Photo-Optical Devices Deliver Reliable, Cost-Effective Sensing and Control Solutions

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Infrared (IR) PhotoOptic devices are used for sensing and control in a variety of general market applications. These devices – LEDs and phototransistors - operating in the near IR region (700-1400 nm) are often used as a simpler and lower cost solution when compared to RF devices, since light is less complex than RF when implemented as the signal source.

Optical sensors are used in industrial, consumer and other applications for sensing movement, position, proximity, ambient light, speed, and direction. Typical applications for IR sensors include the following:

• Security – movement/motion detection, fire alarms/smoke detectors
• Industrial (including automotive) - measurement, counters, motor encoders
• Medical - blood/oxygen/temperature measurement
• Consumer - TVs/STBs, proximity sensors, cell phones, tilt sensors, ATMs/kiosks, and cameras
• Computers - keyboards/mice
• Printers - paper/media/door detection
• Game and Toys – remote control modules

To address the variety of sensing applications, optical sensors are available in a variety of configurations, including:

• IR Emitters and Receivers (sensors)
• Photointerrupters & Photo Reflectors
• Tilt Sensors
• Remote Control Module Receivers

An IR Emitter is a light emitting diode (LED). Different types of IR LEDs are specified based on their packaging and special features, such as output optical power, wavelength, and response time.

IR Receivers are also called sensors since they detect the wavelength and spectral radiation of the light from the IR emitter. IR receivers are specified by optic features, packaging, special circuitry such as an ambient light filter, wide viewing angle, and more.

Since IR emitters and receivers are used in combination, matching the wavelength of the emitter output with the peak sensitivity of the phototransistor receiver can result in improved performance and lower power consumption. This is particularly important in battery powered wireless remote applications. As shown in Figure 1, phototransistors have a wide bandwidth but with a peak sensitivity at around 800 nm.

Until recently, IR emitters typically operated around 950 nm. This wavelength disparity required designers to operate the emitter at higher power and the receiver at higher gain to assure proper operation. Newer emitters, such as the ROHM SIM-041ST, operates at 850 nm resulting in higher output efficiency and potential energy savings of up to 66 percent.

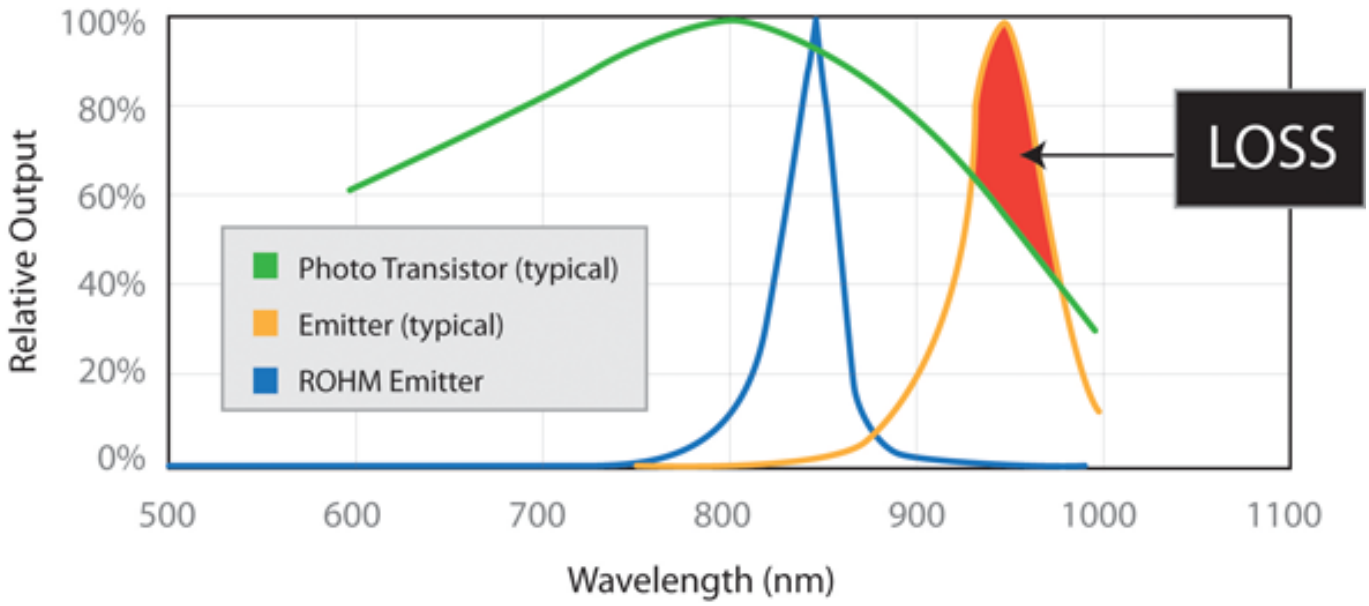

Figure 1. With peak output at 850 nm, high performance emitters such as ROHM Semiconductor's SIM-041ST, operate much closer to the wavelength of phototransistors, resulting in reduced energy losses.

