

IES LM-80-08 Report

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Product : **CLU048-1818C4-273H5MB-F1**
Initial (internal) Issue Date : **2017/10/16**
First Submission To Users Date : **2017/10/16**
Revision Date : **2018/7/3**
Initial Test Date : **2016/10/27**
Complete Test Date : **-**
Test Duration : **10,000 H**
Report Number : **LM1600918**
Drive Current : **4,140mA**



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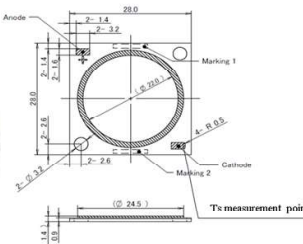
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1. Description of LED light sources Tested

Table 1

| Product | Nominal CCT | Number of Die | Die Spacing | Drive Current | Current Density | Power Density | Product Picture | Mechanical Drawing |
|--------------------------|-------------|---------------|-------------|------------------------|-----------------------|------------------------|--|---|
| CLU048-1818C4-273H5M3-F1 | 2,700K | 324pcs | 0.28mm | 4,140mA (230mA/die) | 544mA/mm ² | 0.337W/mm ² |  |  |

2. Applicable Product Series

Applicable product series of this IES LM-80-08 report shows in Applicable Products.

Identical construction process is used for the applicable product series.



Approved Signatory

Laboratory Director : Tsuyoshi Watanabe

Test engineer : Takakuni Ohta

Test report reviewer (Technical Manager) : Isao Sone

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T. Watanabe
T. Ohta
I. Sone
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3. IES LM-80-08 Reports Requirements

1. Number of LED light sources tested

11 samples are selected for each test condition.

(Nominal T_s =55C,105C,120C)

2. Description of LED sources

Classification : LED Array

Product : CLU048-1818C4-273H5M3-F1

(Nominal CCT : 2,700K)

3. Description of auxiliary equipment

~ Life test equipment ~

Thermal controlled life test system

LED arrays are tested in a thermal chamber which controls the case temperature (T_s) and ambient temperature (T_a) by water cooling system.

~ Measuring equipment ~

Table 2

| Measurement Item | Equipment Name | Part Number | Manufacturer | Measurement Range | Calibration Date | Next Calibration Date |
|--------------------------|--------------------|-------------|----------------------|-----------------------|------------------|-----------------------|
| Temperature | Thermo regulator | LSCC-20A | KYUSHU NISSHO | 0C~120C | 2017/10/10 | 2018/10/31 |
| | Data logger | KV-7500 | Kai Daiarogu | 0C~120C | 2017/10/10 | 2018/10/31 |
| Temperature and humidity | Data logger | TR-72Ui | T&D Corporation | 0C~ 50C, 10~95% RH | 2017/8/31 | 2018/8/30 |
| Drive current | Digital multimeter | 34401A | Agilent Technologies | 10mA~3A | 2017/10/3 | 2018/10/31 |
| Input power | DC power supply | PAS500-1.2 | Kikusui Electronics | 10mA~1.2A | - | - |
| Voltage | Oscilloscope | DPO2012-D1 | Tektronix | 10mV~100V | 2018/2/6 | 2019/2/26 |
| Luminous flux | Integrating sphere | MCPD9800 | Otsuka Electronics | 3lm~30,000lm | 2018/4/16 | 2019/4/30 |

4. Operating cycle

LED arrays are driven with constant direct current (DC).

5. Ambient conditions including airflow temperature and relative humidity

LED arrays are operated in environmental control chambers. The data of the ambient conditions is shown in the tables of individual conditions. The ambient condition complies with the requirements of IES LM-80-08.

Surrounding Air temperature for life test : controlled to within $\pm 5^{\circ}\text{C}$ of the case temperature (T_s)

Humidity : $< 65\% \text{ RH}$

Minimal air flow

Ambient temperature for Photometry measurement : maintained at $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$

6. Case temperature (T_s)

See data tables for individual test conditions.

The case temperature measurement point and detailed mechanical drawing are shown in table 1 of 1. Description of LED Light Sources Tested.

7. Drive current (I_f)

See data tables for individual test conditions.

8. Initial luminous flux, forward voltage and CCT

See data tables for individual test conditions.

9. Lumen maintenance data

See data tables for individual test conditions.

Ambient temperature during lumen measurements is maintained at $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$.

10. Observation of LED light source failures

No failures observed during test.

11. LED light source monitoring interval

Measurements have been taken at each 1,000 hours.

12. Photometric measurement uncertainty

Uncertainty for relative luminous flux measurement is $\pm 1.9\%$.

Long term measurement uncertainty is based on reproducibility tests done over a period of one year, calculated to $k=2$ coverage (i.e. 95% coverage).

13. Chromaticity shift reported over the measurement time

See data tables for individual test conditions.

Ambient temperature during chromaticity testing set to $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$.

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4. IES TM-21-11 Prediction

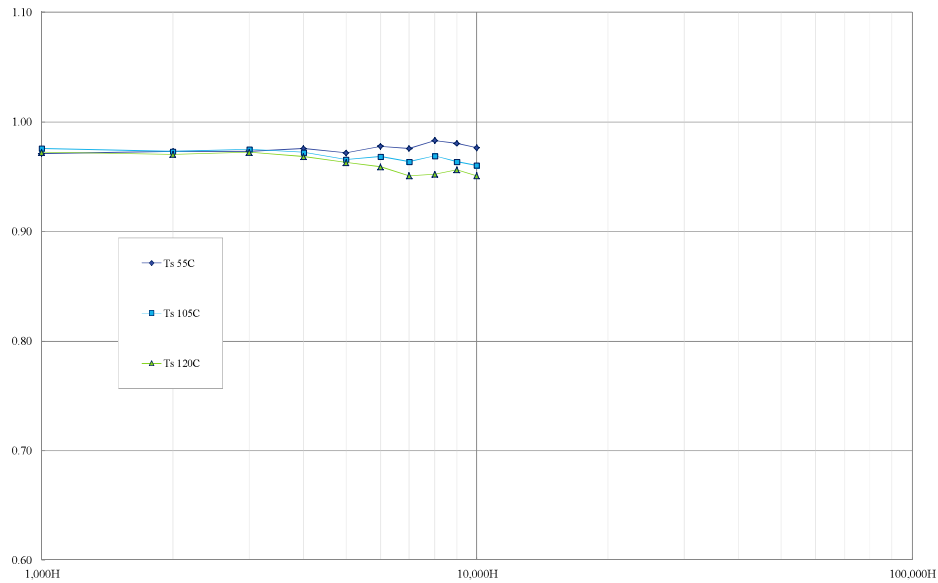
| Test condition | 55C | 105C | 120C |
|------------------------------------|------------------|------------------|------------------|
| Sample size | 11pcs | 11pcs | 11pcs |
| Number of failures | 0pcs | 0pcs | 0pcs |
| DUT drive current used in the test | 4,140mA | 4,140mA | 4,140mA |
| Test duration | 10,000H | 10,000H | 10,000H |
| Test duration used for projection | 5,000H - 10,000H | 5,000H - 10,000H | 5,000H - 10,000H |
| Tested case temperature Tc | 55C | 105C | 120C |
| α | -1.09436E-06 | 1.04861E-06 | 1.97059E-06 |
| B | 0.970 | 0.973 | 0.970 |
| Reported L70 (10k) (hour) | >55000 | >55000 | >55000 |
| Reported L80 (10k) (hour) | >55000 | >55000 | >55000 |
| Reported L90 (10k) (hour) | >55000 | >55000 | 38,000 |

5. IES LM-80-08 Test Summary

Product : CLU048-1818C4-273H5MB-F1
Initial (internal) Issue Date : 2017/10/16
First Submission To Users Date : 2017/10/16
Revision Date : 2018/7/3
Initial Test Date : 2016/10/27
Complete Test Date : -
Test Duration : 10,000 H
Report Number : LM1600918
Drive Current : 4,140mA



