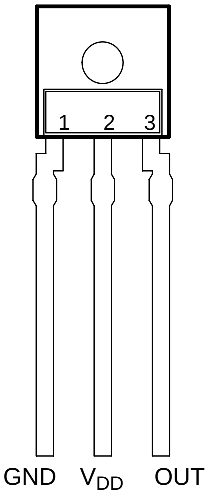
TSL265
HIGH-SENSITIVITY NEAR-INFRARED LIGHT-TO-VOLTAGE CONVERTER

TAOS016 – SEPTEMBER 1999

- **High Sensitivity**
- **Rail-to-Rail Output**
- **Single Voltage Supply Operation**
- **Monolithic Silicon IC Containing Photodiode, Operational Amplifier, and Feedback Components**
- **Converts NIR Light Intensity to Output Voltage**
- **Compact 3-Leaded Infrared-Transmissive Plastic Package**
- **Wide Supply-Voltage Range**
- **Low Supply Current**

PACKAGE (TOP VIEW)

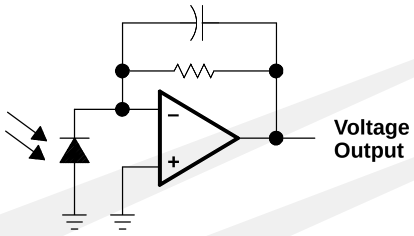


Description

The TSL265 is a high-sensitivity 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 near infrared (NIR) light intensity (irradiance) on the photodiode. The TSL265 has a transimpedance gain of 3.2 GΩ. Bandwidth and signal-to-noise ratio are optimized by means of a patented design that minimizes the effects of photodiode capacitance. It uses design techniques that provide improved offset voltage stability and low power consumption, and is supplied in a 3-lead visible-light-blocking sidelooker package with an integral lens.

The TSL265 is intended for NIR light-sensing applications requiring ultrahigh sensitivity where a linear voltage output is desired.

Functional Block Diagram



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

Absolute Maximum Ratings over operating free-air temperature range (unless otherwise noted)[†]

Supply voltage, V_{DD} (see Note 1)	7 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	240°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	6	V
Operating free-air temperature, T_A	0	70	°C

Electrical Characteristics at V_{DD} = 5 V, T_A = 25°C, λp = 880 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			100	mV
V_{OM}	Maximum output voltage swing	V_{DD} = 4.5 V, ,R_L = 0,		4.49		V
		V_{DD} = 4.5 V, R_L = 10 kΩ	4	4.2		
V_O	Output voltage	E_e = 156 mW/cm^2	1.6	2	2.4	V
α_{vo}	Temperature coefficient of output voltage (V_O)	T_A = 0°C to 70°C, See Note 2		TBD		%/°C
N_e	Irradiance responsivity			12.8		V/(μW/cm^2)
	Power supply rejection	f_{ac} = 100 Hz, 1.3 $V_{O(pp)}$		32		dB
		f_{ac} = 1 kHz, 1.3 $V_{O(pp)}$		19		dB
I_{DD}	Supply current			2.5	4.5	mA

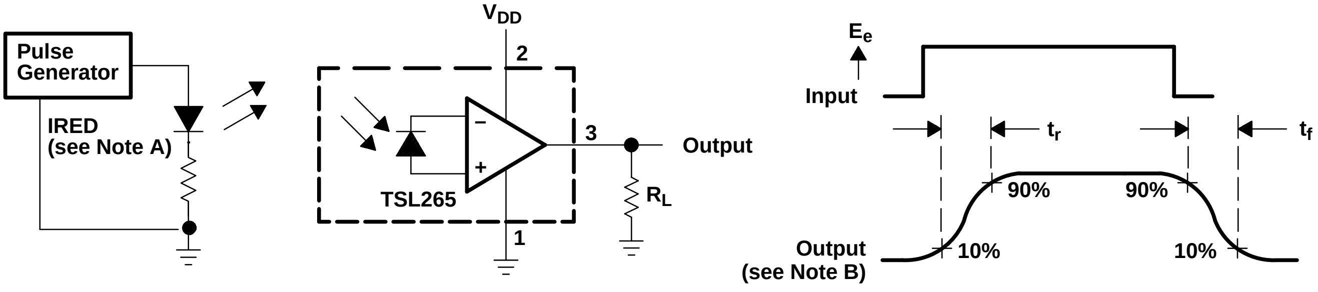
NOTES: 2. The input irradiance E_e is supplied by a GaAlAs infrared-emitting diode with λ_p = 880 nm.
3. Irradiance responsivity is characterized over the range V_O = 0.1 V to 4.5 V.

