



IESNA LM-80-2008

MEASURING LUMEN MAINTENANCE OF LED LIGHT SOURCES

MEASUREMENT AND TEST REPORT For

Lumileds Holding B.V.

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

Model: L128-2780RA35000Q1

Report Type: 10000 Hours Test Report		Product Type: LED Package	
Reviewed By:	Pote Wang	<i>Pote Wang</i>	
Report Number:	R2DG181107053-10		
Test Date:	2014-09-12 to 2016-09-30		
Report Date:	2018-11-13		
Approved By:	Daniel Duan / EE Engineer	<i>Daniel</i>	
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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

Devices tested

Part Number:	L128-2780RA35000Q1
Part Type:	LED Package
Nominal CCT:	2700K
Power:	0.5W
Average Current Density per LED die:	930mA/mm ²
Average Power Density per LED die:	3.1W/mm ²
CRI:	80
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)

This report covers the following models:

Tested model	Multiple model	Total Input Current (mA)	Power (W)	Number of dies	Driver current per die (mA)	Current Density per Die (mA/mm ²)	Power Density per PCB (W/mm ²)	Die Spacing (mm)
L128-2780RA35000Q1	L128-xx80RA3500xxx	150	0.5	1	150	930	0.05102	NA

Note1:

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

Note2:

- The applicant *Lumileds Holding B.V.* declare that their products with model L128-2780RA35000Q1 are the same to the products in report # RSZ140908501-10-10000 and is authorized by original applicant to use their test data.
- All the data in previous report (RSZ140908501-10-10000) is shared in this report.

1.2 Standards Used:

- IESNA LM-80-08: 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 Test Facility

The testing facility used by Bay Area Compliance Laboratories Corp. (Dongguan). is located at No.69,Pulongcun ,Puxinhu Industrial Area, Tangxia , Dongguan, Guangdong, China.

1.4 Description of Auxiliary Equipment

Device	Manufacture	Model No	Serial No	Calibration date	Calibration due date
Integral Sphere	EVERFINE	Diameter 0.3m	1011119	2016-03-10	2017-03-09
Programmable Test Power for LEDs	EVERFINE	LED300E	1008002	2016-03-04	2017-03-03
High accuracy array spectroradiometer	EVERFINE	HAAS-2000	1012016T	2016-03-10	2017-03-09
Standard Light Source	EVERFINE	D062	1011093	2016-09-13	2017-09-12
Precision digital stabilized DC power supply	EVERFINE	WY605-V110	G115987CJ7321114	2016-03-04	2017-03-03
Multilayer aging machine	BACL	B2-270	20015	2016-03-04	2017-03-03
Digital CC&CV DC Power Supply	EVERFINE	WY5015	11090007	2016-03-04	2017-03-03

1.5 Operating Cycle

Samples are driven with a constant direct current (DC)

1.6 Ambient Conditions

For lumen maintenance test, samples were operated in thermal chambers with minimal ambient airflow. For long term reliability test, the case temperature was controlled by mounting several thermocouples on a sample reliability stress board at the designated thermal measurement point, as shown in APPENDIX. The ambient temperature T_A was measured by several thermocouples at a distance of 5 mm above the reliability test board. The relative humidity within chamber was less than 65%.

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

1.7 Photometry Measurement Uncertainty

The uncertainty of the light output (luminous flux) 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 CRI is $U=1.7$ ($K=2$), at the 95% confidence level. This calibration results traceable to the NATIONAL INSTITUTE OF METROLOGY (NIM).

1.8 Sample Set

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.

Each Sample is soldered to all of the reliability stress boards for a given set of IESNA LM-80 tests.

Sample Size:

Total 75Pcs;

Each Ts test condition 25Pcs

The samples tested at Ts 55 °C, Ts 85 °C and Ts 105 °C were received at 2014-09-08 and tested during 2014-09-12 to 2016-09-30. The samples were numbered from 1 to 25, 26 to 50 and 51 to 75

Data Set 1: 55 °C, 150mA

Part Number:	L128-2780RA35000Q1
Number of Units:	25
Actual Case Temperature(T _S):	T _S =54.1 °C
Actual Ambient Temperature(T _A):	T _A =52.5 °C
Life Test Drive Current:	I _F = 150mA
Measurement Current:	I _F = 150mA

Data Set 2: 85 °C,150mA

Part Number:	L128-2780RA35000Q1
Number of Units:	25
Actual Case Temperature(T _S):	T _S =84.3 °C
Actual Ambient Temperature(T _A):	T _A =83.5 °C
Life Test Drive Current:	I _F =150mA
Measurement Current:	I _F = 150mA

Data Set 3: 105 °C, 150mA

Part Number:	L128-2780RA35000Q1
Number of Units:	25
Actual Case Temperature(T _S):	T _S =104.4 °C
Actual Ambient Temperature(T _A):	T _A =103.8 °C
Life Test Drive Current:	I _F = 150mA
Measurement Current:	I _F = 150mA

