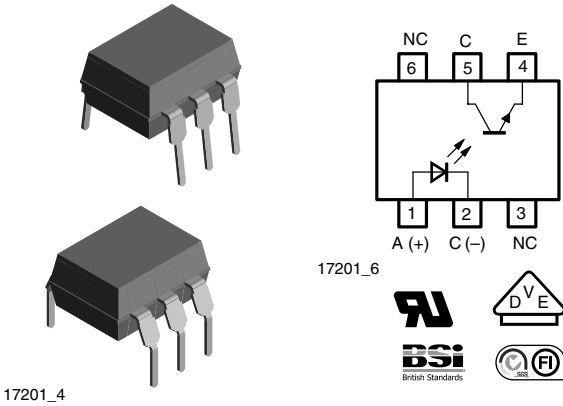


Optocoupler, Phototransistor Output



DESCRIPTION

The TCDT1120(G) series consists of a phototransistor optically coupled to a gallium arsenide infrared emitting diode in a 6 lead plastic dual in line package.

FEATURES

- High common mode rejection
- Four CTR groups available
- Compliant to RoHS directive 2002/95/EC and in accordance to WEEE 2002/96/EC



RoHS
COMPLIANT

APPLICATIONS

- Switch-mode power supplies
- Line receiver
- Computer peripheral interface
- Microprocessor system interface
- Reinforced isolation provides circuit protection against electrical shock (safety class II)
- Circuits for safe protective separation against electrical shock according to safety class II (reinforced isolation):
 - for appl. class I - IV at mains voltage ≤ 300 V
 - for appl. class I - III at mains voltage ≤ 600 V according to DIN EN 60747-5-5

AGENCY APPROVALS

- UL1577, file no. E52744, double protection
- BSI IEC 60950 IEC 60065
- DIN EN 60747-5-5 (VDE 0884)
- FIMKO
- cUL tested to CSA 22.2 bulletin 5A

| ORDER INFORMATION ⁽¹⁾ | |
|----------------------------------|---------------------------|
| PART | REMARKS |
| TCDT1120 | CTR > 40 %, DIP-6 |
| TCDT1122 | CTR 63 % to 125 %, DIP-6 |
| TCDT1123 | CTR 100 % to 200 %, DIP-6 |
| TCDT1124 | CTR 160 % to 320 %, DIP-6 |
| TCDT1120G | CTR > 40 %, DIP-6 |
| TCDT1122G | CTR 63 % to 125 %, DIP-6 |
| TCDT1123G | CTR 100 % to 200 %, DIP-6 |
| TCDT1124G | CTR 160 % to 320 %, DIP-6 |

Note

⁽¹⁾ G = leadform 10.16 mm; G is not marked on the body.

| ABSOLUTE MAXIMUM RATINGS (1) | | | | |
|------------------------------|---------------------------------------|------------|---------------|-----------|
| PARAMETER | TEST CONDITION | SYMBOL | VALUE | UNIT |
| INPUT | | | | |
| Reverse voltage | | V_R | 5 | V |
| Forward current | | I_F | 60 | mA |
| Forward surge current | $t_p \leq 10 \mu\text{s}$ | I_{FSM} | 3 | A |
| Power dissipation | | P_{diss} | 100 | mW |
| Junction temperature | | T_j | 125 | °C |
| OUTPUT | | | | |
| 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 | °C |
| COUPLER | | | | |
| Isolation test voltage (RMS) | $t = 1 \text{ s}$ | V_{ISO} | 5000 | V_{RMS} |
| Total power dissipation | | P_{tot} | 250 | mW |
| Ambient temperature range | | T_{amb} | - 55 to + 100 | °C |
| Storage temperature range | | T_{stg} | - 55 to + 125 | °C |
| Soldering temperature (2) | 2 mm from case, $t \leq 10 \text{ s}$ | T_{sld} | 260 | °C |

Notes

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

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.

