

LM-80 Test Report

NF2L757DR

Issue Date: July 1, 2013	Revision Date: July 9, 2014
Test Initiation Date: April 24, 2013	Test Completion Date: June 30, 2014
Test Duration: 10,000 hours	Report Number: SQETMN558007

Customer Information:

Company Name: Nichia Corporation
 Address: 491-100, Oka, Kaminaka-cho, Anan-shi, Tokushima, 774-8601, JAPAN

Description of Test Samples:

Classification: LED Package
 Model Name: Warm White LED
 Model Number: NF2L757DR (Nominal CCT: 2700 K)

Test Summary:

Data Set	Case Temperature [T _s]	Ambient Temperature [T _A]	Drive Current [I _F]	Lumen Maintenance at 10,000 hours	Chromaticity Shift (Δu'v')	TM-21 Projection L ₇₀ (10K)
1	55 °C	> 50 °C	100 mA	98.1 %	0.0014	> 60600 hours
2	55 °C	> 50 °C	150 mA	98.3 %	0.0017	> 60400 hours
3	55 °C	> 50 °C	200 mA	98.2 %	0.0020	> 60500 hours
4	85 °C	> 80 °C	100 mA	96.4 %	0.0014	> 60600 hours
5	85 °C	> 80 °C	150 mA	96.3 %	0.0020	> 60400 hours
6	85 °C	> 80 °C	200 mA	93.9 %	0.0035	55900 hours
7	105 °C	> 100 °C	100 mA	92.3 %	0.0019	> 60600 hours
8	105 °C	> 100 °C	150 mA	93.4 %	0.0027	> 60400 hours
9	105 °C	> 100 °C	200 mA	90.7 %	0.0034	42800 hours

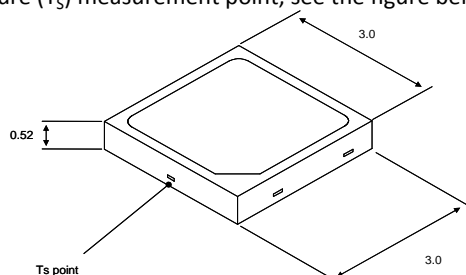
Approved Signatory:



Hitoshi TOHYAMA, Lab Manager

Nichia Corporation LED Testing Laboratory
 1-1, Tatsumi-cho, Anan-shi, TOKUSHIMA 774-0001, JAPAN

IES LM-80-08 Test Report Requirement :

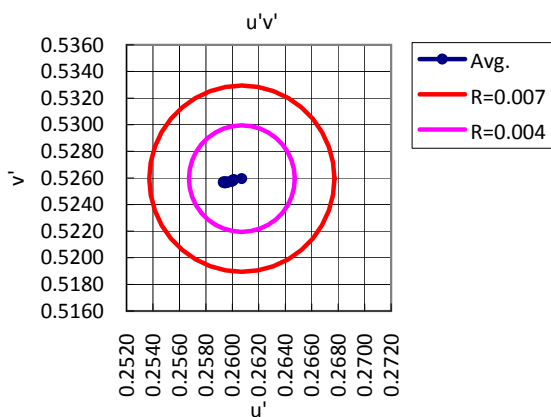
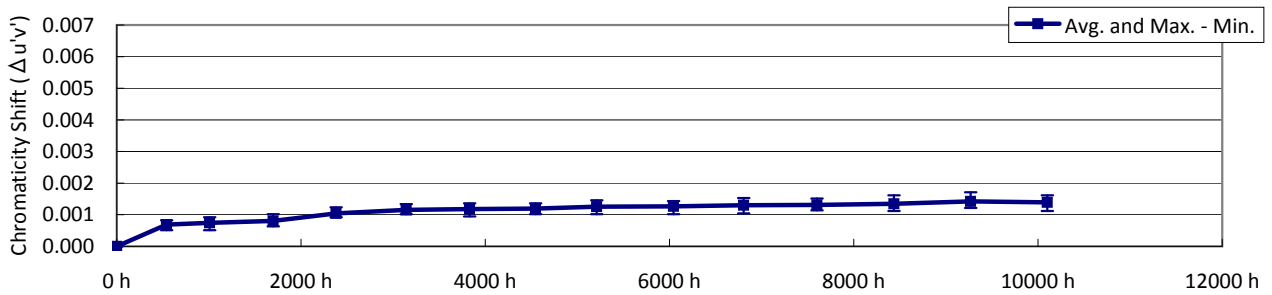
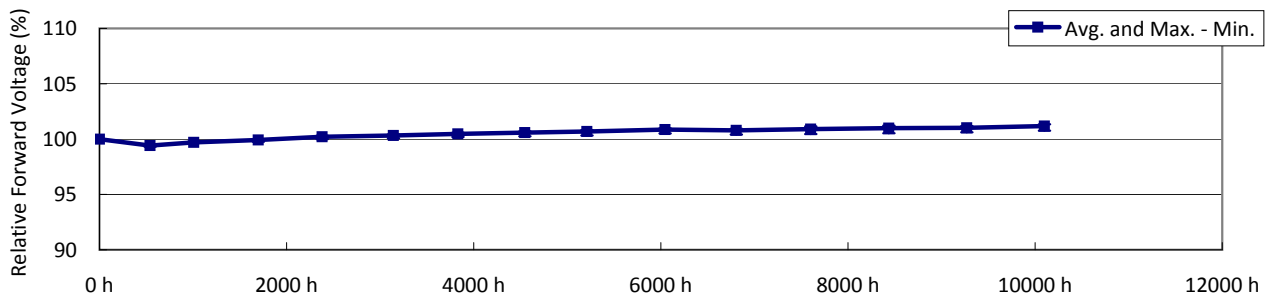
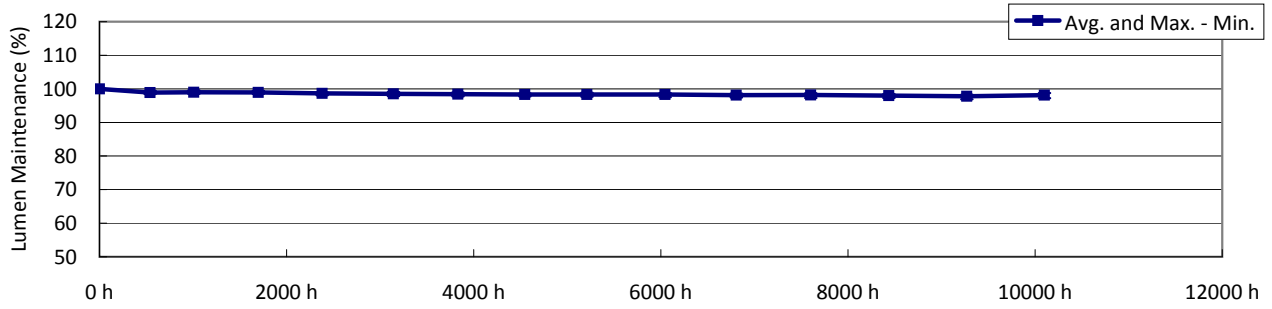
1. **Number of LED light sources tested**
See tables.
 2. **Description of LED light sources**
See Description of Test Samples
 3. **Description of auxiliary equipment**
Active cooling life test system
Consisting of small boxes, in which each box contains a reliability test board, and a water-cooled heat sink or a heater to control device temperature.
LED Tester
Consisting of an integrating sphere, a programmable current-source meter, and a spectroradiometer.
 4. **Operating cycle**
Constant direct current (DC).
 5. **Ambient conditions including airflow, temperature, and relative humidity**
Ambient Temperature (T_A) : See tables
Ambient temperature is the temperature of the air at a distance of 1.5 mm above the reliability test board.
Air flow : < 0.1 m/s
Relative Humidity : < 45 %
 6. **Case temperature (test point temperature)**
See tables.
For the case temperature (T_S) measurement point, see the figure below.
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7. **Drive current of the LED light sources during lifetime test**
See tables.
 8. **Initial luminous flux and forward voltage at photometric measurement current**
See tables.
 9. **Lumen maintenance data for each individual LED light source along with median value, standard deviation, minimum and maximum lumen maintenance value for all of the LED light sources.**
See tables.
 10. **Observation of LED light sources failures including the failure conditions and time of failure.**
No failure observed
 11. **LED light source monitoring interval**
See tables.
 12. **Photometric measurement uncertainty**
Flux measurement: 4.8 % ($k=2$)
Lumen maintenance: 1.8 % ($k=2$)
 13. **Chromaticity shift reported over the measurement time.**
See tables.

Data Set 1 : 55 °C, 100 mA

Actual Case Temperature [T _S]	56.8 °C
Actual Ambient Temperature [T _A]	55.5 °C
Drive Current [I _F]	100 mA
Measurement Current	100 mA

NOTES:

T_S and T_A were measured during initial setup.



Data Set 1 : 55 °C, 100 mA

Actual Case Temperature [T _s]	56.8 °C
Actual Ambient Temperature [T _A]	55.5 °C
Drive Current [I _F]	100 mA
Measurement Current	100 mA

NOTES:

 T_s and T_A were measured during initial setup.

TABLE 1-1
 Initial Characteristics

LED No.	Luminous flux	Forward voltage	CCT	CIE1931		CIE1976							
	Φ _v [lm]	V _F [V]	T _{CP} [K]	x	y	u'	v'						
1	71.3	6.04	2730	0.461	0.416	0.261	0.529						
2	70.2	6.03	2852	0.441	0.394	0.258	0.518						
3	70.5	6.03	2819	0.445	0.399	0.258	0.520						
4	70.0	6.02	2623	0.470	0.418	0.266	0.532						
5	69.4	6.03	2585	0.475	0.423	0.267	0.534						
6	71.0	6.02	2846	0.441	0.394	0.258	0.518						
7	68.7	6.05	2622	0.467	0.414	0.266	0.530						
8	72.0	6.02	2776	0.453	0.408	0.259	0.525						
9	71.3	6.03	2704	0.461	0.413	0.262	0.528						
10	70.1	6.03	2690	0.460	0.410	0.263	0.527						
11	70.2	6.03	2713	0.462	0.416	0.261	0.530						
12	70.7	6.04	2857	0.444	0.400	0.257	0.521						
13	71.5	6.02	2774	0.454	0.408	0.259	0.526						
14	69.8	6.03	2761	0.452	0.404	0.260	0.524						
15	71.1	6.03	2651	0.471	0.423	0.264	0.534						
16	70.5	6.03	2708	0.462	0.415	0.262	0.529						
17	69.0	6.03	2723	0.455	0.405	0.262	0.524						
18	71.9	6.03	2834	0.449	0.408	0.257	0.525						
19	72.0	6.01	2755	0.457	0.412	0.260	0.527						
20	70.7	6.02	2683	0.465	0.418	0.263	0.531						
21	70.7	6.05	2762	0.454	0.408	0.260	0.525						
22	70.2	6.04	2768	0.447	0.396	0.261	0.520						
23	70.0	6.03	2789	0.449	0.402	0.259	0.522						
24	70.4	6.03	2764	0.452	0.405	0.260	0.524						
25	70.4	6.03	2743	0.454	0.405	0.261	0.525						
n	25	25	25	25	25	25	25						
Avg.	70.6	6.03	2741	0.456	0.409	0.261	0.526						
Med.	70.5	6.03	2755	0.454	0.408	0.261	0.525						
σ	0.85	0.008	73.1	0.0093	0.0083	0.0027	0.0045						
Min.	68.7	6.01	2585	0.441	0.394	0.257	0.518						
Max.	72.0	6.05	2857	0.475	0.423	0.267	0.534						

Data Set 1 : 55 °C, 100 mA

Actual Case Temperature [T _s]	56.8 °C
Actual Ambient Temperature [T _A]	55.5 °C
Drive Current [I _F]	100 mA
Measurement Current	100 mA

NOTES:

T_s and T_A were measured during initial setup.

TABLE 1-2
Lumen Maintenance

LED No.	Lumen Maintenance % (Normalized to 100 % at 0 hours)														
	0 h	541 h	1008 h	1698 h	2380 h	3142 h	3830 h	4545 h	5210 h	6044 h	6805 h	7601 h	8436 h	9269 h	10100 h
1	100.0	99.1	99.3	99.2	98.8	98.8	98.7	98.5	98.6	98.8	98.6	98.7	98.4	98.3	98.4
2	100.0	98.6	98.8	98.7	98.5	98.3	98.3	98.1	98.2	98.4	98.3	98.4	98.1	97.9	98.1
3	100.0	98.7	98.9	98.7	98.7	98.4	98.3	98.2	98.3	98.5	98.4	98.4	98.1	97.9	98.3
4	100.0	98.8	98.9	98.8	98.7	98.4	98.3	98.2	98.2	98.3	98.1	98.2	97.8	97.4	97.9
5	100.0	98.8	98.9	98.8	98.8	98.5	98.4	98.5	98.5	98.5	98.3	98.4	98.2	98.1	98.7
6	100.0	99.0	99.0	98.9	98.7	98.6	98.4	98.5	98.5	98.2	98.1	98.3	98.0	97.9	98.6
7	100.0	98.7	98.8	98.6	98.3	98.3	98.2	98.1	98.1	97.8	97.6	97.7	97.4	97.5	98.1
8	100.0	98.7	98.9	98.9	98.4	98.6	98.5	98.3	98.4	98.1	97.9	97.9	97.6	97.7	98.0
9	100.0	99.4	99.5	99.4	98.8	99.0	98.8	98.5	98.6	98.5	98.2	98.2	98.0	98.0	98.1
10	100.0	99.3	99.5	99.4	98.9	99.1	98.9	98.7	98.8	98.8	98.6	98.5	98.3	98.3	98.3
11	100.0	98.7	99.0	98.9	98.6	98.4	98.4	98.3	98.2	98.3	98.1	98.0	97.9	97.6	97.7
12	100.0	99.0	99.1	99.1	98.9	98.7	98.6	98.5	98.6	98.7	98.5	98.5	98.4	98.2	98.3
13	100.0	99.0	99.2	99.1	98.9	98.7	98.7	98.5	98.6	98.7	98.6	98.7	98.5	98.2	98.5
14	100.0	98.8	98.8	98.7	98.4	98.2	98.2	98.0	98.0	97.9	97.8	97.9	97.6	97.4	97.7
15	100.0	99.0	99.1	99.1	98.8	98.6	98.5	98.4	98.4	98.2	98.2	98.2	98.1	97.9	98.4
16	100.0	98.6	98.6	98.6	98.4	98.2	98.1	98.3	98.1	97.8	97.7	97.7	97.7	97.5	98.1
17	100.0	98.7	98.7	98.6	98.4	98.1	98.0	98.1	97.9	97.5	97.4	97.3	97.3	97.0	97.6
18	100.0	99.2	99.2	99.2	98.9	98.8	98.7	98.6	98.6	98.3	98.2	98.0	98.1	97.8	98.2
19	100.0	98.8	99.1	99.0	98.7	98.6	98.6	98.5	98.5	98.3	98.1	98.0	98.1	97.7	98.0
20	100.0	99.0	99.2	99.2	98.8	98.7	98.6	98.5	98.5	98.4	98.2	98.1	98.1	97.7	97.9
21	100.0	98.8	98.9	98.9	98.5	98.4	98.4	98.3	98.3	98.4	98.3	98.3	98.2	97.8	97.9
22	100.0	99.1	99.2	99.2	98.9	98.7	98.7	98.6	98.5	98.7	98.5	98.5	98.3	97.9	97.9
23	100.0	98.7	98.7	98.8	98.4	98.3	98.3	98.2	98.2	98.4	98.2	98.2	98.2	97.8	98.1
24	100.0	98.4	98.5	98.5	98.1	97.9	97.8	97.7	97.6	97.7	97.5	97.5	97.4	96.9	97.2
25	100.0	98.9	99.0	99.0	98.7	98.5	98.5	98.6	98.4	98.4	98.3	98.3	98.3	98.0	98.5
n	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Avg.	100.0	98.9	99.0	98.9	98.6	98.5	98.4	98.3	98.3	98.3	98.1	98.2	98.0	97.8	98.1
Med.	100.0	98.8	99.0	98.9	98.7	98.5	98.4	98.4	98.4	98.4	98.2	98.2	98.1	97.8	98.1
σ	0.00	0.23	0.25	0.25	0.22	0.27	0.27	0.23	0.27	0.34	0.34	0.36	0.33	0.35	0.34
Min.	100.0	98.4	98.5	98.5	98.1	97.9	97.8	97.7	97.6	97.5	97.4	97.3	97.3	96.9	97.2
Max.	100.0	99.4	99.5	99.4	98.9	99.1	98.9	98.7	98.8	98.8	98.6	98.7	98.5	98.3	98.7

TM-21 Projection

Time	4545 h	5210 h	6044 h	6805 h	7601 h	8436 h	9269 h	10100 h							
ln(Avg.)	-0.0167	-0.0168	-0.0172	-0.0187	-0.0186	-0.0203	-0.0225	-0.0191							

Test duration used	4545 h	to	10100 h
B	0.9872		
α	8.1031E-07		
R ²	0.6527		
Calculated L ₇₀ (10K)	424000	hours	
Reported L ₇₀ (10K)	> 60600	hours	

Curve-fit equation:

$$\Phi(t) = B \exp(-\alpha t)$$

Lumen maintenance life equation:

$$L_{70} = \ln(B/0.7) / \alpha$$

Data Set 1 : 55 °C, 100 mA

Actual Case Temperature [T _s]	56.8 °C
Actual Ambient Temperature [T _A]	55.5 °C
Drive Current [I _F]	100 mA
Measurement Current	100 mA

NOTES:

T_s and T_A were measured during initial setup.

TABLE 1-3
Forward Voltage

LED No.	Relative Forward Voltage % (Normalized to 100 % at 0 hours)														
	0 h	541 h	1008 h	1698 h	2380 h	3142 h	3830 h	4545 h	5210 h	6044 h	6805 h	7601 h	8436 h	9269 h	10100 h
1	100.0	99.4	99.7	100.0	100.3	100.4	100.5	100.7	100.7	100.9	100.9	101.0	101.0	101.1	101.3
2	100.0	99.4	99.8	100.0	100.3	100.4	100.5	100.7	100.8	101.0	100.9	101.0	101.0	101.1	101.3
3	100.0	99.4	99.7	99.9	100.2	100.4	100.5	100.6	100.7	100.9	100.8	100.9	101.0	101.1	101.2
4	100.0	99.3	99.7	99.9	100.2	100.3	100.5	100.6	100.7	100.9	100.8	100.9	101.0	101.0	101.2
5	100.0	99.4	99.7	100.0	100.3	100.4	100.5	100.7	100.8	100.9	100.9	100.9	101.0	101.1	101.3
6	100.0	99.3	99.6	99.9	100.2	100.3	100.4	100.5	100.7	100.9	100.7	100.8	100.9	101.0	101.2
7	100.0	99.4	99.7	99.9	100.2	100.3	100.4	100.5	100.6	100.8	100.7	100.8	100.8	100.9	101.1
8	100.0	99.4	99.7	99.8	100.0	100.1	100.2	100.2	100.3	100.5	100.4	100.5	100.5	100.6	100.8
9	100.0	99.3	99.6	99.9	100.2	100.3	100.5	100.6	100.7	100.9	100.7	100.8	100.9	101.0	101.2
10	100.0	99.3	99.7	99.9	100.2	100.3	100.5	100.6	100.7	100.8	100.8	100.8	100.9	101.0	101.2
11	100.0	99.4	99.6	99.9	100.2	100.2	100.4	100.5	100.6	100.7	100.7	100.8	100.9	100.9	101.0
12	100.0	99.4	99.7	99.9	100.2	100.3	100.5	100.6	100.7	100.9	100.8	101.0	101.1	101.1	101.2
13	100.0	99.4	99.7	99.9	100.2	100.3	100.5	100.6	100.7	100.9	100.8	100.9	101.1	101.1	101.2
14	100.0	99.4	99.7	100.0	100.3	100.4	100.5	100.7	100.8	101.0	100.9	101.0	101.2	101.2	101.3
15	100.0	99.4	99.7	99.9	100.2	100.4	100.5	100.6	100.7	100.9	100.9	100.9	101.1	101.1	101.2
16	100.0	99.4	99.7	100.0	100.3	100.4	100.6	100.7	100.8	101.0	100.9	101.1	101.2	101.2	101.3
17	100.0	99.4	99.7	99.9	100.2	100.3	100.5	100.5	100.7	100.8	100.8	100.9	101.0	101.0	101.1
18	100.0	99.5	99.7	100.0	100.3	100.4	100.6	100.7	100.7	100.9	100.9	101.0	101.1	101.1	101.3
19	100.0	99.5	99.7	99.8	100.1	100.2	100.3	100.4	100.5	100.6	100.5	100.6	100.7	100.7	100.9
20	100.0	99.4	99.7	99.9	100.1	100.2	100.4	100.5	100.6	100.7	100.7	100.7	100.9	100.9	101.0
21	100.0	99.4	99.8	100.0	100.3	100.4	100.6	100.7	100.8	100.9	100.9	101.0	101.1	101.1	101.3
22	100.0	99.4	99.7	100.0	100.2	100.4	100.5	100.6	100.7	100.9	100.9	101.0	101.1	101.1	101.2
23	100.0	99.4	99.7	100.0	100.2	100.4	100.5	100.6	100.7	100.9	100.9	101.0	101.1	101.1	101.3
24	100.0	99.5	99.7	100.0	100.2	100.4	100.5	100.6	100.7	100.9	100.8	100.9	101.1	101.1	101.2
25	100.0	99.4	99.7	99.9	100.2	100.4	100.5	100.6	100.7	100.9	100.9	101.1	101.1	101.1	101.2
n	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Avg.	100.0	99.4	99.7	99.9	100.2	100.3	100.5	100.6	100.7	100.9	100.8	100.9	101.0	101.0	101.2
Med.	100.0	99.4	99.7	99.9	100.2	100.4	100.5	100.6	100.7	100.9	100.8	100.9	101.0	101.1	101.2
σ	0.00	0.05	0.04	0.05	0.07	0.08	0.09	0.11	0.11	0.11	0.12	0.15	0.15	0.13	0.14
Min.	100.0	99.3	99.6	99.8	100.0	100.1	100.2	100.2	100.3	100.5	100.4	100.5	100.5	100.6	100.8
Max.	100.0	99.5	99.8	100.0	100.3	100.4	100.6	100.7	100.8	101.0	100.9	101.1	101.2	101.2	101.3

Data Set 1 : 55 °C, 100 mA

Actual Case Temperature [T _s]	56.8 °C
Actual Ambient Temperature [T _A]	55.5 °C
Drive Current [I _F]	100 mA
Measurement Current	100 mA

NOTES:

T_s and T_A were measured during initial setup.

TABLE 1-4
Chromaticity Shift

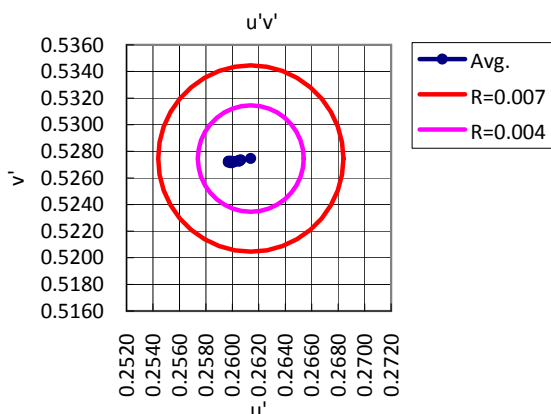
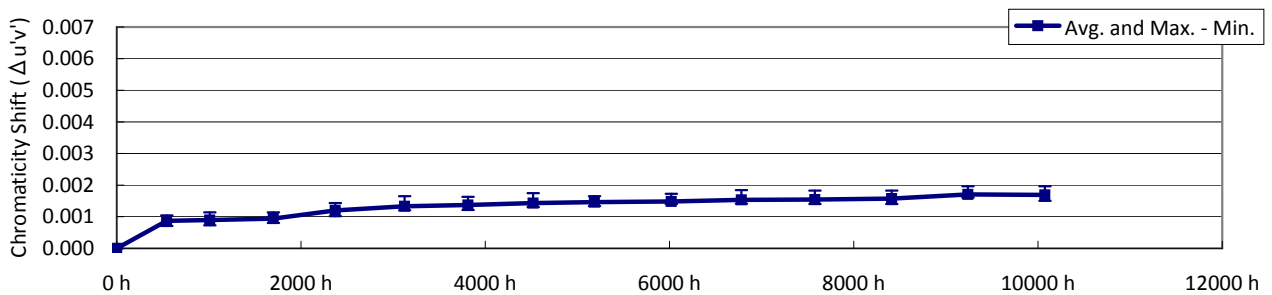
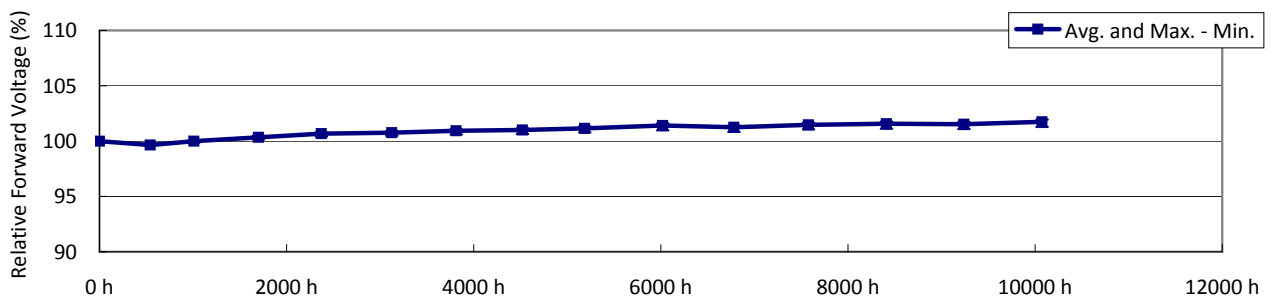
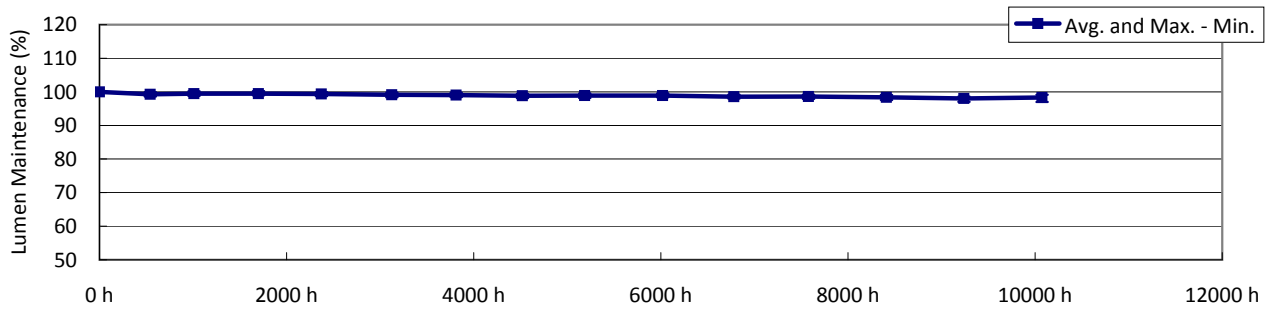
LED No.	Chromaticity Shift Δu'v'														
	0 h	541 h	1008 h	1698 h	2380 h	3142 h	3830 h	4545 h	5210 h	6044 h	6805 h	7601 h	8436 h	9269 h	10100 h
1	0.0000	0.0007	0.0007	0.0008	0.0010	0.0011	0.0012	0.0011	0.0012	0.0012	0.0012	0.0012	0.0012	0.0013	0.0013
2	0.0000	0.0007	0.0007	0.0008	0.0010	0.0011	0.0011	0.0012	0.0012	0.0012	0.0013	0.0013	0.0013	0.0014	0.0014
3	0.0000	0.0006	0.0007	0.0007	0.0010	0.0011	0.0011	0.0012	0.0012	0.0012	0.0013	0.0012	0.0014	0.0014	0.0014
4	0.0000	0.0007	0.0008	0.0008	0.0011	0.0012	0.0012	0.0012	0.0013	0.0013	0.0013	0.0013	0.0014	0.0014	0.0014
5	0.0000	0.0007	0.0007	0.0008	0.0010	0.0011	0.0011	0.0011	0.0012	0.0012	0.0013	0.0012	0.0013	0.0014	0.0013
6	0.0000	0.0008	0.0009	0.0009	0.0010	0.0011	0.0012	0.0011	0.0012	0.0012	0.0013	0.0012	0.0014	0.0014	0.0013
7	0.0000	0.0008	0.0009	0.0010	0.0012	0.0013	0.0013	0.0013	0.0014	0.0014	0.0014	0.0014	0.0015	0.0015	0.0014
8	0.0000	0.0007	0.0008	0.0008	0.0010	0.0012	0.0012	0.0012	0.0012	0.0012	0.0013	0.0012	0.0013	0.0013	0.0013
9	0.0000	0.0007	0.0007	0.0009	0.0011	0.0012	0.0013	0.0014	0.0015	0.0014	0.0014	0.0015	0.0015	0.0015	0.0015
10	0.0000	0.0005	0.0006	0.0007	0.0009	0.0010	0.0010	0.0010	0.0011	0.0011	0.0011	0.0012	0.0012	0.0012	0.0012
11	0.0000	0.0006	0.0007	0.0007	0.0010	0.0011	0.0011	0.0011	0.0012	0.0013	0.0013	0.0013	0.0013	0.0015	0.0014
12	0.0000	0.0005	0.0005	0.0006	0.0009	0.0010	0.0009	0.0010	0.0010	0.0010	0.0010	0.0011	0.0011	0.0012	0.0011
13	0.0000	0.0007	0.0007	0.0008	0.0010	0.0011	0.0011	0.0011	0.0012	0.0012	0.0013	0.0013	0.0013	0.0014	0.0014
14	0.0000	0.0007	0.0007	0.0007	0.0010	0.0011	0.0012	0.0011	0.0013	0.0014	0.0014	0.0014	0.0015	0.0016	0.0016
15	0.0000	0.0007	0.0007	0.0008	0.0011	0.0012	0.0013	0.0013	0.0014	0.0014	0.0015	0.0015	0.0016	0.0017	0.0016
16	0.0000	0.0008	0.0009	0.0009	0.0011	0.0012	0.0012	0.0012	0.0013	0.0013	0.0014	0.0014	0.0014	0.0015	0.0014
17	0.0000	0.0008	0.0008	0.0009	0.0011	0.0012	0.0014	0.0012	0.0014	0.0013	0.0014	0.0014	0.0014	0.0015	0.0014
18	0.0000	0.0006	0.0006	0.0007	0.0009	0.0010	0.0009	0.0010	0.0010	0.0011	0.0011	0.0011	0.0011	0.0012	0.0012
19	0.0000	0.0006	0.0007	0.0007	0.0010	0.0011	0.0011	0.0012	0.0012	0.0012	0.0013	0.0013	0.0013	0.0014	0.0014
20	0.0000	0.0006	0.0007	0.0007	0.0009	0.0010	0.0011	0.0011	0.0012	0.0013	0.0012	0.0013	0.0013	0.0014	0.0014
21	0.0000	0.0007	0.0007	0.0008	0.0010	0.0011	0.0012	0.0012	0.0012	0.0012	0.0013	0.0013	0.0013	0.0014	0.0014
22	0.0000	0.0007	0.0007	0.0008	0.0010	0.0012	0.0011	0.0012	0.0012	0.0012	0.0012	0.0013	0.0013	0.0013	0.0013
23	0.0000	0.0007	0.0008	0.0008	0.0010	0.0011	0.0011	0.0012	0.0013	0.0012	0.0012	0.0012	0.0013	0.0014	0.0014
24	0.0000	0.0006	0.0007	0.0009	0.0011	0.0012	0.0013	0.0013	0.0013	0.0014	0.0014	0.0015	0.0014	0.0015	0.0015
25	0.0000	0.0007	0.0008	0.0008	0.0010	0.0011	0.0012	0.0012	0.0012	0.0013	0.0013	0.0013	0.0013	0.0014	0.0014
n	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Avg.	0.0000	0.0007	0.0007	0.0008	0.0010	0.0012	0.0012	0.0012	0.0013	0.0013	0.0013	0.0013	0.0013	0.0014	0.0014
Med.	0.0000	0.0007	0.0007	0.0008	0.0010	0.0011	0.0012	0.0012	0.0012	0.0012	0.0013	0.0013	0.0013	0.0014	0.0014
σ	0.0000	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Min.	0.0000	0.0005	0.0005	0.0006	0.0009	0.0010	0.0009	0.0010	0.0010	0.0010	0.0010	0.0011	0.0011	0.0012	0.0011
Max.	0.0000	0.0008	0.0009	0.0010	0.0012	0.0013	0.0014	0.0014	0.0015	0.0014	0.0015	0.0015	0.0016	0.0017	0.0016

