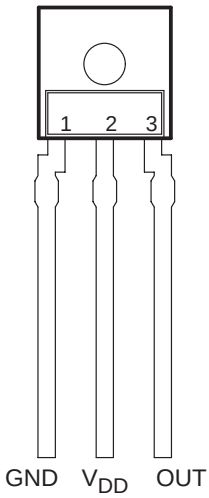
- **Monolithic Silicon IC Containing Photodiode, Operational Amplifier, and Feedback Components**
- **Converts Light Intensity to Output Voltage**
- **High Irradiance Responsivity . . . Typically 60 mV/(μW/cm$^2$) at $\lambda_p$ = 880 nm (TSL253)**
- **High Bandwidth**
- **Compact 3-Leaded Clear Plastic Package**
- **Low Dark (Offset) Voltage . . . 10 mV Max At 25°C, $V_{DD}$ = 5 V**
- **Single-Supply Operation**
- **Wide Supply-Voltage Range . . . 2.7 V to 5.5 V**
- **Low Supply Current . . . 600 μA Typical at $V_{DD}$ = 5 V**
- **Advanced LinCMOS™ Technology**

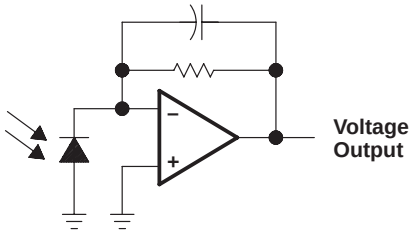
**SR PACKAGE**
**(TOP VIEW)**




## description

The TSL253 and TSL254 are light-to-voltage optical converters, each combining a 1-mm-square photodiode and a transimpedance amplifier (feedback resistor = 16 MΩ, and 1 MΩ respectively) on a single monolithic IC. The output voltage is directly proportional to the light intensity (irradiance) on the photodiode. These devices utilize Texas Instruments silicon-gate LinCMOS technology, which provides improved amplifier offset-voltage stability and low power consumption.

## functional block diagram




## 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.

NOTES: 1. All voltages are with respect to GND.

Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

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## 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, $\lambda p$ = 880 nm, $R_L$ = 10 kΩ (unless otherwise noted) (see Notes 2 and 3)

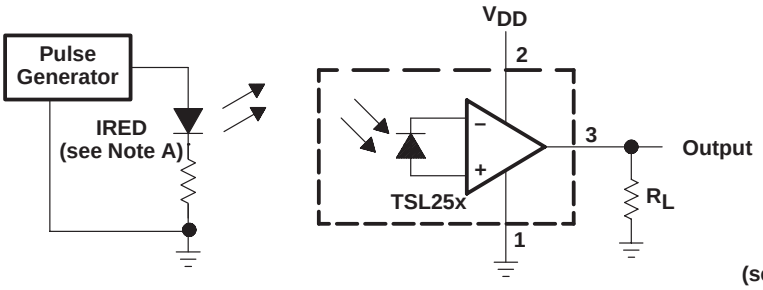
| PARAMETER | | TEST CONDITIONS | TSL253 | | | TSL254 | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| $V_D$ | Dark voltage | $E_e$ = 0 | | | 10 | | | 10 | mV |
| $V_{OM}$ | Maximum output voltage swing | $E_e$ = 2 mW/cm$^2$ | 3 | 3.5 | | 3 | 3.5 | | V |
| $V_O$ | Output voltage | $E_e$ = 35 μW/cm$^2$ | 1.6 | 2 | 2.4 | | | | V |
| | | $E_e$ = 595 μW/cm$^2$ | | | | 1.6 | 2 | 2.4 | |
| $\alpha_{vo}$ | Temperature coefficient of output voltage ($V_O$) | 300 nm < λ < 700 nm | | −0.2 | | | −0.2 | | %/°C |
| | | $\lambda_p$ = 880 nm | | 0.05 | | | 0.05 | | |
| $N_e$ | Irradiance responsivity | | | 60 | | | 3.5 | | mV/(μW/cm$^2$) |
| | Power supply rejection, dc | | | 60 | | | 60 | | dB |
| | Power supply rejection, ac | $f_{ac}$ = 1 kHz | | 18 | | | 44 | | dB |
| $I_{DD}$ | Supply current | | | 0.6 | 1.5 | | 0.6 | 1.5 | mA |

NOTES: 2. The input irradiance $E_e$ is supplied by a GaAlAs infrared-emitting diode with $\lambda_p$ = 880 nm.
3. Irradiance responsivity is characterized over the range $V_O$ = 0.05 to 3 V.

