

# TSL260R, TSL261R, TSL262R

## Infrared Light-to-Voltage Optical Sensors

### General Description

The TSL260R, TSL261R, and TSL262R are infrared light-to-voltage optical sensors, each combining a photodiode and a transimpedance amplifier (feedback resistor = 16 MΩ, 8 MΩ, and 2.8 MΩ 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 sidelooper package with an integral visible light cutoff filter and lens. When supplied in the lead (Pb) free package, the device is RoHS compliant.

*Ordering Information and Content Guide appear at end of datasheet.*

### Key Benefits & Features

The benefits and features of TSL260R, TSL261R, TSL262R, Infrared Light-to-Voltage Optical Sensors are listed below:

**Figure 1:**  
Added Value of Using TSL260R, TSL261R, TSL262R

Benefits	Features
<ul style="list-style-type: none"> <li>Enables Extremely Fast Response to Change</li> </ul>	<ul style="list-style-type: none"> <li>Single Photo-Diode and Trans Impedance Architecture</li> </ul>
<ul style="list-style-type: none"> <li>Enables Fast Response to Visible Light in Range of 400nm to 700nm Wavelengths</li> </ul>	<ul style="list-style-type: none"> <li>260µs Output Rise-Time Response (TSL260R)</li> </ul>
<ul style="list-style-type: none"> <li>Provides for High Sensitivity to Detect a Small Change in Light</li> </ul>	<ul style="list-style-type: none"> <li>High Irradiance Responsivity 111mV/(µW/cm<sup>2</sup>) at λp = 940nm (TSL260R)</li> </ul>
<ul style="list-style-type: none"> <li>Provides Additional Sensitivity Advantages</li> </ul>	<ul style="list-style-type: none"> <li>2x Gain Lens</li> </ul>

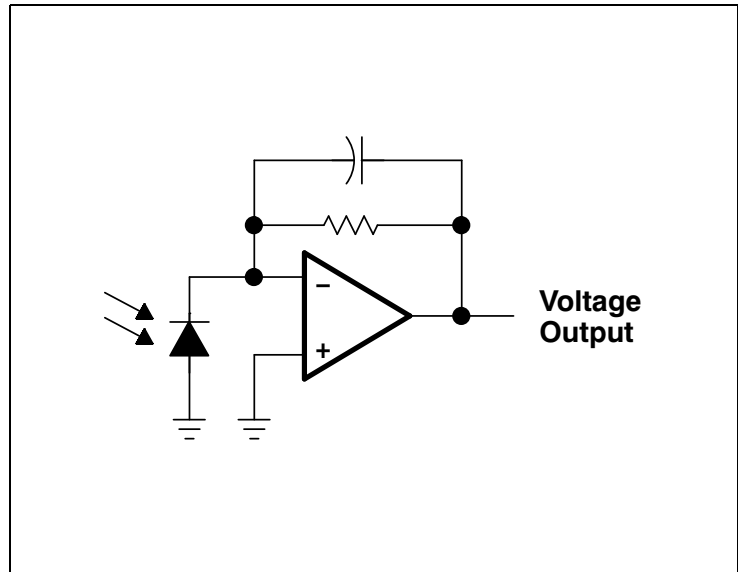
- Integral Visible Light Cutoff Filter
- Monolithic Silicon IC Containing Photodiode, Operational Amplifier, and Feedback Components
- Converts Light Intensity to a Voltage
- Compact 3-Lead Plastic Package
- Single Voltage Supply Operation
- Low Dark (Offset) Voltage....10mV Max
- Low Supply Current.....1.1 mA Typical

- Wide Supply-Voltage Range.... 2.7 V to 5.5 V
- Replacements for TSL260, TSL261, and TSL262
- RoHS Compliant (-LF Package Only)

### Functional Block Diagram

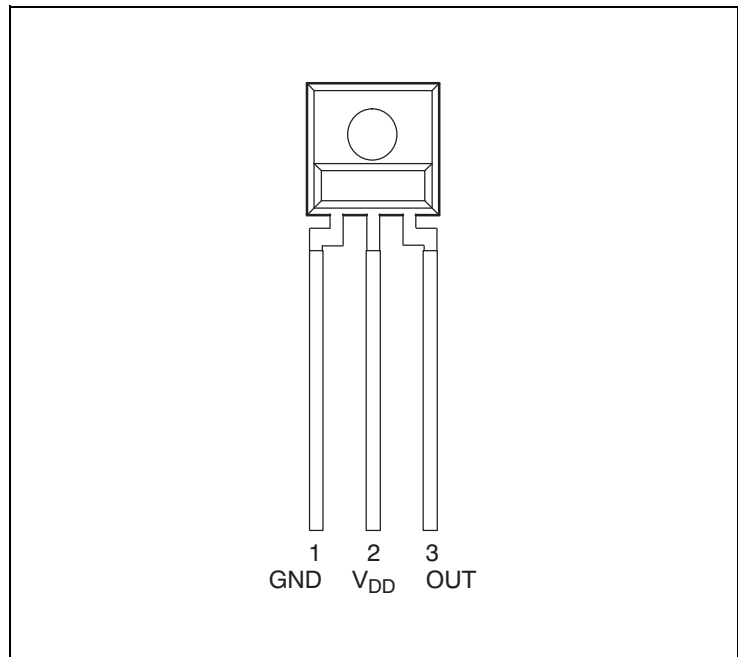
The functional blocks of this device are shown below:

**Figure 2:**  
TSL260R, TSL261R, TSL262R Block Diagram

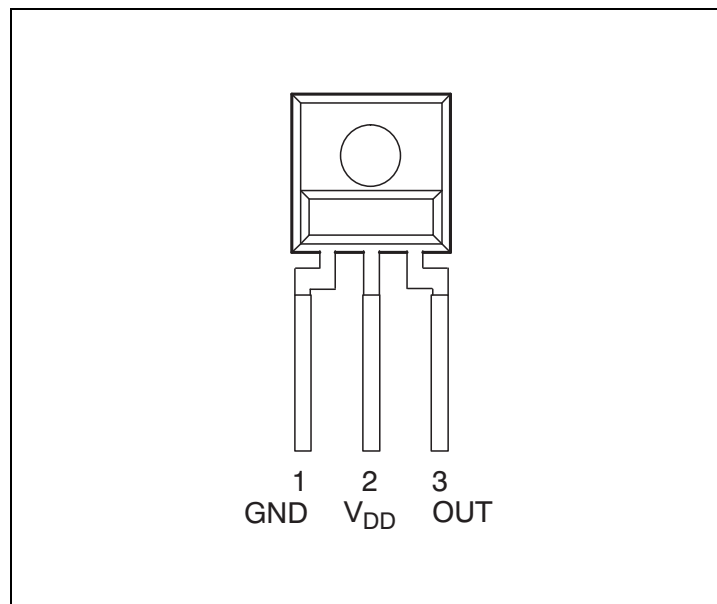


## Pin Assignments

**Figure 3:**  
Package S Sidelooker (Front View)



**Figure 4:**  
Package SM Surface Mount Sidelooker (Front View)



**Figure 5:**  
**Terminal Functions**

Terminal		Description
Name	No	
GND	1	Ground (substrate). All voltages are referenced to GND.
OUT	3	Output voltage
V <sub>DD</sub>	2	Supply voltage

**Absolute Maximum Ratings**

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.

