

# IESNA LM-80-08

MEASURING LUMEN MAINTENANCE OF LED LIGHT SOURCES

## MEASUREMENT AND TEST REPORT

For

### Xiamen Dacol Photoelectronics Technology Co., Ltd.

8021 Xiang'an West Road (Xiang'an) industrial zone, Torch Hi-Tech Industrial Development Zone,  
Xiamen City, Fujian, China

**Model: SMD 2835**

<b>Report Type:</b> 9000 Hours Test Report	<b>Product Type:</b> LED Package
<b>Test Engineer:</b> Pote Wang	<i>Pote Wang</i>
<b>Report Number:</b> R2DG161104050-10-9000-M1	
<b>Test Date:</b> 2016-11-07 to 2018-12-13	
<b>Report Date:</b> 2019-08-09	
<b>Reviewed By:</b> Bill Xiong / EE Engineer	<i>Bill Xiong</i>
<b>Revised Note:</b>	The previous report R2DG161104050-10-9000 is replaced by this report on 2019-08-09
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**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 used in part without prior written consent from Bay Area Compliance Laboratories Corp. (Dongguan).

This report is valid only with a valid digital signature. The digital signature may be available only under the Adobe software above version 7.0.

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## 1 - General Information

### 1.1 Description of LED Light Sources

Devices tested

Part Number:	SMD 2835
Part Type:	LED Package
Nominal CCT:	3500K
Power:	1W
Average Current Density per LED die:	78.9mA/mm <sup>2</sup>
Average Power Density per LED die:	1.421W/mm <sup>2</sup>
CRI:	80
Die Spacing:	0.084 mm

### 1.2 Standards Used:

- IESNA LM-80-08: IES Approved Method for Measuring Lumen Maintenance of LED Light Sources.
- CIE 127:2007: Measurement of LEDs
- ENERGY STAR® Requirements for the Use of LM-80 Data (This standard was not accredited by IAS)

### 1.3 Test Facility

The testing facility used by Bay Area Compliance Laboratories Corp. (Dongguan). is located at No.69,Pulongcun ,Puxinhu Industrial Area, Tangxia , Dongguan, Guangdong, China.

### 1.4 Description of Auxiliary Equipment

Device	Manufacture	Model No	Serial No	Calibration date	Calibration due date
0.3m integrating sphere	EVERFINE	Diameter 0.3m	1011119	2018-03-18	2019-03-18
Programmable Test Power for LEDs	EVERFINE	LED300E	1008002	2018-03-26	2019-03-26
High accuracy array spectroradiometer	EVERFINE	HAAS-2000	1012016T	2018-03-18	2019-03-18
Standard Light Source	EVERFINE	D062	G100278CJ7351206	2018-12-24	2019-12-24
Precision digital stabilized DC power supply	EVERFINE	WY605-V110	G115987CJ7321114	2018-03-26	2019-03-26
Multilayer aging machine	BACL	B2-270	20023	2018-03-13	2019-03-13
Digital CC&CV DC Power Supply	EVERFINE	WY5015	11090005	2018-03-26	2019-03-26

Device	Manufacture	Model No	Serial No	Calibration date	Calibration due date
Digital CC&CV DC Power Supply	EVERFINE	WY5015	11090006	2018-03-26	2019-03-26
Digital CC&CV DC Power Supply	EVERFINE	WY5015	11090009	2017-12-15	2018-12-15

### 1.5 Operating Cycle

Samples are driven with a constant direct current (DC)

### 1.6 Ambient Conditions

For lumen maintenance test, samples were operated in thermal chambers with minimal ambient airflow. For long term reliability test, the case temperature was controlled by mounting several thermocouples on a sample reliability stress board at the designated thermal measurement point, as shown in APPENDIX. The ambient temperature  $T_A$  was measured by several thermocouples at a distance of 5 mm above the reliability test board. The relative humidity within chamber was less than 65%.

For photometry measurement, temperature was set to  $25\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ , RH <65%.

### 1.7 Photometry Measurement Uncertainty

The uncertainty of the light output measurements is  $U=1.59\%$  ( $K=2$ ), at the 95% confidence level. The uncertainty of the correlated color temperature measurements is  $U=21\text{K}$  ( $K=2$ ), at the 95% confidence level. This calibration results traceable to the NATIONAL INSTITUTE OF METROLOGY (NIM).

## 1.8 Sample Set

### Sampling Method:

LED samples for IESNA LM-80 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 IESNA LM-80 tests.

### Sample Size:

Total 75Pcs;

Each Ts test condition 25Pcs

The samples tested at Ts 55 °C, Ts 85 °C and Ts 105 °C were received at 2016-11-04 and tested during 2016-11-07 to 2018-12-13. The samples were numbered from 1 to 25, 26 to 50 and 51 to 75

#### Data Set 1: 55 °C, 60mA

Part Number:	SMD 2835
Number of Units:	25
Actual Case Temperature(T <sub>S</sub> ):	T <sub>S</sub> =54.1 °C
Actual Ambient Temperature(T <sub>A</sub> ):	T <sub>A</sub> =52.1 °C
Life Test Drive Current:	I <sub>F</sub> = 60mA
Measurement Current:	I <sub>F</sub> = 60mA

