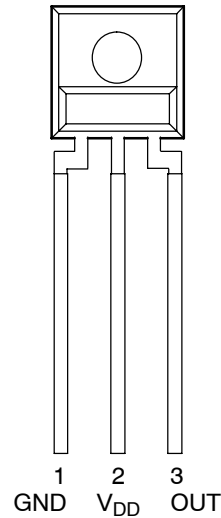
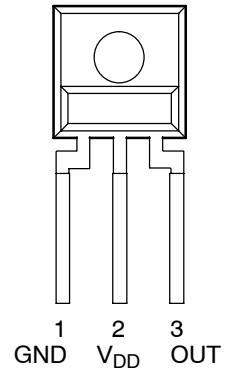


- Monolithic Silicon IC Containing Photodiode, Operational Amplifier, and Feedback Components
- Converts Light Intensity to a Voltage
- Irradiance Responsivity, Typically 9 mV/( $\mu\text{W}/\text{cm}^2$ ) at  $\lambda_p = 635 \text{ nm}$
- Compact 3-Lead Clear Plastic Sidelooker Package
- Single Voltage Supply Operation
- Low Dark (Offset) Voltage....10 mV Max
- Low Supply Current.....1.1 mA Typical
- Wide Supply-Voltage Range.... 2.7 V to 5.5 V
- Replacement for TSL254
- RoHS Compliant (–LF Package Only)

**PACKAGE S**  
**SIDELOOKER**  
**(FRONT VIEW)**



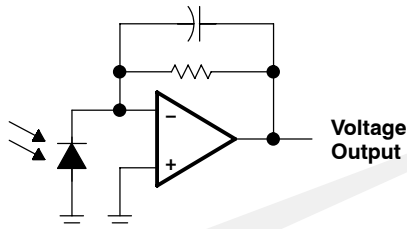
**PACKAGE SM**  
**SURFACE MOUNT**  
**SIDELOOKER**  
**(FRONT VIEW)**



## Description

The TSL254R is a light-to-voltage optical sensor combining a photodiode and a transimpedance amplifier (feedback resistor = 1 M $\Omega$ ) 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. When supplied in the lead (Pb) free package, the device is RoHS compliant.

## Functional Block Diagram



## Available Options

| DEVICE  | T <sub>A</sub> | PACKAGE – LEADS                                  | PACKAGE DESIGNATOR | ORDERING NUMBER |
|---------|----------------|--------------------------------------------------|--------------------|-----------------|
| TSL254R | 0°C to 70°C    | 3-lead Sidelooker                                | S                  | TSL254R         |
| TSL254R | 0°C to 70°C    | 3-lead Sidelooker — Lead (Pb) Free               | S                  | TSL254R-LF      |
| TSL254R | 0°C to 70°C    | 3-lead Surface-Mount Sidelooker — Lead (Pb) Free | SM                 | TSL254RSM-LF    |

## Terminal Functions

| TERMINAL NAME   | NO. | DESCRIPTION                                             |
|-----------------|-----|---------------------------------------------------------|
| GND             | 1   | Ground (substrate). All voltages are referenced to GND. |
| OUT             | 3   | Output voltage                                          |
| V <sub>DD</sub> | 2   | Supply voltage                                          |

# TSL254R

## LIGHT-TO-VOLTAGE OPTICAL SENSOR

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### Absolute Maximum Ratings over operating free-air temperature range (unless otherwise noted)<sup>†</sup>

|                                                                          |               |
|--------------------------------------------------------------------------|---------------|
| Supply voltage, $V_{DD}$ (see Note 1)                                    | 6 V           |
| Output current, $I_O$                                                    | $\pm 10$ mA   |
| Duration of short-circuit current at (or below) 25°C (see Note 2)        | 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         |

<sup>†</sup> 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.

NOTES: 1. All voltages are with respect to GND.  
2. Output may be shorted to supply.

