



IESNA LM-80-2008

MEASURING LUMEN MAINTENANCE OF LED LIGHT SOURCES

MEASUREMENT AND TEST REPORT

For

Guangzhou Hongli Opto-Electronic Co.,Ltd.

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

Model:HL-LM002H384W-9B4C12(Ra2)

Report Type: 7000 Hours Test Report	Product Type: LED Array
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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-LM002H384W-9B4C12(Ra2)
 Part Type: LED Array
 Nominal CCT: 3000K

According to ENERGY STAR Program Guidance Regarding LED Package, LED Array and LED Module Lumen Maintenance Performance Data Supporting Qualification of Lighting Products and family declaration, this report cover the models listed in table 1:

Table 1

Model type	Model name	CCT	Series	Parallel	Power intensity (W/mm ²)	Distance between of dies (mm)	Current (mA)
COB-LM002 series	HL-LM002H384W-9B4C12(Ra2)	3000K	12	4	0.047	0.34	240
COB-LM002 series	HL-LM002H384W-9B4C12(Ra2)	4000K	12	4	0.047	0.34	240
		5000K	12	4	0.047	0.34	240
		5700K	12	4	0.047	0.34	240
		6000K	12	4	0.047	0.34	240
		6500K	12	4	0.047	0.34	240
COB-LM002 series	HL-LM002H384W-3B3C3(Ra2)	3000K	3	3	0.0176	0.57	350
		4000K	3	3	0.0176	0.57	350
		5000K	3	3	0.0176	0.57	350
		5700K	3	3	0.0176	0.57	350
		6000K	3	3	0.0176	0.57	350
		6500K	3	3	0.0176	0.57	350
COB-LM002 series	HL-LM002H384W-5B3C5(Ra2)	3000K	5	3	0.0288	0.57	350
		4000K	5	3	0.0288	0.57	350
		5000K	5	3	0.0288	0.57	350
		5700K	5	3	0.0288	0.57	350

		6000K	5	3	0.0288	0.57	350
		6500K	5	3	0.0288	0.57	350
COB-LM002 series	HL-LM002D62W-9B2C10(Ra2)	3000K	10	2	0.047	0.46	300
		4000K	10	2	0.047	0.46	300
		5000K	10	2	0.047	0.46	300
		5700K	10	2	0.047	0.46	300
		6000K	10	2	0.047	0.46	300
		6500K	10	2	0.047	0.46	300
COB-LM002 series	HL-LM002D62W-7B2C7(Ra2)	3000K	7	2	0.0384	0.48	300
		4000K	7	2	0.0384	0.48	300
		5000K	7	2	0.0384	0.48	300
		5700K	7	2	0.0384	0.48	300
		6000K	7	2	0.0384	0.48	300
		6500K	7	2	0.0384	0.48	300
COB-LM002 series	HL-LM002D62W-5B2C5(Ra2)	3000K	5	2	0.0274	0.48	300
		4000K	5	2	0.0274	0.48	300
		5000K	5	2	0.0274	0.48	300
		5700K	5	2	0.0274	0.48	300
		6000K	5	2	0.0274	0.48	300
		6500K	5	2	0.0274	0.48	300
COB-LM002 series	HL-LM002D62W-3B2C3(Ra2)	3000K	3	2	0.0165	0.57	300
		4000K	3	2	0.0165	0.57	300
		5000K	3	2	0.0165	0.57	300
		5700K	3	2	0.0165	0.57	300
		6000K	3	2	0.0165	0.57	300
		6500K	3	2	0.0165	0.57	300

