Infrared Remote Control Receivers | Application Note

Vishay TSSP Sensor Kit

By Sebastian Schäfer

The TSSP sensor kit comprises three different approaches of reflective sensing: fast proximity (TSSP4056), slow proximity (TSSP4P38), and presence sensing (TSSP4056). A short introduction to the three concepts will be given in the following. For a detailed technical explanation of the measurement procedures, please see the application notes "Vishay's TSSP4056 Sensor for Fast Proximity Sensing" and "Vishay's TSSP-AGC P Sensor Series for Proximity Sensing".

If you are interested, please order here: IRR@vishay.com.

PRESENCE SENSOR

In a presence sensing application, the sensor simply detects if an obstacle is in front of the sensor or not corresponding to the two events "reflection yes" or "reflection no". The application requires no further information, such signal strength, for example. The IR emitter transmits light, which is reflected by the obstacle and then returns to the IR receiver, where a simple "active (lo)" or "inactive (hi)" signal is fed to the microcontroller (please see Fig. 1). If an obstacle is detected, the green LED in the operating panel lights up (please see Fig. 3).

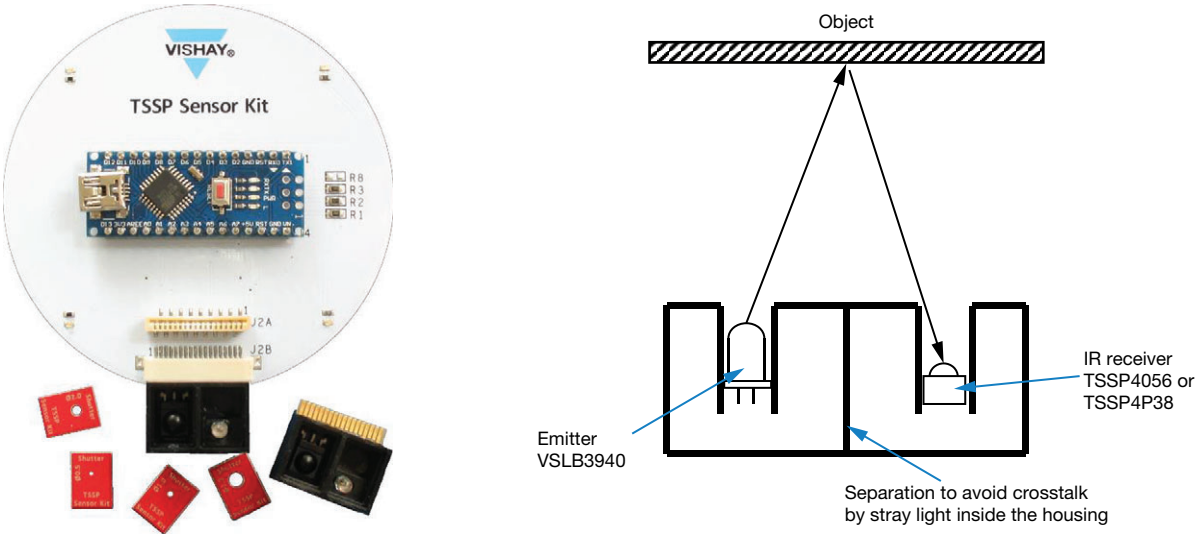

Fig. 1 - TSSP Sensor Kit

Since an IR receiver provides only these two output states (hi, lo), such an application can be easily facilitated with an IR emitter / receiver pair, as shown in the presence sensor example program.

The TSSP fix gain receivers have no automatic gain control and can accept a continuous 38 kHz or 56 kHz square wave signal without problems. Such a signal is recommended when fast reaction times are required. The receiver will respond after a short delay time of approximately 10 cycles of the modulation frequency (~180 µs at 56 kHz).

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Vishay TSSP Sensor Kit

The sensor kit shows how power saving can be implemented by using 350 µs bursts at 56 kHz with a moderate repetition time of 100 ms, as shown in Fig. 2.

