TSL253R

Light-to-Voltage Optical Sensor

General Description

The TSL253R is a light-to-voltage optical sensor combining a photodiode and a transimpedance amplifier (feedback resistor = 16 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.

Ordering Information and Content Guide appear at end of datasheet.

Key Benefits & Features

The benefits and features of TSL253R Light-to-Voltage Optical Sensor are listed below:

Figure 1:
Added Value of Using TSL253R

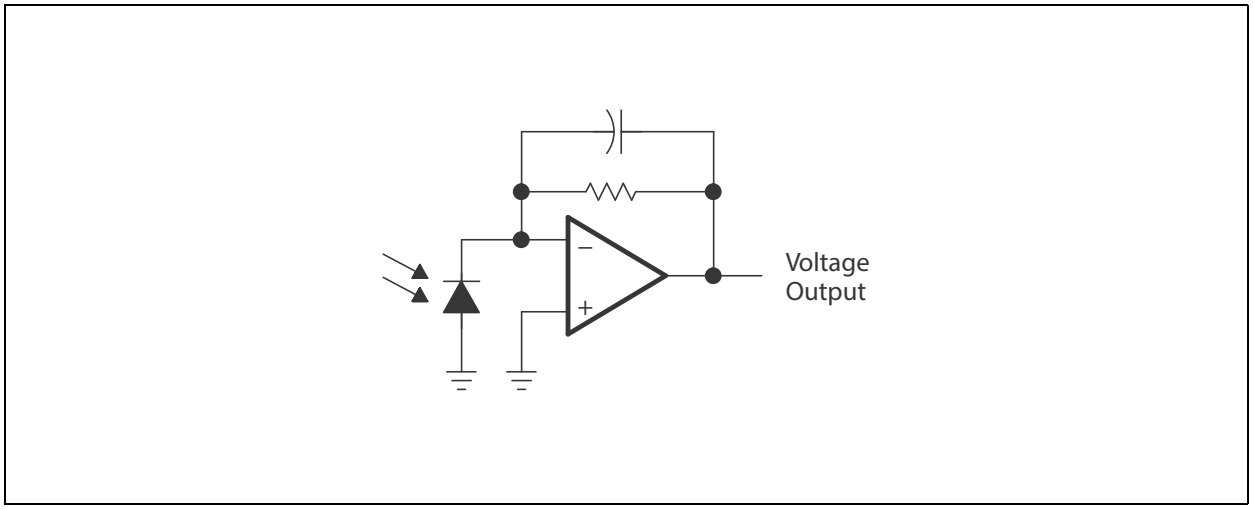
Benefits	Features
• Enables eXtremely Fast Response to Change	• Single Photo-Diode and Trans Impedance Architecture
• Enables Fast Response to Visible Light in Range of 400nm to 700nm Wavelengths	• 7µs Output Rise-Time Response
• Provides for High Sensitivity to Detect a Small Change in Light	• High Irradiance Responsivity 137mV/(µW/cm^2) @ λp = 635nm
• Provides Additional Sensitivity Advantages	• 2x Gain Lense

- 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

Functional Block Diagram

The functional blocks of this device are shown below:

Figure 2:
TSL253R Block Diagram



Pin Assignment

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

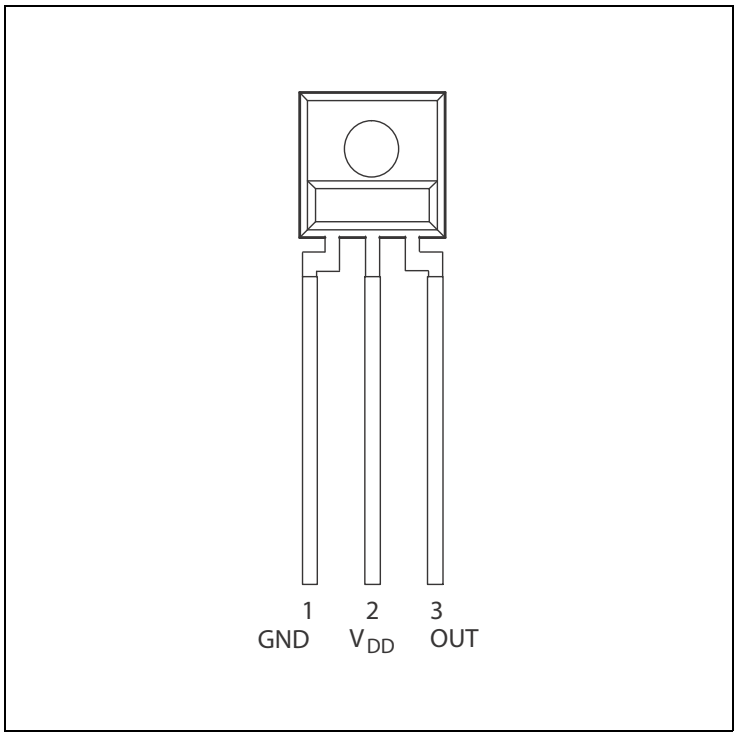


Figure 4:
Pin Diagram of Package SM Surface Mount Sidelooker (Front View)

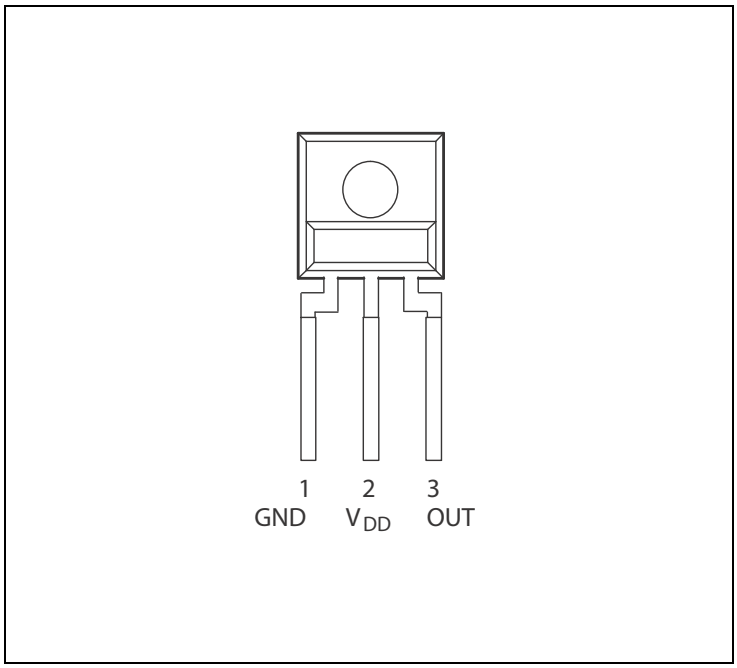


Figure 5:
Terminal Functions

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°C, λ_p=635nm, R_L=10kΩ (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 = 14.6µW/cm^2	1.5	2	2.5	V
α_{vo}	Temperature coefficient of output voltage (V_O)	V_O = 2V @ 25°C, T_A = 0°C to 70°C (4)		2		mV/°C
				0.1		%/°C
R_e	Irradiance responsivity	See note (3) and See note (5)		137		mV/ (µW/cm^2)
I_{DD}	Supply current	E_e = 14.6µW/cm^2		1.1	1.7	mA

Note(s):

1. Measurements are made with R_L = 10kΩ between output and ground.
2. Optical measurements are made using small-angle incident radiation from an LED optical source.
3. The input irradiance E_e is supplied by an AlInGaP LED with peak wavelength λ_p = 635nm
4. 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.
5. 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°C, λ_p = 635nm, R_L = 10kΩ (see Figure 10)

