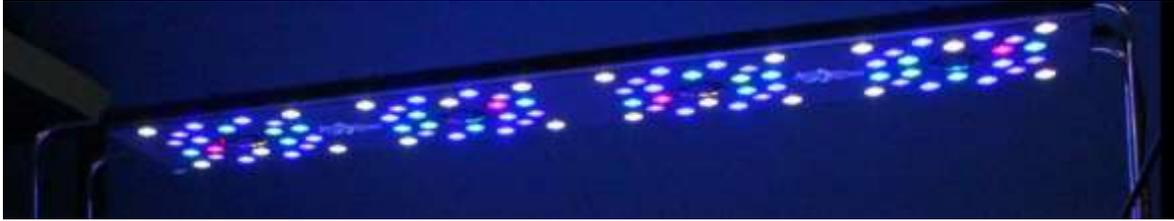


Product Review: Reef Breeders Photon 48-V2+ LED Luminaire

By Dana Riddle



It has been almost 15 years since PFO offered the first commercially available LED luminaire for the aquarium market. These were wildly controversial at that time but LED luminaires are now generally accepted as the light of choice. Since that initial offering, a plethora of units have become available. This time, we'll take a look at the Reef Breeders Photon 48-V2+.

It is not the intent of this article to describe any light as being 'best' – there are simply too many variables involved in making this determination, including, but not limited to purchase price, spectral quality, programming options, light intensity, warranty, inclusion of mounting hardware, and so on.

To start, we'll examine the number of LEDs and their spectral qualities.

The Photon 48-V2+ houses 88 LEDs, ranging from violet (with some spillover into the UV-A range) to deep red. There are six programmable channels for spectral quality and intensity plus a moonlight channel (using 450nm LEDs).

Violet LEDs

There are twenty violet LEDs with peak output at 420nm and are advertised to be 3-watt Semi LEDs.

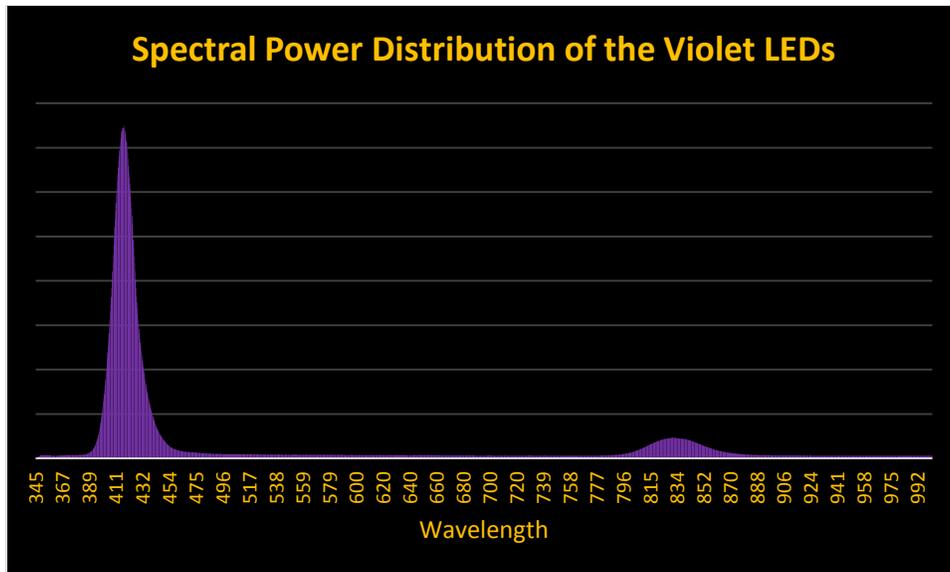


Figure 1. Violet LED SPD.

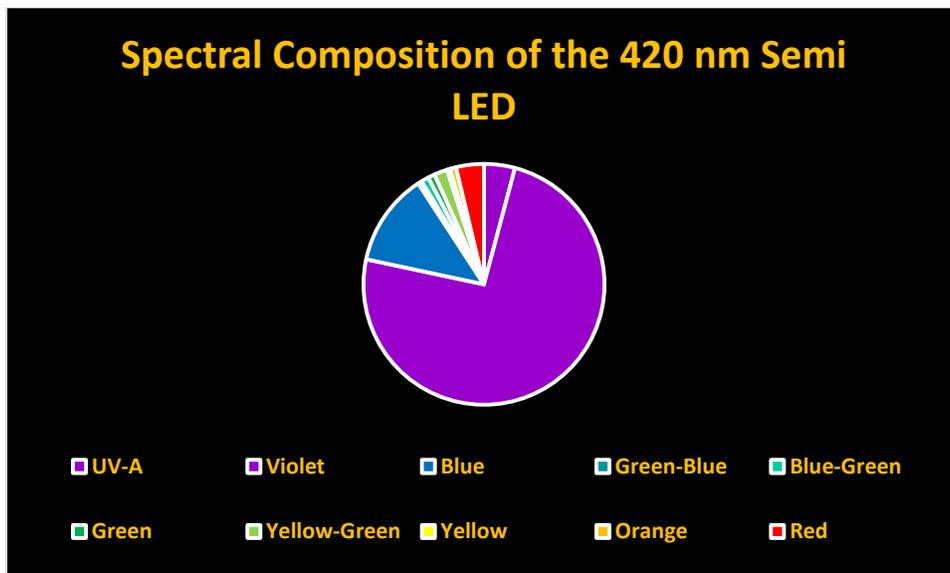


Figure 2. Mostly violet with some spillover into the UV-A range.

