



# IESNA LM-80-2008

MEASURING LUMEN MAINTENANCE OF LED LIGHT SOURCES

## MEASUREMENT AND TEST REPORT

For

**Toyoda Gosei Co., Ltd**

Higashitakasuga, Futatsudera, Ama, Aichi, Japan 490-1207

**Model: Exxxx-xxxxx-xx**

<b>Report Type:</b> 9000 Hours Test Report	<b>Product Type:</b> LED Package
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<b>Revised Note:</b>	The previous report RSZ161128503-10 is replaced by this report on 2016-12-07
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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: PBD-R8Q0-0000-RNR1-1  
 Part Type: LED Package  
 Nominal CCT: 2700K

#### Note:

1. The applicant *Toyoda Gosei Co., Ltd* declare that their product with model Exxxx-xxxxx-xx are the same to the product in report# RSZ150209501-10-9000-M1 and is authorized by original applicant to use their test data.
2. All the data in previous report (RSZ150209501-10-9000-M1) is shared in report.

#### Family products covered by this report:

According to ENERGY STAR® Program Guidance Regarding LED Package, LED Array and LED Module Lumen Maintenance Performance Data Supporting Qualification of Lighting Products, the following products can be covered by this report base on the declaration letter of manufacturer (see attachment B for more information). The information of these models shows that the covered products meet all section 3 item 7 requirements of ENERGY STAR® Program Guidance Regarding LED Package, LED Array and LED Module Lumen Maintenance Performance Data Supporting Qualification of Lighting Products (September 9, 2011)

Series Name	Model Number	CCT(K)	Current (mA)	Volt (v)
2835	Exxxx-xxxxx-xx (Test model: PBD-R8Q0-0000-RNR1-1)	2700/3000/3500/4000/4500/5000/5700/6500	200mA	3V

Model Number Format:

$$\begin{array}{c} \text{E} \\ \text{A1} \end{array} \text{ } \begin{array}{c} \text{XXXX} \\ \text{A2} \end{array} \text{ - } \begin{array}{c} \text{XXXXXX} \\ \text{A3} \end{array} \text{ - } \begin{array}{c} \text{XX} \\ \text{A4} \end{array} \text{ - } \begin{array}{c} \text{XX} \\ \text{A5} \end{array}$$

#### Note:

- A1: E is fixed code.  
 A2: Represent CCT.  
 A3: Represent driving current.  
 A4: Represent color bin, flux, voltage.  
 A5: Order number.

#### Disclaimer:

The truthfulness and accuracy of all the technical information above for the covered LED products is ensured by manufacturer of LED light source. Bay Area Compliance Laboratories Corp. (Dongguan) isn't responsible or gives any guarantees for the truthfulness of the technical information.

### 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	0.3m	2016-03-10	2017-03-09
Programmable Test Power for LEDs	EVERFINE	LED300E	1008002	15V/2000mA	2016-03-04	2017-03-03
High accuracy array spectroradiometer	EVERFINE	HAAS-2000	1012016T	380-780nm	2016-03-10	2017-03-09
Standard Light Source	EVERFINE	D062	1011093	N/A	2015-09-17	2016-09-16
Precision digital stabilized DC power supply	EVERFINE	WY605-V110	G115987CJ 7321114	300VA	2016-03-04	2017-03-03
Multilayer aging machine	BACL	B2-270	20023	25°C~110°C	2016-03-04	2017-03-03
Digital CC&CV DC Power Supply	EVERFINE	WY5015	11090007	(50/15A)	2016-03-04	2017-03-03
Digital CC&CV DC Power Supply	EVERFINE	WY5015	11090005	(50/15A)	2016-03-04	2017-03-03

### 1.5 Operating Cycle

Samples are driven with a constant direct current (DC)

### 1.6 Ambient Conditions

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

For photometry measurement, temperature was set to  $25^\circ\text{C} \pm 2^\circ\text{C}$ , 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 90Pcs;

Each Ts test condition 30Pcs

The samples tested at Ts 55°C, Ts 85°C and Ts 105°C were received at 2015-02-09 and tested during 2015-02-15 to 2016-03-10. The samples were numbered from 1 to 30, 31 to 60 and 61 to 90

#### Data Set 1: 55°C, 200mA

Part Number:	PBD-R8Q0-0000-RNR1-1
Number of Units:	30
Actual Case Temperature(T <sub>S</sub> ):	T <sub>S</sub> =54.6°C
Actual Ambient Temperature(T <sub>A</sub> ):	T <sub>A</sub> =52.5°C
Life Test Drive Current:	I <sub>F</sub> = 200mA
Measurement Current:	I <sub>F</sub> = 200mA

#### Data Set 2: 85°C,200mA

Part Number:	PBD-R8Q0-0000-RNR1-1
Number of Units:	30
Actual Case Temperature(T <sub>S</sub> ):	T <sub>S</sub> =84.1°C
Actual Ambient Temperature(T <sub>A</sub> ):	T <sub>A</sub> =82.6°C
Life Test Drive Current:	I <sub>F</sub> =200mA
Measurement Current:	I <sub>F</sub> = 200mA

#### Data Set 3: 105°C, 200mA

Part Number:	PBD-R8Q0-0000-RNR1-1
Number of Units:	30
Actual Case Temperature(T <sub>S</sub> ):	T <sub>S</sub> =104.1°C
Actual Ambient Temperature(T <sub>A</sub> ):	T <sub>A</sub> =103.9°C
Life Test Drive Current:	I <sub>F</sub> = 200mA
Measurement Current:	I <sub>F</sub> = 200mA

