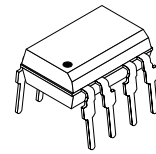
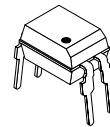
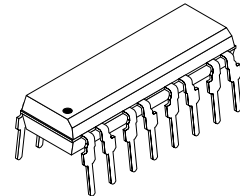


## Optocoupler with Phototransistor Output

### Description

The TCET1600/ TCET2600/ TCET4600 consists of a phototransistor optically coupled to 2 gallium arsenide infrared-emitting diodes in a 4-lead up to 16-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.



14925

### Applications

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

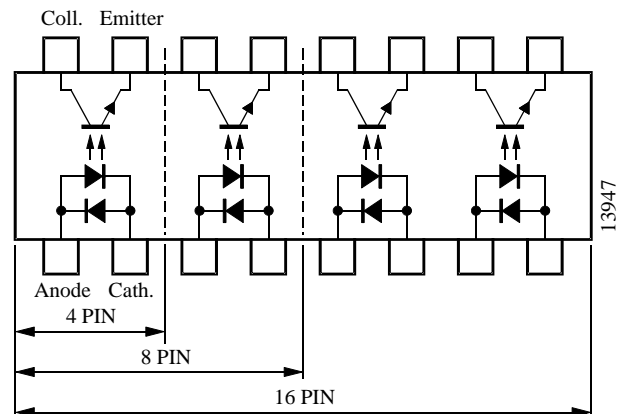
- For appl. class I – IV at mains voltage  $\leq 300\text{ V}$
- For appl. class I – III at mains voltage  $\leq 600\text{ V}$  according to VDE 0884, table 2, suitable for:

**Computer peripheral interface, microprocessor system interface, telecom equipment.**

### VDE Standards

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

- **VDE 0884**  
Optocoupler for electrical safety requirements
- **IEC 950/EN 60950**  
Office machines (applied for reinforced isolation for mains voltage  $\leq 400\text{ V}_{\text{RMS}}$ )
- **VDE 0804**  
Telecommunication apparatus and data processing
- **IEC 65**  
Safety for mains-operated electronic and related household apparatus



**0884**

### Order Instruction

| Ordering Code                     | CTR Ranking | Remarks                |
|-----------------------------------|-------------|------------------------|
| TCET1600/ TCET1600G <sup>1)</sup> | >20%        | 4 Pin = Single channel |
| TCET2600                          | >20%        | 8 Pin = Dual channel   |
| TCET4600                          | >20%        | 16 Pin = Quad channel  |

<sup>1)</sup> G = Leadform 10.16 mm; G is not market on the body



### Features

#### Approvals:

- **BSI:** BS EN 41003, BS EN 60095 (BS 415), BS EN 60950 (BS 7002), Certificate number 7081 and 7402
- **FIMKO (SETI):** EN 60950, Certificate number 11027
- **Underwriters Laboratory (UL) 1577** recognized, file number E-76222 – Double Protection
- **CSA (C-UL) 1577** recognized, file number E-76222 – Double Protection
- **VDE 0884**, Certificate number 115667

#### VDE 0884 related features:

- Rated impulse voltage (transient overvoltage)  $V_{IOTM} = 8$  kV peak
- Isolation test voltage (partial discharge test voltage)  $V_{pd} = 1.6$  kV peak
- Rated isolation voltage (RMS includes DC)  $V_{IOWM} = 600$   $V_{RMS}$  (848 V peak)
- Rated recurring peak voltage (repetitive)  $V_{IORM} = 600$   $V_{RMS}$

- Creepage current resistance according to VDE 0303/IEC 112  
**Comparative Tracking Index: CTI  $\geq 175$**
- Thickness though insulation  $\geq 0.75$  mm
- Internal creepage distance  $> 4$  mm

#### General features:

- Isolation materials according to UL94-VO
- Pollution degree 2 (DIN/VDE 0110 /resp. IEC 664)
- Climatic classification 55/100/21 (IEC 68 part 1)
- Special construction: Therefore, extra low coupling capacity of typical 0.2 pF, high **Common Mode Rejection**
- Low temperature coefficient of CTR
- **G = Leadform 10.16 mm;** provides creepage distance  $> 8$  mm, for TCET2600/ TCET4600 optional; suffix letter 'G' is not marked on the optocoupler
- Coupling System U

