

## Disturbance Sources

Receivers in remote control systems must have high sensitivity and be ready to receive a signal any time. This operating environment also means that they are susceptible to different kinds of disturbance signals. Vishay IR receivers set the internal gain to an optimum sensitivity level such that there are no unwanted output pulses due to noise but also such that the sensitivity be as high as possible for the data signal. Some commonly found disturbance signals described below.

### DC LIGHT SOURCES

The main DC light sources found in remote control environments are sunlight and tungsten (incandescent) bulbs. These kind of disturbance sources will cause a DC current in the detector inside the module, which in turn will produce white noise in the receiver circuit. The negative influence of such DC light can be reduced by optical filtering. Light in the visible range (400 nm to 700 nm), is almost completely removed by the use of an optical cut-off filter at 830 nm. Therefore, only longer wavelength radiation above 830 nm can be detected. Special measures were also

taken in the design of the devices to ensure that the sensitivity above 1050 nm drops off as sharply as possible. The silicon photo detector therefore receives only a limited band from the original spectrum of the "white" light source.

### FLUORESCENT LAMPS

The spectral emission of fluorescent lamps is rather complicated. Very little radiation is emitted in the infrared. The total spectral emission is a combination of the relatively broadband emission from the luminescent phosphor and the spectral peaks emitted from the different gaseous components filling the tubes. The radiation of the activated luminescent materials is mainly in the visible wavelength band and is almost DC light. The affect of this radiation on the IR receivers is therefore insignificant. However, the direct emission of the gas discharge in the lamp carries the modulated signal of the lamp ballast. The IR portion of the optical spectrum of a fluorescent lamp is shown expanded in figure 1. This part of the spectrum can vary depending on the lamp type and also on the temperature of the lamp.

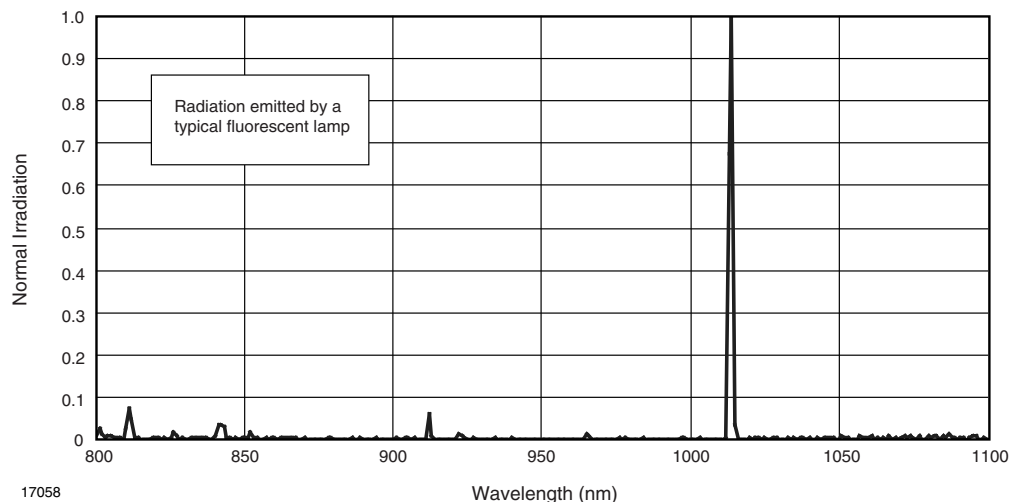


Fig. 1 - Spectral Emission of Fluorescent Lamps

The impact of the light coming from fluorescent lamps to the IR receiver may be very different depending on the ballast which is driving the lamp.

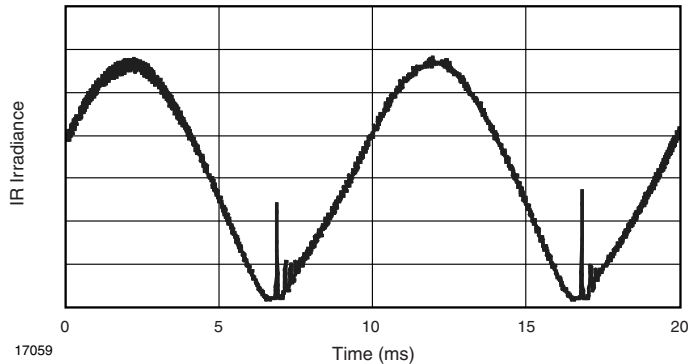


Fig. 2 - Radiated Signal from a Fluorescent Lamp with Coil Ballast

The signal waveforms of four different kinds of lamp ballast are shown in the following diagrams. The signal shown in figure 2 comes from a fluorescent lamp with coil ballast, which is operated at a 50 Hz power line frequency. There is no impact on Vishay's IR receivers due to the 10 ms ignition pulses. However, some lamps also show higher frequency

components (e.g. in figure 2 on the first power line cycle: 19 kHz). These components may interfere with the IR data signal or even cause unexpected output pulses with receivers that are not well designed. A different kind of disturbance signal is caused by fluorescent lamps with an electronic ballast.