**Figure 6:**  
Absolute Maximum Ratings Over Operating Free-Air Temperature Range (unless otherwise noted)

Symbol	Parameter	Min	Max	Units
$V_{DD}$	Supply voltage <sup>(1)</sup>		6	V
$I_O$	Output current		$\pm 10$	mA
	Duration of short-circuit current at (or below) 25°C <sup>(2)</sup>		5	s
$T_A$	Operating free-air temperature range	-25	85	°C
$T_{STRG}$	Storage temperature range	-25	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

**Note(s):**

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

**Figure 7:**  
Recommended Operating Conditions

Symbol	Parameter	Min	Max	Units
$V_{DD}$	Supply voltage	2.7	5.5	V
$T_A$	Operating free-air temperature	0	70	°C

## Electrical Characteristics

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 <sup>(1)</sup>, <sup>(2)</sup> and <sup>(3)</sup>.

**Figure 8:**  
Electrical Characteristics

Symbol	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 ( $V_O$ )	$E_e = 18\ \mu\text{W}/\text{cm}^2$ , $T_A = 0^\circ\text{C to } 70^\circ\text{C}$		8								mV/ $^\circ\text{C}$	
				0.4								%/ $^\circ\text{C}$	
		$E_e = 46\ \mu\text{W}/\text{cm}^2$ , $T_A = 0^\circ\text{C to } 70^\circ\text{C}$					8						mV/ $^\circ\text{C}$
							0.4						%/ $^\circ\text{C}$
		$E_e = 220\ \mu\text{W}/\text{cm}^2$ , $T_A = 0^\circ\text{C to } 70^\circ\text{C}$								8			mV/ $^\circ\text{C}$
										0.4			%/ $^\circ\text{C}$
$N_e$	Irradiance responsivity	See Note <sup>(4)</sup>		111			43.5			9.1		mV/ ( $\mu\text{W}/\text{cm}^2$ )	

Symbol	Parameter	Test Conditions	TSL260R			TSL261R			TSL262R			Unit
			Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
$I_{DD}$	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	1.7	

**Note(s):**

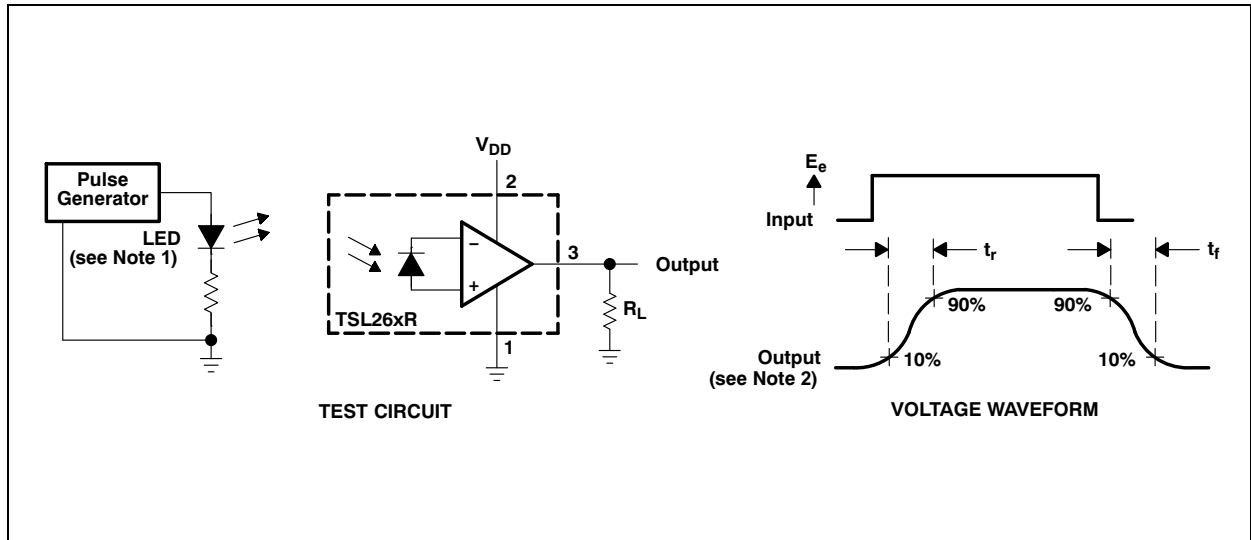
- Measurements are made with  $R_L = 10 \text{ k}\Omega$  between output and ground.
- Optical measurements are made using small-angle incident radiation from an LED optical source.
- The input irradiance  $E_e$  is supplied by a GaAs LED with peak wavelength  $\lambda_p = 940 \text{ nm}$ .
- Irradiance 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  $E_e = 0$ .

