DATASHEET

SMD ▪ Low Power LED
45-21S/XK2C-HXXXXXXXXB2Z6/2T

Features

- LM-80 Certified
- PLCC-2 package
- Top view white LED
- High luminous intensity output
- Wide viewing angle
- Pb-free
- RoHS compliant
- ANSI 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 / X K 2 C – H XX XX XX XX XXZ6 / 2T

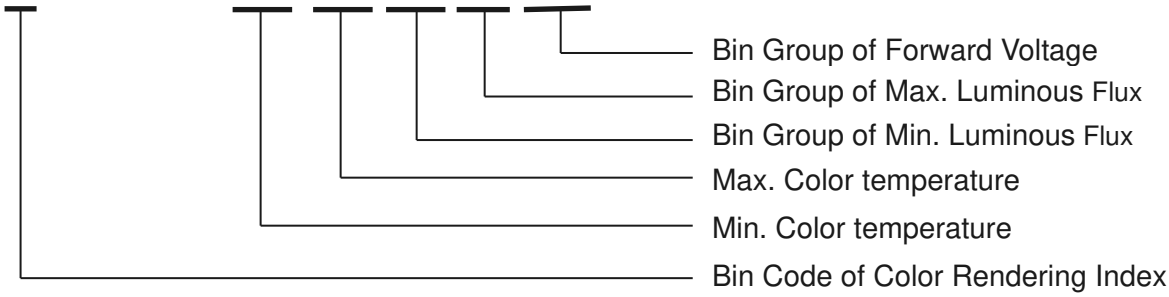


Table of Color Rendering Index

Symbol	Description
M	CRI(Min.) : 60
N	CRI(Min.) : 65
L	CRI(Min.) : 70
Q	CRI(Min.) : 75
K	CRI(Min.) : 80
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-H2727L7M4B2Z6/2T

CRI	80(Min.)
CCT	2700K
Flux	16.0~24.0lm
V_F	2.9~3.6V
I_F	60mA

Mass Production List for CRI>80

Product	CRI Min.(1)	CCT(K)	Φ(lm) Min. (2)	Φ(lm) Max. (2)
45-21S/KK2C-H2727L7M4B2Z6/2T	80	2700K	16	24
45-21S/KK2C-H3030L8M4B2Z6/2T	80	3000K	17	24
45-21S/KK2C-H3535L8M4B2Z6/2T	80	3500K	17	24
45-21S/KK2C-H4040L9N3B2Z6/2T	80	4000K	18	27
45-21S/KK2C-H5050L9N3B2Z6/2T	80	5000K	18	27
45-21S/KK2C-H5757L9N3B2Z6/2T	80	5700K	18	27
45-21S/KK2C-H6565L9N3B2Z6/2T	80	6500K	18	27

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

Device Selection Guide

Chip Materials	Emitted Color	Resin Color
InGaN	Cool White Netural 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)	$R_{th\ J\text{-}S}$	50	℃/W
Junction Temperature	T_j	125	℃
Soldering Temperature	T_{sol}	Reflow Soldering : 260 ℃ for 10 sec. Hand Soldering : 350 ℃ 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	$2\theta_{1/2}$	-----	120	-----	deg	I_F=60mA
Reverse Current	I_R	-----	-----	50	μA	V_R=5V

Notes:
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	Im	I_F=60mA
L8	17	18		
L9	18	19		
M3	19	21		
M4	21	24		
N3	24	27		

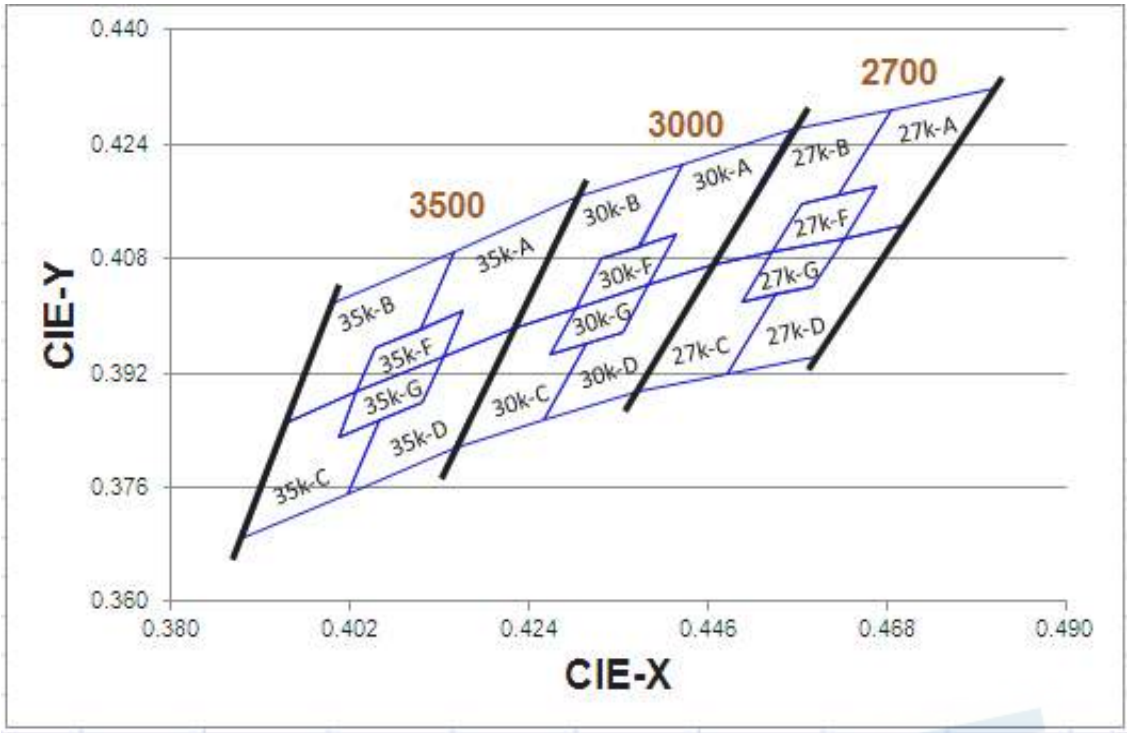
Note:
Tolerance of Luminous flux: ±11%.