#### Data Set 2: 85 °C,60mA

Part Number:	SMD 2835
Number of Units:	25
Actual Case Temperature(T <sub>S</sub> ):	T <sub>S</sub> =84.2 °C
Actual Ambient Temperature(T <sub>A</sub> ):	T <sub>A</sub> =81.5 °C
Life Test Drive Current:	I <sub>F</sub> =60mA
Measurement Current:	I <sub>F</sub> = 60mA

#### Data Set 3: 105 °C, 60mA

Part Number:	SMD 2835
Number of Units:	25
Actual Case Temperature(T <sub>S</sub> ):	T <sub>S</sub> =104.3 °C
Actual Ambient Temperature(T <sub>A</sub> ):	T <sub>A</sub> =101.4 °C
Life Test Drive Current:	I <sub>F</sub> = 60mA
Measurement Current:	I <sub>F</sub> = 60mA

## 2 - Summary of Test Result

<b>Data Set:</b>	<b>Data Set 1, 55 °C, 60mA</b>
Number of Units:	25
Failures Observed:	0
Test Interval and Test Duration:	0h,1000h,2000h,3000h,4000h,5000h,6000h, 7000h,8000h,9000h
Average. Lumen Maintenance at 6000 hours:	99.06%
Average. Lumen Maintenance at 9000 hours:	98.15%
Average Chromaticity Shift at 6000 hours ( $\Delta u'v'$ ):	0.0016
Average Chromaticity Shift at 9000 hours ( $\Delta u'v'$ ):	0.0021
Reported TM-21 L <sub>70</sub> Lifetime:	>54000hours

<b>Data Set:</b>	<b>Data Set 2, 85 °C, 60mA</b>
Number of Units:	25
Failures Observed:	0
Test Interval and Test Duration:	0h,1000h,2000h,3000h,4000h,5000h,6000h, 7000h,8000h,9000h
Average. Lumen Maintenance at 6000 hours:	98.78%
Average. Lumen Maintenance at 9000 hours:	97.68%
Average Chromaticity Shift at 6000 hours( $\Delta u'v'$ ):	0.0017
Average Chromaticity Shift at 9000 hours ( $\Delta u'v'$ ):	0.0025
Reported TM-21 L <sub>70</sub> Lifetime:	>54000hours

<b>Data Set:</b>	<b>Data Set 3, 105 °C, 60mA</b>
Number of Units:	25
Failures Observed:	0
Test Interval and Test Duration:	0h,1000h,2000h,3000h,4000h,5000h,6000h, 7000h,8000h,9000h
Average. Lumen Maintenance at 6000 hours:	98.50%
Average. Lumen Maintenance at 9000 hours:	97.27%
Average Chromaticity Shift at 6000 hours( $\Delta u'v'$ ):	0.0016
Average Chromaticity Shift at 9000 hours ( $\Delta u'v'$ ):	0.0023
Reported TM-21 L <sub>70</sub> Lifetime:	>54000hours

