



# TEST REPORT

ACCORDING TO IES LM-80-2015  
For

## Seoul Semiconductor Co., LTD

97-11, Sandan-ro 163, Danwon-gu, Ansan, Gyeonggi-do, Korea 15429.

**Model: STW8A2PD-XX**

<b>Report Type:</b> 9000 Hours Test Report		<b>Product Type:</b> LED Package	
<b>Test Engineer:</b>	Pote Wang <span style="float: right;"><i>Pote Wang</i></span>		
<b>Report Number:</b>	RSZ180821504-10-M1		
<b>Test Date:</b>	2016-09-23 to 2017-10-03		
<b>Report Date:</b>	2018-11-05		
<b>Reviewed By:</b>	Daniel Duan / EE Engineer <span style="float: right;"><i>Daniel Duan</i></span>		
<b>Revised Note:</b>	The previous report RSZ180821504-10 is replaced by this report on 2018-11-05		
<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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## TABLE OF CONTENTS

<b>1 -</b>	<b>General Information .....</b>	<b>3</b>
1.1	Description of LED Light Sources .....	3
1.2	Standards Used: .....	3
1.3	Testing Equipment .....	3
1.4	Drive Level.....	4
1.5	Ambient Conditions for Maintenance Test.....	4
1.6	Measurement Uncertainty .....	4
1.7	Statement of Traceability.....	5
1.8	Sample Set.....	6
<b>2 -</b>	<b>Summary of Test Result .....</b>	<b>7</b>
<b>3 -</b>	<b>Test Data .....</b>	<b>8</b>
3.1	Data Set 1, 55°C, 200mA (Lumen Maintenance) .....	8
3.2	Data Set 1, 55°C, 200mA (Forward Voltage) .....	9
3.3	Data Set 1, 55°C, 200mA (Chromaticity Shift) .....	10
3.4	Data Set 2, 85°C, 200mA (Lumen Maintenance) .....	11
3.5	Data Set 2, 85°C, 200mA (Forward Voltage) .....	12
3.6	Data Set 2, 85°C, 200mA (Chromaticity Shift) .....	13
3.7	Data Set 3, 105°C, 200mA (Lumen Maintenance) .....	14
3.8	Data Set 3, 105°C, 200mA (Forward Voltage) .....	15
3.9	Data Set 3, 105°C, 200mA (Chromaticity Shift) .....	16
<b>4 -</b>	<b>EUT Photo.....</b>	<b>17</b>
4.1	Mechanical Dimensions.....	17
4.2	EUT Photo .....	17
	Report Revision .....	17

## 1 - General Information

### 1.1 Description of LED Light Sources

#### Sample Size:

75 PCS samples were received on 2016-09-20. The samples were numbered from 1 to 25, 26 to 50 and 51 to 75.

Manufacturer:	Seoul Semiconductor Co., LTD
Part Number:	STW8A2PD-XX
Part Type:	LED Package
Drive Level:	DC 200mA
Nominal CCT:	2700K
Power:	0.66W
Average Current Density per LED die:	640mA/mm <sup>2</sup>
Average Power Density per LED die:	2.105W/mm <sup>2</sup>
CRI:	80
Die Spacing:	0.2mm

#### Note:

1. The applicant Seoul Semiconductor Co., LTD declare that their products with model STW8A2PD-XX are the same to the products in report # RSZ160920505-10-9000-M1 and is authorized by original applicant to use their test data.
2. All the data in previous report (RSZ160920505-10-9000-M1) is shared in this report.

#### 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.

### 1.2 Standards Used:

- IESNA LM-80-15: IES Approved Method for Measuring Lumen Maintenance of LED Light Sources.
- CIE 127:2007: Measurement of LEDs
- 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

Device	Manufacture	Model No	Serial No	Calibration date	Calibration due date
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	G115987CJ7321 114	2017-03-03	2018-03-03
Multilayer aging machine	BACL	B2-270	20005	2017-09-01	2018-09-01
Digital CC&CV DC Power Supply	EVERFINE	WY5015	11090008	2017-07-07	2018-07-07
Digital CC&CV DC Power Supply	EVERFINE	WY5015	11060002	2017-07-07	2018-07-07

#### 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 Measurement Uncertainty

The uncertainty of the light output measurements is  $U=1.59\%$  ( $K=2$ ), at the 95% confidence level. The uncertainty of the correlated color temperature measurements is  $U=21\text{K}$  ( $K=2$ ), at the 95% confidence level.

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).

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## 1.8 Sample Set

### Data Set 1: 55°C, 200mA

Part Number: STW8A2PD-XX  
Number of Units: 25  
Case Temperature: >53°C  
Ambient Temperature: >50°C  
Life Test Drive Current: 200mA  
Measurement Current: 200mA

### Data Set 2: 85°C,200mA

Part Number: STW8A2PD-XX  
Number of Units: 25  
Case Temperature: >83°C  
Ambient Temperature: >80°C  
Life Test Drive Current: 200mA  
Measurement Current: 200mA

### Data Set 3: 105°C,200mA

Part Number: STW8A2PD-XX  
Number of Units: 25  
Case Temperature: >103°C  
Ambient Temperature: >100°C  
Life Test Drive Current: 200mA  
Measurement Current: 200mA

## 2 - Summary of Test Result

Data Set:	Sample Size	Failures Observed:	Test Interval	Test Duration	Reported TM-21 L <sub>70</sub> Lifetime	Reported TM-21 L <sub>90</sub> Lifetime
1	25	0	1000	9000	>54,000hours	>54,000hours
2	25	0	1000	9000	>54,000hours	46,000hours
3	25	0	1000	9000	>54,000hours	40,000hours

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

Data Set:	1000	2000	3000	4000	5000	6000	7000	8000	9000
1	100.32%	100.12%	99.96%	99.76%	99.60%	99.41%	99.24%	99.02%	98.82%
2	100.23%	100.03%	99.78%	99.56%	99.36%	99.11%	98.89%	98.62%	98.39%
3	100.10%	99.89%	99.64%	99.29%	99.05%	98.80%	98.54%	98.24%	97.96%

