



Planar Irradiance Test Report

Test results reported for:

[Redacted]

Orb Optronix report:

[Redacted]

Original issue date:

[Redacted]

Prepared for: [Redacted]

Attn: [Redacted]

Test report prepared by:

Testing performed by:
CSA Group
1003 7th Ave.
Kirkland, WA 98033
425-605-8500
www.OrbOptronix.com

Test report approved by:



1.0 Description of test sample

Orb test sample identificaton: 01		Manufacturer specifications:	
Manufacturer:		Voltage (V):	
Part number:		Test Current (mA):	
Model Number:		Wattage (W):	
Description:		Frequency (Hz):	
Additional equipment:		CCT (K):	

2.0 Scope of testing

Spectral irradiance measured on a customer defined plane.

2.1 Test protocol and data reduction

1. Data is reported for the 380nm to 780nm spectral range with a 1 nm resolution.
2. Lamp is energized for stablization time of 0.5h prior to initiating test.
3. Z-axis defined normal to glass plane at geometric center of reflector.
4. Reflector assembly oriented in glass down orientation.
5. Assembly cooled by forced convection through ventilation ports on assembly at 667CFM.

3.0 Test Conditions

Test Date:

Measurement Coordinates for X,Y Measurements

Method: X,Y Plane
 x-axis Alignment: 0.0 ± 0.005 m
 y-axis Alignment: 0.0 ± 0.005 m
 z-axis Alignment: 0.0 ± 0.002 m

Source to Sensor Distance: 18.0 ± 0.1 inches
 X scan Resolution: 0.050 ± 0.001 m
 Y scan Resolution: 0.050 ± 0.001 m
 X Range: ± 0.650 m
 Y Range: ± 0.650 m

Ambient Lab Conditions

Temperature [°C]: 24.4
 Relative Humidity [%]: 38.9



4.0 Results

Optical Power Measurements

Total* Integrated Radiometric Flux:	173.54	W
Radiometric Efficacy:	16.71%	% (optical watts out/electrical watts in)

Power Uniformity:

Minimum:	17.44	W
Maximum:	251.93	W
Average:	98.00	W
Standard Deviation:	54.57	W
Ratio:	6.92%	% (min irradiance/max irradiance)
Ratio:	38.90%	% (avg irradiance/max irradiance)

PAR Measurements

Total* Integrated PPF**:	842.43	$\mu\text{moles/m}^2/\text{s}$
PPF Efficacy:	0.811	$(\mu\text{moles/m}^2/\text{s})/\text{W}$ (PPF out/electrical watts in)
Total* Integrated YPF***:	802.27	$\mu\text{moles/m}^2/\text{s}$
YPF Efficacy:	0.772	$(\mu\text{moles/m}^2/\text{s})/\text{W}$ (YPF out/electrical watts in)
Photosynthetically Active Yeild Efficiency:	0.952	% (YPF/PPF)

PPF Uniformity:

Minimum:	86.79	$\mu\text{moles/m}^2/\text{s}$
Maximum:	1165.83	$\mu\text{moles/m}^2/\text{s}$
Average:	475.79	$\mu\text{moles/m}^2/\text{s}$
Standard Deviation:	263.17	$\mu\text{moles/m}^2/\text{s}$
Ratio:	7.44%	% (min irradiance/max irradiance)
Ratio:	40.81%	% (avg irradiance/max irradiance)

* Through defined plane.

**Photosynthetic Photon Flux: weighted equally by wavelength and summed between 350nm and 750nm.

***Yield Photon Flux: PPF weighted by action spectrum (average of 20 plant species as defined by McCree) and summed between 350nm and 750nm. (See section 8.0)