Data Set 2 : 55 °C, 150 mA

Actual Case Temperature [T_S]	58.4 °C
Actual Ambient Temperature [T_A]	56.5 °C
Drive Current [I_F]	150 mA
Measurement Current	150 mA

NOTES:

T_S and T_A were measured during initial setup.



Data Set 2 : 55 °C, 150 mA

Actual Case Temperature [T _s]	58.4 °C
Actual Ambient Temperature [T _A]	56.5 °C
Drive Current [I _F]	150 mA
Measurement Current	150 mA

NOTES:

 T_s and T_A were measured during initial setup.

TABLE 2-1
 Initial Characteristics

LED No.	Luminous flux	Forward voltage	CCT	CIE1931		CIE1976							
	Φ _v [lm]	V _F [V]	T _{CP} [K]	x	y	u'	v'						
1	101.3	6.32	2792	0.454	0.412	0.258	0.527						
2	101.1	6.32	2799	0.451	0.406	0.259	0.524						
3	99.1	6.32	2682	0.461	0.411	0.263	0.528						
4	99.3	6.33	2677	0.461	0.410	0.264	0.528						
5	98.8	6.32	2640	0.466	0.413	0.265	0.529						
6	99.3	6.33	2713	0.460	0.412	0.262	0.528						
7	100.6	6.32	2742	0.457	0.411	0.261	0.527						
8	99.5	6.31	2644	0.466	0.414	0.265	0.530						
9	101.3	6.31	2771	0.453	0.407	0.260	0.525						
10	101.2	6.31	2613	0.475	0.426	0.265	0.536						
11	101.4	6.31	2757	0.456	0.411	0.260	0.527						
12	102.3	6.29	2724	0.459	0.413	0.261	0.528						
13	101.6	6.31	2756	0.454	0.408	0.260	0.525						
14	100.1	6.34	2652	0.471	0.424	0.264	0.534						
15	100.9	6.32	2752	0.459	0.416	0.260	0.529						
16	100.3	6.32	2669	0.466	0.418	0.263	0.531						
17	100.6	6.31	2732	0.458	0.412	0.261	0.528						
18	97.8	6.33	2598	0.474	0.422	0.267	0.534						
19	99.2	6.34	2645	0.467	0.416	0.265	0.531						
20	100.9	6.32	2737	0.457	0.410	0.261	0.527						
21	101.4	6.31	2686	0.466	0.420	0.262	0.532						
22	102.0	6.32	2798	0.454	0.412	0.258	0.527						
23	99.6	6.33	2677	0.465	0.417	0.263	0.531						
24	100.4	6.31	2841	0.442	0.395	0.258	0.518						
25	99.2	6.32	2720	0.457	0.408	0.262	0.526						
n	25	25	25	25	25	25	25						
Avg.	100.4	6.32	2713	0.460	0.413	0.262	0.528						
Med.	100.6	6.32	2720	0.459	0.412	0.262	0.528						
σ	1.14	0.010	63.2	0.0076	0.0064	0.0025	0.0035						
Min.	97.8	6.29	2598	0.442	0.395	0.258	0.518						
Max.	102.3	6.34	2841	0.475	0.426	0.267	0.536						

Data Set 2 : 55 °C, 150 mA

Actual Case Temperature [T _s]	58.4 °C
Actual Ambient Temperature [T _A]	56.5 °C
Drive Current [I _F]	150 mA
Measurement Current	150 mA

NOTES:

T_s and T_A were measured during initial setup.

TABLE 2-2
Lumen Maintenance

LED No.	Lumen Maintenance % (Normalized to 100 % at 0 hours)														
	0 h	542 h	1010 h	1699 h	2372 h	3124 h	3812 h	4520 h	5185 h	6019 h	6780 h	7577 h	8411 h	9239 h	10074 h
1	100.0	99.6	99.9	99.9	99.7	99.5	99.4	99.2	99.3	99.3	99.0	99.2	98.9	98.6	98.7
2	100.0	99.2	99.4	99.3	99.3	99.0	98.9	98.8	98.8	99.1	98.8	98.8	98.7	98.2	98.4
3	100.0	99.3	99.4	99.4	99.5	99.1	99.0	98.9	98.9	99.3	98.9	98.8	98.8	98.3	98.6
4	100.0	99.4	99.5	99.5	99.7	99.3	99.2	99.2	99.2	99.6	99.2	99.1	99.1	98.6	99.1
5	100.0	99.3	99.3	99.2	99.4	99.0	98.9	98.8	98.7	98.9	98.5	98.3	98.3	97.7	98.3
6	100.0	99.0	99.0	99.0	99.1	98.8	98.7	98.6	98.7	98.5	98.2	98.2	98.1	97.8	98.4
7	100.0	99.2	99.3	99.2	99.2	99.0	98.9	98.7	98.8	98.4	98.1	98.2	98.0	97.8	98.3
8	100.0	99.9	100.1	100.1	99.9	99.8	99.7	99.4	99.6	99.2	98.9	99.0	98.7	98.5	98.7
9	100.0	99.6	99.8	99.8	99.6	99.5	99.4	99.0	99.2	98.9	98.7	98.9	98.5	98.3	98.4
10	100.0	99.9	100.2	100.2	99.9	99.8	99.7	99.3	99.5	99.3	99.0	99.2	98.8	98.5	98.6
11	100.0	99.8	100.0	100.0	99.8	99.6	99.6	99.3	99.3	99.4	99.1	99.1	98.7	98.3	98.4
12	100.0	98.6	98.8	98.9	98.7	98.4	98.4	98.1	98.2	98.4	98.0	97.9	97.6	97.0	97.0
13	100.0	98.9	99.1	99.3	99.1	98.8	98.9	98.6	98.7	98.9	98.6	98.7	98.6	98.1	98.4
14	100.0	99.1	99.2	99.2	99.0	98.7	98.7	98.5	98.5	98.6	98.2	98.1	98.0	97.5	97.9
15	100.0	99.1	99.2	99.2	99.0	98.7	98.7	98.6	98.6	98.5	98.3	98.3	98.2	97.8	98.4
16	100.0	99.0	99.1	99.2	99.1	98.8	98.8	98.7	98.6	98.4	98.1	98.2	98.0	97.7	98.3
17	100.0	99.5	99.6	99.6	99.5	99.3	99.2	99.1	99.0	98.8	98.6	98.6	98.4	98.2	98.7
18	100.0	99.5	99.7	99.8	99.6	99.4	99.2	99.1	99.1	98.8	98.5	98.6	98.3	98.2	98.5
19	100.0	99.6	99.8	99.9	99.7	99.5	99.4	99.2	99.3	99.1	98.8	98.9	98.5	98.4	98.5
20	100.0	99.7	99.9	99.9	99.8	99.6	99.5	99.3	99.4	99.3	99.1	99.2	98.8	98.6	98.7
21	100.0	99.2	99.4	99.5	99.3	99.2	99.1	98.8	98.9	99.1	98.7	98.8	98.6	98.2	98.3
22	100.0	98.9	99.1	99.2	99.1	98.8	98.8	98.6	98.6	98.9	98.6	98.6	98.4	98.0	98.1
23	100.0	98.9	99.0	99.0	98.8	98.5	98.5	98.3	98.2	98.4	98.1	98.1	97.8	97.4	97.6
24	100.0	99.3	99.5	99.4	99.2	99.0	98.9	98.8	98.6	98.6	98.3	98.2	97.9	97.6	97.9
25	100.0	98.9	99.0	99.1	99.0	98.6	98.6	98.6	98.4	98.3	98.1	98.1	97.9	97.7	98.2
n	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Avg.	100.0	99.3	99.5	99.5	99.4	99.1	99.0	98.8	98.9	98.9	98.6	98.6	98.4	98.0	98.3
Med.	100.0	99.3	99.4	99.4	99.3	99.0	98.9	98.8	98.8	98.9	98.6	98.6	98.4	98.2	98.4
σ	0.00	0.36	0.38	0.38	0.35	0.40	0.38	0.33	0.38	0.37	0.38	0.41	0.40	0.43	0.42
Min.	100.0	98.6	98.8	98.9	98.7	98.4	98.4	98.1	98.2	98.3	98.0	97.9	97.6	97.0	97.0
Max.	100.0	99.9	100.2	100.2	99.9	99.8	99.7	99.4	99.6	99.6	99.2	99.2	99.1	98.6	99.1

TM-21 Projection

Time	4520 h	5185 h	6019 h	6780 h	7577 h	8411 h	9239 h	10074 h							
ln(Avg.)	-0.0116	-0.0113	-0.0112	-0.0145	-0.0141	-0.0163	-0.0198	-0.0168							

Test duration used	4520 h	to	10074 h
B	0.9956		
α	1.3959E-06		
R ²	0.7917		
Calculated L ₇₀ (10K)	252000	hours	
Reported L ₇₀ (10K)	> 60400	hours	

Curve-fit equation:

$$\Phi(t) = B \exp(-\alpha t)$$

Lumen maintenance life equation:

$$L_{70} = \ln(B/0.7) / \alpha$$

Data Set 2 : 55 °C, 150 mA

Actual Case Temperature [T _s]	58.4 °C
Actual Ambient Temperature [T _A]	56.5 °C
Drive Current [I _F]	150 mA
Measurement Current	150 mA

NOTES:

T_s and T_A were measured during initial setup.

TABLE 2-3
Forward Voltage

LED No.	Relative Forward Voltage % (Normalized to 100 % at 0 hours)														
	0 h	542 h	1010 h	1699 h	2372 h	3124 h	3812 h	4520 h	5185 h	6019 h	6780 h	7577 h	8411 h	9239 h	10074 h
1	100.0	99.7	100.0	100.3	100.7	100.8	101.0	101.1	101.2	101.5	101.3	101.6	101.7	101.6	101.9
2	100.0	99.7	100.0	100.3	100.7	100.8	100.9	101.0	101.2	101.4	101.3	101.4	101.5	101.5	101.7
3	100.0	99.7	100.0	100.3	100.7	100.8	101.0	101.1	101.3	101.6	101.4	101.6	101.7	101.7	101.8
4	100.0	99.7	100.1	100.5	100.8	100.9	101.1	101.2	101.3	101.6	101.4	101.6	101.7	101.7	101.9
5	100.0	99.7	100.0	100.3	100.8	100.9	101.0	101.1	101.3	101.5	101.4	101.6	101.7	101.7	101.9
6	100.0	99.6	99.9	100.3	100.6	100.7	100.9	101.0	101.1	101.4	101.2	101.4	101.5	101.5	101.7
7	100.0	99.7	100.0	100.3	100.7	100.8	101.0	101.0	101.2	101.5	101.3	101.5	101.6	101.6	101.8
8	100.0	99.6	100.0	100.3	100.7	100.8	101.0	101.0	101.2	101.5	101.3	101.5	101.7	101.6	101.8
9	100.0	99.7	99.9	100.2	100.6	100.7	100.9	100.9	101.1	101.3	101.2	101.3	101.4	101.4	101.6
10	100.0	99.7	100.0	100.3	100.7	100.9	101.0	101.1	101.3	101.5	101.4	101.6	101.7	101.6	101.9
11	100.0	99.6	100.0	100.4	100.7	100.8	101.0	101.1	101.2	101.5	101.3	101.5	101.6	101.6	101.8
12	100.0	99.6	99.9	100.2	100.4	100.5	100.6	100.7	100.8	101.0	100.8	101.1	101.1	101.1	101.3
13	100.0	99.6	99.9	100.2	100.5	100.5	100.8	100.8	100.9	101.2	101.0	101.2	101.3	101.3	101.5
14	100.0	99.6	100.0	100.4	100.7	100.8	101.0	101.1	101.2	101.5	101.3	101.6	101.8	101.6	101.8
15	100.0	99.6	100.0	100.4	100.7	100.7	100.9	100.9	101.1	101.4	101.2	101.4	101.5	101.5	101.7
16	100.0	99.7	100.0	100.3	100.6	100.7	100.9	101.0	101.1	101.3	101.2	101.4	101.5	101.4	101.7
17	100.0	99.6	100.0	100.4	100.7	100.8	100.9	101.1	101.2	101.5	101.3	101.5	101.6	101.6	101.8
18	100.0	99.7	100.0	100.4	100.7	100.8	101.0	101.1	101.2	101.5	101.3	101.6	101.6	101.6	101.9
19	100.0	99.6	100.0	100.3	100.6	100.7	100.9	101.0	101.1	101.4	101.2	101.4	101.5	101.5	101.7
20	100.0	99.7	100.0	100.5	100.8	100.8	101.1	101.1	101.3	101.5	101.4	101.6	101.7	101.7	101.9
21	100.0	99.6	99.9	100.3	100.5	100.6	100.8	100.8	101.0	101.2	101.1	101.3	101.3	101.3	101.5
22	100.0	99.7	99.9	100.3	100.6	100.7	100.8	100.9	101.0	101.2	101.1	101.3	101.4	101.4	101.6
23	100.0	99.7	100.0	100.4	100.7	100.8	100.9	101.0	101.2	101.4	101.3	101.5	101.6	101.5	101.8
24	100.0	99.7	100.1	100.4	100.7	100.9	101.0	101.1	101.3	101.5	101.4	101.6	101.7	101.6	101.8
25	100.0	99.7	100.0	100.4	100.7	100.8	100.9	101.0	101.1	101.4	101.2	101.4	101.6	101.5	101.7
n	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Avg.	100.0	99.6	100.0	100.3	100.7	100.8	100.9	101.0	101.2	101.4	101.2	101.5	101.6	101.5	101.7
Med.	100.0	99.7	100.0	100.3	100.7	100.8	100.9	101.0	101.2	101.5	101.3	101.5	101.6	101.6	101.8
σ	0.00	0.03	0.05	0.08	0.09	0.10	0.11	0.12	0.12	0.15	0.14	0.14	0.16	0.15	0.16
Min.	100.0	99.6	99.9	100.2	100.4	100.5	100.6	100.7	100.8	101.0	100.8	101.1	101.1	101.1	101.3
Max.	100.0	99.7	100.1	100.5	100.8	100.9	101.1	101.2	101.3	101.6	101.4	101.6	101.8	101.7	101.9

Data Set 2 : 55 °C, 150 mA

Actual Case Temperature [T _s]	58.4 °C
Actual Ambient Temperature [T _A]	56.5 °C
Drive Current [I _F]	150 mA
Measurement Current	150 mA

NOTES:

T_s and T_A were measured during initial setup.

TABLE 2-4
Chromaticity Shift

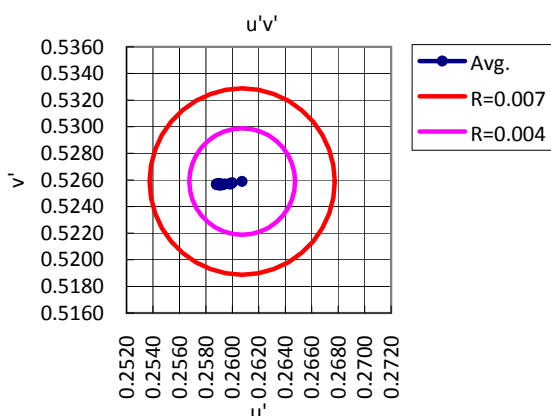
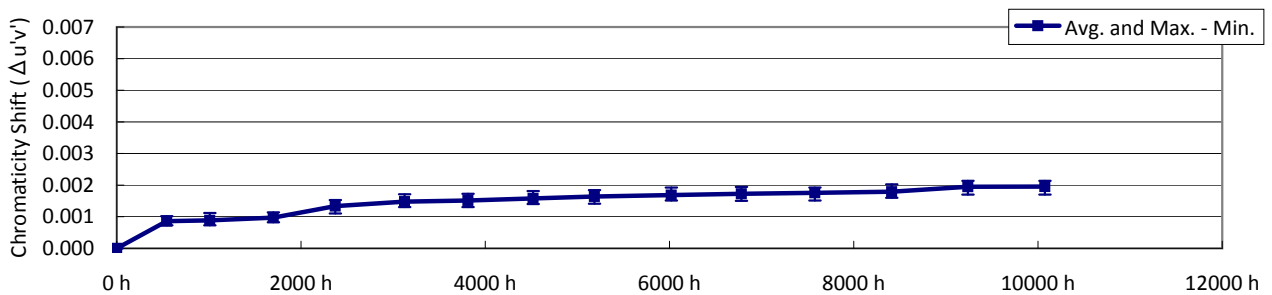
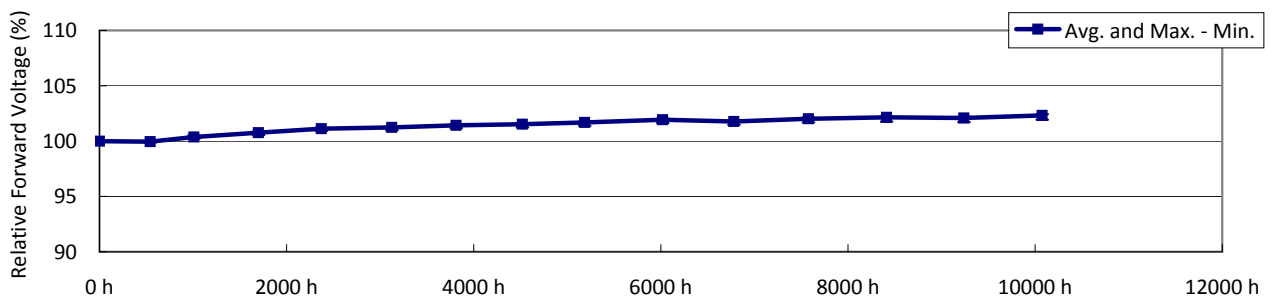
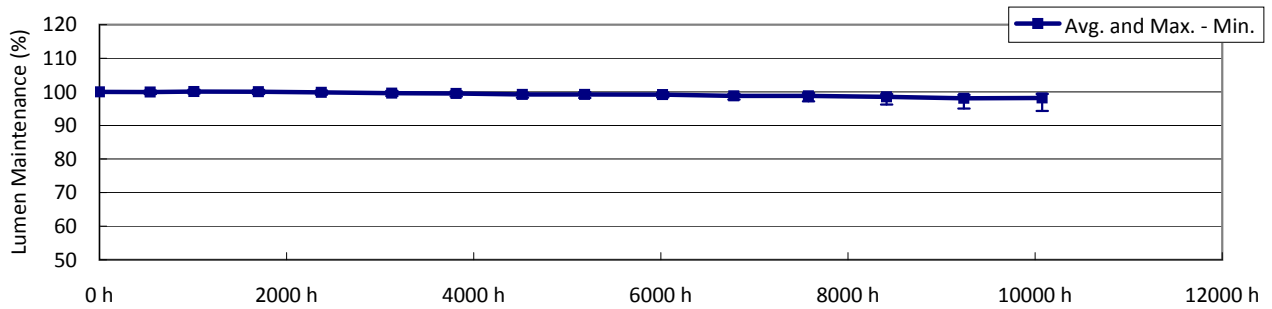
LED No.	Chromaticity Shift Δu'v'														
	0 h	542 h	1010 h	1699 h	2372 h	3124 h	3812 h	4520 h	5185 h	6019 h	6780 h	7577 h	8411 h	9239 h	10074 h
1	0.0000	0.0008	0.0009	0.0010	0.0012	0.0014	0.0014	0.0014	0.0015	0.0015	0.0015	0.0016	0.0016	0.0017	0.0017
2	0.0000	0.0008	0.0008	0.0009	0.0011	0.0012	0.0013	0.0014	0.0013	0.0014	0.0015	0.0014	0.0014	0.0016	0.0016
3	0.0000	0.0009	0.0009	0.0009	0.0012	0.0014	0.0014	0.0015	0.0015	0.0016	0.0016	0.0016	0.0016	0.0018	0.0018
4	0.0000	0.0008	0.0009	0.0009	0.0011	0.0012	0.0013	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0016	0.0015
5	0.0000	0.0009	0.0009	0.0009	0.0012	0.0013	0.0014	0.0015	0.0014	0.0015	0.0015	0.0016	0.0016	0.0017	0.0017
6	0.0000	0.0010	0.0009	0.0011	0.0013	0.0014	0.0014	0.0015	0.0015	0.0016	0.0016	0.0016	0.0016	0.0018	0.0017
7	0.0000	0.0010	0.0011	0.0011	0.0014	0.0016	0.0016	0.0017	0.0016	0.0017	0.0018	0.0018	0.0018	0.0019	0.0019
8	0.0000	0.0010	0.0010	0.0011	0.0013	0.0014	0.0015	0.0015	0.0015	0.0015	0.0016	0.0015	0.0016	0.0017	0.0017
9	0.0000	0.0009	0.0009	0.0009	0.0012	0.0013	0.0013	0.0014	0.0014	0.0014	0.0014	0.0014	0.0015	0.0016	0.0016
10	0.0000	0.0008	0.0008	0.0009	0.0011	0.0013	0.0013	0.0014	0.0014	0.0014	0.0015	0.0015	0.0016	0.0017	0.0017
11	0.0000	0.0007	0.0007	0.0008	0.0010	0.0012	0.0012	0.0013	0.0014	0.0014	0.0015	0.0014	0.0015	0.0016	0.0016
12	0.0000	0.0008	0.0008	0.0008	0.0011	0.0012	0.0012	0.0013	0.0014	0.0014	0.0014	0.0014	0.0015	0.0016	0.0015
13	0.0000	0.0008	0.0008	0.0009	0.0011	0.0012	0.0013	0.0014	0.0014	0.0014	0.0014	0.0014	0.0015	0.0016	0.0016
14	0.0000	0.0008	0.0009	0.0009	0.0011	0.0013	0.0013	0.0013	0.0014	0.0014	0.0015	0.0015	0.0015	0.0017	0.0017
15	0.0000	0.0009	0.0008	0.0009	0.0012	0.0013	0.0013	0.0014	0.0014	0.0014	0.0015	0.0014	0.0015	0.0016	0.0016
16	0.0000	0.0009	0.0009	0.0010	0.0012	0.0013	0.0014	0.0014	0.0015	0.0015	0.0015	0.0016	0.0016	0.0017	0.0017
17	0.0000	0.0010	0.0010	0.0011	0.0014	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0017	0.0017	0.0018	0.0018
18	0.0000	0.0008	0.0009	0.0009	0.0011	0.0013	0.0013	0.0014	0.0014	0.0015	0.0015	0.0016	0.0015	0.0016	0.0016
19	0.0000	0.0008	0.0009	0.0009	0.0012	0.0012	0.0013	0.0013	0.0014	0.0014	0.0014	0.0014	0.0015	0.0016	0.0016
20	0.0000	0.0008	0.0009	0.0009	0.0012	0.0013	0.0014	0.0014	0.0014	0.0015	0.0016	0.0015	0.0015	0.0016	0.0016
21	0.0000	0.0008	0.0008	0.0008	0.0011	0.0012	0.0013	0.0013	0.0014	0.0014	0.0015	0.0015	0.0015	0.0017	0.0017
22	0.0000	0.0008	0.0008	0.0008	0.0011	0.0012	0.0013	0.0013	0.0014	0.0014	0.0014	0.0015	0.0016	0.0016	0.0017
23	0.0000	0.0008	0.0008	0.0008	0.0012	0.0013	0.0013	0.0013	0.0014	0.0014	0.0015	0.0016	0.0016	0.0017	0.0017
24	0.0000	0.0008	0.0009	0.0009	0.0012	0.0014	0.0014	0.0015	0.0016	0.0015	0.0017	0.0017	0.0018	0.0020	0.0020
25	0.0000	0.0009	0.0009	0.0010	0.0012	0.0013	0.0014	0.0014	0.0015	0.0015	0.0016	0.0016	0.0016	0.0017	0.0017
n	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Avg.	0.0000	0.0009	0.0009	0.0009	0.0012	0.0013	0.0014	0.0014	0.0015	0.0015	0.0015	0.0015	0.0016	0.0017	0.0017
Med.	0.0000	0.0008	0.0009	0.0009	0.0012	0.0013	0.0013	0.0014	0.0014	0.0014	0.0015	0.0015	0.0016	0.0017	0.0017
σ	0.0000	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Min.	0.0000	0.0007	0.0007	0.0008	0.0010	0.0012	0.0012	0.0013	0.0013	0.0014	0.0014	0.0014	0.0014	0.0016	0.0015
Max.	0.0000	0.0010	0.0011	0.0011	0.0014	0.0016	0.0016	0.0017	0.0016	0.0017	0.0018	0.0018	0.0018	0.0020	0.0020

Data Set 3 : 55 °C, 200 mA

Actual Case Temperature [T _S]	60.3 °C
Actual Ambient Temperature [T _A]	57.5 °C
Drive Current [I _F]	200 mA
Measurement Current	200 mA

NOTES:

T_S and T_A were measured during initial setup.



