



DesignLights Consortium Test Report

Reference Standards

UL1598-2008

ANSI C82.77-10-2014

IES LM-79-2008

Prepared For

P.Q.L., Inc.

2285 Ward Avenue

Simi Valley, CA 93065

Test Laboratory:

UL-CCIC Company Limited

Test Laboratory Address:

No.2, Chengwan Road, Suzhou Industrial Park, Suzhou 21522, China

Catalog Number

55091

Project Number

4790110305

Report Number

4790110305_7

Test Date

2022-01-05~2022-01-07

Issue Date

2022-01-20

Revision Date

N/A

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Approved By

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Wu, Elvis

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

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Test Summary

DLC Technical Requirements V5.1- issued 2020-02-14

Requirement Category	Test Method	Requirements	Tolerance	Test Result
Minimum Light Output (lm)-Luminaires	IES LM-79-2008	≥2000	-10%	3707.6
Minimum Luminaire Efficacy (lm/W)-Luminaires	IES LM-79-2008	≥125	-3%	126.32
Spacing Criteria (0-180°)	IES LM-79-2008	1.0-2.0	±0.1	1.20
Spacing Criteria (90-270°)	IES LM-79-2008	1.0-2.0	±0.1	1.24
Zonal Lumen Requirement 1(0°-60°)	IES LM-79-2008	≥75%	-3%	80.90%
Allowable CCT (3500K)	IES LM-79-2008/ANSI C78.377-2015	3465±245	N/A	3473
Allowable CCT (5000K)	IES LM-79-2008/ANSI C78.377-2015	5029±283	N/A	4994
Minimum CRI	IES LM-79-2008/CIE 13.3-1995	≥80	-1	81
Minimum R9	IES LM-79-2008	≥0	-1	5.0
Minimum Rg	IES LM-79-2008	≥89	-1	95
Minimum Rf	IES LM-79-2008	≥70	-1	82
Rcs,h1	IES LM-79-2008	-12%-23%	-1%	-12%
Unified Glare Rating (UGR)	IES LM-79-2008	≤22	N/A	21.7
L70 Lumen maintenance (Hours)	N/A	≥50000	N/A	≥50000
L90 Lumen maintenance (Hours)	N/A	≥36000	N/A	≥36000
Power Factor	ANSI C82.77-10-2014	≥0.9	-0.03	0.9652
Total Harmonic Distortion (A%)	ANSI C82.77-10-2014	≤20%	5%	10.93%
In-Situ Temperature Measurement Test for LED 1 (°C)	UL1598-2008	≤105	N/A	60.7
In-Situ Temperature Measurement Test for Driver 1 (°C)	UL1598-2008	≤90	N/A	51.5
Max Chromaticity Shift (1000-6000h)	N/A	≤0.004	0.0004	0.0024
Minimum Luminaire Warranty (Years)	N/A	≥5	N/A	≥5



Test List

Sample Received Date: 2021-12-29

Test Item	Test Date	Model Number	Tests Conducted By
Integrating Sphere Test	2022-01-06	55088	Yang, Gavin X
Integrating Sphere Test	2022-01-06	55089	Yang, Gavin X
Goniophotometer Test	2022-01-05	55088	Yang, Gavin X
THD and PF Test	2022-01-05	55088	Yang, Gavin X
THD and PF Test	2022-01-05	55089	Yang, Gavin X
In-Situ Temperature Measurement Test	2022-01-07	55088	Yang, Gavin X

Remark (if any)

1. UL test equipment information is recorded on Meter Use in UL's Aurora database.
2. The accuracy method decision rule is applied when the compliance or verdict is made to the results of this report.



