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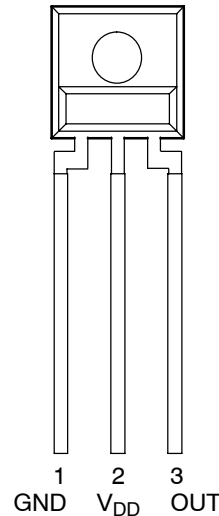
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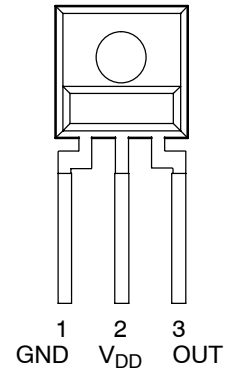


- **Integral Visible Light Cutoff Filter**
- **Monolithic Silicon IC Containing Photodiode, Operational Amplifier, and Feedback Components**
- **Converts Light Intensity to a Voltage**
- **High Irradiance Responsivity, Typically 111 mV/( $\mu\text{W}/\text{cm}^2$ ) at  $\lambda_p = 940 \text{ nm}$  (TSL260R)**
- **Compact 3-Lead Plastic Package**
- **Single Voltage Supply Operation**
- **Low Dark (Offset) Voltage....10mV Max**
- **Low Supply Current.....1.1 mA Typical**
- **Wide Supply-Voltage Range.... 2.7 V to 5.5 V**
- **Replacements for TSL260, TSL261, and TSL262**
- **RoHS Compliant (-LF Package Only)**

**PACKAGE S  
SIDELOOKER  
(FRONT VIEW)**



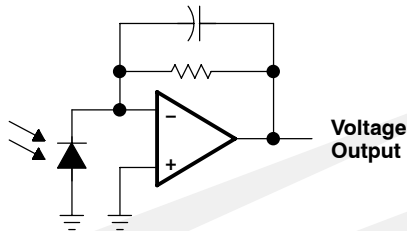
**PACKAGE SM  
SURFACE MOUNT  
SIDELOOKER  
(FRONT VIEW)**



## Description

The TSL260R, TSL261R, and TSL262R are infrared light-to-voltage optical sensors, each combining a photodiode and a transimpedance amplifier (feedback resistor = 16 M $\Omega$ , 8 M $\Omega$ , and 2.8 M $\Omega$  respectively) on a single monolithic IC. Output voltage is directly proportional to the light intensity (irradiance) on the photodiode. These devices have improved amplifier offset-voltage stability and low power consumption and are supplied in a 3-lead plastic sidelooker package with an integral visible light cutoff filter and lens. When supplied in the lead (Pb) free package, the device is RoHS compliant.

## Functional Block Diagram



## Available Options

| DEVICE  | T <sub>A</sub> | PACKAGE - LEADS                                  | PACKAGE DESIGNATOR | ORDERING NUMBER |
|---------|----------------|--|--------------------|-----------------|
| TSL260R | 0°C to 70°C    | 3-lead Sidelooker                                | S                  | TSL260R         |
| TSL260R | 0°C to 70°C    | 3-lead Sidelooker — Lead (Pb) Free               | S                  | TSL260R-LF      |
| TSL260R | 0°C to 70°C    | 3-lead Surface-Mount Sidelooker — Lead (Pb) Free | SM                 | TSL260RSM-LF    |
| TSL261R | 0°C to 70°C    | 3-lead Sidelooker                                | S                  | TSL261R         |
| TSL261R | 0°C to 70°C    | 3-lead Sidelooker — Lead (Pb) Free               | S                  | TSL261R-LF      |
| TSL261R | 0°C to 70°C    | 3-lead Surface-Mount Sidelooker — Lead (Pb) Free | SM                 | TSL261RSM-LF    |
| TSL262R | 0°C to 70°C    | 3-lead Sidelooker                                | S                  | TSL262R         |
| TSL262R | 0°C to 70°C    | 3-lead Sidelooker — Lead (Pb) Free               | S                  | TSL262R-LF      |
| TSL262R | 0°C to 70°C    | 3-lead Surface-Mount Sidelooker — Lead (Pb) Free | SM                 | TSL262RSM-LF    |

# TSL260R, TSL261R, TSL262R INFRARED LIGHT-TO-VOLTAGE OPTICAL SENSORS

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## Terminal Functions

| TERMINAL<br>NAME NO. | DESCRIPTION   |
|----------------------|---|
| GND 1                | Ground (substrate). All voltages are referenced to GND. |
| OUT 3                | Output voltage  |
| V <sub>DD</sub> 2    | Supply voltage  |

## Absolute Maximum Ratings over operating free-air temperature range (unless otherwise noted)<sup>†</sup>

|  |               |
|--|---------------|
| Supply voltage, V <sub>DD</sub> (see Note 1)                             | 6 V           |
| Output current, I <sub>O</sub>   | ±10 mA        |
| Duration of short-circuit current at (or below) 25°C (see Note 2)        | 5 s           |
| Operating free-air temperature range, T <sub>A</sub>                     | –25°C to 85°C |
| Storage temperature range, T <sub>stg</sub>                              | –25°C to 85°C |
| Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds (S Package) | 260°C         |
| Reflow solder, in accordance with J-STD-020C or J-STD-020D (SM Package)  | 260°C         |

<sup>†</sup> Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTES: 1. All voltages are with respect to GND.  
2. Output may be shorted to supply.

