



Shenzhen Belling Efficiency Testing Lab Co., Ltd



TEST REPORT

ANSI/IES LM-80-15

MEASURING LUMEN MAINTENANCE OF LED LIGHT SOURCES For

Jiangxi Elite Semiconductors technology Co., Ltd

Building 9, standard workshop Park, Dupin industrial flat platform, Xiangdong Industrial Park, Pingxiang City, Jiangxi Province

Report No.: BL220310004-9

Product Description: SMD LED

Model No.: SMD2835

Test Initiation Date: 2021-02-19

Test Completion Date: 2021-02-19 to 2022-03-11

Report Issue Date: 2022-03-14

Test Standard: ANSI/IES LM-80-15

Test Laboratory: Shenzhen Belling Efficiency Testing Lab Co., Ltd

Tested by

Sam Chen

Reviewed by

Jason zhou



Note: The test data was only valid for the test sample(s). This test report is prepared for the customer shown above and for the device described herein. It may not be duplicated or use in part without prior written consent from Shenzhen Belling Efficiency Testing Lab Co., Ltd. This report must not be used by the customer to claim product certification, approval, or endorsement By NVLAP, NIST, or any agency of the U.S. Government.

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1-GENERAL INFORMATION

1.1 Product Description for Equipment under Test (EUT)

Manufacturer:	Guangdong Elite Optoelectronic Technology Co.,Ltd
Factory:	Guangdong Elite Optoelectronic Technology Co.,Ltd
Address:	HuAnWei Village, GaoBu Town, Dongguan Province. China
Brand name:	Elite
Part Number:	SMD2835
Part Type:	LED Package
Product Description:	VF: 3V, IF: 150mA
Wavelength:	2700K
Die Spacing(mm):	1.0
Average Power Density per LED die(W/mm2):	0.8
Average Current Density per LED die(mA/mm2):	140
Repersnetative CRI(Ra) of the tested sample set (Indicate whether the reported calue s the mean or median value of the sample set, or per unit):	80
Number of LED Light Source tested:	See tables
Case temperature (test point temperature):	See tables.
Drive current of the LED light source during lifetime test:	See tables.
Observation of LED light source failure including the failure conditions and time of failure.:	See tables.
LED light source monitoring interval:	The LED array are inspected at regular interval (24 hours) throughout the 9000 hours test.
Photometric measurement uncertainty:	1.8% on flux measurements for LM-80 testing.
Chromaticity shift reported over the Measurement time:	See tables.
Date of Receiving Sample:	2021-02-09
Test Duration:	2021-02-19 to 2022-03-11

1.2 Drive Level

Samples are driven with a constant direct current (DC) during maintenance test, photometric and electrical measurement. The current value was regulated to within $\pm 3\%$ of the specified value of the manufacturer during maintenance test, and was within $\pm 0.5\%$ during photometric and electrical measurement test.

1.3 Ambient Conditions for Maintenance Test

For lumen maintenance test, samples within one data set, were installed on cooling boards in thermal chambers with minimal ambient airflow. The case temperature and ambient temperature was monitored by thermocouples which one was soldered to the coldest DUTs' case (TMP_{LED}) location, while the other is mounted at a distance of 5 mm above the TMP location. During life testing, TMP_{LED} of the coldest LEDs were maintained at a temperature that was greater than or equal to 2°C below the corresponding nominal case temperature.

Surrounding air was maintained at a temperature that was greater than or equal to 5°C below the corresponding nominal case temperature. Thermocouples were shielded from direct DUT optical radiation and comply with Type K.

Samples were connected to DC power supply in series circuits with a constant current. The forward current was regulated to within $\pm 3\%$ of the specified value of the manufacturer.

Surrounding Air temperature for life test : controlled to within -5°C of the case temperature (T_s)

Humidity : $< 65\%$ RH

Ambient temperature for Photometry measurement : maintained at $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$

1.4 Photometric measurement uncertainty

The uncertainty of the light output measurements is $U=1.8\%$ ($K=2$)

Long term measurement uncertainty is based on reproducibility tests done over a period of one year, calculated to $K=2$ coverage (i.e. 95% coverage).

1.5 Standards Used:

- ANSI/IES LM-80-15: IES Approved Method for Measuring Lumen Maintenance of LED Light Sources.
- CIE 127:2007: Measurement of LEDs(This test method was not accredited by NVLAP)
- ANSI/ASABE S642 SEP2018: Recommended Methods for Measurement and Testing of LED Products for Plant Growth and Development (This standard was not accredited by NVLAP)

1.6 Test Facility Description

The test facility used by Shenzhen Belling Efficiency Testing Lab Co., Ltd is located at 1Floor, No.1 Building, Meibaohe Industrial Park, Dalang Street, Longhua District, Shenzhen, Guangdong Prov.518101 China.

1.7 Statement of Traceability

Shenzhen Belling Efficiency Testing Lab Co., Ltd attested that all calibration has been performed using suitable standards traceable to National Primary Standards and International System of Units (SI).

1.8 Test Equipment List

Device	Manufacture	Model No.	Serial No.	Calibration due date
Digital Power Meter	YOKOGAWA	WT210	91L929742	2022-03-31
Integral Sphere	SENSING	SPR-600M	N.A	2022-03-31
Optical Color and Electrical Measurement System	SENSING	SPR-3000	S1101108	2022-03-31
Stop watch	KISLO	K610	N/A	2022-04-20
LED aging equipment	Guangzhou CK	Box0516	N.A	2022-04-13
DC Power Supply	Hong Duo Yuan	APS300-5	N/A	2022-03-31
Thermocouple K	Type K	OMEGA	23736-1	2022-04-20

1.9 Sample Set

Sampling Method:

LED samples for ANSI/IES LM-80-15 testing consist of units built from a minimum of three manufacturing lots with each manufacturing lot built from different wafer lots built on non-consecutive days. These manufacturing lots are picked to represent a wide parametric distribution. Each Sample is soldered to all of the reliability stress boards for a given set of ANSI/IES LM-80-15 tests.

Sample Size:

Total 75Pcs; Each Ts test condition 25Pcs, The samples tested at T_s 55°C, T_s 85°C and T_s 105°C were received at 2021-02-09 and tested during 2021-02-19 to 2022-03-11. The samples were numbered from L1 to L25, L26 to L50 and L51 to L75.

