



Report No. : SLED-17-017-R01

LM80 Test Report

IES LM-80-08 Approved Method for Measuring Lumen
Maintenance of LED Light Sources

Samsung Electronics LED Business Report

Report No. : SLED-17-017-R01
Test Initiated Date : 2016.09.12
Test End Date : 2017.12.04
Report issued Date : 2018.01.18

Test result reported for	Testing performed by
SAMSUNG ELECTRONICS LED BUSINESS Lighting Marketing Group Tel) +82-31-8021-3231	SAMSUNG ELECTRONICS LED BUSINESS 1, Samsung-ro, Giheung-gu, Yongin-si, Gyeonggi-do 17113, Korea
Tested By KyungYeup Kwak	Approved by SeungYoon Choi
	
Test Personal Name & Signatory	Approval Name & Signatory

SAMSUNG ELECTRONICS LED BUSINESS Executive Vice President
Accredited by KOLAS, Republic of KOREA

The above testing certificate is the accredited testing items by Korea Laboratory Accreditation Scheme, which signed the ILAC-MRA.

■ Test Summary ■

Life test condition			Summary of result		
Test condition	Current (mA)	Case temperature (°C)	Test duration (h)	Average lumen maintenance (%)	Maximum chromaticity shift ($\Delta u'v'$)
1	1 000	55.0	10 000	97.4	0.001 3
2	1 000	84.8	10 000	97.1	0.001 5
3	1 000	104.9	10 000	96.2	0.002 3

1. Number of LED light sources tested

- 20 Packages tested at actual case temperature 55.0 °C
- 20 Packages tested at actual case temperature 84.8 °C
- 20 Packages tested at actual case temperature 104.9 °C

2. Description of LED light sources

- IF = 1 000 mA, CCT(Nominal) = 2 700 K
- Package Dimension : (3.5 × 3.5) mm
- Samsung Electronics LED Package : LH351C Series (SPHWHxL3D50xxxxxxx)

3. Description of auxiliary equipment

- 1) Instrument Integrating sphere ISP1000-100
- 2) Instrument CAS140-CT
- 3) Keithley 2425 Sourcemeter

4. Operating time

- 10 000 h at (55.0 °C, 84.8 °C, 104.9 °C)
- Drive current : 1 000 mA
- Typical voltage : 3.1 V
- * LED packages are driven with a constant direct current.

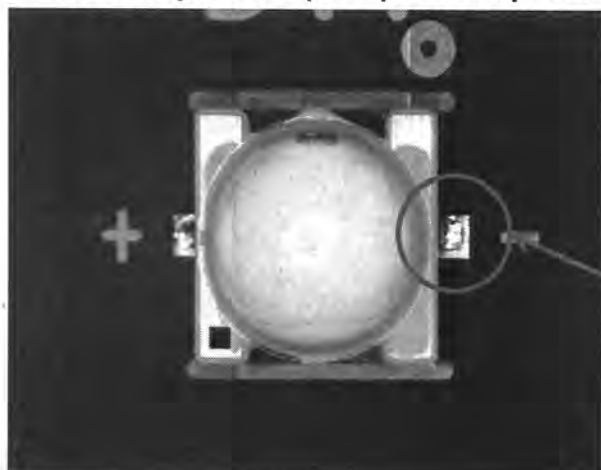
5. Ambient conditions including airflow, temperature and relative humidity

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 : Controlled to -2 °C
- Surrounding air temperature : Controlled to -5 °C
- Relative humidity : < 65 % R.H.

