



# IESNA LM-80-2008

MEASURING LUMEN MAINTENANCE OF LED LIGHT SOURCES

## MEASUREMENT AND TEST REPORT

For

**Luminus Devices, Inc**

1100 Technology Park Drive Billerica.MA01821.USA

**Model:MP-3020 series**

<b>Report Type:</b> 6000 Hours Test Report	<b>Product Type:</b> LED Package
<b>Test Engineer:</b> Daniel Duan	<i>Daniel Duan</i>
<b>Report Number:</b> RSZ150430501-10	
<b>Test Date:</b> 2015-05-05 to 2016-05-14	
<b>Report Date:</b> 2016-05-23	
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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).

This report is valid only with a valid digital signature. The digital signature may be available only under the Adobe software above version 7.0.

## **TABLE OF CONTENTS**

<b>1 - GENERAL INFORMATION.....</b>	<b>3</b>
1.1 DESCRIPTION OF LED LIGHT SOURCES .....	3
1.2 STANDARDS USED:.....	3
1.3 TEST FACILITY .....	3
1.4 DESCRIPTION OF AUXILIARY EQUIPMENT .....	3
1.5 OPERATING CYCLE.....	4
1.6 AMBIENT CONDITIONS .....	4
1.7 PHOTOMETRY MEASUREMENT UNCERTAINTY .....	4
1.8 SAMPLE SET .....	5
<b>2 - SUMMARY OF TEST RESULT .....</b>	<b>6</b>
<b>3 - TEST DATA .....</b>	<b>7</b>
3.1 DATA SET 1, 55 °C, 100MA (LUMEN MAINTENANCE) .....	7
3.2 DATA SET 1, 55 °C, 100MA (CHROMATICITY SHIFT) .....	8
3.3 DATA SET 2, 85 °C, 100MA (LUMEN MAINTENANCE) .....	9
3.4 DATA SET 2, 85 °C, 100MA (CHROMATICITY SHIFT) .....	10
3.5 DATA SET 3, 105 °C, 100MA (LUMEN MAINTENANCE) .....	11
3.6 DATA SET 3, 105 °C, 100MA (CHROMATICITY SHIFT) .....	12
<b>ATTACHMENT A – EUT PHOTO .....</b>	<b>13</b>
A.1 MECHANICAL DIMENSIONS (TA = 25 °C).....	13
A.2 EUT PHOTO .....	13
<b>ATTACHMENT B – DECLARATION LETTER.....</b>	<b>14</b>

## 1 - GENERAL INFORMATION

### 1.1 Description of LED Light Sources

Devices tested

Part Number: MP-3020 series  
 Part Type: LED Package  
 Nominal CCT: 3000K

#### Declaration:

Luminus Devices, Inc declare that their product with model MP-3020 series are the same to the product in report# RSZ150430501-10-6000 and is authorized by original applicant to use their test data. (See attachment B – Declaration Letter)

#### Note:

All the data in previous report (RSZ150430501-10-6000) is shared in report.

### 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.

### 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	2015-03-25	2016-03-25
Programmable Test Power for LEDs	EVERFINE	LED300E	1008002	15V/2000mA	2015-03-05	2016-03-05
High accuracy array spectroradiometer	EVERFINE	HAAS-2000	1012016T	380-780nm	2015-03-25	2016-03-25
Standard Light Source	EVERFINE	D062	1011093	N/A	2015-08-05	2016-08-05
Precision digital stabilized DC power supply	EVERFINE	WY605	G115987C J7321114	300VA	2015-03-05	2016-03-05

Device	Manufacture	Model No	Serial No	Test Range	Calibration date	Calibration due date
Multilayer aging machine	BACL	B2-270	20015	25°C~110°C	2015-03-05	2016-03-05
Digital CC&CV DC Power Supply	EVERFINE	WY5015	11060010	(50V/15A)	2015-03-05	2016-03-05

### 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 66Pcs;

Each Ts test condition 22Pcs

The samples tested at Ts 55 °C, Ts 85 °C and Ts 105 °C were received at 2015-04-30 and tested during 2015-05-05 to 2016-01-10. The samples were numbered from 1 to 22, 23 to 44 and 45 to 66

#### Data Set 1: 55 °C, 100mA

Part Number:	MP-3020 series
Number of Units:	22
Actual Case Temperature( $T_S$ ):	$T_S = 54.3$ °C
Actual Ambient Temperature( $T_A$ ):	$T_A = 51.5$ °C
Life Test Drive Current:	$I_F = 100$ mA
Measurement Current:	$I_F = 100$ mA

#### Data Set 2: 85 °C, 100mA

Part Number:	MP-3020 series
Number of Units:	22
Actual Case Temperature( $T_S$ ):	$T_S = 84.2$ °C
Actual Ambient Temperature( $T_A$ ):	$T_A = 82.5$ °C
Life Test Drive Current:	$I_F = 100$ mA
Measurement Current:	$I_F = 100$ mA

