Test Report

APPLICATION FOR LUMEN MAINTENANCE TESTING ACCORDING TO THE IES LM-80-15 TEST STANDARD

Prepared for: ShenZhen Runlite Technology Co., Ltd.
Building A15, Tantou the 4th Industrial Estate, SongGang Town, Baoan District, ShenZhen, China

Description of the submitted sample(s):

Sample Name	:2110
Sample Model	:T21101-W27IA3A4HB3B6-0000
Sample No.	: 35L0062-01~75
Ratings	:DC 30 mA
Manufacturer	:ShenZhen Runlite Technology Co., Ltd.
State of Sample(s)	: Normal
Sample Quantity	: 75pcs
Part Type	: LED Package
Power	: 0.1 W
CRI (Ra)	: 80
Average current density per LED die	: 415.18mA/mm^2
Average power density per LED die	: 1.384W/mm^2
Minimum die edge to die edge spacing	: 0
Reference Standard	:IES LM-80-15 Measuring Lumen Flux and Color Maintenance of LED Packages, Arrays and Modules
Sample Received Date	:Apr. 15, 2019
Sample Tested Date	:May 06, 2019 to Sept. 23,2019 Nov. 08, 2019 to Jul. 06, 2020
Sample Tested Address	:No.1996, Xin jin qiao Road, Pudong New District, Shanghai, 201206, China and No.1351, Wanfang Road, Minhang District, Shanghai, China
Remark	: Information of the samples and customer was provided by the customer, and the laboratory is NOT responsible for the authenticity of the information provided.

Reviewed by: Eagle liu

Approved by: Vivian Wang
Supervisor/Vivian Wang

Date: Jul. 10, 2020

Check No.: 2447607812

CENTRE TESTING INTERNATIONAL CORPORATION
No.1351, Wanfang Road, Minhang District, Shanghai, China

Test Report

The laboratory that conducted the testing items in this report has been accredited by the National Voluntary Laboratory Accreditation Program (NVLAP LAB CODE: 200889-0), for LM-80 testing of SSL products. And the report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

This report covers the following models

Model type	Model Name	CCT (K)	Series	Parallel	Power intensity PCB (W/mm^2)	Current density per LED die (mA/mm^2)	Current per die (mA)	Distance between of dies (mm)	Current (mA)
Master model	T21101-W27IA3A4 HB3B6-0000	2700	1	1	0.0465	415.18	30	N/A	30
	X2110X-WXXXXX XXXXXXX-XXXX	≥2200	1	1	0.0465	415.18	30	N/A	30

Test Report

1 SUMMARY

	LM-80 Required Temperature		Specified Temperature by Manufacturer
	55℃	85℃	105 ℃
Number of LED tested	25	25	25
Drive Current [I_F]	30 mA	30 mA	30 mA
Measurement Current [I_F]	30 mA	30 mA	30 mA
Actual Case Temp. [T_s]	≥53 ℃	≥83 ℃	≥103 ℃
Actual Ambient Temp. [T_A]	≥50 ℃	≥80 ℃	≥100 ℃
Relative Humidity	≤65%	≤65%	≤65%
Average Lumen Maintenance at 9000 hours (%)	98.88	98.53	98.23
Average Chromaticity Shift (Δu'v') at 9000 hours	0.0012	0.0014	0.0016
Reported L70(9k) (hours)	>54000	>54000	>54000
Reported L90(9k) (hours)	48000	45000	41000
Failures observed	None	None	None

Test Time Points/Average Lumen Maintenance (%)										
Case Temperature	0 Hour	1,000 Hours	2,000 Hours	3,000 Hours	4,000 Hours	5,000 Hours	6,000 Hours	7,000 Hours	8,000 Hours	9,000 Hours
55℃	100.00	100.97	100.70	100.40	100.10	99.84	99.61	99.40	99.14	98.88
85℃	100.00	100.60	100.26	100.10	99.79	99.53	99.29	99.07	98.79	98.53
105℃	100.00	100.29	99.99	99.88	99.60	99.33	99.08	98.83	98.52	98.23

Test Time Points/Average Color Shift (△u'v')										
Case Temperature	0 Hour	1,000 Hours	2,000 Hours	3,000 Hours	4,000 Hours	5,000 Hours	6,000 Hours	7,000 Hours	8,000 Hours	9,000 Hours
55℃	0.0000	0.0003	0.0013	0.0010	0.0011	0.0015	0.0013	0.0011	0.0011	0.0012
85℃	0.0000	0.0004	0.0013	0.0016	0.0018	0.0016	0.0015	0.0016	0.0015	0.0014
105℃	0.0000	0.0005	0.0014	0.0016	0.0016	0.0015	0.0014	0.0014	0.0014	0.0016

Test Report

2 EQUIPMENT LIST

Test Equipment	Model	Calibration Due Date
Spectroradiometer	CDS 600	Sept. 29, 2020
Integrating Sphere	Φ 1.0m	Sept. 29, 2020
Standard Lamp	FFS-100-1000	Sept. 03, 2023
DC Power Supply	WY12010	Sept. 24, 2020
Digital Recorder	34970A	Sept. 23, 2020
Multimeter	FLUKE17B+	Sept. 24, 2020
Oven	LM-80-Q400	Sept. 24, 2020
DC Power Supply	LM-80-Q400	Sept. 24, 2020
Temperature Tester	LM-80-Q400	Sept. 24, 2020

Remark: LM-80-Q400 is an integrated LM-80 Aging Test System

Test Report

3 TEST METHODS

3.1 Requirements of Environmental Conditions

Operation of the LED light sources between photometric measurements shall be at a minimum of two case temperatures, T_s, using the same drive current. The two case temperatures, T_s, at least one of the case temperatures shall be 55°C or 85°C. Case temperatures shall be maintained at a temperature that is higher than the nominal test case temperature - 2°C. The temperature of the surrounding air should be at a temperature that is higher than the nominal test case temperature - 5°C during testing. The surrounding air temperature should be monitored within the test chamber. Humidity shall be maintained to less the 65%RH throughout the life test. The ambient temperature during lumen and chromaticity measurements shall be set to 25℃± 2℃. The LED light source shall be required to cool to room temperature prior to measurement. Airflow shall be minimized for proper light source starting and operation. The operating orientation of the LED light sources under test should be as specified by the manufacturer.