2 - SUMMARY OF TEST RESULT

Data Set:	Data Set 1, 55 °C, 150mA
Number of Units:	25
Failures Observed:	0
Test Interval and Test Duration:	0h,1000h,2000h,3000h,4000h,5000h,6000h,7000h,8000h,9000h,10000h
Average. Lumen Maintenance at 10000 hours:	96.74%
Average Chromaticity Shift at 10000 hours ($\Delta u'v'$):	0.0025
Reported TM-21 L ₇₀ Lifetime:	>60000 hours

Data Set:	Data Set 2, 85 °C, 150mA
Number of Units:	25
Failures Observed:	0
Test Interval and Test Duration:	0h,1000h,2000h,3000h,4000h,5000h,6000h,7000h,8000h,9000h,10000h
Average. Lumen Maintenance at 10000 hours:	94.75%
Average Chromaticity Shift at 10000 hours($\Delta u'v'$):	0.0026
Reported TM-21 L ₇₀ Lifetime:	56,000 hours

Data Set:	Data Set 3, 105 °C, 150mA
Number of Units:	25
Failures Observed:	0
Test Interval and Test Duration:	0h,1000h,2000h,3000h,4000h,5000h,6000h,7000h,8000h,9000h,10000h
Average. Lumen Maintenance at 10000 hours:	92.87%
Average Chromaticity Shift at 10000 hours($\Delta u'v'$):	0.0026
Reported TM-21 L ₇₀ Lifetime:	42000 hours

3 - Test Data

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

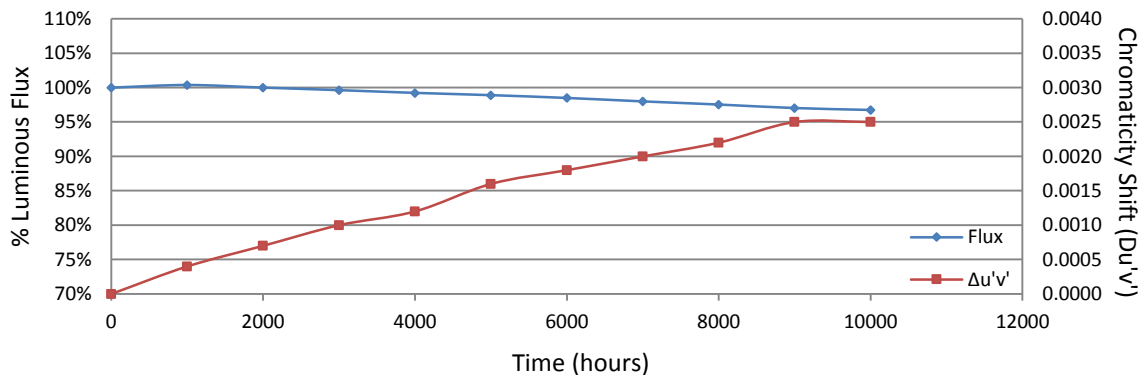
No.	V _F (V)	Φ(lm)	Lumen Maintenance (%)									
	0hr(Initial)		1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs	10000hrs
1	3.244	65.33	100.51	100.23	99.82	99.42	99.13	98.62	98.06	97.57	97.00	96.82
2	3.232	65.67	100.20	99.76	99.22	98.90	98.75	98.37	97.82	97.30	96.74	96.70
3	3.370	62.72	100.56	100.19	99.68	99.27	98.87	98.29	97.70	97.07	96.52	96.48
4	3.361	64.41	100.54	100.26	99.92	99.22	98.76	98.23	97.69	97.14	96.62	96.24
5	3.320	63.58	100.55	100.09	99.75	99.13	98.60	98.19	97.66	97.20	96.79	96.21
6	3.166	66.07	100.33	99.86	99.47	98.88	98.38	97.93	97.40	96.90	96.52	96.41
7	3.162	66.59	100.30	99.80	99.38	98.78	98.38	97.84	97.36	96.82	96.43	96.17
8	3.259	64.95	100.46	99.95	99.60	99.11	98.63	98.09	97.51	96.98	96.63	96.21
9	3.227	65.69	100.40	99.92	99.48	99.07	98.57	98.02	97.52	97.18	96.68	96.41
10	3.206	65.98	100.44	100.09	99.50	99.03	98.62	98.03	97.50	97.12	96.59	96.20
11	3.220	65.29	100.03	99.91	99.34	98.87	98.38	98.12	97.64	97.15	96.77	96.49
12	3.216	66.42	100.20	99.95	99.55	99.16	98.69	98.33	97.65	97.24	96.79	96.63
13	3.179	65.61	100.20	99.82	99.62	99.10	98.63	98.26	97.59	97.18	96.71	96.34
14	3.231	64.79	100.42	100.03	99.86	99.57	98.94	98.64	98.12	97.78	97.25	96.74
15	3.192	65.36	100.32	100.08	99.83	99.59	99.11	98.70	98.13	97.72	97.20	97.12
16	3.211	65.36	100.43	100.05	99.79	99.56	99.14	98.79	98.18	97.72	97.18	96.91
17	3.262	64.64	100.56	100.20	99.78	99.37	99.33	98.98	98.47	98.04	97.45	96.86
18	3.188	66.15	100.20	100.06	99.58	99.12	99.00	98.67	98.14	97.69	97.05	96.66
19	3.177	66.20	100.32	100.11	99.56	99.21	98.97	98.67	98.31	97.84	97.30	96.81
20	3.225	65.06	100.34	100.00	99.77	99.43	99.22	98.83	98.54	98.08	97.53	97.28
21	3.229	65.71	100.32	99.80	99.56	99.22	99.06	98.75	98.36	97.90	97.37	97.23
22	3.212	63.82	100.36	99.91	99.76	99.36	99.15	98.75	98.37	97.90	97.38	97.29
23	3.272	65.78	100.50	99.92	99.67	99.41	99.29	99.00	98.68	98.19	97.66	97.39
24	3.362	64.79	100.59	100.09	99.71	99.61	99.52	99.17	98.81	98.41	97.90	97.58
25	3.315	63.80	100.52	99.95	99.50	99.40	99.29	98.95	98.65	98.15	97.55	97.40
Ave.	3.242	65.19	100.38	100.00	99.63	99.23	98.90	98.49	97.99	97.53	97.02	96.74
Med.	3.227	65.36	100.40	100.00	99.62	99.22	98.94	98.62	98.06	97.57	97.00	96.70
st dev	0.061	0.96	0.1447	0.1403	0.1749	0.2374	0.3272	0.3774	0.4451	0.4588	0.4164	0.4349
Min.	3.162	62.72	100.03	99.76	99.22	98.78	98.38	97.84	97.36	96.82	96.43	96.17
Max.	3.370	66.59	100.59	100.26	99.92	99.61	99.52	99.17	98.81	98.41	97.90	97.58

