



IESNA LM-80-2008

MEASURING LUMEN MAINTENANCE OF LED LIGHT SOURCES

MEASUREMENT AND TEST REPORT

For

Samsung Electronics Co., LTD

1,Samsung-Ro,Giheung-Gu,Yongin-City,Gyeonggi-Do 17113, Korea

Model: SPMWHx228xxxxxxxxx

Report Type: 10000 Hours Test Report		Product Type: LED Package	
Test Engineer:	Pote Wang	<i>Pote Wang</i>	
Report Number:	RSZ151022511-10		
Test Date:	2015-10-19 to 2016-12-09		
Report Date:	2016-12-12		
Reviewed By:	Daniel Duan / EE Manager	<i>Daniel Duan</i>	
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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: SPMWHx228xxxxxxxxx
 Part Type: LED Package
 Nominal CCT: 2700K

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 Pu Long Cun 69, Puxinghu Industrial Area, Tangxia Town, Dongguan, Guangdong, P.R.China.

1.4 Description of Auxiliary Equipment

Device	Manufacture	Model No	Serial No	Test Range	Calibration date	Calibration due date
Integral Sphere	EVERFINE	Diameter 0.3m	1011119	0.3m	2016-03-10	2017-03-09
Programmable Test Power for LEDs	EVERFINE	LED300E	1008002	15V/2000mA	2016-03-04	2017-03-03
High accuracy array spectroradiometer	EVERFINE	HAAS-2000	1012016T	380-780nm	2016-03-10	2017-03-09
Standard Light Source	EVERFINE	D062	1011093	3000K	2016-09-13	2017-09-12
Precision digital stabilized DC power supply	EVERFINE	WY605-V110	G115987CJ7321114	300VA	2016-03-04	2017-03-03
Multilayer aging machine	BACL	B3-900	20030	25 ℃~110 ℃	2016-03-03	2017-03-02
Digital CC&CV DC Power Supply	EVERFINE	WY5015	11060010	(50/15A)	2016-03-04	2017-03-03

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 T_s test condition 25Pcs

The 75pcs samples tested at T_s 55 °C, 85 °C and T_s 105 °C were received at 2015-10-19 and tested during 2015-10-19 to 2016-12-09. The samples were numbered from 1 to 25, 25 to 50 and 51 to 75

Data Set 1: 55 °C, 65mA

Part Number:	SPMWHx228xxxxxxxxxx
Number of Units:	25
Actual Case Temperature(T_s):	$T_s = 54.4$ °C
Actual Ambient Temperature(T_A):	$T_A = 51.7$ °C
Life Test Drive Current:	$I_F = 65$ mA
Measurement Current:	$I_F = 65$ mA

Data Set 2: 85 °C, 65mA

Part Number:	SPMWHx228xxxxxxxxxx
Number of Units:	25
Actual Case Temperature(T_s):	$T_s = 84.2$ °C
Actual Ambient Temperature(T_A):	$T_A = 82.5$ °C
Life Test Drive Current:	$I_F = 65$ mA
Measurement Current:	$I_F = 65$ mA

Data Set 3: 105 °C, 65mA

Part Number:	SPMWHx228xxxxxxxxxx
Number of Units:	25
Actual Case Temperature(T_s):	$T_s = 104.1$ °C
Actual Ambient Temperature(T_A):	$T_A = 101.6$ °C
Life Test Drive Current:	$I_F = 65$ mA
Measurement Current:	$I_F = 65$ mA

2 - Summary OF Test Result

Data Set:	Data Set 1, 55 °C, 65mA
Number of Units:	25
Failures Observed:	0
Test Interval and Test Duration:	0h,1000h,2000h,3000h,4000h,5000h,6000h, 7000h,8000h,8000h,9000h,10000h
Average. Lumen Maintenance at 10000 hours:	99.00%
Average Chromaticity Shift at 10000 hours ($\Delta u'v'$):	0.0024
Reported TM-21 L ₇₀ Lifetime:	>60,000 hours
Reported TM-21 L ₉₀ Lifetime:	>60,000 hours

Data Set:	Data Set 2, 85 °C, 65mA
Number of Units:	25
Failures Observed:	0
Test Interval and Test Duration:	0h,1000h,2000h,3000h,4000h,5000h,6000h, 7000h,8000h,8000h,9000h,10000h
Average. Lumen Maintenance at 10000 hours:	98.53%
Average Chromaticity Shift at 10000 hours($\Delta u'v'$):	0.0026
Reported TM-21 L ₇₀ Lifetime:	>60,000 hours
Reported TM-21 L ₉₀ Lifetime	56,000 hours

Data Set:	Data Set 3, 105 °C, 65mA
Number of Units:	25
Failures Observed:	0
Test Interval and Test Duration:	0h,1000h,2000h,3000h,4000h,5000h,6000h, 7000h,8000h,8000h,9000h,10000h
Average. Lumen Maintenance at 10000 hours:	97.53%
Average Chromaticity Shift at 10000 hours($\Delta u'v'$):	0.0029
Reported TM-21 L ₇₀ Lifetime:	>60,000 hours
Reported TM-21 L ₉₀ Lifetime	38,000 hours

