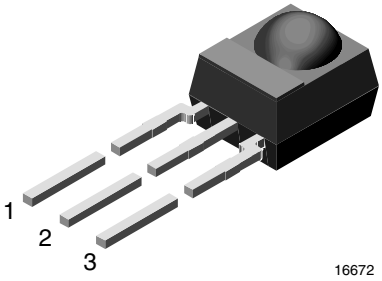
# IR Receiver Modules for Remote Control Systems




## FEATURES

- 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

Pb-free
e3
RoHS COMPLIANT
HALOGEN FREE
GREEN (5-2008)

## MECHANICAL DATA

**Pinning for TSOP41.., TSOP43.., TSOP45..:**

1 = OUT, 2 = GND, 3 = $V_S$

**Pinning for TSOP21.., TSOP23.., TSOP25..:**

1 = OUT, 2 = $V_S$, 3 = GND

## 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 acts as an IR filter.

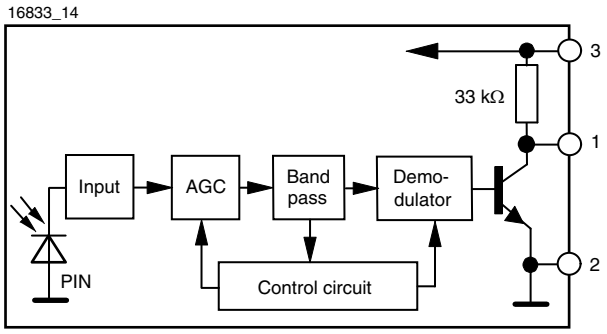
The demodulated output signal can be directly connected to a microprocessor for decoding. The TSOP21.., TSOP41.. are legacy products compatible with all common IR remote control data formats. The TSOP23.., TSOP43 are optimized to better suppress spurious pulses from energy saving fluorescent lamps. The TSOP25.., TSOP45.. have an excellent noise suppression. They are immune to dimmed LCD backlighting and any fluorescent lamps. AGC3 and AGC5 may also suppress some data signals in case of continuous transmission. Between these three receiver types, the TSOP23.., TSOP43.. are preferred. Customers should initially try the TSOP23.., TSOP43.. in their design.

This component has not been qualified according to automotive specifications.

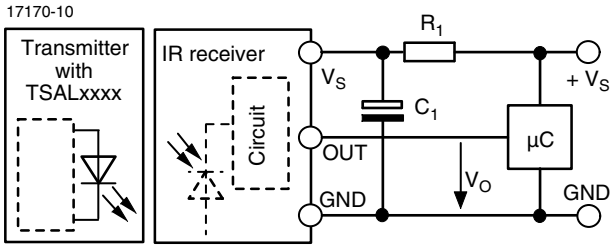
**PARTS TABLE**

| AGC | | LEGACY, FOR SHORT BURST REMOTE CONTROLS (AGC1) | | NOISY ENVIRONMENTS AND SHORT BURSTS (AGC3) | | VERY NOISY ENVIRONMENTS AND SHORT BURSTS (AGC5) | |
|---|---|---|---|---|---|---|---|
| Carrier frequency | 30 kHz | TSOP4130 | TSOP2130 | TSOP4330 | TSOP2330 | TSOP4530 | TSOP2530 |
| | 33 kHz | TSOP4133 | TSOP2133 | TSOP4333 | TSOP2333 | TSOP4533 | TSOP2533 |
| | 36 kHz | TSOP4136 | TSOP2136 | TSOP4336 | TSOP2336 (1)(2) | TSOP4536 | TSOP2536 (1)(2) |
| | 38 kHz | TSOP4138 | TSOP2138 | TSOP4338 | TSOP2338 (3)(4)(5)(6) | TSOP4538 | TSOP2538 (3)(4)(5) |
| | 40 kHz | TSOP4140 | TSOP2140 | TSOP4340 | TSOP2340 | TSOP4540 | TSOP2540 |
| | 56 kHz | TSOP4156 | TSOP2156 | TSOP4356 | TSOP2356 | TSOP4556 | TSOP2556 |
| Package | | Mold | | | | | |
| Pinning | | 1 = OUT, 2 = GND, 3 = $V_S$ | 1 = OUT, 2 = $V_S$, 3 = GND | 1 = OUT, 2 = GND, 3 = $V_S$ | 1 = OUT, 2 = $V_S$, 3 = GND | 1 = OUT, 2 = GND, 3 = $V_S$ | 1 = OUT, 2 = $V_S$, 3 = GND |
| Dimensions (mm) | | 6.0 W x 6.95 H x 5.6 D | | | | | |
| Mounting | | Leaded | | | | | |
| Application | | Remote control | | | | | |
| Best remote control code | | (1) MCIR (2) RCMM (3) Mitsubishi (4) RECS-80 Code (5) r-map (6) XMP-1, XMP-2 | | | | | |

## BLOCK DIAGRAM




## APPLICATION CIRCUIT




The external components $R_1$ and $C_1$ are optional to improve the robustness against electrical overstress (typical values are $R_1$ = 100 Ω, $C_1$ = 0.1 µF).

| ABSOLUTE MAXIMUM RATINGS | | | | |
|---|---|---|---|---|
| **PARAMETER** | **TEST CONDITION** | **SYMBOL** | **VALUE** | **UNIT** |
| Supply voltage | | $V_S$ | -0.3 to +6 | V |
| Supply current | | $I_S$ | 5 | mA |
| Output voltage | | $V_O$ | -0.3 to 5.5 | V |
| Voltage at output to supply | | $V_S - V_O$ | -0.3 to ($V_S$ + 0.3) | V |
| Output current | | $I_O$ | 5 | mA |
| Junction temperature | | $T_j$ | 100 | °C |
| Storage temperature range | | $T_{stg}$ | -25 to +85 | °C |
| Operating temperature range | | $T_{amb}$ | -25 to +85 | °C |
| Power consumption | $T_{amb} \leq 85$ °C | $P_{tot}$ | 10 | mW |
| Soldering temperature | t ≤ 10 s, 1 mm from case | $T_{sd}$ | 260 | °C |

**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 °C, unless otherwise specified) | | | | | | |
|---|---|---|---|---|---|---|
| **PARAMETER** | **TEST CONDITION** | **SYMBOL** | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| Supply current | $E_v$ = 0, $V_S$ = 5 V | $I_{SD}$ | 0.55 | 0.7 | 0.9 | mA |
| | $E_v$ = 40 klx, sunlight | $I_{SH}$ | | 0.8 | | mA |
| Supply voltage | | $V_S$ | 2.5 | | 5.5 | V |
| Transmission distance | $E_v$ = 0, test signal see fig. 1, IR diode TSAL6200, $I_F$ = 200 mA | d | | 45 | | m |
| Output voltage low | $I_{OSL}$ = 0.5 mA, $E_e$ = 0.7 mW/m², test signal see fig. 1 | $V_{OSL}$ | | | 100 | mV |
| Minimum irradiance | Pulse width tolerance: $t_{pi} - 5/f_o < t_{po} < t_{pi} + 6/f_o$, test signal see fig. 1 | $E_{e\ min.}$ | | 0.12 | 0.25 | mW/m² |
| Maximum irradiance | $t_{pi} - 5/f_o < t_{po} < t_{pi} + 6/f_o$, test signal see fig. 1 | $E_{e\ max.}$ | 50 | | | W/m² |
| Directivity | Angle of half transmission distance | $\varphi_{1/2}$ | | ± 45 | | deg |

## TYPICAL CHARACTERISTICS ($T_{amb}$ = 25 °C, unless otherwise specified)

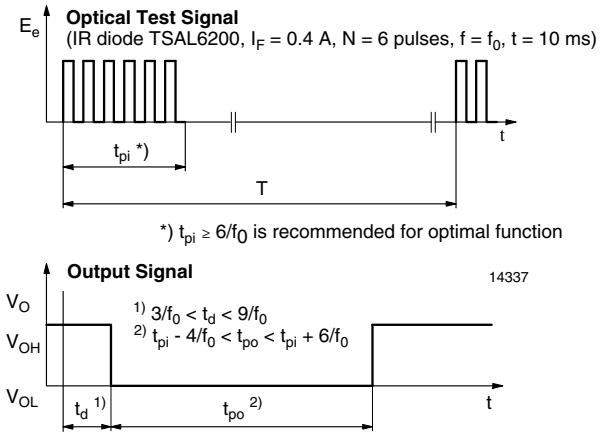



Fig. 1 - Output Active Low

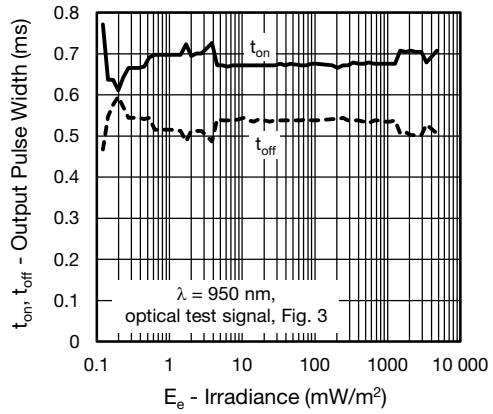



Fig. 4 - Output Pulse Diagram

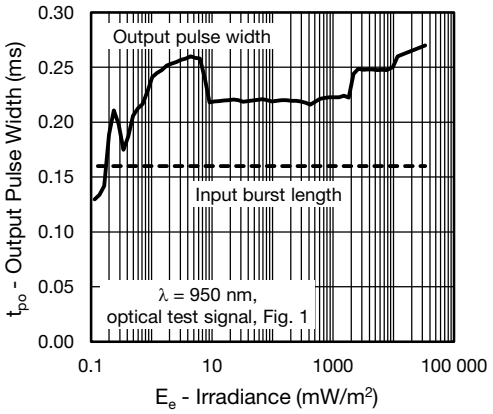



Fig. 2 - Pulse Length and Sensitivity in Dark Ambient

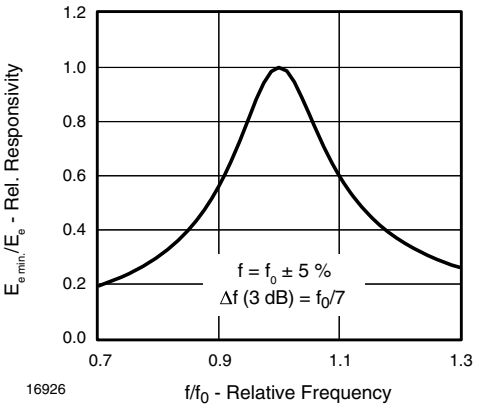



Fig. 5 - Frequency Dependence of Responsivity

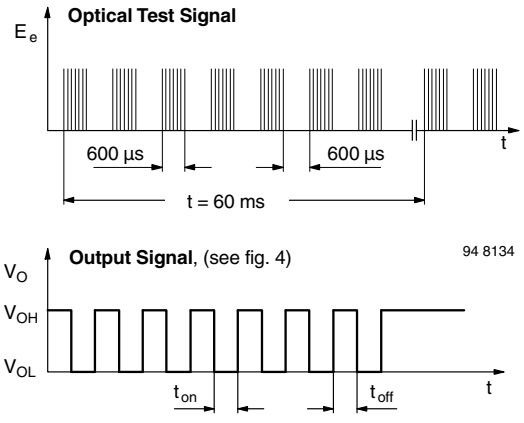



Fig. 3 - Output Function

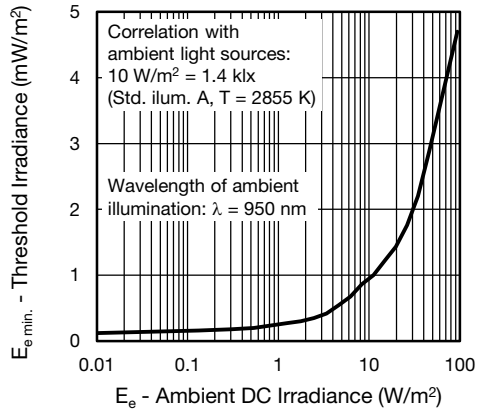



Fig. 6 - Sensitivity in Bright Ambient

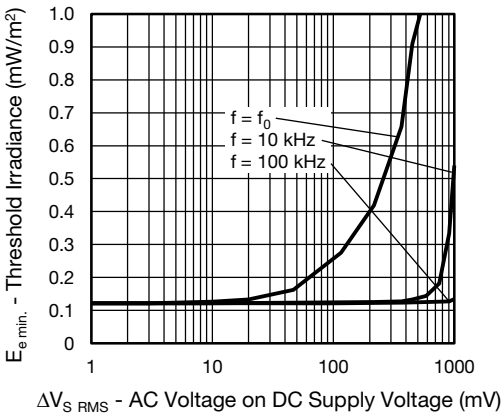



Fig. 7 - Sensitivity vs. Supply Voltage Disturbances

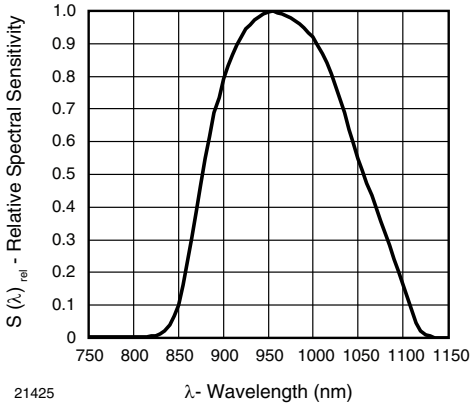



Fig. 10 - Relative Spectral Sensitivity vs. Wavelength

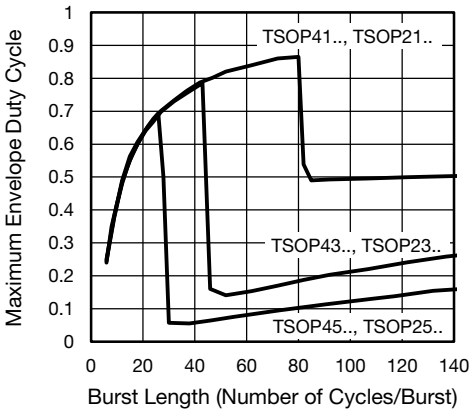



Fig. 8 - Max. Envelope Duty Cycle vs. Burst Length

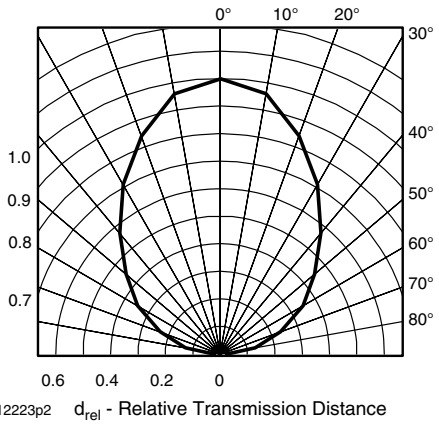



Fig. 11 - Horizontal Directivity

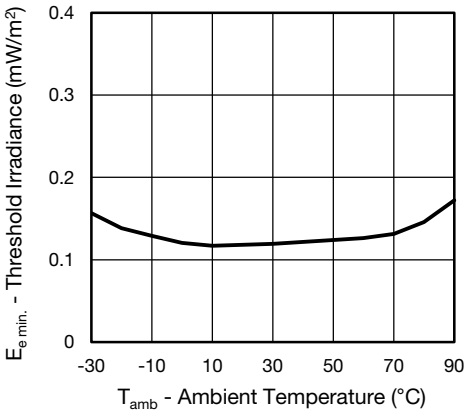



Fig. 9 - Sensitivity vs. Ambient Temperature

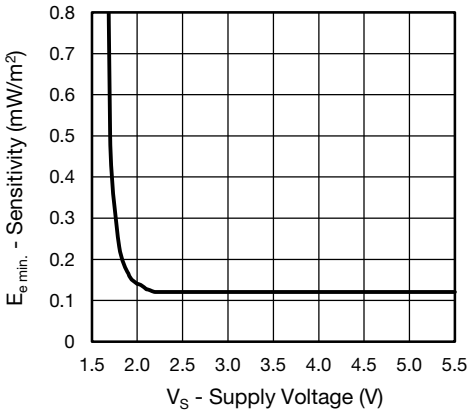



Fig. 12 - Sensitivity vs. Supply Voltage

## 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 figure 13 or figure 14).

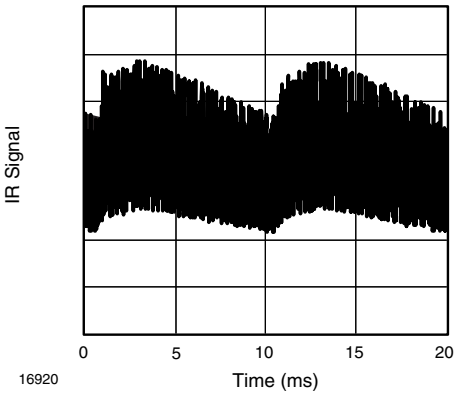



Fig. 13 - IR Disturbance from Fluorescent Lamp with Low Modulation

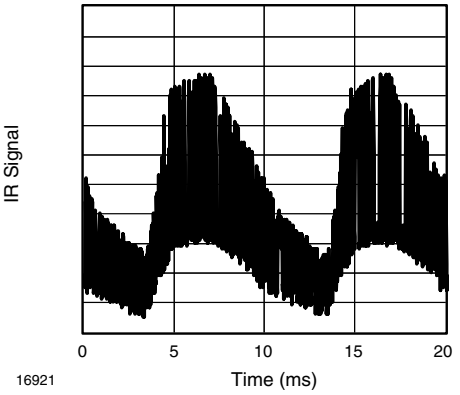


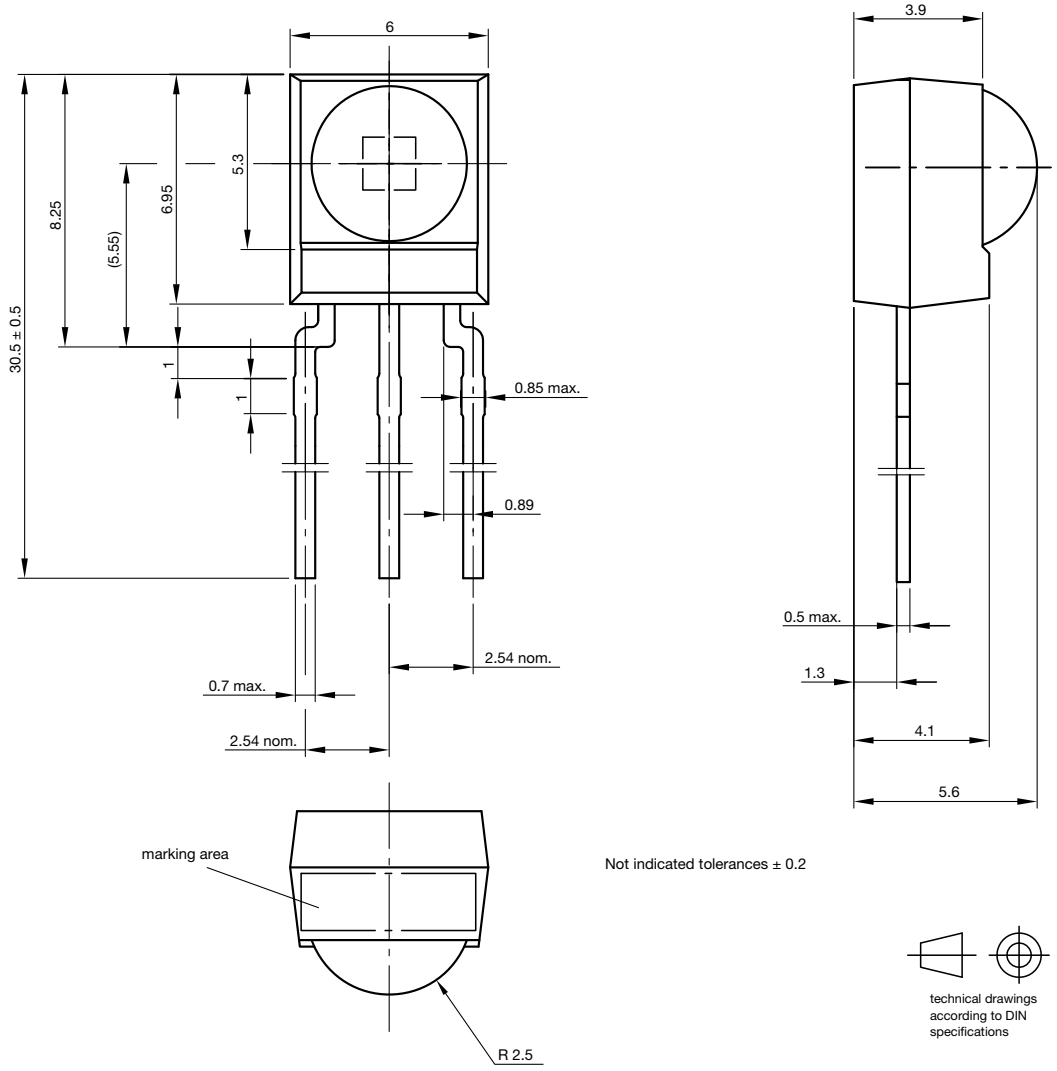

Fig. 14 - IR Disturbance from Fluorescent Lamp with High Modulation

| | TSOP41.., TSOP21.. | TSOP43.., TSOP23.. | TSOP45.., TSOP25.. |
