LCTECH

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Test report of

ENERGY STAR® Program Requirements for Luminaires V1.2-SSL Directional Luminaire

Applicant:
Elec-Tech International Co., Ltd.
NO.1 JINFENG ROAD ,TANGJIAWAN TOWN,XIANGZHOU DISTRICT,ZHUHAI CITY,GUANGDONG PROVINCE, P.R.China

Manufacturer:
Elec-Tech International Co., Ltd.
NO.1 JINFENG ROAD ,TANGJIAWAN TOWN,XIANGZHOU DISTRICT,ZHUHAI CITY,GUANGDONG PROVINCE, P.R.China

For product:
Under Cabinet Luminaires(Residential)

Model:
541961XX
(Where "XX" denotes color temperature,01-10 identifies 2700K,11-30 identifies 3000K,31-40 identifies 3500K,41-50 identifies 4000K,51-60 identifies 4500K, 61-70 identifies 5000K)

Test date:	April 11, 2014 – May 2, 2014
Test laboratory:	LCTECH (Zhongshan) Testing Service Co., Ltd 2/F.,Technology and Enterprise Development Center, Guangyuan Road, Xiaolan, Zhongshan, Guangdong, China
Laboratory note:	/

Complied by:	**Reviewed by:**
Thomas Liu	**Richard Li**
Project Engineer	**Technical Manager**
May 5, 2014	**May 5, 2014**

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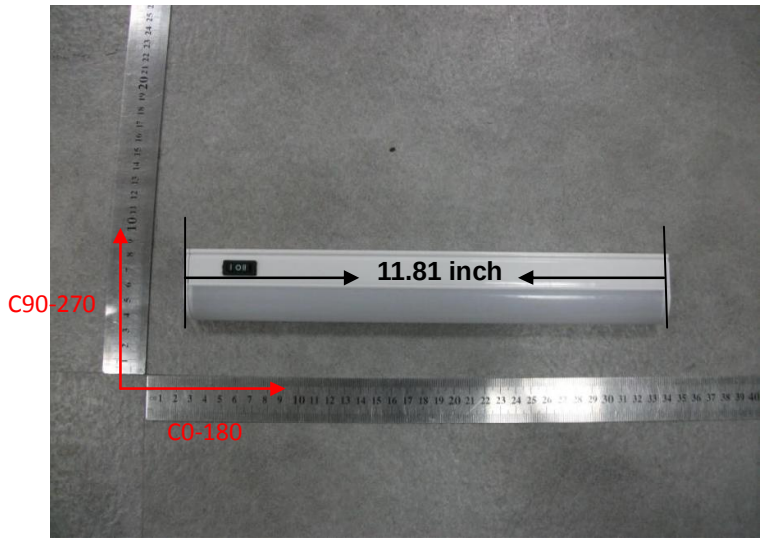
1 General

1.1Product Information

Brand Name	ETI,CE
Trade Mark	-
Model Number	541961XX
Luminaire Type	Under Cabinet Luminaires(Residential)
Rated Power	6W
Rated Initial Lamp Lumens	350lm
Declared CCT	2700K,3000K,3500K,4000K,4500K,5000K
LED manufacture and model	SMD 45-21S, manufactured by EVERLIGHT ELECTRONICS CO,.LTD
LED LM-80 Test Information	Please refer to Appendix A for detail information
Driver model	BLJ06WT00760063LY-OP
Declared Drive Current on Each LED	60mA
Suitable Dimmer	Not compatible with dimmer
Luminaire Aperture size	N/A
Intended used	☒Residential ☐Commercial
Date of Receipt Samples	April 11,2014
Quantity of Receipt Samples	3
Photo	



Picture 1 Top View

1.2 Reference standards or methods

The following standards are partly or totally used or referenced for test:

