



Optoelectronic

Solutions Guide



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Optoelectronic Components Available at TTI

	DIALIGHT	KINGBRIGHT	LITTELFUSE	OSRAM	ROHM	TTE (OPTEK)	TOSHIBA	VISHAY
LEDs, Emitters and Sensors								
Visible LEDs SMD	◆	◆		◆	◆	◆		◆
Visible LEDs Through-hole	◆	◆			◆	◆		◆
RGB LEDs	◆	◆		◆	◆	◆		◆
Circuit Board Indicators	◆	◆						
IR LEDs Sensors		◆		◆	◆	◆		◆
Visible and IR LASERS				◆	◆	◆		
Light Bars		◆						
Bar Graph		◆						
Optocouplers and Phototriacs			◆			◆	◆	◆
Relays			◆				◆	◆
Displays								
Color TFT								◆
Seven Segment and Alpha Numeric		◆			◆			◆
LCD								◆
LED		◆			◆			◆
OLED								◆
IR Touch								◆
VATN LCD								◆
Specialty Sensors								
Ambient Light Sensors		◆		◆	◆			◆
Proximity Sensors		◆		◆	◆	◆		◆
Color Sensors				◆	◆			◆
UV		◆		◆	◆			◆
Biomedical				◆				◆
IR Switches		◆		◆	◆	◆		◆
Panel Mount LEDs	◆		◆					
Custom Products		◆	◆	◆		◆		◆
Light Pipes	◆							

Optoelectronic Components by Industry

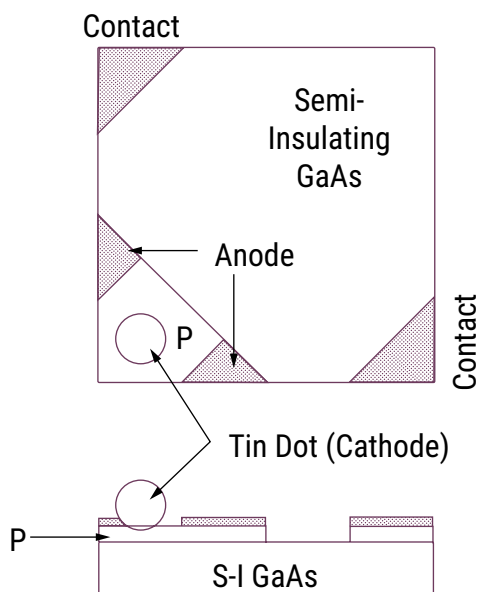
	DIALIGHT	KINGBRIGHT	LITTELFUSE	OSRAM	ROHM	TTE (OPTEK)	TOSHIBA	VISHAY
Industrial	◆	◆	◆	◆	◆	◆	◆	◆
Medical	◆	◆	◆	◆	◆	◆	◆	◆
Mil/Aero	◆		◆	◆	◆	◆	◆	◆
Transportation	◆		◆	◆	◆	◆	◆	◆

General Lighting				◆		◆		◆
Signs/Signage	◆	◆		◆	◆	◆	◆	◆
Video Walls	◆	◆		◆	◆	◆	◆	◆
Stage Lighting				◆	◆			◆
Displays		◆		◆	◆			◆
Medical/Dental	◆	◆	◆	◆	◆	◆	◆	◆
Gaming	◆	◆	◆	◆	◆	◆	◆	◆
Safety/Security	◆	◆		◆	◆	◆	◆	◆
Street/Area Lighting				◆				◆
Horticulture Lighting				◆				◆
Water/Air Purification (UV)		◆		◆	◆			◆
Currency/Document Validation (UV)		◆		◆	◆		◆	◆
Distance/Range Finders				◆	◆	◆		◆

How LED Components have Evolved

You're already familiar with modern consumer LED technology, including energy-efficient light bulbs, indicator lights and the like. Today, the industry is seeing a rapid growth in LED products in industrial lighting, industrial equipment, Industrial Internet of Things (IIOT) devices, medical equipment and transportation applications. In these pages we explore how today's advanced LED technology creates new opportunities for efficiency in product designs, no matter what industries are served.

