



# OPTOELECTRONICS

## Infrared Sensors

### Mid Range Infrared Sensors for Object Detection and Ranging



The mid range sensor series consists of two basic types. The first type, called AGC 0, are sensors whose gain is fixed to enable reproducible object detection in variable ambient lighting conditions. The “0” signifies “no AGC”. These sensors are suitable for both reflective and interruptive (such as a light curtain) sensor applications. The other type, called AGC P (for proximity), contain an automatic gain circuit optimized to provide differential range information. These types are useful for reflective sensor applications where information about an object’s movement toward or away from the sensor must be captured.

#### KEY BENEFITS

- Interrupter sensor: fixed gain type (AGC 0) with a fast 300  $\mu$ s reaction time in light curtain and perimeter guard applications up to 30 meters
- Reflective sensor: either for object detection applications (AGC 0) or object ranging applications (AGC P), effective range from 0.2 meters to 2 meters

#### APPLICATIONS

- Safety switches for garage door, elevator door, gates, and industrial light curtains
- Reflective sensors for toilet, urinal, faucet, hand dryer, and towel dispensers
- Navigational sensor for robotics
- Sensors for large format touch panels
- Object detection in vending machines, parking lots, ATMs, and more

#### RESOURCES

- More IR receiver products at: [www.vishay.com/ir-receiver-modules/](http://www.vishay.com/ir-receiver-modules/)
- Full optoelectronics portfolio at: [www.vishay.com/optoelectronics/](http://www.vishay.com/optoelectronics/)
- For technical questions contact: [IRR@vishay.com](mailto:IRR@vishay.com)
- Sales contacts: [www.vishay.com/doc?99914](http://www.vishay.com/doc?99914)



## Mid Range Detection

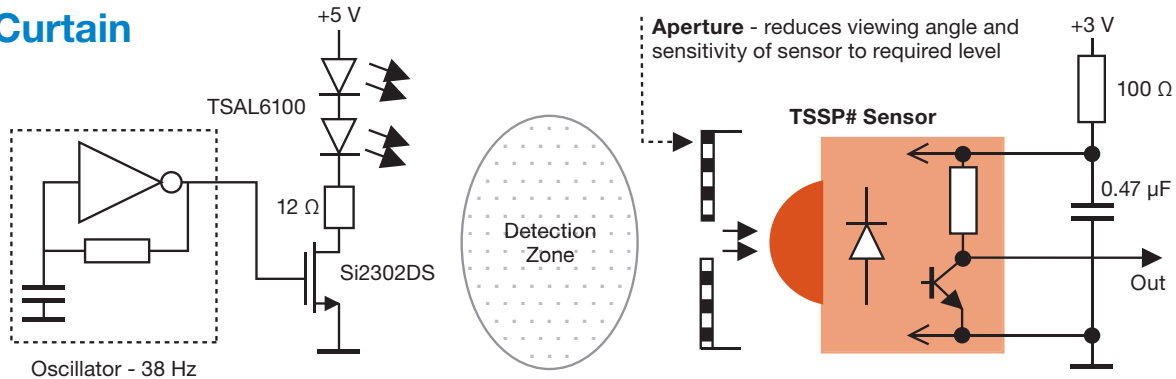
Standard IR remote control receivers have long been used for mid range detection of objects. Most remote control receivers contain an automatic gain circuit to adjust their detection threshold depending on the amount of ambient light and optical noise present. This can cause two problems:

- In noisy environments, the gain of the amplifier may adjust itself to such a low level that sensor responsiveness diminishes or even cuts out entirely
- With low ambient light, the receiver gain can become too sensitive and falsely detect reflections or stray signals from the emitter

Vishay's TSSP9x038, TSSP5x038, and TSSPx038 for presence sensing eliminate these problems by featuring a fixed gain. With a fixed gain the detection threshold and resulting detection distance is fixed. Once the design of the optical parameters such as the intensity of the emitter, the aperture in front of the receiver, and the alignment of emitter and detector are determined, the sensor will have stable, repeatable performance under all lighting conditions. The output of the sensor is the demodulated signal of the emitter (typically transmitting modulated bursts at e.g. 38 kHz or similar frequency).

	Short Range	Mid Range	Long Range
<b>Reflective</b>	< 4 cm	<b>20 cm to 2 m</b>	> 2 m
<b>Interrupter</b>	3 mm	<b>20 cm to 30 m</b>	> 30 m

## Light Curtain



## Fast Response Time

People's lives depend on light curtains and perimeter guards having fast reaction times. Typical reaction times for sensors in this application require the infrared beam to be interrupted for up to 5 ms before detection. The 300 μs response time of Vishay's sensors is much faster. For the fastest response time, a continuous 38 kHz signal should be used. For the longest distance, we recommend driving the TSAL6100 infrared emitter using a 38 kHz burst.

