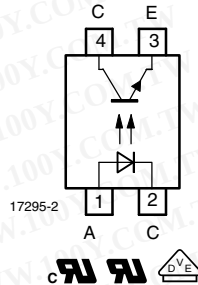
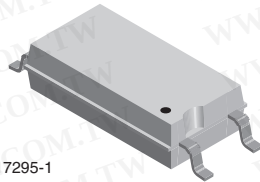


## Optocoupler, Phototransistor Output, SOP-4L, Long Mini-Flat Package



### 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  $> 8\text{ mm}$
- Compliant to RoHS Directive 2002/95/EC and in accordance to WEEE 2002/96/EC



**RoHS**  
COMPLIANT

### DESCRIPTION

The TCLT10.. series consists of a phototransistor optically coupled to a gallium arsenide infrared-emitting diode in a 4 lead SOP4L package.

The elements are mounted on one leadframe providing a fixed distance between input and output for highest safety requirements.

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### APPLICATIONS

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

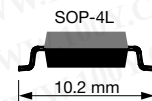
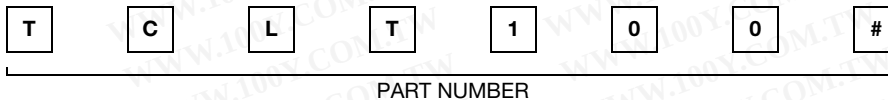
### AGENCY APPROVALS

- UL1577, file no. E76222 system code W, double protection
- CSA (C-UL) 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 60747-5-2 (VDE 0884)
- FIMKO (SETI): EN 60950

### Note

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

### ORDERING INFORMATION



| 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.

| <b>ABSOLUTE MAXIMUM RATINGS</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified) |                                      |            |               |                    |
|--------------------------------------------------------------------------------------------------------|--------------------------------------|------------|---------------|--------------------|
| PARAMETER                                                                                              | TEST 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>                                                                                         |                                      |            |               |                    |
| Isolation test voltage (RMS)                                                                           |                                      | $V_{ISO}$  | 5000          | $V_{RMS}$          |
| Total power dissipation                                                                                |                                      | $P_{tot}$  | 250           | mW                 |
| Operating ambient temperature range                                                                    |                                      | $T_{amb}$  | - 40 to + 100 | $^{\circ}\text{C}$ |
| Storage temperature range                                                                              |                                      | $T_{stg}$  | - 40 to + 100 | $^{\circ}\text{C}$ |
| Soldering temperature                                                                                  |                                      | $T_{sld}$  | 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.

| <b>ELECTRICAL CHARACTERISTICS</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , 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                                                                        | $V_{CE} = 20\text{ V}, I_F = 0, E = 0$                             | $I_{CEO}$   |      | 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 |                                           |          |        |      |      |      |      |
|------------------------|-------------------------------------------|----------|--------|------|------|------|------|
| 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  | %    |

| MAXIMUM SAFETY RATINGS |                |            |      |      |      |      |
|------------------------|----------------|------------|------|------|------|------|
| PARAMETER              | TEST CONDITION | SYMBOL     | MIN. | TYP. | MAX. | UNIT |
| INPUT                  |                |            |      |      |      |      |
| Forward current        |                | $I_F$      |      |      | 130  | mA   |
| OUTPUT                 |                |            |      |      |      |      |
| Power dissipation      |                | $P_{diss}$ |      |      | 265  | mW   |
| COUPLER                |                |            |      |      |      |      |
| Rated impulse voltage  |                | $V_{IOTM}$ |      |      | 8    | kV   |
| Safety temperature     |                | $T_{si}$   |      |      | 150  | °C   |

**Note**

- According to DIN EN 60747-5-2 (see figure 1). 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.

