Disturbance Sources

Receivers in remote control systems have high sensitivity and are ready to receive a signal all the time. This makes it susceptible also to different kinds of disturbances. The concept of Vishay IR receivers is to set the internal gain to an optimum level. This optimum sensitivity is such that there are no unexpected output pulses due to noise but it should be as sensitive as possible for the data signal. Below there is a description of some important disturbance signals which are normal in many places.

DC light sources:

The main DC light sources are sunlight and tungsten (incandescent) bulbs. This kind of disturbance source will force a DC current in the detector inside the module. This DC current will produce white noise in the receiver circuit. The influence of such light can be limited by optical filtering. In the visible, remote control receivers are totally insensitive because they are equipped with an optical cut-off filter at a certain wavelength, e.g. 830 nm. Therefore, only radiation with a longer wavelength is detected. Special measures taken in the design and technology of Vishay devices ensure that sensitivity above 950 nm drops as sharply as possible.

In this way the silicon photo detector receives a limited spectrum originating from the common broadband ''white'' light sources that are emitted in the visible and infrared.

The diagram in Figure 1 shows an actual spectral distribution of sunlight*. In general, the sun can be seen as a thermal radiator, which is influenced by atmospheric absorption.

* under two different atmospheric conditions

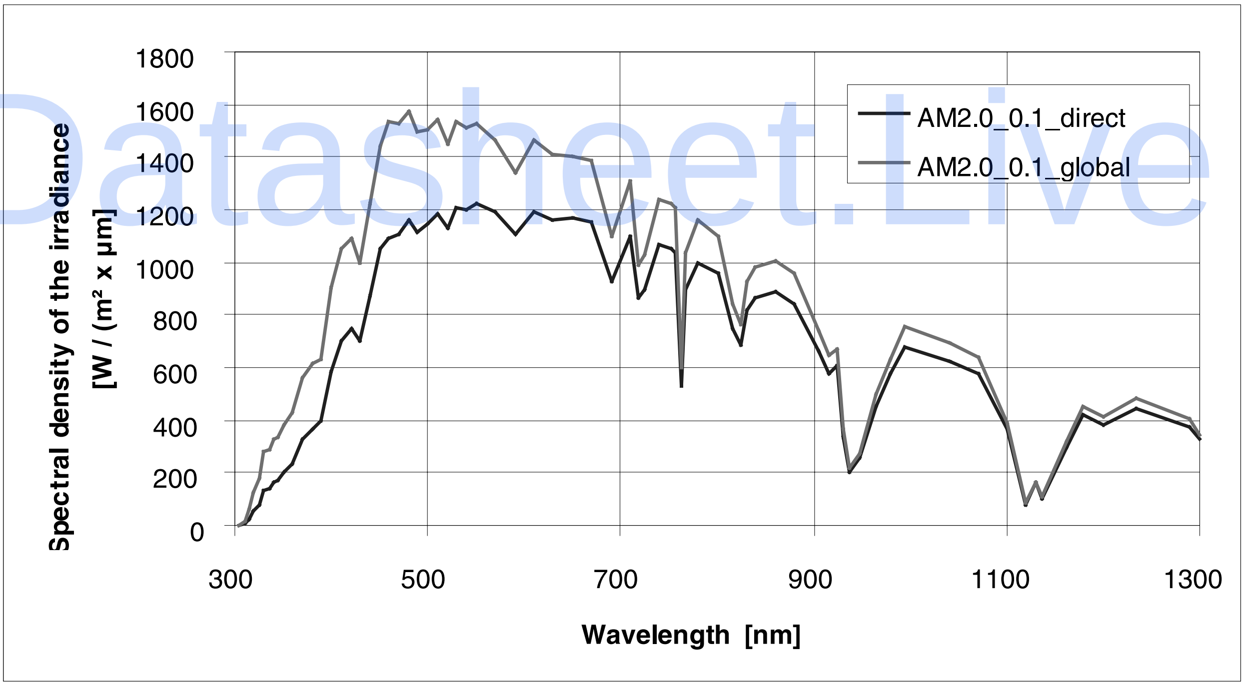

Figure 1. Spectral distribution of the solar spectrum

The visual impression of a lighting source is often different from the assessment by the IR receiver. The diagram in Figure 2 makes this clear. The sunlight is compared with a standard illuminant A radiator (T = 2856 K) that is approximately equivalent to a common tungsten incandescent lamp. Both sources have the same brightness for visible light. Additionally, the spectral sensitivity of the human eye V(λ) and of a filtered silicon detector (similar to Vishay IR receivers) is shown. It can easily be seen that the radiation from the sun contains much less radiation than the tungsten lamp in the sensitive wavelength range of the IR receiver.

