Tall Dome Dual Channel Transmissive Optical Sensor  
with Phototransistor Outputs

DESCRIPTION

The TCUT1600X01 is a compact transmissive sensor that includes an infrared emitter and two phototransistor detectors, located face-to-face in a surface mount package. The tall dome design supports additional mechanical room for vertical signal encoding.

FEATURES

- Package type: surface mount
- Detector type: phototransistor
- Dimensions (L x W x H in mm): 5.5 x 4 x 5.7
- AEC-Q101 qualified
- Gap (in mm): 3
- Aperture (in mm): 0.3
- Channel distance (center to center): 0.8 mm
- Typical output current under test: I_C = 1.6 mA
- Emitter wavelength: 950 nm
- Lead (Pb)-free soldering released
- Moisture sensitivity level (MSL): 1
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

APPLICATIONS

- Automotive optical sensors
- Accurate position sensor for encoder
- Sensor for motion, speed, and direction
- Sensor for “turn and push” encoding

PRODUCT SUMMARY

<table>
<thead>
<tr>
<th>PART NUMBER</th>
<th>GAP WIDTH (mm)</th>
<th>APERTURE WIDTH (mm)</th>
<th>TYPICAL OUTPUT CURRENT UNDER TEST (mA)</th>
<th>DAYLIGHT BLOCKING FILTER INTEGRATED</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCUT1600X01</td>
<td>3</td>
<td>0.3</td>
<td>1.6</td>
<td>No</td>
</tr>
</tbody>
</table>

Note

(1) Conditions like in table basic characteristics/coupler

ORDERING INFORMATION

<table>
<thead>
<tr>
<th>ORDERING CODE</th>
<th>PACKAGING</th>
<th>VOLUME (1)</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCUT1600X01</td>
<td>Tape and reel</td>
<td>MOQ: 1300 pcs, 1300 pcs/reel</td>
<td>Drypack, MSL 1</td>
</tr>
</tbody>
</table>

Note

(1) MOQ: minimum order quantity
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><strong>COUPLER</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total power dissipation</td>
<td>T_{amb} ≤ 95 °C</td>
<td>P_{tot}</td>
<td>37.5</td>
<td>mW</td>
</tr>
<tr>
<td>Junction temperature</td>
<td></td>
<td>T_{j}</td>
<td>110</td>
<td>°C</td>
</tr>
<tr>
<td>Ambient temperature range</td>
<td></td>
<td>T_{amb}</td>
<td>-40 to +105</td>
<td>°C</td>
</tr>
<tr>
<td>Storage temperature range</td>
<td></td>
<td>T_{stg}</td>
<td>-40 to +125</td>
<td>°C</td>
</tr>
<tr>
<td>Soldering temperature</td>
<td>In accordance with fig. 16</td>
<td>T_{sd}</td>
<td>260</td>
<td>°C</td>
</tr>
<tr>
<td><strong>INPUT (EMITTER)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reverse voltage</td>
<td></td>
<td>V_{R}</td>
<td>5</td>
<td>V</td>
</tr>
<tr>
<td>Forward current</td>
<td>T_{amb} ≤ 95 °C</td>
<td>I_{F}</td>
<td>25</td>
<td>mA</td>
</tr>
<tr>
<td>Forward surge current</td>
<td>t_{p} ≤ 10 μs</td>
<td>I_{FSM}</td>
<td>200</td>
<td>mA</td>
</tr>
<tr>
<td>Power dissipation</td>
<td>T_{amb} ≤ 95 °C</td>
<td>P_{V}</td>
<td>37.5</td>
<td>mW</td>
</tr>
<tr>
<td><strong>OUTPUT (DETECTOR)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collector emitter voltage</td>
<td></td>
<td>V_{CEO}</td>
<td>20</td>
<td>V</td>
</tr>
<tr>
<td>Emitter collector voltage</td>
<td></td>
<td>V_{ECO}</td>
<td>7</td>
<td>V</td>
</tr>
<tr>
<td>Collector current</td>
<td></td>
<td>I_{C}</td>
<td>20</td>
<td>mA</td>
</tr>
<tr>
<td>Collector dark current</td>
<td>T_{amb} = 85 °C, V_{CE} = 5 V</td>
<td>I_{CEO}</td>
<td>3.3</td>
<td>μA</td>
</tr>
</tbody>
</table>

