



TEST REPORT

According to ANSI/IES LM-80-15
For

#FOSHAN NATIONSTAR OPTOELECTRONICS CO.,LTD
#NO.18 SOUTH HUABAO ROAD,CHAN CHENGDISTRICT,FOSHAN,GUANGDONG,CHINA

#Model: FM-DP3528WRS-460QH-R809-AX-3

Report Type: 17000 Hours Test Report		Product Type: LED Package	
Reviewed By:	Pote Wang	<i>Pote Wang</i>	
Report Number:	RSZ200103506-10-17000		
Test Date:	2020-03-03 to 2022-04-18		
Report Date:	2022-07-11		
Approved by:	Bill Xiong / EE Engineer		
Prepared By:	Bay Area Compliance Laboratories Corp. (Shenzhen) 5/F(B-West) -7/F, the 3rd Phase of Wan Li Industrial Building D, Shihua Road, Futian Free Trade Zone Shenzhen, Guangdong, China. Tel: +86-755-33320018 Fax: +86-755-33320008		
Test Facility:	Test facility was located at No.12, Pulong East 1 st Road, Tangxia Town, Dongguan, Guangdong, China.		

Note: This test report is prepared for the customer shown above and for the device described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp.(Shenzhen). This report must not be used by the customer to claim product certification, approval, or endorsement by NVLAP, or any agency of the U.S. Government.

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Note:

***: The items tested by Bay Area Compliance Laboratories Corp. (Dongguan) and covered by IAS accreditation, the reference report No. is RSZ200103506-10-12000 (test Date: 2020-03-03 to 2021-08-16).
Bay Area Compliance Laboratories Corp. (Dongguan) is EPA-Recognized Laboratories and the ORG ID: 1109266.

1 - General Information

1.1 Description of LED Light Sources[#]

Sample Size:

75 PCS test samples were in good condition and received on 2020-01-03. The samples were numbered from 1 to 25, 26 to 50 and 51 to 75.

Manufacturer:	FOSHAN NATIONSTAR OPTOELECTRONICS CO.,LTD
Part Number:	FM-DP3528WRS-460QH-R809-AX-3
Part Type:	LED Package
Drive Level:	DC 240mA
Nominal CCT:	2700K
Power:	0.768W
Average Current Density per LED die:	862mA/mm ²
Average Power Density per LED die:	2.76W/mm ²
CRI:	80
Die Spacing:	0.1mm

Sampling Method:

LED samples for IESNA LM-80 testing consist of units built from a minimum of three manufacturing lots with each manufacturing lot built from different wafer lots built on non-consecutive days.

These manufacturing lots are picked to represent a wide parametric distribution.

Family products covered by this report:

According to *ENERGY STAR[®] Requirements for the Use of LM-80 Data*, the following products can be covered by this report base on the information and declaration provided by manufacturer. The information of these models shows that the covered products meet all section 4 requirements of *ENERGY STAR[®] Requirements for the Use of LM-80 Data* (September 28, 2017)

This report covers the following models:

OEM MODEL NUMBER(S)	Power (W)	CCT (K)	Ra	Input Current (mA)	The Number of Dies	Minimum Die Spacing (mm)	Power Density of PCB (mW/mm ²)	Current Density (mA/mm ²)
FM-DP3528WRS-460QH-R809-AX-3	0.768W	2700	80	240	2	0.1	≤78.5	≤862
FM-DP3528WHS-460xxx-R80x-xxx-x	≤0.768W	2200	80	240	2	0.1	≤78.5	≤862
FM-DP3528WRS-460xxx-R80x-xxx-x	≤0.768W	2700	80	240	2	0.1	≤78.5	≤862
FM-DP3528WLS-460xxx-R80x-xxx-x	≤0.768W	3000	80	240	2	0.1	≤78.5	≤862
FM-DP3528WES-460xxx-R80x-xxx-x	≤0.768W	3500	80	240	2	0.1	≤78.5	≤862
FM-DP3528WDS-460xxx-R80x-xxx-x	≤0.768W	4000	80	240	2	0.1	≤78.5	≤862
FM-DP3528WCS-460xxx-R80x-xxx-x	≤0.768W	5000	80	240	2	0.1	≤78.5	≤862
FM-DP3528WFS-460xxx-R80x-xxx-x	≤0.768W	5700	80	240	2	0.1	≤78.5	≤862
FM-DP3528WGS-460xxx-R80x-xxx-x	≤0.768W	6000	80	240	2	0.1	≤78.5	≤862
FM-DP3528WNS-460xxx-R80x-xxx-x	≤0.768W	6500	80	240	2	0.1	≤78.5	≤862

OEM MODEL NUMBER(S)	Power (W)	CCT (K)	Ra	Input Current (mA)	The Number of Dies	Minimum Die Spacing (mm)	Power Density of PCB (mW/mm ²)	Current Density (mA/mm ²)
FM-DP3528WJS-460xxx-R80x-xxx-x	≤0.768W	7000	80	240	2	0.1	≤78.5	≤862
FM-P3528WNS-460xxx-R80x-xxx-x	≤0.64W	6500	80	200	1	/	≤78.5	≤862
FM-P3528WGS-460xxx-R80x-xxx-x	≤0.64W	6000	80	200	1	/	≤78.5	≤862
FM-P3528WFS-460xxx-R80x-xxx-x	≤0.64W	5700	80	200	1	/	≤78.5	≤862
FM-P3528WCS-460xxx-R80x-xxx-x	≤0.64W	5000	80	200	1	/	≤78.5	≤862
FM-P3528WDS-460xxx-R80x-xxx-x	≤0.64W	4000	80	200	1	/	≤78.5	≤862
FM-P3528WES-460xxx-R80x-xxx-x	≤0.64W	3500	80	200	1	/	≤78.5	≤862
FM-P3528WLS-460xxx-R80x-xxx-x	≤0.64W	3000	80	200	1	/	≤78.5	≤862
FM-P3528WRS-460xxx-R80x-xxx-x	≤0.64W	2700	80	200	1	/	≤78.5	≤862

Note:

FM-DP3528W_XS-460_{XXX}-R80_X-_{XXX}-_X
1 2 3 4 5

Identifiers Information (if any):

1. The first X represent CCT range, it can be alphanumeric
2. The second X represent brightness rank range, it can be blank or alphanumeric.
3. The third X represent internal reference code, it can be alphanumeric;
4. The fourth X represent internal management code and customer code, it can be blank or alphanumeric;
5. The fifth X represent color center version, it can be blank or alphanumeric;

1.2 Standards and Reference Documentations

- ANSI/IES LM-80-15: IES Approved Method for Measuring Lumen Maintenance of LED Light Sources.
- *CIE 127:2007: Measurement of LEDs(This standard was not accredited by NVLAP)
- *ENERGY STAR® Requirements for the Use of LM-80 Data (This standard was not accredited by NVLAP)

1.3 Testing Equipment

Device	Manufacture	Model No	Serial No	Calibration date	Calibration due date
0.3m integrating sphere	EVERFINE	Diameter 0.3m	1011119	2022-01-05	2023-01-04
Programmable Test Power for LEDs	EVERFINE	LED300E	1008002	2022-01-05	2023-01-04
High accuracy array spectroradiometer	EVERFINE	HAAS-2000	1012016T	2022-01-05	2023-01-04
Standard Light Source	EVERFINE	D062	1011093	2021-10-15	2022-10-14
Precision digital stabilized DC power supply	EVERFINE	WY605-V110	G115987CJ7321114	2022-01-06	2023-01-05
Multilayer aging machine	BACL	B2-270	20023	2022-01-04	2023-01-03

Device	Manufacture	Model No	Serial No	Calibration date	Calibration due date
DC Power Supply	BACL	B12001-12	90023	2022-01-04	2023-01-03

1.4 Drive Level

Samples are driven with a constant direct current (DC) during maintenance test, photometric and electrical measurement. The current value was regulated to within $\pm 3\%$ of the specified value of the manufacturer during maintenance test, and was within $\pm 0.5\%$ during photometric and electrical measurement test.

1.5 Ambient Conditions for Maintenance Test

For lumen maintenance test, samples within one data set, were installed on cooling boards in thermal chambers with minimal ambient airflow. The case temperature and ambient temperature was monitored by thermocouples which one was soldered to the coldest DUTs' case (TMP_{LED}) location, while the other is mounted at a distance of 5 mm above the TMP location.

During life testing, TMP_{LED} of the coldest LEDs were maintained at a temperature that was greater than or equal to 2°C below the corresponding nominal case temperature. Surrounding air was maintained at a temperature that was greater than or equal to 5°C below the corresponding nominal case temperature. Thermocouples were shielded from direct DUT optical radiation and comply with ASTM E230 Table 1 "Special Limits".

Samples were connected to DC power supply in series circuits with a constant current. The forward current was regulated to within $\pm 3\%$ of the specified value of the manufacturer.

The relative humidity within chamber was kept less than 65% during test.

For photometry measurement, the ambient temperature during test was set to 25°C \pm 2°C, RH <65%.

1.6 Photometric Measurement Method and Uncertainty

Integrating sphere and spectroradiometer is used to measure luminous flux and chromaticity coordinate u'v'. 2 π measurement was used and sample was driven by DC power supply. The forward current was regulated to within $\pm 0.5\%$ of the nominal value. The test system was calibrated by halogen reference lamp. The ambient temperature during test was set to 25°C \pm 2°C, RH <65%. The temperature measurement point was located in the sphere and the temperature was detected by a temperature probe.

The uncertainty of the light output measurements is U=1.59% (K=2), at the 95% confidence level. The uncertainty of the correlated color temperature measurements is U=21K (K=2), at the 95% confidence level.

The uncertainty of the temperature is U=0.8671°C (K=2), at the 95% confidence level.

1.7 Statement of Traceability

Bay Area Compliance Laboratories Corp. (Dongguan) attested that all calibration has been performed using suitable standards traceable to National Primary Standards and International System of Units (SI).

