

Optocoupler, Phototransistor Output, High Temperature



17197_1

DESCRIPTION

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

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

VDE STANDARDS

These couplers perform safety functions according to the following equipment standards:

- **DIN EN 60747-5-5**
Optocoupler for electrical safety requirements
- **IEC 60950/EN 60950**
Office machines (applied for reinforced isolation for mains voltage $\leq 400 V_{RMS}$)
- **VDE 0804**
Telecommunication apparatus and data processing
- **IEC 60065**
Safety for mains-operated electronic and related household apparatus

FEATURES

- Extra low coupling capacity - typical 0.2 pF
- High common mode rejection
- Low temperature coefficient of CTR
- CTR offered in 9 groups
- Reinforced isolation provides circuit protection against electrical shock (safety class II)
- Isolation materials according to UL94-VO
- Pollution degree 2 (DIN/VDE 0110/resp. IEC 60664)
- Climatic classification 55/100/21 (IEC 60068 part 1)
- Rated impulse voltage (transient overvoltage) $V_{IOTM} = 8 \text{ kV}_{peak}$
- Isolation test voltage (partial discharge test voltage) $V_{pd} = 1.6 \text{ kV}$
- Rated isolation voltage (RMS includes DC) $V_{IOWM} = 600 V_{RMS}$
- Rated recurring peak voltage (repetitive) $V_{IORM} = 848 V_{peak}$
- Thickness through insulation $\geq 0.75 \text{ mm}$
- Creepage current resistance according to VDE 0303/ IEC 60112 comparative tracking index: $CTI \geq 175$
- Lead (Pb)-free component
- Component in accordance to RoHS 2002/95/EC and WEEE 2002/96/EC



RoHS
COMPLIANT

APPLICATIONS

- switch-mode power supplies
- line receiver
- computer peripheral interface
- microprocessor system interface
- Circuits for safe protective separation against electrical shock according to safety class II (reinforced isolation):
 - for appl. class I - IV at mains voltage $\leq 300 \text{ V}$
 - for appl. class I - III at mains voltage $\leq 600 \text{ V}$ according to DIN EN 60747-5-5.

AGENCY APPROVALS

- UL1577, file no. E76222 system code U, double protection
- CSA 22.2 bulletin 5A, double protection
- BSI: EN 60065:2002, EN 60950:2000 certificate no. 7081 and 7402
- DIN EN 60747-5-5
- FIMKO



TCET1100/TCET1100G

Optocoupler, Phototransistor Output, Vishay Semiconductors
High Temperature

| ORDER INFORMATION | |
|-------------------|-------------------------|
| PART | REMARKS |
| TCET1100 | CTR 50 to 600 %, DIP-4 |
| TCET1101 | CTR 40 to 80 %, DIP-4 |
| TCET1102 | CTR 63 to 125 %, DIP-4 |
| TCET1103 | CTR 100 to 200 %, DIP-4 |
| TCET1104 | CTR 160 to 320 %, DIP-4 |
| TCET1105 | CTR 50 to 150 %, DIP-4 |
| TCET1106 | CTR 100 to 300 %, DIP-4 |
| TCET1107 | CTR 80 to 160 %, DIP-4 |
| TCET1108 | CTR 130 to 260 %, DIP-4 |
| TCET1109 | CTR 200 to 400 %, DIP-4 |
| TCET1100G | CTR 50 to 600 %, DIP-4 |
| TCET1101G | CTR 40 to 80 %, DIP-4 |
| TCET1102G | CTR 63 to 125 %, DIP-4 |
| TCET1103G | CTR 100 to 200 %, DIP-4 |
| TCET1104G | CTR 160 to 320 %, DIP-4 |
| TCET1105G | CTR 50 to 150 %, DIP-4 |
| TCET1106G | CTR 100 to 300 %, DIP-4 |
| TCET1107G | CTR 80 to 160 %, DIP-4 |
| TCET1108G | CTR 130 to 260 %, DIP-4 |
| TCET1109G | CTR 200 to 400 %, DIP-4 |

Note

G = lead form 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 | 6 | V |
| Forward current | | I_F | 60 | mA |
| Forward surge current | $t_p \leq 10 \mu s$ | 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 | | | | |
| Isolation test voltage (RMS) | $t = 1 min$ | V_{ISO} | 5000 | V_{RMS} |
| Operating ambient temperature range | | T_{amb} | - 40 to + 100 | °C |
| Storage temperature range | | T_{stg} | - 55 to + 125 | °C |
| Soldering temperature | 2 mm from case, $\leq 10 s$ | 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).

| THERMAL CHARACTERISTICS (1) | | | | |
|---|----------------|---------------|-------|------|
| PARAMETER | TEST CONDITION | SYMBOL | VALUE | UNIT |
| LED power dissipation | at 25 °C | P_{diss} | 100 | mW |
| Output power dissipation | at 25 °C | 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 | | θ_{EB} | 173 | °C/W |
| Thermal resistance, junction emitter to case | | θ_{EC} | 149 | °C/W |
| Thermal resistance, junction detector to board | | θ_{DB} | 111 | °C/W |
| Thermal resistance, junction detector to case | | θ_{DC} | 127 | °C/W |
| Thermal resistance, junction emitter to junction detector | | θ_{ED} | 173 | °C/W |
| Thermal resistance, board to ambient (2) | | θ_{BA} | 197 | °C/W |
| Thermal resistance, case to ambient (2) | | θ_{CA} | 4041 | °C/W |

Notes

(1) 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.

