



IESNA LM-80-08

MEASURING LUMEN MAINTENANCE OF LED LIGHT SOURCES

MEASUREMENT AND TEST REPORT For

Hongli Zhihui Group Co.,Ltd.

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

Model: HL-A-2835HW-S1-08-HR3

Report Type: 9000 Hours Test Report	Product Type: LED Package
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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:	HL-A-2835HW-S1-08-HR3
Part Type:	LED Package
Nominal CCT:	2700K
Power:	0.2W
Current Density per LED die:	372mA/mm ²
Power Density per LED die:	1.24W/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:

Differences Items	Testing Products	Multiple Models	Details
Model Name	HL-A-2835HW-S1-08-HR3	HL-A-2835HW-S1-08-HR3(R9)	Only different Model name for different market
		HL-A-PU2835HW-S1-08-HR3	
		HL-A-PU2835HW-S1-08-HR3(R9)	
		HL-A-2835HW-S1-08-PCT-HR3	
		HL-A-2835HW-S1-08-PCT-HR3(R9)	
		HL-A-PU2835HW-S1-08-PCT-HR3	
		HL-A-PU2835HW-S1-08-PCT-HR3(R9)	
		HL-AS-2835HW-S1-08-PCT-HR3	
		HL-AS-2835HW-S1-08-PCT-HR3(R9)	
		HL-AS-PU2835HW-S1-08-PCT-HR3	
		HL-AS-PU2835HW-S1-08-PCT-HR3(R9)	
		HL-A-2835HW-S1-08L-HR3	
		HL-A-2835HW-S1-08HL-HR3	

Differences Items	Testing Products	Multiple Models	Details
		HL-A-2835HW-S1-08L-HR3(R9)	
		HL-A-2835HW-S1-08HL-HR3(R9)	
		HL-A-PU2835HW-S1-08L-HR3	
		HL-A-PU2835HW-S1-08HL-HR3	
		HL-A-PU2835HW-S1-08L-HR3(R9)	
		HL-A-PU2835HW-S1-08HL-HR3(R9)	
		HL-A-2835HW-S1-08L-PCT-HR3	
		HL-A-2835HW-S1-08L-PCT-HR3(R9)	
		HL-A-PU2835HW-S1-08L-PCT-HR3	
		HL-A-PU2835HW-S1-08L-PCT-HR3(R9)	
		HL-AS-2835HW-S1-08L-PCT-HR3	
		HL-AS-2835HW-S1-08L-PCT-HR3(R9)	
		HL-AS-PU2835HW-S1-08L-PCT-HR3	
		HL-AS-PU2835HW-S1-08L-PCT-HR3(R9)	
		SL-*B2835FAB-11CAH	
		SL-*B2835FTA-11CAH	
		SL-*B2835FAA-11CAH	
		SL-*B2835FAB-11CAHH	
		SL-*B2835FAA-11CAHH	
		SL-*B2835FAB-11CAF	
		SL-*B2835FTA-11CAF	
		SL-*B2835FAA-11CAF	
		SL-*B2835FAB-11CAFH	
		SL-*B2835FAA-11CAFH	
		SL-*B2835FAA-11CAE	
		SL-*B2835FTA-11CAE	
		SL-*B2835FAB-11CAE	

Only different Model name for different market

*is a letter I, N, W which stand for CCT: I means Below 3700K; N means 3700-4700K; W means More than 4700K

Differences Items	Testing Products	Multiple Models	Details
		SL-*B2835FAA-11CAEH	
		SL-*B2835FAB-11CAEH	
		SL-*B2835FTA-11CAG	
		SL-*B2835FAB-11CAG	
		SL-*B2835FTA-11CAGH	
		SL-*B2835FTA-11CAI	
		SL-*B2835FAB-11CAI	

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 (This standard was not accredited by IAS)
- 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	2015-03-04	2016-03-04
Programmable Test Power for LEDs	EVERFINE	LED300E	1008002	2015-03-12	2016-03-12
High accuracy array spectroradiometer	EVERFINE	HAAS-2000	1012016T	2014-12-26	2015-12-26
Standard Light Source	EVERFINE	D062	1011093	2015-05-06	2016-05-06
Precision digital stabilized DC power supply	EVERFINE	WY605	G115987CJ7321114	2015-03-12	2016-03-12
Multilayer aging machine	BACL	B2-270	20022	2014-08-11	2015-08-11

Device	Manufacture	Model No	Serial No	Calibration date	Calibration due date
Digital CC&CV DC Power Supply	EVERFINE	WY5015	11090003	2015-03-12	2016-03-12
Digital CC&CV DC Power Supply	EVERFINE	WY5015	11090006	2015-03-12	2016-03-12
Digital CC&CV DC Power Supply	EVERFINE	WY5015	11090007	2015-03-12	2016-03-12

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 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. 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.

