Disturbance Sources for IR Receiver Modules

Receivers in remote control systems have high sensitivity and are ready to receive a signal all the time. This makes it susceptible also for different kinds of disturbances. The concept of Vishay Telefunken 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.

The internal circuit will reduce the gain if it detects a disturbance but it must not change the gain when a data signal is received. Hence the IR receiver has to distinguish between data signal and disturbance signal.

In the following pages the most important disturbances are described.

DC light sources

The main DC light sources are sunlight and tungsten (incandescent) bulbs. These kind of disturbance sources 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 the optical filtering. In the visible, remote–control receivers are totally insensitive because they are equipped with an optical cut–off filter at a wavelength of, e.g. 830 nm. Therefore, only radiation with longer wavelengths are detected. Special measures in the design and technology of Vishay Telefunken 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 which are emitted in the visible and infrared, respectively.
The diagram in Figure 12 shows an actual spectral distribution of the sunlight. In the main, the sun can be seen as a thermal radiator which is influenced by atmospheric absorption.

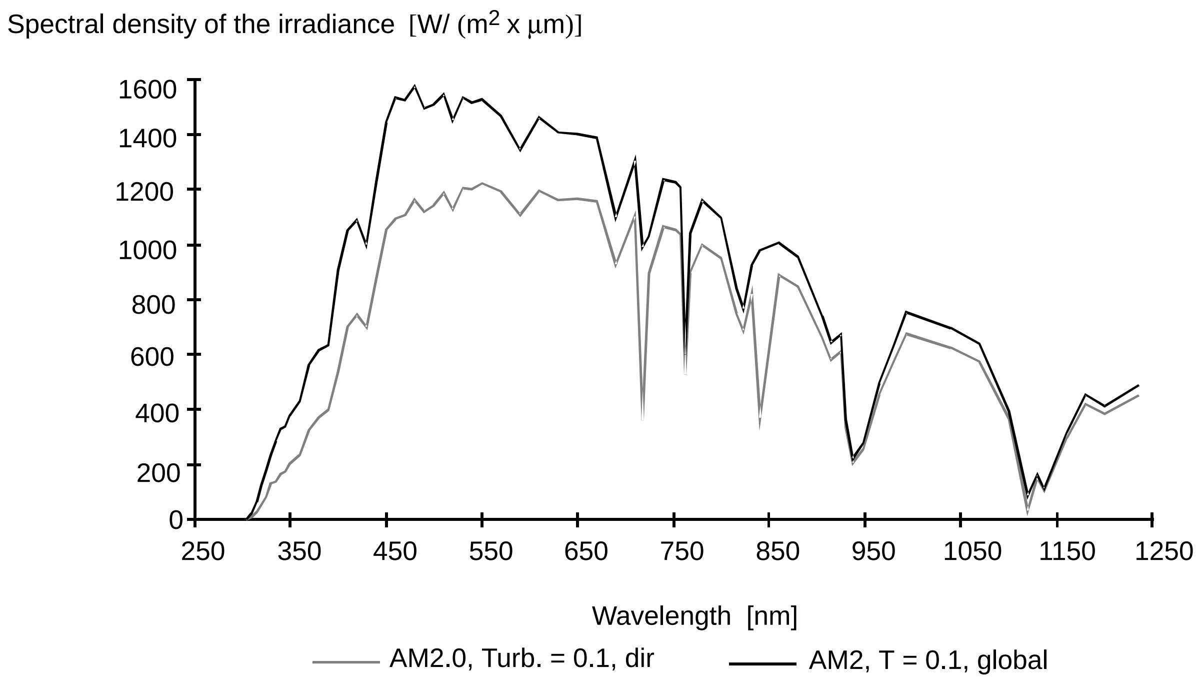

Figure 12. Spectral distribution of the solar spectrum

The visual impression of a lighting source is often different from the assessment by the IR receiver. The diagram in Figure 13 makes this clear. The sunlight is compared with a standard illuminant A radiator (T = 2856 K) which 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 Telefunken BPV23NF) is shown. It can easily be seen that the radiation from the sun–equivalent source contains much less radiation than the tungsten lamp in the sensitive wavelength range of the silicon detector diode.