Switching Characteristics at V_{DD} = 5 V, T_A = 25°C, λ_p = 880 nm, R_L = 10 kΩ (unless otherwise noted) (see Note 3)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_r	Output pulse rise time	See Notes 4 and 5		166	250	μs
t_f	Output pulse fall time	See Notes 4 and 5		163	250	μs
t_s	Output settling time			322		μs
	Integrated noise voltage	f = dc to 1 kHz		3.5		mV RMS
V_n	Output noise voltage, rms	f = 10 Hz, See Note 6		92		μV/$\sqrt{Hz}$ RMS
		f = 100 Hz		86		
		f = 1 Hz		104		

NOTES: 3. Irradiance responsivity is characterized over the range V_O = 0.1 V to 4.5 V.
4. Measured with R_L = 10 kΩ between output and ground.
5. The output waveform is monitored on an oscilloscope with Z_i = 1 MΩ, C_i < 20 pF.
6. Measured with external 1-kHz RC filter (10 kΩ/15.9 nF)

PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT

VOLTAGE WAVEFORM

NOTES: A. The input irradiance is supplied by a pulsed GaAlAs infrared-emitting diode with the following characteristics: λ_p = 880 nm, $t_r < 1\ \mu s$, $t_f < 1\ \mu s$.

B. The output waveform is monitored on an oscilloscope with the following characteristics: $t_r < 100$ ns, $Z_i \geq 1$ MHz, $C_i \leq 20$ pF.