#### Data Set 3: 105 °C, 100mA

Part Number:	MP-3020 series
Number of Units:	22
Actual Case Temperature( $T_S$ ):	$T_S = 104.4$ °C
Actual Ambient Temperature( $T_A$ ):	$T_A = 102.1$ °C
Life Test Drive Current:	$I_F = 100$ mA
Measurement Current:	$I_F = 100$ mA

## 2 - SUMMARY OF TEST RESULT

<b>Data Set:</b>	<b>Data Set 1, 55°C, 100mA</b>
Number of Units:	22
Failures Observed:	0
Test Interval and Test Duration:	0h,1000h,2000h,3000h,4000h,5000h,6000h,7000h,8000h 9000h
Average. Lumen Maintenance at 6000 hours:	97.87%
Average. Lumen Maintenance at 9000 hours:	96.98%
Average Chromaticity Shift at 6000 hours ( $\Delta u'v'$ ):	0.0018
Average Chromaticity Shift at 9000 hours ( $\Delta u'v'$ ):	0.0027
Reported TM-21 L <sub>70</sub> Lifetime:	>54,000 hours

<b>Data Set:</b>	<b>Data Set 2, 85°C, 100mA</b>
Number of Units:	22
Failures Observed:	0
Test Interval and Test Duration:	0h,1000h,2000h,3000h,4000h,5000h,6000h,7000h,8000h 9000h
Average. Lumen Maintenance at 6000 hours:	96.84%
Average. Lumen Maintenance at 9000 hours:	95.59%
Average Chromaticity Shift at 6000 hours( $\Delta u'v'$ ):	0.0028
Average Chromaticity Shift at 9000 hours( $\Delta u'v'$ ):	00038
Reported TM-21 L <sub>70</sub> Lifetime:	>54,000 hours

<b>Data Set:</b>	<b>Data Set 3, 105°C, 100mA</b>
Number of Units:	22
Failures Observed:	0
Test Interval and Test Duration:	0h,1000h,2000h,3000h,4000h,5000h,6000h,7000h,8000h 9000h
Average. Lumen Maintenance at 6000 hours:	96.08%
Average. Lumen Maintenance at 9000 hours:	94.52%
Average Chromaticity Shift at 6000 hours( $\Delta u'v'$ ):	0.0027
Average Chromaticity Shift at 9000 hours( $\Delta u'v'$ ):	0.0041
Reported TM-21 L <sub>70</sub> Lifetime:	>54,000 hours

