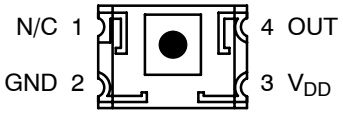
TSL257T
HIGH-SENSITIVITY LIGHT-TO-VOLTAGE CONVERTER

TAOS065B – APRIL 2007

- **Converts Light Intensity to Output Voltage**
- **Monolithic Silicon IC Containing Photodiode, Operational Amplifier, and Feedback Components**
- **High Sensitivity**
- **Single Voltage Supply Operation (2.7 V to 5.5 V)**
- **High Irradiance Responsivity . . . Typical 680 mV/(μW/cm^2) at λ_p = 640 nm**
- **Low Noise (200 μVrms Typ to 1 kHz)**
- **Rail-to-Rail Output**
- **High Power-Supply Rejection (35 dB at 1 kHz)**
- **Low-Profile Surface-Mount Package**
- **RoHS Compliant**

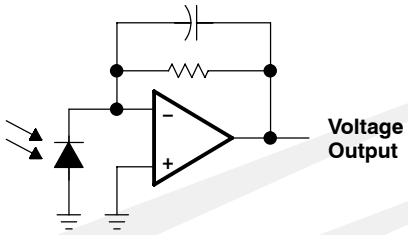
PACKAGE T
4-LEAD SMD
(TOP VIEW)



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.

Functional Block Diagram



Terminal Functions

TERMINAL NAME	TERMINAL T PKG NO.	DESCRIPTION
GND	2	Power supply ground (substrate). All voltages are referenced to GND.
OUT	4	Output voltage.
V_{DD}	3	Supply voltage.
N/C	1	No connection.

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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 . . . . . 5 s
Operating free-air temperature range, T_A . . . . . –25°C to 85°C
Storage temperature range, T_{stg} . . . . . –25°C to 85°C
Solder conditions in accordance with JEDEC–J–SRD–020A, maximum temperature . . . . . 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.

NOTE 1: All voltages are with respect to GND.

Recommended Operating Conditions

	MIN	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, λ_p = 640 nm, R_L = 10 kΩ (unless otherwise noted) (see Notes 2, 3, and 4)

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} = 4.5 V,	No Load		4.49		V
		V_{DD} = 4.5 V,	R_L = 10 kΩ	4	4.2		
V_O	Output voltage	E_e = 2.93 μW/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 5			680		mV/(μW/cm^2)
PSRR	Power supply rejection ratio	f_{ac} = 100 Hz, see Note 6			55		dB
		f_{ac} = 1 kHz, see Note 6			35		dB
I_{DD}	Supply current	E_e = 2.93 μW/cm^2			2	3.8	mA

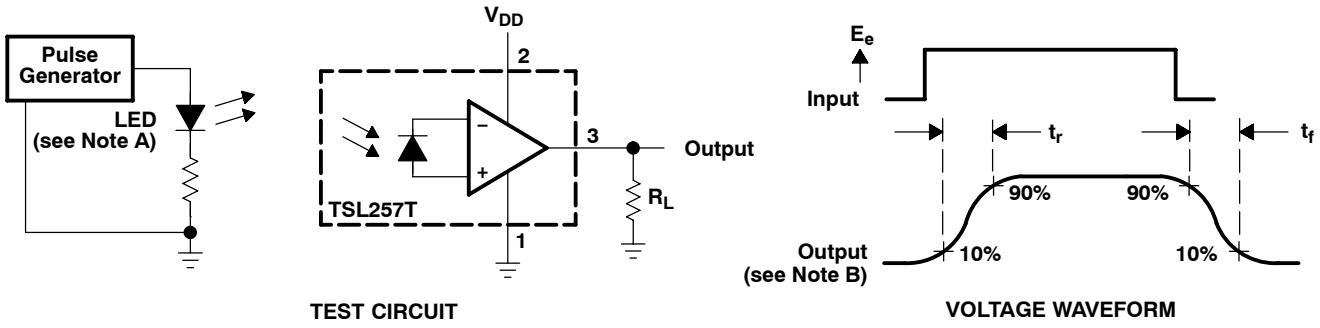
NOTES: 2. Measured with R_L = 10 kΩ between output and ground.
3. Optical measurements are made using small-angle incident radiation from a light-emitting diode (LED) optical source.
4. The input irradiance E_e is supplied by an AlInGaP LED with peak wavelength λ_p = 640 nm.
5. Irradiance responsivity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

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

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
t_r	Output pulse rise time, 10% to 90% of final value	See Note 10 and Figure 1			160	250	μs
t_f	Output pulse fall time, 10% to 90% of final value	See Note 10 and Figure 1			150	250	μs
t_s	Output settling time to 1% of final value	See Note 10 and Figure 1			330		μs
	Integrated noise voltage	f = dc to 1 kHz	E_e = 0		200		μVrms
V_n	Output noise voltage, rms	f = 10 Hz	E_e = 0		6		μV/√Hz rms
		f = 100 Hz	E_e = 0		6		
		f = 1 kHz	E_e = 0		7		

NOTE 7: Switching characteristics apply over the range V_O = 0.1 V to 4.5 V.

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 = 640 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

PHOTODIODE SPECTRAL RESPONSIVITY

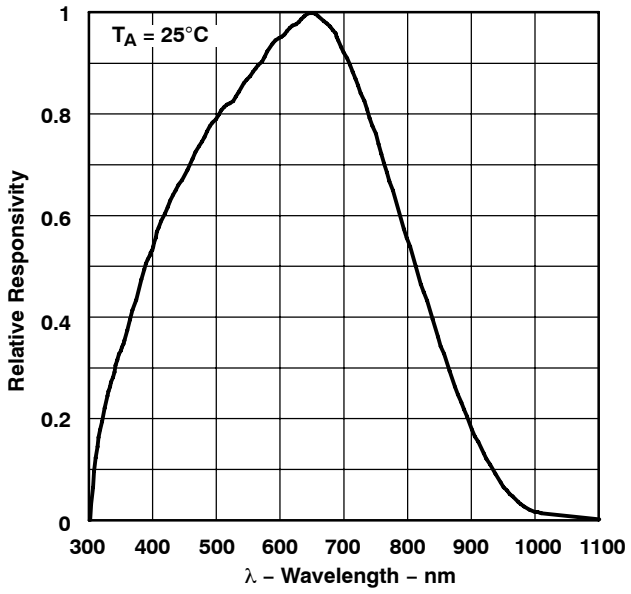


Figure 2

POWER SUPPLY REJECTION RATIO vs FREQUENCY

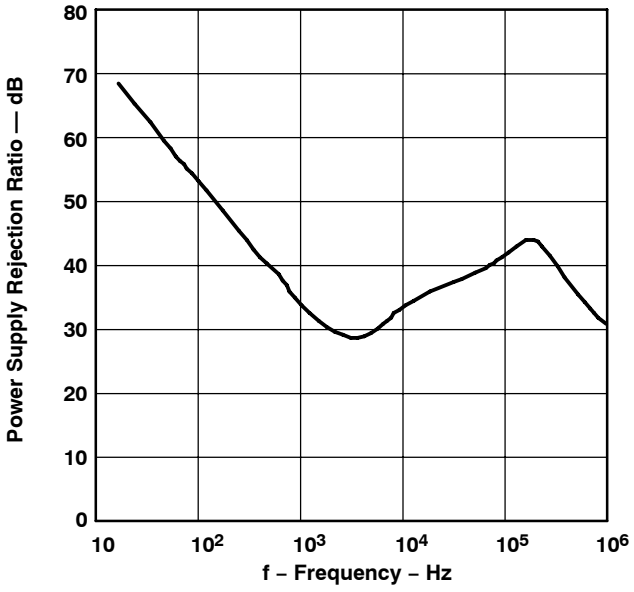


Figure 3

TYPICAL CHARACTERISTICS

DARK VOLTAGE
vs
FREE-AIR TEMPERATURE

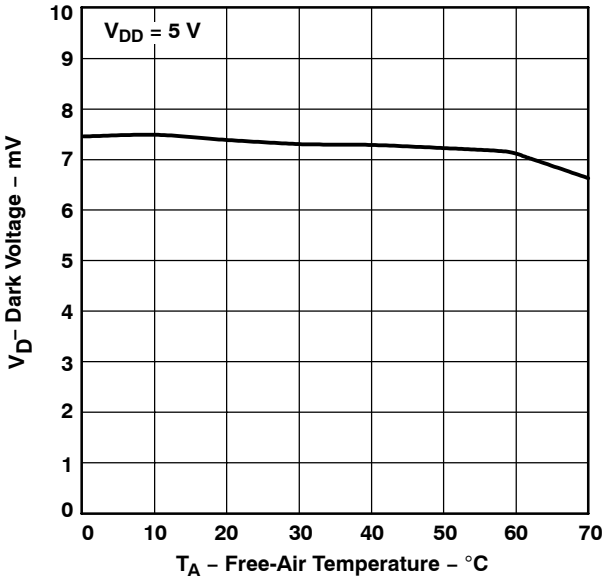


Figure 4

NORMALIZED OUTPUT VOLTAGE
vs.
ANGULAR DISPLACEMENT

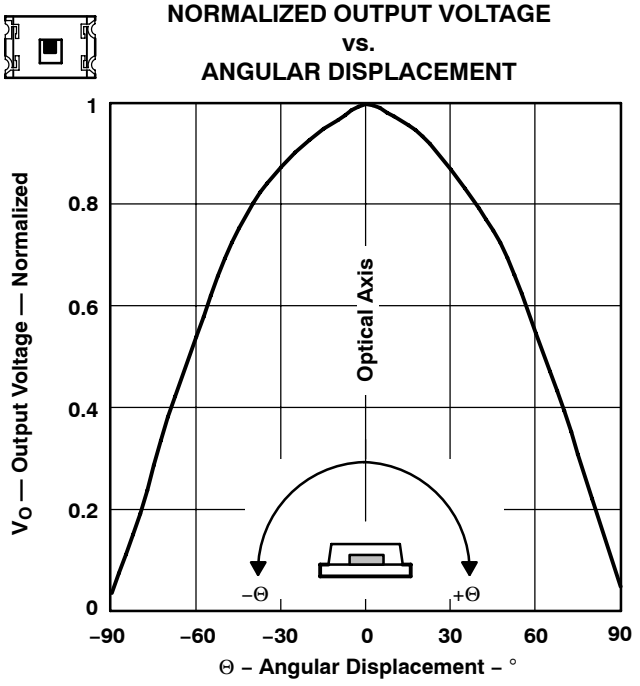


Figure 5

NORMALIZED OUTPUT VOLTAGE
vs.
ANGULAR DISPLACEMENT

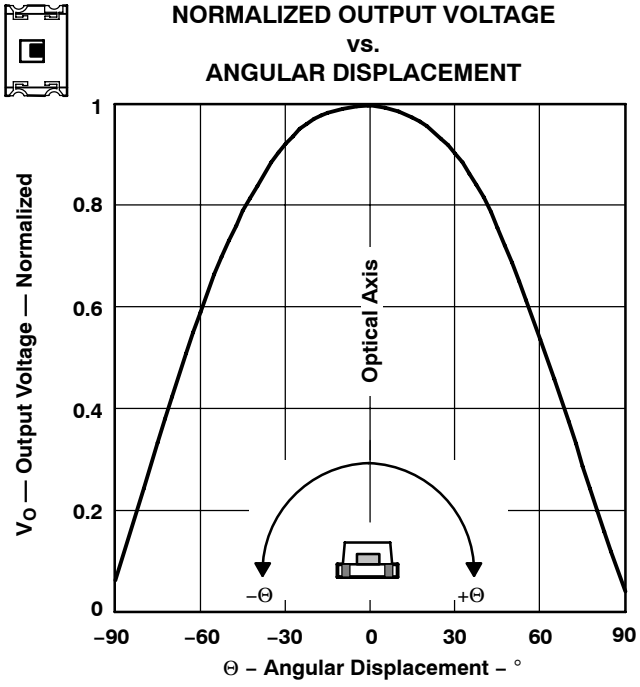
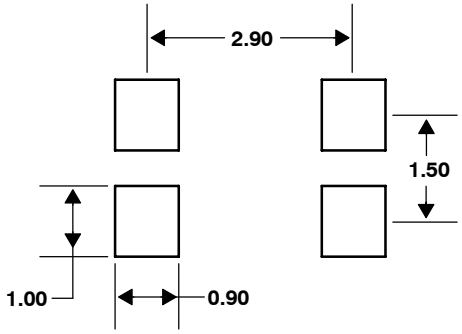


Figure 6

APPLICATION INFORMATION

PCB Pad Layout

Suggested PCB pad layout guidelines for the T package are shown in Figure 7.



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

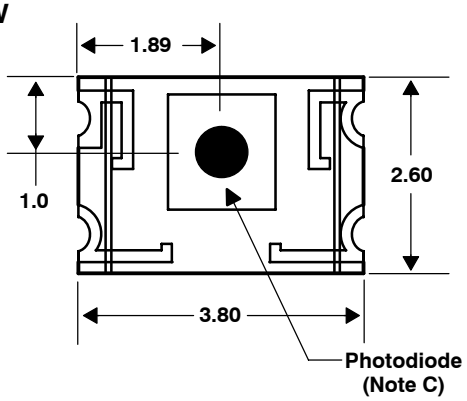
Figure 7. Suggested T Package PCB Layout

MECHANICAL DATA

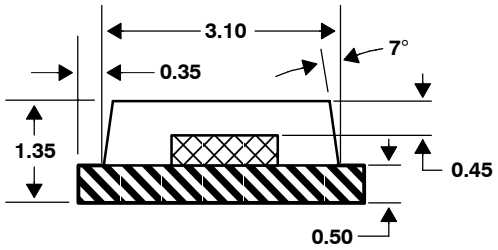
The TSL257T is supplied in a low-profile surface-mount package. This package contains no lead (Pb).

PACKAGE T **Four-Lead Surface Mount Device**

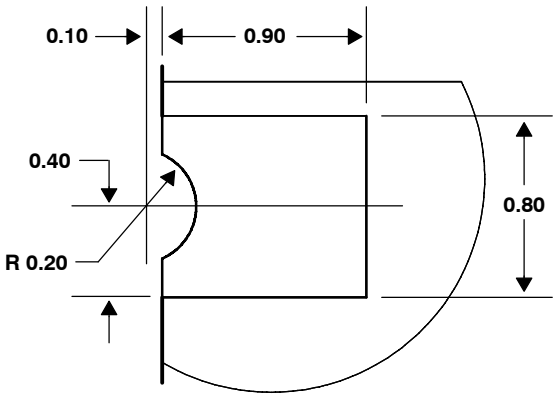
TOP VIEW



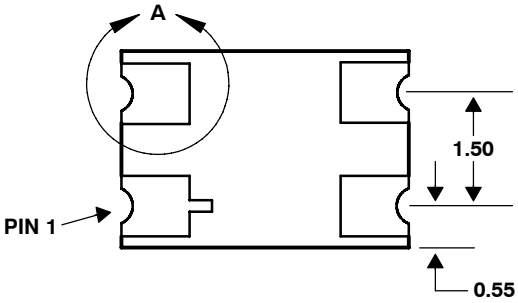
SIDE VIEW



DETAIL A: TYPICAL PACKAGE TERMINAL



BOTTOM VIEW

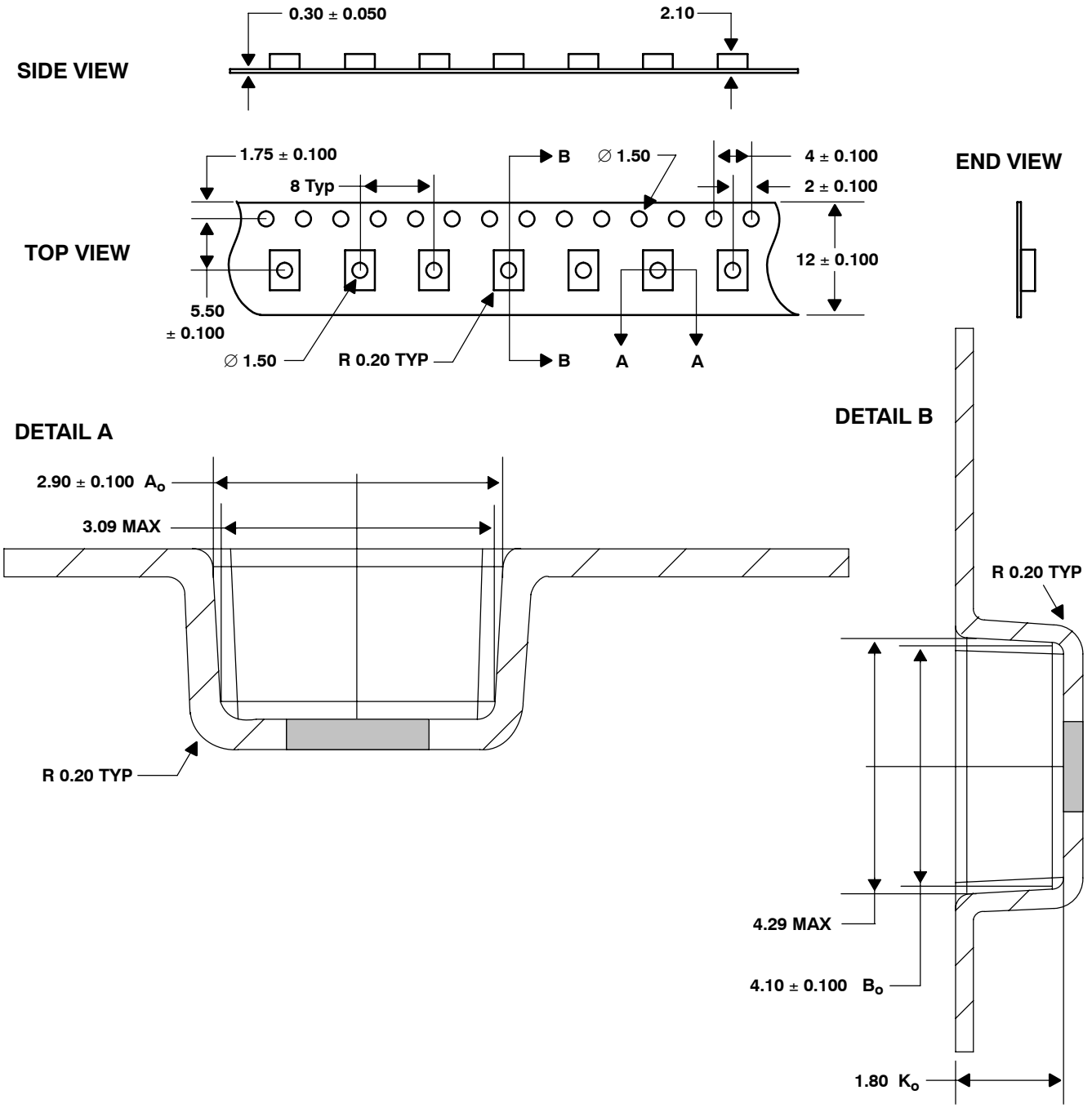


Lead Free

NOTES: A. All linear dimensions are in millimeters.
B. Terminal finish is gold.
C. The center of the 0.75 mm diameter integrated photodiode active area is typically located 0.1 mm above the center of the package.
D. Dimension tolerance is ± 0.15 mm.
E. This drawing is subject to change without notice.

Figure 8. Package T — Four-Lead Surface Mount Device Packaging Configuration

MECHANICAL DATA



NOTES:
A. All linear dimensions are in millimeters.
B. The dimensions on this drawing are for illustrative purposes only. Dimensions of an actual carrier may vary slightly.
C. Symbols on drawing A_o, B_o, and K_o are defined in ANSI EIA Standard 481–B 2001.
D. Each reel is 178 millimeters in diameter and contains 1000 parts.
E. TAOS packaging tape and reel conform to the requirements of EIA Standard 481–B.
F. In accordance with EIA standard, device pin 1 is located next to the sprocket holes in the tape.
G. This drawing is subject to change without notice.

Figure 9. Four Lead Surface Mount Package Carrier Tape

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.

Table 1. TSL257T Solder Reflow Profile

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

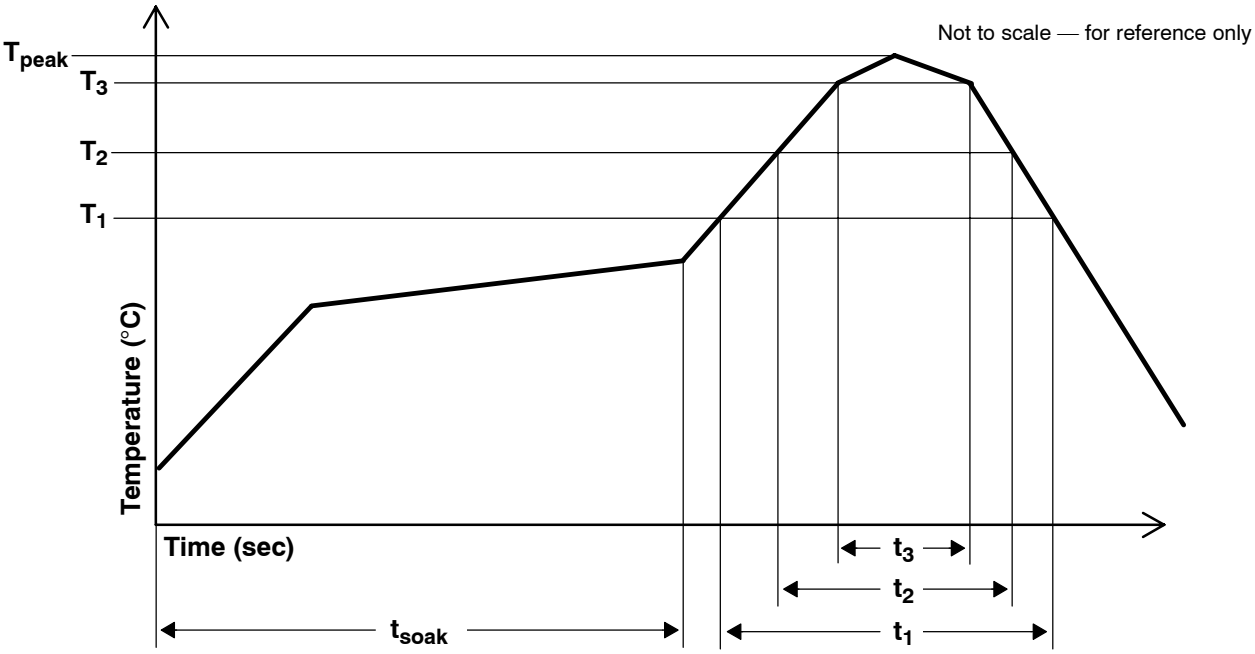


Figure 10. TSL257T Solder Reflow Profile

MANUFACTURING INFORMATION

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.

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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