(2) Refer to wave profile for soldering conditions for through hole devices (DIP).

| ELECTRICAL CHARACTERISTICS (1) | | | | | | |
|--------------------------------------|---|-------------|------|------|------|------|
| PARAMETER | TEST CONDITION | SYMBOL | MIN. | TYP. | MAX. | UNIT |
| INPUT | | | | | | |
| 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 |
| OUTPUT | | | | | | |
| Collector base voltage | $I_C = 100 \mu\text{A}$ | V_{CBO} | 90 | | | V |
| Collector emitter voltage | $I_C = 1 \text{ mA}$ | V_{CEO} | 90 | | | V |
| Emitter collector voltage | $I_E = 100 \mu\text{A}$ | V_{ECO} | 7 | | | V |
| Collector emitter cut-off current | $V_{CE} = 20 \text{ V}, I_F = 0 \text{ A}$ | I_{CEO} | | | 150 | nA |
| COUPLER | | | | | | |
| Collector emitter saturation voltage | $I_F = 10 \text{ mA}, I_C = 1 \text{ mA}$ | V_{CEsat} | | | 0.3 | V |
| Cut-off frequency | $V_{CE} = 5 \text{ V}, I_F = 10 \text{ mA}, R_L = 100 \Omega$ | f_c | | 110 | | kHz |
| Coupling capacitance | $f = 1 \text{ MHz}$ | C_k | | 0.3 | | pF |

Note

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

Minimum and maximum values are tested requirements. Typical values are characteristics of the device and are the result of engineering evaluations. 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 | $V_{CE} = 5\text{ V}, I_F = 1\text{ mA}$ | TCDT1120 | CTR | 10 | | | % | |
| | | TCDT1120G | | | | | | |
| | | TCDT1122 | CTR | 15 | | | % | |
| | | TCDT1122G | | | | | | |
| | | TCDT1123 | CTR | 30 | | | % | |
| | | TCDT1123G | | | | | | |
| | | TCDT1124 | CTR | 60 | | | % | |
| | | TCDT1124G | | | | | | |
| | $V_{CE} = 5\text{ V}, I_F = 10\text{ mA}$ | TCDT1120 | CTR | 40 | | | | % |
| | | TCDT1120G | | | | | | |
| | | TCDT1122 | CTR | 63 | | 125 | | % |
| | | TCDT1122G | | | | | | |
| | | TCDT1123 | CTR | 100 | | 200 | | % |
| | | TCDT1123G | | | | | | |
| TCDT1124 | | CTR | 160 | | 320 | | % | |
| TCDT1124G | | | | | | | | |

| MAXIMUM SAFETY RATINGS (1) | | | | | | |
|----------------------------|----------------|------------|------|------|------|------|
| 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} | | | 6 | kV |
| Safety temperature | | T_{si} | | | 150 | °C |

Note

(1) According to DIN EN 60747-5-5 (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.

| 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} | 1.6 | | | kV |
| Partial discharge test voltage - lot test (sample test) | $t_{Tr} = 60\text{ s}, t_{test} = 10\text{ s},$ (see figure 2) | V_{IOTM} | 6 | | | kV |
| | | V_{pd} | 1.3 | | | kV |
| Insulation resistance | $V_{IO} = 500\text{ V}$ | R_{IO} | 10^{12} | | | Ω |
| | $V_{IO} = 500\text{ V}, T_{amb} \leq 100\text{ °C}$ | R_{IO} | 10^{11} | | | Ω |
| | $V_{IO} = 500\text{ V}, T_{amb} \leq 150\text{ °C}$ (construction test only) | R_{IO} | 10^9 | | | Ω |

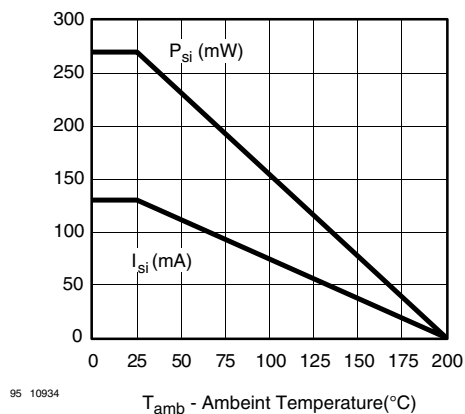


Fig. 1 - Derating Diagram

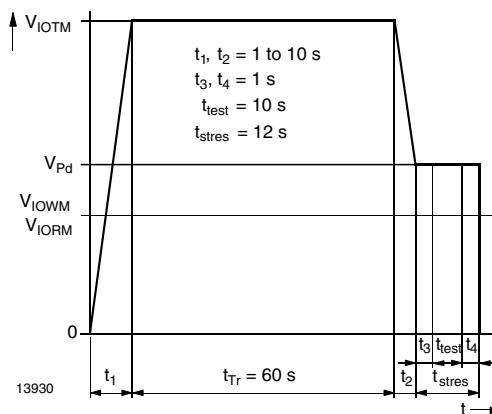


Fig. 2 - Test Pulse Diagram for Sample Test According to DIN EN 60747-5-5/DIN EN 60747-; IEC 60747