Table One. Breakout (%) of the 420nm LED.

	420 nm
UV-A	4.1%
Violet	74.2%
Blue	12.5%
Green-Blue	0.5%
Blue-Green	1.0%
Green	0.9%
Yellow-Green	1.8%
Yellow	0.4%
Orange	0.8%
Red	3.7%

Royal Blue LEDs

There are 24 Royal Blue LEDs with peak output at 450 nm, and are advertised to be 5-watt Cree XT-E LEDs.

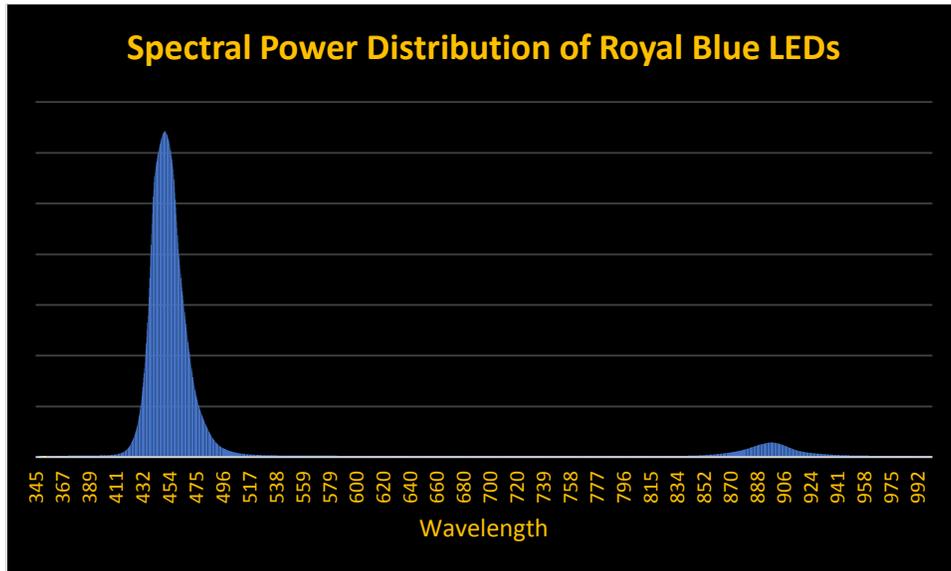


Figure 3. Royal Blue LED SPD.

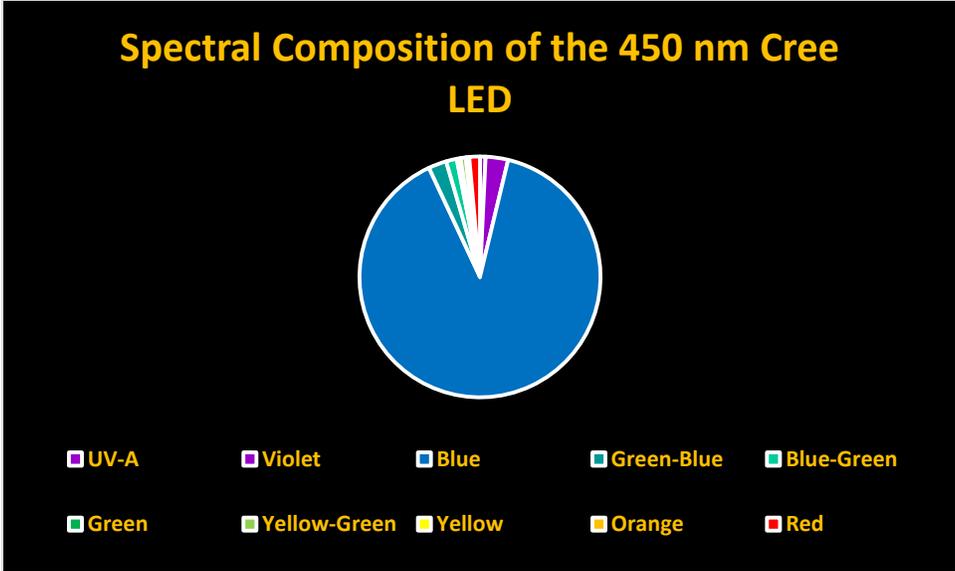


Figure 4. Mostly blue with a little violet.

Table Two. Breakout (%) of the Cree 450nm LED.

