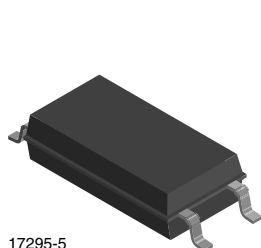
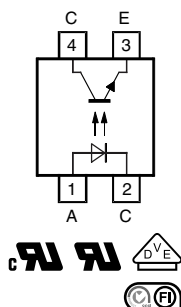


# Optocoupler, Phototransistor Output, LSOP-4, 110 °C Rated, Long Mini-Flat Package



17295-5



## FEATURES

- SMD low profile 4 lead package
- High isolation 5000 V<sub>RMS</sub>
- CTR flexibility available see order information
- Extra low coupling capacitance
- Connected base
- DC input with transistor output
- Temperature range -55 °C to +110 °C
- Creepage distance > 8 mm
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



## DESCRIPTION

The TCLT101. series consists of a phototransistor optically coupled to a gallium arsenide infrared-emitting diode in a 4-lead LSOP package.

## APPLICATIONS

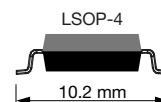
- Switchmode power supplies
- Computer peripheral interface
- Microprocessor system interface

## AGENCY APPROVALS

- UL1577, file no. E76222
- cUL - file no. E76222, equivalent to CSA bulletin 5A
- DIN EN 60747-5-5
- FIMKO: EN 60950

## ORDERING INFORMATION

|             |   |   |   |   |   |   |   |
|-------------|---|---|---|---|---|---|---|
| T           | C | L | T | 1 | 0 | 1 | # |
| PART NUMBER |   |   |   |   |   |   |   |



| AGENCY<br>CERTIFIED/PACKAGE | CTR (%)   |           |            |           |            |           |            |            |
|-----------------------------|-----------|-----------|------------|-----------|------------|-----------|------------|------------|
|                             | 5 mA      | 10 mA     |            | 5 mA      |            |           |            |            |
| UL, cUL, VDE, FIMKO         | 50 to 600 | 63 to 125 | 100 to 200 | 50 to 150 | 100 to 300 | 80 to 160 | 130 to 260 | 200 to 400 |
| LSOP-4                      | TCLT1010  | TCLT1012  | TCLT1013   | TCLT1015  | TCLT1016   | TCLT1017  | TCLT1018   | TCLT1019   |

## ABSOLUTE MAXIMUM RATINGS (T<sub>amb</sub> = 25 °C, unless otherwise specified)

| PARAMETER                 | TEST CONDITION                                  | SYMBOL            | VALUE | UNIT |
|---------------------------|-------------------------------------------------|-------------------|-------|------|
| <b>INPUT</b>              |                                                 |                   |       |      |
| Reverse voltage           |                                                 | V <sub>R</sub>    | 6     | V    |
| Forward current           |                                                 | I <sub>F</sub>    | 60    | mA   |
| Forward surge current     | t <sub>p</sub> ≤ 10 μs                          | I <sub>FSM</sub>  | 1.5   | A    |
| Power dissipation         |                                                 | P <sub>diss</sub> | 100   | mW   |
| Junction temperature      |                                                 | T <sub>j</sub>    | 125   | °C   |
| <b>OUTPUT</b>             |                                                 |                   |       |      |
| Collector emitter voltage |                                                 | V <sub>CEO</sub>  | 70    | V    |
| Emitter collector voltage |                                                 | V <sub>ECO</sub>  | 7     | V    |
| Collector current         |                                                 | I <sub>C</sub>    | 50    | mA   |
| Collector peak current    | t <sub>p</sub> /T = 0.5, t <sub>p</sub> ≤ 10 ms | I <sub>CM</sub>   | 100   | mA   |
| Power dissipation         |                                                 | P <sub>diss</sub> | 150   | mW   |
| Junction temperature      |                                                 | T <sub>j</sub>    | 125   | °C   |



| ABSOLUTE MAXIMUM RATINGS ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified) |                |           |             |                    |
|-------------------------------------------------------------------------------------------------|----------------|-----------|-------------|--------------------|
| PARAMETER                                                                                       | TEST CONDITION | SYMBOL    | VALUE       | UNIT               |
| <b>COUPLER</b>                                                                                  |                |           |             |                    |
| Total power dissipation                                                                         |                | $P_{tot}$ | 250         | mW                 |
| Operating ambient temperature range                                                             |                | $T_{amb}$ | -55 to +110 | $^{\circ}\text{C}$ |
| Storage temperature range                                                                       |                | $T_{stg}$ | -55 to +125 | $^{\circ}\text{C}$ |
| Soldering temperature <sup>(1)</sup>                                                            |                | $T_{sld}$ | 260         | $^{\circ}\text{C}$ |

**Notes**

- 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.

