



# TEST REPORT

According to ANSI/IES LM-80-15

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-LH1308F95W-6B4C6(Ra4)-S-FC-DS**

<b>Report Type:</b> 10000 Hours Test Report		<b>Product Type:</b> LED Module	
<b>Reviewed By:</b>	Pote Wang	<i>Pote Wang</i>	
<b>Report Number:</b>	SZ2220407-12752E-10-10000		
<b>Test Date:</b>	2022-04-10 to 2023-07-05		
<b>Report Date:</b>	2023-07-17		
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<b>Test Facility:</b>	Test facility was located at No.12, Pulong East 1 <sup>st</sup> Road, Tangxia Town, Dongguan, Guangdong, China.		

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## 1 - General Information

### 1.1 Description of LED Light Sources<sup>#</sup>

#### Sample Size:

60 PCS test samples were in good condition and received on 2022-04-07. The samples were numbered from 1 to 15, 16 to 30, 31 to 45 and 46 to 60.

Manufacturer:	Hongli Zhihui Group Co.,Ltd. Guangzhou Branch
Part Number:	HL-LH1308F95W-6B4C6(Ra4)-S-FC-DS
Part Type:	LED Module
Drive Level:	DC 700mA
Nominal CCT:	1600K / 8000K
Power:	12.6W
Average Current Density per LED die:	529.78mA/mm <sup>2</sup>
Average Power Density per LED die:	1.59W/mm <sup>2</sup>
CRI:	90
Die Spacing:	0.2mm

#### Note:

The EUT is designed color with 1600K and 8000K. Data set 1 and 2 corresponding to sample No. 01-30, were aged and tested at 1600K. Data set 3 and 4 corresponding to sample No. 31-60, were aged and tested at 8000K.

#### 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.

#### Family products covered by this report:

According to *ENERGY STAR<sup>®</sup> 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<sup>®</sup> Requirements for the Use of LM-80 Data* (September 28, 2017)

This report covers the following models:

Model type	Model name	CRI (typ.)	CCT (typ.)	Series&Parallel	Power density (W/mm <sup>2</sup> )	Current density per LED die (mA/mm <sup>2</sup> )	Current per die (mA)	Distance between of dies(mm)	Current (mA)
Test model	HL-LH1308F95W-6B4C6(Ra4)-S-FC-DS	90	1600K/8000K	B2C6+B2C6	0.0707	529.78	350	0.2	700
Multiple models	HL-LH1308F95W-6B2C12(Ra4)-S-FC-DS	90	1600K/8000K	B1C12+B1C12	0.0707	529.78	350	0.2	350
Multiple models	LH1308F71W-9B2C12(Ra4)-FC-DS	90	1600K/8000K	B1C12+B1C12	0.0525	516.67	260	0.34	260
Multiple models	LH003F95W-12B2C12(Ra2)-FC-DS	90	1600K/8000K	B1C12+B1C12	0.0349	529.78	350	1.19	350
Multiple models	LH1308F95W-6B4C6(Ra5)-S-FC-DS	90	1600K/8000K	B2C6+B2C6	0.0707	529.78	350	0.2	700

### 1.2 Standards and Reference Documentations

- 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 NVLAP)
- \*ENERGY STAR<sup>®</sup> Requirements for the Use of LM-80 Data (This standard was not accredited by NVLAP)

### 1.3 Testing Equipment

Device	Manufacture	Model No	Serial No	Calibration date	Calibration due date
High Accuracy Array Spectroradiometer	EVERFINE	HAAS 2000	P600674CM5391140	2022-11-18	2023-11-17
0.5M Integrating Sphere	EVERFINE	0.5m	NA	2022-11-18	2023-11-17
LED Test Source	EVERFINE	LTS-300	P185616CJ1391143	2022-11-18	2023-11-17
Standard Light Source	EVERFINE	D062	1011093	2021-09-15	2023-09-14
Multilayer aging machine	BACL	B2-270	20015	2022-10-19	2023-10-18
Digital CC&CV DC Power Supply	EVERFINE	WY5015	11090005	2022-10-20	2023-10-19
Digital CC&CV DC Power Supply	EVERFINE	WY5015	11090003	2022-10-20	2023-10-19

### 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  $2^{\circ}C$  below the corresponding nominal case temperature. Surrounding air was maintained at a temperature that was greater than or equal to  $5^{\circ}C$  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  $25^{\circ}C \pm 2^{\circ}C$ , 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  $25^{\circ}C \pm 2^{\circ}C$ , 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  $U=21K$  ( $K=2$ ), at the 95% confidence level.

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

### 1.7 Statement of Traceability

Bay Area Compliance Laboratories Corp. (Shenzhen) 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, 700mA(1600K)

Part Number: HL-LH1308F95W-6B4C6(Ra4)-S-FC-DS  
Number of Units: 15  
Case Temperature: >53°C  
Ambient Temperature: >50°C  
Life Test Drive Current: 700mA  
Measurement Current: 700mA

### Data Set 2: 105°C, 700mA(1600K)

Part Number: HL-LH1308F95W-6B4C6(Ra4)-S-FC-DS  
Number of Units: 15  
Case Temperature: >103°C  
Ambient Temperature: >100°C  
Life Test Drive Current: 700mA  
Measurement Current: 700mA

### Data Set 3: 55°C, 700mA(8000K)

Part Number: HL-LH1308F95W-6B4C6(Ra4)-S-FC-DS  
Number of Units: 15  
Case Temperature: >53°C  
Ambient Temperature: >50°C  
Life Test Drive Current: 700mA  
Measurement Current: 700mA

### Data Set 4: 105°C, 700mA(8000K)

Part Number: HL-LH1308F95W-6B4C6(Ra4)-S-FC-DS  
Number of Units: 15  
Case Temperature: >103°C  
Ambient Temperature: >100°C  
Life Test Drive Current: 700mA  
Measurement Current: 700mA