## 2 - SUMMARY OF TEST RESULT

<b>Data Set:</b>	<b>Data Set 1, 55°C, 200mA</b>
Number of Units:	30
Failures Observed:	0
Test Interval and Test Duration:	0h,1000h,2000h,3000h,4000h,5000h,6000h,7000h,8000h,9000h
Average. Lumen Maintenance at 6000 hours:	97.40%
Average. Lumen Maintenance at 9000 hours:	96.40%
Average Chromaticity Shift at 6000 hours ( $\Delta u'v'$ ):	0.0024
Average Chromaticity Shift at 9000 hours ( $\Delta u'v'$ ):	0.0033
Reported TM-21 L <sub>70</sub> Lifetime:	>54,000hours

<b>Data Set:</b>	<b>Data Set 2, 85°C, 200mA</b>
Number of Units:	30
Failures Observed:	0
Test Interval and Test Duration:	0h,1000h,2000h,3000h,4000h,5000h,6000h,7000h,8000h,9000h
Average. Lumen Maintenance at 6000 hours:	96.41%
Average. Lumen Maintenance at 9000 hours:	95.02%
Average Chromaticity Shift at 6000 hours( $\Delta u'v'$ ):	0.0021
Average Chromaticity Shift at 9000 hours ( $\Delta u'v'$ ):	0.0034
Reported TM-21 L <sub>70</sub> Lifetime:	>54,000hours

<b>Data Set:</b>	<b>Data Set 3, 105°C, 200mA</b>
Number of Units:	30
Failures Observed:	0
Test Interval and Test Duration:	0h,1000h,2000h,3000h,4000h,5000h,6000h,7000h,8000h,9000h
Average. Lumen Maintenance at 6000 hours:	95.83%
Average. Lumen Maintenance at 9000 hours:	94.03%
Average Chromaticity Shift at 6000 hours( $\Delta u'v'$ ):	0.0023
Average Chromaticity Shift at 9000 hours ( $\Delta u'v'$ ):	0.0035
Reported TM-21 L <sub>70</sub> Lifetime:	51,000hours

### 3 - Test Data

#### 3.1 Data Set 1, 55°C, 200mA (Lumen Maintenance)

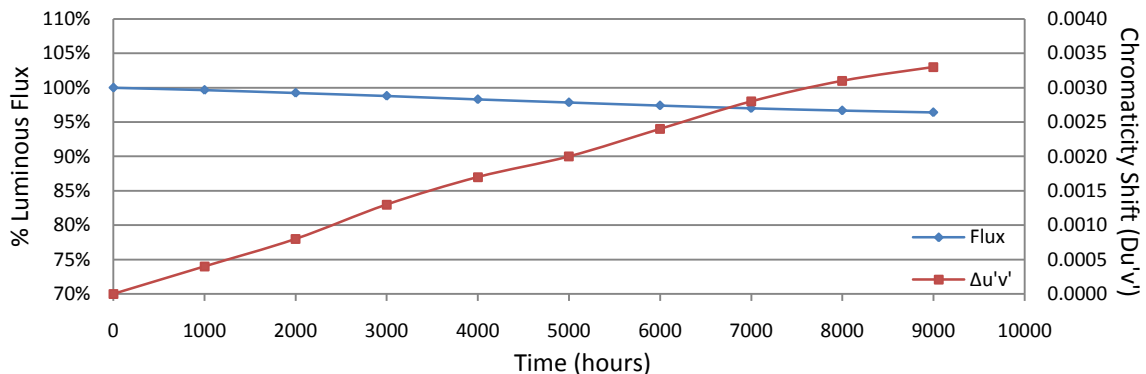
No.	V <sub>F</sub> (V)	Φ(lm)	Lumen Maintenance (%)								
	0hr(Initial)		1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
1	6.486	150.8	99.73	99.27	98.81	98.41	97.81	97.28	96.95	96.75	96.35
2	6.464	150.4	99.60	99.34	98.74	98.14	97.61	97.01	96.54	96.08	95.61
3	6.360	151.1	99.47	99.01	98.54	97.95	97.42	96.96	96.49	95.90	95.30
4	6.467	149.7	99.73	99.33	99.00	98.60	98.26	97.73	97.60	97.53	97.39
5	6.502	149.7	99.67	99.13	98.66	98.40	97.86	97.19	96.79	96.39	96.13
6	6.434	149.4	99.67	99.33	99.00	98.39	97.86	97.39	97.19	97.12	96.79
7	6.305	149.9	99.53	99.00	98.60	98.00	97.80	97.26	96.80	96.40	96.13
8	6.366	150.9	99.54	99.07	98.61	98.34	98.14	97.75	97.08	96.42	96.22
9	6.430	150.0	99.73	99.27	98.73	98.53	98.27	97.80	97.20	96.67	96.53
10	6.382	149.1	99.46	99.13	98.86	98.19	97.79	97.45	97.12	96.78	96.31
11	6.365	150.2	99.53	99.13	98.60	98.27	97.94	97.60	97.00	96.54	96.34
12	6.422	150.4	99.73	99.27	98.74	98.60	97.94	97.41	96.81	96.61	96.21
13	6.441	150.0	99.60	99.27	98.93	98.13	97.40	97.13	96.60	96.53	96.00
14	6.356	149.0	99.73	99.40	98.93	97.85	97.05	96.71	96.44	96.11	95.57
15	6.428	151.9	99.54	99.14	98.75	97.89	97.43	96.77	96.45	96.12	95.79
16	6.416	150.6	99.60	99.27	98.74	97.81	97.41	96.88	96.68	96.35	96.15
17	6.454	151.8	99.60	99.08	98.62	97.43	97.04	96.71	96.25	95.98	95.78
18	6.453	149.4	99.73	99.33	98.80	98.66	97.99	97.59	97.39	97.05	96.99
19	6.337	151.8	99.74	99.28	98.88	98.62	98.09	97.69	97.23	97.10	96.97
20	6.461	150.9	99.60	99.07	98.67	98.21	97.75	97.28	96.95	96.69	96.29
21	6.425	151.3	99.60	99.27	98.74	98.28	97.82	97.36	96.89	96.76	96.63
22	6.462	151.7	99.54	99.08	98.42	97.76	97.10	96.90	96.44	96.24	95.85
23	6.319	149.9	99.87	99.33	98.87	98.13	97.80	97.26	97.20	96.93	96.80
24	6.413	150.4	99.73	99.34	98.87	98.20	97.67	97.21	97.01	96.61	96.41
25	6.505	149.3	99.80	99.40	99.13	98.33	98.06	97.45	97.25	97.05	96.85
26	6.320	150.3	99.60	99.27	98.67	98.34	98.07	97.67	97.27	97.01	96.87
27	7.349	151.2	99.67	99.34	98.74	98.54	98.08	97.69	97.29	96.83	96.56
28	6.489	149.8	99.87	99.40	99.13	98.87	98.53	97.93	97.46	97.00	96.80
29	6.453	149.1	99.73	99.33	98.86	98.79	98.59	98.26	97.65	97.12	97.05
30	6.385	148.9	99.80	99.40	99.26	99.19	98.93	98.66	97.99	97.52	97.25
Ave.	6.448	150.3	99.66	99.24	98.80	98.30	97.85	97.40	97.00	96.67	96.40
Med.	6.429	150.3	99.67	99.27	98.75	98.30	97.84	97.37	97.01	96.68	96.35
st dev	0.1791	0.8942	0.1094	0.1233	0.1860	0.3669	0.4387	0.4450	0.4109	0.4260	0.5196
Min.	6.305	148.9	99.46	99.00	98.42	97.43	97.04	96.71	96.25	95.90	95.30
Max.	7.349	151.9	99.87	99.40	99.26	99.19	98.93	98.66	97.99	97.53	97.39