The First LED (Fall 1961)



The first Light Emitting Diodes were not energy efficient, and aside from indicator lights they were mostly used in niche digital display technology. (For a short time, wristwatches with LED digital displays were more expensive than luxury analog watches!) Four decades later, LED efficiency continues to improve and LEDs are behind some of the most innovative display and industrial lighting technology today, delivering exceptional design flexibility, energy efficiency, longevity and cost savings. LED components consist of a semiconductor light source or die, enclosed in a package (i.e. lead wires and an epoxy shell).

Multiple LED packages comprised of these components typically are combined into a single LED solution. Thanks to technological advances, LED packaging continues to get smaller. Environmental awareness and demands for lower energy usage have increased the adoption and spurred development of smaller, more efficient packages. Today's single-die LED indicators can be found in common sizes ranging from 2 mm to 8 mm, both in surface-mount and through-hole packages, with current ratings from about 1 mA to over 20 mA.

The more powerful LEDs used in industrial lighting also known as High-Output LEDs (HO-LED) require high bay and street lighting driven currents of several amps and higher per system.



Cutting-edge LED package designs provide low thermal resistance and diodes that can withstand electrostatic discharge (ESD) of up to 8,000 V, protecting against damage on the production line.

Beyond the traditional round, domed, or flat LEDs, new and different types of packages are available. One innovative new package is the LED filament, a series of LED chips on a rod-shaped substrate that can simulate incandescent lighting.

Where LED Components are Being Utilized



Transportation – In the automotive space, LEDs provide energy-efficient, powerful solutions for exterior and interior lighting. LED headlamp assemblies combine numerous high-brightness LED components that run cooler and last longer than traditional incandescent headlamp bulbs. On agricultural equipment and machinery, LED technology is replacing HID lamps while OLED displays can replace in-cab indicators and displays. Their use creates not only energy savings, but greater exterior illumination and more granular and informative readouts than traditional gauges or indicator lights could provide.



Industrial – In addition to energy-efficiency gains that now see interior LED lighting operating at an efficiency of over 100 lumens per watt, advancements in color, temperature, longevity and reliability have made industrial lighting less expensive and easier to adopt. Besides illuminating factory floors, LEDs are also replacing incandescent bulbs in task lighting, such as dock work area lighting. When paired with motion sensors, LED lighting becomes even more efficient. In industrial robotics and factory automation, LEDs are deployed in safety light curtain systems (where a break in the light beam is used to stop machinery from operating) as well as in sensing systems that help control industrial robots.



Military and Aerospace – LEDs are being incorporated into military vehicles to reduce power consumption while increasing system reliability and color flexibility. High-power IR LEDs are used for night-vision illumination. Meanwhile, military equipment uses more sensors than ever for detection, movement and control. LED technology has completely revolutionized military task lighting, decreasing service members' fatigue and stress levels. In satellite applications, new IR LEDs and sensors are available in radiation-hardened (Rad-Hard) ratings for the space environment.



Medical – More sensors are being incorporated into medical equipment than ever before, aiding medical professionals in diagnosis and treatment. Exotic wavelengths in infrared (IR) and ultraviolet (UV) are used to analyze blood and urine for diagnostic purposes, in addition to biomedical spectroscopy for tissue analysis and medical imaging. High-power LEDs are being incorporated into exploratory instruments used to examine organs and bodily systems. In dentistry, high-power UV LEDs are widely used to cure dental epoxy for fillings and teeth whitening. Finally, LED technology is being used in treatment of neurological and sleep disorders, while LEDs are creating new opportunities in caring for cancer patients suffering from the side-effects of treatment.

