# IR Receiver Modules for Remote Control Systems



## FEATURES

- Very 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 ambient light
- Two lenses for high sensitivity
- Insensitive to supply voltage ripple and noise
- Ultra small top-view PCB footprint
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

**Pb-free**

**e3**

**RoHS**
COMPLIANT

**HALOGEN**
**FREE**
**GREEN**
**(5-2008)**

## DESCRIPTION

The TSOP39... series are miniaturized receiver modules for infrared remote control systems. Two PIN diodes and a preamplifier are assembled on a leadframe, the epoxy package contains an IR filter. The demodulated output signal can be directly connected to digital circuitry for decoding.

The TSOP394.. series devices are optimized to suppress almost all spurious pulses from energy saving lamps like CFLs. The AGC4 used in the TSOP394.. may suppress some data signals. The TSOP392.. series are provided primarily for compatibility with old AGC2 designs. New designs should prefer the TSOP394.. series containing the newer AGC4.

These components have not been qualified according to automotive specifications.

## MECHANICAL DATA

**Pinning:**

1, 4 = GND, 2 = $V_S$, 3 = OUT

## PARTS TABLE

| AGC | | NOISY ENVIRONMENTS AND SHORT BURSTS (AGC2) | VERY NOISY ENVIRONMENTS AND SHORT BURSTS (AGC4) |
|---|---|---|---|
| Carrier frequency | 30 kHz | TSOP39230 | TSOP39430 |
| | 33 kHz | TSOP39233 | TSOP39433 |
| | 36 kHz | TSOP39236 | TSOP39436 [1][2][3] |
| | 38 kHz | TSOP39238 [2][3][4][5] | TSOP39438 [4][5] |
| | 40 kHz | TSOP39240 | TSOP39440 |
| | 56 kHz | TSOP39256 | TSOP39456 [6][7] |
| Package | | TVCast | |
| Pinning | | 1, 4 = GND, 2 = $V_S$, 3 = OUT | |
| Dimensions (mm) | | 6.8 W x 2.6 H x 5.3 D | |
| Mounting | | Leaded | |
| Application | | Remote control | |
| Best remote control code | | [1] RC-5  [2] RC-6  [3] Panasonic  [4] NEC  [5] Sharp  [6] r-step  [7] Thomson RCA | |

## BLOCK DIAGRAM
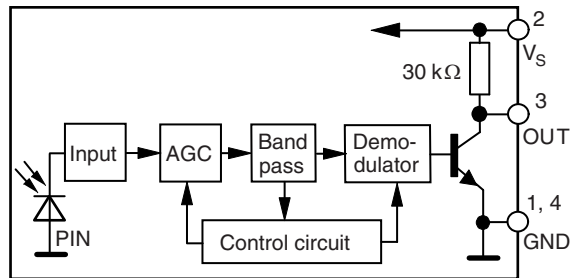


20445-1

## APPLICATION CIRCUIT

17170-11
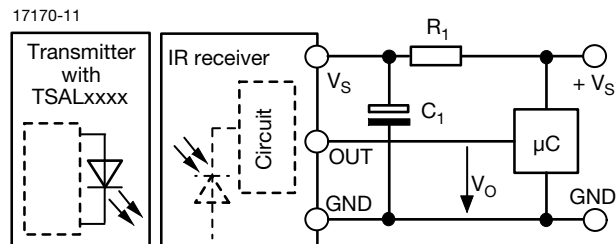


$R_1$ and $C_1$ recommended to reduce supply ripple for $V_S$ < 2.8 V

## ABSOLUTE MAXIMUM RATINGS

| PARAMETER | TEST CONDITION | SYMBOL | VALUE | UNIT |
|---|---|---|---|---|
| Supply voltage | | $V_S$ | -0.3 to +6 | V |
| Supply current | | $I_S$ | 3 | mA |
| Output voltage | | $V_O$ | -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 | $t \leq 10$ 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)