### 3 - Test Data

#### 3.1 Data Set 1, 55°C, 100mA (Lumen Maintenance)

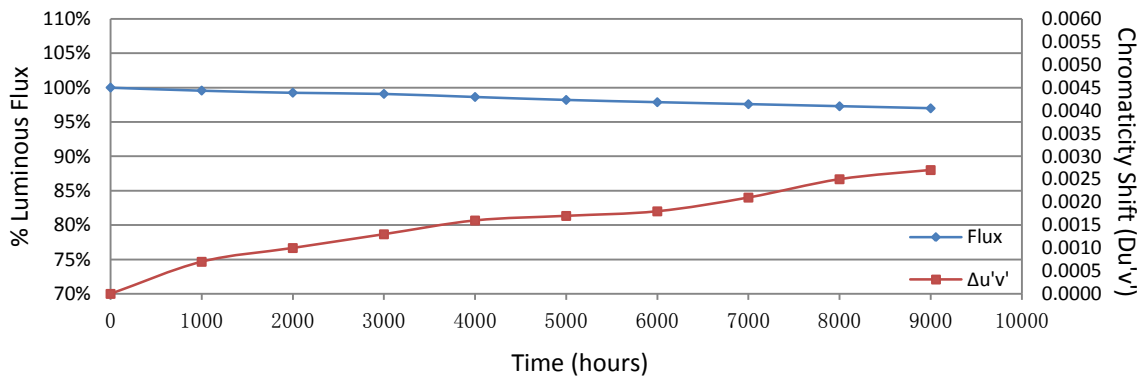
No.	V <sub>F</sub> (V)	Φ(lm)	Lumen Maintenance (%)								
			0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs
1	9.375	110.6	99.64	99.28	99.10	98.64	98.55	98.10	97.83	97.65	97.38
2	9.457	111.8	99.82	99.37	99.11	98.84	98.66	98.57	98.12	97.76	97.50
3	9.457	112.4	99.56	99.20	99.11	98.84	98.67	98.40	98.13	97.86	97.42
4	9.339	111.6	99.37	99.19	99.10	98.75	98.39	97.94	97.49	97.31	97.04
5	9.385	110.4	99.55	99.18	99.00	98.55	98.46	98.10	97.74	97.37	96.92
6	9.354	110.8	99.28	99.01	98.74	98.47	98.29	98.10	97.83	97.29	97.02
7	9.403	112.0	99.46	98.84	98.66	98.21	98.13	97.86	97.59	97.14	96.96
8	9.386	110.2	99.73	99.55	99.36	98.82	98.37	98.19	98.00	97.82	97.37
9	9.357	112.0	99.29	99.11	98.93	98.04	97.68	97.32	97.05	96.88	96.61
10	9.325	111.4	99.46	99.28	98.92	98.38	98.03	97.40	97.04	96.59	96.41
11	9.417	112.2	99.47	98.93	98.75	98.48	97.15	96.97	96.70	96.52	96.26
12	9.360	112.0	99.55	99.20	99.11	98.84	96.52	96.43	96.07	95.89	95.54
13	9.372	110.5	99.64	99.19	99.00	98.82	98.28	98.01	97.65	97.29	97.10
14	9.403	111.0	99.55	99.37	99.28	98.47	98.20	98.02	97.84	97.66	97.21
15	9.438	111.9	99.55	99.37	99.20	98.93	98.57	98.21	98.03	97.68	97.41
16	9.370	112.4	99.38	99.29	99.11	98.67	98.22	98.04	97.78	97.51	97.33
17	9.344	109.6	99.91	99.64	99.54	98.72	98.45	97.90	97.72	97.54	97.26
18	9.343	110.4	99.82	99.55	99.46	99.00	98.73	98.64	98.37	98.10	97.74
19	9.347	110.7	99.64	99.46	99.37	98.83	98.55	98.10	97.74	97.56	97.29
20	9.452	111.9	99.64	99.37	99.20	98.84	98.66	98.30	97.94	97.41	96.96
21	9.349	110.6	99.46	99.01	98.82	98.46	97.92	97.29	96.93	96.47	96.02
22	9.382	109.5	99.63	99.18	99.00	98.36	97.99	97.35	97.17	96.89	96.71
Ave.	9.383	111.2	99.56	99.25	99.08	98.63	98.20	97.87	97.58	97.28	96.98
Med.	9.374	111.2	99.55	99.24	99.10	98.69	98.33	98.03	97.74	97.39	97.07
st dev	0.040	0.9	0.1658	0.2028	0.2313	0.2496	0.5292	0.5380	0.5463	0.5413	0.5328
Min.	9.325	109.5	99.28	98.84	98.66	98.04	96.52	96.43	96.07	95.89	95.54
Max.	9.457	112.4	99.91	99.64	99.54	99.00	98.73	98.64	98.37	98.10	97.74

#### TM-21 Projection:

**Test Duration:** 9000 hours  
**Failures Observed:** 0  
 $\alpha$ : 3.302E-06  
 $\beta$ : 0.999  
**Calculated L<sub>70</sub>:** 108,000 hours  
**Reported L<sub>70</sub>:** >54,000 hours

