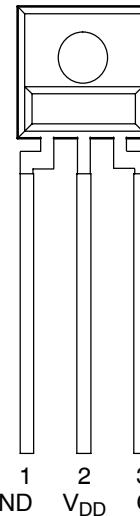
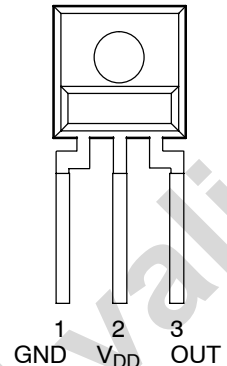


- Monolithic Silicon IC Containing Photodiode, Operational Amplifier, and Feedback Components
- Converts Light Intensity to a Voltage
- Irradiance Responsivity, Typically 9 mV/( $\mu\text{W}/\text{cm}^2$ ) at  $\lambda_p = 635 \text{ nm}$
- Compact 3-Lead Clear Plastic Package
- Single Voltage Supply Operation
- Low Dark (Offset) Voltage....10 mV Max
- Low Supply Current.....1.1 mA Typical
- Wide Supply-Voltage Range.... 2.7 V to 5.5 V
- Replacement for TSL254
- RoHS Compliant (–LF Package Only)

**PACKAGE S**  
**SIDELOOKER**  
**(FRONT VIEW)**



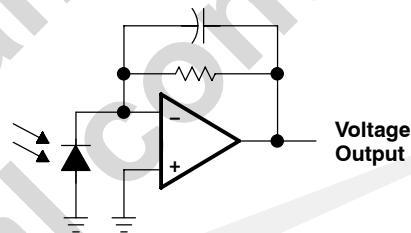
**PACKAGE SM**  
**SURFACE MOUNT**  
**SIDELOOKER**  
**(FRONT VIEW)**



## Description

The TSL254R is a light-to-voltage optical sensor combining a photodiode and a transimpedance amplifier (feedback resistor = 1 M $\Omega$ ) on a single monolithic IC. Output voltage is directly proportional to the light intensity (irradiance) on the photodiode. The device has improved amplifier offset-voltage stability and low power consumption and is supplied in a 3-lead clear plastic sidelooker package with an integral 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
TSL254R	0°C to 70°C	3-lead Sidelooker	S	TSL254R
TSL254R	0°C to 70°C	3-lead Sidelooker — Lead (Pb) Free	S	TSL254R-LF
TSL254R	0°C to 70°C	3-lead Surface-Mount Sidelooker — Lead (Pb) Free	SM	TSL254RSM-LF

## Terminal Functions

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

# TSL254R LIGHT-TO-VOLTAGE OPTICAL SENSOR

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

Supply voltage, $V_{DD}$ (see Note 1)	6 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, $T_{stg}$	-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

<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, $V_{DD}$	2.7		5.5	V
Operating free-air temperature, $T_A$	0		70	°C

## Electrical Characteristics at $V_{DD} = 5$ V, $T_A = 25^\circ\text{C}$ , $\lambda_p = 635$ nm, $R_L = 10$ k $\Omega$ (unless otherwise noted) (see Notes 3, 4, and 5)

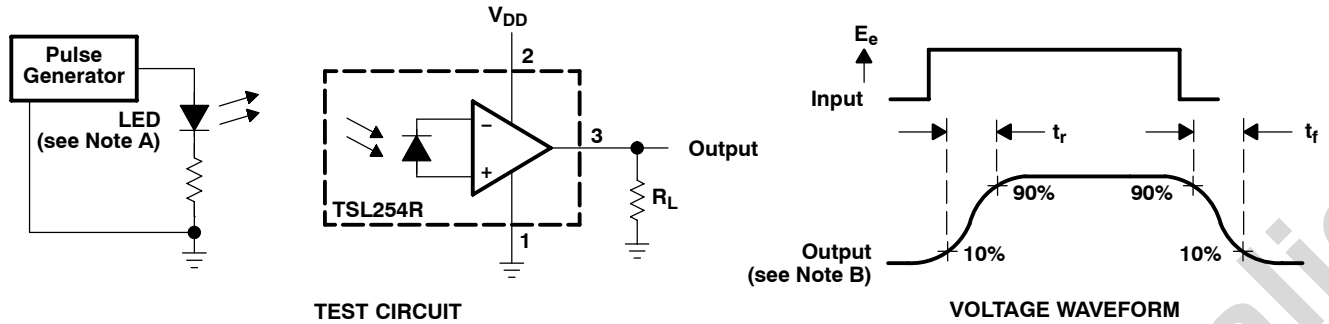
PARAMETER	TEST CONDITIONS	TSL254R			UNIT
		MIN	TYP	MAX	
$V_D$ Dark voltage	$E_e = 0$	0	5	10	mV
$V_{OM}$ Maximum output voltage	$V_{DD} = 4.5$ V	3.0	3.3		V
$V_O$ Output voltage	$E_e = 222 \mu\text{W}/\text{cm}^2$	1.5	2	2.5	V
$\alpha_{V_O}$ Temperature coefficient of output voltage ( $V_O$ )	$V_O = 2$ V @ 25°C, $T_A = 0^\circ\text{C}$ to 70°C (see Note 6)	2			mV/°C
		0.1			%/°C
$R_e$ Irradiance responsivity	See Notes 5 and 7	9			mV/( $\mu\text{W}/\text{cm}^2$ )
$I_{DD}$ Supply current	$E_e = 222 \mu\text{W}/\text{cm}^2$	1.1	1.7		mA

