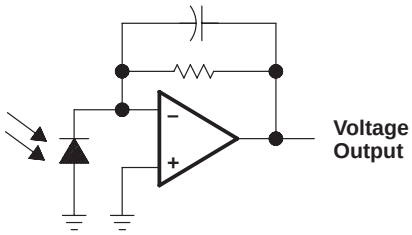
- **Monolithic Silicon IC Containing Photodiode, Operational Amplifier, and Feedback Components**
- **Converts Light Intensity to Output Voltage**
- **High Irradiance Responsivity Typically 80 mV/(μW/cm^2) at λ_p = 880 nm (TSL250)**
- **Compact 3-Leaded Clear Plastic Package**
- **Low Dark (Offset) Voltage . . . 10 mV Max at 25°C, V_{DD} = 5 V**
- **Single-Supply Operation**
- **Wide Supply-Voltage Range . . . 3 V to 9 V**
- **Low Supply Current . . . 800 μA Typical at V_{DD} = 5 V**
- **Advanced LinCMOS™ Technology**

description

The TSL250, TSL251, and TSL252 are light-to-voltage optical sensors, each combining a photodiode and a transimpedance amplifier (feedback resistor = 16 MΩ, 8 MΩ, and 2 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) . . . . . 10 V
Output current, I_O . . . . . ±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 . . . . . 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.
2. Output may be shorted to supply.

recommended operating conditions

	MIN	NOM	MAX	UNIT
Supply voltage, V_{DD}	3	5	9	V
Operating free-air temperature, T_A	0		70	°C

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

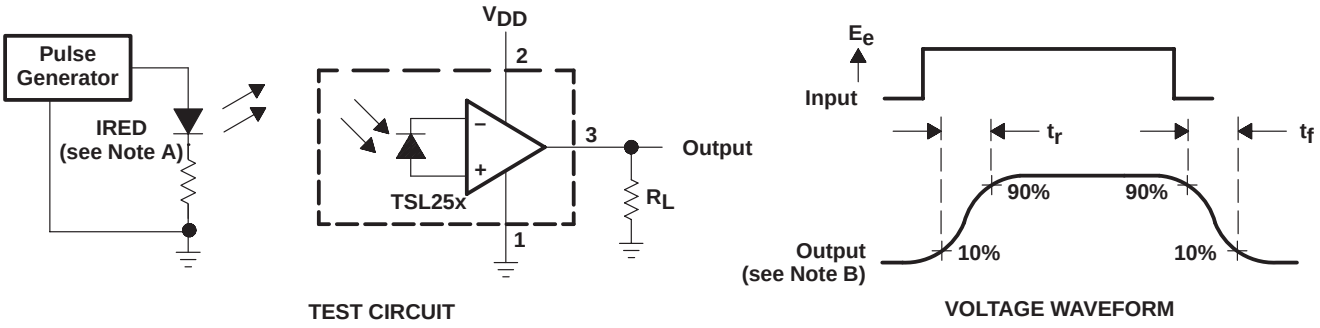
PARAMETER		TEST CONDITIONS	TSL250			TSL251			TSL252			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
V_D	Dark voltage	E_e = 0		3	10		3	10		3	10	mV
V_{OM}	Maximum output voltage swing	E_e = 2 mW/cm^2	3.1	3.5		3.1	3.5		3.1	3.5		V
V_O	Output voltage	E_e = 25 µW/cm^2	1	2	3							V
		E_e = 45 µW/cm^2				1	2	3				
		E_e = 285 µW/cm^2							1	2	3	
α_{vo}	Temperature coefficient of output voltage (V_O)	E_e = 25 µW/cm^2, T_A = 0°C to 70°C		±1								mV/°C
		E_e = 45 µW/cm^2, T_A = 0°C to 70°C					±1					
		E_e = 285 µW/cm^2, T_A = 0°C to 70°C								±1		
N_e	Irradiance responsivity	See Note 4		80			45			7		mV/(µW/cm^2)
I_{DD}	Supply current	E_e = 25 µW/cm^2		900	1600							µA
		E_e = 45 µW/cm^2					900	1600				
		E_e = 285 µW/cm^2								900	1600	