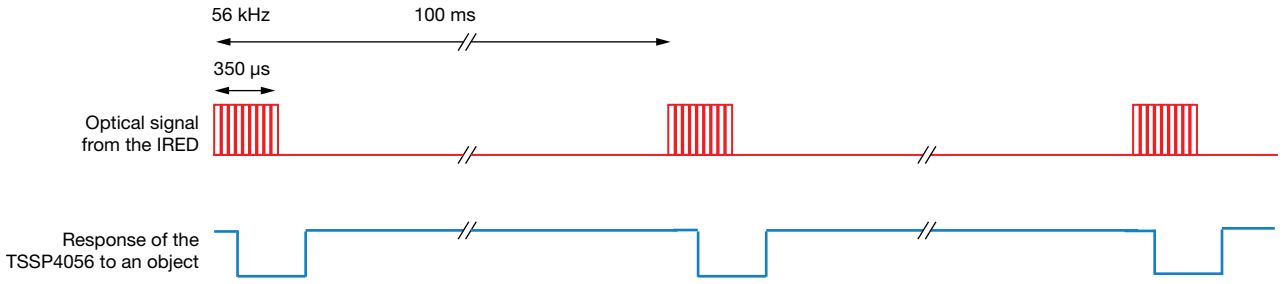

Fig. 2 - Pulsed Signal of the TSSP Presence Sensor Function in the Sensor Kit

The burst length and repetition time can be tuned in the operating panel (Fig. 3) to achieve the best trade-off between reaction time and power savings. The emitter intensity can be modified by three different series resistors, which will control the detection range of the sensor. Since the receiver sensitivity depends on the carrier frequency, the effective detection range can also be adjusted by changing the corresponding value in the operating panel.

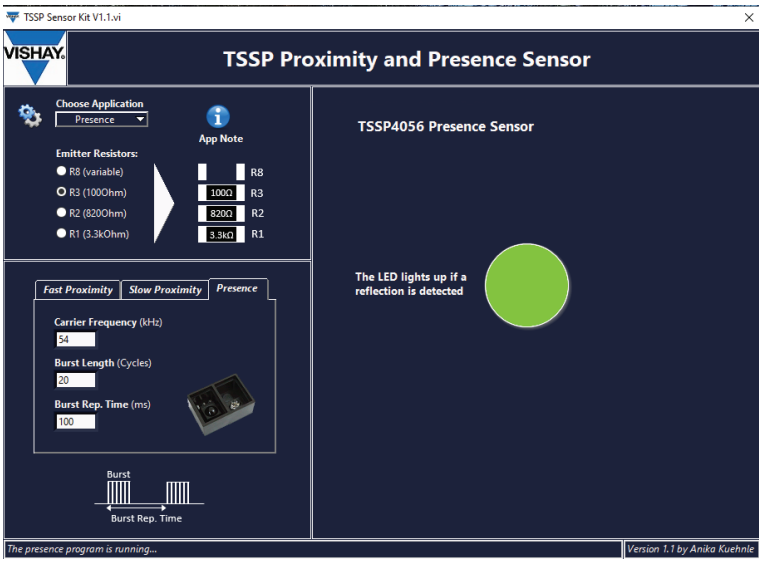

Fig. 3 - Operating Panel of the Presence Function in the TSSP Sensor Kit

APPLICATION NOTE

Vishay TSSP Sensor Kit

FAST PROXIMITY

In proximity sensing, the sensor detects not only the presence of an obstacle, but also provides the additional information if an obstacle is approaching the sensor or moving away from it. This requires additional information about the signal strength of the reflected emitter signal. An object moving towards the sensor will cause an increasing signal strength.

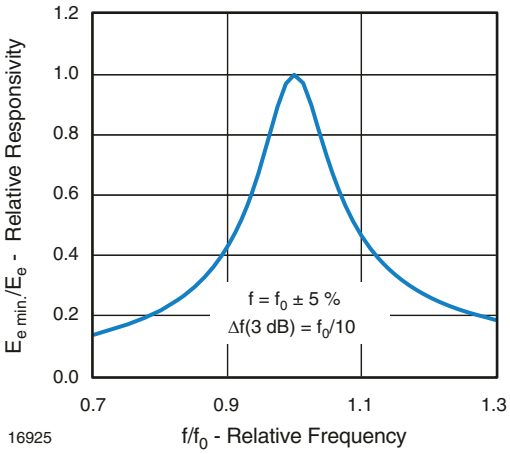

Fig. 4 - TSSP4056 Relative Responsivity vs. Relative Modulation Frequency

The signal decreases when the object is leaving the detection area. Due to their design, IR receivers have only two output states, “inactive (hi)” and “active (lo)”, and thus cannot provide information on the signal strength. One approach to solve this problem is to sweep the IR receiver’s sensitivity by detuning the signal modulation frequency. The relative responsivity of the TSSP4056 is shown in Fig. 4. It can be reduced to less than 15 % when detuning the modulation frequency from 56 kHz down to 32 kHz.