## 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	Reported TM-21 L <sub>90</sub> Lifetime
1	15	0	1000hrs	10000hrs	2.286E-06	1.002	>55,000 hours	47,000 hours
2	15	0	1000hrs	10000hrs	2.898E-06	1.003	>55,000 hours	37,000 hours
3	15	0	1000hrs	10000hrs	2.295E-06	1.002	>55,000 hours	47,000 hours
4	15	0	1000hrs	10000hrs	2.983E-06	0.999	>55,000 hours	35,000 hours

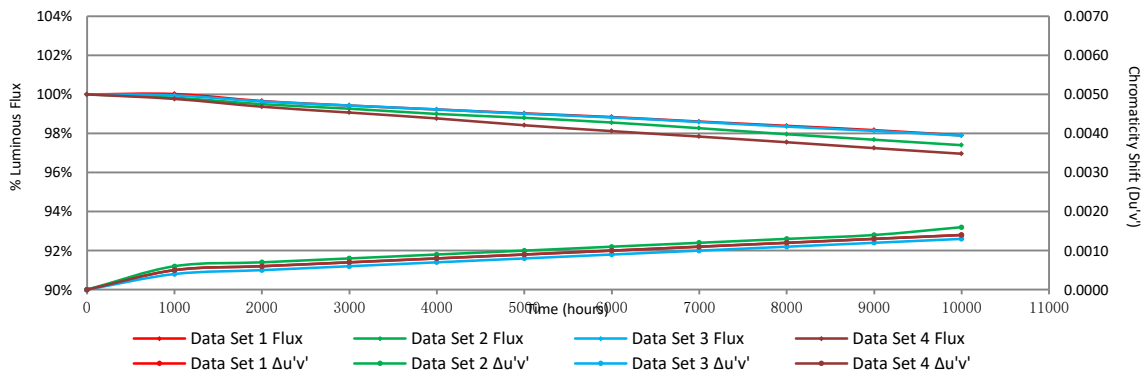
### Average Lumen Maintenance (Percentage of Initial Luminous Flux)

Data Set:	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs	10000hrs
1	100.02%	99.66%	99.43%	99.23%	99.03%	98.84%	98.61%	98.39%	98.17%	97.90%
2	99.83%	99.50%	99.27%	99.00%	98.80%	98.56%	98.27%	97.96%	97.68%	97.40%
3	99.95%	99.64%	99.43%	99.23%	99.01%	98.82%	98.59%	98.35%	98.13%	97.89%
4	99.77%	99.37%	99.07%	98.77%	98.42%	98.12%	97.84%	97.55%	97.25%	96.96%

### Average Chromaticity Shift

Data Set:	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs	10000hrs
1	0.0005	0.0006	0.0007	0.0008	0.0009	0.0010	0.0011	0.0012	0.0013	0.0014
2	0.0006	0.0007	0.0008	0.0009	0.0010	0.0011	0.0012	0.0013	0.0014	0.0016
3	0.0004	0.0005	0.0006	0.0007	0.0008	0.0009	0.0010	0.0011	0.0012	0.0013
4	0.0005	0.0006	0.0007	0.0008	0.0009	0.0010	0.0011	0.0012	0.0013	0.0014

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



### 3 - Test Data

#### 3.1 Data Set 1, 55°C, 700mA, 1600K (Lumen Maintenance)

No.	Φ(lm)	Lumen Maintenance (%)									
	0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs	10000hrs
1	609.70	99.93	99.44	99.08	98.80	98.46	98.03	97.82	97.75	97.61	97.31
2	563.90	100.14	99.72	99.50	99.15	98.94	98.71	98.14	98.07	97.85	97.59
3	593.00	99.95	99.71	99.56	98.99	98.79	98.57	98.35	98.21	97.99	97.82
4	564.30	99.84	99.49	99.34	99.20	99.06	98.83	98.48	97.89	97.75	97.50
5	590.70	100.15	99.64	99.20	99.14	99.05	98.98	98.85	98.48	97.90	97.78
6	578.00	99.84	99.69	99.20	99.07	98.86	98.70	98.49	98.43	97.77	97.60
7	570.90	99.82	99.79	99.56	99.49	99.35	99.21	98.98	98.70	98.56	98.25
8	570.60	100.21	99.79	99.49	99.28	98.93	98.86	98.49	98.42	98.42	98.18
9	581.40	99.72	99.35	99.17	99.04	98.80	98.71	98.57	98.49	98.19	97.64
10	572.40	100.35	99.93	99.49	99.42	99.06	98.76	98.62	98.55	98.48	98.08
11	569.10	99.96	99.72	99.65	99.35	99.28	99.00	98.79	98.65	98.58	98.28
12	582.30	100.10	99.78	99.57	99.21	99.14	98.99	98.78	98.35	97.92	97.75
13	568.50	100.37	99.56	99.42	99.35	98.98	98.91	98.70	98.63	98.47	98.31
14	606.90	100.18	99.70	99.57	99.42	99.34	99.21	99.06	98.83	98.76	98.48
15	575.30	99.70	99.62	99.57	99.50	99.36	99.06	98.99	98.42	98.28	97.93
Avg.	579.80	100.02	99.66	99.43	99.23	99.03	98.84	98.61	98.39	98.17	97.90
Med.	575.30	99.96	99.70	99.49	99.21	99.05	98.86	98.62	98.43	98.19	97.82
st dev	14.41	0.2130	0.1513	0.1793	0.2013	0.2501	0.2908	0.3358	0.2991	0.3643	0.3473
Min.	563.90	99.70	99.35	99.08	98.80	98.46	98.03	97.82	97.75	97.61	97.31
Max.	609.70	100.37	99.93	99.65	99.50	99.36	99.21	99.06	98.83	98.76	98.48

