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Opto Semiconductors

# DURIS® E 2835
# White (CCT 2700 K – 6500 K)

IES LM-80-08 Test Report

Test Documentation No.:
160643W1 ( Document no. R2DG161117050-10 ) – 28th November 2016

# IESNA LM-80-2008

MEASURING LUMEN MAINTENANCE OF LED LIGHT SOURCES

## MEASUREMENT AND TEST REPORT

For

## Osram Opto Semiconductors (Malaysia) Sdn. Bhd.

Bayan Lepas Free Industrial Zone Phase 1,11900 Bayan Lepas, Penang, Malaysia.

Model:RF-27HP32DS-BF-I3-Y

| **Report Type:** | **Product Type:** |
|---|---|
| 9000 Hours Test Report | LED Package |

| | |
|---|---|
| **Test Engineer:** | Daniel Duan |
| **Report Number:** | R2DG161117050-10 |
| **Test Date:** | 2015-02-04 to 2016-03-30 |
| **Report Date:** | 2016-11-22 |
| **Reviewed By:** | Jeanne Han /EE Manager |
| **Prepared By:** | Bay Area Compliance Laboratories Corp. (Dongguan).<br>Pu Long Cun 69, Puxinghu Industrial Area, Tangxia Town,<br>Dongguan, Guangdong, P.R.China.<br>Tel: +86-0769-86858888<br>Fax:+86-0769-86858588 |

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# 1 - General Information

## 1.1 Description of LED Light Sources

Devices tested

Part Number: RF-27HP32DS-BF-I3-Y
Part Type: LED Package
Nominal CCT: 2700K

**Note:**

1. The applicant *Osram Opto Semiconductors (Malaysia) Sdn. Bhd.* declare that their product with model RF-27HP32DS-BF-I3-Y are the same to the product in report# R2DG141217054-10-9000 and is authorized by original applicant to use their test data.

2. All the data in previous report (R2DG141217054-10-9000) is shared in report.

## 1.2 Standards Used:

- IESNA LM-80-08: IES Approved Method for Measuring Lumen Maintenance of LED Light Sources.
- ENERGY STAR® Program Guidance Regarding LED Package, LED Array and LED Module Lumen Maintenance Performance Data Supporting Qualification of Lighting Products(This test method was not accredited by IAS)

## 1.3 Test Facility

The testing facility used by Bay Area Compliance Laboratories Corp. (Dongguan). is located at Pu Long Cun 69, Puxinghu Industrial Area, Tangxia Town, Dongguan, Guangdong, P.R.China.

## 1.4 Description of Auxiliary Equipment

| Device | Manufacture | Model No | Serial No | Test Range | Calibration date | Calibration due date |
|---|---|---|---|---|---|---|
| Integral Sphere | EVERFINE | Diameter 0.3m | 1011119 | 0.3m | 2016-03-10 | 2017-03-09 |
| Programmable Test Power for LEDs | EVERFINE | LED300E | 1008002 | 15V/2000mA | 2016-03-04 | 2017-03-03 |
| High accuracy array spectroradiometer | EVERFINE | HAAS-2000 | 1012016T | 380-780nm | 2016-03-10 | 2017-03-09 |
| Standard Light Source | EVERFINE | D062 | 1011093 | 3000K | 2015-09-17 | 2016-09-16 |
| Precision digital stabilized DC power supply | EVERFINE | WY605-V110 | G115987CJ7321114 | 300VA | 2016-03-04 | 2017-03-03 |
| Multilayer aging machine | BACL | B2-270 | 20005 | 25℃~110℃ | 2015-09-14 | 2016-09-13 |

| Device | Manufacture | Model No | Serial No | Test Range | Calibration date | Calibration due date |
|---|---|---|---|---|---|---|
| Digital CC&CV DC Power Supply | EVERFINE | WY5015 | 11060002 | (50V/15A) | 2016-07-07 | 2017-07-06 |
| Digital CC&CV DC Power Supply | EVERFINE | WY5015 | 11090007 | (50V/15A) | 2016-03-04 | 2017-03-03 |
| Digital CC&CV DC Power Supply | EVERFINE | WY5015 | 11090005 | (50V/15A) | 2016-03-04 | 2017-03-03 |

## 1.5 Operating Cycle

Samples are driven with a constant direct current (DC)

## 1.6 Ambient Conditions

For lumen maintenance test, samples were operated in thermal chambers with minimal ambient airflow. For long term reliability test, the case temperature was controlled by mounting several thermocouples on a sample reliability stress board at the designated thermal measurement point, as shown in APPENDIX. The ambient temperature $T_A$ was measured by several thermocouples at a distance of 5 mm above the reliability test board. The relative humidity within chamber was less than 65%.

For photometry measurement, temperature was set to 25℃ ±2℃, RH <65%.

## 1.7 Photometry Measurement Uncertainty

The uncertainty of the light output measurements is U=1.59% (K=2), at the 95% confidence level. The uncertainty of the correlated color temperature measurements is U=21K (K=2), at the 95% confidence level. This calibration results traceable to the NATIONAL INSTITUTE OF METROLOGY (NIM).

## 1.8 Sample Set

**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.
Each Sample is soldered to all of the reliability stress boards for a given set of IESNA LM-80 tests.

**Sample Size:**
Total 90Pcs;
Each Ts test condition 30Pcs
The samples tested at $T_S$ 55℃, Ts 85℃ and $T_S$ 105℃ were received at 2014-12-17 and tested during 2015-02-04 to 2016-03-30. The samples were numbered from 1 to 30, 31 to 60 and 61 to 90

| **Data Set 1: 55℃, 100mA** | |
|---|---|
| Part Number: | RF-27HP32DS-BF-I3-Y |
| Number of Units: | 30 |
| Actual Case Temperature($T_S$): | $T_S$ =53.1℃ |
| Actual Ambient Temperature($T_A$): | $T_A$ =52.6℃ |
| Life Test Drive Current: | $I_F$ = 100mA |
| Measurement Current: | $I_F$ = 100mA |

| **Data Set 2: 85℃,100mA** | |
|---|---|
| Part Number: | RF-27HP32DS-BF-I3-Y |
| Number of Units: | 30 |
| Actual Case Temperature($T_S$): | $T_S$ =83.4℃ |
| Actual Ambient Temperature($T_A$): | $T_A$ =82.9℃ |
| Life Test Drive Current: | $I_F$ =100mA |
| Measurement Current: | $I_F$ = 100mA |

| **Data Set 3: 105℃, 100mA** | |
|---|---|
| Part Number: | RF-27HP32DS-BF-I3-Y |
| Number of Units: | 30 |
| Actual Case Temperature($T_S$): | $T_S$ =103.5℃ |
| Actual Ambient Temperature($T_A$): | $T_A$ =102.8℃ |
| Life Test Drive Current: | $I_F$ = 100mA |
| Measurement Current: | $I_F$ = 100mA |

# 2 - Summary of Test Result

| **Data Set:** | **Data Set 1, 55 ℃, 100mA** |
|---|---|
| Number of Units: | 30 |
| Failures Observed: | 0 |
| Test Interval and Test Duration: | 0h,1000h,2000h,3000h,4000h,5000h,6000h, 7000h,8000h,9000h |
| Average. Lumen Maintenance at 6000 hours: | 97.66% |
| Average. Lumen Maintenance at 9000 hours: | 96.56% |
| Average Chromaticity Shift at 6000 hours (Δu'v'): | 0.0023 |
| Average Chromaticity Shift at 9000 hours (Δu'v'): | 0.0030 |

| **Data Set:** | **Data Set 2, 85 ℃, 100mA** |
|---|---|
| Number of Units: | 30 |
| Failures Observed: | 0 |
| Test Interval and Test Duration: | 0h,1000h,2000h,3000h,4000h,5000h,6000h, 7000h,8000h,9000h |
| Average. Lumen Maintenance at 6000 hours: | 96.64% |
| Average. Lumen Maintenance at 9000 hours: | 95.19% |
| Average Chromaticity Shift at 6000 hours(Δu'v'): | 0.0022 |
| Average Chromaticity Shift at 9000 hours (Δu'v'): | 0.0031 |

| **Data Set:** | **Data Set 3, 105 ℃, 100mA** |
|---|---|
| Number of Units: | 30 |
| Failures Observed: | 0 |
| Test Interval and Test Duration: | 0h,1000h,2000h,3000h,4000h,5000h,6000h, 7000h,8000h,9000h |
| Average. Lumen Maintenance at 6000 hours: | 95.79% |
| Average. Lumen Maintenance at 9000 hours: | 94.19% |
| Average Chromaticity Shift at 6000 hours(Δu'v'): | 0.0026 |
| Average Chromaticity Shift at 9000 hours (Δu'v'): | 0.0033 |

