



# TEST REPORT

According to IES LM-80-15  
For

**LG Innotek Co.,Ltd**

570, Hyuam-ro, Munsan-eup, Paju-si, Gyeonggi-do, Republic of Korea

**Model: LEMWS28R80MSZBLN**

<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> R2DG181205054-10	
<b>Test Date:</b> 2017-04-05 to 2018-04-15	
<b>Report Date:</b> 2018-12-12	
<b>Reviewed By:</b> Bill Xiong / EE Engineer	<i>Bill Xiong</i>
<b>Test Facility:</b>	Test facility was located at No.69,Pulongcun ,Puxinhu Industrial Area, Tangxia , Dongguan, Guangdong, China.
<b>Prepared By:</b>	Bay Area Compliance Laboratories Corp. (Dongguan). No.69,Pulongcun ,Puxinhu 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).

This report is valid only with a valid digital signature. The digital signature may be available only under the Adobe software above version 7.0.

## TABLE OF CONTENTS

<b>1 - General Information</b> .....	<b>3</b>
1.1 Description of LED Light Sources .....	3
1.2 Standards Used: .....	4
1.3 Testing Equipment .....	4
1.4 Drive Level .....	4
1.5 Ambient Conditions for Maintenance Test.....	4
1.6 Photometric Measurement Method and Uncertainty.....	4
1.7 Statement of Traceability .....	5
1.8 Sample Set.....	5
<b>2 - Summary of Test Result</b> .....	<b>6</b>
<b>3 - Test Data</b> .....	<b>7</b>
3.1 Data Set 1, 55°C, 150mA (Lumen Maintenance) .....	7
3.2 Data Set 1, 55°C, 150mA (Forward Voltage).....	8
3.3 Data Set 1, 55°C, 150mA (Chromaticity Shift) .....	9
3.4 Data Set 2, 85°C, 150mA (Lumen Maintenance) .....	10
3.5 Data Set 2, 85°C, 150mA (Forward Voltage).....	11
3.6 Data Set 2, 85°C, 150mA (Chromaticity Shift).....	12
3.7 Data Set 3, 105°C, 150mA (Lumen Maintenance) .....	13
3.8 Data Set 3, 105°C, 150mA (Forward Voltage).....	14
3.9 Data Set 3, 105°C, 150mA (Chromaticity Shift) .....	15
<b>4 - DUT Photo</b> .....	<b>16</b>
4.1 Mechanical Dimensions .....	16
4.2 DUT Photo.....	16

## 1 - General Information

### 1.1 Description of LED Light Sources

#### Sample Size:

75 PCS samples were received on 2017-04-05. The samples were numbered from 1 to 25, 26 to 50 and 51 to 75.

Manufacturer:	LG Innotek Co.,Ltd
Part Number:	LEMWS28R80MSZBLN
Part Type:	LED Package
Drive Level:	DC 150mA
Nominal CCT:	2700K
Power:	0.5W
Current Density per LED die:	430mA/mm <sup>2</sup>
Power Density per LED die:	1.33W/mm <sup>2</sup>
CRI:	80
Die Spacing:	0.43mm

#### 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® 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:

Testing Model	Multiple Model	Difference	Details
LEMWS28R80MSZBLN	LEMWS28R**MSZ***	All the * means Internal identification code.	The second M means CCT=2700K
	LEMWS28R**LSZ***		The second L means CCT=3000K
	LEMWS28R**KSZ***		The first K means CCT=3500K
	LEMWS28R**JSZ***		The first J means CCT=4000K
	LEMWS28R**ISZ***		The first I means CCT=4500K
	LEMWS28R**HSZ***		The first H means CCT=5000K
	LEMWS28R**GSZ***		The first G means CCT=5700K
	LEMWS28R**FSZ***		The first F means CCT=6500K

#### Note:

- The applicant LG Innotek Co.,Ltd declare that their products with model LEMWS28R80MSZBLN are the same to the products in report # R2DG170405060-10-9000 and is authorized by original applicant to use their test data.
- All the data in previous report (R2DG170405060-10-9000) is shared in this report.

## 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 (This standard was not accredited by IAS)
- 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	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	B3-900	20030	2018-07-17	2019-07-17
Digital CC&CV DC Power Supply	EVERFINE	WY5015	11060002	2018-06-15	2019-06-15
Digital CC&CV DC Power Supply	EVERFINE	WY5015	11090007	2018-03-26	2019-03-26
Digital CC&CV DC Power Supply	EVERFINE	WY5015	11090005	2018-03-26	2019-03-26

## 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  $2^{\circ}C$  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  $U=0.8671^{\circ}\text{C}$  ( $K=2$ ), 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, 150mA

Part Number: LEMWS28R80MSZBLN  
Number of Units: 25  
Case Temperature:  $>53^{\circ}\text{C}$   
Ambient Temperature:  $>50^{\circ}\text{C}$   
Life Test Drive Current: 150mA  
Measurement Current: 150mA

#### Data Set 2: 85°C, 150mA

Part Number: LEMWS28R80MSZBLN  
Number of Units: 25  
Case Temperature:  $>83^{\circ}\text{C}$   
Ambient Temperature:  $>80^{\circ}\text{C}$   
Life Test Drive Current: 150mA  
Measurement Current: 150mA

#### Data Set 3: 105°C, 150mA

Part Number: LEMWS28R80MSZBLN  
Number of Units: 25  
Case Temperature:  $>103^{\circ}\text{C}$   
Ambient Temperature:  $>100^{\circ}\text{C}$   
Life Test Drive Current: 150mA  
Measurement Current: 150mA

