

# TSL260, TSL261, TSL262 IR LIGHT-TO-VOLTAGE OPTICAL SENSORS

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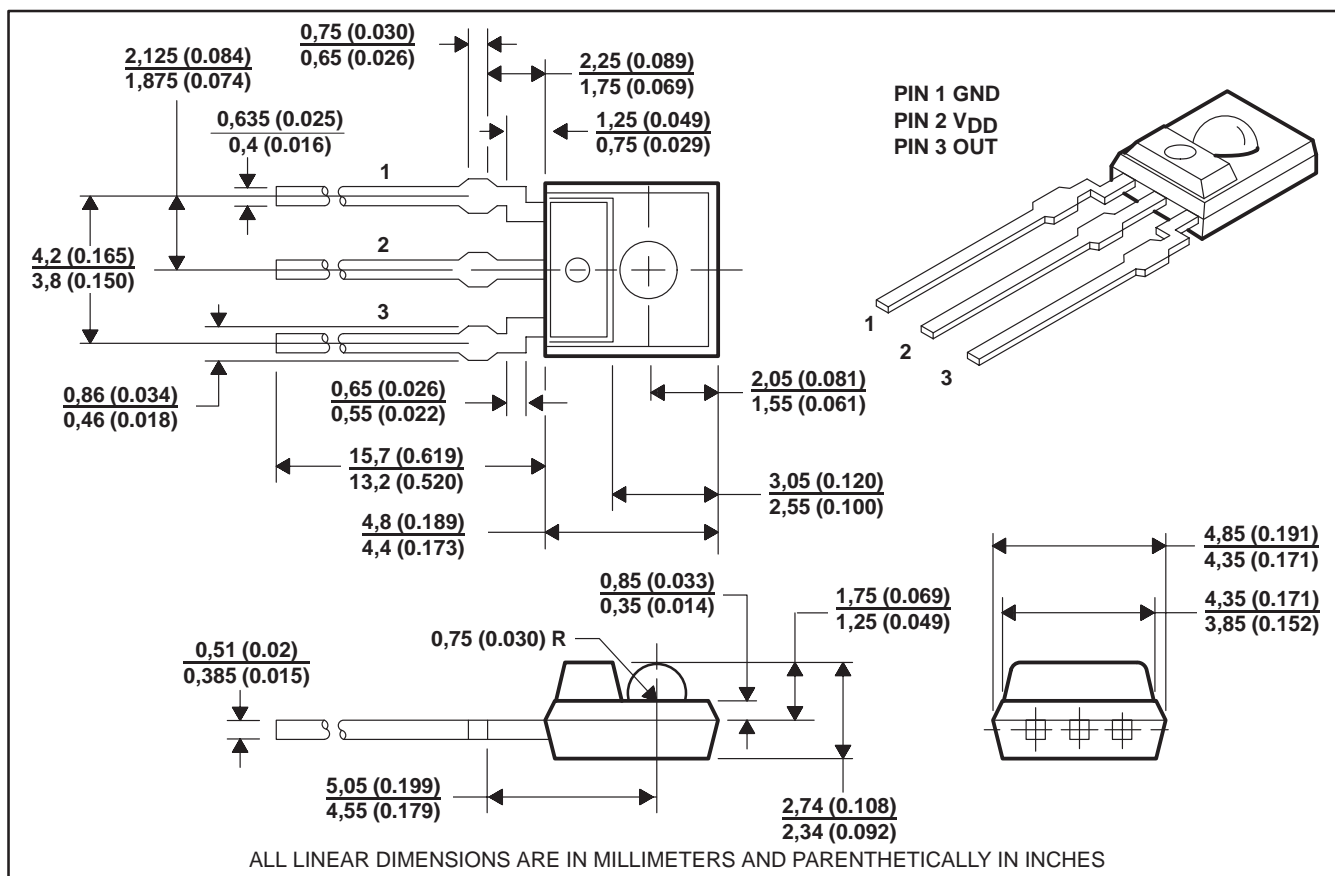
- Integral Visible Light Cutoff Filter
- Monolithic Silicon IC Containing Photodiode, Operational Amplifier, and Feedback Components
- Converts Light Intensity to Output Voltage
- High Irradiance Responsivity Typically  $42 \text{ mV}/(\mu\text{W}/\text{cm}^2)$  at  $\lambda_p = 940 \text{ nm}$  (TSL260)
- Low Dark (Offset) Voltage . . . 10 mV Max at  $25^\circ\text{C}$ ,  $V_{DD} = 5 \text{ V}$
- Single-Supply Operation
- Wide Supply Voltage Range . . . 3 V to 9 V
- Low Supply Current . . . 800  $\mu\text{A}$  Typical at  $V_{DD} = 5 \text{ V}$
- Advanced LinCMOS™ Technology

