

# IES LM-80 Test Report

**Report Issue Date :** January 22, 2021

**Report Number :** I-191001-118-I-03

**Testing Start Date :** October 14, 2019

**Testing Completion Date :** December 21, 2020

**Revision Number :** 03

**Test Duration :** 10 000 h

**Manufacturer Information :**

Applicant : Seoul Semiconductor Co., LTD

Address : 97-11, Sandan-ro 163, Danwon-gu, Ansan, Gyeonggi-do, Korea 15429

**Description of Test Samples :**

Classification : LED Package

PKG Name : Z5M

Part Number : SZ5-M4-Wx-Cx

Drive Current : 700 mA

**Test Procedure :**

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

Tested by



InHoi SIM, Research Engineer

Approved by

YoungJoon WON, Laboratory Manager



Seoul Semiconductor Testing Laboratory(TL-688) is accredited to ISO/IEC 17025:2005 for the above test procedure by IAS, USA which is a signatory to ILAC-MRA.

## Seoul Semiconductor Testing Laboratory

If you need to verify the authenticity of this report, please contact the below address.

97-11, Sandan-ro 163, Danwon-gu, Ansan, Gyeonggi-do, Korea 15429, E-mail: LM80@seoulsemicon.com

## Applicable Series Model Numbers

This LM-80 report is applicable to the following

Model Name	Forward Current	Typical VF	Power	LED Number	Power Density	Current Density	Minimum Spacing	CCT
SZ5-M4-WW-Cx Tested	700 mA	3.1 V	2.1 W	1	0.89 W/mm <sup>2</sup>	291 mA/mm <sup>2</sup>	-	≥2200 K
SZ5-M4-W0-75	700 mA	3.1 V	2.1 W	1	0.89 W/mm <sup>2</sup>	291 mA/mm <sup>2</sup>	-	≥2200 K
SZ5-M4-WN-75	700 mA	3.1 V	2.1 W	1	0.89 W/mm <sup>2</sup>	291 mA/mm <sup>2</sup>	-	≥2200 K
SZ5-M4-WW-75	700 mA	3.1 V	2.1 W	1	0.89 W/mm <sup>2</sup>	291 mA/mm <sup>2</sup>	-	≥2200 K



