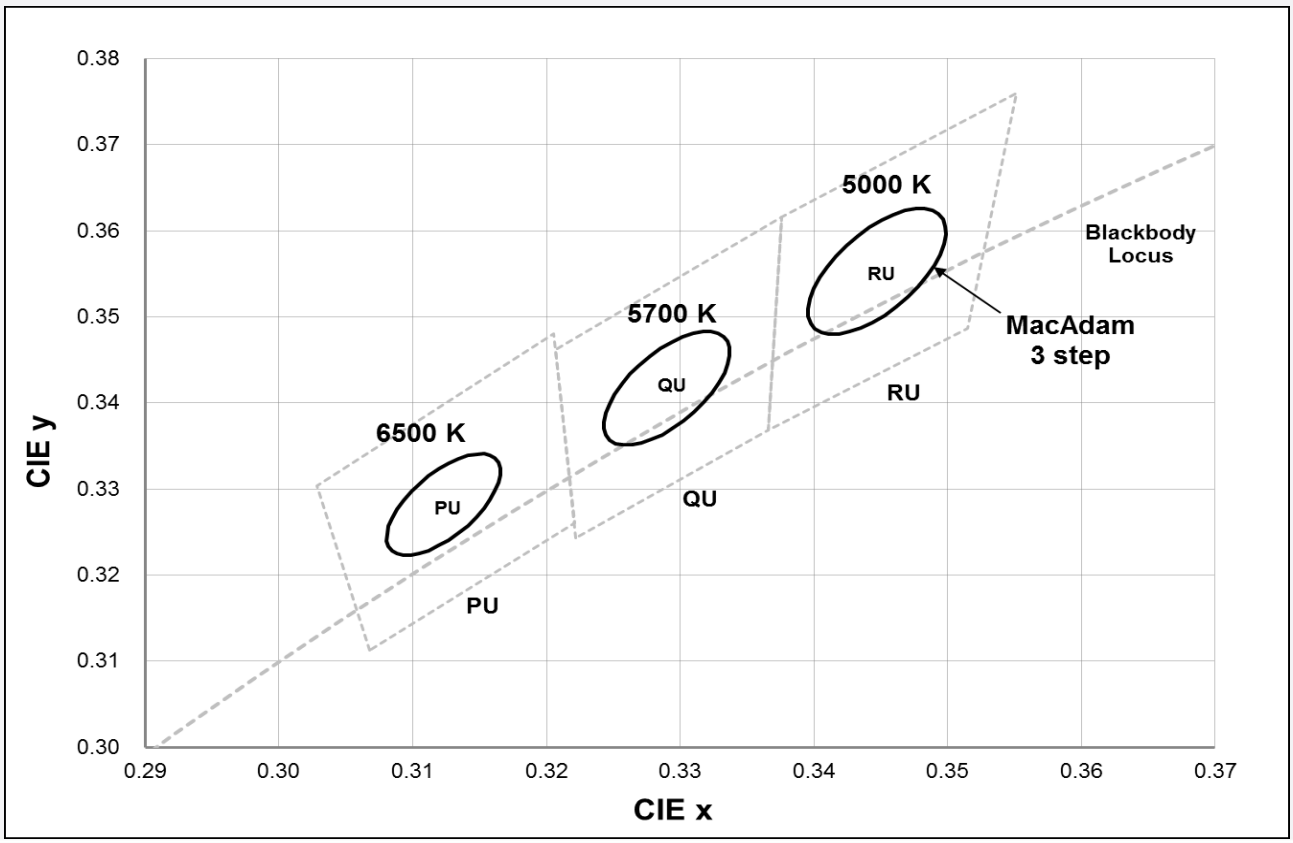
## d) Chromaticity Region & Coordinates ($I_F$ = 150 mA, $T_S$ = 85 ºC) : "L" (Single bin for MacAdam 5-step)



