



# IESNA LM-80-2008

MEASURING LUMEN MAINTENANCE OF LED LIGHT SOURCES

## MEASUREMENT AND TEST REPORT

For

### Shenzhen Refond Optoelectronic Co., Ltd.

6th wing, 2nd block of Baiwangxin Industry Park Songbai Road Nanshan District, Shenzhen, China

**Model: RF-HI13**

<b>Report Type:</b> 9000 Hours Test Report	<b>Product Type:</b> LED Package
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<b>Report Number:</b> R2DG130311050-10A1	
<b>Test Date:</b> 2013-03-22 to 2014-04-30	
<b>Report Date:</b> 2014-05-13	
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**Note:** The test data was only valid for the test sample(s). This test report is prepared for the customer shown above and for the device described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. (Dongguan).

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## 1.5 Operating Cycle

Samples are driven with a constant direct current (DC)

## 1.6 Ambient Conditions

For lumen maintenance test, samples were operated in thermal chambers with minimal ambient airflow. For long term reliability test, the case temperature was controlled by mounting several thermocouples on a sample reliability stress board at the designated thermal measurement point, as shown in APPENDIX. The ambient temperature  $T_A$  was measured by several thermocouples at a distance of 5 mm above the reliability test board. The relative humidity within chamber was less than 65%.

For photometry measurement, temperature was set to  $25\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ , RH <65%.

## 1.7 Photometry Measurement Uncertainty

The uncertainty of the light output measurements is  $U=1.59\%$  ( $K=2$ ), at the 95% confidence level. The uncertainty of the correlated color temperature measurements is  $U=21\text{K}$  ( $K=2$ ), at the 95% confidence level. This calibration results traceable to the NATIONAL INSTITUTE OF METROLOGY (NIM).

## 1.8 Sample Set

### Sampling Method:

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

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

Each Sample is soldered to all of the reliability stress boards for a given set of IESNA LM-80 tests.

### Sample Size:

Total 75Pcs;

Each Ts test condition 25Pcs

The 75pcs samples tested at Ts 45 °C, 55 °C and Ts 85 °C were received at 2013-03-20 and tested during 2013-03-22 to 2014-04-30. The samples were numbered from 1 to 25, 26 to 50 and 51 to 75.

#### Data Set 1: 45 °C, 60mA

Part Number:	RF-HI13
Number of Units:	25
Actual Case Temperature(T <sub>S</sub> ):	T <sub>S</sub> =44.7 °C
Actual Ambient Temperature(T <sub>A</sub> ):	T <sub>A</sub> =43.4 °C
Life Test Drive Current:	I <sub>F</sub> = 60mA
Measurement Current:	I <sub>F</sub> = 60mA

#### Data Set 2: 55°C, 60mA

Part Number:	RF-HI13
Number of Units:	25
Actual Case Temperature(T <sub>S</sub> ):	T <sub>S</sub> =54.3 °C
Actual Ambient Temperature(T <sub>A</sub> ):	T <sub>A</sub> =53.6 °C
Life Test Drive Current:	I <sub>F</sub> = 60mA
Measurement Current:	I <sub>F</sub> = 60mA

#### Data Set 3: 85 °C, 60mA

Part Number:	RF-HI13
Number of Units:	25
Actual Case Temperature(T <sub>S</sub> ):	T <sub>S</sub> =84.3 °C
Actual Ambient Temperature(T <sub>A</sub> ):	T <sub>A</sub> =83.4 °C
Life Test Drive Current:	I <sub>F</sub> = 60mA
Measurement Current:	I <sub>F</sub> = 60mA

## 2 - SUMMARY OF TEST RESULT

<b>Data Set:</b>	<b>Data Set 1, 45 °C, 60mA</b>
Number of Units:	25
Failures Observed:	0
Test Interval and Test Duration:	0h,1000h,2000h,3000h,4000h,5000h,6000h,7000h,8000h,9000h
Average. Lumen Maintenance at 6000 hours:	96.83%
Average Chromaticity Shift at 6000 hours (	0.0015
Average. Lumen Maintenance at 9000 hours:	95.00%
Average Chromaticity Shift at 9000 hours (	0.0022
Reported TM-21 L <sub>70</sub> Lifetime:	>54,000 hours