No.	Name
ANSI/NEMA/ ANSLG C78.377-2008	Specifications for the Chromaticity of Solid State Lighting Products
ANSI/ANSLG C81.61-2009	Specifications for Bases (Caps) for Electric Lamps
ANSI/ANSLG C81.62-2009	Lamp holders for Electric Lamps
ANSI C82.77-2002	Harmonic Emission Limits—Related Power Quality Requirements for Lighting Equipment
ANSI/IEEE C62.41.1-2002	IEEE Guide on the Surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits
ANSI/IEEE C62.41.2-2002	IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000V and Less) AC Power Circuits
ANSI/UL 1598-2008	Standard for Safety of Luminaires
ANSI/UL 1993-2011	Self-Ballasted Lamps and Lamp Adapters
ANSI/UL 8750-2009	Standard for Light Emitting Diode (LED) Equipment for Use in Lighting Products
CIE Pub. No. 13.3-1995	Method of Measuring and Specifying Color Rendering of Light Sources
CIE Pub. No. 15:2004	Colorimetry
IES LM-79-08	Electrical and Photometric Measurements of Solid-State Lighting Products
IES LM-80-08	Measuring Lumen Maintenance of LED Light Sources
IES LM-82-12	IES Approved Method for the Characterization of LED Light Engines and Integrated LED Lamps for Electrical and Photometric Properties as a Function of Temperature
IES TM-21-11	Projecting Long Term Lumen Maintenance of LED Sources

1.3 Equipments

All the equipments for the measurements were calibrated by ISO 17025 accredited laboratory or traceable to National Institute of Metrology (NIM) or National Institute of Standards and Technology (NIST) , below are equipment list

Instrument	ID	Model name	Cal. Date	Next cal. Date
AC power supply	LC-I-923	CHP-500	2014.03.04	2015.03.03
AC power supply	LC-I-953	APW-110N	2014.03.04	2015.03.03
AC power supply	LC-I-950	AFW-215A	2014.03.04	2015.03.03
Power analyzer	LC-I-928	WT210	2014.03.04	2015.03.03
Power analyzer	LC-I-954	WT210	2014.03.04	2015.03.03
Digital caliper	LC-I-973	(0~200)mm	2013-08-20	2014-08-19
Multimeter	LC-I-972	17B	2013-08-14	2014-08-13
Photometric colorimetric electric system (2 meter sphere)	LC-I-900	SPR3000	Before used	Before used
standard lamp	LC-I-961	24V/100W	2013.10.22	2014.10.21
Life test system	LC-I-930	LCTECH-1	2014.03.04	2015.03.03
Temperature chamber	LC-I-920	DY6000	2014.03.04	2015.03.03
Goniophotometer(with mirror)	LC-I-902	GMS2000	2013.05.13	2014.05.12
Digital oscilloscope	LC-I-919	TDS 1002	2014.03.04	2015.03.03
Sound level meter	LC-I-951	AWA5661	2014.02.28	2015.02.27
Anechoic room	LC-I-952	TNX-03	2014.02.26	2015.02.25
Steel tape	LC-I-908	(0-5)m	2014.03.04	2015.03.03
T&H recorder	LC-I-958	DWRP-B(0)	2013.08.22	2014.8.21
T&H recorder	LC-I-959	DWRP-B(0)	2013.08.22	2014.8.21
T&H recorder	LC-I-903	WS-1	2014.03.04	2015.03.03
Surge CDN	LC-I-832	SGN-5010G	2014.02.26	2015.02.25
Surge Tester	LC-I-831	SGZ-6012G	2014.02.26	2015.02.25
J thermocouple	LC-I-096	TT-J-30-SLE(200m/r)	2014.02.21	2015.02.20
Data acquisition/Switch unit	LC-I-098	34970A	2014.03.04	2015.03.03
Low temperature chamber	LC-I-568	TEMI880	2012.07.27	2014.07.26

2 Test conducted and method

2.1 Initial Photometric and Electrical Parameters

2.1.1 The samples were tested with no seasoning. Before measurements were taken, the sample was operated for about 2 hours to reach stabilization and temperature equilibrium. It was judged that stability is reached when the variation (maximum -minimum) of at least 3 readings of the light output and electrical power over a period of 30min, taken 15 minutes apart, is less than 0.5%. The ambient temperature in the whole test process was kept in 25±1°C, and the samples were in its designated orientation for all the measurements.

2.1.2 The samples were first subjected to color, lumen output and electrical parameters measurement by spectroradiometer with 2 meters integrated sphere (4π) and power analyzer.

2.1.3 After integrated sphere test, one of the samples was removed to a mirror-type goniophotometer (Type C) with photometer (f_1<1.5%) for light distribution test. The angle interval was settled based on the sample beam angle, and horizontal angle interval was 15°, vertical angle interval was 5°.

2.1.4 After luminous intensity distribution test, the same sample was subjected to color spatial uniformity measurement by the same goniophotometer with another colorimeter. The horizontal angel interval was 90°; however the vertical was 1°.

