TEST REPORT

ACCORDING TO IES LM-80-2015
For

Hongli Zhihui Group Co.,Ltd. Guangzhou Branch

Room 316, Building 2, No.1, Xianke Yi Road, Huadong Town, Huadu District, Guangzhou, China

Model: HL-AM-2835HW-S1-08-HR5

Report Type: 9000 Hours Test Report	**Product Type:** LED Package
Test Engineer:	Pote Wang
Report Number:	RSZ160329508-10-M1
Test Date:	2016-03-31 to 2017-04-10
Report Date:	2019-01-14
Revised Note:	The previous report RSZ160329508-10 is replaced by this report on 2019-01-14
Reviewed By:	Daniel Duan / EE Manager
Test Facility:	Test facility was located at No.69,Pulongcun ,Puxinhu Industrial Area, Tangxia , Dongguan, Guangdong, China.
Prepared By:	Bay Area Compliance Laboratories Corp. (Dongguan). No.69,Pulongcun ,Puxinhu Industrial Area, Tangxia , Dongguan, Guangdong, China. Tel: +86-0769-86858888 Fax:+86-0769-86858588

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.

TABLE OF CONTENTS

1 - General Information

1.1 Description of LED Light Sources

Sample Size:

90 PCS samples were received on 2016-03-29. The samples were numbered from 1 to 30 , 31 to 60 and 61 to 90.

Manufacturer:	Hongli Zhihui Group Co.,Ltd. Guangzhou Branch
Part Number:	HL-AM-2835HW-S1-08-HR5
Part Type:	LED Package
Drive Level:	DC 60mA
Nominal CCT:	2700K
Power:	0.204W
Average Current Density per LED die:	290.63mA/mm^2
Average Power Density per LED die:	0.988 W/mm^2
CRI:	90
Die Spacing:	N/A

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)

Tested Model	Multiple Models	Differences	Details
HL-AM-2835HW-S1-08-HR5	HL-AW-2835HW-S1-08-HR5	Model Name	The performance enhancing product, has the same appearance
	HL-AW-PU2835HW-S1-08-HR5	Model Name	Only different model name for patent demand market
	HL-AM-PU2835HW-S1-08-HR5		

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® 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	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	20015	25°C~130°C	2017-03-03	2018-03-02
Digital CC&CV DC Power Supply	EVERFINE	WY5015	11090008	(50/15A)	2016-07-07	2017-07-06
Digital CC&CV DC Power Supply	EVERFINE	WY5015	11060002	(50/15A)	2016-07-07	2017-07-06
Digital CC&CV DC Power Supply	EVERFINE	WY5015	11090007	(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 ±3% of the specified value of the manufacturer during maintenance test, and was within ±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 ±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 ± 2°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=21K (K=2), at the 95% confidence level.

The uncertainty of the temperature is U=0.8671°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:	HL-AM-2835HW-S1-08-HR5
Number of Units:	30
Case Temperature:	>53°C
Ambient Temperature:	>50°C
Life Test Drive Current:	60mA
Measurement Current:	60mA

Data Set 2: 85°C,60mA

Part Number:	HL-AM-2835HW-S1-08-HR5
Number of Units:	30
Case Temperature:	>83°C
Ambient Temperature:	>80°C
Life Test Drive Current:	60mA
Measurement Current:	60mA

Data Set 3: 105°C,60mA

Part Number:	HL-AM-2835HW-S1-08-HR5
Number of Units:	30
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	30	0	1000	9000	>54,000 hours
2	30	0	1000	9000	>54,000 hours
3	30	0	1000	9000	>54,000 hours

Average Lumen Maintenance (Percentage of Initial Luminous Flux)

Data Set:	1000	2000	3000	4000	5000	6000	7000	8000	9000
1	100.31%	100.04%	99.93%	99.72%	99.51%	99.33%	99.10%	98.88%	98.70%
2	100.18%	99.77%	99.58%	99.28%	98.97%	98.66%	98.41%	98.14%	97.88%
3	100.11%	99.61%	99.33%	98.90%	98.50%	98.13%	97.79%	97.46%	97.13%

Average Color Maintenance

Data Set:	1000	2000	3000	4000	5000	6000	7000	8000	9000
1	0.0003	0.0004	0.0006	0.001	0.0012	0.0015	0.0017	0.002	0.0022
2	0.0004	0.0005	0.0008	0.0012	0.0014	0.0017	0.0019	0.0022	0.0025
3	0.0005	0.0007	0.0009	0.0014	0.0016	0.0019	0.0021	0.0023	0.0026

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	26.43	100.15	99.96	99.81	99.66	99.51	99.24	98.86	98.75	98.56
2	27.07	100.22	99.89	99.78	99.52	99.30	99.08	98.74	98.52	98.23
3	27.01	100.37	100.22	100.11	99.81	99.56	99.26	98.89	98.70	98.48
4	27.18	100.44	100.22	100.15	99.85	99.71	99.37	99.08	98.79	98.57
5	27.25	100.33	100.11	100.07	99.89	99.67	99.41	99.12	98.86	98.68
6	27.13	100.18	99.82	99.71	99.48	99.34	99.26	99.12	98.86	98.64
7	26.76	100.41	100.30	100.22	99.96	99.78	99.48	99.10	98.92	98.77
8	27.26	100.40	100.18	100.07	99.85	99.67	99.63	99.30	99.23	99.12
9	27.26	100.22	99.93	99.89	99.74	99.63	99.56	99.45	99.23	99.01
10	26.97	100.37	100.11	100.04	99.78	99.70	99.63	99.44	99.18	99.00
11	27.00	100.30	100.15	100.07	100.00	99.85	99.67	99.56	99.37	99.15
12	27.54	100.40	100.29	100.18	99.85	99.75	99.64	99.38	99.16	98.95
13	25.99	100.19	99.92	99.85	99.73	99.58	99.50	99.31	99.15	99.00
14	26.21	100.23	99.85	99.77	99.69	99.43	99.35	99.12	99.08	99.01
15	26.80	100.34	100.04	99.81	99.59	99.25	99.07	98.77	98.58	98.47
16	27.31	100.22	100.11	99.93	99.74	99.49	99.27	98.97	98.76	98.68
17	26.79	100.41	100.07	100.04	99.93	99.59	99.40	99.14	98.88	98.77
18	27.42	100.36	100.04	99.93	99.78	99.49	99.27	98.98	98.76	98.65
19	27.04	100.44	100.18	100.07	99.85	99.63	99.37	99.11	98.89	98.71
20	26.85	100.37	99.93	99.81	99.66	99.55	99.40	99.29	99.03	98.88
21	27.01	100.33	100.19	100.04	99.81	99.56	99.37	99.33	99.15	98.89
22	26.14	100.31	100.11	99.96	99.77	99.62	99.50	99.27	99.12	98.93
23	27.15	100.29	99.93	99.78	99.56	99.30	99.15	99.08	98.78	98.64
24	27.40	100.22	99.96	99.85	99.60	99.38	99.23	99.20	98.94	98.76
25	27.10	100.18	99.85	99.82	99.52	99.37	99.11	98.67	98.45	98.41
26	27.61	100.33	99.89	99.71	99.60	99.46	99.38	99.09	98.73	98.55
27	27.19	100.29	99.78	99.63	99.49	99.19	99.12	98.93	98.75	98.49
28	27.05	100.26	99.93	99.85	99.63	99.33	98.96	98.67	98.37	98.23
29	26.88	100.33	100.04	99.89	99.67	99.40	99.22	99.11	98.85	98.55
30	26.98	100.30	100.15	99.96	99.59	99.30	99.07	99.00	98.67	98.37
Ave.	26.99	100.31	100.04	99.93	99.72	99.51	99.33	99.10	98.88	98.70
Med.	27.05	100.32	100.04	99.91	99.74	99.53	99.36	99.11	98.86	98.68
st dev	0.3854	0.0834	0.1458	0.1536	0.1445	0.1710	0.1903	0.2290	0.2472	0.2504
Min.	25.99	100.15	99.78	99.63	99.48	99.19	98.96	98.67	98.37	98.23
Max.	27.61	100.44	100.30	100.22	100.00	99.85	99.67	99.56	99.37	99.15

