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Opto Semiconductors

# DURIS<sup>®</sup> S 5 White (CCT 2700 K – 6500 K)

IES LM-80-08 Test Report

Test Documentation No.: 150109W7 – 5<sup>th</sup> November 2015



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## Document Information

### Testing Laboratory

OSRAM Opto Semiconductors (Malaysia) Sdn. Bhd.  
Reliability Engineering Test & Analysis Laboratory  
Bayan Lepas Free Industrial Zone, 11900 Penang

Accreditation by DAkkS – No.: D-PL-19681-01-00



<http://www.osram-os.com/media/resource/HIRES/511891/1382448/d-pl-19681-01-00-zertifikat.pdf>

### Customer Information

OSRAM Opto Semiconductors (Malaysia) Sdn. Bhd.  
Business Segment SSL  
Bayan Lepas Free Industrial Zone, 11900 Penang

### Document Data

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### Conclusion

All tests have been performed according to the specified requirements described in IES LM-80-08.  
The results relate only to the listed amount of tested samples.

### Confirmation

Test report prepared by

Chen Kiat Pang  
Technical Coordinator LM-80

Test report approved by

Joanne Ooi  
Technical Coordinator LM-80

# 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.

# Test Report

## 1. Number of LED light sources tested

75 randomly selected samples from mass production.

## 2. Description of LED light sources

Devices tested

- DURIS S 5 GW PSLRS1.EC with CCT 3000 K

## 3. Description of auxiliary equipment

Devices are soldered to metal-core PCB and mounted in a thermal chamber on hot-plates to maintain the desired solder-point temperature. Reliability test boards are removed from the thermal chamber to cool down to room temperature for electrical and optical characterization. Soldering equipment: Heller 1812 MKIII,

Stress equipment: Customized thermal chambers,

Electrical characterization: Keithley 2425-C controlled by customized software,

Measurement equipment: integrating sphere/spectroradiometer: Instrument systems CAS140CT

## 4. Operating cycle

The devices are tested at constant solder-point temperature and constant direct current.

## 5. Ambient conditions including airflow, temperature and relative humidity

Boards with devices under test are operated on controlled thermal plates in an oven with controlled environmental conditions according to section 4.4 of LM-80-08. Case temperature is controlled within -2 °C; ambient temperature in the oven is controlled within -5 °C of case temperature; humidity is below 65 % r.H. and airflow is minimized (not forced) in the oven. The ambient temperature during lumen and chromaticity measurements is set to  $25 \pm 2$  °C.

## 6. Case temperature (test point temperature)

The devices under test are operated at three constant case temperatures of 55 °C, 85 °C and 105 °C. The test point temperature at device is marked in the isometric view graph on page 7.

## 7. Drive current of the LED light source during lifetime test

The devices under test are operated at constant forward current. The operating current is listed in the test data tables.

## 8. Initial luminous flux and forward voltage at photometric measurement current

Please refer to the test data tables on pages 9 – 11.

## 9. Lumen maintenance data for each individual LED light source

Please refer to the test data tables on pages 9 - 11.

## 10. Observation of LED light source failures including the failure conditions and time of failure

None.

## 11. LED light source monitoring interval

Devices were electrically and optically characterized at room temperature at 0 h, 504 h, 1000 h, 2000 h, 3000 h, 4000 h, 5000 h, 6000 h, 7000 h, 8000 h.

## 12. Photometric measurement uncertainty

Measurement uncertainty for luminous flux (GUM): 4.6%

## 13. Chromaticity shift reported over the measurement time

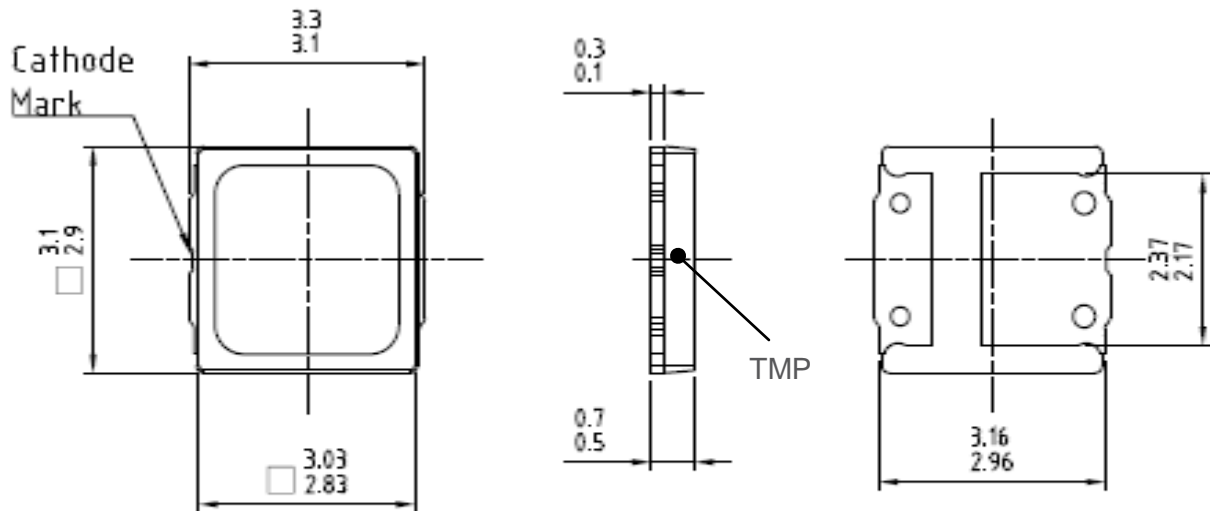
Please refer to the test data tables on pages 9 - 11.

## Summary of Testing Conditions

|                                 | I                     | II                    | III                   |
|---------------------------------|-----------------------|-----------------------|-----------------------|
| Case temperature (solder point) | $T_S = 55\text{ °C}$  | $T_S = 85\text{ °C}$  | $T_S = 105\text{ °C}$ |
| Device drive current            | $I_F = 200\text{ mA}$ | $I_F = 200\text{ mA}$ | $I_F = 200\text{ mA}$ |
| Number of samples               | 25                    | 25                    | 25                    |
| Test start                      | 15.08.2014            | 15.08.2014            | 15.08.2014            |
| Test duration                   | 8,000 hours           | 7,000 hours           | 8,000 hours           |
| Nr. of failures                 | 0                     | 0                     | 0                     |

## Isometric View Graphs and Temperature Measurement Point (TMP)

Device: DURIS S 5 (GW PSLRS1.xC)