2.2 Minimum Starting Temperature

The samples were placed in chamber of -20°C to verify if can be normally operated or not.
A low temperature chamber was used for the measurement.

2.3 Start Time Test

2.3.1 Start time was measured by digital oscilloscope and photometer.
2.3.2 The ambient temperature in the whole test process was kept in 25±1°C, and the samples were in its designated orientation for start time test.

2.4 In Situ Temperature Measurement Test

2.4.1 The LED module and driver used in the luminaire were tested in accordance with ANSI/UL 1598-2008 and ANSI/UL 8750-2009.
2.4.2 Thermocouples were in contact with the TMPLED location described in LM-80 test report and TMPC location of LED driver as detailed by manufacture. In order to gain the maximum temperature, if appropriate, more than one thermocouple was contact in these locations.
2.4.3 The sample was tested in the housing of model HALO H99RTAT as provided by customer which was the designated application, and the housing with the sample was mounted in the standard test box in accordance with UL 1598.(If applicable)
2.4.4 The sample was operated for 4.6 hours to obtain constant temperatures, an Agilent data logger was used for data recording.
2.4.5 The ambient temperature was kept in 25±5°C, and final measured values were normalized to an

ambient of 25°C. The sample was in its designated orientation.

2.5 Transient Protection Test

2.5.1 The line transient was consisting of seven strikes of a 100 kHz ring wave, 2.5 kV level, for both common mode and differential mode.

2.5.2 The ambient temperature was kept in 25±5°C, and the sample was in its designated orientation.

2.6 Operating Frequency

2.6.1 The sample light output waveform was measured by oscilloscope with a photodetector.

2.6.2 The test was conducted at normal operation and dimming operation at all light output levels.

2.6.3 The ambient temperature was kept in 25±1°C, and the sample was in its designated orientation.

2.7 Audible Noise Test

2.7.1 The sample was operated in centre of an anechoic room with a background noise lower than 15 dBA. The microphone was located in 30 cm distance from center of the sample in different directions, and maximum value was used as the test result.

2.7.2 The ambient temperature was kept in 25±5°C, and the sample was in its designated orientation.

2.8 Dimming Test（if applicable）

2.8.1 The sample was connected to a dimmer recommended by customer.

2.8.2 Then adjust the dimmer to measure the light output dimming range by a photometer.

2.8.3 The ambient temperature was kept in 25±1°C, and the sample was in its designated orientation.

3 Test Result

3.1 Test Result Summary

Item	Result	Requirement
Luminaire Efficacy (initial)	67.99 lm/W 1 complete luminaire measured, sphere method	≥29 lm/W
Luminaire Light Output (initial)	349.45 lm 1 complete luminaire measured, sphere method	Luminaire shall deliver a minimum of 125 lumens per lineal foot Minimum light output=123 lm=11.81/12*125
Luminaire Zonal Lumen Density	63.46% of total initial lumens within the 0-60° zone; 25.76% of total initial lumens within the 60-90° zone; >12.88% of total initial lumens within the 60-90° zone aimed toward the backsplash; 1 complete luminaire measured, goniophotometer method	Referring to the plane perpendicular to the length of the luminaire, the luminaire shall deliver a minimum of 60% of total initial lumens within the 0-60° zone (symmetric about the nadir) and a minimum of 12.5% of total initial lumens within the 60-90° zone aimed toward the backsplash.
Light Source Life and Lumen Maintenance	In situ TMP_{LED} temperature: 57.4 °C Drive Current on Each LED: 60 mA Projected L_{70} life: >36000 hours 1 complete luminaire measured, refer to Appendix B and C for TM-21 report details.	L_{70} lumen maintenance life shall be at least: • 25,000 hours for residential grade indoor luminaires • 35,000 hours for residential grade outdoor luminaires • 35,000 hours for commercial grade luminaires
Correlated Color Temperature	2686K, and falls within the 2700K 7-step chromaticity quadrangles 1 complete luminaire measured	Lamps shall have one of correlated color temperatures 2700, 3000, 3500, 4000Kelvin, 5000 Kelvin (commercial only). The luminaire shall fall within the corresponding 7-step chromaticity quadrangles as defined in ANSI/NEMA/ANSLG C78.377-2008.