#### 3.2 Data Set 1, 55°C, 700mA, 1600K (Forward Voltage)

No.	Forward Voltage (V)										
	0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs	10000hrs
1	17.25	17.35	17.31	17.30	17.37	17.43	17.31	17.37	17.39	17.32	17.46
2	17.29	17.31	17.36	17.36	17.38	17.35	17.36	17.37	17.39	17.38	17.36
3	17.31	17.31	17.38	17.38	17.37	17.36	17.37	17.40	17.42	17.27	17.38
4	17.28	17.29	17.37	17.30	17.36	17.31	17.39	17.37	17.30	17.35	17.31
5	17.33	17.33	17.20	17.26	17.53	17.40	17.51	17.36	17.35	17.36	17.37
6	17.30	17.31	17.38	17.37	17.39	17.38	17.37	17.35	17.36	17.26	17.45
7	17.28	17.28	17.42	17.36	17.32	17.40	17.39	17.30	17.36	17.44	17.31
8	17.27	17.26	17.27	17.51	17.39	17.39	17.21	17.44	17.33	17.43	17.25
9	17.29	17.27	17.27	17.49	17.46	17.26	17.43	17.35	17.42	17.32	17.25
10	17.24	17.22	17.27	17.38	17.51	17.29	17.38	17.30	17.33	17.32	17.32
11	17.28	17.27	17.30	17.26	17.37	17.19	17.30	17.51	17.35	17.27	17.20
12	17.37	17.37	17.31	17.26	17.36	17.31	17.39	17.37	17.48	17.37	17.30
13	17.24	17.25	17.38	17.31	17.37	17.30	17.39	17.40	17.30	17.37	17.35
14	17.32	17.31	17.37	17.36	17.54	17.37	17.27	17.25	17.40	17.24	17.38
15	17.32	17.29	17.25	17.21	17.45	17.25	17.38	17.39	17.38	17.37	17.36
Avg.	17.29	17.29	17.32	17.34	17.41	17.33	17.36	17.37	17.37	17.34	17.34
Med.	17.29	17.29	17.31	17.36	17.38	17.35	17.38	17.37	17.36	17.35	17.35
st dev	0.04	0.04	0.06	0.08	0.07	0.07	0.07	0.06	0.05	0.06	0.07
Min.	17.24	17.22	17.20	17.21	17.32	17.19	17.21	17.25	17.30	17.24	17.20
Max.	17.37	17.37	17.42	17.51	17.54	17.43	17.51	17.51	17.48	17.44	17.46

**3.3 Data Set 1, 55°C, 700mA, 1600K (Chromaticity Shift)**

No.	u'	v'	CCT(K)	Chromaticity Shift ( $\Delta u'v'$ )									
	Ohr(Initial)			1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs	10000hrs
1	0.3324	0.5439	1710	0.0002	0.0003	0.0004	0.0005	0.0006	0.0007	0.0008	0.0009	0.0010	0.0011
2	0.3369	0.5434	1669	0.0007	0.0008	0.0009	0.0011	0.0013	0.0014	0.0015	0.0016	0.0017	0.0019
3	0.3338	0.5441	1697	0.0002	0.0003	0.0004	0.0006	0.0007	0.0008	0.0010	0.0012	0.0013	0.0014
4	0.3365	0.5436	1673	0.0007	0.0009	0.0010	0.0011	0.0013	0.0014	0.0015	0.0016	0.0017	0.0017
5	0.3328	0.5439	1706	0.0008	0.0009	0.0008	0.0009	0.0009	0.0010	0.0010	0.0010	0.0010	0.0011
6	0.3356	0.5437	1681	0.0005	0.0006	0.0008	0.0010	0.0011	0.0012	0.0013	0.0014	0.0014	0.0015
7	0.3361	0.5437	1677	0.0006	0.0007	0.0008	0.0009	0.0010	0.0011	0.0012	0.0013	0.0014	0.0015
8	0.3338	0.5437	1697	0.0002	0.0003	0.0004	0.0004	0.0005	0.0006	0.0007	0.0008	0.0009	0.0010
9	0.3347	0.5437	1689	0.0006	0.0008	0.0009	0.0010	0.0012	0.0013	0.0014	0.0015	0.0016	0.0017
10	0.3331	0.5437	1704	0.0003	0.0004	0.0005	0.0007	0.0008	0.0009	0.0011	0.0012	0.0014	0.0015
11	0.3351	0.5436	1686	0.0008	0.0009	0.0010	0.0010	0.0011	0.0011	0.0012	0.0014	0.0015	0.0016
12	0.3338	0.5439	1698	0.0004	0.0005	0.0006	0.0007	0.0008	0.0010	0.0012	0.0014	0.0015	0.0016
13	0.3356	0.5436	1681	0.0003	0.0005	0.0006	0.0007	0.0008	0.0008	0.0008	0.0008	0.0009	0.0010
14	0.3345	0.5437	1691	0.0001	0.0002	0.0003	0.0004	0.0005	0.0006	0.0007	0.0008	0.0009	0.0009
15	0.3384	0.5432	1656	0.0003	0.0004	0.0005	0.0006	0.0007	0.0008	0.0009	0.0010	0.0012	0.0013
Avg.	0.3349	0.5437	1688	0.0005	0.0006	0.0007	0.0008	0.0009	0.0010	0.0011	0.0012	0.0013	0.0014
Med.	0.3347	0.5437	1689	0.0004	0.0005	0.0006	0.0007	0.0008	0.0010	0.0011	0.0012	0.0014	0.0015
st dev	0.0017	0.0002	15	0.0002	0.0002	0.0002	0.0002	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
Min.	0.3324	0.5432	1656	0.0001	0.0002	0.0003	0.0004	0.0005	0.0006	0.0007	0.0008	0.0009	0.0009
Max.	0.3384	0.5441	1710	0.0008	0.0009	0.0010	0.0011	0.0013	0.0014	0.0015	0.0016	0.0017	0.0019