1.8 Sample Set

Data Set 1: 85°C, 240mA

Part Number: FM-DP3528WRS-460QH-R809-AX-3
Number of Units: 25
Case Temperature: >83°C
Ambient Temperature: >80°C
Life Test Drive Current: 240mA
Measurement Current: 240mA

Data Set 2: 105°C, 240mA

Part Number: FM-DP3528WRS-460QH-R809-AX-3
Number of Units: 25
Case Temperature: >103°C
Ambient Temperature: >100°C
Life Test Drive Current: 240mA
Measurement Current: 240mA

Data Set 3: 115° C, 240mA

Part Number: FM-DP3528WRS-460QH-R809-AX-3
Number of Units: 25
Case Temperature: >113°C
Ambient Temperature: >110°C
Life Test Drive Current: 240mA
Measurement Current: 240mA

2 - Summary of Test Result

Data Set:	Sample Size	Failures Observed:	Test Interval	Test Duration	α	β	Reported TM-21 L ₇₀ Lifetime
1	25	0	1000hrs	17000hrs	2.723E-06	1.004	>102000 hours
2	25	0	1000hrs	17000hrs	3.246E-06	1.003	>102000 hours
3	25	0	1000hrs	17000hrs	3.544E-06	1.000	101,000 hours

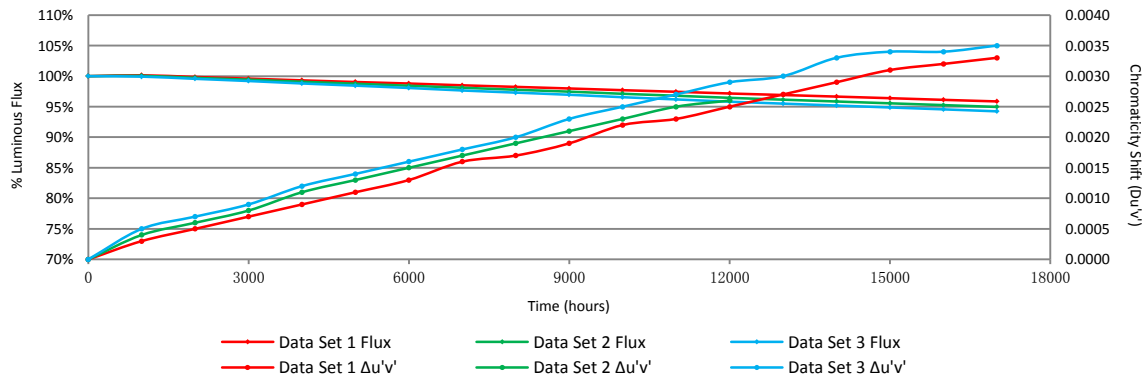
Average Lumen Maintenance (Percentage of Initial Luminous Flux)

Data Set:	** 1000hrs	** 2000hrs	** 3000hrs	** 4000hrs	** 5000hrs	** 6000hrs	** 7000hrs	** 8000hrs	** 9000hrs	** 10000hrs	** 11000hrs	** 12000hrs
1	100.14%	99.86%	99.59%	99.31%	99.04%	98.79%	98.50%	98.24%	97.98%	97.70%	97.44%	97.16%
2	100.05%	99.72%	99.42%	99.08%	98.76%	98.43%	98.10%	97.77%	97.46%	97.11%	96.79%	96.45%
3	99.92%	99.56%	99.20%	98.80%	98.44%	98.06%	97.65%	97.30%	96.95%	96.55%	96.19%	95.82%
	** 13000hrs	** 14000hrs	** 15000hrs	** 16000hrs	** 17000hrs							
	96.91%	96.65%	96.39%	96.12%	95.86%							
	96.15%	95.85%	95.55%	95.26%	94.96%							
	95.50%	95.19%	94.87%	94.56%	94.24%							

Average Chromaticity Shift

Data Set:	** 1000hrs	** 2000hrs	** 3000hrs	** 4000hrs	** 5000hrs	** 6000hrs	** 7000hrs	** 8000hrs	** 9000hrs	** 10000hrs	** 11000hrs	** 12000hrs
1	0.0003	0.0005	0.0007	0.0009	0.0011	0.0013	0.0016	0.0017	0.0019	0.0022	0.0023	0.0025
2	0.0004	0.0006	0.0008	0.0011	0.0013	0.0015	0.0017	0.0019	0.0021	0.0023	0.0025	0.0026
3	0.0005	0.0007	0.0009	0.0012	0.0014	0.0016	0.0018	0.0020	0.0023	0.0025	0.0027	0.0029
	** 13000hrs	** 14000hrs	** 15000hrs	** 16000hrs	** 17000hrs							
	0.0027	0.0029	0.0031	0.0032	0.0033							
	0.0028	0.003	0.0032	0.0033	0.0034							
	0.003	0.0033	0.0034	0.0034	0.0035							

Average Lumen Maintenance and Chromaticity Shift VS. Time



3 - Test Data

3.1 Data Set 1, 85°C, 240mA (Lumen Maintenance)

No.	Φ(lm)	Lumen Maintenance (%)											
	**0hr(Initial)	**1000hrs	**2000hrs	**3000hrs	**4000hrs	**5000hrs	**6000hrs	**7000hrs	**8000hrs	**9000hrs	**10000hrs	**11000hrs	**12000hrs
1	112.20	100.18	99.82	99.64	99.47	99.29	99.11	98.75	98.48	98.31	98.04	97.77	97.59
2	111.60	100.09	99.73	99.46	99.19	98.92	98.57	98.39	98.12	97.85	97.58	97.31	97.13
3	112.20	100.18	99.91	99.55	99.38	99.02	98.75	98.48	98.13	97.86	97.50	97.24	96.97
4	113.20	100.09	99.91	99.65	99.29	99.03	98.76	98.41	98.23	97.88	97.70	97.53	97.17
5	111.00	100.18	99.82	99.64	99.37	99.01	98.83	98.47	98.29	98.02	97.66	97.48	97.21
6	112.40	100.18	99.91	99.56	99.29	99.11	98.93	98.67	98.49	98.31	98.04	97.86	97.51
7	113.00	100.09	99.82	99.65	99.29	98.94	98.67	98.50	98.14	97.79	97.61	97.35	97.08
8	112.30	99.91	99.64	99.29	99.02	98.75	98.58	98.22	98.04	97.77	97.51	97.33	97.15
9	111.10	100.27	100.09	99.73	99.37	99.19	98.83	98.56	98.38	98.11	97.93	97.66	97.39
10	112.10	100.09	99.73	99.38	99.11	98.93	98.66	98.31	97.95	97.77	97.50	97.23	96.97
11	111.70	100.09	99.91	99.64	99.28	99.10	98.84	98.48	98.30	97.94	97.58	97.22	96.96
12	111.90	100.18	99.91	99.64	99.46	99.20	99.02	98.66	98.39	98.03	97.77	97.50	97.32
13	111.30	100.18	99.82	99.55	99.28	98.92	98.65	98.38	98.20	98.02	97.66	97.39	97.04
14	111.50	100.36	100.18	99.82	99.64	99.37	99.01	98.83	98.65	98.48	98.30	98.03	97.76
15	112.20	100.18	99.91	99.73	99.47	99.11	98.75	98.48	98.22	97.86	97.68	97.33	96.97
16	113.30	100.26	100.09	99.91	99.65	99.29	99.03	98.76	98.50	98.23	97.88	97.53	97.18
17	111.70	100.27	99.91	99.73	99.37	99.10	98.93	98.57	98.30	98.03	97.76	97.40	97.14
18	110.00	100.09	99.73	99.45	99.09	98.82	98.55	98.18	97.91	97.73	97.36	97.00	96.82
19	111.10	99.91	99.73	99.55	99.37	99.01	98.83	98.56	98.20	98.02	97.84	97.57	97.30
20	113.40	100.09	99.74	99.47	99.29	99.03	98.77	98.41	98.06	97.88	97.53	97.35	96.91
21	112.60	99.91	99.64	99.38	99.02	98.76	98.58	98.31	97.96	97.60	97.42	97.16	96.89
22	111.70	100.18	99.82	99.64	99.37	99.02	98.66	98.39	98.21	97.94	97.58	97.22	96.87
23	112.00	100.27	99.91	99.64	99.29	99.11	98.93	98.75	98.48	98.21	98.04	97.86	97.50
24	111.30	100.09	99.91	99.64	99.19	98.92	98.65	98.38	98.11	97.93	97.57	97.21	96.95
25	113.00	100.18	99.82	99.47	99.20	98.94	98.76	98.50	98.23	97.88	97.52	97.35	97.17
Avg.	111.99	100.14	99.86	99.59	99.31	99.04	98.79	98.50	98.24	97.98	97.70	97.44	97.16
Med.	112.00	100.18	99.82	99.64	99.29	99.02	98.76	98.48	98.22	97.94	97.66	97.35	97.14
st dev	0.82	0.11	0.13	0.14	0.16	0.16	0.16	0.17	0.19	0.21	0.2279	0.25	0.24
Min.	110.00	99.91	99.64	99.29	99.02	98.75	98.55	98.18	97.91	97.60	97.36	97.00	96.82
Max.	113.40	100.36	100.18	99.91	99.65	99.37	99.11	98.83	98.65	98.48	98.30	98.03	97.76



Bay Area Compliance Laboratories Corp. (Shenzhen)

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 Building D, Shihua Road, Futian Free Trade Zone Shenzhen, Guangdong, China.
 The NVLAP Lab Code is 200707-0

