**IR Receiver Modules for Remote Control Systems**

**FEATURES**
- Very low supply current
- Photo detector and preamplifier in one package
- Optimized for Sony 12, 15, and 20 bit IR-code
- 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
- Very narrow optical filter to minimize the interference from 3D synchronizing signals and other optical noise sources
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

**DESCRIPTION**
The TSOP32S40F, TSOP34S40F 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 decoded by a microprocessor. The TSOP32S40F, TSOP34S40F are compatible with 12, 15, and 20 bit Sony codes. They are optimized to suppress almost all spurious pulses from energy saving fluorescent lamps but will also suppress some data signals.

These components have not been qualified according to automotive specifications.

**PARTS TABLE**

<table>
<thead>
<tr>
<th>AGC</th>
<th>SONY (AGC-S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carrier frequency</td>
<td>40 kHz</td>
</tr>
<tr>
<td>Package</td>
<td>Mold</td>
</tr>
<tr>
<td>Pinning</td>
<td>1 = OUT, 2 = GND, 3 = VS</td>
</tr>
<tr>
<td>Dimensions (mm)</td>
<td>6.0 W x 6.95 H x 5.6 D</td>
</tr>
<tr>
<td>Mounting</td>
<td>Leaded</td>
</tr>
<tr>
<td>Best choice for</td>
<td>(1) Sony 12, 15, and 20 bit IR-codes</td>
</tr>
</tbody>
</table>

**BLOCK DIAGRAM**

**APPLICATION CIRCUIT**

R₁ and C₁ recommended to reduce supply ripple for $V_S < 2.8 \text{ V}$
**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 to +6</td>
<td>V</td>
</tr>
<tr>
<td>Supply current</td>
<td>$I_S$</td>
<td></td>
<td>3</td>
<td>mA</td>
</tr>
<tr>
<td>Output voltage</td>
<td>$V_O$</td>
<td></td>
<td>-0.3 to $(V_S + 0.3)$</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 to +85</td>
<td>°C</td>
</tr>
<tr>
<td>Operating temperature range</td>
<td>$T_{amb}$</td>
<td></td>
<td>-25 to +85</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>

**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.

**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</td>
<td>$E_v = 0, , V_S = 3.3 , V$</td>
<td>$I_{SD}$</td>
<td>0.27</td>
<td>0.35</td>
<td>0.45</td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td>$E_v = 40 , \text{kix}, , \text{sunlight}$</td>
<td>$I_{SH}$</td>
<td>-</td>
<td>0.45</td>
<td>-</td>
<td>mA</td>
</tr>
<tr>
<td>Transmission distance</td>
<td>$E_v = 0, , \text{test signal see Fig. 1, IR diode TSAL6200, } I_F = 50 , mA$</td>
<td>$d$</td>
<td>-</td>
<td>30</td>
<td>-</td>
<td>m</td>
</tr>
<tr>
<td>Output voltage low</td>
<td>$I_{OSL} = 0.5 , mA, , E_e = 0.7 , \text{mW/m}^2, , \text{test signal see Fig. 1}$</td>
<td>$V_{OSL}$</td>
<td>-</td>
<td>-</td>
<td>100</td>
<td>mV</td>
</tr>
<tr>
<td>Minimum irradiance</td>
<td>Pulse width tolerance: $t_{pi} - 5/f_0 &lt; t_{po} &lt; t_{pi} + 6/f_0$, test signal see Fig. 1</td>
<td>$E_{e_{min.}}$</td>
<td>-</td>
<td>0.08</td>
<td>0.15</td>
<td>mW/m²</td>
</tr>
<tr>
<td>Maximum irradiance</td>
<td>$t_{pi} - 5/f_0 &lt; t_{po} &lt; t_{pi} + 6/f_0$, test signal see Fig. 1</td>
<td>$E_{e_{max.}}$</td>
<td>30</td>
<td>-</td>
<td>-</td>
<td>W/m²</td>
</tr>
<tr>
<td>Directivity</td>
<td>Angle of half transmission distance</td>
<td>$\varphi_{1/2}$</td>
<td>-</td>
<td>± 45</td>
<td>-</td>
<td>°</td>
</tr>
</tbody>
</table>