Data Set 3 : 55 °C, 200 mA

Actual Case Temperature [T _s]	60.3 °C
Actual Ambient Temperature [T _A]	57.5 °C
Drive Current [I _F]	200 mA
Measurement Current	200 mA

NOTES:

 T_s and T_A were measured during initial setup.

TABLE 3-1
 Initial Characteristics

LED No.	Luminous flux	Forward voltage	CCT	CIE1931		CIE1976						
	Φ _v [lm]	V _F [V]	T _{CP} [K]	x	y	u'	v'					
1	129.3	6.58	2782	0.453	0.408	0.259	0.525					
2	128.9	6.57	2783	0.449	0.401	0.260	0.522					
3	127.5	6.59	2648	0.469	0.419	0.264	0.532					
4	129.9	6.57	2842	0.444	0.400	0.257	0.521					
5	128.4	6.57	2765	0.453	0.406	0.260	0.524					
6	128.8	6.58	2807	0.449	0.403	0.259	0.523					
7	126.4	6.59	2818	0.445	0.397	0.259	0.520					
8	128.1	6.60	2794	0.450	0.404	0.259	0.523					
9	127.5	6.58	2774	0.450	0.401	0.260	0.522					
10	127.8	6.60	2630	0.471	0.420	0.265	0.533					
11	127.8	6.59	2649	0.467	0.416	0.264	0.531					
12	128.9	6.57	2758	0.456	0.412	0.260	0.527					
13	129.0	6.59	2747	0.456	0.410	0.260	0.526					
14	125.8	6.59	2600	0.474	0.423	0.266	0.534					
15	128.9	6.58	2751	0.454	0.407	0.261	0.525					
16	128.5	6.60	2714	0.463	0.417	0.261	0.530					
17	126.2	6.59	2755	0.453	0.404	0.261	0.524					
18	126.5	6.59	2747	0.452	0.402	0.261	0.523					
19	126.4	6.59	2665	0.464	0.414	0.264	0.529					
20	128.6	6.57	2815	0.448	0.403	0.258	0.523					
21	127.4	6.58	2815	0.446	0.400	0.258	0.521					
22	126.6	6.58	2802	0.445	0.396	0.259	0.520					
23	128.8	6.57	2684	0.467	0.421	0.262	0.532					
24	128.5	6.57	2653	0.469	0.421	0.264	0.533					
25	128.1	6.60	2786	0.449	0.402	0.259	0.523					
n	25	25	25	25	25	25	25					
Avg.	128.0	6.58	2743	0.456	0.408	0.261	0.526					
Med.	128.1	6.58	2758	0.453	0.406	0.260	0.524					
σ	1.11	0.010	68.4	0.0092	0.0083	0.0024	0.0045					
Min.	125.8	6.57	2600	0.444	0.396	0.257	0.520					
Max.	129.9	6.60	2842	0.474	0.423	0.266	0.534					

Data Set 3 : 55 °C, 200 mA

Actual Case Temperature [T _s]	60.3 °C
Actual Ambient Temperature [T _A]	57.5 °C
Drive Current [I _F]	200 mA
Measurement Current	200 mA

NOTES:

 T_s and T_A were measured during initial setup.

TABLE 3-2
 Lumen Maintenance

LED No.	Lumen Maintenance % (Normalized to 100 % at 0 hours)														
	0 h	542 h	1010 h	1699 h	2372 h	3124 h	3812 h	4520 h	5185 h	6019 h	6780 h	7577 h	8412 h	9239 h	10075 h
1	100.0	100.0	100.2	100.2	100.0	99.8	99.7	99.3	99.4	99.4	99.0	99.2	98.9	98.5	98.4
2	100.0	99.3	99.4	99.3	99.1	98.7	98.6	98.3	98.2	98.3	97.7	97.2	96.2	95.0	94.3
3	100.0	99.9	100.0	100.0	100.0	99.5	99.4	99.3	99.1	99.5	99.2	99.1	98.8	98.3	98.7
4	100.0	99.6	99.6	99.5	99.5	98.9	98.9	98.7	98.5	98.7	98.4	98.3	98.0	97.6	98.0
5	100.0	100.3	100.4	100.4	100.4	99.9	99.8	99.7	99.5	99.6	99.4	99.3	99.1	98.8	99.3
6	100.0	100.0	100.0	99.9	99.8	99.4	99.3	99.0	98.9	98.5	97.8	97.2	96.5	95.7	95.6
7	100.0	99.8	99.8	99.7	99.6	99.4	99.2	98.9	99.0	98.7	98.3	98.4	98.1	97.9	98.2
8	100.0	100.4	100.7	100.6	100.3	100.2	100.1	99.6	99.8	99.5	99.1	99.3	99.0	98.7	98.8
9	100.0	100.0	100.3	100.1	99.9	99.8	99.7	99.1	99.3	99.0	98.4	98.6	98.1	97.7	97.3
10	100.0	100.4	100.7	100.6	100.4	100.3	100.2	99.7	99.9	99.8	99.4	99.6	99.3	99.1	98.9
11	100.0	100.1	100.4	100.3	100.0	99.8	99.7	99.3	99.4	99.6	99.3	99.4	99.1	98.7	98.7
12	100.0	99.8	100.1	100.1	99.8	99.7	99.7	99.5	99.4	99.6	99.3	99.4	99.2	98.7	98.9
13	100.0	99.6	99.8	99.9	99.6	99.4	99.4	99.2	99.1	99.3	99.0	99.0	98.9	98.4	98.7
14	100.0	99.5	99.6	99.6	99.4	99.2	99.1	99.0	98.7	98.7	98.4	98.2	97.8	97.1	97.5
15	100.0	99.8	99.9	100.0	99.8	99.5	99.5	99.3	99.1	99.0	98.6	98.5	98.2	97.7	98.2
16	100.0	99.5	99.5	99.5	99.3	99.1	99.0	98.8	98.8	98.6	98.3	98.4	98.2	97.9	98.3
17	100.0	99.8	99.9	99.8	99.7	99.4	99.3	99.1	99.0	98.7	98.5	98.5	98.3	98.0	98.4
18	100.0	100.3	100.4	100.4	100.2	100.0	99.9	99.5	99.6	99.3	99.0	99.1	98.9	98.6	98.7
19	100.0	100.2	100.4	100.4	100.2	99.9	99.8	99.3	99.5	98.8	98.8	99.0	98.7	98.5	98.5
20	100.0	100.2	100.4	100.4	100.1	99.9	99.8	99.4	99.5	99.5	99.2	99.2	99.0	98.6	98.4
21	100.0	100.0	100.2	100.3	100.0	99.8	99.8	99.4	99.4	99.5	99.1	99.2	98.9	98.4	98.4
22	100.0	99.9	100.1	100.2	99.9	99.7	99.7	99.4	99.4	99.6	99.2	99.3	99.0	98.6	98.7
23	100.0	99.8	100.0	100.1	99.8	99.5	99.4	99.1	99.0	99.2	98.9	98.9	98.6	98.3	98.4
24	100.0	100.0	100.2	100.2	100.1	99.9	99.8	99.5	99.5	99.6	99.3	99.3	99.1	98.8	99.1
25	100.0	99.8	99.9	99.9	99.7	99.5	99.3	99.1	99.0	99.0	98.6	98.6	98.4	98.1	98.4
n	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Avg.	100.0	99.9	100.1	100.1	99.9	99.6	99.5	99.2	99.2	99.2	98.8	98.8	98.5	98.1	98.2
Med.	100.0	99.9	100.1	100.1	99.9	99.7	99.7	99.3	99.3	99.3	99.0	99.0	98.8	98.4	98.4
σ	0.00	0.29	0.33	0.34	0.33	0.38	0.38	0.33	0.40	0.44	0.49	0.63	0.77	0.94	1.08
Min.	100.0	99.3	99.4	99.3	99.1	98.7	98.6	98.3	98.2	98.3	97.7	97.2	96.2	95.0	94.3
Max.	100.0	100.4	100.7	100.6	100.4	100.3	100.2	99.7	99.9	99.8	99.4	99.6	99.3	99.1	99.3

TM-21 Projection

Time	4520 h	5185 h	6019 h	6780 h	7577 h	8412 h	9239 h	10075 h							
ln(Avg.)	-0.0078	-0.0080	-0.0084	-0.0120	-0.0120	-0.0152	-0.0195	-0.0183							

Test duration used	4520 h	to	10075 h
B	1.0037		
α	2.2548E-06		
R ²	0.9166		
Calculated L ₇₀ (10K)	160000	hours	
Reported L ₇₀ (10K)	> 60500	hours	

Curve-fit equation:

$$\Phi(t) = B \exp(-\alpha t)$$

Lumen maintenance life equation:

$$L_{70} = \ln(B/0.7) / \alpha$$

Data Set 3 : 55 °C, 200 mA

Actual Case Temperature [T _s]	60.3 °C
Actual Ambient Temperature [T _A]	57.5 °C
Drive Current [I _F]	200 mA
Measurement Current	200 mA

NOTES:

T_s and T_A were measured during initial setup.

TABLE 3-3
Forward Voltage

LED No.	Relative Forward Voltage % (Normalized to 100 % at 0 hours)														
	0 h	542 h	1010 h	1699 h	2372 h	3124 h	3812 h	4520 h	5185 h	6019 h	6780 h	7577 h	8412 h	9239 h	10075 h
1	100.0	99.9	100.4	100.7	101.2	101.3	101.5	101.5	101.7	102.0	101.8	102.1	102.2	102.1	102.4
2	100.0	99.9	100.2	100.5	100.9	101.0	101.2	101.2	101.4	101.6	101.5	101.7	101.8	101.7	101.9
3	100.0	100.0	100.4	100.8	101.2	101.3	101.5	101.6	101.8	102.0	101.9	102.2	102.2	102.2	102.4
4	100.0	99.9	100.2	100.5	100.9	101.0	101.2	101.3	101.4	101.7	101.5	101.8	101.9	101.8	102.0
5	100.0	99.9	100.3	100.6	101.1	101.2	101.4	101.5	101.6	101.9	101.8	102.0	102.1	102.1	102.3
6	100.0	100.0	100.4	100.7	101.2	101.3	101.5	101.6	101.8	102.0	101.8	102.1	102.2	102.1	102.4
7	100.0	99.9	100.3	100.6	101.1	101.2	101.4	101.4	101.6	101.9	101.7	101.9	102.1	102.0	102.3
8	100.0	99.9	100.4	100.7	101.2	101.3	101.4	101.6	101.8	102.0	101.8	102.1	102.2	102.1	102.4
9	100.0	99.9	100.3	100.6	101.1	101.2	101.4	101.5	101.6	101.9	101.7	101.9	102.0	102.0	102.2
10	100.0	99.9	100.3	100.7	101.1	101.2	101.5	101.5	101.7	102.0	101.8	102.0	102.1	102.1	102.3
11	100.0	99.9	100.4	100.8	101.1	101.3	101.4	101.5	101.7	101.9	101.8	102.0	102.2	102.1	102.3
12	100.0	99.9	100.4	100.8	101.1	101.3	101.4	101.6	101.7	102.0	101.8	102.1	102.2	102.1	102.4
13	100.0	100.0	100.4	100.8	101.2	101.2	101.5	101.5	101.7	102.0	101.8	102.0	102.2	102.1	102.3
14	100.0	100.0	100.5	100.9	101.2	101.3	101.5	101.6	101.8	102.0	101.9	102.1	102.2	102.2	102.4
15	100.0	100.0	100.4	100.8	101.1	101.3	101.5	101.5	101.7	101.9	101.8	102.0	102.2	102.1	102.3
16	100.0	99.9	100.3	100.7	101.0	101.1	101.3	101.4	101.5	101.8	101.6	101.9	102.0	101.9	102.1
17	100.0	100.0	100.4	100.8	101.2	101.3	101.5	101.6	101.7	102.0	101.8	102.1	102.2	102.2	102.4
18	100.0	100.0	100.4	100.8	101.2	101.3	101.5	101.6	101.7	102.0	101.8	102.1	102.2	102.1	102.4
19	100.0	100.0	100.4	100.9	101.2	101.3	101.5	101.6	101.7	102.0	101.8	102.1	102.2	102.1	102.4
20	100.0	100.0	100.4	100.8	101.2	101.3	101.4	101.6	101.7	102.0	101.8	102.1	102.2	102.1	102.4
21	100.0	99.9	100.4	100.8	101.1	101.3	101.4	101.5	101.7	101.9	101.8	102.0	102.2	102.2	102.4
22	100.0	100.0	100.4	100.8	101.2	101.3	101.5	101.6	101.7	102.0	101.8	102.1	102.2	102.2	102.4
23	100.0	100.0	100.4	100.8	101.2	101.3	101.5	101.6	101.7	102.0	101.8	102.1	102.2	102.2	102.4
24	100.0	99.9	100.4	100.8	101.1	101.3	101.4	101.5	101.7	101.8	101.7	102.0	102.1	102.1	102.3
25	100.0	100.0	100.4	100.9	101.2	101.3	101.5	101.6	101.8	102.0	101.9	102.1	102.2	102.2	102.4
n	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Avg.	100.0	99.9	100.4	100.8	101.1	101.2	101.4	101.5	101.7	101.9	101.8	102.0	102.1	102.1	102.3
Med.	100.0	99.9	100.4	100.8	101.2	101.3	101.5	101.5	101.7	102.0	101.8	102.1	102.2	102.1	102.4
σ	0.00	0.04	0.07	0.10	0.08	0.09	0.09	0.10	0.10	0.10	0.10	0.11	0.12	0.12	0.12
Min.	100.0	99.9	100.2	100.5	100.9	101.0	101.2	101.2	101.4	101.6	101.5	101.7	101.8	101.7	101.9
Max.	100.0	100.0	100.5	100.9	101.2	101.3	101.5	101.6	101.8	102.0	101.9	102.2	102.2	102.2	102.4

Data Set 3 : 55 °C, 200 mA

Actual Case Temperature [T _s]	60.3 °C
Actual Ambient Temperature [T _A]	57.5 °C
Drive Current [I _F]	200 mA
Measurement Current	200 mA

NOTES:

T_s and T_A were measured during initial setup.

TABLE 3-4
Chromaticity Shift

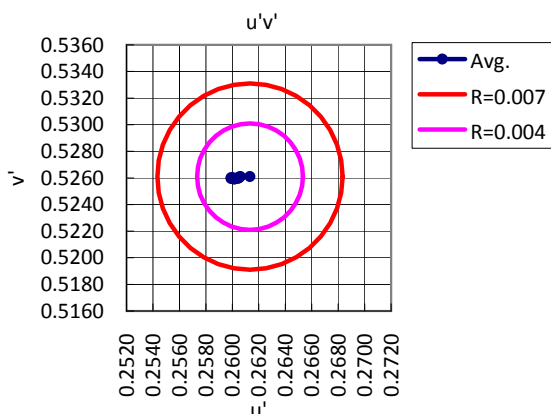
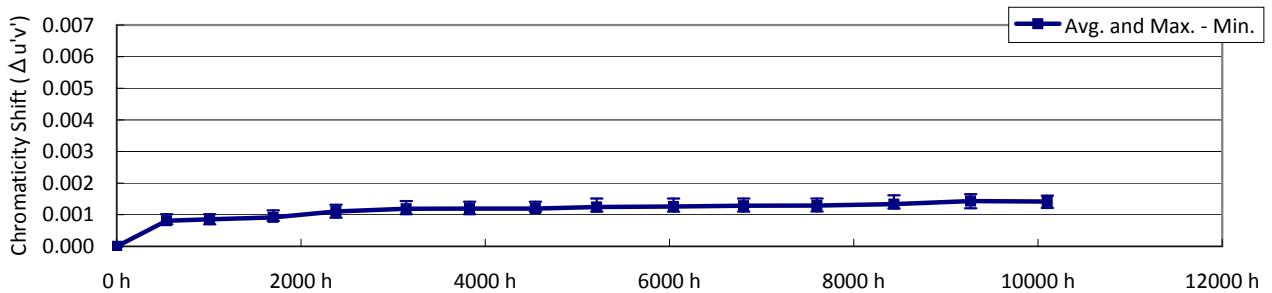
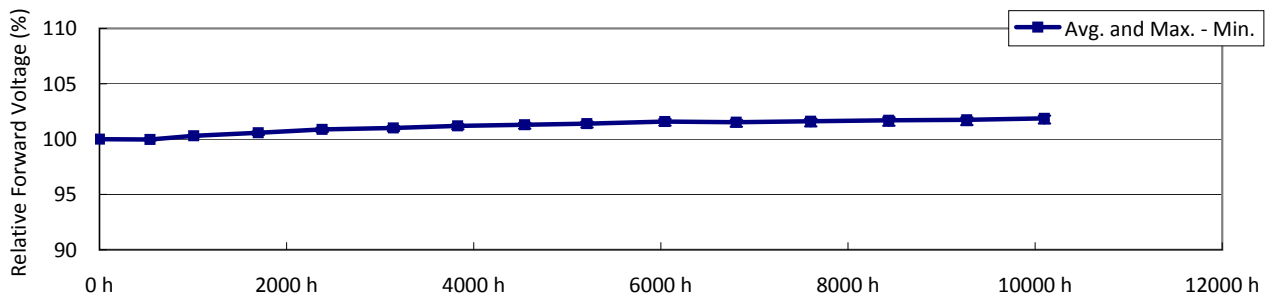
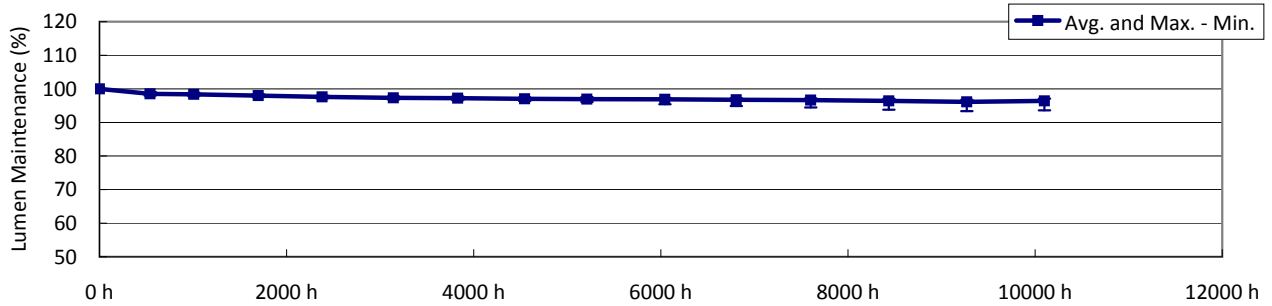
LED No.	Chromaticity Shift Δu'v'														
	0 h	542 h	1010 h	1699 h	2372 h	3124 h	3812 h	4520 h	5185 h	6019 h	6780 h	7577 h	8412 h	9239 h	10075 h
1	0.0000	0.0008	0.0008	0.0010	0.0013	0.0015	0.0015	0.0015	0.0016	0.0017	0.0017	0.0018	0.0018	0.0020	0.0020
2	0.0000	0.0008	0.0009	0.0010	0.0013	0.0015	0.0016	0.0017	0.0017	0.0018	0.0018	0.0018	0.0019	0.0019	0.0018
3	0.0000	0.0009	0.0009	0.0009	0.0013	0.0015	0.0015	0.0015	0.0016	0.0016	0.0017	0.0017	0.0017	0.0018	0.0018
4	0.0000	0.0008	0.0007	0.0009	0.0013	0.0014	0.0015	0.0016	0.0017	0.0017	0.0018	0.0018	0.0019	0.0020	0.0021
5	0.0000	0.0009	0.0009	0.0010	0.0014	0.0016	0.0017	0.0018	0.0018	0.0018	0.0018	0.0019	0.0019	0.0021	0.0020
6	0.0000	0.0010	0.0010	0.0011	0.0015	0.0016	0.0017	0.0017	0.0018	0.0018	0.0019	0.0019	0.0019	0.0021	0.0021
7	0.0000	0.0009	0.0010	0.0011	0.0015	0.0016	0.0017	0.0017	0.0018	0.0019	0.0019	0.0019	0.0020	0.0021	0.0021
8	0.0000	0.0009	0.0009	0.0009	0.0013	0.0015	0.0015	0.0015	0.0016	0.0016	0.0016	0.0017	0.0017	0.0018	0.0018
9	0.0000	0.0008	0.0009	0.0010	0.0014	0.0015	0.0015	0.0016	0.0016	0.0017	0.0017	0.0018	0.0018	0.0020	0.0020
10	0.0000	0.0008	0.0008	0.0009	0.0012	0.0014	0.0014	0.0015	0.0015	0.0016	0.0015	0.0016	0.0016	0.0017	0.0017
11	0.0000	0.0009	0.0009	0.0010	0.0014	0.0015	0.0015	0.0016	0.0016	0.0017	0.0017	0.0018	0.0018	0.0019	0.0020
12	0.0000	0.0007	0.0007	0.0009	0.0012	0.0013	0.0014	0.0015	0.0015	0.0016	0.0016	0.0016	0.0017	0.0019	0.0018
13	0.0000	0.0008	0.0008	0.0009	0.0013	0.0014	0.0014	0.0015	0.0015	0.0016	0.0017	0.0017	0.0017	0.0019	0.0019
14	0.0000	0.0008	0.0009	0.0009	0.0013	0.0014	0.0015	0.0015	0.0016	0.0017	0.0018	0.0018	0.0018	0.0020	0.0020
15	0.0000	0.0009	0.0009	0.0010	0.0014	0.0015	0.0015	0.0016	0.0017	0.0017	0.0018	0.0018	0.0018	0.0019	0.0020
16	0.0000	0.0010	0.0011	0.0011	0.0015	0.0017	0.0017	0.0017	0.0018	0.0018	0.0018	0.0018	0.0019	0.0020	0.0020
17	0.0000	0.0009	0.0010	0.0011	0.0015	0.0016	0.0016	0.0017	0.0018	0.0018	0.0019	0.0019	0.0019	0.0021	0.0021
18	0.0000	0.0008	0.0008	0.0009	0.0013	0.0014	0.0015	0.0015	0.0016	0.0016	0.0016	0.0017	0.0017	0.0018	0.0019
19	0.0000	0.0009	0.0009	0.0010	0.0013	0.0014	0.0015	0.0016	0.0016	0.0016	0.0016	0.0016	0.0017	0.0018	0.0019
20	0.0000	0.0008	0.0008	0.0009	0.0013	0.0014	0.0014	0.0014	0.0015	0.0015	0.0016	0.0016	0.0016	0.0018	0.0018
21	0.0000	0.0008	0.0008	0.0009	0.0013	0.0014	0.0014	0.0015	0.0016	0.0017	0.0017	0.0018	0.0019	0.0020	0.0021
22	0.0000	0.0008	0.0008	0.0008	0.0012	0.0013	0.0013	0.0014	0.0014	0.0015	0.0015	0.0015	0.0016	0.0018	0.0018
23	0.0000	0.0008	0.0008	0.0009	0.0012	0.0013	0.0014	0.0015	0.0015	0.0016	0.0017	0.0017	0.0017	0.0019	0.0019
24	0.0000	0.0008	0.0008	0.0009	0.0011	0.0013	0.0013	0.0014	0.0015	0.0016	0.0016	0.0017	0.0017	0.0019	0.0019
25	0.0000	0.0008	0.0008	0.0009	0.0013	0.0014	0.0014	0.0015	0.0016	0.0017	0.0017	0.0018	0.0019	0.0021	0.0021
n	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Avg.	0.0000	0.0009	0.0009	0.0010	0.0013	0.0015	0.0015	0.0016	0.0016	0.0017	0.0017	0.0018	0.0018	0.0019	0.0020
Med.	0.0000	0.0008	0.0009	0.0009	0.0013	0.0014	0.0015	0.0015	0.0016	0.0017	0.0017	0.0018	0.0018	0.0019	0.0020
σ	0.0000	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Min.	0.0000	0.0007	0.0007	0.0008	0.0011	0.0013	0.0013	0.0014	0.0014	0.0015	0.0015	0.0015	0.0016	0.0017	0.0017
Max.	0.0000	0.0010	0.0011	0.0011	0.0015	0.0017	0.0017	0.0018	0.0018	0.0019	0.0019	0.0019	0.0020	0.0021	0.0021

Data Set 4 : 85 °C, 100 mA

Actual Case Temperature [T_S]	86.5 °C
Actual Ambient Temperature [T_A]	84.6 °C
Drive Current [I_F]	100 mA
Measurement Current	100 mA

NOTES:

T_S and T_A were measured during initial setup.



Data Set 4 : 85 °C, 100 mA

Actual Case Temperature [T _s]	86.5 °C
Actual Ambient Temperature [T _A]	84.6 °C
Drive Current [I _F]	100 mA
Measurement Current	100 mA

NOTES:

 T_s and T_A were measured during initial setup.

TABLE 4-1
 Initial Characteristics

LED No.	Luminous flux	Forward voltage	CCT	CIE1931		CIE1976							
	Φ _v [lm]	V _F [V]	T _{CP} [K]	x	y	u'	v'						
1	70.7	6.03	2824	0.444	0.397	0.258	0.520						
2	71.4	6.02	2699	0.464	0.417	0.262	0.530						
3	70.5	6.02	2659	0.466	0.417	0.264	0.531						
4	70.0	6.02	2620	0.472	0.421	0.265	0.533						
5	70.2	6.01	2742	0.453	0.403	0.261	0.523						
6	69.5	6.02	2643	0.468	0.417	0.265	0.531						
7	70.6	6.02	2675	0.465	0.417	0.263	0.531						
8	71.2	6.01	2695	0.463	0.416	0.262	0.530						
9	70.3	6.01	2693	0.459	0.408	0.263	0.526						
10	70.1	6.02	2792	0.449	0.402	0.259	0.522						
11	69.9	6.03	2759	0.452	0.404	0.261	0.524						
12	69.8	6.03	2765	0.451	0.402	0.260	0.523						
13	70.9	6.01	2816	0.446	0.399	0.259	0.521						
14	70.3	6.02	2787	0.451	0.405	0.259	0.524						
15	71.7	6.03	2719	0.462	0.416	0.261	0.530						
16	71.4	6.02	2768	0.452	0.405	0.260	0.524						
17	70.8	6.03	2732	0.455	0.405	0.262	0.524						
18	71.7	6.02	2840	0.445	0.400	0.257	0.521						
19	70.5	6.02	2817	0.444	0.397	0.259	0.520						
20	70.3	6.02	2650	0.467	0.417	0.264	0.531						
21	69.2	6.03	2588	0.473	0.419	0.267	0.533						
22	70.3	6.02	2774	0.450	0.402	0.260	0.523						
23	70.4	6.02	2701	0.462	0.415	0.262	0.530						
24	71.3	6.01	2763	0.454	0.407	0.260	0.525						
25	71.1	6.04	2819	0.447	0.401	0.258	0.522						
n	25	25	25	25	25	25	25						
Avg.	70.6	6.02	2734	0.456	0.408	0.261	0.526						
Med.	70.5	6.02	2742	0.454	0.405	0.261	0.524						
σ	0.66	0.007	69.5	0.0090	0.0079	0.0025	0.0044						
Min.	69.2	6.01	2588	0.444	0.397	0.257	0.520						
Max.	71.7	6.04	2840	0.473	0.421	0.267	0.533						

Data Set 4 : 85 °C, 100 mA

Actual Case Temperature [T _s]	86.5 °C
Actual Ambient Temperature [T _A]	84.6 °C
Drive Current [I _F]	100 mA
Measurement Current	100 mA

NOTES:

T_s and T_A were measured during initial setup.

TABLE 4-2
Lumen Maintenance

LED No.	Lumen Maintenance % (Normalized to 100 % at 0 hours)														
	0 h	541 h	1007 h	1697 h	2379 h	3141 h	3829 h	4544 h	5210 h	6043 h	6805 h	7601 h	8437 h	9269 h	10100 h
1	100.0	98.5	98.5	98.2	97.7	97.5	97.5	97.1	97.1	97.2	96.9	96.9	96.5	96.3	96.4
2	100.0	98.5	98.3	97.9	97.6	97.3	97.2	97.0	96.9	97.2	97.0	96.9	96.6	96.4	96.6
3	100.0	98.4	98.3	97.9	97.6	97.1	97.0	96.9	96.7	97.0	96.9	96.7	96.5	96.2	96.4
4	100.0	98.4	98.2	97.8	97.6	96.9	96.9	96.9	96.7	96.9	96.8	96.5	96.3	96.1	96.3
5	100.0	98.4	98.3	98.1	97.9	97.5	97.4	97.4	97.2	97.2	97.1	97.0	96.8	96.7	97.1
6	100.0	98.5	98.3	97.9	97.6	97.3	97.2	97.3	97.0	96.7	96.7	96.6	96.4	96.3	96.9
7	100.0	98.4	98.2	97.6	97.1	96.9	96.6	96.4	96.1	95.4	94.9	94.5	93.8	93.4	93.6
8	100.0	98.7	98.6	98.2	97.7	97.7	97.5	97.1	97.3	97.0	96.7	96.7	96.4	96.3	96.7
9	100.0	99.1	98.9	98.3	97.6	97.5	97.3	96.7	96.8	96.3	95.8	95.6	94.9	94.6	94.7
10	100.0	98.9	98.8	98.4	97.7	97.7	97.5	97.0	97.2	97.1	96.8	96.9	96.4	96.3	96.6
11	100.0	98.4	98.2	97.8	97.4	97.1	97.0	96.7	96.7	96.8	96.6	96.6	96.3	95.9	96.0
12	100.0	98.4	98.2	97.9	97.5	97.2	97.1	96.9	96.9	97.1	97.0	96.9	96.8	96.4	96.5
13	100.0	98.5	98.3	98.0	97.7	97.4	97.3	97.2	97.0	97.3	97.2	97.1	97.0	96.7	96.9
14	100.0	98.3	98.1	97.7	97.3	97.0	96.9	96.9	96.7	96.8	96.7	96.6	96.5	96.3	96.5
15	100.0	98.6	98.4	98.1	97.7	97.4	97.3	97.4	97.1	97.1	97.0	96.9	96.8	96.6	97.0
16	100.0	98.0	97.8	97.5	97.2	96.9	96.9	97.0	96.6	96.5	96.4	96.3	96.2	95.9	96.4
17	100.0	98.3	98.1	97.8	97.5	97.2	97.1	97.1	96.9	96.6	96.4	96.4	96.3	96.0	96.5
18	100.0	98.7	98.6	98.3	98.0	97.8	97.8	97.5	97.6	97.3	97.1	97.0	96.9	96.5	96.9
19	100.0	99.0	98.8	98.4	97.9	97.6	97.5	97.1	97.2	97.0	96.8	96.7	96.6	96.2	96.5
20	100.0	98.8	98.7	98.4	97.9	97.5	97.4	97.0	97.1	96.9	96.7	96.6	96.4	96.0	96.2
21	100.0	98.7	98.6	98.3	97.8	97.5	97.4	97.2	97.2	97.3	97.2	97.2	97.1	96.7	96.8
22	100.0	98.4	98.1	97.8	97.5	97.1	97.0	96.9	96.8	97.0	96.8	96.7	96.6	96.2	96.3
23	100.0	98.2	98.0	97.7	97.6	97.2	97.1	97.1	96.9	97.2	97.0	97.0	96.9	96.5	97.0
24	100.0	98.5	98.3	98.0	97.7	97.3	97.2	97.2	97.0	97.0	96.8	96.8	96.6	96.2	96.7
25	100.0	98.5	98.3	98.0	97.8	97.4	97.3	97.3	97.0	97.0	96.9	96.8	96.6	96.3	97.0
n	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Avg.	100.0	98.5	98.4	98.0	97.6	97.3	97.2	97.0	97.0	96.9	96.7	96.6	96.4	96.1	96.4
Med.	100.0	98.5	98.3	98.0	97.6	97.3	97.2	97.1	97.0	97.0	96.8	96.7	96.5	96.3	96.5
σ	0.00	0.25	0.26	0.25	0.21	0.25	0.26	0.25	0.28	0.40	0.48	0.55	0.68	0.71	0.75
Min.	100.0	98.0	97.8	97.5	97.1	96.9	96.6	96.4	96.1	95.4	94.9	94.5	93.8	93.4	93.6
Max.	100.0	99.1	98.9	98.4	98.0	97.8	97.8	97.5	97.6	97.3	97.2	97.2	97.1	96.7	97.1

TM-21 Projection

Time	4544 h	5210 h	6043 h	6805 h	7601 h	8437 h	9269 h	10100 h							
ln(Avg.)	-0.0299	-0.0309	-0.0314	-0.0332	-0.0342	-0.0366	-0.0395	-0.0366							

Test duration used	4544 h	to	10100 h
B	0.9776		
α	1.5746E-06		
R ²	0.8684		
Calculated L ₇₀ (10K)	212000	hours	
Reported L ₇₀ (10K)	> 60600	hours	

Curve-fit equation:

$$\Phi(t) = B \exp(-\alpha t)$$

Lumen maintenance life equation:

$$L_{70} = \ln(B/0.7) / \alpha$$

Data Set 4 : 85 °C, 100 mA

Actual Case Temperature [T _s]	86.5 °C
Actual Ambient Temperature [T _A]	84.6 °C
Drive Current [I _F]	100 mA
Measurement Current	100 mA

NOTES:

T_s and T_A were measured during initial setup.

TABLE 4-3
Forward Voltage

LED No.	Relative Forward Voltage % (Normalized to 100 % at 0 hours)														
	0 h	541 h	1007 h	1697 h	2379 h	3141 h	3829 h	4544 h	5210 h	6043 h	6805 h	7601 h	8437 h	9269 h	10100 h
1	100.0	99.9	100.2	100.4	100.7	100.8	100.9	101.0	101.1	101.2	101.2	101.2	101.3	101.4	101.5
2	100.0	99.9	100.3	100.5	100.9	101.0	101.3	101.3	101.5	101.6	101.6	101.6	101.7	101.8	101.9
3	100.0	99.9	100.3	100.5	100.9	101.1	101.3	101.3	101.5	101.6	101.6	101.6	101.7	101.8	101.9
4	100.0	100.0	100.4	100.6	101.0	101.1	101.3	101.4	101.6	101.7	101.7	101.7	101.8	101.9	102.1
5	100.0	99.9	100.2	100.4	100.6	100.7	100.9	101.0	101.1	101.2	101.1	101.1	101.2	101.3	101.4
6	100.0	99.9	100.3	100.6	100.9	101.1	101.3	101.4	101.5	101.7	101.6	101.7	101.7	101.8	102.0
7	100.0	99.9	100.4	100.6	100.9	101.1	101.3	101.4	101.5	101.7	101.7	101.7	101.8	101.9	102.0
8	100.0	99.9	100.3	100.5	100.8	100.9	101.1	101.1	101.2	101.4	101.3	101.3	101.4	101.5	101.6
9	100.0	99.9	100.3	100.6	100.9	101.1	101.3	101.3	101.5	101.7	101.6	101.6	101.7	101.8	102.0
10	100.0	100.0	100.3	100.6	100.9	101.1	101.3	101.4	101.5	101.7	101.6	101.7	101.7	101.8	102.0
11	100.0	100.0	100.4	100.7	101.0	101.2	101.4	101.5	101.6	101.8	101.7	101.8	102.0	102.0	102.1
12	100.0	100.0	100.3	100.6	100.9	101.1	101.3	101.4	101.4	101.6	101.6	101.7	101.8	101.8	102.0
13	100.0	100.0	100.3	100.6	100.9	101.0	101.2	101.3	101.4	101.6	101.6	101.7	101.8	101.8	101.9
14	100.0	100.0	100.3	100.6	100.9	101.1	101.3	101.4	101.5	101.7	101.6	101.7	101.9	101.8	102.0
15	100.0	99.9	100.3	100.5	100.9	101.0	101.2	101.3	101.4	101.6	101.5	101.7	101.8	101.8	101.9
16	100.0	100.0	100.2	100.5	100.7	100.9	101.0	101.0	101.1	101.3	101.3	101.4	101.5	101.4	101.6
17	100.0	100.0	100.3	100.6	100.8	100.9	101.1	101.2	101.3	101.4	101.4	101.5	101.6	101.6	101.7
18	100.0	99.9	100.3	100.4	100.7	100.8	100.9	101.0	101.0	101.2	101.2	101.2	101.3	101.3	101.4
19	100.0	99.9	100.3	100.6	100.9	101.0	101.2	101.3	101.4	101.6	101.6	101.7	101.8	101.8	101.9
20	100.0	100.0	100.3	100.6	100.9	101.1	101.3	101.4	101.5	101.7	101.6	101.7	101.9	101.9	102.0
21	100.0	100.1	100.4	100.7	101.0	101.1	101.3	101.5	101.6	101.7	101.7	101.8	101.9	101.9	102.1
22	100.0	100.0	100.4	100.7	101.0	101.1	101.3	101.4	101.5	101.7	101.6	101.8	101.9	101.9	102.0
23	100.0	100.1	100.4	100.6	100.9	101.1	101.2	101.3	101.4	101.6	101.6	101.7	101.8	101.8	101.9
24	100.0	99.9	100.3	100.6	100.9	101.0	101.2	101.3	101.4	101.6	101.6	101.7	101.8	101.8	102.0
25	100.0	100.0	100.3	100.6	100.9	101.1	101.3	101.3	101.5	101.7	101.6	101.7	101.9	101.8	102.0
n	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Avg.	100.0	100.0	100.3	100.6	100.9	101.0	101.2	101.3	101.4	101.6	101.5	101.6	101.7	101.7	101.9
Med.	100.0	100.0	100.3	100.6	100.9	101.1	101.3	101.3	101.5	101.6	101.6	101.7	101.8	101.8	102.0
σ	0.00	0.05	0.05	0.08	0.10	0.12	0.14	0.15	0.16	0.17	0.18	0.20	0.21	0.20	0.21
Min.	100.0	99.9	100.2	100.4	100.6	100.7	100.9	101.0	101.0	101.2	101.1	101.1	101.2	101.3	101.4
Max.	100.0	100.1	100.4	100.7	101.0	101.2	101.4	101.5	101.6	101.8	101.7	101.8	102.0	102.0	102.1

Data Set 4 : 85 °C, 100 mA

Actual Case Temperature [T _s]	86.5 °C
Actual Ambient Temperature [T _A]	84.6 °C
Drive Current [I _F]	100 mA
Measurement Current	100 mA

NOTES:

T_s and T_A were measured during initial setup.

TABLE 4-4
Chromaticity Shift

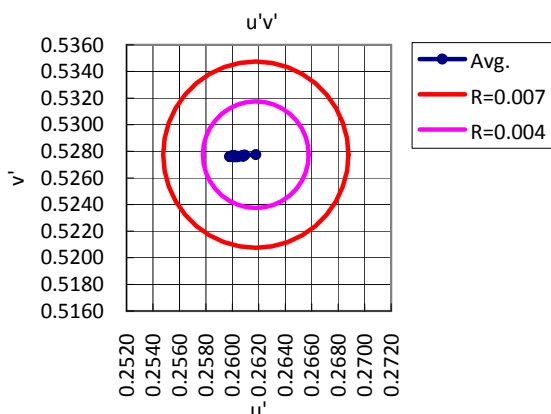
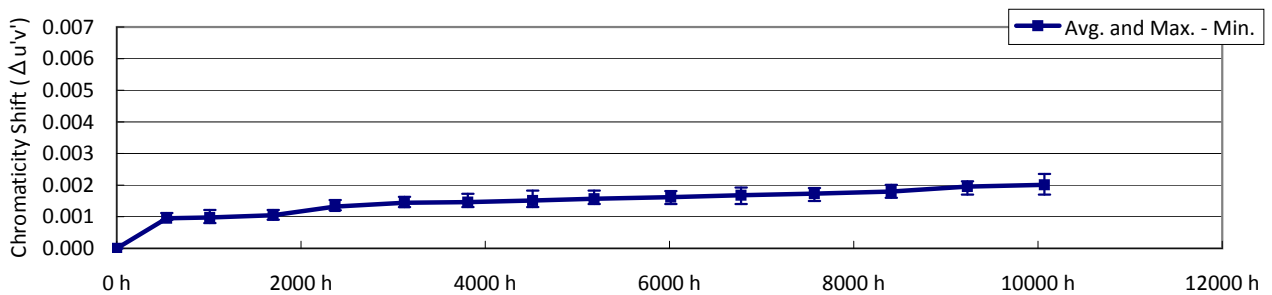
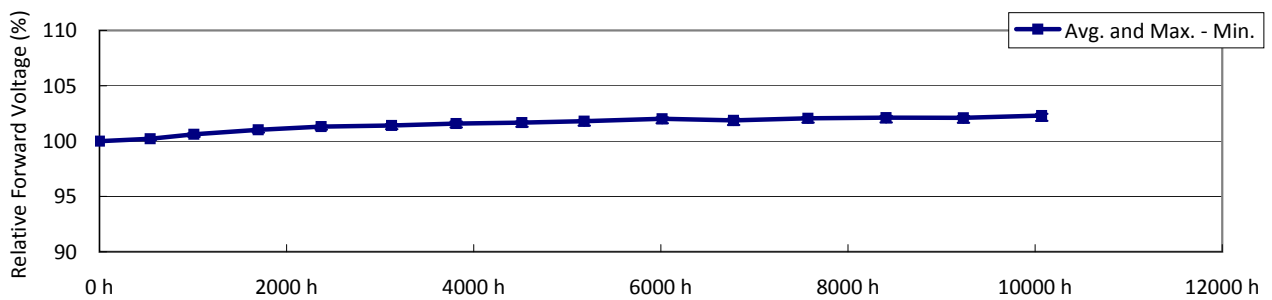
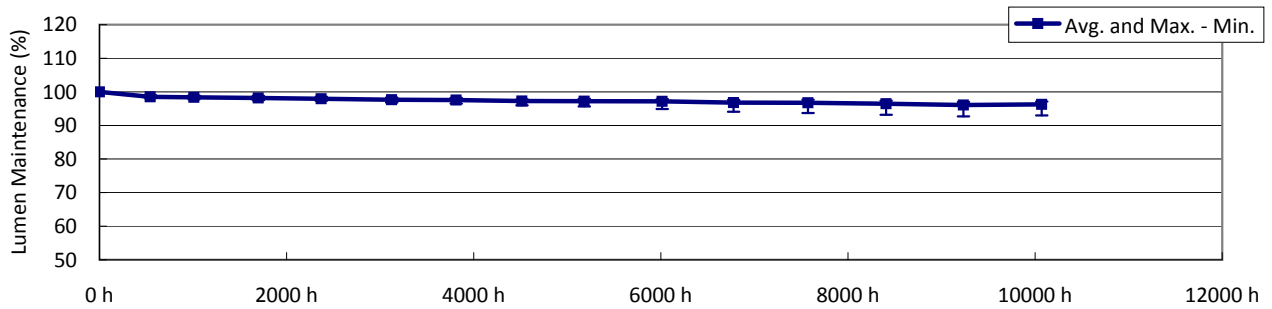
LED No.	Chromaticity Shift Δu'v'														
	0 h	541 h	1007 h	1697 h	2379 h	3141 h	3829 h	4544 h	5210 h	6043 h	6805 h	7601 h	8437 h	9269 h	10100 h
1	0.0000	0.0007	0.0007	0.0008	0.0009	0.0010	0.0011	0.0011	0.0012	0.0012	0.0012	0.0013	0.0013	0.0015	0.0015
2	0.0000	0.0009	0.0008	0.0009	0.0010	0.0011	0.0011	0.0011	0.0011	0.0012	0.0011	0.0012	0.0013	0.0013	0.0014
3	0.0000	0.0009	0.0009	0.0010	0.0012	0.0013	0.0013	0.0013	0.0013	0.0014	0.0014	0.0014	0.0014	0.0015	0.0015
4	0.0000	0.0008	0.0008	0.0009	0.0011	0.0011	0.0012	0.0012	0.0013	0.0013	0.0013	0.0013	0.0014	0.0015	0.0015
5	0.0000	0.0007	0.0008	0.0009	0.0011	0.0012	0.0011	0.0011	0.0012	0.0011	0.0012	0.0011	0.0013	0.0013	0.0014
6	0.0000	0.0010	0.0010	0.0011	0.0013	0.0013	0.0013	0.0013	0.0014	0.0014	0.0014	0.0014	0.0014	0.0015	0.0014
7	0.0000	0.0010	0.0010	0.0011	0.0012	0.0013	0.0013	0.0012	0.0013	0.0013	0.0013	0.0012	0.0013	0.0013	0.0012
8	0.0000	0.0008	0.0009	0.0009	0.0012	0.0013	0.0013	0.0013	0.0013	0.0014	0.0014	0.0014	0.0015	0.0016	0.0016
9	0.0000	0.0009	0.0009	0.0011	0.0013	0.0014	0.0014	0.0014	0.0015	0.0015	0.0015	0.0015	0.0016	0.0016	0.0016
10	0.0000	0.0008	0.0009	0.0009	0.0012	0.0013	0.0014	0.0014	0.0015	0.0014	0.0015	0.0015	0.0016	0.0016	0.0016
11	0.0000	0.0008	0.0009	0.0009	0.0011	0.0011	0.0011	0.0012	0.0012	0.0011	0.0012	0.0012	0.0013	0.0014	0.0014
12	0.0000	0.0008	0.0008	0.0008	0.0010	0.0012	0.0011	0.0011	0.0012	0.0012	0.0012	0.0012	0.0012	0.0013	0.0013
13	0.0000	0.0007	0.0008	0.0008	0.0010	0.0011	0.0011	0.0011	0.0012	0.0012	0.0012	0.0012	0.0013	0.0013	0.0013
14	0.0000	0.0008	0.0008	0.0009	0.0011	0.0011	0.0011	0.0012	0.0012	0.0012	0.0013	0.0013	0.0013	0.0014	0.0014
15	0.0000	0.0008	0.0008	0.0009	0.0011	0.0011	0.0012	0.0011	0.0012	0.0012	0.0012	0.0012	0.0012	0.0014	0.0013
16	0.0000	0.0010	0.0010	0.0011	0.0012	0.0014	0.0013	0.0013	0.0013	0.0014	0.0014	0.0014	0.0015	0.0016	0.0015
17	0.0000	0.0008	0.0009	0.0009	0.0011	0.0012	0.0012	0.0011	0.0012	0.0013	0.0013	0.0013	0.0013	0.0014	0.0014
18	0.0000	0.0008	0.0008	0.0009	0.0011	0.0012	0.0011	0.0012	0.0012	0.0012	0.0013	0.0013	0.0013	0.0015	0.0015
19	0.0000	0.0007	0.0008	0.0009	0.0011	0.0012	0.0013	0.0012	0.0014	0.0014	0.0014	0.0014	0.0014	0.0016	0.0015
20	0.0000	0.0007	0.0008	0.0008	0.0010	0.0011	0.0011	0.0011	0.0011	0.0012	0.0011	0.0011	0.0012	0.0012	0.0013
21	0.0000	0.0007	0.0008	0.0008	0.0010	0.0011	0.0011	0.0011	0.0011	0.0012	0.0012	0.0012	0.0012	0.0013	0.0013
22	0.0000	0.0007	0.0008	0.0008	0.0010	0.0011	0.0010	0.0011	0.0011	0.0011	0.0011	0.0012	0.0012	0.0013	0.0013
23	0.0000	0.0008	0.0008	0.0008	0.0010	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0012	0.0012	0.0013	0.0014
24	0.0000	0.0007	0.0008	0.0008	0.0010	0.0010	0.0011	0.0011	0.0011	0.0011	0.0012	0.0012	0.0012	0.0014	0.0013
25	0.0000	0.0008	0.0009	0.0009	0.0010	0.0011	0.0012	0.0012	0.0012	0.0012	0.0013	0.0013	0.0013	0.0014	0.0014
n	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Avg.	0.0000	0.0008	0.0009	0.0009	0.0011	0.0012	0.0012	0.0012	0.0012	0.0013	0.0013	0.0013	0.0013	0.0014	0.0014
Med.	0.0000	0.0008	0.0008	0.0009	0.0011	0.0011	0.0011	0.0012	0.0012	0.0012	0.0013	0.0013	0.0013	0.0014	0.0014
σ	0.0000	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Min.	0.0000	0.0007	0.0007	0.0008	0.0009	0.0010	0.0010	0.0011	0.0011	0.0011	0.0011	0.0011	0.0012	0.0012	0.0012
Max.	0.0000	0.0010	0.0010	0.0011	0.0013	0.0014	0.0014	0.0014	0.0015	0.0015	0.0015	0.0015	0.0016	0.0016	0.0016

Data Set 5 : 85 °C, 150 mA

Actual Case Temperature [T _S]	88.0 °C
Actual Ambient Temperature [T _A]	85.4 °C
Drive Current [I _F]	150 mA
Measurement Current	150 mA

NOTES:

T_S and T_A were measured during initial setup.



Data Set 5 : 85 °C, 150 mA

Actual Case Temperature [T _S]	88.0 °C
Actual Ambient Temperature [T _A]	85.4 °C
Drive Current [I _F]	150 mA
Measurement Current	150 mA

NOTES:

 T_S and T_A were measured during initial setup.

TABLE 5-1
 Initial Characteristics

LED No.	Luminous flux	Forward voltage	CCT	CIE1931		CIE1976							
	Φ _V [lm]	V _F [V]	T _{CP} [K]	x	y	u'	v'						
1	100.1	6.33	2650	0.470	0.422	0.264	0.533						
2	100.2	6.31	2772	0.450	0.401	0.260	0.522						
3	101.9	6.31	2809	0.450	0.406	0.258	0.524						
4	100.7	6.32	2773	0.451	0.404	0.260	0.524						
5	101.0	6.31	2726	0.459	0.412	0.261	0.528						
6	100.6	6.31	2832	0.443	0.397	0.258	0.520						
7	100.8	6.31	2753	0.454	0.407	0.260	0.525						
8	100.0	6.31	2692	0.463	0.416	0.262	0.530						
9	101.2	6.31	2723	0.462	0.417	0.261	0.530						
10	101.1	6.31	2784	0.452	0.407	0.259	0.525						
11	100.2	6.33	2696	0.463	0.416	0.262	0.530						
12	101.6	6.31	2744	0.457	0.411	0.260	0.527						
13	99.1	6.31	2732	0.455	0.405	0.262	0.525						
14	100.9	6.31	2722	0.460	0.413	0.261	0.528						
15	99.4	6.31	2761	0.452	0.404	0.260	0.524						
16	99.6	6.32	2767	0.453	0.406	0.260	0.524						
17	100.3	6.30	2763	0.452	0.404	0.260	0.524						
18	100.1	6.32	2663	0.466	0.417	0.264	0.531						
19	99.0	6.31	2631	0.468	0.416	0.265	0.531						
20	100.1	6.31	2599	0.474	0.422	0.266	0.534						
21	100.2	6.30	2690	0.465	0.418	0.262	0.531						
22	100.8	6.31	2662	0.467	0.418	0.264	0.531						
23	100.6	6.31	2759	0.452	0.404	0.261	0.523						
24	98.4	6.31	2613	0.471	0.418	0.266	0.532						
25	99.3	6.31	2652	0.466	0.416	0.264	0.530						
n	25	25	25	25	25	25	25						
Avg.	100.3	6.31	2719	0.459	0.411	0.262	0.527						
Med.	100.2	6.31	2726	0.459	0.412	0.261	0.528						
σ	0.83	0.007	61.8	0.0080	0.0070	0.0023	0.0038						
Min.	98.4	6.30	2599	0.443	0.397	0.258	0.520						
Max.	101.9	6.33	2832	0.474	0.422	0.266	0.534						

Data Set 5 : 85 °C, 150 mA

Actual Case Temperature [T _s]	88.0 °C
Actual Ambient Temperature [T _A]	85.4 °C
Drive Current [I _F]	150 mA
Measurement Current	150 mA

NOTES:

 T_s and T_A were measured during initial setup.

TABLE 5-2
 Lumen Maintenance

LED No.	Lumen Maintenance % (Normalized to 100 % at 0 hours)														
	0 h	542 h	1009 h	1698 h	2370 h	3123 h	3811 h	4515 h	5181 h	6014 h	6776 h	7573 h	8407 h	9234 h	10070 h
1	100.0	98.6	98.5	98.4	98.0	97.8	97.7	97.3	97.4	97.4	97.0	97.0	96.5	95.9	95.7
2	100.0	98.6	98.6	98.4	98.0	97.7	97.6	97.3	97.3	97.5	97.2	97.1	96.9	96.3	96.4
3	100.0	98.2	97.9	97.8	97.6	97.2	97.2	96.9	96.8	97.0	96.6	96.4	96.1	95.6	95.8
4	100.0	98.4	98.2	98.0	97.8	97.4	97.4	97.3	97.2	97.5	97.2	97.1	97.0	96.6	97.1
5	100.0	98.2	98.1	98.0	97.8	97.5	97.5	97.3	97.2	97.3	97.0	96.9	96.6	96.2	96.5
6	100.0	98.3	98.1	98.0	97.7	97.4	97.3	97.1	97.0	96.8	96.5	96.4	96.1	95.7	96.1
7	100.0	98.5	98.3	98.1	97.9	97.7	97.6	97.3	97.3	97.0	96.6	96.6	96.3	96.1	96.5
8	100.0	99.1	98.9	98.8	98.6	98.3	98.2	97.7	97.9	97.5	97.3	97.4	97.0	96.9	97.1
9	100.0	98.9	98.8	98.6	98.3	98.1	98.0	97.5	97.6	97.3	97.0	97.1	96.7	96.5	96.6
10	100.0	98.9	98.8	98.7	98.4	98.2	98.1	97.6	97.8	97.7	97.3	97.4	97.1	96.8	96.8
11	100.0	98.5	98.5	98.3	98.0	97.8	97.7	97.4	97.4	97.5	97.2	97.2	96.9	96.6	96.6
12	100.0	98.3	98.2	98.0	97.7	97.4	97.4	97.2	97.1	97.3	97.0	97.0	96.7	96.1	96.3
13	100.0	98.4	98.3	98.1	97.9	97.6	97.5	97.3	97.3	97.4	97.2	97.2	96.9	96.5	96.8
14	100.0	98.2	97.9	97.8	97.5	97.1	97.1	97.0	96.8	96.8	96.5	96.5	96.0	95.6	95.9
15	100.0	98.6	98.3	98.1	97.8	97.4	97.1	96.7	96.4	95.9	95.2	94.8	94.3	93.8	94.2
16	100.0	98.1	97.8	97.5	97.3	96.8	96.5	96.0	95.7	94.9	94.1	93.7	93.2	92.7	93.0
17	100.0	98.6	98.4	98.1	97.9	97.6	97.6	97.2	97.2	96.9	96.6	96.6	96.3	96.1	96.5
18	100.0	99.1	98.9	98.8	98.5	98.3	98.2	97.8	97.9	97.6	97.4	97.3	97.1	96.9	97.1
19	100.0	99.0	98.9	98.8	98.4	98.2	98.1	97.6	97.8	97.6	97.3	97.2	97.1	96.8	96.9
20	100.0	98.8	98.6	98.5	98.1	97.9	97.8	97.4	97.5	97.5	97.2	97.2	97.0	96.6	96.5
21	100.0	98.7	98.6	98.4	98.1	98.0	97.9	97.6	97.7	97.8	97.6	97.7	97.3	97.0	97.1
22	100.0	98.2	98.1	97.9	97.7	97.4	97.3	97.1	97.0	97.3	97.1	97.0	96.7	96.3	96.5
23	100.0	98.3	98.2	98.0	97.8	97.5	97.3	97.1	97.0	97.3	96.9	96.7	96.3	95.7	95.8
24	100.0	98.1	97.9	97.8	97.6	97.3	97.2	97.1	96.9	97.2	96.8	96.7	96.5	96.1	96.6
25	100.0	98.3	98.1	97.9	97.7	97.5	97.4	97.3	97.2	97.4	96.9	96.9	96.6	96.3	96.9
n	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Avg.	100.0	98.5	98.4	98.2	97.9	97.6	97.6	97.3	97.2	97.2	96.8	96.8	96.5	96.1	96.3
Med.	100.0	98.5	98.3	98.1	97.9	97.6	97.5	97.3	97.2	97.3	97.0	97.0	96.7	96.3	96.5
σ	0.00	0.31	0.34	0.35	0.34	0.39	0.40	0.37	0.49	0.61	0.73	0.84	0.91	0.96	0.92
Min.	100.0	98.1	97.8	97.5	97.3	96.8	96.5	96.0	95.7	94.9	94.1	93.7	93.2	92.7	93.0
Max.	100.0	99.1	98.9	98.8	98.6	98.3	98.2	97.8	97.9	97.8	97.6	97.7	97.3	97.0	97.1

TM-21 Projection

Time	4515 h	5181 h	6014 h	6776 h	7573 h	8407 h	9234 h	10070 h							
ln(Avg.)	-0.0279	-0.0281	-0.0286	-0.0323	-0.0330	-0.0361	-0.0402	-0.0379							

Test duration used	4515 h	to	10070 h
B	0.9837		
α	2.2918E-06		
R ²	0.9080		
Calculated L ₇₀ (10K)	148000	hours	
Reported L ₇₀ (10K)	> 60400	hours	

Curve-fit equation:

$$\Phi(t) = B \exp(-\alpha t)$$

Lumen maintenance life equation:

$$L_{70} = \ln(B/0.7) / \alpha$$

Data Set 5 : 85 °C, 150 mA

Actual Case Temperature [T _s]	88.0 °C
Actual Ambient Temperature [T _A]	85.4 °C
Drive Current [I _F]	150 mA
Measurement Current	150 mA

NOTES:

T_s and T_A were measured during initial setup.

TABLE 5-3
Forward Voltage

LED No.	Relative Forward Voltage % (Normalized to 100 % at 0 hours)														
	0 h	542 h	1009 h	1698 h	2370 h	3123 h	3811 h	4515 h	5181 h	6014 h	6776 h	7573 h	8407 h	9234 h	10070 h
1	100.0	100.2	100.6	101.1	101.4	101.5	101.7	101.7	101.9	102.1	102.0	102.2	102.2	102.2	102.4
2	100.0	100.1	100.6	101.0	101.3	101.4	101.6	101.7	101.8	102.0	101.9	102.1	102.1	102.1	102.4
3	100.0	100.2	100.6	101.1	101.4	101.5	101.7	101.8	101.9	102.1	101.9	102.2	102.2	102.2	102.4
4	100.0	100.2	100.6	101.0	101.4	101.5	101.7	101.7	101.9	102.1	101.9	102.1	102.2	102.2	102.4
5	100.0	100.1	100.4	100.8	101.0	101.1	101.2	101.3	101.4	101.6	101.5	101.7	101.7	101.7	101.8
6	100.0	100.2	100.5	101.0	101.2	101.3	101.5	101.5	101.6	101.9	101.7	101.9	101.9	101.9	102.2
7	100.0	100.1	100.5	100.9	101.2	101.3	101.5	101.5	101.6	101.9	101.7	101.9	101.9	101.9	102.2
8	100.0	100.2	100.6	101.1	101.4	101.5	101.7	101.7	101.9	102.1	101.9	102.1	102.2	102.2	102.4
9	100.0	100.2	100.6	101.1	101.4	101.5	101.7	101.8	101.9	102.1	102.0	102.2	102.2	102.2	102.4
10	100.0	100.2	100.6	101.0	101.4	101.4	101.6	101.7	101.8	102.1	101.9	102.1	102.2	102.2	102.4
11	100.0	100.2	100.6	100.9	101.2	101.3	101.4	101.5	101.6	101.8	101.7	101.9	101.9	101.9	102.1
12	100.0	100.2	100.7	101.1	101.4	101.5	101.7	101.8	101.9	102.1	102.0	102.2	102.2	102.2	102.4
13	100.0	100.3	100.7	101.1	101.4	101.5	101.7	101.8	101.9	102.1	102.0	102.2	102.3	102.3	102.5
14	100.0	100.2	100.6	101.0	101.3	101.4	101.8	101.7	101.8	102.0	101.9	102.1	102.2	102.2	102.3
15	100.0	100.3	100.7	101.1	101.4	101.5	101.7	101.8	101.9	102.1	102.0	102.2	102.3	102.2	102.4
16	100.0	100.3	100.7	101.1	101.4	101.5	101.7	101.8	101.9	102.1	101.9	102.1	102.2	102.2	102.4
17	100.0	100.2	100.6	101.1	101.3	101.5	101.6	101.7	101.8	102.1	101.9	102.1	102.2	102.2	102.4
18	100.0	100.2	100.7	101.1	101.4	101.5	101.6	101.7	101.9	102.1	101.9	102.1	102.2	102.1	102.4
19	100.0	100.2	100.6	101.1	101.3	101.5	101.6	101.8	101.9	102.1	101.9	102.1	102.2	102.2	102.4
20	100.0	100.2	100.6	101.1	101.3	101.5	101.6	101.7	101.9	102.1	101.9	102.1	102.2	102.2	102.4
21	100.0	100.2	100.7	101.1	101.3	101.5	101.6	101.7	101.8	102.1	102.0	102.1	102.2	102.2	102.4
22	100.0	100.2	100.6	100.9	101.2	101.3	101.4	101.5	101.6	101.8	101.7	101.9	101.9	101.9	102.1
23	100.0	100.2	100.7	101.1	101.4	101.5	101.7	101.7	101.9	102.1	102.0	102.1	102.1	102.2	102.4
24	100.0	100.2	100.6	101.0	101.2	101.4	101.5	101.6	101.7	101.9	101.8	102.0	102.0	102.0	102.2
25	100.0	100.2	100.6	101.0	101.2	101.3	101.5	101.6	101.7	101.9	101.8	102.0	102.0	102.0	102.2
n	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Avg.	100.0	100.2	100.6	101.0	101.3	101.4	101.6	101.7	101.8	102.0	101.9	102.1	102.1	102.1	102.3
Med.	100.0	100.2	100.6	101.1	101.3	101.5	101.6	101.7	101.9	102.1	101.9	102.1	102.2	102.2	102.4
σ	0.00	0.05	0.07	0.08	0.10	0.11	0.12	0.12	0.13	0.13	0.13	0.13	0.15	0.15	0.15
Min.	100.0	100.1	100.4	100.8	101.0	101.1	101.2	101.3	101.4	101.6	101.5	101.7	101.7	101.7	101.8
Max.	100.0	100.3	100.7	101.1	101.4	101.5	101.8	101.8	101.9	102.1	102.0	102.2	102.3	102.3	102.5

Data Set 5 : 85 °C, 150 mA

Actual Case Temperature [T _s]	88.0 °C
Actual Ambient Temperature [T _A]	85.4 °C
Drive Current [I _F]	150 mA
Measurement Current	150 mA

NOTES:

T_s and T_A were measured during initial setup.

TABLE 5-4
Chromaticity Shift

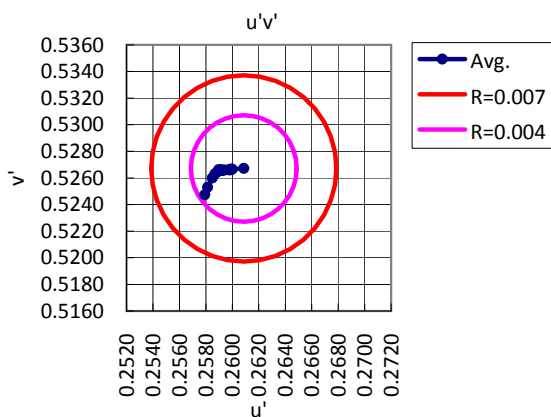
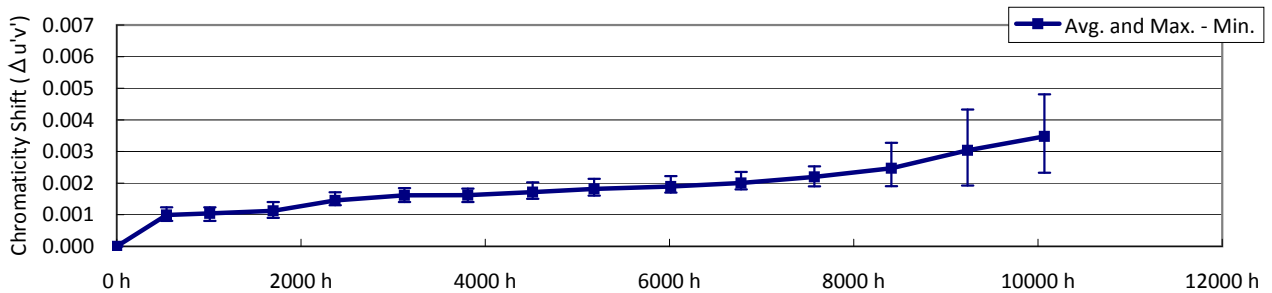
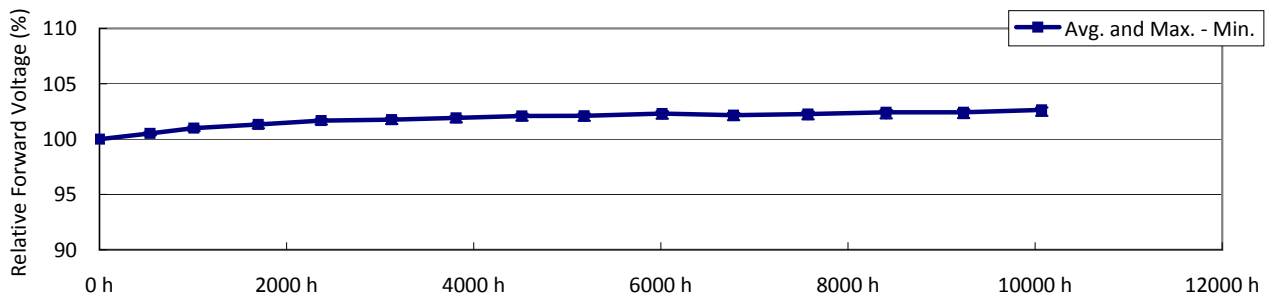
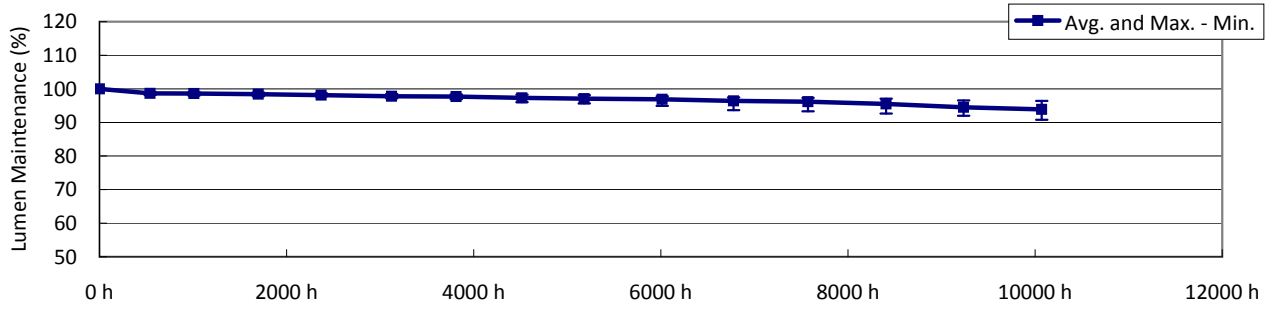
LED No.	Chromaticity Shift Δu'v'														
	0 h	542 h	1009 h	1698 h	2370 h	3123 h	3811 h	4515 h	5181 h	6014 h	6776 h	7573 h	8407 h	9234 h	10070 h
1	0.0000	0.0009	0.0010	0.0010	0.0013	0.0014	0.0015	0.0015	0.0016	0.0016	0.0017	0.0018	0.0018	0.0021	0.0024
2	0.0000	0.0009	0.0009	0.0010	0.0013	0.0015	0.0015	0.0016	0.0017	0.0017	0.0018	0.0019	0.0020	0.0021	0.0022
3	0.0000	0.0010	0.0010	0.0011	0.0013	0.0015	0.0015	0.0015	0.0016	0.0017	0.0017	0.0018	0.0019	0.0020	0.0020
4	0.0000	0.0010	0.0010	0.0011	0.0014	0.0016	0.0016	0.0017	0.0017	0.0018	0.0018	0.0019	0.0019	0.0020	0.0021
5	0.0000	0.0009	0.0009	0.0010	0.0013	0.0014	0.0013	0.0014	0.0015	0.0015	0.0015	0.0016	0.0017	0.0019	0.0020
6	0.0000	0.0010	0.0010	0.0010	0.0013	0.0015	0.0014	0.0016	0.0016	0.0016	0.0018	0.0017	0.0019	0.0021	0.0021
7	0.0000	0.0011	0.0011	0.0011	0.0014	0.0015	0.0015	0.0016	0.0016	0.0017	0.0017	0.0018	0.0019	0.0020	0.0020
8	0.0000	0.0009	0.0010	0.0010	0.0013	0.0015	0.0015	0.0015	0.0016	0.0016	0.0017	0.0017	0.0018	0.0020	0.0020
9	0.0000	0.0009	0.0009	0.0010	0.0013	0.0014	0.0015	0.0015	0.0016	0.0017	0.0017	0.0018	0.0018	0.0020	0.0020
10	0.0000	0.0009	0.0009	0.0010	0.0013	0.0013	0.0014	0.0014	0.0015	0.0015	0.0015	0.0016	0.0017	0.0018	0.0019
11	0.0000	0.0009	0.0009	0.0010	0.0013	0.0014	0.0015	0.0015	0.0016	0.0017	0.0018	0.0018	0.0018	0.0020	0.0021
12	0.0000	0.0009	0.0009	0.0010	0.0012	0.0013	0.0013	0.0014	0.0015	0.0015	0.0016	0.0016	0.0017	0.0018	0.0019
13	0.0000	0.0009	0.0010	0.0010	0.0013	0.0014	0.0014	0.0015	0.0016	0.0016	0.0017	0.0017	0.0018	0.0019	0.0020
14	0.0000	0.0010	0.0010	0.0011	0.0014	0.0014	0.0015	0.0015	0.0016	0.0016	0.0017	0.0018	0.0018	0.0020	0.0022
15	0.0000	0.0010	0.0010	0.0011	0.0013	0.0014	0.0014	0.0015	0.0015	0.0016	0.0016	0.0016	0.0017	0.0018	0.0019
16	0.0000	0.0011	0.0012	0.0012	0.0015	0.0016	0.0017	0.0018	0.0018	0.0018	0.0019	0.0019	0.0019	0.0020	0.0021
17	0.0000	0.0010	0.0010	0.0011	0.0014	0.0015	0.0015	0.0015	0.0015	0.0016	0.0017	0.0018	0.0018	0.0020	0.0019
18	0.0000	0.0010	0.0010	0.0010	0.0013	0.0014	0.0015	0.0015	0.0016	0.0016	0.0017	0.0017	0.0018	0.0020	0.0020
19	0.0000	0.0009	0.0010	0.0011	0.0013	0.0015	0.0016	0.0016	0.0016	0.0017	0.0017	0.0018	0.0018	0.0019	0.0020
20	0.0000	0.0009	0.0009	0.0010	0.0012	0.0014	0.0014	0.0014	0.0015	0.0016	0.0016	0.0016	0.0017	0.0018	0.0019
21	0.0000	0.0009	0.0010	0.0011	0.0013	0.0015	0.0015	0.0015	0.0015	0.0016	0.0016	0.0017	0.0017	0.0019	0.0019
22	0.0000	0.0009	0.0009	0.0010	0.0013	0.0014	0.0014	0.0015	0.0015	0.0016	0.0016	0.0017	0.0018	0.0019	0.0019
23	0.0000	0.0009	0.0008	0.0009	0.0012	0.0013	0.0013	0.0013	0.0014	0.0014	0.0014	0.0015	0.0016	0.0017	0.0017
24	0.0000	0.0009	0.0009	0.0010	0.0013	0.0013	0.0013	0.0014	0.0014	0.0015	0.0015	0.0016	0.0017	0.0019	0.0019
25	0.0000	0.0009	0.0010	0.0011	0.0013	0.0014	0.0014	0.0015	0.0015	0.0016	0.0017	0.0017	0.0018	0.0020	0.0020
n	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Avg.	0.0000	0.0010	0.0010	0.0010	0.0013	0.0014	0.0015	0.0015	0.0016	0.0016	0.0017	0.0017	0.0018	0.0020	0.0020
Med.	0.0000	0.0009	0.0010	0.0010	0.0013	0.0014	0.0015	0.0015	0.0016	0.0016	0.0017	0.0017	0.0018	0.0020	0.0020
σ	0.0000	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Min.	0.0000	0.0009	0.0008	0.0009	0.0012	0.0013	0.0013	0.0013	0.0014	0.0014	0.0014	0.0015	0.0016	0.0017	0.0017
Max.	0.0000	0.0011	0.0012	0.0012	0.0015	0.0016	0.0017	0.0018	0.0018	0.0018	0.0019	0.0019	0.0020	0.0021	0.0024

Data Set 6 : 85 °C, 200 mA

Actual Case Temperature [T_S]	89.6 °C
Actual Ambient Temperature [T_A]	86.5 °C
Drive Current [I_F]	200 mA
Measurement Current	200 mA

NOTES:

T_S and T_A were measured during initial setup.



Data Set 6 : 85 °C, 200 mA

Actual Case Temperature [T _s]	89.6 °C
Actual Ambient Temperature [T _A]	86.5 °C
Drive Current [I _F]	200 mA
Measurement Current	200 mA

NOTES:

 T_s and T_A were measured during initial setup.

TABLE 6-1
 Initial Characteristics

LED No.	Luminous flux	Forward voltage	CCT	CIE1931		CIE1976							
	Φ _v [lm]	V _F [V]	T _{CP} [K]	x	y	u'	v'						
1	130.7	6.57	2794	0.454	0.411	0.258	0.527						
2	129.1	6.58	2796	0.450	0.405	0.259	0.524						
3	128.4	6.58	2802	0.447	0.401	0.259	0.522						
4	126.4	6.59	2624	0.470	0.418	0.265	0.532						
5	128.8	6.57	2835	0.446	0.401	0.258	0.522						
6	130.4	6.59	2754	0.459	0.415	0.260	0.529						
7	127.2	6.58	2665	0.465	0.416	0.264	0.530						
8	128.2	6.58	2707	0.460	0.412	0.262	0.528						
9	129.0	6.59	2849	0.443	0.399	0.257	0.520						
10	129.1	6.59	2816	0.450	0.407	0.258	0.525						
11	127.7	6.59	2760	0.453	0.406	0.260	0.525						
12	128.8	6.57	2715	0.459	0.410	0.262	0.527						
13	129.5	6.57	2791	0.451	0.406	0.259	0.524						
14	127.4	6.60	2747	0.454	0.405	0.261	0.524						
15	129.5	6.58	2717	0.463	0.418	0.261	0.531						
16	129.4	6.58	2729	0.460	0.414	0.261	0.529						
17	128.7	6.58	2791	0.452	0.408	0.259	0.525						
18	129.0	6.58	2744	0.456	0.409	0.261	0.526						
19	128.8	6.59	2807	0.448	0.402	0.259	0.522						
20	127.5	6.57	2603	0.473	0.420	0.266	0.533						
21	126.7	6.59	2606	0.476	0.427	0.266	0.536						
22	128.0	6.59	2682	0.464	0.416	0.263	0.530						
23	127.3	6.58	2671	0.462	0.411	0.264	0.528						
24	128.2	6.58	2736	0.456	0.408	0.261	0.526						
25	128.7	6.61	2755	0.456	0.410	0.260	0.527						
n	25	25	25	25	25	25	25						
Avg.	128.5	6.58	2740	0.457	0.410	0.261	0.527						
Med.	128.7	6.58	2747	0.456	0.410	0.261	0.527						
σ	1.05	0.010	68.8	0.0084	0.0068	0.0026	0.0038						
Min.	126.4	6.57	2603	0.443	0.399	0.257	0.520						
Max.	130.7	6.61	2849	0.476	0.427	0.266	0.536						

Data Set 6 : 85 °C, 200 mA

Actual Case Temperature [T _s]	89.6 °C
Actual Ambient Temperature [T _A]	86.5 °C
Drive Current [I _F]	200 mA
Measurement Current	200 mA

NOTES:

T_s and T_A were measured during initial setup.

TABLE 6-2
Lumen Maintenance

LED No.	Lumen Maintenance % (Normalized to 100 % at 0 hours)														
	0 h	541 h	1009 h	1698 h	2370 h	3123 h	3811 h	4515 h	5181 h	6014 h	6776 h	7573 h	8408 h	9235 h	10070 h
1	100.0	98.7	98.8	98.6	98.3	98.1	98.0	97.7	97.6	97.6	97.4	96.9	96.4	95.4	94.5
2	100.0	98.8	98.8	98.7	98.4	98.1	98.0	97.7	97.6	97.8	97.4	97.2	96.8	95.6	95.3
3	100.0	98.3	98.3	98.1	98.0	97.4	97.4	97.2	97.0	97.2	96.7	96.6	95.7	94.5	94.0
4	100.0	98.4	98.4	98.3	98.3	97.8	97.7	97.5	97.4	97.7	97.1	97.1	96.6	95.6	95.1
5	100.0	98.5	98.4	98.1	97.9	97.3	97.2	96.6	95.8	94.9	93.6	93.3	92.8	92.1	91.9
6	100.0	98.2	98.0	97.8	97.7	97.3	97.1	96.7	96.1	95.5	94.8	94.4	94.0	92.8	92.6
7	100.0	99.1	99.0	98.9	98.7	98.5	98.4	98.3	98.1	97.7	97.5	97.3	97.1	96.5	96.4
8	100.0	98.9	99.0	98.9	98.5	98.4	98.4	98.1	97.9	97.4	97.3	96.9	96.6	96.1	96.0
9	100.0	99.1	99.1	98.9	98.3	98.3	98.2	97.8	97.6	97.1	96.9	96.6	96.2	95.7	94.7
10	100.0	98.7	98.6	98.4	97.9	97.7	97.6	97.3	97.1	96.8	96.6	96.4	96.2	95.7	95.5
11	100.0	98.6	98.7	98.5	98.2	98.0	97.8	97.6	97.4	97.4	97.1	97.0	96.6	95.8	94.6
12	100.0	98.7	98.8	98.6	98.3	98.0	97.9	97.6	97.4	97.5	97.1	96.9	96.2	95.5	94.4
13	100.0	98.7	98.7	98.5	98.3	98.0	97.9	97.7	97.5	97.5	97.1	97.0	96.1	94.8	93.7
14	100.0	98.9	98.8	98.7	98.4	98.1	98.0	97.7	97.5	97.5	97.1	96.9	96.0	94.8	94.4
15	100.0	98.7	98.6	98.5	98.2	97.9	97.8	97.6	97.4	97.3	96.8	96.8	96.1	95.3	94.7
16	100.0	98.5	98.4	98.2	98.1	97.7	97.6	97.3	97.1	96.8	96.4	96.1	95.3	93.9	93.3
17	100.0	98.6	98.5	98.3	98.0	97.6	97.5	97.0	96.6	96.1	95.5	95.3	94.6	93.9	93.8
18	100.0	98.6	98.5	98.1	97.7	97.3	97.0	96.0	95.7	95.0	94.0	93.5	92.6	92.0	90.8
19	100.0	99.0	99.0	98.8	98.5	98.3	98.2	97.8	97.8	97.4	97.1	96.6	96.3	95.9	95.2
20	100.0	98.8	98.7	98.5	98.2	97.9	97.7	97.4	97.3	97.1	96.7	96.2	95.7	94.9	94.2
21	100.0	98.5	98.5	98.2	97.8	97.6	97.4	97.0	96.8	96.6	96.2	96.0	95.1	93.8	92.8
22	100.0	98.5	98.6	98.5	98.2	97.9	97.8	97.6	97.5	97.5	97.0	96.6	95.3	93.5	92.7
23	100.0	98.4	98.4	98.3	98.1	97.7	97.6	97.3	97.0	97.0	96.5	96.0	95.0	92.9	92.1
24	100.0	98.4	98.3	98.1	97.8	97.4	97.3	97.0	96.8	96.8	96.3	96.1	95.4	93.4	92.9
25	100.0	98.3	98.2	98.1	97.7	97.2	96.9	96.1	95.6	95.1	94.4	94.1	93.2	92.3	92.0
n	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Avg.	100.0	98.6	98.6	98.4	98.1	97.8	97.7	97.3	97.1	96.9	96.4	96.2	95.5	94.5	93.9
Med.	100.0	98.6	98.6	98.5	98.2	97.9	97.7	97.5	97.4	97.2	96.8	96.6	96.0	94.8	94.2
σ	0.00	0.25	0.28	0.29	0.27	0.36	0.41	0.55	0.66	0.88	1.10	1.14	1.22	1.36	1.40
Min.	100.0	98.2	98.0	97.8	97.7	97.2	96.9	96.0	95.6	94.9	93.6	93.3	92.6	92.0	90.8
Max.	100.0	99.1	99.1	98.9	98.7	98.5	98.4	98.3	98.1	97.8	97.5	97.3	97.1	96.5	96.4

TM-21 Projection

Time	4515 h	5181 h	6014 h	6776 h	7573 h	8408 h	9235 h	10070 h							
ln(Avg.)	-0.0269	-0.0294	-0.0314	-0.0366	-0.0393	-0.0460	-0.0565	-0.0629							

Test duration used	4515 h	to	10070 h
B	1.0057		
α	6.4881E-06		
R ²	0.9483		
Calculated L ₇₀ (10K)	55900	hours	
Reported L ₇₀ (10K)	55900	hours	

Curve-fit equation:

$$\Phi(t) = B \exp(-\alpha t)$$

Lumen maintenance life equation:

$$L_{70} = \ln(B/0.7) / \alpha$$

Data Set 6 : 85 °C, 200 mA

Actual Case Temperature [T _s]	89.6 °C
Actual Ambient Temperature [T _A]	86.5 °C
Drive Current [I _F]	200 mA
Measurement Current	200 mA

NOTES:

T_s and T_A were measured during initial setup.

TABLE 6-3
Forward Voltage

LED No.	Relative Forward Voltage % (Normalized to 100 % at 0 hours)														
	0 h	541 h	1009 h	1698 h	2370 h	3123 h	3811 h	4515 h	5181 h	6014 h	6776 h	7573 h	8408 h	9235 h	10070 h
1	100.0	100.3	100.7	101.0	101.3	101.4	101.5	101.7	101.7	101.8	101.7	101.8	102.0	102.0	102.1
2	100.0	100.5	101.0	101.3	101.7	101.8	102.0	102.2	102.2	102.4	102.3	102.3	102.5	102.5	102.7
3	100.0	100.4	100.8	101.1	101.5	101.5	101.7	101.9	101.9	102.1	101.9	102.0	102.2	102.2	102.4
4	100.0	100.5	101.0	101.3	101.6	101.7	101.9	102.0	102.1	102.3	102.1	102.2	102.4	102.4	102.6
5	100.0	100.6	101.1	101.4	101.8	101.8	102.0	102.2	102.2	102.4	102.3	102.4	102.5	102.5	102.8
6	100.0	100.5	100.9	101.2	101.5	101.6	101.8	101.9	101.9	102.1	102.0	102.0	102.2	102.2	102.4
7	100.0	100.5	100.9	101.3	101.7	101.7	101.9	102.1	102.1	102.4	102.2	102.3	102.5	102.5	102.7
8	100.0	100.4	100.9	101.2	101.6	101.6	101.8	102.0	102.0	102.2	102.1	102.1	102.3	102.3	102.5
9	100.0	100.5	101.0	101.4	101.8	101.8	102.0	102.2	102.2	102.5	102.3	102.4	102.5	102.5	102.8
10	100.0	100.5	101.0	101.3	101.7	101.8	101.9	102.1	102.1	102.4	102.2	102.3	102.5	102.5	102.7
11	100.0	100.6	101.1	101.5	101.8	101.9	102.1	102.3	102.3	102.5	102.4	102.5	102.6	102.6	102.9
12	100.0	100.5	101.0	101.4	101.7	101.8	102.0	102.1	102.1	102.4	102.2	102.4	102.5	102.5	102.7
13	100.0	100.5	101.0	101.4	101.7	101.8	102.0	102.1	102.2	102.4	102.2	102.4	102.5	102.5	102.7
14	100.0	100.6	101.1	101.5	101.8	101.9	102.0	102.2	102.2	102.5	102.3	102.4	102.6	102.6	102.8
15	100.0	100.6	101.1	101.4	101.8	101.9	102.1	102.2	102.2	102.5	102.3	102.4	102.6	102.6	102.8
16	100.0	100.6	101.1	101.4	101.7	101.8	102.0	102.2	102.2	102.4	102.3	102.4	102.5	102.5	102.7
17	100.0	100.6	101.1	101.4	101.8	101.9	102.0	102.2	102.2	102.4	102.3	102.4	102.5	102.5	102.7
18	100.0	100.4	100.8	101.0	101.3	101.4	101.5	101.7	101.7	101.9	101.7	101.8	101.9	101.9	102.1
19	100.0	100.6	101.0	101.4	101.7	101.8	102.0	102.2	102.2	102.4	102.2	102.3	102.5	102.5	102.7
20	100.0	100.4	100.8	101.1	101.4	101.5	101.6	101.8	101.8	101.9	101.8	101.9	102.0	102.0	102.2
21	100.0	100.6	101.1	101.5	101.8	101.9	102.1	102.2	102.3	102.5	102.4	102.5	102.6	102.7	102.8
22	100.0	100.5	101.0	101.3	101.6	101.7	101.8	102.0	102.0	102.2	102.1	102.2	102.3	102.4	102.5
23	100.0	100.6	101.1	101.4	101.8	101.9	102.1	102.2	102.3	102.4	102.3	102.4	102.6	102.6	102.8
24	100.0	100.6	101.1	101.4	101.8	101.9	102.0	102.2	102.3	102.4	102.3	102.4	102.6	102.7	102.8
25	100.0	100.6	101.2	101.5	101.8	101.9	102.1	102.2	102.3	102.4	102.3	102.4	102.5	102.6	102.8
n	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Avg.	100.0	100.5	101.0	101.3	101.7	101.8	101.9	102.1	102.1	102.3	102.2	102.3	102.4	102.4	102.6
Med.	100.0	100.5	101.0	101.4	101.7	101.8	102.0	102.2	102.2	102.4	102.2	102.4	102.5	102.5	102.7
σ	0.00	0.08	0.11	0.14	0.15	0.17	0.17	0.18	0.19	0.20	0.20	0.21	0.21	0.22	0.22
Min.	100.0	100.3	100.7	101.0	101.3	101.4	101.5	101.7	101.7	101.8	101.7	101.8	101.9	101.9	102.1
Max.	100.0	100.6	101.2	101.5	101.8	101.9	102.1	102.3	102.3	102.5	102.4	102.5	102.6	102.7	102.9

Data Set 6 : 85 °C, 200 mA

Actual Case Temperature [T _s]	89.6 °C
Actual Ambient Temperature [T _A]	86.5 °C
Drive Current [I _F]	200 mA
Measurement Current	200 mA

NOTES:

T_s and T_A were measured during initial setup.

TABLE 6-4
Chromaticity Shift

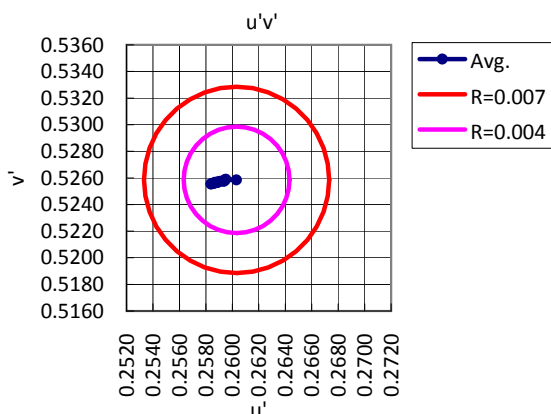
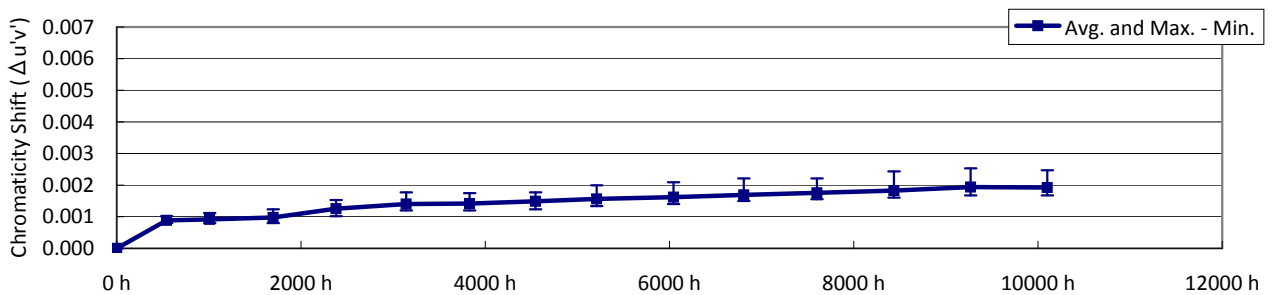
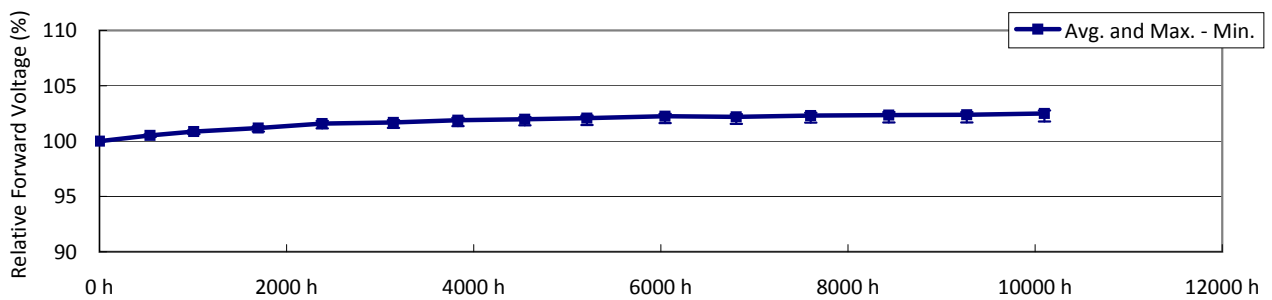
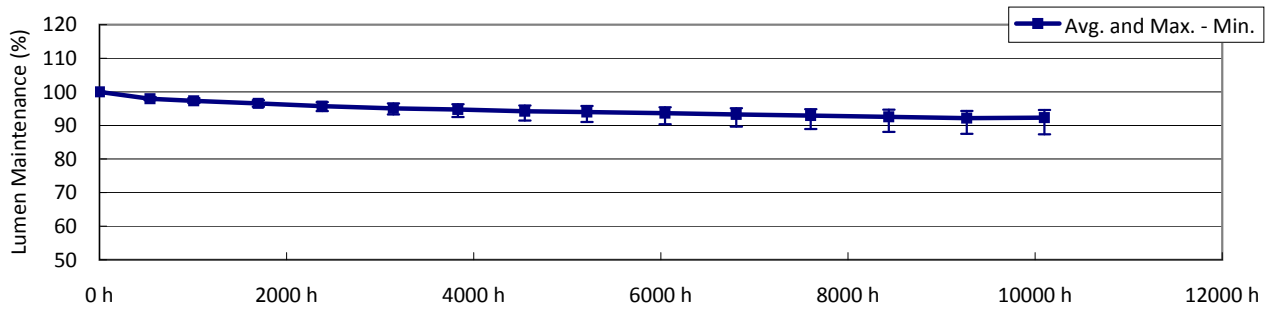
LED No.	Chromaticity Shift Δu'v'														
	0 h	541 h	1009 h	1698 h	2370 h	3123 h	3811 h	4515 h	5181 h	6014 h	6776 h	7573 h	8408 h	9235 h	10070 h
1	0.0000	0.0009	0.0010	0.0010	0.0014	0.0015	0.0015	0.0016	0.0017	0.0017	0.0018	0.0022	0.0024	0.0029	0.0037
2	0.0000	0.0010	0.0010	0.0011	0.0014	0.0016	0.0016	0.0017	0.0017	0.0018	0.0019	0.0022	0.0023	0.0032	0.0035
3	0.0000	0.0010	0.0010	0.0012	0.0015	0.0017	0.0017	0.0018	0.0019	0.0020	0.0024	0.0025	0.0033	0.0039	0.0044
4	0.0000	0.0009	0.0010	0.0010	0.0013	0.0015	0.0015	0.0016	0.0017	0.0018	0.0018	0.0020	0.0022	0.0023	0.0028
5	0.0000	0.0010	0.0011	0.0011	0.0015	0.0016	0.0017	0.0018	0.0018	0.0018	0.0018	0.0019	0.0019	0.0019	0.0023
6	0.0000	0.0010	0.0011	0.0012	0.0015	0.0017	0.0017	0.0018	0.0019	0.0020	0.0021	0.0024	0.0024	0.0031	0.0034
7	0.0000	0.0011	0.0012	0.0012	0.0015	0.0016	0.0017	0.0017	0.0018	0.0019	0.0019	0.0019	0.0021	0.0026	0.0029
8	0.0000	0.0010	0.0011	0.0012	0.0015	0.0016	0.0016	0.0017	0.0018	0.0018	0.0019	0.0020	0.0021	0.0024	0.0025
9	0.0000	0.0010	0.0010	0.0011	0.0014	0.0016	0.0016	0.0017	0.0017	0.0018	0.0019	0.0022	0.0022	0.0025	0.0033
10	0.0000	0.0010	0.0011	0.0013	0.0016	0.0018	0.0018	0.0020	0.0021	0.0022	0.0022	0.0022	0.0023	0.0027	0.0027
11	0.0000	0.0010	0.0010	0.0011	0.0014	0.0016	0.0016	0.0016	0.0018	0.0018	0.0019	0.0020	0.0021	0.0025	0.0035
12	0.0000	0.0009	0.0009	0.0010	0.0013	0.0014	0.0015	0.0015	0.0016	0.0017	0.0018	0.0020	0.0021	0.0024	0.0030
13	0.0000	0.0009	0.0009	0.0011	0.0013	0.0015	0.0014	0.0016	0.0017	0.0019	0.0022	0.0024	0.0027	0.0037	0.0048
14	0.0000	0.0008	0.0008	0.0009	0.0013	0.0015	0.0015	0.0016	0.0017	0.0017	0.0018	0.0022	0.0026	0.0037	0.0043
15	0.0000	0.0009	0.0010	0.0010	0.0013	0.0016	0.0015	0.0017	0.0018	0.0019	0.0019	0.0021	0.0024	0.0025	0.0031
16	0.0000	0.0012	0.0012	0.0014	0.0017	0.0018	0.0018	0.0019	0.0021	0.0021	0.0022	0.0024	0.0030	0.0039	0.0045
17	0.0000	0.0012	0.0012	0.0013	0.0016	0.0018	0.0018	0.0019	0.0020	0.0021	0.0023	0.0024	0.0028	0.0033	0.0034
18	0.0000	0.0011	0.0012	0.0013	0.0017	0.0018	0.0018	0.0019	0.0021	0.0021	0.0022	0.0023	0.0025	0.0026	0.0029
19	0.0000	0.0009	0.0010	0.0011	0.0015	0.0016	0.0016	0.0017	0.0018	0.0019	0.0020	0.0022	0.0024	0.0027	0.0032
20	0.0000	0.0009	0.0009	0.0009	0.0013	0.0014	0.0014	0.0015	0.0016	0.0017	0.0018	0.0021	0.0023	0.0026	0.0027
21	0.0000	0.0009	0.0010	0.0011	0.0015	0.0016	0.0017	0.0017	0.0018	0.0020	0.0021	0.0021	0.0023	0.0028	0.0030
22	0.0000	0.0010	0.0010	0.0010	0.0014	0.0015	0.0015	0.0016	0.0017	0.0018	0.0019	0.0022	0.0029	0.0039	0.0040
23	0.0000	0.0010	0.0011	0.0011	0.0014	0.0016	0.0016	0.0017	0.0018	0.0019	0.0020	0.0025	0.0028	0.0043	0.0047
24	0.0000	0.0009	0.0010	0.0010	0.0013	0.0015	0.0015	0.0016	0.0017	0.0018	0.0020	0.0024	0.0027	0.0040	0.0045
25	0.0000	0.0011	0.0011	0.0012	0.0015	0.0017	0.0017	0.0018	0.0019	0.0020	0.0021	0.0022	0.0029	0.0033	0.0038
n	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Avg.	0.0000	0.0010	0.0010	0.0011	0.0015	0.0016	0.0016	0.0017	0.0018	0.0019	0.0020	0.0022	0.0025	0.0030	0.0035
Med.	0.0000	0.0010	0.0010	0.0011	0.0014	0.0016	0.0016	0.0017	0.0018	0.0019	0.0019	0.0022	0.0024	0.0028	0.0034
σ	0.0000	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002	0.0002	0.0003	0.0006	0.0007
Min.	0.0000	0.0008	0.0008	0.0009	0.0013	0.0014	0.0014	0.0015	0.0016	0.0017	0.0018	0.0019	0.0019	0.0019	0.0023
Max.	0.0000	0.0012	0.0012	0.0014	0.0017	0.0018	0.0018	0.0020	0.0021	0.0022	0.0024	0.0025	0.0033	0.0043	0.0048

Data Set 7 : 105 °C, 100 mA

Actual Case Temperature [T_S]	106.2 °C
Actual Ambient Temperature [T_A]	103.5 °C
Drive Current [I_F]	100 mA
Measurement Current	100 mA

NOTES:

T_S and T_A were measured during initial setup.



Data Set 7 : 105 °C, 100 mA

Actual Case Temperature [T _s]	106.2 °C
Actual Ambient Temperature [T _A]	103.5 °C
Drive Current [I _F]	100 mA
Measurement Current	100 mA

NOTES:

 T_s and T_A were measured during initial setup.

TABLE 7-1
 Initial Characteristics

LED No.	Luminous flux	Forward voltage	CCT	CIE1931		CIE1976						
	Φ _v [lm]	V _F [V]	T _{CP} [K]	x	y	u'	v'					
1	70.5	6.03	2826	0.445	0.398	0.258	0.520					
2	71.5	6.02	2789	0.453	0.409	0.259	0.526					
3	70.3	6.02	2716	0.457	0.408	0.262	0.526					
4	70.3	6.02	2711	0.455	0.404	0.263	0.524					
5	70.8	6.03	2738	0.459	0.414	0.261	0.528					
6	72.0	6.02	2743	0.459	0.415	0.260	0.529					
7	70.9	6.02	2818	0.447	0.401	0.258	0.522					
8	71.2	6.03	2740	0.459	0.414	0.260	0.529					
9	70.6	6.02	2841	0.442	0.396	0.258	0.519					
10	70.1	6.03	2761	0.454	0.408	0.260	0.525					
11	71.2	6.02	2793	0.450	0.404	0.259	0.524					
12	71.3	6.03	2613	0.474	0.424	0.266	0.534					
13	70.9	6.02	2749	0.457	0.412	0.260	0.527					
14	71.6	6.02	2773	0.453	0.407	0.260	0.525					
15	71.1	6.02	2766	0.453	0.406	0.260	0.525					
16	70.9	6.03	2775	0.455	0.412	0.259	0.527					
17	70.8	6.02	2803	0.447	0.400	0.259	0.521					
18	70.2	6.01	2684	0.460	0.409	0.263	0.527					
19	71.5	6.02	2718	0.461	0.416	0.261	0.530					
20	71.2	6.01	2786	0.451	0.405	0.259	0.524					
21	71.1	6.03	2727	0.461	0.416	0.261	0.530					
22	70.4	6.02	2688	0.461	0.411	0.263	0.528					
23	71.1	6.03	2679	0.467	0.421	0.263	0.532					
24	69.4	6.04	2800	0.446	0.397	0.259	0.520					
25	70.9	6.03	2777	0.452	0.406	0.260	0.524					
n	25	25	25	25	25	25	25					
Avg.	70.9	6.02	2753	0.455	0.408	0.260	0.526					
Med.	70.9	6.02	2761	0.455	0.408	0.260	0.526					
σ	0.56	0.006	52.9	0.0072	0.0071	0.0019	0.0038					
Min.	69.4	6.01	2613	0.442	0.396	0.258	0.519					
Max.	72.0	6.04	2841	0.474	0.424	0.266	0.534					

Data Set 7 : 105 °C, 100 mA

Actual Case Temperature [T _s]	106.2 °C
Actual Ambient Temperature [T _A]	103.5 °C
Drive Current [I _F]	100 mA
Measurement Current	100 mA

NOTES:

T_s and T_A were measured during initial setup.

TABLE 7-2
Lumen Maintenance

LED No.	Lumen Maintenance % (Normalized to 100 % at 0 hours)														
	0 h	541 h	1008 h	1698 h	2380 h	3142 h	3830 h	4545 h	5210 h	6044 h	6806 h	7601 h	8436 h	9269 h	10100 h
1	100.0	97.9	97.3	96.6	95.8	95.2	94.8	94.2	94.0	94.0	93.6	93.2	92.7	92.4	92.4
2	100.0	98.0	97.6	96.9	96.4	95.8	95.6	95.1	95.0	95.0	94.7	94.5	94.2	93.9	94.0
3	100.0	97.5	96.7	95.5	94.7	93.9	93.5	93.1	92.7	92.6	92.2	91.8	91.5	91.1	91.3
4	100.0	97.9	97.3	96.4	95.8	95.1	94.7	94.5	94.1	94.0	93.6	93.3	93.0	92.6	92.8
5	100.0	98.0	97.3	96.5	95.9	95.2	94.9	94.5	94.2	93.9	93.5	93.2	92.9	92.7	93.0
6	100.0	97.9	97.2	96.4	95.7	95.1	94.7	94.3	94.2	93.6	93.2	92.9	92.6	92.3	92.7
7	100.0	97.9	97.3	96.7	96.0	95.5	95.2	94.8	94.8	94.2	93.9	93.7	93.4	93.3	93.7
8	100.0	98.4	97.7	96.9	96.0	95.3	94.8	94.1	93.9	93.3	93.0	92.7	92.2	92.0	92.3
9	100.0	98.4	97.8	97.0	96.2	95.6	95.2	94.5	94.5	93.9	93.5	93.2	92.6	92.3	92.4
10	100.0	97.9	96.9	95.6	94.3	93.3	92.5	91.5	91.1	90.4	89.6	88.9	88.1	87.5	87.3
11	100.0	98.2	97.6	96.8	95.8	95.2	94.9	94.3	94.1	93.8	93.5	93.2	92.9	92.3	92.2
12	100.0	97.9	97.3	96.5	95.6	94.9	94.6	94.0	93.7	93.6	93.1	92.8	92.4	91.8	91.7
13	100.0	97.9	97.3	96.6	95.9	95.3	95.1	94.7	94.4	94.5	94.2	94.1	93.9	93.5	93.6
14	100.0	97.7	96.9	96.2	95.3	94.6	94.4	93.9	93.5	93.4	92.9	92.8	92.3	92.0	92.0
15	100.0	98.0	97.3	96.5	95.7	95.0	94.7	94.2	93.9	93.6	93.3	93.1	92.7	92.4	92.6
16	100.0	97.5	96.8	96.0	95.2	94.5	94.1	93.8	93.4	93.0	92.6	92.4	92.1	91.7	92.0
17	100.0	97.7	96.9	95.8	94.7	93.7	93.1	92.4	92.0	91.2	90.7	90.2	89.8	89.4	89.7
18	100.0	98.4	98.1	97.5	96.9	96.5	96.3	95.9	95.8	95.4	95.1	94.8	94.7	94.3	94.6
19	100.0	98.3	98.0	97.3	96.5	96.0	95.8	95.2	95.2	94.8	94.6	94.4	94.3	93.9	94.2
20	100.0	98.4	98.0	97.4	96.6	96.1	95.9	95.4	95.4	95.2	95.0	94.8	94.7	94.3	94.5
21	100.0	98.0	97.6	96.9	96.0	95.5	95.2	94.6	94.4	94.1	93.7	93.3	92.5	92.2	92.2
22	100.0	97.8	97.3	96.6	95.7	95.0	94.6	94.1	93.7	93.4	92.8	92.1	91.4	90.8	90.7
23	100.0	97.5	97.0	96.3	95.5	94.9	94.4	94.0	93.6	93.4	92.9	92.5	92.0	91.3	91.4
24	100.0	97.8	97.1	96.5	95.7	95.1	94.8	94.4	94.0	93.9	93.6	93.2	92.9	92.3	92.6
25	100.0	97.8	97.1	96.4	95.6	95.0	94.5	94.1	93.8	93.3	93.0	92.5	92.1	91.6	91.8
n	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Avg.	100.0	97.9	97.3	96.6	95.7	95.1	94.7	94.2	94.0	93.7	93.3	93.0	92.5	92.2	92.3
Med.	100.0	97.9	97.3	96.5	95.8	95.1	94.8	94.3	94.0	93.8	93.5	93.2	92.6	92.3	92.4
σ	0.00	0.28	0.39	0.50	0.60	0.72	0.83	0.90	1.00	1.10	1.19	1.30	1.42	1.48	1.55
Min.	100.0	97.5	96.7	95.5	94.3	93.3	92.5	91.5	91.1	90.4	89.6	88.9	88.1	87.5	87.3
Max.	100.0	98.4	98.1	97.5	96.9	96.5	96.3	95.9	95.8	95.4	95.1	94.8	94.7	94.3	94.6

TM-21 Projection

Time	4545 h	5210 h	6044 h	6806 h	7601 h	8436 h	9269 h	10100 h							
ln(Avg.)	-0.0595	-0.0621	-0.0655	-0.0696	-0.0731	-0.0775	-0.0816	-0.0801							

Test duration used	4545 h	to	10100 h
B	0.9599		
α	4.1727E-06		
R ²	0.9671		
Calculated L ₇₀ (10K)	75700	hours	
Reported L ₇₀ (10K)	> 60600	hours	

Curve-fit equation:

$$\Phi(t) = B \exp(-\alpha t)$$

Lumen maintenance life equation:

$$L_{70} = \ln(B/0.7) / \alpha$$

Data Set 7 : 105 °C, 100 mA

Actual Case Temperature [T _s]	106.2 °C
Actual Ambient Temperature [T _A]	103.5 °C
Drive Current [I _F]	100 mA
Measurement Current	100 mA

NOTES:

T_s and T_A were measured during initial setup.

TABLE 7-3
Forward Voltage

LED No.	Relative Forward Voltage % (Normalized to 100 % at 0 hours)														
	0 h	541 h	1008 h	1698 h	2380 h	3142 h	3830 h	4545 h	5210 h	6044 h	6806 h	7601 h	8436 h	9269 h	10100 h
1	100.0	100.6	101.0	101.3	101.8	101.8	102.0	102.2	102.3	102.5	102.4	102.5	102.5	102.6	102.7
2	100.0	100.4	100.6	100.9	101.2	101.2	101.5	101.5	101.6	101.7	101.7	101.7	101.7	101.8	101.9
3	100.0	100.5	100.8	101.1	101.5	101.5	101.7	101.8	101.9	102.0	101.9	102.1	102.0	102.1	102.2
4	100.0	100.5	100.9	101.2	101.7	101.8	102.0	102.1	102.2	102.4	102.3	102.4	102.4	102.5	102.7
5	100.0	100.5	100.9	101.2	101.7	101.8	102.0	102.2	102.3	102.4	102.4	102.5	102.5	102.6	102.7
6	100.0	100.5	100.8	101.2	101.7	101.7	102.0	102.1	102.2	102.4	102.3	102.4	102.4	102.5	102.6
7	100.0	100.5	100.8	101.0	101.4	101.5	101.7	101.8	101.8	102.0	101.9	102.0	102.0	102.0	102.2
8	100.0	100.5	100.9	101.2	101.6	101.7	101.9	102.0	102.1	102.3	102.2	102.3	102.2	102.4	102.5
9	100.0	100.5	100.9	101.2	101.7	101.8	102.0	102.1	102.2	102.4	102.3	102.5	102.4	102.6	102.7
10	100.0	100.6	101.0	101.3	101.8	101.9	102.1	102.2	102.3	102.4	102.4	102.5	102.5	102.6	102.8
11	100.0	100.6	100.9	101.3	101.7	101.8	102.0	102.1	102.2	102.5	102.4	102.5	102.6	102.6	102.7
12	100.0	100.5	100.9	101.3	101.7	101.8	102.0	102.1	102.2	102.4	102.4	102.5	102.6	102.6	102.7
13	100.0	100.5	100.9	101.2	101.5	101.7	101.9	102.0	102.1	102.2	102.2	102.3	102.4	102.4	102.5
14	100.0	100.5	100.9	101.2	101.6	101.7	102.0	102.0	102.2	102.3	102.3	102.4	102.5	102.5	102.6
15	100.0	100.5	100.9	101.2	101.6	101.8	102.0	102.1	102.2	102.4	102.3	102.4	102.5	102.5	102.7
16	100.0	100.6	101.0	101.3	101.7	101.8	102.0	102.1	102.2	102.4	102.3	102.4	102.5	102.5	102.6
17	100.0	100.6	100.9	101.2	101.6	101.7	101.9	102.0	102.1	102.3	102.2	102.3	102.4	102.4	102.5
18	100.0	100.4	100.6	100.9	101.2	101.2	101.4	101.4	101.5	101.6	101.6	101.7	101.7	101.7	101.8
19	100.0	100.6	100.8	101.1	101.4	101.5	101.7	101.8	101.8	102.0	102.0	102.0	102.2	102.1	102.2
20	100.0	100.4	100.7	100.9	101.3	101.3	101.5	101.5	101.6	101.7	101.7	101.8	101.9	101.8	101.9
21	100.0	100.6	100.9	101.3	101.6	101.8	102.0	102.1	102.2	102.4	102.3	102.5	102.5	102.5	102.6
22	100.0	100.5	100.9	101.3	101.6	101.8	102.0	102.1	102.2	102.4	102.4	102.5	102.5	102.6	102.7
23	100.0	100.5	100.9	101.3	101.6	101.8	102.0	102.1	102.2	102.4	102.4	102.5	102.6	102.6	102.7
24	100.0	100.6	100.9	101.3	101.6	101.8	101.9	102.0	102.2	102.3	102.3	102.4	102.5	102.5	102.6
25	100.0	100.6	101.0	101.3	101.7	101.9	102.1	102.1	102.2	102.5	102.4	102.6	102.6	102.6	102.8
n	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Avg.	100.0	100.5	100.9	101.2	101.6	101.7	101.9	102.0	102.1	102.2	102.2	102.3	102.3	102.4	102.5
Med.	100.0	100.5	100.9	101.2	101.6	101.8	102.0	102.1	102.2	102.4	102.3	102.4	102.5	102.5	102.6
σ	0.00	0.06	0.09	0.13	0.17	0.19	0.21	0.22	0.24	0.26	0.25	0.27	0.28	0.28	0.30
Min.	100.0	100.4	100.6	100.9	101.2	101.2	101.4	101.4	101.5	101.6	101.6	101.7	101.7	101.7	101.8
Max.	100.0	100.6	101.0	101.3	101.8	101.9	102.1	102.2	102.3	102.5	102.4	102.6	102.6	102.6	102.8

Data Set 7 : 105 °C, 100 mA

Actual Case Temperature [T _s]	106.2 °C
Actual Ambient Temperature [T _A]	103.5 °C
Drive Current [I _F]	100 mA
Measurement Current	100 mA

NOTES:

T_s and T_A were measured during initial setup.

