



TEST REPORT

ACCORDING TO IES LM-80-15
For

Lumileds Holding B.V.

370 W. Trimble Road, San Jose, CA 95131, USA

Model: L128-2790RA35000U1

Report Type: 9000 Hours Test Report		Product Type: LED Package	
Test Engineer:	Pote Wang	<i>Pote Wang</i>	
Report Number:	R2DG190315050-10		
Test Date:	2016-03-31 to 2017-04-10		
Report Date:	2019-03-18		
Reviewed By:	Blake Zhang / EE Engineer	<i>Blake Zhang</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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TABLE OF CONTENTS

1 -	General Information	3
1.1	Description of LED Light Sources	3
1.2	Standards Used:	4
1.3	Testing Equipment	4
1.4	Drive Level.....	4
1.5	Ambient Conditions for Maintenance Test.....	4
1.6	Measurement Uncertainty	5
1.7	Statement of Traceability.....	5
1.8	Sample Set.....	6
2 -	Summary of Test Result	7
3 -	Test Data	8
3.1	Data Set 1, 55°C, 150mA (Lumen Maintenance)	8
3.2	Data Set 1, 55°C, 150mA (Forward Voltage)	9
3.3	Data Set 1, 55°C, 150mA (Chromaticity Shift)	10
3.4	Data Set 2, 85°C, 150mA (Lumen Maintenance)	11
3.5	Data Set 2, 85°C, 150mA (Forward Voltage)	12
3.6	Data Set 2, 85°C, 150mA (Chromaticity Shift)	13
3.7	Data Set 3, 105°C, 150mA (Lumen Maintenance)	14
3.8	Data Set 3, 105°C, 150mA (Forward Voltage)	15
3.9	Data Set 3, 105°C, 150mA (Chromaticity Shift)	16
4 -	EUT Photo.....	17
4.1	Mechanical Dimensions.....	17
4.2	EUT Photo	17

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:	Lumileds Holding B.V.
Part Number:	L128-2790RA35000U1
Part Type:	LED Package
Drive Level:	DC 150mA
Nominal CCT:	2700K
Power:	0.578W
Average Current Density per LED die:	639.31mA/mm ²
Average Power Density per LED die:	2.18W/mm ²
CRI:	90
Die Spacing:	N/A

Note:

1. The applicant Lumileds Holding B.V. declare that their products with model L128-2790RA35000U1 are the same to the products in report #RSZ160329506-10-M1 and is authorized by original applicant to use their test data.
2. All the data in previous report (RSZ160329506-10-M1) is shared in this report.

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:

Multiple model	Total Input Current (mA)	Power (W)	Driver current per die (mA)	Current Density per Die (mA/mm ²)	Power Density per PCB (W/mm ²)
L128-xx90RA3500xxx	150	0.578	150	639.31	0.05898

Note:

1. The first and second x denote designates nominal CCT (22=2200K, 27=2700K, 30=3000K, 35=3500K, 40=4000K,45=4500K,50=5000K,57=5700K,60=6000K,65=6500K),
2. The last three x denote designates=Lumileds internal codes (0A1, 0B1, 0C1, etc. shares the same base part).

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® 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	G115987CJ73 21114	300VA	2017-03-03	2018-03-02
Multilayer aging machine	BACL	B2-270	20015	25°C~130°C	2017-03-03	2018-03-02
Digital CC&CV DC Power Supply	EVERFINE	WY5015	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 $\pm 3\%$ 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 $25^{\circ}C \pm 2^{\circ}C$, 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 $U=0.8671^{\circ}C$ ($K=2$), 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, 150mA

Part Number: L128-2790RA35000U1
Number of Units: 30
Case Temperature: >53°C
Ambient Temperature: >50°C
Life Test Drive Current: 150mA
Measurement Current: 150mA

Data Set 2: 85°C,150mA

Part Number: L128-2790RA35000U1
Number of Units: 30
Case Temperature: >83°C
Ambient Temperature: >80°C
Life Test Drive Current: 150mA
Measurement Current: 150mA

Data Set 3: 105°C,150mA

Part Number: L128-2790RA35000U1
Number of Units: 30
Case Temperature: >103°C
Ambient Temperature: >100°C
Life Test Drive Current: 150mA
Measurement Current: 150mA

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	100.29%	100.01%	99.91%	99.70%	99.53%	99.35%	99.13%	98.96%	98.77%
2	100.20%	99.81%	99.64%	99.36%	99.07%	98.80%	98.42%	98.18%	97.92%
3	100.10%	99.63%	99.35%	98.95%	98.57%	98.20%	97.78%	97.45%	97.14%

Average Color Maintenance

Data Set:	1000	2000	3000	4000	5000	6000	7000	8000	9000
1	0.0002	0.0004	0.0006	0.0009	0.0011	0.0013	0.0015	0.0019	0.0022
2	0.0003	0.0006	0.0008	0.0011	0.0013	0.0015	0.0017	0.002	0.0024
3	0.0004	0.0006	0.0008	0.0014	0.0016	0.0019	0.0019	0.0022	0.0025

