ENERGY STAR ® Luminaire Test Report

ENERGY STAR® Program Requirements Product Specification for Luminaires - Version 2.0

Prepared For

L-TECH CORPORATION

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SLKT400-3090

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Prepared By	Approved By
Alvin Xie	Duff Yang

1.0 Test Summary

ENERGY STAR® Program Requirements Product Specification for Luminaires - Version 2.0

SSL downlight retrofits				
Requirement Category	**Test Method**	**Reqiurement**	**Test Value**	**Results (Pass/Fail)**
Efficacy (lm/W)	IES LM-79-08	Non-directional: 65 lm/W; Directional: 60 lm/W; Inseparable SSL Luminaire:70 lm/W.	65.53	Pass
Light Output (lm)	IES LM-79-08	Non-directional: 800 lm; Othres: 300 lm	962.707	Pass
Zonal Lumen Density	IES LM-79-08	For directional luminaires only.	89.10%	Pass
CCT (K)	ANSI C78.377-2011	fall within the corresponding 7-step chromaticity quadrangles	3072	Pass
CRI	IES LM-79-08 CIE 13.3-1995	Ra ≥ 80	91.91	Pass
R9	IES LM-79-08 CIE 13.3-1996	R9 > 0	53.5	Pass
Color Angular Uniformity	IES LM-79-08 CIE 15: 2004	≤ 0.006 on the CIE 1976 (u',v') diagram	0.0022	Pass
Lumen Maintenance & Light Source Life (hours)	IES LM-80-08 IES TM-21-11	L70 ≥ 25,000 hours for indoor; L70 ≥ 35,000 hours for outdoor; L70 ≥ 50,000 h for inseparable luminaires	>50000	Pass
Color Maintenance	IES LM-80-08 IES LM-84-14	≤ 0.007 on the CIE 1976 (u',v') diagram	0.004	Pass
Source Start Time (ms)	ENERGY STAR Start Time Test Method	1 s for connected luminaires; 750 ms for other luminaires.	249	Pass
Source Run-Up Time (s)	ENERGY STAR Run Up Time Test Method	≤ 45 seconds	N/A	N/A
Power Factor	C82.77-10:2014	power ≤ 5 watts: PF ≥ 0.5; power ≤ 5 watts: PF ≥ 0.5	0.998	Pass
Transient Protection	IEEE C62.41.1-2002	Survival	N/A	Pass
Standby Power Consumption (W)	IEC 62301 ED.2.0 B	Shall not draw power in the off state.	0	Pass
Operating Frequency (Hz)	N/A	Frequency ≥ 120 Hz	120.4	Pass

1.0 Test Summary (Cont'd)

Requirement Category	Test Method	Reqiurement	Test Value	Results (Pass/Fail)
Light Source Replaceability	N/A	Fluorescent & Directional LED luminaire	Validated	Pass
LED Tc Temperature (°C)	ANSI/UL 153:2002 ANSI/UL 1598:2007	Within the highest test temperature in LM-80 report	81.1	Pass
Driver Case Temperature (°C)	ANSI/UL 153:2002 ANSI/UL 1598:2008	≤ TMPC marked on the the driver	43.8	Pass
Recessed Downlight Thermal Performance	ANSI/UL 1598-2008 ASTM E283-04	Insulation contact & Airtight construction	Validated	Pass
SAFETY REQUIREMENTS for luminaire and driver	UL Safety standards	Safety documentation	Validated	Pass
Dimming: Range (Minimum)	N/A	≤20%	Validated	Pass
Dimming: Noice	N/A	24dBA at 1 meter	16.3	Pass
Labeling & Packaging	N/A	Relevant document	Validated	Pass
WARRANTY REQUIREMENTS	N/A	no less than 3 years	Validated	Pass
Lighting Toxics Reduction Requirements	RoHS Directive, 2003	Relevant Documentations	Validated	Pass