The Characteristics of LED Technology

LEDs are the biggest breakthrough in lighting technology since the incandescent bulb. Constant innovation has resulted in more efficient and longer-lasting components. Below are some of the primary characteristics of LEDs for designers to consider:

Optical – LEDs are a directional light source, emitting light in a single direction. Through carefully-designed lenses, light is directed only where it is needed, minimizing waste light and energy consumption.

Mechanical – Surface Mount LEDs are smaller than leaded components, making them ideal for space-limited board sizes and equipment. They are also highly resistant to shock and vibration and are available in a variety of packages. These include Chip style 0201,0402,0603,0606 and Plastic Leadless Chip Carrier (PLCC) in PLCC-2, PLCC-4 & PLCC-6 packages. Additionally, surface mount LEDs are available in reverse mount, side mount and right angle mounting options.

Thermal – One of the main advantages to LED technology is the lower power consumption and resulting lower heat dissipation than traditional lighting solutions. LEDs are affected by heat in ways that other light sources aren't, and exposure to heat outside their tolerance can result in color-shifting and reduced lifespan. With proper thermal management LED components deliver higher efficiency than other lighting or display solutions

Electrical – An LED's light output and color temperature depend on a specific electrical power (wattage), which must be maintained for effective operation. Specifying the component's correct power requirements, as well as precise engineering during the design process, will ensure that the right amount of electrical energy is delivered at all times.

The Advantages of LED and OLED Displays

LED technology has evolved from simple displays, IR emitters and indicators to energy-efficient Organic LED (OLED) displays, with built-in features from touch-sensitive capability to sunlight-readable displays.

In recent decades, popular LED display products have included LED displays, color TFT screens and OLED display units. An OLED (Organic LED) is a light-emitting diode in which the emissive electroluminescent layer is a film of organic compound that emits light in response to an electric current. When compared with similar sized LED displays, OLED displays consume one-tenth of the power, with a smaller footprint and a wider operating temperature range allowing for their use in a wider range of applications. OLED displays also offer wider viewing angles (up to 160 degrees), a higher contrast ratio (200 times better than LCD) and the ability to be clearly visible even in full sunlight.



How Infrared Emitter and Detector Technology are Evolving

An infrared LED, also known as an IR LED or IR emitter, is a discrete component that emits light in the infrared spectrum. Typical emission wavelengths include 850nm, 880nm, 890nm, 940nm and 950nm. IR LEDs may be used to transmit signals or commands to a receiving device in order to accomplish a specific task. In safety, security and surveillance applications, IR LEDs also can illuminate an area with Non visible light that can be captured by IR cameras..

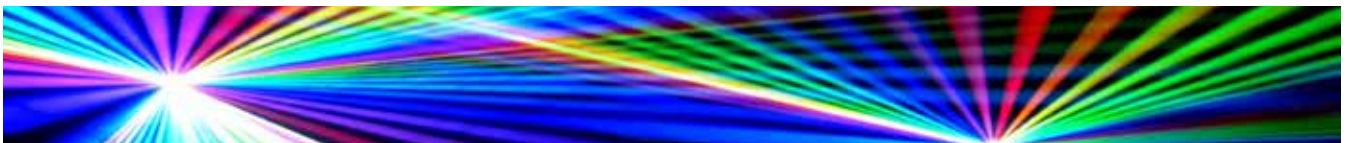
The typical drive current for IR LEDs falls within the 5mA to 50mA range. IR LEDs are packaged in many form factors, with surface mount packages as small as 0402 being very popular and easily optimized for optical and mechanical performance. The development of smaller package sizes means that many applications can make use of side-looker and through-hole 3mm and 5mm LEDs.



An IR detector is a discrete component that converts infrared light into an electronic signal. These devices are also known as photo detectors and sensors, and typically sense IR energy in the wavelengths mentioned above.