TM-21 Projection:

**Test Duration:** 9000 hours  
**Failures Observed:** 0  
 $\alpha$ : 3.946E-06  
 $\beta$ : 0.998  
**Calculated L<sub>70</sub>:** 90,000hours  
**Reported L<sub>70</sub>:** >54,000hours

### 3.2 Data Set 1, 55°C, 200mA (Chromaticity Shift)

No.	u'	v'	CCT(K)	Chromaticity Shift ( $\Delta u'v'$ )								
				0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs
1	0.2588	0.5277	2777	0.0006	0.0009	0.0019	0.0023	0.0023	0.0025	0.0028	0.0028	0.0032
2	0.2602	0.5272	2749	0.0005	0.0009	0.0014	0.0023	0.0025	0.0026	0.0029	0.0031	0.0032
3	0.2588	0.5265	2782	0.0004	0.0009	0.0014	0.0021	0.0024	0.0025	0.0027	0.0029	0.0031
4	0.2579	0.5293	2790	0.0006	0.0011	0.0013	0.0017	0.0024	0.0026	0.0028	0.0030	0.0031
5	0.2586	0.5269	2785	0.0005	0.0009	0.0013	0.0016	0.0022	0.0025	0.0027	0.0030	0.0033
6	0.2583	0.5267	2791	0.0005	0.0010	0.0014	0.0015	0.0020	0.0027	0.0028	0.0031	0.0033
7	0.2596	0.5254	2771	0.0005	0.0013	0.0016	0.0017	0.0021	0.0027	0.0028	0.0033	0.0035
8	0.2590	0.5263	2778	0.0004	0.0009	0.0016	0.0017	0.0020	0.0025	0.0028	0.0031	0.0033
9	0.2579	0.5268	2801	0.0003	0.0010	0.0016	0.0017	0.0020	0.0024	0.0028	0.0031	0.0033
10	0.2597	0.5287	2754	0.0003	0.0008	0.0014	0.0018	0.0021	0.0025	0.0028	0.0031	0.0032
11	0.2576	0.5259	2811	0.0003	0.0007	0.0014	0.0016	0.0019	0.0024	0.0028	0.0030	0.0031
12	0.2581	0.5275	2792	0.0005	0.0011	0.0016	0.0021	0.0025	0.0029	0.0034	0.0037	0.0039
13	0.2591	0.5283	2768	0.0003	0.0007	0.0012	0.0017	0.0018	0.0021	0.0027	0.0030	0.0031
14	0.2596	0.5245	2774	0.0004	0.0009	0.0014	0.0018	0.0021	0.0024	0.0030	0.0032	0.0034
15	0.2582	0.5274	2792	0.0003	0.0008	0.0012	0.0017	0.0020	0.0023	0.0028	0.0031	0.0033
16	0.2589	0.5290	2769	0.0003	0.0007	0.0012	0.0016	0.0018	0.0022	0.0028	0.0030	0.0032
17	0.2597	0.5286	2754	0.0004	0.0008	0.0014	0.0018	0.0021	0.0024	0.0029	0.0033	0.0033
18	0.2584	0.5288	2780	0.0004	0.0007	0.0012	0.0016	0.0019	0.0023	0.0028	0.0030	0.0032
19	0.2600	0.5267	2756	0.0003	0.0008	0.0011	0.0016	0.0020	0.0023	0.0028	0.0030	0.0032
20	0.2581	0.5273	2794	0.0002	0.0008	0.0011	0.0018	0.0021	0.0024	0.0029	0.0033	0.0035
21	0.2597	0.5305	2744	0.0003	0.0006	0.0009	0.0016	0.0017	0.0021	0.0027	0.0029	0.0030
22	0.2617	0.5309	2702	0.0003	0.0008	0.0011	0.0018	0.0020	0.0023	0.0028	0.0030	0.0032
23	0.2586	0.5272	2784	0.0003	0.0007	0.0011	0.0018	0.0019	0.0023	0.0028	0.0030	0.0033
24	0.2594	0.5274	2765	0.0004	0.0008	0.0011	0.0018	0.0020	0.0023	0.0029	0.0031	0.0034
25	0.2598	0.5265	2761	0.0002	0.0007	0.0009	0.0016	0.0018	0.0022	0.0027	0.0031	0.0034
26	0.2591	0.5251	2783	0.0003	0.0008	0.0011	0.0013	0.0020	0.0023	0.0028	0.0031	0.0033
27	0.2575	0.5281	2804	0.0004	0.0007	0.0011	0.0016	0.0021	0.0025	0.0030	0.0033	0.0035
28	0.2607	0.5279	2736	0.0004	0.0008	0.0011	0.0015	0.0020	0.0023	0.0028	0.0030	0.0033
29	0.2579	0.5261	2803	0.0002	0.0007	0.0009	0.0013	0.0018	0.0021	0.0027	0.0030	0.0031
30	0.2582	0.5253	2801	0.0003	0.0006	0.0009	0.0013	0.0017	0.0021	0.0026	0.0030	0.0032
Ave.	0.2590	0.5274	2775	0.0004	0.0008	0.0013	0.0017	0.0020	0.0024	0.0028	0.0031	0.0033
Med.	0.2589	0.5273	2779	0.0003	0.0008	0.0012	0.0017	0.0020	0.0024	0.0028	0.0031	0.0033
st dev	0.0010	0.0015	23.6008	0.0001	0.0002	0.0002	0.0002	0.0002	0.0002	0.0001	0.0002	0.0002
Min.	0.2575	0.5245	2702	0.0002	0.0006	0.0009	0.0013	0.0017	0.0021	0.0026	0.0028	0.0030
Max.	0.2617	0.5309	2811	0.0006	0.0013	0.0019	0.0023	0.0025	0.0029	0.0034	0.0037	0.0039





