



# IESNA LM-80-2008

MEASURING LUMEN MAINTENANCE OF LED LIGHT SOURCES

## MEASUREMENT AND TEST REPORT

For

### ShenZhen JuFei Optoelectronics Co., Ltd.

No.4 Eling Industrial Park,Egongling Community,Pinghu Subdistrict,Longgang District,Shenzhen City

**Model:2835 White SMD LED**

<b>Report Type:</b> 10000 Hours Test Report	<b>Product Type:</b> LED Package
<b>Test Engineer:</b>	Pote Wang <i>Pote Wang</i>
<b>Report Number:</b>	R2DG160507060-10-10000
<b>Test Date:</b>	2016-05-08 to 2017-06-28
<b>Report Date:</b>	2017-07-11
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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).

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## 1 - General Information

### 1.1 Description of LED Light Sources

Devices tested

Part Number: 2835 White SMD LED  
 Part Type: LED Package  
 Nominal CCT: 3000K

### 1.2 Standards Used:

- IESNA LM-80-08: IES Approved Method for Measuring Lumen Maintenance of LED Light Sources.
- ENERGY STAR® Program Guidance Regarding LED Package, LED Array and LED Module Lumen Maintenance Performance Data Supporting Qualification of Lighting Products(This test method 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 Industry Area, Tangxia, Dongguan, Guangdong, China.

### 1.4 Description of Auxiliary Equipment

Device	Manufacture	Model No	Serial No	Test Range	Calibration date	Calibration due date
0.3m integrating sphere	EVERFINE	Diameter 0.3m	1011119	0.3m	2017-03-09	2018-03-09
Programmable Test Power for LEDs	EVERFINE	LED300E	1008002	15V/2000mA	2017-03-03	2018-03-03
High accuracy array spectroradiometer	EVERFINE	HAAS-2000	1012016T	380-780nm	2017-03-09	2018-03-09
Standard Light Source	EVERFINE	D062	1011093	3000K	2016-09-13	2017-09-13
Precision digital stabilized DC power supply	EVERFINE	WY605-V110	G115987C J7321114	300VA	2017-03-03	2018-03-03
Multilayer aging machine	BACL	B2-270	20013	25 °C~110 °C	2016-09-01	2017-09-01
DC Power Supply	GUTE	WYG-5V40A	N/A	0~5V,0~40A	2016-10-27	2017-10-26
DC Power Supply	GUTE	LLA120011 2-U	201208200 1	0~120V,0~1A	2016-12-21	2017-12-20

Device	Manufacture	Model No	Serial No	Test Range	Calibration date	Calibration due date
Digital CC&CV DC Power Supply	EVERFINE	WY5015	11060010	(50/15A)	2017-03-03	2018-03-03

### 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 2016-05-07 and tested during 2016-05-08 to 2017-06-28. The samples were numbered from 1 to 25, 26 to 50 and 51 to 75

#### Data Set 1: 55 °C, 60mA

Part Number:	2835 White SMD LED
Number of Units:	25
Actual Case Temperature(T <sub>S</sub> ):	T <sub>S</sub> =54.2 °C
Actual Ambient Temperature(T <sub>A</sub> ):	T <sub>A</sub> =51.5 °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:	2835 White SMD LED
Number of Units:	25
Actual Case Temperature(T <sub>S</sub> ):	T <sub>S</sub> =84.1 °C
Actual Ambient Temperature(T <sub>A</sub> ):	T <sub>A</sub> =82.5 °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:	2835 White SMD LED
Number of Units:	25
Actual Case Temperature(T <sub>S</sub> ):	T <sub>S</sub> =104.5 °C
Actual Ambient Temperature(T <sub>A</sub> ):	T <sub>A</sub> =103.1 °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,10000h
Average. Lumen Maintenance at 10000 hours:	98.64%
Average Chromaticity Shift at 10000 hours ( $\Delta u'v'$ ):	0.0022
Reported TM-21 L <sub>70</sub> Lifetime:	>60000 hours
Reported TM-21 L <sub>90</sub> Lifetime:	58000 hours

<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,10000h
Average. Lumen Maintenance at 10000 hours:	97.88%
Average Chromaticity Shift at 10000 hours( $\Delta u'v'$ ):	0.0024
Reported TM-21 L <sub>70</sub> Lifetime:	>60000 hours
Reported TM-21 L <sub>90</sub> Lifetime:	43000 hours

<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,10000h
Average. Lumen Maintenance at 10000 hours:	97.39%
Average Chromaticity Shift at 10000 hours( $\Delta u'v'$ ):	0.0026
Reported TM-21 L <sub>70</sub> Lifetime:	>60000 hours
Reported TM-21 L <sub>90</sub> Lifetime:	37000 hours

