

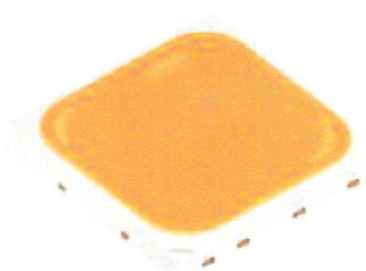
Light is OSRAM

OSRAM
Opto Semiconductors

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

IES LM-80-08 Test Report

Test Documentation No.: 160544W9 (Document No.: QAV-1115-1985) – 25th Jun 2019





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PRELIMINARY 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.**

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Prepared by: Samantha Clarice

Date: 22 December 2016



ANSI Accreditation Code AT1511

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ANSI Accreditation Code AT1511

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1.0 Number of LED light sources tested

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

2.0 Description of LED light sources

- GW P9LT31.EM
- CRI 80
- CCT 3000K

3.0 Package Pictures



Figure 1: GW P9LT31.EM

4.0 Mechanical Drawing

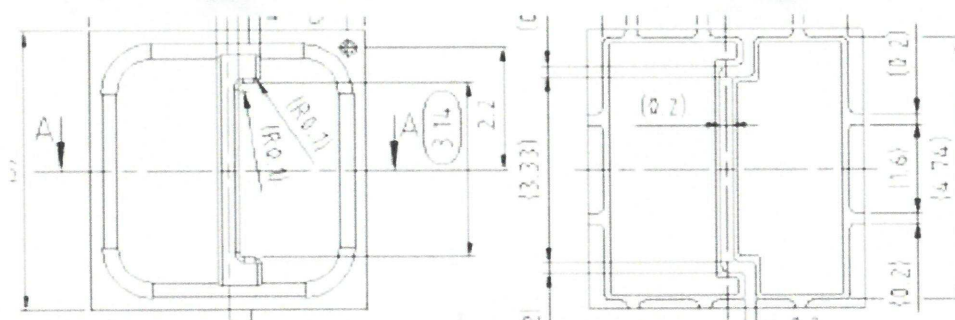


Figure 2: Mechanical drawing for GW P9LT31.EM

5.0 Test Board

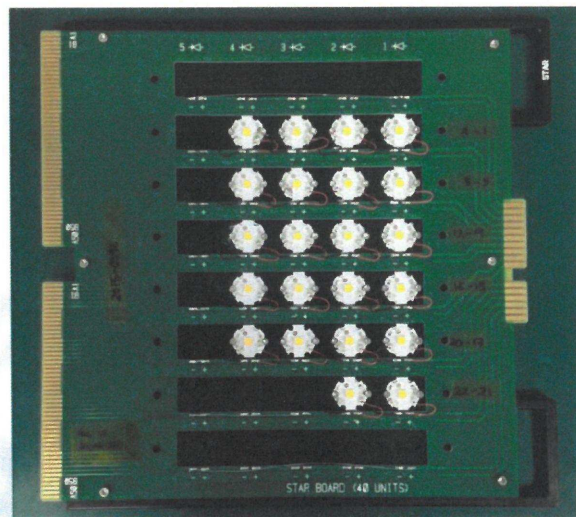


Figure 3: Test Board

6.0 T_s and T_{air} Measurement Point

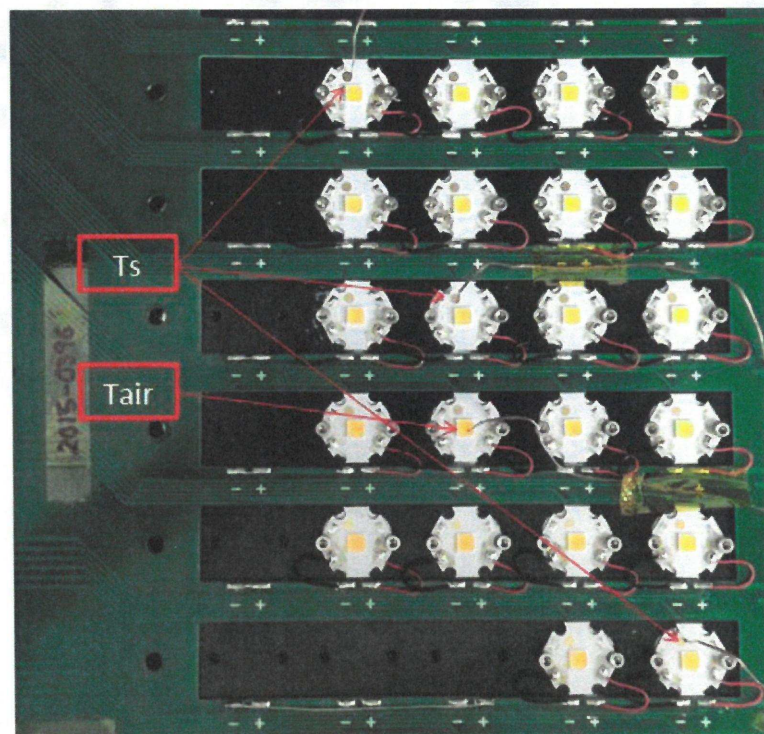


Figure 4: T_s and T_{air} Measurement Point

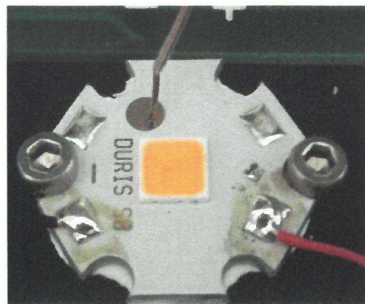


Figure 5: T_s Measurement Point

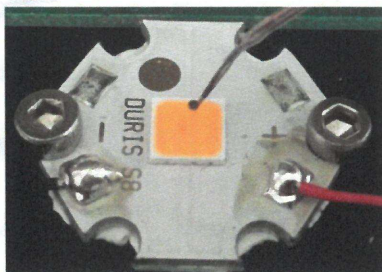


Figure 6: T_{air} Measurement Point (approximately 3mm above LED light source)

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.

8.0 Operating Cycle

8.1 Test Condition

Number of units: 22 units at 55°C, 22 units at 85°C, 22 and 22 units at 105°C

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
53°C	55°C	55°C	<60%
83°C	85°C	85°C	<60%
103°C	105°C	105°C	<60%
103°C	105°C	105°C	<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 5°C 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 17.

13.0 Lumen maintenance data for each individual LED light source

Please refer to section 17.

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:

$T_s = 55^\circ\text{C}$:

24, 48, 168, 500, 1000, 2000, 3000, 4000, 5000, 6000, 7000, 8000 and 9000 hour.

$T_s = 85^\circ\text{C}$:

24, 48, 168, 500, 1000, 2000, 3000, 4000, 5000, 6000, 7000, 8000 and 9000 hour.

$T_s = 105^\circ\text{C}$:

24, 48, 168, 500, 1000, 2000, 3000, 4000, 5000, 6000, 7000, 8000 and 9000 hour.

$T_s = 105^\circ\text{C}$:

24, 48, 168, 500, 1000, 2000, 3000, 4000, 5000, 6000, 7000, 8000 and 9000 hour.

16.0 Chromaticity shift reported over the measurement time

Please refer to section 17.