**3.3 Data Set 2, 85°C, 200mA (Lumen Maintenance)**

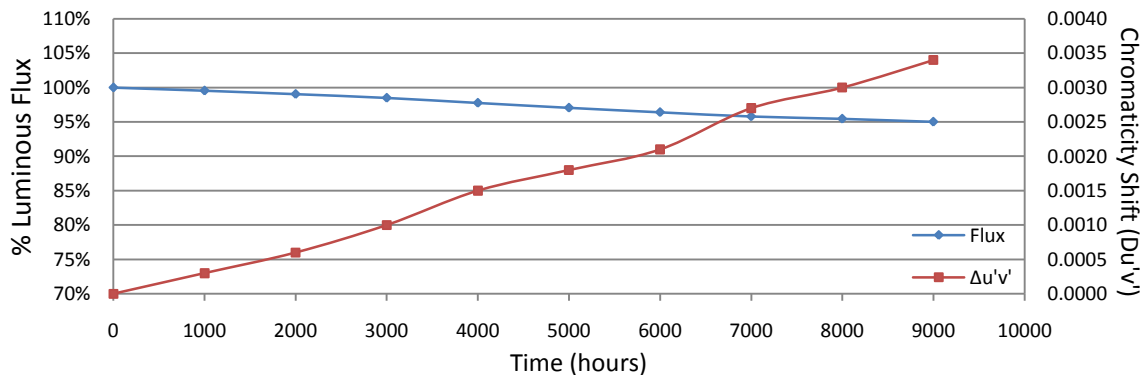
No.	V <sub>F</sub> (V)	Φ(lm)	Lumen Maintenance (%)								
			0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs
31	6.363	151.0	99.60	99.14	98.54	98.61	97.95	97.22	96.36	95.76	95.30
32	6.316	149.8	99.53	99.13	98.66	97.46	96.66	95.93	95.33	94.93	94.73
33	6.488	148.6	99.66	99.13	98.59	97.78	96.97	95.90	95.22	94.62	94.15
34	6.457	150.5	99.60	99.14	98.54	98.07	97.28	96.41	95.88	95.61	95.28
35	6.383	150.0	99.60	99.07	98.40	97.60	96.73	96.27	95.67	94.87	94.33
36	6.327	150.4	99.34	98.94	98.34	97.47	96.68	96.34	95.68	95.48	95.01
37	6.475	151.2	99.47	99.01	98.54	96.83	95.77	95.30	94.71	94.51	94.18
38	6.427	148.1	99.59	98.99	98.24	97.16	96.42	95.81	95.41	95.34	95.00
39	6.448	151.1	99.34	98.94	98.41	97.75	97.35	96.89	96.23	96.03	95.50
40	6.347	150.3	99.67	99.14	98.54	97.80	97.54	96.67	96.01	95.61	95.28
41	6.441	149.2	99.73	99.33	98.99	97.59	97.39	96.38	95.91	95.78	95.51
42	6.419	150.7	99.34	98.94	98.47	97.48	97.08	96.22	95.49	95.22	94.96
43	6.383	150.4	99.73	99.20	98.87	98.01	97.74	97.01	96.21	96.08	95.35
44	6.507	149.8	99.60	99.00	98.46	97.66	97.40	96.66	95.99	95.79	95.53
45	6.465	148.9	99.60	99.19	98.66	97.99	97.25	96.91	96.37	95.97	95.57
46	6.422	151.3	99.34	98.88	98.22	97.29	96.63	96.23	95.64	95.51	94.98
47	6.401	149.0	99.26	98.79	98.39	97.72	96.98	96.71	96.17	95.84	95.50
48	6.448	150.7	99.47	98.94	98.41	97.61	96.88	96.48	95.89	95.75	95.22
49	6.366	149.1	99.87	99.40	98.86	97.85	97.18	96.71	96.38	95.91	95.44
50	6.316	150.0	99.53	98.80	98.27	97.47	96.80	96.47	95.80	95.53	95.13
51	6.501	149.6	99.47	98.93	98.26	97.59	96.93	96.32	95.99	95.66	94.99
52	6.360	150.0	99.53	99.00	98.47	97.73	96.93	96.53	96.00	95.60	95.07
53	6.406	151.1	99.47	98.94	98.41	98.08	97.42	96.82	96.16	95.83	95.43
54	6.406	149.0	99.66	99.06	98.52	98.19	97.92	97.38	96.58	96.17	95.70
55	6.400	149.7	99.53	99.06	98.46	98.06	97.19	95.93	95.19	94.92	94.52
56	6.321	149.8	99.40	98.87	98.33	98.00	97.06	95.86	95.33	95.13	94.53
57	6.444	150.2	99.80	99.40	98.87	98.34	96.74	95.87	95.34	94.61	94.14
58	6.430	149.1	99.73	99.13	98.52	98.26	97.25	96.45	95.84	95.24	94.90
59	6.371	150.7	99.67	99.14	98.54	97.94	96.95	96.42	95.62	95.36	94.82
60	6.473	149.4	99.40	98.86	98.06	97.72	96.72	96.18	95.72	95.18	94.65
Ave.	6.410	150.0	99.55	99.05	98.50	97.77	97.06	96.41	95.80	95.46	95.02
Med.	6.413	150.0	99.56	99.03	98.47	97.74	97.02	96.41	95.86	95.57	95.04
st dev	0.0555	0.8394	0.1518	0.1587	0.2094	0.3661	0.4495	0.4550	0.4271	0.4565	0.4527
Min.	6.316	148.1	99.26	98.79	98.06	96.83	95.77	95.30	94.71	94.51	94.14
Max.	6.507	151.3	99.87	99.40	98.99	98.61	97.95	97.38	96.58	96.17	95.70

