Integrated Connections: The LED Guide
The LED Guide

Light up your next design – we have assembled a library of product information, development kits, and reference designs to jump start your next LED based design project.

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LightSpeed Americas provides LED technical expertise, integrated solutions and best-in-class products, helping to accelerate our customer’s time-to-market.

SPECIALIZED LED DESIGN & SUPPORT ECOSYSTEM
We have assembled a team of Avnet, Supplier and Partner resources to provide a true LED Design and Support Ecosystem.

AVNET ACCOUNT MANAGERS AND FIELD APPLICATION ENGINEERS
Providing customers with day-to-day supply and design chain support for LED Technology requirements.

AVNET ILLUMINEERS
Field-based LED Lighting experts with literally decades of design and sourcing expertise for LED based projects. Trusted advisors mobilized and available for customer support.

SUPPLIER NETWORK
Avnet’s line up of supplier partners provide a full portfolio of electronic control, LED, optics, power management and thermal management devices and solutions.

FROM ENGINEERING TO “TOTAL SOLUTION” DESIGN PARTNERS
The Avnet Technical Network connects customers to design resources with the objective of accelerating new project development. These partners offer engineering design services, software expertise, and manufacturing capabilities tied to LED technology and key markets.

AVNET LIGHTLAB
Avnet LightLab was created to offer our customers a wide range of services tied to our LED and lighting products portfolio. This is complemented by special measurement/evaluation tools, control software, source meters and multimeters, thermal cameras and supplementary tools. Our ultimate goal is to enable customers to bring their products to market more efficiently.

LIGHTING SOLUTIONS – A HOLISTIC APPROACH
What’s Involved and What We Support:
LED ADVANTAGE

The core element of every LED-based lighting system is, of course, the LED itself.

While conventional incandescent ‘light bulbs’ heat a piece of metal wire filament, which not only gets hot but also emits light, LEDs operate on a totally different basis as they use the photoelectric effect. As the color of the emitted light is directly related to the specific temperature of the filament, the expression ‘Color Temperature’ is still used today to describe the variations of white light. LED Lighting has a number of advantages over traditional light sources, but requires an ecosystem of supporting devices.

OPTICS

Once the light is emitted from the light source it needs to be directed and guided according to the individual application needs.

Proper optics are often just as important a part of a good quality product, than other key components like the LEDs and drivers. Suitable high quality optics achieve better beam control by reduction of glare caused by the “point source” LED and a wide angle intensity distribution. It offers possibilities to make more uniform light with different beams and cutoffs. This is needed for illumination standards in many applications such as street lights, aviation lights and medical lights. A good optic also gives a finished look and a protection for the LED.

THERMAL MANAGEMENT

LEDs are temperature dependent

The thermal management of LEDs ensures the reliable operation of the LED, prevents early degradation and optimizes the LED’s optical performance. Operating LED-based lighting systems at high ambient temperatures without proper thermal design may overheat LED packages, eventually lead to short lifespan or device failure in the worst case. Thermal management of LEDs is the most critical part within the LED based lighting system: designers need to ensure that the LED will never exceed its specific maximum permissible junction temperature.

CONTROL & SENSING

With specific control it is not only possible to activate or deactivate the LED light but also to dim it, change temperature or color and manage ambiance.

Modern luminaires are asking for more added value like dimming, presence sensing, remote control, etc. where more complex electronic circuitry are required. LED lighting offers several inherent benefits compared to other lighting systems as they can be integrated into the electronic control system which allows control of color balance and intensity, independent of each other while maintaining color rendering accuracy. To keep today’s development cycles as short as possible there are several suppliers offering intuitive online tools to help simplify your design.

LED DRIVERS

Control the current flow and manage power for LED devices

Some applications require LED drivers to be used between input voltage and required output voltage. According to the type of output we have three groups of drivers: Constant Current (CC) – LEDs are in serial connection and driver delivers precise current value, Constant Voltage (CV) - LEDs are in parallel connection which is ideal for decorative LED strips, this topology is not recommended for dimming and Special Drivers (CC+CV) – a more complex solution allowing both serial and parallel connections. There are several parameters to consider when selecting LED drivers: rated current/voltage, rated power and device efficiency.

POWER MANAGEMENT AND CONVERSION

While incandescent bulbs need a constant voltage to emit a constant amount of light, LED lights require a specific driving circuit.

DC/DC converters, AC/DC converters and other SWITCHED-mode POWER SUPPLIES enable the driving of LEDs in a more efficient way as their power losses are minimal. These driving circuits are more complex requiring a higher number of external components. They operate at switching frequencies from the low 100 kHz range up to more than 1 MHz. Sometimes built-in diagnostic features allow for precise monitoring of the devices. Depending on the application, different kinds of switched power supplies are used. Your Avnet team will consult with you and provide advice about the most suitable driver circuit.
MARKETS SERVED

INDOOR LIGHTING
LED Lighting provides a number of advantages for home, office and retail applications.
LED technology is being used in the home, office and retail. The ability to vary light quality, color, direction and intensity coupled with the capability to customize solutions is making LED based lighting increasingly popular.

OUTDOOR LIGHTING
LED lighting is perfectly suited for outdoor use providing years of virtually maintenance free service.
LED technological ruggedness, low temperature operation and size allows designers to create luminaires in almost any shapes for outdoor use. Their durability is ideal in applications with strong probability of lamp breakage especially in industrial areas, gardens, bridges, public transportation objects and stadiums.

STREET LIGHTING
LED technology is a key element for the future of dynamic traffic management and street illumination.
LED technology has wide usage in Variable Message Signs (VMS) for traffic guidance and information purposes. LED lighting provides better uniformity of luminance improving visibility at night. Optical quality for street illumination and signalization, better night vision and dynamic traffic management has spread the world-wide use of LED street lighting.

SHOW LIGHTING
New LED technology brings innovation and increases customer experience in events and venues across the globe.
Various advantages of LED technology will bring you exceptional event lighting design, event production within electronic backup control, staging effects, optimized power solutions, exhibition lighting and an extensive selection of new ideas.
FEATURED SUPPLIERS

Broadcom is one of the largest producers of visible light-emitting diodes in the world. Broadcom’s LEDs create brilliant lights with rich life-like colors for customer applications that are longer lasting and at a globally competitive price.

Cree Inc. is a market-leading innovator of lighting-class LEDs and semiconductor products for power and radio frequency (RF) applications. With more than 4,000 patents, Cree remains the driving force behind the innovative high-power LEDs that have redefined lighting to significantly improve overall lighting system value for applications such as street, outdoor area, stadium, retail spot and high-bay lighting.

Everlight Electronics is a leading global Optoelectronics manufacturer of low and high Power VISIBLE LEDs, SMD and Thru-Hole Lamps, Digital Displays, INFRARED Emitters, Optical Sensors, Fiber Optic and Optocoupler components. We provide solutions for various applications in the lighting, consumer, computing, automotive, telecommunication and industrial market segments.

OSRAM Opto Semiconductors offers solutions from basic semiconductor technologies to individual customer applications. OSRAM produces top-quality solutions in various fields such as sensor technology and laser systems. The product portfolio comprises high-performance, light-emitting diodes (LEDs) e.g. for automotive and general lighting applications miniature LEDs for indicators, as well as infrared diodes (IR), semiconductor lasers and detectors.