6. Case temperature (Test point temperature)



**Case Temperature
Measurement Point**

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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1 000 mA

1 000 mA

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1 000 mA

1 000 mA

[illegible]

1 000 μA

1 000 mA

[illegible]

1 000 mA

1 000 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	2 709	2 731	2 730	2 731	2 733	2 734	2 734	2 733
2	2 692	2 713	2 716	2 714	2 717	2 718	2 718	2 717
3	2 702	2 722	2 725	2 724	2 725	2 726	2 726	2 725
4	2 721	2 741	2 741	2 742	2 744	2 745	2 745	2 744
5	2 734	2 754	2 753	2 758	2 762	2 762	2 764	2 763
6	2 745	2 763	2 763	2 766	2 767	2 768	2 767	2 767
7	2 677	2 697	2 697	2 699	2 701	2 702	2 703	2 702
8	2 718	2 736	2 743	2 744	2 745	2 747	2 746	2 745
9	2 755	2 779	2 779	2 781	2 783	2 783	2 783	2 782
10	2 698	2 722	2 719	2 721	2 722	2 722	2 721	2 721
11	2 697	2 715	2 715	2 717	2 718	2 718	2 718	2 719
12	2 739	2 754	2 755	2 758	2 760	2 762	2 760	2 760
13	2 734	2 756	2 753	2 756	2 757	2 758	2 758	2 757
14	2 746	2 767	2 769	2 769	2 769	2 770	2 769	2 770
15	2 733	2 751	2 756	2 761	2 761	2 762	2 761	2 760
16	2 705	2 726	2 728	2 729	2 733	2 734	2 734	2 733
17	2 750	2 768	2 770	2 772	2 773	2 775	2 775	2 773
18	2 697	2 717	2 716	2 718	2 720	2 721	2 720	2 720
19	2 723	2 741	2 744	2 746	2 746	2 746	2 747	2 746
20	2 740	2 759	2 759	2 761	2 765	2 765	2 764	2 763
Mean	2 721	2 741	2 742	2 743	2 745	2 746	2 746	2 745
Median	2 722	2 741	2 744	2 745	2 746	2 747	2 747	2 746
std.dev	22	22	22	23	23	23	23	23
Max	2 755	2 779	2 779	2 781	2 783	2 783	2 783	2 782
Min	2 677	2 697	2 697	2 699	2 701	2 702	2 703	2 702

1000 mA

1000 mA

[illegible]

1 000 mA

1 000 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	335.8	3.143	99.0	98.8	98.5	98.5	98.3	98.1	98.0
2	335.6	3.107	98.9	98.7	98.4	98.3	98.2	98.0	97.9
3	336.2	3.077	98.6	98.1	98.0	98.0	97.6	97.6	97.5
4	336.4	3.156	98.7	98.4	97.8	97.8	97.7	97.6	97.4
5	338.9	3.107	98.3	98.2	97.8	97.8	97.7	97.5	97.5
6	340.4	3.090	98.4	97.9	98.0	98.0	97.6	97.7	97.5
7	338.7	3.044	98.6	98.3	98.1	98.1	97.9	97.7	97.6
8	339.5	3.109	98.7	98.4	98.1	98.2	98.0	97.8	97.7
9	338.0	3.106	98.6	98.2	98.2	98.2	97.8	97.8	97.8
10	337.9	3.101	98.7	98.5	98.5	98.3	98.1	98.0	98.2
11	335.0	3.080	98.7	98.1	98.2	98.0	97.8	97.6	97.5
12	335.3	3.058	98.4	98.2	98.2	98.0	97.9	97.7	97.5
13	335.3	3.154	98.6	97.9	97.8	97.8	97.3	97.3	97.3
14	336.5	3.138	98.7	98.5	98.3	98.2	98.0	97.8	98.0
15	338.8	3.077	98.9	98.3	98.2	98.1	97.9	97.8	97.7
16	338.9	3.054	98.6	98.1	98.1	98.0	97.7	97.8	97.6
17	336.2	3.162	99.1	98.4	98.2	98.0	97.8	97.7	97.7
18	338.8	3.080	98.5	98.3	98.0	98.0	97.8	97.7	97.6
19	332.1	3.085	98.5	98.0	97.9	97.9	97.5	97.5	97.4
20	335.0	3.150	98.3	98.1	97.7	97.7	97.5	97.4	97.3
Mean	337.0	3.10	98.6	98.3	98.1	98.0	97.8	97.7	97.6
Median	336.4	3.10	98.6	98.2	98.1	98.0	97.8	97.7	97.6
std.dev	2.0	0.04	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Max	340.4	3.16	99.1	98.8	98.5	98.5	98.3	98.1	98.2
Min	332.1	3.04	98.3	97.9	97.7	97.7	97.3	97.3	97.3