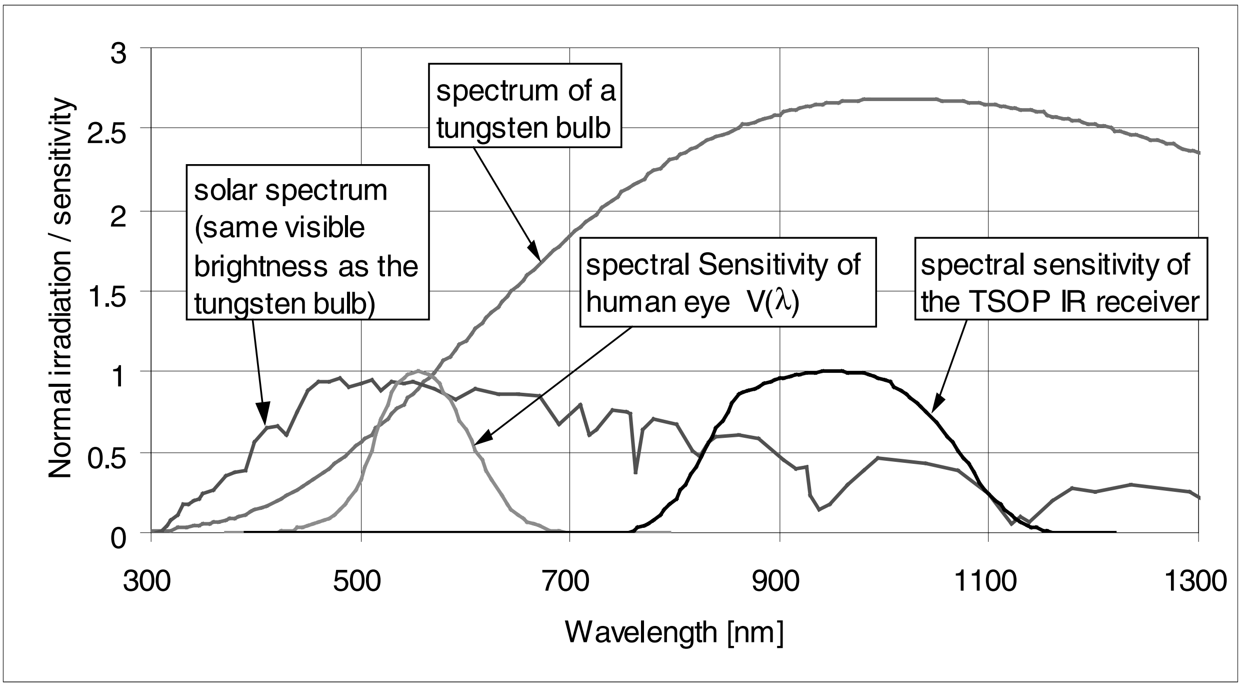

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Figure 2. Spectral Emission and Spectral Sensitivity

Fluorescent Lamps:

The spectral emission of fluorescent lamps is rather complicated. In the infrared only, little radiation is emitted. The spectral emission is a combination of the relative broadband emission of the luminescent phosphor and the lines emitted from the gas filling of the tubes. The radiation of the activated luminescent materials is mainly in the visible wavelength band and it is almost DC light. So, it does not affect the IR receivers seriously. However, the direct emission of the gas discharge in the lamp carries the modulated signal of the lamp ballast. The IR part of such an optical spectrum of a fluorescent lamp is shown in Figure 3. This part of the spectrum looks similar for all usual fluorescent lamps. The main disturbing energy is in the Mercury line at 1014 nm.

