



TEST REPORT

According to ANSI/IES LM-80-15
For

Bridgelux Inc.

46430 Fremont Boulevard , Fremont ,CA 94538 USA

#Model: BXEX-27E-11H-3A

Report Type: 10000 Hours Test Report	Product Type: LED Package
Test Engineer:	Pote Wang <i>Pote Wang</i>
Report Number:	R2XM200324050-10
Test Date:	2018-11-04 to 2019-12-30
Report Date:	2020-03-25
Reviewed By:	Blake Zhang / EE Engineer
Test Facility:	Test facility was located at No.69,Pulongcun ,Puxihu Industrial Area, Tangxia , Dongguan, Guangdong, China.
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Accreditation:	The IAS Accreditation Number TL-460.

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1 - General Information

1.1 Description of LED Light Sources

Sample Size:

75 PCS test samples were in good condition and received on 2018-11-03. The samples were numbered from 1 to 25, 26 to 50 and 51 to 75.

#Manufacturer:	Bridgelux Inc.
#Part Number:	BXEX-27E-11H-3A
#Part Type:	LED Package
#Drive Level:	DC 1000mA
#Nominal CCT:	2700K
#Power:	3.3W
#Average Current Density per LED die:	573mA/mm ²
#Average Power Density per LED die:	1.892W/mm ²
#CRI:	80
#Die Spacing:	N/A

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.

#Family products covered by this report:

According to *ENERGY STAR[®] Requirements for the Use of LM-80 Data*, the following products can be covered by this report base on the information and declaration provided by manufacturer. The information of these models shows that the covered products meet all section 4 requirements of *ENERGY STAR[®] Requirements for the Use of LM-80 Data* (September 28, 2017)

This report covers the following models:

Model Name	Total Input Current (mA)	Power (W)	CCT (K)	Number of dies	Driver current per die (mA)	Current Density per Die (mA/mm ²)	Power Density per PCB (W/mm ²)	Die Spacing (mm)
BXEX-27E-11H-3A (Tested)	1000	3.3	≥2200	1	1000	573	0.2855	N/A
BXEX-(A)(B)-(C)(D)(E)-(F)(G)	1000	3.3	≥2200	1	1000	573	0.2855	N/A

Here is part number designation for LED package products:

BXEX-(A)(B)-(C)(D)(E)-(F)(G)

BXEX: Designates product family

(A) CCT Variation, can be 10-65 for 2200K~6500K;

(B) CRI

(C) Parallel connected variation, can be 1~9 (total chip number is less than 9)

(D) Series connected variation, can be 1~9 (total chip number is less than 9)

(E) Power

(F) Voltage

(G) Customer code: can be 0~ZZ

Note:

1. The applicant Bridgelux Inc. declare that their products with model BXEX-27E-11H-3A are the same to the products in report # R2XM181103070-10 and is authorized by original applicant to use their test data.
2. All the data in previous report (R2XM181103070-10) is shared in this report.

1.2 Standards and Reference Documentations

- ANSI/IES LM-80-15: IES Approved Method for Measuring Lumen Maintenance of LED Light Sources.
- CIE 127:2007: Measurement of LEDs
- ENERGY STAR® Requirements for the Use of LM-80 Data (This standard was not accredited by IAS)

1.3 Testing Equipment

Device	Manufacture	Model No	Serial No	Calibration date	Calibration due date
0.5m integrating sphere	EVERFINE	AIS-2	G185304TA1381172	2019-06-28	2020-06-27
LED Test Source	EVERFINE	LTS-300	P185616CD1371113	2019-06-28	2020-06-27
High Accuracy Array Spectroradiometer	EVERFINE	HAAS-2000	P600674CM1381123	2019-06-28	2020-06-27
Standard Light Source	EVERFINE	D062	G100278CJ7351206	2019-12-24	2020-12-24
Multilayer aging machine	BACL	B2-270	20023	2019-03-10	2020-03-09
Digital CC&CV DC Power Supply	EVERFINE	WY5015	11090005	2019-03-10	2020-03-09

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°C \pm 2°C, RH <65%.

1.6 Photometric Measurement Method and Uncertainty

Integrating sphere and spectroradiometer is used to measure luminous flux and chromaticity coordinate u'v'. 2 π measurement was used and sample was driven by DC power supply. The forward current was regulated to within $\pm 0.5\%$ of the nominal value. The test system was calibrated by halogen reference lamp. The ambient temperature during test was set to 25°C \pm 2°C, RH <65%. The temperature measurement point was located in the sphere and the temperature was detected by a temperature probe.

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=21K (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).

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1.8 Sample Set

Data Set 1: 55°C, 1000mA

Part Number: BXEX-27E-11H-3A
Number of Units: 25
Case Temperature: >53°C
Ambient Temperature: >50°C
Life Test Drive Current: 1000mA
Measurement Current: 1000mA

Data Set 2: 85°C, 1000mA

Part Number: BXEX-27E-11H-3A
Number of Units: 25
Case Temperature: >83°C
Ambient Temperature: >80°C
Life Test Drive Current: 1000mA
Measurement Current: 1000mA

Data Set 3: 105°C, 1000mA

Part Number: BXEX-27E-11H-3A
Number of Units: 25
Case Temperature: >103°C
Ambient Temperature: >100°C
Life Test Drive Current: 1000mA
Measurement Current: 1000mA

2 - Summary of Test Result

Data Set:	Sample Size	Failures Observed:	Test Interval	Test Duration	α	β	Reported TM-21 L ₇₀ Lifetime	Reported TM-21 L ₉₀ Lifetime
1	25	0	1000hrs	10000hrs	1.581E-06	1.002	>60000hrs	>60000hrs
2	25	0	1000hrs	10000hrs	2.091E-06	1.002	>60000hrs	51,000hrs
3	25	0	1000hrs	10000hrs	2.941E-06	1.003	>60000hrs	37,000hrs