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1 000 mA

1 000 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	98.0	97.9	97.9	97.7					
2	97.7	97.7	97.7	97.4					
3	97.3	97.2	97.0	97.0					
4	97.4	97.3	97.2	97.0					
5	97.3	97.3	97.3	97.1					
6	97.3	97.3	97.1	97.1					
7	97.6	97.4	97.3	97.1					
8	97.5	97.4	97.4	97.2					
9	97.6	97.6	97.3	97.4					
10	97.9	97.8	97.7	97.5					
11	97.4	97.3	97.2	97.0					
12	97.3	97.4	97.3	97.1					
13	97.1	97.1	96.8	96.8					
14	97.7	97.8	97.5	97.3					
15	97.5	97.5	97.3	97.2					
16	97.5	97.4	97.1	97.1					
17	97.6	97.5	97.3	97.1					
18	97.4	97.4	97.3	97.1					
19	97.2	97.2	96.9	96.9					
20	97.2	97.0	96.9	96.7					
Mean	97.5	97.4	97.3	97.1					
Median	97.4	97.4	97.3	97.1					
std.dev	0.2	0.2	0.3	0.2					
Max	98.0	97.9	97.9	97.7					
Min	97.1	97.0	96.8	96.7					

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1 000 mA

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1 000 mA

1 000 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	2 704	2 728	2 733	2 733	2 732	2 733	2 733	2 731
2	2 695	2 716	2 718	2 718	2 718	2 720	2 719	2 718
3	2 693	2 717	2 719	2 720	2 720	2 720	2 720	2 720
4	2 696	2 717	2 719	2 720	2 720	2 721	2 721	2 720
5	2 739	2 766	2 766	2 766	2 766	2 768	2 768	2 766
6	2 742	2 764	2 765	2 766	2 766	2 766	2 767	2 766
7	2 738	2 760	2 761	2 760	2 760	2 760	2 761	2 761
8	2 758	2 781	2 788	2 787	2 786	2 787	2 787	2 787
9	2 697	2 721	2 721	2 721	2 721	2 720	2 722	2 721
10	2 725	2 747	2 748	2 749	2 748	2 749	2 750	2 749
11	2 739	2 762	2 763	2 764	2 763	2 764	2 764	2 763
12	2 701	2 724	2 727	2 729	2 729	2 729	2 730	2 728
13	2 724	2 747	2 751	2 752	2 752	2 751	2 752	2 750
14	2 680	2 705	2 707	2 707	2 707	2 708	2 708	2 707
15	2 721	2 745	2 747	2 747	2 747	2 748	2 748	2 747
16	2 725	2 748	2 750	2 750	2 750	2 750	2 750	2 749
17	2 706	2 730	2 730	2 731	2 731	2 732	2 732	2 732
18	2 702	2 725	2 727	2 726	2 727	2 728	2 729	2 728
19	2 730	2 751	2 754	2 754	2 754	2 754	2 755	2 752
20	2 717	2 738	2 739	2 740	2 739	2 741	2 741	2 740
Mean	2 717	2 740	2 742	2 742	2 742	2 743	2 743	2 742
Median	2 719	2 741	2 743	2 744	2 743	2 744	2 745	2 743
std.dev	21	21	21	21	21	21	21	21
Max	2 758	2 781	2 788	2 787	2 786	2 787	2 787	2 787
Min	2 680	2 705	2 707	2 707	2 707	2 708	2 708	2 707

1 000 mA

1 000 mA

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1 000 mA

1 000 mA

[illegible]

