

SMD ■ Low Power LED

45-21S/KK2C-EXXXXXXXXXXXZ6/2T



Features

- LM-80 Certified
- PLCC-2 package
- Top view white LED
- High luminous intensity output
- Wide viewing angle
- Pb-free
- RoHS compliant
- IEC Binning

Description

The Everlight 45-21S package has high efficacy, high CRI, low power consumption, wide viewing angle and a compact form factor. These features make this package an ideal LED for all lighting applications.

Applications

- General lighting
- Decorative and Entertainment Lighting
- Indicators
- Illumination
- Switch lights

Product Number Explanation

45-21S / KK 2 C – E XX XX XX XX XXZ6 / 2T

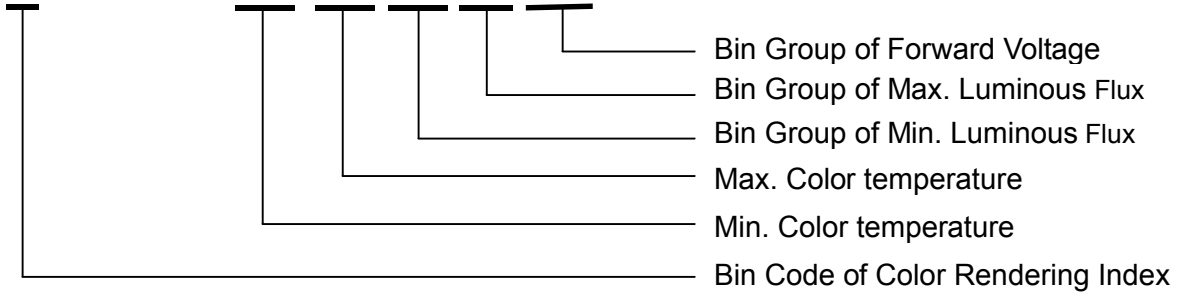


Table of Color Rendering Index

Symbol	Description
M	CRI(Min.) : 60
N	CRI(Min.) : 65
L	CRI(Min.) : 70
Q	CRI(Min.) : 75
K	CRI(Min.) : 80
P	CRI(Min.) : 85
H	CRI(Min.) : 90

Note:
 Tolerance of Color Rendering Index: ±2

Table of Forward Current Index

Symbol	Description
Z6	I _F :60mA

Example:
 45-21S/KK2C-E6565L9N3B2Z6/2T

CRI	80(Min.)
CCT	6500K
Flux	18~27lm
V _F	2.9~3.6V
I _F	60mA

Mass Production list

Product	CRI Min. ⁽¹⁾	CCT(K)	Φ(lm) Min. ⁽²⁾	Φ(lm) Max. ⁽²⁾
45-21S/KK2C-E2727L7M4B2Z6/2T	80	2700K	16	24
45-21S/KK2C-E3030L8M4B2Z6/2T	80	3000K	17	24
45-21S/KK2C-E3535L8M4B2Z6/2T	80	3500K	17	24
45-21S/KK2C-E4040L9N3B2Z6/2T	80	4000K	18	27
45-21S/KK2C-E5050L9N3B2Z6/2T	80	5000K	18	27
45-21S/KK2C-E6565L9N3B2Z6/2T	80	6500K	18	27

Note:

1. Tolerance of Color Rendering Index: ±2
2. Tolerance of Luminous flux: ±11%.

EVERLIGHT

Device Selection Guide

Chip Materials	Emitted Color	Resin Color
InGaN	Cool White Natural White Warm White	Water Clear

Absolute Maximum Ratings (T_{Soldering}=25)

Parameter	Symbol	Rating	Unit
Forward Current	I _F	75	mA
Peak Forward Current (Duty 1/10 @10ms)	I _{FP}	100	mA
Power Dissipation	P _d	270	mW
Operating Temperature	T _{opr}	-40 ~ +85	
Storage Temperature	T _{stg}	-40 ~ +100	
Thermal Resistance (Junction / Soldering point)	R _{th J-S}	50	/W
Junction Temperature	T _j	125	
Soldering Temperature	T _{sol}	Reflow Soldering : 260 Hand Soldering : 350	for 10 sec. for 3 sec.

Note:

The products are sensitive to static electricity and must be carefully taken when handling products

Electro-Optical Characteristics (T_{Soldering}=25)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Luminous Flux ₍₁₎	Φ	16	-----	27	lm	I _F =60mA
Forward Voltage ₍₂₎	V _F	2.9	-----	3.6	V	I _F =60mA
Color Rendering Index ₍₃₎	Ra	80	-----	-----		I _F =60mA
Viewing Angle	2θ _{1/2}	-----	120	-----	deg	I _F =60mA
Reverse Current	I _R	-----	-----	50	μA	V _R =5V

Note:

1. Tolerance of Luminous flux: ±11%.
2. Tolerance of Forward Voltage: ±0.1V.
3. Tolerance of Color Rendering Index: ±2

Bin Range of Luminous Flux

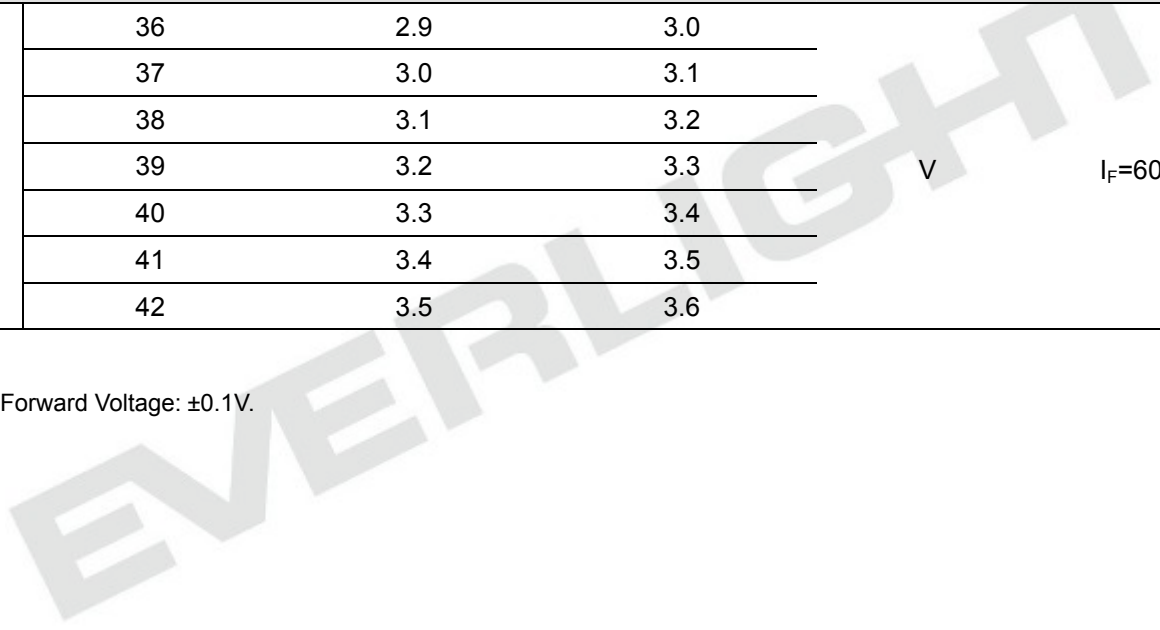
Bin Code	Min.	Max.	Unit	Condition
L7	16	17	lm	I _F =60mA
L8	17	18		
L9	18	19		
M3	19	21		
M4	21	24		
N3	24	27		

Note:
 Tolerance of Luminous flux: ±11%.