<sup>(1)</sup> Wave soldering three cycles are allowed. Also refer to "Assembly Instruction" ([www.vishay.com/doc?80054](http://www.vishay.com/doc?80054)).

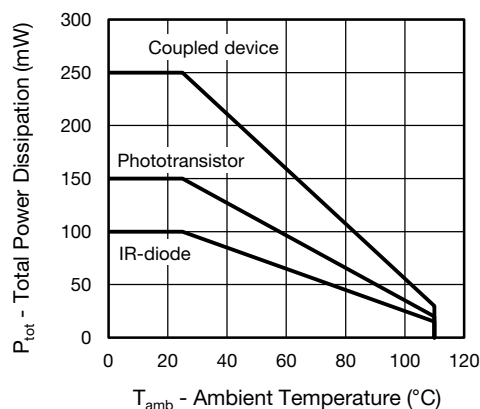


Fig. 1 - Total Power Dissipation vs. Ambient Temperature

| 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 leakage 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 |
| $I_C/I_F$                                                                                     | $V_{CE} = 5\text{ V}, I_F = 5\text{ mA}$  | TCLT1010 | CTR    | 50   | -    | 600  | %    |
|                                                                                               | $V_{CE} = 5\text{ V}, I_F = 10\text{ mA}$ | TCLT1012 | CTR    | 63   | -    | 125  | %    |
|                                                                                               |                                           | TCLT1013 | CTR    | 100  | -    | 200  | %    |
|                                                                                               | $V_{CE} = 5\text{ V}, I_F = 1\text{ mA}$  | TCLT1012 | CTR    | 22   | 45   | -    | %    |
|                                                                                               |                                           | TCLT1013 | CTR    | 34   | 70   | -    | %    |
|                                                                                               | $V_{CE} = 5\text{ V}, I_F = 5\text{ mA}$  | TCLT1015 | CTR    | 50   | -    | 150  | %    |
|                                                                                               |                                           | TCLT1016 | CTR    | 100  | -    | 300  | %    |
|                                                                                               |                                           | TCLT1017 | CTR    | 80   | -    | 160  | %    |
|                                                                                               |                                           | TCLT1018 | CTR    | 130  | -    | 260  | %    |
|                                                                                               |                                           | TCLT1019 | CTR    | 200  | -    | 400  | %    |

| SAFETY AND INSULATION RATINGS                           |                                                                                            |            |           |                    |
|---------------------------------------------------------|--------------------------------------------------------------------------------------------|------------|-----------|--------------------|
| PARAMETER                                               | TEST CONDITION                                                                             | SYMBOL     | VALUE     | UNIT               |
| Partial discharge test voltage - routine test           | 100 %, $t_{test} = 1\text{ s}$                                                             | $V_{pd}$   | 1.6       | 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                 |
|                                                         |                                                                                            | $V_{pd}$   | 1.3       | kV                 |
| Isolation test voltage (RMS)                            |                                                                                            | $V_{ISO}$  | 5000      | $V_{RMS}$          |
| 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       | $^{\circ}\text{C}$ |
| 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.

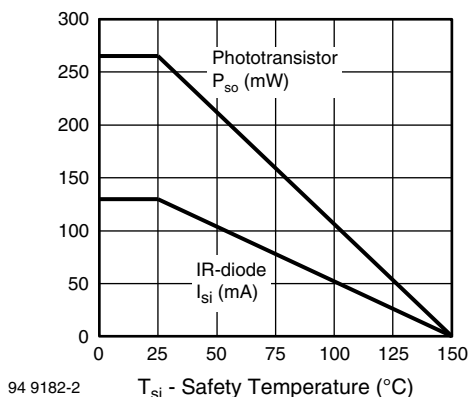


Fig. 2 - Derating Diagram

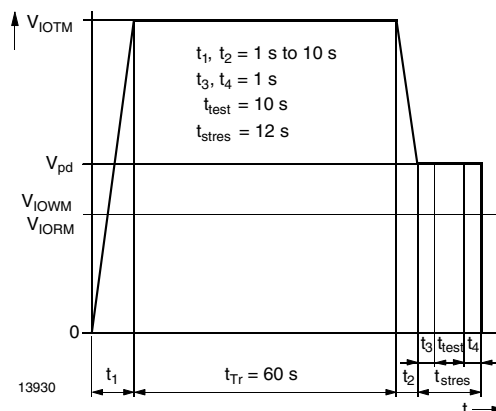


Fig. 3 - Test Pulse Diagram for Sample Test According to DIN EN 60747-5-2 (VDE 0884); IEC 60747-5-5

| 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   | -    | $\mu\text{s}$ |