Figure 1. Switching Times

TYPICAL CHARACTERISTICS

OUTPUT VOLTAGE
vs
IRRADIANCE

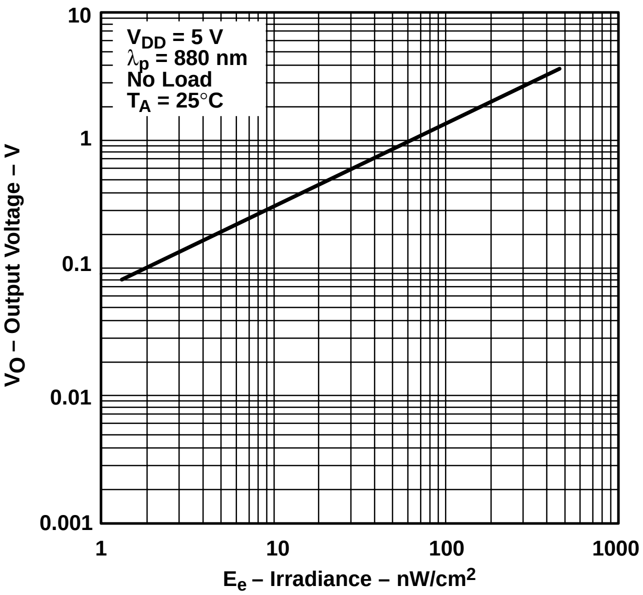


Figure 2

PHOTODIODE SPECTRAL RESPONSE

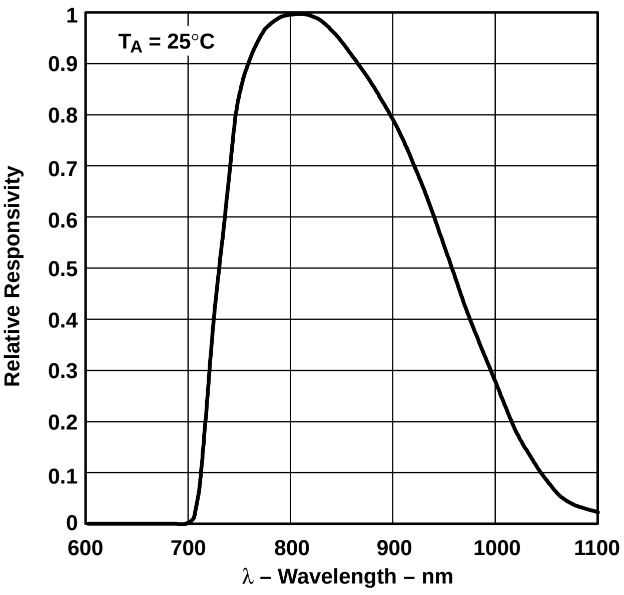


Figure 3

TYPICAL CHARACTERISTICS

MAXIMUM OUTPUT VOLTAGE vs SUPPLY VOLTAGE

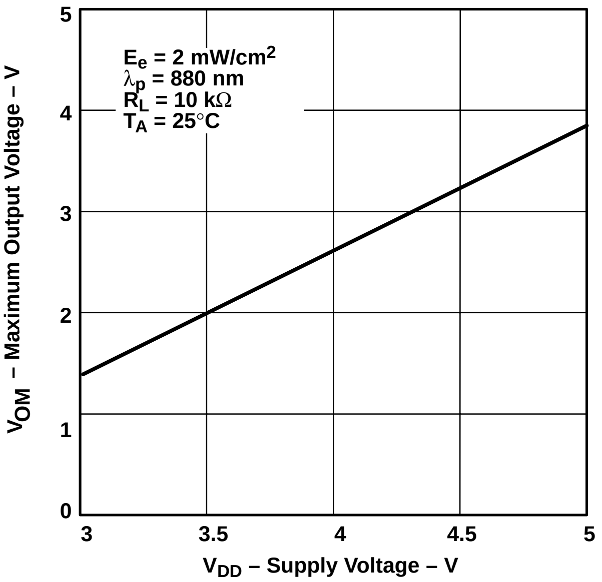