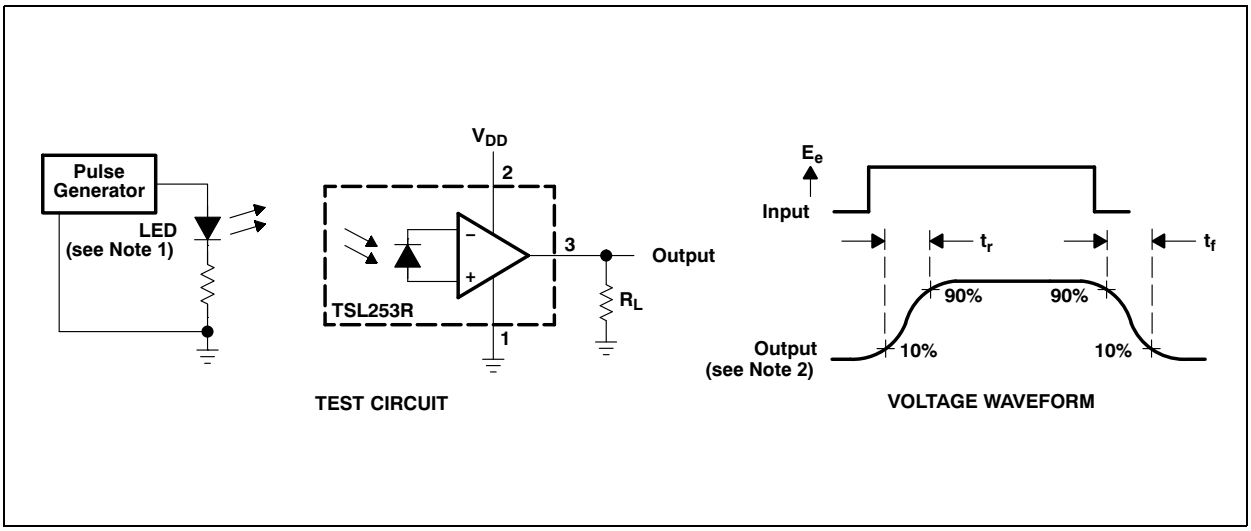
Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
t_r	Output pulse rise time	$V_{O(peak)}$ = 2 V		7		µs
t_f	Output pulse fall time	$V_{O(peak)}$ = 2 V		7		µs
V_n	Output noise voltage	$E_e = 0, V_O = V_D$ f = 1 kHz		1		µV/$\sqrt{\text{Hz}}$
		$E_e = 0, V_O = V_D$ f = 10 kHz		3		
		V_O = 2 V f = 1kHz		4		
		V_O = 2 V f = 10kHz		5		

Note(s):

1. Nonlinearity is defined as the deviation of f_O from a straight line between zero and full scale, expressed as a percent of full scale.

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: λ_p = 635nm, t_r < 1µs, t_f < 1µs.
2. The output waveform is monitored on an oscilloscope with the following characteristics: t_r < 100ns, Z_i ≥ 1MΩ, C_i ≤ 20pF.