<b>Data Set:</b>	<b>Data Set 2, 55°C, 60mA</b>
Number of Units:	25
Failures Observed:	0
Test Interval and Test Duration:	0h,1000h,2000h,3000h,4000h,5000h,6000h,7000h,8000h,9000h
Average. Lumen Maintenance at 6000 hours:	96.32%
Average Chromaticity Shift at 6000 hours :	0.0015
Average. Lumen Maintenance at 9000 hours:	94.06%
Average Chromaticity Shift at 9000 hours :	0.0023
Reported TM-21 L <sub>70</sub> Lifetime	>54,000 hours

<b>Data Set:</b>	<b>Data Set 3, 85 °C, 60mA</b>
Number of Units:	25
Failures Observed:	0
Test Interval and Test Duration:	0h,1000h,2000h,3000h,4000h,5000h,6000h,7000h,8000h,9000h
Average. Lumen Maintenance at 6000 hours:	95.93%
	0.0017
Average. Lumen Maintenance at 9000 hours:	93.09%
Average Chromaticity Shift at 9000 hours :	0.0025
Reported TM-21 L <sub>70</sub> Lifetime	47,000 hours



**3.2 Data Set 1, 45 °C, 60mA (Chromaticity Shift)**

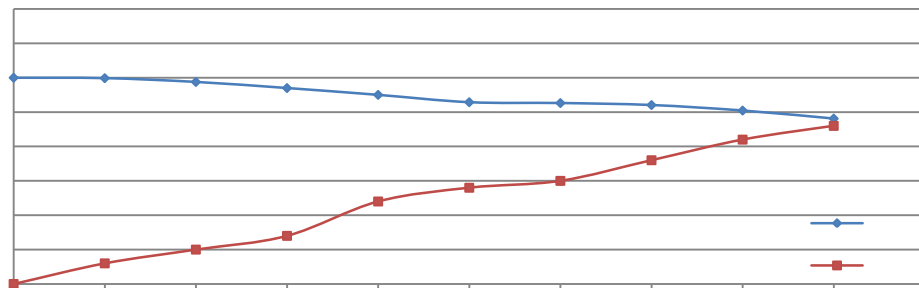
No.			CCT(K)									
	Ohr(Initial)			1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
1	0.2584	0.5309	2771	0.0002	0.0003	0.0005	0.0009	0.0013	0.0014	0.0015	0.0019	0.0022
2	0.2587	0.5301	2769	0.0001	0.0004	0.0007	0.0010	0.0013	0.0016	0.0020	0.0022	0.0023
3	0.2590	0.5293	2766	0.0001	0.0002	0.0005	0.0008	0.0009	0.0012	0.0015	0.0020	0.0022
4	0.2575	0.5305	2791	0.0004	0.0004	0.0005	0.0009	0.0013	0.0013	0.0013	0.0017	0.0018
5	0.2582	0.5261	2798	0.0004	0.0006	0.0008	0.0013	0.0014	0.0016	0.0017	0.0018	0.0021
6	0.2571	0.5268	2818	0.0003	0.0004	0.0005	0.0007	0.0011	0.0011	0.0014	0.0016	0.0018
7	0.2564	0.5269	2832	0.0003	0.0003	0.0004	0.0007	0.0010	0.0012	0.0014	0.0019	0.0022
