





## Test Summary

Life test condition			Summary of result				
Test condition	Current (mA)	Case temperature (°C)	Test duration (h)	Average maintenance (%)	Maximum chromaticity shift ( $\Delta u'v'$ )	Average Power Density (W/mm <sup>2</sup> )	Average Current Density (mA/mm <sup>2</sup> )
1	700	55	9000	97.44%	0.0028	0.1680	58.8112
2	700	85	9000	97.08%	0.0030		
3	700	105	9000	96.77%	0.0032		

### 1. Number of LED Light Sources tested

- 25 Packages tested at actual case temperature 55.9°C
- 25 Packages tested at actual case temperature 85.7°C
- 25 Packages tested at actual case temperature 105.5°C

### 2. Description of LED Light Sources

- Part Number: RF—C35\*1—RBD—FR
- Part Type: PL 3535 660NM LED package
- IF =700mA, CCT(Nominal) = 1000-1500K

### 3. Description of auxiliary equipment

- 1) EVERFINE LT-200A Accelerated Aging-Life Test System for LEDs
- 2) Instrument Integrating sphere 0.5m
- 3) SENSING SPR-3000 Photometric, Colorimetric& Electric System for Light Sources

### 4. Operating time

LED packages are driven with a constant direct current.

- Number of units : 25 at 55°C, 85°C and 105°C
- Drive current : 700mA
- Typical voltage : 1.8-2.4V



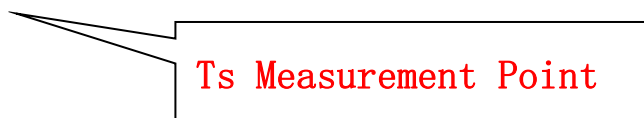
## 5. Ambient conditions including airflow, temperature and relative humidity

The minimal airflow is maintained in chamber.

The ambient temperature around the LED packages inside chamber is controlled by air flowing and the thermocouple readings are monitored.

- Case temperature : Controlled to  $-2^{\circ}\text{C}$
- Surrounding air temperature : Controlled to  $-5^{\circ}\text{C}$
- Relative humidity : 65%RH

## 6. Case temperature (Test point temperature)



## 7. Drive current of the LED Light Sources during lifetime test

See Sub-clause 9.1, 9.2 and 9.3

## 8. Initial luminous flux and forward voltage

See the table

## 9. Lumen maintenance data for each individual LED Light Sources

See the table

Quantity	Model	Serial Number
25	RF-C35*1-RBD-FR	A01-A25 ( $55^{\circ}\text{C}$ )
25	RF-C35*1-RBD-FR	B01-B25 ( $85^{\circ}\text{C}$ )
25	RF-C35*1-RBD-FR	C01-C25 ( $105^{\circ}\text{C}$ )



