



# TEST REPORT

According to ANSI/IES LM-80-15  
For

## Hongli Zhihui Group Co.,Ltd.

No.1, Xianke Yi Road, Huadong Town, Huadu District, Guangzhou, China

**Model: HL-ES-3032FVW-2C-S1-HR3**

<b>Report Type:</b> 6000 Hours Test Report		<b>Product Type:</b> LED Package	
<b>Test Engineer:</b>	Pote Wang	<i>Pote Wang</i>	
<b>Report Number:</b>	RSZ170828523-10		
<b>Test Date:</b>	2017-09-01 to 2018-05-09		
<b>Report Date:</b>	2018-05-24		
<b>Reviewed By:</b>	Blake Zhang / EE Engineer	<i>Blake Zhang</i>	
<b>Test Facility:</b>	Test facility was located at No.69,Pulongcun ,Puxihu Industrial Area, Tangxia , Dongguan, Guangdong, China.		
<b>Prepared By:</b>	Bay Area Compliance Laboratories Corp. (Dongguan). No.69,Pulongcun ,Puxihu Industrial Area, Tangxia , Dongguan, Guangdong, China. Tel: +86-0769-86858888 Fax:+86-0769-86858588		
<b>Accreditation:</b>	The IAS Accreditation Number TL-460.		

**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:

90 PCS samples were received on 2017-08-28. The samples were numbered from 1 to 30, 31 to 60 and 61 to 90.

Manufacturer:	Hongli Zhihui Group Co.,Ltd.
Part Number:	HL-ES-3032FWW-2C-S1-HR3
Part Type:	LED Package
Drive Level:	DC 100mA
Nominal CCT:	2700K
Power:	2W
Current Density per LED die:	110.086mA/mm <sup>2</sup>
Power Density per LED die:	2.2017 W/mm <sup>2</sup>
CRI:	80
Die Spacing:	0.25mm

#### 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:

- ANSI/IES LM-80-15: IES Approved Method for Measuring Lumen Maintenance of LED Light Sources.
- CIE 127:2007: Measurement of LEDs (This standard was not accredited by IAS)
- ENERGY STAR<sup>®</sup> 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	2018-03-18	2019-03-18
Programmable Test Power for LEDs	EVERFINE	LED300E	1008002	2018-03-26	2019-03-26
High accuracy array spectroradiometer	EVERFINE	HAAS-2000	1012016T	2018-03-18	2019-03-18
Standard Light Source	EVERFINE	D062	1011064	2018-01-15	2019-01-15
Precision digital stabilized DC power supply	EVERFINE	WY605-V110	G115987CJ7321114	2018-03-26	2019-03-26
Multilayer aging machine	BACL	B2-270	20015	25°C~130°C	2018-03-13
Digital CC&CV DC Power Supply	EVERFINE	WY5015	11090007	(50/15A)	2018-03-26
Digital CC&CV DC Power Supply	EVERFINE	WY5015	11090005	(50/15A)	2018-03-26
Digital CC&CV DC Power Supply	EVERFINE	WY5015	11090006	(50/15A)	2018-03-26

#### **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. The forward current was regulated to within  $\pm 0.5\%$  of the nominal value. The test system was calibrated by halogen reference lamp. The ambient temperature during test was set to  $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$ , RH <65%. The temperature measurement point was located in the sphere and the temperature was detected by a temperature probe.

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, 100mA

Part Number: HL-ES-3032FVW-2C-S1-HR3  
Number of Units: 30  
Case Temperature: >53°C  
Ambient Temperature: >50°C  
Life Test Drive Current: 100mA  
Measurement Current: 100mA

### Data Set 2: 85°C, 100mA

Part Number: HL-ES-3032FVW-2C-S1-HR3  
Number of Units: 30  
Case Temperature: >83°C  
Ambient Temperature: >80°C  
Life Test Drive Current: 100mA  
Measurement Current: 100mA

### Data Set 3: 105°C, 100mA

Part Number: HL-ES-3032FVW-2C-S1-HR3  
Number of Units: 30  
Case Temperature: >103°C  
Ambient Temperature: >100°C  
Life Test Drive Current: 100mA  
Measurement Current: 100mA

## 2 - Summary of Test Result

Data Set:	Sample Size	Failures Observed:	Test Interval	Test Duration	$\alpha$ :	$\beta$ :	Reported TM-21 L <sub>70</sub> Lifetime
1	30	0	1000hrs	6000hrs	3.873E-06	1.007	>36000hrs
2	30	0	1000hrs	6000hrs	4.507E-06	1.006	>36000hrs
3	30	0	1000hrs	6000hrs	5.466E-06	1.006	>36000hrs

