Subminiature Dual Channel Transmissive Optical Sensor with Phototransistor Outputs

DESCRIPTION

The TCUT1350X01 is a compact transmissive sensor that includes an infrared emitter and two phototransistor detectors, located face-to-face in a surface mount package. TCUT1350X01 is especially designed to meet high operating temperature requirements and is released for operating temperature ranges from -40 °C to +125 °C.

FEATURES

- Package type: surface mount
- Detector type: phototransistor
- Dimensions (L x W x H in mm): 5.5 x 4 x 4
- 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
- Released for high operating temperatures up to 125 °C
- 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

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>TCUT1350X01</td>
<td>3</td>
<td>0.3</td>
<td>1.6</td>
<td>No</td>
</tr>
</tbody>
</table>

Note
- 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>TCUT1350X01</td>
<td>Tape and reel</td>
<td>MOQ: 2000 pcs, 2000 pcs/reel</td>
<td>Drypack, MSL 1</td>
</tr>
</tbody>
</table>

Note
- MOQ: minimum order quantity

For technical questions, contact: sensorstechsupport@vishay.com

THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE. THE PRODUCTS DESCRIBED HEREIN AND THIS DOCUMENT ARE SUBJECT TO SPECIFIC DISCLAIMERS, SET FORTH AT www.vishay.com/doc?91000
ABSOLUTE MAXIMUM RATINGS  \((T_{amb} = 25 ^\circ C, \text{unless otherwise specified})\)

<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} \leq 125 ^\circ 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>140</td>
<td>°C</td>
</tr>
<tr>
<td>Ambient temperature range</td>
<td></td>
<td>(T_{amb})</td>
<td>-40 to +125</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} \leq 125 ^\circ C)</td>
<td>(I_F)</td>
<td>25</td>
<td>mA</td>
</tr>
<tr>
<td>Forward surge current</td>
<td>(t_p \leq 10 \mu s)</td>
<td>(I_{FSM})</td>
<td>200</td>
<td>mA</td>
</tr>
<tr>
<td>Power dissipation</td>
<td>(T_{amb} \leq 125 ^\circ 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_{ECCO})</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 ^\circ C, V_{CE} = 5 V)</td>
<td>(I_{CEO})</td>
<td>3.3</td>
<td>μA</td>
</tr>
</tbody>
</table>

**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>COUPLER</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>mA</td>
<td></td>
</tr>
<tr>
<td></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>0.4</td>
<td>V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INPUT (EMITTER)</td>
<td></td>
<td>V&lt;sub&gt;F&lt;/sub&gt;</td>
<td>1.2</td>
<td>1.4</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td></td>
<td>V&lt;sub&gt;R&lt;/sub&gt; = 5 V</td>
<td>I&lt;sub&gt;R&lt;/sub&gt;</td>
<td>10 μA</td>
<td>V</td>
<td></td>
<td></td>
</tr>
<tr>
<td></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>25 pF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OUTPUT (DETECTOR)</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 V</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>I&lt;sub&gt;E&lt;/sub&gt; = 100 μA</td>
<td>V&lt;sub&gt;EEO&lt;/sub&gt;</td>
<td>7 V</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></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;EEO&lt;/sub&gt;</td>
<td>1 nA</td>
<td>100 nA</td>
<td></td>
<td></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,</td>
<td>t&lt;sub&gt;r&lt;/sub&gt;</td>
<td>9 μs</td>
<td>150 μs</td>
<td>μs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>R&lt;sub&gt;L&lt;/sub&gt; = 100 Ω (see fig. 3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></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,</td>
<td>t&lt;sub&gt;f&lt;/sub&gt;</td>
<td>16 μs</td>
<td>150 μs</td>
<td>μs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>R&lt;sub&gt;L&lt;/sub&gt; = 100 Ω (see fig. 3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>SYMBOL</th>
<th>MIN.</th>
<th>TYP.</th>
<th>MAX.</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>I&lt;sub&gt;F&lt;/sub&gt; - Forward Current (mA)</td>
<td></td>
<td>10</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>V&lt;sub&gt;F&lt;/sub&gt; - Forward Voltage (V)</td>
<td></td>
<td>0.8</td>
<td>1.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>V&lt;sub&gt;F&lt;/sub&gt;</td>
<td></td>
<td>0</td>
<td>160</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For technical questions, contact: sensorstechsupport@vishay.com

THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE. THE PRODUCTS DESCRIBED HEREIN AND THIS DOCUMENT ARE SUBJECT TO SPECIFIC DISCLAIMERS, SET FORTH AT www.vishay.com/doc?91000
**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

Volume/reel = 2000 pcs

Reel-dimension and tape:

Unreel direction

Tape position coming out from reel

Not indicated tolerances ±0.1

Label posted here

Technical drawings according to DIN specification

Leader and trailer tape:

Empty Trailer 200mm min.

Direction of pulling out

Parts mounted

Empty Leader 400mm min.

100mm min. with cover tape

12.4" +2

18.4 max

Drawing-No.: 9.800-5092.01-4
Issue: 1; 14.05.07
2011
## Packaging and Ordering Information

### Notes

(1) MOQ: minimum order quantity
(2) Please refer to datasheets

### TUBE SPECIFICATION FIGURES

![Tube Specification Diagram]

**With rubber stopper**
- Tolerance: ±0.5mm
- Length: 575±1mm

**Drawing-No:** 9.700-5097.01-4
**Issue:** 1, 25 02 00

**Fig. 1**
Packaging and Ordering Information

Vishay Semiconductors Packaging and Ordering Information

Fig. 2

Drawing No.: 9700-5139.01-4
Issue: 1; 10.05.00

Drawing refers to following types: TCRT 5000

With rubber stopper
Tolerance: ± 0.5mm
Length: 575 ± 1mm

Fig. 3

Drawing No.: 9700-5178.01-4
Issue: 1; 25.02.00

With stopper pins
Tolerance: ± 0.5mm
Length: 575 ± 1mm
**Packaging and Ordering Information**

Vishay Semiconductors  Packaging and Ordering Information

---

**Fig. 6**

With stopper pins
Tolerance: ±0.5mm
Length: 575±1mm

Drawing-No.: 9.700-5205.01-4
Issue: 1, 25.02.00

---

**Fig. 7**

With rubber stopper
Tolerance: ±0.5mm
Length: 575±1mm

Drawing-No.: 9.700-5245.01-4
Issue: 1, 25.02.00

---

For technical questions, contact: optocoupleranswers@vishay.com
Fig. 8

Drawing-No.: 9.700-5222.01-4
Issue: 2; 19.11.04
20257

With stopper pins
Tolerance: ±0.5mm
Length: 450±1mm
All dimensions in mm
Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, “Vishay”), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay’s knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer’s responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and / or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer’s technical experts. Product specifications do not expand or otherwise modify Vishay’s terms and conditions of purchase, including but not limited to the warranty expressed therein.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.