- NOTES: 3. Measurements are made with  $R_L = 10$  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 an AlInGaP LED with peak wavelength  $\lambda_p = 635$  nm  
6. The temperature coefficient of output voltage measurement is made by adjusting irradiance such that  $V_O$  is approximately 2 V at 25°C and then with irradiance held constant, measuring  $V_O$  while varying the temperature between 0°C and 70°C.  
7. 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 $V_{DD} = 5$ V, $T_A = 25^\circ\text{C}$ , $\lambda_p = 635$ nm, $R_L = 10$ k $\Omega$ (see Figure 1)

PARAMETER	TEST CONDITIONS	TSL254R			UNIT
		MIN	TYP	MAX	
$t_r$ Output pulse rise time	$V_{O(\text{peak})} = 2$ V	2.5			$\mu\text{s}$
$t_f$ Output pulse fall time	$V_{O(\text{peak})} = 2$ V	2.5			$\mu\text{s}$
$V_n$ Output noise voltage	$E_e = 0$ , $V_O = V_D$ $f = 1$ kHz	1			$\mu\text{V}/\sqrt{\text{Hz}}$
	$E_e = 0$ , $V_O = V_D$ $f = 10$ kHz	1			
	$V_O = 2$ V $f = 1$ kHz	1.5			
	$V_O = 2$ V $f = 10$ kHz	1.5			

PARAMETER MEASUREMENT INFORMATION



- NOTES: A. The input irradiance is supplied by a pulsed AlInGaP light-emitting diode with the following characteristics:  $\lambda_p = 635 \text{ nm}$ ,  $t_r < 1 \mu\text{s}$ ,  $t_f < 1 \mu\text{s}$ .
- 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