**9.1 Test condition 1: 55 °C, Drive Current : 700mA**

Item	V <sub>F</sub> (V)	PPF	Ra	T=55°C Photon Maintenance (%)								
				No.	0 h			1000h	2000h	3000h	4000h	5000h
A01	2.30	3.4210	14.3	100.14	99.94	99.38	99.03	98.88	98.50	98.27	97.83	97.49
A02	2.34	3.3876	14.2	100.09	99.89	99.33	99.05	98.81	98.38	98.13	97.78	97.44
A03	2.29	3.3864	14.8	100.02	99.84	99.32	98.99	98.92	98.42	98.28	97.79	97.58
A04	2.28	3.3907	14.6	100.05	99.92	99.27	98.95	98.84	98.38	98.24	97.69	97.43
A05	2.34	3.4181	14.9	99.91	99.89	99.25	99.03	98.90	98.30	98.54	97.77	97.48
A06	2.33	3.3921	14.0	99.99	99.87	99.35	98.98	98.82	98.38	98.26	97.80	97.49
A07	2.27	3.4122	15.1	100.09	99.95	99.39	99.06	98.87	98.44	98.38	97.73	97.57
A08	2.31	3.4032	14.8	99.98	99.91	99.33	99.05	98.80	98.35	98.53	97.71	97.52
A09	2.33	3.4113	14.1	100.25	100.15	99.51	99.09	98.79	98.32	98.46	97.77	97.48
A10	2.30	3.3889	14.3	99.99	99.99	99.45	98.97	98.80	98.45	98.38	97.73	97.35
A11	2.29	3.3899	14.8	100.08	99.94	99.39	99.03	98.74	98.36	98.24	97.78	97.33
A12	2.31	3.3915	14.6	100.09	100.01	99.44	99.00	98.79	98.41	98.28	97.69	97.51
A13	2.33	3.3921	14.4	99.97	99.99	99.42	99.05	98.71	98.32	98.16	97.71	97.36
A14	2.35	3.4131	14.7	99.92	99.87	99.34	98.99	98.77	98.28	98.30	97.80	97.42
A15	2.32	3.3954	14.1	100.04	99.99	99.45	99.03	98.70	98.42	98.13	97.69	97.35
A16	2.30	3.4145	14.9	100.09	99.88	99.33	98.99	98.77	98.43	98.24	97.71	97.35
A17	2.33	3.3894	15.0	100.17	99.99	99.42	99.05	98.69	98.39	98.14	97.76	97.52
A18	2.36	3.3967	13.9	99.99	99.90	99.35	99.00	98.74	98.38	98.16	97.79	97.47
A19	2.32	3.4057	14.8	100.12	99.93	99.38	99.02	98.80	98.45	98.27	97.73	97.45
A20	2.35	3.4203	14.6	100.17	99.99	99.45	99.05	98.71	98.43	98.17	97.79	97.38
A21	2.30	3.4118	14.1	99.91	99.92	99.41	98.99	98.76	98.29	98.17	97.71	97.40
A22	2.30	3.3974	14.2	99.99	99.90	99.32	99.03	98.69	98.34	98.23	97.72	97.36
A23	2.33	3.3962	15.1	100.07	99.97	99.44	99.01	98.75	98.45	98.39	97.76	97.51
A24	2.35	3.3854	14.0	100.11	99.96	99.40	99.05	98.71	98.31	98.14	97.73	97.42
A25	2.33	3.3889	14.9	100.17	99.97	99.39	99.05	98.66	98.40	98.38	97.74	97.45
Avg.	2.32	3.4000	14.5	100.06	99.94	99.38	99.02	98.78	98.38	98.27	97.75	97.44
Med.	2.32	3.3962	14.6	100.07	99.94	99.39	99.03	98.77	98.38	98.26	97.74	97.45
ST dev.	0.0239	0.0119	0.3803	0.0888	0.0636	0.0615	0.0334	0.0694	0.0583	0.1207	0.0402	0.0717
Max.	2.36	3.4210	15.1	100.25	100.15	99.51	99.09	98.92	98.50	98.54	97.83	97.58
Min.	2.27	3.3854	13.9	99.91	99.84	99.25	98.95	98.66	98.28	98.13	97.69	97.33