COB-LM002 series	HL-LM002H9VW-4B1C16(Ra2)	3000K	16	1	0.0274	0.57	35
		4000K	16	1	0.0274	0.57	35
		5000K	16	1	0.0274	0.57	35
		5700K	16	1	0.0274	0.57	35
		6000K	16	1	0.0274	0.57	35
		6500K	16	1	0.0274	0.57	35
COB-LM002 series	HL-LM002H384W-7B3C12(Ra2)	3000K	12	3	0.047	0.34	250
		4000K	12	3	0.047	0.34	250
		5000K	12	3	0.047	0.34	250
		5700K	12	3	0.047	0.34	250
		6000K	12	3	0.047	0.34	250
		6500K	12	3	0.047	0.34	250
COB-LM002 series	HL-LM002H384W-5B2C12(Ra2)	3000K	12	2	0.04	0.34	200
		4000K	12	2	0.04	0.34	200
		5000K	12	2	0.04	0.34	200
		5700K	12	2	0.04	0.34	200
		6000K	12	2	0.04	0.34	200
		6500K	12	2	0.04	0.34	200
COB-LM002 series	HL-LM002H384W-5B3C8(Ra2)	3000K	8	3	0.041	0.57	300
		4000K	8	3	0.041	0.57	300
		5000K	8	3	0.041	0.57	300
		5700K	8	3	0.041	0.57	300
		6000K	8	3	0.041	0.57	300
		6500K	8	3	0.041	0.57	300
COB-LM002 series	HL-LM002H384W-7B3C7(Ra2)	3000K	7	3	0.041	0.48	350
		4000K	7	3	0.041	0.48	350
		5000K	7	3	0.041	0.48	350

		5700K	7	3	0.041	0.48	350
		6000K	7	3	0.041	0.48	350
		6500K	7	3	0.041	0.48	350
COB-LM002 series	HL-LM002H384W-5B2C7(Ra2)	3000K	7	2	0.0283	0.48	240
		4000K	7	2	0.0283	0.48	240
		5000K	7	2	0.0283	0.48	240
		5700K	7	2	0.0283	0.48	240
		6000K	7	2	0.0283	0.48	240
		6500K	7	2	0.0283	0.48	240
COB-LM002 series	HL-LM002H384W-5B8C3(Ra2)	3000K	3	8	0.0323	0.40	640
		4000K	3	8	0.0323	0.40	640
		5000K	3	8	0.0323	0.40	640
		5700K	3	8	0.0323	0.40	640
		6000K	3	8	0.0323	0.40	640
		6500K	3	8	0.0323	0.40	640
COB-LM002 series	HL-LM002H384W-6B1C12(Ra2)	3000K	12	1	0.0329	1.425	150
		4000K	12	1	0.0329	1.425	150
		5000K	12	1	0.0329	1.425	150
		5700K	12	1	0.0329	1.425	150
		6000K	12	1	0.0329	1.425	150
		6500K	12	1	0.0329	1.425	150
COB-LM002 series	HL-LM002H384W-8B1C16(Ra2)	3000K	16	1	0.0439	0.51	150
		4000K	16	1	0.0439	0.51	150
		5000K	16	1	0.0439	0.51	150
		5700K	16	1	0.0439	0.51	150
		6000K	16	1	0.0439	0.51	150
		6500K	16	1	0.0439	0.51	150

COB-LM002 series	HL-M002H384W-3B2C3(Ra2)	3000K	3	2	0.0165	1.60	300
		4000K	3	2	0.0165	1.60	300
		5000K	3	2	0.0165	1.60	300
		5700K	3	2	0.0165	1.60	300
		6000K	3	2	0.0165	1.60	300
		6500K	3	2	0.0165	1.60	300
COB-LM002 series	HL-M002H384W-6B2C6(Ra2)	3000K	6	2	0.0329	1.36	300
		4000K	6	2	0.0329	1.36	300
		5000K	6	2	0.0329	1.36	300
		5700K	6	2	0.0329	1.36	300
		6000K	6	2	0.0329	1.36	300
		6500K	6	2	0.0329	1.36	300
COB-LM002 series	HL-LM002H384W-8B2C8(Ra2)	3000K	8	2	0.0439	0.47	300
		4000K	8	2	0.0439	0.47	300
		5000K	8	2	0.0439	0.47	300
		5700K	8	2	0.0439	0.47	300
		6000K	8	2	0.0439	0.47	300
		6500K	8	2	0.0439	0.47	300

The family models HL-LM002XW-XBXCX(Ra2) and tested model HL-LM002H384W-9B4C12(Ra2) could meet all the requirements listed as below:

- the tested model has been conducted on the largest LED array and have the largest per chip current;
- the family models have the equal or fewer LED dies than the tested model;
- die spacing greater than or equal to the tested model;
- power density (i.e. W/mm² of PCB or substrate total area, or equivalent calculation) less than or equal to the tested model;
- identical materials used (note: this does not constrain quantity and/or dimensional adjustments);
- identical construction processes used.