1 000 mA

1 000 mA

No.	Cx	Cy	Chromaticity Shift ($\Delta u'v'$)						
	0 h		500 h	1 000 h	2 000 h	3 000 h	4 000 h	5 000 h	6 000 h
1	0.457 2	0.408 2	0.001 2	0.001 4	0.001 7	0.001 7	0.001 8	0.001 9	0.002 0
2	0.457 5	0.409 2	0.000 9	0.001 2	0.001 6	0.001 4	0.001 6	0.001 7	0.001 8
3	0.458 2	0.408 5	0.001 1	0.001 4	0.001 7	0.001 6	0.001 8	0.001 8	0.001 7
4	0.455 7	0.409 7	0.001 0	0.001 3	0.001 6	0.001 5	0.001 6	0.001 7	0.001 8
5	0.458 0	0.410 8	0.001 1	0.001 3	0.001 6	0.001 5	0.001 7	0.001 8	0.001 7
6	0.457 7	0.408 9	0.001 0	0.001 3	0.001 6	0.001 5	0.001 6	0.001 8	0.001 7
7	0.455 8	0.408 3	0.001 0	0.001 5	0.001 7	0.001 6	0.001 7	0.001 8	0.001 8
8	0.458 1	0.410 4	0.001 0	0.001 3	0.001 7	0.001 5	0.001 6	0.001 8	0.001 8
9	0.460 8	0.411 0	0.001 0	0.001 3	0.001 5	0.001 5	0.001 6	0.001 7	0.001 7
10	0.458 0	0.408 7	0.001 0	0.001 3	0.001 6	0.001 5	0.001 6	0.001 7	0.001 7
11	0.456 2	0.407 6	0.001 0	0.001 4	0.001 6	0.001 5	0.001 7	0.001 7	0.001 8
12	0.455 9	0.408 3	0.001 0	0.001 3	0.001 6	0.001 5	0.001 6	0.001 8	0.001 7
13	0.457 3	0.410 1	0.001 1	0.001 4	0.001 6	0.001 5	0.001 6	0.001 8	0.001 8
14	0.454 5	0.408 2	0.000 9	0.001 2	0.001 5	0.001 4	0.001 6	0.001 7	0.001 8
15	0.456 7	0.408 9	0.001 1	0.001 3	0.001 6	0.001 5	0.001 6	0.001 8	0.001 8
16	0.459 6	0.409 5	0.001 0	0.001 3	0.001 6	0.001 5	0.001 6	0.001 7	0.001 7
17	0.455 0	0.407 4	0.000 9	0.001 2	0.001 6	0.001 5	0.001 6	0.001 7	0.001 8
18	0.457 6	0.408 4	0.001 0	0.001 3	0.001 6	0.001 5	0.001 6	0.001 7	0.001 8
19	0.456 3	0.408 1	0.001 0	0.001 2	0.001 6	0.001 4	0.001 6	0.001 7	0.001 8
20	0.458 1	0.410 5	0.001 0	0.001 3	0.001 6	0.001 6	0.001 7	0.001 8	0.001 8
Mean	0.457 2	0.409 0	0.001 0	0.001 3	0.001 6	0.001 5	0.001 6	0.001 8	0.001 8
Median	0.457 4	0.408 8	0.001 0	0.001 3	0.001 6	0.001 5	0.001 6	0.001 8	0.001 8
std.dev	0.001 5	0.001 1	0.000 1	0.000 1	0.000 1	0.000 1	0.000 1	0.000 1	0.000 1
Max	0.460 8	0.411 0	0.001 2	0.001 5	0.001 7	0.001 7	0.001 8	0.001 9	0.002 0
Min	0.454 5	0.407 4	0.000 9	0.001 2	0.001 5	0.001 4	0.001 6	0.001 7	0.001 7