Product Description

Lamp/Luminaire Description: 2x2 Luminaires for Ambient Lighting of Interior Commercial Spaces

Model Number: 55088

Electrical Parameter: 120-277V, 50/60Hz

LED Package: STW8A2PD-XX

Family Model and Variation: 55091, 55089

Dimming Information: Continuous dimming capability

Products Scaled Value

Model Number	CCT	Luminous Flux	Power	Luminous Efficacy
55088	3500k	3750	30	125
55091	4000k	3780	30	126
55089	5000k	3810	30	127

Photos of Products Characteristics





Integrating Sphere Test

Model No.	55089	Sample ID.	4535686
Operate time (Min.)	90	Stabilization time (Min.)	45

Test Method

1. The sample was tested according to the IES LM-79-2008, and the product is assumed to be brand new without seasoning.

2. Photometric parameters were measured using an integrating sphere, a spectroradiometer and software. The ambient temperature condition inside the sphere was maintained at $25\text{ }^{\circ}\text{C} \pm 1\text{ }^{\circ}\text{C}$. The reference standard lamp is rated current 2.679A omni-directional Incandescent lamp and was calibrated by National Institute of Metrology P.R.China.

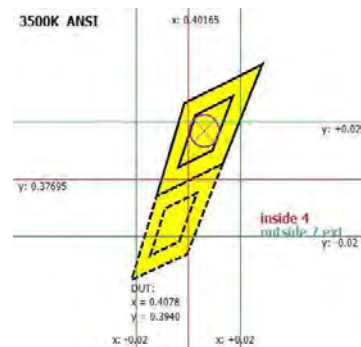
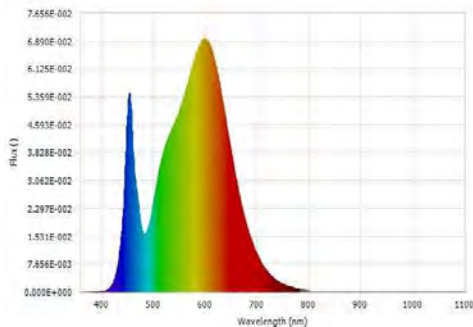
3. The sample measurements were made using a spectroradiometer connected by a fiber optic cable and detector through the detector port of the integrating sphere. Coating reflectance of the integrating sphere was 90% to 98%. Photometric measurement conditions were using 4π geometry. The self-absorption factor is applied in the final test result. The sample was operated at rated voltage and was stabilized before measurement. 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 Test Conditions

Temperature ($^{\circ}\text{C}$)	Voltage (Vac)	Frequency (Hz)	Current (A)	Power (W)	Power Factor	Orientation
24.9	120.1	60	0.2474	29.399	0.9894	Horizontal

Test Results

CCT (K)	CRI (Ra)	R9	Duv	Flux (lm)	Luminous Efficacy (lm/W)	Efficacy(lm/ft)
3473	82	5.0	0.0009	3733.72	127.00	N/A



Luminous Flux (lm)	3733.72	Chrom x	0.4078
Chrom y	0.3940	Chrom u	0.2360
Chrom v	0.3420	Duv	0.0009
Chrom u'	0.2360	Chrom v'	0.5130
CCT (K)	3473	Luminous Efficacy (lm/W)	127.00
Ra	82	R1	80.0
R2	89.0	R3	96.0
R4	80.0	R5	80.0
R6	85.0	R7	85.0
R8	61.0	R9	5.0
R10	74.0	R11	78.0
R12	62.0	R13	82.0
R14	98.0	R15	73.0
Rf	84	Rg	95
Rcs,h1	-12%		



Integrating Sphere Test (Cont'd)