Figure 4

NORMALIZED OUTPUT VOLTAGE vs ANGULAR DISPLACEMENT

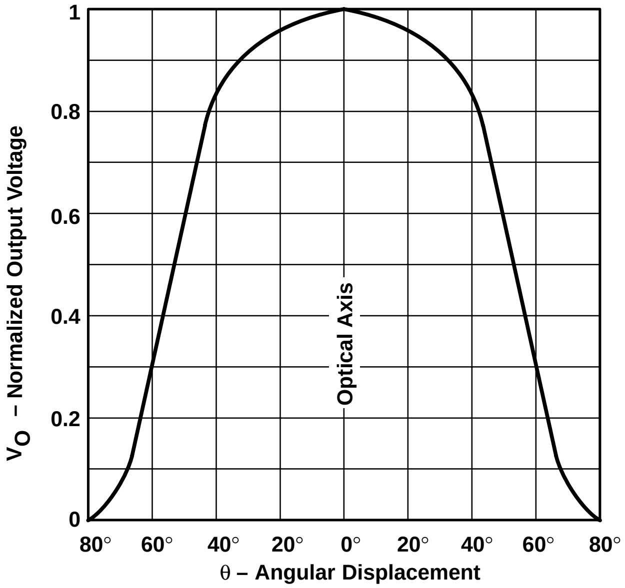


Figure 5

POWER SUPPLY REJECTION RATIO vs FREQUENCY

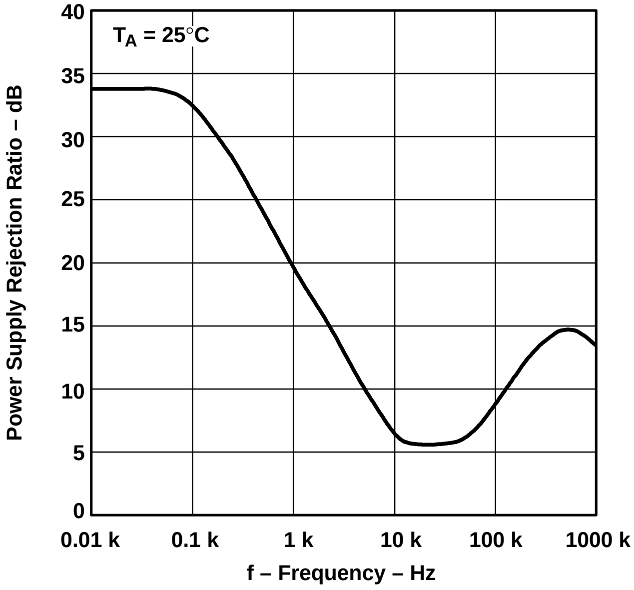


Figure 6

SUPPLY CURRENT vs FREE-AIR TEMPERATURE

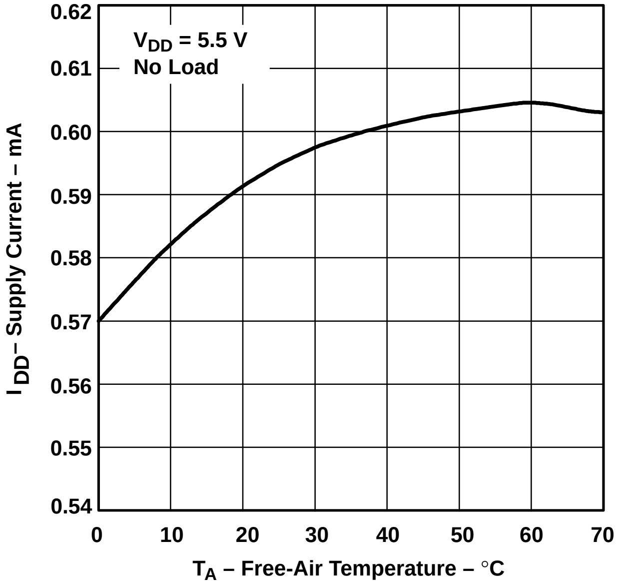


Figure 7

TYPICAL CHARACTERISTICS

