Subminiature Dual Channel Transmissive Optical Sensor with Phototransistor Outputs

DESCRIPTION
The TCUT1300X01 is a compact transmissive sensor that includes an infrared emitter and two phototransistor detectors, located face-to-face in a surface mount package.

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: $I_C = 0.6$ mA
- Emitter wavelength: 950 nm
- Lead (Pb)-free soldering released
- Moisture sensitivity level (MSL): 1
- Compliant to RoHS Directive 2002/95/EC and in accordance to WEEE 2002/96/EC

APPLICATIONS
- Automotive optical sensors
- Accurate position sensor for encoder
- Sensor for motion, speed and direction

Note
** Please see document “Vishay Material Category Policy”: www.vishay.com/doc?99902

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 (I)</th>
<th>DAYLIGHT BLOCKING FILTER INTEGRATED</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCUT1300X01</td>
<td>3</td>
<td>0.3</td>
<td>0.6</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 (I)</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCUT1300X01</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
### ABSOLUTE MAXIMUM RATINGS

**PARAMETER** | **TEST CONDITION** | **SYMBOL** | **VALUE** | **UNIT**
--- | --- | --- | --- | ---
**COUPLER** | | | |
Total power dissipation | $T_{\text{amb}} \leq 95\, ^{\circ}\text{C}$ | $P_{\text{tot}}$ | 37.5 | mW
Junction temperature | | $T_j$ | 110 | °C
Ambient temperature range | | $T_{\text{amb}}$ | -40 to +105 | °C
Storage temperature range | | $T_{\text{stg}}$ | -40 to +125 | °C
Soldering temperature | In accordance with fig. 16 | $T_{\text{sd}}$ | 260 | °C

**INPUT (EMITTER)** | | | |
Reverse voltage | | $V_R$ | 5 | V
Forward current | $T_{\text{amb}} \leq 95\, ^{\circ}\text{C}$ | $I_F$ | 25 | mA
Forward surge current | $t_p \leq 10\, \mu s$ | $I_{\text{FSM}}$ | 200 | mA
Power dissipation | $T_{\text{amb}} \leq 95\, ^{\circ}\text{C}$ | $P_V$ | 37.5 | mW

**OUTPUT (DETECTOR)** | | | |
Collector emitter voltage | | $V_{\text{CEO}}$ | 20 | V
Emitter collector voltage | | $V_{\text{ECO}}$ | 7 | V
Collector current | | $I_C$ | 20 | mA
Collector dark current | $T_{\text{amb}} = 85\, ^{\circ}\text{C}, V_{\text{CE}} = 5\, \text{V}$ | $I_{\text{CEO}}$ | 3.3 | μA

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

**Fig. 2** - Forward Current Limit vs. Ambient Temperature
ELECTRICAL CHARACTERISTICS \((T_{\text{amb}} = 25 \, ^\circ\text{C}, \text{unless otherwise specified})\)

<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_{\text{CE}} = 5 , \text{V}, , I_{\text{F}} = 15 , \text{mA})</td>
<td>(I_{\text{C}})</td>
<td>300</td>
<td>600</td>
<td></td>
<td>(\mu\text{A})</td>
</tr>
<tr>
<td>Collector emitter saturation</td>
<td>(I_{\text{F}} = 15 , \text{mA}, , I_{\text{C}} = 0.05 , \text{mA})</td>
<td>(V_{\text{CEsat}})</td>
<td>0.4</td>
<td></td>
<td></td>
<td>(\text{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_{\text{F}} = 15 , \text{mA})</td>
<td>(V_{\text{F}})</td>
<td>1</td>
<td>1.2</td>
<td>1.4</td>
<td>(\text{V})</td>
</tr>
<tr>
<td>Reverse current</td>
<td>(V_{\text{R}} = 5 , \text{V})</td>
<td>(I_{\text{R}})</td>
<td>10</td>
<td></td>
<td></td>
<td>(\mu\text{A})</td>
</tr>
<tr>
<td>Junction capacitance</td>
<td>(V_{\text{R}} = 0 , \text{V}, , f = 1 , \text{MHz})</td>
<td>(C_{\text{j}})</td>
<td>25</td>
<td></td>
<td></td>
<td>(\text{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_{\text{C}})</td>
<td>(I_{\text{C}} = 1 , \text{mA})</td>
<td>(V_{\text{CEO}})</td>
<td>20</td>
<td></td>
<td></td>
<td>(\text{V})</td>
</tr>
<tr>
<td>Emitter collector voltage</td>
<td>(I_{\text{E}} = 100 , \mu\text{A})</td>
<td>(V_{\text{EEO}})</td>
<td>7</td>
<td></td>
<td></td>
<td>(\text{V})</td>
</tr>
<tr>
<td>Collector dark current</td>
<td>(V_{\text{CE}} = 25 , \text{V}, , I_{\text{F}} = 0 , \text{A}, , E = 0 , \text{lx})</td>
<td>(I_{\text{CEO}})</td>
<td>1</td>
<td>100</td>
<td></td>
<td>(\text{nA})</td>
</tr>
<tr>
<td>SWITCHING CHARACTERISTICS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rise time</td>
<td>(I_{\text{C}} = 0.3 , \text{mA}, , V_{\text{CE}} = 5 , \text{V}, , R_{\text{L}} = 100 , \Omega ) (see fig. 3)</td>
<td>(t_{\text{r}})</td>
<td>20</td>
<td>150</td>
<td></td>
<td>(\mu\text{s})</td>
</tr>
<tr>
<td>Fall time</td>
<td>(I_{\text{C}} = 0.3 , \text{mA}, , V_{\text{CE}} = 5 , \text{V}, , R_{\text{L}} = 100 , \Omega ) (see fig. 3)</td>
<td>(t_{\text{f}})</td>
<td>30</td>
<td>150</td>
<td></td>
<td>(\mu\text{s})</td>
</tr>
</tbody>
</table>