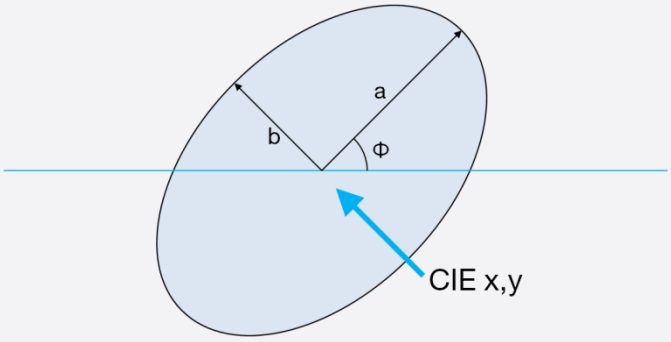



## d) Chromaticity Region & Coordinates ($I_F$ = 150 mA, $T_S$ = 85 ºC) : "U" (Single bin for MacAdam 3-step)



## d) Chromaticity Region & Coordinates ($I_F$ = 150 mA, $T_S$ = 85 °C)



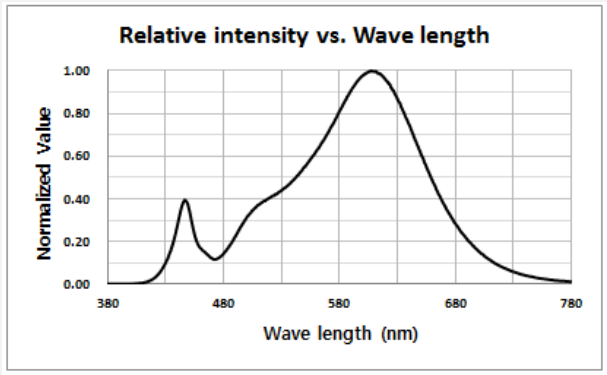

| | CCT (K) | Center point | | Major-axis | Minor-axis | Rotation |
|---|---|---|---|---|---|---|
| | | CIE x | CIE y | a | b | Φ |
| 3 step (U code) | 2200 | 0.5018 | 0.4153 | 0.0086 | 0.0040 | 49.27 |
| | 2700 | 0.4578 | 0.4101 | 0.0081 | 0.0042 | 53.70 |
| | 3000 | 0.4338 | 0.4030 | 0.0083 | 0.0041 | 53.22 |
| | 3500 | 0.4073 | 0.3917 | 0.0093 | 0.0041 | 54.00 |
| | 4000 | 0.3818 | 0.3797 | 0.0094 | 0.0040 | 53.72 |
| | 5000 | 0.3447 | 0.3553 | 0.0082 | 0.0035 | 59.62 |
| | 5700 | 0.3287 | 0.3417 | 0.0075 | 0.0032 | 59.10 |
| | 6500 | 0.3123 | 0.3282 | 0.0067 | 0.0029 | 58.57 |
| 5 step (L code) | 2200 | 0.5018 | 0.4153 | 0.0144 | 0.0066 | 49.27 |
| | 2700 | 0.4578 | 0.4101 | 0.0135 | 0.0070 | 53.70 |
| | 3000 | 0.4338 | 0.4030 | 0.0138 | 0.0068 | 53.22 |
| | 3500 | 0.4073 | 0.3917 | 0.0155 | 0.0068 | 54.00 |
| | 4000 | 0.3818 | 0.3797 | 0.0157 | 0.0067 | 53.72 |
| | 5000 | 0.3447 | 0.3553 | 0.0137 | 0.0058 | 59.62 |
| | 5700 | 0.3287 | 0.3417 | 0.0125 | 0.0053 | 59.10 |
| | 6500 | 0.3123 | 0.3282 | 0.0112 | 0.0048 | 58.57 |

