



TEST REPORT

ACCORDING TO IES LM-80-2015
For

Samsung Electronics Co., LTD.

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

Multiple Model: SPMWHx2296xxxxxxx
Tested Model: SPMWHx2296Q5SGW0xx

Report Type: 9000 Hours Test Report		Product Type: LED Package	
Test Engineer:	Pote Wang	<i>Pote Wang</i>	
Report Number:	RSZ170417502-10		
Test Date:	2016-02-15 to 2017-02-24		
Report Date:	2017-05-12		
Reviewed By:	Daniel Duan / EE Manager	<i>Daniel Duan</i>	
Test Facility:	Test facility was located at No.69,Pulongcun ,Puxinhu Industrial Area, Tangxia , Dongguan, Guangdong, China.		
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Note: The test data was only valid for the test sample(s). This test report is prepared for the customer shown above and for the device described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. (Dongguan).

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

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1 - General Information

1.1 Description of LED Light Sources

Sample Size:

75 PCS samples were received on 2016-02-15. The samples were numbered from 1 to 25, 26 to 50 and 51 to 75.

Manufacturer: Samsung Electronics Co., LTD.
Part Number: SPMWHx2296Q5SGW0xx
Part Type: LED Package
Drive Level: DC 60mA
Nominal CCT: 2700K

Note:

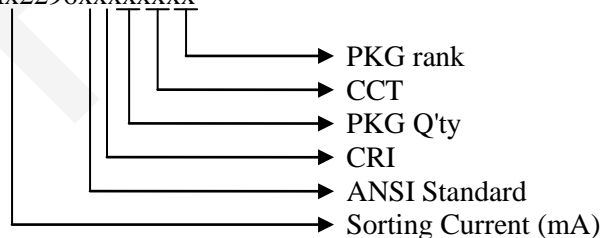
1. The applicant Samsung Electronics Co., LTD. declare that their products with model SPMWHx2296Q5SGW0xx are the same to the products in report# RSZ160215504-10 and is authorized by original applicant to use their test data.
2. All the data in previous report (RSZ160215504-10) is shared in this report.

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 (see attachment B for more information). 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)

Covered models and nomenclature:

Multiple Models: SPMWHx2296xxxxxxxx



*The CRI of the previous report (RSZ160215504-10) is 80.

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-80-15: 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 Testing 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	G115987CJ73 21114	300VA	2017-03-03	2018-03-02
Multilayer aging machine	BACL	B2-270	20015	25°C~130°C	2017-03-03	2018-03-02
Digital CC&CV DC Power Supply	EVERFINE	WY5015	11090007	(50/15A)	2017-03-03	2018-03-02
Digital CC&CV DC Power Supply	EVERFINE	WY5015	11090005	(50/15A)	2017-03-03	2018-03-02
Digital CC&CV DC Power Supply	EVERFINE	WY5015	11090006	(50/15A)	2017-03-03	2018-03-02

1.4 Drive Level

Samples are driven with a constant direct current (DC) during maintenance test, photometric and electrical measurement. The current value was regulated to within $\pm 3\%$ of the specified value of the manufacturer during maintenance test, and was within $\pm 0.5\%$ during photometric and electrical measurement test.

1.5 Ambient Conditions for Maintenance Test

For lumen maintenance test, samples within one data set, were installed on cooling boards in thermal chambers with minimal ambient airflow. The case temperature and ambient temperature was monitored by thermocouples which one was soldered to the coldest DUTs' case (TMP_{LED}) location, while the other is mounted at a distance of 5 mm above the TMP location.

During life testing, TMP_{LED} of the coldest LEDs were maintained at a temperature that was greater than or equal to 2°C below the corresponding nominal case temperature. Surrounding air was maintained at a temperature that was greater than or equal to 5°C below the corresponding nominal case temperature. Thermocouples were shielded from direct DUT optical radiation and comply with ASTM E230 Table 1 “Special Limits”.

Samples were connected to DC power supply in series circuits with a constant current. The forward current was regulated to within $\pm 3\%$ of the specified value of the manufacturer.

The relative humidity within chamber was kept less than 65% during test.

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

1.6 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.

The uncertainty of the temperature is $U=0.8671^{\circ}\text{C}$ ($K=2$), at the 95% confidence level.

1.7 Statement of Traceability

Bay Area Compliance Laboratories Corp. (Dongguan) attested that all calibration has been performed using suitable standards traceable to National Primary Standards and International System of Units (SI).

1.8 Sample Set

Data Set 1: 55°C, 60mA

Part Number: SPMWHx2296Q5SGW0xx
Number of Units: 25
Case Temperature: >53°C
Ambient Temperature: >50°C
Life Test Drive Current: 60mA
Measurement Current: 60mA

Data Set 2: 85°C,60mA

Part Number: SPMWHx2296Q5SGW0xx
Number of Units: 25
Case Temperature: >83°C
Ambient Temperature: >80°C
Life Test Drive Current: 60mA
Measurement Current: 60mA

Data Set 3: 105°C,60mA

Part Number: SPMWHx2296Q5SGW0xx
Number of Units: 25
Case Temperature: >103°C
Ambient Temperature: >100°C
Life Test Drive Current: 60mA
Measurement Current: 60mA

2 - Summary of Test Result

Data Set:	Sample Size	Failures Observed:	Test Interval	Test Duration	Reported TM-21 L ₇₀ Lifetime
1	25	0	1000	9000	>54,000hours
2	25	0	1000	9000	>54,000hours
3	25	0	1000	9000	>54,000hours

Average Lumen Maintenance (Percentage of Initial Luminous Flux)

Data Set:	1000	2000	3000	4000	5000	6000	7000	8000	9000
1	100.12%	99.91%	99.73%	99.54%	99.38%	99.20%	99.00%	98.82%	98.64%
2	99.89%	99.66%	99.41%	99.15%	98.89%	98.63%	98.37%	98.11%	97.87%
3	99.73%	99.41%	99.10%	98.78%	98.43%	98.08%	97.73%	97.40%	97.06%

