High Speed Optocoupler, 1 MBd, Photodiode with Transistor Output

DESCRIPTION

The 6N135 and 6N136 are optocouplers with a GaAlAs infrared emitting diode, optically coupled with an integrated photo detector which consists of a photo diode and a high-speed transistor in a DIP-8 plastic package.

Signals can be transmitted between two electrically separated circuits up to frequencies of 2 MHz. The potential difference between the circuits to be coupled should not exceed the maximum permissible reference voltages.

FEATURES

• Isolation test voltages: 5300 V_RMS
• TTL compatible
• High bit rates: 1 Mbit/s
• High common-mode interference immunity
• Bandwidth 2 MHz
• Open-collector output
• External base wiring possible
• Compliant to RoHS Directive 2002/95/EC and in accordance to WEEE 2002/96/EC

AGENCY APPROVALS

• UL1577, file no. E52744 system code H double protection
• DIN EN 60747-5-2 (VDE0884)/DIN EN 60747-5-5 (pending), available with option 1
• CSA 93751

ORDERING INFORMATION

<table>
<thead>
<tr>
<th>PART NUMBER</th>
<th>PACKAGE OPTION</th>
<th>TAPE AND REEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>6N135 #</td>
<td>DIP-8</td>
<td>7.62 mm</td>
</tr>
<tr>
<td>6N136 #</td>
<td>Option 6</td>
<td>10.16 mm</td>
</tr>
<tr>
<td>6N135-X007T (1)</td>
<td>Option 7</td>
<td>&gt; 0.7 mm</td>
</tr>
<tr>
<td>6N136-X007T (1)</td>
<td>Option 9</td>
<td>&gt; 0.1 mm</td>
</tr>
</tbody>
</table>

AGENCY CERTIFIED/PACKAGE

<table>
<thead>
<tr>
<th>UL, CSA</th>
<th>DIP-8</th>
<th>DIP-8, 400 mil, option 6</th>
<th>SMD-8, option 7</th>
<th>SMD-8, option 9</th>
<th>VDE, UL, CSA</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIP-8</td>
<td>6N135</td>
<td>6N135-X006</td>
<td>6N135-X007T (1)</td>
<td>6N135-X009T (1)</td>
<td>6N136-X017T</td>
</tr>
<tr>
<td>DIP-8, 400 mil, option 6</td>
<td>-</td>
<td>6N136-X016</td>
<td>-</td>
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</tr>
</tbody>
</table>

Note

(1) Also available in tubes; do not add T to end

ABSOLUTE MAXIMUM RATINGS (T_amb = 25 °C, unless otherwise specified)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>TEST CONDITION</th>
<th>SYMBOL</th>
<th>VALUE</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reverse voltage</td>
<td>V_R</td>
<td>5</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Forward current</td>
<td>I_F</td>
<td>25</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>Peak forward current t = 1 ms, duty cycle 50 %</td>
<td>I_FSM</td>
<td>50</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>Maximum surge forward current t = 1 μs, 300 pulses/s</td>
<td>P_diss</td>
<td>700</td>
<td>K/W</td>
<td></td>
</tr>
<tr>
<td>Thermal resistance</td>
<td>R_th</td>
<td>1</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>Power dissipation T_amb = 70 °C</td>
<td>P_diss</td>
<td>45</td>
<td>mW</td>
<td></td>
</tr>
</tbody>
</table>
# 6N135, 6N136

Vishay Semiconductors

## ABSOLUTE MAXIMUM RATINGS (T<sub>amb</sub> = 25 °C, unless otherwise specified)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>TEST CONDITION</th>
<th>SYMBOL</th>
<th>VALUE</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>OUTPUT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supply voltage</td>
<td></td>
<td>V&lt;sub&gt;SO&lt;/sub&gt;</td>
<td>- 0.5 to 15</td>
<td>V</td>
</tr>
<tr>
<td>Output voltage</td>
<td></td>
<td>V&lt;sub&gt;IO&lt;/sub&gt;</td>
<td>- 0.5 to 15</td>
<td>V</td>
</tr>
<tr>
<td>Emitter base voltage</td>
<td></td>
<td>V&lt;sub&gt;EBO&lt;/sub&gt;</td>
<td>5</td>
<td>V</td>
</tr>
<tr>
<td>Output current</td>
<td></td>
<td>I&lt;sub&gt;O&lt;/sub&gt;</td>
<td>8</td>
<td>mA</td>
</tr>
<tr>
<td>Maximum output current</td>
<td></td>
<td>Io</td>
<td>16</td>
<td>mA</td>
</tr>
<tr>
<td>Base current</td>
<td></td>
<td>I&lt;sub&gt;B&lt;/sub&gt;</td>
<td>5</td>
<td>mA</td>
</tr>
<tr>
<td>Thermal resistance</td>
<td></td>
<td></td>
<td>300</td>
<td>K/W</td>
</tr>
<tr>
<td>Power dissipation</td>
<td></td>
<td>T&lt;sub&gt;amb&lt;/sub&gt;</td>
<td>70 °C</td>
<td></td>
</tr>
<tr>
<td>COUPLER</td>
<td></td>
<td></td>
<td>P&lt;sub&gt;diss&lt;/sub&gt;</td>
<td>100 mW</td>
</tr>
<tr>
<td>Isolation test voltage</td>
<td></td>
<td>V&lt;sub&gt;ISO&lt;/sub&gt;</td>
<td>5300</td>
<td>V&lt;sub&gt;RMS&lt;/sub&gt;</td>
</tr>
<tr>
<td>Pollution degree (DIN VDE 0109)</td>
<td></td>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Isolation resistance</td>
<td></td>
<td>R&lt;sub&gt;IO&lt;/sub&gt;</td>
<td>≥ 10&lt;sup&gt;12&lt;/sup&gt;</td>
<td>Ω</td>
</tr>
<tr>
<td>Storage temperature range</td>
<td></td>
<td>T&lt;sub&gt;STG&lt;/sub&gt;</td>
<td>- 55 to + 125</td>
<td>°C</td>
</tr>
<tr>
<td>Ambient temperature range</td>
<td></td>
<td>T&lt;sub&gt;amb&lt;/sub&gt;</td>
<td>- 55 to + 100</td>
<td>°C</td>
</tr>
<tr>
<td>Soldering temperature&lt;sup&gt;(1)&lt;/sup&gt;</td>
<td></td>
<td>T&lt;sub&gt;sld&lt;/sub&gt;</td>
<td>260</td>
<td>°C</td>
</tr>
</tbody>
</table>

### Notes
- Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operational sections of this document. Exposure to absolute maximum ratings for extended periods of the time can adversely affect reliability.
- <sup>(1)</sup> Refer to reflow profile for soldering conditions for surface mounted devices (SMD). Refer to wave profile for soldering conditions for through hole devices (DIP).

