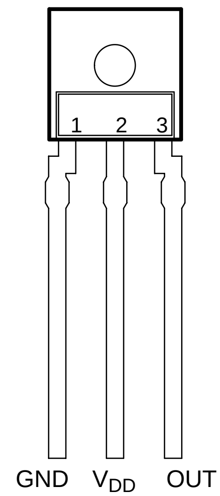
- **High-Resolution Conversion of Light Intensity to Frequency With No External Components**
- **Communicates Directly With a Microcontroller**
- **Compact Three-Leaded Clear-Plastic Package**
- **Single-Supply Operation Down to 2.7 V**
- **Nonlinearity Error Typically 0.2% at 100 kHz**
- **Stable 100 ppm/°C Temperature Coefficient**
- **Single-Supply Operation**

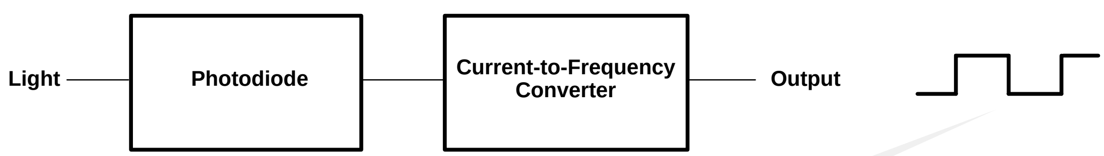
SR PACKAGE (FRONT VIEW)



Description

The TSL235 light-to-frequency converter combines a silicon photodiode and a current-to-frequency converter on a single monolithic CMOS integrated circuit. The output is a square wave (50% duty cycle) with frequency directly proportional to light intensity. Because it is TTL compatible, the output allows direct interface to a microcontroller or other logic circuitry. The device has been temperature compensated for the ultraviolet-to-visible light range of 300 nm to 700 nm and responds over the light range of 300 nm to 1100 nm. The TSL235 is characterized for operation over the temperature range of –25°C to 70°C.

Functional Block Diagram



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

Supply voltage, V_{DD} (see Note 1) . . . . 6.5 V
Operating free-air temperature range, T_A . . . . –25°C to 70°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 voltage values are with respect to GND.

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Recommended Operating Conditions

	MIN	NOM	MAX	UNIT
Supply voltage, V_{DD}	2.7	5	6	V
Operating free-air temperature range, T_A	–25		70	°C

Electrical Characteristics at V_{DD} = 5 V, T_A = 25°C (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{OH}	High-level output voltage	I_{OH} = –4 mA	4	4.3		V
V_{OL}	Low-level output voltage	I_{OL} = 4 mA		0.17	0.26	V
I_{DD}	Supply current			2	3	mA
	Full-scale frequency‡		500			kHz
	Temperature coefficient of output frequency	$\lambda \le$ 700 nm, –25°C $\le T_A \le$ 70°C		±100		ppm/°C
k_{SVS}	Supply-voltage sensitivity	V_{DD} = 5 V ±10%		0.5		%/V

‡ Full-scale frequency is the maximum operating frequency of the device without saturation.

Operating Characteristics at V_{DD} = 5 V, T_A = 25°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
f_O	Output frequency	E_e = 375 µW/cm^2, λ_p = 670 nm	200	250	300	kHz
		E_e = 0		0.25	10	Hz
	Nonlinearity§	f_O = 0 kHz to 10 kHz		±0.1%		%F.S.
		f_O = 0 kHz to 100 kHz		±0.2%		%F.S.
	Step response to full-scale step input			1 pulse of new frequency plus 1 µs		

‡ Full-scale frequency is the maximum operating frequency of the device without saturation.
§ Nonlinearity is defined as the deviation of f_O from a straight line between zero and full scale, expressed as a percent of full scale.