TM-21 Projection:

Test Duration: 10000 hours
Failures Observed: 0
 α : 4.564E-06
 β : 1.01
Calculated L₇₀: 81000 hours
Reported L₇₀: >60000 hours

3.2 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	9000hrs
1	0.2610	0.5260	2737	0.0004	0.0008	0.0012	0.0013	0.0021	0.0023	0.0024	0.0022	0.0023	0.0020
2	0.2612	0.5258	2733	0.0005	0.0008	0.0013	0.0014	0.0023	0.0024	0.0024	0.0025	0.0024	0.0022
3	0.2611	0.5260	2734	0.0003	0.0006	0.0010	0.0012	0.0017	0.0021	0.0022	0.0022	0.0022	0.0021
4	0.2606	0.5259	2747	0.0004	0.0007	0.0011	0.0012	0.0018	0.0023	0.0024	0.0026	0.0026	0.0022
5	0.2618	0.5255	2723	0.0004	0.0007	0.0011	0.0012	0.0014	0.0018	0.0019	0.0022	0.0027	0.0024
6	0.2624	0.5263	2706	0.0003	0.0007	0.0011	0.0012	0.0016	0.0017	0.0021	0.0024	0.0027	0.0025
7	0.2626	0.5259	2704	0.0004	0.0008	0.0011	0.0014	0.0017	0.0018	0.0020	0.0024	0.0029	0.0025
8	0.2612	0.5275	2726	0.0003	0.0006	0.0009	0.0011	0.0013	0.0015	0.0017	0.0021	0.0025	0.0022
9	0.2616	0.5234	2736	0.0004	0.0008	0.0011	0.0014	0.0016	0.0017	0.0020	0.0023	0.0028	0.0025
10	0.2649	0.5273	2651	0.0004	0.0007	0.0009	0.0012	0.0016	0.0017	0.0019	0.0022	0.0027	0.0027
11	0.2622	0.5267	2710	0.0005	0.0008	0.0011	0.0014	0.0017	0.0019	0.0019	0.0022	0.0027	0.0028
12	0.2611	0.5259	2735	0.0005	0.0009	0.0010	0.0013	0.0016	0.0018	0.0019	0.0021	0.0026	0.0026
13	0.2617	0.5245	2729	0.0005	0.0008	0.0009	0.0013	0.0017	0.0019	0.0019	0.0021	0.0027	0.0027
14	0.2614	0.5263	2726	0.0004	0.0007	0.0008	0.0011	0.0014	0.0016	0.0019	0.0020	0.0024	0.0025
15	0.2614	0.5270	2724	0.0004	0.0007	0.0008	0.0011	0.0013	0.0016	0.0019	0.0020	0.0025	0.0027
16	0.2615	0.5261	2727	0.0004	0.0009	0.0010	0.0012	0.0015	0.0018	0.0019	0.0021	0.0026	0.0027
17	0.2619	0.5252	2722	0.0004	0.0008	0.0009	0.0011	0.0014	0.0017	0.0019	0.0021	0.0025	0.0027
18	0.2617	0.5266	2721	0.0006	0.0008	0.0010	0.0012	0.0015	0.0018	0.0020	0.0022	0.0027	0.0025
19	0.2634	0.5271	2682	0.0004	0.0007	0.0009	0.0011	0.0014	0.0017	0.0019	0.0020	0.0023	0.0027
20	0.2655	0.5281	2635	0.0004	0.0008	0.0011	0.0013	0.0016	0.0019	0.0019	0.0022	0.0024	0.0028
21	0.2614	0.5252	2731	0.0004	0.0005	0.0009	0.0011	0.0013	0.0017	0.0017	0.0020	0.0022	0.0025
22	0.2619	0.5244	2725	0.0004	0.0006	0.0010	0.0012	0.0015	0.0018	0.0019	0.0021	0.0024	0.0025
23	0.2619	0.5261	2719	0.0004	0.0005	0.0009	0.0011	0.0014	0.0017	0.0017	0.0020	0.0022	0.0025
24	0.2624	0.5260	2707	0.0004	0.0004	0.0009	0.0011	0.0013	0.0015	0.0016	0.0019	0.0021	0.0025
25	0.2615	0.5259	2726	0.0004	0.0004	0.0009	0.0011	0.0014	0.0016	0.0017	0.0020	0.0022	0.0025
Ave.	0.2620	0.5260	2717	0.0004	0.0007	0.0010	0.0012	0.0016	0.0018	0.0020	0.0022	0.0025	0.0025
Med.	0.2617	0.5260	2725	0.0004	0.0007	0.0010	0.0012	0.0015	0.0018	0.0019	0.0021	0.0025	0.0025
st dev	0.0011	0.0010	26	0.0001	0.0001	0.0001	0.0001	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
Min.	0.2606	0.5234	2635	0.0003	0.0004	0.0008	0.0011	0.0013	0.0015	0.0016	0.0019	0.0021	0.0020
Max.	0.2655	0.5281	2747	0.0006	0.0009	0.0013	0.0014	0.0023	0.0024	0.0024	0.0026	0.0029	0.0028