1.2 Standards Used:

- IESNA LM-80-08: IES Approved Method for Measuring Lumen Maintenance of LED Light Sources.
- 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 Test Facility

The testing facility used by Bay Area Compliance Laboratories Corp. (Dongguan). is located at Pu Long Cun 69, Puxinghu Industrial Area, Tangxia Town, Dongguan, Guangdong, P.R.China.

FINAL

1.4 Description of Auxiliary Equipment

Device	Manufacture	Model No	Serial No	Test Range	Calibration date	Calibration due date
Integral Sphere	EVERFINE	Diameter 0.3m	1011119	380-780nm, Diameter:0.3m,0- 1999Lumen	2014-03-04	2015-03-04
Programmable Test Power for LEDs	EVERFINE	LED300E	1008002	15V/2000mA	2014-03-12	2015-03-12
High accuracy array spectroradiometer	EVERFINE	HAAS-2000	1012016T	380-780nm	2013-12-26	2014-12-26
Standard Light Source	EVERFINE	D062	1011093	N/A	2014-05-06	2015-05-06
Precision digital stabilized DC power supply	EVERFINE	WY605	G115987C J7321114	300VA	2014-03-12	2015-03-12
Multilayer aging machine	Bacl	B2-270	20013	N/A	2014-08-11	2015-08-11
Digital CC&CV DC Power Supply	EVERFINE	WY5015	11090007	(50/15A)	2014-03-12	2015-03-12
Digital CC&CV DC Power Supply	EVERFINE	WY5015	11060010	(50/15A)	2014-03-12	2015-03-12

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 $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$, 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.

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

Sample Size:

Total 30Pcs;

Each Ts test condition 15Pcs

The samples tested at Ts 85°C and TS 100°C were received at 2013-11-23 and tested during 2013-11-26 to 2014-09-15. The samples were numbered from 1 to 15 and 16 to 30.

Data Set 1: 85°C,240mA

Part Number:	HL-LM002H384W-9B4C12 (Ra2)
Number of Units:	15
Actual Case Temperature(T _S):	T _S =84.2°C
Actual Ambient Temperature(T _A):	T _A =82.8°C
Life Test Drive Current:	I _F =240mA
Measurement Current:	I _F = 240mA

Data Set 2: 100°C, 240mA

Part Number:	HL-LM002H384W-9B4C12 (Ra2)
Number of Units:	15
Actual Case Temperature(T _S):	T _S =99.1°C
Actual Ambient Temperature(T _A):	T _A =97.9°C
Life Test Drive Current:	I _F = 240mA
Measurement Current:	I _F = 240mA

2 - SUMMARY OF TEST RESULT

Data Set:	Data Set 1, 85°C, 240mA
Number of Units:	15
Failures Observed:	0
Test Interval and Test Duration:	0h,1000h,2000h,3000h,4000h,5000h,6000h,7000h
Average. Lumen Maintenance at 7000 hours:	96.70%
Average Chromaticity Shift at 7000 hours($\Delta u'v'$):	0.0021
Reported TM-21 L ₇₀ Lifetime:	>39,000 hours

Data Set:	Data Set 2, 100°C, 240mA
Number of Units:	15
Failures Observed:	0
Test Interval and Test Duration:	0h,1000h,2000h,3000h,4000h,5000h,6000h,7000h
Average. Lumen Maintenance at 7000 hours:	95.90%
Average Chromaticity Shift at 7000 hours($\Delta u'v'$):	0.0026
Reported TM-21 L ₇₀ Lifetime:	>39,000 hours

