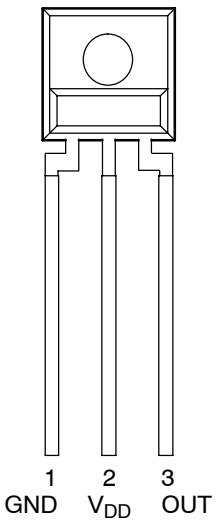
TSL254R
LIGHT-TO-VOLTAGE OPTICAL SENSOR

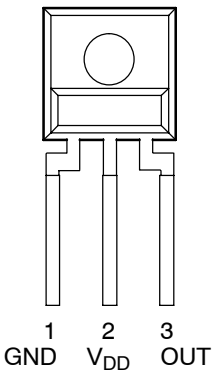
TAOS071C – SEPTEMBER 2007

- **Monolithic Silicon IC Containing Photodiode, Operational Amplifier, and Feedback Components**
- **Converts Light Intensity to a Voltage**
- **Irradiance Responsivity, Typically 9 mV/(μW/cm²) at λ_p = 635 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)



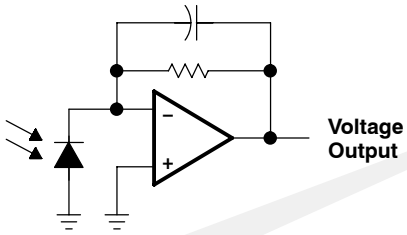
PACKAGE SM
SURFACE MOUNT
SIDELOOKER
(FRONT VIEW)



Description

The TSL254R is a light-to-voltage optical sensor combining a photodiode and a transimpedance amplifier (feedback resistor = 1 MΩ) 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_A	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	TERMINAL NO.	DESCRIPTION
GND	1	Ground (substrate). All voltages are referenced to GND.
OUT	3	Output voltage
V_{DD}	2	Supply voltage

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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

Electrical Characteristics at V_{DD} = 5 V, T_A = 25°C, λp = 635 nm, R_L = 10 kΩ (unless otherwise noted) (see Notes 3, 4, and 5)

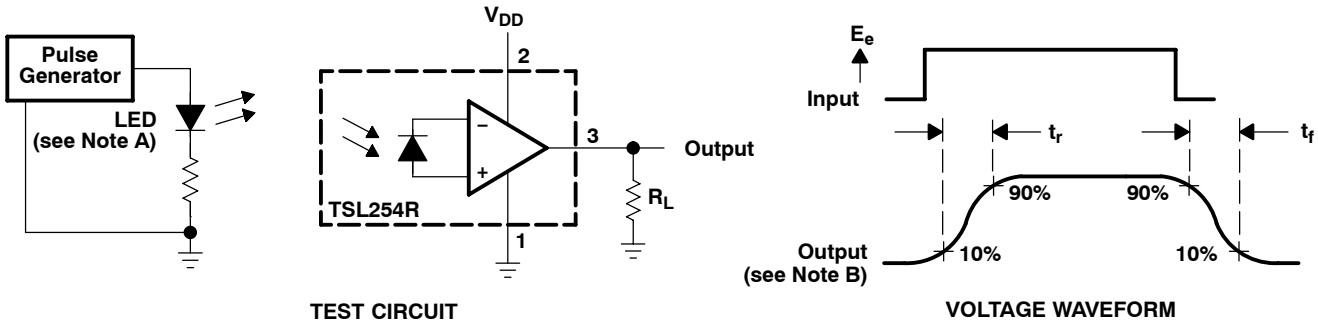
PARAMETER		TEST CONDITIONS	TSL254R			UNIT
			MIN	TYP	MAX	
V_D	Dark voltage	E_e = 0	0	5	10	mV
V_{OM}	Maximum output voltage	V_{DD} = 4.5 V	3.0	3.3		V
V_O	Output voltage	E_e = 222 μW/cm²	1.5	2	2.5	V
α_{vo}	Temperature coefficient of output voltage (V_O)	V_O = 2 V @ 25°C, T_A = 0°C to 70°C (see Note 6)		2		mV/°C
				0.1		%/°C
R_e	Irradiance responsivity	See Notes 5 and 7		9		mV/(μW/cm²)
I_{DD}	Supply current	E_e = 222 μW/cm²		1.1	1.7	mA

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 an AlInGaP LED with peak wavelength λ_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°C, λp = 635 nm, R_L = 10 kΩ (see Figure 1)

PARAMETER		TEST CONDITIONS		TSL254R			UNIT
				MIN	TYP	MAX	
t_r	Output pulse rise time	$V_{O(peak)}$ = 2 V			2.5		μs
t_f	Output pulse fall time	$V_{O(peak)}$ = 2 V			2.5		μs
V_n	Output noise voltage	E_e = 0, V_O = V_D	f = 1 kHz		1		μV/√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