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

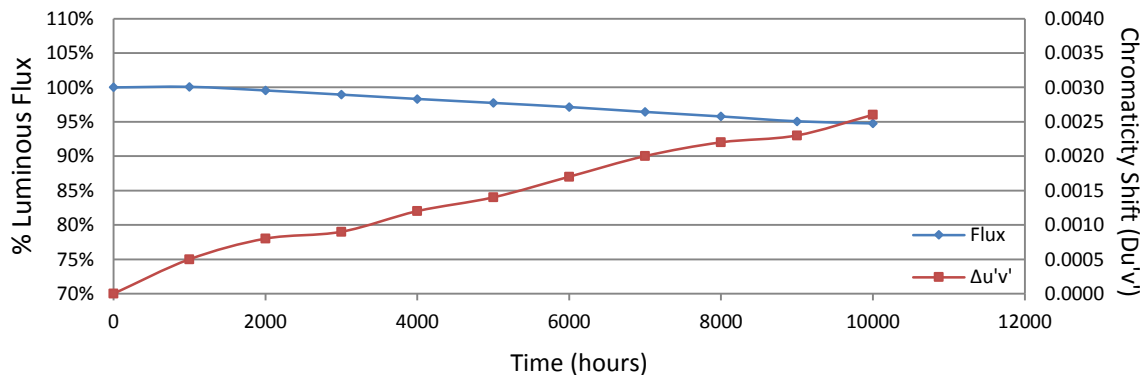
No.	V _F (V)	Φ(lm)	Lumen Maintenance (%)									
			Ohr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
26	3.164	66.01	100.23	99.68	99.21	98.61	98.02	97.45	96.71	96.09	95.27	94.97
27	3.211	64.19	100.31	99.92	99.38	98.82	98.24	97.60	96.90	96.21	95.51	95.19
28	3.277	66.49	100.29	99.77	99.26	98.66	98.45	97.91	97.34	96.54	95.83	95.16
29	3.216	66.18	100.17	99.65	99.12	98.53	97.98	97.34	96.60	96.52	95.65	95.35
30	3.270	66.24	100.03	99.46	98.94	98.35	97.87	97.15	96.45	96.00	95.37	94.99
31	3.235	66.25	100.09	99.55	99.00	98.40	97.87	97.16	96.48	95.73	95.58	95.37
32	3.250	64.60	100.14	99.67	99.16	98.54	97.96	97.15	96.49	95.91	95.20	94.91
33	3.200	65.32	100.14	99.80	99.20	98.55	98.06	97.34	96.62	95.87	95.18	95.16
34	3.304	63.49	100.19	99.81	99.17	98.58	98.14	97.40	96.69	96.00	95.32	95.20
35	3.212	65.48	100.18	99.66	99.08	98.52	98.09	97.27	96.66	95.85	95.17	95.16
36	3.281	65.60	100.11	99.65	99.10	98.48	97.80	97.32	96.55	95.90	95.23	94.79
37	3.210	64.45	100.29	99.72	99.10	98.51	97.78	97.27	96.52	95.84	95.07	94.82
38	3.187	66.27	99.89	99.25	98.67	97.95	97.37	96.86	96.11	95.47	94.66	94.48
39	3.440	65.62	100.49	99.80	99.33	98.66	98.03	97.52	96.80	96.19	95.35	95.02
40	3.219	65.14	99.98	99.60	98.83	98.23	97.62	97.04	96.35	95.72	94.89	94.69
41	3.244	65.19	100.11	99.66	98.94	98.40	97.67	97.13	96.41	95.74	94.94	94.40
42	3.229	63.97	100.00	99.50	98.84	98.26	97.48	96.76	96.03	95.34	94.75	94.58
43	3.278	64.69	99.98	99.47	98.79	97.99	97.48	96.99	96.24	95.58	94.79	94.62
44	3.204	66.84	100.00	99.36	98.67	98.00	97.38	96.89	96.15	95.48	94.63	94.49
45	3.365	63.93	100.19	99.64	98.97	98.34	97.70	97.00	96.45	95.82	95.06	94.48
46	3.178	65.70	99.92	99.42	98.69	98.04	97.38	96.86	96.10	95.54	94.63	94.49
47	3.213	65.39	99.89	99.27	98.65	97.97	97.35	96.80	96.07	95.34	94.74	94.30
48	3.305	66.60	99.94	99.32	98.71	98.02	97.40	96.89	96.16	95.33	94.73	94.43
49	3.207	67.24	100.06	99.41	98.77	98.05	97.44	96.92	96.22	95.40	94.74	94.20
50	3.224	64.96	99.68	98.86	98.20	97.52	96.94	96.37	95.69	94.83	94.20	93.46
Ave.	3.245	65.43	100.09	99.56	98.95	98.32	97.74	97.14	96.43	95.77	95.06	94.75
Med.	3.224	65.48	100.11	99.64	98.97	98.40	97.78	97.15	96.45	95.82	95.07	94.79
st dev	0.061	0.98	0.1691	0.2320	0.2710	0.3069	0.3527	0.3221	0.3392	0.3905	0.3872	0.4364
Min.	3.164	63.49	99.68	98.86	98.20	97.52	96.94	96.37	95.69	94.83	94.20	93.46
Max.	3.440	67.24	100.49	99.92	99.38	98.82	98.45	97.91	97.34	96.54	95.83	95.37