3 - Test Data

3.1 Data Set 1, 55 °C, 65mA (Lumen Maintenance)

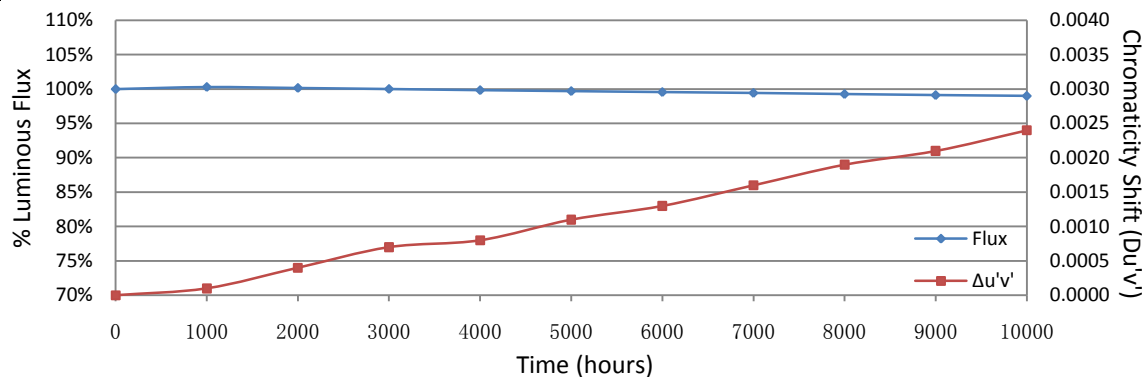
No.	V _F (V)	Φ(lm)	Lumen Maintenance (%)									
			Ohr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
1	2.879	30.35	100.30	100.26	100.23	100.03	99.90	99.70	99.60	99.44	99.37	99.31
2	2.898	30.26	100.20	100.03	99.87	99.77	99.57	99.41	99.21	98.98	98.88	98.78
3	2.869	30.00	100.17	99.90	99.77	99.73	99.67	99.53	99.33	99.20	98.97	98.83
4	2.891	30.62	100.29	100.20	100.03	99.67	99.54	99.51	99.38	99.25	99.22	98.99
5	2.880	30.18	100.33	100.13	100.07	99.97	99.70	99.54	99.44	99.27	99.17	99.04
6	2.923	30.61	100.36	100.16	100.03	99.90	99.67	99.58	99.48	99.35	99.12	99.05
7	2.881	30.22	100.43	100.30	100.13	99.97	99.87	99.64	99.57	99.40	99.24	99.07
8	2.928	30.40	100.46	100.33	100.20	100.07	99.93	99.77	99.54	99.47	99.18	98.98
9	2.891	30.49	100.39	100.20	100.07	100.03	99.84	99.70	99.67	99.51	99.38	99.34
10	2.868	30.16	100.10	99.97	99.90	99.80	99.64	99.50	99.37	99.27	99.04	98.97
11	2.890	30.35	100.23	100.10	99.84	99.74	99.57	99.47	99.41	99.31	99.14	98.91
12	2.891	30.25	100.36	100.26	100.07	99.83	99.80	99.74	99.64	99.50	99.31	99.24
13	2.904	30.32	100.43	100.36	100.03	99.90	99.87	99.70	99.60	99.57	99.34	99.24
14	2.895	30.32	100.20	100.07	99.84	99.74	99.60	99.51	99.37	99.14	99.01	98.85
15	2.891	30.85	100.36	100.26	100.16	99.87	99.81	99.64	99.58	99.35	99.29	99.16
16	2.873	30.12	100.43	100.37	100.23	99.93	99.83	99.70	99.57	99.37	99.34	99.20
17	2.884	29.69	100.24	100.13	99.93	99.70	99.60	99.43	99.39	99.12	98.99	98.96
18	2.903	30.46	100.26	100.03	99.90	99.77	99.54	99.47	99.31	99.24	99.05	98.92
19	2.892	30.25	100.23	100.07	99.97	99.74	99.57	99.31	99.24	99.17	98.91	98.64
20	2.873	29.89	100.23	100.10	99.87	99.77	99.67	99.46	99.30	99.13	99.00	98.90
21	2.877	30.31	100.20	99.93	99.77	99.54	99.41	99.24	99.11	99.04	98.91	98.88
22	2.911	30.32	100.36	100.13	100.07	99.90	99.70	99.44	99.37	99.24	99.18	99.04
23	2.885	30.33	100.30	100.10	99.97	99.84	99.74	99.64	99.41	99.14	99.01	98.81
24	2.879	30.14	100.36	100.30	100.10	99.87	99.83	99.60	99.44	99.07	98.94	98.87
25	2.890	30.25	100.33	100.20	100.13	99.97	99.74	99.67	99.54	99.31	99.07	98.91
Ave.	2.890	30.29	100.30	100.16	100.01	99.84	99.70	99.56	99.43	99.27	99.12	99.00
Med.	2.890	30.31	100.30	100.13	100.03	99.84	99.70	99.54	99.41	99.27	99.12	98.97
st dev	0.0153	0.2338	0.0946	0.1298	0.1386	0.1284	0.1360	0.1362	0.1433	0.1558	0.1575	0.1752
Min.	2.868	29.69	100.10	99.90	99.77	99.54	99.41	99.24	99.11	98.98	98.88	98.64
Max.	2.928	30.85	100.46	100.37	100.23	100.07	99.93	99.77	99.67	99.57	99.38	99.34