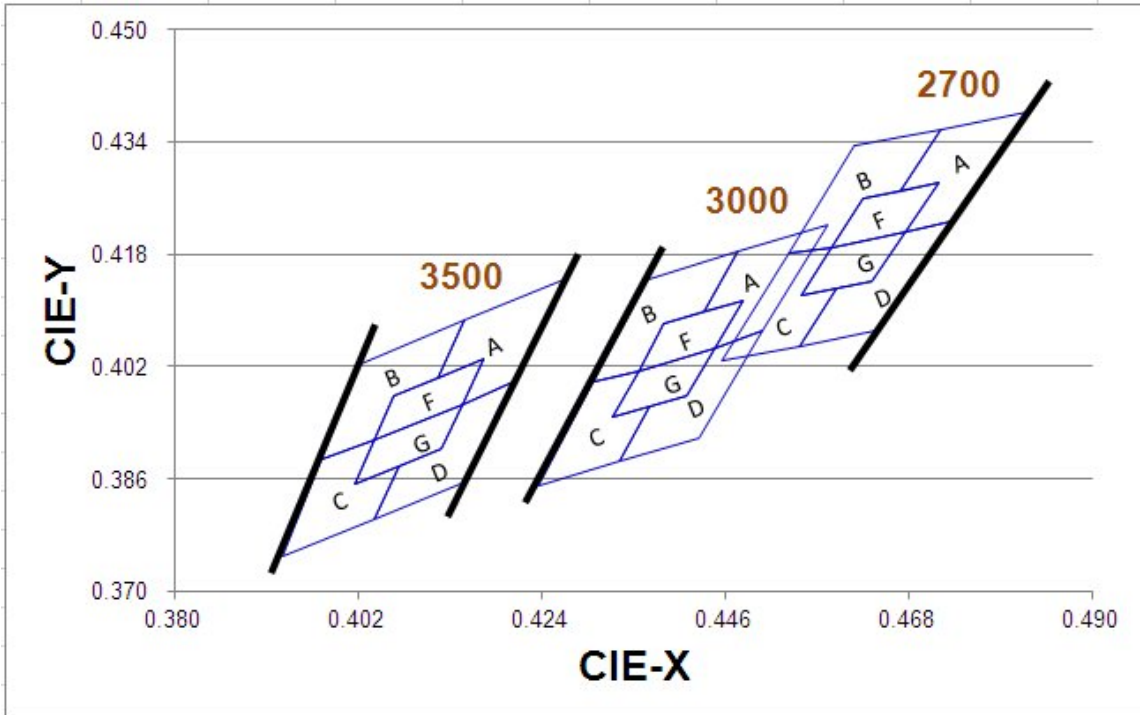
Bin Range of Forward Voltage

Group	Bin Code	Min.	Max.	Unit	Condition
B2	36	2.9	3.0	V	I _F =60mA
	37	3.0	3.1		
	38	3.1	3.2		
	39	3.2	3.3		
	40	3.3	3.4		
	41	3.4	3.5		
	42	3.5	3.6		

Note:
 Tolerance of Forward Voltage: ±0.1V.



The C.I.E. 1931 Chromaticity Diagram



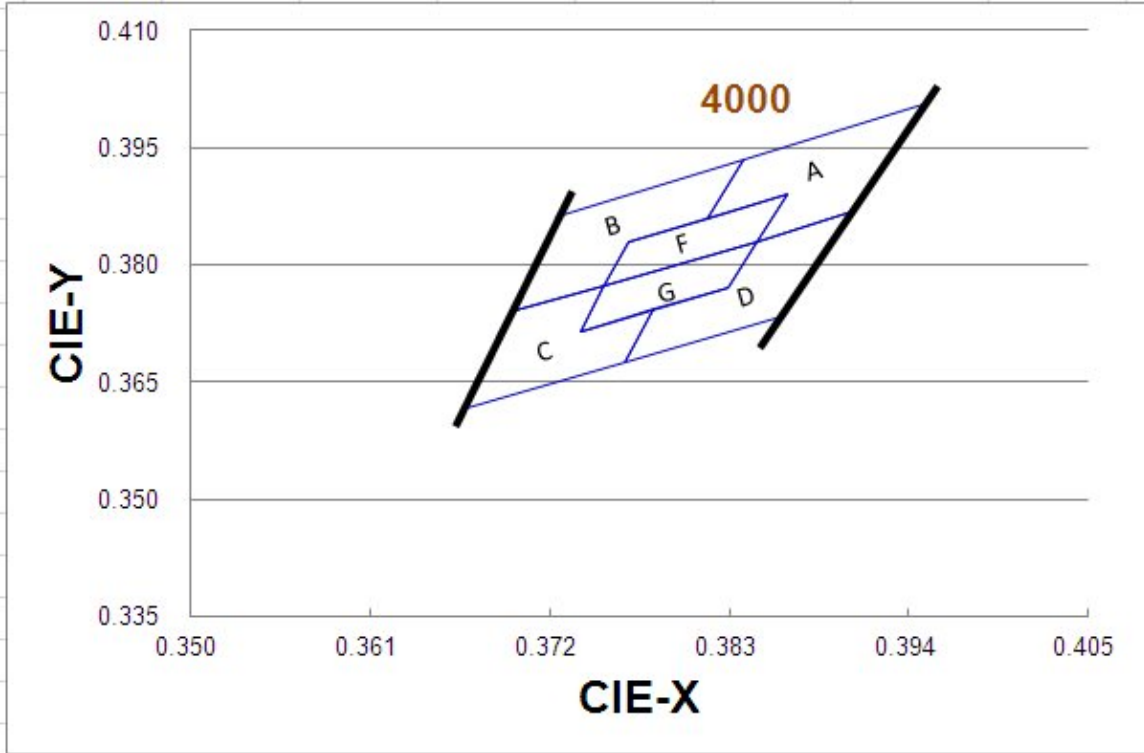
Bin Range of Chromaticity Coordinates

CCT	Bin Code	CIE_x	CIE_y	Bin Code	CIE_x	CIE_y	
2700K	E27K-A	0.4821	0.4383	E27KD	0.4731	0.4227	
		0.4718	0.4359		0.4676	0.4212	
		0.4670	0.4270		0.4636	0.4142	
		0.4715	0.4281		0.4593	0.4132	
		0.4676	0.4212		0.4548	0.4050	
		0.4731	0.4227		0.4640	0.4071	
	Reference Range: 2620K~2730K						
	E27K-B	0.4718	0.4359	E27K-C	0.4535	0.4181	
		0.4614	0.4334		0.4455	0.4028	
		0.4535	0.4181		0.4548	0.4050	
		0.4587	0.4190		0.4593	0.4132	
		0.4624	0.4259		0.4550	0.4121	
0.4670		0.4270	0.4587		0.4190		
Reference Range: 2730K~2850K							
E27K-F	0.4715	0.4281	E27K-G	0.4676	0.4212		
	0.4624	0.4259		0.4587	0.4190		
	0.4587	0.4190		0.4550	0.4121		
	0.4676	0.4212		0.4636	0.4142		
Reference Range: 2675K~2780K							

CCT	Bin Code	CIE_x	CIE_y	Bin Code	CIE_x	CIE_y	
3000K	E30K-A	0.4582	0.4223	E30KD	0.4505	0.4071	
		0.4474	0.4184		0.4447	0.4047	
		0.4433	0.4098		0.4413	0.3979	
		0.4480	0.4115		0.4369	0.3964	
		0.4447	0.4047		0.4332	0.3885	
		0.4505	0.4071		0.4427	0.3918	
	Reference Range: 2810K~2950K						
	E30K-B	0.4474	0.4184	E30K-C	0.4301	0.3998	
		0.4366	0.4145		0.4236	0.3851	
		0.4301	0.3998		0.4332	0.3885	
		0.4356	0.4015		0.4369	0.3964	
		0.4386	0.4081		0.4325	0.3948	
		0.4433	0.4098		0.4356	0.4015	
	Reference Range: 2950K~3100K						
	E30K-F	0.4480	0.4115	E30K-G	0.4447	0.4047	
		0.4386	0.4081		0.4356	0.4015	
		0.4356	0.4015		0.4325	0.3948	
		0.4447	0.4047		0.4413	0.3979	
	Reference Range: 2875K~3000K						

