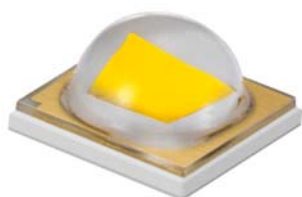


LH351Z – 3535 Ceramic LED @85°C



Introduction

Features

- Package : Ceramic Substrate LED Package
- View Angle: 115 °
- Precondition : JEDEC Level 2a
- Dimension : 3.5 x 3.5 x 1.9 mm
- ESD withstand Voltage : up to $\pm 5\text{kV}$ [HBM]
- Reliability Test : IES-LM-80-08 qualified(TBD)

Applications

- INDOOR LIGHTING : Spot light, Down light
- OUTDOOR LIGHTING : Street light, Security light, Tunnel light, Parking lots light
- INDUSTRIAL LIGHTING : High-bay light, Low-bay light
- CONSUMER LIGHTING : Torch light

SAMSUNG ELECTRONICS

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

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1. Luminous Flux Characteristics (T_j = 85°C)

Nominal CCT	Minimum CRI ¹⁾	Sorting condition lm ² @350mA		Calculated Minimum lm ³⁾		Product Code	BIN Structure
		Rank	Min lm ²	@700mA	@1000mA		
2700K	80	F3 (G2)	90 (100)	158 (175)	203 (226)	SPHWHTL3D20EE3W0F3	Whole
						SPHWHTL3D20EE3WPF3	Quarter
						SPHWHTL3D20EE3WMF3	M3
		G3 (H3)	100 (110)	175 (193)	226 (249)	SPHWHTL3D20EE3W0G3	Whole
						SPHWHTL3D20EE3WPG3	Quarter
						SPHWHTL3D20EE3WMG3	M3
3000K	80	F3 (G3)	90 (100)	158 (175)	203 (226)	SPHWHTL3D20EE3V0F3	Whole
						SPHWHTL3D20EE3VPF3	Quarter
						SPHWHTL3D20EE3VMF3	M3
		G3 (H3)	100 (110)	175 (193)	226 (249)	SPHWHTL3D20EE3V0G3	Whole
						SPHWHTL3D20EE3VPG3	Quarter
						SPHWHTL3D20EE3VMG3	M3
		H3 (J3)	110 (120)	193 (210)	249 (271)	SPHWHTL3D20EE3V0H3	Whole
						SPHWHTL3D20EE3VPH3	Quarter
						SPHWHTL3D20EE3VMH3	M3
3500K	80	G3 (H3)	100 (110)	175 (193)	226 (249)	SPHWHTL3D20EE3U0G3	Whole
						SPHWHTL3D20EE3UPG3	Quarter
						SPHWHTL3D20EE3UMG3	M3
		H3 (J3)	110 (120)	193 (210)	249 (271)	SPHWHTL3D20EE3U0H3	Whole
						SPHWHTL3D20EE3UPH3	Quarter
						SPHWHTL3D20EE3UMH3	M3
4000K	80	G3 (H3)	100 (110)	175 (193)	226 (249)	SPHWHTL3D20EE3T0G3	Whole
						SPHWHTL3D20EE3TPG3	Quarter
						SPHWHTL3D20EE3TMG3	M3
		H3 (J3)	110 (120)	193 (210)	249 (271)	SPHWHTL3D20EE3T0H3	Whole
						SPHWHTL3D20EE3TPH3	Quarter
						SPHWHTL3D20EE3TMH3	M3
4000K	70	H3 (J3)	110 (120)	193 (210)	249 (271)	SPHWHTL3D20CE3T0H3	Whole
						SPHWHTL3D20CE3TPH3	Quarter
						SPHWHTL3D20CE3TMH3	M3
		J3 (K3)	120 (130)	210 (228)	271 (294)	SPHWHTL3D20CE3T0J3	Whole
						SPHWHTL3D20CE3TPJ3	Quarter
						SPHWHTL3D20CE3TMJ3	M3

		K3 (M3)	130 (140)	228 (245)	294 (316)	SPHWHTL3D20CE3T0K3	Whole
						SPHWHTL3D20CE3TPK3	Quarter
						SPHWHTL3D20CE3TMK3	M3
5000K	75	H3 (J3)	110 (120)	193 (210)	249 (271)	SPHWHTL3D20DE3RTH3	M7
		J3 (K3)	120 (130)	210 (228)	271 (294)	SPHWHTL3D20DE3RTJ3	M7
	70	H3 (J3)	110 (120)	193 (210)	249 (271)	SPHWHTL3D20CE3RTH3	M7
		J3 (K3)	120 (130)	210 (228)	271 (294)	SPHWHTL3D20CE3RTJ3	M7
		K3 (M3)	130 (140)	228 (245)	294 (316)	SPHWHTL3D20CE3RTK3	M7
5700K	75	H3 (J3)	110 (120)	193 (210)	249 (271)	SPHWHTL3D20DE3QTH3	M7
	70	H3 (J3)	110 (120)	193 (210)	249 (271)	SPHWHTL3D20CE3QTH3	M7
		J3 (K3)	120 (130)	210 (228)	271 (294)	SPHWHTL3D20CE3QTJ3	M7
		K3 (M3)	130 (140)	228 (245)	294 (316)	SPHWHTL3D20CE3QTK3	M7
6500K	70	H3 (J3)	110 (120)	193 (210)	249 (271)	SPHWHTL3D20CE3PTH3	M7
		J3 (K3)	120 (130)	210 (228)	271 (294)	SPHWHTL3D20CE3PTJ3	M7

()* : Minimum luminous flux @ 25℃

Notes:

- 1) SAMSUNG ELECTRONICS maintains a tolerance of ± 3.0 on CRI measurements.
- 2) SAMSUNG ELECTRONICS maintains a tolerance of $\pm 7\%$ on flux measurements.
- 3) Calculated flux values are for reference only.

2. Characteristics

1) Electro-optical Characteristics

Item	Unit	Min	Typ	Max
Forward voltage ¹⁾ (@350 mA, T _j = 85℃)	V	2.7	2.9	3.0
Forward voltage ¹⁾ (@700 mA, T _j = 85℃)	V		3.1	
Forward voltage ¹⁾ (@1000 mA, T _j = 85℃)	V		3.2	
Operation forward current (T _j = 85℃)	mA	–	–	1000
Thermal resistance R _{th,j-s}	℃/W	–	7	
LED junction temperature T _j	℃	–	–	150
Operating temperature range T _{opr}	℃	–40	–	85
Storage temperature range T _{stg}	℃	–40	–	120
Viewing Angle	°	–	115	–

Item	Unit	3000K	5000K
Forward voltage ¹⁾ (@350 mA, T _j = 25℃)	V	3.0	
Forward voltage ¹⁾ (@350 mA, T _j = 85℃)	V	2.9	
Luminous flux ²⁾ (@350 mA, T _j = 25℃)	lm	110	143
Luminous flux (@350 mA, T _j = 85℃)	lm	100	130
Luminous flux (@700 mA, T _j = 85℃)	lm	175	228
Luminous flux (@1000 mA, T _j = 85℃)	lm	226	293

Notes:

- 1) SAMSUNG ELECTRONICS maintains a tolerance of ±0.1V on forward voltage measurements.
- 2) Characteristics @ 25℃ are for reference only.

2) Vf Rank (T_j = 85℃)

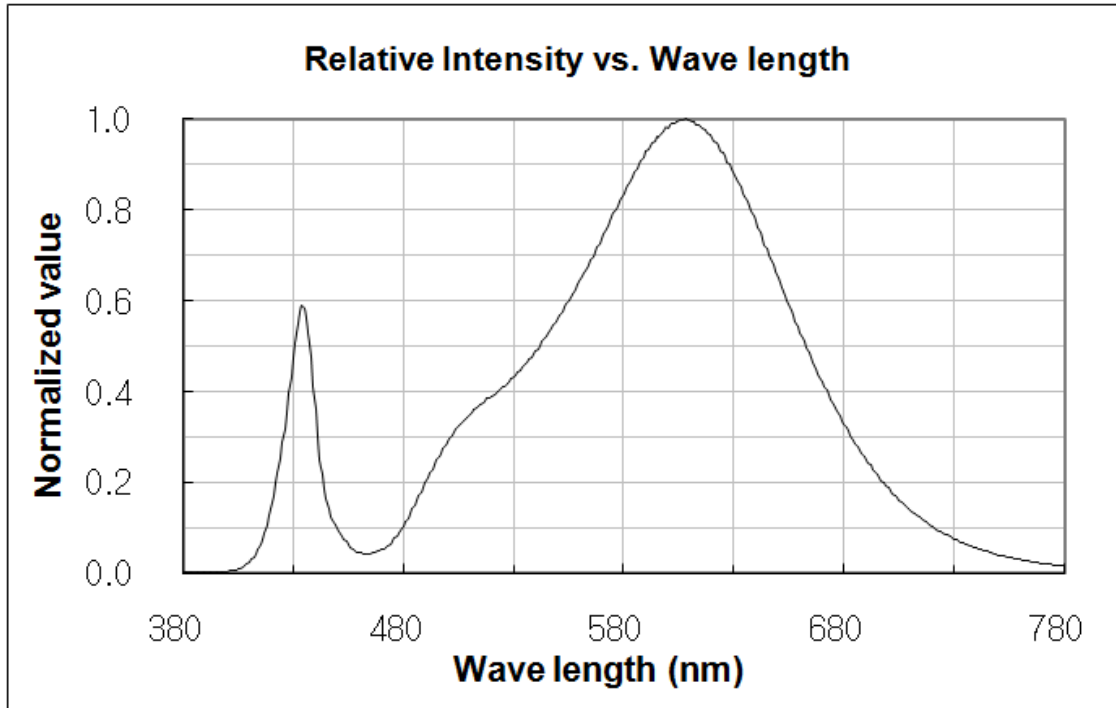
Parameter	Symbol	Condition	Rank	Rank	Min.	Typ.	Max.
Forward Voltage	V _F	I _F = 350mA	E3		2.7	–	3.0

