 Integral Visible Light Cutoff Filter
 Monolithic Silicon IC Containing Photodiode, Operational Amplifier, and Feedback Components
 Converts Light Intensity to Output Voltage
 High Irradiance Responsivity Typically 42 mV/(μW/cm²) at λp = 940 nm (TSL260)

Low Dark (Offset) Voltage . . . 10 mV Max at 25°C, VDD = 5 V
Single-Supply Operation
Wide Supply Voltage Range . . . 3 V to 9 V
Low Supply Current . . . 800 μA Typical at VDD = 5 V
Advanced LinCMOS™ Technology

**description**

The TSL260, TSL261, and TSL262 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 integrated circuit. The output voltage is directly proportional to the infrared light intensity (irradiance) on the photodiode. The TSL260, TSL261, and TSL262 utilize Texas Instruments silicon-gate LinCMOS™ technology, which provides good amplifier offset-voltage stability and low power consumption.

**mechanical data**

The photodiode/amplifier chip is packaged in a black, infrared-transmissive plastic package. The integrated photodiode active area is typically 1.0 mm² (0.0016 in²), 0.5 mm² (0.00078 in²), and 0.26 mm² (0.0004 in²) for the TSL260, TSL261, and TSL262, respectively.

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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 ........................................... −25°C to 85°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds .......................... 240°C

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

recommended operating conditions

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>MIN</th>
<th>NOM</th>
<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage, ( V_{DD} )</td>
<td>3</td>
<td>5</td>
<td>9</td>
<td>V</td>
</tr>
<tr>
<td>Operating free-air temperature, ( T_A )</td>
<td>0</td>
<td>70</td>
<td>85</td>
<td>°C</td>
</tr>
</tbody>
</table>

electrical characteristics at \( V_{DD} = 5 \) V, \( T_A = 25°C \), \( \lambda_p = 940 \) nm, \( R_L = 10 \) kΩ (unless otherwise noted) (see Note 3)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>TEST CONDITIONS</th>
<th>TSL260</th>
<th>TSL261</th>
<th>TSL262</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>( V_{DARK} )</td>
<td>Dark voltage</td>
<td>( E_0 = 0 )</td>
<td>3</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>( V_{OM} )</td>
<td>Maximum output</td>
<td>( E_0 = 2.6 ) mW/cm(^2)</td>
<td>3.1</td>
<td>3.5</td>
<td>3.1</td>
</tr>
<tr>
<td>( V_O )</td>
<td>Output voltage</td>
<td>( E_0 = 48 ) μW/cm(^2)</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( E_0 = 87 ) μW/cm(^2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>( E_0 = 525 ) μW/cm(^2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature coefficient of output voltage (( V_O ))</td>
<td>( E_0 = 48 ) μW/cm(^2), ( T_A = 0°C ) to 70°C</td>
<td></td>
<td></td>
<td>±1</td>
<td>mV/°C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( E_0 = 87 ) μW/cm(^2), ( T_A = 0°C ) to 70°C</td>
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<td></td>
<td></td>
<td>±1</td>
</tr>
<tr>
<td>( N_e )</td>
<td>Irradiance responsivity</td>
<td>See Note 4</td>
<td>42</td>
<td>23</td>
<td>3.8</td>
</tr>
<tr>
<td>( I_{DD} )</td>
<td>Supply current</td>
<td>( E_0 = 48 ) μW/cm(^2), N0 load</td>
<td>900</td>
<td>1600</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>( E_0 = 87 ) μW/cm(^2), N0 load</td>
<td>900</td>
<td>1600</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>( E_0 = 525 ) μW/cm(^2), N0 load</td>
<td>900</td>
<td>1600</td>
<td></td>
</tr>
</tbody>
</table>

NOTES: 3. The input irradiance \( E_0 \) is supplied by a GaAs infrared-emitting diode with \( \lambda_0 = 940 \) nm.
4. Irradiance responsivity is characterized over the range \( V_O = 0.05 \) to 3 V.
operating characteristics at $T_A = 25^\circ C$ (see Figure 1)

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<th>TSL262</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_r$ Output pulse rise time</td>
<td>$V_{DD} = 5 \text{ V}$, $\lambda_p = 940 \text{ nm}$</td>
<td>360</td>
<td>90</td>
<td>7</td>
<td>$\mu$s</td>
</tr>
<tr>
<td>$I_f$ Output pulse fall time</td>
<td>$V_{DD} = 5 \text{ V}$, $\lambda_p = 940 \text{ nm}$</td>
<td>360</td>
<td>90</td>
<td>7</td>
<td>$\mu$s</td>
</tr>
<tr>
<td>$V_n$ Output noise voltage</td>
<td>$V_{DD} = 5 \text{ V}$, $f = 20 \text{ Hz}$</td>
<td>0.6</td>
<td>0.5</td>
<td>0.4</td>
<td>$\mu\text{V}/\sqrt{\text{Hz}}$</td>
</tr>
</tbody>
</table>