| Case temperature | ~ | Lumen Maintenance (normalized value) | | | | | | | | | | | | | | | | | |
|------------------|----------|--------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|----|----|----|----|----|----|----|
| | | 0H | 1,000H | 2,000H | 3,000H | 4,000H | 5,000H | 6,000H | 7,000H | 8,000H | 9,000H | 10,000H | 0H | 0H | 0H | 0H | 0H | 0H | 0H |
| 55C | Max. | 1.000 | 0.985 | 0.985 | 0.987 | 0.993 | 0.986 | 0.989 | 0.990 | 0.997 | 0.992 | 0.988 | | | | | | | |
| | Ave. | 1.000 | 0.971 | 0.973 | 0.973 | 0.976 | 0.972 | 0.978 | 0.976 | 0.983 | 0.981 | 0.976 | | | | | | | |
| | Min. | 1.000 | 0.958 | 0.965 | 0.961 | 0.957 | 0.960 | 0.964 | 0.963 | 0.972 | 0.969 | 0.964 | | | | | | | |
| | Std.dev. | 0.000 | 0.009 | 0.007 | 0.008 | 0.010 | 0.009 | 0.008 | 0.009 | 0.008 | 0.008 | 0.008 | | | | | | | |
| | Median | 1.000 | 0.970 | 0.971 | 0.971 | 0.975 | 0.971 | 0.975 | 0.975 | 0.982 | 0.982 | 0.974 | | | | | | | |
| 105C | Max. | 1.000 | 0.994 | 0.988 | 0.988 | 0.990 | 0.980 | 0.985 | 0.978 | 0.988 | 0.983 | 0.981 | | | | | | | |
| | Ave. | 1.000 | 0.975 | 0.973 | 0.975 | 0.972 | 0.966 | 0.969 | 0.964 | 0.969 | 0.964 | 0.961 | | | | | | | |
| | Min. | 1.000 | 0.965 | 0.960 | 0.964 | 0.959 | 0.949 | 0.951 | 0.951 | 0.940 | 0.936 | 0.928 | | | | | | | |
| | Std.dev. | 0.000 | 0.009 | 0.009 | 0.008 | 0.009 | 0.010 | 0.011 | 0.009 | 0.013 | 0.014 | 0.014 | | | | | | | |
| | Median | 1.000 | 0.972 | 0.969 | 0.974 | 0.971 | 0.965 | 0.970 | 0.962 | 0.970 | 0.967 | 0.961 | | | | | | | |
| 120C | Max. | 1.000 | 0.996 | 0.993 | 0.999 | 1.004 | 0.998 | 1.006 | 0.999 | 1.004 | 1.007 | 1.000 | | | | | | | |
| | Ave. | 1.000 | 0.973 | 0.971 | 0.973 | 0.968 | 0.963 | 0.959 | 0.951 | 0.952 | 0.957 | 0.951 | | | | | | | |
| | Min. | 1.000 | 0.953 | 0.948 | 0.948 | 0.936 | 0.927 | 0.893 | 0.905 | 0.885 | 0.881 | 0.888 | | | | | | | |
| | Std.dev. | 0.000 | 0.013 | 0.014 | 0.017 | 0.020 | 0.024 | 0.035 | 0.029 | 0.035 | 0.037 | 0.035 | | | | | | | |
| | Median | 1.000 | 0.971 | 0.965 | 0.966 | 0.963 | 0.956 | 0.956 | 0.941 | 0.953 | 0.959 | 0.955 | | | | | | | |



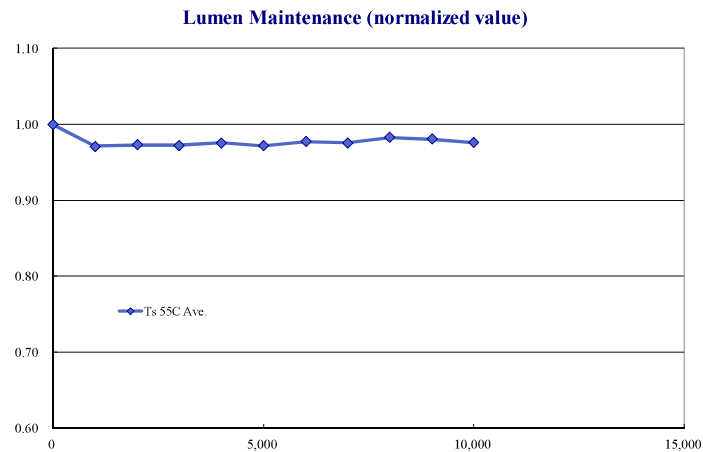
6. IES LM80-08 Test Result

6-1. Test condition 1 : 55C

6-1-1. Lumen Maintenance

| | |
|---------------------------------|--------|
| Actual case temperature (Ts) | 55.5C |
| Actual ambient temperature (Ta) | 56.0C |
| Drive current (If) | 4140mA |

| Sample No. | Luminous Flux (lm) | Lumen Maintenance (normalized value) | | | | | | | | | | | | | | | | | |
|------------|--------------------|--------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|---|---|---|---|---|---|---|
| | | 0H | 1,000 H | 2,000 H | 3,000 H | 4,000 H | 5,000 H | 6,000 H | 7,000 H | 8,000 H | 9,000 H | 10,000 H | H | H | H | H | H | H | H |
| 1 | 17,847 | 1.000 | 0.985 | 0.971 | 0.974 | 0.977 | 0.976 | 0.986 | 0.963 | 0.972 | 0.972 | 0.972 | | | | | | | |
| 2 | 18,500 | 1.000 | 0.979 | 0.985 | 0.987 | 0.990 | 0.986 | 0.986 | 0.984 | 0.993 | 0.989 | 0.986 | | | | | | | |
| 3 | 18,416 | 1.000 | 0.959 | 0.972 | 0.963 | 0.968 | 0.963 | 0.970 | 0.981 | 0.985 | 0.983 | 0.982 | | | | | | | |
| 4 | 18,138 | 1.000 | 0.966 | 0.970 | 0.969 | 0.976 | 0.963 | 0.975 | 0.970 | 0.976 | 0.977 | 0.972 | | | | | | | |
| 5 | 18,464 | 1.000 | 0.983 | 0.985 | 0.985 | 0.985 | 0.984 | 0.989 | 0.990 | 0.995 | 0.989 | 0.988 | | | | | | | |
| 6 | 17,642 | 1.000 | 0.981 | 0.983 | 0.983 | 0.993 | 0.982 | 0.987 | 0.989 | 0.997 | 0.992 | 0.985 | | | | | | | |
| 7 | 18,190 | 1.000 | 0.970 | 0.969 | 0.967 | 0.971 | 0.971 | 0.974 | 0.975 | 0.982 | 0.976 | 0.971 | | | | | | | |
| 8 | 18,219 | 1.000 | 0.970 | 0.965 | 0.971 | 0.975 | 0.968 | 0.977 | 0.978 | 0.983 | 0.982 | 0.974 | | | | | | | |
| 9 | 18,097 | 1.000 | 0.968 | 0.971 | 0.974 | 0.969 | 0.972 | 0.975 | 0.974 | 0.982 | 0.987 | 0.980 | | | | | | | |
| 10 | 18,316 | 1.000 | 0.964 | 0.967 | 0.967 | 0.973 | 0.967 | 0.969 | 0.968 | 0.975 | 0.969 | 0.966 | | | | | | | |
| 11 | 18,209 | 1.000 | 0.958 | 0.967 | 0.961 | 0.957 | 0.960 | 0.964 | 0.966 | 0.973 | 0.972 | 0.964 | | | | | | | |
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| 20 | | | | | | | | | | | | | | | | | | | |
| Max. | | 1.000 | 0.985 | 0.985 | 0.987 | 0.993 | 0.986 | 0.989 | 0.990 | 0.997 | 0.992 | 0.988 | | | | | | | |
| Ave. | | 1.000 | 0.971 | 0.973 | 0.973 | 0.976 | 0.972 | 0.978 | 0.976 | 0.983 | 0.981 | 0.976 | | | | | | | |
| Min. | | 1.000 | 0.958 | 0.965 | 0.961 | 0.957 | 0.960 | 0.964 | 0.963 | 0.972 | 0.969 | 0.964 | | | | | | | |
| Std. dev. | | 0.000 | 0.009 | 0.007 | 0.008 | 0.010 | 0.009 | 0.008 | 0.009 | 0.008 | 0.008 | 0.008 | | | | | | | |
| Median | | 1.000 | 0.970 | 0.971 | 0.971 | 0.975 | 0.971 | 0.975 | 0.975 | 0.982 | 0.982 | 0.974 | | | | | | | |

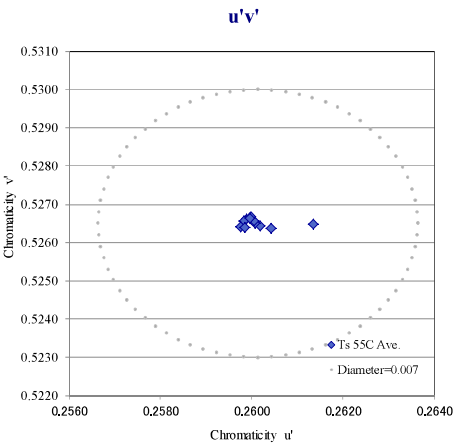
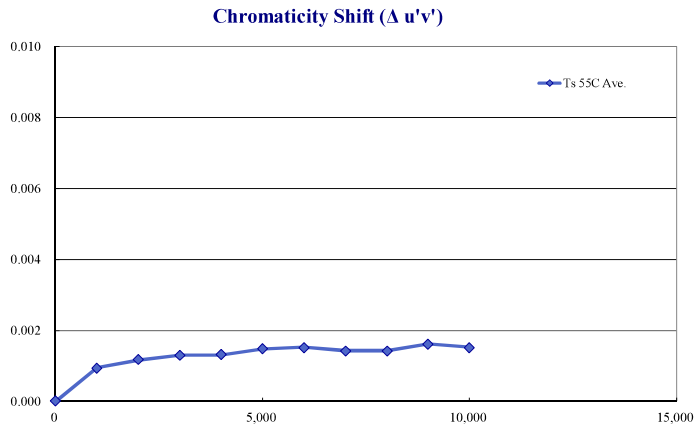