Item	Result	Requirement
CRI(Ra)	84.9 1 complete luminaire measured.	The luminaire (directional luminaires), or replaceable LED light engine or GU24 based integrated LED lamp (non-directional luminaires) shall meet or exceed Ra≥80
Color Angular Uniformity	0.0035 1 complete luminaire measured.	Directional Solid State Indoor Luminaires only. The variation of chromaticity shall be within 0.004 from the weighted average point on the CIE 1976 (u',v') diagram
Color Maintenance	<0.0020(0-6000 hours) Gained from LM-80 report, refer to Appendix A for LM-80 report summary.	For all LM-80 samples, at any measurement point from zero through 6,000 hours, the distance of the chromaticity coordinates from the initial (zero-hour) chromaticity coordinates shall not exceed 0.007 at the temperature(s) adjacent to the measured in situ TMP_{LED} temperature, and at the corresponding drive current.
Source Start Time(s)	0.526 s 3 complete luminaire measured	Light source shall remain continuously illuminated within one second of application of electrical power. All samples shall pass.
Dimming Requirements	-	The luminaire and its components shall provide continuous dimming from 100% to 35% of total light output. Step dimming, if employed, shall provide at least two discrete light output levels ≥ 35% of total light output and not including 100% output. All samples shall pass.
Power Factor	0.901 3 complete luminaire measured	Total luminaire input power less than or equal to 5 watts: PF ≥ 0.5 Total luminaire input power greater than 5 watts: Residential: PF ≥ 0.7 Commercial: PF ≥ 0.9 All samples shall pass.

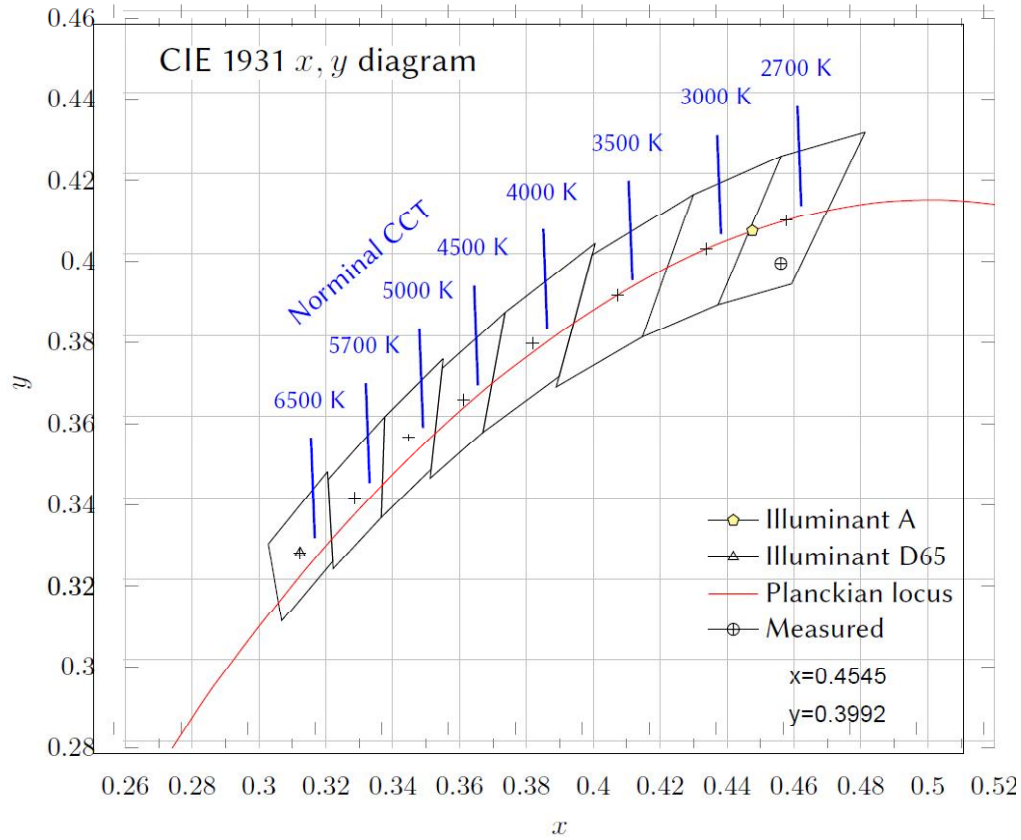
Item	Result	Requirement
Transient Protection	Passed 3 complete luminaire measured.	The line transient shall consist of seven strikes of a 100 kHz ring wave, 2.5 kV level, for both common mode and differential mode. All samples shall pass.
Off-State Power Consumption	0.0 W 1 complete luminaire measured	Luminaires incorporating an integral method of switching shall not draw power in the off state.
Operating Frequency	120.3 Hz 3 complete luminaire measured.	Frequency ≥120 Hz. All samples shall pass.
Noise Requirements	17.2dBA 1 complete luminaire measured.	All ballasts & drivers used within the luminaire shall have a Class A sound rating. Ballasts and drivers are recommended to be installed in the luminaire in such a way that in operation, the luminaire will not emit sound exceeding a measured level of 24 dBA.
Maximum Driver Case Temperature	39.3℃ 1 complete luminaire measured.	Measured temperature at the TMP_C shall be less than or equal to the manufacturer recommended temperature 125 °C.
Minimum Operating Temperature	The luminaire can be operated normally at -18°C 1 complete luminaire measured.	Luminaire shall have a minimum operating temperature of 0°F (-18°C) or below.