### 3 - Test Data

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

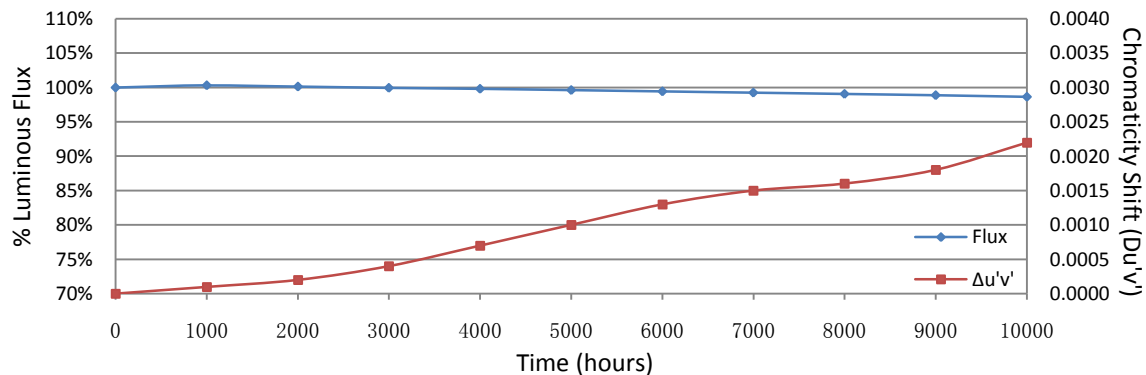
No.	V <sub>F</sub> (V)	Φ(lm)	Lumen Maintenance (%)									
	0hr(Initial)		1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs	10000hrs
1	2.875	30.88	100.32	100.16	100.06	99.97	99.81	99.55	99.35	99.22	99.06	98.74
2	2.870	31.19	100.35	100.13	99.97	99.81	99.71	99.49	99.26	99.07	98.85	98.81
3	2.850	30.74	100.36	100.20	100.10	99.90	99.67	99.45	99.22	98.89	98.73	98.50
4	2.847	31.44	100.25	100.13	99.97	99.81	99.65	99.43	99.36	99.24	99.01	98.82
5	2.947	31.00	100.29	100.23	100.10	99.84	99.55	99.35	99.23	99.00	98.77	98.65
6	3.036	31.11	100.23	100.10	99.90	99.71	99.61	99.36	99.26	99.20	98.84	98.71
7	3.040	31.25	100.22	100.13	99.97	99.74	99.68	99.49	99.46	99.39	99.17	98.82
8	3.012	30.41	100.26	100.07	99.84	99.80	99.51	99.38	99.24	99.01	98.78	98.45
9	3.022	31.01	100.39	100.10	99.90	99.84	99.77	99.42	99.29	99.23	99.10	98.77
10	2.940	30.93	100.29	100.13	99.81	99.68	99.52	99.35	99.16	99.06	98.84	98.61
11	2.798	30.87	100.23	99.94	99.84	99.64	99.42	99.22	99.06	99.00	98.64	98.38
12	2.744	30.69	100.36	100.10	100.03	99.93	99.74	99.67	99.51	99.38	99.15	98.79
13	2.867	31.04	100.35	100.16	99.94	99.81	99.68	99.36	99.26	98.94	98.74	98.58
14	2.871	31.09	100.23	99.90	99.74	99.61	99.49	99.29	99.16	98.97	98.71	98.39
15	2.960	31.05	100.29	100.03	99.74	99.58	99.45	99.23	98.94	98.68	98.55	98.20
16	2.949	31.04	100.32	100.19	100.10	99.77	99.58	99.23	99.03	98.71	98.65	98.55
17	2.960	31.02	100.19	99.90	99.87	99.68	99.52	99.39	99.19	99.03	99.00	98.84
18	3.053	31.12	100.29	100.10	99.90	99.78	99.68	99.52	99.36	99.07	98.94	98.71
19	2.875	30.95	100.32	100.19	100.03	99.74	99.71	99.48	99.45	99.32	99.00	98.74
20	3.082	30.77	100.26	100.10	99.87	99.64	99.55	99.45	99.35	99.32	99.09	98.70
21	3.007	30.81	100.29	100.16	99.97	99.84	99.64	99.45	99.32	99.19	98.99	98.77
22	2.955	30.87	100.32	100.06	99.87	99.68	99.38	99.16	98.93	98.70	98.54	98.38
23	3.041	30.71	100.23	100.03	99.80	99.61	99.45	99.38	99.19	98.93	98.70	98.50
24	2.911	31.05	100.42	100.26	100.13	100.06	100.03	99.90	99.71	99.45	99.32	99.16
25	3.011	31.08	100.32	100.13	99.94	99.71	99.49	99.13	98.94	98.81	98.58	98.52
Ave.	2.941	30.96	100.30	100.10	99.94	99.77	99.61	99.40	99.25	99.07	98.87	98.64
Med.	2.949	31.01	100.29	100.13	99.94	99.77	99.61	99.39	99.26	99.06	98.84	98.70
st dev	0.088	0.21	0.0580	0.0909	0.1116	0.1194	0.1457	0.1629	0.1847	0.2193	0.2129	0.2032
Min.	2.744	30.41	100.19	99.90	99.74	99.58	99.38	99.13	98.93	98.68	98.54	98.20
Max.	3.082	31.44	100.42	100.26	100.13	100.06	100.03	99.90	99.71	99.45	99.32	99.16