3.0 Test List

Test Item	Test	Test Date	Test Model	Tests Conducted By
1	Integrating Sphere Test	4/25/2017	SLKT403-3090 SLKT400-3090	Howie Wang
2	Goniophotometer Test	4/25/2017	SLKT400-3090	Howie Wang
3	Color Angular Uniformity	4/12/2017	SLKT400-3090	Deo Liu
4	Source Start Time & Run-Up time	3/2/2017	SLKT400-3090	Flora Zhang
5	Operating Frequency Test	3/2/2017	SLKT400-3090	Flora Zhang
6	Transient Protection Test	3/16/2017	SLKT400-3090	Deo Liu
7	Standby Power Consumption	3/22/2017	SLKT400-3090	Deo Liu
8	Dimming Test	4/20/2017	SLKT400-3090	Deo Liu
9	In-Situ Temperature Measurement Test	3/14/2017	SLKT400-3090	Deo Liu

Remark (if any)

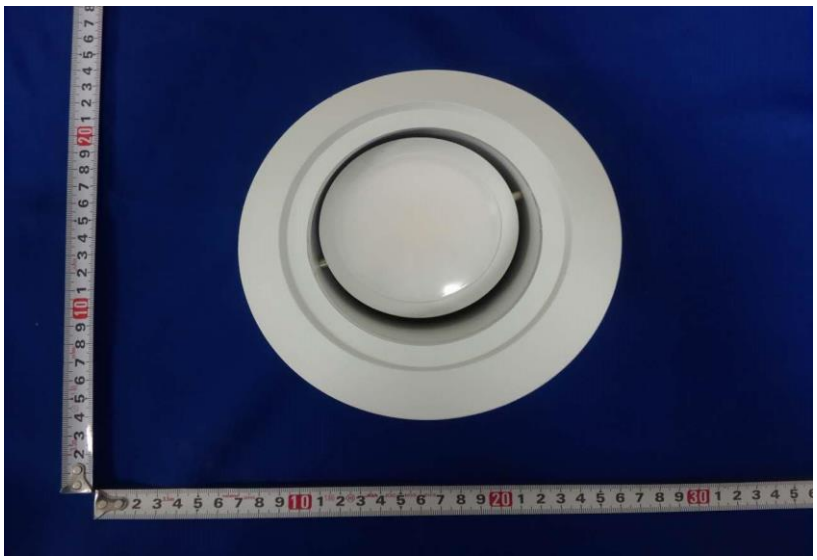
1. UL test equipment information is recorded on Meter Use in UL's Aurora database.

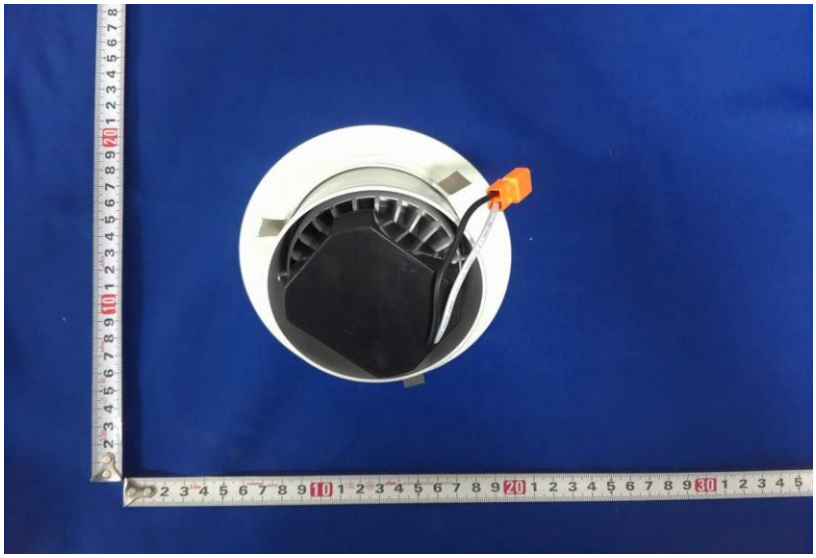
4.0 Production Description

Luminaire Description: SSL downlight retrofits, Indoor Directional
Lighting Source: 2T03X5WW11000003
Mounting: Recessed
LED Driver: LT-LD12/14-R-120/277
Family Model and Variation: SLKT403-3090, SLKT400-4090, SLKT403-4090