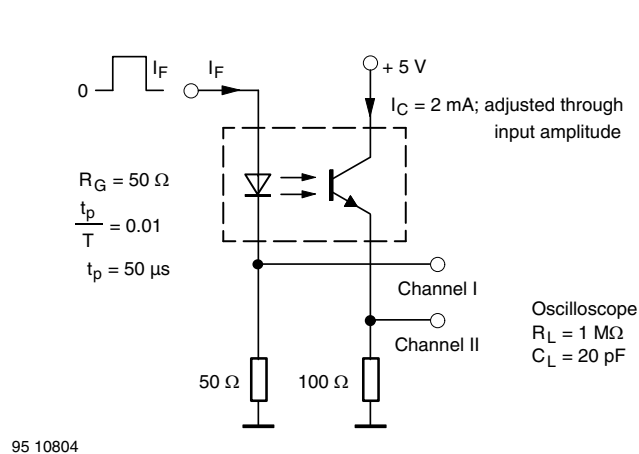


Fig. 4 - Test Circuit, Non-Saturated Operation

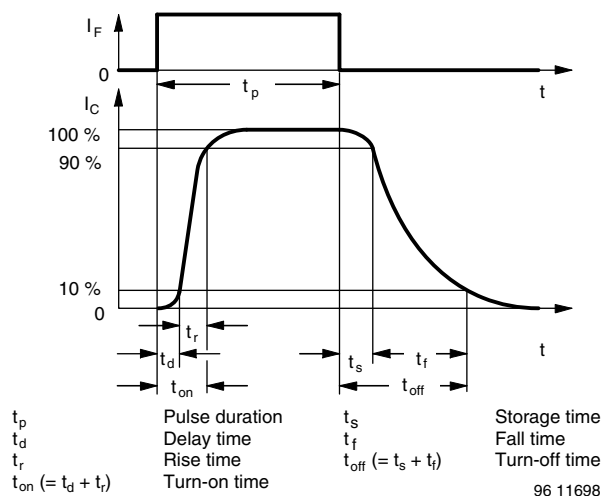


Fig. 6 - Switching Times

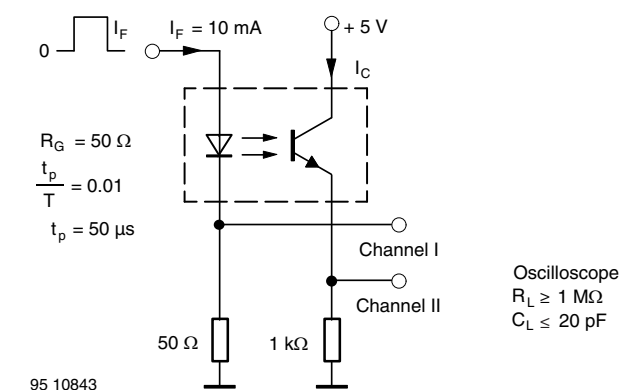


Fig. 5 - Test Circuit, Saturated Operation

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

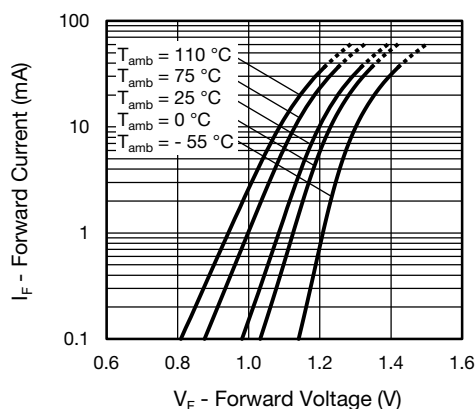


Fig. 7 - Forward Voltage vs. Forward Current

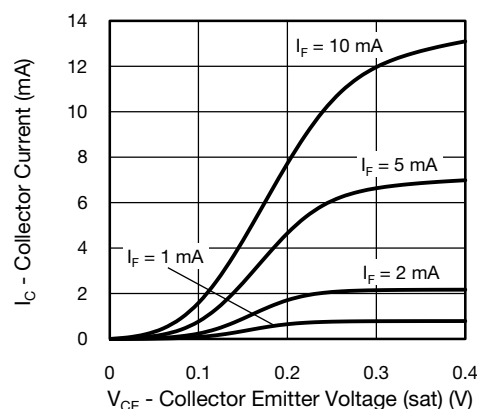


Fig. 10 - Collector Current vs. Collector Emitter Voltage (saturated)