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 2014-02-17 and tested during 2014-02-20 to 2015-05-30 The samples were numbered from 1 to 25, 26 to 50 and 51 to 75

Data Set 1: 55 °C, 60mA

Part Number:	HL-A-2835HW-S1-08-HR3
Number of Units:	25
Actual Case Temperature(T _S):	T _S =54.1 °C
Actual Ambient Temperature(T _A):	T _A =51.9 °C
Life Test Drive Current:	I _F = 60mA
Measurement Current:	I _F = 60mA

Data Set 2: 85 °C,60mA

Part Number:	HL-A-2835HW-S1-08-HR3
Number of Units:	25
Actual Case Temperature(T _S):	T _S =84.3 °C
Actual Ambient Temperature(T _A):	T _A =82.7 °C
Life Test Drive Current:	I _F =60mA
Measurement Current:	I _F = 60mA

Data Set 3: 105 °C, 60mA

Part Number:	HL-A-2835HW-S1-08-HR3
Number of Units:	25
Actual Case Temperature(T _S):	T _S =104.2 °C
Actual Ambient Temperature(T _A):	T _A =103.4 °C
Life Test Drive Current:	I _F = 60mA
Measurement Current:	I _F = 60mA

2 - SUMMARY OF TEST RESULT

Data Set:	Data Set 1, 55 °C, 60mA
Number of Units:	25
Failures Observed:	0
Test Interval and Test Duration:	0h,1000h,2000h,3000h,4000h,5000h,6000h, 7000h,8000h,9000h
Average. Lumen Maintenance at 6000 hours:	97.47%
Average Chromaticity Shift at 6000 hours ($\Delta u'v'$):	0.0017
Average. Lumen Maintenance at 9000 hours:	95.72%
Average Chromaticity Shift at 9000 hours ($\Delta u'v'$):	0.0029
Reported TM-21 L ₇₀ Lifetime:	>54,000 hours

Data Set:	Data Set 2, 85 °C, 60mA
Number of Units:	25
Failures Observed:	0
Test Interval and Test Duration:	0h,1000h,2000h,3000h,4000h,5000h,6000h, 7000h,8000h,9000h
Average. Lumen Maintenance at 6000 hours:	96.90%
Average Chromaticity Shift at 6000 hours($\Delta u'v'$):	0.0022
Average. Lumen Maintenance at 9000 hours:	95.06%
Average Chromaticity Shift at 9000 hours ($\Delta u'v'$):	0.0035
Reported TM-21 L ₇₀ Lifetime:	>54,000 hours

Data Set:	Data Set 3, 105 °C, 60mA
Number of Units:	25
Failures Observed:	0
Test Interval and Test Duration:	0h,1000h,2000h,3000h,4000h,5000h,6000h, 7000h,8000h,9000h
Average. Lumen Maintenance at 6000 hours:	96.39%
Average Chromaticity Shift at 6000 hours($\Delta u'v'$):	0.0027
Average. Lumen Maintenance at 9000 hours:	94.32%
Average Chromaticity Shift at 9000 hours ($\Delta u'v'$):	0.0039
Reported TM-21 L ₇₀ Lifetime:	53,000 hours

