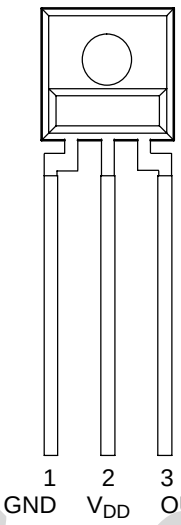
TSL257
HIGH-SENSITIVITY LIGHT-TO-VOLTAGE CONVERTER

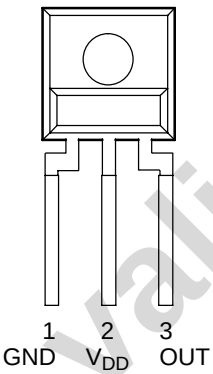
TAOS023E – SEPTEMBER 2007

- **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)**
- **Low Noise (200 μVrms Typ to 1 kHz)**
- **Rail-to-Rail Output**
- **High Power-Supply Rejection (35 dB at 1 kHz)**
- **Compact 3-Leaded Plastic Package**
- **RoHS Compliant (–LF Package Only)**

PACKAGE S
SIDELOOKER
(FRONT VIEW)



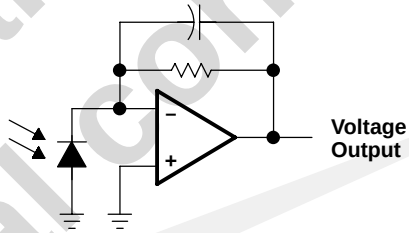
PACKAGE SM
SURFACE MOUNT
SIDELOOKER
(FRONT VIEW)



Description

The TSL257 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 TSL257 has a transimpedance gain of 320 MΩ. The device has improved 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.

Functional Block Diagram



Available Options

DEVICE	T_A	PACKAGE – LEADS	PACKAGE DESIGNATOR	ORDERING NUMBER
TSL257	0°C to 70°C	3-lead Sidelooker	S	TSL257
TSL257	0°C to 70°C	3-lead Sidelooker — Lead (Pb) Free	S	TSL257–LF
TSL257	0°C to 70°C	3-lead Surface-Mount Sidelooker — Lead (Pb) Free	SM	TSL257SM–LF

Terminal Functions

TERMINAL NAME	TERMINAL NO.	DESCRIPTION
GND	1	Ground (substrate). All voltages are referenced to GND.
OUT	3	Output voltage
V_{DD}	2	Supply voltage

Texas Advanced Optoelectronic Solutions Inc.
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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
Lead temperature 1,6 mm (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

† 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 = 470 nm, R_L = 10 kΩ (unless otherwise noted) (see Notes 2 and 3)

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 = 1.54 μW/cm², λ_p = 470 nm, Note 5	1.6	2	2.4	V
α_{VD}	Temperature coefficient of dark voltage (V_D)	T_A = 0°C to 70°C		−15		μV/°C
N_e	Irradiance responsivity	λ_p = 428 nm, see Notes 4 and 8		1.18		V/(μW/cm²)
		λ_p = 470 nm, see Notes 5 and 8		1.30		
		λ_p = 565 nm, see Notes 6 and 8		1.58		
		λ_p = 645 nm, see Notes 7 and 8		1.68		
PSRR	Power supply rejection ratio	f_{ac} = 100 Hz, see Note 9		55		dB
		f_{ac} = 1 kHz, see Note 9		35		dB
I_{DD}	Supply current	E_e = 1.54 μW/cm², λ_p = 470 nm, Note 5		1.9	3.5	mA