**9.2 Test condition 2: 85 °C, Drive Current : 700mA**

Item	V <sub>F</sub> (V)	PPF	Ra	T=85°C Photon Maintenance (%)								
No.	0 h			1000h	2000h	3000h	4000h	5000h	6000h	7000h	8000h	9000h
B01	2.31	3.4104	14.3	99.98	99.82	99.20	98.87	98.56	98.02	97.88	97.55	97.16
B02	2.37	3.3880	14.5	100.16	99.88	99.22	98.81	98.54	98.09	97.93	97.60	97.13
B03	2.30	3.3890	14.5	100.08	99.86	99.20	98.83	98.53	98.03	97.92	97.57	97.13
B04	2.26	3.3906	15.1	99.97	99.79	99.19	98.82	98.56	98.09	97.89	97.54	97.07
B05	2.35	3.3912	15.5	99.93	99.81	99.21	98.76	98.52	97.92	97.96	97.58	97.04
B06	2.37	3.4122	13.5	100.08	99.87	99.20	98.77	98.53	98.07	97.91	97.62	97.08
B07	2.27	3.3945	15.5	100.05	99.89	99.19	98.81	98.52	98.03	97.87	97.51	97.05
B08	2.34	3.4136	15.0	99.98	99.81	99.24	98.83	98.53	98.01	97.93	97.54	97.04
B09	2.31	3.4201	13.8	99.97	99.82	99.18	98.79	98.54	97.90	97.84	97.58	97.12
B10	2.28	3.3867	14.1	100.02	99.92	99.20	98.87	98.59	98.05	97.88	97.53	97.07
B11	2.30	3.3855	15.5	99.98	99.81	99.14	98.80	98.52	97.99	97.93	97.54	96.99
B12	2.34	3.3898	14.2	100.00	99.87	99.22	98.81	98.53	98.02	97.96	97.58	96.98
B13	2.34	3.4172	14.9	99.90	99.80	99.19	98.76	98.54	97.93	97.92	97.63	97.11
B14	2.33	3.3912	15.2	99.96	99.85	99.21	98.77	98.55	97.91	97.95	97.51	97.12
B15	2.34	3.3885	13.9	99.97	99.89	99.20	98.75	98.46	97.92	97.97	97.53	97.06
B16	2.27	3.3958	15.3	99.95	99.90	99.25	98.81	98.55	98.00	97.96	97.54	97.11
B17	2.29	3.4048	15.2	99.98	99.88	99.24	98.80	98.51	98.03	97.91	97.57	97.07
B18	2.38	3.4194	14.4	99.99	99.81	99.19	98.84	98.52	98.05	97.84	97.55	97.09
B19	2.33	3.4109	14.4	100.02	99.82	99.17	98.86	98.50	97.96	97.88	97.58	97.11
B20	2.30	3.3965	15.3	100.04	99.78	99.21	98.76	98.46	98.04	97.93	97.63	97.05
B21	2.29	3.3953	14.5	100.00	99.83	99.20	98.85	98.44	97.92	97.94	97.51	97.07
B22	2.31	3.3845	13.9	100.01	99.78	99.19	98.80	98.52	98.03	97.87	97.57	97.09
B23	2.31	3.3880	15.0	99.99	99.76	99.17	98.81	98.45	98.09	97.92	97.55	97.13
B24	2.32	3.4113	14.4	100.05	99.85	99.15	98.84	98.53	97.91	97.91	97.54	97.06
B25	2.32	3.4023	15.1	100.00	99.93	99.28	98.83	98.59	99.00	99.08	97.77	97.13
Avg.	2.32	3.3991	14.7	100.00	99.84	99.20	98.81	98.52	98.04	97.96	97.57	97.08
Med.	2.31	3.3953	14.5	99.99	99.83	99.20	98.81	98.53	98.02	97.92	97.55	97.08
ST dev.	0.0321	0.0119	0.5902	0.0537	0.0462	0.0302	0.0350	0.0383	0.2093	0.2363	0.0543	0.0441
Max.	2.38	3.4201	15.5	100.16	99.93	99.28	98.87	98.59	99.00	99.08	97.77	97.16
Min.	2.26	3.3845	13.5	99.90	99.76	99.14	98.75	98.44	97.90	97.84	97.51	96.98