### 3.2 Data Set 1, 55°C, 100mA (Chromaticity Shift)

No.	u'	v'	CCT(K)	Chromaticity Shift ( $\Delta u'v'$ )								
				0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs
1	0.2485	0.5207	3057	0.0007	0.0009	0.0011	0.0012	0.0013	0.0014	0.0020	0.0025	0.0028
2	0.2478	0.5212	3070	0.0006	0.0009	0.0012	0.0013	0.0013	0.0015	0.0021	0.0026	0.0028
3	0.2477	0.5210	3074	0.0006	0.0009	0.0013	0.0014	0.0016	0.0017	0.0021	0.0027	0.0030
4	0.2465	0.5176	3129	0.0006	0.0009	0.0012	0.0014	0.0015	0.0016	0.0021	0.0026	0.0029
5	0.2474	0.5193	3095	0.0006	0.0010	0.0012	0.0014	0.0016	0.0016	0.0020	0.0024	0.0028
6	0.2476	0.5177	3100	0.0006	0.0008	0.0013	0.0015	0.0017	0.0017	0.0021	0.0027	0.0030
7	0.2480	0.5192	3080	0.0007	0.0009	0.0013	0.0014	0.0016	0.0019	0.0021	0.0026	0.0029
8	0.2480	0.5209	3069	0.0007	0.0010	0.0013	0.0014	0.0017	0.0019	0.0021	0.0025	0.0028
9	0.2470	0.5203	3097	0.0006	0.0009	0.0011	0.0013	0.0015	0.0016	0.0019	0.0025	0.0027
10	0.2491	0.5191	3051	0.0007	0.0010	0.0012	0.0014	0.0016	0.0017	0.0020	0.0025	0.0028
11	0.2475	0.5174	3105	0.0008	0.0011	0.0008	0.0010	0.0011	0.0012	0.0016	0.0021	0.0024
12	0.2476	0.5200	3085	0.0007	0.0010	0.0007	0.0009	0.0008	0.0009	0.0013	0.0017	0.0021
13	0.2475	0.5195	3090	0.0005	0.0009	0.0015	0.0016	0.0016	0.0014	0.0015	0.0017	0.0015
14	0.2471	0.5189	3105	0.0007	0.0010	0.0017	0.0025	0.0014	0.0011	0.0012	0.0017	0.0026
15	0.2466	0.5188	3118	0.0006	0.0009	0.0017	0.0021	0.0017	0.0011	0.0019	0.0021	0.0025
16	0.2488	0.5199	3054	0.0008	0.0010	0.0017	0.0020	0.0016	0.0017	0.0018	0.0019	0.0024
17	0.2485	0.5191	3066	0.0008	0.0011	0.0017	0.0020	0.0018	0.0018	0.0020	0.0021	0.0025
18	0.2466	0.5182	3124	0.0007	0.0010	0.0014	0.0019	0.0020	0.0017	0.0017	0.0015	0.0018
19	0.2470	0.5172	3120	0.0009	0.0010	0.0016	0.0022	0.0024	0.0026	0.0028	0.0029	0.0028
20	0.2483	0.5203	3063	0.0006	0.0009	0.0009	0.0014	0.0021	0.0023	0.0023	0.0030	0.0028
21	0.2479	0.5191	3082	0.0007	0.0010	0.0019	0.0026	0.0034	0.0035	0.0038	0.0045	0.0043
22	0.2490	0.5205	3045	0.0007	0.0009	0.0010	0.0017	0.0025	0.0031	0.0033	0.0040	0.0040
Ave.	0.2477	0.5194	3085	0.0007	0.0010	0.0013	0.0016	0.0017	0.0018	0.0021	0.0025	0.0027
Med.	0.2477	0.5193	3084	0.0007	0.0010	0.0013	0.0014	0.0016	0.0017	0.0020	0.0025	0.0028
st dev	0.0008	0.0012	24.9221	0.0001	0.0001	0.0003	0.0005	0.0005	0.0006	0.0006	0.0007	0.0006
