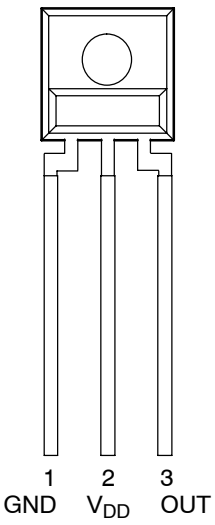
TSL260R, TSL261R, TSL262R
INFRARED LIGHT-TO-VOLTAGE OPTICAL SENSORS

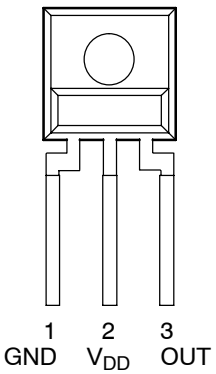
TAOS049E –SEPTEMBER 2007

- **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/(μW/cm²) at λ_p = 940 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)



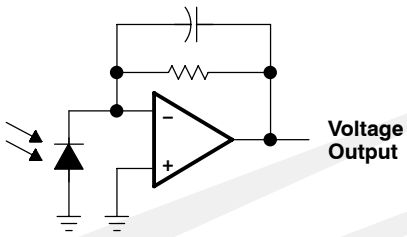
PACKAGE SM
SURFACE MOUNT
SIDELOOKER
(FRONT VIEW)



Description

The TSL260R, TSL261R, and TSL262R are infrared light-to-voltage optical sensors, each combining a photodiode and a transimpedance amplifier (feedback resistor = 16 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 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_A	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

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Terminal Functions

TERMINAL NAME	TERMINAL NO.	DESCRIPTION
GND	1	Ground (substrate). All voltages are referenced to GND.
OUT	3	Output voltage
V_{DD}	2	Supply voltage

Absolute Maximum Ratings over operating free-air temperature range (unless otherwise noted)†

Supply voltage, V_{DD} (see Note 1) . . . . . 6 V
Output current, I_O . . . . . ±10 mA
Duration of short-circuit current at (or below) 25°C (see Note 2) . . . . . 5 s
Operating free-air temperature range, T_A . . . . . –25°C to 85°C
Storage temperature range, T_{stg} . . . . . –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

† 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_{DD}	2.7		5.5	V
Operating free-air temperature, T_A	0		70	°C

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Electrical Characteristics at V_{DD} = 5 V, T_A = 25°C, λp = 940 nm, R_L = 10 kΩ (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 V	3	3.3		3	3.3		3	3.3		V
V_O	Output voltage	E_e = 18 μW/cm²	1	2	3							V
		E_e = 46 μW/cm²				1	2	3				
		E_e = 220 μW/cm²							1	2	3	
α_{vo}	Temperature coefficient of output voltage (V_O)	E_e = 18 μW/cm², T_A = 0°C to 70°C		8								mV/°C
				0.4								%/°C
		E_e = 46 μW/cm², T_A = 0°C to 70°C					8					mV/°C
							0.4					%/°C
		E_e = 220 μW/cm², T_A = 0°C to 70°C								8		mV/°C
										0.4		%/°C
N_e	Irradiance responsivity	See Note 6		111			43.5			9.1		mV/(μW/cm²)
I_{DD}	Supply current	E_e = 18 μW/cm²		1.1	1.7							mA
		E_e = 46 μW/cm²					1.1	1.7				
		E_e = 220 μW/cm²								1.1	1.7	

NOTES: 3. Measurements are made with R_L = 10 kΩ 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 λ_p = 940 nm
6. Irradiance responsivity is characterized over the range V_O = 0.05 to 2.9 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°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 V, λ_p = 940 nm		260			70			7		μs
t_f	Output pulse fall time	V_{DD} = 5 V, λ_p = 940 nm		260			70			7		μs
V_n	Output noise voltage	V_{DD} = 5 V, E_e = 0, f = 1000 Hz		0.8			0.7			0.6		μV/√Hz

