

Report No.: SLED-19-030-R02





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



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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 \odot are not accredited by KOLAS.
- 6. The test results received from external providers for the test results marked ①.

Revision History

Revision History Rev.0 : New Version ev.1 : Typos Correction	Drawn K.Y.KWAK K.Y.KWAK	
Provided the Providence of the		
ev.1 : Typos Correction	KYKWAK	DCDADE
	1.30,403,41.41.	D'O'L HUV
: Extended Test Duration	K.Y.KWAK	D.S.PARK
	- Extended Test Datation	R.O.KWAN



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Test Summary

	Life test	condition		Summary of result	3
Test condition	Current (mA)	Case temperature (°C)	Test duration (h)	Average lumen maintenance (%)	Maximum chromaticity shift (△u'v')
4	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

* LED packages are driven with a constant direct current.

5) Test duration: 17 000 h

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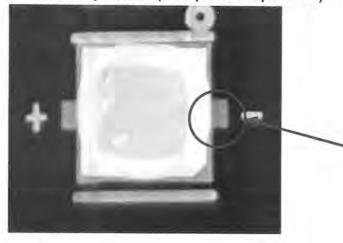
5. Ambient conditions including airflow, temperature and relative humidity

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 °C
- Surrounding air temperature : Contorlled 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

	Flux (lm)	T	700 mA Lumen Maintenance (%)							
No. 1		h (v)	F00 l-	1 000 1						
1			500 h	1 000 h	2 000 h	3 000 h	4 000 h	5 000 h	6 000 h	
	254.6	3.041	99.3	99.2	99.2	98.8	98.7	98.6	98.5	
	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 °C

Drive Current

700 mA

Measurement Current

No.				Lumen	Maintena	nce (%)			
NO.	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
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

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		5							
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 °C

Drive Current

700 mA

Measurement Current

	urement (700 mA	Lumen	Maintena	nco	(%)			
No.	16 000 h	17 000 h	18 000 h					22 000 5	22 000 5	24 000 1
1	98.4	98.5	10 000 11	19 000 11	20 000 11	21	000 h	22 000 h	23 000 n	24 000
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								
								т		
				, o o o o o o o o o o o o o o o o o o o						
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 °C

Drive Current 700 mA

Measurement Current 700 mA

ivieas	urement		700 mA								
No.	u'	٧'	N	Chromaticity Shift (△u'v')							
		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		
						•		***************************************	***************************************		
				-			1	***************************************	***************		

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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		
									0.000 3		
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			



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9.1 Test condition 1

55 ℃

Drive Current

700 mA

Measurement Current

No	Chromaticity Shift (△u'v')												
No.	7 000 h	8 000 h	9 000 h	10 000 h	11 000 h		13 000 h	14 000 h	15 000				
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 °C

Drive Current

700 mA

Measurement Current

Meas	urement (Current	700 mA						
No.					ticity Shift				
140.	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		9.1					-
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			1				
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							
IAHII	0.000 2	0.000 2							



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9.1 Test condition 1

55 °C

Drive Current

Measure	ement Current	700 mA						
No.				CCT (K)				
140.	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
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	1							
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						
IVIIII	2 047	2 040	2 650	2 652	2 652	2 652	2 653	2 653



Report No.: SLED-19-030-R02

9.1 Test condition 1

55 °C

Drive Current

Meas	urement (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											
140.	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			



Report No.: SLED-19-030-R02

9.1 Test condition 1

55 ℃

Drive Current

700 mA

Measurement Current

NI-	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												
No.	16 000 h	17 000 h	18 000 h	19 000 h		21 000 h	22 000 h	23 000 h	24 000 h				
1	2 684	2 683	N.										
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	7 4	***************************************									
9	2 680	2 680	•••••	***************************************	•••••			,					
10	2 650	2 650			•••••								
11	2 698	2 698			1-	***************************************							
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	1	8									
18	2 693	2 693											
19	2 717	2 717											
20	2 672	2 672							***************************************				
								4					
					160								

				2			* 1						
Mean	2 686	2 686											
Median	2 682	2 682											
std.dev	21	21											
Max	2 717	2 717					***************************************						
Min	2 650	2 650			,								





Report No.: SLED-19-030-R02

9.2 Test condition 2

85 °C

Drive Current

700 mA Measurement Current 700 mA

NIa	Flux (lm)	Vf (V)	Lumen Maintenance (%)								
No.	0		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		
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			***************************************						***************************************		

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		



Report No.: SLED-19-030-R02

9.2 Test condition 2

85 °C

Drive Current

700 mA

Measurement Current

Meas	urement (Current	700 mA	1					
No.				Lumen	Maintena	nce (%)			
140.	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

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									••••••
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



Report No.: SLED-19-030-R02

9.2 Test condition 2

85 °C

Drive Current

.,,,,,,,,	Lumen Maintenance (%)												
No.	16 000 1	47 000 1	10.000.1				ce (%) 21 000 h 22 000 h 23 000 h 24						
4			18 000 h	19 000 h	20 000 h	21	000 h	22	000 h	23 000 h	24 000		
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		9									
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											

									•••••				

i													
Mean	98.4	98.4		1		-							
Median	98.4	98.3	,										
std.dev	0.3	0.3											
Max	98.8	98.8											
Min	98.0	97.9											





Report No.: SLED-19-030-R02

9.2 Test condition 2

85 °C

Drive Current

700 mA

Measurement Current

No.	u'	V'			Chroma	aticity Shift	(∆u'v')		
140.	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
							•••••		***************************************
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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



Report No.: SLED-19-030-R02

9.2 Test condition 2 85 °C

Drive Current 700 mA

Meas	urement (Current	700 mA						
No.				Chroma	aticity Shift	t (△u'v')		316	
110.	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



Report No.: SLED-19-030-R02

9.2 Test condition 2

85 °C

Drive Current

700 mA

Measurement Current

ivieas	urement (urrent	700 mA	25.7-27					
No.					ticity Shift				
		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			4				***************************************
5	0.000 5	0.000 6		1.0					
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							



Report No.: SLED-19-030-R02

9.2 Test condition 2

85 °C

Drive Current

700 mA

Measurement Current

Measure	ement Current	700 mA									
No.		CCT (K)									
140.	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 °C

Drive Current

700 mA

Measurement Current

NIa	CCT (K)												
No.	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				
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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9.2 Test condition 2

85 °C

Drive Current

700 mA

Measurement Current

No		4			CCT (K)				
No.	16 000 h	17 000 h	18 000 h	19 000 h		21 000 h	22 000 h	23 000 h	24 000 H
1	2 652	2 651	1	1					
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 °C

Drive Current

Meas	urement (Current	700 mA								
No.	Flux (lm)	Vf (V)			Lumen	Maintena	nce (%)				
140.	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		
			••••••••						••••••		
		***************************************			······································	· · · · · · · · · · · · · · · · · · ·					

· · · · · · · · · · · · · · · · · · ·									***************************************		
	•••••	***************************************		•							
					4						
	***************************************	************************		•••••••							
					,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,						
		-									
				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 °C

Drive Current

700 mA

Measurement Current

ivieas	urement (urrent	700 mA	10					
No.					Maintena				
	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
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

	10								
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 °C

Drive Current

700 mA

Measurement Current

NI-				Lumen	Maintena	nce	(%)			ī		
No.	16 000 h	17 000 h	18 000 h					22	000	h	23 000 h	24 000 H
1	98.4	98.2	1		•					1	1	
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		
7	97.9	97.8								"	***************************************	
8	98.4	98.3		***************************************		,,,,,,,,,,				1		
9	98.0	98.0		***************************************			***************************************			"		
10	98.2	98.1										
11	98.1	98.1			***************************************		****************			7	***************************************	***************************************
12	98.4	98.4						*********		1		
13	98.2	98.1		***************************************				••••••		7		
14	98.4	98.3			••••••							
15	98.0	97.9		***************************************	•••••			••••••		7		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
16	98.4	98.3						•••••		1		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
17	98.0	97.9			,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			•••••		"		***************************************
18	98.3	98.3								1		
19	98.2	98.1						••••••		"		
20	97.6	97.7								1		
				***************************************	••••••••••					1		
										T		
										T		••••••
									••••••			
								•••••		T		•••••
										1		•••••
								•••••	***********	T		***************************************
										1		
								•••••				***************************************
										1		/
Mean	98.1	98.0								1		
Median	98.1	98.0								7		
std.dev	0.3	0.2										***************************************
Max	98.4	98.4	-							1		
Min	97.6	97.6								"†		





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9.3 Test condition 3 105 °C

Drive Current 700 mA

Measurement Current 700 mA

No.	u'	v'	Chromaticity Shift (△u'v')							
NO.	0 h		500 h	1 000 h	2 000 h	3 000 h	4 000 h	5 000 h	6 000 1	
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 **Drive Current**

105 °C 700 mA

Meas	urement (Current	700 mA		3C							
No.	Chromaticity Shift (△u'v')											
IVO.	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			
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	0.000 1	0.000 1	0.000 1	0.000 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			
IAIIII	0.000 0	0.000 3	0.000 /	0.000 /	0.000 /	0.000 6	0.000 6	0.000 0	0.000 9			



Report No.: SLED-19-030-R02

9.3 Test condition 3

105 °C

Drive Current

700 mA

Measurement Current

No	Chromaticity Shift (△u'v')										
No.	16 000 h	17 000 h	18 000 h				22 000 h	23 000 h	24 000 F		
1	0.001 2	0.001 2							2,000,		
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	0.000 1									
Min	0.000 9	0.000 9									



Report No.: SLED-19-030-R02

9.3 Test condition 3 105 °C

Drive Current 700 mA

Measurement Current 700 mA

	cinent current	700 1114		CCT (K)				
No.	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



Report No.: SLED-19-030-R02

9.3 Test condition 3

105 °C

Drive Current

700 mA

Measurement Current

No.	CCT (K)										
140.	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		
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		
***************************************						,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,					
				341							
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		



Report No.: SLED-19-030-R02

9.3 Test condition 3

105 °C

Drive Current

700 mA

Measurement Current

NI-	CCT (K)										
No.	16 000 h	17 000 h	18 000 h	19 000 h		21 000 h	22 000 h	23 000 h	24 000 k		
1	2 722	2 722						25 555 11	21 000 1		
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						2			
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									
			***************************************		***************************************				.,		

