



TEST REPORT

ACCORDING TO IES LM-80-2015
For

Hongli Zhihui Group Co.,Ltd.

No.1, Xianke Yi Road, Huadong Town, Huadu District, Guangzhou, China

Model: HL-ES-3032DW-3C-S1-HR3

Report Type: 9000 Hours Test Report		Product Type: LED Package	
Test Engineer:	Pote Wang <i>Pote Wang</i>		
Report Number:	RSZ160804502-10		
Test Date:	2016-08-07 to 2017-08-27		
Report Date:	2017-09-04		
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).

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1 - General Information

1.1 Description of LED Light Sources

Sample Size:

75 PCS samples were received on 2016-08-04. The samples were numbered from 1 to 25 , 26 to 50 and 51 to 75.

Manufacturer: Hongli Zihui Group Co.,Ltd.
Part Number: HL-ES-3032DW-3C-S1-HR3
Part Type: LED Package
Drive Level: CC 150mA
Nominal CCT: 2700K

Family products covered by this report:

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

Testing Products	Multiple Models	Details
HL-ES-3032DW-3C-S1-HR3	HL-ES-3032DW-3C-S1-HR3(R9)	Only different Model name for different market.
	HL-ES-PU3032DW-3C-S1-HR3	
	HL-ES-PU3032DW-3C-S1-HR3(R9)	
	HL-ES-3032HW-3C-S1-HR3	
	HL-ES-3032HW-3C-S1-HR3(R9)	
	HL-ES-PU3032HW-3C-S1-HR3	
	HL-ES-PU3032HW-3C-S1-HR3(R9)	

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.
- CIE 127:2007: Measurement of LEDs

- 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
0.3m integrating sphere	EVERFINE	Diameter 0.3m	1011119	0.3m	2017-03-09	2018-03-09
Programmable Test Power for LEDs	EVERFINE	LED300E	1008002	15V/2000mA	2017-03-03	2018-03-03
High accuracy array spectroradiometer	EVERFINE	HAAS-2000	1012016T	380-780nm	2017-03-09	2018-03-09
Standard Light Source	EVERFINE	D062	1011093	3000K	2016-09-13	2017-09-13
Precision digital stabilized DC power supply	EVERFINE	WY605-V110	G115987CJ73 21114	300VA	2017-03-03	2018-03-03
Multilayer aging machine	BACL	B3-900	20030	25°C~130°C	2017-03-03	2018-03-03
Digital CC&CV DC Power Supply	EVERFINE	WY5015	11090005	(50V/15A)	2017-03-03	2018-03-03

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 $2^{\circ}C$ below the corresponding nominal case temperature. Surrounding air was maintained at a temperature that was greater than or equal to $5^{\circ}C$ 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 Photometric Measurement Method and Uncertainty

Integrating sphere and spectroradiometer is used to measure luminous flux and chromaticity coordinate $u'v'$. 2π measurement was used and sample was driven by DC power supply. Luminous flux and chromaticity coordinate was scaled by halogen reference lamp. The ambient temperature during test was set to $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$, RH <65%.

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: 85°C, 150mA

Part Number: HL-ES-3032DW-3C-S1-HR3
Number of Units: 30
Case Temperature: >83°C
Ambient Temperature: >80°C
Life Test Drive Current: 150mA
Measurement Current: 150mA

Data Set 2: 105°C,150mA

Part Number: HL-ES-3032DW-3C-S1-HR3
Number of Units: 30
Case Temperature: >103°C
Ambient Temperature: >100°C
Life Test Drive Current: 150mA
Measurement Current: 150mA

Data Set 3: 115° C,150mA

Part Number: HL-ES-3032DW-3C-S1-HR3
Number of Units: 30
Case Temperature: >113°C
Ambient Temperature: >110°C
Life Test Drive Current: 150mA
Measurement Current: 150mA

2 - Summary of Test Result

Data Set:	Sample Size	Failures Observed:	Test Interval(hours)	Test Duration(hours)	Reported TM-21 L ₇₀ Lifetime
1	30	0	1000	9000	>54,000hours
2	30	0	1000	9000	>54,000hours
3	30	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	100.29%	100.01%	99.72%	99.44%	99.20%	98.92%	98.67%	98.47%	98.22%
2	100.14%	99.79%	99.45%	99.13%	98.83%	98.52%	98.24%	97.97%	97.69%
3	99.98%	99.52%	99.10%	98.70%	98.35%	98.02%	97.70%	97.41%	97.10%

Average Color Maintenance

Data Set:	1000	2000	3000	4000	5000	6000	7000	8000	9000
1	0.0002	0.0006	0.0009	0.0012	0.0014	0.0016	0.0018	0.0020	0.0022
2	0.0003	0.0008	0.0010	0.0013	0.0015	0.0017	0.0020	0.0021	0.0024
3	0.0004	0.0010	0.0012	0.0015	0.0018	0.0019	0.0021	0.0024	0.0026

