



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-W2HI32DS-DF-N-Y

Report Type: 10000 Hours Test Report	Product Type: LED Package
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Report Number: R2DG150306053-10-10000-M1	
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Report Date: 2017-11-07	
Reviewed By: Jeanne Han /EE Manager	<i>Jeanne Han</i>
Revised Note:	The previous report R2DG150306053-10-10000 is replaced by this report on 2017-11-07
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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-W2HI32DS-DF-N-Y
 Part Type: LED Package
 Nominal CCT: 2700K

Family products covered by this report:

According to ENERGY STAR® Program Guidance Regarding LED Package, LED Array and LED Module Lumen Maintenance Performance Data Supporting Qualification of Lighting Products, the following products can be covered by this report base on the declaration letter of manufacturer. The information of these models shows that the covered products meet all section 3 item 7 requirements of ENERGY STAR® Program Guidance Regarding LED Package, LED Array and LED Module Lumen Maintenance Performance Data Supporting Qualification of Lighting Products (September 9, 2011)

Series name	Model name	CCT(K)	Current(mA)	Volt(V)
2835	RF- * * * * I32DS- * * - * N(-Y) (Test model: RF-W27HI32DS-DF-N-Y)	2700/3000/4000/ 5000/5700/6000/6500	60	3
2835	RT- * * * * I32DS- * * - * N(-Y)	2700/3000/4000/ 5000/5700/6000/6500	60	3

Model Number Format:

$$\frac{\text{RF}}{\text{A1}} - \frac{*}{\text{A2}} \frac{*}{\text{A3}} \frac{*}{\text{A4}} \text{I32DS} - \frac{*}{\text{A5}} \frac{*}{\text{A6}} - \frac{*}{\text{A7}} \text{N} \frac{(-\text{Y})}{\text{A8}}$$

Note:

A1: Letter RF can be RF or RT, It is an internal Market code which does not affect property;

A2: Letter * represent customer name, it can be C, D, H, K, L, M, P, S, T, W, Y;

A3: Letter ** represent CCT, it can be 27, 30, 35, 40, 45, 50, 57, 60, 62, 65; ** don't mean only two numbers, it maybe also as mentioned 2, 3, 4, 5, 6, 7.

A4: Letter * represent workshop code, it can be R, M, H, T or Q&S which does not affect product property;

A5: Letter I32DS is a fixed code;

A6: Letter ** can be BF, CF, DF, EF, FF or FH, it is an internal Market code which does not affect product property;

A7: Letter *N can be 1N, 2N, 3N, it is an internal Market code which does not affect product property;

A8: A (-Y) on behalf of the centrifugal power equipment is not used. No (-Y) on behalf of using centrifugal power equipment

Disclaimer:

The truthfulness and accuracy of all the technical information above for the covered LED products is ensured by manufacturer of LED light source. Bay Area Compliance Laboratories Corp. (Dongguan) isn't responsible or gives any guarantees for the truthfulness of the technical information.

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
Integral Sphere	EVERFINE	Diameter 0.3m	1011119	0.3m	2017-03-09	2018-03-08
Programmable Test Power for LEDs	EVERFINE	LED300E	1008002	15V/2000mA	2017-03-03	2018-03-02
High accuracy array spectroradiometer	EVERFINE	HAAS-2000	1012016T	380-780nm	2017-03-09	2018-03-08
Standard Light Source	EVERFINE	D062	1011093	3000K	2016-09-13	2017-09-12
Precision digital stabilized DC power supply	EVERFINE	WY605-V110	G115987CJ7321114	300VA	2017-03-03	2018-03-02
Multilayer aging machine	BACL	B2-270	20005	25°C~130°C	2016-09-01	2017-09-01
Digital CC&CV DC Power Supply	EVERFINE	WY5015	11090007	(50V/15A)	2017-03-03	2018-03-02
Digital CC&CV DC Power Supply	EVERFINE	WY5015	11090005	(50V/15A)	2017-03-03	2018-03-02
Digital CC&CV DC Power Supply	EVERFINE	WY5015	11090006	(50V/15A)	2017-03-03	2018-03-02

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 $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$, 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).

FINAL

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 90Pcs;

Each Ts test condition 30Pcs

The samples tested at Ts 55°C, Ts 85°C and Ts 105°C were received at 2015-03-06 and tested during 2015-03-09 to 2017-04-02. The samples were numbered from 1 to 30, 31 to 60 and 61 to 90

Data Set 1: 55°C, 60mA

Part Number:	RF-W2HI32DS-DF-N-Y
Number of Units:	30
Actual Case Temperature(T _S):	T _S =53.2°C
Actual Ambient Temperature(T _A):	T _A =52.7°C
Life Test Drive Current:	I _F = 60mA
Measurement Current:	I _F = 60mA

Data Set 2: 85°C,60mA

Part Number:	RF-W2HI32DS-DF-N-Y
Number of Units:	30
Actual Case Temperature(T _S):	T _S =83.5°C
Actual Ambient Temperature(T _A):	T _A =82.6°C
Life Test Drive Current:	I _F =60mA
Measurement Current:	I _F = 60mA

Data Set 3: 105°C, 60mA

Part Number:	RF-W2HI32DS-DF-N-Y
Number of Units:	30
Actual Case Temperature(T _S):	T _S =104.1°C
Actual Ambient Temperature(T _A):	T _A =103.4°C
Life Test Drive Current:	I _F = 60mA
Measurement Current:	I _F = 60mA

2 - SUMMARY OF TEST RESULT

Data Set:	Data Set 1, 55°C, 60mA
Number of Units:	30
Failures Observed:	0
Test Interval and Test Duration:	0h,1000h,2000h,3000h,4000h,5000h,6000h, 7000h,8000h,9000h,10000h
Average. Lumen Maintenance at 6000 hours:	98.02%
Average. Lumen Maintenance at 9000 hours:	97.11%
Average. Lumen Maintenance at 10000 hours:	96.81%
Average Chromaticity Shift at 6000 hours ($\Delta u'v'$):	0.0020
Average Chromaticity Shift at 9000 hours ($\Delta u'v'$):	0.0025
Average Chromaticity Shift at 10000 hours ($\Delta u'v'$):	0.0027
Reported TM-21 L ₇₀ Lifetime:	>60,000 hours