### Average Color Maintenance

Data Set:	1000	2000	3000	4000	5000	6000	7000	8000	9000
1	0.0003	0.0004	0.0007	0.0011	0.0013	0.0015	0.0017	0.0019	0.0021
2	0.0005	0.0007	0.0008	0.0012	0.0014	0.0016	0.0018	0.0023	0.0025
3	0.0007	0.0009	0.0011	0.0015	0.0016	0.0019	0.0021	0.0025	0.0027

### 3 - Test Data

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

No.	Φ(lm)	Lumen Maintenance (%)								
	0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
1	99.19	100.34	100.11	100.05	99.82	99.67	99.43	99.13	98.91	98.77
2	97.29	100.22	100.07	99.92	99.75	99.69	99.50	99.39	99.09	99.00
3	99.68	100.30	99.88	99.77	99.54	99.43	99.19	99.10	98.86	98.63
4	100.40	100.20	100.10	99.90	99.60	99.44	99.21	98.99	98.75	98.63
5	97.30	100.39	100.20	100.16	99.98	99.87	99.57	99.36	99.08	98.98
6	98.04	100.22	100.20	100.16	99.88	99.64	99.47	99.34	99.11	98.83
7	97.36	100.13	100.04	99.92	99.78	99.68	99.46	99.39	99.33	99.10
8	98.38	100.34	100.15	99.92	99.74	99.59	99.47	99.22	99.08	99.05
9	100.50	100.30	100.20	99.80	99.60	99.50	99.35	99.02	98.81	98.71
10	97.34	100.29	100.10	99.87	99.59	99.40	99.22	99.13	98.78	98.45
11	99.22	100.42	99.95	99.80	99.66	99.45	99.32	99.20	98.94	98.58
12	99.57	100.36	100.06	99.90	99.58	99.35	99.17	99.05	98.83	98.54
13	99.64	100.46	100.05	99.94	99.87	99.81	99.55	99.40	99.20	99.08
14	97.50	100.47	100.41	100.02	99.79	99.71	99.44	99.24	99.07	98.91
15	99.05	100.46	100.31	100.23	99.96	99.77	99.58	99.31	99.23	99.13
16	99.89	100.41	99.99	99.98	99.72	99.44	99.27	99.14	98.91	98.51
17	99.63	100.37	100.17	99.94	99.86	99.56	99.26	99.06	99.03	98.81
18	98.65	100.38	99.93	99.67	99.50	99.37	99.29	99.13	99.04	98.82
19	98.22	100.25	100.02	99.76	99.54	99.47	99.36	99.28	98.96	98.80
20	98.27	100.37	100.16	100.02	99.68	99.58	99.31	99.24	99.04	98.81
21	99.24	100.32	100.30	100.07	100.03	99.77	99.55	99.27	98.95	98.71
22	97.90	100.31	100.12	100.11	99.96	99.80	99.58	99.40	99.24	99.22
23	97.43	100.10	100.10	100.07	99.82	99.67	99.52	99.31	99.17	99.04
24	99.35	100.19	100.15	99.99	99.84	99.69	99.62	99.40	99.08	98.82
25	98.77	100.32	100.10	100.02	99.93	99.76	99.63	99.39	99.13	98.66
Ave.	98.71	100.32	100.12	99.96	99.76	99.60	99.41	99.24	99.02	98.82
Med.	98.77	100.32	100.10	99.94	99.78	99.64	99.44	99.24	99.04	98.81
st dev	1.0125	0.0995	0.1204	0.1390	0.1545	0.1538	0.1448	0.1337	0.1525	0.2111
Min.	97.29	100.10	99.88	99.67	99.50	99.35	99.17	98.99	98.75	98.45
Max.	100.50	100.47	100.41	100.23	100.03	99.87	99.63	99.40	99.33	99.22

TM-21 Projection:

**Test Duration:** 9,000 hours

**Failures Observed:** 0

**α:** 1.902E-06

**β:** 1.005

**Reported L<sub>70</sub>:** >54,000 hours

**Reported L<sub>90</sub>:** >54,000 hours

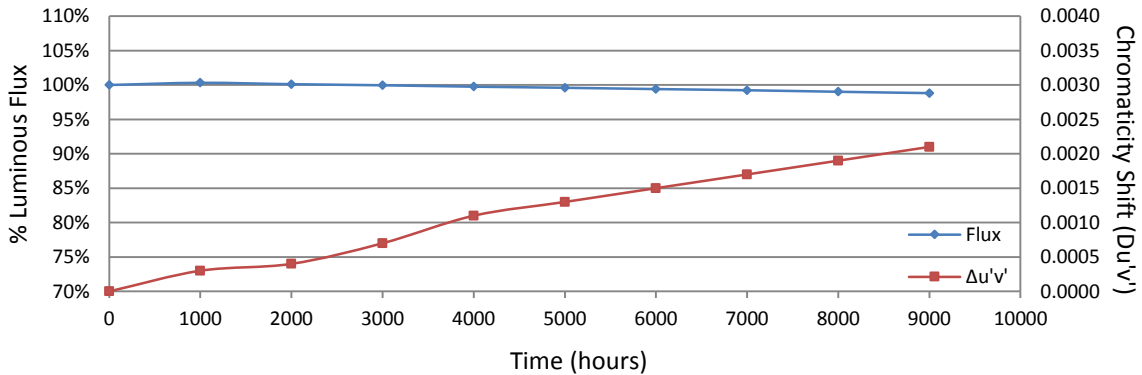


### 3.2 Data Set 1, 55°C, 200mA (Forward Voltage)

No.	Forward Voltage (V)									
	0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
1	3.211	3.212	3.227	3.217	3.217	3.206	3.220	3.218	3.212	3.211
2	3.226	3.229	3.238	3.231	3.231	3.223	3.236	3.225	3.228	3.225
3	3.229	3.233	3.238	3.235	3.235	3.229	3.240	3.235	3.232	3.231
4	3.206	3.210	3.218	3.214	3.214	3.203	3.214	3.209	3.212	3.207
5	3.216	3.219	3.229	3.225	3.225	3.216	3.224	3.220	3.220	3.220
6	3.202	3.207	3.215	3.210	3.210	3.202	3.211	3.208	3.205	3.206
7	3.247	3.254	3.260	3.261	3.261	3.248	3.257	3.253	3.251	3.252
8	3.287	3.291	3.297	3.303	3.303	3.287	3.298	3.290	3.293	3.292
9	3.218	3.221	3.228	3.225	3.225	3.217	3.228	3.222	3.221	3.219
10	3.196	3.201	3.208	3.207	3.207	3.197	3.204	3.202	3.202	3.199
11	3.230	3.236	3.242	3.244	3.244	3.234	3.242	3.236	3.235	3.235
12	3.228	3.233	3.242	3.238	3.238	3.229	3.244	3.231	3.230	3.232
13	3.219	3.221	3.231	3.224	3.224	3.217	3.225	3.222	3.221	3.221
14	3.217	3.218	3.228	3.225	3.225	3.215	3.226	3.219	3.217	3.217
15	3.197	3.200	3.211	3.207	3.207	3.199	3.207	3.220	3.204	3.201
16	3.215	3.214	3.222	3.219	3.219	3.209	3.221	3.206	3.220	3.213
17	3.224	3.226	3.234	3.233	3.233	3.223	3.239	3.220	3.227	3.224
18	3.241	3.245	3.252	3.247	3.247	3.240	3.248	3.227	3.243	3.244
19	3.234	3.236	3.243	3.239	3.239	3.231	3.242	3.242	3.237	3.235
20	3.230	3.231	3.242	3.236	3.236	3.226	3.237	3.234	3.230	3.231
21	3.206	3.210	3.219	3.211	3.211	3.202	3.211	3.212	3.207	3.206
22	3.187	3.190	3.203	3.195	3.195	3.189	3.195	3.200	3.192	3.192
23	3.248	3.252	3.262	3.258	3.258	3.249	3.257	3.255	3.253	3.254
24	3.195	3.198	3.207	3.206	3.206	3.194	3.200	3.201	3.199	3.196
25	3.214	3.218	3.226	3.221	3.221	3.215	3.224	3.222	3.218	3.219
Ave.	3.221	3.224	3.233	3.229	3.229	3.220	3.230	3.225	3.224	3.223
Med.	3.218	3.221	3.229	3.225	3.225	3.217	3.226	3.222	3.221	3.220
st dev	0.0211	0.0215	0.0205	0.0225	0.0225	0.0214	0.0221	0.0199	0.0212	0.0218
Min.	3.187	3.190	3.203	3.195	3.195	3.189	3.195	3.200	3.192	3.192
Max.	3.287	3.291	3.297	3.303	3.303	3.287	3.298	3.290	3.293	3.292

### 3.3 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	0.2597	0.5255	2767	0.0003	0.0004	0.0007	0.0009	0.0010	0.0013	0.0016	0.0019	0.0018
2	0.2599	0.5251	2764	0.0003	0.0002	0.0007	0.0010	0.0010	0.0013	0.0015	0.0018	0.0021
3	0.2581	0.5218	2819	0.0003	0.0004	0.0007	0.0011	0.0012	0.0013	0.0014	0.0019	0.0021
4	0.2576	0.5254	2815	0.0001	0.0003	0.0007	0.0009	0.0012	0.0011	0.0013	0.0017	0.0019
5	0.2577	0.5244	2816	0.0002	0.0004	0.0006	0.0009	0.0013	0.0012	0.0013	0.0016	0.0018
6	0.2592	0.5238	2786	0.0002	0.0004	0.0008	0.0012	0.0014	0.0014	0.0015	0.0017	0.0021
7	0.2570	0.5235	2836	0.0003	0.0005	0.0009	0.0011	0.0012	0.0016	0.0013	0.0016	0.0018
8	0.2585	0.5224	2809	0.0002	0.0005	0.0009	0.0011	0.0014	0.0014	0.0015	0.0018	0.0020
9	0.2568	0.5225	2847	0.0003	0.0004	0.0008	0.0011	0.0014	0.0015	0.0016	0.0019	0.0022
10	0.2574	0.5236	2827	0.0002	0.0003	0.0009	0.0011	0.0013	0.0014	0.0015	0.0017	0.0019
11	0.2572	0.5243	2829	0.0003	0.0005	0.0007	0.0012	0.0015	0.0017	0.0016	0.0018	0.0020
12	0.2573	0.5234	2831	0.0003	0.0004	0.0007	0.0011	0.0015	0.0016	0.0016	0.0017	0.0021
13	0.2599	0.5243	2768	0.0003	0.0004	0.0006	0.0011	0.0015	0.0017	0.0017	0.0017	0.0020
14	0.2586	0.5252	2792	0.0003	0.0005	0.0007	0.0012	0.0015	0.0017	0.0019	0.0019	0.0020
15	0.2562	0.5237	2852	0.0002	0.0004	0.0005	0.0010	0.0013	0.0015	0.0017	0.0018	0.0019
16	0.2572	0.5246	2827	0.0003	0.0005	0.0006	0.0012	0.0014	0.0017	0.0021	0.0022	0.0021
17	0.2587	0.5235	2798	0.0003	0.0004	0.0005	0.0010	0.0014	0.0017	0.0022	0.0022	0.0021
18	0.2599	0.5257	2761	0.0003	0.0004	0.0006	0.0010	0.0013	0.0016	0.0021	0.0022	0.0021
19	0.2593	0.5237	2785	0.0003	0.0004	0.0006	0.0010	0.0014	0.0015	0.0019	0.0022	0.0023
20	0.2567	0.5215	2853	0.0003	0.0004	0.0005	0.0010	0.0013	0.0016	0.0020	0.0022	0.0022
21	0.2573	0.5238	2829	0.0003	0.0006	0.0007	0.0012	0.0014	0.0016	0.0019	0.0024	0.0023
22	0.2571	0.5232	2837	0.0002	0.0003	0.0005	0.0009	0.0011	0.0015	0.0020	0.0022	0.0021
23	0.2598	0.5239	2773	0.0003	0.0004	0.0006	0.0010	0.0013	0.0015	0.0017	0.0022	0.0022
24	0.2557	0.5231	2868	0.0002	0.0004	0.0006	0.0010	0.0013	0.0015	0.0017	0.0022	0.0022
25	0.2561	0.5229	2860	0.0002	0.0003	0.0004	0.0009	0.0010	0.0012	0.0014	0.0022	0.0021
Ave.	0.2580	0.5238	2814	0.0003	0.0004	0.0007	0.0011	0.0013	0.0015	0.0017	0.0019	0.0021
Med.	0.2576	0.5237	2819	0.0003	0.0004	0.0007	0.0010	0.0013	0.0015	0.0016	0.0019	0.0021
st dev	0.0013	0.0011	32.2173	0.0001	0.0001	0.0001	0.0001	0.0002	0.0002	0.0003	0.0002	0.0002
Min.	0.2557	0.5215	2761	0.0001	0.0002	0.0004	0.0009	0.0010	0.0011	0.0013	0.0016	0.0018
Max.	0.2599	0.5257	2868	0.0003	0.0006	0.0009	0.0012	0.0015	0.0017	0.0022	0.0024	0.0023