## Recommended Operating Conditions

|  | MIN | NOM | MAX | UNIT |
|--|-----|-----|-----|------|
| Supply voltage, V <sub>DD</sub>                | 2.7 |     | 5.5 | V    |
| Operating free-air temperature, T <sub>A</sub> | 0   |     | 70  | °C   |

# TSL260R, TSL261R, TSL262R INFRARED LIGHT-TO-VOLTAGE OPTICAL SENSORS

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**Electrical Characteristics at  $V_{DD} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$ ,  $\lambda_p = 940\text{ nm}$ ,  $R_L = 10\text{ k}\Omega$  (unless otherwise noted) (see Notes 3, 4, and 5)**

| PARAMETER   | TEST CONDITIONS  | TSL260R |     |     | TSL261R |     |     | TSL262R |     |                      | UNIT                            |
|---|--|---------|-----|-----|---------|-----|-----|---------|-----|----------------------|---------------------------------|
|   |  | MIN     | TYP | MAX | MIN     | TYP | MAX | MIN     | TYP | MAX                  |                                 |
| $V_D$ Dark voltage  | $E_e = 0$  | 0       | 4   | 10  | 0       | 4   | 10  | 0       | 4   | 10                   | mV                              |
| $V_{OM}$ Maximum output voltage   | $V_{DD} = 4.5\text{ V}$  | 3       | 3.3 |     | 3       | 3.3 |     | 3       | 3.3 |                      | V                               |
| $V_O$ Output voltage  | $E_e = 18\ \mu\text{W}/\text{cm}^2$  | 1       | 2   | 3   |         |     |     |         |     |                      | V                               |
|   | $E_e = 46\ \mu\text{W}/\text{cm}^2$  |         |     |     | 1       | 2   | 3   |         |     |                      |                                 |
|   | $E_e = 220\ \mu\text{W}/\text{cm}^2$   |         |     |     |         |     |     | 1       | 2   | 3                    |                                 |
| $\alpha_{vo}$ Temperature coefficient of output voltage ( $V_O$ )                       | $E_e = 18\ \mu\text{W}/\text{cm}^2$ ,<br>$T_A = 0^\circ\text{C}$ to $70^\circ\text{C}$ | 8       |     |     |         |     |     |         |     |                      | mV/ $^\circ\text{C}$            |
|   |  | 0.4     |     |     |         |     |     |         |     |                      | %/ $^\circ\text{C}$             |
|   | $E_e = 46\ \mu\text{W}/\text{cm}^2$ ,<br>$T_A = 0^\circ\text{C}$ to $70^\circ\text{C}$ |         |     |     | 8       |     |     |         |     |                      | mV/ $^\circ\text{C}$            |
|   |  |         |     |     | 0.4     |     |     |         |     |                      | %/ $^\circ\text{C}$             |
| $E_e = 220\ \mu\text{W}/\text{cm}^2$ ,<br>$T_A = 0^\circ\text{C}$ to $70^\circ\text{C}$ |  |         |     |     |         |     | 8   |         |     | mV/ $^\circ\text{C}$ |                                 |
|   |  |         |     |     |         |     | 0.4 |         |     | %/ $^\circ\text{C}$  |                                 |
| $N_e$ Irradiance responsivity   | See Note 6   | 111     |     |     | 43.5    |     |     | 9.1     |     |                      | mV/ $(\mu\text{W}/\text{cm}^2)$ |
| $I_{DD}$ Supply current   | $E_e = 18\ \mu\text{W}/\text{cm}^2$  | 1.1     |     |     | 1.7     |     |     |         |     |                      | mA                              |
|   | $E_e = 46\ \mu\text{W}/\text{cm}^2$  |         |     |     | 1.1     |     |     | 1.7     |     |                      |                                 |
|   | $E_e = 220\ \mu\text{W}/\text{cm}^2$   |         |     |     |         |     |     | 1.1     |     |                      |                                 |

- NOTES: 3. Measurements are made with  $R_L = 10\text{ k}\Omega$  between output and ground.  
 4. Optical measurements are made using small-angle incident radiation from an LED optical source.  
 5. The input irradiance  $E_e$  is supplied by a GaAs LED with peak wavelength  $\lambda_p = 940\text{ nm}$   
 6. Irradiance responsivity is characterized over the range  $V_O = 0.05$  to  $2.9\text{ V}$ . The best-fit straight line of Output Voltage  $V_O$  versus irradiance  $E_e$  over this range will typically have a positive extrapolated  $V_O$  value for  $E_e = 0$ .

