

IESNA LM-80-2008

MEASURING LUMEN MAINTENANCE OF LED LIGHT SOURCES

MEASUREMENT AND TEST REPORT

For

Shenzhen Refond Optoelectronic Co., Ltd.

6th wing, 2nd block of Baiwangxin Industry Park Songbai Road Nanshan District, Shenzhen, China

Model: RF-HI13

Report Type: 9000 Hours Test Report	Product Type: LED Package
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Report Number: R2DG130311050-10A1	
Test Date: 2013-03-22 to 2014-04-30	
Report Date: 2014-05-13	
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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: RF-HI13
 Part Name: SMD3014
 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	380-780nm, length:0.3m ,0-1999Lumen	2014-03-04	2015-03-04
Programmable Test Power for LEDs	EVERFINE	LED300E	1008002	15V/2000mA	2014-03-12	2015-03-12
High accuracy array spectroradiometer	EVERFINE	HAAS-2000	1012016T	380-780nm	2013-12-26	2014-12-26
Standard Light Source	EVERFINE	D062	1011093	N/A	2013-05-23	2014-05-23
Precision digital stabilized DC power supply	EVERFINE	WY605	G115987C J7321114	300VA	2014-03-12	2015-03-12
Multilayen aging machine	BACL	B2-270	20005	N/A	2013-08-01	2014-08-01
Multi-channel DC source	Taishan Xingguang	T01000F2	ST04392	0~5V,0~40A	2013-08-01	2014-08-01
Multi-channel DC source	Taishan Xingguang	T0100F	ST04387	0~5V,0~40A	2014-03-12	2015-03-12

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 75pcs samples tested at Ts 45 °C, 55 °C and Ts 85 °C were received at 2013-03-20 and tested during 2013-03-22 to 2014-04-30. The samples were numbered from 1 to 25, 26 to 50 and 51 to 75.

Data Set 1: 45 °C, 60mA

Part Number:	RF-HI13
Number of Units:	25
Actual Case Temperature(T _S):	T _S =44.7 °C
Actual Ambient Temperature(T _A):	T _A =43.4 °C
Life Test Drive Current:	I _F = 60mA
Measurement Current:	I _F = 60mA

Data Set 2: 55°C, 60mA

Part Number:	RF-HI13
Number of Units:	25
Actual Case Temperature(T _S):	T _S =54.3 °C
Actual Ambient Temperature(T _A):	T _A =53.6 °C
Life Test Drive Current:	I _F = 60mA
Measurement Current:	I _F = 60mA

Data Set 3: 85 °C, 60mA

Part Number:	RF-HI13
Number of Units:	25
Actual Case Temperature(T _S):	T _S =84.3 °C
Actual Ambient Temperature(T _A):	T _A =83.4 °C
Life Test Drive Current:	I _F = 60mA
Measurement Current:	I _F = 60mA

2 - SUMMARY OF TEST RESULT

Data Set:	Data Set 1, 45 °C, 60mA
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:	96.83%
Average Chromaticity Shift at 6000 hours ($\Delta u'v'$):	0.0015
Average. Lumen Maintenance at 9000 hours:	95.00%
Average Chromaticity Shift at 9000 hours ($\Delta u'v'$):	0.0022
Reported TM-21 L ₇₀ Lifetime:	>54,000 hours

Data Set:	Data Set 2, 55°C, 60mA
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:	96.32%
Average Chromaticity Shift at 6000 hours($\Delta u'v'$):	0.0015
Average. Lumen Maintenance at 9000 hours:	94.06%
Average Chromaticity Shift at 9000 hours($\Delta u'v'$):	0.0023
Reported TM-21 L ₇₀ Lifetime	>54,000 hours

Data Set:	Data Set 3, 85 °C, 60mA
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:	95.93%
Average Chromaticity Shift at 6000 hours($\Delta u'v'$):	0.0017
Average. Lumen Maintenance at 9000 hours:	93.09%
Average Chromaticity Shift at 9000 hours($\Delta u'v'$):	0.0025
Reported TM-21 L ₇₀ Lifetime	47,000 hours