8	0.2590	0.5263	2779	0.0002	0.0004	0.0006	0.0010	0.0014	0.0016	0.0018	0.0020	0.0022
9	0.2598	0.5271	2759	0.0002	0.0006	0.0008	0.0013	0.0015	0.0016	0.0017	0.0022	0.0023
10	0.2594	0.5271	2767	0.0006	0.0008	0.0010	0.0012	0.0013	0.0014	0.0014	0.0016	0.0022
11	0.2592	0.5296	2759	0.0003	0.0007	0.0009	0.0014	0.0016	0.0018	0.0020	0.0020	0.0021
12	0.2582	0.5266	2795	0.0005	0.0007	0.0009	0.0012	0.0014	0.0015	0.0017	0.0020	0.0022
13	0.2584	0.5299	2775	0.0004	0.0006	0.0009	0.0011	0.0015	0.0017	0.0019	0.0021	0.0022
14	0.2582	0.5309	2776	0.0003	0.0007	0.0008	0.0011	0.0016	0.0018	0.0018	0.0022	0.0023
15	0.2591	0.5278	2770	0.0006	0.0005	0.0007	0.0013	0.0015	0.0017	0.0019	0.0021	0.0022
16	0.2600	0.5289	2746	0.0005	0.0008	0.0009	0.0013	0.0014	0.0017	0.0018	0.0018	0.0018
17	0.2588	0.5268	2781	0.0003	0.0004	0.0006	0.0012	0.0016	0.0017	0.0018	0.0022	0.0021
18	0.2586	0.5286	2776	0.0004	0.0004	0.0007	0.0010	0.0015	0.0018	0.0018	0.0022	0.0025
19	0.2575	0.5271	2808	0.0004	0.0007	0.0009	0.0013	0.0015	0.0016	0.0017	0.0020	0.0025
20	0.2593	0.5306	2753	0.0005	0.0006	0.0008	0.0010	0.0011	0.0012	0.0014	0.0016	0.0021
21	0.2578	0.5262	2804	0.0005	0.0008	0.0010	0.0014	0.0015	0.0016	0.0018	0.0022	0.0023
22	0.2579	0.5286	2792	0.0004	0.0009	0.0011	0.0012	0.0013	0.0013	0.0015	0.0019	0.0020
23	0.2591	0.5297	2762	0.0004	0.0004	0.0005	0.0012	0.0015	0.0017	0.0019	0.0021	0.0025
24	0.2586	0.5295	2772	0.0002	0.0005	0.0006	0.0009	0.0011	0.0015	0.0016	0.0018	0.0023
25	0.2588	0.5294	2769	0.0001	0.0002	0.0004	0.0009	0.0011	0.0015	0.0018	0.0019	0.0022
Ave.	0.2585											