Remark: 403 can be with screw thread inwall, 400 can be with smooth inwall. 30, 40 can be CCT 3000K, 4000K

Photos of Luminaire Characteristics





5.0 Photometric Measurements

5.1 Integrating Sphere Test

Model No.	**SLKT400-3090**	**Sample ID.**	**913346**	**Temperature (°C)**	25.1
Model No.	**SLKT403-3090**	**Sample ID.**	**866561**		
Opreate time (Min.)	50	**Stabilization time (Min.)**	45		

Test Method

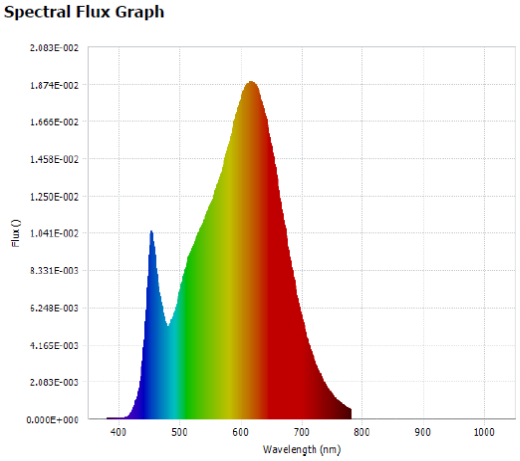
1. The sample was tested according to the IES LM-79-2008.
2. Photometric paramters were measured using an integrating sphere, a spectroradiometer and software. The ambient temperature inside the sphere was maintained at 25°C ± 1°C.
3. The sample measurements were made using a spectroradiometer connected by a fiber optic cable and detector through the detector port of the integrating sphere. The sample was operated at 120 Volts AC, 60Hz. It was stabilized before measurement was made. Chromaticity coordinates, correlated color temperature and color rendering index were calculated from the spectral radiant flux measurements taken at 1 nm intervals over the range of 380 to 780 nm.

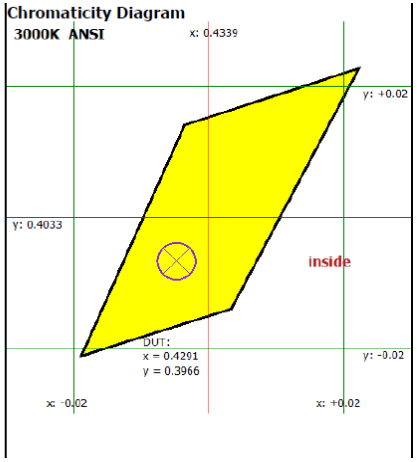
Integrating Sphere Conditions and Results

Model Number	Voltage (Vac)	Frequency	Current (A)	Power (W)	Power Factor	CCT (K)	CRI (Ra)	R9	Luminous Flux (lm)	Luminous Efficacy (lm/W)
SLKT400-3090	120.02	60	0.1226	14.69	0.9980	3072	91.91	53.5	962.707	65.53
SLKT403-3090	119.94	60	0.1194	13.82	0.9650	3110	92.80	59.0	971.332	70.29

5.1 Integrating Sphere Test

Spectral Flux Graph and Spectral Result (For model SLKT400-3090)





Spectral Result

Luminous Flux Φ(v)	962.707 (lm)	Chrom x	0.4291
Chrom y	0.3966	Chrom u	0.2487
Chrom v	0.3448	Duv	-0.0019
Chrom u'	0.2487	Chrom v'	0.5172
CCT	3072.0 (K)	Luminous Efficacy η	65.53 (lm/W)
Ra	91.91	R1	92.3
R2	97.2	R3	97.7
R4	91.3	R5	92.4
R6	95.9	R7	89.8
R8	78.6	R9	53.5
R10	92.7	R11	92.3
R12	83.1	R13	93.9
R14	99.5	R15	88.0
Rf	90	Rg	99