3 - Test Data

3.1 Data Set 1, 45 °C, 60mA (Lumen Maintenance)

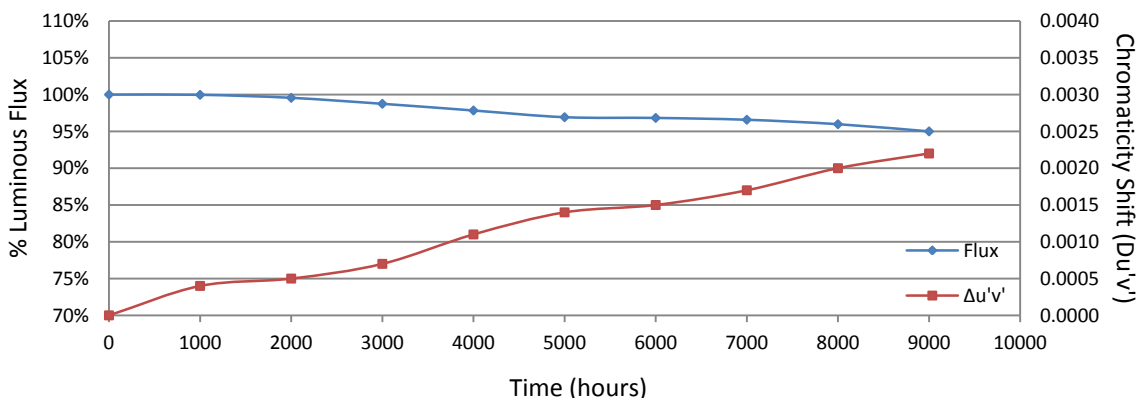
No.	V _F (V)	Φ(lm)	Lumen Maintenance (%)								
			0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs
1	3.121	18.80	99.95	99.57	98.72	97.77	96.70	96.60	96.38	95.90	95.48
2	3.136	18.61	99.89	99.62	98.76	97.64	96.94	96.88	96.51	96.08	94.68
3	3.090	18.45	100.11	99.73	98.75	97.89	96.96	96.86	96.48	95.77	94.80
4	3.075	18.30	100.00	99.73	98.69	97.81	96.89	96.78	96.67	96.07	95.25
5	3.136	19.34	100.10	99.53	98.86	97.62	96.79	96.74	96.33	95.66	94.88
6	3.074	19.84	100.05	99.55	98.79	98.08	97.18	97.08	96.77	96.07	95.31
7	3.093	19.42	99.85	99.43	98.51	97.73	96.81	96.70	96.45	95.88	95.31
8	3.064	19.29	99.95	99.69	98.81	97.98	96.68	96.63	96.42	95.96	95.23
9	3.156	19.23	99.90	99.48	98.75	97.82	96.72	96.67	96.46	95.94	94.44
10	3.061	19.82	99.95	99.45	98.89	97.73	96.92	96.82	96.52	96.01	94.85
11	3.115	18.05	99.83	99.50	98.50	97.67	96.84	96.79	96.51	95.96	94.96
12	3.131	19.54	99.85	99.54	98.57	97.80	97.08	96.93	96.67	96.16	95.14
13	3.133	18.90	100.11	99.47	98.78	97.67	97.14	97.04	96.83	96.24	95.34
14	3.118	18.75	99.95	99.47	98.93	98.08	97.23	97.12	96.91	96.37	95.95
15	3.110	19.78	99.85	99.54	98.89	98.08	97.07	96.97	96.71	95.85	94.89
16	3.156	19.83	99.90	99.50	98.54	97.93	96.72	96.62	96.52	95.97	94.86
17	3.062	19.57	99.90	99.74	98.82	98.01	97.09	96.99	96.78	96.01	94.63
18	3.109	19.43	100.10	99.43	98.71	97.74	96.96	96.91	96.60	95.93	94.90
19	3.109	19.60	100.05	99.44	98.83	97.86	96.99	96.89	96.58	95.97	94.80
20	3.110	19.06	99.95	99.42	98.95	97.85	96.96	96.90	96.80	96.27	95.38
21	3.106	19.66	100.10	99.64	98.83	98.02	97.15	97.00	96.80	95.73	94.76
22	3.092	19.81	99.95	99.65	98.84	97.98	97.17	96.97	96.67	96.16	94.65
23	3.097	19.61	99.95	99.75	98.62	97.81	96.74	96.63	96.38	95.77	94.85
24	3.103	18.63	100.00	99.68	98.71	97.80	96.83	96.56	96.35	95.76	94.63
25	3.087	18.70	99.95	99.41	98.77	97.70	96.74	96.63	96.47	95.99	94.92
Ave.	3.106	19.20	99.97	99.56	98.75	97.84	96.93	96.83	96.58	95.98	95.00
Med.	3.109	19.34	99.95	99.54	98.77	97.81	96.94	96.86	96.52	95.97	94.89
st dev	0.0270	0.5366	0.0901	0.1130	0.1256	0.1434	0.1711	0.1643	0.1675	0.1764	0.3403
Min.	3.061	18.05	99.83	99.41	98.50	97.62	96.68	96.56	96.33	95.66	94.44
Max.	3.156	19.84	100.11	99.75	98.95	98.08	97.23	97.12	96.91	96.37	95.95