With its high potential for energy savings and extended lifetime, LED lighting is now the top choice for the majority of lighting applications. Infineon offers a full range of AC/DC, DC/DC, linear LED control solutions, and microcontroller-based LED solutions addressing various lighting applications from a simple strip light to high power LED headlights. With a focus on supplying tailored LED driver ICs, MOSFETs, and sensors for commercial lighting and automotive lighting applications, finding a solution for your application within our portfolio of high-quality, energy-efficient products is easy.
MAZeT GmbH is a leading provider of electronic design and manufacturing services for the medical engineering, automation engineering and industrial metrology markets. The company specializes in the development of customer and application-specific integrated circuits and embedded systems, while utilizing modern technologies. For example, LED light regulation, color measurement or metrology tasks are application examples for its new JENCOLOR® spectral- & color sensor solutions.

Molex features a full portfolio of interconnect solution for devices and applications using LEDs. Typical uses include main door and outdoor illumination, displays and signage, transportation lighting, and illuminations controls. Products include, flex assemblies, connectors, LED Holders, cable assemblies and sealed interconnect systems.

From outdoor luminaires to commercial refrigeration, innovation in lighting is taking advantage of broad-based technological progress. Whether you are creating a new system or enhancing an existing design, TE is your lighting solutions provider for electromechanical and electronic components that seamlessly integrate controls and transmit power and data across multiple building systems.

Sunon offers active cooling solutions for LED components with thermal capabilities more effective than standard passive heat sinks. Sunon offers cooling modules with three types of configurations to choose from and offer a wide range of customized thermal solutions designed specifically for LED applications.

Surface Mount Technology Corporation (SMT) provides solution based Electronic Manufacturing Services (EMS) for low-to-medium volume, high mix, complex PCB assembly and complete Higher Level Assembly (HLA) integration. SMT's reputation is built upon expertise in manufacturing and supply chain management. Value is driven to customers through exceptional quality, taking every effort to reduce total cost, and thorough customer service. SMT's customer focused cross-functional teams that reduce time to market achieve that value.
Featured Products
Broadcom is one of the largest producers of visible light-emitting diodes in the world. Broadcom’s LEDs create brilliant lights with rich life-like colors for customer applications that are longer lasting and at a globally competitive price.

They offer “one-stop shopping” with their wide array of LED (Light Emitting Diodes) Solutions. Broadcom’s large manufacturing base and many years of experience from their HP and Agilent days make them one of the largest producers of visible LEDs in the world.

BROADCOM CREATES BRILLIANT LONGER LASTING LEDS

HIGH BRIGHTNESS SMT LAMPS

Broadcom SMT Lamps have the same luminous intensity as conventional high brightness, through-hole LEDs. SMT lamps can be assembled adopting common SMT assembly processes and are compatible with industrial reflow soldering processes. The LEDs are made with an advanced optical grade epoxy for superior performance in outdoor sign applications. For easy pick and place assembly, the LEDs are shipped in tape and reel. Every reel is shipped from a single intensity and color bin for better uniformity.

Features & Benefits:
- Compact form factor
- High brightness material
- Available in Red, Amber, Green & Blue
- JEDEC MSL 2A
- Compatible with reflow soldering process
- Typical viewing angle: 15°, 23°, 30° & 40x100°
- Tinted lens
- Well defined spatial radiation pattern
- High Reliability

Applications:
Full Color Sign, Mono Color Sign, Gas Price Sign, Warning Sign, Traffic Signal, Variable Message Sign

2835 LED SERIES

Broadcom 2835 LED series is a 0.2W compact device with superior package design to achieve high light output with better flux performance. They can be driven at high current and are able to dissipate heat efficiently. These LEDs are able to operate under a wide range of environmental conditions, making them ideal for various lighting applications.

Features & Benefits:
- Compact package size of 2.8x3.5mm with low height of 0.7mm
- Available in CCT 3000K, 4000K and 6500K per ANSI
- High CRI ≥ 80
- Superior price-performance ratio in mid power segment
- High Reliability

Applications:
Lighting & Luminaires such as Downlights, Tubes, Panels & Troffers, Advertisement Panel Backlighting, Home Appliances Lightings & Electronics Signage
HIGH BRIGHTNESS CHIPLED SERIES

Broadcom high brightness ChipLED is a surface mount device that offers industry-leading performance in popular 0603 and 0805 footprint. Its small form factor allows flexible board or custom design. The LED can be closely mounted thus offering cost effective solution to customer. Recommended for backlighting, gaming, audio/video equipment, Industrial, and home appliance applications.

Features & Benefits:
- Available in all colors
- Available in industry standard foot print 1.6x0.8x0.6mm and 2.0x1.25x0.8mm
- Compact footprint & high brightness performance
- Well suited for backlighting application
- High reliability
- Wide viewing angle

Applications:
- Available in industry standard foot print 1.6x0.8x0.6mm and 2.0x1.25x0.8mm
- Compact footprint & high brightness performance
- Well suited for backlighting application
- High reliability
- Wide viewing angle

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CREE REINVENTING LEDS

CREE DIRECTIONAL XLAMP LEDS
- Extreme High Power LEDs double the light output of previous high power LEDs of the same size
- Industry’s best lumen density and optical control
- Excellent L90 & L70 lifetimes, even in high stress conditions

<table>
<thead>
<tr>
<th>XLamp</th>
<th>Package</th>
<th>Footprint (mm)</th>
<th>Lumen Range</th>
<th>LPW</th>
<th>Voltage Class</th>
<th>Max Current (A)</th>
<th>Option</th>
<th>Color Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>XQ-E</td>
<td></td>
<td>1.6</td>
<td></td>
<td></td>
<td></td>
<td>1.000</td>
<td>High Intensity</td>
<td>ROY, BLU, GRN, PCA, RDO, RED, HE PHR</td>
</tr>
<tr>
<td>XT-E</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3 V</td>
<td>1.500</td>
<td>ROY</td>
<td></td>
</tr>
<tr>
<td>XP-G3</td>
<td>Discrete</td>
<td>3.45</td>
<td></td>
<td></td>
<td></td>
<td>2.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>XP-L2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>XHP35</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12 V</td>
<td>1.050</td>
<td>High Intensity</td>
<td></td>
</tr>
<tr>
<td>XHP50</td>
<td>Array</td>
<td>5.00</td>
<td></td>
<td></td>
<td>6 V 12 V</td>
<td>3.000 1.500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>XHP70</td>
<td></td>
<td>7.00</td>
<td></td>
<td></td>
<td>6 V 12V</td>
<td>4.800 2.400</td>
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</tr>
</tbody>
</table>

CREE SURFACE MOUNT ARRAYS
- More effective way to achieve lower system cost over mid-power LEDs
- Chip-on-Board Performance in a Surface-Mount LED
- High Lumen Density, Ceramic Reliability
- Tight Color Consistency: 2-Step, 3-Step & 5-Step Bins
<table>
<thead>
<tr>
<th>MH LEDs</th>
<th>Footprint (mm)</th>
<th>Maximum Light Output (lm) at Tj = 85°C</th>
<th>Maximum Current (mA)</th>
<th>Maximum Power (W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MHB-A</td>
<td>9 V</td>
<td>5.0</td>
<td>848</td>
<td>700</td>
</tr>
<tr>
<td></td>
<td>18 V</td>
<td></td>
<td>350</td>
<td>718</td>
</tr>
<tr>
<td></td>
<td>36 V</td>
<td></td>
<td>175</td>
<td></td>
</tr>
<tr>
<td>MHB-B</td>
<td>9 V</td>
<td></td>
<td>700</td>
<td>931</td>
</tr>
<tr>
<td></td>
<td>18 V</td>
<td></td>
<td>350</td>
<td>618</td>
</tr>
<tr>
<td></td>
<td>36 V</td>
<td></td>
<td>175</td>
<td></td>
</tr>
<tr>
<td>MHD-E</td>
<td>9 V</td>
<td></td>
<td>1400</td>
<td>1615</td>
</tr>
<tr>
<td></td>
<td>18 V</td>
<td></td>
<td>700</td>
<td>1418</td>
</tr>
<tr>
<td></td>
<td>36 V</td>
<td></td>
<td>350</td>
<td></td>
</tr>
<tr>
<td>MHD-G</td>
<td>18 V</td>
<td></td>
<td>1000</td>
<td>2253</td>
</tr>
<tr>
<td></td>
<td>36 V</td>
<td></td>
<td>500</td>
<td>175</td>
</tr>
</tbody>
</table>