### 3.4 Data Set 2, 85°C, 200mA (Lumen Maintenance)

No.	Φ(lm)	Lumen Maintenance (%)								
	Ohr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
26	97.72	100.28	100.08	99.90	99.62	99.41	99.13	98.97	98.67	98.47
27	100.70	100.20	100.10	99.70	99.50	99.30	99.20	99.01	98.91	98.53
28	98.73	100.11	99.98	99.82	99.68	99.39	99.20	98.98	98.80	98.56
29	98.52	100.32	100.09	99.91	99.57	99.42	99.30	99.07	98.93	98.69
30	98.02	100.17	99.90	99.66	99.40	99.30	98.92	98.75	98.53	98.30
31	99.84	100.16	99.92	99.59	99.28	99.15	98.85	98.70	98.47	98.35
32	97.93	100.18	100.05	99.97	99.64	99.29	99.00	98.83	98.62	98.52
33	98.81	100.19	100.02	99.82	99.57	99.30	99.00	98.62	98.16	98.00
34	96.53	100.25	100.04	99.77	99.56	99.41	99.18	98.88	98.66	98.46
35	98.77	100.25	99.85	99.76	99.54	99.33	99.10	98.85	98.64	98.42
36	96.79	100.18	99.89	99.58	99.26	98.96	98.77	98.62	98.28	98.04
37	98.79	100.21	100.21	99.79	99.54	99.40	99.15	98.88	98.35	97.98
38	100.20	100.30	99.90	99.80	99.61	99.27	98.83	98.59	98.12	97.70
39	99.68	100.29	100.04	99.93	99.81	99.56	99.40	99.32	99.08	98.82
40	98.66	100.31	100.26	99.94	99.65	99.40	99.06	98.81	98.53	98.28
41	98.71	100.33	100.17	99.97	99.83	99.57	99.18	98.92	98.62	98.55
42	99.86	100.10	99.73	99.45	99.25	99.13	98.88	98.58	98.31	98.19
43	97.30	100.32	100.11	99.88	99.75	99.66	99.55	99.45	99.29	99.14
44	97.82	100.14	99.96	99.55	99.38	99.18	98.89	98.57	98.31	98.15
45	99.45	100.32	100.16	99.77	99.57	99.38	99.12	98.82	98.62	98.51
46	97.62	100.14	100.06	99.63	99.49	99.26	99.09	99.03	98.66	98.33
47	99.64	100.22	99.94	99.78	99.46	99.32	99.00	98.73	98.44	98.03
48	100.00	100.30	100.10	99.86	99.70	99.47	99.29	99.04	98.69	98.38
49	91.40	100.08	100.04	99.91	99.77	99.61	99.57	99.39	99.21	99.09
50	97.42	100.34	100.12	99.89	99.67	99.43	99.10	98.93	98.50	98.30
Ave.	98.36	100.23	100.03	99.78	99.56	99.36	99.11	98.89	98.62	98.39
Med.	98.71	100.22	100.04	99.80	99.57	99.38	99.10	98.88	98.62	98.38
st dev	1.8178	0.0809	0.1233	0.1414	0.1619	0.1574	0.2069	0.2395	0.2998	0.3306
Min.	91.40	100.08	99.73	99.45	99.25	98.96	98.77	98.57	98.12	97.70
Max.	100.70	100.34	100.26	99.97	99.83	99.66	99.57	99.45	99.29	99.14

TM-21 Projection:

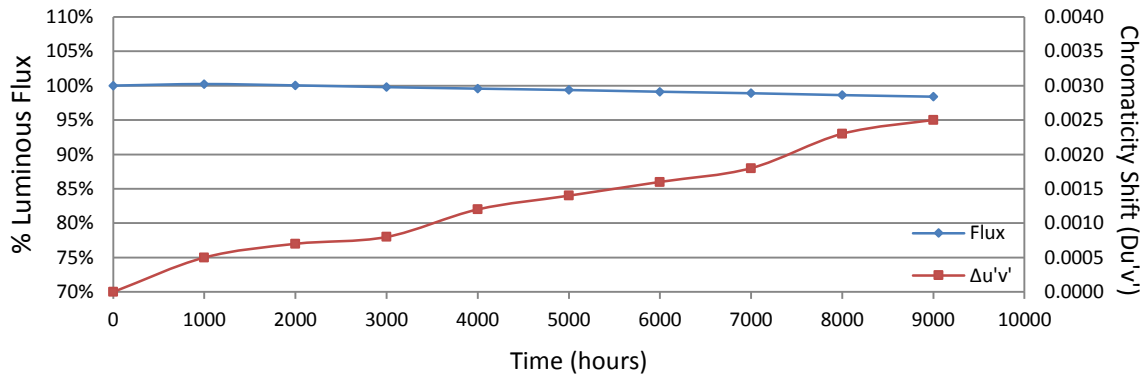
**Test Duration:** 9,000 hours  
**Failures Observed:** 0  
 $\alpha$ : 2.393E-06  
 $\beta$ : 1.005  
**Reported L<sub>70</sub>:** >54,000 hours  
**Reported L<sub>90</sub>:** 46,000 hours