3 - Test Data

3.1 Data Set 1, 85°C, 150mA (Lumen Maintenance)

No.	Φ(lm)	Lumen Maintenance (%)								
	0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
1	192.6	100.31	100.10	99.74	99.48	99.22	98.91	98.70	98.44	98.08
2	185.6	100.38	100.22	99.89	99.78	99.68	99.52	99.25	99.03	98.81
3	190.1	100.47	100.11	99.79	99.63	99.37	99.16	98.90	98.84	98.58
4	188.8	100.16	99.89	99.63	99.31	99.10	98.73	98.46	98.20	98.04
5	190.1	100.26	99.84	99.47	99.37	99.16	98.84	98.53	98.26	98.00
6	186.8	100.48	100.32	100.21	100.05	99.73	99.46	99.41	99.25	98.88
7	185.8	100.43	100.22	99.89	99.68	99.46	99.25	99.09	98.92	98.76
8	188.5	100.27	99.89	99.63	99.31	99.10	98.94	98.67	98.41	98.30
9	186.5	100.11	99.79	99.41	99.14	98.93	98.55	98.18	97.91	97.53
10	190.9	100.31	100.10	99.84	99.58	99.32	99.00	98.85	98.59	98.22
11	189.2	100.21	99.89	99.68	99.52	99.31	99.05	98.78	98.57	98.31
12	188.6	100.32	100.05	99.79	99.42	99.15	98.83	98.41	98.25	98.09
13	187.4	100.37	100.16	99.95	99.79	99.63	99.36	99.15	99.04	98.93
14	188.4	100.21	99.95	99.63	99.31	99.04	98.78	98.46	98.20	97.98
15	189.3	100.42	100.05	99.68	99.42	99.00	98.73	98.47	98.15	97.89
16	186.2	100.16	99.79	99.41	99.03	98.76	98.44	98.12	97.96	97.74
17	191.0	100.26	99.90	99.63	99.37	99.16	98.95	98.69	98.48	98.22
18	187.4	100.32	100.11	99.84	99.41	99.20	98.88	98.72	98.45	98.24
19	188.2	100.27	99.95	99.73	99.42	99.10	98.83	98.57	98.41	98.09
20	187.9	100.48	100.21	99.79	99.41	99.10	98.88	98.67	98.35	98.19
21	184.8	100.43	100.05	99.84	99.57	99.30	98.97	98.70	98.65	98.38
22	188.5	100.05	99.79	99.47	99.20	98.89	98.46	98.09	97.93	97.61
23	187.6	100.32	100.11	99.84	99.47	99.25	98.99	98.77	98.72	98.29
24	186.9	100.21	99.89	99.57	99.36	98.98	98.82	98.61	98.50	98.29
25	189.1	100.16	99.95	99.63	99.37	99.26	98.89	98.63	98.57	98.52
26	187.8	100.21	99.89	99.63	99.36	99.20	98.94	98.67	98.46	98.19
27	187.8	100.16	99.79	99.52	99.20	98.99	98.83	98.46	98.35	97.92
28	189.4	100.32	99.89	99.79	99.42	99.16	98.79	98.68	98.36	98.15
29	187.6	100.27	100.11	99.68	99.41	99.20	98.93	98.56	98.24	98.19
30	188.7	100.42	100.16	99.84	99.52	99.21	98.99	98.78	98.57	98.30
Ave.	188.3	100.29	100.01	99.72	99.44	99.20	98.92	98.67	98.47	98.22
Med.	188.3	100.29	100.00	99.71	99.42	99.18	98.90	98.67	98.45	98.20
st dev	1.7031	0.1153	0.1510	0.1739	0.2042	0.2199	0.2472	0.2979	0.3238	0.3386
Min.	184.8	100.05	99.79	99.41	99.03	98.76	98.44	98.09	97.91	97.53
Max.	192.6	100.48	100.32	100.21	100.05	99.73	99.52	99.41	99.25	98.93

TM-21 Projection:

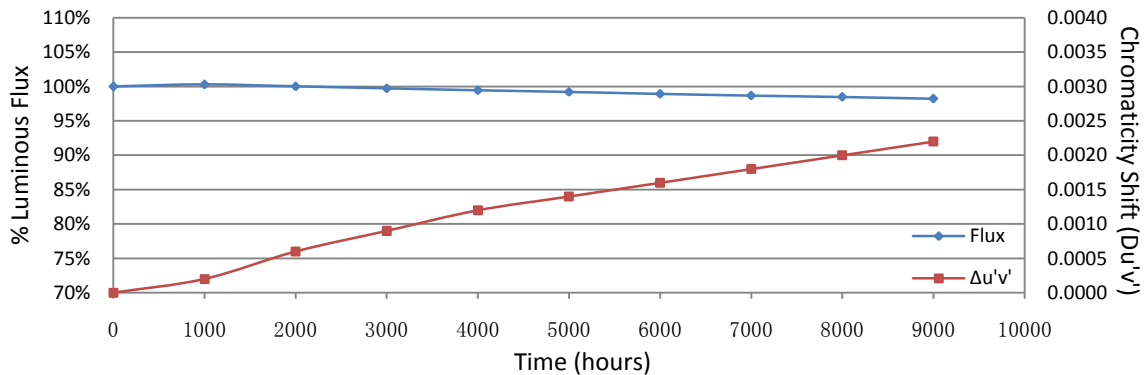
Test Duration: 9,000 hours
Failures Observed: 0
 α : 2.469E-06
 β : 1.004
Reported L₇₀: >54,000 hours

3.2 Data Set 1, 85°C, 150mA (Forward Voltage)

No.	Forward Voltage (V)									
	0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
1	9.384	9.386	9.395	9.431	9.408	9.427	9.404	9.384	9.404	9.392
2	9.426	9.415	9.444	9.442	9.436	9.483	9.439	9.422	9.427	9.412
3	9.424	9.420	9.436	9.435	9.443	9.467	9.434	9.418	9.427	9.409
4	9.522	9.487	9.502	9.511	9.514	9.535	9.497	9.488	9.493	9.785
5	9.518	9.511	9.526	9.591	9.540	9.555	9.520	9.504	9.509	9.501
6	9.467	9.466	9.467	9.475	9.487	9.502	9.470	9.460	9.464	9.458
7	9.393	9.397	9.404	9.408	9.414	9.426	9.400	9.385	9.446	9.390
8	9.415	9.415	9.419	9.426	9.431	9.447	9.418	9.404	9.457	9.402
9	9.577	9.526	9.544	9.546	9.543	9.570	9.540	9.527	9.551	9.518
10	9.419	9.415	9.424	9.433	9.441	9.451	9.423	9.416	9.440	9.410
11	9.379	9.379	9.387	9.395	9.400	9.421	9.401	9.378	9.389	9.372
12	9.496	9.489	9.491	9.505	9.511	9.531	9.504	9.483	9.497	9.490
13	9.482	9.480	9.484	9.492	9.492	9.516	9.490	9.471	9.475	9.480
14	9.326	9.328	9.325	9.334	9.345	9.361	9.331	9.320	9.323	9.322
15	9.456	9.459	9.462	9.469	9.478	9.494	9.471	9.452	9.461	9.454
16	9.469	9.464	9.471	9.480	9.481	9.506	9.474	9.455	9.468	9.459
17	9.397	9.397	9.398	9.413	9.425	9.436	9.415	9.390	9.399	9.395
18	9.426	9.434	9.440	9.434	9.448	9.465	9.434	9.429	9.429	9.426
19	9.421	9.424	9.426	9.427	9.441	9.455	9.434	9.420	9.423	9.415
20	9.389	9.394	9.402	9.401	9.410	9.430	9.405	9.391	9.398	9.394
21	9.418	9.426	9.428	9.435	9.439	9.450	9.432	9.429	9.426	9.421
22	9.478	9.486	9.492	9.493	9.504	9.518	9.496	9.475	9.477	9.472
23	9.384	9.382	9.388	9.394	9.408	9.416	9.398	9.383	9.381	9.372
24	9.412	9.409	9.411	9.418	9.440	9.442	9.428	9.404	9.410	9.415
25	9.409	9.409	9.420	9.420	9.435	9.451	9.434	9.403	9.407	9.413
26	9.463	9.445	9.446	9.456	9.475	9.479	9.461	9.446	9.441	9.441
27	9.451	9.438	9.442	9.446	9.466	9.465	9.446	9.427	9.438	9.434
28	9.426	9.422	9.424	9.427	9.443	9.445	9.424	9.411	9.415	9.422
29	9.457	9.444	9.450	9.450	9.476	9.481	9.459	9.445	9.447	9.443
30	9.457	9.444	9.451	9.460	9.470	9.485	9.460	9.442	9.446	9.446
Ave.	9.438	9.433	9.440	9.448	9.455	9.470	9.445	9.429	9.439	9.439
Med.	9.426	9.425	9.438	9.435	9.443	9.465	9.434	9.425	9.439	9.422
st dev	0.0509	0.0433	0.0453	0.0497	0.0437	0.0455	0.0433	0.0434	0.0439	0.0774
Min.	9.326	9.328	9.325	9.334	9.345	9.361	9.331	9.320	9.323	9.322
Max.	9.577	9.526	9.544	9.591	9.543	9.570	9.540	9.527	9.551	9.785