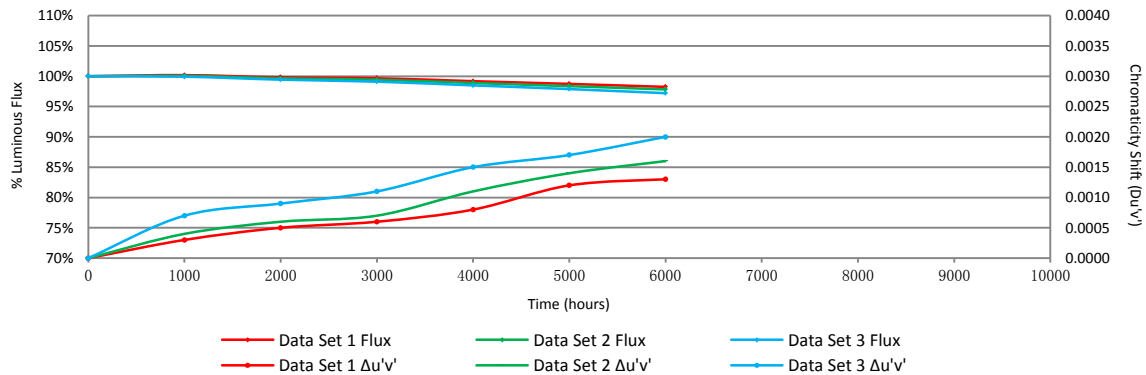
### Average Lumen Maintenance (Percentage of Initial Luminous Flux)

Data Set:	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs
1	100.18%	99.82%	99.66%	99.18%	98.73%	98.24%
2	100.06%	99.65%	99.42%	98.88%	98.36%	97.82%
3	99.92%	99.43%	99.10%	98.49%	97.88%	97.20%

### Average Chromaticity Shift

Data Set:	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs
1	0.0003	0.0005	0.0006	0.0008	0.0012	0.0013
2	0.0004	0.0006	0.0007	0.0011	0.0014	0.0016
3	0.0007	0.0009	0.0011	0.0015	0.0017	0.0020

### Average Lumen Maintenance and Chromaticity Shift VS. Time



### 3 - Test Data

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

No.	Φ(lm)	Lumen Maintenance (%)					
	0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs
1	244.1	100.16	99.84	99.43	98.93	98.53	98.07
2	242.2	100.21	99.79	99.46	99.01	98.64	98.27
3	242.3	100.37	99.96	99.88	99.34	98.93	98.64
4	238.1	100.29	99.92	99.79	99.33	99.08	98.53
5	243.0	99.92	99.75	99.71	99.26	98.52	98.15
6	241.0	100.21	99.96	99.79	99.25	98.80	98.38
7	240.1	100.29	99.96	99.75	99.38	98.79	98.25
8	237.9	100.21	99.96	99.92	99.45	99.03	98.44
9	239.3	100.04	99.67	99.33	98.83	98.37	98.20
10	239.0	100.25	99.92	99.83	99.08	98.74	98.45
11	241.9	100.08	99.63	99.46	99.21	98.68	98.47
12	239.9	99.96	99.67	99.54	99.21	98.58	98.37
13	239.8	100.25	99.96	99.87	99.25	98.71	98.46
14	235.0	100.21	99.83	99.74	99.62	99.32	98.77
15	243.2	100.04	99.59	99.51	99.18	98.56	97.86
16	238.9	100.08	99.79	99.67	99.37	98.79	98.20
17	239.4	100.17	99.83	99.50	99.29	98.87	98.37
18	239.6	100.25	99.83	99.67	98.91	98.66	98.12
19	237.1	100.21	99.83	99.66	99.20	98.90	98.19
20	239.0	100.25	99.83	99.79	99.37	98.83	98.16
21	242.2	100.08	99.75	99.55	99.17	98.51	98.02
22	238.0	99.96	99.58	99.29	98.66	98.24	97.94
23	236.9	100.13	99.79	99.62	98.73	98.18	98.06
24	238.5	100.21	99.83	99.66	99.16	98.70	98.07
25	240.2	100.25	99.92	99.71	99.13	98.63	98.04
26	241.8	100.33	99.88	99.79	99.17	98.68	98.01
27	239.1	100.25	99.79	99.71	99.21	98.87	98.12
28	238.1	100.13	99.66	99.54	99.12	98.70	98.11
29	242.3	100.21	99.92	99.79	99.26	99.09	98.35
30	241.7	100.25	99.88	99.79	99.38	98.88	98.22
Ave.	240.0	100.18	99.82	99.66	99.18	98.73	98.24
Med.	239.7	100.21	99.83	99.69	99.21	98.70	98.20
st dev	2.1421	0.1121	0.1133	0.1650	0.2098	0.2442	0.2118
Min.	235.0	99.92	99.58	99.29	98.66	98.18	97.86
Max.	244.1	100.37	99.96	99.92	99.62	99.32	98.77