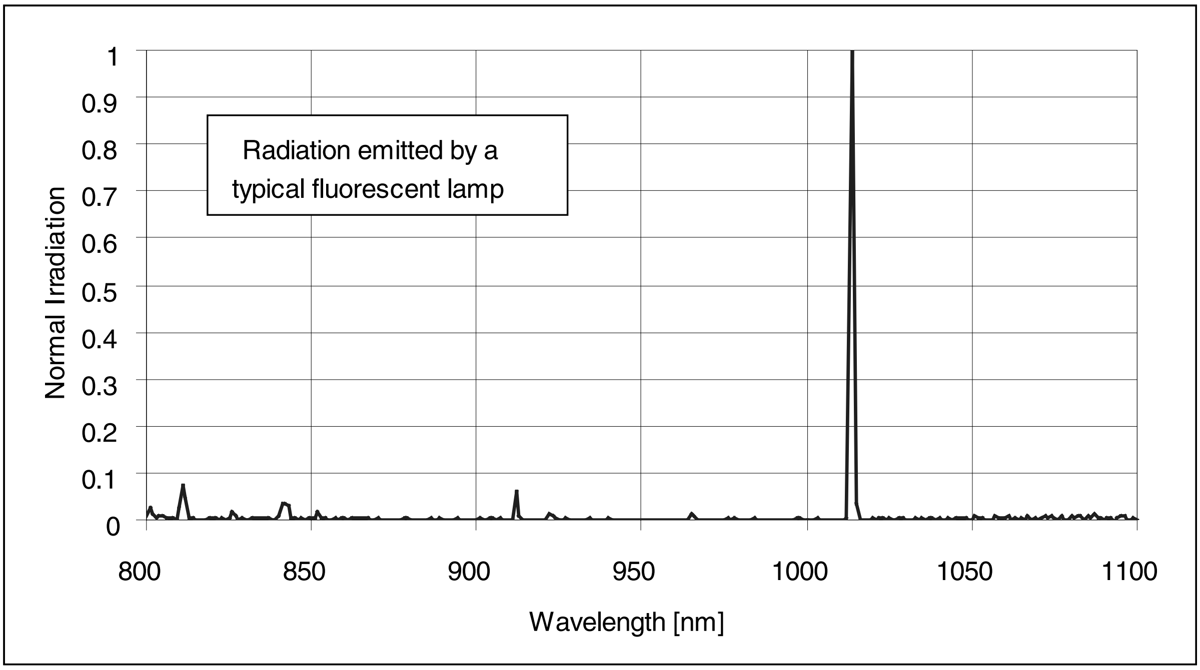

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Figure 3. Spectral Emission of Fluorescent Lamps

The impact of the light coming from these lamps to the IR receiver may be very different depending on the ballast which is driving the lamp. But, generally speaking, the signal spectrum of the IR disturbance signal is below 300 kHz.

Therefore, the TSOP7000 and TSOP5700, which are sensitive for signals between 400 kHz and 500 kHz, are hardly affected by fluorescent lamps. The problems with interference from fluorescent lamps are mainly related to the IR receiver modules for carrier frequencies between 30 kHz and 56 kHz.

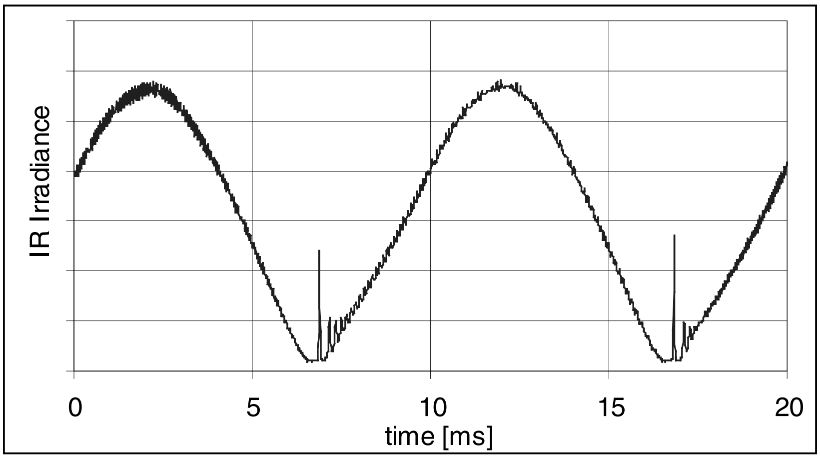

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Figure 4. Radiated Signal from a Fluorescent Lamp with Coil Ballast

The signal waveform of four different kinds of lamp ballast is shown in the following diagrams.

The signal from a lamp as shown in Figure 4 comes from a fluorescent lamp with coil ballast which is operated at 50 Hz power line frequency. There is no impact on Vishay's IR receivers due to the ignition pulses, each of 10 ms. However, some lamps show also higher frequency components (e.g. in Figure 4 on the first power line cycle: 19 kHz). This may interfere with the IR data signal or even cause unexpected output pulses at receivers that are not well designed.