17.0 Test results

17.1 Graphic charts

Lumen maintenance ($I_F = 200\text{mA}$) – Normalized to 0 h

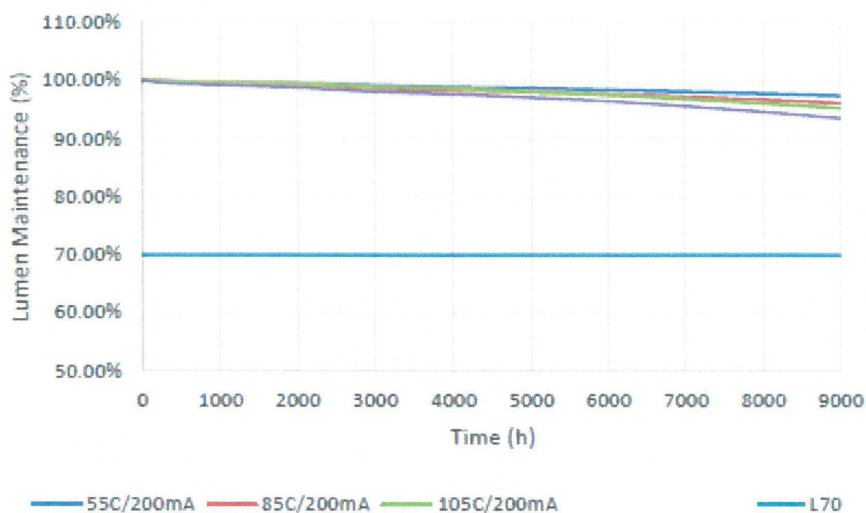


Figure 7: Lumen maintenance

Chromaticity shift Du^*v^* ($I_F = 200\text{mA}$) – Normalize to 0 h

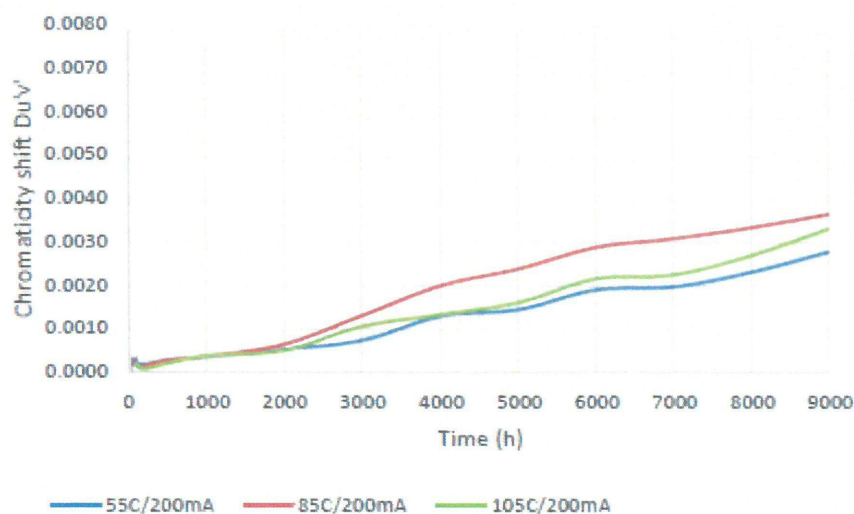


Figure 8: Chromaticity shift Du^*v^*

17.2 Tables

$T_s = T_{air} = 55^{\circ}\text{C}$, $I_f = 200\text{mA}$; $T_s \geq 53^{\circ}\text{C}$ and $T_{air} \geq 50^{\circ}\text{C}$ 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	24h	48h	168h	500h	1000h	2000h	3000h	4000h	5000h	6000h	7000h	8000h	9000h		
1	31.88	502.70	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%		
2	31.89	503.25	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%		
3	31.72	505.52	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%		
4	31.51	502.28	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%		
5	31.87	506.32	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%		
6	31.85	507.35	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%		
7	31.82	505.77	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%		
8	32.14	502.22	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%		
9	31.64	500.54	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%		
10	31.72	503.06	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%		
11	31.37	508.49	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%		
12	31.71	501.65	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%		
13	31.57	505.70	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%		
14	31.99	502.32	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%		
15	31.87	508.24	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%		
16	31.93	502.36	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%		
17	31.69	504.92	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%		
18	31.64	504.43	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%		
19	31.53	502.28	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%		
20	31.86	503.20	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%		
21	32.20	503.09	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%		
22	32.04	504.52	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%		
median	31.84	503.22	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%		
average	31.79	504.10	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%		
std. dev.	0.21	2.19	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%		
min	31.37	500.54	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%		
max	32.20	508.49	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%		