TM-30 Report

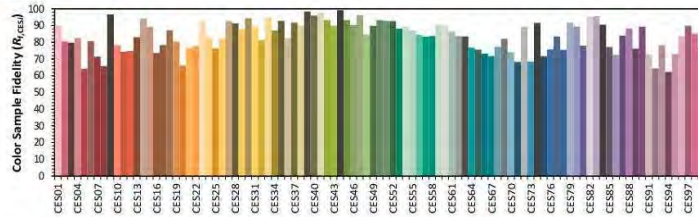
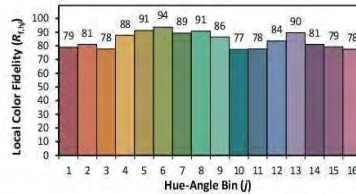
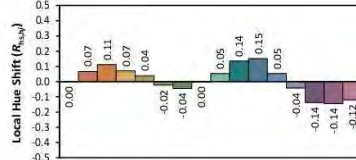
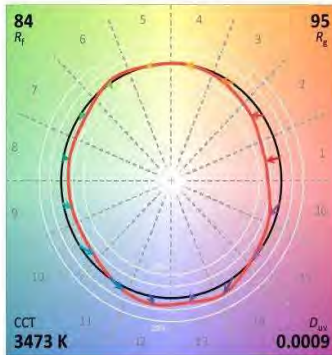
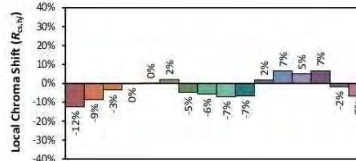
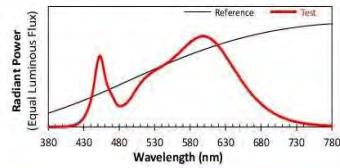
ANSI/IES TM-30-18 Color Rendition Report

Source: STW8A2PD-XX

Manufacturer: P.Q.L., Inc.

Date: 1/6/2022

Model: 55088



Notes: This is a recommended method for displaying ANSI/IES TM-30-18 information.

x 0.4078
 y 0.3940
 u' 0.2360
 v' 0.5130

CIE 13.3-1995
 (CRI)
 R_a 82
 R_g 5

Colors are for visual orientation purposes only. Created with the ANSI/IES TM-30-18 Calculator Version 2.00.



Integrating Sphere Test

Model No.	55089	Sample ID.	4535687
Operate time (Min.)	90	Stabilization time (Min.)	45

Test Method

1. The sample was tested according to the IES LM-79-2008, and the product is assumed to be brand new without seasoning.

2. Photometric parameters were measured using an integrating sphere, a spectroradiometer and software. The ambient temperature condition inside the sphere was maintained at $25\text{ }^{\circ}\text{C} \pm 1\text{ }^{\circ}\text{C}$. The reference standard lamp is rated current 2.679A omni-directional Incandescent lamp and was calibrated by National Institute of Metrology P.R.China.

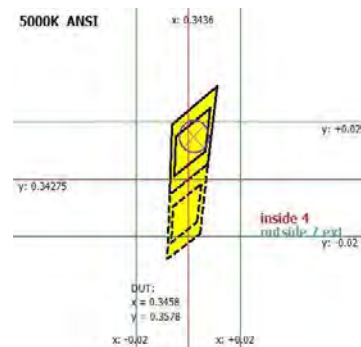
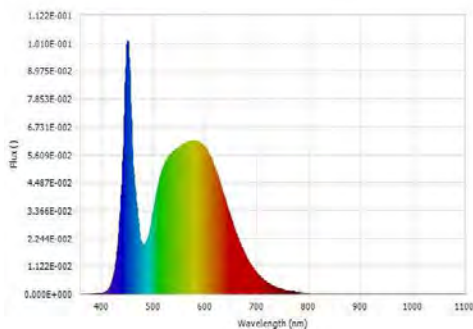
3. The sample measurements were made using a spectroradiometer connected by a fiber optic cable and detector through the detector port of the integrating sphere. Coating reflectance of the integrating sphere was 90% to 98%. Photometric measurement conditions were using 4π geometry. The self-absorption factor is applied in the final test result. The sample was operated at rated voltage and was stabilized before measurement. 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 Test Conditions

Temperature ($^{\circ}\text{C}$)	Voltage (Vac)	Frequency (Hz)	Current (A)	Power (W)	Power Factor	Orientation
24.9	120.09	60	0.2433	28.90	0.9894	Horizontal

Test Results

CCT (K)	CRI (Ra)	R9	Duv	Flux (lm)	Luminous Efficacy (lm/W)	Efficacy(lm/ft)
4994	81	7.0	0.0028	3803.87	131.61	N/A