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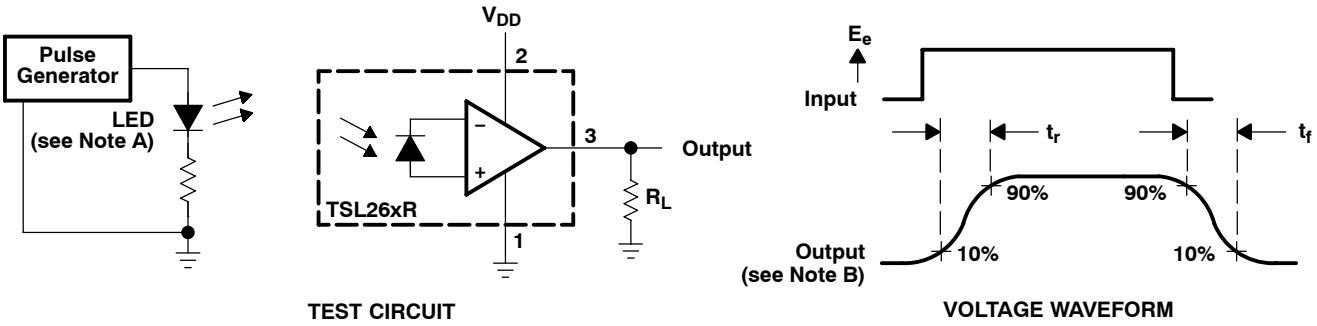
PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT VOLTAGE WAVEFORM

NOTES: A. The input irradiance is supplied by a pulsed GaAs light-emitting diode with the following characteristics: λ_p = 940 nm, t_r < 1 μs, t_f < 1 μs.

B. The output waveform is monitored on an oscilloscope with the following characteristics: t_r < 100 ns, Z_i ≥ 1 MΩ, C_i ≤ 20 pF.