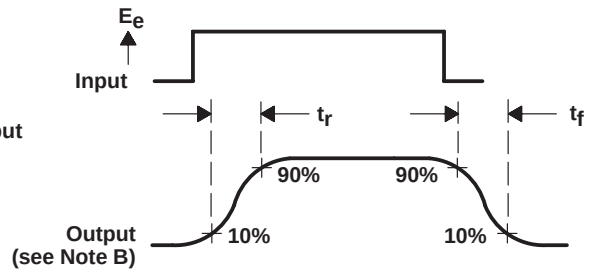
## switching characteristics at $T_A$ = 25°C (see Figure 1)

| PARAMETER | | TEST CONDITIONS | | TSL253 | | | TSL254 | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| $t_r$ | Output pulse rise time | $V_{DD}$ = 5 V, $\lambda_p$ = 880 nm | | | 7.5 | | | 2 | | μs |
| $t_f$ | Output pulse fall time | $V_{DD}$ = 5 V, $\lambda_p$ = 880 nm | | | 7.5 | | | 2 | | μs |
| $V_n$ | Output noise voltage | $V_{DD}$ = 5 V | f = 100 Hz | | 3 | | | 1.7 | | μV/√Hz |
| | | | f = 1 kHz | | 3 | | | 1 | | |
| | | | f = 10 kHz | | 6 | | | 1.3 | | |

## 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: $\lambda_p$ = 880 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 MHz, $C_i$ ≤ 20 pF.