5.0 Photometric Measurements

5.2 Goniophotometer Test

Model No.	SLKT400-3090	Sample ID.	913346
Opreate time (Min.)	60	Stabilization time (Min.)	40

Test Method

1. The sample was tested according to the IES LM-79-2008.
2. Photometric paramters were measured using a type C goniophotometer and software.
3. The ambient temperature shall be maintained at 25° C ± 1° C, measured at a point not more than 1 m from the sample and at the same height as the sample.
4. The samples were operated at rated voltage and was stabilized before measurement. Luminous flux, luminaire efficacy, zonal lumen were calculated from the software taken at 0.5° vertical intervals and 22.5° horizontal intervals.

Goniophotometer Test Conditions

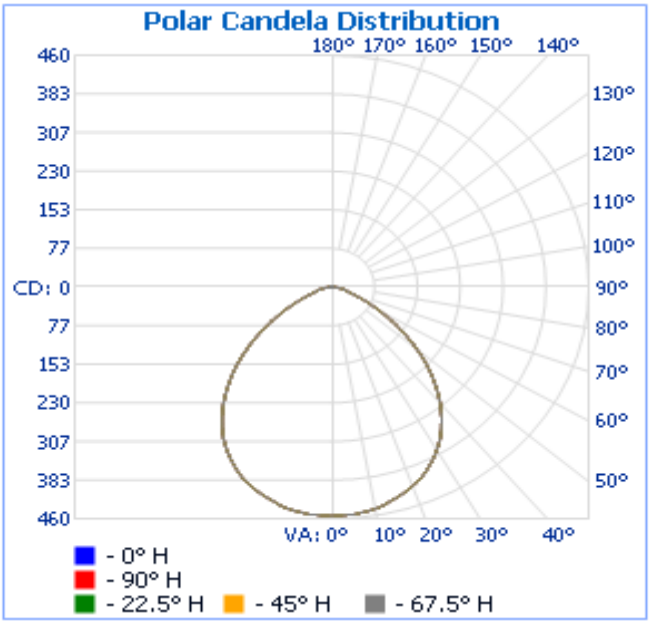
Temperature (°C)	Voltage (Vac)	Frequency	Current (A)	Power (W)	Power Factor	Orientation
25.1	120	60	0.124	14.8	0.9952	Horizonal

Test Results

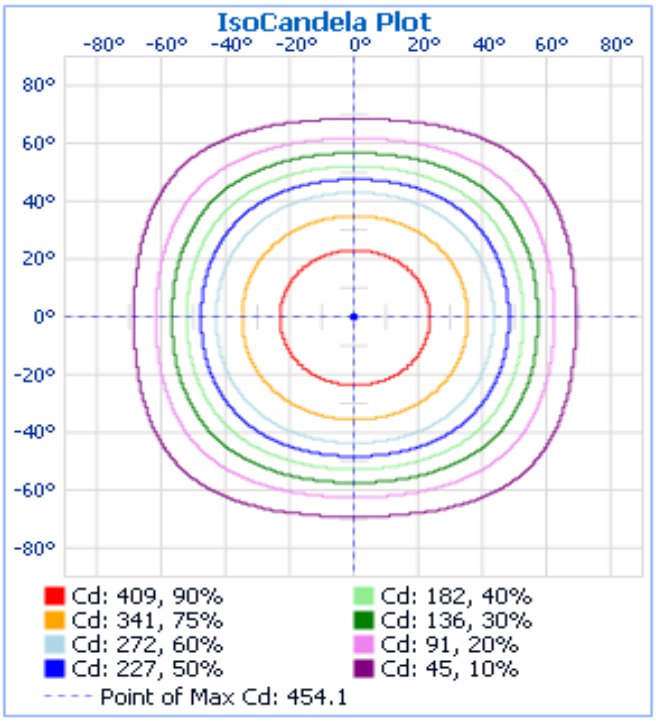
Flux (lm)	Zonal Lumen Requirement (0-60°)	Field Angle (10%)		Beam Angle (50%)		Luminous Efficacy (lm/W)
		Horizontal Spread	Vertical Spread	Horizontal Spread	Vertical Spread	
1009.4	89.10%	137.9	137.9	96	96	68.20