2-Summary of Test Result

Data Set	Sample Size	Failures Observed	Test Interval	Test Duration	α	β	Reported TM-21 L ₉₀ Lifetime
1	25	0	1000hrs	9000hrs	2.047E-06	1.007	>54,000 hours
2	25	0	1000hrs	9000hrs	2.180E-06	1.005	51,000 hours
3	25	0	1000hrs	9000hrs	2.896E-06	1.005	38,000 hours

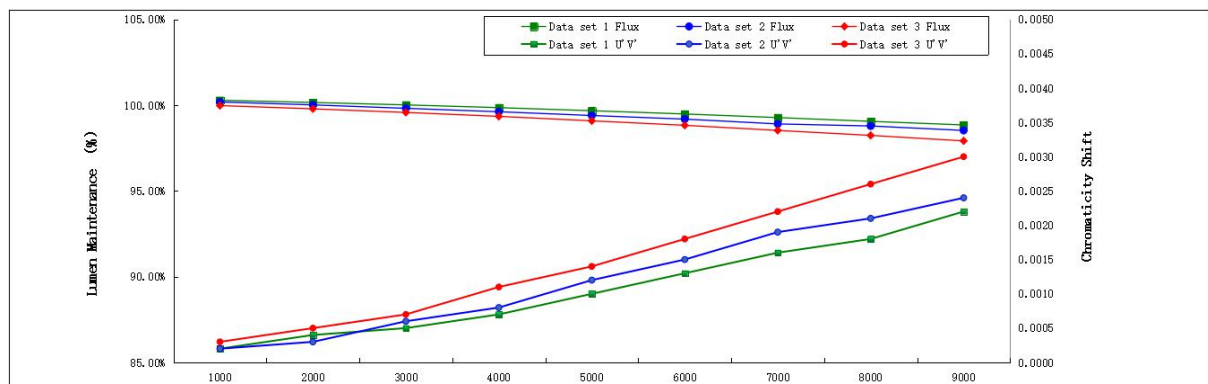
Average Lumen Maintenance (Percentage of Initial)

Data Set	1000h	2000h	3000h	4000h	5000h	6000h	7000h	8000h	9000h
1	100.29%	100.16%	100.02%	99.86%	99.68%	99.49%	99.28%	99.06%	98.85%
2	100.19%	100.02%	99.82%	99.62%	99.40%	99.19%	98.91%	98.79%	98.53%
3	99.98%	99.79%	99.58%	99.35%	99.09%	98.83%	98.53%	98.24%	97.92%

Average Chromaticity Shift

Data Set	1000h	2000h	3000h	4000h	5000h	6000h	7000h	8000h	9000h
1	0.0002	0.0004	0.0005	0.0007	0.0010	0.0013	0.0016	0.0018	0.0022
2	0.0002	0.0003	0.0006	0.0008	0.0012	0.0015	0.0019	0.0021	0.0024
3	0.0003	0.0005	0.0007	0.0011	0.0014	0.0018	0.0022	0.0026	0.0030

Average Lumen Maintenance and Chromaticity Shift Vs. Time



TM-21 Report for Lumen Maintenance



TM-21 Report

Table 1: Report at each LM-80 Test Condition					
Jiangxi Elite Semiconductors technology Co, Ltd SMD2835					
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 1 - 55°C Case Temp		Test Condition 2 - 85°C Case Temp		Test Condition 3 - 105°C Case Temp	
Sample size		Sample size		Sample size	
Number of failures		Number of failures		Number of failures	
DUT drive current used in the test (mA)		DUT drive current used in the test (mA)		DUT drive current used in the test (mA)	
Test duration (hours)		Test duration (hours)		Test duration (hours)	
Test duration used for projection (hour to hour)		Test duration used for projection (hour to hour)		Test duration used for projection (hour to hour)	
Tested case temperature (°C)		Tested case temperature (°C)		Tested case temperature (°C)	
α		α		α	
B		B		B	
Reported L70(9k) (hours)		Reported L70(9k) (hours)		Reported L70(9k) (hours)	

Table 2: Interpolation Report (projection based on <i>in-situ</i> temperature entered)	
$T_{s,1}$ (°C)	105.00
$T_{s,1}$ (K)	378.15
α_1	2.896E-06
B_1	1.005
$T_{s,2}$ (°C)	-
$T_{s,2}$ (K)	-
α_2	-
B_2	-
E_s/k_b	-
A	-
B_0	1.005
$T_{s,1}$ (°C)	105.00
$T_{s,1}$ (K)	378.15
α_1	2.896E-06
Reported L70(9k) at 105°C (hours)	>54000



TM-21 Report

Table 1: Report at each LM-80 Test Condition					
Jiangxi Elite Semiconductors technology Co, Ltd SMD2835					
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 1 - 55°C Case Temp		Test Condition 2 - 85°C Case Temp		Test Condition 3 - 105°C Case Temp	
Sample size		Sample size		Sample size	
Number of failures		Number of failures		Number of failures	
DUT drive current used in the test (mA)		DUT drive current used in the test (mA)		DUT drive current used in the test (mA)	
Test duration (hours)		Test duration (hours)		Test duration (hours)	
Test duration used for projection (hour to hour)		Test duration used for projection (hour to hour)		Test duration used for projection (hour to hour)	
Tested case temperature (°C)		Tested case temperature (°C)		Tested case temperature (°C)	
α		α		α	
B		B		B	
Reported L80(9k) (hours)		Reported L80(9k) (hours)		Reported L80(9k) (hours)	

Table 2: Interpolation Report (projection based on <i>in-situ</i> temperature entered)	
$T_{s,1}$ (°C)	105.00
$T_{s,1}$ (K)	378.15
α_1	2.896E-06
B_1	1.005
$T_{s,2}$ (°C)	-
$T_{s,2}$ (K)	-
α_2	-
B_2	-
E_s/k_b	-
A	-
B_0	1.005
$T_{s,1}$ (°C)	105.00
$T_{s,1}$ (K)	378.15
α_1	2.896E-06
Reported L80(9k) at 105°C (hours)	>54000



TM-21 Report

Table 1: Report at each LM-80 Test Condition					
Jiangxi Elite Semiconductors technology Co, Ltd SMD2835					
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 1 - 55°C Case Temp		Test Condition 2 - 85°C Case Temp		Test Condition 3 - 105°C Case Temp	
Sample size		Sample size		Sample size	
Number of failures		Number of failures		Number of failures	
DUT drive current used in the test (mA)		DUT drive current used in the test (mA)		DUT drive current used in the test (mA)	
Test duration (hours)		Test duration (hours)		Test duration (hours)	
Test duration used for projection (hour to hour)		Test duration used for projection (hour to hour)		Test duration used for projection (hour to hour)	
Tested case temperature (°C)		Tested case temperature (°C)		Tested case temperature (°C)	
α		α		α	
B		B		B	
Reported L90(9k) (hours)		Reported L90(9k) (hours)		Reported L90(9k) (hours)	