# 3 - Test Data

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

| No. | $V_F$(V) | Φ(lm) | Lumen Maintenance (%) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0hr(Initial) | | 1000hrs | 2000hrs | 3000hrs | 4000hrs | 5000hrs | 6000hrs | 7000hrs | 8000hrs | 9000hrs |
| 1 | 9.132 | 103.0 | 100.68 | 100.39 | 100.00 | 99.03 | 98.64 | 98.45 | 98.06 | 97.77 | 97.38 |
| 2 | 9.112 | 102.8 | 100.00 | 99.81 | 99.51 | 98.64 | 97.86 | 97.76 | 97.23 | 96.71 | 96.35 |
| 3 | 9.064 | 103.2 | 100.10 | 99.81 | 99.61 | 98.74 | 98.16 | 97.87 | 97.38 | 97.00 | 96.77 |
| 4 | 9.177 | 106.8 | 100.00 | 99.72 | 99.34 | 98.97 | 98.78 | 98.41 | 97.85 | 97.38 | 96.82 |
| 5 | 9.130 | 103.0 | 99.90 | 99.61 | 99.42 | 98.64 | 98.35 | 97.67 | 96.96 | 96.66 | 96.45 |
| 6 | 9.109 | 104.3 | 100.19 | 99.90 | 99.52 | 97.89 | 97.51 | 96.93 | 96.36 | 95.66 | 95.43 |
| 7 | 9.152 | 106.5 | 99.91 | 99.62 | 99.34 | 97.46 | 97.18 | 96.71 | 96.34 | 95.68 | 95.40 |
| 8 | 9.100 | 102.2 | 100.10 | 99.71 | 99.22 | 98.24 | 98.14 | 97.56 | 97.08 | 96.84 | 96.73 |
| 9 | 9.110 | 104.6 | 100.29 | 100.00 | 99.62 | 98.85 | 98.09 | 97.61 | 97.23 | 96.65 | 96.27 |
| 10 | 9.121 | 96.4 | 100.32 | 99.70 | 99.18 | 98.23 | 98.06 | 97.56 | 97.29 | 96.72 | 96.45 |
| 11 | 9.107 | 102.8 | 100.19 | 99.90 | 99.51 | 98.15 | 97.47 | 97.01 | 96.70 | 96.17 | 96.00 |
| 12 | 9.125 | 105.5 | 100.09 | 99.72 | 99.43 | 98.29 | 97.54 | 97.16 | 96.97 | 96.21 | 95.83 |
| 13 | 9.123 | 102.6 | 100.10 | 99.81 | 99.51 | 98.73 | 97.95 | 97.66 | 97.37 | 96.59 | 96.30 |
| 14 | 9.121 | 101.0 | 100.40 | 100.20 | 99.70 | 99.21 | 98.59 | 98.15 | 97.89 | 97.45 | 97.35 |
| 15 | 9.122 | 103.1 | 100.00 | 99.81 | 99.52 | 98.35 | 97.77 | 97.09 | 96.71 | 96.11 | 95.75 |
| 16 | 9.114 | 92.3 | 100.61 | 100.10 | 99.63 | 98.83 | 97.93 | 97.29 | 97.13 | 96.84 | 96.65 |
| 17 | 9.125 | 104.2 | 100.19 | 99.90 | 99.62 | 98.75 | 98.46 | 98.08 | 97.79 | 97.41 | 97.22 |
| 18 | 9.113 | 100.3 | 100.20 | 99.90 | 99.56 | 98.88 | 98.58 | 98.29 | 97.87 | 97.09 | 96.62 |
| 19 | 9.108 | 102.4 | 100.10 | 99.90 | 99.61 | 99.02 | 98.44 | 97.75 | 97.66 | 97.02 | 96.68 |
| 20 | 9.112 | 100.1 | 100.30 | 99.90 | 99.56 | 98.50 | 98.37 | 97.74 | 97.44 | 97.17 | 97.02 |
| 21 | 9.121 | 101.3 | 100.00 | 99.70 | 99.31 | 98.72 | 97.94 | 96.98 | 96.86 | 96.72 | 96.55 |
| 22 | 9.066 | 104.4 | 100.10 | 99.90 | 99.43 | 98.85 | 97.80 | 97.32 | 97.03 | 96.46 | 96.07 |
| 23 | 9.090 | 105.4 | 100.19 | 99.81 | 99.72 | 99.15 | 98.39 | 97.91 | 97.82 | 97.63 | 97.53 |
| 24 | 9.100 | 103.9 | 99.90 | 99.62 | 99.23 | 98.17 | 97.98 | 97.69 | 97.40 | 96.92 | 96.82 |
| 25 | 9.115 | 98.2 | 100.27 | 99.95 | 99.68 | 99.47 | 99.17 | 99.02 | 98.72 | 98.36 | 98.07 |
| 26 | 9.126 | 101.1 | 100.20 | 100.00 | 99.70 | 98.91 | 98.19 | 97.56 | 97.14 | 96.81 | 96.54 |
| 27 | 9.120 | 101.3 | 100.20 | 100.00 | 99.70 | 98.68 | 97.92 | 97.46 | 96.99 | 96.41 | 95.95 |
| 28 | 9.126 | 100.2 | 100.30 | 100.00 | 99.80 | 99.21 | 98.62 | 98.18 | 97.90 | 97.64 | 97.37 |
| 29 | 9.127 | 103.3 | 100.19 | 99.71 | 99.32 | 98.35 | 97.58 | 97.10 | 96.80 | 96.33 | 95.91 |
| 30 | 9.125 | 100.5 | 100.40 | 100.10 | 99.70 | 98.96 | 98.47 | 97.72 | 97.30 | 97.14 | 96.61 |
| Ave. | 9.116 | 102.2 | 100.18 | 99.87 | 99.53 | 98.66 | 98.13 | 97.66 | 97.31 | 96.85 | 96.56 |
| Med. | 9.121 | 102.8 | 100.19 | 99.90 | 99.54 | 98.74 | 98.11 | 97.67 | 97.26 | 96.82 | 96.58 |
| st dev | 0.021 | 2.96 | 0.1853 | 0.1791 | 0.1873 | 0.4323 | 0.4469 | 0.5179 | 0.5274 | 0.6058 | 0.6276 |
| Min. | 9.064 | 92.3 | 99.90 | 99.61 | 99.18 | 97.46 | 97.18 | 96.71 | 96.34 | 95.66 | 95.40 |
| Max. | 9.177 | 106.8 | 100.68 | 100.39 | 100.00 | 99.47 | 99.17 | 99.02 | 98.72 | 98.36 | 98.07 |

