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DURIS® S 8
White (CCT 2700 K – 6500 K)

IES LM-80-08 Test Report

Test Documentation No.: 160544W7 (Document No.: QAV-1115-1985) – 12th Dec 2018

QAV Technologies Sdn. Bhd. (616788-U)
116, Lintang Kampong Jawa NFIZ3,
Taman Perindustrian Bayan Lepas,
Mk. 12, 11900 Penang. MALAYSIA.
Tel No: 604 – 6438317 Fax No: 604 – 6438597
Website: www.qavtech.com

TEST REPORT

IESNA LM-80-08

Customer	:	OSRAM Opto Semiconductors (Malaysia) Sdn. Bhd.
Address	:	Bayan Lepas Free Industrial Zone Phase 1, 11900 Bayan Lepas, Penang, Malaysia.
Requestor Name	:	Jacqueline Yeap Sang Yee
Product	:	LED Light Source
Test Prime	:	Samantha Clarice
Received Date	:	23 September 2015
Test Perform Date	:	20 November 2015
Report Number	:	QAV-1115-1985
Test Location	:	116, LintangKg.Jawa, FIZ 3, Taman Perindustrian Bayan Lepas, Mk. 12, 11900 Pulau Pinang.

ABSTRACT: This report contains **IESNA LM-80 test result** of **GW P9LTS31.EM** provided by **OSRAM Opto Semiconductors (Malaysia) Sdn Bhd.**

Prepared by: Samantha Clarice Issue Date: 4 February 2017

Contents:

1.0 Number of LED light sources tested

- 22 units/board/test tested at actual case temperature 55ºC (nominal 55ºC)
- 22 units/board/test tested at actual case temperature 85ºC (nominal 85ºC)
- 22 units/board/test tested at actual case temperature 105ºC (nominal 105ºC)
- 22 units/board/test tested at actual case temperature 115ºC (nominal 115ºC)

2.0 Description of LED light sources

- GW P9LT31.EM
- CRI 80
- CCT 3500K

3.0 Package Pictures

Figure 1: GW P9LT31.EM

4.0 Mechanical Drawing

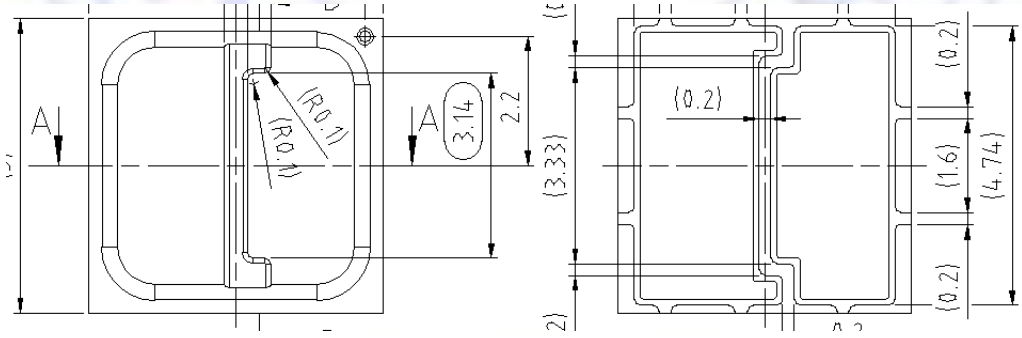


Figure 2: Mechanical drawing for GW P9LT31.EM

5.0 Test Board

Figure 3: Test Board

6.0 T_s and T_{air} Measurement Point

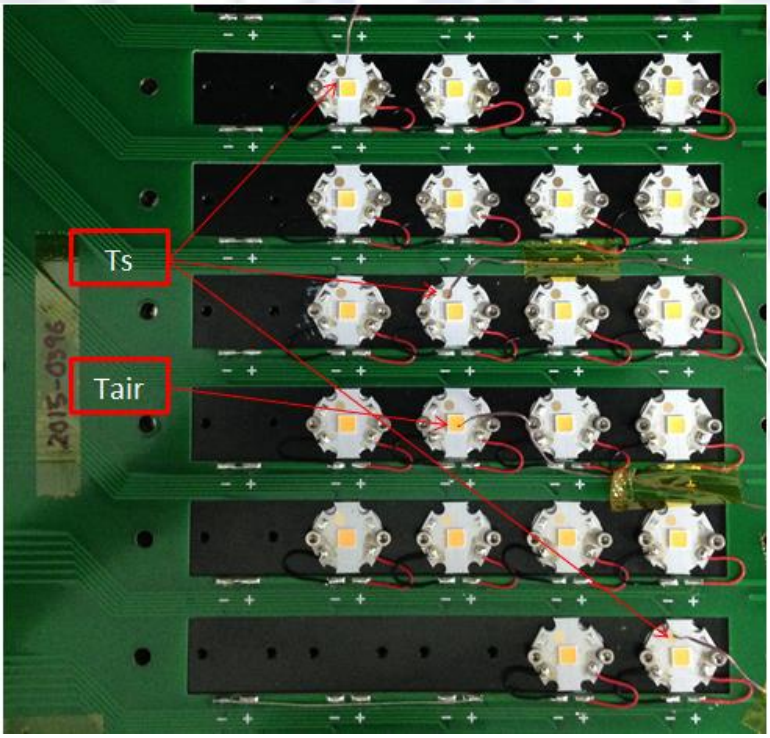


Figure 4: T_s and T_{air} Measurement Point

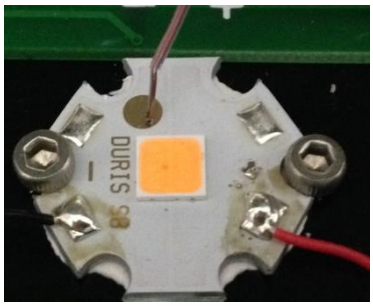


Figure 5: Ts Measurement Point

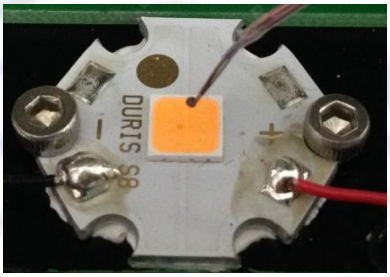


Figure 6: T_{air} Measurement Point (approximately 3mm above LED light source)

7.0 Description of Auxiliary Equipment

- Tester: Automatic LED array tester
- Temperature controlled ovens to create the necessary test conditions
- Arrays driven using constant current driver

Array tester: The tester is capable of testing an entire board with up to 22 samples. The tester consists of a spectrometer, handler, power supplies and a computer.

Sample preparation: Devices under Test (DUT) are soldered to PCBs which are mounted on metallic plates. These plates are mounted on heat sinks to maintain the test temperatures required by LM80 test procedure.

All necessary steps are taken to ensure the uniformity of temperature and environmental conditions to meet LM80 test criteria. The test is conducted as per 107-106-002.

8.0 Operating Cycle
8.1 Test Condition

Number of units: 22 units at 55ºC, 22 units at 85ºC, 22 units at 105ºC and 22 units at 115ºC.
Drive current: 200 mA
Typical Voltage: 32V

9.0 Ambient conditions

Summary of temperature and humidity conditions:

Table 1: Test Environment

Surrounding Temperature	Actual Case Temperature	Nominal Case Temperature	Relative Humidity
53ºC	55ºC	55ºC	<60%
83ºC	85ºC	85ºC	<60%
103ºC	105ºC	105ºC	<60%
113ºC	115 ºC	115 ºC	<60%

9.1 Airflow

Note: Airflow is kept to minimum required to maintain the required temperature uniformity as defined in the LM80 requirements document.

The temperature of the air surrounding DUTs is controlled to be less than 5ºC below the case temperature as required by LM80 specification.

10.0 Case Temperature (Test Point Temperature)

Refer to Table 1 (Test Environment)

11.0 Drive Current of the LED light source during lifetime test

A drive current of 200mA per diode was used during lifetime test.

12.0 Initial luminous flux and forward voltage at photometric measurement current

Please refer to section 18.

13.0 Lumen maintenance data for each individual LED light source

Please refer to section 18.

14.0 Observation of Failures

No optical, electrical or mechanical failure of any LED light source was seen during the lifetime testing.

15.0 LED Light Source monitoring interval

Measurements have been taken after the following durations:

Ts = 55ºC:
24, 48, 168, 500, 1000, 2000, 3000, 4000, 5000, 6000, 7000, 8000, 9000 and 10000 hour.

Ts = 85ºC:
24, 48, 168, 500, 1000, 2000, 3000, 4000, 5000, 6000, 7000, 8000, 9000 and 10000 hour.

Ts = 105ºC:
24, 48, 168, 500, 1000, 2000, 3000, 4000, 5000, 6000, 7000, 8000, 9000 and 10000 hour.

Ts = 115ºC:
24, 48, 168, 500, 1000, 2000, 3000, 4000, 5000, 6000, 7000, 8000, 9000 and 10000 hour.

16.0 Photometric measurement uncertainty

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a level of confidence of approximately 95%,

Luminous Flux (Φ) ± 2.156

17.0 Chromaticity shift reported over the measurement time

Please refer to section 18.

18.0 Test results
18.1 Graphic charts

Lumen maintenance (I_F = 200mA) – Normalized to 0 h

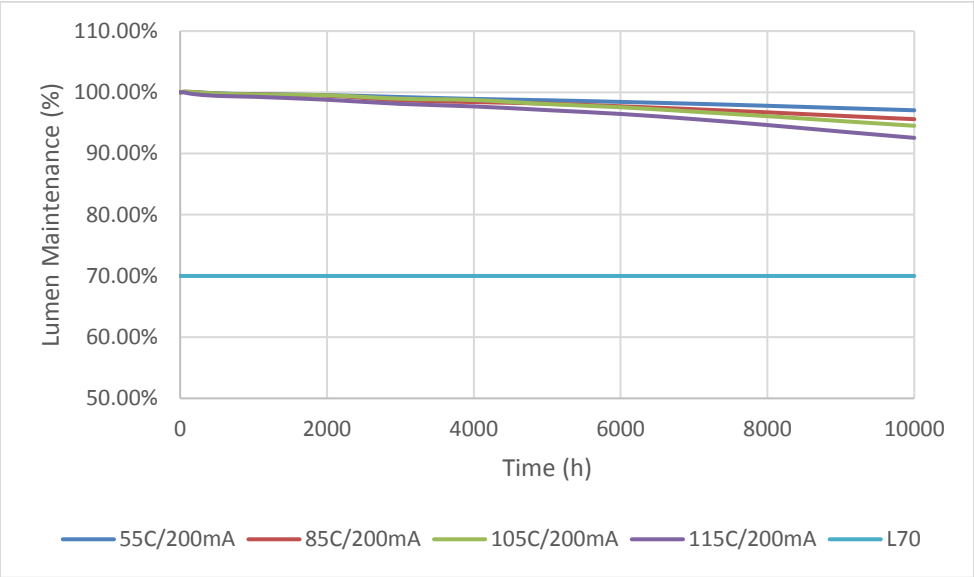


Figure 7: Lumen maintenance

Chromaticity shift Du'v' (I_F = 200mA) – Normalize to 0 h

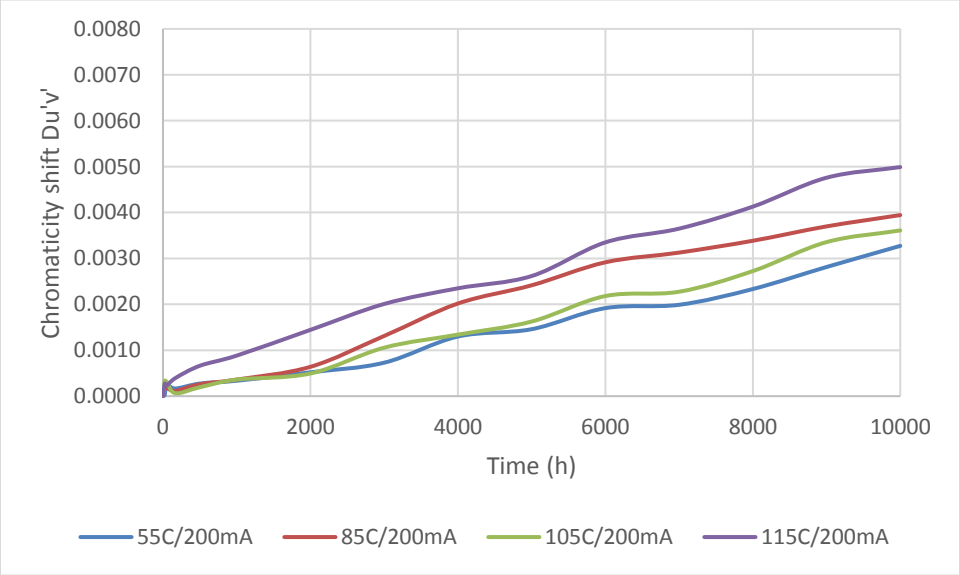


Figure 8: Chromaticity shift Du'v'