TEST CIRCUIT VOLTAGE WAVEFORM

NOTES: A. The input irradiance is supplied by a pulsed AlInGaP light-emitting diode with the following characteristics: λ_p = 635 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

OUTPUT VOLTAGE vs IRRADIANCE

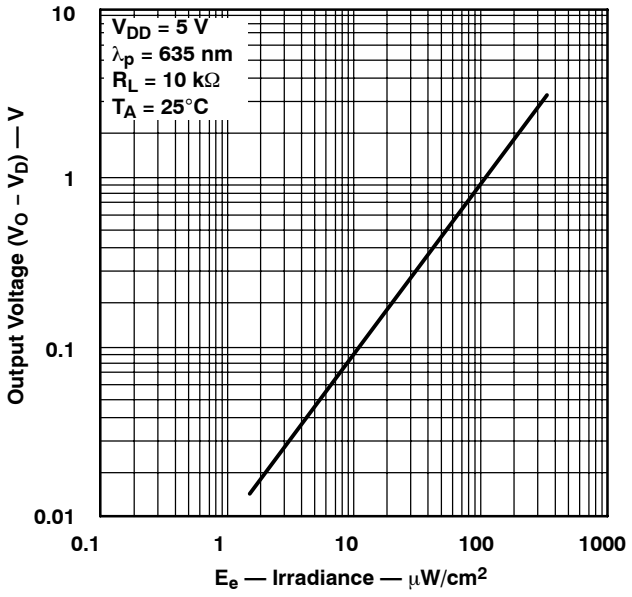


Figure 2

PHOTODIODE SPECTRAL RESPONSIVITY

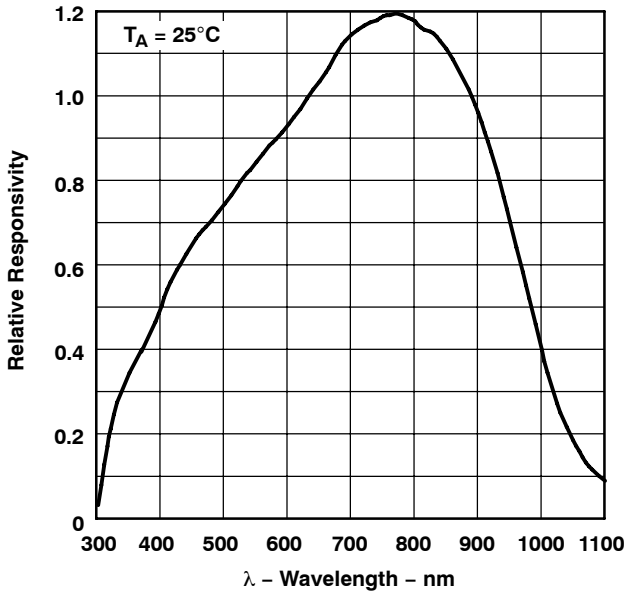


Figure 3

MAXIMUM OUTPUT VOLTAGE vs SUPPLY VOLTAGE

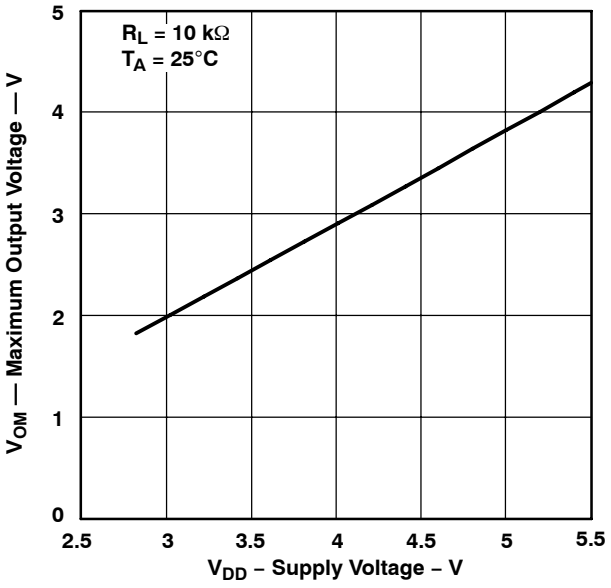


Figure 4

SUPPLY CURRENT vs OUTPUT VOLTAGE