3 - Test Data

3.1 Data Set 1, 55°C, 150mA (Lumen Maintenance)

No.	Φ(lm)	Lumen Maintenance (%)								
	0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
1	53.83	100.33	99.98	99.93	99.67	99.55	99.52	99.46	99.35	99.15
2	53.18	100.28	99.94	99.83	99.70	99.68	99.49	99.42	99.14	99.08
3	56.60	100.19	99.91	99.81	99.59	99.38	99.10	98.90	98.69	98.46
4	55.52	100.25	99.80	99.77	99.48	99.21	98.94	98.61	98.38	98.14
5	57.60	100.10	99.83	99.79	99.55	99.44	99.25	98.91	98.65	98.52
6	56.41	100.39	99.82	99.68	99.47	99.31	99.20	98.97	98.81	98.71
7	55.07	100.42	100.16	100.11	99.73	99.55	99.44	99.36	99.24	98.95
8	57.39	100.31	100.03	99.93	99.83	99.69	99.39	99.04	98.88	98.75
9	54.87	100.33	99.93	99.82	99.65	99.42	99.33	99.27	99.14	99.03
10	55.89	100.38	100.21	100.11	99.84	99.62	99.46	99.36	99.18	99.03
11	57.34	100.19	99.83	99.76	99.55	99.32	99.13	98.69	98.48	98.15
12	56.76	100.30	99.89	99.79	99.61	99.42	99.24	99.12	99.00	98.84
13	56.45	100.39	100.12	100.05	99.86	99.66	99.33	99.06	99.03	98.88
14	56.08	100.34	100.23	100.12	99.98	99.86	99.61	99.36	99.27	99.16
15	55.12	100.22	100.02	99.91	99.71	99.51	99.22	99.11	99.00	98.73
16	54.65	100.29	100.16	100.11	99.84	99.63	99.51	99.23	99.05	98.92
17	56.97	100.23	99.98	99.84	99.70	99.46	99.39	98.96	98.70	98.68
18	55.42	100.29	99.87	99.73	99.62	99.55	99.40	99.39	99.21	99.03
19	56.30	100.37	99.91	99.80	99.66	99.56	99.52	99.43	99.17	99.13
20	57.52	100.35	100.02	99.95	99.79	99.70	99.65	99.50	99.27	99.08
21	54.53	100.24	100.06	99.94	99.60	99.32	99.21	99.06	98.92	98.64
22	54.60	100.22	99.98	99.82	99.65	99.56	99.34	99.03	98.96	98.70
23	56.18	100.30	100.11	100.04	99.82	99.54	99.18	98.91	98.67	98.52
24	56.56	100.16	99.75	99.59	99.40	99.26	98.99	98.76	98.53	98.32
25	55.28	100.36	100.05	99.95	99.82	99.67	99.64	99.53	99.48	99.37
26	56.05	100.27	100.11	100.05	99.88	99.64	99.38	99.16	99.05	98.84
27	56.68	100.26	100.04	99.95	99.65	99.40	99.21	98.76	98.48	98.34
28	56.16	100.25	100.05	99.80	99.79	99.48	99.31	99.06	98.84	98.52
29	55.42	100.29	100.25	100.14	99.93	99.86	99.64	99.46	99.26	98.95
30	56.18	100.30	100.21	100.11	99.73	99.61	99.47	99.00	98.84	98.56
Ave.	55.89	100.29	100.01	99.91	99.70	99.53	99.35	99.13	98.96	98.77
Med.	56.12	100.29	100.02	99.92	99.70	99.55	99.36	99.09	99.00	98.79
st dev	1.0889	0.0736	0.1384	0.1487	0.1406	0.1624	0.1864	0.2570	0.2859	0.3108
Min.	53.18	100.10	99.75	99.59	99.40	99.21	98.94	98.61	98.38	98.14
Max.	57.60	100.42	100.25	100.14	99.98	99.86	99.65	99.53	99.48	99.37

TM-21 Projection:

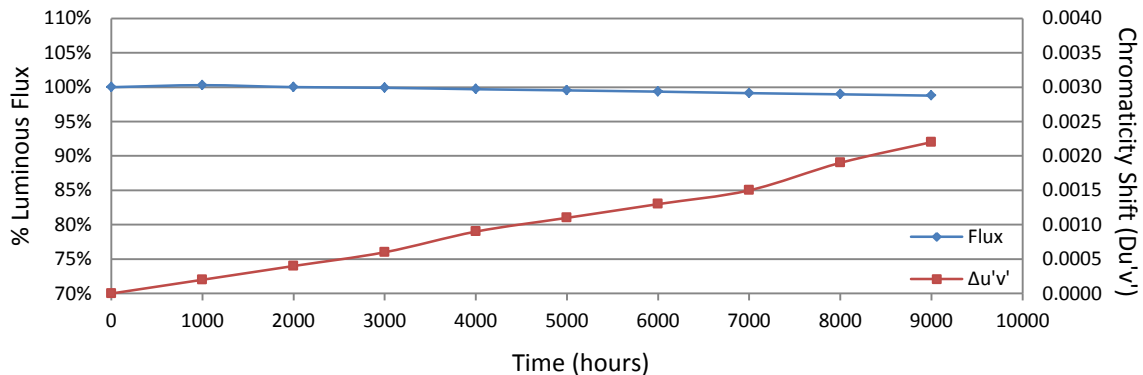
Test Duration: 9,000 hours
Failures Observed: 0
α: 1.894E-06
β: 1.005
Reported L₇₀: >54000 hours

3.2 Data Set 1, 55°C, 150mA (Forward Voltage)

No.	Forward Voltage (V)									
	0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
1	3.024	3.130	3.023	3.107	3.022	3.019	3.025	3.029	3.030	3.045
2	3.030	3.205	3.043	3.110	3.026	3.028	3.030	3.035	3.042	3.127
3	3.058	3.202	3.039	3.050	3.053	3.051	3.055	3.062	3.066	3.146
4	3.515	3.131	3.159	3.622	3.500	3.497	3.503	3.511	3.515	3.555
5	3.061	3.158	3.091	3.046	3.051	3.053	3.054	3.061	3.064	3.101
6	3.043	3.091	3.174	3.135	3.040	3.040	3.041	3.045	3.050	3.190
7	3.066	3.187	3.016	3.144	3.041	3.042	3.044	3.049	3.054	3.172
8	3.050	3.102	3.056	3.048	3.048	3.046	3.053	3.058	3.066	3.142
9	3.038	3.111	3.007	3.065	3.031	3.028	3.032	3.038	3.070	3.068
10	3.067	3.066	3.057	3.114	3.049	3.048	3.054	3.059	3.074	3.176
11	3.047	3.148	3.096	3.115	3.040	3.038	3.043	3.047	3.064	3.073
12	3.080	3.062	3.133	3.094	3.042	3.041	3.048	3.051	3.059	3.094
13	3.130	3.092	3.049	3.085	3.048	3.048	3.052	3.056	3.073	3.089
14	3.151	3.058	3.163	3.153	3.054	3.051	3.054	3.062	3.073	3.188
15	3.060	3.096	3.071	3.102	3.032	3.030	3.035	3.039	3.055	3.097
16	3.072	3.102	3.078	3.122	3.037	3.039	3.039	3.044	3.056	3.072
17	3.115	3.087	3.085	3.177	3.048	3.047	3.050	3.055	3.067	3.068
18	3.067	3.139	3.149	3.042	3.030	3.027	3.032	3.041	3.041	3.084
19	3.089	3.127	3.156	3.013	3.040	3.041	3.044	3.049	3.055	3.144
20	3.098	3.109	3.064	3.168	3.059	3.056	3.060	3.068	3.078	3.081
21	3.494	3.111	3.115	3.112	3.496	3.487	3.489	3.501	3.505	3.497
22	3.488	3.453	3.431	3.502	3.477	3.478	3.484	3.488	3.493	3.499
23	3.065	3.338	3.042	3.078	3.059	3.055	3.061	3.067	3.074	3.087
24	3.029	3.067	3.137	3.084	3.049	3.047	3.052	3.055	3.062	3.095
25	3.091	3.080	3.122	3.059	3.033	3.030	3.038	3.042	3.048	3.089
26	3.058	3.078	2.991	3.064	3.035	3.033	3.038	3.044	3.048	3.082
27	3.123	3.071	3.119	3.132	3.110	3.107	3.112	3.117	3.126	3.200
28	3.119	3.073	3.039	3.056	3.046	3.042	3.049	3.051	3.057	3.150
29	3.176	3.503	3.056	3.221	3.045	3.043	3.050	3.054	3.066	3.156
30	3.109	3.087	3.005	3.121	3.049	3.041	3.046	3.049	3.058	3.094
Ave.	3.120	3.142	3.092	3.131	3.090	3.088	3.092	3.098	3.106	3.155
Med.	3.070	3.106	3.075	3.109	3.047	3.043	3.050	3.053	3.064	3.099
st dev	0.1335	0.1079	0.0825	0.1266	0.1370	0.1363	0.1364	0.1373	0.1360	0.1298
Min.	3.024	3.058	2.991	3.013	3.022	3.019	3.025	3.029	3.030	3.045
Max.	3.515	3.503	3.431	3.622	3.500	3.497	3.503	3.511	3.515	3.555