## 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	25	0	1000hrs	9000hrs	2.522E-06	1.006	>54000hours
2	25	0	1000hrs	9000hrs	2.859E-06	1.004	>54000hours
3	25	0	1000hrs	9000hrs	3.193E-06	1.003	>54000hours

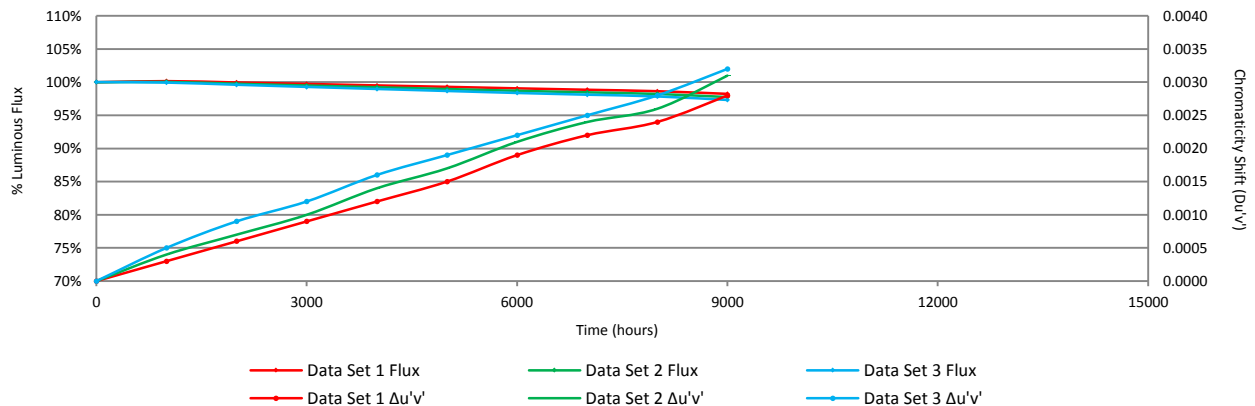
### Average Lumen Maintenance (Percentage of Initial Luminous Flux)

Data Set:	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
1	100.17%	99.96%	99.74%	99.51%	99.29%	99.06%	98.84%	98.62%	98.21%
2	100.05%	99.78%	99.51%	99.25%	98.98%	98.72%	98.48%	98.24%	97.77%
3	99.92%	99.59%	99.27%	98.96%	98.66%	98.36%	98.10%	97.84%	97.31%

### Average Chromaticity Shift

Data Set:	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
1	0.0003	0.0006	0.0009	0.0012	0.0015	0.0019	0.0022	0.0024	0.0028
2	0.0004	0.0007	0.0010	0.0014	0.0017	0.0021	0.0024	0.0026	0.0031
3	0.0005	0.0009	0.0012	0.0016	0.0019	0.0022	0.0025	0.0028	0.0032

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



### 3 - Test Data

#### 3.1 Data Set 1, 55°C, 150mA (Lumen Maintenance)

No.	Φ(lm)	Lumen Maintenance (%)								
	Ohr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
1	77.51	100.05	99.88	99.65	99.42	99.26	99.01	98.84	98.59	98.22
2	77.71	100.12	99.97	99.63	99.36	99.15	98.97	98.79	98.64	97.98
3	78.04	100.09	99.90	99.77	99.58	99.35	99.09	98.92	98.64	98.22
4	77.86	100.08	99.90	99.82	99.56	99.28	99.11	98.79	98.59	98.27
5	77.52	100.06	99.79	99.65	99.52	99.23	98.97	98.75	98.59	98.05
6	77.15	100.09	99.75	99.59	99.43	99.26	99.03	98.85	98.68	98.19
7	77.84	100.24	99.99	99.70	99.54	99.23	99.01	98.92	98.59	98.03
8	77.60	100.27	99.95	99.69	99.51	99.27	98.97	98.85	98.70	98.36
9	77.62	100.32	100.01	99.73	99.37	99.10	99.06	98.93	98.69	98.30
10	77.38	100.21	99.99	99.69	99.35	99.02	98.79	98.54	98.41	98.05
11	77.46	100.15	99.88	99.68	99.39	99.15	98.81	98.59	98.33	97.87
12	77.82	100.03	99.99	99.68	99.47	99.32	99.14	98.95	98.71	98.36
13	77.63	100.22	100.01	99.70	99.59	99.36	99.14	98.84	98.80	98.25
14	77.30	100.19	99.94	99.64	99.48	99.25	99.07	98.94	98.72	98.40
15	77.34	100.18	99.99	99.74	99.53	99.28	99.11	98.71	98.47	98.09
16	77.29	100.21	100.10	99.88	99.53	99.33	99.09	98.96	98.54	98.09
17	77.71	100.17	99.99	99.90	99.63	99.29	99.09	98.93	98.70	98.35
18	77.70	100.14	99.92	99.74	99.64	99.41	99.07	98.74	98.51	98.26
19	77.97	100.19	100.03	99.81	99.56	99.44	99.14	98.91	98.74	98.32
20	77.82	100.21	99.99	99.79	99.56	99.42	99.29	98.96	98.79	98.24
21	77.64	100.22	100.05	99.87	99.67	99.55	99.43	99.24	98.96	98.69
22	77.36	100.16	99.96	99.75	99.47	99.31	99.04	98.90	98.69	98.40
23	77.40	100.19	99.99	99.74	99.52	99.32	99.06	98.67	98.41	98.02
24	77.45	100.39	100.14	99.82	99.65	99.43	99.19	98.97	98.68	98.28
25	77.36	100.18	99.87	99.72	99.50	99.15	98.77	98.50	98.23	98.02
Ave.	77.58	100.17	99.96	99.74	99.51	99.29	99.06	98.84	98.62	98.21
Med.	77.60	100.18	99.99	99.73	99.52	99.28	99.07	98.85	98.64	98.24
st dev	0.2323	0.0836	0.0859	0.0822	0.0903	0.1178	0.1426	0.1585	0.1590	0.1764
Min.	77.15	100.03	99.75	99.59	99.35	99.02	98.77	98.50	98.23	97.87
Max.	78.04	100.39	100.14	99.90	99.67	99.55	99.43	99.24	98.96	98.69