TM-21 Projection:

Test Duration: 9,000 hours

Failures Observed: 0

α: 2.079E-06

β: 1.006

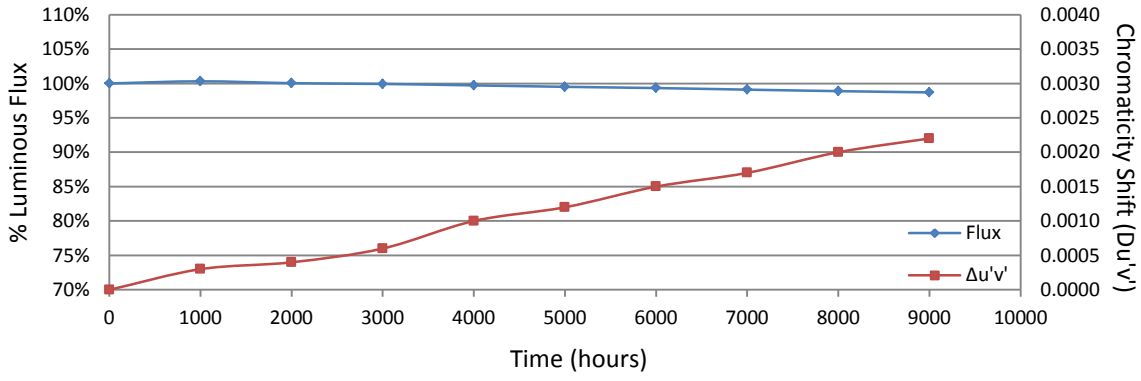
Reported L_{70}: >54000 hours

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	3.015	3.029	2.975	3.021	3.009	3.011	3.013	3.018	3.018	3.023
2	3.035	3.081	3.031	3.026	3.024	3.022	3.026	3.028	3.029	3.041
3	3.018	3.046	3.119	3.061	3.011	3.010	3.014	3.018	3.018	3.015
4	3.030	3.052	3.036	3.024	3.023	3.022	3.024	3.029	3.029	3.025
5	3.028	3.056	3.126	3.027	3.020	3.018	3.024	3.026	3.029	3.022
6	3.029	3.060	3.047	3.023	3.022	3.021	3.023	3.030	3.030	3.019
7	3.017	3.049	3.199	3.009	3.006	3.006	3.008	3.013	3.015	3.009
8	3.034	3.088	3.062	3.027	3.026	3.026	3.028	3.032	3.035	3.026
9	3.027	3.130	3.103	3.012	3.010	3.010	3.014	3.017	3.019	3.011
10	3.025	3.156	3.129	3.043	3.018	3.016	3.018	3.024	3.024	3.023
11	3.035	3.094	3.175	3.032	3.030	3.029	3.030	3.035	3.035	3.027
12	3.024	3.067	3.023	3.020	3.018	3.018	3.022	3.027	3.025	3.018
13	2.834	2.880	2.847	2.832	2.813	2.813	2.815	2.821	2.820	2.817
14	2.823	2.860	2.979	2.820	2.816	2.816	2.819	2.826	2.822	2.818
15	3.025	3.039	3.117	3.023	3.017	3.016	3.020	3.025	3.027	3.032
16	3.036	3.088	3.113	3.027	3.020	3.018	3.025	3.030	3.030	3.032
17	3.026	3.037	3.074	3.023	3.017	3.013	3.019	3.024	3.024	3.037
18	3.059	3.036	3.171	3.022	3.019	3.021	3.024	3.029	3.029	3.019
19	3.025	3.102	3.108	3.020	3.018	3.015	3.019	3.026	3.023	3.016
20	3.031	3.054	3.061	3.020	3.018	3.017	3.021	3.024	3.026	3.028
21	3.016	3.034	3.031	3.019	3.012	3.012	3.013	3.021	3.018	3.018
22	2.816	2.829	2.773	2.814	2.810	2.810	2.812	2.815	2.815	2.819
23	3.021	3.033	3.002	3.015	3.011	3.010	3.018	3.021	3.020	3.019
24	3.030	3.049	3.062	3.029	3.023	3.023	3.025	3.030	3.032	3.034
25	3.025	3.049	3.066	3.024	3.020	3.023	3.025	3.032	3.031	3.031
26	3.023	3.041	3.023	3.052	3.014	3.016	3.020	3.024	3.025	3.022
27	3.029	3.049	3.171	3.025	3.023	3.023	3.028	3.035	3.035	3.028
28	3.030	3.045	3.130	3.049	3.023	3.025	3.029	3.036	3.034	3.034
29	3.011	3.023	3.103	3.008	3.010	3.007	3.013	3.018	3.016	3.030
30	3.019	3.031	3.092	3.018	3.018	3.016	3.022	3.027	3.027	3.038
Ave.	3.007	3.040	3.065	3.006	2.997	2.997	3.000	3.005	3.005	3.004
Med.	3.025	3.049	3.070	3.023	3.018	3.016	3.021	3.026	3.026	3.023
st dev	0.0624	0.0694	0.0905	0.0634	0.0627	0.0626	0.0630	0.0629	0.0634	0.0637
Min.	2.816	2.829	2.773	2.814	2.810	2.810	2.812	2.815	2.815	2.817
Max.	3.059	3.156	3.199	3.061	3.030	3.029	3.030	3.036	3.035	3.041