TM-21 Projection:

Test Duration: 10000 hours
Failures Observed: 0
α: 6.494E-06
β: 1.01
Calculated L₇₀: 56000 hours
Reported L₇₀: 56000 hours

3.4 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
26	0.2618	0.5243	2727	0.0005	0.0006	0.0009	0.0013	0.0015	0.0018	0.0021	0.0021	0.0024	0.0028
27	0.2634	0.5261	2686	0.0005	0.0006	0.0009	0.0012	0.0014	0.0018	0.0020	0.0021	0.0024	0.0026
28	0.2613	0.5259	2731	0.0005	0.0007	0.0008	0.0011	0.0014	0.0016	0.0019	0.0019	0.0021	0.0025
29	0.2614	0.5245	2736	0.0005	0.0008	0.0009	0.0012	0.0014	0.0017	0.0020	0.0021	0.0023	0.0026
30	0.2615	0.5264	2725	0.0005	0.0008	0.0009	0.0013	0.0015	0.0017	0.0020	0.0021	0.0024	0.0025
31	0.2613	0.5259	2731	0.0005	0.0007	0.0009	0.0011	0.0014	0.0017	0.0020	0.0021	0.0023	0.0027
32	0.2635	0.5277	2679	0.0005	0.0009	0.0010	0.0012	0.0015	0.0018	0.0021	0.0022	0.0024	0.0027
33	0.2621	0.5250	2717	0.0004	0.0006	0.0008	0.0011	0.0013	0.0016	0.0019	0.0021	0.0022	0.0024
34	0.2612	0.5255	2735	0.0004	0.0006	0.0008	0.0011	0.0013	0.0016	0.0018	0.0021	0.0022	0.0024
35	0.2624	0.5263	2707	0.0004	0.0008	0.0009	0.0012	0.0014	0.0018	0.0020	0.0022	0.0023	0.0026
36	0.2608	0.5257	2743	0.0003	0.0007	0.0008	0.0011	0.0014	0.0017	0.0020	0.0021	0.0023	0.0025
37	0.2615	0.5252	2731	0.0005	0.0008	0.0010	0.0012	0.0014	0.0017	0.0020	0.0021	0.0023	0.0026
38	0.2622	0.5263	2710	0.0003	0.0009	0.0009	0.0012	0.0014	0.0018	0.0021	0.0022	0.0023	0.0026
39	0.2618	0.5242	2727	0.0004	0.0006	0.0008	0.0011	0.0013	0.0016	0.0019	0.0021	0.0022	0.0024
40	0.2619	0.5263	2717	0.0004	0.0006	0.0008	0.0011	0.0013	0.0016	0.0019	0.0021	0.0022	0.0024
41	0.2614	0.5240	2736	0.0004	0.0007	0.0008	0.0011	0.0014	0.0017	0.0020	0.0021	0.0023	0.0026
42	0.2627	0.5260	2702	0.0004	0.0008	0.0009	0.0013	0.0015	0.0018	0.0021	0.0023	0.0023	0.0026
43	0.2627	0.5264	2700	0.0004	0.0008	0.0008	0.0012	0.0014	0.0017	0.0020	0.0021	0.0023	0.0025
44	0.2627	0.5270	2697	0.0004	0.0008	0.0009	0.0012	0.0015	0.0018	0.0021	0.0023	0.0024	0.0026
45	0.2614	0.5241	2736	0.0004	0.0007	0.0008	0.0011	0.0013	0.0016	0.0019	0.0021	0.0023	0.0026
46	0.2619	0.5271	2713	0.0005	0.0007	0.0009	0.0013	0.0015	0.0017	0.0021	0.0022	0.0023	0.0026
47	0.2634	0.5273	2682	0.0005	0.0009	0.0009	0.0013	0.0015	0.0017	0.0021	0.0023	0.0024	0.0027
48	0.2621	0.5265	2712	0.0004	0.0007	0.0008	0.0011	0.0014	0.0017	0.0020	0.0021	0.0023	0.0026
49	0.2613	0.5268	2728	0.0004	0.0008	0.0009	0.0012	0.0014	0.0017	0.0020	0.0021	0.0023	0.0026
50	0.2610	0.5236	2747	0.0008	0.0014	0.0016	0.0019	0.0021	0.0023	0.0027	0.0029	0.0030	0.0034
Ave.	0.2619	0.5258	2718	0.0005	0.0008	0.0009	0.0012	0.0014	0.0017	0.0020	0.0022	0.0023	0.0026
Med.	0.2618	0.5260	2725	0.0004	0.0007	0.0009	0.0012	0.0014	0.0017	0.0020	0.0021	0.0023	0.0026
st dev	0.0008	0.0011	19	0.0001	0.0002	0.0002	0.0002	0.0002	0.0001	0.0002	0.0002	0.0002	0.0002
Min.	0.2608	0.5236	2679	0.0003	0.0006	0.0008	0.0011	0.0013	0.0016	0.0018	0.0019	0.0021	0.0024
Max.	0.2635	0.5277	2747	0.0008	0.0014	0.0016	0.0019	0.0021	0.0023	0.0027	0.0029	0.0030	0.0034