## description

The TSL260, TSL261, and TSL262 are light-to-voltage optical sensors each combining a photodiode and a transimpedance amplifier (feedback resistor = 16 M $\Omega$ , 8 M $\Omega$ , and 2 M $\Omega$ , respectively) on a single monolithic integrated circuit. The output voltage is directly proportional to the infrared light intensity (irradiance) on the photodiode. The TSL260, TSL261, and TSL262 utilize Texas Instruments silicon-gate LinCMOS™ technology, which provides good amplifier offset-voltage stability and low power consumption.

## mechanical data

The photodiode/amplifier chip is packaged in a black, infrared-transmissive plastic package. The integrated photodiode active area is typically 1,0 mm<sup>2</sup> (0.0016 in<sup>2</sup>), 0,5 mm<sup>2</sup> (0.00078 in<sup>2</sup>), and 0,26 mm<sup>2</sup> (0.0004 in<sup>2</sup>) for the TSL260, TSL261, and TSL262, respectively.



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PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

**TEXAS  
INSTRUMENTS**

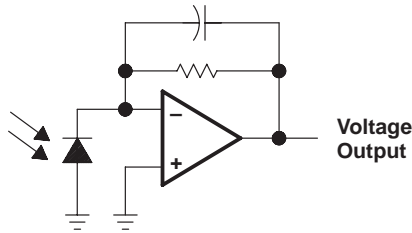
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## functional block diagram



## absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

Supply voltage, $V_{DD}$ (see Note 1)	10 V
Output current, $I_O$	$\pm 10$ 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	-25°C to 85°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	240°C

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

## recommended operating conditions

	MIN	NOM	MAX	UNIT
Supply voltage, $V_{DD}$	3	5	9	V
Operating free-air temperature, $T_A$	0		70	°C

## electrical characteristics at $V_{DD} = 5$ V, $T_A = 25^\circ\text{C}$ , $\lambda_p = 940$ nm, $R_L = 10$ k $\Omega$ (unless otherwise noted) (see Note 3)

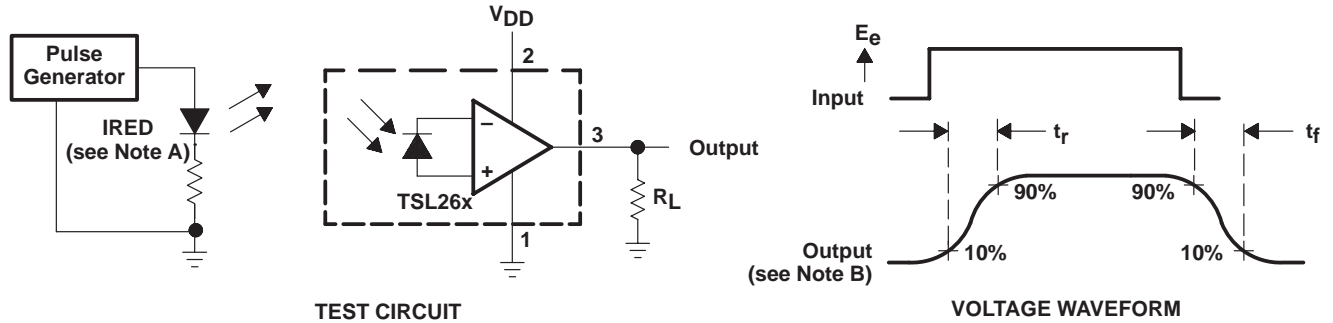
PARAMETER	TEST CONDITIONS	TSL260			TSL261			TSL262			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
$V_{DARK}$ Dark voltage	$E_e = 0$		3	10		3	10		3	10	mV
$V_{OM}$ Maximum output	$E_e = 2.6$ mW/cm <sup>2</sup>	3.1	3.5		3.1	3.5		3.1	3.5		V
$V_O$ Output voltage	$E_e = 48$ $\mu$ W/cm <sup>2</sup>	1	2	3							V
	$E_e = 87$ $\mu$ W/cm <sup>2</sup>				1	2	3				
	$E_e = 525$ $\mu$ W/cm <sup>2</sup>							1	2	3	
Temperature coefficient of output voltage ( $V_O$ )	$E_e = 48$ $\mu$ W/cm <sup>2</sup> , $T_A = 0^\circ\text{C}$ to $70^\circ\text{C}$		$\pm 1$								mV/°C
	$E_e = 87$ $\mu$ W/cm <sup>2</sup> , $T_A = 0^\circ\text{C}$ to $70^\circ\text{C}$					$\pm 1$					
	$E_e = 525$ $\mu$ W/cm <sup>2</sup> , $T_A = 0^\circ\text{C}$ to $70^\circ\text{C}$								$\pm 1$		
$N_e$ Irradiance responsivity	See Note 4		42			23			3.8		mV/( $\mu$ W/cm <sup>2</sup> )
$I_{DD}$ Supply current	$E_e = 48$ $\mu$ W/cm <sup>2</sup> , No load		900	1600							$\mu$ A
	$E_e = 87$ $\mu$ W/cm <sup>2</sup> , No load					900	1600				
	$E_e = 525$ $\mu$ W/cm <sup>2</sup> , No load								900	1600	