1 000 mA

1 000 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	2 714	2 741	2 744	2 749	2 751	2 751	2 753	2 751
2	2 717	2 736	2 741	2 745	2 742	2 743	2 744	2 741
3	2 702	2 726	2 732	2 735	2 732	2 734	2 734	2 729
4	2 748	2 769	2 773	2 777	2 774	2 774	2 776	2 772
5	2 723	2 746	2 749	2 753	2 750	2 753	2 752	2 748
6	2 712	2 734	2 739	2 744	2 741	2 743	2 744	2 739
7	2 735	2 757	2 767	2 770	2 767	2 768	2 769	2 765
8	2 719	2 741	2 746	2 751	2 747	2 749	2 750	2 746
9	2 685	2 705	2 710	2 714	2 711	2 712	2 713	2 710
10	2 706	2 726	2 732	2 735	2 733	2 733	2 734	2 731
11	2 724	2 746	2 753	2 755	2 754	2 756	2 756	2 753
12	2 734	2 756	2 762	2 766	2 762	2 764	2 764	2 759
13	2 728	2 751	2 755	2 759	2 755	2 756	2 758	2 754
14	2 754	2 774	2 778	2 782	2 779	2 780	2 780	2 777
15	2 727	2 750	2 753	2 757	2 755	2 756	2 757	2 753
16	2 690	2 712	2 717	2 722	2 718	2 720	2 720	2 717
17	2 740	2 760	2 764	2 769	2 765	2 767	2 767	2 764
18	2 710	2 732	2 737	2 741	2 739	2 740	2 740	2 737
19	2 726	2 748	2 752	2 756	2 752	2 754	2 755	2 751
20	2 719	2 740	2 744	2 747	2 745	2 745	2 746	2 742
Mean	2 721	2 742	2 747	2 751	2 749	2 750	2 751	2 747
Median	2 721	2 743	2 748	2 752	2 751	2 752	2 753	2 749
std.dev	17	17	17	17	17	17	17	17
Max	2 754	2 774	2 778	2 782	2 779	2 780	2 780	2 777
Min	2 685	2 705	2 710	2 714	2 711	2 712	2 713	2 710