**3.2 Data Set 1, 55°C, 100mA (Forward Voltage)**

No.	Forward Voltage (V)						
	0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs
1	18.17	18.19	18.19	18.13	18.17	18.14	18.16
2	18.13	18.15	18.17	18.13	18.13	18.10	18.12
3	18.18	18.20	18.21	18.17	18.16	18.15	18.17
4	17.98	18.00	18.10	17.97	17.97	17.96	17.98
5	18.15	18.17	18.18	18.14	18.14	18.14	18.15
6	18.00	18.03	18.03	18.00	18.00	18.00	18.01
7	18.15	18.17	18.19	18.14	18.14	18.13	18.15
8	18.10	18.12	18.12	18.10	18.11	18.10	18.11
9	17.92	17.95	17.96	17.92	17.92	17.92	17.94
10	18.10	18.12	18.12	18.10	18.09	18.09	18.10
11	18.17	18.19	18.19	18.17	18.19	18.16	18.17
12	18.06	18.08	18.08	18.06	18.06	18.05	18.07
13	18.16	18.18	18.18	18.18	18.16	18.15	18.17
14	18.15	18.16	18.18	18.16	18.15	18.14	18.15
15	18.11	18.12	18.13	18.12	18.11	18.10	18.11
16	17.98	17.99	17.99	17.98	17.98	17.97	17.99
17	18.02	18.04	18.04	18.02	18.04	18.02	18.03
18	17.97	17.99	18.01	17.98	17.99	17.97	17.98
19	17.95	17.96	17.97	17.95	17.97	17.95	17.95
20	18.03	18.05	18.05	18.05	18.04	18.03	18.04
21	18.07	18.09	18.09	18.08	18.08	18.07	18.09
22	18.09	18.12	18.13	18.10	18.11	18.08	18.09
23	18.01	18.05	18.04	18.01	18.02	18.01	18.03
24	18.11	18.13	18.15	18.11	18.11	18.10	18.12
25	18.12	18.14	18.17	18.13	18.12	18.11	18.15
26	18.15	18.18	18.20	18.16	18.16	18.14	18.16
27	17.95	17.97	17.99	17.95	17.97	17.94	17.96
28	17.94	17.97	17.97	17.93	17.96	17.94	17.95
29	18.14	18.17	18.18	18.15	18.16	18.14	18.15
30	18.09	18.11	18.13	18.10	18.11	18.09	18.10
Ave.	18.07	18.09	18.10	18.07	18.08	18.06	18.08
Med.	18.10	18.12	18.13	18.10	18.11	18.09	18.10
st dev	0.0809	0.0802	0.0805	0.0812	0.0775	0.0764	0.0777
Min.	17.92	17.95	17.96	17.92	17.92	17.92	17.94
Max.	18.18	18.20	18.21	18.18	18.19	18.16	18.17



**3.3 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
1	0.2619	0.5281	2710	0.0004	0.0007	0.0010	0.0013	0.0018	0.0018
2	0.2613	0.5265	2729	0.0004	0.0006	0.0009	0.0011	0.0014	0.0017
3	0.2638	0.5293	2667	0.0002	0.0005	0.0008	0.0011	0.0012	0.0017
4	0.2617	0.5300	2706	0.0002	0.0005	0.0004	0.0009	0.0012	0.0012
5	0.2605	0.5257	2749	0.0003	0.0006	0.0006	0.0012	0.0013	0.0016
6	0.2629	0.5295	2683	0.0002	0.0005	0.0004	0.0010	0.0012	0.0014
7	0.2626	0.5248	2709	0.0003	0.0006	0.0004	0.0011	0.0012	0.0013
8	0.2601	0.5255	2758	0.0001	0.0005	0.0005	0.0009	0.0010	0.0012
9	0.2612	0.5262	2732	0.0004	0.0006	0.0008	0.0011	0.0012	0.0013
10	0.2633	0.5310	2670	0.0002	0.0006	0.0005	0.0010	0.0011	0.0012
11	0.2620	0.5272	2712	0.0003	0.0006	0.0006	0.0011	0.0013	0.0014
12	0.2613	0.5255	2733	0.0004	0.0005	0.0007	0.0009	0.0012	0.0014
13	0.2618	0.5239	2729	0.0002	0.0005	0.0006	0.0007	0.0012	0.0013
14	0.2628	0.5263	2697	0.0002	0.0004	0.0006	0.0007	0.0011	0.0012
15	0.2608	0.5286	2731	0.0002	0.0005	0.0007	0.0007	0.0012	0.0013
16	0.2614	0.5255	2731	0.0003	0.0006	0.0006	0.0006	0.0012	0.0014
17	0.2617	0.5285	2712	0.0001	0.0004	0.0006	0.0005	0.0009	0.0012
18	0.2617	0.5274	2716	0.0002	0.0003	0.0004	0.0004	0.0010	0.0012
19	0.2627	0.5277	2694	0.0002	0.0004	0.0005	0.0005	0.0011	0.0012
20	0.2624	0.5272	2703	0.0002	0.0005	0.0005	0.0007	0.0011	0.0013
21	0.2610	0.5279	2729	0.0003	0.0005	0.0007	0.0006	0.0011	0.0013
22	0.2629	0.5268	2693	0.0002	0.0007	0.0007	0.0007	0.0011	0.0013
23	0.2632	0.5245	2697	0.0004	0.0006	0.0008	0.0008	0.0013	0.0015
24	0.2612	0.5243	2740	0.0002	0.0006	0.0006	0.0007	0.0012	0.0014
25	0.2618	0.5274	2714	0.0004	0.0007	0.0008	0.0008	0.0012	0.0013
26	0.2617	0.5278	2715	0.0003	0.0006	0.0009	0.0008	0.0013	0.0015
27	0.2622	0.5294	2699	0.0001	0.0003	0.0004	0.0006	0.0009	0.0011
28	0.2611	0.5264	2733	0.0002	0.0005	0.0006	0.0008	0.0012	0.0013
29	0.2618	0.5271	2717	0.0001	0.0004	0.0005	0.0006	0.0011	0.0012
30	0.2618	0.5277	2713	0.0002	0.0005	0.0004	0.0005	0.0010	0.0011
Ave.	0.2619	0.5271	2714	0.0003	0.0005	0.0006	0.0008	0.0012	0.0013
Med.	0.2618	0.5272	2714	0.0002	0.0005	0.0006	0.0008	0.0012	0.0013
st dev	0.0009	0.0018	21.2821	0.0001	0.0001	0.0002	0.0002	0.0002	0.0002
Min.	0.2601	0.5239	2667	0.0001	0.0003	0.0004	0.0004	0.0009	0.0011
Max.	0.2638	0.5310	2758	0.0004	0.0007	0.0010	0.0013	0.0018	0.0018