**Figure 9:**  
Dynamic Characteristics at  $T_A = 25^\circ\text{C}$  (see [Figure 10](#))

Symbol	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	$V_{DD} = 5 \text{ V}, E_e = 0,$ $f = 1000 \text{ Hz}$		0.8			0.7			0.6		$\mu\text{V}/\sqrt{\text{Hz}}$

## Parameter Measurement Information

Figure 10:  
Switching Times



**Note(s):**

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



## Typical Operating Characteristics

Figure 11:  
Normalized Output Voltage vs Angular Displacement

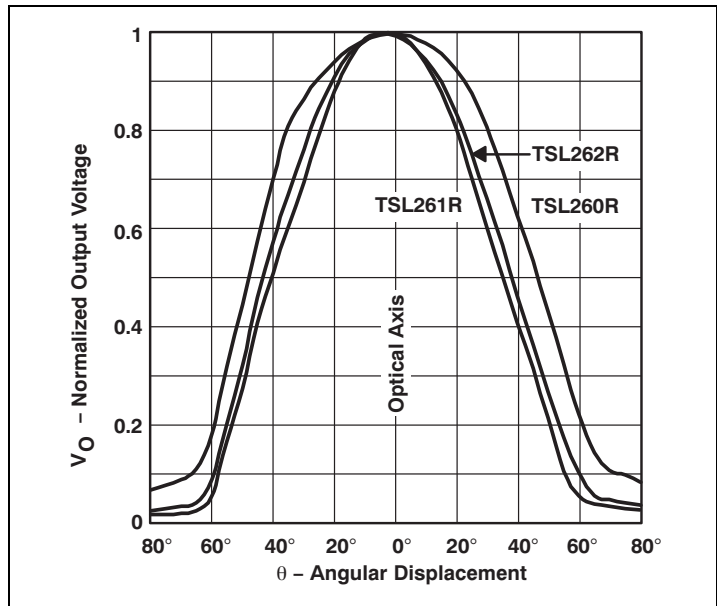
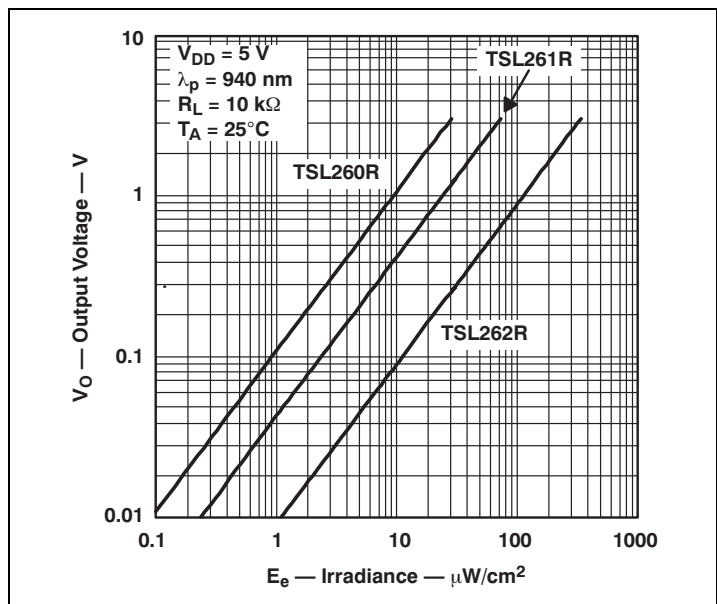
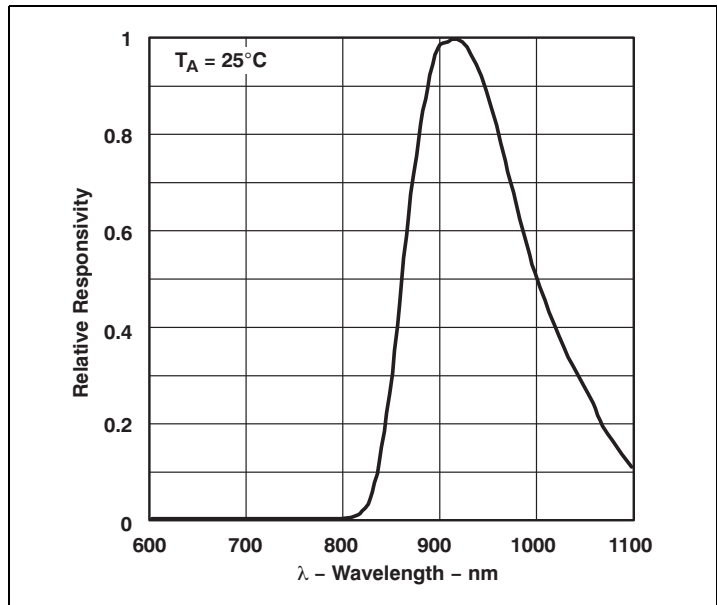


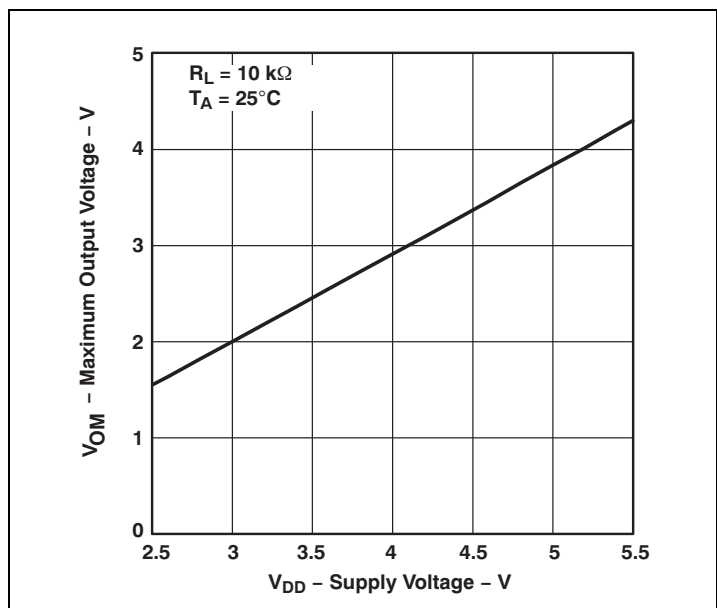
Figure 12:  
Output Voltage vs Irradiance



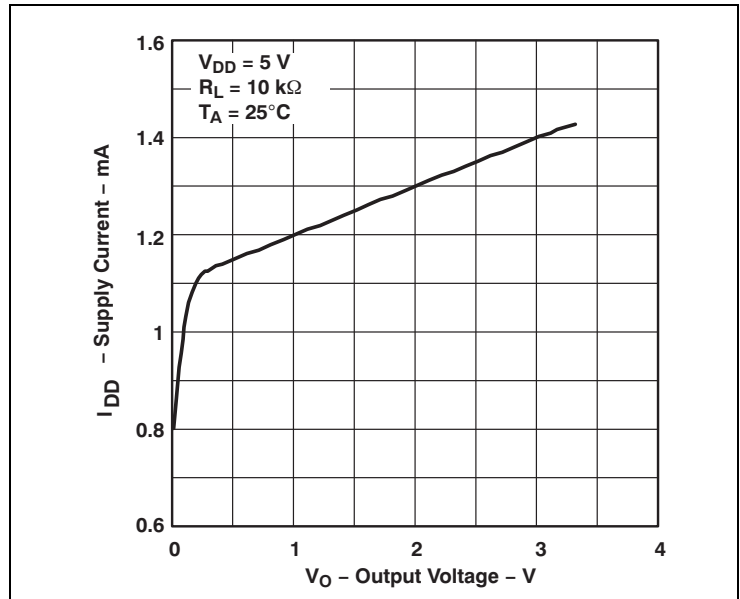
**Figure 13:**  
Photodiode Spectral Responsivity