Table 2: Interpolation Report (projection based on <i>in-situ</i> temperature entered)	
$T_{s,1}$ (°C)	105.00
$T_{s,1}$ (K)	378.15
α_1	2.896E-06
B_1	1.005
$T_{s,2}$ (°C)	-
$T_{s,2}$ (K)	-
α_2	-
B_2	-
E_s/k_b	-
A	-
B_0	1.005
$T_{s,1}$ (°C)	105.00
$T_{s,1}$ (K)	378.15
α_1	2.896E-06
Reported L90(9k) at 105°C (hours)	38,000

3-Test Data

3.1 Data Set 1: 55°C; 150mA (Lumen Maintenance)

Sample No.	Φ (lm)	Lumen Maintenance (%)								
	0hr(Initial)	1000h	2000h	3000h	4000h	5000h	6000h	7000h	8000h	9000h
L1	73.69	100.31	100.10	100.05	99.82	99.64	99.50	99.14	98.96	98.91
L2	72.80	100.23	100.20	100.06	99.81	99.69	99.46	99.22	99.15	98.96
L3	72.66	100.26	100.22	100.01	99.94	99.76	99.48	99.26	99.02	98.85
L4	73.57	100.27	100.23	100.00	99.92	99.61	99.44	99.18	99.03	98.77
L5	72.36	100.30	100.11	100.02	99.83	99.64	99.54	99.41	99.10	98.96
L6	71.92	100.35	100.19	99.95	99.79	99.68	99.48	99.15	99.10	98.76
L7	74.52	100.29	100.12	100.06	99.86	99.70	99.55	99.37	98.97	98.77
L8	72.35	100.23	100.16	100.09	99.92	99.62	99.45	99.24	99.10	98.77
L9	73.33	100.32	100.20	100.00	99.82	99.74	99.53	99.41	99.03	98.86
L10	72.12	100.22	100.12	100.03	99.80	99.62	99.58	99.41	99.12	98.92
L11	72.40	100.30	100.17	99.99	99.82	99.73	99.49	99.43	99.16	98.95
L12	72.14	100.23	100.22	99.96	99.85	99.77	99.51	99.28	99.16	98.82
L13	73.02	100.26	100.23	99.97	99.79	99.64	99.46	99.37	99.11	98.89
L14	72.71	100.33	100.17	100.08	99.96	99.79	99.44	99.33	99.03	98.85
L15	72.54	100.35	100.11	100.05	99.85	99.61	99.45	99.29	99.05	98.86
L16	73.38	100.23	100.16	99.96	99.82	99.67	99.42	99.18	99.05	98.83
L17	71.70	100.35	100.18	100.00	99.96	99.66	99.48	99.19	99.09	98.76
L18	73.87	100.32	100.18	100.05	99.92	99.73	99.48	99.29	99.09	98.77
L19	72.93	100.31	100.10	100.01	99.87	99.72	99.44	99.19	99.11	98.93
L20	73.25	100.24	100.13	100.02	99.91	99.63	99.49	99.30	98.99	98.79
L21	72.91	100.34	100.14	99.96	99.84	99.68	99.54	99.29	99.03	98.89
L22	72.04	100.22	100.13	100.10	99.94	99.75	99.54	99.26	99.06	98.82
L23	73.54	100.29	100.23	100.00	99.84	99.73	99.47	99.25	98.99	98.95
L24	72.51	100.35	100.12	100.04	99.86	99.71	99.49	99.32	99.02	98.87
L25	72.69	100.34	100.11	100.08	99.80	99.59	99.54	99.23	99.00	98.85
Ave.	72.84	100.29	100.16	100.02	99.86	99.68	99.49	99.28	99.06	98.85
Med.	72.71	100.30	100.16	100.02	99.85	99.68	99.48	99.28	99.05	98.85
st dev	0.6802	0.0469	0.0450	0.0437	0.0555	0.0570	0.0418	0.0857	0.0584	0.0677
Min.	71.70	100.22	100.10	99.95	99.79	99.59	99.42	99.14	98.96	98.76
Max.	74.52	100.35	100.23	100.10	99.96	99.79	99.58	99.43	99.16	98.96

3.2 Data Set 1: 55°C; 150mA (Forward Voltage)

Sample No.	Forward Voltage (V)									
	0hr(Initial)	1000h	2000h	3000h	4000h	5000h	6000h	7000h	8000h	9000h
L1	2.847	2.851	2.861	2.849	2.846	2.845	2.862	2.855	2.848	2.867
L2	2.856	2.848	2.865	2.844	2.864	2.866	2.862	2.862	2.846	2.859
L3	2.848	2.854	2.862	2.849	2.848	2.856	2.860	2.854	2.867	2.863
L4	2.853	2.862	2.844	2.845	2.858	2.845	2.851	2.860	2.861	2.859
L5	2.851	2.857	2.855	2.845	2.843	2.857	2.863	2.868	2.856	2.861
L6	2.852	2.850	2.869	2.864	2.846	2.845	2.853	2.844	2.860	2.853
L7	2.856	2.852	2.853	2.858	2.849	2.868	2.868	2.854	2.865	2.853
L8	2.850	2.852	2.853	2.869	2.854	2.855	2.847	2.847	2.866	2.858
L9	2.864	2.847	2.866	2.859	2.853	2.853	2.847	2.853	2.868	2.859
L10	2.846	2.857	2.866	2.843	2.862	2.866	2.850	2.862	2.854	2.858
L11	2.852	2.861	2.851	2.861	2.865	2.853	2.864	2.850	2.862	2.866
L12	2.856	2.865	2.861	2.869	2.843	2.868	2.848	2.867	2.860	2.863
L13	2.861	2.845	2.869	2.855	2.848	2.868	2.845	2.850	2.844	2.863
L14	2.849	2.845	2.849	2.864	2.865	2.851	2.857	2.859	2.851	2.845
L15	2.846	2.868	2.851	2.864	2.865	2.854	2.869	2.844	2.854	2.856
L16	2.854	2.868	2.847	2.846	2.865	2.864	2.854	2.860	2.853	2.850
L17	2.848	2.845	2.869	2.857	2.863	2.857	2.847	2.864	2.863	2.863
L18	2.851	2.862	2.849	2.844	2.848	2.867	2.851	2.867	2.862	2.846
L19	2.853	2.854	2.858	2.852	2.856	2.860	2.862	2.846	2.868	2.854
L20	2.851	2.862	2.860	2.863	2.851	2.864	2.851	2.864	2.865	2.843
L21	2.853	2.862	2.861	2.846	2.850	2.864	2.843	2.850	2.849	2.860
L22	2.845	2.858	2.854	2.867	2.859	2.848	2.854	2.848	2.852	2.856
L23	2.852	2.854	2.868	2.855	2.865	2.855	2.848	2.857	2.864	2.866
L24	2.854	2.847	2.846	2.846	2.864	2.864	2.856	2.868	2.856	2.863
L25	2.849	2.857	2.849	2.861	2.860	2.857	2.869	2.856	2.867	2.865
Ave.	2.852	2.855	2.857	2.855	2.856	2.858	2.855	2.856	2.858	2.858
Med.	2.852	2.854	2.858	2.855	2.856	2.857	2.854	2.856	2.860	2.859
st dev	0.0045	0.007	0.008	0.009	0.008	0.008	0.008	0.008	0.007	0.007
Min.	2.845	2.845	2.844	2.843	2.843	2.845	2.843	2.844	2.844	2.843
Max.	2.864	2.868	2.869	2.869	2.865	2.868	2.869	2.868	2.868	2.867

