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 (1) (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 ( Tamb = 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>Total power dissipation</td>
<td>Tamb ≤ 95 °C</td>
<td>Ptot</td>
<td>37.5</td>
<td>mW</td>
</tr>
<tr>
<td>Junction temperature</td>
<td></td>
<td>Tj</td>
<td>110</td>
<td>°C</td>
</tr>
<tr>
<td>Ambient temperature range</td>
<td>Tamb</td>
<td></td>
<td>-40 to +105</td>
<td>°C</td>
</tr>
<tr>
<td>Storage temperature range</td>
<td>Tstg</td>
<td></td>
<td>-40 to +125</td>
<td>°C</td>
</tr>
<tr>
<td>Soldering temperature</td>
<td></td>
<td>Tsd</td>
<td>260</td>
<td>°C</td>
</tr>
</tbody>
</table>

### INPUT (EMITTER)

| Reverse voltage                       | Tamb ≤ 95 °C      | Vr     | 5     | V     |
| Forward current                       | Tamb ≤ 95 °C      | If     | 25    | mA    |
| Forward surge current                 | t≤ 10 μs          | Ifsm   | 200   | mA    |
| Power dissipation                     | Tamb ≤ 95 °C      | PV     | 37.5  | mW    |

### OUTPUT (DETECTOR)

| Collector emitter voltage             |                   | VCEO   | 20    | V     |
| Emitter collector voltage             |                   | VECO   | 7     | V     |
| Collector current                     | Tamb = 85 °C, VCE = 5 V | Ic     | 20    | mA    |
| Collector dark current                | Tamb = 85 °C, VCE = 5 V | ICEO   | 3.3   | μA    |

### ABSOLUTE MAXIMUM RATINGS

**Fig. 1 - Power Dissipation Limit vs. Ambient Temperature**

**Fig. 2 - Forward Current Limit vs. Ambient Temperature**

For technical questions, contact: sensorstechsupport@vishay.com

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## 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;CESat&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;ECO&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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**Fig. 3 - Test Circuit for t<sub>r</sub> and t<sub>f</sub>**

**Fig. 4 - Switching Times**

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

**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

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

Technical drawings according to DIN specification.

Material cut-outs

Emitter side, wider contact for pin-identification

Optical axis

Injection gate location

Proposed solderpad design

Marking area

Emitter side

Not indicated tolerances ± 0.15

Pin connection top view

Detector side

Ejector marks

Drawing-No.: 6.541-5098.01-4
Issue: 1; 04.11.15

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PACKAGE DIMENSIONS in millimeters

Unreel direction

Reel-design is representative for different types

Anode

Cathode

Label posted here

Empty leader 400 mm min.

Empty trailer 200 mm min.

Drawing-No.: 9.800-5124.01-4

Issue: 1; 04.11.15
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