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

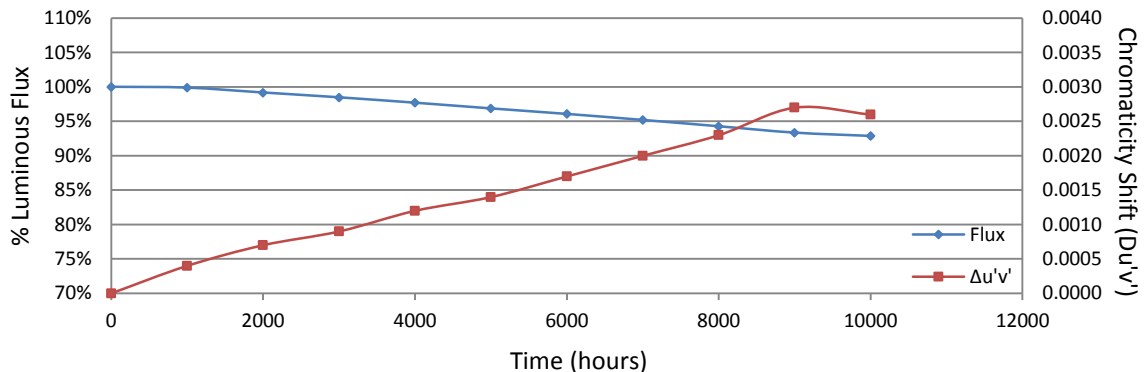
No.	V _F (V)	Φ(lm)	Lumen Maintenance (%)									
			0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
51	3.194	65.68	99.89	99.51	98.78	97.98	97.15	96.38	95.39	94.37	93.47	93.01
52	3.212	66.59	99.80	99.10	98.56	97.76	96.83	96.05	95.10	94.04	93.12	92.79
53	3.239	65.00	99.91	99.48	98.97	98.26	97.22	96.54	95.58	94.57	93.65	93.22
54	3.206	64.89	100.03	99.45	98.78	98.26	97.26	96.53	95.58	94.59	93.67	93.02
55	3.186	65.95	99.76	99.01	98.54	97.95	97.00	96.25	95.31	94.30	93.40	92.71
56	3.177	64.93	99.95	99.20	98.75	98.12	97.17	96.35	95.47	94.49	93.49	93.25
57	3.251	64.82	99.98	99.32	98.49	98.26	97.41	96.53	95.70	94.63	93.77	93.55
58	3.191	66.20	99.77	99.06	98.29	97.82	97.15	96.27	95.42	94.61	93.53	92.96
59	3.271	65.75	100.24	99.41	98.63	98.16	97.49	96.70	95.85	95.00	94.11	93.57
60	3.265	67.22	99.67	98.96	98.23	97.68	97.01	96.16	95.34	94.48	93.59	92.96
61	3.165	65.34	99.71	99.16	98.39	97.44	96.56	96.07	95.49	94.64	93.73	93.01
62	3.177	66.46	99.73	98.99	98.25	97.35	96.46	96.00	95.34	94.51	93.62	92.91
63	3.317	64.32	99.94	99.21	98.54	97.56	96.67	96.02	95.20	94.78	93.89	93.30
64	3.235	65.41	100.02	99.13	98.38	97.43	96.51	95.70	94.89	94.30	93.58	93.43
65	3.166	66.18	99.83	99.00	98.25	97.34	96.40	95.59	94.56	93.74	92.85	92.69
66	3.182	65.54	99.86	99.08	98.38	97.42	96.44	95.61	94.72	93.81	92.94	92.77
67	3.215	66.18	99.82	99.08	98.37	97.43	96.48	95.71	94.83	93.87	92.97	92.93
68	3.218	65.06	99.85	99.17	98.51	97.40	96.48	95.68	94.90	93.88	92.96	92.59
69	3.225	65.71	99.82	99.07	98.37	97.46	96.51	95.75	94.90	93.93	92.98	92.51
70	3.257	64.93	99.98	99.28	98.55	97.72	96.84	95.98	95.15	94.16	93.25	92.59
71	3.245	65.46	99.97	99.22	98.38	97.53	96.93	95.83	94.91	93.97	93.03	92.35
72	3.174	66.22	99.85	98.97	98.23	97.36	96.66	95.56	94.68	93.85	92.84	92.21
73	3.255	64.88	99.92	99.15	98.40	97.53	97.03	96.18	95.10	94.17	93.08	92.65
74	3.271	62.75	99.97	99.20	98.47	97.59	97.04	96.24	95.36	94.23	93.26	92.59
75	3.194	66.48	99.79	98.95	98.15	97.32	96.69	95.89	94.98	93.91	92.84	92.28
Ave.	3.220	65.52	99.88	99.17	98.47	97.69	96.86	96.06	95.19	94.27	93.35	92.87
Med.	3.215	65.54	99.86	99.15	98.40	97.56	96.84	96.05	95.20	94.30	93.40	92.91
st dev	0.040	0.90	0.1241	0.1638	0.2016	0.3237	0.3296	0.3331	0.3379	0.3485	0.3672	0.3729
Min.	3.165	62.75	99.67	98.95	98.15	97.32	96.40	95.56	94.56	93.74	92.84	92.21
Max.	3.317	67.22	100.24	99.51	98.97	98.26	97.49	96.70	95.85	95.00	94.11	93.57