No.	Lumen Maintenance (%)				
	13000hrs	14000hrs	15000hrs	16000hrs	17000hrs
1	97.33	97.06	96.88	96.70	96.43
2	96.86	96.51	96.24	96.06	95.79
3	96.61	96.43	96.08	95.90	95.63
4	97.00	96.73	96.47	96.11	95.85
5	96.94	96.67	96.40	96.22	95.77
6	97.15	96.80	96.44	96.26	95.82
7	96.90	96.64	96.28	95.93	95.75
8	96.88	96.71	96.44	96.17	95.99
9	97.21	96.94	96.76	96.58	96.31
10	96.79	96.52	96.16	95.90	95.63
11	96.69	96.51	96.33	96.15	95.79
12	97.05	96.78	96.51	96.34	96.16
13	96.68	96.32	96.14	95.87	95.69
14	97.49	97.31	96.95	96.68	96.41
15	96.79	96.61	96.35	96.08	95.90
16	96.82	96.56	96.29	96.12	95.76
17	96.96	96.78	96.51	96.24	96.06
18	96.64	96.36	96.09	95.73	95.55
19	96.94	96.67	96.40	96.13	95.77
20	96.65	96.47	96.21	96.03	95.94
21	96.63	96.45	96.18	95.83	95.65
22	96.60	96.24	96.06	95.61	95.43
23	97.32	96.96	96.79	96.70	96.25
24	96.77	96.50	96.32	95.87	95.69
25	96.99	96.73	96.37	95.84	95.49
Avg.	96.91	96.65	96.39	96.12	95.86
Med.	96.88	96.64	96.35	96.11	95.79
st dev	0.24	0.24	0.24	0.30	0.28
Min.	96.60	96.24	96.06	95.61	95.43
Max.	97.49	97.31	96.95	96.70	96.43

3.2 Data Set 1, 85°C, 240mA (Forward Voltage)

No.	Forward Voltage (V)												
	**0hr(Initial)	**1000hrs	**2000hrs	**3000hrs	**4000hrs	**5000hrs	**6000hrs	**7000hrs	**8000hrs	**9000hrs	**10000hrs	**11000hrs	**12000hrs
1	3.103	3.095	3.095	3.106	3.139	3.135	3.099	3.102	3.102	3.096	3.105	3.117	3.115
2	3.105	3.101	3.101	3.114	3.120	3.120	3.102	3.106	3.105	3.101	3.105	3.108	3.108
3	3.073	3.069	3.073	3.079	3.084	3.101	3.070	3.074	3.075	3.072	3.074	3.086	3.102
4	3.092	3.092	3.091	3.091	3.105	3.115	3.087	3.092	3.092	3.091	3.094	3.101	3.109
5	3.106	3.121	3.107	3.110	3.109	3.136	3.103	3.108	3.107	3.107	3.119	3.112	3.115
6	3.100	3.111	3.100	3.105	3.112	3.108	3.094	3.101	3.099	3.103	3.107	3.103	3.102
7	3.086	3.117	3.085	3.087	3.107	3.087	3.082	3.087	3.085	3.088	3.099	3.106	3.109
8	3.124	3.127	3.122	3.136	3.125	3.134	3.123	3.130	3.125	3.126	3.130	3.133	3.141
9	3.102	3.102	3.105	3.099	3.102	3.114	3.102	3.108	3.104	3.104	3.113	3.116	3.115
10	3.106	3.112	3.104	3.116	3.107	3.112	3.106	3.110	3.107	3.108	3.123	3.129	3.124
11	3.069	3.072	3.065	3.068	3.085	3.088	3.070	3.070	3.068	3.069	3.082	3.082	3.094
12	3.087	3.112	3.086	3.092	3.128	3.089	3.088	3.092	3.089	3.089	3.090	3.101	3.104
13	3.081	3.080	3.083	3.082	3.117	3.082	3.080	3.088	3.083	3.084	3.085	3.101	3.094
14	3.111	3.107	3.111	3.114	3.113	3.113	3.108	3.114	3.117	3.112	3.119	3.118	3.120
15	3.089	3.098	3.087	3.093	3.101	3.091	3.086	3.093	3.091	3.091	3.095	3.097	3.106
16	3.104	3.126	3.106	3.112	3.124	3.103	3.106	3.112	3.115	3.108	3.123	3.117	3.116
17	3.112	3.132	3.113	3.108	3.119	3.127	3.109	3.118	3.116	3.109	3.122	3.117	3.113
18	3.108	3.105	3.108	3.111	3.107	3.108	3.104	3.113	3.110	3.107	3.133	3.124	3.113
19	3.082	3.088	3.082	3.080	3.109	3.087	3.078	3.087	3.085	3.087	3.093	3.119	3.098
20	3.130	3.131	3.133	3.128	3.138	3.131	3.127	3.138	3.134	3.136	3.135	3.136	3.133
21	3.092	3.093	3.088	3.094	3.118	3.091	3.089	3.096	3.098	3.095	3.105	3.106	3.107
22	3.106	3.107	3.105	3.105	3.120	3.119	3.103	3.111	3.109	3.105	3.118	3.112	3.127
23	3.077	3.074	3.077	3.073	3.088	3.085	3.075	3.081	3.081	3.079	3.096	3.112	3.106
24	3.093	3.096	3.090	3.092	3.102	3.115	3.092	3.100	3.096	3.093	3.104	3.104	3.099
25	3.133	3.134	3.129	3.132	3.141	3.136	3.128	3.139	3.138	3.130	3.146	3.138	3.141
Avg.	3.099	3.104	3.098	3.101	3.113	3.109	3.096	3.103	3.101	3.100	3.109	3.112	3.112
Med.	3.102	3.105	3.100	3.105	3.112	3.112	3.099	3.102	3.102	3.101	3.105	3.112	3.109
st dev	0.017	0.019	0.017	0.018	0.015	0.018	0.016	0.018	0.017	0.016	0.018	0.014	0.013
Min.	3.069	3.069	3.065	3.068	3.084	3.082	3.070	3.070	3.068	3.069	3.074	3.082	3.094
Max.	3.133	3.134	3.133	3.136	3.141	3.136	3.128	3.139	3.138	3.136	3.146	3.138	3.141



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No.	Forward Voltage (V)				
	13000hrs	14000hrs	15000hrs	16000hrs	17000hrs
1	3.113	3.109	3.114	3.097	3.093
2	3.125	3.112	3.117	3.101	3.095
3	3.083	3.081	3.085	3.072	3.063
4	3.104	3.100	3.099	3.093	3.072
5	3.114	3.113	3.116	3.099	3.084
6	3.105	3.106	3.109	3.099	3.078
7	3.092	3.091	3.096	3.076	3.065
8	3.129	3.131	3.140	3.111	3.103
9	3.114	3.110	3.114	3.084	3.080
10	3.126	3.113	3.119	3.093	3.084
11	3.078	3.075	3.083	3.059	3.077
12	3.099	3.094	3.103	3.074	3.068
13	3.088	3.089	3.097	3.068	3.059
14	3.120	3.116	3.126	3.088	3.091
15	3.097	3.092	3.103	3.068	3.065
16	3.111	3.109	3.127	3.086	3.082
17	3.123	3.116	3.131	3.122	3.086
18	3.119	3.111	3.126	3.095	3.082
19	3.091	3.085	3.100	3.059	3.059
20	3.143	3.137	3.149	3.107	3.111
21	3.102	3.095	3.104	3.068	3.070
22	3.110	3.112	3.116	3.082	3.084
23	3.083	3.082	3.088	3.055	3.061
24	3.099	3.096	3.104	3.070	3.080
25	3.140	3.138	3.149	3.107	3.116
Avg.	3.108	3.105	3.113	3.085	3.080
Med.	3.110	3.109	3.114	3.086	3.080
st dev	0.017	0.017	0.018	0.018	0.015
Min.	3.078	3.075	3.083	3.055	3.059
Max.	3.143	3.138	3.149	3.122	3.116