**3.5 Data Set 2, 85°C, 200mA (Forward Voltage)**

No.	Forward Voltage (V)									
	0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
26	3.260	3.266	3.275	3.273	3.261	3.261	3.268	3.270	3.268	3.268
27	3.192	3.196	3.206	3.199	3.190	3.190	3.200	3.198	3.198	3.194
28	3.209	3.215	3.223	3.218	3.208	3.208	3.217	3.218	3.216	3.212
29	3.211	3.215	3.223	3.219	3.211	3.211	3.214	3.225	3.215	3.213
30	3.271	3.274	3.282	3.275	3.268	3.268	3.278	3.283	3.271	3.273
31	3.240	3.243	3.254	3.250	3.241	3.241	3.247	3.251	3.246	3.246
32	3.206	3.211	3.218	3.215	3.206	3.206	3.212	3.218	3.211	3.211
33	3.241	3.244	3.254	3.247	3.241	3.241	3.247	3.250	3.245	3.246
34	3.258	3.261	3.269	3.264	3.257	3.257	3.263	3.276	3.260	3.264
35	3.199	3.204	3.211	3.208	3.202	3.202	3.209	3.207	3.205	3.204
36	3.266	3.270	3.277	3.277	3.265	3.265	3.272	3.273	3.270	3.269
37	3.209	3.211	3.216	3.219	3.212	3.212	3.214	3.219	3.216	3.213
38	3.207	3.214	3.220	3.219	3.211	3.211	3.213	3.215	3.215	3.215
39	3.212	3.221	3.226	3.223	3.219	3.219	3.224	3.222	3.222	3.219
40	3.234	3.239	3.247	3.244	3.240	3.240	3.252	3.244	3.241	3.240
41	3.244	3.250	3.252	3.251	3.247	3.247	3.255	3.252	3.248	3.247
42	3.211	3.215	3.219	3.219	3.215	3.215	3.231	3.228	3.215	3.214
43	3.239	3.245	3.252	3.247	3.244	3.244	3.316	3.249	3.244	3.245
44	3.223	3.229	3.235	3.234	3.227	3.227	3.264	3.231	3.227	3.230
45	3.227	3.231	3.239	3.238	3.232	3.232	3.268	3.240	3.230	3.230
46	3.207	3.211	3.214	3.215	3.214	3.214	3.254	3.222	3.211	3.211
47	3.207	3.212	3.216	3.217	3.211	3.211	3.215	3.221	3.214	3.211
48	3.185	3.186	3.193	3.204	3.187	3.187	3.191	3.193	3.190	3.186
49	3.202	3.208	3.215	3.221	3.210	3.210	3.211	3.213	3.210	3.208
50	3.230	3.235	3.242	3.247	3.238	3.238	3.238	3.242	3.235	3.235
Ave.	3.224	3.228	3.235	3.234	3.226	3.226	3.239	3.234	3.229	3.228
Med.	3.212	3.221	3.226	3.223	3.219	3.219	3.238	3.228	3.222	3.219
st dev	0.0237	0.0237	0.0243	0.0227	0.0229	0.0229	0.0301	0.0242	0.0228	0.0242
Min.	3.185	3.186	3.193	3.199	3.187	3.187	3.191	3.193	3.190	3.186
Max.	3.271	3.274	3.282	3.277	3.268	3.268	3.316	3.283	3.271	3.273