Part Number <sup>(1)</sup>		Supply Current (mA)	Supply Voltage (V)	Response Time (μs)	Light Curtain Range (m)	Reflective Range (m)
Presence (Digital Out)	Proximity (PWM Out)					
<a href="#">TSSP93038</a> <a href="#">TSSP94038</a> <a href="#">TSSP98038</a> <a href="#">TSSP95038</a> <a href="#">TSSP96038</a>	-	0.37	2.0 to 3.6	300	8 to 12	0.2 to 2
<a href="#">TSSP53038</a> <a href="#">TSSP4038</a> <a href="#">TSSP58038</a> <a href="#">TSSP77038</a> <a href="#">TSSP6038</a> <a href="#">TSSP57038</a> <a href="#">TSSP57038H</a>	<a href="#">TSSP4P38</a> <a href="#">TSSP58P38</a> <a href="#">TSSP77P38</a> <a href="#">TSSP6P38</a> <a href="#">TSSP57P38</a>	0.7	2.5 to 5.5	300	8 to 12	0.2 to 2

TSSP93038  
TSSP53038

TSSP94038  
TSSP4xxx

TSSP98038  
TSSP58xxx

TSSP95038  
TSSP77xxx

TSSP96038  
TSSP6xxx

TSSP57xxx

TSSP57038H

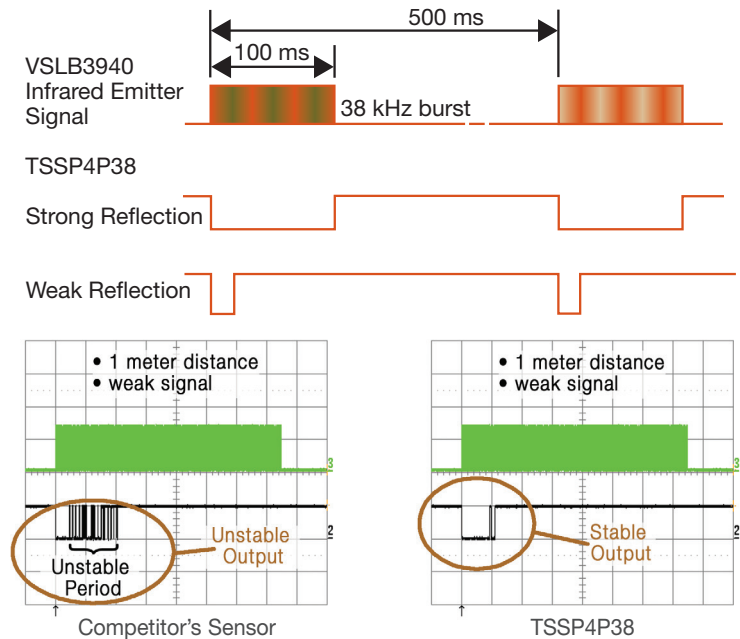
### Note

<sup>(1)</sup> 56 kHz TSSP-receivers also available

## Mid Range Detection With Ranging Capability

Many applications require a reflective sensor that detects not only the presence of an object, but also its relative proximity. This information can answer the question whether an object is moving toward or away from the sensor. This is possible with Vishay's TSSP4P38, TSSP58P38, TSSP6P38, TSSP77P38, and TSSP57P38 infrared proximity sensors.

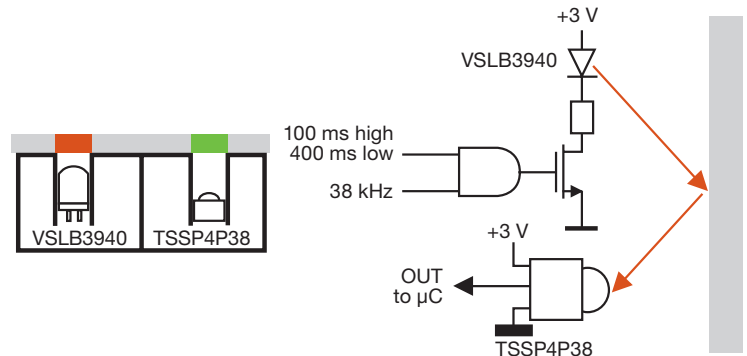
The principle of operation for this type of sensor is that the onboard AGC P circuit reduces the gain in response to a reflected long burst signal from the VSLB3940 IR emitter. The amount of time required to completely suppress the signal, and correspondingly the output pulse width, is inversely proportional to the strength of the signal, which in turn is proportional to the distance to the object. A near object reflects more light, resulting in a longer pulse width, and vice versa. This type of sensor cannot be used to measure absolute distance, but it is very sensitive to changes in distance, and hence relative range.