3 - Test Data

3.1 Data Set 1, 85°C, 240mA (Lumen Maintenance)

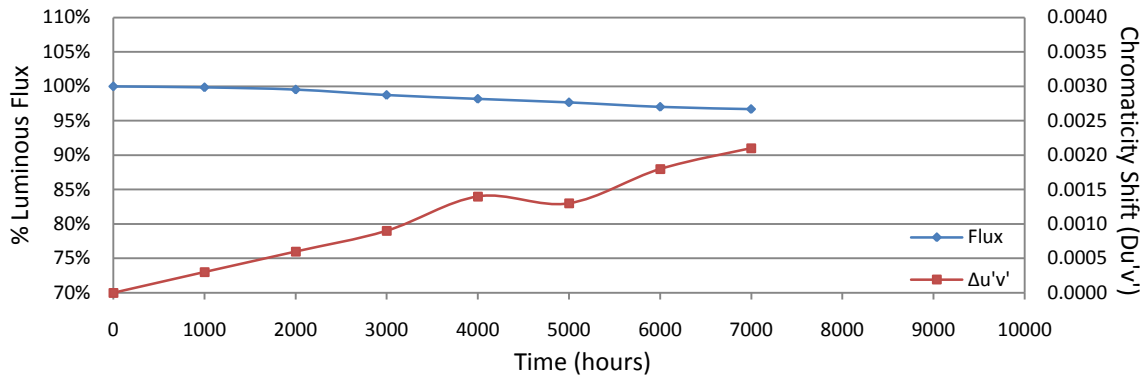
No.	V _F (V)	Φ(lm)	Lumen Maintenance (%)						
	0hr(Initial)		1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs
1	34.51	980.7	99.67	99.33	98.95	98.48	97.97	97.55	97.27
2	34.61	984.5	99.75	99.66	98.77	98.42	97.93	97.36	96.96
3	34.42	988.3	99.54	99.18	98.74	98.36	97.87	96.91	96.74
4	34.45	985.2	99.91	99.73	99.09	98.81	98.30	97.54	97.33
5	34.74	992.8	100.07	99.73	98.64	98.25	97.80	97.06	96.76
6	34.71	990.3	100.05	99.77	98.27	97.91	97.36	96.79	96.34
7	34.55	981.8	99.96	99.71	98.49	98.12	97.69	96.88	96.61
8	34.56	981.0	99.98	99.41	98.64	98.01	97.30	96.63	96.31
9	34.51	978.1	99.99	99.76	98.55	98.50	98.19	97.79	97.48
10	34.38	974.3	99.68	99.57	99.33	98.55	97.91	97.05	96.76
11	34.49	971.6	99.62	99.46	99.09	98.11	97.83	97.21	96.91
12	34.61	980.8	99.82	99.44	98.59	97.69	97.18	96.64	96.15
13	34.59	982.0	100.06	99.57	98.78	97.62	97.13	96.58	96.30
14	34.58	982.8	99.64	99.35	98.92	97.98	97.41	96.81	96.53
15	34.48	978.2	99.71	99.35	98.44	97.39	96.85	96.37	96.04
Ave.	34.55	982.2	99.83	99.53	98.75	98.15	97.65	97.01	96.70
Med.	34.55	981.8	99.82	99.57	98.74	98.12	97.80	96.91	96.74
st dev	0.0996	5.6267	0.1809	0.1894	0.2832	0.3908	0.4200	0.4102	0.4366
Min.	34.38	971.6	99.54	99.18	98.27	97.39	96.85	96.37	96.04
Max.	34.74	992.8	100.07	99.77	99.33	98.81	98.30	97.79	97.48

TM-21 Projection:

Test Duration: 7000 hours
Failures Observed: 0
 α : 5.791E-06
 β : 1.005
Calculated L₇₀: 63,000hours
Reported L₇₀: >39,000hours

