

## Optocoupler, Phototransistor Output, SOP-4L, Long Mini-Flat Package



17295-5



### DESCRIPTION

The TCLT100. series consists of a phototransistor optically coupled to a gallium arsenide infrared-emitting diode in a 4-lead SOP4L package.

### APPLICATIONS

- Switchmode power supplies
- Computer peripheral interface
- Microprocessor system interface

### FEATURES

- SMD low profile 4 lead package
- $V_{IORM} = 1050\text{ V}$
- CTR flexibility available see order information
- Special construction
- Extra low coupling capacitance
- DC input with transistor output
- Creepage distance > 8 mm
- Material categorization:  
for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



### AGENCY APPROVALS

- UL1577, file no. E76222
- CSA (cUL) 22.2 bulletin 5A recognized file no. E-76222
- BSI: BS EN 41003, BS EN 60065 (BS 415), BS EN 60950 (BS 7002), certificate number 7081 and 7402
- DIN EN 60747-5-5 (VDE 0884)
- FIMKO: EN 60950
- CQC

### Note

- See the safety standard approval list "Agency Table" for more detailed information.

| ORDERING INFORMATION  |           |           |            |            |           |            |           |            |            |
|---|-----------|-----------|------------|------------|-----------|------------|-----------|------------|------------|
| <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="border: 1px solid black; padding: 2px 5px;">T</div> <div style="border: 1px solid black; padding: 2px 5px;">C</div> <div style="border: 1px solid black; padding: 2px 5px;">L</div> <div style="border: 1px solid black; padding: 2px 5px;">T</div> <div style="border: 1px solid black; padding: 2px 5px;">1</div> <div style="border: 1px solid black; padding: 2px 5px;">0</div> <div style="border: 1px solid black; padding: 2px 5px;">0</div> <div style="border: 1px solid black; padding: 2px 5px;">#</div> </div> <p style="text-align: center; margin-top: 5px;">PART NUMBER</p> |           |           |            |            |           |            |           |            |            |
| AGENCY CERTIFIED/PACKAGE  | CTR (%)   |           |            |            |           |            |           |            |            |
|   | 5 mA      |           |            | 10 mA      |           |            | 5 mA      |            |            |
| UL, cUL, VDE, BSI, FIMKO  | 50 to 600 | 63 to 125 | 100 to 200 | 160 to 320 | 50 to 150 | 100 to 300 | 80 to 160 | 130 to 260 | 200 to 400 |
| SOP-4L  | TCLT1000  | TCLT1002  | TCLT1003   | TCLT1004   | TCLT1005  | TCLT1006   | TCLT1007  | TCLT1008   | TCLT1009   |

### Note

- Available only on tape and reel.



| ABSOLUTE MAXIMUM RATINGS ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified) |                                      |            |             |                    |
|---|--------------------------------------|------------|-------------|--------------------|
| PARAMETER   | CONDITION                            | SYMBOL     | VALUE       | UNIT               |
| <b>INPUT</b>  |                                      |            |             |                    |
| Reverse voltage   |                                      | $V_R$      | 6           | V                  |
| Forward current   |                                      | $I_F$      | 60          | mA                 |
| Forward surge current   | $t_p \leq 10\text{ }\mu\text{s}$     | $I_{FSM}$  | 1.5         | A                  |
| Power dissipation   |                                      | $P_{diss}$ | 100         | mW                 |
| Junction temperature  |                                      | $T_j$      | 125         | $^{\circ}\text{C}$ |
| <b>OUTPUT</b>   |                                      |            |             |                    |
| Collector emitter voltage   |                                      | $V_{CEO}$  | 70          | V                  |
| Emitter collector voltage   |                                      | $V_{ECO}$  | 7           | V                  |
| Collector current   |                                      | $I_C$      | 50          | mA                 |
| Collector peak current  | $t_p/T = 0.5, t_p \leq 10\text{ ms}$ | $I_{CM}$   | 100         | mA                 |
| Power dissipation   |                                      | $P_{diss}$ | 150         | mW                 |
| Junction temperature  |                                      | $T_j$      | 125         | $^{\circ}\text{C}$ |
| <b>COUPLER</b>  |                                      |            |             |                    |
| Total power dissipation   |                                      | $P_{tot}$  | 250         | mW                 |
| Operating ambient temperature range   |                                      | $T_{amb}$  | -55 to +100 | $^{\circ}\text{C}$ |
| Storage temperature range   |                                      | $T_{stg}$  | -55 to +125 | $^{\circ}\text{C}$ |
| Soldering temperature   |                                      | $T_{slid}$ | 260         | $^{\circ}\text{C}$ |