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

Unit	CCT [K] 0h	u' 0h	v' 0h	Measurement Time of Chromaticity Shift $Du'v'$															
				0h	24h	48h	168h	500h	1000h	2000h	3000h	4000h	5000h	6000h	7000h	8000h	9000h		
1	3533	0.2319	0.5188	0.0000	0.0001	0.0003	0.0001	0.0003	0.0005	0.0007	0.0009	0.0013	0.0016	0.0021	0.0023	0.0023	0.0027	0.0031	
2	3547	0.2316	0.5184	0.0000	0.0001	0.0002	0.0001	0.0002	0.0004	0.0005	0.0006	0.0010	0.0012	0.0016	0.0015	0.0015	0.0019	0.0023	
3	3538	0.2311	0.5206	0.0000	0.0001	0.0002	0.0001	0.0002	0.0004	0.0004	0.0004	0.0008	0.0010	0.0015	0.0015	0.0015	0.0019	0.0023	
4	3537	0.2320	0.5181	0.0000	0.0001	0.0003	0.0002	0.0003	0.0003	0.0004	0.0005	0.0011	0.0013	0.0018	0.0020	0.0020	0.0023	0.0027	
5	3569	0.2305	0.5194	0.0000	0.0001	0.0002	0.0002	0.0003	0.0003	0.0006	0.0012	0.0020	0.0022	0.0026	0.0025	0.0025	0.0028	0.0033	
6	3590	0.2301	0.5185	0.0000	0.0000	0.0002	0.0002	0.0003	0.0004	0.0006	0.0008	0.0016	0.0018	0.0023	0.0025	0.0025	0.0028	0.0033	
7	3594	0.2305	0.5171	0.0000	0.0000	0.0002	0.0002	0.0003	0.0004	0.0006	0.0009	0.0018	0.0021	0.0026	0.0024	0.0024	0.0027	0.0032	
8	3535	0.2322	0.5179	0.0000	0.0000	0.0002	0.0002	0.0003	0.0004	0.0006	0.0009	0.0018	0.0021	0.0026	0.0024	0.0024	0.0027	0.0032	
9	3461	0.2333	0.5217	0.0000	0.0001	0.0003	0.0002	0.0003	0.0002	0.0003	0.0005	0.0010	0.0012	0.0017	0.0019	0.0019	0.0023	0.0028	
10	3484	0.2326	0.5213	0.0000	0.0000	0.0002	0.0002	0.0006	0.0003	0.0003	0.0002	0.0008	0.0006	0.0010	0.0011	0.0011	0.0015	0.0020	
11	3608	0.2296	0.5184	0.0000	0.0001	0.0003	0.0002	0.0002	0.0003	0.0003	0.0006	0.0007	0.0009	0.0014	0.0015	0.0015	0.0018	0.0023	
12	3502	0.2326	0.5197	0.0000	0.0000	0.0003	0.0002	0.0003	0.0002	0.0004	0.0004	0.0011	0.0013	0.0018	0.0020	0.0020	0.0024	0.0029	
13	3569	0.2307	0.5188	0.0000	0.0000	0.0002	0.0002	0.0003	0.0005	0.0009	0.0015	0.0023	0.0022	0.0024	0.0024	0.0024	0.0027	0.0033	
14	3531	0.2323	0.5180	0.0000	0.0000	0.0005	0.0001	0.0004	0.0009	0.0014	0.0012	0.0015	0.0013	0.0016	0.0017	0.0017	0.0019	0.0023	
15	3563	0.2302	0.5206	0.0000	0.0001	0.0003	0.0002	0.0002	0.0003	0.0004	0.0009	0.0014	0.0014	0.0018	0.0017	0.0017	0.0020	0.0024	
16	3533	0.2321	0.5183	0.0000	0.0001	0.0002	0.0002	0.0003	0.0005	0.0009	0.0015	0.0026	0.0024	0.0025	0.0023	0.0023	0.0026	0.0032	
17	3524	0.2312	0.5217	0.0000	0.0000	0.0003	0.0002	0.0003	0.0003	0.0004	0.0006	0.0009	0.0011	0.0016	0.0015	0.0015	0.0019	0.0024	
18	3538	0.2315	0.5194	0.0000	0.0000	0.0003	0.0002	0.0003	0.0003	0.0004	0.0006	0.0010	0.0012	0.0017	0.0018	0.0018	0.0022	0.0029	
19	3499	0.2324	0.5205	0.0000	0.0000	0.0002	0.0002	0.0003	0.0002	0.0003	0.0005	0.0008	0.0009	0.0013	0.0013	0.0013	0.0017	0.0022	
20	3545	0.2315	0.5187	0.0000	0.0000	0.0003	0.0002	0.0003	0.0003	0.0004	0.0005	0.0010	0.0011	0.0017	0.0017	0.0017	0.0021	0.0026	
21	3534	0.2320	0.5185	0.0000	0.0001	0.0003	0.0002	0.0003	0.0004	0.0006	0.0007	0.0013	0.0019	0.0027	0.0027	0.0029	0.0031	0.0037	
22	3560	0.2311	0.5186	0.0000	0.0000	0.0003	0.0002	0.0003	0.0002	0.0005	0.0006	0.0012	0.0016	0.0023	0.0023	0.0028	0.0030	0.0036	
median	3537	0.2316	0.5188	0.0000	0.0000	0.0003	0.0002	0.0003	0.0003	0.0004	0.0006	0.0012	0.0013	0.0018	0.0019	0.0019	0.0023	0.0028	
average	3541	0.2315	0.5192	0.0000	0.0001	0.0003	0.0002	0.0003	0.0004	0.0005	0.0007	0.0013	0.0015	0.0019	0.0020	0.0020	0.0023	0.0028	
std. dev.	35	0.0009	0.0013	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	3461	0.2296	0.5171	0.0000	0.0000	0.0002	0.0001	0.0002	0.0002	0.0003	0.0002	0.0007	0.0006	0.0010	0.0011	0.0011	0.0015	0.0020	
max	3608	0.2333	0.5217	0.0000	0.0001	0.0005	0.0002	0.0006	0.0009	0.0014	0.0015	0.0026	0.0024	0.0027	0.0029	0.0029	0.0031	0.0037	