5.2 Goniophotometer Test (Cont'd)

Light Distribution Curve



Isolux Plot



5.2 Goniophotometer Test (Cont'd)

Zonal Lumen Summary

Zonal Lumen Summary		
Zone	Lumens	% Luminaire
0-30	350.4	34.7%
0-40	563.5	55.8%
0-60	899.7	89.1%
60-90	107.4	10.6%
70-100	38.3	3.8%
90-120	0.7	0.1%
0-90	1,007.1	99.8%
90-180	2.3	0.2%
0-180	1,009.4	100%

Lumens Per Zone

Lumens Per Zone					
Zone	Lumens	% Total	Zone	Lumens	% Total
0-5	10.8	1.1%	90-95	0.2	0%
5-10	32.2	3.2%	95-100	0.1	0%
10-15	52.3	5.2%	100-105	0.1	0%
15-20	70.5	7.0%	105-110	0.1	0%
20-25	86.3	8.6%	110-115	0.1	0%
25-30	98.2	9.7%	115-120	0.1	0%
30-35	105.7	10.5%	120-125	0.1	0%
35-40	107.4	10.6%	125-130	0.1	0%
40-45	103.3	10.2%	130-135	0.1	0%
45-50	93.5	9.3%	135-140	0.2	0%
50-55	78.6	7.8%	140-145	0.2	0%
55-60	60.8	6.0%	145-150	0.2	0%
60-65	42.6	4.2%	150-155	0.2	0%
65-70	26.8	2.7%	155-160	0.2	0%
70-75	16.9	1.7%	160-165	0.1	0%
75-80	12.0	1.2%	165-170	0.1	0%
80-85	6.9	0.7%	170-175	0.1	0%
85-90	2.1	0.2%	175-180	0.0	0%

5.0 Photometric Measurements

5.3 Color Angular Uniformity

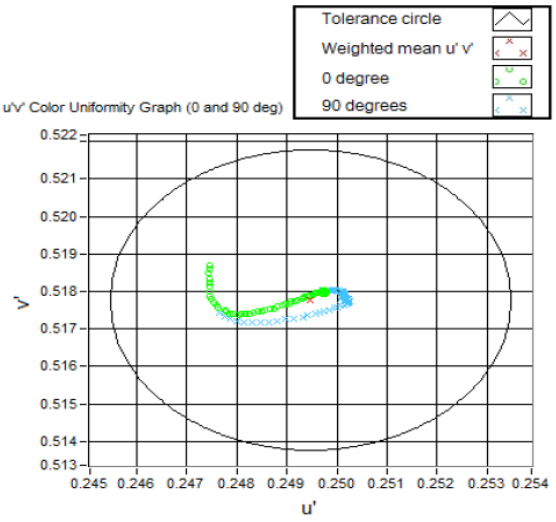
Model No.	SLKT400-3090	Sample ID.	913346

Test Method

1. The sample was tested according to the IES LM-79-2008.
2. Photometric paramters were measured using a type C goniophotometer and software.
3. The ambient temperature shall be maintained at 25° C ± 1° C, measured at a point not more than 1 m from the sample and at the same height as the sample.
4. The sample was operated at 120 Volts AC, 60Hz. It was stabilized before measurement was made.Color spatial uniformity was calculated from the software taken at 1° vertical intervals and 90° horizontal intervals.

