



# TEST REPORT

ACCORDING TO IES LM-80-2015  
For

## Hongli Zhihui Group Co.,Ltd. Guangzhou Branch

Room 316, Building 2, No.1, Xianke Yi Road, Huadong Town, Huadu District, Guangzhou, China

**Model: HL-A-2835HW-2-S1-08L-HR3**

<b>Report Type:</b> 9000 Hours Test Report		<b>Product Type:</b> LED Package	
<b>Test Engineer:</b>	Pote Wang	<i>Pote Wang</i>	
<b>Report Number:</b>	RSZ161206501-10-9000-M2		
<b>Test Date:</b>	2016-12-08 to 2017-12-18		
<b>Report Date:</b>	2019-01-14		
<b>Reviewed By:</b>	Daniel Duan / EE Manager	<i>Daniel Duan</i>	
<b>Revised Note:</b>	The previous report RSZ161206501-10-9000-M1 is replaced by this report on 2019-01-14		
<b>Test Facility:</b>	Test facility was located at No.69,Pulongcun ,Puxinhu Industrial Area, Tangxia , Dongguan, Guangdong, China.		
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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

#### Sample Size:

75 PCS samples were received on 2016-12-06. The samples were numbered from 1 to 25, 26 to 50 and 51 to 75.

Manufacturer:	Hongli Zhihui Group Co.,Ltd. Guangzhou Branch
Part Number:	HL-A-2835HW-2-S1-08L-HR3
Part Type:	LED Package
Drive Level:	DC 65mA
Nominal CCT:	2700K
Power:	0.36 W
Current Density per LED die:	335.83 mA/mm <sup>2</sup>
Power Density per LED die:	0.93 W/mm <sup>2</sup>
CRI:	80
Die Spacing:	0.15mm

#### Family products covered by this report:

According to ENERGY STAR® Requirements for the Use of LM-80 Data, the following products can be covered by this report base on the information and declaration provided by manufacturer. The information of these models shows that the covered products meet all section 4 requirements of ENERGY STAR® Requirements for the Use of LM-80 Data (September 28, 2017)

This report covers the following models:

Test Model Number	Multiple Models	Details
HL-A-2835HW-2-S1-08L-HR3	HL-A-2835HW-2-S1-08L-HR3(R9)	Only different Model name for different market.
	HL-A-2835DW-2-S1-08L-HR3	
	HL-A-2835DW-2-S1-08L-HR3(R9)	
	HL-A-PU2835HW-2-S1-08L-HR3	
	HL-A-PU2835HW-2-S1-08L-HR3(R9)	
	HL-A-PU2835DW-2-S1-08L-HR3	
	HL- A-PU2835DW-2-S1-08L-HR3 (R9)	
	HL-A-2835HW-2-S1-08-HR3	
	HL-A-2835HW-2-S1-08-HR3(R9)	
	HL-A-2835DW-2-S1-08-HR3	
	HL-A-2835DW-2-S1-08-HR3(R9)	
	HL-A-PU2835HW-2-S1-08-HR3	
	HL-A-PU2835HW-2-S1-08-HR3(R9)	
	HL-A-PU2835DW-2-S1-08-HR3	
	HL- A-PU2835DW-2-S1-08-HR3 (R9)	
	HL-A-2835HW-2-S1-08L-PCT-HR3	
	HL-A-2835HW-2-S1-08L-PCT-HR3(R9)	

Test Model Number	Multiple Models	Details
	HL-A-2835DW-2-S1-08L-PCT -HR3	
	HL-A-2835DW-2-S1-08L-PCT -HR3(R9)	
	HL-A-PU2835HW-2-S1-08L-PCT -HR3	
	HL-A-PU2835HW-2-S1-08L-PCT-HR3 (R9)	
	HL-A-PU2835DW-2-S1-08L-PCT -HR3	
	HL-A-PU2835DW-2-S1-08L-PCT-HR3 (R9)	
	HL-A-2835HW-2-S1-08-PCT-HR3	
	HL-A-2835HW-2-S1-08-PCT-HR3(R9)	
	HL-A-2835DW-2-S1-08-PCT-HR3	
	HL-A-2835DW-2-S1-08-PCT-HR3(R9)	
	HL-A-PU2835HW-2-S1-08-PCT-HR3	
	HL-A-PU2835HW-2-S1-08-PCT -HR3(R9)	
	HL-A-PU2835DW-2-S1-08-PCT -HR3	
	HL- A-PU2835DW-2-S1-08-PCT -HR3 (R9)	

## 1.2 Standards Used:

- IESNA LM-80-15: IES Approved Method for Measuring Lumen Maintenance of LED Light Sources.
- ENERGY STAR® Requirements for the Use of LM-80 Data (This standard was not accredited by IAS)

## 1.3 Testing Equipment

Device	Manufacture	Model No	Serial No	Calibration date	Calibration due date
0.3m integrating sphere	EVERFINE	Diameter 0.3m	1011119	2017-03-09	2018-03-09
Programmable Test Power for LEDs	EVERFINE	LED300E	1008002	2017-03-03	2018-03-03
High accuracy array spectroradiometer	EVERFINE	HAAS-2000	1012016T	2017-03-09	2018-03-09
Standard Light Source	EVERFINE	D062	1011093	2017-09-13	2018-09-13
Precision digital stabilized DC power supply	EVERFINE	WY605-V110	G115987CJ7321114	2017-03-03	2018-03-03
Multilayer aging machine	BACL	B2-270	20015	2017-03-03	2018-03-03
Digital CC&CV DC Power Supply	EVERFINE	WY5015	11090007	2017-03-03	2018-03-03

Device	Manufacture	Model No	Serial No	Calibration date	Calibration due date
Digital CC&CV DC Power Supply	EVERFINE	WY5015	11090005	2017-03-03	2018-03-03
Digital CC&CV DC Power Supply	EVERFINE	WY5015	11090006	2017-03-03	2018-03-03

#### 1.4 Drive Level

Samples are driven with a constant direct current (DC) during maintenance test, photometric and electrical measurement. The current value was regulated to within  $\pm 3\%$  of the specified value of the manufacturer during maintenance test, and was within  $\pm 0.5\%$  during photometric and electrical measurement test.

#### 1.5 Ambient Conditions for Maintenance Test

For lumen maintenance test, samples within one data set, were installed on cooling boards in thermal chambers with minimal ambient airflow. The case temperature and ambient temperature was monitored by thermocouples which one was soldered to the coldest DUTs' case ( $TMP_{LED}$ ) location, while the other is mounted at a distance of 5 mm above the TMP location.