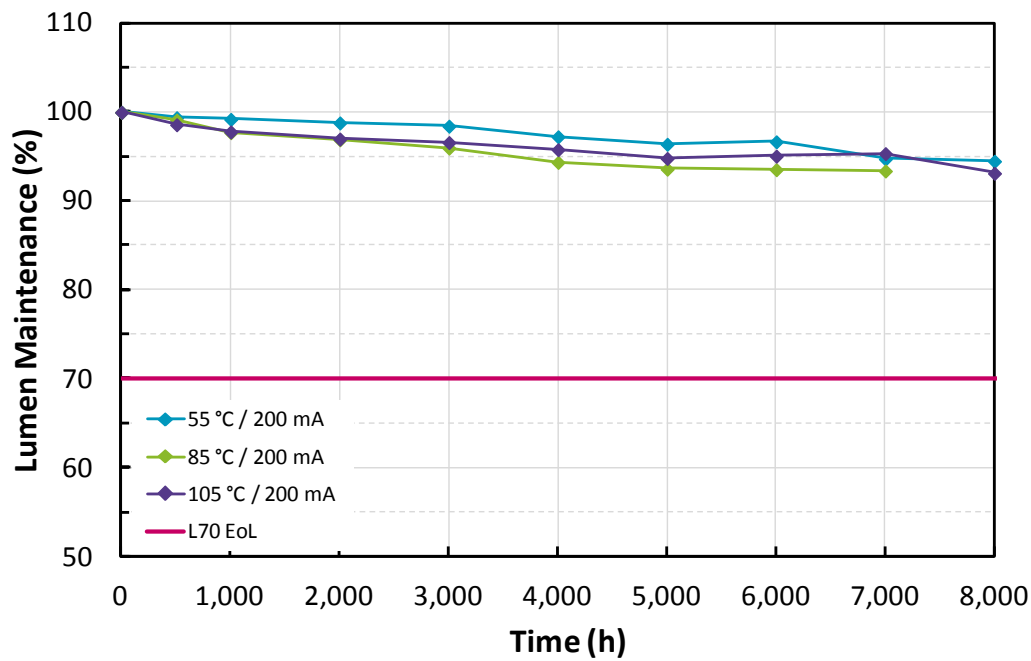


C67062-A0130-A1...01

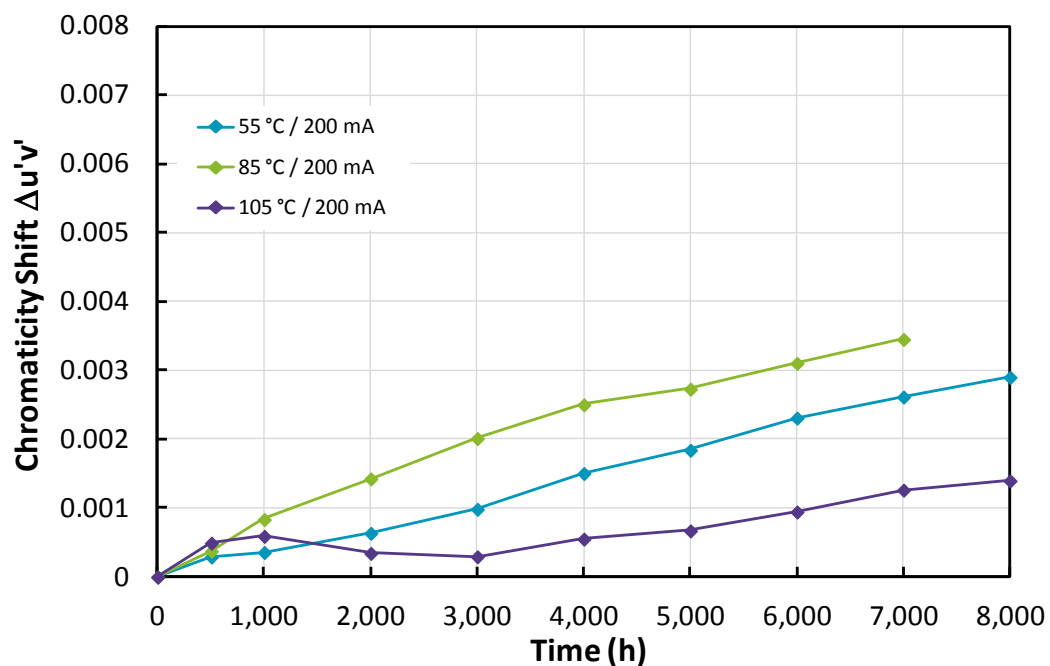
# Test Results

## 1. Graphic charts

Lumen maintenance ( $I_F = 200 \text{ mA}$ ) – Normalized to 0 h



Chromaticity shift  $\Delta u'v'$  ( $I_F = 200 \text{ mA}$ ) – Normalized to 0 h