Average Color Maintenance

Data Set:	1000	2000	3000	4000	5000	6000	7000	8000	9000
1	0.0001	0.0003	0.0006	0.0008	0.0012	0.0015	0.0017	0.0021	0.0023
2	0.0003	0.0005	0.0008	0.0011	0.0014	0.0017	0.002	0.0023	0.0026
3	0.0005	0.0007	0.001	0.0013	0.0016	0.002	0.0023	0.0025	0.0028

3 - Test Data

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

No.	Φ(lm)	Lumen Maintenance (%)								
	0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
1	62.93	100.19	99.90	99.63	99.35	99.08	98.98	98.71	98.43	98.16
2	60.78	100.10	99.92	99.72	99.34	99.14	98.86	98.77	98.57	98.39
3	61.07	100.10	100.00	99.82	99.62	99.35	99.05	98.87	98.67	98.49
4	61.25	99.90	99.53	99.23	99.15	98.96	98.86	98.76	98.68	98.38
5	61.71	100.10	99.90	99.63	99.43	99.35	99.25	99.06	98.96	98.78
6	61.19	100.20	100.10	99.90	99.72	99.62	99.33	98.95	98.77	98.68
7	60.96	100.28	100.18	100.10	99.80	99.70	99.52	99.43	99.33	99.15
8	61.42	100.29	100.10	99.90	99.82	99.63	99.43	99.25	98.96	98.88
9	62.93	100.19	99.90	99.81	99.73	99.54	99.27	99.08	98.98	98.89
10	62.93	100.10	99.81	99.63	99.44	99.35	99.17	98.98	98.81	98.62
11	60.84	100.10	99.82	99.62	99.34	99.24	99.05	98.87	98.57	98.47
12	62.58	100.19	99.90	99.73	99.44	99.36	99.17	99.07	98.80	98.51
13	61.13	100.10	99.82	99.53	99.43	99.25	99.15	99.05	98.95	98.67
14	61.48	100.28	100.10	99.90	99.63	99.43	99.15	98.96	98.86	98.78
15	62.93	100.19	99.81	99.73	99.63	99.35	99.17	98.89	98.71	98.52
16	61.13	100.10	99.90	99.62	99.53	99.35	99.25	98.95	98.67	98.48
17	61.94	100.19	100.10	99.92	99.73	99.63	99.35	99.16	98.98	98.79
18	61.71	100.10	99.90	99.72	99.63	99.35	99.16	98.88	98.78	98.49
19	60.78	100.10	99.82	99.72	99.52	99.44	99.34	99.05	98.86	98.67
20	61.36	99.92	99.72	99.63	99.53	99.45	99.35	99.25	98.97	98.88
21	62.00	100.10	99.90	99.73	99.63	99.44	99.16	98.97	98.79	98.69
22	60.78	100.10	99.82	99.72	99.52	99.44	99.34	99.14	98.86	98.67
23	62.47	100.08	99.90	99.71	99.62	99.54	99.34	99.07	98.98	98.61
24	60.78	100.20	100.10	99.82	99.52	99.34	99.24	99.05	98.86	98.67
25	61.13	99.90	99.82	99.72	99.43	99.15	98.95	98.87	98.67	98.58
Ave.	61.61	100.12	99.91	99.73	99.54	99.38	99.20	99.00	98.82	98.64
Med.	61.36	100.10	99.90	99.72	99.53	99.35	99.17	98.98	98.81	98.67
st dev	0.7667	0.1040	0.1445	0.1627	0.1607	0.1801	0.1693	0.1659	0.1830	0.2037
Min.	60.78	99.90	99.53	99.23	99.15	98.96	98.86	98.71	98.43	98.16
Max.	62.93	100.29	100.18	100.10	99.82	99.70	99.52	99.43	99.33	99.15

TM-21 Projection:

Test Duration: 9,000 hours

Failures Observed: 0

α: 1.840E-06

β: 1.003

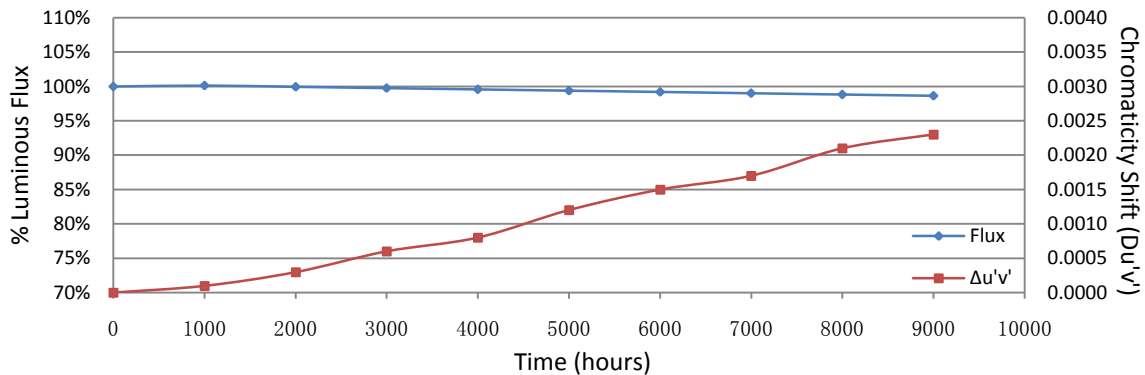
Reported L₇₀: >54,000 hours

3.2 Data Set 1, 55°C, 60mA (Forward Voltage)

No.	Forward Voltage (V)									
	0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
1	8.813	8.831	8.841	8.840	8.846	8.856	8.889	8.892	8.884	8.884
2	8.761	8.772	8.788	8.784	8.800	8.806	8.861	8.823	8.814	8.817
3	8.748	8.762	8.773	8.774	8.776	8.783	8.826	8.816	8.806	8.805
4	8.753	8.775	8.774	8.775	8.777	8.781	8.809	8.817	8.825	8.819
5	8.815	8.837	8.838	8.836	8.846	8.850	8.879	8.889	8.876	8.884
6	8.750	8.769	8.780	8.773	8.781	8.789	8.810	8.838	8.807	8.819
7	8.756	8.776	8.779	8.772	8.790	8.791	8.807	8.817	8.804	8.806
8	8.799	8.823	8.832	8.831	8.832	8.845	8.871	8.877	8.868	8.873
9	8.765	8.761	8.791	8.777	8.780	8.789	8.821	8.824	8.809	8.809
10	8.821	8.833	8.887	8.869	8.853	8.862	8.882	8.891	8.885	8.888
11	8.754	8.763	8.781	8.782	8.777	8.785	8.798	8.814	8.825	8.808
12	8.811	8.831	8.845	8.854	8.837	8.853	8.871	8.883	8.879	8.881
13	8.811	8.826	8.839	8.833	8.839	8.855	8.870	8.888	8.876	8.881
14	8.804	8.819	8.838	8.831	8.833	8.843	8.858	8.878	8.876	8.875
15	8.808	8.822	8.842	8.836	8.835	8.850	8.869	8.881	8.877	8.881
16	8.752	8.769	8.780	8.780	8.776	8.791	8.811	8.818	8.816	8.816
17	8.781	8.791	8.852	8.794	8.794	8.802	8.818	8.835	8.828	8.825
18	8.767	8.769	8.787	8.782	8.778	8.796	8.810	8.830	8.821	8.818
19	8.766	8.775	8.794	8.788	8.785	8.794	8.813	8.826	8.824	8.825
20	8.750	8.766	8.782	8.777	8.781	8.787	8.829	8.825	8.815	8.813
21	8.811	8.825	8.852	8.841	8.843	8.845	8.871	8.889	8.881	8.880
22	8.759	8.758	8.774	8.780	8.783	8.785	8.797	8.814	8.819	8.809
23	8.755	8.769	8.782	8.775	8.789	8.789	8.807	8.813	8.813	8.824
24	8.758	8.765	8.792	8.772	8.793	8.787	8.837	8.815	8.808	8.818
25	8.748	8.758	8.775	8.770	8.776	8.779	8.791	8.807	8.800	8.806
Ave.	8.777	8.790	8.808	8.801	8.804	8.812	8.836	8.844	8.837	8.839
Med.	8.765	8.775	8.791	8.782	8.790	8.794	8.826	8.826	8.824	8.819
st dev	0.0270	0.0297	0.0340	0.0320	0.0288	0.0308	0.0319	0.0325	0.0319	0.0329
Min.	8.748	8.758	8.773	8.770	8.776	8.779	8.791	8.807	8.800	8.805
Max.	8.821	8.837	8.887	8.869	8.853	8.862	8.889	8.892	8.885	8.888

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

No.	u'	v'	CCT(K)	Chromaticity Shift ($\Delta u'v'$)								
				0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs
1	0.2604	0.5218	2770	0.0000	0.0003	0.0006	0.0008	0.0012	0.0015	0.0018	0.0022	0.0024
2	0.2617	0.5228	2736	0.0001	0.0003	0.0006	0.0008	0.0012	0.0014	0.0018	0.0021	0.0024
3	0.2600	0.5234	2770	0.0001	0.0004	0.0005	0.0007	0.0011	0.0014	0.0017	0.0020	0.0022
4	0.2598	0.5232	2775	0.0000	0.0004	0.0005	0.0007	0.0011	0.0014	0.0016	0.0020	0.0021
5	0.2605	0.5226	2762	0.0001	0.0003	0.0006	0.0008	0.0012	0.0016	0.0018	0.0021	0.0025
6	0.2605	0.5235	2759	0.0001	0.0004	0.0006	0.0008	0.0011	0.0015	0.0018	0.0021	0.0023
7	0.2600	0.5223	2774	0.0001	0.0003	0.0005	0.0008	0.0011	0.0015	0.0017	0.0020	0.0023
8	0.2599	0.5212	2782	0.0001	0.0003	0.0005	0.0008	0.0011	0.0015	0.0017	0.0021	0.0024
9	0.2601	0.5238	2766	0.0001	0.0003	0.0006	0.0008	0.0011	0.0015	0.0018	0.0021	0.0023
10	0.2614	0.5220	2745	0.0001	0.0003	0.0005	0.0008	0.0011	0.0015	0.0018	0.0021	0.0024
11	0.2619	0.5223	2734	0.0001	0.0002	0.0005	0.0007	0.0011	0.0014	0.0017	0.0020	0.0024
12	0.2616	0.5219	2743	0.0001	0.0003	0.0006	0.0008	0.0011	0.0015	0.0017	0.0021	0.0024
13	0.2613	0.5218	2749	0.0001	0.0003	0.0006	0.0008	0.0011	0.0015	0.0017	0.0021	0.0024
14	0.2603	0.5224	2768	0.0001	0.0003	0.0006	0.0009	0.0012	0.0015	0.0018	0.0021	0.0024
15	0.2590	0.5210	2803	0.0000	0.0003	0.0006	0.0008	0.0011	0.0015	0.0018	0.0021	0.0024
16	0.2604	0.5226	2765	0.0001	0.0002	0.0005	0.0007	0.0011	0.0014	0.0017	0.0020	0.0023
17	0.2614	0.5229	2742	0.0001	0.0003	0.0005	0.0008	0.0011	0.0015	0.0017	0.0022	0.0024
18	0.2592	0.5243	2783	0.0001	0.0002	0.0005	0.0009	0.0011	0.0015	0.0017	0.0020	0.0023
19	0.2600	0.5217	2778	0.0001	0.0003	0.0005	0.0007	0.0011	0.0015	0.0017	0.0020	0.0022
20	0.2599	0.5231	2774	0.0001	0.0003	0.0006	0.0008	0.0012	0.0015	0.0018	0.0021	0.0024
21	0.2613	0.5217	2749	0.0001	0.0002	0.0005	0.0007	0.0011	0.0014	0.0016	0.0020	0.0022
22	0.2608	0.5233	2753	0.0001	0.0003	0.0005	0.0007	0.0011	0.0015	0.0017	0.0020	0.0023
23	0.2608	0.5243	2750	0.0001	0.0003	0.0006	0.0008	0.0011	0.0015	0.0017	0.0022	0.0023
24	0.2614	0.5221	2745	0.0000	0.0002	0.0005	0.0006	0.0011	0.0014	0.0017	0.0020	0.0022
25	0.2596	0.5224	2783	0.0001	0.0003	0.0007	0.0008	0.0012	0.0016	0.0018	0.0022	0.0025
Ave.	0.2605	0.5226	2762	0.0001	0.0003	0.0006	0.0008	0.0012	0.0015	0.0017	0.0021	0.0023
Med.	0.2604	0.5224	2765	0.0001	0.0003	0.0005	0.0008	0.0011	0.0015	0.0017	0.0021	0.0024
st dev	0.0008	0.0009	17.3607	0.0000	0.0000	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001	0.0001
Min.	0.2590	0.5210	2734	0.0000	0.0002	0.0005	0.0006	0.0011	0.0014	0.0016	0.0020	0.0021
Max.	0.2619	0.5243	2803	0.0001	0.0004	0.0007	0.0009	0.0012	0.0016	0.0018	0.0022	0.0025