TM-21 Projection:

Test Duration: 9000 hours
Failures Observed: 0
α: 5.126E-06
β: 0.998
Calculated L₇₀: 69,000 hours
Reported L₇₀: >54000 hours

3.2 Data Set 1, 45 °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	0.2584	0.5309	2771	0.0002	0.0003	0.0005	0.0009	0.0013	0.0014	0.0015	0.0019	0.0022
2	0.2587	0.5301	2769	0.0001	0.0004	0.0007	0.0010	0.0013	0.0016	0.0020	0.0022	0.0023
3	0.2590	0.5293	2766	0.0001	0.0002	0.0005	0.0008	0.0009	0.0012	0.0015	0.0020	0.0022
4	0.2575	0.5305	2791	0.0004	0.0004	0.0005	0.0009	0.0013	0.0013	0.0013	0.0017	0.0018
5	0.2582	0.5261	2798	0.0004	0.0006	0.0008	0.0013	0.0014	0.0016	0.0017	0.0018	0.0021
6	0.2571	0.5268	2818	0.0003	0.0004	0.0005	0.0007	0.0011	0.0011	0.0014	0.0016	0.0018
7	0.2564	0.5269	2832	0.0003	0.0003	0.0004	0.0007	0.0010	0.0012	0.0014	0.0019	0.0022
8	0.2590	0.5263	2779	0.0002	0.0004	0.0006	0.0010	0.0014	0.0016	0.0018	0.0020	0.0022
9	0.2598	0.5271	2759	0.0002	0.0006	0.0008	0.0013	0.0015	0.0016	0.0017	0.0022	0.0023
10	0.2594	0.5271	2767	0.0006	0.0008	0.0010	0.0012	0.0013	0.0014	0.0014	0.0016	0.0022
11	0.2592	0.5296	2759	0.0003	0.0007	0.0009	0.0014	0.0016	0.0018	0.0020	0.0020	0.0021
12	0.2582	0.5266	2795	0.0005	0.0007	0.0009	0.0012	0.0014	0.0015	0.0017	0.0020	0.0022
13	0.2584	0.5299	2775	0.0004	0.0006	0.0009	0.0011	0.0015	0.0017	0.0019	0.0021	0.0022
14	0.2582	0.5309	2776	0.0003	0.0007	0.0008	0.0011	0.0016	0.0018	0.0018	0.0022	0.0023
15	0.2591	0.5278	2770	0.0006	0.0005	0.0007	0.0013	0.0015	0.0017	0.0019	0.0021	0.0022
16	0.2600	0.5289	2746	0.0005	0.0008	0.0009	0.0013	0.0014	0.0017	0.0018	0.0018	0.0018
17	0.2588	0.5268	2781	0.0003	0.0004	0.0006	0.0012	0.0016	0.0017	0.0018	0.0022	0.0021
18	0.2586	0.5286	2776	0.0004	0.0004	0.0007	0.0010	0.0015	0.0018	0.0018	0.0022	0.0025
19	0.2575	0.5271	2808	0.0004	0.0007	0.0009	0.0013	0.0015	0.0016	0.0017	0.0020	0.0025
20	0.2593	0.5306	2753	0.0005	0.0006	0.0008	0.0010	0.0011	0.0012	0.0014	0.0016	0.0021
21	0.2578	0.5262	2804	0.0005	0.0008	0.0010	0.0014	0.0015	0.0016	0.0018	0.0022	0.0023
22	0.2579	0.5286	2792	0.0004	0.0009	0.0011	0.0012	0.0013	0.0013	0.0015	0.0019	0.0020
23	0.2591	0.5297	2762	0.0004	0.0004	0.0005	0.0012	0.0015	0.0017	0.0019	0.0021	0.0025
24	0.2586	0.5295	2772	0.0002	0.0005	0.0006	0.0009	0.0011	0.0015	0.0016	0.0018	0.0023
25	0.2588	0.5294	2769	0.0001	0.0002	0.0004	0.0009	0.0011	0.0015	0.0018	0.0019	0.0022
Ave.	0.2585	0.5285	2780	0.0004	0.0005	0.0007	0.0011	0.0014	0.0015	0.0017	0.0020	0.0022
Med.	0.2586	0.5286	2775	0.0004	0.0005	0.0007	0.0011	0.0014	0.0016	0.0017	0.0020	0.0022
st dev	0.0008	0.0016	20.7347	0.0001	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
Min.	0.2564	0.5261	2746	0.0001	0.0002	0.0004	0.0007	0.0009	0.0011	0.0013	0.0016	0.0018
Max.	0.2600	0.5309	2832	0.0006	0.0009	0.0011	0.0014	0.0016	0.0018	0.0020	0.0022	0.0025