- NOTES: 3. The input irradiance  $E_e$  is supplied by a GaAs infrared-emitting diode with  $\lambda_p = 940$  nm.  
4. Irradiance responsivity is characterized over the range  $V_O = 0.05$  to 3 V.

operating characteristics at  $T_A = 25^\circ\text{C}$  (see Figure 1)

PARAMETER	TEST CONDITIONS	TSL260			TSL261			TSL262			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
$t_r$	Output pulse rise time	$V_{DD} = 5\text{ V}$ , $\lambda_p = 940\text{ nm}$		360	90			7			$\mu\text{s}$
$t_f$	Output pulse fall time	$V_{DD} = 5\text{ V}$ , $\lambda_p = 940\text{ nm}$		360	90			7			$\mu\text{s}$
$V_n$	Output noise voltage	$V_{DD} = 5\text{ V}$ , $f = 20\text{ Hz}$		0.6	0.5			0.4			$\mu\text{V}/\sqrt{\text{Hz}}$

## PARAMETER MEASUREMENT INFORMATION



- NOTES: A. The input irradiance is supplied by a pulsed GaAs infrared-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:  $t_r < 100\text{ ns}$ ,  $Z_i \geq 1\text{ MHz}$ ,  $C_i \leq 20\text{ pF}$ .