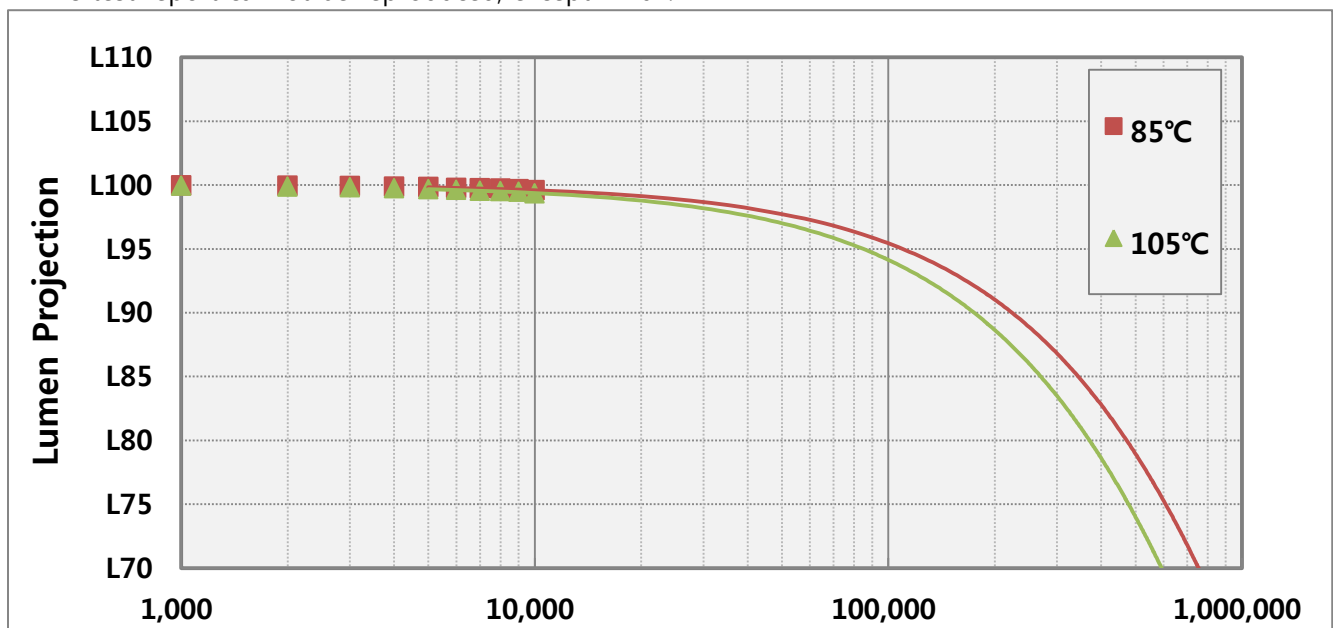
# SEOUL SEMICONDUCTOR

## 1. Test Summary

Items	Nominal Case Temperature		
		85 °C	105 °C
Number of LED tested		20	20
Drive and Measurement Current		700 mA	700 mA
Test Duration		10 000 h	10 000 h
Actual Case Temperature		≥83.5 °C	≥104.2 °C
Actual Ambient Temperature		≥83.6 °C	≥102.8 °C
Air Flow Velocity		≤0.40 m/s	≤0.10 m/s
Averaged Initial Luminous Flux		282.0 lm	282.3 lm
Initial Nominal CCT		2700 K	2700 K
Average Initial CRI		70	69
Total Input Power		2.1 W	2.1 W
Average Current Density (mA/mm <sup>2</sup> )		291	291
Average Power Density (W/mm <sup>2</sup> )		0.89	0.89
Minimum Spacing from die edge to die edge		-	-
Average Lumen Maintenance		99.6 %	99.3 %
Average Chromacity Shift		0.000 5	0.000 8
α		4.742E-07	6.015E-07
B		1.001	1.000
TM-21 Projection L <sub>70</sub>		>60000	>60000
TM-21 Projection L <sub>80</sub>		>60000	>60000
TM-21 Projection L <sub>90</sub>		>60000	>60000

※ The results shown in this certificate refer only to the sample(s) tested unless otherwise stated.

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## 2. IES LM-80-08 Test Report Requirement :

### Number of LED Light Sources Tested

See the Test Summary

### Description of LED Light Sources

See the Description of Test samples at the cover of certificate

### Description of auxiliary equipment

Active cooling Test System

Temperature controlling chamber for LED package/array/module consists of the water cooling heat-sink plates to control the case temperature of each device and of the power supply required by LM-80 test conditions.

Measurement System

Photometric measurement tester for LED package/array/module consists of the integrating sphere with temperature controlling system(TEC) and of programmable current source meter.

### Operating Cycle

Constant Direct Current (DC)

### Ambient Conditions Including Airflow, Temperature and Relative Humidity

Airflow : < 1 m/s

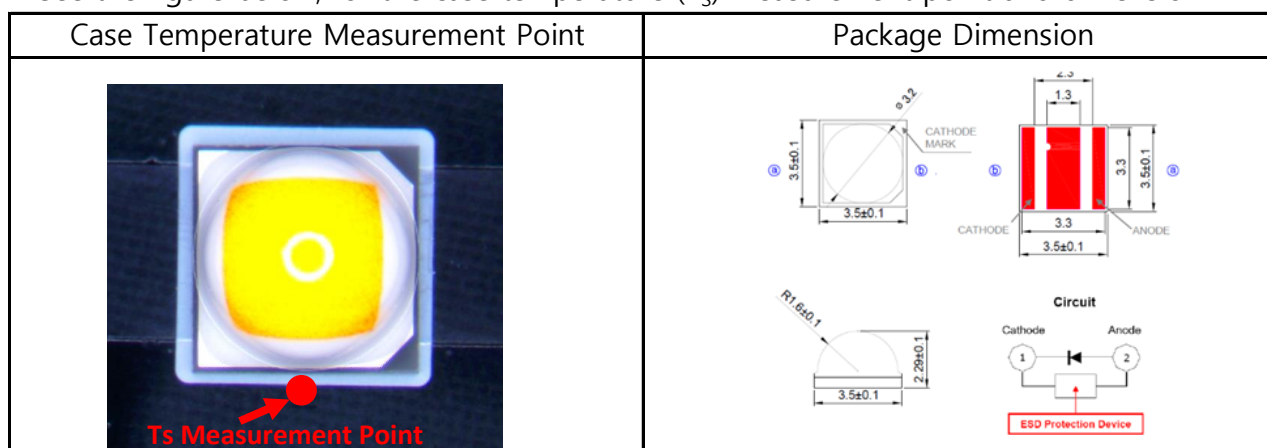
Ambient temperature :  $\geq -5^{\circ}\text{C}$  of Nominal  $T_A$