TABLE 7-4
Chromaticity Shift

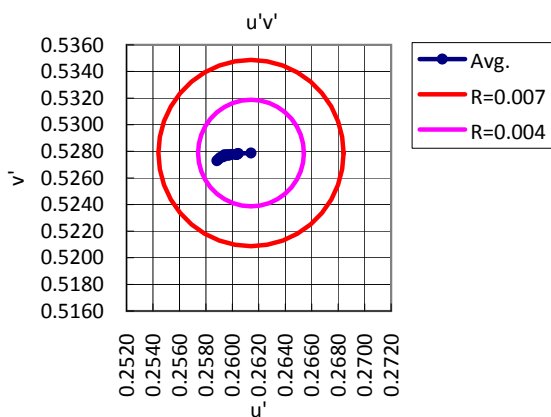
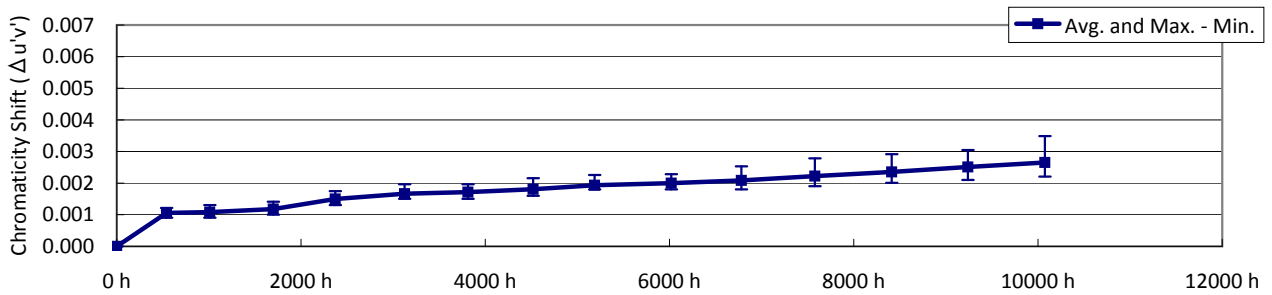
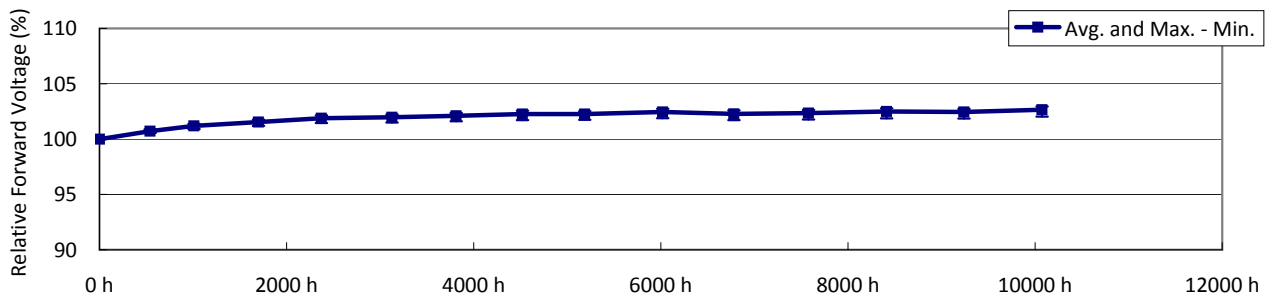
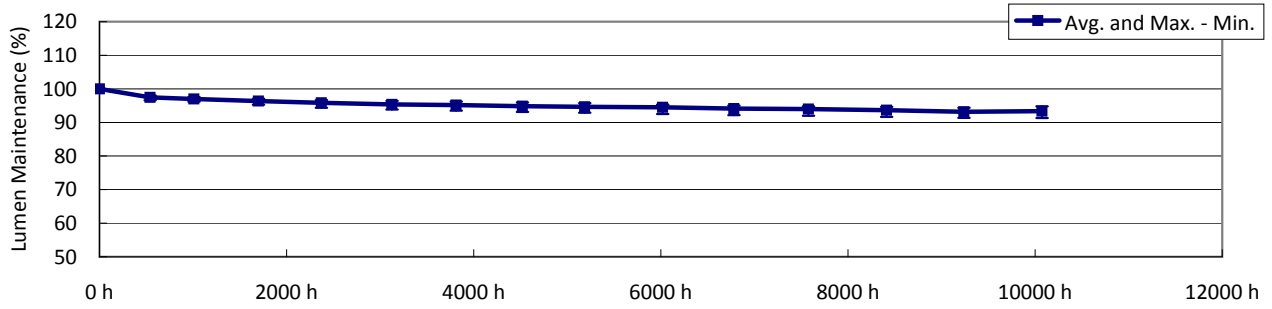
LED No.	Chromaticity Shift Δu'v'														
	0 h	541 h	1008 h	1698 h	2380 h	3142 h	3830 h	4545 h	5210 h	6044 h	6806 h	7601 h	8436 h	9269 h	10100 h
1	0.0000	0.0008	0.0008	0.0008	0.0010	0.0012	0.0012	0.0013	0.0013	0.0014	0.0015	0.0016	0.0017	0.0018	0.0018
2	0.0000	0.0009	0.0009	0.0010	0.0012	0.0014	0.0014	0.0015	0.0015	0.0016	0.0018	0.0018	0.0019	0.0020	0.0021
3	0.0000	0.0009	0.0010	0.0010	0.0013	0.0014	0.0014	0.0015	0.0016	0.0016	0.0018	0.0018	0.0020	0.0021	0.0021
4	0.0000	0.0009	0.0009	0.0010	0.0012	0.0014	0.0014	0.0014	0.0015	0.0014	0.0015	0.0016	0.0016	0.0017	0.0017
5	0.0000	0.0009	0.0009	0.0010	0.0013	0.0014	0.0014	0.0015	0.0015	0.0016	0.0016	0.0017	0.0018	0.0018	0.0018
6	0.0000	0.0010	0.0011	0.0012	0.0014	0.0016	0.0016	0.0017	0.0017	0.0018	0.0018	0.0018	0.0019	0.0020	0.0020
7	0.0000	0.0009	0.0010	0.0011	0.0013	0.0016	0.0016	0.0016	0.0017	0.0018	0.0019	0.0020	0.0021	0.0022	0.0021
8	0.0000	0.0008	0.0009	0.0009	0.0013	0.0014	0.0014	0.0015	0.0015	0.0016	0.0016	0.0017	0.0017	0.0018	0.0018
9	0.0000	0.0008	0.0008	0.0008	0.0011	0.0012	0.0012	0.0012	0.0014	0.0014	0.0016	0.0016	0.0017	0.0017	0.0017
10	0.0000	0.0009	0.0009	0.0010	0.0013	0.0014	0.0015	0.0016	0.0017	0.0017	0.0017	0.0018	0.0019	0.0020	0.0020
11	0.0000	0.0009	0.0009	0.0010	0.0013	0.0014	0.0015	0.0016	0.0017	0.0017	0.0017	0.0018	0.0019	0.0020	0.0020
12	0.0000	0.0008	0.0008	0.0009	0.0012	0.0014	0.0014	0.0015	0.0016	0.0016	0.0017	0.0018	0.0018	0.0020	0.0020
13	0.0000	0.0009	0.0009	0.0009	0.0012	0.0013	0.0013	0.0014	0.0014	0.0015	0.0015	0.0016	0.0017	0.0018	0.0018
14	0.0000	0.0008	0.0008	0.0009	0.0012	0.0013	0.0013	0.0014	0.0015	0.0016	0.0016	0.0017	0.0017	0.0019	0.0018
15	0.0000	0.0009	0.0010	0.0011	0.0014	0.0015	0.0015	0.0016	0.0017	0.0017	0.0018	0.0018	0.0019	0.0020	0.0019
16	0.0000	0.0010	0.0010	0.0010	0.0014	0.0015	0.0015	0.0015	0.0016	0.0017	0.0018	0.0018	0.0019	0.0020	0.0019
17	0.0000	0.0010	0.0011	0.0012	0.0015	0.0018	0.0017	0.0018	0.0020	0.0021	0.0022	0.0022	0.0024	0.0025	0.0025
18	0.0000	0.0010	0.0010	0.0011	0.0013	0.0014	0.0015	0.0015	0.0016	0.0016	0.0017	0.0018	0.0018	0.0020	0.0020
19	0.0000	0.0008	0.0009	0.0009	0.0012	0.0014	0.0014	0.0015	0.0015	0.0016	0.0016	0.0017	0.0017	0.0018	0.0018
20	0.0000	0.0009	0.0009	0.0010	0.0013	0.0015	0.0015	0.0015	0.0016	0.0017	0.0017	0.0018	0.0018	0.0019	0.0019
21	0.0000	0.0008	0.0008	0.0008	0.0011	0.0012	0.0012	0.0013	0.0014	0.0014	0.0015	0.0016	0.0017	0.0018	0.0018
22	0.0000	0.0008	0.0008	0.0009	0.0011	0.0013	0.0013	0.0014	0.0015	0.0016	0.0017	0.0018	0.0019	0.0020	0.0020
23	0.0000	0.0008	0.0008	0.0008	0.0011	0.0012	0.0012	0.0013	0.0014	0.0014	0.0015	0.0016	0.0016	0.0018	0.0018
24	0.0000	0.0009	0.0009	0.0009	0.0012	0.0013	0.0013	0.0013	0.0014	0.0015	0.0016	0.0017	0.0017	0.0019	0.0018
25	0.0000	0.0009	0.0009	0.0010	0.0012	0.0013	0.0014	0.0014	0.0015	0.0016	0.0016	0.0017	0.0018	0.0019	0.0020
n	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Avg.	0.0000	0.0009	0.0009	0.0010	0.0013	0.0014	0.0014	0.0015	0.0016	0.0016	0.0017	0.0018	0.0018	0.0019	0.0019
Med.	0.0000	0.0009	0.0009	0.0010	0.0012	0.0014	0.0014	0.0015	0.0015	0.0016	0.0017	0.0018	0.0018	0.0019	0.0019
σ	0.0000	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002	0.0002	0.0002	0.0001	0.0002	0.0002	0.0002
Min.	0.0000	0.0008	0.0008	0.0008	0.0010	0.0012	0.0012	0.0012	0.0013	0.0014	0.0015	0.0016	0.0016	0.0017	0.0017
Max.	0.0000	0.0010	0.0011	0.0012	0.0015	0.0018	0.0017	0.0018	0.0020	0.0021	0.0022	0.0022	0.0024	0.0025	0.0025

Data Set 8 : 105 °C, 150 mA

Actual Case Temperature [T_S]	106.9 °C
Actual Ambient Temperature [T_A]	103.4 °C
Drive Current [I_F]	150 mA
Measurement Current	150 mA

NOTES:

T_S and T_A were measured during initial setup.



Data Set 8 : 105 °C, 150 mA

Actual Case Temperature [T _S]	106.9 °C
Actual Ambient Temperature [T _A]	103.4 °C
Drive Current [I _F]	150 mA
Measurement Current	150 mA

NOTES:

 T_S and T_A were measured during initial setup.

TABLE 8-1
 Initial Characteristics

LED No.	Luminous flux	Forward voltage	CCT	CIE1931		CIE1976							
	Φ _V [lm]	V _F [V]	T _{CP} [K]	x	y	u'	v'						
1	100.2	6.32	2672	0.466	0.418	0.263	0.531						
2	101.6	6.31	2751	0.456	0.410	0.260	0.526						
3	101.3	6.31	2769	0.454	0.408	0.260	0.525						
4	99.9	6.32	2646	0.470	0.421	0.264	0.533						
5	98.7	6.32	2651	0.466	0.416	0.264	0.530						
6	102.3	6.31	2811	0.453	0.412	0.257	0.527						
7	102.0	6.31	2734	0.461	0.418	0.260	0.530						
8	99.3	6.33	2668	0.464	0.413	0.264	0.529						
9	101.2	6.32	2690	0.465	0.419	0.262	0.531						
10	100.1	6.31	2714	0.459	0.411	0.262	0.527						
11	101.3	6.31	2712	0.463	0.418	0.261	0.531						
12	99.5	6.32	2695	0.460	0.411	0.263	0.528						
13	102.1	6.31	2850	0.446	0.403	0.257	0.522						
14	101.2	6.31	2826	0.446	0.401	0.258	0.521						
15	98.9	6.32	2610	0.470	0.417	0.266	0.532						
16	99.9	6.32	2761	0.453	0.405	0.260	0.524						
17	101.1	6.31	2839	0.444	0.398	0.258	0.520						
18	100.9	6.31	2737	0.459	0.415	0.260	0.529						
19	102.8	6.33	2762	0.457	0.414	0.259	0.528						
20	101.2	6.31	2711	0.461	0.414	0.262	0.529						
21	101.4	6.30	2735	0.459	0.414	0.261	0.529						
22	102.6	6.31	2819	0.449	0.406	0.258	0.524						
23	100.7	6.32	2795	0.446	0.397	0.260	0.520						
24	100.3	6.30	2621	0.471	0.420	0.266	0.533						
25	99.6	6.31	2655	0.468	0.420	0.264	0.532						
n	25	25	25	25	25	25	25						
Avg.	100.8	6.31	2729	0.459	0.412	0.261	0.528						
Med.	101.1	6.31	2734	0.459	0.414	0.261	0.529						
σ	1.13	0.007	69.0	0.0083	0.0070	0.0026	0.0039						
Min.	98.7	6.30	2610	0.444	0.397	0.257	0.520						
Max.	102.8	6.33	2850	0.471	0.421	0.266	0.533						

Data Set 8 : 105 °C, 150 mA

Actual Case Temperature [T _s]	106.9 °C
Actual Ambient Temperature [T _A]	103.4 °C
Drive Current [I _F]	150 mA
Measurement Current	150 mA

NOTES:

T_s and T_A were measured during initial setup.

TABLE 8-2
Lumen Maintenance

LED No.	Lumen Maintenance % (Normalized to 100 % at 0 hours)														
	0 h	541 h	1010 h	1699 h	2372 h	3125 h	3812 h	4520 h	5186 h	6019 h	6781 h	7577 h	8412 h	9239 h	10074 h
1	100.0	97.3	96.8	96.2	95.7	95.3	95.0	94.6	94.4	94.4	94.1	93.8	93.6	93.1	93.2
2	100.0	97.4	97.0	96.3	95.8	95.4	95.2	94.9	94.7	94.9	94.6	94.4	94.2	93.7	93.9
3	100.0	97.3	96.8	96.2	95.7	95.1	94.9	94.5	94.3	94.6	94.1	94.0	93.7	93.0	93.4
4	100.0	97.4	96.9	96.4	96.0	95.4	95.3	95.1	94.9	95.1	94.7	94.6	94.4	93.8	94.4
5	100.0	97.3	96.9	96.3	96.0	95.6	95.5	95.3	95.1	95.2	94.9	94.8	94.6	94.1	94.5
6	100.0	97.4	97.0	96.5	96.1	95.7	95.5	95.3	95.2	95.0	94.7	94.6	94.5	94.1	94.8
7	100.0	97.6	97.2	96.6	96.2	95.8	95.6	95.3	95.1	94.7	94.4	94.2	93.9	93.7	94.2
8	100.0	97.9	97.5	97.1	96.7	96.4	96.2	95.9	95.8	95.3	95.1	94.8	94.5	94.4	94.6
9	100.0	98.0	97.5	97.0	96.4	96.0	95.9	95.5	95.3	94.9	94.6	94.4	94.1	93.9	93.9
10	100.0	97.0	96.2	95.2	94.4	93.8	93.5	93.1	92.9	92.5	92.2	92.0	91.6	91.4	91.3
11	100.0	97.5	97.0	96.5	95.9	95.5	95.3	94.9	94.7	94.7	94.4	94.2	93.6	93.0	92.9
12	100.0	97.5	97.0	96.5	95.9	95.4	95.3	94.9	94.8	95.0	94.8	94.7	94.4	94.0	94.0
13	100.0	96.6	96.2	95.5	94.9	94.3	94.2	93.8	93.6	93.7	93.3	93.2	92.9	92.5	92.7
14	100.0	97.0	96.4	95.6	95.1	94.5	94.3	93.9	93.7	93.7	93.1	93.0	92.7	92.2	92.4
15	100.0	97.4	96.9	96.4	95.9	95.4	95.3	95.0	94.8	94.7	94.2	94.0	93.8	93.5	94.0
16	100.0	97.1	96.4	95.7	95.2	94.6	94.3	93.9	93.6	93.3	92.8	92.7	92.2	91.8	92.1
17	100.0	97.5	96.9	96.1	95.4	94.9	94.6	94.3	94.0	93.6	93.2	92.9	92.6	92.2	92.5
18	100.0	97.7	97.1	96.5	95.9	95.5	95.2	94.9	94.7	94.3	94.0	93.7	93.4	93.0	93.3
19	100.0	98.0	97.5	96.9	96.3	95.8	95.6	95.2	95.0	94.7	94.5	94.2	93.9	93.4	93.6
20	100.0	97.7	97.2	96.7	96.2	95.8	95.6	95.2	94.9	94.3	94.1	94.3	93.9	93.4	93.3
21	100.0	97.8	97.4	96.8	96.3	95.9	95.8	95.4	95.2	95.2	94.8	94.6	94.2	93.5	93.3
22	100.0	97.5	97.1	96.5	95.8	95.4	95.2	94.7	94.5	94.5	94.1	93.9	93.2	92.5	92.2
23	100.0	97.4	97.1	96.6	96.0	95.7	95.6	95.2	95.1	95.2	94.9	94.7	94.3	93.7	93.7
24	100.0	97.5	97.1	96.6	96.1	95.5	95.2	94.7	94.3	94.2	93.7	93.4	92.9	92.3	92.5
25	100.0	97.5	97.1	96.6	96.2	95.9	95.8	95.5	95.2	95.0	94.5	94.3	94.0	93.5	93.7
n	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Avg.	100.0	97.5	97.0	96.4	95.8	95.4	95.2	94.8	94.6	94.5	94.1	94.0	93.7	93.2	93.4
Med.	100.0	97.5	97.0	96.5	95.9	95.5	95.3	94.9	94.8	94.7	94.4	94.2	93.9	93.4	93.4
σ	0.00	0.32	0.37	0.45	0.51	0.57	0.61	0.64	0.66	0.69	0.72	0.73	0.78	0.79	0.88
Min.	100.0	96.6	96.2	95.2	94.4	93.8	93.5	93.1	92.9	92.5	92.2	92.0	91.6	91.4	91.3
Max.	100.0	98.0	97.5	97.1	96.7	96.4	96.2	95.9	95.8	95.3	95.1	94.8	94.6	94.4	94.8

TM-21 Projection

Time	4520 h	5186 h	6019 h	6781 h	7577 h	8412 h	9239 h	10074 h							
ln(Avg.)	-0.0530	-0.0551	-0.0566	-0.0604	-0.0622	-0.0655	-0.0705	-0.0685							

Test duration used	4520 h	to	10074 h
B	0.9623		
α	3.1951E-06		
R ²	0.9557		
Calculated L ₇₀ (10K)	99600	hours	
Reported L ₇₀ (10K)	> 60400	hours	

Curve-fit equation:

$$\Phi(t) = B \exp(-\alpha t)$$

Lumen maintenance life equation:

$$L_{70} = \ln(B/0.7) / \alpha$$

Data Set 8 : 105 °C, 150 mA

Actual Case Temperature [T _s]	106.9 °C
Actual Ambient Temperature [T _A]	103.4 °C
Drive Current [I _F]	150 mA
Measurement Current	150 mA

NOTES:

T_s and T_A were measured during initial setup.

TABLE 8-3
Forward Voltage

LED No.	Relative Forward Voltage % (Normalized to 100 % at 0 hours)														
	0 h	541 h	1010 h	1699 h	2372 h	3125 h	3812 h	4520 h	5186 h	6019 h	6781 h	7577 h	8412 h	9239 h	10074 h
1	100.0	100.9	101.4	101.8	102.2	102.2	102.4	102.6	102.5	102.7	102.6	102.6	102.8	102.7	102.9
2	100.0	100.7	101.2	101.6	102.0	102.1	102.2	102.4	102.3	102.6	102.4	102.5	102.6	102.5	102.8
3	100.0	100.7	101.2	101.6	101.9	102.0	102.2	102.3	102.3	102.6	102.4	102.4	102.6	102.5	102.8
4	100.0	100.8	101.3	101.7	102.1	102.2	102.3	102.5	102.5	102.7	102.5	102.6	102.7	102.7	102.9
5	100.0	100.7	101.1	101.4	101.8	101.9	102.0	102.1	102.1	102.3	102.1	102.2	102.3	102.3	102.5
6	100.0	100.6	101.1	101.4	101.7	101.8	101.9	102.1	102.0	102.2	102.0	102.1	102.2	102.2	102.4
7	100.0	100.7	101.3	101.6	102.0	102.1	102.2	102.4	102.4	102.6	102.4	102.5	102.6	102.6	102.8
8	100.0	100.6	101.1	101.3	101.7	101.7	101.8	102.0	102.0	102.1	102.0	102.0	102.2	102.1	102.3
9	100.0	100.7	101.2	101.6	102.0	102.1	102.2	102.4	102.4	102.6	102.4	102.5	102.6	102.5	102.8
10	100.0	100.7	101.2	101.6	102.0	102.1	102.2	102.4	102.4	102.6	102.4	102.5	102.6	102.6	102.8
11	100.0	100.8	101.2	101.6	102.0	102.1	102.2	102.4	102.3	102.5	102.4	102.5	102.6	102.6	102.8
12	100.0	100.8	101.3	101.6	102.0	102.1	102.2	102.4	102.4	102.6	102.4	102.5	102.6	102.6	102.8
13	100.0	100.8	101.3	101.7	102.0	102.1	102.2	102.4	102.4	102.6	102.5	102.5	102.7	102.6	102.8
14	100.0	100.7	101.1	101.4	101.8	101.9	101.9	102.1	102.1	102.3	102.1	102.1	102.3	102.2	102.4
15	100.0	100.8	101.3	101.6	102.0	102.1	102.2	102.4	102.4	102.6	102.4	102.6	102.6	102.6	102.8
16	100.0	100.9	101.3	101.7	102.1	102.2	102.3	102.5	102.5	102.7	102.5	102.6	102.7	102.7	102.9
17	100.0	100.7	101.3	101.6	102.0	102.1	102.2	102.4	102.4	102.6	102.4	102.5	102.6	102.6	102.8
18	100.0	100.8	101.3	101.7	102.0	102.1	102.2	102.4	102.4	102.6	102.5	102.5	102.7	102.6	102.9
19	100.0	100.7	101.2	101.6	102.0	102.1	102.2	102.4	102.4	102.6	102.4	102.5	102.6	102.6	102.7
20	100.0	100.7	101.2	101.6	101.9	102.1	102.2	102.3	102.4	102.5	102.4	102.4	102.6	102.5	102.8
21	100.0	100.7	101.1	101.4	101.7	101.8	101.9	102.0	102.1	102.2	102.1	102.1	102.2	102.2	102.4
22	100.0	100.7	101.2	101.6	101.9	102.0	102.2	102.3	102.3	102.5	102.4	102.4	102.6	102.6	102.7
23	100.0	100.6	100.9	101.2	101.4	101.5	101.6	101.7	101.7	101.9	101.7	101.8	101.9	101.9	102.0
24	100.0	100.6	101.0	101.2	101.5	101.6	101.6	101.8	101.8	101.9	101.7	101.8	101.9	101.9	102.0
25	100.0	100.7	101.1	101.4	101.7	101.8	101.9	102.1	102.1	102.2	102.0	102.1	102.2	102.2	102.4
n	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Avg.	100.0	100.7	101.2	101.5	101.9	102.0	102.1	102.3	102.3	102.4	102.3	102.4	102.5	102.4	102.7
Med.	100.0	100.7	101.2	101.6	102.0	102.1	102.2	102.4	102.4	102.6	102.4	102.5	102.6	102.6	102.8
σ	0.00	0.08	0.11	0.15	0.18	0.20	0.21	0.22	0.22	0.24	0.24	0.24	0.25	0.25	0.26
Min.	100.0	100.6	100.9	101.2	101.4	101.5	101.6	101.7	101.7	101.9	101.7	101.8	101.9	101.9	102.0
Max.	100.0	100.9	101.4	101.8	102.2	102.2	102.4	102.6	102.5	102.7	102.6	102.6	102.8	102.7	102.9

Data Set 8 : 105 °C, 150 mA

Actual Case Temperature [T _s]	106.9 °C
Actual Ambient Temperature [T _A]	103.4 °C
Drive Current [I _F]	150 mA
Measurement Current	150 mA

NOTES:

T_s and T_A were measured during initial setup.