| SWITCHING CHARACTERISTICS | | | | | | | |
|---------------------------|---|-----------|--------|------|------|------|---------------|
| PARAMETER | TEST CONDITION | PART | SYMBOL | MIN. | TYP. | MAX. | UNIT |
| Current time | $V_S = 5 \text{ V}$, $R_L = 100 \Omega$, (see figure 3) | TCDT1120 | I_F | | 10 | | mA |
| | | TCDT1120G | | | | | |
| | | TCDT1123 | I_F | | 10 | | mA |
| | | TCDT1123G | | | | | |
| | | TCDT1124 | I_F | | 10 | | mA |
| TCDT1124G | | | | | | | |
| Delay time | $V_S = 5 \text{ V}$, $R_L = 100 \Omega$, (see figure 3) | TCDT1120 | t_D | | 2.5 | | μs |
| | | TCDT1120G | | | | | |
| | | TCDT1123 | t_D | | 2.8 | | μs |
| | | TCDT1123G | | | | | |
| | | TCDT1124 | t_D | | 2 | | μs |
| TCDT1124G | | | | | | | |
| Rise time | $V_S = 5 \text{ V}$, $R_L = 100 \Omega$, (see figure 3) | TCDT1120 | t_r | | 3 | | μs |
| | | TCDT1120G | | | | | |
| | | TCDT1123 | t_r | | 4.2 | | μs |
| | | TCDT1123G | | | | | |
| | | TCDT1124 | t_r | | 4 | | μs |
| TCDT1124G | | | | | | | |
| Storage time | $V_S = 5 \text{ V}$, $R_L = 100 \Omega$, (see figure 3) | TCDT1120 | t_s | | 0.3 | | μs |
| | | TCDT1120G | | | | | |
| | | TCDT1123 | t_s | | 0.3 | | μs |
| | | TCDT1123G | | | | | |
| | | TCDT1124 | t_s | | 0.3 | | μs |
| TCDT1124G | | | | | | | |
| Fall time | $V_S = 5 \text{ V}$, $R_L = 100 \Omega$, (see figure 3) | TCDT1120 | t_f | | 3.7 | | μs |
| | | TCDT1120G | | | | | |
| | | TCDT1123 | t_f | | 4.7 | | μs |
| | | TCDT1123G | | | | | |
| | | TCDT1124 | t_f | | 4.7 | | μs |
| TCDT1124G | | | | | | | |

| SWITCHING CHARACTERISTICS | | | | | | | |
|---------------------------|---|-----------|-----------|------|------|------|---------------|
| PARAMETER | TEST CONDITION | PART | SYMBOL | MIN. | TYP. | MAX. | UNIT |
| Turn-on time | $V_S = 5\text{ V}, R_L = 100\ \Omega$, (see figure 3) | TCDT1120 | t_{on} | | 5.5 | | μs |
| | | TCDT1120G | | | | | |
| | | TCDT1123 | t_{on} | | 7 | | μs |
| | | TCDT1123G | | | | | |
| | | TCDT1124 | | | | | |
| TCDT1124G | | | | | | | |
| Turn-off time | $V_S = 5\text{ V}, R_L = 100\ \Omega$, (see figure 3) | TCDT1120 | t_{off} | | 4 | | μs |
| | | TCDT1120G | | | | | |
| | | TCDT1123 | t_{off} | | 5 | | μs |
| | | TCDT1123G | | | | | |
| | | TCDT1124 | | | | | |
| TCDT1124G | | | | | | | |
| Turn-on time | $V_S = 5\text{ V}, R_L = 1\text{ k}\Omega$, (see figure 4) | TCDT1120 | t_{on} | | 16.5 | | μs |
| | | TCDT1120G | | | | | |
| | | TCDT1123 | t_{on} | | 21.5 | | μs |
| | | TCDT1123G | | | | | |
| | | TCDT1124 | | | | | |
| TCDT1124G | | | | | | | |
| Turn-off time | $V_S = 5\text{ V}, R_L = 1\text{ k}\Omega$, (see figure 4) | TCDT1120 | t_{off} | | 22.5 | | μs |
| | | TCDT1120G | | | | | |
| | | TCDT1123 | t_{off} | | 37.5 | | μs |
| | | TCDT1123G | | | | | |
| | | TCDT1124 | | | | | |
| TCDT1124G | | | | | | | |