**CREE INTEGRATED ARRAYS**
- Optimized to Lower System Cost: Improved Lumen Density, Reliability & Color Consistency
- Tight Color Consistency: 2-Step, 3-Step & 5-Step Bins

**CREE HIGH DENSITY INTEGRATED ARRAYS**
- Highest lumen density for their LES
- Optimized for high-intensity spot lights, PAR and CMH replacements

<table>
<thead>
<tr>
<th>CXA LED Arrays</th>
<th>LES (mm)</th>
<th>Lumen Range (lm)</th>
<th>Current Range (mA)</th>
<th>Maximum Power (W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CXB1310</td>
<td>18V</td>
<td>6</td>
<td>800 – 3600</td>
<td>700 – 1400</td>
</tr>
<tr>
<td></td>
<td>36V</td>
<td></td>
<td>350 – 700</td>
<td>24</td>
</tr>
<tr>
<td>CXB1520</td>
<td>9</td>
<td>1160 – 6400</td>
<td>500 – 1400</td>
<td>49</td>
</tr>
</tbody>
</table>

**SMALL (≤14-MM LES) STANDARD-DENSITY INTEGRATED ARRAYS**
Optimized for:
- Directional and non-directional lighting
- Applications that traditionally use incandescent, halogen and CFL
- LES ranging from 6 to 14 mm, delivering light output ranging from 250 to 7300 lm

**LARGE (>14-MM LES) STANDARD-DENSITY INTEGRATED ARRAYS**
Optimized for:
- Directional and non-directional lighting
- Applications that traditionally use ceramic and pulse-start metal halide
- LES ranging from 19 to 30 mm, delivering light output ranging from 800 to 18000 lm
EVERLIGHT LEDS WITH INNOVATION

2835 LED SERIES
Everlight 2835 series is a compact device which allows for design freedom and provides a superior overall system solution when a design requires high lumen output and good efficacy. With an industry standard footprint, the Everlight 2835 series is a perfect upgrade from other mid power offerings.

Features & Benefits:
- Compact package size of 2.8 x 3.5 mm with low height of 0.7 mm
- High efficacy up to 190lm/W with excellent thermal dissipation
- Best price-performance ratio in the low/mid power segment
- Comparable luminosity to 5630, 3030, and 3014
- ANSI & 3-Step MacAdam ellipse color kits available
- Small form factor allows for flexible board designs
- Enables efficient system design with uniformed light
- Meet demanding color quality requirements

Applications:
Downlights, Indoor Area Lighting, Linear, Tubes, Troffers and Lamps

5630 LED SERIES
Everlight 5630 series brings industry-leading performance and reliability to mid-power LEDs for the lighting market. Everlight’s 5630 LED’s low power, high efficacy, and low thermal resistance make it a perfect solution for high-density arrays and strip lighting and backlighting applications where a more uniform light distribution is desired. 5630 enables designs for distributed light sources that meet the most demanding color quality requirements. Offered in the full CCT range from 2700 K – 6500 K and with a minimum of 80 CRI and 90 CRI offerings. Everlight 5630 is engineered for both consumer and professional lighting applications. Ideal for efficient and homogeneous lighting applications.

Features & Benefits:
- Industry standard package 5.6 x 3.0 x 0.65 mm
- Highest efficacy with 210 lm/W at 65 mA
- Full range CCT 2700 K – 6500 K
- ANSI & 3-Step MacAdam ellipse color kits available
- Enables efficient system design with uniformed light
- Meet demanding color quality requirements
- High Reliability

Applications:
Downlights, Indoor Area Lighting, Linear, Tubes and Troffers
**3030 LED SERIES**

Everlight 3030 series brings industry-leading performance and reliability to mid-power LEDs for the lighting market. Everlight’s 3030 LED’s low power, high efficacy, and robust package make it a perfect solution for high-density arrays and linear lighting applications where a highly reliable lighting performance is desired. 3030 enables designs for distributed light sources that meet the most demanding color and performance quality requirements. Offered in the full CCT range from 2700 K – 6500 K and with a minimum of 80 CRI and 90 CRI offerings. Everlight 3030 is engineered for both consumer and professional lighting applications. Ideal for efficient and homogeneous lighting applications.

**Features & Benefits:**
- Industry standard package 3.0 x 3.0 x 0.63 mm
- Highest efficacy with 180 lm/W at 65 mA
- Full range CCT 2700 K – 6500 K
- ANSI & 3-Step MacAdam ellipse color kits available
- Enables efficient system design
- High Reliability

**Applications:**
Downlights, Indoor Area Lighting, Linear, Troffers, Bay Lighting and Street Lighting

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**UVA SERIES**

Everlight UVA LEDs brings whole new markets and potential applications to reality. Everlight UVA LEDs provide a high performance platform with multiple wavelength ranges available for different applications such as ink curing, cosmetic curing, PCB curing, counterfeit bill detection, purification, horticulture catalysis, and semiconductor exposure. Everlight UVA LEDs are available in two main package types: Ceramic 3535 package and Ceramic 2016 package. These two packages allow for a choice between different power densities and package sizes depending on final application.

**Features & Benefits:**
- Robust ceramic based packages: 3.5 x 3.5 mm based and 2.0 x 1.6 x 0.75 mm based
- 4 wavelength selections: 368 nm, 385 nm, 395 nm, 405 nm
- 2 viewing angle selections for 3.5x3.5mm based package: 120° and 50°
- ESD protection up to 8 kV

**Applications:**
Curing: Ink, cosmetic, PCB; Insect Trapping, Counterfeit Bill Detection, Air/Water Purification, Horticulture, and Exposure.

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**AGRICULTURE LIGHTING SERIES**

The easiest way to achieve effective agricultural lighting is to provide a spectrum of light that best replicates sunlight OR by providing the necessary spectrums / color combinations for specific functions. Color combinations vary depending on region, time, temperature, plant, plant cycle, production targets and many other factors. Everlight has all the basic colors needed for replicating sunlight and activating specific functions for agricultural lighting. For any part of the spectrum where additional colors need to be added to the spectrum or additional light functions are needed, there are different Everlight color LEDs available for customer selection and tuning.

Everlight Agriculture LEDs include 450 nm / 525 nm / 660 nm / 730 nm / All White CCT as main colors that alter growth of roots, stems, leaves, and animals. Everlight has multiple packages and power ratings, 0.2 W to >1 W available for design of agriculture lighting fixtures based on these colors.

**Features & Benefits:**
- Standard industry package size selections: 3.5 x 3.5 x 2.03 mm and 2.8 x 3.5 x 0.7mm
- Highest Deep Red and Far Red WPE% and performances in the industry
- LM80 Tested for all packages and wattages
- Field tested and used globally by top horticulture players for 4+ years

**Applications:**
High Vine Plant Lighting, Low Vine Plant Lighting, Vertical Farm Plant Lighting and Animal Lighting
With its high potential for energy savings and extended lifetime, LED lighting is now the top choice for the majority of lighting applications. Infineon offers a full range of AC/DC, DC/DC, linear LED control solutions, and microcontroller-based LED solutions addressing various lighting applications from a simple strip light to high power LED headlights.