	450 nm
UV-A	0.7%
Violet	3.0%
Blue	89.3%
Green-Blue	2.4%
Blue-Green	1.4%
Green	0.5%
Yellow-Green	0.7%
Yellow	0.2%
Orange	0.3%
Red	1.4%

Cool Blue LEDs

The Photon v2+ contains 16 Cool Blue LEDs advertised to have peak output at 480 nm and to be 3-watt Cree XP-E diodes. Peak output is actually 478 nm – close enough!

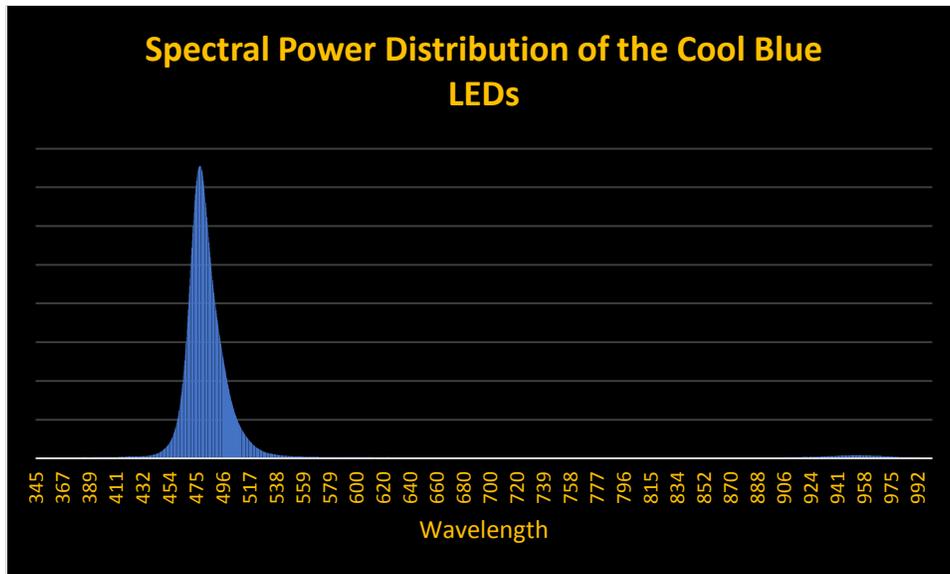


Figure 5. Cool Blue SPD.

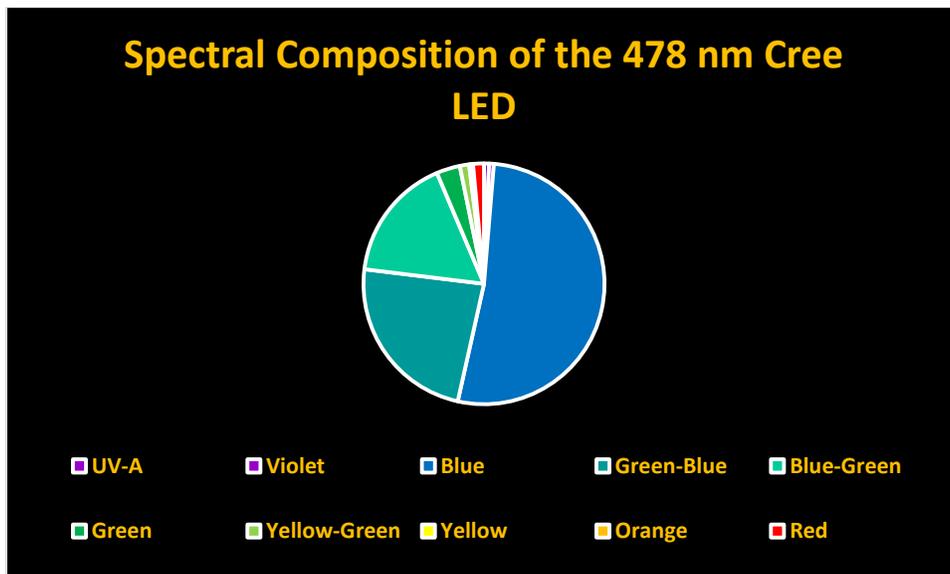


Figure 6. Mostly blue, with some blue-green and green-blue.

Table Three. Breakout (%) of the 478nm LED.

	478 nm
UV-A	0.7%
Violet	0.6%
Blue	52.2%
Green-Blue	23.4%
Blue-Green	16.7%

Green	3.2%
Yellow-Green	1.2%
Yellow	0.2%
Orange	0.3%
Red	1.5%

Green LEDs

This luminaire contains 4 diodes peaking in the green portion of the spectrum at 520nm (advertised to be 3-watt Semi LEDs.)