3 - Test Data

3.1 Data Set 1, 55 °C, 60mA (Lumen Maintenance)

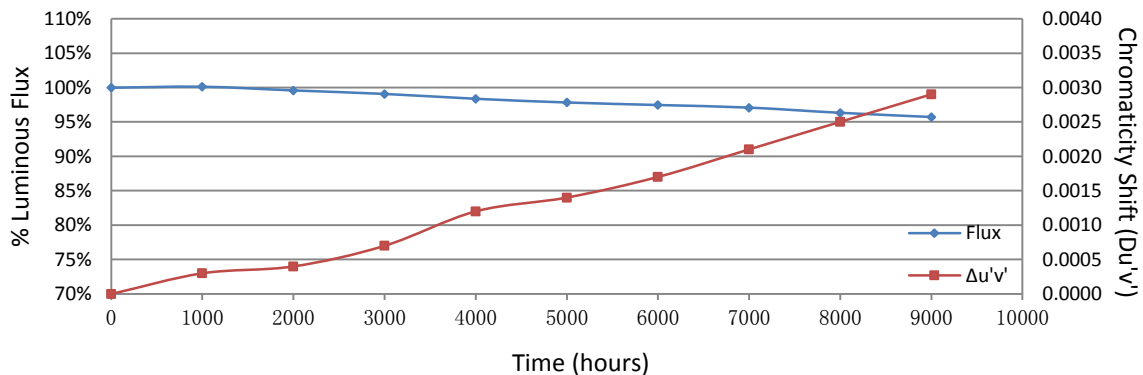
No.	V _F (V)	Φ(lm)	Lumen Maintenance (%)								
			0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000h	8000h
1	2.808	23.10	100.30	99.52	99.18	98.53	98.10	97.62	97.19	96.93	96.36
2	2.806	23.48	100.21	99.62	99.11	98.55	97.83	97.40	97.02	96.59	96.04
3	2.804	23.15	100.22	99.61	99.05	98.36	97.80	97.41	97.06	96.11	95.46
4	2.806	23.51	100.17	99.53	98.98	98.30	98.09	97.70	97.58	97.24	96.77
5	2.807	23.81	100.00	99.71	99.12	98.45	97.82	97.65	97.48	96.47	95.67
6	2.803	23.18	100.17	99.78	99.27	98.66	98.14	97.84	97.50	96.42	95.86
7	2.804	23.42	100.04	99.70	99.23	98.59	98.25	97.69	97.05	96.16	95.69
8	2.806	23.12	99.96	99.44	99.01	98.31	97.75	97.32	97.06	96.80	96.24
9	2.800	23.33	100.43	99.57	98.93	98.41	97.47	97.09	96.61	96.19	95.41
10	2.808	23.31	100.00	99.66	98.88	97.94	97.81	97.51	96.95	95.84	95.24
11	2.808	23.03	100.43	99.78	99.26	98.61	97.83	97.70	97.52	97.13	96.44
12	2.809	23.08	100.52	99.83	99.22	98.22	97.57	97.10	96.92	95.10	94.32
13	2.806	23.20	100.30	99.74	99.31	98.49	97.80	97.24	96.34	96.25	95.73
14	2.806	23.21	100.13	99.61	99.14	98.62	97.76	97.63	97.37	96.04	95.17
15	2.805	23.62	100.76	100.17	99.36	98.52	97.63	97.21	96.74	95.39	94.79
16	2.801	23.27	99.79	99.18	98.28	97.59	97.46	97.12	96.52	95.83	95.23
17	2.809	23.44	100.04	99.45	99.23	98.72	98.12	97.82	97.65	96.93	96.37
18	2.809	23.60	100.04	99.49	99.03	98.22	97.88	97.42	97.20	96.40	95.81
19	2.805	23.06	100.17	99.74	99.31	98.44	98.14	97.79	97.57	96.79	96.40
20	2.804	23.64	100.00	99.41	98.86	98.14	97.55	97.08	96.57	95.85	95.26
21	2.806	22.93	100.22	99.52	99.08	98.39	97.82	97.43	96.90	96.08	95.20
22	2.802	22.63	99.78	99.51	99.03	98.19	97.39	97.08	96.73	96.20	95.71
23	2.807	23.33	100.04	99.70	99.40	98.54	97.94	97.56	97.26	96.53	95.93
24	2.804	23.09	99.83	99.22	98.70	98.35	97.96	97.53	97.18	96.41	95.76
25	2.805	23.36	100.04	99.44	99.19	98.37	98.12	97.73	97.22	96.58	96.15
Ave.	2.806	23.28	100.14	99.60	99.09	98.38	97.84	97.47	97.09	96.33	95.72
Med.	2.806	23.27	100.13	99.61	99.12	98.41	97.82	97.51	97.06	96.40	95.73
st dev	0.0024	0.2587	0.2299	0.2024	0.2382	0.2448	0.2377	0.2542	0.3638	0.5084	0.5686
Min.	2.800	22.63	99.78	99.18	98.28	97.59	97.39	97.08	96.34	95.10	94.32
Max.	2.809	23.81	100.76	100.17	99.40	98.72	98.25	97.84	97.65	97.24	96.77

TM-21 Projection:

Test Duration: 9000 hours
Failures Observed: 0
 α : 5.361E-06
 β : 1.006
Reported L₇₀: >54,000hours

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

No.	u'	v'	CCT(K)	Chromaticity Shift ($\Delta u'v'$)								
				0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000h	8000h
1	0.2645	0.5254	2666	0.0001	0.0005	0.0007	0.0012	0.0015	0.0017	0.0021	0.0025	0.0028
2	0.2636	0.5261	2683	0.0003	0.0004	0.0005	0.0010	0.0016	0.0018	0.0021	0.0027	0.0032
3	0.2640	0.5244	2681	0.0002	0.0004	0.0004	0.0010	0.0014	0.0017	0.0022	0.0026	0.0032
4	0.2648	0.5252	2660	0.0003	0.0004	0.0005	0.0010	0.0015	0.0017	0.0021	0.0026	0.0030
5	0.2637	0.5247	2686	0.0003	0.0005	0.0004	0.0007	0.0017	0.0019	0.0023	0.0028	0.0033
6	0.2643	0.5245	2673	0.0003	0.0004	0.0006	0.0009	0.0013	0.0016	0.0020	0.0024	0.0027
7	0.2656	0.5261	2641	0.0004	0.0003	0.0007	0.0010	0.0014	0.0017	0.0021	0.0026	0.0030
8	0.2643	0.5270	2665	0.0003	0.0004	0.0008	0.0011	0.0014	0.0017	0.0020	0.0024	0.0027
9	0.2657	0.5265	2638	0.0002	0.0003	0.0009	0.0011	0.0013	0.0016	0.0019	0.0025	0.0029
10	0.2651	0.5273	2647	0.0002	0.0003	0.0009	0.0014	0.0014	0.0017	0.0020	0.0024	0.0028
11	0.2634	0.5249	2690	0.0004	0.0001	0.0006	0.0013	0.0014	0.0016	0.0021	0.0026	0.0029
12	0.2647	0.5257	2662	0.0002	0.0004	0.0007	0.0013	0.0010	0.0013	0.0016	0.0021	0.0024
13	0.2652	0.5256	2652	0.0002	0.0003	0.0007	0.0014	0.0014	0.0017	0.0020	0.0024	0.0027
14	0.2642	0.5254	2672	0.0003	0.0001	0.0006	0.0014	0.0012	0.0015	0.0019	0.0024	0.0027
15	0.2651	0.5273	2647	0.0004	0.0006	0.0003	0.0010	0.0021	0.0025	0.0028	0.0032	0.0036
16	0.2646	0.5256	2663	0.0002	0.0004	0.0007	0.0014	0.0013	0.0016	0.0019	0.0023	0.0026
17	0.2637	0.5249	2684	0.0002	0.0004	0.0006	0.0013	0.0013	0.0016	0.0021	0.0026	0.0029
18	0.2644	0.5271	2662	0.0003	0.0004	0.0006	0.0013	0.0013	0.0015	0.0018	0.0023	0.0026
19	0.2624	0.5227	2721	0.0002	0.0002	0.0008	0.0014	0.0016	0.0019	0.0021	0.0026	0.0028
20	0.2647	0.5260	2660	0.0001	0.0005	0.0009	0.0016	0.0013	0.0017	0.0021	0.0025	0.0029
21	0.2633	0.5249	2694	0.0002	0.0004	0.0009	0.0015	0.0014	0.0016	0.0020	0.0022	0.0026
22	0.2651	0.5261	2652	0.0002	0.0004	0.0007	0.0014	0.0015	0.0019	0.0022	0.0026	0.0030
23	0.2654	0.5265	2645	0.0002	0.0004	0.0006	0.0013	0.0016	0.0019	0.0022	0.0027	0.0031
24	0.2625	0.5237	2715	0.0002	0.0004	0.0006	0.0013	0.0014	0.0018	0.0021	0.0026	0.0032
25	0.2651	0.5249	2656	0.0002	0.0004	0.0007	0.0014	0.0015	0.0019	0.0022	0.0027	0.0031
Ave.	0.2644	0.5255	2669	0.0003	0.0004	0.0007	0.0012	0.0014	0.0017	0.0021	0.0025	0.0029
Med.	0.2645	0.5256	2663	0.0002	0.0004	0.0007	0.0013	0.0014	0.0017	0.0021	0.0026	0.0029
st dev	0.0009	0.0011	21.5232	0.0001	0.0001	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0003
Min.	0.2624	0.5227	2638	0.0001	0.0001	0.0003	0.0007	0.0010	0.0013	0.0016	0.0021	0.0024
Max.	0.2657	0.5273	2721	0.0004	0.0006	0.0009	0.0016	0.0021	0.0025	0.0028	0.0032	0.0036