6-1. Test condition 1 : 55C

6-1-2. Chromaticity Shift ($\Delta u'v'$)

| | |
|---------------------------------|--------|
| Actual case temperature (Ts) | 55.5C |
| Actual ambient temperature (Ta) | 56.0C |
| Drive current (If) | 4140mA |

| Sample No. | x | y | Chromaticity Shift ($\Delta u'v'$) | | | | | | | | | | | | | | | | | |
|------------|--------|--------|--------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|---|---|---|---|---|---|---|
| | 0H | 0H | 0H | 1,000 H | 2,000 H | 3,000 H | 4,000 H | 5,000 H | 6,000 H | 7,000 H | 8,000 H | 9,000 H | 10,000 H | H | H | H | H | H | H | H |
| 1 | 0.4557 | 0.4084 | - | 0.0011 | 0.0009 | 0.0012 | 0.0013 | 0.0016 | 0.0016 | 0.0011 | 0.0011 | 0.0010 | 0.0009 | | | | | | | |
| 2 | 0.4583 | 0.4111 | - | 0.0009 | 0.0012 | 0.0014 | 0.0014 | 0.0015 | 0.0015 | 0.0014 | 0.0014 | 0.0016 | 0.0015 | | | | | | | |
| 3 | 0.4582 | 0.4106 | - | 0.0008 | 0.0011 | 0.0011 | 0.0011 | 0.0013 | 0.0014 | 0.0014 | 0.0014 | 0.0016 | 0.0015 | | | | | | | |
| 4 | 0.4587 | 0.4109 | - | 0.0009 | 0.0012 | 0.0013 | 0.0014 | 0.0014 | 0.0016 | 0.0015 | 0.0015 | 0.0018 | 0.0016 | | | | | | | |
| 5 | 0.4575 | 0.4072 | - | 0.0010 | 0.0013 | 0.0014 | 0.0014 | 0.0016 | 0.0016 | 0.0016 | 0.0016 | 0.0017 | 0.0017 | | | | | | | |
| 6 | 0.4543 | 0.4064 | - | 0.0008 | 0.0010 | 0.0012 | 0.0011 | 0.0013 | 0.0014 | 0.0014 | 0.0013 | 0.0015 | 0.0014 | | | | | | | |
| 7 | 0.4588 | 0.4111 | - | 0.0007 | 0.0010 | 0.0011 | 0.0010 | 0.0013 | 0.0013 | 0.0011 | 0.0011 | 0.0013 | 0.0012 | | | | | | | |
| 8 | 0.4559 | 0.4086 | - | 0.0011 | 0.0015 | 0.0016 | 0.0015 | 0.0017 | 0.0018 | 0.0018 | 0.0018 | 0.0020 | 0.0019 | | | | | | | |
| 9 | 0.4557 | 0.4082 | - | 0.0012 | 0.0014 | 0.0016 | 0.0016 | 0.0017 | 0.0017 | 0.0016 | 0.0017 | 0.0020 | 0.0019 | | | | | | | |
| 10 | 0.4589 | 0.4114 | - | 0.0008 | 0.0011 | 0.0012 | 0.0012 | 0.0013 | 0.0013 | 0.0012 | 0.0012 | 0.0014 | 0.0014 | | | | | | | |
| 11 | 0.4577 | 0.4092 | - | 0.0010 | 0.0012 | 0.0012 | 0.0014 | 0.0015 | 0.0015 | 0.0015 | 0.0015 | 0.0017 | 0.0016 | | | | | | | |
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| Max. | | | - | 0.0012 | 0.0015 | 0.0016 | 0.0016 | 0.0017 | 0.0018 | 0.0018 | 0.0018 | 0.0020 | 0.0019 | | | | | | | |
| Ave. | | | - | 0.0009 | 0.0012 | 0.0013 | 0.0013 | 0.0015 | 0.0015 | 0.0014 | 0.0014 | 0.0016 | 0.0015 | | | | | | | |
| Mn. | | | - | 0.0007 | 0.0009 | 0.0011 | 0.0010 | 0.0013 | 0.0013 | 0.0011 | 0.0011 | 0.0010 | 0.0009 | | | | | | | |
| Std. dev. | | | - | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0001 | 0.0001 | 0.0002 | 0.0002 | 0.0003 | 0.0003 | | | | | | | |
| Median | | | - | 0.0009 | 0.0012 | 0.0012 | 0.0014 | 0.0015 | 0.0015 | 0.0014 | 0.0014 | 0.0016 | 0.0015 | | | | | | | |

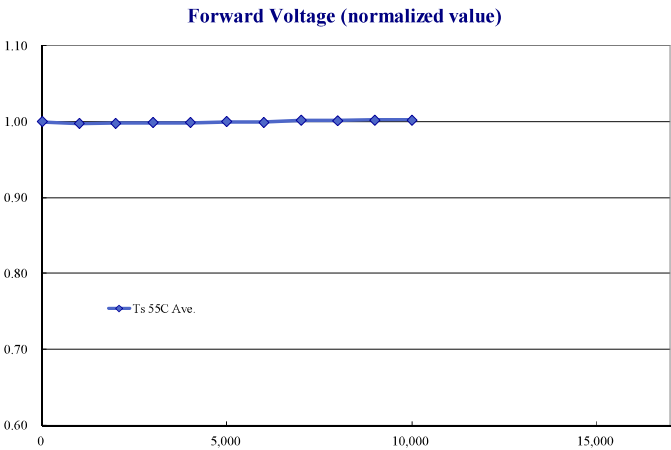


6-1. Test condition 1 : 55C

6-1-3. Forward Voltage

| | |
|---------------------------------|--------|
| Actual case temperature (Ts) | 55.5C |
| Actual ambient temperature (Ta) | 56.0C |
| Drive current (If) | 4140mA |

| Sample No. | Forward Voltage (V) | Forward Voltage (normalized value) | | | | | | | | | | | | | | | | | |
|------------|---------------------|------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|---|---|---|---|---|---|---|
| | | 0H | 1,000 H | 2,000 H | 3,000 H | 4,000 H | 5,000 H | 6,000 H | 7,000 H | 8,000 H | 9,000 H | 10,000 H | H | H | H | H | H | H | H |
| 1 | 57.63 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.02 | 1.01 | 1.01 | 1.01 | | | | | | | |
| 2 | 57.66 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | | | | | |
| 3 | 57.95 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | | | | | |
| 4 | 57.76 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | | | | | |
| 5 | 57.73 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | | | | | |
| 6 | 57.42 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | | | | | |
| 7 | 57.72 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | | | | | |
| 8 | 57.72 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | | | | | |
| 9 | 57.61 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | | | | | |
| 10 | 57.56 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | | | | | |
| 11 | 57.91 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | | | | | |
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| Max | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.02 | 1.01 | 1.01 | 1.01 | | | | | | | |
| Ave | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | | | | | |
| Min | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | | | | | |
| Std. dev | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | | | | | | | |
| Median | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | | | | | |



6-1. Test condition 1 : 55C

6-1-4. Calculated CCT

| | |
|---------------------------------|--------|
| Actual case temperature (Ts) | 55.5C |
| Actual ambient temperature (Ta) | 56.0C |
| Drive current (If) | 4140mA |