Min.	0.2465	0.5172	3045	0.0005	0.0008	0.0007	0.0009	0.0008	0.0009	0.0012	0.0015	0.0015
Max.	0.2491	0.5212	3129	0.0009	0.0011	0.0019	0.0026	0.0034	0.0035	0.0038	0.0045	0.0043





### 3.3 Data Set 2, 85°C, 100mA (Lumen Maintenance)

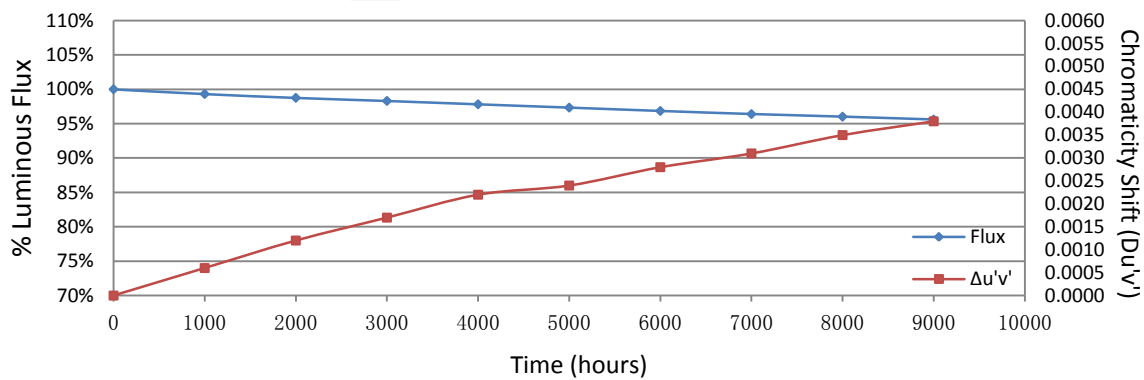
No.	V <sub>F</sub> (V)	Φ(lm)	Lumen Maintenance (%)								
			Ohr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs
23	9.408	111.7	99.37	98.93	98.66	98.03	97.76	97.22	96.87	96.51	96.15
24	9.366	111.0	99.46	98.74	98.38	97.66	97.30	96.76	96.22	95.77	95.32
25	9.382	110.4	99.55	99.09	98.73	98.01	97.64	97.01	96.38	96.11	95.83
26	9.435	111.4	99.64	99.01	98.56	98.47	97.58	96.95	96.41	95.96	95.51
27	9.388	110.8	99.28	98.74	98.29	96.75	96.66	96.12	95.85	95.40	95.04
28	9.328	110.5	99.19	98.64	98.28	97.83	97.65	96.83	96.29	95.84	95.57
29	9.322	110.9	99.28	98.38	97.93	97.29	97.02	96.66	96.12	95.58	95.04
30	9.395	110.7	99.64	99.19	98.74	98.37	97.92	97.29	96.93	96.48	96.03
31	9.388	111.9	99.29	98.66	98.03	97.41	97.14	96.78	96.25	95.89	95.35
32	9.384	111.6	99.19	98.75	98.21	97.67	97.04	96.77	96.24	95.88	95.43
33	9.386	109.6	99.54	99.09	98.63	98.27	97.35	97.17	96.72	96.26	95.89
34	9.378	110.6	99.37	98.82	98.37	97.92	97.47	96.84	96.47	96.20	95.84
35	9.354	112.9	99.29	98.67	98.23	97.79	97.61	97.17	96.90	96.63	96.28
36	9.374	110.5	99.28	98.91	98.46	98.01	97.29	96.83	96.65	96.20	95.75
37	9.387	112.7	99.02	98.58	98.14	97.60	97.25	96.72	96.10	95.65	95.30
38	9.332	110.8	99.19	98.83	98.56	97.92	97.38	96.93	96.39	95.94	95.40
39	9.324	111.0	99.10	98.65	98.20	97.93	97.30	96.76	96.31	95.77	95.41
40	9.351	111.1	99.28	98.74	98.29	97.93	97.57	97.03	96.85	96.58	96.13
41	9.332	111.0	99.19	98.56	98.02	97.66	97.30	97.21	96.76	96.58	96.22
42	9.327	111.5	99.10	98.48	97.94	97.58	96.77	96.50	95.96	95.70	95.25
43	9.391	112.1	99.20	98.39	97.68	97.50	96.88	96.25	95.81	95.45	94.92
44	9.338	111.4	99.37	98.65	98.38	98.11	97.49	96.68	96.14	95.78	95.33
Ave.	9.367	111.2	99.31	98.75	98.30	97.81	97.33	96.84	96.39	96.01	95.59
Med.	9.376	111.0	99.28	98.74	98.29	97.87	97.33	96.83	96.34	95.91	95.47
st dev	0.031	0.8	0.1701	0.2198	0.2802	0.3809	0.3213	0.2975	0.3402	0.3771	0.4066
Min.	9.322	109.6	99.02	98.38	97.68	96.75	96.66	96.12	95.81	95.40	94.92
Max.	9.435	112.9	99.64	99.19	98.74	98.47	97.92	97.29	96.93	96.63	96.28