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



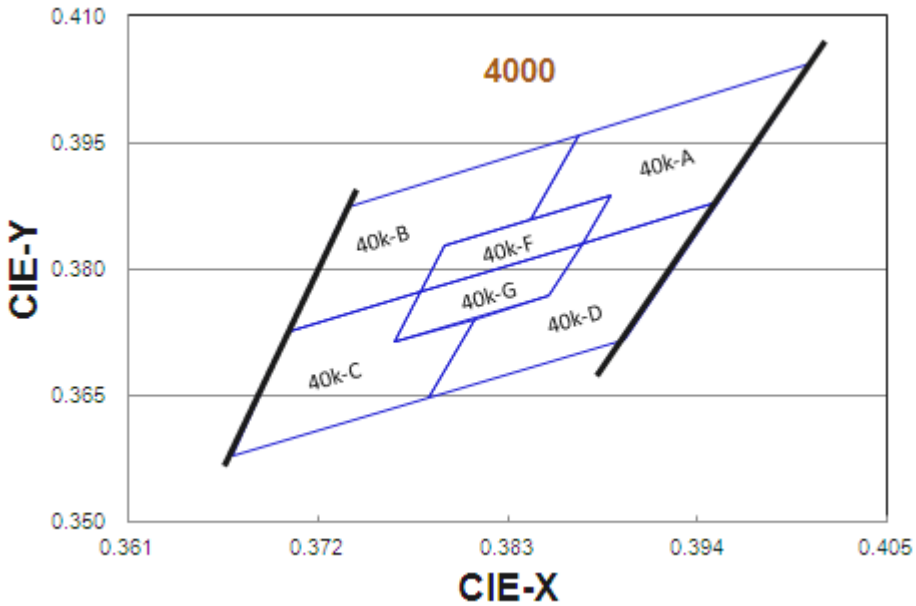
Bin Range of Chromaticity Coordinates

CCT	Bin Code	CIE_x	CIE_y	Bin Code	CIE_x	CIE_y
2700K	27K-A	0.4813	0.4319	27K-D	0.4700	0.4126
		0.4687	0.4289		0.4627	0.4109
		0.4621	0.4169		0.4588	0.4041
		0.4667	0.4180		0.4544	0.4030
		0.4627	0.4109		0.4483	0.3919
		0.4700	0.4126		0.4593	0.3944
	Reference Range:2580K~2700K					
	27K-B	0.4687	0.4289	27K-C	0.4465	0.4071
		0.4562	0.4260		0.4373	0.3893
		0.4465	0.4071		0.4483	0.3919
		0.4539	0.4088		0.4544	0.4030
		0.4576	0.4158		0.4502	0.4020
		0.4621	0.4169		0.4539	0.4088
	Reference Range:2700K~2870K					
	27K-F	0.4667	0.4180	27K-G	0.4627	0.4109
		0.4576	0.4158		0.4539	0.4088
		0.4539	0.4088		0.4502	0.4020
		0.4627	0.4109		0.4588	0.4041
	Reference Range: 2665K~2770K					

CCT	Bin Code	CIE_x	CIE_y	Bin Code	CIE_x	CIE_y
3000K	30K-A	0.4562	0.4260	30K-D	0.4465	0.4071
		0.4430	0.4212		0.4388	0.4043
		0.4375	0.4096		0.4355	0.3977
		0.4422	0.4113		0.4311	0.3962
		0.4388	0.4043		0.4259	0.3853
		0.4465	0.4071		0.4373	0.3893
	Reference Range:2870K~3000K					
	30K-B	0.4430	0.4212	30K-C	0.4221	0.3984
		0.4299	0.4165		0.4147	0.3814
		0.4221	0.3984		0.4259	0.3853
		0.4297	0.4011		0.4311	0.3962
		0.4328	0.4079		0.4267	0.3946
		0.4375	0.4096		0.4297	0.4011
	Reference Range:3000K~3220K					
	30K-F	0.4422	0.4113	30K-G	0.4388	0.4043
		0.4328	0.4079		0.4297	0.4011
		0.4297	0.4011		0.4267	0.3946
		0.4388	0.4043		0.4355	0.3977
	Reference Range:2960K~3080K					

CCT	Bin Code	CIE_x	CIE_y	Bin Code	CIE_x	CIE_y
3500K	35K-A	0.4299	0.4165	35K-D	0.4221	0.3984
		0.4148	0.4090		0.4134	0.3943
		0.4106	0.3981		0.4108	0.3878
		0.4159	0.4007		0.4057	0.3853
		0.4134	0.3943		0.4018	0.3752
		0.4221	0.3984		0.4147	0.3814
	Reference Range:3220K~3500K					
	35K-B	0.4148	0.4090	35K-C	0.3943	0.3853
		0.3996	0.4015		0.3889	0.3690
		0.3943	0.3853		0.4018	0.3752
		0.4029	0.3893		0.4057	0.3853
		0.4051	0.3954		0.4006	0.3829
		0.4106	0.3981		0.4029	0.3893
	Reference Range:3500K~3710K					
	35K-F	0.4159	0.4007	35K-G	0.4134	0.3943
		0.4051	0.3954		0.4029	0.3893
		0.4029	0.3893		0.4006	0.3829
		0.4134	0.3943		0.4108	0.3878
	Reference Range:3360K~3540K					