Typical Characteristics

Figure 11:
Output Voltage vs. Irradiance

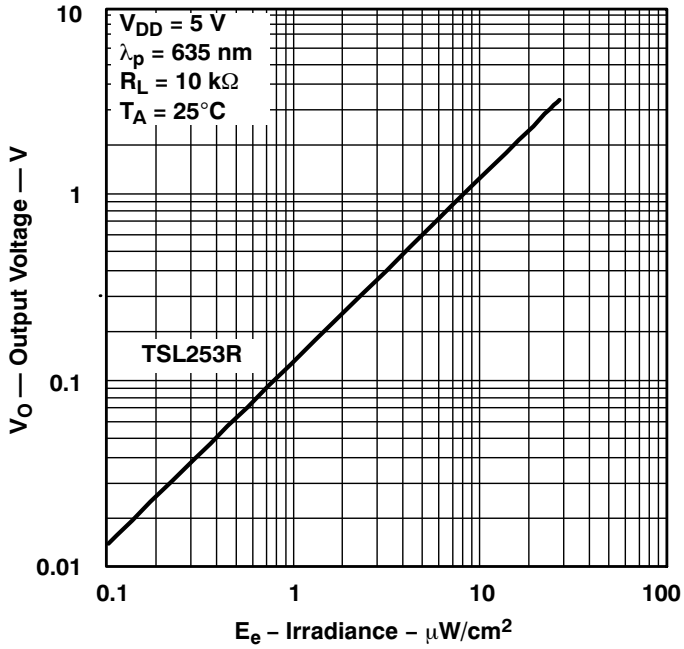


Figure 12:
Photodiode Spectral Responsivity

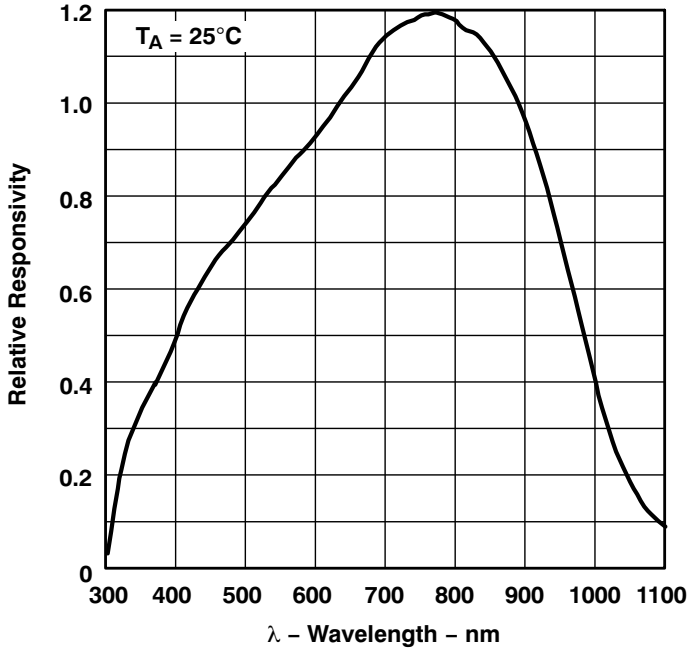


Figure 13:
Maximum Output Voltage vs. Supply Voltage

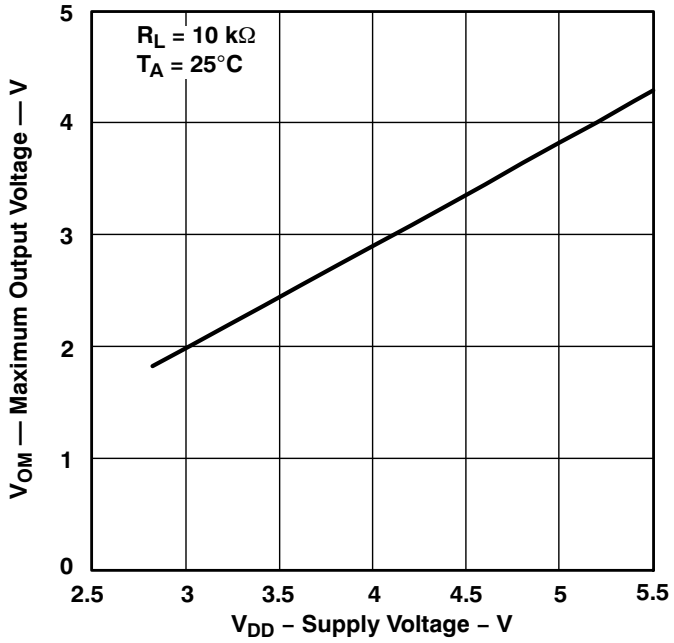


Figure 14:
Supply Current vs. Output Voltage

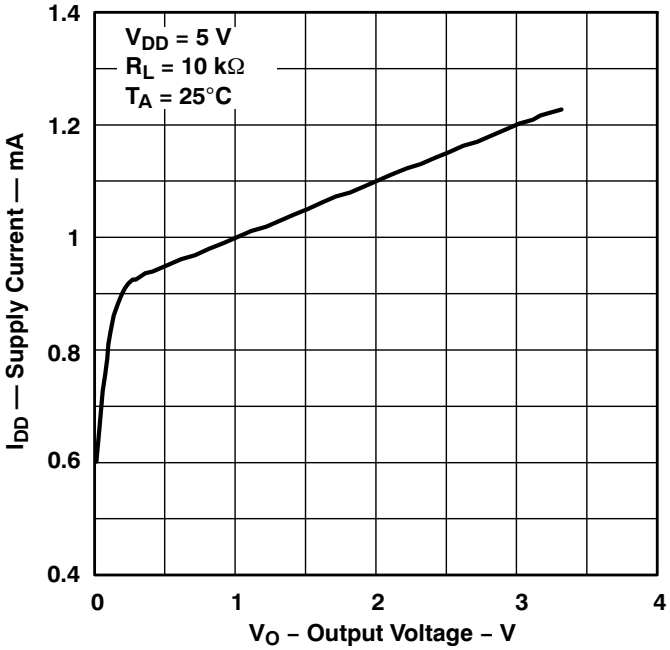
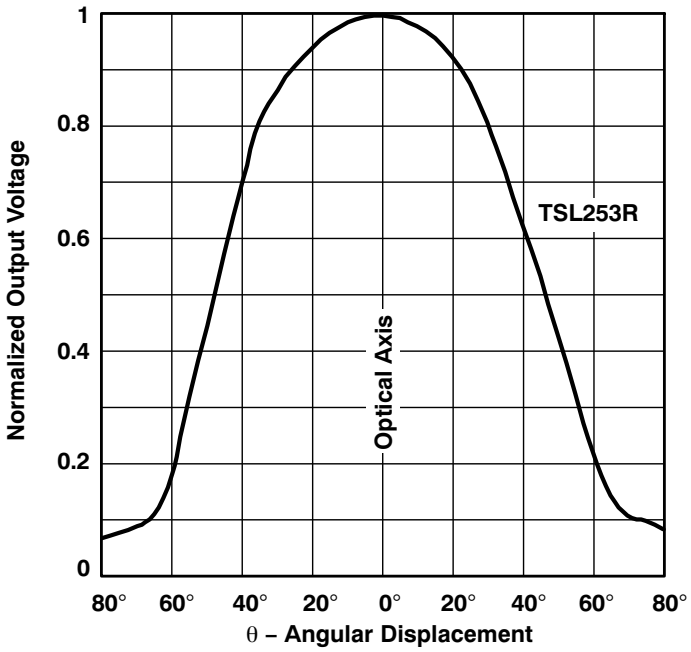


Figure 15:
Normalized Output Voltage vs. Angular Displacement

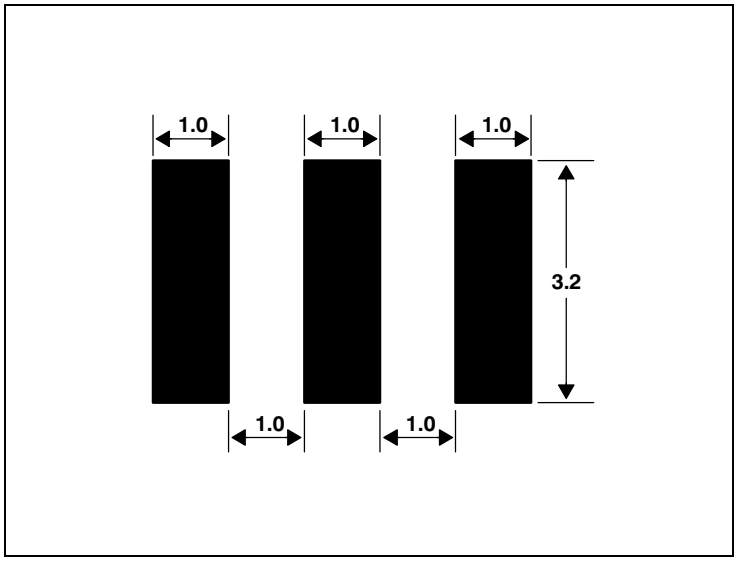


Application Information

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):