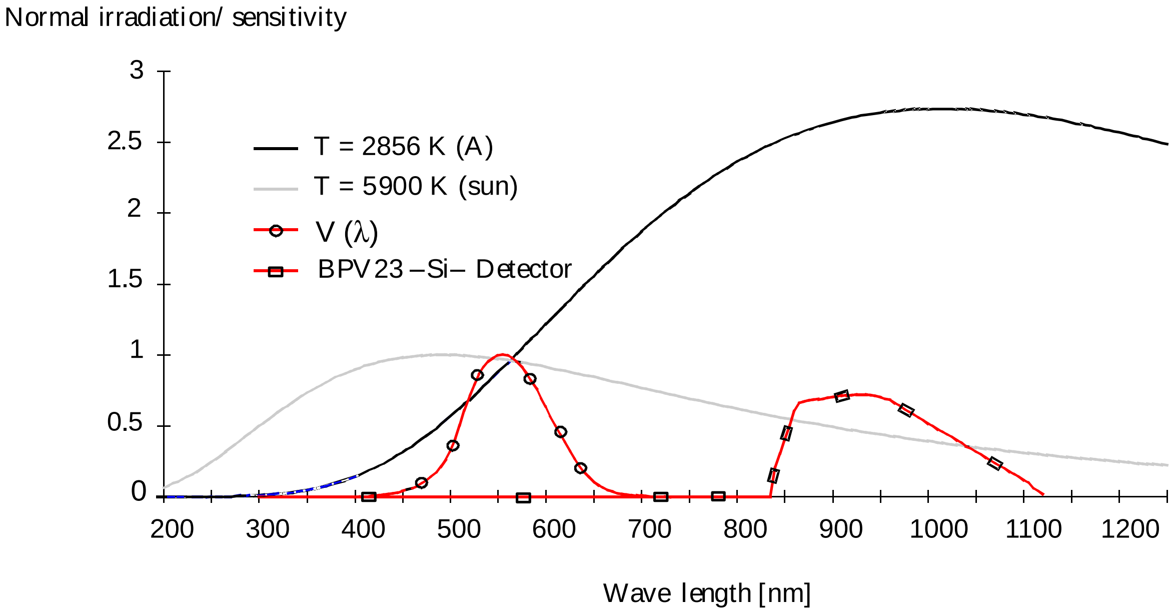

Figure 13. Spectral Emission and Spectral Sensitivity

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, the emitted mercury lines 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 will have all high–frequency parts on it. The spectrum shows emission peaks coming from gas discharge in UV, visible and IR. The IR part of such a spectrum is shown in Figure 14. This part of the spectrum looks similar for all usual fluorescent lamps. The main disturbing energy is in the Mercury line at 1014 nm.