CCT	Bin Code	CIE_x	CIE_y	Bin Code	CIE_x	CIE_y	
3500K	E35K-A	0.4271	0.4146	E35K-D	0.3976	0.3888	
		0.4147	0.4085		0.3929	0.3751	
		0.4115	0.4005		0.4038	0.3804	
		0.4169	0.4031		0.4067	0.3878	
		0.4144	0.3967		0.4016	0.3853	
		0.4209	0.4001		0.4039	0.3916	
	Reference Range: 3250K~3450K						
	E35K-B	0.4147	0.4085	E35K-C	0.3976	0.3888	
		0.4022	0.4024		0.3929	0.3751	
		0.3976	0.3888		0.4038	0.3804	
		0.4039	0.3916		0.4067	0.3878	
		0.4061	0.3978		0.4016	0.3853	
		0.4115	0.4005		0.4039	0.3916	
	Reference Range: 3450K~3700K						
	E35K-F	0.4169	0.4031	E35K-G	0.4144	0.3967	
		0.4061	0.3978		0.4039	0.3916	
		0.4039	0.3916		0.4016	0.3853	
		0.4144	0.3967		0.4118	0.3902	
	Reference Range: 3350K~3550K						

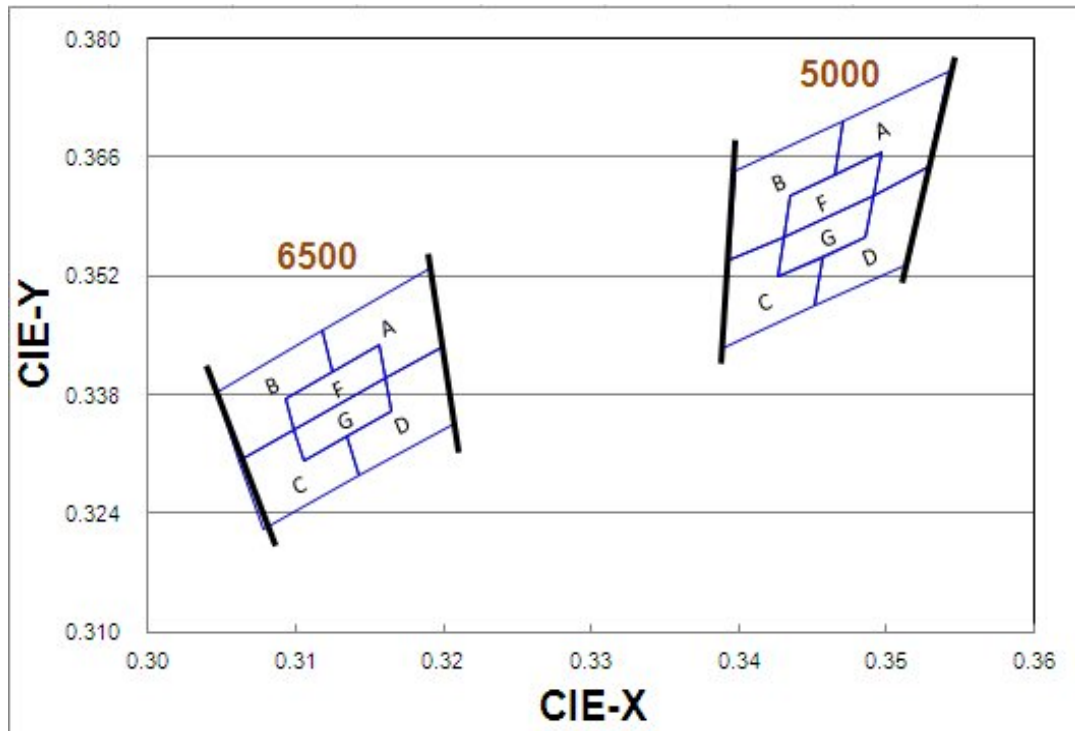
The C.I.E. 1931 Chromaticity Diagram



Bin Range of Chromaticity Coordinates

CCT	Bin Code	CIE_x	CIE_y	Bin Code	CIE_x	CIE_y	
4000K	E40K-A	0.3949	0.4004	E40K-D	0.3906	0.3869	
		0.3838	0.3934		0.3847	0.3830	
		0.3817	0.3860		0.3829	0.3770	
		0.3865	0.3889		0.3784	0.3743	
		0.3847	0.3830		0.3766	0.3675	
		0.3906	0.3869		0.3862	0.3733	
	Reference Range:3810K~4050K						
	E40K-B	0.3838	0.3934	E40K-C	0.3698	0.3740	
		0.3727	0.3864		0.3669	0.3616	
		0.3698	0.3740		0.3766	0.3675	
		0.3754	0.3773		0.3784	0.3743	
		0.3768	0.3830		0.3739	0.3715	
0.3817		0.3860	0.3754		0.3773		
Reference Range:4050K~4300K							
E40K-F	0.3865	0.3889	E40K-G	0.3847	0.3830		
	0.3768	0.3830		0.3754	0.3773		
	0.3754	0.3773		0.3739	0.3715		
	0.3847	0.3830		0.3829	0.3770		
Reference Range:3930K~4150K							

The C.I.E. 1931 Chromaticity Diagram



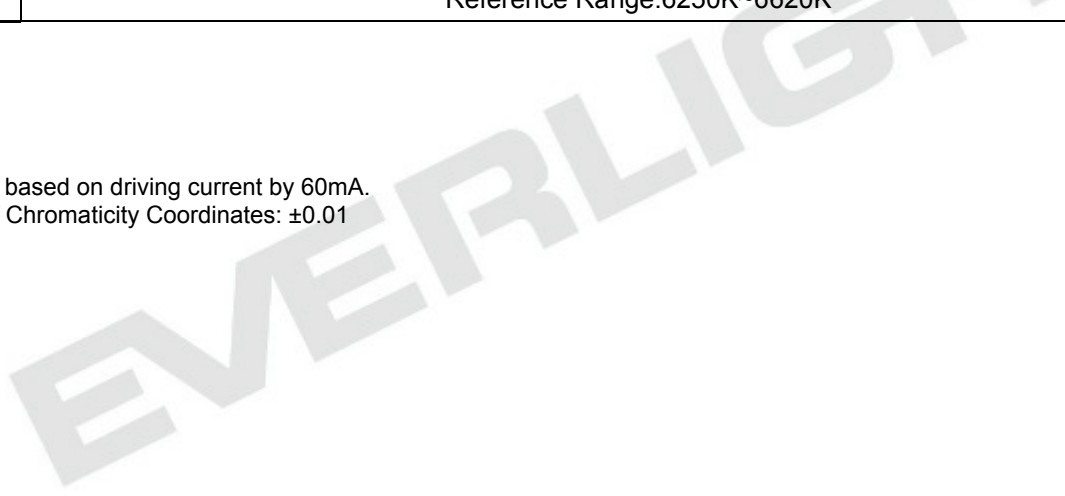
Bin Range of Chromaticity Coordinates

CCT	Bin Code	CIE_x	CIE_y	Bin Code	CIE_x	CIE_y	
5000K	E50K-A	0.3542	0.3761	E50K-D	0.3528	0.3648	
		0.3470	0.3702		0.3491	0.3616	
		0.3465	0.3640		0.3486	0.3566	
		0.3496	0.3665		0.3457	0.3543	
		0.3491	0.3616		0.3451	0.3485	
		0.3528	0.3648		0.3514	0.3535	
	Reference Range:4800K~5000K						
	E50K-B	0.3470	0.3702	E50K-C	0.3393	0.3539	
		0.3398	0.3643		0.3388	0.3435	
		0.3393	0.3539		0.3451	0.3485	
		0.3431	0.3567		0.3457	0.3543	
		0.3434	0.3615		0.3427	0.3519	
0.3465		0.3640	0.3431		0.3567		
Reference Range:5000K~5250K							
E50K-F	0.3496	0.3665	E50K-G	0.3491	0.3616		
	0.3434	0.3615		0.3431	0.3567		
	0.3431	0.3567		0.3427	0.3519		
	0.3491	0.3616		0.3486	0.3566		
Reference Range:4900K~5100K							