3.3 Data Set 1, 85°C, 150mA (Chromaticity Shift)

No.	u'	v'	CCT(K)	Chromaticity Shift ($\Delta u'v'$)								
				0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs
1	0.2568	0.5288	2816	0.0005	0.0008	0.0011	0.0012	0.0015	0.0017	0.0019	0.0020	0.0023
2	0.2598	0.5296	2747	0.0002	0.0006	0.0009	0.0010	0.0014	0.0016	0.0018	0.0019	0.0023
3	0.2579	0.5279	2796	0.0003	0.0006	0.0009	0.0011	0.0013	0.0016	0.0017	0.0018	0.0021
4	0.2575	0.5269	2809	0.0002	0.0005	0.0008	0.0012	0.0013	0.0016	0.0017	0.0018	0.0021
5	0.2566	0.5265	2830	0.0002	0.0005	0.0009	0.0010	0.0013	0.0016	0.0018	0.0018	0.0020
6	0.2595	0.5293	2754	0.0002	0.0005	0.0009	0.0010	0.0013	0.0015	0.0017	0.0016	0.0019
7	0.2564	0.5281	2826	0.0003	0.0006	0.0010	0.0013	0.0014	0.0018	0.0019	0.0021	0.0022
8	0.2549	0.5293	2854	0.0002	0.0005	0.0007	0.0011	0.0013	0.0016	0.0017	0.0019	0.0020
9	0.2607	0.5298	2728	0.0002	0.0005	0.0007	0.0011	0.0013	0.0015	0.0017	0.0018	0.0019
10	0.2558	0.5271	2845	0.0002	0.0005	0.0007	0.0010	0.0013	0.0015	0.0017	0.0020	0.0021
11	0.2568	0.5270	2823	0.0002	0.0006	0.0010	0.0012	0.0014	0.0017	0.0019	0.0021	0.0021
12	0.2570	0.5264	2823	0.0002	0.0005	0.0009	0.0012	0.0013	0.0016	0.0018	0.0020	0.0022
13	0.2584	0.5300	2775	0.0003	0.0006	0.0010	0.0013	0.0014	0.0017	0.0019	0.0021	0.0024
14	0.2563	0.5283	2828	0.0002	0.0005	0.0007	0.0011	0.0013	0.0015	0.0018	0.0019	0.0021
15	0.2578	0.5270	2803	0.0003	0.0006	0.0009	0.0011	0.0014	0.0016	0.0019	0.0021	0.0022
16	0.2577	0.5273	2803	0.0002	0.0005	0.0007	0.0010	0.0012	0.0015	0.0017	0.0020	0.0022
17	0.2556	0.5280	2845	0.0002	0.0006	0.0009	0.0011	0.0013	0.0016	0.0018	0.0021	0.0023
18	0.2577	0.5286	2797	0.0003	0.0005	0.0009	0.0011	0.0013	0.0016	0.0018	0.0021	0.0022
19	0.2579	0.5265	2801	0.0002	0.0006	0.0008	0.0011	0.0014	0.0016	0.0018	0.0020	0.0022
20	0.2584	0.5291	2778	0.0002	0.0006	0.0009	0.0013	0.0014	0.0016	0.0019	0.0021	0.0024
21	0.2577	0.5282	2799	0.0003	0.0007	0.0009	0.0011	0.0014	0.0016	0.0018	0.0021	0.0024
22	0.2571	0.5268	2817	0.0002	0.0005	0.0007	0.0010	0.0012	0.0014	0.0017	0.0018	0.0021
23	0.2606	0.5290	2734	0.0003	0.0006	0.0009	0.0012	0.0014	0.0017	0.0019	0.0021	0.0024
24	0.2585	0.5281	2782	0.0002	0.0006	0.0008	0.0012	0.0014	0.0016	0.0019	0.0021	0.0024
25	0.2563	0.5283	2829	0.0002	0.0006	0.0008	0.0011	0.0013	0.0016	0.0018	0.0021	0.0022
26	0.2565	0.5292	2820	0.0004	0.0007	0.0009	0.0013	0.0014	0.0016	0.0019	0.0021	0.0024
27	0.2565	0.5274	2829	0.0002	0.0006	0.0008	0.0012	0.0014	0.0016	0.0019	0.0021	0.0022
28	0.2581	0.5288	2786	0.0002	0.0005	0.0008	0.0012	0.0013	0.0016	0.0018	0.0021	0.0022
29	0.2576	0.5290	2797	0.0002	0.0006	0.0009	0.0012	0.0014	0.0016	0.0019	0.0022	0.0023
30	0.2576	0.5275	2803	0.0002	0.0006	0.0008	0.0012	0.0014	0.0016	0.0018	0.0021	0.0022
Ave.	0.2575	0.5281	2803	0.0002	0.0006	0.0009	0.0012	0.0014	0.0016	0.0018	0.0020	0.0022
Med.	0.2576	0.5282	2803	0.0002	0.0006	0.0009	0.0011	0.0014	0.0016	0.0018	0.0021	0.0022
st dev	0.0014	0.0011	31.6508	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Min.	0.2549	0.5264	2728	0.0002	0.0005	0.0007	0.0010	0.0012	0.0014	0.0017	0.0016	0.0019
Max.	0.2607	0.5300	2854	0.0005	0.0008	0.0011	0.0013	0.0015	0.0018	0.0019	0.0022	0.0024