| INSULATION RATED PARAMETERS                             |                                                                              |            |           |      |      |          |
|---------------------------------------------------------|------------------------------------------------------------------------------|------------|-----------|------|------|----------|
| PARAMETER                                               | TEST CONDITION                                                               | SYMBOL     | MIN.      | TYP. | MAX. | 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       |
|                                                         |                                                                              | $V_{pd}$   | 1.68      |      |      | kV       |
| Insulation resistance                                   | $V_{IO} = 500\text{ V}$                                                      | $R_{IO}$   | $10^{12}$ |      |      | $\Omega$ |
|                                                         | $V_{IO} = 500\text{ V}, T_{amb} = 100\text{ °C}$                             | $R_{IO}$   | $10^{11}$ |      |      | $\Omega$ |
|                                                         | $V_{IO} = 500\text{ V}, T_{amb} = 150\text{ °C}$<br>(construction test only) | $R_{IO}$   | $10^9$    |      |      | $\Omega$ |

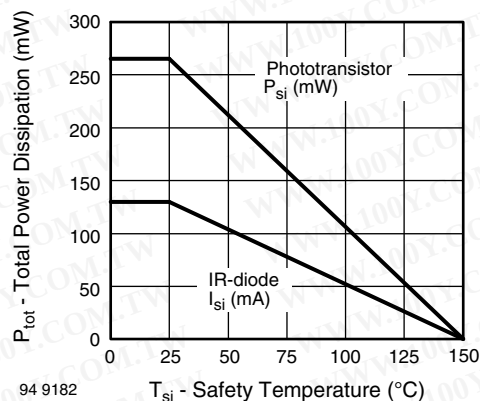


Fig. 1 - Derating Diagram

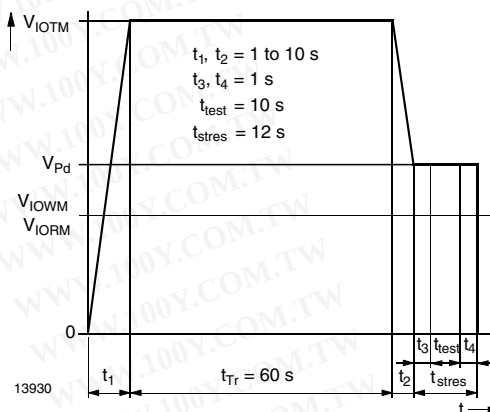


Fig. 2 - Test Pulse Diagram for Sample Test according to DIN EN 60747-5-2 (VDE 0884); IEC60747-5-5

| SWITCHING CHARACTERISTICS |                                                                                       |           |      |      |      |               |
|---------------------------|---------------------------------------------------------------------------------------|-----------|------|------|------|---------------|
| PARAMETER                 | TEST CONDITION                                                                        | SYMBOL    | MIN. | TYP. | MAX. | UNIT          |
| Delay time                | $V_S = 5\text{ V}$ , $I_C = 2\text{ mA}$ , $R_L = 100\ \Omega$ , (see figure 3)       | $t_d$     |      | 3    |      | $\mu\text{s}$ |
| Rise time                 | $V_S = 5\text{ V}$ , $I_C = 2\text{ mA}$ , $R_L = 100\ \Omega$ , (see figure 3)       | $t_r$     |      | 3    |      | $\mu\text{s}$ |
| Fall time                 | $V_S = 5\text{ V}$ , $I_C = 2\text{ mA}$ , $R_L = 100\ \Omega$ , (see figure 3)       | $t_f$     |      | 4.7  |      | $\mu\text{s}$ |
| Storage time              | $V_S = 5\text{ V}$ , $I_C = 2\text{ mA}$ , $R_L = 100\ \Omega$ , (see figure 3)       | $t_s$     |      | 0.3  |      | $\mu\text{s}$ |
| Turn-on time              | $V_S = 5\text{ V}$ , $I_C = 2\text{ mA}$ , $R_L = 100\ \Omega$ , (see figure 3)       | $t_{on}$  |      | 6    |      | $\mu\text{s}$ |
| Turn-off time             | $V_S = 5\text{ V}$ , $I_C = 2\text{ mA}$ , $R_L = 100\ \Omega$ , (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   |      | $\mu\text{s}$ |