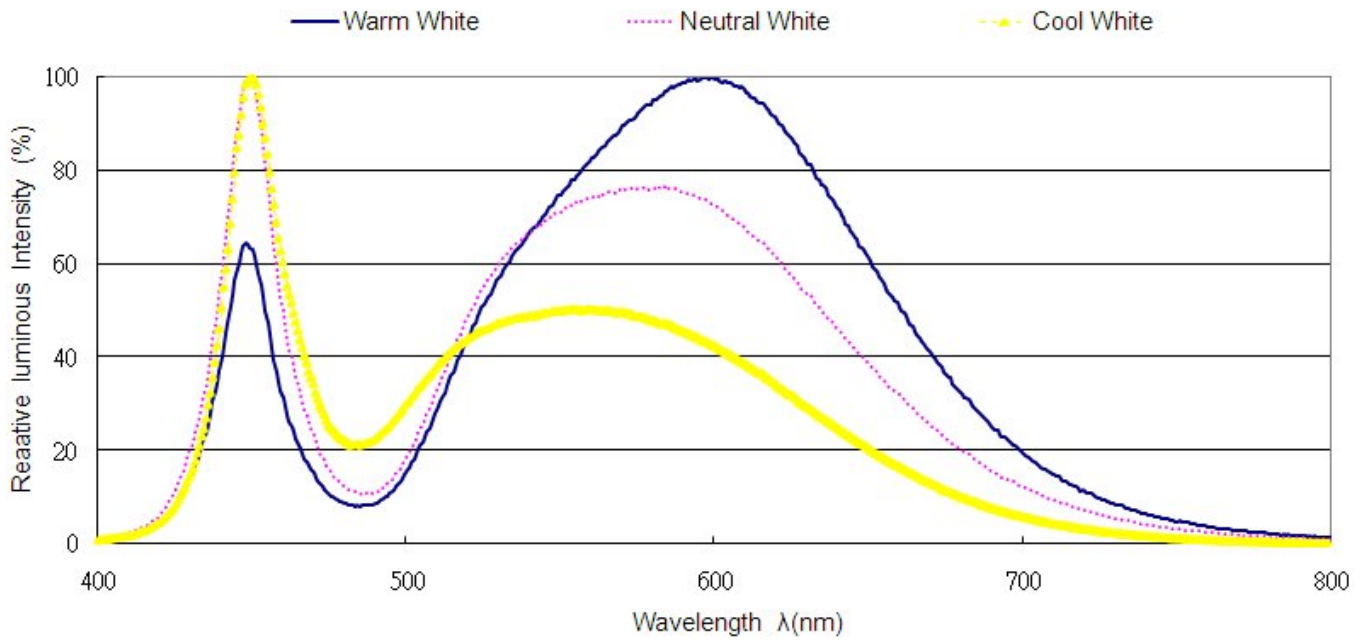
CCT	Bin Code	CIE_x	CIE_y	Bin Code	CIE_x	CIE_y	
6500K	E65K-A	0.3191	0.3528	E65K-D	0.3199	0.3438	
		0.3119	0.3455		0.3161	0.3401	
		0.3125	0.3408		0.3165	0.3361	
		0.3156	0.3440		0.3135	0.3331	
		0.3161	0.3401		0.3143	0.3284	
		0.3199	0.3438		0.3207	0.3347	
	Reference Range:6100K~6450K						
	E65K-B	0.3119	0.3455	E65K-C	0.3062	0.3302	
		0.3046	0.3382		0.3078	0.3221	
		0.3062	0.3302		0.3143	0.3284	
		0.3099	0.3339		0.3135	0.3331	
		0.3093	0.3376		0.3105	0.3301	
		0.3125	0.3408		0.3099	0.3339	
	Reference Range:6450K~6850K						
	E65K-F	0.3156	0.3440	E65K-G	0.3161	0.3401	
		0.3093	0.3376		0.3099	0.3339	
		0.3099	0.3339		0.3105	0.3301	
		0.3161	0.3401		0.3165	0.3361	
	Reference Range:6250K~6620K						

Note:

1. The value is based on driving current by 60mA.
2. Tolerance of Chromaticity Coordinates: ±0.01



Spectrum Distribution



Typical Electro-Optical Characteristics Curves

Fig.1 – Forward Voltage Shift vs. Junction Temperature

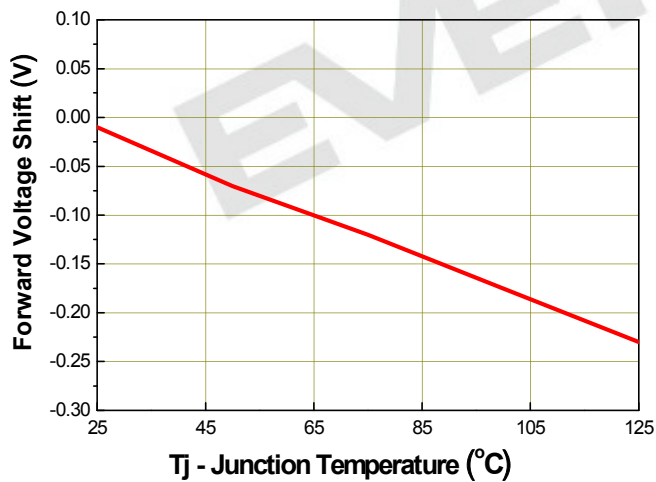
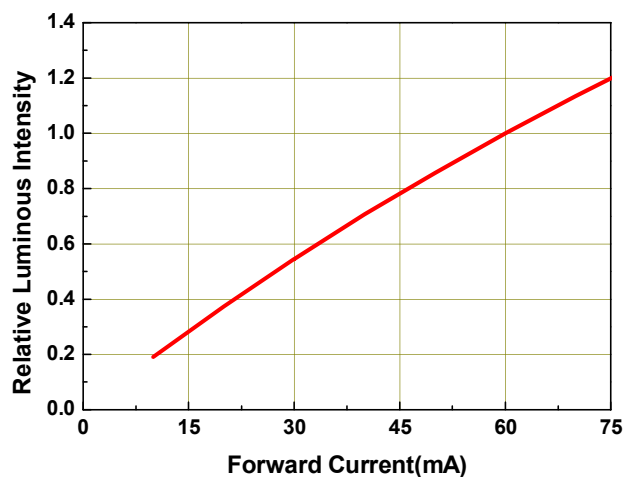