3.3 Data Set 2, 55°C, 60mA (Lumen Maintenance)

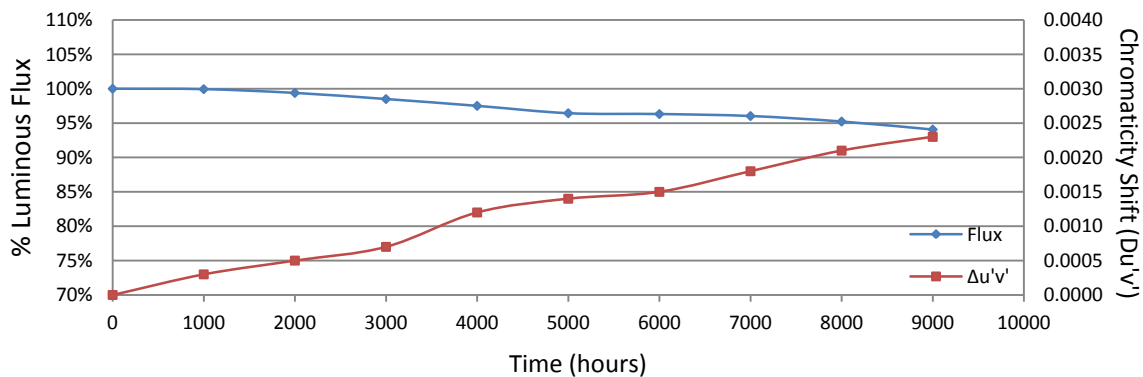
No.	V _F (V)	Φ(lm)	Lumen Maintenance (%)								
	Ohr(Initial)		1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
26	3.109	19.38	99.90	99.23	98.56	97.57	96.49	96.39	96.08	95.20	94.01
27	3.097	19.38	100.05	99.33	98.71	97.78	96.34	96.28	96.08	95.25	94.53
28	3.117	19.55	100.10	99.44	98.57	97.34	96.21	96.16	95.91	95.09	93.96
29	3.113	19.06	99.95	99.42	98.58	97.43	96.38	96.27	95.59	94.96	93.65
30	3.122	19.74	100.00	99.54	98.73	97.57	96.35	96.20	96.00	95.64	94.63
31	3.107	19.60	99.80	99.49	98.47	97.45	96.33	96.17	95.92	95.31	93.88
32	3.137	18.99	99.79	99.26	98.31	97.37	96.47	96.42	96.21	95.52	94.47
33	3.123	18.57	99.84	99.30	98.71	97.79	96.77	96.55	96.45	95.75	94.78
34	3.105	19.64	99.85	99.34	98.37	97.40	96.28	96.13	95.88	95.06	93.84
35	3.109	18.61	100.05	99.36	98.39	97.74	96.67	96.51	96.29	95.49	94.68
36	3.069	19.42	100.00	99.38	98.46	97.48	96.19	96.09	95.83	95.01	93.98
37	3.144	19.75	100.05	99.44	98.58	97.72	96.66	96.30	96.00	95.24	94.33
38	3.135	18.90	99.89	99.42	98.62	97.78	96.51	96.35	96.24	95.24	93.76
39	3.113	19.70	99.95	99.49	98.53	97.77	96.24	96.19	95.99	95.48	93.96
40	3.106	19.62	100.00	99.44	98.78	97.71	96.79	96.43	96.13	95.21	93.83
41	3.101	19.52	99.74	99.44	98.46	97.49	96.16	96.06	95.85	95.08	93.70
42	3.136	18.97	99.89	99.42	98.68	97.47	96.26	96.20	95.94	95.47	94.31
43	3.152	19.29	100.00	99.27	98.39	97.30	96.16	96.06	95.80	95.08	93.68
44	3.119	19.57	99.90	99.54	98.31	97.34	96.53	96.47	95.96	94.99	93.97
45	3.131	18.97	99.84	99.47	98.31	97.31	96.57	96.47	96.15	95.31	94.10
46	3.112	19.32	99.90	99.38	98.34	97.36	96.43	96.38	95.86	94.93	93.74
47	3.119	18.57	99.78	99.30	98.38	97.42	96.61	96.50	96.28	95.05	94.13
48	3.106	19.25	100.05	99.32	98.39	97.40	96.57	96.52	96.26	95.12	93.71
49	3.152	19.67	100.10	99.44	98.32	97.41	96.49	96.34	96.19	95.02	93.90
50	3.105	18.43	100.11	99.35	98.48	97.40	96.58	96.53	95.93	95.23	94.03
Ave.	3.118	19.26	99.94	99.39	98.50	97.51	96.44	96.32	96.03	95.23	94.06
Med.	3.113	19.38	99.95	99.42	98.47	97.45	96.47	96.34	96.00	95.21	93.97
st dev	0.0186	0.4084	0.1099	0.0854	0.1472	0.1691	0.1862	0.1585	0.1950	0.2216	0.3361
Min.	3.069	18.43	99.74	99.23	98.31	97.30	96.16	96.06	95.59	94.93	93.65
Max.	3.152	19.75	100.11	99.54	98.78	97.79	96.79	96.55	96.45	95.75	94.78