Electrical Measurements

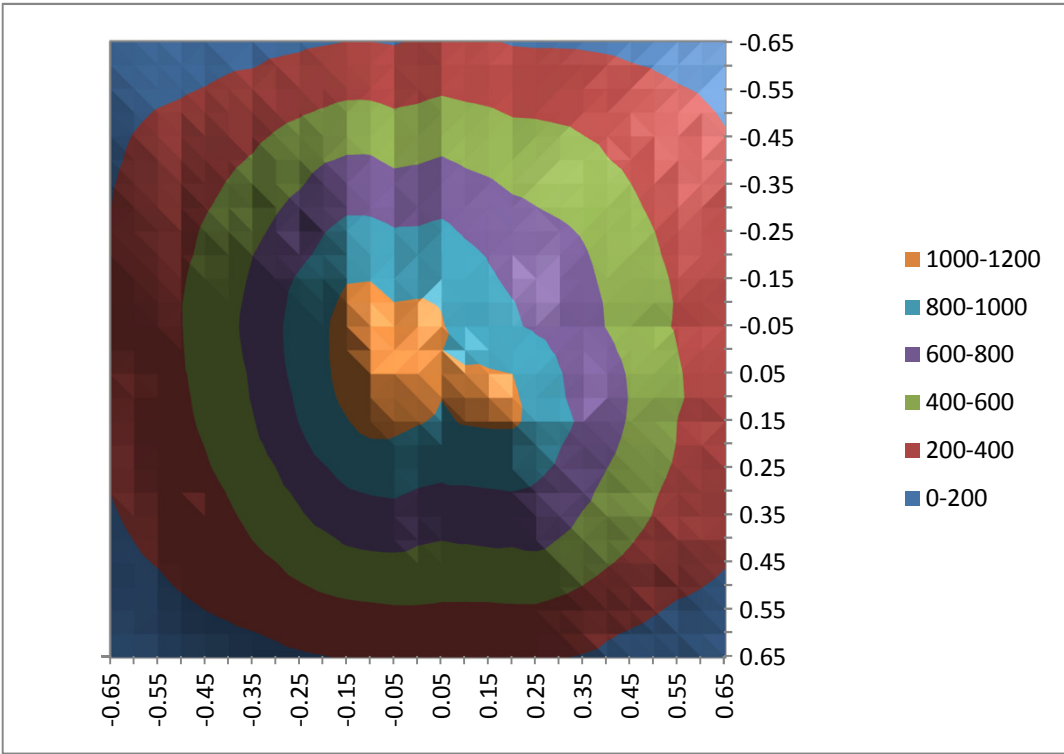
Active Power (W):	1038.600	Average Voltage(V):	107.480
Apparent Power (VA):	1039.300	Average Current (A):	9.670
Power Factor:	0.9993	Frequency (Hz):	59.986



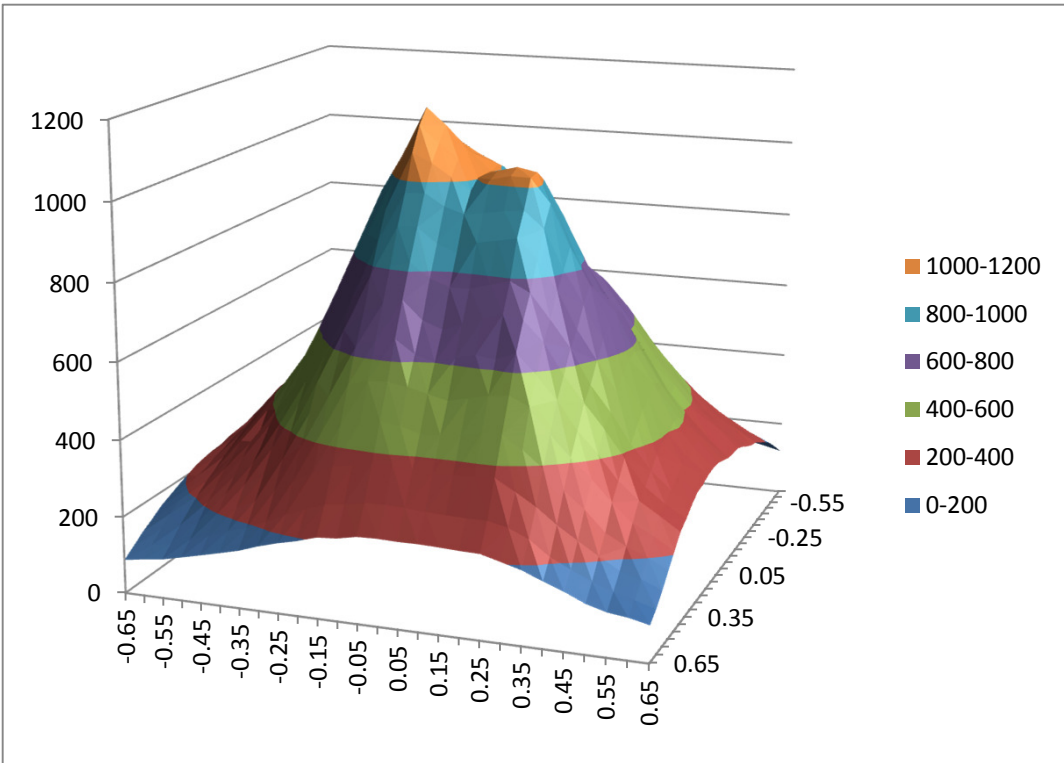
5.0 Uniformity Charts

PAR Distribution

X,Y axes:
Distance [m]
Z axis:
PPF [$\mu\text{moles}/\text{m}^2/\text{s}$]