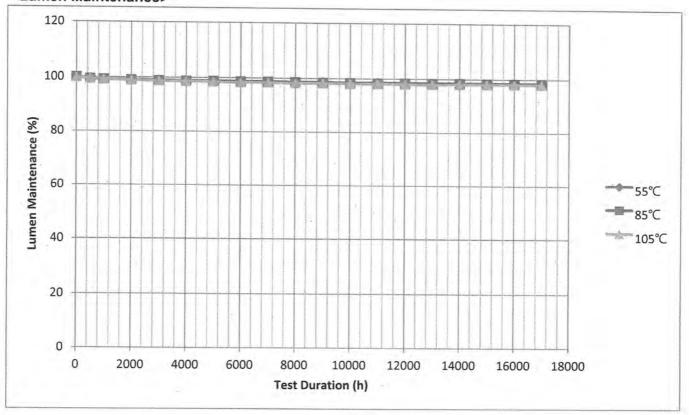
		Å									
Mean	2 678	2 678									
Median	2 677	2 677									
std.dev	23	23									
Max	2 722	2 722									
Min	2 635	2 635									
IVIIII	2 033	2 033	14								



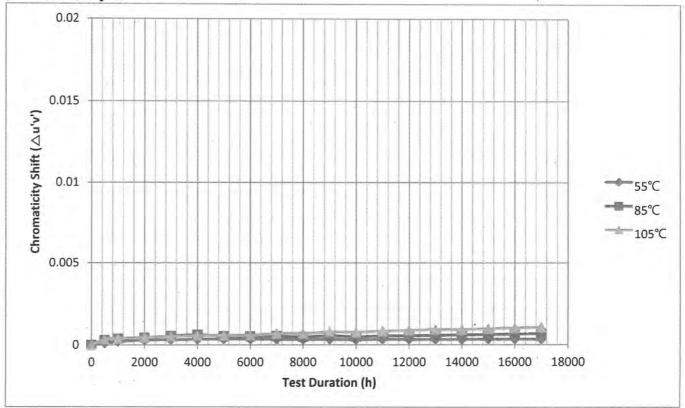
Report No.: SLED-19-030-R02

9.4 Chart

<Lumen Maintenance>

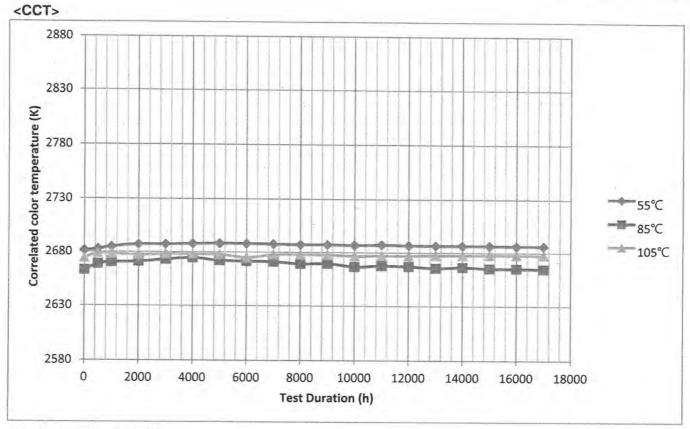








Report No.: SLED-19-030-R02



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

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

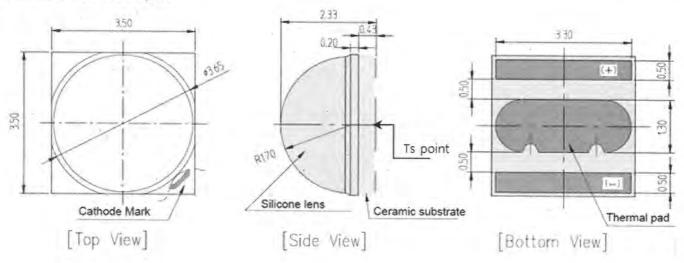
		Table 1: Report at each LM-	80 Test Conditio	i		
Description of LED Ligh (manufacturer, catalog num	model,					
Test Condition 1 - 55°C	Case Temp	Test Condition 2 - 85°C	Case Temp	Test Condition 3 - 105°C Case Temp		
Sample size	20	Sample size	20	Sample size	20	
Number of failures	0	Number of failures	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	
В	0.987	В	0.985	В	0.983	
Reported L90(17k) (hours)	>102000	Reported L90(17k) (hours)	>102000	Reported L90(17k) (hours)	>102000	

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Report No.: SLED-19-030-R02

14. Dimension of samples



15. Cover models



Report No.: SLED-19-031-R02



Test Report

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

Report no.: SLED-19-031-R02
Testing start date: 2017.07.28
Testing completion date: 2019.08.27
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



Report No.: SLED-19-031-R02

■ 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		
	Revision History	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	
1,111				



Report No.: SLED-19-031-R02

■ Test Summary

	Life test	condition	Summary of result						
Test condition	Current (mA)	Case temperature (°C)	Test duration (h)	Average lumen maintenance (%)	Maximum chromaticity shift (△u'v')				
1	1 000	55.2	17 000	98.1	0.000 8				
2	1 000	85.1	17 000	97.9	0.001 4				
3	1 000	105.1	17 000	96.5	0.0023				

Number of the sample

- 20 Packages tested at actual case temperature 55.2 °C
- 20 Packages tested at actual case temperature 85.1 °C
- 20 Packages tested at actual case temperature 105.1 °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 x 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: 1 000 mA

- Typical voltage: 3.06 V

- Total input power : 3.06 W

- Average current density per LED die : 499 mA/mm²

- Average power density per LED die: 1.52 W/mm²
- * LED packages are driven with a constant direct current.
- 5) Test duration: 17 000 h

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SAMSUNG ELECTRONICS LED BUSINESS





Report No.: SLED-19-031-R02

5. Ambient conditions including airflow, temperature and relative humidity

The minimal airflow is maintained in chamber.

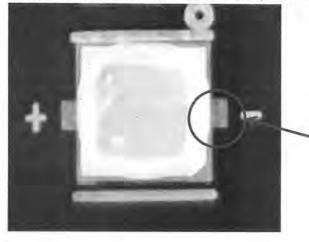
The ambient temperature around the LED packages inside chamber is controlled by air flowing and the thermocouple readings are monitored.

- Case temperature : Contorlled to -2 °C

- Surrounding air temperature : Contorlled 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





Report No.: SLED-19-031-R02

9.1 Test condition 1

55 °C

Drive Current

1 000 mA

Measurement Current

N.	Flux (lm) Vf (V)		Lumen Maintenance (%)								
No.		h	500 h	1 000 h	2 000 h	3 000 h	4 000 h	5 000 h	6 000 h		
1	335.1	3.104	99.1	99.3	98.6	98.5	98.4	98.6	98.5		
2	337.7	3.053	99.1	98.8	98.6	98.4	98.4	98.4	98.1		
3	341.5	3.071	99.6	98.9	98.8	98.6	98.4	98.3	98.0		
4	332.0	3.070	99.1	98.7	98.6	98.6	98.4	98.6	98.3		
5	335.5	3.028	99.9	98.9	98.4	98.3	98.1	98.2	98.2		
6	337.9	3.098	99.4	98.8	98.3	98.4	98.4	98.6	98.6		
7	339.3	3.060	99.6	99.0	98.9	98.9	98.6	98.8	99.0		
8	341.6	3.037	99.2	98.7	98.5	98.4	98.3	98.4	98.2		
9	335.9	3.043	99.7	99.3	98.6	98.9	98.4	98.5	98.1		
10	341.9	3.020	99.6	99.1	98.8	98.6	98.5	98.4	98.2		
11	338.7	- 3.081	99.4	99.1	99.0	98.9	98.8	98.8	98.9		
12	338.3	3.050	99.0	98.9	98.6	98.3	98.3	98.2	98.1		
13	345.7	3.052	99.4	98.8	98.8	98.7	98.5	98.7	98.7		
14	343.8	3.100	100.0	98.9	98.5	98.4	98.7	98.5	98.5		
15	333.9	3.019	99.9	99.2	98.9	98.9	98.6	98.4	98.3		
16	338.1	3.053	99.2	98.8	98.7	98.6	98.6	98.4	98.4		
17	341.0	3.046	99.2	98.8	98.7	98.6	98.5	98.5	98.5		
18	342.2	3.033	99.8	99.4	98.7	98.5	98.6	98.5	98.3		
19	334.6	3.037	100.0	99.2	99.0	98.7	98.6	98.5	98.4		
20	332.0	3.104	99.8	99.5	98.8	98.9	98.8	98.8	98.6		
						30.5		33.0			
		······	•				,		***************************************		
									•••••		
							disministration of the last of	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			
		-							***************************************		
1.0	220.2	2.00	00.5	00.0	00.7	00.6	00.5	00.5	00.4		
Mean	338.3	3.06	99.5	99.0	98.7	98.6	98.5	98.5	98.4		
Median	338.2	3.05	99.5	98.9	98.7	98.6	98.5	98.5	98.4		
std.dev	3.8	0.03	0.3	0.2	0.2	0.2	0.2	0.2	0.3		
Max	345.7	3.10	100.0	99.5	99.0	98.9	98.8	98.8	99.0		
Min	332.0	3.02	99.0	98.7	98.3	98.3	98.1	98.2	98.0		





Report No.: SLED-19-031-R02

9.1 Test condition 1

55 °C

Drive Current

1 000 mA

Measurement Current

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

		***************************************							<u> </u>				
		-											
***************************************					***************************************								

								***************************************	***************************************				
Mean	98.2	98.3	98.2	98.2	98.1	98.2	98.0	98.1	98.2				
Median	98.2	98.3	98.2	98.2	98.1	98.2	98.0	98.1	98.2				
std.dev	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3				
Max	98.7	98.7	98.6	98.7	98.6	98.7	98.6	98.6	98.7				
Min	97.8	97.8	97.7	97.8	97.6	97.7	97.6	97.6	97.6				



Report No.: SLED-19-031-R02

9.1 Test condition 1

55 °C

Drive Current

1 000 mA

Measurement Current

16	Lumen Maintenance (%)												
No.	16 000 h	17 000 h	18 000 h					22 000 h	23 000 h	24 000 1			
1	98.5	98.6		3,0 0,0			000 11	22 000 11	25 000 11	24 000 1			
2 .	97.7	97.7											
3	97.9	97.9								***************************************			
4	98.5	98.5											
5	97.8	97.8											
6	98.7	98.6											
7	98.6	98.6					***************************************			*******************************			
8	98.2	98.2		***************************************	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		***************************************			••••••			
9	97.7	97.7											
10	97.5	97.6	·	***************************************									
11	98.1	98.1							:	***************************************			
12	98.3	98.4											
13	98.5	98.4		***************************************									
14	98.1	98.0											
15	97.9	97.8	•••••										
16	98.1	98.2	***************************************										
17	98.4	98.5						***************************************		***************************************			
18	98.0	97.9											
19	97.8	97.7								••••••			
20	97.6	97.5		· · · · · · · · · · · · · · · · · · ·					***************************************				

