The Avago Advantage

# Avago Product Solutions for **Medical Applications**


**Application Solutions**

**Your Imagination, Our Innovation**
*Sense • Illuminate • Connect*

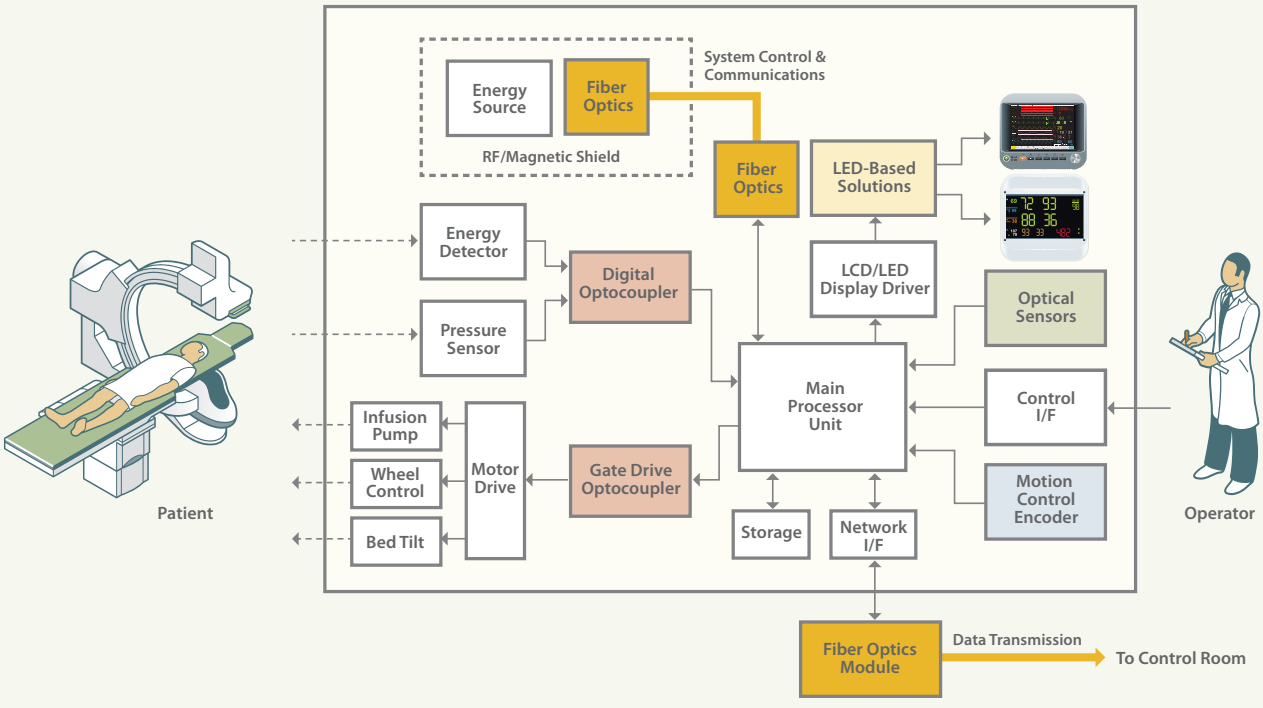
AVAGO TECHNOLOGIES

# Avago Product Solutions for Medical Applications

## The Avago Advantage

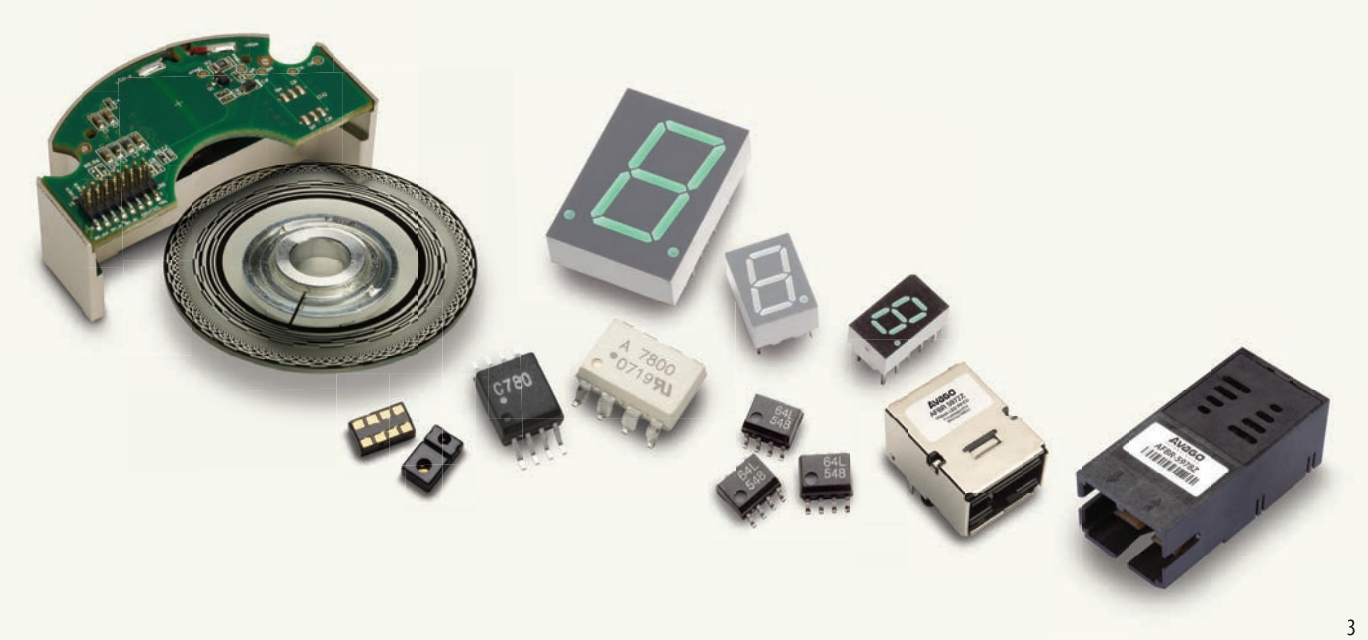
Avago's medical product solutions are the culmination of more than four decades of technical innovation in semiconductors. For medical applications, Avago provides a broad portfolio of components including motion control encoders, optocouplers, fiber optics solutions, LED-based solutions, and optical sensors. System designers involved with medical equipment applications such as medical imaging, monitoring, diagnostics, and therapy can count on Avago to deliver high quality products with unmatched performance while meeting or exceeding safety standards.