3.2 Test Data

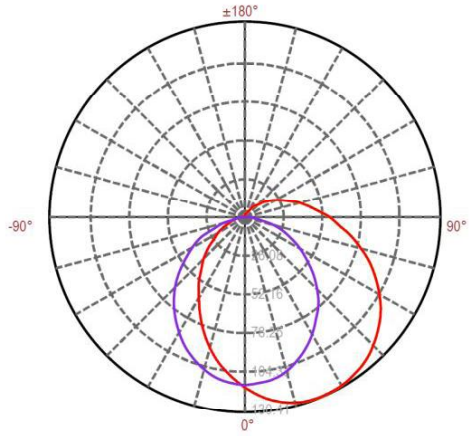
3.2.1 Initial Photometric and Electrical Data

Sample No.	Voltage (V)	Current (A)	Power (W)	Power factor	CCT (K)
S1	120.01	0.048	5.15	0.902	-
S2	120.09	0.046	5.00	0.901	-
S3	120.04	0.048	5.14	0.901	2686
Sample No.	Chromaticity (x)	Chromaticity (y)	CRI	Luminaire Efficacy(lm/w)	Light output(lm)
S1	-	-	-	-	-
S2	-	-	-	-	-
S3	0.4545	0.3992	84.9	349.45	67.99

ANSI Chromaticity Quadrangles Diagram



Light Distribution Curve:



C0(Max):
C0/C180:
C90/C270:

Zonal Lumen Summary:

Zone	Lumens	%Fixture
0-30	86.08	21.87%
0-40	140.23	35.62%
0-60	249.79	63.46%
0-90	351.19	89.22%
90-120	33.27	8.45%
90-130	37.68	9.57%
90-150	41.48	10.54%
90-180	42.41	10.78%
0-180	393.63	100.00%

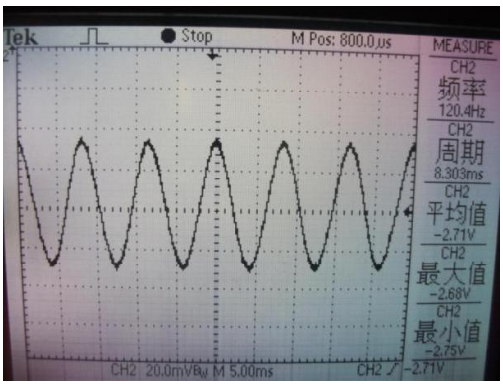
Zone	Lumens
0-10	10.62
10-20	30.2
20-30	45.26
30-40	54.15
40-50	56.54
50-60	53.02
60-70	44.78
70-80	33.73
80-90	22.89
90-100	15.49
100-110	10.7
110-120	7.09
120-130	4.4
130-140	2.51
140-150	1.29
150-160	0.61
160-170	0.27
170-180	0.06

3.2.2 Source Start Time Data

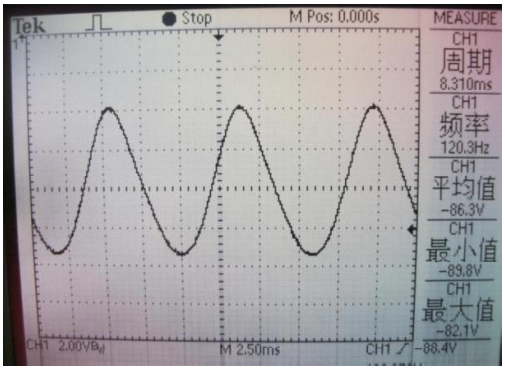
Sample No.	Start time(s)
S1	0.448
S2	0.439
S3	0.692
Average	**0.526**