### Recommended Operating Conditions

|                                       | MIN | NOM | 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, $T_A = 25^\circ\text{C}$ , $\lambda_p = 635$ nm, $R_L = 10$ k $\Omega$ (unless otherwise noted) (see Notes 3, 4, and 5)

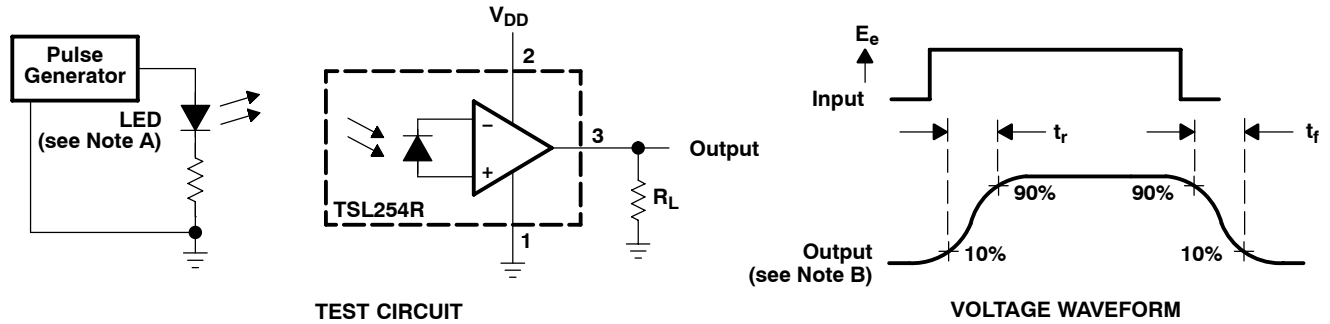
| PARAMETER                                                         | TEST CONDITIONS                                                     | TSL254R |     |     | UNIT                             |
|-------------------------------------------------------------------|---------------------------------------------------------------------|---------|-----|-----|----------------------------------|
|                                                                   |                                                                     | MIN     | TYP | MAX |                                  |
| $V_D$ Dark voltage                                                | $E_e = 0$                                                           | 0       | 5   | 10  | mV                               |
| $V_{OM}$ Maximum output voltage                                   | $V_{DD} = 4.5$ V                                                    | 3.0     | 3.3 |     | V                                |
| $V_O$ Output voltage                                              | $E_e = 222 \mu\text{W}/\text{cm}^2$                                 | 1.5     | 2   | 2.5 | V                                |
| $\alpha_{VO}$ Temperature coefficient of output voltage ( $V_O$ ) | $V_O = 2$ V @ 25°C,<br>$T_A = 0^\circ\text{C}$ to 70°C (see Note 6) |         | 2   |     | mV/°C                            |
|                                                                   |                                                                     |         | 0.1 |     | %/°C                             |
| $R_e$ Irradiance responsivity                                     | See Notes 5 and 7                                                   |         | 9   |     | mV/( $\mu\text{W}/\text{cm}^2$ ) |
| $I_{DD}$ Supply current                                           | $E_e = 222 \mu\text{W}/\text{cm}^2$                                 |         | 1.1 | 1.7 | mA                               |

NOTES: 3. Measurements are made with  $R_L = 10$  k $\Omega$  between output and ground.  
4. Optical measurements are made using small-angle incident radiation from an LED optical source.  
5. The input irradiance  $E_e$  is supplied by an AlInGaP LED with peak wavelength  $\lambda_p = 635$  nm  
6. The temperature coefficient of output voltage measurement is made by adjusting irradiance such that  $V_O$  is approximately 2 V at 25°C and then with irradiance held constant, measuring  $V_O$  while varying the temperature between 0°C and 70°C.  
7. Irradiance responsivity is characterized over the range  $V_O = 0.05$  to 2.9 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  $E_e = 0$ .