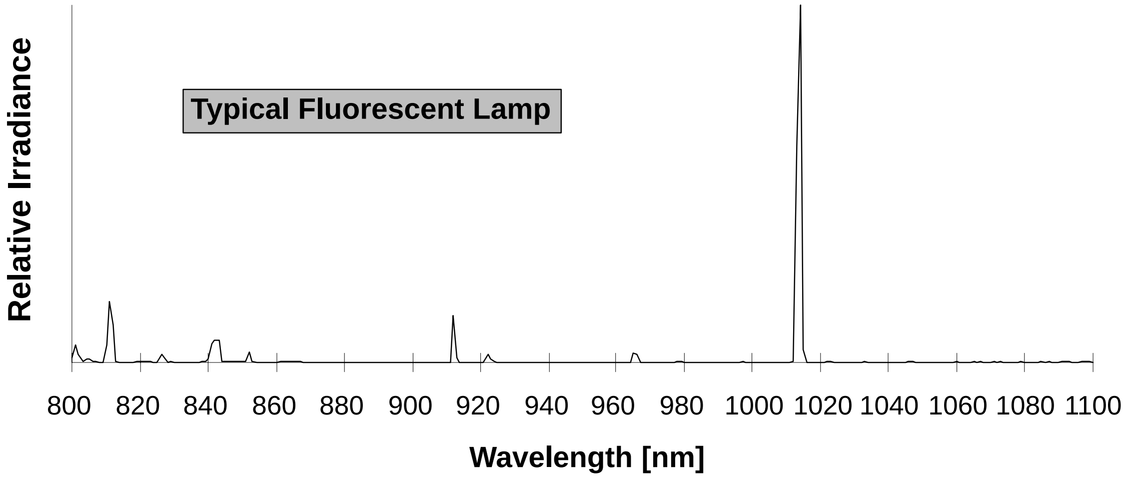

Figure 14. Spectral Emission of Fluorescent Lamps

The modulation of the IR disturbance signal coming from these lamps is very different depending of the ballast which is used in the lamp. How the IR signal will disturb the IR receiver. The signal waveform of three different kinds of lamp ballast is shown in the following diagrams depends on this modulation.

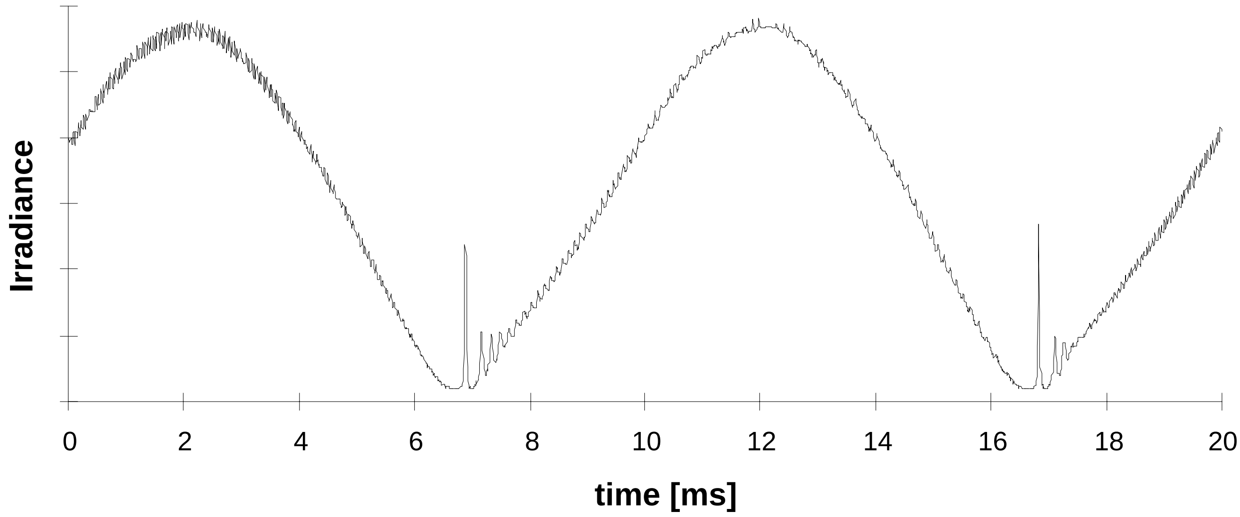

Figure 15. Radiated Signal from a Fluorescent Lamp with Coil Ballast

The signal from a lamp as shown in Figure 15 is coming from a flourescent lamp with coil ballast which is operated at 50 Hz power line frequency. There is no impact on Vishay Telefunkens IR receivers due to the ignition pulses each 10 ms. However, for some lamps there is a changing modulation which contains a signal of higher frequencies (e.g. in Figure 15 on the top of the first shown power line cycle: 19kHz). This can cause unexpected output pulses at receivers which are not well designed.

