

# LH524B – 5250 AC LED



## Introduction

### Features

- Beam Angle: 115°
- Precondition : JEDEC Level 2a
- Dimension : 5.2 x 5.0 x 0.9 mm
- ESD withstand Voltage : up to  $\pm 3$ KV [HBM]

### Applications

- INDOOR LIGHTING : Ambient Light, LED tube, Down light, LED bulb and Ceiling Light

## **SAMSUNG ELECTRONICS**

95, Samsung2-Ro, Giheung-Gu,  
Yongin-City, Gyeonggi-Do 446-711, KOREA



## Contents

1. Product Code Information	-----	3
2. Characteristics	-----	6
3. Resistor Table	-----	7
4. Typical Radiation Pattern	-----	8
5. Relative Spectral Distribution	-----	8
6. Reference Circuit	-----	9
7. Relative luminous flux vs. AC power	-----	9
8. Thermal Characteristics	-----	10
9. Derating Curves	-----	11
10. Outline Drawing & Dimension	-----	12
11. Reliability Test Items & Conditions	-----	13
12. Solder Conditions	-----	14
13. Taping Dimension	-----	15
14. Label Structure	-----	16
15. Lot Number	-----	16
16. Reel Packing Structure	-----	17
17. Aluminum Packing Bag	-----	19
18. Precaution For Use	-----	20
19. Hazard Substance Analysis		23



# 1. Product Code Information

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

Nominal CCT	Product Code	Flux Rank	Sorting Condition $I_m$ @ $25^\circ\text{C}$ 2W AC operation <sup>2)</sup>
			Flux Range ( $\Phi_v, I_m$ ) <sup>1)</sup>
2700K	SPHWHTHAN205S0W0JZ	J2	120 ~ 140
		M2	140 ~ 160
		PZ	160 ~
3000K	SPHWHTHAN205S0V0JZ	J2	120 ~ 140
		M2	140 ~ 160
		PZ	160 ~

### Notes:

1) SAMSUNG ELECTRONICS maintains a tolerance of  $\pm 5\%$  on Luminous Flux measurements.

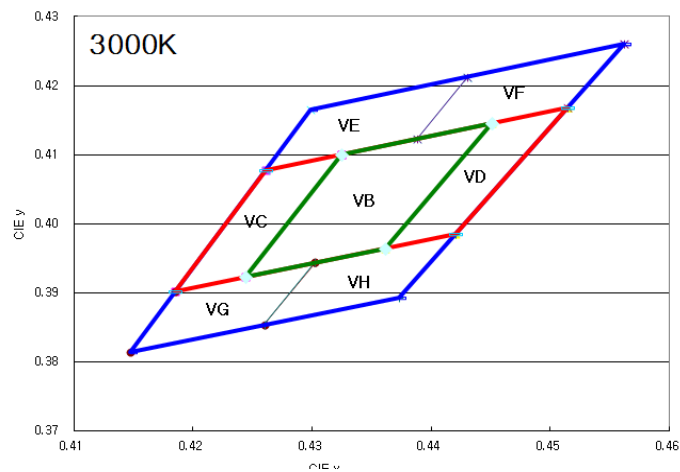
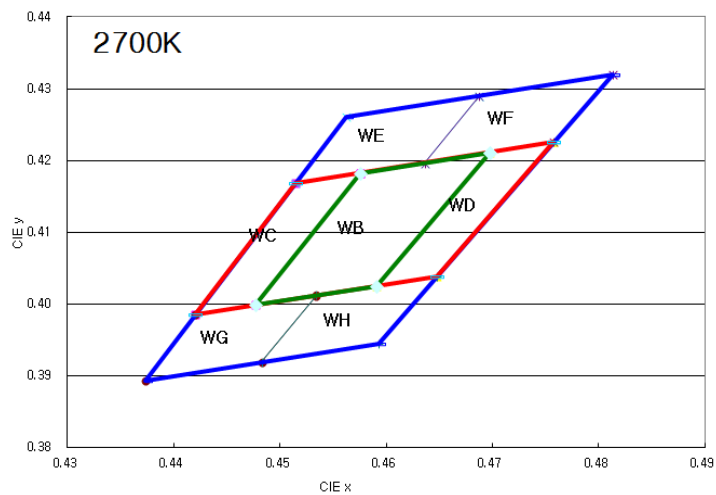
2) Luminous flux is measured in AC operation mode, in which an AC voltage source of 220V [RMS] drives LH524B with a ballast resistor connected in series ( see "*series connection*" on p.9). The ballast resistor is selected from three pre-defined ones (i.e.,  $3.0\text{k}\Omega$ ,  $3.6\text{k}\Omega$ , and  $4.2\text{k}\Omega$ ) in such a way that maintains AC driving current at the desired level of 13.5mA [RMS] with  $\pm 15\%$  tolerance ( see "*Resistor Table*" on p.7).

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

### 1) Color Binning

Nominal CCT	Product Code	Color Rank	Chromaticity Bins
2700K	SPHWHTHAN205S0W0JZ	W0(Whole bin)	WB, WC, WD, WE, WF, WG, WH
3000K	SPHWHTHAN205S0V0JZ	V0(Whole bin)	VB, VC, VD, VE, VF, VG, VH

### 2) Chromaticity Region & Coordinates





## 2) Chromaticity Region & Coordinates (Continued)

Region	CIE X	CIE Y
W rank (2700K)		
WB	0.4697	0.4211
	0.4576	0.4183
	0.4477	0.3998
	0.4591	0.4024
WC	0.4576	0.4183
	0.4515	0.4168
	0.4420	0.3985
	0.4477	0.3998
WD	0.4758	0.4225
	0.4697	0.4211
	0.4591	0.4024
	0.4648	0.4038
WE	0.4688	0.4290
	0.4562	0.4260
	0.4515	0.4168
	0.4636	0.4196
WF	0.4813	0.4319
	0.4688	0.4290
	0.4636	0.4196
	0.4758	0.4225
WG	0.4534	0.4012
	0.4420	0.3985
	0.4373	0.3893
	0.4483	0.3919
WH	0.4648	0.4038
	0.4534	0.4012
	0.4483	0.3919
	0.4593	0.3944

Region	CIE X	CIE Y
V rank (3000K)		
VB	0.4451	0.4146
	0.4324	0.4100
	0.4244	0.3922
	0.4361	0.3964
VC	0.4324	0.4100
	0.4261	0.4077
	0.4185	0.3902
	0.4244	0.3922
VD	0.4515	0.4168
	0.4451	0.4146
	0.4361	0.3964
	0.4420	0.3985
VE	0.4431	0.4213
	0.4299	0.4165
	0.4261	0.4077
	0.4388	0.4122
VF	0.4562	0.4260
	0.4431	0.4213
	0.4388	0.4122
	0.4515	0.4168
VG	0.4303	0.3944
	0.4185	0.3902
	0.4147	0.3814
	0.4260	0.3854
VH	0.4420	0.3985
	0.4303	0.3944
	0.4260	0.3854
	0.4373	0.3893

Notes:

SAMSUNG ELECTRONICS maintains  $\pm 0.005$  tolerance of CCx, CCy

## 2. Characteristics

### 1) Absolute Maximum Rating

Item	Symbol	Rating	Condition
Operating temperature range	$T_{op}$	-40°C ~ +75°C	-
Storage temperature range	$T_{stg}$	-40°C ~ +120°C	-
Temperature of Solder Pad <sup>6)</sup>	$T_s$	85°C	-
Average Power Dissipation in AC operation mode <sup>3-4)</sup>	$P_d$	3W	220~240Vac
			100~120Vac
RMS Current <sup>5)</sup> in AC operation mode <sup>1-2)</sup>	$I_f$	19.5 mA	220~240Vac
			39 mA
Assembly Process Temperature	-	260°C, < 10sec	-
ESD	-	3kV	HBM

1) Max 19.5mA (RMS) current is allowed by 220~240Vac configuration. Refer to [ Resistor Table ] on p.7.

2) Max 39mA (RMS) current is allowed by 100~120Vac configuration. Refer to [ Resistor Table ] on p.7.

3) Average power dissipation only by the LED in AC operation. Power dissipation by any ballast component that is connected to the LED is not included.

4) DC operation (constant current operation) of LH524B must be avoided.