Luminous Flux (lm)	3803.87	Chrom x	0.3458
Chrom y	0.3578	Chrom u	0.2095
Chrom v	0.3252	Duv	0.0028
Chrom u'	0.2095	Chrom v'	0.4878
CCT (K)	4994	Luminous Efficacy (lm/W)	131.61
Ra	81	R1	79.0
R2	85.0	R3	89.0
R4	82.0	R5	79.0
R6	79.0	R7	88.0
R8	68.0	R9	7.0
R10	64.0	R11	80.0
R12	54.0	R13	80.0
R14	94.0	R15	74.0
Rf	82	Rg	97
Rcs,h1	-12%		



Integrating Sphere Test (Cont'd)

TM-30 Report

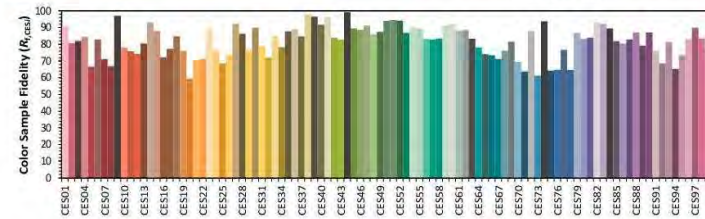
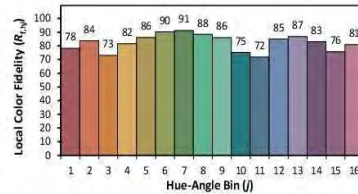
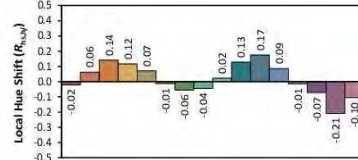
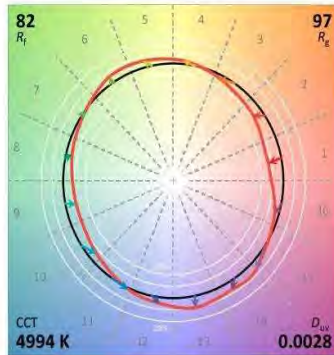
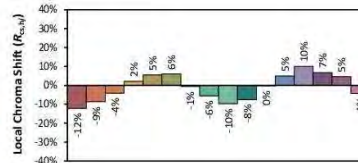
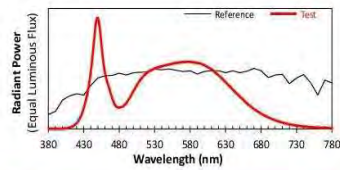
ANSI/IES TM-30-18 Color Rendition Report

Source: STW8A2PD-XX

Manufacturer: P.Q.L., Inc.

Date: 1/6/2022

Model: 55089



Notes: This is a recommended method for displaying ANSI/IES TM-30-18 information.

x 0.3458
 y 0.3578
 u' 0.2095
 v' 0.4878

CIE 13.3-1995
 (CRI)
 R_a 81
 R_9 7

Colors are for visual orientation purposes only. Created with the ANSI/IES TM-30-18 Calculator Version 2.00.



Goniophotometer Test

Model No.	55088	Sample ID.	4535686
Operate time (Min.)	90	Stabilization time (Min.)	45

Test Method

- 1.The sample was tested according to the IES LM-79-2008, and the product is assume to be brand new without seasoning.
- 2.Photometric parameters 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. The reference standard lamp is rated current 3.8581A, 3.8558A, 3.8466A omni-directional Incandescent lamp and was calibrated by National Institute of Metrology P.R.China.
- 4.The samples were operated at rated voltage and was stabilized before measurement. Luminous flux, luminaire efficacy, zonallumen were calculated from the software taken at 1° vertical intervals and 22.5° horizontal intervals. Photometric distance was more than five times of the largest dimension of the test SSL product.

