

# LM561B – 5630 Middle Power LED



## Introduction

### Features

- Beam Angle: 120°
- Precondition : JEDEC Level 2a
- Dimension : 5.6 x 3.0 x 0.8 mm
- ESD withstand Voltage : up to  $\pm 5\text{KV}$  [HBM]

## SAMSUNG ELECTRONICS

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# 1. Product Code Information

## 1) Luminous Flux Bins ( $T_s = 25^\circ\text{C}$ )

| Nominal CCT | Product Code       | Flux Rank | Sorting Condition $I_m$ @65mA |
|-------------|--------------------|-----------|-------------------------------|
|             |                    |           | Flux Range ( $\Phi_v, I_m$ )  |
| 2700K       | SPMWH◆541MD5WAW☆S1 | S1        | 24.0 ~ 26.0                   |
|             | SPMWH◆541MD5WAW☆S2 | S2        | 26.0 ~ 28.0                   |
|             | SPMWH◆541MD5WAW☆S3 | S3        | 28.0 ~ 30.0                   |
| 3000K       | SPMWH◆541MD5WAV☆S1 | S1        | 24.5 ~ 26.5                   |
|             | SPMWH◆541MD5WAV☆S2 | S2        | 26.5 ~ 28.5                   |
|             | SPMWH◆541MD5WAV☆S3 | S3        | 28.5 ~ 30.5                   |
| 3500K       | SPMWH◆541MD5WAU☆S1 | S1        | 25.0 ~ 27.0                   |
|             | SPMWH◆541MD5WAU☆S2 | S2        | 27.0 ~ 29.0                   |
|             | SPMWH◆541MD5WAU☆S3 | S3        | 29.0 ~ 31.0                   |
| 4000K       | SPMWH◆541MD5WAT☆S1 | S1        | 26.0 ~ 28.0                   |
|             | SPMWH◆541MD5WAT☆S2 | S2        | 28.0 ~ 30.0                   |
|             | SPMWH◆541MD5WAT☆S3 | S3        | 30.0 ~ 32.0                   |
| 5000K       | SPMWH◆541MD5WAR☆S1 | S1        | 27.0 ~ 29.0                   |
|             | SPMWH◆541MD5WAR☆S2 | S2        | 29.0 ~ 31.0                   |
|             | SPMWH◆541MD5WAR☆S3 | S3        | 31.0 ~ 33.0                   |
| 5700K       | SPMWH◆541MD5WAQ☆S1 | S1        | 26.5 ~ 28.5                   |
|             | SPMWH◆541MD5WAQ☆S2 | S2        | 28.5 ~ 30.5                   |
|             | SPMWH◆541MD5WAQ☆S3 | S3        | 30.5 ~ 32.5                   |
| 6500K       | SPMWH◆541MD5WAP☆S1 | S1        | 26.0 ~ 28.0                   |
|             | SPMWH◆541MD5WAP☆S2 | S2        | 28.0 ~ 30.0                   |
|             | SPMWH◆541MD5WAP☆S3 | S3        | 30.0 ~ 32.0                   |

### Notes:

- 1)SAMSUNG ELECTRONICS maintains a tolerance of  $\pm 5\%$  on Luminous Flux measurements.
- 2)"◆" (the quantity of PKG on the Reel) can be "T"(2,500pcs) or "1"(10,000pcs).
- 3)Warm white : "☆" can be "0"(Whole Bin), "H"(Half Bin) or "M"(Quarter Bin) of the color binning.  
Cool white : "☆" can be "0"(Whole Bin) or "M"(Quarter Bin) of the color binning.

## 2) Color Bins ( $T_s = 25^\circ\text{C}$ )

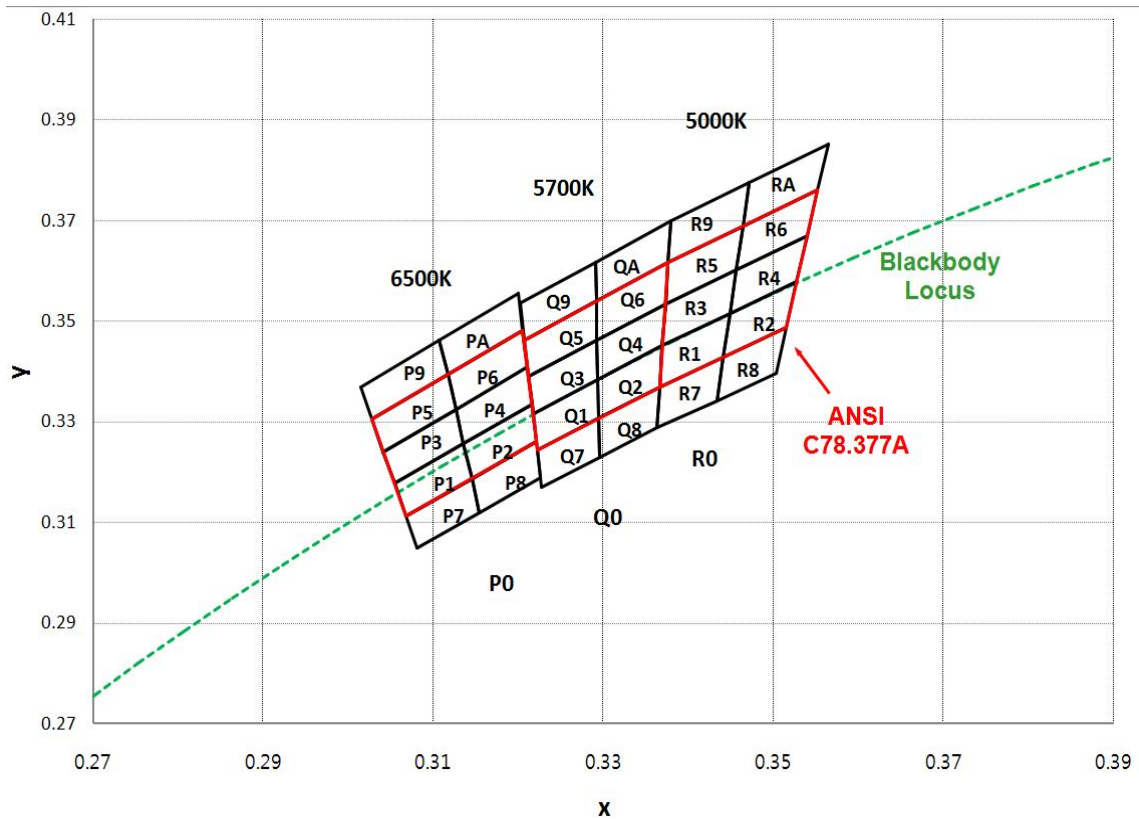
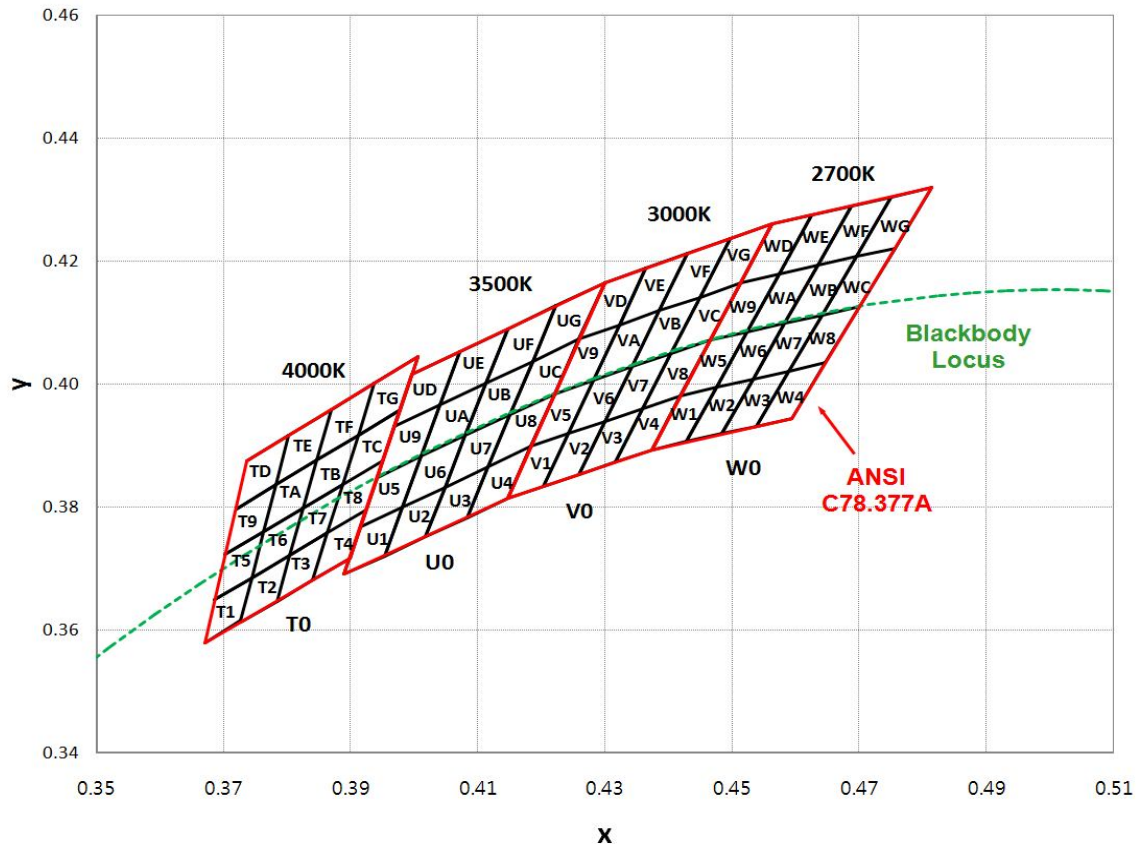
### 1) Color Binning

| Nominal CCT | Product Code                                                   | Color Rank      | Chromaticity Bins                                              |
|-------------|----------------------------------------------------------------|-----------------|----------------------------------------------------------------|
| 2700K       | SPMWH◆541MD5WAW0S1<br>SPMWH◆541MD5WAW0S2<br>SPMWH◆541MD5WAW0S3 | W0(Whole bin)   | W1, W2, W3, W4, W5, W6, W7, W8, W9, WA, WB, WC, WD, WE, WF, WG |
|             | SPMWH◆541MD5WAWHS1<br>SPMWH◆541MD5WAWHS2<br>SPMWH◆541MD5WAWHS3 | WH(Half bin)    | W5, W6, W7, W8, W9, WA, WB, WC                                 |
|             | SPMWH◆541MD5WAWMS1<br>SPMWH◆541MD5WAWMS2<br>SPMWH◆541MD5WAWMS3 | WM(Quarter bin) | W6, W7, WA, WB                                                 |
| 3000K       | SPMWH◆541MD5WAV0S1<br>SPMWH◆541MD5WAV0S2<br>SPMWH◆541MD5WAV0S3 | V0(Whole bin)   | V1, V2, V3, V4, V5, V6, V7, V8, V9, VA, VB, VC, VD, VE, VF, VG |
|             | SPMWH◆541MD5WAVHS1<br>SPMWH◆541MD5WAVHS2<br>SPMWH◆541MD5WAVHS3 | VH(Half bin)    | V5, V6, V7, V8, V9, VA, VB, VC                                 |
|             | SPMWH◆541MD5WAVMS1<br>SPMWH◆541MD5WAVMS2<br>SPMWH◆541MD5WAVMS3 | VM(Quarter bin) | V6, V7, VA, VB                                                 |
| 3500K       | SPMWH◆541MD5WAU0S1<br>SPMWH◆541MD5WAU0S2<br>SPMWH◆541MD5WAU0S3 | U0(Whole bin)   | U1, U2, U3, U4, U5, U6, U7, U8, U9, UA, UB, UC, UD, UE, UF, UG |
|             | SPMWH◆541MD5WAUHS1<br>SPMWH◆541MD5WAUHS2<br>SPMWH◆541MD5WAUHS3 | UH(Half bin)    | U5, U6, U7, U8, U9, UA, UB, UC                                 |
|             | SPMWH◆541MD5WAUMS1<br>SPMWH◆541MD5WAUMS2<br>SPMWH◆541MD5WAUMS3 | UM(Quarter bin) | U6, U7, UA, UB                                                 |

## 1) Color Binning (Continued)

| Nominal CCT | Product Code                                                   | Color Rank      | Chromaticity Bins                                                 |
|-------------|----------------------------------------------------------------|-----------------|-------------------------------------------------------------------|
| 4000K       | SPMWH◆541MD5WAT0S1<br>SPMWH◆541MD5WAT0S2<br>SPMWH◆541MD5WAT0S3 | T0(Whole bin)   | T1, T2, T3, T4, T5, T6, T7, T8,<br>T9, TA, TB, TC, TD, TE, TF, TG |
|             | SPMWH◆541MD5WATHS1<br>SPMWH◆541MD5WATHS2<br>SPMWH◆541MD5WATHS3 | TH(Half bin)    | T5, T6, T7, T8, T9, TA, TB, TC                                    |
|             | SPMWH◆541MD5WATMS1<br>SPMWH◆541MD5WATMS2<br>SPMWH◆541MD5WATMS3 | TM(Quarter bin) | T6, T7, TA, TB                                                    |
| 5000K       | SPMWH◆541MD5WAR0S1<br>SPMWH◆541MD5WAR0S2<br>SPMWH◆541MD5WAR0S3 | R0(Whole bin)   | R1, R2, R3, R4, R5<br>R6, R7, R8, R9 ,RA                          |
|             | SPMWH◆541MD5WARMS1<br>SPMWH◆541MD5WARMS2<br>SPMWH◆541MD5WARMS3 | RM(Quarter bin) | R1, R2, R3, R4, R5, R6                                            |
| 5700K       | SPMWH◆541MD5WAQ0S1<br>SPMWH◆541MD5WAQ0S2<br>SPMWH◆541MD5WAQ0S3 | Q0(Whole bin)   | Q1, Q2, Q3, Q4, Q5<br>Q6, Q7, Q8, Q9, QA                          |
|             | SPMWH◆541MD5WAQMS1<br>SPMWH◆541MD5WAQMS2<br>SPMWH◆541MD5WAQMS3 | QM(Quarter bin) | Q1, Q2, Q3, Q4, Q5, Q6                                            |
| 6500K       | SPMWH◆541MD5WAP0S1<br>SPMWH◆541MD5WAP0S2<br>SPMWH◆541MD5WAP0S3 | P0(Whole bin)   | P1, P2, P3, P4, P5<br>P6, P7, P8, P9, PA                          |
|             | SPMWH◆541MD5WAPMS1<br>SPMWH◆541MD5WAPMS2<br>SPMWH◆541MD5WAPMS3 | PM(Quarter bin) | P1, P2, P3, P4, P5, P6                                            |

## 2) Chromaticity Region & Coordinates



## 2) Chromaticity Region & Coordinates (Continued)

| Region         | CIE X  | CIE Y  | Region | CIE X  | CIE Y  |
|----------------|--------|--------|--------|--------|--------|
| W rank (2700K) |        |        |        |        |        |
| W1             | 0.4373 | 0.3893 | W9     | 0.4465 | 0.4071 |
|                | 0.4418 | 0.3981 |        | 0.4513 | 0.4164 |
|                | 0.4475 | 0.3994 |        | 0.4573 | 0.4178 |
|                | 0.4428 | 0.3906 |        | 0.4523 | 0.4085 |
| W2             | 0.4428 | 0.3906 | WA     | 0.4523 | 0.4085 |
|                | 0.4475 | 0.3994 |        | 0.4573 | 0.4178 |
|                | 0.4532 | 0.4008 |        | 0.4634 | 0.4193 |
|                | 0.4483 | 0.3919 |        | 0.4582 | 0.4099 |
| W3             | 0.4483 | 0.3919 | WB     | 0.4582 | 0.4099 |
|                | 0.4532 | 0.4008 |        | 0.4634 | 0.4193 |
|                | 0.4589 | 0.4021 |        | 0.4695 | 0.4207 |
|                | 0.4538 | 0.3931 |        | 0.4641 | 0.4112 |
| W4             | 0.4538 | 0.3931 | WC     | 0.4641 | 0.4112 |
|                | 0.4589 | 0.4021 |        | 0.4695 | 0.4207 |
|                | 0.4646 | 0.4034 |        | 0.4756 | 0.4221 |
|                | 0.4593 | 0.3944 |        | 0.4700 | 0.4126 |
| W5             | 0.4418 | 0.3981 | WD     | 0.4513 | 0.4164 |
|                | 0.4465 | 0.4071 |        | 0.4562 | 0.4260 |
|                | 0.4523 | 0.4085 |        | 0.4624 | 0.4274 |
|                | 0.4475 | 0.3994 |        | 0.4573 | 0.4178 |
| W6             | 0.4475 | 0.3994 | WE     | 0.4573 | 0.4178 |
|                | 0.4523 | 0.4085 |        | 0.4624 | 0.4274 |
|                | 0.4582 | 0.4099 |        | 0.4687 | 0.4289 |
|                | 0.4532 | 0.4008 |        | 0.4634 | 0.4193 |
| W7             | 0.4532 | 0.4008 | WF     | 0.4634 | 0.4193 |
|                | 0.4582 | 0.4099 |        | 0.4687 | 0.4289 |
|                | 0.4641 | 0.4112 |        | 0.4750 | 0.4304 |
|                | 0.4589 | 0.4021 |        | 0.4695 | 0.4207 |
| W8             | 0.4589 | 0.4021 | WG     | 0.4695 | 0.4207 |
|                | 0.4641 | 0.4112 |        | 0.4750 | 0.4304 |
|                | 0.4700 | 0.4126 |        | 0.4813 | 0.4319 |
|                | 0.4646 | 0.4034 |        | 0.4756 | 0.4221 |

| Region         | CIE X  | CIE Y  | Region | CIE X  | CIE Y  |
|----------------|--------|--------|--------|--------|--------|
| V rank (3000K) |        |        |        |        |        |
| V1             | 0.4147 | 0.3814 | V9     | 0.4221 | 0.3984 |
|                | 0.4183 | 0.3898 |        | 0.4259 | 0.4073 |
|                | 0.4242 | 0.3919 |        | 0.4322 | 0.4096 |
|                | 0.4203 | 0.3833 |        | 0.4281 | 0.4006 |
| V2             | 0.4203 | 0.3833 | VA     | 0.4281 | 0.4006 |
|                | 0.4242 | 0.3919 |        | 0.4322 | 0.4096 |
|                | 0.4300 | 0.3939 |        | 0.4385 | 0.4119 |
|                | 0.4259 | 0.3853 |        | 0.4342 | 0.4028 |
| V3             | 0.4259 | 0.3853 | VB     | 0.4342 | 0.4028 |
|                | 0.4300 | 0.3939 |        | 0.4385 | 0.4119 |
|                | 0.4359 | 0.3960 |        | 0.4449 | 0.4141 |
|                | 0.4316 | 0.3873 |        | 0.4403 | 0.4049 |
| V4             | 0.4316 | 0.3873 | VC     | 0.4403 | 0.4049 |
|                | 0.4359 | 0.3960 |        | 0.4449 | 0.4141 |
|                | 0.4418 | 0.3981 |        | 0.4513 | 0.4164 |
|                | 0.4373 | 0.3893 |        | 0.4465 | 0.4071 |
| V5             | 0.4183 | 0.3898 | VD     | 0.4259 | 0.4073 |
|                | 0.4221 | 0.3984 |        | 0.4299 | 0.4165 |
|                | 0.4281 | 0.4006 |        | 0.4364 | 0.4188 |
|                | 0.4242 | 0.3919 |        | 0.4322 | 0.4096 |
| V6             | 0.4242 | 0.3919 | VE     | 0.4322 | 0.4096 |
|                | 0.4281 | 0.4006 |        | 0.4364 | 0.4188 |
|                | 0.4342 | 0.4028 |        | 0.4430 | 0.4212 |
|                | 0.4300 | 0.3939 |        | 0.4385 | 0.4119 |
| V7             | 0.4300 | 0.3939 | VF     | 0.4385 | 0.4119 |
|                | 0.4342 | 0.4028 |        | 0.4430 | 0.4212 |
|                | 0.4403 | 0.4049 |        | 0.4496 | 0.4236 |
|                | 0.4359 | 0.3960 |        | 0.4449 | 0.4141 |
| V8             | 0.4359 | 0.3960 | VG     | 0.4449 | 0.4141 |
|                | 0.4403 | 0.4049 |        | 0.4496 | 0.4236 |
|                | 0.4465 | 0.4071 |        | 0.4562 | 0.4260 |
|                | 0.4418 | 0.3981 |        | 0.4513 | 0.4164 |