**Figure 14:**  
Maximum Output Voltage vs Supply Voltage

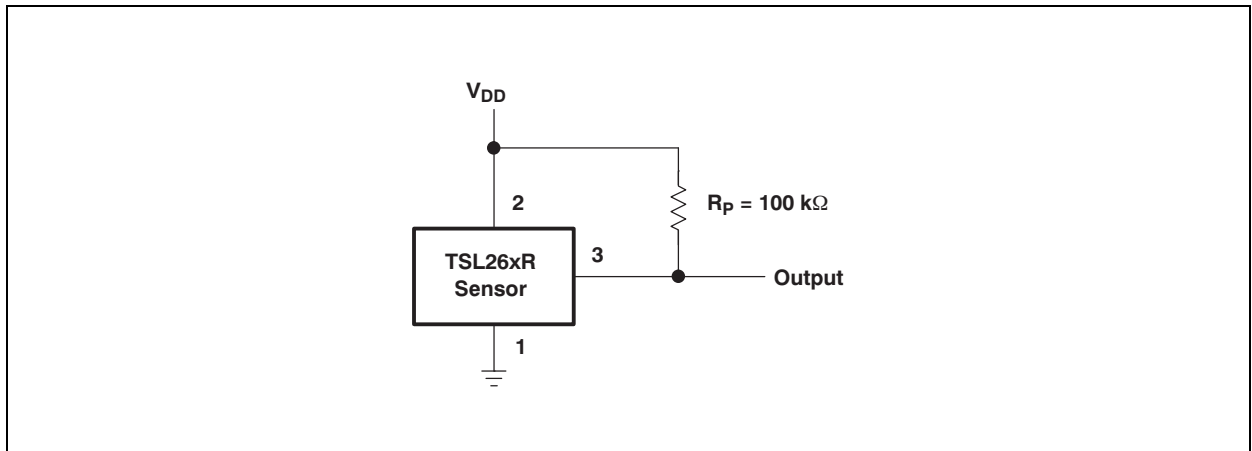


**Figure 15:**  
**Supply Current vs Output Voltage**



## Application Information

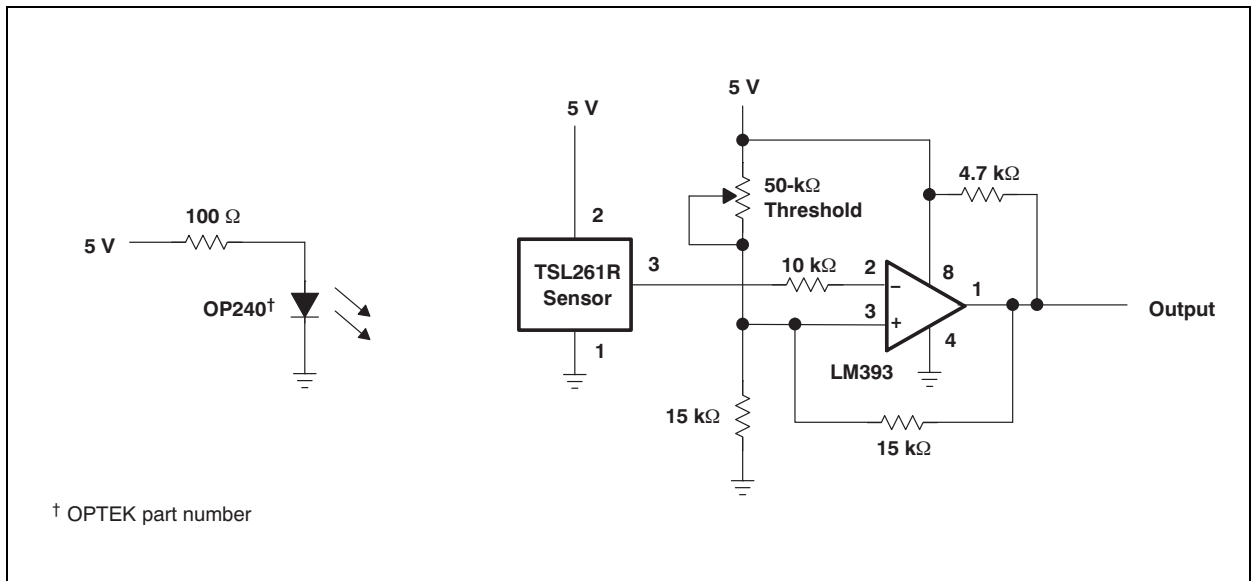
**Figure 16:**  
Pullup for Increased  $V_{OM}$



**Note(s):**

1. 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).