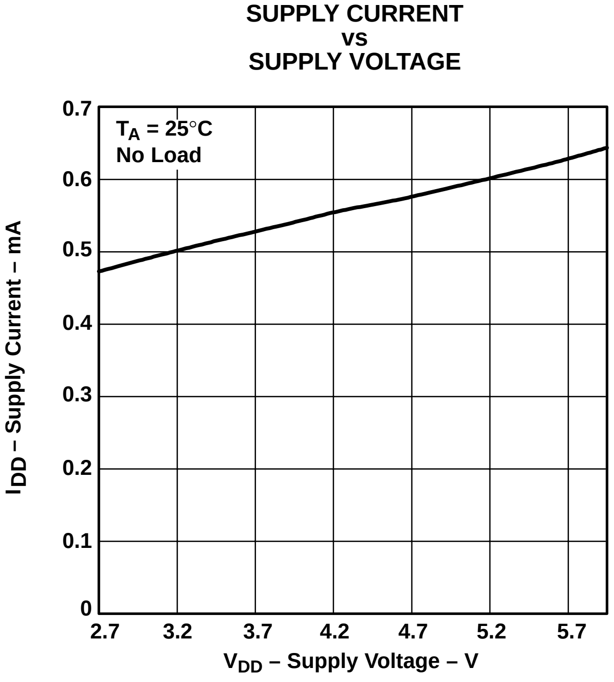


Figure 8

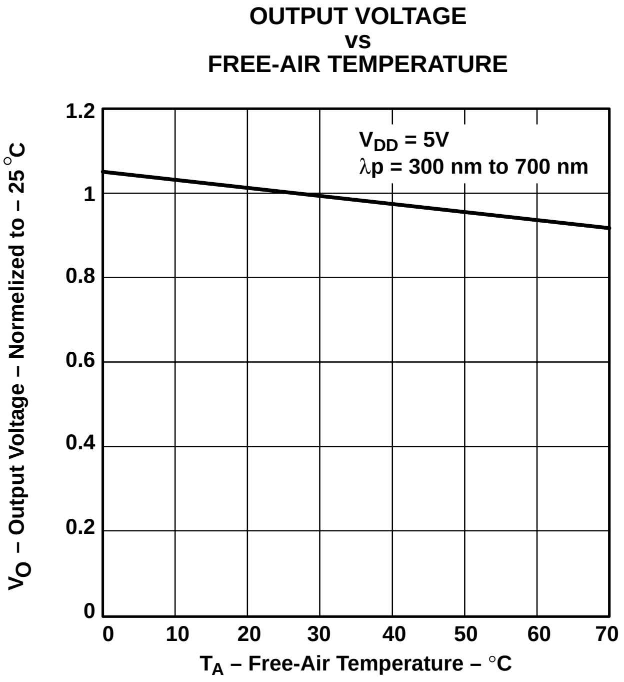


Figure 9

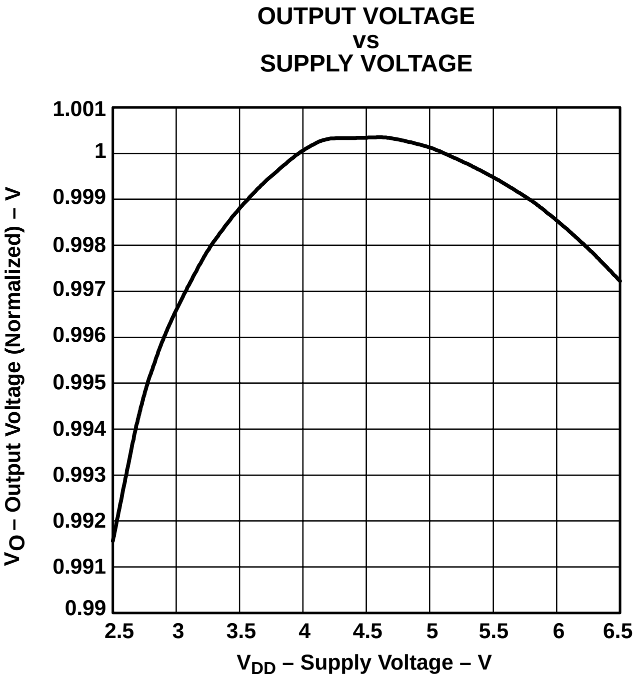


Figure 10

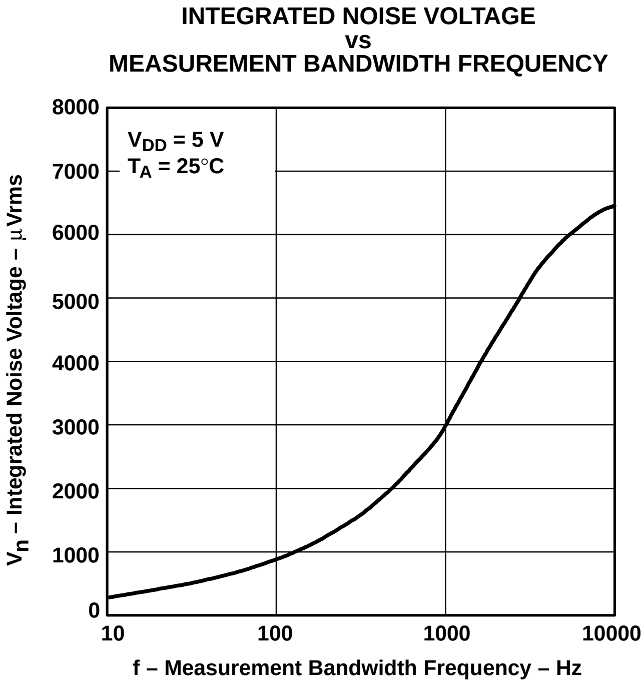


Figure 11

MECHANICAL DATA

The TSL265 is implemented in a clear 3-leaded package with a large molded focusing lens.