\* 5) RMS (Root mean square) current indicates AC operation at 50~60Hz

6) See *Ts point & measurement method* on p.12

### 2) Electro-optical Characteristics

Item	Unit	Nominal CCT	Rank	Min		Max
Luminous Flux <sup>1)</sup> ( $\Phi_v$ ) (@ 2W AC operation, $T_s = 25^\circ\text{C}$ ) <sup>3)</sup>	lm	2700K (W☆)	J2	120	~	140
			M2	140	~	160
			PZ	160	~	-
		3000K (V☆)	J2	120	~	140
			M2	140	~	160
			PZ	160	~	-
Color Rendering Index <sup>2)</sup> ( $R_a$ )	-	-		80	-	-

#### Notes:

1)~2) SAMSUNG ELECTRONICS maintains a tolerance of  $\Phi_v$ :±5 %,  $R_a$  :±3.0 on measurements

3) See *series connection* on p.9

### 3. Resistor Table

AC mains	Vf Bin	Parallel connection <sup>[2]</sup>	
		2W operation [ I <sub>F</sub> = 27 mA]	3W operation [ I <sub>F</sub> = 39 mA]
100Vac	F1	0.8 kΩ	0.4 kΩ
	F3	0.7 kΩ	0.35 kΩ
	F5	0.6 kΩ	0.27 kΩ
110Vac	F1	1.1 kΩ	0.7 kΩ
	F3	1 kΩ	0.6 kΩ
	F5	0.9 kΩ	0.5 kΩ
120Vac	F1	1.4 kΩ	1 kΩ
	F3	1.3 kΩ	0.9 kΩ
	F5	1.2 kΩ	0.8 kΩ
AC mains	Vf Bin	Serial connection <sup>[2]</sup>	
		2W operation [ I <sub>F</sub> = 13.5 mA]	3W operation [ I <sub>F</sub> = 19.5 mA]
220Vac	F1	4.2 kΩ	2.8 kΩ
	F3	3.6 kΩ	2.4 kΩ
	F5	3.0 kΩ	2.0 kΩ
230Vac	F1	4.5 kΩ	3.1 kΩ
	F3	3.9 kΩ	2.7 kΩ
	F5	3.3 kΩ	2.3 kΩ
240Vac	F1	4.8 kΩ	3.4 kΩ
	F3	4.2 kΩ	3 kΩ
	F5	3.6 kΩ	2.6 kΩ

※ I<sub>F</sub> tolerance : ±15%

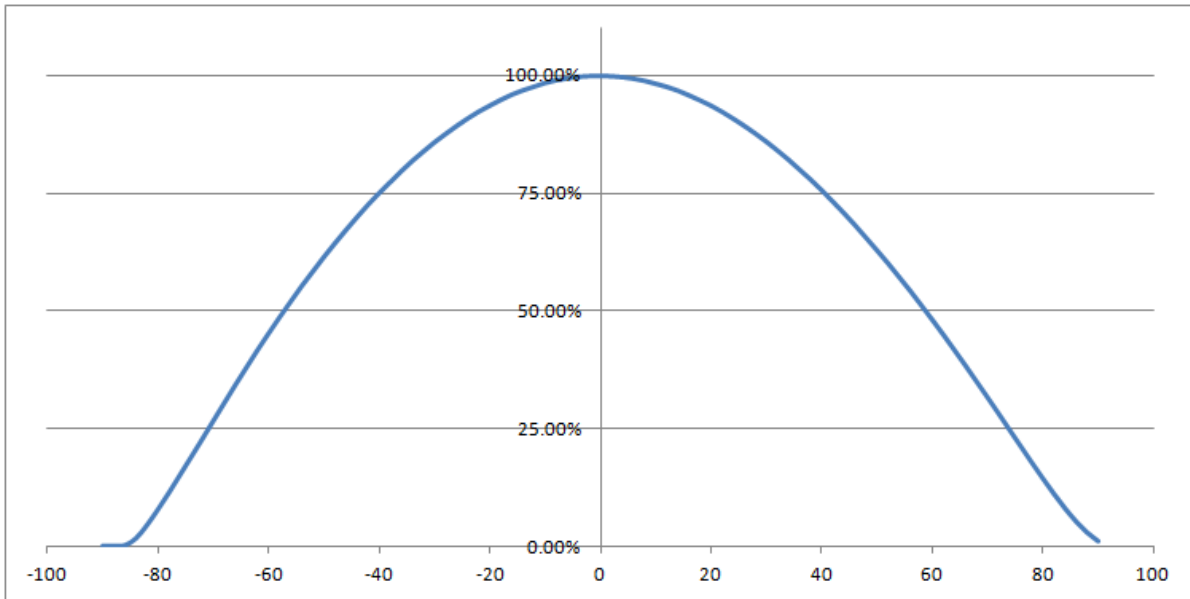
I<sub>F</sub> means RMS (Root mean square) value of current across LH524B by AC operation at 50~60Hz

**Notes:**

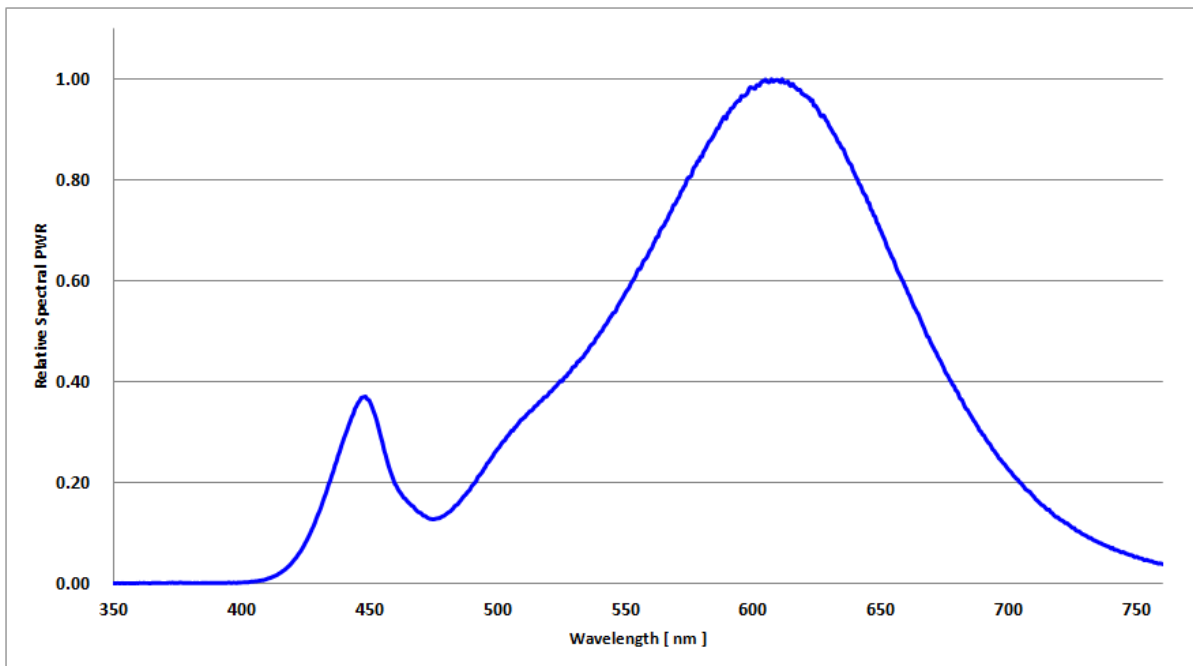
[1] Proper selection of resistor values should be made for LH524B to be driven at the desired current level with acceptable tolerance specified above. The table above summarizes recommended resistor values for the mains voltages by country, and the V<sub>F</sub> rank.

[2] LH524B can be wired in two types of configuration : one is serial connection to be applicable to the mains of 220~240Vac, and the other is parallel connection to the mains of 100~120Vac. For circuit configuration, see "6.Reference circuit" on p.9.