( See the Test Summary for actual  $T_A$  )

Relative Humidity :  $\leq 65\%$  RH

### Case Temperature (Test Point Temperature)

See the figure below, for the case temperature ( $T_S$ ) measurement point and dimension



**Drive Current of the LED Light Source During Lifetime Test**

See the Test Summary

**Initial Luminous Flux and Forward Voltage at Photometric Measurement Current**

See the Test Summary

**Lumen Maintenance Data for Each Individual LED Light Source Along with Median Value, Standard Deviation, Minimum and Maximum Lumen Maintenance Value for All of the LED Light Sources**

See the table of each data set

**Observation of LED light Sources Failures**

No failure observed

**LED Light Source Monitoring Interval**

See the table of each data set

**Photometric Measurement Uncertainty**

Seoul Semiconductor maintain a tolerance of  $\pm 3.0\%$  at 95 % confidence level ( $k = 2$ )

**Chromaticity Shift Over the Measurement Time**

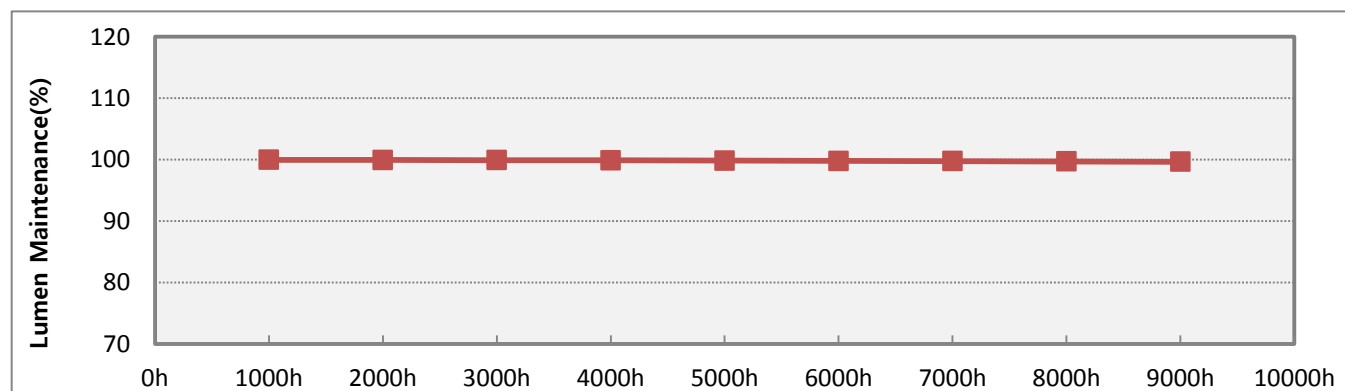
See the table of each data set

**DUT Sampling Method**

Each test units is made with 20 samples that are randomly taken from 40 samples of 3 manufacturing lot. 2 units are tested for LM-80 under 2 different temperature condition.