TM-21 Projection:

Test Duration: 9000 hours
Failures Observed: 0
 α : 6.314E-06
 β : 0.999
Calculated L₇₀: 56,000 hours
Reported L₇₀: >54000 hours

3.4 Data Set 2, 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
26	0.2584	0.5275	2787	0.0004	0.0007	0.0009	0.0012	0.0015	0.0015	0.0017	0.0023	0.0024
27	0.2583	0.5281	2785	0.0003	0.0008	0.0009	0.0014	0.0015	0.0017	0.0020	0.0021	0.0024
28	0.2585	0.5280	2782	0.0004	0.0007	0.0008	0.0013	0.0016	0.0016	0.0019	0.0022	0.0025
29	0.2570	0.5257	2826	0.0004	0.0006	0.0007	0.0014	0.0016	0.0017	0.0019	0.0021	0.0024
30	0.2602	0.5302	2737	0.0003	0.0004	0.0007	0.0010	0.0013	0.0015	0.0017	0.0020	0.0021
31	0.2595	0.5294	2754	0.0003	0.0004	0.0006	0.0010	0.0014	0.0016	0.0017	0.0019	0.0021
32	0.2593	0.5316	2749	0.0004	0.0006	0.0008	0.0014	0.0015	0.0015	0.0020	0.0022	0.0023
33	0.2591	0.5302	2759	0.0002	0.0004	0.0007	0.0011	0.0014	0.0015	0.0017	0.0021	0.0023
34	0.2595	0.5290	2755	0.0003	0.0006	0.0007	0.0009	0.0011	0.0014	0.0018	0.0022	0.0024
35	0.2593	0.5299	2757	0.0006	0.0009	0.0011	0.0014	0.0014	0.0015	0.0020	0.0022	0.0025
36	0.2568	0.5259	2828	0.0002	0.0008	0.0010	0.0013	0.0014	0.0016	0.0017	0.0019	0.0022
37	0.2584	0.5271	2788	0.0004	0.0006	0.0009	0.0011	0.0013	0.0014	0.0016	0.0021	0.0025
38	0.2595	0.5306	2750	0.0003	0.0005	0.0007	0.0014	0.0015	0.0016	0.0021	0.0022	0.0026
39	0.2594	0.5277	2764	0.0001	0.0005	0.0008	0.0015	0.0016	0.0018	0.0018	0.0020	0.0027
40	0.2587	0.5287	2775	0.0004	0.0007	0.0009	0.0014	0.0015	0.0017	0.0018	0.0019	0.0022
41	0.2586	0.5276	2781	0.0005	0.0008	0.0009	0.0015	0.0016	0.0017	0.0018	0.0022	0.0023
42	0.2583	0.5309	2774	0.0002	0.0003	0.0004	0.0011	0.0015	0.0016	0.0018	0.0020	0.0024
43	0.2583	0.5278	2788	0.0000	0.0001	0.0004	0.0009	0.0012	0.0016	0.0018	0.0020	0.0022
44	0.2583	0.5268	2792	0.0002	0.0004	0.0008	0.0011	0.0016	0.0017	0.0017	0.0021	0.0026
45	0.2588	0.5312	2762	0.0001	0.0004	0.0005	0.0009	0.0012	0.0013	0.0016	0.0020	0.0022
46	0.2567	0.5266	2828	0.0000	0.0002	0.0004	0.0010	0.0011	0.0013	0.0015	0.0022	0.0025
47	0.2577	0.5302	2788	0.0003	0.0006	0.0008	0.0010	0.0012	0.0015	0.0018	0.0020	0.0025
48	0.2592	0.5282	2766	0.0004	0.0005	0.0009	0.0010	0.0012	0.0014	0.0016	0.0019	0.0015
49	0.2594	0.5304	2753	0.0004	0.0005	0.0006	0.0012	0.0013	0.0014	0.0018	0.0021	0.0023
50	0.2591	0.5301	2761	0.0001	0.0004	0.0005	0.0010	0.0013	0.0015	0.0015	0.0019	0.0023
Ave.	0.2587	0.5288	2776	0.0003	0.0005	0.0007	0.0012	0.0014	0.0015	0.0018	0.0021	0.0023
Med.	0.2587	0.5287	2774	0.0003	0.0005	0.0008	0.0011	0.0014	0.0015	0.0018	0.0021	0.0024
st dev	0.0009	0.0017	24.6257	0.0002	0.0002	0.0002	0.0002	0.0002	0.0001	0.0002	0.0001	0.0002
Min.	0.2567	0.5257	2737	0.0000	0.0001	0.0004	0.0009	0.0011	0.0013	0.0015	0.0019	0.0015
Max.	0.2602	0.5316	2828	0.0006	0.0009	0.0011	0.0015	0.0016	0.0018	0.0021	0.0023	0.0027