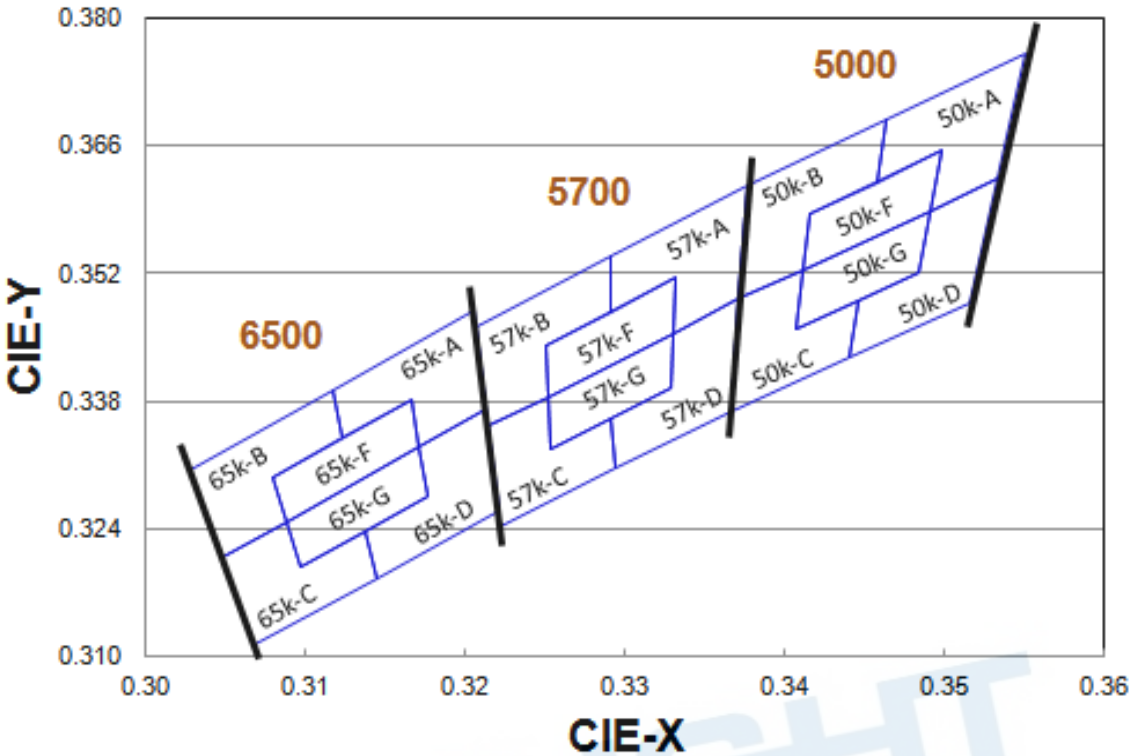
The C.I.E. 1931 Chromaticity Diagram



Bin Range of Chromaticity Coordinates

CCT	Bin Code	CIE_x	CIE_y	Bin Code	CIE_x	CIE_y
4000K	40K-A	0.4006	0.4044	40K-D	0.3952	0.3880
		0.3871	0.3959		0.3873	0.3831
		0.3843	0.3858		0.3854	0.3768
		0.3890	0.3887		0.3810	0.3741
		0.3873	0.3831		0.3784	0.3647
		0.3952	0.3880		0.3898	0.3716
	Reference Range:3700K~3970K					
	40K-B	0.3871	0.3959	40K-C	0.3703	0.3726
		0.3736	0.3874		0.3670	0.3578
		0.3703	0.3726		0.3784	0.3647
		0.3779	0.3773		0.3810	0.3741
		0.3793	0.3828		0.3764	0.3713
		0.3843	0.3858		0.3779	0.3773
	Reference Range:3970K~4270K					
	40K-F	0.3890	0.3887	40K-G	0.3873	0.3831
		0.3793	0.3828		0.3779	0.3773
		0.3779	0.3773		0.3764	0.3713
		0.3873	0.3831		0.3854	0.3768
	Reference Range:3870K~4080K					