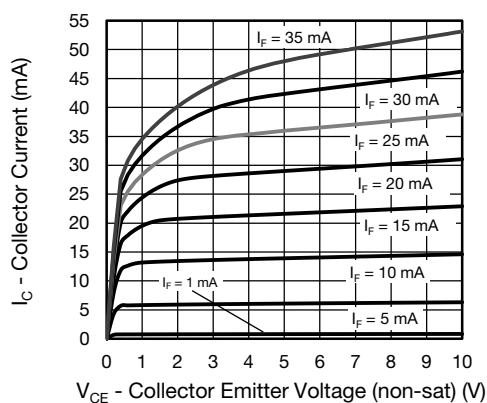


Fig. 8 - Collector Current vs. Collector Emitter Voltage (NS)

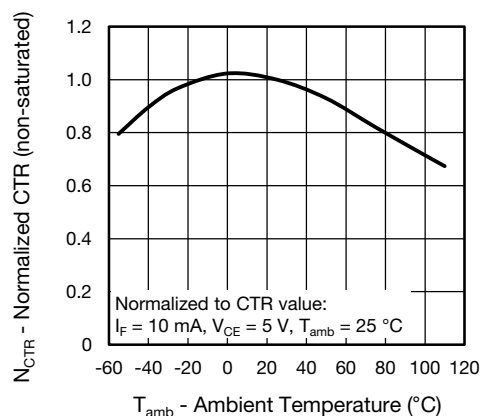


Fig. 11 - Normalized Current Transfer Ratio (non-saturated) vs. Ambient Temperature