**3.4 Data Set 2, 105°C, 700mA, 1600K (Lumen Maintenance)**

No.	$\Phi(lm)$	Lumen Maintenance (%)									
	Ohr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs	10000hrs
16	574.20	99.65	99.44	99.36	99.27	98.97	98.85	98.57	98.29	98.07	98.00
17	572.90	99.35	99.25	99.14	99.01	98.87	98.80	98.45	97.94	97.78	97.49
18	603.90	99.67	99.59	99.35	99.22	98.97	98.64	98.49	98.43	97.93	97.50
19	572.80	99.39	99.34	99.32	99.28	99.07	98.73	98.50	98.29	97.87	97.57
20	557.90	100.34	99.71	99.57	99.48	99.27	98.98	98.83	98.46	98.10	97.88
21	580.80	99.98	99.43	99.16	98.86	98.79	98.52	98.38	97.95	97.81	97.52
22	577.80	100.17	99.57	99.29	98.72	98.43	98.15	97.92	97.78	97.65	97.51
23	602.50	99.92	99.50	99.07	98.51	98.29	97.71	97.29	97.08	96.71	96.50
24	566.70	99.22	99.08	98.99	98.91	98.71	98.57	98.29	97.86	97.58	97.16
25	577.80	100.28	99.57	99.29	99.15	98.91	98.82	98.44	98.22	98.08	97.58
26	578.90	100.09	99.57	99.15	98.79	98.65	98.51	98.08	97.74	97.37	97.10
27	571.80	100.30	99.79	99.35	99.06	98.81	98.71	98.34	98.06	97.81	97.55
28	571.80	99.74	99.63	99.28	98.85	98.71	98.50	98.34	97.85	97.52	97.20
29	578.70	99.86	99.71	99.50	98.79	98.70	98.43	98.13	97.72	97.49	97.29
30	573.90	99.46	99.36	99.25	99.06	98.78	98.48	98.05	97.77	97.44	97.09
Avg.	577.49	99.83	99.50	99.27	99.00	98.80	98.56	98.27	97.96	97.68	97.40
Med.	574.20	99.86	99.57	99.29	99.01	98.79	98.57	98.34	97.94	97.78	97.50
st dev	11.86	0.3670	0.1897	0.1524	0.2569	0.2414	0.3121	0.3555	0.3520	0.3573	0.3616
Min.	557.90	99.22	99.08	98.99	98.51	98.29	97.71	97.29	97.08	96.71	96.50
Max.	603.90	100.34	99.79	99.57	99.48	99.27	98.98	98.83	98.46	98.10	98.00



**3.5 Data Set 2, 105°C, 700mA, 1600K (Forward Voltage)**

No.	Forward Voltage (V)										
	Ohr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs	10000hrs
16	17.29	17.29	17.20	17.40	17.36	17.22	17.39	17.36	17.38	17.23	17.39
17	17.28	17.29	17.27	17.29	17.26	17.22	17.35	17.38	17.40	17.39	17.32
18	17.27	17.29	17.29	17.46	17.43	17.34	17.40	17.36	17.41	17.33	17.37
19	17.27	17.29	17.26	17.28	17.36	17.22	17.31	17.30	17.24	17.31	17.51
20	17.35	17.35	17.35	17.33	17.29	17.32	17.32	17.37	17.48	17.37	17.38
21	17.28	17.29	17.25	17.27	17.28	17.21	17.20	17.39	17.27	17.25	17.31
22	17.29	17.29	17.27	17.20	17.33	17.10	17.37	17.38	17.56	17.36	17.32
23	17.27	17.27	17.27	17.25	17.26	17.18	17.49	17.30	17.25	17.29	17.39
24	17.26	17.25	17.26	17.27	17.20	17.11	17.31	17.39	17.38	17.19	17.45
25	17.30	17.28	17.29	17.46	17.37	17.24	17.43	17.39	17.38	17.21	17.40
26	17.25	17.26	17.16	17.28	17.26	17.35	17.38	17.43	17.38	17.17	17.29
27	17.29	17.29	17.41	17.27	17.21	17.20	17.40	17.38	17.49	17.20	17.31
28	17.30	17.24	17.25	17.27	17.23	17.30	17.36	17.51	17.40	17.20	17.38
29	17.27	17.27	17.22	17.28	17.26	17.15	17.36	17.54	17.38	17.16	17.32
30	17.27	17.27	17.16	17.26	17.18	17.17	17.31	17.38	17.38	17.16	17.40
Avg.	17.28	17.28	17.26	17.30	17.28	17.22	17.36	17.39	17.38	17.25	17.37
Med.	17.28	17.29	17.26	17.28	17.26	17.22	17.36	17.38	17.38	17.23	17.38
st dev	0.02	0.03	0.07	0.08	0.07	0.08	0.06	0.06	0.09	0.08	0.06
Min.	17.25	17.24	17.16	17.20	17.18	17.10	17.20	17.30	17.24	17.16	17.29
Max.	17.35	17.35	17.41	17.46	17.43	17.35	17.49	17.54	17.56	17.39	17.51

