



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.

SAMSUNG ELECTRONICS LED BUSINESS
 Accredited by KOLAS, Republic of KOREA

■ 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 ①.

■ 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

■ 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	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 °C
- 20 Packages tested at actual case temperature 85.1 °C
- 20 Packages tested at actual case temperature 104.9 °C
- ※ 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) mm
- 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 mA
 - Typical voltage : 3 V
 - Total input power : 2.1 W
 - Average current density per LED die : 350 mA/mm²
 - Average power density per LED die : 1.05 W/mm²
- 5) Test duration : 17 000 h

* LED packages are driven with a constant direct current.

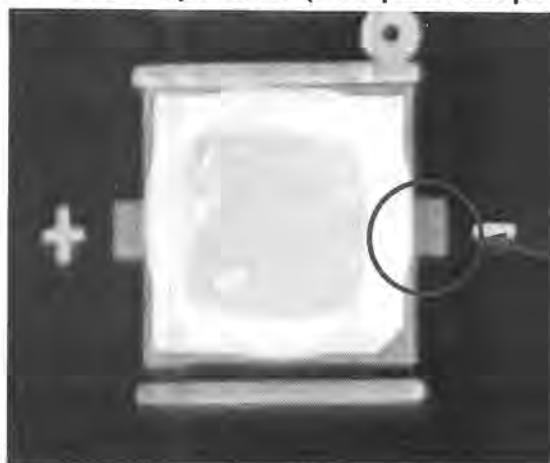
5. Ambient conditions including airflow, temperature and relative humidity

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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9.1 Test condition 1

55 °C

Drive Current

700 mA

Measurement Current

700 mA

[illegible]

9.1 Test condition 1

55 °C

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

9.1 Test condition 1

55 °C

Drive Current

700 mA

Measurement Current

700 mA

[illegible]

9.2 Test condition 2

85 °C

Drive Current

700 mA

Measurement Current

700 mA

[illegible]

9.2 Test condition 2

85 °C

Drive Current

700 mA

Measurement Current

700 mA

[illegible]

9.2 Test condition 2

85 °C

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

9.2 Test condition 2

85 °C

Drive Current

700 mA

Measurement Current

700 mA

[illegible]

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9.3 Test condition 3

105 °C

Drive Current

700 mA

Measurement Current

700 mA

[illegible]