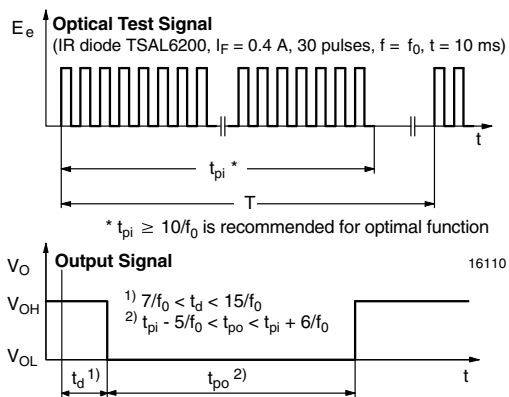| PARAMETER | TEST CONDITION | SYMBOL | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Supply voltage | | $V_S$ | 2.5 | - | 5.5 | V |
| Supply current | $E_v = 0$, $V_S = 3.3$ V | $I_{SD}$ | 0.27 | 0.35 | 0.45 | mA |
| | $E_v = 40$ klx, sunlight | $I_{SH}$ | - | 0.45 | - | mA |
| Transmission distance | $E_v = 0$, test signal see Fig. 1, IR diode TSAL6200, $I_F = 150$ mA | d | - | 45 | - | m |
| Output voltage low | $I_{OSL} = 0.5$ mA, $E_e = 0.7$ mW/m$^2$, 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 | $E_{e\,min.}$ | - | 0.08 | 0.12 | mW/m$^2$ |
| Maximum irradiance | $t_{pi} - 5/f_o < t_{po} < t_{pi} + 6/f_o$, test signal see Fig. 1 | $E_{e\,max.}$ | 30 | - | - | W/m$^2$ |
| Directivity | Angle of half transmission distance | $\varphi_{1/2}$ | - | ± 45 | - | deg |

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



16110

Fig. 1 - Output Active Low


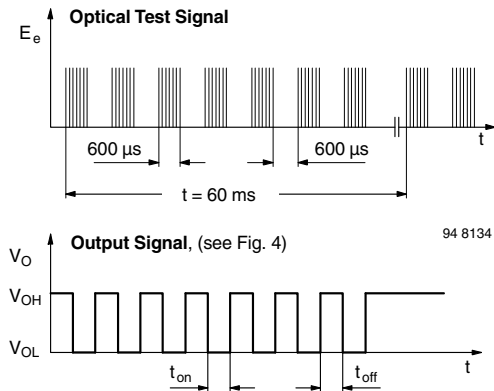
20743
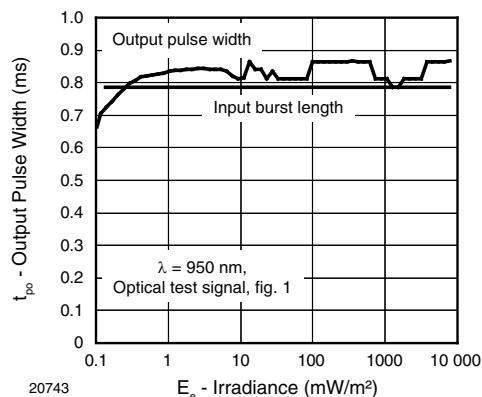
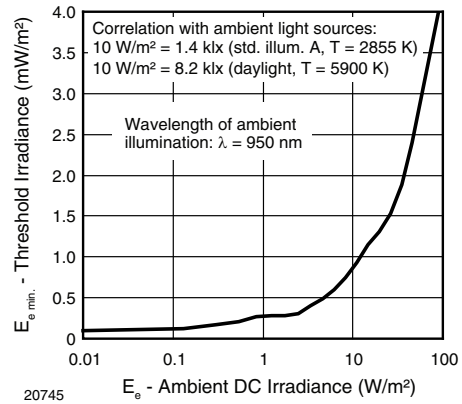Fig. 2 - Pulse Length and Sensitivity in Dark Ambient

**Optical Test Signal**



94 8134

**Output Signal**, (see Fig. 4)

Fig. 3 - Output Function



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Fig. 4 - Output Pulse Diagram



16925

Fig. 5 - Frequency Dependence of Responsivity



20745

Fig. 6 - Sensitivity in Bright Ambient



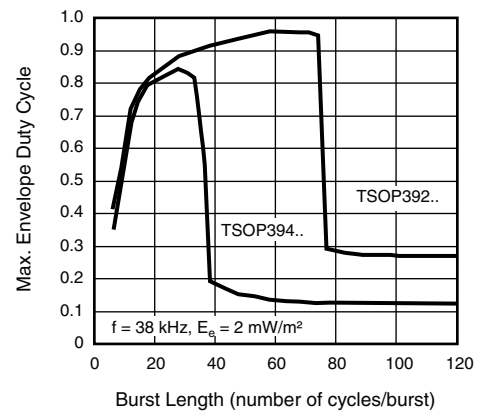Fig. 7 - Sensitivity vs. Supply Voltage Disturbances