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

No.	u'	v'	CCT(K)	Chromaticity Shift (Δu'v')								
	0hr(Initial)			1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
1	0.2662	0.5261	2629	0.0002	0.0003	0.0006	0.0009	0.0011	0.0013	0.0017	0.0019	0.0022
2	0.2605	0.5238	2758	0.0004	0.0005	0.0008	0.0011	0.0013	0.0016	0.0017	0.0021	0.0025
3	0.2624	0.5232	2720	0.0004	0.0006	0.0008	0.0012	0.0015	0.0018	0.0018	0.0022	0.0025
4	0.2622	0.5253	2715	0.0002	0.0003	0.0006	0.0010	0.0012	0.0015	0.0017	0.0021	0.0022
5	0.2615	0.5259	2728	0.0006	0.0007	0.0009	0.0007	0.0009	0.0012	0.0012	0.0015	0.0018
6	0.2629	0.5278	2691	0.0003	0.0005	0.0008	0.0010	0.0013	0.0016	0.0015	0.0020	0.0022
7	0.2637	0.5251	2683	0.0003	0.0003	0.0006	0.0010	0.0012	0.0016	0.0016	0.0020	0.0022
8	0.2634	0.5295	2673	0.0002	0.0003	0.0006	0.0010	0.0012	0.0015	0.0015	0.0019	0.0022
9	0.2631	0.5264	2691	0.0002	0.0002	0.0005	0.0009	0.0012	0.0014	0.0014	0.0018	0.0021
10	0.2646	0.5273	2656	0.0002	0.0003	0.0006	0.0010	0.0012	0.0015	0.0015	0.0019	0.0022
11	0.2647	0.5281	2652	0.0003	0.0003	0.0005	0.0009	0.0011	0.0014	0.0014	0.0019	0.0020
12	0.2624	0.5287	2696	0.0004	0.0003	0.0005	0.0010	0.0012	0.0015	0.0015	0.0019	0.0021
13	0.2600	0.5218	2778	0.0002	0.0004	0.0006	0.0010	0.0012	0.0016	0.0016	0.0020	0.0022
14	0.2603	0.5228	2767	0.0002	0.0002	0.0006	0.0010	0.0012	0.0016	0.0015	0.0019	0.0022
15	0.2653	0.5272	2644	0.0002	0.0003	0.0006	0.0006	0.0012	0.0016	0.0016	0.0020	0.0022
16	0.2626	0.5268	2700	0.0002	0.0003	0.0006	0.0010	0.0013	0.0016	0.0016	0.0020	0.0022
17	0.2672	0.5286	2600	0.0002	0.0004	0.0006	0.0010	0.0012	0.0016	0.0018	0.0019	0.0022
18	0.2612	0.5257	2734	0.0002	0.0004	0.0006	0.0010	0.0013	0.0016	0.0018	0.0020	0.0022
19	0.2628	0.5281	2691	0.0003	0.0004	0.0006	0.0010	0.0013	0.0016	0.0018	0.0020	0.0022
20	0.2656	0.5279	2635	0.0003	0.0005	0.0006	0.0010	0.0012	0.0015	0.0018	0.0021	0.0022
21	0.2607	0.5251	2749	0.0003	0.0006	0.0006	0.0010	0.0012	0.0015	0.0018	0.0020	0.0022
22	0.2575	0.5181	2851	0.0003	0.0005	0.0005	0.0010	0.0013	0.0015	0.0018	0.0020	0.0023
23	0.2625	0.5259	2706	0.0003	0.0007	0.0008	0.0012	0.0014	0.0015	0.0019	0.0021	0.0023
24	0.2631	0.5264	2691	0.0002	0.0004	0.0005	0.0009	0.0011	0.0014	0.0017	0.0018	0.0021
25	0.2632	0.5271	2687	0.0002	0.0005	0.0006	0.0009	0.0013	0.0014	0.0019	0.0020	0.0022
26	0.2606	0.5276	2739	0.0003	0.0005	0.0006	0.0009	0.0012	0.0014	0.0018	0.0019	0.0022
27	0.2585	0.5233	2803	0.0003	0.0005	0.0006	0.0010	0.0012	0.0015	0.0020	0.0020	0.0022
28	0.2640	0.5276	2668	0.0003	0.0005	0.0006	0.0011	0.0013	0.0016	0.0020	0.0021	0.0023
29	0.2631	0.5277	2686	0.0002	0.0005	0.0005	0.0009	0.0011	0.0014	0.0018	0.0019	0.0021
30	0.2635	0.5270	2681	0.0003	0.0006	0.0006	0.0009	0.0013	0.0015	0.0019	0.0020	0.0022
Ave.	0.2626	0.5261	2703	0.0003	0.0004	0.0006	0.0010	0.0012	0.0015	0.0017	0.0020	0.0022
Med.	0.2629	0.5266	2691	0.0003	0.0004	0.0006	0.0010	0.0012	0.0015	0.0017	0.0020	0.0022
st dev	0.0022	0.0024	53.5863	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002	0.0001	0.0001
Min.	0.2575	0.5181	2600	0.0002	0.0002	0.0005	0.0006	0.0009	0.0012	0.0012	0.0015	0.0018
Max.	0.2672	0.5295	2851	0.0006	0.0007	0.0009	0.0012	0.0015	0.0018	0.0020	0.0022	0.0025