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1 000 mA

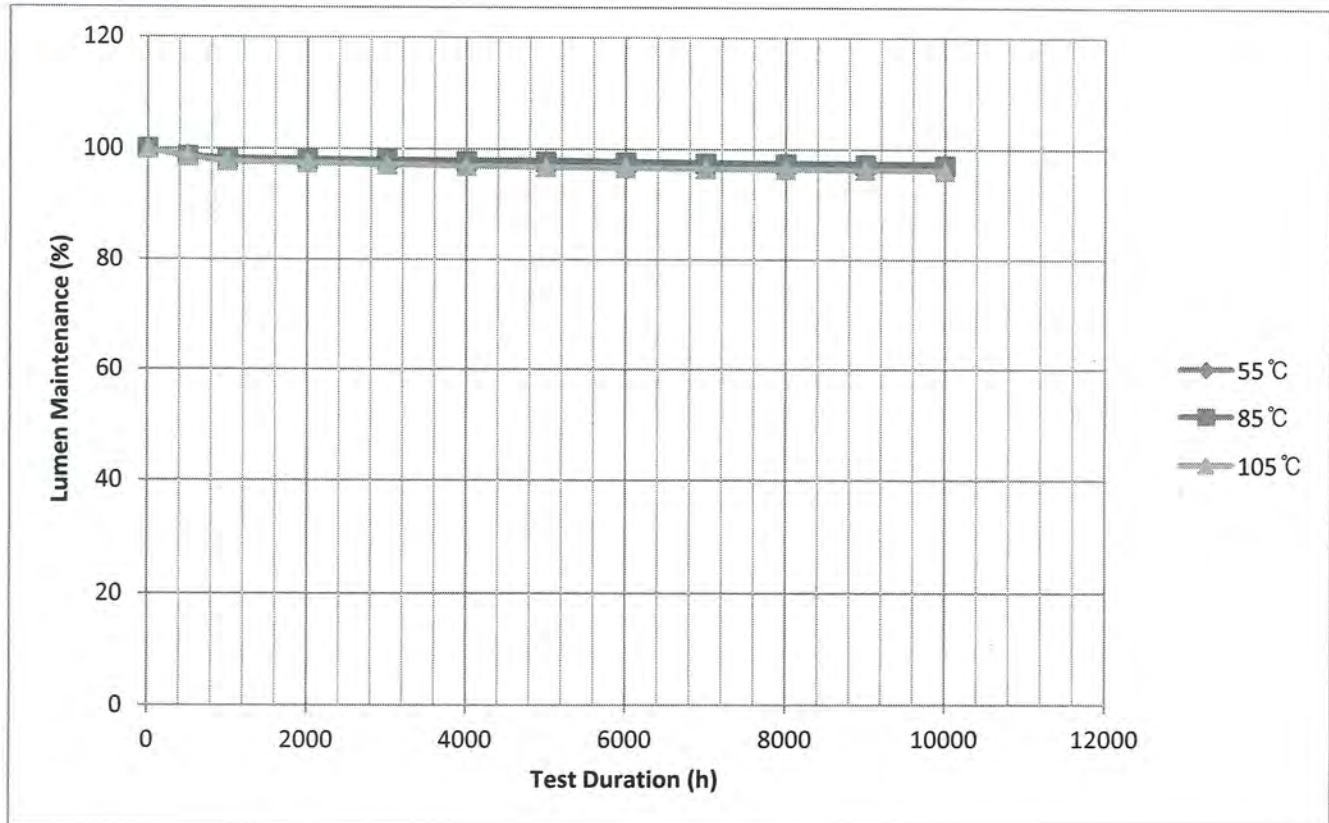
1 000 mA

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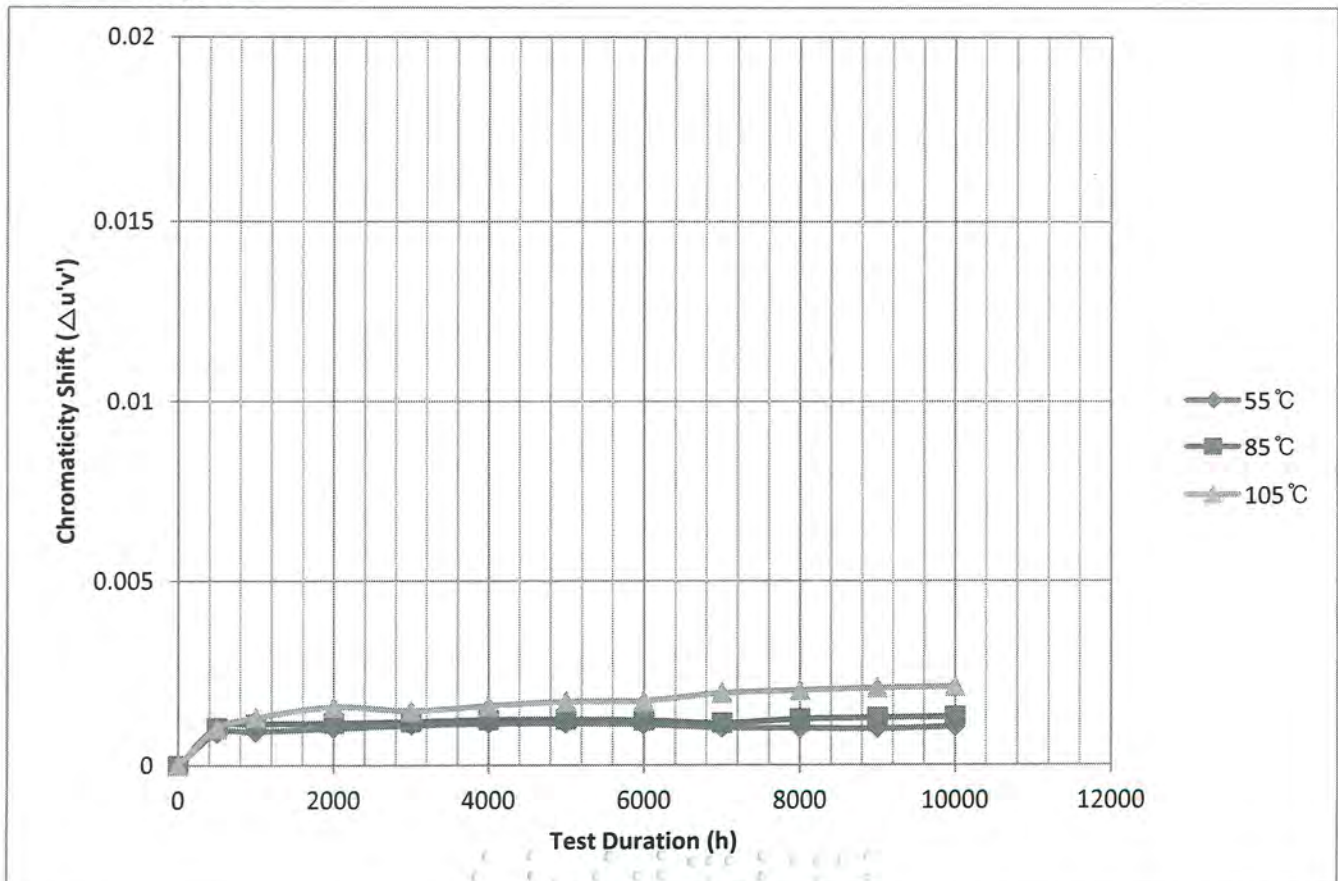
9.4 Chart

