TSL257T

High-Sensitivity Light-to-Voltage Converter

General Description

The TSL257T is a high-sensitivity low-noise light-to-voltage optical converter that combines a photodiode and a transimpedance amplifier on a single monolithic CMOS integrated circuit. Output voltage is directly proportional to light intensity (irradiance) on the photodiode. The TSL257T has a transimpedance gain of 320 MΩ. The device has improved offset voltage stability and low power consumption and is supplied in a compact 4-lead surface-mount package.

Ordering Information and Content Guide appear at end of datasheet.

Key Benefits & Features

The benefits and features of TSL257T, High-Sensitivity Light-to-Voltage Converter are listed below:

Figure 1:
Added Value of Using TSL257T

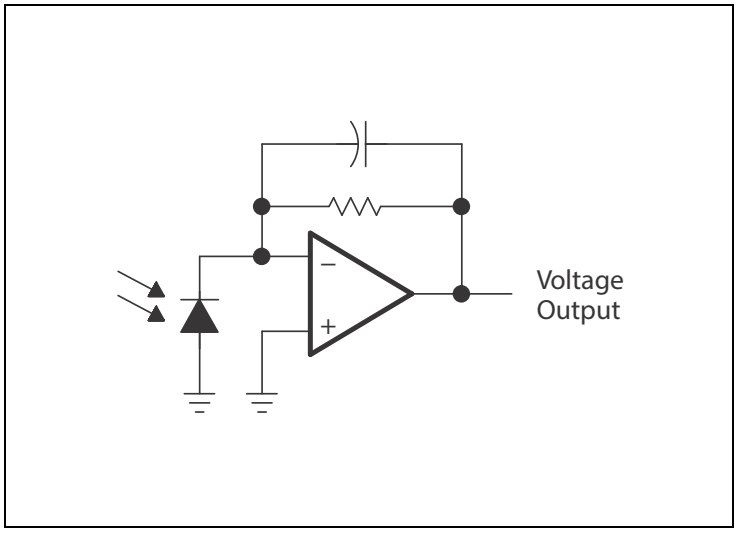
Benefits	Features
• Enables Extremely Fast Response to Change	• Single Photo-diode and Trans Impedance Architecture
• Enables Fast Response to Visible Light in Range of 400nm to 700nm Wavelengths	• 160µs Output Rise-Time Response
• Provides for High Sensitivity to Detect a Small Change in Light	• High Irradiance Responsivity: Typically 680mV/(µW/cm^2) At λp = 640nm
• Provides Full Dynamic Range	• Rail-to-Rail Output Swing
• Reduces Board Space Requirements while Simplifying Designs	• 2.6mm x 3.8mm 4-Lead SMD (T) Package

- Converts Light Intensity to Output Voltage
- Monolithic Silicon IC Containing Photodiode, Operational Amplifier, and Feedback Components
- High Sensitivity
- Single Voltage Supply Operation: (2.7V to 5.5V)
- Low Noise (200µVrms Typ to 1kH z)
- High Power-Supply Rejection (35dB at 1kHz)
- Low-Profile Surface-Mount Package

Functional Block Diagram

The functional blocks of this device are shown below:

Figure 2:
TSL257T Block Diagram



Pin Assignment

Figure 3:
Pin Diagram

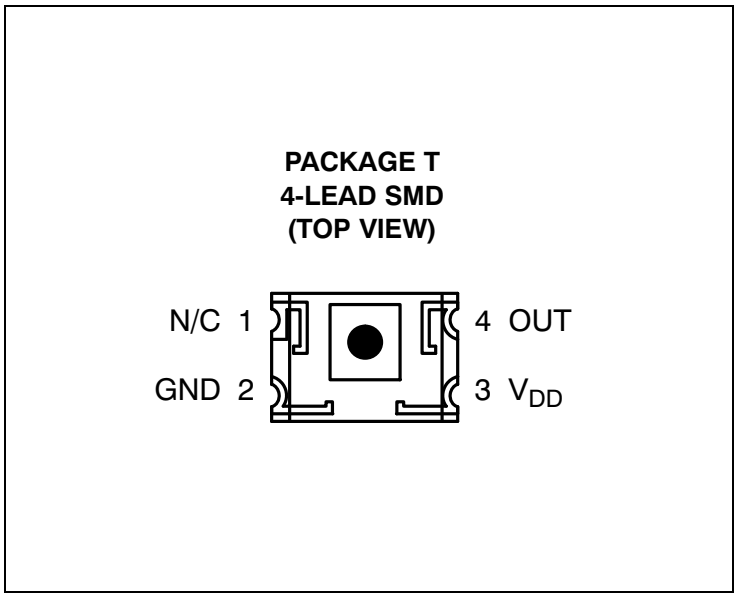


Figure 4:
Terminal Functions

Terminal		Description
T Pkg No.	Name	
1	N/C	No connection
2	GND	Power supply ground (substrate). All voltages are referenced to GND.
3	V_{DD}	Supply voltage
4	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 5:
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		5	s
T_A	Operating free-air temperature range	-25	85	°C
T_{STRG}	Storage temperature range	-25	85	°C
	Solder conditions in accordance with JEDEC-J-SRD-020A, maximum temperature		260	°C

Note(s):

1. All voltages are with respect to GND.

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 6:
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 7:
Electrical Characteristics at V_{DD} = 5V, T_A = 25°C, λ_p = 640nm, 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		15	mV
V_{OM}	Maximum output voltage swing	V_{DD} = 4.5V, No Load		4.49		V
		V_{DD} = 4.5V, R_L = 10kΩ	4	4.2		
V_O	Output voltage	E_e = 2.93µW/cm^2	1.5	2	2.5	V
α_{VD}	Temperature coefficient of dark voltage (V_D)	T_A = 0°C to 70°C		-15		µV/°C
R_e	Irradiance responsivity	See note (4)		680		mV/ (µW/cm^2)
PSRR	Power supply rejection ratio	f_{ac} = 100Hz (5)		55		dB
		f_{ac} = 1kHz (5)		35		dB
I_{DD}	Supply current	E_e = 2.93µW/cm^2		2	3.8	mA

Note(s):

1. Measured with R_L = 10kΩ between output and ground.
2. Optical measurements are made using small-angle incident radiation from a light-emitting diode (LED) optical source.
3. The input irradiance E_e is supplied by an AlInGaP LED with peak wavelength λ_p = 640nm.
4. Irradiance responsivity is characterized over the range V_O = 0.1V to 4.5V. 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.
5. Power supply rejection ratio PSRR is defined as 20 log ($\Delta V_{DD}(f)/\Delta V_O(f)$) with $V_{DD}(f = 0)$ = 5V and $V_O(f = 0)$ = 2V.

Figure 8:
Switching Characteristics at V_{DD} = 5V, T_A = 25°C, λ_p = 640nm, R_L = 10kΩ (unless otherwise noted)

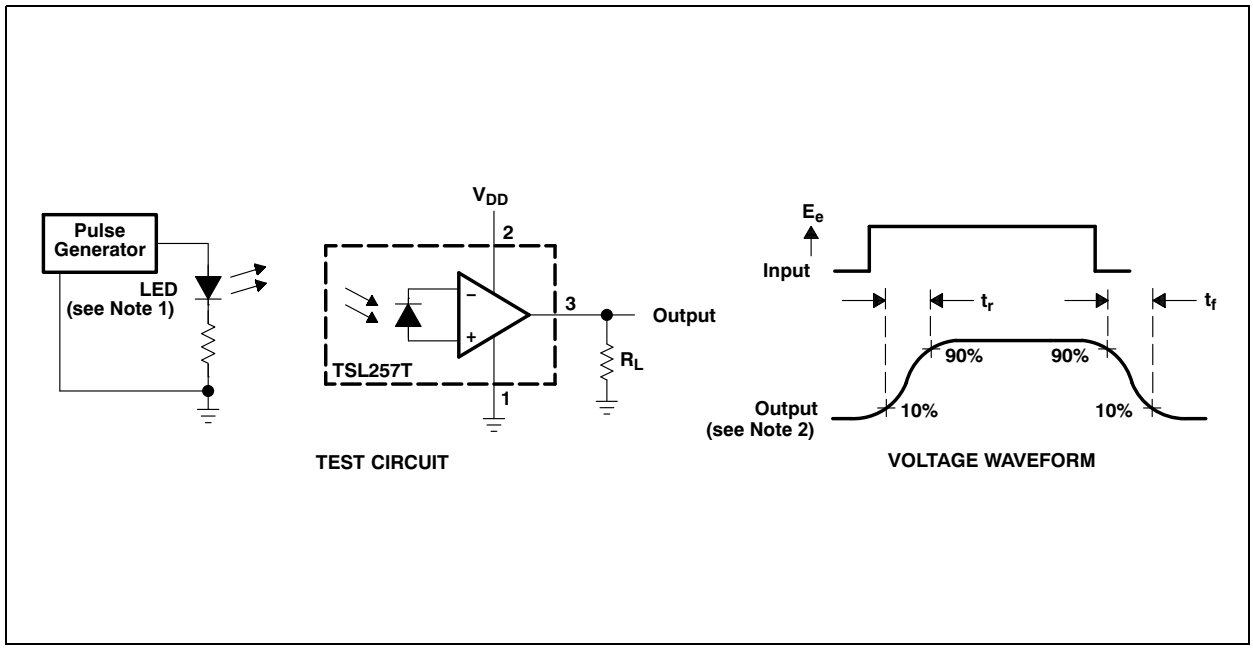
Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
t_r	Output pulse rise time, 10% to 90% of final value	See note (1) and Figure 9		160	250	µs
t_f	Output pulse fall time, 10% to 90% of final value	See note (1) and Figure 9		150	250	µs
t_s	Output settling time to 1% of final value	See note (1) and Figure 9		330		µs
	Integrated noise voltage	f = dc to 1kHz, E_e = 0		200		µVrms
V_n	Output noise voltage, rms	f = 10Hz, E_e = 0		6		$\frac{\mu V}{\sqrt{Hz}}(rms)$
		f = 100Hz, E_e = 0		6		
		f = 1kHz, E_e = 0		7		

Note(s):

1. Switching characteristics apply over the range V_O = 0.1V to 4.5V.

Parameter Measurement Information

Figure 9:
Switching Times



Note(s):

1. The input irradiance is supplied by a pulsed AlInGaP light-emitting diode with the following characteristics: λ_p = 640nm, 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 Operating Characteristics

Figure 10:
Photodiode Spectral Responsivity

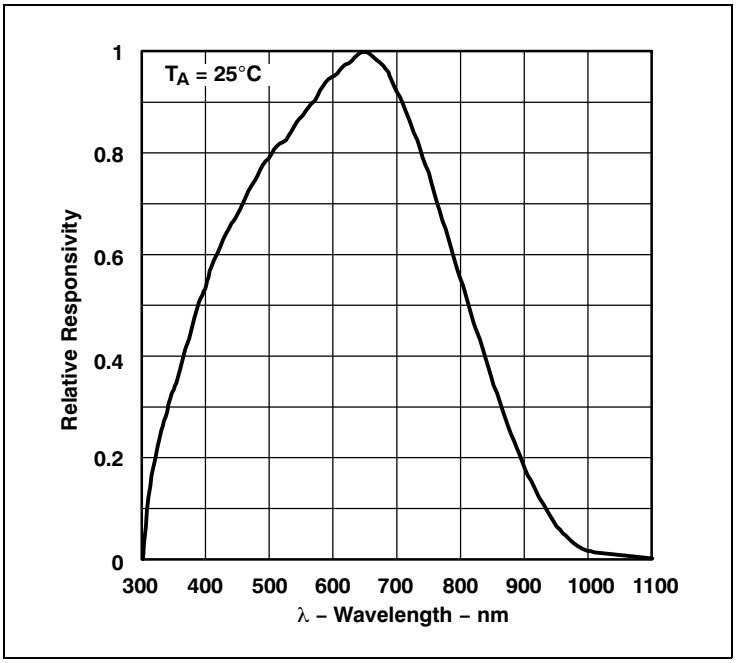


Figure 11:
Power Supply Rejection Ratio vs. Frequency

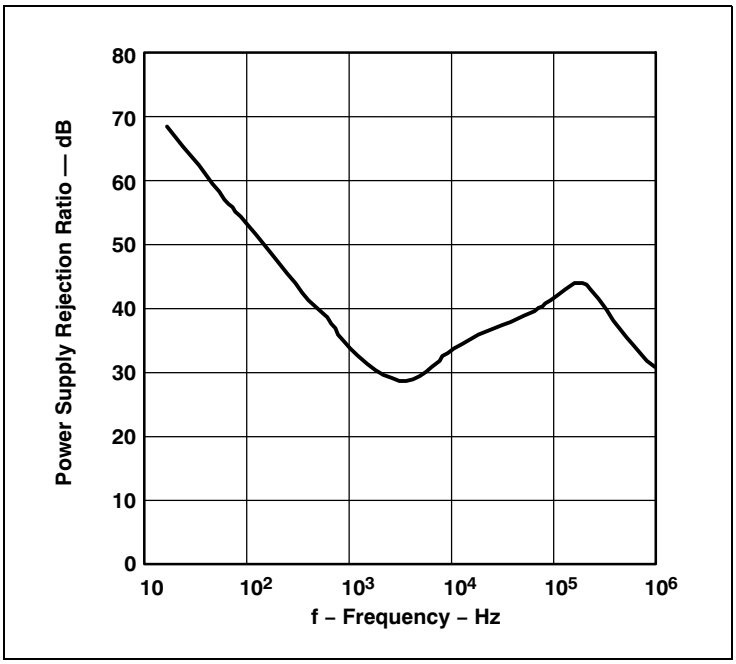


Figure 12:
Dark Voltage vs. Free-Air Temperature

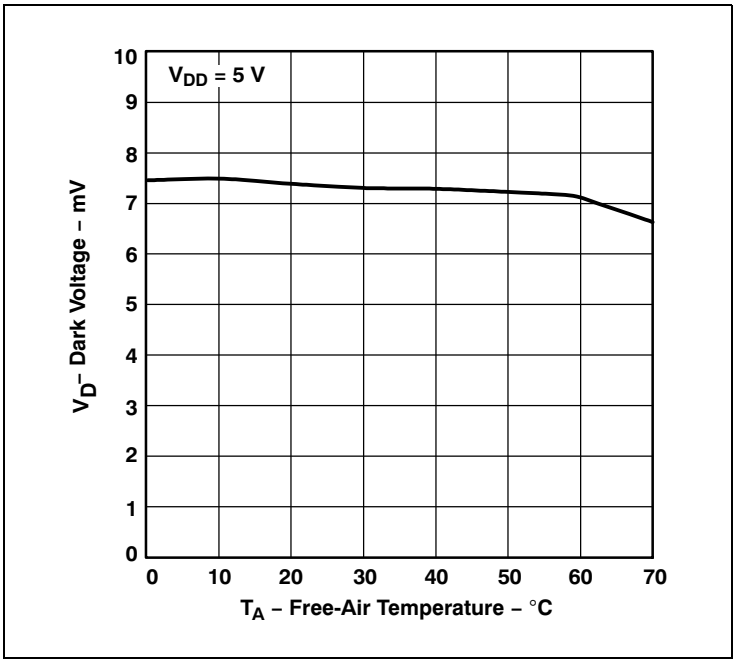


Figure 13:
Normalized Output Voltage vs. Angular Displacement

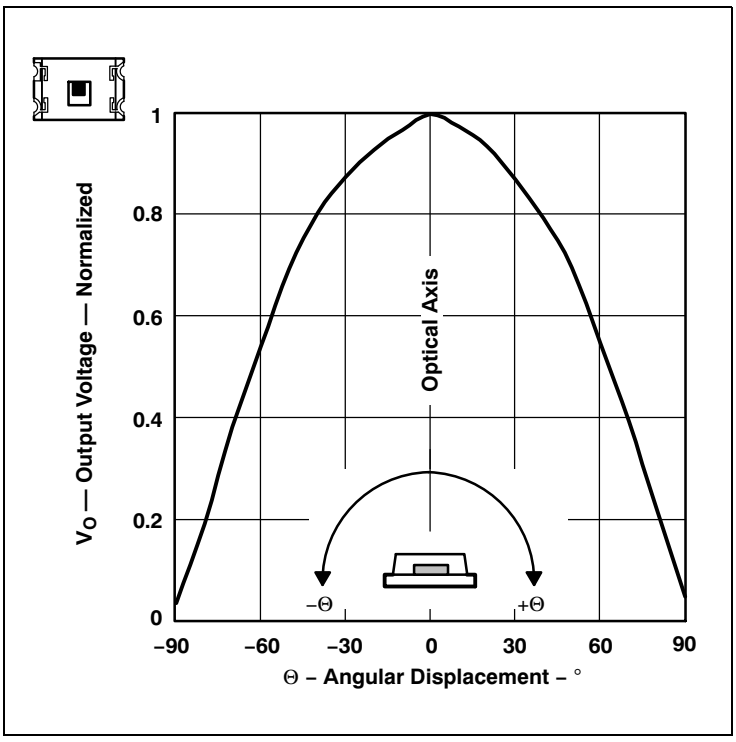
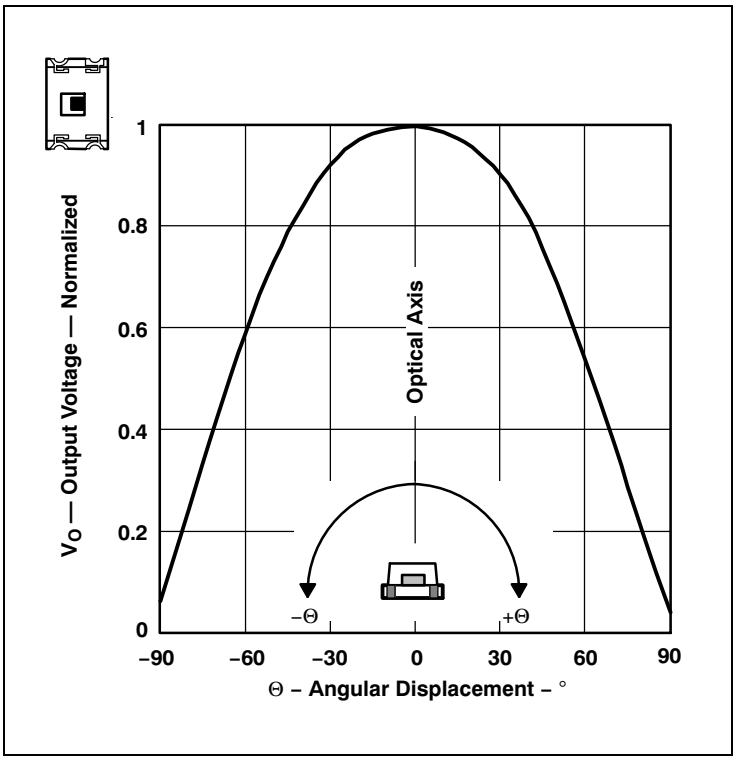


Figure 14:
Normalized Output Voltage vs. Angular Displacement

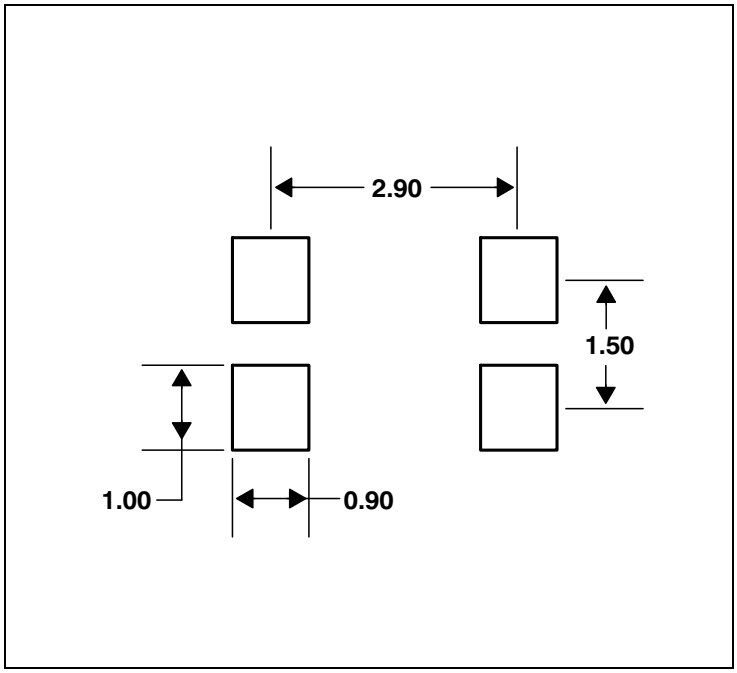


Application Information

PCB Pad Layout

Suggested PCB pad layout guidelines for the T package are shown in Figure 15.

Figure 15:
Suggested T Package PCB Layout



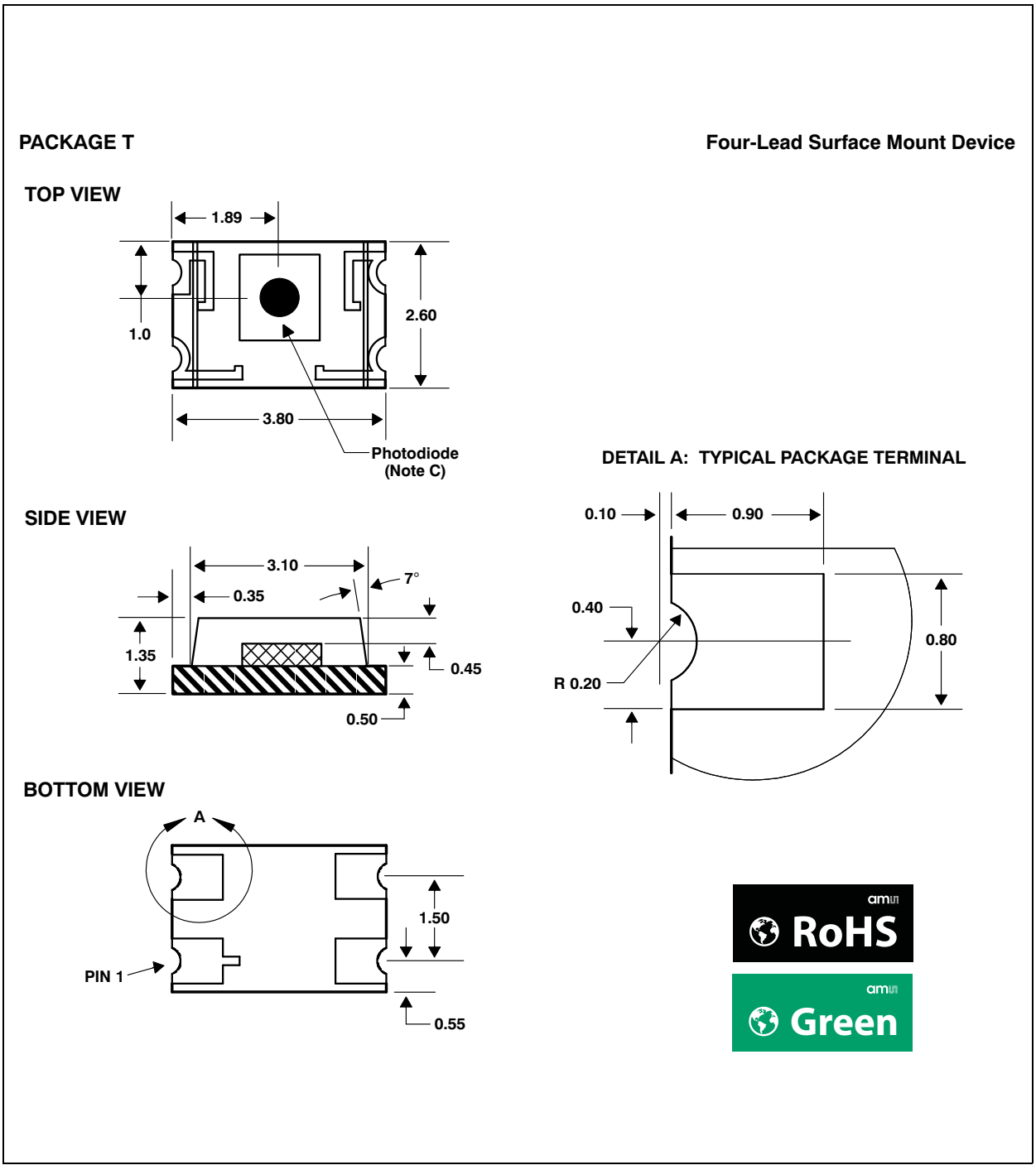
Note(s):

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

Packaging Mechanical Data

The TSL257T is supplied in a low-profile surface-mount package. This package contains no lead (Pb).

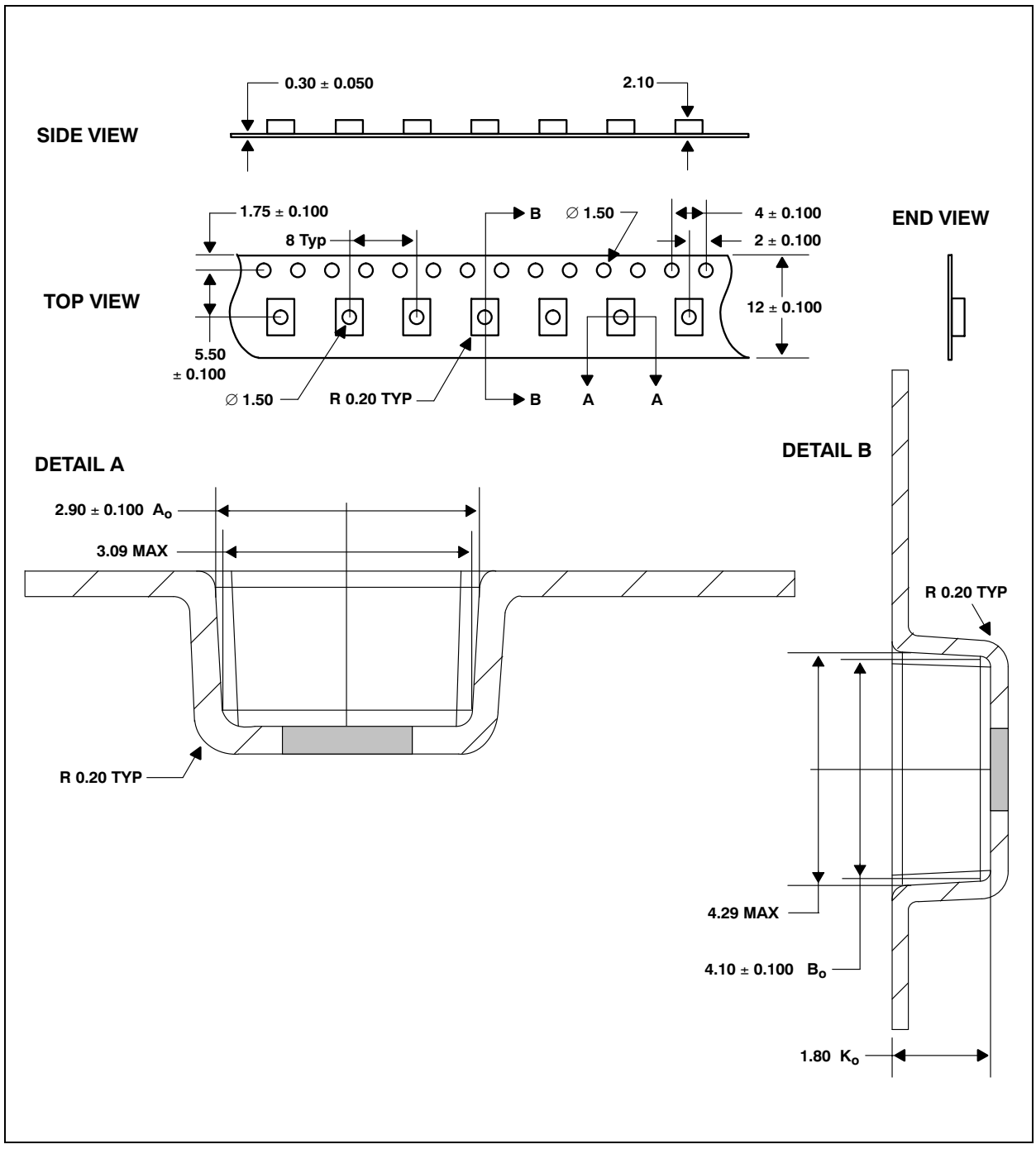
Figure 16:
Package T - Four-Lead Surface Mount Device Packaging Configuration



Note(s):

1. All linear dimensions are in millimeters.
2. Terminal finish is gold.
3. The center of the 0.75mm diameter integrated photodiode active area is typically located 0.1mm above the center of the package.
4. Dimension tolerance is ±0.15mm.
5. This drawing is subject to change without notice.

Figure 17:
Package SM - Plastic Surface Mount Side-Looker Package Configuration



Note(s):

1. All linear dimensions are in millimeters.
2. The dimensions on this drawing are for illustrative purposes only. Dimensions of an actual carrier may vary slightly.
3. Symbols on drawing A_o, B_o, and K_o are defined in ANSI EIA Standard 481-B 2001.
4. Each reel is 178 millimeters in diameter and contains 1000 parts.
5. **ams** packaging tape and reel conform to the requirements of EIA Standard 481-B.
6. In accordance with EIA standard, device pin 1 is located next to the sprocket holes in the tape.
7. This drawing is subject to change without notice.