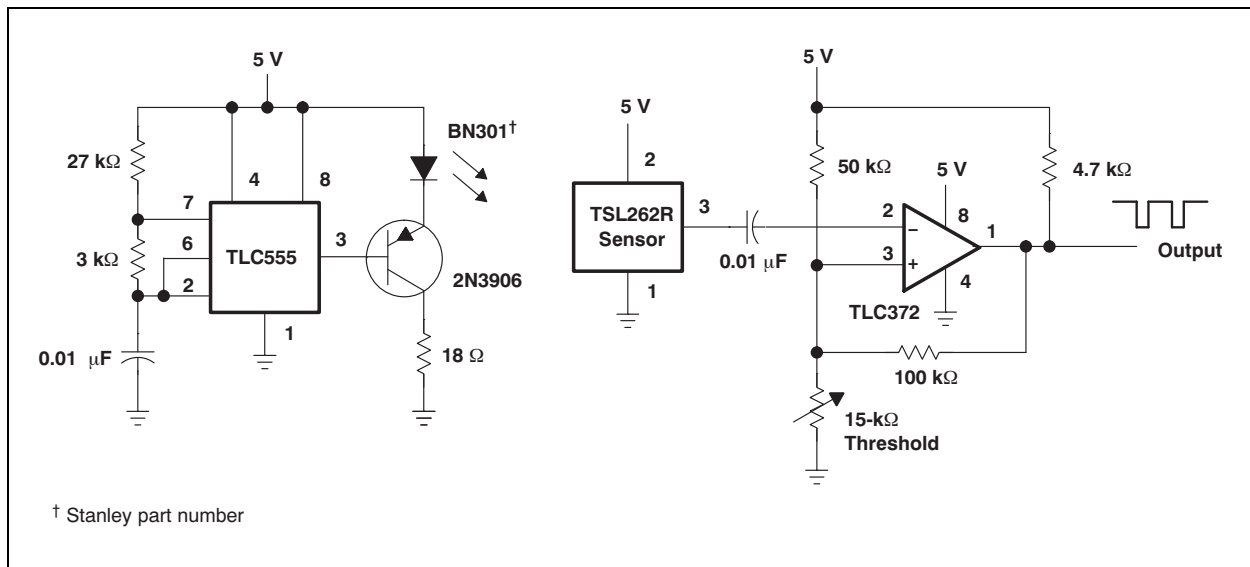
**Figure 17:**  
Short-Range Optical Switch With Hysteresis



**Note(s):**

1. 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.

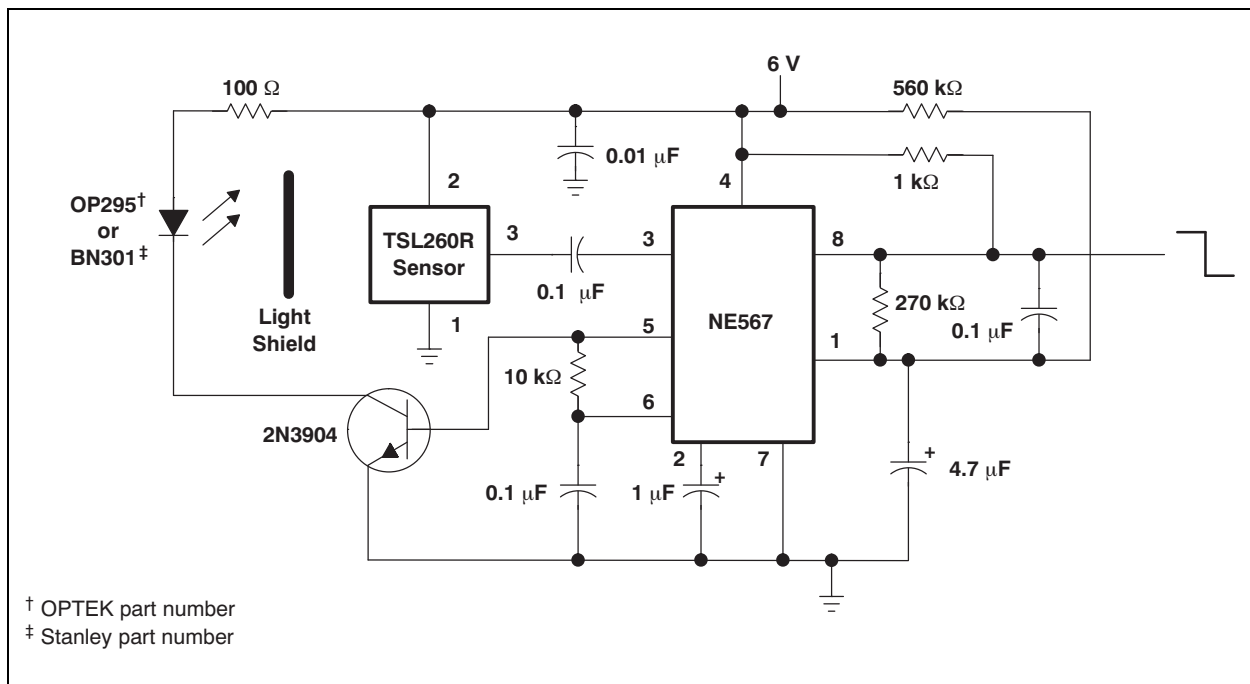
**Figure 18:**  
Pulsed Optical-Beam Interrupter



**Note(s):**

1. 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.