Test Results

Temperature (°C)	Voltage (Vac)	Frequency	Current (A)	Power (W)	Maximum Δu'v'
25.1	120	60	0.124	14.8	0.0022



Target % of peak intensity	10.000
CAU Delta u'v' distance limit value	0.004000

6.0 Electrical Test

6.1 Source Start Time & Run-Up time

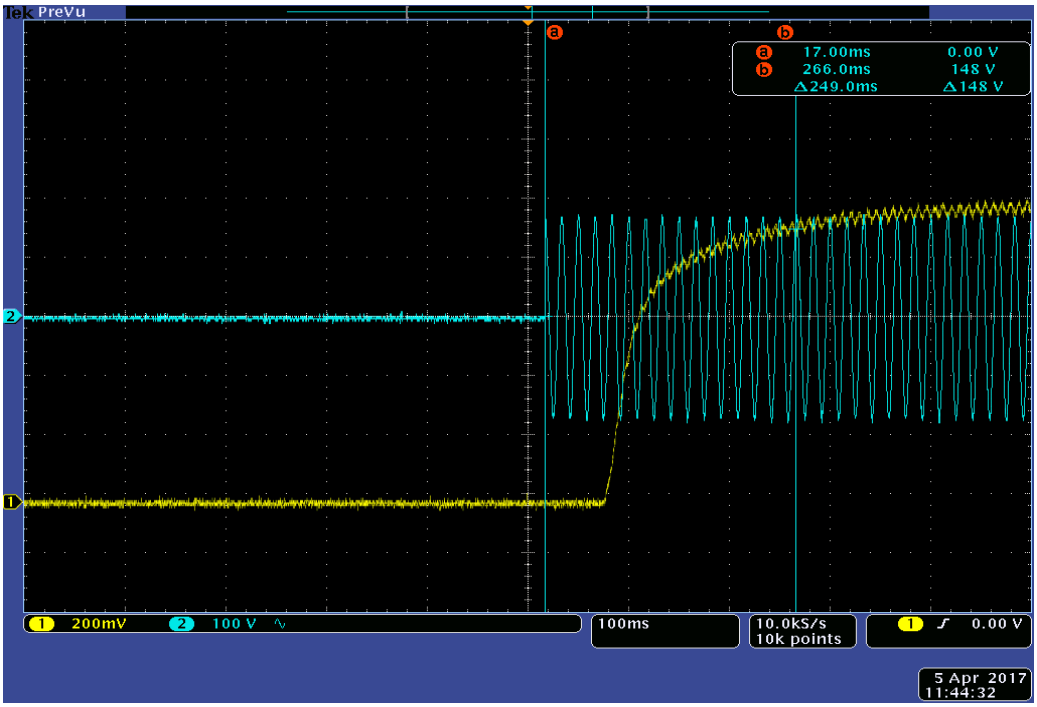
Model No.	SLKT400-3090	Sample ID.	913346

Test Method

1. The sample was tested according to ENERGY STAR Start Time Test and ENERGY STAR Run-Up Time Test for fluorescent luminaires only.
2.Each test sample was operated in its designated orientation at rated input voltage in a 25 ± 5º C ambient . A photodetector is used to monitor the luminaire light output. Time was recorded when the sample was fully illuminated and reached 90% of stabilized lumen output.

Test Results

Temperature (°C)	Voltage (Vac)	Frequency	Start Time (ms)	Run-Up time (s)
25.1	120	60	249	N/A