**Note**

- Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operational sections of this document. Exposure to absolute maximum ratings for extended periods of the time can adversely affect reliability.

| ELECTRICAL CHARACTERISTICS ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified) |  |             |      |      |      |      |
|---|--|-------------|------|------|------|------|
| PARAMETER   | TEST CONDITION   | SYMBOL      | MIN. | TYP. | MAX. | UNIT |
| <b>INPUT</b>  |  |             |      |      |      |      |
| Forward voltage   | $I_F = 50\text{ mA}$   | $V_F$       | -    | 1.25 | 1.6  | V    |
| Junction capacitance  | $V_R = 0\text{ V}, f = 1\text{ MHz}$                               | $C_j$       | -    | 50   | -    | pF   |
| <b>OUTPUT</b>   |  |             |      |      |      |      |
| Collector emitter voltage   | $I_C = 1\text{ mA}$  | $V_{CEO}$   | 70   | -    | -    | V    |
| Emitter collector voltage   | $I_E = 100\text{ }\mu\text{A}$                                     | $V_{ECO}$   | 7    | -    | -    | V    |
| Collector emitter cut-off current   | $V_{CE} = 20\text{ V}, I_F = 0\text{ A}$                           | $I_{CEO}$   | -    | 10   | 100  | nA   |
| <b>COUPLER</b>  |  |             |      |      |      |      |
| Collector emitter saturation voltage  | $I_F = 10\text{ mA}, I_C = 1\text{ mA}$                            | $V_{CEsat}$ | -    | -    | 0.3  | V    |
| Cut-off frequency   | $V_{CE} = 5\text{ V}, I_F = 10\text{ mA}, R_L = 100\text{ }\Omega$ | $f_c$       | -    | 110  | -    | kHz  |
| Coupling capacitance  | $f = 1\text{ MHz}$   | $C_k$       | -    | 0.3  | -    | pF   |

**Note**

- Minimum and maximum values are testing requirements. Typical values are characteristics of the device and are the result of engineering evaluation. Typical values are for information only and are not part of the testing requirements.

| CURRENT TRANSFER RATIO ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified) |   |          |        |      |      |      |      |
|---|---|----------|--------|------|------|------|------|
| PARAMETER   | TEST CONDITION                            | PART     | SYMBOL | MIN. | TYP. | MAX. | UNIT |
| $I_C/I_F$   | $V_{CE} = 5\text{ V}, I_F = 5\text{ mA}$  | TCLT1000 | CTR    | 50   | -    | 600  | %    |
|   |   | TCLT1002 | CTR    | 63   | -    | 125  | %    |
|   | $V_{CE} = 5\text{ V}, I_F = 10\text{ mA}$ | TCLT1003 | CTR    | 100  | -    | 200  | %    |
|   |   | TCLT1004 | CTR    | 160  | -    | 320  | %    |
|   | $V_{CE} = 5\text{ V}, I_F = 1\text{ mA}$  | TCLT1002 | CTR    | 22   | 45   | -    | %    |
|   |   | TCLT1003 | CTR    | 34   | 70   | -    | %    |
|   |   | TCLT1004 | CTR    | 56   | 100  | -    | %    |
|   | $V_{CE} = 5\text{ V}, I_F = 5\text{ mA}$  | TCLT1005 | CTR    | 50   | -    | 150  | %    |
|   |   | TCLT1006 | CTR    | 100  | -    | 300  | %    |
|   |   | TCLT1007 | CTR    | 80   | -    | 160  | %    |
|   |   | TCLT1008 | CTR    | 130  | -    | 260  | %    |
| TCLT1009  |   | CTR      | 200    | -    | 400  | %    |      |