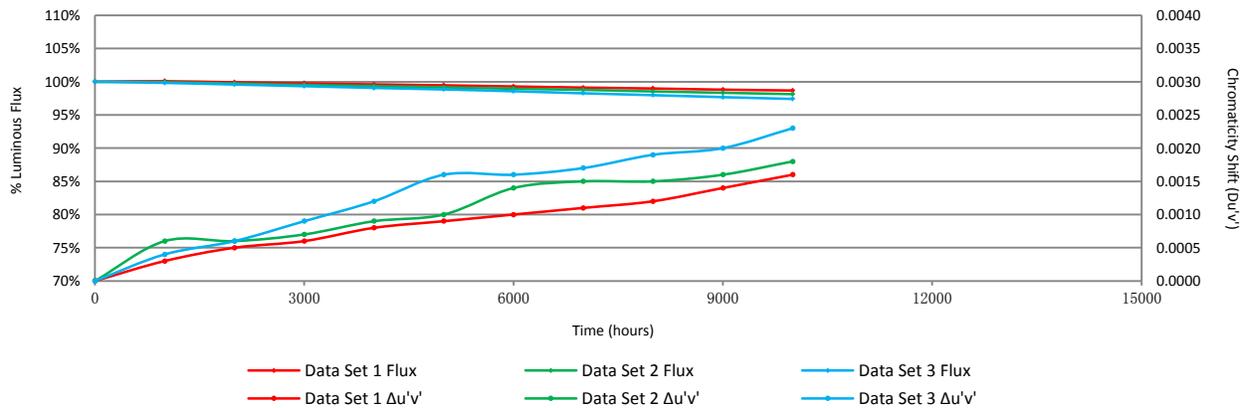
Average Lumen Maintenance (Percentage of Initial Luminous Flux)

Data Set:	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs	10000hrs
1	100.08%	99.91%	99.75%	99.60%	99.46%	99.29%	99.12%	98.98%	98.81%	98.68%
2	99.94%	99.73%	99.52%	99.35%	99.16%	98.95%	98.78%	98.54%	98.34%	98.13%
3	99.83%	99.58%	99.33%	99.07%	98.84%	98.57%	98.26%	97.98%	97.68%	97.41%

Average Chromaticity Shift

Data Set:	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs	10000hrs
1	0.0003	0.0005	0.0006	0.0008	0.0009	0.0010	0.0011	0.0012	0.0014	0.0016
2	0.0006	0.0006	0.0007	0.0009	0.0010	0.0014	0.0015	0.0015	0.0016	0.0018
3	0.0004	0.0006	0.0009	0.0012	0.0016	0.0016	0.0017	0.0019	0.0020	0.0023

Average Lumen Maintenance and Chromaticity Shift VS. Time



3 - Test Data

3.1 Data Set 1, 55°C, 1000mA (Lumen Maintenance)

No.	Φ(lm)	Lumen Maintenance (%)									
	0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs	10000hrs
1	400.4	100.22	100.07	99.95	99.80	99.73	99.53	99.50	99.48	99.45	99.35
2	399.6	100.18	100.15	100.03	99.97	99.85	99.60	99.55	99.35	99.10	99.02
3	400.0	100.03	99.95	99.60	99.48	99.20	99.03	98.93	98.80	98.65	98.48
4	402.8	99.78	99.65	99.50	99.21	99.18	98.88	98.61	98.39	98.11	98.06
5	394.5	100.15	100.03	99.70	99.42	99.21	99.16	98.94	98.91	98.78	98.68
6	394.6	99.92	99.59	99.57	99.52	99.42	99.11	99.09	99.01	98.78	98.38
7	398.3	100.08	99.77	99.75	99.52	99.17	98.97	98.85	98.72	98.44	98.42
8	412.0	100.12	100.00	99.90	99.78	99.39	99.27	99.13	98.98	98.86	98.74
9	407.4	100.25	100.17	100.07	99.95	99.63	99.44	99.24	99.12	98.94	98.92
10	399.6	99.95	99.92	99.85	99.77	99.62	99.50	99.42	99.05	98.95	98.85
11	397.3	100.13	100.00	99.90	99.85	99.77	99.60	99.55	99.47	99.42	99.24
12	391.6	100.13	100.08	100.03	99.95	99.92	99.80	99.57	99.36	99.16	98.98
13	386.4	100.49	100.47	100.31	100.18	100.16	99.95	99.79	99.72	99.46	99.38
14	386.1	99.87	99.82	99.61	99.51	99.46	99.40	99.33	99.17	99.12	98.73
15	399.0	100.28	99.97	99.90	99.80	99.75	99.47	99.25	99.20	98.90	98.72
16	386.7	99.92	99.82	99.69	99.61	99.51	99.28	99.17	99.04	98.91	98.71
17	384.1	99.84	99.66	99.45	99.22	99.17	98.91	98.65	98.46	98.28	98.15
18	386.3	100.31	100.28	100.05	99.79	99.69	99.53	99.38	99.20	98.99	98.89
19	402.8	99.85	99.53	99.28	99.08	99.06	98.81	98.54	98.29	98.21	98.11
20	406.7	99.66	99.51	99.26	99.02	98.97	98.94	98.72	98.60	98.48	98.28
21	396.6	100.05	99.87	99.67	99.55	99.14	99.04	98.89	98.71	98.64	98.49
22	402.0	99.70	99.43	99.28	99.15	99.08	98.98	98.76	98.68	98.53	98.41
23	386.4	100.36	99.97	99.92	99.90	99.72	99.61	99.35	99.28	99.02	98.86
24	388.6	100.28	99.95	99.67	99.59	99.43	99.33	99.15	99.05	98.94	98.92
25	388.1	100.44	100.10	99.77	99.48	99.36	99.05	98.71	98.45	98.20	98.14
Avg.	395.9	100.08	99.91	99.75	99.60	99.46	99.29	99.12	98.98	98.81	98.68
Med.	397.3	100.12	99.95	99.75	99.59	99.43	99.28	99.15	99.04	98.90	98.72
st dev	7.8	0.23	0.25	0.27	0.31	0.31	0.31	0.35	0.37	0.38	0.38
Min.	384.1	99.66	99.43	99.26	99.02	98.97	98.81	98.54	98.29	98.11	98.06
Max.	412.0	100.49	100.47	100.31	100.18	100.16	99.95	99.79	99.72	99.46	99.38