3.3 Data Set 1, 55°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	0.2569	0.5218	2846	0.0003	0.0004	0.0007	0.0008	0.0010	0.0012	0.0013	0.0015	0.0017
2	0.2600	0.5232	2771	0.0005	0.0003	0.0005	0.0008	0.0009	0.0012	0.0015	0.0017	0.0019
3	0.2585	0.5264	2790	0.0001	0.0004	0.0006	0.0008	0.0009	0.0013	0.0013	0.0019	0.0020
4	0.2610	0.5290	2724	0.0002	0.0006	0.0009	0.0010	0.0012	0.0014	0.0016	0.0021	0.0024
5	0.2606	0.5281	2737	0.0002	0.0006	0.0008	0.0011	0.0012	0.0014	0.0016	0.0020	0.0024
6	0.2607	0.5277	2736	0.0002	0.0005	0.0008	0.0011	0.0012	0.0015	0.0016	0.0020	0.0024
7	0.2604	0.5262	2748	0.0001	0.0003	0.0006	0.0009	0.0009	0.0012	0.0013	0.0017	0.0021
8	0.2569	0.5261	2826	0.0002	0.0004	0.0006	0.0010	0.0012	0.0014	0.0015	0.0020	0.0023
9	0.2569	0.5219	2846	0.0003	0.0004	0.0006	0.0010	0.0013	0.0014	0.0015	0.0018	0.0023
10	0.2585	0.5258	2791	0.0002	0.0004	0.0006	0.0009	0.0010	0.0014	0.0015	0.0018	0.0022
11	0.2585	0.5262	2791	0.0001	0.0003	0.0005	0.0008	0.0010	0.0012	0.0014	0.0017	0.0021
12	0.2569	0.5235	2837	0.0004	0.0004	0.0006	0.0009	0.0012	0.0014	0.0015	0.0020	0.0022
13	0.2606	0.5250	2749	0.0002	0.0004	0.0007	0.0009	0.0012	0.0014	0.0015	0.0019	0.0022
14	0.2589	0.5254	2785	0.0002	0.0004	0.0006	0.0008	0.0010	0.0012	0.0014	0.0017	0.0021
15	0.2603	0.5237	2763	0.0002	0.0005	0.0007	0.0009	0.0012	0.0014	0.0015	0.0019	0.0024
16	0.2632	0.5274	2687	0.0002	0.0004	0.0006	0.0009	0.0012	0.0014	0.0016	0.0020	0.0023
17	0.2571	0.5246	2829	0.0002	0.0004	0.0006	0.0009	0.0011	0.0014	0.0015	0.0019	0.0022
18	0.2577	0.5233	2822	0.0003	0.0006	0.0008	0.0010	0.0013	0.0015	0.0016	0.0020	0.0025
19	0.2602	0.5251	2757	0.0002	0.0004	0.0006	0.0009	0.0011	0.0013	0.0015	0.0019	0.0022
20	0.2557	0.5254	2856	0.0002	0.0003	0.0005	0.0008	0.0010	0.0012	0.0014	0.0018	0.0021
21	0.2656	0.5288	2631	0.0002	0.0003	0.0004	0.0007	0.0010	0.0012	0.0014	0.0017	0.0021
22	0.2621	0.5280	2707	0.0002	0.0004	0.0007	0.0009	0.0012	0.0014	0.0014	0.0018	0.0022
23	0.2595	0.5260	2770	0.0002	0.0004	0.0006	0.0009	0.0011	0.0012	0.0014	0.0018	0.0022
24	0.2577	0.5242	2817	0.0000	0.0003	0.0006	0.0007	0.0010	0.0011	0.0012	0.0017	0.0020
25	0.2558	0.5228	2867	0.0002	0.0004	0.0007	0.0009	0.0013	0.0014	0.0014	0.0018	0.0022
26	0.2568	0.5243	2838	0.0002	0.0004	0.0006	0.0008	0.0011	0.0012	0.0016	0.0018	0.0022
27	0.2555	0.5256	2860	0.0002	0.0006	0.0006	0.0009	0.0013	0.0014	0.0017	0.0021	0.0024
28	0.2619	0.5270	2713	0.0002	0.0003	0.0005	0.0009	0.0011	0.0013	0.0015	0.0019	0.0022
29	0.2602	0.5249	2759	0.0002	0.0004	0.0004	0.0007	0.0011	0.0012	0.0014	0.0017	0.0021
30	0.2574	0.5250	2821	0.0003	0.0004	0.0006	0.0009	0.0011	0.0013	0.0017	0.0020	0.0022
Ave.	0.2591	0.5254	2782	0.0002	0.0004	0.0006	0.0009	0.0011	0.0013	0.0015	0.0019	0.0022
Med.	0.2587	0.5254	2788	0.0002	0.0004	0.0006	0.0009	0.0011	0.0013	0.0015	0.0019	0.0022
st dev	0.0024	0.0019	57.4154	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002
Min.	0.2555	0.5218	2631	0.0000	0.0003	0.0004	0.0007	0.0009	0.0011	0.0012	0.0015	0.0017
Max.	0.2656	0.5290	2867	0.0005	0.0006	0.0009	0.0011	0.0013	0.0015	0.0017	0.0021	0.0025