3.3 Data Set 1, 85°C, 240mA (Chromaticity Shift)

No.	u'	v'	CCT(K)	Chromaticity Shift ($\Delta u'v'$)											
				**0hr(Initial)	**1000hrs	**2000hrs	**3000hrs	**4000hrs	**5000hrs	**6000hrs	**7000hrs	**8000hrs	**9000hrs	**10000hrs	**11000hrs
1	0.2560	0.5258	2847	0.0002	0.0003	0.0004	0.0006	0.0007	0.0009	0.0012	0.0014	0.0016	0.0017	0.0018	0.0021
2	0.2576	0.5251	2816	0.0004	0.0006	0.0008	0.0009	0.0010	0.0012	0.0014	0.0015	0.0017	0.0018	0.0021	0.0024
3	0.2566	0.5269	2828	0.0003	0.0006	0.0007	0.0009	0.0012	0.0016	0.0017	0.0019	0.0019	0.0020	0.0022	0.0024
4	0.2569	0.5272	2821	0.0004	0.0005	0.0008	0.0011	0.0013	0.0015	0.0018	0.0018	0.0019	0.0021	0.0022	0.0023
5	0.2587	0.5274	2781	0.0003	0.0005	0.0006	0.0009	0.0012	0.0015	0.0018	0.0019	0.0021	0.0022	0.0023	0.0025
6	0.2562	0.5268	2839	0.0002	0.0005	0.0007	0.0010	0.0012	0.0014	0.0017	0.0019	0.0022	0.0025	0.0028	0.0029
7	0.2576	0.5271	2806	0.0003	0.0005	0.0008	0.0010	0.0014	0.0016	0.0017	0.0020	0.0022	0.0025	0.0027	0.0028
8	0.2567	0.5264	2828	0.0003	0.0005	0.0007	0.0009	0.0010	0.0013	0.0016	0.0017	0.0019	0.0023	0.0026	0.0029
9	0.2572	0.5279	2811	0.0004	0.0005	0.0008	0.0010	0.0013	0.0015	0.0017	0.0020	0.0023	0.0025	0.0026	0.0027
10	0.2575	0.5269	2808	0.0005	0.0007	0.0009	0.0010	0.0013	0.0014	0.0016	0.0019	0.0020	0.0022	0.0023	0.0025
11	0.2586	0.5275	2783	0.0004	0.0007	0.0009	0.0012	0.0014	0.0016	0.0017	0.0018	0.0021	0.0024	0.0025	0.0027
12	0.2566	0.5246	2839	0.0004	0.0005	0.0006	0.0009	0.0010	0.0013	0.0015	0.0016	0.0019	0.0022	0.0025	0.0027
13	0.2568	0.5268	2825	0.0003	0.0006	0.0008	0.0011	0.0012	0.0013	0.0016	0.0017	0.0019	0.0021	0.0023	0.0024
14	0.2593	0.5257	2775	0.0005	0.0006	0.0008	0.0009	0.0011	0.0014	0.0016	0.0019	0.0021	0.0024	0.0025	0.0026
15	0.2570	0.5259	2825	0.0004	0.0006	0.0009	0.0011	0.0013	0.0014	0.0016	0.0018	0.0020	0.0022	0.0024	0.0025
16	0.2559	0.5258	2851	0.0004	0.0005	0.0006	0.0009	0.0010	0.0013	0.0015	0.0017	0.0019	0.0022	0.0023	0.0026
17	0.2568	0.5263	2828	0.0004	0.0005	0.0007	0.0010	0.0011	0.0013	0.0015	0.0016	0.0017	0.0020	0.0022	0.0023
18	0.2579	0.5272	2799	0.0004	0.0006	0.0007	0.0008	0.0009	0.0010	0.0012	0.0013	0.0016	0.0019	0.0021	0.0022
19	0.2583	0.5268	2792	0.0003	0.0004	0.0007	0.0008	0.0009	0.0010	0.0011	0.0013	0.0013	0.0014	0.0015	0.0017
20	0.2577	0.5276	2801	0.0004	0.0004	0.0007	0.0009	0.0011	0.0013	0.0014	0.0016	0.0017	0.0018	0.0019	0.0022
21	0.2565	0.5262	2834	0.0002	0.0004	0.0005	0.0008	0.0011	0.0014	0.0016	0.0019	0.0022	0.0023	0.0024	0.0027
22	0.2570	0.5258	2826	0.0003	0.0005	0.0007	0.0010	0.0012	0.0014	0.0017	0.0019	0.0022	0.0025	0.0026	0.0028
23	0.2576	0.5263	2809	0.0003	0.0004	0.0005	0.0008	0.0010	0.0013	0.0016	0.0020	0.0023	0.0025	0.0028	0.0031
24	0.2583	0.5268	2792	0.0002	0.0004	0.0006	0.0008	0.0009	0.0012	0.0014	0.0015	0.0017	0.0020	0.0023	0.0026
25	0.2582	0.5267	2794	0.0003	0.0006	0.0008	0.0009	0.0012	0.0015	0.0017	0.0018	0.0017	0.0019	0.0021	0.0023
Avg.	0.2573	0.5265	2814	0.0003	0.0005	0.0007	0.0009	0.0011	0.0013	0.0016	0.0017	0.0019	0.0022	0.0023	0.0025
Med.	0.2572	0.5268	2816	0.0003	0.0005	0.0007	0.0009	0.0011	0.0014	0.0016	0.0018	0.0019	0.0022	0.0023	0.0025
st dev	0.0009	0.0008	21	0.0001	0.0001	0.0001	0.0001	0.0002	0.0002	0.0002	0.0002	0.0003	0.0003	0.0003	0.0003
Min.	0.2559	0.5246	2775	0.0002	0.0003	0.0004	0.0006	0.0007	0.0009	0.0011	0.0013	0.0013	0.0014	0.0015	0.0017
Max.	0.2593	0.5279	2851	0.0005	0.0007	0.0009	0.0012	0.0014	0.0016	0.0018	0.0020	0.0023	0.0025	0.0028	0.0031



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No.	Chromaticity Shift ($\Delta u'v'$)				
	13000hrs	14000hrs	15000hrs	16000hrs	17000hrs
1	0.0023	0.0026	0.0028	0.0030	0.0028
2	0.0026	0.0028	0.0029	0.0031	0.0033
3	0.0025	0.0026	0.0028	0.0033	0.0032
4	0.0024	0.0026	0.0029	0.0032	0.0032
5	0.0027	0.0028	0.0029	0.0032	0.0032
6	0.0030	0.0031	0.0032	0.0031	0.0033
7	0.0030	0.0033	0.0035	0.0031	0.0033
8	0.0032	0.0033	0.0035	0.0036	0.0035
9	0.0029	0.0031	0.0033	0.0033	0.0035
10	0.0028	0.0030	0.0031	0.0036	0.0036
11	0.0029	0.0030	0.0033	0.0036	0.0034
12	0.0029	0.0031	0.0032	0.0034	0.0035
13	0.0026	0.0029	0.0031	0.0037	0.0034
14	0.0027	0.0028	0.0030	0.0030	0.0034
15	0.0027	0.0028	0.0031	0.0031	0.0034
16	0.0028	0.0031	0.0032	0.0032	0.0036
17	0.0026	0.0027	0.0028	0.0032	0.0036
18	0.0025	0.0026	0.0029	0.0032	0.0036
19	0.0020	0.0022	0.0023	0.0021	0.0031
20	0.0024	0.0026	0.0028	0.0028	0.0034
21	0.0029	0.0030	0.0033	0.0029	0.0029
22	0.0030	0.0032	0.0035	0.0036	0.0034
23	0.0033	0.0034	0.0036	0.0035	0.0033
24	0.0028	0.0031	0.0032	0.0035	0.0034
25	0.0026	0.0028	0.0031	0.0036	0.0033
Avg.	0.0027	0.0029	0.0031	0.0032	0.0033
Med.	0.0027	0.0029	0.0031	0.0032	0.0034
st dev	0.0003	0.0003	0.0003	0.0004	0.0002
Min.	0.0020	0.0022	0.0023	0.0021	0.0028
Max.	0.0033	0.0034	0.0036	0.0037	0.0036

3.4 Data Set 2, 105°C, 240mA (Lumen Maintenance)

No.	Φ(lm)	Lumen Maintenance (%)											
		**0hr(Initial)	**1000hrs	**2000hrs	**3000hrs	**4000hrs	**5000hrs	**6000hrs	**7000hrs	**8000hrs	**9000hrs	**10000hrs	**11000hrs
26	111.80	100.27	99.91	99.55	99.28	99.02	98.66	98.30	98.12	97.85	97.58	97.32	96.96
27	111.40	99.82	99.55	99.28	99.01	98.74	98.38	97.94	97.58	97.22	96.95	96.68	96.32
28	111.20	100.18	99.91	99.55	99.10	98.65	98.38	98.02	97.66	97.39	96.94	96.58	96.31
29	110.60	100.18	99.73	99.37	99.10	98.64	98.28	97.92	97.65	97.29	97.02	96.65	96.20
30	112.30	99.91	99.73	99.55	99.29	99.11	98.93	98.58	98.22	97.86	97.42	97.06	96.71
31	112.00	100.09	99.64	99.29	98.84	98.57	98.30	98.04	97.77	97.41	97.14	96.79	96.43
32	113.00	100.09	99.73	99.38	99.03	98.76	98.50	98.14	97.79	97.43	96.99	96.73	96.46
33	113.70	100.18	99.82	99.47	99.21	98.77	98.50	98.24	97.98	97.63	97.27	96.92	96.48
34	111.70	99.91	99.46	99.28	98.93	98.66	98.30	97.94	97.58	97.40	97.14	96.69	96.33
35	111.00	100.18	99.91	99.55	99.19	99.01	98.65	98.29	97.84	97.57	97.30	97.03	96.67
36	113.20	100.09	99.65	99.47	99.12	98.76	98.32	98.06	97.70	97.35	97.00	96.73	96.47
37	110.40	100.18	99.82	99.46	99.18	98.82	98.46	98.19	97.92	97.55	97.10	96.74	96.38
38	110.50	99.91	99.64	99.37	99.00	98.64	98.37	98.10	97.74	97.38	96.92	96.65	96.38
39	111.80	99.91	99.64	99.37	99.02	98.66	98.30	97.94	97.76	97.50	97.23	96.87	96.60
40	109.50	100.09	99.91	99.54	99.09	98.72	98.36	97.99	97.63	97.35	96.99	96.71	96.26
41	112.70	100.09	99.82	99.56	99.20	98.76	98.49	98.23	97.87	97.43	97.07	96.81	96.45
42	111.80	100.27	99.91	99.64	99.37	99.02	98.75	98.39	98.03	97.76	97.41	97.14	96.78
43	111.40	99.82	99.46	99.10	98.83	98.47	98.11	97.76	97.49	97.22	96.95	96.59	96.23
44	111.60	99.82	99.64	99.28	98.92	98.66	98.21	97.94	97.58	97.22	96.86	96.51	96.15
45	113.00	99.91	99.65	99.38	98.94	98.58	98.32	98.05	97.79	97.52	97.17	96.81	96.46
46	112.20	99.82	99.47	99.20	98.84	98.57	98.22	97.86	97.59	97.24	96.88	96.61	96.35
47	111.60	99.82	99.37	99.10	98.75	98.48	98.21	97.85	97.49	97.22	96.95	96.59	96.42
48	113.10	100.18	99.82	99.56	99.29	98.94	98.59	98.23	97.79	97.52	97.08	96.82	96.46
49	111.50	100.18	99.82	99.46	99.28	98.92	98.65	98.21	97.85	97.58	97.22	96.77	96.32
50	112.70	100.27	99.91	99.65	99.20	99.02	98.58	98.23	97.87	97.52	97.07	96.89	96.72
Avg.	111.83	100.05	99.72	99.42	99.08	98.76	98.43	98.10	97.77	97.46	97.11	96.79	96.45
Med.	111.80	100.09	99.73	99.46	99.10	98.74	98.38	98.06	97.77	97.43	97.07	96.74	96.43
st dev	1.00	0.16	0.16	0.15	0.17	0.18	0.20	0.19	0.19	0.19	0.18	0.19	0.19
Min.	109.50	99.82	99.37	99.10	98.75	98.47	98.11	97.76	97.49	97.22	96.86	96.51	96.15
Max.	113.70	100.27	99.91	99.65	99.37	99.11	98.93	98.58	98.22	97.86	97.58	97.32	96.96