IR detectors have a typical supply voltage in the 5V to 20V ranges. They are typically packaged similarly to their IR emitter counterparts, the two being generally coupled together for either communication or sensing applications. IR detectors can be packaged or coated with filters for ambient light immunity in high-sunlight, outdoor applications.

The Latest in Laser Technology



Lasers operate in both the visible spectrum (400nm to 700nm) and in the infrared spectrum (850nm and higher). In addition to common uses in commercial and consumer electronics, lasers are finding new applications in industrial, medical, transportation, military and aerospace applications. For example, the LiDAR (Light Detection and Ranging) systems used in autonomous vehicles use lasers to sense and map potential obstacles and determine the vehicle's position in relationship to the obstacle. Also, new automobile headlights are being augmented with mirror-focused lasers, increasing distant high-beam illumination at high speed on poorly-illuminated roads.

The key characteristics that make lasers desirable for these applications include:

Superior beam quality – lasers can emit a near-perfect Gaussian beam, making it possible to accurately output the amount of power needed for a specific application.

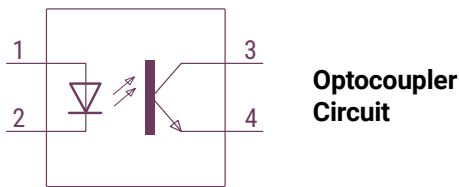
Wide Operating Temperature Range – operates from as low as -20 °C to +70 °C

Compact Design – same form factor and no additional lensing required

How Optocouplers and Solid State Relays are Used

Optocouplers, also known as photocouplers and optoisolators, combine an IR LED emitter and the IR detector that is used to convert the received infrared light into an electronic signal. The basic function of an optocoupler is to switch a range of voltages on the output side while maintaining electrical isolation from the input side, thus preventing the high voltages from affecting the system receiving the switched signals.

These optoelectronic components are commonly used in computer communications, microprocessor input/output signal switching, AC and DC control systems, power supply regulators, chargers and signal isolation equipment. They are often used to enable voltage control, protect low-voltage devices from surges and eliminate electrical noise from signals.



Solid State Relays – a solid-state relay (SSR) is an optoelectronic switching device that switches on or off when a small external current is applied to the LED providing optical coupling through the gap through an adjacent photo sensor. The relay may be designed to switch either AC or DC to the load. It serves the same function as an electromechanical relay, but has no moving parts. SSR's have several output types (AC, DC, or AC/DC) determined by the type of switching device: a transistor (either bipolar or MOS), an SCR, or a TRIAC. SSRs are necessary to switch large electrical loads with small input power.

How Optoelectronic Components are Used in Sensing

The advancement of optoelectronic LED technology has created the need for sensors leading to new developments in this space.

Ambient Light Sensors (ALS) – sensors that provide measurements of ambient light intensity which match the human eye's response to light under a variety of lighting conditions. Commonly used to adjust screen brightness depending on lighting conditions.

Gesture Sensors – sensor that is able to capture and interpret human non-contact movements as commands. The movements will cause a device to turn on or off, adjust screen brightness, volumes and other functions.

Passive Infrared Sensor (PIR) – electronic sensor that measures infrared light radiating from objects in its field of view. These commonly are used to detect human presence to activate lighting or other appliances.

Proximity Sensors – presence detection to activate kiosks, displays in printers, copiers and home appliances. Proximity sensing for lighting control in offices, corridors and public buildings.

Pulse/Heart Rate Sensors – detect pulse rate and heart rate function. Typically used in medical devices and consumer biomedical applications such as smartwatches and fitness trackers.

UV Sensors – sensors used for detecting the intensity of ultraviolet (UV) radiation, industrial curing and medical equipment applications. They also can be used to detect sunlight in order to avoid overexposure.