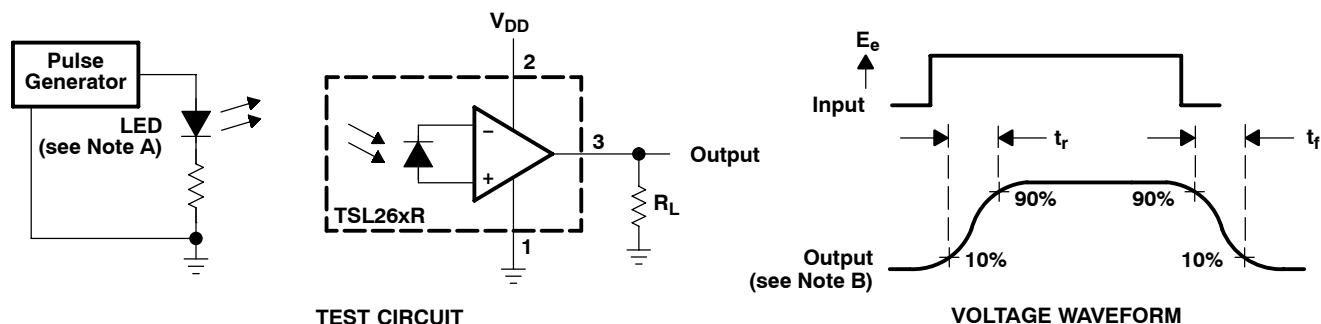
## Dynamic Characteristics at $T_A = 25^\circ\text{C}$ (see Figure 1)

| PARAMETER                    | TEST CONDITIONS   | TSL260R |     |     | TSL261R |     |     | TSL262R |     |     | UNIT                           |
|------------------------------|---|---------|-----|-----|---------|-----|-----|---------|-----|-----|--------------------------------|
|                              |   | MIN     | TYP | MAX | MIN     | TYP | MAX | MIN     | TYP | MAX |                                |
| $t_r$ Output pulse rise time | $V_{DD} = 5\text{ V}$ , $\lambda_p = 940\text{ nm}$         | 260     |     |     | 70      |     |     | 7       |     |     | $\mu\text{s}$                  |
| $t_f$ Output pulse fall time | $V_{DD} = 5\text{ V}$ , $\lambda_p = 940\text{ nm}$         | 260     |     |     | 70      |     |     | 7       |     |     | $\mu\text{s}$                  |
| $V_n$ Output noise voltage   | $V_{DD} = 5\text{ V}$ , $E_e = 0$ ,<br>$f = 1000\text{ Hz}$ | 0.8     |     |     | 0.7     |     |     | 0.6     |     |     | $\mu\text{V}/\sqrt{\text{Hz}}$ |

# TSL260R, TSL261R, TSL262R INFRARED LIGHT-TO-VOLTAGE OPTICAL SENSORS

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## PARAMETER MEASUREMENT INFORMATION



- NOTES: A. The input irradiance is supplied by a pulsed GaAs light-emitting diode with the following characteristics:  $\lambda_p = 940 \text{ nm}$ ,  $t_r < 1 \mu\text{s}$ ,  $t_f < 1 \mu\text{s}$ .  
 B. The output waveform is monitored on an oscilloscope with the following characteristics:  $t_r < 100 \text{ ns}$ ,  $Z_i \geq 1 \text{ M}\Omega$ ,  $C_i \leq 20 \text{ pF}$ .