**Figure 1. Switching Times**

## TYPICAL CHARACTERISTICS

**OUTPUT VOLTAGE vs IRRADIANCE**

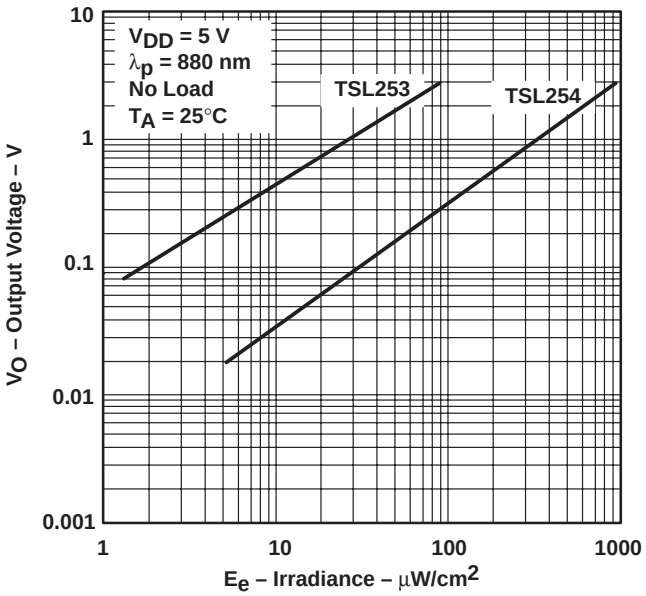



Figure 2

**PHOTODIODE SPECTRAL RESPONSIVITY**

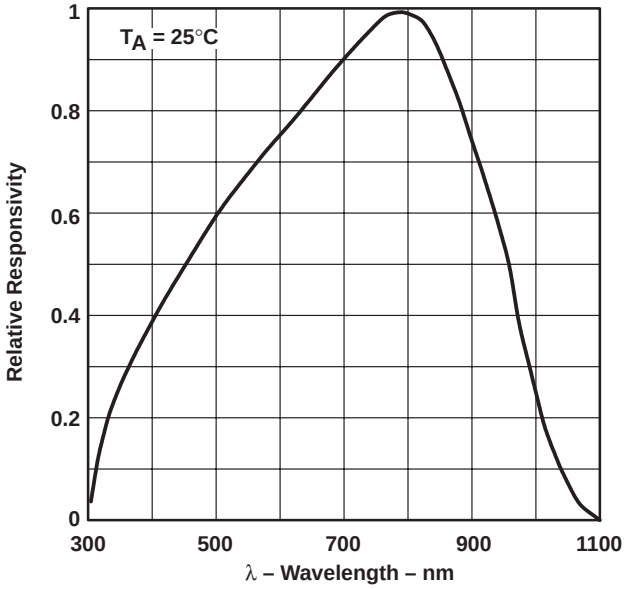



Figure 3

**MAXIMUM OUTPUT VOLTAGE vs SUPPLY VOLTAGE**

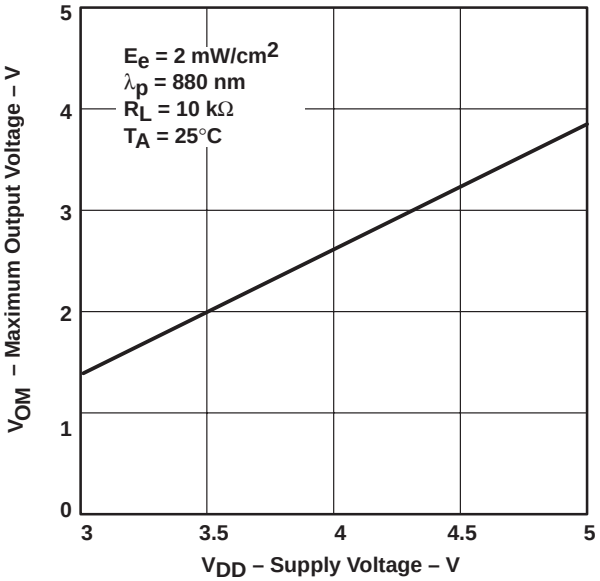



Figure 4

**NORMALIZED OUTPUT VOLTAGE vs ANGULAR DISPLACEMENT**

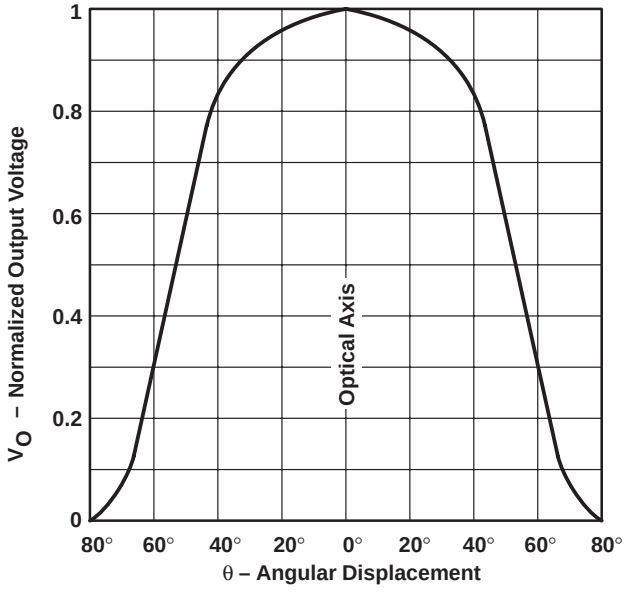



