

POWER FOR HORTICULTURAL LIGHTING

PREMIER TECHNOLOGIES | PROVEN CAPABILITIES





Horticulture Lighting Power Supplies

Power Solutions of Choice
for Horticulture Lighting Applications

Your Global Partner for Horticulture Lighting Power Supplies

Advanced Energy's focus when creating power supplies for horticultural lighting is to minimize your power consumption, installation expense, and the cost of cooling facilities. With our Artesyn product line, we offer a range of high power options (600 W to mW), scaling from single conduction/IP-rated power supplies up to large distributed external systems for ideal for vertical farms and large warehouse grow centers.

Our power supplies for individual luminaires and lower power applications (ranging from 300 to 3000 W) are designed to provide full power in compact, high density packaging that weighs less than other commercially available products.

With large farms, the use of individual luminaires is not efficient. The added complexity of individual control systems on each luminaire and the additional cabling required adds to your installation costs. The additional thermal management needed (air conditioning) as a result of the collective conversion/heat losses from the drivers adds to energy costs.

Using a large centralized current source outside the environmentally controlled growth areas and distributing power directly to all the luminaires can help eliminate the need for individual drivers and the associated costs. By offering single conduction and IP rated solutions up to large distributed external systems, Advanced Energy can help scale power for various power distribution architectures in practically any installation.

Types of Horticultural Lighting

Top Lighting – Greenhouses

- Illumination of the hall and plants from ceiling level
- Retrofitting old HPS, modifying spectral content of light

Challenges: light concentration on plants, uniformity and constant quality of light spectrum, high amount of power needed

Top Lighting – Vertical Farming

- Illumination from top of the plants at close distance

Challenges: uniform intensity and spectral distribution, plants shading each other, photosynthetic efficiency (PPF/W), heat

Intra-Canopy

- Illumination on the side or in between the plants
- Possible with LEDs (HPS too hot)

Challenges: uniform PPF, good color uniformity (if continuous/wide spectrum), spectrum fit to the rest of lighting, light direction

LED Technology Leading Horticultural Lighting Systems

The use of LED technology in horticultural lighting systems is playing a fundamental role in cutting-edge farming and growing practices that are increasingly seen as a potential way of addressing production challenges for food, pharmaceutical ingredients, plants and flowers. LED-based horticultural lighting is one of the largest and fastest growing markets.

Lighting for horticulture is quite distinct from other lighting applications. Light, in the wavelengths useful for horticulture, is called photo-synthetically active radiation (PAR) and falls within the 400 to 700 nm range.

Photosynthetic Photon Flux, or PPF, measures the total amount of PAR photons generated by a luminaire. A higher PPF means the lighting system is more efficient at creating PAR.

As researchers continue to establish the impact of specific wavelengths of light on different plants and stages of growth, broad-spectrum sources such as high pressure sodium (HPS) lamps, popularly used in greenhouses, are being outperformed by LED lights due to their flexibility in producing different PAR wavelengths.

The following benefits combine to make LED lighting the ideal choice for supplemental lighting in greenhouses as well as vertical and indoor farms that depend on artificial light.

- **Spectral output control:** LED lights offer greater control over the light output across different wavelengths, so growers can more closely match spectra to the needs of their plants, plus their luminosity can be adjusted to manage production depending on plant species and growth stage.
- **More precise targeting:** The availability of smaller LED lights improves control over where the light goes, increasing efficiency and reducing energy consumption.
- **Less radiated heat:** LED lights operate cooler than traditional HPS bulbs so can be placed closer to plants, resulting in more dense farms. This also lowers water consumption.
- **Life cycle savings:** LED luminaires typically have a longer lifetime, lower energy consumption and lower maintenance costs than traditional horticultural lighting options

Market Drivers

- Population growth & limited availability of agricultural land
- Ability to grow a steady supply of crops regardless of weather conditions
- Increased, higher-quality yield
- Government initiatives
- Legalization of cannabis for medicinal & recreational purposes
- Technical advances in LED technology

Innovative Modular and Scalable Power Solutions

By offering single conduction and IP rated solutions up to large distributed external systems, Artesyn can help scale power for various power distribution architectures in practically any installation.