During life testing,  $TMP_{LED}$  of the coldest LEDs were maintained at a temperature that was greater than or equal to  $2^{\circ}\text{C}$  below the corresponding nominal case temperature. Surrounding air was maintained at a temperature that was greater than or equal to  $5^{\circ}\text{C}$  below the corresponding nominal case temperature. Thermocouples were shielded from direct DUT optical radiation and comply with ASTM E230 Table 1 "Special Limits".

Samples were connected to DC power supply in series circuits with a constant current. The forward current was regulated to within  $\pm 3\%$  of the specified value of the manufacturer.

The relative humidity within chamber was kept less than 65% during test.

For photometry measurement, the ambient temperature during test was set to  $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$ , RH <65%.

#### 1.6 Photometric Measurement Method and Uncertainty

Integrating sphere and spectroradiometer is used to measure luminous flux and chromaticity coordinate  $u'v'$ .  $2\pi$  measurement was used and sample was driven by DC power supply. Luminous flux and chromaticity coordinate was scaled by halogen reference lamp. The ambient temperature during test was set to  $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$ , RH <65%.

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.

The uncertainty of the temperature is  $U=0.8671^{\circ}\text{C}$  ( $K=2$ ), at the 95% confidence level.

## 1.7 Statement of Traceability

Bay Area Compliance Laboratories Corp. (Dongguan) attested that all calibration has been performed using suitable standards traceable to National Primary Standards and International System of Units (SI).

## 1.8 Sample Set

### Data Set 1: 55°C, 65mA

Part Number: HL-A-2835HW-2-S1-08L-HR3

Number of Units: 25

Case Temperature: >53°C

Ambient Temperature: >50°C

Life Test Drive Current: 65mA

Measurement Current: 65mA

### Data Set 2: 85°C,65mA

Part Number: HL-A-2835HW-2-S1-08L-HR3

Number of Units: 25

Case Temperature: >83°C

Ambient Temperature: >80°C

Life Test Drive Current: 65mA

Measurement Current: 65mA

### Data Set 3: 105°C,65mA

Part Number: HL-A-2835HW-2-S1-08L-HR3

Number of Units: 25

Case Temperature: >103°C

Ambient Temperature: >100°C

Life Test Drive Current: 65mA

Measurement Current: 65mA

## 2 - Summary of Test Result

Data Set:	Sample Size	Failures Observed:	Test Interval (hours)	Test Duration (hours)	Reported TM-21 L <sub>70</sub> Lifetime	Reported TM-21 L <sub>90</sub> Lifetime
1	25	0	1000	9000	>54000 hours	>54000 hours
2	25	0	1000	9000	>54000 hours	44000 hours
3	25	0	1000	9000	>54000 hours	38000 hours

### Average Lumen Maintenance (Percentage of Initial Luminous Flux)

Data Set:	1000	2000	3000	4000	5000	6000	7000	8000	9000
1	100.32%	100.16%	99.97%	99.79%	99.61%	99.44%	99.27%	99.08%	98.86%
2	100.10%	99.88%	99.65%	99.41%	99.17%	98.93%	98.70%	98.45%	98.18%
3	99.91%	99.61%	99.33%	99.04%	98.77%	98.48%	98.22%	97.93%	97.63%

### Average Color Maintenance

Data Set:	1000	2000	3000	4000	5000	6000	7000	8000	9000
1	0.0002	0.0003	0.0006	0.0007	0.0009	0.0011	0.0013	0.0017	0.0021
2	0.0004	0.0007	0.0008	0.0010	0.0013	0.0014	0.0016	0.0019	0.0023
3	0.0008	0.0013	0.0015	0.0017	0.0019	0.0019	0.0021	0.0024	0.0027

### 3 - Test Data

#### 3.1 Data Set 1, 55°C, 65mA (Lumen Maintenance)

No.	Φ(lm)	Lumen Maintenance (%)								
	0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
1	31.50	100.25	100.06	99.87	99.62	99.52	99.46	99.14	98.95	98.73
2	31.97	100.31	100.22	99.94	99.87	99.81	99.56	99.50	99.37	99.22
3	32.19	100.34	100.16	100.03	99.91	99.72	99.53	99.38	99.16	99.01
4	31.89	100.19	99.94	99.84	99.75	99.66	99.44	99.22	99.15	98.93
5	32.42	100.43	100.19	99.94	99.85	99.66	99.48	99.35	99.17	98.95
6	31.14	100.29	100.13	100.10	100.03	99.81	99.68	99.58	99.33	99.23
7	31.47	100.35	100.19	99.97	99.71	99.49	99.27	99.08	98.82	98.60
8	31.04	100.29	100.10	99.81	99.68	99.48	99.39	99.16	99.07	98.81
9	31.43	100.35	100.22	100.16	99.84	99.65	99.40	99.27	99.08	98.82
10	31.18	100.32	100.13	100.10	99.97	99.84	99.65	99.58	99.36	99.26
11	31.92	100.19	100.03	99.84	99.53	99.31	99.12	98.90	98.68	98.46
12	31.56	100.41	100.16	99.90	99.68	99.43	99.14	98.86	98.73	98.45
13	31.70	100.35	100.22	100.09	99.91	99.87	99.68	99.46	99.37	99.09
14	31.34	100.32	100.16	99.94	99.55	99.33	99.30	99.20	99.04	98.76
15	31.69	100.13	99.91	99.72	99.62	99.40	99.24	98.90	98.77	98.52
16	31.84	100.41	100.25	100.09	99.97	99.91	99.59	99.47	99.18	99.03
17	31.84	100.31	100.19	99.94	99.81	99.62	99.53	99.31	99.21	99.15
18	31.89	100.34	100.16	100.09	99.91	99.72	99.56	99.44	99.18	99.03
19	31.45	100.38	100.29	99.97	99.81	99.68	99.59	99.40	99.24	99.01
20	31.96	100.38	100.25	100.09	99.97	99.72	99.50	99.28	99.06	98.72
21	32.41	100.15	100.12	99.88	99.66	99.41	99.35	99.23	99.01	98.73
22	31.53	100.25	100.13	99.84	99.56	99.30	99.18	98.92	98.67	98.38
23	30.88	100.42	100.36	100.23	100.06	99.94	99.84	99.61	99.42	99.13
24	31.85	100.38	100.16	99.97	99.81	99.59	99.40	99.22	99.03	98.90
25	32.20	100.37	100.25	99.91	99.69	99.44	99.22	99.19	98.82	98.51
Ave.	31.69	100.32	100.16	99.97	99.79	99.61	99.44	99.27	99.08	98.86
Med.	31.70	100.34	100.16	99.94	99.81	99.65	99.46	99.27	99.08	98.90
st dev	0.4048	0.0831	0.1002	0.1241	0.1553	0.1921	0.1849	0.2190	0.2243	0.2645
Min.	30.88	100.13	99.91	99.72	99.53	99.30	99.12	98.86	98.67	98.38
Max.	32.42	100.43	100.36	100.23	100.06	99.94	99.84	99.61	99.42	99.26