### 3 - Test Data

#### 3.1 Data Set 1, 55 °C, 60mA (Lumen Maintenance)

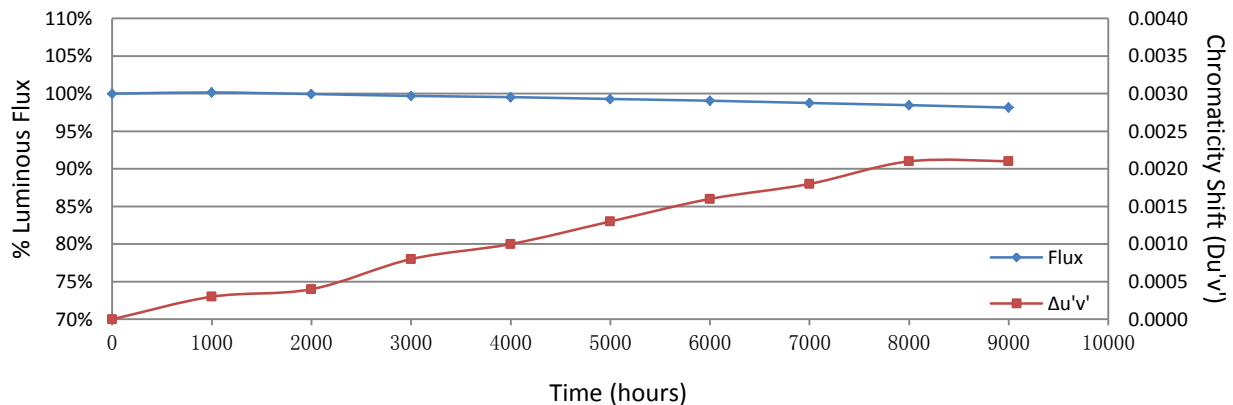
No.	V <sub>F</sub> (V)	Φ(lm)	Lumen Maintenance (%)								
			0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs
1	18.26	121.1	100.08	99.83	99.67	99.59	99.50	99.34	98.93	98.51	98.18
2	18.29	121.7	100.16	100.08	99.84	99.67	99.34	99.01	98.69	98.27	98.03
3	18.24	117.8	100.17	99.83	99.49	99.41	99.24	98.98	98.56	98.22	97.88
4	18.24	122.2	100.08	100.00	99.75	99.51	99.18	98.94	98.85	98.61	98.45
5	18.22	119.5	100.17	99.83	99.75	99.58	99.33	99.16	99.00	98.58	98.33
6	18.21	120.7	100.25	100.08	99.92	99.75	99.42	99.17	98.84	98.76	98.51
7	18.21	121.9	100.25	100.08	99.75	99.59	99.34	99.10	98.61	98.44	98.36
8	18.27	119.1	100.34	100.17	99.92	99.83	99.50	99.24	98.99	98.82	98.32
9	18.23	123.5	100.08	99.92	99.68	99.60	99.27	99.19	98.95	98.70	98.06
10	18.19	119.7	99.92	99.58	99.33	99.08	98.83	98.50	98.25	97.83	97.49
11	18.30	121.4	100.16	99.92	99.59	99.51	99.18	99.01	98.68	98.35	98.27
12	18.20	120.4	100.17	100.08	99.83	99.67	99.42	99.09	98.75	98.50	98.17
13	18.30	121.0	100.08	99.83	99.59	99.42	99.17	99.09	98.84	98.35	98.18
14	18.22	119.0	100.25	100.08	99.75	99.58	99.33	99.16	98.82	98.24	98.07
15	18.23	121.7	99.84	99.59	99.51	99.42	99.01	98.85	98.60	98.27	97.86
16	18.28	121.4	100.08	99.92	99.59	99.26	99.18	98.93	98.60	98.19	98.11
17	18.34	118.0	100.17	99.92	99.66	99.49	99.15	98.73	98.47	98.05	97.80
18	18.22	122.3	100.25	100.16	99.75	99.51	99.35	99.26	99.02	98.77	98.20
19	18.19	118.4	99.92	99.66	99.32	99.16	98.82	98.48	98.14	98.06	97.30
20	18.28	121.9	100.41	100.16	99.84	99.51	99.18	98.85	98.52	98.28	97.87
21	18.20	120.1	100.08	99.75	99.50	99.33	99.17	99.00	98.75	98.67	98.33
22	18.29	119.2	100.34	100.25	99.92	99.75	99.58	99.41	99.16	98.91	98.57
23	18.22	120.9	100.08	99.83	99.67	99.59	99.34	99.09	98.68	98.51	98.35
24	18.24	122.4	100.41	100.08	99.84	99.75	99.67	99.51	99.18	98.86	98.53
25	18.20	120.1	100.33	100.17	100.08	99.83	99.67	99.33	99.08	98.92	98.58
Ave.	18.24	120.6	100.16	99.95	99.70	99.54	99.29	99.06	98.76	98.47	98.15
Med.	18.23	120.9	100.17	99.92	99.75	99.58	99.33	99.09	98.75	98.50	98.18
st dev	0.0408	1.4924	0.1463	0.1876	0.1842	0.1919	0.2161	0.2506	0.2605	0.2939	0.3212
Min.	18.19	117.8	99.84	99.58	99.32	99.08	98.82	98.48	98.14	97.83	97.30
Max.	18.34	123.5	100.41	100.25	100.08	99.83	99.67	99.51	99.18	98.92	98.58

TM-21 Projection:

**Test Duration:** 9000hours  
**Failures Observed:** 0  
 $\alpha$ : 2.806E-06  
 $\beta$ : 1.007  
**Reported L<sub>70</sub>:** >54000hours