**3.4 Data Set 2, 85°C, 100mA (Lumen Maintenance)**

No.	Φ(lm)	Lumen Maintenance (%)					
	Ohr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs
31	240.5	100.04	99.58	99.42	98.92	98.46	97.96
32	238.5	100.17	99.71	99.29	98.83	98.45	98.07
33	241.7	99.92	99.54	99.34	98.55	97.97	97.43
34	240.8	100.04	99.63	99.42	98.96	98.30	97.59
35	239.3	100.21	99.75	99.58	98.83	98.37	97.66
36	242.1	100.04	99.63	99.42	98.80	98.06	97.69
37	239.3	100.08	99.62	99.37	98.79	98.04	97.37
38	240.6	100.29	99.88	99.63	99.17	98.63	97.92
39	241.2	100.17	99.88	99.75	99.00	98.63	98.05
40	240.4	100.12	99.67	99.38	98.92	98.63	98.29
41	237.8	99.87	99.37	99.29	98.78	98.32	97.81
42	238.8	100.08	99.58	99.37	98.79	98.32	97.82
43	236.8	99.79	99.45	99.28	98.69	97.93	97.42
44	239.4	99.83	99.42	99.21	98.54	97.87	97.28
45	237.0	99.96	99.70	99.54	99.20	98.52	98.27
46	241.4	100.08	99.63	99.46	99.05	98.43	97.76
47	239.0	100.29	99.92	99.54	99.21	98.62	97.87
48	240.1	99.92	99.46	99.25	98.63	98.21	97.92
49	239.2	100.08	99.71	99.25	98.79	98.16	97.70
50	237.7	99.92	99.50	99.28	98.49	98.06	97.43
51	238.6	100.21	100.00	99.71	99.08	98.49	97.99
52	241.1	99.96	99.75	99.59	99.29	98.63	98.13
53	238.7	100.17	99.66	99.37	98.79	98.32	97.99
54	240.7	100.12	99.50	99.25	98.75	98.05	97.59
55	241.2	100.04	99.63	99.54	99.09	98.51	97.68
56	237.6	100.08	99.58	99.41	98.95	98.78	98.27
57	240.1	100.12	99.63	99.42	98.88	98.33	97.83
58	239.3	100.04	99.71	99.54	99.16	98.91	98.29
59	237.6	100.21	99.79	99.37	98.61	98.32	97.90
60	238.4	100.04	99.71	99.50	98.95	98.41	97.53
Ave.	239.5	100.06	99.65	99.42	98.88	98.36	97.82
Med.	239.3	100.08	99.63	99.41	98.85	98.35	97.83
st dev	1.4613	0.1271	0.1481	0.1409	0.2128	0.2599	0.2871
Min.	236.8	99.79	99.37	99.21	98.49	97.87	97.28
Max.	242.1	100.29	100.00	99.75	99.29	98.91	98.29