TYPICAL CHARACTERISTICS

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

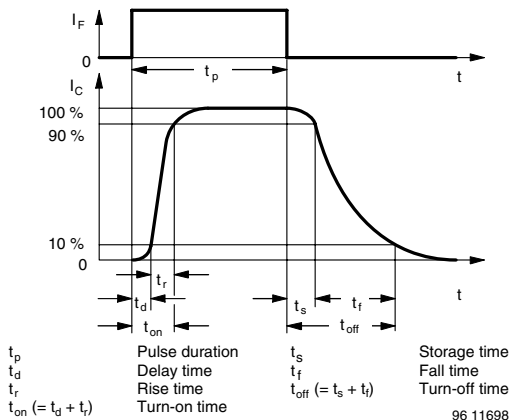


Fig. 3 - Switching Times

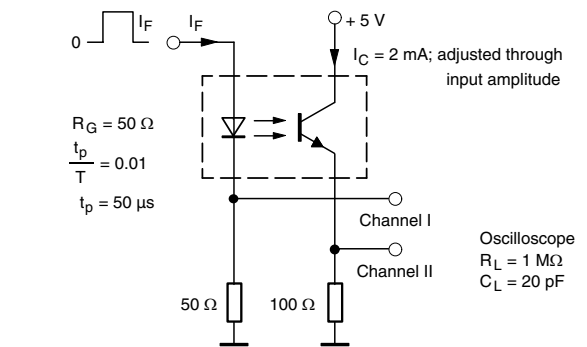


Fig. 4 - Test Circuit, Non-Saturated Operation

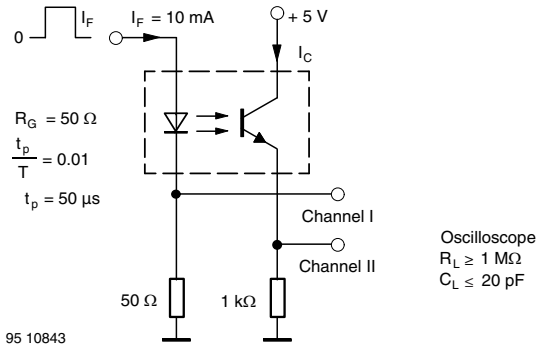


Fig. 5 - Test Circuit, Saturated Operation

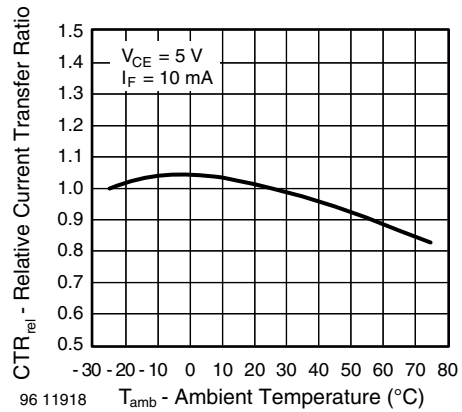


Fig. 8 - Relative Current Transfer Ratio vs. Ambient Temperature

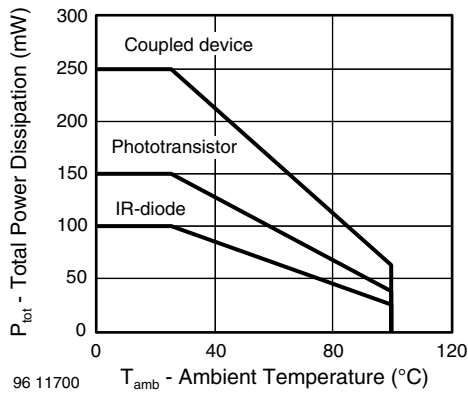


Fig. 6 - Total Power Dissipation vs. Ambient Temperature

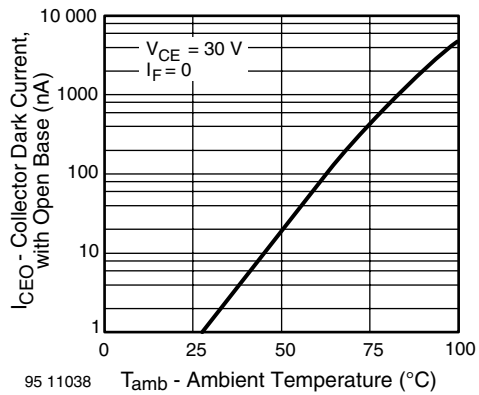