**Typical Medical System Application Diagram**



# Avago's Broad Portfolio of Components for Medical Applications.

| Medical Applications | Medical Systems/Equipment | Motion Control Encoders | Optocouplers | Fiber Optic Solutions | LED-based Solutions | Optical Sensors |
|---|---|---|---|---|---|---|
| **Imaging** | MRI System | ● | ● | ● | ● | ● |
| | PET Scanner | ● | ● | ● | ● | ● |
| | CT Scanner | ● | ● | ● | ● | ● |
| | X-Ray System | ● | ● | ● | ● | ● |
| | Ultrasonic Imaging | ● | ● | ● | ● | ● |
| **Monitoring** | Patient Monitoring System | ● | ● | ● | ● | ● |
| | Endoscopy | ● | ● | ● | ● | ● |
| | Infusion Pump | ● | ● | ● | ● | ● |
| | Insulin Pump | ● | ● | ● | ● | ● |
| **Diagnostics** | Cardio Diagnostics | ● | ● | ● | ● | ● |
| | Vision Microscopy | ● | ● | ● | ● | ● |
| | Blood Analyzer | ● | ● | ● | ● | ● |
| | Diagnostic Sonography | ● | ● | ● | ● | ● |
| **Therapy** | Wheelchair System | ● | ● | | ● | |
| | Medical Bed | ● | ● | | ● | ● |
| | Treadmill System | ● | ● | | ● | ● |
| **Others** | Cardiac Defibrillator | ● | ● | | ● | ● |
| | Neonatal Support System | ● | ● | | ● | ● |
| | Ventillator | ● | ● | | ● | ● |



