Test Report

Report No.: EASZF05270002

APPLICATION FOR LUMEN MAINTENANCE TESTING ACCORDING TO THE IES LM-80-08 TEST STANDARD

Prepared for: Brightek Optoelectronic CO., LTD
No. 7, Bai Sha Road, Xinqiao 2nd Industrial Estate Shajing Bao an District, Shenzhen China 518125

Description of the submitted sample(s):

Sample Name	: 2835 0.5W Lighting Series
Sample Model	: WW 3000K
Model Tested	: WW 3000K
Ratings	: 150 mA
Target CCT	: 3000K
State of Sample(s)	: Normal
Sample Quantity	: 40 pcs
Manufacturer	: Brightek Optoelectronic CO., LTD
Reference Standard	: IES LM-80-08 Approved Method: Measuring Lumen Maintenance of LED Light Sources
Sample Received Date	: May. 24, 2013
Sample Tested Date	: May. 24, 2013 to Feb. 21, 2014

The laboratory that conducted the testing items in this report has been accredited by the National Voluntary Laboratory Accreditation Program (NVLAP LAB CODE: 200889-0), for LM-79 testing of SSL products.
And the report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

Tested by: Kaiser Lee (Tester)

Reviewed by: (Engineer)

Approved by: (Supervisor)

Date: Mar. 24, 2014

Check No.: 1702045991

CENTRE TESTING INTERNATIONAL CORPORATION

NO.1996, Xin jin qiao Road, Pudong New District, Shanghai, 201206, China

Test Report

1 SUMMARY

	LM-80 Required Temperature		Specified Temperature of the manufacturer
	55℃	85℃	--℃
Number of LED tested	20	20	--
Drive Current [I_F]	150 mA	150 mA	--
Measurement Current [I_F]	150 mA	150 mA	--
Actual Case Temp. [T_s]	54.9℃	84.7℃	--
Actual Ambient Temp. [T_A]	54.5℃	84.0℃	--
$\Delta[T_s - T_A]$	0.4℃	0.7℃	--
Average Lumen Maintenance at 6000 hours	99.63 %	99.27%	--
Ave. Chromaticity Shift ($\Delta u'v'$) at 6000 hours	0.0008	0.0008	--
Calculated L70(6k) (hours)	74,000	54,000	--
Reported L70(6k) (hours)	>36000	>36000	--
Failures observed	None	None	--

Test Time Points/Average Lumen Maintenance							
Case Temperature	0 Hour	1,000 Hours	2,000 Hours	3,000 Hours	4,000 Hours	5,000 Hours	6,000 Hours
55℃	100.00	101.76	101.33	100.50	99.60	99.22	99.63
85℃	100.00	101.99	101.35	100.27	98.33	98.37	99.27
--℃	--	--	--	--	--	--	--

Test Time Points/Average Color Shift (△u'v')							
Case Temperature	0 Hour	1,000 Hours	2,000 Hours	3,000 Hours	4,000 Hours	5,000 Hours	6,000 Hours
55℃	0.0000	0.0012	0.0008	0.0013	0.0005	0.0008	0.0008
85℃	0.0000	0.0012	0.0009	0.0009	0.0005	0.0008	0.0008
--℃	--	--	--	--	--	--	--

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2 EQUIPMENT LIST

Test Equipment	Model	Equipment No.	Calibration Date	Calibration Due Date
Spectroradiometer	CDS 2100	ATTEELSH00111	Sept. 22,2012	Sept. 21,2013
Integrating Sphere	LMS-200	ATTEELSH00115	Sept. 22,2012	Sept. 21,2013
Standard Lamp	SCL-600	ATTEELSH00116	Aug.14, 2013	Aug.13, 2014
Digital Recorder	HIOKI LR8400-21	TTE20100242	Oct. 10, 2012	Oct. 09, 2013
Digital Recorder	HIOKI LR8400-21	TTE20100242	Jul.18, 2013	Jun.17, 2014
Digital CC&CV DC Power Supply	GPD-3303S	TTE20110233	Jul.10, 2012	Jun.9, 2013
Digital CC&CV DC Power Supply	GPD-3303S	TTE20110233	Jul.01, 2013	Jun.30, 2014
Digital CC&CV DC Power Supply	GPR-30H10D	TTE20110389	Jul.10, 2012	Jun.9, 2013
Digital CC&CV DC Power Supply	GPR-30H10D	TTE20110389	Jul.01, 2013	Jun.30, 2014
High Temperature Chamber	NMT-1200	TTE20100237	--	--
High Temperature Chamber	NMT-1200	TTE20100240	--	--
Ture RMS Multimeter	189	ATTEELSH00042	Jul.10, 2012	Jun.9, 2013
Ture RMS Multimeter	189	ATTEELSH00042	Jul.01, 2013	Jun.30, 2014
Digital power meter	WT210	ATTEELSH00150	Oct. 15, 2012	Oct. 14, 2013
Digital power meter	WT210	ATTEELSH00150	Jul.01, 2013	Jun.30, 2014