Data Set:	Data Set 2, 85°C, 60mA
Number of Units:	30
Failures Observed:	0
Test Interval and Test Duration:	0h,1000h,2000h,3000h,4000h,5000h,6000h, 7000h,8000h,9000h,10000h
Average. Lumen Maintenance at 6000 hours:	96.95%
Average. Lumen Maintenance at 9000 hours:	95.60%
Average. Lumen Maintenance at 10000 hours:	95.25%
Average Chromaticity Shift at 6000 hours($\Delta u'v'$):	0.0017
Average Chromaticity Shift at 9000 hours ($\Delta u'v'$):	0.0026
Average Chromaticity Shift at 10000 hours ($\Delta u'v'$):	0.0027
Reported TM-21 L ₇₀ Lifetime:	>60,000 hours

Data Set:	Data Set 3, 105°C, 60mA
Number of Units:	30
Failures Observed:	0
Test Interval and Test Duration:	0h,1000h,2000h,3000h,4000h,5000h,6000h, 7000h,8000h,9000h,10000h
Average. Lumen Maintenance at 6000 hours:	96.04%
Average. Lumen Maintenance at 9000 hours:	94.54%
Average. Lumen Maintenance at 10000 hours:	94.15%
Average Chromaticity Shift at 6000 hours($\Delta u'v'$):	0.0017
Average Chromaticity Shift at 9000 hours ($\Delta u'v'$):	0.0028
Average Chromaticity Shift at 10000 hours ($\Delta u'v'$):	0.0031
Reported TM-21 L_{70} Lifetime:	>60,000 hours

3 - Test Data

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

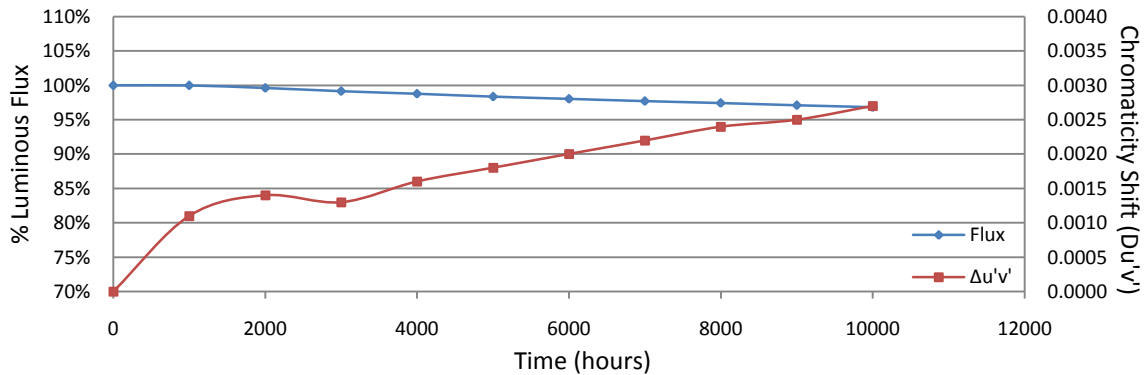
No.	V _F (V)	Φ(lm)	Lumen Maintenance (%)									
	Ohr(Initial)		1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs	10000hrs
1	2.941	24.44	100.20	99.92	99.55	98.98	98.61	98.20	97.91	97.55	97.26	97.05
2	2.950	24.37	100.70	100.33	99.84	99.14	98.89	98.52	98.11	97.87	97.54	97.29
3	2.945	24.71	99.31	99.03	98.46	97.98	97.37	97.05	96.72	96.68	96.40	95.95
4	2.950	23.85	99.37	98.95	98.28	97.78	97.15	96.98	96.52	96.10	95.85	95.68
5	2.949	24.40	100.08	99.80	99.75	99.30	98.98	98.44	97.70	97.25	96.93	96.84
6	2.939	24.28	100.62	100.16	99.88	99.63	99.18	98.64	98.27	98.02	97.78	97.57
7	2.940	24.67	100.45	100.16	99.55	99.35	98.99	98.42	97.97	97.73	97.45	97.24
8	2.935	24.12	99.21	99.05	98.59	98.18	97.76	97.39	96.97	96.68	96.31	95.90
9	2.933	24.53	99.31	99.06	98.65	98.12	97.76	97.11	96.66	96.45	96.00	95.68
10	2.933	24.90	99.48	99.40	99.04	98.59	97.99	97.71	97.63	97.31	97.11	96.83
11	2.939	24.24	100.58	100.04	99.67	99.13	98.60	98.35	98.02	97.69	97.40	97.19
12	2.950	23.68	102.96	102.07	100.21	99.70	99.16	98.86	98.18	98.02	97.55	97.42
13	2.950	24.21	99.17	98.80	97.89	97.60	97.27	96.78	96.53	96.41	96.12	95.75
14	2.936	24.38	99.38	98.97	98.48	97.99	97.50	97.17	97.09	96.96	96.64	96.43
15	2.938	23.16	100.39	100.04	99.78	99.53	99.27	99.01	98.88	98.53	98.19	97.88
16	2.948	24.37	100.62	100.21	99.75	99.34	99.18	98.97	98.73	98.48	98.11	97.83
17	2.942	23.67	100.25	98.94	98.27	97.80	97.42	97.17	96.75	96.49	96.24	96.16
18	2.945	24.49	99.43	99.06	98.90	98.49	98.04	97.80	97.75	97.59	97.43	96.98
19	2.937	24.81	99.07	98.87	98.43	98.11	97.78	97.38	97.10	96.82	96.57	96.25
20	2.945	24.77	99.43	99.35	99.31	98.91	98.71	98.30	98.06	97.82	97.62	97.30
21	2.934	24.23	100.50	100.17	99.88	99.38	98.89	98.80	98.72	98.39	98.10	97.73
22	2.937	23.85	100.96	100.29	99.75	99.33	99.12	98.87	98.74	98.32	97.95	97.74
23	2.944	24.13	99.30	98.80	98.38	98.05	97.51	97.10	96.77	96.35	96.06	95.57
24	2.939	24.15	99.50	99.21	98.96	98.80	98.47	98.05	97.60	97.31	97.06	96.60
25	2.942	24.49	99.71	99.55	99.39	99.10	98.73	98.45	98.12	97.71	97.43	96.82
26	2.927	24.17	99.26	98.84	98.68	98.30	97.97	97.68	97.35	97.10	96.77	96.57
27	2.941	24.65	100.00	99.80	99.39	99.03	98.58	98.38	98.22	97.81	97.40	97.08
28	2.947	24.61	100.12	99.84	99.39	98.98	98.58	98.29	98.01	97.64	97.40	97.24
29	2.938	24.72	100.04	99.76	99.35	98.95	98.58	98.22	97.98	97.61	97.29	96.93
30	2.936	24.79	100.08	99.88	99.39	98.99	98.71	98.43	97.98	97.54	97.26	96.81
Ave.	2.941	24.33	99.98	99.61	99.16	98.75	98.36	98.02	97.70	97.41	97.11	96.81
Med.	2.941	24.38	100.02	99.65	99.37	98.96	98.58	98.26	97.94	97.57	97.27	96.88
st dev	0.006	0.40	0.7913	0.7009	0.6177	0.6162	0.6635	0.6818	0.7031	0.6762	0.6702	0.6897
Min.	2.927	23.16	99.07	98.80	97.89	97.60	97.15	96.78	96.52	96.10	95.85	95.57
Max.	2.950	24.90	102.96	102.07	100.21	99.70	99.27	99.01	98.88	98.53	98.19	97.88

