TESTING
NVLAP LAB CODE 500055-0

Product Test Report - Goniometer Luminaire Evaluation

Method: LM-79:2019
Evaluation: Horticulture Summary

Evaluation: DLC - LED based Horticultural Lighting V 1.2
Evaluation: TM-21 Calculation
Test: In Situ Temp Measurement Test (ISTMT) UL 1598 - 19.2

Test results reported for:
Revolution Microelectronics
Product Description: AVICI Revolution2

Issued Report:
REVS007-010_AVICI Revolution2
Project: 80058294 - TPPPT

Original issue date:
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First Issue

Prepared for:
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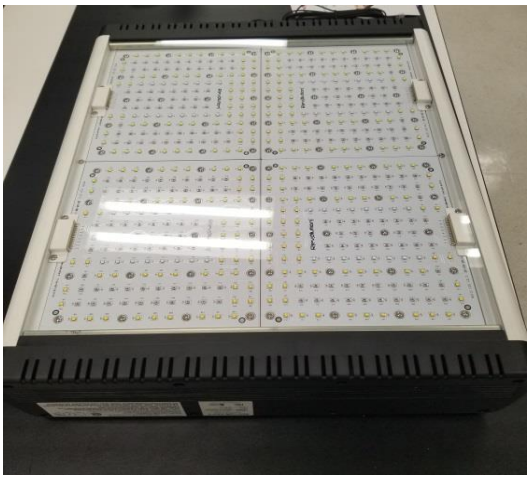
SAMPLE DESCRIPTION

Lab sample identification:	-1
Customer Identification:	SN A2000016 MFG 8 Aug 2020
Manufacturer:	Revolution Microelectronics
Part number:	NA
Model Number:	NA
Description:	AVICI LED 1150W

Manufacturer's ratings	
Max Current (A):	9.6A ~4.2A Typical
Operating voltage:	120-277 V AC
CCT:	NA
Frequency (Hz):	50-60
Type:	LED

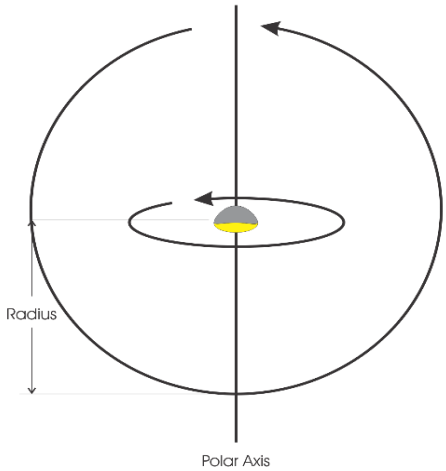
Sample Device as Received



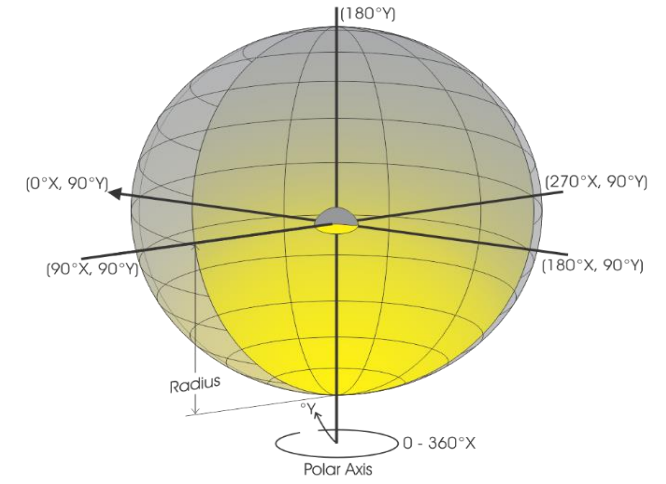
Sample Device Mounted to Test Apparatus

Image At 0° and 0°, See Equipment Geometry

Equipment Geometry - For Sample Device Mounted



Test Geometry - Type C Coordinates



Coordinate System Description

Reference: LM-75-01 Goniophotometer Types and Photometric Coordinates

Type C coordinate system, the polar axis is vertical. The angles measure in the vertical half planes of data are called vertical angles, and the angles to the horizontal half planes are called lateral angles. The vertical V angles range in value from 0° to 180°. The lateral L planes range in value from 0° to 360°.

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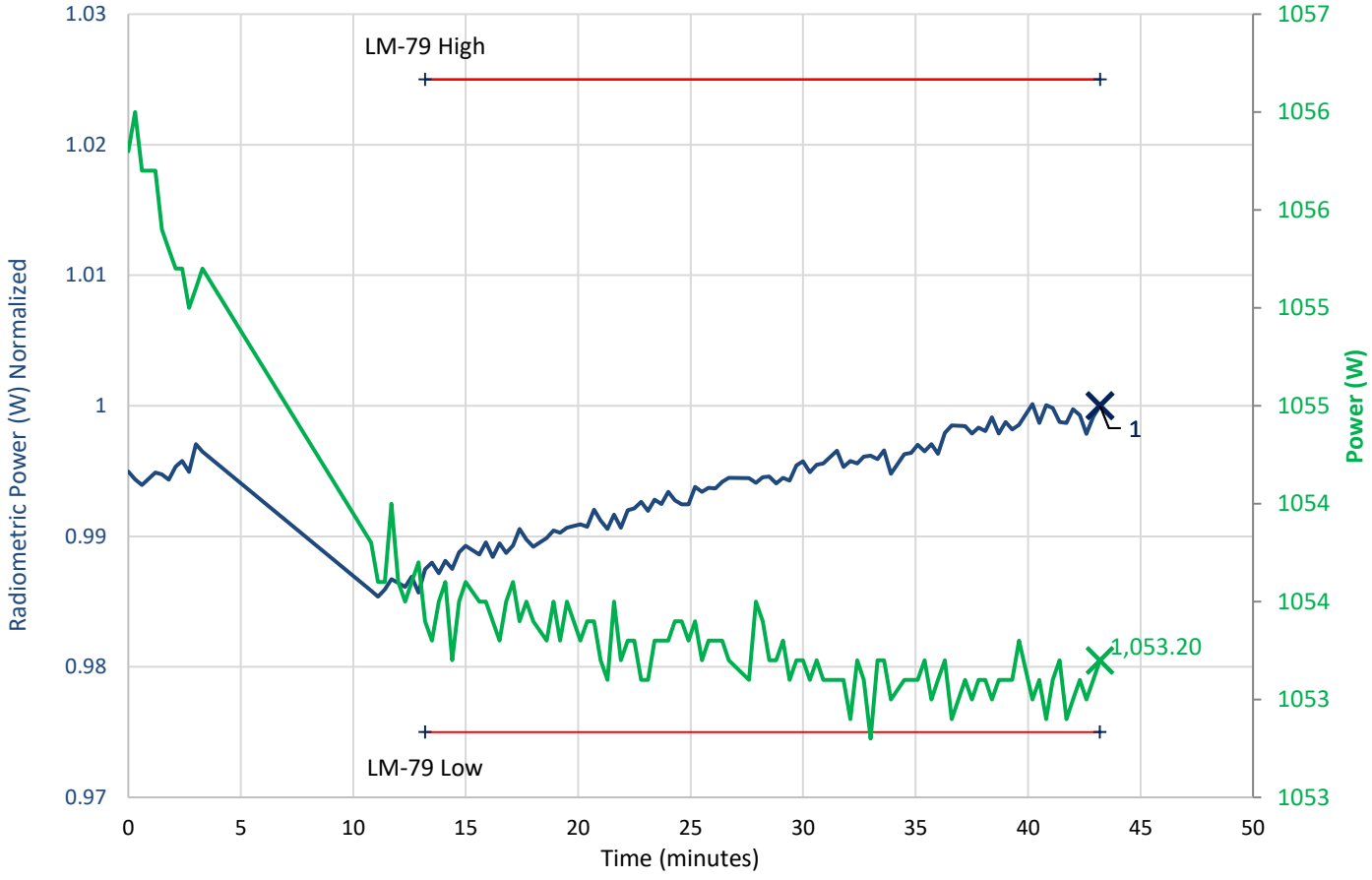
OPTICAL STABILIZATION