Figure 1. Switching Times

TYPICAL CHARACTERISTICS

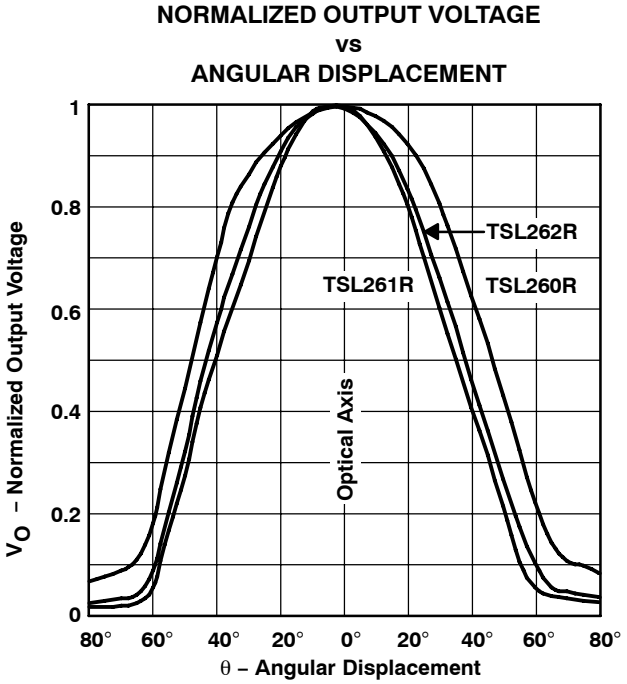


Figure 2

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TYPICAL CHARACTERISTICS

OUTPUT VOLTAGE vs IRRADIANCE

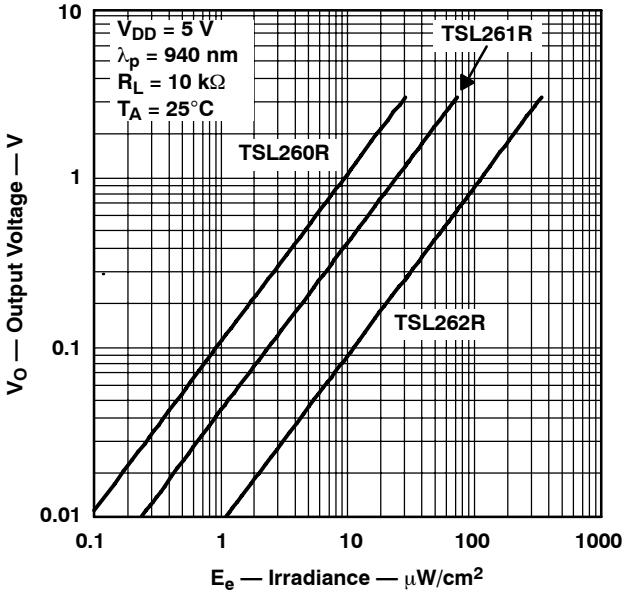

Figure 3

PHOTODIODE SPECTRAL RESPONSIVITY

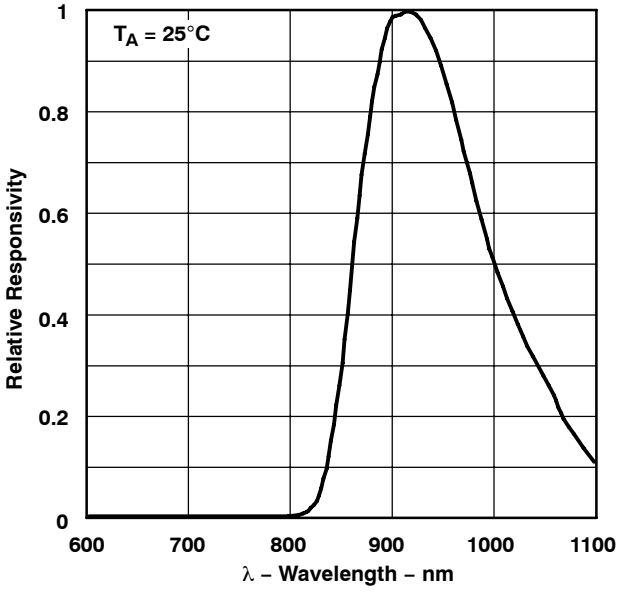

Figure 4

MAXIMUM OUTPUT VOLTAGE vs SUPPLY VOLTAGE

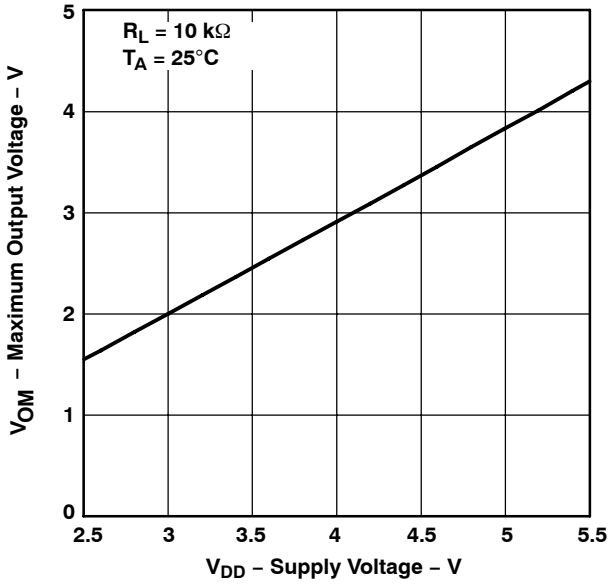

Figure 5

SUPPLY CURRENT vs OUTPUT VOLTAGE

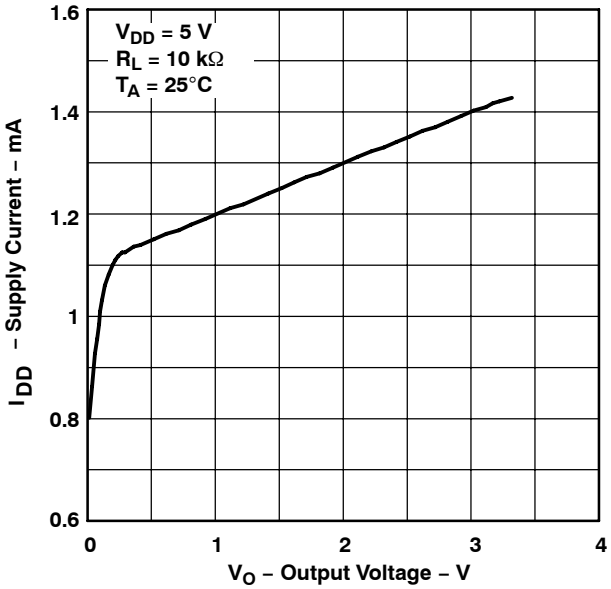

Figure 6