18.2 Tables

$T_s = T_{air} = 55℃$, $I_f = 200mA$; $T_s \geq 53℃$ and $T_{air} \geq 50℃$ in compliance with LM-80
Table 2: Lumen maintenance data – normalized to 0 h for tested units

Unit	VF [V]	Flux [lm]	Measurement Time of Lumen Maintenance														
	0h	0h	0h	24h	48h	168h	500h	1000h	2000h	3000h	4000h	5000h	6000h	7000h	8000h	9000h	10000h
1	29.73	763.56	100.00%	100.02%	100.07%	100.03%	99.79%	99.64%	99.46%	99.18%	99.00%	98.70%	98.41%	98.13%	97.83%	97.47%	97.12%
2	29.84	764.69	100.00%	99.99%	100.03%	100.03%	99.78%	99.65%	99.58%	99.35%	99.23%	99.13%	98.92%	98.63%	98.32%	97.94%	97.54%
3	29.07	768.02	100.00%	99.98%	100.02%	100.01%	99.75%	99.62%	99.56%	99.40%	99.23%	99.11%	98.80%	98.47%	98.10%	97.70%	97.40%
4	28.78	762.94	100.00%	100.00%	100.07%	100.14%	99.93%	99.78%	99.69%	99.49%	99.22%	98.93%	98.69%	98.39%	98.10%	97.74%	97.40%
5	29.44	769.09	100.00%	100.00%	100.04%	100.09%	99.87%	99.68%	99.37%	98.79%	98.25%	98.09%	97.86%	97.59%	97.26%	96.89%	96.47%
6	29.25	770.75	100.00%	99.98%	100.01%	100.05%	99.80%	99.61%	99.41%	99.04%	98.56%	98.43%	98.14%	97.81%	97.46%	97.04%	96.61%
7	28.99	768.34	100.00%	99.98%	100.02%	100.04%	99.78%	99.56%	99.33%	99.02%	98.62%	98.35%	98.07%	97.78%	97.42%	97.02%	96.68%
8	29.79	762.67	100.00%	99.98%	100.02%	100.06%	99.86%	99.68%	99.55%	99.20%	98.54%	98.19%	97.87%	97.51%	97.19%	96.83%	96.45%
9	29.05	760.08	100.00%	100.02%	100.09%	100.10%	99.93%	99.82%	99.73%	99.48%	99.32%	99.07%	98.76%	98.45%	98.07%	97.71%	97.31%
10	29.23	763.86	100.00%	99.99%	100.04%	100.04%	100.02%	99.94%	99.91%	99.65%	99.56%	99.41%	99.15%	98.88%	98.60%	98.24%	97.85%
11	28.37	772.12	100.00%	100.01%	100.08%	100.05%	99.82%	99.71%	99.63%	99.30%	99.27%	99.10%	98.89%	98.64%	98.34%	98.01%	97.73%
12	29.15	761.66	100.00%	99.99%	100.07%	100.08%	99.91%	99.81%	99.70%	99.52%	99.26%	99.00%	98.74%	98.47%	98.12%	97.77%	97.39%
13	29.06	768.03	100.00%	99.97%	100.03%	100.00%	99.77%	99.56%	99.24%	98.63%	98.03%	97.75%	97.47%	97.18%	96.84%	96.44%	96.09%
14	29.59	762.65	100.00%	99.97%	100.02%	99.96%	99.64%	99.41%	99.08%	99.04%	98.82%	98.57%	98.32%	98.04%	97.63%	97.30%	96.96%
15	29.52	771.80	100.00%	100.01%	100.08%	100.07%	99.87%	99.72%	99.52%	98.97%	98.61%	98.42%	98.25%	98.02%	97.76%	97.40%	97.05%
16	29.38	762.79	100.00%	99.97%	100.05%	100.03%	99.81%	99.63%	99.33%	98.67%	97.61%	97.30%	97.08%	96.78%	96.46%	96.09%	95.69%
17	29.01	766.79	100.00%	100.00%	100.06%	100.07%	99.86%	99.71%	99.60%	99.33%	99.20%	99.08%	98.80%	98.53%	98.24%	97.89%	97.55%
18	28.95	766.12	100.00%	100.00%	100.06%	100.06%	99.86%	99.73%	99.59%	99.37%	99.17%	98.98%	98.69%	98.38%	98.00%	97.62%	97.29%
19	28.42	762.73	100.00%	100.00%	100.06%	100.09%	99.94%	99.80%	99.73%	99.47%	99.40%	99.34%	99.01%	98.73%	98.38%	98.00%	97.65%
20	29.32	764.12	100.00%	100.00%	100.07%	100.05%	99.88%	99.77%	99.67%	99.47%	99.30%	99.15%	98.84%	98.52%	98.16%	97.77%	97.44%
21	29.79	763.54	100.00%	100.05%	100.13%	100.04%	99.79%	99.69%	99.57%	99.35%	99.01%	98.69%	98.36%	97.99%	97.63%	97.25%	96.90%
22	29.47	765.62	100.00%	100.02%	100.12%	100.07%	99.88%	99.79%	99.64%	99.44%	99.09%	98.68%	98.40%	98.00%	97.65%	97.28%	96.93%
median	29.24	764.40	100.00%	100.00%	100.06%	100.05%	99.86%	99.70%	99.58%	99.34%	99.13%	98.81%	98.55%	98.26%	97.92%	97.55%	97.20%
average	29.24	765.54	100.00%	100.00%	100.06%	100.05%	99.84%	99.70%	99.54%	99.23%	98.92%	98.70%	98.43%	98.13%	97.80%	97.43%	97.07%
std. dev.	0.41	3.39	0.00%	0.02%	0.03%	0.04%	0.08%	0.11%	0.19%	0.28%	0.49%	0.53%	0.52%	0.53%	0.53%	0.54%	0.55%
min	28.37	760.08	100.00%	99.97%	100.01%	99.96%	99.64%	99.41%	99.08%	98.63%	97.61%	97.30%	97.08%	96.78%	96.46%	96.09%	95.69%
max	29.84	772.12	100.00%	100.05%	100.13%	100.14%	100.02%	99.94%	99.91%	99.65%	99.56%	99.41%	99.15%	98.88%	98.60%	98.24%	97.85%

$T_s = T_{air}$ = 55℃, I_f = 200mA; $T_s \geq$ 53℃ and $T_{air} \geq$ 50℃ in compliance with LM-80
Table 3: Chromaticity shift Du'v' data – normalized to 0 h for tested units

Unit	CCT [k]	u'	v'	Measurement Time of Chromaticity Shift Du'v'													
	0h	0h	0h	0h	24h	48h	168h	500h	1000h	2000h	3000h	4000h	5000h	6000h	7000h	8000h	9000h	10000h
1	3518	0.2504	0.5150	0.0000	0.0001	0.0003	0.0001	0.0003	0.0005	0.0007	0.0009	0.0013	0.0016	0.0021	0.0023	0.0027	0.0031	0.0035
2	3535	0.2502	0.5147	0.0000	0.0001	0.0002	0.0002	0.0003	0.0004	0.0005	0.0006	0.0010	0.0012	0.0016	0.0015	0.0019	0.0023	0.0028
3	3523	0.2500	0.5159	0.0000	0.0001	0.0002	0.0001	0.0002	0.0004	0.0004	0.0004	0.0008	0.0010	0.0015	0.0015	0.0019	0.0023	0.0029
4	3522	0.2505	0.5146	0.0000	0.0001	0.0003	0.0002	0.0003	0.0003	0.0004	0.0005	0.0011	0.0013	0.0018	0.0020	0.0023	0.0027	0.0032
5	3554	0.2496	0.5153	0.0000	0.0001	0.0002	0.0002	0.0003	0.0003	0.0006	0.0012	0.0020	0.0022	0.0026	0.0025	0.0028	0.0033	0.0039
6	3576	0.2494	0.5148	0.0000	0.0000	0.0002	0.0002	0.0003	0.0004	0.0006	0.0008	0.0016	0.0018	0.0023	0.0023	0.0028	0.0033	0.0041
7	3579	0.2496	0.5141	0.0000	0.0000	0.0002	0.0002	0.0003	0.0005	0.0008	0.0010	0.0017	0.0020	0.0024	0.0024	0.0027	0.0032	0.0039
8	3518	0.2506	0.5146	0.0000	0.0000	0.0002	0.0002	0.0003	0.0004	0.0006	0.0009	0.0018	0.0021	0.0026	0.0028	0.0032	0.0036	0.0043
9	3446	0.2512	0.5165	0.0000	0.0001	0.0003	0.0002	0.0003	0.0002	0.0003	0.0005	0.0010	0.0012	0.0017	0.0019	0.0023	0.0028	0.0032
10	3469	0.2508	0.5163	0.0000	0.0000	0.0002	0.0002	0.0006	0.0003	0.0003	0.0002	0.0008	0.0006	0.0010	0.0011	0.0015	0.0020	0.0024
11	3590	0.2492	0.5148	0.0000	0.0001	0.0003	0.0002	0.0002	0.0003	0.0003	0.0006	0.0007	0.0009	0.0014	0.0015	0.0018	0.0021	0.0026
12	3485	0.2508	0.5155	0.0000	0.0000	0.0003	0.0002	0.0003	0.0002	0.0004	0.0004	0.0011	0.0013	0.0018	0.0020	0.0024	0.0029	0.0034
13	3554	0.2498	0.5150	0.0000	0.0000	0.0002	0.0002	0.0003	0.0005	0.0009	0.0015	0.0023	0.0022	0.0024	0.0024	0.0027	0.0033	0.0037
14	3513	0.2506	0.5146	0.0000	0.0000	0.0003	0.0001	0.0004	0.0009	0.0014	0.0012	0.0015	0.0013	0.0016	0.0017	0.0019	0.0023	0.0026
15	3547	0.2495	0.5159	0.0000	0.0001	0.0003	0.0002	0.0003	0.0002	0.0004	0.0009	0.0014	0.0014	0.0018	0.0017	0.0020	0.0024	0.0029
16	3516	0.2505	0.5147	0.0000	0.0001	0.0002	0.0002	0.0003	0.0005	0.0009	0.0015	0.0026	0.0024	0.0025	0.0023	0.0026	0.0032	0.0035
17	3508	0.2500	0.5164	0.0000	0.0000	0.0003	0.0002	0.0003	0.0003	0.0004	0.0006	0.0009	0.0011	0.0016	0.0015	0.0019	0.0024	0.0029
18	3523	0.2502	0.5153	0.0000	0.0000	0.0003	0.0002	0.0003	0.0003	0.0004	0.0006	0.0010	0.0012	0.0017	0.0018	0.0022	0.0029	0.0033
19	3484	0.2507	0.5159	0.0000	0.0000	0.0002	0.0002	0.0003	0.0002	0.0003	0.0005	0.0008	0.0009	0.0013	0.0013	0.0017	0.0022	0.0027
20	3529	0.2502	0.5150	0.0000	0.0000	0.0003	0.0002	0.0003	0.0003	0.0004	0.0005	0.0010	0.0011	0.0017	0.0017	0.0021	0.0026	0.0030
21	3516	0.2505	0.5149	0.0000	0.0001	0.0003	0.0002	0.0003	0.0004	0.0006	0.0007	0.0013	0.0019	0.0027	0.0029	0.0031	0.0037	0.0039
22	3540	0.2500	0.5149	0.0000	0.0000	0.0003	0.0002	0.0003	0.0002	0.0005	0.0006	0.0012	0.0016	0.0023	0.0028	0.0030	0.0036	0.0038
median	3522	0.2502	0.5150	0.0000	0.0000	0.0003	0.0002	0.0003	0.0003	0.0004	0.0006	0.0012	0.0013	0.0018	0.0019	0.0023	0.0028	0.0033
average	3525	0.2502	0.5152	0.0000	0.0001	0.0003	0.0002	0.0003	0.0004	0.0005	0.0007	0.0013	0.0015	0.0019	0.0020	0.0023	0.0028	0.0033
std. dev.	35	0.0005	0.0007	0.0000	0.0000	0.0000	0.0000	0.0001	0.0002	0.0003	0.0004	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
min	3446	0.2492	0.5141	0.0000	0.0000	0.0002	0.0001	0.0002	0.0002	0.0003	0.0002	0.0007	0.0006	0.0010	0.0011	0.0015	0.0020	0.0024
max	3590	0.2512	0.5165	0.0000	0.0001	0.0003	0.0002	0.0006	0.0009	0.0014	0.0015	0.0026	0.0024	0.0027	0.0029	0.0032	0.0037	0.0043

