



ENERGY STAR[®] Luminaire Test Report

ENERGY STAR[®] Program Requirements Product Specification for Luminaires - Version 2.0 - Issued 2015-05-29

Prepared For

L-TECH CORPORATION

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Catalog Number

ULD43W-##90, ULD43BZ-##90, ULD43BK-##90

(##=00-11 intends CCT 2700K, 3000K and 3500K, ##=20-30 intends CCT 2700K, 3000K and 4000K.)

Project Number

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The results contained in this report pertain only to the tested sample.

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1.0 Test Summary

ENERGY STAR® Program Requirements Product Specification for Luminaires - Version 2.0 - Issued 2015-05-29

(Under Cabinet Mount)				
Requirement Category	Test Method	Requirement	Test Value	Results (Pass/Fail)
Efficacy (lm/W)	IES LM-79-08	Non-directional: 65 lm/W; Directional: 50 lm/W; Inseparable SSL Luminaire: 70 lm/W.	63.96	Pass
Light Output (lm)	IES LM-79-08	Luminous Flux (lm)	353.70	Pass
		Under Cabinet: 125 lm/ft	384.46	
Zonal Lumen Density	IES LM-79-08	For directional luminaires only. (0°~60°C) >60%	80.80%	Pass
CCT (K)	ANSI C78.377-2011	fall within the corresponding 7-step chromaticity quadrangles	2783	Pass
CRI	IES LM-79-08, CIE 13.3-1995	Ra ≥ 80	93.2	Pass
R9	IES LM-79-08, CIE 13.3-1995	R9 > 0	59	Pass
Color Angular Uniformity	IES LM-79-08, CIE 15: 2004	≤ 0.006 on the CIE 1976 (u',v') diagram	0.0014	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	60000	Pass
Color Maintenance	IES LM-80-08*, IES LM-84-14	≤ 0.007 on the CIE 1976 (u',v') diagram	0.0031	Pass
Source Start Time (ms)	ENERGY STAR Start Time Test Method	1 s for connected luminaires; 750 ms for other luminaires.	128	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 ≥ 0.7	0.938	Pass
Transient Protection	IEEE C62.41.2-2002	Survival	Validated	Pass
Standby Power Consumption (W)	IEC 62301 ED.2.0 B	Shall not draw power in the off state.	0.04	Pass
Operating Frequency (Hz)	N/A	Frequency ≥ 120 Hz	120.2	Pass

* The standards are NOT covered by the NVLAP scope of test laboratory UL Verification Services (Guangzhou) Co., Ltd.



1.0 Test Summary (Cont'd)

Requirement Category	Test Method	Requirement	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 1598:2008	Within the highest test temperature in LM-80 report	38.3	Pass
Driver Case Temperature (°C)	ANSI/UL 153:2002 ANSI/UL 1598:2008	≤ TMPC marked on the the driver	42	Pass
Recessed Downlight Thermal Performance	ANSI/UL 1598-2008 ASTM E283-04*	Insulation contact & Airtight construction	N/A	N/A
SAFETY REQUIREMENTS for luminaire and driver	UL Safety standards	Safety documentation	Validated	Pass
Dimming: Range (Minimum)	N/A	≤20%	8.24%	Pass
Dimming: Noise	N/A	24dBA at 1 meter	17.9	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

* The standards are NOT covered by the NVLAP scope of test laboratory UL Verification Services (Guangzhou) Co., Ltd.



2.0 Test List

Test Item	Test	Test Date	Test Model	Tests Conducted By
1	Integrating Sphere Test	2107-12-18	ULD43W-0190	Lily Chen
		2107-12-24	ULD43W-2090	Lily Chen
2	Goniophotometer Test	2107-12-18	ULD43W-0190	Lily Chen
3	Color Angular Uniformity	2107-12-18	ULD43W-0190	Lily Chen
4	Source Start Time & Run-Up time	2107-12-18	ULD43W-0190	Lily Chen
5	Operating Frequency Test	2107-12-18	ULD43W-0190	Lily Chen
6	Transient Protection Test	2107-12-18	ULD43W-0190	Lily Chen
7	Standby Power Consumption	2107-12-18	ULD43W-0190	Lily Chen
8	Dimming Test	2107-12-18	ULD43W-0190	Lily Chen
9	In-Situ Temperature Measurement Test	2107-12-18	ULD43W-0190	Lily Chen

Remark (if any)

1, UL test equipment information is recorded on Meter Use in UL's Aurora database.
2, The product belong to Color Tunable, where ##=00-11 intends CCT 2700K,3000K and 3500K, ##=20-30 intends CCT 2700K,3000K and 4000K. The default settings and maximum power are at 2700K color temperature states.