3. Typical Characteristics Graph

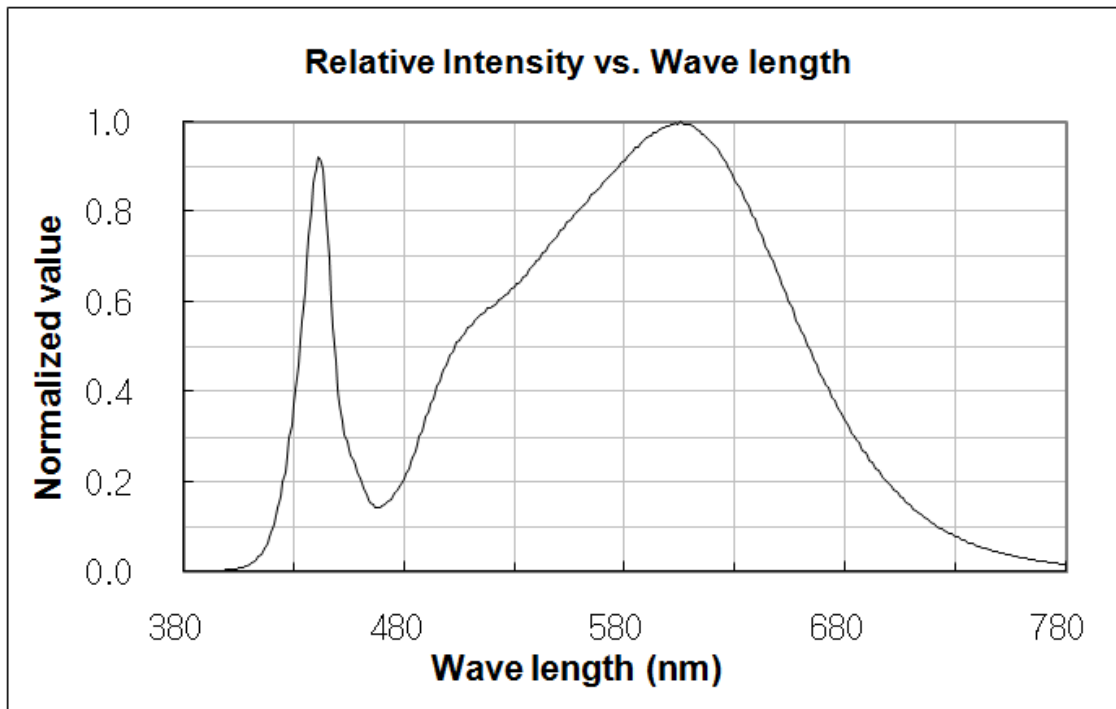
1) Spectrum Distribution

($T_j = 85^\circ\text{C}$)