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

No.	Φ(lm)	Lumen Maintenance (%)								
	Ohr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
26	61.25	100.10	99.90	99.71	99.43	99.23	99.05	98.86	98.76	98.48
27	61.94	99.92	99.63	99.53	99.35	98.98	98.69	98.42	98.22	98.13
28	62.06	100.10	99.81	99.63	99.26	99.07	98.97	98.60	98.32	98.13
29	60.26	99.90	99.72	99.42	99.14	98.76	98.66	98.56	98.27	97.98
30	61.36	99.82	99.72	99.35	99.15	98.88	98.58	98.31	98.11	97.93
31	62.52	99.73	99.46	99.36	99.07	98.80	98.53	98.24	98.06	97.78
32	60.96	99.90	99.62	99.43	99.15	98.95	98.67	98.38	98.10	98.00
33	61.19	99.80	99.53	99.33	98.95	98.86	98.48	98.30	97.91	97.73
34	61.48	99.90	99.72	99.43	99.15	98.96	98.68	98.31	98.11	97.74
35	61.07	100.10	99.82	99.62	99.44	99.05	98.87	98.49	98.20	97.82
36	62.00	99.90	99.73	99.44	99.16	98.97	98.79	98.42	98.03	97.66
37	61.54	99.81	99.63	99.53	99.24	98.96	98.68	98.49	98.29	98.02
38	60.84	99.72	99.42	99.24	99.15	98.87	98.57	98.39	98.09	97.91
39	61.42	99.72	99.43	99.25	98.88	98.58	98.31	98.01	97.83	97.54
40	62.52	99.82	99.46	99.17	98.80	98.61	98.24	97.97	97.68	97.50
41	61.19	99.90	99.62	99.25	98.86	98.48	98.20	98.01	97.63	97.53
42	63.10	99.83	99.54	99.27	98.91	98.54	98.26	98.08	97.80	97.62
43	62.76	99.90	99.71	99.35	99.16	98.98	98.52	98.15	97.86	97.69
44	61.42	99.82	99.63	99.25	99.06	98.78	98.49	98.11	97.74	97.54
45	62.35	100.19	99.81	99.44	99.17	98.97	98.60	98.33	98.14	97.77
46	61.94	100.10	99.92	99.63	99.35	99.06	98.79	98.60	98.32	98.13
47	62.52	99.92	99.73	99.54	99.36	99.17	98.80	98.61	98.34	98.14
48	60.96	99.70	99.62	99.33	99.23	99.05	98.75	98.47	98.28	98.00
49	61.42	99.90	99.72	99.53	99.35	99.06	98.96	98.68	98.40	98.21
50	62.12	99.81	99.53	99.16	98.87	98.70	98.50	98.41	98.23	97.84
Ave.	61.69	99.89	99.66	99.41	99.15	98.89	98.63	98.37	98.11	97.87
Med.	61.48	99.90	99.63	99.42	99.15	98.96	98.66	98.39	98.11	97.84
st dev	0.6917	0.1327	0.1397	0.1523	0.1858	0.1955	0.2266	0.2258	0.2591	0.2496
Min.	60.26	99.70	99.42	99.16	98.80	98.48	98.20	97.97	97.63	97.50
Max.	63.10	100.19	99.92	99.71	99.44	99.23	99.05	98.86	98.76	98.48

TM-21 Projection:

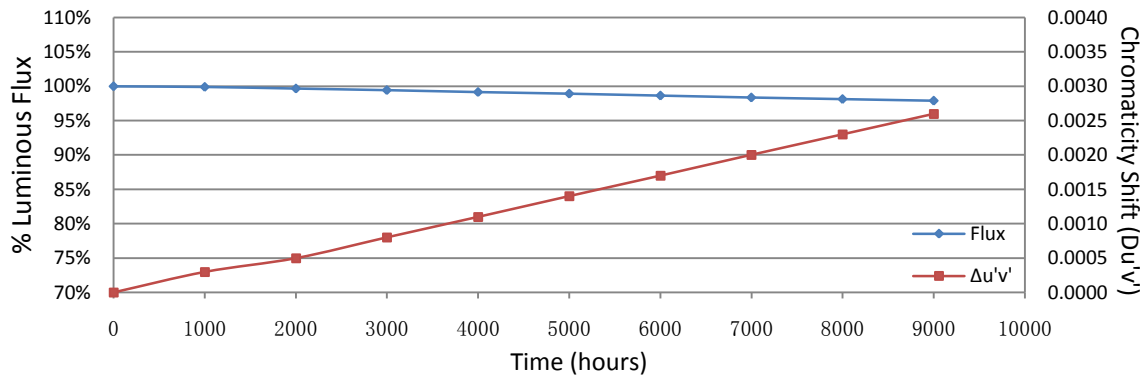
Test Duration: 9,000 hours
Failures Observed: 0
 α : 2.610E-06
 β : 1.002
Reported L₇₀: >54,000 hours