	***************************************	***************************************											
***************************************		-											

1						***************************************							
					•••••				***************************************	***************************************			
										••••••			
					***************************************					***************************************			
Mean	98.1	98.1											
Median	98.1	98.1											
std.dev	0.4	0.4											
Max	98.7	98.6											
Min	97.5	97.5											





Report No.: SLED-19-031-R02

9.1 Test condition 1

55 °C

Drive Current

1 000 mA

Measurement Current

Meas	Measurement Current		1 000 mA								
No.	u'	V'			Chroma	aticity Shift	(∆u'v')				
140.	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 1	0.526 2	0.000 4	0.000 5	0.000 6	0.000 7	0.000 7	0.000 7	0.000 7		
2	0.262 0	0.527 4	0.000 2	0.000 4	0.000 4	0.000 5	0.000 6.	0.000 6	0.000 6		
3	0.263 4	0.529 1	0.000 1	0.000 2	0.000 3	0.000 3	0.000 4	0.000 4	0.000 4		
4	0.262 5	0.527 1	0.000 2	0.000 4	0.000 5	0.000 5	0.000 5	0.000 6	0.000 6		
5	0.263 2	0.530 0	0.000 2	0.000 4	0.000 5	0.000 6	0.000 6	0.000 6	0.000 6		
6	0.262 4	0.527 4	0.000 1	0.000 4	0.000 4	0.000 5	0.000 5	0.000 6	0.000 5		
7	0.262 3	0.527 0	0.000 5	0.000 6	0.000 7	0.000 8	0.000 8	0.000 8	0.000 8		
8	0.262 2	0.528 5	0.000 1	0.000 4	0.000 5	0.000 6	0.000 6	0.000 6	0.000 6		
9	0.262 4	0.527 9	0.000 4	0.000 6	0.000 6	0.000 7	0.000 7	0.000 7	0.000 8		
10	0.262 7	0.529 9	0.000 3	0.000 5	0.000 5	0.000 6	0.000 7	0.000 7	0.000 7		
11	0.262 0	0.527 2	0.000 3	0.000 3	0.000 5	0.000 6	0.000 6	0.000 5	0.000 5		
12	0.263 4	0.528 2	0.000 3	0.000 3	0.000 5	0.000 5	0.000 5	0.000 6	0.000 6		
13	0.263 0	0.526 6	0.000 0	0.000 4	0.000 5	0.000 5	0.000 6	0.000 6	0.000 6		
14	0.262 1	0.526 8	0.000 3	0.000 4	0.000 4	0.000 5	0.000 5	0.000 6	0.000 6		
15	0.262 3	0.527 8	0.000 4	0.000 5	0.000 6	0.000 7	0.000 7	0.000 7	0.000 8		
16	0.262 5	0.526 9	0.000 4	0.000 4	0.000 6	0.000 5	0.000 6	0.000 6	0.000 6		
17	0.262 1	0.526 8	0.000 3	0.000 5	0.000 6	0.000 6	0.000 6	0.000 7	0.000 7		
18	0.260 9	0.526 6	0.000 1	0.000 4	0.000 4	0.000 5	0.000 6	0.000 6	0.000 6		
19	0.263-3	0.528 2	0.000 4	0.000 4	0.000 5	0.000 6	0.000 6	0.000 6	0.000 7		
20	0.262 3	0.528 0	0.000 2	0.000 4	0.000 6	0.000 5	0.000 5	0.000 6	0.000 6		
		-									
		-					/				
Mean	0.262 4	0.527 7	0.000 3	0.000 4	0.000 5	0.000 6	0.000 6	0.000 6	0.000 6		
Median	0.262 3	0.527 4	0.000 3	0.000 4	0.000 5	0.000 5	0.000 6	0.000 6	0.000 6		
std.dev	0.000 7	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	0.263 4	0.530 0	0.000 5	0.000 6	0.000 7	0.000 8	0.000 8	0.000 8	0.000 8		
Min	0.260 9	0.526 2	0.000 0	0.000 2	0.000 3	0.000 3	0.000 4	0.000 4	0.000 4		



Report No.: SLED-19-031-R02

9.1 Test condition 1

55 ℃

Drive Current

1 000 mA

Measurement Current

Meas	urement (Current	1 000 mA						
No.				Chroma	ticity Shift	: (△u'v′)			
110.	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 7	0.000 7	0.000 8	0.000 7	0.000 8	0.000 8	0.000 8	0.000 8	0.000 8
2	0.000.6	0.000 6	0.000 6	0.000 6	0.000 7	0.000 6	0.000 6	0.000 6	0.000 6
3	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 5
4	0.000 6	0.000 7	0.000 7	0.000 6	0.000 7	0.000 7	0.000 7	0.000 7	0.000 7
5	0.000 6	0.000 6	0.000 7	0.000 6	0.000 7	0.000 6	0.000 7	0.000 7	0.000 6
6	0.000 6	0.000 6	0.000 6	0.000 6	0.000 6	0.000 6	0.000 6	0.000 6	0.000 6
7	0.000 8	0.000 9	0.000 9	0.000 8	0.000 8	0.000 8	0.000 8	0.000 8	0.000 8
8	0.000 7	0.000 7	0.000 7	0.000 7	0.000 8	0.000 7	0.000 7	0.000 7	0.000 7
9	0.000 8	0.000 8	0.000 9	0.000 8	0.000 8	0.000 8	0.000 8	0.000 8	0.000 8
10	0.000 7	0.000 8	0.000 7	0.000 8	0.000 8	0.000 8	0.000 8	0.000 8	0.000 8
11	0.000 6	0.000 6	0.000 6	0.000 5	0.000 6	0.000 5	0.000 6	0.000 5	0.000 5
12	0.000 6	0.000 6	0.000 6	0.000 6	0.000 7	0.000 6	0.000 6	0.000 6	0.000 6
13	0.000 6	0.000 6	0.000 7	0.000 6	0.000 7	0.000 6	0.000 7	0.000 7	0.000 7
14	0.000 6	0.000 6	0.000 6	0.000 6	0.000 6	0.000 6	0.000 6	0.000 6	0.000 6
15	0.000 7	0.000 7	0.000 7	0.000 7	0.000 7	0.000 7	0.000 7	0.000 6	0.000 6
16	0.000 7	0.000 7	0.000 7	0.000 7	0.000 7	0.000 7	0.000 8	0.000 7	0.000 7
17	0.000 7	0.000 7	0.000 8	0.000 7	0.000 8	0.000 7	0.000 8	0.000 8	0.000 7
18	0.000 6	0.000 6	0.000 6	0.000 6	0.000 7	0.000 6	0.000 6	0.000 6	0.000 6
19	0.000 7	0.000 7	0.000 7	0.000 7	0.000 7	0.000 7	0.000 7	0.000 7	0.000 7
20	0.000 7	0.000 7	0.000 7	0.000 6	0.000 7	0.000 7	0.000 7	0.000 6	0.000 7
		-						***************************************	***************************************
								i.	
						1			
Mean	0.000 7	0.000 7	0.000 7	0.000 6	0.000 7	0.000 7	0.000 7	0.000 7	0.000 7
Median	0.000 7	0.000 7	0.000 7	0.000 6	0.000 7	0.000 7	0.000 7	0.000 7	0.000 7
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 9	0.000 9	0.000 8	0.000 8	0.000 8	0.000 8	0.000 8	0.000 8
Min	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 5



Report No.: SLED-19-031-R02

9.1 Test condition 1

55 °C

Drive Current

1 000 mA

Measurement Current

No	Chromaticity Shift (△u'v')												
No.	16 000 h	17 000 h	18 000 h				22 000 h	23 000 h	24 000 1				
1	0.000 8	0.000 8					774 .83.0 74.0						
2	0.000 6	0.000 6											
3	0.000 5	0.000 5		***************************************	***************************************								
4	0.000 7	0.000 8			1								
5	0.000 6	0.000 6			1		***************************************		***************************************				
6	0.000 6	0.000 6			***************************************	***************************************							
7	0.000 8	0.000 7						***************************************					
8	0.000 7	0.000 7			•••••								
9	0.000 8	0.000 8					***************************************						
10	0.000 8	0.000 8											
11	0.000 5	0.000 5							***************************************				
12	0.000 6	0.000 6											
13	0.000 7	0.000 7							•••••				
14	0.000 5	0.000 5											
15	0.000 6	0.000 6					i i						
16	0.000 7	0.000 7											
17	0.000 8	0.000 8											
18	0.000 6	0.000 6		1									
19	0.000 7	0.000 7											
20	0.000 6	0.000 6											
		- 0							7				
								-					
				,									
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	Θ										
Min	0.000 5	0.000 5											



Report No. : SLED-19-031-R02

9.1 Test condition 1

55 °C

Drive Current

1 000 mA

Measurement Current

Measure	ement Current	1 000 mA						
No.				CCT (K)				
140.	0 h	500 h	1 000 h	2 000 h	3 000 h	4 000 h	5 000 h	6 000 h
1	2 730	2 737	2 740	2 741	2 743	2 743	2 743	2 743
2	2 705	2 710	2 713	2 713	2 715	2 715	2 716	2 716
3	2 668	2 670	2 672	2 674	2 673	2 676	2 675	2 675
4	2 696	2 698	2 702	2 705	2 704	2 705	2 707	2 707
5	2 671	2 674	2 678	2 680	2 681	2 681	2 682	2 682
6	2 697	2 698	2 704	2 704	2 706	2 706	2 707	2 707
7	2 701	2 711	2 712	2 714	2 716	2 716	2 715	2 715
8	2 698	2 699	2 705	2 707	2 707	2 708	2 709	2 709
9	2 694	2 701	2 704	2 705	2 707	2 707	2 708	2 708
10	2 681	2 687	2 690	2 691	2 692	2 692	2 693	2 693
11	2 707	2 712	2 713	2 716	2 717	2 717	2 716	2 716
12.	2 672	2 676	2 678	2 680	2 680	2 681	2 682	2 681
13	2 688	2 688	2 695	2 697	2 696	2 698	2 699	2 699
14	2 707	2 712	2.714	2 714	2 716	2 716	2 717	2 717
15	2 697	2 705	2 706	2 708	2 709	2 710	2 709	2 711
16	2 696	2 703	2 704	2 706	2 705	2 706	2 707	2 707
17	2 706	2 711	2 714	2 717	2 717	2 717	2 718	2 718
18	2 73-2	2 733	2 740	2 740	2 742	2 743	2 744	2 744
19	2 674	2 680	2 6.81	2 683	2 684	2 685	2 684	2 685
20	2 697	2 700	2 704	2 707	2 706	2 707	2 707	2 707
						••••••		
				•••••				
			,					
Mean	2 696	2 700	2 703	2 705	2 706	2 706	2 707	2 707
Mean	2 697	2 700	2 703	2 706	2 706	2 707	2 708	2 707
Median	17	18	18	18	18	18	18	18
std.dev							2 744	
Max	2 732	2 737	2 740	2 741	2 743	2 743		2 744
Min	2 668	2 670	2 672	2 674	2 673	2 676	2 675	2 675