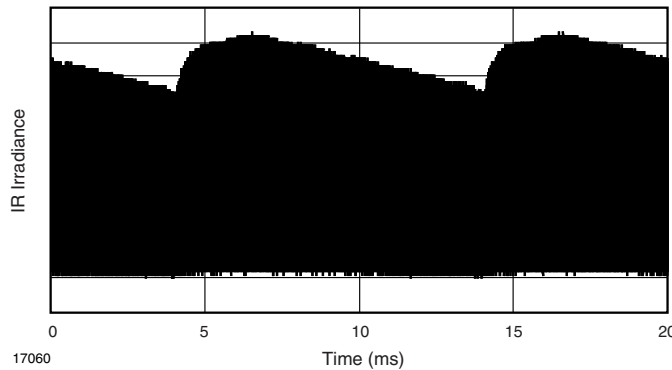


Fig. 3 - Radiated Signal from a Fluorescent Lamp with Low Modulated Electronic Ballast

Typically the frequency of the optical disturbance signal of such lamps is in the range between 50 kHz and 100 kHz. The optical frequency is always twice the electrical frequency of the driver circuit in the lamp ballast. All Vishay IR receiver modules can easily suppress a disturbance signal as shown in figure 3. There will be no unwanted output pulses due to

such lamps. However, the receiver sensitivity will be reduced in proportion to the strength of the disturbance signal. More critical are electronic ballasts with a higher modulation of the oscillating amplitude. Two examples of such kind of lamps are shown in figure 4 and figure 5.

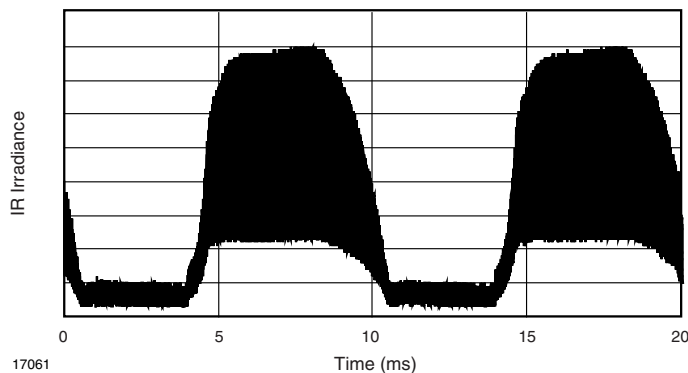


Fig. 4 - Radiated Signal from a Fluorescent Lamp with Strongly Modulated Electronic Ballast (50 Hz power line frequency)

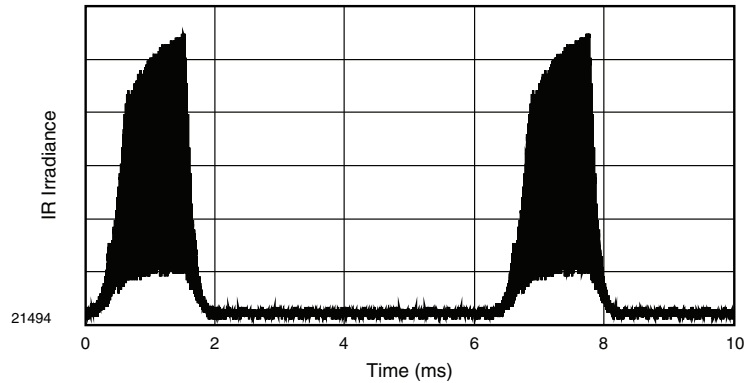


Fig. 5 - Radiated Signal from a Dimmed Backlighting of a LCD TV

Such strongly modulated disturbance signals have a waveform similar to the bursts of a data signal. Hence, almost all IR receivers will produce output pulses due to these disturbance signals. However, many of the Vishay IR receiver modules will suppress even this signal (see table 1).

These receiver modules will evaluate such strongly modulated signals as disturbance and will reduce the internal gain accordingly. They are still capable of receiving a remote control signal at a lower range than without the disturbance signal.

TABLE 1 - DISTURBANCE PULSES DUE TO FLUORESCENT LAMPS OR OTHER NOISE SOURCES					
	AGC1	AGC2/8	AGC3	AGC4	AGC5
<b>EXAMPLES FOR IR RECEIVER TYPES</b>	TSOP41xx TSOP341xx TSOP581xx TSOP381xx	TSOP12xx TSOP48xx TSOP348xx TSOP362xx	TSOP343xx TSOP383xx TSOP353xx TSOP753xx	TSOP24xx TSOP344xx TSOP584xx TSOP854xx	TSOP345xx TSOP325xx TSOP385xx TSOP755xx
Signal from fluorescent lamp as in figure 2	suppressed in most cases	noise suppressed by AGC			
Signal from fluorescent lamp as in figure 3	noise suppressed by AGC				
Signal from fluorescent lamp as in figure 4	disturbance pulses	noise suppressed by AGC			
Signal from fluorescent lamp as in figure 5	disturbance pulses		noise suppressed by AGC		
Signal from plasma displays	suppressed in most cases	noise suppressed by AGC			