Figure 1. Switching Times

## TYPICAL CHARACTERISTICS

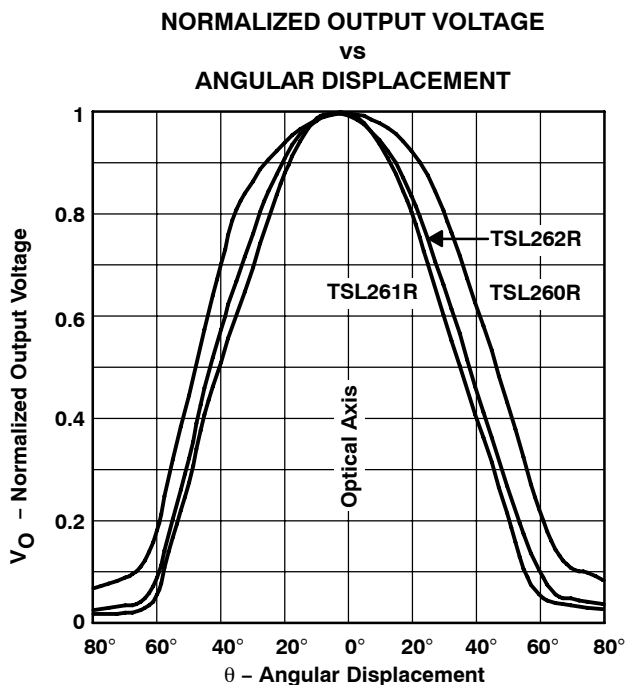


Figure 2

TYPICAL CHARACTERISTICS

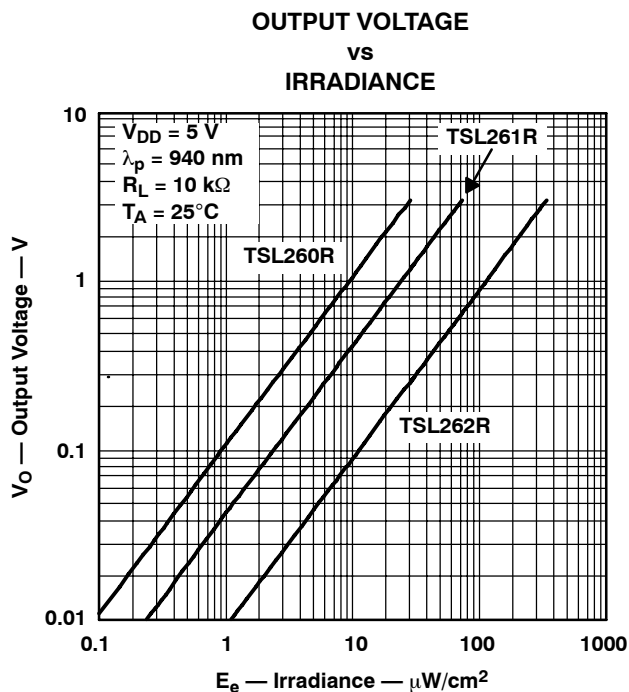


Figure 3

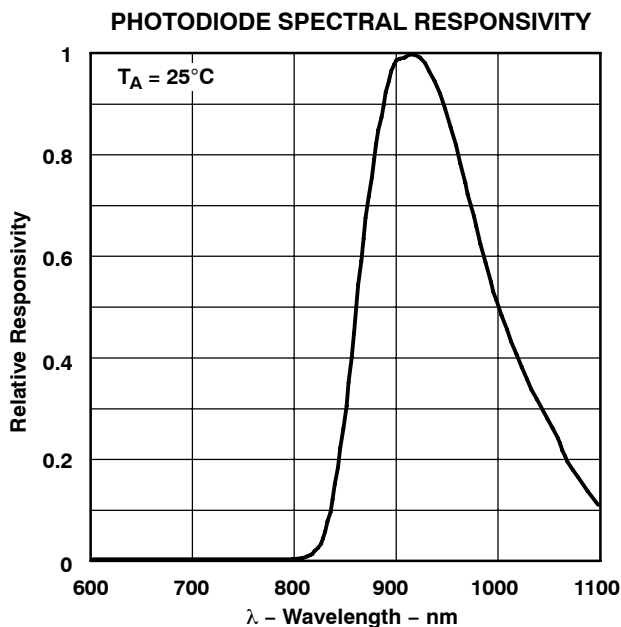


Figure 4

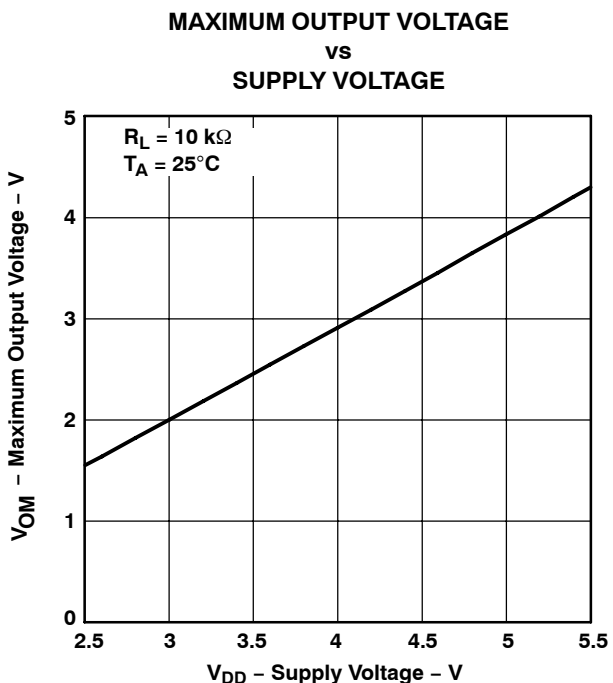


Figure 5

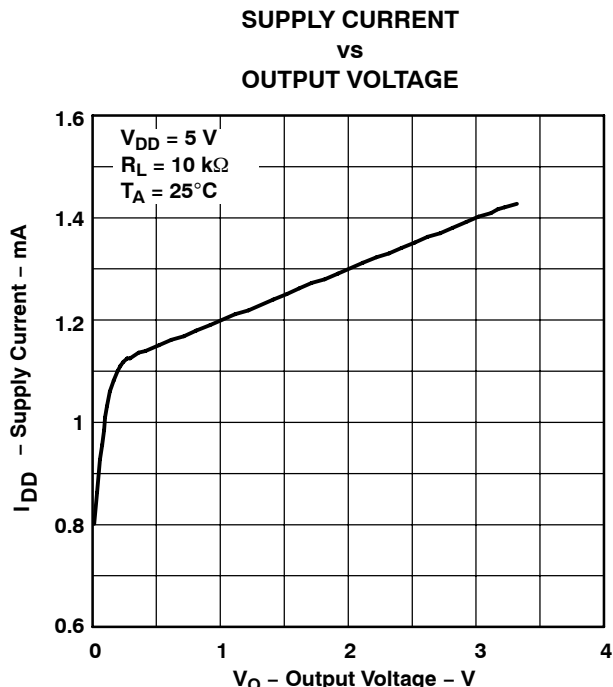
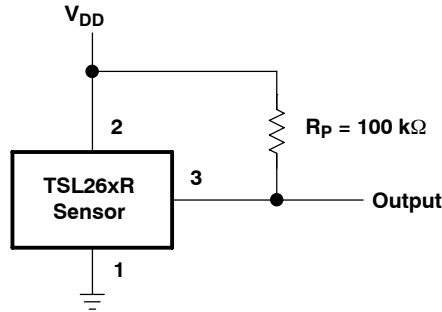