Report No.: SLED-19-031-R02



9.1 Test condition 1

55 °C

Drive Current

Meas	urement (Current	1 000 mA								
No.			CCT (K)								
140.	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	2 743	2 743	2 744	2 743	2 744	2 742	2 743	2 742	2 742		
2	2 716	2.716	2 715	2 716	2 716	2 715	2 715	2 715	2 714		
3	2 676	2 676	2 676	2 675	2 676	2 675	2 675	2 675	2 674		
4	2 706	2 708	2 707	2 707	2 708	2 707	2 707	2 707	2 707		
5	2 682	2 682	2 683	2 682	2 682	2 681	2 682	2 681	2 681		
6	2 707	2 707	2 707	2 707	2 707	2 706	2 707	2 706	2 706		
7	2 716	2 716	2 716	2 715	2 716	2 714	2 715	2 714	2 713		
8	2 710	2 710	2 710	2 709	2 710	2 709	2 709	2 708	2 708		
9	2 707	2 708	2 709	2 707	2 708	2 707	2 708	2 707	2 707		
10	2 693	2 694	2 693	2 694	2 694	2 693	2 693	2 693	2 693		
11	2 717	2 717	2 717	2 716	2 716	2 715	2 715	2 714	2 714		
12	2 683	2 682	2 682	2,681	2 683	2 681	2 682	2 681	2 681		
13	2 698	2 698	2 699	2 699	2 699	2 698	2 699	2 698	2 698		
14	2 716	2 716	2 716	2 716	2 716	2 715	2 715	2 715	2 714		
15	2 709	2 710	2 710	2 709	2 709	2 708	2 708	2 707	2 706		
16	2 708	_2 708	2 709	2 707	2 709	2 707	2 708	2 707	2 707		
17	2 717	2 718	2 719	2 718	2 719	2 717	2 718	2 717	2 717		
18	2 743	2 743	2 743	2 743	2 744	2 742	2 742	2 742	2 741		
19	2 685	2 685	2 685	2 685	2 685	2 684	2 684	2 684	2 683		
20	2 708	2 708	2 708	2 707	2 708	2 707	2 707	2 706	2 706		

			•••••					7	***************************************		
	••••••••						***************************************	***************************************	***************************************		
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,					***************************************						
	***************************************	***************************************									

Mean	2 707	2 707	2 707	2 707	2 708	2 706	2 707	2 706	2 706		
Median	2 708	-2 708	2 709	2 707	2 709	2 707	2 708	2 707	2 707		
std.dev	18	18	18	1.8	18	18	18	18	18		
Max	2 743	2 743	2 744	2 743	2 744	2 742	2 743	2 742	2 742		
Min	2 676	2 676	2 676	2 675	2 676	2 675	2 675	2 675	2 674		



Report No.: SLED-19-031-R02

9.1 Test condition 1

55 °C

Drive Current

ivieas	urement (urrent									
No.	,				CCT (K)						
1.000	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	2 742	2 741				1					
2	2 714	2 714							***************************************		
3	2 674	2 674							***************************************		
4	2 707	2 707									
5	2 680	2 680	ili		••••••••••				***************************************		
6	2 705	2 705						:	***************************************		
7	2 713	2 712					***************************************		***************************************		
8	2 708	2 708							,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		
9 .	2 706	2 706						***************************************	***************************************		
10	2 693	2 693									
11	2 713	2 713						***************************************	***************************************		
12	2 680	2 680			***************************************		***************************************	••••••	•••••••		
13	2 698	2 698									
14	2 714	2 714									
15	2 706	- 2 705							••••••		
16	2 707	2 707									
17	2 717	2 716	-								
18	2 741	2 741									
19	2 683	2 683						-			
20	2 706	2 706									
***************************************	•										
			,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,					· · · · · · · · · · · · · · · · · · ·			
Mean	2 705	⁻ 2 705						9			
Median	2 703	2 703									
std.dev	18	18									
Max	2 742	2 741									
Min	2 674	2 674			, Sec. 17.						





Report No.: SLED-19-031-R02

9.2 Test condition 2

85 °C

Drive Current

1 000 mA

Measurement Current

NI-	Flux (lm) Vf (V)		Lumen Maintenance (%)								
No.	0		500 h	1 000 h	2 000 h	3 000 h	4 000 h	5 000 h	6 000 h		
1	339.4	3.084	98.9	98.9	98.8	98.7	98.2	98.3	98.1		
2	335.6	3.055	99.3	98.7	98.4	98.2	97.9	97.9	98.1		
3	344.1	3.029	99.7	99.2	99.3	99.0	98.5	98.7	98.6		
4	332.5	3.037	99.9	99.5	99.0	98.9	98.6	98.8	98.5		
5	339.4	3.043	99.3	99.4	99.2	99.0	98.7	98.6	98.4		
6	343.6	3.104	99.7	99.4	98.6	98.6	98.5	98.5	98.4		
7	334.1	3.093	99.6	98.9	98.5	98.4	98.1	98.3	98.2		
8	336.1	3.073	99.1	99.0	98.6	98.2	98.0	98.1	98.1		
9	333.9	3.058	98.9	98.7	98.5	98.4	97.9	98.0	97.9		
10	333.8	3.033	99.5	99.4	99.1	98.9	98.6	98.7	98.5		
11	342.9	3.082	99.6	98.9	98.6	98.5	98.5	98.5	98.3		
12	338.3	3.056	99.6	98.8	98.3	98.2	97.7	98.0	97.9		
13	336.8	3.041	99.3	99.0	98.7	98.1	97.8	98.0	97.9		
14	337.9	3.033	99.6	99.3	98.7	98.6	98.3	98.4	98.2		
15	335.2	3.028	99.8	99.0	98.6	98.3	98.1	98.2	98.0		
16	332.7	3.074	99.1	98.7	98.4	98.3	98.0	. 98.1	98.1		
17	331.6	3.085	99.0	98.7	98.3	98.2	97.8	97.9	97.8		
18	346.2	3.063	99.0	98.8	98.5	98.4	98.2	98.4	98.2		
19	336.9	3.105	99.3	98.9	98.7	98.4	98.2	98.4	98.3		
20	337.2	3.016	99.8	99.2	99.0	98.6	98.2	98.2	98.1		
							,				
		-			yuuuuuuu						
Mean	337.4	3.06	99.4	99.0	98.7	98.5	98.2	98.3	98.2		
Median	336.8	3.06	99.4	99.0	98.6	98.4	98.2	98.3	98.2		
std.dev	4.1	0.03	0.3	0.3	0.3	0.3	0.3	0.3	0.2		
Max	346.2	3.10	99.9	99.5	99.3	99.0	98.7	98.8	98.6		
Min	331.6	3.02	98.9	98.7	98.3	98.1	97.7	97.9	97.8		



Report No.: SLED-19-031-R02

9.2 Test condition 2

85 °C

Drive Current

1 000 mA

Measurement Current

No	Lumen Maintenance (%)												
No.	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				
1	98.0	98.0	97.9	97.9	97.7	97.7	97.6	97.7	97.7				
2	98.2	98.0	98.0	98.2	98.0	97.9	98.0	98.1	98.3				
3	98.5	98.4	98.4	98.3	98.2	98.2	98.3	98.2	98.4				
4	98.6	98.3	98.3	98.2	98.1	98.0	98.0	98.1	98.1				
5	98.5	98.5	98.2	98.4	98.1	98.1	98.2	98.3	98.2				
6	98.4	98.3	98.2	98.4	98.1	98.2	98.2	98.1	98.3				
7	98.2	98.2	98.1	98.1	98.0	98.1	98.1	98.2	98.3				
8	98.1	98.1	98.0	98.1	98.0	98.1	98.2	98.2	98.4				
9	98.0	97.8	97.8	97.8	97.6	97.7	97.7	97.8	97.8				
10	98.5	98.4	98.4	98.3	98.1	98.1	98.2	98.3	98.3				
11	98.4	98.2	98.0	98.0	97.8	97.8	97.8	97.9	97.9				
12	98.3	- 98.3	98.2	98.1	98.2	98.0	98.2	98.1	98.1				
13	98.1	97.9	97.9	97,8	97.8	97.9	97.9	98.0	98.1				
14	98.1	98.0	97.9	98.0	97.8	97.7	97.5	97.5	97.7				
15	98.1	98.0	97.9	97.9	97.7	97.6	97.7	97.7	97.9				
16	97.9	97.8	97.7	97.7	97.6	97.5	97.5	97.5	97.6				
17	97.8	97.6	97.5	97.5	97.5	97.4	97.4	97.4	97.5				
18	98.3	98.2	98.1	97.9	97.9	97.9	97.9	98.0	98.1				
19	98.1	97.8	97.7	97.6	97.4	97.3	97.3	97.3	97.4				
20	97.9	97.8	97.7	97.6	97.4	97.3	97.3	97.4	97.3				

		-											
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			ē										
Mean	98.2	98.1	98.0	98.0	97.9	97.8	97.9	97.9	98.0				
Median	98.1	98.1	98.0	98.0	97.9	97.9	97.9	98.0	98.1				
std.dev	0.2	0.3	0.2	0.3	0.3	0.3	0.3	0.3	0.3				
Max	98.6	98.5	98.4	98.4	98.2	98.2	98.3	98.3	98.4				
Min	97.8	97.6	97.5	97.5	97.4	97.3	97.3	97.3	97.3				



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9.2 Test condition 2

85 °C

Drive Current

1 000 mA

Measurement Current

NI	Lumen Maintenance (%)											
No.	16 000 h	17 000 h	18 000 h				22 000 h	23 000 h	24 000 h			
1	97.6	97.7							7 7 7 7 7 2 5 3 5 5			
2	98.1	98.3										
3	98.2	98.2			-							
4	98.0	98.0										
5	98.1	98.2						***************************************	***************************************			
6	98.1	98.2										
7	98.1	98.3						• • • • • • • • • • • • • • • • • • • •	***************************************			
8	98.3	98.2							***************************************			
9	97.7	97.8						••••••	***************************************			
10	98.3	_ 98.3							•••••••			
11	97.9	97.9							***************************************			
12	98.2	98.2							***************************************			
13	98.0	98.1										
14	97.5	97.4										
15	97.8	97.9										
16	97.6	97.5							***************************************			
17	97.4	97.4										
18	98.0	98.0							***************************************			
19	97.2	97.2										
20	97.2	97.2										