3.4 Data Set 2, 85°C, 150mA (Lumen Maintenance)

No.	Φ(lm)	Lumen Maintenance (%)								
	Ohr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
31	56.92	100.25	99.75	99.61	99.39	99.16	98.89	98.59	98.45	98.30
32	56.13	100.12	99.66	99.48	99.02	98.66	98.59	98.33	98.09	97.74
33	57.09	100.21	99.72	99.65	99.30	99.07	98.72	98.23	97.88	97.69
34	57.21	100.31	100.10	99.88	99.62	99.44	99.14	98.50	98.16	97.99
35	55.28	100.16	99.60	99.51	99.29	99.15	98.95	98.63	98.35	98.08
36	54.60	100.29	99.60	99.40	99.18	98.79	98.53	98.22	98.00	97.84
37	56.67	100.02	99.42	99.21	98.85	98.64	98.34	97.74	97.62	97.55
38	55.88	100.11	99.53	99.30	99.12	98.89	98.57	98.12	98.00	97.83
39	57.96	100.16	99.64	99.43	99.22	98.79	98.45	97.91	97.62	97.36
40	53.96	100.33	99.80	99.74	99.41	99.20	98.81	98.31	98.18	97.89
41	54.39	100.24	99.60	99.43	99.21	98.90	98.55	97.98	97.78	97.50
42	55.71	100.22	100.02	99.96	99.69	99.37	99.10	98.83	98.53	98.24
43	55.74	100.30	100.16	100.05	99.96	99.73	99.48	99.10	98.91	98.67
44	54.40	100.20	100.07	99.76	99.58	99.25	98.99	98.68	98.51	98.22
45	56.58	100.23	99.86	99.79	99.54	99.17	98.80	98.14	97.90	97.68
46	56.12	100.09	99.84	99.63	99.45	99.29	99.18	98.82	98.47	98.22
47	56.69	100.25	99.96	99.79	99.47	99.22	98.91	98.71	98.57	98.22
48	56.47	100.23	99.93	99.77	99.50	99.15	98.92	98.69	98.51	98.25
49	54.07	100.06	99.78	99.52	99.39	98.95	98.67	98.37	98.13	97.85
50	54.55	100.04	99.67	99.36	99.12	98.75	98.37	98.13	97.86	97.65
51	57.47	100.23	99.86	99.58	99.29	98.83	98.31	98.21	97.81	97.58
52	56.92	100.18	99.77	99.65	99.26	98.89	98.72	98.12	97.89	97.51
53	54.79	100.05	99.65	99.53	99.27	98.83	98.70	98.25	98.12	97.81
54	56.36	100.32	99.86	99.70	99.43	99.15	98.86	98.60	98.33	98.01
55	56.86	100.25	99.79	99.67	99.53	99.28	98.93	98.87	98.72	98.35
56	55.70	100.32	99.86	99.69	99.39	99.10	99.03	98.65	98.47	98.17
57	55.76	100.29	99.95	99.86	99.39	99.21	98.98	98.57	98.31	98.08
58	55.76	100.32	99.96	99.80	99.44	99.25	99.01	98.73	98.49	98.21
59	54.62	100.11	99.91	99.60	99.18	98.86	98.52	97.93	97.53	97.14
60	56.51	100.25	99.95	99.75	99.42	99.12	98.90	98.66	98.25	98.05
Ave.	55.91	100.20	99.81	99.64	99.36	99.07	98.80	98.42	98.18	97.92
Med.	56.00	100.23	99.82	99.65	99.39	99.13	98.84	98.43	98.17	97.94
st dev	1.0841	0.0939	0.1778	0.1961	0.2147	0.2482	0.2742	0.3337	0.3485	0.3402
Min.	53.96	100.02	99.42	99.21	98.85	98.64	98.31	97.74	97.53	97.14
Max.	57.96	100.33	100.16	100.05	99.96	99.73	99.48	99.10	98.91	98.67

TM-21 Projection:

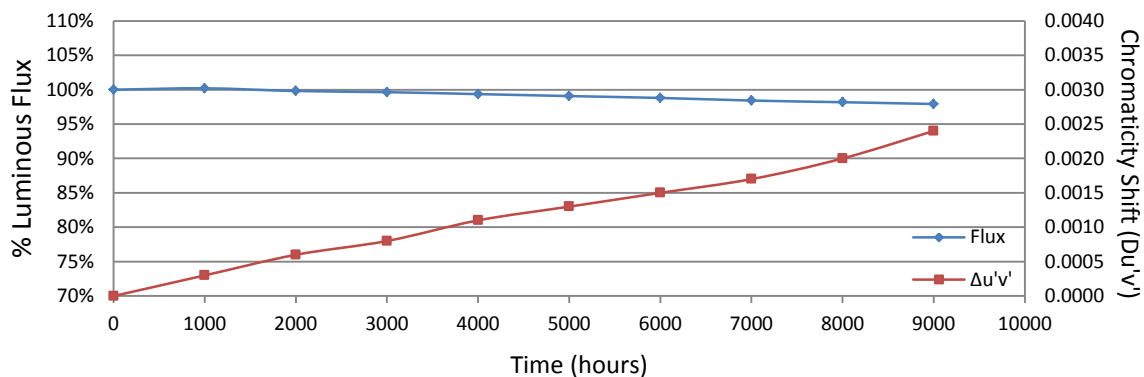
Test Duration: 9,000 hours
Failures Observed: 0
 α : 2.969E-06
 β : 1.005
Reported L₇₀: >54000 hours

