IR Receiver Modules for Remote Control Systems

FEATURES
- Improved immunity against HF and RF noise
- Low supply current
- Photo detector and preamplifier in one package
- Internal filter for PCM frequency
- Improved shielding against EMI
- Supply voltage: 2.5 V to 5.5 V
- Improved immunity against ambient light
- Insensitive to supply voltage ripple and noise
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

MECHANICAL DATA
Pinning for TSOP41.., TSOP43.., TSOP45:...
1 = OUT, 2 = GND, 3 = VS
Pinning for TSOP21.., TSOP23.., TSOP25:...
1 = OUT, 2 = VS, 3 = GND

ORDERING CODE
TSOP2..., TSOP4... - 2160 pieces in tubes

BLOCK DIAGRAM

APPLICATION CIRCUIT
R₁ and C₁ recommended to reduce supply ripple for $V_S < 2.8$ V

DESCRIPTION
These products are miniaturized receivers for infrared remote control systems. A PIN diode and a preamplifier are assembled on a lead frame, the epoxy package contains an IR filter. The demodulated output signal can be directly connected to a microprocessor for decoding.

The TSOP23.., TSOP43.. series devices are optimized to suppress almost all spurious pulses from Wi-Fi and CFL sources. They may suppress some data signals if continuously transmitted.

The TSOP21.., TSOP41.. series devices are provided primarily for compatibility with old AGC1 designs. New designs should prefer the TSOP23.., TSOP43.. series containing the newer AGC3. The TSOP25.., TSOP45.. series are useful to suppress even extreme levels of optical noise, but may also suppress some data signals. Please check compatibility with your codes.

These components have not been qualified according to automotive specifications.
### Parts Table

<table>
<thead>
<tr>
<th>Carrier frequency</th>
<th>Legacy, for short burst remote controls (AGC1)</th>
<th>Noisy environments and short bursts (AGC3)</th>
<th>Very noisy environments and short bursts (AGC5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 kHz</td>
<td>TSOP4130</td>
<td>TSOP2130</td>
<td>TSOP4330</td>
</tr>
<tr>
<td>33 kHz</td>
<td>TSOP4133</td>
<td>TSOP2133</td>
<td>TSOP4333</td>
</tr>
<tr>
<td>36 kHz</td>
<td>TSOP4136</td>
<td>TSOP2136</td>
<td>TSOP4336 (1)</td>
</tr>
<tr>
<td>38 kHz</td>
<td>TSOP4138</td>
<td>TSOP2138</td>
<td>TSOP4338 (2)(3)(4)(5)</td>
</tr>
<tr>
<td>40 kHz</td>
<td>TSOP4140</td>
<td>TSOP2140</td>
<td>TSOP4340</td>
</tr>
<tr>
<td>56 kHz</td>
<td>TSOP4156</td>
<td>TSOP2156</td>
<td>TSOP4536</td>
</tr>
</tbody>
</table>

### Package and Mold

- **Pinning**
  - 1 = OUT, 2 = VS, 3 = GND
- **Dimensions (mm)**
  - 6.0 W x 6.95 H x 5.6 D

### ABSOLUTE MAXIMUM RATINGS

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>TEST CONDITION</th>
<th>SYMBOL</th>
<th>VALUE</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage</td>
<td>VS</td>
<td>-0.3 to +6</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Supply current</td>
<td>IS</td>
<td>5</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>Output voltage</td>
<td>VO</td>
<td>-0.3 to 5.5</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Voltage at output to supply</td>
<td>VS - VO</td>
<td>-0.3 to (VS + 0.3)</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Output current</td>
<td>IO</td>
<td>5</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>Junction temperature</td>
<td>TJ</td>
<td>100</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>Storage temperature range</td>
<td>Tstg</td>
<td>-25 to +85</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>Operating temperature range</td>
<td>Tamb</td>
<td>-25 to +85</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>Power consumption</td>
<td>Pr</td>
<td>10</td>
<td>mW</td>
<td></td>
</tr>
<tr>
<td>Soldering temperature</td>
<td>Ts</td>
<td>260</td>
<td>°C</td>
<td></td>
</tr>
</tbody>
</table>