**Note:** Samsung maintains measurement tolerance of: Cx, Cy = ±0.005

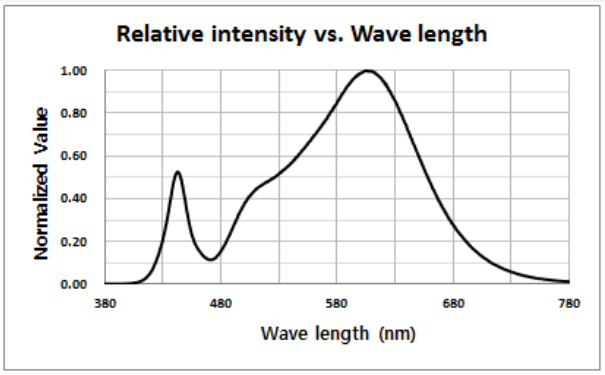
# 3. Typical Characteristics Graphs

## a) Spectrum Distribution ($I_F$ = 150 mA, $T_S$ = 25 ºC)

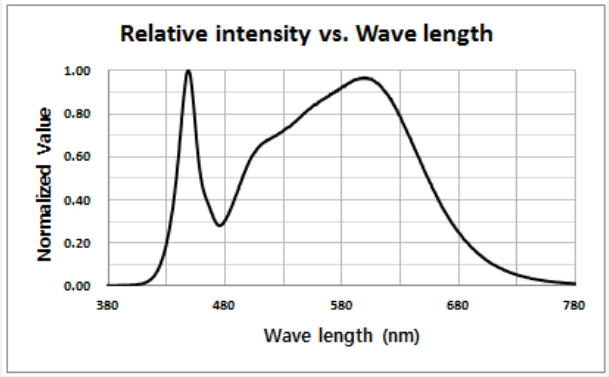
*CCT: 2700 K*



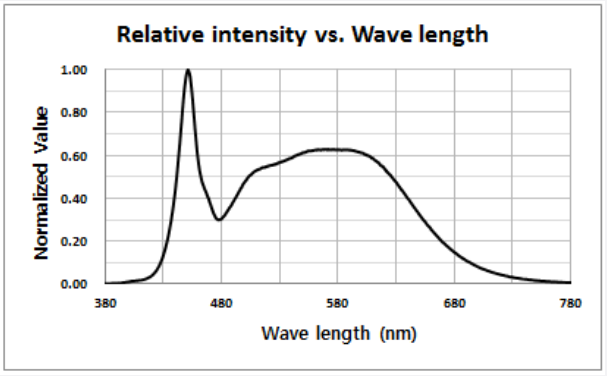

*CCT: 3000 K*



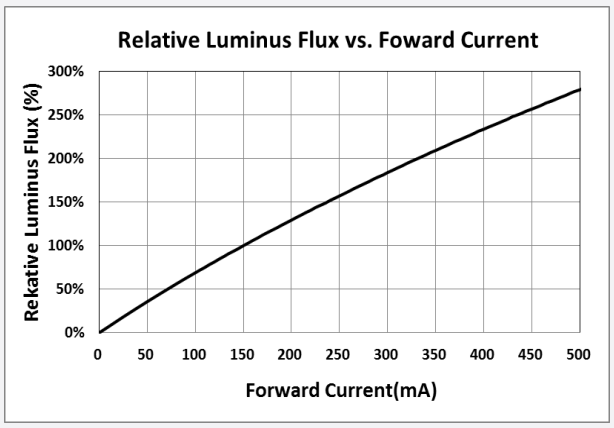

*CCT: 4000 K*

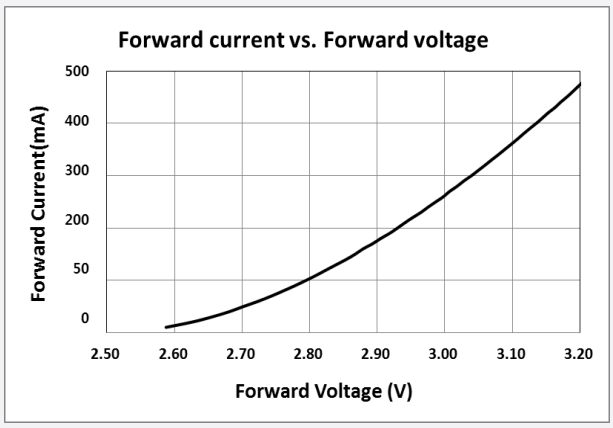



*CCT: 5000 K*

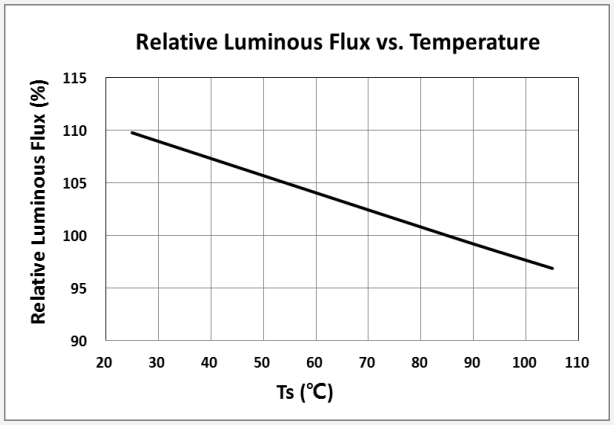


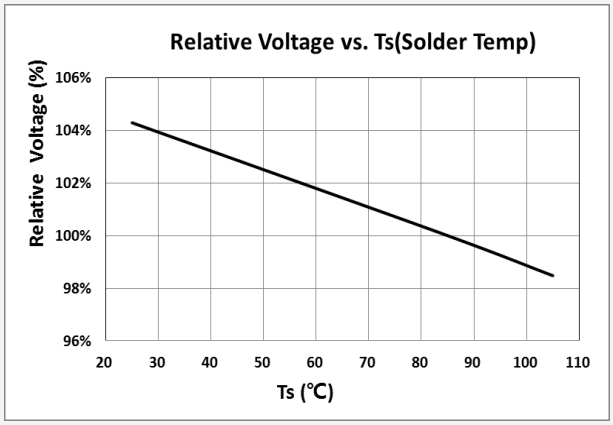

## b) Forward Current Characteristics ($T_S$ = 25 ºC)



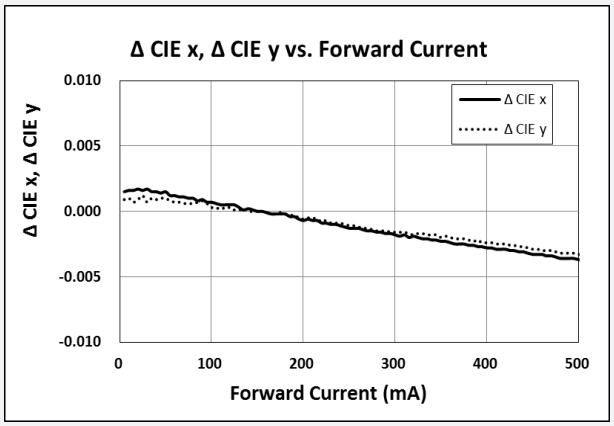



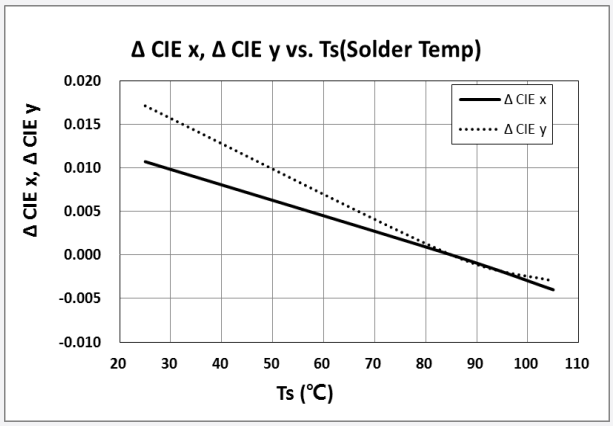
## c) Temperature Characteristics ($I_F$ = 150 mA)



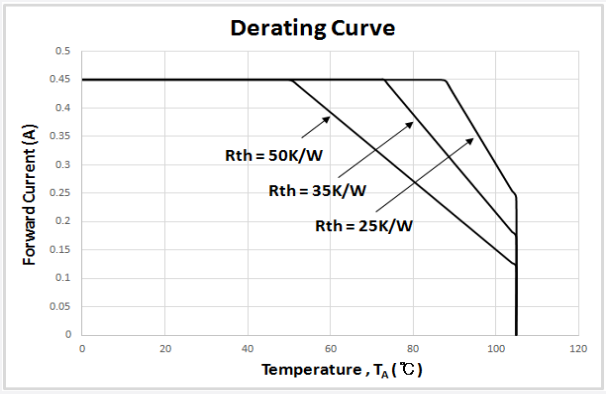




## d) Color Shift Characteristics ($T_S$ = 25 ºC, $I_F$ = 150 mA)



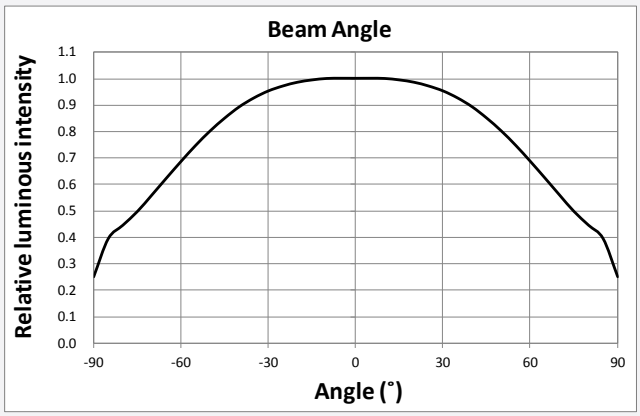

## e) Derating Curve




$R_{th}$ is measured after soldering of LED chip on the metal based substrate.