3.2 Lumen Maintenance Testing Method

Samples under test shall be driven for at least 6,000 hours with data collection at a minimum of every 1000 hours. 10,000 hours are preferred for the purposes of improved predictive modeling.LED light sources are driven at constant current. Checking for LED light source failures either by visual observation or automatic monitoring shall be done at a minimum of every measurement interval. Catastrophic LED light source failure shall be reported and included in the test report. The chromaticity shift shall be measured and reported over the course of the lumen maintenance test time by measuring chromaticity at each photometric test interval.

3.3 Photometric and Electrical Measurements

A CCD Spectroradiometer and Integrating Sphere was used to measure total luminous flux, correlated color temperature, color rendering index, and chromaticity coordinates for each sample. Ambient temperature was measured at a position inside the integrating sphere. Electrical measurements including voltage, current, and power were measured.

Test Report

4 TEST DATA

4.1 55℃, 30 mA

No.	Φv [lm]	VF [V]	CCT [K]	Lumen Maintenance [%]								
	0 h (Initial)			1000 h	2000 h	3000 h	4000 h	5000 h	6000 h	7000 h	8000 h	9000 h
1	10.37	2.88	2639	101.16	101.02	100.64	100.42	100.16	99.94	99.77	99.53	99.26
2	10.30	2.87	2789	101.86	101.31	100.78	100.51	100.24	100.05	99.84	99.60	99.32
3	10.65	2.87	2771	100.27	100.01	99.77	99.49	99.24	99.01	98.83	98.61	98.35
4	10.56	2.87	2622	100.35	100.09	99.88	99.59	99.32	99.11	98.93	98.69	98.47
5	10.60	2.89	2756	100.20	100.00	99.87	99.64	99.34	99.11	98.89	98.62	98.34
6	10.54	2.89	2706	101.75	101.23	100.76	100.51	100.27	100.06	99.85	99.64	99.40
7	10.20	2.88	2673	100.18	100.06	99.83	99.53	99.26	99.01	98.83	98.51	98.24
8	10.64	2.88	2762	101.53	101.16	100.69	100.38	100.15	99.88	99.68	99.38	99.18
9	10.59	2.89	2692	101.49	101.00	100.77	100.46	100.17	99.88	99.70	99.40	99.11
10	10.51	2.89	2666	101.62	101.30	100.90	100.19	99.89	99.70	99.44	99.19	98.94
11	10.58	2.89	2766	101.37	100.67	100.50	100.24	99.99	99.77	99.56	99.34	98.99
12	10.53	2.88	2728	101.29	101.05	100.46	100.26	100.00	99.74	99.54	99.24	99.05
13	10.57	2.87	2679	100.10	100.08	99.92	99.69	99.47	99.29	99.00	98.72	98.47
14	10.35	2.88	2571	101.90	101.11	100.52	100.24	99.99	99.76	99.56	99.26	98.98
15	10.37	2.88	2638	101.09	100.92	100.59	100.30	100.00	99.82	99.59	99.35	99.07
16	10.28	2.89	2609	100.17	100.08	99.85	99.66	99.38	99.14	98.95	98.69	98.50
17	10.35	2.89	2674	100.83	100.78	100.53	100.21	100.00	99.76	99.51	99.24	98.95
18	10.45	2.89	2732	100.45	100.23	100.04	99.74	99.47	99.28	99.09	98.84	98.57
19	10.56	2.89	2681	100.82	100.80	100.62	100.44	100.20	99.95	99.74	99.50	99.20
20	10.60	2.87	2675	100.63	100.58	100.31	100.04	99.77	99.49	99.30	98.99	98.75
21	10.64	2.87	2706	100.81	100.75	100.62	99.85	99.65	99.44	99.21	98.91	98.70
22	10.46	2.87	2646	101.10	100.85	100.70	100.38	100.12	99.88	99.70	99.47	99.20
23	10.65	2.87	2600	100.77	100.72	100.52	100.25	100.02	99.75	99.57	99.32	99.07
24	10.61	2.90	2674	100.77	100.55	100.38	100.09	99.84	99.58	99.36	99.12	98.74
25	10.36	2.89	2622	101.65	101.04	100.63	100.32	100.07	99.89	99.66	99.34	99.09
n	25	25	25	25	25	25	25	25	25	25	25	25
Mean	10.49	2.88	2683	100.97	100.70	100.40	100.10	99.84	99.61	99.40	99.14	98.88
Median	10.54	2.88	2675	100.83	100.78	100.52	100.24	99.99	99.75	99.54	99.24	98.98
St. dev.	0.13	0.01	58.2	0.58	0.44	0.36	0.34	0.34	0.34	0.34	0.35	0.34
Min.	10.20	2.87	2571	100.10	100.00	99.77	99.49	99.24	99.01	98.83	98.51	98.24
Max.	10.65	2.90	2789	101.90	101.31	100.90	100.51	100.27	100.06	99.85	99.64	99.40