Stabilization Description - A series of 111 measurements are recorded during the stabilization period. The final stabilized measurement of normalized radiant power, as defined by LM-79:2019, is reported after 43 minutes of recorded device runtime. The 'Measurements in Range', provided below, are a histogram of measurements recorded during the 30 minute stabilization window.

% of range	Power (W) Normalized	Measurements in Range
98.718%	0.99	6
98.848%	0.99	9
98.977%	0.99	9
99.107%	0.99	6
99.236%	0.99	8
99.366%	0.99	21
99.495%	0.99	12
99.625%	1.00	10
99.754%	1.00	14
99.884%	1.00	8
100.000%	1.00	Reported

% of range	Power (W)	Measurements in Range
99.962%	1052.80	1
99.970%	1052.88	4
99.977%	1052.96	7
99.985%	1053.04	24
99.992%	1053.12	17
100.000%	1053.20	17
100.008%	1053.28	16
100.015%	1053.36	10
100.023%	1053.44	11
100.030%	1053.52	7
100.000%	1053.20	Reported



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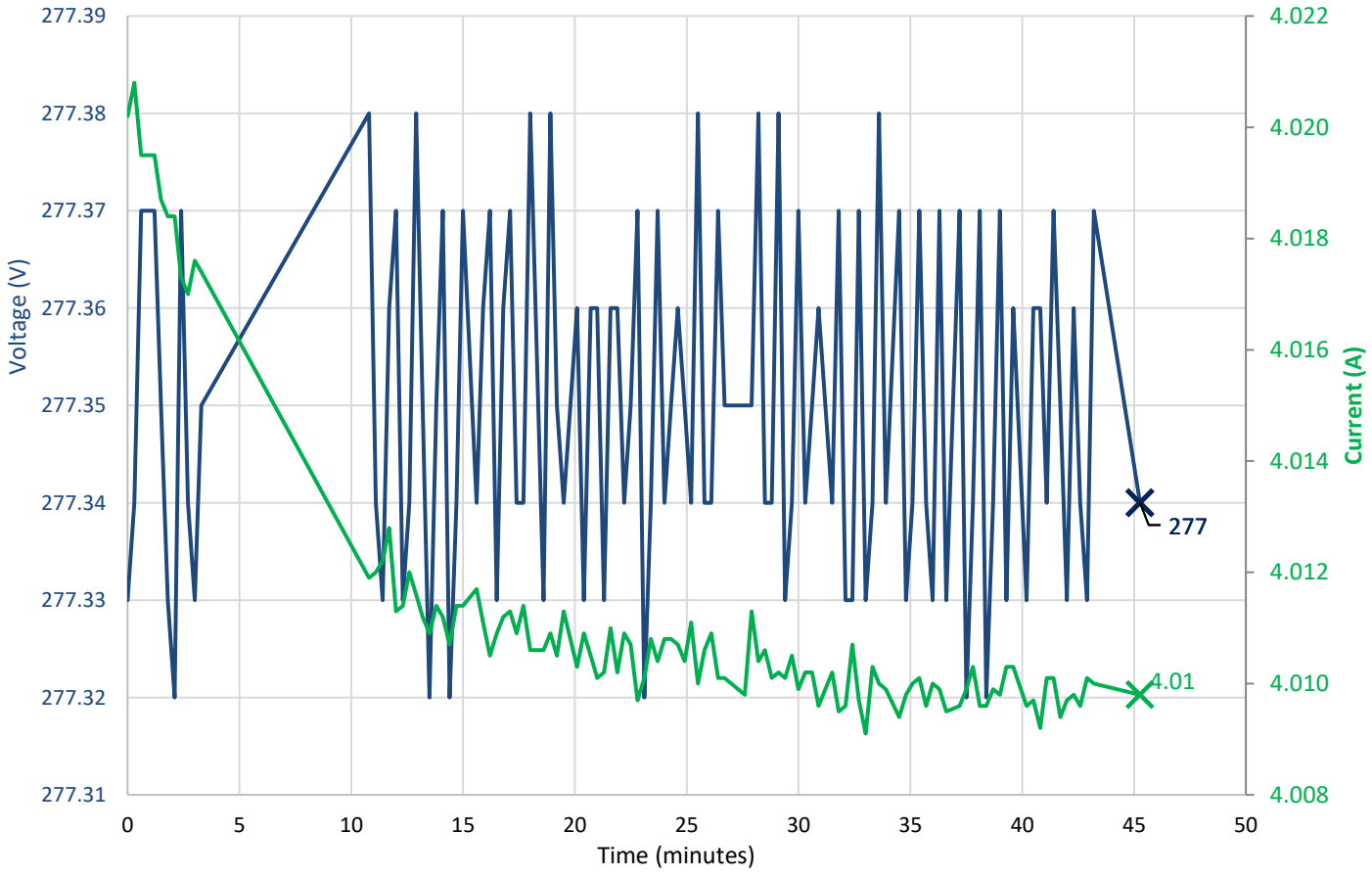
ELECTRICAL STABILIZATION

Stabilization Description - A series of 112 measurements are recorded during the stabilization period. The final stabilized measurement, as defined by LM-79:2019, is reported after 45 minutes of recorded device runtime. The 'Measurements in Range', provided below, are a histogram of measurements recorded during the 30 minute stabilization window.

% of range	Voltage (V)	Measurements in Range
99.993%	277.32	6
99.995%	277.33	20
99.997%	277.33	0
99.999%	277.34	29
100.001%	277.34	13
100.004%	277.35	13
100.006%	277.36	14
100.008%	277.36	0
100.010%	277.37	22
100.012%	277.37	8
100.000%	277.34	Reported

% of range	Current (A)	Measurements in Range
99.983%	4.009	2
99.989%	4.009	12
99.996%	4.010	9
100.002%	4.010	20
100.008%	4.010	14
100.015%	4.010	11
100.021%	4.011	12
100.028%	4.011	3
100.034%	4.011	6
100.041%	4.011	1
100.000%	4.010	Reported



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HORTICULTURE SUMMARY

	Photon Flux (µmol/s)			
WL (nm)	50 nm BIN	100 nm bin	300 nm bin	Total Bin
350-400	6.37 0.3%	-	-	2297.07 100%
400-450	316.97 13.8%	450.64 19.6%	2201.06 95.8%	
450-500	133.67 5.8%			
500-550	187.12 8%	501.07 21.8%		
550-600	313.95 13.7%			
600-650	451.13 19.6%	1249.35 54.4%		
650-700	798.22 34.7%			
700-750	30.36 1.3%	41.81 1.8%	58.04 2.5%	
750-800	11.45 0.5%			
800-900	-	16.07 0.7%		
900-1000	-	31.13 1.4%		