6.0 Electrical Test

6.2 Operating Frequency Test

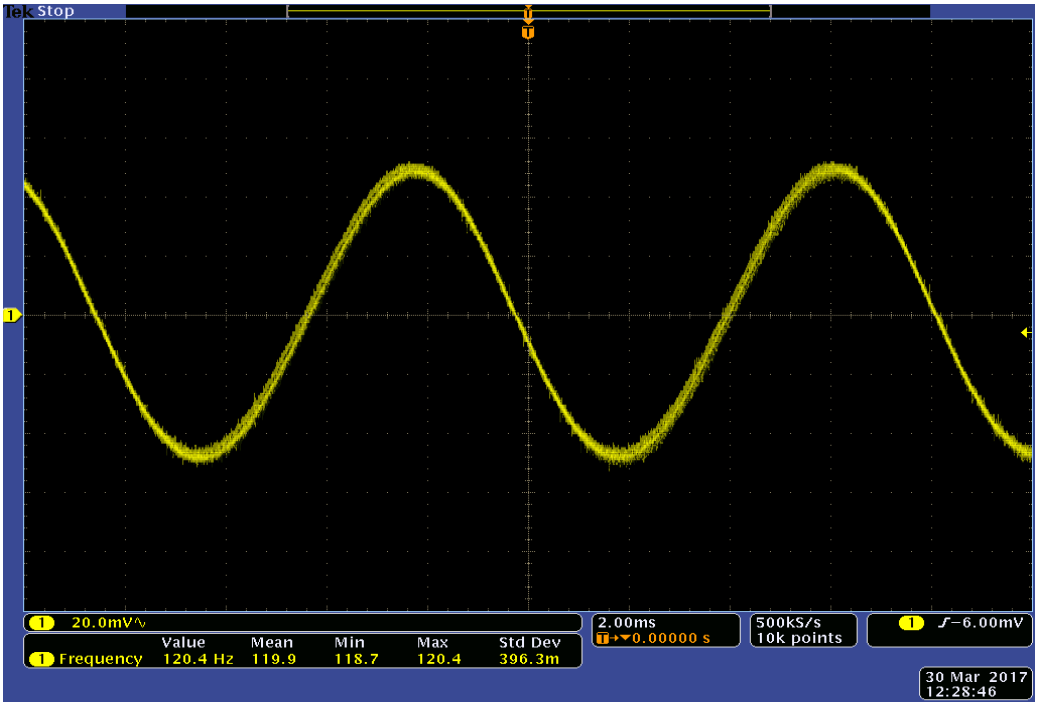
Model No.	SLKT400-3090	Sample ID.	913346

Test Method

1. The sample was tested according to ANSI C82.2-2002 for fluorescent luminaires.
2. Each test sample was operated at rated input voltage. Light output waveform shall be measured with a photodetector, transimpedance amplifier and oscilloscope. The AC ripple on the output DC line was measured and recorded by the oscilloscope according to Energy Star directions.

Test Results

Temperature (°C)	Voltage (Vac)	Frequency	Operating Frequency (Hz)
25.4	120	60	120.4



6.0 Electrical Test

6.3 Transient Protection Test

Model No.	SLKT400-3090	Sample ID.	913346

Test Method

The transient protection tests at ambient temperature were performed on five lamp samples. Each lamp was operated at rated input voltage in the base - up orientation during the tests. A Model PSVAGE8000 test system with an 100kHz Ring Wave Module and a Coupler/Decoupler Module was used to generate the 2500 volt ring wave transient strike across the lamp base contacts. Each wave consisted of a 0.5 microsecond rise time. Seven strikes were performed on each lamp sample in accordance with ANSI/IEEE C62.41 (Category A): Recommended Practice on Surge Voltages in Low – Voltage AC Circuits.

Test Results

Temperature (°C)	Voltage (Vac)	Frequency	After Test - Seven Strikes (Survival/Dead)
25.4	120	60	Survival

6.0 Electrical Test

6.4 Standby Power Consumption

Model No.	SLKT400-3090	Sample ID.	913346

Test Method

A sample was tested according to the IEC 62301-2011 Edition 2. The sample was operated at rated voltage and frequency, working in the active and standby mode*. For loads greater than or equal to 10 W, at least three significant figures shall be reported. After stability, the electral parameter would be measured using proper menthod** and the value of Ue*** was calculated according to the Annex D. The test results shall be compliant with the relative requirements#.

Test Results

Temperature (°C)	Mode	Voltage (Vac)	Frequency	Current (mA)	Power Factor	Standby Power (W)
25.1	No standby mode	120	60	N/A	N/A	0

6.0 Electrical Test

6.5 Dimming Test

Model No.	SLKT400-3090	Sample ID.	913346

Dimmer Information

Manufacture	Lutron	Model Number	S-600P
Rated for CFL / LED	LED	Technology / Features	Forward phase-cut

Test Method

1. The test was performed using a relative photometry method, according to ENERGY STAR Recommended Practice - Light Output on a Dimmer and ENERGY STAR® Recommended Practice - Noise.
2. The measurement was taken one test sample combined with the dimmers. The sample was tested at the rated electrical parameter, and allowed to stabilize and verify by taking light output measurements every minute, until consecutive measurements are no more than 0.5% apart.
3. The noise test shall be conducted on sample in the sound chamber with one microphone. The microphoe was located in six position to get the peak noise.