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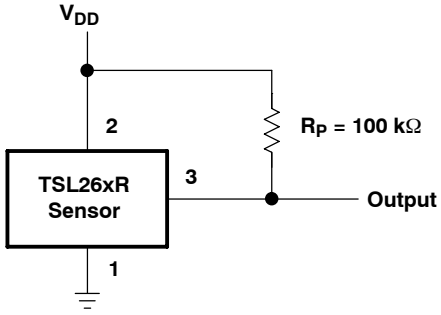
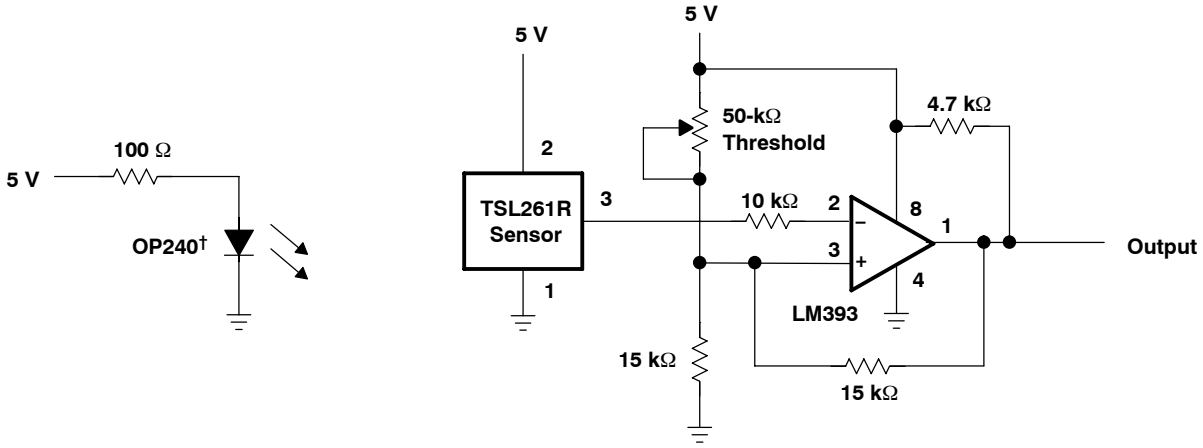


NOTE A: Pullup resistor extends linear output range to near V_{DD} with minimal (several millivolts typical) effect on V_{DARK}; particularly useful at low V_{DD} (3 V to 5 V).

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

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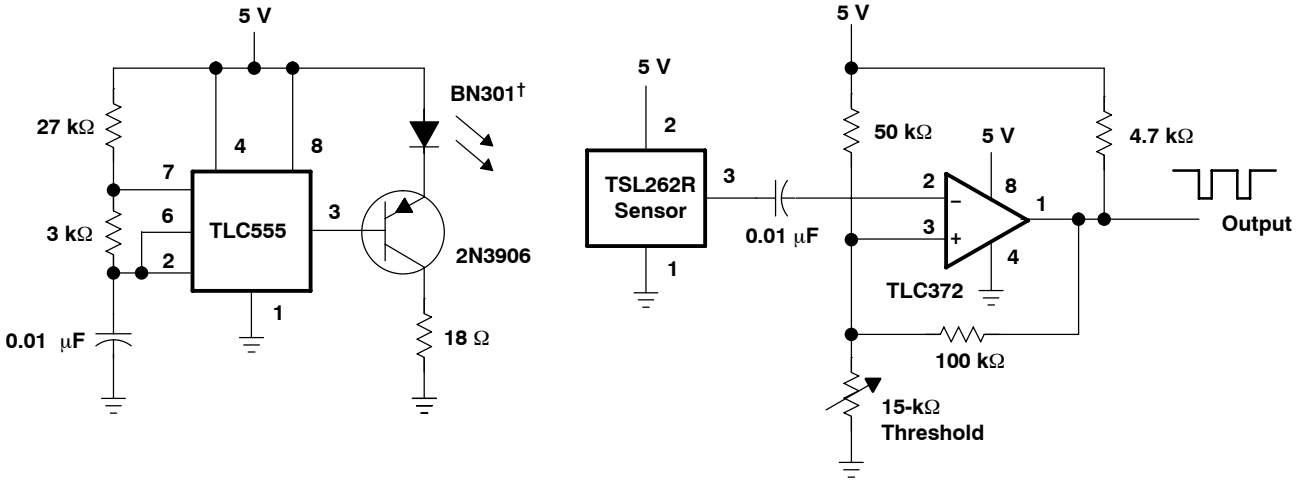
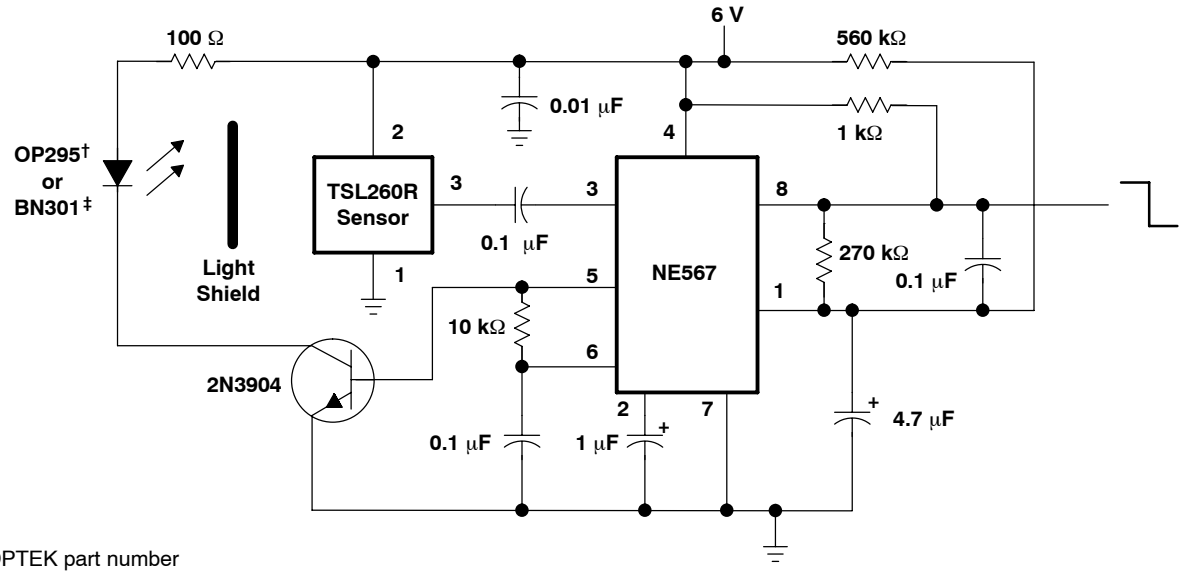
APPLICATION INFORMATION