LCC600 Series 600 W Total Power



- Dimming Control: 0 to 10V or resistive dimming
- 600 watts from -40 to 85°C baseplate operating temperature
- High efficiency design in a 4 x 9 x 1.57 in compact IP65 enclosure under 2 kgs
- Fanless design uses conduction cooling for thermal management – can utilize the same luminaire heatsink for thermal heat transfer
- 90 to 264 VAC or 180 to 305 VAC operating input
- Digital control: Constant voltage (default) or constant current mode of operation; programmable constant current limits through I2C/PMBus®
- External voltage or resistance dimming capable
- Active share/parallel operation for higher power

LCM Series 30 to 3000 W Total Power



- Fan-cooled alternative to the LCC600, saving ~50% of cost
- Digital control – can be set to operate in constant voltage or constant current
- Easily operated in parallel for higher power
- Great for controlled environment applications
- Conformal coating

iHP Series Configurable Intelligent High Power System



- Can drive any LED luminaire
- Customized grow cycle lighting control by setting scheduler (using calendar)
- Dimming Control: 0 to 5 V or 0 to 10 V (output completely off to full max output current)
- Removes driver heat from grow area to save on HVAC costs
- High level of scalability – multiple racks per cabinet can scale up to megawatt levels (in 3 kW increments up to 12 kW in small rack or 24 kW in large rack)
- Highly flexible input (180 to 528 VAC, single or 3-phase) and outputs (12 to 1000 VDC) allows high voltage distribution, saving copper wiring costs
- Intelligent current and voltage source control (local or via Internet) eliminates the need for individual luminaire drivers
- Digitally controlled loop compensation eliminates bothersome flickering throughout entire operating range
- Cloud-based GUI allows simple user customization of lighting profile dashboards

Power Architecture Examples Using Artesyn Power Supplies



Artesyn LCC600



Any 600W LED Luminaire



Artesyn iHP 12KW

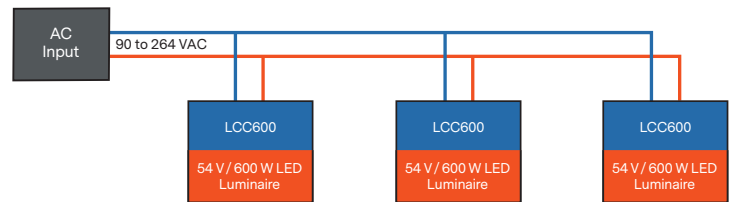


Any 600W LED Luminaire

Conventional Power Distribution with Integrated Luminaire + Driver

Example shown using Advanced Energy's Artesyn LCC600 supply/driver integrated into a 600 W luminaire.

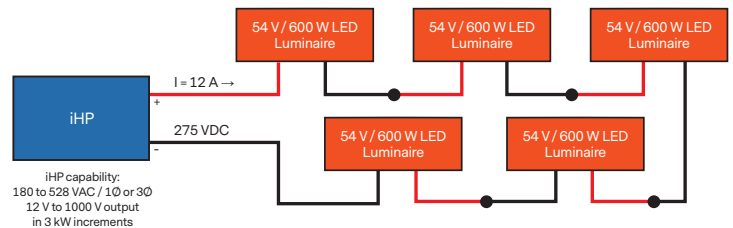
- Easily adaptable for retrofit (can utilize existing power/wiring infrastructure) and new installations
- Dimming Control: 0 to 10V or resistive Dimming (0 to 100% output current)
- Heat generated by both luminaire and driver/power supply needs to be considered in energy/cooling calculations



Centralized Power with Distributed Lighting Using 54 V LED String in Serial Configuration

Example shown using Advanced Energy's Artesyn iHP with (1) 3 kW module set to 275 VDC, 12 A constant current output.