The C.I.E. 1931 Chromaticity Diagram



Bin Range of Chromaticity Coordinates

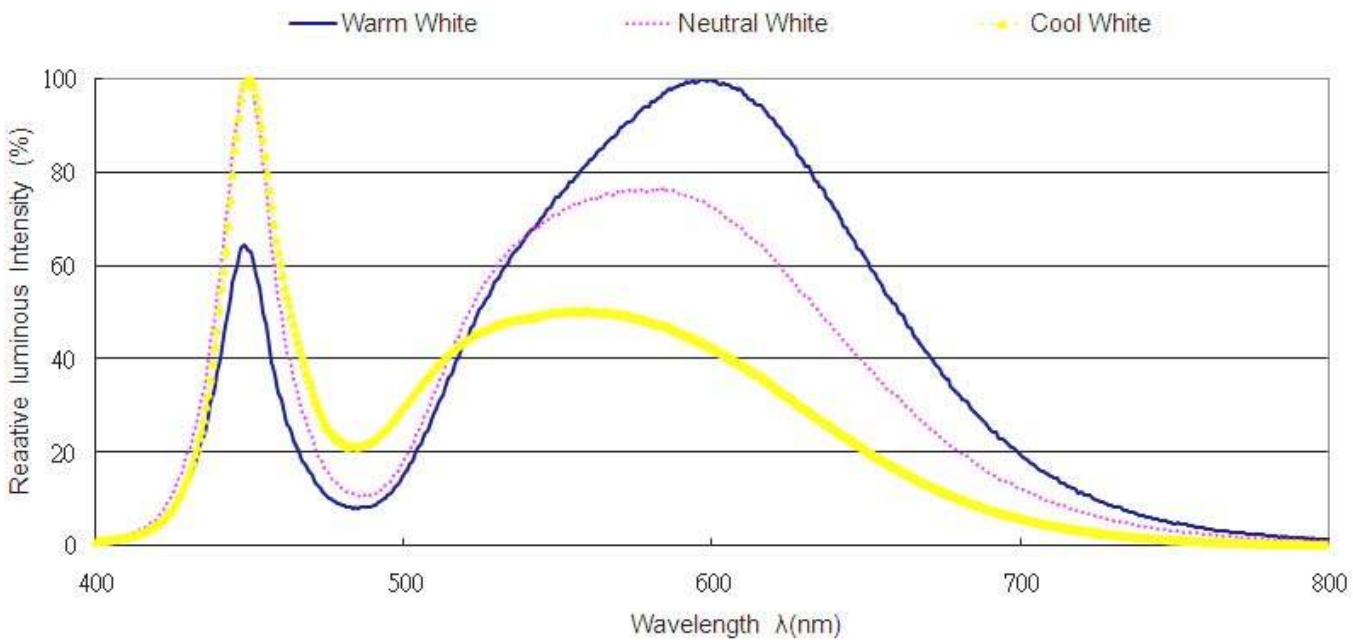
CCT	Bin Code	CIE_x	CIE_y	Bin Code	CIE_x	CIE_y
5000K	50K-A	0.3551	0.3760	50K-D	0.3533	0.3624
		0.3464	0.3688		0.3482	0.3583
		0.3456	0.3604		0.3477	0.3530
		0.3487	0.3629		0.3448	0.3507
		0.3482	0.3583		0.3441	0.3428
		0.3533	0.3624		0.3515	0.3487
	Reference Range:4745K~5000K					
	50K-B	0.3464	0.3688	50K-C	0.3371	0.3493
		0.3376	0.3616		0.3366	0.3369
		0.3371	0.3493		0.3441	0.3428
		0.3422	0.3533		0.3448	0.3507
		0.3425	0.3579		0.3418	0.3483
		0.3456	0.3604		0.3422	0.3533
	Reference Range:5000K~5310K					
	50K-F	0.3487	0.3629	50K-G	0.3482	0.3583
		0.3425	0.3579		0.3422	0.3533
		0.3422	0.3533		0.3418	0.3483
		0.3482	0.3583		0.3477	0.3530
	Reference Range:4910K~5120K					

CCT	Bin Code	CIE_x	CIE_y	Bin Code	CIE_x	CIE_y
5700K	57K-A	0.3376	0.3616	57K-D	0.3371	0.3493
		0.3292	0.3539		0.3321	0.3447
		0.3292	0.3464		0.3320	0.3401
		0.3321	0.3490		0.3293	0.3377
		0.3321	0.3447		0.3294	0.3306
		0.3371	0.3493		0.3366	0.3369
	Reference Range:5310K~5700K					
	57K-B	0.3292	0.3539	57K-C	0.3215	0.3353
		0.3207	0.3462		0.3222	0.3243
		0.3215	0.3353		0.3294	0.3306
		0.3262	0.3395		0.3293	0.3377
		0.3261	0.3436		0.3263	0.335
		0.3292	0.3464		0.3262	0.3395
	Reference Range:5700K~6020K					
	57K-F	0.3321	0.3490	57K-G	0.3321	0.3447
		0.3261	0.3436		0.3262	0.3395
		0.3262	0.3395		0.3263	0.3350
		0.3321	0.3447		0.3320	0.3401
	Reference Range:5520K~5780K					

CCT	Bin Code	CIE_x	CIE_y	Bin Code	CIE_x	CIE_y
6500K	65K-A	0.3205	0.3481	65K-D	0.3213	0.3371
		0.3117	0.3393		0.3161	0.3320
		0.3125	0.3328		0.3166	0.3281
		0.3157	0.3360		0.3136	0.3251
		0.3161	0.3320		0.3145	0.3187
		0.3213	0.3371		0.3221	0.3261
	Reference Range:6020K~6500K					
	65K-B	0.3117	0.3393	65K-C	0.3048	0.3209
		0.3028	0.3304		0.3068	0.3113
		0.3048	0.3209		0.3145	0.3187
		0.3100	0.3259		0.3136	0.3251
		0.3093	0.3297		0.3106	0.3222
		0.3125	0.3328		0.31	0.3259
	Reference Range:6500K~7050K					
	65K-F	0.3157	0.3360	65K-G	0.3161	0.3320
		0.3093	0.3297		0.3100	0.3259
		0.3100	0.3259		0.3106	0.3222
		0.3161	0.3320		0.3166	0.3281
	Reference Range:6300K~6690K					

