IR Receiver Modules for Remote Control Systems

Description
The TSOP312.. series are miniaturized receivers for infrared remote control systems. PIN diode and preamplifier are assembled on lead frame, the epoxy package is designed as IR filter.
The demodulated output signal can directly be decoded by a microprocessor. TSOP312.. is the standard IR remote control receiver series for 3 V supply voltage, supporting all major transmission codes.

Features
- Photo detector and preamplifier in one package
- Internal filter for PCM frequency
- Improved shielding against electrical field disturbance
- TTL and CMOS compatibility
- Output active low
- Supply voltage: 2.7 V to 5.5 V
- Improved immunity against ambient light

Mechanical Data
Pinning:
1 = GND, 2 = V_S, 3 = OUT

Parts Table
<table>
<thead>
<tr>
<th>Part</th>
<th>Carrier Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSOP31230</td>
<td>30 kHz</td>
</tr>
<tr>
<td>TSOP31233</td>
<td>33 kHz</td>
</tr>
<tr>
<td>TSOP31236</td>
<td>36 kHz</td>
</tr>
<tr>
<td>TSOP31237</td>
<td>36.7 kHz</td>
</tr>
<tr>
<td>TSOP31238</td>
<td>38 kHz</td>
</tr>
<tr>
<td>TSOP31240</td>
<td>40 kHz</td>
</tr>
<tr>
<td>TSOP31256</td>
<td>56 kHz</td>
</tr>
</tbody>
</table>

Application Circuit

1. Transmitter with TSALxxxx
2. Control Circuit
3. Demodulator
4. Band Pass
5. AGC
6. PIN

R_T + C_1 recommended to suppress power supply disturbances.
The output voltage should not be held continuously at a voltage below \( V_O = 2.0 \) V by the external circuit.
### Absolute Maximum Ratings

*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>(Pin 2)</td>
<td>$V_S$</td>
<td>- 0.3 to + 6.0</td>
<td>V</td>
</tr>
<tr>
<td>Supply Current</td>
<td>(Pin 2)</td>
<td>$I_S$</td>
<td>3</td>
<td>mA</td>
</tr>
<tr>
<td>Output Voltage</td>
<td>(Pin 3)</td>
<td>$V_O$</td>
<td>- 0.3 to ($V_S$ + 0.3)</td>
<td>V</td>
</tr>
<tr>
<td>Output Current</td>
<td>(Pin 3)</td>
<td>$I_O$</td>
<td>10</td>
<td>mA</td>
</tr>
<tr>
<td>Junction Temperature</td>
<td></td>
<td>$T_J$</td>
<td>100</td>
<td>°C</td>
</tr>
<tr>
<td>Storage Temperature Range</td>
<td></td>
<td>$T_{stg}$</td>
<td>- 25 to + 85</td>
<td>°C</td>
</tr>
<tr>
<td>Operating Temperature Range</td>
<td></td>
<td>$T_{amb}$</td>
<td>- 25 to + 85</td>
<td>°C</td>
</tr>
<tr>
<td>Power Consumption</td>
<td>($T_{amb} \leq 85 \degree C$)</td>
<td>$P_{tot}$</td>
<td>30</td>
<td>mW</td>
</tr>
<tr>
<td>Soldering Temperature</td>
<td>$t \leq 10$ s, 1 mm from case</td>
<td>$T_{sd}$</td>
<td>260</td>
<td>°C</td>
</tr>
</tbody>
</table>