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

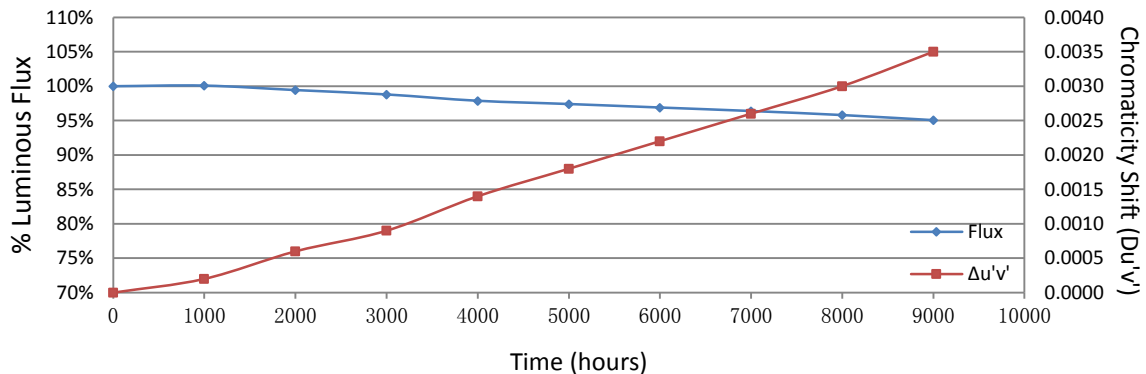
No.	V _F (V)	Φ(lm)	Lumen Maintenance (%)								
			0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000h	8000h
26	2.803	23.25	99.96	99.40	98.71	97.81	97.20	96.86	96.43	96.04	95.31
27	2.806	23.59	100.59	99.92	99.15	98.22	97.92	97.50	97.16	96.44	95.63
28	2.807	23.56	100.47	99.79	98.73	97.88	97.16	96.48	95.76	95.33	95.16
29	2.807	23.51	99.96	99.28	98.26	97.53	97.15	96.72	96.47	96.04	95.24
30	2.801	23.20	100.52	99.66	98.79	98.02	97.46	97.07	96.38	95.95	95.22
31	2.807	23.26	99.83	99.27	98.32	97.38	97.08	96.69	96.17	95.83	95.06
32	2.805	23.12	100.04	99.18	98.36	97.58	97.28	96.76	96.41	95.85	95.29
33	2.806	23.69	100.34	99.66	98.90	98.10	97.55	97.13	96.71	96.16	95.31
34	2.805	23.39	100.13	99.32	98.33	97.35	97.22	96.71	96.28	95.81	95.04
35	2.808	22.61	99.91	99.34	98.85	97.74	97.35	96.90	96.51	95.62	94.78
36	2.806	22.93	99.91	99.22	98.82	97.65	97.30	96.77	96.12	95.64	94.81
37	2.803	23.38	100.09	99.44	98.97	98.12	97.26	96.71	96.41	95.77	95.30
38	2.809	23.35	99.91	99.49	98.97	97.94	97.43	96.75	96.27	95.72	94.95
39	2.803	23.03	99.96	99.52	98.87	98.18	97.48	97.09	96.22	95.53	94.83
40	2.801	22.91	100.39	99.74	99.26	98.17	97.95	97.47	96.73	96.25	95.42
41	2.804	23.11	100.30	99.74	99.18	98.18	97.62	97.14	96.62	96.11	95.28
42	2.807	23.31	100.17	99.79	99.31	98.41	97.68	97.25	96.95	96.53	95.62
43	2.807	23.33	99.87	99.40	98.93	98.07	97.21	96.70	96.14	95.63	94.90
44	2.808	23.13	99.96	99.65	99.22	98.14	97.62	97.02	96.28	95.50	94.77
45	2.806	23.31	100.34	99.66	99.06	98.46	98.24	97.73	97.30	96.53	95.84
46	2.806	23.55	100.08	99.19	98.34	97.75	97.24	96.52	95.84	95.24	94.39
47	2.804	23.81	99.79	98.91	98.49	97.52	97.14	96.60	96.39	95.17	94.41
48	2.807	23.65	99.92	99.11	98.86	97.76	97.08	96.58	95.98	95.35	94.12
49	2.810	23.20	99.91	99.09	98.62	97.41	97.16	96.55	96.12	95.69	94.96
50	2.806	23.45	99.96	99.19	98.76	97.57	97.36	96.80	96.20	95.35	94.97
Ave.	2.806	23.31	100.09	99.44	98.80	97.88	97.41	96.90	96.39	95.80	95.06
Med.	2.806	23.31	99.96	99.40	98.85	97.88	97.30	96.77	96.38	95.77	95.06
st dev	0.0023	0.2733	0.2328	0.2646	0.3144	0.3242	0.2976	0.3282	0.3680	0.3886	0.3981
Min.	2.801	22.61	99.79	98.91	98.26	97.35	97.08	96.48	95.76	95.17	94.12
Max.	2.810	23.81	100.59	99.92	99.31	98.46	98.24	97.73	97.30	96.53	95.84