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

No.	Φ(lm)	Lumen Maintenance (%)								
	0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
31	26.88	100.26	99.89	99.81	99.52	99.29	99.18	99.00	98.81	98.59
32	27.13	100.11	99.78	99.74	99.45	99.08	98.86	98.64	98.42	98.34
33	27.24	100.18	99.63	99.38	99.16	98.94	98.57	98.09	97.80	97.61
34	26.77	100.26	99.66	99.48	99.07	98.80	98.66	98.32	98.13	97.80
35	27.03	100.11	99.63	99.33	99.04	98.59	98.37	98.19	97.85	97.71
36	28.01	100.14	99.68	99.54	99.18	98.86	98.43	98.00	97.68	97.32
37	26.99	100.26	99.85	99.70	99.44	99.07	98.59	98.37	98.00	97.67
38	26.93	100.19	99.89	99.74	99.48	99.03	98.66	98.37	98.07	97.66
39	27.13	100.26	99.82	99.63	99.23	98.97	98.53	98.30	98.08	97.83
40	27.52	100.36	100.11	100.04	99.67	99.35	99.06	98.73	98.47	98.11
41	27.53	99.93	99.64	99.42	99.16	98.84	98.40	98.18	97.78	97.60
42	27.61	100.25	99.86	99.75	99.53	99.28	99.06	98.91	98.70	98.52
43	27.33	100.37	100.07	99.89	99.52	99.23	99.09	98.87	98.68	98.39
44	27.02	100.30	100.04	99.78	99.52	99.30	99.15	98.96	98.67	98.45
45	27.19	100.18	99.78	99.52	99.19	99.04	98.82	98.71	98.38	98.16
46	26.98	100.26	99.85	99.59	99.30	99.04	98.70	98.48	98.22	97.96
47	27.48	100.04	99.56	99.49	99.09	98.69	98.11	97.85	97.63	97.45
48	27.36	100.18	99.82	99.74	99.52	99.23	98.76	98.54	98.21	97.88
49	27.45	100.15	99.78	99.60	99.34	98.98	98.65	98.36	98.00	97.60
50	27.16	100.11	99.85	99.71	99.26	98.90	98.64	98.34	98.01	97.72
51	27.55	100.22	99.89	99.53	99.24	98.87	98.44	98.26	98.00	97.82
52	26.99	100.19	99.59	99.48	99.15	98.93	98.52	98.22	97.96	97.52
53	26.96	100.22	99.81	99.67	99.48	99.11	98.74	98.63	98.41	98.03
54	26.98	100.11	99.63	99.48	99.26	99.00	98.78	98.59	98.22	98.00
55	27.38	100.07	99.74	99.56	99.27	98.94	98.76	98.39	98.17	97.99
56	27.31	100.18	99.78	99.49	99.19	98.90	98.65	98.35	98.21	98.06
57	27.31	99.96	99.52	99.27	98.90	98.54	98.17	97.84	97.47	97.14
58	27.25	100.15	99.71	99.56	99.38	99.08	98.75	98.31	98.02	97.65
59	27.27	100.29	99.60	99.23	98.90	98.61	98.46	98.28	98.13	97.87
60	27.52	100.25	99.75	99.35	99.02	98.58	98.33	98.11	97.97	97.82
Ave.	27.24	100.18	99.77	99.58	99.28	98.97	98.66	98.41	98.14	97.88
Med.	27.25	100.18	99.78	99.56	99.26	98.97	98.65	98.36	98.11	97.82
st dev	0.2711	0.1026	0.1463	0.1861	0.2010	0.2216	0.2704	0.3035	0.3253	0.3489
Min.	26.77	99.93	99.52	99.23	98.90	98.54	98.11	97.84	97.47	97.14
Max.	28.01	100.37	100.11	100.04	99.67	99.35	99.18	99.00	98.81	98.59

TM-21 Projection:

Test Duration: 9,000 hours

Failures Observed: 0

α: 2.823E-06

β: 1.004

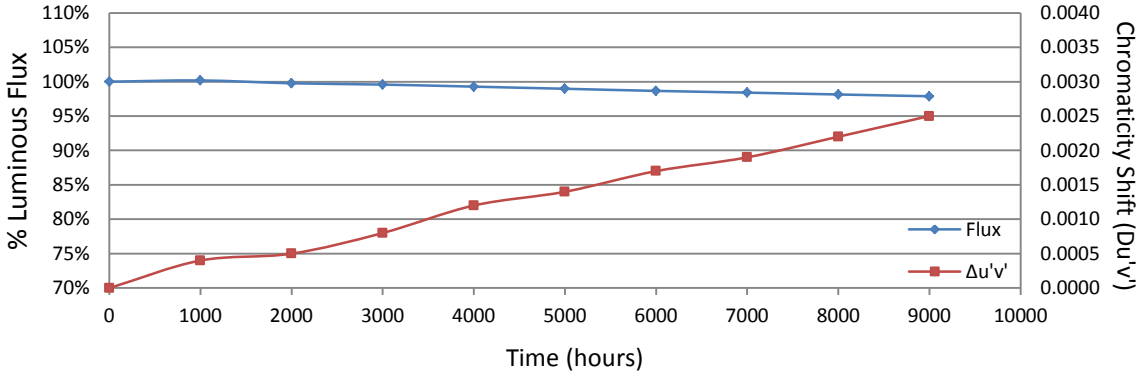
Reported L_{70}: >54000 hours

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
31	3.020	3.025	3.081	3.010	3.005	3.005	3.010	3.014	3.013	3.012
32	3.030	3.086	3.051	3.030	3.019	3.020	3.022	3.030	3.029	3.041
33	3.023	3.032	3.001	3.124	3.014	3.013	3.019	3.024	3.024	3.022
34	3.018	3.039	3.047	3.170	3.010	3.011	3.015	3.019	3.020	3.028
35	3.013	3.025	2.970	3.122	3.004	3.001	3.007	3.009	3.012	3.019
36	3.017	3.026	2.990	3.012	3.010	3.009	3.013	3.015	3.019	3.024
37	3.004	3.023	2.987	3.006	3.000	3.001	3.004	3.011	3.010	3.009
38	3.029	3.032	3.000	3.024	3.022	3.022	3.023	3.027	3.033	3.053
39	3.022	3.025	2.989	3.111	3.009	3.010	3.015	3.018	3.019	3.018
40	3.010	3.016	2.930	3.102	3.007	3.007	3.012	3.015	3.018	3.015
41	3.052	3.039	2.997	3.034	3.026	3.026	3.030	3.031	3.036	3.035
42	3.011	3.028	2.958	3.032	3.007	3.006	3.008	3.015	3.051	3.037
43	3.007	3.022	2.949	3.024	3.006	3.004	3.007	3.014	3.017	3.027
44	3.006	3.033	2.966	3.007	3.003	3.004	3.006	3.010	3.018	3.014
45	3.023	3.043	2.995	3.126	3.018	3.016	3.019	3.024	3.026	3.066
46	3.017	3.030	2.972	3.209	3.014	3.015	3.017	3.023	3.026	3.030
47	3.018	3.032	3.030	3.021	3.015	3.013	3.019	3.024	3.025	3.030
48	3.013	3.027	2.979	3.015	3.011	3.012	3.016	3.020	3.023	3.029
49	3.018	3.025	2.970	3.037	3.009	3.011	3.011	3.018	3.021	3.023
50	3.013	3.030	2.948	3.024	3.012	3.010	3.013	3.019	3.024	3.030
51	3.007	3.020	2.952	3.007	3.002	3.000	3.006	3.009	3.013	3.008
52	3.001	3.017	2.954	3.002	2.996	2.998	3.001	3.006	3.009	3.006
53	3.012	3.027	2.957	3.012	3.009	3.010	3.010	3.014	3.017	3.017
54	3.019	3.030	3.020	3.016	3.016	3.015	3.019	3.024	3.023	3.039
55	3.028	3.033	2.979	3.022	3.020	3.021	3.024	3.028	3.027	3.047
56	3.006	3.020	2.949	3.000	3.000	3.000	3.005	3.008	3.021	3.031
57	3.020	3.029	2.975	3.013	3.012	3.011	3.012	3.019	3.037	3.015
58	3.011	3.033	2.946	3.016	3.010	3.012	3.013	3.021	3.021	3.044
59	3.011	3.022	2.929	3.010	3.011	3.007	3.011	3.014	3.018	3.038
60	3.015	3.024	2.944	3.012	3.009	3.011	3.015	3.015	3.018	3.030
Ave.	3.016	3.030	2.981	3.045	3.010	3.010	3.013	3.018	3.022	3.028
Med.	3.016	3.028	2.974	3.022	3.010	3.011	3.013	3.018	3.021	3.029
st dev	0.0100	0.0123	0.0366	0.0555	0.0068	0.0069	0.0066	0.0067	0.0087	0.0140
Min.	3.001	3.016	2.929	3.000	2.996	2.998	3.001	3.006	3.009	3.006
Max.	3.052	3.086	3.081	3.209	3.026	3.026	3.030	3.031	3.051	3.066

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

No.	u'	v'	CCT(K)	Chromaticity Shift (Δu'v')								
	0hr(Initial)			1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
31	0.2648	0.5272	2653	0.0003	0.0004	0.0005	0.0011	0.0014	0.0016	0.0017	0.0021	0.0023
32	0.2605	0.5263	2747	0.0002	0.0004	0.0006	0.0010	0.0013	0.0016	0.0014	0.0021	0.0024
33	0.2623	0.5277	2703	0.0003	0.0006	0.0007	0.0011	0.0015	0.0018	0.0019	0.0022	0.0025
34	0.2646	0.5286	2652	0.0004	0.0005	0.0007	0.0011	0.0013	0.0016	0.0018	0.0022	0.0024
35	0.2637	0.5268	2678	0.0004	0.0006	0.0009	0.0013	0.0015	0.0017	0.0017	0.0022	0.0025
36	0.2594	0.5287	2761	0.0004	0.0005	0.0008	0.0013	0.0015	0.0017	0.0017	0.0022	0.0025
37	0.2659	0.5288	2625	0.0004	0.0006	0.0010	0.0012	0.0014	0.0017	0.0019	0.0021	0.0024
38	0.2640	0.5255	2677	0.0004	0.0004	0.0009	0.0011	0.0014	0.0017	0.0019	0.0022	0.0025
39	0.2642	0.5266	2669	0.0004	0.0005	0.0009	0.0013	0.0015	0.0016	0.0020	0.0022	0.0024
40	0.2613	0.5280	2723	0.0004	0.0005	0.0008	0.0012	0.0014	0.0016	0.0019	0.0021	0.0025
41	0.2630	0.5273	2691	0.0004	0.0006	0.0009	0.0012	0.0014	0.0017	0.0020	0.0022	0.0025
42	0.2616	0.5261	2724	0.0004	0.0005	0.0009	0.0013	0.0015	0.0018	0.0021	0.0022	0.0026
43	0.2618	0.5259	2721	0.0004	0.0006	0.0009	0.0013	0.0015	0.0018	0.0021	0.0022	0.0025
44	0.2632	0.5284	2682	0.0003	0.0006	0.0009	0.0012	0.0014	0.0017	0.0020	0.0021	0.0025
45	0.2631	0.5275	2687	0.0004	0.0005	0.0009	0.0013	0.0015	0.0017	0.0019	0.0022	0.0025
46	0.2646	0.5294	2650	0.0004	0.0004	0.0008	0.0012	0.0015	0.0016	0.0019	0.0021	0.0024
47	0.2611	0.5257	2736	0.0004	0.0006	0.0008	0.0012	0.0015	0.0017	0.0019	0.0022	0.0025
48	0.2630	0.5281	2687	0.0004	0.0006	0.0009	0.0013	0.0015	0.0017	0.0020	0.0022	0.0026
49	0.2619	0.5278	2710	0.0004	0.0005	0.0008	0.0013	0.0015	0.0017	0.0019	0.0022	0.0024
50	0.2662	0.5276	2625	0.0003	0.0004	0.0008	0.0011	0.0014	0.0016	0.0019	0.0021	0.0024
51	0.2603	0.5261	2751	0.0004	0.0005	0.0008	0.0014	0.0016	0.0018	0.0020	0.0022	0.0025
52	0.2665	0.5285	2615	0.0004	0.0006	0.0009	0.0013	0.0015	0.0017	0.0021	0.0022	0.0025
53	0.2627	0.5261	2702	0.0004	0.0006	0.0009	0.0014	0.0015	0.0018	0.0022	0.0023	0.0026
54	0.2612	0.5260	2733	0.0005	0.0007	0.0009	0.0014	0.0016	0.0017	0.0022	0.0023	0.0026
55	0.2632	0.5294	2678	0.0004	0.0004	0.0009	0.0012	0.0015	0.0017	0.0018	0.0021	0.0024
56	0.2604	0.5265	2747	0.0004	0.0005	0.0008	0.0012	0.0014	0.0016	0.0020	0.0021	0.0025
57	0.2637	0.5285	2671	0.0004	0.0005	0.0009	0.0012	0.0015	0.0017	0.0019	0.0022	0.0025
58	0.2625	0.5273	2701	0.0003	0.0004	0.0008	0.0012	0.0014	0.0016	0.0019	0.0022	0.0024
59	0.2603	0.5267	2748	0.0004	0.0005	0.0008	0.0012	0.0012	0.0017	0.0019	0.0021	0.0025
60	0.2610	0.5276	2731	0.0004	0.0005	0.0009	0.0013	0.0015	0.0018	0.0021	0.0022	0.0026
Ave.	0.2627	0.5274	2696	0.0004	0.0005	0.0008	0.0012	0.0014	0.0017	0.0019	0.0022	0.0025
Med.	0.2629	0.5274	2696	0.0004	0.0005	0.0009	0.0012	0.0015	0.0017	0.0019	0.0022	0.0025
st dev	0.0019	0.0011	40.2937	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Min.	0.2594	0.5255	2615	0.0002	0.0004	0.0005	0.0010	0.0012	0.0016	0.0014	0.0021	0.0023
Max.	0.2665	0.5294	2761	0.0005	0.0007	0.0010	0.0014	0.0016	0.0018	0.0022	0.0023	0.0026