A photointerrupter is a photosensor that integrates an optical receiver and emitter in a single U-shaped package. In a transmission type photointerrupter, the light emitting and detecting elements are placed facing each other. Shape and size are two of the main differentiating features of a photointerrupter. Product characteristics are determined by the slit and gap -- the width or distance from emitter to receiver/sensor. The vertical or horizontal slit width is the window opening for collimating, also called the beam width. Besides the slit and gap, additional selection criteria include the output type, such as analog, digital, and dual-phase output signals. Typical applications include: printers, counters, opto encoders, directional movement detection, and more.

Photo reflectors or reflective type sensors are side-by-side emitter-sensor (photointerrupter) devices that detect reflected beams from a surface. Figure 4 shows a typical photo reflector design. Key electrical characteristics are: transfer gain rate, sensor collector current versus IR LED current, wavelength, and response switching time. Reflective type sensors can be used in proximity sensing applications.

Tilt sensors represent a special type of sensing design for PhotoOptics. Figure 2 is an example of a surface-mount four-way detection sensor consisting of an IR LED and two phototransistors. Optical tilt sensors are not susceptible to vibration or

external energy (RF, magnetic) fields. Ideal applications include orientation/fall/shock detection and image rotation.

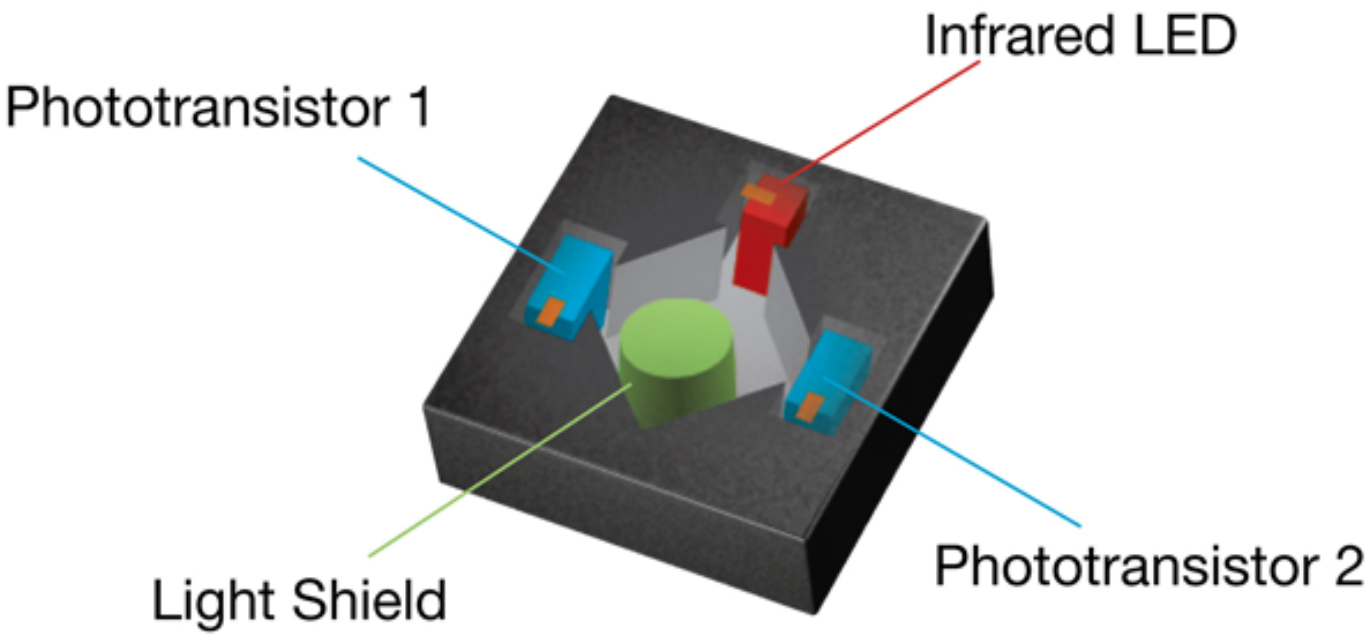

Figure 2. ROHM's RPI-1040 tilt sensor package includes a novel light shield that ensures silent operation, avoiding noise frequently exhibited by other designs during rotation.

Remote control module receivers operate at a variety of carrier frequencies (typically in the 30 kHz to 60 kHz range). Units with a dual lens provide a higher degree and wider range of sensitivity. The small size and (typical) surface mount design make them ideal for embedding in numerous applications. Lead frame versions are also offered. Units with an integrated photo IC have improved anti-noise characteristics.

Typical applications include:

• Audio Visual devices such as audio amplifiers, TVs, VCRs, and CD/DVD/MD players;
• Multimedia equipment;
• Home appliances such as air conditioners, fans, and lighting products;
• CATV set top boxes;
• Toys;
• Any equipment with a wireless remote control.

For additional information, please read the ROHM Semiconductor White Paper entitled, "Using Inrared Technology for Sensing and Control Applications" available for download at www.rohm.com/us/ir-led.htm [1]

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