Goniophotometer Test Conditions

Temperature (°C)	Voltage (Vac)	Frequency (Hz)	Current (A)	Power (W)	Power Factor	Current THD	Orientation
24.7	120.00	60	0.2468	29.35	0.9909	10.93%	Horizontal

Test Results

Luminous Flux (lm)	Zonal Lumen Requirement 1	Zonal Lumen Requirement 2	Beam Angle (50%)		Luminous Efficacy (lm/W)
	0°-60°	N/A	Horizontal Spread	Vertical Spread	
3707.6	80.90%	N/A	105.8	94.5	126.32

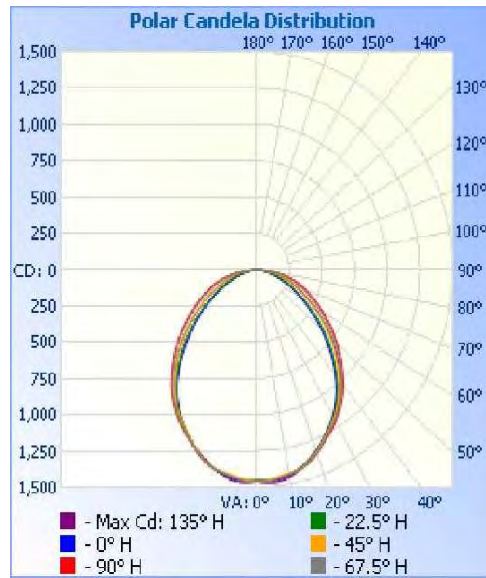
Backlight	Uplight	Glare
N/A	N/A	N/A

UGR		Spacing Criteria (0-180°)	Spacing Criteria (90°-270°)
Crosswise	Endwise		
18.1	21.7	1.20	1.24

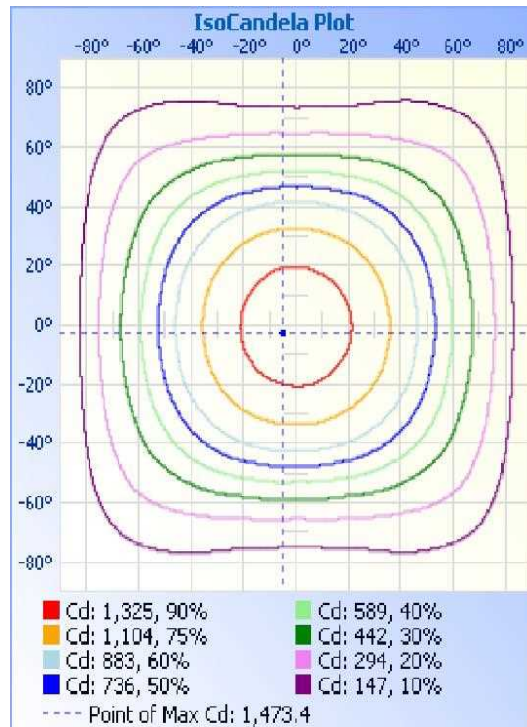


Goniophotometer Test (Cont'd)

Polar Candela Distribution



IsoCandela Plot





Goniophotometer Test (Cont'd)
Zonal Lumen Summary

Zonal Lumen Summary		
Zone	Lumens	% Luminaire
0-30	1112.0	30.00%
0-40	1792.9	48.40%
0-60	3002.6	81.00%
60-90	694.1	18.70%
70-100	309.4	8.30%
90-120	3.5	0.10%
0-90	3696.6	99.70%
90-180	11.0	0.30%
0-180	3707.6	100.00%

Lumens Per Zone

Lumens Per Zone					
Zone	Lumens	%Total	Zone	Lumens	%Total
0-5	34.9	0.90%	90-95	0.8	0.00%
5-10	103.5	2.80%	95-100	0.7	0.00%
10-15	168.0	4.50%	100-105	0.6	0.00%
15-20	225.1	6.10%	105-110	0.5	0.00%
20-25	271.6	7.30%	110-115	0.5	0.00%
25-30	308.8	8.30%	115-120	0.5	0.00%
30-35	335.0	9.00%	120-125	0.5	0.00%
35-40	345.9	9.30%	125-130	0.6	0.00%
40-45	340.6	9.20%	130-135	0.7	0.00%
45-50	322.4	8.70%	135-140	0.8	0.00%
50-55	292.5	7.90%	140-145	0.8	0.00%
55-60	254.2	6.90%	145-150	0.8	0.00%
60-65	213.3	5.80%	150-155	0.8	0.00%
65-70	172.8	4.70%	155-160	0.7	0.00%
70-75	135.5	3.70%	160-165	0.7	0.00%
75-80	98.1	2.60%	165-170	0.6	0.00%
80-85	57.4	1.50%	170-175	0.4	0.00%
85-90	17.0	0.50%	175-180	0.1	0.00%



