

TSL254R

Light-to-Voltage Optical Sensor

General Description

The TSL254R is a light-to-voltage optical sensor combining a photodiode and a transimpedance amplifier (feedback resistor = 1 M Ω) 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.

Ordering Information and Content Guide appear at end of datasheet.

Key Benefits & Features

The benefits and features of TSL254R, Light-to-Voltage Optical Sensor are listed below:

Figure 1:
Added Value of Using TSL254R

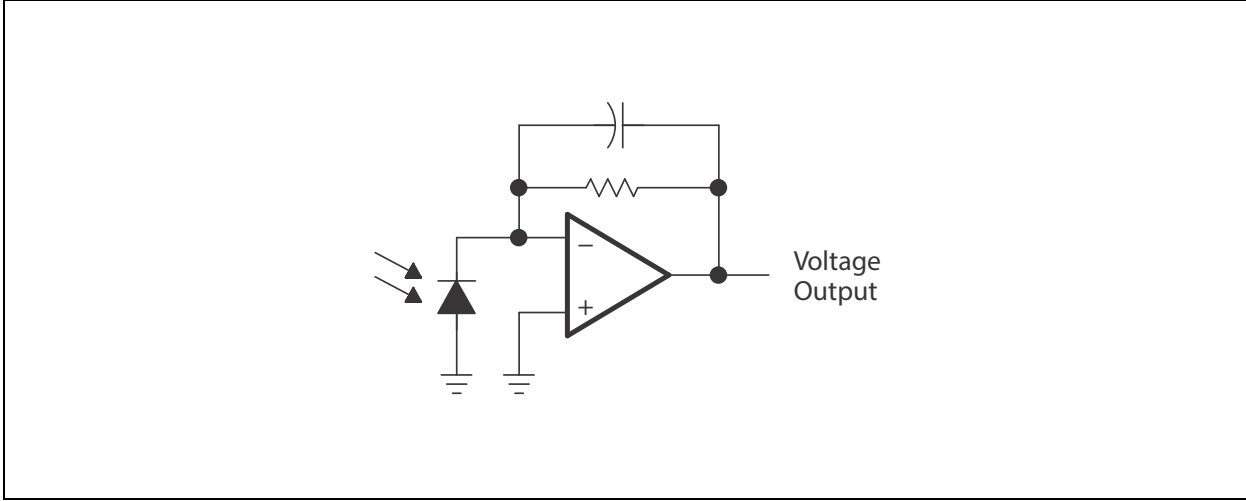
Benefits	Features
<ul style="list-style-type: none"> Enables Extremely Fast Response to Change 	<ul style="list-style-type: none"> Single Photo-Diode and Transimpedance Architecture
<ul style="list-style-type: none"> Enables Fast Response to Visible Light in Range of 400nm to 700nm Wavelengths 	<ul style="list-style-type: none"> 2.5μs Output Rise-Time Response
<ul style="list-style-type: none"> Provides for High Sensitivity to Detect a Small Change in Light 	<ul style="list-style-type: none"> High Irradiance Responsivity: Typically 9mV/(μW/cm²) at λ_p = 635nm
<ul style="list-style-type: none"> Provides Additional Sensitivity Advantages 	<ul style="list-style-type: none"> 2x Gain Lens

- Monolithic Silicon IC Containing Photodiode, Operational Amplifier, and Feedback Components
- Converts Light Intensity to a Voltage
- Compact 3-Lead Clear Plastic Package
- Single Voltage Supply Operation
- Low Dark (Offset) Voltage: 10mV Max
- Low Supply Current: 1.1mA Typical
- Wide Supply-Voltage Range: 2.7V to 5.5V
- Replacement for TSL254
- RoHS Compliant (-LF Package Only)

Functional Block Diagram

The functional blocks of this device are shown below:

Figure 2:
TSL254R Block Diagram



Pin Assignments

Figure 3:
Pin Diagram of Package S Sidelooker (Front View)