TM-21 Projection:

Test Duration: 9000 hours
Failures Observed: 0
α: 5.756E-06
β: 1.002
Reported L₇₀: >54,000hours

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

No.	u'	v'	CCT(K)	Chromaticity Shift ($\Delta u'v'$)								
	0hr(Initial)			1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000h	8000h	9000h
26	0.2654	0.5262	2646	0.0001	0.0004	0.0007	0.0013	0.0019	0.0023	0.0026	0.0031	0.0034
27	0.2655	0.5264	2642	0.0001	0.0003	0.0006	0.0014	0.0021	0.0025	0.0028	0.0034	0.0038
28	0.2647	0.5258	2661	0.0004	0.0007	0.0008	0.0014	0.0014	0.0018	0.0023	0.0026	0.0030
29	0.2630	0.5244	2702	0.0002	0.0006	0.0010	0.0015	0.0018	0.0021	0.0025	0.0027	0.0032
30	0.2632	0.5242	2699	0.0003	0.0005	0.0011	0.0014	0.0018	0.0021	0.0026	0.0031	0.0036
31	0.2622	0.5231	2724	0.0003	0.0005	0.0008	0.0013	0.0019	0.0022	0.0027	0.0031	0.0036
32	0.2652	0.5270	2646	0.0004	0.0006	0.0009	0.0014	0.0017	0.0022	0.0026	0.0031	0.0034
33	0.2660	0.5256	2635	0.0002	0.0007	0.0009	0.0014	0.0019	0.0023	0.0026	0.0030	0.0036
34	0.2666	0.5259	2623	0.0001	0.0004	0.0009	0.0016	0.0018	0.0023	0.0027	0.0031	0.0037
35	0.2653	0.5251	2651	0.0001	0.0007	0.0012	0.0021	0.0013	0.0016	0.0021	0.0025	0.0029
36	0.2631	0.5255	2694	0.0001	0.0006	0.0010	0.0017	0.0018	0.0021	0.0025	0.0029	0.0033
37	0.2660	0.5257	2634	0.0001	0.0007	0.0009	0.0017	0.0018	0.0023	0.0027	0.0029	0.0032
38	0.2639	0.5263	2676	0.0002	0.0005	0.0008	0.0017	0.0017	0.0021	0.0025	0.0031	0.0036
39	0.2651	0.5262	2652	0.0001	0.0005	0.0008	0.0016	0.0016	0.0019	0.0024	0.0029	0.0034
40	0.2649	0.5256	2657	0.0001	0.0007	0.0009	0.0016	0.0014	0.0019	0.0021	0.0027	0.0032
41	0.2653	0.5259	2647	0.0003	0.0006	0.0010	0.0014	0.0017	0.0022	0.0025	0.0029	0.0033
42	0.2631	0.5257	2695	0.0003	0.0004	0.0009	0.0014	0.0018	0.0023	0.0026	0.0029	0.0034
43	0.2644	0.5255	2668	0.0001	0.0007	0.0009	0.0011	0.0018	0.0023	0.0028	0.0031	0.0036
44	0.2641	0.5258	2674	0.0001	0.0006	0.0010	0.0014	0.0017	0.0021	0.0025	0.0030	0.0035
45	0.2633	0.5245	2696	0.0001	0.0006	0.0009	0.0014	0.0017	0.0021	0.0026	0.0029	0.0033
46	0.2655	0.5264	2643	0.0002	0.0006	0.0008	0.0014	0.0017	0.0023	0.0029	0.0033	0.0037
47	0.2646	0.5258	2663	0.0001	0.0008	0.0009	0.0013	0.0019	0.0024	0.0029	0.0033	0.0036
48	0.2643	0.5257	2669	0.0001	0.0006	0.0009	0.0013	0.0018	0.0024	0.0028	0.0032	0.0038
49	0.2655	0.5275	2637	0.0002	0.0006	0.0008	0.0012	0.0018	0.0023	0.0027	0.0030	0.0033
50	0.2620	0.5234	2728	0.0002	0.0005	0.0007	0.0013	0.0019	0.0024	0.0030	0.0033	0.0037
Ave.	0.2645	0.5256	2666	0.0002	0.0006	0.0009	0.0014	0.0018	0.0022	0.0026	0.0030	0.0035
Med.	0.2647	0.5257	2661	0.0001	0.0006	0.0009	0.0014	0.0018	0.0022	0.0026	0.0030	0.0034
st dev	0.0012	0.0010	28.6983	0.0001	0.0001	0.0001	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
Min.	0.2620	0.5231	2623	0.0001	0.0003	0.0006	0.0011	0.0013	0.0016	0.0021	0.0025	0.0029
Max.	0.2666	0.5275	2728	0.0004	0.0008	0.0012	0.0021	0.0021	0.0025	0.0030	0.0034	0.0038