TM-21 Projection:

**Test Duration:** 10000 hours  
**Failures Observed:** 0  
 $\alpha$ : 1.908E-06  
 $\beta$ : 1.006  
**Reported L<sub>70</sub>:** >60000 hours  
**Reported L<sub>90</sub>:** 58000 hours

### 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	9000hrs
1	0.2504	0.5222	2999	0.0001	0.0003	0.0005	0.0007	0.0009	0.0012	0.0014	0.0016	0.0018	0.0022
2	0.2502	0.5218	3007	0.0001	0.0002	0.0004	0.0007	0.0009	0.0012	0.0014	0.0016	0.0018	0.0022
3	0.2480	0.5206	3070	0.0003	0.0001	0.0002	0.0005	0.0006	0.0010	0.0012	0.0013	0.0016	0.0019
4	0.2486	0.5235	3034	0.0001	0.0001	0.0003	0.0007	0.0008	0.0011	0.0014	0.0015	0.0018	0.0021
5	0.2511	0.5229	2977	0.0001	0.0003	0.0003	0.0007	0.0011	0.0013	0.0016	0.0016	0.0019	0.0022
6	0.2497	0.5220	3018	0.0001	0.0004	0.0004	0.0007	0.0010	0.0013	0.0016	0.0017	0.0019	0.0022
7	0.2488	0.5221	3040	0.0001	0.0002	0.0004	0.0007	0.0009	0.0012	0.0014	0.0015	0.0017	0.0022
8	0.2487	0.5218	3045	0.0001	0.0002	0.0004	0.0007	0.0010	0.0013	0.0016	0.0016	0.0018	0.0022
9	0.2505	0.5225	2995	0.0001	0.0003	0.0004	0.0008	0.0009	0.0013	0.0015	0.0017	0.0018	0.0022
10	0.2494	0.5219	3025	0.0002	0.0001	0.0003	0.0007	0.0010	0.0013	0.0015	0.0016	0.0017	0.0021
11	0.2498	0.5203	3026	0.0001	0.0003	0.0004	0.0008	0.0009	0.0014	0.0016	0.0016	0.0018	0.0022
12	0.2511	0.5216	2985	0.0001	0.0004	0.0005	0.0008	0.0011	0.0015	0.0017	0.0017	0.0019	0.0023
13	0.2497	0.5234	3010	0.0001	0.0004	0.0004	0.0008	0.0009	0.0013	0.0015	0.0017	0.0019	0.0024
14	0.2504	0.5222	2998	0.0001	0.0001	0.0004	0.0007	0.0009	0.0013	0.0015	0.0017	0.0018	0.0022
15	0.2495	0.5213	3028	0.0001	0.0002	0.0004	0.0007	0.0009	0.0015	0.0016	0.0018	0.0019	0.0023
16	0.2511	0.5236	2974	0.0001	0.0002	0.0004	0.0006	0.0011	0.0013	0.0015	0.0016	0.0019	0.0022
17	0.2487	0.5198	3058	0.0001	0.0003	0.0005	0.0007	0.0010	0.0015	0.0016	0.0018	0.0020	0.0023
18	0.2504	0.5234	2992	0.0001	0.0002	0.0004	0.0008	0.0010	0.0013	0.0015	0.0017	0.0017	0.0021
19	0.2483	0.5212	3059	0.0001	0.0003	0.0004	0.0008	0.0011	0.0015	0.0016	0.0017	0.0019	0.0023
20	0.2501	0.5239	2995	0.0003	0.0001	0.0003	0.0006	0.0008	0.0012	0.0014	0.0017	0.0017	0.0021
21	0.2515	0.5231	2966	0.0001	0.0002	0.0004	0.0007	0.0010	0.0013	0.0015	0.0017	0.0018	0.0022
22	0.2506	0.5203	3007	0.0001	0.0003	0.0004	0.0007	0.0010	0.0014	0.0016	0.0017	0.0019	0.0023
23	0.2500	0.5216	3013	0.0001	0.0002	0.0004	0.0007	0.0009	0.0013	0.0015	0.0016	0.0018	0.0023
24	0.2485	0.5223	3047	0.0001	0.0003	0.0004	0.0006	0.0010	0.0014	0.0015	0.0016	0.0020	0.0023
25	0.2487	0.5222	3042	0.0001	0.0003	0.0004	0.0007	0.0010	0.0013	0.0015	0.0017	0.0019	0.0023
Ave.	0.2498	0.5221	3016	0.0001	0.0002	0.0004	0.0007	0.0010	0.0013	0.0015	0.0016	0.0018	0.0022
Med.	0.2498	0.5221	3013	0.0001	0.0002	0.0004	0.0007	0.0010	0.0013	0.0015	0.0017	0.0018	0.0022
st dev	0.0010	0.0011	28	0.0000	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Min.	0.2480	0.5198	2966	0.0001	0.0001	0.0002	0.0005	0.0006	0.0010	0.0012	0.0013	0.0016	0.0019
Max.	0.2515	0.5239	3070	0.0003	0.0004	0.0005	0.0008	0.0011	0.0015	0.0017	0.0018	0.0020	0.0024