### Dynamic Characteristics at $V_{DD} = 5$ V, $T_A = 25^\circ\text{C}$ , $\lambda_p = 635$ nm, $R_L = 10$ k $\Omega$ (see Figure 1)

| PARAMETER                    | TEST CONDITIONS                      | TSL254R |     |     | UNIT                           |
|------------------------------|--------------------------------------|---------|-----|-----|--------------------------------|
|                              |                                      | MIN     | TYP | MAX |                                |
| $t_r$ Output pulse rise time | $V_{O(\text{peak})} = 2$ V           |         | 2.5 |     | $\mu\text{s}$                  |
| $t_f$ Output pulse fall time | $V_{O(\text{peak})} = 2$ V           |         | 2.5 |     | $\mu\text{s}$                  |
| $V_n$ Output noise voltage   | $E_e = 0$ , $V_O = V_D$ $f = 1$ kHz  |         | 1   |     | $\mu\text{V}/\sqrt{\text{Hz}}$ |
|                              | $E_e = 0$ , $V_O = V_D$ $f = 10$ kHz |         | 1   |     |                                |
|                              | $V_O = 2$ V $f = 1$ kHz              |         | 1.5 |     |                                |
|                              | $V_O = 2$ V $f = 10$ kHz             |         | 1.5 |     |                                |

## PARAMETER MEASUREMENT INFORMATION



- NOTES: A. The input irradiance is supplied by a pulsed AlInGaP light-emitting diode with the following characteristics:  $\lambda_p = 635 \text{ nm}$ ,  $t_r < 1 \text{ } \mu\text{s}$ ,  $t_f < 1 \text{ } \mu\text{s}$ .
- 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**