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

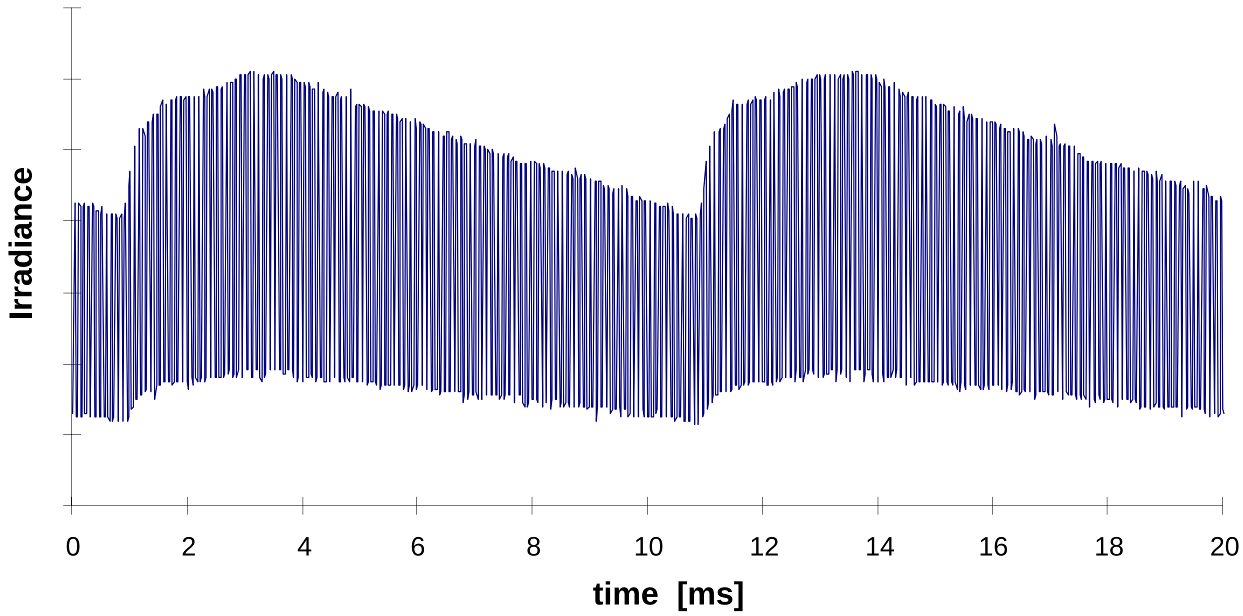

Figure 16. Radiated Signal from a Fluorescent Lamp with Low Modulated Electronic Ballast

Typically the oscillating frequency of the optical disturbance signal of such lamps is in the range between 50 kHz and 100 kHz. The electrical oscillation of the driver circuit in the ballast has the half frequency. All Vishay Telefunken IR receiver modules can suppress this kind of signal efficiently. There will be no unexpected output pulses due to such lamps. However, the 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. An example of such a lamp is shown in Figure 17.

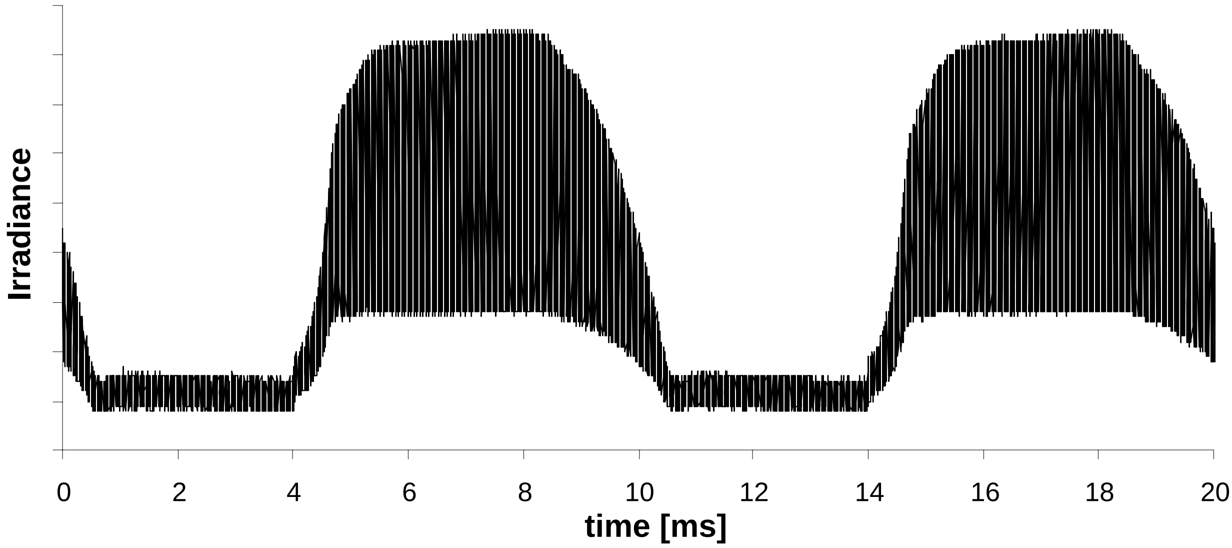

Figure 17. Radiated Signal from a Fluorescent Lamp with Strongly Modulated Electronic Ballast