## 4. Typical Radiation Pattern

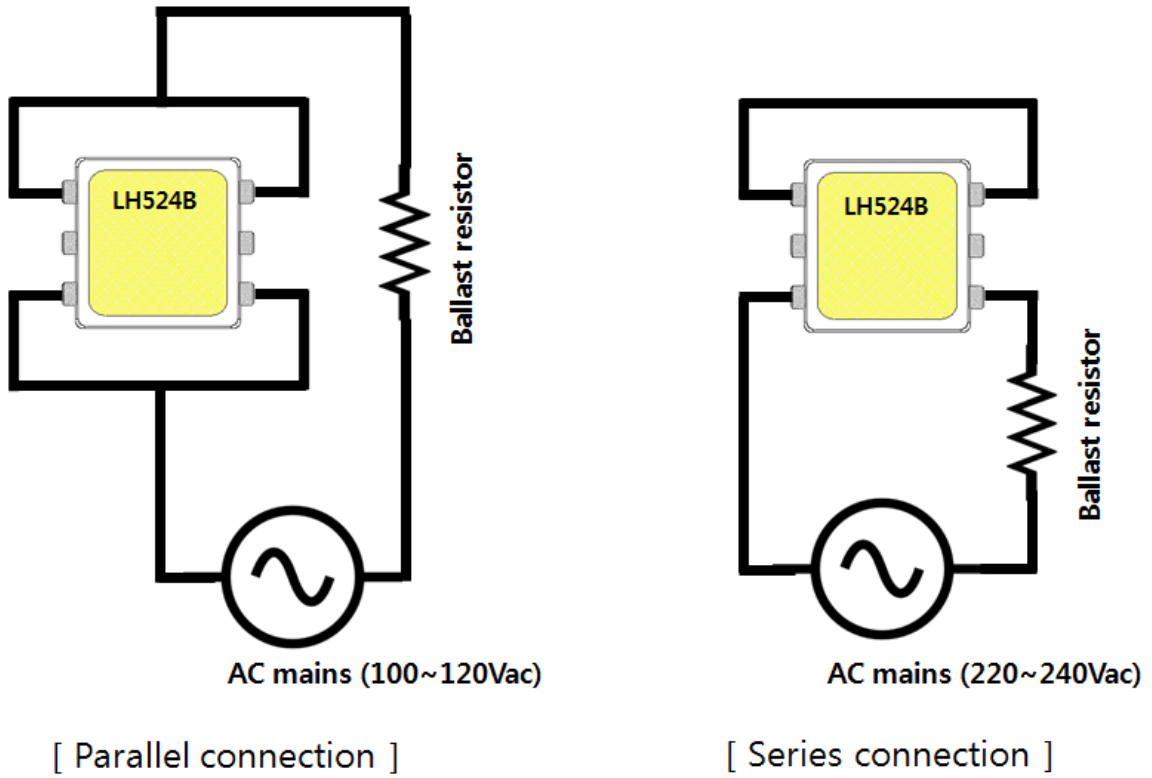


## 5. Relative spectral distribution [ 2700K, 3000K ]

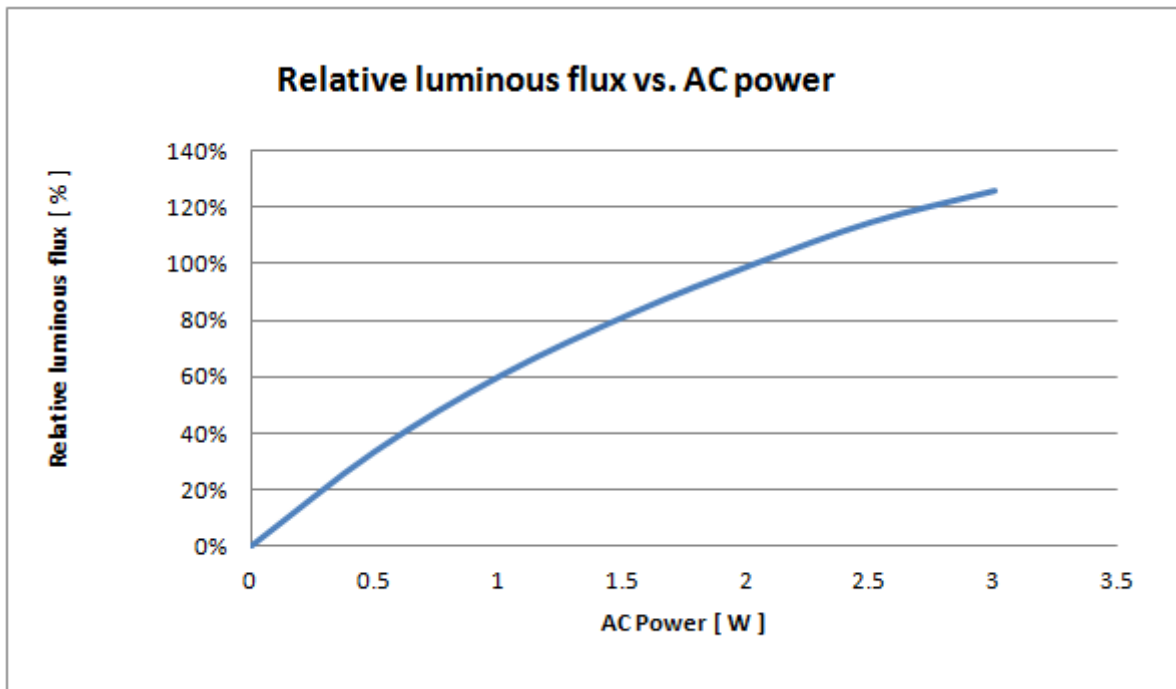




## 6. Reference circuit

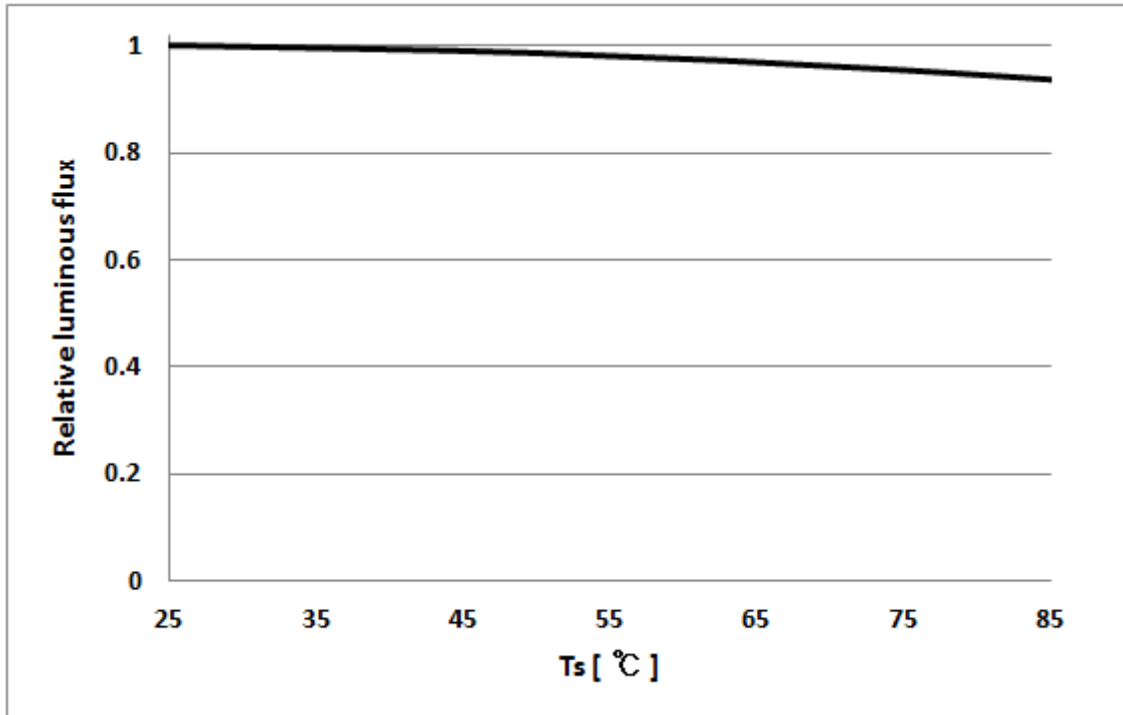


## 7. Relative luminous flux vs. AC power @ 25°C

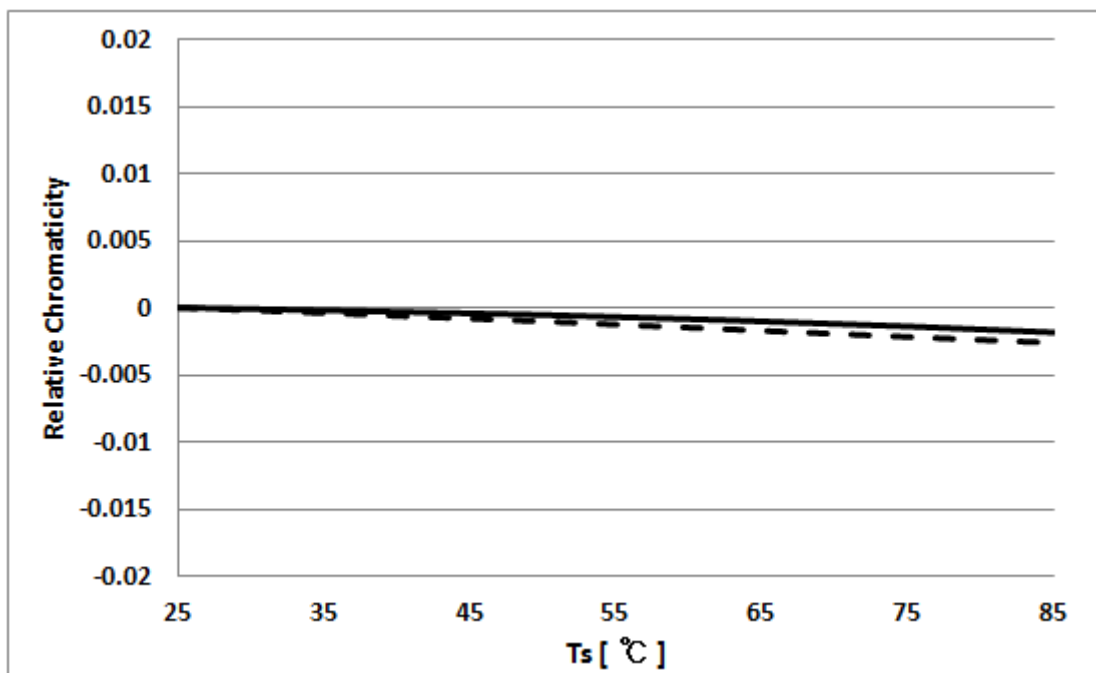


## 8. Thermal characteristics

### 1) Relative luminous flux vs. $T_s$

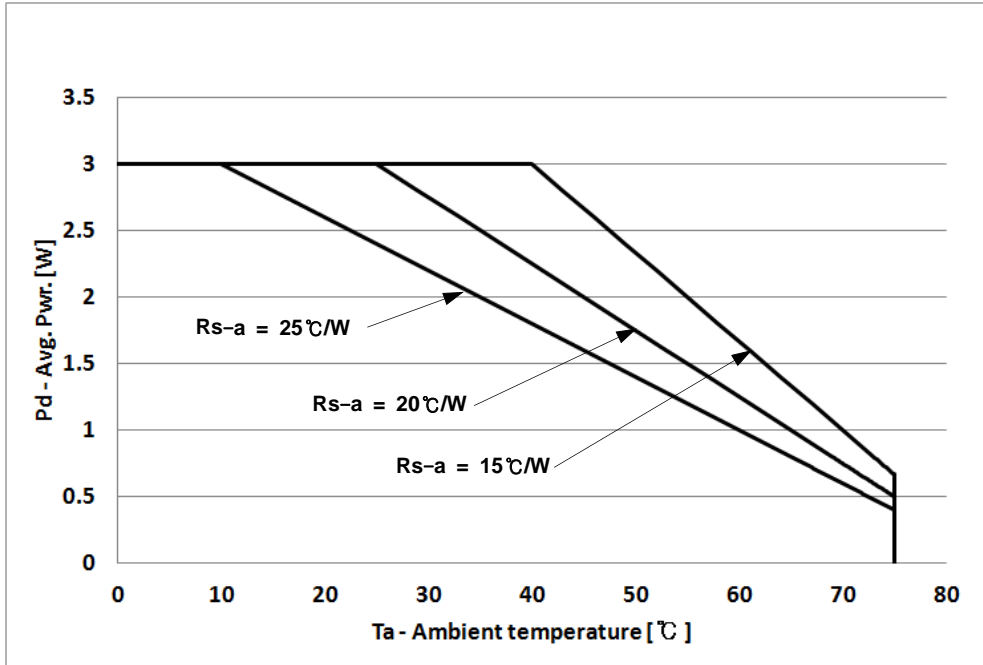


### 2) Relative chromaticity vs. $T_s$



## 9. Derating Curve

Derating curve for 3W AC driving <sup>1)</sup>



1) Maximum power consumption in AC Operation mode based on max.  $T_s = 85\text{°C}$

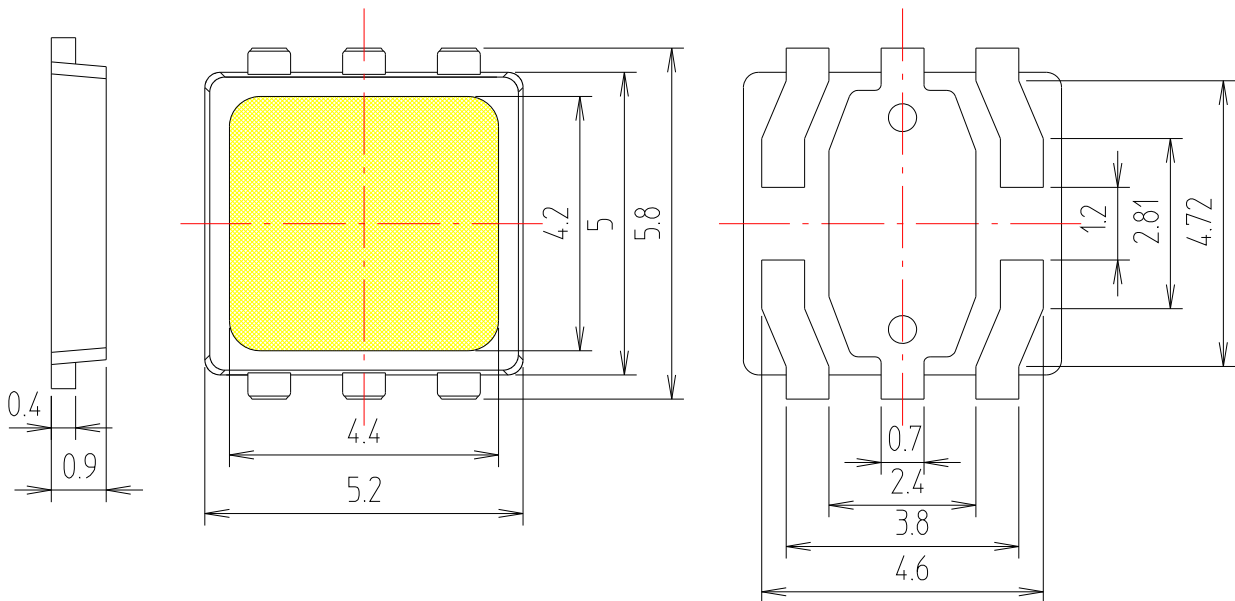
## 10. Outline Drawing & Dimension

1. Tolerance is  $\pm 0.10$  mm
2. The maximum compressing force is 15N on the body <sup>(a)</sup>
3. Do not place pressure on the encapsulation resin <sup>(b)</sup>

**Left Side View**

**Top View**

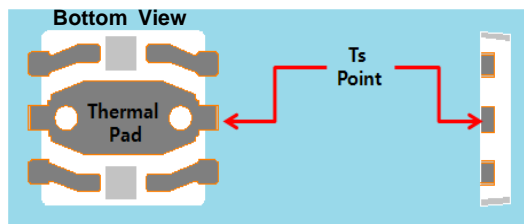
**Bottom View**



### Notes:

#### 1) 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.

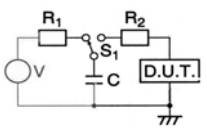


#### 2) Precautions

- 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.

# 11 Reliability Test Items and Conditions

## 1) Test Items

Test Item	Test Conditions	Test Hours/Cycles	Sample No