3.0 Production Description

Luminaire Description: Indoor Directional Luminaires, LED Under cabinet for Color Tunable

120Vac, 60Hz, 7W, CRI 90, CCT 2700K - 4000K, Length 11 inch

Lighting Source: 2T03X2WWxx000xxx made by Edison Opto Corporation

Mounting: Under Cabinet Mount

LED Driver: ULD4-5

Family Model and Variation: ULD43W-##90, ULD43BZ-##90, ULD43BK-##90, W, BZ and BK intends the color of product appearance, W=White, BZ=Brown, BK=Black, ##=00-11 intends CCT 2700K,3000K and 3500K; ##=20-30 intends CCT 2700K,3000K and 4000K. All of the CCT corresponding LED is 0.2 W series model 2T03X2WWxx000xxx except the model name with ##=20-30 of CCT 2700K products use LED is 0.5W series model 2T03X5WWxx000xxx.

Photos of Luminaire Characteristics





4.0 Photometric Measurements

4.1 Integrating Sphere Test

Model No.	ULD43W-0190	Sample ID.	1298516-S001	Temperature (°C)	25.1
Operate time (Min.)	50	Stabilization time (Min.)	45		

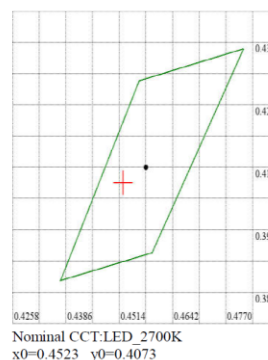
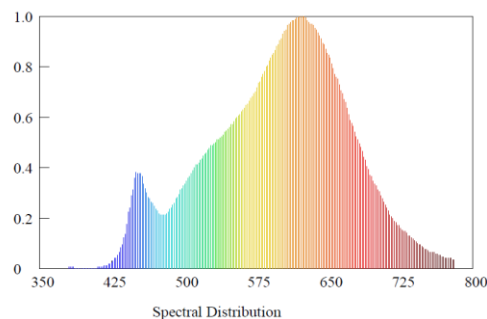
Test Method

1. The sample was tested according to the IES LM-79-2008.
2. Photometric parameters were measured using an integrating sphere, a spectroradiometer and software. The ambient temperature inside the sphere was maintained at $25^{\circ}\text{C} \pm 1^{\circ}\text{C}$.
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 5 nm intervals over the range of 380 to 780 nm.

Integrating Sphere Conditions and Results

Model Number	Orientation	Voltage (Vac)	Frequency (Hz)	Current (A)	Power (W)	Power Factor	CCT (K)	CRI (Ra)	R9	Luminous Flux (lm)	Luminous Efficacy (lm/W)
ULD43W-0190	Horizontal	120.02	60	0.049	5.53	0.938	2783	93.2	59	353.7	63.96

Spectroradiometric Parameters





4.0 Photometric Measurements

4.2 Integrating Sphere Test

Model No.	ULD43W-2090	Sample ID.	1291145-S001	Temperature (°C)	25.1
Operate time (Min.)	50	Stabilization time (Min.)	45		

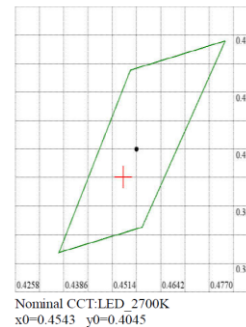
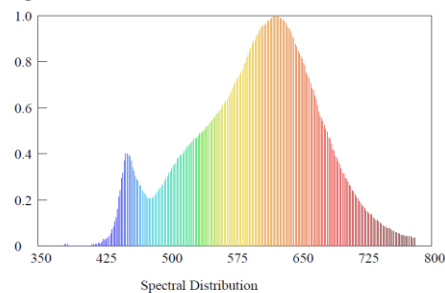
Test Method

1. The sample was tested according to the IES LM-79-2008.
2. Photometric parameters were measured using an integrating sphere, a spectroradiometer and software. The ambient temperature inside the sphere was maintained at $25^{\circ}\text{C} \pm 1^{\circ}\text{C}$.
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 5 nm intervals over the range of 380 to 780 nm.