Figure 1. Switching Times

## TYPICAL CHARACTERISTICS

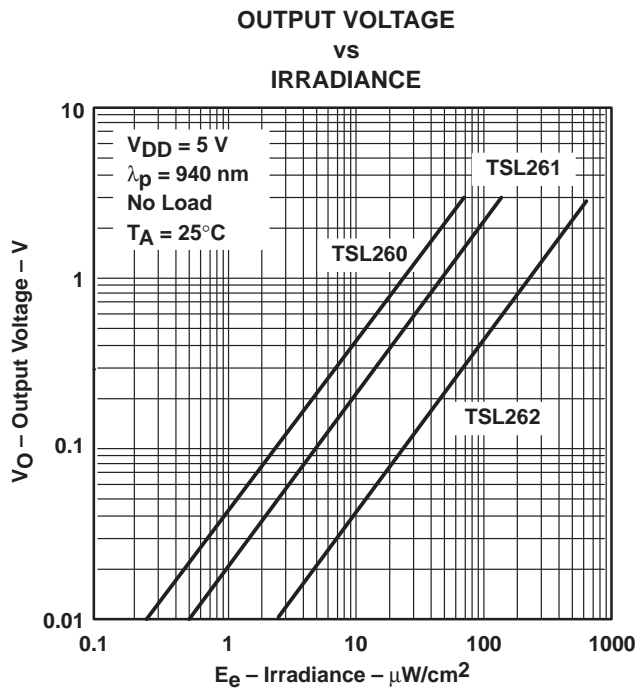


Figure 2

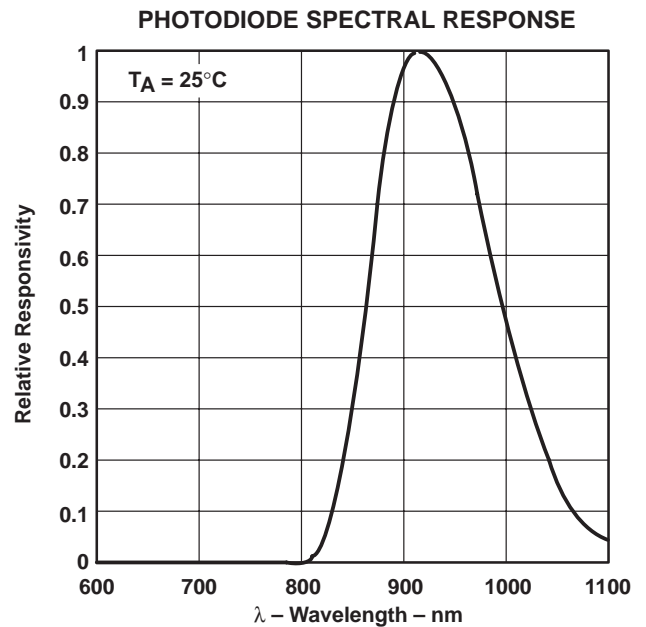


Figure 3

# TSL260, TSL261, TSL262 IR LIGHT-TO-VOLTAGE OPTICAL SENSORS