	Value	*units*	*Description*
①Photosynthetic Photon Flux:	2201	µmol/s	(400 - 700nm)
PPF Efficacy :	2.090	µmol/joule	(PPF/Active Power)
Photon Flux:	2297	µmol/s	(350 - 1000nm)
Photon Efficacy :	2.181	µmol/joule	(Photon Flux/Active Power)
Total Integrated YPF (µmol/s):	1970.0	µmol/s	(Yield Photon Flux)
②YPF Efficacy:	1.871	µmol/joule	(Total Integrated YPF/Active Power)
Photosynthetically Active Yield Efficiency :	89.51	%	(YPF/PPF)

NOTE 1: Photosynthetic Photon Flux: weighted equally by wavelength and summed between 400nm and 700nm.
NOTE 2: Yield Photon Flux: PPF weighted by action spectrum (average of 20 plant species as defined by McCree) and summed between 350nm and 750nm. (See Spectrum)

Electrical Performance

Voltage:	277.3	V	**THD Voltage:**	0.0	%
Current:	4.0	A	**THD Current:**	19.2	%
Frequency:	60.0	Hz			
Active Power:	1053.1	W			
Apparent Power:	1112.1	VA			
Power Factor:	0.95	W/VA			

Thermal Performance

Ambient Temperature: 25.0 °C

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Photon Flux (µmol/s)								
	Channel: BLUE		Channel: WHITE		Channel: RED		Channel: -	
WL (nm)	50 nm BIN	100 nm bin	50 nm BIN	100 nm bin	50 nm BIN	100 nm bin	50 nm BIN	100 nm bin
350-400	0.77 0.0%	-	1.88 0.1%	-	1.45 0.1%	-	- -	-
400-450	182.12 8.3%	243.72 11.1%	139.54 6.3%	203.68 9.3%	1.50 0.1%	3.12 0.1%	- -	-
450-500	61.60 2.8%		64.13 2.9%		1.62 0.1%		- -	-
500-550	0.80 0.0%	1.21 0.1%	183.10 8.3%	489.89 22.3%	1.28 0.1%	3.56 0.2%	- -	-
550-600	0.41 0.0%		306.79 13.9%		2.28 0.1%		- -	-
600-650	0.39 0.0%	0.75 0.0%	247.65 11.3%	335.83 15.3%	213.79 9.7%	920.43 41.8%	- -	-
650-700	0.36 0.0%		88.18 4.0%		706.65 32.1%		- -	-
700-750	0.31 0.0%	0.79 0.0%	23.22 1.1%	30.17 1.4%	4.97 0.2%	7.69 0.3%	- -	-
750-800	0.47 0.0%		6.94 0.3%		2.72 0.1%		- -	-
800-850	0.64 0.0%	1.41 0.1%	3.25 0.1%	5.80 0.3%	2.77 0.1%	5.35 0.2%	- -	-
850-900	0.78 0.0%		2.55 0.1%		2.58 0.1%		- -	-
900-950	1.20 0.1%	3.25 0.1%	3.25 0.1%	8.76 0.4%	4.59 0.2%	10.11 0.5%	- -	-
950-1000	2.04 0.1%		5.51 0.3%		5.52 0.3%		- -	-
350-1000*	251.89 11.0%		1076.00 46.8%		951.72 41.4%		- -	
400-700*	245.67 11.2%		1029.40 46.8%		927.12 42.1%		- -	

* Values represent approximate Bin sum. Each measured channel is summed over wavelength bins, and ratio matched against total Photon Flux. Measurements occur at different times, and may not equal the full on performance reported values.

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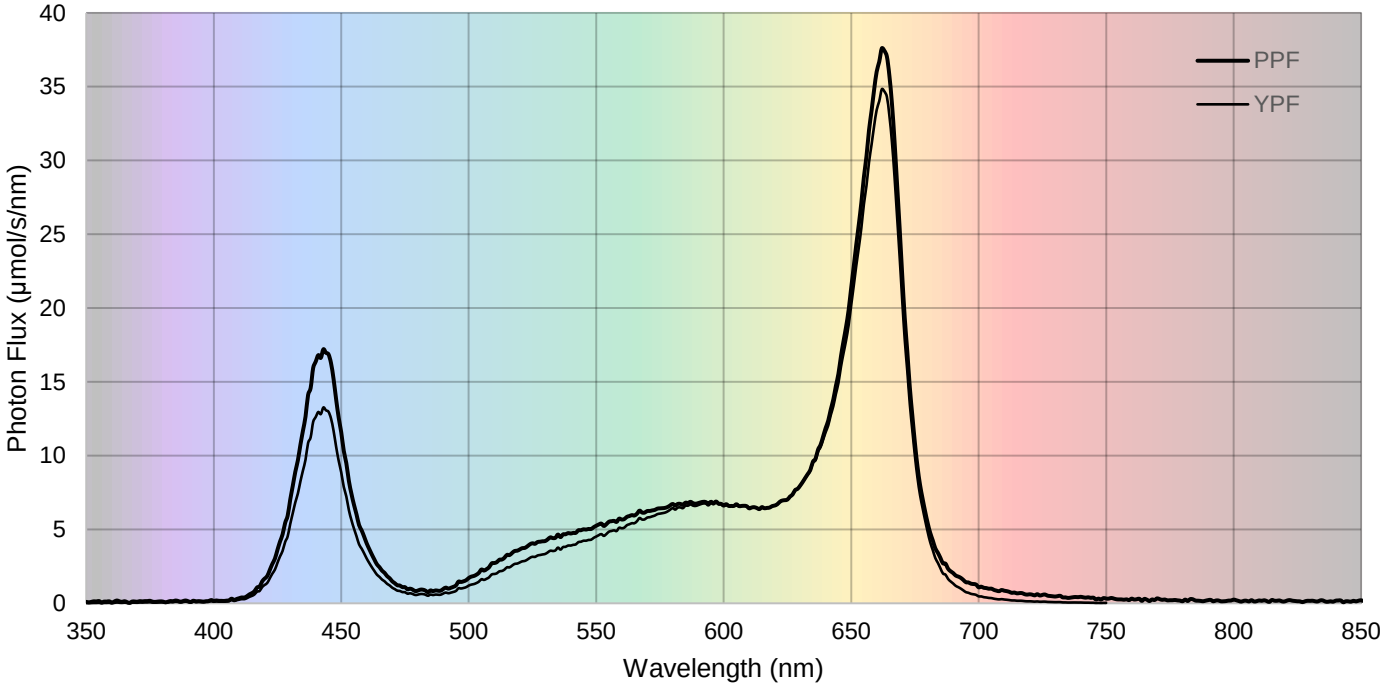
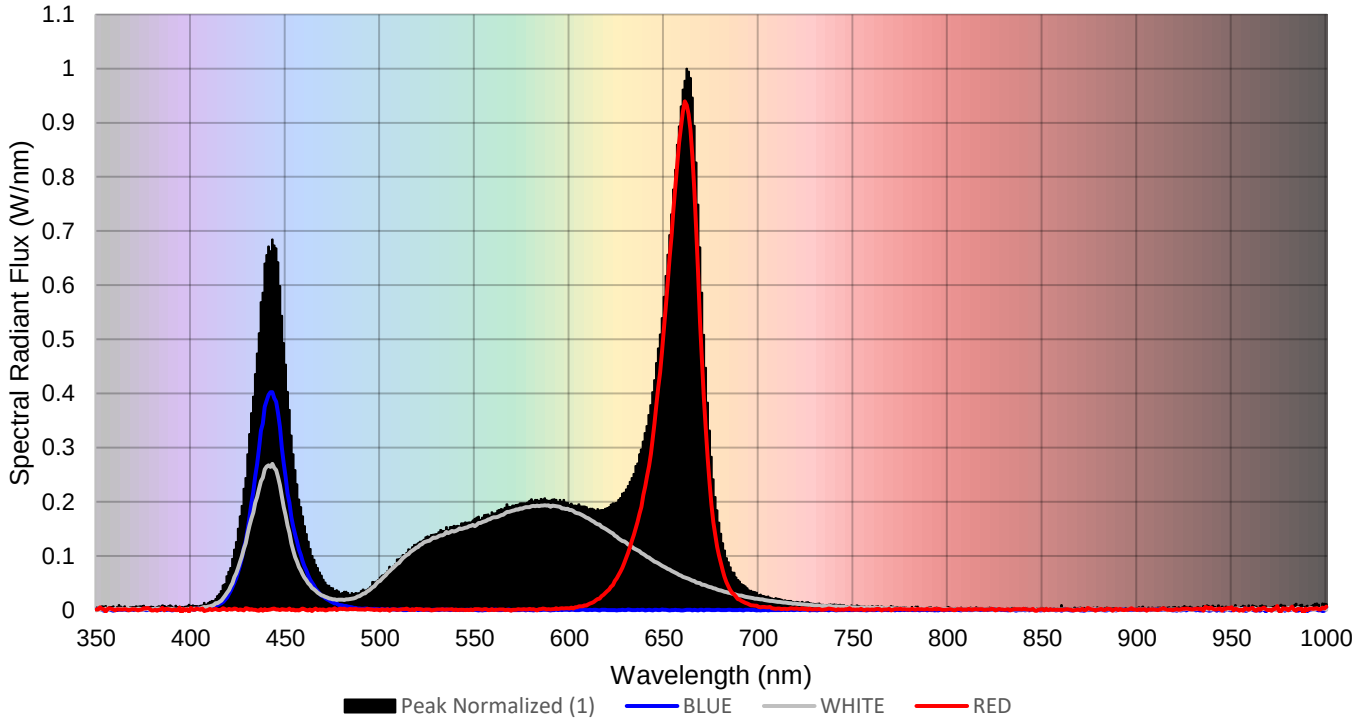
SPECTRAL QUANTUM DISTRIBUTION