### 3.2 Data Set 1, 55 °C, 60mA (Chromaticity Shift)

No.	u'	v'	CCT(K)	Chromaticity Shift ( $\Delta u'v'$ )								
				0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs
1	0.2360	0.5133	3470	0.0003	0.0009	0.0011	0.0011	0.0012	0.0014	0.0017	0.0021	0.0029
2	0.2358	0.5139	3468	0.0004	0.0006	0.0011	0.0014	0.0017	0.0020	0.0022	0.0008	0.0008
3	0.2357	0.5117	3496	0.0004	0.0008	0.0010	0.0013	0.0013	0.0014	0.0018	0.0014	0.0011
4	0.2359	0.5130	3476	0.0002	0.0007	0.0014	0.0015	0.0018	0.0021	0.0025	0.0024	0.0029
5	0.2358	0.5126	3481	0.0011	0.0013	0.0014	0.0013	0.0015	0.0018	0.0022	0.0022	0.0022
6	0.2364	0.5116	3476	0.0003	0.0006	0.0009	0.0012	0.0017	0.0020	0.0023	0.0009	0.0010
7	0.2354	0.5145	3474	0.0002	0.0003	0.0006	0.0011	0.0014	0.0017	0.0019	0.0027	0.0037
8	0.2367	0.5108	3474	0.0001	0.0003	0.0006	0.0010	0.0014	0.0017	0.0019	0.0018	0.0018
9	0.2348	0.5143	3494	0.0002	0.0003	0.0006	0.0010	0.0013	0.0017	0.0020	0.0018	0.0017
10	0.2353	0.5119	3505	0.0002	0.0002	0.0004	0.0008	0.0011	0.0015	0.0017	0.0019	0.0016
11	0.2349	0.5121	3515	0.0001	0.0002	0.0005	0.0005	0.0008	0.0008	0.0010	0.0018	0.0013
12	0.2366	0.5120	3465	0.0002	0.0004	0.0007	0.0008	0.0011	0.0016	0.0017	0.0018	0.0018
13	0.2359	0.5122	3483	0.0001	0.0004	0.0006	0.0010	0.0014	0.0014	0.0016	0.0020	0.0017
14	0.2356	0.5115	3501	0.0001	0.0003	0.0004	0.0008	0.0011	0.0012	0.0014	0.0020	0.0017
15	0.2364	0.5133	3455	0.0001	0.0002	0.0006	0.0009	0.0013	0.0013	0.0015	0.0021	0.0017
16	0.2361	0.5129	3471	0.0004	0.0004	0.0007	0.0011	0.0015	0.0017	0.0019	0.0036	0.0031
17	0.2355	0.5117	3502	0.0001	0.0003	0.0005	0.0008	0.0012	0.0013	0.0014	0.0023	0.0027
18	0.2352	0.5128	3497	0.0001	0.0002	0.0006	0.0011	0.0013	0.0015	0.0017	0.0022	0.0015
19	0.2362	0.5130	3467	0.0004	0.0005	0.0007	0.0011	0.0014	0.0017	0.0018	0.0023	0.0031
20	0.2352	0.5127	3501	0.0002	0.0002	0.0006	0.0008	0.0013	0.0015	0.0017	0.0022	0.0014
21	0.2361	0.5127	3472	0.0002	0.0005	0.0007	0.0009	0.0012	0.0016	0.0017	0.0022	0.0029
22	0.2354	0.5127	3493	0.0001	0.0003	0.0007	0.0009	0.0011	0.0015	0.0016	0.0023	0.0020
23	0.2360	0.5132	3470	0.0001	0.0002	0.0007	0.0009	0.0013	0.0017	0.0018	0.0022	0.0023
24	0.2349	0.5129	3506	0.0001	0.0001	0.0007	0.0009	0.0012	0.0016	0.0017	0.0023	0.0022
25	0.2358	0.5120	3488	0.0001	0.0001	0.0008	0.0009	0.0012	0.0014	0.0016	0.0023	0.0022
Ave.	0.2357	0.5126	3484	0.0003	0.0004	0.0008	0.0010	0.0013	0.0016	0.0018	0.0021	0.0021
Med.	0.2358	0.5127	3481	0.0002	0.0003	0.0007	0.0010	0.0013	0.0016	0.0017	0.0022	0.0018
st dev	0.0005	0.0009	15.9269	0.0002	0.0003	0.0003	0.0002	0.0002	0.0003	0.0003	0.0005	0.0007
Min.	0.2348	0.5108	3455	0.0001	0.0001	0.0004	0.0005	0.0008	0.0008	0.0010	0.0008	0.0008
Max.	0.2367	0.5145	3515	0.0011	0.0013	0.0014	0.0015	0.0018	0.0021	0.0025	0.0036	0.0037





**3.3 Data Set 2, 85 °C, 60mA (Lumen Maintenance)**

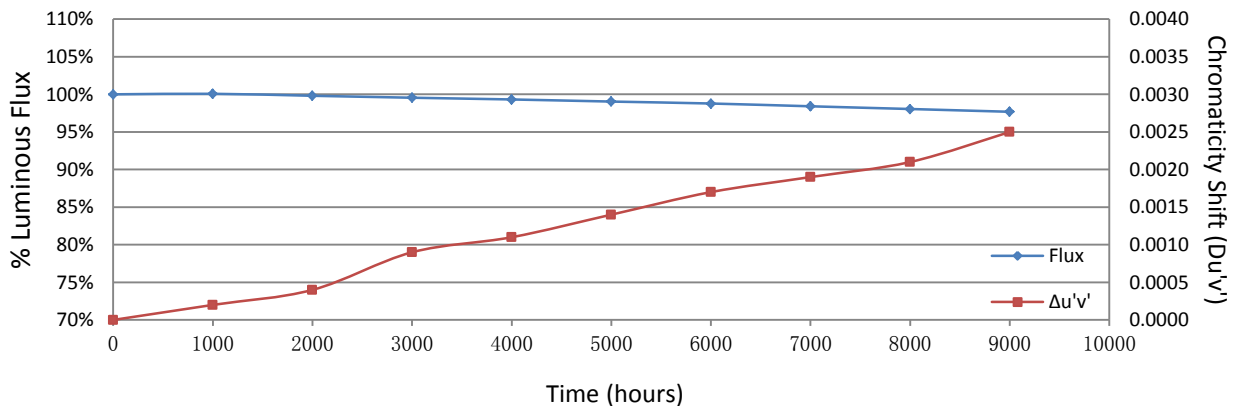
No.	V <sub>F</sub> (V)	Φ(lm)	Lumen Maintenance (%)								
			0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs
26	18.34	121.9	100.16	99.84	99.51	99.34	99.10	98.85	98.52	98.03	97.70
27	18.32	122.6	100.08	99.92	99.59	99.43	99.27	98.94	98.53	98.37	97.88
28	18.32	121.5	100.16	99.84	99.67	99.42	99.18	98.93	98.60	98.27	97.78
29	18.33	120.2	99.92	99.75	99.50	99.25	98.92	98.67	98.34	98.17	97.59
30	18.33	120.7	99.83	99.67	99.42	99.17	98.92	98.51	98.26	98.01	97.85
31	18.22	120.3	100.25	100.17	100.08	99.92	99.67	99.33	98.92	98.25	97.92
32	18.29	122.3	100.16	99.92	99.75	99.51	99.18	98.94	98.36	98.28	97.96
33	18.34	122.6	99.92	99.76	99.59	99.35	99.10	99.02	98.69	98.37	97.96
34	18.31	118.6	99.75	99.49	99.16	98.90	98.48	98.06	97.64	96.96	96.29
35	18.29	121.3	100.08	100.00	99.75	99.59	99.42	99.26	98.76	98.35	98.02
36	18.24	121.2	100.08	99.75	99.42	99.34	99.09	99.01	98.68	98.18	97.94
37	18.21	120.8	99.83	99.50	99.17	99.01	98.59	98.26	97.85	97.27	96.85
38	18.14	119.0	100.08	99.83	99.66	99.50	99.16	98.91	98.49	98.15	97.82
39	18.17	119.8	100.25	100.08	99.92	99.75	99.42	99.08	98.75	98.33	98.00
40	18.20	119.4	100.25	99.83	99.58	99.25	98.99	98.74	98.24	97.91	97.82
41	18.26	121.1	100.08	99.92	99.75	99.50	99.01	98.60	98.27	97.77	97.44
42	18.28	122.1	100.25	99.84	99.59	99.34	99.26	99.02	98.53	98.36	98.03
43	18.18	120.0	100.08	99.75	99.42	99.17	99.00	98.83	98.50	98.42	98.08
44	18.18	120.6	100.25	99.92	99.59	99.25	99.00	98.67	98.26	97.84	97.51
45	18.19	119.8	100.25	99.75	99.58	99.33	99.00	98.75	98.50	97.91	97.50
46	18.32	121.1	99.92	99.83	99.42	99.09	98.84	98.68	98.35	97.69	97.52
47	18.31	120.6	99.75	99.42	99.17	98.92	98.59	98.26	98.01	97.93	97.26
48	18.32	120.2	100.17	99.75	99.33	99.17	98.84	98.59	98.34	98.17	97.75
49	18.28	120.8	100.17	99.83	99.42	99.17	99.01	98.84	98.51	98.18	97.68
50	18.24	121.0	100.08	99.83	99.59	99.34	98.93	98.76	98.35	98.10	97.93
Ave.	18.26	120.8	100.07	99.81	99.55	99.32	99.04	98.78	98.41	98.05	97.68
Med.	18.28	120.8	100.08	99.83	99.58	99.34	99.01	98.83	98.49	98.17	97.82
st dev	0.0622	1.0504	0.1614	0.1678	0.2194	0.2350	0.2653	0.2983	0.2849	0.3490	0.4036
Min.	18.14	118.6	99.75	99.42	99.16	98.90	98.48	98.06	97.64	96.96	96.29
Max.	18.34	122.6	100.25	100.17	100.08	99.92	99.67	99.33	98.92	98.42	98.08