$T_s = T_{air}$ = 55℃, I_f = 200mA; $T_s \geq$ 53℃ and $T_{air} \geq$ 50℃ in compliance with LM-80
Table 4: Forward voltage data – normalized to 0 h for tested units

Unit	VF [V]	Measurement Time of VF														
	0h	0h	24h	48h	168h	500h	1000h	2000h	3000h	4000h	5000h	6000h	7000h	8000h	9000h	10000h
1	29.73	100.00%	100.01%	99.97%	100.04%	100.08%	100.24%	100.00%	100.07%	100.04%	100.09%	100.07%	100.11%	100.13%	100.16%	100.13%
2	29.84	100.00%	100.01%	99.87%	99.95%	99.84%	99.93%	99.91%	99.94%	99.87%	99.92%	99.97%	99.90%	99.86%	99.89%	99.92%
3	29.07	100.00%	99.87%	99.89%	99.91%	99.94%	99.92%	100.09%	100.04%	99.97%	99.99%	100.04%	100.08%	100.03%	100.08%	100.05%
4	28.78	100.00%	99.81%	100.01%	100.07%	99.98%	99.92%	100.02%	99.90%	99.99%	100.03%	99.97%	100.04%	100.09%	100.12%	100.09%
5	29.44	100.00%	100.03%	100.02%	100.10%	100.02%	99.95%	99.99%	99.97%	100.03%	99.99%	99.90%	99.94%	99.99%	100.01%	99.97%
6	29.25	100.00%	99.88%	99.85%	100.04%	100.14%	100.05%	100.05%	100.10%	100.08%	100.05%	100.03%	100.06%	100.09%	100.12%	100.10%
7	28.99	100.00%	99.93%	99.99%	99.94%	100.04%	99.96%	100.03%	99.99%	100.02%	99.97%	99.93%	99.97%	99.94%	99.96%	99.99%
8	29.79	100.00%	100.03%	99.98%	99.93%	99.89%	99.91%	99.90%	99.88%	99.92%	99.95%	99.97%	99.94%	99.90%	99.86%	99.91%
9	29.05	100.00%	99.95%	99.90%	99.87%	99.81%	99.87%	99.76%	99.80%	99.94%	99.98%	99.94%	99.98%	100.04%	100.07%	100.02%
10	29.23	100.00%	100.02%	99.96%	99.91%	99.86%	99.91%	99.86%	99.89%	99.95%	99.98%	100.01%	100.03%	100.01%	100.03%	100.07%
11	28.37	100.00%	100.00%	99.80%	99.72%	99.80%	99.95%	99.79%	99.93%	99.86%	99.93%	99.97%	100.03%	99.96%	100.00%	100.05%
12	29.15	100.00%	100.00%	99.94%	99.94%	100.07%	99.99%	99.93%	99.97%	100.00%	99.95%	100.00%	100.04%	100.07%	100.04%	100.08%
13	29.06	100.00%	99.71%	99.76%	99.84%	99.93%	99.98%	99.96%	99.98%	100.01%	100.05%	100.00%	99.98%	99.94%	99.92%	99.96%
14	29.59	100.00%	99.79%	99.74%	99.70%	99.78%	99.91%	99.87%	99.85%	99.91%	99.97%	99.93%	100.00%	100.04%	100.02%	100.05%
15	29.52	100.00%	100.11%	100.07%	100.04%	99.88%	99.95%	99.87%	99.88%	99.95%	99.99%	99.95%	99.92%	99.97%	100.01%	99.97%
16	29.38	100.00%	100.03%	100.11%	100.04%	99.84%	99.93%	99.98%	99.91%	99.94%	99.98%	99.94%	99.98%	100.03%	100.08%	100.04%
17	29.01	100.00%	100.04%	100.06%	100.11%	100.15%	100.07%	100.18%	100.13%	100.05%	100.01%	100.07%	100.03%	100.07%	100.04%	100.00%
18	28.95	100.00%	100.15%	100.06%	99.93%	99.98%	99.93%	99.75%	99.83%	99.95%	99.99%	100.02%	100.08%	100.13%	100.16%	100.18%
19	28.42	100.00%	100.12%	100.25%	100.30%	100.26%	100.18%	100.15%	100.11%	100.06%	100.09%	100.05%	100.11%	100.17%	100.19%	100.23%
20	29.32	100.00%	100.10%	99.94%	99.83%	99.92%	99.93%	99.83%	99.89%	99.77%	99.87%	99.92%	99.92%	99.89%	99.85%	99.83%
21	29.79	100.00%	99.90%	100.01%	99.99%	99.91%	99.88%	99.89%	99.86%	99.94%	99.99%	99.93%	100.00%	100.05%	100.01%	100.05%
22	29.47	100.00%	99.97%	99.98%	99.91%	99.97%	100.00%	100.00%	99.98%	100.08%	100.11%	100.02%	100.07%	100.14%	100.09%	100.12%
median	29.24	100.00%	100.01%	99.97%	99.94%	99.94%	99.94%	99.94%	99.94%	99.96%	99.99%	99.97%	100.01%	100.04%	100.03%	100.05%
average	29.24	100.00%	99.97%	99.96%	99.96%	99.96%	99.97%	99.95%	99.95%	99.97%	99.99%	99.98%	100.01%	100.02%	100.03%	100.04%
std. dev.	0.41	0.00%	0.11%	0.12%	0.13%	0.13%	0.09%	0.12%	0.09%	0.08%	0.06%	0.05%	0.06%	0.09%	0.09%	0.09%
min	28.37	100.00%	99.71%	99.74%	99.70%	99.78%	99.87%	99.75%	99.80%	99.77%	99.87%	99.90%	99.90%	99.86%	99.85%	99.83%
max	29.84	100.00%	100.15%	100.25%	100.30%	100.26%	100.24%	100.18%	100.13%	100.08%	100.11%	100.07%	100.11%	100.17%	100.19%	100.23%

$T_s = T_{air} = 85℃$, $I_f = 200mA$; $T_s \geq 83℃$ and $T_{air} \geq 80℃$ in compliance with LM-80
Table 5: Lumen maintenance data – normalized to 0 h for tested units

Unit	VF [V]	Flux [lm]	Measurement Time of Lumen Maintenance														
	0h	0h	0h	24h	48h	168h	500h	1000h	2000h	3000h	4000h	5000h	6000h	7000h	8000h	9000h	10000h
1	29.14	764.10	100.00%	99.98%	100.00%	100.15%	99.95%	99.88%	99.61%	98.96%	98.87%	98.56%	98.07%	97.56%	97.00%	96.54%	96.00%
2	29.46	764.44	100.00%	100.03%	100.09%	100.10%	99.85%	99.76%	99.45%	98.61%	98.48%	98.34%	97.89%	97.40%	96.86%	96.35%	95.82%
3	29.69	762.69	100.00%	100.02%	100.09%	99.98%	99.73%	99.67%	99.39%	98.33%	98.02%	97.72%	97.23%	96.75%	96.22%	95.62%	95.06%
4	29.24	760.91	100.00%	100.03%	100.12%	100.09%	99.84%	99.80%	99.64%	99.10%	98.84%	98.68%	98.17%	97.57%	96.99%	96.38%	95.82%
5	29.18	765.58	100.00%	100.02%	100.09%	99.97%	99.65%	99.50%	99.37%	98.92%	98.73%	98.54%	98.17%	97.73%	97.19%	96.60%	96.02%
6	29.05	766.33	100.00%	100.04%	100.10%	99.98%	99.69%	99.60%	99.44%	98.99%	98.55%	98.31%	97.95%	97.55%	97.14%	96.68%	96.15%
7	29.58	768.18	100.00%	100.03%	100.11%	100.12%	99.86%	99.80%	99.52%	98.81%	98.62%	98.42%	98.02%	97.54%	97.02%	96.52%	96.01%
8	29.37	762.07	100.00%	100.02%	100.08%	99.96%	99.72%	99.63%	99.38%	98.65%	98.30%	97.98%	97.57%	97.10%	96.57%	95.99%	95.43%
9	29.35	763.91	100.00%	100.06%	100.09%	100.04%	99.69%	99.60%	99.41%	98.77%	98.50%	98.17%	97.80%	97.35%	96.83%	96.23%	95.73%
10	28.93	767.35	100.00%	100.03%	100.05%	99.90%	99.60%	99.46%	99.37%	98.93%	98.77%	98.63%	98.27%	97.78%	97.36%	96.84%	96.34%
11	28.96	772.68	100.00%	100.03%	100.07%	100.09%	99.85%	99.75%	99.60%	99.02%	98.69%	98.41%	98.04%	97.61%	97.22%	96.83%	96.43%
12	29.16	766.95	100.00%	100.07%	100.11%	100.10%	99.82%	99.72%	99.56%	98.90%	98.61%	98.34%	97.99%	97.52%	96.99%	96.40%	95.87%
13	28.66	770.89	100.00%	100.05%	100.08%	100.03%	99.67%	99.49%	99.37%	98.92%	98.61%	98.21%	97.75%	97.30%	96.67%	95.93%	95.33%
14	28.79	768.01	100.00%	100.07%	100.09%	100.12%	99.84%	99.68%	99.44%	98.82%	98.53%	98.43%	97.85%	97.22%	96.61%	95.90%	95.25%
15	29.84	769.40	100.00%	100.03%	100.07%	100.04%	99.69%	99.49%	99.38%	98.92%	98.69%	98.31%	97.84%	97.34%	96.79%	96.12%	95.47%
16	28.83	765.39	100.00%	100.08%	100.12%	100.10%	99.85%	99.73%	99.46%	98.62%	98.34%	98.08%	97.66%	97.19%	96.66%	96.10%	95.56%
17	29.32	765.63	100.00%	100.08%	100.13%	100.08%	99.82%	99.68%	99.37%	98.42%	97.97%	97.64%	97.23%	96.76%	96.26%	95.76%	95.20%
18	29.37	765.14	100.00%	100.07%	100.09%	100.04%	99.76%	99.64%	99.38%	98.62%	98.25%	98.01%	97.62%	97.15%	96.70%	96.10%	95.59%
19	28.74	767.50	100.00%	100.06%	100.09%	100.04%	99.75%	99.64%	99.45%	98.90%	98.50%	98.30%	97.91%	97.48%	96.98%	96.44%	95.89%
20	29.42	761.28	100.00%	100.08%	100.11%	100.06%	99.80%	99.69%	99.43%	98.36%	98.05%	97.75%	97.31%	96.76%	96.20%	95.55%	94.89%
21	29.44	769.92	100.00%	100.09%	100.08%	100.06%	99.74%	99.63%	99.25%	98.13%	97.72%	97.38%	96.96%	96.54%	96.12%	95.60%	95.11%
22	29.23	764.02	100.00%	100.06%	100.06%	100.18%	99.92%	99.80%	99.56%	97.71%	97.36%	96.94%	96.51%	96.07%	95.55%	94.99%	94.47%
median	29.24	765.60	100.00%	100.05%	100.09%	100.06%	99.78%	99.67%	99.43%	98.81%	98.52%	98.30%	97.85%	97.34%	96.81%	96.17%	95.66%
average	29.22	766.02	100.00%	100.05%	100.09%	100.06%	99.78%	99.66%	99.45%	98.70%	98.41%	98.14%	97.72%	97.24%	96.73%	96.16%	95.61%
std. dev.	0.31	3.08	0.00%	0.03%	0.03%	0.07%	0.09%	0.11%	0.10%	0.34%	0.38%	0.43%	0.43%	0.43%	0.43%	0.46%	0.49%
min	28.66	760.91	100.00%	99.98%	100.00%	99.90%	99.60%	99.46%	99.25%	97.71%	97.36%	96.94%	96.51%	96.07%	95.55%	94.99%	94.47%
max	29.84	772.68	100.00%	100.09%	100.13%	100.18%	99.95%	99.88%	99.64%	99.10%	98.87%	98.68%	98.27%	97.78%	97.36%	96.84%	96.43%

