Transmissive Optical Sensor with Phototransistor Output

DESCRIPTION

The TCST1103, TCST1202, and TCST1300 are transmissive sensors that include an infrared emitter and phototransistor, located face-to-face on the optical axes in a leaded package which blocks visible light. These part numbers include options for aperture width.

FEATURES

- Package type: leaded
- Detector type: phototransistor
- Dimensions (L x W x H in mm): 11.9 x 6.3 x 10.8
- Gap (in mm): 3.1
- Typical output current under test: $I_C = 4$ mA (TCST1103)
- Typical output current under test: $I_C = 2$ mA (TCST1202)
- Typical output current under test: $I_C = 0.5$ mA (TCST1300)
- 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

- Optical switch
- Photo interrupter
- Counter
- Encoder

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 (mA)</th>
<th>DAYLIGHT BLOCKING FILTER INTEGRATED</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCST1103</td>
<td>3.1</td>
<td>1</td>
<td>4</td>
<td>Yes</td>
</tr>
<tr>
<td>TCST1202</td>
<td>3.1</td>
<td>0.5</td>
<td>2</td>
<td>Yes</td>
</tr>
<tr>
<td>TCST1300</td>
<td>3.1</td>
<td>0.25</td>
<td>0.5</td>
<td>Yes</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>TCST1103</td>
<td>Tube</td>
<td>MOQ: 1020 pcs, 85 pcs/tube</td>
<td>Without mounting flange</td>
</tr>
<tr>
<td>TCST1202</td>
<td>Tube</td>
<td>MOQ: 1020 pcs, 85 pcs/tube</td>
<td>Without mounting flange</td>
</tr>
<tr>
<td>TCST1300</td>
<td>Tube</td>
<td>MOQ: 1020 pcs, 85 pcs/tube</td>
<td>Without mounting flange</td>
</tr>
</tbody>
</table>

Note

- MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS ($T_{amb} = 25$ °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>Total power dissipation</td>
<td>$T_{amb} \leq 25$ °C</td>
<td>$P_{tot}$</td>
<td>250</td>
<td>mW</td>
</tr>
<tr>
<td>Ambient temperature range</td>
<td></td>
<td>$T_{amb}$</td>
<td>-55 to +85</td>
<td>°C</td>
</tr>
<tr>
<td>Storage temperature range</td>
<td></td>
<td>$T_{stg}$</td>
<td>-55 to +100</td>
<td>°C</td>
</tr>
<tr>
<td>Soldering temperature</td>
<td>Distance to package: 2 mm; t \leq 5 s</td>
<td>$T_{sd}$</td>
<td>260</td>
<td>°C</td>
</tr>
</tbody>
</table>
# Absolute Maximum Ratings

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

## Input (Emitter)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Condition</th>
<th>Symbol</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reverse voltage</td>
<td>( V_R )</td>
<td>6</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_{FSM} )</td>
<td>3</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>Power dissipation</td>
<td>( P_V )</td>
<td>100</td>
<td>mW</td>
<td></td>
</tr>
<tr>
<td>Junction temperature</td>
<td>( T_j )</td>
<td>100</td>
<td>°C</td>
<td></td>
</tr>
</tbody>
</table>

## Output (Detector)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Condition</th>
<th>Symbol</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector emitter voltage</td>
<td>( V_{CEO} )</td>
<td>70</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Emitter collector voltage</td>
<td>( V_{ECO} )</td>
<td>7</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Collector peak current</td>
<td>( I_{CM} )</td>
<td>200</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>Power dissipation</td>
<td>( P_V )</td>
<td>150</td>
<td>mW</td>
<td></td>
</tr>
<tr>
<td>Junction temperature</td>
<td>( T_j )</td>
<td>100</td>
<td>°C</td>
<td></td>
</tr>
</tbody>
</table>