### 3. 85°C Data Set

No.	Initial Characteristics			Lumen Maintenance								
	Vf (V)	Flux (lm)	CCT (K)	1000 h	2000 h	3000 h	4000 h	5000 h	6000 h	7000 h	8000 h	9000 h
01	3.04	275.74	2693	99.9	99.8	99.8	99.8	99.8	99.7	99.7	99.6	99.5
02	3.04	287.94	2681	100.0	99.9	99.9	99.9	99.8	99.8	99.8	99.8	99.6
03	3.02	282.23	2700	100.0	100.0	100.0	99.9	99.8	99.8	99.8	99.8	99.7
04	3.06	271.14	2671	100.0	100.0	99.9	100.0	99.9	99.9	99.9	99.8	99.7
05	3.06	276.90	2685	100.0	99.9	99.9	99.8	99.8	99.8	99.8	99.7	99.6
06	3.04	285.27	2687	99.9	99.9	99.9	99.9	99.7	99.7	99.7	99.7	99.6
07	3.08	287.09	2684	99.9	99.9	99.9	99.8	99.8	99.7	99.7	99.7	99.6
08	3.05	286.90	2702	100.0	99.9	99.8	99.9	99.8	99.8	99.8	99.8	99.7
09	3.05	271.33	2678	99.9	99.9	100.0	99.8	99.8	99.8	99.7	99.7	99.7
10	3.04	285.92	2700	100.0	99.9	99.9	99.9	99.9	99.8	99.7	99.7	99.6
11	3.06	285.45	2692	100.0	99.9	99.9	99.9	99.9	99.8	99.8	99.8	99.7
12	3.06	271.15	2718	100.1	100.0	100.0	100.0	99.9	99.9	99.8	99.8	99.8
13	3.04	284.71	2709	100.1	100.0	100.0	99.9	99.8	99.9	99.7	99.8	99.7
14	3.06	285.58	2672	100.0	99.9	99.9	99.9	99.8	99.7	99.7	99.7	99.6
15	3.04	281.96	2677	99.9	99.9	99.9	99.8	99.7	99.7	99.6	99.6	99.6
16	3.05	277.35	2683	100.1	100.0	100.0	99.9	99.9	99.8	99.8	99.8	99.7
17	3.05	283.83	2656	100.0	100.0	99.9	99.9	99.9	99.8	99.8	99.7	99.7
18	3.05	286.74	2719	100.0	99.9	99.9	99.8	99.7	99.6	99.6	99.5	99.5
19	3.05	287.75	2717	100.0	99.9	100.0	99.9	99.9	99.8	99.8	99.8	99.6
20	3.07	285.25	2670	99.9	99.9	99.8	99.7	99.7	99.6	99.7	99.5	99.6
Ave.	3.05	282.01	2690	100.0	99.9	99.9	99.9	99.8	99.8	99.7	99.7	99.7
Med.	3.05	284.98	2686	100.0	99.9	99.9	99.9	99.8	99.8	99.7	99.7	99.6
Min.	3.02	271.14	2656	99.9	99.8	99.8	99.7	99.7	99.6	99.6	99.5	99.5
Max.	3.08	287.94	2719	100.1	100.0	100.0	100.0	99.9	99.9	99.9	99.8	99.8
σ	0.01	5.85	17	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1



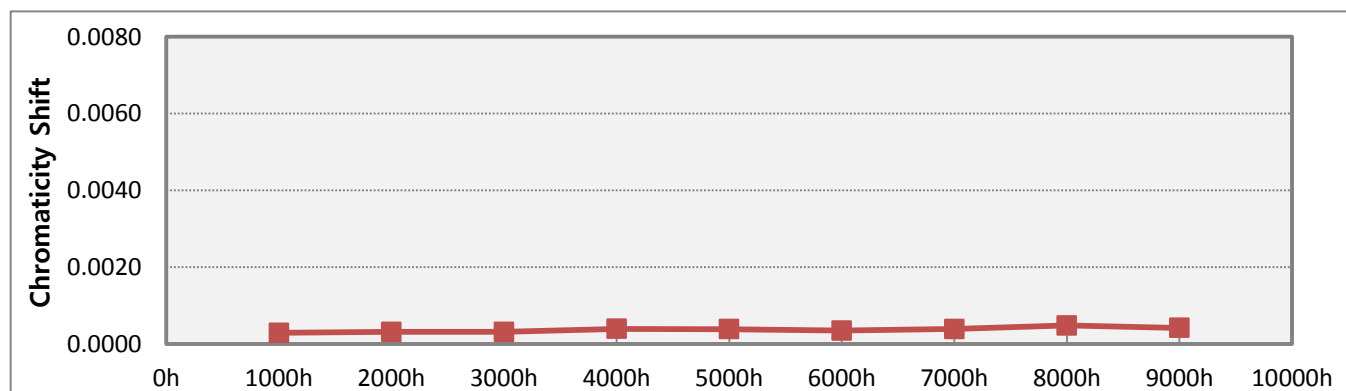


## 3. 85°C Data Set

No.				Lumen Maintenance								
				10000 h								
01				99.5								
02				99.6								
03				99.6								
04				99.7								
05				99.6								
06				99.5								
07				99.5								
08				99.6								
09				99.6								
10				99.6								
11				99.6								
12				99.7								
13				99.6								
14				99.5								
15				99.5								
16				99.7								
17				99.6								
18				99.4								
19				99.6								
20				99.4								
Ave.				99.6								
Med.				99.6								
Min.				99.4								
Max.				99.7								
$\sigma$				0.1								