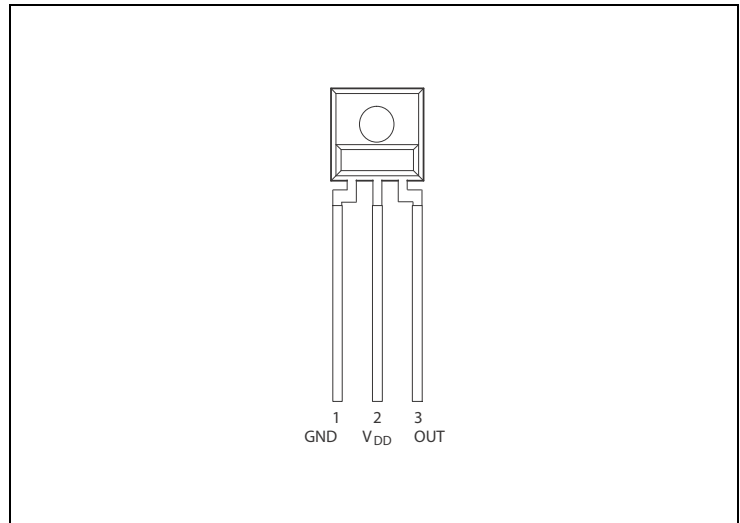


Figure 4:
Pin Diagram of Package SM Surface Mount Sidelooker (Front View)

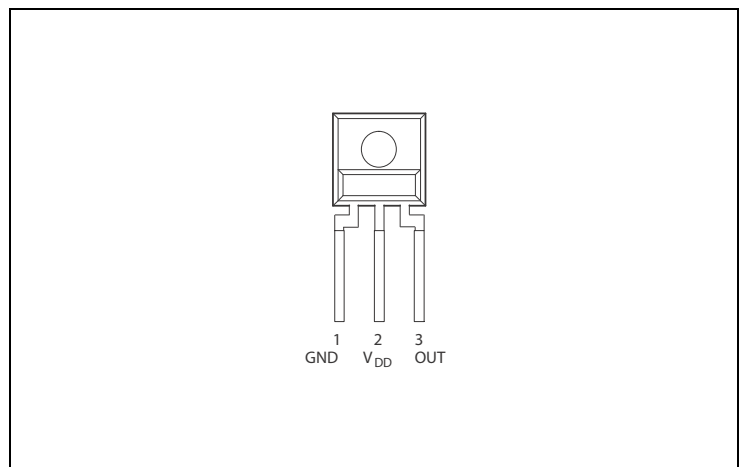


Figure 5:
Terminal Functions

Terminal		Description
No.	Name	
1	GND	Ground (substrate). All voltages are referenced to GND.
2	V _{DD}	Supply voltage
3	OUT	Output voltage

Absolute Maximum Ratings

Stresses beyond those listed under [Absolute Maximum Ratings](#) may cause permanent damage to the device. These are stress ratings only. Functional operation of the device at these or any other conditions beyond those indicated under [Operating Conditions](#) is not implied. Exposure to absolute maximum rating 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	Unit
V_{DD}	Supply voltage ⁽¹⁾		6	V
I_O	Output current		±10	mA
	Duration of short-circuit current at (or below) 25°C ⁽²⁾		5	s
T_A	Operating free-air temperature range	-25	85	°C
T_{STRG}	Storage temperature range	-25	85	°C
	Lead temperature 1.6mm (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.

Electrical Characteristics

All limits are guaranteed. The parameters with min and max values are guaranteed with production tests or SQC (Statistical Quality Control) methods.

Operating Conditions

All defined tolerances for external components in this specification need to be assured over the whole operation condition range and also over lifetime.