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



| ELECTRICAL CHARACTERISTICS | | | | | | |
|--------------------------------------|---|-------------|------|------|------|------|
| 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 | $V_R = 0, f = 1 \text{ MHz}$ | C_j | | 50 | | pF |
| OUTPUT | | | | | | |
| Collector emitter voltage | $I_C = 1 \text{ mA}$ | V_{CE0} | 70 | | | V |
| Emitter collector voltage | $I_E = 100 \mu\text{A}$ | V_{ECO} | 7 | | | V |
| Collector emitter cut-off current | $V_{CE} = 20 \text{ V}, I_F = 0 \text{ A}, E = 0$ | I_{CEO} | | 10 | 100 | 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

$T_{amb} = 25 \text{ °C}$, unless otherwise specified.

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 | TCET1101 TCET1101G | CTR | 13 | 30 | | % |
| | | TCET1102 TCET1102G | CTR | 22 | 45 | | % |
| | | TCET1103 TCET1103G | CTR | 34 | 70 | | % |
| | | TCET1104 TCET1104G | CTR | 56 | 90 | | % |
| | V _{CE} = 5 V, I _F = 5 mA | TCET1100 TCET1100G | CTR | 50 | | 600 | % |
| | | TCET1105 TCET1105G | CTR | 50 | | 150 | % |
| | | TCET1106 TCET1106G | CTR | 100 | | 300 | % |
| | | TCET1107 TCET1107G | CTR | 80 | | 160 | % |
| | | TCET1108 TCET1108G | CTR | 130 | | 260 | % |
| | V _{CE} = 5 V, I _F = 10 mA | TCET1109 TCET1109G | CTR | 200 | | 400 | % |
| | | TCET1101 TCET1101G | CTR | 40 | | 80 | % |
| | | TCET1102 TCET1102G | CTR | 63 | | 125 | % |
| TCET1103 TCET1103G | | CTR | 100 | | 200 | % | |
| | | TCET1104 TCET1104G | CTR | 160 | | 320 | % |

| 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 60747-5-5 (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 s | V _{pd} | 1.6 | | | kV |
| Partial discharge test voltage - lot test (sample test) | t _{Tr} = 60 s, t _{test} = 10 s, (see figure 2) | V _{IOTM} | 8 | | | kV |
| | | V _{pd} | 1.3 | | | kV |
| Insulation resistance | V _{IO} = 500 V | R _{IO} | 10 ¹² | | | Ω |
| | V _{IO} = 500 V, T _{amb} = 100 °C | R _{IO} | 10 ¹¹ | | | Ω |
| | V _{IO} = 500 V, T _{amb} = 150 °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-; IEC60747

| 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 | | 3.0 | | μs |
| Rise time | $V_S = 5\text{ V}$, $I_C = 2\text{ mA}$, $R_L = 100\ \Omega$, (see figure 3) | t_r | | 3.0 | | μs |
| Turn-on time | $V_S = 5\text{ V}$, $I_C = 2\text{ mA}$, $R_L = 100\ \Omega$, (see figure 3) | t_{on} | | 6.0 | | μs |
| Storage time | $V_S = 5\text{ V}$, $I_C = 2\text{ mA}$, $R_L = 100\ \Omega$, (see figure 3) | t_s | | 0.3 | | μs |
| Fall time | $V_S = 5\text{ V}$, $I_C = 2\text{ mA}$, $R_L = 100\ \Omega$, (see figure 3) | t_f | | 4.7 | | μs |
| Turn-off time | $V_S = 5\text{ V}$, $I_C = 2\text{ mA}$, $R_L = 100\ \Omega$, (see figure 3) | t_{off} | | 5.0 | | μs |
| Turn-on time | $V_S = 5\text{ V}$, $I_F = 10\text{ mA}$, $R_L = 1\text{ k}\Omega$, (see figure 4) | t_{on} | | 9.0 | | μs |
| Turn-off time | $V_S = 5\text{ V}$, $I_F = 10\text{ mA}$, $R_L = 1\text{ k}\Omega$, (see figure 4) | t_{off} | | 10.0 | | μs |