$T_s = T_{air}$ = 85℃, I_f = 200mA; $T_s \geq 83$℃ and $T_{air} \geq 80$℃ in compliance with LM-80
Table 6: Chromaticity shift Du'v' data – normalized to 0 h for tested units

Unit	CCT [k]	u'	v'	Measurement Time of Chromaticity Shift Du'v'													
	0h	0h	0h	0h	24h	48h	168h	500h	1000h	2000h	3000h	4000h	5000h	6000h	7000h	8000h	9000h	10000h
1	3540	0.2501	0.5147	0.0000	0.0001	0.0001	0.0001	0.0002	0.0002	0.0005	0.0011	0.0019	0.0023	0.0028	0.0029	0.0031	0.0034	0.0036
2	3495	0.2505	0.5158	0.0000	0.0002	0.0002	0.0001	0.0002	0.0003	0.0006	0.0015	0.0025	0.0027	0.0031	0.0031	0.0033	0.0036	0.0038
3	3533	0.2505	0.5141	0.0000	0.0002	0.0002	0.0001	0.0003	0.0005	0.0008	0.0017	0.0023	0.0024	0.0028	0.0029	0.0031	0.0033	0.0034
4	3438	0.2511	0.5174	0.0000	0.0002	0.0002	0.0002	0.0003	0.0002	0.0005	0.0010	0.0019	0.0023	0.0027	0.0030	0.0033	0.0036	0.0038
5	3558	0.2499	0.5143	0.0000	0.0002	0.0002	0.0001	0.0004	0.0006	0.0008	0.0012	0.0019	0.0025	0.0032	0.0035	0.0038	0.0041	0.0044
6	3553	0.2499	0.5145	0.0000	0.0002	0.0002	0.0001	0.0003	0.0005	0.0007	0.0011	0.0020	0.0025	0.0030	0.0032	0.0035	0.0039	0.0042
7	3533	0.2499	0.5157	0.0000	0.0002	0.0002	0.0001	0.0001	0.0003	0.0005	0.0012	0.0022	0.0027	0.0032	0.0033	0.0035	0.0038	0.0040
8	3490	0.2507	0.5155	0.0000	0.0001	0.0001	0.0001	0.0003	0.0005	0.0009	0.0015	0.0024	0.0026	0.0029	0.0030	0.0032	0.0034	0.0036
9	3464	0.2506	0.5172	0.0000	0.0002	0.0002	0.0001	0.0003	0.0004	0.0007	0.0014	0.0022	0.0027	0.0032	0.0033	0.0036	0.0038	0.0041
10	3550	0.2498	0.5150	0.0000	0.0002	0.0002	0.0002	0.0004	0.0005	0.0007	0.0011	0.0016	0.0023	0.0030	0.0034	0.0038	0.0043	0.0046
11	3552	0.2494	0.5159	0.0000	0.0002	0.0002	0.0002	0.0003	0.0002	0.0004	0.0006	0.0016	0.0022	0.0030	0.0033	0.0037	0.0040	0.0043
12	3504	0.2501	0.5166	0.0000	0.0002	0.0002	0.0002	0.0003	0.0003	0.0004	0.0011	0.0018	0.0024	0.0029	0.0031	0.0034	0.0037	0.0039
13	3594	0.2492	0.5147	0.0000	0.0002	0.0002	0.0002	0.0003	0.0004	0.0006	0.0010	0.0014	0.0021	0.0028	0.0032	0.0037	0.0043	0.0046
14	3564	0.2497	0.5148	0.0000	0.0002	0.0002	0.0003	0.0003	0.0003	0.0006	0.0012	0.0020	0.0023	0.0028	0.0030	0.0032	0.0035	0.0037
15	3525	0.2498	0.5163	0.0000	0.0002	0.0002	0.0002	0.0003	0.0003	0.0005	0.0009	0.0013	0.0019	0.0026	0.0031	0.0036	0.0042	0.0046
16	3523	0.2502	0.5153	0.0000	0.0002	0.0002	0.0001	0.0002	0.0004	0.0006	0.0014	0.0023	0.0025	0.0029	0.0031	0.0033	0.0035	0.0037
17	3511	0.2503	0.5158	0.0000	0.0002	0.0002	0.0001	0.0002	0.0003	0.0007	0.0017	0.0025	0.0026	0.0029	0.0031	0.0033	0.0035	0.0036
18	3555	0.2501	0.5140	0.0000	0.0002	0.0002	0.0001	0.0003	0.0005	0.0008	0.0015	0.0025	0.0028	0.0033	0.0033	0.0035	0.0038	0.0040
19	3526	0.2500	0.5158	0.0000	0.0002	0.0002	0.0002	0.0003	0.0003	0.0006	0.0011	0.0017	0.0023	0.0029	0.0033	0.0036	0.0039	0.0042
20	3499	0.2508	0.5148	0.0000	0.0002	0.0002	0.0001	0.0003	0.0004	0.0008	0.0017	0.0024	0.0025	0.0029	0.0030	0.0032	0.0034	0.0036
21	3539	0.2497	0.5159	0.0000	0.0002	0.0002	0.0001	0.0002	0.0003	0.0006	0.0018	0.0022	0.0026	0.0030	0.0031	0.0033	0.0036	0.0038
22	3537	0.2502	0.5147	0.0000	0.0002	0.0001	0.0002	0.0002	0.0003	0.0006	0.0022	0.0021	0.0024	0.0028	0.0029	0.0031	0.0034	0.0036
median	3533	0.2501	0.5154	0.0000	0.0002	0.0002	0.0001	0.0003	0.0003	0.0006	0.0012	0.0020	0.0024	0.0029	0.0031	0.0034	0.0037	0.0039
average	3527	0.2501	0.5154	0.0000	0.0002	0.0002	0.0001	0.0003	0.0004	0.0006	0.0013	0.0020	0.0024	0.0029	0.0031	0.0034	0.0037	0.0040
std. dev.	35	0.0005	0.0009	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	0.0001	0.0004	0.0004	0.0002	0.0002	0.0002	0.0002	0.0003	0.0004
min	3438	0.2492	0.5140	0.0000	0.0001	0.0001	0.0001	0.0001	0.0002	0.0004	0.0006	0.0013	0.0019	0.0026	0.0029	0.0031	0.0033	0.0034
max	3594	0.2511	0.5174	0.0000	0.0002	0.0002	0.0003	0.0004	0.0006	0.0009	0.0022	0.0025	0.0028	0.0033	0.0035	0.0038	0.0043	0.0046

$T_s = T_{air}$ = 85℃, I_f = 200mA; $T_s \geq$ 83℃ and $T_{air} \geq$ 80℃ in compliance with LM-80
Table 7: Forward voltage data – normalized to 0 h for tested units