Fig.2 - Relative Luminous Intensity vs. Forward Current



Typical Electro-Optical Characteristics Curves

Fig.3 - Relative Luminous Intensity vs. Junction Temperature

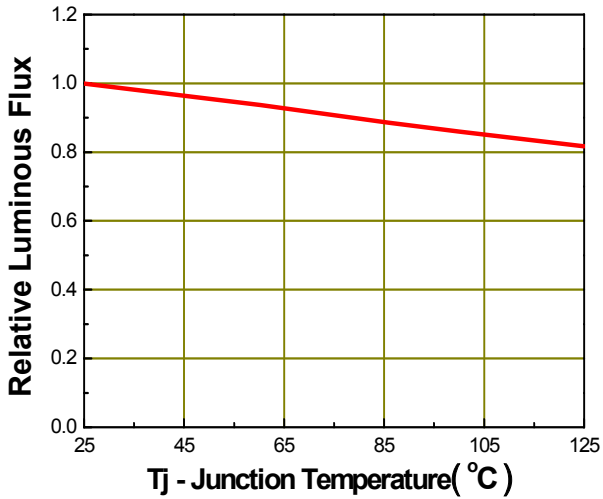


Fig.4 - Forward Current vs. Forward Voltage

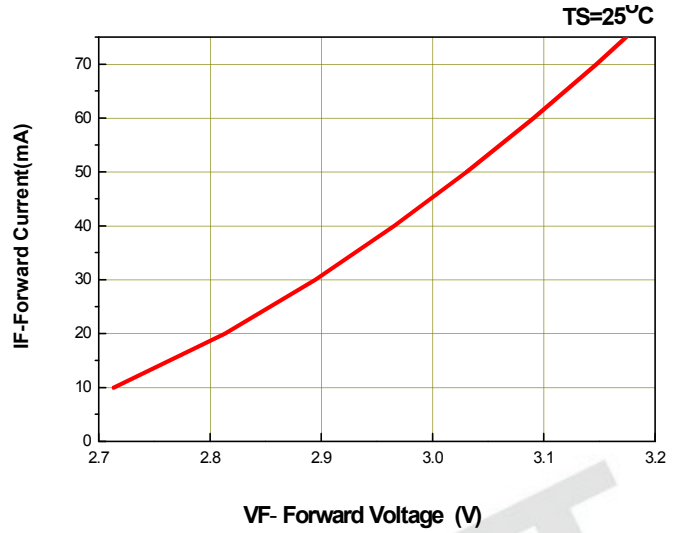


Fig.5 – Max. Driving Forward Current vs. Soldering Temperature

Rth j-s=50° C/W

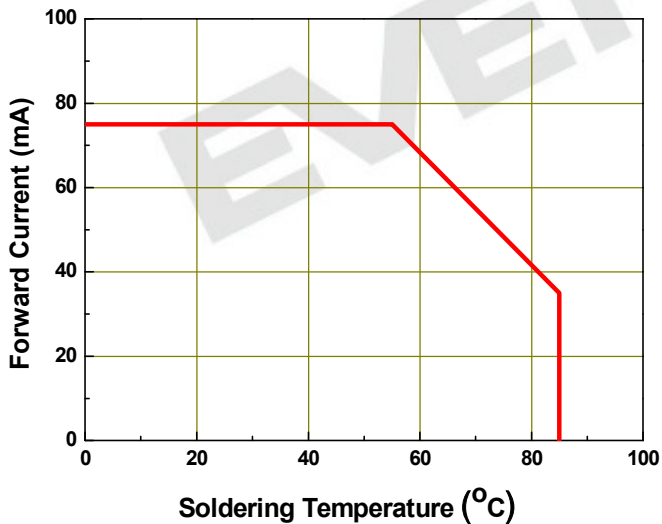
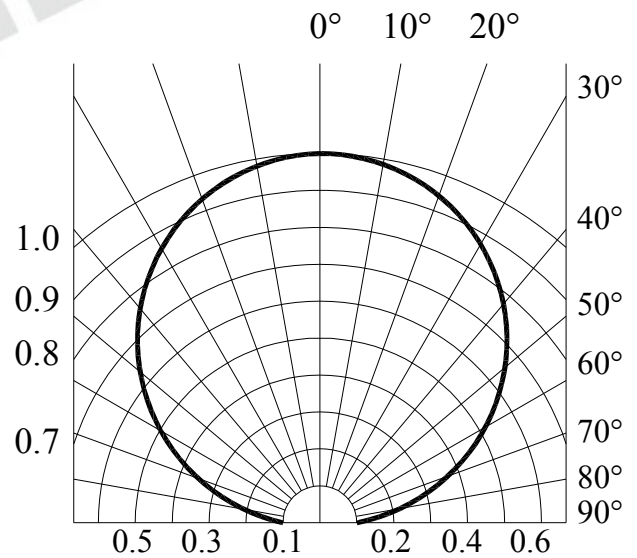
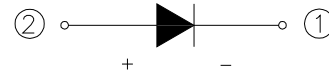
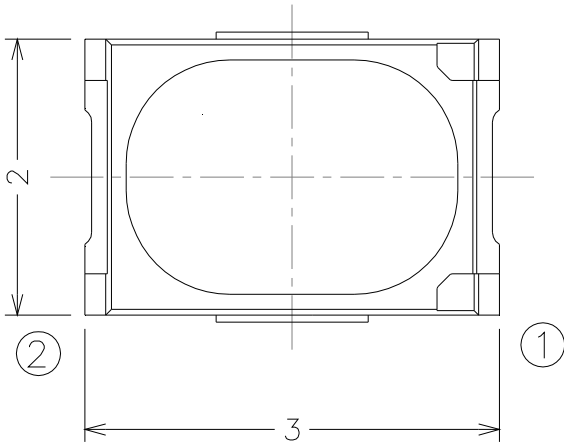


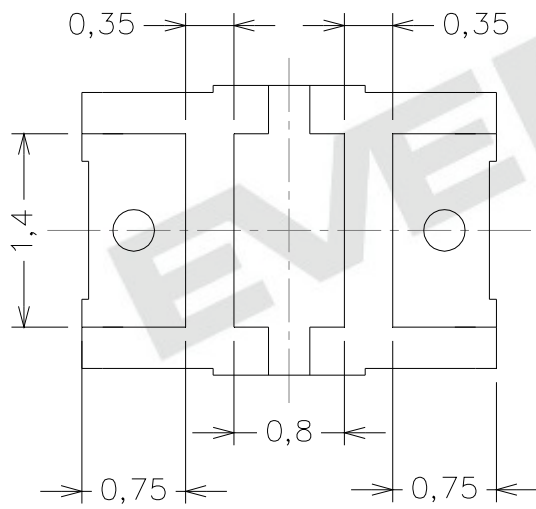
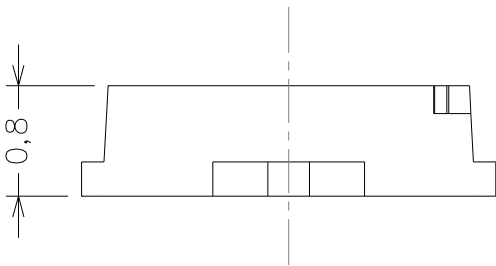
Fig.6 – Radiation Diagram