Figure 6

# TSL260R, TSL261R, TSL262R INFRARED LIGHT-TO-VOLTAGE OPTICAL SENSORS

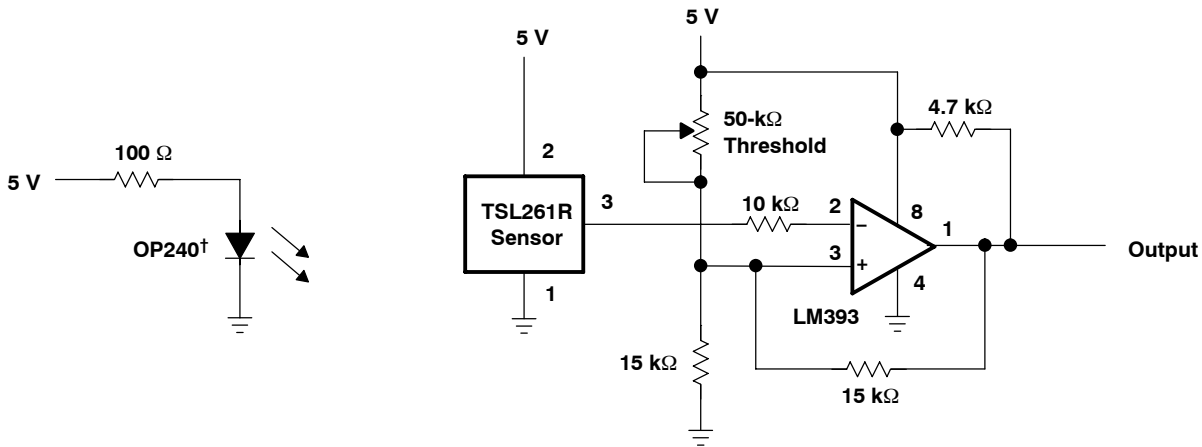
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## APPLICATION INFORMATION



NOTE A: Pullup resistor extends linear output range to near  $V_{DD}$  with minimal (several millivolts typical) effect on  $V_{DARK}$ ; particularly useful at low  $V_{DD}$  (3 V to 5 V).

Figure 7. Pullup for Increased  $V_{OM}$

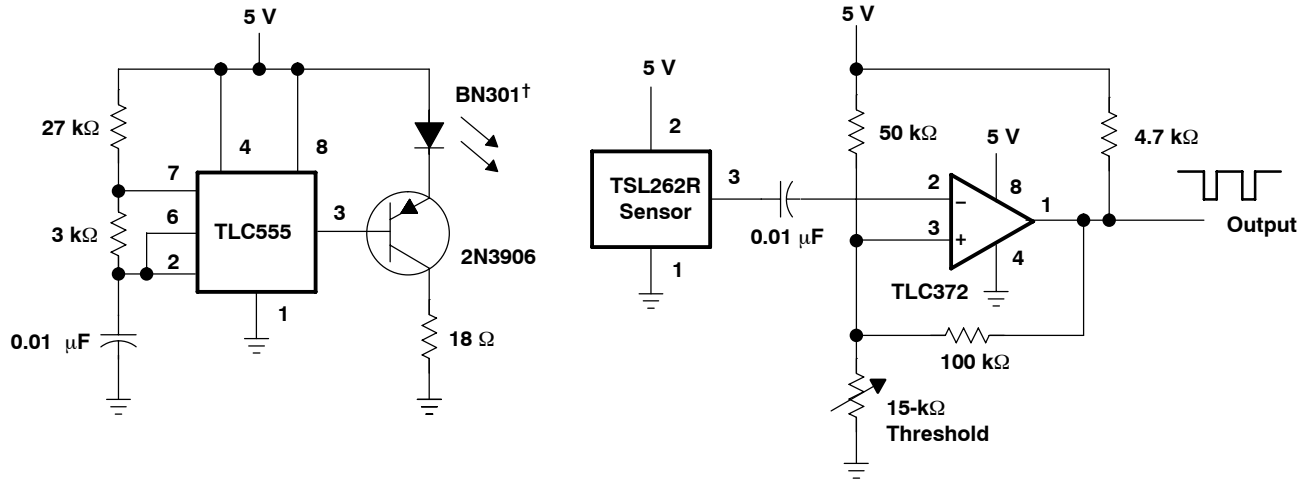


† OPTEK part number

NOTE A: Output goes high when beam is interrupted; working distance is several inches or less. Intended for use as optical-interrupter switch or reflective-object sensor.