$T_s = T_{air} = 55^{\circ}\text{C}$, $I_f = 200\text{mA}$; $T_s \geq 53^{\circ}\text{C}$ and $T_{air} \geq 50^{\circ}\text{C}$ 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
1	31.88	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%
2	31.89	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%
3	31.72	100.00%	99.87%	99.89%	99.91%	99.94%	99.92%	100.09%	100.04%	99.97%	99.99%	100.04%	100.08%	100.05%	100.08%
4	31.51	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%
5	31.87	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%
6	31.85	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%
7	31.82	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%
8	32.14	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%
9	31.64	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%
10	31.72	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%
11	31.37	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%
12	31.71	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%
13	31.57	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%
14	31.99	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%
15	31.87	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%
16	31.93	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%
17	31.69	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%
18	31.64	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%
19	31.53	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%
20	31.86	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%
21	32.20	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%
22	32.04	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%
median	31.84	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%
average	31.79	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%
std. dev.	0.21	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%
min	31.37	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%
max	32.20	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%

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

Unit	VF [V] 0h	Flux [lm] 0h	Measurement Time of Lumen Maintenance													
			0h	24h	48h	168h	500h	1000h	2000h	3000h	4000h	5000h	6000h	7000h	8000h	9000h
1	31.75	503.46	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%
2	31.85	503.62	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%
3	31.92	502.36	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%
4	31.63	501.19	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%
5	31.78	504.28	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%
6	31.68	504.80	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%
7	31.74	506.00	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%
8	31.72	501.96	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%
9	31.95	503.36	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%
10	31.69	505.61	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%
11	31.70	509.09	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%
12	31.73	505.33	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%
13	31.54	507.79	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%
14	31.49	505.95	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%
15	32.18	506.97	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%
16	31.61	504.30	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%
17	31.68	504.46	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%
18	31.85	504.15	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%
19	31.63	505.64	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%
20	31.84	501.53	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%
21	31.72	507.39	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%
22	31.73	503.56	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%
median	31.73	504.38	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%
average	31.75	504.67	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%
std. dev.	0.15	2.05	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%
min	31.49	501.19	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%
max	32.18	509.09	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%

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

Unit	CCT [K]	u' 0h	v' 0h	Measurement Time of Chromaticity Shift Du'v'															
				0h	24h	48h	168h	500h	1000h	2000h	3000h	4000h	5000h	6000h	7000h	8000h	9000h		
1	3561	0.2312	0.5182	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		
2	3512	0.2320	0.5204	0.0000	0.0002	0.0002	0.0001	0.0003	0.0003	0.0006	0.0015	0.0025	0.0027	0.0031	0.0031	0.0031	0.0036		
3	3548	0.2320	0.5172	0.0000	0.0002	0.0002	0.0001	0.0003	0.0003	0.0008	0.0017	0.0023	0.0024	0.0028	0.0029	0.0031	0.0033		
4	3452	0.2330	0.5235	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		
5	3574	0.2310	0.5175	0.0000	0.0002	0.0002	0.0001	0.0003	0.0004	0.0008	0.0012	0.0019	0.0025	0.0032	0.0035	0.0038	0.0041		
6	3569	0.2308	0.5180	0.0000	0.0002	0.0002	0.0001	0.0003	0.0003	0.0005	0.0011	0.0020	0.0025	0.0030	0.0032	0.0035	0.0039		
7	3550	0.2308	0.5202	0.0000	0.0002	0.0002	0.0001	0.0003	0.0003	0.0005	0.0012	0.0022	0.0027	0.0032	0.0033	0.0035	0.0038		
8	3505	0.2325	0.5198	0.0001	0.0001	0.0001	0.0001	0.0003	0.0003	0.0009	0.0015	0.0024	0.0026	0.0029	0.0030	0.0032	0.0034		
9	3480	0.2321	0.5232	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		
10	3567	0.2307	0.5189	0.0000	0.0002	0.0002	0.0002	0.0003	0.0003	0.0005	0.0011	0.0016	0.0023	0.0030	0.0034	0.0037	0.0040		
11	3570	0.2300	0.5206	0.0000	0.0002	0.0002	0.0002	0.0003	0.0003	0.0004	0.0006	0.0012	0.0022	0.0030	0.0034	0.0037	0.0040		
12	3520	0.2312	0.5219	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		
13	3469	0.2296	0.5182	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		
14	3580	0.2305	0.5184	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		
15	3543	0.2306	0.5214	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		
16	3540	0.2314	0.5194	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		
17	3526	0.2316	0.5204	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		
18	3572	0.2313	0.5169	0.0000	0.0002	0.0002	0.0001	0.0003	0.0003	0.0008	0.0015	0.0025	0.0028	0.0033	0.0033	0.0035	0.0038		
19	3542	0.2310	0.5204	0.0000	0.0002	0.0002	0.0001	0.0003	0.0003	0.0008	0.0011	0.0017	0.0023	0.0029	0.0033	0.0036	0.0039		
20	3515	0.2326	0.5184	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		
21	3557	0.2305	0.5206	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		
22	3558	0.2313	0.5181	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		
median	3549	0.2312	0.5196	0.0000	0.0002	0.0001	0.0001	0.0003	0.0003	0.0006	0.0012	0.0020	0.0023	0.0028	0.0031	0.0034	0.0037		
average	3543	0.2313	0.5196	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		
std. dev.	36	0.0008	0.0018	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		
min	3452	0.2296	0.5169	0.0000	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002	0.0004	0.0013	0.0019	0.0026	0.0029	0.0031	0.0033		
max	3609	0.2330	0.5235	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		