TM-21 Projection:

**Test Duration:** 9000 hours  
**Failures Observed:** 0  
**α:** 5.682E-06  
**β:** 0.999  
**Calculated L<sub>70</sub>:** 63,000hours  
**Reported L<sub>70</sub>:** >54,000hours

### 3.4 Data Set 2, 85°C, 200mA (Chromaticity Shift)

No.	u'	v'	CCT(K)	Chromaticity Shift ( $\Delta u'v'$ )								
				0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs
31	0.2586	0.5268	2785	0.0003	0.0007	0.0011	0.0015	0.0019	0.0023	0.0029	0.0031	0.0035
32	0.2586	0.5241	2797	0.0004	0.0006	0.0011	0.0014	0.0020	0.0023	0.0029	0.0033	0.0036
33	0.2590	0.5283	2770	0.0004	0.0008	0.0012	0.0016	0.0021	0.0023	0.0029	0.0033	0.0036
34	0.2583	0.5282	2785	0.0002	0.0007	0.0011	0.0015	0.0018	0.0022	0.0028	0.0031	0.0035
35	0.2599	0.5260	2761	0.0003	0.0006	0.0010	0.0014	0.0017	0.0021	0.0028	0.0032	0.0035
36	0.2589	0.5256	2785	0.0003	0.0006	0.0010	0.0014	0.0017	0.0021	0.0027	0.0030	0.0033
37	0.2593	0.5286	2762	0.0003	0.0005	0.0010	0.0013	0.0017	0.0021	0.0027	0.0029	0.0033
38	0.2591	0.5270	2774	0.0002	0.0004	0.0010	0.0013	0.0017	0.0021	0.0027	0.0030	0.0033
39	0.2580	0.5283	2791	0.0003	0.0006	0.0011	0.0015	0.0018	0.0021	0.0028	0.0031	0.0034
40	0.2592	0.5272	2771	0.0004	0.0007	0.0011	0.0016	0.0018	0.0021	0.0029	0.0031	0.0036
41	0.2581	0.5238	2811	0.0003	0.0006	0.0011	0.0015	0.0019	0.0021	0.0028	0.0032	0.0035
42	0.2594	0.5279	2764	0.0003	0.0006	0.0011	0.0015	0.0018	0.0021	0.0028	0.0031	0.0035
43	0.2608	0.5297	2726	0.0002	0.0005	0.0008	0.0013	0.0016	0.0018	0.0026	0.0029	0.0033
44	0.2582	0.5294	2782	0.0002	0.0005	0.0009	0.0013	0.0016	0.0019	0.0027	0.0029	0.0033
45	0.2580	0.5286	2791	0.0003	0.0005	0.0010	0.0014	0.0017	0.0020	0.0027	0.0029	0.0032
46	0.2582	0.5276	2791	0.0004	0.0008	0.0011	0.0015	0.0018	0.0021	0.0028	0.0031	0.0036
47	0.2581	0.5274	2793	0.0002	0.0006	0.0009	0.0013	0.0018	0.0021	0.0027	0.0030	0.0033
48	0.2585	0.5291	2776	0.0002	0.0005	0.0009	0.0013	0.0016	0.0019	0.0026	0.0028	0.0033
49	0.2595	0.5264	2768	0.0003	0.0006	0.0010	0.0011	0.0014	0.0017	0.0023	0.0025	0.0034
50	0.2586	0.5259	2789	0.0002	0.0006	0.0010	0.0014	0.0018	0.0021	0.0028	0.0030	0.0034
51	0.2591	0.5274	2771	0.0002	0.0004	0.0010	0.0015	0.0018	0.0021	0.0028	0.0030	0.0035
52	0.2597	0.5272	2760	0.0003	0.0006	0.0010	0.0014	0.0017	0.0021	0.0028	0.0030	0.0035
53	0.2602	0.5279	2746	0.0003	0.0007	0.0011	0.0016	0.0020	0.0021	0.0028	0.0031	0.0035
54	0.2596	0.5286	2757	0.0004	0.0007	0.0011	0.0016	0.0020	0.0021	0.0028	0.0030	0.0034
55	0.2580	0.5261	2801	0.0003	0.0007	0.0011	0.0016	0.0020	0.0022	0.0028	0.0031	0.0037
56	0.2593	0.5255	2776	0.0003	0.0006	0.0011	0.0016	0.0020	0.0021	0.0028	0.0031	0.0035
57	0.2599	0.5286	2749	0.0004	0.0007	0.0011	0.0016	0.0019	0.0021	0.0028	0.0030	0.0034
58	0.2583	0.5269	2791	0.0003	0.0006	0.0010	0.0015	0.0017	0.0019	0.0025	0.0029	0.0032
59	0.2590	0.5264	2779	0.0003	0.0007	0.0011	0.0017	0.0021	0.0022	0.0028	0.0031	0.0034
60	0.2587	0.5270	2782	0.0003	0.0007	0.0011	0.0016	0.0020	0.0021	0.0028	0.0030	0.0034
Ave.	0.2589	0.5273	2776	0.0003	0.0006	0.0010	0.0015	0.0018	0.0021	0.0027	0.0030	0.0034
Med.	0.2590	0.5273	2778	0.0003	0.0006	0.0011	0.0015	0.0018	0.0021	0.0028	0.0030	0.0034
st dev	0.0007	0.0014	18.0397	0.0001	0.0001	0.0001	0.0001	0.0002	0.0001	0.0001	0.0001	0.0001
Min.	0.2580	0.5238	2726	0.0002	0.0004	0.0008	0.0011	0.0014	0.0017	0.0023	0.0025	0.0032
Max.	0.2608	0.5297	2811	0.0004	0.0008	0.0012	0.0017	0.0021	0.0023	0.0029	0.0033	0.0037