Figure 5

## TYPICAL CHARACTERISTICS

**POWER SUPPLY REJECTION vs FREQUENCY**

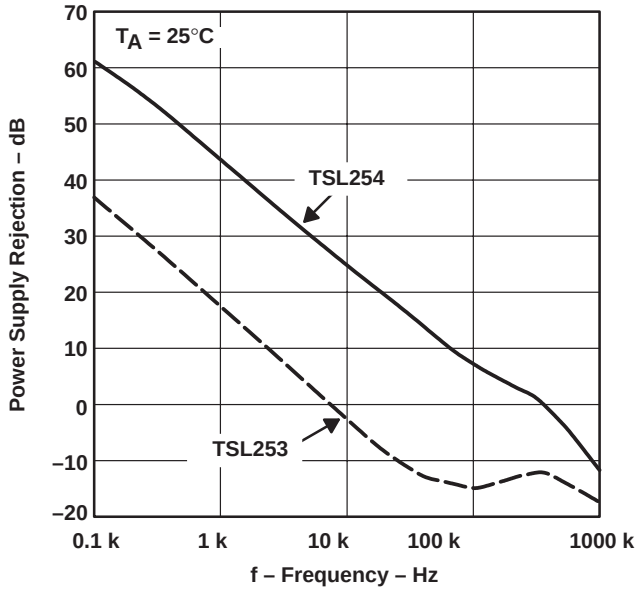



Figure 6

**SUPPLY CURRENT vs FREE-AIR TEMPERATURE**

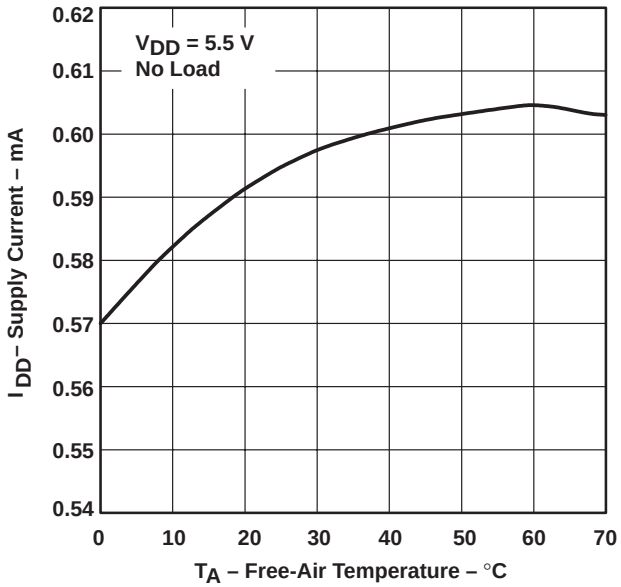



Figure 7

**SUPPLY CURRENT vs SUPPLY VOLTAGE**

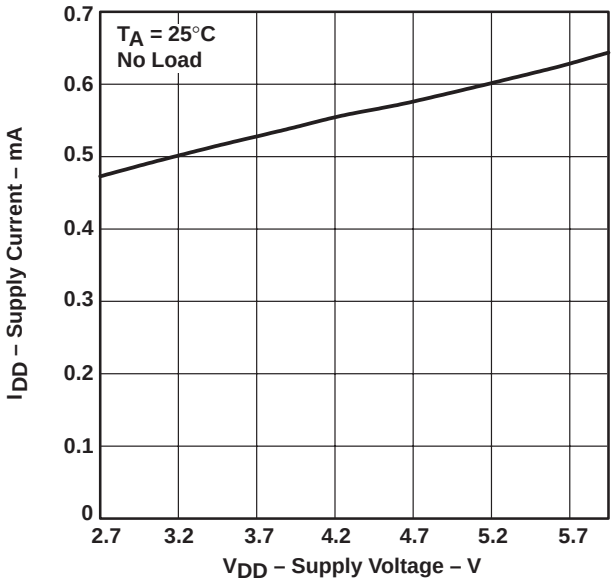



Figure 8

