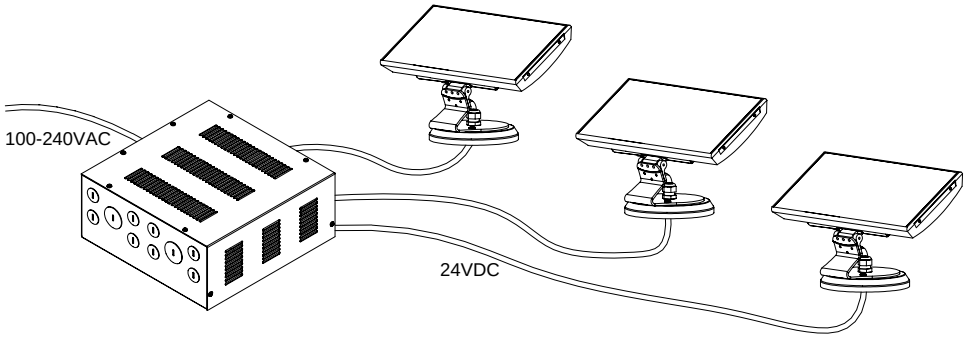
POWERING SOLID STATE LIGHTING SYSTEMS

How are LEDs driven and what power options are available for LED-based fixtures?

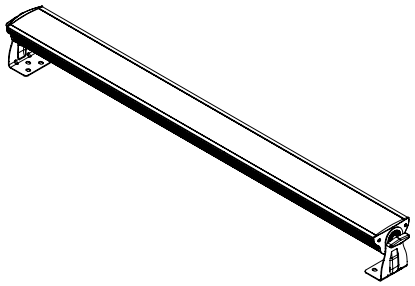
Power options for LED systems can take many forms. Each has performance and cost advantages for particular applications. In general the trend is towards integration of line voltage power system to facilitate larger scale installations and maintenance.

LEDs are inherently low voltage devices and voltage levels across each LED are in the range of 2 to 3 volts. But the important electrical drive characteristic is current control. Current levels should be fixed to insure constant output in color and intensity. Thus modulation techniques such as pulse-width modulation (PWM) are preferred over other means of driving LEDs. As a result, many LED systems are low-voltage systems running anywhere from 12VDC to 24VDC supply voltages from a power supply to the fixtures. In addition, voltage and current supplied to the LED must be carefully controlled and regulated to insure long-life and reliability.

Low Voltage Power System
In the figure below is one example of a low voltage distribution system using a 'star' configuration where each fixture has a home run of a unified power and data cable back to the power and data supply. Each fixture is individually addressable and the intelligence in the system resides in both the power/data (PDS) supply and the fixture. In Color Kinetics' system, the PDS provides a link to standard DMX data or Ethernet-based control systems.



On-board Power Integration
In another approach, the power supply can be integrated directly into the fixture. This configuration uses a standard switching power supply component incorporated directly into the fixture. The overall control and schematic of the system is similar to the low voltage system shown above but the packaging has changed. This configuration allows the fixture to be directly connected to line voltage. This approach can save on setup and installation costs but this additional components require additional space and increase thermal loads of the fixture. The ColorBlaze, shown to the right, is an excellent example of this approach – a high-output lighting system for theatrical use that is easy to install by simply connecting it to line voltage.



In-Board Power Integration
The final approach is the integration of the power supply directly into the circuitry that provides current regulation and control of the LEDs. This approach, called Powercore™, integrates all power and control circuitry to provide a very efficient means of consolidating line voltage conversion and LED current regulation into a single circuit.

Powercore™ digital power processing technology drives LED systems by integrating power and data management directly into the fixture and eliminating the need for an external power supply. Powercore surpasses traditional power supply technology by streamlining multiple conversion and regulation stages into a single, flexible, microprocessor-controlled power stage that rapidly, efficiently and accurately controls power output to LED systems directly from line voltage. Benefits of Powercore include lowered installation costs, extended runs of fixtures, uninterrupted runs without low voltage supplies, longer lead cabling, simple connection of power and data to a NEMA-type enclosure and more.

Power Factor Correction (PFC)

Powercore also integrates power factor correction into each and every fixture and this has a number of benefits. Power factor is a measure of how effectively equipment converts electric current to useful power output. Low power factor results in higher currents for a given amount of power and low power factor is bad because higher currents require heavier gauge wiring, larger transformers and results in greater losses. Thus, many of the costs of generating and distributing power are related to current, rather than power. Also, low power factor loads can pollute the electricity for other electricity customers as well. Finally, power companies will often bill customers a surcharge if their power factor is too low.

Loads such as motors, transformers, lighting ballasts and low quality power supplies for computers and consumer electronics often have poor power factor. Power Factor Correction irons out the artifacts in current, producing a clean current waveform similar to that of an incandescent bulb, which has perfect power factor. PFC results in cleaner main power and can reduce the cost of electricity and result in less loss in power distribution systems - yours and the electric company's - by limiting maximum currents. More products can be run on a given circuit with PFC than without PFC.

Color Kinetics's new power technology incorporates active full power factor correction thus mitigating the effects of low power factor. Power Factor in CK’s systems can be above 0.995 where a power factor of 1 is an ideal resistive load. This is good for you, your neighbors and the power company. As stated above, in some cases high power factor can improve circuit loading in your facility and, in some cases, even reduce electrical bills.

There are several relevant standards in this area including Electro-Magnetic Compatibility (EMC) Directives EN61000-3-2 (Harmonics) and EN61000-3-3 (Flicker) under Class C for lighting devices. For the US, devices must also meet FCC Part 15 regulations. Color Kinetics' Power Factor Corrected power systems comply with all the above regulations.