Low-Cost 450-watt LED Reference Design Challenges

Cost & Performance of Traditional 1000-W HPS Horticultural Lighting

Smaller...Cooler-Running...Selectable Spectrums...More Uniform Light

Easy-to-Use Remote Control with Smartphone

Cuts Annual Electricity Cost in Half and Still Get Same Productivity

Eliminates Cost and Labor of Bulb Replacement Every 24 Months

It is well known that LED lighting has a much more plant-friendly spectrum than HPS. LED can also easily provide 30-40% more productivity-per-watt than HPS--- which has most of its energy in the much-less useable yellow orange/green wavelengths. But that alone has not been enough to cause a major industry transition to LED.

The Reference Design here outlines an approach which not only delivers that known 25-30% productivity gain through a better spectrum characteristic, but ,with optics options not possible with HPS, can also facilitate significant gains in PPFD uniformity, a benefit which is the equivalent of having a fixture of even 25-30% more efficient.

The low cost and simplicity of the TFH-450 approach, coupled with its ability to be smart-phone controlled with off-the-shelf elements, opens up all kinds of possibilities.

Figure 1

Figure 2

Figure 1 shows the basic unit—a silent-fan, active-cooled pin-fin heat-sink weighing less than 1.6Kg--- can accommodate over 400 watts of LED power (eight 50-watt COBs). Figures 2 shows the same module but with high-efficiency, compact, 60-degree reflectors.

The carefully chosen beam angle of 60 degrees allows the hanging distance to be tripled without affecting average PPFD. More important, it dramatically improves the max/min PPFD uniformity (same as a 25%-more-efficient fixture), reduces "spillage" (wasted light off to the side) and greatly lessens the need to continually adjust hanging distance for plants which grow taller.

See Figure 3, showing the typical hanging distance recommendation shown for a high percentage of grow lights. The diagonal light travel Is 26 inches, twice as far as straight down. Because of the "inverse square law" of physics for light travel in this situation, this causes received PPFD at the sides to be only 25% of what exists in the center !

In Figure 4, we have the same amount of light reaching the grow bed. However, the diagonal distance is now reduced to being almost the same as straight down. Light attenuation at the sides is dramatically less. In simple language, we can say with Figure 3 we are "over" lighting the center area but "starving" the sides. With Figure 4, we are taking much of that excessive center light and sending it outward, to even things out.

The result is a grow bed which now makes sense, instead of either too much or too little light everywhere—not a formula for a productive growing facility.

Figure 3

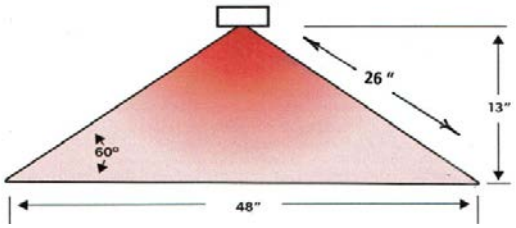

Figure 4

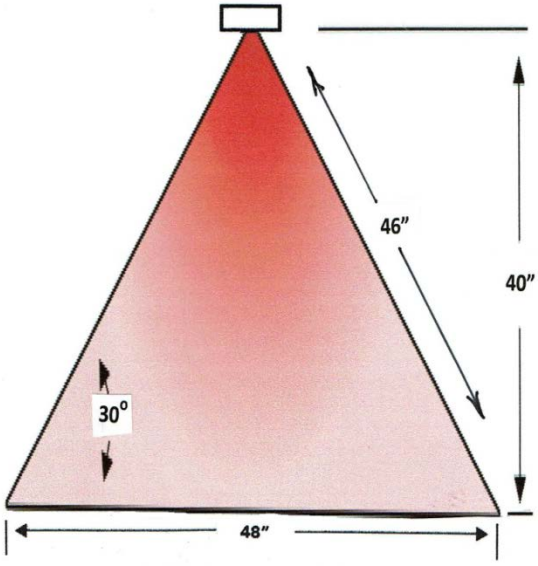

Figure 3 Typical Spectrum Options.