Report No. : SLED-19-030-R02

9.3 Test condition 3

105 °C

Drive Current

700 mA

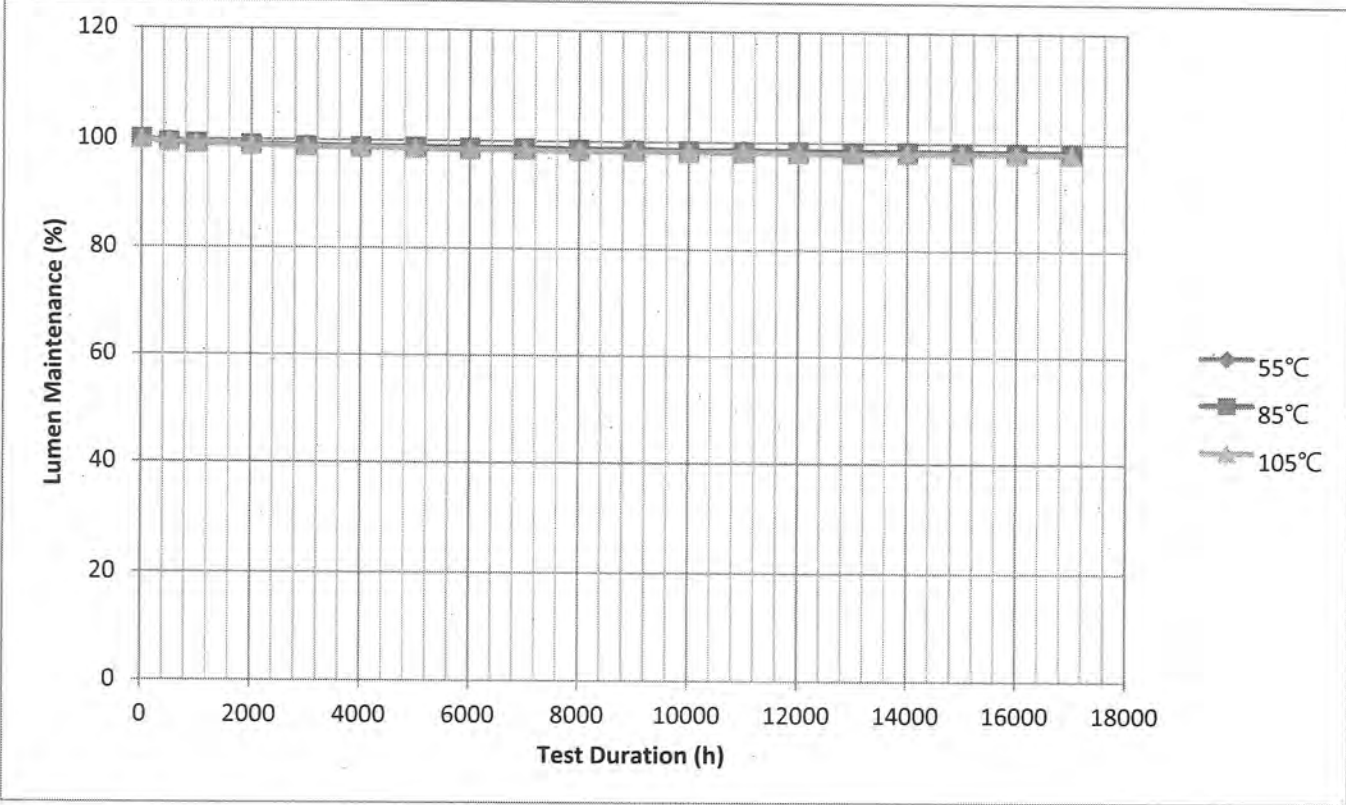
Measurement Current

700 mA

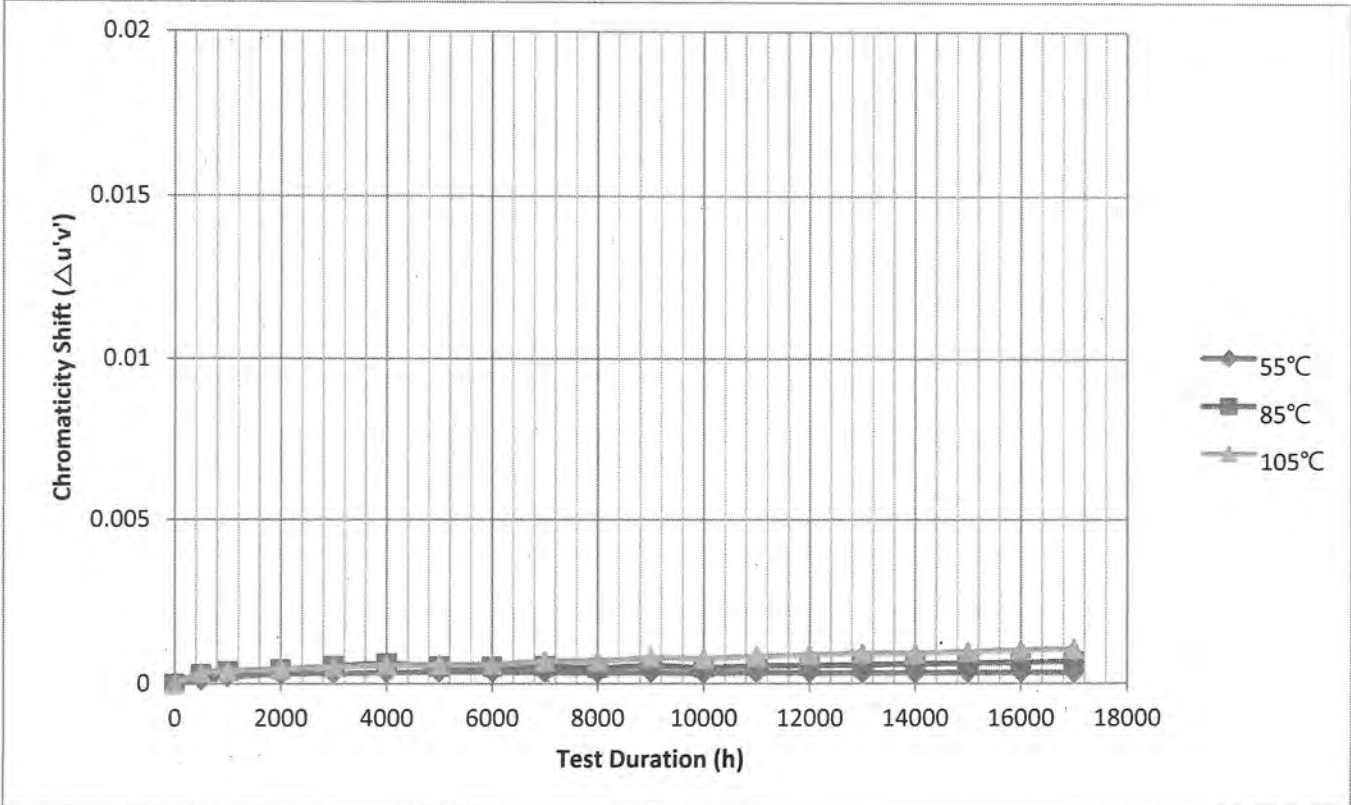
No.	CCT (K)							
	0 h	500 h	1 000 h	2 000 h	3 000 h	4 000 h	5 000 h	6 000 h
1	2 720	2 723	2 723	2 722	2 722	2 722	2 722	2 718