3 Photometry Measurement Uncertainty

The uncertainty of the light output measurements is U=1.7% (K=2), at the 95% confidence level. This calibration results traceable to the NATIONAL INSTITUTE OF METROLOGY (NIM).

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4 TEST METHODS

4.1 Requirements of Environmental Conditions

Operation of the LED light sources between photometric measurements shall be at a minimum of three case temperatures, T_s, using the same drive current. The three case temperatures, T_s, shall be 55℃ and 85℃ with a third temperature selected by the manufacturer. Case temperatures shall be controlled to -2℃ during life testing. The temperature of the surrounding air should be maintained to within -5℃ of the case temperature during testing. The surrounding air temperature should be monitored within the test chamber. Humidity shall be maintained to less the 65%RH throughout the life test.

The case temperature T_s is the cathode lead temperature of the LED mounted on a reliability test board. The ambient temperature T_A is the temperature of the air at a distance of 50mm above the reliability test board.

The ambient temperature during lumen and chromaticity measurements shall be set to 25℃± 2℃. The LED light source shall be required to cool to room temperature prior to measurement.

Airflow shall be minimized for proper light source starting and operation.

The operating orientation of the LED light sources under test should be as specified by the manufacturer.

4.2 Lumen Maintenance Testing Method

Samples under test shall be driven for at least 6,000 hours with data collection at a minimum of every 1000 hours. 10,000 hours are preferred for the purposes of improved predictive modeling.

LED light sources are driven at constant current.

Checking for LED light source failures either by visual observation or automatic monitoring shall be done at a minimum of every measurement interval. Catastrophic LED light source failure shall be reported and included in the test report.

The chromaticity shift shall be measured and reported over the course of the lumen maintenance test time by measuring chromaticity at each photometric test interval.

4.3 Photometric and Electrical Measurements

A Labsphere Model CDS 2100 CCD Spectroradiometer and 50cm Integrating Sphere was used to measure total luminous flux, correlated color temperature, color rendering index, and chromaticity coordinates for each sample.

Ambient temperature was measured at a position inside the integrating sphere. Electrical measurements including voltage, current, and power were measured using the Digital Power Meter.

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5 TEST RESULTS

5.1 55℃, 150 mA

Case Temperature [T_s] : 54.9℃
Ambient Temperature [T_A] : 54.5℃
Drive Current [I_F] : 150 mA
Measurement Current : 150 mA