Goniophotometer Test (Cont'd)
Intensity Data(cd)

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	1454	1454	1454	1454	1454	1454	1454	1454	1454	1454	1454	1454	1454	1454	1454	1454	1454
1	1452	1455	1455	1466	1463	1462	1458	1453	1455	1455	1454	1463	1462	1461	1457	1453	1452
2	1455	1457	1456	1466	1465	1467	1464	1458	1457	1456	1454	1464	1465	1465	1463	1456	1455
3	1455	1456	1455	1464	1466	1470	1468	1462	1458	1454	1451	1463	1464	1468	1467	1461	1455
4	1457	1454	1450	1461	1465	1472	1471	1464	1458	1453	1449	1458	1462	1469	1470	1463	1457
5	1456	1450	1444	1456	1462	1472	1473	1465	1456	1450	1443	1454	1458	1467	1470	1462	1456
6	1454	1446	1440	1451	1458	1471	1472	1464	1455	1445	1438	1449	1455	1466	1468	1461	1454
7	1450	1441	1434	1445	1454	1468	1469	1461	1451	1442	1433	1443	1451	1462	1465	1458	1450
8	1445	1438	1430	1440	1449	1463	1463	1455	1447	1438	1427	1438	1446	1457	1459	1451	1445
9	1440	1433	1426	1436	1444	1457	1457	1450	1442	1434	1423	1433	1439	1450	1452	1445	1440
10	1434	1429	1422	1432	1439	1448	1450	1442	1436	1430	1420	1427	1433	1442	1443	1438	1434
11	1428	1425	1419	1428	1432	1440	1441	1435	1430	1425	1416	1423	1426	1433	1433	1430	1428
12	1420	1421	1416	1423	1424	1432	1432	1425	1422	1420	1413	1418	1418	1424	1424	1420	1420
13	1412	1414	1412	1418	1418	1423	1420	1415	1414	1415	1409	1413	1412	1414	1413	1409	1412
14	1402	1407	1407	1413	1411	1412	1410	1405	1405	1408	1403	1407	1405	1405	1402	1398	1402
15	1391	1398	1399	1406	1403	1402	1398	1394	1393	1398	1395	1401	1396	1393	1390	1386	1391
16	1379	1388	1390	1398	1395	1392	1386	1380	1382	1387	1386	1392	1387	1382	1378	1373	1379
17	1366	1374	1378	1388	1385	1380	1374	1368	1369	1373	1374	1382	1377	1371	1365	1361	1366
18	1353	1361	1365	1375	1375	1369	1362	1355	1356	1361	1360	1369	1366	1359	1352	1348	1353
19	1339	1346	1349	1360	1362	1358	1350	1342	1342	1347	1344	1353	1353	1347	1340	1335	1339
20	1324	1332	1334	1346	1348	1344	1337	1329	1327	1331	1329	1338	1338	1334	1328	1321	1324
25	1247	1252	1255	1268	1274	1274	1267	1257	1252	1251	1250	1262	1266	1261	1256	1247	1247
30	1162	1170	1180	1198	1207	1203	1193	1177	1166	1169	1174	1191	1198	1192	1180	1166	1162
35	1058	1073	1093	1116	1125	1115	1100	1078	1066	1072	1088	1110	1116	1103	1086	1064	1058
40	933	952	981	1013	1027	1018	993	958	940	952	979	1008	1019	1005	979	946	933
45	794	818	860	900	917	906	877	830	798	819	860	898	910	895	864	816	794
50	653	684	739	789	807	792	754	695	657	686	741	787	801	781	740	681	653
55	515	546	614	672	694	676	626	556	523	550	616	671	688	665	613	546	515
60	392	423	494	559	585	564	505	432	398	427	496	558	578	554	494	423	392
65	291	317	384	456	485	461	395	324	292	321	387	454	480	452	386	318	291
70	205	228	293	365	396	370	301	234	209	231	295	365	392	363	294	229	205
75	134	156	219	284	310	288	225	162	137	160	221	283	306	280	221	157	134
80	73	96	149	193	211	196	154	100	74	98	151	190	205	188	149	97	73
85	27	43	69	90	96	92	74	47	30	45	70	86	90	85	68	44	27
90	1	2	3	2	2	3	4	3	2	2	2	2	2	2	2	2	1
95	1	1	1	2	1	2	1	1	1	1	1	2	2	2	1	1	1
100	1	1	1	2	1	1	1	1	1	1	1	2	1	1	1	1	1
105	1	1	1	2	1	1	1	1	1	1	1	2	1	1	1	1	1
110	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1
115	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
120	1	1	1	2	1	1	1	1	1	1	2	1	1	1	1	1	1
125	1	1	1	2	1	1	1	1	1	1	2	2	2	2	1	1	1
130	1	2	1	2	1	1	2	2	2	1	2	1	2	2	1	2	1
135	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
140	2	2	2	2	2	3	3	2	2	2	2	2	3	2	2	2	2
145	2	3	2	3	2	3	2	3	3	2	2	3	2	2	2	2	2
150	2	3	3	3	2	3	3	3	2	3	3	3	3	3	3	3	2
155	3	3	3	3	3	3	4	3	3	3	3	3	4	3	4	3	3
160	3	4	4	3	3	4	4	4	4	4	4	4	4	4	4	4	3
165	4	5	5	4	4	4	4	5	4	4	5	5	5	4	4	4	4
170	5	5	6	5	5	5	5	5	5	5	5	6	6	6	5	5	5
175	5	5	6	5	5	5	5	6	6	5	6	5	6	5	6	5	5
180	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5