MSL Test	125 °C 24hrs drying → 60 °C, 60 %RH 120hrs → 260 °C 10sec 3 cycles	1 cycle	11
Room Temperature life test	25 °C±3 °C, IF = Max AC 13.5mA (RMS)	1,000 hrs	22
High Temperature life test	Ts=85 °C±3 °C, IF = Max AC 13.5mA (RMS)	1,000 hrs	22
High Temperature humidity life test	85 °C±3 °C, 85 %±2 %RH, IF = Max AC 13.5mA (RMS)	1,000 hrs	22
Low Temperature life test	-40 °C±3 °C, IF = Max AC 13.5mA (RMS)	1,000 hrs	22
Powered Temperature Cycle test	-45°C/20 min ↔ 85°C/20 min, Sweep 100min cycle on/off: each 5 min, AC 13.5mA	100 cycle	22
Thermal Shock	-45 °C/15 min ↔ 125 °C/15 min → Hot plate 180 °C	500 cycle	100
High Temperature Storage	Ta=120 °C±3 °C	1000 hrs	11
Low Temperature Storage	Ta=-40 °C±3 °C	1000 hrs	11
ESD(HBM)	 <p>R1:10 MΩ, R2:1.5 kΩ, C:100 pF, V = ±3 kV</p>	5 times	5
Vibration Test	20~2000~20 Hz 200 m/s <sup>2</sup> , Sweep 4 min X, Y, Z 3 direction, each 1 cycle	4 cycles	11
Mechanical Shock Test	1500G, 0.5 ms, 3 shocks each X-Y-Z axis	5 cycles	11

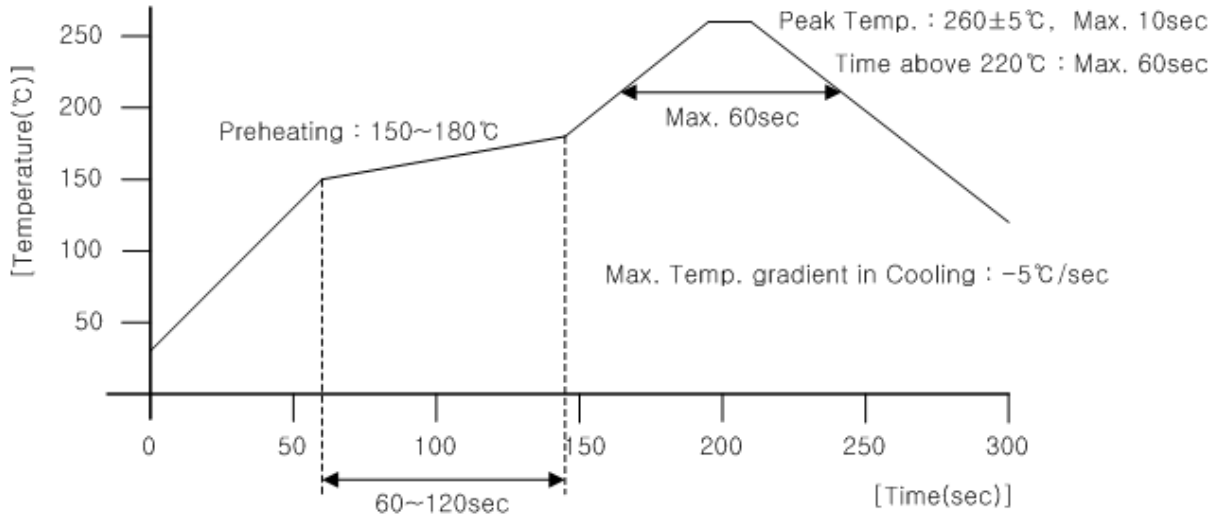
## 2) Criteria for Judging the Damage

Item	Symbol	Test Condition	Limit	
			Min	Max
Luminous Flux	$\Phi_v$	AC 2W (see series connection on p.9)	Init. Value*0.7	Init. Value*1.2
RMS Current	$I_r$	AC 2W (see series connection on p.9)	Init. Value*0.7	Init. Value*1.2