TM-21 Projection:

Test Duration: 10,000 hours
Failures Observed: 0
α: 3.154E-06
β: 0.999
Reported L₇₀: >60000 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	0.2583	0.5281	2785	0.0009	0.0012	0.0012	0.0017	0.0019	0.0022	0.0024	0.0026	0.0028	0.0031
2	0.2612	0.5294	2720	0.0011	0.0013	0.0014	0.0017	0.0019	0.0021	0.0023	0.0025	0.0026	0.0030
3	0.2598	0.5297	2747	0.0012	0.0013	0.0015	0.0018	0.0021	0.0024	0.0025	0.0027	0.0028	0.0032
4	0.2619	0.5302	2702	0.0013	0.0014	0.0017	0.0020	0.0023	0.0026	0.0027	0.0029	0.0030	0.0032
5	0.2604	0.5300	2732	0.0018	0.0020	0.0015	0.0011	0.0011	0.0012	0.0015	0.0016	0.0017	0.0016
6	0.2601	0.5285	2745	0.0009	0.0011	0.0010	0.0016	0.0017	0.0020	0.0023	0.0025	0.0026	0.0028
7	0.2620	0.5317	2694	0.0010	0.0013	0.0011	0.0016	0.0018	0.0020	0.0022	0.0025	0.0026	0.0028
8	0.2595	0.5276	2763	0.0011	0.0014	0.0013	0.0019	0.0021	0.0023	0.0026	0.0026	0.0028	0.0030
9	0.2605	0.5301	2730	0.0012	0.0014	0.0014	0.0020	0.0021	0.0025	0.0028	0.0029	0.0030	0.0032
10	0.2597	0.5305	2746	0.0018	0.0019	0.0013	0.0012	0.0011	0.0013	0.0015	0.0015	0.0015	0.0016
11	0.2622	0.5311	2693	0.0010	0.0013	0.0011	0.0017	0.0019	0.0021	0.0025	0.0026	0.0027	0.0029
12	0.2621	0.5304	2697	0.0010	0.0013	0.0011	0.0016	0.0019	0.0021	0.0024	0.0026	0.0026	0.0029
13	0.2604	0.5285	2739	0.0012	0.0014	0.0014	0.0020	0.0022	0.0025	0.0028	0.0032	0.0029	0.0018
14	0.2612	0.5299	2716	0.0012	0.0014	0.0014	0.0019	0.0022	0.0024	0.0027	0.0028	0.0029	0.0033
15	0.2579	0.5270	2801	0.0012	0.0019	0.0021	0.0013	0.0012	0.0011	0.0013	0.0012	0.0012	0.0011
16	0.2612	0.5302	2716	0.0011	0.0013	0.0010	0.0017	0.0019	0.0021	0.0026	0.0026	0.0027	0.0029
17	0.2593	0.5276	2767	0.0011	0.0014	0.0010	0.0015	0.0017	0.0019	0.0023	0.0025	0.0026	0.0028
18	0.2595	0.5297	2754	0.0012	0.0017	0.0014	0.0019	0.0022	0.0025	0.0027	0.0029	0.0030	0.0033
19	0.2587	0.5296	2771	0.0010	0.0016	0.0013	0.0018	0.0020	0.0023	0.0026	0.0027	0.0028	0.0030
20	0.2579	0.5298	2787	0.0010	0.0016	0.0015	0.0011	0.0007	0.0006	0.0006	0.0012	0.0013	0.0014
21	0.2598	0.5274	2757	0.0010	0.0012	0.0014	0.0019	0.0023	0.0025	0.0026	0.0031	0.0030	0.0033
22	0.2596	0.5291	2755	0.0011	0.0013	0.0011	0.0016	0.0019	0.0021	0.0023	0.0026	0.0027	0.0030
23	0.2602	0.5309	2733	0.0012	0.0016	0.0015	0.0022	0.0024	0.0026	0.0028	0.0031	0.0031	0.0035
24	0.2598	0.5290	2750	0.0011	0.0014	0.0012	0.0016	0.0019	0.0021	0.0024	0.0027	0.0027	0.0031
25	0.2605	0.5297	2732	0.0018	0.0020	0.0014	0.0012	0.0011	0.0012	0.0012	0.0015	0.0015	0.0016
26	0.2601	0.5297	2741	0.0010	0.0019	0.0015	0.0011	0.0011	0.0013	0.0015	0.0016	0.0015	0.0016
27	0.2607	0.5324	2716	0.0006	0.0009	0.0008	0.0014	0.0016	0.0019	0.0021	0.0024	0.0024	0.0027
28	0.2616	0.5319	2700	0.0006	0.0009	0.0007	0.0013	0.0016	0.0018	0.0023	0.0023	0.0025	0.0027
29	0.2588	0.5301	2766	0.0006	0.0008	0.0007	0.0013	0.0015	0.0018	0.0022	0.0023	0.0024	0.0027
30	0.2584	0.5298	2776	0.0007	0.0008	0.0006	0.0011	0.0010	0.0012	0.0016	0.0023	0.0024	0.0027
Ave.	0.2601	0.5297	2741	0.0011	0.0014	0.0013	0.0016	0.0018	0.0020	0.0022	0.0024	0.0025	0.0027
Med.	0.2601	0.5298	2743	0.0011	0.0014	0.0013	0.0016	0.0019	0.0021	0.0023	0.0026	0.0027	0.0029
st dev	0.0012	0.0013	29	0.0003	0.0003	0.0003	0.0003	0.0004	0.0005	0.0006	0.0006	0.0006	0.0007
Min.	0.2579	0.5270	2693	0.0006	0.0008	0.0006	0.0011	0.0007	0.0006	0.0006	0.0012	0.0012	0.0011
Max.	0.2622	0.5324	2801	0.0018	0.0020	0.0021	0.0022	0.0024	0.0026	0.0028	0.0032	0.0031	0.0035