**9.2.1 Test condition 2: 85 °C, Drive Current : 700mA**

No.	T=85°C Chromaticity Shift ( u'v')											
	0 h			1000h	2000h	3000h	4000h	5000h	6000h	7000h	8000h	9000h
	u'	v'	CCT(K)									
B01	0.5848	0.5111	1010	0.0003	0.0007	0.0009	0.0011	0.0013	0.0018	0.0023	0.0026	0.0028
B02	0.5840	0.5111	1010	0.0003	0.0005	0.0006	0.0008	0.0012	0.0016	0.0022	0.0027	0.003
B03	0.5843	0.5114	1004	0.0002	0.0004	0.0005	0.0008	0.0012	0.0016	0.0023	0.0027	0.0029
B04	0.5838	0.5118	1010	0.0003	0.0007	0.0008	0.0011	0.0016	0.0019	0.0021	0.0025	0.0027
B05	0.5843	0.5112	1001	0.0002	0.0005	0.0007	0.0012	0.0015	0.0021	0.0022	0.0026	0.0029
B06	0.5842	0.5115	1007	0.0004	0.0008	0.0008	0.0011	0.0017	0.0021	0.0023	0.0028	0.003
B07	0.5849	0.5116	1011	0.0002	0.0006	0.0008	0.0009	0.0014	0.0018	0.0021	0.0027	0.0028
B08	0.5845	0.5110	1002	0.0004	0.0008	0.0009	0.001	0.0016	0.0018	0.0023	0.0026	0.0029
B09	0.5838	0.5116	1009	0.0003	0.0007	0.0008	0.0011	0.0017	0.0021	0.0025	0.003	0.0032
B10	0.5839	0.5118	1006	0.0002	0.0006	0.0007	0.0012	0.0016	0.0019	0.0025	0.0031	0.0032
B11	0.5843	0.5120	1009	0.0003	0.0005	0.0005	0.0007	0.0013	0.0018	0.0022	0.0026	0.0028
B12	0.5842	0.5119	1005	0.0002	0.0006	0.0008	0.0011	0.0015	0.0018	0.0023	0.0027	0.003
B13	0.5838	0.5116	1012	0.0003	0.0005	0.0007	0.0012	0.0014	0.0019	0.0025	0.0029	0.003
B14	0.5849	0.5116	1002	0.0002	0.0006	0.0008	0.0011	0.0016	0.0021	0.0024	0.0028	0.003
B15	0.5841	0.5118	1005	0.0004	0.0007	0.0009	0.0013	0.0016	0.002	0.0023	0.0029	0.0031
B16	0.5843	0.5113	1008	0.0003	0.0005	0.0007	0.0012	0.0015	0.002	0.0024	0.0027	0.0028
B17	0.5845	0.5116	1004	0.0004	0.0007	0.0009	0.0009	0.0016	0.0019	0.0023	0.0027	0.0031
B18	0.5848	0.5116	1004	0.0002	0.0005	0.0008	0.0011	0.0016	0.0019	0.0025	0.0029	0.003
B19	0.5844	0.5112	1013	0.0003	0.0005	0.0006	0.001	0.0014	0.002	0.0023	0.0028	0.0031
B20	0.5843	0.5113	1018	0.0002	0.0006	0.0007	0.0009	0.0013	0.0018	0.0025	0.003	0.0032
B21	0.5849	0.5119	1001	0.0003	0.0007	0.0008	0.001	0.0017	0.0022	0.0026	0.0027	0.003
B22	0.5842	0.5113	1000	0.0004	0.0008	0.0009	0.0011	0.0015	0.002	0.0024	0.0027	0.003
B23	0.5846	0.5113	1011	0.0002	0.0004	0.0008	0.0012	0.0015	0.002	0.0023	0.0027	0.003
B24	0.5846	0.5121	1004	0.0004	0.0006	0.0008	0.001	0.0017	0.0021	0.0025	0.0028	0.0029
B25	0.5841	0.5115	1003	0.0002	0.0007	0.0007	0.0011	0.0014	0.002	0.0024	0.0027	0.0029
Avg.	0.5843	0.5115	1007	0.0003	0.0006	0.0008	0.0010	0.0015	0.0019	0.0023	0.0028	0.0030
Med.	0.5843	0.5116	1006	0.0003	0.0006	0.0008	0.0011	0.0015	0.0019	0.0023	0.0027	0.0030
ST dev.	0.0003	0.0003	4.4747	0.0001	0.0001	0.0001	0.0001	0.0002	0.0002	0.0001	0.0001	0.0001
Max.	0.5849	0.5121	1018	0.0004	0.0008	0.0009	0.0013	0.0017	0.0022	0.0026	0.0031	0.0032
Min.	0.5838	0.5110	1000	0.0002	0.0004	0.0005	0.0007	0.0012	0.0016	0.0021	0.0025	0.0027



**9.3 Test condition 3: 105 °C, Drive Current : 700mA**

Item	V <sub>F</sub> (V)	PPF	Ra	T=105°C Photon Maintenance (%)			
No.		0 h		1000h	2000h	3000h	4000h





**9.3.1 Test condition 3: 105 °C, Drive Current : 700mA**

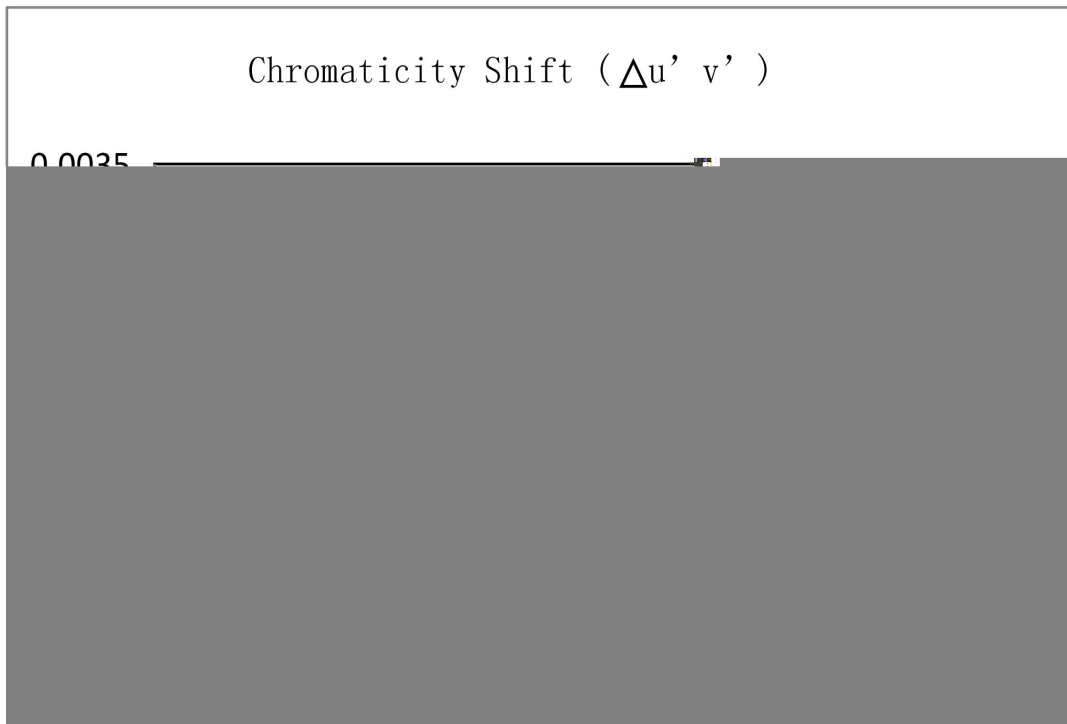
T=105°C Chromaticity Shift ( u'v')