A different kind of disturbance signal is caused by fluorescent lamps with electronic ballast.

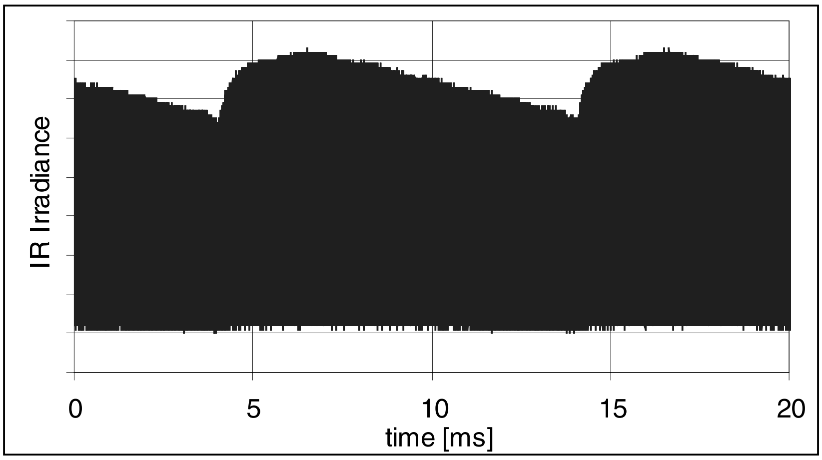

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Figure 5. Radiated Signal from a Fluorescent Lamp with Low Modulated Electronic Ballast

Typically the oscillating frequency of the optical disturbance signal of such lamps is in the range between 50 kHz and 100 kHz. This frequency is twice the electrical oscillating frequency of the driver circuit in the lamp ballast. All Vishay IR receiver modules can suppress a disturbance signal as shown in Figure 5 efficiently.

There will be no unexpected output pulses due to such lamps. However, sensitivity will be reduced according to the strength of the disturbance signal. More critical are the electronic ballasts with a higher modulation of the oscillating amplitude. Two examples of such kind of lamps are shown in Figure 6 and Figure 7.

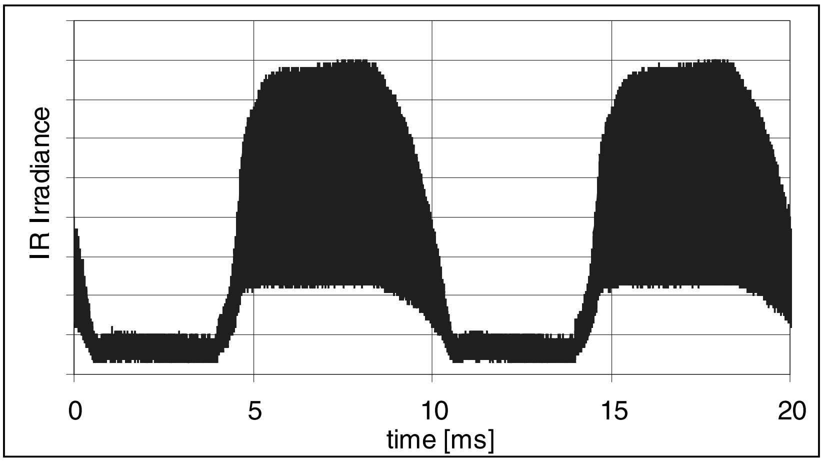

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Figure 6. Radiated Signal from a Fluorescent Lamp with Strongly Modulated Electronic Ballast (50 Hz power line frequency)

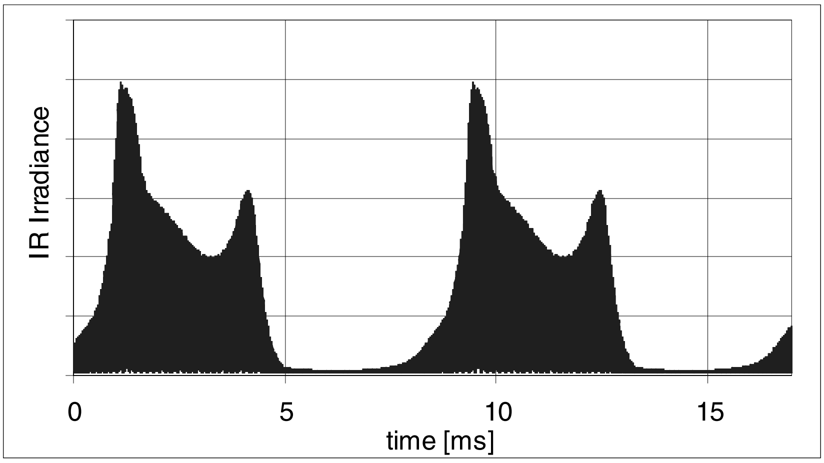

Figure 7. Radiated Signal from a Fluorescent Lamp with Extreme Modulation (60 Hz power line frequency)