**3.6 Data Set 2, 105°C, 700mA, 1600K (Chromaticity Shift)**

No.	u'	v'	CCT(K)	Chromaticity Shift ( $\Delta u'v'$ )									
	Ohr(Initial)			1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs	10000hrs
16	0.3332	0.5439	1703	0.0005	0.0006	0.0007	0.0008	0.0010	0.0011	0.0012	0.0013	0.0014	0.0014
17	0.3347	0.5437	1689	0.0003	0.0003	0.0004	0.0005	0.0005	0.0005	0.0005	0.0006	0.0007	0.0007
18	0.3285	0.5439	1746	0.0000	0.0001	0.0002	0.0003	0.0004	0.0006	0.0008	0.0010	0.0011	0.0013
19	0.3344	0.5437	1692	0.0003	0.0005	0.0006	0.0007	0.0009	0.0010	0.0011	0.0012	0.0013	0.0014
20	0.3386	0.5434	1655	0.0001	0.0002	0.0003	0.0003	0.0004	0.0005	0.0006	0.0008	0.0010	0.0011
21	0.3350	0.5438	1686	0.0030	0.0031	0.0031	0.0033	0.0034	0.0035	0.0036	0.0036	0.0037	0.0038
22	0.3324	0.5440	1710	0.0006	0.0008	0.0009	0.0010	0.0011	0.0012	0.0013	0.0014	0.0015	0.0017
23	0.3305	0.5434	1727	0.0005	0.0006	0.0007	0.0009	0.0010	0.0012	0.0013	0.0014	0.0015	0.0016
24	0.3345	0.5436	1691	0.0007	0.0008	0.0009	0.0011	0.0012	0.0013	0.0015	0.0017	0.0018	0.0018
25	0.3334	0.5439	1701	0.0007	0.0008	0.0009	0.0010	0.0011	0.0011	0.0012	0.0013	0.0014	0.0015
26	0.3344	0.5438	1692	0.0005	0.0006	0.0007	0.0008	0.0009	0.0010	0.0011	0.0011	0.0012	0.0014
27	0.3376	0.5432	1664	0.0004	0.0005	0.0006	0.0007	0.0008	0.0009	0.0010	0.0011	0.0012	0.0013
28	0.3343	0.5438	1693	0.0008	0.0008	0.0009	0.0010	0.0011	0.0013	0.0014	0.0015	0.0017	0.0019
29	0.3368	0.5434	1671	0.0004	0.0005	0.0006	0.0006	0.0006	0.0007	0.0008	0.0009	0.0010	0.0011
30	0.3350	0.5437	1686	0.0003	0.0004	0.0005	0.0006	0.0007	0.0008	0.0009	0.0010	0.0011	0.0013
Avg.	0.3342	0.5437	1694	0.0006	0.0007	0.0008	0.0009	0.0010	0.0011	0.0012	0.0013	0.0014	0.0016
Med.	0.3344	0.5437	1692	0.0005	0.0006	0.0007	0.0008	0.0009	0.0010	0.0011	0.0012	0.0013	0.0014
st dev	0.0025	0.0002	23	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007
Min.	0.3285	0.5432	1655	0.0000	0.0001	0.0002	0.0003	0.0004	0.0005	0.0005	0.0006	0.0007	0.0007
Max.	0.3386	0.5440	1746	0.0030	0.0031	0.0031	0.0033	0.0034	0.0035	0.0036	0.0036	0.0037	0.0038

**3.7 Data Set 3, 55°C, 700mA, 8000K (Lumen Maintenance)**

No.	Φ(lm)	Lumen Maintenance (%)									
	Ohr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs	10000hrs
31	1403.00	99.36	99.14	98.93	98.79	98.65	98.43	98.29	98.08	97.86	97.65
32	1416.00	100.14	99.72	99.44	99.29	99.08	98.80	98.59	98.38	98.02	97.88
33	1392.00	99.93	99.78	99.57	99.28	99.14	98.92	98.56	98.20	97.99	97.63
34	1440.00	99.72	99.58	99.44	99.17	98.96	98.75	98.54	98.26	98.06	97.85
35	1398.00	100.07	99.71	99.43	99.28	99.00	98.93	98.78	98.57	98.35	98.07
36	1387.00	100.36	99.64	99.35	99.21	98.92	98.70	98.49	98.20	97.91	97.76
37	1410.00	100.35	99.65	99.36	99.08	98.87	98.87	98.58	98.30	98.23	98.01
38	1424.00	100.07	99.65	99.37	99.09	98.88	98.74	98.60	98.46	98.24	98.10
39	1427.00	100.21	99.86	99.65	99.44	99.30	99.02	98.67	98.39	98.11	97.83
40	1421.00	99.44	99.30	99.16	99.01	98.87	98.73	98.59	98.38	98.17	97.96
41	1398.00	99.71	99.57	99.50	99.36	99.14	98.93	98.71	98.64	98.28	98.07
42	1425.00	99.72	99.65	99.58	99.44	99.16	98.95	98.81	98.46	98.32	98.11
43	1411.00	100.21	99.79	99.65	99.43	99.15	99.01	98.80	98.58	98.44	98.16
44	1421.00	99.79	99.72	99.44	99.16	98.87	98.59	98.31	98.03	97.75	97.47
45	1410.00	100.14	99.86	99.57	99.36	99.22	98.94	98.58	98.37	98.16	97.80
Avg.	1412.20	99.95	99.64	99.43	99.23	99.01	98.82	98.59	98.35	98.13	97.89
Med.	1411.00	100.07	99.65	99.44	99.28	99.00	98.87	98.59	98.38	98.16	97.88
st dev	14.65	0.3130	0.1942	0.1892	0.1825	0.1747	0.1639	0.1536	0.1783	0.1953	0.2040
Min.	1387.00	99.36	99.14	98.93	98.79	98.65	98.43	98.29	98.03	97.75	97.47
Max.	1440.00	100.36	99.86	99.65	99.44	99.30	99.02	98.81	98.64	98.44	98.16

