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
- Supply voltage: 2.5 V to 5.5 V
- Improved immunity against optical noise
- Insensitive to supply voltage ripple and noise
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

DESCRIPTION
The TSOP22.., TSOP48.., TSOP24.. and TSOP44.. series are miniaturized IR receiver modules for infrared remote control systems. A PIN diode and a preamplifier are assembled on lead frame, the epoxy package contains an IR filter.

The demodulated output signal can be directly connected to a microprocessor for decoding.

The TSOP24.., TSOP44.. 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 TSOP22.., TSOP48.. series devices are provided primarily for compatibility with old AGC2 designs. New designs should prefer the TSOP24.., TSOP44.. series containing the newer AGC4.

These components have not been qualified according to automotive specifications.

PARTS TABLE

<table>
<thead>
<tr>
<th>Carrier frequency</th>
<th>AGC LEGACY, FOR LONG BURST REMOTE CONTROLS (AGC2)</th>
<th>RECOMMENDED FOR LONG BURST CODES (AGC4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 kHz</td>
<td>TSOP4830</td>
<td>TSOP4430</td>
</tr>
<tr>
<td>33 kHz</td>
<td>TSOP4833</td>
<td>TSOP4433</td>
</tr>
<tr>
<td>36 kHz</td>
<td>TSOP4836</td>
<td>TSOP4436</td>
</tr>
<tr>
<td>38 kHz</td>
<td>TSOP4838</td>
<td>TSOP4438</td>
</tr>
<tr>
<td>40 kHz</td>
<td>TSOP4840</td>
<td>TSOP4440</td>
</tr>
<tr>
<td>56 kHz</td>
<td>TSOP4856</td>
<td>TSOP4456</td>
</tr>
</tbody>
</table>

Package | Mold
---|---
Leaded |

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

Application | Best choice for
---|---
Remote control | (1) RC-5 (2) RC-6 (3) Panasonic (4) NEC (5) Sharp (6) r-step (7) Thomson RCA
**BLOCK DIAGRAM**

```
16833_14

Input → AGC → Band pass → Demodulator

Control circuit

33 kΩ

Notes:
- 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.

**APPLICATION CIRCUIT**

```
17170-11

Transmitter with TSALxxxx

IR receiver

V_S

R_1

C_1

μC

GND

V_O

GND

Note:
- R_1 and C_1 recommended to reduce supply ripple for V_S < 2.8 V

**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>V_S</td>
<td></td>
<td>-0.3</td>
<td>V</td>
</tr>
<tr>
<td>Supply current</td>
<td>I_S</td>
<td></td>
<td>5</td>
<td>mA</td>
</tr>
<tr>
<td>Output voltage</td>
<td>V_O</td>
<td></td>
<td>-0.3</td>
<td>V</td>
</tr>
<tr>
<td>Voltage at output to supply</td>
<td>V_S - V_O</td>
<td></td>
<td>-0.3</td>
<td>V</td>
</tr>
<tr>
<td>Output current</td>
<td>I_O</td>
<td></td>
<td>5</td>
<td>mA</td>
</tr>
<tr>
<td>Junction temperature</td>
<td>T_J</td>
<td></td>
<td>100</td>
<td>°C</td>
</tr>
<tr>
<td>Storage temperature range</td>
<td>T_STG</td>
<td></td>
<td>-25</td>
<td>°C</td>
</tr>
<tr>
<td>Operating temperature range</td>
<td>T_Amb</td>
<td></td>
<td>-25</td>
<td>°C</td>
</tr>
<tr>
<td>Power consumption</td>
<td>P_tot</td>
<td></td>
<td>10</td>
<td>mW</td>
</tr>
<tr>
<td>Soldering temperature</td>
<td>T_sd</td>
<td></td>
<td>260</td>
<td>°C</td>
</tr>
</tbody>
</table>