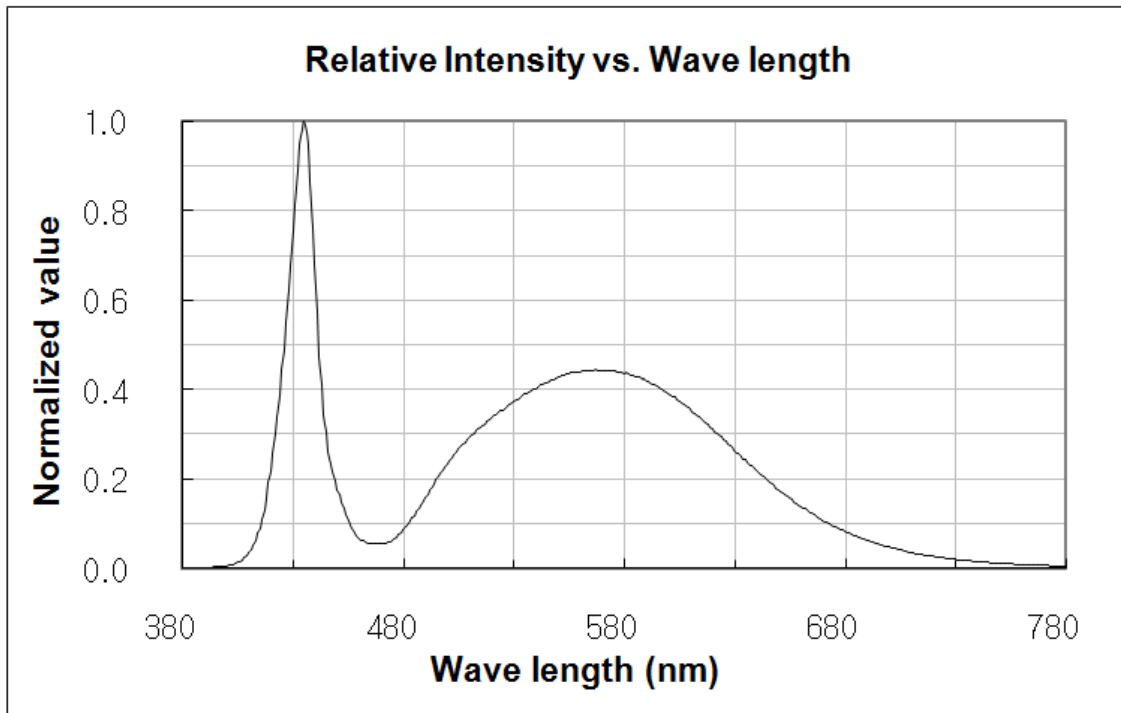
2700K & 3000K



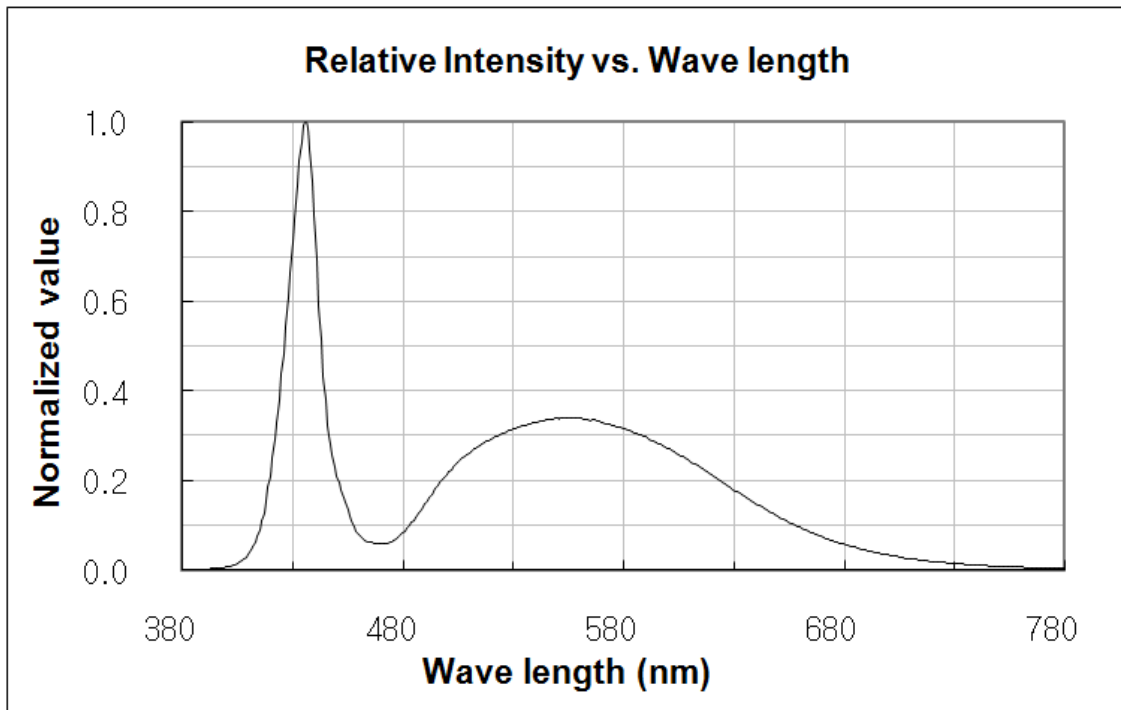
3500K & 4000K



5000K



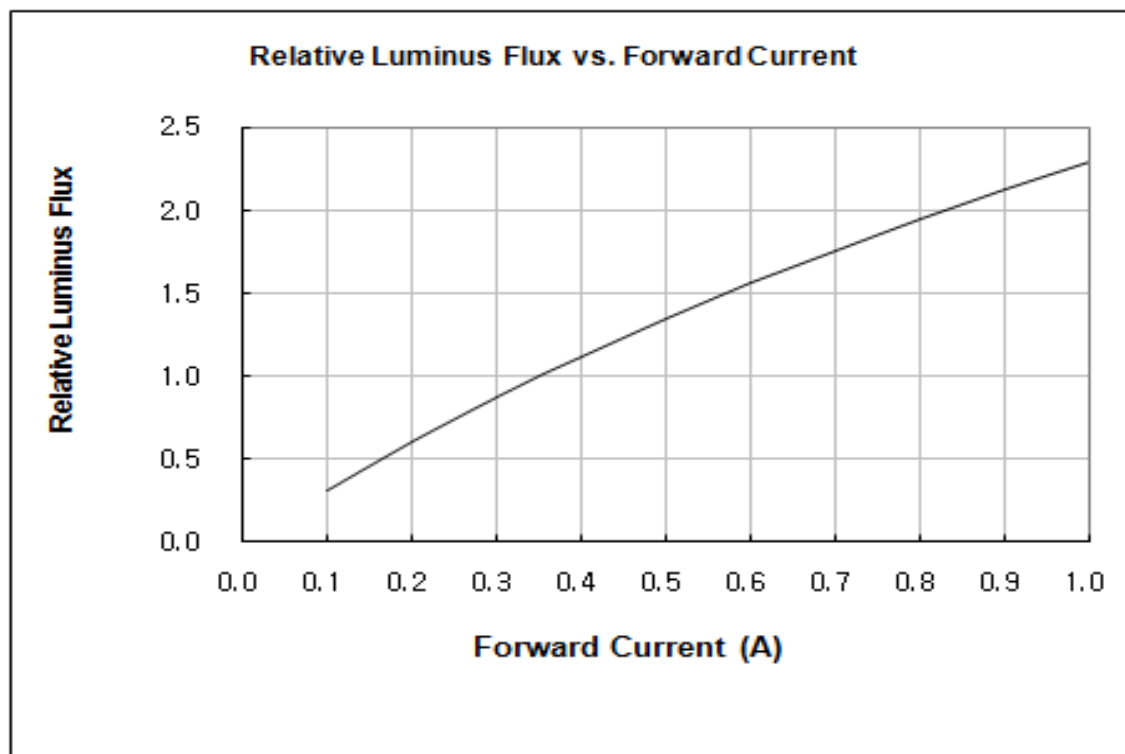
5700K & 6500K



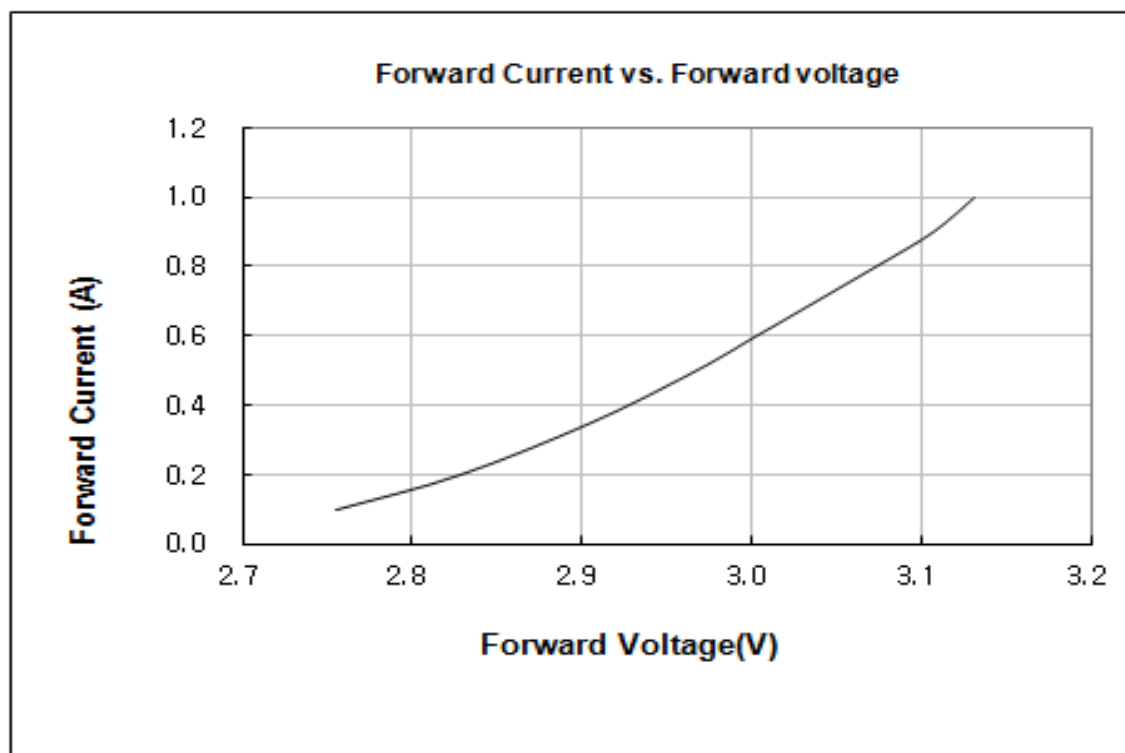
2) Forward Current Characteristics

($T_j = 85^\circ\text{C}$)

Relative Flux vs. Forward Current

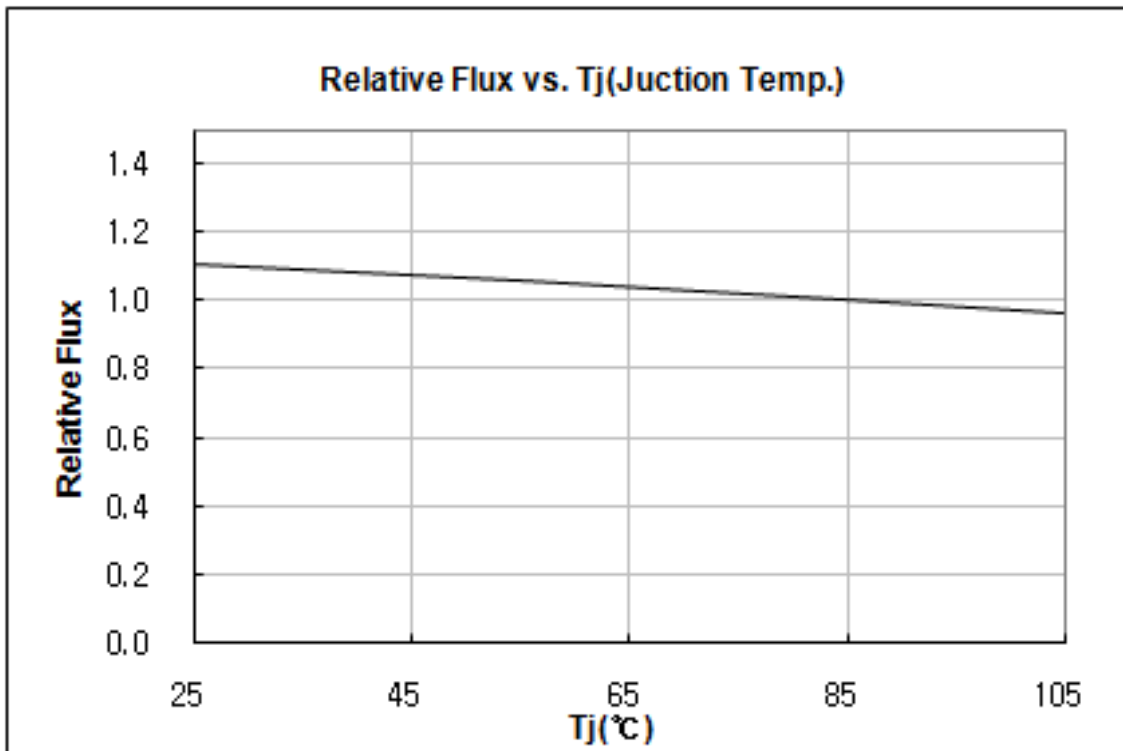


Forward Current vs. Forward Voltage

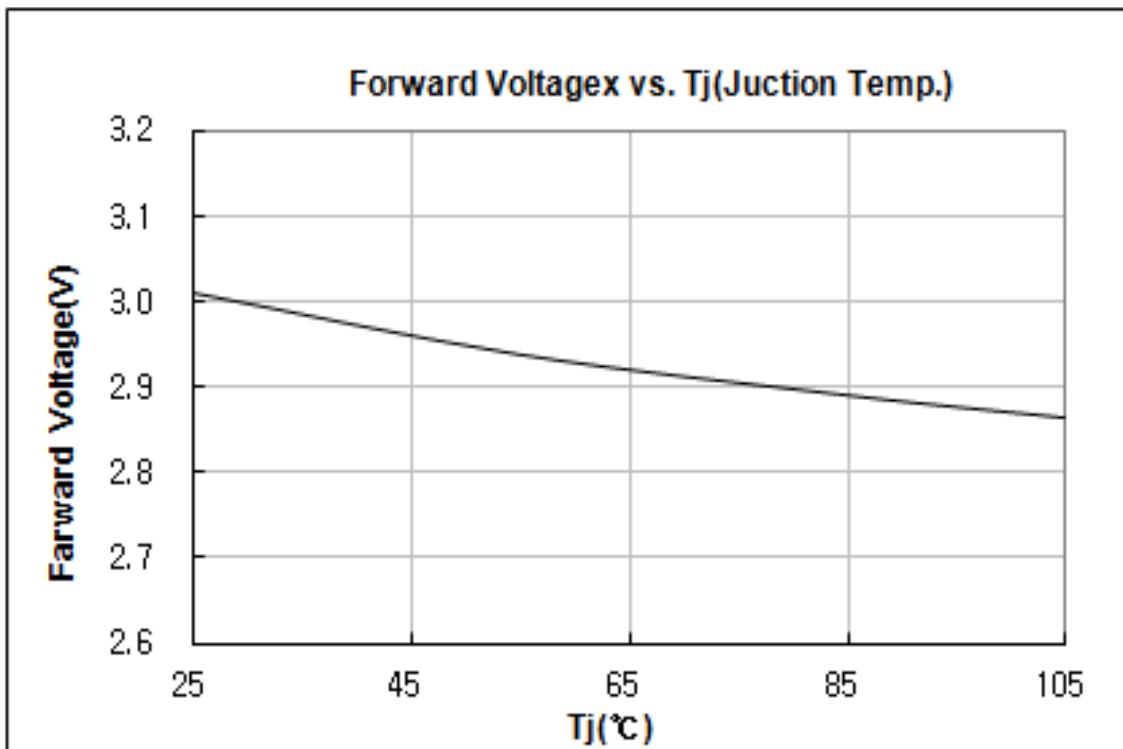


3) Temperature Characteristics

Relative Flux vs. Junction Temperature ($I_F = 350\text{mA}$)

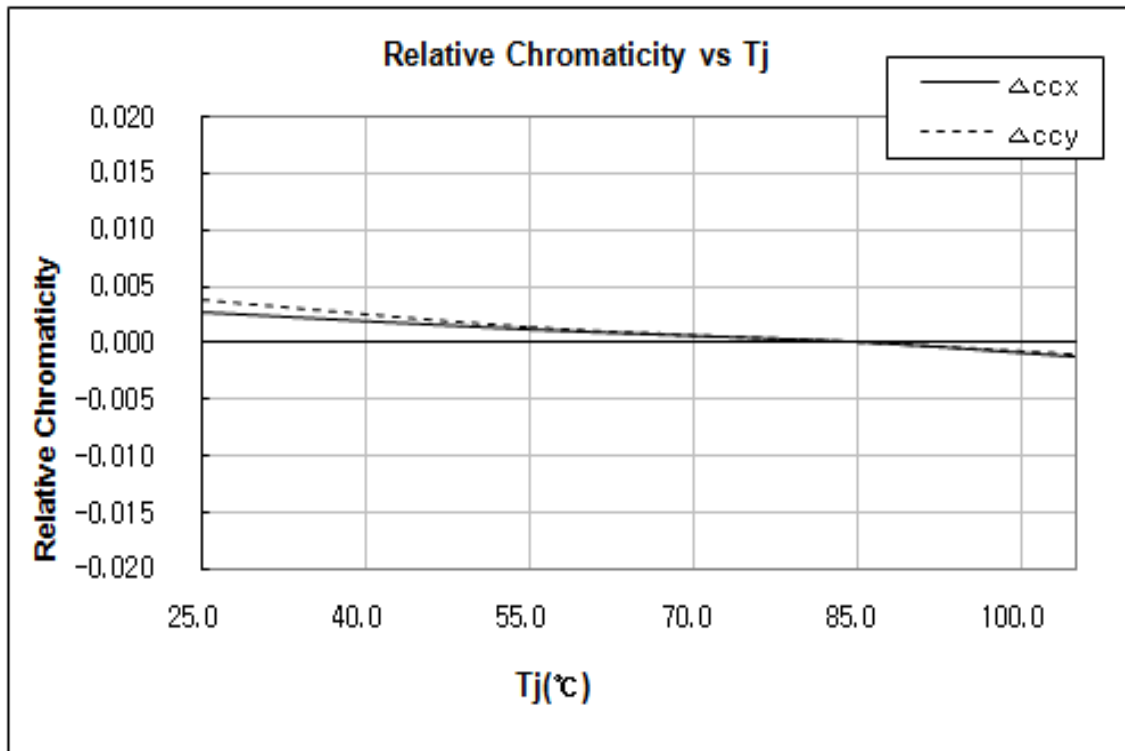


Forward Voltage vs. Junction Temperature ($I_F = 350\text{mA}$)