3.5 Data Set 3, 105 °C, 60mA (Lumen Maintenance)

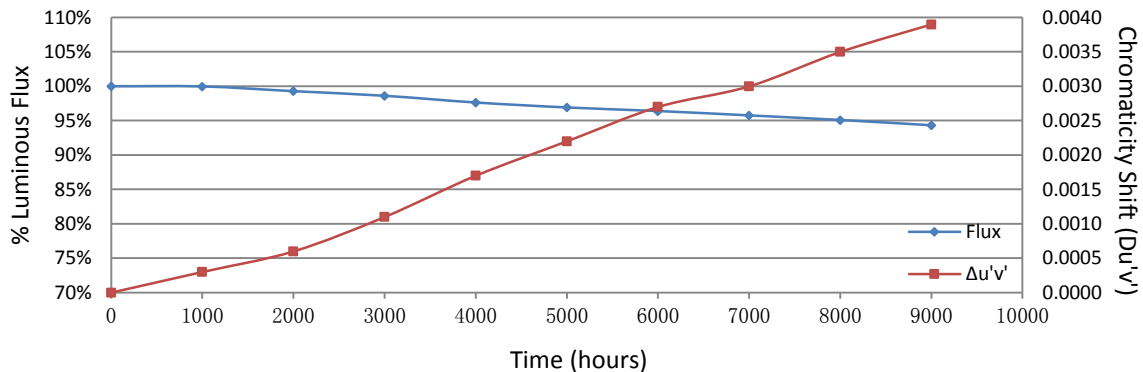
No.	V _F (V)	Φ(lm)	Lumen Maintenance (%)								
			0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000h	8000h
51	2.809	23.71	99.92	99.37	98.52	97.64	96.96	96.54	96.04	95.44	94.56
52	2.804	23.42	100.00	99.40	98.68	97.52	97.10	96.58	95.86	95.22	94.41
53	2.808	22.98	99.91	99.52	98.74	97.74	97.08	96.52	96.17	95.21	94.13
54	2.803	23.24	99.78	99.18	98.32	97.16	96.90	96.34	95.61	94.75	93.98
55	2.803	23.40	99.66	99.06	98.25	97.18	96.75	96.37	96.11	95.38	94.44
56	2.804	22.86	99.65	98.99	98.12	97.24	96.81	96.33	95.63	94.84	93.88
57	2.805	23.50	100.04	99.40	98.43	97.57	97.11	96.77	96.26	95.53	94.72
58	2.808	22.99	99.83	99.43	98.26	97.39	96.65	95.95	95.48	95.04	93.91
59	2.806	23.24	100.43	99.96	98.92	98.06	97.81	97.38	96.73	96.34	95.57
60	2.807	23.59	100.25	99.66	98.52	97.54	97.16	96.57	95.89	95.17	94.32
61	2.800	23.43	99.87	99.53	98.42	97.48	96.54	96.07	95.31	94.54	93.81
62	2.807	22.72	99.96	99.52	98.33	97.40	96.43	96.08	95.42	94.76	94.01
63	2.808	22.62	100.09	99.29	98.50	97.30	96.77	96.15	95.53	94.83	94.08
64	2.808	23.17	100.13	99.48	98.96	98.14	97.15	96.46	95.68	95.17	94.56
65	2.810	23.12	99.83	99.13	98.88	97.88	97.06	96.24	95.46	94.81	94.38
66	2.810	23.38	99.74	99.10	99.06	97.95	96.79	96.41	95.68	94.82	94.23
67	2.803	23.01	99.91	99.48	99.09	98.09	97.26	96.78	95.91	95.18	94.65
68	2.805	23.21	99.91	99.31	98.88	97.63	96.77	96.34	95.73	95.30	94.57
69	2.804	23.46	99.87	99.23	98.85	97.74	96.80	96.21	95.65	95.14	94.42
70	2.806	23.63	100.04	99.15	98.73	97.84	96.70	96.19	95.68	95.01	94.03
71	2.809	23.42	100.04	99.19	98.68	97.82	96.75	95.94	95.35	94.75	94.06
72	2.809	23.34	100.21	98.71	98.67	97.81	96.92	96.36	95.54	95.16	94.52
73	2.804	22.91	100.13	98.91	98.65	97.42	96.90	96.51	95.81	95.29	94.67
74	2.807	23.40	99.96	98.93	98.42	97.56	96.92	96.54	95.81	94.83	93.93
75	2.805	23.59	100.08	99.07	98.43	97.54	96.61	96.06	95.55	94.74	94.07
Ave.	2.806	23.25	99.97	99.28	98.61	97.63	96.91	96.39	95.76	95.09	94.32
Med.	2.806	23.34	99.96	99.29	98.65	97.57	96.90	96.36	95.68	95.14	94.32
st dev	0.0026	0.2903	0.1833	0.2713	0.2680	0.2778	0.2786	0.3078	0.3217	0.3676	0.3827
Min.	2.800	22.62	99.65	98.71	98.12	97.16	96.43	95.94	95.31	94.54	93.81
Max.	2.810	23.71	100.43	99.96	99.09	98.14	97.81	97.38	96.73	96.34	95.57