## 2) Chromaticity Region & Coordinates (Continued)

| Region         | CIE X  | CIE Y  | Region | CIE X  | CIE Y  |
|----------------|--------|--------|--------|--------|--------|
| U rank (3500K) |        |        |        |        |        |
| U1             | 0.3889 | 0.3690 | U9     | 0.3941 | 0.3848 |
|                | 0.3915 | 0.3768 |        | 0.3968 | 0.3930 |
|                | 0.3981 | 0.3800 |        | 0.4040 | 0.3966 |
|                | 0.3953 | 0.3720 |        | 0.4010 | 0.3882 |
| U2             | 0.3953 | 0.3720 | UA     | 0.4010 | 0.3882 |
|                | 0.3981 | 0.3800 |        | 0.4040 | 0.3966 |
|                | 0.4048 | 0.3832 |        | 0.4113 | 0.4001 |
|                | 0.4017 | 0.3751 |        | 0.4080 | 0.3916 |
| U3             | 0.4017 | 0.3751 | UB     | 0.4080 | 0.3916 |
|                | 0.4048 | 0.3832 |        | 0.4113 | 0.4001 |
|                | 0.4116 | 0.3865 |        | 0.4186 | 0.4037 |
|                | 0.4082 | 0.3782 |        | 0.4150 | 0.3950 |
| U4             | 0.4082 | 0.3782 | UC     | 0.4150 | 0.3950 |
|                | 0.4116 | 0.3865 |        | 0.4186 | 0.4037 |
|                | 0.4183 | 0.3898 |        | 0.4259 | 0.4073 |
|                | 0.4147 | 0.3814 |        | 0.4221 | 0.3984 |
| U5             | 0.3915 | 0.3768 | UD     | 0.3968 | 0.3930 |
|                | 0.3941 | 0.3848 |        | 0.3996 | 0.4015 |
|                | 0.4010 | 0.3882 |        | 0.4071 | 0.4052 |
|                | 0.3981 | 0.3800 |        | 0.4040 | 0.3966 |
| U6             | 0.3981 | 0.3800 | UE     | 0.4040 | 0.3966 |
|                | 0.4010 | 0.3882 |        | 0.4071 | 0.4052 |
|                | 0.4080 | 0.3916 |        | 0.4146 | 0.4089 |
|                | 0.4048 | 0.3832 |        | 0.4113 | 0.4001 |
| U7             | 0.4048 | 0.3832 | UF     | 0.4113 | 0.4001 |
|                | 0.4080 | 0.3916 |        | 0.4146 | 0.4089 |
|                | 0.4150 | 0.3950 |        | 0.4222 | 0.4127 |
|                | 0.4116 | 0.3865 |        | 0.4186 | 0.4037 |
| U8             | 0.4116 | 0.3865 | UG     | 0.4186 | 0.4037 |
|                | 0.4150 | 0.3950 |        | 0.4222 | 0.4127 |
|                | 0.4221 | 0.3984 |        | 0.4299 | 0.4165 |
|                | 0.4183 | 0.3898 |        | 0.4259 | 0.4073 |

| Region         | CIE X  | CIE Y  | Region | CIE X  | CIE Y  |
|----------------|--------|--------|--------|--------|--------|
| T rank (4000K) |        |        |        |        |        |
| T1             | 0.367  | 0.3578 | T9     | 0.3702 | 0.3722 |
|                | 0.3726 | 0.3612 |        | 0.3763 | 0.376  |
|                | 0.3744 | 0.3685 |        | 0.3782 | 0.3837 |
|                | 0.3686 | 0.3649 |        | 0.3719 | 0.3797 |
| T2             | 0.3726 | 0.3612 | TA     | 0.3763 | 0.3760 |
|                | 0.3783 | 0.3646 |        | 0.3825 | 0.3798 |
|                | 0.3804 | 0.3721 |        | 0.3847 | 0.3877 |
|                | 0.3744 | 0.3685 |        | 0.3782 | 0.3837 |
| T3             | 0.3783 | 0.3646 | TB     | 0.3825 | 0.3798 |
|                | 0.3840 | 0.3681 |        | 0.3887 | 0.3836 |
|                | 0.3863 | 0.3758 |        | 0.3912 | 0.3917 |
|                | 0.3804 | 0.3721 |        | 0.3847 | 0.3877 |
| T4             | 0.384  | 0.3681 | TC     | 0.3887 | 0.3837 |
|                | 0.3898 | 0.3716 |        | 0.395  | 0.3875 |
|                | 0.3924 | 0.3794 |        | 0.3978 | 0.3958 |
|                | 0.3863 | 0.3758 |        | 0.3912 | 0.3917 |
| T5             | 0.3686 | 0.3649 | TD     | 0.3719 | 0.3797 |
|                | 0.3744 | 0.3685 |        | 0.3782 | 0.3837 |
|                | 0.3763 | 0.376  |        | 0.3802 | 0.3916 |
|                | 0.3702 | 0.3722 |        | 0.3736 | 0.3874 |
| T6             | 0.3744 | 0.3685 | TE     | 0.3782 | 0.3837 |
|                | 0.3804 | 0.3721 |        | 0.3847 | 0.3877 |
|                | 0.3825 | 0.3798 |        | 0.3869 | 0.3958 |
|                | 0.3763 | 0.376  |        | 0.3802 | 0.3916 |
| T7             | 0.3804 | 0.3721 | TF     | 0.3847 | 0.3877 |
|                | 0.3863 | 0.3758 |        | 0.3912 | 0.3917 |
|                | 0.3887 | 0.3836 |        | 0.3937 | 0.4001 |
|                | 0.3825 | 0.3798 |        | 0.3869 | 0.3958 |
| T8             | 0.3863 | 0.3758 | TG     | 0.3912 | 0.3917 |
|                | 0.3924 | 0.3794 |        | 0.3978 | 0.3958 |
|                | 0.395  | 0.3875 |        | 0.4006 | 0.4044 |
|                | 0.3887 | 0.3836 |        | 0.3937 | 0.4001 |

## 2) Chromaticity Region & Coordinates (Continued)

| Region         | CIE X  | CIE Y  | Region | CIE X  | CIE Y  |
|----------------|--------|--------|--------|--------|--------|
| R rank (5000K) |        |        |        |        |        |
| R1             | 0.3366 | 0.3369 | R6     | 0.3456 | 0.3601 |
|                | 0.3441 | 0.3428 |        | 0.3539 | 0.3669 |
|                | 0.3449 | 0.3515 |        | 0.3551 | 0.3760 |
|                | 0.3369 | 0.3451 |        | 0.3464 | 0.3688 |
| R2             | 0.3441 | 0.3428 | R7     | 0.3363 | 0.3287 |
|                | 0.3515 | 0.3487 |        | 0.3433 | 0.3341 |
|                | 0.3527 | 0.3578 |        | 0.3441 | 0.3428 |
|                | 0.3449 | 0.3515 |        | 0.3366 | 0.3369 |
| R3             | 0.3369 | 0.3451 | R8     | 0.3433 | 0.3341 |
|                | 0.3449 | 0.3515 |        | 0.3503 | 0.3396 |
|                | 0.3456 | 0.3601 |        | 0.3515 | 0.3487 |
|                | 0.3373 | 0.3534 |        | 0.3441 | 0.3428 |
| R4             | 0.3449 | 0.3515 | R9     | 0.3376 | 0.3616 |
|                | 0.3527 | 0.3578 |        | 0.3464 | 0.3688 |
|                | 0.3539 | 0.3669 |        | 0.3471 | 0.3775 |
|                | 0.3456 | 0.3601 |        | 0.3379 | 0.3698 |
| R5             | 0.3373 | 0.3534 | RA     | 0.3464 | 0.3688 |
|                | 0.3456 | 0.3601 |        | 0.3551 | 0.3760 |
|                | 0.3464 | 0.3688 |        | 0.3564 | 0.3851 |
|                | 0.3376 | 0.3616 |        | 0.3471 | 0.3775 |
| Q rank (5700K) |        |        |        |        |        |
| Q1             | 0.3222 | 0.3243 | Q6     | 0.3292 | 0.3461 |
|                | 0.3294 | 0.3306 |        | 0.3373 | 0.3534 |
|                | 0.3293 | 0.3384 |        | 0.3376 | 0.3616 |
|                | 0.3217 | 0.3316 |        | 0.3292 | 0.3539 |
| Q2             | 0.3294 | 0.3306 | Q7     | 0.3227 | 0.3170 |
|                | 0.3366 | 0.3369 |        | 0.3295 | 0.3228 |
|                | 0.3369 | 0.3451 |        | 0.3294 | 0.3306 |
|                | 0.3293 | 0.3384 |        | 0.3222 | 0.3243 |
| Q3             | 0.3217 | 0.3316 | Q8     | 0.3295 | 0.3228 |
|                | 0.3293 | 0.3384 |        | 0.3363 | 0.3287 |
|                | 0.3292 | 0.3461 |        | 0.3366 | 0.3369 |
|                | 0.3212 | 0.3389 |        | 0.3294 | 0.3306 |
| Q4             | 0.3293 | 0.3384 | Q9     | 0.3207 | 0.3462 |
|                | 0.3369 | 0.3451 |        | 0.3292 | 0.3539 |
|                | 0.3373 | 0.3534 |        | 0.3291 | 0.3617 |
|                | 0.3292 | 0.3461 |        | 0.3202 | 0.3535 |
| Q5             | 0.3212 | 0.3389 | QA     | 0.3292 | 0.3539 |
|                | 0.3292 | 0.3461 |        | 0.3376 | 0.3616 |
|                | 0.3292 | 0.3539 |        | 0.3379 | 0.3698 |
|                | 0.3207 | 0.3462 |        | 0.3291 | 0.3617 |

| Region         | CIE X  | CIE Y  | Region | CIE X  | CIE Y  |
|----------------|--------|--------|--------|--------|--------|
| P rank (6500K) |        |        |        |        |        |
| P1             | 0.3068 | 0.3113 | P6     | 0.3126 | 0.3324 |
|                | 0.3145 | 0.3187 |        | 0.3210 | 0.3408 |
|                | 0.3135 | 0.3256 |        | 0.3205 | 0.3481 |
|                | 0.3055 | 0.3177 |        | 0.3117 | 0.3393 |
| P2             | 0.3145 | 0.3187 | P7     | 0.3081 | 0.3049 |
|                | 0.3221 | 0.3261 |        | 0.3154 | 0.3119 |
|                | 0.3216 | 0.3334 |        | 0.3145 | 0.3187 |
|                | 0.3135 | 0.3256 |        | 0.3068 | 0.3113 |
| P3             | 0.3055 | 0.3177 | P8     | 0.3154 | 0.3119 |
|                | 0.3135 | 0.3256 |        | 0.3226 | 0.3188 |
|                | 0.3126 | 0.3324 |        | 0.3221 | 0.3261 |
|                | 0.3041 | 0.3240 |        | 0.3145 | 0.3187 |
| P4             | 0.3135 | 0.3256 | P9     | 0.3028 | 0.3304 |
|                | 0.3216 | 0.3334 |        | 0.3117 | 0.3393 |
|                | 0.3210 | 0.3408 |        | 0.3107 | 0.3461 |
|                | 0.3126 | 0.3324 |        | 0.3015 | 0.3368 |
| P5             | 0.3041 | 0.3240 | PA     | 0.3117 | 0.3393 |
|                | 0.3126 | 0.3324 |        | 0.3205 | 0.3481 |
|                | 0.3117 | 0.3393 |        | 0.3200 | 0.3554 |
|                | 0.3028 | 0.3304 |        | 0.3107 | 0.3461 |

**Notes:** SAMSUNG ELECTRONICS maintains  $\pm 0.005$  tolerance of Cx, Cy

## 2. Characteristics

### 1) Absolute Maximum Rating

| Item                         | Symbol    | Rating           | Condition                  |
|------------------------------|-----------|------------------|----------------------------|
| Operating temperature range  | $T_{op}$  | -40 °C ~ +85 °C  | –                          |
| Storage temperature range    | $T_{stg}$ | -40 °C ~ +120 °C | –                          |
| LED junction temperature     | $T_J$     | 110 °C           | –                          |
| Forward Current              | $I_F$     | 180 mA           | –                          |
| Peak Pulsed Forward Current  | $I_{FP}$  | 300 mA           | Duty 1/10 pulse width 10ms |
| Assembly Process Temperature | –         | 260 °C, < 10sec  | –                          |
| ESD                          | –         | 5kV              | HBM                        |

### 2) Electro-optical Characteristics

| Item                                                                            | Unit | Nominal CCT   | Product Code | Rank | Min  | Typ  | Max  |
|---------------------------------------------------------------------------------|------|---------------|--------------|------|------|------|------|
| Forward Voltage <sup>1)</sup> ( $V_F$ )<br>(@65 mA, $T_s = 25^\circ\text{C}$ )  | V    | -             | -            | WA   | AZ   | 2.70 | 2.80 |
|                                                                                 |      |               |              |      | A1   | 2.80 | 2.90 |
|                                                                                 |      |               |              |      | A2   | 2.90 | 3.00 |
|                                                                                 |      |               |              |      | A3   | 3.00 | 3.10 |
|                                                                                 |      |               |              |      | A4   | 3.10 | 3.20 |
| Luminous Flux <sup>2)</sup> ( $\Phi_v$ )<br>(@65 mA, $T_s = 25^\circ\text{C}$ ) | lm   | 2700K<br>(W☆) | *WAW☆S1      | S1   | 24.0 | -    | 26.0 |
|                                                                                 |      |               | *WAW☆S2      | S2   | 26.0 | -    | 28.0 |
|                                                                                 |      |               | *WAW☆S3      | S3   | 28.0 | -    | 30.0 |
|                                                                                 |      | 3000K<br>(V☆) | *WAV☆S1      | S1   | 24.5 | -    | 26.5 |
|                                                                                 |      |               | *WAV☆S2      | S2   | 26.5 | -    | 28.5 |
|                                                                                 |      |               | *WAV☆S3      | S3   | 28.5 | -    | 30.5 |
|                                                                                 |      | 3500K<br>(U☆) | *WAU☆S1      | S1   | 25.0 | -    | 27.0 |
|                                                                                 |      |               | *WAU☆S2      | S2   | 27.0 | -    | 29.0 |
|                                                                                 |      |               | *WAU☆S3      | S3   | 29.0 | -    | 31.0 |
|                                                                                 |      | 4000K<br>(T☆) | *WAT☆S1      | S1   | 26.0 | -    | 28.0 |
|                                                                                 |      |               | *WAT☆S2      | S2   | 28.0 | -    | 30.0 |
|                                                                                 |      |               | *WAT☆S3      | S3   | 30.0 | -    | 32.0 |
|                                                                                 |      | 5000K<br>(R☆) | *WAR☆S1      | S1   | 27.0 | -    | 29.0 |
|                                                                                 |      |               | *WAR☆S2      | S2   | 29.0 | -    | 31.0 |
|                                                                                 |      |               | *WAR☆S3      | S3   | 31.0 | -    | 33.0 |
|                                                                                 |      | 5700K<br>(Q☆) | *WAQ☆S1      | S1   | 26.5 | -    | 28.5 |
|                                                                                 |      |               | *WAQ☆S2      | S2   | 28.5 | -    | 30.5 |
|                                                                                 |      |               | *WAQ☆S3      | S3   | 30.5 | -    | 32.5 |
|                                                                                 |      | 6500K<br>(P☆) | *WAP☆S1      | S1   | 26.0 | -    | 28.0 |
|                                                                                 |      |               | *WAP☆S2      | S2   | 28.0 | -    | 30.0 |
|                                                                                 |      |               | *WAP☆S3      | S3   | 30.0 | -    | 32.0 |
| Reverse Voltage<br>(@5 mA, $T_s = 25^\circ\text{C}$ )                           | V    | -             | -            | -    | 0.7  | -    | 1.2  |
| Color Rendering Index <sup>3)</sup> ( $R_a$ )                                   | -    | -             | -            | 5    | 80   | -    | -    |
| Special CRI <sup>4)</sup> (R9)                                                  | -    | -             | -            | -    | 0    | -    | -    |
| Thermal resistance ( $R_{th, j-s}$ )                                            | °C/W |               |              |      | -    | 16   | -    |