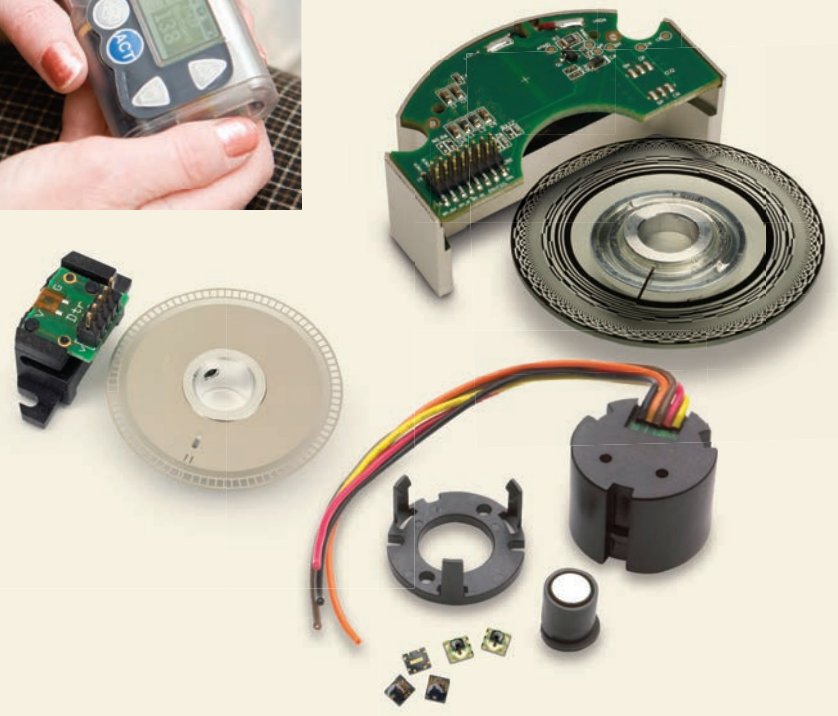
# Motion Control Encoders

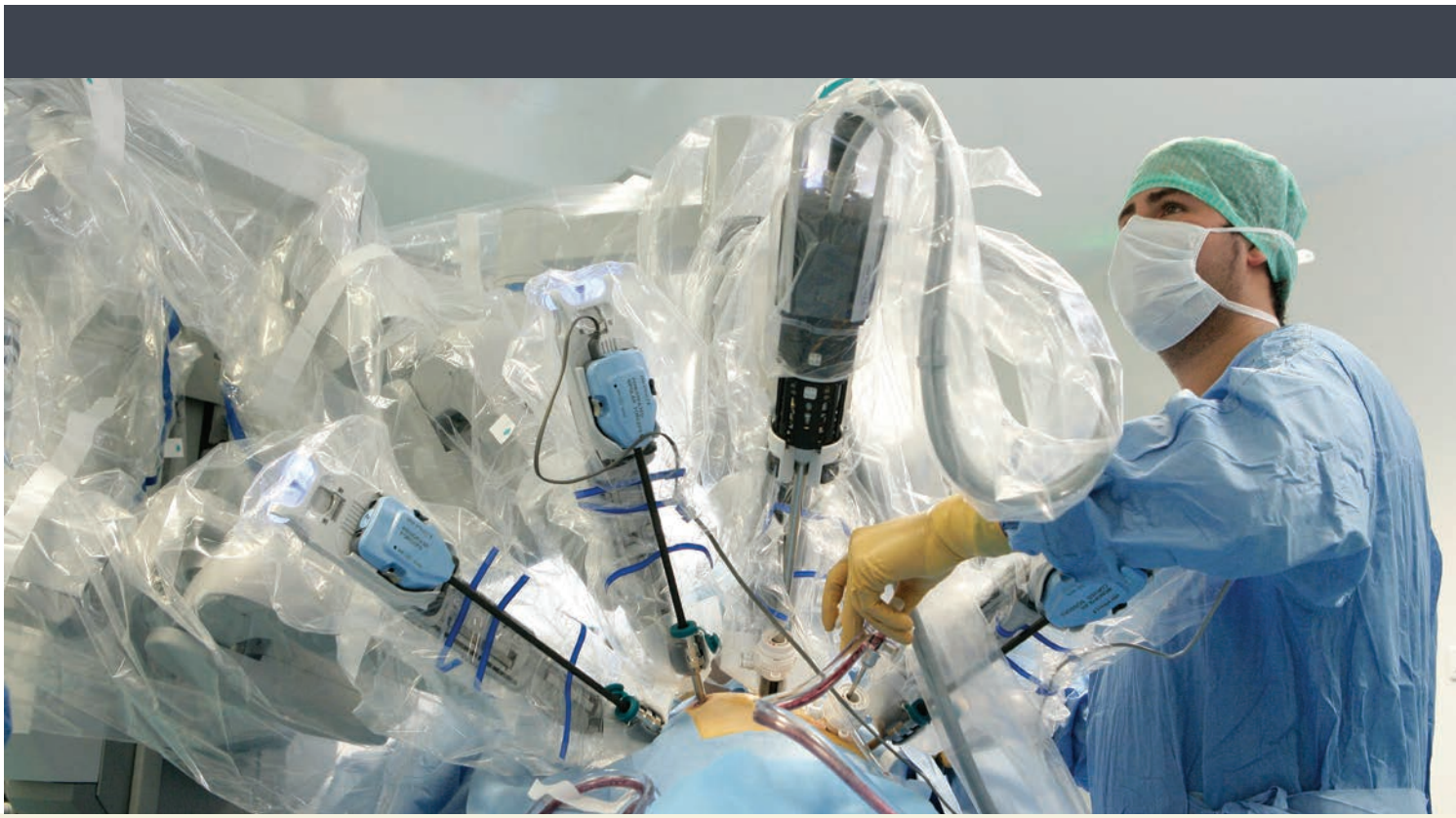
## for Precise Positioning and Motion Sensing