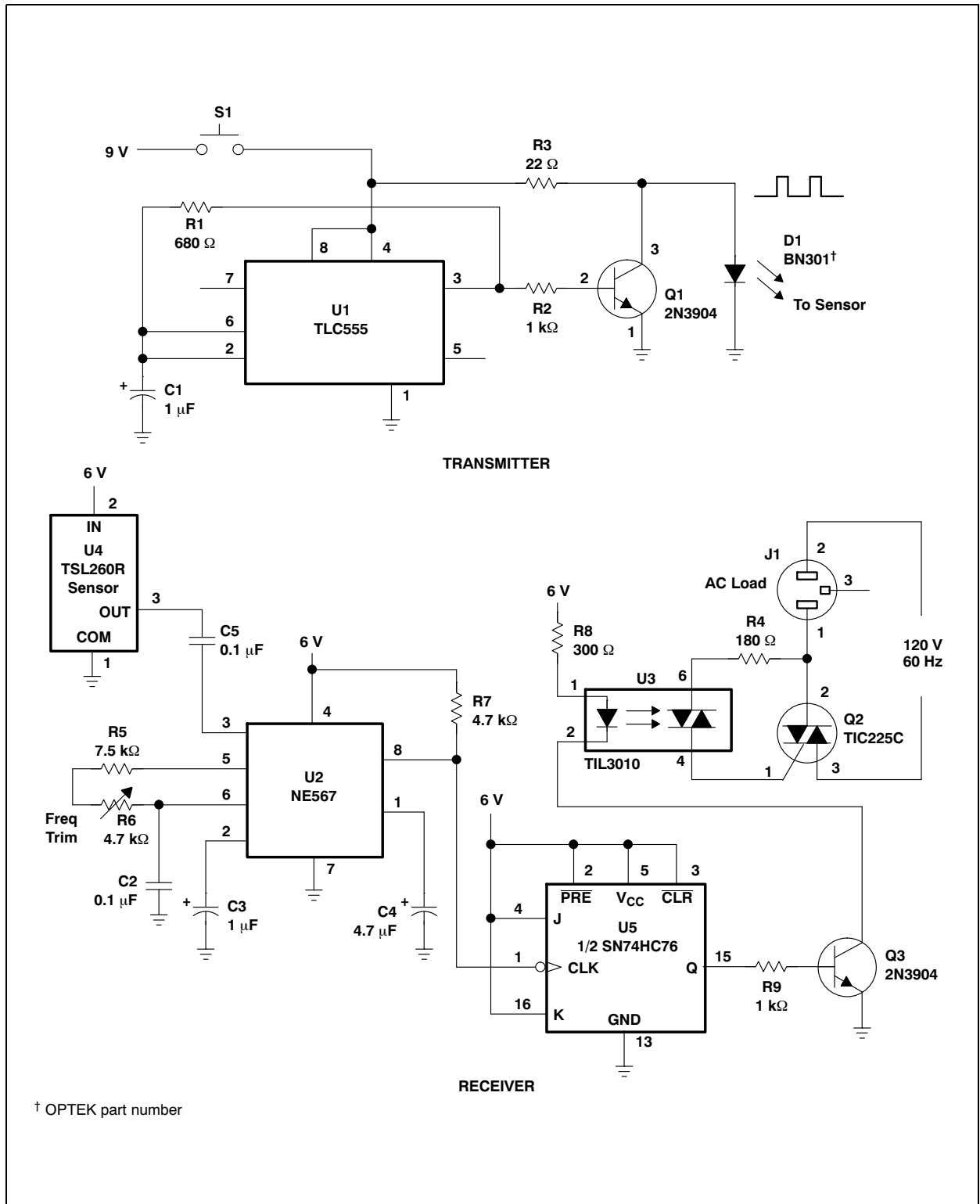
**Figure 19:**  
Proximity Detector



**Note(s):**

1. 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.

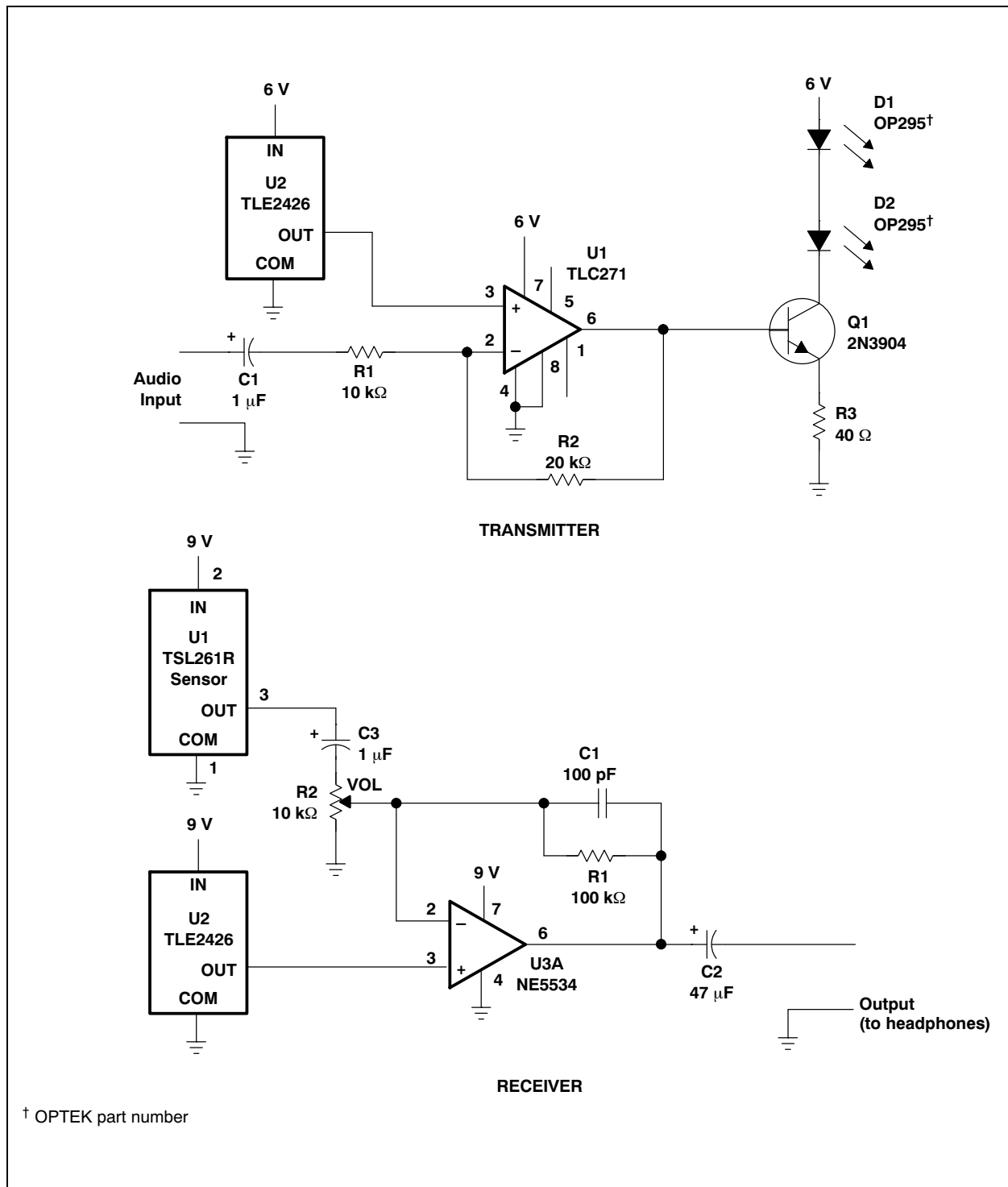
Figure 20:  
IR Remote Control



**Note(s):**

1. Single-channel remote control can be used to switch logic or light dc loads by way of U5 or ac loads by way of the optocoupler and triac as shown. Applications include ceiling fans, lamps, electric heaters, etc.