TM-21 Projection:

**Test Duration:** 9000 hours

**Failures Observed:** 0

**α:** 1.844E-06

**β:** 1.005

**Reported L<sub>70</sub>:** >54000 hours

**Reported L<sub>90</sub>:** >54000 hours

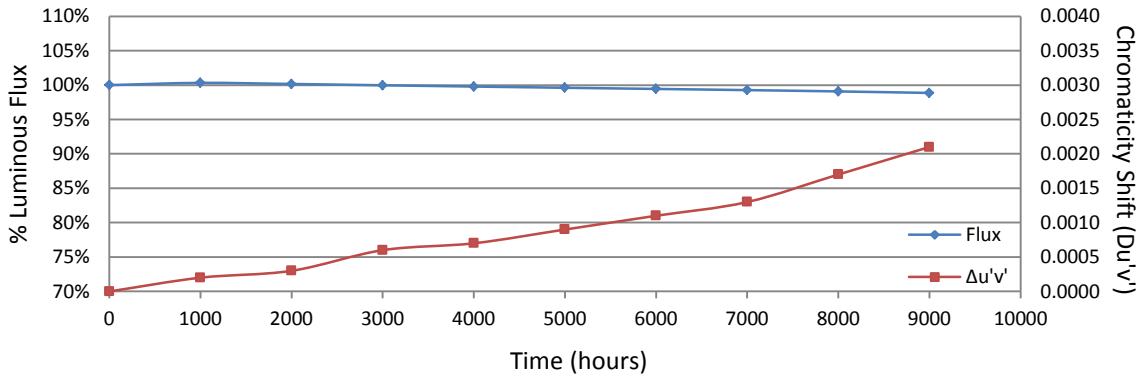


### 3.2 Data Set 1, 55°C, 65mA (Forward Voltage)

No.	Forward Voltage (V)									
	0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
1	2.736	2.737	2.754	2.739	2.739	2.736	2.736	2.737	2.736	2.739
2	2.749	2.751	2.758	2.749	2.751	2.749	2.748	2.749	2.750	2.751
3	2.748	2.749	2.756	2.747	2.749	2.748	2.747	2.747	2.748	2.751
4	2.740	2.741	2.747	2.739	2.742	2.739	2.740	2.742	2.742	2.744
5	2.743	2.744	2.745	2.742	2.744	2.742	2.742	2.745	2.744	2.744
6	2.740	2.742	2.745	2.741	2.745	2.741	2.743	2.744	2.743	2.743
7	2.734	2.736	2.742	2.734	2.736	2.735	2.733	2.737	2.738	2.736
8	2.747	2.748	2.753	2.747	2.750	2.747	2.746	2.749	2.747	2.748
9	2.738	2.740	2.745	2.738	2.741	2.739	2.738	2.740	2.739	2.740
10	2.735	2.736	2.740	2.735	2.741	2.735	2.735	2.737	2.736	2.737
11	2.738	2.740	2.746	2.739	2.740	2.738	2.739	2.739	2.740	2.739
12	2.737	2.739	2.743	2.739	2.739	2.737	2.741	2.738	2.739	2.739
13	2.738	2.740	2.744	2.739	2.740	2.739	2.738	2.739	2.744	2.739
14	2.737	2.739	2.745	2.746	2.739	2.738	2.737	2.742	2.793	2.739
15	2.735	2.738	2.742	2.737	2.739	2.736	2.739	2.740	2.746	2.739
16	2.739	2.741	2.745	2.740	2.743	2.740	2.739	2.743	2.742	2.742
17	2.740	2.742	2.745	2.739	2.742	2.740	2.740	2.745	2.744	2.742
18	2.741	2.745	2.748	2.746	2.745	2.743	2.742	2.744	2.756	2.745
19	2.736	2.739	2.744	2.739	2.739	2.737	2.736	2.740	2.760	2.740
20	2.740	2.743	2.746	2.742	2.743	2.740	2.739	2.743	2.741	2.744
21	2.746	2.749	2.753	2.746	2.749	2.747	2.747	2.748	2.749	2.751
22	2.735	2.738	2.743	2.736	2.738	2.736	2.735	2.738	2.738	2.740
23	2.737	2.740	2.742	2.738	2.739	2.737	2.737	2.744	2.744	2.739
24	2.741	2.744	2.753	2.742	2.743	2.741	2.740	2.742	2.744	2.743
25	2.745	2.747	2.761	2.746	2.747	2.745	2.744	2.746	2.749	2.748
Ave.	2.740	2.742	2.747	2.741	2.743	2.740	2.740	2.742	2.746	2.742
Med.	2.739	2.741	2.745	2.739	2.742	2.739	2.739	2.742	2.744	2.742
st dev	0.0043	0.0042	0.0056	0.0041	0.0041	0.0042	0.0040	0.004	0.011	0.004
Min.	2.734	2.736	2.740	2.734	2.736	2.735	2.733	2.737	2.736	2.736
Max.	2.749	2.751	2.761	2.749	2.751	2.749	2.748	2.749	2.793	2.751