**3.2 Data Set 1, 55°C, 150mA (Forward Voltage)**

No.	Forward Voltage (V)									
	Ohr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
1	2.907	2.907	2.907	2.911	2.905	2.908	2.906	2.901	2.901	2.909
2	2.901	2.899	2.900	2.901	2.898	2.901	2.899	2.919	2.908	2.903
3	2.909	2.908	2.909	2.911	2.907	2.909	2.906	2.910	2.909	2.911
4	2.917	2.913	2.915	2.921	2.912	2.916	2.913	2.909	2.916	2.917
5	2.909	2.905	2.906	2.912	2.904	2.907	2.905	2.895	2.908	2.910
6	2.933	2.930	2.931	2.937	2.930	2.930	2.931	2.900	2.935	2.935
7	2.909	2.907	2.906	2.913	2.907	2.910	2.908	2.908	2.912	2.911
8	2.909	2.906	2.907	2.910	2.906	2.908	2.906	2.926	2.912	2.911
9	2.913	2.910	2.911	2.918	2.911	2.913	2.909	2.923	2.915	2.914
10	2.929	2.925	2.926	2.927	2.928	2.930	2.926	2.905	2.928	2.931
11	2.911	2.907	2.906	2.908	2.906	2.912	2.907	2.906	2.909	2.913
12	2.916	2.910	2.911	2.918	2.912	2.913	2.912	2.905	2.915	2.917
13	2.918	2.915	2.914	2.915	2.913	2.915	2.915	2.909	2.918	2.920
14	2.918	2.912	2.912	2.913	2.912	2.916	2.912	2.903	2.923	2.919
15	2.912	2.908	2.907	2.910	2.908	2.912	2.909	2.908	2.915	2.914
16	2.910	2.905	2.902	2.904	2.902	2.905	2.902	2.926	2.933	2.908
17	2.935	2.928	2.927	2.929	2.928	2.929	2.928	2.923	2.909	2.936
18	2.910	2.906	2.905	2.906	2.905	2.906	2.905	2.905	2.911	2.910
19	2.909	2.910	2.906	2.906	2.906	2.906	2.906	2.906	2.940	2.913
20	2.938	2.935	2.934	2.934	2.934	2.934	2.933	2.905	2.909	2.940
21	2.911	2.903	2.901	2.902	2.902	2.904	2.902	2.909	2.902	2.916
22	2.900	2.898	2.898	2.898	2.897	2.899	2.898	2.926	2.909	2.908
23	2.908	2.908	2.905	2.906	2.906	2.912	2.906	2.923	2.903	2.914
24	2.903	2.902	2.900	2.899	2.898	2.900	2.899	2.905	2.905	2.912
25	2.902	2.902	2.900	2.901	2.901	2.901	2.900	2.924	2.903	2.929
Ave.	2.913	2.910	2.910	2.912	2.910	2.912	2.910	2.911	2.914	2.917
Med.	2.910	2.908	2.907	2.911	2.906	2.910	2.906	2.908	2.911	2.914
st dev	0.0103	0.0095	0.0099	0.0106	0.0102	0.0097	0.0099	0.0094	0.0105	0.0097
Min.	2.900	2.898	2.898	2.898	2.897	2.899	2.898	2.895	2.901	2.903
Max.	2.938	2.935	2.934	2.937	2.934	2.934	2.933	2.926	2.940	2.940