## 2. Tables

Test condition I:  $T_S = 55\text{ °C}$ ,  $I_F = 200\text{ mA}$

Lumen maintenance ( $I_F = 200\text{ mA}$ ) – Normalized to 0 h

|           |      | U <sub>F</sub> [V] Φ <sub>V</sub> [lm] |        | Measurement Time of Lumen Maintenance |       |        |        |        |        |        |        |        |        |
|-----------|------|--|--------|---------------------------------------|-------|--------|--------|--------|--------|--------|--------|--------|--------|
|           |      | 0 h                                    | 0 h    | 0 h                                   | 504 h | 1000 h | 2000 h | 3000 h | 4000 h | 5000 h | 6000 h | 7000 h | 8000 h |
| 1         | 6.31 | 139.00                                 | 100.00 | 99.38                                 | 99.48 | 99.40  | 99.18  | 98.48  | 97.56  | 97.69  | 95.61  | 95.09  |        |
| 2         | 6.30 | 139.40                                 | 100.00 | 99.39                                 | 99.34 | 99.25  | 99.12  | 97.91  | 97.21  | 97.48  | 95.62  | 95.25  |        |
| 3         | 6.31 | 131.50                                 | 100.00 | 99.36                                 | 99.22 | 98.84  | 98.72  | 97.85  | 97.25  | 97.49  | 95.76  | 95.72  |        |
| 4         | 6.24 | 132.40                                 | 100.00 | 99.36                                 | 99.38 | 99.14  | 98.88  | 98.17  | 97.57  | 97.96  | 96.16  | 96.05  |        |
| 5         | 6.30 | 131.00                                 | 100.00 | 99.28                                 | 99.07 | 98.77  | 98.25  | 97.46  | 96.55  | 96.95  | 95.06  | 94.87  |        |
| 6         | 6.31 | 138.10                                 | 100.00 | 99.53                                 | 99.48 | 99.26  | 98.59  | 97.89  | 96.96  | 97.17  | 95.01  | 94.41  |        |
| 7         | 6.30 | 137.60                                 | 100.00 | 99.60                                 | 99.26 | 98.69  | 98.14  | 96.86  | 95.93  | 96.22  | 94.27  | 93.81  |        |
| 8         | 6.24 | 136.30                                 | 100.00 | 99.08                                 | 98.81 | 98.33  | 97.97  | 96.68  | 95.30  | 95.52  | 93.63  | 93.45  |        |
| 9         | 6.32 | 126.10                                 | 100.00 | 99.49                                 | 99.59 | 99.56  | 99.43  | 98.30  | 97.68  | 98.02  | 96.06  | 96.17  |        |
| 10        | 6.27 | 128.30                                 | 100.00 | 99.19                                 | 98.66 | 98.00  | 97.57  | 96.38  | 95.46  | 95.40  | 93.48  | 93.27  |        |
| 11        | 6.27 | 134.00                                 | 100.00 | 99.44                                 | 99.09 | 98.54  | 98.00  | 96.70  | 95.51  | 95.67  | 93.60  | 93.04  |        |
| 12        | 6.29 | 135.30                                 | 100.00 | 99.30                                 | 98.95 | 98.40  | 97.95  | 96.80  | 96.08  | 96.52  | 94.76  | 94.44  |        |
| 13        | 6.28 | 131.20                                 | 100.00 | 99.43                                 | 99.14 | 98.47  | 97.87  | 96.24  | 95.18  | 95.28  | 93.32  | 92.89  |        |
| 14        | 6.29 | 133.90                                 | 100.00 | 99.51                                 | 99.31 | 98.84  | 98.30  | 97.14  | 96.26  | 96.56  | 94.49  | 94.23  |        |
| 15        | 6.25 | 127.30                                 | 100.00 | 99.26                                 | 98.88 | 98.23  | 97.71  | 96.43  | 95.57  | 96.00  | 94.14  | 94.01  |        |
| 16        | 6.24 | 127.50                                 | 100.00 | 99.26                                 | 98.96 | 98.46  | 98.11  | 96.91  | 95.90  | 96.55  | 94.93  | 94.96  |        |
| 17        | 6.28 | 125.10                                 | 100.00 | 99.49                                 | 99.42 | 98.70  | 98.30  | 96.84  | 96.05  | 96.33  | 94.36  | 94.38  |        |
| 18        | 6.33 | 130.20                                 | 100.00 | 99.35                                 | 99.21 | 99.00  | 98.78  | 97.59  | 96.99  | 97.00  | 95.26  | 95.06  |        |
| 19        | 6.24 | 130.30                                 | 100.00 | 99.58                                 | 99.75 | 99.68  | 99.47  | 98.44  | 97.84  | 98.00  | 96.10  | 95.84  |        |
| 20        | 6.25 | 128.50                                 | 100.00 | 99.42                                 | 98.66 | 98.62  | 98.13  | 96.85  | 96.24  | 96.58  | 94.81  | 94.69  |        |
| 21        | 6.29 | 135.00                                 | 100.00 | 99.52                                 | 99.76 | 99.93  | 99.89  | 98.80  | 98.15  | 98.37  | 96.30  | 95.83  |        |
| 22        | 6.24 | 128.00                                 | 100.00 | 99.26                                 | 98.97 | 98.39  | 98.04  | 96.53  | 95.68  | 96.02  | 94.25  | 94.04  |        |
| 23        | 6.34 | 127.40                                 | 100.00 | 99.34                                 | 99.12 | 98.31  | 97.55  | 95.80  | 94.71  | 94.90  | 92.73  | 92.44  |        |
| 24        | 6.25 | 135.40                                 | 100.00 | 99.52                                 | 99.24 | 98.47  | 97.96  | 96.44  | 95.64  | 96.01  | 93.88  | 93.48  |        |
| 25        | 6.30 | 128.60                                 | 100.00 | 99.50                                 | 99.44 | 98.92  | 99.07  | 97.71  | 96.87  | 97.36  | 95.05  | 95.00  |        |
| median    | 6.29 | 131.20                                 | 100.00 | 99.39                                 | 99.22 | 98.70  | 98.25  | 96.91  | 96.24  | 96.56  | 94.81  | 94.44  |        |
| average   | 6.28 | 131.90                                 | 100.00 | 99.39                                 | 99.21 | 98.81  | 98.44  | 97.25  | 96.41  | 96.68  | 94.75  | 94.50  |        |
| std. dev. | 0.03 | 4.27                                   | 0.00   | 0.13                                  | 0.30  | 0.49   | 0.64   | 0.82   | 0.95   | 0.96   | 0.98   | 1.04   |        |
| min.      | 6.24 | 125.10                                 | 100.00 | 99.08                                 | 98.66 | 98.00  | 97.55  | 95.80  | 94.71  | 94.90  | 92.73  | 92.44  |        |
| max.      | 6.34 | 139.40                                 | 100.00 | 99.60                                 | 99.76 | 99.93  | 99.89  | 98.80  | 98.15  | 98.37  | 96.30  | 96.17  |        |