**ELECTRICAL AND OPTICAL CHARACTERISTICS (T_amb = 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_v = 0, V_S = 5 V</td>
<td>I_SD</td>
<td>0.55</td>
<td>0.7</td>
<td>0.9</td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td>E_v = 40 klx, sunlight</td>
<td>I_SHL</td>
<td>-</td>
<td>0.8</td>
<td>-</td>
<td>mA</td>
</tr>
<tr>
<td>Supply voltage</td>
<td>V_S</td>
<td></td>
<td>2.5</td>
<td>-</td>
<td>5.5</td>
<td>V</td>
</tr>
<tr>
<td>Transmission distance</td>
<td>E_v = 0, test signal see Fig. 1, IR diode TSAL6200, I_F = 50 mA</td>
<td>d</td>
<td>-</td>
<td>24</td>
<td>-</td>
<td>m</td>
</tr>
<tr>
<td>Output voltage low</td>
<td>I_OSL = 0.5 mA, E_e = 0.7 mW/m², test signal see Fig. 1</td>
<td>V_OSL</td>
<td>-</td>
<td>-</td>
<td>100</td>
<td>mV</td>
</tr>
<tr>
<td>Minimum irradiance</td>
<td>E_e min.</td>
<td></td>
<td>-</td>
<td>0.12</td>
<td>0.25</td>
<td>mW/m²</td>
</tr>
<tr>
<td>Maximum irradiance</td>
<td>E_e max.</td>
<td></td>
<td>50</td>
<td>-</td>
<td>-</td>
<td>W/m²</td>
</tr>
<tr>
<td>Directivity</td>
<td>Angle of half transmission distance</td>
<td>Φ_t/2</td>
<td>-</td>
<td>± 45</td>
<td>-</td>
<td>deg</td>
</tr>
</tbody>
</table>

Note:
- R_1 and C_1 recommended to reduce supply ripple for V_S < 2.8 V
TYPICAL CHARACTERISTICS (\(T_{\text{amb}} = 25^\circ \text{C}\), unless otherwise specified)

**Fig. 1 - Output Active Low**

- Optical Test Signal (IR diode TSAL6200, \(I_C = 0.4 \text{ A}\), 30 pulses, \(f = f_0\), \(t = 10 \text{ ms}\))
- Output Signal
- \(E_e\) - Irradiance (mW/m²)
- \(V_O\), \(V_{OH}\), \(V_{OL}\)
- \(t_{PI}\), \(t_{PO}\)

**Fig. 2 - Pulse Length and Sensitivity in Dark Ambient**

- Output pulse width
- Input burst length
- \(\lambda = 950 \text{ nm}\), optical test signal, fig. 1

**Fig. 3 - Output Function**

- Optical Test Signal
- \(E_e\) - Output Pulse Width (ms)
- \(V_O\), \(V_{OH}\), \(V_{OL}\)

**Fig. 4 - Output Pulse Diagram**

- \(t_{PI}\), \(t_{PO}\)
- \(E_e\) - Irradiance (mW/m²)
- \(V_{OH}\), \(V_{OL}\)

**Fig. 5 - Frequency Dependence of Responsivity**

- \(f = f_0 \pm 5\%\)
- \(\Delta f(3 \text{ dB}) = f_0/10\)

**Fig. 6 - Sensitivity in Bright Ambient**

- \(E_{\text{th}}\) - Threshold Irradiance (mW/m²)
- \(E_e\) - Ambient DC Irradiance (W/m²)
- \(t_{ON}\), \(t_{OFF}\)
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:**

<table>
<thead>
<tr>
<th></th>
<th>TSOP22.., TSOP48..</th>
<th>TSOP24.., TSOP44..</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum burst length</td>
<td>10 cycles/burst</td>
<td>10 cycles/burst</td>
</tr>
<tr>
<td>After each burst of length a minimum gap time is required of</td>
<td>10 to 70 cycles ≥ 12 cycles</td>
<td>10 to 35 cycles ≥ 12 cycles</td>
</tr>
<tr>
<td>For bursts greater than a minimum gap time in the data stream is needed of</td>
<td>70 cycles &gt; 4 x burst length</td>
<td>35 cycles &gt; 10 x burst length</td>
</tr>
<tr>
<td>Maximum number of continuous short bursts/second</td>
<td>800</td>
<td>1300</td>
</tr>
<tr>
<td>NEC code</td>
<td>Yes</td>
<td>Preferred</td>
</tr>
<tr>
<td>RC5/RC6 code</td>
<td>Yes</td>
<td>Preferred</td>
</tr>
<tr>
<td>Thomson 56 kHz code</td>
<td>Yes</td>
<td>Preferred</td>
</tr>
<tr>
<td>Sharp code</td>
<td>Yes</td>
<td>Preferred</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 and critical disturbance patterns are suppressed (example: signal pattern of Fig. 14 or highly dimmed LCDs)</td>
</tr>
</tbody>
</table>

**Note**

- For data formats with short bursts please see the datasheet of TSOP23.., TSOP43..
PACKAGE DIMENSIONS in millimeters

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