3.3 Data Set 1: 55°C; 150mA (Chromaticity Shift)

Sample No.	u'	v'	CCT(K)	Chromaticity Shift $\Delta u'v'$								
	0hr(Initial)			1000h	2000h	3000h	4000h	5000h	6000h	7000h	8000h	9000h
L1	0.2600	0.5260	2759	0.0001	0.0003	0.0005	0.0007	0.0009	0.0011	0.0015	0.0018	0.0023
L2	0.2581	0.5258	2801	0.0002	0.0004	0.0005	0.0008	0.0010	0.0012	0.0016	0.0018	0.0021
L3	0.2604	0.5265	2748	0.0002	0.0004	0.0006	0.0007	0.0011	0.0013	0.0017	0.0020	0.0022
L4	0.2588	0.5252	2787	0.0003	0.0004	0.0005	0.0009	0.0012	0.0014	0.0015	0.0018	0.0021
L5	0.2612	0.5259	2732	0.0001	0.0003	0.0006	0.0007	0.0011	0.0012	0.0016	0.0019	0.0022
L6	0.2599	0.5257	2762	0.0001	0.0004	0.0006	0.0007	0.0009	0.0012	0.0015	0.0017	0.0020
L7	0.2592	0.5278	2767	0.0003	0.0005	0.0006	0.0007	0.0010	0.0014	0.0015	0.0019	0.0023
L8	0.2592	0.5258	2777	0.0003	0.0005	0.0006	0.0008	0.0009	0.0013	0.0017	0.0018	0.0023
L9	0.2593	0.5243	2781	0.0002	0.0005	0.0006	0.0009	0.0010	0.0015	0.0016	0.0020	0.0021
L10	0.2611	0.5259	2734	0.0002	0.0003	0.0005	0.0007	0.0012	0.0013	0.0017	0.0017	0.0020
L11	0.2592	0.5258	2776	0.0002	0.0004	0.0006	0.0007	0.0011	0.0014	0.0016	0.0017	0.0023
L12	0.2608	0.5262	2740	0.0003	0.0004	0.0005	0.0009	0.0010	0.0012	0.0016	0.0020	0.0022
L13	0.2583	0.5259	2796	0.0001	0.0003	0.0004	0.0006	0.0010	0.0012	0.0015	0.0019	0.0022
L14	0.2585	0.5256	2793	0.0002	0.0003	0.0005	0.0009	0.0009	0.0014	0.0016	0.0016	0.0022
L15	0.2604	0.5264	2748	0.0003	0.0005	0.0006	0.0007	0.0011	0.0014	0.0016	0.0016	0.0023
L16	0.2597	0.5258	2766	0.0002	0.0004	0.0005	0.0008	0.0009	0.0013	0.0015	0.0020	0.0022
L17	0.2598	0.5256	2764	0.0004	0.0005	0.0006	0.0007	0.0010	0.0014	0.0017	0.0019	0.0022
L18	0.2601	0.5261	2757	0.0003	0.0004	0.0005	0.0007	0.0011	0.0012	0.0016	0.0019	0.0019
L19	0.2595	0.5262	2767	0.0003	0.0004	0.0006	0.0007	0.0009	0.0015	0.0016	0.0017	0.0023
L20	0.2597	0.5257	2767	0.0003	0.0004	0.0005	0.0007	0.0009	0.0013	0.0016	0.0018	0.0023
L21	0.2585	0.5257	2792	0.0002	0.0003	0.0006	0.0007	0.0010	0.0014	0.0016	0.0017	0.0022
L22	0.2611	0.5259	2735	0.0001	0.0003	0.0005	0.0008	0.0009	0.0013	0.0015	0.0017	0.0020
L23	0.2589	0.5252	2787	0.0003	0.0004	0.0005	0.0007	0.0010	0.0014	0.0017	0.0017	0.0020
L24	0.2593	0.5259	2775	0.0002	0.0003	0.0006	0.0007	0.0009	0.0015	0.0015	0.0019	0.0020
L25	0.2604	0.5265	2747	0.0002	0.0003	0.0004	0.0008	0.0011	0.0011	0.0016	0.0018	0.0021
Ave.	0.2597	0.5259	2766	0.0002	0.0004	0.0005	0.0007	0.0010	0.0013	0.0016	0.0018	0.0022
Med.	0.2597	0.5259	2767	0.0002	0.0004	0.0005	0.0007	0.0010	0.0013	0.0016	0.0018	0.0022
st dev	0.0009	0.0006	20.33	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Min.	0.2581	0.5243	2732	0.0001	0.0003	0.0004	0.0006	0.0009	0.0011	0.0015	0.0016	0.0019
Max.	0.2612	0.5278	2801	0.0004	0.0005	0.0006	0.0009	0.0012	0.0015	0.0017	0.0020	0.0023