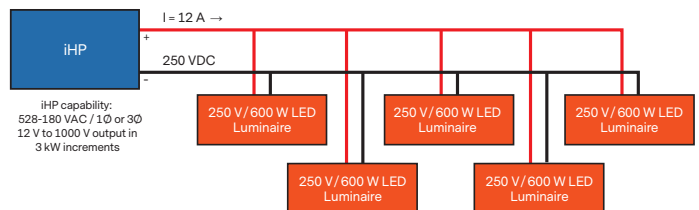
- Centralized power source and the associated conversion/heat losses can be managed separately outside the environmentally controlled growth space, lowering cooling and energy costs
- Higher voltage distribution can help reduce total installation cost (e.g., reduced wire sizes)
- Faults in serial configuration can shut down all the luminaires connected in the same loop



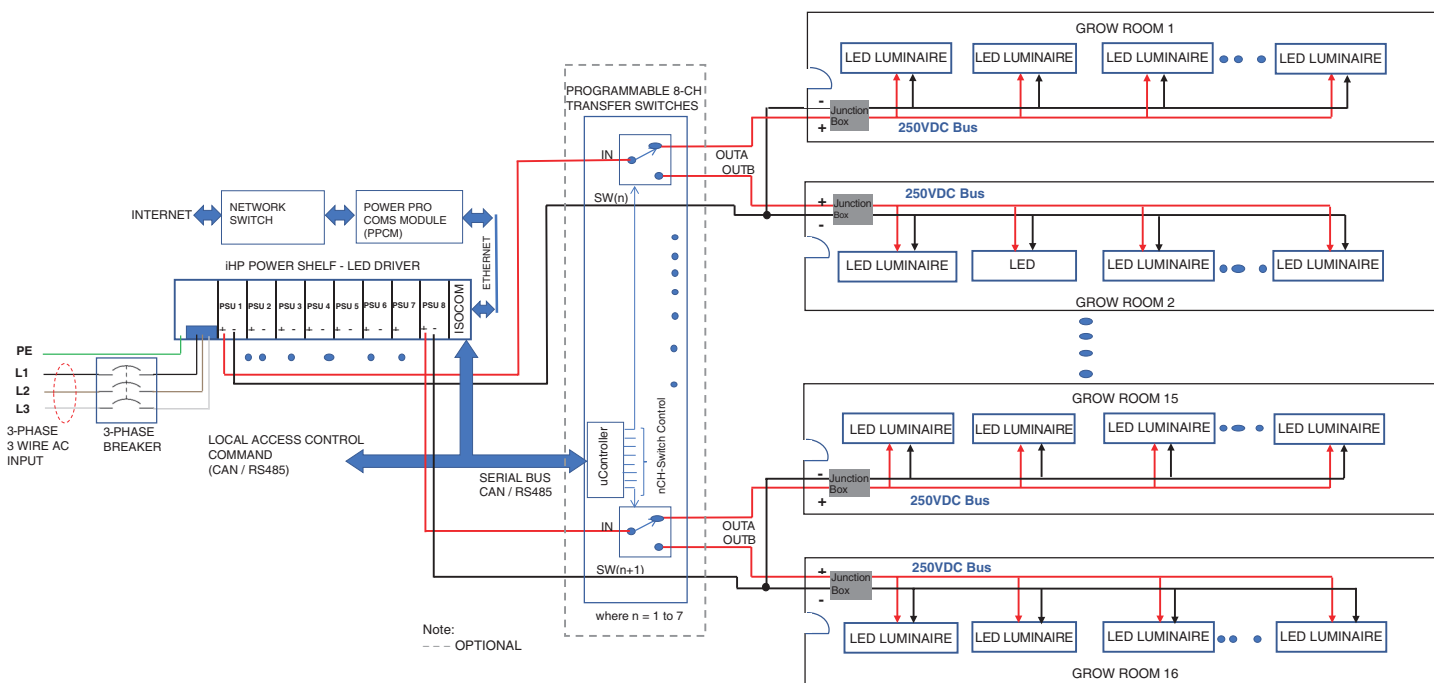
Centralized Power with Distributed Lighting Using 250 V LED String in Parallel Configuration

Example shown using Advanced Energy's Artesyn iHP with one (1) 3 kW module set to 250 Vdc, 12 A constant current output.