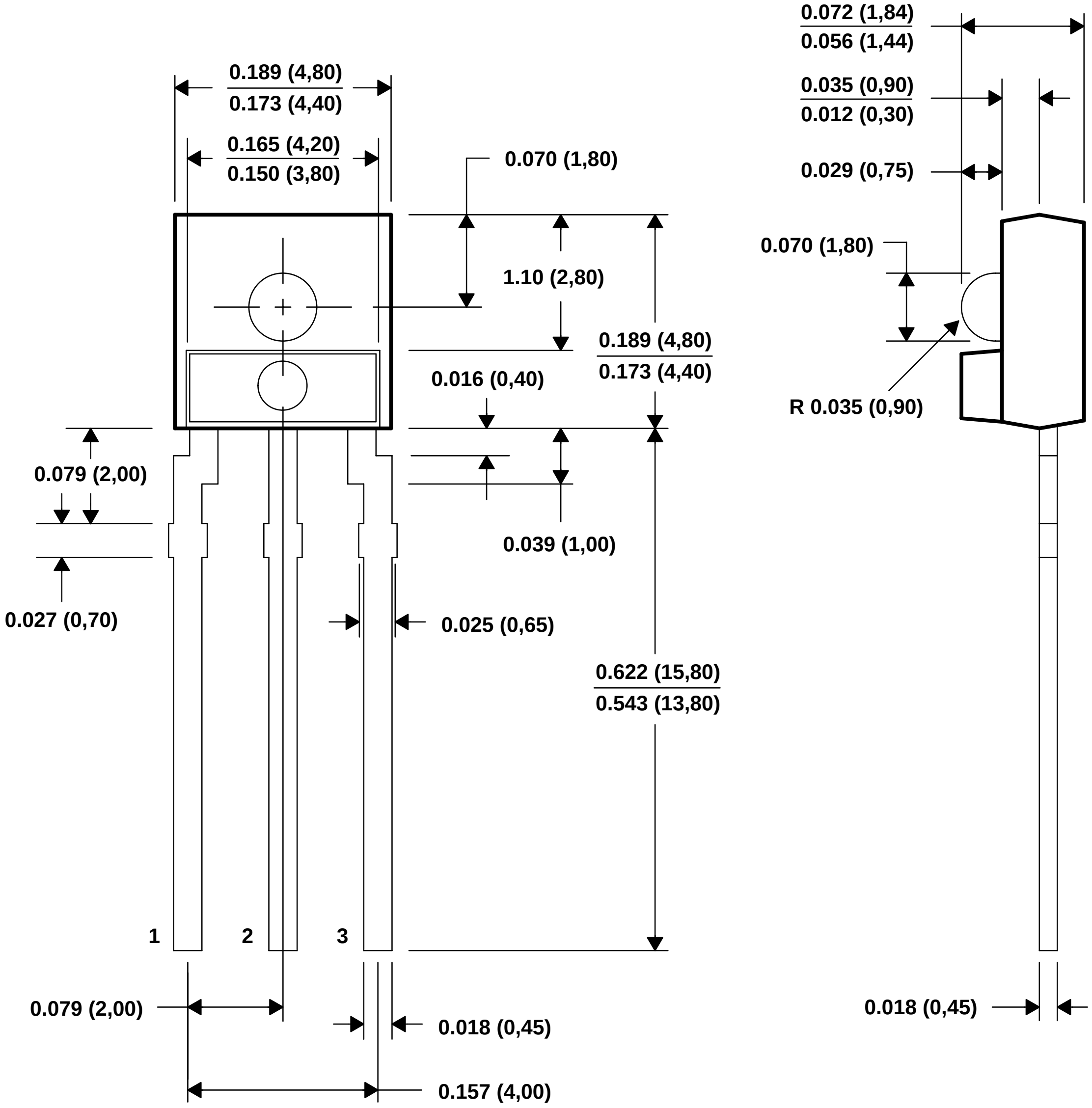


Figure 12. Package Configuration

NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. All dimensions apply before solder dip.
D. Package body is a clear nonfilled optically transparent material
E. Index of refraction of clear plastic is 1.55.

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.

NOTICE

Texas Advanced Optoelectronic Solutions, Inc. (TAOS) reserves the right to make changes to the products contained in this document to improve performance or for any other purpose, or to discontinue them without notice. Customers are advised to contact TAOS to obtain the latest product information before placing orders or designing TAOS products into systems.

TAOS assumes no responsibility for the use of any products or circuits described in this document or customer product design, conveys no license, either expressed or implied, under any patent or other right, and makes no representation that the circuits are free of patent infringement. TAOS further makes no claim as to the suitability of its products for any particular purpose, nor does TAOS assume any liability arising out of the use of any product or circuit, and specifically disclaims any and all liability, including without limitation consequential or incidental damages.

TEXAS ADVANCED OPTOELECTRONIC SOLUTIONS, INC. PRODUCTS ARE NOT DESIGNED OR INTENDED FOR USE IN CRITICAL APPLICATIONS IN WHICH THE FAILURE OR MALFUNCTION OF THE TAOS PRODUCT MAY RESULT IN PERSONAL INJURY OR DEATH. USE OF TAOS PRODUCTS IN LIFE SUPPORT SYSTEMS IS EXPRESSLY UNAUTHORIZED AND ANY SUCH USE BY A CUSTOMER IS COMPLETELY AT THE CUSTOMER'S RISK.