## Basic Characteristics

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

### Coupler

<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>Current transfer ratio</td>
<td>( V_{CE} = 5 , V, , I_F = 20 , mA )</td>
<td>TCST1103</td>
<td>CTR</td>
<td>10</td>
<td>20</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td>( V_{CE} = 5 , V, , I_F = 20 , mA )</td>
<td>TCST1202</td>
<td>CTR</td>
<td>5</td>
<td>10</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td>( V_{CE} = 5 , V, , I_F = 20 , mA )</td>
<td>TCST1300</td>
<td>CTR</td>
<td>1.25</td>
<td>2.5</td>
<td>%</td>
</tr>
<tr>
<td>Collector current</td>
<td>( V_{CE} = 5 , V, , I_F = 20 , mA )</td>
<td>TCST1103</td>
<td>( I_C )</td>
<td>2</td>
<td>4</td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td>( V_{CE} = 5 , V, , I_F = 20 , mA )</td>
<td>TCST1202</td>
<td>( I_C )</td>
<td>1</td>
<td>2</td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td>( V_{CE} = 5 , V, , I_F = 20 , mA )</td>
<td>TCST1300</td>
<td>( I_C )</td>
<td>0.25</td>
<td>0.5</td>
<td>mA</td>
</tr>
<tr>
<td>Collector emitter saturation voltage</td>
<td>( I_F = 20 , mA, , I_C = 1 , mA )</td>
<td>TCST1103</td>
<td>( V_{CEsat} )</td>
<td>0.4</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>( I_F = 20 , mA, , I_C = 0.5 , mA )</td>
<td>TCST1202</td>
<td>( V_{CEsat} )</td>
<td>0.4</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>( I_F = 20 , mA, , I_C = 0.1 , mA )</td>
<td>TCST1300</td>
<td>( V_{CEsat} )</td>
<td>0.4</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>Resolution, path of the shutter crossing the radiant sensitive zone</td>
<td>( I_{Crel} = 10 , % , to , 90 , % )</td>
<td>TCST1103</td>
<td>( s )</td>
<td>0.6</td>
<td>-</td>
<td>mm</td>
</tr>
<tr>
<td></td>
<td>( I_{Crel} = 10 , % , to , 90 , % )</td>
<td>TCST1202</td>
<td>( s )</td>
<td>0.4</td>
<td>-</td>
<td>mm</td>
</tr>
<tr>
<td></td>
<td>( I_{Crel} = 10 , % , to , 90 , % )</td>
<td>TCST1300</td>
<td>( s )</td>
<td>0.2</td>
<td>-</td>
<td>mm</td>
</tr>
</tbody>
</table>
BASIC CHARACTERISTICS (T_{\text{amb}} = 25 ^\circ \text{C}, unless otherwise specified)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>TEST CONDITION</th>
<th>PART</th>
<th>SYMBOL</th>
<th>MIN.</th>
<th>TYP.</th>
<th>MAX.</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>INPUT (EMITTER)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forward voltage</td>
<td>(I_F = 60 \text{ mA})</td>
<td></td>
<td>(V_F)</td>
<td>1.25</td>
<td>1.6</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Junction capacitance</td>
<td>(V_R = 0 \text{ V}, f = 1 \text{ MHz})</td>
<td></td>
<td>(C_j)</td>
<td>50</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>
<td></td>
</tr>
<tr>
<td>Collector emitter voltage</td>
<td>(I_C = 1 \text{ mA})</td>
<td></td>
<td>(V_{CEO})</td>
<td>70</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Emitter collector voltage</td>
<td>(I_E = 10 \mu\text{A})</td>
<td></td>
<td>(V_{ECEO})</td>
<td>7</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Collector dark current</td>
<td>(V_{CE} = 25 \text{ V}, I_F = 0 \text{ A, E = 0 lx})</td>
<td></td>
<td>(I_{CEO})</td>
<td>100 nA</td>
<td></td>
<td></td>
<td>nA</td>
</tr>
</tbody>
</table>

SWITCHING CHARACTERISTICS

<table>
<thead>
<tr>
<th></th>
<th>(I_C = 2 \text{ mA, V_S = 5 V, R_L = 100 \Omega}) (see figure 2)</th>
<th>(t_{on})</th>
<th>10</th>
<th>(\mu\text{s})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turn-on time</td>
<td>(I_C = 2 \text{ mA, V_S = 5 V, R_L = 100 \Omega}) (see figure 2)</td>
<td>(t_{off})</td>
<td>8</td>
<td>(\mu\text{s})</td>
</tr>
</tbody>
</table>

Fig. 2 - Test Circuit for \(t_{on}\) and \(t_{off}\)

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

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>TEST CONDITION</th>
<th>PART</th>
<th>SYMBOL</th>
<th>MIN.</th>
<th>TYP.</th>
<th>MAX.</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector dark current</td>
<td>(V_{CE} = 5 \text{ V}, I_F = 20 \text{ mA})</td>
<td></td>
<td>(C_T)</td>
<td>0.1</td>
<td>0.5</td>
<td>2.0</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 3 - Switching Times

Fig. 4 - Forward Current vs. Forward Voltage

Fig. 5 - Relative Current Transfer Ratio vs. Ambient Temperature
**Fig. 6 - Collector Dark Current vs. Ambient Temperature**

- **$I_{CEO}$ - Collector Dark Current (nA)**
- **$T_{amb}$ - Ambient Temperature (°C)**
- **$V_{CE} = 25$ V, $I_F = 0$ A**

**Fig. 7 - Collector Current vs. Forward Current**

- **$I_C - Collector Current (mA)$**
- **$I_F - Forward Current (mA)$**
- **$V_{CE} = 5$ V**

**Fig. 8 - Collector Current vs. Collector Emitter Voltage**

- **$I_C - Collector Current (mA)$**
- **$V_{CE} - Collector Emitter Voltage (V)$**
- **$I_F = 50$ mA, 20 mA, 10 mA, 5 mA, 2 mA, 1 mA**

**Fig. 9 - Current Transfer Ratio vs. Forward Current**

- **$CTR - Current Transfer Ratio (%)$**
- **$I_C - Collector Current (mA)$**
- **$V_{CE} = 5$ V**

**Fig. 10 - Turn-off/Turn-on Time vs. Collector Current**

- **$t_{on}, t_{off} - Turn on/Turn off Time (µs)$**
- **Non saturated operation**
- **$V_S = 5$ V, $R_L = 100$ Ω**

**Fig. 11 - Relative Collector Current vs. Displacement**

- **$I_{rel} - Relative Collector Current$**
- **$A = 1$ mm**
- **$s - Displacement (mm)$**

For technical questions, contact: sensorstechsupport@vishay.com

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**PACKAGE DIMENSIONS** in millimeters

![Package Dimensions Diagram]

**Fig. 12 - Relative Collector Current vs. Displacement**

**Fig. 13 - Relative Collector Current vs. Displacement**

**Drawing-No.:** 6.550-5039.01-4

**Issue:** 2; 10.11.98

**weight:** ca. 0.80g
**TUBE DIMENSIONS** in millimeters

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

Drawing-No.: 9.700-5100.01-4
Issue: 1; 25.02.00
## Packaging and Ordering Information

### 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**

### 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
TCST8020-PAER | 2500 | Bulk | - | 22

### Notes

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

Fig. 3

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

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

Fig. 6
With stopper pins
Tolerance: ±0.5mm
Length: 575±1mm

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

Fig. 7
With rubber stopper
Tolerance: ±0.5mm
Length: 575±1mm

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