3.4 Data Set 2, 105°C, 150mA (Lumen Maintenance)

No.	Φ(lm)	Lumen Maintenance (%)								
	Ohr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
31	189.0	100.21	99.84	99.42	99.10	98.84	98.52	98.15	97.94	97.72
32	186.0	100.16	99.78	99.52	99.14	98.82	98.60	98.17	97.90	97.69
33	189.4	100.11	99.74	99.21	98.79	98.47	98.26	97.94	97.78	97.62
34	187.0	100.16	99.73	99.30	98.93	98.72	98.45	98.02	97.75	97.43
35	186.1	100.21	99.84	99.36	99.03	98.71	98.44	98.17	97.90	97.47
36	190.9	100.05	99.90	99.42	99.06	98.85	98.64	98.32	98.06	97.70
37	189.5	100.11	99.89	99.63	99.37	98.89	98.63	98.21	97.89	97.63
38	188.3	99.95	99.58	99.31	99.10	98.78	98.62	98.25	97.82	97.50
39	189.2	100.21	99.84	99.37	99.05	98.63	98.41	98.31	97.89	97.62
40	191.6	100.16	99.74	99.37	99.06	98.70	98.38	98.17	97.96	97.44
41	184.4	100.22	99.84	99.35	99.08	98.92	98.54	98.26	98.05	97.83
42	190.7	100.16	99.90	99.48	99.16	98.85	98.48	98.11	97.80	97.59
43	183.4	100.05	99.78	99.62	99.18	98.85	98.53	98.26	97.87	97.38
44	187.5	100.11	99.63	99.31	99.04	98.72	98.35	98.24	97.87	97.44
45	190.3	100.16	99.79	99.42	99.16	98.84	98.42	98.16	97.95	97.69
46	186.2	100.27	99.84	99.52	99.19	98.98	98.50	98.23	98.12	97.91
47	186.8	100.05	99.79	99.46	99.14	98.82	98.45	98.07	97.75	97.43
48	185.9	100.16	99.78	99.62	99.25	99.09	98.82	98.44	98.22	97.96
49	193.4	100.05	99.69	99.33	98.97	98.71	98.29	98.04	97.72	97.47
50	186.4	100.21	99.89	99.62	99.30	99.09	98.82	98.66	98.34	98.12
51	185.1	100.05	99.78	99.51	99.19	98.97	98.65	98.54	98.38	98.11
52	186.4	100.16	99.84	99.52	99.30	99.03	98.82	98.66	98.44	98.12
53	185.4	100.05	99.68	99.41	99.08	98.76	98.44	98.06	97.84	97.68
54	189.6	100.16	99.89	99.58	99.16	98.95	98.68	98.42	98.26	98.00
55	187.8	99.95	99.63	99.31	99.15	98.83	98.56	98.35	98.19	97.87
56	189.1	100.16	99.74	99.26	98.84	98.47	98.10	97.78	97.51	97.36
57	189.1	100.26	99.95	99.68	99.37	99.00	98.68	98.31	98.04	97.78
58	187.4	100.16	99.84	99.63	99.36	99.04	98.61	98.29	97.97	97.76
59	188.1	100.27	99.89	99.57	99.31	98.94	98.62	98.35	98.03	97.71
60	187.9	100.16	99.73	99.47	99.10	98.78	98.46	98.24	97.92	97.71
Ave.	187.9	100.14	99.79	99.45	99.13	98.83	98.52	98.24	97.97	97.69
Med.	187.9	100.16	99.79	99.44	99.14	98.84	98.52	98.24	97.93	97.69
st dev	2.2550	0.0835	0.0918	0.1293	0.1434	0.1567	0.1657	0.1909	0.2101	0.2232
Min.	183.4	99.95	99.58	99.21	98.79	98.47	98.10	97.78	97.51	97.36
Max.	193.4	100.27	99.95	99.68	99.37	99.09	98.82	98.66	98.44	98.12

TM-21 Projection:

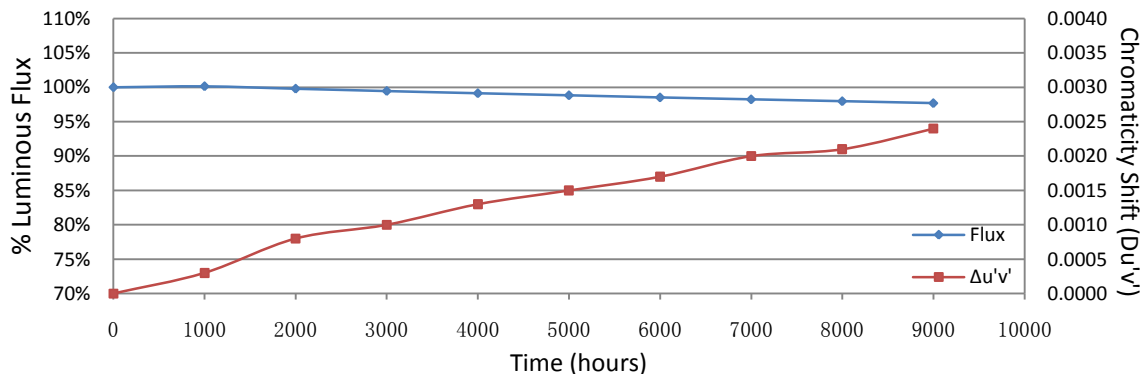
Test Duration: 9,000 hours
Failures Observed: 0
 α : 2.921E-06
 β : 1.003
Reported L₇₀: >54,000 hours

