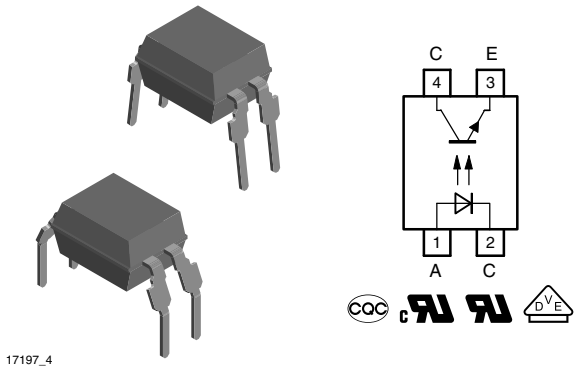
# Optocoupler, Phototransistor Output, High Temperature




## FEATURES

- High common mode rejection
- Low temperature coefficient of CTR
- Reinforced isolation provides circuit protection against electrical shock (safety class II)
- Isolation materials according to UL 94 V-0
- Pollution degree 2 (DIN / VDE 0110 / resp. IEC 60664)
- Climatic classification 55 / 100 / 21 (IEC 60068 part 1)
- Rated impulse voltage (transient overvoltage) $V_{IOTM}$ = 6 $kV_{peak}$
- Isolation test voltage (partial discharge test voltage) $V_{pd}$ = 1.6 kV
- Rated recurring peak voltage (repetitive) $V_{IORM}$ = 850 $V_{peak}$
- Creepage current resistance according to VDE 0303 / IEC 60112 comparative tracking index: CTI ≥ 175
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free

e3

RoHS COMPLIANT

## LINKS TO ADDITIONAL RESOURCES

Related Documents

## DESCRIPTION

The TCET110. consists of a phototransistor optically coupled to a gallium arsenide infrared-emitting diode in a 4-lead plastic dual inline package.

## AGENCY APPROVALS

- UL 1577
- cUL 1577
- DIN EN 60747-5-5 (VDE 0884-5)
- BSI: EN 62368-1:2014
- CQC GB4943.1-2011
- CQC GB8898-2011

## APPLICATIONS

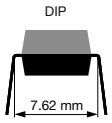
Circuits for safe protective separation against electrical shock according to safety class II (reinforced isolation):

- For application class I to IV at mains voltage ≤ 300 V
- For application class I to III at mains voltage ≤ 600 V according to DIN EN 60747-5-5 (VDE 0884), suitable for:
  - Switch-mode power supplies
  - Line receiver
  - Computer peripheral interface
  - Microprocessor system interface

## ORDERING INFORMATION

| T | C | E | T | 1 | 1 | 0 | # | # |
|---|---|---|---|---|---|---|---|---|

PART NUMBER — LEAD FORM




| AGENCY CERTIFIED / PACKAGE | CTR (%) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 10 mA | | | | | | | | |
| UL, cUL, VDE, BSI, CQC | 50 to 600 | 40 to 80 | 63 to 125 | 100 to 200 | 160 to 320 | 100 to 300 | 80 to 160 | 130 to 260 | 200 to 400 |
| DIP-4 | TCET1100 | - | TCET1102 | TCET1103 | - | TCET1106 | TCET1107 | TCET1108 | TCET1109 |
| DIP-4, 400 mil | TCET1100G | TCET1101G | TCET1102G | TCET1103G | TCET1104G | TCET1106G | TCET1107G | TCET1108G | TCET1109G |