TM-21 Projection:

Test Duration: 9000 hours
Failures Observed: 0
α: 6.740E-06
β: 1.003
Reported L₇₀: 53,000 hours

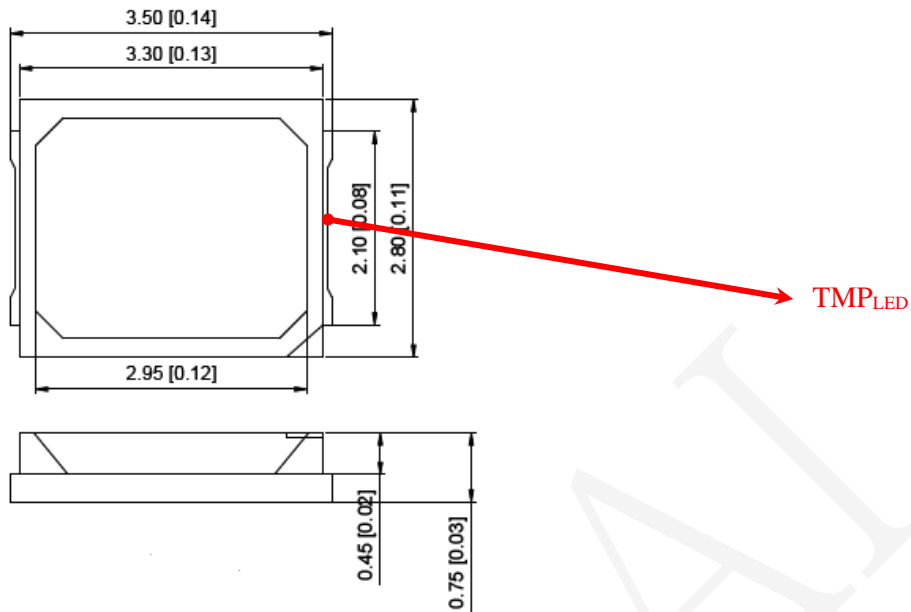
3.6 Data Set 3, 105 °C, 60mA (Chromaticity Shift)