TM-21 Projection:

Test Duration: 10,000 hours
Failures Observed: 0
α: 1.432E-06
β: 1.004
Reported L₇₀: >60,000 hours
Reported L₉₀: >60,000 hours

3.2 Data Set 1, 55 °C, 65mA (Chromaticity Shift)

No.	u'	v'	CCT(K)	Chromaticity Shift ($\Delta u'v'$)									
				Ohr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
1	0.2550	0.5298	2851	0.0001	0.0003	0.0007	0.0010	0.0012	0.0014	0.0018	0.0021	0.0023	0.0024
2	0.2546	0.5329	2842	0.0001	0.0003	0.0006	0.0008	0.0011	0.0013	0.0016	0.0018	0.0021	0.0024
3	0.2545	0.5292	2864	0.0001	0.0004	0.0006	0.0008	0.0010	0.0013	0.0016	0.0019	0.0021	0.0024
4	0.2535	0.5331	2867	0.0001	0.0004	0.0007	0.0008	0.0010	0.0013	0.0017	0.0019	0.0022	0.0025
5	0.2548	0.5291	2858	0.0000	0.0004	0.0007	0.0008	0.0011	0.0013	0.0016	0.0020	0.0022	0.0024
6	0.2536	0.5370	2846	0.0001	0.0005	0.0007	0.0009	0.0011	0.0014	0.0016	0.0020	0.0021	0.0024
7	0.2563	0.5312	2813	0.0001	0.0004	0.0006	0.0008	0.0010	0.0013	0.0016	0.0019	0.0021	0.0024
8	0.2569	0.5309	2803	0.0000	0.0004	0.0008	0.0009	0.0011	0.0014	0.0017	0.0020	0.0022	0.0026
9	0.2554	0.5312	2835	0.0001	0.0004	0.0006	0.0008	0.0010	0.0013	0.0016	0.0019	0.0021	0.0024
10	0.2535	0.5324	2870	0.0002	0.0004	0.0006	0.0008	0.0010	0.0013	0.0016	0.0019	0.0021	0.0024
11	0.2562	0.5312	2816	0.0001	0.0004	0.0006	0.0008	0.0011	0.0013	0.0016	0.0019	0.0021	0.0024
12	0.2559	0.5320	2820	0.0001	0.0004	0.0008	0.0008	0.0010	0.0013	0.0016	0.0019	0.0021	0.0024
13	0.2545	0.5300	2859	0.0003	0.0003	0.0006	0.0008	0.0010	0.0013	0.0016	0.0018	0.0020	0.0024
14	0.2563	0.5322	2809	0.0002	0.0004	0.0006	0.0008	0.0010	0.0013	0.0016	0.0018	0.0021	0.0024
15	0.2530	0.5369	2859	0.0002	0.0003	0.0006	0.0008	0.0010	0.0013	0.0015	0.0017	0.0020	0.0023
16	0.2574	0.5357	2772	0.0002	0.0004	0.0007	0.0008	0.0010	0.0013	0.0016	0.0018	0.0020	0.0024
17	0.2556	0.5322	2826	0.0001	0.0004	0.0007	0.0008	0.0011	0.0013	0.0016	0.0019	0.0021	0.0024
18	0.2565	0.5331	2801	0.0001	0.0004	0.0006	0.0008	0.0010	0.0013	0.0016	0.0019	0.0021	0.0024
19	0.2564	0.5333	2803	0.0001	0.0004	0.0006	0.0008	0.0010	0.0014	0.0016	0.0019	0.0021	0.0023
20	0.2552	0.5272	2858	0.0002	0.0003	0.0006	0.0008	0.0010	0.0013	0.0016	0.0018	0.0019	0.0023
21	0.2552	0.5311	2839	0.0001	0.0004	0.0006	0.0007	0.0010	0.0013	0.0016	0.0019	0.0021	0.0024
22	0.2547	0.5307	2853	0.0001	0.0005	0.0008	0.0008	0.0011	0.0014	0.0018	0.0020	0.0022	0.0026
23	0.2554	0.5320	2829	0.0001	0.0004	0.0006	0.0008	0.0010	0.0013	0.0016	0.0019	0.0021	0.0024
24	0.2562	0.5330	2808	0.0002	0.0003	0.0006	0.0008	0.0010	0.0013	0.0016	0.0020	0.0021	0.0023
25	0.2542	0.5307	2863	0.0001	0.0005	0.0007	0.0008	0.0011	0.0014	0.0017	0.0020	0.0022	0.0024
Ave.	0.2552	0.5319	2835	0.0001	0.0004	0.0007	0.0008	0.0011	0.0013	0.0016	0.0019	0.0021	0.0024
Med.	0.2552	0.5320	2839	0.0001	0.0004	0.0006	0.0008	0.0010	0.0013	0.0016	0.0019	0.0021	0.0024
st dev	0.0012	0.0023	26.3076	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001	0.0001
Min.	0.2530	0.5272	2772	0.0000	0.0003	0.0006	0.0007	0.0010	0.0013	0.0015	0.0017	0.0019	0.0023
Max.	0.2574	0.5370	2870	0.0003	0.0005	0.0008	0.0010	0.0012	0.0014	0.0018	0.0021	0.0023	0.0026