#### TM-21 Projection:

**Test Duration:** 9000 hours  
**Failures Observed:** 0  
**α:** 4.583E-06  
**β:** 0.996  
**Calculated L<sub>70</sub>:** 77,000 hours  
**Reported L<sub>70</sub>:** >54,000 hours

### 3.4 Data Set 2, 85°C, 100mA (Chromaticity Shift)

No.	u'	v'	CCT(K)	Chromaticity Shift ( $\Delta u'v'$ )								
	0hr(Initial)			1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
23	0.2471	0.5189	3106	0.0008	0.0015	0.0017	0.0021	0.0025	0.0030	0.0031	0.0033	0.0035
24	0.2489	0.5181	3063	0.0008	0.0011	0.0016	0.0021	0.0026	0.0034	0.0035	0.0037	0.0040
25	0.2473	0.5198	3093	0.0006	0.0009	0.0008	0.0015	0.0022	0.0031	0.0033	0.0036	0.0037
26	0.2465	0.5187	3122	0.0007	0.0013	0.0007	0.0010	0.0017	0.0024	0.0029	0.0031	0.0034
27	0.2489	0.5203	3048	0.0006	0.0011	0.0012	0.0015	0.0020	0.0027	0.0030	0.0035	0.0037
28	0.2472	0.5197	3095	0.0006	0.0011	0.0015	0.0016	0.0016	0.0023	0.0028	0.0033	0.0035
29	0.2485	0.5184	3071	0.0006	0.0011	0.0021	0.0022	0.0019	0.0026	0.0031	0.0035	0.0037
30	0.2477	0.5208	3075	0.0005	0.0009	0.0018	0.0019	0.0016	0.0022	0.0028	0.0033	0.0035
31	0.2489	0.5198	3051	0.0006	0.0011	0.0024	0.0025	0.0024	0.0026	0.0033	0.0036	0.0039
32	0.2479	0.5189	3085	0.0008	0.0013	0.0023	0.0028	0.0026	0.0028	0.0035	0.0038	0.0042
33	0.2465	0.5189	3122	0.0006	0.0011	0.0019	0.0026	0.0025	0.0026	0.0033	0.0036	0.0039
34	0.2477	0.5201	3082	0.0006	0.0012	0.0018	0.0026	0.0024	0.0025	0.0033	0.0036	0.0039
35	0.2467	0.5188	3115	0.0006	0.0011	0.0019	0.0026	0.0026	0.0026	0.0029	0.0033	0.0039
36	0.2473	0.5197	3094	0.0005	0.0010	0.0018	0.0025	0.0028	0.0030	0.0032	0.0036	0.0040
37	0.2482	0.5197	3070	0.0006	0.0012	0.0019	0.0026	0.0029	0.0031	0.0034	0.0038	0.0042
38	0.2477	0.5205	3078	0.0007	0.0014	0.0021	0.0028	0.0031	0.0033	0.0036	0.0040	0.0043
39	0.2468	0.5188	3114	0.0006	0.0011	0.0016	0.0025	0.0029	0.0029	0.0028	0.0033	0.0036
40	0.2477	0.5188	3091	0.0006	0.0011	0.0016	0.0025	0.0027	0.0030	0.0032	0.0036	0.0041
41	0.2478	0.5194	3083	0.0006	0.0012	0.0017	0.0025	0.0026	0.0027	0.0030	0.0034	0.0038
42	0.2471	0.5186	3108	0.0007	0.0012	0.0018	0.0023	0.0024	0.0028	0.0029	0.0030	0.0034
43	0.2477	0.5196	3085	0.0006	0.0013	0.0019	0.0024	0.0030	0.0030	0.0030	0.0031	0.0035
44	0.2471	0.5192	3103	0.0006	0.0011	0.0018	0.0022	0.0027	0.0028	0.0029	0.0030	0.0033
Ave.	0.2476	0.5193	3089	0.0006	0.0012	0.0017	0.0022	0.0024	0.0028	0.0031	0.0035	0.0038
Med.	0.2477	0.5193	3088	0.0006	0.0011	0.0018	0.0024	0.0025	0.0028	0.0031	0.0035	0.0038
st dev	0.0007	0.0007	21.0727	0.0001	0.0001	0.0004	0.0005	0.0004	0.0003	0.0002	0.0003	0.0003
Min.	0.2465	0.5181	3048	0.0005	0.0009	0.0007	0.0010	0.0016	0.0022	0.0028	0.0030	0.0033
Max.	0.2489	0.5208	3122	0.0008	0.0015	0.0024	0.0028	0.0031	0.0034	0.0036	0.0040	0.0043