3.2 Data Set 1, 85°C, 240mA (Chromaticity Shift)

No.	u'	v'	CCT(K)	Chromaticity Shift ($\Delta u'v'$)						
	0hr(Initial)			1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs
1	0.2511	0.5199	2995	0.0003	0.0006	0.0007	0.0013	0.0016	0.0020	0.0024
2	0.2513	0.5196	2994	0.0004	0.0006	0.0007	0.0013	0.0015	0.0021	0.0024
3	0.2498	0.5186	3037	0.0002	0.0005	0.0008	0.0013	0.0015	0.0023	0.0025
4	0.2517	0.5205	2979	0.0002	0.0006	0.0007	0.0012	0.0013	0.0018	0.0022
5	0.2510	0.5203	2996	0.0003	0.0004	0.0007	0.0013	0.0012	0.0017	0.0021
6	0.2508	0.5201	3003	0.0003	0.0004	0.0006	0.0015	0.0013	0.0017	0.0022
7	0.2514	0.5202	2988	0.0003	0.0004	0.0007	0.0013	0.0012	0.0017	0.0022
8	0.2514	0.5193	2993	0.0004	0.0005	0.0007	0.0013	0.0014	0.0018	0.0021
9	0.2509	0.5198	3001	0.0005	0.0008	0.0010	0.0015	0.0013	0.0016	0.0019
10	0.2514	0.5201	2988	0.0005	0.0008	0.0011	0.0015	0.0013	0.0017	0.0019
11	0.2515	0.5193	2989	0.0004	0.0007	0.0013	0.0016	0.0010	0.0013	0.0016
12	0.2511	0.5198	2997	0.0003	0.0006	0.0011	0.0014	0.0013	0.0017	0.0021
13	0.2512	0.5198	2995	0.0003	0.0006	0.0009	0.0013	0.0013	0.0018	0.0020
14	0.2512	0.5196	2995	0.0004	0.0006	0.0010	0.0013	0.0012	0.0017	0.0019
15	0.2514	0.5203	2986	0.0004	0.0006	0.0009	0.0013	0.0013	0.0018	0.0020
Ave.	0.2511	0.5198	2996	0.0003	0.0006	0.0009	0.0014	0.0013	0.0018	0.0021
Med.	0.2512	0.5198	2995	0.0003	0.0006	0.0008	0.0013	0.0013	0.0017	0.0021
st dev	0.0004	0.0005	12.9199	0.0001	0.0001	0.0002	0.0001	0.0001	0.0002	0.0002
Min.	0.2498	0.5186	2979	0.0002	0.0004	0.0006	0.0012	0.0010	0.0013	0.0016
Max.	0.2517	0.5205	3037	0.0005	0.0008	0.0013	0.0016	0.0016	0.0023	0.0025



3.3 Data Set 2, 100°C, 240mA (Lumen Maintenance)

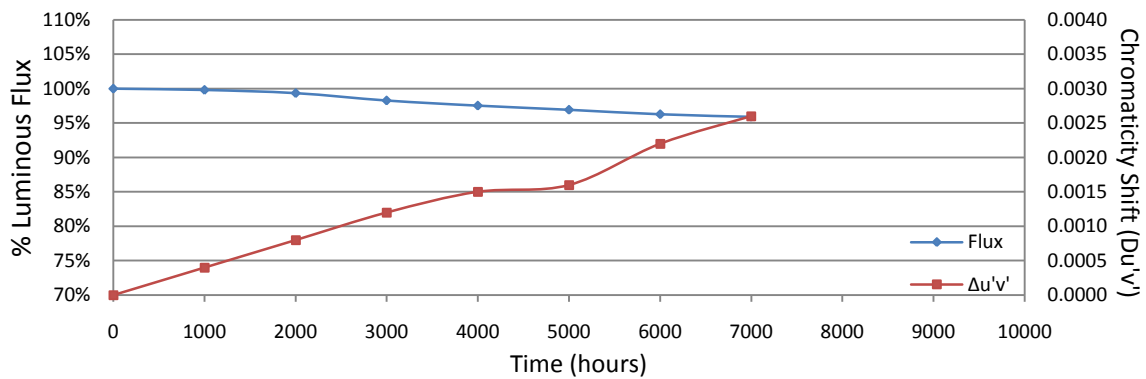
No.	V _F (V)	Φ(lm)	Lumen Maintenance (%)						
	0hr(Initial)		1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs
16	34.59	984.5	99.54	99.36	98.36	98.19	97.25	96.53	96.03
17	34.63	988.1	99.56	99.11	97.72	97.35	96.80	95.99	95.70
18	34.53	986.4	99.57	99.20	97.98	96.90	96.48	95.87	95.34
19	34.48	977.1	99.98	99.45	98.79	98.05	97.42	96.53	96.23
20	34.65	983.9	99.75	99.37	98.72	97.54	96.96	96.36	96.04
21	34.64	983.5	99.59	99.17	97.74	97.38	96.89	96.21	95.91
22	34.53	974.9	99.94	99.52	98.46	98.08	97.42	96.72	96.34
23	34.44	987.4	99.93	99.57	98.26	97.48	97.00	96.46	96.14
24	34.53	978.8	99.99	99.63	98.43	97.66	97.12	96.65	96.11
25	34.50	974.3	99.87	99.35	98.46	97.76	96.78	95.97	95.52
26	34.44	983.0	99.62	99.34	97.95	97.24	96.61	95.86	95.48
27	34.46	973.4	99.93	99.18	98.47	97.16	96.75	96.10	95.87
28	34.39	970.9	99.90	98.92	98.12	97.65	96.94	96.34	95.99
29	34.66	989.4	99.94	99.54	98.42	97.10	96.64	95.96	95.72
30	34.61	979.7	99.70	99.33	98.23	97.32	96.86	96.32	96.11
Ave.	34.54	981.0	99.79	99.34	98.27	97.52	96.93	96.26	95.90
Med.	34.53	983.0	99.87	99.35	98.36	97.48	96.89	96.32	95.99
st dev	0.0872	5.8895	0.1711	0.1946	0.3202	0.3779	0.2777	0.2868	0.2924
Min.	34.39	970.9	99.54	98.92	97.72	96.90	96.48	95.86	95.34
Max.	34.66	989.4	99.99	99.63	98.79	98.19	97.42	96.72	96.34