Precise motion control is vital for many life support systems and medical equipments, whether it is for controlling the robotic arm attached to an operating table, controlling the infusion pump to provide precisely controlled rate of fluid delivery to the patient, or just controlling a mechanical function assisting the patient. As a positioning sensor, a motion control encoder is crucial in providing accurate measurement of position and movement within the system.

Avago offers rotary and linear type incremental and rotary type absolute encoders. The incremental encoder provides relative positional data referenced to a known start position, whereas the absolute encoder provides absolute positional data with no reference to another position. These encoders sense the mechanical motion and translate the information (i.e., position, velocity, acceleration) into useful digital data. In addition, Avago also offers rotary encoders, also known as shaft encoders, which convert the angular position or motion of a shaft or axle into useful digital data.

Avago motion control encoders enable accurate level control of the surgical bed or the rate of fluid delivery from an insulin pump.





Avago motion control encoders are ideal for robotic assisted medical applications where accurate measurement of position and movement is crucial.

Avago offers a wide range of motion control encoder solutions that meet the stringent requirements of precise positioning and velocity sensing for medical applications:

- **Incremental Encoders:** The Avago incremental encoder solutions include a wide selection of optically transmissive and reflective encoders. These products are available in various chip modules and plastic housings. Key features include high resolution, minimal switching glitch, and small form factor.
- **Absolute Encoders:** The Avago absolute encoder solutions include the optically transmissive and magnetic encoders. These products are available in various chips, modules and plastic housings.
- **Rotary Encoders:** The Avago rotary encoder solutions include an extensive selection of housed rotary switches which can be used for human-machine interface for rotary control or data entry. Rotary resolution options range from 50 to 3600 counts per resolution (CPR) for incremental and 17-bit single turn absolute.
- **Encoder Accessories:** The Avago encoder accessories include a wide variety of cables and alignment tools providing customers with a complete encoder solution and enabling easier assembly of Avago encoders to the end applications.