No.	u'	v'	CCT(K)	Chromaticity Shift ($\Delta u'v'$)								
				0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000h	8000h
51	0.2640	0.5255	2676	0.0001	0.0007	0.0009	0.0017	0.0020	0.0024	0.0027	0.0031	0.0036
52	0.2642	0.5255	2671	0.0003	0.0007	0.0011	0.0017	0.0019	0.0023	0.0026	0.0031	0.0036
53	0.2629	0.5207	2719	0.0004	0.0006	0.0010	0.0015	0.0020	0.0025	0.0030	0.0033	0.0038
54	0.2655	0.5254	2646	0.0004	0.0005	0.0009	0.0015	0.0020	0.0024	0.0028	0.0033	0.0037
55	0.2641	0.5250	2676	0.0004	0.0006	0.0009	0.0015	0.0019	0.0024	0.0028	0.0032	0.0038
56	0.2644	0.5251	2669	0.0002	0.0006	0.0010	0.0017	0.0019	0.0024	0.0027	0.0034	0.0039
57	0.2653	0.5260	2649	0.0003	0.0005	0.0011	0.0017	0.0019	0.0023	0.0027	0.0033	0.0038
58	0.2654	0.5259	2646	0.0004	0.0006	0.0011	0.0018	0.0021	0.0025	0.0027	0.0031	0.0037
59	0.2653	0.5266	2645	0.0003	0.0007	0.0012	0.0019	0.0020	0.0025	0.0029	0.0030	0.0034
60	0.2643	0.5259	2670	0.0004	0.0006	0.0011	0.0017	0.0022	0.0027	0.0030	0.0035	0.0040
61	0.2654	0.5261	2645	0.0004	0.0006	0.0011	0.0018	0.0021	0.0026	0.0030	0.0033	0.0037
62	0.2650	0.5257	2655	0.0003	0.0006	0.0011	0.0019	0.0037	0.0040	0.0043	0.0049	0.0053
63	0.2636	0.5250	2687	0.0002	0.0007	0.0013	0.0019	0.0019	0.0023	0.0027	0.0031	0.0036
64	0.2660	0.5256	2636	0.0004	0.0004	0.0009	0.0014	0.0022	0.0025	0.0028	0.0033	0.0036
65	0.2642	0.5251	2675	0.0002	0.0006	0.0012	0.0017	0.0025	0.0029	0.0033	0.0037	0.0041
66	0.2650	0.5253	2658	0.0003	0.0006	0.0011	0.0017	0.0025	0.0030	0.0033	0.0038	0.0043
67	0.2655	0.5256	2646	0.0003	0.0007	0.0012	0.0018	0.0023	0.0028	0.0030	0.0035	0.0039
68	0.2662	0.5257	2632	0.0002	0.0007	0.0013	0.0017	0.0022	0.0026	0.0029	0.0035	0.0039
69	0.2650	0.5272	2649	0.0003	0.0007	0.0012	0.0017	0.0023	0.0028	0.0031	0.0036	0.0040
70	0.2635	0.5240	2693	0.0004	0.0005	0.0011	0.0016	0.0021	0.0025	0.0030	0.0035	0.0040
71	0.2638	0.5252	2682	0.0003	0.0005	0.0011	0.0016	0.0025	0.0029	0.0032	0.0036	0.0040
72	0.2632	0.5264	2690	0.0003	0.0004	0.0009	0.0015	0.0023	0.0028	0.0032	0.0038	0.0040
73	0.2645	0.5244	2669	0.0004	0.0004	0.0011	0.0017	0.0022	0.0026	0.0031	0.0035	0.0040
74	0.2642	0.5254	2673	0.0003	0.0005	0.0012	0.0015	0.0021	0.0025	0.0030	0.0035	0.0041
75	0.2631	0.5252	2696	0.0003	0.0006	0.0012	0.0016	0.0024	0.0028	0.0032	0.0038	0.0040
Ave.	0.2645	0.5253	2666	0.0003	0.0006	0.0011	0.0017	0.0022	0.0027	0.0030	0.0035	0.0039
Med.	0.2644	0.5255	2669	0.0003	0.0006	0.0011	0.0017	0.0021	0.0025	0.0030	0.0035	0.0039
st dev	0.0009	0.0012	21.4093	0.0001	0.0001	0.0001	0.0001	0.0004	0.0003	0.0003	0.0004	0.0004
Min.	0.2629	0.5207	2632	0.0001	0.0004	0.0009	0.0014	0.0019	0.0023	0.0026	0.0030	0.0034
Max.	0.2662	0.5272	2719	0.0004	0.0007	0.0013	0.0019	0.0037	0.0040	0.0043	0.0049	0.0053



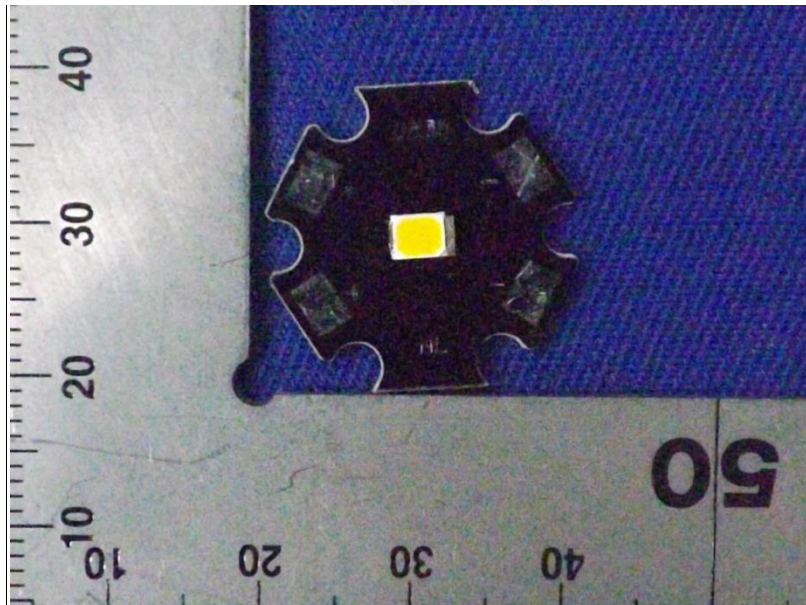
Appendix A – EUT PHOTO

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



All dimensions are in millimeter

A.2 EUT Photo



Report Revision

Report Number	Report Date	Contents
RSZ140217504-10-9000	2015-06-03	Original report. Update the company name of Applicant.
RSZ140217504-10-9000-M1	2018-05-28	Update the Description of LED Light Sources in page 3. Add the Family Declaration in page 3 to page 5.

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

FINAL