TM-21 Projection:

Test Duration: 7000 hours
Failures Observed: 0
 α : 6.979E-06
 β : 1.005
Calculated L₇₀: 52,000hours
Reported L₇₀: >39,000hours

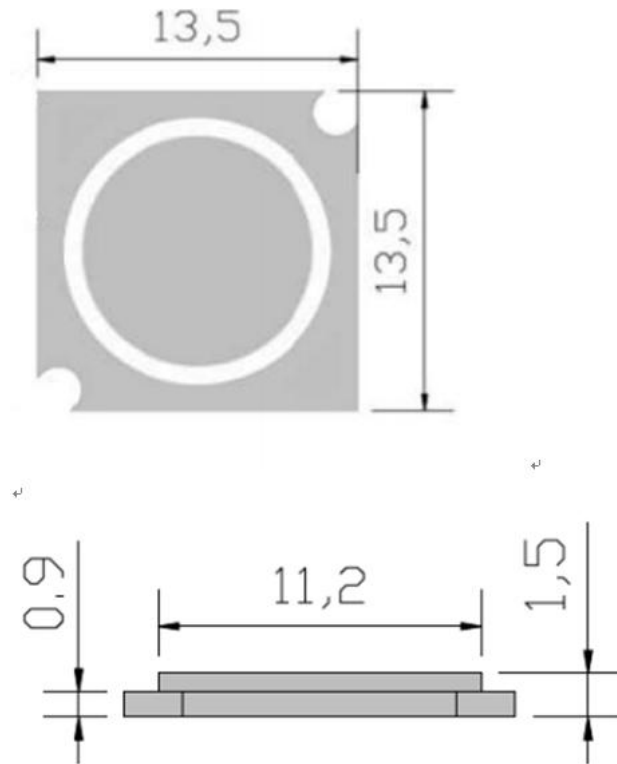
3.4 Data Set 2, 100°C, 240mA (Chromaticity Shift)