Spectral Quantum Distribution



Spectral Radiant Flux (Normalized)



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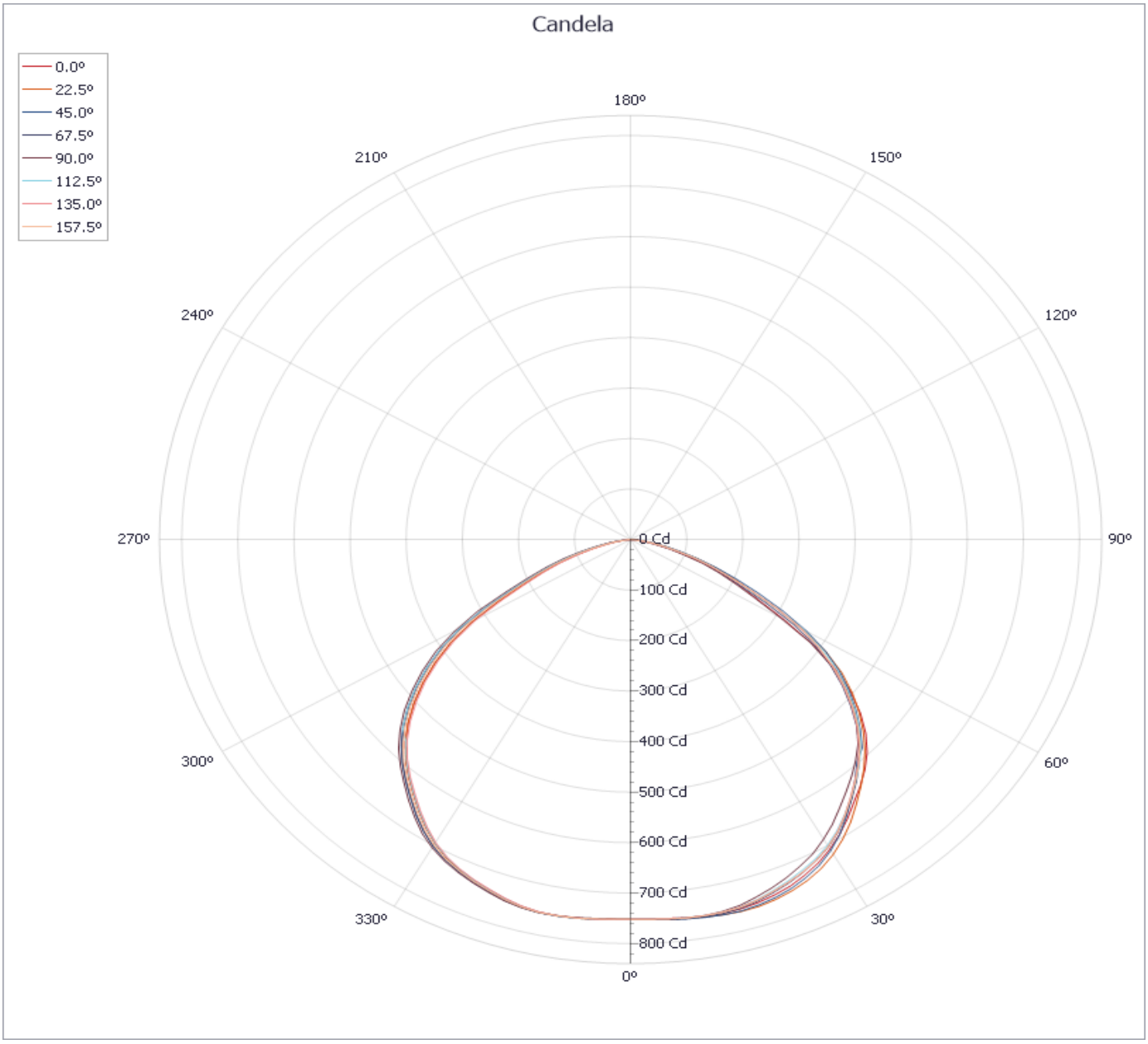
PHOTOSYNTHETIC PHOTON INTENSITY

Axis values of Candela (Cd) do not represent units of meaurement. Actual value reported are Photosynthetic Photon Intensity Distribution (PPID) in units of (µmol/s·sr)



