# 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-EMC-3030DW-2C-S1-HR3

| | |
|---|---|
| **Report Type:**<br>9000 Hours Test Report | **Product Type:**<br>LED Package |
| **Test Engineer:** | Pote Wang |
| **Report Number:** | RSZ190408501-10 |
| **Test Date:** | 2017-05-14 to 2018-05-24 |
| **Report Date:** | 2019-04-09 |
| **Reviewed By:** | Daniel Duan / EE Engineer |
| **Test Facility:** | Test facility was located at No.69,Pulongcun, Puxinhu Industrial Area, Tangxia , Dongguan, Guangdong, China. |
| **Prepared By:** | Bay Area Compliance Laboratories Corp. (Dongguan).<br>No.69,Pulongcun ,Puxinhu Industrial Area, Tangxia ,<br>Dongguan, Guangdong, China.<br>Tel: +86-0769-86858888<br>Fax:+86-0769-86858588 |
| **Accreditation:** | The IAS Accreditation NumberTL-460. |

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# 1 - General Information

## 1.1 Description of LED Light Sources

### Sample Size:

50 PCS samples were received on 2017-05-10. The samples were numbered from 1 to 25 and 26 to 50.

| | |
|---|---|
| Manufacturer: | Hongli Zhihui Group Co.,Ltd. Guangzhou Branch |
| Part Number: | HL-EMC-3030DW-2C-S1-HR3 |
| Part Type: | LED Package |
| Drive Level: | DC 150mA |
| Nominal CCT: | 2700K |
| Power: | 1.02W |
| Current Density per LED die: | 930.0019mA/mm$^2$ |
| Power Density per LED die: | 3.162W/mm$^2$ |
| CRI: | 80 |
| Die Spacing: | 0.22mm |

### 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.

### Note:

1. The applicant Hongli Zhihui Group Co.,Ltd. Guangzhou Branch. declare that their products with model HL-EMC-3030DW-2C-S1-HR3 are the same to the products in report#R2DG170510050-10-9000 and is authorized by original applicant to use their test data.

2. All the data in previous report (R2DG170510050-10-9000) is shared in this report.

## 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® 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 | 20013 | 2017-09-01 | 2018-09-01 |
| Multilayer aging machine | BACL | B3-900 | 20030 | 2017-07-17 | 2018-07-17 |
| Digital CC&CV DC Power Supply | EVERFINE | WY5015 | 11090008 | 2017-07-07 | 2018-07-07 |

| Device | Manufacture | Model No | Serial No | Calibration date | Calibration due date |
|---|---|---|---|---|---|
| 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 ±3% of the specified value of the manufacturer during maintenance test, and was within ±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°C below the corresponding nominal case temperature. Surrounding air was maintained at a temperature that was greater than or equal to 5°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 ±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°C ± 2°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'. 2π measurement was used and sample was drived by DC power supply. The forward current was regulated to within ±0.5% of the nominal value. The test system was calibrated by halogen reference lamp. The ambient temperature during test was set to 25°C ± 2°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°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: 85°C, 150mA**

| | |
|---|---|
| Part Number: | HL-EMC-3030DW-2C-S1-HR3 |
| Number of Units: | 25 |
| Case Temperature: | >83°C |
| Ambient Temperature: | >80°C |
| Life Test Drive Current: | 150mA |
| Measurement Current: | 150mA |

**Data Set 2: 105°C, 150mA**

| | |
|---|---|
| Part Number: | HL-EMC-3030DW-2C-S1-HR3 |
| Number of Units: | 25 |
| Case Temperature: | >103°C |
| Ambient Temperature: | >100°C |
| Life Test Drive Current: | 150mA |
| Measurement Current: | 150mA |

## 2 - Summary of Test Result

| Data Set: | Sample Size | Failures Observed: | Test Interval | Test Duration | α: | β: | Reported TM-21 $L_{70}$ Lifetime | Reported TM-21 $L_{90}$ Lifetime |
|---|---|---|---|---|---|---|---|---|
| 1 | 25 | 0 | 1000hrs | 9000hrs | 3.217E-06 | 1.005 | >54000 hours | 34000 hours |
| 2 | 25 | 0 | 1000hrs | 9000hrs | 3.718E-06 | 1.005 | >54000 hours | 30000 hours |

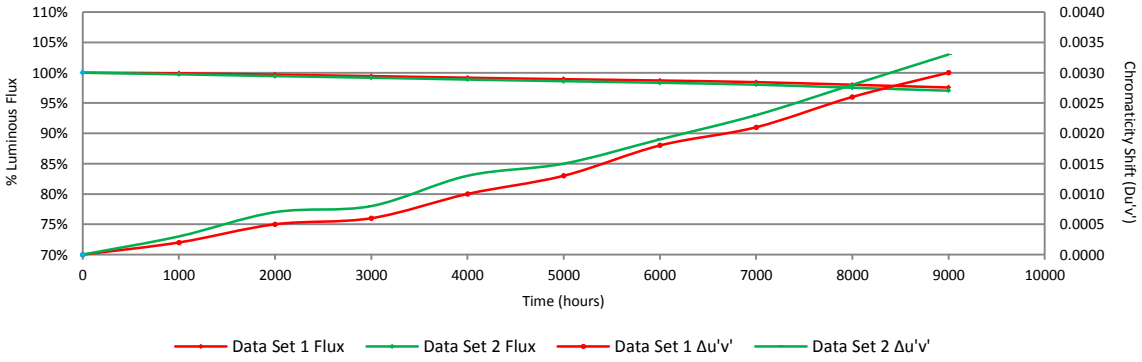
Average Lumen Maintenance (Percentage of Initial Luminous Flux)

| Data Set: | 1000hrs | 2000hrs | 3000hrs | 4000hrs | 5000hrs | 6000hrs | 7000hrs | 8000hrs | 9000hrs |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 99.90% | 99.67% | 99.44% | 99.17% | 98.93% | 98.71% | 98.44% | 98.01% | 97.56% |
| 2 | 99.73% | 99.44% | 99.17% | 98.87% | 98.60% | 98.34% | 98.03% | 97.52% | 97.03% |