3.4 Data Set 2: 85°C; 150mA (Lumen Maintenance)

Sample No.	$\Phi(\text{lm})$	Lumen Maintenance (%)								
	0hr(Initial)	1000h	2000h	3000h	4000h	5000h	6000h	7000h	8000h	9000h
L26	72.85	100.21	100.06	99.84	99.58	99.32	99.28	98.92	98.81	98.48
L27	72.21	100.25	100.04	99.88	99.56	99.38	99.26	98.98	98.83	98.53
L28	73.53	100.16	99.98	99.85	99.72	99.31	99.22	98.93	98.75	98.55
L29	72.67	100.19	99.99	99.90	99.61	99.50	99.24	98.97	98.76	98.58
L30	72.82	100.20	99.98	99.78	99.54	99.43	99.14	98.83	98.74	98.64
L31	73.64	100.23	99.96	99.81	99.73	99.39	99.14	98.90	98.81	98.61
L32	73.69	100.15	99.97	99.83	99.67	99.50	99.25	98.85	98.77	98.50
L33	72.50	100.25	99.98	99.81	99.58	99.37	99.23	98.83	98.74	98.47
L34	73.88	100.13	100.08	99.90	99.64	99.43	99.22	98.89	98.84	98.50
L35	71.79	100.15	99.99	99.85	99.56	99.35	99.11	98.92	98.84	98.56
L36	72.57	100.24	99.98	99.86	99.60	99.45	99.13	98.80	98.78	98.50
L37	73.16	100.22	100.01	99.82	99.72	99.41	99.10	98.95	98.84	98.68
L38	72.82	100.21	100.07	99.83	99.61	99.45	99.21	99.01	98.77	98.51
L39	71.74	100.18	100.05	99.79	99.67	99.46	99.25	98.98	98.84	98.42
L40	71.78	100.13	100.06	99.87	99.71	99.37	99.12	98.92	98.77	98.54
L41	73.37	100.17	100.01	99.80	99.64	99.34	99.13	99.04	98.80	98.58
L42	72.99	100.19	100.05	99.89	99.59	99.46	99.22	98.96	98.72	98.51
L43	73.91	100.23	99.99	99.78	99.59	99.37	99.29	98.79	98.73	98.44
L44	71.58	100.14	100.06	99.77	99.55	99.38	99.23	98.84	98.79	98.56
L45	73.81	100.19	100.02	99.75	99.62	99.31	99.13	98.83	98.76	98.46
L46	71.83	100.26	100.05	99.79	99.55	99.36	99.20	99.02	98.80	98.63
L47	72.30	100.25	100.07	99.81	99.72	99.52	99.21	98.84	98.83	98.52
L48	72.23	100.16	100.01	99.76	99.58	99.30	99.12	98.82	98.78	98.45
L49	72.75	100.15	99.97	99.82	99.55	99.31	99.23	99.07	98.81	98.48
L50	72.09	100.21	99.99	99.83	99.54	99.52	99.17	98.85	98.83	98.59
Ave.	72.74	100.19	100.02	99.82	99.62	99.40	99.19	98.91	98.79	98.53
Med.	72.75	100.19	100.01	99.82	99.60	99.38	99.21	98.92	98.79	98.52
st dev	0.7376	0.0408	0.0383	0.0428	0.0638	0.0692	0.0582	0.0801	0.0379	0.0663
Min.	71.58	100.13	99.96	99.75	99.54	99.30	99.10	98.79	98.72	98.42
Max.	73.91	100.26	100.08	99.90	99.73	99.52	99.29	99.07	98.84	98.68

3.5 Data Set 2: 85°C; 150mA (Forward Voltage)

Sample No.	Forward Voltage (V)									
	0hr(Initial)	1000h	2000h	3000h	4000h	5000h	6000h	7000h	8000h	9000h
L26	2.860	2.852	2.859	2.857	2.854	2.857	2.855	2.844	2.849	2.862
L27	2.848	2.844	2.856	2.860	2.862	2.862	2.859	2.849	2.853	2.861
L28	2.867	2.862	2.858	2.869	2.868	2.858	2.863	2.849	2.845	2.861
L29	2.848	2.860	2.849	2.849	2.848	2.865	2.867	2.852	2.844	2.862
L30	2.850	2.866	2.868	2.848	2.847	2.850	2.854	2.849	2.857	2.850
L31	2.854	2.849	2.866	2.844	2.862	2.848	2.864	2.849	2.855	2.846
L32	2.855	2.857	2.861	2.844	2.864	2.853	2.866	2.855	2.865	2.848
L33	2.853	2.865	2.849	2.867	2.852	2.862	2.867	2.847	2.857	2.863
L34	2.854	2.858	2.868	2.858	2.857	2.861	2.861	2.849	2.867	2.843
L35	2.849	2.853	2.848	2.854	2.868	2.863	2.852	2.859	2.869	2.865
L36	2.846	2.848	2.868	2.862	2.847	2.860	2.855	2.852	2.858	2.851
L37	2.849	2.856	2.868	2.859	2.868	2.848	2.864	2.857	2.844	2.858
L38	2.856	2.866	2.846	2.851	2.864	2.859	2.845	2.865	2.851	2.867
L39	2.844	2.864	2.866	2.856	2.854	2.848	2.859	2.863	2.863	2.843
L40	2.844	2.852	2.851	2.856	2.865	2.860	2.869	2.848	2.848	2.848
L41	2.850	2.844	2.859	2.867	2.848	2.863	2.866	2.845	2.850	2.853
L42	2.860	2.869	2.844	2.861	2.848	2.845	2.863	2.855	2.855	2.851
L43	2.850	2.861	2.854	2.858	2.845	2.843	2.853	2.851	2.866	2.855
L44	2.849	2.865	2.855	2.861	2.860	2.851	2.856	2.865	2.843	2.844
L45	2.853	2.846	2.866	2.864	2.865	2.855	2.844	2.862	2.854	2.867
L46	2.840	2.861	2.863	2.860	2.868	2.867	2.843	2.849	2.861	2.864
L47	2.849	2.868	2.854	2.868	2.847	2.862	2.862	2.853	2.843	2.858
L48	2.858	2.852	2.865	2.864	2.848	2.849	2.851	2.844	2.860	2.863
L49	2.851	2.851	2.857	2.869	2.844	2.849	2.852	2.848	2.846	2.853
L50	2.855	2.858	2.853	2.869	2.861	2.850	2.848	2.855	2.867	2.853
Ave.	2.852	2.857	2.858	2.859	2.857	2.856	2.858	2.853	2.855	2.856
Med.	2.850	2.858	2.858	2.860	2.857	2.857	2.859	2.851	2.855	2.855
st dev	0.0058	0.008	0.008	0.008	0.009	0.007	0.008	0.006	0.008	0.008
Min.	2.840	2.844	2.844	2.844	2.844	2.843	2.843	2.844	2.843	2.843
Max.	2.867	2.869	2.868	2.869	2.868	2.867	2.869	2.865	2.869	2.867