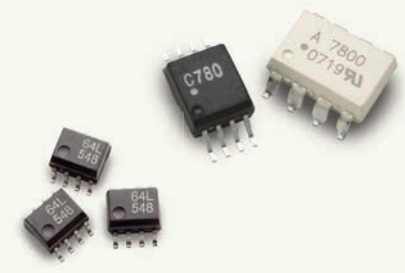
Further information on Avago motion control encoder solutions is available at:
**www.avagotech.com/encoders**

# Optocouplers

## for High Voltage Protection and Signal Isolation

Optocouplers are ideal for use in isolating high voltage circuits from low voltage circuits to prevent catastrophic failure in a typical medical equipment system. For medical applications, optocouplers could also be used to protect both patient and operator from electric shock when interfacing with the medical equipment. Typical functions of an optocoupler include:

- Isolation of electrical circuits
- Management of different voltages and impedances
- Suppression of electrical noise and transient interference
- Elimination of ground loops

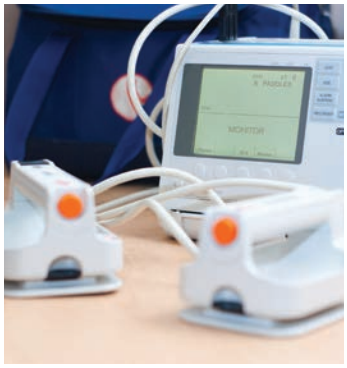


Avago offers a wide range of optocoupler solutions for medical applications:

- **Digital Optocouplers:** The Avago digital optocouplers are versatile logic gate optocouplers that can be used in a wide array of isolation applications ranging from power supply and motor control circuits to data communications and digital logic interface circuits. Switching speed option ranges from 100kBd to 100MBd.
- **Isolation Amplifiers:** The Avago isolation amplifiers provide electrically-isolated signal buffering and amplification. Key features include high common mode rejection (CMR), wide bandwidth and high linearity. Unlike Hall Effect Transducers, these devices are immune to magnetic fields, thereby making them favorable for applications like MRI machines and CT scanners.
- **Gate Drive Optocouplers**: The Avago gate drive optocouplers include highly integrated gate drive optocouplers with output drive current up to 5.0 A. These devices are optimized for driving IGBT and power MOSFET devices for motor control and power conversion applications. Other key features include $V_{CE}$ desaturation (DESAT) detection, active Miller clamp, under voltage lockout (UVLO) detection, "soft" IGBT turn-off, and isolated open collector fault feedback.

Avago optocoupler solutions meet international medical safety standards requirements for both component level and application specifications (i.e., IEC 60747-5-5, IEC 60601-1). For more information on Avago's regulatory standards approved optocouplers, please refer to the Avago Regulatory Guide to Isolation Circuits document (Publication Number: AV02-2041EN). Further information on Avago optocoupler solutions is available at:

**www.avagotech.com/optocouplers**
**www.avagotech.com/hermetic-optocouplers**



Avago optocouplers help protect patient and operator from electric shock when interfacing with the medical equipment.


Avago isolation amplifiers provide electrically-isolated signal buffering and amplification.

# Fiber-Optic Solutions
## for Highly Reliable Data Transmission

Fiber optic communication plays an important role in many medical systems, particularly for providing mission-critical system control and status communications. Especially in systems that have high energy radiation such as the MRI system, CT Scanner and PET Scanner, it is imperative that fiber optics be used as a communication link from the main controller to the energy source to help prevent radio frequency interference (RFI) and electromagnetic interference (EMI) from jeopardizing signal integrity. Furthermore, data communications between the operating room and the control room are becoming increasingly important in hospitals. Patient data taken from the operating room are transmitted to a centralized control room for advanced analysis and/or archive. RFI and EMI are pervasive in hospital environments, especially in operating rooms where data cables are strung across noisy and unshielded areas in which data transmission integrity could be compromised. Immune to RFI and EMI, Avago fiber optic solutions are ideal for providing highly reliable data transmission.

Avago fiber optic solutions are ideal for use in hospital environments where RFI and EMI are pervasive.

Avago fiber optic solutions provide highly reliable data communications between the operating room and the control room.