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
61	27.80	100.07	99.60	99.28	98.88	98.38	98.13	97.84	97.63	97.34
62	27.22	100.11	99.56	99.41	98.82	98.38	98.13	97.91	97.47	97.28
63	27.16	99.89	99.52	99.34	98.97	98.60	98.16	97.86	97.57	97.24
64	27.18	100.04	99.74	99.37	99.04	98.79	98.42	98.23	97.90	97.65
65	27.44	100.11	99.67	99.27	98.87	98.47	98.07	97.89	97.45	97.23
66	26.78	100.19	99.78	99.48	99.03	98.58	98.21	97.98	97.68	97.39
67	26.63	100.15	99.59	99.25	98.76	98.42	98.20	98.01	97.67	97.33
68	27.06	100.18	99.56	99.22	98.78	98.37	98.15	97.82	97.63	97.45
69	27.70	99.93	99.35	99.10	98.70	98.27	97.83	97.62	97.18	96.90
70	24.37	100.04	99.59	99.22	98.89	98.44	98.11	97.78	97.50	97.25
71	26.99	100.19	99.44	99.30	98.81	98.22	97.74	97.33	96.96	96.70
72	27.38	100.29	99.78	99.60	99.20	98.76	98.28	97.81	97.48	97.01
73	27.02	100.07	99.59	99.37	98.96	98.56	98.04	97.71	97.41	97.19
74	26.99	100.04	99.70	99.59	99.11	98.81	98.37	97.89	97.52	97.22
75	26.96	100.19	99.67	99.48	98.92	98.66	98.18	97.77	97.37	96.88
76	26.81	100.22	99.74	99.59	99.22	98.88	98.47	98.10	97.76	97.24
77	26.85	100.15	99.59	99.33	98.99	98.62	98.21	97.88	97.47	97.13
78	27.31	100.22	99.85	99.60	99.19	98.76	98.46	98.02	97.73	97.29
79	26.88	99.96	99.78	99.40	99.07	98.66	98.21	97.73	97.47	97.25
80	26.84	100.11	99.52	99.25	98.88	98.40	97.95	97.39	97.02	96.61
81	26.08	100.27	99.81	99.42	99.04	98.62	98.27	97.89	97.55	97.12
82	27.26	100.11	99.67	99.49	99.16	98.75	98.35	98.02	97.65	97.21
83	26.52	100.08	99.43	99.06	98.60	98.27	98.04	97.93	97.66	97.17
84	26.81	99.96	99.29	98.88	98.43	98.10	97.72	97.28	96.98	96.64
85	27.41	100.22	99.56	99.20	98.69	98.29	97.92	97.63	97.34	96.79
86	27.76	100.07	99.46	99.06	98.60	98.13	97.80	97.59	97.30	97.01
87	26.91	100.19	99.52	99.22	98.77	98.29	97.99	97.70	97.47	97.25
88	25.61	100.23	99.73	99.49	99.14	98.79	98.59	98.24	97.89	97.70
89	27.34	100.15	99.63	99.34	98.87	98.43	97.99	97.40	96.96	96.63
90	26.00	99.96	99.58	99.15	98.62	98.23	97.81	97.46	97.04	96.77
Ave.	26.90	100.11	99.61	99.33	98.90	98.50	98.13	97.79	97.46	97.13
Med.	26.99	100.11	99.59	99.33	98.89	98.46	98.14	97.83	97.48	97.22
st dev	0.6841	0.1036	0.1360	0.1766	0.2015	0.2218	0.2239	0.2473	0.2645	0.2823
Min.	24.37	99.89	99.29	98.88	98.43	98.10	97.72	97.28	96.96	96.61
Max.	27.80	100.29	99.85	99.60	99.22	98.88	98.59	98.24	97.90	97.70

TM-21 Projection:

Test Duration: 9,000 hours

Failures Observed: 0

α: 3.589E-06

β: 1.003

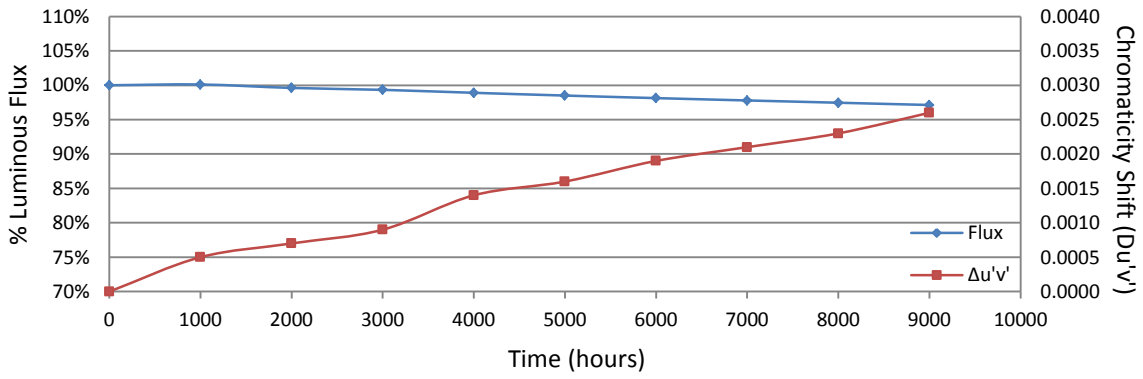
Reported L_{70}: >54000 hours

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
61	3.022	3.037	3.025	3.026	3.018	3.018	3.023	3.026	3.030	3.040
62	3.019	3.037	3.041	3.019	3.017	3.018	3.018	3.024	3.027	3.035
63	3.006	3.024	3.032	3.005	3.004	3.007	3.010	3.010	3.015	3.019
64	3.004	3.030	3.024	3.004	3.001	3.004	3.004	3.006	3.012	3.029
65	3.013	3.040	3.042	3.009	3.008	3.009	3.012	3.016	3.022	3.024
66	3.036	3.066	3.033	3.068	3.033	3.035	3.039	3.043	3.048	3.041
67	3.030	3.053	3.051	3.030	3.025	3.026	3.032	3.034	3.039	3.039
68	3.018	3.039	3.017	3.121	3.018	3.017	3.022	3.032	3.026	3.030
69	3.025	3.049	3.045	3.024	3.020	3.020	3.026	3.027	3.037	3.055
70	3.632	3.669	3.607	3.634	3.634	3.632	3.639	3.637	3.645	3.676
71	3.026	3.046	3.042	3.030	3.026	3.027	3.028	3.031	3.036	3.038
72	3.011	3.025	3.030	3.012	3.005	3.007	3.007	3.010	3.016	3.048
73	3.023	3.042	3.031	3.023	3.019	3.020	3.023	3.026	3.029	3.056
74	3.026	3.043	2.982	3.019	3.017	3.018	3.019	3.024	3.026	3.056
75	3.031	3.046	3.038	3.025	3.024	3.023	3.024	3.028	3.031	3.060
76	3.021	3.041	3.128	3.021	3.019	3.017	3.022	3.024	3.027	3.043
77	3.025	3.041	3.005	3.023	3.023	3.023	3.027	3.036	3.033	3.037
78	3.030	3.037	3.005	3.027	3.023	3.023	3.027	3.029	3.034	3.036
79	3.018	3.037	3.042	3.027	3.018	3.015	3.019	3.021	3.024	3.068
80	3.031	3.053	3.086	3.028	3.026	3.024	3.031	3.032	3.040	3.062
81	2.816	2.845	2.803	2.816	2.813	2.811	2.815	2.816	2.822	2.900
82	3.029	3.043	3.029	3.076	3.024	3.024	3.027	3.030	3.036	3.049
83	3.026	3.042	3.008	3.192	3.021	3.020	3.025	3.027	3.031	3.042
84	3.014	3.029	3.016	3.017	3.014	3.012	3.017	3.019	3.021	3.088
85	3.025	3.045	3.023	3.033	3.026	3.024	3.030	3.032	3.033	3.040
86	3.028	3.040	2.973	3.024	3.024	3.020	3.028	3.029	3.032	3.034
87	3.018	3.026	3.029	3.015	3.014	3.013	3.017	3.020	3.022	3.021
88	2.819	2.829	2.774	2.816	2.815	2.814	2.818	2.822	2.824	2.827
89	3.026	3.043	3.049	3.024	3.024	3.022	3.029	3.028	3.036	3.070
90	2.824	2.835	2.775	2.819	2.817	2.817	2.820	2.823	2.823	2.839
Ave.	3.022	3.041	3.026	3.034	3.019	3.019	3.023	3.025	3.029	3.047
Med.	3.024	3.041	3.030	3.024	3.019	3.019	3.023	3.027	3.030	3.040
st dev	0.1308	0.1342	0.1360	0.1367	0.1319	0.1317	0.1323	0.1316	0.1324	0.1333
Min.	2.816	2.829	2.774	2.816	2.813	2.811	2.815	2.816	2.822	2.827
Max.	3.632	3.669	3.607	3.634	3.634	3.632	3.639	3.637	3.645	3.676

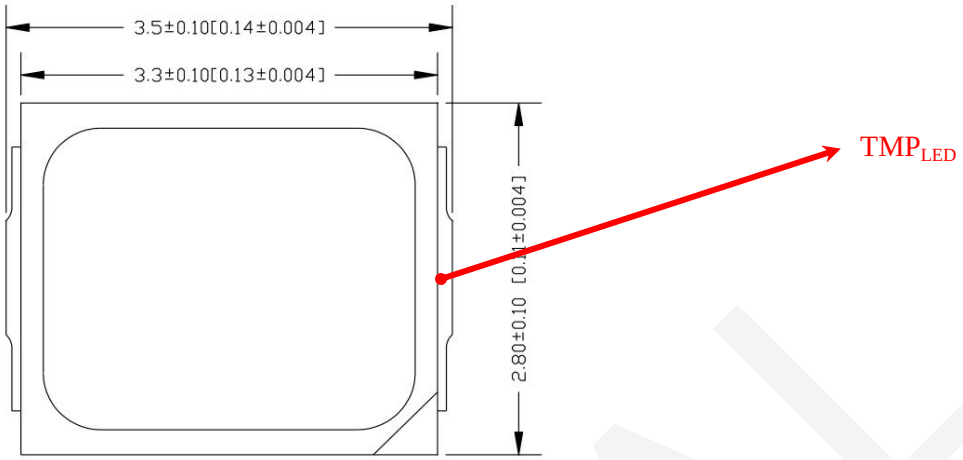
3.9 Data Set 3, 105°C, 60mA (Chromaticity Shift)