- 347/600 VAC 3-Phase input (Analog: 0 to 5 V or 0 to 10 V dimming Control (0 to 100% output current), Digital: Cloud-Based Ethernet or LAN control)
- Centralized power source and the associated conversion/heat losses can be managed separately outside the environmentally controlled growth space, lowering cooling and energy cost
- Higher voltage distribution can help reduce total installation cost (e.g., reduced wire sizes)
- Faults in parallel configuration will not shut down all luminaires connected on the same power rail



ARCHITECTURE OF IHP REMOTE POWER SYSTEM FOR HORTICULTURE LED LIGHTING



APPLICATION EXAMPLE: LARGE WAREHOUSE FARM REQUIRES 125.3 KW OF LED LUMINARIES

Scenario 1: Standard Direct Integrated Lighting			
AC Hook-Up Wiring	Integrated Power, Driver, & Thermal Management	Annual A/C Cost Due to Power Dissipation	Relative Installation and First Year Cost
\$21,000	\$54,400	\$9,281	\$80,681
Hoop p to 240 integrated lights	Cost of conversion, driver and thermals for 600 W (240 pcs)	Based on 8.8 KW power loss requiring 30,133.5 BTUs/Hr cooling	

Scenario 2: Distributed Lighting Using LED String Configuration in 48 V Configuration			
DC Hook-Up Wiring	Remote Power Supply	A/C Cost Due to Power Dissipation	Relative Installation and First Year Cost
\$56,808	\$16,116	\$0	\$72,924
Installation requires 1/0 cable to rack, 8 AWG to tier, 10 AWG to fixture	Cost of remote CC mode precision power supply (iHP) using 48 V configuration	All power dissipation is external to the installation	

Scenario 3: Distributed Lighting Using LED String Configuration in 200 V Configuration			
DC Hook-Up Wiring	Remote Power Supply	A/C Cost Due to Power Dissipation	Relative Installation and First Year Cost
\$12,108	\$16,116	\$0	\$28,254
Installation requires 6 AWG to rack, 14 AWG to tier, 16 AWG to future	Cost of remote CC mode precision power supply (iHP) using 200 V configuration	All power dissipation is external to the installation	

¹ A/C cost calculation used: $(\text{Operating hours} \times \text{BTU per hour}) \times 0.293 = \text{kWh} \times \text{Electricity costs per kWh}$

² Hook-up wiring requirements are estimated and costs are relative based on low volume online prices



For international contact information,
visit advancedenergy.com

powersales@aei.com
+1 888 412 7832

ABOUT ADVANCED ENERGY

Advanced Energy (AE) has devoted more than three decades to perfecting power for its global customers. We design and manufacture highly engineered, precision power conversion, measurement and control solutions for mission-critical applications and processes.

Our products enable customer innovation in complex applications for a wide range of industries including semiconductor equipment, industrial, manufacturing, telecommunications, data center computing, and medical. With deep applications know-how and responsive service and support across the globe, we build collaborative partnerships to meet rapid technological developments, propel growth for our customers, and innovate the future of power.

PRECISION | POWER | PERFORMANCE

Specifications are subject to change without notice. Not responsible for errors or omissions. ©2021 Advanced Energy Industries, Inc. All rights reserved. Advanced Energy® and AE® are U.S. trademarks of Advanced Energy Industries, Inc.