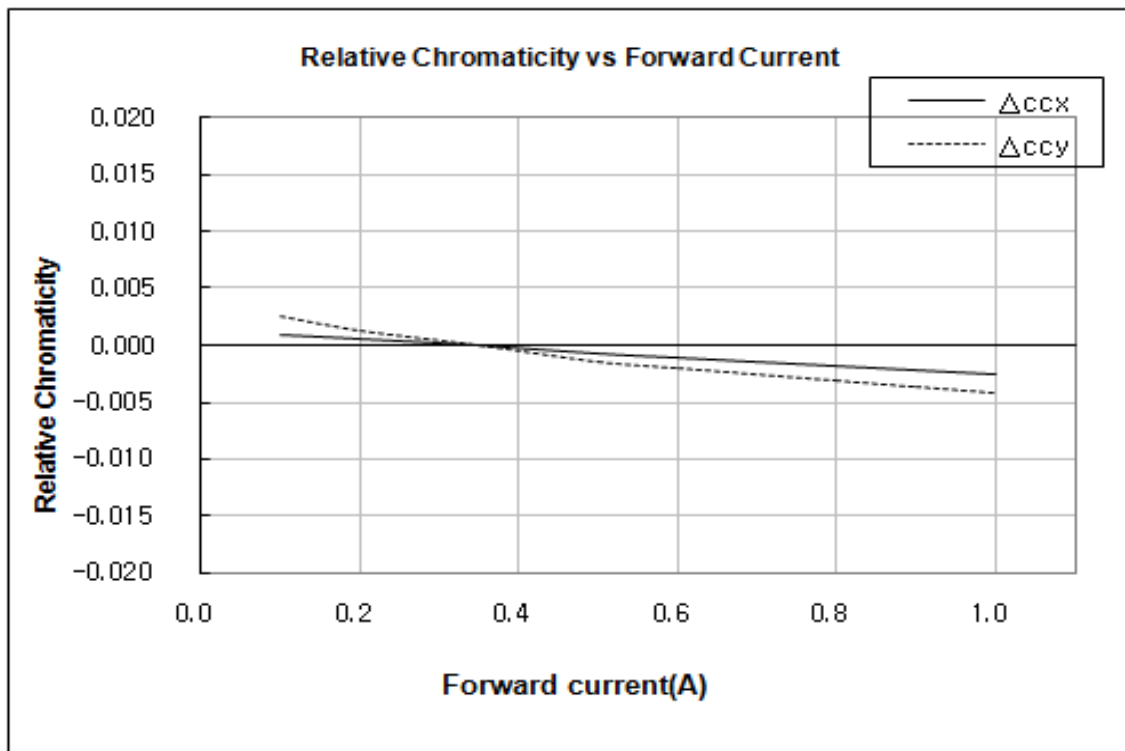


4) Color shift Characteristics

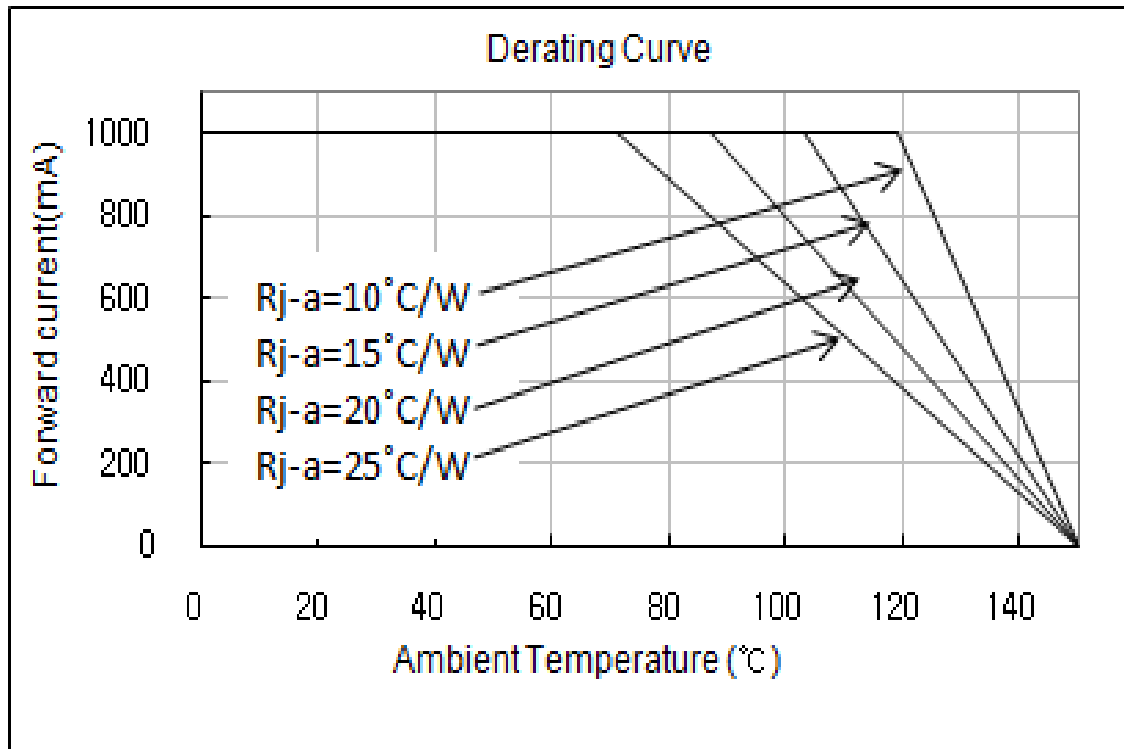
Color x,y vs. Forward Current ($I_F = 350\text{mA}$, Cool White)



Color x,y vs. Substrate Temp. ($I_F = 350\text{mA}$, Cool White)