**Figure 21:**  
IR Voice-Band Audio Link



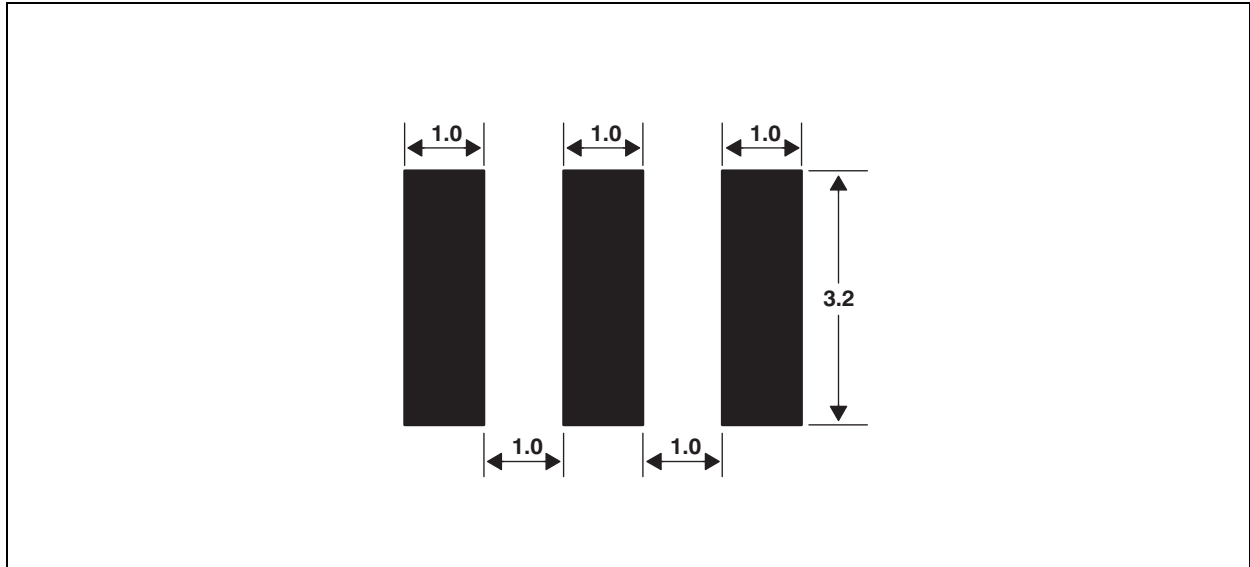
**Note(s):**

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

### PCB Pad Layout

Suggested PCB pad layout guidelines for the SM surface mount package are shown in [Figure 24](#).

**Figure 22:**  
Suggested SM Package PCB Layout



**Note(s):**

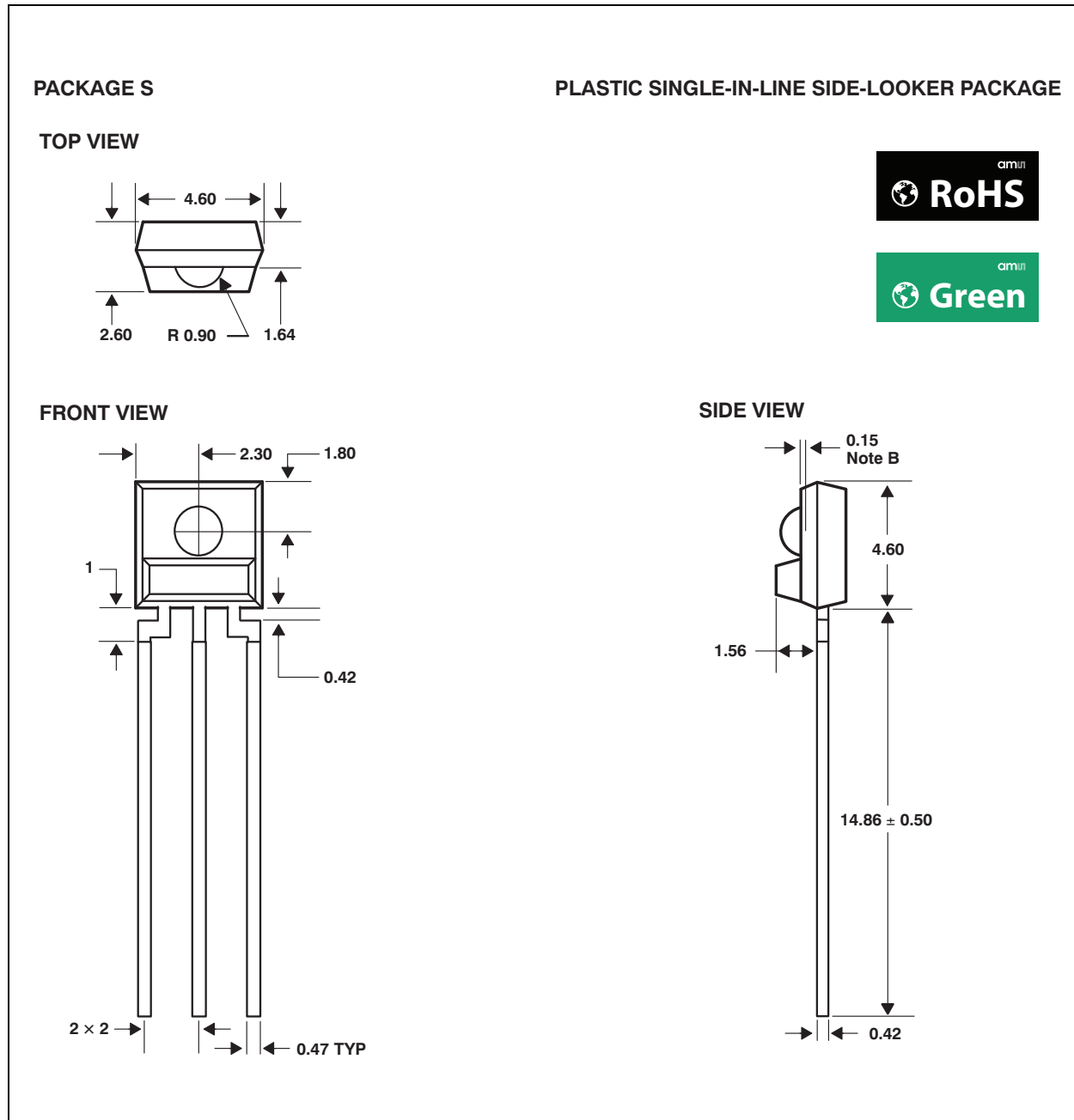
1. All linear dimensions are in millimeters.
2. This drawing is subject to change without notice.



## 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  $1.0 \text{ mm}^2$  ( $0.0016 \text{ in}^2$ ) for TSL260R,  $0.5 \text{ mm}^2$  ( $0.00078 \text{ in}^2$ ) for the TSL261R, and  $0.26 \text{ mm}^2$  ( $0.0004 \text{ in}^2$ ) for the TSL262R.