| Sample No. | ANSI Target CCT (K) | Calculated CCT (K) | | | | | | | | | | | | | | | | | |
|------------|---------------------|--------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|---|---|---|---|---|---|---|
| | | 0H | 1,000 H | 2,000 H | 3,000 H | 4,000 H | 5,000 H | 6,000 H | 7,000 H | 8,000 H | 9,000 H | 10,000 H | H | H | H | H | H | H | H |
| 1 | 2,700 | 2,742 | 2,766 | 2,761 | 2,768 | 2,770 | 2,775 | 2,777 | 2,751 | 2,755 | 2,759 | 2,757 | | | | | | | |
| 2 | 2,700 | 2,726 | 2,745 | 2,751 | 2,754 | 2,755 | 2,756 | 2,756 | 2,755 | 2,755 | 2,760 | 2,758 | | | | | | | |
| 3 | 2,700 | 2,724 | 2,741 | 2,748 | 2,747 | 2,747 | 2,752 | 2,753 | 2,752 | 2,752 | 2,758 | 2,756 | | | | | | | |
| 4 | 2,700 | 2,720 | 2,737 | 2,744 | 2,745 | 2,748 | 2,748 | 2,753 | 2,750 | 2,751 | 2,757 | 2,754 | | | | | | | |
| 5 | 2,700 | 2,707 | 2,729 | 2,734 | 2,736 | 2,737 | 2,740 | 2,741 | 2,740 | 2,740 | 2,743 | 2,743 | | | | | | | |
| 6 | 2,700 | 2,746 | 2,763 | 2,767 | 2,768 | 2,769 | 2,772 | 2,777 | 2,775 | 2,774 | 2,779 | 2,776 | | | | | | | |
| 7 | 2,700 | 2,719 | 2,733 | 2,740 | 2,742 | 2,740 | 2,746 | 2,745 | 2,742 | 2,742 | 2,747 | 2,744 | | | | | | | |
| 8 | 2,700 | 2,742 | 2,766 | 2,774 | 2,774 | 2,775 | 2,779 | 2,781 | 2,781 | 2,781 | 2,786 | 2,785 | | | | | | | |
| 9 | 2,700 | 2,739 | 2,768 | 2,771 | 2,776 | 2,775 | 2,777 | 2,777 | 2,775 | 2,777 | 2,785 | 2,782 | | | | | | | |
| 10 | 2,700 | 2,720 | 2,739 | 2,744 | 2,745 | 2,745 | 2,747 | 2,747 | 2,744 | 2,745 | 2,751 | 2,750 | | | | | | | |
| 11 | 2,700 | 2,721 | 2,741 | 2,745 | 2,744 | 2,748 | 2,752 | 2,752 | 2,751 | 2,751 | 2,756 | 2,755 | | | | | | | |
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| Max | | 2,746 | 2,768 | 2,774 | 2,776 | 2,775 | 2,779 | 2,781 | 2,781 | 2,781 | 2,786 | 2,785 | | | | | | | |
| Ave | | 2,728 | 2,748 | 2,753 | 2,755 | 2,755 | 2,759 | 2,760 | 2,756 | 2,757 | 2,762 | 2,760 | | | | | | | |
| Min | | 2,707 | 2,729 | 2,734 | 2,736 | 2,737 | 2,740 | 2,741 | 2,740 | 2,740 | 2,743 | 2,743 | | | | | | | |
| Std. dev | | 12 | 14 | 13 | 14 | 13 | 14 | 14 | 14 | 14 | 14 | 14 | | | | | | | |
| Median | | 2,724 | 2,741 | 2,748 | 2,747 | 2,748 | 2,752 | 2,753 | 2,751 | 2,752 | 2,758 | 2,756 | | | | | | | |

6-1. Test condition 1 : 55C

6-1-5. Ra

| | |
|---------------------------------|--------|
| Actual case temperature (Ts) | 55.5C |
| Actual ambient temperature (Ta) | 56.0C |
| Drive current (If) | 4140mA |

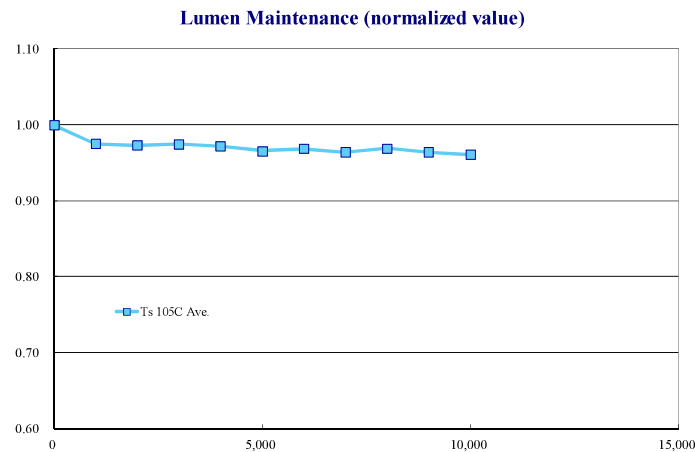
| Sample No. | Ra | Ra | | | | | | | | | | | | | | | | | |
|------------|----|----|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|---|---|---|---|---|---|---|
| | 0H | 0H | 1,000 H | 2,000 H | 3,000 H | 4,000 H | 5,000 H | 6,000 H | 7,000 H | 8,000 H | 9,000 H | 10,000 H | H | H | H | H | H | H | H |
| 1 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | | | | | | | |
| 2 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | | | | | | | |
| 3 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | | | | | | | |
| 4 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | | | | | | | |
| 5 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | | | | | | | |
| 6 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | | | | | | | |
| 7 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | | | | | | | |
| 8 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | | | | | | | |
| 9 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | | | | | | | |
| 10 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | | | | | | | |
| 11 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | | | | | | | |
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| Max | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | | | | | | | |
| Ave | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | | | | | | | |
| Min | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | | | | | | | |
| Std. dev | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | |
| Median | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | | | | | | | |

6-2. Test condition 2 : 105C

6-2-1. Lumen Maintenance

| | |
|---------------------------------|--------|
| Actual case temperature (Ts) | 105.1C |
| Actual ambient temperature (Ta) | 103.2C |
| Drive current (If) | 4140mA |

| Sample No. | Luminous Flux (lm) | Lumen Maintenance (normalized value) | | | | | | | | | | | | | | | | | |
|------------|--------------------|--------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|---|---|---|---|---|---|---|
| | | 0H | 1,000 H | 2,000 H | 3,000 H | 4,000 H | 5,000 H | 6,000 H | 7,000 H | 8,000 H | 9,000 H | 10,000 H | H | H | H | H | H | H | H |
| 1 | 17,482 | 1.000 | 0.994 | 0.988 | 0.988 | 0.990 | 0.980 | 0.981 | 0.978 | 0.984 | 0.981 | 0.974 | | | | | | | |
| 2 | 17,981 | 1.000 | 0.966 | 0.964 | 0.965 | 0.967 | 0.953 | 0.960 | 0.962 | 0.972 | 0.968 | 0.963 | | | | | | | |
| 3 | 18,182 | 1.000 | 0.972 | 0.969 | 0.973 | 0.971 | 0.964 | 0.963 | 0.959 | 0.970 | 0.967 | 0.962 | | | | | | | |
| 4 | 18,139 | 1.000 | 0.968 | 0.964 | 0.964 | 0.966 | 0.957 | 0.954 | 0.955 | 0.964 | 0.957 | 0.957 | | | | | | | |
| 5 | 17,939 | 1.000 | 0.987 | 0.983 | 0.985 | 0.981 | 0.977 | 0.981 | 0.978 | 0.988 | 0.983 | 0.981 | | | | | | | |
| 6 | 18,073 | 1.000 | 0.977 | 0.976 | 0.979 | 0.978 | 0.968 | 0.974 | 0.953 | 0.958 | 0.951 | 0.947 | | | | | | | |
| 7 | 17,921 | 1.000 | 0.965 | 0.968 | 0.970 | 0.962 | 0.960 | 0.963 | 0.959 | 0.966 | 0.962 | 0.961 | | | | | | | |
| 8 | 17,927 | 1.000 | 0.970 | 0.969 | 0.974 | 0.968 | 0.965 | 0.970 | 0.964 | 0.964 | 0.952 | 0.957 | | | | | | | |
| 9 | 18,204 | 1.000 | 0.982 | 0.981 | 0.983 | 0.981 | 0.978 | 0.985 | 0.974 | 0.983 | 0.979 | 0.978 | | | | | | | |
| 10 | 17,976 | 1.000 | 0.982 | 0.979 | 0.977 | 0.973 | 0.975 | 0.975 | 0.969 | 0.971 | 0.968 | 0.960 | | | | | | | |
| 11 | 17,886 | 1.000 | 0.968 | 0.960 | 0.964 | 0.959 | 0.949 | 0.951 | 0.951 | 0.940 | 0.936 | 0.928 | | | | | | | |
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| Max. | | 1.000 | 0.994 | 0.988 | 0.988 | 0.990 | 0.980 | 0.985 | 0.978 | 0.988 | 0.983 | 0.981 | | | | | | | |
| Ave. | | 1.000 | 0.975 | 0.973 | 0.975 | 0.972 | 0.966 | 0.969 | 0.964 | 0.969 | 0.964 | 0.961 | | | | | | | |
| Min. | | 1.000 | 0.965 | 0.960 | 0.964 | 0.959 | 0.949 | 0.951 | 0.951 | 0.940 | 0.936 | 0.928 | | | | | | | |
| Std. dev. | | 0.000 | 0.009 | 0.009 | 0.008 | 0.009 | 0.010 | 0.011 | 0.009 | 0.013 | 0.014 | 0.014 | | | | | | | |
| Median | | 1.000 | 0.972 | 0.969 | 0.974 | 0.971 | 0.965 | 0.970 | 0.962 | 0.970 | 0.967 | 0.961 | | | | | | | |