Figure 7:
Recommended Operating Conditions

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

Figure 8:
Electrical Characteristics at $V_{DD}=5V$, $T_A=25^\circ\text{C}$, $\lambda_p=635\text{nm}$, $R_L=10\text{k}\Omega$ (unless otherwise noted) ⁽¹⁾ ⁽²⁾ ⁽³⁾

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_D	Dark voltage	$E_e = 0$	0	5	10	mV
V_{OM}	Maximum output voltage	$V_{DD} = 4.5V$	3.0	3.3		V
V_O	Output voltage	$E_e = 222\mu\text{W}/\text{cm}^2$	1.5	2	2.5	V
α_{vo}	Temperature coefficient of output voltage (V_O)	$V_O = 2V @ 25^\circ\text{C}$, $T_A = 0^\circ\text{C} \text{ to } 70^\circ\text{C}$ ⁽⁴⁾		2		mV/°C
				0.1		%/°C
R_e	Irradiance responsivity	See notes ⁽³⁾ and ⁽⁵⁾		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

Note(s):

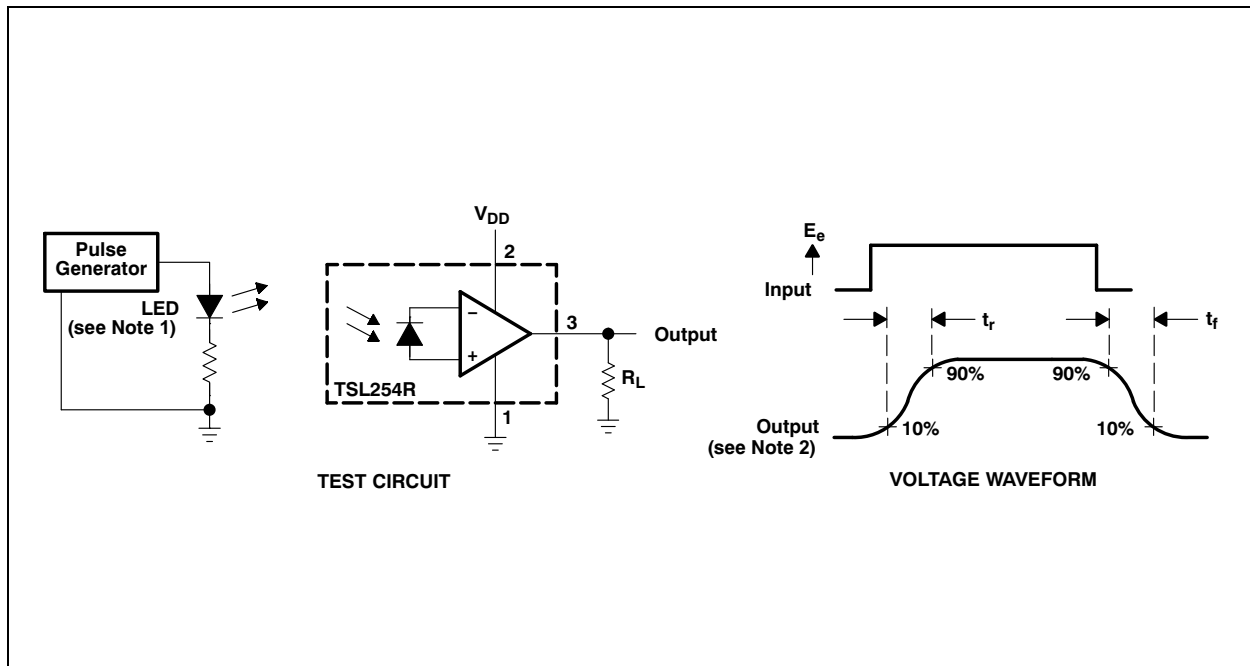
- Measurements are made with $R_L = 10\text{k}\Omega$ between output and ground.
- Optical measurements are made using small-angle incident radiation from an LED optical source.
- The input irradiance E_e is supplied by an AlInGaP LED with peak wavelength $\lambda_p = 635\text{nm}$.
- The temperature coefficient of output voltage measurement is made by adjusting irradiance such that V_O is approximately 2V at 25°C and then with irradiance held constant, measuring V_O while varying the temperature between 0°C and 70°C.
- Irradiance responsivity is characterized over the range $V_O = 0.05$ to 2.9V. 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 $V_{DD} = 5V$, $T_A = 25^\circ C$, $\lambda_p = 635nm$, $R_L = 10k\Omega$ (see Figure 10)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
t_r	Output pulse rise time	$V_{O(peak)} = 2V$		2.5		μs
t_f	Output pulse rise time	$V_{O(peak)} = 2V$		2.5		μs
V_n	Output noise voltage	$E_e = 0, V_O = V_D, f = 1kHz$		1		$\frac{\mu V}{\sqrt{Hz}}$
		$E_e = 0, V_O = V_D, f = 10kHz$		1		
		$V_O = 2V, f = 1kHz$		1.5		
		$V_O = 2V, f = 10kHz$		1.5		