**3.3 Data Set 1, 55°C, 150mA (Chromaticity Shift)**

No.	u'	v'	CCT(K)	Chromaticity Shift ( $\Delta u'v'$ )								
	0hr(Initial)			1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
1	0.2605	0.5249	2752	0.0002	0.0006	0.0009	0.0012	0.0016	0.0019	0.0025	0.0024	0.0026
2	0.2604	0.5263	2748	0.0003	0.0006	0.0009	0.0012	0.0015	0.0019	0.0025	0.0027	0.0024
3	0.2603	0.5237	2762	0.0002	0.0006	0.0009	0.0012	0.0015	0.0019	0.0021	0.0026	0.0026
4	0.2626	0.5259	2704	0.0004	0.0006	0.0009	0.0012	0.0015	0.0019	0.0019	0.0025	0.0026
5	0.2624	0.5256	2709	0.0002	0.0006	0.0009	0.0012	0.0015	0.0018	0.0021	0.0024	0.0028
6	0.2616	0.5258	2725	0.0002	0.0006	0.0009	0.0012	0.0015	0.0019	0.0023	0.0025	0.0028
7	0.2615	0.5258	2728	0.0003	0.0006	0.0010	0.0013	0.0016	0.0020	0.0023	0.0024	0.0028
8	0.2608	0.5254	2744	0.0002	0.0006	0.0008	0.0011	0.0014	0.0019	0.0022	0.0024	0.0027
9	0.2613	0.5262	2731	0.0002	0.0006	0.0009	0.0012	0.0015	0.0019	0.0021	0.0023	0.0029
10	0.2615	0.5266	2725	0.0002	0.0006	0.0009	0.0012	0.0015	0.0019	0.0022	0.0024	0.0028
11	0.2607	0.5241	2752	0.0004	0.0007	0.0009	0.0013	0.0017	0.0021	0.0024	0.0026	0.0030
12	0.2617	0.5247	2728	0.0001	0.0006	0.0009	0.0012	0.0015	0.0019	0.0023	0.0024	0.0028
13	0.2614	0.5256	2731	0.0003	0.0007	0.0009	0.0012	0.0016	0.0019	0.0021	0.0024	0.0028
14	0.2604	0.5252	2754	0.0004	0.0006	0.0009	0.0012	0.0015	0.0019	0.0022	0.0024	0.0029
15	0.2614	0.5263	2727	0.0002	0.0006	0.0009	0.0012	0.0015	0.0019	0.0021	0.0024	0.0027
16	0.2618	0.5257	2722	0.0003	0.0006	0.0009	0.0013	0.0016	0.0020	0.0021	0.0022	0.0029
17	0.2614	0.5263	2726	0.0003	0.0006	0.0009	0.0013	0.0016	0.0019	0.0021	0.0024	0.0028
18	0.2606	0.5254	2748	0.0003	0.0006	0.0009	0.0013	0.0016	0.0020	0.0023	0.0025	0.0030
19	0.2611	0.5259	2736	0.0003	0.0006	0.0009	0.0012	0.0016	0.0020	0.0022	0.0025	0.0029
20	0.2618	0.5287	2710	0.0003	0.0006	0.0008	0.0011	0.0015	0.0018	0.0021	0.0023	0.0027
21	0.2605	0.5250	2753	0.0004	0.0007	0.0009	0.0013	0.0016	0.0020	0.0023	0.0026	0.0029
22	0.2622	0.5288	2700	0.0002	0.0005	0.0009	0.0011	0.0015	0.0019	0.0022	0.0023	0.0027
23	0.2611	0.5244	2742	0.0004	0.0006	0.0009	0.0012	0.0016	0.0019	0.0021	0.0025	0.0029
24	0.2604	0.5254	2753	0.0002	0.0006	0.0008	0.0012	0.0015	0.0019	0.0022	0.0024	0.0028
25	0.2613	0.5253	2733	0.0002	0.0006	0.0008	0.0012	0.0015	0.0018	0.0021	0.0023	0.0028
Ave.	0.2612	0.5257	2734	0.0003	0.0006	0.0009	0.0012	0.0015	0.0019	0.0022	0.0024	0.0028
Med.	0.2613	0.5256	2731	0.0003	0.0006	0.0009	0.0012	0.0015	0.0019	0.0022	0.0024	0.0028
st dev	0.0007	0.0012	16.9301	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Min.	0.2603	0.5237	2700	0.0001	0.0005	0.0008	0.0011	0.0014	0.0018	0.0019	0.0022	0.0024
Max.	0.2626	0.5288	2762	0.0004	0.0007	0.0010	0.0013	0.0017	0.0021	0.0025	0.0027	0.0030

**3.4 Data Set 2, 85°C, 150mA (Lumen Maintenance)**

No.	Φ(lm)	Lumen Maintenance (%)								
	Ohr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
26	77.73	100.26	99.99	99.77	99.46	99.10	98.86	98.49	98.44	98.07
27	77.19	100.14	100.05	99.86	99.66	99.49	99.13	98.74	98.37	97.97
28	77.63	100.12	99.86	99.56	99.32	99.09	98.88	98.61	98.42	97.90
29	77.32	100.01	99.81	99.56	99.19	98.98	98.59	98.45	98.12	97.65
30	77.63	99.83	99.68	99.51	99.18	98.93	98.60	98.45	98.17	97.54
31	77.71	100.19	99.87	99.46	99.25	98.91	98.62	98.30	98.07	97.57
32	77.89	100.17	99.83	99.50	99.24	98.97	98.77	98.63	98.25	97.93
33	77.59	100.12	99.88	99.56	99.15	98.85	98.66	98.53	98.25	97.91
34	77.00	100.14	100.04	99.78	99.53	99.25	98.92	98.70	98.29	97.81
35	77.38	100.19	99.90	99.78	99.52	99.34	99.10	98.84	98.64	98.07
36	77.70	100.01	99.78	99.52	99.42	99.11	98.93	98.67	98.48	98.07
37	77.34	99.92	99.79	99.53	99.28	99.13	98.97	98.75	98.51	98.19
38	77.93	99.86	99.60	99.41	99.20	98.86	98.63	98.38	98.13	97.63
39	77.71	99.88	99.63	99.24	98.94	98.67	98.35	98.07	97.94	97.34
40	77.46	99.92	99.59	99.30	98.86	98.63	98.44	98.18	97.95	97.35
41	77.27	99.99	99.64	99.24	98.91	98.67	98.38	98.20	98.06	97.41
42	78.17	100.09	99.90	99.59	99.35	99.00	98.76	98.46	98.00	97.42
43	77.32	99.91	99.72	99.46	99.16	98.80	98.63	98.46	98.06	97.65
44	77.00	100.06	99.71	99.57	99.32	99.12	98.82	98.53	98.38	97.88
45	77.72	100.05	99.72	99.43	99.27	99.11	98.76	98.49	98.42	97.92
46	77.05	100.08	99.73	99.51	99.25	99.05	98.83	98.64	98.46	97.90
47	77.33	99.97	99.69	99.37	99.21	98.99	98.76	98.42	98.34	97.96
48	77.52	99.95	99.57	99.41	99.20	98.90	98.57	98.39	98.13	97.73
49	77.61	100.15	99.88	99.60	99.15	98.76	98.47	98.29	98.03	97.59
50	77.36	100.14	99.72	99.30	99.13	98.89	98.58	98.24	98.04	97.79
Ave.	77.50	100.05	99.78	99.51	99.25	98.98	98.72	98.48	98.24	97.77
Med.	77.52	100.06	99.78	99.51	99.24	98.98	98.76	98.46	98.25	97.81
st dev	0.2941	0.1176	0.1360	0.1641	0.1861	0.2062	0.2069	0.1945	0.1988	0.2443
Min.	77.00	99.83	99.57	99.24	98.86	98.63	98.35	98.07	97.94	97.34
Max.	78.17	100.26	100.05	99.86	99.66	99.49	99.13	98.84	98.64	98.19