Common Optoelectronic Applications



Visible

- Interior/Exterior Light Fixtures
- Signage
- Message Boards
- Video Displays
- General Illumination

Displays

- Handheld Equipment
- Medical Equipment
- Industrial Equipment
- Infotainment/Transportation



Infrared

- IR Security Cameras
- IR Sensing
- Reflective Object Sensor Detection
- Transmissive Object Sensor Detection
- Industrial Automation
- Medical Diagnostics
- Robotics

Laser

- Industrial Automation
- Safety Light Curtains
- LiDAR/Autonomous Driving
- Military/Aerospace Sensors and Avionics
- Distance Sensing
- Stage Lighting

Specialty Sensor

- Industrial Automation (IIoT)
- Medical Equipment
- Handheld Equipment
- Biometric Monitoring
- High Speed Inspection Systems



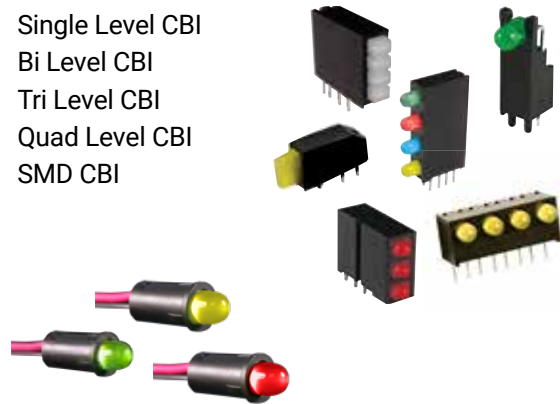
Surface Mount

- PLCC SMD LEDs
- Chip SMD LED
- Multicolor SMD LEDs
- Subminiature LEDs
- Reverse Mount LEDs
- SOT-23 SMD LEDs
- UV LEDs
- Special Colors



Circuit Board and Panel Mount Indicators

- Single Level CBI
- Bi Level CBI
- Tri Level CBI
- Quad Level CBI
- SMD CBI



Through-hole

- 3mm & 5mm Round
- Oval LEDs
- Rectangular LEDs
- Multicolor LEDs
- Low Current LEDs
- Resistor LEDs
- Blinking LEDs



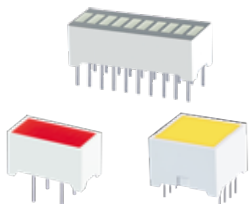
Infrared Emitters and Detectors

- IR Emitters SMD
- IR Emitters Through-hole
- IR Detectors SMD
- IR Detectors Through-hole



Seven Segment Displays Light Bars and Bar Graphs

- 7-Segment Display
- Alphanumeric Displays
- SMD and Through-hole



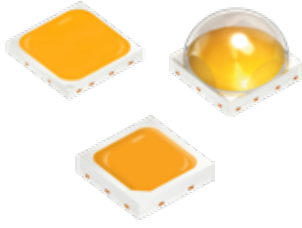
Sensors

- IR Sensors
- Ambient Light Sensors
- Color Sensors



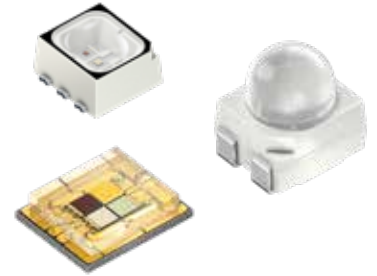
White LEDs

- Mid Power
- High Power
- Ultra High Power
- Chip on Board
- 3030 SMD
- 3737 SMD
- 5050 SMD
- 7070 SMD



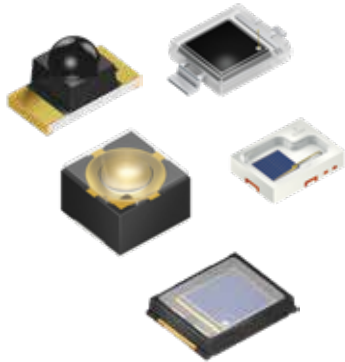
Color LEDs

- Mid Power
- High Power
- Chip on Board
- 3030 SMD
- 2226 SMD
- Various Beam Angles
80°, 120°, 150°
- UV LEDs