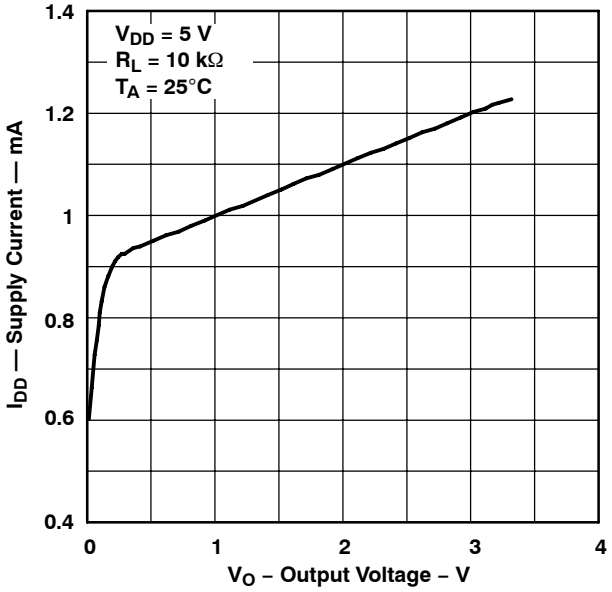


Figure 5

TYPICAL CHARACTERISTICS

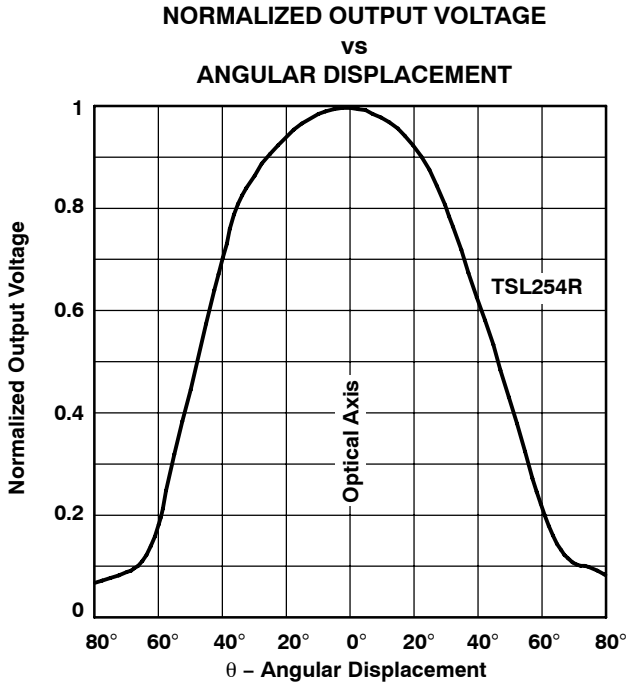
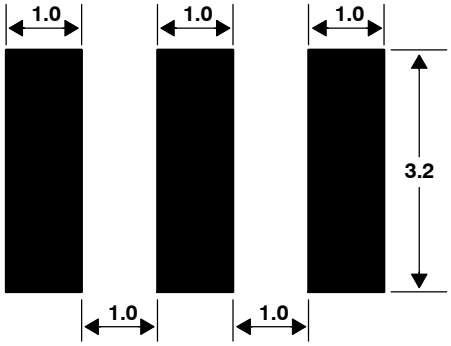


Figure 6

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.

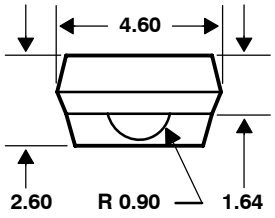
Figure 7. Suggested SM Package PCB Layout

MECHANICAL INFORMATION

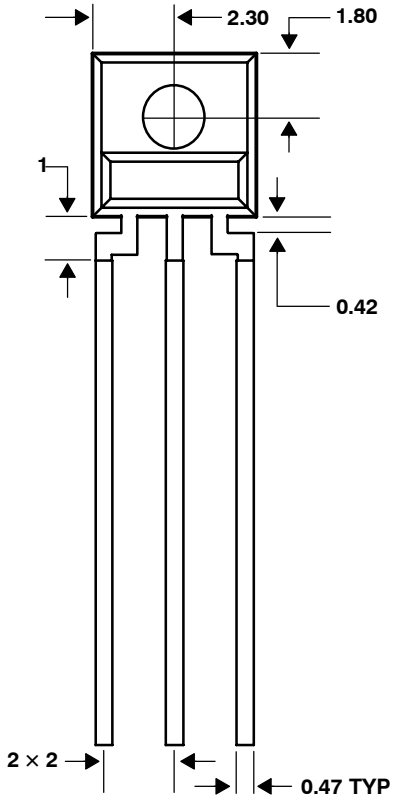
The device is supplied in a clear plastic three-lead package (S). The integrated photodiode active area is typically 1,0 mm^2 (0.0016 in^2).

