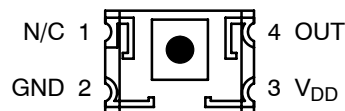


- Converts Light Intensity to Output Voltage
- Monolithic Silicon IC Containing Photodiode, Operational Amplifier, and Feedback Components
- High Sensitivity
- Single Voltage Supply Operation (2.7 V to 5.5 V)
- High Irradiance Responsivity . . . Typical 680 mV/($\mu\text{W}/\text{cm}^2$) at $\lambda_p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

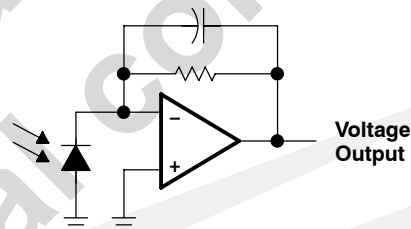
PACKAGE T
4-LEAD SMD
(TOP VIEW)



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 M Ω . 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 | 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, $T_A = 25^\circ\text{C}$, $\lambda_p = 640$ nm, $R_L = 10$ k Ω (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, $R_L = 10$ k Ω | 4 | 4.2 | | |
| V_O Output voltage | $E_e = 2.93$ $\mu\text{W}/\text{cm}^2$ | 1.5 | 2 | 2.5 | V |
| α_{VD} Temperature coefficient of dark voltage (V_D) | $T_A = 0^\circ\text{C}$ to 70°C | | –15 | | $\mu\text{V}/^\circ\text{C}$ |
| R_e Irradiance responsivity | See Note 5 | | 680 | | $\text{mV}/(\mu\text{W}/\text{cm}^2)$ |
| PSRR Power supply rejection ratio | $f_{ac} = 100$ Hz, see Note 6 | | 55 | | dB |
| | $f_{ac} = 1$ kHz, see Note 6 | | 35 | | |
| I_{DD} Supply current | $E_e = 2.93$ $\mu\text{W}/\text{cm}^2$ | | 2 | 3.8 | mA |

NOTES: 2. Measured with $R_L = 10$ k Ω 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 $\lambda_p = 640$ 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.

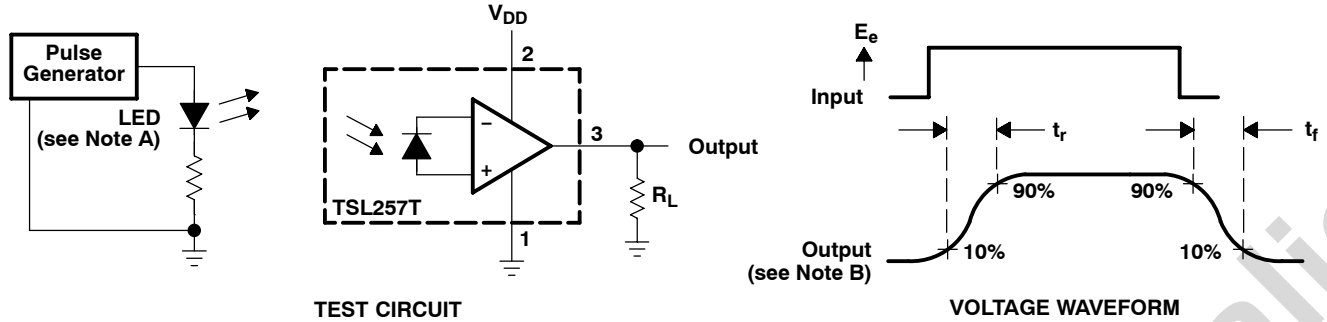
Switching Characteristics at $V_{DD} = 5$ V, $T_A = 25^\circ\text{C}$, $\lambda_p = 640$ nm, $R_L = 10$ k Ω (unless otherwise noted)

| 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 | $f = \text{dc to } 1$ kHz $E_e = 0$ | | 200 | | μV_{rms} |
| V_n Output noise voltage, rms | $f = 10$ Hz $E_e = 0$ | | 6 | | $\mu\text{V}/\sqrt{\text{Hz}}$ 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.