No.	Φ_v [lm]	V_F [V]	CCT (K)	Lumen Maintenance [%]					
	0 h (Initial)			1000 h	2000 h	3000 h	4000 h	5000 h	6000 h
1	49.45	3.222	3171.0	100.59	99.94	99.11	98.38	96.48	97.98
2	45.87	3.202	3166.3	104.47	104.84	103.27	102.88	99.72	102.07
3	47.60	3.204	3127.9	103.47	102.96	102.08	101.01	102.88	100.78
4	47.65	3.206	3149.2	98.47	96.43	96.08	95.19	92.51	98.80
5	48.72	3.204	3144.3	102.07	100.41	99.73	98.32	97.02	99.10
6	49.24	3.213	3157.3	100.65	100.06	98.76	97.56	96.00	97.60
7	48.85	3.223	3166.8	101.78	100.16	99.63	98.53	99.86	98.24
8	48.28	3.123	3153.8	101.57	100.79	100.06	99.15	99.96	99.01
9	48.97	3.216	3165.9	100.67	100.37	99.61	98.51	98.98	98.82
10	48.70	3.187	3249.1	102.09	101.70	100.70	99.75	99.26	99.20
11	48.41	3.315	3137.5	100.58	100.10	99.28	98.26	98.97	99.81
12	50.12	3.201	3146.8	98.72	98.84	97.92	97.13	97.23	98.32
13	49.02	3.185	3183.6	100.88	99.55	98.59	97.37	97.55	98.29
14	47.13	3.193	3145.3	103.25	102.78	101.91	100.95	99.62	101.93
15	49.25	3.186	3150.8	103.19	101.52	100.45	99.70	99.53	100.32
16	48.15	3.207	3165.2	99.71	100.29	98.94	98.57	100.12	98.63
17	45.43	3.170	3173.3	105.04	106.45	105.30	104.53	102.97	103.08
18	48.85	3.194	3136.5	100.43	100.14	99.49	98.22	98.69	97.42
19	45.23	3.197	3167.9	106.35	108.93	108.84	108.07	106.28	104.31
20	48.40	3.209	3153.4	101.14	100.25	100.31	99.83	100.79	98.82
n	20	20	20	20	20	20	20	20	20
Mean	48.17	3.20	3160.6	101.76	101.33	100.50	99.60	99.22	99.63
Median	48.56	3.20	3155.6	101.36	100.33	99.68	98.55	99.40	98.91
St. dev.	1.34	0.03	25.14	2.04	2.78	2.78	2.86	2.87	1.89
Min.	45.23	3.12	3127.9	98.47	96.43	96.08	95.19	92.51	97.42
Max.	50.12	3.32	3249.1	106.35	108.93	108.84	108.07	106.28	104.31

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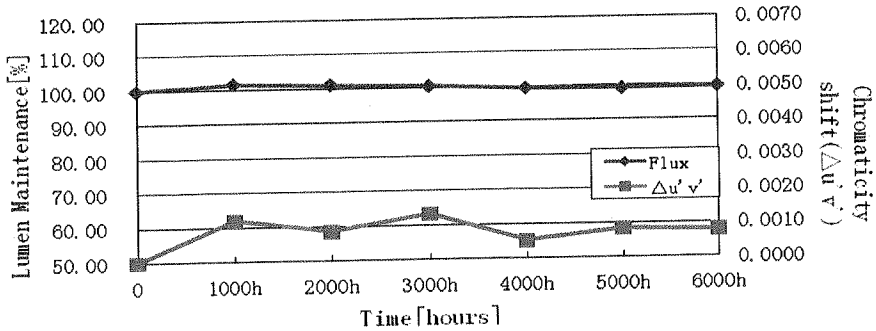
No.	u'	v'	Chromaticity Shift Δu'v'					
	0 h (Initial)		1000 h	2000 h	3000 h	4000 h	5000 h	6000 h
1	0.2442	0.5200	0.0006	0.0009	0.0016	0.0006	0.0005	0.0007
2	0.2454	0.5217	0.0013	0.0010	0.0012	0.0004	0.0007	0.0010
3	0.2449	0.5203	0.0020	0.0014	0.0002	0.0008	0.0015	0.0001
4	0.2451	0.5206	0.0013	0.0008	0.0014	0.0005	0.0005	0.0010
5	0.2445	0.5208	0.0011	0.0008	0.0016	0.0006	0.0004	0.0006
6	0.2441	0.5210	0.0011	0.0008	0.0013	0.0004	0.0005	0.0006
7	0.2453	0.5183	0.0011	0.0006	0.0014	0.0003	0.0007	0.0008
8	0.2451	0.5176	0.0010	0.0007	0.0015	0.0006	0.0003	0.0009
9	0.2430	0.5147	0.0010	0.0008	0.0016	0.0006	0.0035	0.0005
10	0.2464	0.5168	0.0015	0.0011	0.0013	0.0006	0.0007	0.0013
11	0.2448	0.5210	0.0012	0.0008	0.0014	0.0005	0.0005	0.0008
12	0.2441	0.5187	0.0012	0.0008	0.0014	0.0004	0.0007	0.0007
13	0.2447	0.5217	0.0013	0.0007	0.0010	0.0001	0.0010	0.0009
14	0.2447	0.5209	0.0011	0.0008	0.0014	0.0006	0.0009	0.0004
15	0.2439	0.5218	0.0013	0.0009	0.0008	0.0002	0.0007	0.0016
16	0.2447	0.5181	0.0013	0.0009	0.0015	0.0005	0.0006	0.0003
17	0.2440	0.5210	0.0010	0.0008	0.0015	0.0006	0.0006	0.0004
18	0.2448	0.5202	0.0009	0.0008	0.0016	0.0007	0.0005	0.0015
19	0.2442	0.5200	0.0006	0.0009	0.0016	0.0006	0.0005	0.0007
20	0.2454	0.5217	0.0013	0.0010	0.0012	0.0004	0.0007	0.0010
n	20	20	20	20	20	20	20	20
Mean	0.2447	0.5197	0.0012	0.0008	0.0013	0.0005	0.0008	0.0008
Median	0.2447	0.5205	0.0012	0.0008	0.0014	0.0006	0.0007	0.0007
St. dev.	0.0007	0.0020	0.0003	0.0002	0.0003	0.0002	0.0007	0.0004
Min.	0.2430	0.5147	0.0006	0.0006	0.0002	0.0001	0.0003	0.0001
Max.	0.2464	0.5218	0.0020	0.0014	0.0016	0.0008	0.0035	0.0016