Average Chromaticity Shift

| Data Set: | 1000hrs | 2000hrs | 3000hrs | 4000hrs | 5000hrs | 6000hrs | 7000hrs | 8000hrs | 9000hrs |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.0002 | 0.0005 | 0.0006 | 0.0010 | 0.0013 | 0.0018 | 0.0021 | 0.0026 | 0.0030 |
| 2 | 0.0003 | 0.0007 | 0.0008 | 0.0013 | 0.0015 | 0.0019 | 0.0023 | 0.0028 | 0.0033 |

Average Lumen Maintenance and Chromaticity Shift VS. Time




## 3 -

## Test Data

### 3.1 Data Set 1, 85°C, 150mA (Lumen Maintenance)

| No. | Φ(lm) | Lumen Maintenance (%) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0hr(Initial) | 1000hrs | 2000hrs | 3000hrs | 4000hrs | 5000hrs | 6000hrs | 7000hrs | 8000hrs | 9000hrs |
| 1 | 139.5 | 100.07 | 99.93 | 99.64 | 99.43 | 99.28 | 99.21 | 98.92 | 98.42 | 97.85 |
| 2 | 137.8 | 99.93 | 99.78 | 99.64 | 99.56 | 99.35 | 99.13 | 98.84 | 98.40 | 97.97 |
| 3 | 138.1 | 100.07 | 99.71 | 99.42 | 99.06 | 98.84 | 98.70 | 98.48 | 98.04 | 97.61 |
| 4 | 139.2 | 99.86 | 99.71 | 99.57 | 99.35 | 98.99 | 98.92 | 98.71 | 98.28 | 97.99 |
| 5 | 137.3 | 99.85 | 99.64 | 99.42 | 99.27 | 98.98 | 98.91 | 98.54 | 98.18 | 97.67 |
| 6 | 140.8 | 100.07 | 99.93 | 99.50 | 99.15 | 99.01 | 98.86 | 98.44 | 97.94 | 97.51 |
| 7 | 142.3 | 99.86 | 99.58 | 99.44 | 99.09 | 98.95 | 98.74 | 98.38 | 98.03 | 97.33 |
| 8 | 139.1 | 99.78 | 99.64 | 99.42 | 99.28 | 98.99 | 98.85 | 98.71 | 98.20 | 97.70 |
| 9 | 140.2 | 99.93 | 99.79 | 99.43 | 99.22 | 99.00 | 98.86 | 98.57 | 97.86 | 97.43 |
| 10 | 141.3 | 99.86 | 99.65 | 99.50 | 99.15 | 98.94 | 98.80 | 98.51 | 98.02 | 97.38 |
| 11 | 141.3 | 100.07 | 99.72 | 99.36 | 99.01 | 98.73 | 98.30 | 98.02 | 97.74 | 97.31 |
| 12 | 138.5 | 100.14 | 99.78 | 99.57 | 99.28 | 99.06 | 98.92 | 98.56 | 98.19 | 97.76 |
| 13 | 137.0 | 100.07 | 99.78 | 99.64 | 99.34 | 99.12 | 98.76 | 98.61 | 98.18 | 97.88 |
| 14 | 136.7 | 100.15 | 99.93 | 99.78 | 99.41 | 99.20 | 98.76 | 98.46 | 98.17 | 97.59 |
| 15 | 137.5 | 99.85 | 99.71 | 99.35 | 99.05 | 98.76 | 98.69 | 98.47 | 98.18 | 97.75 |
| 16 | 138.3 | 99.93 | 99.71 | 99.49 | 99.20 | 98.92 | 98.77 | 98.63 | 98.26 | 98.05 |
| 17 | 138.8 | 99.86 | 99.78 | 99.71 | 99.28 | 99.06 | 98.70 | 98.49 | 97.98 | 97.77 |
| 18 | 138.2 | 99.71 | 99.42 | 99.35 | 99.06 | 98.70 | 98.63 | 98.34 | 97.83 | 97.40 |
| 19 | 136.5 | 99.78 | 99.56 | 99.19 | 99.12 | 98.90 | 98.83 | 98.53 | 98.17 | 97.66 |
| 20 | 138.5 | 99.71 | 99.49 | 99.28 | 99.13 | 98.92 | 98.84 | 98.41 | 98.05 | 97.40 |
| 21 | 137.2 | 99.85 | 99.49 | 99.20 | 98.91 | 98.69 | 98.54 | 98.40 | 98.03 | 97.81 |
| 22 | 136.3 | 99.78 | 99.41 | 99.05 | 98.68 | 98.53 | 98.17 | 97.87 | 97.43 | 96.77 |
| 23 | 139.4 | 99.86 | 99.50 | 99.35 | 99.00 | 98.78 | 98.57 | 98.28 | 97.56 | 96.84 |
| 24 | 140.0 | 99.71 | 99.36 | 99.14 | 98.86 | 98.57 | 97.64 | 97.29 | 97.07 | 96.79 |
| 25 | 138.5 | 99.78 | 99.71 | 99.49 | 99.28 | 98.92 | 98.70 | 98.56 | 98.12 | 97.91 |
| Avg. | 138.7 | 99.90 | 99.67 | 99.44 | 99.17 | 98.93 | 98.71 | 98.44 | 98.01 | 97.56 |
| Med. | 138.5 | 99.86 | 99.71 | 99.43 | 99.15 | 98.94 | 98.76 | 98.49 | 98.05 | 97.66 |
| st dev | 1.5968 | 0.1365 | 0.1602 | 0.1796 | 0.1958 | 0.2003 | 0.3114 | 0.3260 | 0.3053 | 0.3578 |
| Min. | 136.3 | 99.71 | 99.36 | 99.05 | 98.68 | 98.53 | 97.64 | 97.29 | 97.07 | 96.77 |
| Max. | 142.3 | 100.15 | 99.93 | 99.78 | 99.56 | 99.35 | 99.21 | 98.92 | 98.42 | 98.05 |