**Note**

- G = lead form 10.16 mm; G is not marked on the body

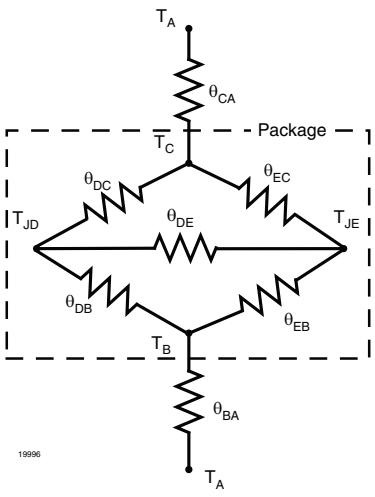
| ABSOLUTE MAXIMUM RATINGS ($T_{amb}$ = 25 °C, unless otherwise specified) | | | | |
|---|---|---|---|---|
| **PARAMETER** | **TEST CONDITION** | **SYMBOL** | **VALUE** | **UNIT** |
| **INPUT** | | | | |
| Reverse voltage | | $V_R$ | 6 | V |
| Forward current | | $I_F$ | 60 | mA |
| Forward surge current | $t_p \leq 10$ µs | $I_{FSM}$ | 1.5 | A |
| **OUTPUT** | | | | |
| Collector emitter voltage | | $V_{CEO}$ | 70 | V |
| Emitter collector voltage | | $V_{ECO}$ | 7 | V |
| Collector current | | $I_C$ | 50 | mA |
| Collector peak current | $t_p/T = 0.5$, $t_p \leq 10$ ms | $I_{CM}$ | 100 | mA |
| **COUPLER** | | | | |
| Operating ambient temperature range | | $T_{amb}$ | -40 to +100 | °C |
| Storage temperature range | | $T_{stg}$ | -55 to +125 | °C |
| Soldering temperature (1) | 2 mm from case, ≤ 10 s | $T_{sld}$ | 260 | °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

(1) Refer to wave profile for soldering conditions for through hole devices

| THERMAL CHARACTERISTICS | | | |
|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **VALUE** | **UNIT** |
| LED power dissipation | $P_{diss}$ | 100 | mW |
| Output power dissipation | $P_{diss}$ | 150 | mW |
| Maximum LED junction temperature | $T_{jmax.}$ | 125 | °C |
| Maximum output die junction temperature | $T_{jmax.}$ | 125 | °C |
| Thermal resistance, junction emitter to board | $\theta_{EB}$ | 173 | °C/W |
| Thermal resistance, junction emitter to case | $\theta_{EC}$ | 149 | °C/W |
| Thermal resistance, junction detector to board | $\theta_{DB}$ | 111 | °C/W |
| Thermal resistance, junction detector to case | $\theta_{DC}$ | 127 | °C/W |
| Thermal resistance, junction emitter to junction detector | $\theta_{ED}$ | 173 | °C/W |
| Thermal resistance, board to ambient (1) | $\theta_{BA}$ | 197 | °C/W |
| Thermal resistance, case to ambient (1) | $\theta_{CA}$ | 4041 | °C/W |




**Notes**

- The thermal model is represented in the thermal network below. Each resistance value given in this model can be used to calculate the temperatures at each node for a given operating condition. The thermal resistance from board to ambient will be dependent on the type of PCB, layout and thickness of copper traces. For a detailed explanation of the thermal model, please reference Vishay's "Thermal Characteristics of Optocouplers" application note

(1) For 2 layer FR4 board (4" x 3" x 0.062")

