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

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) (mA)</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

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## ABSOLUTE MAXIMUM RATINGS

<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>Total power dissipation</td>
<td>$T_{amb} \leq 95 , ^\circ\text{C}$</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>$T_{amb}$</td>
<td></td>
<td>-40 to +105</td>
<td>°C</td>
</tr>
<tr>
<td>Storage temperature range</td>
<td>$T_{stg}$</td>
<td></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>INPUT (EMITTER)</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>$T_{amb} \leq 95 , ^\circ\text{C}$</td>
<td>$I_F$</td>
<td>25</td>
<td>mA</td>
</tr>
<tr>
<td>Forward surge current</td>
<td>$t_p \leq 10 , \mu\text{s}$</td>
<td>$I_{FSM}$</td>
<td>200</td>
<td>mA</td>
</tr>
<tr>
<td>Power dissipation</td>
<td>$T_{amb} \leq 95 , ^\circ\text{C}$</td>
<td>$P_V$</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>$V_{CEO}$</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>$T_{amb} = 85 , ^\circ\text{C}, V_{CE} = 5 , \text{V}$</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](image1)

![Fig. 2 - Forward Current Limit vs. Ambient Temperature](image2)
### 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>300</td>
<td>600</td>
<td></td>
<td>μA</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; = 0.05 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></td>
<td>25</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;EEO&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>1</td>
<td></td>
<td>100</td>
<td>nA</td>
</tr>
<tr>
<td><strong>SWITCHING CHARACTERISTICS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rise time</td>
<td>I&lt;sub&gt;C&lt;/sub&gt; = 0.3 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>20</td>
<td></td>
<td>150</td>
<td>μs</td>
</tr>
<tr>
<td>Fall time</td>
<td>I&lt;sub&gt;C&lt;/sub&gt; = 0.3 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>30</td>
<td></td>
<td>150</td>
<td>μs</td>
</tr>
</tbody>
</table>

*Fig. 3 - Test Circuit for t<sub>r</sub> and t<sub>f</sub>*

*Fig. 4 - Switching Times*

### 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

REFLOW SOLDER PROFILE

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

FLOOR LIFE

Level 1, acc. JEDEC, J-STD-020. No time limit.

<table>
<thead>
<tr>
<th>RELIABILITY TESTS IN REFERENCE TO AEC-Q101 RELEASE</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEST</td>
</tr>
<tr>
<td>High temperature storage</td>
</tr>
<tr>
<td>Low temperature storage</td>
</tr>
<tr>
<td>Temperature cycling</td>
</tr>
<tr>
<td>H3TRB</td>
</tr>
<tr>
<td>Intermittent operational life</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RELIABILITY TESTS IN REFERENCE TO ENHANCED TEMPERATURE RELEASE ACC. AEC-Q101</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEST</td>
</tr>
<tr>
<td>High temperature storage</td>
</tr>
<tr>
<td>Temperature cycling</td>
</tr>
<tr>
<td>Power temperature cycle</td>
</tr>
</tbody>
</table>
PACKAGE DIMENSIONS in millimeters

Emitter side
Wider contact for
Pin identification

Material Cutouts

Not indicated tolerances ±0.15

In accordance with specifications

Pin connection
Top view

Proposed solderpad design

Marking area

Drawing-No.: 6541-5051.01-4
Issue 6; 14.05.07
19536

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Rev. 2.9, 04-Oct-11

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PACKAGE DIMENSIONS in millimeters
Volume/reel = 2000 pcs

Reel-dimension and tape:

Tape position coming out from reel

Not indicated tolerances ±0.1

Technical drawings according to IEC specifications

Volume/reel = 2000 pcs

Parts mounted

Empty Leader 400mm min.

100mm min. with cover tape

Leader and trailer tape:

Empty Trailer 200mm min.

Direction of pulling out

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

**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**

![Diagram](image)

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

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

Fig. 1
Fig. 2

Drawing-No.: 9.700-5139.01-4
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.: 9.700-5178.01-4
Issue: 1; 25.02.00

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

Fig. 4

Drawing-No.: 9.700-5100.01-4
Issue: 1, 25.02.00

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

Fig. 5

Drawing-No.: 9.700-5140.01-4
Issue: 1, 25.02.00

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

Fig. 6

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

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

Fig. 7

Drawing-No.: 9.700-5245.01-4
Issue: 1, 25.02.00
With stopper pins
Tolerance: ±0.5mm
Length: 450±1mm
All dimensions in mm

Fig. 8
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