3.3 Data Set 2, 85 °C, 65mA (Lumen Maintenance)

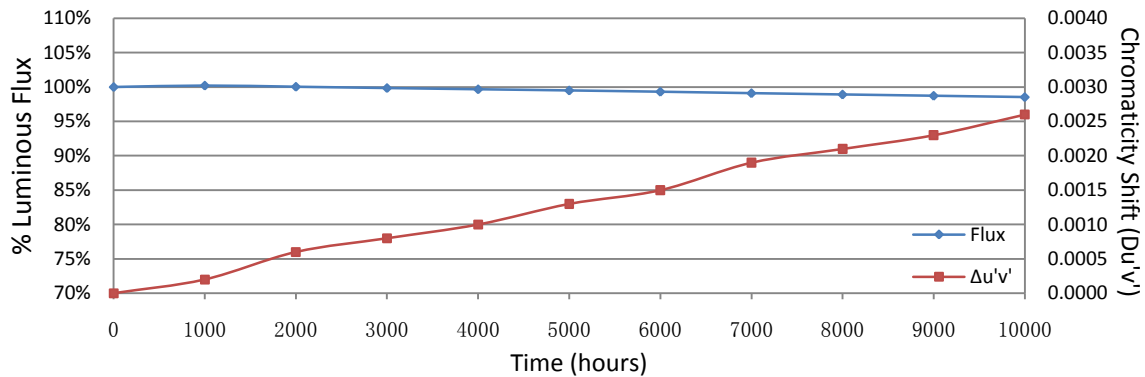
No.	V _F (V)	Φ(lm)	Lumen Maintenance (%)									
			0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
26	2.922	30.60	100.26	100.13	99.93	99.77	99.64	99.61	99.48	99.41	99.12	98.99
27	2.875	30.36	100.23	100.07	99.90	99.67	99.60	99.54	99.31	99.08	98.98	98.78
28	2.872	30.07	100.27	100.23	100.03	99.77	99.67	99.47	99.24	98.97	98.87	98.67
29	2.863	30.06	100.27	100.07	99.90	99.70	99.53	99.47	99.27	99.00	98.77	98.60
30	2.875	30.36	100.13	99.87	99.70	99.60	99.41	99.24	99.08	98.81	98.48	98.39
31	2.873	30.08	100.03	99.77	99.73	99.47	99.20	99.07	98.90	98.60	98.30	98.24
32	2.884	30.25	100.13	99.93	99.74	99.44	99.21	99.04	98.84	98.81	98.58	98.25
33	2.912	30.46	100.26	100.13	99.84	99.61	99.51	99.18	98.98	98.72	98.62	98.33
34	2.882	30.47	100.10	100.03	99.97	99.70	99.41	99.05	98.92	98.62	98.29	98.13
35	2.892	30.54	100.26	100.07	99.87	99.64	99.38	99.08	99.02	98.79	98.62	98.30
36	2.888	30.65	100.20	100.03	99.90	99.74	99.45	99.22	98.86	98.69	98.60	98.40
37	2.887	30.74	100.13	100.07	99.93	99.77	99.54	99.28	99.02	98.83	98.73	98.57
38	2.886	30.52	100.07	100.03	99.80	99.67	99.61	99.41	99.08	98.92	98.72	98.53
39	2.886	30.44	100.20	99.93	99.74	99.64	99.57	99.38	99.15	98.95	98.85	98.62
40	2.899	30.46	100.23	100.10	99.80	99.67	99.51	99.44	99.18	99.05	98.88	98.69
41	2.945	30.61	100.29	100.20	99.93	99.74	99.61	99.51	99.28	99.15	99.02	98.86
42	2.879	29.96	100.20	100.17	99.90	99.70	99.53	99.37	99.17	98.97	98.80	98.63
43	2.889	30.47	100.10	99.87	99.77	99.61	99.41	99.31	99.05	98.88	98.72	98.56
44	2.895	30.20	100.23	100.03	99.87	99.70	99.54	99.24	99.17	99.01	98.87	98.61
45	2.958	30.87	100.19	99.90	99.81	99.61	99.51	99.25	99.06	98.93	98.87	98.61
46	2.913	30.48	100.33	100.13	99.93	99.84	99.67	99.44	99.31	99.11	98.95	98.82
47	2.899	30.11	100.27	100.03	99.83	99.77	99.60	99.37	99.27	99.04	98.94	98.70
48	2.880	29.98	100.27	100.10	99.77	99.63	99.53	99.43	99.13	99.07	98.80	98.57
49	3.025	30.23	100.23	100.07	99.70	99.64	99.50	99.34	99.01	98.68	98.41	98.15
50	2.890	29.95	100.30	99.93	99.83	99.63	99.33	99.00	98.63	98.56	98.30	98.26
Ave.	2.899	30.36	100.21	100.04	99.85	99.67	99.50	99.31	99.10	98.91	98.72	98.53
Med.	2.888	30.44	100.23	100.07	99.84	99.67	99.53	99.34	99.08	98.93	98.77	98.57
st dev	0.0344	0.2561	0.0785	0.1115	0.0889	0.0906	0.1258	0.1694	0.1841	0.1979	0.2308	0.2284
Min.	2.863	29.95	100.03	99.77	99.70	99.44	99.20	99.00	98.63	98.56	98.29	98.13
Max.	3.025	30.87	100.33	100.23	100.03	99.84	99.67	99.61	99.48	99.41	99.12	98.99

