Mechanical Design Notes

There are many aspects in the design of an appliance, which will affect the IR sensitivity of the receiver such as window size, window material, distance of the receiver to the window or to a light guide.

WINDOW

The size of the window in front of the IR receiver should be large enough so that the viewing angle of the IR receiver is not overly restricted. The window size and the distance of the IR receiver behind the window should be designed to enable a directivity of at least ± 50°. A formula to calculate the optimal window size, given the required viewing angle, can be found on the website in the separate window size documents. A module with a mechanical holder (e.g. TSOP4838AY1) can sometimes help to place the sensitive area of the IR receiver module closer to the window.

When the front panel of an appliance is black, it is usually desired that the optical window in front of the IR receiver also be tinted black. That means that a plastic material is required, which is transparent for infrared signals but opaque for visible light. The diagram in figure 1 shows an example of the spectral transmittance of such a plastic material.

The cut-off wavelength of the window material should be between 700 nm and 850 nm in order to appear black and in order not to absorb IR signal energy.

There is a loss of power in every front panel of about 8 % due to reflection (4 % at each side). There is a compromise necessary on the design of the panel thickness. On the one hand, the thickness of the panel should be kept small to minimize the loss of energy in the plastic material. On the other hand, the thickness of the plastic should not be too small (or the color of the plastic too light) in order to avoid being able to see inside the appliance. In contrast to other products that have a shiny external metal shielding, the Vishay TSOP IR receiver modules have a black package with internal shielding, which prevents visibility behind the front panel.

The relationship between the necessary thickness and the optical transmittance is given by:

$\tau(\lambda) = (1 - \rho) \times e^{(-a(\lambda) \times d)}$

$\tau(\lambda)$ = spectral transmittance

ρ = constant factor for reflection loss (typically about 0.08)

e = 2.718282

$\alpha(\lambda)$ = coefficient of plastic material (about 0.03 mm^{-1} at 950 nm in the example above)

d = thickness of front panel

There are several plastic materials with such a spectral behavior. Some examples of polycarbonate are:

- Makrolon 2407; color code: 971000, 972000, and 971059; supplier: Covestro
- Lexan: color code: 71257; supplier: Sabic

NAME	COLOR CODE	RESIN	SUPPLIER
Lexan	71257	103R	Sabic
Lexan	71257	143R	Sabic
Lexan	71257	121R	Sabic
Lexan	71257	223R	Sabic
Lexan	71257	203R	Sabic
Lexan	71257	HF1110R	Sabic

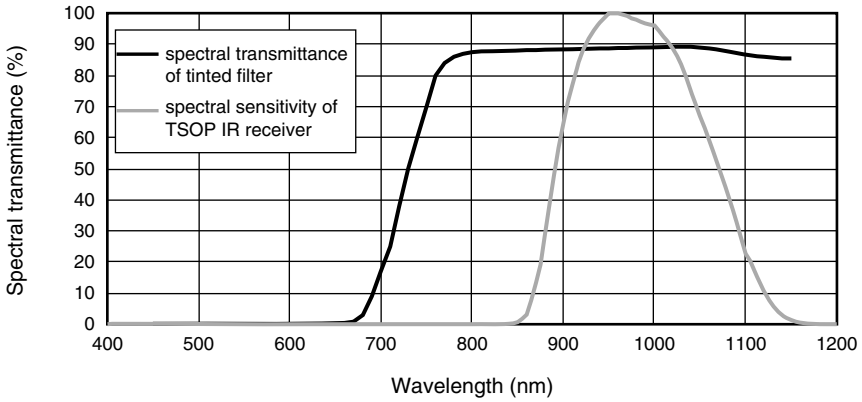


Fig. 1 - Spectral Transmittance for IR Transmissive Window Material

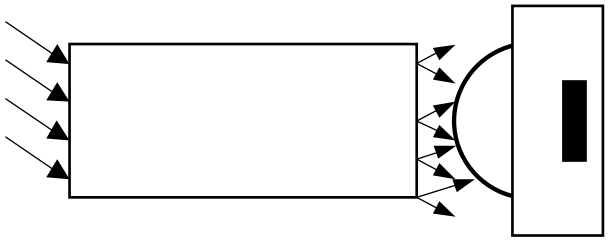
Another very common design is a silver colored front panel, usually either equipped with tiny holes for the IR signal to pass through or a partially reflecting material for this purpose. Although stylish, this design is very non-optimal in terms of transmission range as there is a high loss of signal through the panel.

LIGHT GUIDES

A light guide is a piece of transparent plastic, usually cylindrical, that makes use of the principle of total internal reflection to pass light from the front panel to a receiver located further back in the appliance.

Some of the reasons for using a light could be to span a distance between the window and the IR receiver, to have a smaller window than would otherwise be possible or to protect the IR receiver from high voltage discharges occurring at the front of a TV set due to ESD.

The use of a light pipe compromises the achievable transmission range and directivity due to signal loss at the coupling between the light guide and the IR receiver. The light guide should be optimally placed as close as possible to the vertex of the optical lens of the IR receiver



17074

Fig. 2 - Loss of Signal Power at the Coupling to the Light Guide

MECHANICAL VERSIONS OF THE VISHAY IR RECEIVERS

Vishay offers many different mechanical versions of the IR receiver modules in order to provide a solution for almost any requirement.

In addition to Vishay's SMD packages, there are also three different standard through-hole packages with two pinouts. The through hole parts are available with different lengths leads, bent leads, and optional plastic or metal holders.