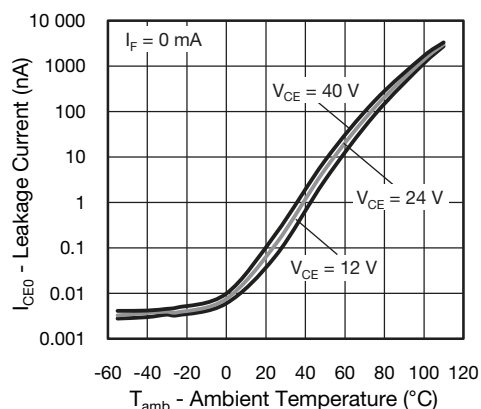


Fig. 9 - Leakage Current vs. Ambient Temperature

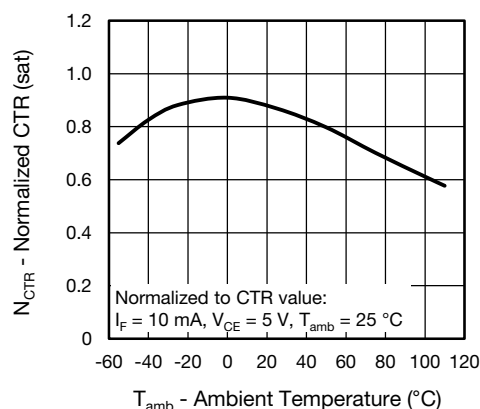


Fig. 12 - Normalized Current Transfer Ratio (saturated) vs. Ambient Temperature

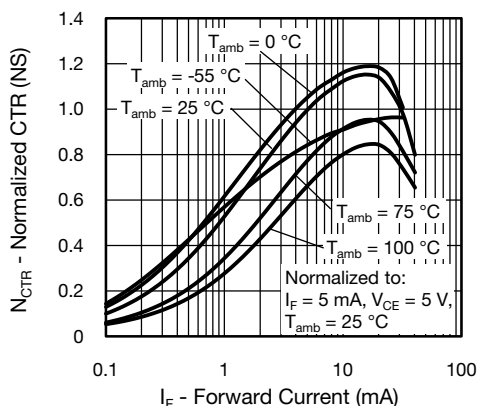


Fig. 13 - Normalized CTR (non-saturated) vs. Forward Current

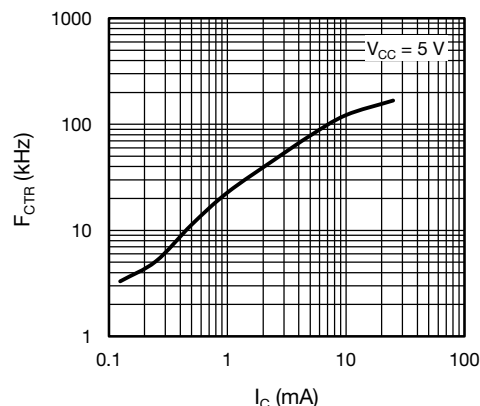


Fig. 16 - CTR Frequency vs. Collector Current

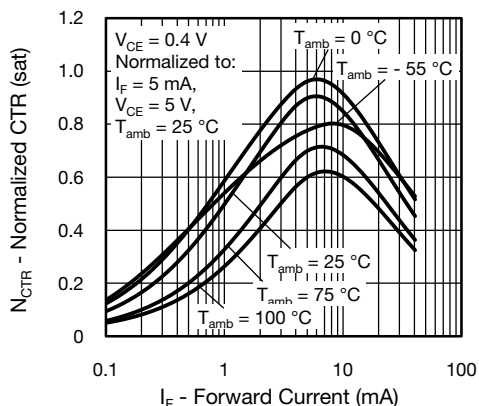


Fig. 14 - Normalized CTR (saturated) vs. Forward Current

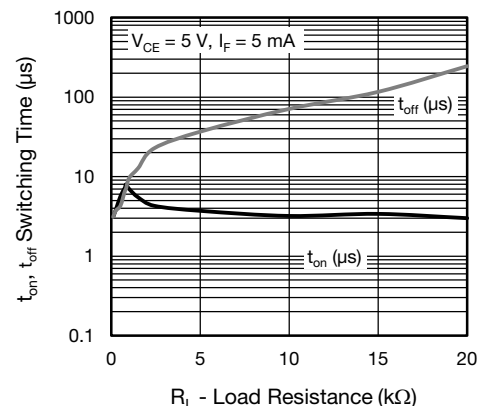


Fig. 17 - Switching Time vs. Load Resistance

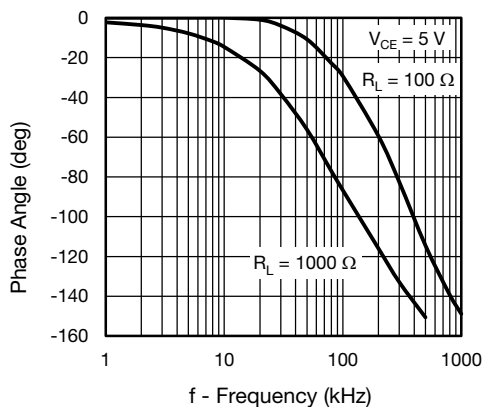


Fig. 15 - Phase Angle vs. Frequency

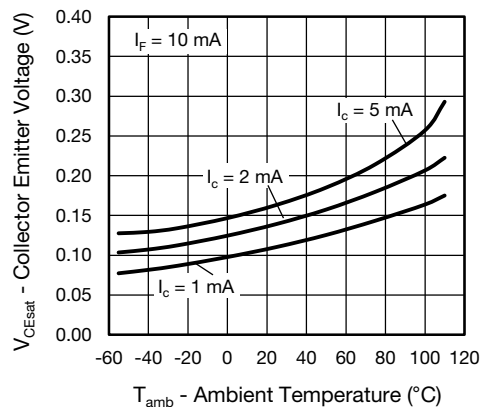