## ELECTRICAL CHARACTERISTICS (T<sub>amb</sub> = 25 °C, unless otherwise specified)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>TEST CONDITION</th>
<th>PART</th>
<th>SYMBOL</th>
<th>MIN.</th>
<th>TYP.</th>
<th>MAX.</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>INPUT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forward voltage</td>
<td>I&lt;sub&gt;F&lt;/sub&gt; = 16 mA</td>
<td></td>
<td>V&lt;sub&gt;F&lt;/sub&gt;</td>
<td>1.33</td>
<td>1.9</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Breakdown voltage</td>
<td>I&lt;sub&gt;R&lt;/sub&gt; = 10 μA</td>
<td></td>
<td>V&lt;sub&gt;BR&lt;/sub&gt;</td>
<td>5</td>
<td>V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reverse current</td>
<td>V&lt;sub&gt;R&lt;/sub&gt; = 5 V</td>
<td></td>
<td>I&lt;sub&gt;R&lt;/sub&gt;</td>
<td>0.5</td>
<td>10</td>
<td>μA</td>
<td></td>
</tr>
<tr>
<td>Capacitance</td>
<td>V&lt;sub&gt;R&lt;/sub&gt; = 0 V, f = 1 MHz</td>
<td></td>
<td>C&lt;sub&gt;O&lt;/sub&gt;</td>
<td>30</td>
<td>pF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature coefficient, forward voltage</td>
<td>I&lt;sub&gt;F&lt;/sub&gt; = 16 mA</td>
<td></td>
<td>ΔV&lt;sub&gt;F&lt;/sub&gt;/ΔT&lt;sub&gt;A&lt;/sub&gt;</td>
<td>- 1.7</td>
<td>mV/°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OUTPUT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Logic low supply current</td>
<td>I&lt;sub&gt;F&lt;/sub&gt; = 16 mA, V&lt;sub&gt;O&lt;/sub&gt; = open, V&lt;sub&gt;CC&lt;/sub&gt; = 15 V</td>
<td></td>
<td>I&lt;sub&gt;CCL&lt;/sub&gt;</td>
<td>150</td>
<td></td>
<td>μA</td>
<td></td>
</tr>
<tr>
<td>Logic high supply current</td>
<td>I&lt;sub&gt;F&lt;/sub&gt; = 0 mA, V&lt;sub&gt;O&lt;/sub&gt; = open, V&lt;sub&gt;CC&lt;/sub&gt; = 15 V</td>
<td></td>
<td>I&lt;sub&gt;CCH&lt;/sub&gt;</td>
<td>0.01</td>
<td>1</td>
<td>μA</td>
<td></td>
</tr>
<tr>
<td>Output voltage, output low</td>
<td>I&lt;sub&gt;F&lt;/sub&gt; = 16 mA, I&lt;sub&gt;O&lt;/sub&gt; = 1.1 mA, V&lt;sub&gt;CC&lt;/sub&gt; = 4.5 V</td>
<td>6N135</td>
<td>V&lt;sub&gt;OL&lt;/sub&gt;</td>
<td>0.1</td>
<td>0.4</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I&lt;sub&gt;F&lt;/sub&gt; = 16 mA, I&lt;sub&gt;O&lt;/sub&gt; = 2.4 mA, V&lt;sub&gt;CC&lt;/sub&gt; = 4.5 V</td>
<td>6N136</td>
<td>V&lt;sub&gt;OL&lt;/sub&gt;</td>
<td>0.1</td>
<td>0.4</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Output current, output high</td>
<td>I&lt;sub&gt;F&lt;/sub&gt; = 0 mA, V&lt;sub&gt;O&lt;/sub&gt; = V&lt;sub&gt;CC&lt;/sub&gt; = 5.5 V</td>
<td></td>
<td>I&lt;sub&gt;OH&lt;/sub&gt;</td>
<td>3</td>
<td>500</td>
<td>nA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I&lt;sub&gt;F&lt;/sub&gt; = 0 mA, V&lt;sub&gt;O&lt;/sub&gt; = V&lt;sub&gt;CC&lt;/sub&gt; = 15 V</td>
<td></td>
<td>I&lt;sub&gt;OH&lt;/sub&gt;</td>
<td>0.01</td>
<td>1</td>
<td>μA</td>
<td></td>
</tr>
<tr>
<td>COUPLER</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capacitance (input to output)</td>
<td>f = 1 MHz</td>
<td></td>
<td>C&lt;sub&gt;O&lt;/sub&gt;</td>
<td>0.6</td>
<td></td>
<td>pF</td>
<td></td>
</tr>
</tbody>
</table>

### Note
- Minimum and maximum values are testing requirements. Typical values are characteristics of the device and are the result of engineering evaluation. Typical values are for information only and are not part of the testing requirements.
### CURRENT TRANSFER RATIO

**Parameter:** Current transfer ratio  
**Test Condition:** $I_F = 16 \text{ mA}, V_O = 0.4 \text{ V}, V_{CC} = 4.5 \text{ V}$  
**Symbol:** CTR  
**Part:** 6N135  
**Min.:** 7  
**Typ.:** 16  
**Max.:** 95  
**Unit:** %

**Test Condition:** $I_F = 16 \text{ mA}, V_O = 0.5 \text{ V}, V_{CC} = 4.5 \text{ V}$  
**Part:** 6N136  
**Min.:** 5  
**Typ.:** 35  
**Max.:** 95  
**Unit:** %

### SWITCHING CHARACTERISTICS

**Parameter:** Switching characteristics  
**Test Condition:** $I_F = 16 \text{ mA}, VCC = 5 \text{ V}, R_L = 4.1 \text{ k\Omega}$  
**Symbol:** $t_{PHL}$  
**Part:** 6N135  
**Min.:** 0.3  
**Typ.:** 1.5  
**Max.:** 2.7  
**Unit:** $\mu\text{s}$

**Part:** 6N136  
**Min.:** 0.2  
**Typ.:** 0.8  
**Max.:** 1.7  
**Unit:** $\mu\text{s}$

**Test Condition:** $I_F = 16 \text{ mA}, VCC = 5 \text{ V}, R_L = 1.9 \text{ k\Omega}$  
**Symbol:** $t_{PLH}$  
**Part:** 6N135  
**Min.:** 0.2  
**Typ.:** 0.4  
**Max.:** 0.7  
**Unit:** $\mu\text{s}$

**Part:** 6N136  
**Min.:** 0.1  
**Typ.:** 0.4  
**Max.:** 0.7  
**Unit:** $\mu\text{s}$

### COMMON MODE TRANSIENT IMMUNITY

**Parameter:** Common mode transient immunity  
**Test Condition:** $I_F = 0 \text{ mA}, V_{CM} = 10 \text{ Vp-p}, VCC = 5 \text{ V}, R_L = 4.1 \text{ k\Omega}$  
**Symbol:** $|CM_{H}|$  
**Part:** 6N135  
**Min.:** 1000  
**Typ.:** 1000  
**Max.:** 1000  
**Unit:** $\text{V/\mu s}$