| ELECTRICAL CHARACTERISTICS ($T_{amb}$ = 25 °C, unless otherwise specified) | | | | | | |
|---|---|---|---|---|---|---|
| **PARAMETER** | **TEST CONDITION** | **SYMBOL** | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| **INPUT** | | | | | | |
| Forward voltage | $I_F$ = 50 mA | $V_F$ | - | 1.25 | 1.6 | V |
| Junction capacitance | $V_R$ = 0, f = 1 MHz | $C_j$ | - | 50 | - | pF |
| **OUTPUT** | | | | | | |
| Collector emitter voltage | $I_C$ = 1 mA | $V_{CEO}$ | 70 | - | - | V |
| Emitter collector voltage | $I_E$ = 100 µA | $V_{ECO}$ | 7 | - | - | V |
| Collector emitter cut-off current | $V_{CE}$ = 20 V, $I_F$ = 0 A, E = 0 | $I_{CEO}$ | - | 10 | 100 | nA |
| **COUPLER** | | | | | | |
| Collector emitter saturation voltage | $I_F$ = 10 mA, $I_C$ = 1 mA | $V_{CEsat}$ | - | - | 0.3 | V |
| Cut-off frequency | $V_{CE}$ = 5 V, $I_F$ = 10 mA, $R_L$ = 100 Ω | $f_c$ | - | 110 | - | kHz |
| Coupling capacitance | f = 1 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 V, $I_F$ = 1 mA | TCET1101G | CTR | 13 | 30 | - | % |
| | | TCET1102, TCET1102G | CTR | 22 | 45 | - | % |
| | | TCET1103, TCET1103G | CTR | 34 | 70 | - | % |
| | | TCET1104G | CTR | 56 | 90 | - | % |
| | $V_{CE}$ = 5 V, $I_F$ = 5 mA | TCET1100, TCET1100G | CTR | 50 | - | 600 | % |
| | | TCET1106, TCET1106G | CTR | 100 | - | 300 | % |
| | | TCET1107, TCET1107G | CTR | 80 | - | 160 | % |
| | | TCET1108, TCET1108G | CTR | 130 | - | 260 | % |
| | | TCET1109, TCET1109G | CTR | 200 | - | 400 | % |
| | $V_{CE}$ = 5 V, $I_F$ = 10 mA | TCET1101, TCET1101G | CTR | 40 | - | 80 | % |
| | | TCET1102, TCET1102G | CTR | 63 | - | 125 | % |
| | | TCET1103, TCET1103G | CTR | 100 | - | 200 | % |
| | | TCET1104, TCET1104G | CTR | 160 | - | 320 | % |

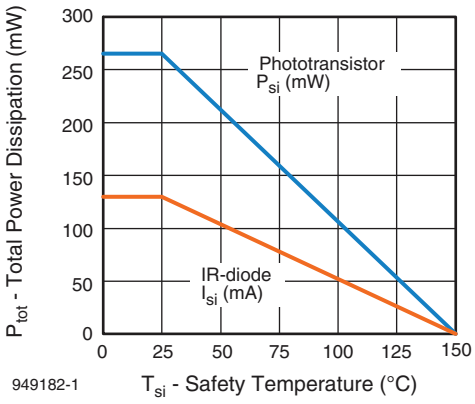



Fig. 1 - Derating Diagram

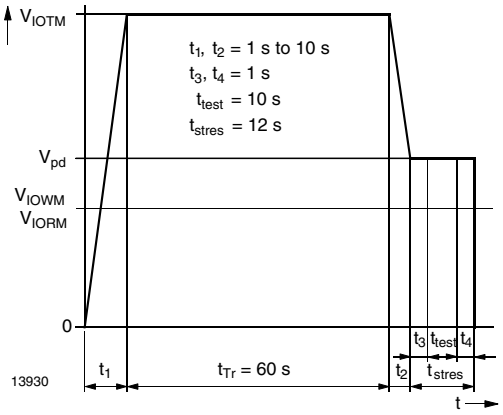



Fig. 2 - Test Pulse Diagram for Sample Test According to DIN EN 60747-5-5 / DIN EN 60747-; IEC 60747

| SWITCHING CHARACTERISTICS | | | | | | |
|---|---|---|---|---|---|---|
| **PARAMETER** | **TEST CONDITION** | **SYMBOL** | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| Delay time | $V_S$ = 5 V, $I_C$ = 2 mA, $R_L$ = 100 Ω, (see Fig. 3) | $t_d$ | - | 3 | - | µs |
| Rise time | $V_S$ = 5 V, $I_C$ = 2 mA, $R_L$ = 100 Ω, (see Fig. 3) | $t_r$ | - | 3 | - | µs |
| Turn-on time | $V_S$ = 5 V, $I_C$ = 2 mA, $R_L$ = 100 Ω, (see Fig. 3) | $t_{on}$ | - | 6 | - | µs |
| Storage time | $V_S$ = 5 V, $I_C$ = 2 mA, $R_L$ = 100 Ω, (see Fig. 3) | $t_s$ | - | 0.3 | - | µs |
| Fall time | $V_S$ = 5 V, $I_C$ = 2 mA, $R_L$ = 100 Ω, (see Fig. 3) | $t_f$ | - | 4.7 | - | µs |
| Turn-off time | $V_S$ = 5 V, $I_C$ = 2 mA, $R_L$ = 100 Ω, (see Fig. 3) | $t_{off}$ | - | 5 | - | µs |
| Turn-on time | $V_S$ = 5 V, $I_F$ = 10 mA, $R_L$ = 1 kΩ, (see Fig. 4) | $t_{on}$ | - | 9 | - | µs |
| Turn-off time | $V_S$ = 5 V, $I_F$ = 10 mA, $R_L$ = 1 kΩ, (see Fig. 4) | $t_{off}$ | - | 10 | - | µs |