Unit	VF [V]	Measurement Time of VF														
	0h	0h	24h	48h	168h	500h	1000h	2000h	3000h	4000h	5000h	6000h	7000h	8000h	9000h	10000h
1	29.14	100.00%	100.05%	99.99%	100.07%	100.03%	99.97%	100.03%	100.00%	100.07%	100.02%	100.05%	100.12%	100.17%	100.14%	100.18%
2	29.46	100.00%	99.95%	99.92%	100.08%	100.08%	99.90%	99.99%	99.96%	99.93%	100.00%	99.96%	100.01%	99.97%	100.01%	100.05%
3	29.69	100.00%	99.92%	100.02%	99.74%	99.89%	99.98%	99.87%	99.93%	100.01%	99.95%	99.98%	100.01%	99.98%	100.01%	99.98%
4	29.24	100.00%	100.14%	100.12%	100.22%	100.05%	99.97%	99.86%	99.98%	100.05%	100.03%	100.01%	100.06%	100.10%	100.07%	100.02%
5	29.18	100.00%	99.85%	99.96%	99.86%	100.02%	99.91%	99.94%	99.97%	100.03%	99.98%	100.00%	99.97%	100.02%	99.97%	99.94%
6	29.05	100.00%	99.81%	99.98%	99.93%	100.13%	100.06%	99.83%	99.99%	100.03%	100.05%	100.02%	100.00%	100.03%	99.98%	100.01%
7	29.58	100.00%	99.83%	99.80%	99.98%	99.73%	99.94%	99.92%	99.86%	100.01%	99.95%	99.96%	100.00%	99.95%	99.93%	99.97%
8	29.37	100.00%	99.99%	99.79%	99.83%	100.07%	99.97%	99.90%	99.92%	99.99%	99.96%	100.01%	100.05%	100.01%	100.03%	100.06%
9	29.35	100.00%	100.12%	99.98%	100.07%	99.90%	99.93%	100.09%	99.96%	100.04%	99.98%	100.01%	99.95%	100.01%	100.04%	100.02%
10	28.93	100.00%	100.02%	99.92%	100.10%	100.02%	99.98%	100.01%	99.98%	100.04%	100.02%	100.05%	100.01%	99.97%	99.95%	99.98%
11	28.96	100.00%	99.98%	100.09%	99.93%	99.93%	99.95%	99.87%	99.90%	99.98%	99.94%	99.99%	99.93%	99.88%	99.93%	99.96%
12	29.16	100.00%	100.08%	100.00%	100.01%	99.81%	99.92%	99.88%	99.92%	99.96%	100.02%	99.99%	99.95%	99.98%	100.03%	99.98%
13	28.66	100.00%	99.92%	99.88%	99.97%	99.92%	99.99%	99.93%	99.97%	100.06%	100.02%	100.01%	100.03%	100.01%	100.03%	99.99%
14	28.79	100.00%	99.85%	99.84%	99.80%	100.06%	100.01%	100.00%	100.05%	99.97%	99.99%	99.96%	100.00%	100.03%	100.04%	100.08%
15	29.84	100.00%	99.88%	99.94%	99.87%	99.90%	99.93%	99.89%	99.95%	100.02%	100.05%	100.09%	100.12%	100.07%	100.09%	100.14%
16	28.83	100.00%	99.89%	100.11%	100.08%	100.01%	100.05%	100.08%	100.03%	100.06%	100.03%	100.02%	100.01%	100.03%	99.99%	100.03%
17	29.32	100.00%	100.18%	100.00%	100.24%	100.16%	100.08%	100.07%	100.11%	100.04%	100.08%	100.05%	100.10%	100.06%	100.03%	100.07%
18	29.37	100.00%	99.84%	99.88%	99.76%	99.85%	99.95%	99.83%	99.94%	100.01%	99.97%	100.01%	100.08%	100.12%	100.07%	100.04%
19	28.74	100.00%	100.18%	99.97%	100.10%	100.11%	100.06%	99.97%	100.04%	99.95%	100.02%	100.01%	100.06%	100.09%	100.04%	100.01%
20	29.42	100.00%	99.98%	100.06%	99.97%	100.07%	99.92%	99.76%	99.87%	99.94%	99.98%	100.02%	99.97%	99.91%	99.95%	100.00%
21	29.44	100.00%	100.18%	100.11%	100.04%	100.03%	99.96%	99.93%	99.99%	100.03%	99.97%	100.03%	99.97%	100.01%	100.04%	100.09%
22	29.23	100.00%	100.00%	100.02%	100.17%	99.96%	99.91%	99.94%	99.96%	100.00%	100.03%	99.99%	100.04%	100.09%	100.12%	100.07%
median	29.24	100.00%	99.98%	99.98%	100.00%	100.02%	99.97%	99.93%	99.97%	100.02%	100.01%	100.01%	100.01%	100.02%	100.03%	100.02%
average	29.22	100.00%	99.98%	99.97%	99.99%	99.99%	99.97%	99.94%	99.97%	100.01%	100.00%	100.01%	100.02%	100.02%	100.02%	100.03%
std. dev.	0.31	0.00%	0.12%	0.10%	0.14%	0.11%	0.05%	0.09%	0.06%	0.04%	0.04%	0.03%	0.05%	0.07%	0.06%	0.06%
min	28.66	100.00%	99.81%	99.79%	99.74%	99.73%	99.90%	99.76%	99.86%	99.93%	99.94%	99.96%	99.93%	99.88%	99.93%	99.94%
max	29.84	100.00%	100.18%	100.12%	100.24%	100.16%	100.08%	100.09%	100.11%	100.07%	100.08%	100.09%	100.12%	100.17%	100.14%	100.18%

$T_s = T_{air} = 105℃$, $I_f = 200mA$; $T_s \geq 103℃$ and $T_{air} \geq 100℃$ in compliance with LM-80
Table 8: Lumen maintenance data – normalized to 0 h for tested units

Unit	VF [V]	Flux [lm]	Measurement Time of Lumen Maintenance														
	0h	0h	0h	24h	48h	168h	500h	1000h	2000h	3000h	4000h	5000h	6000h	7000h	8000h	9000h	10000h
1	29.24	767.38	100.00%	100.02%	100.13%	100.22%	100.02%	99.85%	99.49%	98.79%	98.67%	98.10%	97.51%	96.80%	96.04%	95.24%	94.47%
2	29.08	763.20	100.00%	99.99%	100.10%	99.96%	99.76%	99.64%	99.48%	98.89%	98.64%	97.98%	97.51%	96.85%	96.17%	95.40%	94.63%
3	29.29	768.34	100.00%	100.00%	100.14%	100.11%	99.83%	99.73%	99.62%	99.12%	98.92%	98.30%	97.83%	97.18%	96.47%	95.72%	95.00%
4	28.93	761.63	100.00%	100.00%	100.13%	100.05%	99.79%	99.70%	99.64%	99.11%	98.90%	98.26%	97.73%	97.04%	96.37%	95.58%	94.84%
5	29.44	770.25	100.00%	99.94%	100.09%	100.05%	99.82%	99.71%	99.61%	99.11%	98.98%	98.37%	97.91%	97.14%	96.27%	95.50%	94.67%
6	29.52	765.53	100.00%	100.01%	100.16%	100.02%	99.69%	99.53%	99.10%	98.27%	98.13%	97.46%	96.87%	96.12%	95.33%	94.50%	93.75%
7	29.36	766.20	100.00%	100.02%	100.15%	100.11%	99.88%	99.75%	99.60%	99.02%	98.82%	98.26%	97.74%	97.07%	96.37%	95.57%	94.80%
8	29.14	774.50	100.00%	100.01%	100.14%	100.09%	99.90%	99.80%	99.71%	99.20%	99.03%	98.45%	97.97%	97.32%	96.61%	95.82%	95.02%
9	29.50	766.29	100.00%	99.98%	100.11%	100.09%	99.87%	99.64%	99.39%	98.87%	98.61%	97.92%	97.34%	96.62%	95.88%	95.06%	94.30%
10	29.33	765.81	100.00%	99.97%	100.10%	100.11%	99.89%	99.76%	99.73%	99.15%	98.86%	98.19%	97.70%	97.04%	96.27%	95.53%	94.74%
11	28.82	774.09	100.00%	99.98%	100.11%	100.04%	99.77%	99.61%	99.58%	99.22%	98.97%	98.38%	97.83%	97.13%	96.44%	95.70%	95.01%
12	29.93	765.32	100.00%	99.96%	100.09%	99.98%	99.75%	99.45%	99.03%	98.14%	97.88%	97.28%	96.65%	95.96%	95.22%	94.43%	93.63%
13	29.75	768.81	100.00%	99.96%	100.07%	99.98%	99.77%	99.60%	99.45%	98.82%	98.62%	97.90%	97.29%	96.53%	95.65%	94.82%	94.01%
14	29.37	774.04	100.00%	100.02%	100.11%	100.06%	99.80%	99.69%	99.72%	98.88%	98.67%	97.95%	97.48%	96.80%	96.21%	95.51%	94.82%
15	28.94	769.25	100.00%	99.98%	100.13%	100.03%	99.75%	99.56%	99.41%	98.88%	98.62%	97.95%	97.49%	96.80%	96.13%	95.30%	94.58%
16	29.06	761.77	100.00%	99.98%	100.09%	100.17%	99.96%	99.76%	99.68%	99.20%	98.94%	98.26%	97.78%	97.03%	96.35%	95.57%	94.76%
17	29.55	763.55	100.00%	100.01%	100.12%	99.99%	99.79%	99.66%	99.54%	99.06%	98.84%	98.09%	97.51%	96.75%	96.10%	95.38%	94.66%
18	29.28	766.66	100.00%	99.97%	100.08%	99.95%	99.79%	99.60%	99.56%	99.04%	98.87%	98.20%	97.67%	96.89%	96.07%	95.10%	94.17%
19	29.06	768.52	100.00%	99.98%	100.11%	100.02%	99.77%	99.63%	99.70%	99.32%	99.15%	98.46%	97.91%	97.18%	96.35%	95.47%	94.67%
20	28.59	762.27	100.00%	100.01%	100.17%	100.11%	99.91%	99.76%	99.68%	99.20%	98.94%	98.24%	97.69%	97.00%	96.32%	95.59%	94.83%
21	29.53	769.29	100.00%	100.00%	100.03%	99.84%	99.63%	99.43%	99.26%	98.90%	98.62%	97.89%	97.43%	96.52%	95.71%	94.82%	93.98%
22	29.75	765.40	100.00%	99.99%	100.07%	99.88%	99.70%	99.54%	99.42%	98.87%	98.59%	97.86%	97.37%	96.62%	95.89%	95.08%	94.35%
median	29.31	766.48	100.00%	99.99%	100.11%	100.04%	99.79%	99.65%	99.57%	99.03%	98.83%	98.14%	97.59%	96.87%	96.19%	95.43%	94.66%
average	29.29	767.19	100.00%	99.99%	100.11%	100.04%	99.81%	99.65%	99.52%	98.96%	98.74%	98.08%	97.56%	96.84%	96.10%	95.30%	94.53%
std. dev.	0.33	3.77	0.00%	0.02%	0.03%	0.09%	0.09%	0.11%	0.19%	0.29%	0.29%	0.30%	0.32%	0.34%	0.36%	0.39%	0.40%
min	28.59	761.63	100.00%	99.94%	100.03%	99.84%	99.63%	99.43%	99.03%	98.14%	97.88%	97.28%	96.65%	95.96%	95.22%	94.43%	93.63%
max	29.93	774.50	100.00%	100.02%	100.17%	100.22%	100.02%	99.85%	99.73%	99.32%	99.15%	98.46%	97.97%	97.32%	96.61%	95.82%	95.02%

$T_s = T_{air}$ = 105℃, I_f = 200mA; $T_s \geq$ 103℃ and $T_{air} \geq$ 100℃ in compliance with LM-80
Table 9: Chromaticity shift Du'v' data – normalized to 0 h for tested units