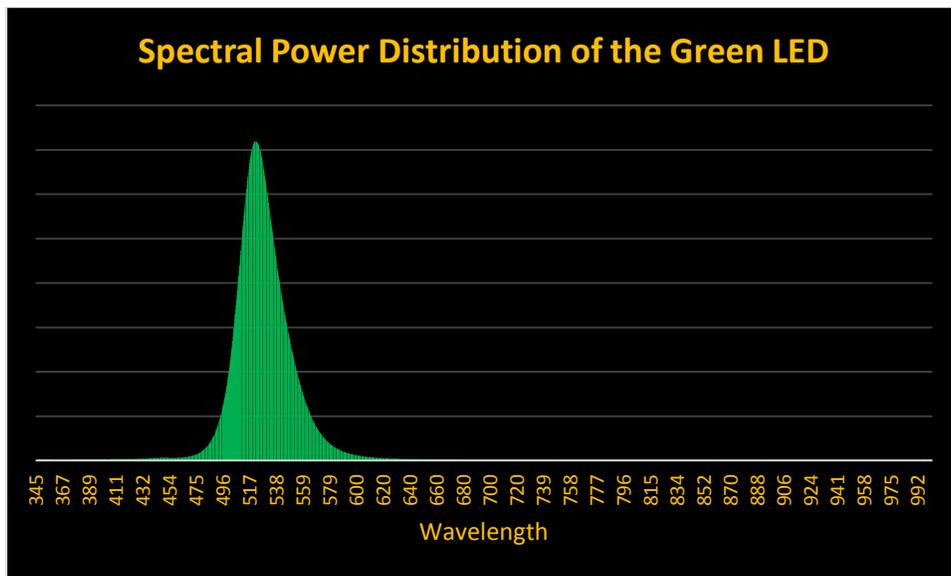


Figure 7. Green LED SPD.

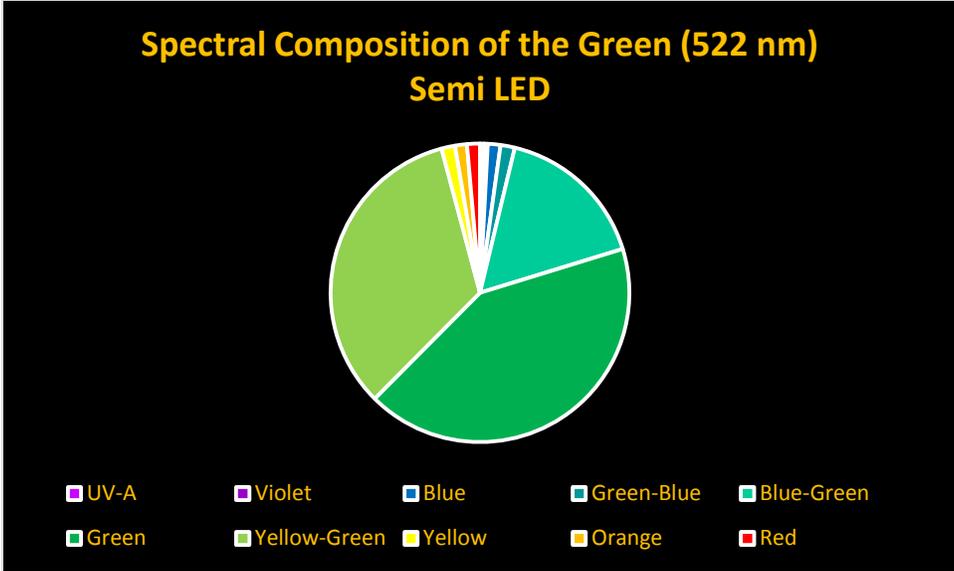


Figure 8. Green light is absorbed by the accessory pigment peridinin.

Table Four. Breakout (%) of the 522nm LED.

	Green (522 nm)
UV-A	0.5%
Violet	0.4%
Blue	1.4%
Green-Blue	1.5%
Blue-Green	16.5%
Green	42.2%
Yellow-Green	33.4%
Yellow	1.5%
Orange	1.3%
Red	1.4%

Deep Red LEDs

This light houses four 3-watt Osram 660nm Deep Red LEDs.

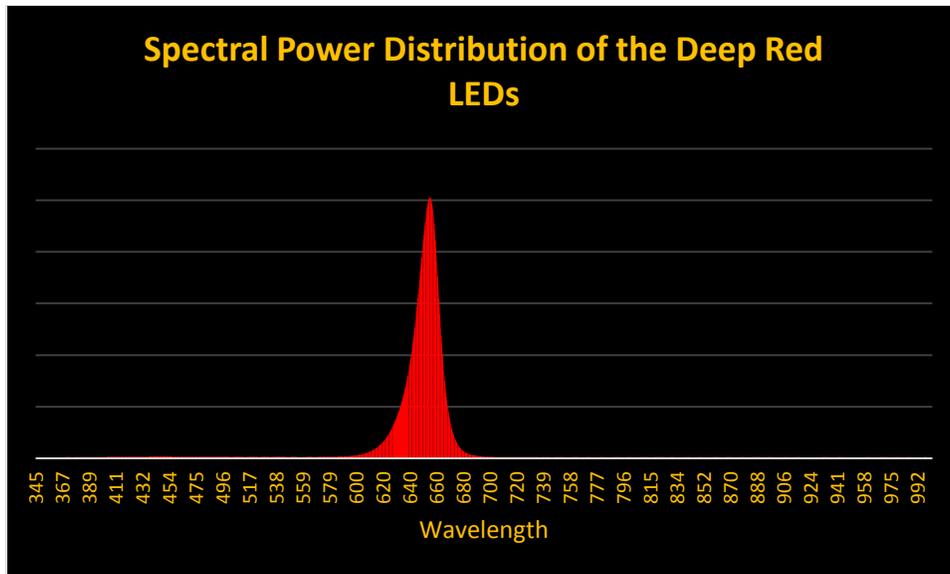


Figure 9. SPD of the Deep Red LED.