TM-21 Projection:

Test Duration: 10000 hours
Failures Observed: 0
α: 8.734E-06
β: 1.01
Calculated L₇₀: 42000 hours
Reported L₇₀: 42000 hours

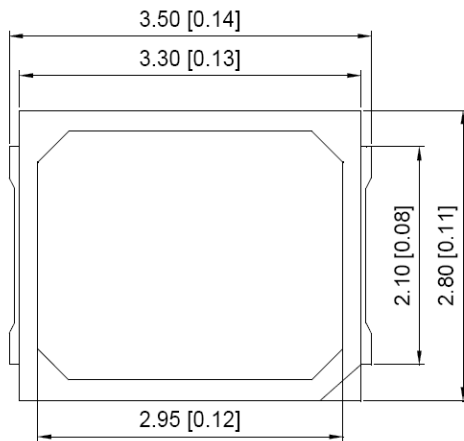
3.6 Data Set 3, 105 °C, 150mA (Chromaticity Shift)

No.	u'	v'	CCT(K)	Chromaticity Shift ($\Delta u'v'$)									
				0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
51	0.2612	0.5240	2742	0.0005	0.0008	0.0009	0.0012	0.0014	0.0017	0.0021	0.0023	0.0027	0.0027
52	0.2629	0.5260	2697	0.0004	0.0008	0.0008	0.0011	0.0012	0.0017	0.0020	0.0023	0.0025	0.0025
53	0.2629	0.5270	2693	0.0003	0.0008	0.0009	0.0012	0.0014	0.0017	0.0021	0.0023	0.0026	0.0026
54	0.2618	0.5262	2718	0.0003	0.0007	0.0009	0.0011	0.0014	0.0017	0.0020	0.0023	0.0026	0.0026
55	0.2621	0.5249	2718	0.0004	0.0008	0.0010	0.0013	0.0014	0.0019	0.0021	0.0025	0.0028	0.0027
56	0.2613	0.5254	2734	0.0004	0.0008	0.0009	0.0012	0.0014	0.0017	0.0021	0.0024	0.0027	0.0027
57	0.2625	0.5262	2705	0.0003	0.0008	0.0009	0.0012	0.0014	0.0017	0.0020	0.0023	0.0026	0.0025
58	0.2624	0.5255	2709	0.0004	0.0007	0.0009	0.0012	0.0014	0.0017	0.0021	0.0023	0.0028	0.0027
59	0.2618	0.5255	2722	0.0002	0.0006	0.0009	0.0011	0.0013	0.0017	0.0019	0.0022	0.0026	0.0024
60	0.2643	0.5269	2665	0.0001	0.0007	0.0009	0.0012	0.0014	0.0017	0.0020	0.0023	0.0027	0.0026
61	0.2628	0.5258	2700	0.0002	0.0007	0.0008	0.0011	0.0014	0.0017	0.0020	0.0023	0.0026	0.0026
62	0.2627	0.5267	2698	0.0004	0.0006	0.0008	0.0012	0.0014	0.0017	0.0020	0.0023	0.0026	0.0026
63	0.2617	0.5267	2719	0.0003	0.0006	0.0008	0.0011	0.0013	0.0017	0.0020	0.0022	0.0026	0.0024
64	0.2613	0.5239	2740	0.0004	0.0006	0.0008	0.0011	0.0014	0.0016	0.0020	0.0023	0.0028	0.0026