|---|---|---|---|
| Minimum burst length | 6 cycles/burst | 6 cycles/burst | 6 cycles/burst |
| After each burst of length<br>A gap time is required of | 6 to 70 cycles<br>≥ 10 cycles | 6 to 35 cycles<br>≥ 10 cycles | 6 to 24 cycles<br>≥ 10 cycles |
| For bursts greater than<br>a minimum gap time in the data stream is needed of | 70 cycles<br>> 1.2 x burst length | 35 cycles<br>> 6 x burst length | 24 cycles<br>> 25 ms |
| Maximum number of continuous short bursts/second | 2000 | 2000 | 2000 |
| MCIR code | yes | preferred | yes |
| RCMM code | yes | preferred | yes |
| XMP-1, XMP-2 code | yes | preferred | yes |
| Suppression of interference from fluorescent lamps | Common disturbance patterns are supressed (example: signal pattern of fig. 14) | Even critical disturbance patterns are suppressed (examples: signal pattern of fig. 14 and fig. 15) | Even critical disturbance patterns are suppressed (examples: signal pattern of fig. 14 and fig. 15) |

**Notes**

- For data formats with long bursts (more than 10 carrier cycles) please see the datasheet for TSOP48.., TSOP44.., TSOP22.., TSOP24..
- Best choice of AGC for some popular IR-codes:
  - TSOP2336,TSOP4336: MCIR, RCMM
  - TSOP2538, TSOP4538: Mitsubishi, RECS-80 Code
  - TSOP2338, TSOP4338: XMP-1, XMP-2, r-map
- For SIRCS 15 and 20 bit, Sony 12 bit IR-codes, please see the datasheet for TSOP4S40, TSOP2S40

**PACKAGE DIMENSIONS** in millimeters

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