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

operating characteristics at T_A = 25°C (see Figure 1)

PARAMETER		TEST CONDITIONS	TSL250			TSL251			TSL252			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
t_r	Output pulse rise time	V_{DD} = 5 V, λ_p = 880 nm		360			90			7		µs
t_f	Output pulse fall time	V_{DD} = 5 V, λ_p = 880 nm		360			90			7		µs
V_n	Output noise voltage	V_{DD} = 5 V, f = 20 Hz		0.6			0.5			0.4		µV/√Hz

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 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

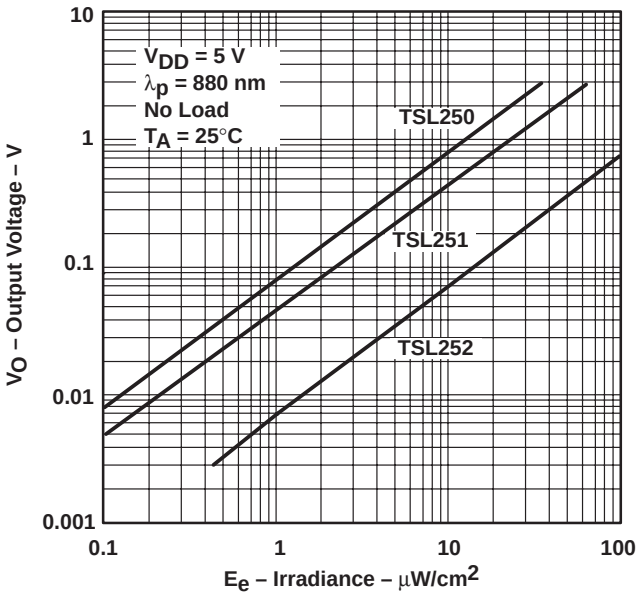


Figure 2

PHOTODIODE SPECTRAL RESPONSIVITY

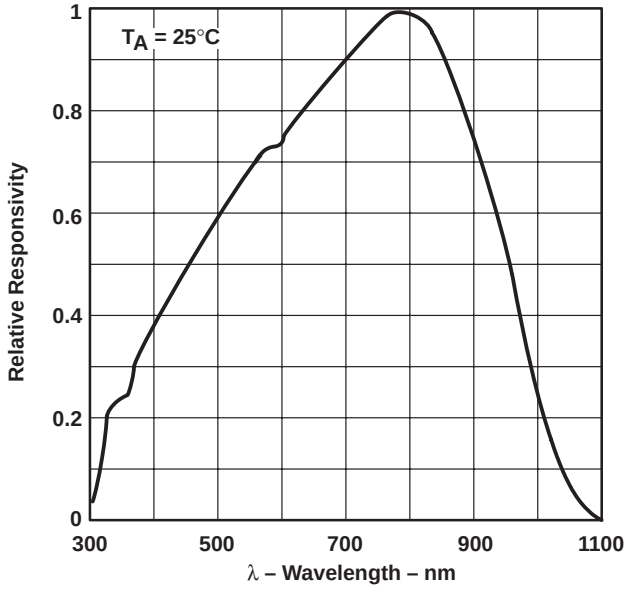


Figure 3

MAXIMUM OUTPUT VOLTAGE vs SUPPLY VOLTAGE

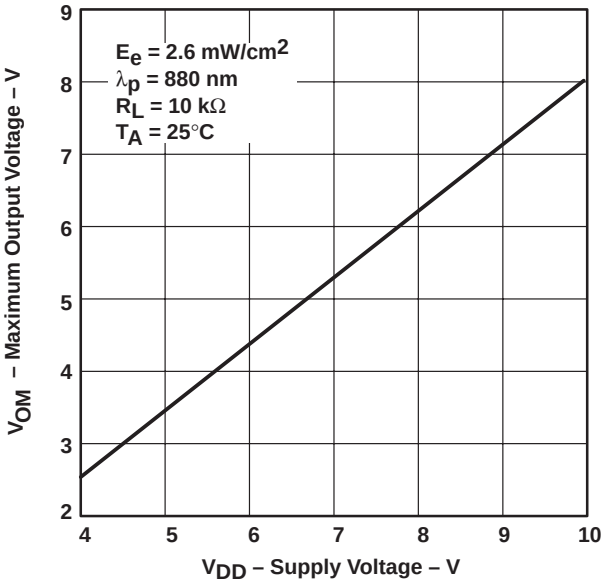


Figure 4

SUPPLY CURRENT vs OUTPUT VOLTAGE

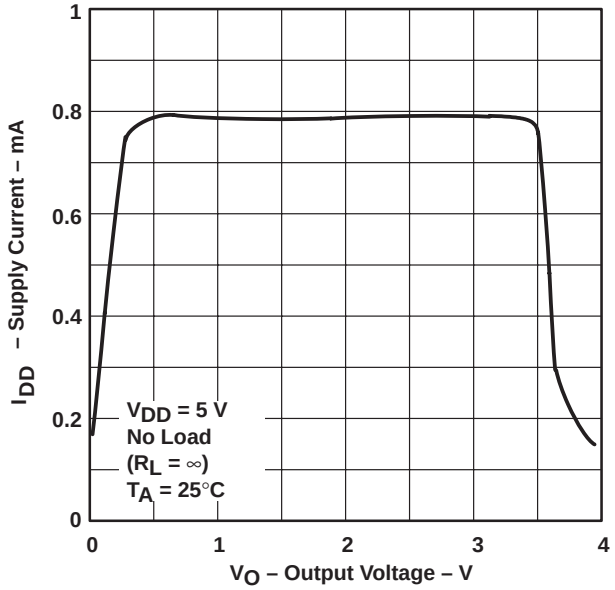


Figure 5

TYPICAL CHARACTERISTICS

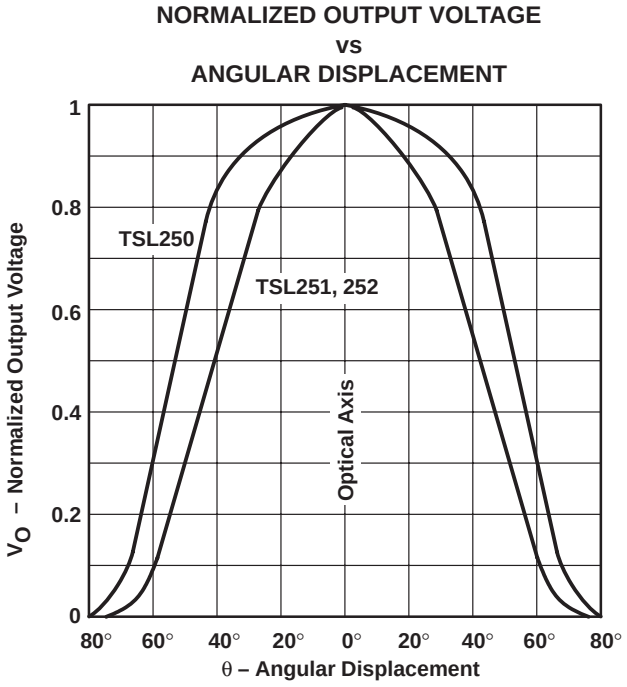
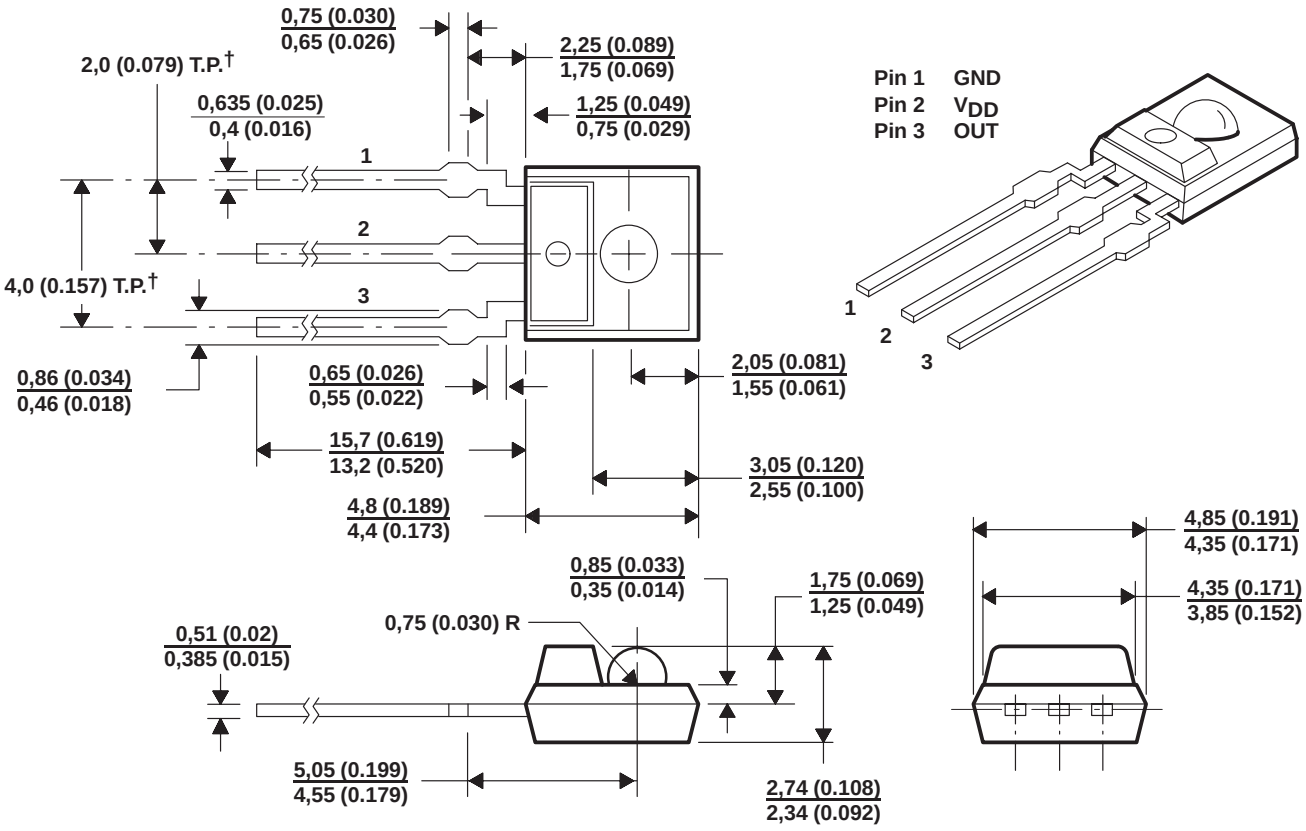


Figure 6

APPLICATION INFORMATION

The photodiode/amplifier chip is packaged in a clear plastic three-leaded package. The integrated photodiode active area is typically 1,0 mm^2 (0.0016 in^2) for TSL250, 0,5 mm^2 (0.00078 in^2) for the TSL251, and 0,26 mm^2 (0.0004 in^2) for the TSL252.



† True position when unit is installed.

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

Figure 7. Mechanical Data

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)
TSL250	OBSOLETE	TO	LL	3		TBD	Call TI	Call TI
TSL251	OBSOLETE	TO	LL	3		TBD	Call TI	Call TI
TSL252	OBSOLETE	TO	LL	3		TBD	Call TI	Call TI

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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