**TM-21 Projection:**

**Test Duration:** 9000hours  
**Failures Observed:** 0  
**α:** 3.347E-06  
**β:** 1.007  
**Reported L<sub>70</sub>:** >54000hours

### 3.4 Data Set 2, 85 °C, 60mA (Chromaticity Shift)

No.	u'	v'	CCT(K)	Chromaticity Shift ( $\Delta u'v'$ )								
				0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs
26	0.2360	0.5142	3459	0.0002	0.0002	0.0009	0.0010	0.0013	0.0015	0.0017	0.0022	0.0028
27	0.2348	0.5143	3495	0.0002	0.0005	0.0011	0.0011	0.0013	0.0016	0.0017	0.0023	0.0029
28	0.2364	0.5139	3450	0.0002	0.0002	0.0009	0.0011	0.0013	0.0017	0.0018	0.0023	0.0031
29	0.2355	0.5130	3486	0.0002	0.0003	0.0009	0.0012	0.0011	0.0013	0.0014	0.0024	0.0030
30	0.2355	0.5132	3487	0.0003	0.0004	0.0012	0.0011	0.0013	0.0016	0.0017	0.0021	0.0020
31	0.2358	0.5119	3490	0.0002	0.0003	0.0011	0.0012	0.0013	0.0016	0.0018	0.0022	0.0029
32	0.2358	0.5150	3458	0.0003	0.0004	0.0010	0.0012	0.0013	0.0018	0.0020	0.0023	0.0030
33	0.2358	0.5140	3467	0.0002	0.0003	0.0010	0.0012	0.0012	0.0016	0.0019	0.0023	0.0028
34	0.2352	0.5127	3499	0.0003	0.0002	0.0005	0.0008	0.0009	0.0011	0.0015	0.0023	0.0028
35	0.2353	0.5126	3497	0.0004	0.0004	0.0008	0.0012	0.0014	0.0016	0.0019	0.0019	0.0023
36	0.2367	0.5138	3442	0.0002	0.0005	0.0011	0.0013	0.0015	0.0016	0.0018	0.0018	0.0022
37	0.2351	0.5144	3486	0.0002	0.0004	0.0007	0.0011	0.0013	0.0014	0.0018	0.0019	0.0022
38	0.2357	0.5116	3496	0.0003	0.0005	0.0009	0.0012	0.0015	0.0015	0.0019	0.0019	0.0023
39	0.2352	0.5119	3509	0.0004	0.0008	0.0008	0.0011	0.0015	0.0014	0.0020	0.0020	0.0023
40	0.2364	0.5133	3455	0.0004	0.0006	0.0012	0.0014	0.0019	0.0020	0.0023	0.0018	0.0022
41	0.2345	0.5150	3496	0.0002	0.0006	0.0009	0.0012	0.0014	0.0018	0.0020	0.0017	0.0022
42	0.2345	0.5139	3509	0.0001	0.0005	0.0009	0.0011	0.0013	0.0017	0.0021	0.0019	0.0022
43	0.2357	0.5129	3481	0.0002	0.0006	0.0009	0.0012	0.0015	0.0018	0.0021	0.0017	0.0022
44	0.2361	0.5137	3461	0.0001	0.0005	0.0009	0.0012	0.0014	0.0018	0.0021	0.0019	0.0022
45	0.2365	0.5138	3450	0.0002	0.0004	0.0007	0.0011	0.0013	0.0018	0.0021	0.0019	0.0023
46	0.2356	0.5121	3496	0.0002	0.0004	0.0010	0.0013	0.0016	0.0020	0.0023	0.0021	0.0024
47	0.2348	0.5135	3503	0.0002	0.0004	0.0009	0.0010	0.0014	0.0019	0.0021	0.0019	0.0023
48	0.2365	0.5128	3461	0.0002	0.0004	0.0009	0.0011	0.0016	0.0021	0.0022	0.0022	0.0023
49	0.2357	0.5134	3478	0.0002	0.0005	0.0010	0.0013	0.0015	0.0019	0.0020	0.0023	0.0024
50	0.2345	0.5129	3519	0.0001	0.0003	0.0009	0.0012	0.0015	0.0018	0.0019	0.0023	0.0022
Ave.	0.2356	0.5134	3481	0.0002	0.0004	0.0009	0.0011	0.0014	0.0017	0.0019	0.0021	0.0025
Med.	0.2357	0.5134	3486	0.0002	0.0004	0.0009	0.0012	0.0014	0.0017	0.0019	0.0021	0.0023
st dev	0.0007	0.0009	21.6506	0.0001	0.0001	0.0002	0.0001	0.0002	0.0002	0.0002	0.0002	0.0003
Min.	0.2345	0.5116	3442	0.0001	0.0002	0.0005	0.0008	0.0009	0.0011	0.0014	0.0017	0.0020
Max.	0.2367	0.5150	3519	0.0004	0.0008	0.0012	0.0014	0.0019	0.0021	0.0023	0.0024	0.0031