#### Notes:

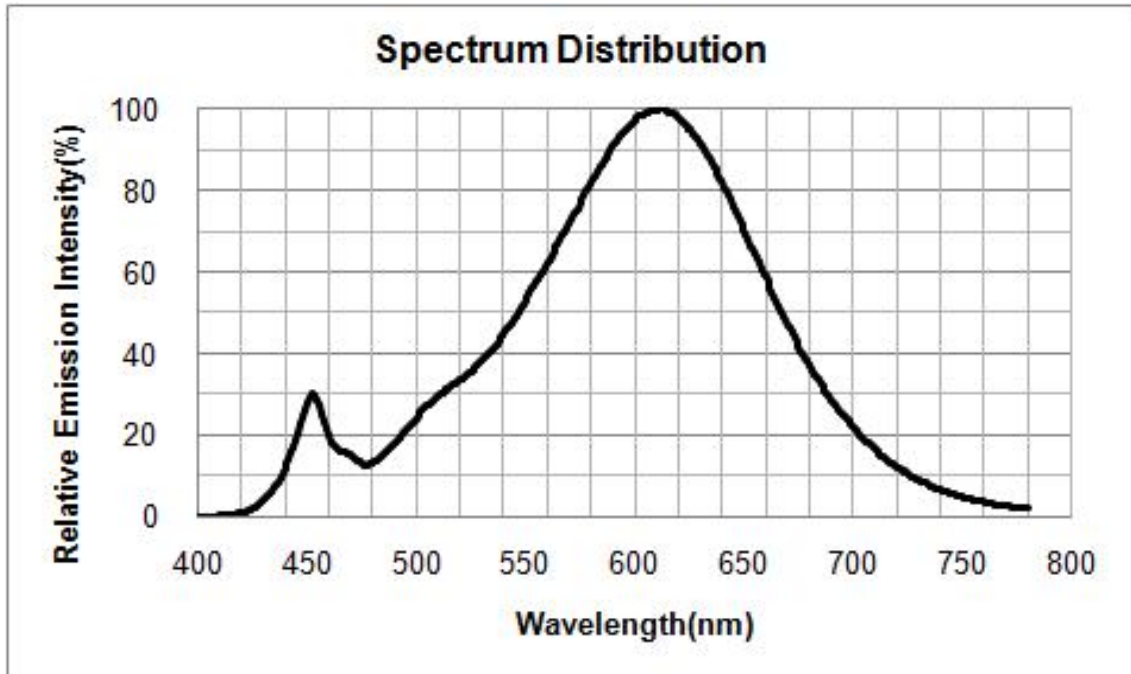
1)~4) SAMSUNG ELECTRONICS maintains a tolerance of  $V_F: \pm 0.1$  V,  $\Phi_v: \pm 5$  %,  $R_a: \pm 3.0$ ,  $R9: \pm 6.5$  on measurements

5) " \* " is Product Code of "SPMWH◆541MD5"

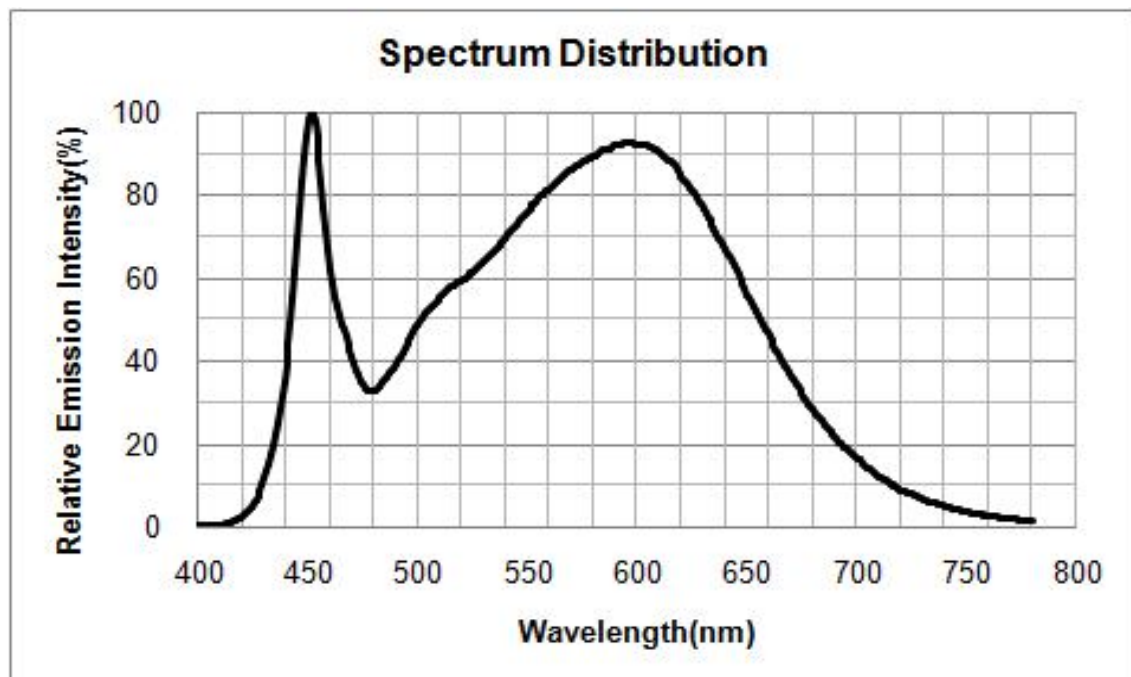
### 3. Typical Characteristics Graph ( $T_s = 25^\circ\text{C}$ )

#### 1) Spectrum Distribution

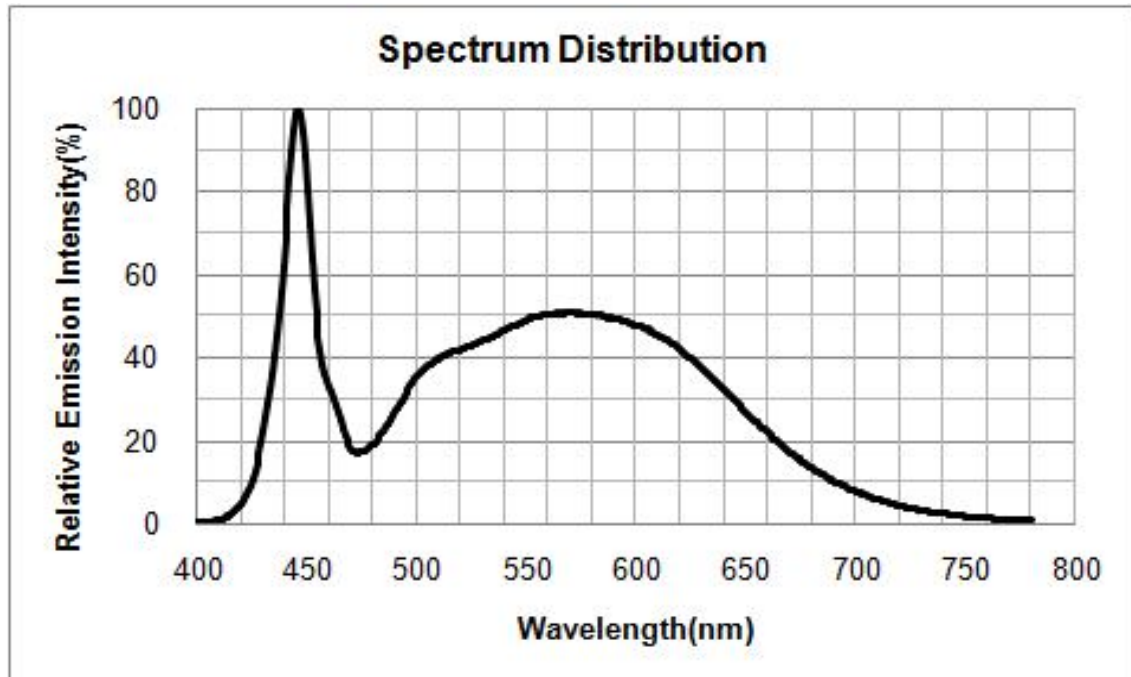
[CCT : 2700K & 3000K]



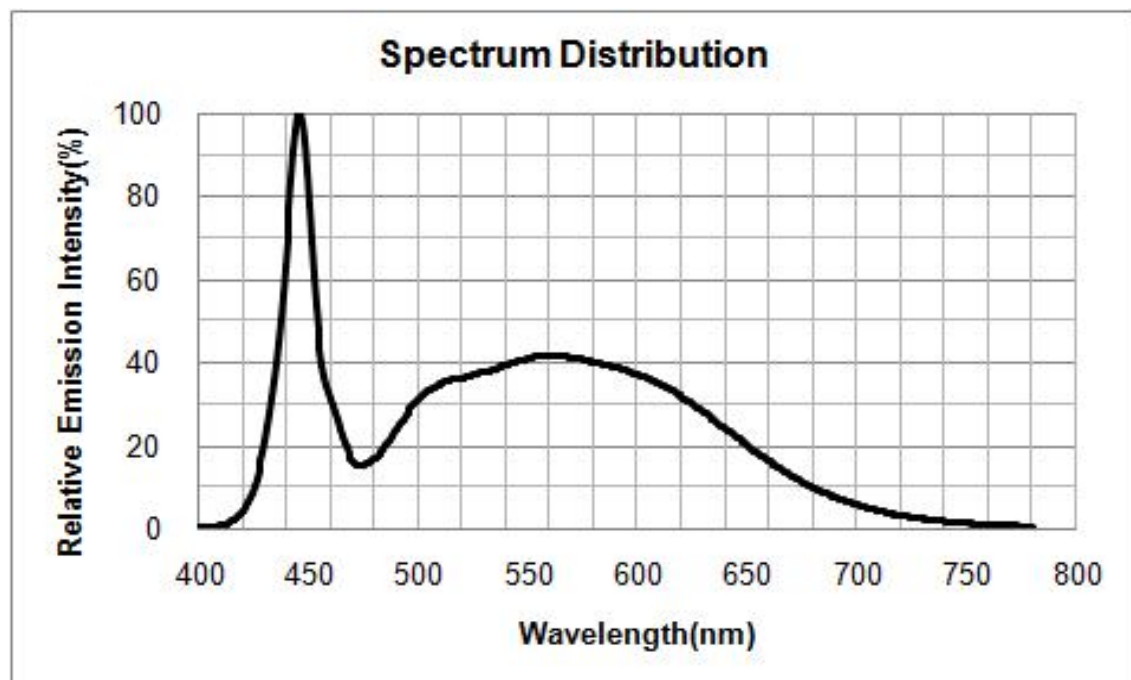
[CCT : 3500K & 4000K]



[CCT : 5000K & 5700K]



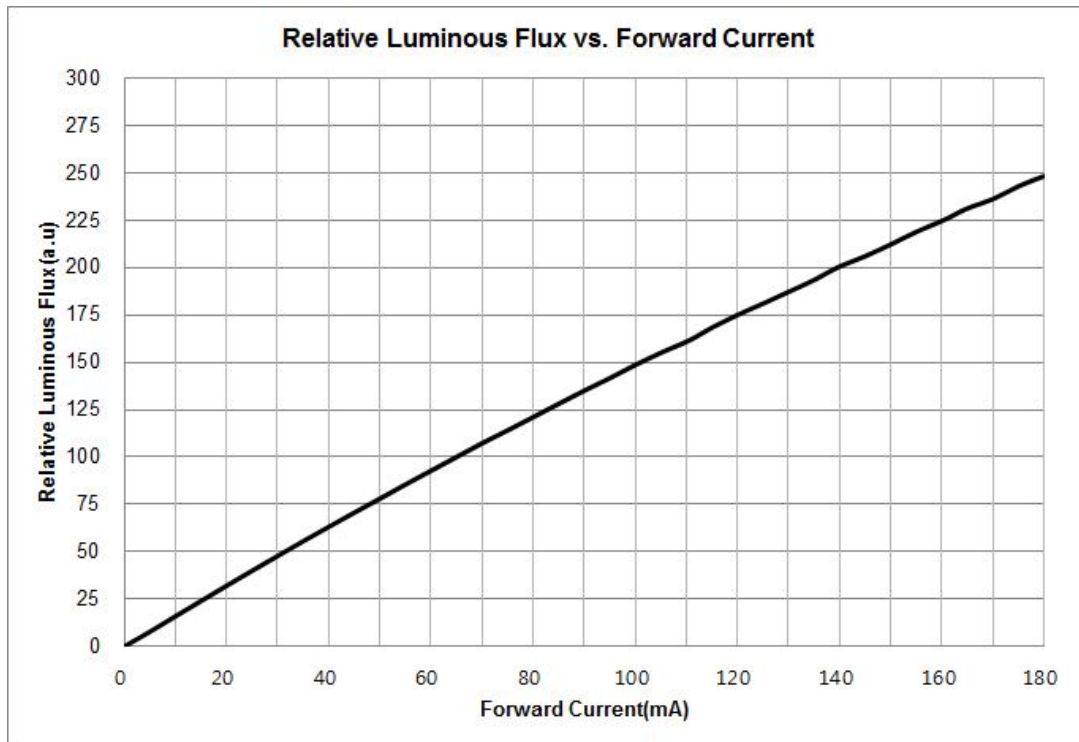
[CCT : 6500K]



## 2) Forward Current Characteristics

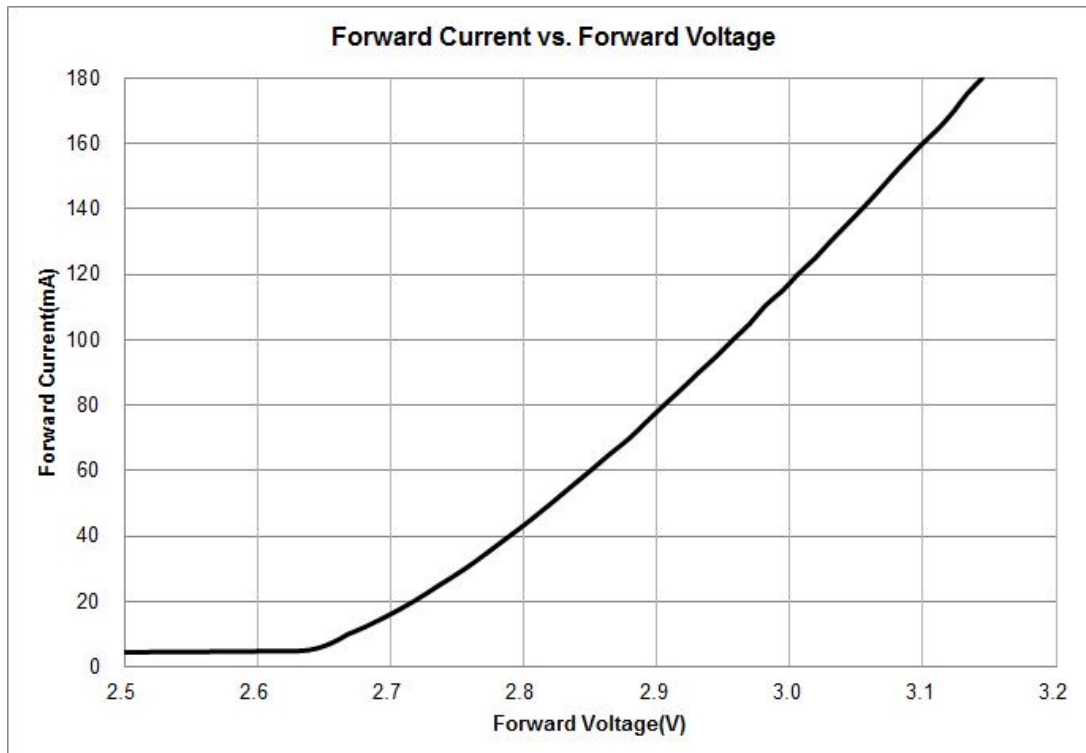
[Relative Luminous Flux vs. Forward Current]

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



[Forward Current vs. Forward Voltage]

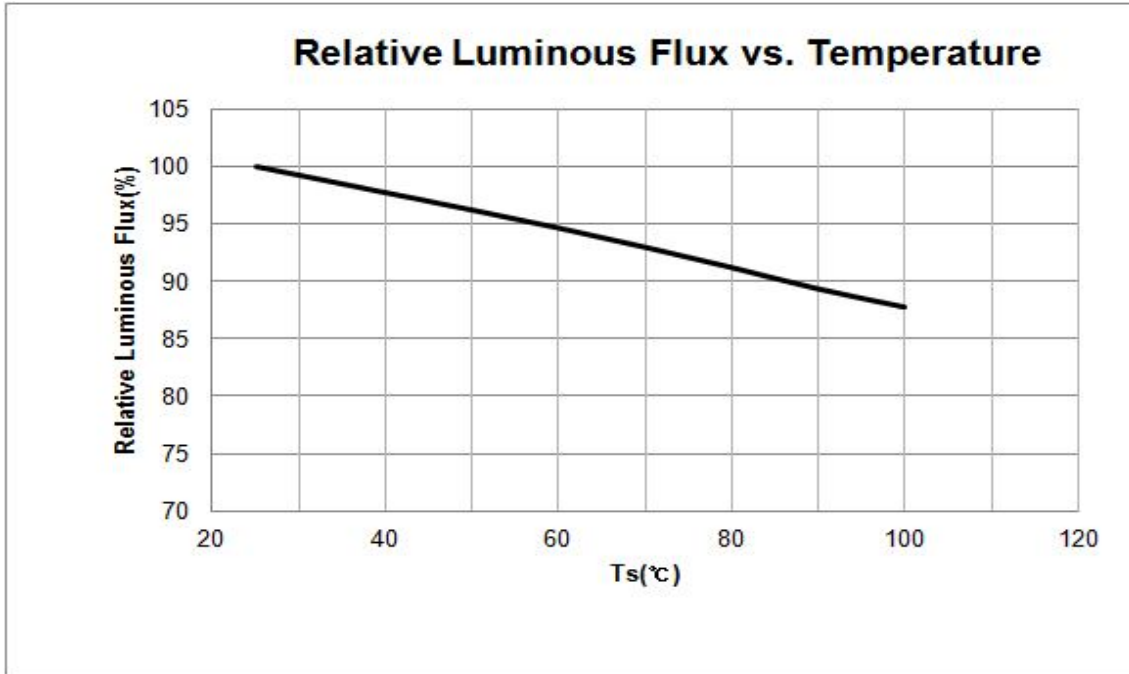
( $T_s = 25^\circ\text{C}$ )



### 3) Temperature Characteristics

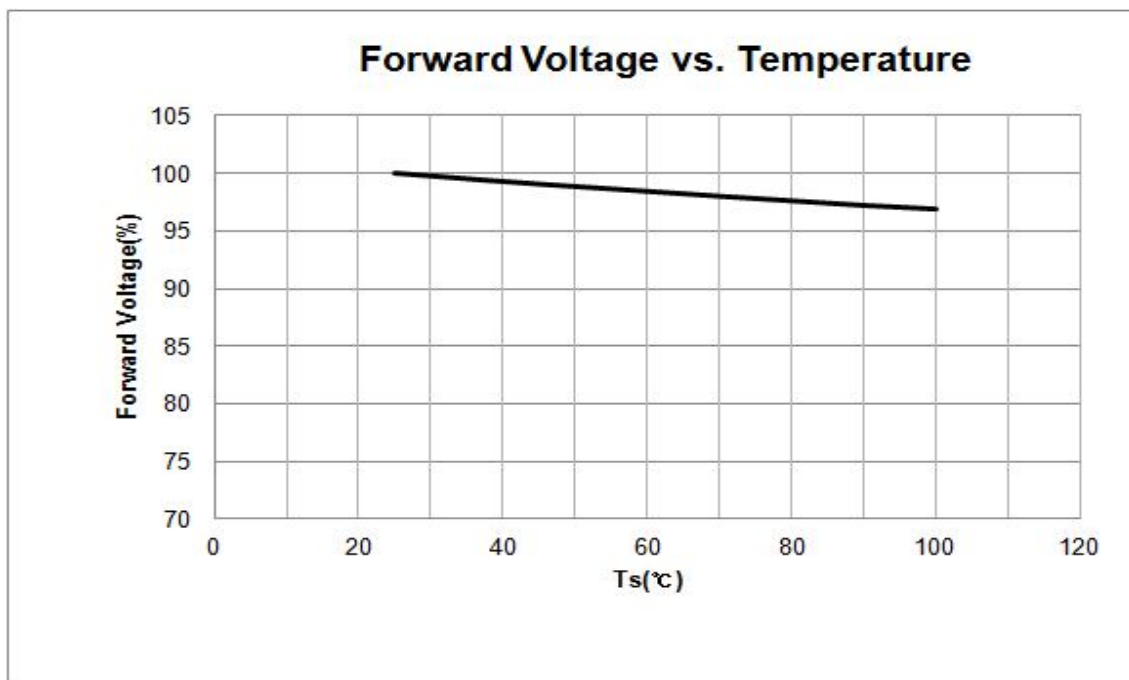
[Relative Luminous Flux vs.  $T_s$ ]