Fig. 9 - Collector Dark Current vs. Ambient Temperature

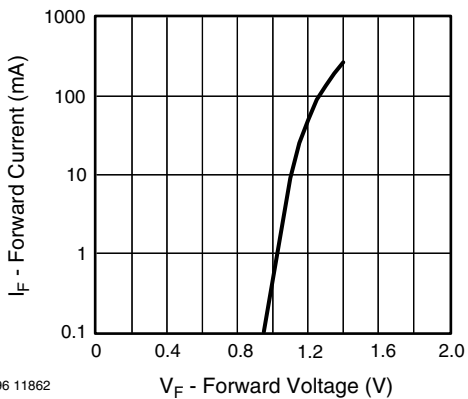


Fig. 7 - Forward Current vs. Forward Voltage

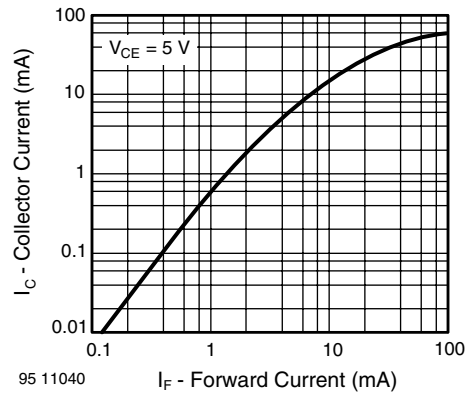


Fig. 10 - Collector Current vs. Forward Current

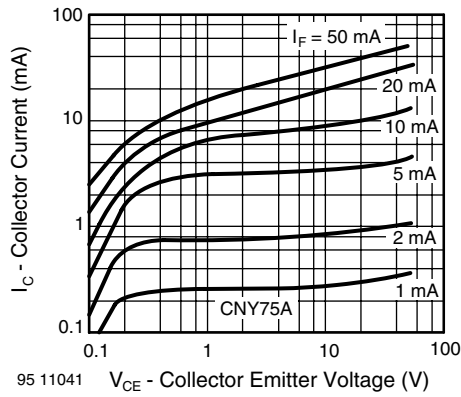


Fig. 11 - Collector Current vs. Collector Emitter Voltage

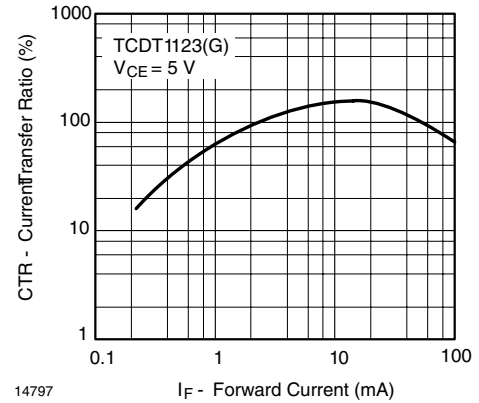


Fig. 14 - Current Transfer Ratio vs. Forward Current

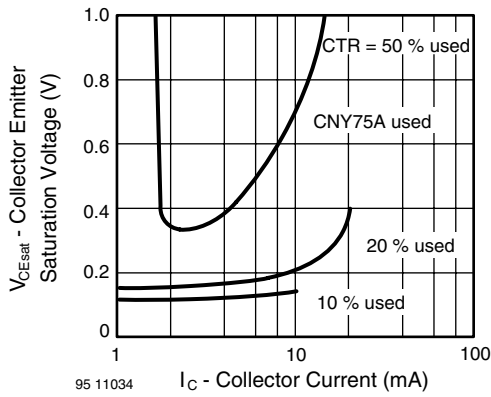


Fig. 12 - Collector Emitter Saturation Voltage vs. Collector Current