**3.5 Data Set 2, 85°C, 100mA (Forward Voltage)**

No.	Forward Voltage (V)						
	0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs
31	18.09	18.14	18.13	18.12	18.12	18.10	18.11
32	17.95	17.98	18.00	17.97	17.98	17.95	17.97
33	18.12	18.17	18.17	18.15	18.15	18.12	18.13
34	18.07	18.08	18.11	18.10	18.09	18.07	18.07
35	18.05	18.09	18.09	18.08	18.07	18.06	18.06
36	18.09	18.12	18.12	18.11	18.11	18.09	18.10
37	17.99	18.01	18.01	18.02	18.00	17.99	18.00
38	18.04	18.07	18.07	18.07	18.06	18.04	18.04
39	17.98	17.99	17.99	17.99	17.98	17.97	17.99
40	18.08	18.11	18.10	18.11	18.09	18.08	18.09
41	18.08	18.11	18.10	18.10	18.09	18.07	18.09
42	18.02	18.03	18.04	18.03	18.02	18.04	18.03
43	17.94	17.98	17.95	17.95	17.94	18.00	17.96
44	18.08	18.11	18.10	18.09	18.08	18.11	18.10
45	17.93	17.95	18.15	18.15	18.09	18.11	18.09
46	18.14	18.17	18.15	18.09	18.15	18.14	18.15
47	18.11	18.14	18.12	18.16	18.11	18.10	18.11
48	18.14	18.16	18.16	17.97	18.14	18.15	18.17
49	17.96	17.97	17.98	17.96	17.96	17.99	17.97
50	17.95	17.97	17.96	17.96	17.94	17.96	17.97
51	18.03	18.04	18.05	18.04	18.02	18.04	18.04
52	18.15	18.17	18.18	18.16	18.17	18.14	18.16
53	17.96	17.98	18.01	17.98	17.98	17.95	17.98
54	17.95	17.97	18.00	17.97	17.97	17.95	17.98
55	18.15	18.16	18.20	18.16	18.16	18.14	18.17
56	18.00	18.01	18.03	18.02	18.01	18.00	18.02
57	17.93	17.95	17.97	17.95	17.93	17.93	17.95
58	18.11	18.13	18.15	18.12	18.13	18.11	18.13
59	17.92	17.93	17.95	17.93	18.06	18.06	18.08
60	18.05	18.08	18.09	18.07	18.06	18.06	18.07
Ave.	18.04	18.06	18.07	18.05	18.06	18.05	18.06
Med.	18.05	18.08	18.09	18.07	18.07	18.06	18.07
st dev	0.0753	0.0794	0.0755	0.0751	0.0729	0.0669	0.0681
Min.	17.92	17.93	17.95	17.93	17.93	17.93	17.95
Max.	18.15	18.17	18.20	18.16	18.17	18.15	18.17

**3.6 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
31	0.2616	0.5266	2721	0.0003	0.0005	0.0009	0.0009	0.0012	0.0014
32	0.2632	0.5298	2677	0.0003	0.0007	0.0009	0.0010	0.0014	0.0016
33	0.2629	0.5284	2689	0.0004	0.0004	0.0005	0.0009	0.0012	0.0016
34	0.2589	0.5223	2800	0.0005	0.0007	0.0007	0.0010	0.0014	0.0017
35	0.2610	0.5271	2732	0.0004	0.0007	0.0009	0.0010	0.0014	0.0017
36	0.2607	0.5276	2737	0.0004	0.0006	0.0006	0.0010	0.0014	0.0016
37	0.2612	0.5259	2734	0.0003	0.0005	0.0009	0.0008	0.0012	0.0015
38	0.2604	0.5259	2750	0.0002	0.0004	0.0005	0.0011	0.0012	0.0015
39	0.2613	0.5288	2719	0.0003	0.0005	0.0005	0.0009	0.0012	0.0014
40	0.2623	0.5291	2696	0.0002	0.0005	0.0005	0.0009	0.0012	0.0014
41	0.2635	0.5265	2683	0.0006	0.0008	0.0008	0.0013	0.0013	0.0016
42	0.2622	0.5279	2705	0.0005	0.0007	0.0007	0.0011	0.0015	0.0016
43	0.2617	0.5276	2716	0.0004	0.0005	0.0007	0.0010	0.0014	0.0014
44	0.2616	0.5274	2718	0.0003	0.0005	0.0005	0.0010	0.0012	0.0013
45	0.2622	0.5274	2706	0.0004	0.0009	0.0011	0.0013	0.0017	0.0018
46	0.2605	0.5234	2759	0.0004	0.0008	0.0007	0.0012	0.0016	0.0016
47	0.2590	0.5245	2786	0.0004	0.0006	0.0009	0.0013	0.0016	0.0017
48	0.2617	0.5279	2714	0.0005	0.0006	0.0006	0.0011	0.0014	0.0014
49	0.2633	0.5285	2680	0.0004	0.0006	0.0005	0.0009	0.0014	0.0015
50	0.2622	0.5264	2709	0.0004	0.0006	0.0006	0.0014	0.0014	0.0015
51	0.2631	0.5291	2681	0.0005	0.0005	0.0006	0.0011	0.0014	0.0015
52	0.2611	0.5268	2732	0.0004	0.0006	0.0006	0.0011	0.0015	0.0017
53	0.2629	0.5284	2687	0.0004	0.0004	0.0006	0.0011	0.0014	0.0017
54	0.2609	0.5249	2744	0.0004	0.0005	0.0007	0.0011	0.0015	0.0017
55	0.2624	0.5269	2703	0.0004	0.0005	0.0006	0.0011	0.0016	0.0018
56	0.2616	0.5290	2713	0.0004	0.0005	0.0005	0.0010	0.0014	0.0017
57	0.2597	0.5277	2757	0.0004	0.0004	0.0005	0.0011	0.0016	0.0017
58	0.2626	0.5253	2706	0.0004	0.0005	0.0013	0.0009	0.0013	0.0015
59	0.2630	0.5287	2685	0.0004	0.0007	0.0004	0.0016	0.0019	0.0021
60	0.2619	0.5295	2704	0.0005	0.0008	0.0005	0.0010	0.0014	0.0017
Ave.	0.2617	0.5272	2718	0.0004	0.0006	0.0007	0.0011	0.0014	0.0016
Med.	0.2617	0.5275	2714	0.0004	0.0006	0.0006	0.0010	0.0014	0.0016
st dev	0.0012	0.0018	30.7194	0.0001	0.0001	0.0002	0.0002	0.0002	0.0002
Min.	0.2589	0.5223	2677	0.0002	0.0004	0.0004	0.0008	0.0012	0.0013
Max.	0.2635	0.5298	2800	0.0006	0.0009	0.0013	0.0016	0.0019	0.0021