3.5 Data Set 2, 105°C, 150mA (Forward Voltage)

No.	Forward Voltage (V)									
	0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
31	9.410	9.413	9.414	9.428	9.442	9.448	9.425	9.401	9.414	9.402
32	9.375	9.377	9.383	9.389	9.393	9.410	9.395	9.378	9.385	9.377
33	9.398	9.405	9.407	9.420	9.418	9.434	9.414	9.398	9.414	9.394
34	9.382	9.382	9.383	9.400	9.406	9.415	9.406	9.383	9.385	9.383
35	9.417	9.413	9.421	9.436	9.432	9.456	9.433	9.414	9.414	9.417
36	9.446	9.439	9.449	9.459	9.465	9.478	9.482	9.438	9.446	9.441
37	9.352	9.348	9.355	9.358	9.358	9.384	9.361	9.339	9.351	9.341
38	9.393	9.401	9.408	9.410	9.418	9.428	9.418	9.389	9.396	9.391
39	9.448	9.451	9.457	9.463	9.466	9.486	9.456	9.442	9.445	9.441
40	9.434	9.442	9.445	9.454	9.449	9.466	9.451	9.436	9.436	9.439
41	9.409	9.407	9.413	9.419	9.423	9.435	9.429	9.406	9.401	9.408
42	9.432	9.440	9.450	9.451	9.458	9.480	9.454	9.435	9.436	9.444
43	9.403	9.394	9.409	9.423	9.413	9.425	9.413	9.394	9.400	9.406
44	9.434	9.439	9.442	9.463	9.454	9.477	9.450	9.430	9.434	9.426
45	9.520	9.443	9.445	9.461	9.457	9.476	9.459	9.435	9.429	9.428
46	9.562	9.489	9.494	9.505	9.499	9.515	9.494	9.474	9.475	9.483
47	9.472	9.480	9.486	9.499	9.496	9.510	9.485	9.460	9.470	9.457
48	9.534	9.466	9.465	9.478	9.480	9.495	9.468	9.451	9.485	9.447
49	9.543	9.544	9.549	9.558	9.556	9.572	9.548	9.540	9.540	9.537
50	9.508	9.434	9.444	9.458	9.460	9.475	9.441	9.443	9.444	9.425
51	9.532	9.447	9.452	9.465	9.464	9.471	9.449	9.441	9.436	9.430
52	9.558	9.466	9.470	9.478	9.480	9.501	9.478	9.462	9.463	9.462
53	9.873	9.473	9.471	9.494	9.488	9.511	9.478	9.461	9.467	9.453
54	9.529	9.378	9.387	9.399	9.403	9.411	9.384	9.366	9.369	9.369
55	9.569	9.426	9.428	9.443	9.444	9.454	9.439	9.413	9.422	9.411
56	9.509	9.510	9.521	9.529	9.527	9.558	9.522	9.504	9.508	9.506
57	9.519	9.381	9.378	9.398	9.405	9.408	9.386	9.370	9.378	9.366
58	9.577	9.433	9.428	9.453	9.451	9.475	9.435	9.428	9.429	9.428
59	9.509	9.422	9.434	9.439	9.439	9.454	9.431	9.412	9.424	9.420
60	9.507	9.420	9.417	9.438	9.447	9.459	9.420	9.404	9.409	9.411
Ave.	9.485	9.432	9.437	9.449	9.450	9.466	9.443	9.425	9.430	9.425
Med.	9.490	9.434	9.438	9.452	9.450	9.469	9.440	9.429	9.429	9.426
st dev	0.0986	0.0423	0.0425	0.0427	0.0409	0.0431	0.0406	0.0417	0.0411	0.0410
Min.	9.352	9.348	9.355	9.358	9.358	9.384	9.361	9.339	9.351	9.341
Max.	9.873	9.544	9.549	9.558	9.556	9.572	9.548	9.540	9.540	9.537

3.6 Data Set 2, 105°C, 150mA (Chromaticity Shift)

No.	u'	v'	CCT(K)	Chromaticity Shift ($\Delta u'v'$)								
				0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs
31	0.2583	0.5285	2783	0.0003	0.0008	0.0012	0.0014	0.0015	0.0019	0.0020	0.0021	0.0025
32	0.2563	0.5287	2826	0.0002	0.0008	0.0011	0.0014	0.0015	0.0017	0.0020	0.0020	0.0024
33	0.2568	0.5273	2822	0.0004	0.0008	0.0010	0.0013	0.0016	0.0017	0.0020	0.0021	0.0024
34	0.2582	0.5288	2785	0.0002	0.0007	0.0009	0.0013	0.0014	0.0016	0.0019	0.0021	0.0023
35	0.2561	0.5277	2835	0.0002	0.0007	0.0009	0.0013	0.0014	0.0016	0.0019	0.0021	0.0023
36	0.2569	0.5268	2823	0.0004	0.0008	0.0011	0.0014	0.0015	0.0018	0.0020	0.0022	0.0025
37	0.2579	0.5291	2789	0.0003	0.0008	0.0010	0.0013	0.0015	0.0017	0.0019	0.0021	0.0023
38	0.2574	0.5285	2803	0.0003	0.0008	0.0010	0.0013	0.0015	0.0018	0.0020	0.0022	0.0024
39	0.2572	0.5279	2811	0.0004	0.0008	0.0010	0.0013	0.0015	0.0018	0.0020	0.0022	0.0024
40	0.2566	0.5266	2831	0.0002	0.0007	0.0010	0.0012	0.0015	0.0017	0.0019	0.0022	0.0023
41	0.2591	0.5284	2766	0.0003	0.0008	0.0010	0.0013	0.0016	0.0018	0.0020	0.0022	0.0024
42	0.2579	0.5267	2802	0.0003	0.0007	0.0010	0.0013	0.0015	0.0017	0.0020	0.0022	0.0024
43	0.2584	0.5266	2790	0.0002	0.0007	0.0009	0.0012	0.0015	0.0017	0.0019	0.0022	0.0023
44	0.2572	0.5269	2816	0.0003	0.0008	0.0010	0.0013	0.0015	0.0017	0.0020	0.0022	0.0025
45	0.2567	0.5272	2825	0.0002	0.0007	0.0009	0.0012	0.0014	0.0016	0.0019	0.0021	0.0024
46	0.2597	0.5288	2752	0.0003	0.0007	0.0009	0.0012	0.0015	0.0016	0.0019	0.0022	0.0023
47	0.2565	0.5271	2830	0.0004	0.0008	0.0010	0.0013	0.0015	0.0017	0.0020	0.0022	0.0025
48	0.2577	0.5292	2794	0.0003	0.0008	0.0010	0.0013	0.0015	0.0017	0.0020	0.0023	0.0025
49	0.2553	0.5268	2859	0.0004	0.0009	0.0011	0.0013	0.0015	0.0018	0.0020	0.0022	0.0024
50	0.2572	0.5290	2805	0.0003	0.0007	0.0012	0.0014	0.0015	0.0017	0.0019	0.0022	0.0024
51	0.2590	0.5281	2770	0.0004	0.0008	0.0010	0.0013	0.0015	0.0017	0.0020	0.0022	0.0025
52	0.2584	0.5306	2772	0.0002	0.0007	0.0009	0.0011	0.0014	0.0017	0.0018	0.0022	0.0022
53	0.2582	0.5268	2793	0.0003	0.0007	0.0009	0.0013	0.0014	0.0017	0.0019	0.0021	0.0023
54	0.2562	0.5272	2836	0.0004	0.0008	0.0010	0.0014	0.0015	0.0018	0.0020	0.0022	0.0023
55	0.2572	0.5289	2806	0.0003	0.0007	0.0010	0.0012	0.0014	0.0017	0.0019	0.0022	0.0023
56	0.2581	0.5269	2796	0.0003	0.0007	0.0009	0.0013	0.0014	0.0017	0.0019	0.0021	0.0023
57	0.2569	0.5267	2824	0.0003	0.0009	0.0010	0.0013	0.0015	0.0019	0.0021	0.0022	0.0025
58	0.2583	0.5287	2783	0.0003	0.0007	0.0009	0.0013	0.0014	0.0017	0.0019	0.0021	0.0024
59	0.2551	0.5285	2854	0.0003	0.0007	0.0010	0.0012	0.0014	0.0017	0.0019	0.0022	0.0023
60	0.2593	0.5295	2758	0.0002	0.0008	0.0010	0.0012	0.0015	0.0018	0.0020	0.0022	0.0024
Ave.	0.2575	0.5280	2805	0.0003	0.0008	0.0010	0.0013	0.0015	0.0017	0.0020	0.0021	0.0024
Med.	0.2573	0.5280	2804	0.0003	0.0008	0.0010	0.0013	0.0015	0.0017	0.0020	0.0022	0.0024
st dev	0.0011	0.0011	27.2340	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Min.	0.2551	0.5266	2752	0.0002	0.0007	0.0009	0.0011	0.0014	0.0016	0.0018	0.0020	0.0022
Max.	0.2597	0.5306	2859	0.0004	0.0009	0.0012	0.0014	0.0016	0.0019	0.0021	0.0023	0.0025