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

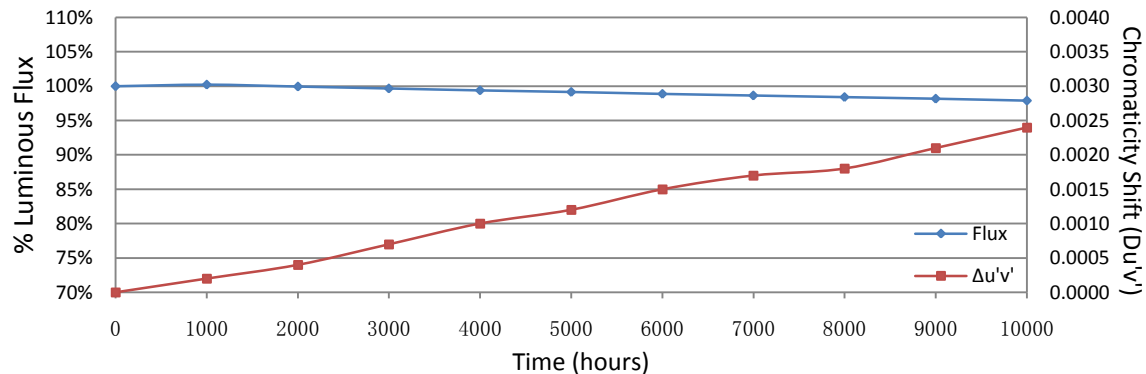
No.	V <sub>F</sub> (V)	Φ(lm)	Lumen Maintenance (%)									
			Ohr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
26	3.118	31.11	100.29	99.94	99.65	99.36	99.13	98.87	98.68	98.49	98.26	97.94
27	2.902	31.25	100.35	99.90	99.46	99.23	98.91	98.69	98.37	98.24	98.05	97.79
28	2.919	31.05	100.23	100.06	99.94	99.68	99.65	99.48	99.23	99.00	98.87	98.71
29	2.921	30.66	100.26	99.93	99.80	99.51	99.38	99.02	98.76	98.56	98.37	98.08
30	3.102	30.66	100.29	100.07	99.84	99.61	99.58	99.25	99.02	98.66	98.37	98.17
31	2.922	30.82	100.23	99.97	99.81	99.64	99.42	99.09	98.96	98.73	98.51	98.28
32	2.930	30.51	100.29	100.03	99.87	99.67	99.21	98.95	98.79	98.72	98.59	98.39
33	3.022	30.93	100.06	99.74	99.55	99.22	98.97	98.74	98.45	98.25	97.93	97.77
34	2.959	30.72	100.07	99.90	99.77	99.38	99.25	98.93	98.67	98.40	98.27	97.85
35	2.795	31.21	100.19	99.84	99.58	99.36	99.04	98.69	98.40	98.21	97.98	97.79
36	2.978	31.10	100.10	99.74	99.32	99.13	98.97	98.78	98.52	98.20	97.94	97.59
37	2.976	30.89	100.13	99.94	99.48	99.22	99.16	98.83	98.61	98.32	98.09	97.80
38	2.966	31.09	100.10	99.77	99.45	99.16	99.10	98.78	98.52	98.26	98.10	97.81
39	3.020	31.19	100.06	99.71	99.39	99.13	99.10	98.75	98.36	97.95	97.69	97.40
40	3.198	30.92	100.13	99.90	99.48	99.19	99.06	98.77	98.58	98.42	98.09	97.83
41	2.914	31.08	100.16	99.77	99.49	99.36	98.94	98.68	98.42	98.20	97.91	97.68
42	3.184	30.90	100.26	99.90	99.68	99.35	99.19	98.87	98.58	98.35	98.16	97.90
43	2.940	30.87	100.23	99.97	99.74	99.42	99.19	98.87	98.57	98.35	98.06	97.70
44	3.054	31.08	100.23	100.10	99.77	99.49	99.29	99.10	98.68	98.49	98.26	98.01
45	3.001	30.80	100.32	100.03	99.71	99.45	99.29	99.12	98.93	98.54	98.28	98.05
46	3.032	30.70	100.23	99.97	99.67	99.38	99.19	98.79	98.47	98.18	97.95	97.69
47	3.040	30.87	100.06	99.94	99.77	99.42	99.16	98.87	98.77	98.45	98.22	97.89
48	2.968	31.07	100.10	99.71	99.52	99.16	98.94	98.68	98.46	98.20	97.91	97.52
49	3.033	30.75	100.26	99.93	99.80	99.58	99.19	98.89	98.57	98.28	98.02	97.72
50	3.030	30.90	100.13	99.87	99.55	99.13	98.83	98.51	98.41	98.16	97.83	97.73
Ave.	2.997	30.93	100.19	99.91	99.64	99.37	99.16	98.88	98.63	98.38	98.15	97.88
Med.	2.978	30.90	100.23	99.93	99.67	99.36	99.16	98.87	98.58	98.35	98.09	97.81
st dev	0.091	0.19	0.0909	0.1126	0.1671	0.1775	0.1981	0.2093	0.2222	0.2302	0.2613	0.2834
Min.	2.795	30.51	100.06	99.71	99.32	99.13	98.83	98.51	98.36	97.95	97.69	97.40
Max.	3.198	31.25	100.35	100.10	99.94	99.68	99.65	99.48	99.23	99.00	98.87	98.71