**3.5 Data Set 2, 85°C, 150mA (Forward Voltage)**

No.	Forward Voltage (V)									
	0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
26	2.903	2.903	2.902	2.902	2.902	2.902	2.901	2.901	2.904	2.918
27	2.915	2.915	2.912	2.913	2.914	2.913	2.911	2.919	2.916	2.925
28	2.911	2.911	2.909	2.910	2.912	2.911	2.907	2.910	2.910	2.926
29	2.911	2.911	2.911	2.911	2.911	2.910	2.909	2.909	2.914	2.917
30	2.906	2.904	2.903	2.905	2.905	2.906	2.903	2.895	2.911	2.913
31	2.913	2.910	2.910	2.911	2.911	2.911	2.909	2.900	2.914	2.925
32	2.912	2.911	2.910	2.910	2.912	2.910	2.909	2.908	2.911	2.916
33	2.910	2.913	2.908	2.909	2.912	2.909	2.906	2.926	2.911	2.916
34	2.904	2.903	2.902	2.903	2.906	2.902	2.901	2.923	2.905	2.908
35	2.913	2.926	2.912	2.914	2.913	2.912	2.911	2.905	2.915	2.917
36	2.907	2.904	2.906	2.906	2.907	2.904	2.905	2.906	2.908	2.911
37	2.908	2.905	2.905	2.905	2.911	2.906	2.905	2.905	2.910	2.912
38	2.912	2.910	2.909	2.910	2.913	2.909	2.909	2.909	2.913	2.915
39	2.907	2.904	2.903	2.905	2.906	2.903	2.902	2.903	2.906	2.910
40	2.904	2.903	2.901	2.902	2.905	2.902	2.902	2.908	2.906	2.908
41	2.920	2.919	2.919	2.919	2.920	2.919	2.918	2.926	2.922	2.923
42	2.912	2.910	2.910	2.909	2.910	2.909	2.908	2.923	2.911	2.913
43	2.911	2.907	2.909	2.907	2.910	2.908	2.906	2.905	2.912	2.913
44	2.896	2.894	2.895	2.894	2.900	2.894	2.895	2.906	2.898	2.900
45	2.901	2.898	2.900	2.898	2.900	2.903	2.899	2.905	2.904	2.904
46	2.910	2.906	2.908	2.923	2.952	2.907	2.906	2.909	2.911	2.909
47	2.929	2.925	2.926	2.925	2.925	2.925	2.924	2.926	2.927	2.928
48	2.927	2.921	2.923	2.922	2.923	2.926	2.921	2.923	2.931	2.926
49	2.904	2.902	2.905	2.901	2.901	2.902	2.902	2.905	2.909	2.905
50	2.928	2.922	2.924	2.923	2.923	2.923	2.922	2.924	2.930	2.926
Ave.	2.911	2.909	2.909	2.909	2.912	2.909	2.908	2.911	2.912	2.915
Med.	2.911	2.910	2.909	2.909	2.911	2.909	2.906	2.908	2.911	2.915
st dev	0.0081	0.0082	0.0076	0.0081	0.0108	0.0077	0.0072	0.0094	0.0080	0.0078
Min.	2.896	2.894	2.895	2.894	2.900	2.894	2.895	2.895	2.898	2.900
Max.	2.929	2.926	2.926	2.925	2.952	2.926	2.924	2.926	2.931	2.928