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

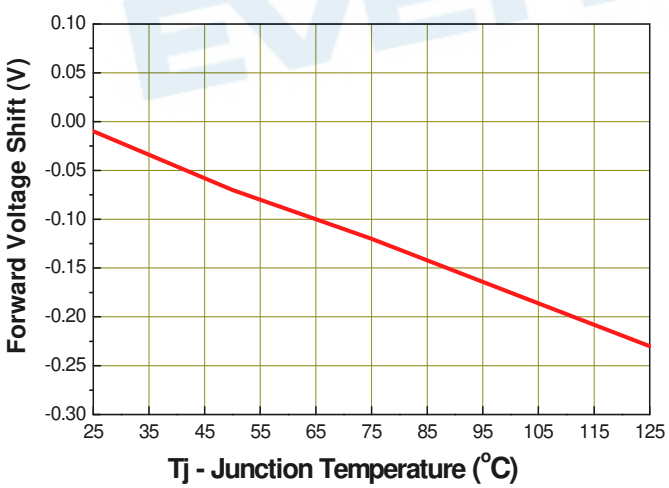
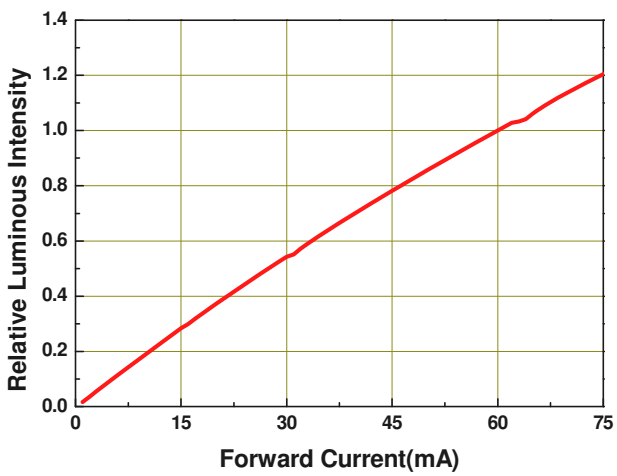


Fig.2 - Relative Luminous Intensity vs. Forward Current



Typical Electro-Optical Characteristics Curves

Fig.3 - Relative Luminous Intensity vs. Junction Temperature

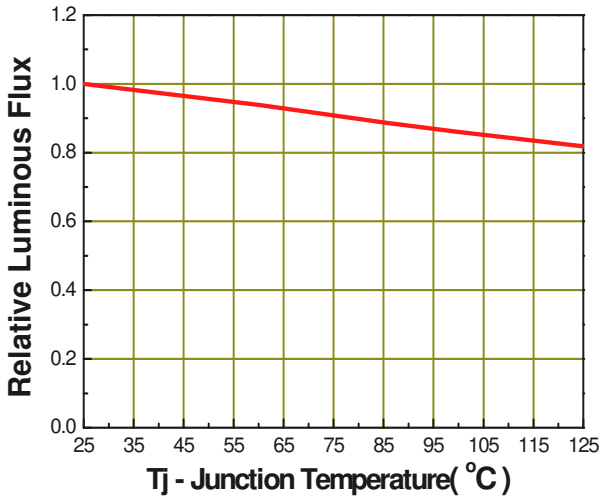


Fig.4 - Forward Current vs. Forward Voltage

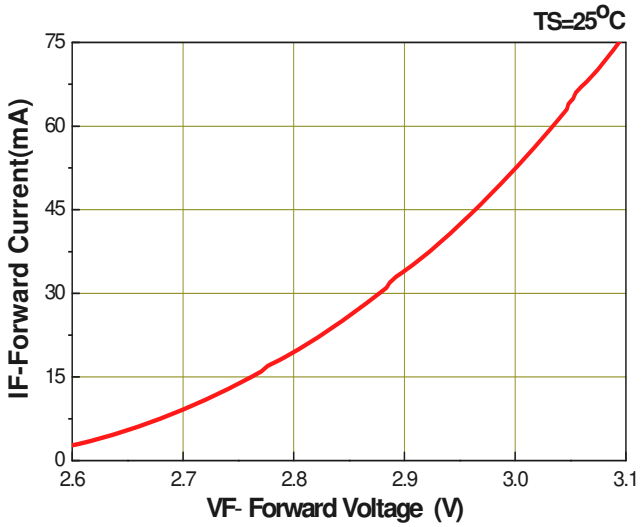


Fig.5 – Max. Driving Forward Current vs. Soldering Temperature

Rth j-s=50 ° C/W

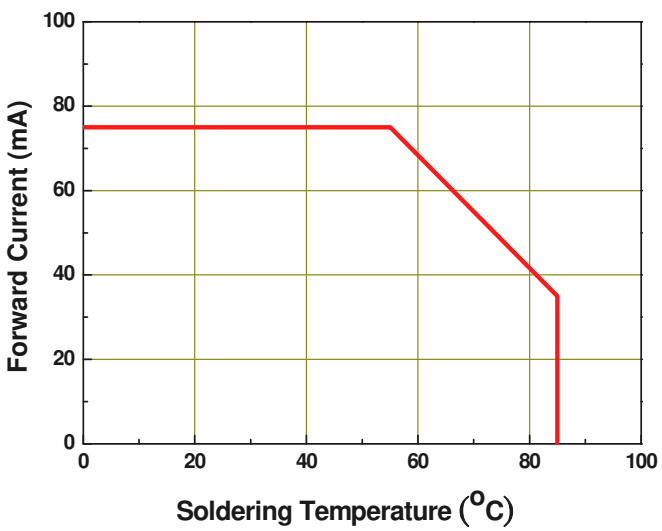
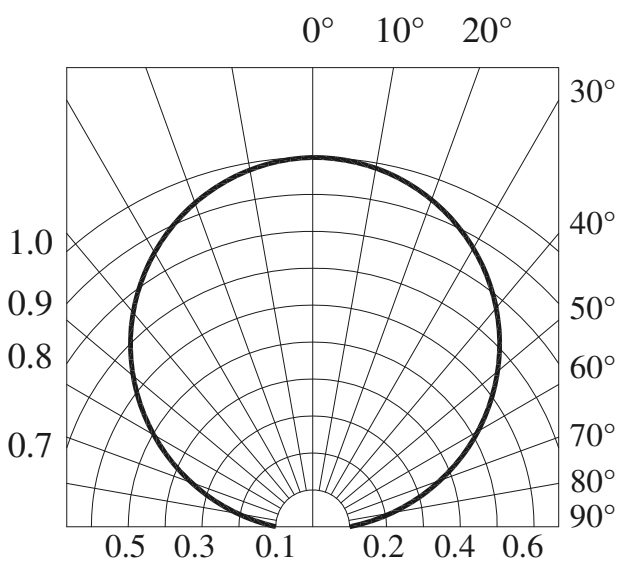
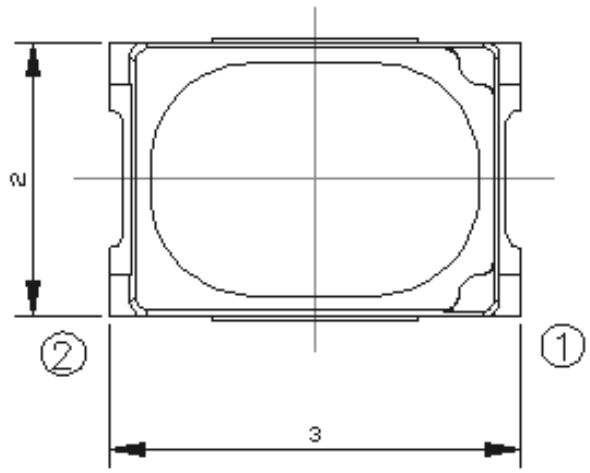