95 10804

Fig. 3 - Test Circuit, Non-Saturated Operation



95 10843

Fig. 4 - Test Circuit, Saturated Operation

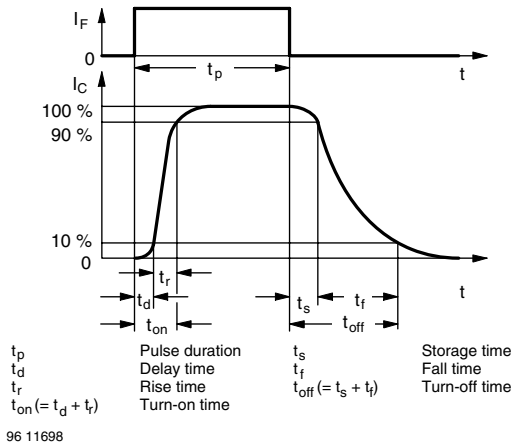


Fig. 5 - Switching Times

TYPICAL CHARACTERISTICS

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

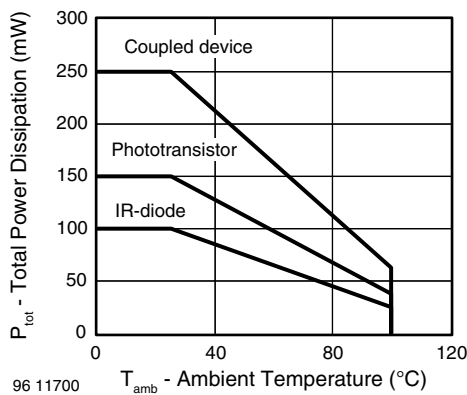


Fig. 6 - Total Power Dissipation vs. Ambient Temperature

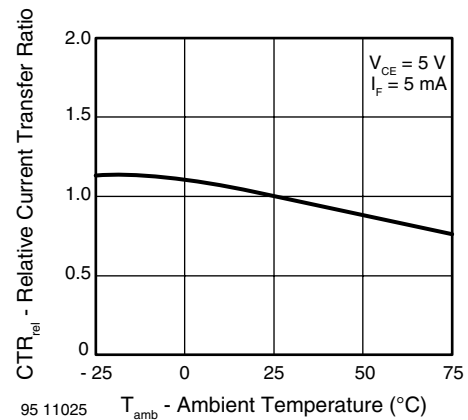


Fig. 8 - Relative Current Transfer Ratio vs. Ambient Temperature



Fig. 7 - Forward Current vs. Forward Voltage

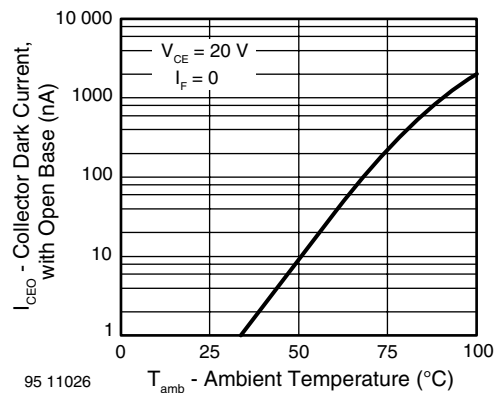


Fig. 9 - Collector Dark Current vs. Ambient Temperature



95 11027

Fig. 10 - Collector Current vs. Forward Current



95 11029

Fig. 13 - Current Transfer Ratio vs. Forward Current



95 10985

Fig. 11 - Collector Current vs. Collector Emitter Voltage



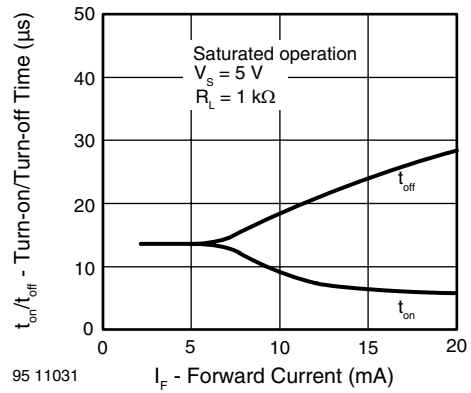
95 11030

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



95 11028

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



95 11031

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



TCET1100/TCET1100G

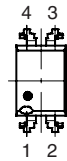
Optocoupler, Phototransistor Output, Vishay Semiconductors
High Temperature

PACKAGE DIMENSIONS in millimeters



E. g.:
Special features: endstackable
to 2.54 mm (0.100") spacing

Weight: ca. 0.25 g
Creepage distance: > 6 mm
Air path: > 6 mm
after mounting on PC board



Drawing-No.: 6.544-5302.03-4
Issue: 5; 20.03.02



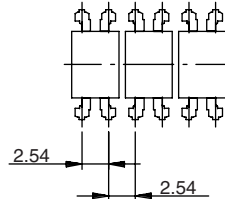
technical drawings
according to DIN
specifications

14789



E. g.:
Special features: endstackable
to 2.54 mm (0.100") spacing

Weight: ca. 0.25 g
Creepage distance: > 8 mm
Air path: > 8 mm
after mounting on PC board



Drawing-No.: 6.544-5303.03-4
Issue: 4; 20.03.02



technical drawings
according to DIN
specifications

14792

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