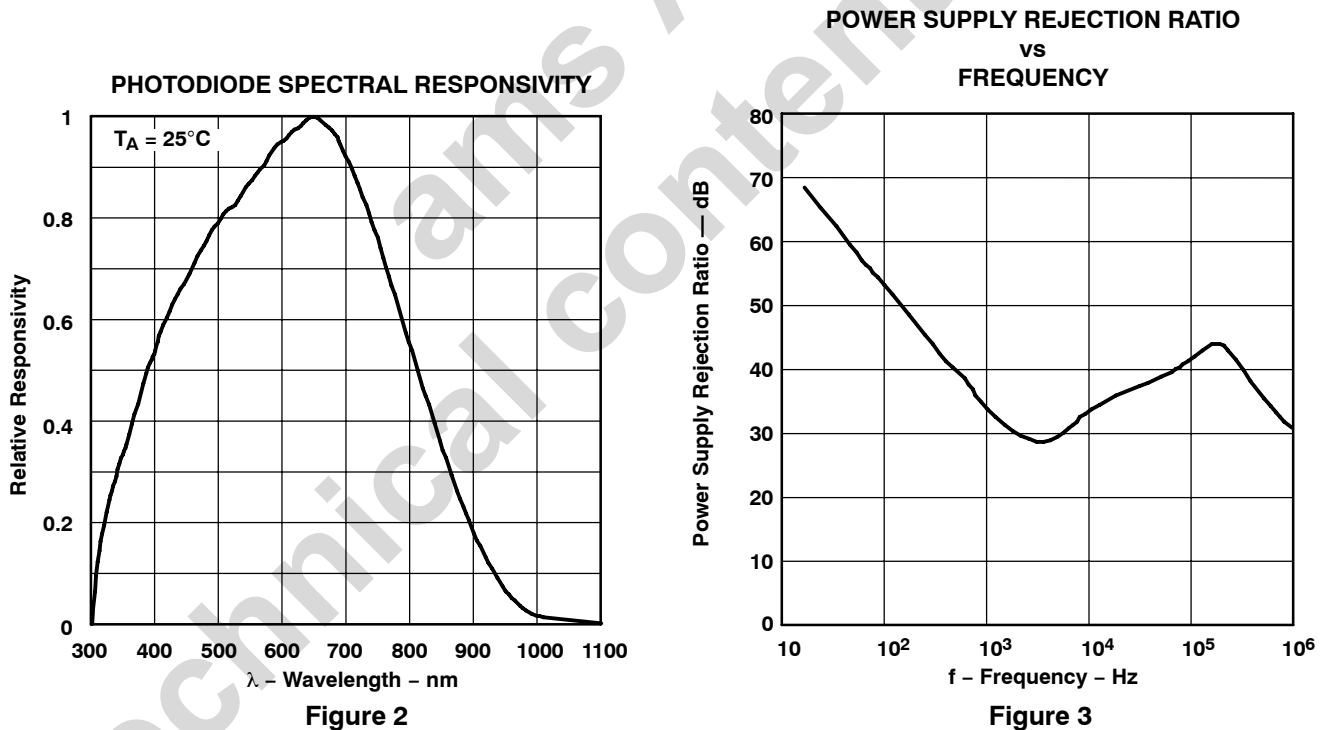
PARAMETER MEASUREMENT INFORMATION



- NOTES: A. The input irradiance is supplied by a pulsed AlInGaP light-emitting diode with the following characteristics: $\lambda_p = 640 \text{ nm}$, $t_r < 1 \mu\text{s}$, $t_f < 1 \mu\text{s}$.
- B. The output waveform is monitored on an oscilloscope with the following characteristics: $t_r < 100 \text{ ns}$, $Z_i \geq 1 \text{ M}\Omega$, $C_i \leq 20 \text{ pF}$.