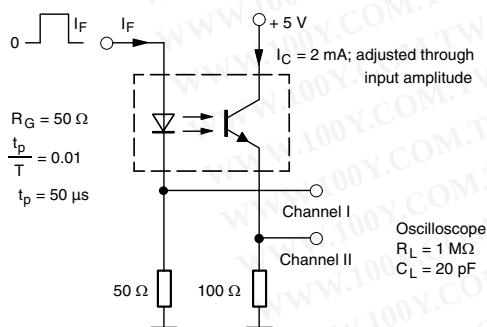


Fig. 3 - Test Circuit, Non-Saturated Operation

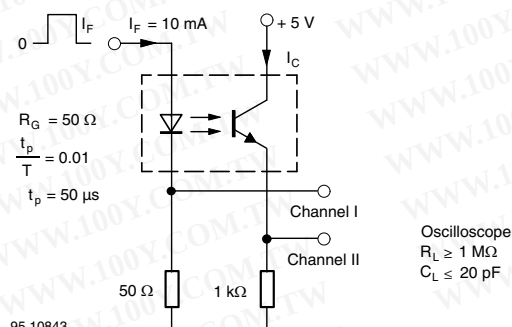


Fig. 4 - Test Circuit, Saturated Operation

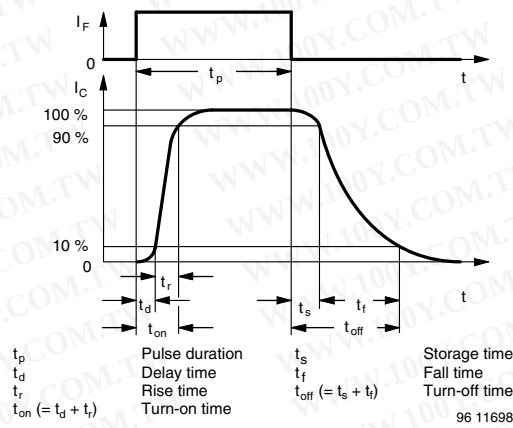


Fig. 5 - Switching Times

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

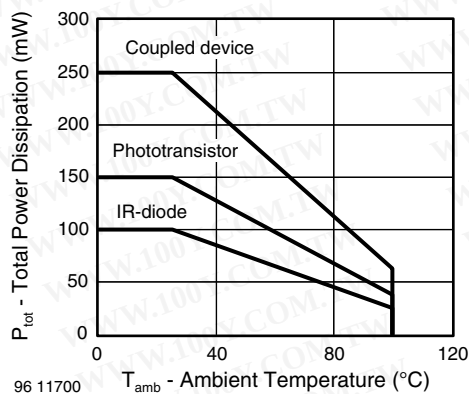


Fig. 6 - Total Power Dissipation vs. Ambient Temperature

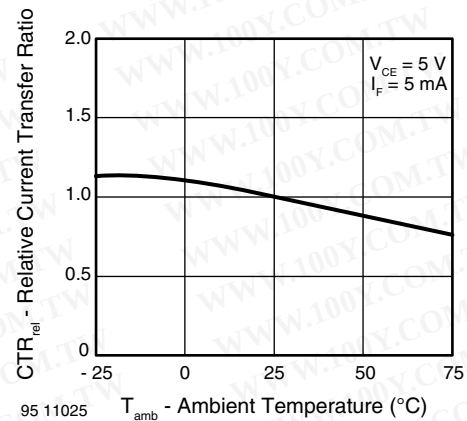


Fig. 8 - Relative Current Transfer Ratio vs. Ambient Temperature

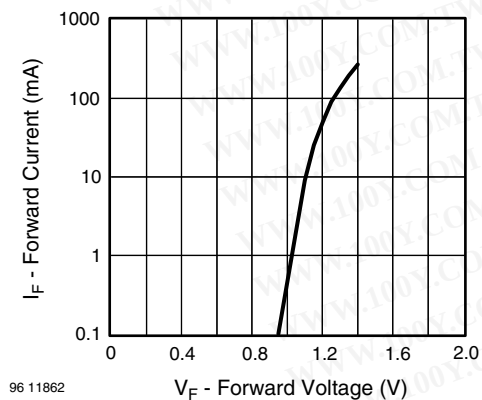


Fig. 7 - Forward Current vs. Forward Voltage

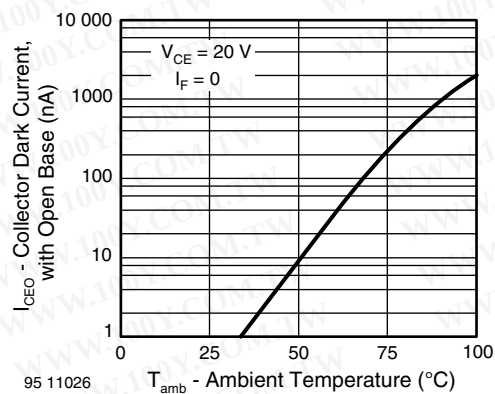


Fig. 9 - Collector Dark Current vs. Ambient Temperature

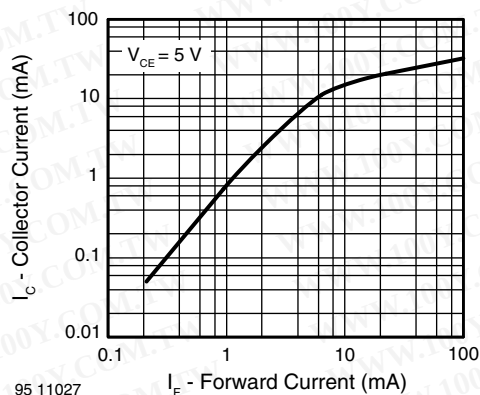


Fig. 10 - Collector Current vs. Forward Current

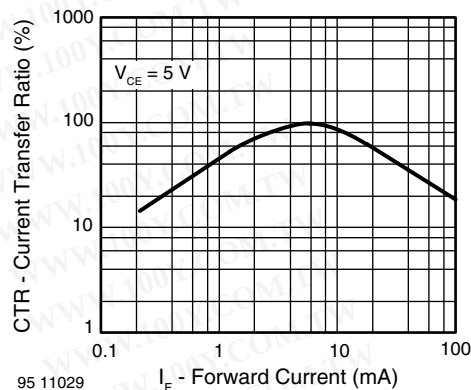


Fig. 13 - Current Transfer Ratio vs. Forward Current

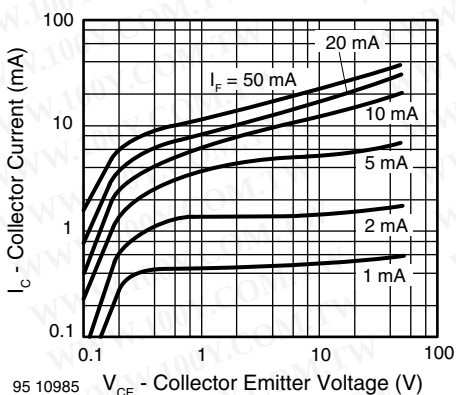


Fig. 11 - Collector Current vs. Collector Emitter Voltage

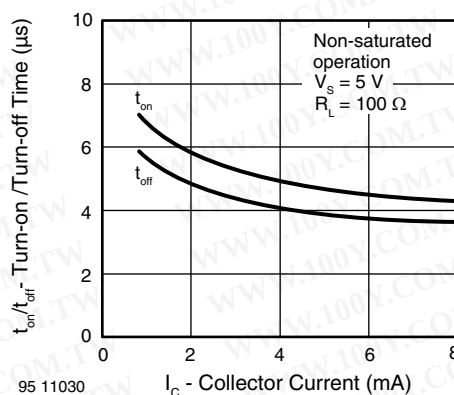


Fig. 14 - Turn-on/off Time vs. Collector Current

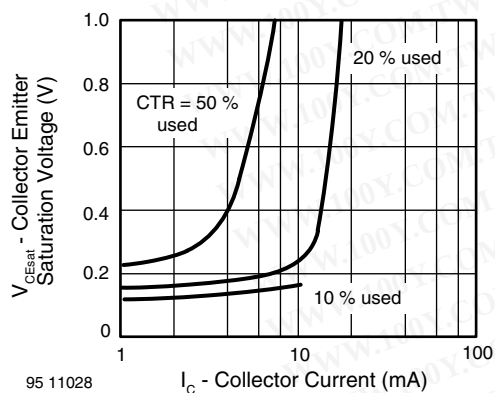