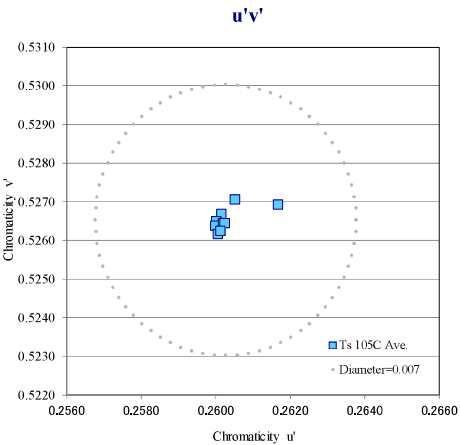
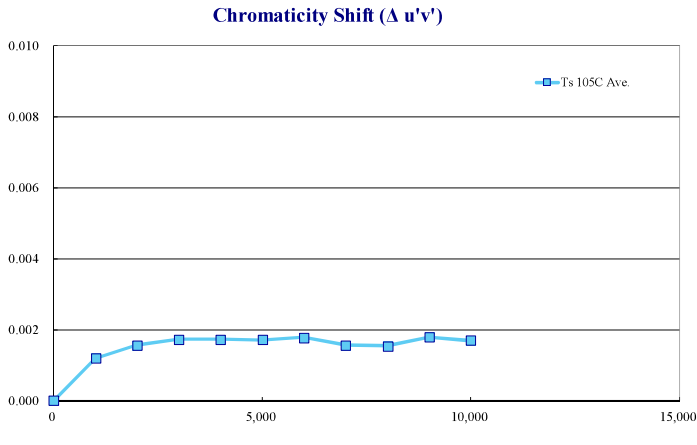


6-2. Test condition 2 : 105C

6-2-2. Chromaticity Shift ($\Delta u'v'$)

| | |
|---------------------------------|--------|
| Actual case temperature (Ts) | 105.1C |
| Actual ambient temperature (Ta) | 103.2C |
| Drive current (If) | 4140mA |

| Sample No. | x | | y | | Chromaticity Shift ($\Delta u'v'$) | | | | | | | | | | | | | | | | |
|------------|--------|--------|----|--------|--------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|----------|---|---|---|---|---|---|---|
| | 0H | 0H | 0H | 0H | 1,000 H | 2,000 H | 3,000 H | 4,000 H | 5,000 H | 6,000 H | 7,000 H | 8,000 H | 9,000 H | 10,000 H | H | H | H | H | H | H | H |
| 1 | 0.4570 | 0.4098 | - | 0.0009 | 0.0013 | 0.0015 | 0.0014 | 0.0014 | 0.0015 | 0.0013 | 0.0013 | 0.0017 | 0.0014 | | | | | | | | |
| 2 | 0.4582 | 0.4106 | - | 0.0011 | 0.0015 | 0.0017 | 0.0018 | 0.0016 | 0.0017 | 0.0017 | 0.0017 | 0.0019 | 0.0018 | | | | | | | | |
| 3 | 0.4581 | 0.4098 | - | 0.0012 | 0.0013 | 0.0015 | 0.0015 | 0.0014 | 0.0014 | 0.0013 | 0.0013 | 0.0016 | 0.0014 | | | | | | | | |
| 4 | 0.4580 | 0.4102 | - | 0.0012 | 0.0015 | 0.0017 | 0.0017 | 0.0016 | 0.0019 | 0.0017 | 0.0016 | 0.0018 | 0.0018 | | | | | | | | |
| 5 | 0.4596 | 0.4116 | - | 0.0012 | 0.0016 | 0.0018 | 0.0019 | 0.0019 | 0.0019 | 0.0019 | 0.0019 | 0.0021 | 0.0021 | | | | | | | | |
| 6 | 0.4591 | 0.4115 | - | 0.0013 | 0.0016 | 0.0017 | 0.0018 | 0.0018 | 0.0019 | 0.0014 | 0.0013 | 0.0017 | 0.0015 | | | | | | | | |
| 7 | 0.4570 | 0.4085 | - | 0.0012 | 0.0016 | 0.0018 | 0.0017 | 0.0018 | 0.0018 | 0.0016 | 0.0017 | 0.0020 | 0.0018 | | | | | | | | |
| 8 | 0.4585 | 0.4100 | - | 0.0012 | 0.0016 | 0.0018 | 0.0018 | 0.0018 | 0.0018 | 0.0016 | 0.0015 | 0.0017 | 0.0018 | | | | | | | | |
| 9 | 0.4576 | 0.4085 | - | 0.0011 | 0.0017 | 0.0019 | 0.0019 | 0.0019 | 0.0020 | 0.0014 | 0.0016 | 0.0019 | 0.0018 | | | | | | | | |
| 10 | 0.4587 | 0.4096 | - | 0.0014 | 0.0018 | 0.0019 | 0.0018 | 0.0018 | 0.0018 | 0.0016 | 0.0015 | 0.0018 | 0.0016 | | | | | | | | |
| 11 | 0.4590 | 0.4116 | - | 0.0012 | 0.0017 | 0.0018 | 0.0017 | 0.0017 | 0.0018 | 0.0017 | 0.0015 | 0.0018 | 0.0017 | | | | | | | | |
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| Max. | | | - | 0.0014 | 0.0018 | 0.0019 | 0.0019 | 0.0019 | 0.0020 | 0.0019 | 0.0019 | 0.0021 | 0.0021 | | | | | | | | |
| Ave. | | | - | 0.0012 | 0.0016 | 0.0017 | 0.0017 | 0.0017 | 0.0018 | 0.0016 | 0.0015 | 0.0018 | 0.0017 | | | | | | | | |
| Min. | | | - | 0.0009 | 0.0013 | 0.0015 | 0.0014 | 0.0014 | 0.0014 | 0.0013 | 0.0013 | 0.0016 | 0.0014 | | | | | | | | |
| Std. dev. | | | - | 0.0001 | 0.0001 | 0.0001 | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 | | | | | | | | |
| Median | | | - | 0.0012 | 0.0016 | 0.0018 | 0.0018 | 0.0018 | 0.0018 | 0.0016 | 0.0015 | 0.0018 | 0.0018 | | | | | | | | |

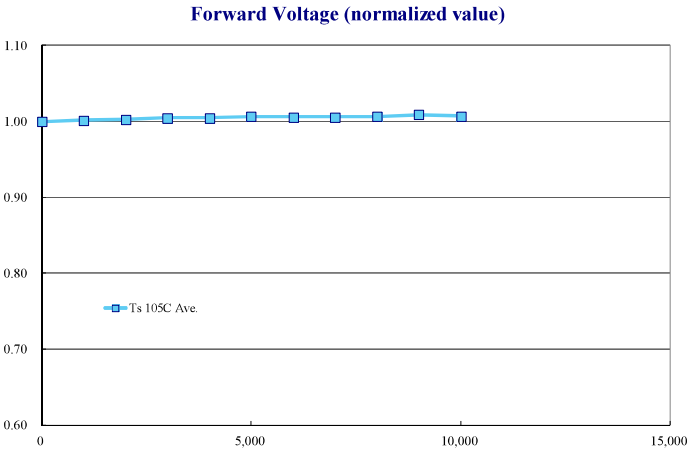


6-2. Test condition 2 : 105C

6-2-3. Forward Voltage

| | |
|---------------------------------|--------|
| Actual case temperature (Ts) | 105.1C |
| Actual ambient temperature (Ta) | 103.2C |
| Drive current (If) | 4140mA |

| Sample No. | Forward Voltage (V) | Forward Voltage (normalized value) | | | | | | | | | | | | | | | | | |
|------------|---------------------|------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|------|---|---|---|---|---|---|
| | | 0H | 1,000 H | 2,000 H | 3,000 H | 4,000 H | 5,000 H | 6,000 H | 7,000 H | 8,000 H | 9,000 H | 10,000 H | H | H | H | H | H | H | H |
| 1 | 57.37 | 1.00 | 1.00 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | | | | | | | |
| 2 | 57.40 | 1.00 | 1.00 | 1.00 | 1.00 | 1.01 | 1.00 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | | | | | | | |
| 3 | 57.61 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.01 | 1.01 | 1.00 | 1.01 | 1.01 | 1.00 | | | | | | | |
| 4 | 57.36 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.01 | 1.01 | 1.00 | 1.01 | 1.01 | 1.01 | | | | | | | |
| 5 | 57.47 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | | | | | | | |
| 6 | 57.53 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.01 | 1.01 | 1.01 | 1.00 | 1.00 | 1.01 | 1.00 | | | | | | |
| 7 | 57.43 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | | | | | | | |
| 8 | 57.51 | 1.00 | 1.00 | 1.00 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | | | | | | |
| 9 | 57.60 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.01 | 1.00 | | | | | | | |
| 10 | 57.45 | 1.00 | 1.00 | 1.00 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | | | | | | | |
| 11 | 57.41 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.01 | 1.00 | 1.00 | 1.00 | | | | | | | |
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| Max | | 1.00 | 1.00 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | | | | | | | |
| Ave | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | | | | | | | |
| Min | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | | | | | | | |
| Std. dev | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | | | | | | |
| Median | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | | | | | | | |



6-2. Test condition 2 : 105C

6-2-4. Calculated CCT

| | |
|---------------------------------|--------|
| Actual case temperature (Ts) | 105.1C |
| Actual ambient temperature (Ta) | 103.2C |
| Drive current (If) | 4140mA |

| Sample No. | ANSI Target CCT (K) | Calculated CCT (K) | | | | | | | | | | | | | | | | | |
|------------|---------------------|--------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|---|---|---|---|---|---|---|
| | | 0H | 1,000 H | 2,000 H | 3,000 H | 4,000 H | 5,000 H | 6,000 H | 7,000 H | 8,000 H | 9,000 H | 10,000 H | H | H | H | H | H | H | H |
| 1 | 2,700 | 2,734 | 2,754 | 2,763 | 2,766 | 2,765 | 2,765 | 2,767 | 2,763 | 2,763 | 2,769 | 2,765 | | | | | | | |
| 2 | 2,700 | 2,724 | 2,746 | 2,756 | 2,761 | 2,763 | 2,761 | 2,762 | 2,762 | 2,760 | 2,764 | 2,762 | | | | | | | |
| 3 | 2,700 | 2,720 | 2,740 | 2,747 | 2,752 | 2,751 | 2,750 | 2,750 | 2,747 | 2,747 | 2,753 | 2,750 | | | | | | | |
| 4 | 2,700 | 2,724 | 2,748 | 2,755 | 2,759 | 2,760 | 2,759 | 2,763 | 2,759 | 2,758 | 2,763 | 2,761 | | | | | | | |
| 5 | 2,700 | 2,711 | 2,737 | 2,745 | 2,750 | 2,751 | 2,752 | 2,753 | 2,750 | 2,751 | 2,755 | 2,754 | | | | | | | |
| 6 | 2,700 | 2,719 | 2,744 | 2,751 | 2,756 | 2,757 | 2,757 | 2,758 | 2,747 | 2,746 | 2,752 | 2,749 | | | | | | | |
| 7 | 2,700 | 2,725 | 2,749 | 2,759 | 2,764 | 2,763 | 2,764 | 2,763 | 2,760 | 2,762 | 2,767 | 2,763 | | | | | | | |
| 8 | 2,700 | 2,715 | 2,739 | 2,749 | 2,754 | 2,753 | 2,755 | 2,755 | 2,750 | 2,748 | 2,749 | 2,753 | | | | | | | |
| 9 | 2,700 | 2,715 | 2,740 | 2,752 | 2,755 | 2,755 | 2,756 | 2,757 | 2,745 | 2,749 | 2,754 | 2,752 | | | | | | | |
| 10 | 2,700 | 2,709 | 2,735 | 2,746 | 2,749 | 2,747 | 2,747 | 2,747 | 2,744 | 2,741 | 2,747 | 2,742 | | | | | | | |
| 11 | 2,700 | 2,719 | 2,747 | 2,754 | 2,757 | 2,755 | 2,756 | 2,755 | 2,755 | 2,746 | 2,750 | 2,748 | | | | | | | |
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| 20 | | | | | | | | | | | | | | | | | | | |
| Max | | 2,734 | 2,754 | 2,763 | 2,766 | 2,765 | 2,765 | 2,767 | 2,763 | 2,763 | 2,769 | 2,765 | | | | | | | |
| Ave | | 2,719 | 2,743 | 2,752 | 2,757 | 2,756 | 2,757 | 2,757 | 2,753 | 2,752 | 2,757 | 2,754 | | | | | | | |
| Min | | 2,709 | 2,735 | 2,745 | 2,749 | 2,747 | 2,747 | 2,747 | 2,744 | 2,741 | 2,747 | 2,742 | | | | | | | |
| Std. dev | | 7 | 6 | 5 | 5 | 6 | 5 | 6 | 7 | 7 | 7 | 7 | | | | | | | |
| Median | | 2,719 | 2,744 | 2,752 | 2,756 | 2,755 | 2,756 | 2,757 | 2,750 | 2,749 | 2,754 | 2,753 | | | | | | | |

6-2. Test condition 2 : 105C

6-2-5. Ra

| | |
|---------------------------------|--------|
| Actual case temperature (Ts) | 105.1C |
| Actual ambient temperature (Ta) | 103.2C |
| Drive current (If) | 4140mA |

| Sample No. | Ra | Ra | | | | | | | | | | | | | | | | | |
|------------|----|----|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|---|---|---|---|---|---|---|
| | 0H | 0H | 1,000 H | 2,000 H | 3,000 H | 4,000 H | 5,000 H | 6,000 H | 7,000 H | 8,000 H | 9,000 H | 10,000 H | H | H | H | H | H | H | H |
| 1 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | | | | | | | |
| 2 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | | | | | | | |
| 3 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | | | | | | | |
| 4 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | | | | | | | |
| 5 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | | | | | | | |
| 6 | 93 | 93 | 93 | 93 | 93 | 94 | 94 | 94 | 93 | 93 | 94 | 94 | | | | | | | |
| 7 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | | | | | | | |
| 8 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | | | | | | | |
| 9 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | | | | | | | |
| 10 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | | | | | | | |
| 11 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | | | | | | | |
| 12 | | | | | | | | | | | | | | | | | | | |
| 13 | | | | | | | | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | | | | | | | | |
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| 19 | | | | | | | | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | | | | | | | | |
| Max | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | | | | | | | |
| Ave | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | | | | | | | |
| Min | 93 | 93 | 93 | 93 | 94 | 94 | 94 | 94 | 93 | 93 | 94 | 94 | | | | | | | |
| Std. dev | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | |
| Median | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | | | | | | | |

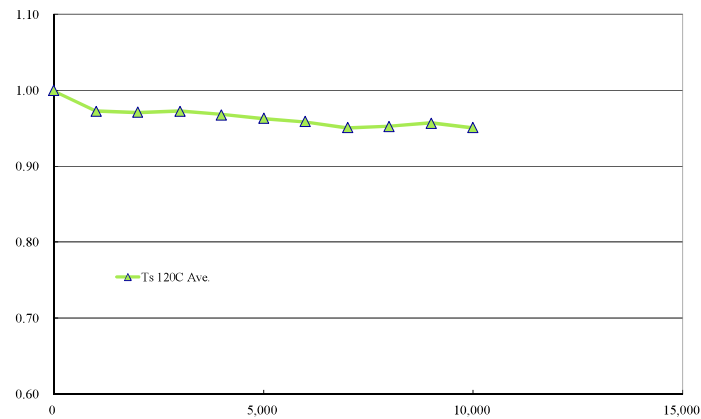
6-3. Test condition 3 : 120C

6-3-1. Lumen Maintenance

| | |
|---------------------------------|--------|
| Actual case temperature (Ts) | 120.5C |
| Actual ambient temperature (Ta) | 122.8C |
| Drive current (If) | 4140mA |

| Sample No. | Luminous Flux (lm) | Lumen Maintenance (normalized value) | | | | | | | | | | | | | | | | | |
|------------|--------------------|--------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|---|---|---|---|---|---|---|
| | | 0H | 1,000 H | 2,000 H | 3,000 H | 4,000 H | 5,000 H | 6,000 H | 7,000 H | 8,000 H | 9,000 H | 10,000 H | H | H | H | H | H | H | H |
| 1 | 17,983 | 1.000 | 0.971 | 0.974 | 0.978 | 0.973 | 0.966 | 0.970 | 0.966 | 0.969 | 0.969 | 0.961 | | | | | | | |
| 2 | 18,022 | 1.000 | 0.966 | 0.965 | 0.966 | 0.963 | 0.956 | 0.956 | 0.941 | 0.953 | 0.962 | 0.955 | | | | | | | |
| 3 | 17,858 | 1.000 | 0.962 | 0.958 | 0.957 | 0.946 | 0.938 | 0.893 | 0.905 | 0.885 | 0.881 | 0.888 | | | | | | | |
| 4 | 18,459 | 1.000 | 0.982 | 0.987 | 0.989 | 0.985 | 0.991 | 0.998 | 0.999 | 1.002 | 1.003 | 1.000 | | | | | | | |
| 5 | 18,199 | 1.000 | 0.978 | 0.977 | 0.984 | 0.983 | 0.983 | 0.988 | 0.985 | 0.957 | 0.959 | 0.953 | | | | | | | |
| 6 | 18,354 | 1.000 | 0.996 | 0.993 | 0.999 | 1.004 | 0.998 | 1.006 | 0.984 | 0.982 | 0.996 | 0.985 | | | | | | | |
| 7 | 17,968 | 1.000 | 0.967 | 0.957 | 0.957 | 0.955 | 0.942 | 0.944 | 0.937 | 0.942 | 0.945 | 0.935 | | | | | | | |
| 8 | 18,407 | 1.000 | 0.991 | 0.992 | 0.997 | 0.994 | 0.995 | 0.994 | 0.959 | 1.004 | 1.007 | 0.999 | | | | | | | |
| 9 | 17,991 | 1.000 | 0.974 | 0.964 | 0.963 | 0.958 | 0.956 | 0.952 | 0.930 | 0.951 | 0.958 | 0.955 | | | | | | | |
| 10 | 17,799 | 1.000 | 0.960 | 0.961 | 0.961 | 0.952 | 0.943 | 0.940 | 0.934 | 0.927 | 0.934 | 0.924 | | | | | | | |
| 11 | 17,778 | 1.000 | 0.953 | 0.948 | 0.948 | 0.936 | 0.927 | 0.907 | 0.918 | 0.906 | 0.911 | 0.904 | | | | | | | |
| 12 | | | | | | | | | | | | | | | | | | | |
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| 19 | | | | | | | | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | | | | | | | | |
| Max. | | 1.000 | 0.996 | 0.993 | 0.999 | 1.004 | 0.998 | 1.006 | 0.999 | 1.004 | 1.007 | 1.000 | | | | | | | |
| Ave. | | 1.000 | 0.973 | 0.971 | 0.973 | 0.968 | 0.963 | 0.959 | 0.951 | 0.952 | 0.957 | 0.951 | | | | | | | |
| Min. | | 1.000 | 0.953 | 0.948 | 0.948 | 0.936 | 0.927 | 0.893 | 0.905 | 0.885 | 0.881 | 0.888 | | | | | | | |
| Std. dev. | | 0.000 | 0.013 | 0.014 | 0.017 | 0.020 | 0.024 | 0.035 | 0.029 | 0.035 | 0.037 | 0.035 | | | | | | | |
| Median | | 1.000 | 0.971 | 0.965 | 0.966 | 0.963 | 0.956 | 0.956 | 0.941 | 0.953 | 0.959 | 0.955 | | | | | | | |