Test Results

Temperature (°C)	Voltage (Vac)	Frequency	Baseline Light Output (lx)	Maximum Light Output (lx)	Minimum Light Output (lx)
25.1	120	60	1951	1931	203
Ambient Sound (dBA)	**Peak Noise at BLO (dBA)**	**Peak Noise at MaxLO (dBA)**	**Peak Noise at MinLO (dBA)**	**Maximum Light Output Ratio (%)**	**Minimum Light Output Ratio (%)**
16.1	16.3	16.3	16.3	99%	10%

7.0 In-Situ Temperature Measurement Test

Model No.	SLKT400-3090	Sample ID.	913346

Test Method

1. In-Situ Temperature Measurement Test is conducted according to the UL1598-2008, Section 14 or UL 153-2002, Sections 124.
2. The testing was conducted in a room with ambient temperature of 25°C ± 5°C. The apparatus construction followed those described in UL1598-2008 for normal temperature testing. Thermocpuples were placed on the LED package in the locations indicated by LM-80 report. The temperature was recorded after the lamp was operating for a minimum of 7.5 hours.

In-Situ Temperature Measurement Test Conditions

Temperature	Voltage (Vac)	Frequency	Current (A)	Power (W)	Power Factor	Orientation
24.4	120.02	60	0.1226	14.69	0.998	Horizonal

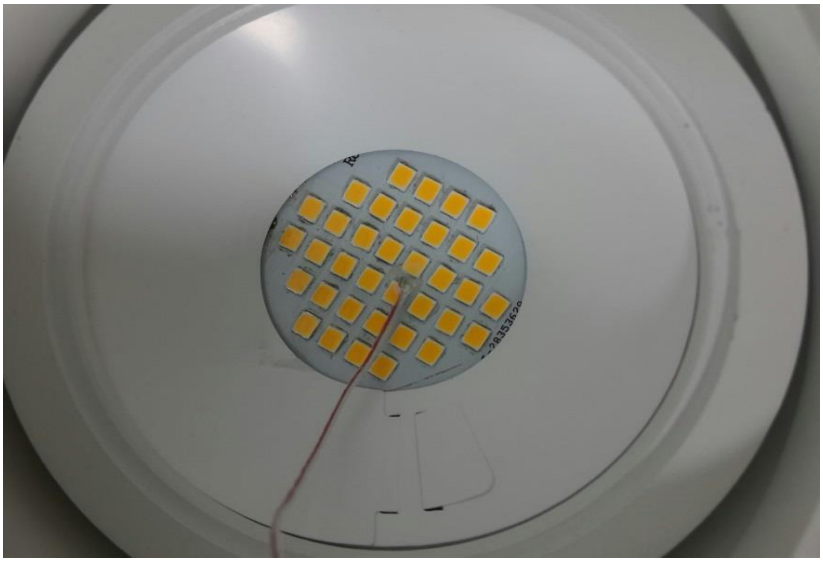
Test Results

Thermocouple Location	Manufacturer Declared Current (mA)	Temperature for Lighting source (°C)		LED Model Number	LM-80 Limit Current (mA)	LM-80 Limit Temp. (°C)
		Test result column 1	Test result (Correct to 25 °C)			
TMP of LEDs	150	80.5	81.1	2T03X5WW11000003	150	85
Ambient temperature	N/A	24.4	25.0			

Thermocouple Location	Temperature for LED driver (°C)		LED driver Model Number	LED Driver Tc Temp. (°C)
	Test result column 1	Test result (Correct to 25 °C)		
TMP of LED drivers	43.2	43.8	LT-LD12/14-R-120/277	90
Ambient temperature	24.4	25.0		

7.0 In-Situ Temperature Measurement Test (Cont'd)

Test Photos for LEDs



Test Photos for LED Drivers

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