## 12. Solder Conditions

### 1) Reflow Conditions ( Pb Free )

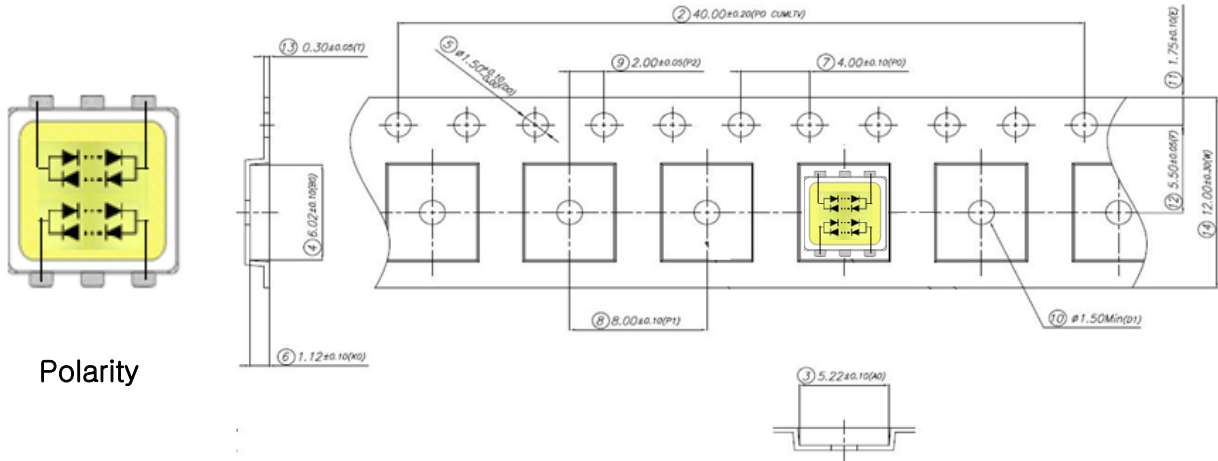
Reflow Frequency : 2 times max.



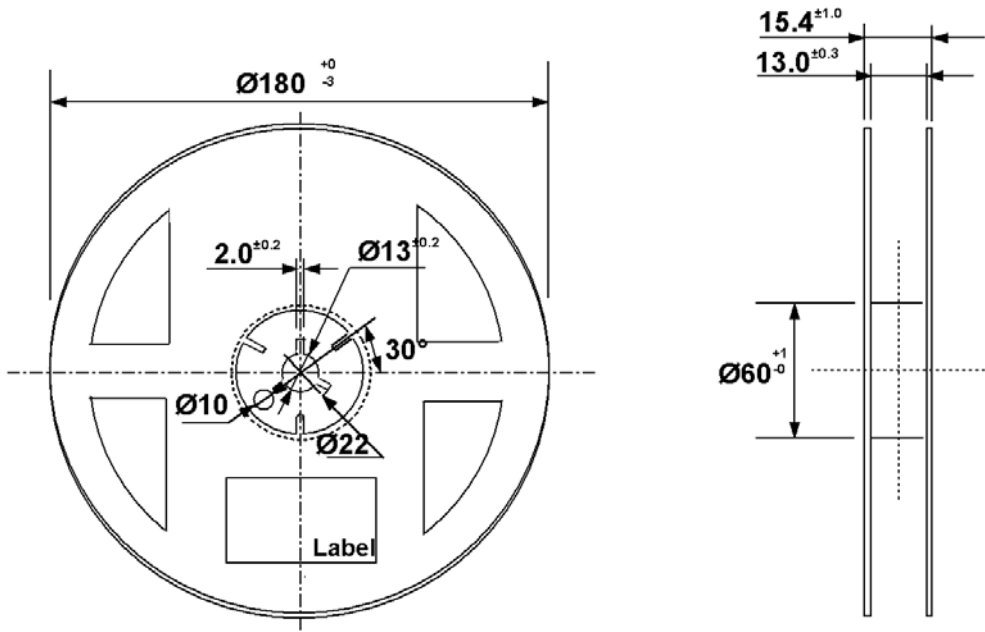
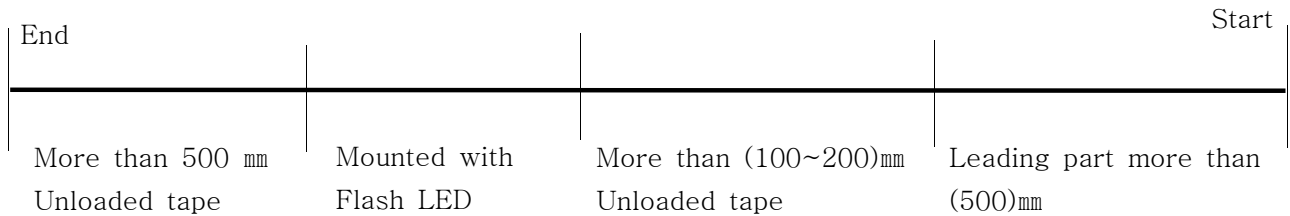
### 2) For Manual Soldering

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

### 13. Taping Dimension



Polarity

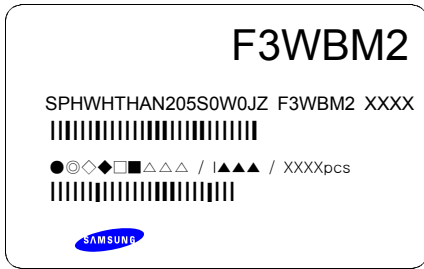


Tolerance ±0.2 , Unit:mm

- (1) Quantity : The quantity/reel to be 1000 pcs.
- (2) Cumulative Tolerance : Cumulative tolerance/10 pitches to be ±0.2 mm
- (3) Adhesion Strength of Cover Tape : Adhesion strength to be 0.1–0.7 N 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.



## 14. Label Structure



### Rank Code

/F3/ : VF Rank (refer to page 9)

/WB/ : Chromaticity Coordinate Rank, CIE (refer to page 4)

/M2/ : Luminous Flux (refer to page 3)

## 15. Lot Number

The Lot number is composed of the following characters

●◎◇◆□■△△△ / |▲▲▲ / 1000PCS

● : Production Site (S:SAMSUNG LED, G:Gosin China)

◎ : L (LED)

◇ : Product State (A:Normality, B:Bulk, C:First Production, R:Reproduction, S:Sample)

◆ : Year (S:2008, T:2009, U:2010...)

□ : Month (1 ~ 9, A, B)

■ : Day (1 ~ 9, A, B ~ V)

△ : SAMSUNG LED Product Number (1 ~ 999)

▲ : Reel Number (1 ~ 999)



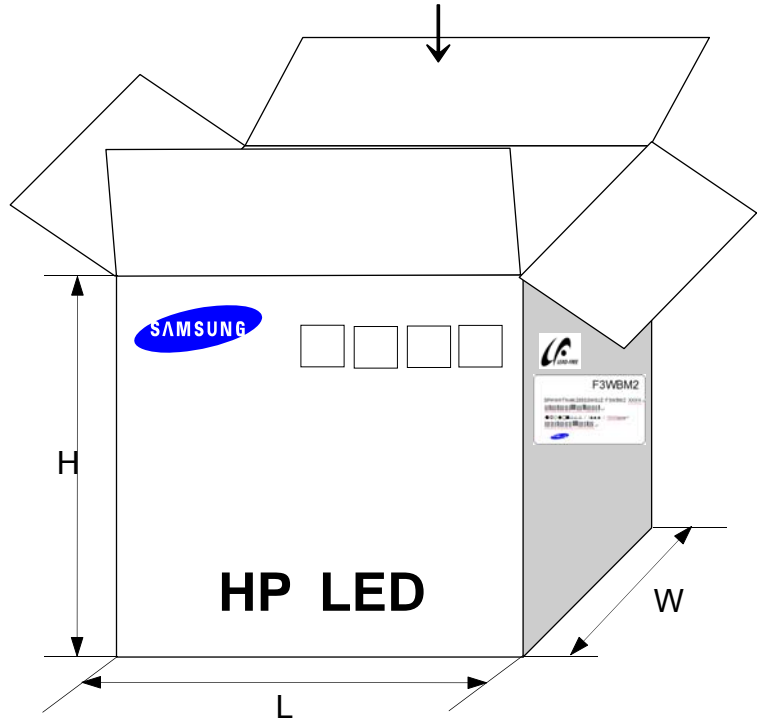
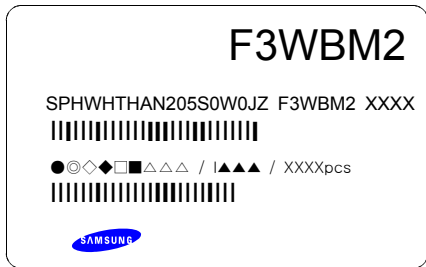




#### 4) Carton Box

Material : Paper(SW3B(B))