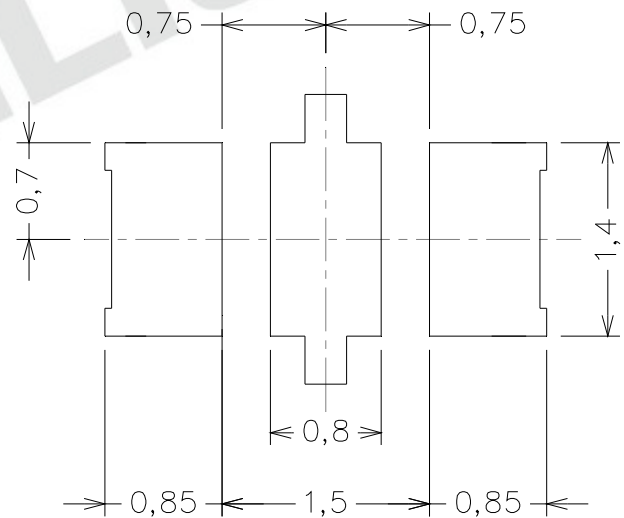
Package Dimension



Polarity



Bot. view



Soldering patterns

Note:
 Tolerance unless mentioned is ± 0.1 mm; Unit = mm

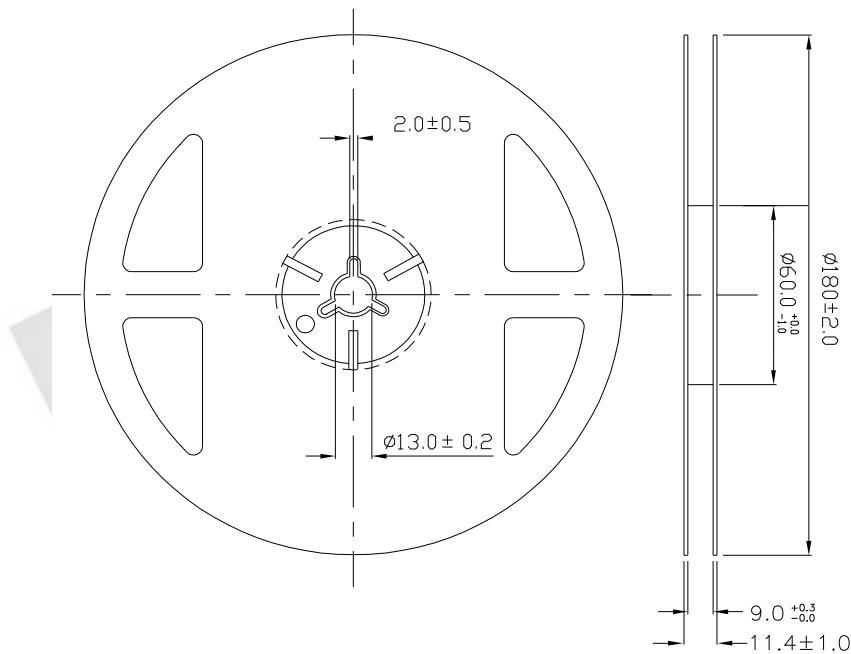
Moisture Resistant Packing Materials

Label Explanation



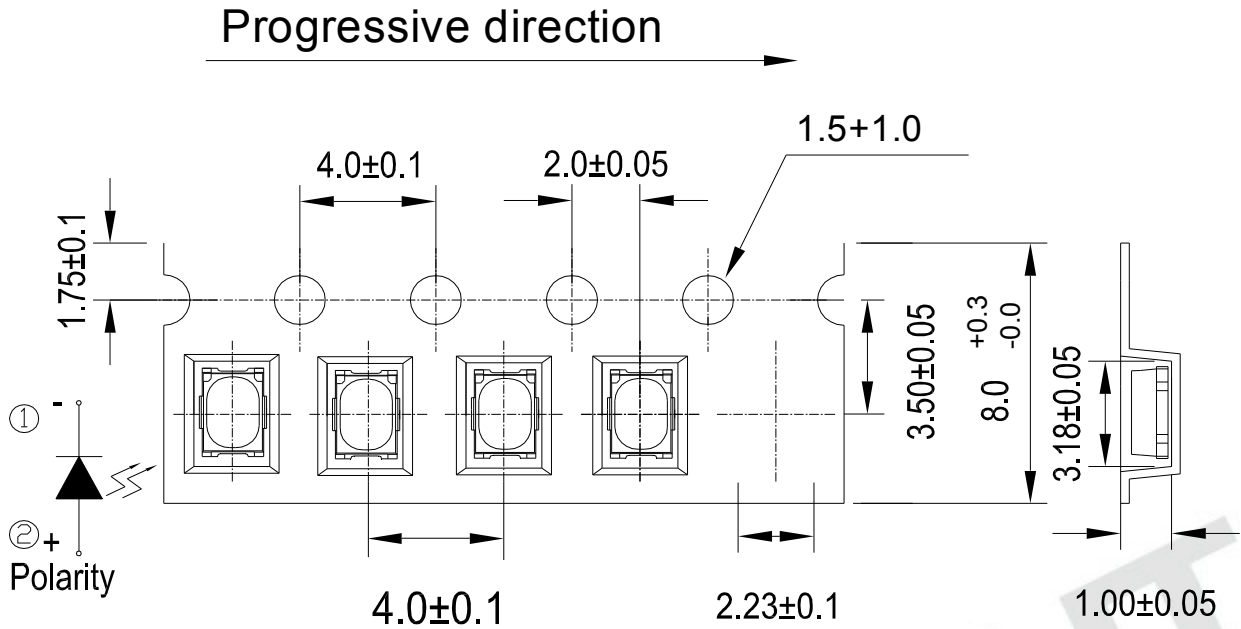
- CPN: Customer's Product Number
- P/N: Product Number
- QTY: Packing Quantity
- CAT: Luminous Intensity Rank
- HUE: Dom. Wavelength Rank
- REF: Forward Voltage Rank
- LOT No: Lot Number

Reel Dimensions



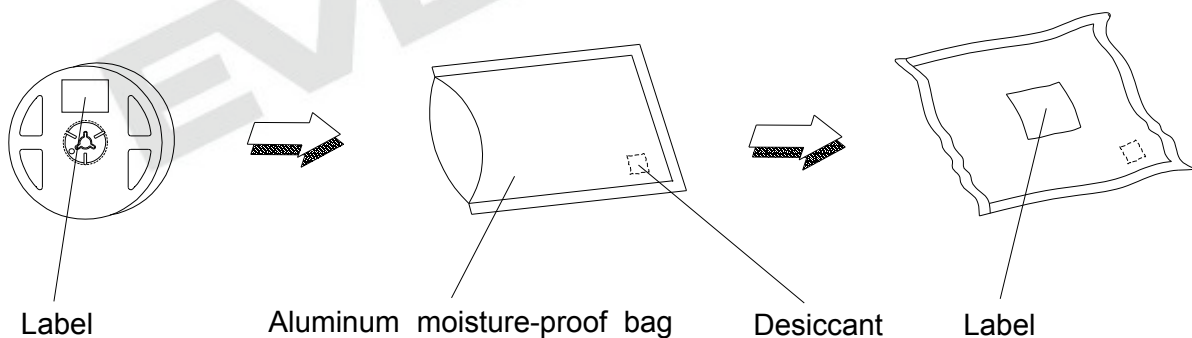
Note:
 Tolerances unless mentioned ± 0.1 mm. Unit = mm

Carrier Tape Dimensions: Loaded Quantity 250/500/1000/2000 pcs Per Reel.



Note:
 Tolerance unless mentioned is ±0.1mm; Unit = mm

Moisture Resistant Packing Process



Reliability Test Items and Conditions

The reliability of products shall be satisfied with items listed below.

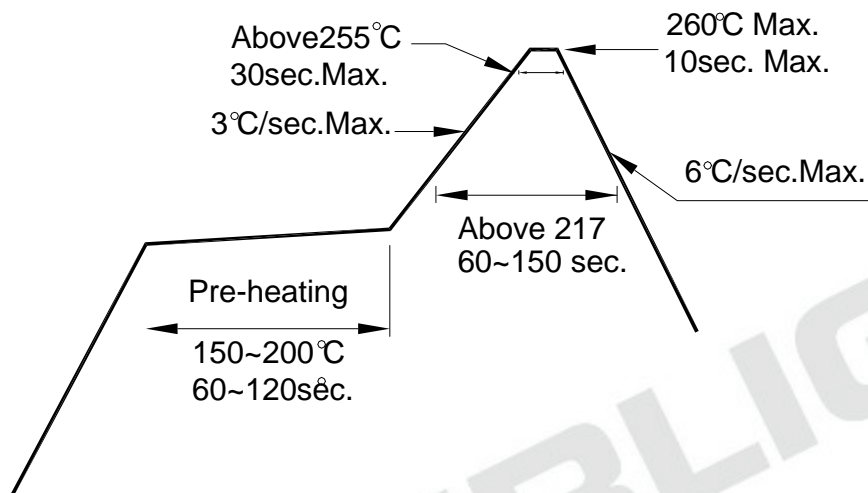
Confidence level : 90%

LTPD : 10%

No.	Items	Test Condition	Test Hours/Cycles	Sample Size	Ac/Re
1	Reflow Soldering	Temp. : 260 /10sec.	6 Min.	22 PCS.	0/1
2	Thermal Shock	H : +100 20min 10 sec L : -10 20min	500 Cycles	22 PCS.	0/1
3	Temperature Cycle	H : +100 30min 5 min L : -40 30min	500 Cycles	22 PCS.	0/1
4	High Temperature/Humidity Reverse Bias	Ta=85 ,85%RH	1000 Hrs.	22 PCS.	0/1
5	High Temperature/Humidity Operation	Ta=85 ,85%RH, I _F = 40 mA	1000 Hrs.	22 PCS.	0/1
6	Low Temperature Storage	Ta=-40	1000 Hrs.	22 PCS.	0/1
7	High Temperature Storage	Ta=85	1000 Hrs.	22 PCS.	0/1
8	Low Temperature Operation Life	Ta=-40 , I _F = 75 mA	1000 Hrs.	22 PCS.	0/1
9	High Temperature Operation/ Life#1	Ta=25 , I _F = 75 mA	1000 Hrs.	22 PCS.	0/1
10	High Temperature Operation/ Life#2	Ta=55 , I _F =75 mA	1000 Hrs.	22 PCS.	0/1
11	High Temperature Operation/ Life#3	Ta=85 , I _F = 40 mA	1000 Hrs.	22 PCS.	0/1

Precautions for Use

1. Over-current-proof
Customer must apply resistors for protection; otherwise slight voltage shift will cause big current change (Burn out will happen).
2. Storage
 - 2.1 Do not open moisture proof bag before the products are ready to use.
 - 2.2 Before opening the package: The LEDs should be kept at 30 °C or less and 90%RH or less.
 - 2.3 After opening the package: The LED's floor life is 168 Hrs under 30 °C or less and 60% RH or less. If unused LEDs remain, it should be stored in moisture proof packages.
 - 2.4 If the moisture absorbent material (silica gel) has faded away or the LEDs have exceeded the storage time, baking treatment should be performed using the following conditions.
Baking treatment: 60±5 °C for 24 hours.
3. Soldering Condition
 - 3.1 Pb-free solder temperature profile