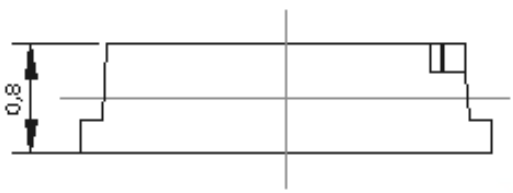
Fig.6 – Radiation Diagram

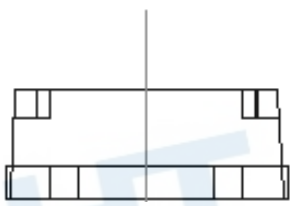


Package Dimension

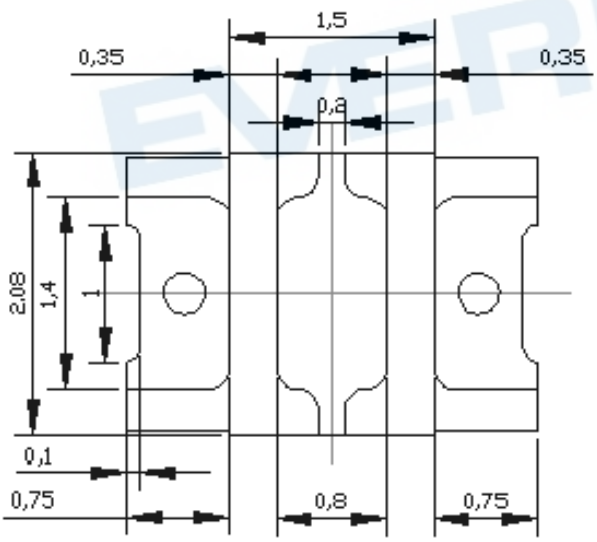


Polarity

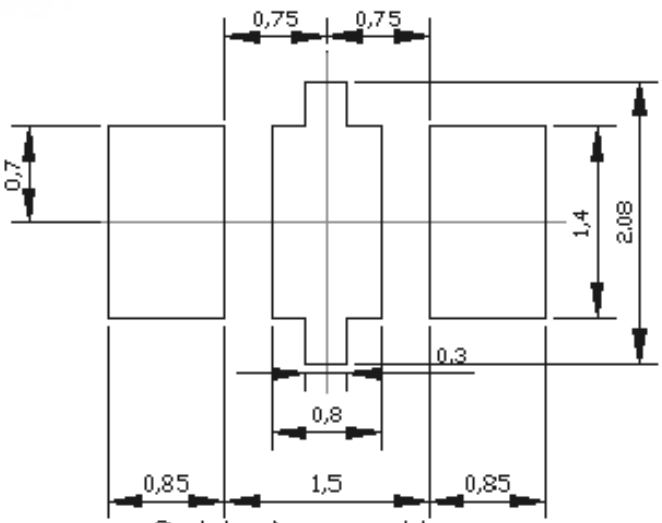




Recommended Solde Pad



Bot. view

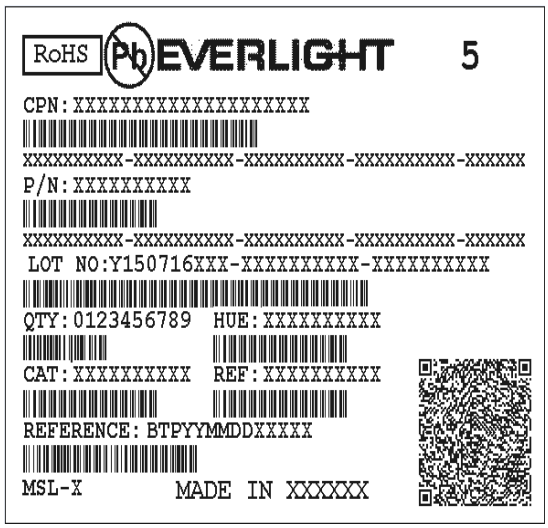


Soldering patterns

Note:
Tolerance unless mentioned is ±0.2mm; Unit = mm

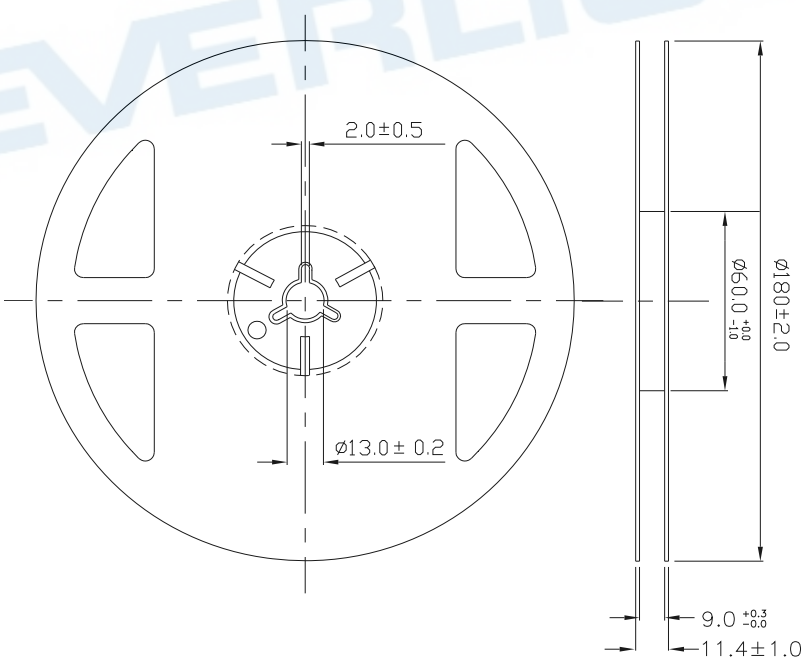