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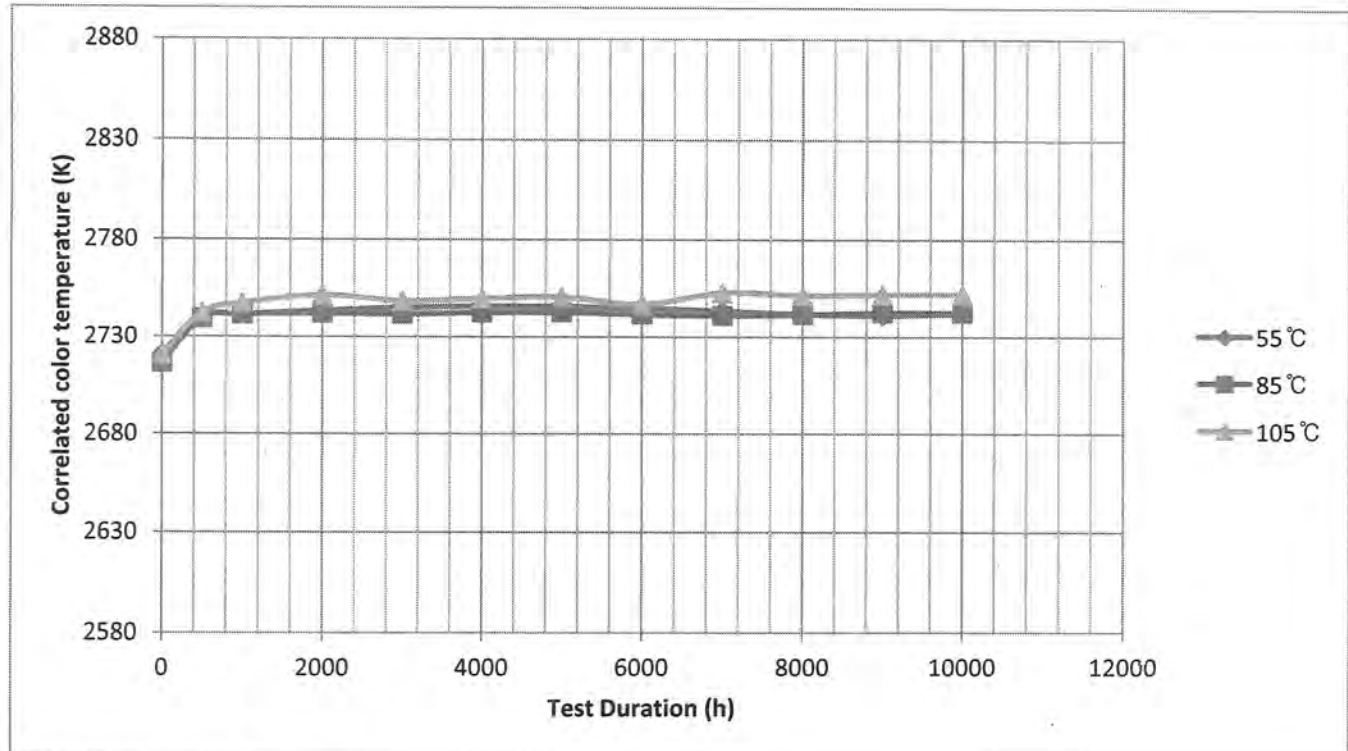
<Lumen Maintenance>