Parameter Measurement Information

Figure 10:
Switching Times



Note(s):

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

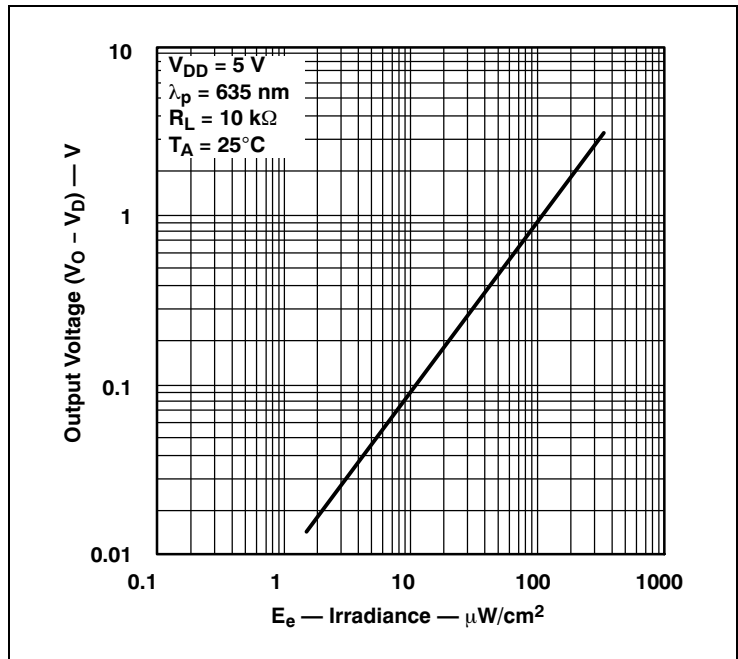


Figure 12: Photodiode Spectral Responsivity

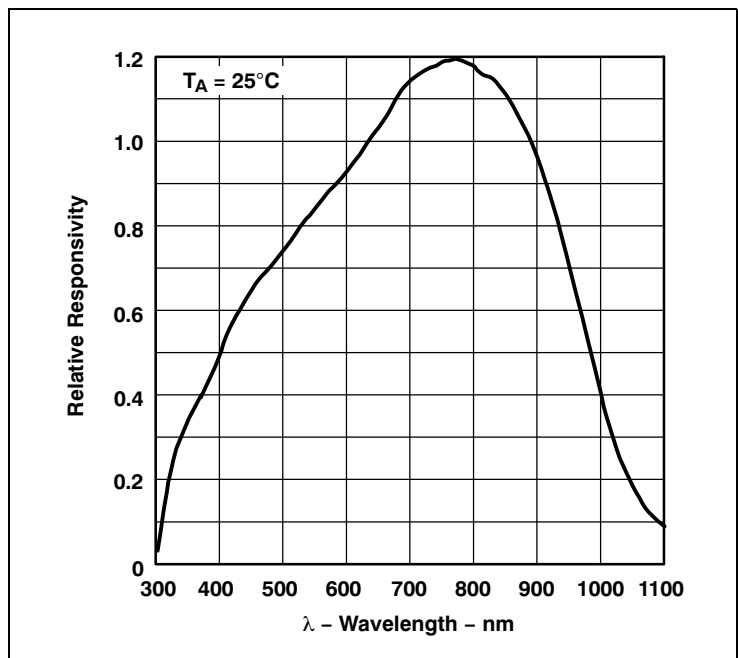