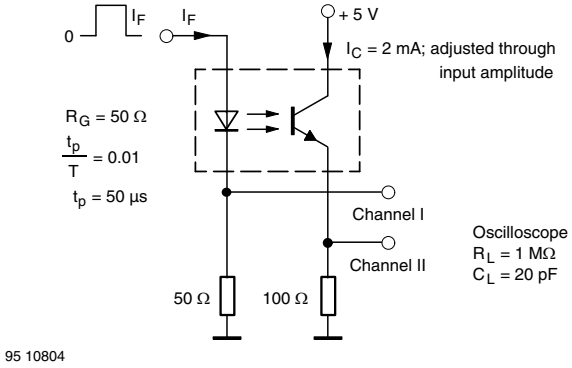



Fig. 3 - Test Circuit, Non-Saturated Operation

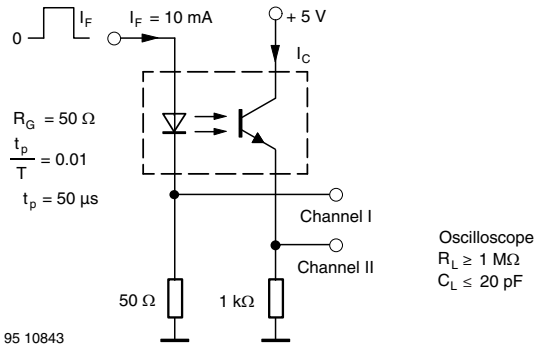



Fig. 4 - Test Circuit, Saturated Operation

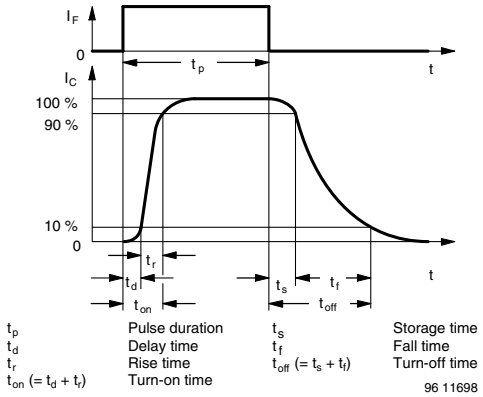



Fig. 5 - Switching Times

| **SAFETY AND INSULATION RATINGS** ($T_{amb}$ = 25 °C, unless otherwise specified) | | | | |
|---|---|---|---|---|
| **PARAMETER** | **TEST CONDITION** | **SYMBOL** | **MIN.** | **UNIT** |
| Climatic classification | According to IEC 68 part 1 | | 55 / 100 / 21 | |
| Pollution degree | According to DIN VDE 0109 | | 2 | |
| Comparative tracking index | Insulation group IIIa | CTI | 175 | |
| Maximum rated withstanding isolation voltage | According to UL1577, t = 1 min | $V_{ISO}$ | 5000 | $V_{RMS}$ |
| Maximum transient isolation voltage | According to DIN EN 60747-5-5 | $V_{IOTM}$ | 6000 | $V_{peak}$ |
| Maximum repetitive peak isolation voltage | According to DIN EN 60747-5-5 | $V_{IORM}$ | 850 | $V_{peak}$ |
| Isolation resistance | $T_{amb}$ = 25 °C, $V_{IO}$ = 500 V | $R_{IO}$ | ≥ $10^{12}$ | Ω |
| | $T_{amb}$ = 100 °C, $V_{IO}$ = 500 V | $R_{IO}$ | ≥ $10^{11}$ | Ω |
| | $T_{amb}$ = $T_S$, $V_{IO}$ = 500 V | $R_{IO}$ | ≥ $10^{9}$ | Ω |
| Output safety power | | $P_{SO}$ | 265 | mW |
| Input safety current | | $I_{SI}$ | 130 | mA |
| Input safety temperature | | $T_S$ | 150 | °C |
| Creepage distance | DIP-4 | | ≥ 7 | mm |
| Clearance distance | | | ≥ 7 | mm |
| Creepage distance | DIP-4, 400 mil | | ≥ 8 | mm |
| Clearance distance | | | ≥ 8 | mm |
| Insulation thickness | | DTI | ≥ 0.4 | mm |
| Input to output test voltage, method B | $V_{IORM}$ x 1.875 = $V_{PR}$, 100 % production test with $t_M$ = 1 s, partial discharge < 5 pC | $V_{PR}$ | 1600 | $V_{peak}$ |
| Input to output test voltage, method A | $V_{IORM}$ x 1.6 = $V_{PR}$, 100 % sample test with $t_M$ = 10 s, partial discharge < 5 pC | $V_{PR}$ | 1300 | $V_{peak}$ |