2	2 682	2 688	2 689	2 686	2 687	2 687	2 687	2 684
3	2 654	2 657	2 657	2 655	2 656	2 656	2 656	2 653
4	2 660	2 664	2 664	2 662	2 662	2 663	2 663	2 660
5	2 633	2 637	2 637	2 636	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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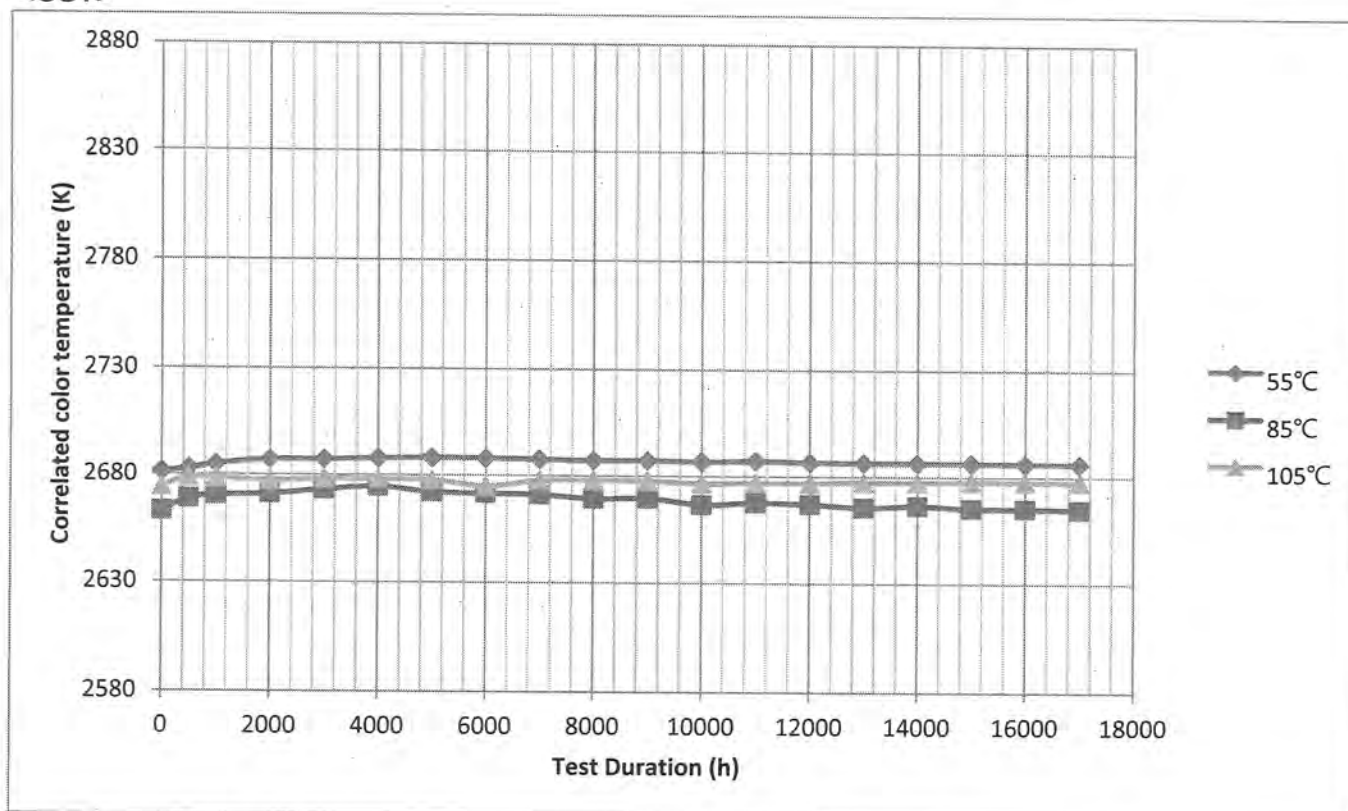
9.4 Chart
<Lumen Maintenance>