Such strongly modulated disturbance signals have a similar waveform as the bursts of a data signal. Hence almost all IR receivers will make output pulses due to that disturbance signal. However, many of the Vishay IR receiver modules will even suppress this signal (see Table 1). These receiver modules will evaluate such strongly modulated signal as disturbance and will set the internal gain accordingly. They can still receive a remote control signal at the same time.

	TSOP11xx TSOP21xx TSOP321xx TSOP41xx TSOP341xx TSOP61xx TSOP361xx	TSOP12xx TSOP22xx TSOP322xx TSOP48xx TSOP348xx TSOP62xx TSOP362xx	TSOP24xx TSOP324xx TSOP44xx TSOP344xx	TSOP5700 TSOP7000
Signal from Fluorescent Lamp as in Figure 4	suppressed in most cases	suppressed		
Signal from Fluorescent Lamp as in Figure 5	suppressed			
Signal from Fluorescent Lamp as in Figure 6	disturbance pulses	suppressed		
Signal from Fluorescent Lamp as in Figure 7	disturbance pulses		suppressed	

Table 1: Disturbance Pulses due to Fluorescent Lamps

Disturbance from the CR Tube of a TV

The main influence from the cathode ray tube (CRT) of a TV affects the IR receiver by electro magnetic interference (EMI). The closer the receiver is to the CRT the stronger the interference. So the resistance to EMI is also determined by selecting a suitable location in the TV set.

Influence on the IR remote control receivers is mainly caused by the deflection frequencies and their harmonics. These frequencies can be 15.625 kHz (625 ∗ 25), 31.25 kHz or 15.75 kHz (525 ∗ 30), 31.5 kHz. This signal does not have a constant amplitude. It is modulated depending on the pattern on the TV tube. There are critical patterns which produce an EMI signal that is similar to an IR remote control burst signal. In case of normal TV operation this means only a temporary disturbance (producing unwanted output pulses). However, if a steady TV picture (e.g. test pattern or the screen during programming of the TV) makes a critical EMI signal then the impact on the IR remote control may be more serious. If there are continuous disturbance pulses at the output of the IR receiver then the TV may be in a situation where it can no longer be controlled by IR.

The Vishay TSOP IR receiver modules have two kinds of countermeasures against this interference: the internal metal shielding and the Automatic Gain Control (AGC).

The internal metal shielding is an efficient protection against EMI because the metal shield is very close to the sensitive photo diode. It is inside the plastic package, which is an advantage because the package appears black and has no shiny blaze behind the front panel.