3.5 Data Set 3, 85 °C, 60mA (Lumen Maintenance)

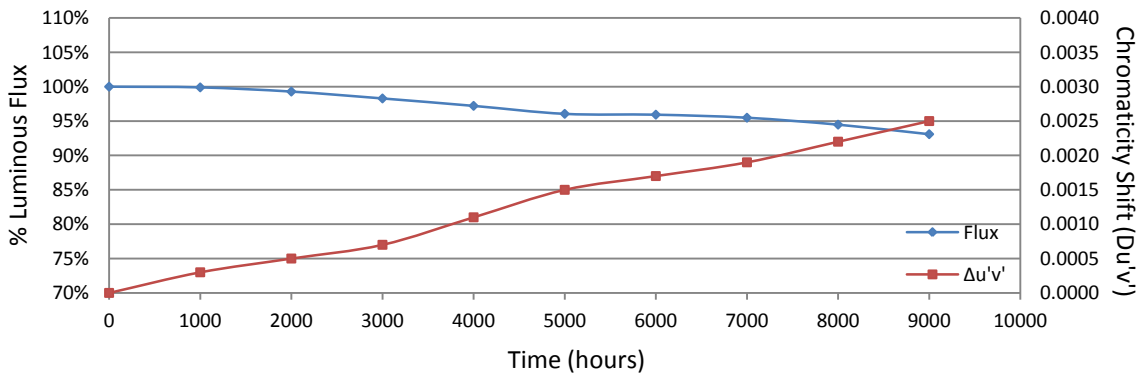
No.	V _F (V)	Φ(lm)	Lumen Maintenance (%)								
			Ohr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs
51	3.101	19.30	99.84	99.48	98.55	97.36	96.32	96.27	95.91	95.03	93.16
52	3.137	18.44	99.95	99.35	98.32	97.29	96.31	96.20	95.66	94.69	93.22
53	3.130	19.11	99.95	99.16	98.22	97.07	96.02	95.92	95.55	94.56	93.25
54	3.130	18.40	100.00	99.24	98.26	97.39	96.25	96.20	95.76	94.62	92.83
55	3.111	19.58	99.85	99.28	98.11	97.29	96.07	95.91	95.56	94.74	93.00
56	3.103	19.65	99.80	99.34	98.47	97.10	96.03	95.88	95.17	94.66	93.33
57	3.117	18.34	100.11	99.45	98.36	97.33	95.91	95.80	95.15	94.06	92.80
58	3.100	19.39	99.85	99.28	98.19	97.32	95.98	95.87	95.41	94.43	93.24
59	3.125	18.79	99.84	99.20	98.24	97.13	95.90	95.80	95.37	94.15	92.87
60	3.114	18.37	99.89	99.24	98.20	97.28	95.86	95.81	95.16	94.50	92.76
61	3.130	18.64	99.79	99.46	98.44	97.10	95.71	95.60	95.33	94.26	92.97
62	3.115	19.38	99.90	99.33	98.30	97.01	96.23	96.18	95.72	94.27	92.83
63	3.114	18.78	100.05	99.36	98.40	97.07	96.06	95.95	95.63	94.62	93.24
64	3.095	19.53	100.10	99.33	98.31	97.13	95.80	95.75	95.39	94.32	92.73
65	3.136	18.96	99.84	99.16	98.10	97.10	95.99	95.94	95.78	94.67	93.09
66	3.097	19.39	99.95	99.33	98.35	97.11	96.13	96.08	95.67	94.22	93.09