TM-21 Projection:

Test Duration: 10,000 hours
Failures Observed: 0
α: 1.965E-06
β: 1.005
Reported L₇₀: >60,000 hours
Reported L₉₀: 56,000 hours

3.4 Data Set 2, 85 °C, 65mA (Chromaticity Shift)

No.	u'	v'	CCT(K)	Chromaticity Shift ($\Delta u'v'$)									
				0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
26	0.2543	0.5315	2856	0.0001	0.0006	0.0007	0.0010	0.0011	0.0015	0.0017	0.0020	0.0023	0.0025
27	0.2546	0.5307	2853	0.0002	0.0006	0.0008	0.0010	0.0013	0.0015	0.0019	0.0021	0.0023	0.0025
28	0.2559	0.5294	2832	0.0002	0.0006	0.0008	0.0010	0.0012	0.0016	0.0019	0.0022	0.0024	0.0027
29	0.2557	0.5320	2824	0.0002	0.0006	0.0008	0.0010	0.0012	0.0015	0.0018	0.0020	0.0023	0.0026
30	0.2566	0.5328	2800	0.0002	0.0005	0.0007	0.0009	0.0012	0.0014	0.0018	0.0020	0.0023	0.0025
31	0.2599	0.5349	2723	0.0002	0.0006	0.0008	0.0010	0.0014	0.0016	0.0019	0.0021	0.0023	0.0026
32	0.2545	0.5297	2861	0.0002	0.0006	0.0008	0.0010	0.0013	0.0015	0.0019	0.0020	0.0023	0.0026
33	0.2551	0.5334	2831	0.0002	0.0006	0.0008	0.0010	0.0013	0.0015	0.0019	0.0021	0.0023	0.0025
34	0.2547	0.5314	2848	0.0002	0.0006	0.0008	0.0009	0.0012	0.0015	0.0018	0.0021	0.0022	0.0026
35	0.2545	0.5336	2842	0.0002	0.0006	0.0008	0.0009	0.0012	0.0014	0.0018	0.0020	0.0023	0.0025
36	0.2535	0.5329	2867	0.0001	0.0005	0.0007	0.0010	0.0012	0.0014	0.0017	0.0020	0.0022	0.0025
37	0.2539	0.5331	2857	0.0002	0.0006	0.0008	0.0010	0.0013	0.0015	0.0018	0.0021	0.0023	0.0027
38	0.2538	0.5317	2867	0.0002	0.0005	0.0007	0.0009	0.0012	0.0014	0.0018	0.0020	0.0022	0.0025
39	0.2539	0.5332	2858	0.0002	0.0005	0.0008	0.0010	0.0012	0.0014	0.0019	0.0020	0.0022	0.0025
40	0.2557	0.5324	2823	0.0002	0.0006	0.0008	0.0010	0.0013	0.0015	0.0019	0.0021	0.0023	0.0026
41	0.2546	0.5359	2828	0.0002	0.0006	0.0009	0.0010	0.0013	0.0015	0.0018	0.0021	0.0023	0.0026
42	0.2548	0.5310	2848	0.0002	0.0006	0.0008	0.0010	0.0013	0.0016	0.0020	0.0021	0.0023	0.0027
43	0.2545	0.5323	2849	0.0003	0.0006	0.0008	0.0010	0.0014	0.0016	0.0019	0.0021	0.0023	0.0027
44	0.2574	0.5329	2783	0.0002	0.0006	0.0008	0.0010	0.0014	0.0015	0.0019	0.0021	0.0023	0.0027
45	0.2534	0.5366	2851	0.0002	0.0006	0.0009	0.0010	0.0013	0.0015	0.0019	0.0020	0.0022	0.0025
46	0.2556	0.5370	2802	0.0002	0.0006	0.0008	0.0010	0.0012	0.0014	0.0018	0.0021	0.0022	0.0025
47	0.2566	0.5305	2812	0.0002	0.0008	0.0010	0.0012	0.0014	0.0017	0.0021	0.0023	0.0025	0.0029
48	0.2564	0.5327	2806	0.0003	0.0005	0.0008	0.0009	0.0012	0.0015	0.0019	0.0021	0.0023	0.0025
49	0.2567	0.5317	2804	0.0002	0.0006	0.0008	0.0010	0.0013	0.0016	0.0019	0.0022	0.0024	0.0026
50	0.2558	0.5293	2834	0.0002	0.0006	0.0008	0.0010	0.0013	0.0015	0.0019	0.0021	0.0024	0.0026
Ave.	0.2553	0.5325	2830	0.0002	0.0006	0.0008	0.0010	0.0013	0.0015	0.0019	0.0021	0.0023	0.0026
Med.	0.2548	0.5324	2834	0.0002	0.0006	0.0008	0.0010	0.0013	0.0015	0.0019	0.0021	0.0023	0.0026
st dev	0.0015	0.0020	32.2979	0.0000	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Min.	0.2534	0.5293	2723	0.0001	0.0005	0.0007	0.0009	0.0011	0.0014	0.0017	0.0020	0.0022	0.0025
Max.	0.2599	0.5370	2867	0.0003	0.0008	0.0010	0.0012	0.0014	0.0017	0.0021	0.0023	0.0025	0.0029