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## TYPICAL CHARACTERISTICS

**OUTPUT VOLTAGE  
vs  
IRRADIANCE**

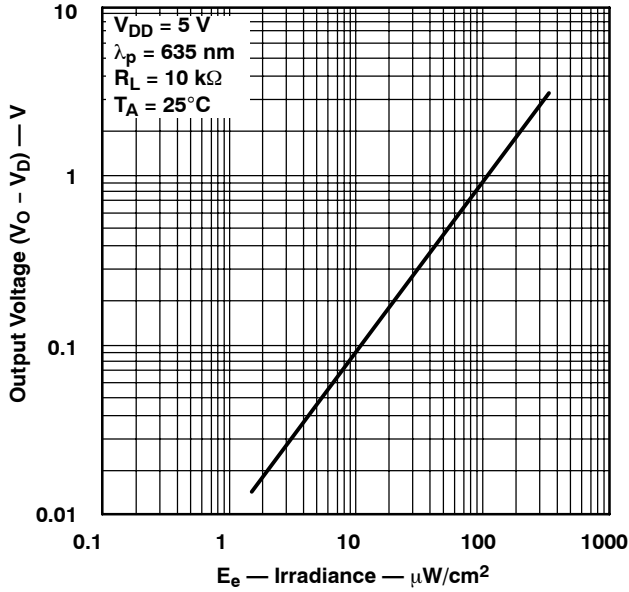


Figure 2

**PHOTODIODE SPECTRAL RESPONSIVITY**

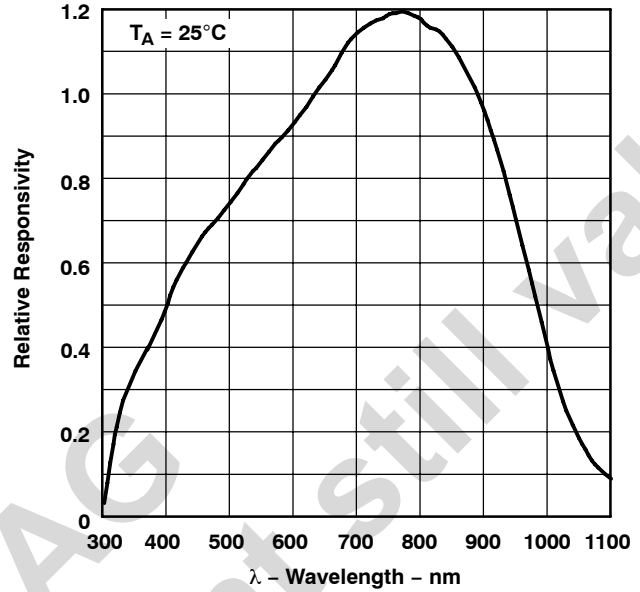


Figure 3

**MAXIMUM OUTPUT VOLTAGE  
vs  
SUPPLY VOLTAGE**

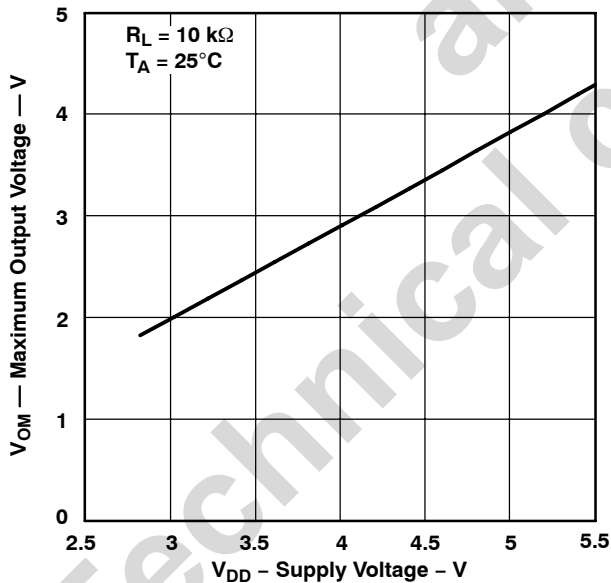


Figure 4

**SUPPLY CURRENT  
vs  
OUTPUT VOLTAGE**

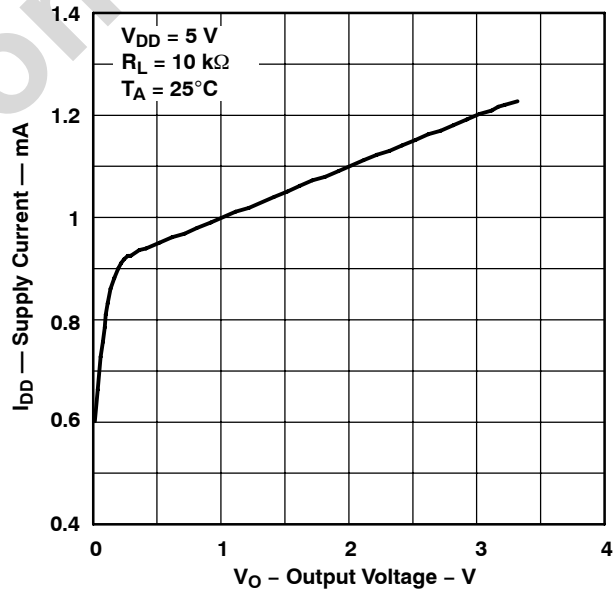


Figure 5



TYPICAL CHARACTERISTICS

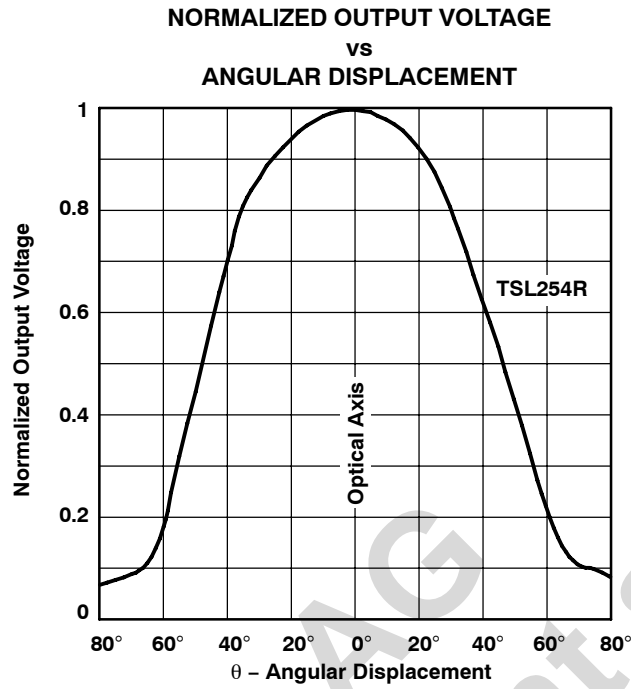


Figure 6

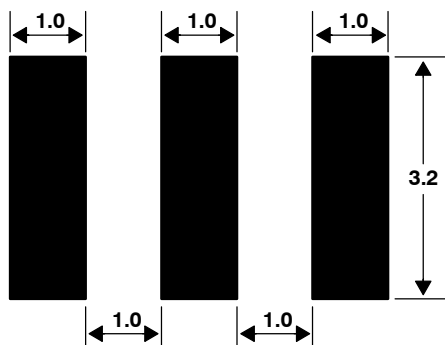
# TSL254R LIGHT-TO-VOLTAGE OPTICAL SENSOR

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## APPLICATION INFORMATION