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

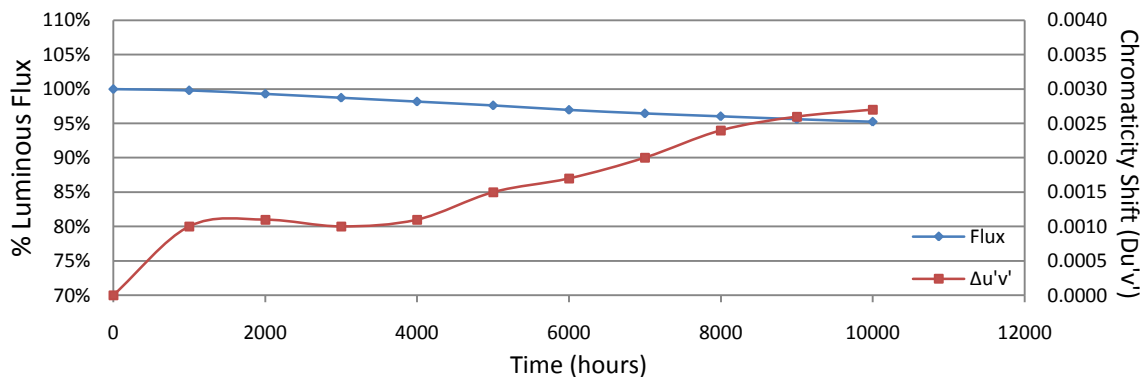
No.	V _F (V)	Φ(lm)	Lumen Maintenance (%)									
			Ohr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
31	2.944	24.47	99.84	99.39	98.08	97.71	97.26	96.85	96.57	96.16	95.59	95.26
32	2.933	24.59	100.45	99.80	99.76	99.35	98.94	98.25	97.84	97.32	97.03	96.71
33	2.935	24.45	100.29	99.67	99.43	98.90	98.36	97.79	97.34	96.93	96.52	96.24
34	2.935	24.64	100.37	99.76	99.59	99.03	98.42	97.85	97.32	96.96	96.43	96.14
35	2.937	24.66	100.24	99.68	99.19	98.82	98.34	97.69	96.92	96.59	96.15	95.82
36	2.935	24.05	99.04	98.59	97.84	97.13	96.67	96.05	95.72	95.43	95.14	94.89
37	2.943	24.42	100.33	99.75	99.43	98.89	98.44	97.91	97.50	97.05	96.68	96.44
38	2.937	24.14	100.17	99.63	99.17	98.59	98.18	97.64	97.06	96.60	96.02	95.65
39	2.940	24.61	100.28	99.51	98.98	98.33	97.93	97.40	96.91	96.46	96.18	95.86
40	2.945	24.25	99.88	99.59	98.80	98.14	97.73	97.15	96.74	96.41	96.00	95.46
41	2.940	24.21	99.38	98.93	98.55	97.89	97.32	96.90	96.24	95.66	95.13	94.67
42	2.940	24.31	99.79	99.38	99.14	98.60	98.11	97.49	96.87	96.42	96.05	95.72
43	2.937	23.38	99.96	99.70	99.49	98.97	98.42	97.78	97.31	96.88	96.54	96.24
44	2.948	24.12	99.83	99.42	99.17	98.67	98.26	97.60	97.06	96.72	96.39	96.14
45	2.939	24.35	99.79	99.67	99.43	99.01	98.44	97.78	97.17	96.76	96.39	95.98
46	2.935	24.45	99.02	98.73	98.12	97.83	97.34	96.69	96.11	95.71	95.17	94.85
47	2.938	23.55	99.45	99.15	99.02	98.34	97.83	97.11	96.56	96.05	95.50	95.12
48	2.943	24.53	99.51	98.98	98.41	97.88	97.43	96.70	96.13	95.72	95.31	95.03
49	2.936	24.36	99.55	99.14	98.48	97.87	97.45	96.72	96.02	95.57	95.11	94.58
50	2.943	23.83	99.66	99.54	98.99	98.36	97.86	97.15	96.56	96.10	95.55	95.34
51	2.932	24.57	99.47	98.98	98.45	98.01	97.56	96.87	96.26	95.77	95.40	95.12
52	2.919	24.54	99.39	98.66	98.33	97.84	97.43	96.66	95.97	95.48	95.19	94.87
53	2.945	24.60	99.47	98.94	98.50	98.09	97.68	97.03	96.50	96.02	95.61	95.24
54	2.939	24.47	99.55	98.98	98.32	97.67	96.98	96.32	95.79	95.34	94.85	94.56
55	2.940	23.79	99.50	98.87	98.28	97.60	96.76	96.09	95.54	95.00	94.70	94.24
56	2.935	24.66	99.51	98.54	98.18	97.32	96.59	95.78	95.42	94.81	94.48	93.88
57	2.936	24.22	99.38	98.60	97.94	97.32	96.49	95.75	95.46	94.92	94.55	94.34
58	2.946	24.57	100.12	99.63	97.80	97.35	96.42	95.73	95.44	95.24	94.71	94.42
59	2.945	24.18	100.17	99.71	97.85	97.27	96.48	95.74	95.33	95.08	94.67	94.09
60	2.940	23.14	100.13	99.57	98.14	97.58	96.63	95.98	95.72	95.55	94.94	94.47
Ave.	2.939	24.27	99.78	99.28	98.70	98.15	97.59	96.95	96.45	96.02	95.60	95.25
Med.	2.939	24.39	99.79	99.40	98.53	98.05	97.62	96.97	96.53	96.03	95.53	95.18
st dev	0.006	0.39	0.3998	0.4166	0.5917	0.6240	0.7210	0.7542	0.7119	0.7087	0.7199	0.7631
Min.	2.919	23.14	99.02	98.54	97.80	97.13	96.42	95.73	95.33	94.81	94.48	93.88
Max.	2.948	24.66	100.45	99.80	99.76	99.35	98.94	98.25	97.84	97.32	97.03	96.71