| SAFETY AND INSULATION RATINGS                           |  |            |           |                    |
|---|--|------------|-----------|--------------------|
| PARAMETER   | CONDITION  | SYMBOL     | VALUE     | UNIT               |
| Partial discharge test voltage - routine test           | 100 %, $t_{test} = 1\text{ s}$   | $V_{pd}$   | 2         | kV                 |
| Partial discharge test voltage - lot test (sample test) | $t_{Tr} = 60\text{ s}, t_{test} = 10\text{ s}$ ,<br>(see figure 2)                         | $V_{IOTM}$ | 8         | kV <sub>peak</sub> |
|   |  | $V_{pd}$   | 1.68      | kV <sub>peak</sub> |
| Isolation test voltage (RMS)                            |  | $V_{ISO}$  | 5000      | V <sub>RMS</sub>   |
| Insulation resistance                                   | $V_{IO} = 500\text{ V}$  | $R_{IO}$   | $10^{12}$ | $\Omega$           |
|   | $V_{IO} = 500\text{ V}, T_{amb} = 100\text{ }^{\circ}\text{C}$                             | $R_{IO}$   | $10^{11}$ | $\Omega$           |
|   | $V_{IO} = 500\text{ V}, T_{amb} = 150\text{ }^{\circ}\text{C}$<br>(construction test only) | $R_{IO}$   | $10^9$    | $\Omega$           |
| Forward current   |  | $I_{si}$   | 130       | mA                 |
| Power dissipation                                       |  | $P_{so}$   | 265       | mW                 |
| Rated impulse voltage                                   |  | $V_{IOTM}$ | 8         | kV                 |
| Safety temperature                                      |  | $T_{si}$   | 150       | $^{\circ}\text{C}$ |
| Comparative tracking index                              |  | CTI        | 175       |                    |
| Clearance distance                                      |  |            | 8.0       | mm                 |
| Creepage distance                                       |  |            | 8.0       | mm                 |
| Insulation distance (internal)                          |  |            | 0.40      | mm                 |

**Note**

- According to DIN EN 60747-5-2 (VDE 0884) (see figure 2). This optocoupler is suitable for safe electrical isolation only within the safety ratings. Compliance with the safety ratings shall be ensured by means of suitable protective circuits.

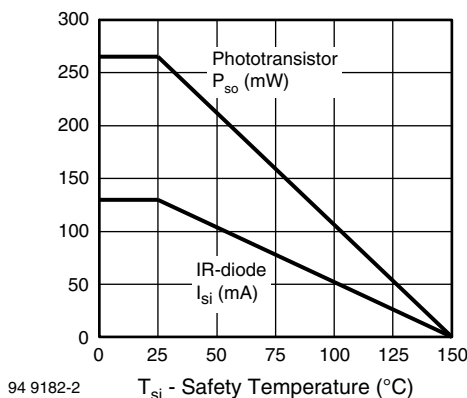


Fig. 1 - Derating Diagram



Fig. 2 - Test Pulse Diagram for Sample Test according to DIN EN 60747-5-2 (VDE 0884); IEC60747-5-5