# TSL254R LIGHT-TO-VOLTAGE OPTICAL SENSOR

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## TYPICAL CHARACTERISTICS

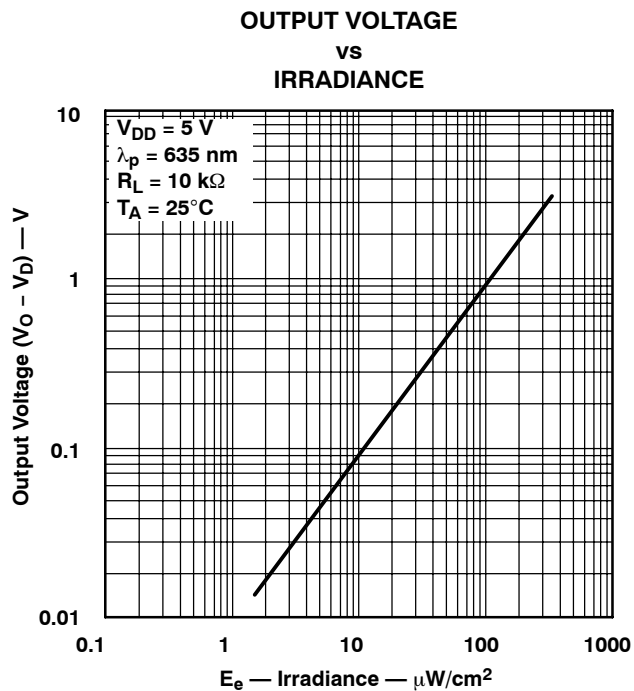


Figure 2

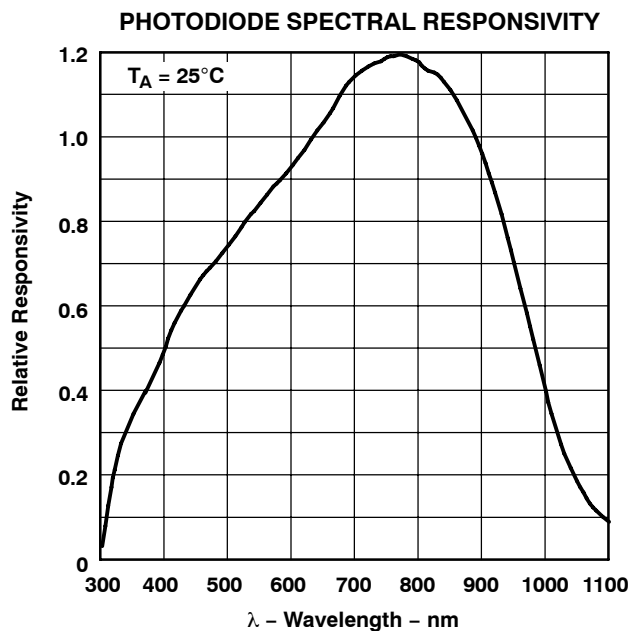


Figure 3

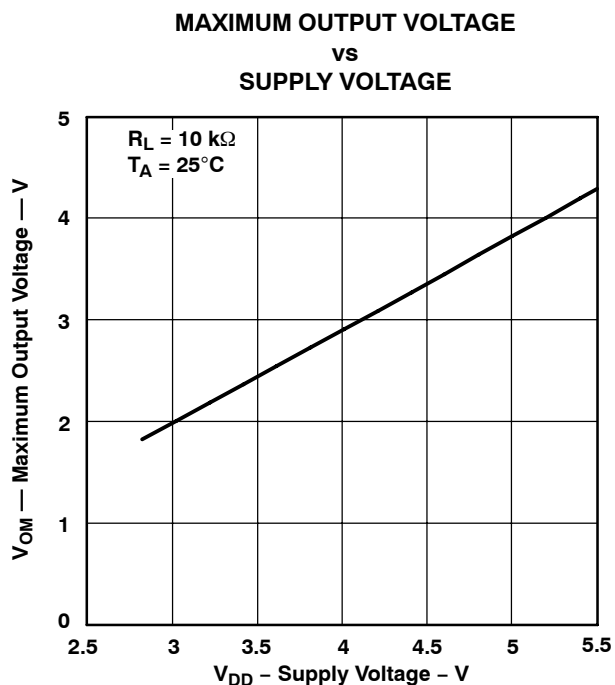


Figure 4

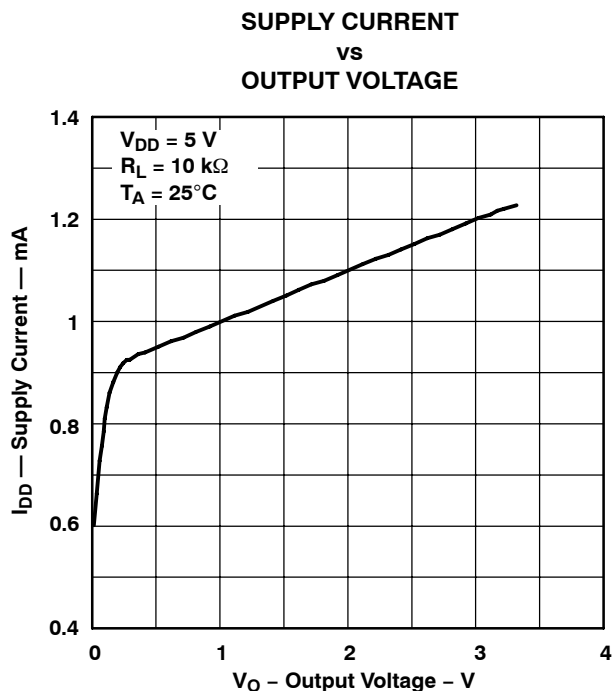
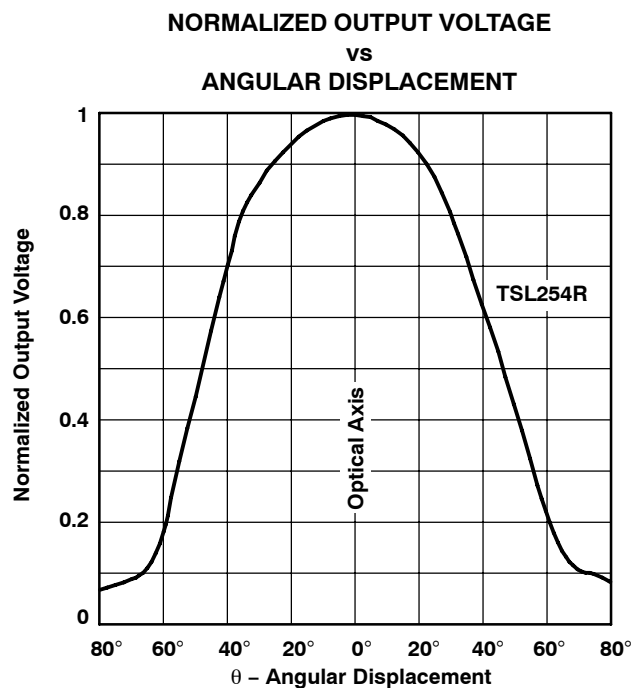