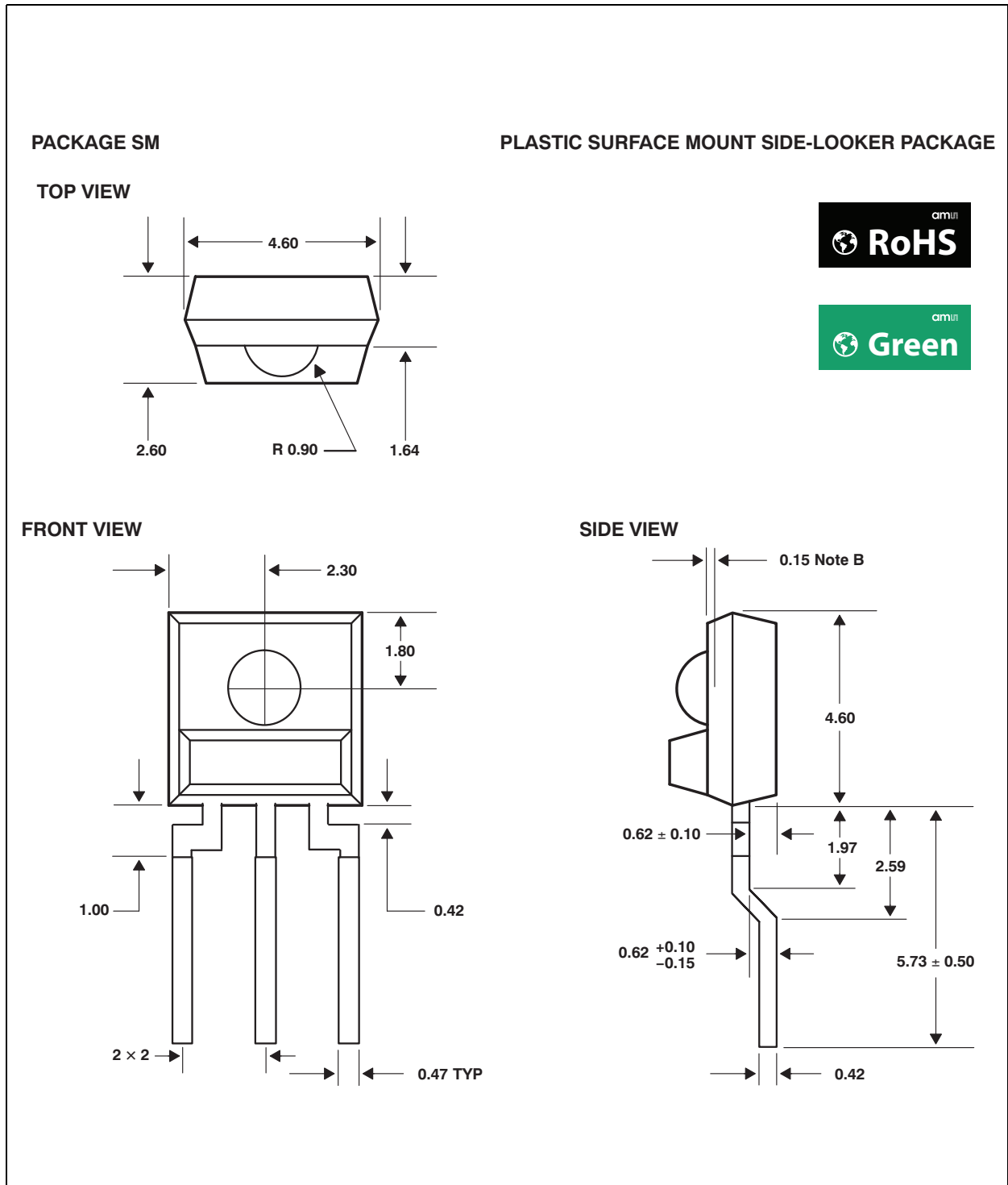
**Figure 23:**  
**Package S — Single-In-Line Side-Looker Package Configuration**



**Note(s):**

1. All linear dimensions are in millimeters; tolerance is  $\pm 0.25 \text{ mm}$  unless otherwise stated.
2. Dimension is to center of lens arc, which is located below the package face.
3. The integrated photodiode active area is typically located in the center of the lens and  $0.97 \text{ mm}$  below the top of the lens surface.
4. Index of refraction of clear plastic is 1.55.
5. Lead finish for TSL26xR-LF: solder dipped, 100% Sn.
6. This drawing is subject to change without notice.

**Figure 24:**  
**Package SM — Surface Mount Side-Looker Package Configuration**



**Note(s):**

1. All linear dimensions are in millimeters; tolerance is  $\pm 0.25$  mm unless otherwise stated.
2. Dimension is to center of lens arc, which is located below the package face.
3. 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.
4. Index of refraction of clear plastic is 1.55.
5. Lead finish for TSL26xRSM-LF: solder dipped, 100% Sn.
6. This drawing is subject to change without notice.

## Ordering & Contact Information

Figure 25:  
Ordering Information

Ordering Code	Device	T <sub>A</sub>	Package – Leads	Package Designator
TSL260R-LF	TSL260R	0°C to 70°C	3-lead Sidelooker — Lead (Pb) Free	S
TSL260RSM-LF	TSL260R	0°C to 70°C	3-lead Surface-Mount Sidelooker — Lead (Pb) Free	SM
TSL261R-LF	TSL261R	0°C to 70°C	3-lead Sidelooker — Lead (Pb) Free	S
TSL261RSM-LF	TSL261R	0°C to 70°C	3-lead Surface-Mount Sidelooker — Lead (Pb) Free	SM
TSL262R-LF	TSL262R	0°C to 70°C	3-lead Sidelooker — Lead (Pb) Free	S
TSL262RSM-LF	TSL262R	0°C to 70°C	3-lead Surface-Mount Sidelooker — Lead (Pb) Free	SM

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Document Status	Product Status	Definition
Product Preview	Pre-Development	Information in this datasheet is based on product ideas in the planning phase of development. All specifications are design goals without any warranty and are subject to change without notice
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## Revision Information

Changes from 049E (2007-Sep) to current revision 1-00 (2016-Jul-05)	Page
Content of TAOS datasheet was updated to latest <b>ams</b> design	
Updated Key Benefits & Features section	1
Updated note under Figure 23	17
Updated Figure 25	19

**Note(s):**

1. Page and figure numbers for the previous version may differ from page and figure numbers in the current revision.
2. Correction of typographical errors is not explicitly mentioned.

**Content Guide**

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