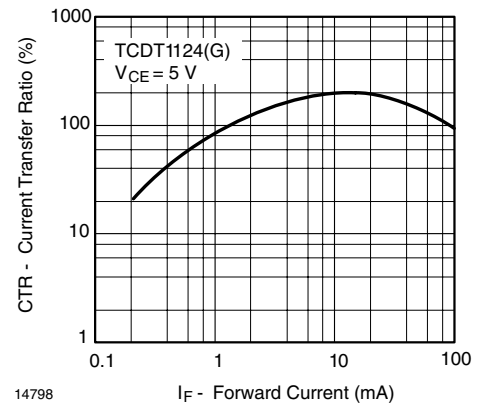


Fig. 15 - Current Transfer Ratio vs. Forward Current

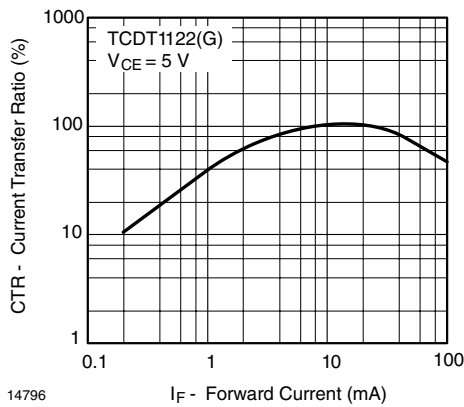


Fig. 13 - Current Transfer Ratio vs. Forward Current

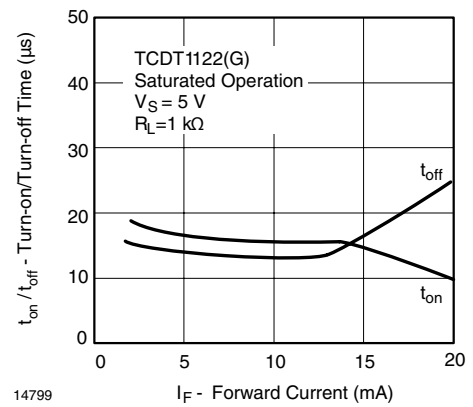


Fig. 16 - Turn-on/off Time vs. Forward Current

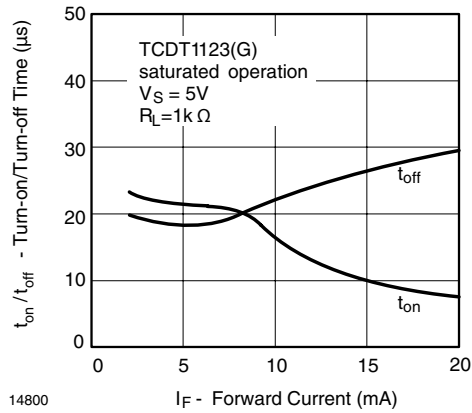


Fig. 17 - Turn-on/off Time vs. Forward Current

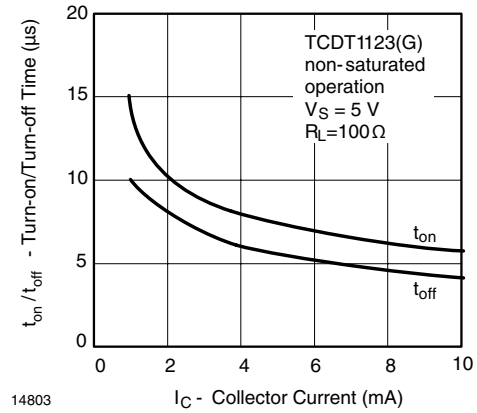


Fig. 20 - Turn-on/off Time vs. Collector Current

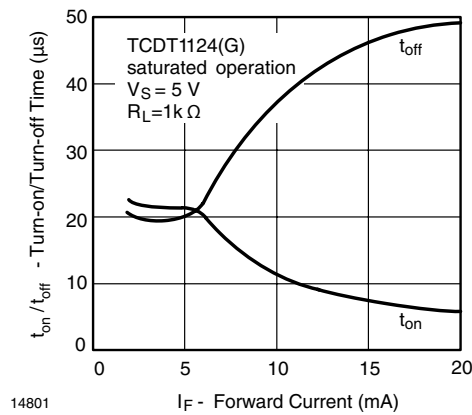


Fig. 18 - Turn-on/off Time vs. Forward Current