Figure 1. Switching Times

TYPICAL CHARACTERISTICS



TYPICAL CHARACTERISTICS

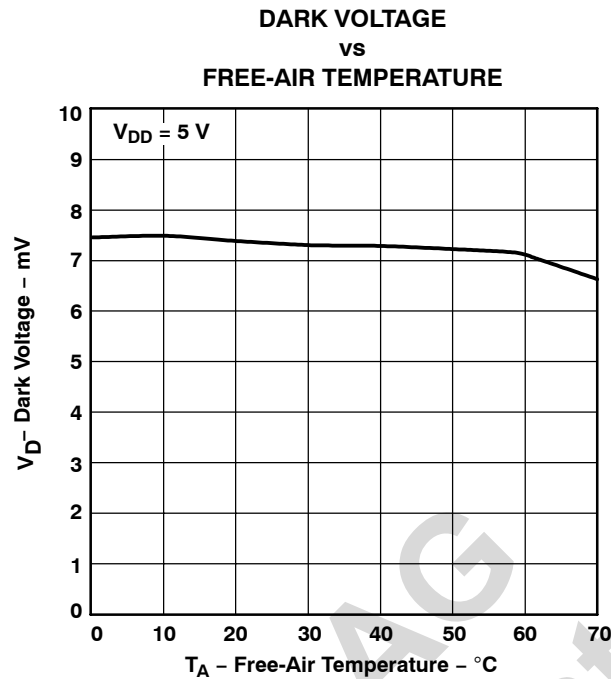


Figure 4

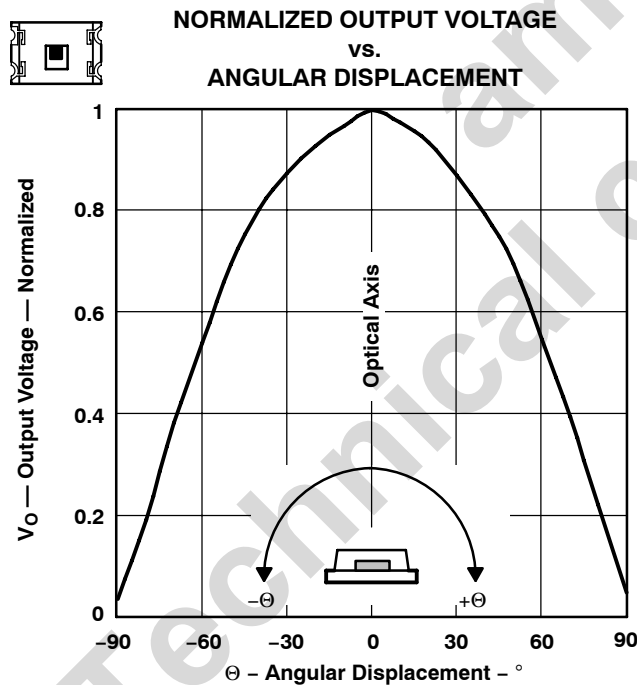


Figure 5

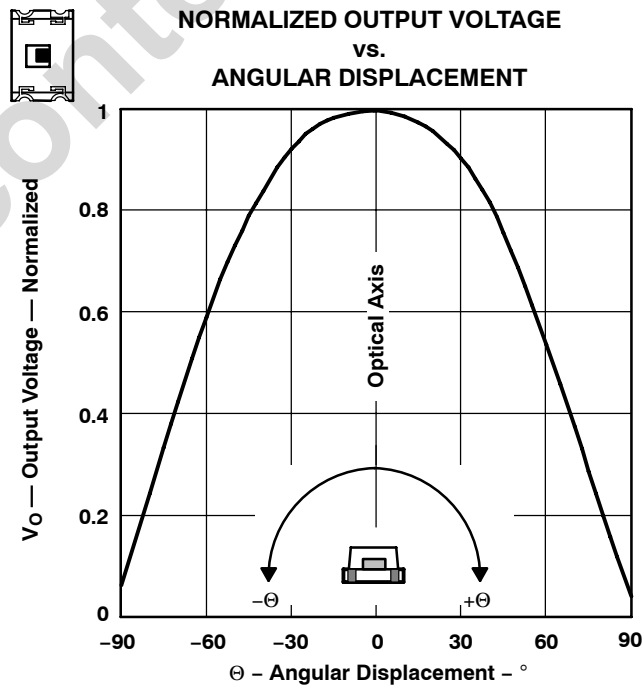
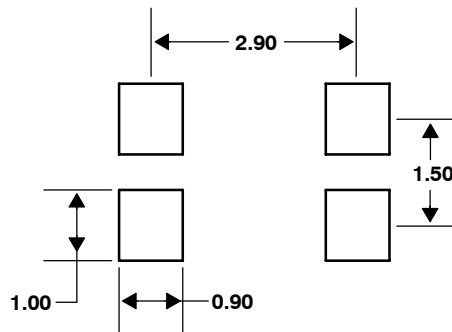


Figure 6

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

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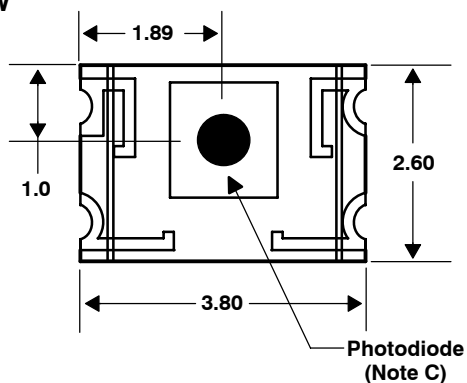
MECHANICAL DATA

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

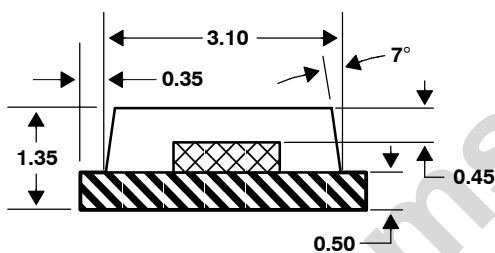
PACKAGE T

Four-Lead Surface Mount Device

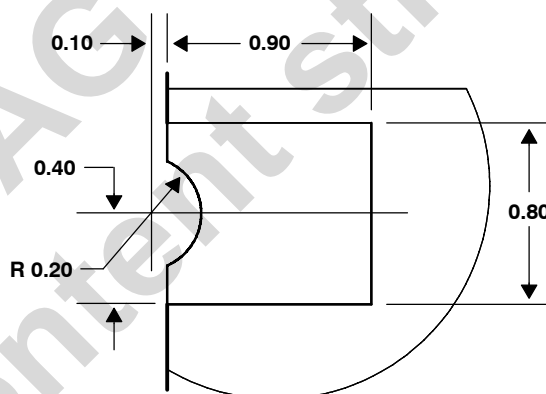
TOP VIEW



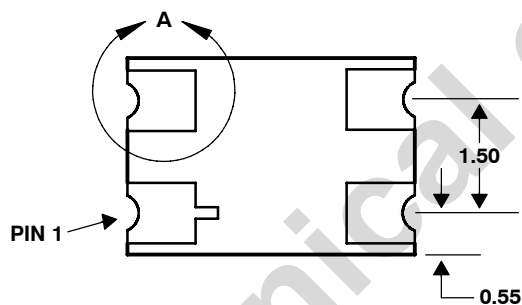
SIDE VIEW



DETAIL A: TYPICAL PACKAGE TERMINAL



BOTTOM VIEW



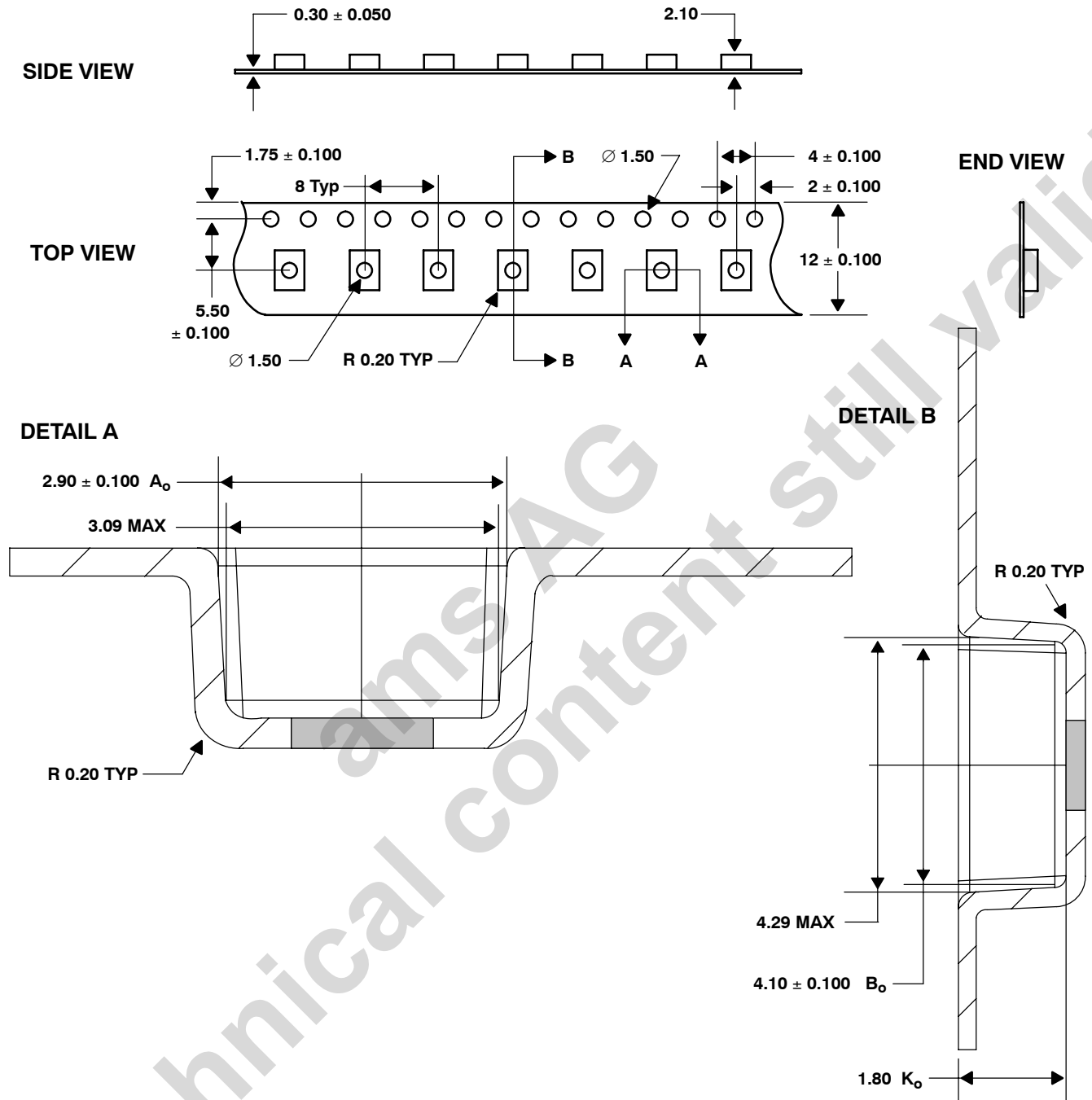
Lead Free