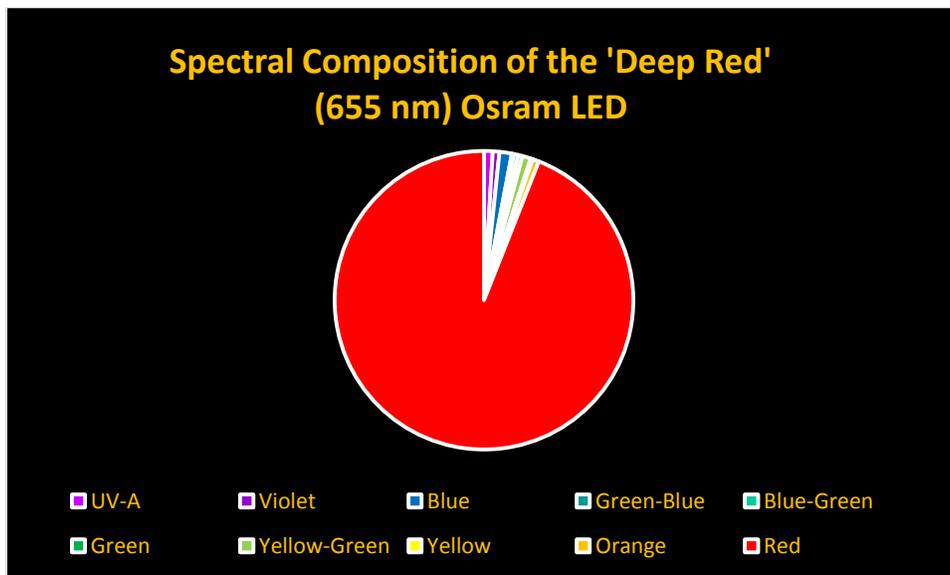


Figure 10. Red light can be absorbed by chlorophylls *a* and *C2* in zooxanthellae.

Table Five. Breakout (%) of the Deep Red LED.

	Red (655 nm)
UV-A	0.9%
Violet	0.7%
Blue	1.3%
Green-Blue	0.2%
Blue-Green	0.5%
Green	0.5%

Yellow-Green	0.9%
Yellow	0.2%
Orange	0.7%
Red	94.0%

White LEDs

This light has twenty 5500K White (5-watt Cree XP-E) LEDs.

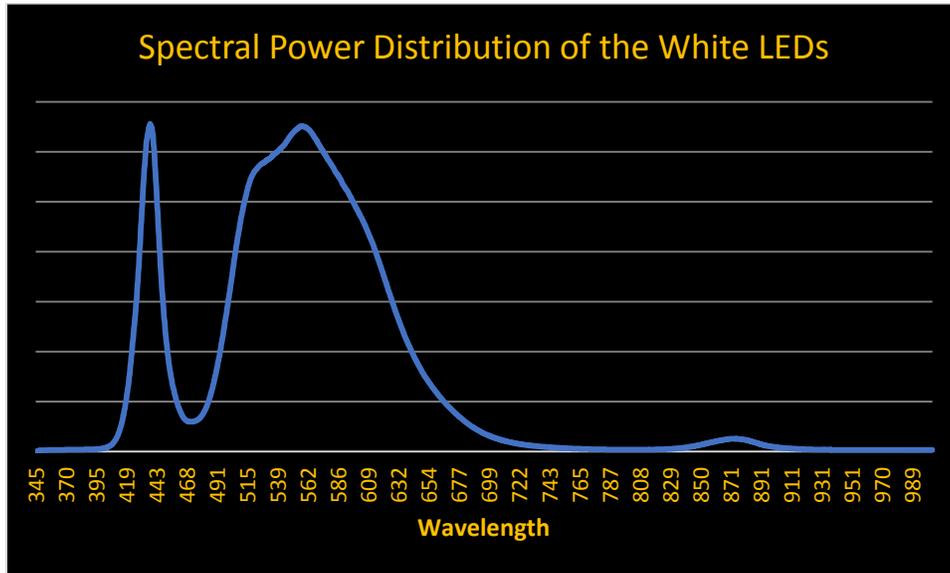


Figure 11. White light in LEDs is produced when blue light excites phosphors.

