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Powercore

Powercore: Integrated Power Management for LED Lighting Systems

Patented Powercore[®] digital power processing technology represents a completely new, holistic approach to digital power processing that surpasses traditional power supply technology. Powercore integrates a microprocessor-controlled power conversion and regulation stage into LED lighting fixtures, efficiently and accurately controlling output directly from line voltage. Powercore increases the operating efficiency, lowers the overall cost, and simplifies the installation of LED lighting systems.

POWERCORE CKTECHNOLOGY

Powercore, an advanced power management system patented by Color Kinetics, integrates the power supply directly into a fixture's circuitry. By consolidating line voltage conversion and LED current regulation, Powercore limits power losses, maximizes operational efficiency, and lowers the cost of installation, operation, and maintenance.



ColorBlast 12 and its companion fixture, ColorBlast 6, are low-voltage, colorchanging LED fixtures from Color Kinetics. ColorBlast 12 is powered by a low-voltage power supply wired to mains.



A typical low-voltage configuration consists of one or more power supplies providing power and control to one or more lighting fixtures. Here, PDS-150e power supplies run three ColorBlast 12 fixtures each.

Power Options for LED Lighting Fixtures

Power options for LED lighting fixtures afford performance, ease-ofuse, or cost advantages for particular applications. Three common power options are:

- Low-voltage power distribution
- Onboard power integration
- · Inboard power integration (Powercore)

Where inboard power integration is appropriate, users can reap many significant advantages, including increased system efficiency and lower cost and complexity of installation, operation, and maintenance.

Low Voltage Power Distribution

Low-voltage LED fixtures require low-voltage power supplies or transformers and special cabling to convert line voltage into low voltage. A low-voltage power supply is essentially a "brick" in the power cord, similar to a laptop computer's power supply, and it usually produces direct current (DC).

Low-voltage systems are relatively inefficient because power is lost in the conversion from line voltage to low voltage, often through a series of modules for buck conversion, filtering, and processing. Nevertheless, low-voltage systems are preferable for certain types of applications. The rental, touring, and entertainment industries favor low-voltage lighting fixtures, which are often combined with other low-voltage devices for controlling light and sound in theatrical productions. Lowvoltage fixtures can sometimes address aesthetic concerns as well for instance, in stage designs which require no visible cabling, low-

voltage fixtures can be run wirelessly with battery packs and RF controllers.

A typical low-voltage configuration is a "star" configuration, where each fixture or series of fixtures connects directly to a low-voltage power supply through a unified power cable, often a proprietary leader cable designed to work with a specific fixture. The power supply, in turn, is connected to a power source. The number of fixtures that can be attached to each power supply is limited by such factors as the fixtures' power consumption, the distance between the fixtures and the power supply, and the number of available power supply ports.

ColorBlast[®] 12 is a color-changing, low-voltage LED floodlight from Color Kinetics, often used for wall-washing. Up to three fixtures can be connected to a single power supply, each on a maximum cable run of 60 feet. Installations requiring many fixtures use multiple power supplies, each positioned appropriately in relation to the fixtures, and each connected to a power source.

Onboard Power Integration

Onboard power integration uses the same overall control scheme of traditional low-voltage systems but offers a few advantages. It replaces external lowvoltage power supplies with standard switching power supplies integrated directly into the fixtures, allowing the fixtures to be connected directly to line voltage. This approach can save on setup and installation costs, but the additional fixture components can increase fixture size and thermal load.

ColorBlaze[®], from Color Kinetics, is a high-output linear LED fixture for theatrical use that features onboard power supplies and related thermal management controls, such as onboard thermal sensors and cooling fans. ColorBlaze can be installed simply by connecting it to line voltage with a standard IEC power cable.

Inboard Power Integration

Inboard power integration represents an entirely different approach to power management. Inboard power integration schemes incorporate the power supply directly into the fixture's circuitry to create an efficient power stage that consolidates line voltage conversion and LED current regulation. By integrating



a single, efficient power stage into the LED lighting fixture itself, inboard power integration can eliminate a significant percentage of the power losses associated with low-voltage configurations with multiple power stages.

Where inboard power integration is appropriate, users can reap many advantages, including increased system efficiency and lower cost and complexity of installation, operation, and maintenance.

Powercore Features and Benefits

Powercore is state-of-the-art for fully integrated, inboard power management of LED lighting fixtures. Among many other benefits, Powercore can:

- · Lower the cost and complexity of installation and maintenance
- Eliminate a signification percentage of the power losses associated with external low-voltage power supplies and cabling
- Maximize operational efficiency through active power factor correction
- · Increase the useful life and reliability of LED sources in lighting fixtures
- Enable universal power input
- Enable standard dimming methods, allowing the use of selected commercially available dimmers



ColorBlaze, a powerful, full-color linear LED fixture for theatrical and stage applications from Color Kinetics, features onboard power integration, thermal sensors, and cooling fans. ColorBlaze connects to power with a standard IEC power cable.

* Unlike conventional lighting, dimming LED lighting fixtures improves efficacy (lumens per watt) and increases lumen maintenance. * Powercore simplifies and lowers the cost of installation and operation. Fixtures featuring Powercore technology install like conventional lighting fixtures, and can cost the same or less to install.

Powercore Lowers the Cost and Complexity of Installation and Maintenance

By eliminating the need for external power supplies and special cabling, Powercore reduces installation costs and removes barriers to adoption, as electrical contractors and installers can easily install Powercore-based systems using familiar methods and tools.

Powercore also lowers cost and eases installation by reducing a system's total parts count, minimizing the size and weight of the power management components required to run a lighting system, and extending fixture and cable runs.