Integrating Sphere Conditions and Results

Model Number	Orientation	Voltage (Vac)	Frequency (Hz)	Current (A)	Power (W)	Power Factor	CCT (K)	CRI (Ra)	R9	Luminous Flux (lm)	Luminous Efficacy (lm/W)
ULD43W-2090	Horizontal	120.08	60	0.049	5.45	0.932	2731	92.6	56	420.06	77.08

Spectroradiometric Parameters





5.0 Photometric Measurements

5.1 Goniophotometer Test

Model No.	ULD43W-0190	Sample ID.	1298516-S001
Operate time (Min.)	90	Stabilization time (Min.)	45

Test Method

1. The sample was tested according to the IES LM-79-2008.
2. Photometric parameters were measured using a type C goniophotometer and software.
3. The ambient temperature shall be maintained at $25^{\circ}\text{C} \pm 1^{\circ}\text{C}$, 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 1° vertical intervals and 22.5° horizontal intervals.

Goniophotometer Test Conditions

Temperature (°C)	Voltage (Vac)	Frequency	Current (A)	Power (W)	Power Factor	Orientation
25	119.97	60	0.0493	5.53	0.935	Horizontal

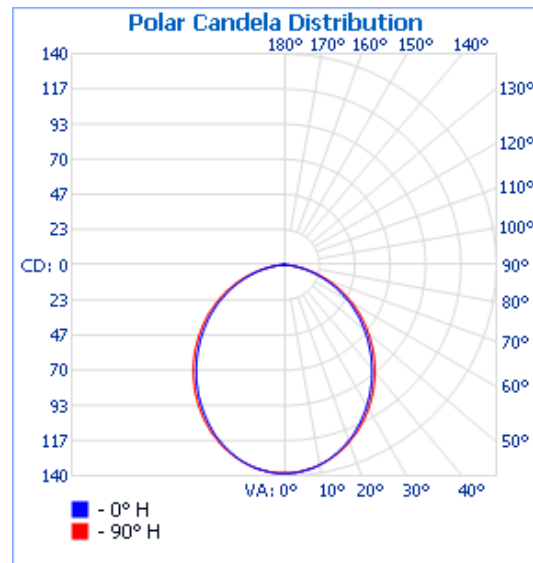
Test Results

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	
352.3	80.80%	157.9	156.2	104.1	101.1	63.7

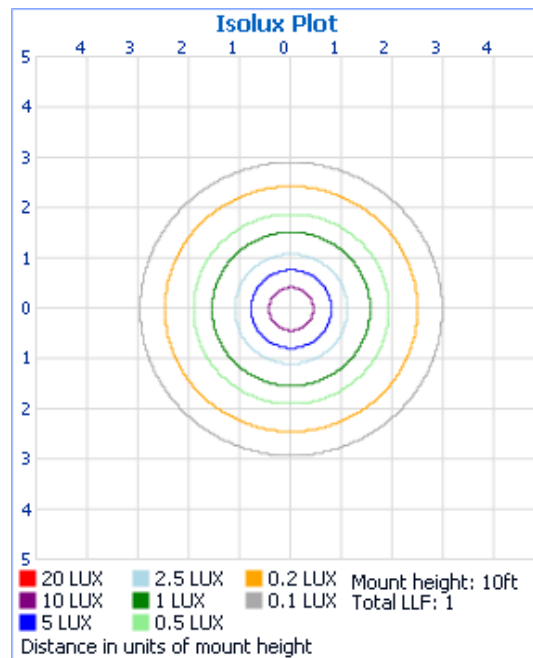


5.1 Goniophotometer Test (Cont'd)

Light Distribution Curve



Isolux Plot





5.1 Goniophotometer Test (Cont'd)

Zonal Lumen Summary

Zonal Lumen Summary

Zone	Lumens	% Luminaire
0-30	103.9	29.5%
0-40	166.9	47.4%
0-60	284.8	80.8%
60-90	67.1	19.1%
70-100	27.1	7.7%
90-120	0.3	0.1%
0-90	352.0	99.9%
90-180	0.4	0.1%
0-180	352.3	100%