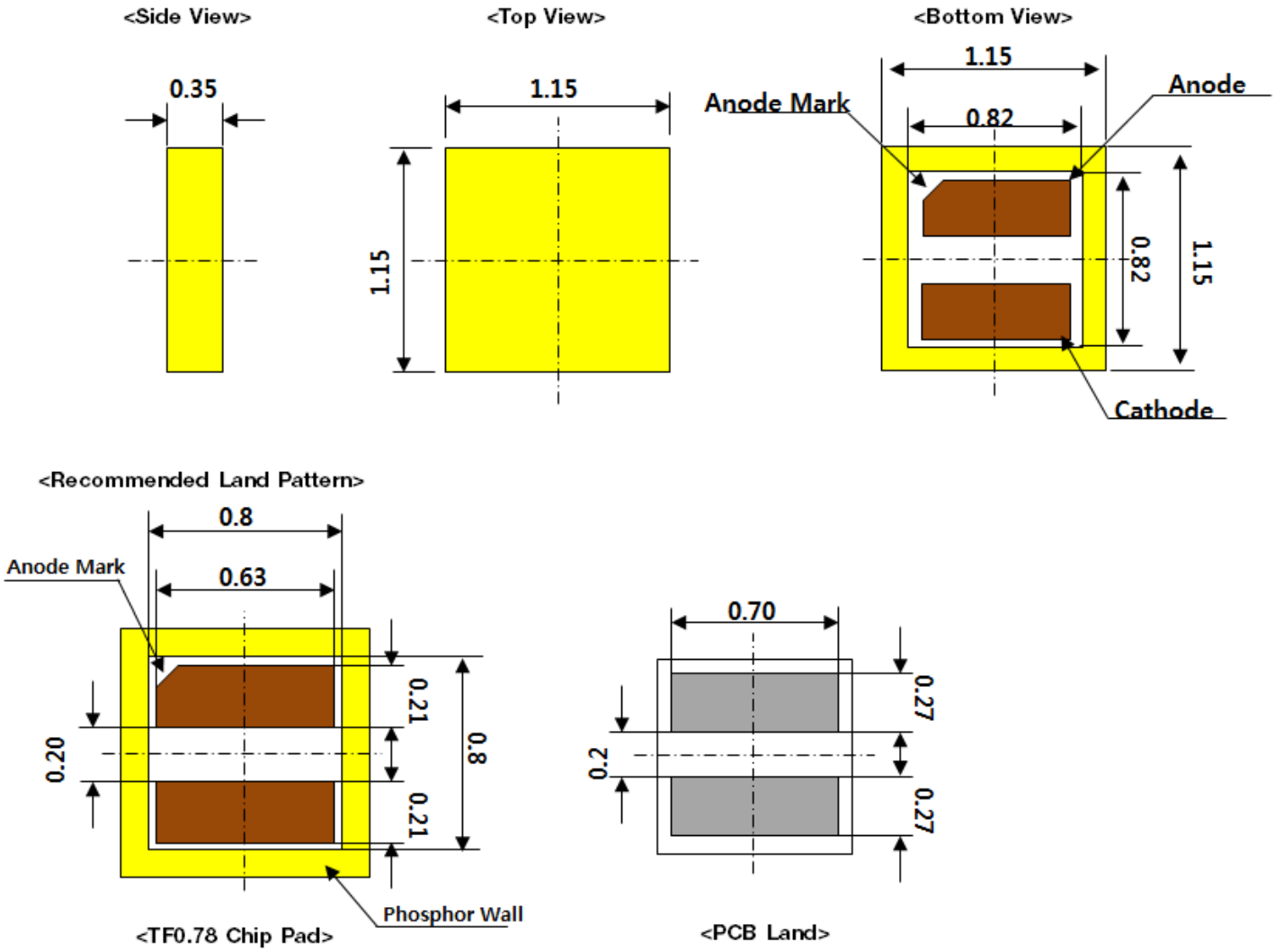
*metal: aluminum (refer to page 17)

## f) Beam Angle Characteristics ($I_F$ = 150 mA)



## 4. Outline Drawing & Dimension

1. Tolerance is ±0.10 mm
2. Do not place LEDs with pressure

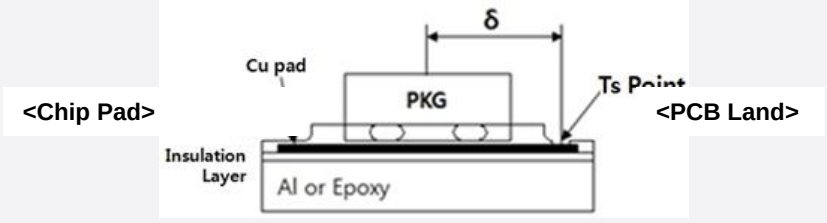



**$T_S$ Point & Measurement Method:**

Measure nearest point from the center of LED chip (δ) as shown below.

Distance between chip center and $T_S$ point (δ) = 3.5 mm

$T_J = T_S$ + Power x Thermal resistance at $T_S$ ($R_{J-S}$)

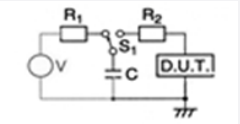


**Precautions:**

1) This LED chip PKG does not contain built-in ESD protection device.
2) Pressure on the LEDs will influence to the reliability of the LEDs. Precautions should be taken to avoid strong pressure on the LEDs. Do not put stress on the LEDs during heating.
3) Re-soldering should not be done after the LEDs have been soldered. If re-soldering is unavoidable, LED`s characteristics should be carefully checked before and after such repair.
4) Do not stack assembled PCBs together. Since materials of LEDs is soft, abrasion between two PCB assembled with LED might cause catastrophic failure of the LEDs.