3.5 Data Set 2, 85°C, 60mA (Forward Voltage)

No.	Forward Voltage (V)									
	0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
26	8.807	8.829	8.850	8.838	8.843	8.847	8.874	8.885	8.881	8.879
27	8.753	8.784	8.796	8.795	8.830	8.799	8.816	8.832	8.822	8.826
28	8.743	8.769	8.771	8.772	8.776	8.785	8.800	8.814	8.816	8.799
29	8.757	8.771	8.785	8.774	8.798	8.791	8.811	8.895	8.830	8.824
30	8.744	8.760	8.780	8.776	8.772	8.777	8.792	8.805	8.807	8.795
31	8.760	8.768	8.798	8.788	8.797	8.788	8.803	8.819	8.817	8.824
32	8.803	8.813	8.834	8.825	8.842	8.840	8.855	8.881	8.871	8.866
33	8.751	8.759	8.780	8.773	8.781	8.790	8.818	8.816	8.812	8.804
34	8.802	8.810	8.836	8.832	8.839	8.844	8.858	8.881	8.872	8.881
35	8.809	8.816	8.838	8.829	8.841	8.844	8.861	8.883	8.878	8.901
36	8.752	8.760	8.776	8.771	8.783	8.791	8.794	8.820	8.809	8.807
37	8.796	8.810	8.836	8.835	8.836	8.842	8.856	8.883	8.873	8.875
38	8.808	8.814	8.833	8.827	8.831	8.839	8.855	8.880	8.866	8.868
39	8.794	8.811	8.833	8.825	8.833	8.839	8.855	8.873	8.861	8.862
40	8.854	8.835	8.861	8.846	8.856	8.863	8.884	8.906	8.889	8.895
41	8.826	8.820	8.854	8.834	8.849	8.860	8.886	8.887	8.887	8.889
42	8.819	8.826	8.850	8.838	8.851	8.865	8.869	8.889	8.906	8.884
43	8.812	8.822	8.842	8.838	8.856	8.857	8.866	8.887	8.881	8.885
44	8.804	8.825	8.844	8.833	8.843	8.850	8.869	8.881	8.877	8.884
45	8.757	8.773	8.788	8.787	8.792	8.791	8.801	8.826	8.817	8.817
46	8.749	8.762	8.774	8.766	8.789	8.788	8.797	8.811	8.810	8.810
47	8.803	8.825	8.841	8.829	8.845	8.849	8.866	8.881	8.873	8.870
48	8.748	8.771	8.782	8.773	8.787	8.788	8.801	8.820	8.808	8.810
49	8.820	8.828	8.854	8.843	8.857	8.858	8.866	8.891	8.881	8.883
50	8.757	8.760	8.776	8.773	8.785	8.798	8.793	8.818	8.807	8.812
Ave.	8.785	8.797	8.816	8.809	8.820	8.823	8.838	8.859	8.850	8.850
Med.	8.796	8.810	8.833	8.825	8.833	8.839	8.855	8.881	8.866	8.866
st dev	0.0323	0.0281	0.0321	0.0296	0.0300	0.0314	0.0335	0.0345	0.0338	0.0363
Min.	8.743	8.759	8.771	8.766	8.772	8.777	8.792	8.805	8.807	8.795
Max.	8.854	8.835	8.861	8.846	8.857	8.865	8.886	8.906	8.906	8.901

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

No.	u'	v'	CCT(K)	Chromaticity Shift ($\Delta u'v'$)								
				0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs
26	0.2604	0.5215	2771	0.0002	0.0005	0.0008	0.0010	0.0014	0.0017	0.0020	0.0024	0.0026
27	0.2598	0.5237	2773	0.0004	0.0005	0.0008	0.0010	0.0015	0.0017	0.0020	0.0024	0.0026
28	0.2617	0.5236	2733	0.0004	0.0005	0.0008	0.0010	0.0015	0.0017	0.0020	0.0024	0.0026
29	0.2603	0.5217	2771	0.0003	0.0004	0.0008	0.0010	0.0014	0.0017	0.0020	0.0024	0.0026
30	0.2608	0.5243	2750	0.0003	0.0005	0.0008	0.0010	0.0014	0.0017	0.0020	0.0024	0.0026
31	0.2607	0.5236	2755	0.0004	0.0005	0.0008	0.0010	0.0014	0.0017	0.0019	0.0023	0.0026
32	0.2617	0.5228	2736	0.0003	0.0004	0.0007	0.0010	0.0013	0.0017	0.0019	0.0023	0.0025
33	0.2602	0.5233	2766	0.0003	0.0005	0.0008	0.0010	0.0013	0.0017	0.0019	0.0024	0.0026
34	0.2600	0.5232	2772	0.0004	0.0005	0.0008	0.0010	0.0014	0.0017	0.0020	0.0024	0.0026
35	0.2616	0.5221	2741	0.0003	0.0005	0.0008	0.0010	0.0014	0.0017	0.0019	0.0024	0.0026
36	0.2603	0.5226	2768	0.0004	0.0005	0.0009	0.0011	0.0015	0.0018	0.0020	0.0024	0.0026
37	0.2592	0.5217	2796	0.0004	0.0005	0.0009	0.0011	0.0015	0.0018	0.0020	0.0025	0.0027
38	0.2621	0.5225	2729	0.0003	0.0004	0.0008	0.0010	0.0013	0.0017	0.0019	0.0024	0.0026
39	0.2602	0.5220	2772	0.0003	0.0004	0.0008	0.0010	0.0014	0.0017	0.0019	0.0023	0.0026
40	0.2604	0.5226	2766	0.0003	0.0005	0.0008	0.0010	0.0014	0.0017	0.0019	0.0023	0.0026
41	0.2606	0.5216	2765	0.0004	0.0005	0.0009	0.0011	0.0015	0.0018	0.0020	0.0024	0.0026
42	0.2615	0.5230	2740	0.0003	0.0005	0.0008	0.0011	0.0015	0.0018	0.0020	0.0024	0.0026
43	0.2606	0.5239	2754	0.0003	0.0005	0.0008	0.0011	0.0014	0.0017	0.0019	0.0024	0.0026
44	0.2598	0.5216	2782	0.0003	0.0005	0.0008	0.0010	0.0013	0.0017	0.0019	0.0023	0.0025
45	0.2589	0.5235	2793	0.0002	0.0004	0.0008	0.0010	0.0014	0.0017	0.0019	0.0023	0.0025
46	0.2603	0.5238	2761	0.0003	0.0004	0.0008	0.0010	0.0013	0.0017	0.0019	0.0023	0.0025
47	0.2605	0.5230	2761	0.0003	0.0004	0.0007	0.0009	0.0014	0.0017	0.0019	0.0023	0.0025
48	0.2611	0.5225	2751	0.0003	0.0004	0.0008	0.0010	0.0014	0.0017	0.0020	0.0023	0.0026
49	0.2588	0.5219	2805	0.0004	0.0005	0.0009	0.0010	0.0015	0.0018	0.0020	0.0024	0.0026
50	0.2603	0.5228	2767	0.0004	0.0005	0.0009	0.0012	0.0015	0.0018	0.0020	0.0024	0.0026
Ave.	0.2605	0.5228	2763	0.0003	0.0005	0.0008	0.0011	0.0014	0.0017	0.0020	0.0023	0.0026
Med.	0.2604	0.5228	2766	0.0003	0.0005	0.0008	0.0010	0.0014	0.0017	0.0020	0.0024	0.0026
st dev	0.0008	0.0008	19.1818	0.0001	0.0000	0.0000	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000
Min.	0.2588	0.5215	2729	0.0002	0.0004	0.0007	0.0009	0.0013	0.0017	0.0019	0.0023	0.0025
Max.	0.2621	0.5243	2805	0.0004	0.0005	0.0009	0.0012	0.0015	0.0018	0.0020	0.0025	0.0027