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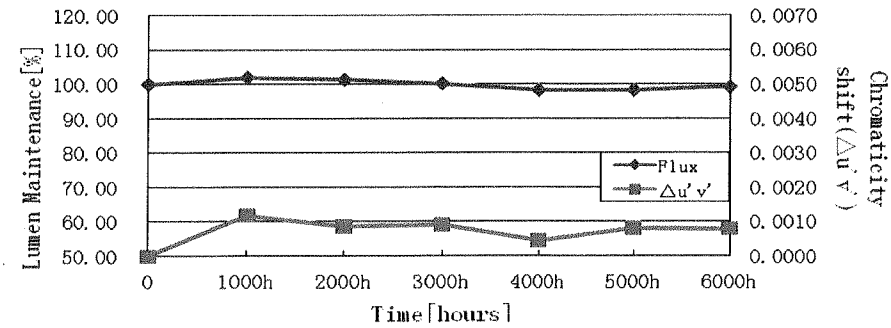
5.2 85℃, 150 mA

Case Temperature [T_s] : 84.7℃
Ambient Temperature [T_A] : 84.0℃
Drive Current [I_F] : 150 mA
Measurement Current : 150 mA

No.	Φ_v [lm]	V_F [V]	CCT(K)	Lumen Maintenance [%]					
	0 h (Initial)			1000 h	2000 h	3000 h	4000 h	5000 h	6000 h
1	48.70	3.226	3166.0	103.37	102.85	101.58	99.67	100.04	99.06
2	46.12	3.219	3161.9	101.95	102.73	101.37	99.00	97.94	103.71
3	46.34	3.205	3210.7	104.51	104.73	104.47	102.18	99.65	103.13
4	49.23	3.211	3191.2	102.11	100.10	98.40	97.60	98.37	98.15
5	49.73	3.198	3196.1	101.51	101.17	99.68	96.94	98.35	97.25
6	46.50	3.199	3166.1	101.63	101.48	99.83	97.38	96.80	101.66
7	49.22	3.204	3147.3	101.83	101.48	101.00	98.39	98.92	98.23
8	49.31	3.214	3187.0	101.10	99.70	98.76	97.49	98.36	97.89
9	48.52	3.204	3146.5	103.69	102.29	101.11	99.44	99.63	100.16
10	49.83	3.197	3182.1	100.54	100.12	99.12	97.03	97.57	96.75
11	50.25	3.246	3180.7	100.06	99.42	98.15	96.00	97.21	95.00
12	48.42	3.188	3216.4	99.57	99.09	98.72	96.14	97.73	97.48
13	47.98	3.194	3152.2	103.88	102.21	101.10	100.17	99.92	100.27
14	49.53	3.220	3147.6	98.53	97.88	96.47	95.36	94.08	96.91
15	49.04	3.194	3170.3	99.45	98.92	98.04	96.62	97.25	97.45
16	49.49	3.189	3184.7	101.68	101.09	99.52	97.53	97.11	97.60
17	45.04	3.192	3161.1	105.73	104.84	104.75	104.17	103.02	104.04
18	48.03	3.184	3168.0	102.69	101.52	100.71	97.98	99.02	100.17
19	49.48	3.204	3166.9	101.05	100.81	99.41	97.09	95.35	98.24
20	46.98	3.213	3173.4	104.87	104.56	103.30	100.49	100.98	102.19
n	20	20	20	20	20	20	20	20	20
Mean	48.39	3.21	3173.8	101.99	101.35	100.27	98.33	98.37	99.27
Median	48.87	3.20	3169.2	101.75	101.32	99.75	97.57	98.35	98.24
St. dev.	1.46	0.01	19.87	1.92	1.96	2.14	2.18	1.96	2.54
Min.	45.04	3.18	3146.5	98.53	97.88	96.47	95.36	94.08	95.00
Max.	50.25	3.25	3216.4	105.73	104.84	104.75	104.17	103.02	104.04