Lumen Maintenance (normalized value)

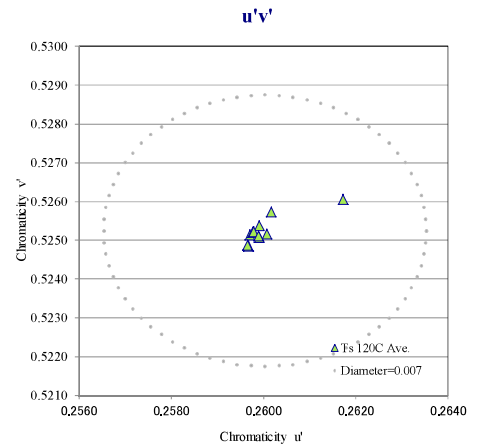
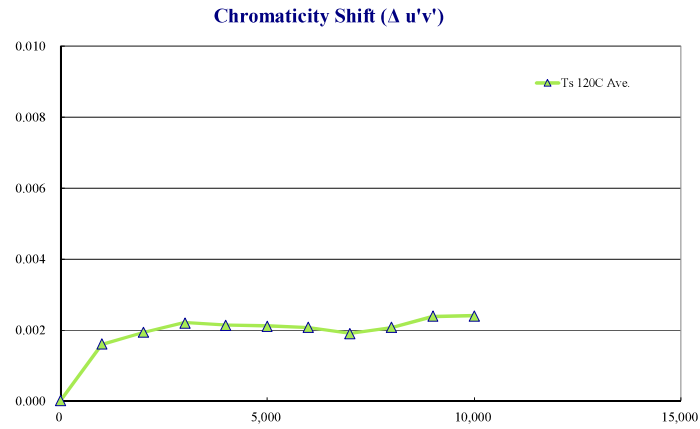


6-3. Test condition 3 : 120C

6-3-2. Chromaticity Shift ($\Delta u'v'$)

| | |
|---------------------------------|--------|
| Actual case temperature (Ts) | 120.5C |
| Actual ambient temperature (Ta) | 122.8C |
| Drive current (If) | 4140mA |

| Sample No. | x | y | Chromaticity Shift ($\Delta u'v'$) | | | | | | | | | | | | | | | | | |
|------------|--------|--------|--------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|---|---|---|---|---|---|---|
| | 0H | 0H | 0H | 1,000 H | 2,000 H | 3,000 H | 4,000 H | 5,000 H | 6,000 H | 7,000 H | 8,000 H | 9,000 H | 10,000 H | H | H | H | H | H | H | H |
| 1 | 0.4580 | 0.4096 | - | 0.0016 | 0.0019 | 0.0022 | 0.0023 | 0.0023 | 0.0023 | 0.0022 | 0.0021 | 0.0023 | 0.0023 | | | | | | | |
| 2 | 0.4586 | 0.4097 | - | 0.0015 | 0.0019 | 0.0020 | 0.0020 | 0.0020 | 0.0021 | 0.0017 | 0.0019 | 0.0022 | 0.0021 | | | | | | | |
| 3 | 0.4609 | 0.4127 | - | 0.0014 | 0.0019 | 0.0022 | 0.0020 | 0.0020 | 0.0015 | 0.0017 | 0.0018 | 0.0021 | 0.0022 | | | | | | | |
| 4 | 0.4546 | 0.4053 | - | 0.0017 | 0.0022 | 0.0024 | 0.0023 | 0.0023 | 0.0023 | 0.0023 | 0.0023 | 0.0025 | 0.0026 | | | | | | | |
| 5 | 0.4575 | 0.4090 | - | 0.0019 | 0.0022 | 0.0025 | 0.0024 | 0.0024 | 0.0025 | 0.0021 | 0.0023 | 0.0027 | 0.0027 | | | | | | | |
| 6 | 0.4577 | 0.4061 | - | 0.0018 | 0.0021 | 0.0024 | 0.0025 | 0.0024 | 0.0024 | 0.0022 | 0.0023 | 0.0027 | 0.0026 | | | | | | | |
| 7 | 0.4577 | 0.4100 | - | 0.0015 | 0.0018 | 0.0021 | 0.0020 | 0.0019 | 0.0020 | 0.0019 | 0.0019 | 0.0023 | 0.0022 | | | | | | | |
| 8 | 0.4551 | 0.4056 | - | 0.0018 | 0.0022 | 0.0025 | 0.0023 | 0.0023 | 0.0023 | 0.0016 | 0.0022 | 0.0025 | 0.0025 | | | | | | | |
| 9 | 0.4574 | 0.4088 | - | 0.0015 | 0.0017 | 0.0020 | 0.0018 | 0.0019 | 0.0020 | 0.0018 | 0.0020 | 0.0023 | 0.0024 | | | | | | | |
| 10 | 0.4543 | 0.4059 | - | 0.0016 | 0.0019 | 0.0022 | 0.0021 | 0.0021 | 0.0020 | 0.0019 | 0.0022 | 0.0025 | 0.0025 | | | | | | | |
| 11 | 0.4583 | 0.4090 | - | 0.0013 | 0.0017 | 0.0019 | 0.0017 | 0.0015 | 0.0015 | 0.0015 | 0.0017 | 0.0021 | 0.0021 | | | | | | | |
| 12 | | | | | | | | | | | | | | | | | | | | |
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| 19 | | | | | | | | | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | | | | | | | | | |
| Max | | | - | 0.0019 | 0.0022 | 0.0025 | 0.0025 | 0.0024 | 0.0025 | 0.0023 | 0.0023 | 0.0027 | 0.0027 | | | | | | | |
| Ave | | | - | 0.0016 | 0.0019 | 0.0022 | 0.0021 | 0.0021 | 0.0021 | 0.0019 | 0.0021 | 0.0024 | 0.0024 | | | | | | | |
| Min | | | - | 0.0013 | 0.0017 | 0.0019 | 0.0017 | 0.0015 | 0.0015 | 0.0015 | 0.0017 | 0.0021 | 0.0021 | | | | | | | |
| Std. dev | | | - | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0003 | 0.0003 | 0.0003 | 0.0002 | 0.0002 | 0.0002 | | | | | | | |
| Median | | | - | 0.0016 | 0.0019 | 0.0022 | 0.0021 | 0.0021 | 0.0021 | 0.0019 | 0.0021 | 0.0023 | 0.0024 | | | | | | | |