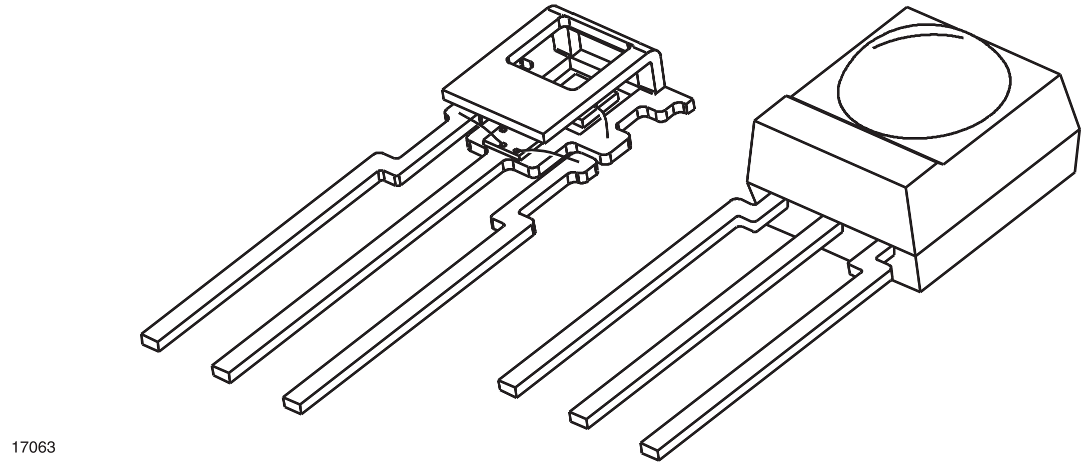

Figure 8. Internal Metal Shielding against EMI

The AGC will suppress the remaining influence from EMI in a similar way as the disturbance from the fluorescent lamps. It will reduce the gain as much as necessary. But unlike the signal from lamps, the CRT signal can have any waveform modulation. Thus it is difficult to filter out the influence of this disturbance completely.

The AGC of the TSOP24xx and TSOP44xx series was optimized to suppress the EMI of a CRT in a TV. It has the lowest probability of unexpected pulses due to electromagnetic noise from TV tube. Higher bandwidth types (mainly TSOP11xx, TSOP21xx and TSOP41xx) are not as robust in this respect.

Supply Voltage Disturbance

A further influence on the TSOP IR receiver modules may come from a supply voltage that is not smooth. Such a disturbed supply voltage can be caused by a switching power supply which is not filtered well, or by other components in the circuit that produce spikes on the supply line. These ripple disturbances will lead to lower sensitivity because the internal regulation of the gain will reduce the sensitivity in order to avoid unwanted output pulses. The application circuit for the TSOP modules in Figure 9 filters the supply voltage and guarantee the full sensitivity also with ripples on the supply voltage.

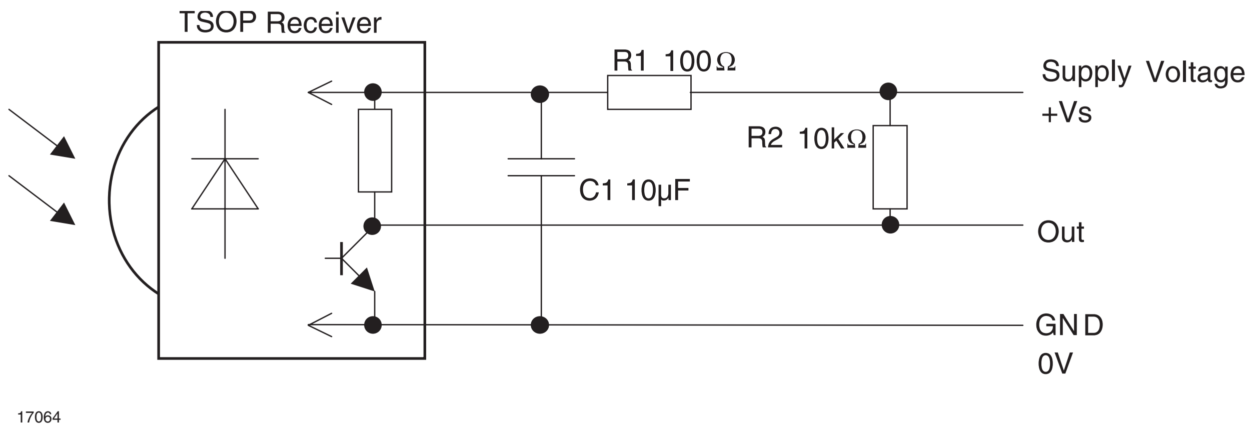

Figure 9. Application Circuit with Filter for Supply Voltage Ripple

If the supply voltage is disturbed only by narrow spikes the value of the capacitor C1 can be lower. In most circuits 100 nF is sufficient. The location of the capacitor C1 should be close to the receiver.

The resistor R2 is optional if a steeper slope of the output pulse is required.

All Vishay IR receivers are offered for a supply voltage V_S of 5 V and 3 V.

The units with a TSOP part number starting with a ”3” (e.g. TSOP32238) can work in the range between 2.4 V and 5.5 V). For the other types the supply voltage should be in the range between 4.5 V to 5.5 V.

The TSOP7000 and TSOP5700 have also an extended range for the supply voltage between 2.7 V and 5.5 V.

Almost all parts exist in two versions of supply voltage (3 V and 5 V) with the same electrical, optical and mechanical performance.

Example:

TSOP4838YA1 works at 5 V; the TSOP34838YA1 works at 3 V.