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

No.	Φ(lm)	Lumen Maintenance (%)								
	0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
51	62.64	99.90	99.73	99.44	99.17	98.88	98.61	98.42	98.24	97.96
52	60.78	99.92	99.62	99.44	99.05	98.77	98.39	98.01	97.61	97.24
53	60.78	99.82	99.52	99.14	98.96	98.57	98.29	97.91	97.53	97.14
54	60.32	99.72	99.32	99.14	98.76	98.46	98.08	97.88	97.60	97.12
55	61.02	99.80	99.43	99.13	98.85	98.38	98.18	97.80	97.43	97.23
56	62.52	99.73	99.46	99.17	98.80	98.43	97.97	97.60	97.31	97.04
57	61.02	99.71	99.52	99.23	98.85	98.48	98.18	97.90	97.62	97.23
58	61.48	99.72	99.43	99.15	98.86	98.39	98.11	97.84	97.54	97.27
59	61.89	99.53	99.34	98.97	98.68	98.30	97.83	97.46	97.09	96.80
60	62.41	99.54	99.17	98.97	98.61	98.32	97.95	97.48	97.02	96.56
61	60.78	99.72	99.44	99.05	98.57	98.29	97.91	97.53	97.14	96.76
62	61.65	99.53	99.16	98.78	98.41	98.04	97.57	97.10	96.63	96.24
63	61.36	100.10	99.82	99.53	99.35	99.05	98.78	98.58	98.31	98.03
64	62.18	99.90	99.61	99.34	99.07	98.78	98.60	98.31	98.04	97.84
65	62.81	99.82	99.46	99.27	99.00	98.61	98.34	98.07	97.88	97.52
66	61.36	99.72	99.35	99.05	98.68	98.40	98.11	97.73	97.46	97.08
67	62.23	99.63	99.45	99.07	98.70	98.33	97.96	97.67	97.49	97.12
68	62.00	99.73	99.35	98.97	98.60	98.23	97.85	97.39	97.10	96.82
69	61.25	99.62	99.33	98.96	98.58	98.20	97.81	97.44	97.06	96.69
70	62.00	99.82	99.44	99.16	98.69	98.42	97.95	97.56	97.19	96.82
71	63.10	99.73	99.37	99.00	98.72	98.35	97.89	97.53	97.16	96.97
72	61.13	99.62	99.35	98.95	98.77	98.30	97.92	97.63	97.15	96.78
73	62.23	99.63	99.26	98.79	98.52	98.14	97.67	97.40	97.12	96.66
74	61.13	99.53	99.25	98.95	98.58	98.20	97.82	97.45	97.06	96.68
75	62.23	99.63	99.16	98.79	98.60	98.33	98.14	97.67	97.20	96.93
Ave.	61.69	99.73	99.41	99.10	98.78	98.43	98.08	97.73	97.40	97.06
Med.	61.65	99.72	99.43	99.07	98.72	98.38	97.97	97.67	97.31	97.04
st dev	0.7372	0.1405	0.1653	0.1991	0.2228	0.2388	0.2960	0.3479	0.4016	0.4314
Min.	60.32	99.53	99.16	98.78	98.41	98.04	97.57	97.10	96.63	96.24
Max.	63.10	100.10	99.82	99.53	99.35	99.05	98.78	98.58	98.31	98.03

TM-21 Projection:

Test Duration: 9,000 hours

Failures Observed: 0

α: 3.513E-06

β: 1.002

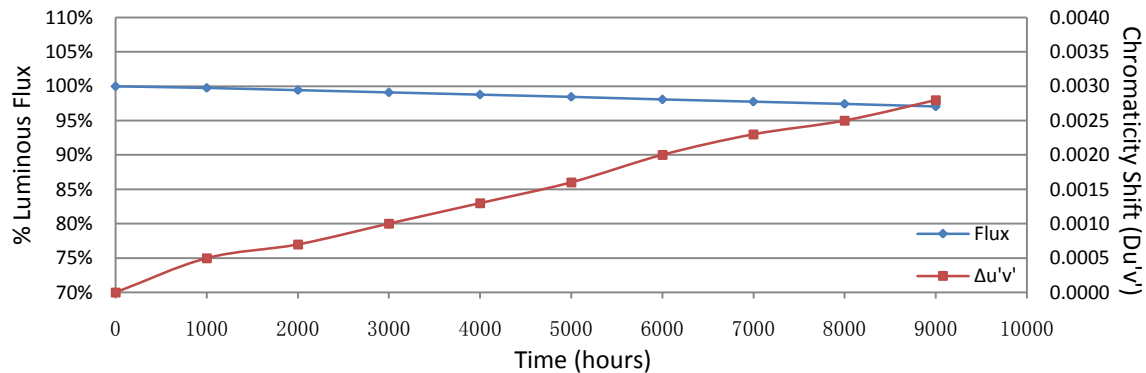
Reported L₇₀: >54,000 hours

3.8 Data Set 3, 105°C, 60mA (Forward Voltage)

No.	Forward Voltage (V)									
	0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
51	8.762	8.804	8.788	8.786	8.790	8.801	8.808	8.827	8.816	8.819
52	8.755	8.786	8.789	8.774	8.799	8.802	8.801	8.822	8.810	8.813
53	8.752	8.789	8.789	8.782	8.790	8.796	8.808	8.832	8.848	8.818
54	8.754	8.783	8.785	8.783	8.789	8.801	8.807	8.827	8.825	8.825
55	8.800	8.829	8.831	8.828	8.840	8.845	8.858	8.876	8.877	8.876
56	8.752	8.802	8.779	8.794	8.793	8.792	8.807	8.823	8.816	8.819
57	8.808	8.848	8.843	8.840	8.856	8.854	8.872	8.890	8.887	8.884
58	8.811	8.852	8.838	8.831	8.845	8.851	8.872	8.882	8.880	8.870
59	8.751	8.795	8.800	8.792	8.813	8.818	8.830	8.839	8.848	8.827
60	8.813	8.845	8.842	8.849	8.847	8.860	8.924	8.887	8.892	8.887
61	8.751	8.781	8.780	8.775	8.788	8.785	8.804	8.813	8.809	8.811
62	8.750	8.832	8.832	8.826	8.842	8.839	8.858	8.869	8.868	8.866
63	8.808	8.832	8.838	8.833	8.846	8.840	8.865	8.885	8.875	8.871
64	8.748	8.777	8.783	8.801	8.787	8.806	8.804	8.822	8.811	8.810
65	8.798	8.836	8.833	8.829	8.846	8.841	8.859	8.878	8.868	8.871
66	8.795	8.827	8.827	8.826	8.850	8.832	8.859	8.868	8.865	8.869
67	8.744	8.770	8.770	8.772	8.789	8.780	8.797	8.808	8.809	8.804
68	8.756	8.781	8.785	8.787	8.799	8.810	8.812	8.833	8.820	8.825
69	8.792	8.830	8.836	8.837	8.843	8.843	8.864	8.880	8.863	8.886
70	8.745	8.775	8.777	8.770	8.781	8.781	8.798	8.809	8.804	8.803
71	8.804	8.837	8.837	8.831	8.844	8.853	8.863	8.888	8.880	8.873
72	8.798	8.824	8.832	8.831	8.836	8.844	8.854	8.874	8.874	8.868
73	8.752	8.771	8.775	8.773	8.783	8.782	8.794	8.816	8.811	8.815
74	8.802	8.830	8.836	8.830	8.843	8.849	8.855	8.874	8.881	8.867
75	8.778	8.792	8.798	8.796	8.810	8.801	8.816	8.835	8.836	8.830
Ave.	8.775	8.809	8.809	8.807	8.818	8.820	8.836	8.850	8.847	8.844
Med.	8.762	8.804	8.800	8.801	8.813	8.818	8.830	8.839	8.848	8.830
st dev	0.0260	0.0273	0.0269	0.0264	0.0274	0.0271	0.0339	0.0297	0.0308	0.0302
Min.	8.744	8.770	8.770	8.770	8.781	8.780	8.794	8.808	8.804	8.803
Max.	8.813	8.852	8.843	8.849	8.856	8.860	8.924	8.890	8.892	8.887

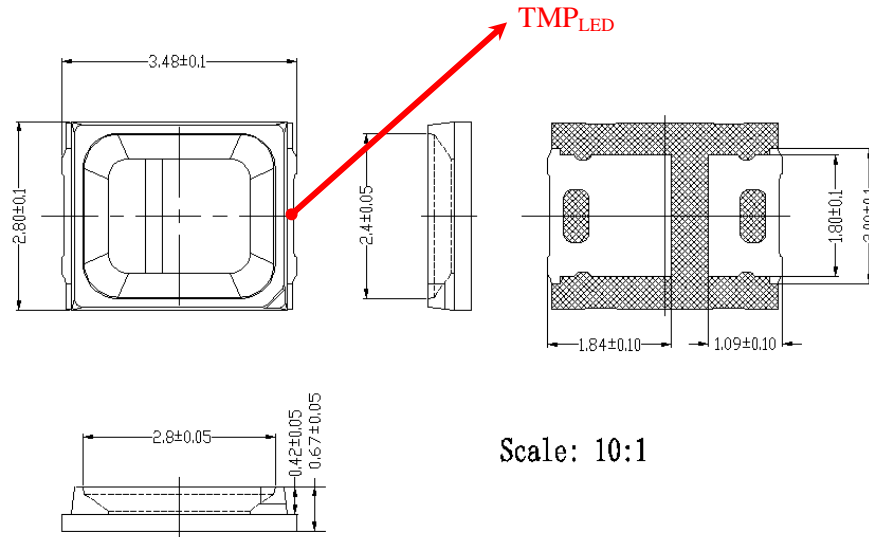
3.9 Data Set 3, 105°C, 60mA (Chromaticity Shift)