No.	0 h		CCT(K)	1000h	2000h	3000h	4000h	5000h	6000h	7000h	8000h	9000h
	u'	v'										
C01	0.5846	0.5196	1006	0.0003	0.0007	0.0009	0.0013	0.0019	0.0021	0.0026	0.0026	0.003
C02	0.5841	0.5109	1011	0.0003	0.0006	0.001	0.0012	0.0017	0.002	0.0027	0.0029	0.0031
C03	0.5845	0.5113	1003	0.0004	0.0007	0.0011	0.0013	0.0017	0.0021	0.0026	0.003	0.0032
C04	0.5841	0.5114	1012	0.0003	0.0008	0.0011	0.0014	0.0019	0.0023	0.003	0.0032	0.0034
C05	0.5843	0.5114	1003	0.0002	0.0007	0.0008	0.0013	0.0017	0.002	0.0025	0.0027	0.0031
C06	0.5839	0.5114	1013	0.0004	0.0005	0.0008	0.0013	0.0016	0.0021	0.0026	0.0029	0.003
C07	0.5851	0.5113	1011	0.0003	0.0007	0.001	0.0015	0.0019	0.0022	0.0028	0.003	0.0031
C08	0.5847	0.5111	1009	0.0004	0.0006	0.0009	0.0012	0.0017	0.0021	0.0026	0.0029	0.0032
C09	0.5836	0.5116	1014	0.0002	0.0007	0.0008	0.0013	0.002	0.0023	0.0027	0.0029	0.0031
C10	0.5840	0.5121	1009	0.0003	0.0008	0.0011	0.0014	0.0021	0.0024	0.0028	0.0031	0.0033
C11	0.5841	0.5119	1010	0.0004	0.0007	0.0009	0.0013	0.0017	0.0021	0.0027	0.003	0.0032
C12	0.5844	0.5121	1007	0.0003	0.0006	0.0008	0.0015	0.002	0.002	0.0026	0.0028	0.0031
C13	0.5835	0.5117	1013	0.0004	0.0005	0.0007	0.0012	0.0017	0.0021	0.0028	0.003	0.0032
C14	0.5852	0.5115	1001	0.0002	0.0007	0.0008	0.0013	0.0017	0.0022	0.0026	0.0029	0.0031
C15	0.5843	0.5118	1001	0.0005	0.0006	0.0007	0.0014	0.0019	0.0021	0.0026	0.003	0.0033
C16	0.5844	0.5111	1013	0.0003	0.0008	0.0011	0.0013	0.002	0.0022	0.003	0.0032	0.0033
C17	0.5847	0.5119	1007	0.0003	0.0007	0.001	0.0013	0.0017	0.0021	0.0028	0.0028	0.0032
C18	0.5850	0.5118	1006	0.0004	0.0006	0.0009	0.0013	0.0018	0.0023	0.003	0.0031	0.0034
C19	0.5842	0.5115	1014	0.0002	0.0007	0.0012	0.0015	0.002	0.0022	0.0026	0.0029	0.0033
C20	0.5845	0.5110	1022	0.0003	0.0005	0.0007	0.0013	0.0017	0.0021	0.0027	0.003	0.0032
C21	0.5846	0.5118	1001	0.0002	0.0007	0.0011	0.0014	0.0019	0.0022	0.0028	0.0031	0.0033
C22	0.5842	0.5112	1001	0.0004	0.0008	0.001	0.0013	0.0018	0.0021	0.0029	0.0032	0.0034
C23	0.5845	0.5111	1018	0.0004	0.0007	0.0008	0.0014	0.0019	0.0023	0.003	0.0031	0.0033
C24	0.5845	0.5123	1009	0.0003	0.0006	0.0009	0.0013	0.0018	0.0022	0.0028	0.003	0.0032
C25	0.5843	0.5114	1004	0.0002	0.0007	0.001	0.0015	0.002	0.0021	0.0026	0.0028	0.0031
Avg.	0.5844	0.5118	1009	0.0003	0.0007	0.0009	0.0013	0.0018	0.0022	0.0027		