**TM-21 Projection:**

**Test Duration:** 10000 hours  
**Failures Observed:** 0  
 $\alpha$ : 2.564E-06  
 $\beta$ : 1.004  
**Reported L<sub>70</sub>:** >60000 hours  
**Reported L<sub>90</sub>:** 43000 hours

### 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	9000hrs
26	0.2483	0.5222	3052	0.0001	0.0004	0.0007	0.0009	0.0008	0.0014	0.0016	0.0015	0.0019	0.0023
27	0.2485	0.5240	3034	0.0001	0.0004	0.0007	0.0009	0.0010	0.0015	0.0017	0.0018	0.0021	0.0020
28	0.2478	0.5208	3074	0.0002	0.0004	0.0007	0.0009	0.0009	0.0015	0.0017	0.0019	0.0021	0.0021
29	0.2496	0.5213	3024	0.0002	0.0005	0.0008	0.0010	0.0010	0.0016	0.0018	0.0018	0.0021	0.0023
30	0.2479	0.5214	3066	0.0002	0.0004	0.0007	0.0009	0.0010	0.0013	0.0017	0.0018	0.0020	0.0022
31	0.2503	0.5228	2997	0.0001	0.0004	0.0006	0.0009	0.0009	0.0016	0.0017	0.0018	0.0021	0.0024
32	0.2492	0.5226	3026	0.0001	0.0004	0.0008	0.0011	0.0013	0.0019	0.0019	0.0019	0.0022	0.0025
33	0.2505	0.5227	2993	0.0001	0.0003	0.0006	0.0009	0.0013	0.0016	0.0018	0.0018	0.0021	0.0023
34	0.2489	0.5209	3044	0.0001	0.0003	0.0006	0.0010	0.0013	0.0014	0.0016	0.0017	0.0021	0.0023
35	0.2485	0.5235	3037	0.0001	0.0003	0.0006	0.0009	0.0014	0.0016	0.0017	0.0019	0.0020	0.0024
36	0.2476	0.5202	3083	0.0002	0.0004	0.0007	0.0009	0.0013	0.0015	0.0017	0.0018	0.0020	0.0024
37	0.2497	0.5215	3020	0.0001	0.0004	0.0006	0.0009	0.0012	0.0015	0.0016	0.0018	0.0020	0.0023
38	0.2480	0.5214	3064	0.0001	0.0003	0.0006	0.0009	0.0013	0.0014	0.0016	0.0018	0.0021	0.0023
39	0.2502	0.5240	2993	0.0001	0.0004	0.0007	0.0010	0.0013	0.0016	0.0017	0.0018	0.0021	0.0023
40	0.2489	0.5217	3039	0.0001	0.0004	0.0008	0.0010	0.0014	0.0016	0.0017	0.0019	0.0022	0.0025
41	0.2490	0.5222	3035	0.0001	0.0004	0.0007	0.0010	0.0013	0.0014	0.0017	0.0018	0.0022	0.0024
42	0.2508	0.5212	2995	0.0001	0.0003	0.0006	0.0009	0.0013	0.0014	0.0016	0.0018	0.0021	0.0024
43	0.2486	0.5211	3050	0.0001	0.0003	0.0007	0.0009	0.0013	0.0015	0.0017	0.0019	0.0022	0.0024
44	0.2508	0.5245	2976	0.0002	0.0004	0.0007	0.0010	0.0013	0.0015	0.0017	0.0019	0.0021	0.0024
45	0.2476	0.5217	3072	0.0002	0.0004	0.0007	0.0010	0.0013	0.0016	0.0017	0.0017	0.0020	0.0022
46	0.2484	0.5194	3068	0.0002	0.0003	0.0006	0.0009	0.0013	0.0017	0.0018	0.0019	0.0021	0.0024
47	0.2502	0.5226	3002	0.0002	0.0003	0.0006	0.0009	0.0011	0.0014	0.0016	0.0018	0.0020	0.0023
48	0.2491	0.5223	3030	0.0001	0.0004	0.0008	0.0010	0.0013	0.0014	0.0017	0.0019	0.0021	0.0024
49	0.2506	0.5224	2994	0.0000	0.0005	0.0008	0.0010	0.0014	0.0016	0.0017	0.0019	0.0022	0.0026
50	0.2507	0.5243	2978	0.0001	0.0004	0.0008	0.0010	0.0013	0.0015	0.0017	0.0019	0.0022	0.0025
Ave.	0.2492	0.5221	3030	0.0002	0.0004	0.0007	0.0010	0.0012	0.0015	0.0017	0.0018	0.0021	0.0024
Med.	0.2490	0.5222	3034	0.0001	0.0004	0.0007	0.0009	0.0013	0.0015	0.0017	0.0018	0.0021	0.0024
st dev	0.0011	0.0013	32	0.0001	0.0001	0.0001	0.0001	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001
Min.	0.2476	0.5194	2976	0.0000	0.0003	0.0006	0.0009	0.0008	0.0013	0.0016	0.0015	0.0019	0.0020
Max.	0.2508	0.5245	3083	0.0002	0.0005	0.0008	0.0011	0.0014	0.0019	0.0019	0.0019	0.0022	0.0026