- 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 A₀, B₀, and K₀ 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 , ($T_{\text{peak}} - 10^\circ\text{C}$) | 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 |

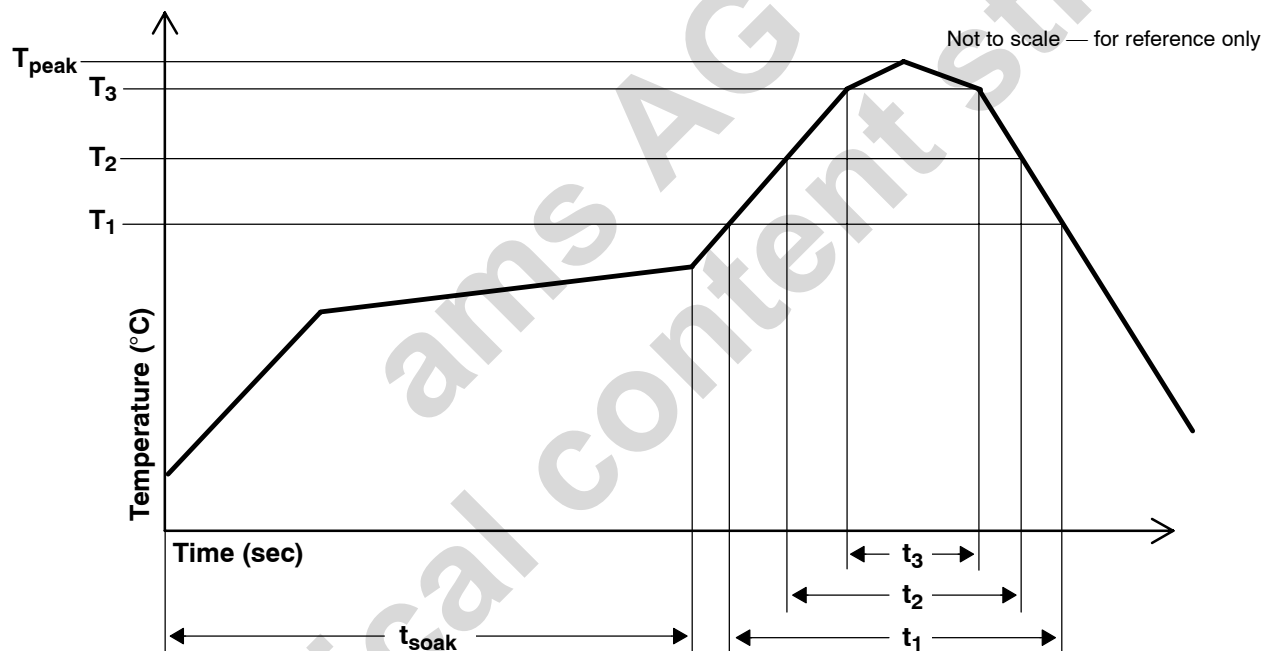


Figure 10. TSL257T Solder Reflow Profile

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.

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