† 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

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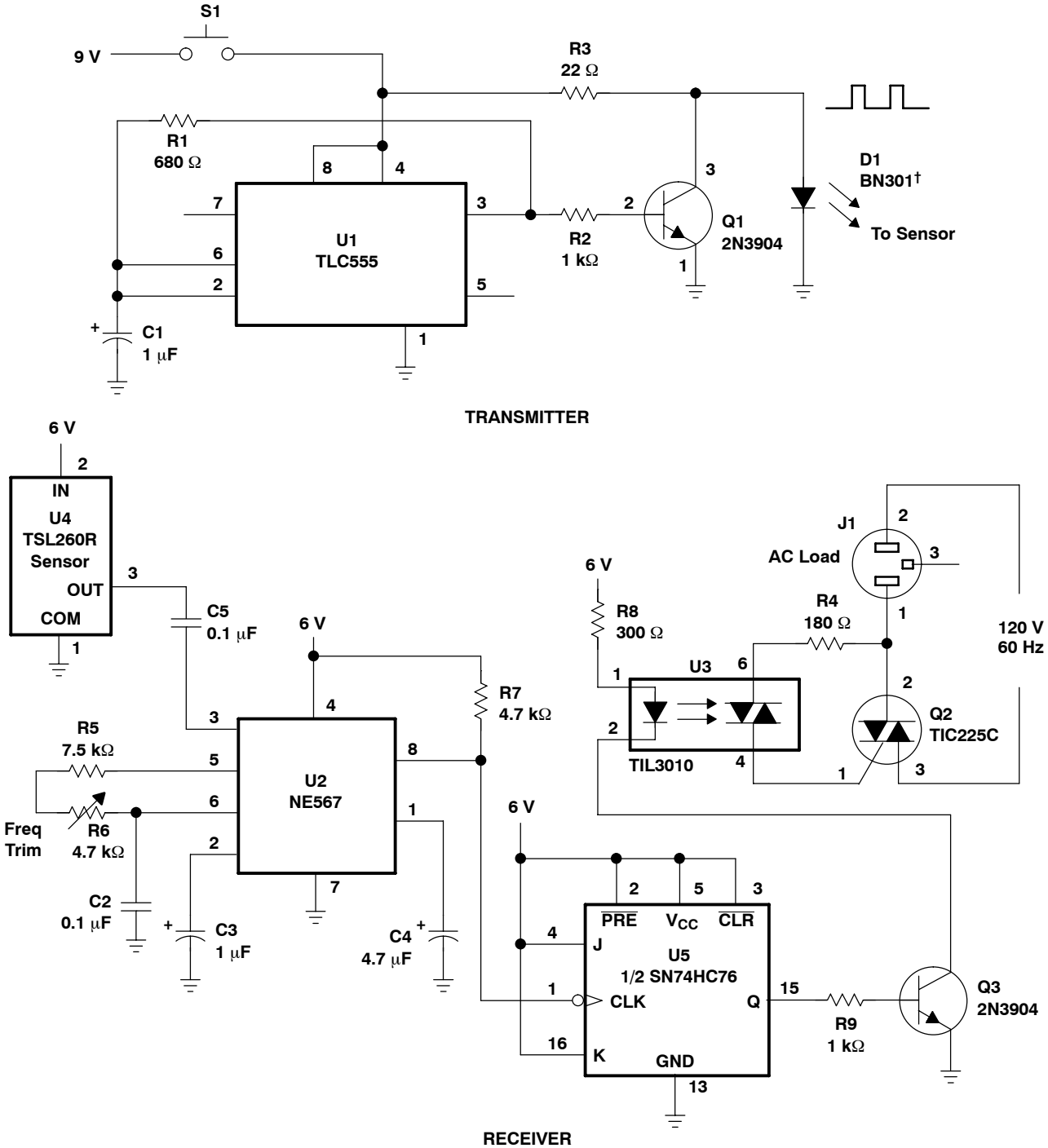
APPLICATION INFORMATION