**Part:** 6N136  
**Min.:** 1000  
**Typ.:** 1000  
**Max.:** 1000  
**Unit:** $\text{V/\mu s}$

**Test Condition:** $I_F = 16 \text{ mA}, V_{CM} = 10 \text{ Vp-p}, VCC = 5 \text{ V}, R_L = 4.1 \text{ k\Omega}$  
**Symbol:** $|CM_{L}|$  
**Part:** 6N135  
**Min.:** 1000  
**Typ.:** 1000  
**Max.:** 1000  
**Unit:** $\text{V/\mu s}$

**Part:** 6N136  
**Min.:** 1000  
**Typ.:** 1000  
**Max.:** 1000  
**Unit:** $\text{V/\mu s}$

### SAFETY AND INSULATION RATINGS

**Parameter:** Safety and insulation ratings  
**Test Condition:** Climatic classification (according to IEC 68 part 1)  
**Symbol:** 55/100/21  
**Min.:**  
**Typ.:**  
**Max.:**  
**Unit:**

**Parameter:** Comparative tracking index  
**Symbol:** CTI  
**Min.:** 175  
**Typ.:** 399  
**Max.:**  
**Unit:**

**Parameter:** $V_{OTM}$  
**Min.:** 8000  
**Typ.:**  
**Max.:**  
**Unit:** V

**Parameter:** $V_{ORM}$  
**Min.:** 890  
**Typ.:**  
**Max.:**  
**Unit:** V

**Parameter:** $P_{SO}$  
**Min.:** 500  
**Typ.:**  
**Max.:**  
**Unit:** mW

**Parameter:** $I_{SI}$  
**Min.:** 300  
**Typ.:**  
**Max.:**  
**Unit:** mA

**Parameter:** $T_{SI}$  
**Min.:** 175  
**Typ.:**  
**Max.:**  
**Unit:** °C

**Parameter:** Creepage distance  
**Symbol:** Standard DIP-8  
**Min.:** 7  
**Typ.:**  
**Max.:**  
**Unit:** mm

**Parameter:** Clearance distance  
**Symbol:** Standard DIP-8  
**Min.:** 7  
**Typ.:**  
**Max.:**  
**Unit:** mm

**Parameter:** Creepage distance  
**Symbol:** 400 mil DIP-8  
**Min.:** 8  
**Typ.:**  
**Max.:**  
**Unit:** mm

**Parameter:** Clearance distance  
**Symbol:** 400 mil DIP-8  
**Min.:** 8  
**Typ.:**  
**Max.:**  
**Unit:** mm

### Note

- According to DIN EN 60747-5-2 (VDE 0884), this optocoupler is suitable for “safe electrical insulation” only within the safety ratings. Compliance with the safety ratings shall be ensured by means of protective circuits.
TYPICAL CHARACTERISTICS \( (T_{\text{amb}} = 25 \, ^\circ\text{C}, \text{unless otherwise specified}) \)

![Fig. 1 - LED Forward Current vs. Forward Voltage](image1)

![Fig. 2 - Permissible Forward LED Current vs. Temperature](image2)

![Fig. 3 - Permissible Power Dissipation vs. Temperature](image3)

![Fig. 4 - Output Current vs. Output Voltage](image4)

![Fig. 5 - Output Current vs. Temperature](image5)

![Fig. 6 - Propagation Delay vs. Ambient Temperature](image6)
Fig. 7 - Propagation Delay vs. Ambient Temperature

Fig. 8 - Logic High Output Current vs. Temperature

Fig. 9 - Small Signal Current Transfer Ratio vs. Quiescent Input Current

Fig. 10 - Switching Times
Fig. 11 - Common-Mode Interference Immunity

PACKAGE DIMENSIONS in millimeters

Pulse generator
$Z_O = 50\ \Omega$
$t_{r,tf} = 8\ \text{ns}$

Option 6

Option 7

Option 9

For technical questions, contact: optocoupleranswers@vishay.com

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PACKAGE MARKING

Notes
• Only options 1, and 7 are reflected in the package marking.
• The VDE logo is only marked on option 1 parts.
• Tape and reel suffix (T) is not part of the package marking.
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Please note that some Vishay documentation may still make reference to RoHS Directive 2002/95/EC. We confirm that all the products identified as being compliant to Directive 2002/95/EC conform to Directive 2011/65/EU.

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