Test Report

No.	u'	v'	Chromaticity Shift Δu'v'								
	0 h (Initial)		1000 h	2000 h	3000 h	4000 h	5000 h	6000 h	7000 h	8000 h	9000 h
1	0.2650	0.5292	0.0005	0.0011	0.0015	0.0011	0.0017	0.0016	0.0010	0.0013	0.0015
2	0.2593	0.5222	0.0004	0.0009	0.0007	0.0007	0.0013	0.0012	0.0010	0.0012	0.0012
3	0.2597	0.5242	0.0002	0.0010	0.0008	0.0010	0.0015	0.0016	0.0013	0.0009	0.0009
4	0.2662	0.5279	0.0005	0.0014	0.0012	0.0013	0.0018	0.0015	0.0014	0.0012	0.0010
5	0.2599	0.5267	0.0003	0.0011	0.0006	0.0007	0.0013	0.0014	0.0009	0.0012	0.0010
6	0.2621	0.5275	0.0003	0.0013	0.0012	0.0014	0.0018	0.0020	0.0017	0.0014	0.0014
7	0.2630	0.5312	0.0003	0.0015	0.0017	0.0011	0.0017	0.0015	0.0013	0.0014	0.0017
8	0.2595	0.5273	0.0001	0.0007	0.0006	0.0008	0.0013	0.0010	0.0007	0.0004	0.0007
9	0.2621	0.5309	0.0005	0.0009	0.0008	0.0010	0.0018	0.0014	0.0011	0.0006	0.0005
10	0.2639	0.5285	0.0004	0.0013	0.0010	0.0010	0.0017	0.0013	0.0011	0.0013	0.0014
11	0.2591	0.5281	0.0003	0.0008	0.0008	0.0006	0.0016	0.0013	0.0010	0.0010	0.0011
12	0.2616	0.5248	0.0003	0.0016	0.0010	0.0012	0.0017	0.0014	0.0012	0.0013	0.0015
13	0.2635	0.5269	0.0003	0.0016	0.0004	0.0009	0.0013	0.0010	0.0007	0.0004	0.0006
14	0.2686	0.5291	0.0003	0.0021	0.0010	0.0012	0.0011	0.0013	0.0017	0.0022	0.0020
15	0.2651	0.5294	0.0001	0.0016	0.0013	0.0017	0.0015	0.0013	0.0009	0.0012	0.0015
16	0.2664	0.5301	0.0004	0.0013	0.0013	0.0013	0.0016	0.0012	0.0011	0.0013	0.0012
17	0.2632	0.5299	0.0005	0.0014	0.0008	0.0009	0.0016	0.0014	0.0011	0.0015	0.0016
18	0.2613	0.5253	0.0004	0.0010	0.0012	0.0011	0.0012	0.0012	0.0012	0.0009	0.0007
19	0.2628	0.5303	0.0003	0.0011	0.0011	0.0014	0.0012	0.0014	0.0011	0.0007	0.0007
20	0.2640	0.5257	0.0004	0.0008	0.0011	0.0010	0.0015	0.0015	0.0011	0.0008	0.0009
21	0.2617	0.5292	0.0001	0.0014	0.0010	0.0009	0.0011	0.0010	0.0008	0.0011	0.0012
22	0.2649	0.5282	0.0001	0.0017	0.0012	0.0011	0.0014	0.0013	0.0010	0.0007	0.0008
23	0.2668	0.5306	0.0003	0.0014	0.0010	0.0012	0.0014	0.0014	0.0009	0.0011	0.0010
24	0.2637	0.5275	0.0004	0.0015	0.0010	0.0013	0.0015	0.0012	0.0009	0.0011	0.0011
25	0.2664	0.5263	0.0003	0.0009	0.0013	0.0011	0.0013	0.0011	0.0011	0.0014	0.0019
n	25	25	25	25	25	25	25	25	25	25	25
Mean	0.2632	0.5279	0.0003	0.0013	0.0010	0.0011	0.0015	0.0013	0.0011	0.0011	0.0012
Median	0.2632	0.5281	0.0003	0.0013	0.0010	0.0011	0.0015	0.0013	0.0011	0.0012	0.0011
St. dev.	0.0026	0.0023	0.0001	0.0003	0.0003	0.0003	0.0002	0.0002	0.0002	0.0004	0.0004
Min.	0.2591	0.5222	0.0001	0.0007	0.0004	0.0006	0.0011	0.0010	0.0007	0.0004	0.0005
Max.	0.2686	0.5312	0.0005	0.0021	0.0017	0.0017	0.0018	0.0020	0.0017	0.0022	0.0020

Test Report

Forward Voltage[V] -55℃									
No.	0 h (Initial)	2000 h	3000 h	4000 h	5000 h	6000 h	7000 h	8000 h	9000 h
1	2.88	2.88	2.88	2.88	2.89	2.89	2.89	2.88	2.88
2	2.87	2.87	2.87	2.87	2.88	2.88	2.88	2.87	2.87
3	2.87	2.87	2.87	2.87	2.88	2.88	2.88	2.87	2.87
4	2.87	2.87	2.87	2.87	2.87	2.87	2.88	2.87	2.87
5	2.89	2.89	2.89	2.89	2.89	2.89	2.90	2.89	2.89
6	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89
7	2.88	2.88	2.88	2.88	2.88	2.88	2.88	2.88	2.88
8	2.88	2.88	2.88	2.88	2.89	2.89	2.89	2.88	2.88
9	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89
10	2.89	2.89	2.89	2.89	2.89	2.89	2.90	2.89	2.89
11	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89
12	2.88	2.87	2.87	2.87	2.88	2.88	2.88	2.87	2.87
13	2.87	2.87	2.87	2.87	2.87	2.88	2.88	2.87	2.87
14	2.88	2.87	2.87	2.87	2.87	2.87	2.87	2.86	2.87
15	2.88	2.89	2.88	2.88	2.89	2.89	2.89	2.88	2.88
16	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.88	2.89
17	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89
18	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89
19	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89
20	2.87	2.87	2.87	2.87	2.87	2.87	2.88	2.87	2.87
21	2.87	2.87	2.87	2.87	2.87	2.87	2.87	2.87	2.87
22	2.87	2.87	2.87	2.87	2.87	2.87	2.87	2.87	2.87
23	2.87	2.87	2.87	2.87	2.87	2.87	2.88	2.87	2.87
24	2.90	2.89	2.89	2.89	2.89	2.90	2.90	2.89	2.89
25	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89
n	25	25	25	25	25	25	25	25	25
Mean	2.88	2.88	2.88	2.88	2.88	2.88	2.89	2.88	2.88
Median	2.88	2.88	2.88	2.88	2.89	2.89	2.89	2.88	2.88
St. dev.	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Min.	2.87	2.87	2.87	2.87	2.87	2.87	2.87	2.86	2.87
Max.	2.90	2.89	2.89	2.89	2.89	2.90	2.90	2.89	2.89