$T_s = T_{air} = 85^{\circ}\text{C}$, $I_f = 200\text{mA}$; $T_s \geq 83^{\circ}\text{C}$ and $T_{air} \geq 80^{\circ}\text{C}$ 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	24h	48h	168h	500h	1000h	2000h	3000h	4000h	5000h	6000h	7000h	8000h	9000h
1	31.75	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%
2	31.85	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%
3	31.92	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%
4	31.63	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%
5	31.78	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%
6	31.68	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%
7	31.74	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%
8	31.72	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%
9	31.95	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%
10	31.69	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%
11	31.70	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%
12	31.73	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%
13	31.54	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%
14	31.49	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%
15	32.18	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%
16	31.61	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%
17	31.68	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%
18	31.85	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%
19	31.63	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%
20	31.84	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%
21	31.72	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%
22	31.73	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%
median	31.73	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%
average	31.75	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%
std. dev.	0.15	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%
min	31.49	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%
max	32.18	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%

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

Unit	VF [V] 0h	Flux [lm] 0h	Measurement Time of Lumen Maintenance													
			0h	24h	48h	168h	500h	1000h	2000h	3000h	4000h	5000h	6000h	7000h	8000h	9000h
1	32.25	505.88	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%
2	31.63	502.91	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%
3	31.92	506.36	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%
4	31.62	501.92	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%
5	31.87	507.61	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%
6	31.92	504.48	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%
7	31.86	505.01	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%
8	31.73	510.38	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%
9	31.91	504.75	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%
10	31.95	504.45	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%
11	31.67	509.80	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%
12	32.24	504.06	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%
13	32.10	506.41	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%
14	31.89	510.02	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%
15	31.81	506.70	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%
16	31.72	501.81	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%
17	31.95	503.13	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%
18	31.90	505.06	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%
19	31.81	506.27	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%
20	31.58	502.32	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%
21	31.88	506.68	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%
22	32.11	504.06	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%
median	31.88	505.04	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%
average	31.88	505.46	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%
std. dev.	0.18	2.47	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%
min	31.58	501.81	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%
max	32.25	510.38	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%