Figure 13:
Maximum Output Voltage vs. Supply Voltage

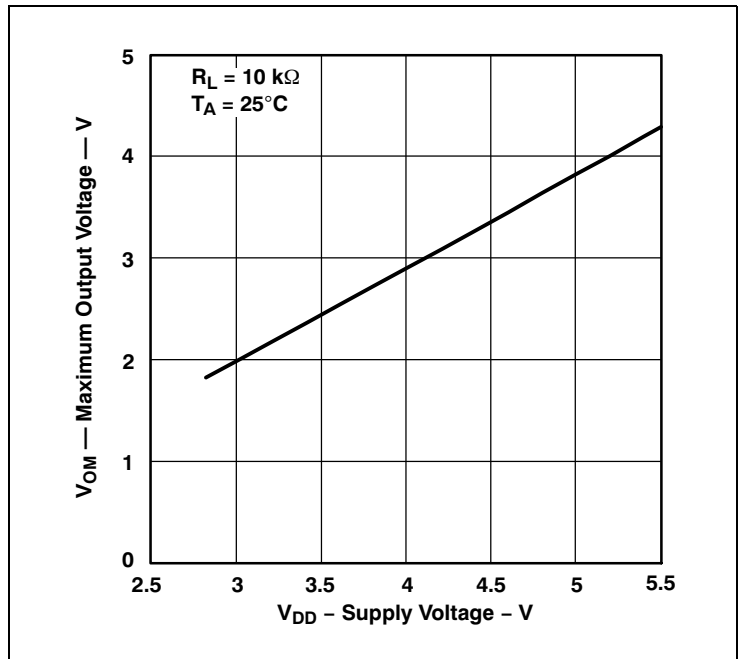


Figure 14:
Supply Current vs. Output Voltage

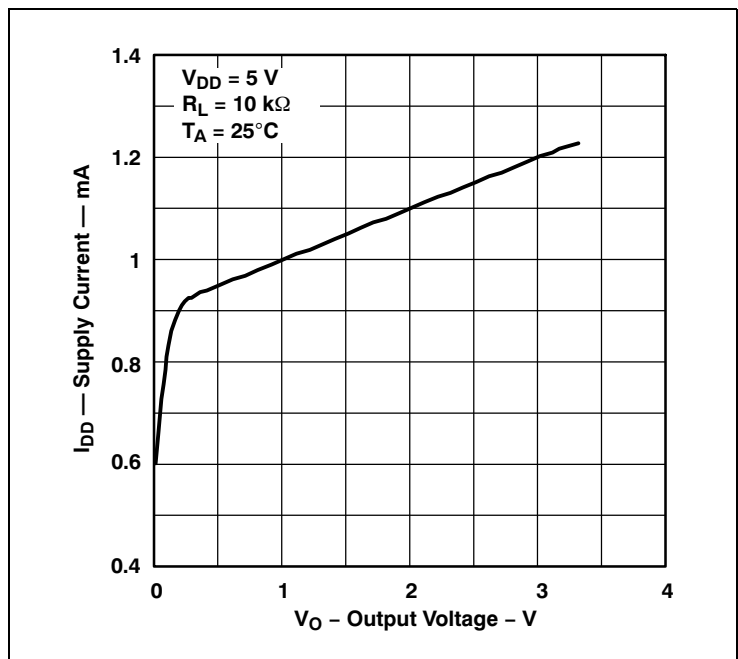
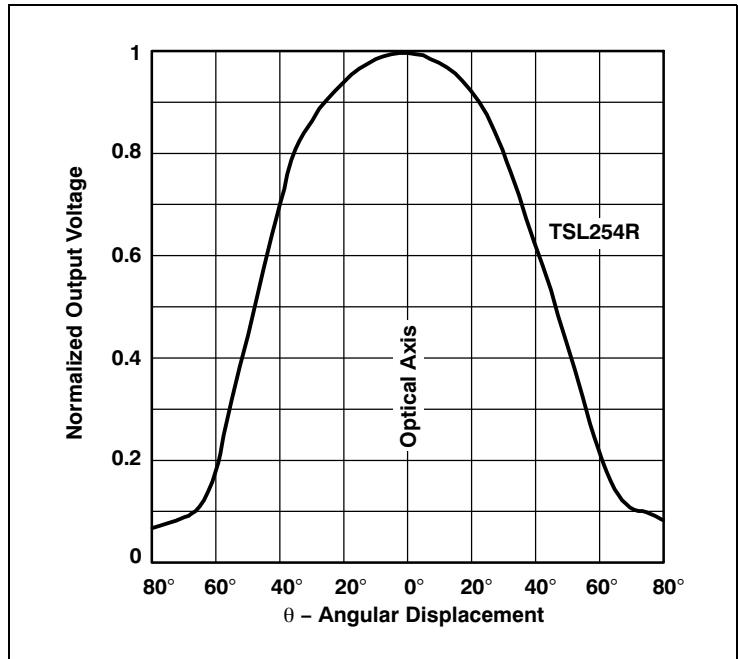