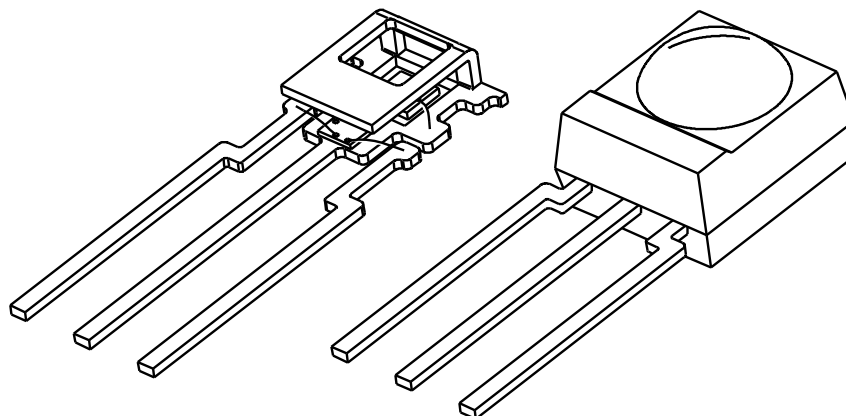
### DISTURBANCE BY ELECTROMAGNETIC INTERFERENCE

The Vishay IR receivers are very robust against high frequency EMI sources, such as mobile phones, wireless phones, wireless LAN antennas, etc. This robustness is achieved by a special circuit design.

Another way how the IR receivers can be disturbed is the coupling of electrical fields at low frequencies. Most critical are those signals that are below 100kHz or close to the band pass frequency of the IR receiver. The typical sources for such interference signals that affect the IR receivers by capacitive coupling are backlighting of LCD TVs, vacuum fluorescent displays (VFD, common in DVD players), cathode ray tubes (CRT, common in older TVs), switch mode power supplies or control circuits for motors. The closer the receiver is to the source of EMI, the stronger the interference. So the resistance to EMI is heavily determined by selecting a suitable location for the IR receiver in the application.

The Vishay TSOP IR receiver modules have two kinds of countermeasures against EMI interference; internal metal

shielding (see fig. 6) and Automatic Gain Control (AGC). The internal metal shielding is an effective protection against EMI because the metal shield is situated very close to the sensitive photo diode. Being inside the plastic package, the shielding remains invisible to the user and has no shiny reflection behind the front panel of the appliance. The AGC will suppress any remaining influence from EMI using the same mechanism described for the disturbance from fluorescent lamps. The AGC will reduce the gain of the receiver until spurious pulses are not present at the output. The IR receivers with AGC4 or AGC3 setting have the lowest probability of spurious pulses caused by EMI pattern.



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Fig. 6 - Internal Metal Shielding against EMI

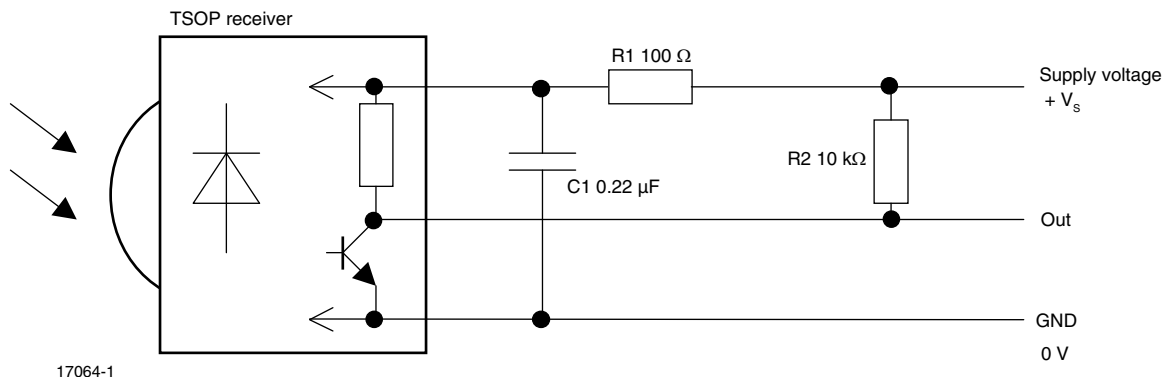
## SUPPLY VOLTAGE DISTURBANCE

A further negative influence on the TSOP IR receiver modules may come from noise on the supply voltage. Such disturbance can be caused by a switching power supply which is not well filtered, or by other digital circuits which produce spikes on the supply line. In contrast to other IR receiver, Vishay's devices have in internal voltage stabilisation. Hence the performance of the receiver modules are hardly affected by ripple on the supply voltage as long as the amplitude is less than 100 mV.

The application circuit in figure 7 filters the supply voltage so

that transient spikes or ripple are attenuated. This might be useful to protect the IR receiver from electrical overstress or to maintain a reliable function in case of very strong ripple.

The resistor R2 can optionally be used if a steeper slope of the output rising edge is required. Each Vishay IR receivers type is available for supply voltages  $V_S$  in the range between 2.7 V and 5.5 V. Please see our product matrix for more details.



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Fig. 7 - Application Circuit with Filter for Supply Voltage Ripple