No.	u'	v'	CCT(K)	Chromaticity Shift (Δu'v')								
	0hr(Initial)			1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
61	0.2585	0.5251	2794	0.0004	0.0006	0.0009	0.0015	0.0017	0.0020	0.0021	0.0025	0.0028
62	0.2629	0.5281	2688	0.0006	0.0006	0.0009	0.0014	0.0016	0.0020	0.0020	0.0025	0.0027
63	0.2640	0.5274	2669	0.0004	0.0005	0.0009	0.0014	0.0016	0.0019	0.0021	0.0024	0.0027
64	0.2650	0.5280	2647	0.0004	0.0006	0.0008	0.0013	0.0016	0.0017	0.0020	0.0022	0.0026
65	0.2632	0.5287	2681	0.0004	0.0007	0.0008	0.0014	0.0016	0.0018	0.0020	0.0023	0.0026
66	0.2623	0.5251	2713	0.0004	0.0007	0.0009	0.0014	0.0017	0.0018	0.0020	0.0024	0.0027
67	0.2631	0.5270	2689	0.0005	0.0008	0.0009	0.0015	0.0018	0.0019	0.0022	0.0025	0.0028
68	0.2672	0.5282	2603	0.0005	0.0008	0.0011	0.0013	0.0017	0.0019	0.0020	0.0023	0.0026
69	0.2639	0.5283	2667	0.0004	0.0007	0.0009	0.0013	0.0016	0.0018	0.0020	0.0023	0.0026
70	0.2641	0.5265	2671	0.0005	0.0006	0.0009	0.0013	0.0016	0.0018	0.0020	0.0022	0.0027
71	0.2606	0.5240	2754	0.0005	0.0008	0.0009	0.0014	0.0017	0.0019	0.0021	0.0023	0.0027
72	0.2591	0.5272	2773	0.0005	0.0007	0.0009	0.0014	0.0016	0.0019	0.0020	0.0026	0.0030
73	0.2627	0.5265	2699	0.0005	0.0008	0.0010	0.0014	0.0016	0.0018	0.0021	0.0025	0.0027
74	0.2645	0.5265	2662	0.0005	0.0007	0.0010	0.0013	0.0016	0.0018	0.0020	0.0022	0.0026
75	0.2661	0.5280	2625	0.0005	0.0009	0.0011	0.0015	0.0018	0.0020	0.0022	0.0024	0.0028
76	0.2646	0.5263	2662	0.0005	0.0006	0.0009	0.0013	0.0016	0.0019	0.0022	0.0023	0.0026
77	0.2621	0.5260	2714	0.0004	0.0004	0.0009	0.0012	0.0016	0.0018	0.0021	0.0023	0.0025
78	0.2635	0.5268	2681	0.0004	0.0005	0.0008	0.0012	0.0015	0.0017	0.0019	0.0022	0.0025
79	0.2604	0.5259	2750	0.0005	0.0007	0.0009	0.0013	0.0016	0.0018	0.0021	0.0023	0.0026
80	0.2643	0.5267	2666	0.0005	0.0008	0.0011	0.0013	0.0016	0.0019	0.0023	0.0024	0.0026
81	0.2621	0.5232	2725	0.0005	0.0007	0.0009	0.0013	0.0016	0.0019	0.0020	0.0023	0.0027
82	0.2653	0.5286	2639	0.0005	0.0006	0.0009	0.0013	0.0016	0.0018	0.0019	0.0022	0.0026
83	0.2657	0.5278	2633	0.0006	0.0007	0.0010	0.0014	0.0017	0.0019	0.0021	0.0023	0.0026
84	0.2644	0.5264	2665	0.0005	0.0008	0.0010	0.0015	0.0016	0.0019	0.0022	0.0022	0.0026
85	0.2609	0.5282	2731	0.0005	0.0007	0.0011	0.0015	0.0016	0.0019	0.0021	0.0022	0.0026
86	0.2603	0.5275	2745	0.0004	0.0005	0.0009	0.0012	0.0016	0.0018	0.0020	0.0024	0.0026
87	0.2635	0.5268	2682	0.0005	0.0008	0.0011	0.0015	0.0017	0.0020	0.0022	0.0024	0.0027
88	0.2633	0.5248	2694	0.0004	0.0006	0.0009	0.0013	0.0015	0.0017	0.0020	0.0021	0.0025
89	0.2619	0.5279	2711	0.0005	0.0007	0.0011	0.0014	0.0016	0.0019	0.0022	0.0024	0.0028
90	0.2606	0.5217	2763	0.0005	0.0007	0.0010	0.0014	0.0017	0.0019	0.0021	0.0023	0.0027
Ave.	0.2630	0.5266	2693	0.0005	0.0007	0.0009	0.0014	0.0016	0.0019	0.0021	0.0023	0.0026
Med.	0.2633	0.5268	2685	0.0005	0.0007	0.0009	0.0014	0.0016	0.0019	0.0021	0.0023	0.0026
st dev	0.0021	0.0016	46.1709	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Min.	0.2585	0.5217	2603	0.0004	0.0004	0.0008	0.0012	0.0015	0.0017	0.0019	0.0021	0.0025
Max.	0.2672	0.5287	2794	0.0006	0.0009	0.0011	0.0015	0.0018	0.0020	0.0023	0.0026	0.0030



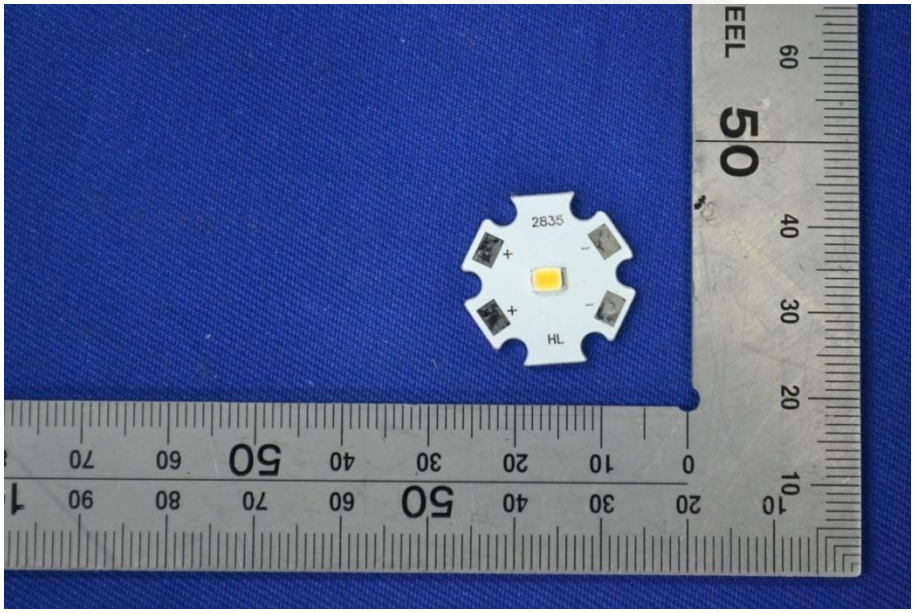
4 - EUT Photo

4.1 Mechanical Dimensions



All dimensions are in millimeter

4.2 EUT Photo



4.3 Report Revision

Report Number	Report Date	Contents
RSZ160329508-10	2017-05-05	Original report.
RSZ160329508-10-M1	2019-01-14	Update the Logo of lab on the Page1 Update Company name and address on page 1. Add DUT Characteristics on page 3 according to ENERGY STAR requirements

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