THD and PF Test

Model No.	55088	Sample ID.	4535686
Operate time (Min.)	90	Stabilization time (Min.)	45

Test Method

1. The samples were tested according to the ANSI C82.77-10-2014.
2. The ambient temperature condition was maintained at $25\text{ }^{\circ}\text{C} \pm 1\text{ }^{\circ}\text{C}$. The sample measurement was made using a digital power meter and power supply. The sample was operated at rated voltage and stabilized before measurement. The total harmonic distortion were calculated from the digital power meter.

Test Results

Temperature ($^{\circ}\text{C}$)	Voltage (Vac)	Frequency (Hz)	Current (A)	Power (W)	Power Factor	Current THD	Orientation
24.7	120.00	60	0.2468	29.35	0.9909	10.93%	Horizontal
24.7	277.13	60	0.1092	29.24	0.9663	8.30%	Horizontal



THD and PF Test

Model No.	55089	Sample ID.	4535686
Operate time (Min.)	90	Stabilization time (Min.)	45

Test Method

1. The samples were tested according to the ANSI C82.77-10-2014.
2. The ambient temperature condition was maintained at 25 °C ± 1 °C. The sample measurement was made using a digital power meter and power supply. The sample was operated at rated voltage and stabilized before measurement. The total harmonic distortion were calculated from the digital power meter.

Test Results

Temperature (°C)	Voltage (Vac)	Frequency (Hz)	Current (A)	Power (W)	Power Factor	Current THD	Orientation
24.7	120.02	60	0.2424	28.83	0.9909	10.85%	Horizontal
24.7	277.11	60	0.1076	28.77	0.9652	8.36%	Horizontal



In-Situ Temperature Measurement Test

Model No.	55088	Sample ID.	4535686
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Test Method

1. In-Situ Temperature Measurement Test is conducted according to the UL 1598-2008, Section 14.
 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. Thermocouples were placed on the LED package in the locations indicated by LM-80 report. Thermocouples were placed on the LED driver case in the locations specified by the manufacture if necessary. The temperature was recorded after the lamp was operated by 7.5 hours.
 3. The data and photos in LM-80 test report is provided by the customer/ The data and photos in driver specification is provided by the customer.