LED LIGHTING SOLUTIONS FROM INFINEON

THE ONLY 0-10V DIMMING IC ON THE MARKET TODAY: CDM10V

Infineon’s CDM10V is the industry’s first single-chip lighting interface IC dedicated for lighting applications capable of transforming an analog 0–10 V input into a PWM or dimming input signal required by a lighting controller IC. The signal is delivered in the form of a 5 mA optocoupler-ready 0 to 100 percent PWM output. One-time configuration of key parameters such as minimum duty cycle (1 to 10 percent), PWM output frequency (200 Hz to 2 kHz), dimmer/resistor bias current (50 µA to 500 µA) and "Dim-to-Off" functionality allows the CDM10V to be used across a variety of different commercial and industrial LED lighting applications.

Part Number: CDM10VXTSA1

CDM10v, the Coolest Dimming solution is a fully integrated 0-10 Volt dimming interface IC and comes in a 6 pin SOT package to meet small space requirements.

LINEAR DC-DC IC’S: BCR450/401/402/320

The BCR linear LED drivers are perfectly suited for driving LED currents from 10 mA to 250 mA, making them the ideal choice for low- to mid-power LEDs in general lighting applications. This represents the lowest-cost solution that requires an ultra-low external part count and PCB space. The light output can be adjusted via an external resistor. PWM dimming is supported either by a microcontroller interface or by means of an external digital transistor. Thanks to its negative thermal coefficient, the LED load will be protected from overheating.

Key Features:
- LED Driver 9, 12, 15, 18, and 24 Volt 6-Pin SC-74
- LED Driver 6-Pin SC-74
- LED Driver 4-Pin (3+Tab) SOT-343
- LED Driver 6-Pin SC-74 T/R
SWITCHED MODE DC-DC IC’S: ILD4001/6150

Infineon has a broad portfolio of DC/DC LED drivers that support currents from 150 mA to 3 A, making them the ideal choice for high and ultra-high-power LEDs in general lighting applications.

The buck topology is supported by the ILD4000 and ILD6000 families. Buck/boost, boost and SEPIC configuration are supported by the ILD1150 family. The ILD4000 is the low-cost DC/DC LED driver IC family with a breakdown voltage of 40 V and basic thermal protection. The ILD6000 is the feature-rich DC/DC LED driver IC family with a breakdown voltage of 60 V and advanced thermal protection.

Key Features:
- LED Driver 5, 9, 12, 15, 18 or 24 Volt 6-Pin SC-74
- LED Driver Buck 1-Channel Analog/PWM 60 Volt 1.5 Amp 8-Pin DSO T/R

MULTIMODE LED FLYBACK CONTROLLER: IRS2982S

Infineon’s latest Multimode Flyback Controller IC, IRS2982S, for LED lighting is targeting mid-range to high-end LED drivers for outdoor, interior, office and industrial lighting applications. Its integrated startup cell together with CrCM, DCM and burst mode optimize overall efficiency from standby to 100 percent while keeping time to light less than 0.5 seconds and reducing the use of external components.

The IRS2982S is ideal for single stage converters with an unsmoothened DC bus to obtain high power factor and low line current total harmonic distortion (THD). It supports universal input and operates both at AC and DC inputs.

Key Features:
- LED Driver Buck/Boost/Flyback
- 1-Channel None 0.4 Amp 8-Pin SOIC T/R

LIGHTING-BASED PROCESSORS: XMC1200/1300

The term “smart lighting” refers to the expansion of traditional LED illumination technology to include new functionalities, such as wired or wireless connectivity, programmability, sensors, enhanced light quality and sophisticated color mixing.

Thanks to special features dedicated to LED lighting, XMC™ microcontrollers help bring this new dimension into traditional LED lighting systems. With their Brightness and Color Control Unit (BCCU), XMC1200/1300/1400 series products offer an industry-unique module for automatically controlling the dimming level and color of multi-channel LED lamps. Users can quickly configure their ideal solution without the need for expert knowledge in lighting.

Part Families:
- MCU 32-Bit XMC1000 ARM Cortex M0 RISC 200KB Flash 3.3V/5 Volt 38-Pin TSSOP T/R
- MCU 32-Bit XMC1000 ARM Cortex M0 RISC 32KB Flash 3.3V/5 Volt 28-Pin TSSOP T/R
- MCU 32-Bit XMC1000 ARM Cortex M0 RISC 32KB Flash 3.3V/5 Volt 16-Pin TSSOP T/R
- MCU 32-Bit XMC1500 ARM Cortex M0 RISC 16KB Flash 3.3V/5Volt 38-Pin TSSOP T/R

AC-DC SWITCHED MODE POWER MANAGEMENT SOLUTION: ICL8105/5101

The ICL8105 is a high-performance configurable single-stage flyback controller with Power Factor Correction (PFC) for constant current output LED drivers. The digital core of the ICL8105, along with its advanced control algorithms, provide multi-operation modes, such as quasiresonant mode, discontinuous conduction mode or active burst mode. Thanks to this functionality and a smooth transition between the operation modes, the controller delivers high efficiency, high power factor and low harmonic distortion through the entire load range.

The ICL5101 integrates a half-bridge controller with a PFC stage in a single package. The high level of integration assures a low number of external components, enabling small form factor designs ideal for compact power supplies in lighting applications, such as LED drivers. All operation parameters of the IC are adjustable via simple resistors, being the ideal choice for an affordable and reliable configuration.

- Digital Flyback Controller IC for LED driver
- LED Driver Resonant 16-Pin PGDSO T/R
EXPERTS IN COLOR SENSING

MTSCiCF INTEGRAL TRUE COLOR SENSOR

The MTCSiCF is a True Color Sensor IC with a filter function based on the color standard CIE 1931/DIN 5033 (human eye perception) in a compact QFN16 package. The MTCSiCF is long-term stable over the entire product lifetime and resistant to external influences such as temperature or aging drifts, due to the special JENCOLOR® interference filter technology.

Features:
- JENCOLOR® interference filter technology
- Filter curves based on CIE 1931/DIN 5033
- Human eye perception
- High transmission and blocking
- No aging of the filter
- High temperature stability up to 100°C
- High signal frequency
- Minimal cross talk
- Compact size (diameter of the optical sensitive surface approx. 2 mm)
- Easily compatible with analog and digital signal converters from MAZeT

Part Family:
Integral True Color Sensor
MCDC04 ANALOG TO DIGITAL CONVERTER

The ASIC MCDC04 is a low noise sensor interface application specific standard product (ASSP) and suitable for coupling of multi-channel optical sensors or sensors using current output. Optional the integration time and sensitivity can be controlled by external programming to extend the internal functions and parameters. This ASIC is especially suitable for signal conditioning of photodiodes of array sensors like color or other optical sensors with maximum of 4 channels per chip.