**BASIC CHARACTERISTICS \((T_{\text{amb}} = 25 \, ^\circ\text{C}, \text{unless otherwise specified})\)**

![Test Circuit for \(t_{\text{r}}\) and \(t_{\text{f}}\)](image)

![Switching Times](image)

![Forward Current vs. Forward Voltage](image)

![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 - Relative Collector Current vs. Horizontal Displacement
**RELIABILITY TESTS IN REFERENCE TO AEC-Q101 RELEASE**

<table>
<thead>
<tr>
<th>TEST</th>
<th>CONDITION</th>
<th>DURATION</th>
<th>LOT SIZE - REJECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>High temperature storage</td>
<td>$T_{\text{stg (max)}} = 100 , ^\circ\text{C}$</td>
<td>1000 h</td>
<td>3 x 50 pcs - 0 pcs</td>
</tr>
<tr>
<td>Low temperature storage</td>
<td>$T_{\text{stg (min)}} = - 40 , ^\circ\text{C}$</td>
<td>1000 h</td>
<td>3 x 50 pcs - 0 pcs</td>
</tr>
<tr>
<td>Temperature cycling</td>
<td>- 40 °C/+ 100 °C</td>
<td>1000 x</td>
<td>3 x 77 pcs - 0 pcs</td>
</tr>
<tr>
<td>H3TRB</td>
<td></td>
<td>1000 h</td>
<td>3 x 77 pcs - 0 pcs</td>
</tr>
<tr>
<td>Intermittent operational life</td>
<td>Emitters: $I_F = 80 , \text{mA DC}$, detectors: $V_{CE} = 16 , \text{V}$, duty cycle: 2 min on, 2 min off, $T_{\text{amb}} = 25 , ^\circ\text{C}$</td>
<td>1000 h</td>
<td>3 x 77 pcs - 0 pcs</td>
</tr>
<tr>
<td></td>
<td>(15 000 cycles)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**RELIABILITY TESTS IN REFERENCE TO ENHANCED TEMPERATURE RELEASE ACC. AEC-Q101**

<table>
<thead>
<tr>
<th>TEST</th>
<th>CONDITION</th>
<th>DURATION</th>
<th>LOT SIZE - REJECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>High temperature storage</td>
<td>$T_{\text{stg (max)}} = 125 , ^\circ\text{C}$</td>
<td>1000 h</td>
<td>1 x 50 pcs - 0 pcs</td>
</tr>
<tr>
<td>Temperature cycling</td>
<td>- 40 °C/+ 150 °C</td>
<td>1000 x</td>
<td>1 x 77 pcs - 0 pcs</td>
</tr>
<tr>
<td>Power temperature cycle</td>
<td>- 25 °C/+ 85 °C, $I_F = 50 , \text{mA}$, $V_{CE} = 16 , \text{V}$, 2 min on, 2 min off</td>
<td>1000 h</td>
<td>1 x 77 pcs - 0 pcs</td>
</tr>
<tr>
<td></td>
<td>(15 000 cycles)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**FLOOR LIFE**

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

![Package Dimensions Diagram]

Dimensions:
- Emitter side
- Wider contact for Pin identification
- Material Cutouts
- Not indicated tolerances ±0.15

Inked drawing according to specifications

**Drawing-No.: 6.541-5051.01-4**
**Issue: 6, 14.05.07**

19536

For technical questions, contact: sensorstechsupport@vishay.com

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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 IEC specifications

Leader and trailer tape:

Empty Trailer 200mm min.

Direction of pulling out

Parts mounted

Empty Leader 400mm min.

100mm min. with cover tape

Drawing-No: 9.800-5092.01-4
Issue: 1: 14.05.07
2011

φ33.0 ±0.0

φ25.0 ±0.0

φ13 ±0.2

12.4 ±2

18.4 max

4.2

4.2

5.7

1.75

8

2

4

φ1.5

6.2

5.5

12.4

3

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### Packaging and Ordering Information

**Vishay Semiconductors**

#### PART NUMBER | MOQ (1) | PCS PER TUBE | TUBE SPEC. (FIGURE) | CONSTITUENTS (FORMS)
--- | --- | --- | --- | ---
CNY70 | 4000 | 80 | 1 | 28
TCPT1300X01 | 2000 | Reel | (2) | 29
TCRT1000 | 1000 | Bulk | - | 26
TCRT1010 | 1000 | Bulk | - | 26
TCRT5000 | 4500 | 50 | 2 | 27
TCRT5000L | 2400 | 48 | 3 | 27
TCST1030 | 5200 | 65 | 5 | 24
TCST1030L | 2600 | 65 | 6 | 24
TCST1103 | 1020 | 85 | 4 | 24
TCST1202 | 1020 | 85 | 4 | 24
TCST1230 | 4800 | 60 | 7 | 24
TCST1300 | 1020 | 85 | 4 | 24
TCST2103 | 1020 | 85 | 4 | 24
TCST2202 | 1020 | 85 | 4 | 24
TCST2300 | 1020 | 85 | 4 | 24
TCST5250 | 4860 | 30 | 8 | 24
TCUT1300X01 | 2000 | Reel | (2) | 29
TCZT8020-PAER | 2500 | Bulk | - | 22

**Notes**

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

---

#### TUBE SPECIFICATION FIGURES

![TUBE SPECIFICATION FIGURE](image)

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

Drawing-No.: 9.700-5097.01-4  
Issue: 1, 25.02.00  
15198

Fig. 1
Packaging and Ordering Information

Vishay Semiconductors  Packaging and Ordering Information

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**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

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**Fig. 3**

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

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

Fig. 8
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