For example, ColorBlast Powercore, the Powercore-based version of the low-voltage ColorBlast 12 fixture discussed previously, can be connected together in runs of 30 to 50 fixtures per circuit, depending on the configuration, as opposed to a maximum of three fixtures per power supply. This dramatically reduces the number of power / data supplies required for a installations with many fixtures. Similarly, individual run lengths can extend to 175 ft, as opposed to the low-power configuration's run limit of 60 ft, further simplifying installation and adding flexibility in fixture positioning.

By minimizing the number of required power supplies and eliminating the need for special cabling in a lighting system, Powercore simplifies and lowers the cost of maintenance in much the same way that it simplifies and lowers the cost of installation.



Powercore Minimizes Operational Power Losses

Powercore can eliminate a significant percentage of the power losses associated with external low-voltage power supplies and cabling. For colorchanging fixtures, Powercore eliminates approximately 18% of the power losses incurred in low-voltage power distribution systems. For white-light (eW) fixtures, which feature integration of power factor correction and LED driver circuitry into a single power management stage, Powercore can achieve up to 90% power efficiency from end to end.



* LED lighting fixtures that incorporate Powercore technology offer energyefficiency superior to comparable conventional and non-Powercore LED lighting fixtures. Powercore makes LED lighting fixtures better for the environment and less expensive to operate.

Inboard Power Integration for eW (single color) Powercore Fixture

Powercore Maximizes Operations Efficiency through Active Power Factor Correction

Powercore incorporates active power factor correction circuitry into each circuit to mitigate the effects of low power factor and maximize operational efficiency.

Power factor is a measure of how effectively a device converts electric current to useful power output. Low power factor results in higher currents for a given amount of power. Low power factor loads can pollute the electricity supply by tying up grid capacity in excess of the actual wattage that customers require to run their electrical devices. To compensate for low power factor, power companies must either generate more energy than is actually necessary, or increase the size of the components in their transmission systems (wiring, generators, conductors, transformers, and so on) to handle the higher currents. In either case, low power factor results in higher costs for generation and transmission, and results in greater energy losses. Power companies often bill customers a surcharge if their power factor is too low, driving up the cost of electrical operation across the board.

* Power factor correction lowers the cost of electricity, minimizes wasted current, and increases the efficiency of the entire electric generation and distribution system. Motors, transformers, lighting ballasts, and low-quality power supplies for computers and consumer electronics often have low power factor. *Power factor correction* (PFC) uses a system of inductors, capacitors, or voltage converters to adjust the power factor of electronic devices toward the ideal power factor of 1.0. Because PFC results in cleaner main power with less loss in power distribution systems, more devices can run more efficiently on a circuit with PFC.

Power factor in Color Kinetics lighting systems typically measures above 0.995, very close to the ideal power factor of 1.0.

Powercore Increases the Useful Life and Reliability of LED Sources in Lighting Fixtures

Line power supplied to LED lighting systems ranges from 100 to 277 volts, depending on region, while LEDs typically consume only two to three volts each. Power conversion and regulation, therefore, is especially important in LED lighting systems — not only to step voltages down to appropriate and efficient levels, but also to minimize current fluctuations, power surges, and short circuits that can shorten LED lifetimes, cause inconsistencies in color output and intensity, or disrupt operation.

An LED driver is an electronic circuit responsible for converting input power into a *current source* — a source in which current remains constant despite fluctuations in voltage. Powercore incorporates both an integrated LED driver and a pulse-width modulation (PWM) switch controller to fix current levels, ensuring consistent LED source operation and maximizing useful life.

A closed-loop control system provides accurate tracking of loads and current control, ensures high efficiency even at low loads, and can eliminate OFF state power consumption, a hidden energy cost in some traditional low-voltage systems.

Powercore Enables Universal Power Input

Because Powercore integrates the power supply directly into the fixture, and the voltage required to run the fixture is known, Powercore supports universal power input. As a result, some Powercore fixtures can receive input voltages in the range of 100 – 277 VAC, and reliably and efficiently supply the required wattage to run the fixture. This means that Powercore-enabled lighting fixtures can be installed and operated in the same way in any part of the world, regardless of local line voltage — an especially useful feature for touring productions and lighting designers with clients in multiple countries.

* Powercore ensures consistent and reliable LED source operation, maximizes useful life, and eliminates OFF state power consumption.



CN Tower — Toronto, Canada



World Market Center – Las Vegas, Nevada

A Proven Technology

Color Kinetics was the first lighting company to develop highperformance solid-state lighting systems with integrated control technology, beginning with ColorCast 14 and iColor Cove MX Powercore in 2004. Since then, Color Kinetics has incorporated Powercore technology into more than 20 commercial products, providing a key differentiator in the increasingly competitive LED lighting market. Color Kinetics plans to incorporate Powercore into the majority of its new LED fixtures, including many already in development.

A number of high-profile landmarks around the world are illuminated by Powercore-based LED systems today, including:

- CN Tower in Toronto, Ontario, Canada, the world's tallest free-standing tower
- The legendary Hollywood Bowl in Los Angeles, California
- Globen Arena in Stockholm, Sweden, the world's largest spherical building
- The Singapore Flyer, the world's largest observation wheel

Powercore fixtures have also been installed successfully in thousands of commercial, retail, and residential venues, and have been used to dramatic effect by dozens of touring and theatrical productions around the world.

Color Kinetics offers a growing portfolio of Powercore-enabled whitelight LED lighting fixtures for general illumination, bringing the benefits of inboard power integration to linear cove lights, under-cabinet fixtures, downlighting, and wall washing and wall grazing, and architectural floodlighting and spotlighting.



Harrah's — Atlantic City, New Jersey



Target Interactive Breezeway — New York, New York



Natural History Museum – London, England

Please visit the LED Lighting Showcase at www. colorkinetics.com/showcase/ for dozens of additional examples of Powercore fixtures in use around the world

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