- Conversion of 4 sensor signals of photodiodes (e.g. RGB/XYZ color plus one blank channel for compensation of parasitic currents or temperature conversion) or other sensors with current signal output
- Configurable conversion gain and integration time supports a very high dynamic range of 1 – 1,000,000
- Up to 16 bit signal resolution by achievable sensitivity up to 20 fA/LSB
- Adjustable operation modes like continuous, by command and externally synchronized (by given start and start/end signal) measurement
- Option: external control of integration time and reference current (gain)
- High linearity of amplifying, no cross talking
- High absolute accuracy without additional sources
- High reliability internal reference source generation
- Consideration of negative offset
- Measurement of current for both polarities
- Measurement of integration time
- Supply and temperature independent response
- Inherent ripple rejection of the 50 Hz/60 Hz external disturbances
- 16 Bit/400 kHz fast I²C interface with programmable slave addresses
- Very low current consumption in active, in Power down and Standby mode
- Supply voltage 2.7 V to 3.6 V
- Temperature range –40°C to 125°C
- Deliverable in SMD package and as bare die

Part Family:
16 bit 4-channel analog-to-digital converter (ADC) with I2C control/output
Molex delivers space-saving interconnect solutions for device designs using LED products. As the use of LEDs continues to expand into consumer electronics, factory automation equipment, lighting and automotive uses, Molex interconnect components can provide cost effective solutions that also improve manufacturing efficiencies. From board-to-board and wire-to-board configurations to FPC-to-board requirements, Molex provides interconnect solutions to meet your needs when incorporating LEDs into your innovative designs.

**MOLEX INTERCONNECT SOLUTION FOR DEVICES USING LEDS**

**TERMIMATE™ ONE-CIRCUIT TERMINAL-STYLE CONNECTOR SYSTEM**

The sleek TermiMate™ wire-to-board and board-to-board system minimizes shadowing in LED lighting applications while providing space savings and reduced component costs. The new TermiMate connector system offers wire-to-board and board-to-board options using the same plug terminal for design flexibility and component and assembly cost savings.

<table>
<thead>
<tr>
<th>Features</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low profile and compact size</td>
<td>Provides space-saving; low height prevents shadows in LED lighting applications</td>
</tr>
<tr>
<td>Plug terminal for both wire-to-board and board-to-board configurations</td>
<td>Offers design flexibility and component cost saving</td>
</tr>
<tr>
<td>Terminal-only system</td>
<td>Provides further space and component cost savings versus two-piece housing style systems</td>
</tr>
<tr>
<td>Floating tolerance (Board-to-Board)</td>
<td>Absorbs inexact mating tolerances to facilitate correct insertion and prevent terminal damage</td>
</tr>
<tr>
<td>Secure friction lock</td>
<td>Provides secure mating and prevents accidental disconnect</td>
</tr>
</tbody>
</table>

**LITE-TRAP™ SMT WIRE-TO-BOARD CONNECTOR SYSTEM, PUSH-BUTTON TYPE**

Ideal for thin LED lighting-module applications, Molex’s Lite-Trap™ SMT wire-to-board connectors offer easy wire removability and low-profile top-and-bottom entry styles for reduced shadowing.

<table>
<thead>
<tr>
<th>Features</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low profile top-and-bottom entry styles</td>
<td>Provide reduced shadowing effects for LED applications</td>
</tr>
<tr>
<td>User-friendly push-button latch</td>
<td>Ensures easy wire extraction</td>
</tr>
<tr>
<td>Low wire insertion and high wire retention forces</td>
<td>Enable easy wire insertion; provides secure contact retention</td>
</tr>
<tr>
<td>Long wire insulation design</td>
<td>Provides stable wire placement for additional contact assurance</td>
</tr>
<tr>
<td>Compact industry-standard PCB pattern layout</td>
<td>Saves space and is drop-in compatible with certain competitive products</td>
</tr>
<tr>
<td>Wire stopper feature</td>
<td>Facilitates correct wire insertion depth placement</td>
</tr>
<tr>
<td>Dual-contact gate-style terminal design</td>
<td>Provides secure electrical contact and high wire retention force</td>
</tr>
</tbody>
</table>
FLEXI-LATCH™ 2.00MM PITCH RIGHT ANGLE FPC-TO-BORDER CONNECTOR SYSTEM

Flexi-Latch™ connectors provide secure mating assurance along with space and cost savings versus wire-to-board systems for rugged applications such as automotive lighting or industrial controls.

<table>
<thead>
<tr>
<th>Features</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cable retention force of 20N</td>
<td>Provides secure mating retention force that meets automotive shock and vibration requirements</td>
</tr>
<tr>
<td>Positive inertia lock</td>
<td>Prevents partial cable insertion for secure mating</td>
</tr>
<tr>
<td>Audible click when mated</td>
<td>Offers additional mating assurance</td>
</tr>
<tr>
<td>Multiple polarizing keys</td>
<td>Prevent against incorrect cable insertion</td>
</tr>
<tr>
<td>-40 to 125 degrees operating temperature range</td>
<td>Meets automotive requirements</td>
</tr>
<tr>
<td>FPC retention tabs</td>
<td>Position cable for proper mating and prevent cable drop-out during assembly</td>
</tr>
</tbody>
</table>

SOLIGIE® PRINTED ELECTRONICS LED LIGHTING ASSEMBLIES

Through integration of substrate design, printing, quality control and component-placement operations, Soligie® Customized Printed Electronics LED Lighting Assemblies provide high-quality customized lighting solutions at minimized costs.

<table>
<thead>
<tr>
<th>Features</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roll-to-roll (R2R) laminate processing and component placement on flexible substrates</td>
<td>Provide an economical manufacturing and assembly process, which maintains a high level of light output</td>
</tr>
<tr>
<td>Configurable design options for custom applications</td>
<td>Enable new lighting designs and solutions for a wide variety of markets and applications. Differentiates products by unique lighting effects and platforms.</td>
</tr>
<tr>
<td>Soligie® printed electronics design expertise</td>
<td>Provides solutions that can range from printed traces to complete parts. Able to produce in high volumes.</td>
</tr>
<tr>
<td>Broad knowledge base of technology, materials, associated companies and research institutions</td>
<td>Boosts efficiency in identifying solutions and partners for technology development and implementation.</td>
</tr>
<tr>
<td>ITAR, ISO 13485:2003 and ISO 9001:2008 process and documentation controls</td>
<td>Assures reliability and compliance to these industry-accepted standards</td>
</tr>
</tbody>
</table>
OSRAM Opto Semiconductors is a global leader in opto-semiconductor technologies with over forty years of continuous innovations. We possess in-depth LED knowledge and technology leadership in chip materials, production processes, chip structuring, light conversion technologies, chip packaging and optical design for innovative solutions in lighting, visualization and sensing for application-specific designs. OSRAM Opto Semiconductors' broad LED product portfolio provides optimal application solutions in the automotive, industry, personal electronics, and general lighting sectors.

OSRAM LEDS LEAD THE WAY

AUTOMOTIVE / TRANSPORTATION
- Leader in the automotive segment with leading-edge LED portfolio for forward lighting applications (i.e. headlamps, fog, auxiliary, driving, etc.)
- Recipient of multiple PACE (Premier Automotive Suppliers’ Contribution to Excellence) Awards.
- Offering the broadest exterior and interior LED lighting solutions for all types of transportation applications: automotive, aviation, bus, rail/train, construction vehicles, emergency vehicles, marine, motorcycles, off-road vehicles, trucks, aftermarket, agricultural, work lights, etc.

Part Families:
- OSLON® Black Flat (1 - 5 chip)
- OSLON® Signal
- Power TOPLED®
- TOPLED®

SIGNS / SIGNAGE / VARIABLE MESSAGE SIGNS
Address the demand for reliable real time information with the ability to change/adapt (i.e. variable) to immediate conditions with small, dedicated & powerful LEDs that are the perfect match for modern information and signaling solutions for clear, precise visibility and eye-catching appearance.

Part Families:
- DISPLIX® Oval
- TOPLED® Black w/ lens – 30°
- TOPLED® Black Surface

PERSONAL ELECTRONICS / WEARABLES
Variety of innovative components for modern fitness tracking and health monitoring (wearables) along with flash and backlighting applications in different packages, sizes and performance classes.