$T_s = T_{air} = 105^{\circ}C$, $I_f = 200mA$; $T_s \geq 103^{\circ}C$ and $T_{air} \geq 100^{\circ}C$ 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	1h	0h	1h	0h	1h	168h	48h	24h	0h	50h	1000h	2000h	3000h	4000h	5000h	6000h	7000h	8000h	9000h		
1	3534	0.2311	0.5209	0.0000	0.0000	0.0003	0.0003	0.0003	0.0000	0.0002	0.0001	0.0001	0.0003	0.0005	0.0013	0.0014	0.0016	0.0016	0.0022	0.0024	0.0029	0.0035
2	3549	0.2316	0.5182	0.0000	0.0000	0.0003	0.0003	0.0003	0.0000	0.0001	0.0003	0.0003	0.0005	0.0007	0.0013	0.0016	0.0019	0.0024	0.0025	0.0029	0.0035	
3	3555	0.2308	0.5200	0.0000	0.0000	0.0003	0.0003	0.0000	0.0000	0.0000	0.0002	0.0004	0.0004	0.0009	0.0012	0.0014	0.0015	0.0021	0.0021	0.0025	0.0031	
4	3543	0.2321	0.5172	0.0000	0.0000	0.0003	0.0003	0.0000	0.0000	0.0001	0.0003	0.0006	0.0006	0.0012	0.0012	0.0014	0.0016	0.0022	0.0022	0.0026	0.0032	
5	3610	0.2295	0.5184	0.0000	0.0000	0.0003	0.0003	0.0000	0.0000	0.0001	0.0002	0.0003	0.0004	0.0010	0.0013	0.0015	0.0015	0.0021	0.0021	0.0026	0.0031	
6	3572	0.2312	0.5173	0.0000	0.0000	0.0003	0.0004	0.0000	0.0000	0.0001	0.0004	0.0006	0.0011	0.0019	0.0021	0.0024	0.0029	0.0031	0.0031	0.0035	0.0041	
7	3541	0.2311	0.5203	0.0000	0.0000	0.0003	0.0000	0.0000	0.0001	0.0003	0.0001	0.0004	0.0005	0.0012	0.0012	0.0014	0.0017	0.0023	0.0024	0.0028	0.0035	
8	3655	0.2285	0.5172	0.0000	0.0000	0.0003	0.0003	0.0000	0.0000	0.0001	0.0002	0.0002	0.0004	0.0007	0.0007	0.0010	0.0010	0.0012	0.0018	0.0018	0.0022	0.0028
9	3578	0.2309	0.5175	0.0000	0.0000	0.0003	0.0003	0.0000	0.0000	0.0001	0.0002	0.0004	0.0007	0.0007	0.0010	0.0010	0.0012	0.0018	0.0018	0.0022	0.0028	
10	3517	0.2317	0.5208	0.0000	0.0000	0.0003	0.0003	0.0000	0.0000	0.0001	0.0002	0.0002	0.0003	0.0009	0.0013	0.0017	0.0023	0.0024	0.0029	0.0035	0.0041	
11	3628	0.2291	0.5180	0.0000	0.0000	0.0003	0.0003	0.0000	0.0000	0.0001	0.0002	0.0005	0.0005	0.0008	0.0009	0.0013	0.0019	0.0018	0.0023	0.0029	0.0035	
12	3550	0.2313	0.5188	0.0000	0.0000	0.0003	0.0003	0.0000	0.0000	0.0001	0.0003	0.0006	0.0012	0.0020	0.0022	0.0024	0.0029	0.0030	0.0034	0.0040	0.0040	
13	3533	0.2308	0.5219	0.0000	0.0000	0.0003	0.0003	0.0000	0.0000	0.0001	0.0002	0.0004	0.0005	0.0012	0.0015	0.0018	0.0025	0.0026	0.0031	0.0038	0.0038	