TYPICAL CHARACTERISTICS

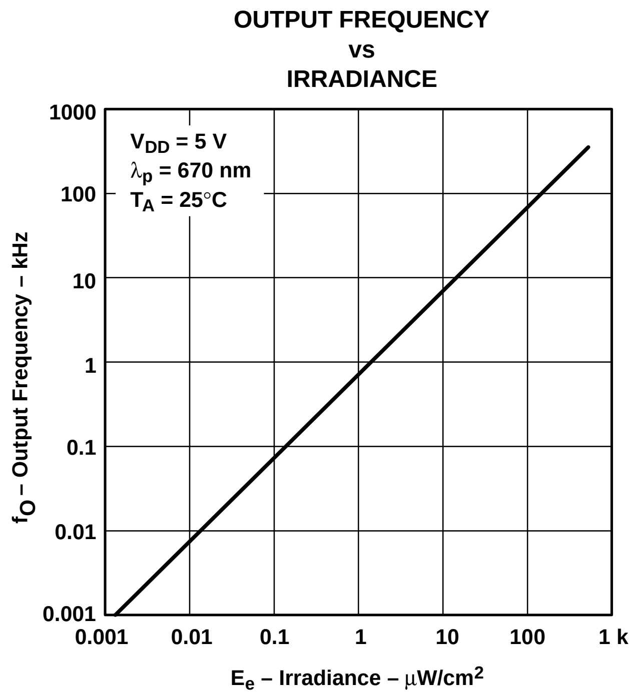


Figure 1

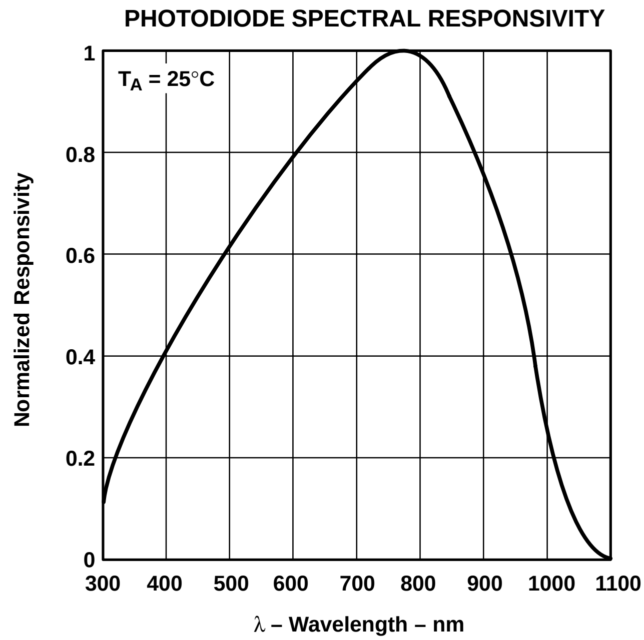


Figure 2

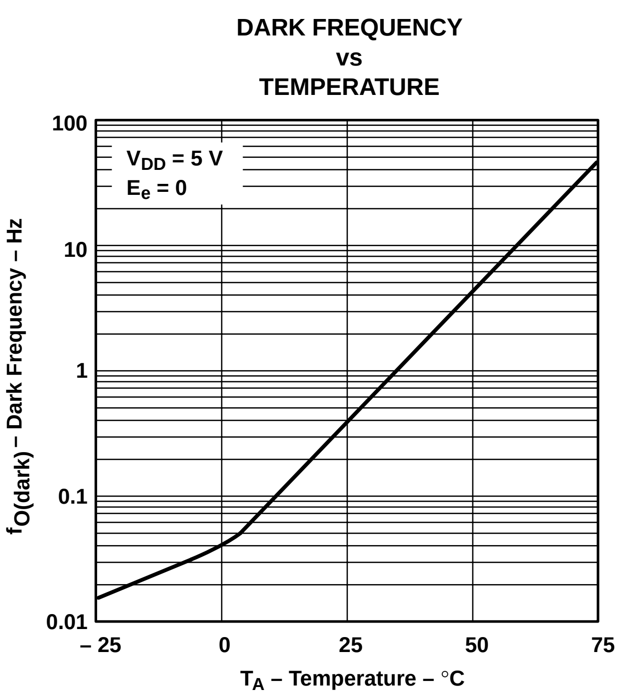


Figure 3

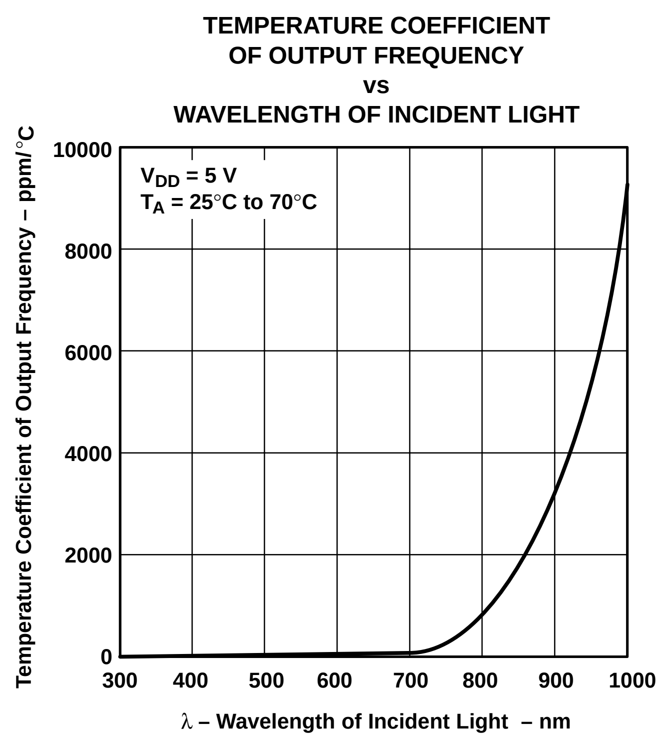


Figure 4

TYPICAL CHARACTERISTICS

**OUTPUT FREQUENCY
vs
SUPPLY VOLTAGE**

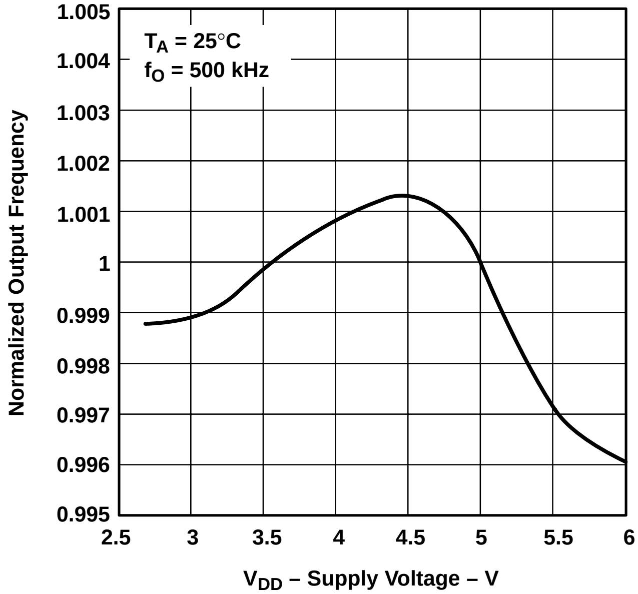


Figure 5

APPLICATION INFORMATION

Power-supply considerations

For optimum device performance, power-supply lines should be decoupled by a 0.01-µF to 0.1-µF capacitor with short leads (see Figure 6).

Output interface

The output of the device is designed to drive a standard TTL or CMOS logic input over short distances. If lines greater than 12 inches are used on the output, a buffer or line driver is recommended.

Measuring the frequency

The choice of interface and measurement technique depends on the desired resolution and data-acquisition rate. For maximum data-acquisition rate, period-measurement techniques are used.

Period measurement requires the use of a fast reference clock with available resolution directly related to reference-clock rate. The technique is employed to measure rapidly varying light levels or to make a fast measurement of a constant light source.

Maximum resolution and accuracy may be obtained using frequency-measurement, pulse-accumulation, or integration techniques. Frequency measurements provide the added benefit of averaging out random- or high-frequency variations (jitter) resulting from noise in the light signal. Resolution is limited mainly by available counter registers and allowable measurement time. Frequency measurement is well suited for slowly varying or constant light levels and for reading average light levels over short periods of time. Integration, the accumulation of pulses over a very long period of time, can be used to measure exposure — the amount of light present in an area over a given time period.