### 3.3 Data Set 1, 55°C, 65mA (Chromaticity Shift)

No.	u'	v'	CCT(K)	Chromaticity Shift ( $\Delta u'v'$ )								
	0hr(Initial)			1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
1	0.2563	0.5291	2824	0.0005	0.0006	0.0006	0.0008	0.0011	0.0014	0.0020	0.0022	0.0025
2	0.2584	0.5343	2756	0.0001	0.0002	0.0004	0.0006	0.0008	0.0010	0.0014	0.0018	0.0021
3	0.2579	0.5323	2775	0.0001	0.0002	0.0006	0.0008	0.0009	0.0011	0.0015	0.0017	0.0022
4	0.2579	0.5321	2776	0.0001	0.0002	0.0006	0.0006	0.0009	0.0011	0.0016	0.0017	0.0023
5	0.2563	0.5325	2809	0.0001	0.0002	0.0005	0.0008	0.0009	0.0011	0.0014	0.0016	0.0021
6	0.2586	0.5325	2760	0.0002	0.0003	0.0006	0.0008	0.0010	0.0012	0.0017	0.0018	0.0022
7	0.2581	0.5305	2779	0.0001	0.0003	0.0005	0.0008	0.0009	0.0011	0.0013	0.0017	0.0022
8	0.2586	0.5337	2754	0.0000	0.0003	0.0005	0.0008	0.0009	0.0011	0.0013	0.0017	0.0021
9	0.2589	0.5315	2757	0.0001	0.0002	0.0005	0.0007	0.0008	0.0011	0.0012	0.0017	0.0020
10	0.2575	0.5315	2788	0.0002	0.0001	0.0006	0.0008	0.0009	0.0011	0.0012	0.0017	0.0020
11	0.2564	0.5307	2815	0.0005	0.0003	0.0004	0.0007	0.0008	0.0011	0.0014	0.0017	0.0021
12	0.2587	0.5311	2764	0.0004	0.0004	0.0005	0.0008	0.0010	0.0013	0.0016	0.0017	0.0021
13	0.2579	0.5327	2773	0.0002	0.0003	0.0005	0.0007	0.0009	0.0011	0.0013	0.0017	0.0021
14	0.2584	0.5305	2772	0.0003	0.0005	0.0006	0.0008	0.0009	0.0012	0.0014	0.0019	0.0022
15	0.2588	0.5313	2761	0.0004	0.0005	0.0005	0.0007	0.0008	0.0013	0.0014	0.0019	0.0023
16	0.2565	0.5299	2815	0.0002	0.0003	0.0004	0.0007	0.0008	0.0011	0.0013	0.0018	0.0022
17	0.2594	0.5313	2749	0.0002	0.0003	0.0005	0.0007	0.0009	0.0012	0.0013	0.0018	0.0022
18	0.2578	0.5318	2779	0.0001	0.0001	0.0006	0.0007	0.0008	0.0010	0.0010	0.0016	0.0019
19	0.2564	0.5311	2813	0.0002	0.0001	0.0007	0.0008	0.0009	0.0010	0.0010	0.0014	0.0019
20	0.2580	0.5307	2780	0.0001	0.0003	0.0005	0.0007	0.0008	0.0011	0.0008	0.0012	0.0017
21	0.2575	0.5331	2780	0.0001	0.0004	0.0006	0.0008	0.0008	0.0011	0.0012	0.0017	0.0021
22	0.2576	0.5308	2788	0.0001	0.0004	0.0006	0.0007	0.0009	0.0012	0.0014	0.0017	0.0022
23	0.2590	0.5328	2750	0.0001	0.0003	0.0007	0.0009	0.0009	0.0011	0.0012	0.0014	0.0019
24	0.2589	0.5334	2750	0.0002	0.0004	0.0005	0.0007	0.0008	0.0011	0.0014	0.0017	0.0022
25	0.2587	0.5342	2751	0.0001	0.0004	0.0004	0.0007	0.0008	0.0011	0.0012	0.0017	0.0021
Ave.	0.2579	0.5318	2777	0.0002	0.0003	0.0006	0.0007	0.0009	0.0011	0.0013	0.0017	0.0021
Med.	0.2580	0.5315	2775	0.0001	0.0003	0.0005	0.0007	0.0009	0.0011	0.0013	0.0017	0.0021
st dev	0.0009	0.0013	23.0317	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002	0.0002	0.0002
Min.	0.2563	0.5291	2749	0.0000	0.0001	0.0004	0.0006	0.0008	0.0010	0.0008	0.0012	0.0017
Max.	0.2594	0.5343	2824	0.0005	0.0006	0.0007	0.0009	0.0011	0.0014	0.0020	0.0022	0.0025



### 3.4 Data Set 2, 85°C, 65mA (Lumen Maintenance)

No.	Φ(lm)	Lumen Maintenance (%)								
	Ohr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
26	31.61	100.16	99.97	99.78	99.49	99.21	99.08	98.96	98.67	98.32
27	31.65	100.22	99.91	99.75	99.59	99.21	99.02	98.80	98.70	98.61
28	31.67	100.03	99.72	99.53	99.34	99.02	98.80	98.42	98.23	98.01
29	31.40	100.19	100.06	99.78	99.55	99.39	99.24	98.98	98.73	98.44
30	31.72	99.87	99.62	99.56	99.18	99.02	98.68	98.39	98.11	98.01
31	31.74	100.06	99.78	99.59	99.28	98.96	98.77	98.68	98.42	98.20
32	31.47	100.03	99.78	99.52	99.36	98.95	98.79	98.63	98.47	98.28
33	31.21	100.16	99.94	99.84	99.68	99.33	98.94	98.69	98.43	98.21
34	31.67	100.03	99.84	99.56	99.46	99.21	99.08	98.83	98.52	98.11
35	31.46	100.25	100.03	99.71	99.43	99.21	99.05	98.79	98.51	98.19
36	31.50	100.16	100.06	99.87	99.65	99.49	99.24	98.92	98.67	98.41
37	31.57	99.94	99.71	99.56	99.40	99.21	98.89	98.76	98.54	98.42
38	30.89	100.10	99.81	99.68	99.48	99.22	98.96	98.80	98.58	98.41
39	31.17	100.19	99.90	99.65	99.49	99.26	99.13	98.94	98.68	98.40
40	31.64	100.03	99.81	99.56	99.21	98.99	98.74	98.45	98.20	97.88
41	31.44	100.19	100.03	99.81	99.59	99.43	99.11	98.98	98.76	98.41
42	31.17	100.10	99.90	99.58	99.26	99.04	98.78	98.59	98.33	98.11
43	31.65	100.19	100.03	99.68	99.34	99.15	98.83	98.52	98.17	97.88
44	31.47	100.06	99.87	99.65	99.40	99.17	98.98	98.70	98.35	98.03
45	31.44	99.87	99.75	99.55	99.27	98.98	98.76	98.63	98.35	98.03
46	31.65	100.06	99.91	99.59	99.21	98.96	98.70	98.39	98.29	97.88
47	32.04	100.19	99.94	99.69	99.34	99.06	98.78	98.53	98.28	97.85
48	31.70	100.13	99.84	99.68	99.46	99.31	99.05	98.71	98.39	98.14
49	32.07	100.19	99.97	99.66	99.31	99.16	98.88	98.72	98.41	98.04
50	31.61	99.97	99.84	99.49	99.37	99.21	98.83	98.77	98.51	98.23
Ave.	31.54	100.10	99.88	99.65	99.41	99.17	98.93	98.70	98.45	98.18
Med.	31.61	100.10	99.90	99.65	99.40	99.21	98.89	98.71	98.43	98.19
st dev	0.2567	0.1055	0.1182	0.1065	0.1384	0.1531	0.1659	0.1827	0.1854	0.2104
Min.	30.89	99.87	99.62	99.49	99.18	98.95	98.68	98.39	98.11	97.85
Max.	32.07	100.25	100.06	99.87	99.68	99.49	99.24	98.98	98.76	98.61

TM-21 Projection:

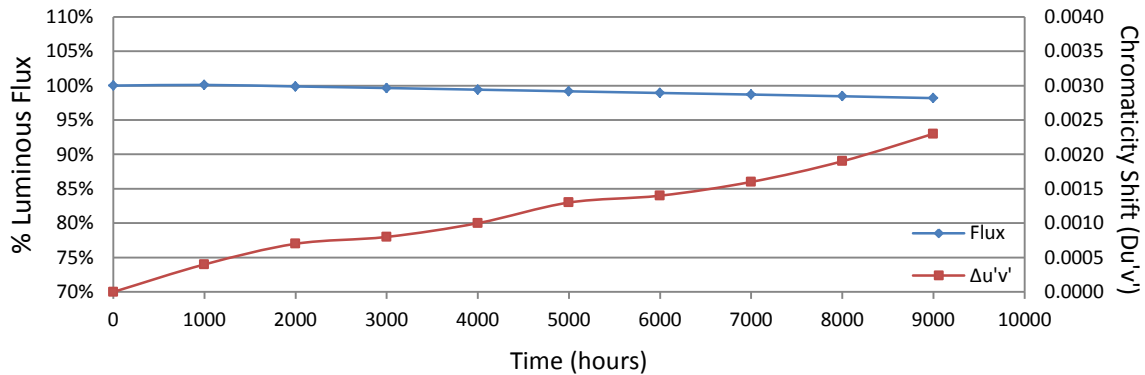
**Test Duration:** 9000 hours  
**Failures Observed:** 0  
 $\alpha$ : 2.470E-06  
 $\beta$ : 1.004  
**Reported L<sub>70</sub>:** >54000 hours  
**Reported L<sub>90</sub>:** 44000 hours

### 3.5 Data Set 2, 85°C, 65mA (Forward Voltage)

No.	Forward Voltage (V)									
	0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
26	2.735	2.740	2.746	2.736	2.739	2.737	2.736	2.738	2.740	2.739
27	2.734	2.738	2.745	2.736	2.737	2.737	2.736	2.737	2.739	2.738
28	2.735	2.739	2.745	2.736	2.738	2.736	2.736	2.738	2.739	2.739
29	2.733	2.738	2.753	2.735	2.736	2.736	2.737	2.736	2.739	2.738
30	2.735	2.739	2.753	2.737	2.739	2.738	2.737	2.740	2.738	2.739
31	2.736	2.739	2.746	2.736	2.739	2.738	2.739	2.755	2.739	2.739
32	2.734	2.738	2.744	2.734	2.737	2.736	2.735	2.739	2.737	2.737
33	2.734	2.739	2.744	2.736	2.736	2.738	2.737	2.738	2.738	2.738
34	2.734	2.737	2.744	2.734	2.737	2.736	2.737	2.737	2.737	2.739
35	2.735	2.738	2.745	2.738	2.737	2.738	2.738	2.738	2.737	2.738
36	2.735	2.739	2.744	2.738	2.738	2.738	2.742	2.738	2.739	2.739
37	2.740	2.743	2.748	2.742	2.743	2.741	2.749	2.743	2.745	2.744
38	2.740	2.744	2.749	2.748	2.741	2.743	2.742	2.742	2.745	2.745
39	2.733	2.736	2.743	2.739	2.736	2.735	2.734	2.735	2.736	2.737
40	2.734	2.738	2.747	2.738	2.737	2.736	2.734	2.736	2.736	2.737
41	2.735	2.739	2.743	2.741	2.738	2.736	2.737	2.738	2.738	2.738
42	2.733	2.738	2.741	2.738	2.737	2.737	2.735	2.735	2.738	2.737
43	2.735	2.739	2.746	2.741	2.738	2.736	2.736	2.738	2.739	2.738
44	2.735	2.738	2.744	2.738	2.736	2.735	2.735	2.735	2.738	2.737
45	2.734	2.738	2.745	2.737	2.736	2.735	2.736	2.736	2.749	2.737
46	2.735	2.739	2.747	2.739	2.738	2.736	2.739	2.735	2.737	2.739
47	2.744	2.746	2.753	2.763	2.745	2.745	2.780	2.744	2.749	2.746
48	2.740	2.743	2.756	2.742	2.741	2.741	2.749	2.740	2.742	2.744
49	2.741	2.744	2.750	2.752	2.742	2.742	2.744	2.743	2.744	2.744
50	2.736	2.739	2.745	2.741	2.739	2.737	2.739	2.737	2.740	2.739
Ave.	2.736	2.740	2.747	2.740	2.738	2.738	2.740	2.739	2.740	2.739
Med.	2.735	2.739	2.745	2.738	2.738	2.737	2.737	2.738	2.739	2.739
st dev	0.0029	0.0025	0.0037	0.0063	0.0024	0.0027	0.0093	0.004	0.004	0.003
Min.	2.733	2.736	2.741	2.734	2.736	2.735	2.734	2.735	2.736	2.737
Max.	2.744	2.746	2.756	2.763	2.745	2.745	2.780	2.755	2.749	2.746