| SWITCHING CHARACTERISTICS ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified) |   |           |      |      |      |               |
|--|---|-----------|------|------|------|---------------|
| PARAMETER  | TEST CONDITION  | SYMBOL    | MIN. | TYP. | MAX. | UNIT          |
| Delay time   | $V_S = 5\text{ V}$ , $I_C = 2\text{ mA}$ , $R_L = 100\text{ }\Omega$ , (see figure 3) | $t_d$     | -    | 3    | -    | $\mu\text{s}$ |
| Rise time  | $V_S = 5\text{ V}$ , $I_C = 2\text{ mA}$ , $R_L = 100\text{ }\Omega$ , (see figure 3) | $t_r$     | -    | 3    | -    | $\mu\text{s}$ |
| Fall time  | $V_S = 5\text{ V}$ , $I_C = 2\text{ mA}$ , $R_L = 100\text{ }\Omega$ , (see figure 3) | $t_f$     | -    | 4.7  | -    | $\mu\text{s}$ |
| Storage time   | $V_S = 5\text{ V}$ , $I_C = 2\text{ mA}$ , $R_L = 100\text{ }\Omega$ , (see figure 3) | $t_s$     | -    | 0.3  | -    | $\mu\text{s}$ |
| Turn-on time   | $V_S = 5\text{ V}$ , $I_C = 2\text{ mA}$ , $R_L = 100\text{ }\Omega$ , (see figure 3) | $t_{on}$  | -    | 6    | -    | $\mu\text{s}$ |
| Turn-off time  | $V_S = 5\text{ V}$ , $I_C = 2\text{ mA}$ , $R_L = 100\text{ }\Omega$ , (see figure 3) | $t_{off}$ | -    | 5    | -    | $\mu\text{s}$ |
| Turn-on time   | $V_S = 5\text{ V}$ , $I_F = 10\text{ mA}$ , $R_L = 1\text{ k}\Omega$ , (see figure 4) | $t_{on}$  | -    | 9    | -    | $\mu\text{s}$ |
| Turn-off time  | $V_S = 5\text{ V}$ , $I_F = 10\text{ mA}$ , $R_L = 1\text{ k}\Omega$ , (see figure 4) | $t_{off}$ | -    | 10   | -    | $\mu\text{s}$ |