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

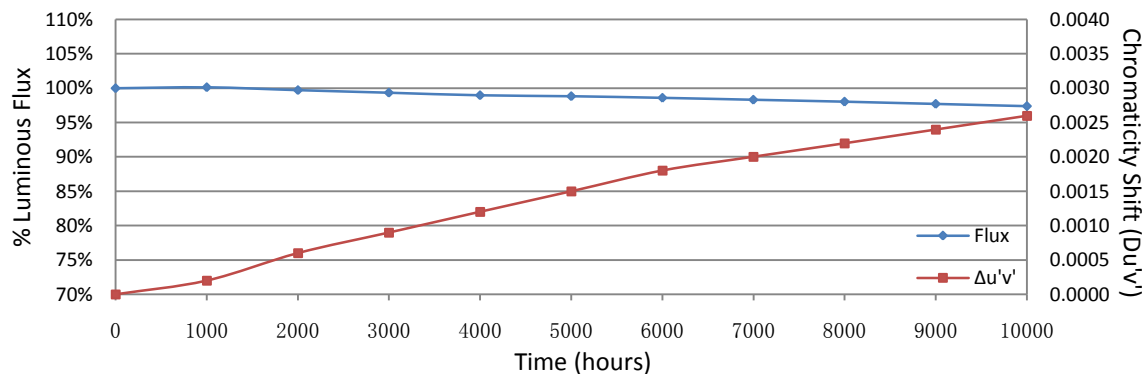
No.	V <sub>F</sub> (V)	Φ(lm)	Lumen Maintenance (%)									
			0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
51	3.034	31.23	100.10	99.74	99.39	98.98	98.85	98.66	98.46	98.21	97.73	97.50
52	2.974	31.06	100.19	99.77	99.48	99.10	98.78	98.52	98.16	97.84	97.68	97.30
53	3.004	30.67	100.13	99.61	99.25	98.83	98.73	98.57	98.21	97.98	97.65	97.23
54	3.062	30.89	100.19	99.81	99.51	99.16	99.00	98.83	98.58	98.25	97.80	97.44
55	3.036	30.80	100.23	99.81	99.51	99.19	99.12	98.90	98.77	98.34	98.18	97.95
56	3.104	30.75	100.07	99.67	99.41	99.06	99.02	98.93	98.73	98.37	98.02	97.72
57	3.144	30.61	100.16	99.67	99.35	98.92	98.89	98.60	98.40	98.01	97.81	97.58
58	3.104	30.61	100.23	99.77	99.41	99.02	98.99	98.82	98.56	98.17	97.81	97.55
59	3.025	31.02	100.16	99.84	99.52	99.16	99.10	98.81	98.52	98.26	97.81	97.42
60	3.022	30.66	100.13	99.61	99.35	98.89	98.79	98.50	98.17	97.95	97.72	97.29
61	3.127	31.08	100.16	99.68	99.39	98.97	98.87	98.71	98.29	97.97	97.59	97.30
62	2.781	31.26	100.03	99.68	99.30	98.82	98.75	98.56	98.24	97.82	97.44	96.96
63	2.971	31.10	100.10	99.87	99.55	99.23	98.87	98.62	98.30	97.88	97.59	97.20
64	3.117	30.88	99.97	99.58	99.35	99.13	99.00	98.61	98.32	97.86	97.54	97.25
65	2.967	31.01	100.06	99.74	99.26	98.94	98.84	98.65	98.45	98.16	97.84	97.39
66	3.013	31.24	99.87	99.46	99.17	98.82	98.62	98.37	97.98	97.60	97.28	97.22
67	3.006	30.70	100.13	99.64	99.32	98.99	98.79	98.57	98.40	98.08	97.75	97.59
68	3.062	30.93	100.13	99.74	99.29	99.00	98.84	98.64	98.42	98.25	97.80	97.61
69	2.922	30.19	100.03	99.60	99.17	98.91	98.77	98.54	98.31	98.11	97.81	97.38
70	2.730	31.08	100.06	99.61	99.10	98.78	98.62	98.33	98.01	97.81	97.52	97.46
71	2.899	31.03	100.16	99.81	99.23	98.81	98.68	98.45	98.10	97.91	97.58	97.23
72	3.027	31.03	100.13	99.68	99.16	98.78	98.68	98.36	97.94	97.78	97.49	97.20
73	3.102	31.07	100.03	99.65	99.13	98.84	98.68	98.52	98.29	98.04	97.62	97.36
74	3.077	30.74	99.97	99.64	99.22	98.70	98.50	98.24	97.98	97.76	97.40	97.10
75	2.894	31.06	100.10	99.74	99.29	98.91	98.84	98.58	98.36	98.10	97.75	97.62
Ave.	3.008	30.91	100.10	99.70	99.32	98.96	98.83	98.59	98.32	98.02	97.69	97.39
Med.	3.025	31.01	100.13	99.68	99.32	98.94	98.84	98.58	98.31	98.01	97.72	97.38
st dev	0.102	0.25	0.0853	0.0958	0.1303	0.1459	0.1542	0.1743	0.2219	0.2020	0.1948	0.2161
Min.	2.730	30.19	99.87	99.46	99.10	98.70	98.50	98.24	97.94	97.60	97.28	96.96
Max.	3.144	31.26	100.23	99.87	99.55	99.23	99.12	98.93	98.77	98.37	98.18	97.95