### PCB Pad Layout

Suggested PCB pad layout guidelines for the SM surface mount package are shown in Figure 7.



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

**Figure 7. Suggested SM Package PCB Layout**

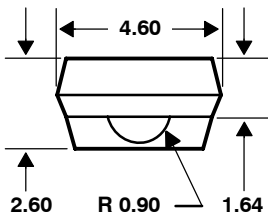
MECHANICAL INFORMATION

The device is supplied in a clear plastic three-lead package (S). The integrated photodiode active area is typically 1,0 mm<sup>2</sup> (0.0016 in<sup>2</sup>).

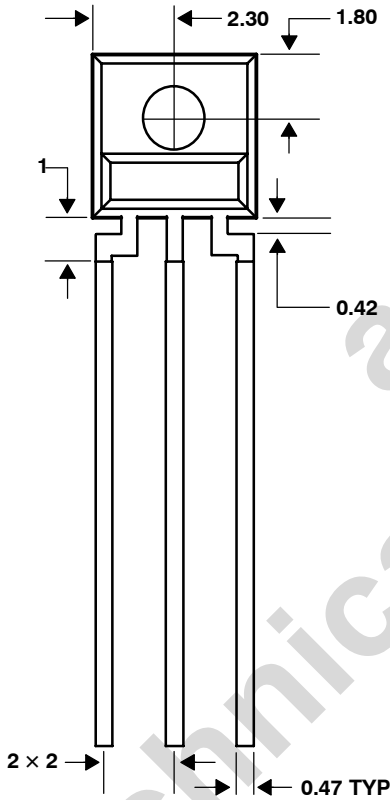
PACKAGE S

PLASTIC SINGLE-IN-LINE SIDE-LOOKER PACKAGE

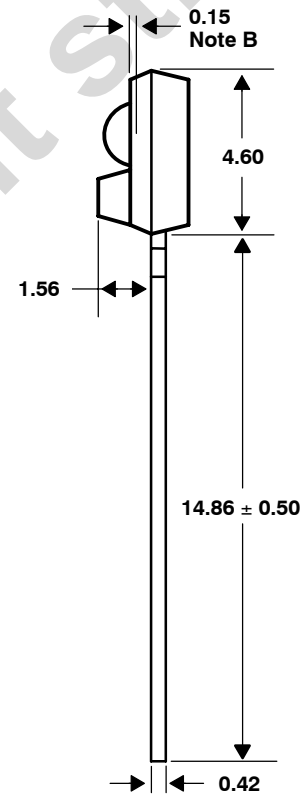
TOP VIEW



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 TSL254R solder dipped, 63% Sn/37% Pb. Lead finish for TSL254R-LF: solder dipped, 100% Sn.  
 F. This drawing is subject to change without notice.