No.	u'	v'	CCT(K)	Chromaticity Shift ($\Delta u'v'$)						
	0hr(Initial)			1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs
16	0.2496	0.5182	3045	0.0005	0.0008	0.0013	0.0017	0.0015	0.0022	0.0026
17	0.2509	0.5199	3002	0.0005	0.0007	0.0012	0.0015	0.0016	0.0023	0.0027
18	0.2511	0.5198	2996	0.0004	0.0008	0.0010	0.0014	0.0016	0.0022	0.0027
19	0.2497	0.5181	3042	0.0005	0.0008	0.0013	0.0017	0.0014	0.0021	0.0025
20	0.2507	0.5199	3006	0.0004	0.0008	0.0013	0.0015	0.0015	0.0021	0.0026
21	0.2511	0.5198	2996	0.0004	0.0008	0.0011	0.0014	0.0016	0.0022	0.0026
22	0.2514	0.5199	2990	0.0003	0.0008	0.0012	0.0016	0.0016	0.0020	0.0023
23	0.2508	0.5199	3003	0.0004	0.0009	0.0012	0.0015	0.0016	0.0021	0.0024
24	0.2515	0.5198	2987	0.0004	0.0009	0.0012	0.0015	0.0015	0.0020	0.0025
25	0.2508	0.5193	3007	0.0005	0.0010	0.0012	0.0015	0.0017	0.0022	0.0024
26	0.2513	0.5199	2992	0.0004	0.0007	0.0011	0.0014	0.0017	0.0023	0.0026
27	0.2514	0.5201	2988	0.0006	0.0007	0.0012	0.0015	0.0022	0.0027	0.0029
28	0.2507	0.5191	3012	0.0004	0.0009	0.0013	0.0017	0.0016	0.0022	0.0027
29	0.2507	0.5199	3006	0.0004	0.0007	0.0010	0.0014	0.0018	0.0024	0.0026
30	0.2512	0.5195	2996	0.0004	0.0007	0.0011	0.0014	0.0019	0.0023	0.0026
Ave.	0.2509	0.5195	3005	0.0004	0.0008	0.0012	0.0015	0.0016	0.0022	0.0026
Med.	0.2509	0.5198	3002	0.0004	0.0008	0.0012	0.0015	0.0016	0.0022	0.0026
st dev	0.0006	0.0006	17.4923	0.0001	0.0001	0.0001	0.0001	0.0002	0.0002	0.0002
Min.	0.2496	0.5181	2987	0.0003	0.0007	0.0010	0.0014	0.0014	0.0020	0.0023
Max.	0.2515	0.5201	3045	0.0006	0.0010	0.0013	0.0017	0.0022	0.0027	0.0029



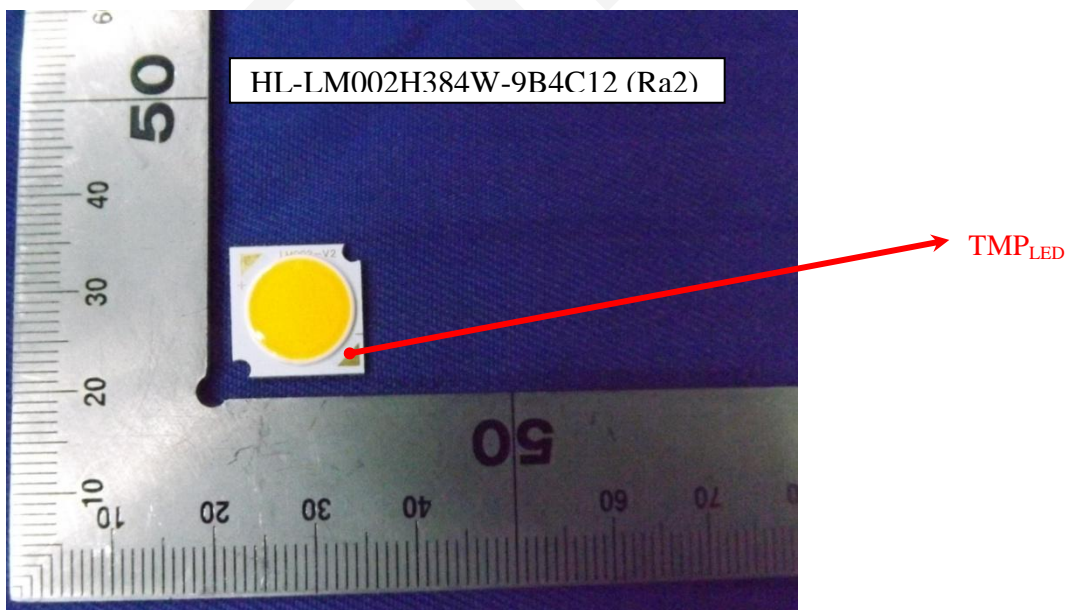
Appendix A – EUT PHOTO

A.1 Mechanical Dimensions (Ta = 25°C)



All dimensions are in millimeter

A.2 EUT Photo



Appendix B – Family declaration letter

FINNAL

Appendix C – REVISION HISTORY

Report Number	Report Date	Contents
RSZ131126501-10	2014/09/28	Original report.
RSZ131126501-10-M1	2014/10/09	Update the covered models in section1.1
RSZ131126501-10-M2	2016/02/03	Update the covered models in section1.1
RSZ131126501-10-M3	2016/10/31	Add the series model

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