Unit	CCT [k]	u'	v'	Measurement Time of Chromaticity Shift Du'v'														
	0h	0h	0h	0h	24h	48h	168h	500h	1000h	2000h	3000h	4000h	5000h	6000h	7000h	8000h	9000h	10000h
1	3515	0.2501	0.5160	0.0000	0.0003	0.0003	0.0002	0.0001	0.0003	0.0005	0.0013	0.0014	0.0016	0.0022	0.0024	0.0029	0.0035	0.0037
2	3532	0.2503	0.5147	0.0000	0.0003	0.0003	0.0001	0.0003	0.0005	0.0007	0.0013	0.0016	0.0019	0.0024	0.0025	0.0029	0.0035	0.0038
3	3538	0.2498	0.5156	0.0000	0.0003	0.0003	0.0000	0.0002	0.0004	0.0004	0.0009	0.0012	0.0015	0.0021	0.0021	0.0025	0.0031	0.0034
4	3525	0.2506	0.5142	0.0000	0.0003	0.0003	0.0001	0.0003	0.0006	0.0006	0.0012	0.0014	0.0016	0.0022	0.0022	0.0026	0.0032	0.0036
5	3592	0.2492	0.5148	0.0000	0.0003	0.0003	0.0001	0.0002	0.0003	0.0004	0.0010	0.0013	0.0015	0.0021	0.0021	0.0026	0.0031	0.0034
6	3554	0.2500	0.5142	0.0000	0.0003	0.0004	0.0001	0.0004	0.0006	0.0011	0.0019	0.0021	0.0024	0.0029	0.0031	0.0035	0.0041	0.0043
7	3522	0.2500	0.5158	0.0000	0.0003	0.0003	0.0000	0.0001	0.0004	0.0005	0.0012	0.0014	0.0017	0.0023	0.0024	0.0028	0.0035	0.0038
8	3638	0.2486	0.5142	0.0000	0.0003	0.0003	0.0002	0.0003	0.0002	0.0002	0.0007	0.0010	0.0012	0.0018	0.0018	0.0022	0.0028	0.0032
9	3564	0.2498	0.5143	0.0000	0.0003	0.0003	0.0002	0.0002	0.0004	0.0007	0.0014	0.0017	0.0020	0.0025	0.0027	0.0031	0.0038	0.0039
10	3502	0.2503	0.5160	0.0000	0.0003	0.0003	0.0001	0.0002	0.0002	0.0003	0.0009	0.0013	0.0017	0.0023	0.0024	0.0029	0.0035	0.0038
11	3615	0.2489	0.5145	0.0000	0.0003	0.0003	0.0000	0.0002	0.0005	0.0005	0.0008	0.0009	0.0013	0.0019	0.0018	0.0023	0.0029	0.0033
12	3536	0.2501	0.5150	0.0000	0.0003	0.0003	0.0001	0.0003	0.0006	0.0012	0.0020	0.0022	0.0024	0.0029	0.0030	0.0034	0.0040	0.0042
13	3518	0.2498	0.5165	0.0000	0.0003	0.0003	0.0001	0.0002	0.0004	0.0005	0.0012	0.0015	0.0018	0.0025	0.0026	0.0031	0.0038	0.0040
14	3573	0.2491	0.5159	0.0000	0.0004	0.0003	0.0000	0.0002	0.0004	0.0004	0.0010	0.0012	0.0017	0.0022	0.0023	0.0029	0.0033	0.0035
15	3531	0.2499	0.5156	0.0000	0.0003	0.0003	0.0001	0.0002	0.0004	0.0005	0.0010	0.0014	0.0017	0.0023	0.0024	0.0029	0.0036	0.0038
16	3490	0.2507	0.5156	0.0000	0.0003	0.0003	0.0002	0.0002	0.0003	0.0004	0.0010	0.0013	0.0016	0.0020	0.0022	0.0026	0.0034	0.0036
17	3535	0.2503	0.5144	0.0000	0.0004	0.0004	0.0001	0.0003	0.0004	0.0006	0.0012	0.0015	0.0018	0.0024	0.0025	0.0030	0.0037	0.0039
18	3557	0.2499	0.5145	0.0000	0.0004	0.0003	0.0001	0.0003	0.0004	0.0005	0.0011	0.0014	0.0017	0.0023	0.0024	0.0028	0.0036	0.0039
19	3493	0.2501	0.5172	0.0000	0.0003	0.0003	0.0001	0.0002	0.0003	0.0003	0.0005	0.0008	0.0012	0.0018	0.0018	0.0023	0.0029	0.0031
20	3509	0.2505	0.5151	0.0000	0.0004	0.0004	0.0002	0.0003	0.0002	0.0004	0.0010	0.0014	0.0016	0.0021	0.0022	0.0026	0.0035	0.0038
21	3534	0.2497	0.5162	0.0000	0.0003	0.0002	0.0001	0.0003	0.0002	0.0001	0.0006	0.0008	0.0011	0.0016	0.0016	0.0019	0.0026	0.0028
22	3552	0.2501	0.5143	0.0000	0.0004	0.0004	0.0002	0.0002	0.0001	0.0001	0.0004	0.0007	0.0009	0.0016	0.0017	0.0021	0.0027	0.0030
median	3534	0.2500	0.5150	0.0000	0.0003	0.0003	0.0001	0.0002	0.0004	0.0005	0.0010	0.0014	0.0017	0.0022	0.0023	0.0028	0.0035	0.0037
average	3542	0.2499	0.5152	0.0000	0.0003	0.0003	0.0001	0.0002	0.0004	0.0005	0.0011	0.0013	0.0016	0.0022	0.0023	0.0027	0.0034	0.0036
std. dev.	37	0.0005	0.0009	0.0000	0.0000	0.0000	0.0001	0.0001	0.0001	0.0003	0.0004	0.0004	0.0004	0.0003	0.0004	0.0004	0.0004	0.0004
min	3490	0.2486	0.5142	0.0000	0.0003	0.0002	0.0000	0.0001	0.0001	0.0001	0.0004	0.0007	0.0009	0.0016	0.0016	0.0019	0.0026	0.0028
max	3638	0.2507	0.5172	0.0000	0.0004	0.0004	0.0002	0.0004	0.0006	0.0012	0.0020	0.0022	0.0024	0.0029	0.0031	0.0035	0.0041	0.0043

$T_s = T_{air}$ = 105℃, I_f = 200mA; $T_s \geq$ 103℃ and $T_{air} \geq$ 100℃ in compliance with LM-80
Table 10: Forward voltage data – normalized to 0 h for tested units

Unit	VF [V]	Measurement Time of VF														
	0h	0h	24h	48h	168h	500h	1000h	2000h	3000h	4000h	5000h	6000h	7000h	8000h	9000h	10000h
1	29.24	100.00%	99.93%	99.98%	100.03%	99.91%	100.12%	99.97%	100.03%	100.07%	100.02%	100.06%	100.09%	100.12%	100.08%	100.04%
2	29.08	100.00%	99.95%	99.99%	99.81%	99.90%	99.91%	99.69%	99.82%	99.89%	99.95%	99.97%	100.00%	100.04%	99.99%	99.95%
3	29.29	100.00%	99.82%	99.95%	99.91%	99.94%	99.80%	99.74%	99.79%	99.83%	99.88%	99.92%	99.88%	99.93%	99.88%	99.85%
4	28.93	100.00%	100.20%	100.12%	100.15%	100.06%	100.13%	100.18%	100.16%	100.09%	100.12%	100.09%	100.12%	100.08%	100.11%	100.16%
5	29.44	100.00%	99.89%	100.08%	99.92%	99.90%	100.01%	99.88%	99.96%	99.94%	99.98%	100.01%	99.96%	100.00%	99.95%	99.92%
6	29.52	100.00%	100.08%	100.21%	100.29%	100.20%	100.12%	100.10%	100.15%	100.07%	100.04%	100.06%	100.11%	100.07%	100.05%	100.09%
7	29.36	100.00%	99.87%	100.02%	99.97%	99.93%	100.04%	100.03%	100.01%	99.89%	99.93%	99.95%	100.00%	100.05%	100.02%	100.05%
8	29.14	100.00%	100.16%	100.05%	100.06%	100.04%	100.14%	100.19%	100.11%	100.05%	99.98%	100.01%	100.06%	100.03%	100.00%	100.05%
9	29.50	100.00%	100.19%	100.10%	100.11%	100.04%	100.15%	99.88%	100.08%	99.99%	100.03%	100.06%	100.02%	100.07%	100.04%	100.08%
10	29.33	100.00%	99.91%	100.19%	100.19%	99.96%	100.07%	100.15%	100.09%	100.11%	100.06%	100.01%	100.05%	100.08%	100.10%	100.06%
11	28.82	100.00%	100.17%	100.01%	100.09%	99.96%	99.98%	99.99%	100.03%	100.05%	100.01%	99.98%	100.00%	100.03%	99.99%	99.95%
12	29.93	100.00%	100.24%	100.19%	100.06%	99.99%	99.97%	100.14%	100.03%	100.07%	100.03%	100.00%	100.01%	100.03%	100.08%	100.03%
13	29.75	100.00%	99.77%	99.77%	99.76%	99.92%	100.00%	100.01%	99.95%	100.00%	100.04%	100.00%	100.02%	100.04%	100.09%	100.05%
14	29.37	100.00%	100.00%	99.99%	100.05%	99.96%	99.92%	99.98%	99.87%	99.95%	99.99%	99.95%	100.00%	100.04%	100.09%	100.04%
15	28.94	100.00%	100.16%	100.07%	100.00%	99.91%	99.98%	100.10%	100.01%	100.04%	100.02%	99.99%	100.02%	100.06%	100.01%	99.98%
16	29.06	100.00%	99.89%	99.95%	99.93%	100.05%	99.95%	99.84%	99.86%	99.95%	99.97%	99.99%	100.01%	100.02%	100.00%	100.03%
17	29.55	100.00%	99.89%	100.03%	100.09%	100.01%	99.90%	100.02%	100.05%	99.98%	100.00%	99.98%	100.02%	99.99%	100.02%	99.97%
18	29.28	100.00%	99.75%	100.01%	100.04%	99.90%	99.95%	100.02%	99.97%	100.02%	100.03%	100.02%	100.05%	100.07%	100.09%	100.06%
19	29.06	100.00%	100.10%	100.10%	99.93%	99.97%	99.98%	99.87%	99.98%	100.01%	100.04%	100.01%	100.04%	100.08%	100.11%	100.08%
20	28.59	100.00%	99.73%	99.79%	100.04%	99.91%	100.02%	99.83%	99.93%	100.02%	99.97%	99.99%	99.96%	99.91%	99.94%	99.98%
21	29.53	100.00%	100.13%	100.11%	100.06%	99.99%	99.84%	99.72%	99.80%	99.89%	99.92%	99.98%	99.96%	99.92%	99.97%	100.01%
22	29.75	100.00%	99.86%	100.07%	99.97%	99.91%	100.02%	99.94%	100.00%	100.06%	100.04%	100.01%	100.06%	100.10%	100.11%	100.06%
median	29.31	100.00%	99.94%	100.04%	100.04%	99.96%	99.99%	99.99%	100.00%	100.01%	100.02%	100.00%	100.02%	100.04%	100.03%	100.04%
average	29.29	100.00%	99.99%	100.04%	100.02%	99.97%	100.00%	99.97%	99.99%	100.00%	100.00%	100.00%	100.02%	100.03%	100.03%	100.02%
std. dev.	0.33	0.00%	0.16%	0.11%	0.12%	0.07%	0.10%	0.15%	0.11%	0.08%	0.05%	0.04%	0.05%	0.06%	0.06%	0.07%
min	28.59	100.00%	99.73%	99.77%	99.76%	99.90%	99.80%	99.69%	99.79%	99.83%	99.88%	99.92%	99.88%	99.91%	99.88%	99.85%
max	29.93	100.00%	100.24%	100.21%	100.29%	100.20%	100.15%	100.19%	100.16%	100.11%	100.12%	100.09%	100.12%	100.12%	100.11%	100.16%

$T_s = T_{air}$ = 115℃, I_f = 200mA; $T_s \geq$ 113℃ and $T_{air} \geq$ 110℃ in compliance with LM-80
Table 11: Lumen maintenance data – normalized to 0 h for tested units