**3.5 Data Set 3, 105°C, 200mA (Lumen Maintenance)**

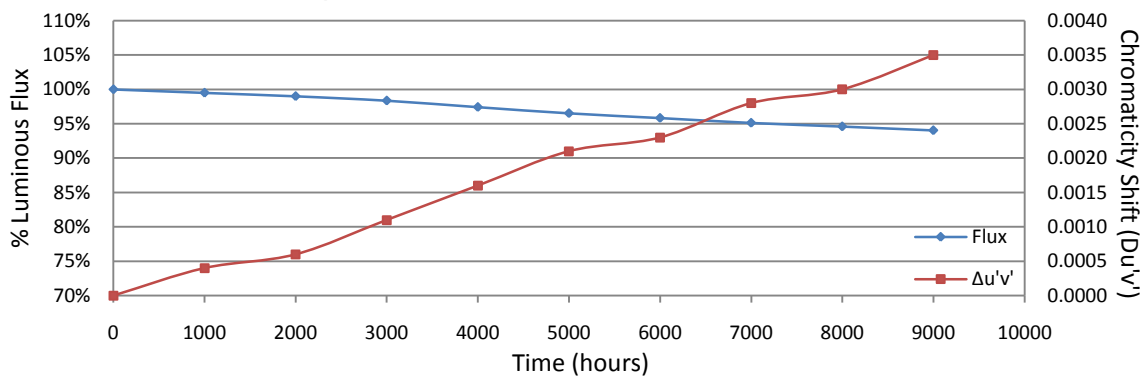
No.	V <sub>F</sub> (V)	Φ(lm)	Lumen Maintenance (%)								
			0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs
61	6.339	149.9	99.40	98.80	98.27	97.26	96.33	95.73	94.93	94.33	93.93
62	6.489	150.3	99.33	98.80	98.14	97.27	96.27	95.74	94.88	94.48	94.01
63	6.314	149.2	99.46	99.06	98.39	97.52	96.65	96.11	95.58	94.97	94.30
64	6.311	149.4	99.46	98.80	98.26	97.39	96.45	95.92	95.25	94.78	94.31
65	6.447	149.4	99.60	99.06	98.33	97.32	96.32	95.72	95.25	95.05	94.58
66	6.361	150.6	99.54	99.07	98.34	97.34	96.41	95.82	95.22	95.09	94.36
67	6.453	152.0	99.34	98.82	98.16	97.11	96.12	95.53	94.87	94.34	94.08
68	6.320	150.0	99.67	99.13	98.40	97.67	96.87	96.13	95.67	95.13	94.60
69	6.480	149.0	99.73	99.19	98.52	98.05	97.18	96.64	95.97	95.30	94.70
70	6.410	150.9	99.34	98.81	98.34	97.42	96.69	95.96	95.36	94.90	94.37
71	6.390	153.4	99.54	98.96	98.37	97.59	96.68	96.02	95.24	94.72	94.46
72	6.408	149.0	99.46	98.79	98.12	97.05	95.91	95.10	94.36	93.89	93.15
73	6.429	151.1	99.54	99.14	98.61	97.09	96.29	95.70	94.97	94.31	93.65
74	6.392	150.7	99.60	99.07	97.88	97.35	96.48	95.75	95.16	94.49	94.09
75	6.431	149.8	99.53	98.93	98.26	97.00	96.13	95.46	94.86	94.33	93.59
76	6.365	150.3	99.53	99.00	98.40	97.87	96.94	96.47	95.74	95.14	94.54
77	6.429	148.7	99.39	98.86	98.18	97.51	96.84	95.97	95.43	95.09	94.49
78	6.478	148.3	99.66	99.19	98.65	97.71	96.97	96.09	95.48	95.08	94.47
79	6.323	151.2	99.47	99.07	98.54	97.62	97.02	96.16	95.57	94.71	94.25
80	6.499	150.3	99.47	98.94	98.34	97.41	96.47	95.61	95.01	94.28	93.81
81	6.493	151.8	99.67	99.14	98.42	97.56	96.77	95.85	95.26	94.47	93.87
82	6.439	149.6	99.67	99.26	98.60	97.53	96.72	95.99	95.05	94.45	93.78
83	6.444	148.6	99.39	98.86	98.05	97.58	97.17	96.57	95.56	94.82	94.28
84	6.334	151.2	99.40	99.01	98.35	97.29	96.36	95.70	94.97	94.51	93.85
85	6.464	150.0	99.47	99.00	98.33	97.20	96.13	95.47	94.60	94.07	93.47
86	6.378	149.5	99.53	99.13	98.60	97.32	96.32	95.52	94.92	94.11	93.51
87	6.411	149.1	99.46	98.93	98.39	97.32	96.18	95.44	94.77	94.23	93.76
88	6.495	149.2	99.40	98.99	98.39	97.25	96.18	95.44	94.37	94.10	93.36
89	6.473	148.5	99.60	99.26	98.86	97.71	96.63	95.89	94.88	94.55	93.87
90	6.402	148.8	99.40	98.92	98.45	97.24	96.17	95.50	94.49	94.09	93.41
Ave.	6.413	150.0	99.50	99.00	98.36	97.42	96.52	95.83	95.12	94.59	94.03
Med.	6.420	149.9	99.47	99.00	98.36	97.37	96.46	95.78	95.10	94.50	94.05
st dev	0.0594	1.1791	0.1101	0.1449	0.1969	0.2432	0.3409	0.3525	0.4021	0.3921	0.4233
Min.	6.311	148.3	99.33	98.79	97.88	97.00	95.91	95.10	94.36	93.89	93.15
Max.	6.499	153.4	99.73	99.26	98.86	98.05	97.18	96.64	95.97	95.30	94.70