With a strong reputation in industrial networking and data communications, Avago offers a wide array of industrial-grade fiber optic solutions that are suited for medical applications:

- **Compact 650nm Ethernet Transceiver:** The Avago 650nm Ethernet transceiver provides Fast Ethernet (100Mbps) communications over standard plastic optical fiber (POF) cable. It features a compact form factor similar to the UTP connector.
- **650/820/850/1300nm Transmitters & Receivers:** The Avago simplex transmitter-receiver solutions support data rates from DC to 160MBd, link distances up to 5000 meters, and connector types including SMA, ST, FC, SC and Avago Versatile Link. Key features include high galvanic isolation, EMI rejection and noise immunity.
- **Plastic Optical Fiber Cables:** The Avago HFBR-R/EXXYYYZ series of POF cables are constructed of a single step index fiber sheathed in black polyethylene jacket. The duplex fiber consists of two simplex fibers joined with a zip cord web.
- **POF Cable Connectors:** The Avago HFBR-4501Z, HFBR-4503Z and HFBR-4506Z crimp-type connectors are available for POF cable termination in simplex, simplex latching, duplex and duplex latching. The Avago HFBR-453XZ crimpless-type connectors are an enhanced version of the HFBR-4501Z and HFBR-4503Z connectors, compatible with Avago's Versatile Link series of transmitter and receiver products.

Further information on Avago fiber optics solutions is available at:
**www.avagotech.com/fiber**
**www.avagotech.com/pof**

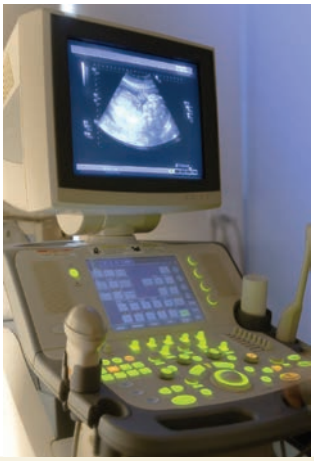
# LED-based Solutions

## for General Illumination, Lighting Indicator, and Display Panel

LED is ubiquitous in modern medical applications. It is used for general illumination, lighting indicator, backlighting, signage and display. Compared to conventional lighting such as incandescent halogen, compact fluorescent and high-intensity discharge, LED lighting boasts many overt benefits that include:

- High Brightness
- Energy Efficiency
- Instant-on, Dimmable Lighting
- Compact Size

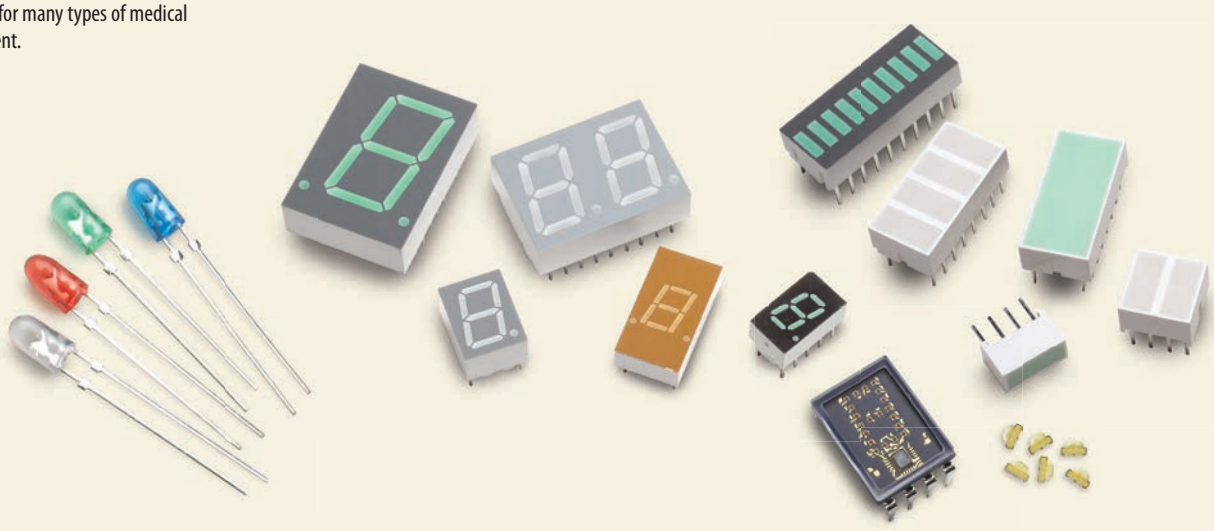
Avago offers "one stop shopping" with a wide array of LED-based solutions for medical applications:



- **High Brightness LEDs:** The Avago high brightness LED solutions include through-hole lamps, surface mount lamps, surface mount PLCC LEDs, mini PLCC-2 surface mount LEDs, Envisium™ Surface Mount Power PLCC-4 LEDs, High Power LEDs, and Moonstone™ High Power LEDs.
- **LED Indicators and Displays:** The Avago LED indicator and display solutions include standard through-hole lamps, subminiature lamps, surface mount ChipLEDs, auto focus auxiliary flash LEDs, light bars and bar graph arrays, 7-segment LED displays, and smart displays.