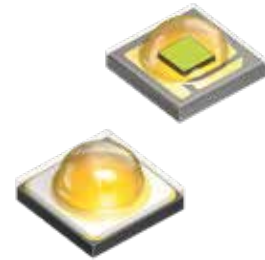
Infrared Emitters and Detectors

- IR Emitter
- Mid Power
- High Power
- Photodetectors
- Lensed
- Filtered Lenses
- SMD



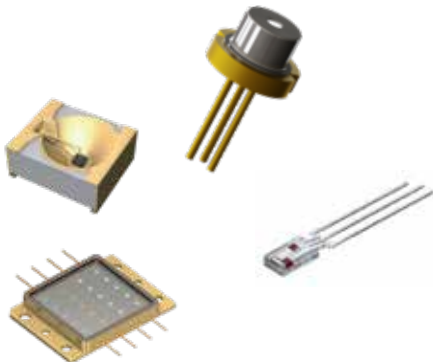
Horticulture LEDs

- 660nm Hyper Red
- 450nm Deep Blue
- 3030 Ceramic SMD
- 120° Beam Angle



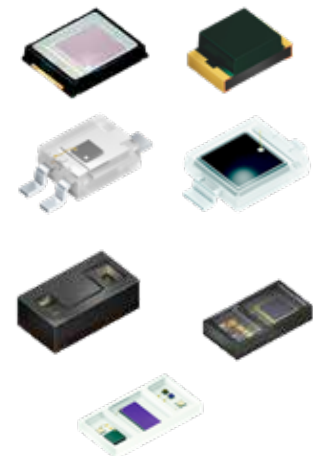
LASERS

- Infrared
- Visible



Speciality Sensors

- Ambient Light
- Proximity
- Biomonitoring



IR Emitters and Detectors

- IR Emitter Through-hole
- Photodetectors Through-hole
- Plastic Molded
- Metal Can Packages
- Custom Options Available



Slotted Switches

- Various Gap Sizes
- Single Channel
- Dual Channel
- PCB Mounted
- Wired
- Custom Options Available



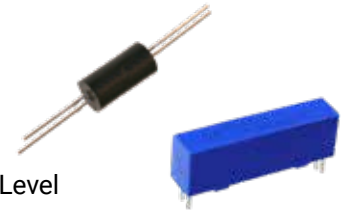
Reflective Switches

- Short-distance
- Long-distance
- Through-hole
- Wired
- SMD
- Custom Options Available



Optocouplers

- High Voltage
- Ultra High Voltage
- High Speed
- SMD
- High-Reliability/Space Level



Metal Can Emitters and Detectors

- IR Emitter Through-hole
- Photodetectors Through-hole
- TO-5
- TO-18
- TO-46
- TO-72
- Custom Options Available



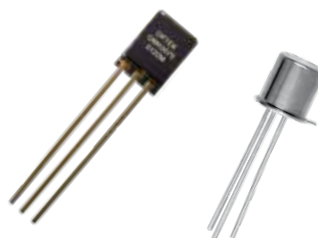
Photodiode Arrays

- Flex Sense Array
- Multichip Options
- Various Photodiode Options
- Custom Options Available



Mil/Aero and Space

- IR Emitters
- IR Detectors
- Optocouplers
- Custom Options Available
- Hall Effect
- TX and TXV Pprocessed to MIL-PRF-19500





The DNA of tech.™

IR Emitter

- Chip LEDs
- PLCC LEDs
- Gull Wing
- High Power



Receivers

- Mold/Minimold
- Minicast
- TV Cast
- HemidaLL
- Panhead
- Belobog



Photodiodes, Phototransistors

- Large Area Photodiodes
- Visible and Infrared Sensitivity
- Infrared-Only Sensitivity
- FAM Packaging
- SMD and Through-hole Packaging