3.6 Data Set 2: 85°C; 150mA (Chromaticity Shift)

Sample No.	u'	v'	CCT(K)	Chromaticity Shift $\Delta u'v'$								
	0hr(Initial)			1000h	2000h	3000h	4000h	5000h	6000h	7000h	8000h	9000h
L26	0.2619	0.5256	2721	0.0001	0.0002	0.0005	0.0006	0.0011	0.0013	0.0018	0.0019	0.0023
L27	0.2592	0.5257	2778	0.0002	0.0003	0.0005	0.0009	0.0013	0.0016	0.0019	0.0020	0.0024
L28	0.2594	0.5245	2778	0.0002	0.0003	0.0006	0.0009	0.0013	0.0015	0.0017	0.0019	0.0023
L29	0.2584	0.5256	2794	0.0002	0.0003	0.0007	0.0008	0.0013	0.0013	0.0017	0.0020	0.0024
L30	0.2585	0.5257	2793	0.0002	0.0002	0.0006	0.0008	0.0013	0.0015	0.0020	0.0022	0.0023
L31	0.2589	0.5252	2785	0.0003	0.0004	0.0006	0.0008	0.0011	0.0016	0.0017	0.0020	0.0022
L32	0.2590	0.5253	2784	0.0002	0.0003	0.0004	0.0008	0.0010	0.0017	0.0019	0.0021	0.0025
L33	0.2613	0.5260	2731	0.0001	0.0003	0.0005	0.0006	0.0010	0.0016	0.0019	0.0023	0.0024
L34	0.2598	0.5248	2768	0.0001	0.0003	0.0006	0.0007	0.0013	0.0015	0.0018	0.0021	0.0022
L35	0.2613	0.5265	2730	0.0001	0.0004	0.0007	0.0008	0.0012	0.0014	0.0018	0.0020	0.0025
L36	0.2604	0.5264	2748	0.0002	0.0004	0.0005	0.0010	0.0014	0.0015	0.0020	0.0023	0.0025
L37	0.2596	0.5257	2767	0.0001	0.0002	0.0005	0.0009	0.0010	0.0013	0.0018	0.0020	0.0023
L38	0.2581	0.5257	2800	0.0002	0.0003	0.0004	0.0008	0.0011	0.0016	0.0018	0.0020	0.0024
L39	0.2601	0.5266	2753	0.0003	0.0005	0.0007	0.0010	0.0012	0.0013	0.0020	0.0020	0.0024
L40	0.2602	0.5266	2752	0.0002	0.0004	0.0006	0.0007	0.0013	0.0016	0.0020	0.0023	0.0024
L41	0.2600	0.5248	2763	0.0002	0.0003	0.0005	0.0006	0.0012	0.0017	0.0019	0.0022	0.0024
L42	0.2582	0.5259	2797	0.0002	0.0004	0.0004	0.0007	0.0012	0.0015	0.0017	0.0020	0.0023
L43	0.2591	0.5264	2776	0.0002	0.0003	0.0004	0.0008	0.0009	0.0016	0.0020	0.0021	0.0024
L44	0.2612	0.5264	2731	0.0001	0.0002	0.0005	0.0009	0.0013	0.0017	0.0020	0.0022	0.0024
L45	0.2598	0.5247	2769	0.0003	0.0004	0.0006	0.0009	0.0013	0.0014	0.0018	0.0021	0.0023
L46	0.2611	0.5258	2737	0.0001	0.0003	0.0006	0.0009	0.0013	0.0015	0.0019	0.0021	0.0023
L47	0.2592	0.5258	2777	0.0002	0.0004	0.0006	0.0009	0.0010	0.0013	0.0019	0.0019	0.0025
L48	0.2609	0.5263	2738	0.0002	0.0003	0.0004	0.0007	0.0010	0.0016	0.0018	0.0021	0.0022
L49	0.2605	0.5265	2746	0.0002	0.0004	0.0007	0.0009	0.0012	0.0013	0.0019	0.0022	0.0023
L50	0.2608	0.5261	2740	0.0002	0.0003	0.0007	0.0008	0.0014	0.0018	0.0019	0.0019	0.0024
Ave.	0.2599	0.5258	2762	0.0002	0.0003	0.0006	0.0008	0.0012	0.0015	0.0019	0.0021	0.0024
Med.	0.2598	0.5258	2767	0.0002	0.0003	0.0006	0.0008	0.0012	0.0015	0.0019	0.0021	0.0024
st dev	0.0011	0.0006	23.85	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Min.	0.2581	0.5245	2721	0.0001	0.0002	0.0004	0.0006	0.0009	0.0013	0.0017	0.0019	0.0022
Max.	0.2619	0.5266	2800	0.0003	0.0005	0.0007	0.0010	0.0014	0.0018	0.0020	0.0023	0.0025