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## TYPICAL CHARACTERISTICS

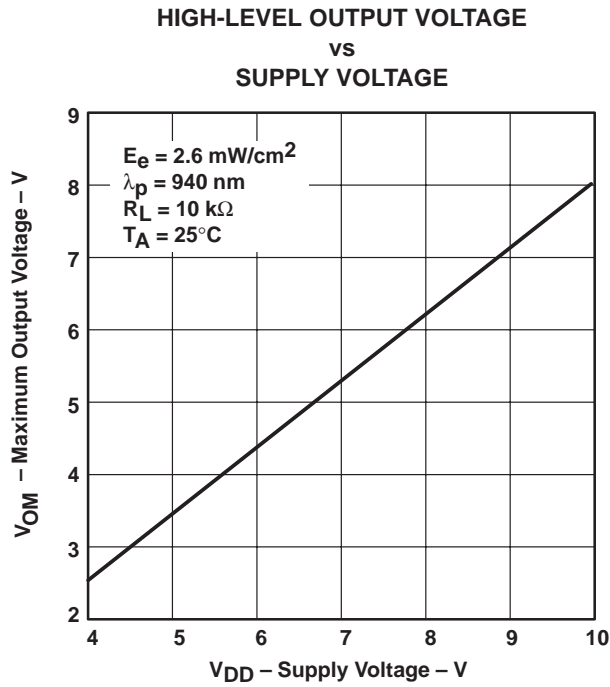


Figure 4

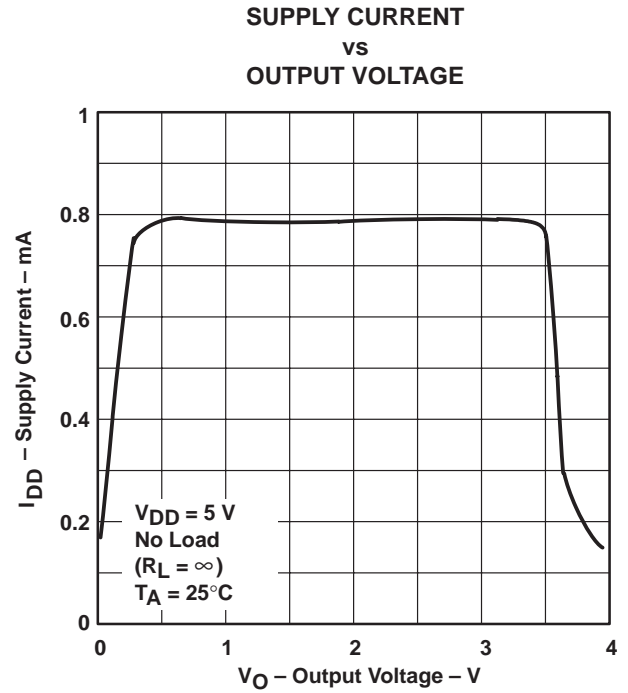


Figure 5

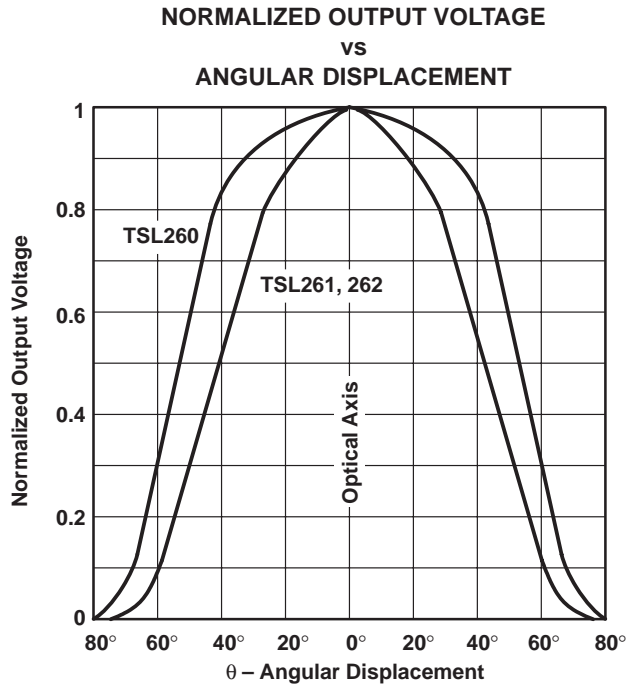
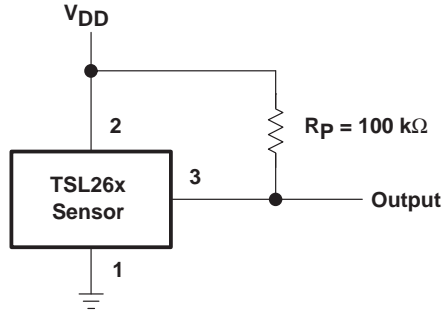