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PPID TABLE

LOWER HEMISPHERE

South Pole

0	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	752	752	752	752	752	752	752	752	752	752	752	752	752	752	752	752	752
2.5	751	752	753	753	752	752	752	752	753	753	752	752	752	753	753	752	752
5	753	754	755	755	754	753	753	754	754	755	754	754	753	755	754	754	754
7.5	755	757	758	757	756	755	755	756	756	756	756	756	755	756	756	756	756
10	757	759	760	758	756	756	756	756	756	757	757	756	756	757	756	756	756
12.5	758	761	761	758	754	756	756	756	755	756	757	756	756	756	755	756	756
15	757	762	761	756	750	753	753	754	752	752	754	754	754	752	751	753	753
17.5	754	762	759	751	743	748	749	749	745	746	749	749	750	745	745	747	748
20	749	758	754	744	734	740	742	742	738	738	741	741	743	738	737	740	740
22.5	743	753	748	736	725	732	735	735	730	731	734	734	735	730	729	733	733
25	734	745	739	727	714	723	727	726	721	722	726	725	727	721	720	724	724
27.5	723	735	728	716	702	713	717	716	711	711	716	715	718	710	709	714	714
30	709	721	712	704	686	701	704	703	696	696	703	702	706	696	694	700	701
32.5	693	704	693	687	669	684	686	687	678	678	686	685	691	677	675	683	684
35	674	683	670	668	649	665	666	666	657	657	666	666	671	657	654	662	664
37.5	654	661	646	647	631	644	644	645	635	636	645	643	650	635	632	641	642
40	637	638	622	626	612	624	622	623	615	615	624	623	628	614	612	620	621
42.5	618	615	597	602	594	604	601	602	593	593	602	601	607	592	589	598	600
45	596	591	584	576	573	580	575	578	568	568	578	577	585	566	564	574	576
47.5	568	563	555	546	547	553	547	550	538	538	551	549	557	551	533	544	547
50	535	532	524	512	520	521	515	517	504	504	519	516	527	518	498	512	514
52.5	494	498	491	476	484	487	479	482	467	467	483	481	491	483	461	475	478
55	445	459	454	435	439	449	439	442	425	426	444	440	453	443	419	436	439
57.5	383	412	412	389	380	405	396	398	380	380	401	398	411	401	373	392	395
60	313	353	362	335	306	354	348	350	326	328	351	347	362	351	318	340	344
62.5	254	290	306	272	248	289	292	293	266	267	293	288	307	292	256	281	285
65	213	233	251	217	204	227	233	234	211	212	233	230	244	233	204	222	227
67.5	176	195	203	179	169	186	185	187	171	172	188	185	196	187	166	181	183
70	143	158	162	146	135	152	148	151	137	137	152	150	160	152	132	145	148
72.5	105	124	124	112	98	119	115	116	102	103	117	115	125	117	97	110	113
75	77	89	93	80	71	84	81	84	73	73	84	83	91	84	69	79	81
77.5	52	65	66	54	45	59	56	57	52	47	57	56	63	58	44	52	55
80	32	42	43	34	28	37	35	36	39	30	37	35	41	37	27	33	35
82.5	18	25	25	20	13	22	20	21	22	15	21	20	24	21	13	18	19
85	5	12	11	7	3	8	7	7	9	4	8	7	10	8	3	6	6
87.5	1	2	2	1	1	1	1	1	1	1	1	1	2	1	0	1	1
90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Equator

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PPID TABLE

LOWER HEMISPHERE

	0	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
Equator	90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	92.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	97.5	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
	102.5	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
	107.5	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
	112.5	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
	117.5	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
	122.5	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
	127.5	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
	132.5	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
	137.5	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
	142.5	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
	147.5	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
	152.5	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
	157.5	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
	162.5	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
	167.5	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
	172.5	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
	177.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
North Pole	180	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

UL 1598-19.7 REQUIREMENTS

*The following applicable sections are referenced from UL1598. See standard for complete requirements

SECTION	SECTION DESCRIPTION	LAB REMARK	VERDICT
19.7	**Thermocouples**	-	-
19.7.1	Temperature recorded at points on a luminaire shall be measured by means of thermocouples	Thermocouples Used	PASS
19.7.2	Thermocouples shall have conductors no larger than 0.21 mm^2 (No. 24 AWG) and no smaller than 0.05 mm^2 (No. 30 AWG). Thermocouples shall comply with the requirements specified in ASTM MNL 12 and thermocouples as listed in the table of the limits of error specified in NIST ITS 90, or ISA MC96.1. Thermocouple conductors smaller than No.30 AWG may be used for miniature circuitry and components. The thermocouple junction shall be fused.	Observed Specifications met	PASS
19.7.3	If referee temperature measurements are required, No. 30 AWG iron and constantan thermocouples and a potentiometer-type instrument shall be used.	-	- NA -
19.7.4	A thermocouple junction and the adjacent thermocouple conductor shall be held in good thermal contact with the surface of the material where a temperature is being measured. Tape alone shall not be relied upon as a means to provide good thermal contact of the thermocouple junction. Acceptable means of securing a thermocouple include water glass, cyanoacrylate, melting the tip into plastic, soldering, or wedging between two surfaces.	Arctic Alumina™ Thermal Epoxy See UL 1598 19.2 Test for measurement point	PASS
19.7.5	A thermocouple used to measure a conductor temperature for through wiring shall be placed in contact with the conductor through a slit in the insulation and retained in place by a wrap of tape.	Not Applicable	- NA -
19.2	**Temperature Test Stabilization**	-	-
19.2.1	Temperature tests shall be conducted in accordance with Clause 19.2 and the normal and abnormal temperature tests of Clauses 14 and 15.	Compliant	PASS
19.2.2	Temperatures shall be measured by thermocouples, as specified in Clause 19.7.	Compliant	PASS
19.2.3	The temperature of ballast and transformer coils shall be measured using thermocouples that are directly in contact with the inner surfaces of the coil or using the rise-of-resistance method described in Clause 19.6. The resulting temperature shall not exceed the applicable temperatures specified in Table 14.1.2.	Not Applicable	- NA -
19.2.4	Temperatures shall be measured after they have stabilized, when:	-	-
	a) the test has been running for a minimum of 7.5 h; or	-	Not Tested
	b) the test has been running for a minimum of 3 h; and	3.5 Hours	PASS
	c) three successive readings taken at 15 min intervals are within 1 °C of one another and are not rising.	See UL 1598 19.2 Test	PASS
19.4	**Frequency**	-	-
19.4.1	Frequency-sensitive equipment shall be tested at rated frequency, and equipment marked with more than one frequency shall be tested at the frequency that will produce the maximum temperature rise.	Frequency-sensitivity not tested.	Not Tested

UL 1598-19.7 REQUIREMENTS

*The following applicable sections are referenced from UL1598. See standard for complete requirements

SECTION	SECTION DESCRIPTION	LAB REMARK	VERDICT
19.5	**Ambient Temperature**	-	-
19.51	Tests shall be conducted in an ambient temperature of 25 ± 5 °C. Ambient temperature variations above or below 25 °C shall be respectively subtracted from or added to temperatures recorded at points on the luminaire.	See UL 1598 19.2 Test Min: 22.0 °C Max: 24.0 °C	PASS