**3.8 Data Set 3, 55°C, 700mA, 8000K (Forward Voltage)**

No.	Forward Voltage (V)										
	Ohr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs	10000hrs
31	17.30	17.33	17.51	17.37	17.36	17.52	17.37	17.38	17.31	17.37	17.30
32	17.35	17.40	17.38	17.20	17.36	17.37	17.39	17.31	17.36	17.48	17.40
33	17.31	17.34	17.36	17.30	17.30	17.32	17.36	17.38	17.36	17.32	17.55
34	17.39	17.45	17.37	17.31	17.39	17.38	17.31	17.31	17.36	17.37	17.36
35	17.32	17.37	17.39	17.36	17.30	17.31	17.38	17.37	17.30	17.31	17.38
36	17.34	17.41	17.36	17.31	17.31	17.39	17.32	17.35	17.42	17.29	17.40
37	17.28	17.29	17.27	17.38	17.28	17.53	17.29	17.38	17.37	17.39	17.37
38	17.32	17.34	17.33	17.35	17.37	17.37	17.37	17.37	17.36	17.47	17.47
39	17.36	17.37	17.39	17.35	17.46	17.38	17.39	17.32	17.37	17.50	17.55
40	17.35	17.37	17.37	17.39	17.31	17.38	17.31	17.31	17.31	17.22	17.38
41	17.29	17.30	17.26	17.40	17.43	17.37	17.36	17.36	17.37	17.28	17.31
42	17.33	17.36	17.50	17.39	17.36	17.49	17.38	17.36	17.40	17.32	17.29
43	17.32	17.40	17.38	17.35	17.35	17.30	17.34	17.34	17.51	17.36	17.50
44	17.42	17.43	17.41	17.39	17.23	17.40	17.31	17.36	17.31	17.32	17.37
45	17.48	17.37	17.39	17.45	17.36	17.37	17.37	17.35	17.36	17.37	17.22
Avg.	17.34	17.37	17.38	17.35	17.34	17.39	17.35	17.35	17.36	17.36	17.39
Med.	17.33	17.37	17.38	17.36	17.36	17.38	17.36	17.36	17.36	17.36	17.38
st dev	0.05	0.04	0.07	0.06	0.06	0.07	0.03	0.03	0.05	0.08	0.09
Min.	17.28	17.29	17.26	17.20	17.23	17.30	17.29	17.31	17.30	17.22	17.22
Max.	17.48	17.45	17.51	17.45	17.46	17.53	17.39	17.38	17.51	17.50	17.55

**3.9 Data Set 3, 55°C, 700mA, 8000K (Chromaticity Shift)**

No.	u'	v'	CCT(K)	Chromaticity Shift ( $\Delta u'v'$ )									
	Ohr(Initial)			1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs	10000hrs
31	0.1976	0.4491	8042	0.0007	0.0008	0.0009	0.0010	0.0008	0.0009	0.0010	0.0011	0.0012	0.0014
32	0.1970	0.4483	8190	0.0003	0.0005	0.0007	0.0008	0.0009	0.0010	0.0011	0.0012	0.0013	0.0014
33	0.1974	0.4462	8382	0.0006	0.0007	0.0008	0.0008	0.0010	0.0010	0.0011	0.0012	0.0013	0.0014
34	0.1966	0.4575	7350	0.0001	0.0002	0.0003	0.0004	0.0005	0.0007	0.0008	0.0009	0.0010	0.0011
35	0.1975	0.4467	8319	0.0001	0.0002	0.0003	0.0005	0.0006	0.0007	0.0008	0.0010	0.0011	0.0012
36	0.1959	0.4513	7965	0.0002	0.0003	0.0004	0.0005	0.0006	0.0008	0.0009	0.0009	0.0011	0.0013
37	0.1964	0.4537	7705	0.0004	0.0005	0.0006	0.0006	0.0007	0.0009	0.0010	0.0011	0.0012	0.0012
38	0.1957	0.4540	7724	0.0001	0.0002	0.0003	0.0004	0.0005	0.0007	0.0008	0.0009	0.0010	0.0011
39	0.1969	0.4530	7717	0.0007	0.0008	0.0008	0.0009	0.0011	0.0012	0.0013	0.0014	0.0014	0.0016
40	0.1969	0.4502	7985	0.0007	0.0007	0.0008	0.0008	0.0009	0.0010	0.0011	0.0011	0.0012	0.0013
41	0.1972	0.4517	7818	0.0005	0.0006	0.0006	0.0006	0.0008	0.0009	0.0011	0.0011	0.0012	0.0013
42	0.1962	0.4530	7784	0.0004	0.0006	0.0006	0.0007	0.0008	0.0010	0.0011	0.0011	0.0012	0.0013
43	0.1964	0.4502	8030	0.0003	0.0004	0.0004	0.0005	0.0006	0.0007	0.0008	0.0008	0.0009	0.0010
44	0.1978	0.4530	7652	0.0003	0.0004	0.0004	0.0005	0.0006	0.0007	0.0008	0.0009	0.0010	0.0011
45	0.1969	0.4552	7527	0.0004	0.0005	0.0006	0.0007	0.0008	0.0009	0.0010	0.0010	0.0011	0.0012
Avg.	0.1968	0.4515	7879	0.0004	0.0005	0.0006	0.0007	0.0008	0.0009	0.0010	0.0011	0.0012	0.0013
Med.	0.1969	0.4517	7818	0.0004	0.0005	0.0006	0.0006	0.0008	0.0009	0.0010	0.0011	0.0012	0.0013
st dev	0.0006	0.0031	288	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0001	0.0002
Min.	0.1957	0.4462	7350	0.0001	0.0002	0.0003	0.0004	0.0005	0.0007	0.0008	0.0008	0.0009	0.0010
Max.	0.1978	0.4575	8382	0.0007	0.0008	0.0009	0.0010	0.0011	0.0012	0.0013	0.0014	0.0014	0.0016