Figure 5



**TYPICAL CHARACTERISTICS**



**Figure 6**

# TSL254R

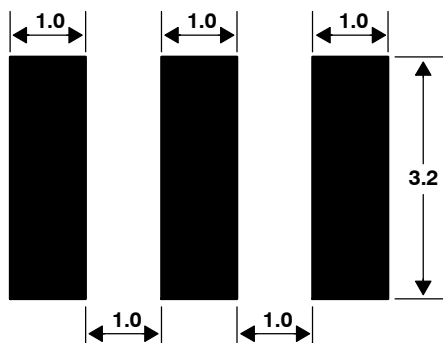
## LIGHT-TO-VOLTAGE OPTICAL SENSOR

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### APPLICATION INFORMATION

#### PCB Pad Layout

Suggested PCB pad layout guidelines for the SM surface mount 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 SM Package PCB Layout**



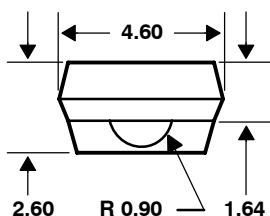
## MECHANICAL INFORMATION

The device is supplied in a clear plastic three-lead package (S). The integrated photodiode active area is typically  $1,0 \text{ mm}^2$  ( $0.0016 \text{ in}^2$ ).

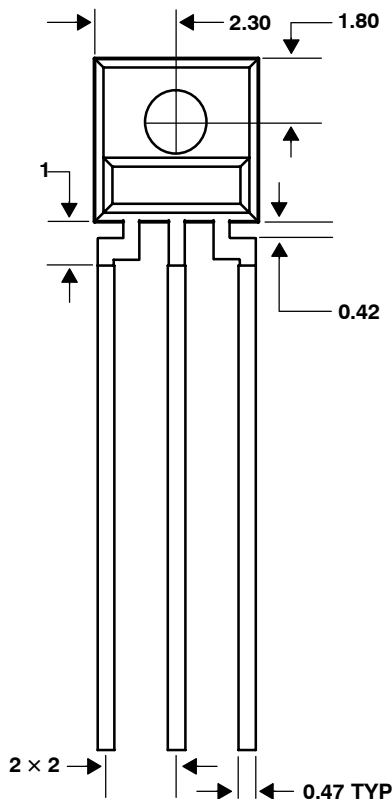
### PACKAGE S

### PLASTIC SINGLE-IN-LINE SIDE-LOOKER PACKAGE

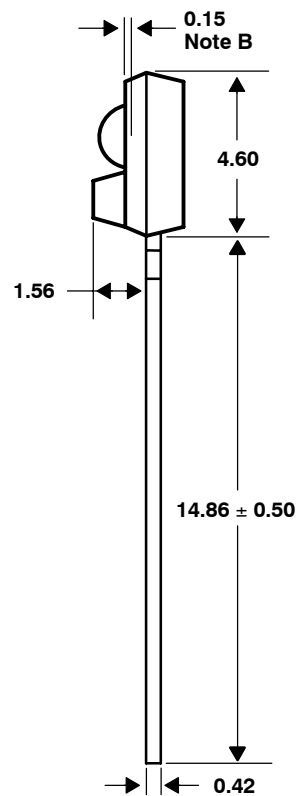
#### TOP VIEW



#### FRONT VIEW



#### SIDE VIEW



Lead Free  
Available

- NOTES:
- A. All linear dimensions are in millimeters; tolerance is  $\pm 0.25 \text{ mm}$  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  $0.97 \text{ mm}$  below the top of the lens surface.
  - D. Index of refraction of clear plastic is 1.55.
  - E. Lead finish for TSL254R solder dipped, 63% Sn/37% Pb. Lead finish for TSL254R-LF: solder dipped, 100% Sn.
  - F. This drawing is subject to change without notice.

**Figure 8. Package S — Single-In-Line Side-Looker Package Configuration**

# TSL254R LIGHT-TO-VOLTAGE OPTICAL SENSOR

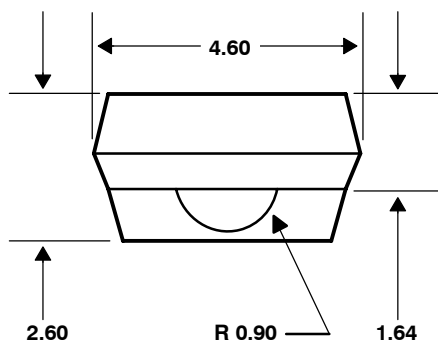
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## MECHANICAL DATA

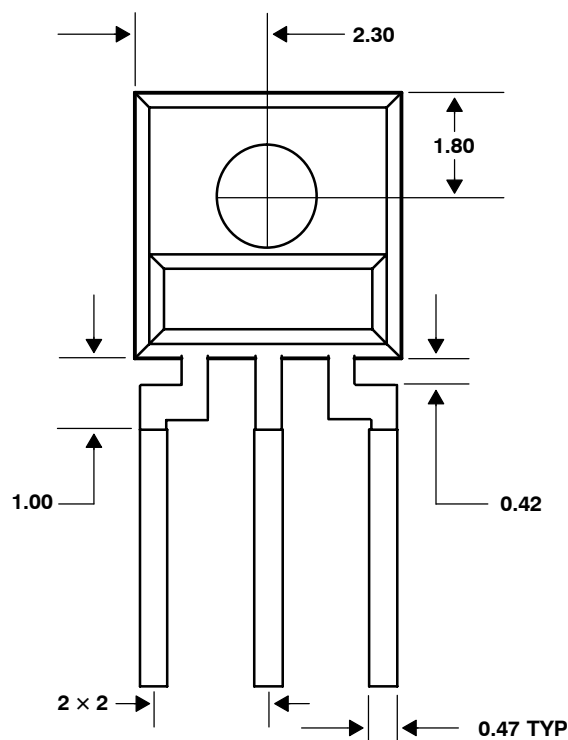
### PACKAGE SM

### PLASTIC SURFACE MOUNT SIDE-LOOKER PACKAGE

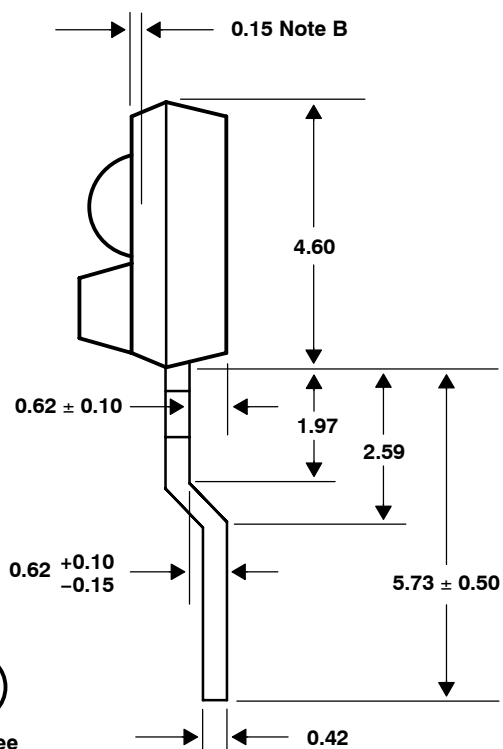
#### TOP VIEW



#### FRONT VIEW



#### SIDE VIEW



Lead Free

- NOTES: A. All linear dimensions are in millimeters; tolerance is  $\pm 0.25$  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 TSL254RSM-LF: solder dipped, 100% Sn.  
 F. This drawing is subject to change without notice.

Figure 9. Package SM — Surface Mount Side-Looker Package Configuration



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