### 3.2 Data Set 1, 85°C, 150mA (Forward Voltage)

| No. | Forward Voltage (V) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0hr(Initial) | 1000hrs | 2000hrs | 3000hrs | 4000hrs | 5000hrs | 6000hrs | 7000hrs | 8000hrs | 9000hrs |
| 1 | 5.980 | 5.975 | 5.979 | 5.975 | 5.978 | 5.979 | 6.004 | 5.981 | 5.995 | 5.994 |
| 2 | 5.892 | 5.883 | 5.886 | 5.883 | 5.885 | 5.888 | 5.906 | 5.888 | 5.900 | 5.917 |
| 3 | 5.898 | 5.895 | 5.895 | 5.888 | 5.894 | 5.895 | 5.912 | 5.894 | 5.904 | 5.912 |
| 4 | 5.906 | 5.888 | 5.889 | 5.889 | 5.902 | 5.894 | 5.908 | 5.893 | 5.904 | 5.916 |
| 5 | 5.895 | 5.886 | 5.889 | 5.890 | 5.894 | 5.891 | 5.907 | 5.892 | 5.899 | 5.914 |
| 6 | 6.009 | 5.998 | 6.000 | 6.001 | 6.012 | 6.006 | 6.031 | 6.003 | 6.015 | 6.024 |
| 7 | 6.008 | 6.000 | 5.997 | 6.002 | 6.006 | 6.004 | 6.033 | 6.010 | 6.014 | 6.021 |
| 8 | 5.900 | 5.893 | 5.901 | 5.894 | 5.898 | 5.902 | 5.913 | 5.900 | 5.906 | 5.933 |
| 9 | 6.032 | 6.027 | 6.026 | 6.028 | 6.031 | 6.032 | 6.056 | 6.033 | 6.041 | 6.050 |
| 10 | 5.981 | 5.974 | 5.975 | 5.977 | 5.979 | 5.985 | 6.003 | 5.981 | 5.987 | 5.997 |
| 11 | 5.983 | 5.976 | 5.980 | 5.981 | 5.984 | 5.989 | 6.005 | 5.984 | 5.991 | 6.000 |
| 12 | 5.969 | 5.963 | 5.963 | 5.963 | 5.967 | 5.970 | 5.986 | 5.967 | 5.976 | 5.982 |
| 13 | 5.895 | 5.904 | 5.889 | 5.892 | 5.903 | 5.897 | 5.907 | 5.896 | 5.899 | 5.917 |
| 14 | 5.976 | 5.972 | 5.968 | 5.973 | 5.980 | 5.979 | 5.996 | 5.972 | 5.982 | 5.996 |
| 15 | 5.889 | 5.876 | 5.880 | 5.880 | 5.887 | 5.882 | 5.902 | 5.886 | 5.889 | 5.903 |
| 16 | 5.895 | 5.885 | 5.884 | 5.887 | 5.891 | 5.887 | 5.902 | 5.890 | 5.893 | 5.907 |
| 17 | 6.012 | 6.001 | 6.003 | 6.008 | 6.009 | 6.013 | 6.032 | 6.008 | 6.014 | 6.025 |
| 18 | 5.888 | 5.873 | 5.878 | 5.882 | 5.881 | 5.883 | 5.895 | 5.881 | 5.887 | 5.903 |
| 19 | 5.886 | 5.875 | 5.881 | 5.883 | 5.890 | 5.886 | 5.896 | 5.884 | 5.889 | 5.900 |
| 20 | 5.896 | 5.884 | 5.889 | 5.894 | 5.891 | 5.894 | 5.906 | 5.894 | 5.898 | 5.910 |
| 21 | 5.880 | 5.870 | 5.875 | 5.881 | 5.879 | 5.882 | 5.894 | 5.881 | 5.886 | 5.904 |
| 22 | 5.949 | 5.927 | 5.937 | 5.938 | 5.971 | 5.939 | 5.955 | 5.937 | 5.944 | 5.962 |
| 23 | 5.984 | 5.980 | 5.987 | 5.981 | 5.989 | 5.986 | 6.006 | 5.984 | 5.993 | 6.006 |
| 24 | 5.999 | 5.991 | 5.999 | 6.000 | 6.002 | 6.002 | 5.909 | 6.001 | 6.011 | 5.917 |
| 25 | 5.895 | 5.888 | 5.893 | 5.900 | 5.896 | 5.894 | 5.907 | 5.894 | 5.903 | 5.914 |
| Avg. | 5.940 | 5.931 | 5.934 | 5.935 | 5.940 | 5.938 | 5.951 | 5.937 | 5.945 | 5.953 |
| Med. | 5.906 | 5.904 | 5.901 | 5.900 | 5.903 | 5.902 | 5.912 | 5.900 | 5.906 | 5.917 |
| st dev | 0.0518 | 0.0528 | 0.0524 | 0.0525 | 0.0533 | 0.0536 | 0.0563 | 0.0530 | 0.0540 | 0.0501 |
| Min. | 5.880 | 5.870 | 5.875 | 5.880 | 5.879 | 5.882 | 5.894 | 5.881 | 5.886 | 5.900 |
| Max. | 6.032 | 6.027 | 6.026 | 6.028 | 6.031 | 6.032 | 6.056 | 6.033 | 6.041 | 6.050 |