Figure 8. Short-Range Optical Switch With Hysteresis

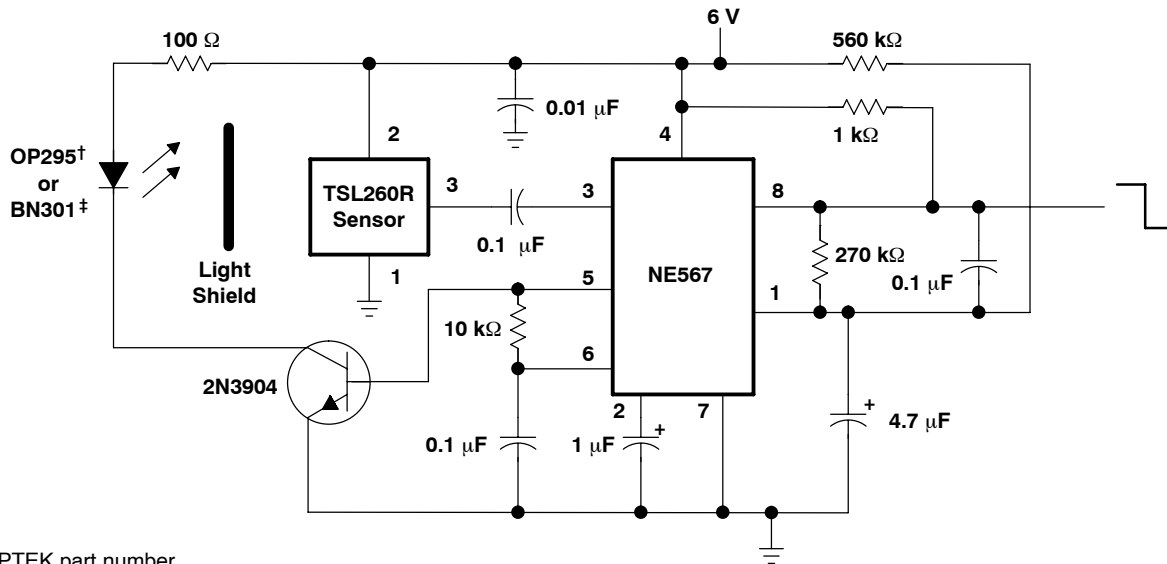
APPLICATION INFORMATION



† Stanley part number

NOTE A: Output pulses low until beam is interrupted. Useful range is 1 ft to 20 ft; can be extended with lenses. This configuration is suited for object detection, safety guards, security systems, and automatic doors.

Figure 9. Pulsed Optical-Beam Interrupter



† OPTEK part number

‡ Stanley part number

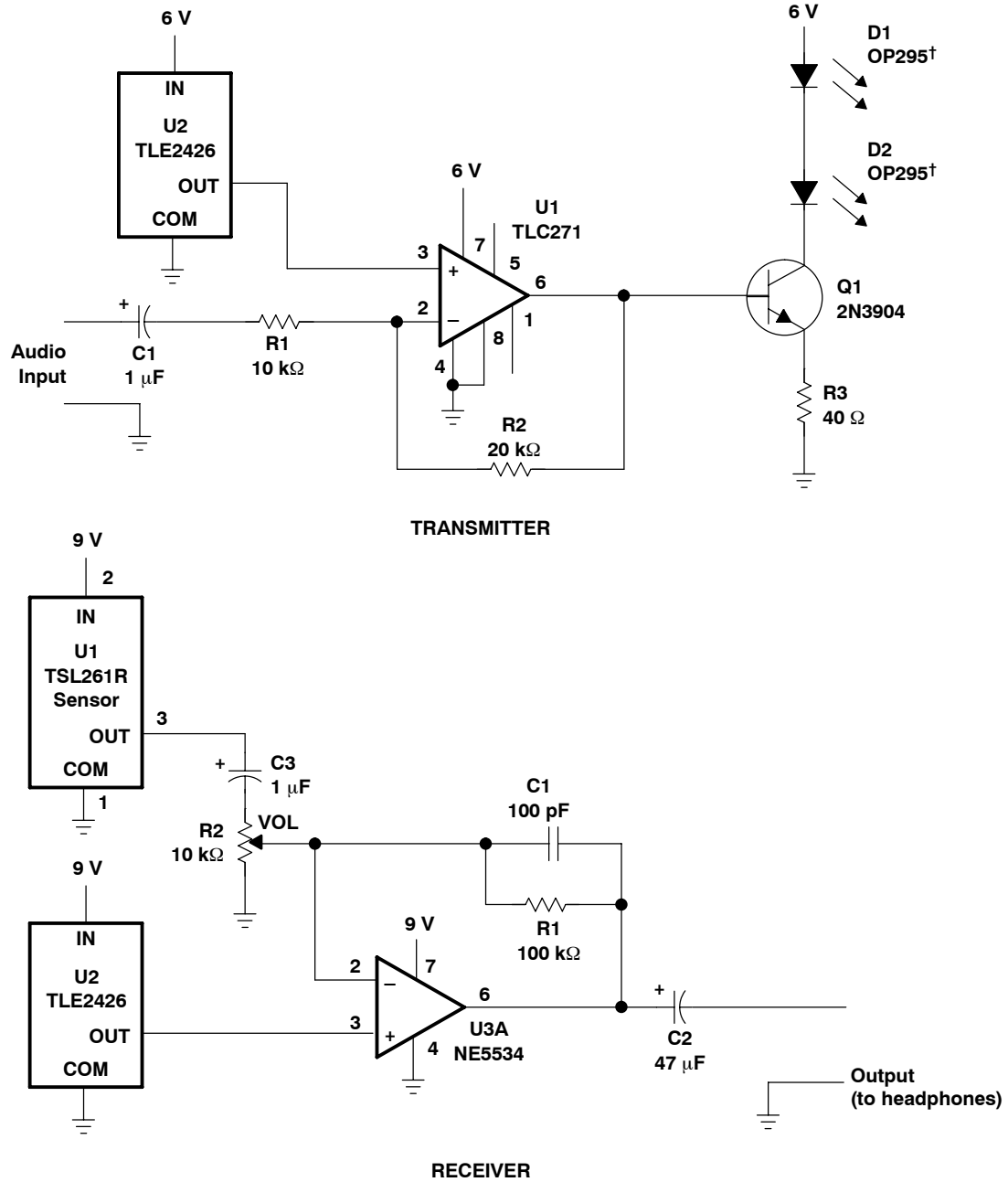
NOTE A: Output goes low when light pulses from emitter are reflected back to sensor. Range is 6 in to 18 in depending upon object reflectance. Useful for automatic doors, annunciators, object avoidance in robotics, automatic faucets, and security systems.