Lumens Per Zone

Lumens Per Zone

Zone	Lumens	% Total	Zone	Lumens	% Total
0-5	3.3	0.9%	90-95	0.2	0.1%
5-10	9.7	2.8%	95-100	0.1	0%
10-15	15.7	4.5%	100-105	0.0	0%
15-20	21.0	6.0%	105-110	0.0	0%
20-25	25.4	7.2%	110-115	0.0	0%
25-30	28.8	8.2%	115-120	0.0	0%
30-35	31.0	8.8%	120-125	0.0	0%
35-40	32.1	9.1%	125-130	0.0	0%
40-45	32.0	9.1%	130-135	0.0	0%
45-50	31.0	8.8%	135-140	0.0	0%
50-55	28.9	8.2%	140-145	0.0	0%
55-60	26.0	7.4%	145-150	0.0	0%
60-65	22.3	6.3%	150-155	0.0	0%
65-70	18.0	5.1%	155-160	0.0	0%
70-75	13.2	3.8%	160-165	0.0	0%
75-80	8.4	2.4%	165-170	0.0	0%
80-85	4.0	1.1%	170-175	0.0	0%
85-90	1.1	0.3%	175-180	0.0	0%



5.1 Goniophotometer Test (Cont'd)

Candela Table - Type C

	0	22.5	45	67.5	90	112.5	135	157.5	180	202.5	225	247.5	270	292.5	315	337.5	360
0	138	138	138	138	138	138	138	138	138	138	138	138	138	138	138	138	138
1	138	138	138	138	138	138	138	138	138	138	138	138	138	138	138	138	138
2	138	138	138	138	138	138	138	138	138	138	138	138	138	138	138	138	138
3	138	138	138	138	138	138	138	138	138	138	138	138	138	138	138	138	138
4	138	138	138	138	138	138	138	138	138	138	138	138	138	138	138	138	138
5	137	137	137	137	137	137	137	137	137	137	137	137	137	137	137	137	137
6	137	137	137	137	137	137	137	137	137	137	137	137	137	137	137	137	137
7	137	136	136	136	136	136	136	136	137	136	136	136	136	136	136	136	137
8	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136
9	135	135	135	135	135	135	135	135	135	135	135	135	135	136	135	135	136
10	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135	135
11	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134
12	133	133	133	133	133	133	133	133	133	133	133	133	133	133	133	133	133
13	132	132	132	132	132	132	132	132	132	132	132	132	132	132	132	132	132
14	131	131	131	132	132	132	131	131	131	131	131	132	132	132	131	131	131
15	130	130	130	131	131	131	130	130	130	130	130	131	131	131	130	130	130
16	129	129	129	130	130	130	129	129	129	129	129	130	130	130	129	129	129
17	128	128	128	128	129	128	128	128	128	128	128	128	129	128	128	128	128
18	127	127	127	127	128	127	127	127	127	127	127	127	128	127	127	127	127
19	126	125	126	126	126	126	126	125	126	125	126	126	126	126	126	125	126
20	124	124	124	125	125	125	124	124	124	124	124	125	125	125	124	124	124
25	117	117	118	118	118	118	118	117	117	117	118	118	118	118	118	117	117
30	109	109	109	111	111	111	109	109	109	109	109	111	111	111	109	109	109
35	100	100	101	102	103	102	101	100	100	100	101	102	103	102	101	100	100
40	90	90	91	93	93	93	91	90	90	90	91	93	93	93	91	90	90
45	80	80	82	83	83	83	82	80	80	80	82	83	83	83	82	80	80
50	70	70	71	73	73	73	71	70	70	70	71	73	73	73	71	70	70
55	60	60	61	63	63	63	61	60	60	60	61	63	63	63	61	60	60
60	50	50	51	52	53	52	51	50	50	50	51	52	53	52	51	50	50
65	39	40	41	42	42	42	41	40	39	40	41	42	42	42	41	40	39
70	29	30	30	31	31	31	30	30	29	30	30	31	31	31	30	30	29
75	19	20	20	21	21	21	20	20	19	20	20	21	21	21	20	20	19
80	11	11	11	12	12	12	11	11	11	11	11	12	12	12	11	11	11
85	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
90	0	0	1	1	1	1	1	0	0	0	1	1	1	1	1	0	0
95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
105	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
110	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
115	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
120	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
125	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
130	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
135	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
140	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
145	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
150	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
155	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
160	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
165	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
170	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
175	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
180	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



5.0 Photometric Measurements

5.2 Color Angular Uniformity

Model No.	ULD43W-0190	Sample ID.	1298516-S001
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Test Method

1. The sample was tested according to the IES LM-79-2008.
2. Photometric parameters were measured using a type C goniophotometer and software.
3. The ambient temperature shall be maintained at $25^{\circ}\text{C} \pm 1^{\circ}\text{C}$, 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 $\Delta u'v'$
25.1	120.05	60	0.049	5.56	0.0014