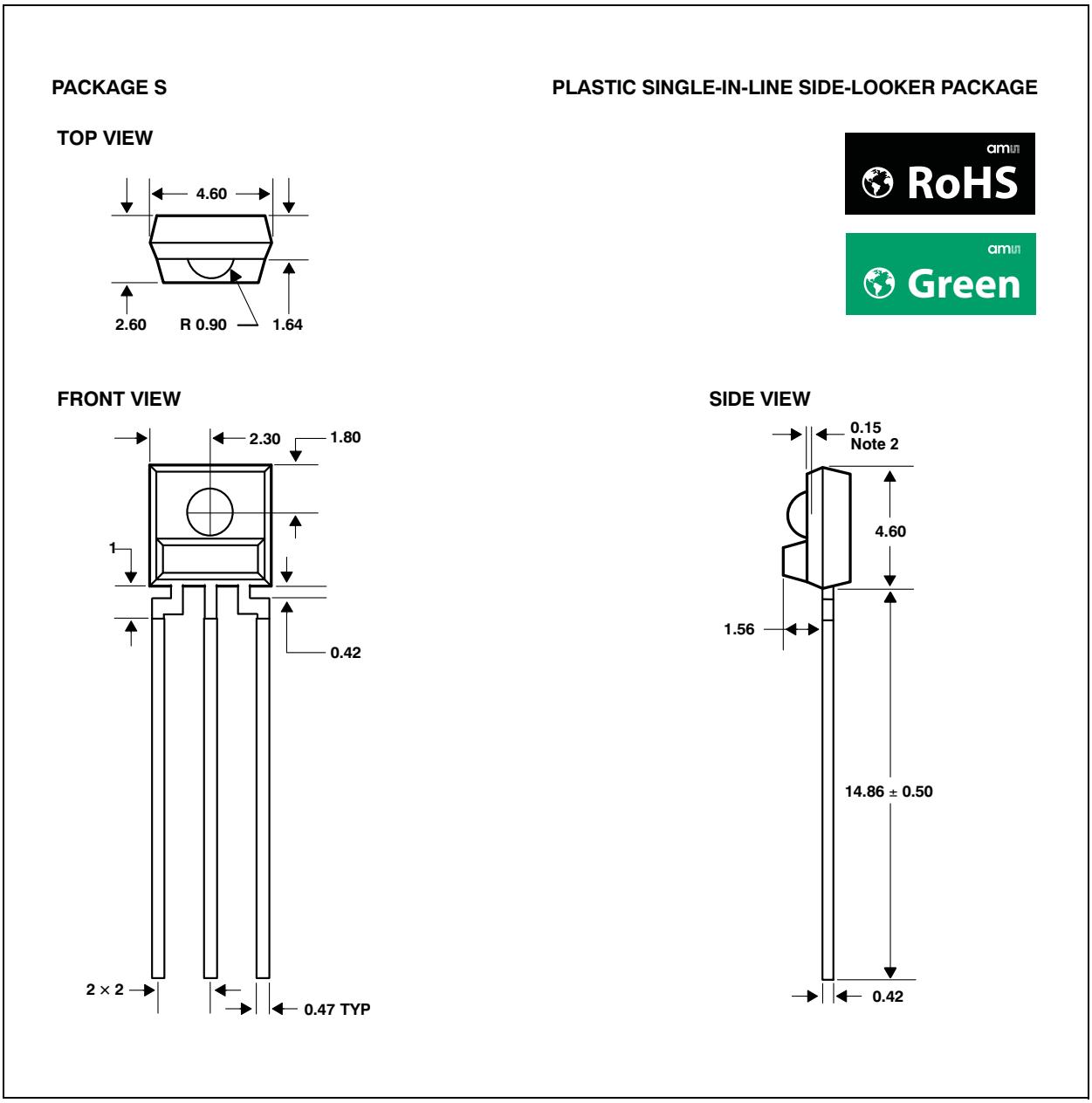
1. All linear dimensions are in millimeters.
2. This drawing is subject to change without notice.

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).