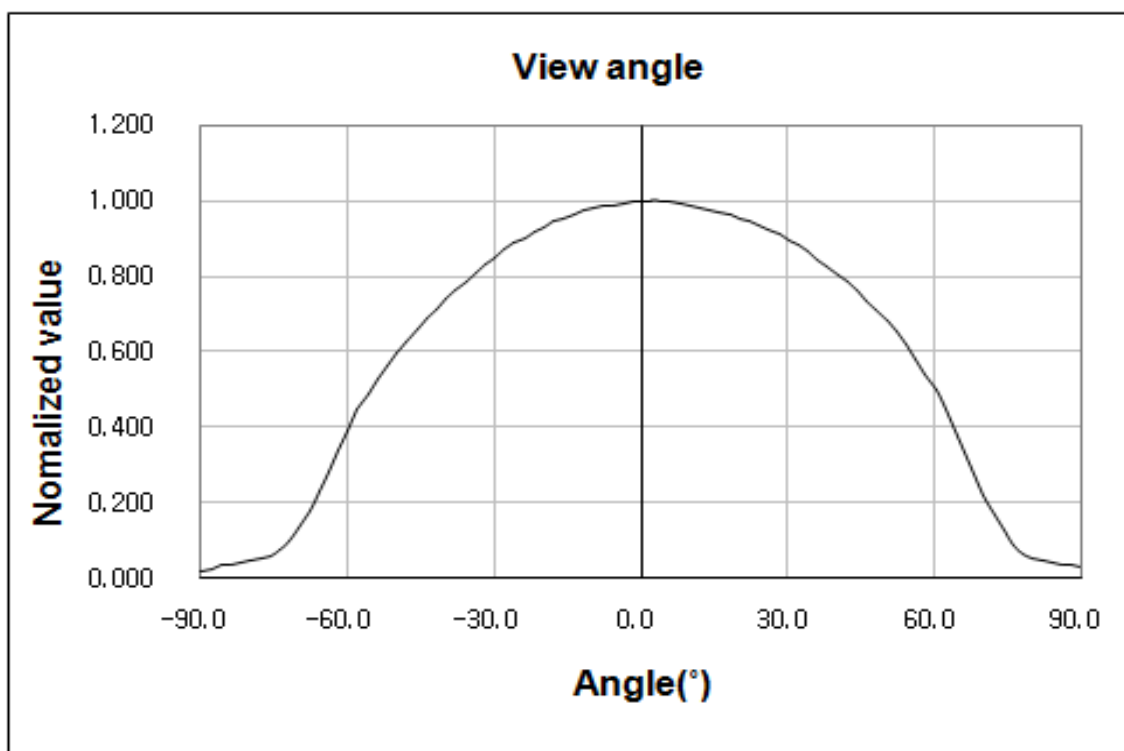


5) Derating Curve



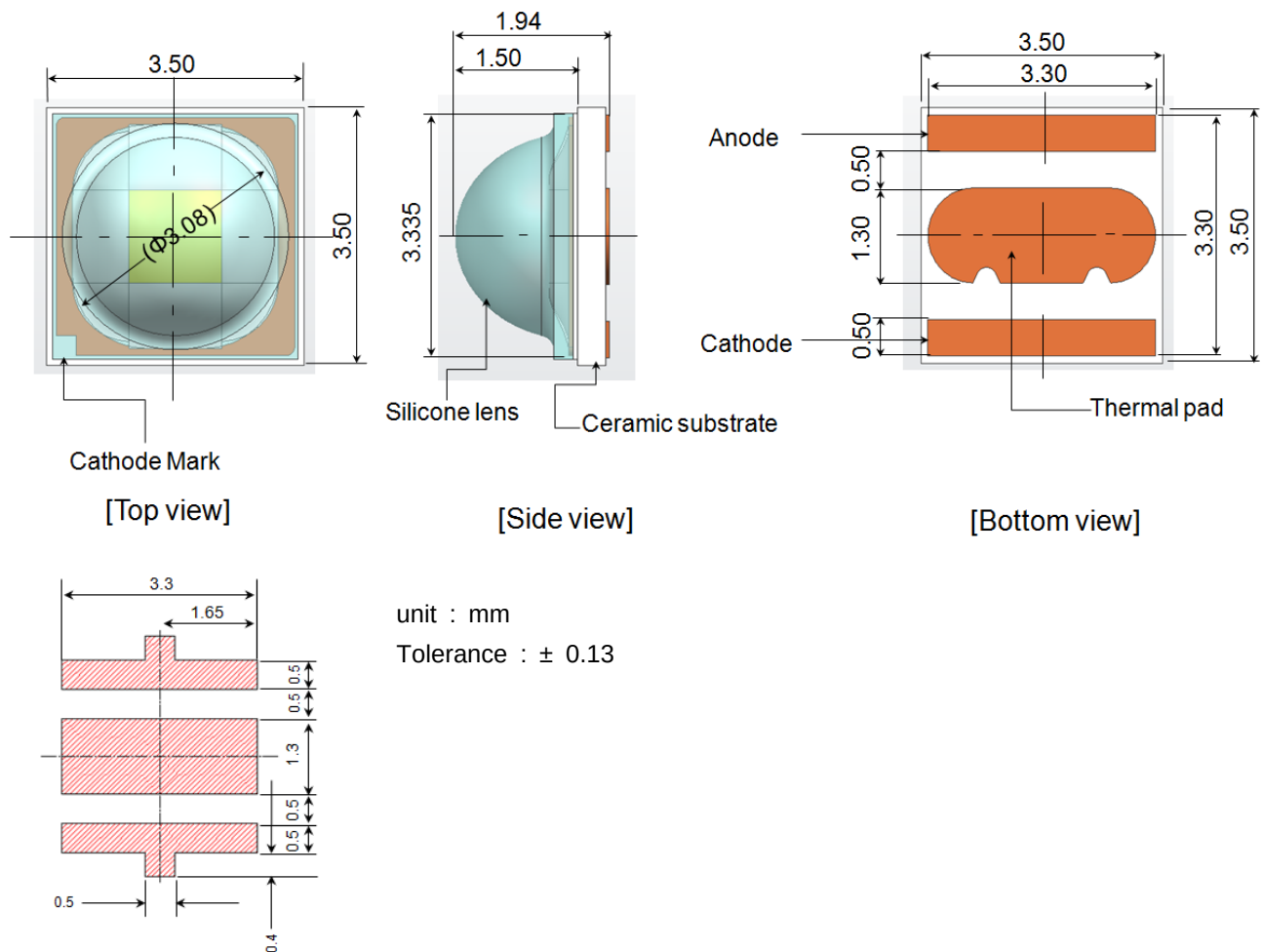
6) Viewing angle Characteristics

Viewing angle



4. Outline Drawing & Dimension

Recommended Land Pattern



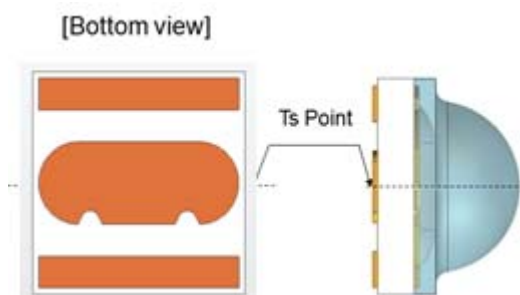
* This LED has built-in ESD protection device(s) connected in parallel to LED Chip(s).

* The thermal pad is electrically isolated from the anode and cathode contact pads.

Ts Point & Measurement Method

* Measure the nearest point to the thermal pad as shown below. If necessary, remove PSR of PCB to reach Ts point.

* Thermal pad must be soldered to the PCB to dissipate heat properly. Otherwise, LED can be damaged.



5. Reliability Test Items and Conditions

1) Test Items and Results

Test Items	Test Conditions	Test Hours/Cycles	n
Room Temperature Life Test	25℃, DC 1000 mA	1000 Hr	22
High Temperature humidity Life Test	85℃, 85%, DC 1000 mA	1000 Hr	22
High Temperature Life Test	85℃, DC 1000 mA	1000 Hr	22
Low Temperature Life Test	-40℃, DC 1000 mA	1000 Hr	22
Temperature humidity Cycle On/Off test	-40 / 85 ℃, each 20 min, 100 min transfer Power On/off each 5 min, DC 1000 mA	100 Cycles	11
Thermal Shock	-45 ℃/15 min ↔ 125 ℃/ 15 min. Temp.change within 5min.	500 Cycles	100
High Temperature Storage	Ta=120℃	1000 Hr	11
Low Temperature Storage	Ta=-40℃	1000 Hr	11
ESD(HBM)	Q1=10MΩ, R2=1.5KΩ, C=100pF, V=±5KV, 5Times	5 Times (±5kV)	5

2) Criteria for Judging the Damage

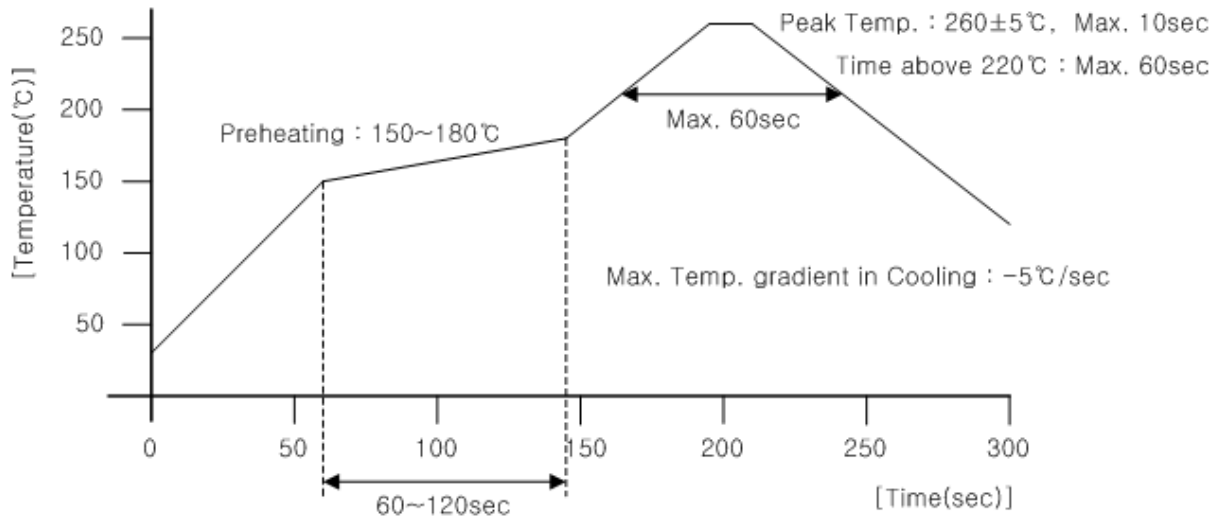
Item	Symbol	Test Condition [T _a = 25℃]	Limit	
			Min.	Max.
Forward Voltage	V _F	350 mA	L.S.L. * 0.9	U.S.L. * 1.1
Luminous flux	Im	350 mA	L.S.L. * 0.7	U.S.L. * 1.1

* U.S.L. : Upper Standard Level L.S.L. : Lower Standard Level

6. Solder Conditions

1) Reflow Conditions (Pb Free)

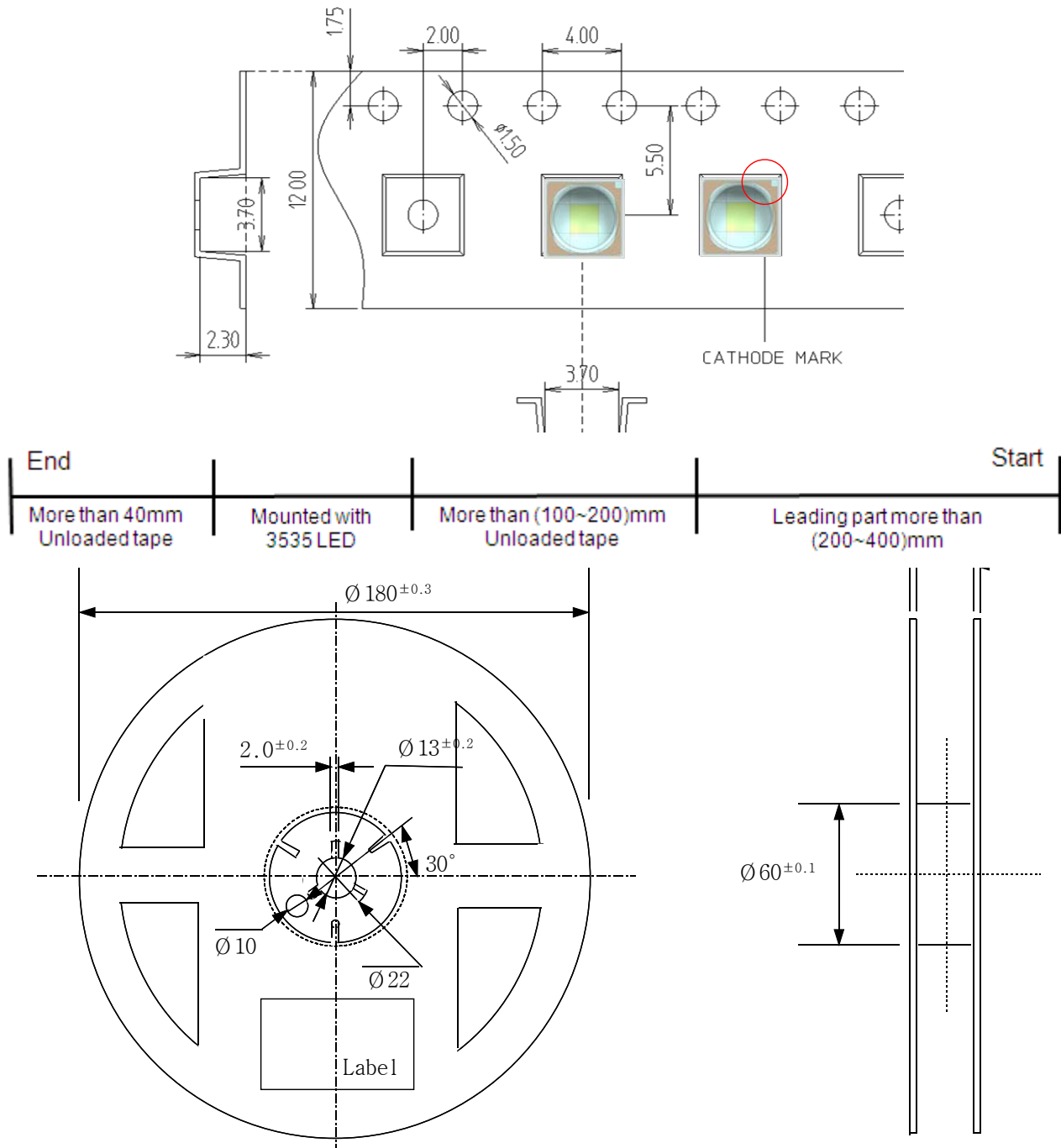
Reflow Frequency : 2 times max.