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No.	Lumen Maintenance (%)				
	13000hrs	14000hrs	15000hrs	16000hrs	17000hrs
26	96.69	96.51	96.24	95.80	95.44
27	95.96	95.60	95.24	94.88	94.70
28	96.04	95.77	95.41	95.05	94.87
29	95.84	95.48	95.30	94.94	94.39
30	96.35	95.99	95.73	95.46	95.10
31	96.07	95.80	95.54	95.00	94.91
32	96.19	95.84	95.49	95.13	94.96
33	96.13	95.95	95.60	95.25	94.90
34	95.97	95.70	95.43	94.99	94.45
35	96.40	96.13	95.86	95.77	95.50
36	96.11	95.76	95.41	95.32	94.88
37	96.11	95.74	95.56	95.29	95.02
38	96.02	95.75	95.48	95.29	95.02
39	96.42	96.06	95.71	95.35	94.90
40	95.98	95.62	95.43	95.16	94.98
41	96.10	95.74	95.39	95.30	95.12
42	96.51	96.33	96.06	95.53	95.17
43	95.96	95.69	95.33	95.15	94.79
44	95.88	95.52	95.16	95.07	94.80
45	96.11	95.84	95.49	95.04	94.78
46	96.08	95.81	95.54	95.28	94.83
47	96.15	95.88	95.61	95.43	95.07
48	96.11	95.76	95.49	95.14	94.87
49	96.05	95.78	95.43	95.16	94.89
50	96.45	96.27	95.92	95.74	95.56
Avg.	96.15	95.85	95.55	95.26	94.96
Med.	96.11	95.78	95.49	95.25	94.90
st dev	0.21	0.25	0.25	0.25	0.27
Min.	95.84	95.48	95.16	94.88	94.39
Max.	96.69	96.51	96.24	95.80	95.56



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3.5 Data Set 2, 105°C, 240mA (Forward Voltage)

No.	Forward Voltage (V)												
	**0hr(Initial)	**1000hrs	**2000hrs	**3000hrs	**4000hrs	**5000hrs	**6000hrs	**7000hrs	**8000hrs	**9000hrs	**10000hrs	**11000hrs	**12000hrs
26	3.099	3.147	3.093	3.096	3.106	3.100	3.094	3.101	3.101	3.097	3.113	3.105	3.105
27	3.107	3.122	3.104	3.118	3.123	3.133	3.104	3.112	3.112	3.109	3.122	3.114	3.115
28	3.085	3.105	3.086	3.100	3.133	3.107	3.083	3.091	3.089	3.088	3.092	3.106	3.101
29	3.084	3.088	3.084	3.089	3.111	3.099	3.082	3.090	3.089	3.084	3.097	3.099	3.100
30	3.106	3.107	3.104	3.111	3.114	3.121	3.102	3.109	3.108	3.117	3.114	3.114	3.107
31	3.109	3.126	3.106	3.109	3.108	3.115	3.106	3.115	3.114	3.111	3.122	3.111	3.109
32	3.092	3.095	3.087	3.095	3.104	3.114	3.086	3.093	3.094	3.095	3.100	3.108	3.104
33	3.132	3.133	3.130	3.128	3.129	3.129	3.128	3.142	3.134	3.133	3.143	3.146	3.145
34	3.105	3.099	3.100	3.101	3.105	3.119	3.097	3.108	3.103	3.104	3.115	3.113	3.113
35	3.104	3.096	3.094	3.100	3.116	3.114	3.094	3.104	3.099	3.103	3.104	3.107	3.112
36	3.123	3.120	3.115	3.124	3.128	3.132	3.117	3.128	3.125	3.120	3.127	3.128	3.126
37	3.097	3.093	3.091	3.098	3.106	3.105	3.092	3.101	3.098	3.099	3.102	3.107	3.107
38	3.095	3.084	3.087	3.092	3.126	3.099	3.089	3.095	3.091	3.092	3.098	3.102	3.104
39	3.115	3.113	3.109	3.116	3.121	3.127	3.109	3.117	3.115	3.114	3.123	3.118	3.114
40	3.106	3.096	3.103	3.111	3.116	3.123	3.099	3.106	3.111	3.106	3.107	3.109	3.109
41	3.109	3.124	3.105	3.118	3.126	3.119	3.103	3.112	3.104	3.104	3.114	3.118	3.113
42	3.079	3.079	3.079	3.083	3.082	3.085	3.073	3.082	3.083	3.076	3.082	3.092	3.100
43	3.075	3.069	3.072	3.073	3.079	3.085	3.070	3.076	3.084	3.068	3.073	3.089	3.097
44	3.102	3.096	3.101	3.102	3.103	3.129	3.096	3.104	3.099	3.098	3.101	3.101	3.101
45	3.116	3.110	3.114	3.114	3.115	3.135	3.114	3.119	3.115	3.115	3.120	3.113	3.101
46	3.104	3.101	3.105	3.108	3.108	3.129	3.102	3.106	3.104	3.103	3.108	3.104	3.109
47	3.096	3.092	3.092	3.097	3.108	3.114	3.089	3.097	3.095	3.091	3.098	3.103	3.109
48	3.131	3.130	3.132	3.138	3.138	3.139	3.128	3.135	3.136	3.130	3.137	3.136	3.135
49	3.101	3.100	3.114	3.113	3.114	3.118	3.101	3.105	3.104	3.103	3.106	3.108	3.107
50	3.094	3.087	3.106	3.095	3.103	3.095	3.089	3.095	3.097	3.092	3.097	3.101	3.109
Avg.	3.103	3.104	3.101	3.105	3.113	3.115	3.098	3.106	3.104	3.102	3.109	3.110	3.110
Med.	3.104	3.100	3.103	3.102	3.114	3.118	3.097	3.105	3.103	3.103	3.107	3.108	3.109
st dev	0.014	0.019	0.014	0.015	0.014	0.015	0.015	0.015	0.014	0.015	0.016	0.012	0.011
Min.	3.075	3.069	3.072	3.073	3.079	3.085	3.070	3.076	3.083	3.068	3.073	3.089	3.097
Max.	3.132	3.147	3.132	3.138	3.138	3.139	3.128	3.142	3.136	3.133	3.143	3.146	3.145



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No.	Forward Voltage (V)				
	13000hrs	14000hrs	15000hrs	16000hrs	17000hrs
26	3.115	3.100	3.107	3.080	3.082
27	3.123	3.111	3.119	3.095	3.099
28	3.102	3.092	3.100	3.074	3.070
29	3.119	3.089	3.099	3.080	3.065
30	3.125	3.110	3.116	3.120	3.088
31	3.128	3.118	3.121	3.153	3.120
32	3.102	3.094	3.100	3.118	3.080
33	3.143	3.138	3.147	3.147	3.116
34	3.119	3.106	3.112	3.113	3.088
35	3.113	3.101	3.106	3.111	3.082
36	3.135	3.126	3.131	3.120	3.107
37	3.107	3.100	3.101	3.105	3.076
38	3.103	3.095	3.101	3.076	3.074
39	3.135	3.116	3.119	3.095	3.122
40	3.116	3.108	3.112	3.088	3.091
41	3.118	3.116	3.116	3.093	3.095
42	3.093	3.089	3.087	3.059	3.065
43	3.085	3.083	3.080	3.055	3.059
44	3.111	3.114	3.108	3.080	3.086
45	3.127	3.128	3.125	3.099	3.101
46	3.114	3.112	3.112	3.082	3.086
47	3.104	3.107	3.102	3.076	3.082
48	3.138	3.143	3.141	3.113	3.113
49	3.120	3.107	3.112	3.086	3.086
50	3.105	3.101	3.102	3.076	3.076
Avg.	3.116	3.108	3.111	3.096	3.088
Med.	3.116	3.107	3.112	3.093	3.086
st dev	0.014	0.015	0.015	0.024	0.017
Min.	3.085	3.083	3.080	3.055	3.059
Max.	3.143	3.143	3.147	3.153	3.122