**3.3 Data Set 2, 55°C, 60mA (Lumen Maintenance)**

No.	V <sub>F</sub> (V)		Lumen Maintenance (%)								
	0hr(Initial)		1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
26	3.109	19.38	99.90	99.23	98.56	97.57	96.49	96.39	96.08	95.20	94.01
27	3.097	19.38	100.05	99.33	98.71	97.78	96.34	96.28	96.08	95.25	94.53
28	3.117	19.55	100.10	99.44	98.57	97.34	96.21	96.16	95.91	95.09	93.96
29	3.113	19.06	99.95	99.42	98.58	97.43	96.38	96.27	95.59	94.96	93.65
30	3.122	19.74	100.00	99.54	98.73	97.57	96.35	96.20	96.00	95.64	94.63
31	3.107	19.60	99.80	99.49	98.47	97.45	96.33	96.17	95.92	95.31	93.88
32	3.137	18.99	99.79	99.26	98.31	97.37	96.47	96.42	96.21	95.52	94.47
33	3.123	18.57	99.84	99.30	98.71	97.79	96.77	96.55	96.45	95.75	94.78

**3.4 Data Set 2, 55°C, 60mA (Chromaticity Shift)**

No.			CCT(K)									
	0hr(Initial)			1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
26	0.2584	0.5275	2787	0.0004	0.0007	0.0009	0.0012	0.0015	0.0015	0.0017	0.0023	0.0024
27	0.2583	0.5281	2785	0.0003	0.0008	0.0009	0.0014	0.0015	0.0017	0.0020	0.0021	0.0024
28	0.2585	0.5280	2782	0.0004	0.0007	0.0008	0.0013	0.0016	0.0016	0.0019	0.0022	0.0025
29	0.2570	0.5257	2826	0.0004	0.0006	0.0007	0.0014	0.0016	0.0017	0.0019	0.0021	0.0024
30	0.2602	0.5302	2737	0.0003	0.0004	0.0007	0.0010	0.0013	0.0015	0.0017	0.0020	0.0021
31	0.2595	0.5294	2754	0.0003	0.0004	0.0006	0.0010	0.0014	0.0016	0.0017	0.0019	0.0021
32	0.2593	0.5316	2749	0.0004	0.0006	0.0008	0.0014	0.0015	0.0015	0.0020	0.0022	0.0023
33	0.2591	0.5302	2759	0.0002	0.0004	0.0007	0.0011	0.0014	0.0015	0.0017	0.0021	0.0023
34	0.2595	0.5290	2755	0.0003	0.0006	0.0007	0.0009	0.0011	0.0014	0.0018	0.0022	0.0024
35	0.2593	0.5299	2757	0.0006	0.0009	0.0011	0.0014	0.0014	0.0015	0.0020	0.0022	0.0025
36	0.2568	0.5259	2828	0.0002	0.0008	0.0010	0.0013	0.0014	0.0016	0.0017	0.0019	0.0022
37	0.2584	0.5271	2788	0.0004	0.0006	0.0009	0.0011	0.0013	0.0014	0.0016	0.0021	0.0025
38	0.2595	0.5306	2750	0.0003	0.0005	0.0007	0.0014	0.0015	0.0016	0.0021	0.0022	0.0026
39	0.2594	0.5277	2764	0.0001	0.0005	0.0008	0.0015	0.0016	0.0018	0.0018	0.0020	0.0027
40	0.2587	0.5287	2775	0.0004	0.0007	0.0009	0.0014	0.0015	0.0017	0.0018	0.0019	0.0022
41	0.2586	0.5276	2781	0.0005	0.0008	0.0009	0.0015	0.0016	0.0017	0.0018	0.0022	0.0023
42	0.2583	0.5309	2774	0.0002	0.0003	0.0004	0.0011	0.0015	0.0016	0.0018	0.0020	0.0024
43	0.2583	0.5278	2788	0.0000	0.0001	0.0004	0.0009	0.0012	0.0016	0.0018	0.0020	0.0022
44	0.2583	0.5268	2792	0.0002	0.0004	0.0008	0.0011	0.0016	0.0017	0.0017	0.0021	0.0026
45	0.2588	0.5312	2762	0.0001	0.0004	0.0005	0.0009	0.0012	0.0013	0.0016	0.0020	0.0022
46	0.2567	0.5266	2828	0.0000	0.0002	0.0004	0.0010	0.0011	0.0013	0.0015	0.0022	0.0025
47	0.2577	0.5302	2788	0.0003	0.0006	0.0008	0.0010	0.0012	0.0015	0.0018	0.0020	0.0025
48	0.2592	0.5282	2766	0.0004	0.0005	0.0009	0.0010	0.0012	0.0014	0.0016	0.0019	0.0015
49	0.2594	0.5304	2753	0.0004	0.0005	0.0006	0.0012	0.0013	0.0014	0.0018	0.0021	0.0023
50	0.2591	0.5301	2761	0.0001	0.0004	0.0005	0.0010	0.0013	0.0015	0.0015	0.0019	0.0023
Ave.	0.2587	0.5288	2776	0.0003	0.0005	0.0007	0.0012	0.0014	0.0015	0.0018	0.0021	0.0023
Med.	0.2587	0.5287	2774	0.0003	0.0005	0.0008	0.0011	0.0014	0.0015	0.0018	0.0021	0.0024
st dev	0.0009	0.0017	24.6257	0.0002	0.0002	0.0002	0.0002	0.0002	0.0001	0.0002	0.0001	0.0002
Min.	0.2567	0.5257	2737	0.0000	0.0001	0.0004	0.0009	0.0011	0.0013	0.0015	0.0019	0.0015
Max.	0.2602	0.5316	2828	0.0006	0.0009	0.0011	0.0015	0.0016	0.0018	0.0021	0.0023	0.0027



