Reflective Optical Sensor with Transistor Output

**DESCRIPTION**
The TCRT5000 and TCRT5000L are reflective sensors which include an infrared emitter and phototransistor in a leaded package which blocks visible light. The package includes two mounting clips. TCRT5000L is the long lead version.

**FEATURES**
- Package type: leaded
- Detector type: phototransistor
- Dimensions (L x W x H in mm): 10.2 x 5.8 x 7
- Peak operating distance: 2.5 mm
- Operating range within > 20 % relative collector current: 0.2 mm to 15 mm
- Typical output current under test: I_C = 1 mA
- Daylight blocking filter
- Emitter wavelength: 950 nm
- Lead (Pb)-free soldering released
- Compliant to RoHS directive 2002/95/EC and in accordance to WEEE 2002/96/EC

**APPLICATIONS**
- Position sensor for shaft encoder
- Detection of reflective material such as paper, IBM cards, magnetic tapes etc.
- Limit switch for mechanical motions in VCR
- General purpose - wherever the space is limited

**PRODUCT SUMMARY**

<table>
<thead>
<tr>
<th>PART NUMBER</th>
<th>DISTANCE FOR MAXIMUM CTR_{rel} (1) (mm)</th>
<th>DISTANCE RANGE FOR RELATIVE I_{out} &gt; 20 % (mm)</th>
<th>TYPICAL OUTPUT CURRENT UNDER TEST (2) (mA)</th>
<th>DAYLIGHT BLOCKING FILTER INTEGRATED</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCRT5000</td>
<td>2.5</td>
<td>0.2 to 15</td>
<td>1</td>
<td>Yes</td>
</tr>
<tr>
<td>TCRT5000L</td>
<td>2.5</td>
<td>0.2 to 15</td>
<td>1</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**Notes**
(1) CTR: current transfere ratio, I_{out}/I_{in}
(2) Conditions like in table basic characteristics/sensors

**ORDERING INFORMATION**

<table>
<thead>
<tr>
<th>ORDERING CODE</th>
<th>PACKAGING</th>
<th>VOLUME (1)</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCRT5000</td>
<td>Tube</td>
<td>MOQ: 4500 pcs, 50 pcs/tube</td>
<td>3.5 mm lead length</td>
</tr>
<tr>
<td>TCRT5000L</td>
<td>Tube</td>
<td>MOQ: 2400 pcs, 48 pcs/tube</td>
<td>15 mm lead length</td>
</tr>
</tbody>
</table>

**Note**
(1) MOQ: minimum order quantity

**ABSOLUTE MAXIMUM RATINGS (1)**

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>TEST CONDITION</th>
<th>SYMBOL</th>
<th>VALUE</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>INPUT (EMITTER)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reverse voltage</td>
<td>V_R</td>
<td>5</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Forward current</td>
<td>I_F</td>
<td>60</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>Forward surge current</td>
<td>I_P ≤ 10 µs</td>
<td>I_{FSM}</td>
<td>3</td>
<td>A</td>
</tr>
<tr>
<td>Power dissipation</td>
<td>T_{amb} ≤ 25 °C</td>
<td>P_V</td>
<td>100</td>
<td>mW</td>
</tr>
<tr>
<td>Junction temperature</td>
<td>T_J</td>
<td>100</td>
<td>°C</td>
<td></td>
</tr>
</tbody>
</table>
### Absolute Maximum Ratings (1)

<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>Output (Detector)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collector emitter voltage</td>
<td></td>
<td>V&lt;sub&gt;CEO&lt;/sub&gt;</td>
<td>70</td>
<td>V</td>
</tr>
<tr>
<td>Emitter collector voltage</td>
<td></td>
<td>V&lt;sub&gt;ECEO&lt;/sub&gt;</td>
<td>5</td>
<td>V</td>
</tr>
<tr>
<td>Collector current</td>
<td></td>
<td>I&lt;sub&gt;C&lt;/sub&gt;</td>
<td>100</td>
<td>mA</td>
</tr>
<tr>
<td>Power dissipation</td>
<td>T&lt;sub&gt;amb&lt;/sub&gt; ≤ 55 °C</td>
<td>P&lt;sub&gt;V&lt;/sub&gt;</td>
<td>100</td>
<td>mW</td>
</tr>
<tr>
<td>Junction temperature</td>
<td></td>
<td>T&lt;sub&gt;J&lt;/sub&gt;</td>
<td>100</td>
<td>°C</td>
</tr>
<tr>
<td><strong>Sensor</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total power dissipation</td>
<td>T&lt;sub&gt;amb&lt;/sub&gt; ≤ 25 °C</td>
<td>P&lt;sub&gt;tot&lt;/sub&gt;</td>
<td>200</td>
<td>mW</td>
</tr>
<tr>
<td>Ambient temperature range</td>
<td></td>
<td>T&lt;sub&gt;amb&lt;/sub&gt;</td>
<td>-25 to +85</td>
<td>°C</td>
</tr>
<tr>
<td>Storage temperature range</td>
<td></td>
<td>T&lt;sub&gt;stg&lt;/sub&gt;</td>
<td>-25 to +100</td>
<td>°C</td>
</tr>
<tr>
<td>Soldering temperature</td>
<td></td>
<td>T&lt;sub&gt;sd&lt;/sub&gt;</td>
<td>260</td>
<td>°C</td>
</tr>
</tbody>
</table>