### 3.6 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	9000hrs
26	0.2587	0.5235	2799	0.0005	0.0004	0.0006	0.0011	0.0012	0.0016	0.0017	0.0024	0.0024
27	0.2575	0.5253	2815	0.0004	0.0006	0.0005	0.0012	0.0012	0.0016	0.0016	0.0024	0.0025
28	0.2574	0.5226	2832	0.0006	0.0008	0.0005	0.0013	0.0013	0.0016	0.0016	0.0024	0.0026
29	0.2578	0.5241	2814	0.0004	0.0006	0.0005	0.0012	0.0011	0.0015	0.0016	0.0022	0.0024
30	0.2603	0.5247	2758	0.0006	0.0008	0.0009	0.0013	0.0014	0.0017	0.0020	0.0024	0.0028
31	0.2577	0.5255	2812	0.0004	0.0007	0.0009	0.0013	0.0014	0.0016	0.0018	0.0024	0.0026
32	0.2592	0.5238	2787	0.0005	0.0008	0.0011	0.0015	0.0016	0.0019	0.0020	0.0025	0.0029
33	0.2582	0.5250	2801	0.0005	0.0007	0.0008	0.0013	0.0015	0.0016	0.0019	0.0023	0.0027
34	0.2594	0.5243	2780	0.0005	0.0006	0.0007	0.0012	0.0014	0.0016	0.0017	0.0021	0.0025
35	0.2580	0.5257	2803	0.0004	0.0006	0.0006	0.0009	0.0012	0.0013	0.0015	0.0019	0.0021
36	0.2557	0.5227	2869	0.0005	0.0001	0.0007	0.0013	0.0014	0.0016	0.0020	0.0023	0.0027
37	0.2578	0.5241	2815	0.0006	0.0008	0.0007	0.0010	0.0015	0.0013	0.0016	0.0019	0.0025
38	0.2600	0.5237	2768	0.0004	0.0007	0.0005	0.0011	0.0015	0.0017	0.0019	0.0023	0.0027
39	0.2568	0.5245	2836	0.0004	0.0006	0.0007	0.0009	0.0011	0.0012	0.0013	0.0016	0.0019
40	0.2583	0.5245	2803	0.0003	0.0006	0.0010	0.0010	0.0014	0.0015	0.0017	0.0020	0.0025
41	0.2591	0.5244	2785	0.0005	0.0007	0.0009	0.0012	0.0014	0.0016	0.0018	0.0023	0.0026
42	0.2573	0.5257	2819	0.0004	0.0009	0.0009	0.0011	0.0013	0.0015	0.0013	0.0015	0.0017
43	0.2587	0.5251	2790	0.0005	0.0007	0.0009	0.0010	0.0013	0.0014	0.0018	0.0021	0.0022
44	0.2569	0.5204	2855	0.0005	0.0008	0.0011	0.0014	0.0016	0.0018	0.0022	0.0024	0.0026
45	0.2580	0.5243	2810	0.0005	0.0007	0.0010	0.0015	0.0016	0.0019	0.0022	0.0025	0.0028
46	0.2584	0.5241	2803	0.0005	0.0007	0.0009	0.0010	0.0012	0.0017	0.0019	0.0024	0.0025
47	0.2564	0.5244	2845	0.0006	0.0008	0.0013	0.0013	0.0016	0.0017	0.0020	0.0023	0.0025
48	0.2561	0.5215	2867	0.0005	0.0007	0.0010	0.0011	0.0016	0.0019	0.0022	0.0024	0.0028
49	0.2587	0.5271	2782	0.0007	0.0004	0.0009	0.0014	0.0017	0.0022	0.0025	0.0031	0.0032
50	0.2583	0.5236	2807	0.0005	0.0006	0.0013	0.0012	0.0009	0.0013	0.0018	0.0024	0.0026
Ave.	0.2580	0.5242	2810	0.0005	0.0007	0.0008	0.0012	0.0014	0.0016	0.0018	0.0023	0.0025
Med.	0.2580	0.5243	2807	0.0005	0.0007	0.0009	0.0012	0.0014	0.0016	0.0018	0.0023	0.0026
st dev	0.0011	0.0014	28.3975	0.0001	0.0002	0.0002	0.0002	0.0002	0.0002	0.0003	0.0003	0.0003
Min.	0.2557	0.5204	2758	0.0003	0.0001	0.0005	0.0009	0.0009	0.0012	0.0013	0.0015	0.0017
Max.	0.2603	0.5271	2869	0.0007	0.0009	0.0013	0.0015	0.0017	0.0022	0.0025	0.0031	0.0032



### 3.7 Data Set 3, 105°C, 200mA (Lumen Maintenance)

No.	Φ(lm)	Lumen Maintenance (%)								
	0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
51	98.57	100.24	100.15	99.86	99.63	99.34	99.07	98.71	98.30	97.97
52	99.83	100.17	99.77	99.69	99.46	99.24	98.80	98.56	98.26	97.99
53	99.13	100.13	99.79	99.61	99.24	99.03	98.85	98.57	98.47	98.16
54	100.30	99.90	99.70	99.51	99.31	99.02	98.75	98.42	98.16	97.96
55	100.10	100.20	100.10	99.61	99.15	98.87	98.58	98.35	98.05	97.86
56	99.20	100.11	100.07	99.61	99.28	98.94	98.79	98.58	98.26	97.98
57	100.20	100.10	99.90	99.75	99.29	98.88	98.63	98.46	98.28	98.08
58	100.50	100.20	99.90	99.70	99.27	99.01	98.61	98.31	98.11	97.86
59	98.01	100.16	100.03	99.64	99.44	99.12	98.71	98.40	98.10	98.05
60	99.77	100.17	99.82	99.46	99.01	98.87	98.57	98.15	97.74	97.50
61	100.00	100.10	99.82	99.53	99.09	98.85	98.68	98.36	97.97	97.75
62	98.80	99.99	99.75	99.55	99.17	98.87	98.63	98.37	98.00	97.58
63	99.65	100.19	99.96	99.59	99.38	99.09	98.77	98.50	98.11	97.80
64	100.00	100.10	99.93	99.85	99.38	99.22	99.01	98.74	98.44	98.06
65	98.99	100.22	99.75	99.61	99.25	99.08	98.79	98.74	98.48	98.08
66	100.10	100.10	99.90	99.71	99.45	99.26	98.99	98.83	98.59	98.32
67	98.58	99.96	99.72	99.48	99.25	99.07	98.80	98.52	98.31	98.05
68	98.82	100.09	100.01	99.65	99.15	98.87	98.61	98.29	98.03	97.80
69	98.44	100.02	99.95	99.80	99.45	99.19	98.92	98.58	98.26	97.93
70	99.67	99.86	99.75	99.64	99.20	99.02	98.86	98.67	98.34	98.05
71	100.20	99.90	99.80	99.63	99.27	98.95	98.89	98.65	98.47	98.21
72	100.10	100.10	99.90	99.51	99.25	99.10	98.78	98.50	98.17	97.87
73	99.98	100.12	99.85	99.44	99.02	99.02	98.80	98.52	98.16	97.80
74	97.63	100.17	100.11	99.86	99.49	99.26	98.96	98.82	98.35	97.98
75	100.60	100.10	99.90	99.70	99.27	99.19	99.06	98.87	98.56	98.26
Ave.	99.49	100.10	99.89	99.64	99.29	99.05	98.80	98.54	98.24	97.96
Med.	99.77	100.10	99.90	99.63	99.27	99.03	98.79	98.52	98.26	97.98
st dev	0.8129	0.1041	0.1308	0.1204	0.1499	0.1464	0.1480	0.1852	0.2034	0.1929
Min.	97.63	99.86	99.70	99.44	99.01	98.85	98.57	98.15	97.74	97.50
Max.	100.60	100.24	100.15	99.86	99.63	99.34	99.07	98.87	98.59	98.32

TM-21 Projection:

**Test Duration:** 9,000 hours

**Failures Observed:** 0

**α:** 2.706E-06

**β:** 1.004

**Reported L<sub>70</sub>:** >54,000 hours

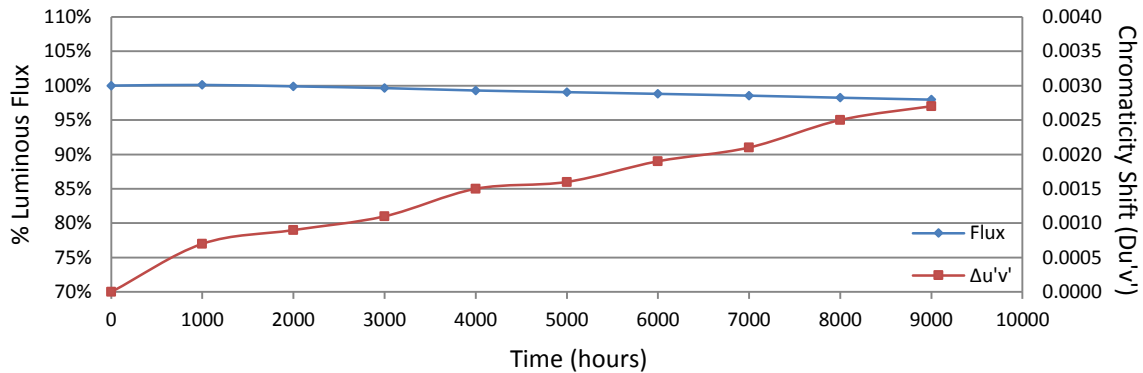
**Reported L<sub>90</sub>:** 40,000 hours

### 3.8 Data Set 3, 105°C, 200mA (Forward Voltage)

No.	Forward Voltage (V)									
	0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
51	3.214	3.217	3.226	3.229	3.219	3.219	3.223	3.224	3.220	3.217
52	3.198	3.205	3.217	3.216	3.202	3.202	3.207	3.219	3.204	3.203
53	3.205	3.210	3.213	3.219	3.205	3.205	3.216	3.254	3.212	3.209
54	3.202	3.204	3.209	3.218	3.200	3.200	3.205	3.208	3.205	3.204
55	3.198	3.204	3.208	3.213	3.200	3.200	3.206	3.207	3.203	3.203
56	3.234	3.239	3.243	3.248	3.232	3.232	3.239	3.238	3.235	3.238
57	3.215	3.220	3.225	3.237	3.215	3.215	3.226	3.222	3.223	3.221
58	3.211	3.217	3.220	3.242	3.213	3.213	3.223	3.221	3.214	3.214
59	3.211	3.217	3.221	3.229	3.211	3.211	3.219	3.217	3.215	3.212
60	3.204	3.206	3.211	3.222	3.203	3.203	3.210	3.209	3.207	3.204
61	3.210	3.216	3.218	3.229	3.210	3.210	3.232	3.220	3.214	3.215
62	3.235	3.239	3.240	3.247	3.232	3.232	3.249	3.242	3.233	3.237
63	3.200	3.202	3.207	3.217	3.200	3.200	3.211	3.205	3.202	3.203
64	3.228	3.229	3.233	3.248	3.225	3.225	3.242	3.229	3.227	3.225
65	3.215	3.221	3.224	3.233	3.213	3.213	3.225	3.222	3.216	3.217
66	3.232	3.236	3.241	3.247	3.229	3.229	3.238	3.236	3.233	3.232
67	3.222	3.225	3.229	3.238	3.223	3.223	3.231	3.228	3.224	3.222
68	3.215	3.221	3.227	3.236	3.217	3.217	3.228	3.224	3.219	3.218
69	3.211	3.212	3.218	3.228	3.211	3.211	3.216	3.219	3.214	3.211
70	3.193	3.195	3.201	3.208	3.192	3.192	3.200	3.203	3.196	3.191
71	3.204	3.206	3.211	3.219	3.201	3.201	3.211	3.211	3.206	3.204
72	3.205	3.205	3.210	3.222	3.205	3.205	3.215	3.211	3.207	3.206
73	3.216	3.221	3.223	3.231	3.217	3.217	3.224	3.223	3.217	3.217
74	3.212	3.218	3.220	3.234	3.211	3.211	3.221	3.224	3.228	3.223
75	3.224	3.225	3.230	3.242	3.223	3.223	3.235	3.232	3.227	3.224
Ave.	3.213	3.216	3.221	3.230	3.212	3.212	3.222	3.222	3.216	3.215
Med.	3.211	3.217	3.220	3.229	3.211	3.211	3.223	3.222	3.215	3.215
st dev	0.0115	0.0117	0.0111	0.0118	0.0109	0.0109	0.0127	0.0123	0.0108	0.0115
Min.	3.193	3.195	3.201	3.208	3.192	3.192	3.200	3.203	3.196	3.191
Max.	3.235	3.239	3.243	3.248	3.232	3.232	3.249	3.254	3.235	3.238