Test Report

No.	u'	v'	Chromaticity Shift Δu'v'					
	0 h (Initial)		1000 h	2000 h	3000 h	4000 h	5000 h	6000 h
1	0.2452	0.5173	0.0013	0.0011	0.0010	0.0005	0.0007	0.0010
2	0.2448	0.5192	0.0020	0.0017	0.0002	0.0011	0.0017	0.0005
3	0.2437	0.5193	0.0010	0.0006	0.0013	0.0003	0.0003	0.0006
4	0.2434	0.5195	0.0009	0.0007	0.0011	0.0003	0.0005	0.0010
5	0.2438	0.5219	0.0007	0.0003	0.0011	0.0002	0.0006	0.0002
6	0.2449	0.5206	0.0012	0.0010	0.0008	0.0004	0.0010	0.0011
7	0.2437	0.5196	0.0014	0.0007	0.0008	0.0004	0.0007	0.0009
8	0.2456	0.5183	0.0015	0.0014	0.0004	0.0008	0.0014	0.0015
9	0.2434	0.5215	0.0013	0.0012	0.0006	0.0007	0.0011	0.0014
10	0.2444	0.5181	0.0009	0.0008	0.0014	0.0004	0.0003	0.0004
11	0.2429	0.5188	0.0009	0.0006	0.0009	0.0001	0.0006	0.0005
12	0.2444	0.5219	0.0012	0.0007	0.0010	0.0001	0.0005	0.0005
13	0.2452	0.5197	0.0018	0.0015	0.0002	0.0011	0.0016	0.0009
14	0.2441	0.5203	0.0009	0.0001	0.0011	0.0001	0.0008	0.0009
15	0.2436	0.5203	0.0012	0.0011	0.0008	0.0004	0.0010	0.0011
16	0.2436	0.5225	0.0010	0.0009	0.0011	0.0004	0.0006	0.0005
17	0.2438	0.5219	0.0011	0.0007	0.0012	0.0004	0.0005	0.0007
18	0.2447	0.5179	0.0010	0.0006	0.0013	0.0003	0.0006	0.0005
19	0.2452	0.5173	0.0013	0.0011	0.0010	0.0005	0.0007	0.0010
20	0.2448	0.5192	0.0020	0.0017	0.0002	0.0011	0.0017	0.0005
n	20	20	20	20	20	20	20	20
Mean	0.2442	0.5199	0.0012	0.0009	0.0009	0.0005	0.0008	0.0008
Median	0.2440	0.5197	0.0012	0.0007	0.0010	0.0004	0.0007	0.0008
St. dev.	0.0008	0.0016	0.0003	0.0004	0.0004	0.0003	0.0004	0.0004
Min.	0.2429	0.5173	0.0007	0.0001	0.0002	0.0001	0.0003	0.0002
Max.	0.2456	0.5225	0.0020	0.0017	0.0014	0.0011	0.0017	0.0015