† OPTEK part number

NOTE A: 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 11. IR Remote Control

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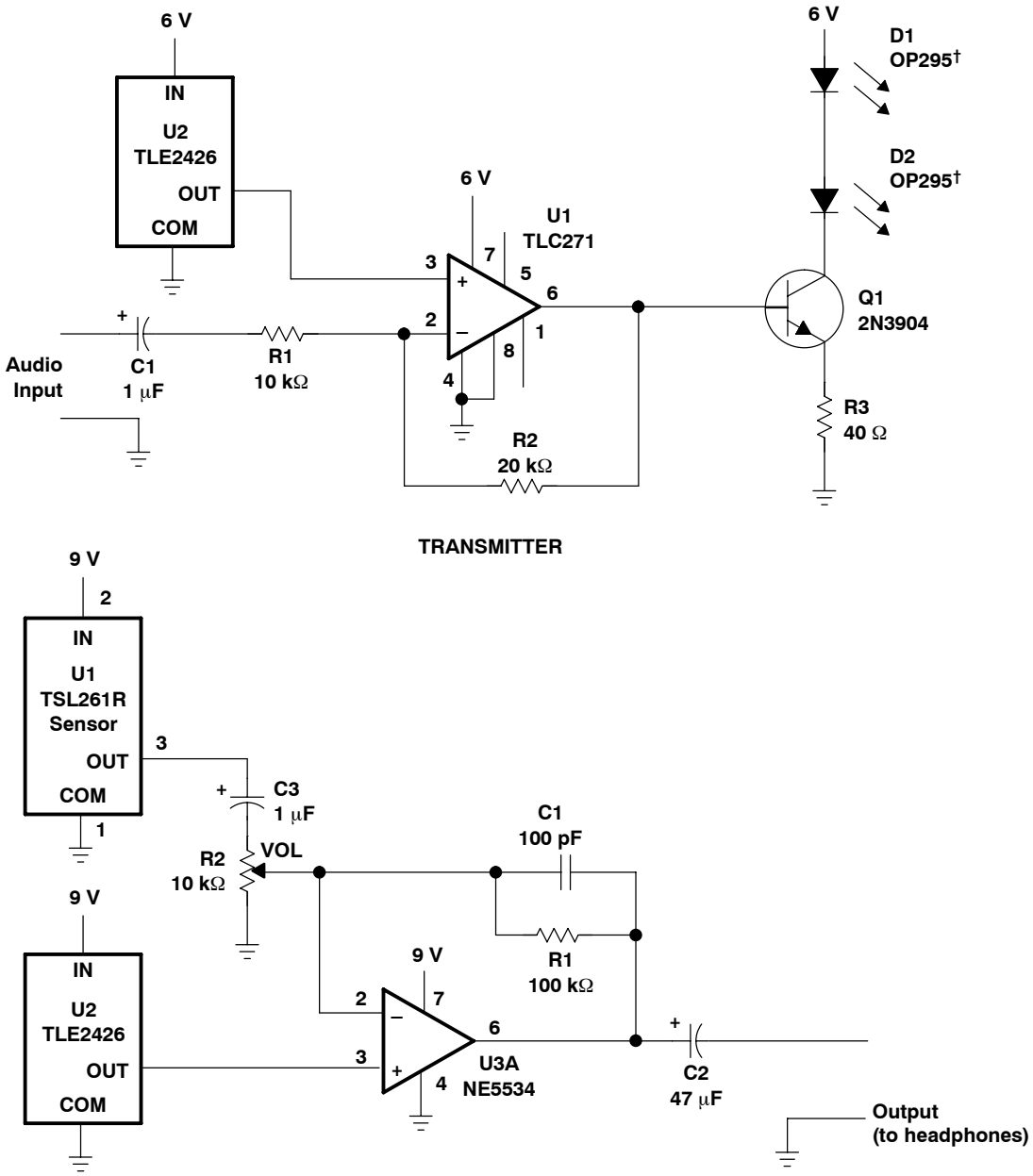
APPLICATION INFORMATION