**3.6 Data Set 2, 85°C, 150mA (Chromaticity Shift)**

No.	u'	v'	CCT(K)	Chromaticity Shift ( $\Delta u'v'$ )								
	Ohr(Initial)			1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
26	0.2604	0.5254	2753	0.0005	0.0007	0.0011	0.0014	0.0017	0.0021	0.0023	0.0026	0.0028
27	0.2619	0.5252	2721	0.0004	0.0006	0.0009	0.0013	0.0017	0.0021	0.0023	0.0024	0.0030
28	0.2605	0.5260	2748	0.0004	0.0006	0.0011	0.0014	0.0018	0.0021	0.0026	0.0024	0.0029
29	0.2617	0.5280	2714	0.0004	0.0006	0.0011	0.0013	0.0017	0.0021	0.0025	0.0026	0.0030
30	0.2609	0.5257	2740	0.0005	0.0007	0.0011	0.0013	0.0017	0.0021	0.0024	0.0025	0.0030
31	0.2609	0.5248	2744	0.0004	0.0007	0.0011	0.0013	0.0018	0.0021	0.0025	0.0026	0.0030
32	0.2604	0.5253	2752	0.0003	0.0006	0.0009	0.0013	0.0017	0.0021	0.0024	0.0026	0.0030
33	0.2611	0.5246	2741	0.0004	0.0007	0.0011	0.0014	0.0017	0.0021	0.0023	0.0026	0.0032
34	0.2608	0.5267	2738	0.0003	0.0006	0.0010	0.0013	0.0017	0.0021	0.0023	0.0026	0.0032
35	0.2624	0.5247	2714	0.0004	0.0007	0.0011	0.0014	0.0017	0.0021	0.0025	0.0027	0.0032
36	0.2605	0.5251	2751	0.0004	0.0006	0.0010	0.0013	0.0017	0.0021	0.0023	0.0026	0.0033
37	0.2623	0.5265	2707	0.0004	0.0006	0.0009	0.0013	0.0017	0.0020	0.0024	0.0025	0.0032
38	0.2609	0.5255	2740	0.0003	0.0006	0.0009	0.0013	0.0017	0.0020	0.0023	0.0025	0.0030
39	0.2614	0.5253	2732	0.0004	0.0006	0.0011	0.0014	0.0018	0.0020	0.0024	0.0024	0.0030
40	0.2608	0.5242	2748	0.0004	0.0006	0.0010	0.0014	0.0017	0.0022	0.0024	0.0027	0.0031
41	0.2616	0.5258	2726	0.0004	0.0007	0.0011	0.0014	0.0018	0.0022	0.0025	0.0026	0.0032
42	0.2609	0.5254	2741	0.0004	0.0006	0.0011	0.0014	0.0017	0.0021	0.0024	0.0026	0.0030
43	0.2620	0.5268	2712	0.0004	0.0006	0.0009	0.0014	0.0017	0.0021	0.0023	0.0026	0.0031
44	0.2612	0.5262	2731	0.0003	0.0006	0.0009	0.0014	0.0017	0.0020	0.0023	0.0025	0.0030
45	0.2605	0.5265	2745	0.0004	0.0006	0.0010	0.0014	0.0017	0.0021	0.0023	0.0025	0.0030
46	0.2621	0.5262	2714	0.0004	0.0006	0.0009	0.0013	0.0017	0.0020	0.0023	0.0025	0.0030
47	0.2617	0.5262	2722	0.0004	0.0007	0.0011	0.0014	0.0018	0.0021	0.0023	0.0026	0.0033
48	0.2611	0.5277	2728	0.0004	0.0008	0.0011	0.0014	0.0017	0.0021	0.0024	0.0026	0.0031
49	0.2619	0.5261	2718	0.0005	0.0011	0.0010	0.0014	0.0018	0.0021	0.0024	0.0026	0.0031
50	0.2609	0.5255	2742	0.0004	0.0011	0.0011	0.0014	0.0018	0.0021	0.0023	0.0026	0.0031
Ave.	0.2612	0.5258	2733	0.0004	0.0007	0.0010	0.0014	0.0017	0.0021	0.0024	0.0026	0.0031
Med.	0.2611	0.5257	2738	0.0004	0.0006	0.0011	0.0014	0.0017	0.0021	0.0024	0.0026	0.0030
st dev	0.0006	0.0009	14.2896	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Min.	0.2604	0.5242	2707	0.0003	0.0006	0.0009	0.0013	0.0017	0.0020	0.0023	0.0024	0.0028
Max.	0.2624	0.5280	2753	0.0005	0.0011	0.0011	0.0014	0.0018	0.0022	0.0026	0.0027	0.0033

**3.7 Data Set 3, 105°C, 150mA (Lumen Maintenance)**

No.	Φ(lm)	Lumen Maintenance (%)								
	Ohr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
51	77.53	100.05	99.77	99.51	99.24	99.01	98.62	98.30	98.17	97.72
52	77.71	100.04	99.73	99.38	99.20	98.91	98.60	98.25	98.06	97.52
53	77.76	100.06	99.79	99.42	99.20	98.91	98.62	98.15	98.10	97.62
54	77.44	99.91	99.60	99.39	99.15	98.97	98.57	98.41	98.13	97.37
55	77.72	99.94	99.58	99.23	98.87	98.64	98.39	98.11	97.81	97.34
56	77.58	99.92	99.55	99.20	98.84	98.58	98.39	98.03	97.81	97.47
57	77.83	99.90	99.52	99.05	98.70	98.42	98.21	97.97	97.58	97.03
58	77.39	99.91	99.65	99.30	98.86	98.55	98.19	97.78	97.57	97.13
59	77.56	99.87	99.63	99.29	98.97	98.56	98.17	97.99	97.55	97.10
60	77.00	99.90	99.65	99.31	99.06	98.69	98.42	98.27	97.91	97.19
61	77.51	99.81	99.61	99.24	98.88	98.62	98.27	98.05	97.82	97.30
62	77.60	99.91	99.54	99.28	98.90	98.62	98.26	97.98	97.78	97.40
63	76.92	99.90	99.53	99.28	99.05	98.76	98.35	98.00	97.76	97.24
64	77.72	99.94	99.55	99.29	98.93	98.65	98.34	98.15	97.89	97.12
65	77.58	99.91	99.54	99.25	98.94	98.63	98.32	98.18	97.83	97.37
66	77.54	99.83	99.47	99.23	98.87	98.71	98.30	98.09	97.86	97.47
67	77.18	99.88	99.52	99.20	98.85	98.55	98.39	98.19	97.85	97.28
68	77.73	99.87	99.58	99.18	98.84	98.53	98.33	98.08	97.81	97.43
69	77.77	99.88	99.55	99.18	98.91	98.55	98.35	98.10	97.93	97.49
70	77.78	99.94	99.56	99.23	98.91	98.55	98.28	98.03	97.94	97.42
71	77.67	99.96	99.60	99.33	98.98	98.61	98.33	98.25	97.82	97.18
72	77.79	99.90	99.47	99.19	98.88	98.53	98.29	98.02	97.67	97.12
73	77.24	99.86	99.56	99.26	98.89	98.60	98.27	97.86	97.79	97.27
74	77.63	99.95	99.55	99.21	98.98	98.61	98.21	97.90	97.59	96.97
75	77.22	100.03	99.74	99.27	99.12	98.80	98.48	98.38	97.86	97.23
Ave.	77.54	99.92	99.59	99.27	98.96	98.66	98.36	98.10	97.84	97.31
Med.	77.58	99.91	99.56	99.26	98.91	98.62	98.33	98.09	97.82	97.30
st dev	0.2499	0.0649	0.0865	0.0932	0.1352	0.1497	0.1312	0.1557	0.1654	0.1843
Min.	76.92	99.81	99.47	99.05	98.70	98.42	98.17	97.78	97.55	96.97
Max.	77.83	100.06	99.79	99.51	99.24	99.01	98.62	98.41	98.17	97.72