### 3. 85°C Data Set

No.	Initial Characteristics			Chromaticity Shift du'v'								
	u'	v'	CRI	1000 h	2000 h	3000 h	4000 h	5000 h	6000 h	7000 h	8000 h	9000 h
01	0.2619	0.5324	70	0.0002	0.0003	0.0004	0.0003	0.0003	0.0004	0.0004	0.0005	0.0004
02	0.2624	0.5330	70	0.0004	0.0002	0.0003	0.0003	0.0003	0.0003	0.0005	0.0004	0.0006
03	0.2612	0.5341	70	0.0003	0.0002	0.0003	0.0005	0.0003	0.0002	0.0005	0.0004	0.0003
04	0.2629	0.5327	70	0.0003	0.0002	0.0003	0.0005	0.0004	0.0002	0.0003	0.0004	0.0004
05	0.2621	0.5331	70	0.0002	0.0004	0.0002	0.0004	0.0003	0.0002	0.0003	0.0004	0.0003
06	0.2620	0.5330	70	0.0003	0.0004	0.0003	0.0003	0.0004	0.0004	0.0004	0.0006	0.0003
07	0.2621	0.5334	70	0.0003	0.0004	0.0003	0.0005	0.0004	0.0005	0.0004	0.0004	0.0003
08	0.2614	0.5323	70	0.0003	0.0004	0.0002	0.0004	0.0005	0.0005	0.0003	0.0004	0.0004
09	0.2624	0.5332	70	0.0002	0.0003	0.0004	0.0005	0.0004	0.0003	0.0004	0.0006	0.0004
10	0.2612	0.5339	70	0.0002	0.0004	0.0004	0.0003	0.0004	0.0005	0.0006	0.0006	0.0005
11	0.2618	0.5332	70	0.0004	0.0004	0.0003	0.0005	0.0003	0.0004	0.0004	0.0003	0.0005
12	0.2604	0.5338	70	0.0003	0.0002	0.0004	0.0004	0.0003	0.0003	0.0003	0.0006	0.0006
13	0.2609	0.5335	70	0.0002	0.0002	0.0004	0.0004	0.0005	0.0002	0.0004	0.0006	0.0005
14	0.2627	0.5332	70	0.0003	0.0004	0.0003	0.0003	0.0004	0.0002	0.0004	0.0005	0.0003
15	0.2624	0.5336	70	0.0003	0.0004	0.0002	0.0003	0.0003	0.0005	0.0003	0.0005	0.0003
16	0.2622	0.5332	70	0.0004	0.0003	0.0003	0.0004	0.0005	0.0003	0.0003	0.0003	0.0004
17	0.2636	0.5332	70	0.0002	0.0003	0.0004	0.0002	0.0005	0.0004	0.0005	0.0006	0.0003
18	0.2603	0.5337	70	0.0003	0.0003	0.0004	0.0003	0.0004	0.0003	0.0003	0.0004	0.0004
19	0.2604	0.5338	70	0.0003	0.0003	0.0003	0.0003	0.0004	0.0004	0.0005	0.0006	0.0005
20	0.2628	0.5336	70	0.0003	0.0004	0.0004	0.0005	0.0004	0.0003	0.0003	0.0004	0.0005
Ave.	0.2619	0.5333	70	0.0003	0.0003	0.0003	0.0004	0.0004	0.0003	0.0004	0.0005	0.0004
Med.	0.2621	0.5332	70	0.0003	0.0003	0.0003	0.0004	0.0004	0.0003	0.0004	0.0005	0.0004
Min.	0.2603	0.5323	70	0.0002	0.0002	0.0002	0.0002	0.0003	0.0002	0.0003	0.0003	0.0003
Max.	0.2636	0.5341	70	0.0004	0.0004	0.0004	0.0005	0.0005	0.0005	0.0006	0.0006	0.0006
σ	0.0009	0.0005	0.2	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001