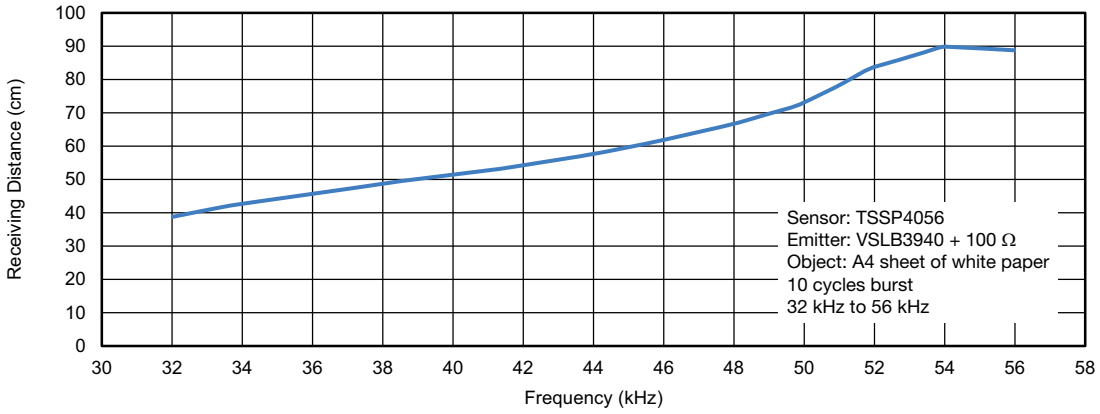

Fig. 5 - Receiving Distance of the TSSP Sensor Kit at Different Modulation Frequencies

When keeping the emitter intensity constant, the lower responsivity results in a lower receiving distance. Fig. 5 illustrates how the receiving range of the TSSP sensor kit changes with the modulation frequency: the receiving distance increases monotonically from 32 kHz to 54 kHz.

Vishay TSSP Sensor Kit

This range can be used for sensing. The reflecting object in this measurement was an A4 sized sheet of white paper. For other targets the absolute distance will change because the reflected signal strength depends on the size and reflectivity of the object. Please see "Vishay Infrared Receivers for Presence Sensor Applications" for more details.

For this reason, the graphical user interface shows only a relative detection distance chart in percent (please see Fig. 6).

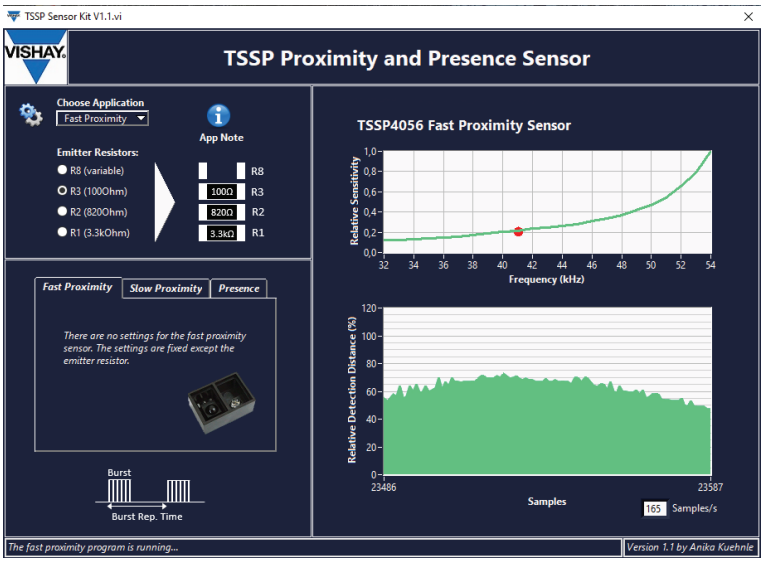

Fig. 6 - Operating Panel of the TSSP4056 Fast Proximity Function in the TSSP Sensor Kit

During the measurement the frequency is constant at 54 kHz, corresponding to the largest range, until the receiver detects a reflected signal from an object in range. After an object detection, the frequency is lowered step by step and thereby reduces the detection distance until the object is out of range again (please see Fig. 7). The threshold frequency obtained when the object is at the edge of being detected provides the relative detection distance to the object.

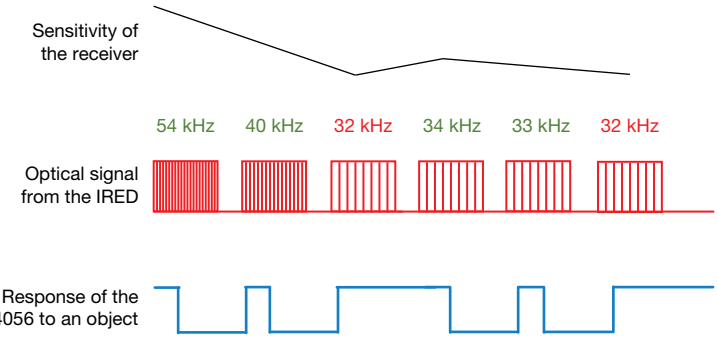

Fig. 7

Fig. 7 - simplified sketch of the signal pattern used in the fast proximity program. The emitter sends bursts with decreasing frequency until the object is out of reach (red marked frequency). This threshold frequency corresponds to the detection distance of the object.

