Choosing an Infrared Receiver Based on AGC Type

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IR Receivers

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Until recently, most light bulbs used for domestic lighting in the United States were incandescent. While Asia and Europe have largely switched to fluorescent lighting, Americans have been slow to adopt compact fluorescent lights (CFLs). While CFLs do save energy, they also emit a significant amount of infrared noise and may impact the performance of the remote control infrared (IR) receiver found on televisions and other consumer electronics. In fact, the effect of ambient lighting on performance is the most critical factor when choosing an infrared receiver.

Noise Rejection

The primary performance characteristic to evaluate when choosing an infrared receiver is its ability to receive data signals and to suppress all other sources of noise. An infrared receiver may have the industry's best transmission distance and lowest price but, if susceptible to noise, be a bad choice for design engineers. If it is susceptible to noise, repeated remote control unit command entries are required — noise from other light sources in the room is being received at the same time as the emitted data and corrupting the signal. This noise might include emissions from incandescent, halogen, neon, fluorescent and compact fluorescent lamps; liquid crystal and plasma displays; and sunlight.

IR receiver control circuits provide feedback of the received signal to the automatic gain control (AGC) circuitry. This reduces the gain of the amplifier in the presence of noise signals to ensure that no spurious pulses are received and keeps the gain high if data is being received. Ambient DC light sources, like incandescent and halogen lamps or sunlight, will cause the gain to be reduced. When turned on, an incandescent lamp may produce spurious pulses at the output of the infrared receiver until the AGC has settled the gain to a lower level. After this, the noise of the lamp will be filtered but at the cost of reducing the maximum receiving range.

Other than an effect on range, DC light sources will not corrupt data signals. AC signals are another story. While applying a 10W/m² DC signal, an AC signal that is 1000 times lower (1mW/m²) can still be received by the infrared receiver. Fluorescent lights and flat screen TV emissions are the most common AC noise sources affecting an infrared receiver. Figure 1 charts the relative IR receiver sensitivity of the TSOP34836 receiver along with the near infrared emission produced by a
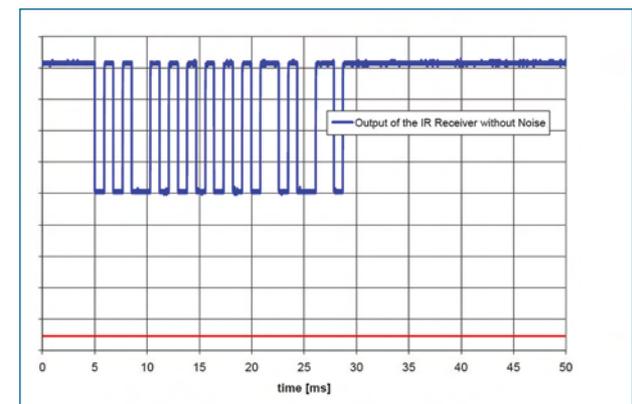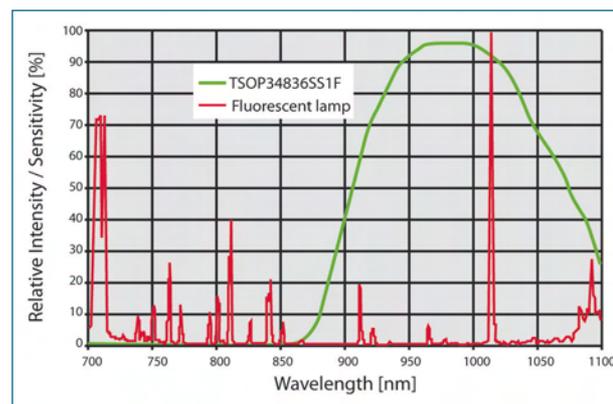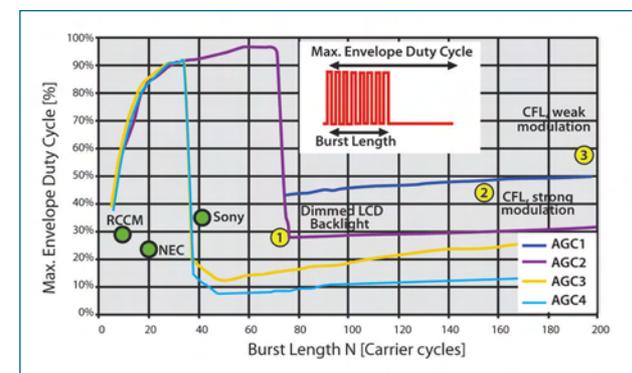

Figure 1., right, The relative IR receiver sensitivity of TSOP34836 receiver along with the near infrared emission produced by a "warm" fluorescent light.

Figure 2. above, far right, AGC-type Comparison - Data Signals and Noise.

Figure 3. below, far right, An oscilloscope image for the receiver output (blue) when receiving the RC5 code, using a receiver with AGC1™ without disturbing noise (red).

"warm" fluorescent light. This large optical noise at 1014 nm can be a corrupting source.

The AGC circuitry utilizes some inherent differences to distinguish data from noise. But because there are so many different possible noise sources and coding schemes, no single AGC algorithm can completely suppress all noise and pass encoded data signals. To solve this problem, Vishay has developed four different AGC response algorithms based on coding schemes and ambient noise conditions. These AGC algorithms allow developers to choose the most appropriate receiver for their expected operating environment. For example, AGC1™ was developed for compatibility with any coding scheme in low noise environments and for data transmission up to 4 kbit/sec. AGC2™ was developed for typical remote control coding schemes with a reliable function in noisy environments, AGC3™ for the operation with fast coding schemes and better noise suppression and AGC4™ for best noise suppression including dimmed LCD backlighting and Plasma displays. In Figure 2, AGC1, AGC2, AGC3 and AGC4, common infrared data signals and common noise sources are graphed. Any signal below the curve will be received as a legitimate data signal by the receiver and passed to the output. Any signal above the curve will be filtered out as noise.