### ELECTRICAL AND OPTICAL CHARACTERISTICS (Tamb = 25 °C, unless otherwise specified)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>TEST CONDITION</th>
<th>SYMBOL</th>
<th>MIN.</th>
<th>TYP.</th>
<th>MAX.</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply current</td>
<td>E&lt;sub&gt;s&lt;/sub&gt; = 0, VS = 5 V</td>
<td>ISD</td>
<td>0.55</td>
<td>0.7</td>
<td>0.9</td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td>E&lt;sub&gt;s&lt;/sub&gt; = 40 klx, sunlight</td>
<td>ISH</td>
<td>-</td>
<td>0.8</td>
<td>-</td>
<td>mA</td>
</tr>
<tr>
<td>Supply voltage</td>
<td>VS</td>
<td>2.5</td>
<td>5.5</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Transmission distance</td>
<td>d</td>
<td>-</td>
<td>24</td>
<td>-</td>
<td>-</td>
<td>m</td>
</tr>
<tr>
<td>Output voltage low</td>
<td>IO&lt;sub&gt;SL&lt;/sub&gt; = 0.5 mA, E&lt;sub&gt;s&lt;/sub&gt; = 0.7 mW/m&lt;sup&gt;2&lt;/sup&gt;, test signal see Fig. 1</td>
<td>V&lt;sub&gt;OSL&lt;/sub&gt;</td>
<td>-</td>
<td>-</td>
<td>100</td>
<td>mV</td>
</tr>
<tr>
<td>Minimum irradiance</td>
<td>E&lt;sub&gt;min&lt;/sub&gt;</td>
<td>Pulse width tolerance: t&lt;sub&gt;p1&lt;/sub&gt; - 5/fo &lt; tp &lt; t&lt;sub&gt;p1&lt;/sub&gt; + 6/fo, test signal see Fig. 1</td>
<td>E&lt;sub&gt;s&lt;/sub&gt;</td>
<td>-</td>
<td>0.12</td>
<td>0.25</td>
</tr>
<tr>
<td>Maximum irradiance</td>
<td>E&lt;sub&gt;max&lt;/sub&gt;</td>
<td>t&lt;sub&gt;p1&lt;/sub&gt; - 5/fo &lt; tp &lt; t&lt;sub&gt;p1&lt;/sub&gt; + 6/fo, test signal see Fig. 1</td>
<td>E&lt;sub&gt;s&lt;/sub&gt;</td>
<td>50</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Directivity</td>
<td>φ&lt;sub&gt;1/2&lt;/sub&gt;</td>
<td>Angle of half transmission distance</td>
<td>φ&lt;sub&gt;1&lt;/sub&gt;/2</td>
<td>-</td>
<td>± 45</td>
<td>-</td>
</tr>
</tbody>
</table>

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**Note**

- Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect the device reliability.

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**Special options**


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**Application**

Remote control
**TYPICAL CHARACTERISTICS** (T<sub>amb</sub> = 25 °C, unless otherwise specified)

- **Output Active Low**
- **Output Pulse Diagram**
- **Pulse Length and Sensitivity in Dark Ambient**
- **Frequency Dependence of Responsivity**
- **Sensitivity in Bright Ambient**

**Input burst length**

### Optical Test Signal

- (IR diode TSAL6200, I<sub>p</sub> = 0.4 A, N = 6 pulses, f = f<sub>p</sub>, t = 10 ms)

### Output Signal

- V<sub>O</sub>
- V<sub>OH</sub>
- V<sub>OL</sub>

### Output Pulse Width

- t<sub>p0</sub>
- t<sub>i</sub> *)

*) t<sub>i</sub> ≥ 6/f<sub>0</sub> is recommended for optimal function

### E<sub>e</sub> - Irradiance (mW/m<sup>2</sup>)

- t<sub>on</sub>, t<sub>off</sub> - Output Pulse Width (ms)