Chromaticity shift  $\Delta u'v'$  ( $I_F = 200\text{ mA}$ ) – Normalized to 0 h

|           | CCT [K] |       | u'    | v'     | Measurement Time of Color Shift Δu'v' |        |        |        |        |        |        |        |        |  |
|-----------|---------|-------|-------|--------|---------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--|
|           | 0 h     | 0 h   | 0 h   | 0 h    | 504 h                                 | 1000 h | 2000 h | 3000 h | 4000 h | 5000 h | 6000 h | 7000 h | 8000 h |  |
| 1         | 3117    | 0.247 | 0.519 | 0.0000 | 0.0002                                | 0.0001 | 0.0002 | 0.0004 | 0.0007 | 0.0009 | 0.0013 | 0.0017 | 0.0020 |  |
| 2         | 3124    | 0.246 | 0.519 | 0.0000 | 0.0003                                | 0.0002 | 0.0004 | 0.0006 | 0.0011 | 0.0013 | 0.0017 | 0.0020 | 0.0022 |  |
| 3         | 3064    | 0.250 | 0.516 | 0.0000 | 0.0002                                | 0.0002 | 0.0005 | 0.0007 | 0.0011 | 0.0013 | 0.0017 | 0.0020 | 0.0022 |  |
| 4         | 3067    | 0.249 | 0.518 | 0.0000 | 0.0002                                | 0.0002 | 0.0004 | 0.0007 | 0.0009 | 0.0010 | 0.0014 | 0.0017 | 0.0019 |  |
| 5         | 3108    | 0.248 | 0.515 | 0.0000 | 0.0002                                | 0.0003 | 0.0006 | 0.0010 | 0.0014 | 0.0017 | 0.0022 | 0.0025 | 0.0029 |  |
| 6         | 3048    | 0.250 | 0.518 | 0.0000 | 0.0002                                | 0.0002 | 0.0004 | 0.0007 | 0.0011 | 0.0015 | 0.0020 | 0.0023 | 0.0026 |  |
| 7         | 3147    | 0.246 | 0.517 | 0.0000 | 0.0002                                | 0.0003 | 0.0007 | 0.0011 | 0.0016 | 0.0021 | 0.0026 | 0.0029 | 0.0030 |  |
| 8         | 3078    | 0.249 | 0.518 | 0.0000 | 0.0005                                | 0.0006 | 0.0009 | 0.0013 | 0.0018 | 0.0023 | 0.0030 | 0.0033 | 0.0036 |  |
| 9         | 3075    | 0.248 | 0.519 | 0.0000 | 0.0004                                | 0.0004 | 0.0005 | 0.0007 | 0.0011 | 0.0013 | 0.0016 | 0.0018 | 0.0020 |  |
| 10        | 3094    | 0.248 | 0.517 | 0.0000 | 0.0002                                | 0.0005 | 0.0009 | 0.0013 | 0.0019 | 0.0024 | 0.0031 | 0.0035 | 0.0039 |  |
| 11        | 3125    | 0.247 | 0.516 | 0.0000 | 0.0002                                | 0.0003 | 0.0007 | 0.0012 | 0.0018 | 0.0022 | 0.0028 | 0.0032 | 0.0035 |  |
| 12        | 3131    | 0.247 | 0.516 | 0.0000 | 0.0005                                | 0.0006 | 0.0011 | 0.0015 | 0.0022 | 0.0024 | 0.0029 | 0.0032 | 0.0037 |  |
| 13        | 3116    | 0.248 | 0.516 | 0.0000 | 0.0002                                | 0.0004 | 0.0008 | 0.0012 | 0.0020 | 0.0026 | 0.0032 | 0.0036 | 0.0039 |  |
| 14        | 3057    | 0.249 | 0.519 | 0.0000 | 0.0003                                | 0.0002 | 0.0005 | 0.0008 | 0.0012 | 0.0016 | 0.0020 | 0.0022 | 0.0024 |  |
| 15        | 3068    | 0.249 | 0.518 | 0.0000 | 0.0003                                | 0.0004 | 0.0008 | 0.0011 | 0.0017 | 0.0021 | 0.0024 | 0.0027 | 0.0032 |  |
| 16        | 3085    | 0.248 | 0.517 | 0.0000 | 0.0005                                | 0.0006 | 0.0009 | 0.0013 | 0.0018 | 0.0020 | 0.0026 | 0.0029 | 0.0031 |  |
| 17        | 3118    | 0.247 | 0.517 | 0.0000 | 0.0003                                | 0.0005 | 0.0009 | 0.0013 | 0.0019 | 0.0023 | 0.0028 | 0.0031 | 0.0033 |  |
| 18        | 3056    | 0.249 | 0.519 | 0.0000 | 0.0002                                | 0.0002 | 0.0005 | 0.0007 | 0.0013 | 0.0015 | 0.0019 | 0.0022 | 0.0024 |  |
| 19        | 3106    | 0.248 | 0.517 | 0.0000 | 0.0002                                | 0.0001 | 0.0003 | 0.0005 | 0.0009 | 0.0011 | 0.0016 | 0.0019 | 0.0022 |  |
| 20        | 3099    | 0.248 | 0.516 | 0.0000 | 0.0002                                | 0.0005 | 0.0007 | 0.0013 | 0.0019 | 0.0020 | 0.0025 | 0.0027 | 0.0029 |  |
| 21        | 3076    | 0.248 | 0.519 | 0.0000 | 0.0002                                | 0.0000 | 0.0001 | 0.0002 | 0.0006 | 0.0009 | 0.0013 | 0.0016 | 0.0019 |  |
| 22        | 3064    | 0.249 | 0.517 | 0.0000 | 0.0005                                | 0.0006 | 0.0009 | 0.0014 | 0.0020 | 0.0024 | 0.0029 | 0.0030 | 0.0033 |  |
| 23        | 3100    | 0.248 | 0.516 | 0.0000 | 0.0002                                | 0.0004 | 0.0008 | 0.0015 | 0.0023 | 0.0029 | 0.0034 | 0.0038 | 0.0040 |  |
| 24        | 3162    | 0.246 | 0.515 | 0.0000 | 0.0006                                | 0.0007 | 0.0011 | 0.0018 | 0.0024 | 0.0028 | 0.0032 | 0.0036 | 0.0039 |  |
| 25        | 3068    | 0.249 | 0.518 | 0.0000 | 0.0001                                | 0.0001 | 0.0003 | 0.0006 | 0.0009 | 0.0014 | 0.0018 | 0.0021 | 0.0025 |  |
| median    | 3094    | 0.248 | 0.517 | 0.0000 | 0.0002                                | 0.0003 | 0.0007 | 0.0011 | 0.0016 | 0.0020 | 0.0024 | 0.0027 | 0.0029 |  |
| average   | 3094    | 0.248 | 0.517 | 0.0000 | 0.0003                                | 0.0004 | 0.0006 | 0.0010 | 0.0015 | 0.0018 | 0.0023 | 0.0026 | 0.0029 |  |
| std. dev. | 31      | 0.001 | 0.001 | 0.0000 | 0.0001                                | 0.0002 | 0.0003 | 0.0004 | 0.0005 | 0.0006 | 0.0007 | 0.0007 | 0.0007 |  |
| min.      | 3048    | 0.246 | 0.515 | 0.0000 | 0.0001                                | 0.0000 | 0.0001 | 0.0002 | 0.0006 | 0.0009 | 0.0013 | 0.0016 | 0.0019 |  |
| max.      | 3162    | 0.250 | 0.519 | 0.0000 | 0.0006                                | 0.0007 | 0.0011 | 0.0018 | 0.0024 | 0.0029 | 0.0034 | 0.0038 | 0.0040 |  |