### Absolute Maximum Ratings

#### Input (Emitter)

| Parameter             | Test Conditions           | Symbol    | Value     | Unit       |
|-----------------------|---------------------------|-----------|-----------|------------|
| Reverse voltage       |                           | $V_R$     | 6         | V          |
| Forward current       |                           | $I_F$     | $\pm 60$  | mA         |
| Forward surge current | $t_p \leq 10 \mu s$       | $I_{FSM}$ | $\pm 1.5$ | A          |
| Power dissipation     | $T_{amb} \leq 25^\circ C$ | $P_V$     | 100       | mW         |
| Junction temperature  |                           | $T_j$     | 125       | $^\circ C$ |

#### Output (Detector)

| Parameter                 | Test Conditions               | Symbol    | Value | Unit       |
|---------------------------|-------------------------------|-----------|-------|------------|
| 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         |
| Power dissipation         | $T_{amb} \leq 25^\circ C$     | $P_V$     | 150   | mW         |
| Junction temperature      |                               | $T_j$     | 125   | $^\circ C$ |

#### Coupler

| Parameter                           | Test Conditions              | Symbol    | Value       | Unit       |
|-------------------------------------|------------------------------|-----------|-------------|------------|
| Isolation test voltage (RMS)        | $t = 1$ min                  | $V_{IO}$  | 5           | kV         |
| Total power dissipation             | $T_{amb} \leq 25^\circ C$    | $P_{tot}$ | 250         | mW         |
| Operating ambient temperature range |                              | $T_{amb}$ | -40 to +100 | $^\circ C$ |
| Storage temperature range           |                              | $T_{stg}$ | -55 to +125 | $^\circ C$ |
| Soldering temperature               | 2 mm from case $t \leq 10$ s | $T_{sd}$  | 260         | $^\circ C$ |

**Electrical Characteristics** ( $T_{amb} = 25^{\circ}\text{C}$ )

## Input (Emitter)

| Parameter            | Test Conditions                        | Symbol | Min. | Typ. | Max. | Unit |
|----------------------|--|--------|------|------|------|------|
| Forward voltage      | $I_F = \pm 50 \text{ mA}$              | $V_F$  |      | 1.25 | 1.6  | V    |
| Junction capacitance | $V_R = 0 \text{ V}, f = 1 \text{ MHz}$ | $C_j$  |      | 50   |      | pF   |

## Output (Detector)

| Parameter                 | Test Conditions                         | Symbol    | Min. | Typ. | Max. | Unit |
|---------------------------|---|-----------|------|------|------|------|
| Collector emitter voltage | $I_C = 100 \mu\text{A}$                 | $V_{CEO}$ | 70   |      |      | V    |
| Emitter collector voltage | $I_E = 100 \mu\text{A}$                 | $V_{CEO}$ | 7    |      |      | V    |
| Collector dark current    | $V_{CE} = 20 \text{ V}, I_f = 0, E = 0$ | $I_{CEO}$ |      |      | 100  | nA   |

## Coupler

| Parameter                            | Test Conditions   | Symbol      | Min. | Typ. | Max. | Unit |
|--------------------------------------|---|-------------|------|------|------|------|
| Collector emitter saturation voltage | $I_F \pm 10 \text{ mA}, I_C = 1 \text{ mA}$                     | $V_{CEsat}$ |      |      | 0.3  | V    |
| Cut-off frequency                    | $V_{CE} = 5 \text{ V}, I_F \pm 10 \text{ mA}, R_L = 100 \Omega$ | $f_c$       |      | 100  |      | kHz  |
| Coupling capacitance                 | $f = 1 \text{ MHz}$   | $C_k$       |      | 0.3  |      | pF   |

## Current Transfer Ratio (CTR)

| Parameter | Test Conditions                                | Type                          | Symbol | Min. | Typ. | Max. | Unit |
|-----------|--|-------------------------------|--------|------|------|------|------|
| $I_C/I_F$ | $V_{CE} = 5 \text{ V}, I_F = \pm 5 \text{ mA}$ | TCET1600<br>up to<br>TCET4600 | CTR    | 0.20 |      | 3.0  |      |



### Maximum Safety Ratings (according to VDE 0884) see figure 1

This device is used for protective separation against electrical shock only within the maximum safety ratings. This must be ensured by using protective circuits in the applications.