				1								
	- 1											
		*										
				_								
Mean	97.9	97.9										
Median	98.0	98.0		•>>-	•••••				••••••••			
td.dev	0.3	0.4							•			
Max	98.3	98.3										
Min	97.2	97.2										



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9.2 Test condition 2 85 ℃

Drive Current 1 000 mA
Measurement Current 1 000 mA

Meas	urement (Current	1 000 mA						
No.	u'	V			Chroma	aticity Shift	: (△u'v')		
110.	0	h	500 h	1 000 h	2 000 h	3 000 h	4 000 h	5 000 h	6 000 h
1	0.262 3	0.527 9	0.000 3	0.000 4	0.000 6	0.000 6	0.000 6	0.000 7	0.000 7
2	0.263 3	0.529 2	0.000 1	0.000 4	0.000 4	0.000 5	0.000 6	0.000 7	0.000 6
3	0.262 4	0.528 2	0.000 1	0.000 4	0.000 4	0.000 6	0.000 6	0.000 7	0.000 6
4	0.263 5	0.527 6	0.000 4	0.000 5	0.000 6	0.000 6	0.000 7	0.000 7	0.000 7
5	0.261 9	0.528 6	0.000 4	0.000 5	0.000 6	0.000 6	0.000 6	0.000 7	0.000 7
6	0.261 7	0.527 2	0.000 1	0.000 4	0.000 5	0.000 6	0.000 7	0.000 7	0.000 7
7	0.261 3	0.527 6	0.000 2	0.000 4	0.000 4	0.000 5	0.000 5	0.000 6	0.000 6
8	0.262 4	0.529 1	0.000 3	0.000 5	0.000 7	0.000 6	0.000 8	0.000 7	0.000 7
9	0.262 9	0.528 4	0.000 3	0.000 4	0.000 6	0.000 5	0.000 6	0.000 7	0.000 6
10	0.261 5	0.527 8	0.000 3	0.000 5	0.000 6	0.000 6	0.000 7	0.000 7	0.000 7
11	0.263 7	0.529 0	0.000 2	0.000 4	0.000 5	0.000 6	0.000 7	0.000 6	0.000 7
12	0.262 3	0.527 8	0.000 4	0.000 5	0.000 6	0.000 7	0.000 9	0.000 9	0.000 9
13	0.261 3	0.527 0	0.000 4	0.000 5	0.000 7	0.000 9	0.000 8	0.000 9	0.000 9
14	0.263 5	0.528 7	0.000 4	0.000 4	0.000 5	0.000 5	0.000 7	0.000 8	0.000 6
15	0.262 1	0.527 7	0.000 3	0.000 6	0.000 8	0.000 8	0.000 9	0.000 8	0.000 8
16	0.261 4	0.527 1	0.000 2	0.000 5	0.000 6	0.000 7	0.000 9	0.000 8	0.000 8
17	0.262 5	0.527 3	0.000 3	0.000 3	0.000 5	0.000 6	0.000 6	0.000 7	0.000 7
18	0.261 9	0.527 0	0.000 3	0.000 4	0.000 6	0.000 6	0.000 7	0.000 8	0.000 7
19	0.263 2	0.528 1	0.000 2	0.000 3	0.000 5	0.000 5	0.000 6	0.000 5	0.000 6
20	0.264 0	0.529 6	0.000 2	0.000 4	0.000 4	0.000 5	0.000 6	0.000 6	0.000 7
Mean Median	0.262 4 0.262 3	0.528 0 0.527 8	0.000 3	0.000 4	0.000 6 0.000 6	0.000 6 0.000 6	0.000 7	0.000 7	0.000 7
std.dev	0.000 8	0.000 8	0.000 1	0.000 1	0.000 1	0.000 1	0.000 1	0.000 1	0.000 1
Max	0.264 0	0.529 6	0.000 4	0.000 6	0.000 8	0.000 9	0.000 9	0.000 9	0.000 9
Min	0.261 3	0.527 0	0.000 1	0.000 3	0.000 4	0.000 5	0.000 5	0.000 5	0.000 6



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9.2 Test condition 2

85 °C

Drive Current

1 000 mA

Measurement Current

Meas	urement	Current	1 000 mA						
No.				Chroma	aticity Shift	: (△u'v')			
140.	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 7	0.000 7	0.000 7	0.000 7	0.000 7	0.000 7
2	0.000 6	0.000 6	0.000 7	0.000 6	0.000 6	0.000 6	0.000 6	0.000 6	0.000 7
3	0.000 6	0.000 6	0.000 6	0.000 6	0.000 6	0.000 6	0.000 6	0.000 6	0.000 6
4	0.000 8	0.000 8	0.000 7	0.000 7	0.000 7	0.000 7	0.000 7	0.000 7	0.000 7
5	0.000 6	0.000 8	0.000 7	0.000 6	0.000 7	0.000 7	0.000 7	0.000 7	0.000 7
6	0.000 7	0.000 7	0.000 8	0.000 7	0.000 8	0.000 8	0.000 8	0.000 8	0.000 8
7	0.000 6	0.000 6	0.000 5	0.000 6	0.000 5	0.000 5	0.000 5	0.000 5	0.000 6
8	0.000 8	0.000 8	0.000 8	0.000 7	0.000 7	0.000 7	0.000 7	0.000 7	0.000 7
9	0.000 6	0.000 7	0.000 7	0.000 6	0.000 7	0.000 7	0.000 7	0.000 7	0.000 7
10	0.000 7	0.000 7	0.000 8	0.000 7	0.000 7	0.000 7	0.000 7	0.000 8	0.000 8
11	0.000 9	0.000 9	0.001 0	0.001 0	0.001 0	0.001 0	0.001 0	0.001 1	0.001 1
12	0.000 9	0.001 0	0.001 1	0.001 1	0.001 2	0.001 2	0.001 2	0.001 3	0.001 3
13	0.001 0	0.001 0	0.001 1	0.001 2	0.001 2	0.001 2	0.001 2	0.001 2	0.001 3
14	0.000 8	0.000 8	0.001 0	0.001 0	0.001 1	0.001 1	0.001 2	0.001 2	0.001 2
15	0.001 0	0.001 0	0.001 0	0.001 0	0.001 0	0.001 1	0.001 1	0.001 1	0.001 2
16	0.001 0	0.001 0	0.001 1	0.001 0	0.001 1	0.001 1	0.001 1	0.001 1	0.001 1
17	0.000 8	0.000 9	0.000 9	0.000 9	0.001 0	0.001 1	0.001 1	0.001 1	0.001 1
18	0.000 9	0.000 9	0.001 0	0.001 1	0.001 1	0.001 1	0.001 1	0.001 2	0.001 2
19	0.000 7	0.000 8	0.000 8	0.000 8	0.000 8	0.000 9	0.000 9	0.001 0	0.001 0
20	0.000 8	0.000 7	0.000 8	0.000 8	0.000 8	0.000 9	0.000 9	0.000 9	0.000 9

									,
	· · · · · · · · · · · · · · · · · · ·	-							
					11				

						***************************************			***************************************

Mean	0.000 8	0.000 8	0.000 8	0.000 8	0.000 8	0.000 9	0.000 9	0.000 9	0.000 9
Median	0.000 8	0.000 8	0.000 8	0.000 7	0.000 8	0.000 8	0.000 8	0.000 9	0.000 9
std.dev	0.000 1	0.000 2	0.000 2	0.000 2	0.000 2	0.000 2	0.000 2	0.000 2	0.000 2
Max	0.001 0	0.001 0	0.001 1	0.001 2	0.001 2	0.001 2	0.001 2	0.001 3	0.001 3
Min	0.000 6	0.000 6	0.000 5	0.000 6	0.000 5	0.000 5	0.000 5	0.000 5	0.000 6



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9.2 Test condition 2

85 °C

Drive Current

1 000 mA

Measurement Current

	urement Current 1 000 mA Chromaticity Shift (△u'v')											
No.	16 000 h	17 000 h	10 000 6				22 000 1	22,000 !	24.000 !			
1	0.000 7	0.000 8	16 000 11	19 000 h	20 000 h	21 000 h	22 000 h	23 000 h	24 000 r			
2	0.000 7	0.000 7										
3	0.000 7	0.000 7										
4	0.000 7	0.000 7		••••••								
5	0.000 7	0.000 8		·····								
6	0.000 9	0.000 9										
7	0.000 6	0.000 6							***************************************			
8	0.000 7	0.000 7			•••••							
9	0.000 7	0.000 8										
10	0.000 8	0.000 8		• • • • • • • • • • • • • • • • • • • •								
11	0.001 1	0.001 1					*******************************					
12	0.001 3	0.001 4							,			
13	0.001 3	0.001 3			***************************************		***************************************					
14	0.001 2	0.001 2										
15	0.001 2	0.001 2					***************************************		***************************************			
16	0.001 2	0.001 2							***************************************			
17	0.001 2	0.001 2		,					•			
18	0.001 2	0.001 2							••••••			
19	0.001 0	0.001 1							***************************************			
20	0.001 0	0.001 0										
		-										
					-							
,												

			1 x									
				V								
					74)					
Mean	0.000 9	0.001 0										
Median	0.000 9	0.000 9										
std.dev	0.000 2	0.000 2										
Max	0.001 3	0.001 4										
Min	0.000 6	0.000 6										