No.	u'	v'	CCT(K)	Chromaticity Shift ($\Delta u'v'$)								
				0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs
51	0.2594	0.5236	2782	0.0004	0.0007	0.0010	0.0012	0.0016	0.0019	0.0024	0.0026	0.0028
52	0.2602	0.5214	2774	0.0004	0.0006	0.0010	0.0012	0.0015	0.0019	0.0022	0.0025	0.0028
53	0.2603	0.5221	2770	0.0005	0.0007	0.0010	0.0013	0.0016	0.0019	0.0022	0.0025	0.0028
54	0.2610	0.5220	2755	0.0004	0.0007	0.0010	0.0015	0.0016	0.0020	0.0022	0.0026	0.0028
55	0.2618	0.5221	2737	0.0004	0.0007	0.0009	0.0012	0.0016	0.0019	0.0022	0.0025	0.0028
56	0.2615	0.5244	2734	0.0004	0.0007	0.0010	0.0013	0.0016	0.0018	0.0021	0.0025	0.0027
57	0.2620	0.5223	2732	0.0005	0.0007	0.0011	0.0013	0.0017	0.0020	0.0024	0.0026	0.0029
58	0.2590	0.5218	2801	0.0005	0.0007	0.0010	0.0014	0.0016	0.0020	0.0023	0.0026	0.0028
59	0.2615	0.5228	2741	0.0005	0.0007	0.0010	0.0014	0.0017	0.0020	0.0023	0.0025	0.0028
60	0.2611	0.5232	2748	0.0005	0.0007	0.0010	0.0014	0.0017	0.0020	0.0022	0.0026	0.0028
61	0.2586	0.5221	2806	0.0005	0.0006	0.0010	0.0013	0.0016	0.0019	0.0022	0.0025	0.0027
62	0.2605	0.5242	2755	0.0006	0.0009	0.0012	0.0015	0.0018	0.0022	0.0025	0.0027	0.0029
63	0.2602	0.5217	2774	0.0005	0.0007	0.0010	0.0013	0.0016	0.0020	0.0022	0.0025	0.0028
64	0.2600	0.5225	2773	0.0005	0.0008	0.0011	0.0014	0.0016	0.0020	0.0024	0.0026	0.0028
65	0.2613	0.5222	2747	0.0005	0.0007	0.0010	0.0014	0.0017	0.0019	0.0024	0.0026	0.0028
66	0.2601	0.5216	2776	0.0004	0.0007	0.0010	0.0013	0.0016	0.0020	0.0022	0.0025	0.0028
67	0.2604	0.5238	2759	0.0005	0.0007	0.0010	0.0013	0.0016	0.0019	0.0022	0.0025	0.0027
68	0.2615	0.5231	2738	0.0005	0.0006	0.0009	0.0012	0.0016	0.0018	0.0021	0.0023	0.0025
69	0.2611	0.5225	2749	0.0005	0.0006	0.0009	0.0012	0.0015	0.0019	0.0022	0.0025	0.0028
70	0.2600	0.5234	2771	0.0005	0.0007	0.0010	0.0012	0.0016	0.0019	0.0022	0.0025	0.0028
71	0.2601	0.5226	2771	0.0005	0.0007	0.0010	0.0013	0.0016	0.0019	0.0022	0.0025	0.0028
72	0.2610	0.5226	2752	0.0005	0.0007	0.0009	0.0012	0.0016	0.0019	0.0022	0.0025	0.0028
73	0.2598	0.5209	2786	0.0004	0.0007	0.0010	0.0014	0.0016	0.0019	0.0023	0.0026	0.0028
74	0.2619	0.5226	2732	0.0005	0.0007	0.0010	0.0013	0.0015	0.0019	0.0022	0.0024	0.0027
75	0.2618	0.5232	2733	0.0005	0.0007	0.0010	0.0014	0.0017	0.0020	0.0024	0.0026	0.0029
Ave.	0.2606	0.5226	2760	0.0005	0.0007	0.0010	0.0013	0.0016	0.0020	0.0023	0.0025	0.0028
Med.	0.2605	0.5225	2755	0.0005	0.0007	0.0010	0.0013	0.0016	0.0019	0.0022	0.0025	0.0028
st dev	0.0009	0.0009	21.4198	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Min.	0.2586	0.5209	2732	0.0004	0.0006	0.0009	0.0012	0.0015	0.0018	0.0021	0.0023	0.0025
Max.	0.2620	0.5244	2806	0.0006	0.0009	0.0012	0.0015	0.0018	0.0022	0.0025	0.0027	0.0029



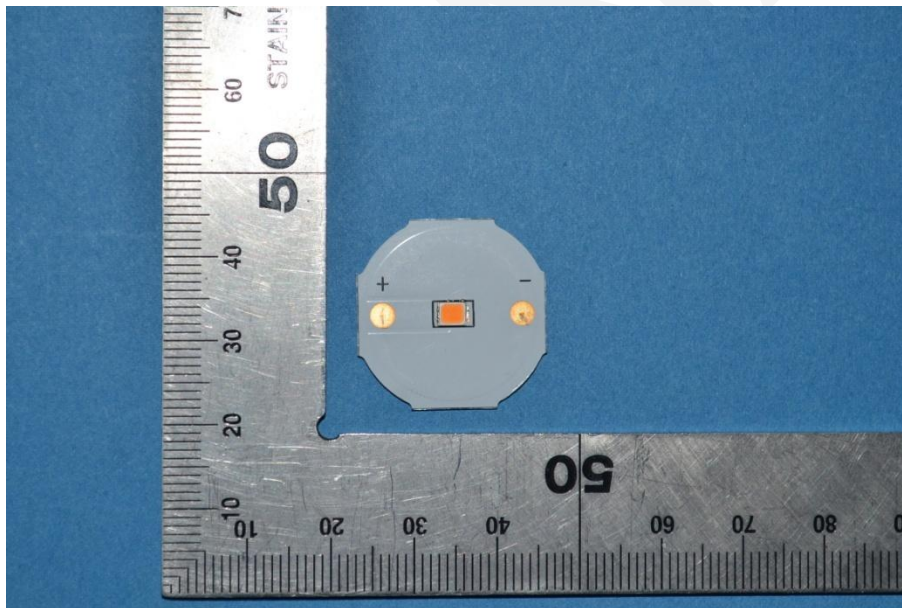
4 - EUT Photo

4.1 Mechanical Dimensions



All dimensions are in millimeter

4.2 EUT Photo



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