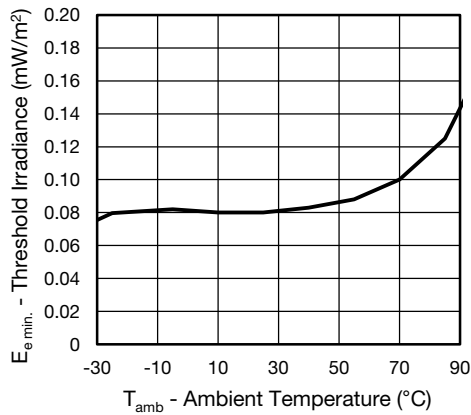Fig. 8 - Max. Envelope Duty Cycle vs. Burst Length
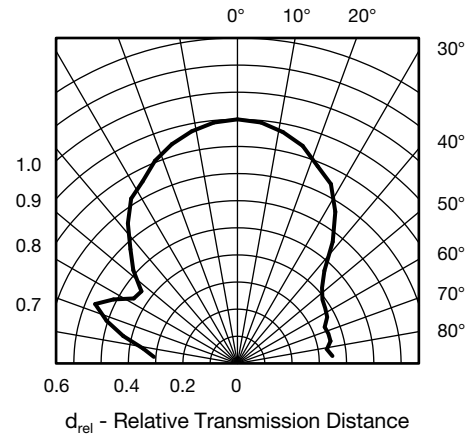
Fig. 9 - Sensitivity vs. Ambient Temperature



Fig. 12 - Vertical Directivity



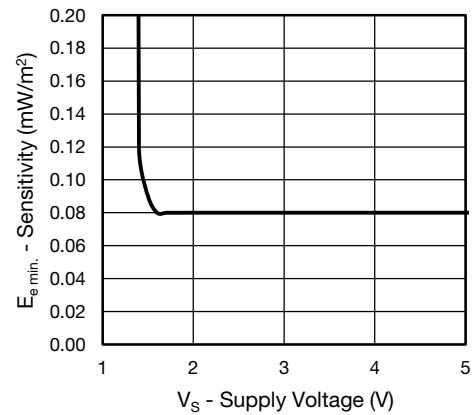Fig. 10 - Relative Spectral Sensitivity vs. Wavelength



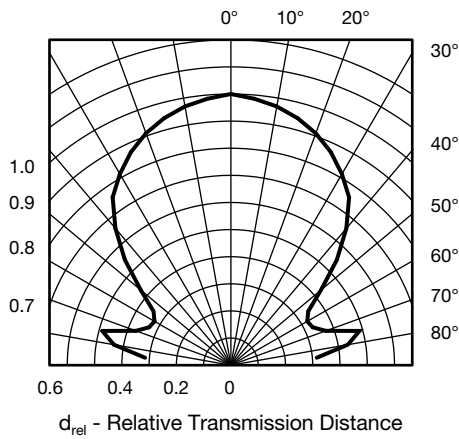Fig. 13 - Sensitivity vs. Supply Voltage



Fig. 11 - Horizontal Directivity

## 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 pattern from fluorescent lamps with electronic ballasts (see Fig. 14 or Fig. 15)
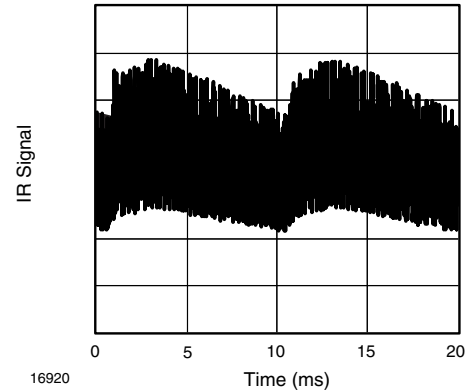


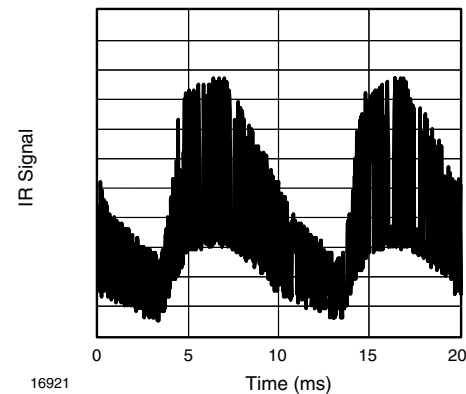Fig. 14 - IR Disturbance from Fluorescent Lamp with Low Modulation