Figure 10. Proximity Detector





APPLICATION INFORMATION



† OPTEK part number

NOTE A: Simple transmission of audio signal over short distances (<10 ft). Applications include wireless headphones, wireless-telephone headset, and wireless-headset intercom.

Figure 12. IR Voice-Band Audio Link

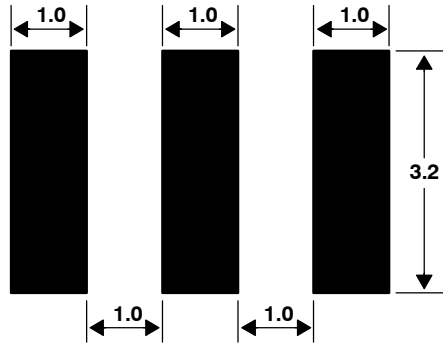
# TSL260R, TSL261R, TSL262R INFRARED LIGHT-TO-VOLTAGE OPTICAL SENSORS

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## APPLICATION INFORMATION

### PCB Pad Layout

Suggested PCB pad layout guidelines for the SM surface mount package are shown in Figure 16.



- NOTES: A. All linear dimensions are in millimeters.  
B. This drawing is subject to change without notice.

**Figure 13. Suggested SM Package PCB Layout**

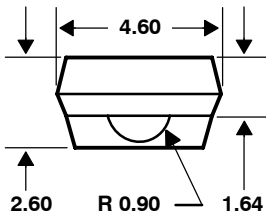
MECHANICAL DATA

The TSL260R, TSL261R, and TSL262R are supplied in a clear 3-lead through-hole package with a molded lens. The integrated photodiode active area is typically 1,0 mm<sup>2</sup> (0.0016 in<sup>2</sup>) for TSL260R, 0,5 mm<sup>2</sup> (0.00078 in<sup>2</sup>) for the TSL261R, and 0,26 mm<sup>2</sup> (0.0004 in<sup>2</sup>) for the TSL262R.

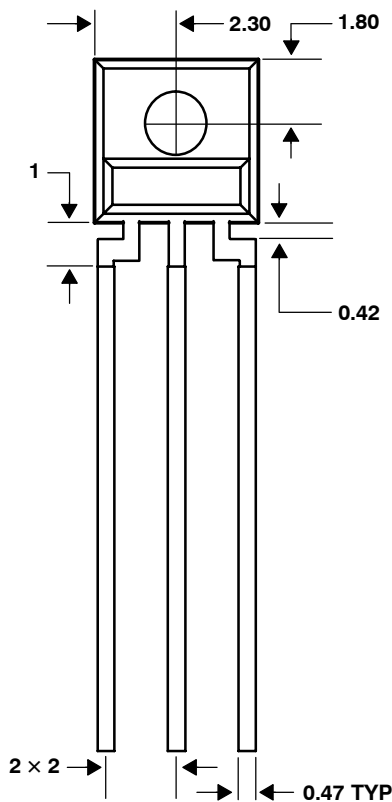
PACKAGE S

PLASTIC SINGLE-IN-LINE SIDE-LOOKER PACKAGE

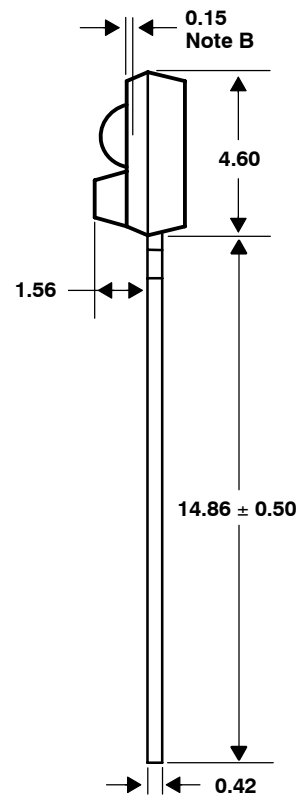
TOP VIEW



FRONT VIEW



SIDE VIEW



Lead Free Available

- NOTES: A. All linear dimensions are in millimeters; tolerance is  $\pm 0.25$  mm unless otherwise stated.  
 B. Dimension is to center of lens arc, which is located below the package face.  
 C. The integrated photodiode active area is typically located in the center of the lens and 0.97 mm below the top of the lens surface.  
 D. Index of refraction of clear plastic is 1.55.  
 E. Lead finish for TSL26xR: solder dipped, 63% Sn/37% Pb. Lead finish for TSL26xR-LF: solder dipped, 100% Sn.  
 F. This drawing is subject to change without notice.