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9.2 Test condition 2

85 °C

Drive Current

1 000 mA

Measurement Current

Measure	ement Current	1 000 mA						
No.				CCT (K)				
140.	0 h	500 h	1 000 h	2 000 h	3 000 h	4 000 h	5 000 h	6 000 H
1	2 698	2 702	2 704	2 708	2 707	2 707	2 708	2 707
2	2 672	2 673	2 677	2 678	2 680	2 681	2 681	2 680
3	2 694	2 695	2 700	2 700	2 703	2 703	2 704	2 703
4	2 673	2 678	2 680	2 682	2 682	2 683	2 683	2 683
5	2 703	2 709	2 710	2 712	2 711	2 712	2 713	2 712
6	2 712	2 713	2 718	2 719	2 721	2 722	2 722	2 721
7	2 720	2 723	2 726	2 727	2 728	2 728	2 729	2 728
8	2 691	2 695	2 699	2 701	2 700	2 703	2 701	2 700
9	2 683	2 687	2 688	2 691	2 690	2 691	2 692	2 691
10	2 715	2 720	2 722	2 724	2 725	2 725	2 726	2 724
11	2 663	2 665	2 668	2 669	2 671	2 672	2 672	2 672
12	2 698	2 703	2 705	2 706	2 709	2 711	2 711	2 711
13	2 722	2 728	2 729	2 732	2 735	2 734	2 736	2 735
14	2 669	2 674	2 674	2 676	2 676	2 679	2 680	2 677
15	2 702	2 707	2 711	2 714	2 713	2 715	2 715	2 714
16	2 719	2 721	2.726	2 727	2 729	2 732	2 730	2 730
17	2 696	2 700	2 700	2 704	2 705	2 705	2 706	2 705
18	2 709	2 714	2 715	2 719	2 718	2 720	2 722	2 719
19	2 678	2 680	2 682	2 685	2 683 -	2 685	2 685	2 684
20	2 654	2 657	2 659	2 660	2 661	2 663	2 663	2 663
Mean	2 694	2 697	2 700	2 702	2 702	2 704	2 704	2 703
Median	2 697	2 701	2.702	2 705	2 706	2 706	2 707	2 706
std.dev	20	21	21	21	21	21	21	21
Max	2 722	2 728	2 729	2 732	2 735	2 734	2 736	2 735
Min	2 654	2 657	2 659	2 660	2 661	2 663	2 663	2 663



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9.2 Test condition 2

85 °C

Drive Current

1 000 mA

Measurement Current

Meas	urement (urrent	1 000 mA						
No.				-	CCT (K)				
140.	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
1	2 707	2 706	2 707	2 705	2 706	2 705	2 705	2 705	2 704
2	2 680	2 679	2 680	2 678	2 678	2 678	2 677	2 677	2 677
3	2 702	- 2 701	2 700	2 701	2 700	2 699	2 699	2 699	2 698
4	2 684	2 683	2 682	2 680	2 680	2 680	2 679	2 679	2 679
5	2 711	2 713	2 711	2 710	2 710	2 710	2 709	2 709	2 709
6	2 721	2 720	2 722	2 720	2 721	2 720	2 720	2 720	2 720
7	2 728	2 727	2 725	2 726	2 725	2 724	2 724	2 724	2 723
8	2 702	2 701	2.701	2 698	2 698	2 698	2 698	2 697	2 697
9	2 691	2 692	2 691	2 689	2 690	2 689	2 689	2 689	2 689
10	2 725	2 723	2 725	2 723	2 723	2 723	2 723	2 722	2 722
11	2 675	2 675	2 675	2 675	2 676	2 676	2 675	2 676	2 675
12	2 711	2 712	2 713	2 713	2 714	2 714	2 714	2 714	2 715
13	2 736	2 736	2 738	2 738	2 739	2 738	2 737	2 737	2 738
14	2 680	2 679	2 682	2 682	2 683	2 683	2 684	2 683	2 684
15	2 716	2 716	2 716	2 715	2 715	2 716	2 716	2 716	2 716
16	2 733	2 733	2 733	2 733	2 733	2 733	2 733	2 732	2 732
17	2 706	2 708	2 708	2 708	2 709	2 709	2 709	2 709	2 709
18	2 7.22	2 721	2 723	2 723	2 723	2 724	2 723	2 724	2 724
19	2 687	2 687	2 686	2 686	.2 687	2 687	2 688	2 688	2 688
20	2 665	2 664	2 665	2 664	2 665	2 665	2 664	2 665	2 665
	***************************************	***************************************	••••••••••					*********************	
					<u> </u>			.,	
		*************************	***************************************						

					/				
***************************************		***************************************							
***************************************		***************************************	***************************************						
				20					
Mean	2 704	2 704	2 704	2 703	2 704	2 704	2 703	2 703	2 703
Median	2 706	2 707	2 707	2 707	2 707	2 707	2 707	2 707	2 707
std.dev	21	21	21	21	21	21	21	21	21
Max	2 736	2 736	2 738	2 738	2 739	2 738	2 737	2 737	2 738
Min	2 665	2 664	2 665	2 664	2 665	2 665	2 664	2 665	2 665



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9.2 Test condition 2

85 °C

Drive Current

1 000 mA

Measurement Current

No					CCT (K)				
No.	16 000 h	17 000 h	18 000 h	19 000 h		21 000 h	22 000 h	23 000 h	24 000 F
1	2 7.04	2 704							2,000,
2	2 677	2 676	•••••						
3	2 698	2 698	•••••		•••••••		***************************************		
4	2 679	2 679							
5	2 709	2 709			***************************************		******************************	,	
6	2 720	2 720							
7	2 723	2 723	13					••••••	***************************************
8	2 697	2 696							
9	2 689	2 689			•••••			A	***************************************
10	2 722	2 722	recommendation of	***************************************	,				••••••
11	2 675	2 674						***************************************	***************************************
12	2 715	2 715							
13	2 736	2 736							
14	2 684	2 684						***************************************	
15	2 717	2 717						***************************************	
1.6	2 732	2 732		-2					
17	2 710	2 709							
18	2 724	2 723			+				
19	2 689	2 689							
20	2 666	2 665							••••••
								***************************************	••••••
***************************************									***************************************
									••••••

									••••••
							-		
Mean	2 703	2 703							
Median	2 706	2 706	1	=					
std.dev	21	- 21							
Max	2 736	2 736							
Min	2 666	2 665		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,					



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9.3 Test condition 3

105 °C

Drive Current

1 000 mA

Measurement Current

Meas	urement (1 000 mA	A .					
No.	Flux (lm)	Vf (V)			Lumen	Maintena	nce (%)		
		h	500 h	1 000 h	2 000 h	3 000 h	4 000 h	5 000 h	6 000 h
1	339.7	3.071	99.6	99.0	98.8	98.6	98.2	97.8	97.7
2	336.4	3.049	99.0	98.1	98.0	97.7	97.1	97.0	97.0
3	343.8	3.042	99.9	99.6	98.5	98.3	97.9	97.7	97.4
4	334.9	3.017	99.5	98.7	98.2	98.1	97.5	97.5	97.4
5	341.0	3.025	98.7	98.2	97.9	98.0	97.6	97.7	97.4
6	343.3	3.089	98.6	98.4	98.1	97.9	97.5	97.7	97.2
7	330.7	3.083	99.4	99.1	98.3	97.9	97.6	97.3	97.0
8	342.4	3.028	99.3	98.5	98.3	97.8	97.8	97.3	96.9
9	344.2	3.039	99.6	98.2	98.5	98.3	97.8	97.5	97.3
10	340.9	3.030	99.5	98.8	98.7	98.3	98.2	97.6	97.6
11	337.5	3.059	98.5	98.1	97.7	97.4	97.1	97.2	97.1
12	339.9	3.039	99.0	98.4	98.2	97.8	97.6	97.3	97.0
13	339.8	3.061	99.3	98.7	98.4	98.2	97.7	97.4	97.0
14	341.9	3.042	98.8	98.5	98.4	98.2	97.9	97.6	97.6
15	330.5	3.056	100.1	99.8	99.4	98.5	98.1	98.1	98.0
16	336.6	3.096	98.7	98.3	. 98.3	97.9	97.4	97.5	97.4
17	334.9	3.095	99.0	98.6	98.3	98.2	97.4	97.3	97.2
18	341.1	3.087	98.7	98.5	98.3	98.0	97.7	97.4	97.0
19	340.5	3.059	99.2	99.1	98.8	98.5	98.0	97.5	97.5
20	334.3	3.018	99.7	99.2	98.8	98.5	98.0	97.5	97.3
						***************************************		***************************************	***************************************
Mean	338.7	3.05	99.2	98.7	98.4	98.1	97.7	97.5	97.3
Median	339.8	3.05	99.3	98.5	98.3	98.1	97.7	97.5	97.3
std.dev	4.1	0.03	0.5	0.5	0.4	0.3	0.3	0.2	0.3
Max	344.2	3.10	100.1	99.8	99.4	98.6	98.2	98.1	98.0
Min	330.5	3.02	98.5	98.1	97.7	97.4	97.1	97.0	96.9



Report No.: SLED-19-031-R02

9.3 Test condition 3

105 °C

Drive Current

1 000 mA

Measurement Current

NI-		•	Lumen Maintenance (%)								
No.	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		
1	97.4	97.4	97.5	97.4	97.3	97.2	97.2	97.1	97.2		
2	96.9	96.8	97.0	97.0	96.9	97.0	97.0	97.0	97.1		
3	97.4	97.1	97.3	97.3	97.2	97.2	97.1	97.1	97.2		
4	97.2	97.2	97.4	97.1	97.1	97.0	97.0	96.9	97.0		
5	97.1	96.9	97.0	97.0	96.7	96.7	96.6	96.5	96.6		
6	97.0	97.0	97.2	97.0	96.8	96.8	96.8	96.7	96.8		
7	96.7	96.7	96.8	96.8	96.6	96.5	96.5	96.4	96.4		
8	96.6	96.6	96.5	96.4	96.4	96.3	96.2	96.0	96.1		
9	97.1	97.0	97.2	97.1	97.0	97.0	97.0	96.9	97.0		
10	97.5	97.3	97.5	97.4	97.3	97.1	97.0	96.9	96.9		
11	97.0	96.9	97.1	97.1	97.0	97.0	97.1	97.0	97.1		
12	96.9	97.0	96.9	96.9	96.8	96.8	96.9	96.7	96.9		
13	97.2	97.0	97.1	96.9	96.7	96.7	96.6	96.6	96.7		
14	97.2	96.9	96.8	96.6	96.3	96.1	96.1	96.0	96.0		
15	97.7	97.2	97.2	97.2	96.9	96.7	96.5	96.3	96.3		
16	97.3	97.2	97.1	97.0	96.9	96.8	96.7	96.6	96.6		
17	97.0	97.0	97.1	97.1	97.0	97.0	97.0	96.8	96.9		
18	97.0	97.0	97.1	97.0	96.9	96.9	96.9	96.9	96.9		
19	97.2	97.1	97.3	97.1	97.1	97.0	97.1	97.0	97.1		
20	96.9	96.6	96.9	96.6	96.5	96.4	96.4	96.2	96.3		
Mean	97.1	97.0	97.1	97.0	96.9	96.8	96.8	96.7	96.8		
Median	97.1	97.0	97,1	97.0	96.9	96.9	96.9	96.8	96.9		
std.dev	0.3	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.4		
Max	97.7	97.4	97.5	97.4	97.3	97.2	97.2	97.1	97.2		
Min	96.6	96.6	96.5	96.4	96.3	96.1	96.1	96.0	96.0		