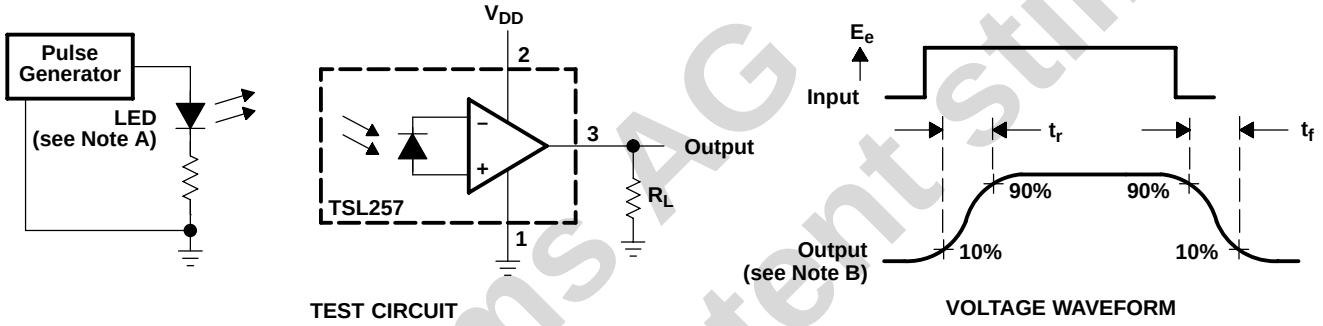
NOTES: 2. Measured with R_L = 10 kΩ between output and ground.
3. Optical measurements are made using small-angle incident radiation from a light-emitting diode (LED) optical source.
4. The input irradiance is supplied by a GaN/SiC light-emitting diode with the following characteristics: peak wavelength λ_p = 428 nm, spectral halfwidth $\Delta\lambda_{1/2}$ = 65 nm.
5. The input irradiance is supplied by an InGaN light-emitting diode with the following characteristics: peak wavelength λ_p = 470 nm, spectral halfwidth $\Delta\lambda_{1/2}$ = 35 nm.
6. The input irradiance is supplied by a GaP light-emitting diode with the following characteristics: peak wavelength λ_p = 565 nm, spectral halfwidth $\Delta\lambda_{1/2}$ = 28 nm.
7. The input irradiance is supplied by an AlGaAs light-emitting diode with the following characteristics: peak wavelength λ_p = 645 nm, spectral halfwidth $\Delta\lambda_{1/2}$ = 25 nm.
8. 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.
9. 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 = 470 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 10: 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 InGaN light-emitting diode with the following characteristics: λ_p = 470 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