TYPE	SIZE(mm)		
	L	W	H
7 inch	245	194	232



# 17. Aluminum Packing Bag

**CAUTION**

This bag contains  
**MOISTURE SENSITIVE DEVICES**

**LEVEL**

**2a**

1. Shelf life in sealed bag: 12 months at <math>< 40^{\circ}\text{C}</math> and <math>< 90\%</math> relative humidity (RH)
2. Peak package body temperature: 240 °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°C / 60% RH, or
  - b. Stored at <math>< 10\%</math> RH
4. Devices require bake, before mounting, if:
  - a. Humidity Indicator Card is > 65% when read at 23±5°C, or
  - b. 2a is not met.
5. If baking is required, devices must be baked for 1 hours at 60±5°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

**F3WBM2**

SPHWHHTAN 205S0W0JZ F3WBM2 XXXX ←

●◇◆■▲△▲ / ▲▲▲ / XXXXpcs ←

**ATTENTION**

OBSERVE PRECAUTIONS  
FOR HANDLING

ELECTROSTATIC  
SENSITIVE  
DEVICES

**■ 주의 사항**

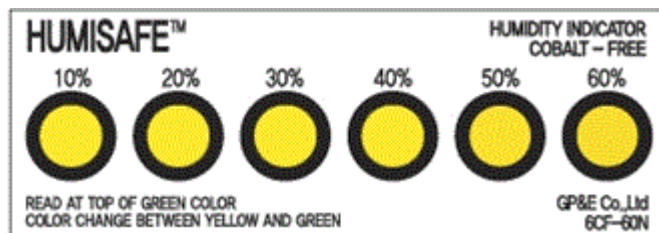
이 알루미늄 지퍼 백은 습기 및 정전기로부터 제품을 보호하기 위하여 제작되었습니다. 개봉 후에는 즉시 솔더 작업을 실시하는 것을 권장합니다.

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 Packing Bag



## 18. 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. ~40°C, ~90%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 ~40°C, 습도 ~90%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 reflow등의 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°C/60%RH,

a. 제품은 30°C/60%RH보다 같거나 낮은 조립조건에서 672시간(28일)이내에 조립해야 함.

- b. Stored at <10%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  $23\pm 5^{\circ}\text{C}$ .  
만약 습도표시카드의 수치가  $23\pm 5^{\circ}\text{C}$ 에서  $60\%$  이상이라면, 제품 실장 전 **baking**해야 함.

8) Devices must be baked for 1 hour at  $60\pm 5^{\circ}\text{C}$ , if baking is required.  
만약 **baking**이 필요하다면, 제품은  $60\pm 5^{\circ}\text{C}$ 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 봉지체를 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

# 19. Hazard Substance Analysis



**Test Report No.** F690101/LF-CTSAYAA14-07434    **Issued Date:** 2014. 02. 13    **Page** 1 of 16

**SAMSUNG ELECTRONICS CO., LTD.**  
95, Samsung2-ro, Gihyeung-gu  
yongin-si, Gyeonggi-do  
Korea

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

---

<b>SGS File No.</b>	: AYAA14-07434
<b>Product Name</b>	: SPHWHTHAN205
<b>Item/Part Name</b>	: LH524B
<b>Received Date</b>	: 2014. 02. 06
<b>Test Period</b>	: 2014. 02. 07 ~ 2014. 02. 13
<b>Test Requested</b>	: One hundred-fifty one (151) substances in the Candidate List of Substances of Very High Concern (SVHC) for authorization published by European Chemicals Agency (ECHA) on December 16, 2013 regarding Regulation (EC) No 1907/2006 concerning the REACH.
<b>Test Method</b>	: Please refer to next page(s).
<b>Test Result(s)</b>	: Please refer to next page(s).
<b>Summary</b>	: 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

The results shown in this test report refer only to the sample(s) submitted by the client, not cover the quality of the whole batch. This report should be used as intended, and shall not be used for advertisement and lawsuit.

The document is issued by the Company subject to its General Conditions of Service printed hereafter, or available on its website at <http://www.sgs.com/Service/Conditions>, and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at <http://www.sgs.com/Service/Conditions>. It is intended to serve as the evidence of liability, and not a contract and jurisdiction issues defined therein. Any holder of this document is advised that information contained herein reflects the Company's findings on the basis of its information only and without the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not constitute parties to a transaction from assuming all their rights and obligations under the transaction documents. This document cannot be reproduced or used in any form without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Online version is valid if the word is shown on this report as for only the original.

SGS Korea Co., Ltd. | 322, The Ovalley, 7th, LS-e, Dongan-gu, Anyang-si, Gyeonggi-do, Korea 431-030  
T +82 (0)21 4606 000 F +82 (0)21 4606 003 <http://www.sgs.com/kr>

Member of the SGS Group (Societ  Generale de Surveillance)

F401 Version 1

**Test Method:**

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

**Remarks:**

- 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=substancetypelist\\_WAR\\_substanceordlist&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&substancetypelis](http://echa.europa.eu/proposals-to-identify-substances-of-very-high-concern-previous-consultations?p_p_id=substancetypelist_WAR_substanceordlist&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&substancetypelis)  
 (Proposals to identify SVHC consultations)  
 This list is under evaluation by ECHA and may subject to change in the future.
- 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).
- 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.
- 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)
- 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.
- 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.

This document is issued by the Company subject to its General Conditions of Service printed on each report, or available on request or accessible at <http://www.sgs.com/Products/Services/Conditions>, and, for electronic format documents, subject to Terms and Conditions for Electronic Documents <http://www.sgs.com/Products/Services/Conditions>. A notice is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained herein reflects the Company's findings at the time of its release and only within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not constitute a guarantee or a representation from consulting of their rights and obligations under the transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any dissemination, alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report are only for the sample(s) of

SGS Korea Co., Ltd. | 302, The Ovalley, 76, LS-ro, Dongan-gu, Anyang-si, Gyeonggi-do, Korea 431-030  
 T +82 (0)21-4606 000 F +82 (0)21-4606 000 <http://www.sgs.com/kr>

Member of the SGS Group (Société Générale de Surveillance)



## 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
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 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 ( $\alpha$ -HBCDD, $\beta$ -HBCDD, $\gamma$ -HBCDD)	25637-99-4 3194-55-6 (134237-51-7, 134237-50-6, 134237-52-8)	247-148-4 221-695-9	N.D.	0.05	PBT
Lead hydrogen arsenate*	7784-40-9	232-064-2	N.D.	0.005	Carcinogen Toxic for Reproduction
Sodium dichromate* (Sodium dichromate, dehydrate)	10588-01-9 (7789-12-0)	234-190-3	N.D.	0.005	Carcinogen Mutagen 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

This document is issued by the Company subject to the General Conditions of Service printed hereon, or available on its web site at <http://www.sgs.com/ServiceConditions>, and, for electronic format documents, subject to Terms and Conditions for Electronic Documents <http://www.sgs.com/ServiceConditions>. It is issued in the limitation of liability, risk and/or exclusion and jurisdiction laws defined therein. Any holder of this document is advised that information contained herein reflects the Company's findings at the time of its issuance only and within the scope of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not create any parties to a transaction from accepting all their rights and obligations under the transaction documents. This document cannot be reproduced or used in any form without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Please refer to the back of this report for any other important information.

SGS Korea Co., Ltd. 302, The Ovalley 7E, LS-ro, Dongan-gu, Anyang-si, Gyeonggi-do, Korea 431-000  
t +82 (0)2-14608 000 f +82 (0)2-14608 050 <http://www.sgs.com/kr>

Member of the SGS Group (Società Generale di Sorveglianza)

F401 Version 1

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 Carcinogen
Anthracene oil, anthracene paste; distr. Lights	91995-17-4	295-278-5	N.D.	0.05	PBT; vPvB Carcinogen Mutagen
Anthracene oil, anthracene paste, anthracene fraction	91995-15-2	295-275-9	N.D.	0.05	PBT; vPvB Carcinogen Mutagen
Anthracene oil, anthracene-low	90640-82-7	292-604-8	N.D.	0.05	PBT; vPvB Carcinogen Mutagen
Anthracene oil, anthracene paste	90640-81-6	292-603-2	N.D.	0.05	PBT; vPvB Carcinogen Mutagen
Coal tar pitch, high temperature	65996-93-2	266-028-2	N.D.	0.05	PBT; vPvB Carcinogen
Lead sulfochromate yellow (C.I. Pigment Yellow 34)*	1344-37-2	215-693-7	N.D.	0.005	Carcinogen Toxic for Reproduction
Lead chromate molybdate sulfate red (C.I. Pigment Red 104)*	12656-85-8	235-759-9	N.D.	0.005	Carcinogen Toxic for Reproduction
Lead chromate*	7758-97-6	231-846-0	N.D.	0.005	Carcinogen Toxic for Reproduction
Acrylamide	79-06-01	201-173-7	N.D.	0.05	Carcinogen Mutagen

This document is issued by the Company subject to its General Conditions of Service printed (or made) available on request or available at <http://www.samsungled.com/sgs/conditions>, and, for electronic format documents, subject to Terms and Conditions for Electronic Documents <http://www.samsungled.com/sgs/conditions>. Samsung is liable to the limitation of liability, total exclusion and jurisdiction clause defined therein. Any holder of this document is advised that information contained herein will be the Company's findings at the time of its issuance only and within the limits of Client's instructions, if any. The Company's sole responsibility is to the Client and this document does not constitute part of a transaction from accepting of their rights and obligations under the transaction documents. This document cannot be reproduced or used without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. (Please observe the model in stress in this document as far as possible.)