**3.5 Data Set 3, 105°C, 100mA (Lumen Maintenance)**

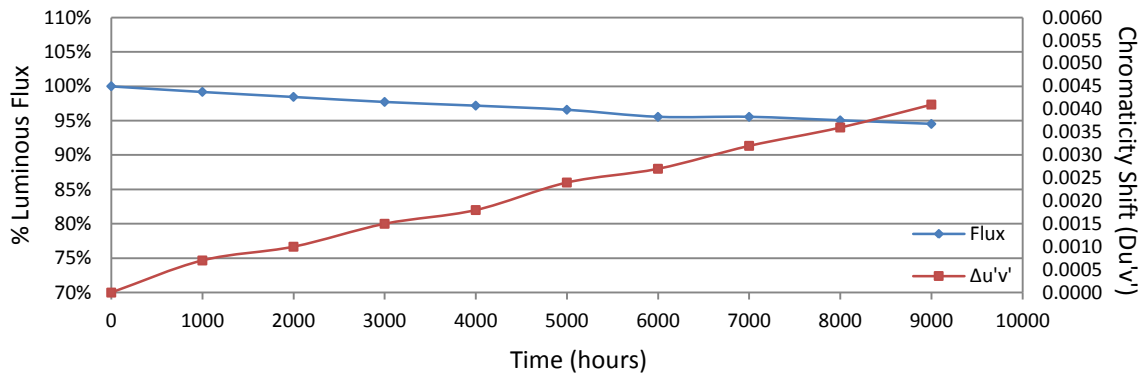
No.	V <sub>F</sub> (V)	Φ(lm)	Lumen Maintenance (%)								
			0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs
45	9.323	110.0	99.18	98.36	97.82	97.36	97.18	96.64	96.00	95.64	95.09
46	9.375	106.0	99.25	98.49	97.83	97.64	96.70	96.04	95.66	95.19	94.72
47	9.367	108.5	99.08	98.43	97.70	97.14	96.87	96.31	95.76	95.30	94.75
48	9.322	112.1	99.11	98.48	97.68	96.79	96.61	95.99	95.36	94.74	94.20
49	9.300	111.2	99.19	98.65	97.93	97.39	96.58	95.86	95.23	94.69	94.15
50	9.339	111.0	99.10	98.92	98.29	97.93	97.57	97.03	96.40	95.77	95.14
51	9.377	111.4	99.19	98.29	97.58	97.13	96.68	96.50	96.05	95.51	95.06
52	9.334	111.1	99.01	98.38	97.48	96.67	95.86	95.41	94.96	94.42	93.88
53	9.379	112.2	99.02	98.13	97.59	96.97	96.26	95.90	95.37	94.83	94.21
54	9.350	111.4	99.19	98.74	98.03	97.49	96.59	96.05	95.51	94.97	94.43
55	9.322	111.0	99.10	98.65	97.84	96.85	96.58	96.22	95.86	95.32	94.68
56	9.346	111.5	98.92	98.12	97.40	96.86	96.05	95.70	95.07	94.44	93.90
57	9.333	111.5	99.01	98.12	97.40	96.68	95.96	95.87	95.34	94.89	94.35
58	9.378	111.1	99.91	99.19	98.38	97.84	97.12	96.40	95.86	95.23	94.78
59	9.428	111.3	99.28	98.65	97.93	97.39	96.86	96.14	95.78	95.24	94.88
60	9.439	112.5	99.29	98.58	97.96	97.51	97.16	96.53	96.09	95.47	95.02
61	9.342	110.8	99.19	98.38	97.65	97.29	96.75	96.12	95.58	95.22	94.77
62	9.429	111.4	99.28	98.38	97.58	97.40	96.86	96.50	96.05	95.69	95.15
63	9.368	111.5	99.10	98.12	97.31	96.68	95.96	95.34	94.71	94.26	93.90
64	9.351	111.0	99.28	98.20	97.48	97.03	96.40	95.77	95.23	94.77	94.14
65	9.384	110.6	99.28	98.28	97.47	97.02	96.29	95.84	95.12	94.58	94.12
66	9.390	111.9	99.11	98.39	97.50	96.96	95.98	95.53	95.08	94.64	94.19
Ave.	9.363	111.0	99.18	98.45	97.72	97.18	96.58	96.08	95.55	95.04	94.52
Med.	9.359	111.3	99.18	98.39	97.67	97.14	96.60	96.04	95.54	95.08	94.56
st dev	0.037	1.4	0.1923	0.2736	0.2846	0.3694	0.4570	0.4188	0.4377	0.4401	0.4352
Min.	9.300	106.0	98.92	98.12	97.31	96.67	95.86	95.34	94.71	94.26	93.88
Max.	9.439	112.5	99.91	99.19	98.38	97.93	97.57	97.03	96.40	95.77	95.15