Figure 15:
Normalized Output Voltage vs. Angular Displacement

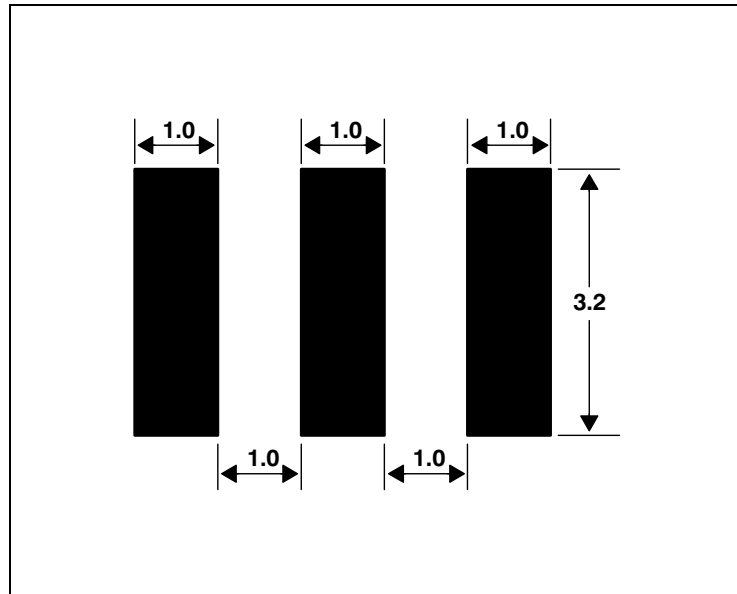


Application Information

PCB Pad Layout

Suggested PCB pad layout guidelines for the SM surface mount package are shown in [Figure 16](#).

Figure 16:
Suggested SM Package PCB Layout



Note(s):