Figure 8. Package S — Single-In-Line Side-Looker Package Configuration

# TSL254R LIGHT-TO-VOLTAGE OPTICAL SENSOR

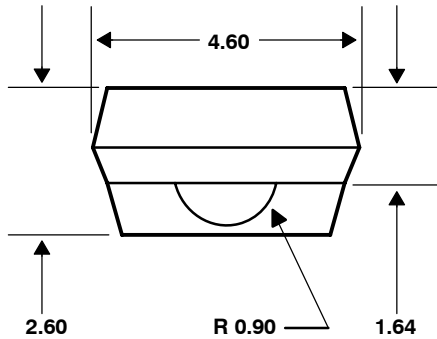
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## MECHANICAL DATA

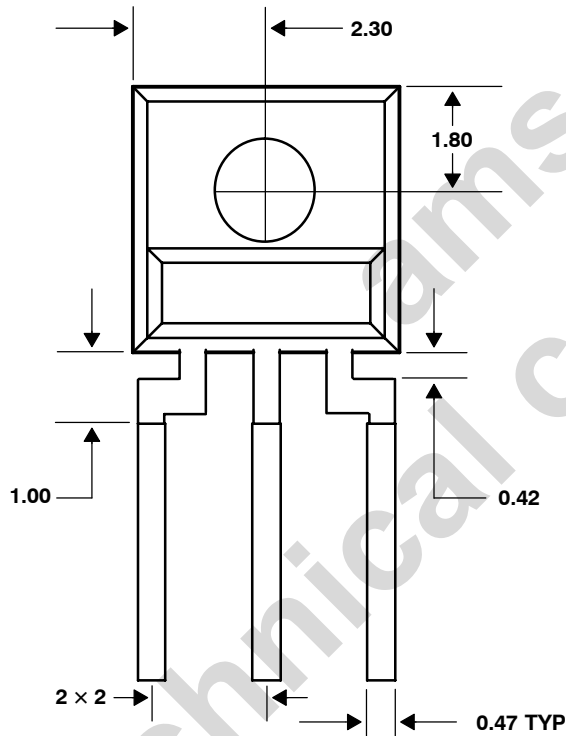
### PACKAGE SM

### PLASTIC SURFACE MOUNT SIDE-LOOKER PACKAGE

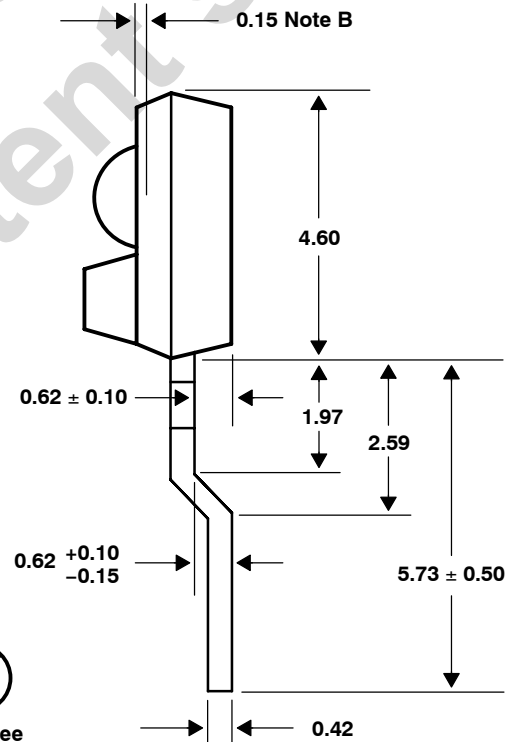
#### TOP VIEW



#### 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 TSL254RSM-LF: solder dipped, 100% Sn.  
 F. This drawing is subject to change without notice.

Figure 9. Package SM — Surface Mount Side-Looker Package Configuration



**PRODUCTION DATA** — information in this document is current at publication date. Products conform to specifications in accordance with the terms of Texas Advanced Optoelectronic Solutions, Inc. standard warranty. Production processing does not necessarily include testing of all parameters.

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**TSL254R**  
**LIGHT-TO-VOLTAGE OPTICAL SENSOR**

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