Moisture Resistant Packing Materials

Label Explanation



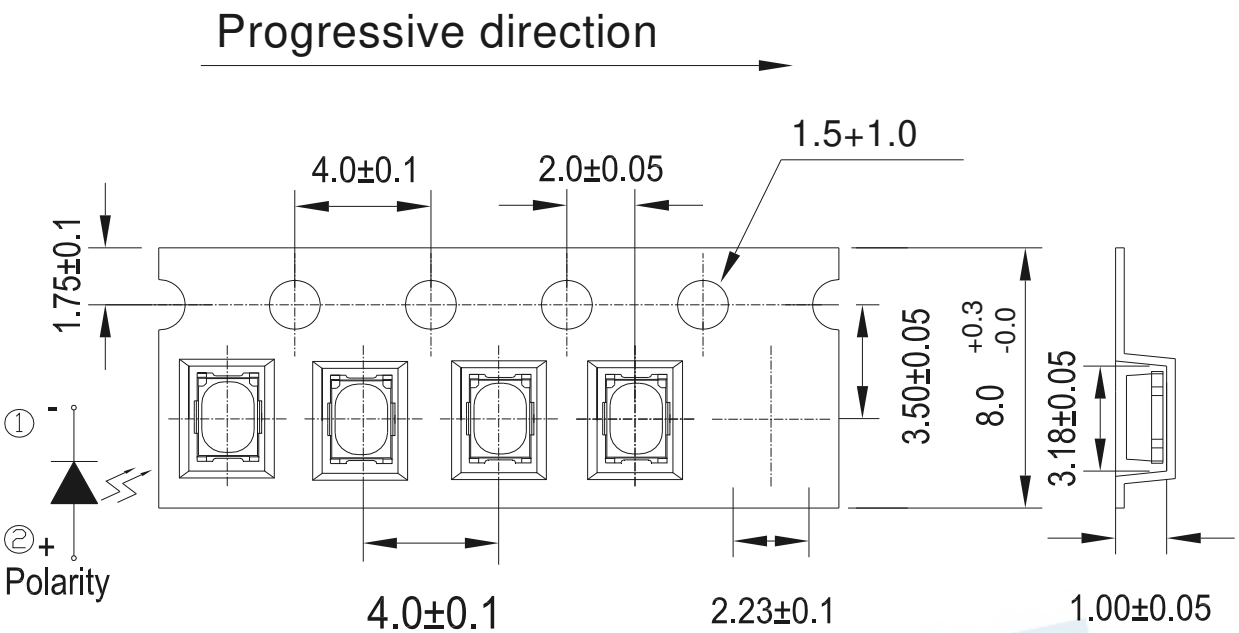
- CPN: Customer's Product Number
- P/N: Product Number
- QTY: Packing Quantity
- CAT: Luminous Intensity Rank
- HUE: Dom. Wavelength Rank
- REF: Forward Voltage Rank
- LOT No: Lot Number

Reel Dimensions



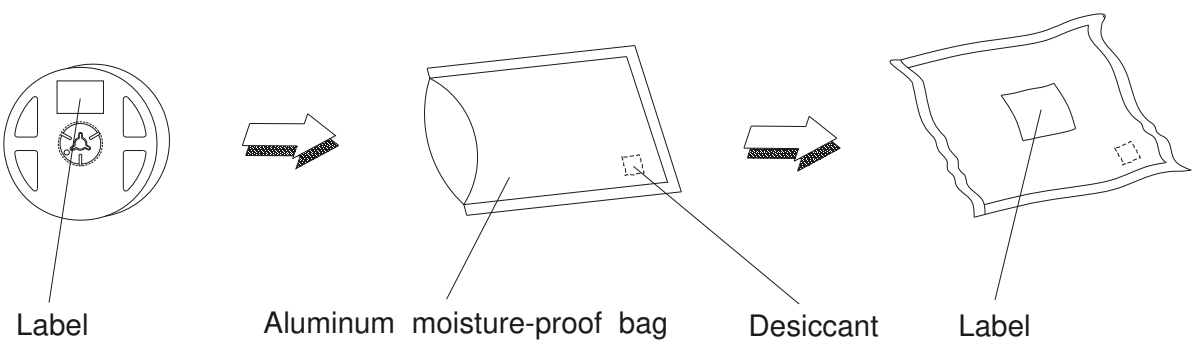
Note:
Tolerances unless mentioned ±0.1mm. Unit = mm