3.7 Data Set 3, 115° C, 150mA (Lumen Maintenance)

No.	Φ(lm)	Lumen Maintenance (%)								
		0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs
61	186.6	99.95	99.57	99.20	98.87	98.55	98.29	97.96	97.70	97.53
62	189.6	99.84	99.47	99.05	98.58	98.36	98.10	97.89	97.57	97.26
63	185.4	100.11	99.46	99.14	98.65	98.27	97.90	97.63	97.52	97.25
64	185.7	99.89	99.41	98.87	98.55	98.28	97.79	97.52	97.20	96.98
65	188.1	100.11	99.63	99.10	98.72	98.30	97.87	97.66	97.40	97.24
66	188.5	99.95	99.68	99.10	98.62	98.14	97.77	97.35	97.08	96.71
67	189.2	100.16	99.58	99.15	98.73	98.36	97.89	97.46	97.15	96.83
68	185.7	100.05	99.62	99.25	98.82	98.38	98.12	97.68	97.36	97.09
69	185.2	99.95	99.51	98.97	98.43	98.06	97.79	97.46	97.14	96.76
70	188.2	99.84	99.47	99.15	98.83	98.51	98.19	97.93	97.72	97.34
71	187.1	100.05	99.57	99.14	98.82	98.56	98.18	97.97	97.65	97.22
72	187.1	99.95	99.47	99.09	98.72	98.50	98.13	97.86	97.59	97.33
73	188.8	99.84	99.31	98.89	98.52	98.25	98.04	97.72	97.46	97.19
74	185.6	99.95	99.41	98.98	98.60	98.38	98.01	97.74	97.47	97.20
75	190.4	99.84	99.37	98.90	98.48	98.27	97.79	97.43	97.06	96.69
76	188.9	100.05	99.74	99.36	98.94	98.57	98.36	98.09	97.72	97.46
77	186.6	100.16	99.57	99.30	98.82	98.29	98.02	97.70	97.53	97.21
78	189.4	99.84	99.47	99.21	98.79	98.36	97.84	97.47	97.15	96.94
79	186.2	100.05	99.52	99.09	98.87	98.50	98.07	97.58	97.31	97.05
80	186.9	99.95	99.52	98.93	98.56	98.23	97.91	97.54	97.27	97.06
81	186.7	100.05	99.46	99.09	98.61	98.29	97.91	97.59	97.21	96.95
82	183.0	99.89	99.51	99.18	98.63	98.25	97.92	97.54	97.10	96.72
83	191.3	99.90	99.48	99.06	98.69	98.27	98.12	97.75	97.44	97.07
84	187.7	99.89	99.57	99.09	98.67	98.24	98.03	97.76	97.60	97.12
85	188.4	99.95	99.58	99.15	98.78	98.30	98.04	97.66	97.29	97.03
86	189.2	99.68	99.15	98.73	98.31	97.89	97.46	97.25	96.93	96.41
87	187.3	100.11	99.68	99.36	98.99	98.56	98.29	97.92	97.76	97.28
88	186.9	100.16	99.73	99.25	98.88	98.56	98.29	98.07	97.86	97.70
89	185.5	100.11	99.57	99.08	98.71	98.54	98.11	97.90	97.57	97.04
90	188.6	100.05	99.52	99.20	98.73	98.52	98.25	97.93	97.56	97.24
Ave.	187.5	99.98	99.52	99.10	98.70	98.35	98.02	97.70	97.41	97.10
Med.	187.2	99.95	99.52	99.10	98.71	98.33	98.03	97.69	97.45	97.11
st dev	1.7930	0.1198	0.1216	0.1453	0.1562	0.1644	0.1982	0.2185	0.2438	0.2730
Min.	183.0	99.68	99.15	98.73	98.31	97.89	97.46	97.25	96.93	96.41
Max.	191.3	100.16	99.74	99.36	98.99	98.57	98.36	98.09	97.86	97.70

TM-21 Projection:

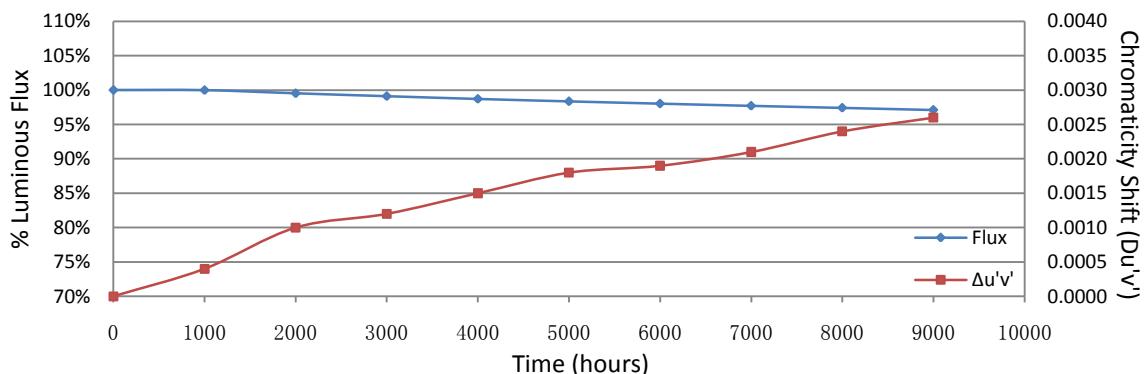
Test Duration: 9,000 hours
Failures Observed: 0
α: 3.251E-06
β: 1.000
Reported L₇₀: >54,000 hours

3.8 Data Set 3, 115° C, 150mA (Forward Voltage)

No.	Forward Voltage (V)									
	0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
61	9.519	9.437	9.446	9.459	9.467	9.478	9.448	9.421	9.437	9.433
62	9.492	9.398	9.398	9.408	9.409	9.426	9.409	9.386	9.389	9.393
63	9.515	9.415	9.422	9.432	9.428	9.439	9.420	9.399	9.411	9.403
64	9.541	9.407	9.418	9.424	9.425	9.437	9.416	9.404	9.412	9.402
65	9.599	9.461	9.463	9.476	9.475	9.487	9.474	9.445	9.464	9.451
66	9.537	9.403	9.399	9.423	9.414	9.432	9.423	9.415	9.403	9.393
67	9.604	9.465	9.468	9.488	9.476	9.491	9.470	9.465	9.454	9.461
68	9.524	9.381	9.383	9.406	9.403	9.409	9.391	9.390	9.386	9.385
69	9.506	9.510	9.517	9.536	9.532	9.547	9.519	9.509	9.514	9.507
70	9.585	9.449	9.458	9.482	9.474	9.478	9.468	9.457	9.443	9.441
71	9.514	9.394	9.392	9.417	9.402	9.417	9.411	9.413	9.384	9.385
72	9.510	9.355	9.359	9.375	9.374	9.380	9.378	9.360	9.351	9.356
73	9.489	9.366	9.364	9.385	9.376	9.400	9.382	9.364	9.354	9.353
74	9.633	9.486	9.494	9.528	9.505	9.531	9.508	9.502	9.487	9.488
75	9.485	9.493	9.494	9.514	9.504	9.622	9.503	9.488	9.476	9.482
76	9.544	9.422	9.428	9.449	9.430	9.459	9.446	9.436	9.424	9.424
77	9.518	9.422	9.421	9.431	9.424	9.440	9.428	9.413	9.410	9.418
78	9.505	9.404	9.402	9.419	9.414	9.435	9.405	9.393	9.395	9.391
79	9.516	9.427	9.432	9.447	9.439	9.457	9.438	9.420	9.416	9.419
80	9.540	9.426	9.432	9.453	9.438	9.460	9.430	9.414	9.422	9.436
81	9.564	9.438	9.439	9.459	9.447	9.465	9.444	9.426	9.427	9.428
82	9.495	9.377	9.387	9.397	9.389	9.405	9.391	9.374	9.536	9.373
83	9.582	9.459	9.466	9.479	9.476	9.491	9.479	9.453	9.454	9.452
84	9.481	9.406	9.408	9.424	9.428	9.429	9.434	9.395	9.397	9.397
85	9.521	9.422	9.432	9.454	9.431	9.450	9.436	9.410	9.404	9.413
86	9.514	9.523	9.528	9.551	9.533	9.557	9.539	9.510	9.503	9.511
87	9.584	9.431	9.435	9.449	9.436	9.456	9.445	9.429	9.425	9.419
88	9.637	9.484	9.487	9.503	9.496	9.507	9.492	9.478	9.479	9.474
89	9.469	9.395	9.403	9.421	9.411	9.414	9.405	9.386	9.386	9.385
90	9.623	9.508	9.505	9.532	9.515	9.527	9.523	9.495	9.498	9.490
Ave.	9.538	9.432	9.436	9.454	9.446	9.464	9.445	9.428	9.431	9.425
Med.	9.520	9.424	9.432	9.449	9.434	9.457	9.437	9.418	9.423	9.419
st dev	0.0472	0.0439	0.0445	0.0466	0.0443	0.0533	0.0438	0.0432	0.0467	0.0431
Min.	9.469	9.355	9.359	9.375	9.374	9.380	9.378	9.360	9.351	9.353
Max.	9.637	9.523	9.528	9.551	9.533	9.622	9.539	9.510	9.536	9.511

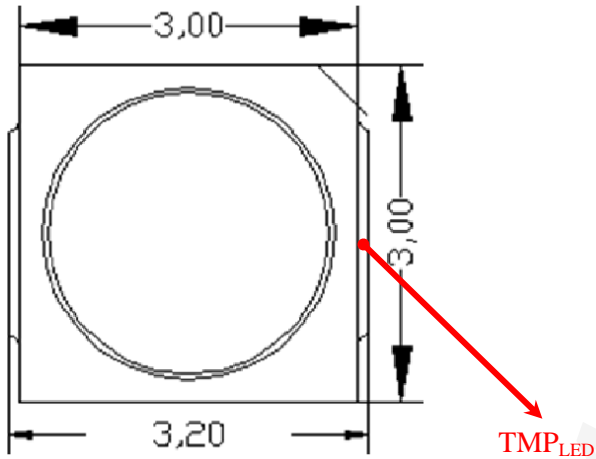
3.9 Data Set 3, 115° C, 150mA (Chromaticity Shift)