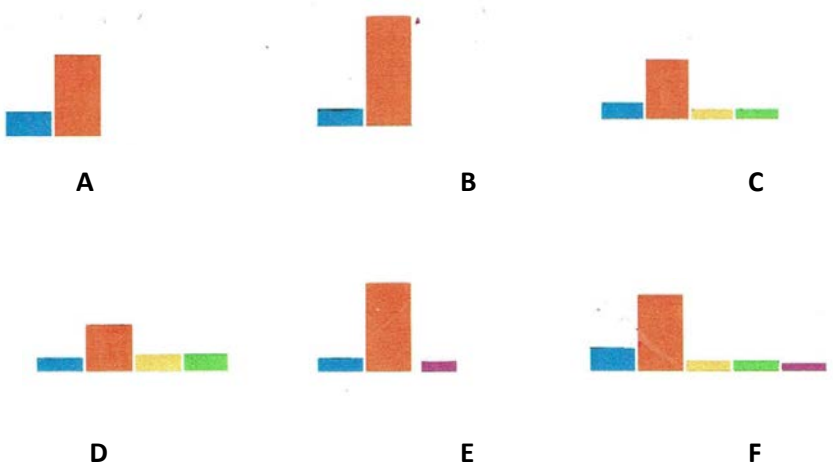

Figure 3 shows examples what is achievable just by using different combinations of five TYF COB types .The bar height shows the relative PPF energy for each wavelength color band.

While C,D and F show some green and yellow contribution, that would be accomplished by having one COB which is a full-spectrum white COB with a 3000K or 4000K color temperature.

Figure 4

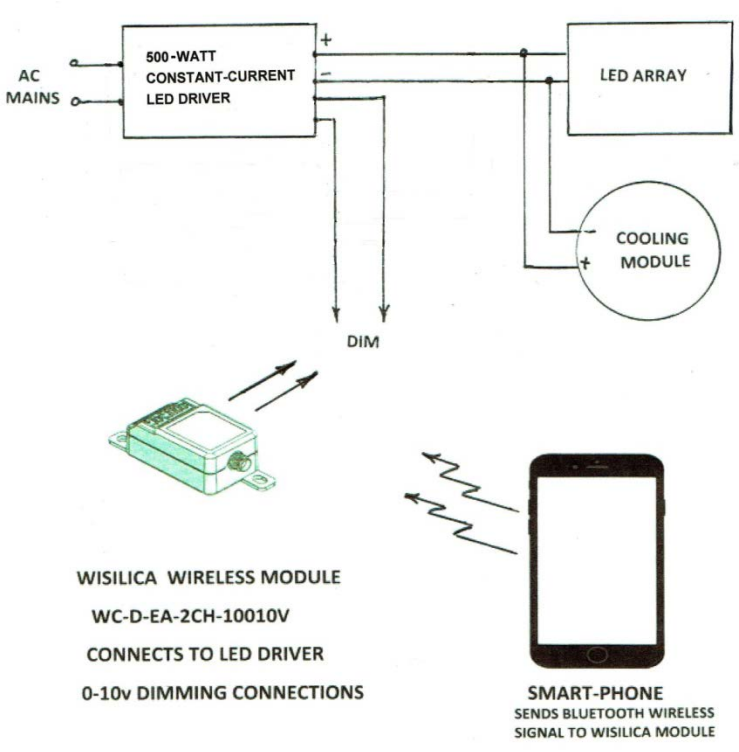

Figure 4 shows a system block diagram. The COB LEDs are powered by a constant-current analog-dimmable (0-10V) driver. ***Note: A grow-light wattage rating is based on adding the light source wattage (the LEDs or bulb) plus the wattage of the ballast or LED driver (which typically accounts for about 10-11% of total fixture wattage. So a fixture with 500 watts of "light" would typically have final rating close to 550 watts. Similarly, a 1000 W HPS, because of ballast losses, delivers only about 875-900 watts of actual light .In other words, the Reference Design would actually be described as a "550 watt" unit.***

The diagram also shows an optional low-cost, small, standard made by Wisilica. Upon receiving a Bluetooth signal from a smart-phone or tablet, the module supplies a 0-10V wire-connection signal to the LED driver to set its brightness level. The module has a second, identical output, also smart-phone controllable, which could be used, in conjunction with a mechanical or solid state relay, to switch the AC power to the grow light on or off.

The Reference Design represents a practical approach to a high-performance, compact, lightweight, very-low-cost grow-light... a genuine alternative to HPS. The final design details can be defined to suit individual needs or preferences in terms of enclosure design or the way features are implemented.

For assistance or recommendations about such details, please contact sales@tyf-usa.com.