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

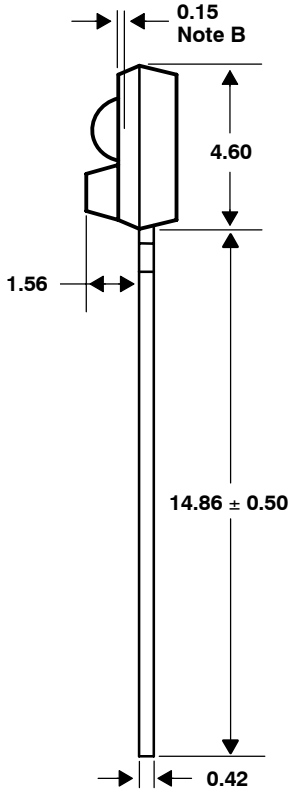
TOP VIEW



FRONT VIEW



SIDE VIEW



Pb
Lead Free Available

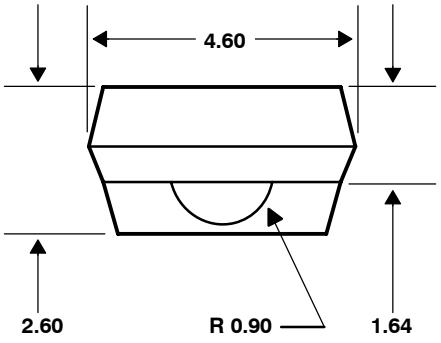
NOTES: A. All linear dimensions are in millimeters; tolerance is ± 0.25 mm unless otherwise stated.
B. Dimension is to center of lens arc, which is located below the package face.
C. The integrated photodiode active area is typically located in the center of the lens and 0.97 mm below the top of the lens surface.
D. Index of refraction of clear plastic is 1.55.
E. Lead finish for 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

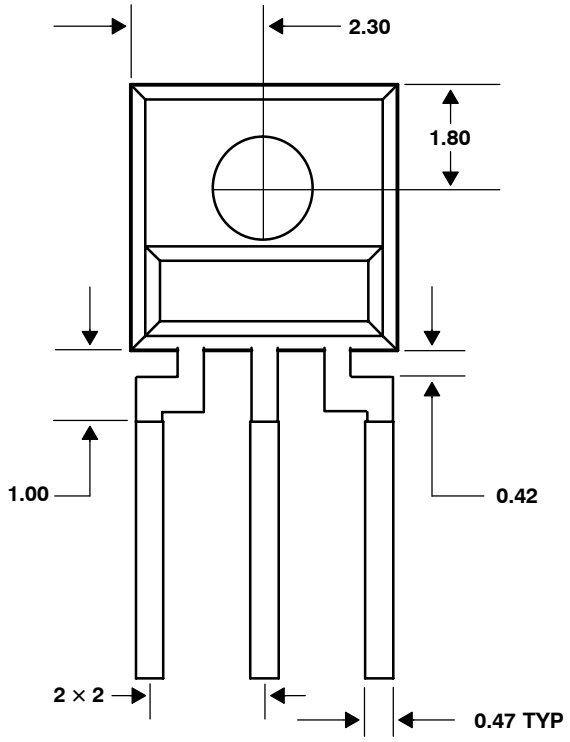
MECHANICAL DATA

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

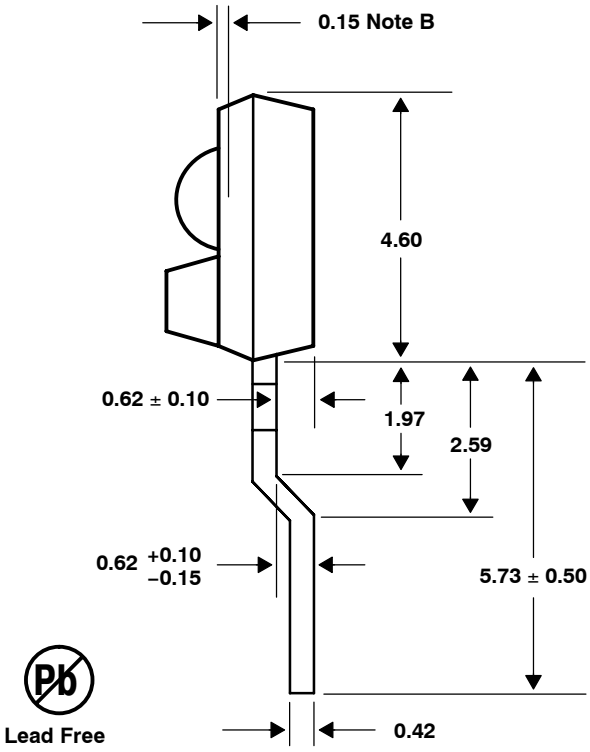
TOP VIEW



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 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

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