## 5. Reliability Test Items & Conditions

### a) Test Items

| Test Item | Test Condition | Test Hour / Cycle | Sample Size |
|---|---|---|---|
| MSL Test | 125 ºC 24 h drying → 60 ºC, 60 % RH 120 h → 260 ºC 10 sec 3 cycles | 1 cycle | 11 |
| Room Temperature Life Test | 25 ºC, Derated max current | 1000 h | 22 |
| High Temperature Life Test | 85 ºC, Derated max current | 1000 h | 22 |
| High Temperature Humidity Life Test | 85 ºC, 85 % RH, Derated max current | 1000 h | 22 |
| Low Temperature Life Test | -40 ºC, DC Derated max current | 1000 h | 22 |
| Powered Temperature Cycle Test | -45 ºC / 20 min ↔ 85 ºC / 20 min, sweep 100 min cycle on/off: each 5 min, Derated max current | 100 cycles | 22 |
| Thermal Shock | -45 ºC / 15 min ↔ 125 ºC / 15 min → Hot plate 180 ºC | 800 cycles | 100 |
| High Temperature Storage | 120 ºC | 1000 h | 11 |
| Low Temperature Storage | -40 ºC | 1000 h | 11 |
| ESD (HBM) |   $R_1$: 10 MΩ<br>$R_2$: 1.5 kΩ<br>C: 100 pF<br>V: ±5 kV | 5 times | 5 |
| Vibration Test | 20~2000~20 Hz, 200 m/s$^2$, sweep 4 min X, Y, Z 3 direction, each 1 cycle | 4 cycles | 11 |
| Mechanical Shock Test | 1500 g, 0.5 ms | 5 cycles | 11 |

### b) Criteria for Judging the Damage

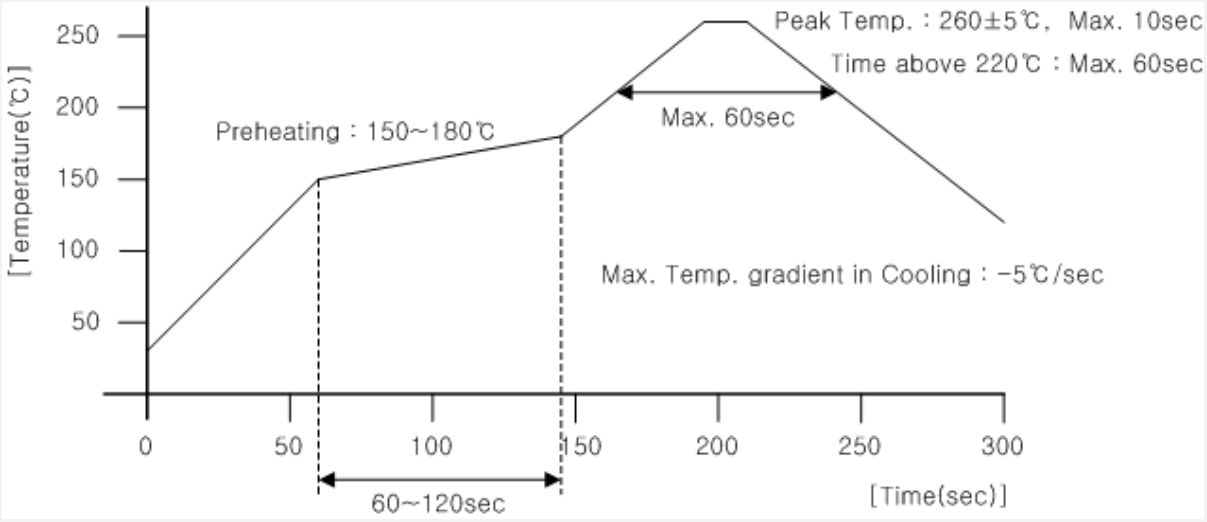
| Item | Symbol | Test Condition ($T_s$ = 25 ºC) | Limit | |
|---|---|---|---|---|
| | | | Min | Max |
| Forward Voltage | $V_F$ | $I_F$ = Derated max current | Init. Value * 0.9 | Init. Value * 1.1 |
| Luminous Flux | $\Phi_v$ | $I_F$ = Derated max current | Init. Value * 0.7 | Init. Value * 1.1 |

SAMSUNG

## 6. Soldering Conditions

### a) Reflow Conditions (Pb free)

Reflow frequency: 2 times max.



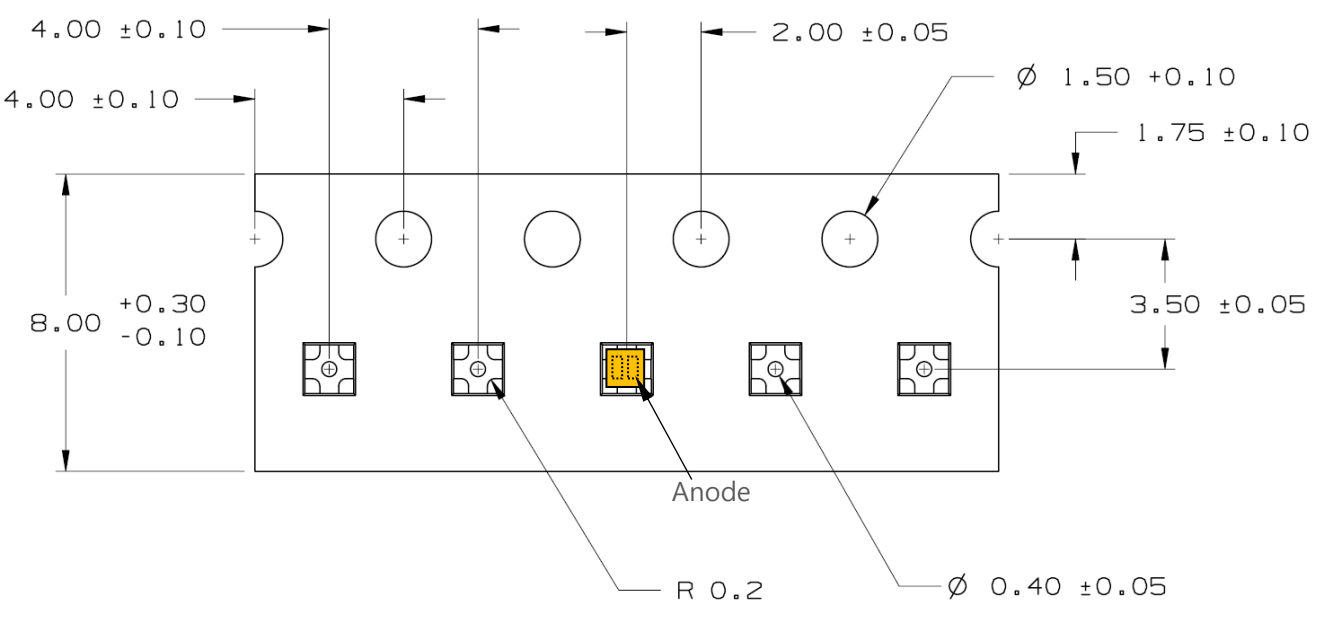

### b) Manual Soldering Conditions

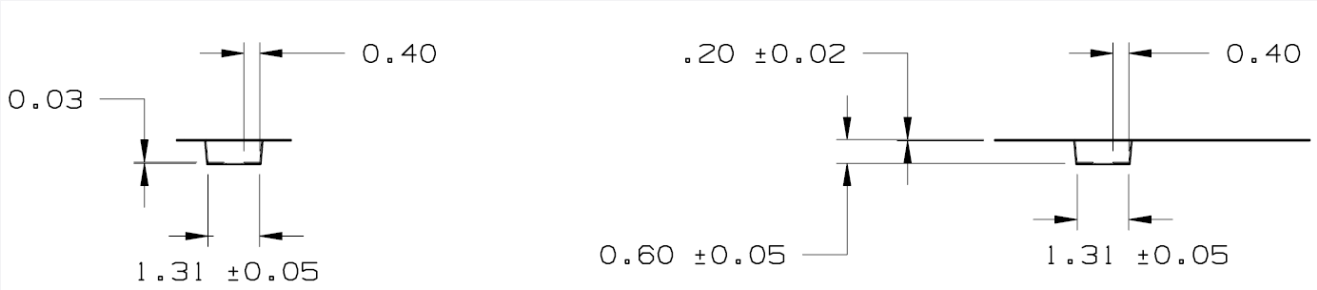
Not more than 5 seconds @ max. 300 ºC, under soldering iron

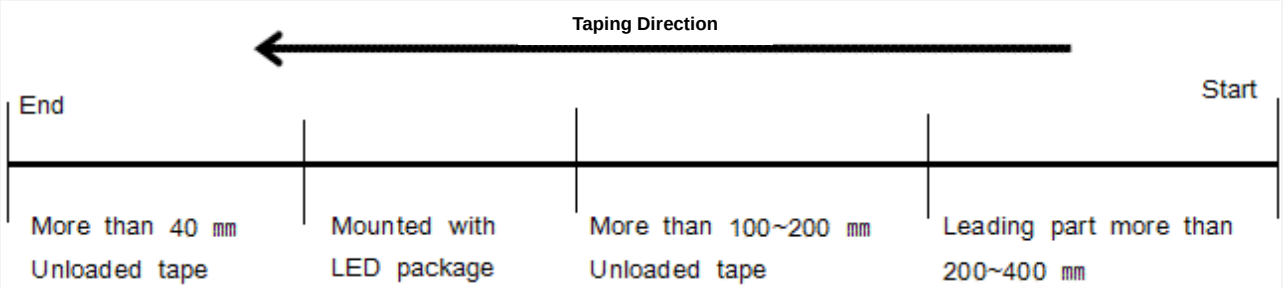
## 7. Tape & Reel

### a) Taping Dimension

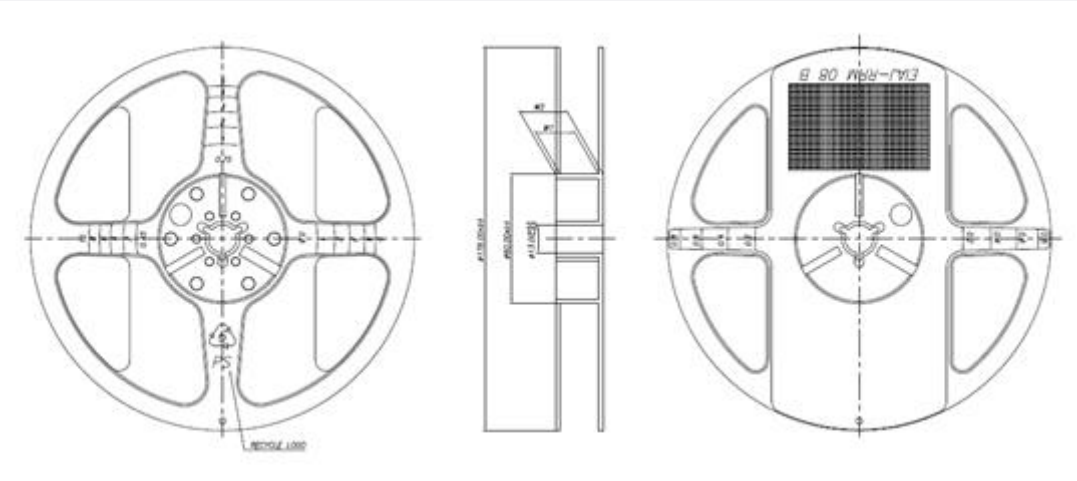
(unit: mm)



## b) Reel Dimension



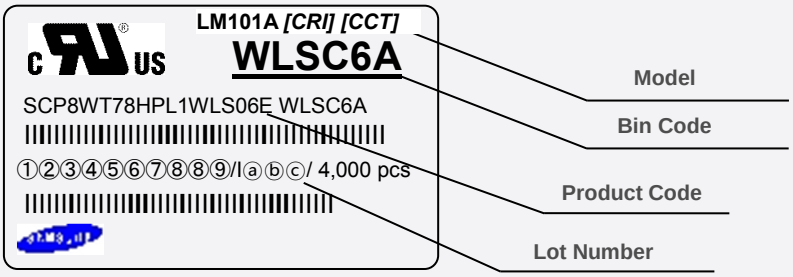
| Width | W1 | W2 |
|---|---|---|
| 8mm | 9 ±0.3 | 11.9 ±1.0 |

**Notes:**

1) Quantity: The quantity/reel is 4,000 pcs
2) Cumulative Tolerance: Cumulative tolerance / 10 pitches is ±0.2 mm
3) Packaging: P/N, Manufacturing data code no. and quantity are indicated on the aluminum packing bag

## 8. Label Structure

### a) Label Structure




Note: Denoted product code and bin code above is only an example

Bin Code:

ⓐⓑ: Chromaticity bin (refer to page 10-14)

ⓒⓓ: Luminous Flux bin (refer to page 7-9)

ⓔⓕ: Forward Voltage bin (refer to page 11)

### b) Lot Number

The lot number is composed of the following characters:


①②③④⑤⑥⑦⑧⑨ / Ⅰⓐⓑⓒ / 4,000 pcs

①② : Production site (G3: Shenzhen China, G4: Guangzhou China, GB: Nanchang China)

③ : Product state (A: Normal, B: Bulk, C: First Production, R: Reproduction, S: Sample)

④ : Year (Y: 2014, Z: 2015, A: 2016 …)

⑤ : Month (1~9, A, B, C)

⑥ : Day (1~9, A, B~V)

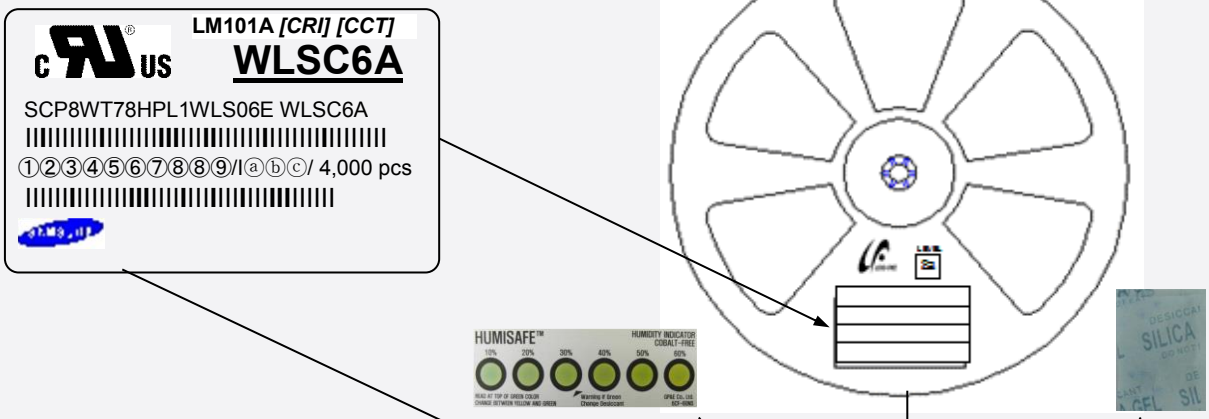
⑦⑧⑨ : Product serial number (001 ~ 999)

ⓐⓑⓒ : Reel number (001 ~ 999) or (AAA ~ ZZZ)

# 9. Packing Structure

## a) Packing Process

**Reel**



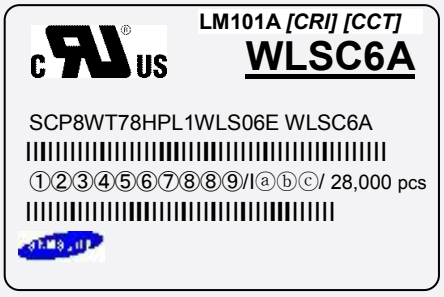

**Aluminum Vinyl Bag**

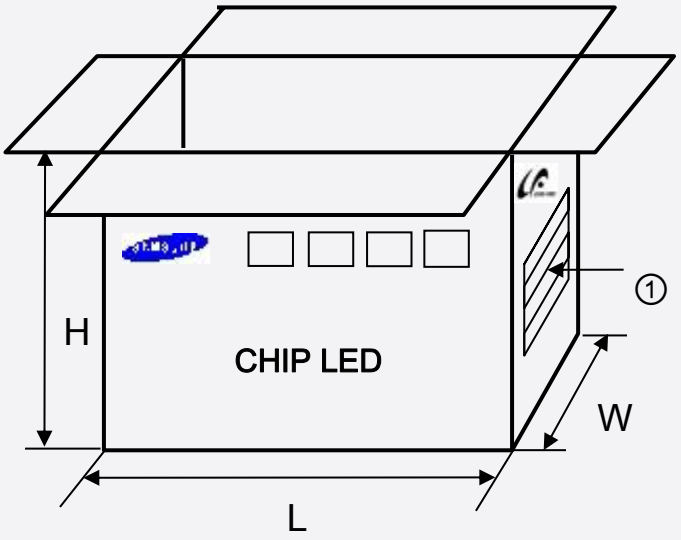
**Outer Box**

Material: Paper (SW3B(A))

| Type | Size (mm) | | | Note |
|---|---|---|---|---|
| | L | W | H | |
| 7 inch | 245 ± 5 | 220 ± 5 | 86 ± 5 | Up to 7 reels max. |

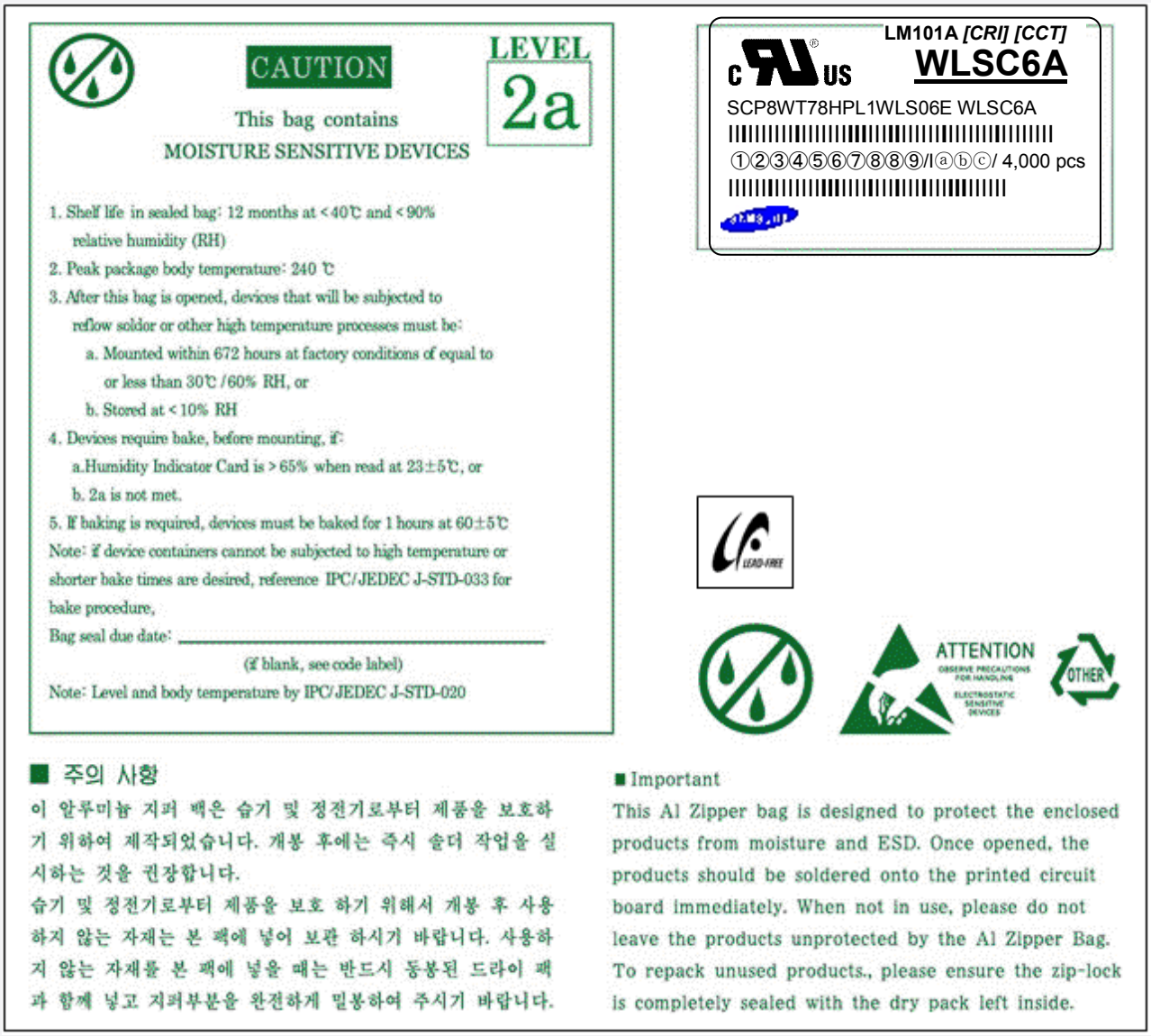
① **Side Label**




SAMSUNG

## b) Aluminum Vinyl Packing Bag




## c) Silica Gel & Humidity Indicator Card inside Aluminum Vinyl Bag


## 10. Precautions in Handling & Use

1) For over-current-proof function, customers are recommended to apply resistors to prevent sudden change of the current caused by slight shift of the voltage.
2) This device should not be used in any type of fluid such as water, oil, organic solvent, etc. When washing is required, IPA is recommended to use.
3) When the LEDs illuminate, operating current should be decided after considering the ambient maximum temperature.
4) LEDs must be stored in a clean environment. If the LEDs are to be stored for three months or more after being shipped from Samsung, they should be packed by a sealed container with nitrogen gas injected (shelf life of sealed bags: 12 months, temperature ~40 ºC, ~90 % RH).
5) After storage bag is opened, device subjected to soldering, solder reflow, or other high temperature processes must be:
   a. Mounted within 672 hours (28 days) at an assembly line with a condition of no more than 30 ºC / 60 % RH, or
   b. Stored at <10 % RH
6) Repack unused products with anti-moisture packing, fold to close any opening and then store in a dry place.
7) Devices require baking before mounting, if humidity card reading is >60 % at 23 ± 5 ºC.
8) Devices must be baked for 1 hour at 60 ± 5 ºC, if baking is required.
9) The LEDs are sensitive to the static electricity and surge. It is recommended to use a wrist band or anti-electrostatic glove when handling the LEDs. If voltage exceeding the absolute maximum rating is applied to LEDs, it may cause damage or even destruction to LED devices. Damaged LEDs may show some unusual characteristics such as increase in leak current, lowered turn-on voltage, or abnormal lighting of LEDs at low current.
10) VoCs (Volatile Organic Compounds) can be generated from adhesives, flux, hardener or organic additives used in luminaires (fixtures). LED silicone encapsulant is permeable to those chemicals and they may lead to a discoloration of encapsulant when they exposed to heat or light. This phenomenon can cause a significant loss of light emitted (output) from the luminaires. In order to prevent these problems, we recommend users to know the physical properties of materials used in luminaires and they must be carefully selected.
11) Risk of sulfurization (or tarnishing)

    The LED from Samsung does not use a silver-plated lead frame but if the LED is attached in silver-plated substrate, the surface color of substrate may change to black (or dark colored) when it is exposed to sulfur (S), chlorine (Cl) or other halogen compound. Sulfurization of substrate may cause intensity degradation, change of chromaticity coordinates and, in extreme cases, open circuit, It requires caution. Due to possible sulfurization of substrate, LED should not be used and stored together with oxidizing substances made of materials such as rubber, plain paper, lead solder cream, etc.

# Legal and additional information.

## About Samsung Electronics Co., Ltd.

Samsung inspires the world and shapes the future with transformative ideas and technologies. The company is redefining the worlds of TVs, smartphones, wearable devices, tablets, digital appliances, network systems, and memory, system LSI, foundry and LED solutions. For the latest news, please visit the Samsung Newsroom at news.samsung.com.
US$216.7 billion. To discover more, please visit www.samsungled.com.



Samsung Electronics Co., Ltd.
95, Samsung 2-ro
Giheung-gu
Yongin-si, Gyeonggi-do, 446-711
KOREA

www.samsungled.com

SAMSUNG