2) For Manual Soldering

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

7. Tape And Reel



- (1) Quantity : The quantity/reel to be 1,000 pcs.
- (2) Cumulative Tolerance : Cumulative tolerance/10 pitches to be ± 0.2 mm
- (3) Adhesion Strength of Cover Tape : Adhesion strength to be 0.1-0.7N when the cover tape is turned off from the carrier tape at 10° 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



Rank Code

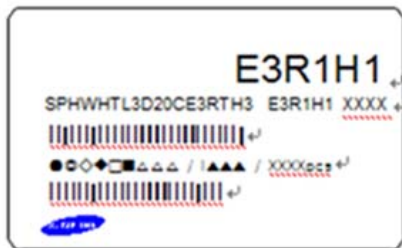
/E3/ : VF Rank

/R1/ : Color Rank

/H1/ : Flux Bin

2) LOT Number

The Lot number is composed of the following characters



● ◎ ◇ ◆ □ ■ △ △ △ / ! ▲ ▲ ▲ / 1000PCS

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

◎ : L (LED)

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

◆ : Year (U:2010, V:2011, W:2012, Y:2013...)

□ : Month (1 ~ 9, A, B)

■ : Day (1 ~ 9, A, B ~ V)

△ : SAMSUNG ELECTRONICS Product Number (1 ~ 999)

▲ : Reel Number (1 ~ 999)

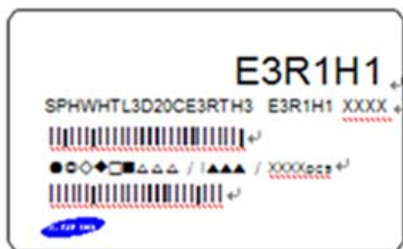
9. Packing Structure

1) Packing Process

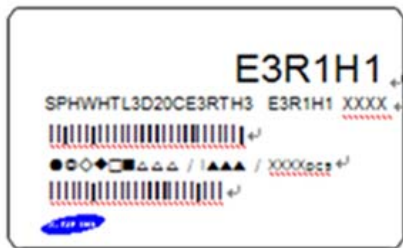
Reel



Aluminum Vinyl Bag



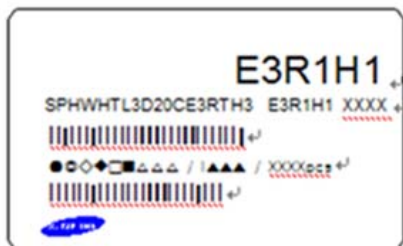
Inner Box (Max. 2reel)



Material : Paper(SW3B(B))

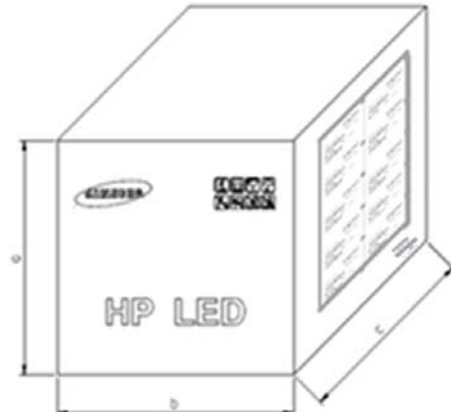
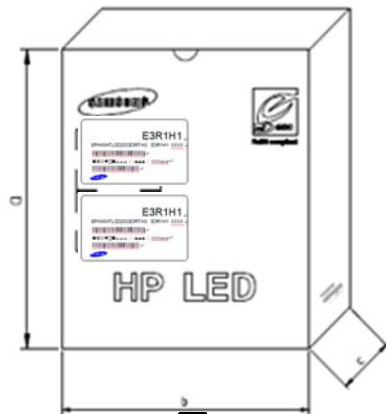
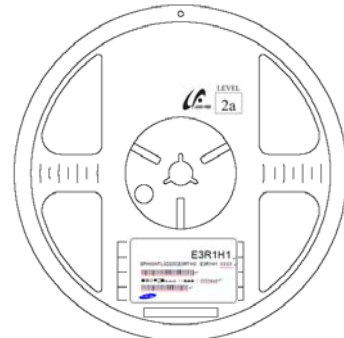
TYPE	SIZE(mm)		
	(a)	(b)	(c)
7inch	219	185	44

Out Box (Max. 5 inner box)



Material : Paper(SW3B(B))

TYPE	SIZE(mm)		
	(a)	(b)	(c)
7inch	245	194	232



2) Aluminum Packing Bag

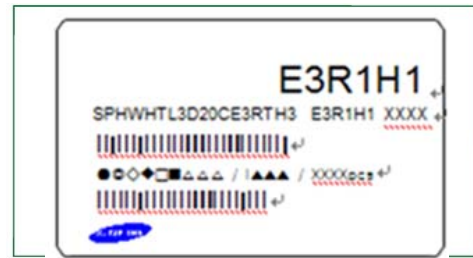


CAUTION

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°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 $<10\%$ RH
 4. Devices require bake, before mounting, if:
 - a. Humidity Indicator Card is $>65\%$ when read at $23\pm5^{\circ}\text{C}$, or
 - b. 2a is not met.
 5. If baking is required, devices must be baked for 1 hours at $60\pm5^{\circ}\text{C}$
- 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



ATTENTION
OBSERVE PRECAUTIONS
FOR HANDLING
ELECTROSTATIC
SENSITIVE
DEVICES



주의 사항

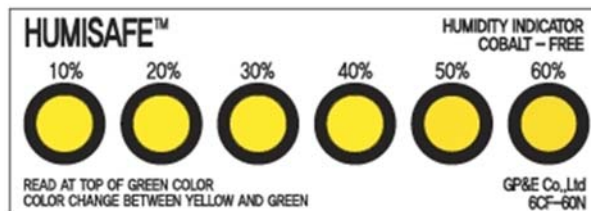
이 알루미늄 지퍼 백은 습기 및 정전기로부터 제품을 보호하기 위하여 제작되었습니다. 개봉 후에는 즉시 솔더 작업을 실시하는 것을 권장합니다.

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.

There are Silica Gel and Humidity Indicator Card in the Aluminum Bag



10. Precaution for use

- 1) For over current-protection, customers are recommended to apply resistors connected in series with the LEDs to mitigate sudden change of the forward current caused by shift of the forward voltage.
- 2) This device should not be used in any type of fluid such as water, oil, organic solvent, etc. When cleaning is required, IPA is recommended as cleaning agent. Solvent-based cleaning agent such as Zestron^(R) may damage the silicone resins used in the device.
- 3) When the device is in operation, the forward current should be carefully determined considering the maximum ambient temperature and the corresponding junction temperature.
- 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 with a nitrogen-filled container.
(Shelf life of sealed bags: 12 months, temp. 0~40°C, 0~90%RH)
- 5) After storage bag is open, device subject to soldering, solder reflow, or other high temperature processes must be:
 - a. Mounted within 672 hours (28 days) at an assembly line with a condition of no more than 30°C/60%RH.
 - b. Stored at <10% RH.
- 6) Repack unused Products with anti-moisture packing, fold to close any opening and then store in a dry place.
- 7) Devices require baking before mounting, if humidity card reading reaches 60% at 23±5°C.
- 8) Devices must be baked for 1hours at 60±5°C, if baking is required.
- 9) The LEDs are sensitive to the static electricity and surge current. It is recommended to use a wrist band or anti-electrostatic glove when handling the LEDs.
If voltage exceeding the absolute maximum rating is applied to LEDs, it may cause damage or even destruction to LED devices.
Damaged LEDs may show some unusual characteristics such as increase in leakage current, lowered turn-on voltage, or abnormal lighting of LEDs at low current.
- 10) VOCs (volatile organic compounds) can be generated from adhesives, flux, hardener or organic additives used in luminaires (fixtures). Transparent LED silicone encapsulant is permeable to those chemicals and they may lead a discoloration of encapsualnt when they expose to heat or light. This phenomenon can cause a significant loss of light emitted(output) from the luminaires(fixture)s. This phenomenon can give a significant loss of light emitted(output) from the luminaires(fixture)s. In order to prevent these problems, we recommend you to know the physical properties of materials used in luminaires, They must be selected carefully.