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

No.	Φ(lm)	Lumen Maintenance (%)					
	Ohr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs
61	241.5	99.71	99.13	98.96	98.26	97.43	96.73
62	239.9	99.79	99.37	99.21	98.71	98.00	97.29
63	244.1	100.12	99.59	99.39	98.73	98.44	97.71
64	240.0	100.17	99.63	99.42	98.88	98.21	97.88
65	241.0	99.96	99.54	99.13	98.76	98.34	97.51
66	240.1	100.08	99.50	99.21	98.46	97.83	97.21
67	241.4	99.92	99.50	99.09	98.30	97.72	97.18
68	240.3	100.04	99.38	99.13	98.63	98.17	97.88
69	241.0	99.71	99.21	99.00	98.55	98.26	97.34
70	241.4	100.17	99.71	99.42	99.05	98.38	97.85
71	237.6	100.04	99.66	99.28	98.44	98.02	97.26
72	237.5	99.87	99.28	98.69	98.23	97.89	97.31
73	238.3	100.17	99.58	99.37	98.87	98.11	97.27
74	239.3	100.08	99.58	99.29	98.54	97.91	96.99
75	240.0	99.96	99.38	99.08	98.08	97.58	97.00
76	239.8	99.71	99.08	98.83	98.96	98.46	97.79
77	240.8	99.83	99.50	99.17	98.80	98.26	97.67
78	242.3	99.71	99.30	98.89	98.06	97.36	96.78
79	241.5	99.75	99.38	99.01	98.10	97.39	96.77
80	241.0	99.92	99.46	99.00	98.13	97.80	97.10
81	240.7	99.79	99.25	99.00	98.42	97.51	96.59
82	240.0	99.83	99.46	99.08	98.67	97.67	96.63
83	241.0	99.92	99.42	98.92	98.22	97.76	96.85
84	241.9	99.83	99.21	99.05	98.43	97.77	96.82
85	243.7	99.84	99.22	99.02	98.28	97.74	96.80
86	243.3	100.04	99.55	99.05	98.64	97.99	97.08
87	242.8	99.96	99.46	98.97	98.31	97.61	97.16
88	242.3	100.04	99.63	99.22	98.47	97.81	97.28
89	240.1	99.83	99.38	98.92	98.38	97.50	97.13
90	242.2	99.92	99.50	99.09	98.47	97.61	97.19
Ave.	240.9	99.92	99.43	99.10	98.49	97.88	97.20
Med.	241.0	99.92	99.46	99.08	98.47	97.82	97.19
st dev	1.5911	0.1459	0.1625	0.1763	0.2712	0.3243	0.3779
Min.	237.5	99.71	99.08	98.69	98.06	97.36	96.59
Max.	244.1	100.17	99.71	99.42	99.05	98.46	97.88