Each AGC type responds to noise at a different rate. Data and noise signals can be distinguished by the receiver according to the carrier frequency, burst length and maximum envelope duty cycle. The following figures demonstrate the affect that strongly modulated fluorescent light and plasma emissions have on a receiver that was not correctly chosen for its environment. Figure 3 shows an oscilloscope image of the receiver output (blue) when receiving the RC5 code, using a receiver with AGC1 without disturbing noise (red).

Figure 4 shows the AGC1 receiver output when the same RC5 signal is being received in the presence of a strongly modulated fluorescent light. Note that the transmitted signal is corrupted by spurious pulses. In this case the data signal would need to be sent again; repeated pressing of the remote control unit buttons.

Figure 5 shows the AGC1 receiver output when receiving the same RC5 code plus noise from the plasma television in which it is assembled. It would be nearly impossible to use the remote control unit given this level of noise being passed by the receiver.

To filter these noise signals, a receiver with a higher AGC level is required. For the fluorescent light and plasma displays, moving from AGC1 to AGC2 would likely solve the problem. For devices with dimmed LCD backlighting, it is recommended that an AGC4 receiver be used.

Package and Holders

In the olden days only televisions were equipped with infrared receivers for remote control, and a standard 3-leaded device was offered by all suppliers. It is difficult for manufacturers of TV sets to locate the printed circuit board with the infrared receiver circuitry on the same plane as or close to the receiving window, so suppliers offered holders that would raise the receiver up above the printed circuit board or move it out beyond its edge to be directly behind the receiving window.

Today, infrared receivers are a common feature of notebook PCs, LCD displays, desktop PCs, air conditioners and general lighting control. For these applications, the window and location of the infrared receiver are an integral part of the PCB and housing design, allowing surface-mount receivers without holders to be used which eliminates the cost of holders and simplifies assembly.

Coding Schemes

To reduce the possibility of ambient lighting corrupting a transmitted signal and to conserve battery power, coding schemes sent over a carrier frequency were created to send commands from the remote control to the receiver. A data word consists of a series of 0's, no light emitted from the remote control unit, and 1's, bursts of infrared light emitted. Lacking global standards, early adopters devised their own coding schemes. As a result, there are hundreds of coding schemes; however, there are three commonly used schemes: bi-phasing code, pulse distance code, and pulse length code.

These codes are transmitted from the remote control unit to the infrared receiver using an infrared emitter pulsed at several possible carrier frequencies (kHz): 30, 33, 36, 36.7, 38, 40, 56, and 455. The data signal frequency and infrared receiver band pass center carrier frequency should be the same.

The Future of IR Receivers

Like many optical components, recently introduced IR receivers, use surface-mount package technology to reduce device size while still meeting transmit distance requirements of 30 meters. A recent trend has remote controlled units and set-top boxes equipped with both IR emitters and receivers enabling data communications. From time to time RF remote control units are proposed as alternatives for infrared remote control. But to date, their performance limitations and cost have prevented widespread adoption. **WDD**

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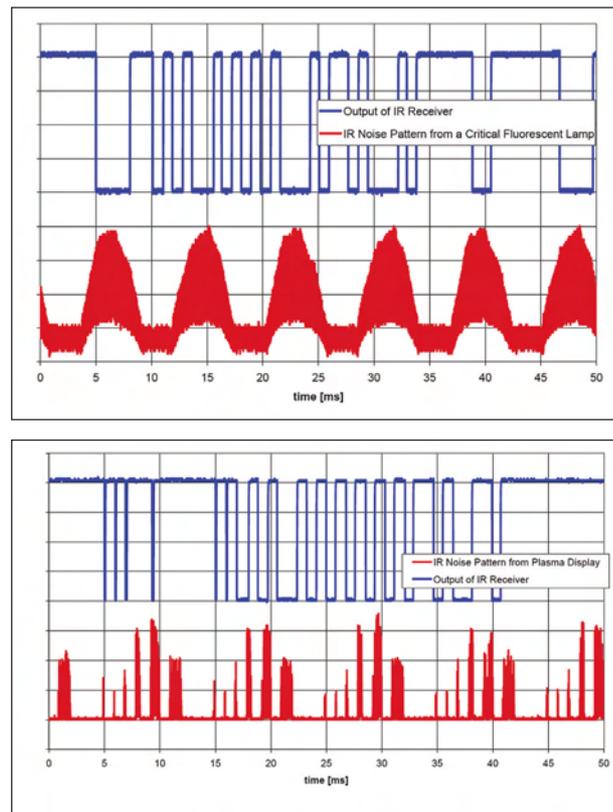
Top, Figure 4. The AGC1 receiver output when the same RC5 signal is being received in the presence of a strongly modulated fluorescent light. Bottom, Figure 5. The AGC1 receiver output when receiving the same RC5 code plus noise from the plasma television in which it is assembled.
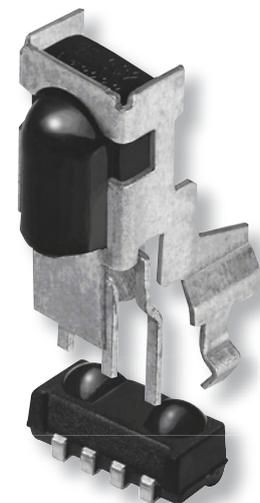
Figure 6. Vishay's PC1 Top View holder and the TSOP75, with a new low-profile surface.