3.6 Data Set 2, 105°C, 240mA (Chromaticity Shift)

No.	u'	v'	CCT(K)	Chromaticity Shift ($\Delta u'v'$)											
	**0hr(Initial)			**1000hrs	**2000hrs	**3000hrs	**4000hrs	**5000hrs	**6000hrs	**7000hrs	**8000hrs	**9000hrs	**10000hrs	**11000hrs	**12000hrs
26	0.2567	0.5251	2835	0.0002	0.0004	0.0005	0.0006	0.0010	0.0011	0.0013	0.0014	0.0016	0.0018	0.0020	0.0021
27	0.2578	0.5265	2804	0.0002	0.0004	0.0005	0.0008	0.0010	0.0013	0.0015	0.0019	0.0021	0.0023	0.0023	0.0024
28	0.2575	0.5262	2812	0.0002	0.0003	0.0005	0.0008	0.0011	0.0012	0.0013	0.0017	0.0019	0.0022	0.0024	0.0026
29	0.2579	0.5248	2809	0.0005	0.0007	0.0009	0.0010	0.0011	0.0013	0.0015	0.0015	0.0017	0.0019	0.0022	0.0024
30	0.2568	0.5260	2827	0.0004	0.0006	0.0009	0.0010	0.0013	0.0014	0.0017	0.0019	0.0020	0.0021	0.0023	0.0024
31	0.2569	0.5256	2829	0.0005	0.0008	0.0011	0.0014	0.0017	0.0018	0.0019	0.0020	0.0022	0.0024	0.0027	0.0030
32	0.2574	0.5260	2816	0.0006	0.0009	0.0011	0.0014	0.0017	0.0020	0.0021	0.0022	0.0023	0.0026	0.0028	0.0029
33	0.2582	0.5263	2796	0.0006	0.0009	0.0011	0.0014	0.0017	0.0019	0.0022	0.0022	0.0023	0.0025	0.0028	0.0030
34	0.2580	0.5268	2798	0.0003	0.0006	0.0009	0.0013	0.0015	0.0017	0.0020	0.0022	0.0024	0.0025	0.0028	0.0030
35	0.2573	0.5267	2813	0.0005	0.0006	0.0008	0.0011	0.0013	0.0017	0.0018	0.0022	0.0025	0.0025	0.0026	0.0027
36	0.2571	0.5272	2816	0.0003	0.0004	0.0006	0.0008	0.0010	0.0012	0.0015	0.0018	0.0022	0.0024	0.0027	0.0029
37	0.2572	0.5267	2817	0.0004	0.0005	0.0006	0.0010	0.0011	0.0012	0.0013	0.0016	0.0017	0.0018	0.0021	0.0023
38	0.2570	0.5259	2825	0.0005	0.0006	0.0008	0.0009	0.0012	0.0013	0.0014	0.0017	0.0018	0.0019	0.0020	0.0023
39	0.2590	0.5277	2773	0.0004	0.0006	0.0007	0.0010	0.0011	0.0012	0.0013	0.0014	0.0015	0.0016	0.0018	0.0019
40	0.2593	0.5294	2757	0.0004	0.0006	0.0010	0.0013	0.0016	0.0017	0.0018	0.0020	0.0021	0.0022	0.0023	0.0025
41	0.2567	0.5267	2826	0.0003	0.0006	0.0009	0.0012	0.0015	0.0016	0.0018	0.0019	0.0021	0.0022	0.0025	0.0027
42	0.2581	0.5265	2797	0.0004	0.0005	0.0007	0.0010	0.0013	0.0016	0.0018	0.0021	0.0023	0.0026	0.0027	0.0029
43	0.2567	0.5253	2834	0.0004	0.0007	0.0009	0.0011	0.0013	0.0015	0.0018	0.0021	0.0024	0.0027	0.0030	0.0033
44	0.2590	0.5254	2782	0.0006	0.0007	0.0009	0.0012	0.0013	0.0015	0.0016	0.0018	0.0020	0.0022	0.0025	0.0028
45	0.2585	0.5280	2782	0.0005	0.0007	0.0011	0.0013	0.0015	0.0016	0.0019	0.0021	0.0022	0.0022	0.0025	0.0026
46	0.2568	0.5266	2825	0.0005	0.0007	0.0009	0.0012	0.0013	0.0017	0.0019	0.0021	0.0023	0.0024	0.0027	0.0028
47	0.2576	0.5260	2811	0.0004	0.0006	0.0008	0.0011	0.0014	0.0017	0.0018	0.0019	0.0021	0.0024	0.0026	0.0028
48	0.2580	0.5261	2801	0.0005	0.0006	0.0009	0.0010	0.0013	0.0015	0.0016	0.0019	0.0021	0.0023	0.0025	0.0026
49	0.2581	0.5280	2790	0.0003	0.0007	0.0009	0.0010	0.0012	0.0015	0.0016	0.0020	0.0022	0.0023	0.0024	0.0026
50	0.2579	0.5258	2804	0.0005	0.0007	0.0008	0.0011	0.0011	0.0013	0.0017	0.0018	0.0020	0.0023	0.0026	0.0026
Avg.	0.2577	0.5265	2807	0.0004	0.0006	0.0008	0.0011	0.0013	0.0015	0.0017	0.0019	0.0021	0.0023	0.0025	0.0026
Med.	0.2576	0.5263	2811	0.0004	0.0006	0.0009	0.0011	0.0013	0.0015	0.0017	0.0019	0.0021	0.0023	0.0025	0.0026
st dev	0.0008	0.0010	20	0.0001	0.0001	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0003	0.0003	0.0003	0.0003
Min.	0.2567	0.5248	2757	0.0002	0.0003	0.0005	0.0006	0.0010	0.0011	0.0013	0.0014	0.0015	0.0016	0.0018	0.0019
Max.	0.2593	0.5294	2835	0.0006	0.0009	0.0011	0.0014	0.0017	0.0020	0.0022	0.0022	0.0025	0.0027	0.0030	0.0033



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No.	Chromaticity Shift ($\Delta u'v'$)				
	13000hrs	14000hrs	15000hrs	16000hrs	17000hrs
26	0.0024	0.0026	0.0028	0.0031	0.0035
27	0.0025	0.0026	0.0028	0.0032	0.0036
28	0.0028	0.0030	0.0031	0.0030	0.0034
29	0.0026	0.0028	0.0030	0.0030	0.0035
30	0.0025	0.0026	0.0027	0.0028	0.0032
31	0.0032	0.0034	0.0035	0.0030	0.0033
32	0.0030	0.0033	0.0036	0.0034	0.0033
33	0.0031	0.0032	0.0033	0.0032	0.0031
34	0.0032	0.0034	0.0036	0.0038	0.0035
35	0.0030	0.0033	0.0035	0.0037	0.0035
36	0.0031	0.0033	0.0035	0.0033	0.0033
37	0.0025	0.0028	0.0029	0.0033	0.0032
38	0.0025	0.0028	0.0030	0.0036	0.0034
39	0.0021	0.0022	0.0024	0.0025	0.0029
40	0.0026	0.0028	0.0030	0.0031	0.0030
41	0.0028	0.0029	0.0030	0.0026	0.0025
42	0.0032	0.0033	0.0034	0.0033	0.0033
43	0.0036	0.0039	0.0041	0.0040	0.0035
44	0.0030	0.0032	0.0034	0.0033	0.0035
45	0.0028	0.0031	0.0034	0.0035	0.0036
46	0.0029	0.0030	0.0031	0.0032	0.0036
47	0.0031	0.0032	0.0033	0.0031	0.0034
48	0.0029	0.0031	0.0034	0.0033	0.0031
49	0.0028	0.0031	0.0033	0.0036	0.0035
50	0.0028	0.0030	0.0033	0.0039	0.0042
Avg.	0.0028	0.0030	0.0032	0.0033	0.0034
Med.	0.0028	0.0031	0.0033	0.0033	0.0034
st dev	0.0003	0.0003	0.0004	0.0004	0.0003
Min.	0.0021	0.0022	0.0024	0.0025	0.0025
Max.	0.0036	0.0039	0.0041	0.0040	0.0042

3.7 Data Set 3, 115°C, 240mA (Lumen Maintenance)

No.	Φ(m)	Lumen Maintenance (%)											
		**0hr(Initial)	**1000hrs	**2000hrs	**3000hrs	**4000hrs	**5000hrs	**6000hrs	**7000hrs	**8000hrs	**9000hrs	**10000hrs	**11000hrs
51	112.10	100.18	99.91	99.64	99.20	98.93	98.57	98.04	97.68	97.50	97.15	96.79	96.52
52	113.40	99.91	99.56	99.29	98.94	98.50	98.06	97.62	97.44	97.00	96.65	96.30	95.94
53	112.60	100.09	99.82	99.38	98.93	98.67	98.22	97.87	97.51	97.25	96.89	96.54	96.18
54	113.00	100.09	99.73	99.29	98.94	98.58	98.23	97.79	97.35	97.08	96.81	96.37	95.93
55	112.30	99.91	99.64	99.20	98.93	98.58	98.22	97.77	97.42	97.06	96.71	96.35	95.99
56	112.30	99.73	99.47	99.11	98.75	98.31	97.95	97.60	97.15	96.71	96.26	95.90	95.55
57	113.80	99.82	99.38	99.03	98.68	98.33	97.89	97.45	97.10	96.75	96.31	96.05	95.78
58	112.60	99.91	99.47	99.11	98.58	98.22	97.78	97.42	97.16	96.89	96.54	96.18	95.83
59	111.70	99.82	99.37	99.10	98.66	98.21	97.76	97.49	97.14	96.78	96.42	96.15	95.70
60	111.50	99.91	99.55	99.19	98.74	98.30	97.94	97.58	97.22	96.86	96.41	95.96	95.52
61	112.00	99.73	99.29	99.02	98.66	98.30	97.86	97.59	97.32	96.88	96.52	96.16	95.80
62	112.40	99.91	99.56	99.11	98.67	98.31	97.86	97.42	96.98	96.71	96.26	95.91	95.55
63	111.30	100.18	99.73	99.46	99.01	98.65	98.29	97.93	97.48	97.04	96.59	96.23	95.87
64	111.40	99.91	99.64	99.28	98.92	98.56	98.20	97.94	97.67	97.31	97.04	96.59	96.23
65	111.50	100.09	99.73	99.46	99.10	98.83	98.39	98.03	97.67	97.31	96.86	96.59	96.14
66	112.10	99.73	99.38	98.93	98.48	98.04	97.77	97.32	97.06	96.79	96.34	95.90	95.54
67	111.90	99.91	99.64	99.37	99.11	98.66	98.21	97.68	97.23	96.78	96.43	96.07	95.71
68	110.20	100.09	99.64	99.18	98.82	98.46	98.09	97.82	97.46	97.10	96.73	96.37	96.01
69	113.10	99.82	99.47	99.12	98.67	98.23	97.97	97.52	97.17	96.82	96.37	96.02	95.67
70	110.70	99.91	99.64	99.28	98.83	98.46	98.10	97.74	97.38	97.02	96.57	96.21	95.75
71	112.50	100.09	99.64	99.29	98.76	98.40	97.96	97.60	97.24	96.80	96.36	96.00	95.64
72	111.70	99.73	99.28	98.93	98.66	98.39	98.03	97.49	97.14	96.78	96.42	95.88	95.52
73	112.30	99.82	99.38	98.93	98.66	98.40	98.04	97.60	97.15	96.71	96.26	95.90	95.46
74	111.10	99.82	99.46	99.01	98.56	98.20	97.84	97.30	97.03	96.85	96.49	96.04	95.68
75	111.00	99.91	99.55	99.28	98.83	98.56	98.20	97.75	97.30	96.94	96.49	96.22	95.95
Avg.	112.02	99.92	99.56	99.20	98.80	98.44	98.06	97.65	97.30	96.95	96.55	96.19	95.82
Med.	112.10	99.91	99.56	99.19	98.76	98.40	98.04	97.60	97.24	96.88	96.49	96.16	95.78
st dev	0.84	0.14	0.16	0.18	0.18	0.21	0.21	0.21	0.20	0.22	0.2451	0.25	0.26
Min.	110.20	99.73	99.28	98.93	98.48	98.04	97.76	97.30	96.98	96.71	96.26	95.88	95.46
Max.	113.80	100.18	99.91	99.64	99.20	98.93	98.57	98.04	97.68	97.50	97.15	96.79	96.52