#### Input (Emitter)

| Parameters      | Test Conditions | Symbol   | Value | Unit |
|-----------------|-----------------|----------|-------|------|
| Forward current |                 | $I_{si}$ | 130   | mA   |

#### Output (Detector)

| Parameters        | Test Conditions                 | Symbol   | Value | Unit |
|-------------------|---------------------------------|----------|-------|------|
| Power dissipation | $T_{amb} \leq 25^\circ\text{C}$ | $P_{si}$ | 265   | mW   |

#### Coupler

| Parameters            | Test Conditions | Symbol     | Value | Unit             |
|-----------------------|-----------------|------------|-------|------------------|
| Rated impulse voltage |                 | $V_{IOTM}$ | 8     | kV               |
| Safety temperature    |                 | $T_{si}$   | 150   | $^\circ\text{C}$ |

### Insulation Rated Parameters (according to VDE 0884)

| Parameter   | Test Conditions  | 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) | $t_{Tr} = 60\text{ s}$ , $t_{test} = 10\text{ s}$ ,<br>(see figure 2)                  | $V_{IOTM}$ | 8         |      |      | kV       |
|   |  | $V_{pd}$   | 1.3       |      |      | kV       |
| Insulation resistance                                   | $V_{IO} = 500\text{ V}$  | $R_{IO}$   | $10^{12}$ |      |      | $\Omega$ |
|   | $V_{IO} = 500\text{ V}$ ,<br>$T_{amb} = 100^\circ\text{C}$                             | $R_{IO}$   | $10^{11}$ |      |      | $\Omega$ |
|   | $V_{IO} = 500\text{ V}$ ,<br>$T_{amb} = 150^\circ\text{C}$<br>(construction test only) | $R_{IO}$   | $10^9$    |      |      | $\Omega$ |