Carrier Tape Dimensions: Loaded Quantity 250 /500/1000/2000/3000 pcs. Per Reel



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

Moisture Resistant Packing Process



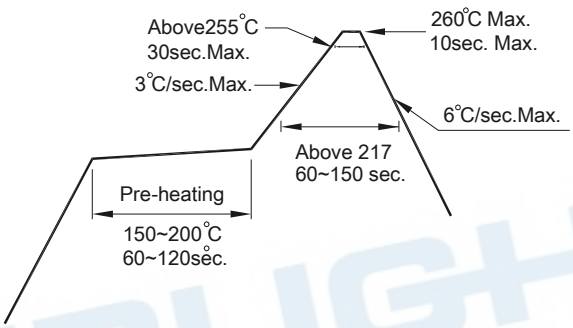
Reliability Test Items and Conditions

The reliability of products shall be satisfied with items listed below.
Confidence level：90%
LTPD：10%

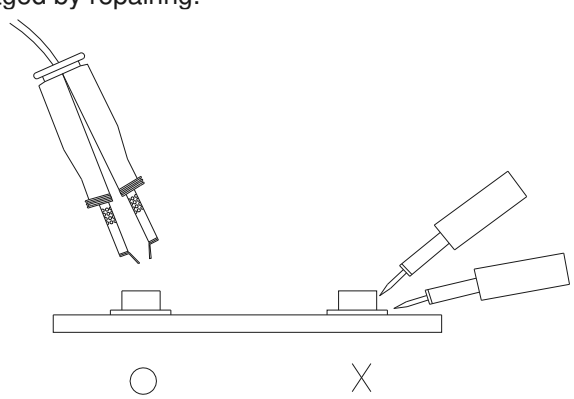
No.	Items	Test Condition	Test Hours/Cycles	Sample Size	Ac/Re
1	Reflow Soldering	Temp. : 260℃/10sec.	6 Min.	22 PCS.	0/1
2	Thermal Shock	H : +100℃ 20min ∫ 10 sec L : -10℃ 20min	500 Cycles	22 PCS.	0/1
3	Temperature Cycle	H : +100℃ 30min ∫ 5 min L : -40℃ 30min	500 Cycles	22 PCS.	0/1
4	High Temperature/Humidity 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℃ or less and 90%RH or less.
   2.3 After opening the package: The LED's floor life is 168 Hrs under 30℃ 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℃ 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.



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

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 ℃)
25	SMD 45-21S (3020, 3500K)	# B01 - # B25 (85 ℃)
25	SMD 45-21S (3020, 3500K)	# 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 (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.

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) ℃
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)

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℃Avg.	19.26	3.15	100.1%	99.4%	99.5%	98.3%	97.1%	96.0%
85℃Avg.	19.27	3.16	100.0%	99.5%	98.6%	97.4%	95.8%	94.4%
95℃Avg.	19.29	3.15	99.9%	99.0%	97.8%	96.6%	95.0%	93.2%

Temp.	Initial (0 hr)			Chromaticity Shift (Δu'v')					
	CIEx	CIEy	CCT	1000 hrs	2000 hrs	3000 hrs	4000 hrs	5000 hrs	6000 hrs
55℃Avg.	0.4154	0.3905	3284.4	0.0006	0.0006	0.0006	0.0007	0.0013	0.0020
85℃Avg.	0.4158	0.3906	3276.6	0.0010	0.0007	0.0011	0.0011	0.0015	0.0015
95℃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

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

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 (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.

6 TEST CONDITIONS

Main Test Equipment:

Name	Brand	Model	S/N	Traceability
Standard Light Source / Spectroradiometer	Labsphere	SCL-600 / CDS 2100	D112 / 0811116355	NIST
Source Meter	Keithley	2400	1321218	NMI
Digital Multimeter	Agilent	U1242A	MY48490144	NMI

Environmental Conditions:

Temperature:	(25 ± 1) ℃
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)

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℃Avg.	21.33	3.10	100.2 %	100.0 %	99.2 %	98.3 %	97.0 %	95.7 %
85℃Avg.	21.12	3.11	100.2 %	100.3 %	99.2 %	98.0 %	96.1 %	94.6 %
95℃Avg.	20.29	3.10	100.2 %	100.1 %	98.9 %	98.0 %	95.8 %	93.9 %

Temp.	Initial (0 hr)			Chromaticity Shift (Δu'v')					
	CIEx	CIEy	CCT	1000 hrs	2000 hrs	3000 hrs	4000 hrs	5000 hrs	6000 hrs
55℃Avg.	0.3307	0.3413	5576.2	0.0011	0.0014	0.0017	0.0028	0.0036	0.0040
85℃Avg.	0.3307	0.3406	5576.9	0.0015	0.0015	0.0016	0.0028	0.0036	0.0038
95℃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

DISCLAIMER

1. EVERLIGHT reserves the right(s) on the adjustment of product material mix for the specification.
2. The product meets EVERLIGHT published specification for a period of twelve (12) months from date of shipment.
3. The graphs shown in this datasheet are representing typical data only and do not show guaranteed values.
4. When using this product, please observe the absolute maximum ratings and the instructions for using outlined in these specification sheets. EVERLIGHT assumes no responsibility for any damage resulting from the use of the product which does not comply with the absolute maximum ratings and the instructions included in these specification sheets.
5. These specification sheets include materials protected under copyright of EVERLIGHT. Reproduction in any form is prohibited without obtaining EVERLIGHT's prior consent.
6. This product is not intended to be used for military, aircraft, automotive, medical,