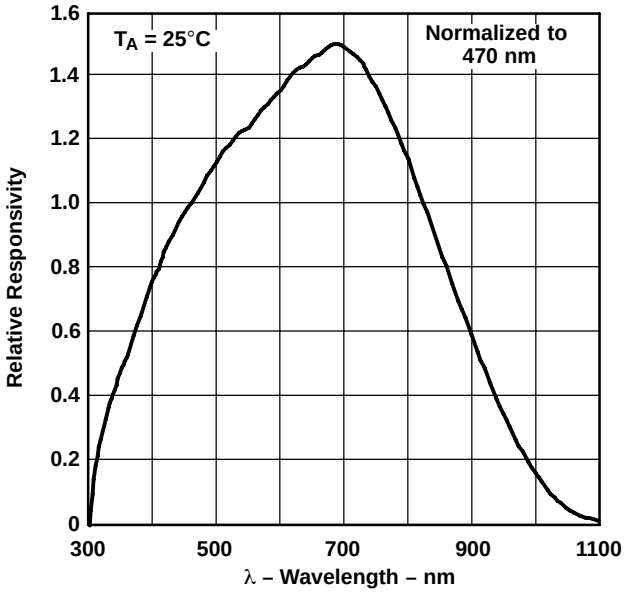


Figure 2

POWER SUPPLY REJECTION RATIO vs FREQUENCY

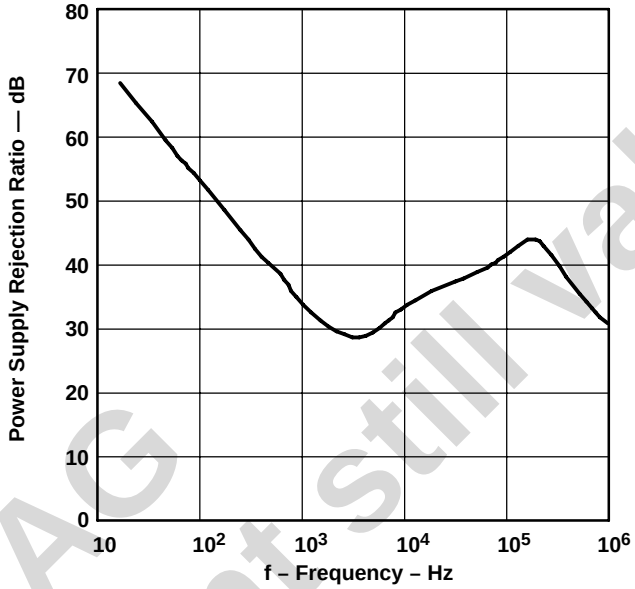


Figure 3

DARK VOLTAGE vs FREE-AIR TEMPERATURE

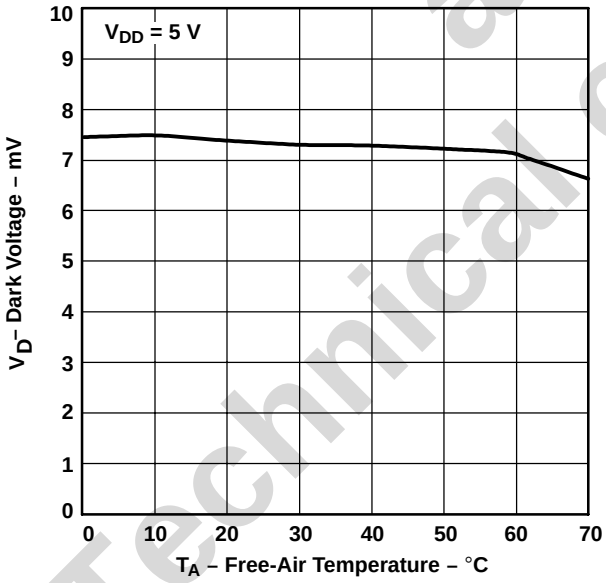


Figure 4

NORMALIZED RESPONSE vs ANGULAR DISPLACEMENT

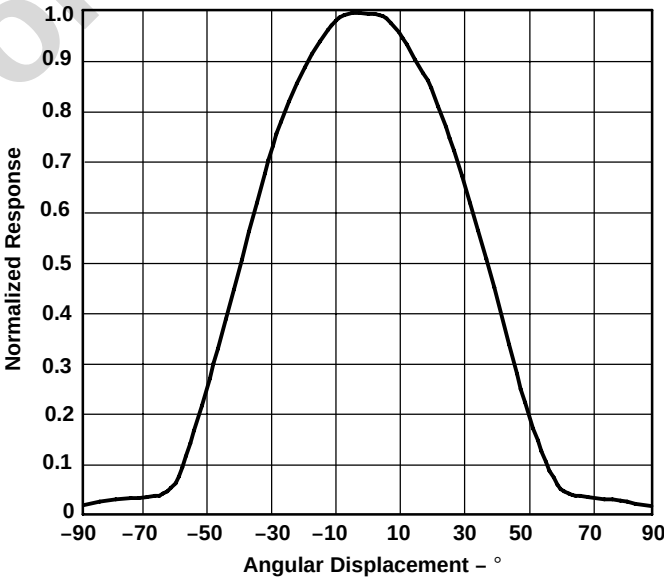
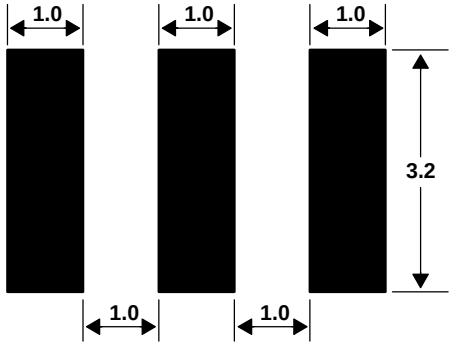


Figure 5

APPLICATION INFORMATION

PCB Pad Layout

Suggested PCB pad layout guidelines for the SM surface mount package are shown in Figure 6.



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

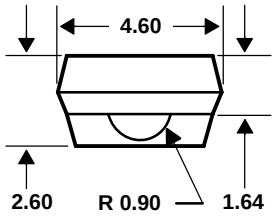
Figure 6. Suggested SM Package PCB Layout

MECHANICAL DATA

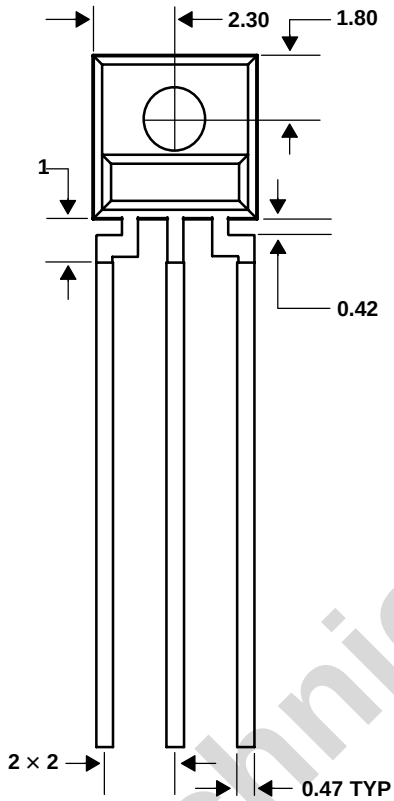
The device is supplied in a clear plastic three-lead sidelooker through-hole package (S).