† 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

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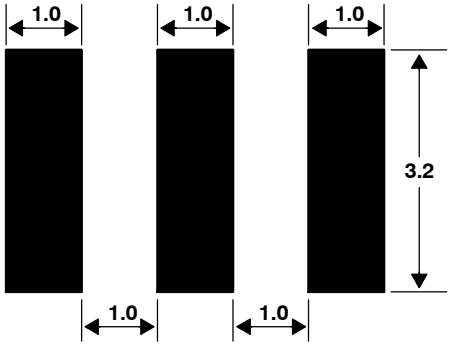
APPLICATION INFORMATION

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

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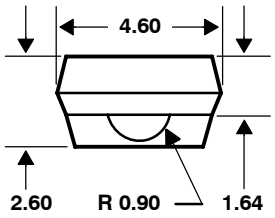
MECHANICAL DATA

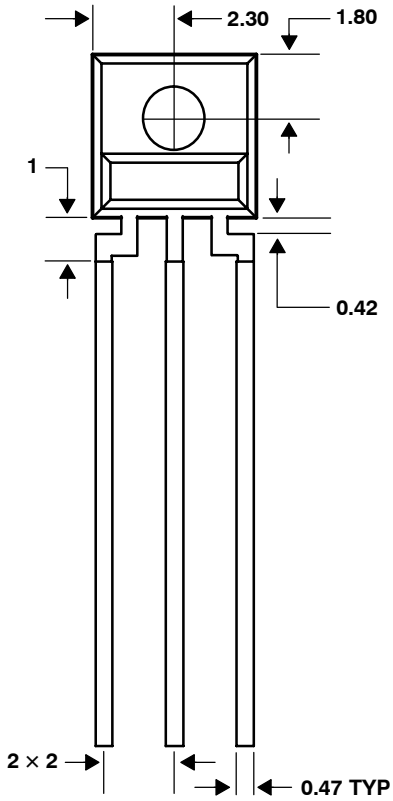
The TSL260R, TSL261R, and TSL262R are supplied in a clear 3-lead through-hole package with a molded lens. The integrated photodiode active area is typically 1,0 mm^2 (0.0016 in^2) for TSL260R, 0,5 mm^2 (0.00078 in^2) for the TSL261R, and 0,26 mm^2 (0.0004 in^2) for the TSL262R.