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#### 9.4 Chart





## 10. Observation of failures

No optical, Electrical or mechanical failure of any LED Package was seen during the lifetime testing.

## 11. Photometric measurement uncertainty

2%

## 12. TM-21-11 report: Projecting long term lumen maintenance of LED Light Sources



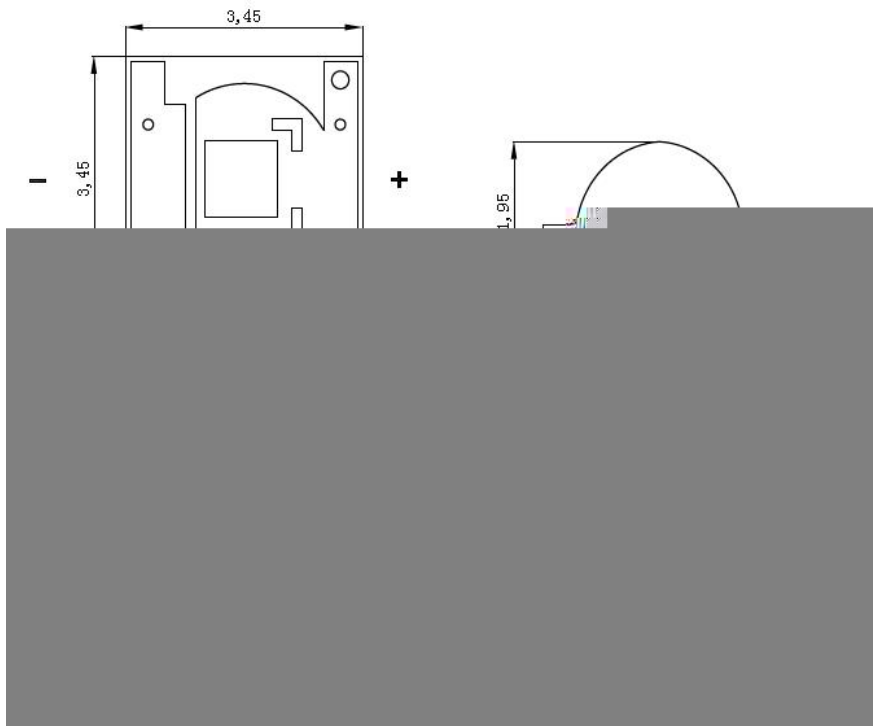


**13. ENERGY STAR® LM-80 Cover Sheet**

<b>Administrative Information</b>	
Tested subcomponent series:	-
Tested subcomponent model number:	RF—C35*1—RBD—FR
Report issue date:	January 27, 2021
Report revision date (if applicable):	-
Testing start date:	January 16, 2020
Testing completion date:	January 25, 2021
DUT sampling method:	<p>LED samples for IESNA LM-80 testing consist of units built from a minimum of three manufacturing lots with each manufacturing lot built from different wafer lots built on non-consecutive days.</p> <p>These manufacturing lots are picked to represent a wide parametric distribution.</p> <p>Each Sample is soldered to all of the reliability stress boards for a given set of IESNA LM-80 tests.</p>
<b>DUT Identification</b>	
DUT manufacturer's name:	SHENZHEN REFOND OPTOELECTRONICS UV TECHNOLOGY CO.,LTD
DUT identification, e.g., model number:	RF—C35*1—RBD—FR
Description of DUT, including if the DUT is an LED package or module:	PL 3535 660NM LED package
<b>DUT Characteristics</b>	
Total input power (W):	2
Average current density per LED die (mA/mm <sup>2</sup> ):	58.8112
Average power density per LED die (W/mm <sup>2</sup> ):	0.1680
Representative CRI (Ra) of the tested sample set:	13-16
Minimum die edge to die edge spacing:	-



14. Mechanical Dimensions



15. Photo of samples:



\*\*\*\*\*END OF THIS REPORT\*\*\*\*\*