### 3.3 Data Set 1, 85°C, 150mA (Chromaticity Shift)

| No. | u' | v' | CCT(K) | Chromaticity Shift (Δu'v') | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0hr(Initial) | | | 1000hrs | 2000hrs | 3000hrs | 4000hrs | 5000hrs | 6000hrs | 7000hrs | 8000hrs | 9000hrs |
| 1 | 0.2631 | 0.5279 | 2686 | 0.0003 | 0.0004 | 0.0007 | 0.0011 | 0.0015 | 0.0018 | 0.0021 | 0.0025 | 0.0028 |
| 2 | 0.2618 | 0.5242 | 2727 | 0.0002 | 0.0005 | 0.0007 | 0.0010 | 0.0014 | 0.0020 | 0.0022 | 0.0025 | 0.0030 |
| 3 | 0.2612 | 0.5237 | 2742 | 0.0001 | 0.0004 | 0.0005 | 0.0009 | 0.0011 | 0.0018 | 0.0021 | 0.0025 | 0.0029 |
| 4 | 0.2604 | 0.5239 | 2758 | 0.0002 | 0.0006 | 0.0007 | 0.0012 | 0.0013 | 0.0018 | 0.0023 | 0.0027 | 0.0031 |
| 5 | 0.2620 | 0.5251 | 2720 | 0.0002 | 0.0004 | 0.0007 | 0.0009 | 0.0012 | 0.0016 | 0.0020 | 0.0024 | 0.0029 |
| 6 | 0.2621 | 0.5241 | 2723 | 0.0002 | 0.0006 | 0.0007 | 0.0011 | 0.0015 | 0.0019 | 0.0022 | 0.0026 | 0.0031 |
| 7 | 0.2606 | 0.5251 | 2749 | 0.0002 | 0.0004 | 0.0005 | 0.0010 | 0.0013 | 0.0017 | 0.0021 | 0.0027 | 0.0031 |
| 8 | 0.2609 | 0.5247 | 2744 | 0.0002 | 0.0005 | 0.0006 | 0.0009 | 0.0012 | 0.0017 | 0.0019 | 0.0024 | 0.0030 |
| 9 | 0.2629 | 0.5243 | 2704 | 0.0002 | 0.0006 | 0.0007 | 0.0010 | 0.0015 | 0.0018 | 0.0022 | 0.0027 | 0.0031 |
| 10 | 0.2609 | 0.5242 | 2747 | 0.0002 | 0.0005 | 0.0006 | 0.0010 | 0.0014 | 0.0018 | 0.0022 | 0.0026 | 0.0030 |
| 11 | 0.2617 | 0.5246 | 2729 | 0.0002 | 0.0006 | 0.0006 | 0.0011 | 0.0013 | 0.0018 | 0.0022 | 0.0026 | 0.0030 |
| 12 | 0.2616 | 0.5236 | 2735 | 0.0001 | 0.0004 | 0.0004 | 0.0008 | 0.0013 | 0.0016 | 0.0021 | 0.0025 | 0.0029 |
| 13 | 0.2625 | 0.5253 | 2708 | 0.0001 | 0.0006 | 0.0007 | 0.0012 | 0.0014 | 0.0020 | 0.0024 | 0.0029 | 0.0033 |
| 14 | 0.2624 | 0.5243 | 2715 | 0.0002 | 0.0005 | 0.0008 | 0.0011 | 0.0013 | 0.0017 | 0.0021 | 0.0026 | 0.0030 |
| 15 | 0.2626 | 0.5244 | 2710 | 0.0002 | 0.0004 | 0.0006 | 0.0010 | 0.0012 | 0.0017 | 0.0021 | 0.0025 | 0.0030 |
| 16 | 0.2619 | 0.5246 | 2723 | 0.0001 | 0.0005 | 0.0006 | 0.0009 | 0.0014 | 0.0017 | 0.0021 | 0.0026 | 0.0028 |
| 17 | 0.2623 | 0.5251 | 2714 | 0.0001 | 0.0004 | 0.0005 | 0.0009 | 0.0009 | 0.0017 | 0.0019 | 0.0025 | 0.0027 |
| 18 | 0.2614 | 0.5246 | 2734 | 0.0003 | 0.0006 | 0.0007 | 0.0013 | 0.0016 | 0.0021 | 0.0025 | 0.0029 | 0.0034 |
| 19 | 0.2615 | 0.5243 | 2734 | 0.0002 | 0.0006 | 0.0009 | 0.0013 | 0.0015 | 0.0020 | 0.0024 | 0.0029 | 0.0032 |
| 20 | 0.2625 | 0.5250 | 2710 | 0.0002 | 0.0006 | 0.0009 | 0.0012 | 0.0014 | 0.0018 | 0.0021 | 0.0026 | 0.0031 |
| 21 | 0.2619 | 0.5251 | 2723 | 0.0002 | 0.0005 | 0.0005 | 0.0008 | 0.0009 | 0.0015 | 0.0019 | 0.0024 | 0.0026 |
| 22 | 0.2612 | 0.5219 | 2751 | 0.0002 | 0.0005 | 0.0005 | 0.0008 | 0.0013 | 0.0017 | 0.0021 | 0.0026 | 0.0028 |
| 23 | 0.2616 | 0.5245 | 2732 | 0.0001 | 0.0004 | 0.0007 | 0.0008 | 0.0011 | 0.0019 | 0.0021 | 0.0025 | 0.0027 |
| 24 | 0.2602 | 0.5248 | 2759 | 0.0002 | 0.0004 | 0.0007 | 0.0009 | 0.0013 | 0.0015 | 0.0019 | 0.0024 | 0.0027 |
| 25 | 0.2607 | 0.5247 | 2748 | 0.0000 | 0.0003 | 0.0006 | 0.0008 | 0.0010 | 0.0014 | 0.0019 | 0.0024 | 0.0027 |
| Avg. | 0.2617 | 0.5246 | 2729 | 0.0002 | 0.0005 | 0.0006 | 0.0010 | 0.0013 | 0.0018 | 0.0021 | 0.0026 | 0.0030 |
| Med. | 0.2617 | 0.5246 | 2729 | 0.0002 | 0.0005 | 0.0007 | 0.0010 | 0.0013 | 0.0018 | 0.0021 | 0.0026 | 0.0030 |
| st dev | 0.0008 | 0.0010 | 18.3144 | 0.0001 | 0.0001 | 0.0001 | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 |
| Min. | 0.2602 | 0.5219 | 2686 | 0.0000 | 0.0003 | 0.0004 | 0.0008 | 0.0009 | 0.0014 | 0.0019 | 0.0024 | 0.0026 |
| Max. | 0.2631 | 0.5279 | 2759 | 0.0003 | 0.0006 | 0.0009 | 0.0013 | 0.0016 | 0.0021 | 0.0025 | 0.0029 | 0.0034 |