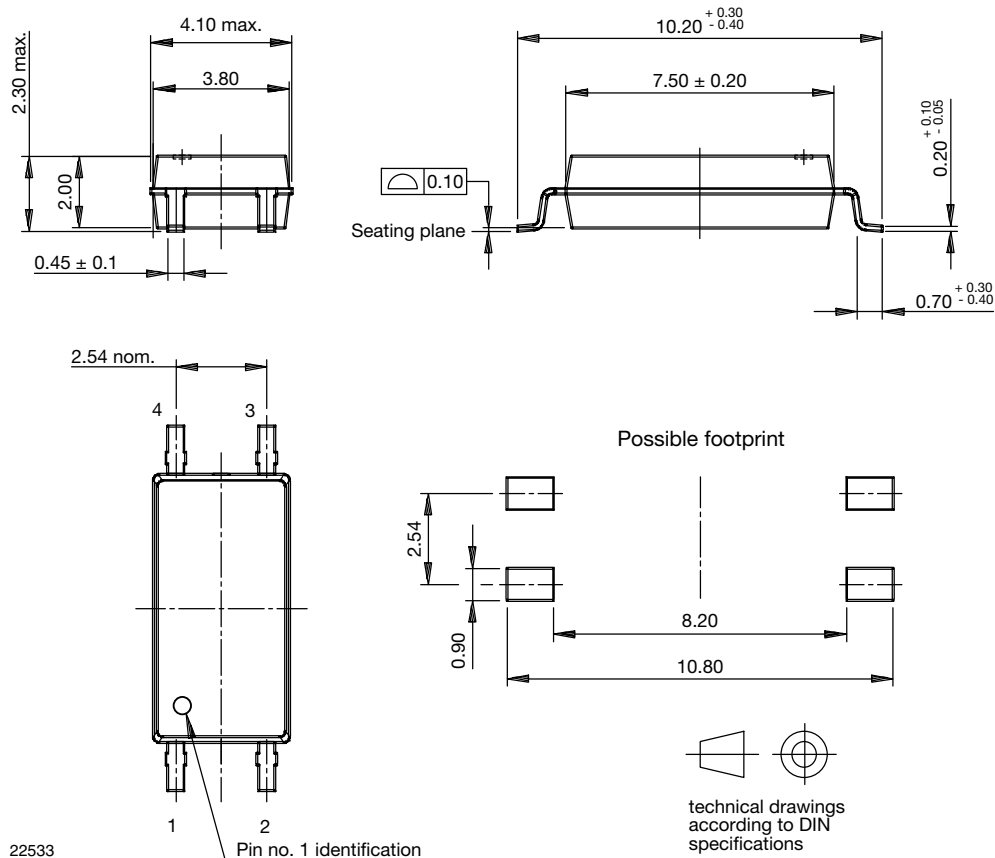
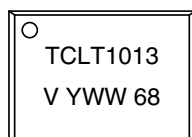


Fig. 18 - Collector Emitter Voltage vs. Ambient Temperature (saturated)

## PACKAGE DIMENSIONS (in millimeters)



## PACKAGE MARKING (example of TCLT1013)



## TAPE AND REEL DIMENSIONS (in millimeters)

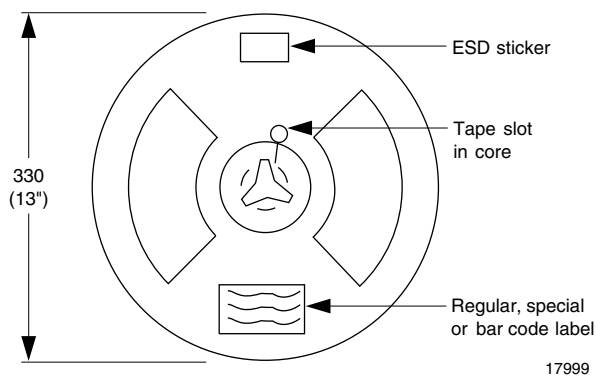


Fig. 19 - Reel Dimensions (3000 units per reel)

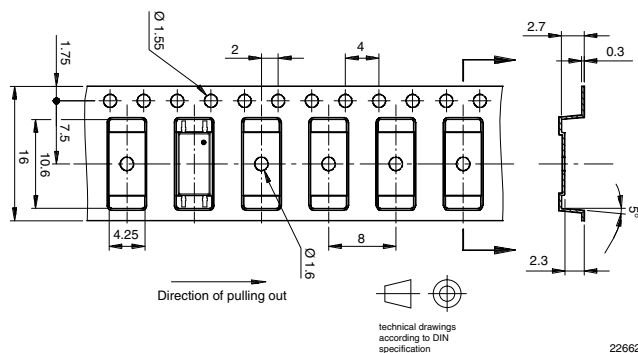
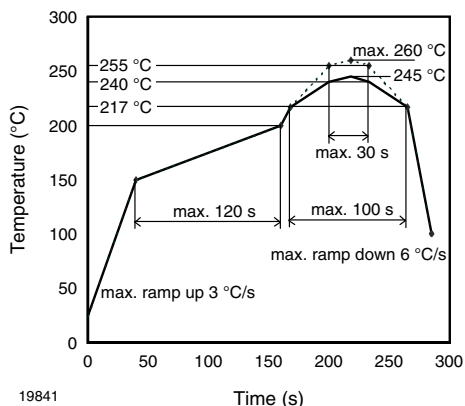


Fig. 20 - Tape Dimensions



## SOLDER PROFILE



19841

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



## Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and / or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.