## 3.2 Data Set 1, 55 ℃, 100mA (Chromaticity Shift)

| No. | u' | v' | CCT(K) | Chromaticity Shift (Δu'v') | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0hr(Initial) | | | 1000hrs | 2000hrs | 3000hrs | 4000hrs | 5000hrs | 6000hrs | 7000hrs | 8000hrs | 9000hrs |
| 1 | 0.2596 | 0.5321 | 2740 | 0.0009 | 0.0012 | 0.0013 | 0.0020 | 0.0021 | 0.0027 | 0.0033 | 0.0037 | 0.0038 |
| 2 | 0.2590 | 0.5315 | 2756 | 0.0007 | 0.0010 | 0.0012 | 0.0016 | 0.0018 | 0.0023 | 0.0024 | 0.0028 | 0.0026 |
| 3 | 0.2602 | 0.5332 | 2723 | 0.0005 | 0.0009 | 0.0010 | 0.0013 | 0.0016 | 0.0022 | 0.0025 | 0.0028 | 0.0033 |
| 4 | 0.2606 | 0.5337 | 2714 | 0.0005 | 0.0008 | 0.0011 | 0.0015 | 0.0017 | 0.0021 | 0.0022 | 0.0023 | 0.0028 |
| 5 | 0.2588 | 0.5319 | 2757 | 0.0005 | 0.0007 | 0.0010 | 0.0014 | 0.0016 | 0.0021 | 0.0023 | 0.0025 | 0.0031 |
| 6 | 0.2596 | 0.5327 | 2739 | 0.0007 | 0.0008 | 0.0011 | 0.0015 | 0.0018 | 0.0021 | 0.0022 | 0.0021 | 0.0028 |
| 7 | 0.2587 | 0.5311 | 2763 | 0.0008 | 0.0012 | 0.0015 | 0.0019 | 0.0021 | 0.0025 | 0.0026 | 0.0028 | 0.0029 |
| 8 | 0.2597 | 0.5326 | 2737 | 0.0009 | 0.0016 | 0.0018 | 0.0022 | 0.0025 | 0.0029 | 0.0032 | 0.0033 | 0.0033 |
| 9 | 0.2595 | 0.5327 | 2740 | 0.0006 | 0.0012 | 0.0017 | 0.0023 | 0.0024 | 0.0029 | 0.0032 | 0.0033 | 0.0034 |
| 10 | 0.2605 | 0.5327 | 2721 | 0.0008 | 0.0011 | 0.0016 | 0.0021 | 0.0024 | 0.0028 | 0.0033 | 0.0035 | 0.0035 |
| 11 | 0.2589 | 0.5322 | 2755 | 0.0006 | 0.0009 | 0.0014 | 0.0018 | 0.0021 | 0.0026 | 0.0028 | 0.0030 | 0.0029 |
| 12 | 0.2594 | 0.5333 | 2739 | 0.0005 | 0.0008 | 0.0014 | 0.0018 | 0.0019 | 0.0024 | 0.0028 | 0.0029 | 0.0028 |
| 13 | 0.2596 | 0.5311 | 2744 | 0.0006 | 0.0007 | 0.0013 | 0.0016 | 0.0019 | 0.0023 | 0.0025 | 0.0026 | 0.0026 |
| 14 | 0.2597 | 0.5318 | 2740 | 0.0004 | 0.0008 | 0.0013 | 0.0019 | 0.0021 | 0.0025 | 0.0030 | 0.0033 | 0.0031 |
| 15 | 0.2595 | 0.5319 | 2744 | 0.0006 | 0.0007 | 0.0010 | 0.0017 | 0.0020 | 0.0023 | 0.0027 | 0.0028 | 0.0027 |
| 16 | 0.2614 | 0.5343 | 2694 | 0.0006 | 0.0009 | 0.0012 | 0.0019 | 0.0021 | 0.0023 | 0.0037 | 0.0038 | 0.0035 |
| 17 | 0.2603 | 0.5319 | 2727 | 0.0006 | 0.0008 | 0.0011 | 0.0019 | 0.0022 | 0.0023 | 0.0027 | 0.0030 | 0.0029 |
| 18 | 0.2603 | 0.5341 | 2719 | 0.0007 | 0.0008 | 0.0012 | 0.0019 | 0.0022 | 0.0025 | 0.0029 | 0.0033 | 0.0030 |
| 19 | 0.2595 | 0.5316 | 2745 | 0.0006 | 0.0007 | 0.0011 | 0.0017 | 0.0021 | 0.0023 | 0.0026 | 0.0028 | 0.0027 |
| 20 | 0.2608 | 0.5320 | 2717 | 0.0005 | 0.0008 | 0.0012 | 0.0017 | 0.0019 | 0.0023 | 0.0026 | 0.0034 | 0.0032 |
| 21 | 0.2604 | 0.5326 | 2723 | 0.0005 | 0.0007 | 0.0011 | 0.0026 | 0.0020 | 0.0023 | 0.0027 | 0.0030 | 0.0035 |
| 22 | 0.2604 | 0.5333 | 2720 | 0.0005 | 0.0010 | 0.0013 | 0.0018 | 0.0021 | 0.0026 | 0.0029 | 0.0031 | 0.0031 |
| 23 | 0.2600 | 0.5322 | 2733 | 0.0006 | 0.0007 | 0.0010 | 0.0012 | 0.0017 | 0.0021 | 0.0026 | 0.0028 | 0.0029 |
| 24 | 0.2601 | 0.5334 | 2726 | 0.0005 | 0.0008 | 0.0010 | 0.0007 | 0.0014 | 0.0023 | 0.0029 | 0.0032 | 0.0032 |
| 25 | 0.2600 | 0.5321 | 2734 | 0.0007 | 0.0012 | 0.0017 | 0.0010 | 0.0013 | 0.0026 | 0.0030 | 0.0035 | 0.0038 |
| 26 | 0.2596 | 0.5321 | 2741 | 0.0006 | 0.0008 | 0.0010 | 0.0010 | 0.0007 | 0.0018 | 0.0023 | 0.0027 | 0.0032 |
| 27 | 0.2607 | 0.5320 | 2719 | 0.0004 | 0.0010 | 0.0013 | 0.0011 | 0.0009 | 0.0015 | 0.0017 | 0.0021 | 0.0028 |
| 28 | 0.2595 | 0.5330 | 2739 | 0.0004 | 0.0009 | 0.0013 | 0.0013 | 0.0010 | 0.0015 | 0.0016 | 0.0020 | 0.0028 |
| 29 | 0.2598 | 0.5321 | 2736 | 0.0005 | 0.0007 | 0.0009 | 0.0009 | 0.0008 | 0.0013 | 0.0015 | 0.0018 | 0.0025 |
| 30 | 0.2602 | 0.5319 | 2728 | 0.0005 | 0.0009 | 0.0012 | 0.0012 | 0.0013 | 0.0014 | 0.0017 | 0.0019 | 0.0025 |
| Ave. | 0.2599 | 0.5324 | 2734 | 0.0006 | 0.0009 | 0.0012 | 0.0016 | 0.0018 | 0.0023 | 0.0026 | 0.0029 | 0.0030 |
| Med. | 0.2598 | 0.5322 | 2737 | 0.0006 | 0.0008 | 0.0012 | 0.0017 | 0.0019 | 0.0023 | 0.0027 | 0.0029 | 0.0030 |
| st dev | 0.0006 | 0.0008 | 14.8037 | 0.0001 | 0.0002 | 0.0002 | 0.0004 | 0.0005 | 0.0004 | 0.0005 | 0.0005 | 0.0004 |
| Min. | 0.2587 | 0.5311 | 2694 | 0.0004 | 0.0007 | 0.0009 | 0.0007 | 0.0007 | 0.0013 | 0.0015 | 0.0018 | 0.0025 |
| Max. | 0.2614 | 0.5343 | 2763 | 0.0009 | 0.0016 | 0.0018 | 0.0026 | 0.0025 | 0.0029 | 0.0037 | 0.0038 | 0.0038 |