In-Situ Temperature Measurement Test Conditions

Temperature (°C)	Voltage (Vac)	Frequency (Hz)	Current (A)	Power (W)	Power Factor	Current THD	Orientation
24.3	120.00	60	0.2468	29.35	0.9909	10.93%	Horizontal

Test Results (LEDs)

Thermocouple Location	Declared Light Source Current (mA)	Temperature for Light Source (°C)		Max Chromaticity Shift (1000-6000h)	LED Model Number	LM-80 Limit Current (mA)	LM-80 Limit Temp (°C)
		Test Result	Test Result (Correct to 25 °C)				
Ambient TEMP	N/A	24.3	25.0				
TMP of Location 1	110	60.0	60.7	0.0024	STW8A2PD-XX	200	105

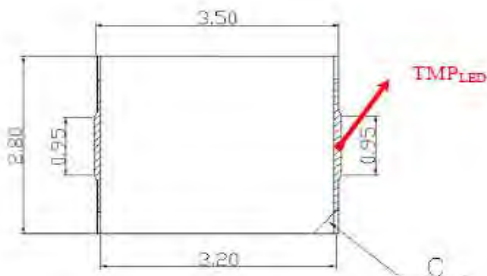
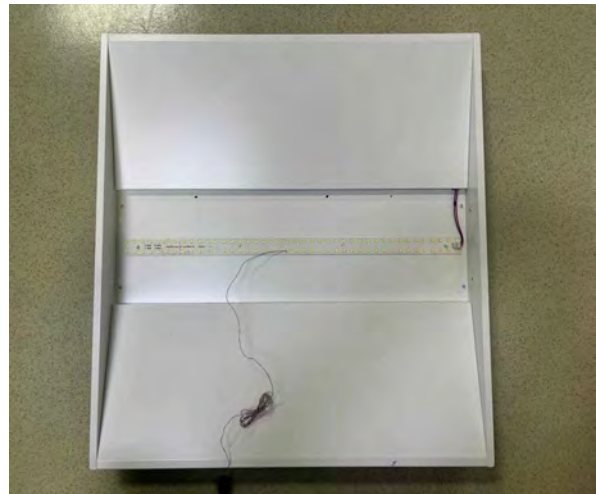
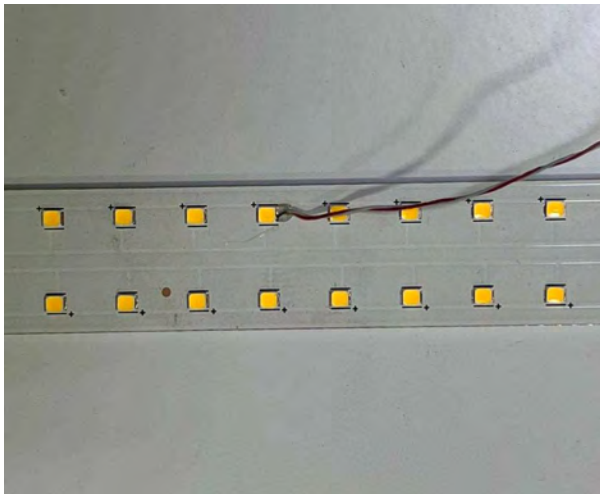
Test Results (Drivers)

Thermocouple Location	Temperature for Driver (°C)		Driver Model Number	Driver Limit Temp (°C)
	Test Result	Test Result (Correct to 25 °C)		
Ambient TEMP	24.3	25.0		
TMP of Location 1	50.8	51.5	SIF 30-I0650 120-277 W D1	85



In-Situ Temperature Measurement Test (Cont'd)

Test Photos for Ts Point of Light Sources & Tc Point of Drivers





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