Test condition II:  $T_S = 85\text{ }^{\circ}\text{C}$ ,  $I_F = 200\text{ mA}$

Lumen maintenance ( $I_F = 200\text{ mA}$ ) – Normalized to 0 h

|           | $U_F$ [V] $\Phi_V$ [lm] |        | Measurement Time of Lumen Maintenance |       |        |        |        |        |        |        |        |
|-----------|-------------------------|--------|---------------------------------------|-------|--------|--------|--------|--------|--------|--------|--------|
|           | 0 h                     | 0 h    | 0 h                                   | 504 h | 1000 h | 2000 h | 3000 h | 4000 h | 5000 h | 6000 h | 7000 h |
| 1         | 6.36                    | 137.90 | 100.00                                | 99.81 | 98.68  | 97.90  | 96.84  | 95.12  | 94.19  | 94.05  | 93.41  |
| 2         | 6.31                    | 132.50 | 100.00                                | 98.91 | 96.89  | 95.79  | 94.63  | 92.95  | 92.35  | 92.00  | 91.72  |
| 3         | 6.30                    | 131.60 | 100.00                                | 98.90 | 97.93  | 97.12  | 96.27  | 94.95  | 94.20  | 94.15  | 94.09  |
| 4         | 6.25                    | 132.20 | 100.00                                | 99.13 | 97.56  | 97.05  | 96.44  | 95.13  | 94.38  | 94.33  | 94.19  |
| 5         | 6.27                    | 138.70 | 100.00                                | 99.24 | 98.47  | 98.05  | 97.22  | 96.09  | 95.46  | 95.53  | 95.46  |
| 6         | 6.23                    | 132.10 | 100.00                                | 98.83 | 97.64  | 96.38  | 95.15  | 93.15  | 92.03  | 91.60  | 91.10  |
| 7         | 6.42                    | 129.20 | 100.00                                | 98.80 | 96.96  | 96.02  | 94.95  | 93.53  | 92.69  | 92.88  | 93.06  |
| 8         | 6.25                    | 129.20 | 100.00                                | 99.35 | 98.43  | 97.78  | 97.05  | 95.48  | 94.79  | 94.66  | 94.53  |
| 9         | 6.30                    | 135.70 | 100.00                                | 99.22 | 97.77  | 96.73  | 95.44  | 93.41  | 92.10  | 92.04  | 92.13  |
| 10        | 6.35                    | 127.30 | 100.00                                | 99.02 | 97.70  | 96.91  | 95.65  | 93.83  | 92.82  | 92.62  | 92.49  |
| 11        | 6.33                    | 129.30 | 100.00                                | 98.96 | 97.04  | 96.25  | 95.34  | 93.85  | 93.40  | 93.74  | 93.92  |
| 12        | 6.24                    | 129.40 | 100.00                                | 99.19 | 98.05  | 97.55  | 96.98  | 95.79  | 95.19  | 95.29  | 95.39  |
| 13        | 6.33                    | 127.50 | 100.00                                | 99.18 | 97.63  | 96.53  | 95.34  | 93.60  | 92.75  | 92.71  | 92.74  |
| 14        | 6.24                    | 134.50 | 100.00                                | 98.85 | 97.53  | 96.71  | 95.84  | 94.40  | 93.66  | 93.68  | 93.70  |
| 15        | 6.27                    | 123.90 | 100.00                                | 98.76 | 96.27  | 95.43  | 94.70  | 93.16  | 92.77  | 92.90  | 92.78  |
| 16        | 6.30                    | 134.90 | 100.00                                | 99.00 | 97.83  | 97.23  | 96.23  | 94.34  | 93.46  | 93.40  | 93.12  |
| 17        | 6.30                    | 134.60 | 100.00                                | 99.15 | 97.68  | 96.86  | 96.00  | 94.33  | 93.67  | 93.69  | 93.70  |
| 18        | 6.27                    | 127.60 | 100.00                                | 99.03 | 98.18  | 97.54  | 96.85  | 95.34  | 94.49  | 94.36  | 94.00  |
| 19        | 6.35                    | 128.80 | 100.00                                | 99.34 | 98.74  | 98.54  | 97.90  | 96.39  | 95.63  | 95.50  | 94.98  |
| 20        | 6.27                    | 128.80 | 100.00                                | 99.34 | 98.58  | 98.08  | 97.35  | 95.77  | 94.93  | 94.72  | 94.44  |
| 21        | 6.29                    | 136.90 | 100.00                                | 99.30 | 97.86  | 96.82  | 95.56  | 93.62  | 92.46  | 92.04  | 91.54  |
| 22        | 6.28                    | 129.60 | 100.00                                | 99.19 | 97.59  | 96.79  | 96.05  | 94.48  | 94.03  | 93.98  | 93.93  |
| 23        | 6.31                    | 130.40 | 100.00                                | 99.35 | 97.30  | 96.05  | 94.53  | 92.83  | 91.99  | 91.95  | 91.98  |
| 24        | 6.31                    | 134.00 | 100.00                                | 99.22 | 97.74  | 96.85  | 96.20  | 94.75  | 94.09  | 94.10  | 94.05  |
| 25        | 6.32                    | 122.50 | 100.00                                | 98.99 | 96.80  | 95.88  | 94.96  | 92.92  | 92.61  | 92.74  | 92.62  |
| median    | 6.30                    | 130.40 | 100.00                                | 99.15 | 97.70  | 96.85  | 96.00  | 94.34  | 93.66  | 93.69  | 93.70  |
| average   | 6.30                    | 131.16 | 100.00                                | 99.12 | 97.71  | 96.91  | 95.98  | 94.37  | 93.61  | 93.55  | 93.40  |
| std. dev. | 0.04                    | 4.09   | 0.00                                  | 0.24  | 0.62   | 0.79   | 0.93   | 1.07   | 1.12   | 1.16   | 1.18   |
| min.      | 6.23                    | 122.50 | 100.00                                | 98.76 | 96.27  | 95.43  | 94.53  | 92.83  | 91.99  | 91.60  | 91.10  |
| max.      | 6.42                    | 138.70 | 100.00                                | 99.81 | 98.74  | 98.54  | 97.90  | 96.39  | 95.63  | 95.53  | 95.46  |