### 3.4 Data Set 2, 105°C, 150mA (Lumen Maintenance)

| No. | Φ(lm) | Lumen Maintenance (%) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0hr(Initial) | 1000hrs | 2000hrs | 3000hrs | 4000hrs | 5000hrs | 6000hrs | 7000hrs | 8000hrs | 9000hrs |
| 26 | 138.2 | 99.71 | 99.57 | 99.42 | 99.13 | 98.91 | 98.77 | 98.41 | 97.90 | 97.61 |
| 27 | 125.1 | 99.76 | 99.44 | 98.96 | 98.56 | 98.08 | 97.60 | 97.20 | 96.72 | 96.08 |
| 28 | 137.2 | 99.78 | 99.64 | 99.56 | 99.27 | 98.83 | 98.47 | 98.32 | 97.81 | 97.52 |
| 29 | 133.3 | 99.70 | 99.47 | 99.32 | 99.25 | 98.87 | 98.65 | 98.20 | 97.75 | 97.52 |
| 30 | 139.0 | 99.64 | 99.42 | 99.21 | 98.99 | 98.78 | 98.63 | 98.35 | 97.91 | 97.41 |
| 31 | 136.3 | 99.71 | 99.41 | 99.19 | 98.90 | 98.61 | 98.39 | 98.17 | 97.58 | 97.14 |
| 32 | 137.3 | 99.64 | 99.34 | 99.20 | 98.98 | 98.69 | 98.54 | 98.32 | 97.67 | 97.16 |
| 33 | 138.3 | 99.78 | 99.42 | 99.13 | 98.84 | 98.77 | 98.41 | 98.12 | 97.61 | 97.25 |
| 34 | 137.2 | 99.64 | 99.13 | 98.83 | 98.47 | 98.32 | 98.10 | 97.59 | 97.08 | 96.50 |
| 35 | 140.3 | 99.71 | 99.43 | 99.22 | 99.07 | 98.79 | 98.72 | 98.36 | 97.72 | 97.29 |
| 36 | 136.3 | 99.63 | 99.34 | 99.12 | 98.83 | 98.61 | 98.31 | 98.02 | 97.73 | 97.14 |
| 37 | 141.2 | 99.65 | 99.43 | 99.36 | 99.01 | 98.94 | 98.80 | 98.65 | 98.16 | 97.59 |
| 38 | 136.5 | 99.71 | 99.41 | 99.12 | 98.90 | 98.61 | 98.32 | 97.95 | 97.29 | 96.70 |
| 39 | 139.1 | 99.78 | 99.42 | 99.14 | 98.85 | 98.63 | 98.20 | 97.84 | 97.27 | 96.84 |
| 40 | 139.3 | 99.86 | 99.35 | 98.92 | 98.64 | 98.35 | 98.28 | 97.92 | 97.34 | 96.98 |
| 41 | 137.8 | 100.07 | 99.71 | 99.27 | 98.84 | 98.40 | 98.11 | 97.90 | 97.31 | 96.81 |
| 42 | 141.6 | 99.86 | 99.51 | 99.08 | 98.73 | 98.38 | 97.88 | 97.46 | 97.25 | 96.68 |
| 43 | 137.8 | 99.85 | 99.56 | 99.13 | 98.69 | 98.40 | 97.97 | 97.61 | 97.31 | 96.73 |
| 44 | 137.2 | 99.78 | 99.56 | 99.20 | 98.91 | 98.69 | 98.47 | 98.18 | 97.38 | 97.08 |
| 45 | 136.5 | 99.63 | 99.27 | 99.05 | 98.75 | 98.53 | 98.39 | 98.10 | 97.58 | 96.70 |
| 46 | 138.1 | 99.71 | 99.20 | 98.99 | 98.62 | 98.26 | 98.04 | 97.68 | 97.10 | 96.67 |
| 47 | 139.0 | 99.78 | 99.57 | 99.28 | 98.85 | 98.56 | 98.27 | 97.91 | 97.27 | 96.76 |
| 48 | 137.4 | 99.56 | 99.49 | 99.20 | 98.69 | 98.47 | 98.25 | 97.96 | 97.53 | 97.09 |
| 49 | 137.3 | 99.64 | 99.34 | 99.20 | 98.91 | 98.76 | 98.32 | 98.18 | 97.89 | 97.23 |
| 50 | 139.5 | 99.71 | 99.43 | 99.21 | 99.00 | 98.85 | 98.71 | 98.28 | 97.85 | 97.35 |
| Avg. | 137.5 | 99.73 | 99.44 | 99.17 | 98.87 | 98.60 | 98.34 | 98.03 | 97.52 | 97.03 |
| Med. | 137.8 | 99.71 | 99.43 | 99.20 | 98.85 | 98.61 | 98.32 | 98.10 | 97.58 | 97.09 |
| st dev | 3.1020 | 0.1064 | 0.1298 | 0.1573 | 0.1994 | 0.2253 | 0.2930 | 0.3338 | 0.3293 | 0.3809 |
| Min. | 125.1 | 99.56 | 99.13 | 98.83 | 98.47 | 98.08 | 97.60 | 97.20 | 96.72 | 96.08 |
| Max. | 141.6 | 100.07 | 99.71 | 99.56 | 99.27 | 98.94 | 98.80 | 98.65 | 98.16 | 97.61 |