3.2 Data Set 1, 55°C, 1000mA (Forward Voltage)

No.	Forward Voltage (V)										
	Ohr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs	10000hrs
1	3.020	3.058	3.078	3.060	3.050	3.047	3.041	3.047	3.053	3.051	3.050
2	3.049	3.056	3.077	3.051	3.060	3.078	3.050	3.048	3.058	3.060	3.052
3	3.021	3.069	3.070	3.041	3.049	3.042	3.050	3.048	3.053	3.045	3.052
4	3.048	3.068	3.058	3.047	3.048	3.038	3.059	3.043	3.065	3.052	3.051
5	3.025	3.046	3.047	3.043	3.057	3.075	3.050	3.048	3.031	3.057	3.060
6	3.045	3.058	3.042	3.047	3.048	3.048	3.079	3.042	3.040	3.044	3.046
7	3.001	3.025	3.029	3.027	3.047	3.076	3.050	3.049	3.049	3.049	3.059
8	3.021	3.044	3.050	3.060	3.046	3.047	3.049	3.056	3.048	3.047	3.038
9	3.032	3.077	3.052	3.075	3.046	3.041	3.067	3.042	3.049	3.038	3.054
10	3.011	3.037	3.065	3.039	3.063	3.045	3.050	3.079	3.050	3.059	3.039
11	3.042	3.054	3.056	3.049	3.032	3.042	3.044	3.052	3.030	3.045	3.048
12	3.061	3.078	3.054	3.044	3.051	3.074	3.038	3.049	3.051	3.039	3.067
13	3.044	3.060	3.046	3.048	3.043	3.041	3.048	3.048	3.041	3.041	3.054
14	3.044	3.062	3.044	3.049	3.041	3.045	3.044	3.049	3.045	3.058	3.048
15	3.009	3.017	3.040	3.035	3.042	3.078	3.068	3.049	3.059	3.033	3.037
16	3.004	3.018	3.035	3.053	3.034	3.045	3.059	3.046	3.048	3.044	3.042
17	3.053	3.061	3.022	3.047	3.024	3.043	3.061	3.067	3.048	3.042	3.047
18	3.031	3.036	3.042	3.042	3.046	3.047	3.040	3.060	3.040	3.033	3.046
19	3.030	3.045	3.028	3.051	3.057	3.046	3.078	3.033	3.043	3.047	3.041
20	3.046	3.069	3.072	3.058	3.045	3.080	3.042	3.042	3.064	3.040	3.048
21	3.105	3.102	3.109	3.091	3.105	3.107	3.105	3.108	3.103	3.007	3.106
22	3.028	3.029	3.017	3.066	3.064	3.066	3.059	3.063	3.042	3.022	3.051
23	3.057	3.061	3.060	3.066	3.052	3.059	3.051	3.052	3.069	3.046	3.048
24	3.009	3.013	3.026	3.065	3.021	3.038	3.044	3.042	3.043	3.048	3.056
25	3.016	3.022	3.032	3.037	3.065	3.080	3.048	3.079	3.041	3.041	3.043
Avg.	3.034	3.051	3.050	3.052	3.049	3.057	3.055	3.054	3.051	3.044	3.051
Med.	3.031	3.056	3.047	3.049	3.048	3.047	3.050	3.049	3.048	3.045	3.048
st dev	0.023	0.022	0.021	0.014	0.016	0.019	0.015	0.016	0.015	0.012	0.013
Min.	3.001	3.013	3.017	3.027	3.021	3.038	3.038	3.033	3.030	3.007	3.037
Max.	3.105	3.102	3.109	3.091	3.105	3.107	3.105	3.108	3.103	3.060	3.106

3.3 Data Set 1, 55°C, 1000mA (Chromaticity Shift)

No.	u'	v'	CCT(K)	Chromaticity Shift ($\Delta u'v'$)									
				1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs	10000hrs
1	0.2600	0.5265	2757	0.0006	0.0008	0.0012	0.0014	0.0016	0.0021	0.0021	0.0021	0.0019	0.0019
2	0.2597	0.5253	2767	0.0005	0.0008	0.0011	0.0012	0.0008	0.0010	0.0011	0.0011	0.0012	0.0015
3	0.2600	0.5258	2759	0.0003	0.0005	0.0009	0.0012	0.0012	0.0011	0.0013	0.0011	0.0016	0.0021
4	0.2590	0.5247	2786	0.0003	0.0003	0.0006	0.0009	0.0009	0.0008	0.0009	0.0007	0.0011	0.0015
5	0.2582	0.5234	2810	0.0003	0.0006	0.0009	0.0012	0.0009	0.0004	0.0005	0.0005	0.0007	0.0009
6	0.2588	0.5236	2795	0.0004	0.0004	0.0007	0.0007	0.0009	0.0009	0.0006	0.0006	0.0009	0.0012
7	0.2592	0.5255	2778	0.0003	0.0004	0.0006	0.0005	0.0007	0.0009	0.0010	0.0009	0.0009	0.0010
8	0.2582	0.5246	2805	0.0001	0.0001	0.0005	0.0005	0.0007	0.0009	0.0009	0.0007	0.0010	0.0013
9	0.2599	0.5256	2763	0.0001	0.0003	0.0004	0.0004	0.0006	0.0007	0.0010	0.0014	0.0015	0.0016
10	0.2616	0.5267	2722	0.0003	0.0001	0.0002	0.0004	0.0006	0.0006	0.0009	0.0012	0.0012	0.0012
11	0.2595	0.5247	2774	0.0001	0.0004	0.0006	0.0005	0.0008	0.0009	0.0013	0.0016	0.0016	0.0015
12	0.2600	0.5248	2763	0.0002	0.0001	0.0003	0.0004	0.0011	0.0009	0.0009	0.0012	0.0014	0.0017
13	0.2609	0.5235	2750	0.0006	0.0004	0.0004	0.0007	0.0012	0.0009	0.0008	0.0011	0.0013	0.0015
14	0.2614	0.5253	2732	0.0004	0.0004	0.0005	0.0008	0.0009	0.0014	0.0012	0.0015	0.0017	0.0020
15	0.2598	0.5259	2763	0.0002	0.0004	0.0006	0.0004	0.0002	0.0009	0.0012	0.0016	0.0019	0.0022
16	0.2603	0.5245	2759	0.0004	0.0009	0.0009	0.0008	0.0009	0.0011	0.0019	0.0021	0.0024	0.0026
17	0.2610	0.5245	2744	0.0002	0.0003	0.0004	0.0007	0.0006	0.0006	0.0010	0.0012	0.0015	0.0018
18	0.2595	0.5233	2782	0.0004	0.0007	0.0006	0.0006	0.0010	0.0008	0.0009	0.0011	0.0012	0.0014
19	0.2577	0.5245	2815	0.0004	0.0003	0.0004	0.0010	0.0014	0.0012	0.0012	0.0017	0.0021	0.0026
20	0.2591	0.5243	2786	0.0003	0.0004	0.0004	0.0009	0.0013	0.0010	0.0011	0.0016	0.0018	0.0020
21	0.2600	0.5259	2759	0.0004	0.0008	0.0009	0.0013	0.0018	0.0018	0.0019	0.0021	0.0023	0.0026
22	0.2596	0.5263	2766	0.0004	0.0001	0.0002	0.0006	0.0012	0.0013	0.0013	0.0014	0.0017	0.0019
23	0.2579	0.5222	2823	0.0002	0.0007	0.0007	0.0004	0.0006	0.0007	0.0007	0.0007	0.0008	0.0010
24	0.2592	0.5229	2790	0.0004	0.0007	0.0007	0.0007	0.0007	0.0006	0.0007	0.0007	0.0008	0.0010
25	0.2600	0.5234	2770	0.0004	0.0006	0.0006	0.0005	0.0004	0.0005	0.0006	0.0007	0.0008	0.0009
Avg.	0.2596	0.5247	2773	0.0003	0.0005	0.0006	0.0008	0.0009	0.0010	0.0011	0.0012	0.0014	0.0016
Med.	0.2597	0.5247	2767	0.0003	0.0004	0.0006	0.0007	0.0009	0.0009	0.0010	0.0012	0.0014	0.0015
st dev	0.0010	0.0012	25	0.0001	0.0002	0.0003	0.0003	0.0004	0.0004	0.0004	0.0005	0.0005	0.0005
Min.	0.2577	0.5222	2722	0.0001	0.0001	0.0002	0.0004	0.0002	0.0004	0.0005	0.0005	0.0007	0.0009
Max.	0.2616	0.5267	2823	0.0006	0.0009	0.0012	0.0014	0.0018	0.0021	0.0021	0.0021	0.0024	0.0026