**3.8 Data Set 3, 105°C, 100mA (Forward Voltage)**

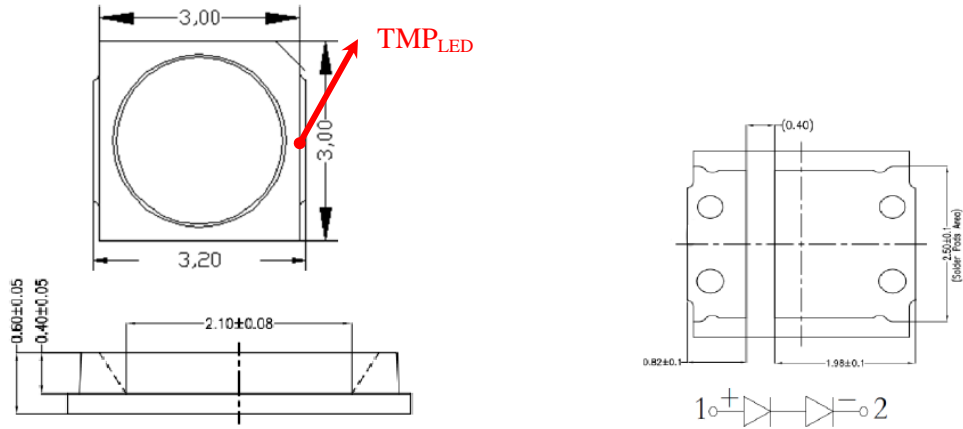
No.	Forward Voltage (V)						
	0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs
61	18.20	18.18	18.21	18.07	18.19	18.15	18.16
62	17.97	17.96	17.99	18.10	17.97	17.95	17.95
63	18.13	18.11	18.15	18.16	18.12	18.10	18.11
64	18.11	18.11	18.14	18.03	18.12	18.10	18.11
65	18.10	18.10	18.12	17.95	18.11	18.11	18.10
66	17.96	17.96	17.96	18.13	17.96	17.97	17.96
67	18.14	18.14	18.16	18.08	18.15	18.13	18.13
68	17.96	17.96	17.98	18.06	17.96	17.95	17.96
69	18.16	18.15	18.17	18.17	18.16	18.15	18.15
70	18.07	18.06	18.08	18.07	18.07	18.05	18.06
71	18.08	18.08	18.10	18.10	18.09	18.07	18.07
72	18.15	18.14	18.17	18.16	18.15	18.13	18.14
73	18.03	18.03	18.04	18.03	18.03	18.01	18.03
74	17.93	17.93	17.95	17.95	17.94	17.92	17.95
75	18.13	18.15	18.14	18.13	18.15	18.11	18.14
76	18.06	18.08	18.08	18.08	18.08	18.06	18.08
77	18.05	18.05	18.06	18.06	18.06	18.04	18.04
78	18.14	18.15	18.15	18.14	18.15	18.12	18.13
79	18.17	18.18	18.18	18.18	18.17	18.16	18.16
80	18.01	18.01	18.01	18.01	17.99	17.99	17.99
81	17.96	17.97	17.99	17.98	17.96	17.96	17.96
82	17.97	17.97	17.99	17.97	17.96	17.95	17.96
83	18.01	18.01	18.04	18.03	18.00	18.01	18.00
84	18.06	18.04	18.06	18.07	18.02	18.03	18.02
85	18.01	18.00	18.02	18.02	17.99	17.99	17.99
86	18.20	18.18	18.20	18.21	18.17	18.17	18.17
87	18.15	18.15	18.16	18.17	18.13	18.13	18.13
88	18.06	18.05	18.06	18.07	18.04	18.04	18.04
89	18.05	18.05	18.06	18.09	18.03	18.04	18.04
90	18.11	18.10	18.12	18.13	18.08	18.09	18.09
Ave.	18.07	18.07	18.08	18.08	18.07	18.06	18.06
Med.	18.07	18.07	18.08	18.08	18.08	18.06	18.07
st dev	0.0777	0.0763	0.0764	0.0697	0.0784	0.0734	0.0736
Min.	17.93	17.93	17.95	17.95	17.94	17.92	17.95
Max.	18.20	18.18	18.21	18.21	18.19	18.17	18.17