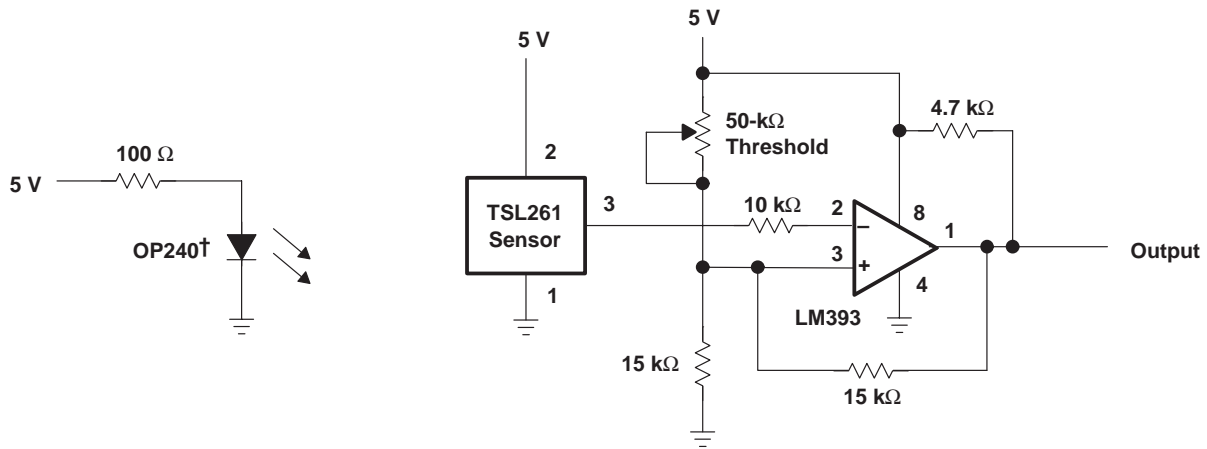
Figure 6

APPLICATION INFORMATION



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

Figure 7. Pullup for Increased V<sub>OM</sub>



† OPTEK part number

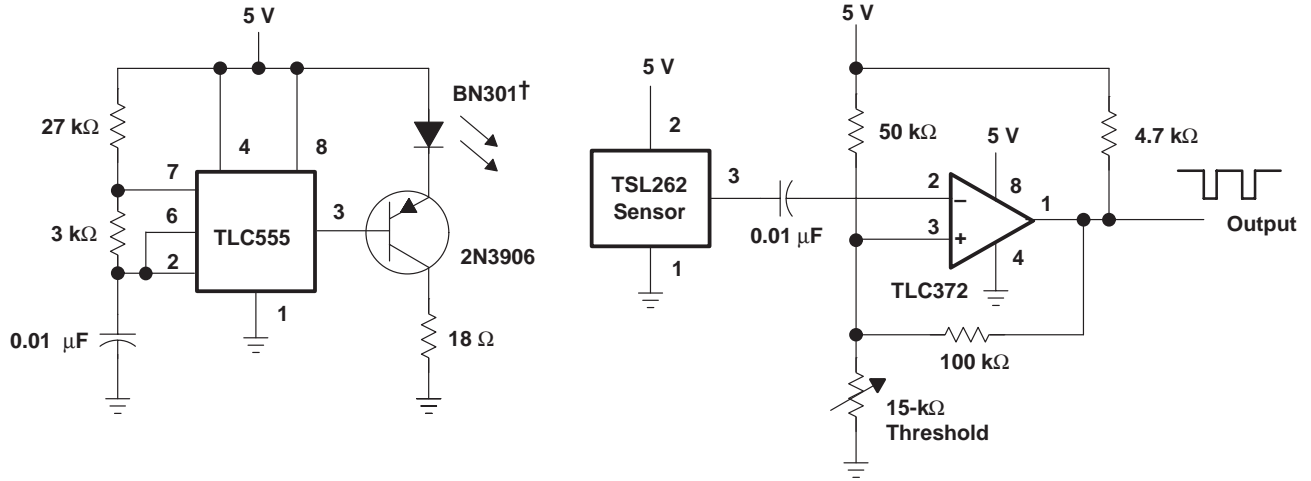
NOTE A: Output goes high when beam is interrupted; working distance is several inches or less. Intended for use as optical-interrupter switch or reflective-object sensor.

Figure 8. Short-Range Optical Switch With Hysteresis

# TSL260, TSL261, TSL262 IR LIGHT-TO-VOLTAGE OPTICAL SENSORS

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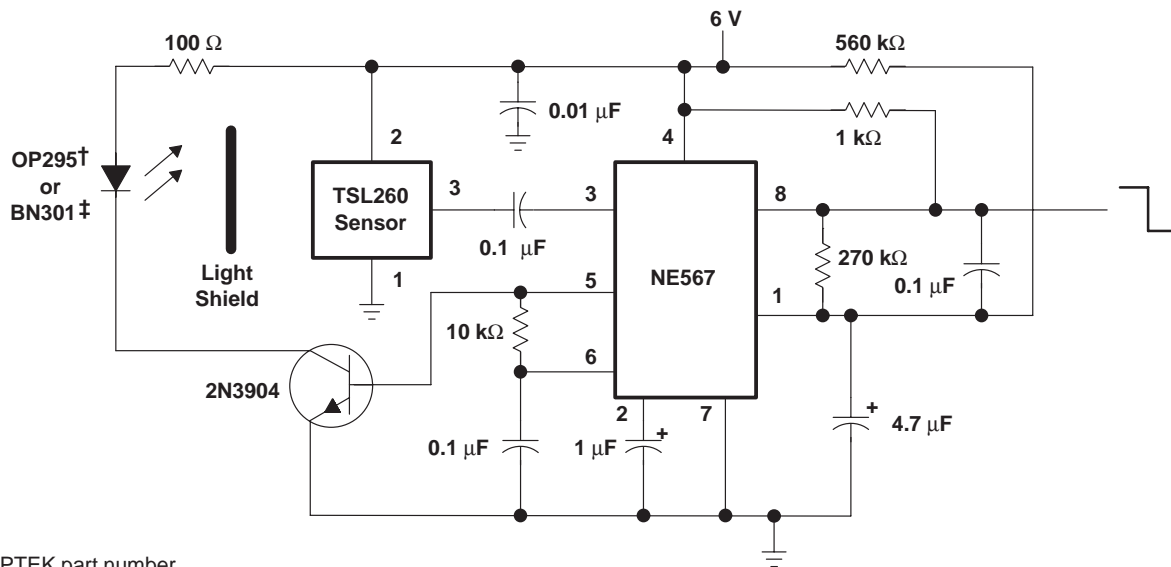
## APPLICATION INFORMATION