Chromaticity shift  $\Delta u'v'$  ( $I_F = 0\text{ mA}$ ) – Normalized to 0 h

|           | CCT [K] | u'    | v'    | Measurement Time of Color Shift Δu'v' |        |        |        |        |        |        |        |        |
|-----------|---------|-------|-------|---------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|
|           |         | 0 h   | 0 h   | 0 h                                   | 0 h    | 504 h  | 1000 h | 2000 h | 3000 h | 4000 h | 5000 h | 6000 h |
| 1         | 3145    | 0.246 | 0.516 | 0.0000                                | 0.0004 | 0.0007 | 0.0015 | 0.0023 | 0.0031 | 0.0039 | 0.0045 | 0.0054 |
| 2         | 3155    | 0.246 | 0.516 | 0.0000                                | 0.0004 | 0.0012 | 0.0021 | 0.0028 | 0.0034 | 0.0036 | 0.0043 | 0.0048 |
| 3         | 3070    | 0.249 | 0.518 | 0.0000                                | 0.0004 | 0.0007 | 0.0014 | 0.0018 | 0.0021 | 0.0022 | 0.0025 | 0.0026 |
| 4         | 3067    | 0.249 | 0.518 | 0.0000                                | 0.0004 | 0.0008 | 0.0012 | 0.0015 | 0.0017 | 0.0018 | 0.0020 | 0.0022 |
| 5         | 3142    | 0.247 | 0.515 | 0.0000                                | 0.0004 | 0.0005 | 0.0009 | 0.0014 | 0.0016 | 0.0016 | 0.0019 | 0.0021 |
| 6         | 3094    | 0.248 | 0.517 | 0.0000                                | 0.0004 | 0.0008 | 0.0016 | 0.0023 | 0.0030 | 0.0033 | 0.0038 | 0.0041 |
| 7         | 3106    | 0.248 | 0.517 | 0.0000                                | 0.0004 | 0.0011 | 0.0018 | 0.0024 | 0.0028 | 0.0033 | 0.0033 | 0.0033 |
| 8         | 3098    | 0.248 | 0.518 | 0.0000                                | 0.0002 | 0.0005 | 0.0010 | 0.0015 | 0.0018 | 0.0021 | 0.0026 | 0.0029 |
| 9         | 3090    | 0.248 | 0.518 | 0.0000                                | 0.0002 | 0.0007 | 0.0015 | 0.0023 | 0.0030 | 0.0033 | 0.0037 | 0.0040 |
| 10        | 3082    | 0.248 | 0.518 | 0.0000                                | 0.0003 | 0.0007 | 0.0014 | 0.0023 | 0.0030 | 0.0035 | 0.0040 | 0.0043 |
| 11        | 3093    | 0.248 | 0.519 | 0.0000                                | 0.0005 | 0.0012 | 0.0017 | 0.0023 | 0.0028 | 0.0029 | 0.0031 | 0.0031 |
| 12        | 3095    | 0.248 | 0.516 | 0.0000                                | 0.0004 | 0.0007 | 0.0011 | 0.0015 | 0.0017 | 0.0018 | 0.0019 | 0.0021 |
| 13        | 3141    | 0.247 | 0.514 | 0.0000                                | 0.0003 | 0.0009 | 0.0016 | 0.0025 | 0.0031 | 0.0035 | 0.0040 | 0.0042 |
| 14        | 3125    | 0.247 | 0.518 | 0.0000                                | 0.0005 | 0.0008 | 0.0013 | 0.0017 | 0.0021 | 0.0021 | 0.0023 | 0.0026 |
| 15        | 3103    | 0.248 | 0.517 | 0.0000                                | 0.0006 | 0.0016 | 0.0021 | 0.0028 | 0.0032 | 0.0033 | 0.0036 | 0.0045 |
| 16        | 3115    | 0.247 | 0.517 | 0.0000                                | 0.0005 | 0.0008 | 0.0012 | 0.0018 | 0.0025 | 0.0026 | 0.0029 | 0.0031 |
| 17        | 3092    | 0.248 | 0.517 | 0.0000                                | 0.0003 | 0.0007 | 0.0013 | 0.0018 | 0.0022 | 0.0022 | 0.0025 | 0.0026 |
| 18        | 3090    | 0.249 | 0.516 | 0.0000                                | 0.0004 | 0.0007 | 0.0012 | 0.0018 | 0.0021 | 0.0024 | 0.0029 | 0.0036 |
| 19        | 3050    | 0.249 | 0.518 | 0.0000                                | 0.0002 | 0.0002 | 0.0004 | 0.0008 | 0.0013 | 0.0017 | 0.0021 | 0.0026 |
| 20        | 3088    | 0.248 | 0.517 | 0.0000                                | 0.0002 | 0.0004 | 0.0008 | 0.0012 | 0.0017 | 0.0019 | 0.0023 | 0.0024 |
| 21        | 3157    | 0.246 | 0.517 | 0.0000                                | 0.0004 | 0.0009 | 0.0018 | 0.0027 | 0.0035 | 0.0041 | 0.0050 | 0.0058 |
| 22        | 3106    | 0.247 | 0.518 | 0.0000                                | 0.0003 | 0.0008 | 0.0015 | 0.0019 | 0.0024 | 0.0024 | 0.0028 | 0.0032 |
| 23        | 3057    | 0.249 | 0.520 | 0.0000                                | 0.0004 | 0.0012 | 0.0019 | 0.0025 | 0.0030 | 0.0032 | 0.0036 | 0.0040 |
| 24        | 3177    | 0.245 | 0.518 | 0.0000                                | 0.0004 | 0.0007 | 0.0013 | 0.0017 | 0.0020 | 0.0019 | 0.0022 | 0.0023 |
| 25        | 3102    | 0.248 | 0.516 | 0.0000                                | 0.0007 | 0.0016 | 0.0023 | 0.0030 | 0.0036 | 0.0036 | 0.0038 | 0.0046 |
| median    | 3098    | 0.248 | 0.517 | 0.0000                                | 0.0004 | 0.0008 | 0.0014 | 0.0019 | 0.0025 | 0.0026 | 0.0029 | 0.0032 |
| average   | 3106    | 0.248 | 0.517 | 0.0000                                | 0.0004 | 0.0008 | 0.0014 | 0.0020 | 0.0025 | 0.0027 | 0.0031 | 0.0035 |
| std. dev. | 32      | 0.001 | 0.001 | 0.0000                                | 0.0001 | 0.0003 | 0.0004 | 0.0006 | 0.0007 | 0.0008 | 0.0009 | 0.0011 |
| min.      | 3050    | 0.245 | 0.514 | 0.0000                                | 0.0002 | 0.0002 | 0.0004 | 0.0008 | 0.0013 | 0.0016 | 0.0019 | 0.0021 |
| max.      | 3177    | 0.249 | 0.520 | 0.0000                                | 0.0007 | 0.0016 | 0.0023 | 0.0030 | 0.0036 | 0.0041 | 0.0050 | 0.0058 |

Test condition III:  $T_S = 105\text{ }^{\circ}\text{C}$ ,  $I_F = 200\text{ mA}$