**3.5 Data Set 3, 85 °C, 60mA (Lumen Maintenance)**

No.	V <sub>F</sub> (V)		Lumen Maintenance (%)								
	Ohr(Initial)		1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
51	3.101	19.30	99.84	99.48	98.55	97.36	96.32	96.27	95.91	95.03	93.16
52	3.137	18.44	99.95	99.35	98.32	97.29	96.31	96.20	95.66	94.69	93.22
53	3.130	19.11	99.95	99.16	98.22	97.07	96.02	95.92	95.55	94.56	93.25
54	3.130	18.40	100.00	99.24	98.26	97.39	96.25	96.20	95.76	94.62	92.83
55	3.111	19.58	99.85	99.28	98.11	97.29	96.07	95.91	95.56	94.74	93.00
56	3.103	19.65	99.80	99.34	98.47	97.10	96.03	95.88	95.17	94.66	93.33
57	3.117	18.34	100.11	99.45	98.36	97.33	95.91	95.80	95.15	94.06	92.80
58	3.100	19.39	99.85	99.28	98.19	97.32	95.98	95.87	95.41	94.43	93.24
59	3.125	18.79	99.84	99.20	98.24	97.13	95.90	95.80	95.37	94.15	92.87
60	3.114	18.37	99.89	99.24	98.20	97.28	95.86	95.81	95.16	94.50	92.76
61	3.130	18.64	99.79	99.46	98.44	97.10	95.71	95.60	95.33	94.26	92.97
62	3.115	19.38	99.90	99.33	98.30	97.01	96.23	96.18	95.72	94.27	92.83
63	3.114	18.78	100.05	99.36	98.40	97.07	96.06	95.95	95.63	94.62	93.24
64	3.095	19.53	100.10	99.33	98.31	97.13	95.80	95.75	95.39	94.32	92.73
65	3.136	18.96	99.84	99.16	98.10	97.10	95.99	95.94	95.78	94.67	93.09
66	3.097	19.39	99.95	99.33	98.35	97.11	96.13	96.08	95.67	94.22	93.09
67	3.122	18.75	99.79	99.25	98.45	97.17	96.11	96.00	95.63	94.51	93.01
68	3.136	18.80	99.79	99.10	98.51	97.45	96.17	96.06	95.64	94.26	93.09
69	3.100	19.28	100.05	99.33	98.18	97.10	95.80	95.75	95.23	94.45	93.36
70	3.122	18.38	99.84	99.35	98.37	97.44	95.92	95.81	95.32	94.34	93.47
71	3.120	19.07	99.74	99.37	98.27	97.27	96.28	96.07	95.54	94.55	93.13
72	3.126	18.74	99.73	99.36	98.13	97.01	96.00	95.78	95.25	94.34	92.53
73	3.130	18.64	100.11	99.25	98.23	97.26	96.24	96.14	95.76	94.80	93.62
74	3.119	18.42	99.78	99.13	98.10	97.23	96.09	95.82	95.33	94.63	93.54
75	3.100	19.90	100.00	99.15	98.14	97.14	95.98	95.58	95.28	94.27	92.96
Ave.	3.117	18.96	99.90	99.29	98.29	97.21	96.05	95.93	95.49	94.48	93.09
Med.	3.119	18.80	99.85	99.33	98.27	97.17	96.03	95.91	95.54	94.50	93.09
st dev	0.0133	0.4653	0.1187	0.1041	0.1322	0.1312	0.1688	0.1863	0.2241	0.2290	0.2675
Min.	3.095	18.34	99.73	99.10	98.10	97.01	95.71	95.58	95.15	94.06	92.53
Max.	3.137	19.90	100.11	99.48	98.55	97.45	96.32	96.27	95.91	95.03	93.62

TM-21 Projection:

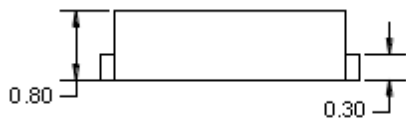
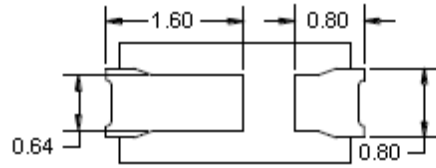
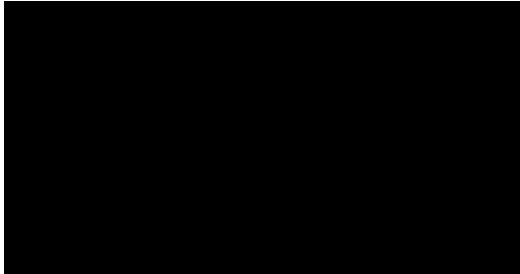
 $\alpha$ : $\beta$ :