3.4 Data Set 2, 85°C, 1000mA (Lumen Maintenance)

No.	Φ(lm)	Lumen Maintenance (%)									
	0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs	10000hrs
26	403.5	99.98	99.70	99.55	99.50	99.11	98.64	98.27	97.92	97.79	97.62
27	400.0	99.90	99.68	99.50	99.38	99.20	98.95	99.45	98.43	98.35	97.50
28	403.8	99.68	99.55	99.21	99.08	98.98	98.81	98.56	98.24	97.97	97.77
29	387.2	100.23	100.13	100.05	99.85	99.72	99.43	99.30	99.17	99.15	98.81
30	389.6	100.18	100.13	100.10	99.97	99.82	99.44	99.08	98.79	98.69	98.51
31	392.8	100.05	99.75	99.39	99.24	98.93	98.78	98.65	98.17	98.04	97.73
32	401.7	99.95	99.78	99.60	99.48	99.20	98.88	98.78	98.66	98.56	98.43
33	404.6	99.90	99.43	99.23	99.04	98.91	98.67	98.54	98.17	98.10	97.95
34	395.4	99.70	99.49	99.29	99.24	98.94	98.81	98.53	98.25	97.75	97.65
35	394.4	100.33	100.20	99.90	99.65	99.59	99.44	99.37	99.29	99.16	99.01
36	394.0	100.20	99.87	99.77	99.57	99.11	98.96	98.71	98.53	98.35	98.27
37	400.4	100.20	100.05	99.85	99.75	99.48	99.43	99.20	98.98	98.85	98.73
38	398.0	99.60	99.55	99.22	99.07	98.99	98.57	98.29	98.27	98.07	97.61
39	408.0	99.44	99.14	99.07	98.90	98.73	98.48	98.31	98.06	97.82	97.67
40	382.5	100.18	100.13	100.05	99.87	99.76	99.66	99.45	99.35	99.19	99.03
41	397.5	100.15	99.92	99.50	98.99	98.77	98.67	98.54	98.19	97.96	97.91
42	394.6	99.77	99.42	99.34	99.09	98.83	98.58	98.33	98.12	97.80	97.67
43	398.2	99.75	99.50	99.25	99.07	98.87	98.62	98.42	98.34	97.92	97.71
44	394.7	99.70	99.47	99.34	99.24	99.14	98.96	98.81	98.61	98.51	98.28
45	396.6	99.77	99.60	99.45	99.34	99.19	99.09	98.94	98.84	98.64	98.51
46	405.7	99.75	99.70	99.33	99.09	98.87	98.72	98.64	98.40	98.13	97.86
47	395.5	100.08	99.62	99.17	98.71	98.63	98.43	98.15	98.00	97.88	97.75
48	408.9	99.63	99.54	99.29	99.14	99.05	98.92	98.70	98.68	98.26	98.02
49	403.6	100.35	100.05	99.95	99.85	99.80	99.55	99.18	99.06	98.79	98.64
50	388.2	99.97	99.74	99.69	99.54	99.46	99.30	99.18	99.00	98.76	98.56
Avg.	397.6	99.94	99.73	99.52	99.35	99.16	98.95	98.78	98.54	98.34	98.13
Med.	397.5	99.95	99.70	99.45	99.24	99.11	98.88	98.70	98.43	98.26	97.95
st dev	6.6	0.25	0.27	0.31	0.34	0.36	0.37	0.40	0.42	0.46	0.48
Min.	382.5	99.44	99.14	99.07	98.71	98.63	98.43	98.15	97.92	97.75	97.50
Max.	408.9	100.35	100.20	100.10	99.97	99.82	99.66	99.45	99.35	99.19	99.03