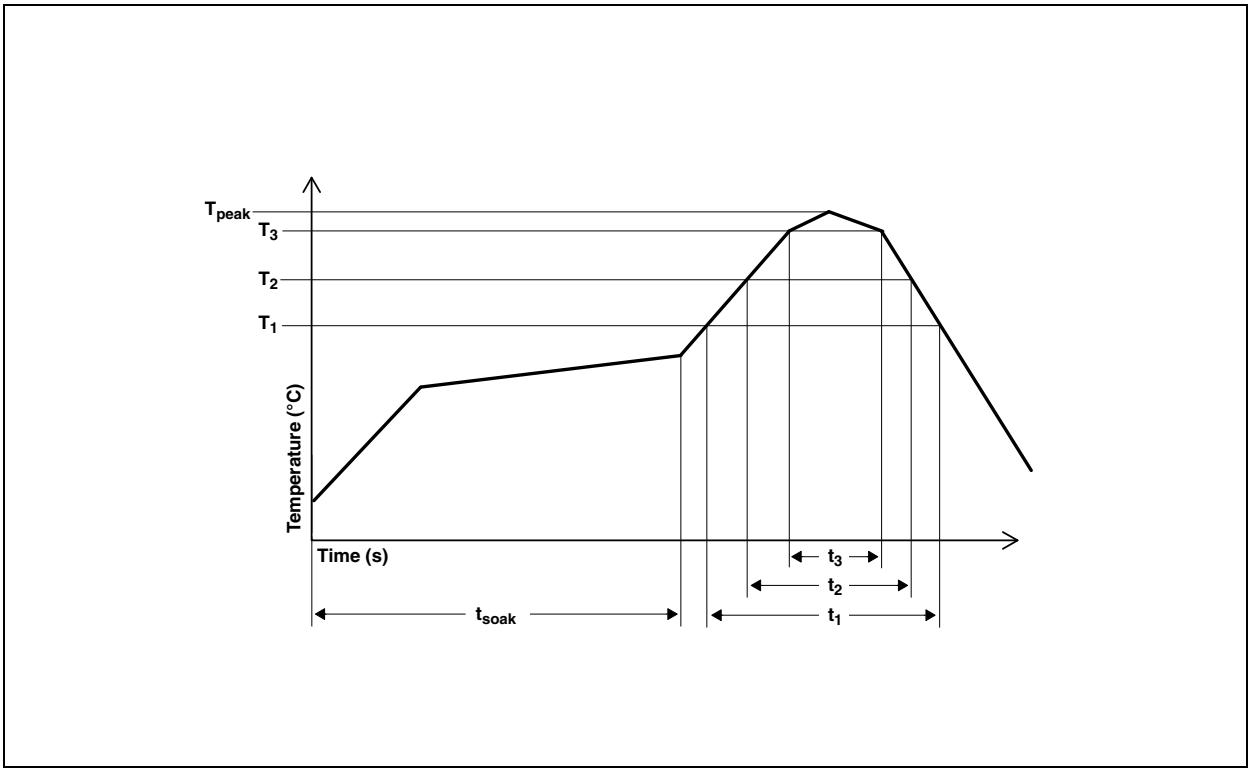
Manufacturing Information

The reflow profile specified here describes expected maximum heat exposure of devices during the solder reflow process of the device on a PWB. Temperature is measured at the top of the device. Devices should be limited to one pass through the solder reflow profile.

Figure 18:
TSL257T Solder Reflow Profile

Parameter	Reference	TSL257T
Average temperature gradient in preheating		2.5°C/s
Soak time	t_{soak}	2 to 3 minutes
Time above T_1, 217°C	t_1	Max 60 s
Time above T_2, 230°C (T_2)	t_2	Max 50 s
Time above T_3, (T_{peak} - 10°C)	t_3	Max 10 s
Peak temperature in reflow	T_{peak}	260°C (-0°C/5°C)
Temperature gradient in cooling		Max -5°C/s

Figure 19:
TSL257T Solder Reflow Profile



Note(s):

1. Not to scale - for reference only.

Moisture Sensitivity

Optical characteristics of the device can be adversely affected during the soldering process by the release and vaporization of moisture that has been previously absorbed into the package molding compound. To ensure the package molding compound contains the smallest amount of absorbed moisture possible, each device is dry-baked prior to being packed for shipping. Devices are packed in a sealed aluminized envelope with silica gel to protect them from ambient moisture during shipping, handling, and storage before use.

This package has been assigned a moisture sensitivity level of MSL 3 and the devices should be stored under the following conditions:

- Temperature Range: 5°C to 50°C
- Relative Humidity: 60% maximum
- Total Time: 6 months from the date code on the aluminized envelope - if unopened
- Opened Time: 168 hours or fewer

Rebaking will be required if the devices have been stored unopened for more than 6 months or if the aluminized envelope has been open for more than 168 hours. If rebaking is required, it should be done at 90°C for 4 hours.

Ordering & Contact Information

Figure 20:
Ordering Information

Ordering Code	Device	T_A	Package - Leads	Package Designator
TSL257T	TSL257	0°C to 70°C	3-Lead Surface-Mount Device	T

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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 065B (2007-Apr) to current revision 1-00 (2016-Jul-18)	Page
Content of TAOS datasheet was converted to the latest **ams** design	
Added Figure 1	1
Added Figure 20	16

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