**3.10 Data Set 4, 105°C, 700mA, 8000K (Lumen Maintenance)**

No.	$\Phi(lm)$	Lumen Maintenance (%)									
	Ohr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs	10000hrs
46	1410.00	100.14	99.86	99.43	98.94	98.44	97.94	97.59	97.23	96.81	96.52
47	1406.00	99.64	99.50	99.22	98.93	98.51	98.15	97.80	97.51	97.23	97.08
48	1399.00	99.71	99.50	99.14	98.78	98.50	98.07	97.71	97.57	97.36	97.07
49	1404.00	99.72	99.29	99.00	98.72	98.36	98.08	97.86	97.58	97.22	96.79
50	1422.00	99.79	99.23	98.87	98.66	98.38	98.10	97.82	97.54	97.33	97.05
51	1418.00	100.28	99.44	99.15	98.80	98.38	98.24	98.10	97.88	97.46	97.04
52	1432.00	99.86	99.58	99.23	98.95	98.67	98.32	98.11	97.84	97.42	97.07
53	1417.00	99.93	99.29	99.01	98.73	98.52	98.38	98.09	97.81	97.46	97.11
54	1394.00	99.71	99.14	98.85	98.57	98.21	97.99	97.85	97.56	97.42	97.20
55	1413.00	99.72	99.22	98.94	98.58	98.30	98.02	97.88	97.59	97.38	97.24
56	1410.00	99.36	99.15	99.01	98.79	98.44	98.09	97.87	97.66	97.23	96.88
57	1424.00	99.93	99.37	99.02	98.74	98.31	97.96	97.61	97.26	97.12	96.91
58	1416.00	99.58	99.44	99.22	99.08	98.73	98.59	98.31	97.95	97.67	97.25
59	1402.00	99.57	99.29	98.93	98.64	98.22	97.93	97.50	97.15	96.86	96.58
60	1430.00	99.58	99.30	98.95	98.60	98.32	97.97	97.55	97.13	96.85	96.57
Avg.	1413.13	99.77	99.37	99.07	98.77	98.42	98.12	97.84	97.55	97.25	96.96
Med.	1413.00	99.72	99.30	99.01	98.74	98.38	98.08	97.85	97.57	97.33	97.05
st dev	11.11	0.2341	0.1880	0.1617	0.1521	0.1492	0.1865	0.2321	0.2619	0.2501	0.2412
Min.	1394.00	99.36	99.14	98.85	98.57	98.21	97.93	97.50	97.13	96.81	96.52
Max.	1432.00	100.28	99.86	99.43	99.08	98.73	98.59	98.31	97.95	97.67	97.25

**3.11 Data Set 4, 105°C, 700mA, 8000K (Forward Voltage)**

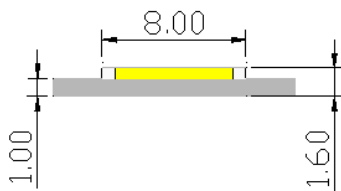
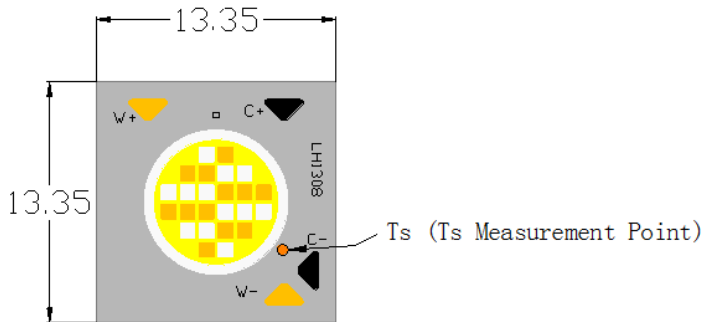
No.	Forward Voltage (V)										
	Ohr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs	10000hrs
46	17.42	17.45	17.45	17.30	17.36	17.36	17.58	17.35	17.38	17.37	17.54
47	17.31	17.34	17.29	17.31	17.36	17.38	17.40	17.33	17.36	17.37	17.37
48	17.35	17.31	17.27	17.35	17.30	17.36	17.38	17.31	17.22	17.35	17.39
49	17.28	17.32	17.30	17.31	17.39	17.31	17.38	17.41	17.35	17.31	17.31
50	17.35	17.39	17.47	17.38	17.30	17.48	17.39	17.38	17.39	17.47	17.31
51	17.40	17.38	17.31	17.39	17.31	17.37	17.39	17.39	17.30	17.39	17.30
52	17.32	17.33	17.28	17.35	17.28	17.31	17.38	17.37	17.43	17.39	17.40
53	17.35	17.34	17.48	17.39	17.37	17.49	17.56	17.36	17.45	17.33	17.51
54	17.37	17.49	17.38	17.40	17.46	17.37	17.47	17.37	17.39	17.35	17.44
55	17.34	17.33	17.30	17.36	17.31	17.26	17.52	17.40	17.29	17.47	17.50
56	17.34	17.36	17.44	17.40	17.43	17.28	17.31	17.31	17.31	17.23	17.36
57	17.33	17.37	17.36	17.45	17.36	17.27	17.40	17.39	17.31	17.37	17.43
58	17.36	17.38	17.38	17.36	17.35	17.38	17.32	17.36	17.35	17.51	17.50
59	17.34	17.42	17.36	17.31	17.23	17.26	17.39	17.29	17.42	17.31	17.36
60	17.37	17.39	17.39	17.36	17.36	17.42	17.38	17.31	17.31	17.31	17.36
Avg.	17.35	17.37	17.36	17.36	17.34	17.35	17.42	17.35	17.35	17.37	17.41
Med.	17.35	17.37	17.36	17.36	17.36	17.36	17.39	17.36	17.35	17.37	17.39
st dev	0.03	0.05	0.07	0.04	0.06	0.07	0.08	0.04	0.06	0.07	0.08
Min.	17.28	17.31	17.27	17.30	17.23	17.26	17.31	17.29	17.22	17.23	17.30
Max.	17.42	17.49	17.48	17.45	17.46	17.49	17.58	17.41	17.45	17.51	17.54