PARAMETER MEASUREMENT INFORMATION

NOTE: A. The input irradiance is supplied by a pulsed GaAs infrared-emitting diode with the following characteristics: $\lambda_p = 940 \text{ nm}$, $t_r < 1 \mu\text{s}$, $t_f < 1 \mu\text{s}$.

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

Figure 1. Switching Times

TYPICAL CHARACTERISTICS

OUTPUT VOLTAGE vs IRRADIANCE

PHOTODIODE SPECTRAL RESPONSE

Figure 2

Figure 3
TYPICAL CHARACTERISTICS

HIGH-LEVEL OUTPUT VOLTAGE vs SUPPLY VOLTAGE

\[ V_{OM} \] – Maximum Output Voltage – V
\[ V_{DD} \] – Supply Voltage – V
\[ E_0 = 2.6 \text{ mW/cm}^2 \]
\[ \lambda_p = 940 \text{ nm} \]
\[ R_L = 10 \text{ k}\Omega \]
\[ T_A = 25^\circ \text{C} \]

SUPPLY CURRENT vs OUTPUT VOLTAGE

\[ I_{DD} \] – Supply Current – mA
\[ V_{DD} = 5 \text{ V} \]
No Load
\( R_L = \infty \)
\[ T_A = 25^\circ \text{C} \]

NORMALIZED OUTPUT VOLTAGE vs ANGULAR DISPLACEMENT

Figure 4

Figure 5

Figure 6
APPLICATION INFORMATION

NOTE A: Pullup resistor extends linear output range to near \( V_{DD} \) with minimal (several millivolts typical) effect on \( V_{DARK} \); particularly useful at low \( V_{DD} \) (3 V to 5 V).

Figure 7. Pullup for Increased \( V_{OM} \)

\[
\begin{align*}
\text{V}_{DD} & \rightarrow 2 \\
\text{Rp} = 100 \, k\Omega & \rightarrow 3 \\
\text{Output} & \\
\end{align*}
\]

\[
\begin{align*}
\text{TSL26x} & \\
\text{Sensor} & \\
\end{align*}
\]

† OPTEK part number

NOTE A: Output goes high when beam is interrupted; working distance is several inches or less. Intended for use as optical-interruptor switch or reflective-object sensor.

Figure 8. Short-Range Optical Switch With Hysteresis

\[
\begin{align*}
\text{5 V} & \rightarrow 1 \\
\text{OP240} & \rightarrow 2 \\
\text{TSL261} & \\
\text{Sensor} & \\
\end{align*}
\]

\[
\begin{align*}
\text{5 V} & \rightarrow 3 \\
\text{5 V} & \rightarrow 4 \\
\text{Threshold} & \rightarrow 5 \\
\text{10 k\Omega} & \\
\text{15 k\Omega} & \\
\text{15 k\Omega} & \\
\text{15 k\Omega} & \\
\text{4.7 k\Omega} & \\
\text{LM393} & \\
\text{Output} & \\
\end{align*}
\]
APPLICATION INFORMATION

NOTE A: Output pulses low until beam is interrupted. Useful range is 1 ft to 20 ft; can be extended with lenses. This configuration is suited for object detection, safety guards, security systems, and automatic doors.

† Stanley part number

Figure 9. Pulsed Optical-Beam Interrupter

† OPTEK part number
‡ Stanley part number

NOTE A: Output goes low when light pulses from emitter are reflected back to sensor. Range is 6 in to 18 in depending upon object reflectance. Useful for automatic doors, annunciators, object avoidance in robotics, automatic faucets, and security systems.

Figure 10. Proximity Detector
APPLICATION INFORMATION

NOTE A: Single-channel remote control can be used to switch logic or light dc loads by way of U5 or ac loads by way of the optocoupler and triac as shown. Applications include ceiling fans, lamps, electric heaters, etc.

Figure 11. IR Remote Control
APPLICATION INFORMATION

NOTE A: Simple transmission of audio signal over short distances (<10 ft). Applications include wireless headphones, wireless-telephone headset, and wireless-headset intercom.

Figure 12. IR Voice-Band Audio Link
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