**TYPICAL CHARACTERISTICS** ($T_{amb}$ = 25 °C, unless otherwise specified)

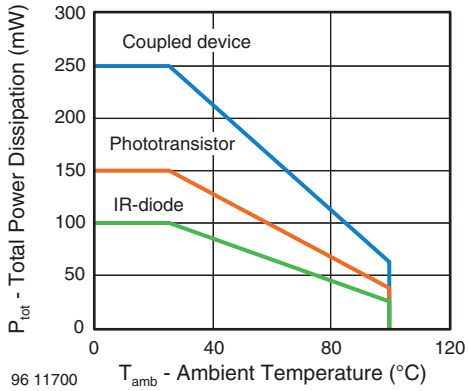



Fig. 6 - Total Power Dissipation vs. Ambient Temperature

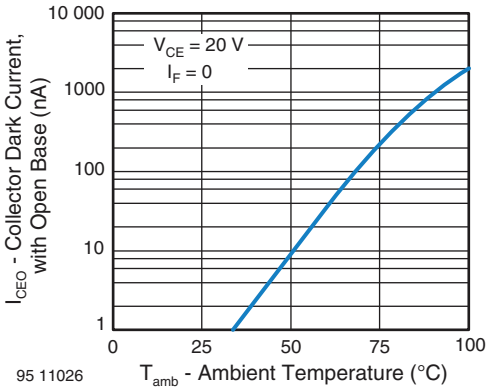



Fig. 9 - Collector Dark Current vs. Ambient Temperature

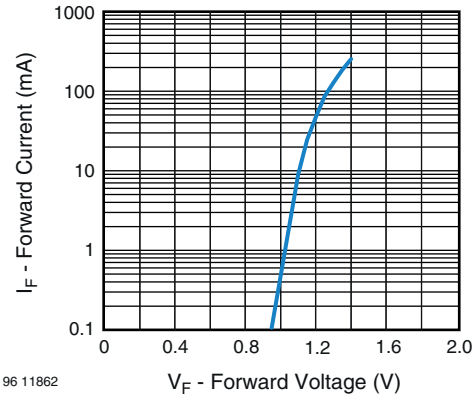



Fig. 7 - Forward Current vs. Forward Voltage

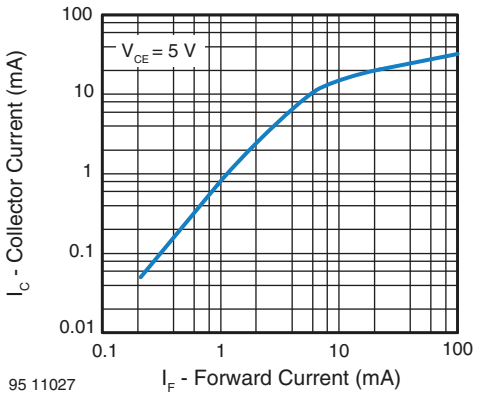



Fig. 10 - Collector Current vs. Forward Current

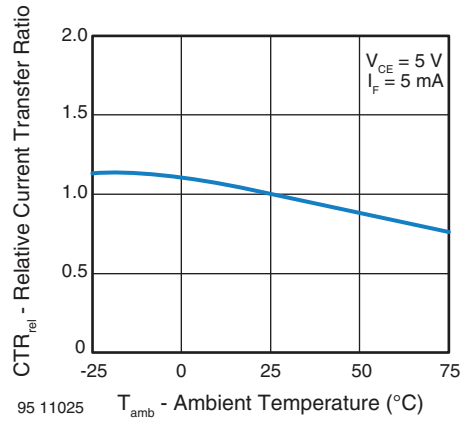