## 3.3 Data Set 2, 85℃, 100mA (Lumen Maintenance)

| No. | $V_F$(V) | Φ(lm) | Lumen Maintenance (%) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0hr(Initial) | | 1000hrs | 2000hrs | 3000hrs | 4000hrs | 5000hrs | 6000hrs | 7000hrs | 8000hrs | 9000hrs |
| 31 | 9.097 | 100.00 | 100.00 | 99.66 | 99.24 | 98.28 | 97.63 | 97.01 | 96.70 | 96.27 | 95.72 |
| 32 | 9.103 | 101.60 | 100.20 | 99.70 | 99.31 | 98.21 | 97.28 | 96.63 | 96.26 | 95.94 | 95.68 |
| 33 | 9.123 | 99.40 | 99.82 | 99.21 | 98.74 | 97.31 | 97.10 | 96.27 | 95.89 | 95.48 | 95.11 |
| 34 | 9.105 | 105.60 | 99.91 | 99.53 | 99.15 | 98.86 | 97.73 | 97.25 | 96.69 | 96.21 | 95.74 |
| 35 | 9.106 | 104.20 | 99.90 | 99.52 | 99.04 | 98.27 | 97.41 | 96.64 | 95.88 | 95.48 | 95.17 |
| 36 | 9.104 | 102.70 | 100.29 | 99.81 | 99.42 | 98.54 | 97.66 | 97.02 | 96.85 | 96.51 | 96.15 |
| 37 | 9.117 | 100.90 | 100.10 | 99.60 | 99.11 | 97.94 | 97.48 | 96.51 | 96.03 | 95.63 | 95.28 |
| 38 | 9.118 | 102.30 | 100.20 | 99.90 | 99.51 | 98.44 | 97.21 | 96.71 | 96.00 | 95.84 | 95.48 |
| 39 | 9.123 | 102.60 | 99.81 | 99.32 | 99.03 | 97.76 | 97.26 | 96.69 | 96.01 | 95.47 | 94.91 |
| 40 | 9.115 | 101.5 | 99.61 | 99.31 | 98.92 | 97.77 | 97.42 | 96.75 | 96.33 | 96.03 | 95.72 |
| 41 | 9.115 | 103.3 | 100.10 | 99.61 | 99.52 | 98.35 | 97.97 | 97.58 | 97.39 | 96.67 | 96.28 |
| 42 | 9.136 | 99.4 | 100.23 | 99.83 | 99.42 | 98.88 | 98.15 | 97.54 | 97.22 | 96.62 | 96.28 |
| 43 | 9.129 | 103.8 | 100.10 | 99.81 | 98.55 | 97.98 | 97.11 | 96.63 | 96.28 | 95.92 | 95.57 |
| 44 | 9.117 | 100.4 | 99.80 | 99.60 | 99.07 | 97.60 | 97.30 | 96.66 | 96.22 | 95.58 | 95.14 |
| 45 | 9.111 | 102.2 | 99.80 | 99.61 | 99.22 | 97.67 | 97.07 | 96.98 | 96.28 | 95.61 | 95.17 |
| 46 | 9.100 | 102.3 | 99.90 | 99.61 | 99.32 | 98.24 | 97.42 | 96.80 | 96.36 | 95.75 | 95.21 |
| 47 | 9.061 | 104.0 | 99.62 | 99.23 | 98.75 | 97.88 | 97.12 | 96.44 | 95.70 | 95.08 | 94.73 |
| 48 | 9.128 | 104.4 | 100.00 | 99.71 | 99.23 | 98.37 | 97.03 | 96.17 | 95.76 | 95.31 | 94.83 |
| 49 | 9.103 | 101.7 | 99.90 | 99.41 | 99.02 | 98.82 | 98.01 | 97.59 | 97.15 | 96.40 | 96.05 |
| 50 | 9.123 | 105.5 | 99.81 | 99.34 | 98.96 | 98.01 | 97.25 | 96.59 | 95.83 | 95.36 | 94.88 |
| 51 | 9.102 | 101.9 | 99.80 | 99.31 | 98.63 | 97.52 | 97.24 | 96.67 | 95.87 | 95.17 | 94.68 |
| 52 | 9.079 | 101.9 | 99.80 | 99.51 | 101.57 | 100.29 | 98.72 | 98.14 | 97.57 | 96.93 | 96.37 |
| 53 | 9.057 | 104.6 | 99.81 | 99.33 | 98.85 | 97.42 | 96.65 | 95.79 | 94.87 | 94.41 | 94.07 |
| 54 | 9.107 | 103.4 | 100.19 | 99.81 | 99.23 | 98.36 | 96.81 | 96.17 | 95.45 | 94.71 | 94.12 |
| 55 | 9.118 | 103.9 | 100.19 | 99.90 | 99.33 | 97.79 | 96.82 | 96.25 | 95.56 | 94.88 | 94.37 |
| 56 | 9.115 | 100.3 | 99.90 | 99.57 | 99.05 | 97.73 | 97.11 | 96.43 | 96.10 | 95.33 | 94.90 |
| 57 | 9.098 | 101.1 | 99.90 | 99.51 | 98.85 | 96.92 | 96.71 | 95.71 | 95.05 | 94.43 | 93.98 |
| 58 | 9.110 | 100.8 | 100.00 | 99.50 | 98.98 | 97.19 | 96.86 | 96.02 | 95.42 | 94.80 | 94.50 |
| 59 | 9.186 | 102.5 | 99.51 | 99.12 | 98.83 | 97.55 | 96.75 | 95.87 | 95.78 | 95.05 | 94.55 |
| 60 | 9.131 | 102.5 | 99.71 | 99.12 | 98.73 | 97.41 | 96.36 | 95.69 | 95.60 | 95.29 | 95.17 |
| Ave. | 9.111 | 102.4 | 99.93 | 99.53 | 99.15 | 98.05 | 97.29 | 96.64 | 96.14 | 95.60 | 95.19 |
| Med. | 9.113 | 102.3 | 99.90 | 99.55 | 99.06 | 97.96 | 97.25 | 96.64 | 96.02 | 95.53 | 95.17 |
| st dev | 0.023 | 1.68 | 0.1996 | 0.2252 | 0.5241 | 0.6549 | 0.4948 | 0.5856 | 0.6506 | 0.6587 | 0.6713 |
| Min. | 9.057 | 99.4 | 99.51 | 99.12 | 98.55 | 96.92 | 96.36 | 95.69 | 94.87 | 94.41 | 93.98 |
| Max. | 9.186 | 105.6 | 100.29 | 99.90 | 101.57 | 100.29 | 98.72 | 98.14 | 97.57 | 96.93 | 96.37 |