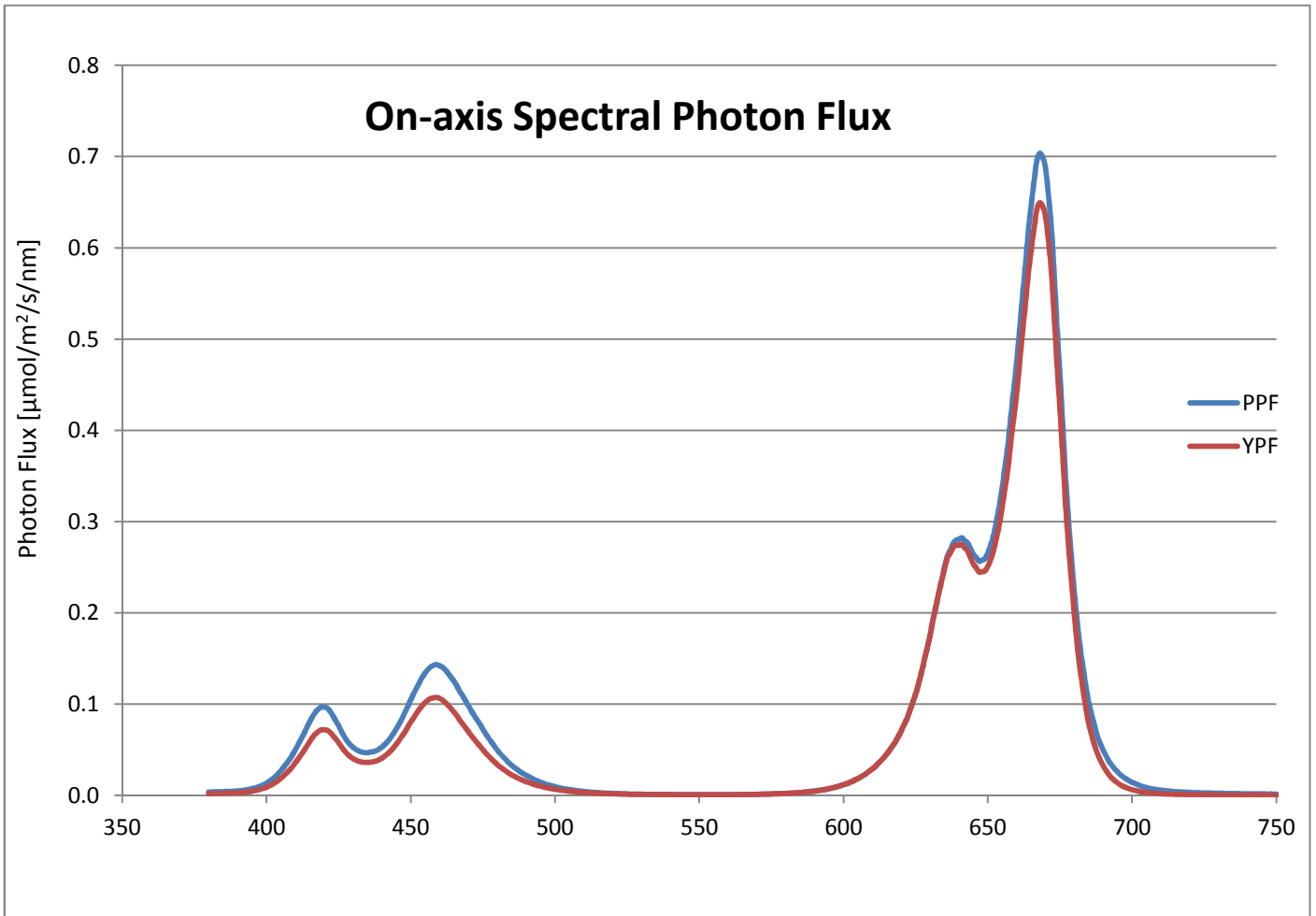
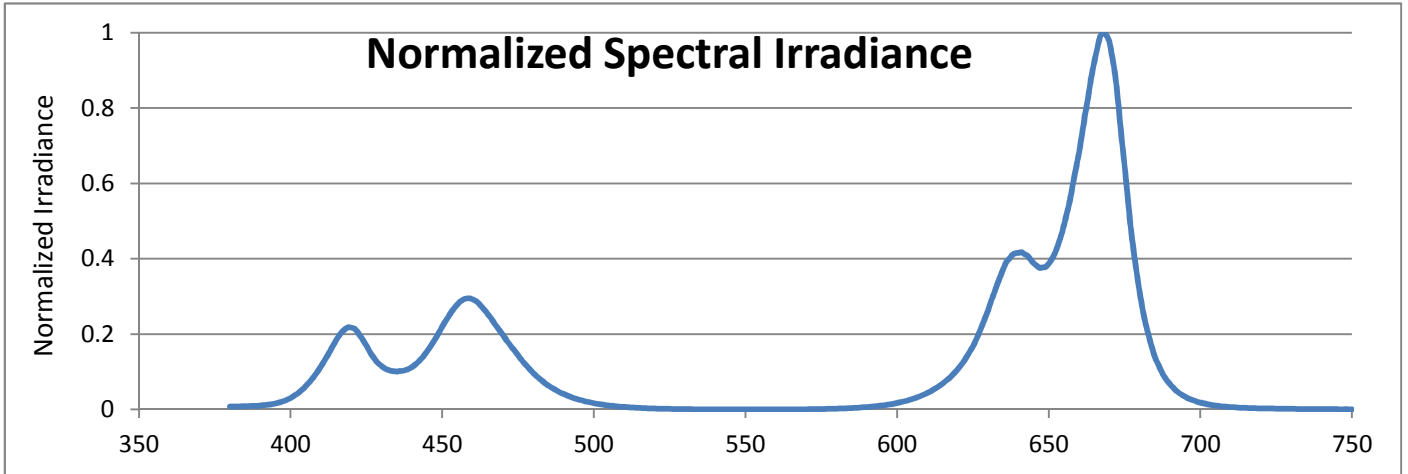