TM-21 Projection:

**Test Duration:** 9000 hours  
**Failures Observed:** 0  
**α:** 7.003E-06  
**β:** 1.000  
**Calculated L<sub>70</sub>:** 51,000hours  
**Reported L<sub>70</sub>:** 51,000hours

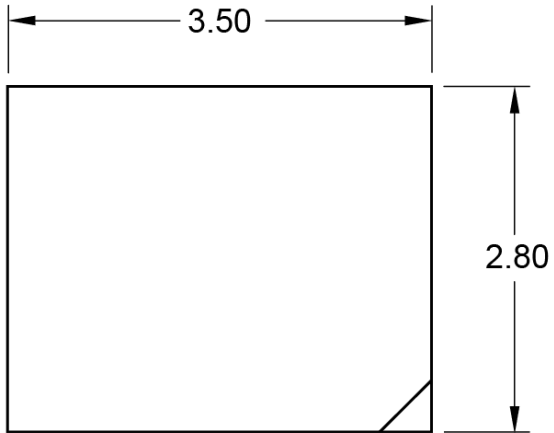
### 3.6 Data Set 3, 105°C, 200mA (Chromaticity Shift)

No.	u'	v'	CCT(K)	Chromaticity Shift ( $\Delta u'v'$ )								
				0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs
61	0.2587	0.5261	2786	0.0003	0.0006	0.0011	0.0017	0.0022	0.0023	0.0028	0.0030	0.0036
62	0.2608	0.5311	2719	0.0001	0.0005	0.0012	0.0016	0.0021	0.0023	0.0028	0.0030	0.0034
63	0.2605	0.5266	2746	0.0004	0.0008	0.0012	0.0019	0.0023	0.0025	0.0030	0.0033	0.0039
64	0.2586	0.5263	2788	0.0003	0.0005	0.0011	0.0016	0.0021	0.0023	0.0028	0.0030	0.0035
65	0.2601	0.5280	2747	0.0002	0.0006	0.0010	0.0016	0.0020	0.0023	0.0028	0.0030	0.0035
66	0.2589	0.5286	2771	0.0003	0.0006	0.0011	0.0016	0.0021	0.0023	0.0028	0.0030	0.0035
67	0.2592	0.5288	2764	0.0004	0.0007	0.0011	0.0017	0.0022	0.0024	0.0030	0.0032	0.0036
68	0.2595	0.5247	2774	0.0002	0.0006	0.0010	0.0016	0.0020	0.0022	0.0028	0.0031	0.0035
69	0.2589	0.5273	2777	0.0004	0.0006	0.0011	0.0016	0.0020	0.0023	0.0028	0.0030	0.0035
70	0.2602	0.5287	2743	0.0004	0.0006	0.0009	0.0014	0.0019	0.0021	0.0027	0.0029	0.0034
71	0.2593	0.5288	2761	0.0004	0.0007	0.0011	0.0017	0.0021	0.0023	0.0028	0.0031	0.0036
72	0.2593	0.5231	2787	0.0004	0.0005	0.0010	0.0016	0.0021	0.0023	0.0029	0.0031	0.0035
73	0.2599	0.5283	2750	0.0005	0.0007	0.0011	0.0017	0.0021	0.0023	0.0029	0.0031	0.0036
74	0.2575	0.5260	2812	0.0004	0.0006	0.0011	0.0016	0.0022	0.0024	0.0028	0.0030	0.0036
75	0.2601	0.5279	2747	0.0004	0.0006	0.0011	0.0017	0.0021	0.0023	0.0028	0.0031	0.0035
76	0.2582	0.5249	2802	0.0004	0.0007	0.0011	0.0016	0.0021	0.0023	0.0028	0.0030	0.0035
77	0.2598	0.5282	2754	0.0004	0.0008	0.0011	0.0016	0.0021	0.0023	0.0028	0.0031	0.0035
78	0.2589	0.5274	2776	0.0004	0.0006	0.0011	0.0017	0.0021	0.0024	0.0029	0.0031	0.0037
79	0.2595	0.5275	2763	0.0003	0.0006	0.0009	0.0016	0.0020	0.0022	0.0027	0.0030	0.0033