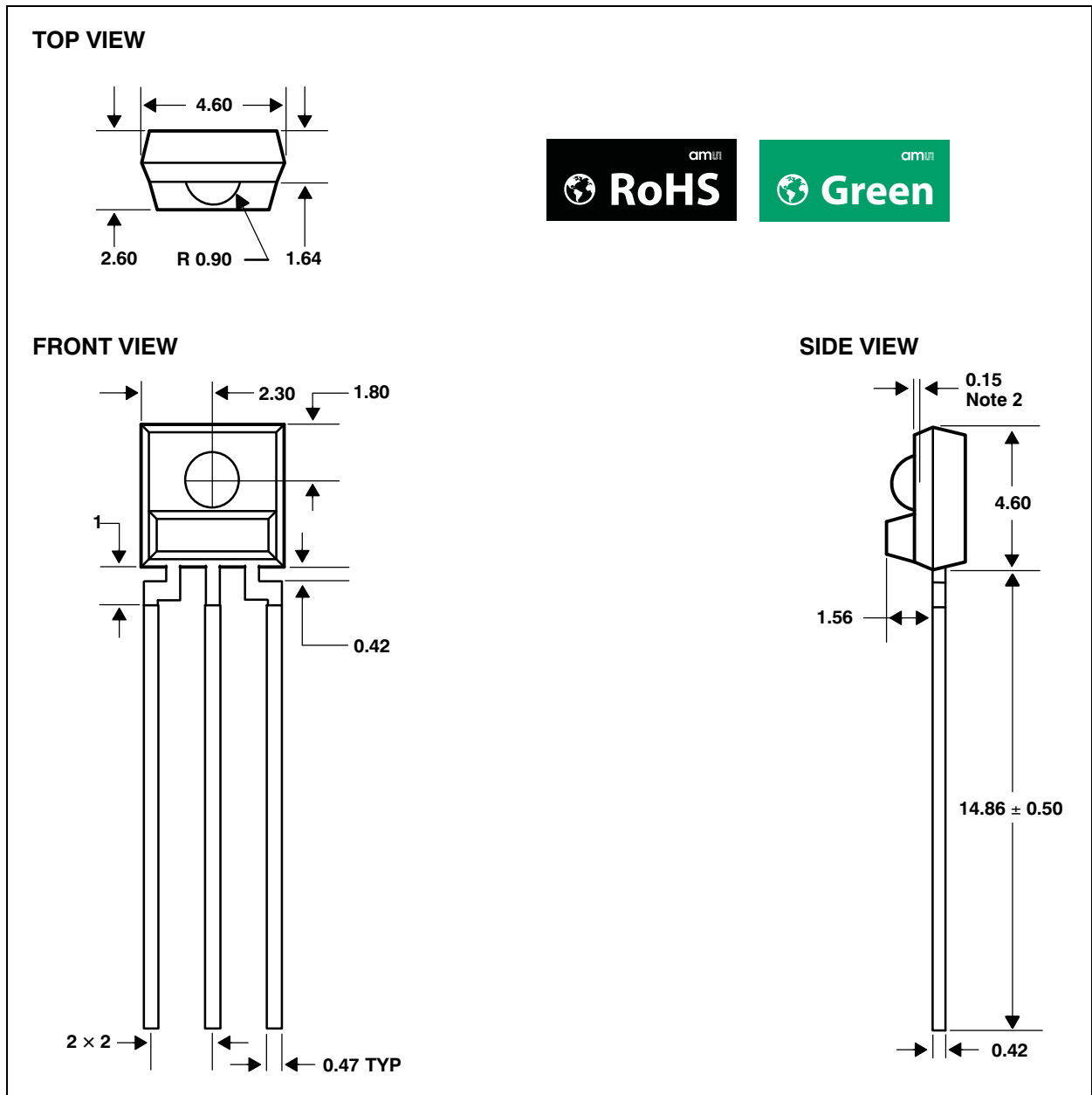
1. All linear dimensions are in millimeters.
2. This drawing is subject to change without notice.

Mechanical Information

The device is supplied in a clear plastic three-lead package (S). The integrated photodiode active area is typically 1.0mm^2 (0.0016in^2).