Test Report

4.2 85℃, 30 mA

No.	Φv [lm]	VF [V]	CCT [K]	Lumen Maintenance [%]								
	0 h (Initial)			1000 h	2000 h	3000 h	4000 h	5000 h	6000h	7000 h	8000 h	9000 h
1	10.45	2.89	2682	101.17	100.41	100.16	99.87	99.64	99.47	99.26	99.01	98.80
2	10.52	2.87	2606	100.55	99.74	99.78	99.47	99.25	99.01	98.76	98.51	98.27
3	10.56	2.87	2795	100.11	100.00	99.87	99.66	99.34	99.07	98.84	98.48	98.27
4	10.47	2.90	2688	100.16	99.89	99.76	99.43	99.15	98.88	98.72	98.37	98.20
5	10.51	2.89	2706	100.87	100.62	100.35	100.07	99.82	99.59	99.35	99.01	98.78
6	10.08	2.87	2564	99.91	99.81	99.68	99.53	99.29	99.04	98.88	98.58	98.24
7	10.63	2.87	2734	100.28	100.07	99.95	99.76	99.47	99.19	98.97	98.75	98.51
8	10.38	2.89	2589	100.41	100.26	100.03	99.79	99.54	99.27	99.09	98.77	98.57
9	10.38	2.89	2641	101.10	100.79	100.65	100.30	100.10	99.91	99.71	99.42	99.13
10	10.10	2.87	2690	100.04	99.65	99.81	99.51	99.20	98.96	98.75	98.48	98.26
11	10.26	2.89	2736	100.12	99.89	99.74	99.44	99.20	98.96	98.72	98.47	98.15
12	10.64	2.89	2718	99.88	99.71	99.84	99.69	99.45	99.24	98.98	98.75	98.43
13	10.59	2.88	2725	100.06	99.93	99.82	99.46	99.23	99.02	98.74	98.43	98.23
14	10.50	2.89	2620	100.74	100.19	100.02	99.65	99.36	99.12	98.87	98.62	98.35
15	10.47	2.89	2682	100.10	99.71	99.92	99.60	99.34	99.12	98.93	98.71	98.40
16	10.46	2.89	2552	99.99	99.89	99.70	99.52	99.20	99.00	98.75	98.47	98.19
17	10.78	2.87	2856	101.82	101.20	100.74	100.24	99.99	99.78	99.52	99.27	99.05
18	9.81	2.87	2679	101.86	100.96	100.59	100.21	99.91	99.67	99.40	99.17	98.84
19	10.63	2.88	2689	101.31	100.73	100.38	100.10	99.78	99.51	99.30	99.03	98.78
20	10.57	2.87	2687	100.63	100.47	100.10	99.90	99.58	99.35	99.15	98.90	98.60
21	10.73	2.88	2762	101.30	101.04	100.88	100.07	99.83	99.55	99.27	99.03	98.72
22	10.38	2.88	2737	99.48	99.48	99.61	99.45	99.22	98.96	98.73	98.41	98.08
23	10.49	2.87	2592	100.88	100.47	100.11	99.91	99.70	99.52	99.28	99.05	98.80
24	10.44	2.87	2746	100.74	100.37	100.19	99.99	99.74	99.52	99.33	99.04	98.73
25	10.52	2.88	2751	101.50	101.30	100.91	100.19	99.84	99.64	99.39	99.07	98.87
n	25	25	25	25	25	25	25	25	25	25	25	25
Mean	10.45	2.88	2689	100.60	100.26	100.10	99.79	99.53	99.29	99.07	98.79	98.53
Median	10.49	2.88	2689	100.55	100.19	100.02	99.76	99.47	99.24	98.98	98.75	98.51
St. dev.	0.21	0.01	73.2	0.64	0.52	0.39	0.29	0.29	0.30	0.29	0.30	0.30
Min.	9.81	2.87	2552	99.48	99.48	99.61	99.43	99.15	98.88	98.72	98.37	98.08
Max.	10.78	2.90	2856	101.86	101.30	100.91	100.30	100.10	99.91	99.71	99.42	99.13

Test Report

No.	u'	v'	Chromaticity Shift Δu'v'								
	0 h (Initial)		1000 h	2000 h	3000 h	4000 h	5000 h	6000 h	7000 h	8000 h	9000 h
1	0.2631	0.5282	0.0002	0.0011	0.0021	0.0022	0.0022	0.0020	0.0018	0.0014	0.0014
2	0.2666	0.5301	0.0004	0.0008	0.0028	0.0029	0.0010	0.0016	0.0009	0.0012	0.0015
3	0.2581	0.5266	0.0005	0.0014	0.0021	0.0021	0.0018	0.0011	0.0021	0.0016	0.0017
4	0.2627	0.5286	0.0006	0.0020	0.0015	0.0014	0.0019	0.0019	0.0015	0.0009	0.0010
5	0.2625	0.5251	0.0004	0.0012	0.0023	0.0023	0.0009	0.0012	0.0018	0.0018	0.0019
6	0.2683	0.5328	0.0005	0.0021	0.0024	0.0026	0.0025	0.0026	0.0026	0.0020	0.0019
7	0.2605	0.5289	0.0001	0.0014	0.0021	0.0026	0.0022	0.0013	0.0024	0.0025	0.0023
8	0.2675	0.5298	0.0003	0.0011	0.0011	0.0014	0.0016	0.0018	0.0013	0.0014	0.0013
9	0.2654	0.5267	0.0004	0.0022	0.0022	0.0024	0.0021	0.0023	0.0021	0.0019	0.0023
10	0.2623	0.5303	0.0007	0.0020	0.0016	0.0018	0.0017	0.0018	0.0017	0.0014	0.0010
11	0.2606	0.5276	0.0003	0.0003	0.0019	0.0022	0.0023	0.0021	0.0021	0.0018	0.0017
12	0.2618	0.5260	0.0003	0.0007	0.0019	0.0027	0.0024	0.0018	0.0020	0.0015	0.0015
13	0.2607	0.5299	0.0005	0.0007	0.0004	0.0010	0.0011	0.0008	0.0006	0.0009	0.0010
14	0.2660	0.5296	0.0005	0.0011	0.0009	0.0019	0.0008	0.0007	0.0008	0.0009	0.0011
15	0.2632	0.5280	0.0006	0.0011	0.0011	0.0008	0.0015	0.0015	0.0011	0.0016	0.0018
16	0.2685	0.5354	0.0003	0.0017	0.0015	0.0019	0.0016	0.0015	0.0013	0.0008	0.0005
17	0.2555	0.5258	0.0006	0.0010	0.0018	0.0018	0.0019	0.0019	0.0019	0.0014	0.0014
18	0.2630	0.5295	0.0003	0.0016	0.0018	0.0013	0.0018	0.0013	0.0015	0.0015	0.0013
19	0.2624	0.5300	0.0005	0.0016	0.0015	0.0023	0.0017	0.0009	0.0020	0.0023	0.0021
20	0.2634	0.5253	0.0004	0.0010	0.0008	0.0005	0.0006	0.0014	0.0006	0.0010	0.0014
21	0.2592	0.5287	0.0003	0.0018	0.0017	0.0019	0.0021	0.0019	0.0017	0.0012	0.0011
22	0.2612	0.5243	0.0004	0.0006	0.0004	0.0007	0.0008	0.0010	0.0007	0.0010	0.0004
23	0.2671	0.5316	0.0002	0.0016	0.0014	0.0018	0.0015	0.0014	0.0014	0.0016	0.0019
24	0.2606	0.5254	0.0004	0.0010	0.0024	0.0017	0.0012	0.0012	0.0024	0.0021	0.0018
25	0.2603	0.5257	0.0004	0.0008	0.0011	0.0017	0.0011	0.0015	0.0010	0.0005	0.0006
n	25	25	25	25	25	25	25	25	25	25	25
Mean	0.2628	0.5284	0.0004	0.0013	0.0016	0.0018	0.0016	0.0015	0.0016	0.0015	0.0014
Median	0.2625	0.5286	0.0004	0.0011	0.0017	0.0019	0.0017	0.0015	0.0017	0.0014	0.0014
St. dev.	0.0033	0.0027	0.0001	0.0005	0.0006	0.0006	0.0005	0.0005	0.0006	0.0005	0.0005
Min.	0.2555	0.5243	0.0001	0.0003	0.0004	0.0005	0.0006	0.0007	0.0006	0.0005	0.0004
Max.	0.2685	0.5354	0.0007	0.0022	0.0028	0.0029	0.0025	0.0026	0.0026	0.0025	0.0023