Fig. 3 - Test Circuit, Non-Saturated Operation

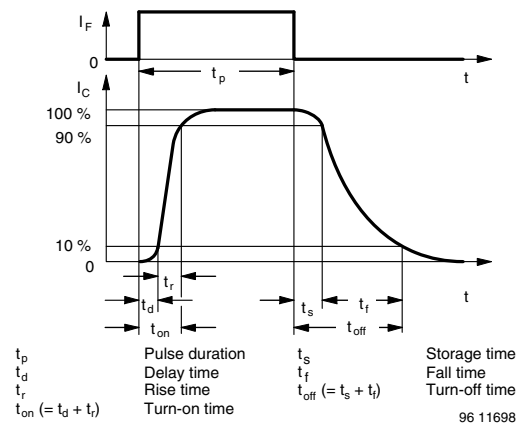


Fig. 5 - Switching Times



Fig. 4 - Test Circuit, Saturated Operation

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

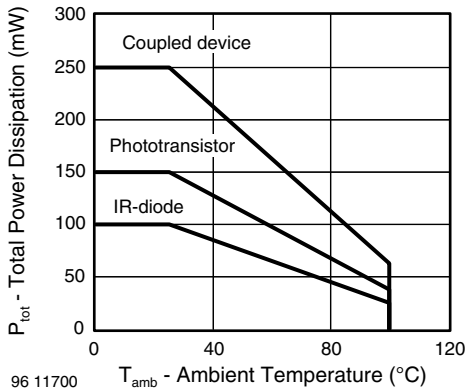


Fig. 6 - Total Power Dissipation vs. Ambient Temperature

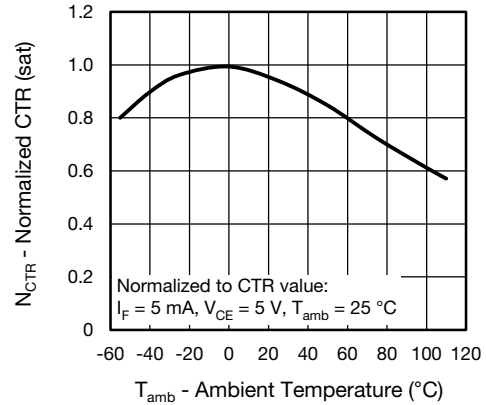


Fig. 9 - Normalized Current Transfer Ratio (saturated) vs. Ambient Temperature

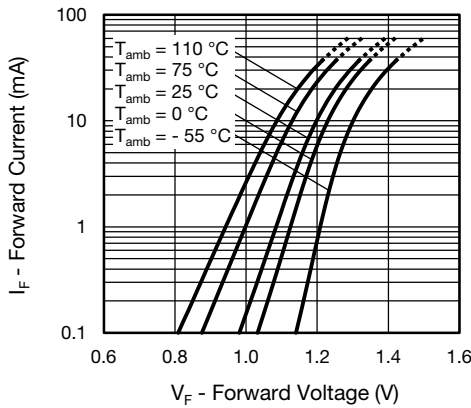


Fig. 7 - Forward Current vs. Forward Voltage

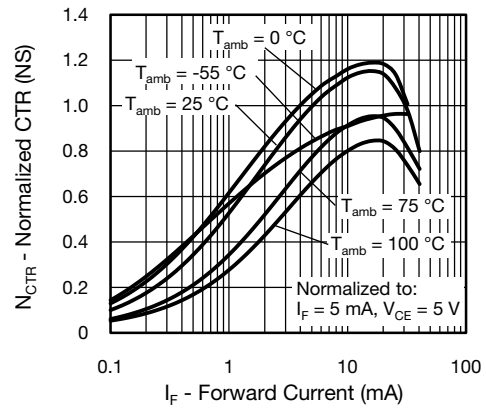


Fig. 10 - Normalized Current Transfer Ratio (non-saturated) vs. Forward Current

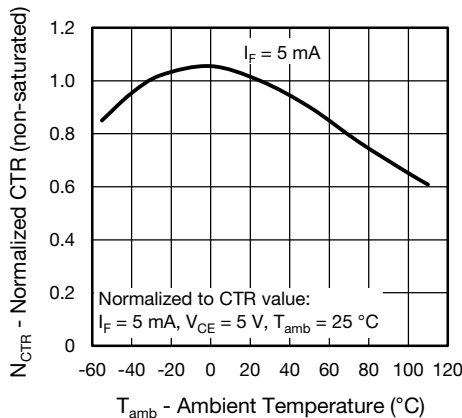


Fig. 8 - Normalized Current Transfer Ratio (non-saturated) vs. Ambient Temperature