3.5 Data Set 2, 85°C, 150mA (Forward Voltage)

No.	Forward Voltage (V)									
	0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
31	3.100	3.069	3.197	3.134	3.052	3.055	3.060	3.063	3.069	3.157
32	3.061	3.069	3.033	3.132	3.044	3.040	3.043	3.050	3.055	3.077
33	3.083	3.088	3.028	3.084	3.047	3.045	3.049	3.054	3.060	3.074
34	3.165	3.113	3.034	3.062	3.054	3.051	3.055	3.062	3.067	3.191
35	3.059	3.057	3.010	3.071	3.038	3.034	3.039	3.044	3.050	3.146
36	3.050	3.054	3.160	3.111	3.036	3.030	3.038	3.042	3.047	3.137
37	3.070	3.065	3.041	3.112	3.041	3.044	3.049	3.053	3.057	3.195
38	3.062	3.066	3.008	3.064	3.041	3.043	3.046	3.053	3.060	3.071
39	3.068	3.071	3.073	3.109	3.048	3.048	3.053	3.059	3.066	3.124
40	3.055	3.051	3.017	3.080	3.020	3.022	3.026	3.030	3.036	3.064
41	3.043	3.075	2.995	2.974	3.025	3.028	3.029	3.034	3.041	3.046
42	3.049	3.070	3.076	3.066	3.033	3.034	3.038	3.043	3.046	3.092
43	3.058	3.068	3.041	3.020	3.042	3.042	3.048	3.056	3.054	3.102
44	3.044	3.051	3.110	3.067	3.022	3.023	3.030	3.034	3.037	3.105
45	3.054	3.067	3.115	2.985	3.038	3.039	3.045	3.062	3.056	3.078
46	3.081	3.079	3.093	3.040	3.048	3.048	3.053	3.082	3.065	3.071
47	3.061	3.083	3.112	3.093	3.038	3.040	3.048	3.049	3.058	3.111
48	3.098	3.138	3.100	3.190	3.043	3.045	3.050	3.069	3.075	3.097
49	3.036	3.118	3.031	3.072	3.019	3.019	3.023	3.058	3.039	3.050
50	3.037	3.143	3.074	3.097	3.024	3.024	3.031	3.039	3.045	3.048
51	3.062	3.128	3.060	3.097	3.053	3.054	3.057	3.073	3.085	3.077
52	3.061	3.080	3.158	3.135	3.042	3.042	3.047	3.077	3.062	3.079
53	3.045	3.052	2.979	3.056	3.029	3.031	3.034	3.043	3.050	3.064
54	3.053	3.073	3.236	3.121	3.039	3.041	3.045	3.054	3.055	3.149
55	3.071	3.078	3.063	3.100	3.043	3.044	3.048	3.063	3.065	3.083
56	3.039	3.200	3.022	3.097	3.032	3.032	3.037	3.047	3.049	3.041
57	3.053	3.070	3.122	3.110	3.037	3.042	3.043	3.050	3.055	3.046
58	3.052	3.072	3.031	3.163	3.032	3.035	3.037	3.040	3.044	3.034
59	3.074	3.066	3.060	3.073	3.487	3.486	3.490	3.497	3.503	3.486
60	3.062	3.116	3.079	3.115	3.040	3.043	3.048	3.049	3.061	3.045
Ave.	3.064	3.084	3.072	3.088	3.053	3.053	3.058	3.068	3.070	3.105
Med.	3.060	3.072	3.062	3.095	3.040	3.042	3.046	3.053	3.056	3.079
st dev	0.0249	0.0336	0.0602	0.0459	0.0825	0.0822	0.0821	0.0821	0.0825	0.0840
Min.	3.036	3.051	2.979	2.974	3.019	3.019	3.023	3.030	3.036	3.034
Max.	3.165	3.200	3.236	3.190	3.487	3.486	3.490	3.497	3.503	3.486

3.6 Data Set 2, 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	9000hrs
31	0.2593	0.5275	2766	0.0002	0.0003	0.0004	0.0009	0.0012	0.0014	0.0016	0.0019	0.0022
32	0.2614	0.5265	2726	0.0003	0.0006	0.0007	0.0012	0.0014	0.0016	0.0018	0.0022	0.0025
33	0.2580	0.5260	2803	0.0004	0.0008	0.0009	0.0013	0.0014	0.0017	0.0019	0.0022	0.0025
34	0.2565	0.5255	2838	0.0002	0.0004	0.0007	0.0010	0.0012	0.0014	0.0017	0.0020	0.0023
35	0.2576	0.5218	2831	0.0004	0.0006	0.0008	0.0013	0.0014	0.0016	0.0017	0.0021	0.0024
36	0.2611	0.5257	2735	0.0002	0.0004	0.0007	0.0011	0.0012	0.0015	0.0016	0.0020	0.0024
37	0.2588	0.5256	2786	0.0003	0.0004	0.0007	0.0010	0.0012	0.0016	0.0017	0.0020	0.0024
38	0.2592	0.5253	2779	0.0004	0.0005	0.0008	0.0013	0.0014	0.0016	0.0019	0.0022	0.0025
39	0.2558	0.5252	2854	0.0004	0.0007	0.0008	0.0012	0.0013	0.0015	0.0018	0.0022	0.0024
40	0.2578	0.5249	2811	0.0003	0.0005	0.0009	0.0010	0.0013	0.0014	0.0016	0.0018	0.0023
41	0.2563	0.5204	2869	0.0003	0.0007	0.0009	0.0012	0.0014	0.0016	0.0017	0.0020	0.0025
42	0.2614	0.5260	2729	0.0003	0.0006	0.0009	0.0012	0.0014	0.0016	0.0017	0.0021	0.0024
43	0.2578	0.5230	2820	0.0004	0.0006	0.0009	0.0013	0.0013	0.0016	0.0018	0.0020	0.0024
44	0.2610	0.5253	2741	0.0003	0.0006	0.0010	0.0012	0.0014	0.0015	0.0018	0.0020	0.0025
45	0.2580	0.5277	2795	0.0004	0.0007	0.0009	0.0012	0.0014	0.0016	0.0018	0.0021	0.0024
46	0.2608	0.5280	2732	0.0002	0.0006	0.0009	0.0011	0.0013	0.0015	0.0016	0.0020	0.0022
47	0.2577	0.5272	2803	0.0004	0.0007	0.0009	0.0012	0.0014	0.0016	0.0018	0.0021	0.0023
48	0.2608	0.5275	2735	0.0003	0.0005	0.0008	0.0011	0.0012	0.0014	0.0017	0.0020	0.0022
49	0.2583	0.5229	2810	0.0003	0.0007	0.0009	0.0012	0.0014	0.0016	0.0018	0.0020	0.0024
50	0.2594	0.5261	2771	0.0003	0.0006	0.0009	0.0011	0.0013	0.0015	0.0016	0.0019	0.0023
51	0.2602	0.5278	2745	0.0003	0.0005	0.0007	0.0010	0.0012	0.0016	0.0018	0.0021	0.0023
52	0.2600	0.5278	2750	0.0003	0.0006	0.0008	0.0011	0.0013	0.0016	0.0018	0.0021	0.0024
53	0.2589	0.5220	2801	0.0003	0.0007	0.0009	0.0011	0.0013	0.0016	0.0017	0.0020	0.0024
54	0.2592	0.5263	2774	0.0004	0.0006	0.0008	0.0011	0.0013	0.0016	0.0017	0.0021	0.0024
55	0.2606	0.5288	2734	0.0003	0.0006	0.0007	0.0010	0.0013	0.0016	0.0017	0.0020	0.0023
56	0.2612	0.5266	2731	0.0003	0.0005	0.0007	0.0010	0.0013	0.0015	0.0017	0.0019	0.0023
57	0.2596	0.5261	2767	0.0003	0.0005	0.0008	0.0011	0.0013	0.0016	0.0017	0.0020	0.0024
58	0.2595	0.5272	2765	0.0003	0.0006	0.0008	0.0011	0.0012	0.0016	0.0017	0.0020	0.0024
59	0.2596	0.5273	2762	0.0001	0.0004	0.0008	0.0010	0.0012	0.0015	0.0015	0.0018	0.0023
60	0.2593	0.5254	2775	0.0002	0.0007	0.0009	0.0012	0.0014	0.0016	0.0018	0.0021	0.0025
Ave.	0.2592	0.5258	2778	0.0003	0.0006	0.0008	0.0011	0.0013	0.0015	0.0017	0.0020	0.0024
Med.	0.2593	0.5261	2773	0.0003	0.0006	0.0008	0.0011	0.0013	0.0016	0.0017	0.0020	0.0024
st dev	0.0015	0.0020	39.6301	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Min.	0.2558	0.5204	2726	0.0001	0.0003	0.0004	0.0009	0.0012	0.0014	0.0015	0.0018	0.0022
Max.	0.2614	0.5288	2869	0.0004	0.0008	0.0010	0.0013	0.0014	0.0017	0.0019	0.0022	0.0025