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No.	Lumen Maintenance (%)				
	13000hrs	14000hrs	15000hrs	16000hrs	17000hrs
51	96.25	95.99	95.63	95.27	95.00
52	95.59	95.24	94.97	94.62	94.44
53	95.91	95.56	95.20	95.03	94.85
54	95.49	95.31	94.87	94.69	94.16
55	95.55	95.19	95.01	94.84	94.48
56	95.19	94.92	94.57	94.12	93.86
57	95.52	95.17	94.82	94.55	94.29
58	95.38	95.03	94.67	94.40	94.14
59	95.43	95.26	94.90	94.36	93.73
60	95.25	94.98	94.62	94.17	93.99
61	95.54	95.27	94.91	94.55	94.02
62	95.37	95.02	94.75	94.31	94.13
63	95.60	95.24	95.06	94.97	94.34
64	95.96	95.60	95.24	94.88	94.52
65	95.70	95.52	95.34	94.89	94.80
66	95.18	94.92	94.65	94.38	94.29
67	95.44	95.08	94.91	94.55	94.01
68	95.64	95.28	95.10	94.83	94.74
69	95.23	94.87	94.43	93.90	93.46
70	95.39	95.03	94.67	94.49	94.31
71	95.29	94.93	94.58	94.31	93.96
72	95.34	94.99	94.63	94.45	94.27
73	95.10	94.84	94.48	94.39	93.94
74	95.41	95.05	94.69	94.15	93.61
75	95.68	95.41	95.05	94.86	94.59
Avg.	95.50	95.19	94.87	94.56	94.24
Med.	95.44	95.17	94.87	94.55	94.27
st dev	0.26	0.27	0.29	0.33	0.39
Min.	95.10	94.84	94.43	93.90	93.46
Max.	96.25	95.99	95.63	95.27	95.00



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3.8 Data Set 3, 115°C, 240mA (Forward Voltage)

No.	Forward Voltage (V)												
	**0hr(Initial)	**1000hrs	**2000hrs	**3000hrs	**4000hrs	**5000hrs	**6000hrs	**7000hrs	**8000hrs	**9000hrs	**10000hrs	**11000hrs	**12000hrs
51	3.130	3.121	3.130	3.131	3.128	3.127	3.123	3.129	3.124	3.123	3.127	3.129	3.122
52	3.132	3.124	3.136	3.137	3.134	3.135	3.126	3.133	3.131	3.127	3.133	3.135	3.134
53	3.093	3.087	3.090	3.091	3.106	3.092	3.084	3.093	3.092	3.085	3.089	3.091	3.090
54	3.114	3.107	3.112	3.132	3.131	3.132	3.109	3.118	3.114	3.113	3.117	3.117	3.117
55	3.113	3.101	3.106	3.118	3.112	3.116	3.105	3.112	3.106	3.108	3.107	3.102	3.107
56	3.113	3.107	3.112	3.124	3.115	3.139	3.106	3.116	3.108	3.110	3.115	3.114	3.113
57	3.123	3.119	3.119	3.138	3.124	3.124	3.117	3.125	3.117	3.120	3.123	3.124	3.119
58	3.093	3.085	3.087	3.096	3.086	3.096	3.084	3.090	3.084	3.092	3.091	3.099	3.094
59	3.111	3.105	3.107	3.111	3.108	3.117	3.104	3.111	3.103	3.107	3.111	3.113	3.114
60	3.096	3.092	3.089	3.116	3.092	3.098	3.089	3.095	3.089	3.091	3.098	3.103	3.108
61	3.061	3.060	3.055	3.081	3.062	3.069	3.055	3.061	3.060	3.058	3.061	3.068	3.074
62	3.072	3.073	3.070	3.076	3.072	3.073	3.067	3.076	3.069	3.072	3.074	3.084	3.082
63	3.137	3.153	3.132	3.141	3.142	3.140	3.132	3.139	3.132	3.134	3.138	3.138	3.135
64	3.117	3.115	3.115	3.120	3.121	3.122	3.112	3.120	3.113	3.115	3.122	3.127	3.125
65	3.102	3.109	3.098	3.125	3.104	3.106	3.097	3.108	3.098	3.100	3.106	3.101	3.107
66	3.079	3.095	3.079	3.087	3.075	3.097	3.076	3.085	3.078	3.078	3.082	3.094	3.097
67	3.090	3.096	3.087	3.106	3.097	3.099	3.087	3.098	3.087	3.090	3.095	3.103	3.103
68	3.075	3.079	3.073	3.078	3.082	3.096	3.074	3.082	3.073	3.074	3.079	3.089	3.106
69	3.101	3.111	3.099	3.106	3.106	3.133	3.097	3.107	3.101	3.101	3.105	3.102	3.105
70	3.118	3.154	3.118	3.124	3.127	3.133	3.119	3.127	3.119	3.117	3.124	3.128	3.118
71	3.115	3.137	3.117	3.133	3.142	3.139	3.115	3.123	3.115	3.114	3.121	3.123	3.114
72	3.098	3.103	3.099	3.102	3.105	3.126	3.095	3.104	3.097	3.101	3.105	3.101	3.107
73	3.126	3.130	3.132	3.135	3.134	3.141	3.128	3.135	3.125	3.127	3.134	3.129	3.124
74	3.092	3.099	3.095	3.101	3.094	3.101	3.094	3.098	3.092	3.094	3.100	3.108	3.108
75	3.065	3.077	3.065	3.068	3.072	3.072	3.067	3.071	3.064	3.067	3.074	3.080	3.090
Avg.	3.103	3.106	3.101	3.111	3.107	3.113	3.098	3.106	3.100	3.101	3.105	3.108	3.109
Med.	3.102	3.105	3.099	3.116	3.106	3.117	3.097	3.108	3.101	3.101	3.106	3.103	3.108
st dev	0.021	0.023	0.022	0.022	0.023	0.023	0.021	0.021	0.021	0.020	0.021	0.018	0.015
Min.	3.061	3.060	3.055	3.068	3.062	3.069	3.055	3.061	3.060	3.058	3.061	3.068	3.074
Max.	3.137	3.154	3.136	3.141	3.142	3.141	3.132	3.139	3.132	3.134	3.138	3.138	3.135



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No.	Forward Voltage (V)				
	13000hrs	14000hrs	15000hrs	16000hrs	17000hrs
51	3.137	3.141	3.138	3.113	3.116
52	3.138	3.144	3.142	3.113	3.111
53	3.106	3.100	3.099	3.072	3.072
54	3.133	3.123	3.123	3.097	3.095
55	3.119	3.117	3.117	3.093	3.093
56	3.128	3.128	3.121	3.099	3.095
57	3.124	3.133	3.129	3.103	3.101
58	3.101	3.096	3.094	3.074	3.091
59	3.115	3.116	3.115	3.091	3.091
60	3.103	3.098	3.109	3.078	3.078
61	3.070	3.066	3.065	3.042	3.038
62	3.086	3.076	3.077	3.059	3.053
63	3.139	3.142	3.142	3.116	3.116
64	3.127	3.120	3.134	3.097	3.099
65	3.112	3.104	3.118	3.080	3.113
66	3.089	3.084	3.103	3.061	3.084
67	3.102	3.099	3.138	3.072	3.093
68	3.092	3.081	3.105	3.053	3.070
69	3.113	3.108	3.099	3.078	3.091
70	3.121	3.128	3.127	3.105	3.116
71	3.129	3.124	3.119	3.111	3.103
72	3.105	3.106	3.132	3.099	3.082
73	3.130	3.137	3.130	3.120	3.120
74	3.109	3.106	3.093	3.095	3.082
75	3.077	3.072	3.119	3.059	3.051
Avg.	3.112	3.110	3.116	3.087	3.090
Med.	3.113	3.108	3.119	3.093	3.093
st dev	0.019	0.023	0.020	0.022	0.021
Min.	3.070	3.066	3.065	3.042	3.038
Max.	3.139	3.144	3.142	3.120	3.120