TM-21 Projection:

Test Duration: 10,000 hours
Failures Observed: 0
 α : 4.797E-06
 β : 0.998
Reported L₇₀: >60,000 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
31	0.2616	0.5316	2701	0.0018	0.0019	0.0016	0.0013	0.0011	0.0012	0.0013	0.0016	0.0019	0.0017
32	0.2592	0.5282	2767	0.0007	0.0010	0.0011	0.0011	0.0017	0.0019	0.0021	0.0027	0.0028	0.0027
33	0.2606	0.5297	2730	0.0006	0.0009	0.0010	0.0010	0.0016	0.0017	0.0020	0.0025	0.0026	0.0026
34	0.2605	0.5312	2726	0.0006	0.0009	0.0010	0.0011	0.0017	0.0019	0.0021	0.0026	0.0027	0.0029
35	0.2581	0.5284	2788	0.0006	0.0009	0.0009	0.0010	0.0015	0.0018	0.0020	0.0025	0.0027	0.0029
36	0.2628	0.5293	2687	0.0019	0.0018	0.0017	0.0013	0.0012	0.0013	0.0015	0.0017	0.0018	0.0018
37	0.2596	0.5306	2746	0.0006	0.0010	0.0009	0.0009	0.0014	0.0016	0.0018	0.0024	0.0024	0.0027
38	0.2595	0.5280	2761	0.0007	0.0009	0.0010	0.0011	0.0016	0.0018	0.0020	0.0025	0.0026	0.0027
39	0.2602	0.5317	2730	0.0007	0.0009	0.0011	0.0012	0.0017	0.0019	0.0022	0.0026	0.0027	0.0029
40	0.2618	0.5316	2699	0.0005	0.0008	0.0008	0.0010	0.0014	0.0017	0.0020	0.0024	0.0032	0.0034
41	0.2600	0.5292	2745	0.0018	0.0018	0.0016	0.0011	0.0011	0.0012	0.0015	0.0017	0.0019	0.0018
42	0.2590	0.5277	2772	0.0010	0.0008	0.0006	0.0010	0.0015	0.0018	0.0020	0.0025	0.0026	0.0027
43	0.2586	0.5287	2777	0.0009	0.0008	0.0008	0.0011	0.0016	0.0018	0.0021	0.0026	0.0026	0.0028
44	0.2615	0.5297	2711	0.0009	0.0009	0.0006	0.0010	0.0015	0.0018	0.0021	0.0025	0.0027	0.0029
45	0.2588	0.5289	2772	0.0009	0.0009	0.0006	0.0012	0.0016	0.0018	0.0021	0.0025	0.0028	0.0029
46	0.2605	0.5299	2732	0.0017	0.0021	0.0016	0.0011	0.0010	0.0011	0.0014	0.0015	0.0015	0.0016
47	0.2594	0.5281	2762	0.0010	0.0009	0.0007	0.0010	0.0014	0.0018	0.0020	0.0025	0.0026	0.0027
48	0.2595	0.5307	2748	0.0009	0.0009	0.0006	0.0009	0.0014	0.0016	0.0019	0.0025	0.0026	0.0027
49	0.2593	0.5287	2762	0.0010	0.0009	0.0006	0.0009	0.0014	0.0016	0.0020	0.0025	0.0026	0.0027
50	0.2623	0.5311	2690	0.0009	0.0009	0.0008	0.0013	0.0017	0.0020	0.0023	0.0028	0.0029	0.0031
51	0.2605	0.5301	2730	0.0009	0.0012	0.0009	0.0012	0.0016	0.0018	0.0021	0.0025	0.0028	0.0027
52	0.2595	0.5291	2755	0.0009	0.0012	0.0009	0.0011	0.0015	0.0018	0.0020	0.0025	0.0026	0.0029
53	0.2582	0.5287	2784	0.0010	0.0011	0.0009	0.0010	0.0014	0.0017	0.0020	0.0025	0.0027	0.0028
54	0.2604	0.5310	2728	0.0010	0.0011	0.0009	0.0012	0.0016	0.0019	0.0021	0.0027	0.0028	0.0029
55	0.2607	0.5305	2724	0.0009	0.0012	0.0009	0.0010	0.0016	0.0017	0.0020	0.0025	0.0027	0.0027
56	0.2612	0.5320	2708	0.0010	0.0011	0.0009	0.0012	0.0016	0.0018	0.0021	0.0025	0.0026	0.0027
57	0.2605	0.5293	2734	0.0010	0.0012	0.0011	0.0010	0.0014	0.0017	0.0019	0.0025	0.0026	0.0028
58	0.2603	0.5307	2732	0.0008	0.0012	0.0012	0.0012	0.0015	0.0018	0.0021	0.0026	0.0028	0.0032
59	0.2610	0.5296	2723	0.0008	0.0011	0.0012	0.0012	0.0016	0.0018	0.0021	0.0026	0.0027	0.0032
60	0.2595	0.5274	2764	0.0008	0.0012	0.0012	0.0011	0.0016	0.0017	0.0021	0.0027	0.0028	0.0031
Ave.	0.2602	0.5297	2740	0.0010	0.0011	0.0010	0.0011	0.0015	0.0017	0.0020	0.0024	0.0026	0.0027
Med.	0.2603	0.5297	2733	0.0009	0.0010	0.0009	0.0011	0.0015	0.0018	0.0020	0.0025	0.0027	0.0028
st dev	0.0012	0.0013	28	0.0004	0.0003	0.0003	0.0001	0.0002	0.0002	0.0002	0.0003	0.0003	0.0004
Min.	0.2581	0.5274	2687	0.0005	0.0008	0.0006	0.0009	0.0010	0.0011	0.0013	0.0015	0.0015	0.0016
Max.	0.2628	0.5320	2788	0.0019	0.0021	0.0017	0.0013	0.0017	0.0020	0.0023	0.0028	0.0032	0.0034