Slotted Switches, Transmissive Sensors

- Single Channel
- Dual Channel
- Turn and Push Triple Channel
- Quad Channel Encoders, Absolute and Incremental
- Direction, Speed
- SMD



Optocouplers

- High Isolation
- High Speed
- Photo TRIAC
- MOSFET Driver
- Photo Relay



Visible LEDs

- Indicator LEDs
- Chip LEDs
- PLCC LEDs
- RGB LEDs
- UV LEDs



Digital Sensors

- Proximity Sensors
- Ambient Light Sensors
- RGB Sensors
- Gesture Sensors



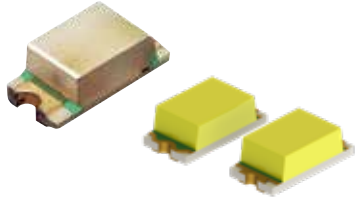
Displays

- Monochrome OLED Graphic Character
- Monochrome LCD Graphic Character
- Color TFT Capacitive Touch Resistive Touch
- VATN LCD



SMD LEDs

- Chip LEDs
- PLCC
- Lense Type
- High Power



Through-hole LEDs

- 3mm LEDs
- 5mm LEDs
- Oval LEDs



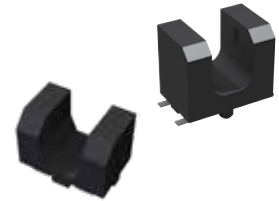
Infrared Emitters, LASERS and Detectors

- IR Emitter SMD
- Photodetectors SMD
- IR Emitter Through-hole
- Photodetectors Through-hole
- IR LASERS



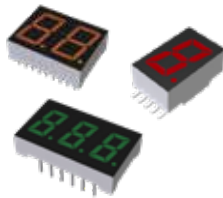
Infrared Photo Detectors

- IR Transmissive
- IR Reflective
- Ambient Light Sensor
- Proximity Sensor
- 4 Direction Sensor



Numeric Displays

- Seven Segment, 1-3 Segments
- Through-hole
- SMD



Expertise Applied | Answers Delivered

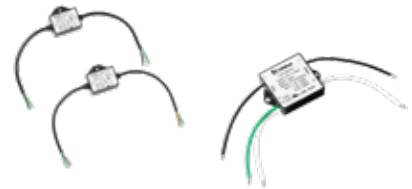
Optocouplers

- Digital Output
- Analog Output
- High Speed
- High Voltage



Surge Protection

- LSP05
- LSP10
- AC(V) 120, 240, 277, 347, 480



Solid State Relays (SSR)

- Form-A & B
- Power MOSFETs
- AC power – SCR based
- Gate Drivers
- Current Limited



TOSHIBA
Leading Innovation >>>

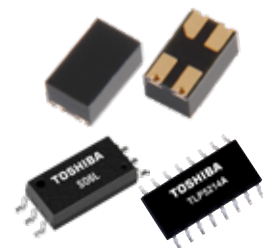
Panel Mount Indicators

- Multicolor LED Options
- Plastic Housing
- Metal Housing
- Tab Quick Connect
- Wire Connection
- Lensed and Unlensed



Optocouplers

- Analog Output
- Digital Output
- IGBT/MOSFET Output
- High Speed Communication
- High Current Photorelays



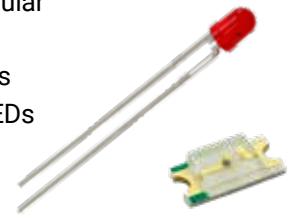
Panel Mount Indicators

- LED
- Incandescent
 - Commercial
 - MIL-DLT-3661C
- Neon



LEDs

- 2, 3, 5mm, and Rectangular
- MicroLED® SMD
 - Top View Chip LEDs
 - Right Angle Side LEDs
 - PLCC -, -4, Mini
- Through-hole



Circuit Board Indicators

- SMD
- Through-hole
 - 2, 3, 5mm and Rectangular
- PRISM® SMD



Light Pipes

- Vertical
- Right Angle
- Single Position
- Multi Arrays
- Optical Light Bleed Shields



Glossary of Terms

Candela (CD) – The base unit of luminous intensity in the International System of Units; that is, luminous power per unit solid angle emitted by a point light source in a particular direction.