**3.9 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
61	0.2602	0.5246	2759	0.0006	0.0006	0.0009	0.0011	0.0014	0.0017
62	0.2623	0.5273	2705	0.0006	0.0007	0.0011	0.0013	0.0015	0.0015
63	0.2580	0.5266	2800	0.0007	0.0009	0.0012	0.0015	0.0015	0.0016
64	0.2612	0.5264	2730	0.0006	0.0008	0.0009	0.0014	0.0015	0.0016
65	0.2602	0.5265	2752	0.0007	0.0008	0.0011	0.0015	0.0016	0.0017
66	0.2595	0.5228	2783	0.0008	0.0010	0.0011	0.0015	0.0017	0.0018
67	0.2624	0.5292	2696	0.0009	0.0013	0.0015	0.0018	0.0019	0.0020
68	0.2612	0.5276	2725	0.0007	0.0009	0.0012	0.0015	0.0016	0.0017
69	0.2611	0.5278	2729	0.0008	0.0008	0.0010	0.0014	0.0015	0.0012
70	0.2609	0.5275	2733	0.0007	0.0011	0.0013	0.0015	0.0017	0.0021
71	0.2635	0.5263	2683	0.0007	0.0009	0.0009	0.0016	0.0018	0.0021
72	0.2622	0.5267	2709	0.0007	0.0009	0.0011	0.0016	0.0018	0.0021
73	0.2618	0.5288	2709	0.0006	0.0010	0.0012	0.0016	0.0018	0.0021
74	0.2618	0.5293	2707	0.0005	0.0008	0.0011	0.0014	0.0018	0.0020
75	0.2612	0.5279	2724	0.0005	0.0007	0.0010	0.0014	0.0018	0.0020
76	0.2619	0.5276	2712	0.0006	0.0008	0.0009	0.0013	0.0017	0.0021
77	0.2617	0.5280	2715	0.0006	0.0008	0.0010	0.0016	0.0017	0.0021
78	0.2626	0.5266	2702	0.0007	0.0011	0.0013	0.0016	0.0018	0.0021
79	0.2612	0.5261	2733	0.0007	0.0009	0.0013	0.0016	0.0019	0.0021
80	0.2597	0.5253	2769	0.0005	0.0007	0.0011	0.0015	0.0016	0.0019
81	0.2635	0.5287	2675	0.0007	0.0009	0.0011	0.0016	0.0018	0.0021
82	0.2634	0.5294	2674	0.0006	0.0009	0.0011	0.0015	0.0017	0.0021
83	0.2612	0.5271	2728	0.0007	0.0010	0.0013	0.0018	0.0021	0.0024
84	0.2611	0.5255	2737	0.0007	0.0009	0.0010	0.0016	0.0018	0.0022
85	0.2621	0.5289	2703	0.0007	0.0010	0.0012	0.0017	0.0019	0.0022
86	0.2610	0.5276	2730	0.0006	0.0009	0.0010	0.0015	0.0017	0.0020
87	0.2601	0.5245	2764	0.0008	0.0011	0.0012	0.0016	0.0019	0.0022
88	0.2612	0.5278	2726	0.0005	0.0009	0.0012	0.0016	0.0017	0.0020
89	0.2629	0.5272	2693	0.0007	0.0009	0.0011	0.0016	0.0018	0.0021
90	0.2609	0.5261	2739	0.0008	0.0010	0.0013	0.0017	0.0018	0.0021
Ave.	0.2614	0.5271	2725	0.0007	0.0009	0.0011	0.0015	0.0017	0.0020
Med.	0.2612	0.5273	2726	0.0007	0.0009	0.0011	0.0015	0.0018	0.0021
st dev	0.0012	0.0015	30.0131	0.0001	0.0001	0.0001	0.0001	0.0002	0.0003
Min.	0.2580	0.5228	2674	0.0005	0.0006	0.0009	0.0011	0.0014	0.0012
Max.	0.2635	0.5294	2800	0.0009	0.0013	0.0015	0.0018	0.0021	0.0024

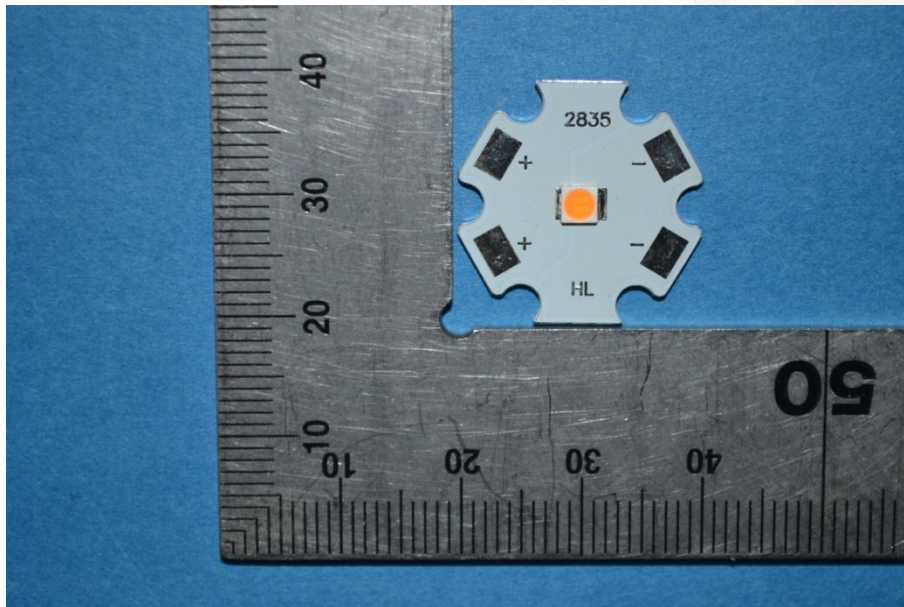
**4 - DUT Photo**

**4.1 Mechanical Dimensions**



All dimensions are in millimeter

**4.2 DUT Photo**



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