Package S – Plastic Single-In-Line Side-Looker Package

Figure 17:
Package S - Plastic Single-In-Line Side-Looker Package Configuration

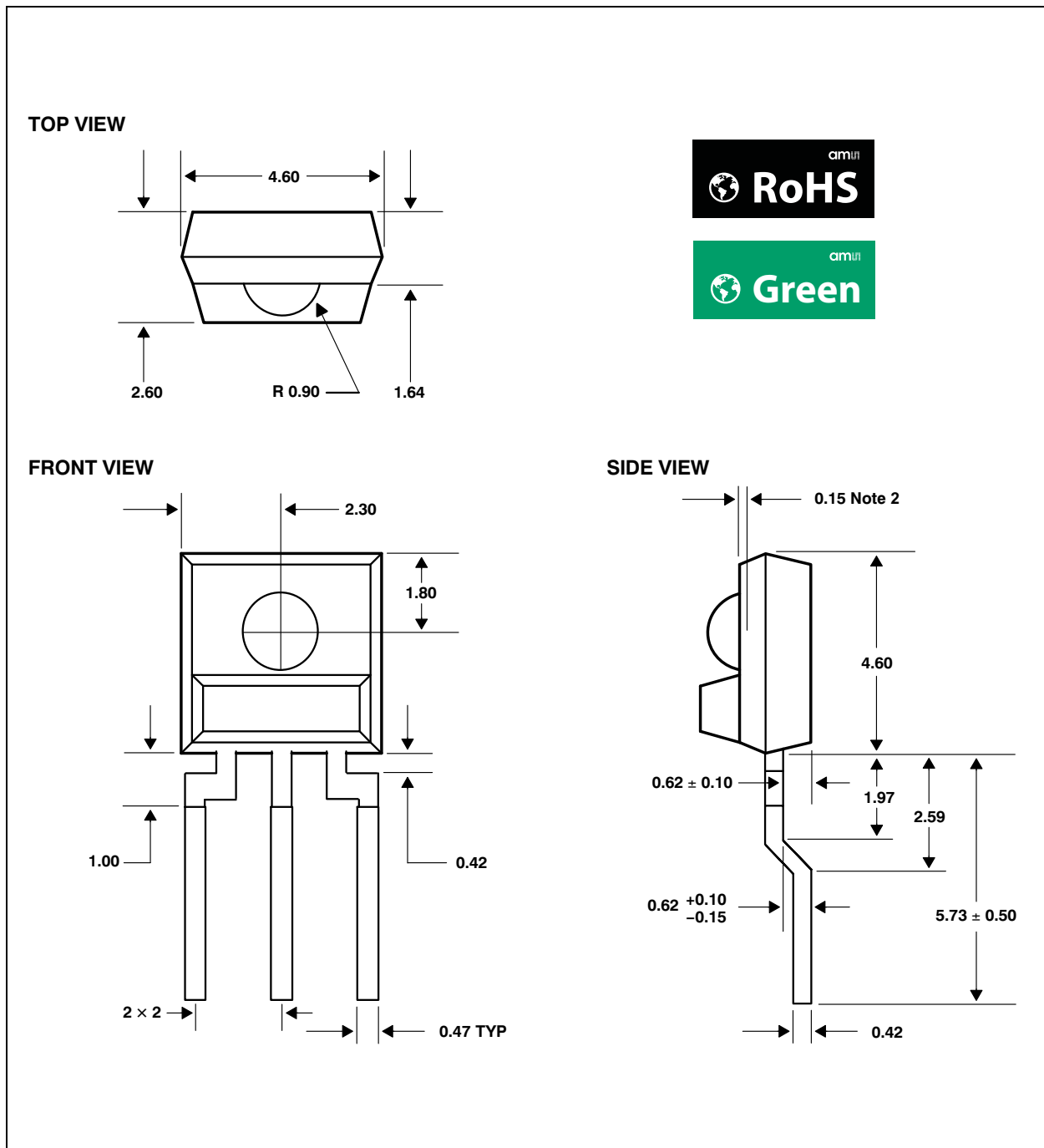


Note(s):

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 0.97mm below the top of the lens surface.
4. Index of refraction of clear plastic is 1.55.
5. Lead finish for TSL254R-LF: solder dipped, 100% Sn.
6. This drawing is subject to change without notice.

Package SM – Plastic Surface Mount Side-Looker Package

Figure 18:
Package SM - Plastic Surface Mount 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 0.97mm below the top of the lens surface.
4. Index of refraction of clear plastic is 1.55.
5. Lead finish for TSL254RSM-LF: solder dipped, 100% Sn.
6. This drawing is subject to change without notice.

Ordering & Contact Information

Figure 19:
Ordering Information

Ordering Code	Device	T _A	Package-Leads	Package Designator
TSL254R-LF	TSL254R	0°C to 70°C	3-lead Sidelooker - Lead (Pb) Free	S
TSL254RSM-LF	TSL254R	0°C to 70°C	3-lead Surface-Mount Sidelooker - Lead (Pb) Free	SM

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Document Status

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
Preliminary Datasheet	Pre-Production	Information in this datasheet is based on products in the design, validation or qualification phase of development. The performance and parameters shown in this document are preliminary without any warranty and are subject to change without notice
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Revision Information

Changes from 071C (2007-Sep) to current revision 1-00 (2016-Jul-27)	Page
Content of TAOS datasheet was converted to the latest ams design	
Added Figure 1	1
Updated note under Figure 17	12
Updated Figure 19	14

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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