3.7 Data Set 3, 105°C, 150mA (Lumen Maintenance)

No.	Φ(lm)	Lumen Maintenance (%)								
	Ohr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
61	55.48	100.23	99.89	99.64	99.33	98.99	98.79	98.25	98.04	97.73
62	56.47	100.07	99.29	99.19	98.72	98.48	97.96	97.63	97.18	96.94
63	55.08	100.04	99.47	99.15	98.75	98.38	98.11	97.86	97.62	97.31
64	57.02	100.07	99.49	99.21	98.65	98.21	97.91	97.53	97.18	96.88
65	55.62	100.13	99.69	99.37	98.99	98.60	98.27	97.95	97.73	97.25
66	56.85	100.11	99.58	99.31	98.91	98.54	98.12	97.70	97.34	96.97
67	56.25	100.02	99.59	99.27	98.92	98.60	98.12	97.83	97.49	97.23
68	55.68	99.96	99.43	99.19	98.72	98.37	98.15	97.67	97.41	97.00
69	55.52	100.04	99.66	99.24	98.69	98.32	98.14	97.98	97.75	97.42
70	57.12	100.02	99.58	99.23	98.72	98.34	98.13	97.64	97.27	97.01
71	54.04	100.07	99.61	99.39	98.82	98.41	98.15	97.76	97.59	97.28
72	56.61	99.96	99.52	99.24	98.75	98.32	97.90	97.58	97.26	97.03
73	56.24	99.93	99.29	98.86	98.38	98.06	97.80	97.16	96.66	96.18
74	56.42	100.12	99.66	99.38	98.97	98.53	98.25	97.86	97.48	97.24
75	57.30	100.19	100.03	99.84	99.37	98.83	98.57	98.46	98.12	97.75
76	55.02	100.20	99.84	99.73	99.33	98.80	98.40	97.86	97.55	97.29
77	56.35	100.25	99.73	99.38	99.09	98.90	98.33	97.62	97.32	97.11
78	57.42	100.24	99.60	99.22	98.82	98.62	98.22	97.58	97.28	97.07
79	55.30	100.20	99.84	99.66	99.42	99.02	98.52	97.99	97.61	97.18
80	56.30	100.07	99.56	99.38	99.11	98.77	98.24	97.73	97.41	97.07
81	55.94	100.09	99.50	99.36	99.00	98.55	98.19	97.78	97.46	97.07
82	55.27	100.24	99.80	99.60	99.26	98.93	98.61	98.26	98.01	97.79
83	56.00	100.27	99.80	99.50	99.13	98.82	98.52	98.23	97.86	97.61
84	55.69	100.04	99.59	99.19	98.76	98.40	97.90	97.32	96.89	96.39
85	56.79	99.84	99.52	99.37	98.98	98.59	98.12	97.73	97.29	96.95
86	55.36	100.20	99.73	99.44	99.01	98.65	98.32	97.65	97.40	97.06
87	56.62	100.14	99.81	99.59	99.29	98.78	98.41	97.76	97.44	97.19
88	56.60	100.12	99.88	99.45	99.08	98.75	98.36	98.07	97.67	97.37
89	56.57	100.14	99.58	99.10	98.80	98.39	98.00	97.45	97.15	96.89
90	55.46	100.07	99.48	99.06	98.68	98.03	97.58	97.37	97.10	96.84
Ave.	56.08	100.10	99.63	99.35	98.95	98.57	98.20	97.78	97.45	97.14
Med.	56.25	100.10	99.60	99.36	98.94	98.57	98.17	97.74	97.43	97.09
st dev	0.7779	0.1039	0.1755	0.2131	0.2555	0.2598	0.2593	0.2924	0.3229	0.3465
Min.	54.04	99.84	99.29	98.86	98.38	98.03	97.58	97.16	96.66	96.18
Max.	57.42	100.27	100.03	99.84	99.42	99.02	98.79	98.46	98.12	97.79

TM-21 Projection:

Test Duration: 9,000 hours

Failures Observed: 0

α: 3.739E-06

β: 1.004

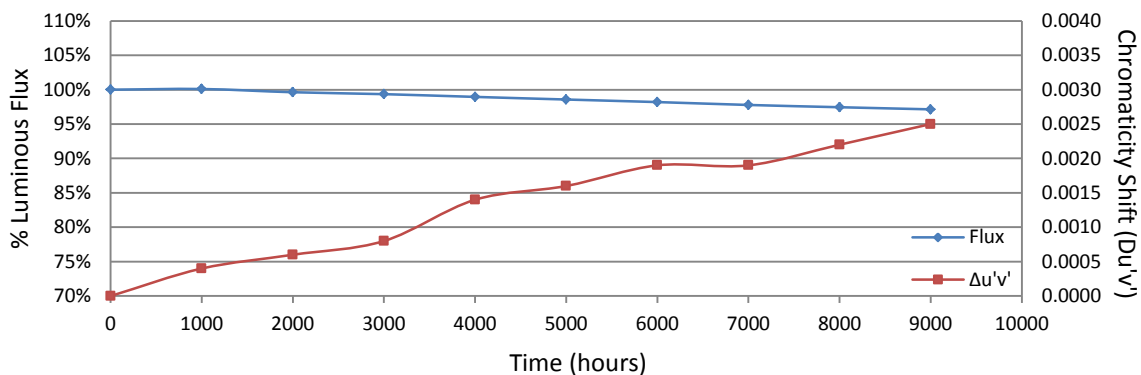
Reported L₇₀: >54000 hours

3.8 Data Set 3, 105°C, 150mA (Forward Voltage)

No.	Forward Voltage (V)									
	0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
61	3.057	3.092	3.123	3.161	3.040	3.039	3.045	3.052	3.059	3.047
62	3.058	3.095	3.263	3.038	3.040	3.041	3.046	3.051	3.060	3.045
63	3.055	3.082	3.116	3.007	3.030	3.031	3.037	3.041	3.045	3.039
64	3.074	3.116	3.129	3.065	3.042	3.043	3.048	3.051	3.063	3.072
65	3.044	3.086	3.174	3.063	3.032	3.033	3.039	3.041	3.049	3.069
66	3.048	3.074	3.180	3.016	3.038	3.037	3.044	3.047	3.054	3.053
67	3.045	3.084	3.166	2.998	3.038	3.037	3.042	3.043	3.051	3.055
68	3.048	3.088	3.114	3.013	3.037	3.038	3.044	3.044	3.052	3.042
69	3.044	3.085	3.124	3.014	3.035	3.037	3.041	3.043	3.054	3.048
70	3.064	3.100	3.128	2.987	3.045	3.047	3.050	3.063	3.062	3.082
71	3.027	3.055	3.128	2.985	3.020	3.020	3.027	3.029	3.042	3.027
72	3.056	3.123	3.209	3.069	3.046	3.049	3.053	3.055	3.067	3.050
73	3.039	3.093	3.172	3.012	3.031	3.037	3.038	3.043	3.048	3.033
74	3.054	3.065	3.113	2.999	3.039	3.042	3.047	3.048	3.053	3.043
75	3.067	3.078	3.164	3.030	3.056	3.060	3.060	3.067	3.073	3.057
76	3.044	3.071	3.187	2.988	3.033	3.035	3.037	3.045	3.049	3.034
77	3.060	3.090	3.186	3.083	3.047	3.056	3.054	3.062	3.065	3.054
78	3.062	3.093	3.234	3.147	3.048	3.052	3.055	3.061	3.064	3.051
79	3.043	3.068	3.272	3.233	3.034	3.034	3.041	3.047	3.057	3.038
80	3.051	3.077	3.212	3.049	3.041	3.043	3.046	3.055	3.059	3.043
81	3.091	3.057	3.156	3.071	3.028	3.028	3.030	3.037	3.041	3.031
82	3.038	3.057	3.337	3.020	3.027	3.029	3.033	3.042	3.045	3.040
83	3.051	3.068	3.142	3.092	3.041	3.043	3.047	3.052	3.062	3.045
84	3.049	3.085	3.107	3.045	3.033	3.039	3.041	3.043	3.059	3.041
85	3.072	3.080	3.146	3.162	3.041	3.040	3.048	3.052	3.058	3.045
86	3.038	3.065	3.074	2.994	3.028	3.027	3.032	3.036	3.051	3.030
87	3.050	3.074	3.260	3.142	3.042	3.042	3.048	3.054	3.063	3.046
88	3.048	3.079	3.128	3.128	3.038	3.039	3.044	3.052	3.058	3.043
89	3.055	3.096	3.294	3.055	3.046	3.047	3.051	3.057	3.068	3.050
90	3.040	3.064	3.326	3.110	3.030	3.031	3.037	3.047	3.050	3.037
Ave.	3.052	3.081	3.179	3.059	3.038	3.039	3.044	3.049	3.056	3.046
Med.	3.051	3.081	3.165	3.047	3.038	3.039	3.044	3.048	3.058	3.045
st dev	0.0128	0.0162	0.0684	0.0634	0.0076	0.0086	0.0077	0.0086	0.0080	0.0122
Min.	3.027	3.055	3.074	2.985	3.020	3.020	3.027	3.029	3.041	3.027
Max.	3.091	3.123	3.337	3.233	3.056	3.060	3.060	3.067	3.073	3.082

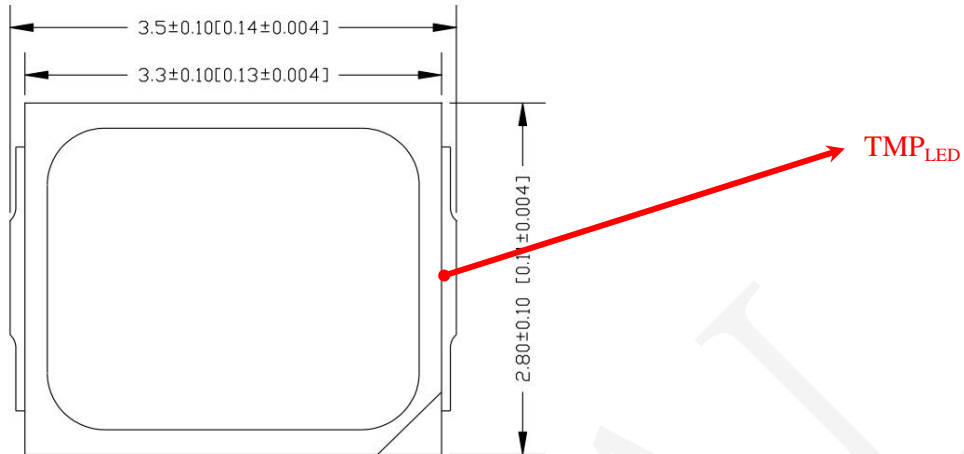
3.9 Data Set 3, 105°C, 150mA (Chromaticity Shift)