**TYPICAL CHARACTERISTICS** ($T_{amb} = 25 \, ^\circ C$, unless otherwise specified)

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**Fig. 3 - Output Function**

Optical Test Signal

- $E_e$ - Irradiance (mW/m²)
- $t_{on}$ - Output Pulse Width (ms)
- $t_{off}$ - Output Pulse Width (ms)

$t = 60$ ms

Output Signal, (see Fig. 4)

$V_O$, $V_{OH}$, $V_{OL}$

$600 \mu s, 600 \mu s$

**Fig. 4 - Output Pulse Diagram**

$t_{on}$, $t_{off}$ - Output Pulse Width (ms)

$\lambda = 950$ nm, optical test signal, fig. 3

$E_e -$ Irradiance (mW/m²)

$0.1$ $1$ $10$ $100$ $1000$ $10,000$

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

$E_{rms}/E_s -$ Relative Responsivity

$0.1$ $0.2$ $0.3$ $0.4$ $0.5$ $0.6$ $0.7$ $0.8$ $0.9$ $1.0$

$f/f_0 -$ Relative Frequency

$0.7$ $0.9$ $1.1$ $1.3$

$\Delta f(3$ dB$) = f_s/10$

$f = f_0$ ± 5 %

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

$E_e_{min.}/E_e -$ Relative Responsivity

$0$ $0.5$ $1.0$ $1.5$ $2.0$ $2.5$ $3.0$ $3.5$ $4.0$

$E_e -$ Ambient DC Irradiance (W/m²)

$0.01$ $0.1$ $1$ $10$ $100$ $1000$ $10,000$

$\Delta V_{RM}$ - AC Voltage on DC Supply Voltage (mV)

$0$ $0.5$ $1.0$ $1.5$ $2.0$ $2.5$ $3.0$

$f = f_0$

$f = 30$ kHz

$f = 10$ kHz

$f = 100$ Hz

$E_e min. -$ Threshold Irradiance (mW/m²)

$10$ W/m² = 1.4 klx (std. illum. A, $T = 2855$ K)

$10$ W/m² = 8.2 klx (daylight, $T = 5900$ K)

Wavelength of ambient illumination: $\lambda = 950$ nm

Correlation with ambient light sources:

10 W/m² = 1.4 klx (std. illum. A, $T = 2855$ K)

10 W/m² = 8.2 klx (daylight, $T = 5900$ K)

$E_{min.}$ - Threshold Irradiance (mW/m²)

Correlation with ambient light sources:

10 W/m² = 1.4 klx (std. illum. A, $T = 2855$ K)

10 W/m² = 8.2 klx (daylight, $T = 5900$ K)

$E_e min./E_e -$ Relative Responsivity

$0$ $0.1$ $0.2$ $0.3$ $0.4$ $0.5$ $0.6$ $0.7$ $0.8$ $0.9$ $1.0$

$E_e min. -$ Threshold Irradiance (mW/m²)

$0.01$ $0.1$ $1$ $10$ $100$ $1000$ $10,000$

$E_e -$ Ambient DC Irradiance (W/m²)

$0$ $0.1$ $0.2$ $0.3$ $0.4$ $0.5$ $0.6$ $0.7$ $0.8$ $0.9$ $1.0$

$E_{rms} -$ Irradiance (mW/m²)

$0.1$ $1$ $10$ $100$ $1000$ $10,000$

$\Delta V_{RM} -$ AC Voltage on DC Supply Voltage (mV)

$0$ $0.1$ $0.2$ $0.3$ $0.4$ $0.5$ $0.6$ $0.7$ $0.8$ $0.9$ $1.0$

Burst Length (number of cycles/burst)