**3.5 Data Set 3, 105 °C, 60mA (Lumen Maintenance)**

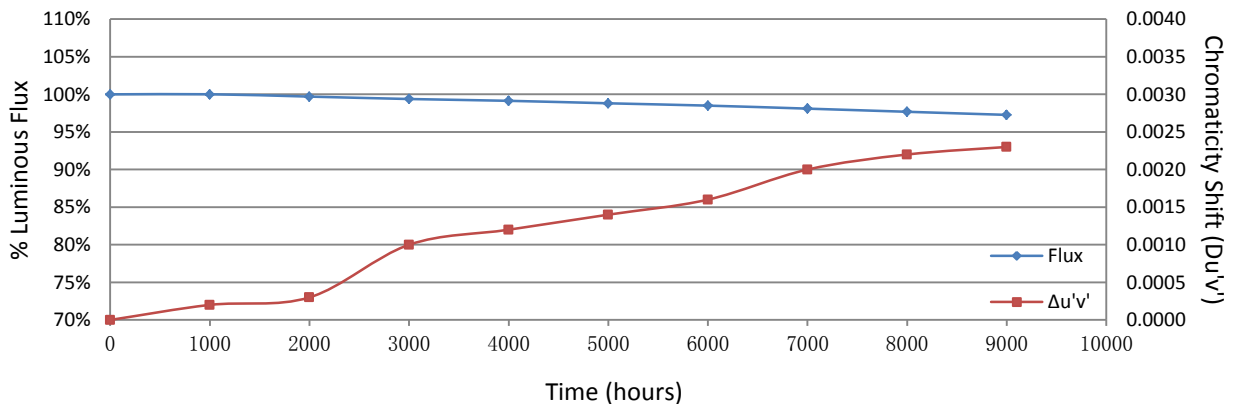
No.	V <sub>F</sub> (V)	Φ(lm)	Lumen Maintenance (%)								
			0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs
51	18.20	120.9	100.17	99.83	99.50	99.26	98.92	98.51	98.01	97.35	96.77
52	18.17	119.6	99.75	99.33	99.08	98.91	98.49	98.24	97.83	97.41	96.99
53	18.29	122.1	99.84	99.67	99.34	99.02	98.61	98.28	97.95	97.54	97.05
54	18.27	120.1	100.17	99.92	99.75	99.58	99.33	99.00	98.58	98.25	97.92
55	18.21	122.1	100.08	99.84	99.51	99.26	98.94	98.61	98.28	97.95	97.46
56	18.32	119.6	100.17	99.75	99.50	99.25	98.91	98.58	98.08	97.66	97.24
57	18.29	121.2	100.08	99.59	99.17	98.84	98.51	98.27	97.85	97.44	97.03
58	18.20	120.6	99.67	99.34	99.00	98.76	98.26	97.84	97.51	97.10	96.68
59	18.31	119.7	100.17	99.92	99.58	99.33	99.08	98.91	98.58	98.08	97.83
60	18.17	115.8	99.83	99.40	98.96	98.79	98.45	98.01	97.58	97.15	96.37
61	18.27	119.5	99.83	99.58	99.41	99.33	99.25	98.91	98.58	98.08	97.91
62	18.30	122.0	100.16	99.84	99.59	99.34	99.02	98.77	98.36	98.20	97.79
63	18.25	120.2	99.75	99.42	99.00	98.75	98.42	98.09	97.67	97.00	96.67
64	18.31	121.0	100.08	99.83	99.59	99.42	99.09	98.84	98.35	98.10	97.60
65	18.24	118.7	100.17	99.92	99.58	99.41	98.99	98.65	98.32	97.89	97.39
66	18.29	123.0	99.92	99.67	99.51	99.27	99.11	98.78	98.46	98.37	97.89
67	18.24	121.5	99.84	99.67	99.34	99.18	98.85	98.44	98.19	97.86	97.28
68	18.25	120.9	100.17	100.08	99.67	99.42	99.09	98.76	98.43	97.68	97.35
69	18.29	119.9	100.08	99.92	99.83	99.67	99.42	99.17	98.75	98.08	97.83
70	18.20	118.8	100.17	99.92	99.58	99.33	98.91	98.57	97.98	97.22	97.05
71	18.24	121.9	100.16	99.84	99.34	99.18	98.85	98.61	98.20	97.79	97.21
72	18.22	120.5	99.92	99.59	99.17	98.92	98.51	98.26	97.93	97.68	97.43
73	18.24	122.8	99.92	99.51	99.02	98.70	98.29	98.13	97.72	97.39	97.15
74	18.28	120.4	100.17	99.75	99.34	99.09	98.67	98.34	97.92	97.51	96.68
75	18.20	120.3	99.92	99.50	99.09	98.59	98.25	97.84	97.42	97.26	97.17
Ave.	18.25	120.5	100.01	99.70	99.38	99.14	98.81	98.50	98.10	97.68	97.27
Med.	18.25	120.5	100.08	99.75	99.41	99.25	98.91	98.57	98.08	97.68	97.24
st dev	0.0449	1.5147	0.1679	0.2076	0.2542	0.2915	0.3406	0.3594	0.3660	0.3938	0.4404
Min.	18.17	115.8	99.67	99.33	98.96	98.59	98.25	97.84	97.42	97.00	96.37
Max.	18.32	123.0	100.17	100.08	99.83	99.67	99.42	99.17	98.75	98.37	97.92