Part Families:
- CHIPLED
- PointLED®
- FIREFLY®
PHOSPHOR CONVERTED YELLOW LEDS

For high temperature applications providing less thermal roll-off, reduced color shift, and potential of increased brightness from anticipated InGaN roadmap increases.

Part Families:
- OSLON® Signal
- OSLON® Compact CL
- OSLON® Black Flat
- Advanced Power TOPLED®
- TOLED® Black Surface

LINEAR & AMBIENT LIGHTING

Efficient and consistent. OSRAM Opto Semiconductors offers a broad range of low/mid-power LED packages which are perfect light sources for linear and ambient lighting applications.

Part Families:
- DURIS® E
- DURIS® S

OUTDOOR AND AREA LIGHTING

Highly reliable and top performance. The following high-power LED packages are designed for high flux and efficacies, even under harsh conditions.

Part Families:
- OSLON® SSL
- OSLON® Square
- DURIS® P

DOWNLIGHT AND TRACK LIGHTING

Scalability and high flux densities. OSRAM Opto Semiconductors provides leading LED options for directional indoor applications – both as SMD and COB devices.

Part Family:
- DURIS® S
- SOLERIO® S

INFRARED ILLUMINATION

Combining great performance and small dimensions, OSRAM Opto Semiconductors’ state-of-the-art infrared (IR) illumination components secure new opportunities for our customers. Designers and manufacturers of IR based applications clearly benefit from OSRAM Opto Semiconductors’ high quality infrared components, allowing high system efficiency along with low total system costs.

Part Number:
- OSLUX® SFH 4780S
- OSLUX® SFH 4786S
Sunon offers a wide range of customized thermal solutions designed specifically for LED applications.

Sunon’s lightweight aluminum heat sinks can solve thermal management issues for low lumen LED fixtures. For high lumen LED output, passive cooling is simply not enough and thermal management can become a challenge. Sunon offers active cooling solutions to dissipate the heat produced by LED components with thermal capabilities that are more effective than passive heat sinks.

### SUNON LED COOLING SOLUTIONS

#### ACTIVE COOLING MODULES

Active cooling (the use of fan plus heat sinks) can significantly reduce the weight and size of the lighting fixture.

<table>
<thead>
<tr>
<th>Citizen</th>
<th>GE Lighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>COB 10.9~42.9W</td>
<td>COB 89.3~177.9W</td>
</tr>
<tr>
<td>LED Module maximum operating temperature (Tc) &lt;100°C</td>
<td>LED Module maximum operating temperature (Tc) &lt;100°C</td>
</tr>
<tr>
<td>Size: Ø86 x 40.4mm</td>
<td>Size: Ø86x57.4mm</td>
</tr>
<tr>
<td>Weight (g): 163</td>
<td>Weight (g): 268</td>
</tr>
<tr>
<td>Fan Speed (RPM): 2200</td>
<td>Fan Speed (RPM): 2200</td>
</tr>
<tr>
<td>Noise @ 1M , (dB(A)): 16.5</td>
<td>Noise @ 1M , (dB(A)): 15.9</td>
</tr>
</tbody>
</table>
## ACTIVE COOLING FANS

<table>
<thead>
<tr>
<th>Module No.</th>
<th>HA60201V3-E00U-A99</th>
<th>EF30080S2-E00U-A99</th>
<th>HA30101V3-E00U-A99</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module Dimension (mm)</td>
<td>84.9 x 20.4</td>
<td>30 x 8</td>
<td>39.8 x 10.4</td>
</tr>
<tr>
<td>Weight (g)</td>
<td>30.5</td>
<td>4.3</td>
<td>7.3</td>
</tr>
<tr>
<td>Rated Voltage (V)</td>
<td>12</td>
<td>3.3/5</td>
<td>12</td>
</tr>
<tr>
<td>Power Consumption (W)</td>
<td>0.34</td>
<td>0.20 / 0.40</td>
<td>0.30</td>
</tr>
<tr>
<td>Fan Speed (RPM)</td>
<td>2300</td>
<td>4300 / 7000</td>
<td>4400</td>
</tr>
<tr>
<td>Air Flow (CFM)</td>
<td>13</td>
<td>1.8 / 3.0</td>
<td>1.9</td>
</tr>
<tr>
<td>Static Pressure (Inch–H2O)</td>
<td>0.03</td>
<td>0.03 / 0.08</td>
<td>0.04</td>
</tr>
<tr>
<td>Noise @ 1M (dBA)</td>
<td>17.5</td>
<td>3.1 / 17.0</td>
<td>10.5</td>
</tr>
<tr>
<td>Safety</td>
<td>UL / CUR / TUV / CE</td>
<td>UL / CUR / TUV / CE</td>
<td>UL / CUR / TUV / CE</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module No.</th>
<th>HA60150V3-E02U-A99</th>
<th>HA60151V3-E01U-A99</th>
<th>HA60200V3-E00U-A99</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module Dimension (mm)</td>
<td>84.9 x 15.4</td>
<td>84.9 x 15.4</td>
<td>84.9 x 20.4</td>
</tr>
<tr>
<td>Weight (g)</td>
<td>27.3</td>
<td>27.3</td>
<td>30.5</td>
</tr>
<tr>
<td>Rated Voltage (V)</td>
<td>5</td>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td>Power Consumption (W)</td>
<td>0.40</td>
<td>0.34</td>
<td>0.31</td>
</tr>
<tr>
<td>Fan Speed (RPM)</td>
<td>2300</td>
<td>2300</td>
<td>2300</td>
</tr>
<tr>
<td>Air Flow (CFM)</td>
<td>13.2</td>
<td>13.2</td>
<td>13</td>
</tr>
<tr>
<td>Static Pressure (Inch–H2O)</td>
<td>0.03</td>
<td>0.03</td>
<td>0.03</td>
</tr>
<tr>
<td>Noise @ 1M (dBA)</td>
<td>16.1</td>
<td>16.1</td>
<td>17.5</td>
</tr>
<tr>
<td>Safety</td>
<td>UL / CUR / TUV / CE</td>
<td>UL / CUR / TUV / CE</td>
<td>UL / CUR / TUV / CE</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module No.</th>
<th>HA40101V3-E00U-A99</th>
<th>HA60150V3-E03U-A99</th>
<th>HA60151V3-E00U-A99</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module Dimension (mm)</td>
<td>48.9 x 10.6</td>
<td>84.9 x 15.4</td>
<td>84.9 x 15.4</td>
</tr>
<tr>
<td>Weight (g)</td>
<td>11.8</td>
<td>29.1</td>
<td>29.1</td>
</tr>
<tr>
<td>Rated Voltage (V)</td>
<td>12</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>Power Consumption (W)</td>
<td>0.32</td>
<td>0.26</td>
<td>0.28</td>
</tr>
<tr>
<td>Fan Speed (RPM)</td>
<td>3900</td>
<td>2300</td>
<td>2300</td>
</tr>
<tr>
<td>Air Flow (CFM)</td>
<td>4.5</td>
<td>9.7</td>
<td>9.7</td>
</tr>
<tr>
<td>Static Pressure (Inch–H2O)</td>
<td>0.05</td>
<td>0.03</td>
<td>0.03</td>
</tr>
<tr>
<td>Noise @ 1M (dBA)</td>
<td>13.1</td>
<td>15.4</td>
<td>15.4</td>
</tr>
<tr>
<td>Safety</td>
<td>UL / CUR / TUV / CE</td>
<td>UL / CUR / TUV / CE</td>
<td>UL / CUR / TUV / CE</td>
</tr>
</tbody>
</table>
TE Connectivity offers a broad portfolio of Lighting Connectors for multiple applications. Whether you are creating a new system or enhancing an existing design, TE can help. They are a market leading provider of electromechanical and electronic components. TE engineers have enabled seamless integration of controls, power transmission and data across multiple lighting systems. Products include: Ballast Connectors, LED Holders, Lighting Cable Assemblies, Plug & Socket Connector Accessories, Plug & Socket Connectors, Poke-In Connectors and Solid State Connectors. Products are engineered to be compact, easy-to-install interconnect solutions that reduce labor, cost and waste.