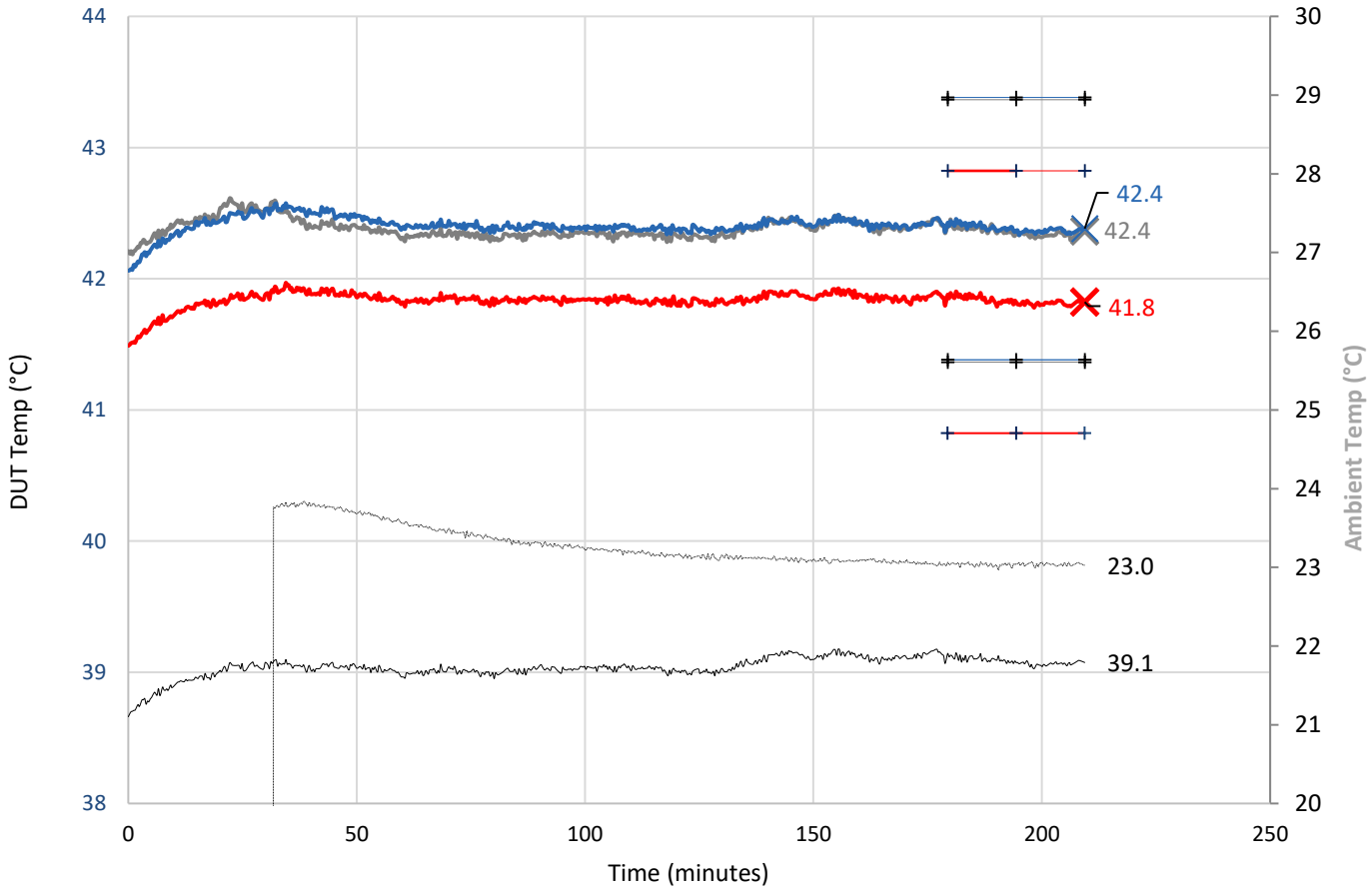
UL 1598 19.2 TEST

Stabilization Description - A series of 601 measurements are recorded during the stabilization period. The final stabilized measurement, as defined by UL 1598:2008 19.2.4, is reported after 209 minutes or 3.5 hours of device runtime, where three successive readings taken at 15 min intervals are within 1 °C of one another and are not rising.

Δ 25 (°C)	Ambient Temp (°C)	Measurements in Range
-2.0	23.0	86
-1.9	23.1	154
-1.9	23.1	69
-1.8	23.2	44
-1.7	23.3	30
-1.6	23.4	29
-1.5	23.5	21
-1.4	23.6	17
-1.3	23.7	20
-1.2	23.8	44
-2.0	23.0	Reported

Source	ISTMT Part or Device Under Test for 25°C Ambient Condition	Temp (°C)	*Est for 35 °C
1	OSLON SSL LH CPDP λ_{Peak} 660nm	41.8	53.8
2	OSLON GW CSSRM2.EM CT	42.4	54.3
3	OSLON SSL LH CPDP λ_{Peak} 465nm	42.4	54.4
4	Driver	39.1	51.1