80	0.2615	0.5316	2704	0.0003	0.0006	0.0010	0.0015	0.0020	0.0021	0.0026	0.0029	0.0033
81	0.2593	0.5276	2766	0.0004	0.0008	0.0011	0.0017	0.0022	0.0023	0.0029	0.0031	0.0036
82	0.2608	0.5301	2725	0.0004	0.0007	0.0010	0.0016	0.0021	0.0023	0.0027	0.0029	0.0034
83	0.2589	0.5263	2780	0.0004	0.0004	0.0009	0.0014	0.0020	0.0021	0.0026	0.0028	0.0033
84	0.2580	0.5262	2800	0.0004	0.0005	0.0009	0.0015	0.0020	0.0022	0.0027	0.0030	0.0033
85	0.2591	0.5275	2771	0.0004	0.0005	0.0010	0.0015	0.0020	0.0023	0.0028	0.0030	0.0034
86	0.2593	0.5264	2771	0.0004	0.0006	0.0011	0.0016	0.0021	0.0023	0.0028	0.0030	0.0035
87	0.2602	0.5276	2747	0.0004	0.0006	0.0010	0.0018	0.0023	0.0025	0.0030	0.0033	0.0038
88	0.2597	0.5281	2757	0.0005	0.0006	0.0011	0.0016	0.0021	0.0023	0.0029	0.0030	0.0035
89	0.2587	0.5277	2778	0.0004	0.0006	0.0010	0.0016	0.0021	0.0023	0.0028	0.0030	0.0035
90	0.2585	0.5255	2793	0.0004	0.0006	0.0010	0.0016	0.0021	0.0023	0.0028	0.0030	0.0036
Ave.	0.2594	0.5274	2765	0.0004	0.0006	0.0011	0.0016	0.0021	0.0023	0.0028	0.0030	0.0035
Med.	0.2593	0.5276	2769	0.0004	0.0006	0.0011	0.0016	0.0021	0.0023	0.0028	0.0030	0.0035
st dev	0.0009	0.0018	24.6159	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Min.	0.2575	0.5231	2704	0.0001	0.0004	0.0009	0.0014	0.0019	0.0021	0.0026	0.0028	0.0033
Max.	0.2615	0.5316	2812	0.0005	0.0008	0.0012	0.0019	0.0023	0.0025	0.0030	0.0033	0.0039



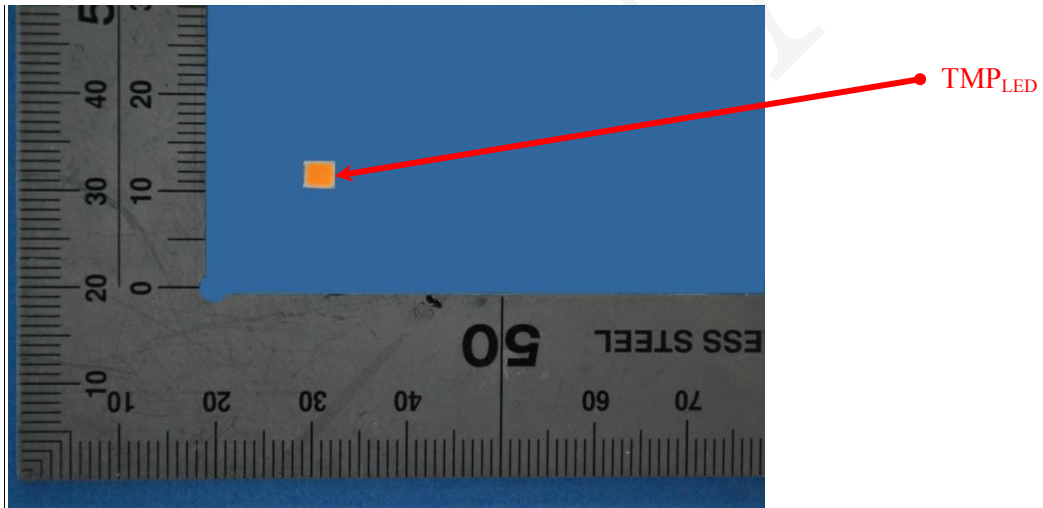
## Attachment A – EUT PHOTO

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



All dimensions are in millimeter

### A.2 EUT Photo



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**Attachment B – Family declaration Letter**

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**Report Revision**

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Report Number	Report Date	Contents
RSZ161128503-10	2016-12-05	Original report.
RSZ161128503-10-M1	2016-12-07	Update the model number in page 1.

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