3.9 Data Set 3, 115°C, 240mA (Chromaticity Shift)

No.	u'	v'	CCT(K)	Chromaticity Shift ($\Delta u'v'$)											
	**0hr(Initial)			**1000hrs	**2000hrs	**3000hrs	**4000hrs	**5000hrs	**6000hrs	**7000hrs	**8000hrs	**9000hrs	**10000hrs	**11000hrs	**12000hrs
51	0.2574	0.5275	2807	0.0003	0.0005	0.0006	0.0010	0.0011	0.0013	0.0014	0.0016	0.0019	0.0020	0.0022	0.0023
52	0.2575	0.5274	2805	0.0006	0.0007	0.0010	0.0011	0.0013	0.0016	0.0017	0.0018	0.0018	0.0019	0.0022	0.0024
53	0.2567	0.5256	2832	0.0006	0.0008	0.0011	0.0012	0.0013	0.0015	0.0017	0.0019	0.0020	0.0021	0.0021	0.0022
54	0.2572	0.5274	2813	0.0005	0.0008	0.0011	0.0012	0.0015	0.0016	0.0017	0.0018	0.0020	0.0024	0.0025	0.0026
55	0.2587	0.5287	2774	0.0004	0.0007	0.0010	0.0013	0.0015	0.0016	0.0018	0.0021	0.0023	0.0023	0.0025	0.0028
56	0.2581	0.5277	2792	0.0005	0.0006	0.0010	0.0013	0.0016	0.0019	0.0022	0.0024	0.0025	0.0025	0.0028	0.0030
57	0.2569	0.5281	2816	0.0005	0.0007	0.0010	0.0013	0.0015	0.0018	0.0019	0.0023	0.0026	0.0029	0.0030	0.0032
58	0.2570	0.5276	2818	0.0004	0.0006	0.0010	0.0014	0.0016	0.0017	0.0020	0.0022	0.0024	0.0027	0.0030	0.0033
59	0.2584	0.5267	2789	0.0004	0.0004	0.0006	0.0008	0.0012	0.0015	0.0018	0.0021	0.0023	0.0025	0.0027	0.0031
60	0.2578	0.5252	2810	0.0006	0.0007	0.0009	0.0011	0.0012	0.0014	0.0018	0.0021	0.0024	0.0027	0.0030	0.0032
61	0.2579	0.5274	2798	0.0007	0.0009	0.0012	0.0014	0.0015	0.0016	0.0017	0.0018	0.0019	0.0020	0.0021	0.0022
62	0.2588	0.5274	2778	0.0007	0.0009	0.0011	0.0013	0.0014	0.0017	0.0020	0.0021	0.0021	0.0024	0.0025	0.0026
63	0.2580	0.5273	2797	0.0007	0.0010	0.0011	0.0014	0.0016	0.0017	0.0018	0.0020	0.0023	0.0026	0.0028	0.0030
64	0.2578	0.5249	2812	0.0006	0.0009	0.0012	0.0013	0.0016	0.0018	0.0020	0.0022	0.0023	0.0025	0.0028	0.0030
65	0.2578	0.5274	2800	0.0006	0.0009	0.0010	0.0014	0.0016	0.0018	0.0020	0.0023	0.0025	0.0027	0.0028	0.0029
66	0.2586	0.5294	2773	0.0004	0.0006	0.0008	0.0011	0.0014	0.0016	0.0020	0.0022	0.0023	0.0024	0.0026	0.0030
67	0.2570	0.5261	2824	0.0004	0.0006	0.0009	0.0013	0.0014	0.0017	0.0020	0.0022	0.0023	0.0026	0.0028	0.0029
68	0.2582	0.5260	2799	0.0006	0.0009	0.0012	0.0014	0.0016	0.0017	0.0020	0.0021	0.0025	0.0026	0.0029	0.0032
69	0.2561	0.5258	2846	0.0003	0.0006	0.0009	0.0012	0.0015	0.0018	0.0022	0.0025	0.0026	0.0025	0.0029	0.0030
70	0.2585	0.5278	2782	0.0002	0.0004	0.0007	0.0011	0.0015	0.0017	0.0018	0.0022	0.0025	0.0027	0.0029	0.0030
71	0.2576	0.5269	2807	0.0001	0.0003	0.0006	0.0009	0.0012	0.0016	0.0018	0.0021	0.0025	0.0029	0.0030	0.0031
72	0.2572	0.5253	2823	0.0004	0.0005	0.0006	0.0010	0.0011	0.0014	0.0016	0.0017	0.0021	0.0023	0.0027	0.0031
73	0.2568	0.5255	2832	0.0003	0.0005	0.0006	0.0009	0.0010	0.0012	0.0015	0.0018	0.0022	0.0025	0.0026	0.0028
74	0.2580	0.5262	2801	0.0004	0.0006	0.0008	0.0011	0.0012	0.0015	0.0016	0.0018	0.0021	0.0024	0.0027	0.0028
75	0.2574	0.5260	2814	0.0004	0.0006	0.0008	0.0009	0.0012	0.0014	0.0017	0.0020	0.0021	0.0023	0.0025	0.0026
Avg.	0.2577	0.5269	2806	0.0005	0.0007	0.0009	0.0012	0.0014	0.0016	0.0018	0.0020	0.0023	0.0025	0.0027	0.0029
Med.	0.2578	0.5273	2807	0.0004	0.0006	0.0010	0.0012	0.0014	0.0016	0.0018	0.0021	0.0023	0.0025	0.0027	0.0030
st dev	0.0007	0.0011	18	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0003	0.0003	0.0003
Min.	0.2561	0.5249	2773	0.0001	0.0003	0.0006	0.0008	0.0010	0.0012	0.0014	0.0016	0.0018	0.0019	0.0021	0.0022
Max.	0.2588	0.5294	2846	0.0007	0.0010	0.0012	0.0014	0.0016	0.0019	0.0022	0.0025	0.0026	0.0029	0.0030	0.0033



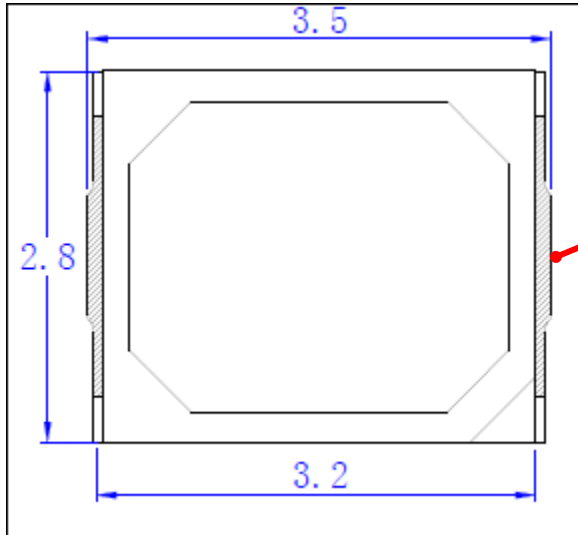
Bay Area Compliance Laboratories Corp. (Shenzhen)

5/F(B-West) -7/F, the 3rd Phase of Wan Li Industrial
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No.	Chromaticity Shift ($\Delta u'v'$)				
	13000hrs	14000hrs	15000hrs	16000hrs	17000hrs
51	0.0024	0.0027	0.0029	0.0036	0.0042
52	0.0025	0.0027	0.0029	0.0032	0.0035
53	0.0023	0.0026	0.0027	0.0028	0.0032
54	0.0028	0.0029	0.0030	0.0026	0.0028
55	0.0031	0.0034	0.0035	0.0031	0.0030
56	0.0032	0.0034	0.0037	0.0033	0.0030
57	0.0034	0.0036	0.0039	0.0037	0.0036
58	0.0036	0.0038	0.0040	0.0038	0.0043
59	0.0034	0.0036	0.0037	0.0038	0.0035
60	0.0034	0.0036	0.0039	0.0040	0.0038
61	0.0023	0.0024	0.0025	0.0031	0.0035
62	0.0028	0.0029	0.0030	0.0031	0.0036
63	0.0031	0.0031	0.0032	0.0031	0.0036
64	0.0031	0.0035	0.0037	0.0031	0.0033
65	0.0030	0.0033	0.0035	0.0030	0.0031
66	0.0033	0.0035	0.0037	0.0031	0.0031
67	0.0030	0.0033	0.0035	0.0031	0.0030
68	0.0035	0.0038	0.0039	0.0039	0.0038
69	0.0031	0.0033	0.0034	0.0034	0.0034
70	0.0031	0.0034	0.0035	0.0035	0.0034
71	0.0033	0.0034	0.0035	0.0034	0.0034
72	0.0034	0.0037	0.0038	0.0035	0.0036
73	0.0030	0.0032	0.0033	0.0033	0.0034
74	0.0030	0.0032	0.0035	0.0037	0.0036
75	0.0028	0.0031	0.0034	0.0038	0.0038
Avg.	0.0030	0.0033	0.0034	0.0034	0.0035
Med.	0.0031	0.0033	0.0035	0.0033	0.0035
st dev	0.0004	0.0004	0.0004	0.0004	0.0004
Min.	0.0023	0.0024	0.0025	0.0026	0.0028
Max.	0.0036	0.0038	0.0040	0.0040	0.0043

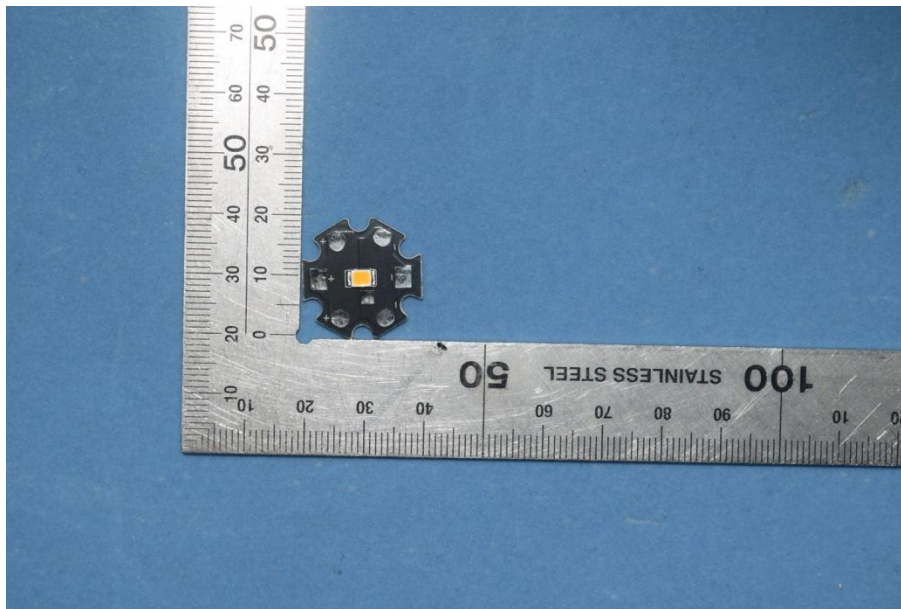
4 - DUT Photo

4.1 Mechanical Dimensions



All dimensions are in millimeter

4.2 DUT Photo



Directions

1. The information marked "superscript #" is provided by the applicant, the laboratory is not responsible for its authenticity and this information can affect the validity of the result in the test report.
2. This report includes some test methods are not in NVLAP accreditation scope marked *.
3. Unless otherwise stated the results shown in this test report refer only to the sample(s) tested.
4. Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.
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