**3.8 Data Set 3, 105°C, 150mA (Forward Voltage)**

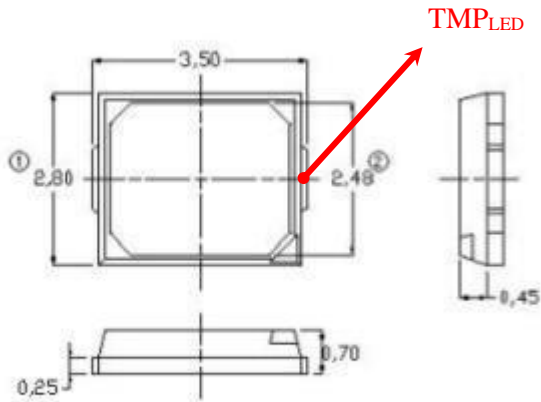
No.	Forward Voltage (V)									
	0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
51	2.912	2.907	2.909	2.907	2.909	2.908	2.906	2.909	2.913	2.911
52	2.923	2.924	2.923	2.922	2.924	2.920	2.922	2.924	2.929	2.925
53	2.902	2.899	2.902	2.900	2.901	2.899	2.899	2.901	2.908	2.904
54	2.907	2.905	2.906	2.902	2.904	2.903	2.903	2.904	2.909	2.908
55	2.918	2.913	2.915	2.913	2.912	2.913	2.913	2.912	2.920	2.918
56	2.901	2.901	2.901	2.900	2.900	2.900	2.900	2.900	2.907	2.905
57	2.913	2.912	2.911	2.910	2.911	2.910	2.910	2.911	2.917	2.915
58	2.912	2.911	2.909	2.908	2.908	2.908	2.909	2.908	2.915	2.914
59	2.920	2.917	2.918	2.916	2.918	2.915	2.920	2.918	2.923	2.921
60	2.903	2.903	2.903	2.901	2.902	2.900	2.902	2.902	2.908	2.906
61	2.910	2.909	2.908	2.908	2.906	2.906	2.909	2.906	2.914	2.912
62	2.924	2.923	2.922	2.920	2.922	2.921	2.924	2.922	2.928	2.931
63	2.976	2.937	2.933	2.934	2.935	2.933	2.935	2.935	2.941	2.939
64	2.901	2.900	2.899	2.899	2.900	2.900	2.900	2.900	2.906	2.910
65	2.915	2.914	2.913	2.913	2.912	2.914	2.913	2.912	2.921	2.924
66	2.901	2.900	2.900	2.899	2.899	2.898	2.898	2.899	2.905	2.908
67	2.900	2.900	2.898	2.898	2.924	2.898	2.899	2.924	2.903	2.904
68	2.915	2.915	2.914	2.911	2.937	2.912	2.913	2.937	2.917	2.917
69	2.915	2.915	2.916	2.914	2.934	2.912	2.913	2.934	2.920	2.920
70	2.910	2.911	2.912	2.910	2.956	2.910	2.911	2.916	2.916	2.915
71	2.909	2.908	2.909	2.905	2.914	2.905	2.908	2.914	2.912	2.917
72	2.906	2.906	2.905	2.904	2.906	2.905	2.906	2.906	2.913	2.914
73	2.909	2.908	2.908	2.906	2.910	2.906	2.908	2.910	2.916	2.913
74	2.910	2.909	2.908	2.907	2.911	2.907	2.909	2.911	2.905	2.913
75	2.901	2.901	2.899	2.899	2.900	2.900	2.899	2.900	2.904	2.906
Ave.	2.913	2.910	2.910	2.908	2.914	2.908	2.909	2.913	2.915	2.915
Med.	2.910	2.909	2.909	2.907	2.911	2.907	2.909	2.911	2.914	2.914
st dev	0.0150	0.0089	0.0085	0.0086	0.0142	0.0084	0.0090	0.0113	0.0090	0.0085
Min.	2.900	2.899	2.898	2.898	2.899	2.898	2.898	2.899	2.903	2.904
Max.	2.976	2.937	2.933	2.934	2.956	2.933	2.935	2.937	2.941	2.939