**3.6 Data Set 3, 85 °C, 60mA (Chromaticity Shift) 0**

No.			CCT(K)									
	0hr(Initial)			1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
51	0.2605	0.5279	2739	0.0005	0.0007	0.0009	0.0011	0.0013	0.0013	0.0015	0.0022	0.0025
52	0.2583	0.5300	2778	0.0003	0.0004	0.0006	0.0014	0.0015	0.0018	0.0019	0.0020	0.0025
53	0.2593	0.5305	2755	0.0002	0.0006	0.0008	0.0016	0.0018	0.0019	0.0022	0.0023	0.0024
54	0.2591	0.5302	2758	0.0004	0.0008	0.0010	0.0015	0.0017	0.0017	0.0022	0.0024	0.0029
55	0.2601	0.5287	2745	0.0003	0.0005	0.0009	0.0011	0.0015	0.0017	0.0019	0.0021	0.0023
56	0.2597	0.5291	2752	0.0004	0.0005	0.0008	0.0009	0.0012	0.0014	0.0016	0.0019	0.0023
57	0.2592	0.5306	2756	0.0004	0.0005	0.0007	0.0011	0.0015	0.0016	0.0019	0.0021	0.0026
58	0.2598	0.5283	2753	0.0004	0.0005	0.0006	0.0013	0.0016	0.0018	0.0021	0.0023	0.0027
59	0.2574	0.5311	2792	0.0003	0.0003	0.0007	0.0011	0.0014	0.0017	0.0021	0.0023	0.0025
60	0.2594	0.5288	2759	0.0001	0.0005	0.0006	0.0014	0.0016	0.0017	0.0018	0.0019	0.0023
61	0.2588	0.5302	2766	0.0006	0.0008	0.0009	0.0012	0.0016	0.0018	0.0020	0.0023	0.0027
62	0.2578	0.5256	2807	0.0005	0.0006	0.0009	0.0013	0.0014	0.0016	0.0020	0.0023	0.0023
63	0.2587	0.5287	2775	0.0004	0.0007	0.0008	0.0010	0.0012	0.0012	0.0015	0.0018	0.0027
64	0.2596	0.5293	2752	0.0001	0.0002	0.0005	0.0007	0.0010	0.0014	0.0015	0.0022	0.0027
65	0.2588	0.5303	2766	0.0002	0.0005	0.0006	0.0010	0.0015	0.0019	0.0020	0.0023	0.0026
66	0.2600	0.5284	2749	0.0002	0.0002	0.0005	0.0008	0.0014	0.0016	0.0019	0.0019	0.0021
67	0.2587	0.5309	2764	0.0001	0.0003	0.0006	0.0007	0.0017	0.0018	0.0018	0.0022	0.0028
68	0.2592	0.5305	2755	0.0002	0.0002	0.0004	0.0012	0.0015	0.0015	0.0018	0.0020	0.0025
69	0.2572	0.5262	2818	0.0002	0.0007	0.0008	0.0014	0.0014	0.0015	0.0018	0.0022	0.0025
70	0.2587	0.5292	2772	0.0001	0.0004	0.0005	0.0009	0.0018	0.0018	0.0018	0.0022	0.0023
71	0.2577	0.5280	2800	0.0001	0.0005	0.0005	0.0010	0.0015	0.0016	0.0018	0.0022	0.0025
72	0.2593	0.5313	2751	0.0001	0.0005	0.0007	0.0014	0.0017	0.0019	0.0019	0.0021	0.0025

## Appendix A – EUT PHOTO

### A.1 Mechanical Dimensions (Ta = 25 °C)



Unit: mm

### A.2 EUT Photo



TMPL<sub>LED</sub>

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