Lumen maintenance ( $I_F = 200\text{ mA}$ ) – Normalized to 0 h

|           | $U_F$ [V] $\Phi_V$ [lm] |        | Measurement Time of Lumen Maintenance |       |        |        |        |        |        |        |        |        |
|-----------|-------------------------|--------|---------------------------------------|-------|--------|--------|--------|--------|--------|--------|--------|--------|
|           | 0 h                     | 0 h    | 0 h                                   | 504 h | 1000 h | 2000 h | 3000 h | 4000 h | 5000 h | 6000 h | 7000 h | 8000 h |
| 1         | 6.28                    | 132.40 | 100.00                                | 98.30 | 97.57  | 97.20  | 96.83  | 96.12  | 95.15  | 95.24  | 95.11  | 92.96  |
| 2         | 6.30                    | 131.10 | 100.00                                | 98.74 | 98.15  | 96.96  | 96.87  | 96.23  | 95.33  | 95.65  | 95.90  | 93.72  |
| 3         | 6.27                    | 137.50 | 100.00                                | 98.72 | 97.95  | 96.61  | 96.02  | 95.26  | 94.17  | 94.54  | 94.84  | 92.56  |
| 4         | 6.31                    | 137.00 | 100.00                                | 98.65 | 97.72  | 96.46  | 95.71  | 95.02  | 94.01  | 94.45  | 94.75  | 92.32  |
| 5         | 6.31                    | 130.50 | 100.00                                | 98.66 | 98.37  | 97.71  | 97.24  | 96.37  | 95.15  | 95.56  | 96.11  | 94.08  |
| 6         | 6.28                    | 137.50 | 100.00                                | 98.51 | 97.87  | 97.33  | 97.05  | 96.42  | 95.49  | 95.71  | 95.86  | 93.58  |
| 7         | 6.27                    | 127.90 | 100.00                                | 98.40 | 97.79  | 97.08  | 96.46  | 95.98  | 95.36  | 95.47  | 96.04  | 94.04  |
| 8         | 6.26                    | 133.20 | 100.00                                | 98.16 | 97.20  | 96.40  | 95.57  | 94.79  | 93.90  | 94.22  | 94.76  | 92.70  |
| 9         | 6.25                    | 128.70 | 100.00                                | 98.10 | 96.87  | 96.17  | 95.71  | 94.91  | 93.83  | 93.94  | 93.97  | 91.66  |
| 10        | 6.27                    | 128.10 | 100.00                                | 98.87 | 98.11  | 97.31  | 96.94  | 96.29  | 95.45  | 95.79  | 96.04  | 93.81  |
| 11        | 6.27                    | 132.40 | 100.00                                | 98.15 | 97.11  | 96.31  | 96.07  | 95.36  | 94.24  | 94.56  | 94.96  | 92.80  |
| 12        | 6.27                    | 127.90 | 100.00                                | 98.48 | 97.48  | 96.46  | 95.91  | 95.11  | 94.26  | 94.61  | 95.02  | 92.94  |
| 13        | 6.30                    | 128.60 | 100.00                                | 98.72 | 97.96  | 97.16  | 96.64  | 95.76  | 94.92  | 95.18  | 95.59  | 93.45  |
| 14        | 6.25                    | 127.50 | 100.00                                | 98.63 | 97.16  | 96.37  | 96.13  | 95.49  | 94.80  | 95.22  | 95.63  | 93.55  |
| 15        | 6.30                    | 128.40 | 100.00                                | 98.80 | 97.96  | 97.31  | 97.03  | 95.60  | 94.60  | 94.55  | 94.73  | 92.50  |
| 16        | 6.25                    | 126.90 | 100.00                                | 98.16 | 97.07  | 96.60  | 96.35  | 95.78  | 94.53  | 94.17  | 94.12  | 91.94  |
| 17        | 6.27                    | 129.90 | 100.00                                | 98.58 | 97.90  | 97.33  | 96.99  | 96.20  | 95.36  | 95.46  | 95.86  | 93.59  |
| 18        | 6.27                    | 128.00 | 100.00                                | 98.56 | 97.87  | 97.23  | 96.94  | 96.06  | 95.05  | 95.24  | 95.81  | 93.81  |
| 19        | 6.31                    | 133.30 | 100.00                                | 98.76 | 98.11  | 97.36  | 97.08  | 96.45  | 95.34  | 95.65  | 96.03  | 93.60  |
| 20        | 6.29                    | 129.80 | 100.00                                | 98.89 | 98.21  | 97.40  | 96.99  | 96.19  | 95.05  | 95.46  | 95.71  | 93.35  |
| 21        | 6.34                    | 129.00 | 100.00                                | 98.88 | 98.28  | 97.47  | 97.20  | 96.40  | 95.56  | 95.89  | 96.22  | 94.01  |
| 22        | 6.30                    | 127.70 | 100.00                                | 98.79 | 98.18  | 97.54  | 97.24  | 96.68  | 95.59  | 95.77  | 95.80  | 93.40  |
| 23        | 6.35                    | 127.40 | 100.00                                | 98.87 | 98.02  | 96.76  | 96.05  | 95.01  | 93.45  | 94.20  | 94.38  | 92.13  |
| 24        | 6.28                    | 130.90 | 100.00                                | 99.05 | 98.23  | 97.26  | 97.02  | 96.00  | 95.09  | 95.34  | 95.51  | 93.18  |
| 25        | 6.34                    | 121.70 | 100.00                                | 98.66 | 97.76  | 97.00  | 96.91  | 95.51  | 94.53  | 94.83  | 95.11  | 92.74  |
| median    | 6.28                    | 129.00 | 100.00                                | 98.66 | 97.90  | 97.16  | 96.87  | 95.98  | 95.05  | 95.24  | 95.59  | 93.35  |
| average   | 6.29                    | 130.13 | 100.00                                | 98.60 | 97.80  | 96.99  | 96.60  | 95.80  | 94.81  | 95.07  | 95.35  | 93.14  |
| std. dev. | 0.03                    | 3.63   | 0.00                                  | 0.26  | 0.42   | 0.45   | 0.54   | 0.56   | 0.62   | 0.60   | 0.66   | 0.69   |
| min.      | 6.25                    | 121.70 | 100.00                                | 98.10 | 96.87  | 96.17  | 95.57  | 94.79  | 93.45  | 93.94  | 93.97  | 91.66  |
| max.      | 6.35                    | 137.50 | 100.00                                | 99.05 | 98.37  | 97.71  | 97.24  | 96.68  | 95.59  | 95.89  | 96.22  | 94.08  |