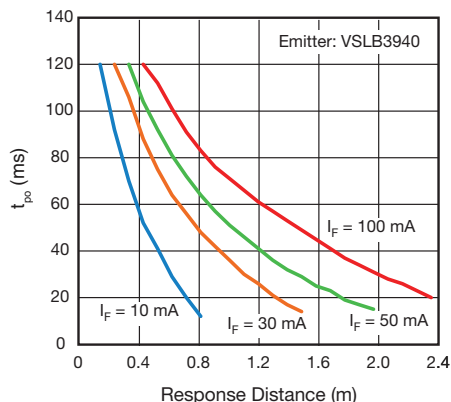
## No Crosstalk Allowed

Like all infrared proximity sensors, the receiver's view must be limited to only the reflected infrared light. If the detector is exposed to light within the package or if the emitter and detector share a common window, this will lead to crosstalk. Detection will be unreliable. The distance between the emitter and detector, and how far they are recessed, will affect the range.

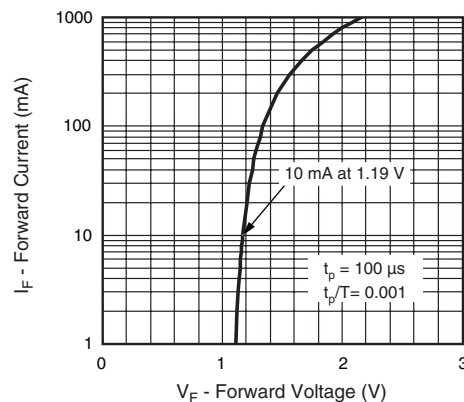
In a close arrangement of emitter and receiver, the working distance is mainly determined by the forward current through the emitter and the reflectivity of the detected obstacle. In the graphics below a grey card with 15 % reflectivity was used to determine the detection range at different forward currents through the VSLB3940 emitter.



If, for example, a response distance of 0.2 m to 0.8 m is needed in a sensor application, the emitter should be driven at 10 mA forward current. This can come about by adjusting the current limiting resistor in the emitter circuit to the appropriate value. An initial estimate neglecting the power loss across the transistor yields  $181 \Omega = (3 \text{ V} - 1.19 \text{ V})/0.01 \text{ A}$ .



$t_{po}$  vs. Distance Kodak Gray Card Plus 15 %



Forward Current vs. Forward Voltage



# OPTOELECTRONICS

## Infrared Sensors

### WORLDWIDE SALES CONTACTS

#### THE AMERICAS

##### UNITED STATES

VISHAY AMERICAS  
 ONE GREENWICH PLACE  
 SHELTON, CT 06484  
 UNITED STATES  
 PH: +1-402-563-6866  
 FAX: +1-402-563-6296

#### ASIA

##### SINGAPORE

VISHAY INTERTECHNOLOGY ASIA PTE LTD.  
 37A TAMPINES STREET 92 #07-00  
 SINGAPORE 528886  
 PH: +65-6788-6668  
 FAX: +65-6788-0988

##### P.R. CHINA

VISHAY CHINA CO., LTD.  
 15D, SUN TONG INFOPORT PLAZA  
 55 HUAI HAI WEST ROAD  
 SHANGHAI 200030  
 P.R. CHINA  
 PH: +86-21-5258 5000  
 FAX: +86-21-5258 7979

##### JAPAN

VISHAY JAPAN CO., LTD.  
 SHIBUYA PRESTIGE BLDG. 4F  
 3-12-22, SHIBUYA  
 SHIBUYA-KU  
 TOKYO 150-0002  
 JAPAN  
 PH: +81-3-5466-7150  
 FAX: +81-3-5466-7160

#### EUROPE

##### GERMANY

VISHAY ELECTRONIC GMBH  
 DR.-FELIX-ZANDMAN-PLATZ 1  
 95100 SELB  
 GERMANY  
 PH: +49-9287-71-0  
 FAX: +49-9287-70435

##### FRANCE

VISHAY S.A.  
 199, BD DE LA MADELEINE  
 06003 NICE, CEDEX 1  
 FRANCE  
 PH: +33-4-9337-2727  
 FAX: +33-4-9337-2726

##### UNITED KINGDOM

VISHAY LTD.  
 SUITE 6C, TOWER HOUSE  
 ST. CATHERINE'S COURT  
 SUNDERLAND ENTERPRISE PARK  
 SUNDERLAND SR5 3XJ  
 UNITED KINGDOM  
 PH: +44-191-516-8584  
 FAX: +44-191-549-9556