3.2.3 Operating Frequency Test

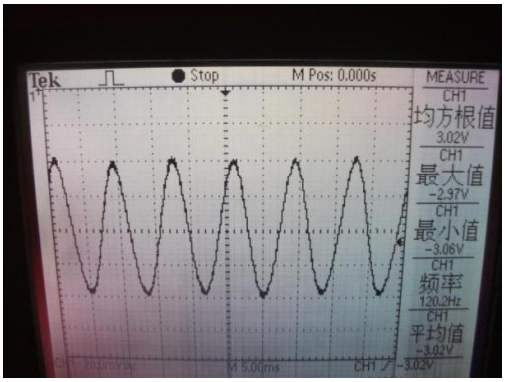
Sample No.	Frequency (Hz)
S1	120.4
S2	120.3
S3	120.2
AVG	**120.3**



Picture 1：Frequency of S1



Picture 2：Frequency of S2

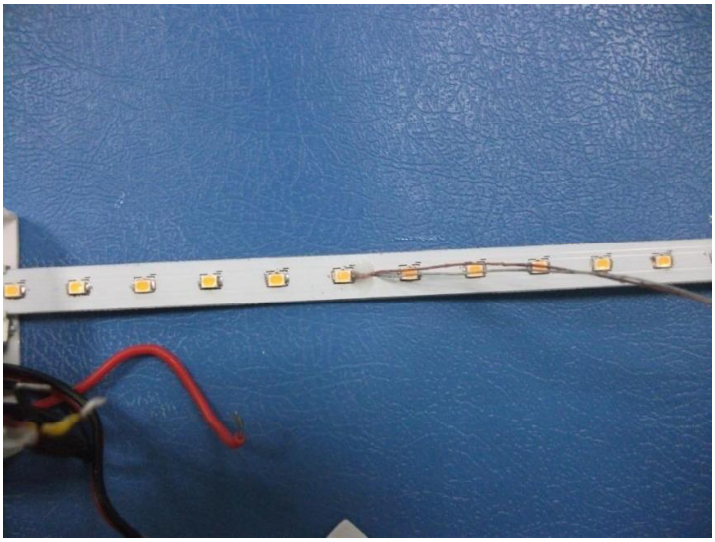


Picture 3：Frequency of S3

3.2.4 In Situ Temperature Test

Sample No.	In situ TMP_{LED} temperature	In situ TMP_C Temperature
S1	57.4°C(LED current 60mA)	39.3°C

Thermocouple contact photograph(TMP_{LED}):

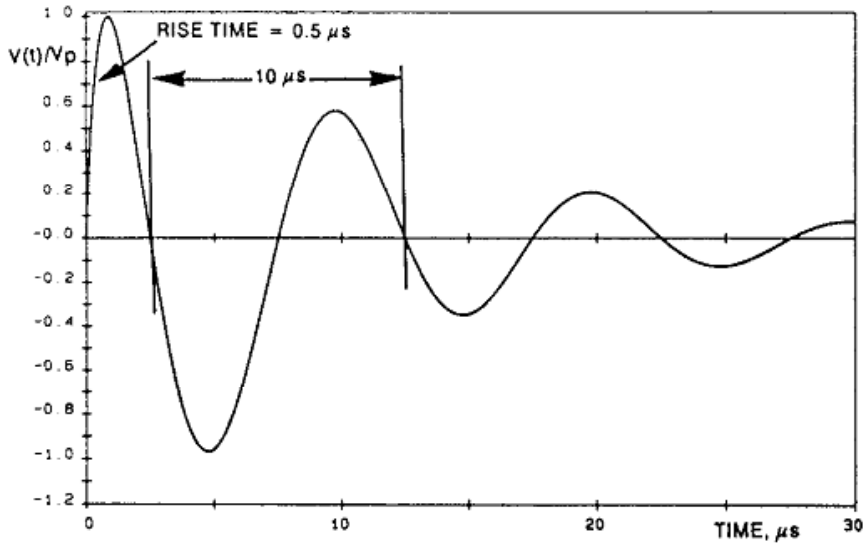


Thermocouple contact photograph(TMP_{Driver}):

3.2.5 Transient Protection Test

Sample No.	Pass or fail
S1	Pass
S2	Pass
S3	Pass

100 kHz Ring Wave Graph:



Appendix A LED LM-80 Report Summary

Report originated by	SGS Taiwan Ltd.		
Manufactured by	EVERLIGHT ELECTRONICS CO.,LTD.		
LM-80 report No.	OA-2012-90030		
LED Model	SMD 45-21S(3020,3500K)		
LED Part Number	-		
Number of LED light source tested	25 per case temperature		
Drive Current	60 mA		
Case temperature	55℃	85℃	95℃
6000 hours lumen maintenance	96.0%	94.4%	93.2%
6000 hours color maintenance(Δu'v')	0.0020	0.0015	0.0012

Appendix B TM-21 Inputs

TM-21 Inputs

Instructions
Yellow fields are completed by the user. Fields not used should be left blank. Cyan fields are calculated based on user entries. First, enter a description of the LED light source tested. Then complete the fields labeled "LM-80 Testing Details". Test duration must be at least 6,000 hours. If only one case temperature data set is to be used (no interpolation), complete only "Tested case temperature 1". For only two case temperature data sets, complete 1 and 2. Next, further to the right, in the corresponding box(es) for each tested case temperature, enter the test data along with the time (in hours) at which each measurement was taken. Data entered must be normalized then averaged measured data (per TM-21 sections 5.2.1 and 5.2.2). Enter drive current, *in-situ* temperature data and the percentage of initial lumens to project to in the fields labeled "*In-Situ* Inputs". Results can be tailored to estimate lumen maintenance at a specific time by entering a value (t) in the yellow field. A complete TM-21 report will appear on the next tab labeled "Report".

Description of LED Light Source Tested (manufacturer, model, catalog number)
LED model:SMD 45-21S(3020,3500K),manufactured by Everlight Electronics Co.,Ltd

LM-80 Testing Details	
Total number of units tested per case temperature:	25
Number of failures:	0
Number of units measured:	25
Test duration (hours):	6000
Tested drive current (mA):	60
Tested case temperature 1 (T_c, C):	55
Tested case temperature 2 (T_c, C):	85
Tested case temperature 3 (T_c, C):	95

LM-80 Test Inputs

Test Data for 55 C Case Temperature		Test Data for 85 C Case Temperature		Test Data for 95 C Case Temperature	
Time (hours)	Lumen Maintenance (%)	Time (hours)	Lumen Maintenance (%)	Time (hours)	Lumen Maintenance (%)
0	100.00%	0	100.00%	0	100.00%
1000	100.10%	1000	100.00%	1000	99.90%
2000	99.40%	2000	99.50%	2000	99.00%
3000	99.50%	3000	98.60%	3000	97.80%
4000	98.30%	4000	97.40%	4000	96.60%
5000	97.10%	5000	95.80%	5000	95.00%
6000	96.00%	6000	94.40%	6000	93.20%

In-Situ Inputs

Drive current for each LED package/array/module (mA):	60
In-situ case temperature (T_c, C):	57.4
Percentage of initial lumens to project to (e.g. for L_{70}, enter 70):	70

Results

Time (t) at which to estimate lumen maintenance (hours):	6,000
Lumen maintenance at time (t) (%):	96.41%
Calculated L70 (hours):	43,000
Reported L70 (hours):	>36000

Appendix C TM-21 Report

TM-21 Report

Table 1: Report at each LM-80 Test Condition					
Description of LED Light Source Tested (manufacturer, model, catalog number)	LED model:SMD 45-21S(3020,3500K),manufactured by Everlight Electronics Co.,Ltd				
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

Table 2: Interpolation Report (projection based on *in-situ* temperature entered)	
$T_{s,1}$ (C)	55.00
$T_{s,1}$ (K)	328.15
α_1	8.328E-06
B_1	1.013
$T_{s,2}$ (C)	85.00
$T_{s,2}$ (K)	358.15
α_2	1.183E-05
B_2	1.017
E_a/k_b	1.38E+03
A	5.507E-04
B_0	1.015
$T_{s,i}$ (C)	57.40
$T_{s,i}$ (K)	330.55
α_i	8.585E-06
Projected L70(6k) at 57.4 C (hours)	43,000
Reported L70(6k) at 57.4 C (hours)	>36000

Report Generated By: Thomas Liu	Notes:
Company: LCTECH (Zhongshan) Testing Service Co.,Ltd	
Date: 2014-5-15	

****End of test report****