Test Report

Forward Voltage [V] -85℃									
No.	0 h (Initial)	2000 h	3000 h	4000 h	5000 h	6000 h	7000 h	8000 h	9000 h
1	2.89	2.89	2.89	2.89	2.89	2.90	2.90	2.89	2.89
2	2.87	2.87	2.87	2.87	2.87	2.88	2.88	2.87	2.87
3	2.87	2.87	2.87	2.87	2.87	2.88	2.88	2.87	2.87
4	2.90	2.89	2.89	2.89	2.89	2.90	2.90	2.89	2.89
5	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89
6	2.87	2.87	2.87	2.87	2.87	2.88	2.88	2.87	2.87
7	2.87	2.87	2.87	2.85	2.87	2.87	2.87	2.87	2.87
8	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89
9	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89
10	2.87	2.87	2.87	2.87	2.87	2.87	2.87	2.87	2.87
11	2.89	2.89	2.89	2.89	2.89	2.89	2.90	2.89	2.89
12	2.89	2.89	2.88	2.89	2.89	2.89	2.89	2.88	2.88
13	2.88	2.88	2.88	2.88	2.88	2.89	2.89	2.88	2.88
14	2.89	2.89	2.88	2.89	2.89	2.89	2.89	2.89	2.89
15	2.89	2.87	2.88	2.88	2.88	2.88	2.88	2.87	2.87
16	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89
17	2.87	2.87	2.87	2.87	2.87	2.87	2.87	2.87	2.87
18	2.87	2.87	2.87	2.86	2.87	2.87	2.87	2.87	2.87
19	2.88	2.88	2.88	2.88	2.88	2.88	2.88	2.88	2.87
20	2.87	2.87	2.87	2.87	2.87	2.87	2.87	2.87	2.87
21	2.88	2.87	2.87	2.87	2.87	2.88	2.88	2.87	2.87
22	2.88	2.87	2.87	2.87	2.87	2.88	2.88	2.87	2.87
23	2.87	2.87	2.87	2.87	2.87	2.87	2.87	2.87	2.87
24	2.87	2.87	2.87	2.87	2.87	2.87	2.88	2.87	2.87
25	2.88	2.87	2.87	2.87	2.87	2.88	2.88	2.87	2.87
n	25	25	25	25	25	25	25	25	25
Mean	2.88	2.88	2.88	2.88	2.88	2.88	2.88	2.88	2.88
Median	2.88	2.87	2.87	2.87	2.87	2.88	2.88	2.87	2.87
St. dev.	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Min.	2.87	2.87	2.87	2.85	2.87	2.87	2.87	2.87	2.87
Max.	2.90	2.89	2.89	2.89	2.89	2.90	2.90	2.89	2.89