3.7 Data Set 3: 105°C; 150mA (Lumen Maintenance)

Sample No.	Φ (lm)	Lumen Maintenance (%)								
	0hr(Initial)	1000h	2000h	3000h	4000h	5000h	6000h	7000h	8000h	9000h
L51	73.21	100.03	99.82	99.69	99.43	99.06	98.86	98.59	98.31	97.90
L52	72.68	99.94	99.74	99.56	99.36	99.07	98.82	98.51	98.28	97.97
L53	73.29	99.95	99.86	99.54	99.36	99.13	98.74	98.53	98.16	98.00
L54	72.39	100.03	99.76	99.52	99.30	99.12	98.85	98.52	98.30	97.83
L55	71.70	99.96	99.82	99.54	99.41	99.05	98.77	98.44	98.22	97.95
L56	73.00	100.01	99.81	99.56	99.31	99.21	98.83	98.56	98.17	98.00
L57	72.34	99.93	99.85	99.50	99.29	99.02	98.75	98.66	98.15	97.88
L58	72.61	100.02	99.75	99.57	99.31	99.11	98.82	98.49	98.19	97.90
L59	72.64	99.98	99.74	99.64	99.27	99.20	98.76	98.48	98.29	98.08
L60	73.66	100.02	99.72	99.54	99.30	99.01	98.83	98.64	98.15	97.83
L61	72.83	99.94	99.73	99.69	99.36	99.12	98.88	98.55	98.13	97.81
L62	72.31	99.97	99.88	99.58	99.43	99.22	98.79	98.52	98.17	97.85
L63	73.51	100.03	99.87	99.48	99.35	99.23	98.95	98.48	98.23	97.89
L64	73.72	99.96	99.88	99.61	99.45	99.11	98.83	98.43	98.40	97.85
L65	73.23	99.96	99.80	99.68	99.31	99.19	98.78	98.45	98.17	97.84
L66	73.30	99.93	99.73	99.58	99.27	99.15	98.94	98.45	98.18	97.89
L67	73.64	99.94	99.75	99.69	99.36	99.05	98.92	98.59	98.21	97.91
L68	72.12	100.03	99.78	99.49	99.42	99.05	98.82	98.48	98.39	97.86
L69	73.69	99.97	99.77	99.61	99.32	98.99	98.81	98.49	98.23	97.94
L70	72.01	99.97	99.83	99.51	99.42	99.01	98.83	98.62	98.17	98.11
L71	73.14	99.94	99.73	99.53	99.35	99.03	98.87	98.59	98.41	97.98
L72	73.24	99.96	99.75	99.58	99.29	99.08	98.88	98.47	98.38	97.88
L73	73.70	99.95	99.87	99.61	99.37	99.01	98.80	98.60	98.31	97.86
L74	71.92	100.02	99.75	99.59	99.41	99.15	98.85	98.65	98.31	98.01
L75	73.68	100.01	99.81	99.64	99.33	99.00	98.86	98.53	98.19	98.00
Ave.	72.94	99.98	99.79	99.58	99.35	99.09	98.83	98.53	98.24	97.92
Med.	73.14	99.97	99.78	99.58	99.35	99.08	98.83	98.52	98.22	97.90
st dev	0.6333	0.0363	0.0541	0.0637	0.0546	0.0752	0.0548	0.0690	0.0873	0.0801
Min.	71.70	99.93	99.72	99.48	99.27	98.99	98.74	98.43	98.13	97.81
Max.	73.72	100.03	99.88	99.69	99.45	99.23	98.95	98.66	98.41	98.11

3.8 Data Set 3: 105°C; 150mA (Forward Voltage)

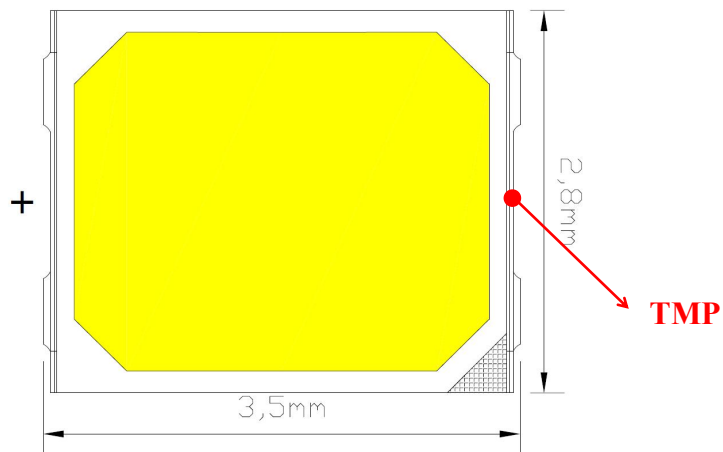
Sample No.	Forward Voltage (V)									
	0hr(Initial)	1000h	2000h	3000h	4000h	5000h	6000h	7000h	8000h	9000h
L51	2.862	2.866	2.864	2.864	2.843	2.856	2.867	2.844	2.867	2.866
L52	2.857	2.851	2.848	2.854	2.866	2.844	2.860	2.848	2.850	2.865
L53	2.864	2.862	2.843	2.866	2.854	2.859	2.867	2.862	2.841	2.851
L54	2.851	2.845	2.858	2.854	2.845	2.866	2.866	2.860	2.858	2.843
L55	2.849	2.846	2.851	2.852	2.855	2.864	2.859	2.864	2.844	2.857
L56	2.859	2.847	2.844	2.853	2.846	2.844	2.850	2.859	2.847	2.847
L57	2.851	2.861	2.851	2.857	2.867	2.868	2.858	2.861	2.853	2.860
L58	2.845	2.865	2.852	2.849	2.852	2.850	2.864	2.853	2.854	2.864
L59	2.846	2.856	2.863	2.864	2.862	2.851	2.864	2.868	2.861	2.848
L60	2.847	2.858	2.847	2.862	2.868	2.867	2.868	2.848	2.850	2.859
L61	2.850	2.858	2.868	2.861	2.851	2.862	2.848	2.852	2.868	2.853
L62	2.860	2.849	2.862	2.844	2.856	2.851	2.843	2.852	2.863	2.850
L63	2.852	2.850	2.854	2.861	2.862	2.857	2.859	2.855	2.847	2.848
L64	2.860	2.862	2.844	2.848	2.853	2.869	2.849	2.861	2.857	2.849
L65	2.848	2.851	2.852	2.843	2.852	2.847	2.846	2.856	2.850	2.863
L66	2.852	2.846	2.867	2.847	2.865	2.865	2.854	2.845	2.866	2.850
L67	2.860	2.844	2.855	2.866	2.855	2.858	2.856	2.862	2.862	2.845
L68	2.855	2.860	2.862	2.861	2.867	2.866	2.852	2.866	2.869	2.861
L69	2.850	2.849	2.853	2.848	2.855	2.855	2.855	2.863	2.863	2.858
L70	2.844	2.860	2.849	2.867	2.852	2.863	2.866	2.844	2.858	2.851
L71	2.849	2.852	2.868	2.853	2.847	2.847	2.861	2.850	2.868	2.848
L72	2.862	2.862	2.867	2.850	2.849	2.854	2.851	2.864	2.863	2.865
L73	2.850	2.843	2.868	2.866	2.867	2.861	2.855	2.853	2.855	2.850
L74	2.843	2.863	2.844	2.852	2.847	2.854	2.850	2.867	2.855	2.865
L75	2.850	2.844	2.847	2.845	2.856	2.846	2.855	2.859	2.866	2.856
Ave.	2.853	2.854	2.855	2.855	2.856	2.857	2.857	2.857	2.857	2.855
Med.	2.851	2.852	2.853	2.854	2.855	2.857	2.856	2.859	2.858	2.853
st dev	0.0062	0.008	0.009	0.008	0.008	0.008	0.007	0.007	0.008	0.007
Min.	2.843	2.843	2.843	2.843	2.843	2.844	2.843	2.844	2.841	2.843
Max.	2.864	2.866	2.868	2.867	2.868	2.869	2.868	2.868	2.869	2.866