( $I_F = 65\text{mA}$ )



[Forward Voltage vs.  $T_s$ ]

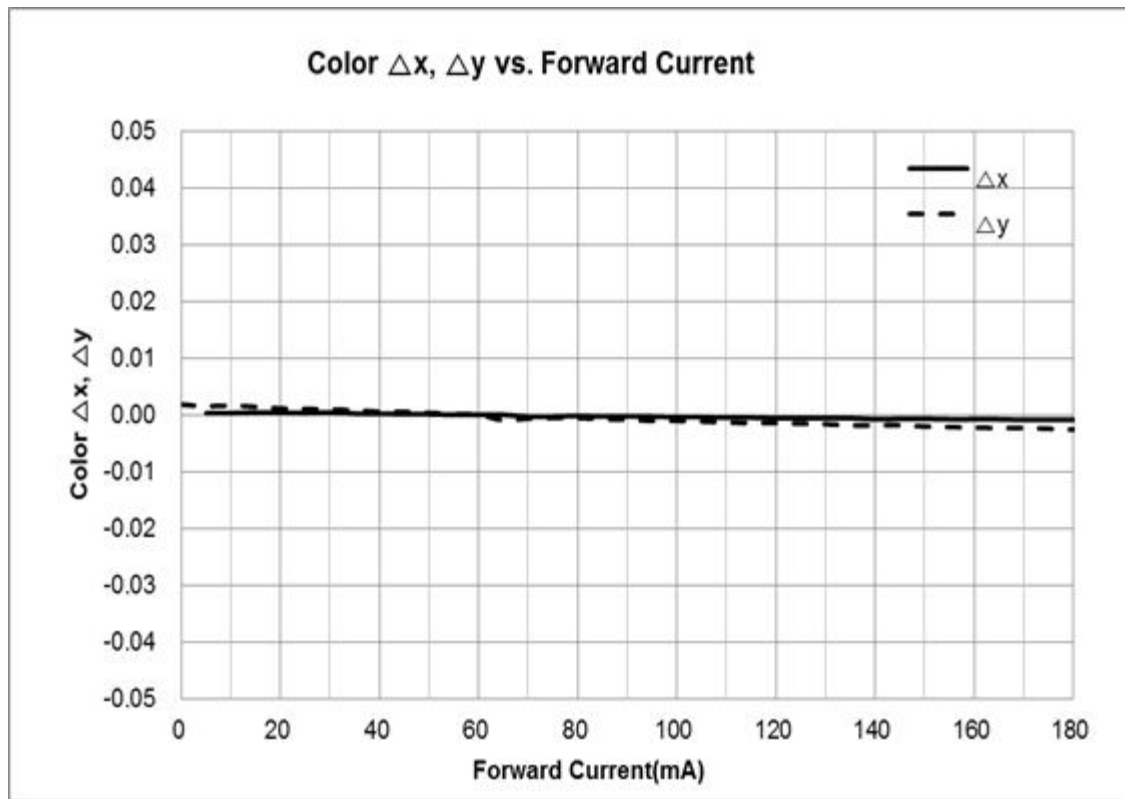
( $I_F = 65\text{mA}$ )



#### 4) Color shift Characteristics

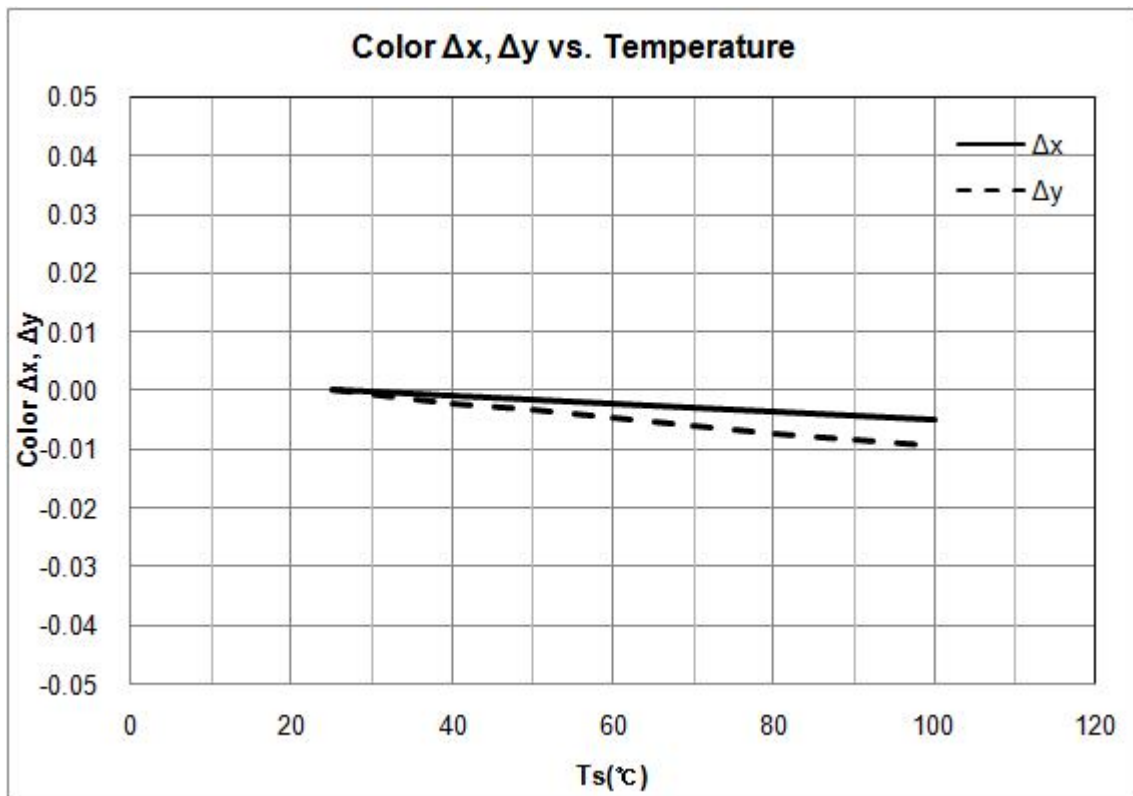
[Color  $\Delta x$ ,  $\Delta y$  vs. Forward Current]

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

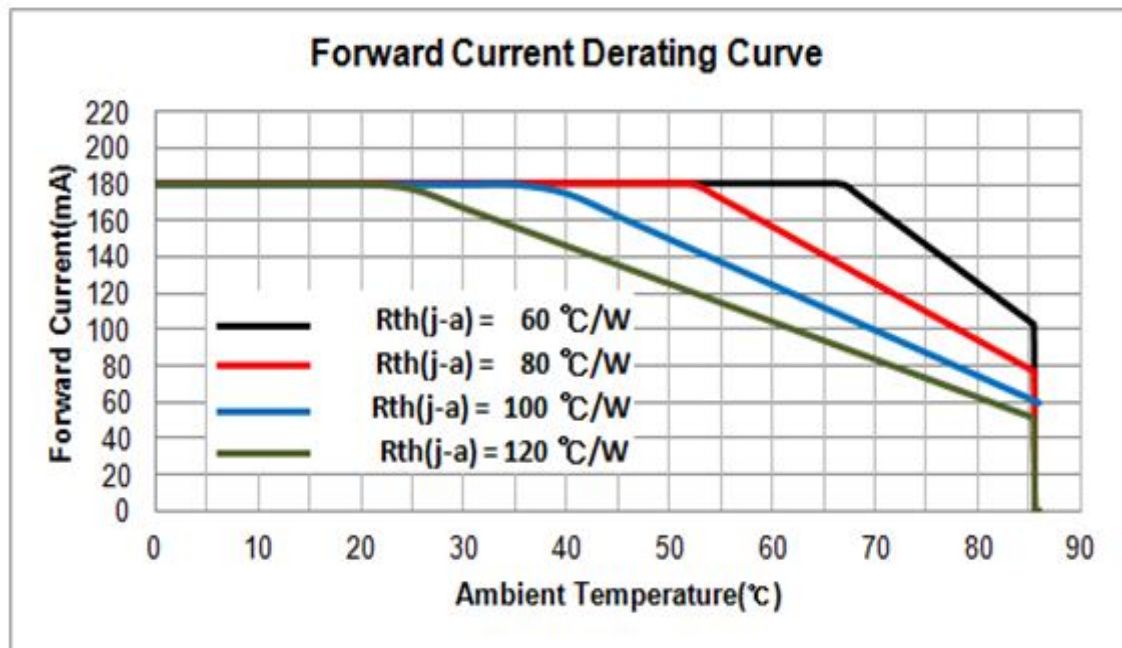


[Color  $\Delta x$ ,  $\Delta y$  vs.  $T_s$ ]

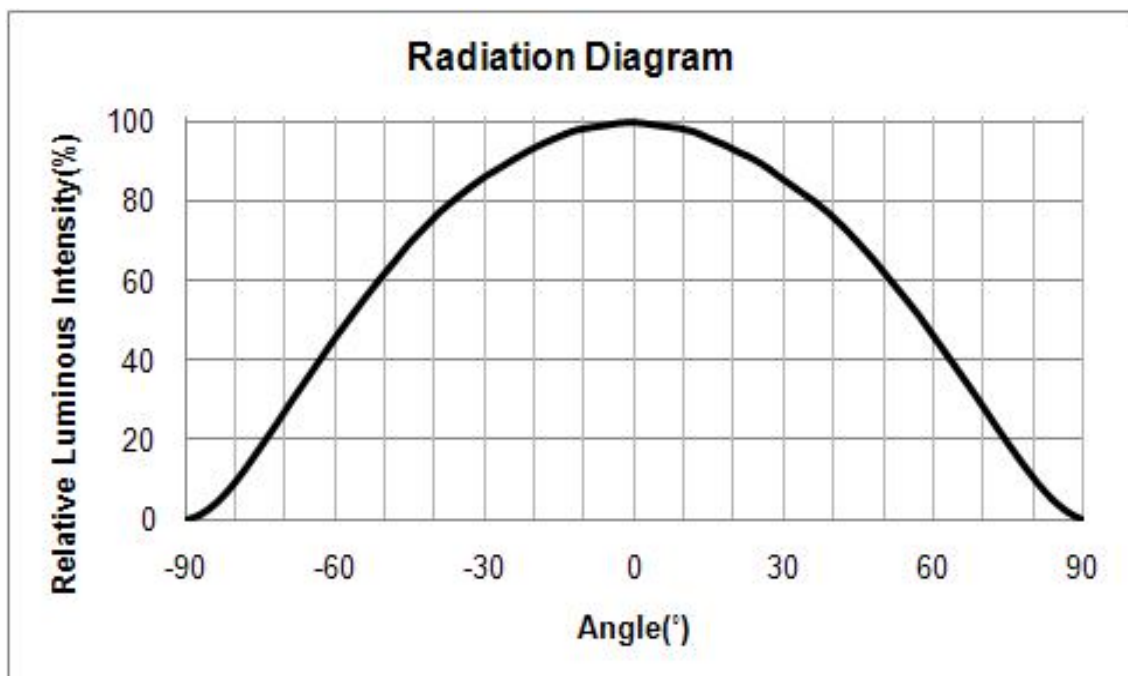
( $I_F = 65\text{mA}$ )



## 5) Derating Curve



## 6) Beam Angle Characteristics



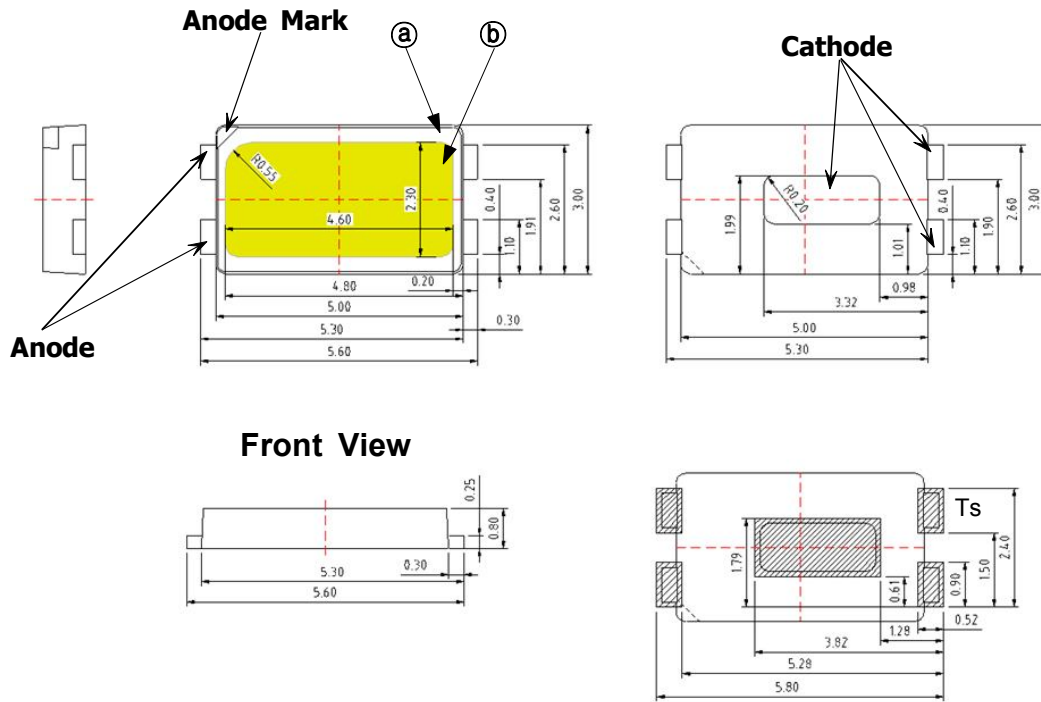
## 4. Outline Drawing & Dimension

1. Tolerance is  $\pm 0.10$  mm
2. The maximum compressing force is 15N on the body ①
3. Do not place pressure on the encapsulation resin ②

Left Side View

Top View

Bottom View



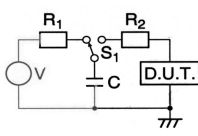
### Recommended Land Pattern

#### Notes:

- 1) This LED has built-in ESD protection device(s) connected in parallel to LED Chip(s).
- 2) Ts point & measurement method
  - ① Measure the nearest point to the thermal pad. If necessary, remove PSR of PCB to reach Ts point.
  - ② Thermal pad must be soldered to the PCB to dissipate heat properly. Otherwise, LED can be damaged.
- 3) Precautions
  - ① The pressure on the LEDs will influence to the reliability of the LEDs. Precautions should be taken to avoid the strong pressure on the LEDs. Do not put stress on the LEDs during heating.
  - ② 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.
  - ③ 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 and Conditions

### 1) Test Items

| Test Item                           | Test Conditions                                                                     | Test Hours/Cycles                                 | Sample No |   |
|-------------------------------------|-------------------------------------------------------------------------------------|---------------------------------------------------|-----------|---|
| MSL Test                            | 125 ℃ 24hrs drying → 60 ℃, 60 %RH 120hrs<br>→ 260 ℃ 10sec 3 cycles                  | 1 cycle                                           | 11        |   |
| Room Temperature life test          | 25 ℃±3 ℃, DC180 mA                                                                  | 1,000 hrs                                         | 22        |   |
| High Temperature life test          | 85 ℃±3 ℃, DC180 mA                                                                  | 1,000 hrs                                         | 22        |   |
| High Temperature humidity life test | 85 ℃±3 ℃, 85 %±2 %RH, DC180 mA                                                      | 1,000 hrs                                         | 22        |   |
| Low Temperature life test           | -40 ℃±3 ℃, DC180 mA                                                                 | 1,000 hrs                                         | 22        |   |
| Powered Temperature Cycle test      | -45℃/20 min ↔ 85℃/20 min, Sweep<br>100min cycle on/off: each 5 min, DC 180mA        | 100 cycle                                         | 22        |   |
| Thermal Shock                       | -45 ℃/15 min ↔ 125 ℃/15 min<br>→ Hot plate 180 ℃                                    | 500 cycle                                         | 100       |   |
| High Temperature Storage            | Ta=120 ℃±3 ℃                                                                        | 1000 hrs                                          | 11        |   |
| Low Temperature Storage             | Ta=-40 ℃±3 ℃                                                                        | 1000 hrs                                          | 11        |   |
| ESD(HBM)                            |  | R1:10 MΩ,<br>R2:1.5 kΩ,<br>C:100 pF,<br>V = ±5 kV | 5 times   | 5 |
| ESD(MM)                             |                                                                                     | R1:10 MΩ,<br>R2: 0,<br>C:200 pF,<br>V = ±0.5 kV   | 5 times   | 5 |
| Vibration Test                      | 20~2000~20 Hz 200 m/s², Sweep 4 min<br>X, Y, Z 3 direction, each 1 cycle            | 4 cycles                                          | 11        |   |
| Mechanical Shock Test               | 1500G, 0.5 ms                                                                       | 5 cycles                                          | 11        |   |

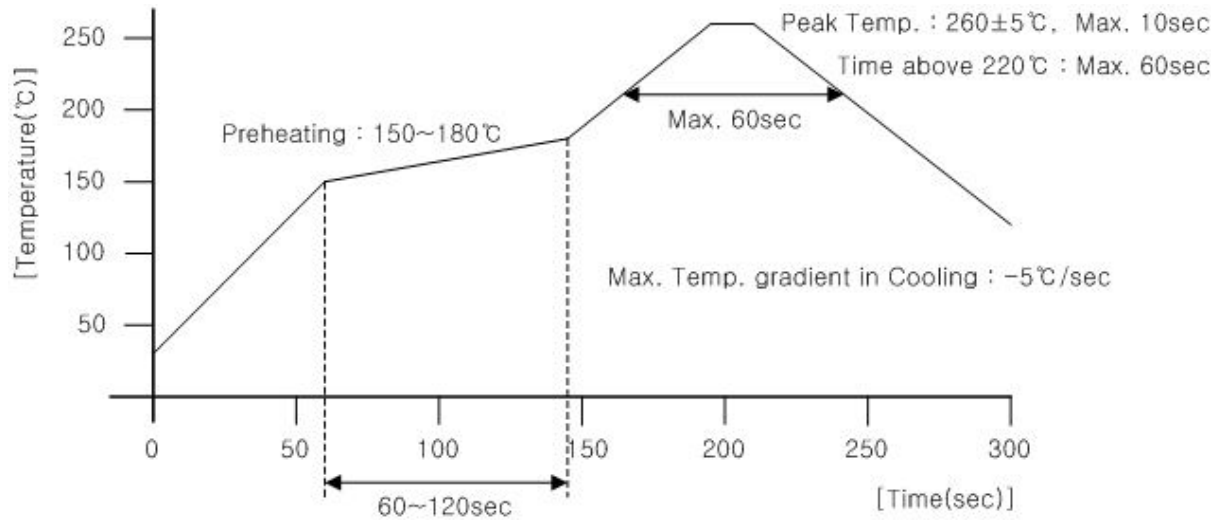
### 2) Criteria for Judging the Damage

| Item            | Symbol         | Test Condition         | Limit           |                 |
|-----------------|----------------|------------------------|-----------------|-----------------|
|                 |                |                        | Min             | Max             |
| Forward Voltage | V <sub>F</sub> | I <sub>F</sub> = 65 mA | Init. Value*0.9 | Init. Value*1.1 |
| Luminous Flux   | Φ <sub>v</sub> | I <sub>F</sub> = 65 mA | Init. Value*0.7 | Init. Value*1.2 |

## 6. Solder Conditions

### 1) Reflow Conditions ( Pb Free )

Reflow Frequency : 2 times max.