### 3.6 Data Set 2, 85°C, 65mA (Chromaticity Shift)

No.	u'	v'	CCT(K)	Chromaticity Shift ( $\Delta u'v'$ )								
	0hr(Initial)			1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
26	0.2578	0.5308	2784	0.0004	0.0006	0.0008	0.0010	0.0011	0.0013	0.0013	0.0019	0.0025
27	0.2601	0.5330	2728	0.0002	0.0006	0.0008	0.0009	0.0010	0.0013	0.0015	0.0017	0.0023
28	0.2581	0.5321	2772	0.0004	0.0006	0.0008	0.0009	0.0011	0.0013	0.0015	0.0019	0.0022
29	0.2594	0.5322	2744	0.0004	0.0007	0.0009	0.0009	0.0011	0.0014	0.0014	0.0019	0.0023
30	0.2574	0.5310	2792	0.0003	0.0006	0.0008	0.0009	0.0011	0.0014	0.0017	0.0019	0.0023
31	0.2576	0.5309	2789	0.0004	0.0009	0.0009	0.0010	0.0014	0.0015	0.0017	0.0020	0.0024
32	0.2590	0.5309	2758	0.0004	0.0006	0.0008	0.0010	0.0014	0.0013	0.0016	0.0019	0.0022
33	0.2604	0.5317	2725	0.0002	0.0006	0.0008	0.0010	0.0013	0.0013	0.0016	0.0018	0.0022
34	0.2564	0.5292	2821	0.0003	0.0006	0.0008	0.0009	0.0013	0.0015	0.0017	0.0019	0.0023
35	0.2592	0.5316	2751	0.0005	0.0009	0.0008	0.0011	0.0014	0.0016	0.0017	0.0020	0.0024
36	0.2587	0.5304	2768	0.0004	0.0007	0.0008	0.0011	0.0013	0.0015	0.0018	0.0019	0.0023
37	0.2606	0.5325	2719	0.0004	0.0008	0.0008	0.0010	0.0013	0.0014	0.0016	0.0018	0.0022
38	0.2603	0.5325	2725	0.0004	0.0006	0.0008	0.0010	0.0014	0.0015	0.0017	0.0018	0.0022
39	0.2589	0.5305	2763	0.0003	0.0006	0.0008	0.0010	0.0013	0.0013	0.0015	0.0018	0.0020
40	0.2574	0.5297	2798	0.0004	0.0008	0.0009	0.0011	0.0014	0.0016	0.0019	0.0021	0.0024
41	0.2583	0.5304	2775	0.0003	0.0007	0.0009	0.0011	0.0014	0.0015	0.0017	0.0019	0.0022
42	0.2579	0.5305	2783	0.0004	0.0006	0.0008	0.0010	0.0013	0.0014	0.0016	0.0018	0.0022
43	0.2583	0.5304	2774	0.0004	0.0007	0.0009	0.0011	0.0013	0.0015	0.0017	0.0020	0.0022
44	0.2570	0.5302	2805	0.0004	0.0007	0.0009	0.0011	0.0013	0.0015	0.0017	0.0020	0.0022
45	0.2578	0.5302	2787	0.0004	0.0007	0.0009	0.0011	0.0014	0.0015	0.0018	0.0021	0.0023
46	0.2584	0.5316	2767	0.0004	0.0006	0.0008	0.0010	0.0013	0.0014	0.0017	0.0020	0.0022
47	0.2579	0.5328	2773	0.0003	0.0007	0.0009	0.0011	0.0013	0.0014	0.0017	0.0019	0.0023
48	0.2589	0.5331	2752	0.0004	0.0006	0.0009	0.0011	0.0014	0.0015	0.0016	0.0020	0.0023
49	0.2561	0.5302	2824	0.0004	0.0007	0.0009	0.0011	0.0013	0.0016	0.0018	0.0021	0.0025
50	0.2586	0.5322	2761	0.0004	0.0006	0.0009	0.0011	0.0014	0.0015	0.0017	0.0021	0.0022
Ave.	0.2584	0.5312	2770	0.0004	0.0007	0.0008	0.0010	0.0013	0.0014	0.0016	0.0019	0.0023
Med.	0.2583	0.5309	2772	0.0004	0.0006	0.0008	0.0010	0.0013	0.0015	0.0017	0.0019	0.0023
st dev	0.0012	0.0011	28.2373	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Min.	0.2561	0.5292	2719	0.0002	0.0006	0.0008	0.0009	0.0010	0.0013	0.0013	0.0017	0.0020
Max.	0.2606	0.5331	2824	0.0005	0.0009	0.0009	0.0011	0.0014	0.0016	0.0019	0.0021	0.0025



### 3.7 Data Set 3, 105°C, 65mA (Lumen Maintenance)

No.	Φ(lm)	Lumen Maintenance (%)								
	Ohr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
51	31.63	99.91	99.68	99.43	99.15	99.02	98.77	98.61	98.39	98.13
52	31.97	99.62	99.44	99.09	98.87	98.56	98.34	98.12	97.78	97.56
53	31.79	99.94	99.65	99.43	99.21	98.68	98.36	98.08	97.64	97.39
54	30.89	100.10	99.94	99.74	99.55	99.16	98.80	98.41	98.25	98.09
55	31.98	99.84	99.41	99.28	98.97	98.66	98.37	98.16	97.78	97.56
56	32.28	99.63	99.38	99.23	98.95	98.57	98.33	98.11	97.89	97.58
57	31.92	100.06	99.66	99.34	99.12	98.87	98.59	98.43	98.15	97.81
58	31.27	100.16	99.78	99.52	99.30	99.10	98.82	98.53	98.11	97.76
59	31.71	100.13	99.91	99.65	99.31	98.93	98.52	98.27	97.92	97.54
60	31.77	99.84	99.46	99.24	98.96	98.65	98.36	97.95	97.70	97.26
61	31.48	100.13	99.87	99.56	99.21	99.02	98.70	98.41	98.13	97.84
62	31.42	100.19	99.90	99.55	99.33	99.11	98.70	98.44	98.19	97.80
63	31.95	100.03	99.78	99.50	99.22	99.06	98.81	98.50	98.22	97.84
64	32.53	99.78	99.48	99.23	99.02	98.83	98.59	98.46	98.09	97.88
65	31.64	99.91	99.65	99.21	98.83	98.55	98.39	98.17	97.98	97.69
66	32.54	99.91	99.60	99.35	99.02	98.62	98.25	98.13	97.88	97.57
67	31.76	100.19	99.72	99.46	99.15	98.90	98.58	98.30	97.98	97.61
68	31.89	99.84	99.53	99.31	99.09	98.87	98.68	98.34	98.02	97.84
69	32.08	99.91	99.56	99.22	98.94	98.66	98.44	98.13	97.91	97.63
70	31.98	99.72	99.41	99.06	98.62	98.53	98.28	98.09	97.84	97.44
71	31.40	99.68	99.46	99.08	98.79	98.47	98.18	97.90	97.61	97.29
72	31.41	99.94	99.62	99.36	99.08	98.66	98.38	98.03	97.64	97.33
73	32.00	99.59	99.41	99.06	98.72	98.47	98.19	97.94	97.59	97.28
74	31.67	99.87	99.62	99.21	98.83	98.58	98.29	98.01	97.76	97.54
75	31.87	99.84	99.40	99.06	98.81	98.62	98.31	98.09	97.83	97.52
Ave.	31.79	99.91	99.61	99.33	99.04	98.77	98.48	98.22	97.93	97.63
Med.	31.79	99.91	99.62	99.31	99.02	98.66	98.39	98.16	97.91	97.58
st dev	0.3720	0.1794	0.1766	0.1925	0.2180	0.2201	0.2053	0.2049	0.2189	0.2368
Min.	30.89	99.59	99.38	99.06	98.62	98.47	98.18	97.90	97.59	97.26
Max.	32.54	100.19	99.94	99.74	99.55	99.16	98.82	98.61	98.39	98.13

TM-21 Projection:

**Test Duration:** 9000 hours

**Failures Observed:** 0

**α:** 2.856E-06

**β:** 1.002

**Reported L<sub>70</sub>:** >54000 hours

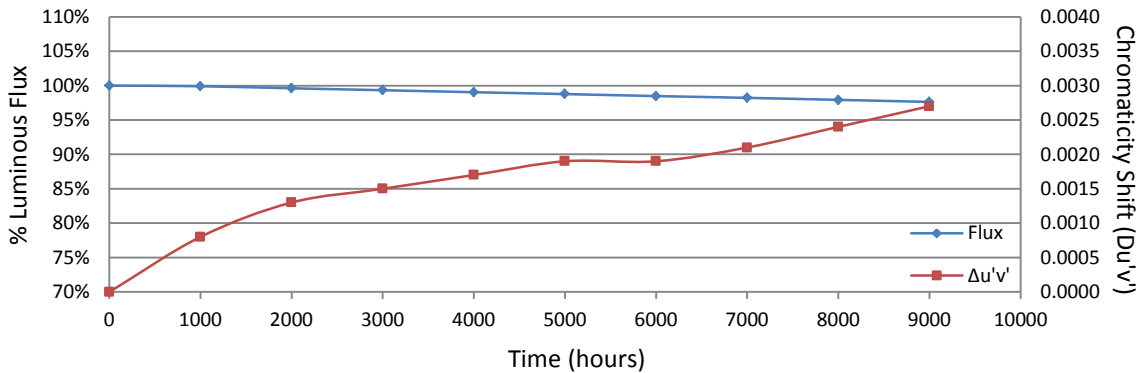
**Reported L<sub>90</sub>:** 38000 hours