3.9 Data Set 3: 105°C; 150mA (Chromaticity Shift)

Sample No.	u'	v'	CCT(K)	Chromaticity Shift $\Delta u'v'$								
	0hr(Initial)			1000h	2000h	3000h	4000h	5000h	6000h	7000h	8000h	9000h
L51	0.2593	0.5243	2781	0.0001	0.0005	0.0007	0.0009	0.0012	0.0015	0.0020	0.0027	0.0029
L52	0.2613	0.5261	2729	0.0004	0.0005	0.0006	0.0009	0.0016	0.0019	0.0022	0.0025	0.0031
L53	0.2593	0.5243	2781	0.0003	0.0006	0.0007	0.0010	0.0015	0.0018	0.0021	0.0023	0.0032
L54	0.2613	0.5259	2732	0.0001	0.0004	0.0007	0.0010	0.0014	0.0018	0.0024	0.0026	0.0028
L55	0.2612	0.5265	2730	0.0004	0.0005	0.0007	0.0011	0.0015	0.0018	0.0023	0.0026	0.0030
L56	0.2623	0.5267	2706	0.0004	0.0005	0.0008	0.0009	0.0013	0.0017	0.0023	0.0025	0.0030
L57	0.2612	0.5259	2733	0.0003	0.0006	0.0007	0.0012	0.0015	0.0018	0.0022	0.0023	0.0029
L58	0.2584	0.5256	2795	0.0002	0.0005	0.0006	0.0009	0.0013	0.0018	0.0022	0.0028	0.0033
L59	0.2584	0.5255	2795	0.0001	0.0005	0.0009	0.0009	0.0014	0.0018	0.0021	0.0026	0.0027
L60	0.2600	0.5260	2758	0.0002	0.0007	0.0008	0.0009	0.0015	0.0016	0.0018	0.0024	0.0031
L61	0.2595	0.5261	2769	0.0003	0.0006	0.0008	0.0012	0.0014	0.0017	0.0022	0.0027	0.0032
L62	0.2609	0.5263	2739	0.0004	0.0006	0.0009	0.0012	0.0013	0.0016	0.0023	0.0026	0.0029
L63	0.2588	0.5252	2787	0.0001	0.0004	0.0007	0.0012	0.0015	0.0018	0.0019	0.0026	0.0029
L64	0.2600	0.5266	2757	0.0003	0.0005	0.0008	0.0010	0.0013	0.0019	0.0020	0.0025	0.0028
L65	0.2600	0.5247	2764	0.0001	0.0006	0.0007	0.0011	0.0012	0.0019	0.0024	0.0027	0.0032
L66	0.2597	0.5258	2766	0.0004	0.0005	0.0009	0.0011	0.0013	0.0017	0.0021	0.0025	0.0032
L67	0.2600	0.5265	2757	0.0002	0.0006	0.0007	0.0008	0.0014	0.0017	0.0022	0.0025	0.0031
L68	0.2608	0.5262	2740	0.0004	0.0005	0.0008	0.0012	0.0014	0.0019	0.0020	0.0025	0.0029
L69	0.2597	0.5246	2770	0.0004	0.0007	0.0008	0.0013	0.0015	0.0019	0.0022	0.0027	0.0030
L70	0.2611	0.5259	2735	0.0002	0.0007	0.0009	0.0012	0.0016	0.0019	0.0021	0.0027	0.0027
L71	0.2596	0.5257	2769	0.0004	0.0005	0.0006	0.0011	0.0013	0.0017	0.0022	0.0025	0.0032
L72	0.2593	0.5243	2782	0.0003	0.0006	0.0007	0.0011	0.0013	0.0016	0.0023	0.0026	0.0030
L73	0.2597	0.5246	2770	0.0004	0.0005	0.0006	0.0012	0.0015	0.0019	0.0021	0.0024	0.0033
L74	0.2611	0.5258	2736	0.0002	0.0006	0.0007	0.0012	0.0013	0.0019	0.0022	0.0025	0.0027
L75	0.2598	0.5246	2769	0.0002	0.0005	0.0007	0.0009	0.0015	0.0019	0.0023	0.0025	0.0031
Ave.	0.2601	0.5256	2758	0.0003	0.0005	0.0007	0.0011	0.0014	0.0018	0.0022	0.0026	0.0030
Med.	0.2600	0.5258	2764	0.0003	0.0005	0.0007	0.0011	0.0014	0.0018	0.0022	0.0025	0.0030
st dev	0.0010	0.0008	23.54	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002
Min.	0.2584	0.5243	2706	0.0001	0.0004	0.0006	0.0008	0.0012	0.0015	0.0018	0.0023	0.0027
Max.	0.2623	0.5267	2795	0.0004	0.0007	0.0009	0.0013	0.0016	0.0019	0.0024	0.0028	0.0033

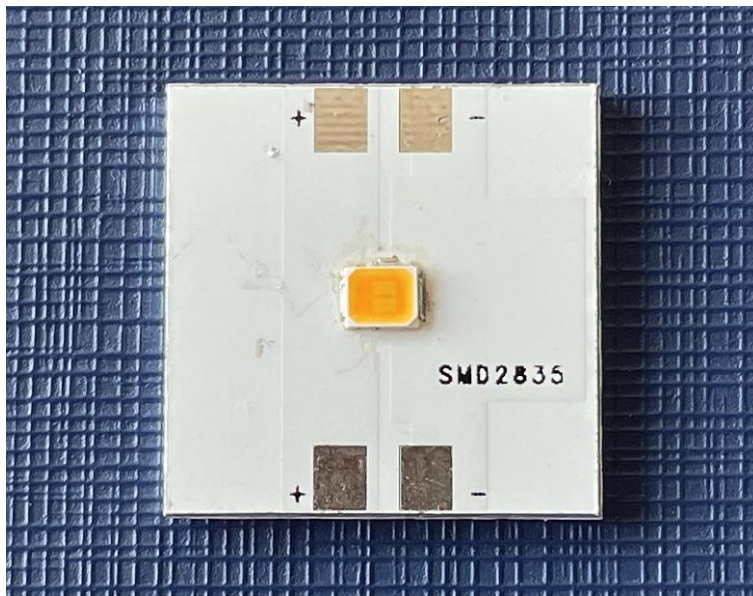
4-EUT Photos

4.1 Mechanical Dimensions



Note: All dimensions are in millimeters(mm).

4.2 EUT Photo



----End of report----