Report No.: SLED-19-031-R02

9.3 Test condition 3

105 °C

Drive Current -

1 000 mA

Measurement Current

NI-	Lumen Maintenance (%)											
No.	16 000 h	17 000 h	18 000 h			21 000 h	22 000 h	23 000 h	24 000 1			
1	97.1	97.0					-	AC 000	2.0001			
2	97.0	96.9			••••••		••••••					
3	97.0	97.0		••••••								
4	96.9	96.8		••••••••••			***************************************					
5	96.4	96.3		***************************************								
6	96.6	96.6	***************************************									
7	96.3	96.2					***************************************					
8	96.0	95.9	•••••••••••									
9	96.9	96.9					************************					
10	96.7	96.5										
11	96.9	96.8		***************************************	***************************************				*******************************			
12	96.8	96.6										
13	96.5	96.5			********************			i	***************************************			
14	95.8	95.8							***************************************			
15	96.0	95.9	·····		***************************************							
16	96.5	96.3										
17	96.8	96.8			***************************************			***************************************				
18	96.9	96.7										
19	96.9	96.8							••••••••			
20	96.1	96.1										
									••••••			
***************************************	-								***************************************			
					***************************************				***************************************			

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					a .							
		,		•	······································				/			
Mean	96.6	96.5										
Median	96.7	96.6										
std.dev	0.4	0.4			•••••							
Max	97.1	97.0										
Min	95.8	95.8										



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9.3 Test condition 3

105 °C

Drive Current

1 000 mA

Measurement Current

Meas	urement	Current	1 000 mA						
No.	u'	V'			Chroma	aticity Shift	: (△u'v')		
INO.	0	h	500 h	1 000 h	2 000 h	3 000 h	4 000 h	5 000 h	6 000 h
1	0.260 9	0.526 2	0.000 9	0.001 3	0.001 4	0.001 6	0.001 6	0.001 6	0.001 6
2	0.264 2	0.528 9	0.000 6	0.000 7	0.001 0	0.000 8	0.001 0	0.001 1	0.001 1
3	0.261 9	0.527 2	0.000 9	0.001 3	0.001 7	0.001 5	0.001 6	0.001 5	0.001 5
4	0.261 4	0.527 2	0.001 0	0.001 3	0.001 4	0.001 5	0.001 6	0.001 5	0.001 4
5	0.263 3	0.528 5	0.000 6	0.000 9	0.001 1	0.001 2	0.001 2	0.001 5	0.001 4
6	0.263 0	0.527 7	0.000 6	0.000 5	0.000 8	0.000 9	0.000 8	0.000 9	0.001 0
7	0.263 7	0.528 6	0.000 9	0.000 8	0.001 3	0.001 1	0.001 3	0.001 1	0.001 2
8	0.262 3	0.529 6	0.000 9	0.001 2	0.001 4	0.001 5	0.001 6	0.001 5	0.001 4
9	0.263 0	0.528 7	0.000 8	0.001 2	0.001 4	0.001 5	0.001 4	0.001 5	0.001 4
10	0.261 2	0.528 7	0.000 4	0.001 0	0.001 4	0.001 3	0.001 3	0.001 4	0.001 5
11	0.263 1	0.527 1	0.001 1	0.001 2	0.001 4	0.001 2	0.001 5	0.001 3	0.001 3
12	0.261 9	0.528 0	0.001 0	0.001 3	0.001 3	0.001 4	0.001 6	0.001 5	0.001 4
13	0.262 0	0.526 3	0.000 9	0.001 2	0.001 3	0.001 4	0.001 4	0.001 5	0.001 4
14	0.262 1	0.527 3	0.001 0	0.001 1	0.001 3	0.001 5	0.001 4	0.001 5	0.001 5
15	0.262 2	0.527 9	0.000 7	0.001 1	0.001 3	0.001 1	0.001 3	0.001 2	0.001 2
16	0.261 8	0.525 8	0.001 0	0.001 3	0.001 6	0.001 5	0.001 7	0.001 5	0.001 4
17	0.261 1	0.527 0	0.000 5	0.000 7	0.001 0	0.001 1	0.001 3	0.001 1	0.001 1
18	0.261 3	0.527 0	0.000 7	0.000 6	0.001 0	0.001 3	0.001 2	0.001 3	0.001 3
19	0.263 5	0.528 3	0.001 0	0.001 0	0.001 3	0.001 1	0.001 3	0.001 5	0.001 1
20	0.261 8	0.527 0	0.001 1	0.001 3	0.001 6	0.001 5	0.001 7	0.001 6	0.001 5
***************************************					,				
					•••••				***************************************
***************************************								,	
					-				
Mean	0.262 3	0.527 6	0.000 8	0.001 1	0.001 3	0.001 3	0.001 4	0.001 4	0.001 3
Median	0.262 0	0.527 5	0.000 9	0.001 1	0.001 3	0.001 4	0.001 4	0.001 5	0.001 4
std.dev	0.001 0	0.001 0	0.000 2	0.000 3	0.000 2	0.000 2	0.000 2	0.000 2	0.000 2
Max	0.264 2	0.529 6	0.001 1	0.001 3	0.001 7	0.001 6	0.001 7	0.001 6	0.001 6
Min	0.260 9	0.525 8	0.000 4	0.000 5	0.000 8	0.000 8	0.000 8	0.000 9	0.001 0



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9.3 Test condition 3

105 °C

Drive Current

1 000 mA

Meas	urement	Current	1 000 mA						
No.				Chroma	aticity Shift	: (△u'v')			
INO.	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	0.001 8	0.002 0	0.002 0	0.002 0	0.002 0	0.002 1	0.002 1	0.002 1	0.002 2
2	0.001 1	0.001 0	0.001 2	0.001 1	0.001 2	0.001 3	0.001 3	0.001 3	0.001 3
3	0.001 7	0.001 6	0.001 6	0.001 5	0.001 6	0.001 6	0.001 6	0.001 6	0.001 6
4	0.001 7	0.001 6	0.001 6	0.001 5	0.001 6	0.001 6	0.001 6	0.001 6	0.001 7
5	0.001 4	0.001 7	0.001 6	0.001 5	0.001 7	0.001 8	0.001 8	0.001 8	0.001 9
6	0.001 0	0.000 9	0.001 1	0.001 2	0.001 2	0.001 3	0.001 3	0.001 3	0.001 4
7	0.001 3	0.001 3	0.001 2	0.001 2	0.001 3	0.001 3	0.001 3	0.001 3	0.001 4
8	0.001 6	0.001 6	0.001 5	0.001 4	0.001 6	0.001 6	0.001 5	0.001 5	0.001 6
9	0.001 4	0.001 6	0.001 6	0.001 4	0.001 6	0.001 6	0.001 6	0.001 6	0.001 7
10	0.001 3	0.001 2	0.001 4	0.001 3	0.001 4	0.001 4	0.001 4	0.001 4	0.001 5
11	0.001 5	0.001 5	0.001 5	0.001 6	0.001 6	0.001 7	0.001 7	0.001 7	0.001 8
12	0.001 5	0.001 6	0.001 5	0.001 5	0.001 6	0.001 6	0.001 6	0.001 5	0.001 6
13	0.001 5	0.001 7	0.001 7	0.001 7	0.001 8	0.001 9	0.001 9	0.001 9	0.002 0
14	0.001 5	0.001 5	0.001 7	0.001 6	0.001 7	0.001 8	0.001 7	0.001 7	0.001 8
15	0.001 3	0.001 2	0.001 5	0.001 3	0.001 4	0.001 5	0.001 4	0.001 4	0.001 5
16	0.001 8	0.001 9	0.001 9	0.001 8	0.001 9	0.002 0	0.002 0	0.002 0	0.002 1
17	0.001 2	0.001 4	0.001 3	0.001 3	0.001 4	0.001 5	0.001 5	0.001 5	0.001 5
18	0.001 2	0.001 2	0.001 4	0.001 3	0.001 3	0.001 4	0.001 4	0.001 4	0.001 5
19	0.001 3	0.001 3	0.001 6	0.001 5	0.001 6	0.001 6	0.001 7	0.001 6	0.001 7
20	0.001 6	0.001 6	0.001 5	0.001 5	0.001 6	0.001 6	0.001 5	0.001 5	0.001 6
			•		***************************************				
					***************************************		***************************************		
				-					
							•••••		
Mean	0.001 4	0.001 5	0.001 5	0.001 5	0.001 6	0.001 6	0.001 6	0.001 6	0.001 7
Median	0.001 5	0.001 5	0.001 5	0.001 5	0.001 6	0.001 6	0.001 6	0.001 5	0.001 6
std.dev	0.000 2	0.000 3	0.000 2	0.000 2	0.000 2	0.000 2	0.000 2	0.000 2	0.000 2
Max	0.001 8	0.002 0	0.002 0	0.002 0	0.002 0	0.002 1	0.002 1	0.002 1	0.002 2
Min	0.001 0	0.000 9	0.001 1	0.001 1	0.001 2	0.001 3	0.001 3	0.001 3	0.001 3



Report No.: SLED-19-031-R02

9.3 Test condition 3

105 °C

Drive Current

1 000 mA

Measurement Current

No	Chromaticity Shift (△u'v')										
No.	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	0.002 3	0.002 3							0.3.2.3.3.		
2	0.001 4	0.001 5	•••••								
3	0.001 7	0.001 7			• • • • • • • • • • • • • • • • • • • •		***************************************				
4	0.001 7	0.001 8		;	•••••						
5	0.002 0	0.002 1		***************************************	•••••			• • • • • • • • • • • • • • • • • • • •			
6	0.001 5	0.001 6		***************************************	•			•••••			
7	0.001 4	0.001 5		-				•••••			
. 8	0.001 6	0.001 7						,			
9	0.001 7	0.001 8			(2)						
10	0.001 5	0.001 6									
11	0.001 8	0.001 9									
12	0.001 7	0.001 7									
13	0.002 1	0.002 2									
14	0.001 9	0.001 9									
15	0.001 6	0.001 7									
16	0.002 2	0.002 3									
17	0.001 6	0.001 7			-1						
18	0.001 5	0.001 6									
19	0.001 8	0.001 9									
20	0.001 6	0.001 7									
		-									
					18						
								in .			
								-			
Mean	0.001 7	0.001 8									
Median	0.001 7	0.001 7									
std.dev	0.000 3	0.000 3									
Max	0.002 3	0.002 3									
Min	0.001 4	0.001 5									