**3.9 Data Set 3, 105°C, 150mA (Chromaticity Shift)**

No.	u'	v'	CCT(K)	Chromaticity Shift ( $\Delta u'v'$ )								
	0hr(Initial)			1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
51	0.2612	0.5265	2730	0.0006	0.0009	0.0012	0.0015	0.0019	0.0022	0.0025	0.0026	0.0031
52	0.2612	0.5262	2732	0.0006	0.0009	0.0012	0.0016	0.0020	0.0022	0.0024	0.0026	0.0034
53	0.2606	0.5255	2748	0.0005	0.0009	0.0012	0.0016	0.0019	0.0023	0.0025	0.0026	0.0032
54	0.2621	0.5267	2711	0.0005	0.0009	0.0012	0.0016	0.0020	0.0023	0.0025	0.0026	0.0032
55	0.2608	0.5258	2742	0.0005	0.0009	0.0012	0.0016	0.0020	0.0023	0.0028	0.0026	0.0032
56	0.2600	0.5251	2761	0.0005	0.0009	0.0012	0.0015	0.0018	0.0022	0.0025	0.0025	0.0031
57	0.2609	0.5257	2741	0.0005	0.0009	0.0012	0.0016	0.0020	0.0023	0.0028	0.0034	0.0033
58	0.2607	0.5278	2736	0.0005	0.0009	0.0012	0.0016	0.0019	0.0022	0.0025	0.0025	0.0031
59	0.2603	0.5268	2749	0.0005	0.0009	0.0013	0.0016	0.0019	0.0023	0.0026	0.0026	0.0031
60	0.2610	0.5259	2736	0.0005	0.0008	0.0011	0.0015	0.0019	0.0022	0.0025	0.0026	0.0032
61	0.2606	0.5242	2753	0.0003	0.0009	0.0013	0.0016	0.0020	0.0023	0.0024	0.0027	0.0032
62	0.2609	0.5254	2742	0.0006	0.0009	0.0013	0.0016	0.0020	0.0023	0.0026	0.0026	0.0031
63	0.2612	0.5279	2726	0.0006	0.0009	0.0013	0.0017	0.0020	0.0023	0.0026	0.0026	0.0032
64	0.2596	0.5274	2761	0.0005	0.0009	0.0011	0.0015	0.0018	0.0022	0.0025	0.0026	0.0030
65	0.2607	0.5267	2741	0.0005	0.0009	0.0012	0.0016	0.0019	0.0023	0.0025	0.0025	0.0033
66	0.2618	0.5249	2726	0.0006	0.0010	0.0012	0.0016	0.0019	0.0022	0.0024	0.0030	0.0032
67	0.2607	0.5273	2738	0.0005	0.0009	0.0012	0.0015	0.0020	0.0022	0.0026	0.0030	0.0034
68	0.2599	0.5256	2762	0.0005	0.0009	0.0012	0.0015	0.0018	0.0022	0.0025	0.0029	0.0032
69	0.2618	0.5247	2725	0.0005	0.0008	0.0012	0.0015	0.0018	0.0022	0.0024	0.0030	0.0031
70	0.2604	0.5243	2756	0.0004	0.0009	0.0011	0.0015	0.0018	0.0022	0.0025	0.0030	0.0031
71	0.2605	0.5248	2753	0.0005	0.0009	0.0013	0.0016	0.0020	0.0023	0.0026	0.0030	0.0033
72	0.2609	0.5246	2744	0.0005	0.0008	0.0011	0.0015	0.0019	0.0022	0.0024	0.0031	0.0031
73	0.2624	0.5269	2704	0.0005	0.0009	0.0012	0.0015	0.0019	0.0022	0.0025	0.0031	0.0033
74	0.2609	0.5247	2745	0.0006	0.0010	0.0012	0.0017	0.0020	0.0022	0.0024	0.0030	0.0033
75	0.2613	0.5259	2730	0.0005	0.0009	0.0012	0.0016	0.0019	0.0022	0.0025	0.0030	0.0030
Ave.	0.2609	0.5259	2740	0.0005	0.0009	0.0012	0.0016	0.0019	0.0022	0.0025	0.0028	0.0032
Med.	0.2609	0.5258	2741	0.0005	0.0009	0.0012	0.0016	0.0019	0.0022	0.0025	0.0026	0.0032
st dev	0.0007	0.0011	14.7301	0.0001	0.0001	0.0001	0.0000	0.0001	0.0000	0.0001	0.0003	0.0001
Min.	0.2596	0.5242	2704	0.0003	0.0008	0.0011	0.0015	0.0018	0.0022	0.0024	0.0025	0.0030
Max.	0.2624	0.5279	2762	0.0006	0.0010	0.0013	0.0017	0.0020	0.0023	0.0028	0.0034	0.0034

#### 4 - DUT Photo

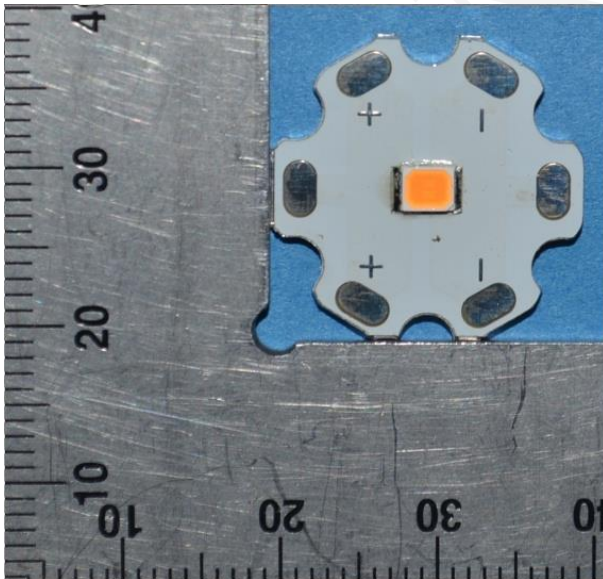
##### 4.1 Mechanical Dimensions



All dimensions are in millimeter

All dimensions are in millimeter

##### 4.2 DUT Photo



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