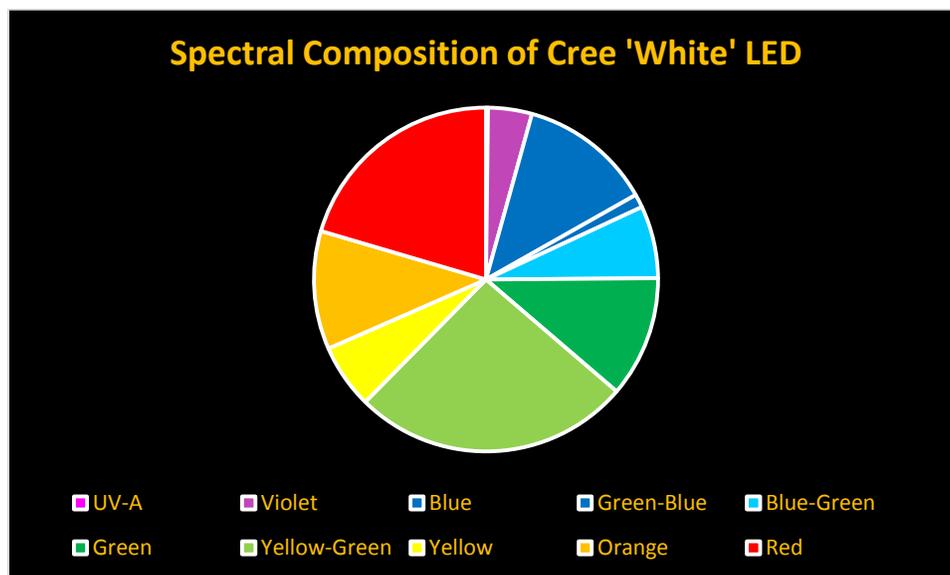


Figure 12. This spectral composition appears as white light.

Table Six. Breakout (%) of the white LED.

	White
UV-A	0.2%
Violet	4.1%
Blue	12.5%
Green-Blue	1.3%
Blue-Green	6.8%
Green	11.4%
Yellow-Green	26.1%
Yellow	6.0%
Orange	11.1%
Red	20.4%

Moonlight

Moonlight is simulated by the 450nm LEDs.

Photosynthetically Active Radiation (PAR) and Light Distribution Patterns at Various Depths

For practical purposes, light intensity is best reported through use of a quantum (PAR) meter. Simply taking one measurement doesn't tell us much, so I used a grid system and measured PPF every 4 inches on center. There were 41 measurements made at 3 different depths, for a total of 123. The LEDs were at 100% power on all 6 channels using the 'custom' option in the wireless controller with the light positioned 12.25" off the water's surface.

Figure 13 demonstrates light intensity just below the water's surface. Notice how the tank's center brace affects light intensity.

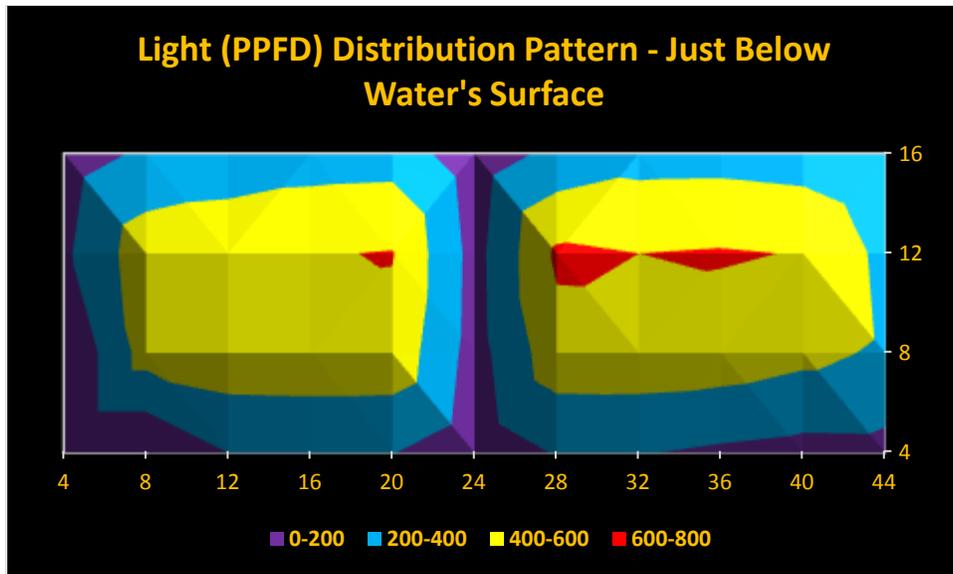


Figure 13. The aquarium's central brace casts a shadow, but...

Figure 14 shows light intensity at a depth of 10 inches. The shadow of the brace has all but disappeared. The front of the tank is at the top, and the overflow is at bottom left.