6.0 Electrical Test

6.1 Source Start Time & Run-Up time

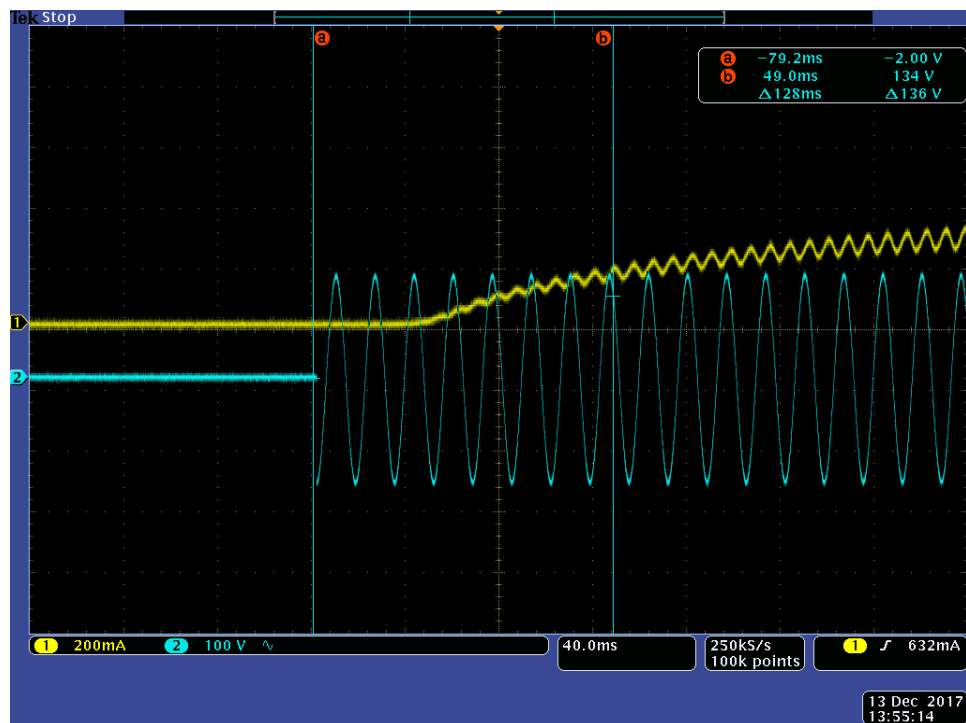
Model No.	ULD43W-0190	Sample ID.	1298516-S001
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Test Method

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 $25 \pm 5^\circ\text{C}$ 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)
25.2	120	60	128	N/A





6.0 Electrical Test

6.2 Operating Frequency Test

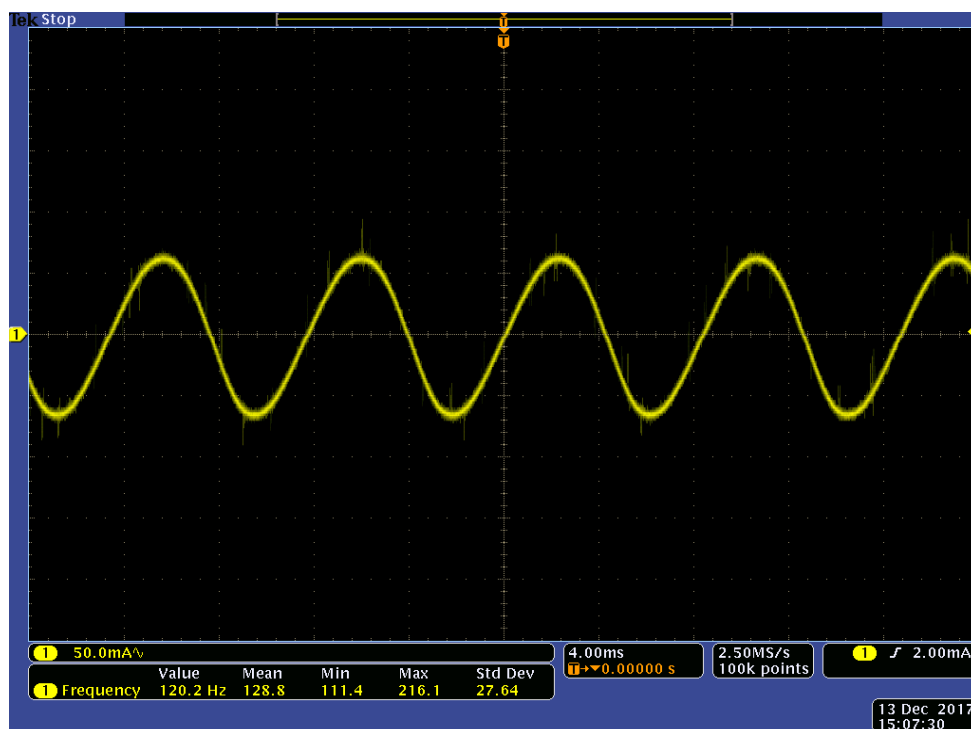
Model No.	ULD43W-0190	Sample ID.	1298516-S001
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Test Method