3.5 Data Set 3, 105 °C, 65mA (Lumen Maintenance)

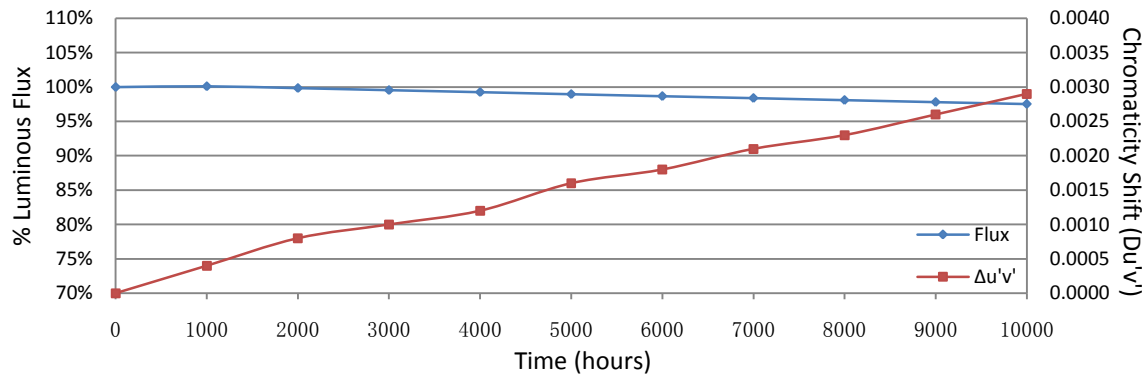
No.	V _F (V)	Φ(lm)	Lumen Maintenance (%)									
			0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
51	2.900	30.39	100.26	99.97	99.74	99.37	99.01	98.78	98.42	98.19	97.86	97.66
52	2.872	30.12	99.83	99.54	99.07	98.71	98.31	98.11	97.94	97.54	97.31	97.21
53	2.934	30.38	100.16	100.03	99.70	99.41	98.98	98.82	98.62	98.22	97.93	97.66
54	2.898	30.20	100.13	99.97	99.74	99.67	99.34	99.07	98.94	98.68	98.38	97.95
55	2.902	30.30	99.80	99.54	99.24	98.98	98.88	98.65	98.48	98.28	97.92	97.56
56	2.919	30.35	100.10	99.87	99.57	99.14	98.95	98.75	98.35	98.02	97.76	97.59
57	2.886	30.16	100.13	99.90	99.67	99.24	99.07	98.87	98.64	98.34	97.94	97.58
58	2.929	30.02	100.27	99.93	99.73	99.33	99.17	99.00	98.77	98.43	98.10	97.80
59	2.874	30.21	100.13	99.80	99.50	99.40	99.11	98.78	98.51	98.31	98.05	97.95
60	2.890	30.44	99.90	99.67	99.21	99.15	98.88	98.55	98.23	98.16	97.90	97.60
61	2.869	30.08	99.93	99.80	99.47	99.14	98.77	98.54	98.17	97.81	97.44	97.14
62	2.881	30.54	100.03	99.93	99.64	99.28	98.79	98.26	97.97	97.71	97.61	97.41
63	2.883	30.66	100.10	99.90	99.61	99.32	98.96	98.56	98.27	97.98	97.59	97.36
64	2.919	30.30	100.23	100.03	99.77	99.50	99.21	98.78	98.48	98.05	97.79	97.62
65	2.883	30.61	100.16	99.90	99.64	99.38	99.09	98.79	98.33	97.88	97.58	97.35
66	2.862	29.98	100.20	99.97	99.73	99.47	99.13	98.83	98.47	98.37	98.03	97.60
67	2.872	30.24	100.03	99.80	99.47	99.24	98.94	98.58	98.41	98.21	97.92	97.52
68	2.886	30.53	100.23	100.07	99.74	99.41	99.21	98.92	98.72	98.46	98.13	97.74
69	2.896	30.32	100.20	99.90	99.67	99.44	99.14	98.81	98.52	98.38	98.09	97.72
70	2.879	30.38	100.10	99.74	99.61	99.31	99.14	98.85	98.58	98.26	98.06	97.63
71	2.875	30.23	100.07	99.67	99.57	99.21	99.01	98.74	98.48	98.25	97.78	97.59
72	2.886	30.53	100.16	99.67	99.34	99.02	98.82	98.59	98.23	97.90	97.58	97.45
73	2.874	30.52	100.13	99.84	99.48	99.12	98.66	98.30	98.00	97.71	97.48	97.08
74	2.876	30.26	100.20	99.83	99.44	99.14	98.74	98.41	98.08	97.69	97.46	97.22
75	2.883	30.08	100.13	99.87	99.50	99.17	98.77	98.47	98.14	97.77	97.47	97.21
Ave.	2.889	30.31	100.11	99.85	99.55	99.26	98.96	98.67	98.39	98.10	97.81	97.53
Med.	2.883	30.30	100.13	99.87	99.61	99.28	98.98	98.75	98.42	98.19	97.86	97.59
st dev	0.0190	0.1865	0.1243	0.1432	0.1840	0.1981	0.2201	0.2344	0.2562	0.2916	0.2705	0.2336
Min.	2.862	29.98	99.80	99.54	99.07	98.71	98.31	98.11	97.94	97.54	97.31	97.08
Max.	2.934	30.66	100.27	100.07	99.77	99.67	99.34	99.07	98.94	98.68	98.38	97.95