### 3.5 Data Set 2, 105°C, 150mA (Forward Voltage)

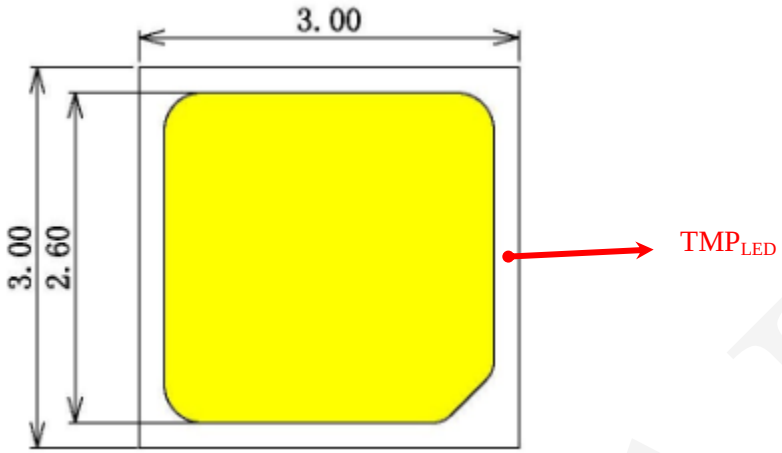
| No. | Forward Voltage (V) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0hr(Initial) | 1000hrs | 2000hrs | 3000hrs | 4000hrs | 5000hrs | 6000hrs | 7000hrs | 8000hrs | 9000hrs |
| 26 | 5.948 | 5.942 | 5.952 | 5.950 | 5.956 | 5.951 | 5.969 | 5.951 | 5.959 | 5.969 |
| 27 | 5.991 | 5.983 | 5.988 | 5.991 | 5.999 | 5.987 | 6.011 | 5.989 | 5.999 | 6.006 |
| 28 | 5.974 | 5.964 | 5.976 | 5.974 | 5.979 | 5.970 | 5.992 | 5.974 | 5.981 | 5.990 |
| 29 | 5.953 | 5.943 | 5.964 | 5.950 | 5.956 | 5.948 | 5.969 | 5.948 | 5.959 | 5.971 |
| 30 | 5.955 | 5.946 | 6.004 | 5.951 | 5.967 | 5.952 | 5.970 | 5.951 | 5.959 | 5.970 |
| 31 | 5.891 | 5.884 | 5.904 | 5.887 | 5.894 | 5.888 | 5.901 | 5.890 | 5.894 | 5.907 |
| 32 | 5.884 | 5.874 | 5.937 | 5.882 | 5.885 | 5.883 | 5.896 | 5.885 | 5.888 | 5.901 |
| 33 | 5.895 | 5.892 | 6.001 | 5.894 | 5.897 | 5.897 | 5.909 | 5.894 | 5.900 | 5.912 |
| 34 | 6.049 | 6.051 | 6.055 | 6.048 | 6.054 | 6.053 | 6.069 | 6.048 | 6.056 | 6.064 |
| 35 | 5.974 | 5.972 | 5.977 | 5.975 | 5.984 | 5.976 | 5.995 | 5.972 | 5.982 | 5.994 |
| 36 | 5.946 | 5.939 | 5.942 | 5.948 | 5.946 | 5.949 | 5.963 | 5.942 | 5.952 | 5.965 |
| 37 | 5.990 | 5.980 | 6.080 | 5.994 | 5.992 | 5.993 | 6.011 | 5.990 | 5.996 | 6.007 |
| 38 | 5.886 | 5.880 | 5.888 | 5.888 | 5.886 | 5.888 | 5.896 | 5.885 | 5.890 | 5.902 |
| 39 | 5.901 | 5.892 | 5.925 | 5.898 | 5.900 | 5.901 | 5.912 | 5.900 | 5.903 | 5.916 |
| 40 | 5.900 | 5.895 | 5.906 | 5.904 | 5.907 | 5.902 | 5.915 | 5.903 | 5.906 | 5.922 |
| 41 | 5.892 | 5.880 | 5.890 | 5.889 | 5.890 | 5.888 | 5.899 | 5.891 | 5.892 | 5.903 |
| 42 | 6.004 | 5.995 | 6.003 | 6.002 | 6.002 | 6.003 | 6.025 | 6.005 | 6.009 | 6.018 |
| 43 | 5.880 | 5.870 | 5.879 | 5.877 | 5.881 | 5.881 | 5.893 | 5.882 | 5.884 | 5.895 |
| 44 | 5.990 | 5.978 | 5.987 | 5.990 | 5.991 | 5.995 | 6.010 | 5.993 | 5.998 | 6.006 |
| 45 | 5.957 | 5.948 | 5.954 | 5.956 | 5.958 | 5.961 | 5.976 | 5.959 | 5.963 | 5.968 |
| 46 | 5.887 | 5.881 | 5.885 | 5.890 | 5.900 | 5.890 | 5.902 | 5.892 | 5.893 | 5.905 |
| 47 | 5.905 | 5.898 | 5.907 | 5.906 | 5.957 | 5.906 | 5.918 | 5.906 | 5.910 | 5.931 |
| 48 | 5.970 | 5.962 | 5.967 | 5.970 | 5.974 | 5.974 | 5.990 | 5.973 | 5.978 | 5.993 |
| 49 | 5.887 | 5.879 | 5.884 | 5.888 | 5.892 | 5.891 | 5.900 | 5.891 | 5.892 | 5.918 |
| 50 | 5.988 | 5.968 | 5.975 | 5.977 | 5.977 | 5.979 | 5.995 | 5.975 | 5.982 | 5.999 |
| Avg. | 5.940 | 5.932 | 5.953 | 5.939 | 5.945 | 5.940 | 5.955 | 5.940 | 5.945 | 5.957 |
| Med. | 5.948 | 5.942 | 5.954 | 5.950 | 5.956 | 5.949 | 5.969 | 5.948 | 5.959 | 5.968 |
| st dev | 0.0484 | 0.0486 | 0.0537 | 0.0482 | 0.0480 | 0.0484 | 0.0515 | 0.0474 | 0.0493 | 0.0474 |
| Min. | 5.880 | 5.870 | 5.879 | 5.877 | 5.881 | 5.881 | 5.893 | 5.882 | 5.884 | 5.895 |
| Max. | 6.049 | 6.051 | 6.080 | 6.048 | 6.054 | 6.053 | 6.069 | 6.048 | 6.056 | 6.064 |