14	3591	0.2293	0.5206	0.0000	0.0000	0.0004	0.0003	0.0000	0.0000	0.0000	0.0002	0.0004	0.0004	0.0010	0.0012	0.0017	0.0022	0.0023	0.0029	0.0033	0.0033	
15	3546	0.2310	0.5200	0.0000	0.0000	0.0003	0.0003	0.0000	0.0000	0.0001	0.0002	0.0004	0.0005	0.0010	0.0014	0.0017	0.0023	0.0024	0.0029	0.0036	0.0036	
16	3505	0.2324	0.5200	0.0000	0.0000	0.0003	0.0003	0.0000	0.0000	0.0001	0.0002	0.0003	0.0004	0.0010	0.0013	0.0016	0.0020	0.0022	0.0026	0.0034	0.0034	
17	3553	0.2316	0.5177	0.0000	0.0000	0.0004	0.0004	0.0000	0.0000	0.0001	0.0003	0.0004	0.0006	0.0012	0.0015	0.0018	0.0024	0.0025	0.0030	0.0037	0.0037	
18	3572	0.2309	0.5179	0.0000	0.0000	0.0004	0.0003	0.0000	0.0000	0.0001	0.0003	0.0004	0.0005	0.0011	0.0014	0.0017	0.0023	0.0024	0.0028	0.0036	0.0036	
19	3507	0.2312	0.5231	0.0000	0.0000	0.0003	0.0003	0.0000	0.0000	0.0001	0.0002	0.0003	0.0005	0.0008	0.0012	0.0018	0.0018	0.0023	0.0029	0.0036	0.0036	
20	3528	0.2320	0.5190	0.0000	0.0000	0.0004	0.0004	0.0000	0.0000	0.0001	0.0002	0.0003	0.0004	0.0010	0.0014	0.0016	0.0021	0.0022	0.0026	0.0035	0.0035	
21	3547	0.2305	0.5212	0.0000	0.0000	0.0003	0.0002	0.0000	0.0000	0.0001	0.0003	0.0002	0.0001	0.0006	0.0008	0.0011	0.0016	0.0016	0.0019	0.0026	0.0026	
22	3566	0.2313	0.5176	0.0000	0.0000	0.0004	0.0004	0.0000	0.0000	0.0002	0.0002	0.0001	0.0001	0.0004	0.0007	0.0009	0.0016	0.0017	0.0021	0.0027	0.0027	
median	3550	0.2311	0.5189	0.0000	0.0000	0.0003	0.0003	0.0000	0.0000	0.0001	0.0002	0.0004	0.0005	0.0010	0.0014	0.0017	0.0022	0.0023	0.0028	0.0035	0.0035	
average	3558	0.2309	0.5192	0.0000	0.0000	0.0003	0.0003	0.0000	0.0000	0.0001	0.0002	0.0004	0.0005	0.0011	0.0013	0.0016	0.0022	0.0023	0.0027	0.0034	0.0034	
std. dev.	37	0.0010	0.0017	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	0.0001	0.0001	0.0001	0.0004	0.0004	0.0004	0.0004	0.0005	0.0004	0.0004	
min	3505	0.2285	0.5172	0.0000	0.0000	0.0002	0.0002	0.0000	0.0000	0.0000	0.0001	0.0001	0.0001	0.0001	0.0004	0.0007	0.0009	0.0016	0.0016	0.0019	0.0026	
max	3655	0.2324	0.5231	0.0000	0.0000	0.0004	0.0004	0.0000	0.0000	0.0002	0.0004	0.0006	0.0012	0.0020	0.0022	0.0024	0.0029	0.0031	0.0031	0.0035	0.0041	