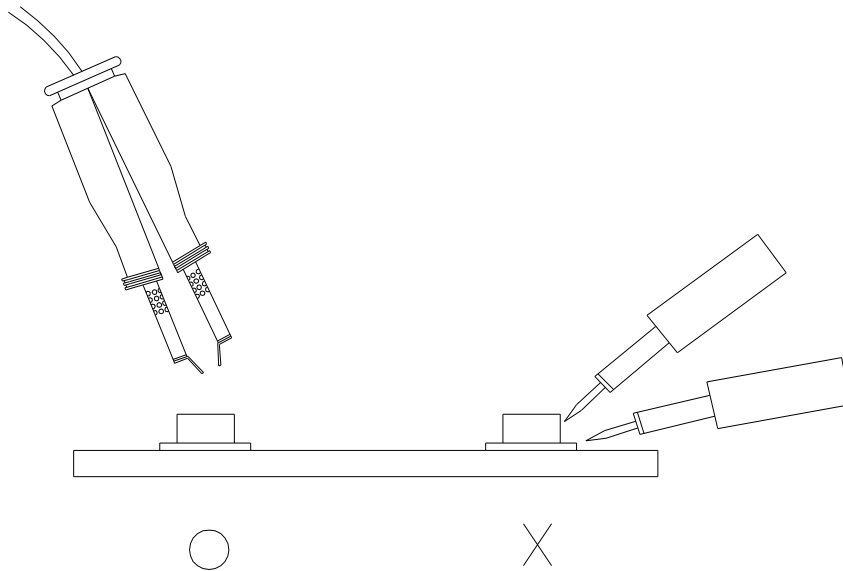
- 3.2 Reflow soldering should not be done more than two times.
- 3.3 When soldering, do not put stress on the LEDs during heating.
- 3.4 After soldering, do not warp the circuit board.

4. Soldering Iron

Each terminal is to go to the tip of soldering iron temperature less than 350 for 3 seconds within once in less than the soldering iron capacity 25W. Leave two seconds and more intervals, and do soldering of each terminal. Be careful because the damage of the product is often started at the time of the hand solder.

5. Repairing

Repair should not be done after the LEDs have been soldered. When repairing is unavoidable, a double-head soldering iron should be used (as below figure). It should be confirmed beforehand whether the characteristics of the LEDs will or will not be damaged by repairing.





Report No.: OA-2012-90030

Page 1 of 25

Issued: Aug. 20, 2013

TEST REPORT

The following tested product(s) were submitted and identified by the vendor as:

Applicant : EVERLIGHT ELECTRONICS CO., LTD.
Address of Applicant : No.6-8, Zhonghua Rd., Shulin Dist, New Taipei City
23860, Taiwan, R.O.C.
Testing Laboratory : SGS Taiwan Ltd., Optics Laboratory
Laboratory Address : 33, Wu Chyuan Rd., New Taipei Industrial Park, New
Taipei City, Taiwan 24886
Product Name : SMD C type Low Power LED 3020 Series
Model / Serial Number : SMD 45-21S (3020, 3500K)
Manufacturer : EVERLIGHT ELECTRONICS CO., LTD.
Rating : DC 60 mA, 0.2 W (Typical)
Tested Condition : DC 60 mA (Constant Current)
Test Standard/Method : IES LM-80-08 Approved Method: Measuring Lumen
Maintenance of LED Light Sources
Date of Issue : Aug. 20, 2013

The submitted products have been tested as requested and the following results were obtained,
and the report, not applicable for lawsuit, refers only to the unit(s) submitted for test.

Test Results : -PLEASE SEE ATTACHED SHEETS-

Signed for and on behalf of
SGS TAIWAN Ltd.

Calvin Tzou
Technical Manager

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Report No.: OA-2012-90030

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Issued: Aug. 20, 2013

1 SAMPLING DESCRIPTION

No sampling action and method employed

2 DATE OF RECEIPT OF SAMPLES

Sep. 27, 2012

3 DATE(S) OF PERFORMANCE OF THE TEST

Sep. 27, 2012 ~ Aug. 19, 2013

4 IDENTITY OF SAMPLES

Quantity	Model	Serial Number
25	SMD 45-21S (3020, 3500K)	# A01 - # A25 (55 °C)
25	SMD 45-21S (3020, 3500K)	# B01 - # B25 (85 °C)
25	SMD 45-21S (3020, 3500K)	# C01 - # C25 (95 °C)

5 TEST ITEMS

5.1 Data Summary of Lumen and Color Maintenance

Test results were concluded by different Case Temperatures (Ts).

5.2 Lumen Maintenance and Color Maintenance Test

Testing specifications by different case temperatures according to IES LM-80-08 Approved Method: Measuring Lumen Maintenance of LED Light Sources and client's requirements were implemented per the following items.

5.2.1 Total Luminous Flux (Φ_v)

The test results of total luminous flux were implemented referring to Clause 2 PROPERTIES OF LEDS & Clause 6 MEASUREMENT OF LUMINOUS FLUX of CIE 127: 2007 2nd edition MEASUREMENT OF LEDS and IES LM-80-08 Approved Method: Measuring Lumen Maintenance of LED Light Sources, when the UUTs were powered with constant current of I_f .

5.2.2 Correlated Color Temperature (CCT), CIE Color Coordinate (CIEx, CIEy) & Chromaticity Shift ($\Delta u'v'$)

The test results of correlated color temperature were implemented referring to CIE 127:2007 2nd edition MEASUREMENT OF LEDS, CIE 15: 2004 COLORIMETRY.

The test results of color coordinate were implemented referring to CIE 127: 2007 2nd edition MEASUREMENT OF LEDS, CIE 15:2004 COLORIMETRY.

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Issued: Aug. 20, 2013

6 TEST CONDITIONS

Main Test Equipment:

Name	Brand	Model	S/N	Traceability
Standard Light Source / Spectroradiometer	Labsphere	SCL-600 / CDS 2100	D112 / 0811118355	NIST
Source Meter	Keithley	2400	1321218	NMI
Digital Multimeter	Agilent	U1242A	MY48490144	NMI

Environmental Conditions:

Temperature: (25 ± 1) °C
Relative Humidity: < 65 % RH

UUT Conditions:

LED Light source: LED Package
Drive Current: DC 60 mA (Typical)
Forward Voltage: DC 3.2 V (Typical)
Power Consumption: 0.2 W
CCT: 3500 K
Package Dimension: L 3.0 mm x W 2.0 mm x H 0.8 mm
Prior operation: 0 hour
Total Operation Duration: 6000 hours
Target CCT: 3500 K
Sample Size: 75 pcs (25 pcs for each temperature)
Failed Quantity: 0 pcs

Measurement Conditions:

Interval Time: 0, 1000, 2000, 3000, 4000, 5000, 6000 hours
Warm up Time: < 1 minute (Initial)
Relative measurement uncertainty: 2.8 % (95 % Confidence Level)

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Issued: Aug. 20, 2013

7 TEST RESULTS

7.1 Data Summary of Lumen and Color Maintenance

Temp.	Initial (0 hr)		Luminous Maintenance (%)					
	TLF(lm)	V _F (V)	1000 hrs	2000 hrs	3000 hrs	4000 hrs	5000 hrs	6000 hrs
55°C Avg.	19.26	3.15	100.1%	99.4%	99.5%	98.3%	97.1%	96.0%
85°C Avg.	19.27	3.16	100.0%	99.5%	98.6%	97.4%	95.8%	94.4%
95°C Avg.	19.29	3.15	99.9%	99.0%	97.8%	96.6%	95.0%	93.2%

Temp.	Initial (0 hr)			Chromaticity Shift ($\Delta u'v'$)					
	CIEx	CIEy	CCT	1000 hrs	2000 hrs	3000 hrs	4000 hrs	5000 hrs	6000 hrs
55°C Avg.	0.4154	0.3905	3284.4	0.0006	0.0006	0.0006	0.0007	0.0013	0.0020
85°C Avg.	0.4158	0.3906	3276.6	0.0010	0.0007	0.0011	0.0011	0.0015	0.0015
95°C Avg.	0.4153	0.3900	3280.4	0.0007	0.0008	0.0012	0.0013	0.0009	0.0012