Fig. 8 - Relative Current Transfer Ratio vs. Ambient Temperature

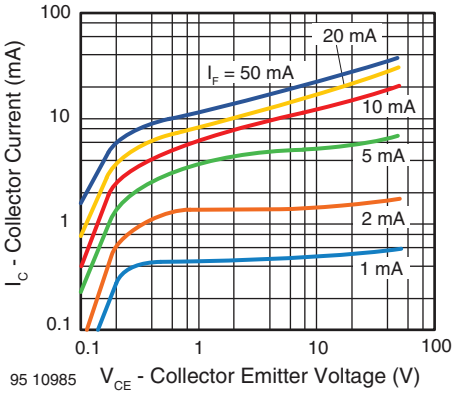



Fig. 11 - Collector Current vs. Collector Emitter Voltage

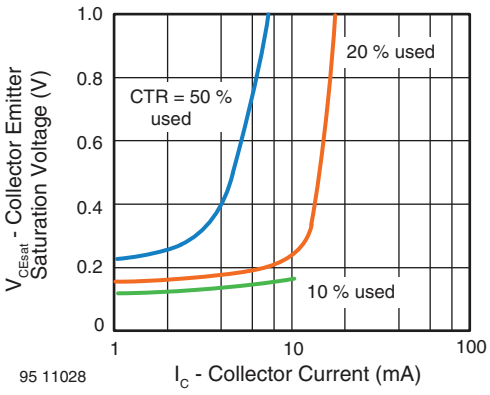



Fig. 12 - Collector Emitter Saturation Voltage vs. Collector Current

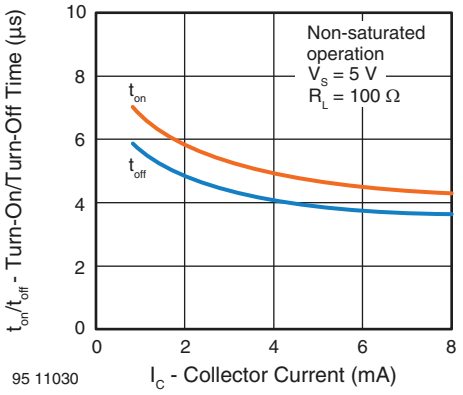



Fig. 14 - Turn-On / Off Time vs. Collector Current

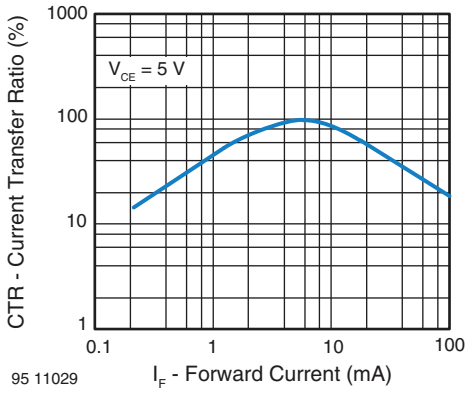



Fig. 13 - Current Transfer Ratio vs. Forward Current

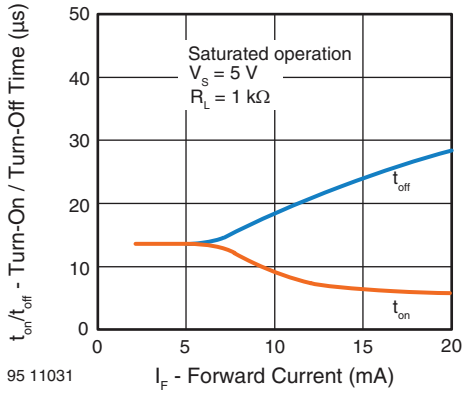
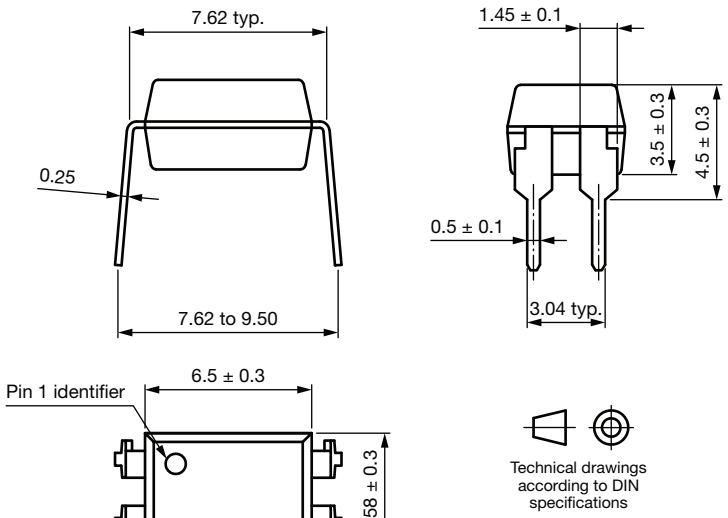