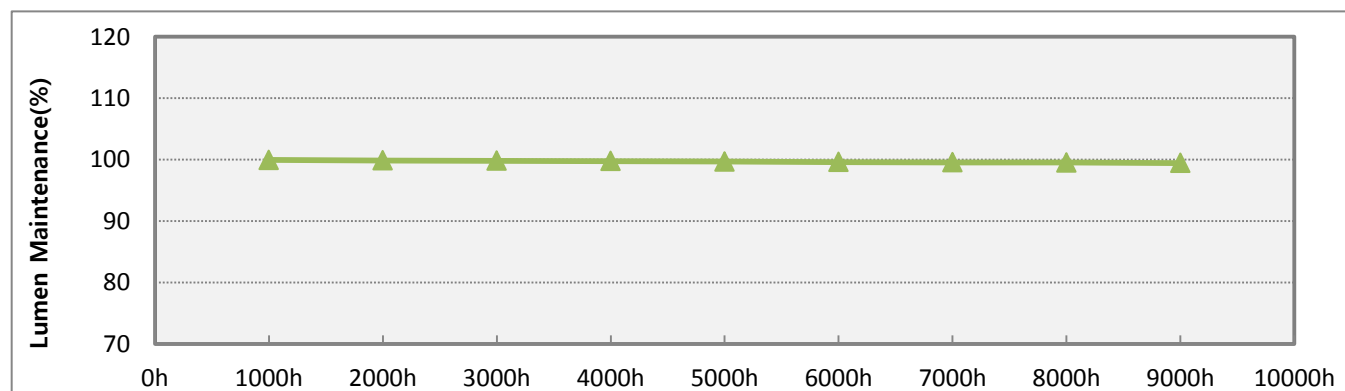


### 3. 85°C Data Set

No.					Chromaticity Shift du'v'								
					10000 h								
01					0.0005								
02					0.0005								
03					0.0006								
04					0.0007								
05					0.0005								
06					0.0003								
07					0.0004								
08					0.0004								
09					0.0007								
10					0.0004								
11					0.0006								
12					0.0006								
13					0.0007								
14					0.0007								
15					0.0003								
16					0.0003								
17					0.0007								
18					0.0006								
19					0.0004								
20					0.0005								
Ave.					0.0005								
Med.					0.0005								
Min.					0.0003								
Max.					0.0007								
σ					0.0001								

#### 4. 105°C Data Set

No.	Initial Characteristics			Lumen Maintenance								
	Vf (V)	Flux (lm)	CCT (K)	1000 h	2000 h	3000 h	4000 h	5000 h	6000 h	7000 h	8000 h	9000 h
01	3.02	283.82	2608	100.1	100.0	99.9	100.0	99.8	99.8	99.8	99.5	99.6
02	3.07	273.93	2603	99.9	99.9	99.7	99.7	99.6	99.6	99.5	99.5	99.4
03	3.04	283.86	2627	100.0	99.9	99.9	99.8	99.7	99.7	99.7	99.5	99.5
04	3.05	289.54	2648	99.9	99.9	99.7	99.7	99.6	99.5	99.4	99.5	99.3
05	3.08	281.41	2622	99.9	99.8	99.8	99.7	99.6	99.5	99.5	99.5	99.4
06	3.06	266.48	2649	100.0	99.9	99.8	99.8	99.7	99.6	99.6	99.4	99.5
07	3.07	280.80	2635	99.9	99.8	99.7	99.7	99.6	99.5	99.5	99.4	99.4
08	3.07	290.39	2619	99.9	99.8	99.8	99.8	99.7	99.6	99.4	99.4	99.4
09	3.05	283.73	2607	99.9	99.8	99.7	99.6	99.5	99.5	99.4	99.4	99.4
10	3.05	277.49	2613	99.9	99.8	99.7	99.6	99.6	99.5	99.4	99.5	99.4
11	3.05	274.99	2633	100.0	100.0	99.9	99.9	99.9	99.8	99.7	99.6	99.6
12	3.05	287.16	2644	100.0	100.0	100.0	99.8	99.8	99.7	99.7	99.6	99.5
13	3.02	287.12	2648	99.9	99.9	99.8	99.7	99.6	99.6	99.6	99.5	99.4
14	3.02	282.42	2654	100.0	99.9	99.8	99.7	99.6	99.6	99.6	99.6	99.5
15	3.23	274.40	2660	100.0	99.8	99.8	99.7	99.7	99.5	99.5	99.6	99.5
16	3.04	283.44	2626	100.0	100.0	99.9	99.8	99.8	99.7	99.6	99.6	99.6
17	3.09	288.50	2649	99.9	99.8	99.8	99.7	99.6	99.6	99.5	99.5	99.4
18	3.07	286.53	2624	100.0	99.9	99.8	99.8	99.7	99.7	99.5	99.6	99.5
19	3.08	280.39	2619	99.9	99.8	99.8	99.7	99.5	99.5	99.5	99.5	99.4
20	3.08	289.97	2644	99.9	99.8	99.9	99.8	99.7	99.6	99.5	99.5	99.5
Ave.	3.06	282.32	2632	99.9	99.9	99.8	99.7	99.7	99.6	99.5	99.5	99.5
Med.	3.05	283.59	2630	99.9	99.9	99.8	99.7	99.6	99.6	99.5	99.5	99.4
Min.	3.02	266.48	2603	99.9	99.8	99.7	99.6	99.5	99.5	99.4	99.4	99.3
Max.	3.23	290.39	2660	100.1	100.0	100.0	100.0	99.9	99.8	99.8	99.6	99.6
σ	0.04	6.30	17	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1



