IR Receiver Modules for Remote Control Systems

Description
The TSOP22.. 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. TSOP22.. is the standard IR remote control receiver series, 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
• Low power consumption

Special Features
• Improved immunity against ambient light
• Suitable burst length ≥ 10 cycles/burst

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

Parts Table
<table>
<thead>
<tr>
<th>Part</th>
<th>Carrier Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSOP2230</td>
<td>30 kHz</td>
</tr>
<tr>
<td>TSOP2233</td>
<td>33 kHz</td>
</tr>
<tr>
<td>TSOP2236</td>
<td>36 kHz</td>
</tr>
<tr>
<td>TSOP2237</td>
<td>36.7 kHz</td>
</tr>
<tr>
<td>TSOP2238</td>
<td>38 kHz</td>
</tr>
<tr>
<td>TSOP2240</td>
<td>40 kHz</td>
</tr>
<tr>
<td>TSOP2256</td>
<td>56 kHz</td>
</tr>
</tbody>
</table>

Block Diagram

Application Circuit

R_1 + C_1 recommended to suppress power supply disturbances. The output voltage should not be held continuously at a voltage below V_O ~ 3.3 V by the external circuit.
**Absolute Maximum Ratings**

$T_{amb} = 25 \, ^{\circ}C$, unless otherwise specified

<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>5</td>
<td>mA</td>
</tr>
<tr>
<td>Output Voltage</td>
<td>(Pin 1)</td>
<td>$V_O$</td>
<td>0.3 to 6.0</td>
<td>V</td>
</tr>
<tr>
<td>Output Current</td>
<td>(Pin 1)</td>
<td>$I_O$</td>
<td>5</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</td>
<td></td>
<td>$T_{stg}$</td>
<td>-25 to 85</td>
<td>°C</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td></td>
<td>$T_{amb}$</td>
<td>-25 to 85</td>
<td>°C</td>
</tr>
<tr>
<td>Power Consumption</td>
<td></td>
<td>$P_{tot}$</td>
<td>50</td>
<td>mW</td>
</tr>
<tr>
<td>Soldering Temperature</td>
<td></td>
<td>$T_{sd}$</td>
<td>260</td>
<td>°C</td>
</tr>
</tbody>
</table>

**Electrical and Optical Characteristics**

$T_{amb} = 25 \, ^{\circ}C$, 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 (Pin 2)</td>
<td>$V_S = 5 , V$, $E_e = 0$</td>
<td>$I_{SD}$</td>
<td>0.8</td>
<td>1.2</td>
<td>1.5</td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td>$V_S = 5 , V$, $E_e = 40 , klx$, sunlight</td>
<td>$I_{SH}$</td>
<td>1.5</td>
<td></td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>Supply Voltage (Pin 2)</td>
<td></td>
<td>$V_S$</td>
<td>4.5</td>
<td>5.5</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Transmission Distance</td>
<td></td>
<td>$E_e$</td>
<td>0.1</td>
<td>1.5</td>
<td></td>
<td>mW/m²</td>
</tr>
<tr>
<td>Output Voltage Low (Pin 1)</td>
<td>$I_{OL} = 0.3 , mA$, $E_e = 0.7 , mW/m²$, $f = f_o$, test signal see fig. 1</td>
<td>$V_{OL}$</td>
<td>250</td>
<td></td>
<td></td>
<td>mV</td>
</tr>
<tr>
<td>Irradiance (30 - 40 kHz)</td>
<td>Pulse width tolerance: $t_p - 5/t_o &lt; t_{pc} &lt; t_p + 6/t_o$, test signal see fig.1</td>
<td>$E_e$</td>
<td>0.2</td>
<td>0.4</td>
<td></td>
<td>mW/m²</td>
</tr>
<tr>
<td>Irradiance (56 kHz)</td>
<td>Pulse width tolerance: $t_p - 5/t_o &lt; t_{pc} &lt; t_p + 6/t_o$, test signal see fig.1</td>
<td>$E_e$</td>
<td>0.3</td>
<td>0.5</td>
<td></td>
<td>mW/m²</td>
</tr>
<tr>
<td>Irradiance</td>
<td>$t_p - 5/t_o &lt; t_{pc} &lt; t_p + 6/t_o$, test signal see fig.1</td>
<td>$E_e$</td>
<td>0.3</td>
<td>0.5</td>
<td></td>
<td>mW/m²</td>
</tr>
<tr>
<td>Directivity</td>
<td>Angle of half transmission distance</td>
<td>$\phi_{1/2}$</td>
<td>± 45</td>
<td></td>
<td></td>
<td>deg</td>
</tr>
</tbody>
</table>
**Typical Characteristics** \((T_{\text{amb}} = 25 \, ^\circ C \text{ unless otherwise specified})\)

- **Output Function**
  - Optical Test Signal
    - (IR diode TSAL6200, \(I_r = 0.4 \, A\), 30 pulses, \(f = f_0\), \(T = 10 \, ms\))
    - \(t_{\text{pi}} \geq 10/f_0\) is recommended for optimal function

- **Output Signal**
  - \(V_O\)
  - \(V_{\text{ON}}\)
  - \(V_{\text{OL}}\)
  - \(t_{\text{pi}}\)
  - \(t_{\text{po}}\)

- **Typical Characteristics Diagrams**
  - **Figure 1. Output Function**
  - **Figure 2. Pulse Length and Sensitivity in Dark Ambient**
  - **Figure 3. Output Function**
  - **Figure 4. Output Pulse Diagram**
  - **Figure 5. Frequency Dependence of Responsivity**
  - **Figure 6. Sensitivity in Bright Ambient**
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. Directivity
**Suitable Data Format**

The circuit of the TSOP22.. 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 1.0 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 TSOP22.. 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 TSOP22.. 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 13 or Figure 14).
Package Dimensions in mm

Drawing-No.: 6550-5169.01-4
Issue 5, 08 03 00

Technical drawings according to DIN specifications

Not indicated tolerances ±0.2
Ozone Depleting Substances Policy Statement

It is the policy of Vishay Semiconductor GmbH to

1. Meet all present and future national and international statutory requirements.
2. Regularly and continuously improve the performance of our products, processes, distribution and operating systems with respect to their impact on the health and safety of our employees and the public, as well as their impact on the environment.

It is particular concern to control or eliminate releases of those substances into the atmosphere which are known as ozone depleting substances (ODSs).

The Montreal Protocol (1987) and its London Amendments (1990) intend to severely restrict the use of ODSs and forbid their use within the next ten years. Various national and international initiatives are pressing for an earlier ban on these substances.

Vishay Semiconductor GmbH has been able to use its policy of continuous improvements to eliminate the use of ODSs listed in the following documents.

2. Class I and II ozone depleting substances in the Clean Air Act Amendments of 1990 by the Environmental Protection Agency (EPA) in the USA

Vishay Semiconductor GmbH can certify that our semiconductors are not manufactured with ozone depleting substances and do not contain such substances.

We reserve the right to make changes to improve technical design and may do so without further notice.

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