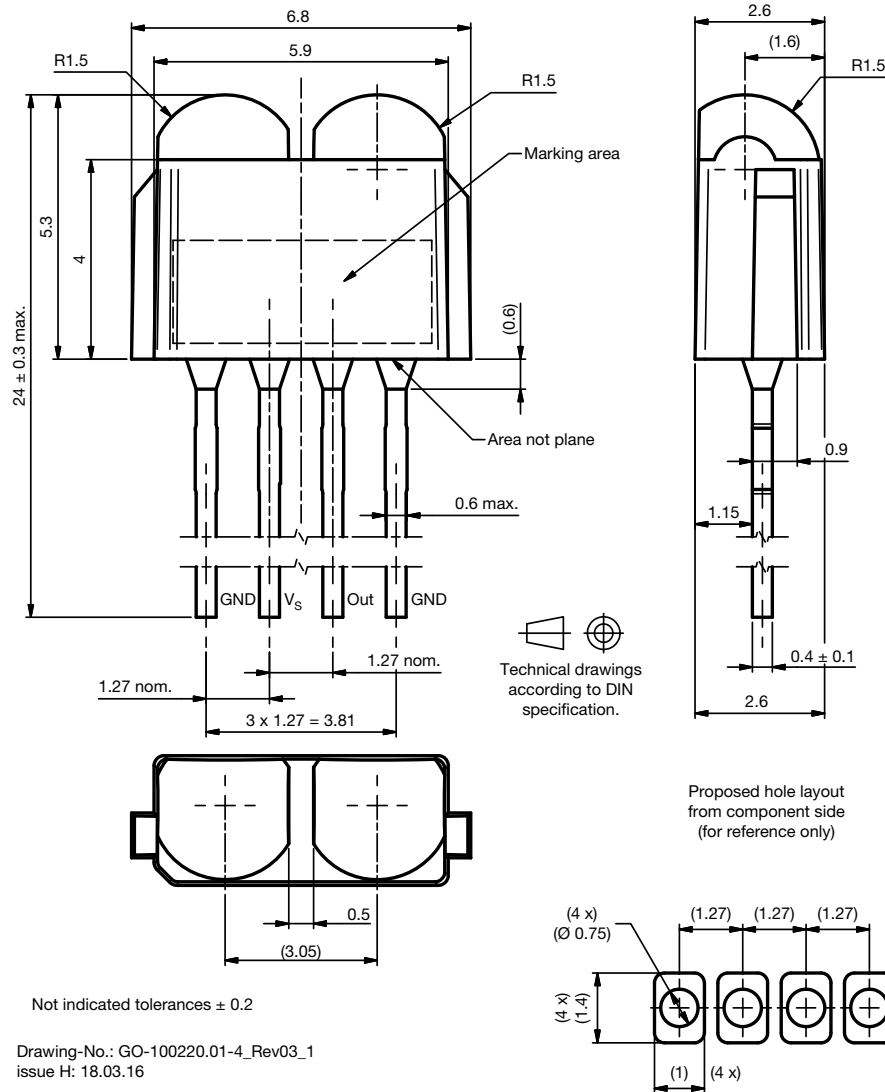Fig. 15 - IR Disturbance from Fluorescent Lamp with High Modulation

| | TSOP392.. | TSOP394.. |
|---|---|---|
| Minimum burst length | 10 cycles/burst | 10 cycles/burst |
| After each burst of length a minimum gap time is required of | 10 to 70 cycles ≥ 10 cycles | 10 to 35 cycles ≥ 10 cycles |
| For bursts greater than a minimum gap time in the data stream is needed of | 70 cycles > 4 x burst length | 35 cycles > 10 x burst length |
| Maximum number of continuous short bursts/second | 1800 | 1500 |
| NEC code | Yes | Preferred |
| RC5 / RC6 code | Yes | Preferred |
| Thomson 56 kHz code | Yes | Preferred |
| Sharp code | Yes | Preferred |
| Suppression of interference from fluorescent lamps | Mild disturbance patterns are suppressed (example: signal pattern of Fig. 13) | Complex and critical disturbance patterns are suppressed (example: signal pattern of Fig. 14 or highly dimmed LCDs) |

**Note**
- For data formats with short bursts please see the datasheet for TSOP393.., TSOP395..

**PACKAGE DIMENSIONS** in millimeters



Marking area

Area not plane

GND   V$_S$   Out   GND

Technical drawings according to DIN specification.

Not indicated tolerances ± 0.2

Drawing-No.: GO-100220.01-4_Rev03_1
issue H: 18.03.16

Proposed hole layout from component side (for reference only)

**BULK PACKAGING**

Standard shipping for TVCast is in conductive plastic bags. The packing quantity is determined by weight and the number of components per carton may vary by a maximum of ± 0.3 %.

**ORDERING INFORMATION**



| T | S |  | P | | d | d | | d | | d | d |

O = receiver
S = sensor

IC and package type

AGC

Frequency
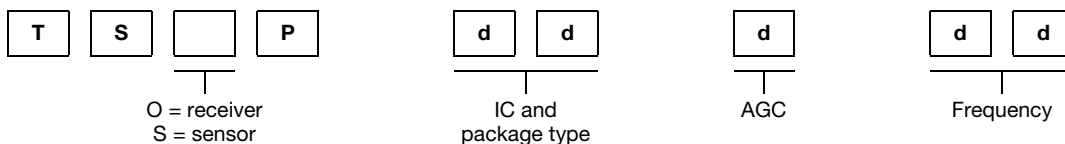
**Note**
• d = "digit", please consult the list of available series on the previous page to create a valid part number.

**Example: TSOP39438**

**PACKAGING QUANTITY**

• 400 pieces per bag (each bag is individually boxed).

• 6 bags per carton

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