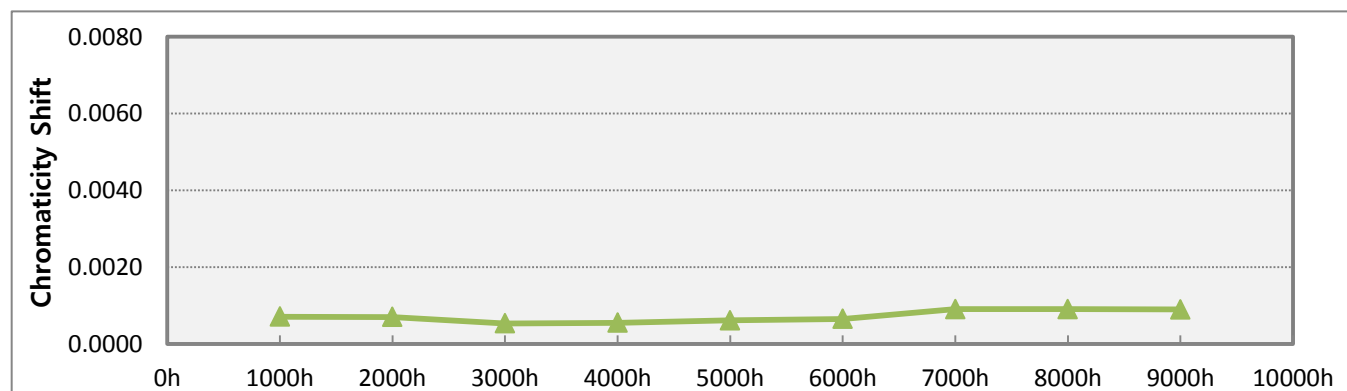


## 4. 105°C Data Set

No.				Lumen Maintenance								
				10000 h								
01				99.4								
02				99.3								
03				99.3								
04				99.3								
05				99.2								
06				99.4								
07				99.3								
08				99.3								
09				99.2								
10				99.2								
11				99.5								
12				99.4								
13				99.4								
14				99.4								
15				99.3								
16				99.4								
17				99.3								
18				99.4								
19				99.4								
20				99.3								
Ave.				99.3								
Med.				99.3								
Min.				99.2								
Max.				99.5								
$\sigma$				0.1								