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)
25.1	120	60	120.2





6.0 Electrical Test

6.3 Transient Protection Test

Model No.	ULD43W-0190	Sample ID.	1298516-S001
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Test Method

The transient protection tests at ambient temperature were performed on one sample. Each sample was operated at rated input voltage in the specific orientation during the tests. A 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 luminaire contacts. Each wave consisted of a 0.5 microsecond rise time. Seven strikes were performed on each 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	120	60	Survival



6.0 Electrical Test

6.4 Standby Power Consumption

Model No.	ULD43W-0190	Sample ID.	1298516-S001
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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 electrical parameter would be measured using proper method** and the value of U_e *** 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	Standby mode	120	60	0.381	0.8740	0.04

* The working mode is controlled stably by the light sensor. When environment gets dim, it works in active mode. If not, it works in standby mode. The sample was tested under different illuminance to change mode.

** The sample was tested with direct meter reading method according to IEC 62301-2011 Section 5.3.4.

*** The uncertainty of the test equipment (Power Analyzer) U_e is equal to 0.2% ($K=2$, at the 95% confidence level).

As U_e is no greater than the permitted value U_{ma} specified in IEC 62301-2011 Section 4.4.1, the measurement is acceptable.



6.0 Electrical Test

6.5 Dimming Test

Model No.	ULD43W-0190	Sample ID.	1298516-S001
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Dimmer Information

Manufacture	Lutron	Model Number	DVCL-153P
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 microphone 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	425		400	35
Ambient Sound (dBA)	Peak Noise at BLO (dBA)	Peak Noise at MaxLO (dBA)	Peak Noise at MinLO (dBA)	Position (degree)	Maximum Light Output Ratio (%)	Minimum Light Output Ratio (%)
17.7	17.8	17.9	17.9	N/A	94.12%	8.24%



7.0 In-Situ Temperature Measurement Test

Model No.	ULD43W-0190	Sample ID.	1298516-S001
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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 $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$. The apparatus construction followed those described in UL1598-2008 for normal temperature testing. Thermocouples 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
22.4	120.08	60	0.049	5.45	0.932	Face Down

Test Results

Thermocouple Location	Customer claim Current (mA)	Temperature for Lighting source ($^{\circ}\text{C}$)		LED Model Number	LM-80 Limit Current (mA)	LM-80 Limit Temp. ($^{\circ}\text{C}$)
		Test result column 1	Test result (Correct to 25°C)			
TMP of LEDs	60	35.7	38.3	2T03X2WWxx00 0xxx	60	85
Ambient temperature	N/A	22.4	25.0			

Thermocouple Location	Temperature for LED driver ($^{\circ}\text{C}$)		LED driver Model Number	LED Driver Tc Temp. ($^{\circ}\text{C}$)
	Test result column 1	Test result (Correct to 25°C)		
TMP of LED drivers	39.4	42.0	ULD4-5	90
Ambient temperature	22.4	25.0		

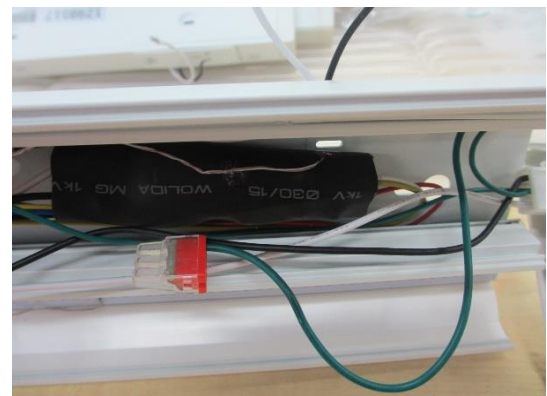


7.0 In-Situ Temperature Measurement Test (Cont'd)

Test Photos for LEDs



Test Photos for LED Drivers





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