## 3.4 Data Set 2, 85 ℃, 100mA (Chromaticity Shift)

| No. | u' | v' | CCT(K) | Chromaticity Shift (Δu'v') | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0hr(Initial) | | | 1000hrs | 2000hrs | 3000hrs | 4000hrs | 5000hrs | 6000hrs | 7000hrs | 8000hrs | 9000hrs |
| 31 | 0.2601 | 0.5324 | 2730 | 0.0006 | 0.0009 | 0.0010 | 0.0011 | 0.0014 | 0.0014 | 0.0015 | 0.0016 | 0.0027 |
| 32 | 0.2601 | 0.5326 | 2729 | 0.0007 | 0.0008 | 0.0012 | 0.0010 | 0.0013 | 0.0014 | 0.0016 | 0.0017 | 0.0029 |
| 33 | 0.2594 | 0.5331 | 2740 | 0.0008 | 0.0014 | 0.0017 | 0.0017 | 0.0019 | 0.0027 | 0.0028 | 0.0028 | 0.0035 |
| 34 | 0.2611 | 0.5341 | 2701 | 0.0004 | 0.0007 | 0.0009 | 0.0012 | 0.0012 | 0.0016 | 0.0021 | 0.0022 | 0.0030 |
| 35 | 0.2594 | 0.5312 | 2748 | 0.0006 | 0.0008 | 0.0009 | 0.0011 | 0.0013 | 0.0014 | 0.0018 | 0.0021 | 0.0025 |
| 36 | 0.2608 | 0.5333 | 2711 | 0.0009 | 0.0011 | 0.0013 | 0.0014 | 0.0015 | 0.0018 | 0.0021 | 0.0026 | 0.0030 |
| 37 | 0.2604 | 0.5322 | 2724 | 0.0010 | 0.0013 | 0.0015 | 0.0018 | 0.0020 | 0.0021 | 0.0025 | 0.0028 | 0.0033 |
| 38 | 0.2600 | 0.5312 | 2737 | 0.0008 | 0.0011 | 0.0013 | 0.0016 | 0.0018 | 0.0035 | 0.0037 | 0.0036 | 0.0031 |
| 39 | 0.2597 | 0.5319 | 2740 | 0.0008 | 0.0009 | 0.0011 | 0.0015 | 0.0017 | 0.0028 | 0.0030 | 0.0036 | 0.0032 |
| 40 | 0.2597 | 0.5308 | 2743 | 0.0007 | 0.0011 | 0.0012 | 0.0014 | 0.0016 | 0.0027 | 0.0028 | 0.0031 | 0.0032 |
| 41 | 0.2592 | 0.5328 | 2746 | 0.0007 | 0.0011 | 0.0014 | 0.0016 | 0.0018 | 0.0025 | 0.0030 | 0.0036 | 0.0035 |
| 42 | 0.2608 | 0.5329 | 2713 | 0.0009 | 0.0013 | 0.0016 | 0.0017 | 0.0019 | 0.0024 | 0.0030 | 0.0034 | 0.0034 |
| 43 | 0.2592 | 0.5324 | 2748 | 0.0007 | 0.0009 | 0.0013 | 0.0014 | 0.0016 | 0.0021 | 0.0025 | 0.0030 | 0.0034 |
| 44 | 0.2595 | 0.5325 | 2740 | 0.0010 | 0.0016 | 0.0018 | 0.0021 | 0.0022 | 0.0025 | 0.0029 | 0.0033 | 0.0037 |
| 45 | 0.2603 | 0.5312 | 2729 | 0.0006 | 0.0011 | 0.0015 | 0.0015 | 0.0017 | 0.0021 | 0.0023 | 0.0027 | 0.0030 |
| 46 | 0.2604 | 0.5331 | 2721 | 0.0007 | 0.0014 | 0.0018 | 0.0018 | 0.0021 | 0.0025 | 0.0027 | 0.0030 | 0.0032 |
| 47 | 0.2593 | 0.5331 | 2743 | 0.0005 | 0.0011 | 0.0016 | 0.0016 | 0.0018 | 0.0021 | 0.0023 | 0.0027 | 0.0031 |
| 48 | 0.2584 | 0.5322 | 2765 | 0.0009 | 0.0012 | 0.0016 | 0.0018 | 0.0019 | 0.0023 | 0.0025 | 0.0030 | 0.0034 |
| 49 | 0.2597 | 0.5322 | 2737 | 0.0008 | 0.0009 | 0.0013 | 0.0015 | 0.0016 | 0.0019 | 0.0023 | 0.0024 | 0.0029 |
| 50 | 0.2601 | 0.5331 | 2727 | 0.0008 | 0.0009 | 0.0014 | 0.0016 | 0.0017 | 0.0020 | 0.0021 | 0.0020 | 0.0027 |
| 51 | 0.2608 | 0.5326 | 2713 | 0.0011 | 0.0013 | 0.0017 | 0.0018 | 0.0020 | 0.0023 | 0.0024 | 0.0028 | 0.0032 |
| 52 | 0.2602 | 0.5337 | 2722 | 0.0008 | 0.0009 | 0.0025 | 0.0021 | 0.0019 | 0.0022 | 0.0024 | 0.0027 | 0.0030 |
| 53 | 0.2594 | 0.5332 | 2740 | 0.0009 | 0.0011 | 0.0016 | 0.0022 | 0.0019 | 0.0021 | 0.0023 | 0.0025 | 0.0029 |
| 54 | 0.2583 | 0.5321 | 2768 | 0.0009 | 0.0010 | 0.0015 | 0.0021 | 0.0021 | 0.0021 | 0.0023 | 0.0027 | 0.0032 |
| 55 | 0.2595 | 0.5328 | 2741 | 0.0009 | 0.0011 | 0.0016 | 0.0023 | 0.0021 | 0.0022 | 0.0025 | 0.0028 | 0.0031 |
| 56 | 0.2605 | 0.5325 | 2721 | 0.0011 | 0.0014 | 0.0017 | 0.0023 | 0.0023 | 0.0023 | 0.0023 | 0.0026 | 0.0030 |
| 57 | 0.2604 | 0.5325 | 2724 | 0.0010 | 0.0013 | 0.0019 | 0.0025 | 0.0025 | 0.0024 | 0.0027 | 0.0030 | 0.0033 |
| 58 | 0.2598 | 0.5313 | 2739 | 0.0007 | 0.0009 | 0.0013 | 0.0019 | 0.0022 | 0.0019 | 0.0022 | 0.0024 | 0.0026 |
| 59 | 0.2601 | 0.5318 | 2732 | 0.0008 | 0.0011 | 0.0014 | 0.0021 | 0.0024 | 0.0025 | 0.0024 | 0.0026 | 0.0030 |
| 60 | 0.2602 | 0.5325 | 2726 | 0.0006 | 0.0008 | 0.0012 | 0.0018 | 0.0022 | 0.0019 | 0.0025 | 0.0029 | 0.0031 |
| Ave. | 0.2599 | 0.5324 | 2733 | 0.0008 | 0.0011 | 0.0015 | 0.0017 | 0.0019 | 0.0022 | 0.0025 | 0.0027 | 0.0031 |
| Med. | 0.2601 | 0.5325 | 2735 | 0.0008 | 0.0011 | 0.0015 | 0.0017 | 0.0019 | 0.0022 | 0.0024 | 0.0027 | 0.0031 |
| st dev | 0.0007 | 0.0008 | 14.8555 | 0.0002 | 0.0002 | 0.0003 | 0.0004 | 0.0003 | 0.0004 | 0.0004 | 0.0005 | 0.0003 |
| Min. | 0.2583 | 0.5308 | 2701 | 0.0004 | 0.0007 | 0.0009 | 0.0010 | 0.0012 | 0.0014 | 0.0015 | 0.0016 | 0.0025 |
| Max. | 0.2611 | 0.5341 | 2768 | 0.0006 | 0.0009 | 0.0010 | 0.0011 | 0.0014 | 0.0014 | 0.0037 | 0.0036 | 0.0037 |