PACKAGE S **PLASTIC SINGLE-IN-LINE SIDE-LOOKER PACKAGE**

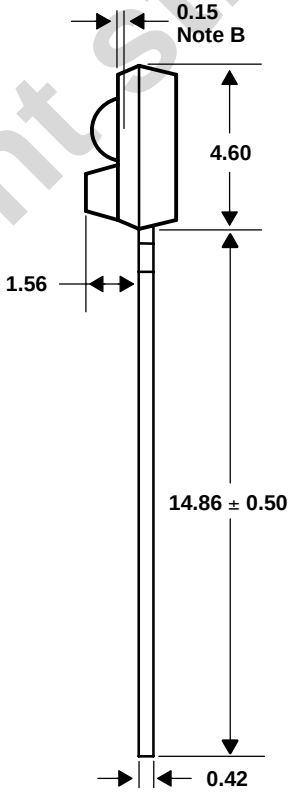
TOP VIEW



FRONT VIEW



SIDE VIEW



Pb
Lead Free Available

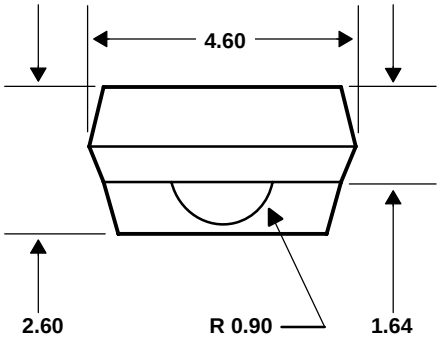
NOTES: A. All linear dimensions are in millimeters; tolerance is ± 0.25 mm unless otherwise stated.
B. Dimension is to center of lens arc, which is located below the package face.
C. The integrated photodiode active area is round with a typical diameter of 0.75 mm and is typically located in the center of the lens and 0.97 mm below the top of the lens surface.
D. Index of refraction of clear plastic is 1.55.
E. Lead finish for TSL257: solder dipped, 63% Sn/37% Pb. Lead finish for TSL257–LF: solder dipped, 100% Sn.
F. This drawing is subject to change without notice.

Figure 7. Package S — Single-In-Line Side-Looker Package Configuration

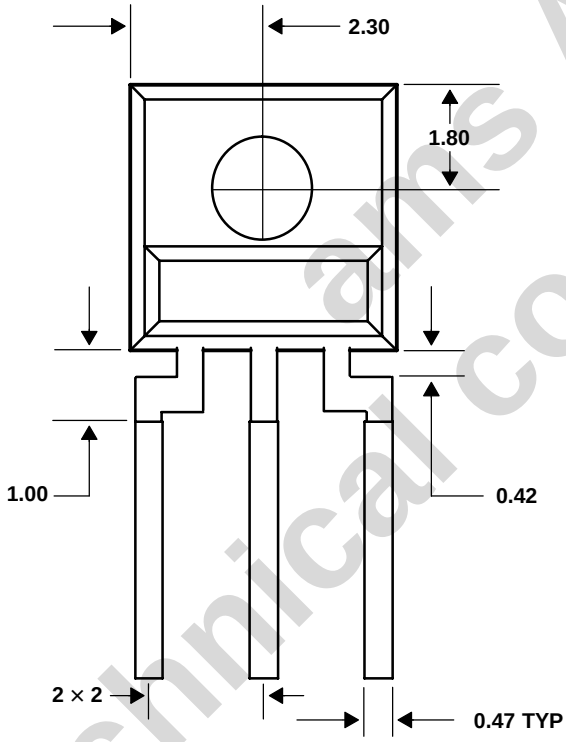
MECHANICAL DATA

PACKAGE SM **PLASTIC SURFACE MOUNT SIDE-LOOKER PACKAGE**

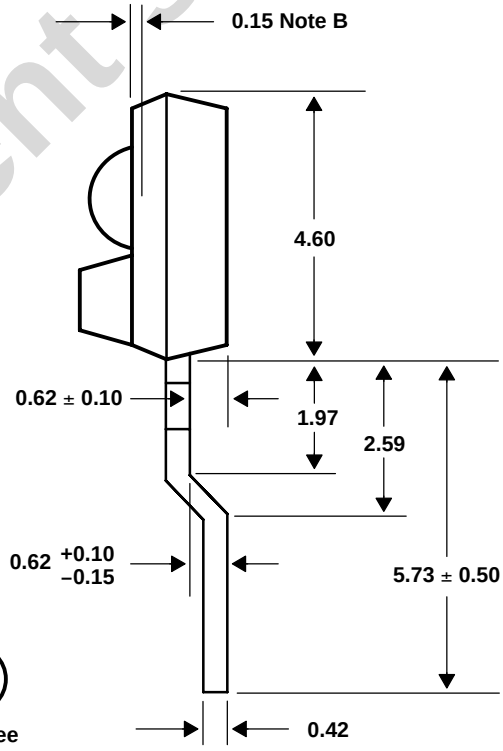
TOP VIEW



FRONT VIEW



SIDE VIEW



Pb
Lead Free

NOTES: A. All linear dimensions are in millimeters; tolerance is ± 0.25 mm unless otherwise stated.
B. Dimension is to center of lens arc, which is located below the package face.
C. The integrated photodiode active area is typically located in the center of the lens and 0.97 mm below the top of the lens surface.
D. Index of refraction of clear plastic is 1.55.
E. Lead finish for TSL257SM–LF: solder dipped, 100% Sn.
F. This drawing is subject to change without notice.

Figure 8. Package SM — Surface Mount Side-Looker Package Configuration