## TM-21 Projection:

**Test Duration:** 9000 hours  
**Failures Observed:** 0  
 $\alpha$ : 5.501E-06  
 $\beta$ : 0.993  
**Calculated L<sub>70</sub>:** 64,000 hours  
**Reported L<sub>70</sub>:** >54,000 hours

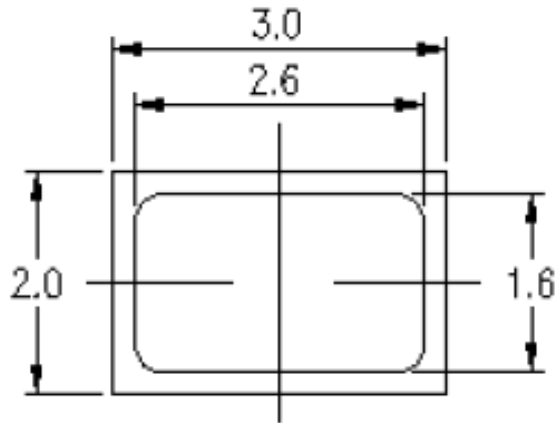
### 3.6 Data Set 3, 105°C, 100mA (Chromaticity Shift)

No.	u'	v'	CCT(K)	Chromaticity Shift ( $\Delta u'v'$ )								
	0hr(Initial)			1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
45	0.2477	0.5181	3095	0.0006	0.0011	0.0013	0.0018	0.0023	0.0025	0.0029	0.0033	0.0037
46	0.2484	0.5208	3059	0.0009	0.0017	0.0025	0.0030	0.0035	0.0037	0.0041	0.0044	0.0050
47	0.2476	0.5196	3086	0.0006	0.0006	0.0013	0.0018	0.0024	0.0028	0.0033	0.0037	0.0042
48	0.2477	0.5189	3089	0.0007	0.0010	0.0016	0.0021	0.0026	0.0032	0.0038	0.0040	0.0045
49	0.2480	0.5196	3076	0.0007	0.0008	0.0016	0.0021	0.0026	0.0031	0.0034	0.0038	0.0044
50	0.2478	0.5207	3074	0.0005	0.0008	0.0013	0.0019	0.0024	0.0029	0.0033	0.0036	0.0041
51	0.2499	0.5208	3021	0.0007	0.0011	0.0013	0.0019	0.0025	0.0027	0.0032	0.0036	0.0040
52	0.2474	0.5171	3109	0.0007	0.0011	0.0014	0.0015	0.0006	0.0001	0.0004	0.0013	0.0014
53	0.2480	0.5189	3081	0.0006	0.0010	0.0013	0.0014	0.0023	0.0027	0.0032	0.0036	0.0040
54	0.2467	0.5186	3117	0.0007	0.0011	0.0015	0.0016	0.0023	0.0030	0.0034	0.0037	0.0043
55	0.2469	0.5183	3115	0.0007	0.0011	0.0014	0.0015	0.0023	0.0028	0.0034	0.0037	0.0043
56	0.2486	0.5197	3061	0.0006	0.0010	0.0011	0.0012	0.0021	0.0025	0.0029	0.0033	0.0038
57	0.2493	0.5207	3037	0.0007	0.0011	0.0016	0.0018	0.0025	0.0028	0.0031	0.0036	0.0041
58	0.2472	0.5178	3111	0.0008	0.0011	0.0017	0.0019	0.0026	0.0030	0.0034	0.0038	0.0043
59	0.2485	0.5198	3063	0.0006	0.0010	0.0016	0.0018	0.0024	0.0027	0.0032	0.0036	0.0041
60	0.2483	0.5208	3062	0.0006	0.0010	0.0015	0.0017	0.0023	0.0028	0.0032	0.0036	0.0042
61	0.2475	0.5175	3104	0.0006	0.0010	0.0016	0.0018	0.0025	0.0029	0.0037	0.0037	0.0042
62	0.2474	0.5212	3081	0.0006	0.0010	0.0016	0.0018	0.0024	0.0028	0.0032	0.0036	0.0041
63	0.2478	0.5185	3088	0.0007	0.0011	0.0018	0.0021	0.0022	0.0027	0.0034	0.0038	0.0043
64	0.2472	0.5191	3100	0.0006	0.0010	0.0017	0.0019	0.0026	0.0025	0.0033	0.0037	0.0042
65	0.2479	0.5189	3084	0.0007	0.0011	0.0016	0.0019	0.0025	0.0025	0.0032	0.0037	0.0043
66	0.2479	0.5178	3092	0.0007	0.0011	0.0017	0.0020	0.0026	0.0029	0.0037	0.0042	0.0047
Ave.	0.2479	0.5192	3082	0.0007	0.0010	0.0015	0.0018	0.0024	0.0027	0.0032	0.0036	0.0041
Med.	0.2478	0.5190	3085	0.0007	0.0010	0.0016	0.0018	0.0024	0.0028	0.0033	0.0037	0.0042
st dev	0.0007	0.0012	24.5386	0.0001	0.0002	0.0003	0.0003	0.0005	0.0006	0.0007	0.0006	0.0007
Min.	0.2467	0.5171	3021	0.0005	0.0006	0.0011	0.0012	0.0006	0.0001	0.0004	0.0013	0.0014
Max.	0.2499	0.5212	3117	0.0009	0.0017	0.0025	0.0030	0.0035	0.0037	0.0041	0.0044	0.0050



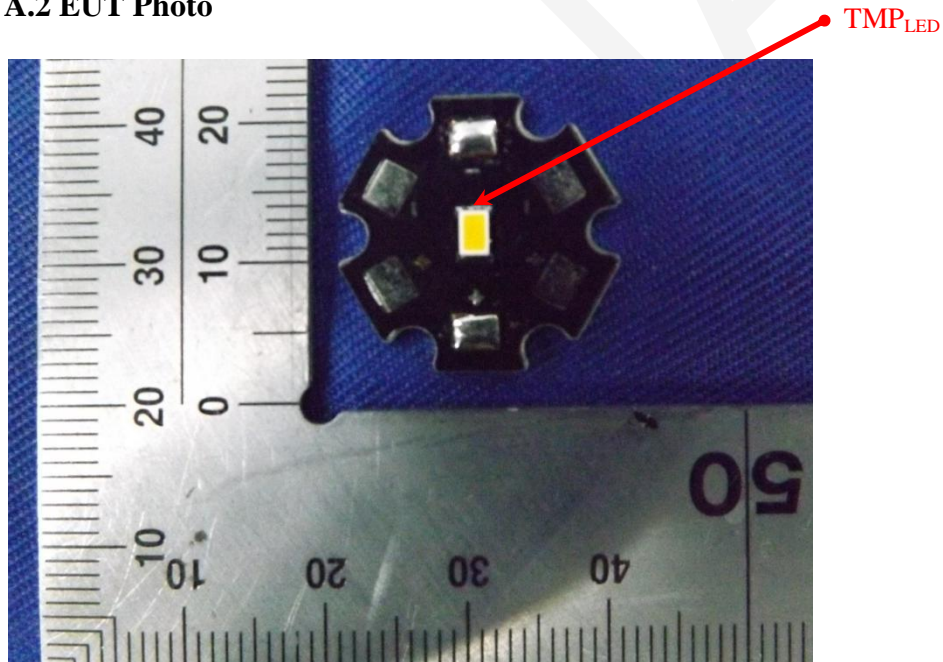
## Attachment A – EUT PHOTO

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



All dimensions are in millimeter

### A.2 EUT Photo



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**Attachment B – Declaration Letter**

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