**TM-21 Projection:**

**Test Duration:** 10000 hours  
**Failures Observed:** 0  
**α:** 2.970E-06  
**β:** 1.003  
**Reported L<sub>70</sub>:** >60000 hours  
**Reported L<sub>90</sub>:** 37000 hours

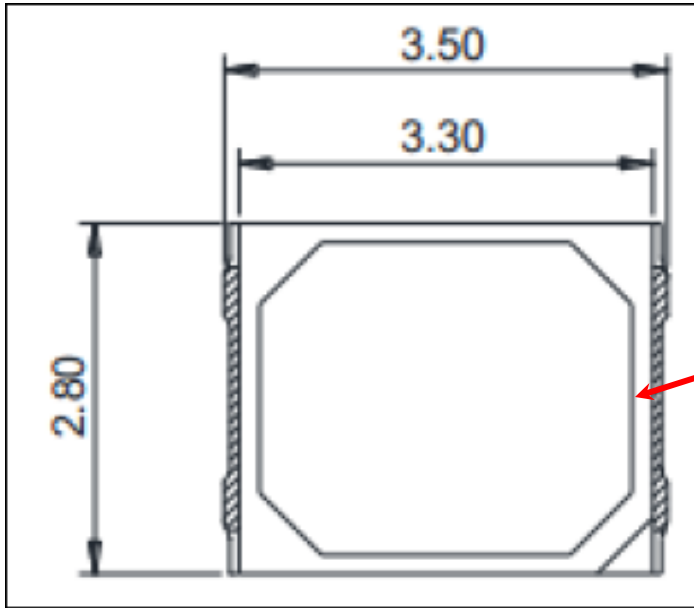
### 3.6 Data Set 3, 105 °C, 60mA (Chromaticity Shift)