### 3.6 Data Set 2, 105°C, 150mA (Chromaticity Shift)

| No. | u' | v' | CCT(K) | Chromaticity Shift (Δu'v') | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0hr(Initial) | | | 1000hrs | 2000hrs | 3000hrs | 4000hrs | 5000hrs | 6000hrs | 7000hrs | 8000hrs | 9000hrs |
| 26 | 0.2626 | 0.5262 | 2703 | 0.0004 | 0.0008 | 0.0009 | 0.0012 | 0.0014 | 0.0019 | 0.0023 | 0.0027 | 0.0031 |
| 27 | 0.2592 | 0.5214 | 2797 | 0.0001 | 0.0001 | 0.0004 | 0.0010 | 0.0009 | 0.0010 | 0.0015 | 0.0018 | 0.0022 |
| 28 | 0.2612 | 0.5257 | 2735 | 0.0003 | 0.0006 | 0.0011 | 0.0015 | 0.0016 | 0.0017 | 0.0023 | 0.0026 | 0.0031 |
| 29 | 0.2597 | 0.5231 | 2777 | 0.0001 | 0.0004 | 0.0008 | 0.0014 | 0.0013 | 0.0014 | 0.0020 | 0.0024 | 0.0030 |
| 30 | 0.2622 | 0.5250 | 2715 | 0.0003 | 0.0006 | 0.0011 | 0.0016 | 0.0019 | 0.0018 | 0.0023 | 0.0027 | 0.0031 |
| 31 | 0.2616 | 0.5239 | 2732 | 0.0002 | 0.0005 | 0.0010 | 0.0015 | 0.0017 | 0.0017 | 0.0022 | 0.0025 | 0.0029 |
| 32 | 0.2620 | 0.5238 | 2726 | 0.0003 | 0.0007 | 0.0011 | 0.0016 | 0.0019 | 0.0018 | 0.0022 | 0.0028 | 0.0030 |
| 33 | 0.2619 | 0.5238 | 2727 | 0.0003 | 0.0007 | 0.0011 | 0.0017 | 0.0019 | 0.0021 | 0.0023 | 0.0028 | 0.0031 |
| 34 | 0.2634 | 0.5228 | 2700 | 0.0004 | 0.0008 | 0.0009 | 0.0014 | 0.0018 | 0.0025 | 0.0028 | 0.0031 | 0.0038 |
| 35 | 0.2615 | 0.5253 | 2729 | 0.0004 | 0.0008 | 0.0008 | 0.0015 | 0.0019 | 0.0025 | 0.0027 | 0.0031 | 0.0036 |
| 36 | 0.2640 | 0.5268 | 2671 | 0.0003 | 0.0006 | 0.0009 | 0.0013 | 0.0019 | 0.0025 | 0.0029 | 0.0032 | 0.0037 |
| 37 | 0.2603 | 0.5253 | 2756 | 0.0003 | 0.0007 | 0.0006 | 0.0011 | 0.0013 | 0.0019 | 0.0024 | 0.0028 | 0.0032 |
| 38 | 0.2620 | 0.5257 | 2718 | 0.0005 | 0.0008 | 0.0009 | 0.0013 | 0.0016 | 0.0022 | 0.0026 | 0.0031 | 0.0036 |
| 39 | 0.2620 | 0.5249 | 2720 | 0.0004 | 0.0006 | 0.0008 | 0.0013 | 0.0013 | 0.0017 | 0.0024 | 0.0030 | 0.0033 |
| 40 | 0.2622 | 0.5262 | 2710 | 0.0004 | 0.0007 | 0.0009 | 0.0015 | 0.0018 | 0.0022 | 0.0029 | 0.0033 | 0.0037 |