**OUTPUT VOLTAGE vs FREE-AIR TEMPERATURE**

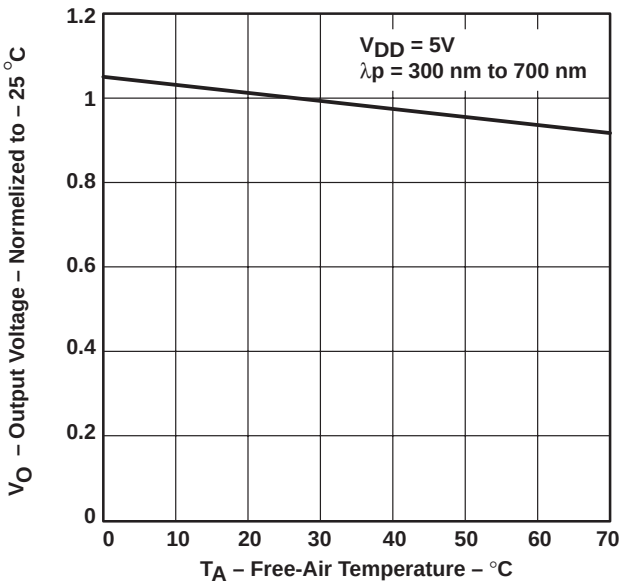



Figure 9

## TYPICAL CHARACTERISTICS

**OUTPUT VOLTAGE
vs
SUPPLY VOLTAGE**

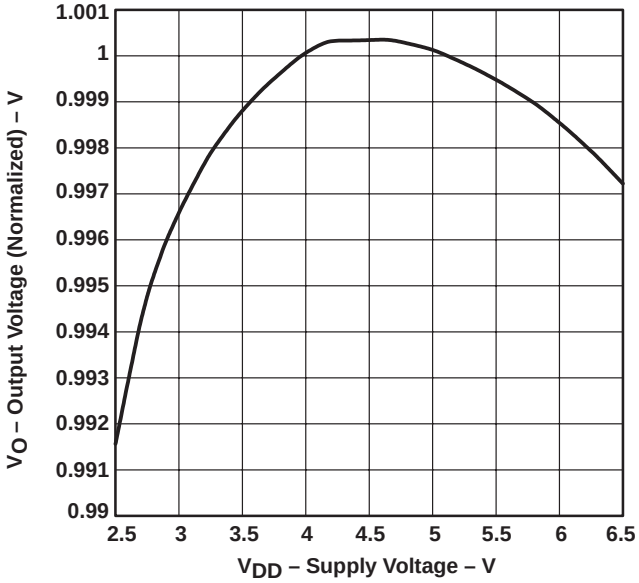



**Figure 10**

**INTEGRATED NOISE VOLTAGE
vs
MEASUREMENT BANDWIDTH FREQUENCY**

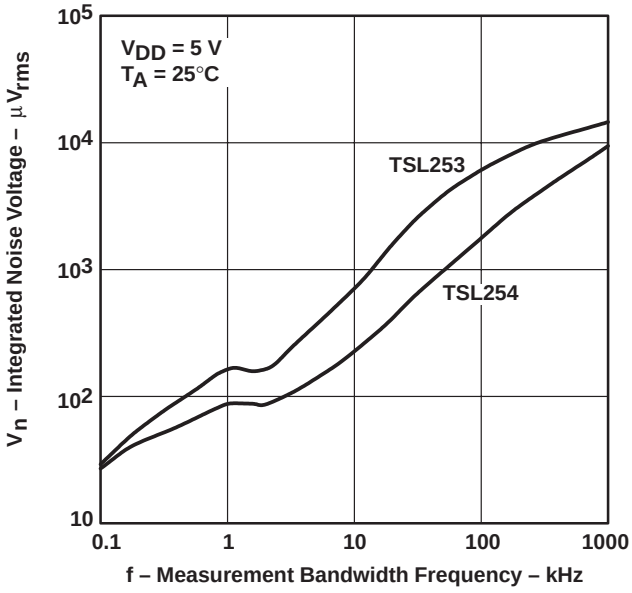
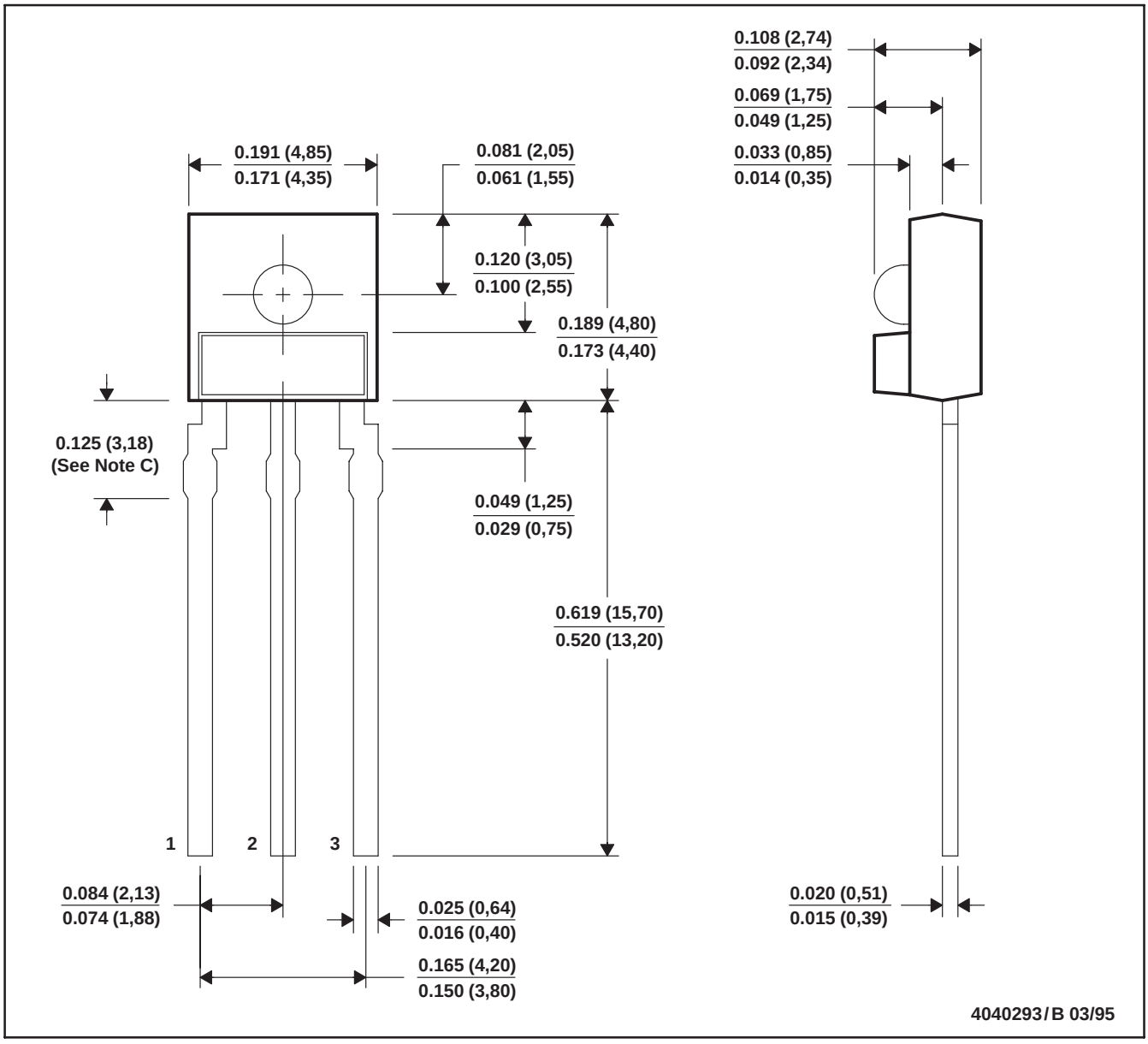



**Figure 11**

## MECHANICAL DATA

**SR (R-PSIP-T3)** **PLASTIC SINGLE-IN-LINE PACKAGE (OPTO)**




NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Lead dimensions are not controlled within this area.
D. All dimensions apply before solder dip.
E. Package body is a clear nonfilled optically transparent material
F. Index of refraction of clear plastic is 1.55.

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