Test Report

4.3 105℃, 30 mA

No.	Φv [lm]	VF [V]	CCT [K]	Lumen Maintenance [%]								
	0 h (Initial)			1000 h	2000 h	3000 h	4000 h	5000 h	6000 h	7000 h	8000 h	9000 h
1	10.38	2.87	2614	100.56	100.24	100.01	99.80	99.47	99.22	99.03	98.71	98.40
2	10.47	2.87	2726	99.53	99.40	99.39	99.17	98.91	98.64	98.33	98.06	97.79
3	10.49	2.89	2636	99.30	99.70	99.76	99.43	99.15	98.88	98.67	98.35	98.10
4	10.41	2.87	2768	101.06	100.63	100.48	100.22	99.95	99.68	99.39	99.08	98.83
5	10.53	2.88	2702	99.91	99.89	99.90	99.73	99.55	99.27	99.02	98.72	98.50
6	10.51	2.89	2711	100.54	99.70	99.71	99.37	99.03	98.82	98.59	98.30	98.06
7	10.42	2.88	2698	101.58	101.03	100.36	100.14	99.89	99.68	99.37	99.07	98.72
8	10.57	2.88	2729	100.09	99.87	99.87	99.64	99.38	99.11	98.86	98.65	98.41
9	10.64	2.89	2720	99.79	99.67	99.67	99.52	99.26	99.04	98.78	98.43	98.24
10	10.36	2.90	2631	100.07	99.46	99.47	99.16	98.90	98.65	98.47	98.20	97.93
11	10.71	2.87	2759	100.78	100.27	100.10	99.80	99.54	99.26	99.03	98.78	98.45
12	10.47	2.88	2681	99.83	99.73	99.72	99.49	99.19	98.94	98.67	98.39	98.11
13	10.39	2.89	2640	101.62	101.02	100.63	100.34	100.11	99.86	99.54	99.16	98.85
14	10.39	2.89	2660	99.52	99.50	99.55	99.38	99.15	98.88	98.63	98.31	98.03
15	10.38	2.87	2613	99.56	99.53	99.51	99.26	98.99	98.76	98.61	98.32	98.01
16	10.43	2.89	2641	100.19	99.56	99.48	99.24	98.98	98.70	98.42	98.14	97.84
17	10.55	2.88	2673	99.76	99.46	99.41	99.15	98.92	98.66	98.41	98.06	97.79
18	10.04	2.89	2745	100.54	99.84	99.84	99.66	99.41	99.14	98.79	98.47	98.24
19	10.41	2.90	2663	101.65	101.05	100.72	100.14	99.87	99.64	99.42	99.06	98.79
20	10.81	2.88	2740	100.36	100.25	99.99	99.63	99.40	99.15	98.88	98.64	98.36
21	10.28	2.87	2691	99.60	99.50	99.42	99.29	98.95	98.68	98.43	98.03	97.67
22	10.32	2.89	2683	101.91	101.12	100.94	100.01	99.67	99.41	99.23	98.97	98.68
23	10.48	2.87	2725	99.50	99.93	99.85	99.73	99.47	99.19	98.94	98.54	98.22
24	10.15	2.89	2660	99.65	99.77	99.52	99.30	99.04	98.75	98.50	98.13	97.76
25	10.45	2.88	2672	100.28	99.54	99.57	99.37	99.16	98.95	98.65	98.35	98.07
n	25	25	25	25	25	25	25	25	25	25	25	25
Mean	10.44	2.88	2687	100.29	99.99	99.88	99.60	99.33	99.08	98.83	98.52	98.23
Median	10.43	2.88	2683	100.09	99.77	99.76	99.52	99.26	99.04	98.78	98.43	98.22
St. dev.	0.16	0.01	44.7	0.77	0.56	0.44	0.36	0.36	0.36	0.35	0.35	0.35
Min.	10.04	2.87	2613	99.30	99.40	99.39	99.15	98.90	98.64	98.33	98.03	97.67
Max.	10.81	2.90	2768	101.91	101.12	100.94	100.34	100.11	99.86	99.54	99.16	98.85

Test Report

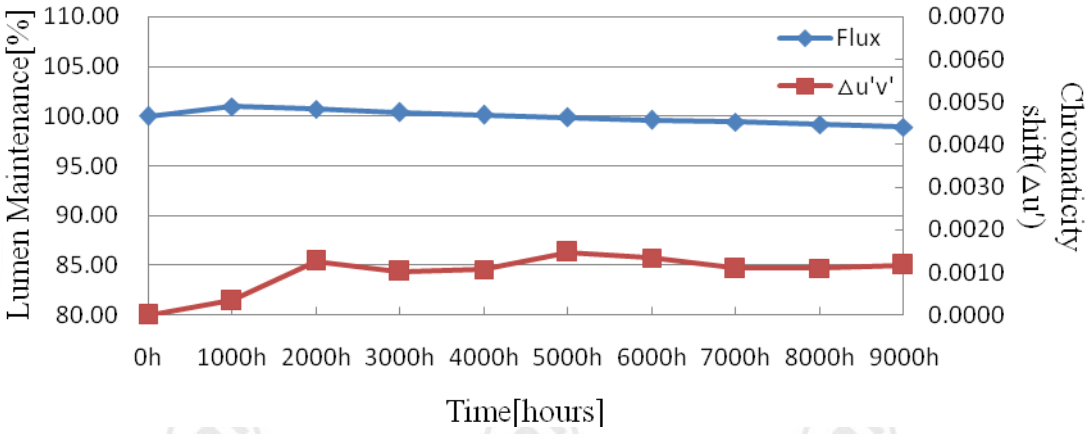
No.	u'	v'	Chromaticity Shift Δu'v'								
	0 h (Initial)		1000 h	2000 h	3000 h	4000 h	5000 h	6000 h	7000 h	8000 h	9000 h
1	0.2663	0.5293	0.0002	0.0020	0.0028	0.0025	0.0023	0.0014	0.0022	0.0017	0.0016
2	0.2615	0.5254	0.0005	0.0022	0.0025	0.0019	0.0013	0.0010	0.0012	0.0015	0.0017
3	0.2656	0.5267	0.0003	0.0006	0.0012	0.0017	0.0017	0.0013	0.0013	0.0017	0.0016
4	0.2598	0.5244	0.0004	0.0006	0.0017	0.0018	0.0010	0.0014	0.0006	0.0006	0.0005
5	0.2618	0.5300	0.0006	0.0010	0.0013	0.0007	0.0011	0.0011	0.0010	0.0012	0.0012
6	0.2622	0.5258	0.0003	0.0023	0.0011	0.0006	0.0008	0.0016	0.0017	0.0019	0.0022
7	0.2625	0.5274	0.0009	0.0015	0.0020	0.0026	0.0016	0.0010	0.0010	0.0006	0.0006
8	0.2621	0.5220	0.0007	0.0005	0.0004	0.0025	0.0005	0.0006	0.0011	0.0007	0.0010
9	0.2614	0.5277	0.0004	0.0007	0.0024	0.0012	0.0018	0.0013	0.0016	0.0014	0.0012
10	0.2658	0.5273	0.0002	0.0015	0.0019	0.0023	0.0023	0.0025	0.0017	0.0021	0.0023
11	0.2598	0.5264	0.0010	0.0018	0.0012	0.0022	0.0015	0.0013	0.0021	0.0019	0.0019
12	0.2634	0.5271	0.0008	0.0019	0.0023	0.0025	0.0017	0.0017	0.0018	0.0013	0.0016
13	0.2645	0.5322	0.0004	0.0006	0.0004	0.0006	0.0008	0.0011	0.0007	0.0009	0.0006
14	0.2643	0.5277	0.0002	0.0013	0.0004	0.0006	0.0007	0.0010	0.0006	0.0009	0.0010
15	0.2664	0.5294	0.0005	0.0012	0.0017	0.0020	0.0011	0.0008	0.0012	0.0018	0.0025
16	0.2650	0.5291	0.0003	0.0021	0.0016	0.0018	0.0017	0.0010	0.0021	0.0016	0.0023
17	0.2630	0.5311	0.0004	0.0019	0.0022	0.0014	0.0012	0.0009	0.0006	0.0014	0.0016
18	0.2604	0.5267	0.0008	0.0012	0.0016	0.0012	0.0022	0.0015	0.0010	0.0016	0.0015
19	0.2642	0.5277	0.0005	0.0012	0.0007	0.0009	0.0007	0.0011	0.0012	0.0010	0.0013
20	0.2603	0.5285	0.0004	0.0008	0.0005	0.0010	0.0011	0.0009	0.0007	0.0004	0.0008
21	0.2614	0.5347	0.0004	0.0024	0.0024	0.0024	0.0024	0.0024	0.0017	0.0023	0.0023
22	0.2623	0.5324	0.0006	0.0021	0.0014	0.0014	0.0022	0.0021	0.0015	0.0014	0.0019
23	0.2616	0.5254	0.0001	0.0007	0.0026	0.0023	0.0015	0.0011	0.0020	0.0023	0.0024
24	0.2642	0.5282	0.0006	0.0016	0.0018	0.0016	0.0020	0.0024	0.0018	0.0015	0.0016
25	0.2636	0.5283	0.0002	0.0012	0.0009	0.0009	0.0020	0.0014	0.0015	0.0012	0.0017
n	25	25	25	25	25	25	25	25	25	25	25
Mean	0.2629	0.5280	0.0005	0.0014	0.0016	0.0016	0.0015	0.0014	0.0014	0.0014	0.0016
Median	0.2625	0.5277	0.0004	0.0013	0.0016	0.0017	0.0015	0.0013	0.0013	0.0014	0.0016
St. dev.	0.0020	0.0027	0.0002	0.0006	0.0007	0.0007	0.0006	0.0005	0.0005	0.0005	0.0006
Min.	0.2598	0.5220	0.0001	0.0005	0.0004	0.0006	0.0005	0.0006	0.0006	0.0004	0.0005
Max.	0.2664	0.5347	0.0010	0.0024	0.0028	0.0026	0.0024	0.0025	0.0022	0.0023	0.0025