<Chromaticity Shift>



<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

12. Photometric measurement uncertainty

3.5%

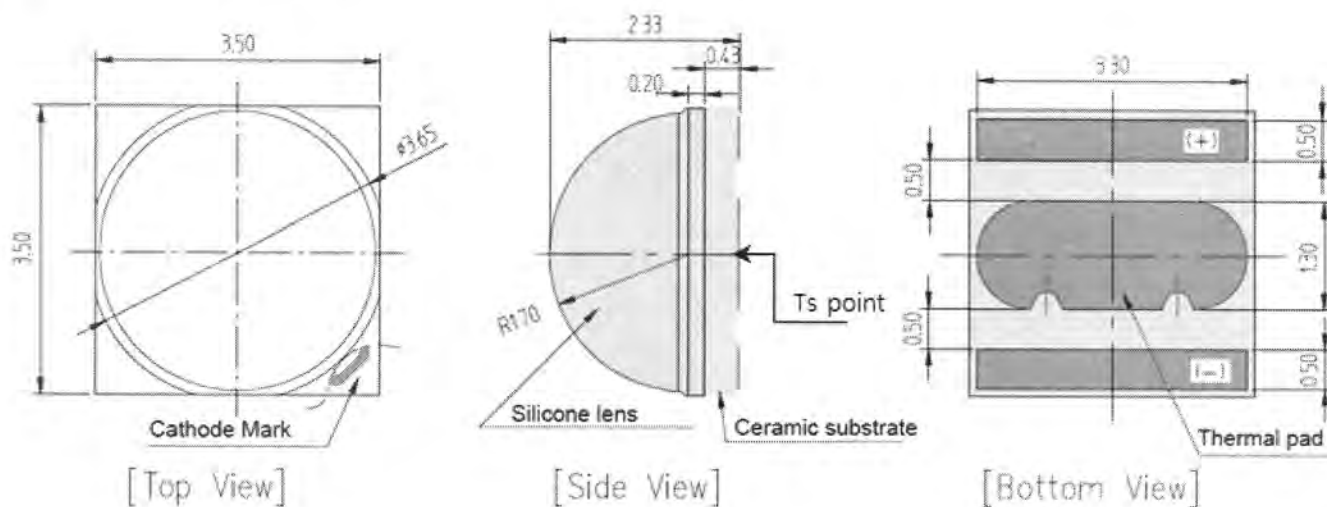
13. TM-21-11 Report : Projecting Long Term Lumen Maintenance of LED Light Source

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)	1000	DUT drive current used in the test (mA)	1000	DUT drive current used in the test (mA)	1000
Test duration (hours)	10,000	Test duration (hours)	10,000	Test duration (hours)	10,000
Test duration used for projection (hour to hour)	5,000 - 10,000	Test duration used for projection (hour to hour)	5,000 - 10,000	Test duration used for projection (hour to hour)	5,000 - 10,000
Tested case temperature (°C)	55	Tested case temperature (°C)	85	Tested case temperature (°C)	105
α	1.112E-06	α	1.173E-06	α	1.273E-06
B	0.984	B	0.983	B	0.974
Reported L70(10k) (hours)	>60000	Reported L70(10k) (hours)	>60000	Reported L70(10k) (hours)	>60000

14. Dimension of samples

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