## 3.5 Data Set 3, 105 ℃, 100mA (Lumen Maintenance)

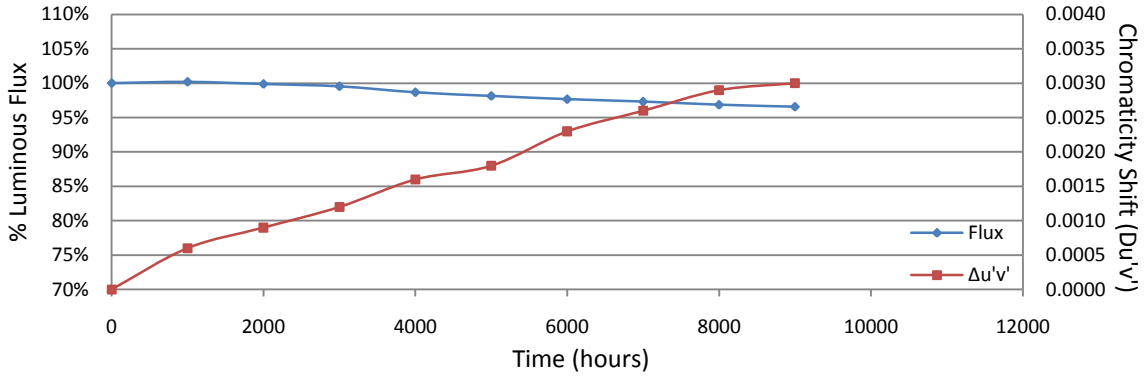
| No. | $V_F$(V) | Φ(lm) | Lumen Maintenance (%) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0hr(Initial) | | 1000hrs | 2000hrs | 3000hrs | 4000hrs | 5000hrs | 6000hrs | 7000hrs | 8000hrs | 9000hrs |
| 61 | 9.118 | 102.5 | 100.29 | 99.80 | 99.22 | 98.05 | 97.09 | 96.39 | 95.98 | 95.30 | 94.85 |
| 62 | 9.092 | 107.3 | 99.72 | 99.25 | 98.79 | 97.76 | 96.64 | 95.81 | 95.43 | 95.25 | 94.78 |
| 63 | 9.118 | 102.6 | 99.42 | 98.93 | 98.44 | 97.40 | 96.31 | 95.39 | 94.51 | 94.17 | 93.69 |
| 64 | 9.088 | 104.2 | 99.62 | 99.04 | 98.37 | 97.02 | 96.64 | 96.55 | 95.74 | 95.02 | 94.37 |
| 65 | 9.105 | 104.6 | 100.00 | 99.52 | 98.85 | 97.23 | 96.08 | 95.70 | 94.85 | 94.33 | 93.86 |
| 66 | 9.114 | 102.5 | 99.51 | 99.12 | 98.54 | 97.31 | 96.38 | 95.93 | 95.28 | 94.57 | 93.96 |
| 67 | 9.096 | 100.0 | 99.42 | 98.93 | 98.65 | 97.50 | 96.56 | 95.69 | 94.89 | 94.26 | 93.58 |
| 68 | 9.126 | 100.9 | 99.90 | 99.41 | 98.98 | 98.10 | 96.96 | 96.10 | 95.62 | 95.21 | 94.72 |
| 69 | 9.055 | 105.7 | 99.62 | 99.05 | 98.58 | 97.35 | 96.22 | 95.36 | 94.99 | 94.33 | 93.67 |
| 70 | 9.105 | 104.6 | 99.90 | 99.43 | 99.04 | 97.80 | 96.85 | 95.98 | 95.53 | 94.85 | 94.47 |
| 71 | 9.058 | 103.6 | 99.42 | 98.84 | 98.46 | 96.91 | 96.34 | 96.08 | 95.11 | 94.65 | 94.32 |
| 72 | 9.085 | 107.9 | 100.09 | 99.63 | 99.17 | 98.42 | 97.22 | 96.48 | 96.01 | 95.64 | 95.00 |
| 73 | 9.108 | 102.9 | 99.81 | 99.32 | 98.74 | 98.15 | 96.91 | 96.21 | 95.86 | 95.50 | 95.18 |
| 74 | 9.122 | 102.4 | 100.00 | 99.41 | 99.02 | 98.34 | 97.45 | 96.53 | 96.04 | 95.46 | 94.88 |
| 75 | 9.121 | 98.9 | 99.74 | 99.25 | 99.81 | 98.58 | 97.87 | 97.27 | 96.85 | 96.17 | 95.61 |
| 76 | 9.132 | 104.3 | 99.90 | 99.33 | 98.85 | 97.51 | 96.16 | 95.79 | 95.30 | 94.67 | 94.22 |
| 77 | 9.119 | 101.0 | 99.70 | 99.11 | 98.87 | 97.50 | 96.88 | 95.99 | 95.14 | 94.95 | 94.48 |
| 78 | 9.116 | 102.3 | 99.41 | 99.02 | 98.53 | 96.91 | 95.92 | 95.27 | 94.34 | 94.30 | 93.90 |
| 79 | 9.115 | 103.2 | 100.10 | 99.71 | 99.22 | 97.67 | 96.54 | 94.93 | 94.33 | 93.90 | 93.33 |
| 80 | 9.117 | 102.6 | 99.81 | 99.32 | 98.64 | 97.35 | 96.53 | 96.12 | 95.68 | 95.19 | 94.78 |
| 81 | 9.117 | 103.5 | 99.81 | 99.32 | 98.74 | 96.91 | 96.29 | 95.61 | 95.39 | 94.62 | 94.05 |
| 82 | 9.123 | 103.9 | 99.62 | 99.23 | 98.94 | 97.40 | 96.63 | 95.40 | 94.83 | 94.28 | 93.72 |
| 83 | 9.118 | 104.6 | 99.81 | 99.33 | 98.76 | 97.23 | 96.65 | 95.25 | 94.36 | 93.97 | 93.43 |
| 84 | 9.135 | 99.9 | 99.85 | 99.33 | 98.72 | 97.20 | 96.68 | 95.58 | 94.96 | 94.17 | 93.61 |
| 85 | 9.113 | 102.4 | 99.61 | 99.22 | 98.44 | 97.04 | 96.23 | 95.83 | 95.13 | 94.59 | 93.99 |
| 86 | 9.124 | 100.5 | 99.80 | 99.27 | 98.33 | 97.27 | 96.46 | 95.54 | 95.00 | 94.54 | 93.84 |
| 87 | 9.120 | 102.6 | 99.81 | 99.32 | 98.73 | 97.24 | 96.37 | 95.46 | 94.93 | 94.39 | 93.91 |
| 88 | 9.122 | 101.0 | 99.70 | 99.31 | 98.64 | 97.50 | 96.37 | 95.89 | 95.32 | 94.86 | 94.29 |
| 89 | 9.121 | 102.1 | 100.00 | 99.41 | 98.63 | 97.04 | 95.81 | 94.84 | 94.28 | 93.64 | 93.37 |
| 90 | 9.119 | 102.6 | 99.71 | 99.22 | 98.44 | 96.86 | 96.19 | 94.78 | 94.37 | 94.04 | 93.76 |
| Ave. | 9.111 | 102.9 | 99.77 | 99.28 | 98.77 | 97.49 | 96.57 | 95.79 | 95.20 | 94.69 | 94.19 |
| Med. | 9.118 | 102.6 | 99.80 | 99.31 | 98.73 | 97.37 | 96.54 | 95.80 | 95.13 | 94.60 | 94.02 |
| st dev | 0.019 | 2.03 | 0.2186 | 0.2202 | 0.3153 | 0.4757 | 0.4450 | 0.5482 | 0.6115 | 0.5840 | 0.5834 |
| Min. | 9.055 | 98.9 | 99.41 | 98.84 | 98.33 | 96.86 | 95.81 | 94.78 | 94.28 | 93.64 | 93.33 |
| Max. | 9.135 | 107.9 | 100.29 | 99.80 | 99.81 | 98.58 | 97.87 | 97.27 | 96.85 | 96.17 | 95.61 |