Fig. 15 - Turn-On / Off Time vs. Forward Current

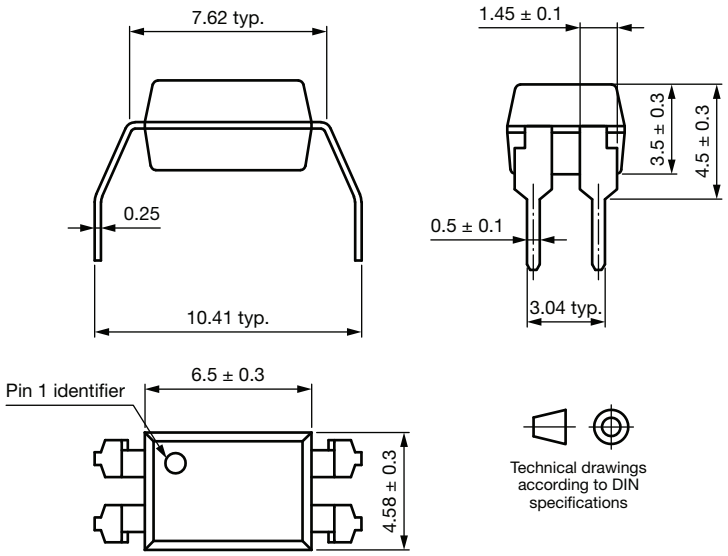
## PACKAGE DIMENSIONS in millimeters

### DIP-4




Drawing-No.: 6.544-5436.01-4

### DIP-4, 400 mil

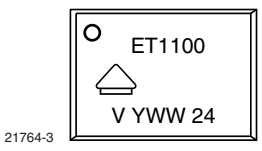



Drawing-No.: 6.544-5437.01-4

## PACKING INFORMATION (in millimeters)

| TUBE PACKING | | | |
|---|---|---|---|
| **TYPE** | **UNITS/TUBE** | **TUBES/BOX** | **UNITS/BOX** |
| DIP-4, standard and option 6 | 100 | 40 | 4000 |

## PACKAGE MARKING



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