67	3.122	18.75	99.79	99.25	98.45	97.17	96.11	96.00	95.63	94.51	93.01
68	3.136	18.80	99.79	99.10	98.51	97.45	96.17	96.06	95.64	94.26	93.09
69	3.100	19.28	100.05	99.33	98.18	97.10	95.80	95.75	95.23	94.45	93.36
70	3.122	18.38	99.84	99.35	98.37	97.44	95.92	95.81	95.32	94.34	93.47
71	3.120	19.07	99.74	99.37	98.27	97.27	96.28	96.07	95.54	94.55	93.13
72	3.126	18.74	99.73	99.36	98.13	97.01	96.00	95.78	95.25	94.34	92.53
73	3.130	18.64	100.11	99.25	98.23	97.26	96.24	96.14	95.76	94.80	93.62
74	3.119	18.42	99.78	99.13	98.10	97.23	96.09	95.82	95.33	94.63	93.54
75	3.100	19.90	100.00	99.15	98.14	97.14	95.98	95.58	95.28	94.27	92.96
Ave.	3.117	18.96	99.90	99.29	98.29	97.21	96.05	95.93	95.49	94.48	93.09
Med.	3.119	18.80	99.85	99.33	98.27	97.17	96.03	95.91	95.54	94.50	93.09
st dev	0.0133	0.4653	0.1187	0.1041	0.1322	0.1312	0.1688	0.1863	0.2241	0.2290	0.2675
Min.	3.095	18.34	99.73	99.10	98.10	97.01	95.71	95.58	95.15	94.06	92.53
Max.	3.137	19.90	100.11	99.48	98.55	97.45	96.32	96.27	95.91	95.03	93.62

TM-21 Projection:

Test Duration: 9000 hours
Failures Observed: 0
 α : 7.731E-06
 β : 1.003
Calculated L₇₀: 47,000 hours
Reported L₇₀: 47,000 hours

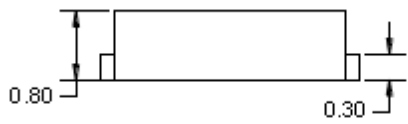
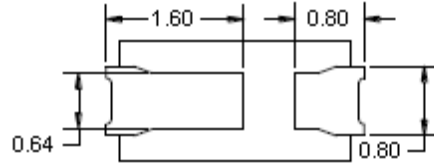
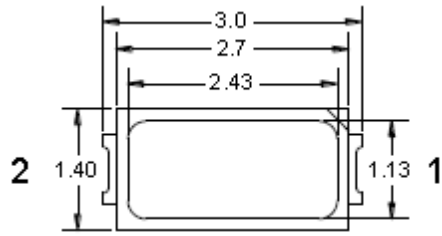
3.6 Data Set 3, 85 °C, 60mA (Chromaticity Shift)