$T_s = T_{air} = 105^{\circ}\text{C}$, $I_f = 200\text{mA}$; $T_s \geq 103^{\circ}\text{C}$ and $T_{air} \geq 100^{\circ}\text{C}$ 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	24h	48h	168h	500h	1000h	2000h	3000h	4000h	5000h	6000h	7000h	8000h	9000h
1	32.25	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%
2	31.63	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%
3	31.92	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%
4	31.62	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%
5	31.87	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%
6	31.92	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%
7	31.86	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%
8	31.73	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%
9	31.91	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%
10	31.95	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%
11	31.67	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%
12	32.24	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%
13	32.10	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%
14	31.89	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%
15	31.81	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%
16	31.72	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%
17	31.95	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%
18	31.90	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%
19	31.81	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%
20	31.58	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%
21	31.88	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%
22	32.11	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%
median	31.88	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%
average	31.88	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%
std. dev.	0.18	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%
min	31.58	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%
max	32.25	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%

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

For Information Only!

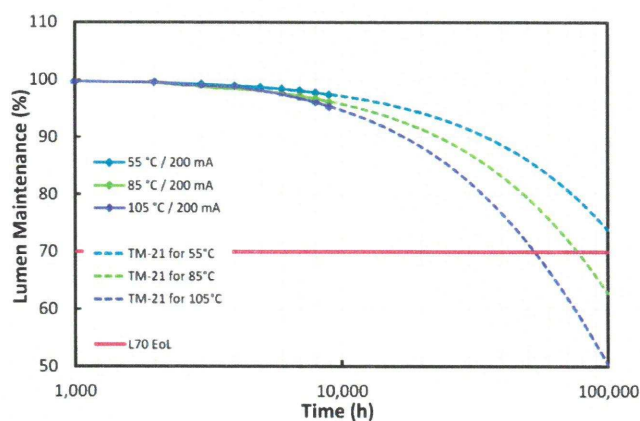
1. General Information

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
Case temperature (solder point)	$T_s = 55^\circ\text{C}$	$T_s = 85^\circ\text{C}$	$T_s = 105^\circ\text{C}$
α	3.051E-06	4.693E-06	7.015E-06
B	1.002E+00	1.004E+00	1.016E+00
Reported L70	> 54,000 hours	> 54,000 hours	53,141 hours

3. Graphic chart



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 conditions 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
- DURIS® S 8 GW P9LR35.PM Gen5 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



ment to any 3rd party in any form without the
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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.



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