X,Y axes:
Distance [m]
Z axis:
PPF [$\mu\text{moles}/\text{m}^2/\text{s}$]





6.0 Spectral





7.0 Equipment and Reference Standard

Lamp Calibration Chain: Irradiance measurements are traceable to NIST through a 2nd generation lamp of known Irradiance maintained at Orb Optronix. The calibration chain is given below.

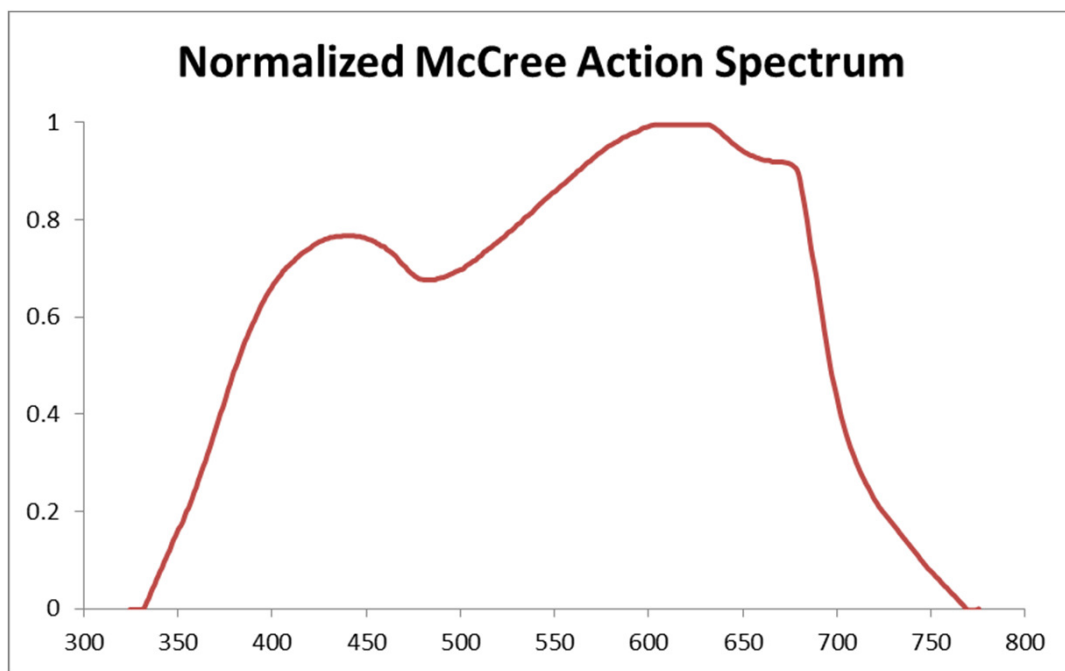
Generation	Standard	Report/File Number	Calibration Date	Description
1	s/n F-626	NIST# 844/278192-09	1/3/2011	NIST 1000W standard lamp

Test Instrumentation

Item	Description /use	Manufacturer	Model	Serial#	Calibration due
2-Axis X,Y Translation Stages	-	Orb Optronix		-	at use
Spectroradiometer	Optical Measurements	Orb Optronix	SP-100	2913927	9-Dec-14
Digital Power Meter	Electrical Measurements	Yokogawa	WT210	91L122464	29-Apr-15

8.0 Additional Information

McCree, K. J., 1972. The action spectrum, absorptance and quantum yield of photosynthesis in crop plants. *Agrie. Meteorol*, 9: 191-216.



END OF REPORT