Test Report

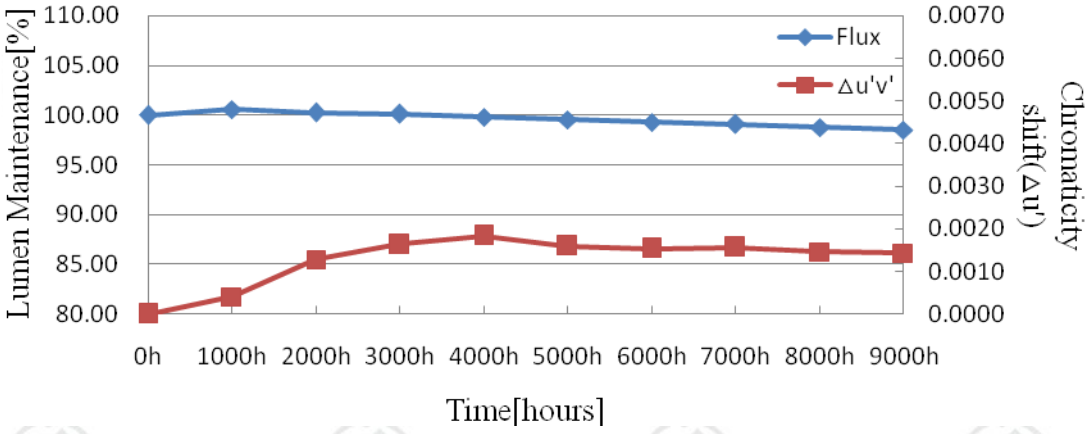
Forward Voltage[V] -105℃									
No.	0 h (Initial)	2000 h	3000 h	4000 h	5000 h	6000 h	7000 h	8000 h	9000 h
1	2.87	2.87	2.87	2.87	2.87	2.88	2.88	2.87	2.87
2	2.87	2.87	2.87	2.87	2.87	2.87	2.88	2.87	2.87
3	2.89	2.89	2.89	2.89	2.89	2.89	2.90	2.89	2.89
4	2.87	2.87	2.87	2.87	2.87	2.87	2.88	2.87	2.87
5	2.88	2.88	2.88	2.88	2.88	2.88	2.88	2.88	2.88
6	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.88
7	2.88	2.89	2.88	2.89	2.89	2.89	2.89	2.88	2.88
8	2.88	2.88	2.88	2.88	2.88	2.88	2.88	2.88	2.88
9	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.88	2.88
10	2.90	2.89	2.89	2.89	2.89	2.90	2.90	2.89	2.89
11	2.87	2.87	2.87	2.87	2.87	2.87	2.87	2.87	2.87
12	2.88	2.87	2.87	2.87	2.87	2.88	2.88	2.87	2.87
13	2.89	2.88	2.88	2.88	2.88	2.89	2.89	2.88	2.88
14	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89
15	2.87	2.87	2.87	2.87	2.87	2.87	2.88	2.87	2.87
16	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89
17	2.88	2.88	2.88	2.88	2.88	2.88	2.88	2.88	2.88
18	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.88
19	2.90	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89
20	2.88	2.87	2.87	2.87	2.87	2.87	2.88	2.87	2.87
21	2.87	2.87	2.87	2.87	2.87	2.87	2.87	2.87	2.87
22	2.89	2.89	2.88	2.89	2.88	2.89	2.89	2.88	2.88
23	2.87	2.87	2.87	2.87	2.87	2.87	2.88	2.87	2.87
24	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89
25	2.88	2.88	2.88	2.87	2.88	2.88	2.88	2.87	2.87
n	25	25	25	25	25	25	25	25	25
Mean	2.88	2.88	2.88	2.88	2.88	2.88	2.88	2.88	2.88
Median	2.88	2.88	2.88	2.88	2.88	2.88	2.88	2.88	2.88
St. dev.	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Min.	2.87	2.87	2.87	2.87	2.87	2.87	2.87	2.87	2.87
Max.	2.90	2.89	2.89	2.89	2.89	2.90	2.90	2.89	2.89