### 3.8 Data Set 3, 105°C, 65mA (Forward Voltage)

No.	Forward Voltage (V)									
	0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
51	2.734	2.738	2.746	2.737	2.737	2.737	2.736	2.735	2.738	2.742
52	2.743	2.748	2.763	2.747	2.747	2.745	2.744	2.744	2.745	2.749
53	2.738	2.743	2.757	2.745	2.741	2.741	2.739	2.745	2.744	2.742
54	2.734	2.739	2.750	2.738	2.736	2.737	2.736	2.736	2.735	2.741
55	2.741	2.745	2.762	2.744	2.743	2.742	2.742	2.744	2.742	2.744
56	2.739	2.742	2.750	2.743	2.741	2.741	2.742	2.741	2.740	2.743
57	2.739	2.744	2.751	2.743	2.742	2.741	2.742	2.743	2.742	2.744
58	2.738	2.743	2.755	2.745	2.741	2.740	2.742	2.742	2.741	2.749
59	2.746	2.749	2.757	2.753	2.749	2.748	2.751	2.748	2.748	2.748
60	2.737	2.742	2.751	2.741	2.741	2.740	2.740	2.741	2.739	2.741
61	2.735	2.739	2.748	2.741	2.738	2.736	2.736	2.737	2.737	2.738
62	2.734	2.740	2.749	2.757	2.738	2.737	2.736	2.737	2.738	2.738
63	2.738	2.743	2.752	2.753	2.740	2.740	2.740	2.739	2.740	2.742
64	2.748	2.752	2.766	2.758	2.751	2.749	2.749	2.749	2.749	2.751
65	2.737	2.742	2.752	2.749	2.740	2.739	2.738	2.742	2.765	2.741
66	2.744	2.747	2.759	2.756	2.746	2.745	2.745	2.748	2.745	2.747
67	2.735	2.739	2.757	2.743	2.736	2.737	2.741	2.739	2.735	2.738
68	2.739	2.744	2.754	2.760	2.742	2.741	2.746	2.745	2.741	2.743
69	2.741	2.747	2.761	2.748	2.745	2.746	2.748	2.750	2.744	2.745
70	2.739	2.743	2.751	2.749	2.744	2.744	2.747	2.742	2.742	2.743
71	2.737	2.741	2.750	2.742	2.743	2.739	2.745	2.740	2.739	2.741
72	2.736	2.739	2.747	2.743	2.739	2.739	2.736	2.737	2.738	2.739
73	2.739	2.744	2.750	2.746	2.742	2.742	2.739	2.741	2.742	2.743
74	2.734	2.740	2.751	2.742	2.737	2.738	2.737	2.736	2.742	2.739
75	2.742	2.748	2.760	2.747	2.745	2.744	2.745	2.744	2.749	2.746
Ave.	2.739	2.743	2.754	2.747	2.742	2.741	2.742	2.742	2.742	2.743
Med.	2.738	2.743	2.752	2.745	2.741	2.741	2.742	2.742	2.742	2.743
st dev	0.0038	0.004	0.005	0.006	0.004	0.004	0.004	0.004	0.006	0.004
Min.	2.734	2.738	2.746	2.737	2.736	2.736	2.736	2.735	2.735	2.738
Max.	2.748	2.752	2.766	2.760	2.751	2.749	2.751	2.750	2.765	2.751