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9.3 Test condition 3

105 °C

Drive Current

1 000 mA

Measurement Current

Measure	ement Current	1 000 mA							
No.		CCT (K)							
140.	0 h	500 h	1 000 h	2 000 h	3 000 h	4 000 h	5 000 h	6 000 h	
1	2 735	2 751	2 758	2 761	2 762	2 762	2 762	2 759	
2	2 652	2 664	2 664	2 669	2 664	2 667	2 669	2 666	
3	2 709	2 727	2.734	2 740	2 735	2 738	2 735	2 733	
4	2 718	2 737	2 744	2 745	2 746	2 747	2 744	2 741	
5	2 674	2 685	2 690	2 694	2 694	2 693	2 698	2 695	
6	2 682	2 692	2 690	2 695	2 695	2 693	2 693	2 693	
7	2 665	2 680	2 680	2 689	2 683	2 686	2 682	2 682	
8	2 691	2 709	2 714	2 717	2 717	2 719	2 716	2 713	
9	2 680	2 696	2 701	2 705	2 706	2 705	2 706	2 702	
10	2 717	2 723	2 735	2 742	2 740	2 738	2 739	2 740	
11	2 683	2 702	2 704	2 709	2 704	2 707	2 703	2 701	
12	2 705	2 724	2 730	2 730	2 730	2 732	2 730	2 727	
13	2 710	2 728	2 734	2 735	2 735	2 734	2 735	2 732	
14	2 704	2 723	2 723	2 728	2 729	2 727	2 728	2 728	
15	2 699	2 710	2 718	2 721	2 717	2 720	2 716	2 715	
16	2 717	2 733	2 739	2 746	2 742	2 744	2 741	2 735	
17.	2 726	2 734	2 738	2 742	2 744	2 747	2 742	2 740	
18	2 722	2 734	. 2 733	2 740	2 744	2 742	2 743	2 740	
19	2 669	2 688	2 688	2 693	2 686	2 691	2 693	2 684	
20	2 712	2 733	2 738	2 740	2 739	2 742	2 739	2 736	
				***************************************		***************************************		***************************************	
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	-							***************************************	
		***************************************						,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	

***************************************				***************************************				***************************************	
Mean	2 698	2 714	2 718	2 722	2 721	2 722	2 721	2 718	
Median	2 704	2 723	2 727	2 729	2 730	2 730	2 729	2 727	
std.dev	23	23	25	24	26	26	25	25	
Max	2 735	2 751	2 758	2 761	2 762	2 762	2 762	2 759	
Min	2 652	2 664	2 664	2 669	2 664	2 667	2 669	2 666	
(4)11.1	2 032	2 004	2 004	2 003	2 004	2 007	2 003	2 000	



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9.3 Test condition 3

105 °C

Drive Current

1 000 mA

Meas	urement (Current	1 000 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 1
1	2 763	2 765	2 763	2 760	2 761	2 761	2 760	2 760	2 760
2	2 664	2 662	2 661	2 657	2 658	2 658	2 656	2 656	2 655
3	2 733	2 732	2 727	2 723	2 724	2 722	2 719	2 717	2 717
4	2 744	2 741	2 737	2 733	2 734	2 732	2 730	2 728	2 728
5	2 695	2 698	2 695	2 690	2 694	2 694	2 692	2 692	2 693
6	2 691	2 689	2 689	2 686	2 686	2 685	2 683	2 682	2 681
7	2 682	2 679	2 674	2 672	2 672	2 670	2 667	2 665	2 665
8	2 714	2 713	2 708	2 705	2 706	2 704	2 701	2 700	2 699
9	2 700	2 703	2 699	2 694	2 696	2 694	2 692	2 691	2 691
10	2 734	2 732	2 732	2 727	2 727	2 725	2 722	2 721	2 721
11	2 704	2 702	2 699	2 700	2 698	2 698	2 696	2 694	2 694
12	2 728	2 727	2 723	2 720	2 720	2 719	2 716	2 715	2 714
13	2 734	2 736	2 734	2 730	2 732	2 732	2 730	2 730	2 730
14	2 726	2 726	2 728	2 724	2 725	2 725	2 723	2 722	2 722
15	2 715	2 712	2 714	2 707	2 708	2 707	2 705	2 703	2 703
16	2 741	2 744	2 740	2 734	2 737	2 736	2 734	2 733	2 734
17	2 739	2 743	2 738	2.735	2 736	2 734	2 732	2 731	2 732
18	2 736	2 735	2 734	2 727	2 728	2 726	2 723	2 722	2 722
19	2 686	2 685	2 687	2 684	2 684	2 683	2 682	2 680	2 680
20	2 737	2 735	2 731	2 727	2 727	2 725	2 723	2 721	2 721
		-							
					-				
Mean	2 718	2 718	2 716	2 712	2 713	2 712	2 709	2 708	2 708
Median	2 727	2 726	2 725	2 721	2 722	2 720	2 718	2 716	2 716
std.dev	25	26	26	-25	25	25	26	26	26
Max	2 763	2 765	2 763	2 760	2 761	2 761	2 760	2 760	2 760
Min	2 664	2 662	2 661	2 657	2 658	2 658	2 656	2 656	2 655



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9.3 Test condition 3

105 °C

Drive Current

1 000 mA

Measurement Current

NI	CCT (K)										
No.	16 000 h	17 000 h	18 000 h	19 000 h		21 000 h	22 000 h	23 000 h	24 000		
1	2 762	2 762				1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1					
2	2 654	2 654	•••••								
3	2 718	2 717			***************************************		d	••••••			
4	2 729	2 728							***************************************		
5	2 694	2 695			8				***************************************		
6	2 682	2 681			***************************************	•			***************************************		
7	2 665	2 666	••••••••••						***************************************		
8	2 700	2 699							***************************************		
9	2 692	2 692	••••••		***************************************						
10	2 722	2 721							***************************************		
11	2 695	2 695			***************************************				***************************************		
12	2 715	2 714									
13	2 732	2 732							***************************************		
14	2 724	2 724							•		
15	2 704	2 703							••••••••		
16	2 735	2 735									
17	2 732	2 731							***************************************		
18	2 722	2 721									
19	2 681	2 680	13						***************************************		
20	2 722	- 2 721									
									•••••		

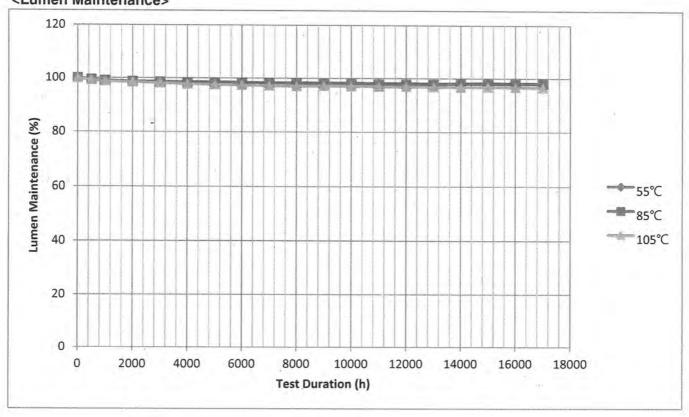
								0	••••••		
.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,							·······		***************************************		
Mean	2 709	2 709									
Median	2 716	2 716									
std.dev	26	26		.,					***************************************		
Max	2 762	2 762				·		.,,,,	•••••		
Min	2 654	2 654									

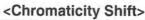


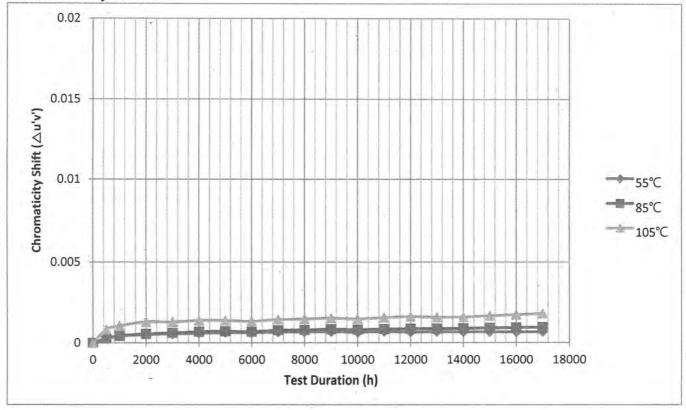
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9.4 Chart

<Lumen Maintenance>



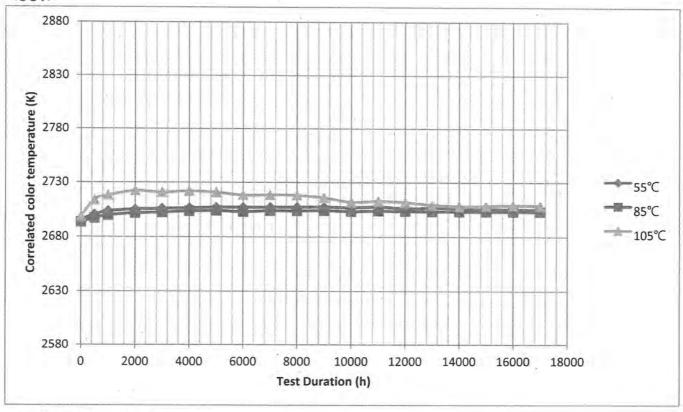






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10. Observation of failures

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 12 000 11 000 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

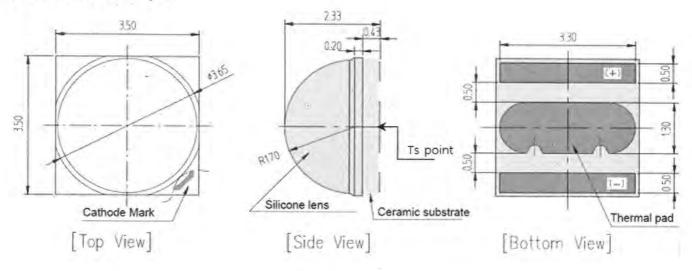
		Table 1: Report at each LM-	80 Test Condition	n_	
Description of LED Ligh (manufacturer, catalog num	model,				
Test Condition 1 - 55°C	Case Temp	Test Condition 2 - 85°C	Case Temp	Test Condition 3 - 105°	C Case Temp
Sample size	20	Sample size	20	Sample size	20
Number of failures	0	Number of failures	0	Number of failures	0
DUT drive current used in the test (mA)	1 000	DUT drive current used in the test (mA)	1 000	DUT drive current used in the test (mA)	1 000
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	1.667E-07	α	1.484E-07	α	6.010E-07
В	0.984	В	0.981	В	0.975
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