No.	u'	v'	CCT(K)	Chromaticity Shift ($\Delta u'v'$)								
	0hr(Initial)			1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
61	0.2589	0.5278	2774	0.0004	0.0009	0.0013	0.0016	0.0017	0.0020	0.0022	0.0022	0.0026
62	0.2585	0.5296	2775	0.0004	0.0009	0.0011	0.0015	0.0017	0.0019	0.0022	0.0022	0.0026
63	0.2582	0.5286	2785	0.0004	0.0009	0.0012	0.0016	0.0018	0.0019	0.0022	0.0023	0.0024
64	0.2586	0.5283	2779	0.0004	0.0010	0.0013	0.0016	0.0018	0.0019	0.0021	0.0023	0.0027
65	0.2569	0.5283	2816	0.0005	0.0010	0.0012	0.0015	0.0017	0.0020	0.0022	0.0022	0.0025
66	0.2587	0.5288	2774	0.0004	0.0009	0.0012	0.0015	0.0017	0.0019	0.0022	0.0024	0.0025
67	0.2576	0.5290	2797	0.0004	0.0009	0.0011	0.0015	0.0017	0.0019	0.0022	0.0024	0.0026
68	0.2584	0.5293	2779	0.0004	0.0009	0.0012	0.0015	0.0017	0.0019	0.0022	0.0024	0.0026
69	0.2556	0.5288	2840	0.0003	0.0009	0.0011	0.0014	0.0016	0.0018	0.0019	0.0022	0.0022
70	0.2584	0.5294	2776	0.0005	0.0010	0.0012	0.0016	0.0018	0.0019	0.0021	0.0024	0.0026
71	0.2582	0.5294	2782	0.0004	0.0009	0.0011	0.0015	0.0017	0.0018	0.0020	0.0024	0.0026
72	0.2576	0.5275	2803	0.0006	0.0009	0.0009	0.0012	0.0017	0.0018	0.0021	0.0024	0.0026
73	0.2569	0.5281	2816	0.0005	0.0010	0.0012	0.0016	0.0017	0.0019	0.0021	0.0025	0.0027
74	0.2578	0.5299	2788	0.0004	0.0009	0.0012	0.0014	0.0016	0.0018	0.0020	0.0024	0.0026
75	0.2558	0.5271	2845	0.0005	0.0009	0.0012	0.0016	0.0016	0.0018	0.0021	0.0025	0.0027
76	0.2561	0.5273	2837	0.0004	0.0009	0.0011	0.0014	0.0016	0.0018	0.0020	0.0023	0.0026
77	0.2579	0.5297	2786	0.0004	0.0009	0.0012	0.0015	0.0017	0.0019	0.0021	0.0024	0.0025
78	0.2584	0.5289	2780	0.0004	0.0009	0.0011	0.0015	0.0016	0.0018	0.0020	0.0024	0.0026
79	0.2569	0.5279	2817	0.0006	0.0010	0.0013	0.0016	0.0018	0.0020	0.0022	0.0025	0.0027
80	0.2588	0.5289	2771	0.0004	0.0009	0.0011	0.0015	0.0017	0.0018	0.0020	0.0023	0.0025
81	0.2574	0.5283	2804	0.0004	0.0010	0.0012	0.0016	0.0018	0.0019	0.0022	0.0024	0.0026
82	0.2597	0.5279	2757	0.0004	0.0009	0.0011	0.0015	0.0017	0.0019	0.0021	0.0024	0.0026
83	0.2565	0.5271	2830	0.0005	0.0010	0.0012	0.0016	0.0018	0.0019	0.0022	0.0026	0.0027
84	0.2561	0.5275	2836	0.0004	0.0009	0.0012	0.0016	0.0018	0.0019	0.0021	0.0025	0.0026
85	0.2581	0.5272	2795	0.0005	0.0010	0.0012	0.0016	0.0018	0.0019	0.0022	0.0025	0.0027
86	0.2559	0.5265	2846	0.0005	0.0009	0.0012	0.0016	0.0017	0.0018	0.0021	0.0024	0.0026
87	0.2579	0.5291	2791	0.0005	0.0010	0.0013	0.0016	0.0019	0.0021	0.0022	0.0025	0.0031
88	0.2581	0.5296	2783	0.0005	0.0010	0.0013	0.0016	0.0017	0.0020	0.0023	0.0025	0.0031
89	0.2579	0.5292	2790	0.0005	0.0011	0.0014	0.0017	0.0019	0.0021	0.0025	0.0027	0.0031
90	0.2585	0.5295	2776	0.0005	0.0012	0.0014	0.0017	0.0020	0.0021	0.0025	0.0025	0.0031
Ave.	0.2577	0.5285	2798	0.0004	0.0010	0.0012	0.0015	0.0018	0.0019	0.0021	0.0024	0.0026
Med.	0.2579	0.5287	2789	0.0004	0.0009	0.0012	0.0016	0.0017	0.0019	0.0021	0.0024	0.0026
st dev	0.0011	0.0009	25.2253	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0003	0.0002
Min.	0.2556	0.5265	2757	0.0003	0.0009	0.0009	0.0012	0.0016	0.0018	0.0019	0.0021	0.0022
Max.	0.2597	0.5299	2846	0.0006	0.0012	0.0014	0.0017	0.0020	0.0021	0.0025	0.0027	0.0031



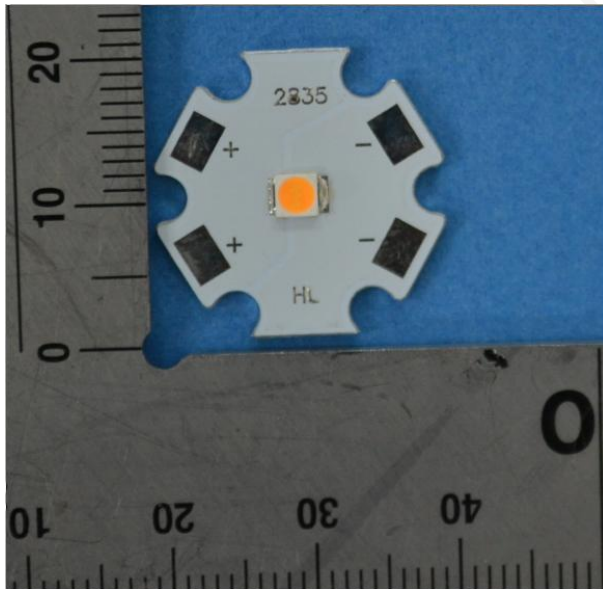
4 - EUT Photo

4.1 Mechanical Dimensions



All dimensions are in millimeter

4.2 EUT Photo



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