Unit	VF [V]	Flux [lm]	Measurement Time of Lumen Maintenance														
	0h	0h	0h	24h	48h	168h	500h	1000h	2000h	3000h	4000h	5000h	6000h	7000h	8000h	9000h	10000h
1	29.49	762.57	100.00%	99.97%	99.87%	99.49%	99.04%	98.74%	98.30%	97.52%	97.03%	96.28%	95.66%	94.89%	94.05%	93.00%	91.91%
2	29.52	762.75	100.00%	99.98%	99.93%	99.64%	99.38%	99.28%	99.02%	98.42%	98.00%	97.41%	96.65%	95.74%	94.78%	93.73%	92.71%
3	28.54	763.69	100.00%	99.95%	99.86%	99.47%	99.14%	98.98%	98.73%	98.16%	97.70%	97.14%	96.60%	95.76%	94.73%	93.68%	92.69%
4	29.23	761.82	100.00%	99.98%	99.94%	99.67%	99.43%	99.34%	99.18%	98.69%	98.30%	97.56%	96.93%	95.93%	94.84%	93.64%	92.45%
5	29.06	763.61	100.00%	99.98%	99.99%	99.78%	99.55%	99.46%	99.17%	98.48%	97.39%	96.73%	95.99%	95.00%	93.86%	92.70%	91.71%
6	28.97	775.43	100.00%	99.96%	99.94%	99.56%	99.30%	99.23%	99.06%	98.62%	98.26%	97.57%	96.88%	96.10%	95.08%	94.02%	93.03%
7	29.26	767.18	100.00%	100.00%	100.00%	99.69%	99.45%	99.35%	99.16%	98.71%	98.32%	97.70%	97.11%	96.27%	95.22%	93.99%	92.88%
8	28.88	758.55	100.00%	100.00%	99.94%	99.67%	99.41%	99.30%	99.02%	98.43%	98.10%	97.56%	96.92%	96.09%	95.09%	94.00%	92.89%
9	28.94	765.53	100.00%	100.03%	99.99%	99.80%	99.51%	99.37%	98.70%	97.76%	97.23%	96.65%	96.06%	95.38%	94.60%	93.65%	92.76%
10	29.14	774.44	100.00%	100.02%	100.03%	99.80%	99.49%	99.37%	98.78%	98.21%	97.88%	97.40%	96.78%	95.93%	94.90%	93.84%	92.89%
11	28.83	770.92	100.00%	100.02%	100.03%	99.75%	99.50%	99.37%	98.78%	98.18%	97.93%	97.26%	96.63%	95.74%	94.76%	93.69%	92.74%
12	29.15	768.58	100.00%	100.05%	100.04%	99.74%	99.38%	99.14%	98.47%	97.47%	96.91%	96.28%	95.66%	94.87%	93.85%	92.77%	91.73%
13	29.47	760.38	100.00%	99.90%	99.90%	99.85%	99.57%	99.52%	98.89%	97.92%	97.32%	96.72%	96.16%	95.29%	94.31%	93.22%	92.20%
14	29.13	765.88	100.00%	100.02%	100.05%	99.82%	99.15%	98.70%	97.52%	96.57%	96.26%	95.58%	94.93%	94.11%	93.18%	92.13%	91.11%
15	29.43	767.11	100.00%	100.03%	100.00%	99.80%	99.49%	99.40%	98.92%	98.24%	97.46%	96.80%	96.22%	95.35%	94.37%	93.36%	92.30%
16	29.14	766.12	100.00%	100.07%	100.07%	99.77%	99.18%	98.73%	97.55%	96.33%	95.68%	94.94%	94.36%	93.55%	92.53%	91.53%	90.50%
17	28.94	771.41	100.00%	100.02%	100.03%	99.80%	99.48%	99.38%	98.93%	98.46%	98.38%	97.94%	97.32%	96.52%	95.62%	94.58%	93.55%
18	28.98	766.16	100.00%	100.02%	100.06%	99.74%	99.59%	99.50%	99.06%	98.49%	98.38%	97.85%	97.29%	96.54%	95.72%	94.72%	93.71%
19	29.05	765.10	100.00%	100.09%	100.15%	99.88%	99.51%	99.30%	98.70%	97.94%	97.78%	97.12%	96.43%	95.60%	94.67%	93.65%	92.67%
20	28.53	763.74	100.00%	100.03%	100.03%	99.79%	99.57%	99.51%	99.13%	98.64%	98.56%	98.02%	97.48%	96.58%	95.58%	94.56%	93.51%
21	28.93	762.37	100.00%	100.06%	100.12%	99.99%	99.63%	99.51%	99.12%	98.64%	98.24%	97.76%	97.08%	96.27%	95.32%	94.28%	93.30%
22	29.23	765.11	100.00%	100.06%	100.13%	99.66%	99.46%	99.48%	99.14%	98.51%	98.30%	97.72%	97.08%	96.25%	95.27%	94.18%	93.14%
median	29.09	765.32	100.00%	100.02%	100.01%	99.76%	99.47%	99.36%	98.93%	98.33%	97.90%	97.33%	96.64%	95.75%	94.77%	93.68%	92.72%
average	29.08	765.84	100.00%	100.01%	100.00%	99.73%	99.42%	99.27%	98.79%	98.11%	97.70%	97.09%	96.46%	95.63%	94.65%	93.59%	92.56%
std. dev.	0.27	4.26	0.00%	0.04%	0.08%	0.12%	0.16%	0.26%	0.47%	0.65%	0.74%	0.79%	0.79%	0.78%	0.79%	0.79%	0.79%
min	28.53	758.55	100.00%	99.90%	99.86%	99.47%	99.04%	98.70%	97.52%	96.33%	95.68%	94.94%	94.36%	93.55%	92.53%	91.53%	90.50%
max	29.52	775.43	100.00%	100.09%	100.15%	99.99%	99.63%	99.52%	99.18%	98.71%	98.56%	98.02%	97.48%	96.58%	95.72%	94.72%	93.71%

$T_s = T_{air}$ = 115℃, I_f = 200mA; $T_s \geq$ 113℃ and $T_{air} \geq$ 110℃ in compliance with LM-80
Table 12: Chromaticity shift Du'v' data – normalized to 0 h for tested units

Unit	CCT [k]	u'	v'	Measurement Time of Chromaticity Shift du'dv'														
	0h	0h	0h	0h	24h	48h	168h	500h	1000h	2000h	3000h	4000h	5000h	6000h	7000h	8000h	9000h	10000h
1	3517	0.2504	0.5151	0.0000	0.0003	0.0003	0.0007	0.0012	0.0016	0.0021	0.0027	0.0030	0.0024	0.0031	0.0033	0.0038	0.0044	0.0047
2	3492	0.2506	0.5158	0.0000	0.0003	0.0003	0.0005	0.0008	0.0010	0.0014	0.0019	0.0023	0.0026	0.0033	0.0036	0.0039	0.0045	0.0045
3	3477	0.2505	0.5168	0.0000	0.0003	0.0003	0.0007	0.0010	0.0013	0.0017	0.0022	0.0027	0.0022	0.0028	0.0031	0.0036	0.0043	0.0046
4	3451	0.2509	0.5171	0.0000	0.0002	0.0002	0.0005	0.0007	0.0009	0.0011	0.0016	0.0019	0.0020	0.0027	0.0029	0.0035	0.0042	0.0045
5	3520	0.2504	0.5150	0.0000	0.0003	0.0002	0.0004	0.0006	0.0008	0.0013	0.0019	0.0027	0.0030	0.0037	0.0040	0.0042	0.0046	0.0047
6	3667	0.2484	0.5134	0.0000	0.0003	0.0002	0.0004	0.0006	0.0008	0.0010	0.0014	0.0014	0.0016	0.0025	0.0027	0.0033	0.0041	0.0044
7	3523	0.2501	0.5155	0.0000	0.0003	0.0002	0.0004	0.0005	0.0007	0.0010	0.0015	0.0018	0.0024	0.0033	0.0036	0.0042	0.0049	0.0051
8	3425	0.2514	0.5170	0.0000	0.0003	0.0003	0.0005	0.0008	0.0010	0.0013	0.0018	0.0022	0.0024	0.0031	0.0035	0.0038	0.0044	0.0046
9	3533	0.2500	0.5153	0.0000	0.0003	0.0003	0.0003	0.0006	0.0008	0.0016	0.0024	0.0029	0.0032	0.0039	0.0043	0.0047	0.0052	0.0055
10	3595	0.2490	0.5151	0.0000	0.0003	0.0002	0.0002	0.0004	0.0006	0.0012	0.0017	0.0021	0.0025	0.0035	0.0038	0.0045	0.0052	0.0055
11	3591	0.2493	0.5144	0.0000	0.0003	0.0003	0.0003	0.0004	0.0006	0.0013	0.0019	0.0022	0.0027	0.0034	0.0037	0.0043	0.0053	0.0056
12	3550	0.2497	0.5154	0.0000	0.0003	0.0003	0.0003	0.0006	0.0010	0.0018	0.0025	0.0031	0.0034	0.0039	0.0043	0.0047	0.0052	0.0054
13	3450	0.2511	0.5165	0.0000	0.0002	0.0003	0.0003	0.0006	0.0007	0.0014	0.0022	0.0028	0.0031	0.0036	0.0040	0.0044	0.0049	0.0051
14	3521	0.2502	0.5154	0.0000	0.0002	0.0002	0.0003	0.0010	0.0015	0.0025	0.0030	0.0032	0.0035	0.0040	0.0043	0.0047	0.0052	0.0053
15	3555	0.2498	0.5150	0.0000	0.0003	0.0003	0.0003	0.0006	0.0007	0.0014	0.0020	0.0028	0.0033	0.0039	0.0044	0.0049	0.0054	0.0057
16	3535	0.2500	0.5153	0.0000	0.0003	0.0003	0.0003	0.0010	0.0015	0.0025	0.0031	0.0034	0.0035	0.0038	0.0042	0.0044	0.0048	0.0050
17	3561	0.2493	0.5158	0.0000	0.0003	0.0002	0.0003	0.0005	0.0007	0.0012	0.0016	0.0017	0.0022	0.0031	0.0033	0.0039	0.0047	0.0049
18	3499	0.2502	0.5164	0.0000	0.0002	0.0002	0.0004	0.0004	0.0005	0.0011	0.0016	0.0018	0.0022	0.0031	0.0033	0.0039	0.0047	0.0049
19	3480	0.2505	0.5167	0.0000	0.0003	0.0003	0.0002	0.0005	0.0008	0.0015	0.0021	0.0023	0.0028	0.0037	0.0039	0.0044	0.0050	0.0053
20	3516	0.2503	0.5153	0.0000	0.0003	0.0003	0.0003	0.0006	0.0007	0.0012	0.0016	0.0017	0.0021	0.0030	0.0031	0.0037	0.0044	0.0047
21	3528	0.2504	0.5146	0.0000	0.0003	0.0002	0.0006	0.0007	0.0008	0.0014	0.0018	0.0022	0.0028	0.0038	0.0039	0.0043	0.0050	0.0053
22	3555	0.2500	0.5144	0.0000	0.0003	0.0003	0.0005	0.0006	0.0006	0.0012	0.0017	0.0020	0.0024	0.0033	0.0037	0.0041	0.0049	0.0050
median	3522	0.2502	0.5154	0.0000	0.0003	0.0003	0.0003	0.0006	0.0008	0.0014	0.0019	0.0022	0.0026	0.0034	0.0037	0.0042	0.0048	0.0050
average	3525	0.2501	0.5155	0.0000	0.0003	0.0002	0.0004	0.0007	0.0009	0.0015	0.0020	0.0024	0.0026	0.0034	0.0037	0.0042	0.0048	0.0050
std. dev.	54	0.0007	0.0009	0.0000	0.0000	0.0000	0.0001	0.0002	0.0003	0.0004	0.0005	0.0006	0.0005	0.0004	0.0005	0.0004	0.0004	0.0004
min	3425	0.2484	0.5134	0.0000	0.0002	0.0002	0.0002	0.0004	0.0005	0.0010	0.0014	0.0014	0.0016	0.0025	0.0027	0.0033	0.0041	0.0044
max	3667	0.2514	0.5171	0.0000	0.0003	0.0003	0.0007	0.0012	0.0016	0.0025	0.0031	0.0034	0.0035	0.0040	0.0044	0.0049	0.0054	0.0057