| 41 | 0.2639 | 0.5292 | 2664 | 0.0006 | 0.0008 | 0.0007 | 0.0012 | 0.0014 | 0.0018 | 0.0023 | 0.0029 | 0.0034 |
| 42 | 0.2611 | 0.5259 | 2735 | 0.0004 | 0.0006 | 0.0008 | 0.0013 | 0.0016 | 0.0021 | 0.0025 | 0.0030 | 0.0034 |
| 43 | 0.2611 | 0.5241 | 2744 | 0.0004 | 0.0007 | 0.0007 | 0.0012 | 0.0013 | 0.0018 | 0.0023 | 0.0028 | 0.0032 |
| 44 | 0.2629 | 0.5254 | 2699 | 0.0004 | 0.0006 | 0.0009 | 0.0014 | 0.0016 | 0.0020 | 0.0023 | 0.0029 | 0.0033 |
| 45 | 0.2636 | 0.5242 | 2690 | 0.0004 | 0.0007 | 0.0007 | 0.0011 | 0.0014 | 0.0017 | 0.0021 | 0.0026 | 0.0030 |
| 46 | 0.2615 | 0.5252 | 2729 | 0.0004 | 0.0007 | 0.0006 | 0.0013 | 0.0015 | 0.0022 | 0.0025 | 0.0031 | 0.0035 |
| 47 | 0.2624 | 0.5268 | 2704 | 0.0004 | 0.0007 | 0.0008 | 0.0011 | 0.0015 | 0.0020 | 0.0022 | 0.0028 | 0.0032 |
| 48 | 0.2621 | 0.5249 | 2717 | 0.0004 | 0.0007 | 0.0007 | 0.0011 | 0.0013 | 0.0017 | 0.0022 | 0.0028 | 0.0032 |
| 49 | 0.2608 | 0.5239 | 2751 | 0.0004 | 0.0006 | 0.0007 | 0.0011 | 0.0013 | 0.0017 | 0.0020 | 0.0026 | 0.0031 |
| 50 | 0.2620 | 0.5246 | 2723 | 0.0004 | 0.0006 | 0.0009 | 0.0013 | 0.0015 | 0.0021 | 0.0024 | 0.0030 | 0.0034 |
| Avg. | 0.2619 | 0.5250 | 2723 | 0.0003 | 0.0007 | 0.0008 | 0.0013 | 0.0015 | 0.0019 | 0.0023 | 0.0028 | 0.0033 |
| Med. | 0.2620 | 0.5250 | 2723 | 0.0004 | 0.0007 | 0.0008 | 0.0013 | 0.0015 | 0.0019 | 0.0023 | 0.0028 | 0.0032 |
| st dev | 0.0012 | 0.0015 | 29.3077 | 0.0001 | 0.0001 | 0.0002 | 0.0002 | 0.0003 | 0.0003 | 0.0003 | 0.0003 | 0.0003 |
| Min. | 0.2592 | 0.5214 | 2664 | 0.0001 | 0.0001 | 0.0004 | 0.0010 | 0.0009 | 0.0010 | 0.0015 | 0.0018 | 0.0022 |
| Max. | 0.2640 | 0.5292 | 2797 | 0.0006 | 0.0008 | 0.0011 | 0.0017 | 0.0019 | 0.0025 | 0.0029 | 0.0033 | 0.0038 |

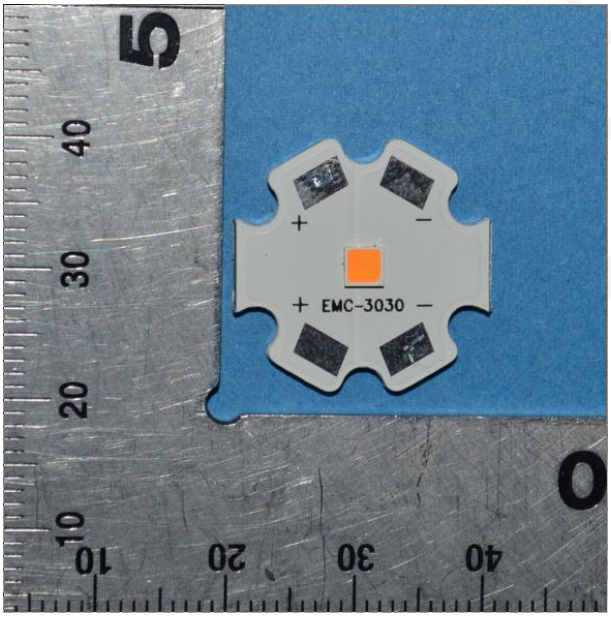
## 4 - DUT Photo

### 4.1 Mechanical Dimensions




All dimensions are in millimeter

### 4.2 DUT Photo




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