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

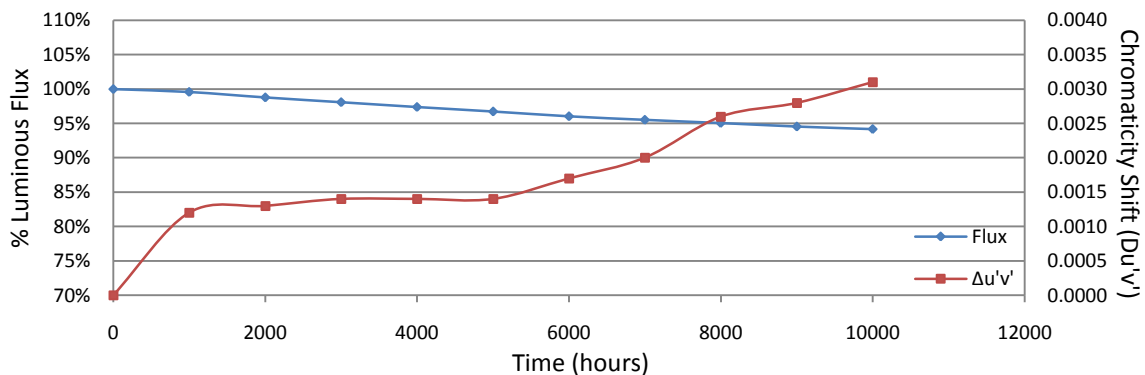
No.	V _F (V)	Φ(lm)	Lumen Maintenance (%)									
			Ohr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
61	2.936	24.43	100.16	99.30	98.12	97.46	96.85	96.07	95.42	94.88	94.47	93.90
62	2.940	24.49	100.20	99.43	98.12	97.47	96.90	96.12	95.51	95.22	94.65	94.32
63	2.950	24.27	99.71	99.05	98.35	97.69	97.03	96.46	95.76	95.30	94.77	94.40
64	2.948	24.67	99.76	99.07	98.34	97.69	96.96	96.35	95.62	95.05	94.49	93.84
65	2.932	24.47	99.84	99.14	98.37	97.63	96.98	96.32	95.75	95.22	94.56	94.28
66	2.946	24.40	99.80	99.02	98.24	97.54	96.89	96.23	95.45	95.00	94.59	94.22
67	2.946	24.21	99.55	99.01	98.31	97.52	96.86	96.28	95.83	95.58	94.96	94.67
68	2.936	24.61	99.47	98.70	98.25	97.60	96.87	96.06	95.81	95.49	95.04	94.56
69	2.945	24.41	99.39	98.69	98.20	97.54	96.89	96.11	95.62	95.37	94.76	94.43
70	2.940	24.26	99.79	98.76	98.31	97.44	96.70	95.92	95.63	95.42	94.81	94.31
71	2.938	24.21	99.50	98.68	98.27	97.69	96.94	96.12	95.66	95.50	95.04	94.47
72	2.947	24.72	100.20	99.51	97.98	97.41	96.84	96.00	95.63	95.47	94.94	94.54
73	2.940	24.46	100.16	99.43	98.20	97.51	96.97	96.20	95.67	95.38	94.93	94.56
74	2.949	24.43	99.96	99.10	98.61	97.95	97.18	96.44	95.99	95.58	95.09	94.68
75	2.950	24.58	99.27	98.45	98.25	97.56	96.87	96.05	95.61	95.08	94.67	94.43
76	2.935	24.28	99.30	98.48	98.02	97.36	96.87	96.09	95.63	95.06	94.69	94.32
77	2.949	24.13	99.30	98.47	97.97	97.18	96.81	96.10	95.57	95.19	94.74	94.53
78	2.940	24.10	99.67	98.55	98.09	97.30	96.56	95.89	95.35	94.98	94.40	94.11
79	2.937	24.39	99.63	98.77	98.07	97.21	96.47	95.86	94.92	94.51	93.89	93.44
80	2.939	24.15	99.83	99.05	98.30	97.47	96.73	96.02	95.28	94.58	94.20	93.91
81	2.944	24.41	99.34	98.65	98.03	97.34	96.64	95.90	95.41	94.76	94.35	94.06
82	2.920	24.65	99.11	98.42	97.77	97.20	96.55	95.86	95.33	94.73	94.20	93.59
83	2.939	24.47	99.06	98.41	97.63	97.02	96.40	95.75	95.34	94.89	94.28	93.95
84	2.946	24.66	99.15	98.54	97.81	97.20	96.55	95.90	95.62	94.89	94.44	94.04
85	2.933	23.97	99.04	98.46	97.71	97.12	96.41	95.79	95.29	94.87	94.41	94.20
86	2.944	23.97	99.33	98.50	97.79	96.95	96.58	95.87	95.16	94.79	94.12	93.74
87	2.943	24.20	99.42	98.47	97.77	97.07	96.61	95.95	95.12	94.75	94.13	93.60
88	2.944	24.46	99.39	98.36	97.75	96.93	96.28	95.58	94.97	94.48	94.07	93.66
89	2.927	24.06	99.42	98.46	98.21	97.34	96.72	96.05	95.34	94.85	94.35	93.97
90	2.945	24.55	99.27	98.33	97.76	97.19	96.42	95.72	95.44	94.70	94.01	93.65
Ave.	2.941	24.37	99.57	98.77	98.09	97.39	96.74	96.04	95.49	95.05	94.54	94.15
Med.	2.942	24.41	99.49	98.68	98.12	97.43	96.83	96.05	95.54	95.03	94.53	94.21
st dev	0.007	0.21	0.3457	0.3572	0.2459	0.2443	0.2199	0.2107	0.2510	0.3270	0.3347	0.3569
Min.	2.920	23.97	99.04	98.33	97.63	96.93	96.28	95.58	94.92	94.48	93.89	93.44
Max.	2.950	24.72	100.20	99.51	98.61	97.95	97.18	96.46	95.99	95.58	95.09	94.68

TM-21 Projection:

Test Duration: 10,000 hours
Failures Observed: 0
 α : 5.358E-06
 β : 0.992
Reported L₇₀: >60,000 hours

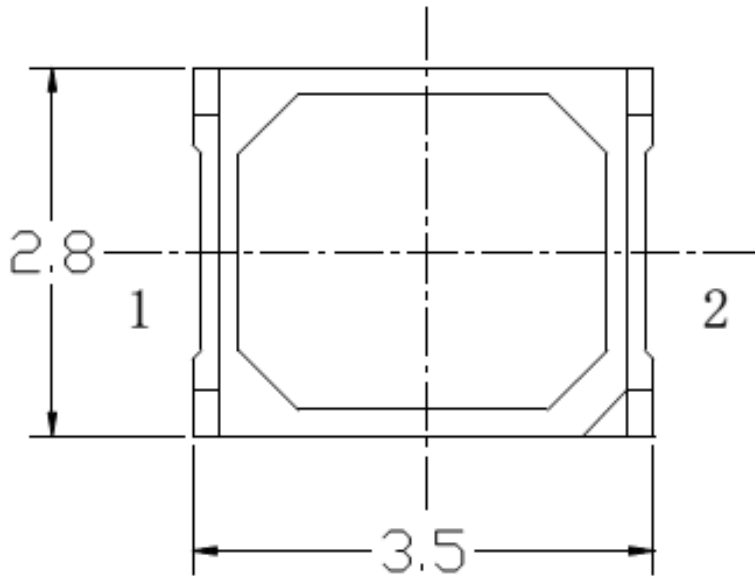
3.6 Data Set 3, 105°C, 60mA (Chromaticity Shift)

No.	u'	v'	CCT(K)	Chromaticity Shift ($\Delta u'v'$)									
	0hr(Initial)			1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs	10000hrs
61	0.2605	0.5293	2735	0.0008	0.0009	0.0008	0.0009	0.0014	0.0016	0.0018	0.0026	0.0028	0.0030
62	0.2595	0.5295	2755	0.0012	0.0010	0.0008	0.0011	0.0016	0.0018	0.0021	0.0027	0.0029	0.0032
63	0.2618	0.5305	2702	0.0014	0.0014	0.0009	0.0010	0.0014	0.0017	0.0020	0.0027	0.0028	0.0031
64	0.2582	0.5278	2789	0.0014	0.0013	0.0009	0.0009	0.0014	0.0016	0.0019	0.0026	0.0028	0.0031
65	0.2608	0.5291	2728	0.0013	0.0013	0.0010	0.0011	0.0015	0.0017	0.0021	0.0026	0.0030	0.0031
66	0.2622	0.5326	2686	0.0013	0.0014	0.0010	0.0011	0.0014	0.0017	0.0021	0.0028	0.0029	0.0031
67	0.2616	0.5303	2708	0.0014	0.0015	0.0012	0.0010	0.0014	0.0016	0.0020	0.0026	0.0028	0.0031
68	0.2590	0.5294	2765	0.0013	0.0015	0.0011	0.0011	0.0015	0.0017	0.0020	0.0026	0.0029	0.0031
69	0.2624	0.5306	2689	0.0014	0.0015	0.0014	0.0010	0.0014	0.0016	0.0021	0.0025	0.0028	0.0031
70	0.2603	0.5297	2735	0.0013	0.0015	0.0014	0.0009	0.0011	0.0014	0.0020	0.0025	0.0028	0.0030
71	0.2599	0.5278	2754	0.0012	0.0015	0.0014	0.0013	0.0014	0.0017	0.0020	0.0025	0.0028	0.0030
72	0.2585	0.5305	2771	0.0009	0.0013	0.0015	0.0013	0.0016	0.0019	0.0021	0.0027	0.0029	0.0032
73	0.2599	0.5293	2746	0.0009	0.0012	0.0013	0.0013	0.0014	0.0017	0.0020	0.0025	0.0026	0.0030
74	0.2597	0.5312	2744	0.0008	0.0013	0.0015	0.0016	0.0017	0.0019	0.0022	0.0027	0.0030	0.0033
75	0.2587	0.5303	2768	0.0009	0.0012	0.0014	0.0013	0.0014	0.0016	0.0019	0.0024	0.0025	0.0030
76	0.2607	0.5291	2731	0.0008	0.0011	0.0014	0.0014	0.0014	0.0017	0.0019	0.0025	0.0028	0.0031
77	0.2598	0.5287	2750	0.0008	0.0010	0.0013	0.0017	0.0013	0.0016	0.0019	0.0023	0.0028	0.0030
78	0.2608	0.5295	2727	0.0008	0.0012	0.0015	0.0018	0.0014	0.0016	0.0018	0.0025	0.0028	0.0030
79	0.2575	0.5274	2806	0.0012	0.0013	0.0014	0.0017	0.0015	0.0017	0.0020	0.0025	0.0028	0.0031
80	0.2607	0.5301	2725	0.0011	0.0013	0.0014	0.0017	0.0014	0.0016	0.0021	0.0026	0.0028	0.0031
81	0.2600	0.5292	2744	0.0012	0.0014	0.0014	0.0018	0.0014	0.0017	0.0020	0.0025	0.0028	0.0031
82	0.2593	0.5303	2754	0.0014	0.0014	0.0017	0.0017	0.0014	0.0016	0.0018	0.0026	0.0029	0.0030
83	0.2607	0.5293	2730	0.0013	0.0014	0.0016	0.0017	0.0014	0.0018	0.0019	0.0024	0.0029	0.0031
84	0.2581	0.5289	2786	0.0013	0.0014	0.0017	0.0018	0.0015	0.0017	0.0019	0.0024	0.0028	0.0031
85	0.2587	0.5277	2780	0.0012	0.0014	0.0017	0.0017	0.0015	0.0017	0.0021	0.0026	0.0028	0.0031
86	0.2620	0.5304	2697	0.0012	0.0013	0.0017	0.0017	0.0015	0.0018	0.0020	0.0026	0.0029	0.0031
87	0.2595	0.5280	2761	0.0013	0.0013	0.0017	0.0018	0.0015	0.0017	0.0020	0.0026	0.0028	0.0032
88	0.2617	0.5312	2701	0.0012	0.0014	0.0016	0.0017	0.0013	0.0016	0.0019	0.0025	0.0027	0.0030
89	0.2590	0.5270	2775	0.0013	0.0013	0.0017	0.0018	0.0015	0.0018	0.0020	0.0026	0.0030	0.0031
90	0.2593	0.5306	2754	0.0012	0.0013	0.0017	0.0017	0.0014	0.0017	0.0020	0.0026	0.0028	0.0030
Ave.	0.2600	0.5295	2743	0.0012	0.0013	0.0014	0.0014	0.0014	0.0017	0.0020	0.0026	0.0028	0.0031
Med.	0.2599	0.5295	2745	0.0012	0.0013	0.0014	0.0015	0.0014	0.0017	0.0020	0.0026	0.0028	0.0031
st dev	0.0013	0.0013	31	0.0002	0.0002	0.0003	0.0003	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Min.	0.2575	0.5270	2686	0.0008	0.0009	0.0008	0.0009	0.0011	0.0014	0.0018	0.0023	0.0025	0.0030
Max.	0.2624	0.5326	2806	0.0014	0.0015	0.0017	0.0018	0.0017	0.0019	0.0022	0.0028	0.0030	0.0033



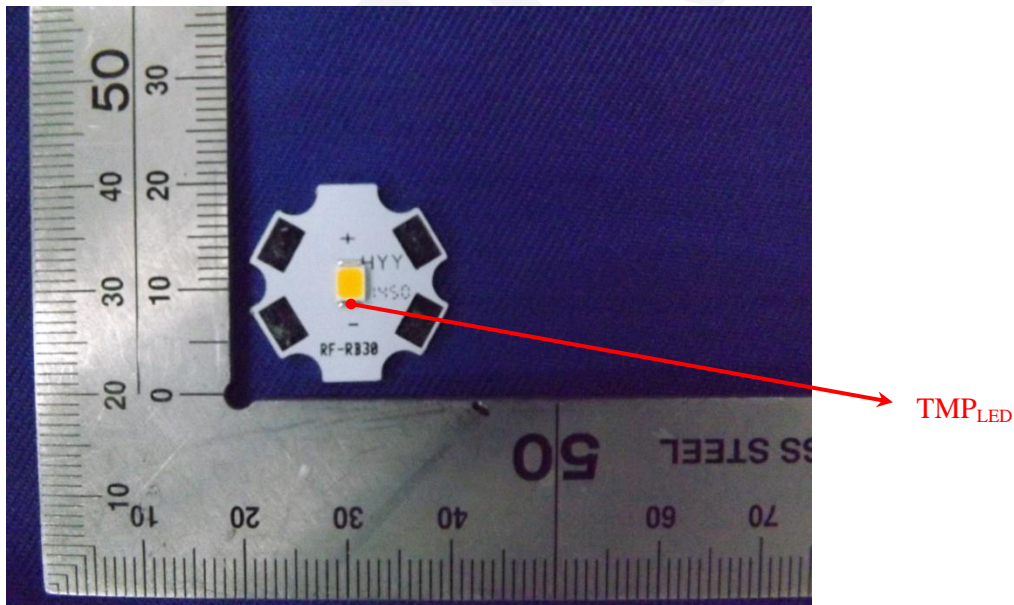
Attachment A – EUT PHOTO

A.1 Mechanical Dimensions (Ta = 25°C)



All dimensions are in millimeter

A.2 EUT Photo



Attachment B –Report Revision

Report Number	Report Date	Contents
R2DG150306053-10-10000	2017-04-14	Original report.
R2DG150306053-10-10000-M1	2017-11-07	Update the Family Declaration in page 3.

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

FINNAL