Chromaticity/Color Temperature – The measure of the light source relative to the black body curve measured in Kelvin. Incandescent lamps have low color temperatures around 2700K-3500K, natural white LED light sources are 5000K-6000K and blue LED light sources are 6000K and higher.

Color Rendering Index (CRI) – Same as Correlated Color Temperature (CCT), this is a measure of the color shift of an illuminated object versus the color seen in normal sunlight. The higher the CRI value, the sharper, crisper and more natural the illuminated object will appear.

Efficacy – A measure of how well an LED or light source produces visible light. It is the ratio of luminous flux to power, measured in lumens per watt. LED Efficacy is calculated by Lumens divided by Watts. This will also help compare different LED products so you can compare side by side.

LED Drivers – Current control devices used to supply constant current to LEDs, while the input voltages change with temperature and other environmental conditions.

Lumens/Lux – Measures of light intensity. A lumen is the SI unit measuring the total quantity of visible light emitted by a source per unit of time. A lux is the SI measure of visible light radiated over an area; one lux is the amount of light needed to light up one square meter by 1 lumen. (See also Millicandela.)

Lumen Maintenance – An indicator of the ability of an LED to maintain its original intensity over its lifetime. Typically, a high-power LED will maintain 70 percent of its initial intensity over 40,000 to 50,000 hours.

Millicandela (MCD) – Equal to 1/1000 of a candela that is luminous power, per unit solid angle emitted by a point light source in a particular direction. The higher the MCD, the higher the LED light intensity over a defined area.

Phosphor – An inorganic chemical compound processed into fine powder; used in blue LED encapsulation to convert light into the white spectrum.

RGB LED – Three-color LED die (red, green and blue) packaged in a single surface mount package. As the primary colors used to make white light, RGB components commonly are used in digital signage boards for full-color display applications.

UVA, UVB, UVC – Ultraviolet (UV) light, broken into three wavelength segments: UVA=380-315nm; UVB=315-280nm; UVC=280nm and lower. UV light is used for dental epoxy and nail curing, air and water filtration and germicidal applications.



Why Buy from the Specialist in Electronic Component Distribution?

Founded in 1971, TTI has steadily grown to become the world's leading interconnect, passive, electromechanical and discrete component distributor in the industry. The company was founded on the premise that passive component purchasing could be made more efficient by offering product specialization, customer-driven service, and proprietary supply chain solutions.



Knowledgeable Product Experts

Specialization allows TTI product managers to provide much better product insight to support your manufacturing from design through production. TTI Specialists' commitment to our customers is key to our continued success.



Broader and Deeper Inventories

TTI maintains extensive component inventories, stocking more than 500,000 part numbers in North America and over 850,000 globally – that's more interconnect, passive, electromechanical and discrete inventory available than from any other source.



AIM - Advanced Inventory Management Platform

TTI's proprietary supply chain system is specifically designed for managing IP&E products and partnerships with premier manufacturers. This allows us to provide the BOM coverage necessary to deploy comprehensive solutions that reduce total cost of ownership and mitigate line down risk.

Quality and Reliability

TTI is the first distributor to have all global warehouse locations ISO registered and currently are certified to ISO 9001 with AS9100C and ISO 14001 in North America, ISO 9001, EN 9100, ISO 14001 and EN 9120 in TTI Europe and ISO 9001 in TTI Asia.

Year after year, customers rate our inventory availability, on-time delivery and accuracy among the very best in the industry – call your local TTI Specialists at 1.800.CALL.TTI and discover why.