#### 4. 105°C Data Set

No.	Initial Characteristics			Chromaticity Shift du'v'								
	u'	v'	CRI	1000 h	2000 h	3000 h	4000 h	5000 h	6000 h	7000 h	8000 h	9000 h
01	0.2652	0.5380	69	0.0005	0.0009	0.0005	0.0007	0.0009	0.0004	0.0005	0.0005	0.0011
02	0.2655	0.5378	69	0.0007	0.0006	0.0006	0.0006	0.0007	0.0006	0.0011	0.0006	0.0009
03	0.2641	0.5386	69	0.0010	0.0006	0.0004	0.0005	0.0007	0.0005	0.0010	0.0012	0.0010
04	0.2629	0.5389	69	0.0006	0.0008	0.0005	0.0006	0.0007	0.0007	0.0008	0.0007	0.0008
05	0.2644	0.5382	69	0.0004	0.0007	0.0004	0.0005	0.0007	0.0009	0.0010	0.0005	0.0009
06	0.2630	0.5382	69	0.0009	0.0010	0.0006	0.0006	0.0007	0.0005	0.0008	0.0010	0.0009
07	0.2637	0.5384	69	0.0007	0.0006	0.0003	0.0004	0.0005	0.0006	0.0005	0.0007	0.0012
08	0.2644	0.5392	69	0.0008	0.0004	0.0003	0.0007	0.0008	0.0007	0.0012	0.0011	0.0006
09	0.2653	0.5382	69	0.0008	0.0007	0.0007	0.0005	0.0006	0.0008	0.0011	0.0011	0.0009
10	0.2649	0.5380	69	0.0007	0.0005	0.0007	0.0005	0.0005	0.0006	0.0010	0.0007	0.0009
11	0.2640	0.5376	69	0.0008	0.0010	0.0006	0.0005	0.0006	0.0005	0.0012	0.0012	0.0009
12	0.2632	0.5383	69	0.0008	0.0005	0.0006	0.0004	0.0004	0.0009	0.0012	0.0012	0.0011
13	0.2631	0.5381	69	0.0008	0.0006	0.0007	0.0006	0.0006	0.0005	0.0011	0.0008	0.0010
14	0.2629	0.5375	69	0.0005	0.0010	0.0005	0.0007	0.0006	0.0006	0.0011	0.0013	0.0011
15	0.2625	0.5380	70	0.0007	0.0009	0.0007	0.0008	0.0005	0.0007	0.0012	0.0012	0.0008
16	0.2642	0.5383	69	0.0004	0.0006	0.0006	0.0004	0.0004	0.0004	0.0005	0.0010	0.0008
17	0.2629	0.5386	69	0.0009	0.0005	0.0006	0.0005	0.0007	0.0009	0.0005	0.0009	0.0008
18	0.2643	0.5384	69	0.0010	0.0004	0.0006	0.0003	0.0009	0.0006	0.0009	0.0011	0.0006
19	0.2645	0.5388	69	0.0006	0.0008	0.0004	0.0008	0.0005	0.0008	0.0006	0.0006	0.0009
20	0.2633	0.5381	69	0.0005	0.0010	0.0003	0.0004	0.0005	0.0009	0.0008	0.0007	0.0007
Ave.	0.2639	0.5383	69	0.0007	0.0007	0.0005	0.0006	0.0006	0.0007	0.0009	0.0009	0.0009
Med.	0.2640	0.5382	69	0.0007	0.0007	0.0006	0.0005	0.0006	0.0006	0.0010	0.0009	0.0009
Min.	0.2625	0.5375	69	0.0004	0.0004	0.0003	0.0003	0.0004	0.0004	0.0005	0.0005	0.0006
Max.	0.2655	0.5392	70	0.0010	0.0010	0.0007	0.0008	0.0009	0.0009	0.0012	0.0013	0.0012
σ	0.0009	0.0004	0.2	0.0002	0.0002	0.0001	0.0001	0.0001	0.0002	0.0003	0.0003	0.0002



#### 4. 105°C Data Set

No.					Chromaticity Shift du'v'								
					10000 h								
01					0.0008								
02					0.0011								
03					0.0009								
04					0.0006								
05					0.0008								
06					0.0010								
07					0.0006								
08					0.0008								
09					0.0009								
10					0.0006								
11					0.0009								
12					0.0006								
13					0.0007								
14					0.0009								
15					0.0008								
16					0.0011								
17					0.0006								
18					0.0011								
19					0.0010								
20					0.0011								
Ave.					0.0008								
Med.					0.0009								
Min.					0.0006								
Max.					0.0011								
σ					0.0002								