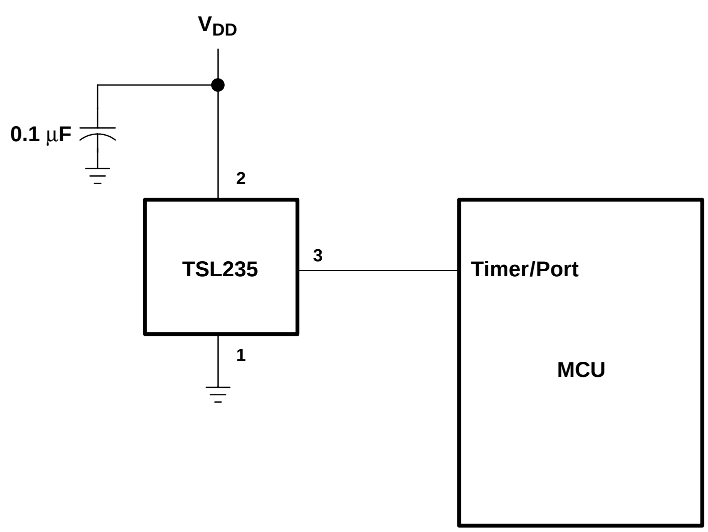
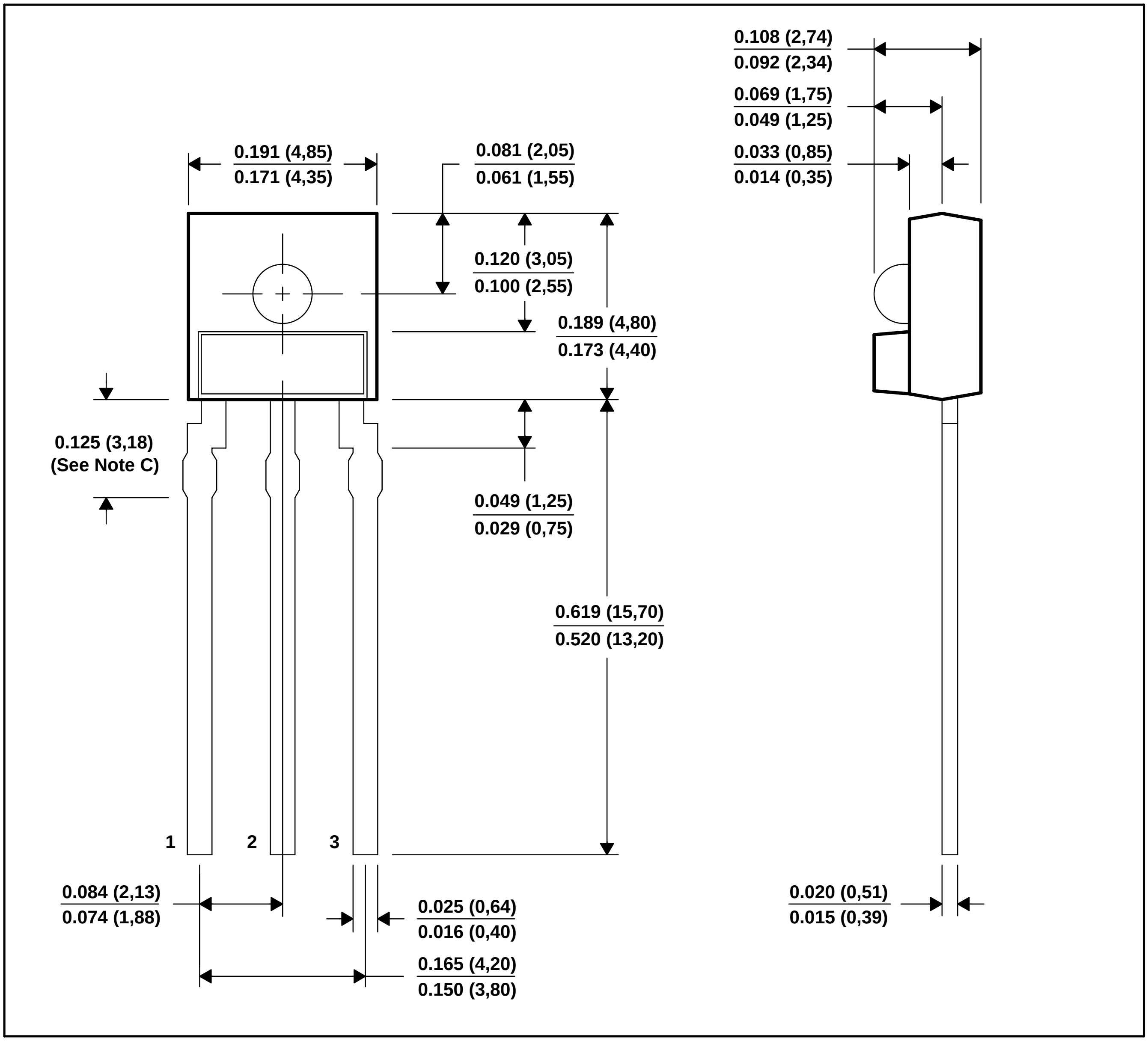


Figure 6. Typical TSL235 Interface to a Microcontroller

MECHANICAL DATA

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



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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