Fig. 12 - Collector Emitter Saturation Voltage vs. Collector Current

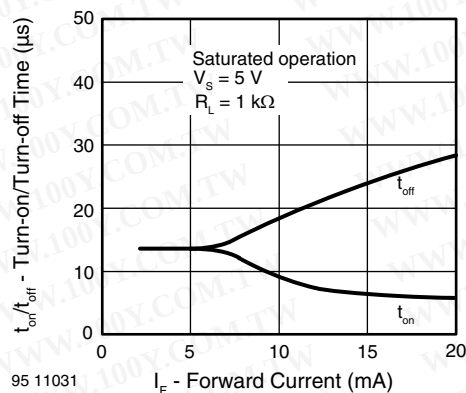


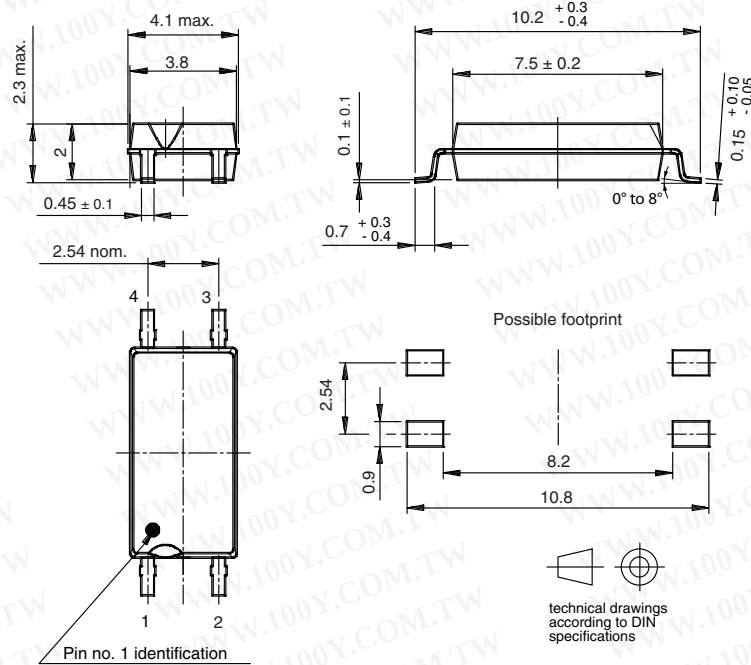
Fig. 15 - Turn-on/off Time vs. Forward Current



## TCLT10..Series

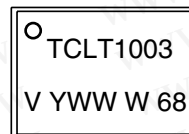
Optocoupler, Phototransistor Output, Vishay Semiconductors  
SOP-4L, Long Mini-Flat Package

### PACKAGE DIMENSIONS in millimeters



Drawing-No.: 6.544-5331.01-4  
Issue: 1; 04.04.00  
15243

### PACKAGE MARKING



21764-96



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