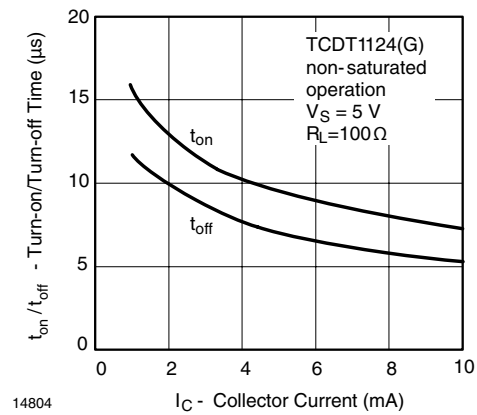


Fig. 21 - Turn-on/off Time vs. Collector Current

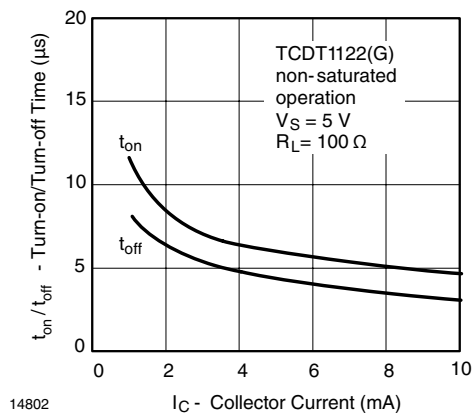


Fig. 19 - Turn-on/off Time vs. Collector Current

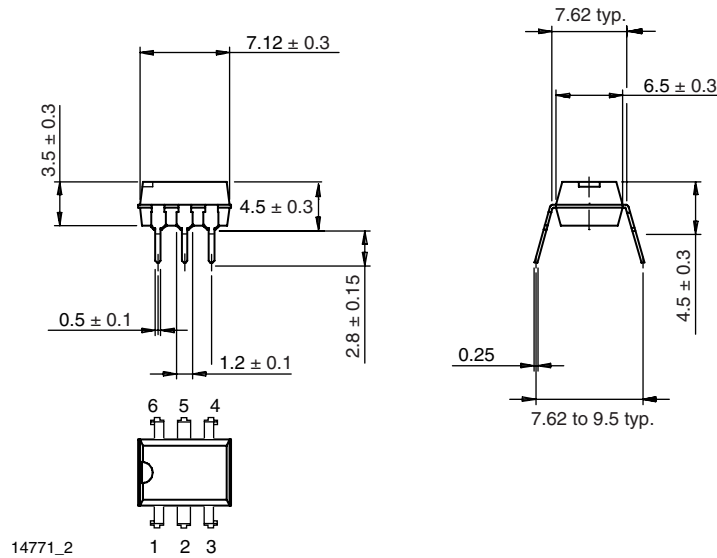


TCDT1120, TCDT1120G

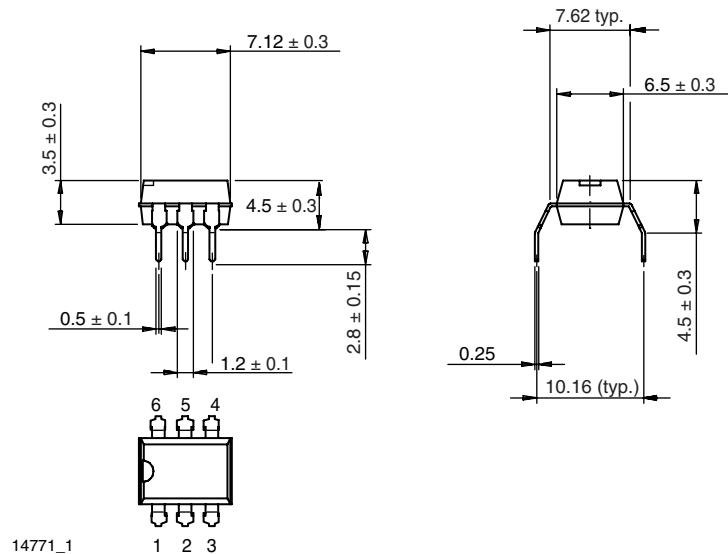
Optocoupler, Phototransistor Output Vishay Semiconductors

PACKAGE DIMENSIONS in millimeters

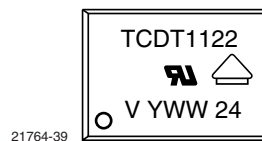
DIP-6



DIP-6, 400 mil



PACKAGE MARKING



Note

Example of marking used for the TCDT1122 and TCDT1122G



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