**TM-21 Projection:**

**Test Duration:** 9000hours  
**Failures Observed:** 0  
**α:** 3.822E-06  
**β:** 1.007  
**Reported L<sub>70</sub>:** >54000hours

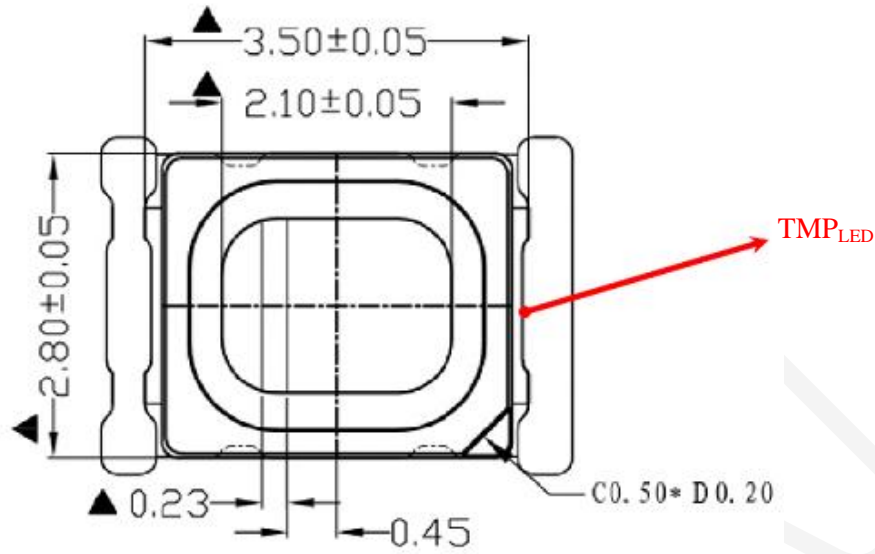
### 3.6 Data Set 3, 105 °C, 60mA (Chromaticity Shift)