SGS Korea Co., Ltd. | 332, The Ovalway, 7 B, LS-ro, Dongan-gu, Anyang-si, Gyeonggi-do, Korea 431-030  
 T +82 (0)2 4600 000 F +82 (0)2 4600 050 <http://www.samsungled.com>

Member of the SGS Group (Société Générale de Surveillance)

Substance Name	CAS number	EC number	Concentration (%)	Reporting Limit (%)	Classification
Boric acid*	10043-35-3 11113-50-1	233-139-2 234-343-4	N.D.	0.005	Toxic for Reproduction
Disodium tetraborate, anhydrous*	1330-43-4 12179-04-3 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 Mutagen Toxic for Reproduction
Ammonium dichromate*	7789-09-5	232-143-1	N.D.	0.005	Carcinogen Mutagen Toxic for Reproduction
Potassium dichromate*	7778-50-9	231-906-6	N.D.	0.005	Carcinogen Mutagen Toxic for Reproduction
Potassium chromate*	7789-00-6	232-140-5	N.D.	0.005	Carcinogen Mutagen

This document is issued by the Company subject to the General Conditions of Service printed hereon, or available at <http://www.sgs.com/ServiceConditions>, and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at <http://www.sgs.com/ServiceConditions>. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues set forth therein. Any holder of this document is advised that information contained herein reflects the Company's findings at the time of its issuance only and represents the state of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not constitute parties to a transaction from absolving all their rights and obligations under the transaction documents. This document cannot be reproduced or used in full without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated, the results shown in this report are for only the sample(s).

SGS Korea Co., Ltd. | 322, The Chivalley, 76, LS-ro, Dongan-gu, Anyang-si, Gyeonggi-do, Korea 431-080  
T +82 (0)21 4600 300 F +82 (0)21 4600 020 <http://www.sgs.com/kr>

Member of the SGS Group (Société Générale de Surveillances)

Substance Name	CAS number	EC number	Concentration (%)	Reporting Limit (%)	Classification
Cobalt(II) sulphate*	10124-43-3	233-334-2	N.D.	0.005	Carcinogen Toxic for Reproduction
Cobalt(II) dinitrate*	10141-05-6	233-402-1	N.D.	0.005	Carcinogen Toxic for Reproduction
Cobalt(II) carbonate*	513-79-1	208-169-4	N.D.	0.005	Carcinogen Toxic for Reproduction
Cobalt(II) diacetate*	71-48-7	200-755-8	N.D.	0.005	Carcinogen 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 Mutagen
Acids generated from chromium trioxide and their oligomers:  Chromic acid Dichromic acid  Oligomers of chromic acid and dichromic acid	7738-94-5 13530-68-2 -	231-801-5 236-881-5 -	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 Toxic for Reproduction
Hydrazine	7803-57-8 302-01-2	206-114-9	N.D.	0.05	Carcinogen
Strontium chromate*	7789-06-2	232-142-6	N.D.	0.005	Carcinogen

This document is issued by the Company subject to the General Conditions of Service printed hereon, or available on request or accessible at <http://www.sgs.com/sgs/ClientandConditions.aspx>, and, for electronic format documents, subject to Terms and Conditions for Electronic Documents <http://www.sgs.com/sgs/ClientandConditions.aspx>. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is asked that information contained herein reflects the Company's findings at the time of its issuance only and within the limits of SGS's instructions, if any. The Company's sole responsibility is to the Client and this document does not constitute part of a transaction from accepting all their rights and obligations under the transaction documents. This document cannot be reproduced or used without prior written approval of the Company. Any unauthorised alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report are for only the sample(s).

SGS Korea Co., Ltd. | 332, The Chivalley, 7-6, LS-ro, Dongan-gu, Anyang-si, Gyeonggi-do, Korea 431-030  
 T +82 (0)31-4800 000 F +82 (0)31-4800 020 <http://www.sgs.com/sgs/kr>

Member of the SGS Group (Société Générale de Surveillance)

Substance Name	CAS number	EC number	Concentration (%)	Reporting Limit (%)	Classification
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 o-Anisidine	90-04-0	201-963-1	N.D.	0.05	Carcinogenic
4-(1,1,3,3-tetramethylbutyl) phenol, (4-tert-Octylphenol)	140-66-9	205-426-2	N.D.	0.05	Equivalent level of concern having probable serious effects to the environment
Aluminosilicate Refractory Ceramic Fibres* (RCF)	650-017-00-8 (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) 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 reaction products with aniline (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 (DMAC)	127-19-5	204-826-4	N.D.	0.05	Toxic for reproduction
Pentazinc chromate 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-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 Toxic for reproduction
Zirconia Aluminosilicate Refractory Ceramic Fibres (Zr-RCF)*	650-017-00-8 (Index no.)	-	N.D.	0.005	Carcinogenic

This document is issued by the Company subject to the General Conditions of Service printed hereon, or which can be requested on our website at <http://www.samsung.com/sgs/sgs/conditions>, and, for all other formal documents, subject to Terms and Conditions for the electronic Documents <http://www.samsung.com/sgs/sgs/conditions>. It is intended to draw to the attention of the Client, the user and the recipient of this document that the information contained herein reflects the Company's findings at the time of its issuance only and without the limits of the Company's responsibilities, if any. The Company's sole responsibility is to the Client and this document does not constitute a guarantee or a warranty of any kind, nor does it constitute an offer of insurance or any other financial product. This document cannot be reproduced or used in any way without the prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Please refer to the back of this report for further information.

SGS Korea Co., Ltd.

322, The Daejeon, 716, LG-ro, Dongan-gu, Anyang-si, Gyeonggi-do, Korea 431-080  
T +82 (0)31 4600 000 F +82 (0)31 4600 023 <http://www.samsung.com>

Member of the SGS Group (Sociétés Générales de Surveillance)

Substance Name	CAS number	EC number	Concentration (%)	Reporting Limit (%)	Classification
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 o-Anisidine	90-04-0	201-963-1	N.D.	0.05	Carcinogenic
4-(1,1,3,3-tetramethylbutyl) phenol, (4-tert-Octylphenol)	140-66-9	205-426-2	N.D.	0.05	Equivalent level of concern having probable serious effects to the environment
Aluminosilicate Refractory Ceramic Fibres* (RCF)	650-017-00-8 (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) 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 reaction products with aniline (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 (DMAC)	127-19-5	204-826-4	N.D.	0.05	Toxic for reproduction
Pentazinc chromate 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 hydroxyoctaoxidizincatedichromate*	11103-86-9	234-329-8	N.D.	0.005	Carcinogenic
Trilead diarsenate*	3687-31-8	222-979-5	N.D.	0.005	Carcinogenic Toxic for reproduction
Zirconia Aluminosilicate Refractory Ceramic Fibres (Zr-RCF)*	650-017-00-8 (Index no.)	-	N.D.	0.005	Carcinogenic

This document is issued by the Company subject to the General Conditions of Service printed hereon, or available on request or accessible at <http://www.sgs.com/ServiceConditions.aspx>, and, for abstracts format documents, subject to Terms and Conditions for the abstract document <http://www.sgs.com/ServiceConditions.aspx>. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that the information contained herein reflects the Company's findings at the time of its issuance only and within the limits of its accreditation, if any. The Company's sole responsibility is to the Client and this document does not constitute parties to a transaction from ascertaining their rights and obligations under the transaction documents. This document cannot be reproduced or used in full without prior written approval of the Company. Any unauthorised alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated, the results shown in this test report are for only the sample(s).

SGS Korea Co., Ltd | 222, The Ovalley, 7 E, LG-m, Dongan-gu, Anyang-si, Gyeonggi-do, Korea 431-030  
 T +82 (0)2 4908 0000 F +82 (0)2 4908 023 <http://www.sgs.com/kr>

Member of the SGS Group (Société Générale de Surveillance)

Substance Name	CAS number	EC number	Concentration (%)	Reporting Limit (%)	Classification
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
$\beta$ -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
$\alpha,\alpha$ -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

This document is issued by the Company subject to the General Conditions of Service printed hereon, or available on request or accessible at <http://www.sgs.com/ServiceConditions>, and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at <http://www.sgs.com/ServiceConditions>. Liability is given to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained herein reflects the Company's findings at the time of the issuance only and does not constitute a warranty. The Company's sole responsibility is to the Client and this document does not constitute a contract or a transaction from accepting all their rights and obligations under the transaction documents. This document cannot be reproduced or used in any way without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this report are for only the sample(s).