TABLE 8-4
Chromaticity Shift

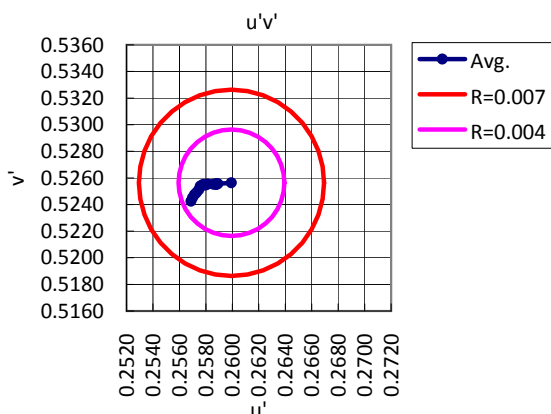
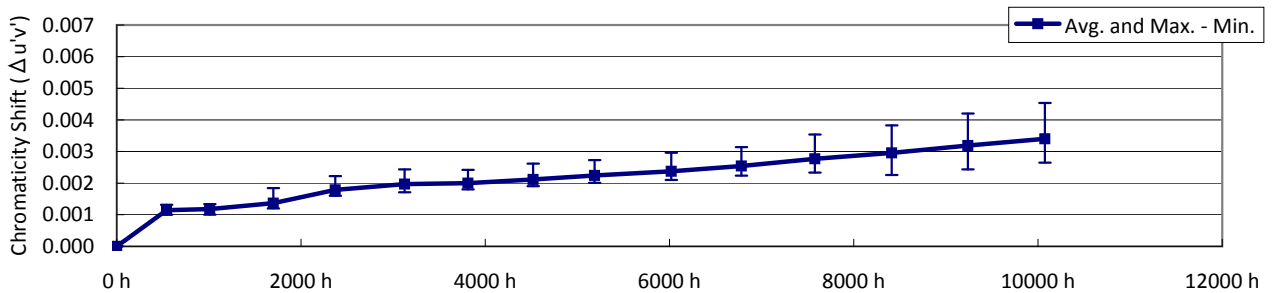
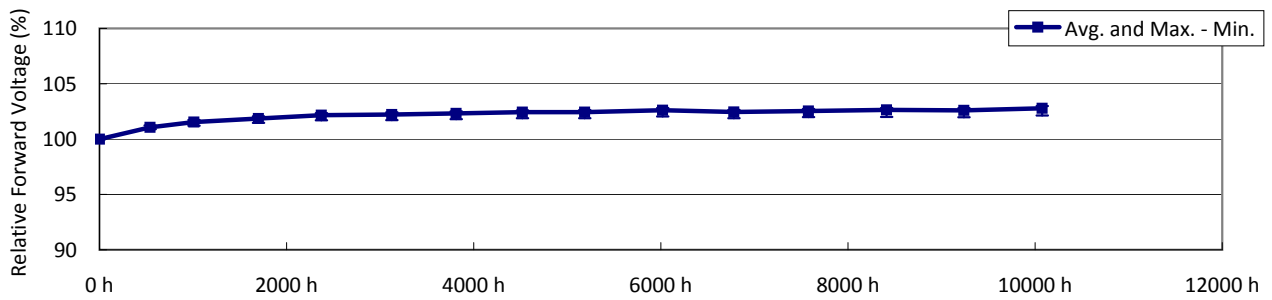
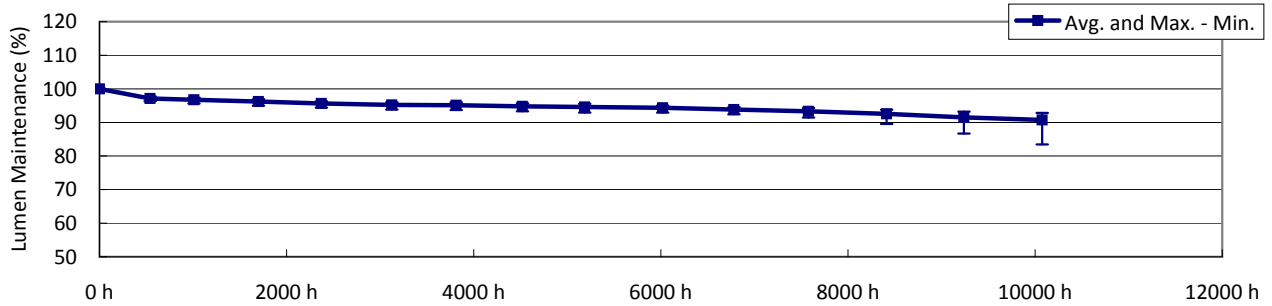
LED No.	Chromaticity Shift Δu'v'														
	0 h	541 h	1010 h	1699 h	2372 h	3125 h	3812 h	4520 h	5186 h	6019 h	6781 h	7577 h	8412 h	9239 h	10074 h
1	0.0000	0.0010	0.0010	0.0011	0.0014	0.0016	0.0016	0.0017	0.0018	0.0018	0.0019	0.0019	0.0020	0.0021	0.0022
2	0.0000	0.0010	0.0010	0.0011	0.0015	0.0016	0.0017	0.0017	0.0018	0.0019	0.0019	0.0020	0.0021	0.0022	0.0023
3	0.0000	0.0010	0.0011	0.0012	0.0015	0.0017	0.0018	0.0019	0.0020	0.0021	0.0021	0.0022	0.0023	0.0025	0.0025
4	0.0000	0.0010	0.0010	0.0011	0.0014	0.0016	0.0016	0.0017	0.0018	0.0019	0.0020	0.0020	0.0021	0.0022	0.0023
5	0.0000	0.0012	0.0012	0.0014	0.0017	0.0018	0.0019	0.0019	0.0021	0.0022	0.0022	0.0023	0.0024	0.0025	0.0027
6	0.0000	0.0012	0.0012	0.0013	0.0016	0.0017	0.0018	0.0019	0.0020	0.0021	0.0022	0.0024	0.0025	0.0026	0.0026
7	0.0000	0.0012	0.0012	0.0012	0.0015	0.0017	0.0017	0.0018	0.0019	0.0020	0.0021	0.0021	0.0023	0.0024	0.0024
8	0.0000	0.0012	0.0012	0.0013	0.0016	0.0017	0.0018	0.0019	0.0020	0.0021	0.0022	0.0023	0.0024	0.0025	0.0026
9	0.0000	0.0010	0.0010	0.0011	0.0015	0.0016	0.0017	0.0017	0.0019	0.0020	0.0020	0.0021	0.0022	0.0023	0.0023
10	0.0000	0.0011	0.0013	0.0014	0.0017	0.0018	0.0019	0.0021	0.0021	0.0022	0.0023	0.0024	0.0024	0.0026	0.0026
11	0.0000	0.0009	0.0010	0.0010	0.0014	0.0015	0.0015	0.0016	0.0018	0.0018	0.0019	0.0020	0.0021	0.0024	0.0027
12	0.0000	0.0010	0.0010	0.0012	0.0015	0.0017	0.0017	0.0018	0.0019	0.0020	0.0020	0.0021	0.0022	0.0023	0.0025
13	0.0000	0.0011	0.0011	0.0012	0.0015	0.0017	0.0017	0.0018	0.0019	0.0019	0.0021	0.0021	0.0022	0.0024	0.0024
14	0.0000	0.0009	0.0010	0.0011	0.0014	0.0016	0.0017	0.0018	0.0020	0.0021	0.0021	0.0024	0.0026	0.0027	0.0029
15	0.0000	0.0010	0.0011	0.0012	0.0014	0.0016	0.0017	0.0018	0.0020	0.0020	0.0021	0.0022	0.0023	0.0025	0.0026
16	0.0000	0.0010	0.0010	0.0011	0.0014	0.0016	0.0016	0.0017	0.0019	0.0019	0.0021	0.0021	0.0023	0.0025	0.0026
17	0.0000	0.0012	0.0012	0.0013	0.0017	0.0020	0.0020	0.0022	0.0023	0.0023	0.0025	0.0028	0.0029	0.0030	0.0032
18	0.0000	0.0011	0.0011	0.0011	0.0015	0.0017	0.0017	0.0017	0.0018	0.0018	0.0019	0.0020	0.0021	0.0022	0.0023
19	0.0000	0.0010	0.0011	0.0011	0.0015	0.0017	0.0017	0.0018	0.0019	0.0020	0.0021	0.0024	0.0025	0.0026	0.0027
20	0.0000	0.0010	0.0010	0.0011	0.0014	0.0015	0.0016	0.0017	0.0018	0.0018	0.0018	0.0020	0.0021	0.0023	0.0025
21	0.0000	0.0009	0.0009	0.0011	0.0014	0.0016	0.0016	0.0017	0.0018	0.0019	0.0020	0.0022	0.0025	0.0026	0.0028
22	0.0000	0.0010	0.0010	0.0011	0.0013	0.0015	0.0016	0.0017	0.0018	0.0019	0.0020	0.0023	0.0027	0.0030	0.0035
23	0.0000	0.0011	0.0011	0.0012	0.0015	0.0017	0.0018	0.0019	0.0020	0.0021	0.0022	0.0024	0.0027	0.0029	0.0033
24	0.0000	0.0010	0.0010	0.0011	0.0014	0.0015	0.0016	0.0017	0.0018	0.0019	0.0020	0.0022	0.0025	0.0026	0.0028
25	0.0000	0.0011	0.0011	0.0012	0.0015	0.0017	0.0017	0.0018	0.0021	0.0022	0.0023	0.0024	0.0025	0.0027	0.0029
n	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Avg.	0.0000	0.0011	0.0011	0.0012	0.0015	0.0017	0.0017	0.0018	0.0019	0.0020	0.0021	0.0022	0.0024	0.0025	0.0027
Med.	0.0000	0.0010	0.0011	0.0011	0.0015	0.0017	0.0017	0.0018	0.0019	0.0020	0.0021	0.0022	0.0023	0.0025	0.0026
σ	0.0000	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002	0.0002	0.0002	0.0002	0.0003
Min.	0.0000	0.0009	0.0009	0.0010	0.0013	0.0015	0.0015	0.0016	0.0018	0.0018	0.0018	0.0019	0.0020	0.0021	0.0022
Max.	0.0000	0.0012	0.0013	0.0014	0.0017	0.0020	0.0020	0.0022	0.0023	0.0023	0.0025	0.0028	0.0029	0.0030	0.0035

Data Set 9 : 105 °C, 200 mA

Actual Case Temperature [T_S]	108.8 °C
Actual Ambient Temperature [T_A]	105.6 °C
Drive Current [I_F]	200 mA
Measurement Current	200 mA

NOTES:

T_S and T_A were measured during initial setup.



Data Set 9 : 105 °C, 200 mA

Actual Case Temperature [T _s]	108.8 °C
Actual Ambient Temperature [T _A]	105.6 °C
Drive Current [I _F]	200 mA
Measurement Current	200 mA

NOTES:

 T_s and T_A were measured during initial setup.

TABLE 9-1
 Initial Characteristics

LED No.	Luminous flux	Forward voltage	CCT	CIE1931		CIE1976							
	Φ _v [lm]	V _F [V]	T _{CP} [K]	x	y	u'	v'						
1	128.0	6.60	2783	0.452	0.406	0.259	0.524						
2	129.7	6.57	2777	0.454	0.410	0.259	0.526						
3	129.7	6.60	2729	0.460	0.414	0.261	0.529						
4	129.6	6.57	2802	0.451	0.407	0.258	0.525						
5	128.2	6.58	2806	0.446	0.398	0.259	0.520						
6	128.9	6.58	2775	0.453	0.408	0.259	0.525						
7	129.8	6.59	2731	0.460	0.415	0.261	0.529						
8	128.2	6.58	2792	0.451	0.407	0.259	0.525						
9	129.0	6.60	2687	0.464	0.416	0.263	0.530						
10	128.8	6.57	2765	0.456	0.411	0.260	0.527						
11	128.9	6.60	2716	0.461	0.415	0.261	0.529						
12	129.2	6.60	2734	0.461	0.417	0.260	0.530						
13	129.3	6.57	2772	0.454	0.409	0.259	0.526						
14	129.5	6.58	2728	0.460	0.415	0.261	0.529						
15	130.8	6.58	2757	0.459	0.416	0.259	0.529						
16	128.5	6.58	2760	0.454	0.407	0.260	0.525						
17	127.3	6.59	2815	0.447	0.401	0.258	0.522						
18	129.0	6.57	2811	0.442	0.392	0.259	0.518						
19	127.3	6.59	2764	0.452	0.405	0.260	0.524						
20	127.5	6.58	2686	0.466	0.419	0.262	0.532						
21	128.8	6.57	2809	0.448	0.402	0.259	0.522						
22	129.3	6.58	2637	0.475	0.428	0.264	0.536						
23	128.0	6.57	2828	0.447	0.404	0.258	0.523						
24	127.9	6.58	2831	0.444	0.398	0.258	0.520						
25	129.4	6.57	2825	0.447	0.403	0.258	0.523						
n	25	25	25	25	25	25	25						
Avg.	128.8	6.58	2765	0.455	0.409	0.260	0.526						
Med.	128.9	6.58	2772	0.454	0.408	0.259	0.525						
σ	0.86	0.011	49.6	0.0076	0.0080	0.0016	0.0042						
Min.	127.3	6.57	2637	0.442	0.392	0.258	0.518						
Max.	130.8	6.60	2831	0.475	0.428	0.264	0.536						

Data Set 9 : 105 °C, 200 mA

Actual Case Temperature [T _s]	108.8 °C
Actual Ambient Temperature [T _A]	105.6 °C
Drive Current [I _F]	200 mA
Measurement Current	200 mA

NOTES:

T_s and T_A were measured during initial setup.

TABLE 9-2
Lumen Maintenance

LED No.	Lumen Maintenance % (Normalized to 100 % at 0 hours)														
	0 h	541 h	1010 h	1699 h	2372 h	3124 h	3812 h	4520 h	5186 h	6019 h	6781 h	7578 h	8412 h	9239 h	10075 h
1	100.0	97.2	96.8	96.3	95.7	95.3	95.2	94.9	94.7	94.6	94.2	93.9	93.4	92.7	92.4
2	100.0	97.0	96.8	96.3	95.7	95.2	95.2	95.0	94.8	95.0	94.6	94.1	93.7	92.9	92.5
3	100.0	96.8	96.7	96.0	95.7	95.1	95.0	94.7	94.4	94.5	93.8	92.8	91.5	89.8	88.1
4	100.0	96.8	96.6	95.9	95.6	94.9	94.8	94.6	94.4	94.4	93.9	93.1	91.9	90.5	88.9
5	100.0	96.9	96.6	96.0	95.6	95.0	94.9	94.6	94.4	94.0	93.1	91.4	89.6	86.7	83.5
6	100.0	97.3	96.8	96.3	95.9	95.4	95.3	95.1	95.0	94.4	94.1	93.6	93.0	92.2	91.4
7	100.0	97.0	96.7	96.2	95.6	95.2	95.2	94.9	94.8	94.2	93.8	93.2	92.5	91.6	91.2
8	100.0	97.7	97.2	96.9	96.3	96.1	96.0	95.7	95.5	95.0	94.4	94.0	93.0	91.7	90.4
9	100.0	97.6	97.0	96.7	96.1	95.9	95.8	95.5	95.3	94.7	94.0	93.3	92.1	90.5	88.8
10	100.0	97.6	97.1	96.8	96.0	95.8	95.7	95.4	95.2	95.0	94.6	94.3	93.6	92.7	92.0
11	100.0	97.1	96.8	96.4	95.8	95.4	95.3	95.0	94.8	94.6	94.1	93.8	93.2	92.3	91.7
12	100.0	97.2	96.9	96.6	96.1	95.7	95.6	95.2	95.0	95.0	94.5	93.7	92.9	91.9	91.1
13	100.0	97.2	96.8	96.4	95.9	95.4	95.3	95.1	94.8	94.9	94.4	93.7	93.0	91.6	91.0
14	100.0	97.1	96.8	96.4	95.9	95.4	95.4	95.1	94.9	94.8	94.4	93.5	92.5	91.5	91.0
15	100.0	97.1	96.7	96.3	95.8	95.2	95.1	94.7	94.5	94.3	93.8	93.0	92.2	91.2	90.7
16	100.0	97.0	96.5	96.0	95.6	95.1	95.0	94.6	94.4	94.0	93.6	93.1	92.6	91.8	91.6
17	100.0	97.2	96.7	96.1	95.5	95.0	95.0	94.7	94.5	94.1	93.6	93.3	92.9	92.3	92.2
18	100.0	97.4	96.9	96.2	95.4	94.9	94.7	94.2	93.9	93.4	92.8	92.4	91.9	91.1	90.5
19	100.0	97.7	97.4	96.9	96.2	95.8	95.7	95.3	95.1	94.8	94.3	94.2	93.8	93.2	92.9
20	100.0	97.1	96.9	96.3	95.4	94.9	94.7	94.3	94.1	93.8	93.3	93.1	92.5	91.8	91.2
21	100.0	97.3	96.8	96.3	95.7	95.3	95.3	95.0	94.8	94.8	94.3	94.0	93.5	92.9	92.6
22	100.0	96.3	95.7	95.0	94.4	93.9	93.7	93.3	92.9	92.9	92.4	92.0	91.5	90.7	90.4
23	100.0	96.9	96.4	95.9	95.3	94.8	94.7	94.4	94.3	94.3	93.7	93.1	92.5	91.7	91.5
24	100.0	96.7	96.2	95.6	95.0	94.4	94.3	93.9	93.7	93.6	93.1	92.7	92.1	91.2	90.7
25	100.0	97.3	96.8	96.1	95.7	95.3	95.2	94.9	94.6	94.2	93.7	93.0	92.0	91.0	90.4
n	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Avg.	100.0	97.1	96.7	96.2	95.7	95.2	95.1	94.8	94.6	94.4	93.9	93.3	92.5	91.5	90.7
Med.	100.0	97.1	96.8	96.3	95.7	95.2	95.2	94.9	94.7	94.4	93.9	93.3	92.5	91.7	91.1
σ	0.00	0.32	0.33	0.41	0.40	0.48	0.49	0.51	0.55	0.55	0.57	0.69	0.90	1.31	1.92
Min.	100.0	96.3	95.7	95.0	94.4	93.9	93.7	93.3	92.9	92.9	92.4	91.4	89.6	86.7	83.5
Max.	100.0	97.7	97.4	96.9	96.3	96.1	96.0	95.7	95.5	95.0	94.6	94.3	93.8	93.2	92.9

TM-21 Projection

Time	4520 h	5186 h	6019 h	6781 h	7578 h	8412 h	9239 h	10075 h							
ln(Avg.)	-0.0534	-0.0556	-0.0579	-0.0634	-0.0694	-0.0775	-0.0888	-0.0971							

Test duration used	4520 h	to	10075 h
B	0.9878		
α	8.0403E-06		
R ²	0.9533		
Calculated L ₇₀ (10K)	42800	hours	
Reported L ₇₀ (10K)	42800	hours	

Curve-fit equation:

$$\Phi(t) = B \exp(-\alpha t)$$

Lumen maintenance life equation:

$$L_{70} = \ln(B/0.7) / \alpha$$

Data Set 9 : 105 °C, 200 mA

Actual Case Temperature [T _s]	108.8 °C
Actual Ambient Temperature [T _A]	105.6 °C
Drive Current [I _F]	200 mA
Measurement Current	200 mA

NOTES:

T_s and T_A were measured during initial setup.

TABLE 9-3
Forward Voltage

LED No.	Relative Forward Voltage % (Normalized to 100 % at 0 hours)														
	0 h	541 h	1010 h	1699 h	2372 h	3124 h	3812 h	4520 h	5186 h	6019 h	6781 h	7578 h	8412 h	9239 h	10075 h
1	100.0	101.1	101.6	101.9	102.2	102.3	102.4	102.5	102.5	102.7	102.5	102.6	102.7	102.7	102.9
2	100.0	101.0	101.4	101.7	102.0	102.0	102.1	102.3	102.2	102.4	102.2	102.3	102.4	102.3	102.5
3	100.0	101.0	101.5	101.8	102.1	102.1	102.2	102.3	102.3	102.4	102.3	102.4	102.4	102.4	102.6
4	100.0	101.1	101.6	102.0	102.3	102.3	102.4	102.6	102.6	102.7	102.5	102.6	102.7	102.7	102.9
5	100.0	101.0	101.6	101.9	102.3	102.3	102.4	102.6	102.5	102.7	102.5	102.7	102.7	102.6	102.9
6	100.0	101.1	101.6	101.9	102.2	102.3	102.4	102.5	102.5	102.7	102.5	102.6	102.8	102.7	102.9
7	100.0	101.0	101.6	101.9	102.3	102.3	102.4	102.6	102.6	102.7	102.5	102.6	102.8	102.7	102.9
8	100.0	100.9	101.4	101.7	102.0	102.0	102.1	102.2	102.2	102.4	102.2	102.3	102.4	102.3	102.5
9	100.0	101.1	101.6	101.9	102.3	102.3	102.4	102.6	102.5	102.7	102.6	102.6	102.7	102.6	102.8
10	100.0	101.0	101.6	101.9	102.2	102.3	102.4	102.5	102.5	102.6	102.5	102.6	102.8	102.7	102.9
11	100.0	101.1	101.5	101.8	102.1	102.1	102.2	102.3	102.3	102.5	102.4	102.4	102.5	102.5	102.6
12	100.0	101.0	101.4	101.8	102.0	102.1	102.2	102.3	102.2	102.5	102.3	102.4	102.5	102.4	102.6
13	100.0	100.9	101.3	101.6	101.8	101.8	101.9	102.0	102.0	102.2	102.0	102.1	102.2	102.1	102.3
14	100.0	101.1	101.5	101.9	102.2	102.2	102.3	102.5	102.4	102.7	102.5	102.6	102.7	102.7	103.0
15	100.0	101.1	101.5	101.9	102.2	102.2	102.4	102.5	102.6	102.7	102.5	102.6	102.7	102.7	102.9
16	100.0	101.1	101.6	101.9	102.2	102.3	102.5	102.5	102.6	102.8	102.6	102.7	102.8	102.8	103.0
17	100.0	101.1	101.6	101.9	102.2	102.2	102.3	102.5	102.5	102.7	102.5	102.6	102.7	102.7	102.8
18	100.0	100.9	101.2	101.5	101.7	101.7	101.8	101.9	101.9	102.0	101.9	102.0	102.0	102.0	102.1
19	100.0	101.1	101.6	102.0	102.3	102.3	102.5	102.5	102.6	102.7	102.6	102.7	102.8	102.8	102.9
20	100.0	101.2	101.6	101.9	102.2	102.3	102.4	102.5	102.5	102.6	102.5	102.6	102.7	102.6	102.8
21	100.0	101.1	101.6	102.0	102.3	102.3	102.4	102.5	102.5	102.7	102.6	102.7	102.8	102.7	102.9
22	100.0	101.2	101.7	102.0	102.3	102.4	102.5	102.6	102.6	102.8	102.6	102.7	102.8	102.8	102.9
23	100.0	101.1	101.6	102.0	102.3	102.4	102.5	102.6	102.6	102.8	102.6	102.7	102.8	102.8	103.0
24	100.0	101.2	101.7	102.1	102.3	102.4	102.5	102.6	102.6	102.8	102.6	102.7	102.8	102.7	102.9
25	100.0	101.1	101.6	101.9	102.2	102.3	102.5	102.5	102.5	102.7	102.5	102.6	102.8	102.7	102.9
n	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Avg.	100.0	101.1	101.5	101.9	102.2	102.2	102.3	102.4	102.4	102.6	102.5	102.5	102.6	102.6	102.8
Med.	100.0	101.1	101.6	101.9	102.2	102.3	102.4	102.5	102.5	102.7	102.5	102.6	102.7	102.7	102.9
σ	0.00	0.08	0.12	0.14	0.16	0.17	0.18	0.18	0.19	0.20	0.20	0.20	0.21	0.21	0.22
Min.	100.0	100.9	101.2	101.5	101.7	101.7	101.8	101.9	101.9	102.0	101.9	102.0	102.0	102.0	102.1
Max.	100.0	101.2	101.7	102.1	102.3	102.4	102.5	102.6	102.6	102.8	102.6	102.7	102.8	102.8	103.0

Data Set 9 : 105 °C, 200 mA

Actual Case Temperature [T _s]	108.8 °C
Actual Ambient Temperature [T _A]	105.6 °C
Drive Current [I _F]	200 mA
Measurement Current	200 mA

NOTES:

T_s and T_A were measured during initial setup.

TABLE 9-4
Chromaticity Shift

LED No.	Chromaticity Shift Δu'v'														
	0 h	541 h	1010 h	1699 h	2372 h	3124 h	3812 h	4520 h	5186 h	6019 h	6781 h	7578 h	8412 h	9239 h	10075 h
1	0.0000	0.0011	0.0011	0.0012	0.0016	0.0017	0.0018	0.0019	0.0020	0.0021	0.0022	0.0023	0.0025	0.0026	0.0027
2	0.0000	0.0012	0.0012	0.0014	0.0019	0.0021	0.0020	0.0022	0.0022	0.0023	0.0024	0.0025	0.0027	0.0028	0.0030
3	0.0000	0.0011	0.0012	0.0013	0.0017	0.0019	0.0020	0.0021	0.0022	0.0023	0.0024	0.0027	0.0029	0.0031	0.0033
4	0.0000	0.0011	0.0012	0.0014	0.0018	0.0019	0.0019	0.0020	0.0022	0.0022	0.0024	0.0024	0.0025	0.0027	0.0031
5	0.0000	0.0012	0.0012	0.0014	0.0018	0.0020	0.0020	0.0021	0.0022	0.0027	0.0031	0.0035	0.0038	0.0042	0.0045
6	0.0000	0.0012	0.0013	0.0014	0.0018	0.0020	0.0020	0.0021	0.0022	0.0026	0.0027	0.0030	0.0031	0.0034	0.0038
7	0.0000	0.0013	0.0013	0.0015	0.0019	0.0020	0.0020	0.0021	0.0022	0.0024	0.0024	0.0029	0.0032	0.0034	0.0033
8	0.0000	0.0012	0.0012	0.0014	0.0018	0.0020	0.0020	0.0021	0.0022	0.0023	0.0027	0.0029	0.0034	0.0038	0.0041
9	0.0000	0.0010	0.0010	0.0012	0.0016	0.0018	0.0019	0.0019	0.0021	0.0021	0.0023	0.0023	0.0023	0.0024	0.0027
10	0.0000	0.0011	0.0012	0.0013	0.0017	0.0019	0.0019	0.0021	0.0021	0.0022	0.0023	0.0024	0.0024	0.0025	0.0026
11	0.0000	0.0011	0.0011	0.0013	0.0017	0.0019	0.0019	0.0020	0.0022	0.0024	0.0025	0.0026	0.0027	0.0030	0.0032
12	0.0000	0.0011	0.0011	0.0013	0.0017	0.0019	0.0019	0.0020	0.0022	0.0022	0.0023	0.0026	0.0030	0.0031	0.0033
13	0.0000	0.0011	0.0011	0.0013	0.0018	0.0020	0.0020	0.0021	0.0022	0.0024	0.0027	0.0032	0.0035	0.0039	0.0044
14	0.0000	0.0010	0.0010	0.0012	0.0016	0.0018	0.0018	0.0020	0.0021	0.0022	0.0023	0.0029	0.0033	0.0036	0.0037
15	0.0000	0.0011	0.0011	0.0013	0.0018	0.0019	0.0020	0.0022	0.0023	0.0024	0.0025	0.0029	0.0032	0.0035	0.0038
16	0.0000	0.0012	0.0013	0.0014	0.0018	0.0020	0.0021	0.0022	0.0023	0.0023	0.0025	0.0027	0.0028	0.0031	0.0032
17	0.0000	0.0012	0.0013	0.0015	0.0019	0.0022	0.0022	0.0023	0.0025	0.0026	0.0028	0.0030	0.0031	0.0034	0.0035
18	0.0000	0.0011	0.0012	0.0014	0.0019	0.0021	0.0021	0.0023	0.0025	0.0026	0.0028	0.0029	0.0031	0.0035	0.0038
19	0.0000	0.0011	0.0011	0.0013	0.0017	0.0019	0.0019	0.0020	0.0021	0.0022	0.0024	0.0025	0.0026	0.0028	0.0029
20	0.0000	0.0012	0.0012	0.0013	0.0018	0.0019	0.0020	0.0021	0.0022	0.0023	0.0023	0.0024	0.0025	0.0026	0.0027
21	0.0000	0.0011	0.0012	0.0013	0.0017	0.0019	0.0019	0.0021	0.0022	0.0023	0.0024	0.0027	0.0028	0.0030	0.0033
22	0.0000	0.0011	0.0011	0.0013	0.0017	0.0019	0.0019	0.0020	0.0023	0.0024	0.0025	0.0025	0.0026	0.0027	0.0027
23	0.0000	0.0011	0.0012	0.0014	0.0018	0.0020	0.0021	0.0022	0.0022	0.0024	0.0027	0.0032	0.0034	0.0037	0.0039
24	0.0000	0.0011	0.0012	0.0014	0.0018	0.0020	0.0021	0.0021	0.0023	0.0024	0.0026	0.0027	0.0029	0.0033	0.0037
25	0.0000	0.0012	0.0012	0.0018	0.0022	0.0024	0.0024	0.0026	0.0027	0.0030	0.0031	0.0033	0.0035	0.0036	0.0038
n	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Avg.	0.0000	0.0011	0.0012	0.0014	0.0018	0.0020	0.0020	0.0021	0.0022	0.0024	0.0025	0.0028	0.0030	0.0032	0.0034
Med.	0.0000	0.0011	0.0012	0.0013	0.0018	0.0019	0.0020	0.0021	0.0022	0.0023	0.0025	0.0027	0.0029	0.0031	0.0033
σ	0.0000	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002	0.0002	0.0003	0.0004	0.0005	0.0005
Min.	0.0000	0.0010	0.0010	0.0012	0.0016	0.0017	0.0018	0.0019	0.0020	0.0021	0.0022	0.0023	0.0023	0.0024	0.0026
Max.	0.0000	0.0013	0.0013	0.0018	0.0022	0.0024	0.0024	0.0026	0.0027	0.0030	0.0031	0.0035	0.0038	0.0042	0.0045