LED LIGHTING SOLUTIONS FROM TE CONNECTIVITY™

LUMAWISE™ LED HOLDERS
TE Connectivity (TE) has a broad range of solderless LED holders that give fixture designers an easier way to integrate LEDs. These scalable LED holders form the core of the fixture ecosystem by integrating LED electrical, mechanical, thermal and optical interconnectivity. And compared to traditional methods of LED integration, these holders can accelerate time to market, minimize applied costs, facilitate easy integration and improve assembly efficiency.

LUMAWISE™ LED HOLDERS TYPE Z
TE’s LUMAWISE LED Holders Type Z provide a quick and easy solderless connection to LED arrays and are designed to enable customers to develop Zhaga compliant modules. Offered with or without optics attachment features, the LUMAWISE LED Holders Type Z are available in a configuration to suit your needs. The optics attachment version functions with LEDIL optics to provide the lighting designer with beam shaping flexibility in spot and downlight applications.

Product Family:
LED Holder For Sharp Mega Zenigata LED

LUMAWISE™ SCALABLE LED HOLDERS
TE’s LUMAWISE Scalable LED holders enable connectivity to a wide range of LED arrays and is available in pre-assembled one piece & two piece configurations for ultimate design flexibility. The two piece design utilizes the same part for both positions and its scalability makes it broadly applicable to multiple commercially available LED arrays. The inherent flexibility of the platform allows accommodation of a virtually infinite range of LED package sizes and plating materials.

Part Family:
LED Holders and Solderless LED Sockets
SOLDERLESS TERMINATION OF CHIP-ON-BOARD LED
Offering higher level of integration via a solderless connection to array and chip-on-board (COB) LEDs. These sockets mechanically secure and electrically connect the LED to a luminaire without the need to solder. Sockets allow the LED to be directly attached to a PCB or heat sink using a few standard screws. They have multi-point connection, accept optics, include fast attachment features and provide proper orientation.

Part Family:
Lumawise LED Holder for Z50 Series LED

NECTOR M™
TE’s NECTOR M power system is a flexible, fully pluggable, modular wiring connectors and cabling solution for the permanent & temporary power and control electrical installations. The NECTOR M power system offers an ideal solution for both indoor and a sealed version for outdoor.

Part Families:
- Connector Accessories Ring Nut Black
- Connector Accessories Molded Boot Straight 7.4–16 Cable Diameter Semi-Rigid Polyolefin
- Connector Accessories Plastic Screw Nut

HERMAPHRODITIC BLADE CONNECTORS
The TE Hermaphroditic Blade Connectors are available in 2, 4 and 6 positions. The connector mates to itself which allows a single part number to be stocked. They mate and un-mate horizontally and vertically. The connector can be articulated from 90° to 180°. The hermaphroditic blade and receptacle connector is a new SMT connector and is intended for use with in-line board-to-board applications like LED lighting modules, Incandescent lighting strips and Channel lettering. The connectors are surface mount technology friendly with tape and reel packaging for high speed SMT processes and a low profile flat surface that is compatible with SMT and reflow processing. The connector has rounded corners to minimize shadowing and a solder pad footprint compatible with TE Electronics SMT Poke-In LED connector.

Part Families:
- Mini Hermaphroditic Connectors
- Hermaphroditic Blade Connectors
- Hermaphroditic Blade Receptacles
Tools and Reference Designs
OSRAM Opto Semiconductors has a powerful array of online tools designed to help customers like you design their next LED lighting application.

APPLICATION NOTES
Looking for more in-depth technical information on OSRAM products and project reference designs? Check out the comprehensive Application Notes library.

PRINTED CIRCUIT BOARD DESIGN FILES
These design files allow standard designs to be used for prototyping and proof of concept of complex designs with various shapes and OSRAM LED footprints. These files are available for download or in a buy-it-now configuration from our preferred vendor for instant sampling. The free ViewMate Gerber Viewer from Pentalogix is one of the many free tools available to view the downloadable Gerber files from our tools site.

LED OPTIC SELECTOR TOOL
It has never been easier to match off-the-shelf lenses with our products. This tool helps users find the best lens solutions by filtering preferences based on beam angle, mechanical size (diameter and height), number of LEDs, vendor and vendor part number.

TECHNICAL TRAINING AND COLLATERAL
OSRAM has a full library of training and resource materials including:
- LED Fundamentals Videos
- Technical Papers & Presentations
- Product Brochures and Catalogs
- LED Standards & Regulations Information
- Brilliant Mix Application Note
- Technical Glossary

CREATE THE LIGHTING OF THE FUTURE, FASTER.
Looking for the LED expertise to help you get ahead of the competition? Then get PASS – Premium Application Support Services. With PASS, you’ll get access to OSRAM Opto Semiconductors’ application engineering expertise and lab services through a lean, affordable, a-la-carte program. PASS, available for commercial businesses, is an open, collaborative design and testing process that keeps you involved, allowing flexibility along the way. So make it good, make it fast, and make it easy – with PASS.
**MTCS-INT-AB4 TRUE COLOR AND OEM BOARD**

The MTCS-INT-AB product family enables users to implement their own True Color OEM board into lighting, backlight, LED test, color selection or other applications. The MTCS-INT-AB is ideal to measure color coordinates (XYZ), CCT or brightness levels. The sensor system is based on the JENCOLOR® standard components MTCSiCF (True Color sensor) and MCDC04 (Signal converter). The sensor is based on the CIE 1931 XYZ color standard, while the signal converter allows an output at 16/20 bit at a dynamic range of 1-to-1,000,000 and the option to freely choose the integration time.

**MTCS-C3 DEVELOPMENT KIT**

The SET DK MTCS-C3 Development Kit includes the MTCS-C3 OEM sensor board embedded into a metallic casing with optical components and test software. The main components of the system and its installation and usage are described within this document. The Set DK MTCS-C3 is delivered without pre-calibration. So it is not specified for an application but was prepared for a user specific calibration as application specific setting and calibration of the system.

**MTCS-INT-AB4 APPLICATION SPECIFIC TEST SYSTEM**

The OEM sensor solution is a small PCB for general color measurement and control applications, with a high bandwidth for light energy and optimized for handheld applications. The sensor board includes a True Color sensor MTCSiCF based on the international CIE 1931 standard, an analog-to-digital converter MCDC04EQ with a high dynamic range, an EEPROM for sensor data, power regulator and an I²C-interface.
CREE PRODUCT CHARACTERIZATION TOOL (PCT)

Cree Product Characterization Tool (PCT) is a web-based tool that enables design engineers to identify the best Cree XLamp LEDs for their designs. With the PCT, design engineers can select from multiple lighting-system design parameters to compare up to three LED models simultaneously to make critical design choices.