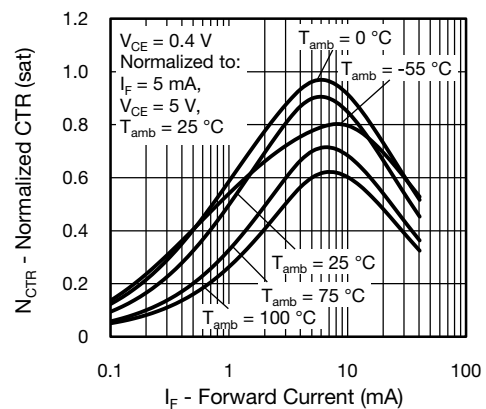


Fig. 11 - Normalized Current Transfer Ratio (saturated) vs. Forward Current



Fig. 12 - Collector Dark Current vs. Ambient Temperature



Fig. 15 - Collector Emitter Saturation Voltage vs. Collector Current



Fig. 13 - Collector Current vs. Forward Current



Fig. 16 - Current Transfer Ratio vs. Forward Current



Fig. 14 - Collector Current vs. Collector Emitter Voltage

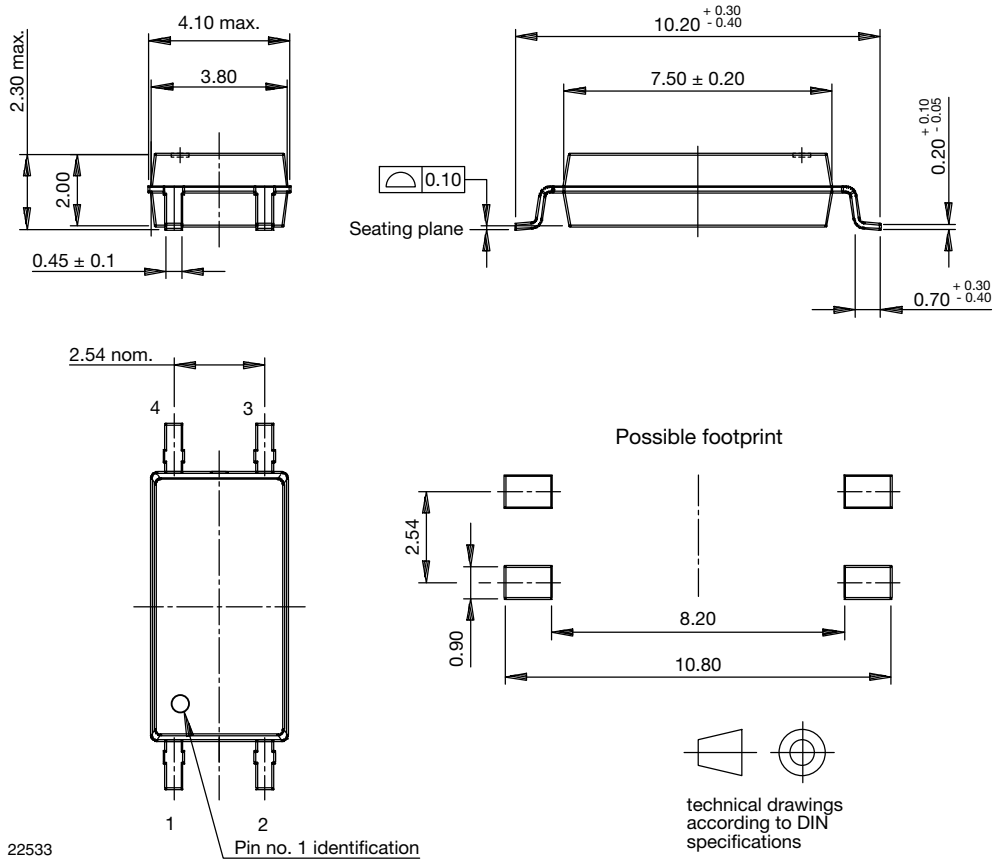


Fig. 17 - Turn-on/off Time vs. Collector Current

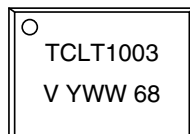


Fig. 18 - Turn-on/off Time vs. Forward Current

**PACKAGE DIMENSIONS** (in millimeters)



**PACKAGE MARKING** (example)



**TAPE AND REEL DIMENSIONS** (in millimeters)

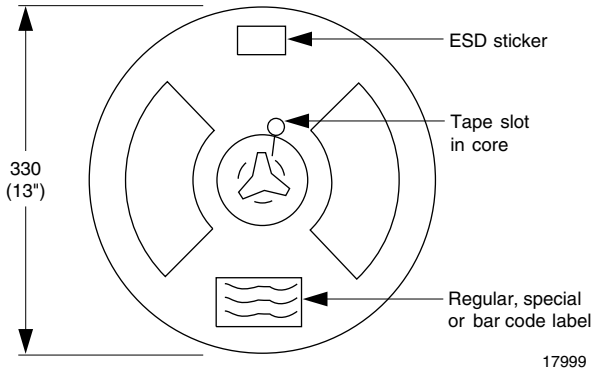


Fig. 19 - Reel Dimensions (3000 units per reel)

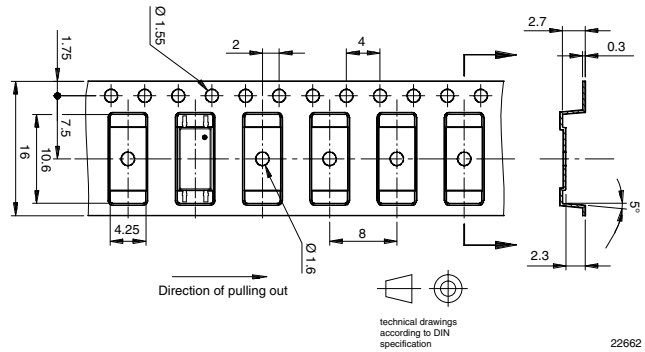


Fig. 20 - Tape Dimensions

**SOLDER PROFILE**



Fig. 21 - Lead (Pb)-free Reflow Solder Profile according to J-STD-020

**HANDLING AND STORAGE CONDITIONS**

ESD level: HBM class 2

Floor life: unlimited

Conditions:  $T_{amb} < 30\text{ °C}$ , RH < 85 %

Moisture sensitivity level 1, according to J-STD-020





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