65	0.2617	0.5243	2729	0.0004	0.0007	0.0009	0.0012	0.0014	0.0017	0.0020	0.0023	0.0026	0.0026
66	0.2622	0.5257	2713	0.0004	0.0006	0.0009	0.0012	0.0013	0.0017	0.0019	0.0023	0.0027	0.0026
67	0.2612	0.5262	2731	0.0003	0.0005	0.0007	0.0011	0.0012	0.0016	0.0019	0.0022	0.0026	0.0025
68	0.2617	0.5248	2728	0.0004	0.0007	0.0009	0.0012	0.0014	0.0017	0.0020	0.0023	0.0028	0.0026
69	0.2623	0.5254	2711	0.0003	0.0005	0.0008	0.0011	0.0013	0.0016	0.0019	0.0022	0.0026	0.0025
70	0.2614	0.5254	2731	0.0004	0.0006	0.0008	0.0011	0.0014	0.0016	0.0019	0.0022	0.0026	0.0025
71	0.2618	0.5265	2718	0.0005	0.0008	0.0009	0.0013	0.0014	0.0018	0.0020	0.0024	0.0027	0.0027
72	0.2623	0.5264	2707	0.0004	0.0006	0.0009	0.0012	0.0014	0.0017	0.0020	0.0022	0.0026	0.0026
73	0.2619	0.5244	2724	0.0004	0.0007	0.0008	0.0011	0.0013	0.0016	0.0019	0.0023	0.0026	0.0025
74	0.2624	0.5258	2709	0.0003	0.0006	0.0007	0.0011	0.0013	0.0016	0.0019	0.0021	0.0026	0.0024
75	0.2613	0.5251	2735	0.0005	0.0008	0.0009	0.0013	0.0014	0.0017	0.0020	0.0024	0.0027	0.0026
Ave.	0.2621	0.5256	2716	0.0004	0.0007	0.0009	0.0012	0.0014	0.0017	0.0020	0.0023	0.0027	0.0026
Med.	0.2619	0.5257	2718	0.0004	0.0007	0.0009	0.0012	0.0014	0.0017	0.0020	0.0023	0.0026	0.0026
st dev	0.0007	0.0009	17	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Min.	0.2612	0.5239	2665	0.0001	0.0005	0.0007	0.0011	0.0012	0.0016	0.0019	0.0021	0.0025	0.0024
Max.	0.2643	0.5270	2742	0.0005	0.0008	0.0010	0.0013	0.0014	0.0019	0.0021	0.0025	0.0028	0.0027



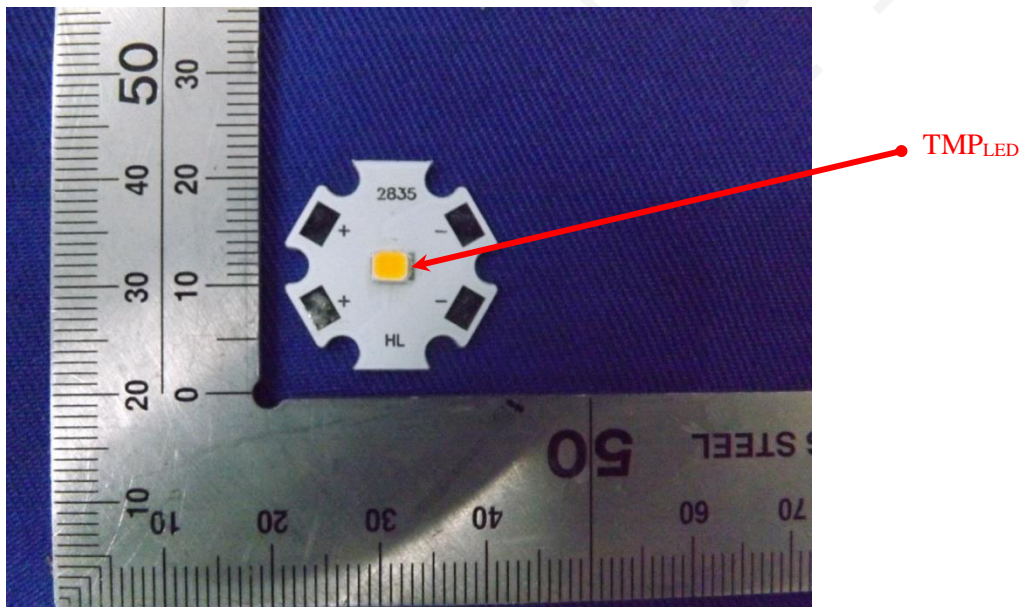
Attachment A – EUT PHOTO

A.1 Mechanical Dimensions (Ta = 25 °C)



All dimensions are in millimeter

A.2 EUT Photo



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