Such a strongly modulated disturbance signal looks very similar to the bursts of a data signal. Hence almost all IR receivers will make output pulses due to that signal. However, many of the Vishay Telfunken IR receiver modules will even suppress this signal (see Table 4). These receiver modules will evaluate such strongly modulated signals as disturbance and will set the internal gain accordingly. They can still receive a remote control signal at the same time.

Table 4. Disturbance Pulses due to Fluorescent Lamps

	TSOP11xx TSOP21xx	**TSOP12xx TSOP15xx TSOP22xx TSOP48xx**	**TSOP13xx**	**TSOP17xx**	**TSOP 18xx TSOP 28xx**	**TSOP18 xxSS3V**	**TFMM5xx0**
Signal from Fluorescent Lamp as in Figure 15	suppressed in most cases	suppressed					
Signal from Fluorescent Lamp as in Figure 16	suppressed						
Signal from Fluorescent Lamp as in Figure 17	disturbance pulses	suppressed		distur-bance pulses	suppressed		distur-bance pulses

Disturbance from the CR Tube of a TV

The main influence from the CRT of a TV set is by Electro Magnetic Interference (EMI). The closer the receiver is to the CRT the stronger is the interference. So the steadiness against EMI is also determined by selecting a suitable location in the TV.

The 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 patterns on the TV tube. There are critical patterns which produce a signal that looks like a data burst signal.

The Vishay Telefunken TSOP IR receiver modules have two kinds of countermeasure 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 is very close to the sensitive photodiode. It is inside the plastic package which is an advantage because the package appears black and has no blaze behind the front panel.

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 TSOP13 series has the lowest probability of unexpected pulses due to electromagnetic noise from TV picture tube. The types with higher bandwidth (mainly TSOP11.. and TSOP21..) will more likely show unwanted pulses in this condition.

Disturbance on the Supply Voltage

A further influence to the TSOP IR receiver modules may come from a supply voltage which 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 which produce spikes on the supply line. Such disturbances will lead to a 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 18 will filter the supply voltage and guarantee the full sensitivity also with disturbed supply voltage.

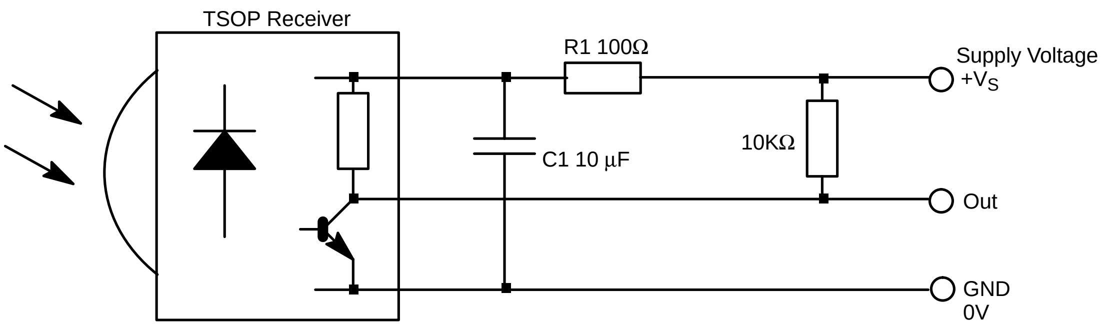

Figure 18. Application Circuit with Filter for Supply Voltage

If the supply voltage is disturbed only by narrow spikes the value of the capacitor C1 can be lower. In most circuits 220nF is sufficient. The location of the capacitor C1 should be close to the receiver.

If the supply voltage is absolutely smooth no filter (R1, C1) is necessary.

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

The supply voltage should be in the range between 4.5V to 5.5V for all IR receiver modules. The TSOP18xxSS3V has an extended range for the supply voltage between 3V and 6V.