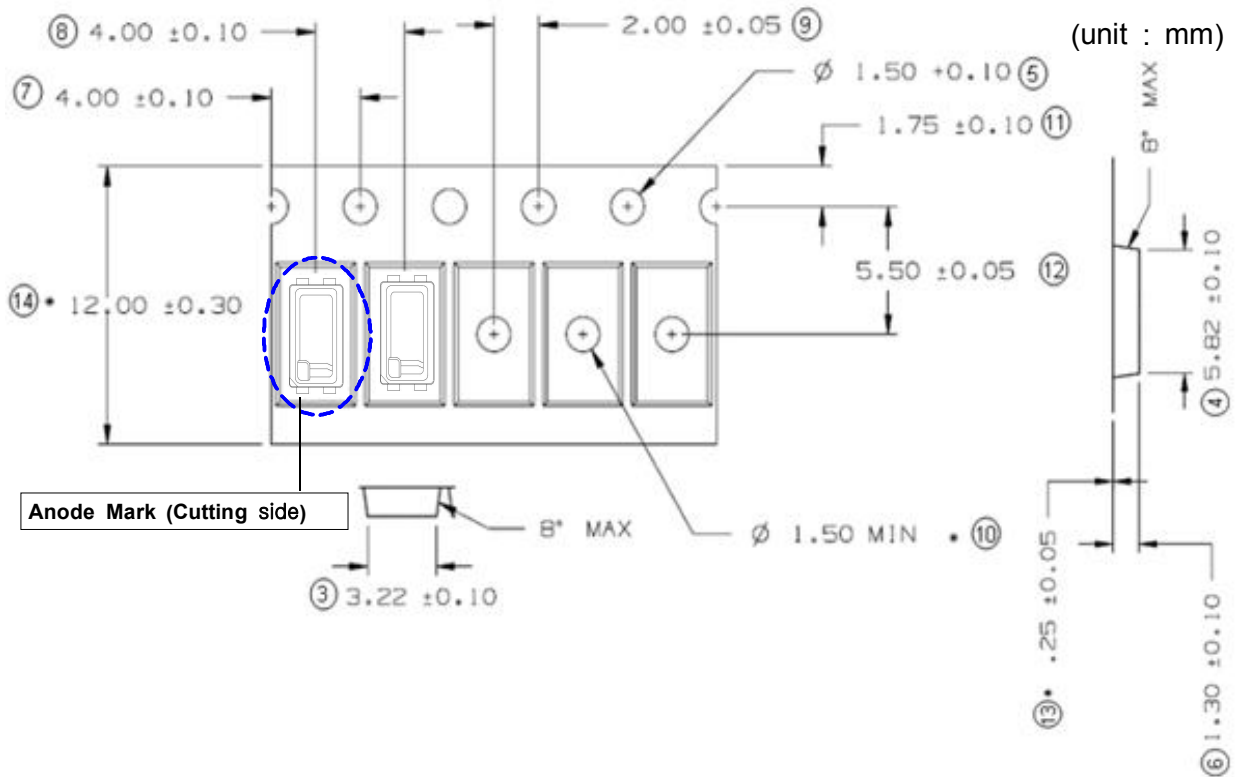


### 2) For Manual Soldering

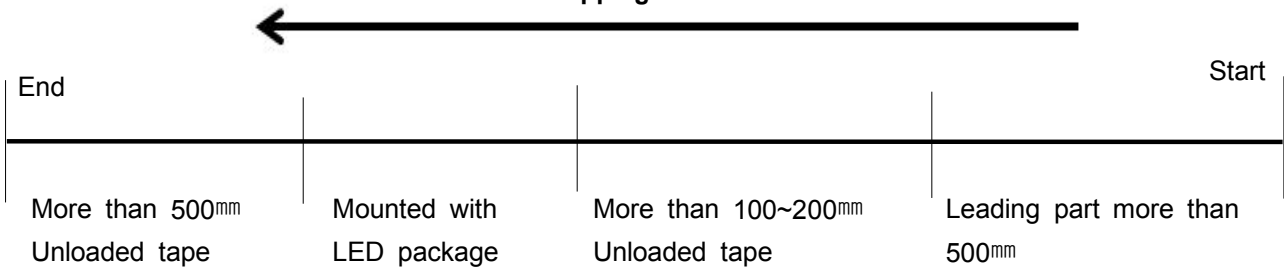
Not more than 5 seconds @Max. 300°C, under soldering iron.

## 7. Tape & Reel

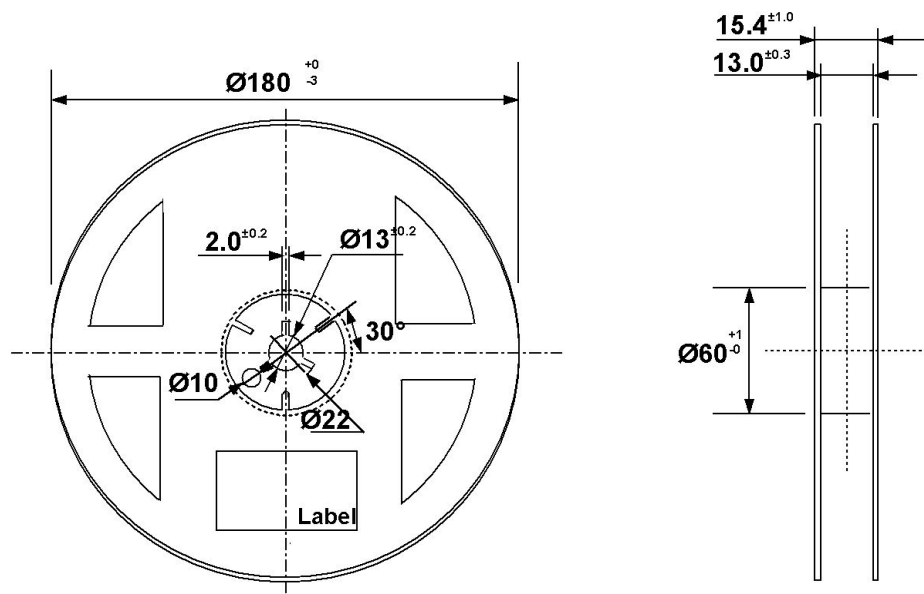
### 1) Taping Dimension



Tapping Direction

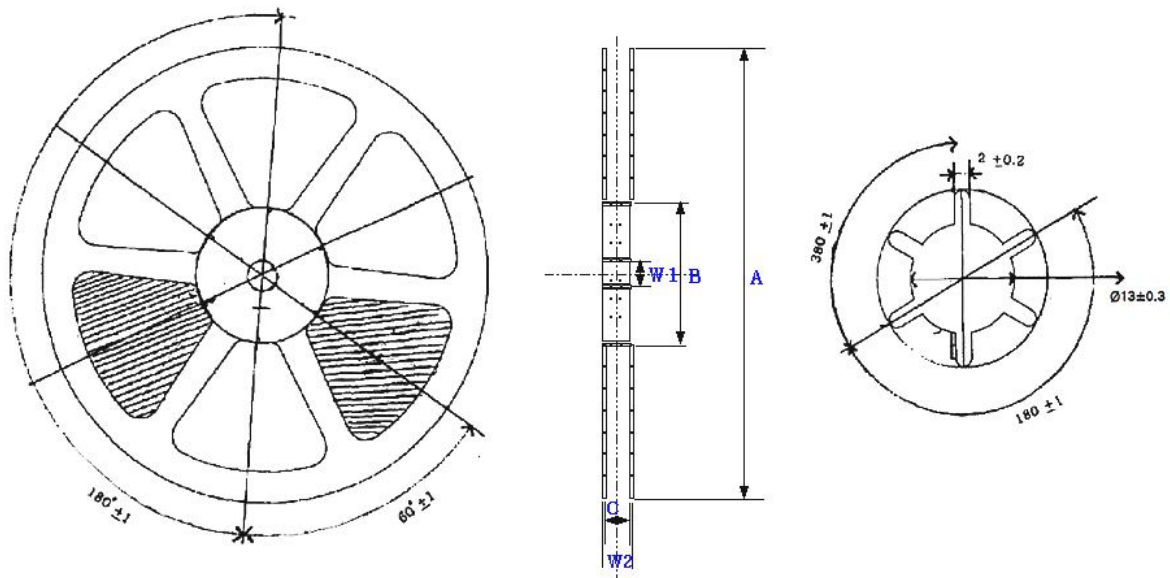


**2-1) Reel Dimension (max 2,500 pcs)**



**Tolerance    ±0.2 , Unit:mm**

## 2-2) Reel Dimension (max 10,000 pcs)

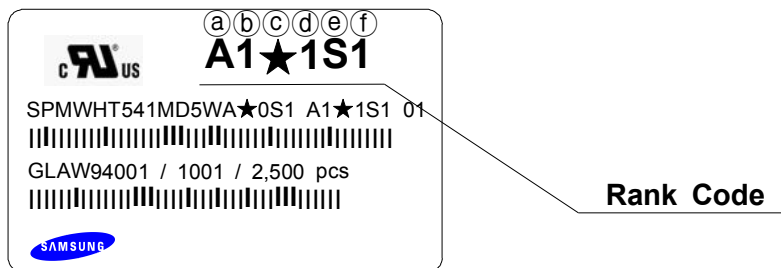


| Symbol   | A      | B    | C      | W1     | W2     |
|----------|--------|------|--------|--------|--------|
| Spec(mm) | Ø330±1 | 80±1 | 13±0.5 | 13±0.3 | 17.5±1 |

- (1) Quantity : The quantity/Reel to be 2,500 pcs or 10,000 pcs, .
- (2) Cumulative Tolerance : Cumulative tolerance/10 pitches to be  $\pm 0.2\text{mm}$
- (3) Adhesion Strength of Cover Tape : Adhesion strength to be 0.1-0.7N when the cover tape is turned off from the carrier tape at 10°C angle to be the carrier tape.
- (4) Packaging : P/N, Manufacturing data code no. and quantity to be indicated on a damp proof Package.

## 8. Label Structure

### 1) Label Structure



N.B) Denoted rank is the only example.

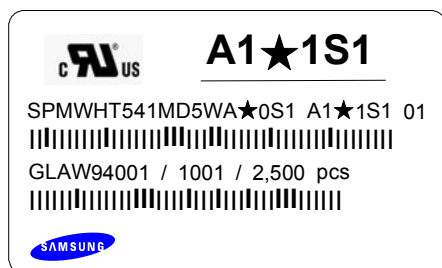
'★' means All kind of Chromaticity Coordinate Rank.

### Rank Code

- ①② : Forward Voltage( $V_F$ ) Rank (refer to page. 11)
- ③④ : Chromaticity Coordinate Rank (refer to page. 4~10)
- ⑤⑥ : Luminous Flux( $\Phi_v$ , lm) Rank (refer to page. 3)

### 2) LOT Number

The Lot number is composed of the following characters



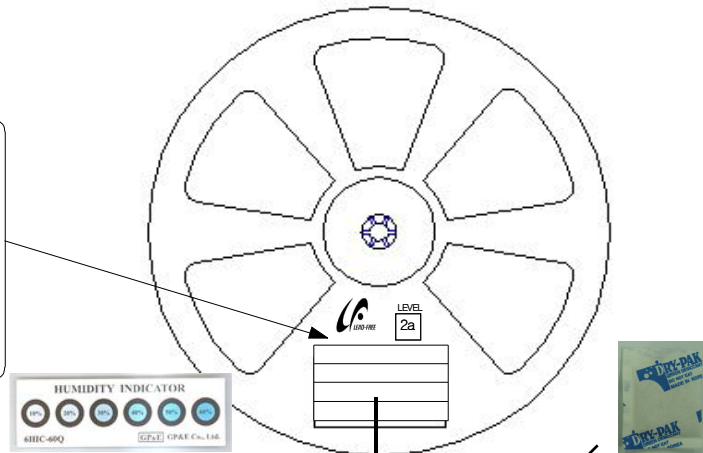
①②③④⑤⑥⑦⑧⑨ / 1①②③ / 2,500 PCS

- ① : Production Site (S:SAMSUNG ELECTRONICS, G:TIAJIN CHINA)
- ② : L (LED)
- ③ : Product State (A:Normality, 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 : SAMSUNG ELECTRONICS LED Product number (001 ~ 999)
- ①②③ : Reel Number (001 ~ 999)

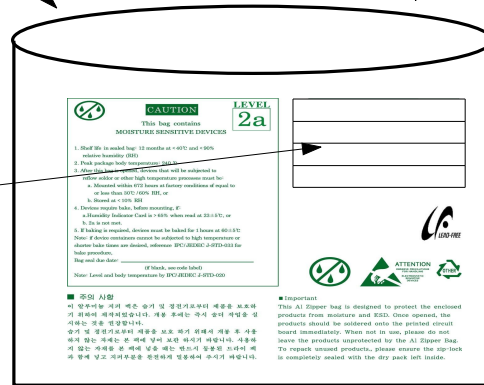
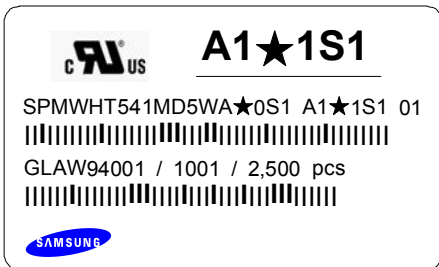
## 9. Packing Structure

### 1-1) Packing Process (The quantity of PKG on the Reel to be Max 2,500 pcs)

#### Reel



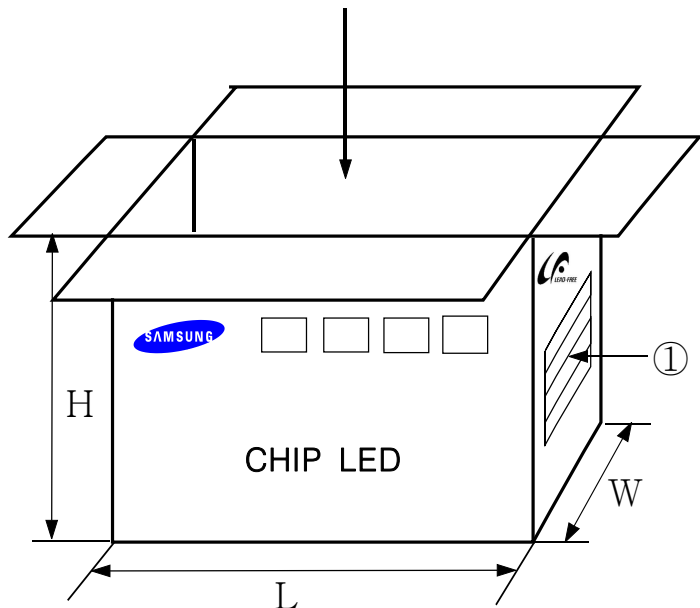
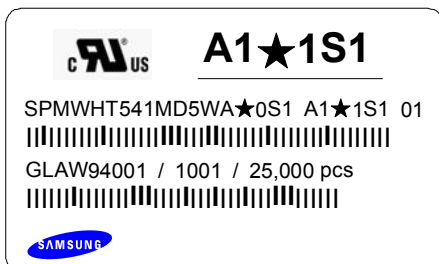
#### Aluminum Vinyl Bag



Material : Paper(SW3B(B))

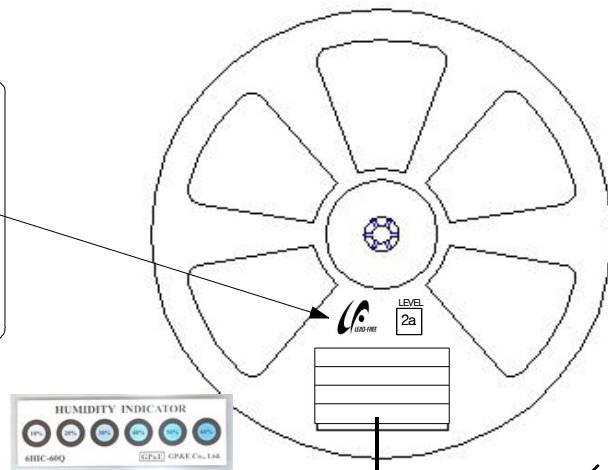
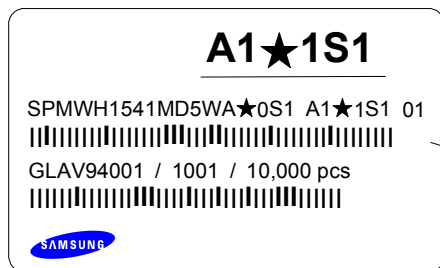
| TYPE  | SIZE(mm) |       |       |
|-------|----------|-------|-------|
|       | L        | W     | H     |
| 7inch | 245±5    | 220±5 | 182±5 |
| 7inch | 245±5    | 220±5 | 86±5  |