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

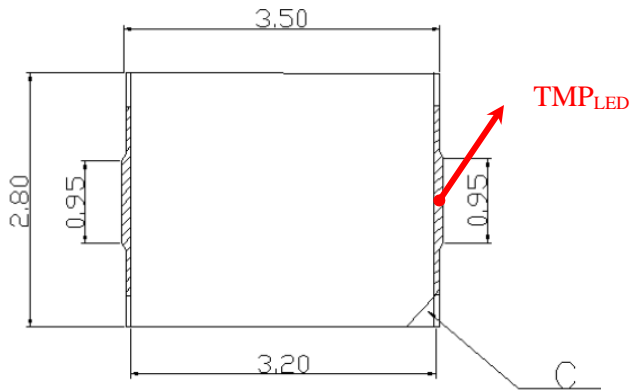
No.	u'	v'	CCT(K)	Chromaticity Shift ( $\Delta u'v'$ )								
	0hr(Initial)			1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
51	0.2582	0.5253	2801	0.0006	0.0007	0.0011	0.0014	0.0012	0.0014	0.0019	0.0025	0.0027
52	0.2573	0.5241	2826	0.0007	0.0008	0.0012	0.0015	0.0015	0.0016	0.0019	0.0025	0.0027
53	0.2567	0.5230	2845	0.0008	0.0008	0.0011	0.0015	0.0015	0.0015	0.0018	0.0026	0.0029
54	0.2581	0.5244	2808	0.0007	0.0007	0.0009	0.0014	0.0014	0.0017	0.0016	0.0025	0.0027
55	0.2588	0.5256	2786	0.0007	0.0012	0.0011	0.0015	0.0014	0.0017	0.0017	0.0024	0.0028
56	0.2563	0.5225	2857	0.0007	0.0009	0.0011	0.0016	0.0017	0.0018	0.0018	0.0025	0.0029
57	0.2588	0.5262	2784	0.0006	0.0007	0.0010	0.0015	0.0017	0.0017	0.0019	0.0024	0.0026
58	0.2594	0.5267	2769	0.0007	0.0008	0.0010	0.0015	0.0017	0.0019	0.0021	0.0025	0.0028
59	0.2616	0.5254	2727	0.0006	0.0007	0.0010	0.0014	0.0017	0.0018	0.0020	0.0024	0.0026
60	0.2585	0.5244	2799	0.0008	0.0008	0.0010	0.0016	0.0017	0.0021	0.0022	0.0026	0.0029
61	0.2566	0.5236	2845	0.0006	0.0007	0.0012	0.0014	0.0017	0.0019	0.0021	0.0024	0.0025
62	0.2561	0.5230	2858	0.0007	0.0009	0.0011	0.0015	0.0016	0.0020	0.0021	0.0023	0.0027
63	0.2594	0.5239	2781	0.0007	0.0008	0.0013	0.0016	0.0017	0.0021	0.0022	0.0027	0.0030
64	0.2587	0.5247	2793	0.0007	0.0007	0.0012	0.0015	0.0017	0.0021	0.0022	0.0026	0.0028
65	0.2581	0.5245	2806	0.0008	0.0008	0.0013	0.0013	0.0016	0.0019	0.0020	0.0023	0.0026
66	0.2556	0.5231	2869	0.0008	0.0009	0.0013	0.0016	0.0018	0.0022	0.0023	0.0027	0.0030
67	0.2580	0.5257	2803	0.0007	0.0005	0.0009	0.0013	0.0015	0.0017	0.0018	0.0021	0.0025
68	0.2583	0.5244	2804	0.0008	0.0010	0.0010	0.0015	0.0017	0.0020	0.0020	0.0024	0.0027
69	0.2586	0.5251	2794	0.0007	0.0009	0.0011	0.0015	0.0017	0.0021	0.0022	0.0025	0.0029
70	0.2569	0.5240	2837	0.0008	0.0010	0.0011	0.0015	0.0017	0.0021	0.0021	0.0025	0.0029
71	0.2576	0.5249	2817	0.0007	0.0009	0.0011	0.0015	0.0017	0.0021	0.0023	0.0025	0.0028
72	0.2561	0.5242	2854	0.0012	0.0013	0.0013	0.0018	0.0019	0.0024	0.0026	0.0028	0.0032
73	0.2577	0.5252	2812	0.0008	0.0013	0.0010	0.0016	0.0018	0.0021	0.0024	0.0026	0.0028
74	0.2581	0.5244	2808	0.0007	0.0012	0.0009	0.0014	0.0016	0.0021	0.0023	0.0021	0.0023
75	0.2586	0.5249	2795	0.0007	0.0013	0.0009	0.0014	0.0016	0.0020	0.0022	0.0025	0.0026
Ave.	0.2579	0.5245	2811	0.0007	0.0009	0.0011	0.0015	0.0016	0.0019	0.0021	0.0025	0.0027
Med.	0.2581	0.5244	2806	0.0007	0.0008	0.0011	0.0015	0.0017	0.0020	0.0021	0.0025	0.0028
st dev	0.0013	0.0010	32.3591	0.0001	0.0002	0.0001	0.0001	0.0002	0.0002	0.0002	0.0002	0.0002
Min.	0.2556	0.5225	2727	0.0006	0.0005	0.0009	0.0013	0.0012	0.0014	0.0016	0.0021	0.0023
Max.	0.2616	0.5267	2869	0.0012	0.0013	0.0013	0.0018	0.0019	0.0024	0.0026	0.0028	0.0032





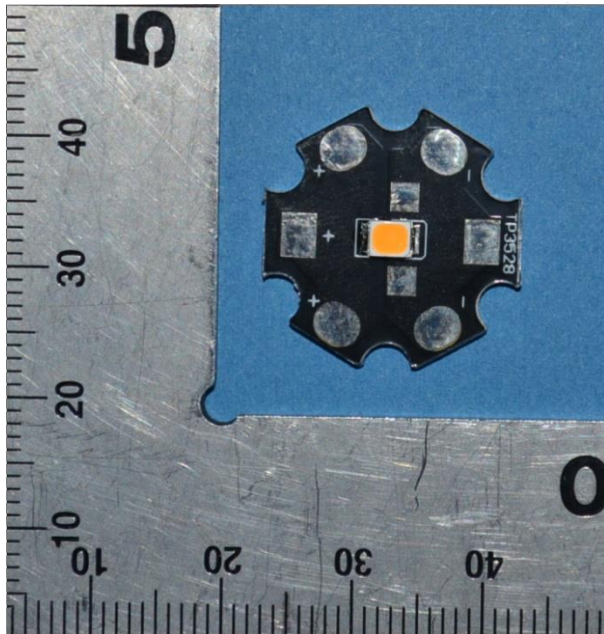
## 4 - EUT Photo

### 4.1 Mechanical Dimensions



All dimensions are in millimeter

### 4.2 EUT Photo



### Report Revision

Report Number	Report Date	Contents
RSZ180821504-10	2018-08-24	Original report.
RSZ180821504-10-M1	2018-11-05	Update the Mechanical Dimensions in page17.

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