Triple Channel Transmissive Optical Sensor With Phototransistor Outputs for “Turn and Push” Encoding

DESCRIPTION
The TCUT1630X01 is a compact transmissive sensor that includes an infrared emitter and three phototransistor detectors, located face-to-face in a surface-mount package. The tall dome design supports an additional transistor and 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 5.85 x 7
- AEC-Q101 qualified
- Gap (in mm): 3
- Aperture (in mm): 0.3
- Typical output current under test: I_C = 1.3 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>TCUT1630X01</td>
<td>3</td>
<td>0.3</td>
<td>1.3</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>TCUT1630X01</td>
<td>Tape and reel</td>
<td>MOQ: 1100 pcs, 1100pcs/reel</td>
<td>Drypack, MSL 1</td>
</tr>
</tbody>
</table>

Note
(1) MOQ: minimum order quantity
### ABSOLUTE MAXIMUM RATINGS  
(T\textsubscript{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>COUPLER</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Junction temperature</td>
<td>T\textsubscript{j}</td>
<td>110</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>Ambient temperature range</td>
<td>T\textsubscript{amb}</td>
<td>-40 to +105</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>Storage temperature range</td>
<td>T\textsubscript{stg}</td>
<td>-40 to +125</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>Soldering temperature</td>
<td>In accordance with Fig. 17</td>
<td>T\textsubscript{sd}</td>
<td>260</td>
<td>°C</td>
</tr>
<tr>
<td>INPUT (EMITTER)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reverse voltage</td>
<td></td>
<td>V\textsubscript{R}</td>
<td>5</td>
<td>V</td>
</tr>
<tr>
<td>Forward current</td>
<td>T\textsubscript{amb} ≤ 95 °C</td>
<td>I\textsubscript{F}</td>
<td>25</td>
<td>mA</td>
</tr>
<tr>
<td>Forward surge current</td>
<td>t\textsubscript{p} ≤ 10 μs</td>
<td>I\textsubscript{FSM}</td>
<td>200</td>
<td>mA</td>
</tr>
<tr>
<td>Total power dissipation</td>
<td>T\textsubscript{amb} ≤ 95 °C</td>
<td>P\textsubscript{V}</td>
<td>37.5</td>
<td>mW</td>
</tr>
<tr>
<td>OUTPUT (DETECTOR)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collector emitter voltage</td>
<td></td>
<td>V\textsubscript{CEO}</td>
<td>20</td>
<td>V</td>
</tr>
<tr>
<td>Emitter collector voltage</td>
<td></td>
<td>V\textsubscript{ECEO}</td>
<td>7</td>
<td>V</td>
</tr>
<tr>
<td>Collector current</td>
<td></td>
<td>I\textsubscript{C}</td>
<td>20</td>
<td>mA</td>
</tr>
<tr>
<td>Collector dark current</td>
<td>T\textsubscript{amb} = 85 °C, V\textsubscript{CE} = 5 V</td>
<td>I\textsubscript{CEO}</td>
<td>3.3</td>
<td>μA</td>
</tr>
<tr>
<td>Total power dissipation</td>
<td>T\textsubscript{amb} ≤ 95 °C</td>
<td>P\textsubscript{V}</td>
<td>37.5</td>
<td>mW</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_{amb} = 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>COUPLER</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collector current per channel</td>
<td>V_{CE} = 5 V, I_{F} = 15 mA</td>
<td>I_{C}</td>
<td>0.45</td>
<td>1.3</td>
<td>-</td>
<td>mA</td>
</tr>
<tr>
<td>Collector emitter saturation voltage</td>
<td>I_{F} = 15 mA, I_{C} = 0.2 mA</td>
<td>V_{CE}Sat</td>
<td>-</td>
<td>-</td>
<td>0.4</td>
<td>V</td>
</tr>
<tr>
<td>INPUT (EMITTER)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forward voltage</td>
<td>I_{C} = 15 mA</td>
<td>V_{F}</td>
<td>1</td>
<td>1.2</td>
<td>1.4</td>
<td>V</td>
</tr>
<tr>
<td>Reverse current</td>
<td>V_{R} = 5 V</td>
<td>I_{R}</td>
<td>-</td>
<td>-</td>
<td>10</td>
<td>μA</td>
</tr>
<tr>
<td>Junction capacitance</td>
<td>V_{R} = 0 V, f = 1 MHz</td>
<td>C_{j}</td>
<td>25</td>
<td>-</td>
<td>-</td>
<td>pF</td>
</tr>
<tr>
<td>OUTPUT (DETECTOR)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collector emitter voltage I_{C}</td>
<td>I_{C} = 1 mA</td>
<td>V_{CEO}</td>
<td>20</td>
<td>-</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>Emitter collector voltage</td>
<td>I_{C} = 100 μA</td>
<td>V_{EEO}</td>
<td>7</td>
<td>-</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>Collector dark current</td>
<td>V_{CEO} = 25 V, I_{F} = 0 A, E = 0 lx</td>
<td>I_{CEO}</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_{C} = 0.7 mA, V_{CEO} = 5 V, R_{L} = 100 Ω (see Fig. 3)</td>
<td>t_{r}</td>
<td>-</td>
<td>9</td>
<td>150</td>
<td>μs</td>
</tr>
<tr>
<td>Fall time</td>
<td>I_{C} = 0.7 mA, V_{CEO} = 5 V, R_{L} = 100 Ω (see Fig. 3)</td>
<td>t_{f}</td>
<td>-</td>
<td>16</td>
<td>150</td>
<td>μs</td>
</tr>
</tbody>
</table>

BASIC CHARACTERISTICS (T_{amb} = 25 °C, unless otherwise specified)

![Fig. 3 - Test Circuit for t_{r} and t_{f}](image)

![Fig. 4 - Switching Times](image)

![Fig. 5 - Forward Current vs. Forward Voltage](image)

![Fig. 6 - Forward Voltage vs. Ambient Temperature](image)
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 - Rise / Fall Time vs. Collector Current

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For technical questions, contact: sensorstechsupport@vishay.com

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**Fig. 13 - Relative Collector Current vs. Horizontal Displacement**
Horizontal Shutter (0.25 mm thickness)

**Fig. 14 - Relative Collector Current vs. Vertical Displacement**
Vertical Shutter (0.25 mm thickness)

**Fig. 15 - Application example**

IF = 15 mA, + VC = 5 V

**Fig. 16 - Top View Sensor**
Channel Positions and Origin of Horizontal Shutter

**Fig. 17 - Top View Sensor**
Channel Positions and Origin of Vertical Shutter

**REFLOW SOLDER PROFILE**

Fig. 18 - Lead (Pb)-free Reflow Solder Profile
According to J-STD-020
**FLOOR LIFE**
Level 1, according to JEDEC®, J-STD-020. No time limit.

**PACKAGE DIMENSIONS** in millimeters

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Not indicated tolerances ± 0.15 mm

Technical drawings according to DIN specification.

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Recommended Footprint

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Top view

- A1
- n.c.
- Cath.
- n.c.
- n.c.
- E1
- E2
- Col.
- n.c.
- E3

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Ejector marks

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Optical axes emitter

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Material cut-outs

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Drawing No.: 6.541-5106.01-4
Issue: 1; 20.06.2016

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PACKAGE DIMENSIONS in millimeters
Volume/reel = 1100 pcs

Drawing-No.: 9,800-5133.01-4
Issue: 1; 29.06.2016
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