ABSOLUTE MAXIMUM RATINGS

Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

Fig. 2 - Forward Current Limit vs. Ambient Temperature
## ELECTRICAL CHARACTERISTICS (T<sub>amb</sub> = 25 °C, unless otherwise specified)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>TEST CONDITION</th>
<th>SYMBOL</th>
<th>MIN.</th>
<th>TYP.</th>
<th>MAX.</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>COUPLER</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collector current per channel</td>
<td>V&lt;sub&gt;CE&lt;/sub&gt; = 5 V, I&lt;sub&gt;F&lt;/sub&gt; = 15 mA</td>
<td>I&lt;sub&gt;C&lt;/sub&gt;</td>
<td>0.7</td>
<td>1.6</td>
<td>-</td>
<td>mA</td>
</tr>
<tr>
<td>Collector emitter saturation voltage</td>
<td>I&lt;sub&gt;F&lt;/sub&gt; = 15 mA, I&lt;sub&gt;C&lt;/sub&gt; = 0.2 mA</td>
<td>V&lt;sub&gt;CESat&lt;/sub&gt;</td>
<td>-</td>
<td>-</td>
<td>0.4</td>
<td>V</td>
</tr>
<tr>
<td><strong>INPUT (EMITTER)</strong></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; = 15 mA</td>
<td>V&lt;sub&gt;F&lt;/sub&gt;</td>
<td>1</td>
<td>1.2</td>
<td>1.4</td>
<td>V</td>
</tr>
<tr>
<td>Reverse current</td>
<td>V&lt;sub&gt;R&lt;/sub&gt; = 5 V</td>
<td>I&lt;sub&gt;R&lt;/sub&gt;</td>
<td>-</td>
<td>-</td>
<td>10</td>
<td>μA</td>
</tr>
<tr>
<td>Junction capacitance</td>
<td>V&lt;sub&gt;R&lt;/sub&gt; = 0 V, f = 1 MHz</td>
<td>C&lt;sub&gt;j&lt;/sub&gt;</td>
<td>-</td>
<td>25</td>
<td>-</td>
<td>pF</td>
</tr>
<tr>
<td><strong>OUTPUT (DETECTOR)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collector emitter voltage I&lt;sub&gt;C&lt;/sub&gt;</td>
<td>I&lt;sub&gt;C&lt;/sub&gt; = 1 mA</td>
<td>V&lt;sub&gt;CEO&lt;/sub&gt;</td>
<td>20</td>
<td>-</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>Emitter collector voltage</td>
<td>I&lt;sub&gt;E&lt;/sub&gt; = 100 μA</td>
<td>V&lt;sub&gt;ECEO&lt;/sub&gt;</td>
<td>7</td>
<td>-</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>Collector dark current</td>
<td>V&lt;sub&gt;CE&lt;/sub&gt; = 25 V, I&lt;sub&gt;F&lt;/sub&gt; = 0 A, E = 0 lx</td>
<td>I&lt;sub&gt;CEO&lt;/sub&gt;</td>
<td>-</td>
<td>1</td>
<td>100</td>
<td>nA</td>
</tr>
</tbody>
</table>

### SWITCHING CHARACTERISTICS

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>TEST CONDITION</th>
<th>SYMBOL</th>
<th>MIN.</th>
<th>TYP.</th>
<th>MAX.</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rise time</td>
<td>I&lt;sub&gt;C&lt;/sub&gt; = 0.7 mA, V&lt;sub&gt;CE&lt;/sub&gt; = 5 V, R&lt;sub&gt;L&lt;/sub&gt; = 100 Ω (see fig. 3)</td>
<td>t&lt;sub&gt;r&lt;/sub&gt;</td>
<td>-</td>
<td>9</td>
<td>150</td>
<td>μs</td>
</tr>
<tr>
<td>Fall time</td>
<td>I&lt;sub&gt;C&lt;/sub&gt; = 0.7 mA, V&lt;sub&gt;CE&lt;/sub&gt; = 5 V, R&lt;sub&gt;L&lt;/sub&gt; = 100 Ω (see fig. 3)</td>
<td>t&lt;sub&gt;f&lt;/sub&gt;</td>
<td>-</td>
<td>16</td>
<td>150</td>
<td>μs</td>
</tr>
</tbody>
</table>

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

- **Fig. 3** - Test Circuit for t<sub>r</sub> and t<sub>f</sub>
- **Fig. 4** - Switching Times
- **Fig. 5** - Forward Current vs. Forward Voltage
- **Fig. 6** - Forward Voltage vs. Ambient Temperature
**Fig. 7** - Collector Current vs. Forward Current

**Fig. 8** - Collector Current vs. Collector Emitter Voltage

**Fig. 9** - Collector Emitter Saturation Voltage vs. Ambient Temperature

**Fig. 10** - Collector Current vs. Ambient Temperature

**Fig. 11** - Collector Dark Current vs. Ambient Temperature

**Fig. 12** - Relative Collector Current vs. Horizontal Displacement
Fig. 13 - Relative Collector Current vs. Vertical Displacement

Fig. 14 - Rise/Fall Time vs. Collector Current

Fig. 15 - Application example

Fig. 16 - Lead (Pb)-free Reflow Solder Profile acc. J-STD-020

**REFLOW SOLDER PROFILE**

**FLOOR LIFE**

Level 1, acc. JEDEC®, J-STD-020. No time limit.
PACKAGE DIMENSIONS in millimeters

Technical drawings according to DIN specification.

Not indicated tolerances ± 0.15

Pin connection top view

Material cut-outs

Emitter side, wider contact for pin-identification

Optical axis

Injection gate location

Detector side

Proposed solderpad design

Ejector marks

Emitter side

Material cut-outs

Not indicated tolerances ± 0.15

Technical drawings according to DIN specification.

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Material cut-outs

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Optical axis

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Detector side

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Technical drawings according to DIN specification.
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