### Electrical and Optical Characteristics

*Electrical and Optical Characteristics*

<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 Current (Pin 3)</td>
<td>$E_s = 0$</td>
<td>$I_{SD}$</td>
<td>0.7</td>
<td>1.2</td>
</tr>
<tr>
<td></td>
<td>$E_s = 40$ kx, sunlight</td>
<td>$I_{SH}$</td>
<td>1.3</td>
<td>mA</td>
</tr>
<tr>
<td>Supply Voltage</td>
<td></td>
<td>$V_O$</td>
<td>2.7</td>
<td>5.5</td>
</tr>
<tr>
<td>Transmission Distance</td>
<td>$E_s = 0$, test signal see fig.1, IR diode TSAL6200, $I_f = 250$ mA</td>
<td>$d$</td>
<td>35</td>
<td>m</td>
</tr>
<tr>
<td>Output Voltage Low (Pin 1)</td>
<td>$I_{OSL} = 0.5$ mA, $E_s = 0.7$ mW/m², test signal see fig.1</td>
<td>$V_{OSL}$</td>
<td>250</td>
<td>mV</td>
</tr>
<tr>
<td>Irradiance (30 - 40 kHz)</td>
<td>$V_S = 3$ V, Pulse width tolerance: $t_{pi} - 5f_0 &lt; t_{po} &lt; t_{pi} + 6f_0$, test signal see fig.1</td>
<td>$E_{e_{min}}$</td>
<td>0.35</td>
<td>0.5</td>
</tr>
<tr>
<td>Irradiance (56 kHz)</td>
<td>$V_S = 3$ V, Pulse width tolerance: $t_{pi} - 5f_0 &lt; t_{po} &lt; t_{pi} + 6f_0$, test signal see fig.1</td>
<td>$E_{e_{min}}$</td>
<td>0.4</td>
<td>0.6</td>
</tr>
<tr>
<td>Irradiance (30 - 40 kHz)</td>
<td>$V_S = 5$ V, Pulse width tolerance: $t_{pi} - 5f_0 &lt; t_{po} &lt; t_{pi} + 6f_0$, test signal see fig.1</td>
<td>$E_{e_{min}}$</td>
<td>0.45</td>
<td>0.6</td>
</tr>
<tr>
<td>Irradiance (56 kHz)</td>
<td>$V_S = 5$ V, Pulse width tolerance: $t_{pi} - 5f_0 &lt; t_{po} &lt; t_{pi} + 6f_0$, test signal see fig.1</td>
<td>$E_{e_{min}}$</td>
<td>0.5</td>
<td>0.7</td>
</tr>
<tr>
<td>Irradiance</td>
<td>$t_{pi} - 5f_0 &lt; t_{po} &lt; t_{pi} + 6f_0$, test signal see fig.1</td>
<td>$E_{e_{max}}$</td>
<td>30</td>
<td>W/m²</td>
</tr>
<tr>
<td>Directivity</td>
<td>Angle of half transmission distance</td>
<td>$\psi_{1/2}$</td>
<td>± 45</td>
<td>deg</td>
</tr>
</tbody>
</table>
Typical Characteristics (Tamb = 25 °C unless otherwise specified)

**Figure 1. Output Function**

- Optical Test Signal
  - (IR diode TSAL2202, \( I_c = 0.4 \, A \), 30 pulses, \( f = f_o \), \( T = 10 \, ms \))

**Figure 2. Pulse Length and Sensitivity in Dark Ambient**

- Output Signal
  - \( t_{P1} \), \( t_{P2} \)
  - 1) \( 7f_o < t_p < 15f_o \)
  - 2) \( t_p - 5f_o < t_p < f_p + 6f_o \)

**Figure 3. Output Function**

- Output Signal
  - \( t_{on} \), \( t_{off} \)

**Figure 4. Output Pulse Diagram**

- Output Pulse Width (ns)
  - \( E_o \) - Irradiance (mW/m²)

**Figure 5. Frequency Dependence of Responsivity**

- \( E_{rel} / E_o \) - Rel. Responsivity
  - \( f = f_o \pm 5\% \)

**Figure 6. Sensitivity in Bright Ambient**

- Output Signal
  - \( \lambda = 950 \, nm, \) optical test signal, fig.3
Figure 7. Sensitivity vs. Supply Voltage Disturbances

Figure 8. Sensitivity vs. Electric Field Disturbances

Figure 9. Max. Envelope Duty Cycle vs. Burstlength

Figure 10. Sensitivity vs. Ambient Temperature

Figure 11. Relative Spectral Sensitivity vs. Wavelength

Figure 12. Horizontal Directivity $\theta_x$
Figure 13. Vertical Directivity $\phi_y$

Figure 14. Sensitivity vs. Supply Voltage $E_s$ vs. $V_S$
Suitable Data Format

The circuit of the TSOP312.. is designed in that way that unexpected output pulses due to noise or disturbance signals are avoided. A bandpass filter, an integrator stage and an automatic gain control are used to suppress such disturbances.

The distinguishing mark between data signal and disturbance signal are carrier frequency, burst length and duty cycle.

The data signal should fulfill the following conditions:

- Carrier frequency should be close to center frequency of the bandpass (e.g. 38 kHz).
- Burst length should be 10 cycles/burst or longer.
- After each burst which is between 10 cycles and 70 cycles a gap time of at least 14 cycles is necessary.
- For each burst which is longer than 1.8 ms a corresponding gap time is necessary at some time in the data stream. This gap time should be at least 4 times longer than the burst.
- Up to 800 short bursts per second can be received continuously.


When a disturbance signal is applied to the TSOP312.. it can still receive the data signal. However the sensitivity is reduced to that level that no unexpected pulses will occur.

Some examples for such disturbance signals which are suppressed by the TSOP312.. are:

- DC light (e.g. from tungsten bulb or sunlight)
- Continuous signal at 38 kHz or at any other frequency
- Signals from fluorescent lamps with electronic ballast with high or low modulation (see Figure 15 or Figure 16 ).

![Figure 15. IR Signal from Fluorescent Lamp with low Modulation](image1)

![Figure 16. IR Signal from Fluorescent Lamp with high Modulation](image2)
Package Dimensions in mm

Drawing-No: 6550-5095.01-4
Issue: 17; 22.03.04

All dimensions in mm

technical drawings according to DIN specifications

06 12116
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Vishay Semiconductor GmbH, P.O.B. 3535, D-74025 Heilbronn, Germany
Telephone: 49 (0)7131 67 2831, Fax number: 49 (0)7131 67 2423
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