3.5 Data Set 2, 85°C, 1000mA (Forward Voltage)

No.	Forward Voltage (V)										
	Ohr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs	10000hrs
26	3.033	3.046	3.038	3.026	3.025	3.034	3.048	3.045	3.045	3.042	3.049
27	3.046	3.060	3.044	3.043	3.047	3.049	3.047	3.036	3.041	3.044	3.042
28	3.023	3.028	3.024	3.022	3.025	3.034	3.025	3.045	3.040	3.027	3.029
29	3.006	3.027	3.044	3.057	3.050	3.046	3.042	3.035	3.023	3.039	3.023
30	3.013	3.024	3.043	3.031	3.040	3.041	3.026	3.038	3.025	3.025	3.042
31	3.046	3.062	3.049	3.050	3.047	3.042	3.042	3.041	3.039	3.044	3.047
32	3.042	3.056	3.056	3.043	3.043	3.043	3.059	3.060	3.047	3.059	3.042
33	3.032	3.043	3.050	3.049	3.048	3.035	3.028	3.045	3.048	3.044	3.043
34	3.107	3.103	3.101	3.102	3.109	3.103	3.102	3.105	3.103	3.101	3.107
35	3.029	3.044	3.050	3.033	3.037	3.037	3.039	3.045	3.027	3.034	3.033
36	3.001	3.013	2.999	2.998	3.005	2.993	2.995	2.999	2.995	3.009	3.006
37	3.077	3.070	3.043	3.052	3.049	3.051	3.064	3.044	3.042	3.047	3.041
38	3.045	3.061	3.039	3.031	3.039	3.033	3.028	3.033	3.061	3.042	3.041
39	3.015	3.024	3.032	3.037	3.035	3.021	3.054	3.044	3.032	3.027	3.037
40	3.040	3.059	3.042	3.044	3.048	3.046	3.046	3.038	3.059	3.044	3.045
41	3.037	3.051	3.040	3.060	3.039	3.033	3.035	3.046	3.028	3.035	3.044
42	3.018	3.027	3.042	3.048	3.047	3.048	3.049	3.043	3.047	3.045	3.047
43	3.025	3.030	3.037	3.028	3.022	3.023	3.026	3.036	3.044	3.044	3.052
44	2.998	3.008	3.007	3.003	3.003	3.008	3.005	3.007	3.009	3.003	3.000
45	2.998	3.013	2.899	3.004	2.891	3.000	3.001	3.003	3.004	2.976	2.989
46	3.019	3.050	3.049	3.045	3.040	3.045	3.031	3.042	3.043	3.057	3.042
47	3.061	3.100	3.104	3.102	3.102	3.096	3.107	3.101	3.103	3.106	3.101
48	3.044	3.074	3.060	3.060	3.043	3.053	3.050	3.050	3.047	3.055	3.053
49	3.003	3.019	3.043	3.059	3.057	3.049	3.048	3.032	3.049	3.041	3.062
50	3.047	3.056	3.069	3.045	3.052	3.044	3.049	3.049	3.045	3.039	3.049
Avg.	3.032	3.046	3.040	3.043	3.038	3.040	3.042	3.042	3.042	3.041	3.043
Med.	3.032	3.046	3.043	3.044	3.043	3.042	3.042	3.043	3.043	3.042	3.042
st dev	0.025	0.025	0.037	0.025	0.038	0.024	0.026	0.023	0.024	0.026	0.025
Min.	2.998	3.008	2.899	2.998	2.891	2.993	2.995	2.999	2.995	2.976	2.989
Max.	3.107	3.103	3.104	3.102	3.109	3.103	3.107	3.105	3.103	3.106	3.107

3.6 Data Set 2, 85°C, 1000mA (Chromaticity Shift)

No.	u'	v'	CCT(K)	Chromaticity Shift ($\Delta u'v'$)									
				0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
26	0.2594	0.5254	2774	0.0004	0.0004	0.0003	0.0005	0.0012	0.0014	0.0013	0.0014	0.0016	0.0018
27	0.2588	0.5257	2787	0.0006	0.0006	0.0004	0.0006	0.0012	0.0015	0.0014	0.0015	0.0017	0.0021
28	0.2583	0.5234	2808	0.0006	0.0005	0.0007	0.0007	0.0011	0.0014	0.0016	0.0013	0.0016	0.0020
29	0.2609	0.5254	2742	0.0008	0.0014	0.0013	0.0015	0.0017	0.0022	0.0023	0.0022	0.0025	0.0029
30	0.2597	0.5241	2774	0.0006	0.0006	0.0004	0.0008	0.0012	0.0011	0.0011	0.0012	0.0012	0.0015
31	0.2591	0.5247	2783	0.0005	0.0009	0.0010	0.0011	0.0013	0.0018	0.0025	0.0018	0.0021	0.0025
32	0.2595	0.5255	2771	0.0004	0.0006	0.0008	0.0009	0.0011	0.0016	0.0018	0.0016	0.0018	0.0021
33	0.2592	0.5252	2779	0.0005	0.0005	0.0007	0.0008	0.0009	0.0014	0.0014	0.0013	0.0017	0.0023
34	0.2590	0.5243	2787	0.0007	0.0005	0.0007	0.0007	0.0007	0.0013	0.0013	0.0012	0.0015	0.0019
35	0.2590	0.5249	2785	0.0005	0.0003	0.0004	0.0005	0.0005	0.0011	0.0012	0.0012	0.0013	0.0015
36	0.2598	0.5265	2760	0.0006	0.0008	0.0008	0.0009	0.0010	0.0015	0.0018	0.0017	0.0018	0.0020
37	0.2575	0.5246	2820	0.0006	0.0004	0.0007	0.0008	0.0009	0.0013	0.0015	0.0016	0.0015	0.0016
38	0.2596	0.5261	2766	0.0006	0.0006	0.0009	0.0009	0.0009	0.0015	0.0016	0.0016	0.0017	0.0018
39	0.2582	0.5259	2799	0.0007	0.0003	0.0006	0.0007	0.0008	0.0013	0.0016	0.0017	0.0016	0.0018
40	0.2591	0.5224	2795	0.0004	0.0003	0.0001	0.0005	0.0008	0.0008	0.0009	0.0009	0.0009	0.0010
41	0.2611	0.5250	2740	0.0006	0.0004	0.0008	0.0008	0.0009	0.0013	0.0016	0.0015	0.0015	0.0016
42	0.2596	0.5243	2775	0.0006	0.0004	0.0007	0.0008	0.0010	0.0014	0.0015	0.0016	0.0017	0.0018
43	0.2594	0.5250	2775	0.0004	0.0003	0.0006	0.0007	0.0006	0.0012	0.0013	0.0014	0.0013	0.0013
44	0.2588	0.5253	2787	0.0006	0.0006	0.0008	0.0009	0.0010	0.0015	0.0017	0.0017	0.0016	0.0016
45	0.2578	0.5251	2810	0.0005	0.0007	0.0007	0.0008	0.0008	0.0013	0.0014	0.0015	0.0015	0.0016
46	0.2592	0.5247	2781	0.0007	0.0006	0.0008	0.0011	0.0011	0.0013	0.0014	0.0016	0.0014	0.0014
47	0.2595	0.5248	2774	0.0006	0.0007	0.0010	0.0012	0.0012	0.0014	0.0016	0.0017	0.0016	0.0016
48	0.2580	0.5254	2805	0.0005	0.0006	0.0007	0.0009	0.0009	0.0011	0.0013	0.0013	0.0013	0.0015
49	0.2563	0.5221	2859	0.0006	0.0009	0.0011	0.0013	0.0013	0.0015	0.0017	0.0019	0.0017	0.0016
50	0.2600	0.5241	2766	0.0007	0.0007	0.0008	0.0010	0.0010	0.0013	0.0013	0.0014	0.0014	0.0015
Avg.	0.2591	0.5248	2784	0.0006	0.0006	0.0007	0.0009	0.0010	0.0014	0.0015	0.0015	0.0016	0.0018
Med.	0.2592	0.5250	2781	0.0006	0.0006	0.0007	0.0008	0.0010	0.0014	0.0015	0.0015	0.0016	0.0016
st dev	0.0010	0.0010	25	0.0001	0.0002	0.0003	0.0002	0.0002	0.0003	0.0003	0.0003	0.0003	0.0004
Min.	0.2563	0.5221	2740	0.0004	0.0003	0.0001	0.0005	0.0005	0.0008	0.0009	0.0009	0.0009	0.0010
Max.	0.2611	0.5265	2859	0.0008	0.0014	0.0013	0.0015	0.0017	0.0022	0.0025	0.0022	0.0025	0.0029

3.7 Data Set 3, 105°C, 1000mA (Lumen Maintenance)

No.	Φ(lm)	Lumen Maintenance (%)									
	0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs	10000hrs
51	394.9	99.52	99.27	99.24	99.19	99.11	99.01	98.78	98.58	98.15	97.75
52	393.1	99.57	99.36	98.78	98.58	98.45	98.19	98.04	97.89	97.66	97.28
53	381.2	100.16	100.00	99.84	99.42	99.29	98.98	98.77	98.50	98.37	98.29
54	401.7	99.48	99.28	99.10	98.95	98.61	98.31	98.01	97.78	97.46	96.99
55	387.8	99.61	99.25	98.97	98.79	98.66	98.32	98.09	97.60	97.45	97.32
56	415.1	99.71	99.30	98.70	98.60	98.22	97.81	97.45	97.06	96.89	96.72
57	401.2	99.88	99.68	99.55	99.08	98.88	98.65	98.50	98.31	98.06	97.66
58	408.2	99.66	99.66	99.49	99.12	98.65	98.36	97.62	97.48	97.13	96.86
59	406.0	99.46	99.11	98.87	98.82	98.45	98.25	97.88	97.68	97.34	97.22
60	389.1	99.87	99.56	99.00	98.25	98.07	97.89	97.82	97.66	97.02	96.63
61	392.8	99.72	99.44	99.13	98.52	98.32	98.14	97.99	97.76	97.63	97.35
62	395.1	99.90	99.72	99.22	99.06	98.96	98.84	98.30	97.95	97.57	97.19
63	390.8	99.56	99.46	99.44	99.05	98.62	98.39	97.90	97.75	97.57	97.42
64	376.4	100.11	99.87	99.39	99.18	98.99	98.59	97.82	97.29	96.92	96.76
65	375.1	100.40	99.92	99.89	99.63	99.49	99.01	98.80	98.53	98.27	97.84
66	397.4	99.87	99.52	99.32	99.19	99.09	98.87	98.54	97.91	97.76	97.56
67	399.4	100.23	99.72	99.40	99.32	99.20	99.12	99.02	98.75	98.47	98.05
68	390.1	100.13	99.95	99.74	99.49	99.28	99.00	98.74	98.51	98.36	98.08
69	390.3	99.80	99.49	99.39	99.31	98.82	98.59	98.31	98.13	97.75	97.49
70	382.9	99.43	99.24	98.93	98.72	98.51	98.33	98.25	98.02	97.78	97.57
71	375.9	100.08	99.97	99.89	99.63	99.44	99.31	99.12	98.78	98.56	98.24
72	399.1	99.55	99.17	98.92	98.57	98.15	98.05	97.67	97.44	97.24	96.97
73	396.5	99.77	99.65	99.50	99.32	99.12	98.74	98.51	98.18	97.78	97.60
74	386.7	100.16	99.95	99.72	99.46	99.35	99.07	98.60	98.32	97.80	97.54
75	371.5	100.24	100.00	99.89	99.57	99.19	98.52	97.82	97.63	97.12	96.90
Avg.	391.9	99.83	99.58	99.33	99.07	98.84	98.57	98.26	97.98	97.68	97.41
Med.	392.8	99.80	99.56	99.39	99.12	98.88	98.59	98.25	97.91	97.66	97.42
st dev	10.8	0.29	0.29	0.37	0.38	0.42	0.41	0.47	0.47	0.49	0.47
Min.	371.5	99.43	99.11	98.70	98.25	98.07	97.81	97.45	97.06	96.89	96.63
Max.	415.1	100.40	100.00	99.89	99.63	99.49	99.31	99.12	98.78	98.56	98.29

3.8 Data Set 3, 105°C, 1000mA (Forward Voltage)

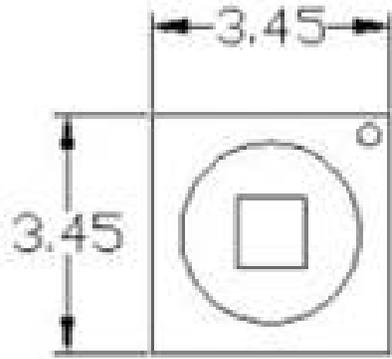
No.	Forward Voltage (V)										
	Ohr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs	10000hrs
51	3.016	3.029	3.021	3.028	3.023	3.029	3.022	3.027	3.027	3.039	3.031
52	3.007	3.018	2.999	3.004	2.994	3.001	3.003	2.996	3.006	2.992	2.998
53	3.001	3.008	3.006	2.994	2.996	2.989	2.966	3.006	2.992	3.003	3.001
54	3.036	3.039	3.049	3.044	3.040	3.045	3.043	3.042	3.045	3.042	3.046
55	3.107	3.105	3.108	3.103	3.106	3.102	3.105	3.102	3.106	3.107	3.102
56	3.036	3.048	3.043	3.047	3.047	3.044	3.054	3.045	3.048	3.044	3.043
57	3.027	3.038	3.024	3.023	3.031	3.039	3.027	3.027	3.027	3.032	3.037
58	3.034	3.053	3.046	3.014	3.033	3.039	3.039	3.035	3.037	3.035	3.037
59	3.010	3.017	3.018	3.014	3.014	3.017	3.019	3.017	3.018	3.018	3.011
60	3.018	3.010	2.998	2.994	3.017	3.017	2.998	2.993	3.004	2.996	3.009
61	2.997	3.005	2.932	3.003	2.976	3.000	2.823	2.906	3.002	2.949	2.992
62	3.094	3.103	3.086	3.090	3.070	3.105	3.107	3.102	3.100	3.088	3.106
63	3.016	3.023	3.020	3.026	3.028	3.026	3.025	3.034	3.029	3.027	3.026
64	3.019	3.027	3.022	3.028	3.021	3.036	3.038	3.025	3.025	3.023	3.031
65	3.009	3.039	3.028	3.018	3.017	3.034	3.021	3.024	3.038	3.028	3.016
66	3.046	3.073	3.056	3.075	3.069	3.055	3.057	3.098	3.082	3.079	3.072
67	3.093	3.119	3.097	3.105	3.108	3.106	3.101	3.103	3.102	3.103	3.103
68	3.022	3.033	3.030	3.026	3.035	3.036	3.039	3.034	3.028	3.023	3.026
69	3.050	3.068	3.062	3.049	3.039	3.047	3.047	3.050	3.035	3.039	3.030
70	3.053	3.073	3.083	3.080	3.083	3.086	3.087	3.088	3.084	3.085	3.082
71	3.029	3.036	3.029	3.025	3.027	3.027	3.027	3.022	3.023	3.038	3.024
72	3.033	3.040	3.041	3.023	3.031	3.022	3.029	3.030	3.039	3.037	3.031
73	3.068	3.074	3.060	3.058	3.067	3.049	3.054	3.069	3.071	3.072	3.075
74	3.014	3.020	3.054	3.057	3.050	3.050	3.052	3.058	3.049	3.049	3.060
75	2.998	3.010	3.005	3.003	3.005	3.007	3.005	3.007	2.995	3.000	3.007
Avg.	3.033	3.044	3.037	3.037	3.037	3.040	3.032	3.038	3.040	3.038	3.040
Med.	3.027	3.038	3.030	3.026	3.031	3.036	3.038	3.034	3.035	3.037	3.031
st dev	0.030	0.032	0.037	0.033	0.033	0.031	0.055	0.043	0.033	0.037	0.033
Min.	2.997	3.005	2.932	2.994	2.976	2.989	2.823	2.906	2.992	2.949	2.992
Max.	3.107	3.119	3.108	3.105	3.108	3.106	3.107	3.103	3.106	3.107	3.106

3.9 Data Set 3, 105°C, 1000mA (Chromaticity Shift)

No.	u'	v'	CCT(K)	Chromaticity Shift ($\Delta u'v'$)									
				0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
51	0.2582	0.5234	2808	0.0005	0.0008	0.0012	0.0014	0.0014	0.0016	0.0016	0.0017	0.0019	0.0020
52	0.2621	0.5259	2715	0.0005	0.0006	0.0008	0.0013	0.0014	0.0013	0.0014	0.0017	0.0018	0.0019
53	0.2615	0.5252	2730	0.0005	0.0005	0.0011	0.0016	0.0017	0.0018	0.0017	0.0023	0.0023	0.0024
54	0.2589	0.5243	2789	0.0002	0.0008	0.0008	0.0013	0.0014	0.0013	0.0014	0.0018	0.0018	0.0020
55	0.2605	0.5258	2748	0.0001	0.0005	0.0010	0.0015	0.0018	0.0016	0.0017	0.0021	0.0021	0.0021
56	0.2571	0.5251	2826	0.0004	0.0007	0.0008	0.0013	0.0016	0.0015	0.0015	0.0017	0.0016	0.0016
57	0.2594	0.5256	2772	0.0002	0.0007	0.0010	0.0016	0.0018	0.0018	0.0017	0.0021	0.0021	0.0021
58	0.2592	0.5259	2775	0.0004	0.0009	0.0009	0.0014	0.0017	0.0016	0.0016	0.0019	0.0019	0.0018
59	0.2590	0.5254	2783	0.0003	0.0007	0.0011	0.0014	0.0017	0.0018	0.0022	0.0020	0.0020	0.0020
60	0.2621	0.5257	2715	0.0003	0.0005	0.0006	0.0011	0.0013	0.0012	0.0017	0.0017	0.0018	0.0021
61	0.2626	0.5266	2702	0.0003	0.0007	0.0011	0.0016	0.0019	0.0017	0.0021	0.0022	0.0025	0.0029
62	0.2615	0.5256	2727	0.0002	0.0008	0.0011	0.0017	0.0019	0.0020	0.0022	0.0023	0.0024	0.0026
63	0.2624	0.5254	2711	0.0003	0.0005	0.0008	0.0012	0.0017	0.0017	0.0018	0.0022	0.0022	0.0024
64	0.2631	0.5243	2699	0.0007	0.0004	0.0007	0.0007	0.0010	0.0010	0.0012	0.0014	0.0017	0.0021
65	0.2620	0.5242	2724	0.0003	0.0003	0.0007	0.0007	0.0011	0.0010	0.0011	0.0013	0.0018	0.0024
66	0.2614	0.5254	2731	0.0004	0.0008	0.0010	0.0014	0.0019	0.0020	0.0021	0.0023	0.0023	0.0024
67	0.2601	0.5257	2758	0.0002	0.0008	0.0009	0.0013	0.0018	0.0018	0.0020	0.0023	0.0022	0.0022
68	0.2594	0.5251	2776	0.0002	0.0005	0.0007	0.0011	0.0015	0.0017	0.0016	0.0018	0.0020	0.0024
69	0.2615	0.5256	2728	0.0001	0.0004	0.0006	0.0011	0.0015	0.0017	0.0016	0.0018	0.0021	0.0025
70	0.2616	0.5245	2732	0.0003	0.0002	0.0007	0.0010	0.0014	0.0016	0.0015	0.0017	0.0021	0.0025
71	0.2614	0.5229	2742	0.0007	0.0007	0.0008	0.0009	0.0011	0.0013	0.0012	0.0013	0.0018	0.0023
72	0.2620	0.5269	2713	0.0007	0.0007	0.0009	0.0013	0.0017	0.0020	0.0017	0.0022	0.0022	0.0023
73	0.2610	0.5258	2739	0.0006	0.0006	0.0009	0.0013	0.0018	0.0020	0.0019	0.0022	0.0023	0.0025
74	0.2620	0.5256	2717	0.0004	0.0006	0.0007	0.0011	0.0017	0.0019	0.0018	0.0021	0.0021	0.0022
75	0.2629	0.5240	2706	0.0007	0.0008	0.0009	0.0009	0.0013	0.0012	0.0013	0.0014	0.0020	0.0026
Avg.	0.2609	0.5252	2743	0.0004	0.0006	0.0009	0.0012	0.0016	0.0016	0.0017	0.0019	0.0020	0.0023
Med.	0.2615	0.5254	2731	0.0003	0.0007	0.0009	0.0013	0.0017	0.0017	0.0017	0.0019	0.0021	0.0023
st dev	0.0016	0.0009	34	0.0002	0.0002	0.0002	0.0003	0.0003	0.0003	0.0003	0.0003	0.0002	0.0003
Min.	0.2571	0.5229	2699	0.0001	0.0002	0.0006	0.0007	0.0010	0.0010	0.0011	0.0013	0.0016	0.0016
Max.	0.2631	0.5269	2826	0.0007	0.0009	0.0012	0.0017	0.0019	0.0020	0.0022	0.0023	0.0025	0.0029

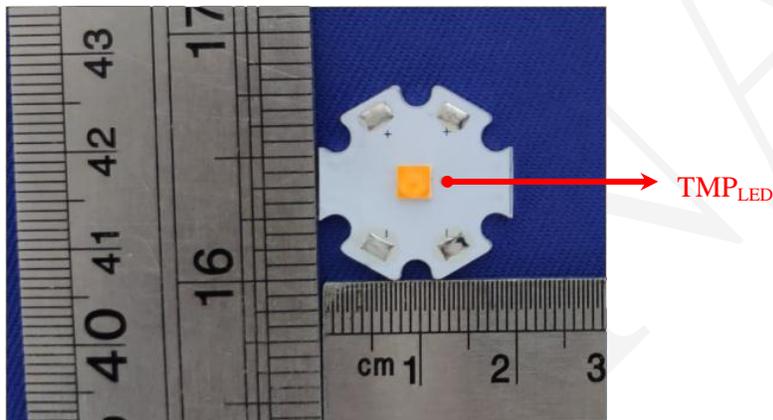
4 - DUT Photo

4.1 #Mechanical Dimensions



All dimensions are in millimeter

4.2 DUT Photo



Directions

1. The information marked "superscript #" is provided by the applicant, the laboratory is not responsible for its authenticity and this information can affect the validity of the result in the test report.
2. Unless otherwise stated the results shown in this test report refer only to the sample(s) tested.
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C.P. Ramani

C.P. Ramani, P.E., C.B.O
President



SCOPE OF ACCREDITATION

FIELDS OF TESTING	ACCREDITED TEST METHODS
ENERGY STAR Program Requirements for Lighting (except Electromagnetic and Radio Frequency Interference, Air Tight for Restricted Air Flow, and Mercury Content) (continued)	IES LM-78-17 IESNA approved method for total luminous flux measurement of lamps using an integrating sphere photometer IES LM-79-2008: Approved Method for Electrical and Photometric Measurements of Solid-State Lighting Products, Sections 9, 10 and 12 IES LM-80-2008: Approved Method for Measuring Lumen Maintenance of LED Light Sources (LED Packages/Modules/Arrays) IES LM-80-2015: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays and Modules IES LM-82-2012: Characterization of LED Light Engines and LED Lamps for Electrical and Photometric Properties as a Function of Temperature IES LM-84-2014: Approved Method for Measuring Luminous Flux and Color Maintenance of LED Lamps, Light Engines, and Luminaires IES LM-85-14 Electrical and Photometric Measurements of High-Power IES LM-86-2015 Measuring Luminous Flux and Color Maintenance of Remote Phosphor Components IES TM-16-2005: Technical Memorandum on Light Emitting Diode (LED) Sources and Systems IES TM-21-11 Projecting Long Term Lumen Maintenance of LED Light Sources IES TM-26-2015: Method for Projecting Catastrophic Failure Rate of LED Packages IES TM-28-2014: Projecting Long-Term Luminous Flux Maintenance of LED Lamps and Luminaires NEMA SSL 7A-2013 Phase Cut Dimming for Solid-State Lighting – Basic Compatibility NEMA SSL 7A-2015 Phase cut dimming for solid-state lighting – basic compatibility NEMA 77-2017 Temporal Light Artifacts: Test Methods and Guidance for Acceptance Criteria SASO 2870:2015: Energy Efficiency, Functionality and Labeling Requirements for Lighting Products, Part 1 SASO 2870:2018: Energy Efficiency, Functionality and Labeling Requirements for Lighting Products, Part 1 SASO 2902:2018: Energy Efficiency, Functionality and Labeling Requirements for Lighting Products, Part 2 US EPA: ENERGY STAR Program Requirements V1.5 for decorative light strings Appendix A US EPA ENERGY STAR Program Requirements V1.1 for Lamps (Light Bulbs), (except Sections 4, 12, and 13)