Test Report

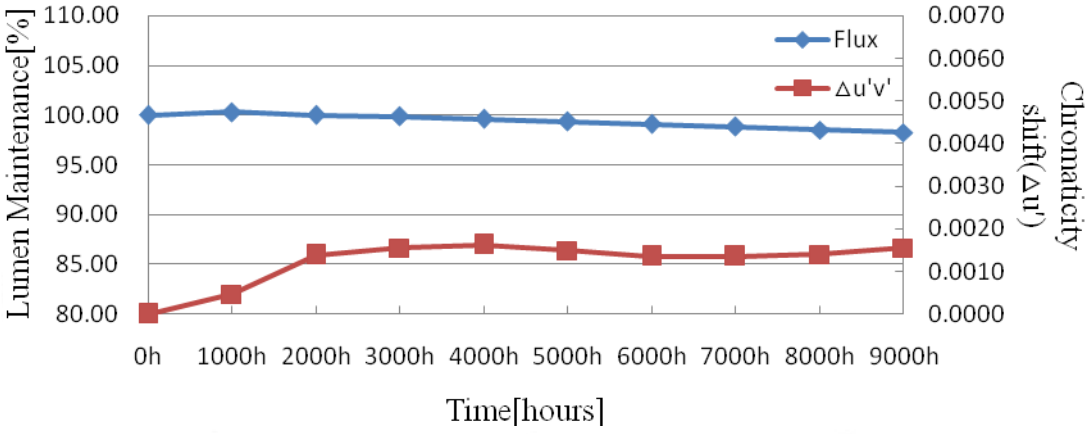
5 Graph of Lumen Maintenance and Chromaticity Shift



Graph 1 - 55℃, 30 mA



Graph 2 -85℃, 30 mA



Graph 3 - 105℃, 30 mA

Test Report

6 TM-21-11 Report: Projecting Long Term Lumen Maintenance of LED Light Source

Table 1: Report at each LM-80 Test Condition			
	55℃ Case Temperature	**85℃ Case Temperature**	**105℃ Case Temperature**
Sample size	25	25	25
Number of failures	0	0	0
DUT drive current used in the test (mA)	30	30	30
Test duration (hours)	9,000	9,000	9,000
Test duration used for projection (hour to hour)	4,000 - 9,000	4,000 - 9,000	4,000 - 9,000
Tested case temperature (^{0}C)	55	85	105
α	2.415E-06	2.518E-06	2.753E-06
B	1.011	1.008	1.007
Reported L70(9k) (hours)	>54000	>54000	>54000

Table 1: Report at each LM-80 Test Condition			
	55℃ Case Temperature	**85℃ Case Temperature**	**105℃ Case Temperature**
Sample size	25	25	25
Number of failures	0	0	0
DUT drive current used in the test (mA)	30	30	30
Test duration (hours)	9,000	9,000	9,000
Test duration used for projection (hour to hour)	4,000 - 9,000	4,000 - 9,000	4,000 - 9,000
Tested case temperature (^{0}C)	55	85	105
α	2.415E-06	2.518E-06	2.753E-06
B	1.011	1.008	1.007
Reported L90(9k) (hours)	48000	45000	41000

Test Report

Photos of the sample

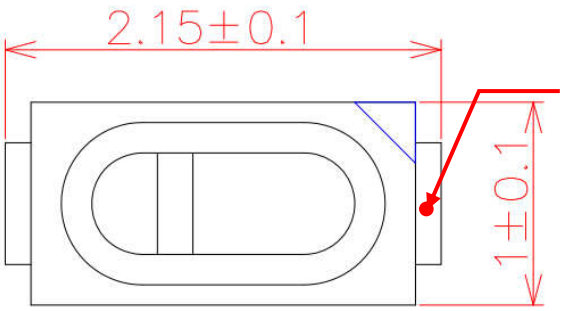


Fig.1- Mechanical Dimension

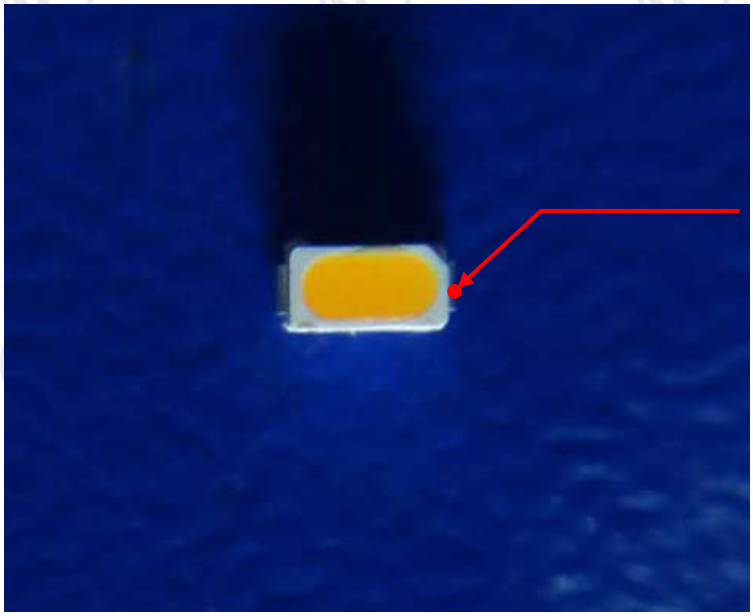


Fig.2- Overall view

*** End of Report ***