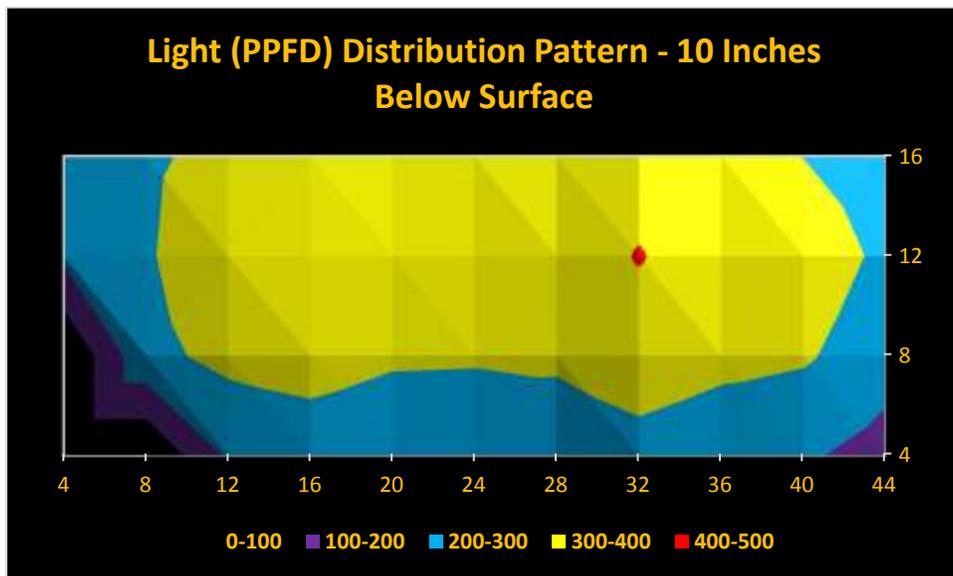


Figure 14. ... but practically disappears at a depth of 10 inches, with the light at full power and 12.25" above the water's surface.

Figure 15 is the light intensity distribution at 19 inches.

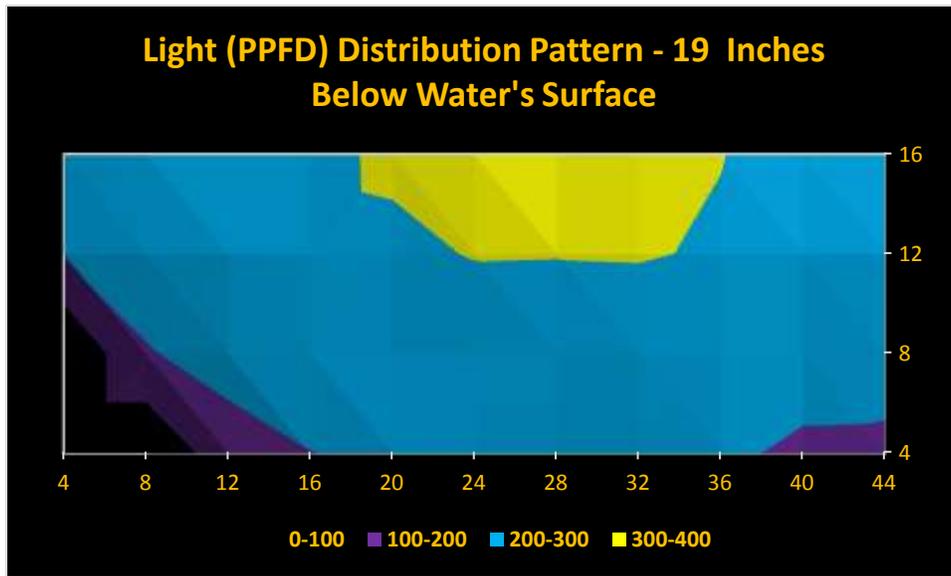


Figure 15. The front of the aquarium is at top and the overflow is at bottom left.

When the luminaire was adjusted to be about 3 inches above the water's surface, I measured a maximum of $480 \mu\text{mol}\cdot\text{m}^{-2}\cdot\text{second}$ at a depth of 19 inches and a minimum of ~ 380 . Note these measurements were made with when there was no water surface agitation. With surface agitation (at a depth of 19" and the light at full power 3" off the surface) PAR values varied between 450 and 500.

Photosynthetically Usable Radiation (PUR)

Some wavelengths are better at promoting photosynthesis than others. For our purposes, Photosynthetically Usable Radiation is an estimate of how bandwidths of light drive photosynthetic processes. A Seneye device was used to estimate Photosynthetically Usable Radiation (PUR). See Figure 16.