**3.12 Data Set 4, 105°C, 700mA, 8000K (Chromaticity Shift)**

No.	u'	v'	CCT(K)	Chromaticity Shift ( $\Delta u'v'$ )									
	Ohr(Initial)			1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs	10000hrs
46	0.1980	0.4480	8125	0.0005	0.0006	0.0007	0.0008	0.0009	0.0010	0.0011	0.0012	0.0013	0.0015
47	0.1964	0.4528	7778	0.0004	0.0004	0.0005	0.0006	0.0007	0.0009	0.0009	0.0011	0.0012	0.0013
48	0.1970	0.4508	7924	0.0002	0.0003	0.0004	0.0005	0.0006	0.0007	0.0008	0.0009	0.0010	0.0011
49	0.1970	0.4540	7621	0.0006	0.0007	0.0008	0.0009	0.0010	0.0012	0.0013	0.0013	0.0015	0.0016
50	0.1965	0.4517	7876	0.0004	0.0005	0.0005	0.0006	0.0008	0.0009	0.0010	0.0011	0.0013	0.0014
51	0.1968	0.4549	7558	0.0006	0.0007	0.0008	0.0009	0.0010	0.0011	0.0012	0.0013	0.0014	0.0015
52	0.1963	0.4546	7625	0.0009	0.0010	0.0010	0.0011	0.0012	0.0013	0.0014	0.0015	0.0016	0.0017
53	0.1964	0.4519	7867	0.0006	0.0007	0.0008	0.0009	0.0010	0.0011	0.0012	0.0012	0.0014	0.0015
54	0.1975	0.4448	8533	0.0005	0.0006	0.0007	0.0009	0.0009	0.0010	0.0011	0.0011	0.0013	0.0014
55	0.1958	0.4552	7612	0.0007	0.0008	0.0009	0.0010	0.0011	0.0012	0.0013	0.0013	0.0015	0.0016
56	0.1961	0.4544	7655	0.0002	0.0003	0.0004	0.0005	0.0007	0.0008	0.0009	0.0010	0.0010	0.0011
57	0.1960	0.4533	7771	0.0004	0.0005	0.0006	0.0007	0.0008	0.0009	0.0010	0.0011	0.0011	0.0012
58	0.1968	0.4510	7924	0.0003	0.0004	0.0005	0.0007	0.0009	0.0009	0.0010	0.0011	0.0012	0.0012
59	0.1964	0.4517	7892	0.0003	0.0004	0.0005	0.0007	0.0008	0.0009	0.0010	0.0011	0.0011	0.0012
60	0.1975	0.4477	8199	0.0003	0.0004	0.0005	0.0006	0.0007	0.0009	0.0009	0.0010	0.0010	0.0011
Avg.	0.1967	0.4518	7864	0.0005	0.0006	0.0007	0.0008	0.0009	0.0010	0.0011	0.0012	0.0013	0.0014
Med.	0.1965	0.4519	7867	0.0004	0.0005	0.0006	0.0007	0.0009	0.0009	0.0010	0.0011	0.0013	0.0014
st dev	0.0006	0.0030	263	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
Min.	0.1958	0.4448	7558	0.0002	0.0003	0.0004	0.0005	0.0006	0.0007	0.0008	0.0009	0.0010	0.0011
Max.	0.1980	0.4552	8533	0.0009	0.0010	0.0010	0.0011	0.0012	0.0013	0.0014	0.0015	0.0016	0.0017

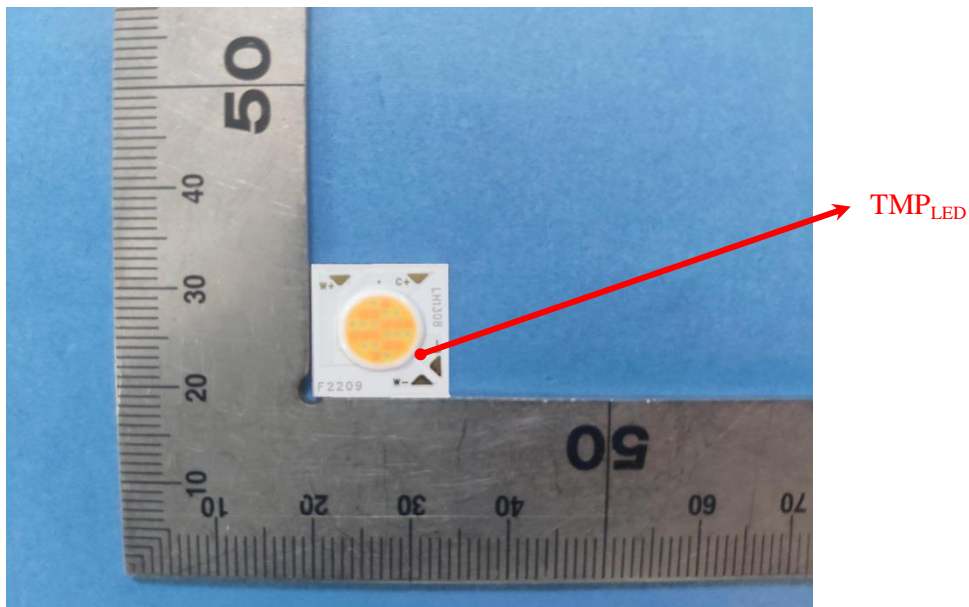
## 4 - DUT Photo

### 4.1 Mechanical Dimensions



All dimensions are in millimeter

### 4.2 DUT Photo



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### Directions

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1. The information marked "superscript #" is provided by the applicant, the laboratory is not responsible for its authenticity and this information can affect the validity of the result in the test report.
2. This report includes some test methods are not in NVLAP accreditation scope marked \*.
3. Unless otherwise stated the results shown in this test report refer only to the sample(s) tested.
4. Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.
5. The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor  $K=2$  with the 95% confidence interval.
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\*\*\*\*\*END OF REPORT\*\*\*\*\*