<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 11 000 12 000 13 000 14 000 15 000 16 000 17 000

12. Photometric measurement uncertainty

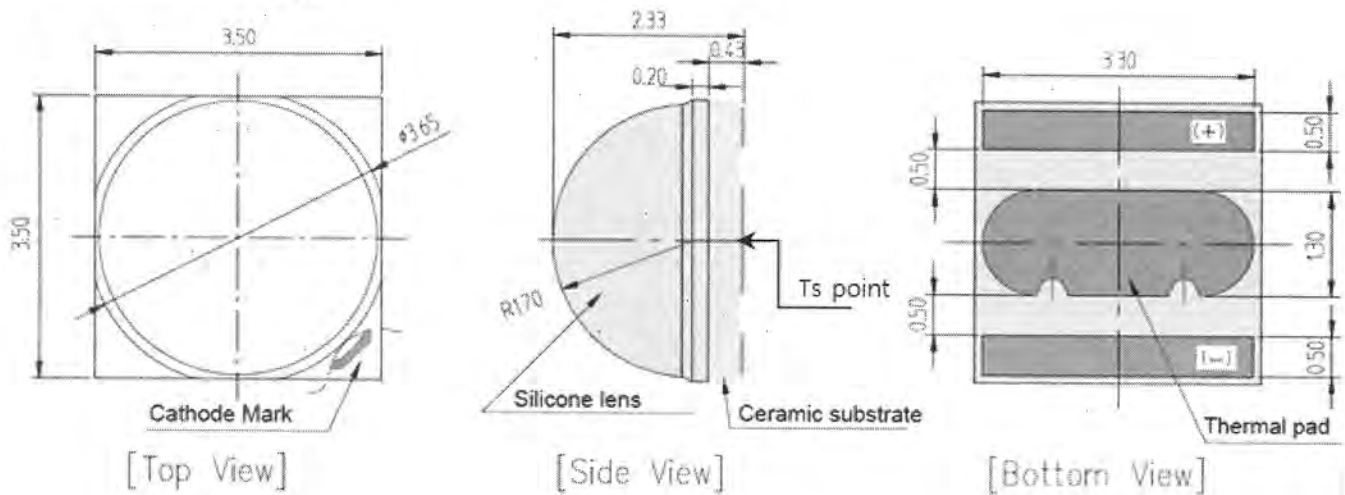
3.5%

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

14. Dimension of samples



15. Cover models

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