PACKAGE S **PLASTIC SINGLE-IN-LINE SIDE-LOOKER PACKAGE**

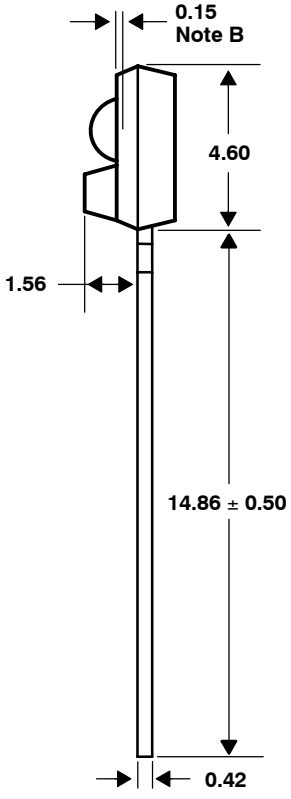
TOP VIEW



FRONT VIEW



SIDE VIEW



Pb
Lead Free
Available

NOTES: A. All linear dimensions are in millimeters; tolerance is ± 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

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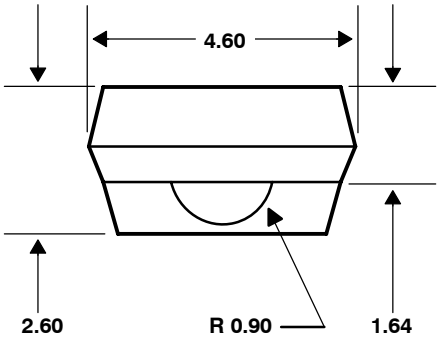
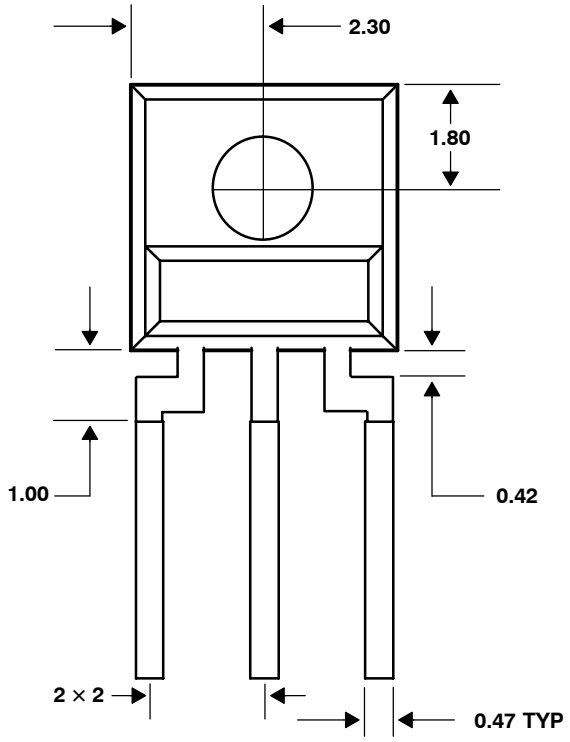
MECHANICAL DATA

PACKAGE SM **PLASTIC SURFACE MOUNT SIDE-LOOKER PACKAGE**

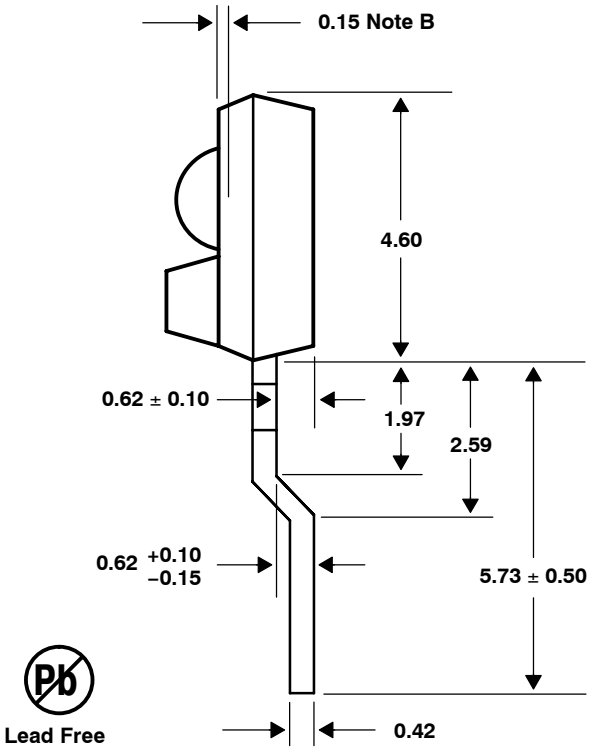
TOP VIEW



FRONT VIEW



SIDE VIEW



NOTES: A. All linear dimensions are in millimeters; tolerance is ± 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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