Figure 14. Package S — Single-In-Line Side-Looker Package Configuration

# TSL260R, TSL261R, TSL262R INFRARED LIGHT-TO-VOLTAGE OPTICAL SENSORS

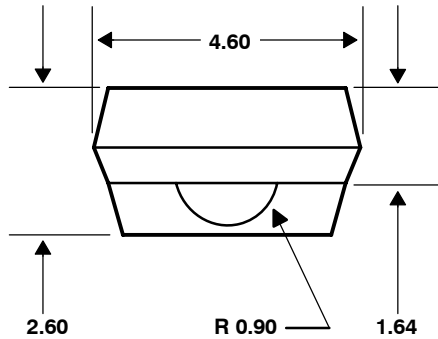
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## MECHANICAL DATA

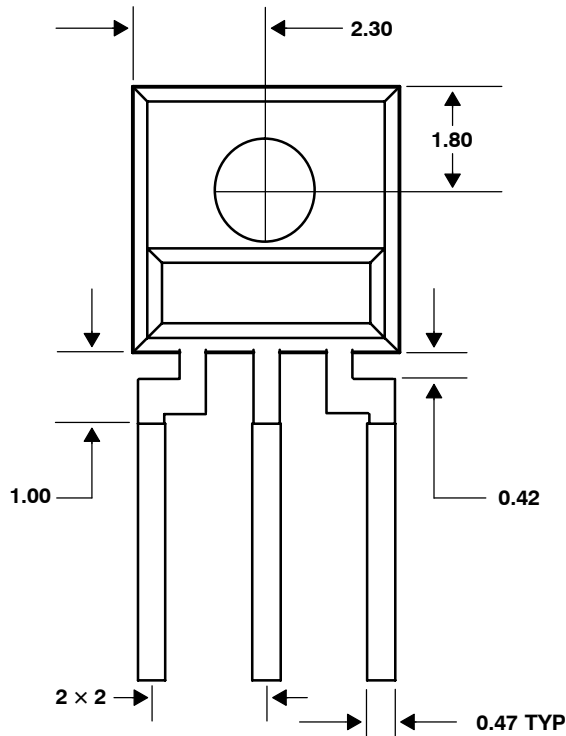
### PACKAGE SM

### PLASTIC SURFACE MOUNT SIDE-LOOKER PACKAGE

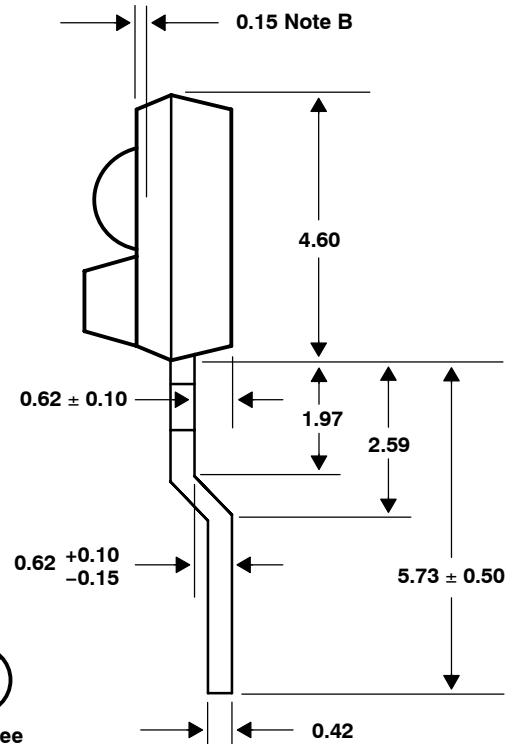
#### TOP VIEW



#### FRONT VIEW



#### SIDE VIEW



- NOTES: A. All linear dimensions are in millimeters; tolerance is  $\pm 0.25$  mm unless otherwise stated.  
 B. Dimension is to center of lens arc, which is located below the package face.  
 C. The integrated photodiode active area is typically located in the center of the lens and 0.97 mm below the top of the lens surface.  
 D. Index of refraction of clear plastic is 1.55.  
 E. Lead finish for TSL26xRSM-LF: solder dipped, 100% Sn.  
 F. This drawing is subject to change without notice.

Figure 15. Package SM — Surface Mount Side-Looker Package Configuration

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# TSL260R, TSL261R, TSL262R INFRARED LIGHT-TO-VOLTAGE OPTICAL SENSORS

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