Chromaticity shift  $\Delta u'v'$  ( $I_F = 0\text{ mA}$ ) – Normalized to 0 h

|           | CCT [K] |       | $u'$ $v'$ |        | Measurement Time of Color Shift $\Delta u'v'$ |        |        |        |        |        |        |        |        |
|-----------|---------|-------|-----------|--------|---|--------|--------|--------|--------|--------|--------|--------|--------|
|           | 0 h     | 0 h   | 0 h       | 0 h    | 504 h   | 1000 h | 2000 h | 3000 h | 4000 h | 5000 h | 6000 h | 7000 h | 8000 h |
| 1         | 3093    | 0.248 | 0.518     | 0.0000 | 0.0007  | 0.0007 | 0.0003 | 0.0001 | 0.0004 | 0.0003 | 0.0008 | 0.0015 | 0.0016 |
| 2         | 3084    | 0.249 | 0.516     | 0.0000 | 0.0004  | 0.0003 | 0.0004 | 0.0004 | 0.0002 | 0.0008 | 0.0008 | 0.0010 | 0.0012 |
| 3         | 3070    | 0.249 | 0.517     | 0.0000 | 0.0004  | 0.0004 | 0.0001 | 0.0001 | 0.0002 | 0.0003 | 0.0007 | 0.0009 | 0.0010 |
| 4         | 3070    | 0.249 | 0.516     | 0.0000 | 0.0004  | 0.0006 | 0.0004 | 0.0003 | 0.0006 | 0.0007 | 0.0009 | 0.0013 | 0.0014 |
| 5         | 3132    | 0.247 | 0.516     | 0.0000 | 0.0004  | 0.0002 | 0.0003 | 0.0004 | 0.0002 | 0.0008 | 0.0008 | 0.0012 | 0.0016 |
| 6         | 3129    | 0.247 | 0.518     | 0.0000 | 0.0004  | 0.0007 | 0.0004 | 0.0002 | 0.0006 | 0.0007 | 0.0009 | 0.0012 | 0.0013 |
| 7         | 3074    | 0.249 | 0.518     | 0.0000 | 0.0005  | 0.0007 | 0.0004 | 0.0004 | 0.0008 | 0.0006 | 0.0009 | 0.0011 | 0.0013 |
| 8         | 3103    | 0.248 | 0.518     | 0.0000 | 0.0005  | 0.0007 | 0.0004 | 0.0003 | 0.0007 | 0.0005 | 0.0008 | 0.0010 | 0.0011 |
| 9         | 3093    | 0.248 | 0.518     | 0.0000 | 0.0008  | 0.0009 | 0.0007 | 0.0004 | 0.0010 | 0.0011 | 0.0017 | 0.0023 | 0.0025 |
| 10        | 3109    | 0.248 | 0.516     | 0.0000 | 0.0006  | 0.0007 | 0.0005 | 0.0004 | 0.0006 | 0.0008 | 0.0011 | 0.0014 | 0.0016 |
| 11        | 3083    | 0.248 | 0.519     | 0.0000 | 0.0005  | 0.0006 | 0.0003 | 0.0002 | 0.0004 | 0.0007 | 0.0010 | 0.0012 | 0.0015 |
| 12        | 3144    | 0.247 | 0.516     | 0.0000 | 0.0007  | 0.0009 | 0.0007 | 0.0008 | 0.0010 | 0.0008 | 0.0011 | 0.0012 | 0.0014 |
| 13        | 3081    | 0.248 | 0.518     | 0.0000 | 0.0007  | 0.0008 | 0.0005 | 0.0004 | 0.0007 | 0.0006 | 0.0008 | 0.0010 | 0.0011 |
| 14        | 3101    | 0.248 | 0.516     | 0.0000 | 0.0007  | 0.0009 | 0.0008 | 0.0005 | 0.0008 | 0.0007 | 0.0009 | 0.0012 | 0.0012 |
| 15        | 3130    | 0.247 | 0.517     | 0.0000 | 0.0004  | 0.0007 | 0.0002 | 0.0001 | 0.0004 | 0.0006 | 0.0009 | 0.0012 | 0.0012 |
| 16        | 3097    | 0.248 | 0.519     | 0.0000 | 0.0007  | 0.0008 | 0.0004 | 0.0002 | 0.0007 | 0.0005 | 0.0010 | 0.0015 | 0.0014 |
| 17        | 3105    | 0.248 | 0.517     | 0.0000 | 0.0004  | 0.0004 | 0.0001 | 0.0002 | 0.0002 | 0.0007 | 0.0008 | 0.0012 | 0.0013 |
| 18        | 3067    | 0.249 | 0.518     | 0.0000 | 0.0004  | 0.0004 | 0.0001 | 0.0000 | 0.0003 | 0.0005 | 0.0007 | 0.0010 | 0.0012 |
| 19        | 3086    | 0.248 | 0.517     | 0.0000 | 0.0004  | 0.0004 | 0.0001 | 0.0000 | 0.0002 | 0.0007 | 0.0007 | 0.0010 | 0.0010 |
| 20        | 3091    | 0.248 | 0.517     | 0.0000 | 0.0003  | 0.0004 | 0.0001 | 0.0001 | 0.0004 | 0.0009 | 0.0010 | 0.0013 | 0.0015 |
| 21        | 3079    | 0.248 | 0.519     | 0.0000 | 0.0003  | 0.0002 | 0.0001 | 0.0001 | 0.0002 | 0.0008 | 0.0008 | 0.0012 | 0.0015 |
| 22        | 3085    | 0.249 | 0.517     | 0.0000 | 0.0004  | 0.0004 | 0.0002 | 0.0001 | 0.0004 | 0.0004 | 0.0009 | 0.0015 | 0.0017 |
| 23        | 3123    | 0.247 | 0.517     | 0.0000 | 0.0004  | 0.0005 | 0.0005 | 0.0007 | 0.0012 | 0.0011 | 0.0015 | 0.0017 | 0.0019 |
| 24        | 3078    | 0.249 | 0.515     | 0.0000 | 0.0004  | 0.0005 | 0.0003 | 0.0003 | 0.0007 | 0.0007 | 0.0010 | 0.0012 | 0.0013 |
| 25        | 3088    | 0.248 | 0.518     | 0.0000 | 0.0006  | 0.0008 | 0.0006 | 0.0006 | 0.0009 | 0.0007 | 0.0011 | 0.0013 | 0.0015 |
| median    | 3091    | 0.248 | 0.517     | 0.0000 | 0.0004  | 0.0006 | 0.0004 | 0.0003 | 0.0006 | 0.0007 | 0.0009 | 0.0012 | 0.0014 |
| average   | 3096    | 0.248 | 0.517     | 0.0000 | 0.0005  | 0.0006 | 0.0003 | 0.0003 | 0.0006 | 0.0007 | 0.0009 | 0.0013 | 0.0014 |
| std. dev. | 21      | 0.001 | 0.001     | 0.0000 | 0.0001  | 0.0002 | 0.0002 | 0.0002 | 0.0003 | 0.0002 | 0.0002 | 0.0003 | 0.0003 |
| min.      | 3067    | 0.247 | 0.515     | 0.0000 | 0.0003  | 0.0002 | 0.0001 | 0.0000 | 0.0002 | 0.0003 | 0.0007 | 0.0009 | 0.0010 |
| max.      | 3144    | 0.249 | 0.519     | 0.0000 | 0.0008  | 0.0009 | 0.0008 | 0.0008 | 0.0012 | 0.0011 | 0.0017 | 0.0023 | 0.0025 |

----- End of the accredited section of the report -----

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

For Information Only!

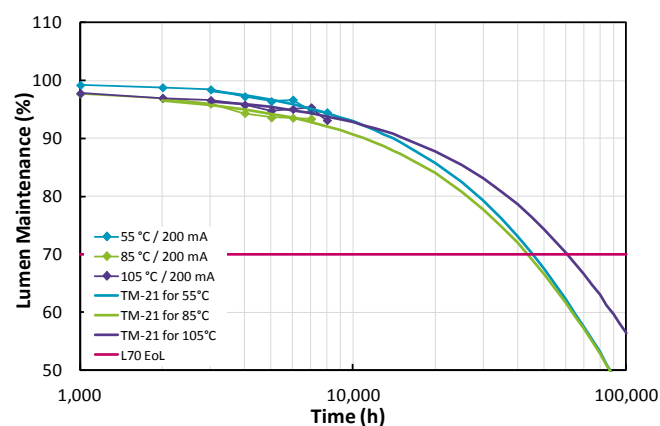
## 1. General Information

|  |  |
|--|--|
| Description of LED light source tested | DURIS S 5 GW PSLRS1.EC   |
| Sample size per temperature            | 25   |
| LED drive current used in the test     | 200 mA   |
| Test duration                          | 8,000 hours for Test Condition I & III<br>7,000 hours for Test Conditions II                               |
| Test duration used for projection      | 3,000 hours to 8,000 hours for Test Conditions I & III<br>2,000 hours to 7,000 hours for Test Condition II |

## 2. Projection Data

|                                 | I                    | II                   | III                   |
|---------------------------------|----------------------|----------------------|-----------------------|
| Case temperature (solder point) | $T_S = 55\text{ °C}$ | $T_S = 85\text{ °C}$ | $T_S = 105\text{ °C}$ |
| $\alpha$                        | 7.991E-06            | 7.703E-06            | 5.534E-06             |
| B                               | 1.007E+00            | 9.796E-01            | 9.806E-01             |
| Reported L70                    | 45,451 hours         | >42,000 hours        | >48,000 hours         |

## 3. Graphic chart



## 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 conditions 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 S 5 GW PSLRS1.EC | with CCT 2700 K – 6500 K |
| • DURIS S 5 GW PSLRS1.PC | with CCT 3000 K – 6500 K |
| • DURIS S 5 GW PSLRS1.CC | with CCT 2700 K – 4000 K |
| • DURIS S 5 GW PSLR31.EM | with CCT 2700 K – 6500 K |
| • DURIS S 5 GW PSLR32.EM | with CCT 2700 K – 6500 K |
| • DURIS S 5 GW PSLR31.CM | with CCT 2700 K – 4000 K |
| • DURIS S 5 GW PSLR32.CM | with CCT 2700 K – 4000 K |
| • DURIS S 5 GW PSLM31.EM | with CCT 2700 K – 6500 K |
| • DURIS S 5 GW PSLM31.CM | with CCT 2700 K – 4000 K |

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](http://www.osram-os.com)

**OSRAM**  
Opto Semiconductors