### 3.9 Data Set 3, 105°C, 65mA (Chromaticity Shift)

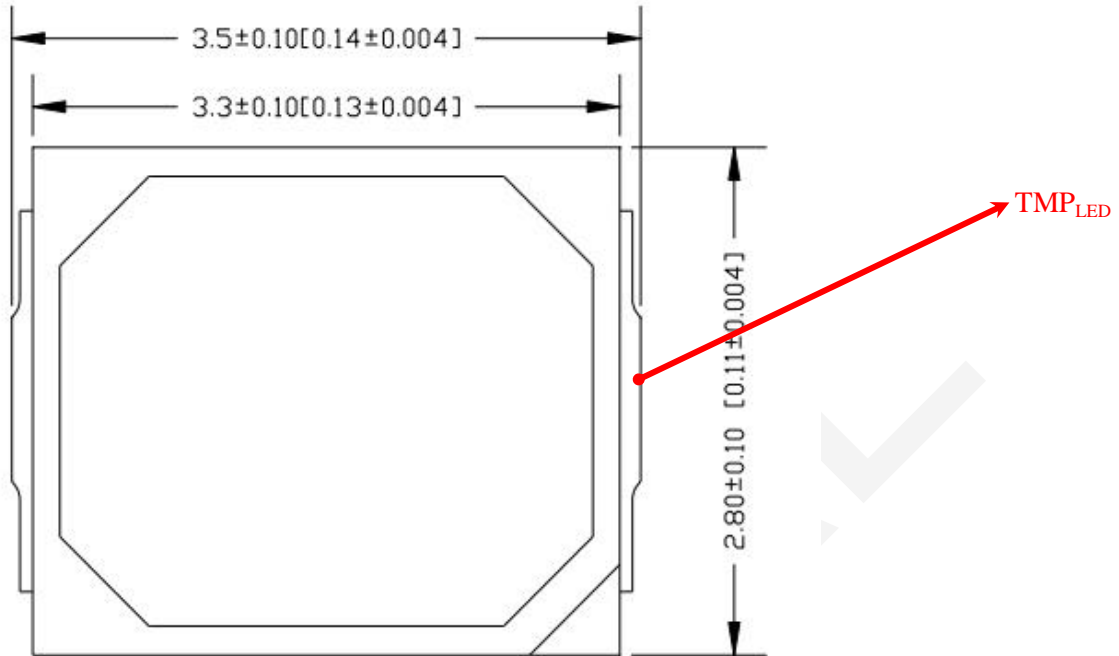
No.	u'	v'	CCT(K)	Chromaticity Shift ( $\Delta u'v'$ )								
	0hr(Initial)			1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
51	0.2562	0.5301	2821	0.0005	0.0009	0.0011	0.0012	0.0012	0.0016	0.0016	0.0021	0.0025
52	0.2593	0.5327	2745	0.0007	0.0011	0.0014	0.0015	0.0016	0.0018	0.0019	0.0023	0.0026
53	0.2581	0.5315	2774	0.0006	0.0011	0.0014	0.0016	0.0015	0.0018	0.0018	0.0022	0.0026
54	0.2611	0.5326	2708	0.0006	0.0012	0.0014	0.0016	0.0017	0.0016	0.0017	0.0022	0.0026
55	0.2584	0.5313	2770	0.0008	0.0013	0.0015	0.0018	0.0018	0.0019	0.0020	0.0025	0.0028
56	0.2572	0.5328	2787	0.0004	0.0012	0.0014	0.0017	0.0019	0.0017	0.0017	0.0022	0.0026
57	0.2562	0.5302	2822	0.0008	0.0012	0.0013	0.0016	0.0018	0.0017	0.0017	0.0022	0.0025
58	0.2588	0.5331	2754	0.0004	0.0011	0.0014	0.0016	0.0019	0.0017	0.0020	0.0021	0.0025
59	0.2598	0.5343	2728	0.0006	0.0011	0.0014	0.0017	0.0019	0.0019	0.0020	0.0022	0.0026
60	0.2585	0.5322	2763	0.0009	0.0013	0.0014	0.0017	0.0020	0.0018	0.0021	0.0023	0.0026
61	0.2566	0.5296	2816	0.0006	0.0011	0.0014	0.0017	0.0019	0.0018	0.0020	0.0023	0.0026
62	0.2575	0.5291	2798	0.0007	0.0014	0.0016	0.0018	0.0020	0.0020	0.0023	0.0026	0.0028
63	0.2572	0.5301	2800	0.0008	0.0013	0.0016	0.0017	0.0021	0.0019	0.0022	0.0025	0.0028
64	0.2592	0.5338	2743	0.0009	0.0015	0.0016	0.0018	0.0020	0.0020	0.0024	0.0026	0.0028
65	0.2608	0.5342	2709	0.0009	0.0016	0.0016	0.0018	0.0022	0.0021	0.0024	0.0026	0.0030
66	0.2574	0.5330	2783	0.0009	0.0014	0.0016	0.0018	0.0020	0.0020	0.0022	0.0026	0.0028
67	0.2569	0.5293	2810	0.0006	0.0013	0.0016	0.0017	0.0021	0.0020	0.0022	0.0026	0.0028
68	0.2575	0.5304	2792	0.0008	0.0015	0.0017	0.0019	0.0021	0.0021	0.0023	0.0026	0.0029
69	0.2580	0.5316	2777	0.0009	0.0014	0.0015	0.0018	0.0020	0.0020	0.0024	0.0026	0.0029
70	0.2609	0.5350	2703	0.0008	0.0014	0.0017	0.0019	0.0022	0.0021	0.0024	0.0027	0.0029
71	0.2589	0.5319	2756	0.0009	0.0014	0.0016	0.0018	0.0021	0.0021	0.0022	0.0026	0.0029
72	0.2589	0.5319	2757	0.0005	0.0008	0.0010	0.0012	0.0016	0.0014	0.0015	0.0018	0.0021
73	0.2587	0.5333	2755	0.0010	0.0016	0.0017	0.0019	0.0022	0.0021	0.0024	0.0027	0.0029
74	0.2569	0.5314	2802	0.0011	0.0016	0.0017	0.0019	0.0024	0.0024	0.0024	0.0028	0.0030
75	0.2589	0.5330	2752	0.0011	0.0015	0.0017	0.0018	0.0021	0.0026	0.0022	0.0029	0.0031
Ave.	0.2583	0.5319	2769	0.0008	0.0013	0.0015	0.0017	0.0019	0.0019	0.0021	0.0024	0.0027
Med.	0.2584	0.5319	2770	0.0008	0.0013	0.0015	0.0017	0.0020	0.0019	0.0022	0.0025	0.0028
st dev	0.0014	0.0016	34.8222	0.0002	0.0002	0.0002	0.0002	0.0003	0.0003	0.0003	0.0002	0.0002
Min.	0.2562	0.5291	2703	0.0004	0.0008	0.0010	0.0012	0.0012	0.0014	0.0015	0.0018	0.0021
Max.	0.2611	0.5350	2822	0.0011	0.0016	0.0017	0.0019	0.0024	0.0026	0.0024	0.0029	0.0031





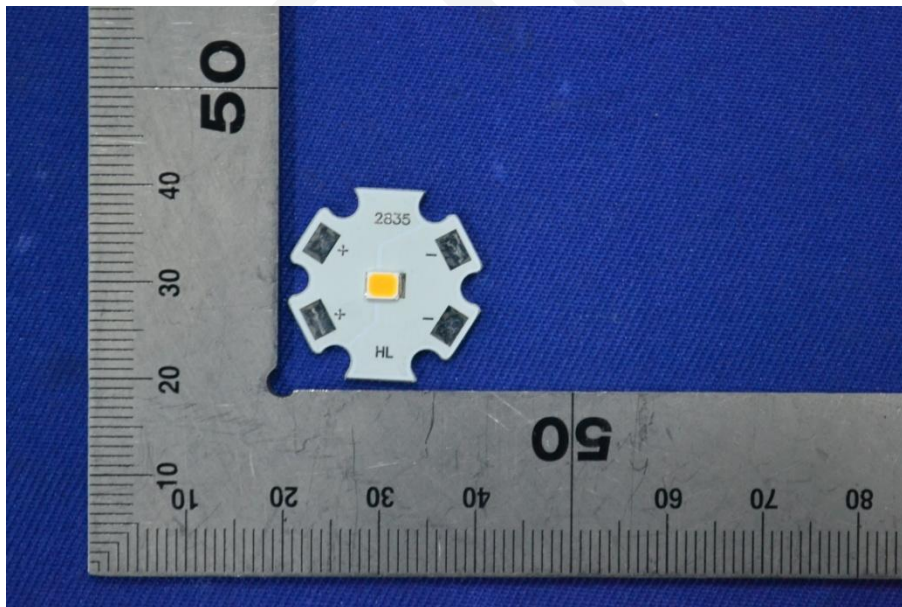
## 4 - EUT Photo

### 4.1 Mechanical Dimensions



All dimensions are in millimeter

### 4.2 EUT Photo



### 4.3 Report Revision (LM-80)

Report Number	Report Date	Contents
RSZ161206501-10-9000	2017-12-25	Original report.
RSZ161206501-10-9000-M1	2018-03-02	Update the Power Density per LED die in page 3.
RSZ161206501-10-9000-M2	2018-03-02	Update the Logo of lab on the Page1 Update Company name and address on page 1.

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

FINAL