Further information on Avago LED-based solutions is available at:
**www.avagotech.com/leds**

Avago LED-based solutions offer high brightness and energy efficient lighting for many types of medical equipment.



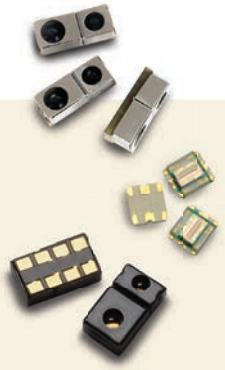

# Optical Sensors

## for Light Sensing and Object/Motion Detection

Avago optical sensors are used to enable automatic light sensing and motion detection while LED lighting indicators and seven-segment displays are used to illuminate vital information.

Optical sensors such as proximity and light sensors can greatly enhance patience and operator experience when interfacing with medical equipments. Typical functions of an optical sensor include:

- Ambient Light Sensing
- Contactless Control Switch
- Object Detection
- Motion Detection



Avago provides a wide range of optical sensor solutions that are suited for medical applications:

- **Ambient Light Sensors:** The Avago ambient light sensor solutions provide precise light detection for a wide range of ambient brightness. Key features include fast responsiveness to ambient light, automatic adjustment to LCD backlight intensity and low power consumption.
- **Proximity Sensors:** The Avago proximity sensor solutions provide accurate object detection or motion detection for various distance ranges. Key features include low optical crosstalk, signal conditioning and compact size.
- **Integrated Sensor Module:** The Avago integrated ALS+PS module offers both ambient light sensing and proximity sensing capabilities in one device. This integrated miniature-size sensor provides ease of design and implementation.

Further information on Avago optical sensor solutions is available at:
**www.avagotech.com/sensors**

# Your Imagination. Our Innovation

Avago Technologies is a leading designer, developer and global supplier of a broad range of analog, mixed signal and optoelectronics components and subsystems with a focus in III-V compound semiconductor design and processing. Backed by an extensive portfolio of intellectual property including approximately 4,200 patents and pending applications, Avago products serve three primary target markets: wireless communications, wired infrastructure, and industrial and other. Avago has a global employee presence and heritage of technical innovation dating back 50 years to its Hewlett-Packard roots.

## Avago products serve three diverse end markets

**Wireless Communications** serving the smartphone/handset and Base Station infrastructure markets with over 250 patents and leading-edge products that include:

- Power Amplifiers
- Front End Modules
- Film Bulk Acoustic Resonator (FBAR) Filters
- GPS/GLONASS LNAs
- Optical Finger Navigation
- LED Backlighting, Screen Illumination
- Ambient Light and Proximity Sensors

**Wired Infrastructure** for switches/routers, data centers, supercomputers and storage/servers with over 200 patents in parallel optics alone and products that include:

- 120Gb Parallel Optic Arrays
- 20Gb SerDes ASICs in 40nm
- Storage Fibre Channel Transceivers
- QSFP/SFP Sonet Transceivers

**Industrial and Other** for alternative energy power generation, electronic sign and signals, automated manufacturing, automotive lighting, GPS/GLONASS navigation, motor inverter system, battery charging and management, infotainment systems and vehicle safety systems with products that include:

- Inverters
- Isolation and Digital Optocouplers
- Motion Control Optical & Magnetic Encoders
- Polymer Optical Fiber
- Indicator and Display LEDs


For product information and a complete list of distributors, please go to our web site:
**www.avagotech.com**

For technical support please email a Technical Response Center in your region:
*United States:* support@avagotech.com
*Europe*: info@promotionteam.de
*Asia Pacific*: pacrim.components@avagotech.com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