**Note**

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

### Basic Characteristics (1)

<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>Input (Emitter)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forward voltage</td>
<td>IF = 60 mA</td>
<td>V&lt;sub&gt;F&lt;/sub&gt;</td>
<td>1.25</td>
<td>1.5</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Junction capacitance</td>
<td>VR = 0 V, f = 1 MHz</td>
<td>C&lt;sub&gt;j&lt;/sub&gt;</td>
<td>17</td>
<td></td>
<td>pF</td>
<td></td>
</tr>
<tr>
<td>Radiant intensity</td>
<td>IF = 60 mA, tp = 20 ms</td>
<td>I&lt;sub&gt;e&lt;/sub&gt;</td>
<td>21</td>
<td></td>
<td>mW/sr</td>
<td></td>
</tr>
<tr>
<td>Peak wavelength</td>
<td>IF = 100 mA</td>
<td>λ&lt;sub&gt;p&lt;/sub&gt;</td>
<td>940</td>
<td></td>
<td>nm</td>
<td></td>
</tr>
<tr>
<td>Virtual source diameter</td>
<td>Method: 63 % encircled energy</td>
<td>d</td>
<td>2.1</td>
<td></td>
<td>mm</td>
<td></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</td>
<td>IC = 1 mA</td>
<td>V&lt;sub&gt;CEO&lt;/sub&gt;</td>
<td>70</td>
<td></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Emitter collector voltage</td>
<td>IS = 100 µA</td>
<td>V&lt;sub&gt;ECEO&lt;/sub&gt;</td>
<td>7</td>
<td></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Collector dark current</td>
<td>V&lt;sub&gt;CE&lt;/sub&gt; = 20 V, IF = 0 A, E = 0 lx</td>
<td>I&lt;sub&gt;CED&lt;/sub&gt;</td>
<td>10</td>
<td>200</td>
<td>nA</td>
<td></td>
</tr>
<tr>
<td><strong>Sensor</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collector current</td>
<td>V&lt;sub&gt;CE&lt;/sub&gt; = 5 V, IF = 10 mA, D = 12 mm</td>
<td>I&lt;sub&gt;C&lt;/sub&gt; (2) (3)</td>
<td>0.5</td>
<td>1</td>
<td>2.1</td>
<td>mA</td>
</tr>
<tr>
<td>Collector emitter saturation voltage</td>
<td>IF = 10 mA, IC = 0.1 mA, D = 12 mm</td>
<td>V&lt;sub&gt;CESAT&lt;/sub&gt; (2) (3)</td>
<td>0.4</td>
<td></td>
<td></td>
<td>V</td>
</tr>
</tbody>
</table>

**Note**

(1) T<sub>amb</sub> = 25 °C, unless otherwise specified
(2) See figure 3
(3) Test surface: mirror (Mfr. Spindler a. Hoyer, Part No. 340005)
BASIC CHARACTERISTICS

$T_{\text{amb}} = 25 \, ^\circ\text{C}$, unless otherwise specified

Fig. 2 - Test Circuit

Fig. 3 - Test Circuit

Fig. 4 - Forward Current vs. Forward Voltage

Fig. 5 - Relative Current Transfer Ratio vs. Ambient Temperature

Fig. 6 - Collector Current vs. Forward Current

Fig. 7 - Collector Emitter Saturation Voltage vs. Collector Current
TCRT5000, TCRT5000L
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Reflective Optical Sensor with Transistor Output

Fig. 8 - Current Transfer Ratio vs. Forward Current

Fig. 9 - Relative Collector Current vs. Distance

PACKAGE DIMENSIONS in millimeters, TCRT5000
TCRT5000, TCRT5000L

Reflective Optical Sensor with Transistor Output

Vishay Semiconductors

PACKAGE DIMENSIONS in millimeters, TCRT5000L

Reference plane "A"

* Tolerances related to reference plane "A"

** Tolerances related on lead end

Footprint Top View

*: Tolerances related on lead end

Drawing-No. 6.550-5144.01-4
Issue: 4, 11.04.02

01 11037

weight: ca. 0.23g
TCRT5000, TCRT5000L
Vishay Semiconductors
Reflective Optical Sensor with Transistor Output

**TUBE DIMENSIONS** in millimeters, **TCRT5000**

```
\begin{figure}
\centering
\includegraphics[width=0.8\textwidth]{tube_dimensions_tcrt5000.png}
\caption{TUBE DIMENSIONS in millimeters, TCRT5000}
\end{figure}
```

**TUBE DIMENSIONS** in millimeters, **TCRT5000L**

```
\begin{figure}
\centering
\includegraphics[width=0.8\textwidth]{tube_dimensions_tcrt5000L.png}
\caption{TUBE DIMENSIONS in millimeters, TCRT5000L}
\end{figure}
```
# Packaging and Ordering Information

## Parts List

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

**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

**Fig. 1**
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

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Fig. 4

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

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

Fig. 5

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

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

15199

15202
With stopper pins
Tolerance ±0.5mm
Length 575±1mm

Drawing-No.: 9700-5205.01-4
Issue 1, 25.02.00

Fig. 6

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

Drawing-No.: 9700-5245.01-4
Issue 1, 25.02.00

Fig. 7
Fig. 8

Drawing-No.: 9700-5222.01-4
Issue: 2; 19.11.04
20257

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