TM-21 Projection:

Test Duration: 10,000 hours
Failures Observed: 0
α: 2.914E-06
β: 1.004
Reported L₇₀: >60,000 hours
Reported L₉₀: 38,000 hours

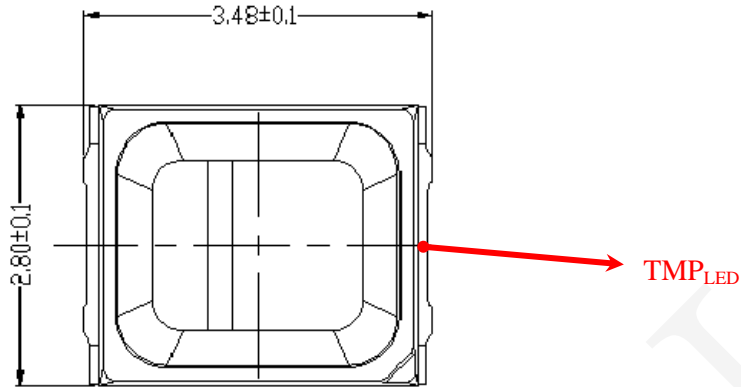
3.6 Data Set 3, 105 °C, 65mA (Chromaticity Shift)

No.	u'	v'	CCT(K)	Chromaticity Shift ($\Delta u'v'$)									
				Ohr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
51	0.2550	0.5304	2846	0.0004	0.0007	0.0010	0.0012	0.0015	0.0017	0.0020	0.0023	0.0025	0.0027
52	0.2562	0.5313	2817	0.0006	0.0008	0.0011	0.0013	0.0017	0.0020	0.0022	0.0025	0.0027	0.0030
53	0.2557	0.5335	2816	0.0004	0.0008	0.0010	0.0012	0.0016	0.0018	0.0021	0.0023	0.0025	0.0028
54	0.2554	0.5314	2833	0.0003	0.0007	0.0009	0.0011	0.0014	0.0017	0.0020	0.0023	0.0024	0.0028
55	0.2556	0.5311	2830	0.0003	0.0007	0.0010	0.0012	0.0016	0.0017	0.0020	0.0023	0.0025	0.0028
56	0.2549	0.5315	2844	0.0004	0.0008	0.0010	0.0013	0.0016	0.0018	0.0021	0.0023	0.0026	0.0029
57	0.2551	0.5270	2862	0.0003	0.0007	0.0009	0.0011	0.0016	0.0017	0.0020	0.0023	0.0026	0.0028
58	0.2569	0.5320	2798	0.0004	0.0008	0.0010	0.0012	0.0015	0.0018	0.0021	0.0023	0.0025	0.0028
59	0.2537	0.5354	2850	0.0004	0.0008	0.0010	0.0012	0.0015	0.0017	0.0019	0.0023	0.0024	0.0027
60	0.2545	0.5319	2850	0.0003	0.0007	0.0010	0.0012	0.0015	0.0017	0.0020	0.0023	0.0025	0.0028
61	0.2582	0.5327	2768	0.0004	0.0008	0.0010	0.0013	0.0016	0.0018	0.0021	0.0025	0.0027	0.0030
62	0.2542	0.5322	2854	0.0003	0.0007	0.0009	0.0012	0.0015	0.0017	0.0020	0.0022	0.0024	0.0028
63	0.2540	0.5303	2869	0.0004	0.0008	0.0010	0.0012	0.0016	0.0017	0.0021	0.0023	0.0025	0.0028
64	0.2554	0.5318	2832	0.0004	0.0007	0.0010	0.0012	0.0016	0.0018	0.0020	0.0023	0.0026	0.0029