$0$ $25$ $50$ $75$ $100$ $125$ $150$

**Fig. 7 - Sensitivity vs. Supply Voltage Disturbances**

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

Max. Envelope Duty Cycle

TSOP32S40F, TSOP34S40F

$E_e = 2$ mW/m²

$f = 38$ kHz

Correlation with ambient light sources:

10 W/m² = 1.4 klx (std. illum. A, $T = 2855$ K)

10 W/m² = 8.2 klx (daylight, $T = 5900$ K)

$E_{min.}$ - Threshold Irradiance (mW/m²)

Correlation with ambient light sources:

10 W/m² = 1.4 klx (std. illum. A, $T = 2855$ K)

10 W/m² = 8.2 klx (daylight, $T = 5900$ K)

$E_e min./E_e -$ Relative Responsivity

$0$ $0.1$ $0.2$ $0.3$ $0.4$ $0.5$ $0.6$ $0.7$ $0.8$ $0.9$ $1.0$

$E_e min. -$ Threshold Irradiance (mW/m²)

$0.01$ $0.1$ $1$ $10$ $100$ $1000$ $10,000$

$E_e -$ Ambient DC Irradiance (W/m²)

$0$ $0.1$ $0.2$ $0.3$ $0.4$ $0.5$ $0.6$ $0.7$ $0.8$ $0.9$ $1.0$

$E_{rms} -$ Irradiance (mW/m²)

$0.1$ $1$ $10$ $100$ $1000$ $10,000$

$\Delta V_{RM} -$ AC Voltage on DC Supply Voltage (mV)

$0$ $0.1$ $0.2$ $0.3$ $0.4$ $0.5$ $0.6$ $0.7$ $0.8$ $0.9$ $1.0$

Burst Length (number of cycles/burst)

$0$ $25$ $50$ $75$ $100$ $125$ $150$

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

Max. Envelope Duty Cycle

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Correlation with ambient light sources:

10 W/m² = 1.4 klx (std. illum. A, $T = 2855$ K)

10 W/m² = 8.2 klx (daylight, $T = 5900$ K)
Fig. 9 - Sensitivity vs. Ambient Temperature

Fig. 11 - Horizontal Directivity

Fig. 10 - Relative Spectral Sensitivity vs. Wavelength

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

The TSOP32S40F, TSOP34S40F parts are designed to suppress spurious output pulses due to noise or disturbance signals. Data and disturbance signals can be distinguished by the devices according to carrier frequency, burst length and envelope duty cycle. The data signal should be close to the band-pass center frequency (40 kHz) and fulfill the conditions in the table below.

When a data signal is applied to the TSOP32S40F, TSOP34S40F in the presence of a disturbance signal, the sensitivity of the receiver is reduced to insure that no spurious pulses are present at the output. Some examples of disturbance signals which are suppressed are:

- DC light (e.g. from tungsten bulb or sunlight)
- Continuous signals at any frequency
- Strongly or weakly modulated noise from fluorescent lamps with electronic ballasts (see Fig. 13 or Fig. 14).

<table>
<thead>
<tr>
<th>Minimum burst length: 10 cycles/burst</th>
</tr>
</thead>
<tbody>
<tr>
<td>After each burst of length, a minimum gap time is required of 10 to 70 cycles ≥ 10 cycles</td>
</tr>
<tr>
<td>For bursts greater than a minimum gap time in the data stream is needed of 70 cycles x 10 x burst length</td>
</tr>
<tr>
<td>Maximum number of continuous short bursts/second: 1800</td>
</tr>
<tr>
<td>Suppression of interference from fluorescent lamps: Most common disturbance patterns are suppressed</td>
</tr>
</tbody>
</table>

Fig. 13 - IR Disturbance from Fluorescent Lamp With Low Modulation

Fig. 14 - IR Disturbance from Fluorescent Lamp With High Modulation
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