SGS Korea Co., Ltd. 322, The Cityvalley, 76, LS-ro, Dongan-gu, Anyang-si, Gyeonggi-do, Korea 431-050  
 T +82 (0)2 4600 000 F +82 (0)21 4600 050 <http://www.sgs.com/kr>

Member of the SGS Group (Società Globale di Sorveglianza)

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 vPvB
Pentacosaflluorotridecanoic acid	72629-94-8	276-745-2	N.D.	0.05	vPvB
Tricosaflluorododecanoic acid	307-55-1	206-203-2	N.D.	0.05	vPvB
Henicosaflluoroundecanoic acid	2058-94-8	218-165-4	N.D.	0.05	vPvB
Heptacosaflluorotetradecanoic 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-dicarbox amide (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

This document is issued by the Company subject to its General Conditions of Service printed on each report or available at <http://www.sgs.com/ServiceConditions> and, for electronic format documents, subject to Terms and Conditions for Electronic Documents <http://www.sgs.com/ServiceConditions>. It is intended to be used as a reference only and does not constitute a contract. The Company's sole responsibility is to its Client and this document does not assume any liability in a transaction from oversteering of their rights and obligations under the transaction documents. This document cannot be reproduced or used in any way without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Please refer to the back of the report as to how to use it.

SGS Korea Co., Ltd. 322, The Ovalley, 78, LS-ro, Dongan-gu, Anyang-si, Gyeonggi-do, Korea 431-030  
 t +82 (0)31 4600 000 f +82 (0)31 4600 003 <http://www.sgs.com/kr>

Member of the SGS Group (Società Generale del Gruppo)



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

This document is issued by the Company subject to its General Conditions of Service printed hereon or available at <http://www.samsungled.com>, and for electronic format documents subject to Terms and Conditions for Electronic Documents <http://www.samsungled.com>. Samsung is not liable for the completion of liability, test condition and jurisdiction issues without the client's signature. The holder of this document is not liable for information contained herein unless the Company's findings at the time of the information only and within the limits of the Client's instructions, if any. The Company's sole responsibility is to the Client and this document does not constitute parties in a transaction from accepting all their rights and obligations under the transaction documents. This document cannot be produced except in full without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated, the results shown in this report are for only for the sample(s).

SGS Korea Co., Ltd. 322, The Ovalley, 76, LS-ro, Dongso-gu, Anyang-si, Gyeonggi-do, Korea 431-020  
 T +82 (0)21 4600 000 F +82 (0)21 4600 000 <http://www.samsungled.com>

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

This document is issued by the Company subject to its General Conditions of Service printed on back, or available on request on our website at [www.samsung.com/sgs](http://www.samsung.com/sgs), and, for alternative formal documents, subject to Terms and Conditions for Business Documents [www.sgs.com/sgs/businessdocuments](http://www.sgs.com/sgs/businessdocuments). It is the Client's sole responsibility to verify the information contained herein with the Company's findings at the time of its issuance only and within the limits of its accreditation, if any. The Company's sole responsibility is to the Client and this document does not constitute a warranty or assumption of liability on the part of the Company. This document cannot be reproduced or used in any form without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this report are for only the sample(s).

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 Mutagenic
Diethyl sulphate	64-67-5	200-589-6	N.D.	0.05	Carcinogenic 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 Mutagenic
4-Aminoazobenzene; 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; n-propyl bromide	106-94-5	203-445-0	N.D.	0.05	Toxic for reproduction

This document is issued by the Company subject to its General Conditions of Service printed hereon, or which are posted on available at <http://www.samsung.com/sgs>, and, for electronic format documents, subject to Terms and Conditions for Electronic Documents <http://www.samsung.com/sgs>. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained herein will be the Company's findings at the time of its issuance only and within the scope of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not constitute, neither in a transaction from acquiring all their rights and obligations under the transaction documents. This document cannot be reproduced or copied in any way without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Clients should be aware of the restrictions in this report as far as the sample is.

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 (PFQA)	335-67-1	206-397-9	N.D.	0.05	Toxic for reproduction

This document is issued by the Company subject to its General Conditions of Service printed separately or available on request on [www.sgs.com/ServiceConditions](http://www.sgs.com/ServiceConditions) and, for electronic format documents, subject to Terms and Conditions for Electronic Documents [www.sgs.com/ServiceConditions](http://www.sgs.com/ServiceConditions). Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its issuance only and within the limits of its accreditation. If any, The Company's sole responsibility is to its Client and this document does not create any liability in a transaction from proceeding of their rights and obligations under the transaction document. This document cannot be reproduced or used in full without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the word values in this document refer only to the sample(s).

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; 2-imidazolone-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 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

This document is issued by the Company subject to its General Conditions of Service printed hereon, or available on request or accessible at <http://www.sgs.com/ServiceandConditions.aspx>, and, for electronic format documents, subject to Terms and Conditions for Electronic Documents <http://www.sgs.com/ServiceandConditions.aspx>. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined in the 3.10.10 section of this document to add that the information contained herein is the Company's findings at the time of the information only and without the limit of liability mentioned, if any. The Company's sole responsibility is to the Client and this document does not constitute advice or a transaction from assuming all their rights and obligations under the transaction documents. This document cannot be reproduced or used in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the word is shown in this document is for only for the sample(s).

SGS Korea Co., Ltd. | 320, The Ovalley, 76, LS-ro, Dongan-gu, Anyang-si, Gyeonggi-do, Korea 431-030  
 T +82 (0)21 4606 000 F +82 (0)21 4606 020 <http://www.sgs.com/kr>

Member of the SGS Group (Società Générale da Sorveglianza)

## 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/guest/candidate-list-table> (Candidate list)

[http://echa.europa.eu/proposals-to-identify-substances-of-very-high-concern-previous-consultations?p\\_p\\_id=substancetypelist\\_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&substancetypelist](http://echa.europa.eu/proposals-to-identify-substances-of-very-high-concern-previous-consultations?p_p_id=substancetypelist_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&substancetypelist)  
(Proposals to identify SVHC consultations)

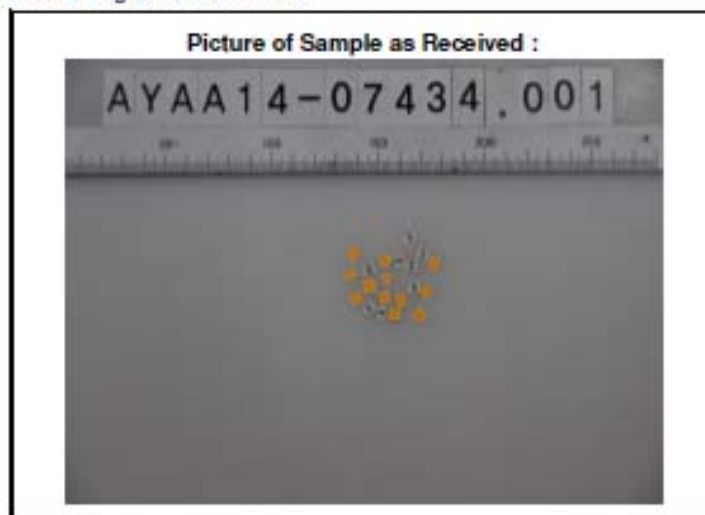
4. \*.The test result is based on the calculation of selected element(s) / marker(s) and to the worst-case scenario. For detail information, please refer to the SGS REACH website: [www.reach.sgs.com/substance-of-very-high-concern-analysis-information-page.htm](http://www.reach.sgs.com/substance-of-very-high-concern-analysis-information-page.htm)

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.



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

This document is issued by the Company subject to its General Conditions of Service printed on each report or available on its website at [www.sgs.com/Products/Client\\_and\\_Conditions.aspx](http://www.sgs.com/Products/Client_and_Conditions.aspx), and, for electronic format documents, subject to Terms and Conditions for its clients [http://www.sgs.com/Products/Client\\_and\\_Conditions.aspx](http://www.sgs.com/Products/Client_and_Conditions.aspx). It remains the client's responsibility to ensure that information contained herein reflects the Company's findings at the time of its issuance only and within the limits of its instructions, if any. The Company's sole responsibility is to the Client and this document does not constitute parties to a transaction from assuming all their rights and obligations under the transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report are for only the sample(s) tested.

SGS Korea Co., Ltd. | 322, The Ovalley, 78, LS-ro, Dongan-gu, Anyang-si, Gyeonggi-do, Korea 431-080  
 T +82 (0)21-4606 000 F +82 (0)21-4606 059 <http://www.sgs.com/kr>

Member of the SGS Group (Société Générale de Surveillance)

## 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. Generally on the basis of: - appropriate long-term animal studies - 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: - appropriate animal studies, - 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. <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: - 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, - other relevant information. <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: - 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, - 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.

This document is issued by the Company subject to its General Conditions of Service printed hereon, or available on its web site at <http://www.sgs.com/ServiceConditions>, and, for documents formal documents, subject to Terms and Conditions for its clients' Documents at <http://www.sgs.com/clients/clientsdocuments>. A further condition is the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is asked that information contained herein will be the Company's findings at the time of its information only and without the limits of Client's instructions, if any. The Company's sole responsibility is to the Client and this document does not constitute parties to a transaction from ascertaining of their rights and obligations under the transaction documents. This document cannot be reproduced without the prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated, the results shown in this report are for only the sample(s).

SGS Korea Co., Ltd | 322, The Ovalley, 7th, LS-ro, Dongan-gu, Anyang-si, Gyeonggi-do, Korea 431-030  
T +82 (0)21 4606 900 F +82 (0)21 4606 050 <http://korea.sgsgroup.kr>

Member of the SGS Group (Società Globale di Sorveglianza)

F401 Version 1