Lumen maintenance life projection

Table 1: Report at each LM-80 Test Condition					
Description of LED Light Source Tested (manufacturer, model, catalog number)					
Test Condition 1 - 55°C Case Temp		Test Condition 2 - 85°C Case Temp		Test Condition 3 - 95°C Case Temp	
Sample size	25	Sample size	25	Sample size	25
Number of failures	0	Number of failures	0	Number of failures	0
DUT drive current used in the test (mA)	60	DUT drive current used in the test (mA)	60	DUT drive current used in the test (mA)	60
Test duration (hours)	6,000	Test duration (hours)	6,000	Test duration (hours)	6,000
Test duration used for projection (hour to hour)	1,000 - 6,000	Test duration used for projection (hour to hour)	1,000 - 6,000	Test duration used for projection (hour to hour)	1,000 - 6,000
Tested case temperature (°C)	55	Tested case temperature (°C)	85	Tested case temperature (°C)	95
α	8.328E-06	α	1.183E-05	α	1.381E-05
B	1.013	B	1.017	B	1.017
Calculated L70(6k) (hours)	44,000	Calculated L70(6k) (hours)	32,000	Calculated L70(6k) (hours)	27,000
Reported L70(6k) (hours)	>36000	Reported L70(6k) (hours)	32,000	Reported L70(6k) (hours)	27,000





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TEST REPORT

The following tested product(s) were submitted and identified by the vendor as:

Applicant : EVERLIGHT ELECTRONICS CO., LTD.
Address of Applicant : No.6-8, Zhonghua Rd., Shulin Dist, New Taipei City
23860, Taiwan, R.O.C.
Testing Laboratory : SGS Taiwan Ltd., Optics Laboratory
Laboratory Address : 33, Wu Chyuan Rd., New Taipei Industrial Park, New
Taipei City, Taiwan 24886
Product Name : SMD C type Low Power LED 3020 Series
Model / Serial Number : SMD 45-21S (3020, 5700K)
Manufacturer : EVERLIGHT ELECTRONICS CO., LTD.
Rating : DC 60 mA, 0.2 W (Typical)
Tested Condition : DC 60 mA (Constant Current)
Test Standard/Method : IES LM-80-08 Approved Method: Measuring Lumen
Maintenance of LED Light Sources
Date of Issue : Jul. 23, 2013

The submitted products have been tested as requested and the following results were obtained,
and the report, not applicable for lawsuit, refers only to the unit(s) submitted for test.

Test Results : -PLEASE SEE ATTACHED SHEETS-

Signed for and on behalf of
SGS TAIWAN Ltd.

Calvin Tzou
Technical Manager

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Issued: Jul. 23, 2013

1 SAMPLING DESCRIPTION

No sampling action and method employed

2 DATE OF RECEIPT OF SAMPLES

Sep. 27, 2012

3 DATE(S) OF PERFORMANCE OF THE TEST

Oct. 22, 2012 ~ Jul.10, 2013

4 IDENTITY OF SAMPLES

Quantity	Model	Serial Number
25	SMD 45-21S (3020, 5700K)	# A01 - # A25 (55 ℃)
25	SMD 45-21S (3020, 5700K)	# B01 - # B25 (85 ℃)
25	SMD 45-21S (3020, 5700K)	# C01 - # C25 (95 ℃)

5 TEST ITEMS

5.1 Data Summary of Lumen and Color Maintenance

Test results were concluded by different Case Temperatures (Ts).

5.2 Lumen Maintenance and Color Maintenance Test

Testing specifications by different case temperatures according to IES LM-80-08 Approved Method: Measuring Lumen Maintenance of LED Light Sources and client's requirements were implemented per the following items.

5.2.1 Total Luminous Flux (Φ_v)

The test results of total luminous flux were implemented referring to Clause 2 PROPERTIES OF LEDS & Clause 6 MEASUREMENT OF LUMINOUS FLUX of CIE 127: 2007 2nd edition MEASUREMENT OF LEDS and IES LM-80-08 Approved Method: Measuring Lumen Maintenance of LED Light Sources, when the UUTs were powered with constant current of I_F .

5.2.2 Correlated Color Temperature (CCT), CIE Color Coordinate (CIE_x, CIE_y) & Chromaticity Shift ($\Delta u'v'$)

The test results of correlated color temperature were implemented referring to CIE 127:2007 2nd edition MEASUREMENT OF LEDS, CIE 15: 2004 COLORIMETRY. The test results of color coordinate were implemented referring to CIE 127: 2007 2nd edition MEASUREMENT OF LEDS, CIE 15:2004 COLORIMETRY.

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6 TEST CONDITIONS

Main Test Equipment:

Name	Brand	Model	S/N	Traceability
Standard Light Source / Spectroradiometer	Labsphere	SCL-600 / CDS 2100	D112 / 0811118355	NIST
Source Meter	Keithley	2400	1321218	NMI
Digital Multimeter	Agilent	U1242A	MY48490144	NMI

Environmental Conditions:

Temperature: (25 ± 1) °C
 Relative Humidity: < 65 % RH

UUT Conditions:

LED Light source: LED Package
 Drive Current: DC 60 mA (Typical)
 Forward Voltage: DC 3.2 V (Typical)
 Power Consumption: 0.2 W
 CCT: 5700 K
 Package Dimension: L 3.0 mm x W 2.0 mm x H 0.8 mm
 Prior operation: 0 hour
 Total Operation Duration: 6000 hours
 Target CCT: 5700 K
 Sample Size: 75 pcs (25 pcs for each temperature)
 Failed Quantity: 0 pcs

Measurement Conditions:

Interval Time: 0, 1000, 2000, 3000, 4000, 5000, 6000 hours
 Warm up Time: < 1 minute (Initial)
 Relative measurement uncertainty: 2.8 % (95 % Confidence Level)

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7 TEST RESULTS

7.1 Data Summary of Lumen and Color Maintenance

Temp.	Initial (0 hr)		Luminous Maintenance (%)					
	TLF(lm)	V _F (V)	1000 hrs	2000 hrs	3000 hrs	4000 hrs	5000 hrs	6000 hrs
55°C Avg.	21.33	3.10	100.2 %	100.0 %	99.2 %	98.3 %	97.0 %	95.7 %
85°C Avg.	21.12	3.11	100.2 %	100.3 %	99.2 %	98.0 %	96.1 %	94.6 %
95°C Avg.	20.29	3.10	100.2 %	100.1 %	98.9 %	98.0 %	95.8 %	93.9 %

Temp.	Initial (0 hr)			Chromaticity Shift ($\Delta u'v'$)					
	CIE _x	CIE _y	CCT	1000 hrs	2000 hrs	3000 hrs	4000 hrs	5000 hrs	6000 hrs
55°C Avg.	0.3307	0.3413	5576.2	0.0011	0.0014	0.0017	0.0028	0.0036	0.0040
85°C Avg.	0.3307	0.3406	5576.9	0.0015	0.0015	0.0016	0.0028	0.0036	0.0038
95°C Avg.	0.3306	0.3397	5583.2	0.0018	0.0020	0.0023	0.0031	0.0042	0.0039



Lumen maintenance life projection

Table 1: Report at each LM-80 Test Condition					
Description of LED Light Source Tested (manufacturer, model, catalog number)					
Test Condition 1 - 55°C Case Temp		Test Condition 2 - 85°C Case Temp		Test Condition 3 - 95°C Case Temp	
Sample size	25	Sample size	25	Sample size	25
Number of failures	0	Number of failures	0	Number of failures	0
DUT drive current used in the test (mA)	60	DUT drive current used in the test (mA)	60	DUT drive current used in the test (mA)	60
Test duration (hours)	6,000	Test duration (hours)	6,000	Test duration (hours)	6,000
Test duration used for projection (hour to hour)	1,000 - 6,000	Test duration used for projection (hour to hour)	1,000 - 6,000	Test duration used for projection (hour to hour)	1,000 - 6,000
Tested case temperature (°C)	55	Tested case temperature (°C)	85	Tested case temperature (°C)	95
α	9.435E-06	α	1.223E-05	α	1.330E-05
B	1.017	B	1.023	B	1.024
Calculated L70(6k) (hours)	40,000	Calculated L70(6k) (hours)	31,000	Calculated L70(6k) (hours)	29,000
Reported L70(6k) (hours)	>36000	Reported L70(6k) (hours)	31,000	Reported L70(6k) (hours)	29,000