Test Report

6 TM-21-11 Report: Projecting Long Term Lumen Maintenance of LED Light Source

Table 1: Report at each LM-80 Test Condition					
Description of LED Light Source Tested (manufacturer, model, catalog number)	Munafacturer: Brightek Optoelectronic CO., LTDModel: WW 3000K				
Test Condition 1 - 55°C Case Temp		Test Condition 2 - 85°C Case Temp			
Sample size	20	Sample size	20	Sample size	-
Number of failures	0	Number of failures	0	Number of failures	-
DUT drive current used in the test (mA)	150	DUT drive current used in the test (mA)	150	DUT drive current used in the test (mA)	-
Test duration (hours)	6,000	Test duration (hours)	6,000	Test duration (hours)	-
Test duration used for projection (hour to hour)	1,000 - 6,000	Test duration used for projection (hour to hour)	1,000 - 6,000	Test duration used for projection (hour to hour)	-
Tested case temperature (°C)	55	Tested case temperature (°C)	85	Tested case temperature (°C)	-
α	5.080E-06	α	6.981E-06	α	-
B	1.021	B	1.024	B	-
Calculated L70(6k) (hours)	74,000	Calculated L70(6k) (hours)	54,000	Calculated L70(6k) (hours)	-
Reported L70(6k) (hours)	>36000	Reported L70(6k) (hours)	>36000	Reported L70(6k) (hours)	-

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Photos of the sample

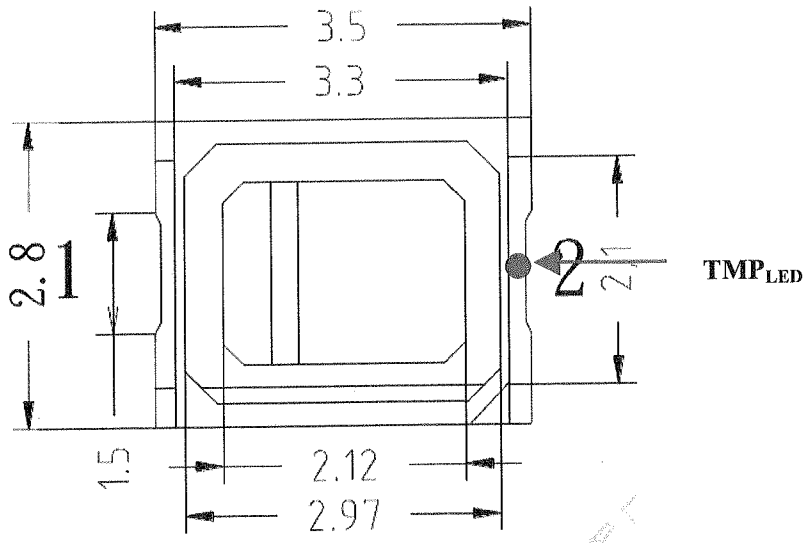

Fig.1- Mechanical Dimension

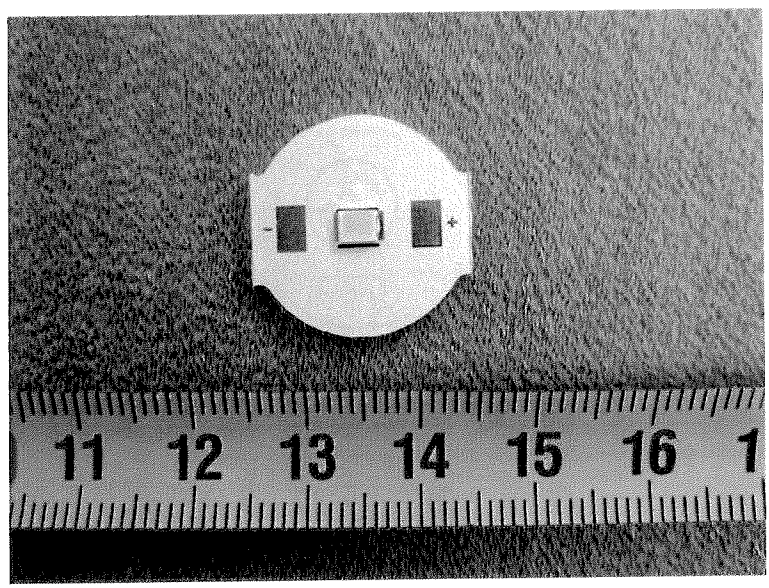

Fig.2- Overall view

*** End of Report ***

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