Plastic Single-In-Line Side-Looker Package

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

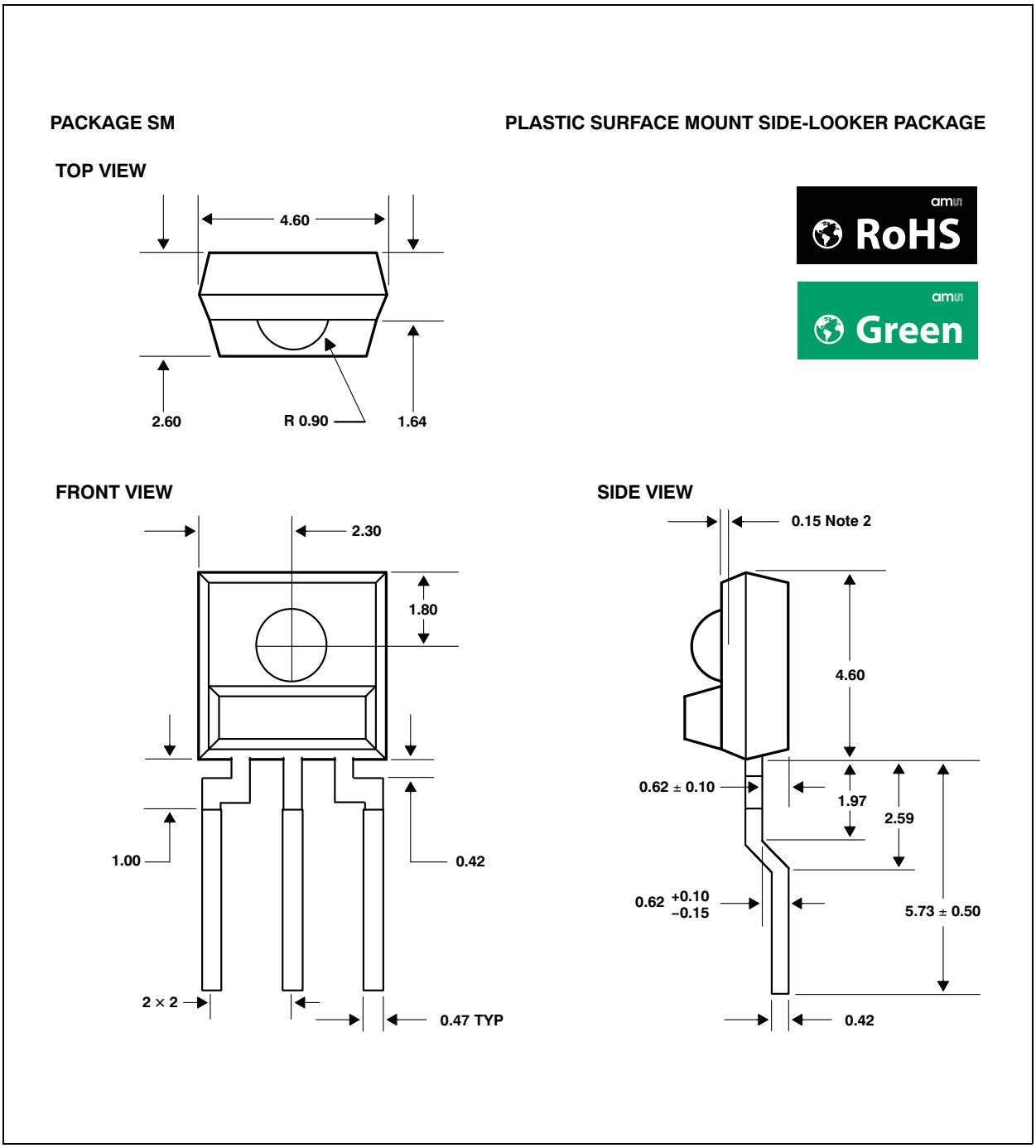


Note(s):

1. All linear dimensions are in millimeters; tolerance is ±0.25mm 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 solder dipped, 100% Sn.
6. This drawing is subject to change without notice.

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 ±0.25mm 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 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
TSL253R-LF	TSL253R	0°C to 70°C	3-lead Sidelooker - Lead (Pb) Free	S
TSL253RSM-LF	TSL253R	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
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Revision Information

Changes from 053D (2007-Sep) to current revision 1-00 (2016-Apr-19)	Page
Content of TAOS datasheet was converted to the latest **ams** design	
Updated Key Benefits & Features	1

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