For all valid LED drive currents, the PCT quickly and easily does the following:

- Shows all critical LED design parameters, such as luminous flux and efficacy, for selected LED models
- Performs de-rating calculations based on junction temperature (Tj)
- Calculates LED valuations, such as lumens per dollar (lm/$)
- Estimates simple LED design parameters, such as the number of LEDs required and total power consumption

The Cree PCT design tool simplifies the task of translating nominal LED performance to real-world conditions and acts like an interactive data sheet, giving users a more intuitive way to design LED systems.
SURFACE MOUNT TECHNOLOGY SOLUTIONS FOR LEDS

Surface Mount Technology Corporation (SMT) provides world-class Electronic Manufacturing and Design Engineering Services for low-to-medium volume custom LED assemblies and complex driver assemblies.

Our value to our customers is from our integrated solutions based business model, our exceptional quality, our expertise in providing cost reduction ideas, our on-time delivery and exceptional customer service. SMT has been placing LED’s for over 15 years, and has the expertise and equipment to place even the most difficult package types. There is nothing we enjoy more as a company than helping our customers solve their challenges.

LED PCB ASSEMBLY CAPABILITIES
- Specialized state of the art assembly and test equipment
- Custom Binning and Placement Process
- LED Traceability to the location reference
- LED Conformal Coating equipment
- Touchscreen LED
- Complete turnkey fixtures with light engines
- LED optics and enclosures
- Prototypes
- PCB layouts of LED circuits
- PCB Power supplies
- Heat sinks

LED MARKETS
- Outdoor Sports Lighting
- High Bay
- Medical Lightning
- Automotive and Aviation lightning
- Architectural Lightning

SMT ENGINEERING
- All Intellectual Property belongs to the customer
- Complete electronic product design capability (concept to production)
- Engineering Design Layout and Optics Design
- Thermal testing and Analysis
- Experts in power electronic design
- Experts in embedded microcontroller design from 8 to 32 bit
- Experts in connectivity: Wi-Fi, Mi-Wi, BLE, Cellular, Zigbee
- Ethernet, USB, CAN, SAE J-1939, OBD II
- Production test fixture development
- LED Light Lab capabilities to test lumen output
SMT ENGINEERING IS READY TO BRING YOU THE SOLUTIONS THAT YOU NEED.

PCB SPECIFICATIONS CAPABILITIES
- Base Material: Aluminum/FR-4
- Flexible PCB (up to 8 layers)
- Rigid-flex PCB (up to 6 layers)
- CEM-1, CEM-3 FR-4, FR-4 High TG, Polyimide, Aluminum-based material.
- HAL, HAL lead free, Immersion Gold/Silver/Tin, Hard Gold, OSP surface treatment
- Surface Treatments: Immersion gold, HASL, OSP

SMT has the ability to take a project from concept to design to production in a seamless integrated NPI process, that ensures shortest time to market and lowest overall costs. SMT has the experience and provides solutions to many different market sectors and in many unique ways. SMT provides solutions to all industries and enables our customers to bring leading edge technology to their customers resulting in a time to market and cost competitive advantage.

Surface Mount Technology Corporation (SMT) is a certified and highly recommended partner in the Avnet Technical Network supporting LED Technology and the Lighting Market. The Avnet Technical Network connects customers to design resources with the objective of accelerating new project development. These partners offer engineering design services, software expertise, and unique manufacturing capabilities.

AVNET TECHNICAL NETWORK
SMT’s relationships with established LED suppliers and their broad product knowledge for integrating complementary devices – MCU/MPUs, Wireless and Power, make them an ideal engineering and design partner for Lighting.

CUSTOMER SUCCESS STORIES
SMT Engineering met our customer’s aggressive design goals of providing higher light output, longer product life, better thermal design and more control, within their timeline and budget by providing a unique solution.

SMT Engineering met our customer’s requirement for higher light output, longer battery life, and better thermal design, with a unique solutions on time and on budget.

SMT Engineering met our customer’s timeline to get new LED product approved prior to their next model year. SMT Completed PPAP and IMDS to strict automotive specifications.

SMT was able to provide our expertise through the DFx process to help our customer achieve the lowest production cost while still providing a quick time to market.

SMT is able to provide a short lead time and reaction to customer spikes in demand on assemblies after material availability.

SMT’s equipment set allows us the ability to build larger panel size boards, reducing our customers PCB costs.
Avnet LightLab

The Avnet LightLab is a state of the art facility equipped with a LED metrology suite from Instrument Systems. Avnet LightLab was designed to measure the key optical, electrical and thermal characteristics of high power LEDs, modules and luminaires. Avnet's team of illumineers, LED application engineers, uses LightLab capabilities to assist its customers throughout all phases of the design process – from product definition and component selection, through final design verification.

Avnet LightLab was designed to support a broad range of LED applications including general illumination, medical, industrial, transportation, military, signage and security applications. Our equipment can perform all the relevant radiometric measurements from UV-B through near IR in addition to photometric and colorometric measurements over the visible range.

LIGHTLAB CAPABILITIES AND EQUIPMENT
- Integrating spheres for 2 and 4 total flux measurements.
- Computer-controlled goniophotometers for intensity versus angle characterization
- Spectroradiometers for Spectral Power Distribution (SPD) characterization
- Colorimetric software to analyze LED CIE color coordinates, CCT and CRI
- Precision LED Power Supplies
- Radiance/luminance spotmeters
- Luxmeters
- Thermal imagers for troubleshooting thermal management problems
- Precision temperature logging for thermal management characterization

With this suite of lab equipment, Avnet LightLab Illumineers can perform a wide range of LED tests on individual LEDs, LED modules and complete LED luminaires. Typical tests include:
- Total flux measurements.
- Intensity versus viewing angle
- Illuminance measurements
- Luminance of extended sources such as LCD back lights
- Luminous efficiency
- Characterization of secondary optics
- Spectral Power Distribution (SPD)
- CIE color coordinates
- Correlated Color Temperature (CCT)
- Color Rendering Index (CRI)
# Americas Linecard

## LED Solutions

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/LIGHTSPEED
LED Services & Support

DESIGN CHAIN SERVICES®
Avnet offers engineers a host of services from any point in the design cycle from concept to architectural design to new product introduction and on through next generation modification or end-of-life. Avnet has the technical products, services and tools to accelerate design cycles — including ASIC and programmable logic engineering services, IP cores and more. With offerings that run the gamut from Web seminars to connector assembly, Avnet offers it all.

Assembly and Programming
- Commercial and military interconnect assembly
- Custom cable assembly
- Device programming
- Motor modification
- ElectroAir™ avionic components
- Power supply modification
- Thermal management

Design Tools
- Design Resource Center
- Development and evaluation kits
- Embedded OS solutions
- IP cores

Engineering Services
- ASIC design/FPGA design
- Systems design
- Design service partners

Technical Education
- SpeedWay Design Workshops™
- On-Ramp Technical Sessions™
- Seminars/Webinars

SUPPLY CHAIN SERVICES®
Avnet optimizes supply chains by providing end-to-end supply chain services to electronic original equipment manufacturers (EOEMs), Electronic Manufacturing Services (EMS) providers and electronic component manufacturers. By combining internal competencies of global warehousing and logistics, finance, information technology and asset management with objective, external industry-wide data, Avnet’s supply chain services allow customers to increase their overall business knowledge — enabling more informed decisions.

Component Intelligence
- Bill of material (BOM) analysis
- Inventory optimization services
- Green initiative programs

Supply Chain Assessment
- Discovery and logistical analysis
- Financial analysis
- Project implementation

Inventory Management Solutions
- Bonded inventory programs
- EDI Point-of-Use Replenishment Systems (POURS)
- Vendor-managed inventory
- In-plant stores
- New product introduction (NPI) program support
- Pipeline inventory from forecasts
- Inventory ownership programs