APPLICATION NOTE

Vishay TSSP Sensor Kit

SLOW PROXIMITY

A second approach to measuring the strength of an incoming optical signal evaluates the control speed of the receiver's automatic gain control (AGC). More precisely, the AGC logic examines the burst length and the gap times of the optical signal, to distinguish between data signal and noise. If the burst length exceeds a certain value, the AGC identifies a noise signal and starts to decrease the sensitivity. The time required to suppress such a signal is longer when the signal is strong than when the signal is weak, resulting in a pulse length corresponding to the distance of an object. This kind of analog information can be evaluated by a microcontroller. The signal pattern applied in the TSSP sensor kit is illustrated in Fig. 8. A burst length of 120 ms is long enough for the AGC to suppress the signal, either partly (strong signal) or almost completely (weak signal).

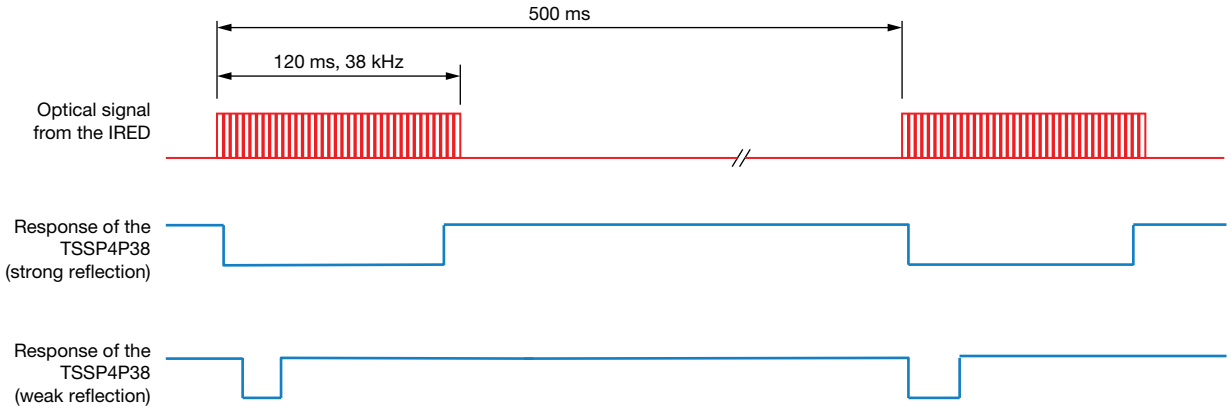

Fig. 8 - TSSP Sensor Kit Signal Pattern for Slow Proximity

The output burst length is shown in the operating panel in Fig. 9. A long burst corresponds to a short object distance and vice versa. After such a long burst signal the receiver needs to recover to its maximum sensitivity again. A repetition time of 500 ms provides enough gap time for the receiver to reach full sensitivity and to start the next measurement. Burst length and repetition time can also be adjusted in the operating panel.

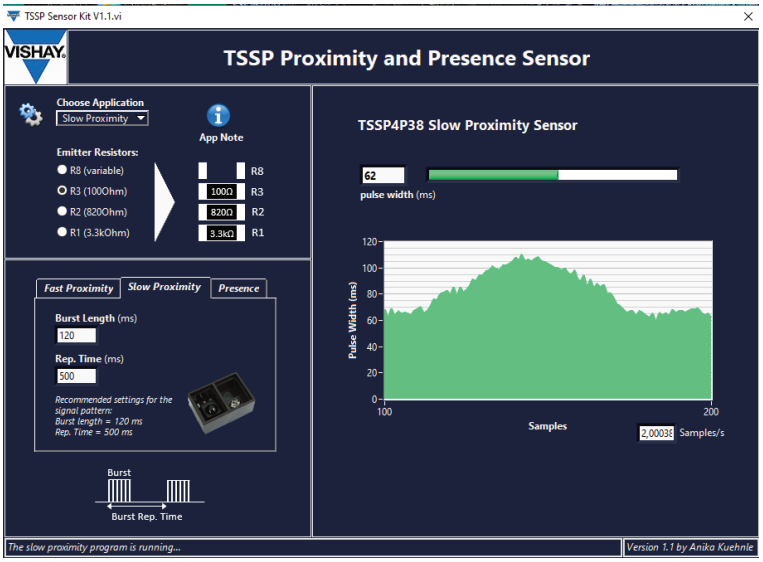

Fig. 9 - Operating Panel of the Slow Proximity Function in the TSSP Sensor Kit

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