† 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



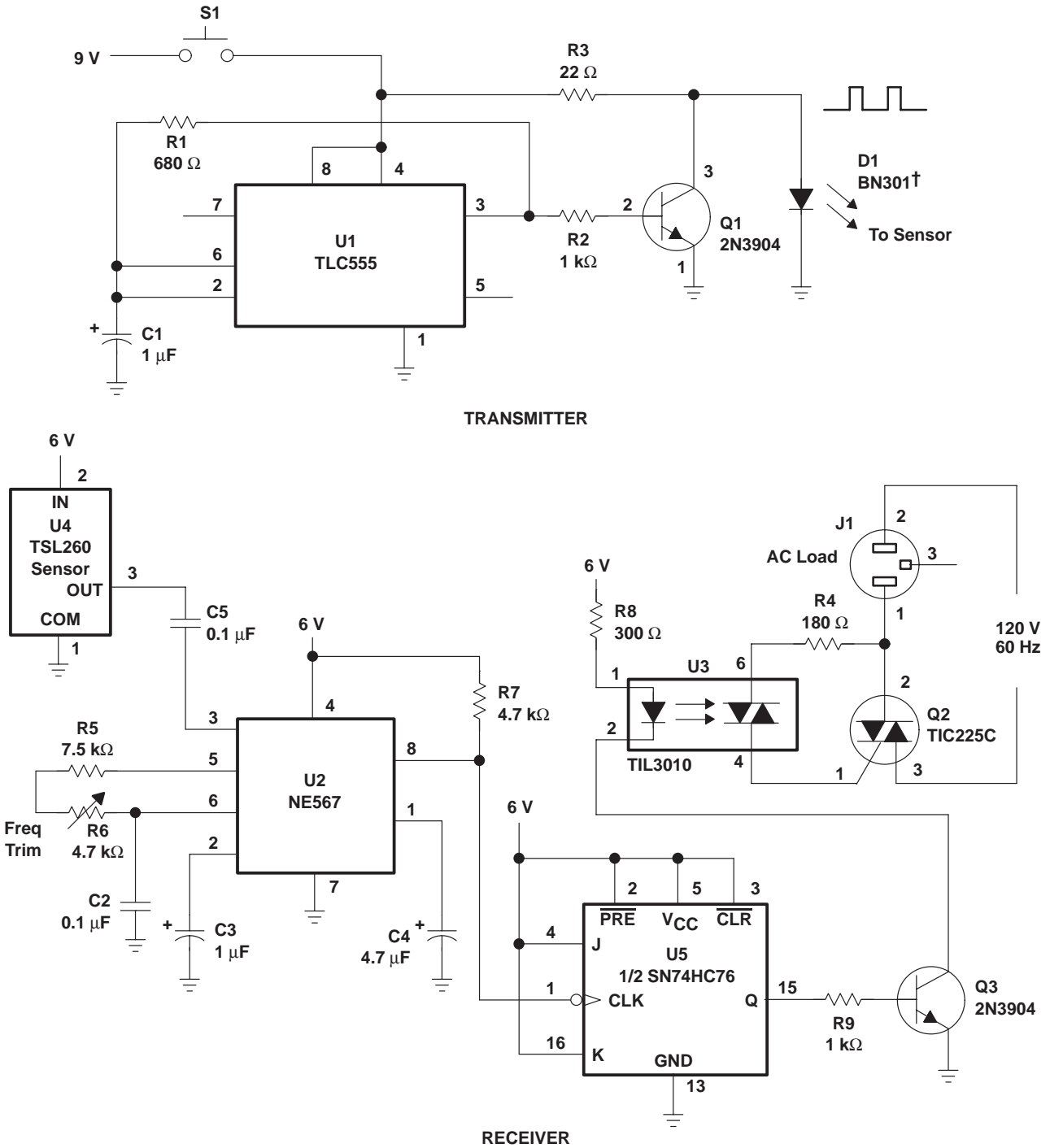
† OPTEK part number

‡ 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

APPLICATION INFORMATION



† OPTEK part number

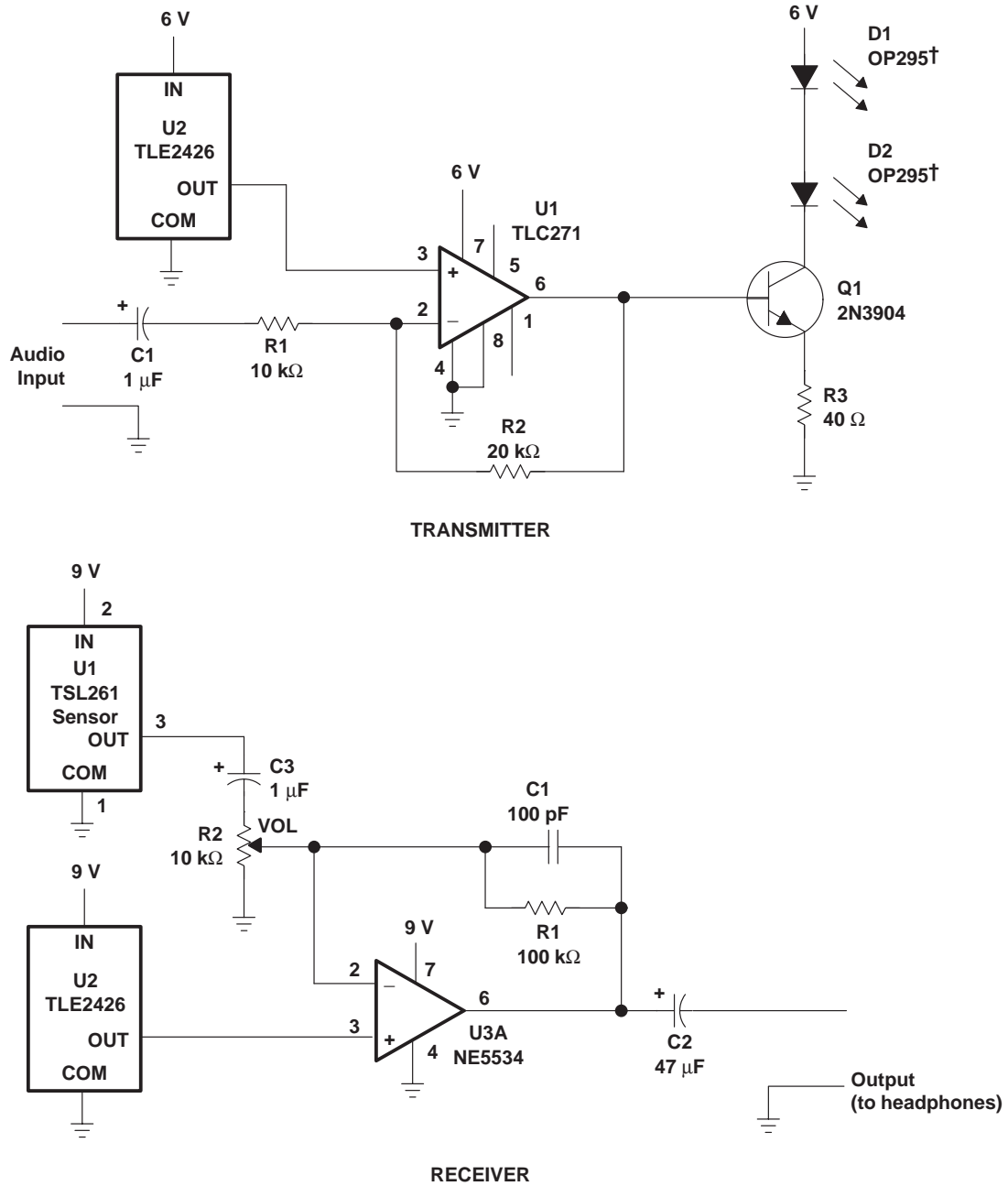
NOTE A: Single-channel remote control can be used to switch logic or light dc loads by way of U5 or ac loads by way of the optocoupler and triac as shown. Applications include ceiling fans, lamps, electric heaters, etc.

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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