## 3.6 Data Set 3, 105 ℃, 100mA (Chromaticity Shift)

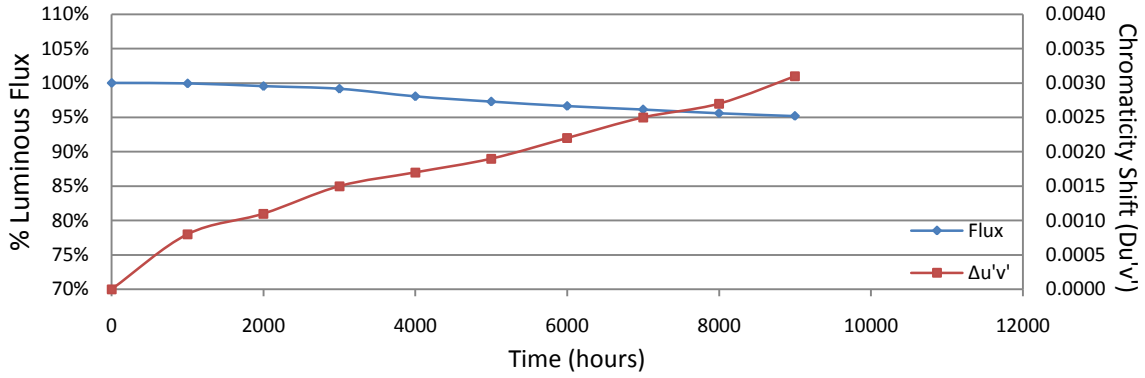
| No. | u' | v' | CCT(K) | Chromaticity Shift (Δu'v') | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0hr(Initial) | | | 1000hrs | 2000hrs | 3000hrs | 4000hrs | 5000hrs | 6000hrs | 7000hrs | 8000hrs | 9000hrs |
| 61 | 0.2601 | 0.5330 | 2727 | 0.0010 | 0.0013 | 0.0016 | 0.0022 | 0.0025 | 0.0026 | 0.0029 | 0.0030 | 0.0033 |
| 62 | 0.2591 | 0.5315 | 2754 | 0.0008 | 0.0012 | 0.0015 | 0.0021 | 0.0024 | 0.0025 | 0.0027 | 0.0029 | 0.0030 |
| 63 | 0.2590 | 0.5314 | 2756 | 0.0008 | 0.0011 | 0.0013 | 0.0020 | 0.0024 | 0.0026 | 0.0029 | 0.0032 | 0.0035 |
| 64 | 0.2611 | 0.5333 | 2704 | 0.0008 | 0.0015 | 0.0017 | 0.0023 | 0.0026 | 0.0028 | 0.0030 | 0.0030 | 0.0033 |
| 65 | 0.2597 | 0.5323 | 2739 | 0.0008 | 0.0011 | 0.0015 | 0.0021 | 0.0023 | 0.0025 | 0.0028 | 0.0029 | 0.0031 |
| 66 | 0.2598 | 0.5317 | 2737 | 0.0007 | 0.0010 | 0.0013 | 0.0021 | 0.0023 | 0.0025 | 0.0026 | 0.0027 | 0.0028 |
| 67 | 0.2603 | 0.5323 | 2725 | 0.0008 | 0.0012 | 0.0017 | 0.0021 | 0.0025 | 0.0028 | 0.0030 | 0.0031 | 0.0032 |
| 68 | 0.2606 | 0.5325 | 2718 | 0.0008 | 0.0013 | 0.0016 | 0.0021 | 0.0025 | 0.0027 | 0.0030 | 0.0032 | 0.0036 |
| 69 | 0.2581 | 0.5324 | 2770 | 0.0008 | 0.0010 | 0.0014 | 0.0019 | 0.0022 | 0.0025 | 0.0027 | 0.0028 | 0.0029 |
| 70 | 0.2597 | 0.5329 | 2735 | 0.0010 | 0.0013 | 0.0016 | 0.0021 | 0.0025 | 0.0028 | 0.0030 | 0.0029 | 0.0033 |
| 71 | 0.2598 | 0.5328 | 2733 | 0.0010 | 0.0013 | 0.0017 | 0.0025 | 0.0025 | 0.0030 | 0.0031 | 0.0031 | 0.0032 |
| 72 | 0.2591 | 0.5331 | 2748 | 0.0009 | 0.0013 | 0.0016 | 0.0023 | 0.0024 | 0.0028 | 0.0030 | 0.0031 | 0.0031 |
| 73 | 0.2596 | 0.5319 | 2742 | 0.0008 | 0.0011 | 0.0013 | 0.0021 | 0.0022 | 0.0026 | 0.0028 | 0.0030 | 0.0031 |
| 74 | 0.2596 | 0.5334 | 2735 | 0.0009 | 0.0011 | 0.0016 | 0.0023 | 0.0024 | 0.0028 | 0.0029 | 0.0034 | 0.0035 |
| 75 | 0.2596 | 0.5319 | 2741 | 0.0007 | 0.0010 | 0.0013 | 0.0020 | 0.0023 | 0.0026 | 0.0026 | 0.0029 | 0.0029 |
| 76 | 0.2594 | 0.5314 | 2748 | 0.0010 | 0.0012 | 0.0014 | 0.0021 | 0.0023 | 0.0028 | 0.0029 | 0.0029 | 0.0029 |
| 77 | 0.2602 | 0.5324 | 2727 | 0.0008 | 0.0012 | 0.0016 | 0.0022 | 0.0025 | 0.0030 | 0.0035 | 0.0037 | 0.0035 |
| 78 | 0.2594 | 0.5308 | 2750 | 0.0008 | 0.0011 | 0.0014 | 0.0020 | 0.0023 | 0.0028 | 0.0031 | 0.0035 | 0.0033 |
| 79 | 0.2599 | 0.5317 | 2737 | 0.0010 | 0.0014 | 0.0016 | 0.0021 | 0.0025 | 0.0030 | 0.0031 | 0.0037 | 0.0033 |
| 80 | 0.2599 | 0.5318 | 2736 | 0.0008 | 0.0012 | 0.0013 | 0.0020 | 0.0023 | 0.0027 | 0.0028 | 0.0033 | 0.0033 |
| 81 | 0.2597 | 0.5318 | 2740 | 0.0009 | 0.0015 | 0.0018 | 0.0010 | 0.0017 | 0.0025 | 0.0029 | 0.0031 | 0.0035 |
| 82 | 0.2594 | 0.5325 | 2744 | 0.0010 | 0.0009 | 0.0016 | 0.0019 | 0.0015 | 0.0021 | 0.0025 | 0.0033 | 0.0035 |
| 83 | 0.2604 | 0.5326 | 2722 | 0.0008 | 0.0016 | 0.0018 | 0.0019 | 0.0019 | 0.0021 | 0.0024 | 0.0034 | 0.0035 |
| 84 | 0.2605 | 0.5332 | 2718 | 0.0008 | 0.0016 | 0.0022 | 0.0025 | 0.0025 | 0.0026 | 0.0030 | 0.0035 | 0.0038 |
| 85 | 0.2598 | 0.5323 | 2735 | 0.0008 | 0.0014 | 0.0016 | 0.0019 | 0.0019 | 0.0021 | 0.0024 | 0.0033 | 0.0033 |
| 86 | 0.2594 | 0.5320 | 2746 | 0.0009 | 0.0013 | 0.0017 | 0.0021 | 0.0021 | 0.0023 | 0.0024 | 0.0030 | 0.0033 |
| 87 | 0.2600 | 0.5328 | 2729 | 0.0009 | 0.0015 | 0.0020 | 0.0022 | 0.0024 | 0.0026 | 0.0027 | 0.0033 | 0.0036 |
| 88 | 0.2608 | 0.5324 | 2714 | 0.0008 | 0.0016 | 0.0022 | 0.0023 | 0.0026 | 0.0027 | 0.0030 | 0.0036 | 0.0038 |
| 89 | 0.2603 | 0.5339 | 2719 | 0.0011 | 0.0013 | 0.0018 | 0.0021 | 0.0024 | 0.0025 | 0.0027 | 0.0028 | 0.0033 |
| 90 | 0.2601 | 0.5319 | 2732 | 0.0008 | 0.0012 | 0.0016 | 0.0021 | 0.0026 | 0.0027 | 0.0030 | 0.0031 | 0.0033 |
| Ave. | 0.2598 | 0.5323 | 2735 | 0.0009 | 0.0013 | 0.0016 | 0.0021 | 0.0023 | 0.0026 | 0.0028 | 0.0032 | 0.0033 |
| Med. | 0.2598 | 0.5324 | 2736 | 0.0008 | 0.0012 | 0.0016 | 0.0021 | 0.0024 | 0.0026 | 0.0029 | 0.0031 | 0.0033 |
| st dev | 0.0006 | 0.0007 | 13.9023 | 0.0001 | 0.0002 | 0.0002 | 0.0003 | 0.0003 | 0.0002 | 0.0002 | 0.0003 | 0.0003 |
| Min. | 0.2581 | 0.5308 | 2704 | 0.0007 | 0.0009 | 0.0013 | 0.0010 | 0.0015 | 0.0021 | 0.0024 | 0.0027 | 0.0028 |
| Max. | 0.2611 | 0.5339 | 2770 | 0.0011 | 0.0016 | 0.0022 | 0.0025 | 0.0026 | 0.0030 | 0.0035 | 0.0037 | 0.0038 |

## Lumen Maintenance and Chromaticity Shift VS Time

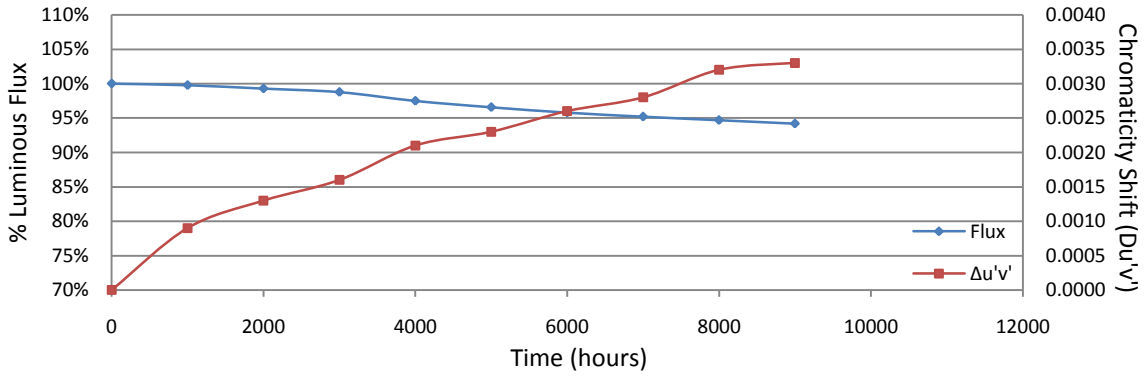
### Data Set 1:




### Data Set 2:

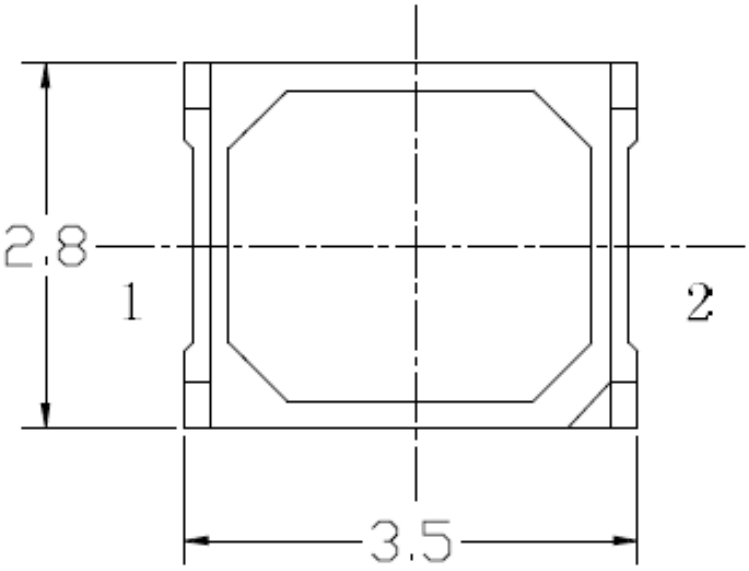



### Data Set 3:



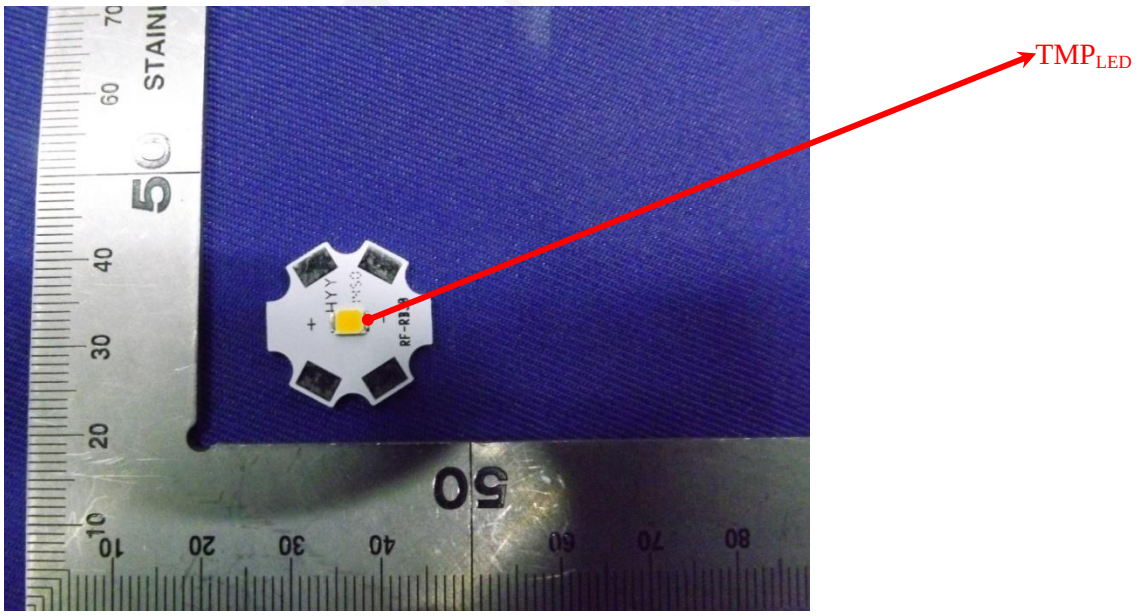
# Attachment A – EUT Photo

## A.1 Mechanical Dimensions (Ta = 25 ℃)




All dimensions are in millimeter

## A.2 EUT Photo




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

# Appendix A:
# Lumen Maintenance Projection (IES TM-21-11)

For Information Only!

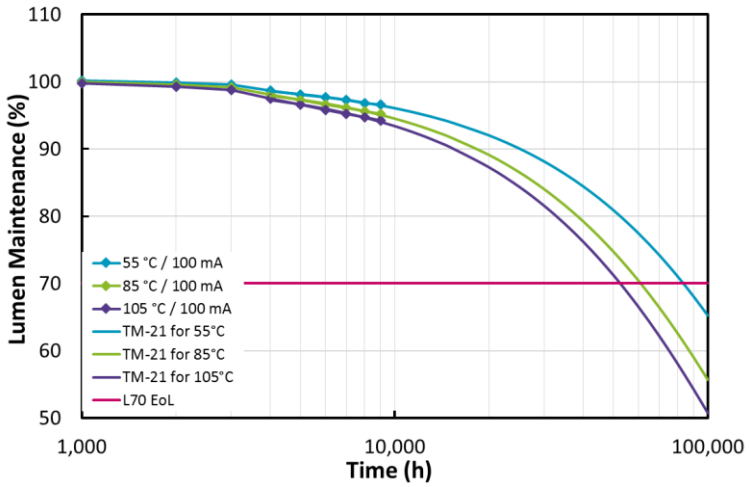
## 1. General Information

| | |
|---|---|
| Description of LED light source tested | RF-27HP32DS-BF-I3-Y |
| Sample size per temperature | 30 |
| LED drive current used in the test | 100 mA |
| Test duration | 9,000 hours |
| Test duration used for projection | 4,000 hours to 9,000 hours |

## 2. Projection Data

| | I | II | III |
|---|---|---|---|
| Case temperature (solder point) | $T_S$ = 55 °C | $T_S$ = 85 °C | $T_S$ = 105 °C |
| α | 4.300E-06 | 5.863E-06 | 6.779E-06 |
| B | 1.003E+00 | 1.002E+00 | 1.000E+00 |
| Reported L70 | >54,000 hours | >54,000 hours | 53,000 hours |

## 3. Graphic chart



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# Appendix B:
# Additional Models Covered By Testing

The 9 September 2011 ENERGY STAR® *Program Guidance Regarding LED Package, LED Array and LED Module Lumen Maintenance Performance Data Supporting Qualification of Lighting Products* defines conditons for which a LM-80 report may be applied to cover models that have not been directly tested.

The following list of models may be covered by the test results in this report:

- DURIS® E 2835 GW JTLRS1.EM with CCT 2700 K – 6500 K

# Disclaimer

Please carefully read the below terms and conditions before using the Information.
If you do not agree with any of these terms and conditions, do not use the Information.

The Information contained in this document does not constitute an independent warranty. The committed behavior is described in the Product data sheet.

Further explanations:
Data: The Data used in this Document consider the reliability test results under the mentioned driving conditions only. For Product information on the maximum operating conditions please refer to the Product data sheet or contact your local sales partner.
Conditions: The conditions for the generation of the data are as follows:
1. The Data and curves shown in this Document are based on experiments carried out under laboratory conditions on a random sample size of LED with readouts at discrete readout times (where applicable). Thus, the Data above represent a limited number of production lots only and may differ between different assembly lots over time (including chip or package changes). Thus, the behavior of the LED in the final application may differ from the Data. The behavior of the LED at conditions or readout times deviating from those stated above may not be deduced from the Data.
2. For long term operation additional failure modes of the chip or package can occur which are not shown in this Document.
3. Possible differences in the thermal management of OSRAM OS and customer's setup may lead to a different aging behavior.
4. The lifetime projection data presented in this Document has been evaluated in accordance with the lifetime extrapolation method described and defined in IES TM-21-11. The lifetime projection is based on the Data shown in this Document. The Data had been collected and assembled according to IES LM-80-08.

END OF DOCUMENT

OSRAM Opto Semiconductors
GmbH

Head Office:

Leibnizstrasse 4
93055 Regensburg, Germany
Phone +49 941 850-5
Fax +49 941 850-1002
www.osram-os.com

OSRAM
Opto Semiconductors