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

**Test Report No. F690101/LF-CTSAYAA13-16056**

Issued Date: 2013. 04. 04 Page 2 of 7

Sample No. : AYAA13-16056.001
Sample Description : SPHWHTL3D
Item No./Part No. : LH351Z
Materials : Al2O3, Cu, Ni, Pd, Au, Silicone, Phosphor

Heavy Metals

Test Items	Unit	Test Method	MDL	Results
Cadmium (Cd)	mg/kg	With reference to IEC 62321:2008, ICP	0.5	N.D.
Lead (Pb)	mg/kg	With reference to IEC 62321:2008, ICP	5	N.D.
Mercury (Hg)	mg/kg	With reference to IEC 62321:2008, ICP	2	N.D.
Hexavalent Chromium (Cr VI)	mg/kg	With reference to IEC 62321:2008, UV-VIS	1	N.D.

Flame Retardants-PBBs/PBDEs

Test Items	Unit	Test Method	MDL	Results
Monobromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Dibromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Tribromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Tetrabromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Pentabromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Hexabromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Heptabromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Octabromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Nonabromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Decabromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Monobromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Dibromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Tribromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Tetrabromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Pentabromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Hexabromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Heptabromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Octabromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.

NOTE:

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- (7) * = Boiling-water-extraction:
 Negative = Absence of CrVI coating
 Positive = Presence of CrVI coating; the detected concentration in boiling-water-extraction solution is equal or greater than 0.02 mg/kg with 50 cm² sample surface area.

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**Test Report No. F690101/LF-CTSAYAA13-16056**

Issued Date: 2013. 04. 04 Page 3 of 7

Sample No. : AYAA13-16056.001
Sample Description : SPHWHTL3D
Item No./Part No. : LH351Z
Materials : Al₂O₃, Cu, Ni, Pd, Au, Silicone, Phosphor

Flame Retardants-PBBs/PBDEs

Test Items	Unit	Test Method	MDL	Results
Nonabromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Decabromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.

Halogen Content

Test Items	Unit	Test Method	MDL	Results
Bromine(Br)	mg/kg	BS EN 14582:2007, IC	30	N.D.
Chlorine(Cl)	mg/kg	BS EN 14582:2007, IC	30	N.D.
Fluorine(F)	mg/kg	BS EN 14582:2007, IC	30	N.D.
Iodine(I)	mg/kg	BS EN 14582:2007, IC	50	N.D.

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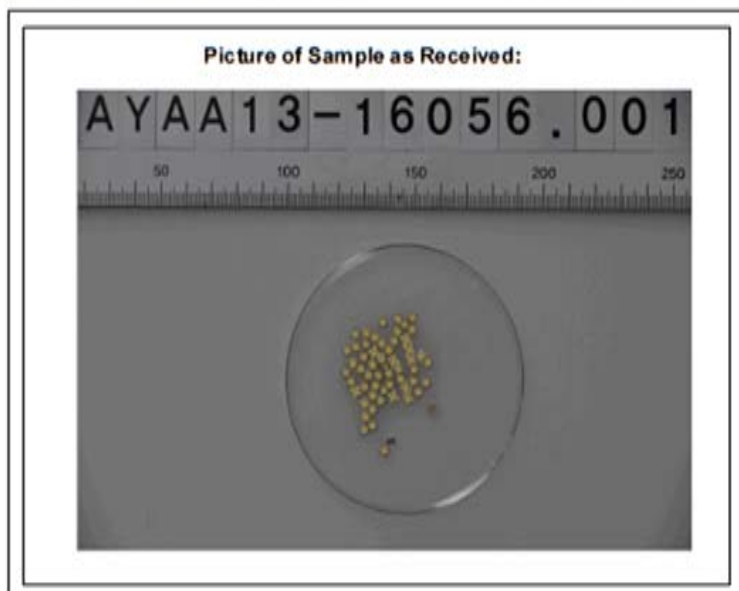
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Issued Date: 2013. 04. 04 Page 4 of 7



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[illegible]

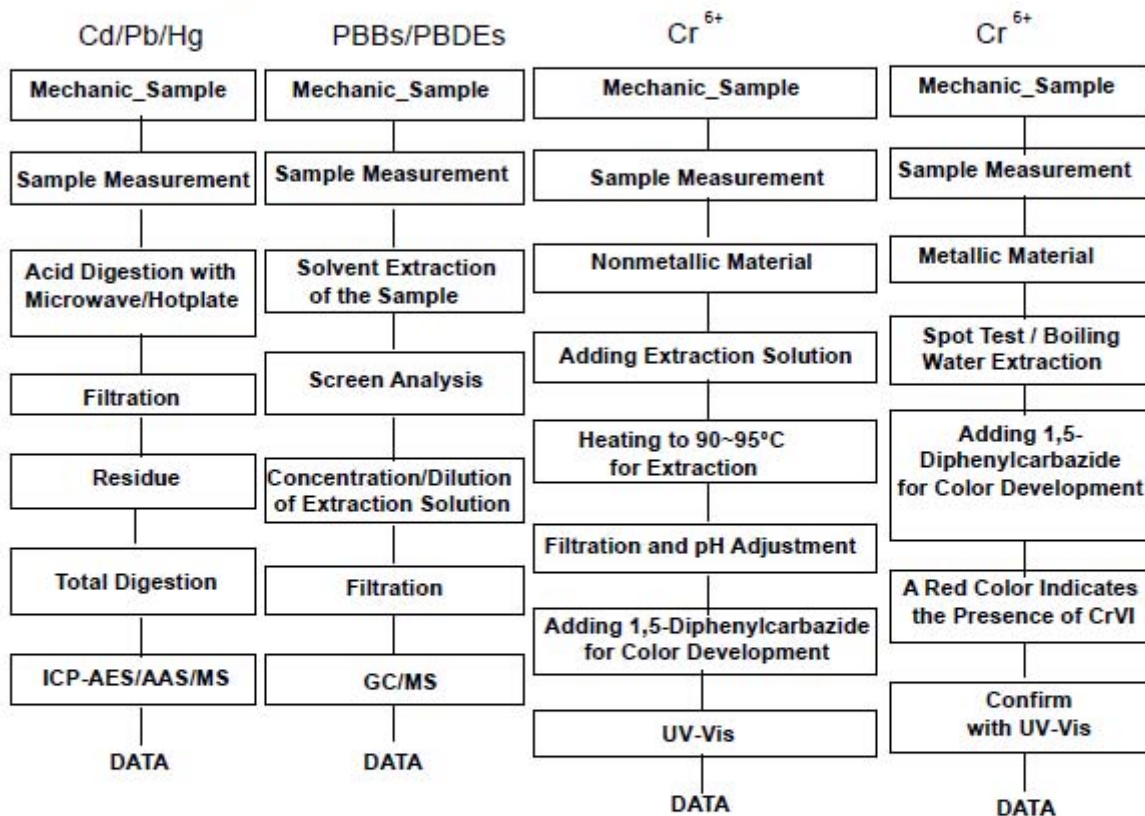
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Test Report No. F690101/LF-CTSAYAA13-16056

Issued Date: 2013. 04. 04 Page 5 of 7

Testing Flow Chart for RoHS: Cd/Pb/Hg/Cr⁶⁺ /PBBs&PBDEs Testing

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The samples were dissolved totally by pre-conditioning method according to above flow chart for Cd,Pb,Hg.
Section Chief : Gilsae Yi

```

graph TD
    A[Sample screening using XRF.] --> B{Liquid containing water(>80%)?}
    B -- Yes --> D[Dilute the solution (EPA300)]
    B -- No --> C[Weigh the samples into the combustion boat.]
    C --> E[Add absorption solution into the bomb or tube.]
    E --> F[Admit O2 gas or O2 +Ar2 gas and start the combustion.]
    F --> G[Allow during absorption of the burnt gas.]
    G --> H[Analyze absorbed solution using Ion Chromatography.]
    H --> I[Data]
    D --> I
  
```

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Test Report No. F690101/LF-CTSAYAA13-16056

Issued Date: 2013. 04. 04 Page 7 of 7

*** End ***

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Revision History

Date	Revision History	Writer	
		Drawn	Approved
2013.07.24	New version	S.B.HONG	Y.T.KIM
2013.08.03	1st	S.B.HONG	Y.T.KIM
2013.10.15	2nd	S.B.HONG	Y.T.KIM
2013.11.11	3rd	S.B.HONG	Y.T.KIM
2013.11.28	4th	S.B.HONG	Y.T.KIM
2014.01.08	5th	S.B.HONG	Y.T.KIM
2014.01.09	6th	S.B.HONG	Y.T.KIM
2014.01.14	7th	S.B.HONG	Y.T.KIM
2014.03.31	8th	S.B.HONG	M.Y.Son
2014.04.15	9th	S.B.HONG	M.Y.Son