**Estimated ISTMT performance at manufacturer maximum rated ambient air temperature of 35 °C*



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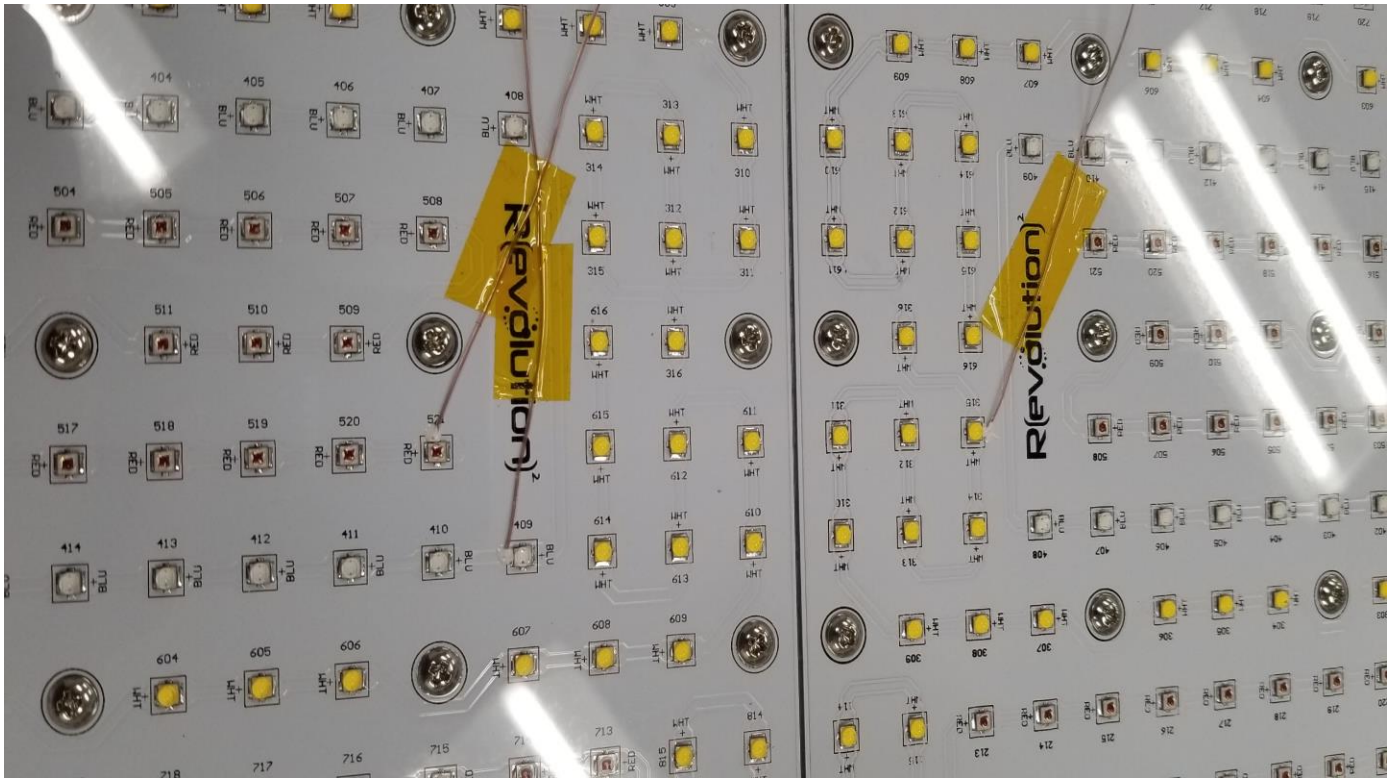
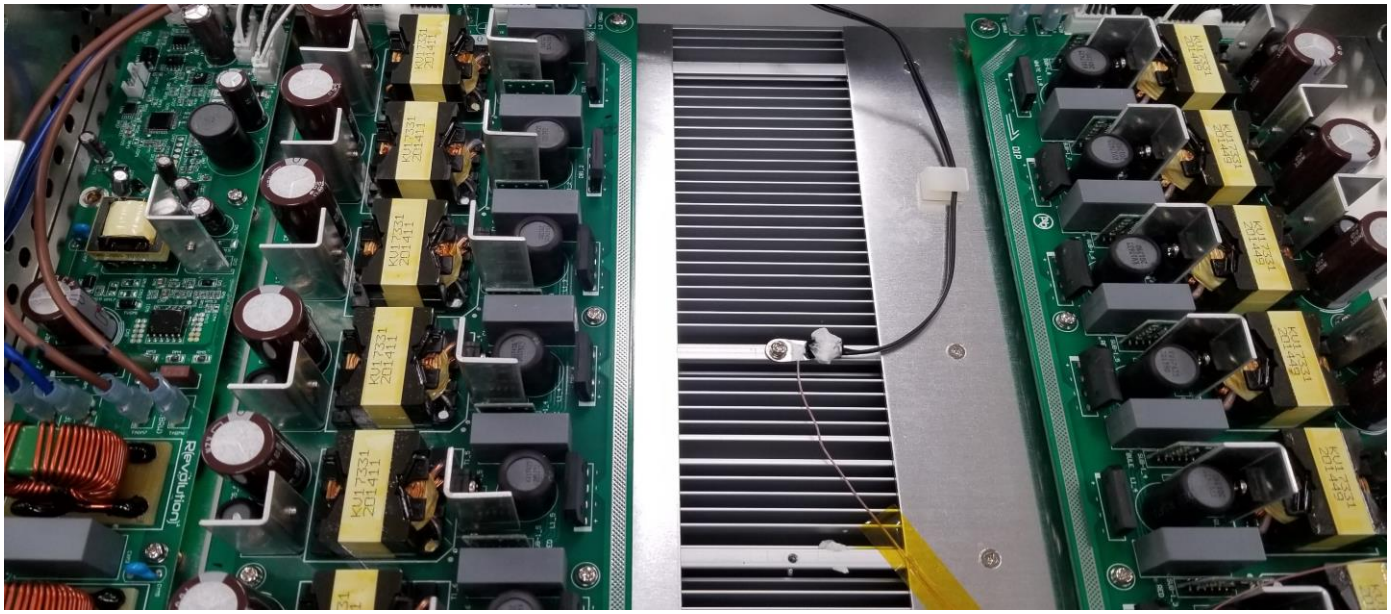
UL 1598 19.2 TEST





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DLC FOR HORTICULTURAL LIGHTING

This sample was evaluated in accordance with Design Lighting Consortium requirements for Horticultural Lighting Version 1.2 effective October 21, 2019. Test notes and evaluation requirements provided below for applicable sections. For a complete section description, visit designlights.org

Parameter/Attribute/Metric	Requirement	Requirement Type	Method of Measurement/Evaluation	EVALUATION VERDICT
Photosynthetic Photon Flux (PPF) (µmol/s)	n/a	Reported	(ANSI/IES LM-79) 400-700nm range, with 400-500nm, 500-600nm, and 600-700nm bins reported alongside the total	Reported Horticulture Summary See Page: 6 - 7
Far-Red Photon Flux (PF_{FR}) (µmol/s)	n/a	Reported	(ANSI/IES LM-79) 700-800nm range	Reported Horticulture Summary See Page: 6 - 7
Spectral Quantum Distribution (SQD) (µmol/s·sr)	n/a	Reported	(ANSI/IES LM-79) 400-800nm range	Reported Spectral Quantum Distribution See Page: 8
Photosynthetic Photon Intensity Distribution (PPID) (µmol/s·sr)	n/a	Reported	(ANSI/IES LM-79) 400-700nm range	Reported Photosynthetic Photon Intensity See Page: 9
Photosynthetic Photon Efficacy (PPE) (µmol/J)	≥1.9 µmol/J, with -5% tolerance	Required/Threshold	(ANSI/IES LM-79) 400-700nm range	PASS 2.1 µmol/J Horticulture Summary See Page: 6 - 7
Photon Flux Maintenance, Photosynthetic (PFM_P)	Q_{90} ≥36,000 hours	Required/Threshold TM-21 Calculation See Page: 18 - 19	(ANSI/IES LM-80 / IES TM-21 or IES LM-84 / IES TEM-28) 400-700nm range	PASS 45000 Hours TM-21 Calculation See Page: 18 - 19
Photon Flux Maintenance, Far-Red (PFM_{FR})	Report time to Q_{90}	Reported TM-21 Calculation See Page: 18 - 19	(ANSI/IES LM-80 / IES TM-21 or IES LM-84 / IES TEM-28) 700-800nm range	45000 Hrs

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DLC FOR HORTICULTURAL LIGHTING

Parameter/Attribute/Metric	Requirement	Requirement Type	Method of Measurement/Evaluation	EVALUATION VERDICT
Fan Lifetime	≥50,000 hours	Required/Threshold Horticulture Summary See Page: 6 - 7	Fan Technical Specification Sheet, Fixture Technical Specification Sheet	Evaluation Not Requested
Warranty	5 years	Required/Threshold Horticulture Summary See Page: 6 - 7	Legal Warranty Terms & Conditions	Available, not included in report
Power Factor	≥0.9	Required/Threshold Horticulture Summary See Page: 6 - 7	Electrical Testing per ANSI/IES LM-79	PASS 0.95 Horticulture Summary See Page: 6 - 7
Total Harmonic Distortion, Current (THDi)	≤20%	Required/Threshold Horticulture Summary See Page: 6 - 7	Electrical Testing per ANSI/IES LM-79	PASS 19.2% Horticulture Summary See Page: 6 - 7
Safety Certification	Appropirate Horticultral Lighting designation by OSHA NRTL or SCC-recognezed body	Required/Threshold Horticulture Summary See Page: 6 - 7	Per safety certification body	Certification not included in report. Ask from Manufacturer