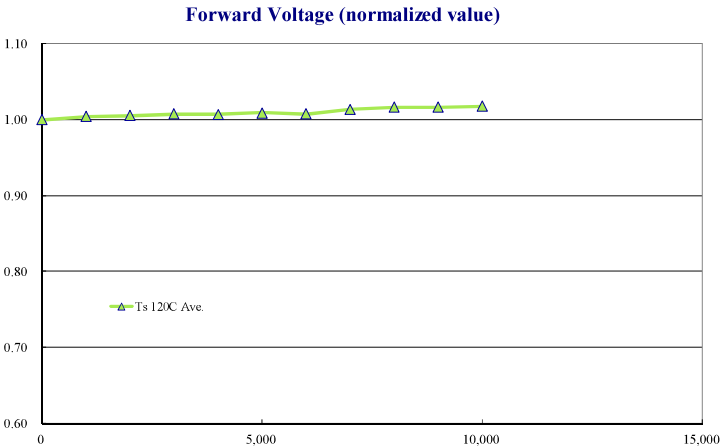


6-3. Test condition 3 : 120C

6-3-3. Forward Voltage

| | |
|---------------------------------|--------|
| Actual case temperature (Ts) | 120.5C |
| Actual ambient temperature (Ta) | 122.8C |
| Drive current (If) | 4140mA |

| Sample No. | Forward Voltage (V) | Forward Voltage (normalized value) | | | | | | | | | | | | | | | | | |
|------------|---------------------|------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|---|---|---|---|---|---|---|
| | | 0H | 1,000 H | 2,000 H | 3,000 H | 4,000 H | 5,000 H | 6,000 H | 7,000 H | 8,000 H | 9,000 H | 10,000 H | H | H | H | H | H | H | H |
| 1 | 57.59 | 1.00 | 1.00 | 1.00 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | | | | | | | |
| 2 | 57.46 | 1.00 | 1.00 | 1.00 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | | | | | | | |
| 3 | 57.52 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.01 | 1.00 | 1.03 | 1.03 | 1.03 | 1.03 | | | | | | | |
| 4 | 58.29 | 1.00 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | 1.02 | 1.02 | 1.02 | 1.02 | | | | | | | |
| 5 | 58.27 | 1.00 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | 1.02 | 1.02 | 1.02 | | | | | | | |
| 6 | 58.21 | 1.00 | 1.01 | 1.01 | 1.01 | 1.01 | 1.02 | 1.01 | 1.02 | 1.01 | 1.01 | 1.01 | | | | | | | |
| 7 | 57.24 | 1.00 | 1.00 | 1.00 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | | | | | | | |
| 8 | 58.31 | 1.00 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | 1.00 | 1.02 | 1.02 | 1.02 | | | | | | | |
| 9 | 57.42 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.01 | 1.01 | 1.00 | 1.01 | 1.01 | 1.01 | | | | | | | |
| 10 | 57.14 | 1.00 | 1.00 | 1.00 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | 1.02 | 1.02 | | | | | | | |
| 11 | 57.14 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.03 | 1.03 | 1.03 | 1.03 | | | | | | | |
| 12 | | | | | | | | | | | | | | | | | | | |
| 13 | | | | | | | | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | | | | | | | | |
| 15 | | | | | | | | | | | | | | | | | | | |
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| 18 | | | | | | | | | | | | | | | | | | | |
| 19 | | | | | | | | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | | | | | | | | |
| Max | | 1.00 | 1.01 | 1.01 | 1.01 | 1.01 | 1.02 | 1.01 | 1.03 | 1.03 | 1.03 | 1.03 | | | | | | | |
| Ave | | 1.00 | 1.00 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | 1.02 | 1.02 | 1.02 | | | | | | | |
| Min | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.01 | 1.01 | 1.01 | | | | | | | |
| Std. dev | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | | | | | | | |
| Median | | 1.00 | 1.00 | 1.00 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | 1.01 | 1.02 | 1.02 | | | | | | | |



6-3. Test condition 3 : 120C

6-3-4. Calculated CCT

| | |
|---------------------------------|--------|
| Actual case temperature (Ts) | 120.5C |
| Actual ambient temperature (Ta) | 122.8C |
| Drive current (If) | 4140mA |

| Sample No. | ANSI Target CCT (K) | Calculated CCT (K) | | | | | | | | | | | | | | | | | |
|------------|---------------------|--------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|---|---|---|---|---|---|---|
| | | 0H | 1,000 H | 2,000 H | 3,000 H | 4,000 H | 5,000 H | 6,000 H | 7,000 H | 8,000 H | 9,000 H | 10,000 H | H | H | H | H | H | H | H |
| 1 | 2,700 | 2,720 | 2,754 | 2,761 | 2,769 | 2,769 | 2,770 | 2,771 | 2,768 | 2,764 | 2,770 | 2,768 | | | | | | | |
| 2 | 2,700 | 2,712 | 2,743 | 2,750 | 2,754 | 2,754 | 2,754 | 2,754 | 2,745 | 2,751 | 2,756 | 2,755 | | | | | | | |
| 3 | 2,700 | 2,703 | 2,733 | 2,742 | 2,748 | 2,745 | 2,744 | 2,729 | 2,737 | 2,739 | 2,742 | 2,745 | | | | | | | |
| 4 | 2,700 | 2,732 | 2,771 | 2,779 | 2,784 | 2,782 | 2,782 | 2,783 | 2,782 | 2,782 | 2,787 | 2,788 | | | | | | | |
| 5 | 2,700 | 2,722 | 2,761 | 2,768 | 2,772 | 2,771 | 2,772 | 2,774 | 2,766 | 2,770 | 2,778 | 2,777 | | | | | | | |
| 6 | 2,700 | 2,725 | 2,764 | 2,770 | 2,777 | 2,778 | 2,778 | 2,776 | 2,771 | 2,773 | 2,782 | 2,779 | | | | | | | |
| 7 | 2,700 | 2,725 | 2,757 | 2,763 | 2,768 | 2,767 | 2,764 | 2,765 | 2,762 | 2,765 | 2,771 | 2,770 | | | | | | | |
| 8 | 2,700 | 2,728 | 2,768 | 2,774 | 2,780 | 2,777 | 2,778 | 2,777 | 2,757 | 2,776 | 2,779 | 2,781 | | | | | | | |
| 9 | 2,700 | 2,721 | 2,753 | 2,758 | 2,763 | 2,761 | 2,762 | 2,762 | 2,758 | 2,765 | 2,770 | 2,772 | | | | | | | |
| 10 | 2,700 | 2,743 | 2,778 | 2,784 | 2,789 | 2,786 | 2,786 | 2,783 | 2,780 | 2,784 | 2,792 | 2,792 | | | | | | | |
| 11 | 2,700 | 2,711 | 2,738 | 2,746 | 2,752 | 2,747 | 2,743 | 2,738 | 2,742 | 2,744 | 2,752 | 2,754 | | | | | | | |
| 12 | | | | | | | | | | | | | | | | | | | |
| 13 | | | | | | | | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | | | | | | | | |
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| 17 | | | | | | | | | | | | | | | | | | | |
| 18 | | | | | | | | | | | | | | | | | | | |
| 19 | | | | | | | | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | | | | | | | | |
| Max. | | 2,743 | 2,778 | 2,784 | 2,789 | 2,786 | 2,786 | 2,783 | 2,782 | 2,784 | 2,792 | 2,792 | | | | | | | |
| Ave. | | 2,722 | 2,756 | 2,763 | 2,769 | 2,767 | 2,767 | 2,765 | 2,761 | 2,765 | 2,771 | 2,771 | | | | | | | |
| Min. | | 2,703 | 2,733 | 2,742 | 2,748 | 2,745 | 2,743 | 2,729 | 2,737 | 2,739 | 2,742 | 2,745 | | | | | | | |
| Std. dev. | | 10 | 13 | 13 | 13 | 13 | 14 | 17 | 14 | 14 | 14 | 14 | | | | | | | |
| Median | | 2,722 | 2,757 | 2,763 | 2,769 | 2,769 | 2,770 | 2,771 | 2,762 | 2,765 | 2,771 | 2,772 | | | | | | | |

6-3. Test condition 3 : 120C

6-3-5. Ra

| | |
|---------------------------------|--------|
| Actual case temperature (Ts) | 120.5C |
| Actual ambient temperature (Ta) | 122.8C |
| Drive current (If) | 4140mA |

| Sample No. | Ra | Ra | | | | | | | | | | | | | | | | | | |
|------------|----|----|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|---|---|---|---|---|---|---|---|
| | 0H | 0H | 1,000 H | 2,000 H | 3,000 H | 4,000 H | 5,000 H | 6,000 H | 7,000 H | 8,000 H | 9,000 H | 10,000 H | H | H | H | H | H | H | H | H |
| 1 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | | | | | | | | |
| 2 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | | | | | | | | |
| 3 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | | | | | | | | |
| 4 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | | | | | | | | |
| 5 | 94 | 94 | 94 | 94 | 95 | 95 | 95 | 95 | 95 | 95 | 94 | 95 | | | | | | | | |
| 6 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | | | | | | | | |
| 7 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | | | | | | | | |
| 8 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 94 | 95 | 95 | 95 | | | | | | | | |
| 9 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | | | | | | | | |
| 10 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | | | | | | | | |
| 11 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | | | | | | | | |
| 12 | | | | | | | | | | | | | | | | | | | | |
| 13 | | | | | | | | | | | | | | | | | | | | |
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| 17 | | | | | | | | | | | | | | | | | | | | |
| 18 | | | | | | | | | | | | | | | | | | | | |
| 19 | | | | | | | | | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | | | | | | | | | |
| Max. | | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | 95 | | | | | | | | |
| Ave. | | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | | | | | | | | |
| Min. | | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | | | | | | | | |
| Std. dev. | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | |
| Median | | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | | | | | | | | |