Test Report

IES LM-80-15 Approved Method for Measuring Lumen Maintenance of LED Light Sources

Report no. : SLED-19-030-R02
Testing start date : 2017.11.28
Testing completion date : 2019.12.30
Report issued date : 2019.05.31
Report revised date : 2020.05.21

Client	Testing performed by
SAMSUNG ELECTRONICS LED BUSINESS Lighting Marketing Group	**SAMSUNG ELECTRONICS LED BUSINESS** 1, Samsung-ro, Giheung-gu, Yongin-si, Gyeonggi-do 17113, Korea e-mail) kwon.sc@samsung.com
Tested By	**Technical Manager**
KyungYeup Kwak	DooSung Park
Test Personal Name & Signatory	**Approval Name & Signatory**

The above test report is the accredited test result by Korea Laboratory Accreditation Scheme, which signed the ILAC-MRA.

※ If you need confirmation about the authenticity of the test report, please contact the above contact information.

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■ Test Report Information ■

1. ■ This test report complies with KS Q ISO/IEC 17025 and KOLAS accreditation regulations.
2. □ This test report does not comply with KS Q ISO/IEC 17025 and KOLAS accreditation regulations.
3. The test results are limited to samples provided by the client and cannot be partially replicated without the approval of this authority, except as a whole.
4. If a statement of conformity is provided in this report, the applied decision rule does not apply the measurement uncertainty except for the case where the measurement uncertainty is mentioned in the above test method.
5. The test results marked ◎ are not accredited by KOLAS.
6. The test results received from external providers for the test results marked ◐.

■ Revision History ■

Data	Revision History	Writer	
		Drawn	Approved
2019.05.31	Rev.0 : New Version	K.Y.KWAK	D.S.PARK
2020.03.30	Rev.1 : Typos Correction	K.Y.KWAK	D.S.PARK
2020.05.21	Rev.2 : Extended Test Duration	K.Y.KWAK	D.S.PARK

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■ Test Summary ■

Life test condition			Summary of result		
Test condition	Current (mA)	Case temperature (℃)	Test duration (h)	Average lumen maintenance (%)	Maximum chromaticity shift (△u'v')
1	700	55.0	17 000	98.5	0.000 6
2	700	85.1	17 000	98.4	0.000 8
3	700	104.9	17 000	98.0	0.001 2

1. Number of the sample

- 20 Packages tested at actual case temperature 55.0 ℃
- 20 Packages tested at actual case temperature 85.1 ℃
- 20 Packages tested at actual case temperature 104.9 ℃

※ Sampling method : Minimum three manufacturing lots with each manufacturing lot built from different wafer lots built on non-consecutive days.

2. Description of LED light sources

- Tested model code : SPHWHTL3D50CE4W***
- Product series : LH351C (SPHWHTL3D50C******)
- Sample manufacturer : Samsung Electronics
- Sample Type : LED Package
- Package dimension : (3.5 × 3.5) ㎜
- Minimum die spacing : -
- CCT / CRI (Nominal) : 2 700 K / 70

3. Location of Test

■ Permanent Testing Lab ☐ On Site Testing

(Address : 1, Samsung-ro, Giheung-gu, Yongin-si, Gyeonggi-do 17113, Korea)

4. Description of auxiliary equipment and Operating time

1) Instrument Integrating sphere ISP1000-100
2) Instrument CAS140-CT
3) Keithley 2425 Sourcemeter
4) Electrical condition
- Drive current : 700 ㎃
- Typical voltage : 3 V
- Total input power : 2.1 W
- Average current density per LED die : 350 ㎃/㎟
- Average power density per LED die : 1.05 W/㎟

* LED packages are driven with a constant direct current.

5) Test duration : 17 000 h

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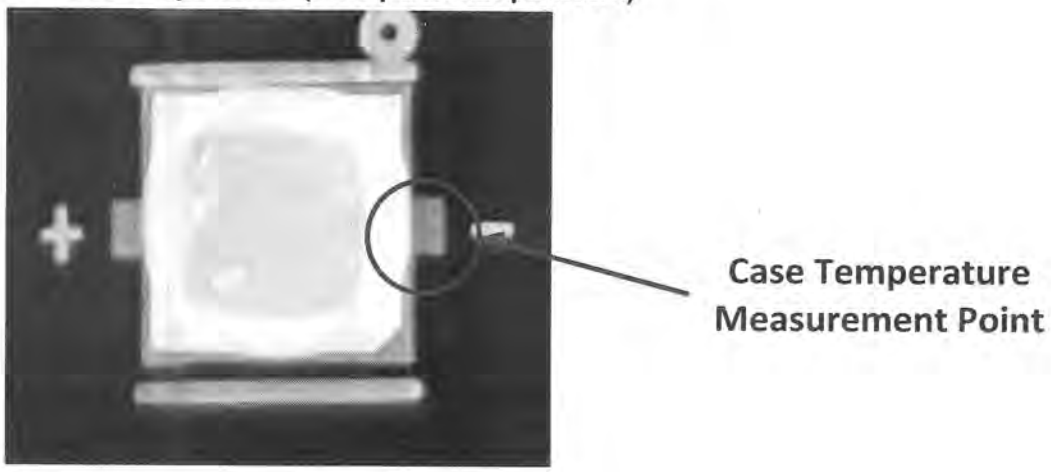
5. Ambient conditions including airflow, temperature and relative humidity

The minimal airflow is maintained in chamber.

The ambient temperature around the LED packages inside chamber is controlled by air flowing and the thermocouple readings are monitored.

- Case temperature : Contorlled to -2 ℃
- Surrounding air temperature : Contorlled to -5 ℃
- Relative humidity : < 65 % R.H.

6. Case temperature (Test point temperature)



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

See Sub-clause 9.1, 9.2 and 9.3

8. Initial luminous flux and forward voltage

See the table

9. Lumen maintenance data for each individual LED light source

See the table

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9.1 Test condition 1 **55 ℃**

Drive Current **700 mA**

Measurement Current **700 mA**

No.	Flux (lm)	Vf (V)	Lumen Maintenance (%)						
	0 h		500 h	1 000 h	2 000 h	3 000 h	4 000 h	5 000 h	6 000 h
1	254.6	3.041	99.3	99.2	99.2	98.8	98.7	98.6	98.5
2	250.9	3.062	99.8	99.5	99.1	99.0	98.7	98.8	98.8
3	257.6	2.987	99.7	99.5	99.2	99.2	99.0	99.0	98.9
4	252.1	2.977	99.5	99.1	99.1	98.9	98.7	98.9	98.8
5	251.3	2.982	99.2	99.1	99.1	99.0	98.9	98.7	98.5
6	257.8	3.037	99.8	99.6	99.3	98.9	98.7	98.8	98.8
7	253.9	3.044	99.8	99.4	99.1	99.1	98.7	98.7	98.8
8	256.8	3.010	99.7	99.4	99.0	99.0	98.7	98.7	98.7
9	256.4	2.966	99.5	99.2	98.8	98.7	98.6	98.6	98.4
10	260.3	2.963	99.8	99.3	99.0	99.0	98.8	98.9	98.7
11	255.3	3.000	99.8	99.3	99.1	99.3	99.0	99.2	99.0
12	258.3	3.020	99.8	99.6	99.4	99.3	99.1	99.0	98.9
13	256.7	3.002	99.3	99.2	99.1	99.0	98.8	98.7	98.5
14	261.6	2.955	99.5	99.1	99.0	98.6	98.5	98.4	98.4
15	249.7	2.945	99.6	99.5	99.3	99.1	99.0	98.9	98.8
16	255.9	3.012	99.6	99.3	99.0	99.1	98.8	98.9	98.8
17	257.1	3.032	99.9	99.4	99.1	99.1	98.6	98.6	98.5
18	261.0	2.982	99.0	98.8	98.8	98.7	98.6	98.6	98.4
19	254.0	3.007	99.8	99.4	99.3	99.2	99.1	99.1	98.9
20	260.9	2.929	99.5	99.1	99.0	99.0	98.9	98.9	98.9
Mean	256.1	3.00	99.6	99.3	99.1	99.0	98.8	98.8	98.7
Median	256.5	3.00	99.7	99.3	99.1	99.0	98.8	98.8	98.8
std.dev	3.5	0.04	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Max	261.6	3.06	99.9	99.6	99.4	99.3	99.1	99.2	99.0
Min	249.7	2.93	99.0	98.8	98.8	98.6	98.5	98.4	98.4

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9.1 Test condition 1 **55 ℃**

Drive Current **700 mA**

Measurement Current **700 mA**

No.	Lumen Maintenance (%)								
	7 000 h	8 000 h	9 000 h	10 000 h	11 000 h	12 000 h	13 000 h	14 000 h	15 000 h
1	98.5	98.5	98.4	98.4	98.4	98.4	98.4	98.5	98.4
2	98.8	98.6	98.7	98.4	98.6	98.4	98.3	98.4	98.3
3	99.0	98.9	99.0	98.7	98.9	98.8	98.7	98.8	98.7
4	98.6	98.4	98.3	98.4	98.4	98.2	98.2	98.2	98.1
5	98.6	98.5	98.5	98.4	98.5	98.4	98.4	98.5	98.4
6	99.0	98.9	99.0	98.9	99.0	98.9	98.9	99.0	99.0
7	98.6	98.6	98.6	98.5	98.7	98.6	98.5	98.7	98.6
8	98.7	98.6	98.6	98.5	98.6	98.7	98.7	98.8	98.8
9	98.5	98.4	98.4	98.2	98.3	98.3	98.2	98.2	98.2
10	98.8	98.6	98.6	98.5	98.6	98.5	98.5	98.5	98.5
11	98.9	98.8	98.9	98.8	98.8	98.8	98.7	98.8	98.8
12	98.9	98.8	98.8	98.8	98.8	98.8	98.7	98.8	98.8
13	98.5	98.3	98.3	98.2	98.2	98.2	98.2	98.2	98.2
14	98.4	98.3	98.2	98.2	98.3	98.2	98.2	98.3	98.2
15	98.7	98.6	98.6	98.4	98.5	98.4	98.3	98.3	98.2
16	98.9	98.7	98.5	98.3	98.4	98.4	98.3	98.3	98.3
17	98.5	98.4	98.4	98.2	98.3	98.2	98.1	98.2	98.1
18	98.4	98.3	98.4	98.2	98.3	98.2	98.3	98.3	98.3
19	99.0	98.9	98.8	98.7	98.7	98.7	98.6	98.7	98.6
20	98.9	98.9	98.8	98.8	98.9	98.9	98.9	98.9	98.9
Mean	98.7	98.6	98.6	98.5	98.6	98.5	98.4	98.5	98.5
Median	98.7	98.6	98.6	98.4	98.5	98.4	98.4	98.5	98.4
std.dev	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3
Max	99.0	98.9	99.0	98.9	99.0	98.9	98.9	99.0	99.0
Min	98.4	98.3	98.2	98.2	98.2	98.2	98.1	98.2	98.1

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9.1 Test condition 1 **55 ℃**

Drive Current **700 mA**

Measurement Current **700 mA**

No.	Lumen Maintenance (%)								
	16 000 h	17 000 h	18 000 h	19 000 h	20 000 h	21 000 h	22 000 h	23 000 h	24 000 h
1	98.4	98.5							
2	98.3	98.4							
3	98.7	98.7							
4	98.2	98.2							
5	98.4	98.5							
6	98.9	98.9							
7	98.6	98.5							
8	98.8	99.0							
9	98.1	98.1							
10	98.5	98.5							
11	98.8	98.8							
12	98.7	98.8							
13	98.2	98.3							
14	98.3	98.3							
15	98.2	98.3							
16	98.2	98.3							
17	98.2	98.1							
18	98.3	98.4							
19	98.6	98.6							
20	98.9	99.0							
Mean	98.5	98.5							
Median	98.4	98.5							
std.dev	0.3	0.3							
Max	98.9	99.0							
Min	98.1	98.1							

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9.1 Test condition 1 **55 ℃**

Drive Current **700 mA**

Measurement Current **700 mA**

No.	u'	v'	Chromaticity Shift (△u'v')						
	0 h		500 h	1 000 h	2 000 h	3 000 h	4 000 h	5 000 h	6 000 h
1	0.263 0	0.528 8	0.000 1	0.000 3	0.000 3	0.000 4	0.000 4	0.000 3	0.000 4
2	0.263 6	0.529 2	0.000 1	0.000 2	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3
3	0.264 2	0.530 3	0.000 0	0.000 1	0.000 2	0.000 2	0.000 3	0.000 4	0.000 4
4	0.261 8	0.527 1	0.000 1	0.000 3	0.000 3	0.000 3	0.000 4	0.000 4	0.000 4
5	0.263 4	0.529 4	0.000 1	0.000 2	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3
6	0.263 3	0.528 3	0.000 1	0.000 2	0.000 3	0.000 3	0.000 3	0.000 3	0.000 4
7	0.262 3	0.528 8	0.000 0	0.000 1	0.000 3	0.000 3	0.000 4	0.000 4	0.000 4
8	0.264 0	0.530 3	0.000 1	0.000 2	0.000 3	0.000 3	0.000 4	0.000 4	0.000 3
9	0.262 8	0.530 4	0.000 1	0.000 2	0.000 3	0.000 3	0.000 3	0.000 4	0.000 3
10	0.264 0	0.532 2	0.000 1	0.000 2	0.000 3	0.000 3	0.000 3	0.000 3	0.000 4
11	0.262 3	0.528 6	0.000 2	0.000 2	0.000 4	0.000 3	0.000 3	0.000 3	0.000 3
12	0.263 2	0.529 1	0.000 1	0.000 2	0.000 2	0.000 2	0.000 3	0.000 3	0.000 3
13	0.262 5	0.527 2	0.000 0	0.000 1	0.000 2	0.000 3	0.000 2	0.000 4	0.000 3
14	0.263 2	0.528 5	0.000 0	0.000 2	0.000 3	0.000 3	0.000 3	0.000 3	0.000 4
15	0.261 9	0.528 0	0.000 2	0.000 3	0.000 4	0.000 4	0.000 4	0.000 4	0.000 5
16	0.262 7	0.527 9	0.000 1	0.000 2	0.000 3	0.000 3	0.000 4	0.000 4	0.000 3
17	0.261 6	0.527 8	0.000 0	0.000 3	0.000 3	0.000 3	0.000 3	0.000 4	0.000 3
18	0.262 3	0.529 3	0.000 1	0.000 2	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3
19	0.261 8	0.526 9	0.000 1	0.000 3	0.000 4	0.000 4	0.000 5	0.000 4	0.000 5
20	0.263 5	0.529 0	0.000 1	0.000 2	0.000 3	0.000 3	0.000 4	0.000 4	0.000 3
Mean	0.262 9	0.528 9	0.000 1	0.000 2	0.000 3	0.000 3	0.000 3	0.000 4	0.000 4
Median	0.262 9	0.528 8	0.000 1	0.000 2	0.000 3	0.000 3	0.000 3	0.000 4	0.000 3
std.dev	0.000 8	0.001 3	0.000 1	0.000 1	0.000 0	0.000 1	0.000 1	0.000 1	0.000 1
Max	0.264 2	0.532 2	0.000 2	0.000 3	0.000 4	0.000 4	0.000 5	0.000 4	0.000 5
Min	0.261 6	0.526 9	0.000 0	0.000 1	0.000 2	0.000 2	0.000 2	0.000 3	0.000 3

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9.1 Test condition 1 **55 ℃**

Drive Current **700 mA**

Measurement Current **700 mA**

No.	Chromaticity Shift (△u'v')								
	7 000 h	8 000 h	9 000 h	10 000 h	11 000 h	12 000 h	13 000 h	14 000 h	15 000 h
1	0.000 3	0.000 4	0.000 3	0.000 3	0.000 4	0.000 3	0.000 3	0.000 3	0.000 3
2	0.000 3	0.000 2	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3
3	0.000 4	0.000 3	0.000 3	0.000 3	0.000 4	0.000 4	0.000 4	0.000 4	0.000 4
4	0.000 4	0.000 4	0.000 4	0.000 4	0.000 4	0.000 4	0.000 4	0.000 4	0.000 4
5	0.000 2	0.000 3	0.000 3	0.000 2	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3
6	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3
7	0.000 4	0.000 3	0.000 4	0.000 3	0.000 4	0.000 3	0.000 3	0.000 3	0.000 3
8	0.000 4	0.000 4	0.000 4	0.000 4	0.000 4	0.000 4	0.000 4	0.000 4	0.000 4
9	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3
10	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3
11	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3
12	0.000 3	0.000 3	0.000 3	0.000 2	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3
13	0.000 3	0.000 3	0.000 3	0.000 2	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3
14	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3
15	0.000 4	0.000 4	0.000 4	0.000 4	0.000 4	0.000 4	0.000 4	0.000 4	0.000 4
16	0.000 4	0.000 4	0.000 4	0.000 4	0.000 5	0.000 5	0.000 5	0.000 5	0.000 5
17	0.000 4	0.000 3	0.000 3	0.000 4	0.000 4	0.000 3	0.000 3	0.000 4	0.000 3
18	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3	0.000 2	0.000 2
19	0.000 4	0.000 4	0.000 4	0.000 4	0.000 4	0.000 4	0.000 4	0.000 4	0.000 4
20	0.000 4	0.000 3	0.000 4	0.000 3	0.000 4	0.000 3	0.000 3	0.000 3	0.000 3
Mean	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3
Median	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3	0.000 3
std.dev	0.000 1	0.000 0	0.000 1	0.000 1	0.000 1	0.000 1	0.000 1	0.000 1	0.000 1
Max	0.000 4	0.000 4	0.000 4	0.000 4	0.000 5	0.000 5	0.000 5	0.000 5	0.000 5
Min	0.000 2	0.000 2	0.000 3	0.000 2	0.000 3	0.000 3	0.000 3	0.000 2	0.000 2

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9.1 Test condition 1 **55 ℃**

Drive Current **700 mA**

Measurement Current **700 mA**

No.	Chromaticity Shift (△u'v')								
	16 000 h	17 000 h	18 000 h	19 000 h	20 000 h	21 000 h	22 000 h	23 000 h	24 000 h
1	0.000 3	0.000 3							
2	0.000 3	0.000 3							
3	0.000 4	0.000 4							
4	0.000 4	0.000 4							
5	0.000 3	0.000 3							
6	0.000 3	0.000 3							
7	0.000 3	0.000 3							
8	0.000 4	0.000 4							
9	0.000 3	0.000 3							
10	0.000 3	0.000 3							
11	0.000 3	0.000 3							
12	0.000 3	0.000 3							
13	0.000 3	0.000 3							
14	0.000 3	0.000 3							
15	0.000 4	0.000 4							
16	0.000 5	0.000 6							
17	0.000 4	0.000 3							
18	0.000 2	0.000 2							
19	0.000 4	0.000 4							
20	0.000 3	0.000 4							
Mean	0.000 3	0.000 3							
Median	0.000 3	0.000 3							
std.dev	0.000 1	0.000 1							
Max	0.000 5	0.000 6							
Min	0.000 2	0.000 2							

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9.1 Test condition 1 **55 ℃**

Drive Current **700 mA**

Measurement Current **700 mA**

No.	CCT (K)							
	0 h	500 h	1 000 h	2 000 h	3 000 h	4 000 h	5 000 h	6 000 h
1	2 679	2 680	2 684	2 686	2 686	2 686	2 686	2 687
2	2 664	2 666	2 669	2 670	2 670	2 670	2 669	2 670
3	2 649	2 650	2 651	2 653	2 653	2 655	2 656	2 656
4	2 710	2 712	2 715	2 717	2 716	2 718	2 718	2 717
5	2 668	2 669	2 671	2 673	2 672	2 672	2 672	2 673
6	2 674	2 675	2 677	2 680	2 681	2 681	2 681	2 681
7	2 694	2 695	2 695	2 700	2 701	2 702	2 702	2 703
8	2 653	2 654	2 657	2 659	2 659	2 661	2 660	2 659
9	2 676	2 678	2 680	2 682	2 681	2 681	2 684	2 683
10	2 647	2 648	2 650	2 652	2 652	2 652	2 653	2 653
11	2 694	2 698	2 698	2 701	2 701	2 700	2 700	2 701
12	2 673	2 674	2 675	2 677	2 677	2 678	2 678	2 677
13	2 696	2 696	2 698	2 700	2 700	2 700	2 702	2 701
14	2 676	2 677	2 681	2 682	2 682	2 682	2 682	2 683
15	2 706	2 710	2 711	2 713	2 714	2 714	2 714	2 715
16	2 688	2 689	2 691	2 693	2 694	2 696	2 696	2 694
17	2 711	2 711	2 716	2 718	2 718	2 718	2 719	2 718
18	2 691	2 693	2 694	2 696	2 697	2 697	2 697	2 697
19	2 711	2 712	2 715	2 717	2 720	2 720	2 720	2 720
20	2 667	2 669	2 671	2 673	2 672	2 674	2 674	2 674
Mean	2 681	2 683	2 685	2 687	2 687	2 688	2 688	2 688
Median	2 678	2 679	2 683	2 684	2 684	2 684	2 685	2 685
std.dev	20	20	21	21	21	21	21	21
Max	2 711	2 712	2 716	2 718	2 720	2 720	2 720	2 720
Min	2 647	2 648	2 650	2 652	2 652	2 652	2 653	2 653

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SAMSUNG ELECTRONICS LED BUSINESS
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9.1 Test condition 1 **55 ℃**

Drive Current **700 mA**

Measurement Current **700 mA**

No.	CCT (K)								
	7 000 h	8 000 h	9 000 h	10 000 h	11 000 h	12 000 h	13 000 h	14 000 h	15 000 h
1	2 685	2 686	2 685	2 685	2 685	2 685	2 684	2 684	2 684
2	2 669	2 668	2 669	2 669	2 669	2 668	2 668	2 668	2 668
3	2 655	2 655	2 655	2 655	2 656	2 655	2 655	2 655	2 655
4	2 718	2 717	2 717	2 717	2 717	2 717	2 717	2 717	2 717
5	2 672	2 673	2 672	2 671	2 672	2 672	2 671	2 671	2 671
6	2 680	2 679	2 680	2 680	2 680	2 679	2 679	2 679	2 679
7	2 701	2 701	2 701	2 700	2 701	2 700	2 700	2 700	2 700
8	2 660	2 659	2 660	2 659	2 660	2 659	2 660	2 660	2 660
9	2 682	2 682	2 682	2 681	2 682	2 681	2 681	2 680	2 680
10	2 652	2 652	2 652	2 651	2 652	2 651	2 651	2 651	2 651
11	2 700	2 699	2 700	2 699	2 699	2 699	2 698	2 698	2 698
12	2 678	2 676	2 677	2 676	2 677	2 676	2 676	2 676	2 676
13	2 701	2 701	2 700	2 700	2 700	2 700	2 699	2 699	2 699
14	2 682	2 682	2 681	2 680	2 681	2 681	2 680	2 680	2 680
15	2 714	2 713	2 713	2 713	2 713	2 713	2 713	2 713	2 713
16	2 696	2 696	2 696	2 696	2 697	2 697	2 697	2 697	2 698
17	2 719	2 717	2 717	2 717	2 717	2 717	2 717	2 717	2 717
18	2 696	2 696	2 695	2 695	2 695	2 695	2 694	2 694	2 694
19	2 719	2 718	2 719	2 718	2 718	2 718	2 717	2 717	2 717
20	2 673	2 673	2 674	2 672	2 673	2 672	2 672	2 672	2 672
Mean	2 688	2 687	2 687	2 687	2 687	2 687	2 687	2 686	2 686
Median	2 683	2 684	2 683	2 683	2 683	2 683	2 682	2 682	2 682
std.dev	21	21	21	21	21	21	21	21	21
Max	2 719	2 718	2 719	2 718	2 718	2 718	2 717	2 717	2 717
Min	2 652	2 652	2 652	2 651	2 652	2 651	2 651	2 651	2 651

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9.1 Test condition 1 **55 ℃**

Drive Current **700 mA**

Measurement Current **700 mA**

No.	CCT (K)								
	16 000 h	17 000 h	18 000 h	19 000 h	20 000 h	21 000 h	22 000 h	23 000 h	24 000 h
1	2 684	2 683							
2	2 668	2 668							
3	2 656	2 656							
4	2 717	2 717							
5	2 671	2 671							
6	2 679	2 679							
7	2 700	2 699							
8	2 660	2 660							
9	2 680	2 680							
10	2 650	2 650							
11	2 698	2 698							
12	2 676	2 675							
13	2 699	2 699							
14	2 679	2 679							
15	2 713	2 712							
16	2 698	2 698							
17	2 716	2 716							
18	2 693	2 693							
19	2 717	2 717							
20	2 672	2 672							
Mean	2 686	2 686							
Median	2 682	2 682							
std.dev	21	21							
Max	2 717	2 717							
Min	2 650	2 650							

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9.2 Test condition 2 **85 ℃**

Drive Current **700 mA**

Measurement Current **700 mA**

No.	Flux (lm)	Vf (V)	Lumen Maintenance (%)						
	0 h		500 h	1 000 h	2 000 h	3 000 h	4 000 h	5 000 h	6 000 h
1	255.0	3.033	99.4	99.3	99.3	99.3	99.1	99.0	98.7
2	249.4	3.027	99.5	99.4	99.3	98.8	98.8	98.9	98.7
3	259.3	3.015	99.5	99.5	99.3	99.0	98.6	98.7	98.6
4	253.5	2.983	99.2	99.1	99.2	98.6	98.5	98.5	98.5
5	255.7	2.969	99.5	99.3	98.9	98.8	98.5	98.5	98.5
6	254.2	2.983	99.5	99.4	99.2	99.3	99.2	99.2	98.9
7	252.7	2.941	99.3	99.2	98.9	98.6	98.6	98.5	98.5
8	250.7	3.022	99.5	99.3	99.0	98.8	98.9	98.7	98.9
9	253.2	3.047	99.5	99.4	99.2	99.1	99.0	98.9	99.0
10	256.4	2.973	99.3	99.1	98.9	98.6	98.8	98.6	98.4
11	253.1	2.997	99.5	99.1	98.9	98.8	98.2	98.3	98.5
12	257.3	3.020	99.0	98.9	98.7	98.6	98.7	98.3	98.2
13	258.0	2.993	99.6	99.2	99.2	98.8	98.9	99.2	98.8
14	255.5	3.024	99.3	99.1	98.8	98.5	98.7	98.4	98.4
15	249.3	2.997	99.5	99.2	99.0	99.0	98.9	99.0	98.9
16	254.1	3.075	99.4	99.2	99.0	98.3	98.3	98.6	98.5
17	256.7	3.064	99.3	99.2	99.0	98.8	98.7	98.7	98.6
18	261.3	3.043	99.4	99.0	98.7	98.8	98.7	98.8	98.7
19	258.4	2.996	99.4	99.1	98.7	98.8	98.8	98.9	98.6
20	253.7	2.993	99.4	99.1	98.9	98.4	98.2	98.3	98.1
Mean	254.9	3.01	99.4	99.2	99.0	98.8	98.7	98.7	98.6
Median	254.6	3.01	99.4	99.2	99.0	98.8	98.7	98.7	98.6
std.dev	3.2	0.03	0.1	0.2	0.2	0.3	0.3	0.3	0.2
Max	261.3	3.07	99.6	99.5	99.3	99.3	99.2	99.2	99.0
Min	249.3	2.94	99.0	98.9	98.7	98.3	98.2	98.3	98.1

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9.2 Test condition 2 **85 ℃**

Drive Current **700 mA**

Measurement Current **700 mA**

No.	Lumen Maintenance (%)								
	7 000 h	8 000 h	9 000 h	10 000 h	11 000 h	12 000 h	13 000 h	14 000 h	15 000 h
1	98.9	98.8	98.7	98.8	98.7	98.8	98.6	98.7	98.6
2	98.9	98.8	98.7	98.6	98.6	98.7	98.6	98.7	98.7
3	98.9	98.7	98.3	98.4	98.3	98.4	98.2	98.3	98.3
4	98.4	98.4	98.3	98.3	98.2	98.3	98.3	98.3	98.3
5	98.3	98.1	98.1	98.0	98.0	98.0	97.9	98.1	98.0
6	98.9	98.7	98.7	98.6	98.5	98.6	98.5	98.5	98.5
7	98.4	98.4	98.3	98.2	98.2	98.3	98.2	98.3	98.3
8	99.0	98.7	98.4	98.2	98.1	98.1	98.0	98.0	97.9
9	98.8	98.7	98.5	98.7	98.4	98.5	98.4	98.4	98.3
10	98.4	98.4	98.5	98.5	98.6	98.6	98.6	98.6	98.6
11	98.2	98.4	98.7	98.7	98.6	98.7	98.6	98.6	98.6
12	98.5	98.3	98.4	98.4	98.4	98.4	98.4	98.5	98.5
13	98.5	98.1	98.2	98.4	98.0	98.1	98.2	98.1	98.0
14	98.4	98.2	98.2	98.3	98.1	98.3	98.3	98.4	98.4
15	98.7	98.9	98.7	98.7	98.7	98.8	98.7	98.8	98.7
16	98.3	98.3	98.2	98.2	98.1	98.2	98.1	98.2	98.1
17	98.3	98.7	98.1	98.2	98.1	98.2	98.0	98.0	98.0
18	98.9	98.6	98.4	98.2	98.1	98.1	98.0	98.1	98.1
19	98.9	98.7	98.5	98.5	98.4	98.6	98.5	98.6	98.6
20	98.4	98.2	98.3	98.1	98.2	98.2	98.2	98.3	98.2
Mean	98.6	98.5	98.4	98.4	98.3	98.4	98.3	98.4	98.3
Median	98.5	98.5	98.4	98.4	98.3	98.4	98.3	98.4	98.3
std.dev	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3
Max	99.0	98.9	98.7	98.8	98.7	98.8	98.7	98.8	98.7
Min	98.2	98.1	98.1	98.0	98.0	98.0	97.9	98.0	97.9

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9.2 Test condition 2 **85 ℃**

Drive Current **700 mA**

Measurement Current **700 mA**

No.	Lumen Maintenance (%)								
	16 000 h	17 000 h	18 000 h	19 000 h	20 000 h	21 000 h	22 000 h	23 000 h	24 000 h
1	98.5	98.6							
2	98.7	98.7							
3	98.2	98.2							
4	98.3	98.4							
5	98.0	98.1							
6	98.5	98.5							
7	98.3	98.3							
8	98.0	97.9							
9	98.2	98.3							
10	98.7	98.7							
11	98.5	98.6							
12	98.5	98.6							
13	98.0	98.0							
14	98.4	98.5							
15	98.8	98.8							
16	98.2	98.2							
17	98.0	97.9							
18	98.2	98.1							
19	98.6	98.6							
20	98.4	98.3							
Mean	98.4	98.4							
Median	98.4	98.3							
std.dev	0.3	0.3							
Max	98.8	98.8							
Min	98.0	97.9							

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9.2 Test condition 2 **85 ℃**

Drive Current **700 mA**

Measurement Current **700 mA**

No.	u'	v'	Chromaticity Shift (△u'v')						
	0 h		500 h	1 000 h	2 000 h	3 000 h	4 000 h	5 000 h	6 000 h
1	0.264 6	0.529 0	0.000 3	0.000 4	0.000 5	0.000 6	0.000 7	0.000 6	0.000 6
2	0.263 4	0.528 1	0.000 3	0.000 4	0.000 5	0.000 6	0.000 7	0.000 6	0.000 6
3	0.265 3	0.530 1	0.000 2	0.000 3	0.000 5	0.000 6	0.000 7	0.000 6	0.000 6
4	0.263 7	0.527 5	0.000 2	0.000 3	0.000 3	0.000 4	0.000 5	0.000 4	0.000 4
5	0.264 1	0.528 8	0.000 3	0.000 4	0.000 4	0.000 5	0.000 6	0.000 5	0.000 5
6	0.262 9	0.528 4	0.000 2	0.000 4	0.000 4	0.000 5	0.000 6	0.000 5	0.000 5
7	0.264 2	0.527 6	0.000 3	0.000 3	0.000 4	0.000 5	0.000 6	0.000 5	0.000 5
8	0.265 2	0.529 9	0.000 2	0.000 3	0.000 4	0.000 6	0.000 7	0.000 6	0.000 7
9	0.263 3	0.528 2	0.000 3	0.000 3	0.000 4	0.000 5	0.000 6	0.000 5	0.000 5
10	0.264 5	0.529 5	0.000 2	0.000 3	0.000 4	0.000 5	0.000 6	0.000 5	0.000 4
11	0.263 8	0.527 6	0.000 4	0.000 5	0.000 5	0.000 6	0.000 6	0.000 5	0.000 5
12	0.263 3	0.527 4	0.000 4	0.000 4	0.000 5	0.000 6	0.000 7	0.000 5	0.000 6
13	0.262 9	0.526 4	0.000 3	0.000 5	0.000 5	0.000 6	0.000 7	0.000 5	0.000 5
14	0.262 0	0.527 3	0.000 3	0.000 4	0.000 5	0.000 5	0.000 6	0.000 5	0.000 5
15	0.264 4	0.527 1	0.000 4	0.000 4	0.000 5	0.000 5	0.000 6	0.000 5	0.000 5
16	0.263 3	0.527 0	0.000 2	0.000 3	0.000 4	0.000 4	0.000 5	0.000 5	0.000 5
17	0.264 2	0.528 9	0.000 2	0.000 3	0.000 4	0.000 5	0.000 5	0.000 5	0.000 5
18	0.264 5	0.528 7	0.000 3	0.000 4	0.000 5	0.000 6	0.000 7	0.000 6	0.000 6
19	0.263 8	0.527 8	0.000 3	0.000 4	0.000 5	0.000 6	0.000 6	0.000 6	0.000 5
20	0.263 8	0.528 0	0.000 3	0.000 4	0.000 5	0.000 6	0.000 6	0.000 5	0.000 5
Mean	0.263 9	0.528 2	0.000 3	0.000 4	0.000 4	0.000 5	0.000 6	0.000 5	0.000 5
Median	0.263 8	0.528 0	0.000 3	0.000 4	0.000 5	0.000 5	0.000 6	0.000 5	0.000 5
std.dev	0.000 8	0.001 0	0.000 1	0.000 1	0.000 1	0.000 1	0.000 1	0.000 1	0.000 1
Max	0.265 3	0.530 1	0.000 4	0.000 5	0.000 5	0.000 6	0.000 7	0.000 6	0.000 7
Min	0.262 0	0.526 4	0.000 2	0.000 3	0.000 3	0.000 4	0.000 5	0.000 4	0.000 4

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9.2 Test condition 2 **85 ℃**

Drive Current **700 mA**

Measurement Current **700 mA**

No.	Chromaticity Shift (△u'v')								
	7 000 h	8 000 h	9 000 h	10 000 h	11 000 h	12 000 h	13 000 h	14 000 h	15 000 h
1	0.000 6	0.000 6	0.000 7	0.000 6	0.000 6	0.000 6	0.000 6	0.000 7	0.000 7
2	0.000 6	0.000 4	0.000 7	0.000 7	0.000 7	0.000 7	0.000 7	0.000 7	0.000 7
3	0.000 5	0.000 3	0.000 5	0.000 3	0.000 4	0.000 4	0.000 5	0.000 5	0.000 5
4	0.000 5	0.000 4	0.000 5	0.000 4	0.000 5	0.000 5	0.000 5	0.000 5	0.000 5
5	0.000 5	0.000 4	0.000 5	0.000 4	0.000 5	0.000 5	0.000 5	0.000 5	0.000 5
6	0.000 5	0.000 5	0.000 5	0.000 4	0.000 5	0.000 5	0.000 4	0.000 5	0.000 5
7	0.000 5	0.000 5	0.000 5	0.000 4	0.000 5	0.000 5	0.000 4	0.000 5	0.000 5
8	0.000 5	0.000 3	0.000 4	0.000 4	0.000 4	0.000 5	0.000 5	0.000 5	0.000 6
9	0.000 5	0.000 5	0.000 6	0.000 5	0.000 6	0.000 6	0.000 6	0.000 6	0.000 6
10	0.000 5	0.000 5	0.000 5	0.000 4	0.000 5	0.000 5	0.000 5	0.000 5	0.000 4
11	0.000 6	0.000 5	0.000 6	0.000 5	0.000 6	0.000 6	0.000 6	0.000 6	0.000 7
12	0.000 6	0.000 6	0.000 6	0.000 6	0.000 6	0.000 6	0.000 7	0.000 7	0.000 7
13	0.000 5	0.000 5	0.000 5	0.000 5	0.000 5	0.000 6	0.000 6	0.000 6	0.000 7
14	0.000 6	0.000 5	0.000 6	0.000 6	0.000 6	0.000 6	0.000 6	0.000 7	0.000 7
15	0.000 5	0.000 5	0.000 6	0.000 5	0.000 6	0.000 6	0.000 6	0.000 7	0.000 7
16	0.000 5	0.000 5	0.000 6	0.000 5	0.000 6	0.000 6	0.000 7	0.000 7	0.000 7
17	0.000 5	0.000 5	0.000 6	0.000 6	0.000 6	0.000 6	0.000 7	0.000 7	0.000 7
18	0.000 6	0.000 6	0.000 6	0.000 5	0.000 6	0.000 6	0.000 6	0.000 7	0.000 7
19	0.000 6	0.000 6	0.000 6	0.000 5	0.000 6	0.000 6	0.000 6	0.000 7	0.000 7
20	0.000 6	0.000 5	0.000 6	0.000 5	0.000 6	0.000 6	0.000 6	0.000 7	0.000 7
Mean	0.000 5	0.000 5	0.000 6	0.000 5	0.000 5	0.000 6	0.000 6	0.000 6	0.000 6
Median	0.000 5	0.000 5	0.000 6	0.000 5	0.000 6	0.000 6	0.000 6	0.000 6	0.000 7
std.dev	0.000 0	0.000 1	0.000 1	0.000 1	0.000 1	0.000 1	0.000 1	0.000 1	0.000 1
Max	0.000 6	0.000 6	0.000 7	0.000 7	0.000 7	0.000 7	0.000 7	0.000 7	0.000 7
Min	0.000 5	0.000 3	0.000 4	0.000 3	0.000 4	0.000 4	0.000 4	0.000 5	0.000 4

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9.2 Test condition 2 **85 ℃**

Drive Current **700 mA**

Measurement Current **700 mA**

No.	Chromaticity Shift (△u'v')								
	16 000 h	17 000 h	18 000 h	19 000 h	20 000 h	21 000 h	22 000 h	23 000 h	24 000 h
1	0.000 7	0.000 7							
2	0.000 7	0.000 8							
3	0.000 5	0.000 6							
4	0.000 5	0.000 6							
5	0.000 5	0.000 6							
6	0.000 5	0.000 5							
7	0.000 5	0.000 5							
8	0.000 6	0.000 6							
9	0.000 6	0.000 6							
10	0.000 4	0.000 4							
11	0.000 7	0.000 8							
12	0.000 8	0.000 8							
13	0.000 7	0.000 7							
14	0.000 7	0.000 8							
15	0.000 7	0.000 8							
16	0.000 8	0.000 8							
17	0.000 8	0.000 8							
18	0.000 7	0.000 8							
19	0.000 7	0.000 7							
20	0.000 7	0.000 8							
Mean	0.000 7	0.000 7							
Median	0.000 7	0.000 7							
std.dev	0.000 1	0.000 1							
Max	0.000 8	0.000 8							
Min	0.000 4	0.000 4							

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Gyeonggi-do 17113, Korea

9.2 Test condition 2 **85 ℃**

Drive Current **700 mA**

Measurement Current **700 mA**

No.	CCT (K)							
	0 h	500 h	1 000 h	2 000 h	3 000 h	4 000 h	5 000 h	6 000 h
1	2 645	2 650	2 653	2 655	2 657	2 659	2 655	2 656
2	2 673	2 679	2 682	2 684	2 686	2 688	2 686	2 686
3	2 626	2 630	2 632	2 635	2 638	2 640	2 637	2 637
4	2 669	2 673	2 673	2 674	2 677	2 678	2 675	2 674
5	2 656	2 662	2 663	2 664	2 667	2 667	2 664	2 664
6	2 681	2 686	2 690	2 687	2 690	2 692	2 691	2 689
7	2 657	2 663	2 662	2 663	2 666	2 668	2 666	2 666
8	2 629	2 634	2 636	2 638	2 641	2 643	2 641	2 641
9	2 675	2 680	2 681	2 682	2 685	2 685	2 683	2 684
10	2 645	2 648	2 649	2 651	2 653	2 656	2 653	2 652
11	2 666	2 674	2 677	2 676	2 678	2 678	2 675	2 674
12	2 677	2 685	2 686	2 687	2 689	2 690	2 686	2 686
13	2 690	2 697	2 700	2 699	2 701	2 703	2 698	2 698
14	2 706	2 712	2 714	2 715	2 715	2 718	2 714	2 714
15	2 654	2 663	2 662	2 663	2 663	2 665	2 661	2 662
16	2 680	2 683	2 684	2 685	2 686	2 688	2 686	2 685
17	2 652	2 656	2 658	2 659	2 660	2 661	2 660	2 659
18	2 647	2 654	2 656	2 657	2 659	2 660	2 658	2 657
19	2 666	2 672	2 672	2 673	2 674	2 676	2 675	2 672
20	2 664	2 670	2 672	2 671	2 674	2 675	2 673	2 671
Mean	2 663	2 669	2 670	2 671	2 673	2 674	2 672	2 671
Median	2 665	2 671	2 672	2 672	2 674	2 676	2 674	2 672
std.dev	20	20	20	20	19	19	19	19
Max	2 706	2 712	2 714	2 715	2 715	2 718	2 714	2 714
Min	2 626	2 630	2 632	2 635	2 638	2 640	2 637	2 637

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9.2 Test condition 2 **85 ℃**

Drive Current **700 mA**

Measurement Current **700 mA**

No.	CCT (K)								
	7 000 h	8 000 h	9 000 h	10 000 h	11 000 h	12 000 h	13 000 h	14 000 h	15 000 h
1	2 655	2 655	2 656	2 653	2 653	2 653	2 652	2 653	2 652
2	2 685	2 679	2 683	2 681	2 681	2 680	2 678	2 680	2 677
3	2 633	2 627	2 630	2 626	2 626	2 625	2 622	2 624	2 622
4	2 676	2 675	2 676	2 674	2 675	2 675	2 674	2 675	2 675
5	2 664	2 662	2 663	2 661	2 661	2 661	2 659	2 660	2 659
6	2 689	2 687	2 689	2 686	2 687	2 687	2 686	2 686	2 685
7	2 664	2 664	2 664	2 662	2 663	2 663	2 662	2 663	2 662
8	2 636	2 632	2 633	2 629	2 630	2 629	2 626	2 627	2 625
9	2 683	2 683	2 683	2 681	2 682	2 682	2 681	2 682	2 682
10	2 654	2 651	2 653	2 651	2 652	2 652	2 651	2 652	2 649
11	2 674	2 672	2 672	2 667	2 669	2 668	2 666	2 666	2 665
12	2 686	2 684	2 684	2 680	2 681	2 680	2 679	2 679	2 678
13	2 697	2 696	2 693	2 691	2 691	2 690	2 688	2 688	2 687
14	2 715	2 712	2 712	2 708	2 710	2 709	2 707	2 708	2 707
15	2 661	2 659	2 658	2 655	2 656	2 655	2 654	2 653	2 653
16	2 685	2 684	2 684	2 682	2 683	2 682	2 681	2 682	2 681
17	2 659	2 658	2 657	2 655	2 656	2 656	2 655	2 656	2 655
18	2 657	2 657	2 656	2 651	2 654	2 653	2 652	2 653	2 652
19	2 673	2 672	2 672	2 669	2 670	2 670	2 669	2 669	2 668
20	2 672	2 670	2 668	2 665	2 667	2 666	2 664	2 665	2 664
Mean	2 671	2 669	2 669	2 666	2 667	2 667	2 665	2 666	2 665
Median	2 673	2 671	2 670	2 666	2 668	2 667	2 665	2 666	2 664
std.dev	20	20	20	20	20	20	20	20	20
Max	2 715	2 712	2 712	2 708	2 710	2 709	2 707	2 708	2 707
Min	2 633	2 627	2 630	2 626	2 626	2 625	2 622	2 624	2 622

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Gyeonggi-do 17113, Korea

9.2 Test condition 2 **85 ℃**

Drive Current **700 mA**

Measurement Current **700 mA**

No.	CCT (K)								
	16 000 h	17 000 h	18 000 h	19 000 h	20 000 h	21 000 h	22 000 h	23 000 h	24 000 h
1	2 652	2 651							
2	2 678	2 676							
3	2 621	2 621							
4	2 675	2 675							
5	2 659	2 658							
6	2 685	2 685							
7	2 662	2 662							
8	2 625	2 626							
9	2 682	2 682							
10	2 650	2 648							
11	2 664	2 663							
12	2 678	2 677							
13	2 686	2 688							
14	2 707	2 706							
15	2 652	2 651							
16	2 681	2 681							
17	2 655	2 655							
18	2 652	2 654							
19	2 668	2 668							
20	2 664	2 665							
Mean	2 665	2 665							
Median	2 664	2 664							
std.dev	21	20							
Max	2 707	2 706							
Min	2 621	2 621							

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9.3 Test condition 3 **105 ℃**

Drive Current **700 mA**

Measurement Current **700 mA**

No.	Flux (lm)	Vf (V)	Lumen Maintenance (%)						
	0 h		500 h	1 000 h	2 000 h	3 000 h	4 000 h	5 000 h	6 000 h
1	259.0	3.014	99.9	99.6	99.2	98.9	98.8	98.6	98.5
2	255.6	3.014	99.3	99.1	98.7	98.4	98.4	98.4	98.2
3	262.5	2.987	99.4	99.1	98.6	98.5	98.3	98.2	98.0
4	258.5	2.965	99.4	99.1	98.9	98.8	98.6	98.5	98.3
5	260.6	2.931	99.4	99.2	98.9	98.5	98.4	98.2	98.0
6	256.2	3.038	99.6	99.3	99.0	98.8	98.7	98.7	98.4
7	259.0	3.014	99.4	99.1	98.9	98.8	98.6	98.5	98.3
8	262.3	2.996	99.4	99.5	98.8	98.7	98.6	98.3	98.2
9	259.0	2.959	99.4	99.2	98.9	98.4	98.2	98.1	97.9
10	259.2	2.969	99.4	99.3	99.0	98.9	98.8	98.8	98.7
11	261.1	3.034	99.8	99.6	99.0	98.7	98.8	98.8	98.5
12	252.7	2.983	99.5	99.2	98.9	98.8	98.7	98.6	98.4
13	256.5	3.057	99.5	99.3	99.0	99.0	98.8	98.7	98.6
14	257.7	3.027	99.4	99.2	98.7	98.6	98.5	98.5	98.4
15	262.2	2.957	99.7	99.5	99.0	98.6	98.7	98.4	98.1
16	257.0	3.057	99.4	99.2	98.9	98.4	98.2	98.3	98.1
17	258.9	3.035	99.5	99.3	98.7	98.6	98.7	98.6	98.4
18	259.0	3.025	99.8	99.6	99.1	99.0	99.0	98.8	98.6
19	256.1	2.990	99.5	99.3	98.8	98.6	98.6	98.5	98.3
20	253.2	3.027	99.5	99.3	99.1	98.8	98.7	98.4	98.2
Mean	258.3	3.00	99.5	99.3	98.9	98.7	98.6	98.5	98.3
Median	258.9	3.01	99.4	99.3	98.9	98.7	98.6	98.5	98.3
std.dev	2.8	0.04	0.2	0.2	0.1	0.2	0.2	0.2	0.2
Max	262.5	3.06	99.9	99.6	99.2	99.0	99.0	98.8	98.7
Min	252.7	2.93	99.3	99.1	98.6	98.4	98.2	98.1	97.9

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9.3 Test condition 3 **105 ℃**

Drive Current **700 mA**

Measurement Current **700 mA**

No.	Lumen Maintenance (%)								
	7 000 h	8 000 h	9 000 h	10 000 h	11 000 h	12 000 h	13 000 h	14 000 h	15 000 h
1	98.7	98.7	98.5	98.4	98.5	98.3	98.4	98.3	98.3
2	98.3	98.1	97.9	97.8	97.7	97.8	97.7	97.9	97.8
3	98.0	97.9	97.9	97.8	97.8	97.8	97.7	97.9	97.8
4	98.2	98.1	98.0	97.9	97.9	97.8	97.6	97.7	97.7
5	98.2	98.1	98.1	97.9	98.0	98.0	97.9	98.1	98.0
6	98.5	98.3	98.1	98.0	97.9	97.8	97.7	97.8	97.7
7	98.3	98.3	98.1	98.0	98.0	97.9	97.8	98.0	97.9
8	98.1	98.2	98.3	98.3	98.4	98.4	98.3	98.4	98.4
9	97.8	97.8	98.0	97.8	97.9	97.9	97.9	98.0	97.9
10	98.7	98.5	98.3	98.3	98.1	98.2	98.1	98.2	98.2
11	98.6	98.1	98.1	98.0	98.0	98.0	97.9	98.1	98.1
12	98.5	98.2	98.4	98.3	98.3	98.3	98.3	98.4	98.3
13	98.5	98.5	98.4	98.3	98.2	98.2	98.1	98.2	98.2
14	98.4	98.5	98.4	98.4	98.4	98.4	98.3	98.4	98.3
15	98.0	97.8	98.1	98.0	98.0	98.1	98.0	98.0	98.0
16	98.1	98.2	98.4	98.2	98.2	98.2	98.2	98.3	98.3
17	98.3	98.3	98.1	98.0	97.9	97.9	97.8	97.9	98.0
18	98.6	98.5	98.5	98.5	98.4	98.4	98.3	98.5	98.4
19	98.1	98.0	98.2	98.1	98.1	98.1	98.0	98.1	98.1
20	98.2	97.9	98.0	97.8	97.8	97.7	97.7	97.7	97.7
Mean	98.3	98.2	98.2	98.1	98.1	98.1	98.0	98.1	98.1
Median	98.3	98.2	98.1	98.0	98.0	98.1	97.9	98.1	98.0
std.dev	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Max	98.7	98.7	98.5	98.5	98.5	98.4	98.4	98.5	98.4
Min	97.8	97.8	97.9	97.8	97.7	97.7	97.6	97.7	97.7

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9.3 Test condition 3 **105 ℃**

Drive Current **700 mA**

Measurement Current **700 mA**

No.	Lumen Maintenance (%)								
	16 000 h	17 000 h	18 000 h	19 000 h	20 000 h	21 000 h	22 000 h	23 000 h	24 000 h
1	98.4	98.2							
2	97.9	97.9							
3	97.8	97.8							
4	97.7	97.7							
5	98.1	98.0							
6	97.7	97.6							
7	97.9	97.8							
8	98.4	98.3							
9	98.0	98.0							
10	98.2	98.1							
11	98.1	98.1							
12	98.4	98.4							
13	98.2	98.1							
14	98.4	98.3							
15	98.0	97.9							
16	98.4	98.3							
17	98.0	97.9							
18	98.3	98.3							
19	98.2	98.1							
20	97.6	97.7							
Mean	98.1	98.0							
Median	98.1	98.0							
std.dev	0.3	0.2							
Max	98.4	98.4							
Min	97.6	97.6							

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9.3 Test condition 3 **105 ℃**

Drive Current **700 mA**

Measurement Current **700 mA**

No.	u'	v'	Chromaticity Shift (△u'v')						
	0 h		500 h	1 000 h	2 000 h	3 000 h	4 000 h	5 000 h	6 000 h
1	0.261 5	0.526 4	0.000 4	0.000 4	0.000 6	0.000 6	0.000 6	0.000 7	0.000 6
2	0.263 0	0.528 1	0.000 3	0.000 4	0.000 3	0.000 4	0.000 5	0.000 5	0.000 5
3	0.264 2	0.528 5	0.000 4	0.000 5	0.000 6	0.000 7	0.000 7	0.000 7	0.000 8
4	0.264 0	0.528 2	0.000 3	0.000 4	0.000 5	0.000 5	0.000 6	0.000 6	0.000 6
5	0.265 1	0.529 4	0.000 3	0.000 3	0.000 4	0.000 5	0.000 5	0.000 5	0.000 5
6	0.263 5	0.527 4	0.000 3	0.000 4	0.000 4	0.000 5	0.000 5	0.000 5	0.000 5
7	0.263 7	0.527 4	0.000 4	0.000 4	0.000 4	0.000 5	0.000 6	0.000 5	0.000 5
8	0.263 1	0.529 2	0.000 3	0.000 4	0.000 5	0.000 5	0.000 6	0.000 6	0.000 6
9	0.264 6	0.530 1	0.000 3	0.000 3	0.000 5	0.000 5	0.000 5	0.000 6	0.000 7
10	0.263 5	0.529 0	0.000 3	0.000 4	0.000 5	0.000 5	0.000 5	0.000 6	0.000 5
11	0.263 4	0.527 1	0.000 3	0.000 4	0.000 5	0.000 6	0.000 6	0.000 6	0.000 6
12	0.263 8	0.528 2	0.000 3	0.000 4	0.000 5	0.000 5	0.000 6	0.000 6	0.000 6
13	0.263 7	0.527 2	0.000 3	0.000 3	0.000 5	0.000 5	0.000 6	0.000 6	0.000 7
14	0.264 7	0.529 4	0.000 3	0.000 3	0.000 4	0.000 5	0.000 5	0.000 5	0.000 4
15	0.261 6	0.526 6	0.000 3	0.000 4	0.000 5	0.000 6	0.000 6	0.000 6	0.000 7
16	0.262 6	0.525 9	0.000 4	0.000 5	0.000 5	0.000 6	0.000 6	0.000 6	0.000 6
17	0.262 8	0.527 6	0.000 3	0.000 3	0.000 4	0.000 5	0.000 6	0.000 6	0.000 6
18	0.263 5	0.528 6	0.000 3	0.000 3	0.000 5	0.000 5	0.000 5	0.000 6	0.000 5
19	0.262 1	0.527 5	0.000 3	0.000 3	0.000 4	0.000 5	0.000 5	0.000 5	0.000 5
20	0.263 0	0.527 6	0.000 3	0.000 4	0.000 5	0.000 6	0.000 6	0.000 6	0.000 7
Mean	0.263 4	0.528 0	0.000 3	0.000 4	0.000 5	0.000 5	0.000 6	0.000 6	0.000 6
Median	0.263 5	0.527 8	0.000 3	0.000 4	0.000 5	0.000 5	0.000 6	0.000 6	0.000 6
std.dev	0.001 0	0.001 1	0.000 0	0.000 1	0.000 1	0.000 1	0.000 1	0.000 1	0.000 1
Max	0.265 1	0.530 1	0.000 4	0.000 5	0.000 6	0.000 7	0.000 7	0.000 7	0.000 8
Min	0.261 5	0.525 9	0.000 3	0.000 3	0.000 3	0.000 4	0.000 5	0.000 5	0.000 4

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9.3 Test condition 3 **105 ℃**

Drive Current **700 mA**

Measurement Current **700 mA**

No.	Chromaticity Shift (△u'v')								
	7 000 h	8 000 h	9 000 h	10 000 h	11 000 h	12 000 h	13 000 h	14 000 h	15 000 h
1	0.000 8	0.000 8	0.000 9	0.000 9	0.000 9	0.001 0	0.001 1	0.001 0	0.001 1
2	0.000 6	0.000 6	0.000 7	0.000 8	0.000 8	0.000 9	0.000 9	0.000 9	0.001 0
3	0.000 8	0.000 8	0.000 9	0.000 9	0.001 0	0.001 0	0.001 1	0.001 1	0.001 1
4	0.000 7	0.000 7	0.000 8	0.000 8	0.000 8	0.000 9	0.000 9	0.000 9	0.001 0
5	0.000 7	0.000 7	0.000 8	0.000 7	0.000 8	0.000 9	0.000 9	0.000 9	0.001 0
6	0.000 7	0.000 6	0.000 8	0.000 8	0.000 8	0.000 9	0.001 0	0.001 0	0.001 1
7	0.000 6	0.000 7	0.000 7	0.000 7	0.000 8	0.000 8	0.000 8	0.000 8	0.000 9
8	0.000 7	0.000 7	0.000 8	0.000 7	0.000 8	0.000 9	0.000 9	0.000 9	0.000 9
9	0.000 7	0.000 7	0.000 8	0.000 8	0.000 9	0.000 9	0.000 9	0.000 9	0.001 0
10	0.000 7	0.000 6	0.000 8	0.000 8	0.000 8	0.000 9	0.000 9	0.000 9	0.001 0
11	0.000 7	0.000 7	0.000 8	0.000 7	0.000 8	0.000 9	0.000 9	0.000 9	0.000 9
12	0.000 7	0.000 7	0.000 8	0.000 7	0.000 8	0.000 8	0.000 9	0.000 8	0.000 9
13	0.000 7	0.000 7	0.000 8	0.000 8	0.000 9	0.000 9	0.001 0	0.001 0	0.001 0
14	0.000 6	0.000 5	0.000 7	0.000 7	0.000 7	0.000 8	0.000 8	0.000 8	0.000 9
15	0.000 7	0.000 8	0.000 8	0.000 9	0.000 9	0.001 0	0.001 0	0.001 0	0.001 1
16	0.000 8	0.000 8	0.000 9	0.000 8	0.000 9	0.000 9	0.000 9	0.000 9	0.001 0
17	0.000 7	0.000 7	0.000 8	0.000 8	0.000 8	0.000 9	0.000 9	0.000 9	0.001 0
18	0.000 7	0.000 6	0.000 8	0.000 7	0.000 8	0.000 8	0.000 9	0.000 9	0.000 9
19	0.000 6	0.000 6	0.000 7	0.000 7	0.000 7	0.000 8	0.000 8	0.000 8	0.000 9
20	0.000 7	0.000 7	0.000 8	0.000 8	0.000 8	0.000 9	0.000 9	0.000 9	0.000 9
Mean	0.000 7	0.000 7	0.000 8	0.000 8	0.000 8	0.000 9	0.000 9	0.000 9	0.001 0
Median	0.000 7	0.000 7	0.000 8	0.000 8	0.000 8	0.000 9	0.000 9	0.000 9	0.001 0
std.dev	0.000 1	0.000 1	0.000 1	0.000 1	0.000 1	0.000 1	0.000 1	0.000 1	0.000 1
Max	0.000 8	0.000 8	0.000 9	0.000 9	0.001 0	0.001 0	0.001 1	0.001 1	0.001 1
Min	0.000 6	0.000 5	0.000 7	0.000 7	0.000 7	0.000 8	0.000 8	0.000 8	0.000 9

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9.3 Test condition 3 **105 ℃**

Drive Current **700 mA**

Measurement Current **700 mA**

No.	Chromaticity Shift (△u'v')								
	16 000 h	17 000 h	18 000 h	19 000 h	20 000 h	21 000 h	22 000 h	23 000 h	24 000 h
1	0.001 2	0.001 2							
2	0.001 0	0.001 1							
3	0.001 2	0.001 2							
4	0.001 0	0.001 0							
5	0.001 0	0.001 1							
6	0.001 1	0.001 2							
7	0.000 9	0.000 9							
8	0.001 0	0.001 0							
9	0.001 0	0.001 1							
10	0.001 0	0.001 1							
11	0.001 0	0.001 0							
12	0.000 9	0.000 9							
13	0.001 1	0.001 1							
14	0.000 9	0.001 0							
15	0.001 1	0.001 2							
16	0.001 0	0.001 0							
17	0.001 0	0.001 1							
18	0.001 0	0.001 0							
19	0.000 9	0.001 0							
20	0.001 0	0.001 0							
Mean	0.001 0	0.001 1							
Median	0.001 0	0.001 1							
std.dev	0.000 1	0.000 1							
Max	0.001 2	0.001 2							
Min	0.000 9	0.000 9							

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9.3 Test condition 3 **105 ℃**

Drive Current **700 mA**

Measurement Current **700 mA**

No.	CCT (K)							
	0 h	500 h	1 000 h	2 000 h	3 000 h	4 000 h	5 000 h	6 000 h
1	2 720	2 723	2 723	2 722	2 722	2 722	2 722	2 718
2	2 682	2 688	2 689	2 686	2 687	2 687	2 687	2 684
3	2 654	2 657	2 657	2 655	2 656	2 656	2 656	2 653
4	2 660	2 664	2 664	2 662	2 662	2 663	2 663	2 660
5	2 633	2 637	2 637	2 636	2 637	2 637	2 637	2 633
6	2 674	2 679	2 680	2 678	2 680	2 679	2 678	2 676
7	2 669	2 677	2 677	2 675	2 676	2 676	2 675	2 673
8	2 675	2 679	2 678	2 677	2 678	2 678	2 678	2 676
9	2 641	2 645	2 644	2 643	2 644	2 643	2 643	2 641
10	2 668	2 672	2 672	2 671	2 672	2 672	2 671	2 668
11	2 676	2 681	2 681	2 680	2 681	2 680	2 680	2 677
12	2 665	2 669	2 670	2 669	2 670	2 670	2 669	2 666
13	2 670	2 675	2 674	2 672	2 673	2 673	2 672	2 670
14	2 640	2 647	2 646	2 646	2 646	2 647	2 647	2 644
15	2 717	2 718	2 718	2 717	2 719	2 718	2 718	2 715
16	2 698	2 701	2 700	2 699	2 700	2 700	2 700	2 697
17	2 687	2 693	2 693	2 692	2 693	2 693	2 693	2 690
18	2 669	2 674	2 673	2 672	2 673	2 673	2 673	2 670
19	2 704	2 709	2 707	2 706	2 707	2 708	2 706	2 704
20	2 684	2 687	2 687	2 686	2 687	2 687	2 686	2 683
Mean	2 674	2 679	2 678	2 677	2 678	2 678	2 678	2 675
Median	2 672	2 678	2 678	2 676	2 677	2 677	2 677	2 674
std.dev	23	23	23	23	23	23	23	23
Max	2 720	2 723	2 723	2 722	2 722	2 722	2 722	2 718
Min	2 633	2 637	2 637	2 636	2 637	2 637	2 637	2 633

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9.3 Test condition 3 **105 ℃**

Drive Current **700 mA**

Measurement Current **700 mA**

No.	CCT (K)								
	7 000 h	8 000 h	9 000 h	10 000 h	11 000 h	12 000 h	13 000 h	14 000 h	15 000 h
1	2 722	2 722	2 722	2 720	2 721	2 721	2 722	2 721	2 722
2	2 686	2 687	2 687	2 685	2 686	2 686	2 686	2 686	2 686
3	2 655	2 656	2 656	2 655	2 656	2 656	2 656	2 656	2 657
4	2 663	2 664	2 664	2 663	2 663	2 664	2 664	2 664	2 665
5	2 636	2 637	2 635	2 635	2 635	2 635	2 635	2 635	2 635
6	2 679	2 679	2 679	2 677	2 678	2 678	2 678	2 678	2 678
7	2 676	2 676	2 675	2 675	2 675	2 675	2 675	2 676	2 676
8	2 679	2 679	2 679	2 679	2 679	2 679	2 680	2 680	2 680
9	2 644	2 644	2 644	2 642	2 643	2 644	2 644	2 644	2 645
10	2 672	2 671	2 671	2 670	2 670	2 670	2 671	2 671	2 671
11	2 679	2 679	2 679	2 678	2 678	2 678	2 679	2 679	2 679
12	2 669	2 670	2 670	2 667	2 668	2 668	2 669	2 669	2 669
13	2 673	2 672	2 672	2 671	2 672	2 672	2 672	2 672	2 672
14	2 647	2 647	2 647	2 646	2 646	2 646	2 646	2 647	2 647
15	2 717	2 717	2 717	2 715	2 716	2 715	2 716	2 715	2 716
16	2 699	2 700	2 699	2 698	2 699	2 698	2 699	2 699	2 699
17	2 692	2 692	2 692	2 691	2 691	2 691	2 691	2 691	2 692
18	2 672	2 673	2 672	2 671	2 672	2 672	2 672	2 672	2 673
19	2 707	2 707	2 706	2 706	2 706	2 706	2 706	2 707	2 707
20	2 686	2 686	2 686	2 685	2 685	2 685	2 685	2 685	2 686
Mean	2 678	2 678	2 678	2 676	2 677	2 677	2 677	2 677	2 678
Median	2 677	2 677	2 677	2 676	2 676	2 676	2 677	2 677	2 677
std.dev	23	23	23	23	23	23	23	23	23
Max	2 722	2 722	2 722	2 720	2 721	2 721	2 722	2 721	2 722
Min	2 636	2 637	2 635	2 635	2 635	2 635	2 635	2 635	2 635

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9.3 Test condition 3 **105 ℃**

Drive Current **700 mA**

Measurement Current **700 mA**

No.	CCT (K)								
	16 000 h	17 000 h	18 000 h	19 000 h	20 000 h	21 000 h	22 000 h	23 000 h	24 000 h
1	2 722	2 722							
2	2 686	2 686							
3	2 657	2 657							
4	2 665	2 665							
5	2 635	2 635							
6	2 678	2 678							
7	2 676	2 676							
8	2 681	2 681							
9	2 645	2 645							
10	2 671	2 671							
11	2 679	2 678							
12	2 669	2 669							
13	2 672	2 672							
14	2 647	2 647							
15	2 715	2 715							
16	2 699	2 698							
17	2 692	2 692							
18	2 673	2 673							
19	2 707	2 707							
20	2 685	2 685							
Mean	2 678	2 678							
Median	2 677	2 677							
std.dev	23	23							
Max	2 722	2 722							
Min	2 635	2 635							

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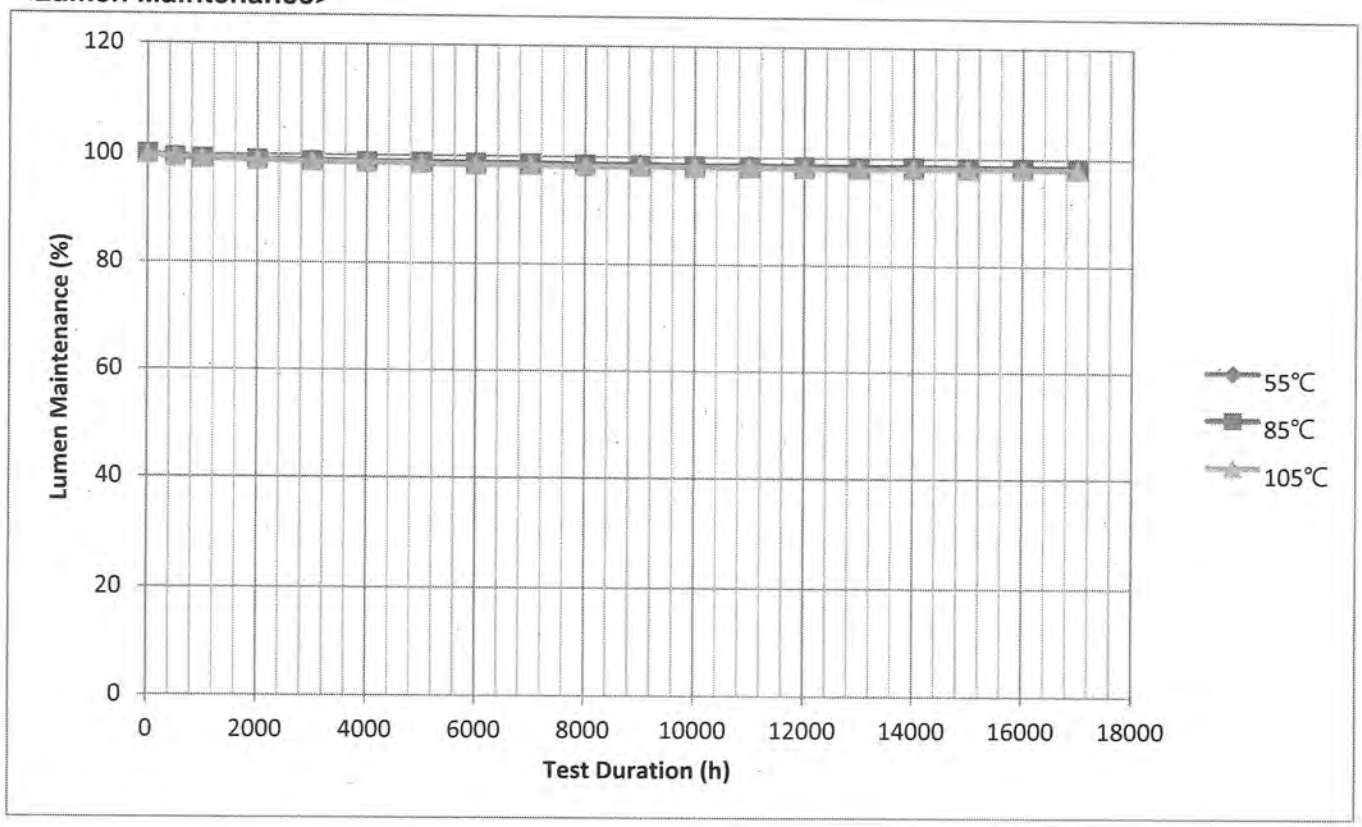
9.4 Chart

<Lumen Maintenance>



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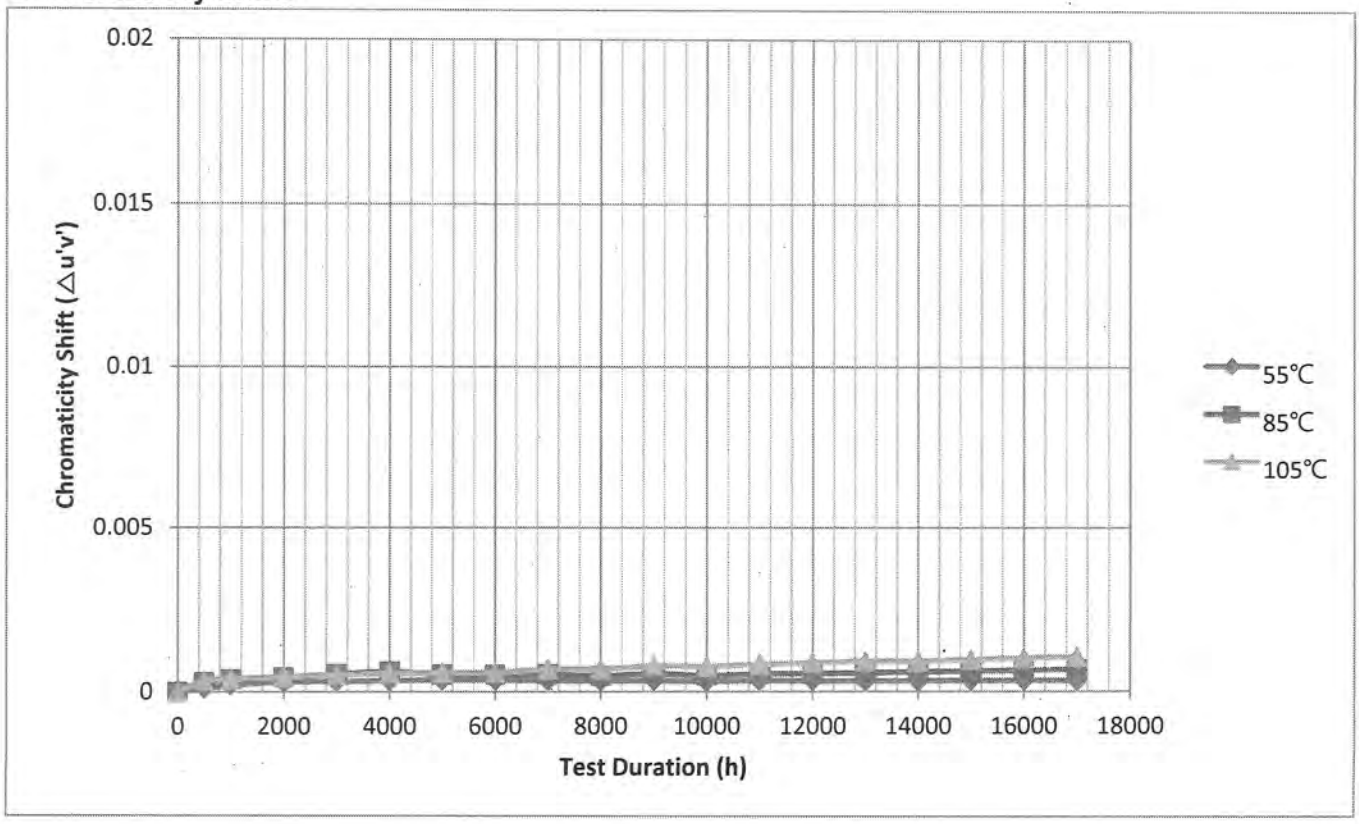

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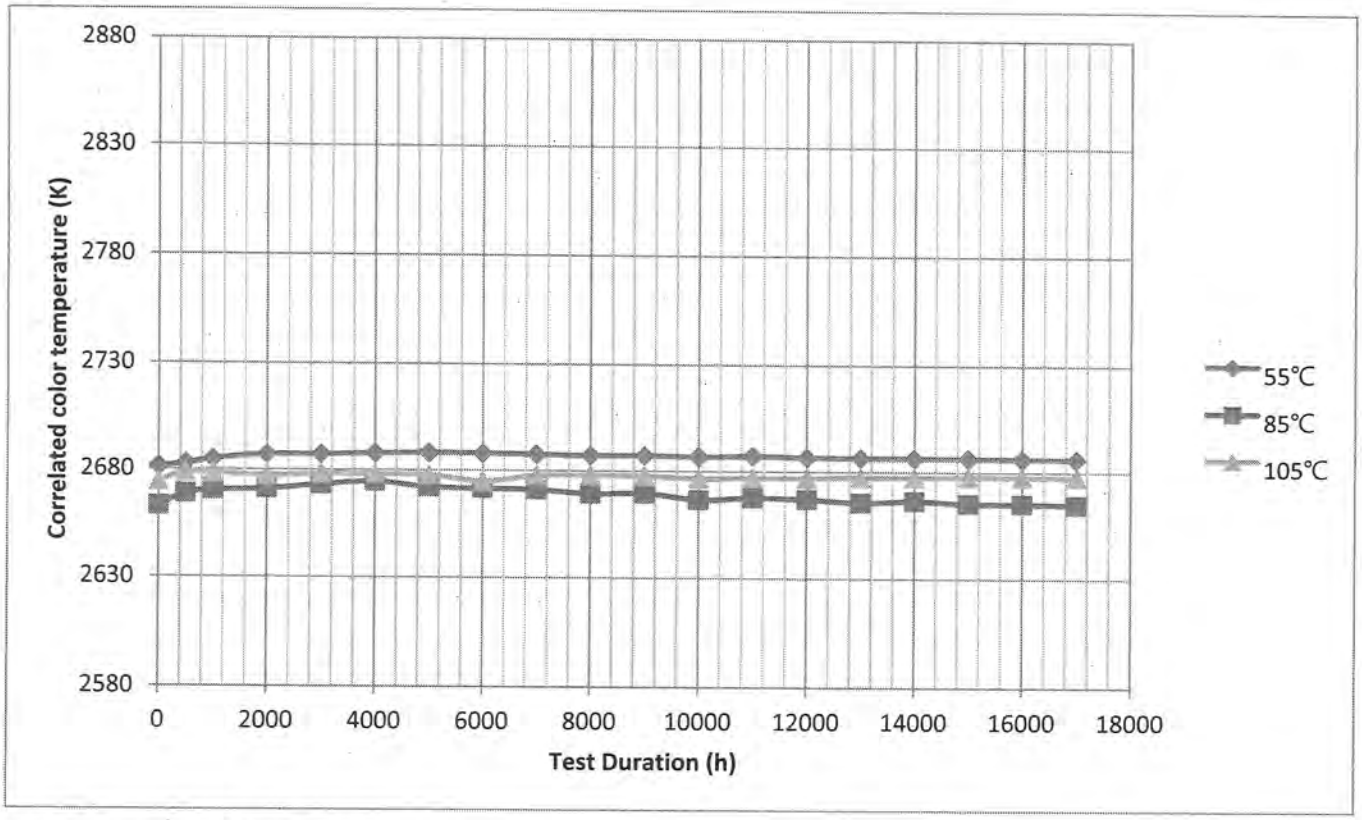
<CCT>



10. Observation of failures

No optical, Electrical or mechanical failure of any LED Package was seen during the lifetime testing.

11. LED light source monitoring interval

0	500	1 000	2 000	3 000	4 000	5 000	6 000	7 000	8 000
9 000	10 000	11 000	12 000	13 000	14 000	15 000	16 000	17 000	

12. Photometric measurement uncertainty

3.5%

13. TM-21-11 Report : Projecting Long Term Lumen Maintenance of LED Light Source

Table 1: Report at each LM-80 Test Condition

Description of LED Light Source Tested (manufacturer, model, catalog number)	

Test Condition 1 - 55°C Case Temp		Test Condition 2 - 85°C Case Temp		Test Condition 3 - 105°C Case Temp	
Sample size	20	Sample size	20	Sample size	20
Number of failures	0	Number of failures	0	Number of failures	0
DUT drive current used in the test (mA)	700	DUT drive current used in the test (mA)	700	DUT drive current used in the test (mA)	700
Test duration (hours)	17,000	Test duration (hours)	17,000	Test duration (hours)	17,000
Test duration used for projection (hour to hour)	8,000 - 17,000	Test duration used for projection (hour to hour)	8,000 - 17,000	Test duration used for projection (hour to hour)	8,000 - 17,000
Tested case temperature (°C)	55	Tested case temperature (°C)	85	Tested case temperature (°C)	105
α	1.230E-07	α	7.389E-08	α	1.606E-07
B	0.987	B	0.985	B	0.983
Reported L90(17k) (hours)	>102000	Reported L90(17k) (hours)	>102000	Reported L90(17k) (hours)	>102000

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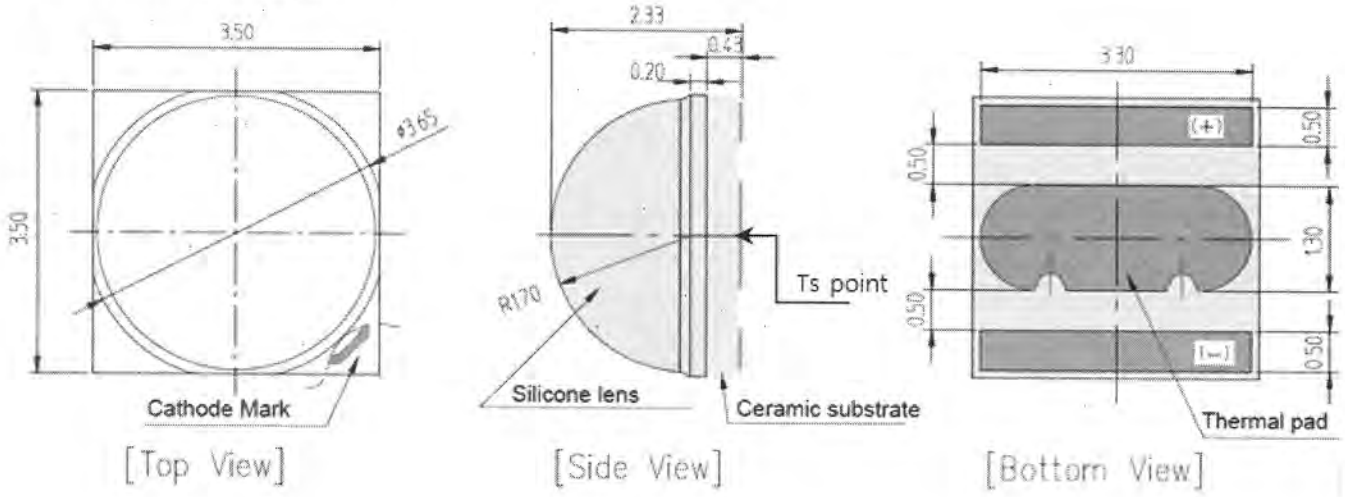
14. Dimension of samples



15. Cover models

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