No.	u'	v'	CCT(K)	Chromaticity Shift ( $\Delta u'v'$ )								
				0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs
51	0.2355	0.5125	3493	0.0002	0.0002	0.0011	0.0012	0.0014	0.0019	0.0021	0.0021	0.0023
52	0.2349	0.5117	3520	0.0002	0.0003	0.0010	0.0011	0.0015	0.0018	0.0021	0.0023	0.0024
53	0.2350	0.5143	3488	0.0002	0.0004	0.0009	0.0011	0.0013	0.0017	0.0021	0.0021	0.0023
54	0.2362	0.5118	3478	0.0001	0.0002	0.0007	0.0009	0.0012	0.0014	0.0019	0.0023	0.0023
55	0.2353	0.5124	3502	0.0003	0.0004	0.0011	0.0011	0.0014	0.0017	0.0021	0.0022	0.0022
56	0.2357	0.5115	3499	0.0003	0.0005	0.0011	0.0012	0.0015	0.0018	0.0022	0.0023	0.0023
57	0.2367	0.5130	3451	0.0002	0.0004	0.0009	0.0010	0.0014	0.0017	0.0021	0.0021	0.0023
58	0.2366	0.5139	3445	0.0003	0.0005	0.0011	0.0010	0.0014	0.0017	0.0019	0.0023	0.0024
59	0.2368	0.5137	3441	0.0003	0.0006	0.0010	0.0011	0.0014	0.0017	0.0020	0.0022	0.0023
60	0.2372	0.5125	3442	0.0002	0.0004	0.0009	0.0009	0.0012	0.0014	0.0017	0.0023	0.0023
61	0.2360	0.5143	3460	0.0002	0.0003	0.0009	0.0011	0.0013	0.0015	0.0018	0.0023	0.0023
62	0.2357	0.5143	3466	0.0001	0.0002	0.0010	0.0012	0.0014	0.0017	0.0020	0.0023	0.0023
63	0.2368	0.5113	3467	0.0002	0.0002	0.0011	0.0012	0.0016	0.0019	0.0021	0.0023	0.0024
64	0.2363	0.5123	3469	0.0001	0.0001	0.0009	0.0011	0.0013	0.0017	0.0019	0.0022	0.0023
65	0.2360	0.5111	3493	0.0001	0.0002	0.0009	0.0009	0.0012	0.0016	0.0018	0.0023	0.0023
66	0.2358	0.5136	3471	0.0001	0.0004	0.0011	0.0012	0.0014	0.0018	0.0022	0.0023	0.0023
67	0.2357	0.5124	3487	0.0002	0.0003	0.0012	0.0013	0.0014	0.0017	0.0020	0.0023	0.0022
68	0.2366	0.5136	3449	0.0002	0.0004	0.0011	0.0013	0.0015	0.0014	0.0018	0.0022	0.0024
69	0.2356	0.5124	3491	0.0001	0.0003	0.0010	0.0012	0.0013	0.0014	0.0015	0.0023	0.0023
70	0.2353	0.5130	3494	0.0002	0.0003	0.0009	0.0012	0.0012	0.0014	0.0018	0.0021	0.0026
71	0.2376	0.5131	3423	0.0001	0.0004	0.0011	0.0013	0.0014	0.0016	0.0021	0.0024	0.0024
72	0.2364	0.5135	3455	0.0002	0.0003	0.0012	0.0013	0.0014	0.0016	0.0019	0.0022	0.0023
73	0.2346	0.5143	3501	0.0002	0.0003	0.0010	0.0013	0.0013	0.0015	0.0017	0.0021	0.0022
74	0.2355	0.5123	3494	0.0001	0.0004	0.0010	0.0013	0.0013	0.0016	0.0019	0.0023	0.0024
75	0.2362	0.5119	3479	0.0002	0.0006	0.0012	0.0014	0.0015	0.0017	0.0021	0.0023	0.0022
Ave.	0.2360	0.5128	3474	0.0002	0.0003	0.0010	0.0012	0.0014	0.0016	0.0020	0.0022	0.0023
Med.	0.2360	0.5125	3478	0.0002	0.0003	0.0010	0.0012	0.0014	0.0017	0.0020	0.0023	0.0023
st dev	0.0007	0.0010	24.0498	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002	0.0002	0.0001	0.0001
Min.	0.2346	0.5111	3423	0.0001	0.0001	0.0007	0.0009	0.0012	0.0014	0.0015	0.0021	0.0022
Max.	0.2376	0.5143	3520	0.0003	0.0006	0.0012	0.0014	0.0016	0.0019	0.0022	0.0024	0.0026



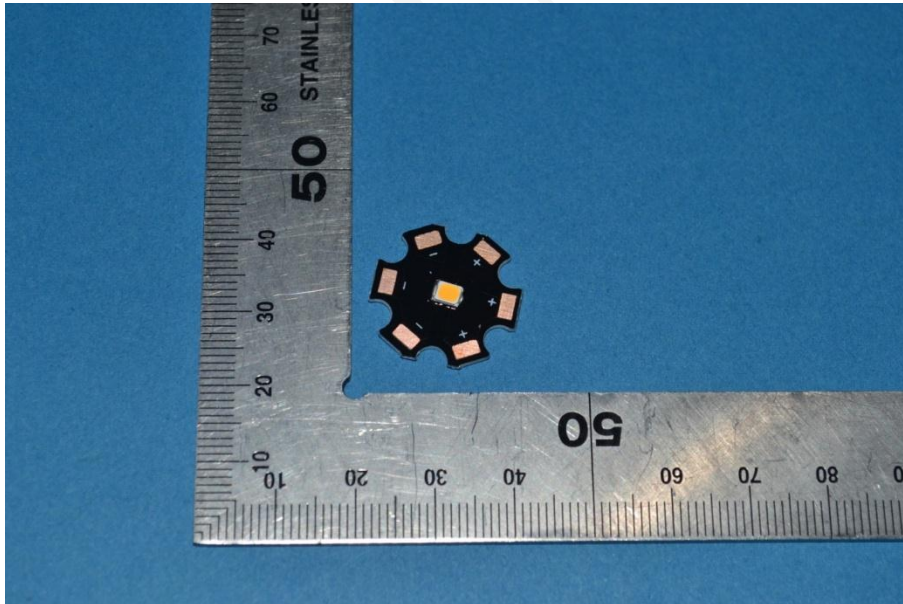
## Attachment A – EUT Photo

### A.1 Mechanical Dimensions (Ta = 25 °C)



All dimensions are in millimeter

### A.2 EUT Photo



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## Attachment B Report Revision

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Report Number	Report Date	Contents
R2DG161104050-10-9000	2019-01-18	Original report.
R2DG161104050-10-9000-M1	2019-08-09	Update the Logo of lab on the Page1 and the Die Spacing on page 3.

\*\*\*\*\*END OF REPORT\*\*\*\*\*

FINAL