65	0.2545	0.5344	2838	0.0004	0.0008	0.0010	0.0012	0.0016	0.0017	0.0022	0.0023	0.0026	0.0028
66	0.2546	0.5315	2850	0.0004	0.0008	0.0010	0.0013	0.0015	0.0018	0.0022	0.0023	0.0026	0.0028
67	0.2577	0.5316	2782	0.0004	0.0008	0.0011	0.0012	0.0015	0.0018	0.0021	0.0023	0.0026	0.0029
68	0.2542	0.5345	2845	0.0004	0.0007	0.0010	0.0012	0.0016	0.0018	0.0021	0.0023	0.0026	0.0029
69	0.2557	0.5321	2823	0.0004	0.0007	0.0010	0.0012	0.0014	0.0017	0.0019	0.0023	0.0025	0.0028
70	0.2559	0.5320	2820	0.0004	0.0007	0.0010	0.0012	0.0016	0.0017	0.0021	0.0023	0.0025	0.0028
71	0.2572	0.5307	2798	0.0003	0.0007	0.0010	0.0012	0.0015	0.0019	0.0021	0.0024	0.0027	0.0030
72	0.2579	0.5376	2753	0.0004	0.0009	0.0011	0.0013	0.0017	0.0019	0.0022	0.0025	0.0027	0.0029
73	0.2548	0.5327	2841	0.0004	0.0008	0.0010	0.0012	0.0016	0.0019	0.0021	0.0023	0.0026	0.0029
74	0.2557	0.5314	2827	0.0004	0.0008	0.0011	0.0013	0.0016	0.0018	0.0022	0.0024	0.0026	0.0029
75	0.2576	0.5330	2779	0.0004	0.0008	0.0010	0.0012	0.0016	0.0018	0.0021	0.0023	0.0025	0.0028
Ave.	0.2556	0.5322	2825	0.0004	0.0008	0.0010	0.0012	0.0016	0.0018	0.0021	0.0023	0.0026	0.0029
Med.	0.2554	0.5319	2832	0.0004	0.0008	0.0010	0.0012	0.0016	0.0018	0.0021	0.0023	0.0026	0.0028
st dev	0.0013	0.0020	30.1524	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Min.	0.2537	0.5270	2753	0.0003	0.0007	0.0009	0.0011	0.0014	0.0017	0.0019	0.0022	0.0024	0.0027
Max.	0.2582	0.5376	2869	0.0006	0.0009	0.0011	0.0013	0.0017	0.0020	0.0022	0.0025	0.0027	0.0030



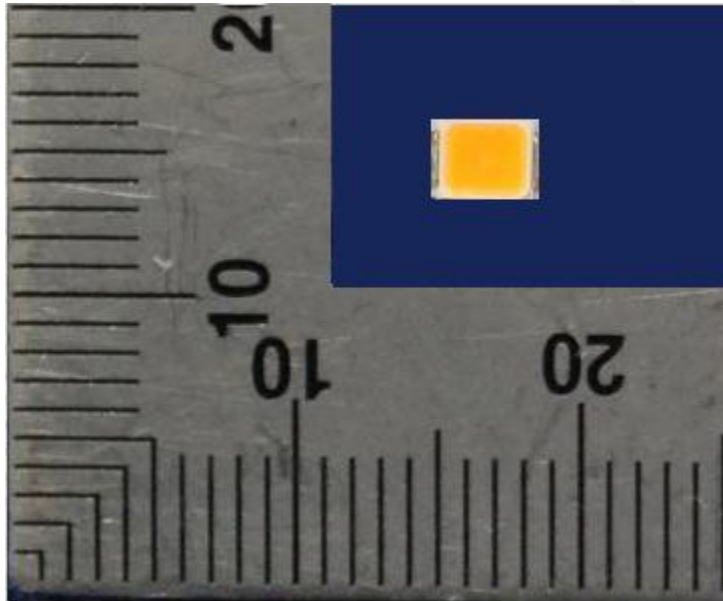
Attachment A – EUT Photo

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



All dimensions are in millimeter

A.2 EUT Photo



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