① SIDE

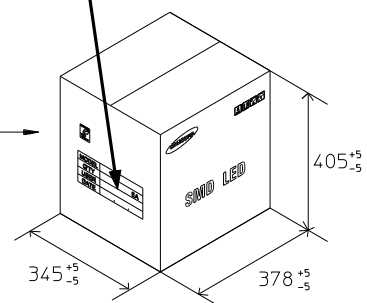
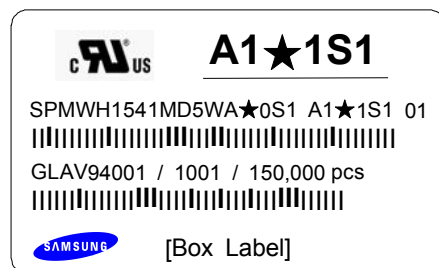
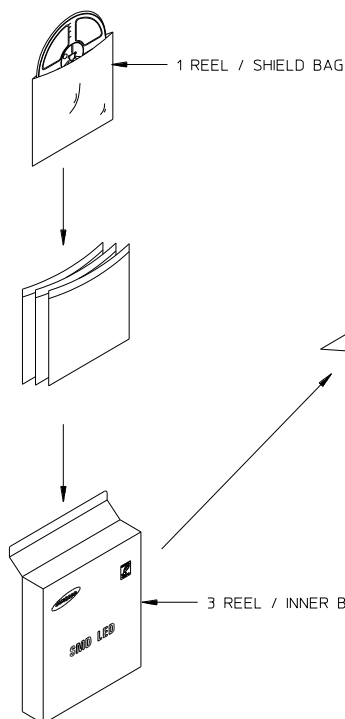
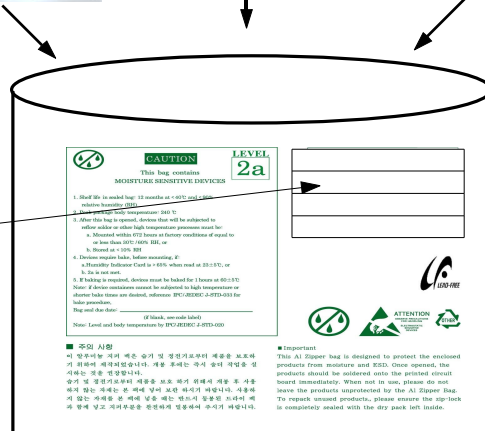
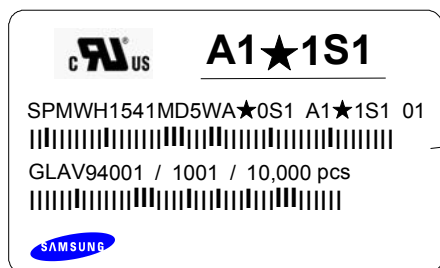


## 1-2) Packing Process (The quantity of PKG on the Reel to be Max 10,000 pcs)

### Reel



### Aluminum Vinyl Bag



5 INNER/OUT BOX

| Box   | SIZE(mm) |       |       |
|-------|----------|-------|-------|
|       | L        | W     | H     |
| Inner | 340±5    | 370±5 | 80±5  |
| Outer | 345±5    | 378±5 | 405±5 |

## 2) Aluminum Packing Bag



**CAUTION**

**This bag contains**

**MOISTURE SENSITIVE DEVICES**

**LEVEL**  
**2a**

1. Shelf life in sealed bag: 12 months at  $<40^{\circ}\text{C}$  and  $<90\%$  relative humidity (RH)
2. Peak package body temperature:  $240^{\circ}\text{C}$
3. After this bag is opened, devices that will be subjected to reflow solder or other high temperature processes must be:
  - a. Mounted within 672 hours at factory conditions of equal to or less than  $30^{\circ}\text{C} / 60\% \text{ RH}$ , or
  - b. Stored at  $<10\% \text{ RH}$
4. Devices require bake, before mounting, if:
  - a. Humidity Indicator Card is  $>65\%$  when read at  $23 \pm 5^{\circ}\text{C}$ , or
  - b. 2a is not met.
5. If baking is required, devices must be baked for 1 hours at  $60 \pm 5^{\circ}\text{C}$

Note: if device containers cannot be subjected to high temperature or shorter bake times are desired, reference IPC/JEDEC J-STD-033 for bake procedure,

Bag seal due date: \_\_\_\_\_

(if blank, see code label)

Note: Level and body temperature by IPC/JEDEC J-STD-020


**A1★1S1**

---

SPMWHT541MD5WA★0S1 A1★1S1 01  
 |||||

GLAW94001 / 1001 / 2,500 pcs  
 |||||





**ATTENTION**  
OBSERVE PRECAUTIONS  
FOR HANDLING  
ELECTROSTATIC  
SENSITIVE  
DEVICES



## ■ 주의 사항

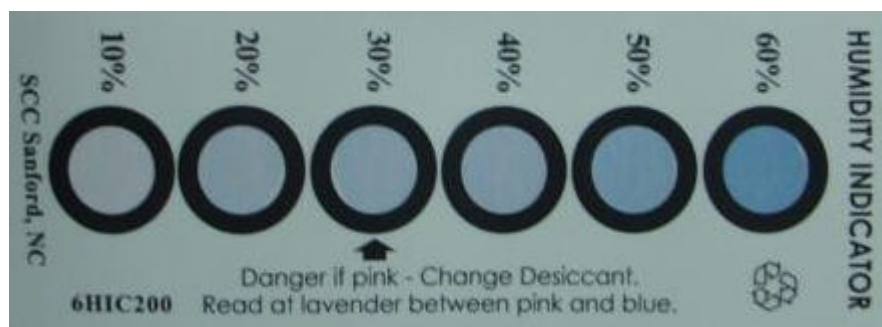
이 알루미늄 지퍼 백은 습기 및 정전기로부터 제품을 보호하기 위하여 제작되었습니다. 개봉 후에는 즉시 솔더 작업을 실시하는 것을 권장합니다.

습기 및 정전기로부터 제품을 보호 하기 위해서 개봉 후 사용하지 않는 자재는 본 팩에 넣어 보관 하시기 바랍니다. 사용하지 않는 자재를 본 팩에 넣을 때는 반드시 동봉된 드라이 팩과 함께 넣고 지퍼부분을 완전하게 밀봉하여 주시기 바랍니다.

■ Important

This Al Zipper bag is designed to protect the enclosed products from moisture and ESD. Once opened, the products should be soldered onto the printed circuit board immediately. When not in use, please do not leave the products unprotected by the Al Zipper Bag. To repack unused products., please ensure the zip-lock is completely sealed with the dry pack left inside.

## Silica gel & Humidity Indicator Card in Aluminum Vinyl Bag



## 10. Precaution for 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.

과전류 방지를 위해 전압의 미세한 이동에 의해 야기되는 전류의 순간 변화를 방지하기 위해 저항 등의 설치를 권장함.

- 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.

제품은 물, 오일, 유기물과 같은 액체 타입에서의 사용은 제한되며, 세정이 필요할 시에는 IPA 사용을 권장함.

- 3) When the LEDs illuminate, operating current should be decided after considering the ambient maximum temperature.

LED의 발광 시, 동작 전류는 주변 최고온도를 고려하여 결정되어야 함.

- 4) LEDs must be stored in a clean environment.

If the LEDs are to be stored for 3 months or more after being shipped from Samsung Electronics, they should be packed by a sealed container with nitrogen gas injected. (Shelf life of sealed bags: 12 months, temp.  $\sim 40^{\circ}\text{C}$ ,  $\sim 90\%\text{RH}$ )

LED의 보관은 청정한 환경에서 보존되어야 하며, 만약 삼성전자로부터 공급받는 후 3개월 또는 그 이상 보관이 필요하다면 질소 가스를 동봉한 보존용기에 보관되어야 함. (보존 bag의 수명 : 12 개월, 보존 온도  $\sim 40^{\circ}\text{C}$ , 습도  $\sim 90\%\text{RH}$ )

- 5) After storage bag is open, device subjected to soldering, solder reflow, or other high temperature processes must be:

보존 Bag이 개봉된 후에, 납땀이나 reflow 등의 높은 온도에 노출되는 제품은 다음의 사항에 부합되어야 함.

- a. Mounted within 672 hours(28 days) at an assembly line with a condition of no more than  $30^{\circ}\text{C}/60\%\text{RH}$ ,

- a. 제품은  $30^{\circ}\text{C}/60\%\text{RH}$ 보다 같거나 낮은 조립조건에서 672시간(28일)이내에 조립해야 함.

- b. Stored at  $<10\%\text{RH}$ .

- b. 10% 이하의 상대습도에서 보관되어야 함.

- 6) Repack unused Products with anti-moisture packing, fold to close any opening and then store in a dry place.

사용하지 않은 제품은 방습팩에 넣어 개봉 부위를 닫아서 다시 포장한 후, 건조한 장소에서 보관할 것을 권장함.

7) Devices require baking before mounting, if humidity card reading is  $>60\%$  at  $23\pm5^{\circ}\text{C}$ .  
만약 습도표시카드의 수치가  $23\pm5^{\circ}\text{C}$ 에서  $60\%$  이상이라면, 제품 실장 전 baking해야 함.

8) Devices must be baked for 1 hour at  $60\pm5^{\circ}\text{C}$ , if baking is required.  
만약 baking이 필요하다면, 제품은  $60\pm5^{\circ}\text{C}$ 에서 1시간 정도 baking 되어야 함.

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.  
LED는 정전기 및 서지에 민감한 제품이므로, LED 제품을 다룰 시에는 정전기 방지장갑이나 손목밴드를 사용하기를 권장함.

If voltage exceeding the absolute maximum rating is applied to LEDs, it may cause damage or even destruction to LED devices.

만약 절대 허용치를 초과하는 전압이 LED에 가해지면, LED 소자는 파괴되거나 손상될 수 있음.

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.

손상된 제품은 누설전류의 증가, Turn on 전압의 저하, 저 전류에서의 점등불량 등의 이상 거동을 보일 수 있음.

10) VOCs (volatile organic compounds) can be generated from adhesives, flux, hardener or organic additives used in luminaires (fixtures).

Transparent LED silicone encapsulant is permeable to those chemicals and they may lead a discoloration of encapsulant when they expose to heat or light.

VOCs(휘발성 유기 화합물)는 등기구에 사용되는 접착제, Flux, 경화제, 유기물 첨가제에서 발생하여 LED 실리콘 봉지제를 투과하고, 빛 또는 열에 노출되었을 때 변색이 발생 할 수 있음.

This phenomenon can cause a significant loss of light emitted(output) from the luminaires(fixture).

이러한 현상은 등기구로부터 나오는 빛의 중대한 손실을 줄 수 있음.

In order to prevent these problems, we recommend you to know the physical properties of the materials used in luminaires, They must be selected carefully.

이러한 문제 발생 방지를 위해서, 등기구에 사용되는 자재에 대한 물성을 알고 주의하여 선택 되어야함.

### 11) Risk of Sulfurization (or Tarnishing)

The LED from Samsung Electronics uses a silver-plated lead frame and its surface color may change to black(or dark colored) when it is exposed to sulfur(S), chlorine (Cl) or other halogen compound.

삼성전자의 LED는 Ag(은)을 도금한 리드프레임을 사용함. 이 리드프레임의 표면이 황(S), 염소(Cl), 또는 다른 할로겐 화합물들에 노출시 Ag(은)은 검정(또는 어두운색)으로 바뀔 수 있음.

Sulfurization of lead frame may cause intensity degradation, change of chromaticity coordinates and, in extreme cases, open circuit. It requires caution.

리드 프레임의 황화(Sulfurization)는 광량 저하, 색좌표 변화 및 심한 경우 LED 무등(Open) 불량을 일으킬 수도 있으니 주의가 필요함.

Due to possible sulfurization of lead frame, LED should not be used and stored together with oxidizing substances made of materials in a following list,  
: Rubber, plain paper, lead solder cream and so on.

리드 프레임 황화(Sulfurization)의 근원이 될 수 있으니 LED는 아래의 목록으로 만들어진 산화성 물질들과 함께 저장, 사용이 불가함 : 고무, 일반 종이, 납땜 크림 등

## 12. Hazard Substance Analysis

### 1) SVHC (Reach) Report



#### Test Report

No. F690101/LF-CTSAYAA14-58066

Issued Date: 2014. 12. 26

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SAMSUNG ELECTRONICS CO  
95 Samsung 2-ro Giheung-gu  
Yongin-city Gyeonggi-do  
Korea

The following sample(s) was/were submitted and identified by/on behalf of the client as:-

|                |                                                                                                                                                                                                                                                            |
|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SGS File No.   | : AYAA14-58066                                                                                                                                                                                                                                             |
| Product Name   | : 5630G2 white PKG                                                                                                                                                                                                                                         |
| Item/Part Name | : N/A                                                                                                                                                                                                                                                      |
| Received Date  | : 2014. 12. 18                                                                                                                                                                                                                                             |
| Test Period    | : 2014. 12. 19 ~ 2014. 12. 26                                                                                                                                                                                                                              |
| Test Requested | : One hundred-sixty one (161) substances in the Candidate List of Substances of Very High Concern (SVHC) for authorization published by European Chemicals Agency (ECHA) on December 17, 2014 regarding Regulation (EC) No 1907/2006 concerning the REACH. |
| Test Method    | : Please refer to next page(s).                                                                                                                                                                                                                            |
| Test Result(s) | : Please refer to next page(s).                                                                                                                                                                                                                            |
| Summary        | : According to the specified scope and analytical technique, concentrations of all SVHC are <0.1% in the submitted sample(s).                                                                                                                              |

SGS Korea Co., Ltd

Jeff Jang / Chemical Lab Mgr

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### Test Method:

SGS In-House method - Analyzed by ICP-OES, PLM, UV/VIS, LC/MS, GC/MS and colorimetric method

### Remarks:

1. The chemical analysis of specified SVHC is performed by means of currently available analytical techniques against the following SVHC related documents published by ECHA:  
<http://echa.europa.eu/web/guest/candidate-list-table> (Candidate list)  
[http://echa.europa.eu/proposals-to-identify-substances-of-very-high-concern-previous-consultations?p\\_p\\_id=substancetypeolist\\_WAR\\_substanceportlet&p\\_p\\_lifecycle=0&p\\_p\\_state=normal&p\\_p\\_mode=view&p\\_p\\_col\\_id=column-1&p\\_p\\_col\\_pos=2&p\\_p\\_col\\_count=4&substancetypeolist](http://echa.europa.eu/proposals-to-identify-substances-of-very-high-concern-previous-consultations?p_p_id=substancetypeolist_WAR_substanceportlet&p_p_lifecycle=0&p_p_state=normal&p_p_mode=view&p_p_col_id=column-1&p_p_col_pos=2&p_p_col_count=4&substancetypeolist)  
 (Proposals to identify SVHC consultations)  
 This list is under evaluation by ECHA and may subject to change in the future.
2. In accordance with Regulation (EC) No 1907/2006, any producer or importer of articles shall notify ECHA, in accordance with paragraph 2 of Article 7, if a substance meets the criteria in Article 57 and is identified in accordance with Article 59(1) of the Regulation, if (a) the substance is present in those articles in quantities totaling over one tonne per producer or importer per year; and (b) the substance is present in those articles above a concentration of 0.1 % weight by weight (w/w).
3. Article 33 of Regulation (EC) No 1907/2006 requires supplier of an article containing a substance meeting the criteria in Article 57 and identified in accordance with Article 59(1) in a concentration above 0.1 % weight by weight (w/w) shall provide the recipient of the article with sufficient information, available to the supplier, to allow safe use of the article including, as a minimum, the name of that substance in the Candidate List.
4. SGS adopts the interpretation of ECHA for SVHC in article unless indicated otherwise. Detail explanation is available at the following link:  
[http://webstage.contribute.sgs.net/corpreach/documents/SGS-CTS\\_SVHC-paper-EN-11.pdf](http://webstage.contribute.sgs.net/corpreach/documents/SGS-CTS_SVHC-paper-EN-11.pdf)
5. Test results in this report are based on the tested sample. This report refers to testing result of composite material group by equal weight proportion. The material in each composite test group may come from one article.
6. If a SVHC is found over the reporting limit, client is suggested to identify the component which contains the SVHC and the exact concentration of the SVHC by requesting further quantitative analysis from the laboratory.

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F401 Version 2



# Test Report

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## Test Result(s)

| Substance Name                                                                                       | CAS number                                                               | EC number              | Concentration (%) | Reporting Limit (%) | Classification                                                                                           |
|------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|------------------------|-------------------|---------------------|----------------------------------------------------------------------------------------------------------|
| Alkanes, C10-13, chloro (Short Chain Chlorinated Paraffins)                                          | 85535-84-8                                                               | 287-476-5              | N.D.              | 0.05                | PBT                                                                                                      |
| Anthracene                                                                                           | 120-12-7                                                                 | 204-371-1              | N.D.              | 0.05                | PBT                                                                                                      |
| Benzyl butyl phthalate (BBP)                                                                         | 85-68-7                                                                  | 201-622-7              | N.D.              | 0.05                | Toxic for Reproduction                                                                                   |
| Bis(2-ethylhexyl)phthalate (DEHP)                                                                    | 117-81-7                                                                 | 204-211-0              | N.D.              | 0.05                | Toxic for Reproduction<br>Equivalent level of concern having probable serious effects to the environment |
| Bis(tributyltin)oxide                                                                                | 56-35-9                                                                  | 200-268-0              | N.D.              | 0.05                | PBT                                                                                                      |
| Cobalt dichloride*                                                                                   | 7646-79-9                                                                | 231-589-4              | N.D.              | 0.005               | Carcinogen<br>Toxic for Reproduction                                                                     |
| 4,4-Diaminodiphenylmethane                                                                           | 101-77-9                                                                 | 202-974-4              | N.D.              | 0.05                | Carcinogen                                                                                               |
| Diarsenic pentaoxide*                                                                                | 1303-28-2                                                                | 215-116-9              | N.D.              | 0.005               | Carcinogen                                                                                               |
| Diarsenic trioxide*                                                                                  | 1327-53-3                                                                | 215-481-4              | N.D.              | 0.005               | Carcinogen                                                                                               |
| Dibutyl phthalate (DBP)                                                                              | 84-74-2                                                                  | 201-557-4              | N.D.              | 0.05                | Toxic for Reproduction                                                                                   |
| Hexabromocyclododecane (HBCDD) and all major diastereoisomers identified (α-HBCDD, β-HBCDD, γ-HBCDD) | 25637-99-4<br>3194-55-6<br>(134237-51-7,<br>134237-50-6,<br>134237-52-8) | 247-148-4<br>221-695-9 | N.D.              | 0.05                | PBT                                                                                                      |
| Lead hydrogen arsenate*                                                                              | 7784-40-9                                                                | 232-064-2              | N.D.              | 0.005               | Carcinogen<br>Toxic for Reproduction                                                                     |
| Sodium dichromate* (Sodium dichromate, dehydrate)                                                    | 10588-01-9<br>(7789-12-0)                                                | 234-190-3              | N.D.              | 0.005               | Carcinogen<br>Mutagen<br>Toxic for Reproduction                                                          |
| 5-tert-butyl-2,4,6-trinitro-m-xylene (musk xylene)                                                   | 81-15-2                                                                  | 201-329-4              | N.D.              | 0.05                | vPvB                                                                                                     |
| Triethyl arsenate*                                                                                   | 15606-95-8                                                               | 427-700-2              | N.D.              | 0.005               | Carcinogen                                                                                               |

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| Substance Name                                                    | CAS number | EC number | Concentration (%) | Reporting Limit (%) | Classification                       |
|-------------------------------------------------------------------|------------|-----------|-------------------|---------------------|--------------------------------------|
| Di-isobutyl phthalate(DIBP)                                       | 84-69-5    | 201-553-2 | N.D.              | 0.05                | Toxic for Reproduction               |
| 2,4-Dinitrotoluene                                                | 121-14-2   | 204-450-0 | N.D.              | 0.05                | Carcinogen                           |
| Tris(2-chloroethyl) phosphate                                     | 115-96-8   | 204-118-5 | N.D.              | 0.05                | Toxic for Reproduction               |
| Anthracene oil                                                    | 90640-80-5 | 292-602-7 | N.D.              | 0.05                | PBT; vPvB<br>Carcinogen              |
| Anthracene oil,<br>anthracene paste;<br>distn. Lights             | 91995-17-4 | 295-278-5 | N.D.              | 0.05                | PBT; vPvB<br>Carcinogen<br>Mutagen   |
| Anthracene oil,<br>anthracene paste,<br>anthracene fraction       | 91995-15-2 | 295-275-9 | N.D.              | 0.05                | PBT; vPvB<br>Carcinogen<br>Mutagen   |
| Anthracene oil,<br>anthracene-low                                 | 90640-82-7 | 292-604-8 | N.D.              | 0.05                | PBT; vPvB<br>Carcinogen<br>Mutagen   |
| Anthracene oil,<br>anthracene paste                               | 90640-81-6 | 292-603-2 | N.D.              | 0.05                | PBT; vPvB<br>Carcinogen<br>Mutagen   |
| Coal tar pitch,<br>high temperature                               | 65996-93-2 | 266-028-2 | N.D.              | 0.05                | PBT; vPvB<br>Carcinogen              |
| Lead sulfochromate yellow<br>(C.I. Pigment Yellow 34)*            | 1344-37-2  | 215-693-7 | N.D.              | 0.005               | Carcinogen<br>Toxic for Reproduction |
| Lead chromate molybdate<br>sulfate red (C.I. Pigment Red<br>104)* | 12656-85-8 | 235-759-9 | N.D.              | 0.005               | Carcinogen<br>Toxic for Reproduction |
| Lead chromate*                                                    | 7758-97-6  | 231-846-0 | N.D.              | 0.005               | Carcinogen<br>Toxic for Reproduction |
| Acrylamide                                                        | 79-06-01   | 201-173-7 | N.D.              | 0.05                | Carcinogen<br>Mutagen                |

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| Substance Name                           | CAS number                           | EC number              | Concentration (%) | Reporting Limit (%) | Classification                                  |
|------------------------------------------|--------------------------------------|------------------------|-------------------|---------------------|-------------------------------------------------|
| Boric acid*                              | 10043-35-3<br>11113-50-1             | 233-139-2<br>234-343-4 | N.D.              | 0.005               | Toxic for Reproduction                          |
| Disodium tetraborate, anhydrous*         | 1330-43-4<br>12179-04-3<br>1303-96-4 | 215-540-4              | N.D.              | 0.005               | Toxic for Reproduction                          |
| Tetraboron disodium heptaoxide, hydrate* | 12267-73-1                           | 235-541-3              | N.D.              | 0.005               | Toxic for Reproduction                          |
| Trichloroethylene                        | 79-01-6                              | 201-167-4              | N.D.              | 0.05                | Carcinogen                                      |
| Sodium chromate*                         | 7775-11-3                            | 231-889-5              | N.D.              | 0.005               | Carcinogen<br>Mutagen<br>Toxic for Reproduction |
| Ammonium dichromate*                     | 7789-09-5                            | 232-143-1              | N.D.              | 0.005               | Carcinogen<br>Mutagen<br>Toxic for Reproduction |
| Potassium dichromate*                    | 7778-50-9                            | 231-906-6              | N.D.              | 0.005               | Carcinogen<br>Mutagen<br>Toxic for Reproduction |
| Potassium chromate*                      | 7789-00-6                            | 232-140-5              | N.D.              | 0.005               | Carcinogen<br>Mutagen                           |

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| Substance Name                                                                                                                                        | CAS number                   | EC number                   | Concentration (%) | Reporting Limit (%) | Classification                       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|-----------------------------|-------------------|---------------------|--------------------------------------|
| Cobalt(II) sulphate*                                                                                                                                  | 10124-43-3                   | 233-334-2                   | N.D.              | 0.005               | Carcinogen<br>Toxic for Reproduction |
| Cobalt(II) dinitrate*                                                                                                                                 | 10141-05-6                   | 233-402-1                   | N.D.              | 0.005               | Carcinogen<br>Toxic for Reproduction |
| Cobalt(II) carbonate*                                                                                                                                 | 513-79-1                     | 208-169-4                   | N.D.              | 0.005               | Carcinogen<br>Toxic for Reproduction |
| Cobalt(II) diacetate*                                                                                                                                 | 71-48-7                      | 200-755-8                   | N.D.              | 0.005               | Carcinogen<br>Toxic for Reproduction |
| 2-Methoxyethanol                                                                                                                                      | 109-86-4                     | 203-713-7                   | N.D.              | 0.05                | Toxic for Reproduction               |
| 2-Ethoxyethanol                                                                                                                                       | 110-80-5                     | 203-804-1                   | N.D.              | 0.05                | Toxic for Reproduction               |
| Chromium trioxide*                                                                                                                                    | 1333-82-0                    | 215-607-8                   | N.D.              | 0.005               | Carcinogen<br>Mutagen                |
| Acids generated from chromium trioxide and their oligomers:<br><br>Chromic acid<br>Dichromic acid<br><br>Oligomers of chromic acid and dichromic acid | 7738-94-5<br>13530-68-2<br>- | 231-801-5<br>236-881-5<br>- | N.D.              | 0.005               | Carcinogen                           |
| 1-methyl-2-pyrrolidone                                                                                                                                | 872-50-4                     | 212-828-1                   | N.D.              | 0.05                | Toxic for Reproduction               |
| 2-ethoxyethyl acetate                                                                                                                                 | 111-15-9                     | 203-839-2                   | N.D.              | 0.05                | Toxic for Reproduction               |
| 1,2-benzenedicarboxylic acid, di-C6-8-branched alkyl esters, C7-rich                                                                                  | 71888-89-6                   | 276-158-1                   | N.D.              | 0.05                | Toxic for Reproduction               |
| 1,2-benzenedicarboxylic acid, di-C7-11-branched and linear alkyl esters                                                                               | 68515-42-4                   | 271-084-6                   | N.D.              | 0.05                | Toxic for Reproduction               |
| 1,2,3-trichloropropane                                                                                                                                | 96-18-4                      | 202-486-1                   | N.D.              | 0.05                | Carcinogen<br>Toxic for Reproduction |
| Hydrazine                                                                                                                                             | 7803-57-8<br>302-01-2        | 206-114-9                   | N.D.              | 0.05                | Carcinogen                           |
| Strontium chromate*                                                                                                                                   | 7789-06-2                    | 232-142-6                   | N.D.              | 0.005               | Carcinogen                           |

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|-------------------------------------------------------------------------------|-----------------------------|------------|-------------------|---------------------|-----------------------------------------------------------------------------------------|
| 1,2-Dichloroethane                                                            | 107-06-2                    | 203-458-1  | N.D.              | 0.05                | Carcinogenic                                                                            |
| 2,2'-dichloro-4,4'-methylenedianiline (MOCA)                                  | 101-14-4                    | 202-918-9  | N.D.              | 0.05                | Carcinogenic                                                                            |
| 2-Methoxyaniline<br>o-Anisidine                                               | 90-04-0                     | 201-963-1  | N.D.              | 0.05                | Carcinogenic                                                                            |
| 4-(1,1,3,3-tetramethylbutyl)<br>phenol, (4-tert-Octylphenol)                  | 140-66-9                    | 205-426-2  | N.D.              | 0.05                | Equivalent level of<br>concern having probable<br>serious effects to the<br>environment |
| Aluminosilicate Refractory<br>Ceramic Fibres* (RCF)                           | 650-017-00-8<br>(Index no.) | -          | N.D.              | 0.005               | Carcinogenic                                                                            |
| Arsenic acid*                                                                 | 7778-39-4                   | 231-901-9  | N.D.              | 0.005               | Carcinogenic                                                                            |
| Bis(2-methoxyethyl) ether                                                     | 111-96-6                    | 203-924-4  | N.D.              | 0.05                | Toxic for reproduction                                                                  |
| Bis(2-methoxyethyl)<br>phthalate                                              | 117-82-8                    | 204-212-6- | N.D.              | 0.05                | Toxic for reproduction                                                                  |
| Calcium arsenate*                                                             | 7778-44-1                   | 231-904-5  | N.D.              | 0.005               | Carcinogenic                                                                            |
| Dichromium tris(chromate)*                                                    | 24613-89-6                  | 246-356-2  | N.D.              | 0.005               | Carcinogenic                                                                            |
| Formaldehyde, oligomeric<br>reaction products with aniline<br>(technical MDA) | 25214-70-4                  | 500-036-1  | N.D.              | 0.05                | Carcinogenic                                                                            |
| Lead diazide*                                                                 | 13424-46-9                  | 236-542-1  | N.D.              | 0.005               | Toxic for reproduction                                                                  |
| Lead dipicrate*                                                               | 6477-64-1                   | 229-335-2  | N.D.              | 0.005               | Toxic for reproduction                                                                  |
| Lead styphnate*                                                               | 15245-44-0                  | 239-290-2  | N.D.              | 0.005               | Toxic for reproduction                                                                  |
| N,N-dimethylacetamide<br>(DMAC)                                               | 127-19-5                    | 204-826-4  | N.D.              | 0.05                | Toxic for reproduction                                                                  |
| Pentazinc chromate<br>octahydroxide*                                          | 49663-84-5                  | 256-418-0  | N.D.              | 0.005               | Carcinogenic                                                                            |
| Phenolphthalein                                                               | 77-09-8                     | 201-004-7  | N.D.              | 0.05                | Carcinogenic                                                                            |
| Potassium hydroxyocta-<br>oxodizincatedichromate*                             | 11103-86-9                  | 234-329-8  | N.D.              | 0.005               | Carcinogenic                                                                            |
| Trilead diarsenate*                                                           | 3687-31-8                   | 222-979-5  | N.D.              | 0.005               | Carcinogenic<br>Toxic for reproduction                                                  |

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| Substance Name                                                                                                                            | CAS number               | EC number | Concentration (%) | Reporting Limit (%) | Classification         |
|-------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|-----------|-------------------|---------------------|------------------------|
| Zirconia Aluminosilicate Refractory Ceramic Fibres (Zr-RCF)*                                                                              | 650-017-00-8 (Index no.) | -         | N.D.              | 0.005               | Carcinogenic           |
| 1,2-bis(2-methoxyethoxy) ethane (TEGDME; triglyme)                                                                                        | 112-49-2                 | 203-977-3 | N.D.              | 0.05                | Toxic for reproduction |
| 1,2-dimethoxyethane; ethylene glycol dimethyl ether (EGDME)                                                                               | 110-71-4                 | 203-794-9 | N.D.              | 0.05                | Toxic for reproduction |
| Diboron trioxide*                                                                                                                         | 1303-86-2                | 215-125-8 | N.D.              | 0.005               | Toxic for reproduction |
| Formamide                                                                                                                                 | 75-12-7                  | 200-842-0 | N.D.              | 0.05                | Toxic for reproduction |
| Lead(II) bis(methanesulfonate)*                                                                                                           | 17570-76-2               | 401-750-5 | N.D.              | 0.005               | Toxic for reproduction |
| TGIC(1,3,5-tris (oxiranyl methyl)-1,3,5-triazine-2,4,6-(1H,3H,5H)-trione)                                                                 | 2451-62-9                | 219-514-3 | N.D.              | 0.05                | Mutagenic              |
| β-TGIC (1,3,5-tris[(2S and 2R)-2,3-epoxypropyl]-1,3,5-triazine-2,4,6-(1H,3H,5H)-trione)**                                                 | 59653-74-6               | 423-400-0 | N.D.              | 0.05                | Mutagenic              |
| 4,4'-bis(dimethylamino) benzophenone (Michler's ketone)                                                                                   | 90-94-8                  | 202-027-5 | N.D.              | 0.05                | Carcinogenic           |
| N,N,N',N'-tetramethyl-4,4'-methylenedianiline (Michler's base)                                                                            | 101-61-1                 | 202-959-2 | N.D.              | 0.05                | Carcinogenic           |
| [4-[4,4'-bis(dimethylamino) benzhydrylidene]cyclohexa-2,5-dien-1-ylidene] dimethylammonium chloride (C.I. Basic Violet 3)                 | 548-62-9                 | 208-953-6 | N.D.              | 0.05                | Carcinogenic           |
| [4-[[4-anilino-1-naphthyl][4-(dimethylamino)phenyl]methylene]cyclohexa-2,5-dien-1-ylidene] dimethylammonium chloride (C.I. Basic Blue 26) | 2580-56-5                | 219-943-6 | N.D.              | 0.05                | Carcinogenic           |
| α,α-Bis[4-(dimethylamino) phenyl]-4 (phenylamino) naphthalene-1-methanol (C.I. Solvent Blue 4)                                            | 6786-83-0                | 229-851-8 | N.D.              | 0.05                | Carcinogenic           |
| 4,4'-bis(dimethylamino)-4''-(methylamino)trityl alcohol                                                                                   | 561-41-1                 | 209-218-2 | N.D.              | 0.05                | Carcinogenic           |

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| Substance Name                                                                                                                                                                                                                                                                     | CAS number | EC number | Concentration (%) | Reporting Limit (%) | Classification                                                            |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-----------|-------------------|---------------------|---------------------------------------------------------------------------|
| Bis(pentabromophenyl) ether (DecaBDE)                                                                                                                                                                                                                                              | 1163-19-5  | 214-604-9 | N.D.              | 0.05                | PBT<br>vPvB                                                               |
| Pentacosfluorotridecanoic acid                                                                                                                                                                                                                                                     | 72629-94-8 | 276-745-2 | N.D.              | 0.05                | vPvB                                                                      |
| Tricosfluorododecanoic acid                                                                                                                                                                                                                                                        | 307-55-1   | 206-203-2 | N.D.              | 0.05                | vPvB                                                                      |
| Henicosfluoroundecanoic acid                                                                                                                                                                                                                                                       | 2058-94-8  | 218-165-4 | N.D.              | 0.05                | vPvB                                                                      |
| Heptacosfluorotetradecanoic acid                                                                                                                                                                                                                                                   | 376-06-7   | 206-803-4 | N.D.              | 0.05                | vPvB                                                                      |
| 4-(1,1,3,3-tetramethylbutyl) phenol, ethoxylated - covering well-defined substances and UVCB substances, polymers and homologues                                                                                                                                                   | -          | -         | N.D.              | 0.05                | Equivalent level of concern - probable serious effects on the environment |
| 4-Nonylphenol, branched and linear - substances with a linear and/or branched alkyl chain with a carbon number of 9 covalently bound in position 4 to phenol, covering also UVCB- and well-defined substances which include any of the individual isomers or a combination thereof | -          | -         | N.D.              | 0.05                | Equivalent level of concern - probable serious effects on the environment |
| Diazene-1,2-dicarboxamide (C,C'-azodi(formamide))                                                                                                                                                                                                                                  | 123-77-3   | 204-650-8 | N.D.              | 0.05                | Equivalent level of concern - probable serious effects on human health    |
| Cyclohexane-1,2-dicarboxylic anhydride (Hexahydrophthalic anhydride - HHPA)                                                                                                                                                                                                        | 85-42-7    | 201-604-9 | N.D.              | 0.05                | Equivalent level of concern - probable serious effects on human health    |

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| Substance Name                                                                                                                                      | CAS number                                     | EC number                                  | Concentration (%) | Reporting Limit (%) | Classification                                                                                                   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|--------------------------------------------|-------------------|---------------------|------------------------------------------------------------------------------------------------------------------|
| Hexahydromethylphthalic anhydride, Hexahydro-4-methylphthalic anhydride, Hexahydro-1-methylphthalic anhydride, Hexahydro-3-methylphthalic anhydride | 25550-51-0, 19438-60-9, 48122-14-1, 57110-29-9 | 247-094-1, 243-072-0, 256-356-4, 260-566-1 | N.D.              | 0.05                | Equivalent level of concern - probable serious effects on human health                                           |
| Methoxy acetic acid                                                                                                                                 | 625-45-6                                       | 210-894-6                                  | N.D.              | 0.05                | Toxic for reproduction equivalent level of concern -probable serious effects on human health and the environment |
| 1,2-Benzenedicarboxylic acid, dipentylester, branched and linear                                                                                    | 84777-06-0                                     | 284-032-2                                  | N.D.              | 0.05                | Toxic for reproduction                                                                                           |
| Diisopentylphthalate (DIPP)                                                                                                                         | 605-50-5                                       | 210-088-4                                  | N.D.              | 0.05                | Toxic for reproduction                                                                                           |
| N-pentyl-isopentylphthalate                                                                                                                         | -                                              | -                                          | N.D.              | 0.05                | Toxic for reproduction                                                                                           |
| 1,2-Diethoxyethane                                                                                                                                  | 629-14-1                                       | 211-076-1                                  | N.D.              | 0.05                | Toxic for reproduction                                                                                           |
| N,N-dimethylformamide; dimethyl formamide                                                                                                           | 68-12-2                                        | 200-679-5                                  | N.D.              | 0.05                | Toxic for reproduction                                                                                           |
| Dibutyltin dichloride (DBT)                                                                                                                         | 683-18-1                                       | 211-670-0                                  | N.D.              | 0.05                | Toxic for reproduction                                                                                           |
| Acetic acid, lead salt, basic*                                                                                                                      | 51404-69-4                                     | 257-175-3                                  | N.D.              | 0.005               | Toxic for reproduction                                                                                           |
| Basic lead carbonate (trilead bis(carbonate)dihydroxide)*                                                                                           | 1319-46-6                                      | 215-290-6                                  | N.D.              | 0.005               | Toxic for reproduction                                                                                           |
| Lead oxide sulfate (basic lead sulfate)*                                                                                                            | 12036-76-9                                     | 234-853-7                                  | N.D.              | 0.005               | Toxic for reproduction                                                                                           |
| [Phthalato(2-)]dioxotrilead (dibasic lead phthalate)*                                                                                               | 69011-06-9                                     | 273-688-5                                  | N.D.              | 0.005               | Toxic for reproduction                                                                                           |

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| Substance Name                         | CAS number | EC number | Concentration (%) | Reporting Limit (%) | Classification         |
|----------------------------------------|------------|-----------|-------------------|---------------------|------------------------|
| Dioxobis(stearato)trilead*             | 12578-12-0 | 235-702-8 | N.D.              | 0.005               | Toxic for reproduction |
| Fatty acids, C16-18, lead salts*       | 91031-62-8 | 292-966-7 | N.D.              | 0.005               | Toxic for reproduction |
| Lead bis(tetrafluoroborate)*           | 13814-96-5 | 237-486-0 | N.D.              | 0.005               | Toxic for reproduction |
| Lead cyanamidate*                      | 20837-86-9 | 244-073-9 | N.D.              | 0.005               | Toxic for reproduction |
| Lead dinitrate*                        | 10099-74-8 | 233-245-9 | N.D.              | 0.005               | Toxic for reproduction |
| Lead oxide (lead monoxide)*            | 1317-36-8  | 215-267-0 | N.D.              | 0.005               | Toxic for reproduction |
| Lead tetroxide (orange lead)*          | 1314-41-6  | 215-235-6 | N.D.              | 0.005               | Toxic for reproduction |
| Lead titanium trioxide*                | 12060-00-3 | 235-038-9 | N.D.              | 0.005               | Toxic for reproduction |
| Lead Titanium Zirconium Oxide*         | 12626-81-2 | 235-727-4 | N.D.              | 0.005               | Toxic for reproduction |
| Pentalead tetraoxide sulphate*         | 12065-90-6 | 235-067-7 | N.D.              | 0.005               | Toxic for reproduction |
| Pyrochlore, antimony lead yellow*      | 8012-00-8  | 232-382-1 | N.D.              | 0.005               | Toxic for reproduction |
| Silicic acid, barium salt, lead-doped* | 68784-75-8 | 272-271-5 | N.D.              | 0.005               | Toxic for reproduction |
| Silicic acid, lead salt*               | 11120-22-2 | 234-363-3 | N.D.              | 0.005               | Toxic for reproduction |
| Sulfurous acid, lead salt, dibasic*    | 62229-08-7 | 263-467-1 | N.D.              | 0.005               | Toxic for reproduction |
| Tetraethyllead*                        | 78-00-2    | 201-075-4 | N.D.              | 0.005               | Toxic for reproduction |
| Tetralead trioxide sulphate*           | 12202-17-4 | 235-380-9 | N.D.              | 0.005               | Toxic for reproduction |

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| Substance Name                                     | CAS number  | EC number | Concentration (%) | Reporting Limit (%) | Classification            |
|----------------------------------------------------|-------------|-----------|-------------------|---------------------|---------------------------|
| Trilead dioxide phosphonate*                       | 12141-20-7  | 235-252-2 | N.D.              | 0.005               | Toxic for reproduction    |
| Furan                                              | 110-00-9    | 203-727-3 | N.D.              | 0.05                | Carcinogenic              |
| Propylene oxide; 1,2-epoxypropane; methyloxirane   | 75-56-9     | 200-879-2 | N.D.              | 0.05                | Carcinogenic<br>Mutagenic |
| Diethyl sulphate                                   | 64-67-5     | 200-589-6 | N.D.              | 0.05                | Carcinogenic<br>Mutagenic |
| Dimethyl sulphate                                  | 77-78-1     | 201-058-1 | N.D.              | 0.05                | Carcinogenic              |
| 3-ethyl-2-methyl-2-(3-methylbutyl)-1,3-oxazolidine | 143860-04-2 | 421-150-7 | N.D.              | 0.05                | Toxic for reproduction    |
| Dinoseb                                            | 88-85-7     | 201-861-7 | N.D.              | 0.05                | Toxic for reproduction    |
| 4,4'-methylenedi-o-toluidine                       | 838-88-0    | 212-658-8 | N.D.              | 0.05                | Carcinogenic              |
| 4,4'-oxydianiline and its salts                    | 101-80-4    | 202-977-0 | N.D.              | 0.05                | Carcinogenic<br>Mutagenic |
| 4-Aminoazobenzene;<br>4-Phenylazoaniline           | 60-09-3     | 200-453-6 | N.D.              | 0.05                | Carcinogenic              |
| 4-methyl-m-phenylenediamine (2,4-toluene-diamine)  | 95-80-7     | 202-453-1 | N.D.              | 0.05                | Carcinogenic              |
| 6-methoxy-m-toluidine (p-cresidine)                | 120-71-8    | 204-419-1 | N.D.              | 0.05                | Carcinogenic              |
| Biphenyl-4-ylamine                                 | 92-67-1     | 202-177-1 | N.D.              | 0.05                | Carcinogenic              |
| o-aminoazotoluene                                  | 97-56-3     | 202-591-2 | N.D.              | 0.05                | Carcinogenic              |
| o-Toluidine; 2-Aminotoluene                        | 95-53-4     | 202-429-0 | N.D.              | 0.05                | Carcinogenic              |
| N-methylacetamide                                  | 79-16-3     | 201-182-6 | N.D.              | 0.05                | Toxic for reproduction    |
| 1-bromopropane;<br>n-propyl bromide                | 106-94-5    | 203-445-0 | N.D.              | 0.05                | Toxic for reproduction    |

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| Substance Name                                                                                                                                                                                                                                                                                                                      | CAS number | EC number | Concentration (%) | Reporting Limit (%) | Classification                                                                 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-----------|-------------------|---------------------|--------------------------------------------------------------------------------|
| Cadmium                                                                                                                                                                                                                                                                                                                             | 7440-43-9  | 231-152-8 | N.D.              | 0.005               | Carcinogenic                                                                   |
| Cadmium oxide*                                                                                                                                                                                                                                                                                                                      | 1306-19-0  | 215-146-2 | N.D.              | 0.005               | Carcinogenic                                                                   |
| Dipentyl phthalate (DPP)                                                                                                                                                                                                                                                                                                            | 131-18-0   | 205-017-9 | N.D.              | 0.05                | Toxic for reproduction                                                         |
| 4-Nonylphenol, branched and linear, ethoxylated [substances with a linear and/or branched alkyl chain with a carbon number of 9 covalently bound in position 4 to phenol, ethoxylated covering UVCB- and well-defined substances, polymers and homologues, which include any of the individual isomers and/or combinations thereof] | -          | -         | N.D.              | 0.05                | Equivalent level of concern having probable serious effects to the environment |
| Ammonium pentadecafluorooctanoate (APFO)                                                                                                                                                                                                                                                                                            | 3825-26-1  | 223-320-4 | N.D.              | 0.05                | Toxic for reproduction                                                         |
| Pentadecafluorooctanoic acid (PFOA)                                                                                                                                                                                                                                                                                                 | 335-67-1   | 206-397-9 | N.D.              | 0.05                | Toxic for reproduction                                                         |

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| Substance Name                                                                                                                                       | CAS number | EC number | Concentration (%) | Reporting Limit (%) | Classification                                                                              |
|------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-----------|-------------------|---------------------|---------------------------------------------------------------------------------------------|
| Dihexyl phthalate                                                                                                                                    | 84-75-3    | 201-559-5 | N.D.              | 0.05                | Toxic for reproduction                                                                      |
| Trixylyl phosphate                                                                                                                                   | 25155-23-1 | 246-677-8 | N.D.              | 0.05                | Toxic for reproduction                                                                      |
| Imidazolidine-2-thione;<br>2-imidazoline-2-thiol                                                                                                     | 96-45-7    | 202-506-9 | N.D.              | 0.05                | Toxic for reproduction                                                                      |
| Disodium 4-amino-3-[[4'-[(2,4-diaminophenyl)azo][1,1'-biphenyl]-4-yl]azo]-5-hydroxy-6-(phenylazo)naphthalene-2,7-disulphonate (C.I. Direct Black 38) | 1937-37-7  | 217-710-3 | N.D.              | 0.05                | Carcinogenic                                                                                |
| Disodium 3,3'-[[1,1'-biphenyl]-4,4'-diylbis(azo)]bis(4-aminonaphthalene-1-sulphonate) (C.I. Direct Red 28)                                           | 573-58-0   | 209-358-4 | N.D.              | 0.05                | Carcinogenic                                                                                |
| Cadmium sulphide*                                                                                                                                    | 1306-23-6  | 215-147-8 | N.D.              | 0.005               | Carcinogenic<br>Equivalent level of concern having probable serious effects to human health |
| Lead di(acetate)*                                                                                                                                    | 301-04-2   | 206-104-4 | N.D.              | 0.005               | Toxic for reproduction                                                                      |

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| Substance Name                                                   | CAS number | EC number              | Concentration (%) | Reporting Limit (%) | Classification                                                                                                                     |
|------------------------------------------------------------------|------------|------------------------|-------------------|---------------------|------------------------------------------------------------------------------------------------------------------------------------|
| 1,2-Benzenedicarboxylic acid, dihexyl ester, branched and linear | 68515-50-4 | 271-093-5              | N.D.              | 0.05                | Toxic for reproduction                                                                                                             |
| Cadmium chloride*                                                | 10108-64-2 | 233-296-7              | N.D.              | 0.005               | Carcinogenic<br>Mutagenic<br>Toxic for Reproduction<br>Equivalent level of concern having probable serious effects to human health |
| Sodium perborate*; perboric acid, sodium salt*                   | -          | 239-172-9<br>234-390-0 | N.D.              | 0.005               | Toxic for reproduction                                                                                                             |
| Sodium peroxometaborate*                                         | 7632-04-4  | 231-556-4              | N.D.              | 0.005               | Toxic for reproduction                                                                                                             |

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| Substance Name                                                                                                                                                                                                                                               | CAS number                | EC number | Concentration (%) | Reporting Limit (%) | Classification                                                                                                                      |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|-----------|-------------------|---------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| 2-benzotriazol-2-yl-4,6-di-tert-butylphenol (UV-320)                                                                                                                                                                                                         | 3846-71-7                 | 223-346-6 | N.D               | 0.05                | PBT<br>vPvB                                                                                                                         |
| 2-(2H-benzotriazol-2-yl)-4,6-ditertpentylphenol (UV-328)                                                                                                                                                                                                     | 25973-55-1                | 247-384-8 | N.D               | 0.05                | PBT<br>vPvB                                                                                                                         |
| 2-ethylhexyl 10-ethyl-4,4-dioctyl-7-oxo-8-oxa-3,5-dithia-4-stannatetradecanoate (DOTE)                                                                                                                                                                       | 15571-58-1                | 239-622-4 | N.D               | 0.05                | Toxic for Reproduction                                                                                                              |
| Reaction mass of 2-ethylhexyl 10-ethyl-4,4-dioctyl-7-oxo-8-oxa-3,5-dithia-4-stannatetradecanoate and 2-ethylhexyl 10-ethyl-4-[[2-[(2-ethylhexyl)oxy]-2-oxoethyl]thio]-4-octyl-7-oxo-8-oxa-3,5-dithia-4-stannatetradecanoate (reaction mass of DOTE and MOTE) | -                         | -         | N.D               | 0.05                | Toxic for Reproduction                                                                                                              |
| Cadmium fluoride                                                                                                                                                                                                                                             | 7790-79-6                 | 232-222-0 | N.D               | 0.005               | Carcinogenic<br>Mutagenic<br>Toxic for Reproduction<br>Equivalent level of concern having probable serious effects to human health  |
| Cadmium sulphate                                                                                                                                                                                                                                             | 10124-36-4;<br>31119-53-6 | 233-331-6 | N.D               | 0.005               | Carcinogenic<br>Mutagenic;<br>Toxic for Reproduction<br>Equivalent level of concern having probable serious effects to human health |

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### Note:

1. RL = Reporting Limit
2. N.D. = Not detected (lower than RL)

N.A. = Not applicable for respective material type.

The submitted sample was found to contain significant amount of specific element(s) of SVHC. Upon further test verification and also information provided from client, the possibility that the element(s) content originate from SVHC is very unlikely, even though their presence cannot be exclude entirely. It may be assumed that the detected element(s) have a non-SVHC source.

3. Definition of classification is listed in Appendix A of this report in accordance with 67/548/EEC and Regulation (EC) No 1907/2006. For detail information, Detail explanation is available at the following link:  
<http://echa.europa.eu/web/quest/candidate-list-table> (Candidate list)  
[http://echa.europa.eu/proposals-to-identify-substances-of-very-high-concern-previous-consultations?p\\_p\\_id=substancetypeelist\\_WAR\\_substanceportlet&p\\_p\\_lifecycle=0&p\\_p\\_state=normal&p\\_p\\_mode=view&p\\_p\\_col\\_id=column-1&p\\_p\\_col\\_pos=2&p\\_p\\_col\\_count=4&substancetypeelis](http://echa.europa.eu/proposals-to-identify-substances-of-very-high-concern-previous-consultations?p_p_id=substancetypeelist_WAR_substanceportlet&p_p_lifecycle=0&p_p_state=normal&p_p_mode=view&p_p_col_id=column-1&p_p_col_pos=2&p_p_col_count=4&substancetypeelis)  
 (Proposals to identify SVHC consultations)
4. \*.The test result is based on the calculation of selected element(s) / marker(s) and to the worst-case scenario. For detail information, please refer to the SGS REACH website: [www.reach.sgs.com/substance-of-very-high-concern-analysis-information-page.htm](http://www.reach.sgs.com/substance-of-very-high-concern-analysis-information-page.htm)  
 The client is advised to review the chemical formulation to ascertain above metal substances present in the article.  
 RL = 0.005% is evaluated for element (i.e. cobalt, arsenic, lead, sodium, chromium, chromium(VI), silicon, aluminum, zirconium, boron, and potassium respectively), except molybdenum RL=0.0005%  
 0.1% (w/w) = 1,000 ppm = 1,000 mg/kg
5. \*\*.β-TGIC is one of the isomers for TGIC compounds and hence, tested together. The reported test result is based the proposed ratio as according to ECHA dossier.

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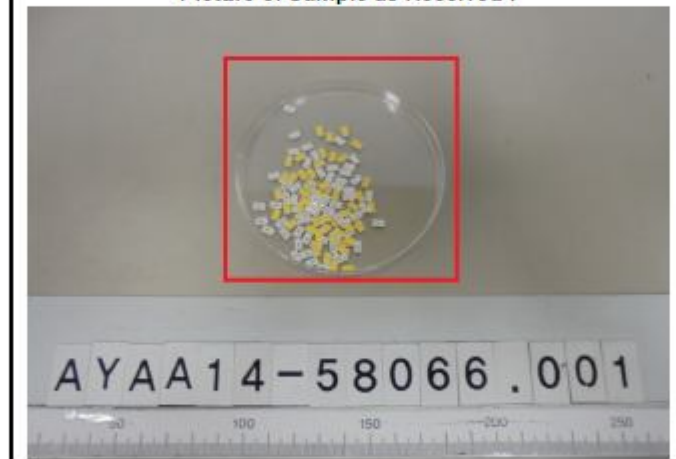
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Picture of Sample as Received :



\*\*\* End of Report \*\*\*

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## Appendix A

| Classification                    | Definition under 67/548/EEC and Regulation (EC) No 1907/2006                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Carcinogen Category 1:            | <u>Substances known to be carcinogenic to man.</u> There is sufficient evidence to establish a causal association between human exposure to a substance and the development of cancer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Carcinogen Category 2:            | <u>Substances which should be regarded as if they are carcinogenic to man.</u> There is sufficient evidence to provide a strong presumption that human exposure to a substance may result in the development of cancer.<br>Generally on the basis of:<br>- appropriate long-term animal studies<br>- other relevant information.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Mutagen Category 1:               | <u>Substances known to be mutagenic to man.</u> There is sufficient evidence to establish a causal association between human exposure to a substance and heritable genetic damage.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Mutagen Category 2:               | <u>Substances which should be regarded as if they are mutagenic to man.</u> There is sufficient evidence to provide a strong presumption that human exposure to the substance may result in the development of heritable genetic damage, generally on the basis of:<br>- appropriate animal studies,<br>- other relevant information.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Toxic to Reproduction Category 1: | <u>Substances known to impair fertility in humans.</u> There is sufficient evidence to establish a causal relationship between human exposure to the substance and impaired fertility.<br><u>Substances known to cause developmental toxicity in humans.</u> There is sufficient evidence to establish a causal relationship between human exposure to the substance and subsequent developmental toxic effects in the progeny.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Toxic to Reproduction Category 2: | <u>Substances which should be regarded as if they impair fertility in humans.</u> There is sufficient evidence to provide a strong presumption that human exposure to the substance may result in impaired fertility on the basis of:<br>- clear evidence in animal studies of impaired fertility in the absence of toxic effects, or, evidence of impaired fertility occurring at around the same dose levels as other toxic effects but which is not a secondary nonspecific consequence of the other toxic effects,<br>- other relevant information.<br><u>Substances which should be regarded as if they cause developmental toxicity to humans.</u> There is sufficient evidence to provide a strong presumption that human exposure to the substance may result in developmental toxicity, generally on the basis of:<br>- clear results in appropriate animal studies where effects have been observed in the absence of signs of marked maternal toxicity, or at around the same dose levels as other toxic effects but which are not a secondary non-specific consequence of the other toxic effects,<br>- other relevant information. |
| PBT & vPvB:                       | Substances which are persistent, bioaccumulative and toxic (PBT) or very persistent and very bioaccumulative (vPvB) pose a particular challenge to the chemicals safety management. For these substances a "safe" concentration in the environment cannot be established with sufficient reliability.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

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## Revision History

| Date       | No. | Revision History                                                                                                      | Writer    |          |
|------------|-----|-----------------------------------------------------------------------------------------------------------------------|-----------|----------|
|            |     |                                                                                                                       | Drawn     | Approved |
| 2013.02.08 | 1.0 | New version.                                                                                                          | W.H Jung  | Y.T KIM  |
| 2013.03.06 | 2.0 | Add up Quarter and half of color binning.                                                                             | W.H Jung  | Y.T KIM  |
| 2013.03.25 | 3.0 | 1) Change of tapping Q'ty from 2,000 pcs to 2,500 pcs.<br>2) Change of CIE tolerance x,y:±0.005                       | C.H. KWON | Y.T KIM  |
| 2013.05.14 | 4.0 | Add up a mark of UL certification.                                                                                    | W.H Jung  | Y.T KIM  |
| 2013.06.25 | 5.0 | 1) Add up ErP(Energy-related Products) of the Energy regulation.<br>2) Change of Graph on Color shift Characteristics | W.H Jung  | Y.T KIM  |
| 2013.11.09 | 6.0 | 1) Deletes ErP(Energy-related Products) codes in the product data sheet.                                              | W.H Jung  | S.B Yun  |
| 2014.01.23 | 7.0 | 1) Update of SGS data.<br>2) Deletes UL mark of the label on the reel.<br>3) Add up a Small box                       | W.H Jung  | S.B Yun  |
| 2015.02.03 | 8.0 | Maximum Current upgrade(150→180mA)                                                                                    | Y.J Cho   | J.K Park |
|            |     |                                                                                                                       |           |          |
|            |     |                                                                                                                       |           |          |
|            |     |                                                                                                                       |           |          |
|            |     |                                                                                                                       |           |          |