No.	u'	v'	CCT(K)	Chromaticity Shift ($\Delta u'v'$)								
	0hr(Initial)			1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
61	0.2599	0.5261	2761	0.0004	0.0007	0.0009	0.0014	0.0016	0.0017	0.0019	0.0022	0.0025
62	0.2614	0.5282	2719	0.0004	0.0006	0.0007	0.0013	0.0016	0.0019	0.0019	0.0023	0.0025
63	0.2579	0.5234	2817	0.0004	0.0007	0.0009	0.0014	0.0016	0.0018	0.0019	0.0022	0.0026
64	0.2567	0.5236	2842	0.0004	0.0005	0.0007	0.0014	0.0016	0.0018	0.0020	0.0023	0.0025
65	0.2576	0.5245	2817	0.0004	0.0006	0.0008	0.0012	0.0016	0.0018	0.0018	0.0022	0.0025
66	0.2604	0.5258	2752	0.0004	0.0005	0.0007	0.0013	0.0015	0.0018	0.0019	0.0022	0.0025
67	0.2569	0.5216	2849	0.0004	0.0005	0.0007	0.0013	0.0015	0.0018	0.0018	0.0021	0.0026
68	0.2595	0.5261	2769	0.0004	0.0007	0.0009	0.0014	0.0016	0.0019	0.0020	0.0022	0.0026
69	0.2589	0.5248	2788	0.0004	0.0007	0.0008	0.0013	0.0015	0.0018	0.0018	0.0021	0.0025
70	0.2592	0.5268	2771	0.0004	0.0006	0.0008	0.0012	0.0014	0.0017	0.0018	0.0022	0.0024
71	0.2589	0.5242	2790	0.0005	0.0006	0.0009	0.0014	0.0016	0.0019	0.0020	0.0022	0.0027
72	0.2587	0.5249	2792	0.0004	0.0006	0.0008	0.0013	0.0016	0.0018	0.0020	0.0023	0.0025
73	0.2563	0.5239	2850	0.0003	0.0005	0.0008	0.0013	0.0015	0.0017	0.0018	0.0021	0.0024
74	0.2565	0.5235	2848	0.0004	0.0005	0.0007	0.0013	0.0015	0.0018	0.0019	0.0021	0.0025
75	0.2589	0.5275	2775	0.0004	0.0005	0.0007	0.0012	0.0014	0.0017	0.0017	0.0022	0.0024
76	0.2599	0.5259	2760	0.0004	0.0006	0.0008	0.0013	0.0015	0.0018	0.0019	0.0022	0.0025
77	0.2595	0.5249	2775	0.0004	0.0005	0.0008	0.0013	0.0015	0.0019	0.0019	0.0022	0.0025
78	0.2588	0.5264	2783	0.0004	0.0006	0.0007	0.0012	0.0015	0.0019	0.0019	0.0022	0.0024
79	0.2579	0.5232	2817	0.0004	0.0005	0.0007	0.0013	0.0014	0.0017	0.0018	0.0020	0.0025
80	0.2592	0.5256	2778	0.0005	0.0007	0.0009	0.0014	0.0016	0.0019	0.0020	0.0023	0.0025
81	0.2573	0.5238	2828	0.0003	0.0006	0.0008	0.0012	0.0014	0.0019	0.0018	0.0021	0.0024
82	0.2561	0.5234	2857	0.0005	0.0008	0.0009	0.0014	0.0017	0.0020	0.0020	0.0024	0.0027
83	0.2560	0.5247	2853	0.0008	0.0013	0.0018	0.0022	0.0024	0.0025	0.0027	0.0030	0.0033
84	0.2595	0.5253	2772	0.0005	0.0005	0.0009	0.0014	0.0016	0.0019	0.0020	0.0023	0.0025
85	0.2600	0.5247	2764	0.0005	0.0008	0.0009	0.0013	0.0015	0.0018	0.0019	0.0022	0.0025
86	0.2587	0.5238	2798	0.0006	0.0008	0.0010	0.0016	0.0017	0.0020	0.0020	0.0024	0.0027
87	0.2582	0.5258	2798	0.0004	0.0007	0.0007	0.0014	0.0015	0.0018	0.0019	0.0023	0.0026
88	0.2574	0.5247	2821	0.0004	0.0007	0.0009	0.0014	0.0016	0.0019	0.0020	0.0023	0.0025
89	0.2570	0.5229	2840	0.0004	0.0007	0.0009	0.0014	0.0016	0.0018	0.0020	0.0023	0.0026
90	0.2566	0.5230	2849	0.0005	0.0008	0.0009	0.0015	0.0016	0.0019	0.0020	0.0023	0.0027
Ave.	0.2583	0.5248	2801	0.0004	0.0006	0.0008	0.0014	0.0016	0.0019	0.0019	0.0022	0.0025
Med.	0.2587	0.5247	2795	0.0004	0.0006	0.0008	0.0013	0.0016	0.0018	0.0019	0.0022	0.0025
st dev	0.0014	0.0015	36.8083	0.0001	0.0001	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
Min.	0.2560	0.5216	2719	0.0003	0.0005	0.0007	0.0012	0.0014	0.0017	0.0017	0.0020	0.0024
Max.	0.2614	0.5282	2857	0.0008	0.0013	0.0018	0.0022	0.0024	0.0025	0.0027	0.0030	0.0033



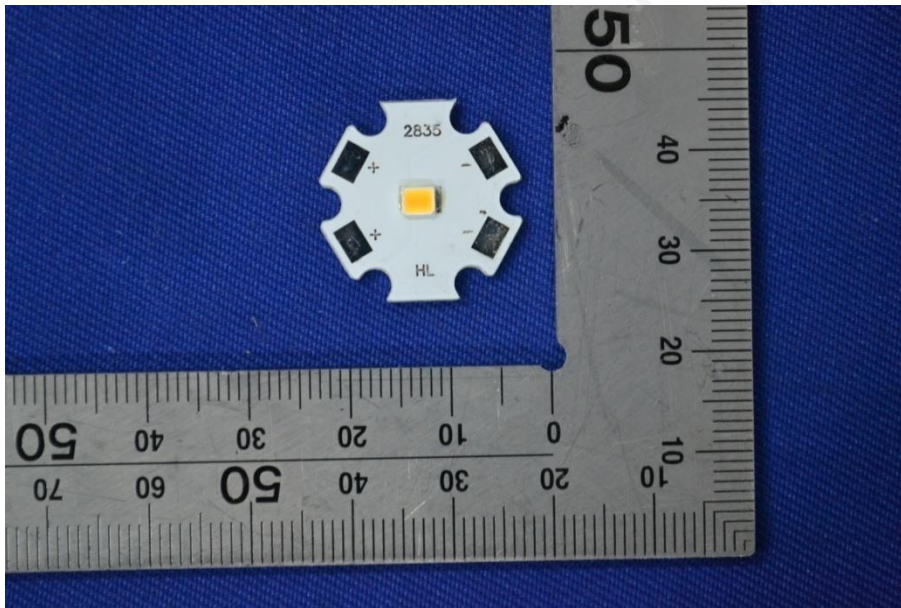
4 - EUT Photo

4.1 Mechanical Dimensions



All dimensions are in millimeter

4.2 EUT Photo



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