No.	u'	v'	CCT(K)	Chromaticity Shift ($\Delta u'v'$)								
	0hr(Initial)			1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
51	0.2605	0.5279	2739	0.0005	0.0007	0.0009	0.0011	0.0013	0.0013	0.0015	0.0022	0.0025
52	0.2583	0.5300	2778	0.0003	0.0004	0.0006	0.0014	0.0015	0.0018	0.0019	0.0020	0.0025
53	0.2593	0.5305	2755	0.0002	0.0006	0.0008	0.0016	0.0018	0.0019	0.0022	0.0023	0.0024
54	0.2591	0.5302	2758	0.0004	0.0008	0.0010	0.0015	0.0017	0.0017	0.0022	0.0024	0.0029
55	0.2601	0.5287	2745	0.0003	0.0005	0.0009	0.0011	0.0015	0.0017	0.0019	0.0021	0.0023
56	0.2597	0.5291	2752	0.0004	0.0005	0.0008	0.0009	0.0012	0.0014	0.0016	0.0019	0.0023
57	0.2592	0.5306	2756	0.0004	0.0005	0.0007	0.0011	0.0015	0.0016	0.0019	0.0021	0.0026
58	0.2598	0.5283	2753	0.0004	0.0005	0.0006	0.0013	0.0016	0.0018	0.0021	0.0023	0.0027
59	0.2574	0.5311	2792	0.0003	0.0003	0.0007	0.0011	0.0014	0.0017	0.0021	0.0023	0.0025
60	0.2594	0.5288	2759	0.0001	0.0005	0.0006	0.0014	0.0016	0.0017	0.0018	0.0019	0.0023
61	0.2588	0.5302	2766	0.0006	0.0008	0.0009	0.0012	0.0016	0.0018	0.0020	0.0023	0.0027
62	0.2578	0.5256	2807	0.0005	0.0006	0.0009	0.0013	0.0014	0.0016	0.0020	0.0023	0.0023
63	0.2587	0.5287	2775	0.0004	0.0007	0.0008	0.0010	0.0012	0.0012	0.0015	0.0018	0.0027
64	0.2596	0.5293	2752	0.0001	0.0002	0.0005	0.0007	0.0010	0.0014	0.0015	0.0022	0.0027
65	0.2588	0.5303	2766	0.0002	0.0005	0.0006	0.0010	0.0015	0.0019	0.0020	0.0023	0.0026
66	0.2600	0.5284	2749	0.0002	0.0002	0.0005	0.0008	0.0014	0.0016	0.0019	0.0019	0.0021
67	0.2587	0.5309	2764	0.0001	0.0003	0.0006	0.0007	0.0017	0.0018	0.0018	0.0022	0.0028
68	0.2592	0.5305	2755	0.0002	0.0002	0.0004	0.0012	0.0015	0.0015	0.0018	0.0020	0.0025
69	0.2572	0.5262	2818	0.0002	0.0007	0.0008	0.0014	0.0014	0.0015	0.0018	0.0022	0.0025
70	0.2587	0.5292	2772	0.0001	0.0004	0.0005	0.0009	0.0018	0.0018	0.0018	0.0022	0.0023
71	0.2577	0.5280	2800	0.0001	0.0005	0.0005	0.0010	0.0015	0.0016	0.0018	0.0022	0.0025
72	0.2593	0.5313	2751	0.0001	0.0005	0.0007	0.0014	0.0017	0.0019	0.0019	0.0021	0.0025
73	0.2594	0.5316	2746	0.0001	0.0006	0.0008	0.0014	0.0018	0.0019	0.0021	0.0023	0.0023
74	0.2578	0.5291	2791	0.0002	0.0004	0.0005	0.0009	0.0016	0.0016	0.0016	0.0023	0.0024
75	0.2596	0.5289	2754	0.0001	0.0004	0.0005	0.0008	0.0018	0.0019	0.0019	0.0022	0.0024
Ave.	0.2589	0.5293	2768	0.0003	0.0005	0.0007	0.0011	0.0015	0.0017	0.0019	0.0022	0.0025
Med.	0.2592	0.5292	2759	0.0002	0.0005	0.0007	0.0011	0.0015	0.0017	0.0019	0.0022	0.0025
st dev	0.0010	0.0015	22.7496	0.0001	0.0002	0.0002	0.0003	0.0002	0.0002	0.0002	0.0002	0.0002
Min.	0.2568	0.5256	2739	0.0001	0.0002	0.0004	0.0007	0.0010	0.0012	0.0015	0.0018	0.0021
Max.	0.2605	0.5316	2818	0.0006	0.0008	0.0010	0.0016	0.0018	0.0019	0.0022	0.0024	0.0029



Appendix A – EUT PHOTO

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



Unit: mm

A.2 EUT Photo



TMPLLED



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