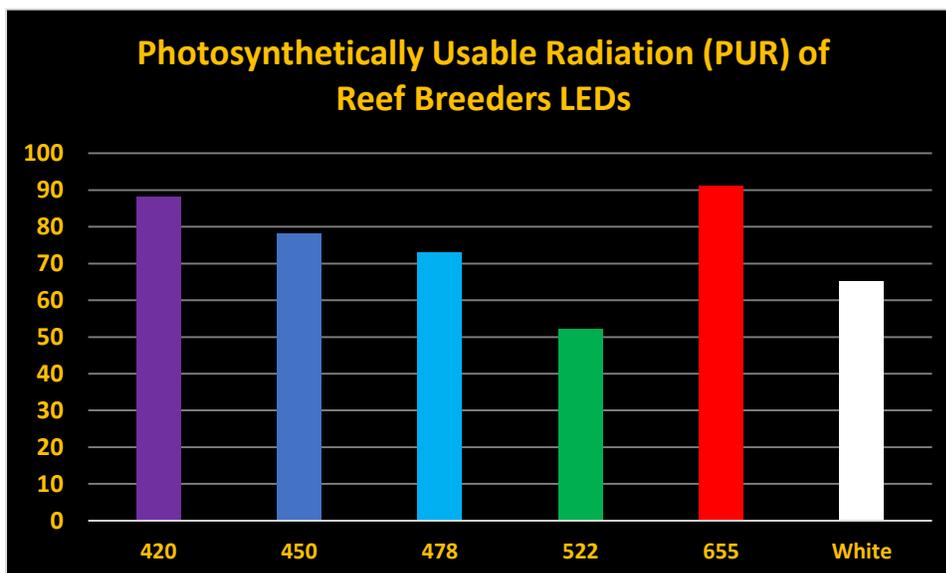


Figure 16. The Photon V2+ has 6 independently programmable channels, and a Seneye device was used to estimate PUR of each.

Controller

A wireless controller is included along with a USB cord for charging the unit. Programming is straight forward for each channel. These options are available – sunlight, cloudy, moonlight, and manual modes. There is also a lightning mode. See Figure 17.

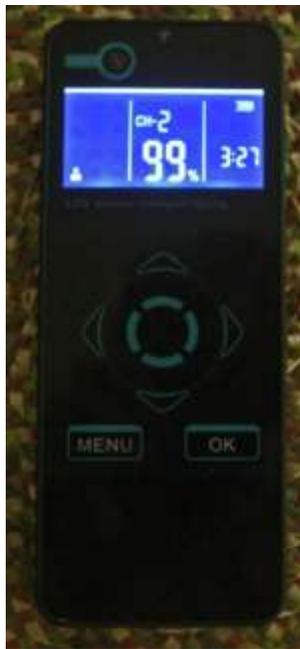


Figure 17. The wireless controller is recharged via a USB cable.

Cooling

Excessive heat is an enemy of light-emitting diodes and if not controlled, at best, can negatively affect output and, at worst, can destroy them. The Photon V2+ light has four cooling fans to keep temperature under control. As a footnote, the rectifier (power supply) can be as warm as about 90° F. A generous cord length allows it to be mounted away from the display tank.

Optional Equipment

None! This light comes with everything you'll need. In addition to the light and power supply, there is the wireless controller and USB cable for charging, and two mounting options. The first is a cable and

sling affair that allows suspending the luminaire from the ceiling. This is the best option for many acrylic tanks. The other option is the use of mounting legs.

Discussion

It is practically impossible to examine a luminaire with as many programming options as this light offers. Hence, color analyses were made of each channel and light intensity at full power. Height of the lamp above the water's surface was chosen due to another luminaire currently being tested (such as the Radion G5 Pro which has a recommended mounting height of 11 inches) hence this light was positioned at 12.25" above the water (this is one of the presets when using the mounting legs and is about as high as it can be when using this option.) Even at this height, this luminaire could deliver PPFd sufficient at a depth of 19 inches for light-loving corals such as many *Acropora* species. Considering that the Photon V2+ can be positioned to as little as about 3" off the water's surface, it is obvious that care should be exercised when positioning this powerful light. As always, use of a quality PAR meter (such as Apogee Instruments' MQ-510) is highly recommended.

Testing Methods and Materials

A 90-gallon aquarium (48" x 24" x 24") was filled with freshwater to the overflow level. The Reef Breeders luminaire was centered above the aquarium and at a distance of 12.25 inches from the water level using the mounting legs included with the light. Spectral compositions were determined by an Ocean Optics USB 2000 and OceanView software. Data were loaded into a proprietary MS Excel program, analyzed and graphed. Photosynthetically Active Radiation (PAR) was reported by an Apogee Instruments' MQ-510 quantum meter. Light distribution patterns were determined by taking PAR measurements every 4 inches across an eggcrate grid, supported at 3 distances from the light source by PVC pipes. All six channels were programmed to be at maximum power in the 'custom' mode on the controller. See photo 18. Photosynthetically Usable Radiation was estimated by a Seneye device.



Figure 18. The test aquarium with the eggcrate grid on the bottom.

Manufacturer's Suggested Retail Price

MSRP is \$699.99 USD.

Warranty

Two years, with service performed in the State of Rhode Island.

Credits

This light is on loan to me and will be donated to the Twin Cities Marine Aquarium Society after testing is completed. These individual and groups made this possible:

Jennifer & Doug Wanner of New Wave Aquaria

Ryan Snodgrass

TCMAS.org (Twin Cities Marine Aquarium Society)

Abhishek Dasgupta

As a final note, I performed this testing at no charge, and have no financial interest in any lighting company.