$T_s = T_{air}$ = 115℃, I_f = 200mA; $T_s \geq$ 113℃ and $T_{air} \geq$ 110℃ in compliance with LM-80
Table 13: Forward voltage data – normalized to 0 h for tested units

Unit	VF [V]	Measurement Time of VF														
	0h	0h	24h	48h	168h	500h	1000h	2000h	3000h	4000h	5000h	6000h	7000h	8000h	9000h	10000h
1	29.49	100.00%	99.94%	99.80%	99.92%	100.00%	99.95%	100.03%	99.98%	100.04%	100.01%	100.03%	99.99%	99.96%	99.91%	99.95%
2	29.52	100.00%	100.08%	99.96%	99.94%	99.94%	99.98%	99.99%	99.96%	100.03%	100.01%	100.04%	100.08%	100.05%	100.03%	99.99%
3	28.54	100.00%	100.09%	100.15%	100.14%	100.17%	100.06%	100.20%	100.10%	100.02%	100.07%	100.04%	100.09%	100.13%	100.16%	100.12%
4	29.23	100.00%	99.94%	100.13%	100.11%	100.00%	99.94%	99.92%	99.98%	100.01%	99.98%	100.03%	100.06%	100.11%	100.14%	100.09%
5	29.06	100.00%	99.79%	99.64%	99.94%	100.06%	99.87%	99.79%	99.82%	99.84%	99.86%	99.90%	99.88%	99.93%	99.89%	99.93%
6	28.97	100.00%	99.90%	100.07%	100.15%	100.09%	99.97%	100.09%	100.04%	100.02%	100.05%	100.03%	100.06%	100.11%	100.15%	100.19%
7	29.26	100.00%	100.00%	99.95%	99.96%	100.04%	99.99%	100.05%	100.01%	100.09%	100.04%	100.00%	100.03%	99.99%	100.01%	100.05%
8	28.88	100.00%	99.79%	99.74%	100.01%	99.94%	100.02%	100.04%	99.98%	99.82%	99.89%	99.97%	100.01%	100.06%	100.03%	99.98%
9	28.94	100.00%	100.16%	100.03%	100.05%	99.93%	100.10%	100.08%	100.14%	100.03%	100.01%	99.97%	100.00%	99.96%	99.92%	99.97%
10	29.14	100.00%	100.08%	100.20%	99.95%	100.01%	99.95%	100.11%	100.02%	100.04%	100.00%	100.04%	100.00%	99.94%	99.99%	100.04%
11	28.83	100.00%	100.18%	99.92%	100.03%	100.00%	100.07%	99.93%	100.01%	100.05%	100.03%	99.99%	100.05%	100.01%	99.98%	99.95%
12	29.15	100.00%	99.90%	100.03%	99.99%	99.89%	99.92%	100.17%	100.00%	100.08%	100.04%	100.01%	100.06%	100.03%	99.99%	100.03%
13	29.47	100.00%	99.82%	99.99%	99.87%	99.81%	99.85%	100.01%	99.93%	99.98%	99.97%	100.01%	100.05%	100.11%	100.06%	100.01%
14	29.13	100.00%	100.09%	100.09%	100.03%	100.09%	100.06%	100.22%	100.11%	100.16%	100.08%	100.05%	100.11%	100.15%	100.19%	100.15%
15	29.43	100.00%	100.05%	100.11%	100.00%	99.94%	100.06%	100.04%	100.15%	100.07%	100.03%	100.03%	100.08%	100.14%	100.10%	100.13%
16	29.14	100.00%	100.13%	100.16%	100.00%	99.90%	99.93%	99.95%	99.99%	99.89%	99.94%	99.97%	99.91%	99.87%	99.82%	99.85%
17	28.94	100.00%	100.06%	99.93%	99.89%	99.96%	100.03%	99.97%	99.96%	100.05%	100.03%	99.98%	100.03%	100.06%	100.08%	100.12%
18	28.98	100.00%	100.02%	99.96%	99.81%	99.89%	99.97%	99.84%	99.91%	100.01%	99.97%	99.99%	100.05%	100.11%	100.14%	100.11%
19	29.05	100.00%	100.06%	100.14%	99.88%	99.98%	100.06%	100.02%	100.05%	100.11%	100.05%	100.09%	100.14%	100.10%	100.15%	100.19%
20	28.53	100.00%	100.03%	100.04%	100.01%	100.03%	99.97%	100.01%	99.99%	100.03%	100.07%	100.02%	100.01%	99.96%	100.01%	99.96%
21	28.93	100.00%	100.07%	100.03%	100.17%	100.09%	100.03%	99.94%	99.98%	100.02%	100.06%	100.02%	100.05%	100.11%	100.07%	100.11%
22	29.23	100.00%	100.06%	100.13%	99.92%	99.87%	99.96%	100.07%	100.01%	100.10%	100.05%	100.01%	100.08%	100.12%	100.09%	100.12%
median	29.09	100.00%	100.05%	100.03%	100.00%	99.99%	99.98%	100.03%	100.00%	100.03%	100.03%	100.01%	100.05%	100.06%	100.05%	100.05%
average	29.08	100.00%	100.01%	100.01%	99.99%	99.98%	99.99%	100.02%	100.01%	100.02%	100.01%	100.01%	100.04%	100.05%	100.04%	100.05%
std. dev.	0.27	0.00%	0.11%	0.14%	0.09%	0.09%	0.07%	0.11%	0.07%	0.08%	0.06%	0.04%	0.06%	0.08%	0.10%	0.09%
min	28.53	100.00%	99.79%	99.64%	99.81%	99.81%	99.85%	99.79%	99.82%	99.82%	99.86%	99.90%	99.88%	99.87%	99.82%	99.85%
max	29.52	100.00%	100.18%	100.20%	100.17%	100.17%	100.10%	100.22%	100.15%	100.16%	100.08%	100.09%	100.14%	100.15%	100.19%	100.19%

This test is accredited under the laboratory's ISO/IEC 17025 accreditation issued by ANSI-ASQ National Accreditation Board/ANAB. Refer to certificate and scope of accreditation AT1511.

Test Conducted by	Approved Signatory
	
.....	.....
Samantha Clarice Project Engineer	See Kiat Siang Technical Manager

END OF REPORT

Appendix A:
Lumen Maintenance Projection (IES TM-21-11)

For Information Only!

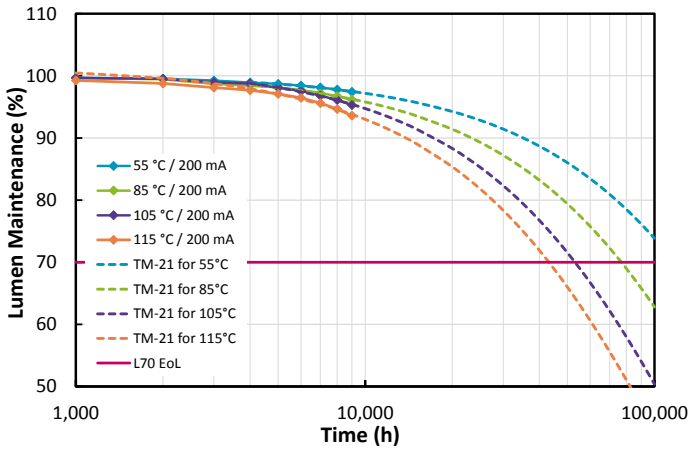
1. General Information

Description of LED light source tested	DURIS® S 8 GW P9LT31.EM
Sample size per temperature	22
LED drive current used in the test	200 mA
Current per die	200 mA
Test duration	9,000 hours
Test duration used for projection	4,000 hours to 9,000 hours

2. Projection Data

	I	II	III	IV
Case temperature (solder point)	T_S = 55°C	T_S = 85°C	T_S = 105°C	T_S = 115°C
α	3.051E-06	4.693E-06	7.015E-06	8.572E-06
B	1.002E+00	1.004E+00	1.016E+00	1.013E+00
Reported L70	> 54,000 hours	> 54,000 hours	53,141 hours	43,155 hours

3. Graphic chart



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Appendix B:
Additional Models Covered By Testing

The 9 September 2011 ENERGY STAR® *Program Guidance Regarding LED Package, LED Array and LED Module Lumen Maintenance Performance Data Supporting Qualification of Lighting Products* defines conditons for which a LM-80 report may be applied to cover models that have not been directly tested.

The following list of models may be covered by the test results in this report:

- DURIS® S 8 GW P9LT31.EM with CCT 2700 K – 6500 K up to 200mA
- DURIS® S 8 GW P9LT32.EM with CCT 2700 K – 6500 K up to 1000mA
- DURIS® S 8 GW P9LT31.CM with CCT 2700 K – 4000 K up to 200mA
- DURIS® S 8 GW P9LT31.PM with CCT 4000 K – 6500 K up to 200mA
- DURIS® S 8 GW P9LT32.PM with CCT 3000 K – 6500 K up to 1000mA
- DURIS® S 8 GW P9LR31.EM with CCT 2700 K – 6500 K up to 200mA
- DURIS® S 8 GW P9LR33.CM with CCT 2700 K – 4000 K up to 200mA
- DURIS® S 8 GW P9LR31.PM with CCT 4000 K – 6500 K up to 200mA
- DURIS® S 8 GW P9LR32.EM with CCT 2700 K – 6500 K up to 800mA
- DURIS® S 8 GW P9LM31.EM with CCT 2700 K – 6500 K up to 200mA
- DURIS® S 8 GW P9LR34.PM with CCT 2700 K – 6500 K up to 200mA
- DURIS® S 8 GW P9LR34.EM with CCT 2700 K – 6500 K up to 200mA
- DURIS® S 8 GW P9LR35.PM with CCT 2700 K – 6500 K up to 800mA
- DURIS® S 8 GW P9LR35.EM with CCT 2700 K – 6500 K up to 800mA

Note: The devices are stressed and tested at current-per-die of 200mA. This report can be referenced when the current employed in application is lower than the specified current of the respective devices as stated above

Disclaimer

Please carefully read the below terms and conditions before using the Information.
If you do not agree with any of these terms and conditions, do not use the Information.

The Information contained in this document does not constitute an independent warranty. The committed behavior is described in the Product data sheet.

Further explanations:
Data: The Data used in this Document consider the reliability test results under the mentioned driving conditions only. For Product information on the maximum operating conditions please refer to the Product data sheet or contact your local sales partner.
Conditions: The conditions for the generation of the data are as follows:
1. The Data and curves shown in this Document are based on experiments carried out under laboratory conditions on a random sample size of LED with readouts at discrete readout times (where applicable). Thus, the Data above represent a limited number of production lots only and may differ between different assembly lots over time (including chip or package changes). Thus, the behavior of the LED in the final application may differ from the Data. The behavior of the LED at conditions or readout times deviating from those stated above may not be deduced from the Data.
2. For long term operation additional failure modes of the chip or package can occur which are not shown in this Document.
3. Possible differences in the thermal management of OSRAM OS and customer's setup may lead to a different aging behavior.
4. The lifetime projection data presented in this Document has been evaluated in accordance with the lifetime extrapolation method described and defined in IES TM-21-11. The lifetime projection is based on the Data shown in this Document. The Data had been collected and assembled according to IES LM-80-15.

END OF DOCUMENT

OSRAM Opto Semiconductors
GmbH

Head Office:

Leibnizstrasse 4
93055 Regensburg, Germany
Phone +49 941 850-5
Fax +49 941 850-1002
www.osram-os.com

OSRAM
Opto Semiconductors