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TM-21 CALCULATION

Table 1: Report at each LM-80 Test Condition					
Description of LED Light Source Tested (manufacturer, model, catalog number)	LD CQAR				
Test Condition 1 - 55ºC Case Temp		**Test Condition 2 - 85ºC Case Temp**			
Sample size	24	Sample size	24	Sample size	-
Number of failures	0	Number of failures	0	Number of failures	-
DUT drive current used in the test (mA)	700	DUT drive current used in the test (mA)	700	DUT drive current used in the test (mA)	-
Test duration (hours)	8,000	Test duration (hours)	8,000	Test duration (hours)	-
Test duration used for projection (hour to hour)	3,000 - 8,000	Test duration used for projection (hour to hour)	3,000 - 8,000	Test duration used for projection (hour to hour)	-
Tested case temperature (ºC)	55	Tested case temperature (ºC)	85	Tested case temperature (ºC)	-
α	-4.346E-07	α	-4.652E-06	α	-
B	0.999	B	0.974	B	-
Reported L90(8k) (hours)	(240,000)	Reported L90(8k) (hours)	(17,000)	Reported L90(8k) (hours)	-

One or more of the tests resulted in negative L70 values. Please refer to sections 5.2.5 and 6.4 of IES TM-21-11 for instructions on how to estimate the reported lumen maintenance life (L70).

Table 2: Interpolation Report (projection based on *in-situ* temperature entered)	
$T_{s,1}$ (ºC)	55.00
$T_{s,1}$ (K)	328.15
α_1	-4.346E-07
B_1	0.999
$T_{s,2}$ (ºC)	-
$T_{s,2}$ (K)	-
α_2	-
B_2	-
E_a/k_b	-
A	-
B_0	0.999
$T_{s,i}$ (ºC)	54.40
$T_{s,i}$ (K)	327.55
α_i	-
Reported L90(8k) at 54.4ºC (hours)	(240,000)

Report Generated By: Aaron Miller	Notes: Blue Channel Negative L70 value instructions indicate 6x16000hr rule = >96000 hour lifetime. Evaluation performed for 700mA drive condition, and estimated manufacturer maximum ambient air temperature of 35C
Company: CSA Group, Seattle Washington	
Date: 10/30/2020	

TM-21 Report

Table 1: Report at each LM-80 Test Condition					
Description of LED Light Source Tested (manufacturer, model, catalog number)	LH CPDP				
Test Condition 1 - 55ºC Case Temp		**Test Condition 2 - 85ºC Case Temp**			
Sample size	24	Sample size	24	Sample size	-
Number of failures	0	Number of failures	0	Number of failures	-
DUT drive current used in the test (mA)	800	DUT drive current used in the test (mA)	800	DUT drive current used in the test (mA)	-
Test duration (hours)	25,000	Test duration (hours)	25,000	Test duration (hours)	-
Test duration used for projection (hour to hour)	12,000 - 25,000	Test duration used for projection (hour to hour)	12,000 - 25,000	Test duration used for projection (hour to hour)	-
Tested case temperature (ºC)	55	Tested case temperature (ºC)	85	Tested case temperature (ºC)	-
α	1.445E-06	α	9.680E-07	α	-
B	0.961	B	0.959	B	-
Reported L90(25k) (hours)	45,000	Reported L90(25k) (hours)	65,000	Reported L90(25k) (hours)	-

Table 2: Interpolation Report (projection based on *in-situ* temperature entered)	
$T_{s,1}$ (ºC)	55.00
$T_{s,1}$ (K)	328.15
α_1	1.445E-06
B_1	0.961
$T_{s,2}$ (ºC)	-
$T_{s,2}$ (K)	-
α_2	-
B_2	-
E_a/k_b	-
A	-
B_0	0.961
$T_{s,i}$ (ºC)	41.80
$T_{s,i}$ (K)	314.95
α_i	1.445E-06
Reported L90(25k) at	45,000

Report Generated By: Aaron Miller	Notes: For Red Channel Evaluation performed for 800mA drive condition, and estimated manufacturer maximum ambient air temperature of 35C
Company: CSA Group, Seattle Washington	
Date: 10/20/2020	

TM-21 Report

Table 1: Report at each LM-80 Test Condition					
Description of LED Light Source Tested (manufacturer, model, catalog number)	GW CSSRM2.EM				
Test Condition 1 - 55ºC Case Temp		**Test Condition 2 - 85ºC Case Temp**			
Sample size	24	Sample size	24	Sample size	-
Number of failures	0	Number of failures	0	Number of failures	-
DUT drive current used in the test (mA)	1050	DUT drive current used in the test (mA)	1050	DUT drive current used in the test (mA)	-
Test duration (hours)	16,000	Test duration (hours)	16,000	Test duration (hours)	-
Test duration used for projection (hour to hour)	8,000 - 16,000	Test duration used for projection (hour to hour)	8,000 - 16,000	Test duration used for projection (hour to hour)	-
Tested case temperature (ºC)	55	Tested case temperature (ºC)	85	Tested case temperature (ºC)	-
α	-1.167E-07	α	3.338E-08	α	-
B	0.999	B	0.998	B	-
Reported L90(16k) (hours)	(896,000)	Reported L90(16k) (hours)	>96000	Reported L90(16k) (hours)	-

One or more of the tests resulted in negative L70 values. Please refer to sections 5.2.5 and 6.4 of IES TM-21-11 for instructions on how to estimate the reported lumen maintenance life (L70).

Table 2: Interpolation Report (projection based on *in-situ* temperature entered)	
$T_{s,1}$ (ºC)	55.00
$T_{s,1}$ (K)	328.15
α_1	-1.167E-07
B_1	0.999
$T_{s,2}$ (ºC)	-
$T_{s,2}$ (K)	-
α_2	-
B_2	-
E_a/k_b	-
A	-
B_0	0.999
$T_{s,i}$ (ºC)	54.30
$T_{s,i}$ (K)	327.45
α_i	-
Reported L90(16k) at	(896,000)

Report Generated By: Aaron Miller	Notes: White Channel Negative L70 value instructions indicate 6x16000hr rule = >96000 hour lifetime. Evaluation performed for 1050mA drive condition, and estimated manufacturer maximum ambient air temperature of 35C
Company: CSA Group, Seattle Washington	
Date: 10/30/2020	

EQUIPMENT

Item	Description/use	Manufacturer	Model	Serial #	Calibration Due
Spectrometer	Spectrum	Orb Optronix	SP-75	4013726	7/16/2021
Radiometer	Power Meter	Newport	2936R	18953	3/25/2021
Quantum Sensor	PAR vs Angle	Gigahertz-Optik	PS-3701	44466	3/25/2021
AC Power Supply	DUT AC Voltage	QuadTech	31015	QT3101500128	Not Applicable
Power Analyzer	Electrical	Yokogawa	WT310E	C25K10003V	8/16/2021
Goniometer	Angular & IES data	Orb Optronix	Gono 7_M	GONO007	8/16/2021
Spectral Suite	Software - Spectrum	Orb Optronix	SS V3	3.1.17.901	Not Applicable
Spectral Suite	Software - IES	Orb Optronix	SS V3	3.0.16.951	Not Applicable

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REVISION HISTORY

REVISION	DATE	APPROVED	DESCRIPTION OF REVISION
010	10/30/2020	ACM	⓪ORIGINAL

END OF REPORT

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