No.	u'	v'	CCT(K)	Chromaticity Shift ( $\Delta u'v'$ )									
				0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
51	0.2494	0.5231	3019	0.0001	0.0006	0.0009	0.0012	0.0016	0.0018	0.0020	0.0018	0.0023	0.0023
52	0.2495	0.5231	3017	0.0001	0.0006	0.0009	0.0012	0.0013	0.0019	0.0020	0.0020	0.0023	0.0024
53	0.2496	0.5207	3029	0.0001	0.0006	0.0009	0.0012	0.0016	0.0020	0.0020	0.0020	0.0023	0.0026
54	0.2496	0.5213	3024	0.0002	0.0006	0.0008	0.0012	0.0015	0.0018	0.0020	0.0022	0.0023	0.0024
55	0.2505	0.5224	2994	0.0002	0.0006	0.0008	0.0011	0.0015	0.0017	0.0018	0.0021	0.0022	0.0023
56	0.2494	0.5204	3035	0.0002	0.0006	0.0009	0.0012	0.0014	0.0017	0.0020	0.0022	0.0024	0.0024
57	0.2510	0.5212	2990	0.0001	0.0007	0.0010	0.0014	0.0015	0.0019	0.0020	0.0022	0.0024	0.0026
58	0.2508	0.5220	2990	0.0002	0.0006	0.0008	0.0011	0.0013	0.0017	0.0018	0.0022	0.0023	0.0023
59	0.2486	0.5209	3052	0.0002	0.0007	0.0009	0.0012	0.0013	0.0020	0.0019	0.0022	0.0024	0.0024
60	0.2497	0.5221	3018	0.0001	0.0006	0.0009	0.0012	0.0016	0.0020	0.0019	0.0021	0.0023	0.0025
61	0.2488	0.5213	3044	0.0003	0.0006	0.0008	0.0011	0.0014	0.0015	0.0017	0.0021	0.0023	0.0024
62	0.2495	0.5220	3024	0.0001	0.0007	0.0009	0.0013	0.0015	0.0017	0.0019	0.0022	0.0024	0.0025
63	0.2481	0.5203	3068	0.0001	0.0006	0.0008	0.0011	0.0014	0.0017	0.0017	0.0022	0.0024	0.0025
64	0.2503	0.5226	2999	0.0001	0.0007	0.0009	0.0012	0.0015	0.0018	0.0021	0.0022	0.0024	0.0024
65	0.2493	0.5223	3025	0.0001	0.0007	0.0009	0.0012	0.0015	0.0020	0.0022	0.0023	0.0026	0.0026
66	0.2492	0.5224	3027	0.0001	0.0006	0.0008	0.0012	0.0016	0.0017	0.0018	0.0022	0.0024	0.0027
67	0.2507	0.5232	2987	0.0001	0.0007	0.0011	0.0015	0.0017	0.0021	0.0023	0.0023	0.0026	0.0029
68	0.2497	0.5229	3012	0.0001	0.0006	0.0009	0.0011	0.0015	0.0017	0.0020	0.0022	0.0024	0.0027
69	0.2495	0.5214	3026	0.0001	0.0006	0.0009	0.0011	0.0016	0.0018	0.0020	0.0022	0.0023	0.0027
70	0.2486	0.5234	3036	0.0001	0.0006	0.0009	0.0012	0.0014	0.0017	0.0021	0.0022	0.0024	0.0027
71	0.2488	0.5208	3048	0.0001	0.0007	0.0009	0.0012	0.0016	0.0017	0.0021	0.0022	0.0025	0.0028
72	0.2521	0.5245	2945	0.0001	0.0007	0.0009	0.0012	0.0015	0.0017	0.0019	0.0022	0.0024	0.0028
73	0.2507	0.5229	2987	0.0001	0.0006	0.0008	0.0011	0.0014	0.0014	0.0017	0.0021	0.0023	0.0027
74	0.2501	0.5221	3007	0.0001	0.0006	0.0009	0.0012	0.0015	0.0017	0.0020	0.0021	0.0024	0.0028
75	0.2499	0.5223	3010	0.0001	0.0006	0.0009	0.0011	0.0015	0.0017	0.0020	0.0021	0.0024	0.0028
Ave.	0.2497	0.5221	3017	0.0002	0.0006	0.0009	0.0012	0.0015	0.0018	0.0020	0.0022	0.0024	0.0026
Med.	0.2496	0.5221	3019	0.0001	0.0006	0.0009	0.0012	0.0015	0.0017	0.0020	0.0022	0.0024	0.0026
st dev	0.0009	0.0010	26	0.0000	0.0001	0.0001	0.0001	0.0001	0.0002	0.0001	0.0001	0.0001	0.0002
Min.	0.2481	0.5203	2945	0.0001	0.0006	0.0008	0.0011	0.0013	0.0014	0.0017	0.0018	0.0022	0.0023
Max.	0.2521	0.5245	3068	0.0003	0.0007	0.0011	0.0015	0.0017	0.0021	0.0023	0.0023	0.0026	0.0029



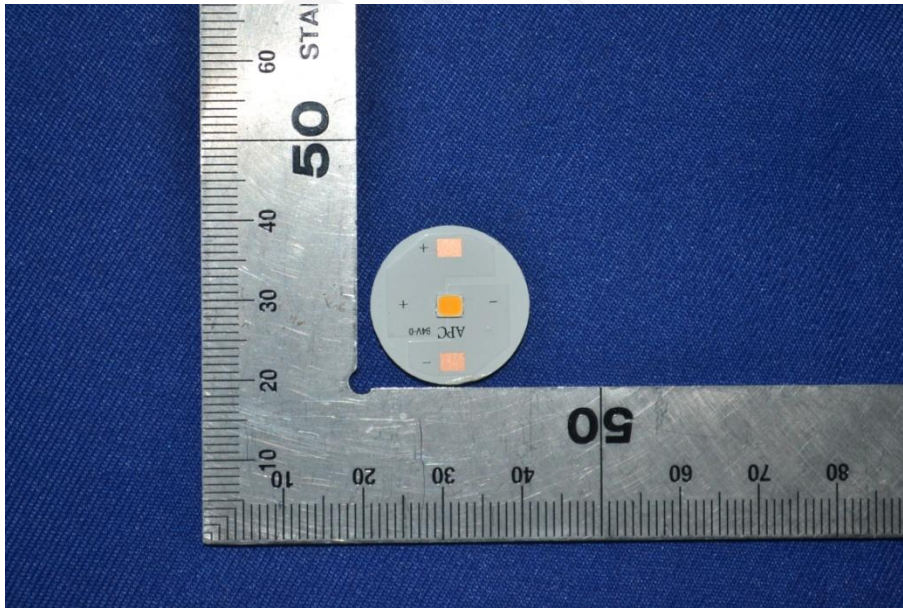
## Attachment A – EUT Photo

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



All dimensions are in millimeter

### A.2 EUT Photo



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