### λ = 950 nm, optical test signal, Fig. 1

### λ = 950 nm, optical test signal, Fig. 3

### λ = 950 nm, optical test signal, Fig. 4

### λ = 950 nm, optical test signal, Fig. 5

### λ = 950 nm, optical test signal, Fig. 6
Fig. 7 - Sensitivity vs. Supply Voltage Disturbances

Fig. 8 - Max. Envelope Duty Cycle vs. Burst Length

Fig. 9 - Sensitivity vs. Ambient Temperature

Fig. 10 - Relative Spectral Sensitivity vs. Wavelength

Fig. 11 - Horizontal Directivity

Fig. 12 - Sensitivity vs. Supply Voltage
SUITABLE DATA FORMAT

This series is designed to suppress spurious output pulses due to noise or disturbance signals. The devices can distinguish data signals from noise due to differences in frequency, burst length, and envelope duty cycle. The data signal should be close to the device’s band-pass center frequency (e.g. 38 kHz) and fulfill the conditions in the table below.

When a data signal is applied to the product in the presence of a disturbance, the sensitivity of the receiver is automatically reduced by the AGC to insure that no spurious pulses are present at the receiver's output. Some examples which are suppressed are:

- DC light (e.g. from tungsten bulbs sunlight)
- Continuous signals at any frequency
- Strongly or weakly modulated patterns from fluorescent lamps with electronic ballasts (see Fig. 13 or Fig. 14).
- 2.4 GHz and 5 GHz Wi-Fi

<table>
<thead>
<tr>
<th>Minimum burst length</th>
<th>TSOP41.., TSOP21..</th>
<th>TSOP43.., TSOP23..</th>
<th>TSOP45.., TSOP25..</th>
</tr>
</thead>
<tbody>
<tr>
<td>After each burst of length</td>
<td>6 cycles/burst</td>
<td>6 cycles/burst</td>
<td>6 cycles/burst</td>
</tr>
<tr>
<td>A gap time is required of</td>
<td>6 to 70 cycles</td>
<td>6 to 35 cycles</td>
<td>6 to 24 cycles</td>
</tr>
<tr>
<td>≥ 10 cycles</td>
<td>≥ 10 cycles</td>
<td>≥ 10 cycles</td>
<td></td>
</tr>
<tr>
<td>For bursts greater than a minimum gap time in the data stream is needed of</td>
<td>70 cycles</td>
<td>35 cycles</td>
<td>24 cycles</td>
</tr>
<tr>
<td>&gt; 1.2 x burst length</td>
<td>&gt; 6 x burst length</td>
<td>&gt; 25 ms</td>
<td></td>
</tr>
<tr>
<td>Maximum number of continuous short bursts/second</td>
<td>2000</td>
<td>2000</td>
<td>2000</td>
</tr>
<tr>
<td>MCIR code</td>
<td>Yes</td>
<td>Preferred</td>
<td>Yes</td>
</tr>
<tr>
<td>XMP-1, XMP-2 code</td>
<td>Yes</td>
<td>Preferred</td>
<td>Yes</td>
</tr>
<tr>
<td>Suppression of interference from fluorescent lamps</td>
<td>Mild disturbance patterns are suppressed (example: signal pattern of Fig. 13)</td>
<td>Complex disturbance patterns are suppressed (example: signal pattern of Fig. 14)</td>
<td>Critical disturbance patterns are suppressed, e.g. highly dimmed LCDs</td>
</tr>
</tbody>
</table>

Note

- For data formats with long bursts (more than 10 carrier cycles) please see the datasheet for TSOP48.., TSOP44.., TSOP22.., TSOP24..
PACKAGE DIMENSIONS in millimeters

Drawing-No.: 6.550-5169.01-4
Issue: 9; 03.11.10

13655

Technical drawings according to DIN specifications

Not indicated tolerances ± 0.2

marking area

R 2.5
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