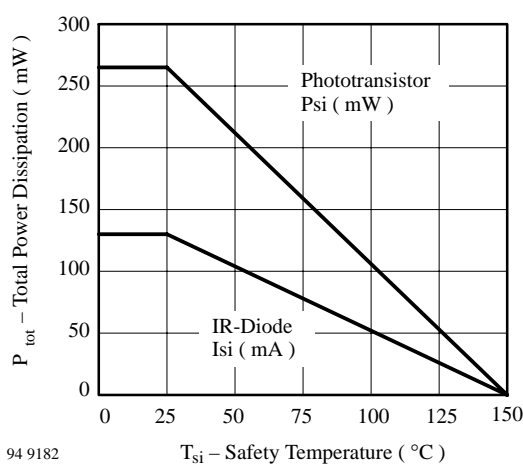


Figure 1. Derating diagram

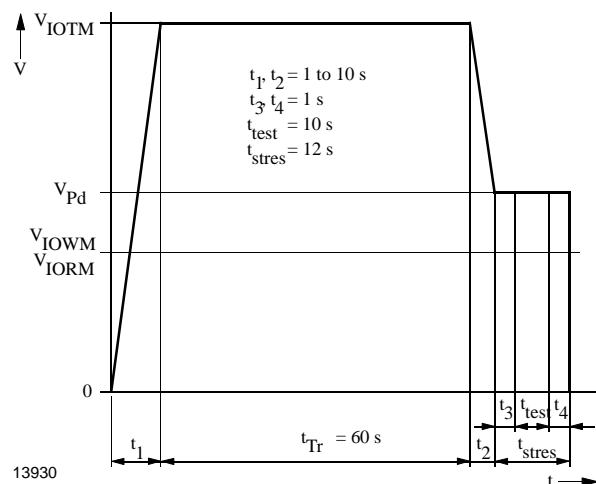


Figure 2. Test pulse diagram for sample test according to DIN VDE 0884

## Switching Characteristics

| Parameter     | Test Conditions   | Symbol    | Typ. | Unit          |
|---------------|---|-----------|------|---------------|
| Delay time    | $V_S = 5\text{ V}$ , $I_C = 2\text{ mA}$ , $R_L = 100\ \Omega$ (see figure 3)       | $t_d$     | 3.0  | $\mu\text{s}$ |
| Rise time     |   | $t_r$     | 3.0  | $\mu\text{s}$ |
| Turn-on time  |   | $t_{on}$  | 6.0  | $\mu\text{s}$ |
| Storage time  |   | $t_s$     | 0.3  | $\mu\text{s}$ |
| Fall time     |   | $t_f$     | 4.7  | $\mu\text{s}$ |
| Turn-off time |   | $t_{off}$ | 5.0  | $\mu\text{s}$ |
| Turn-on time  | $V_S = 5\text{ V}$ , $I_F = 10\text{ mA}$ , $R_L = 1\text{ k}\Omega$ (see figure 4) | $t_{on}$  | 9.0  | $\mu\text{s}$ |
| Turn-off time |   | $t_{off}$ | 10.0 | $\mu\text{s}$ |

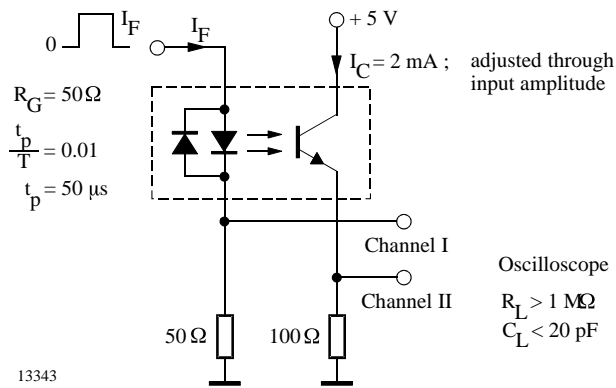


Figure 3. Test circuit, non-saturated operation

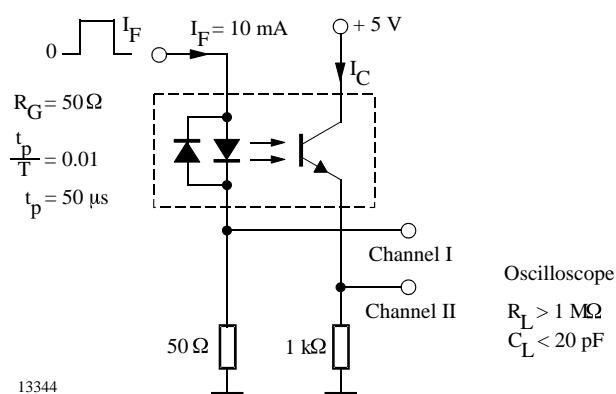


Figure 4. Test circuit, saturated operation

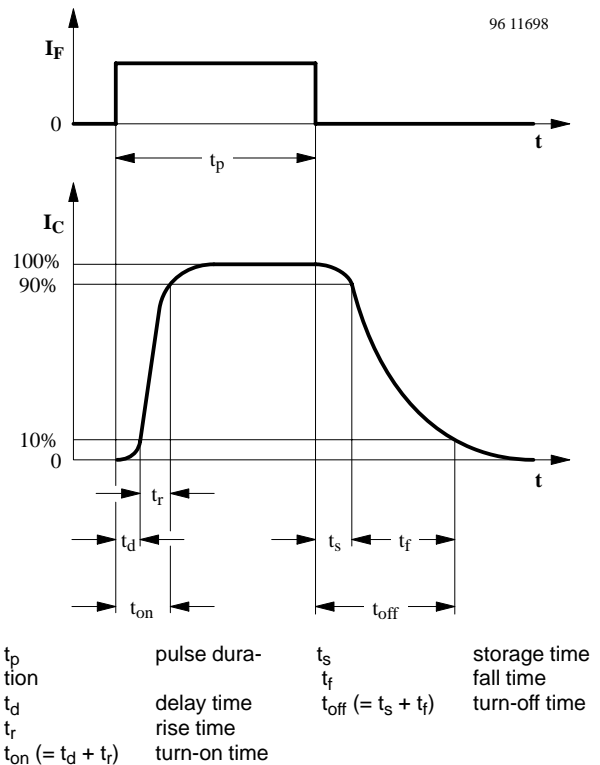


Figure 5. Switching times



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

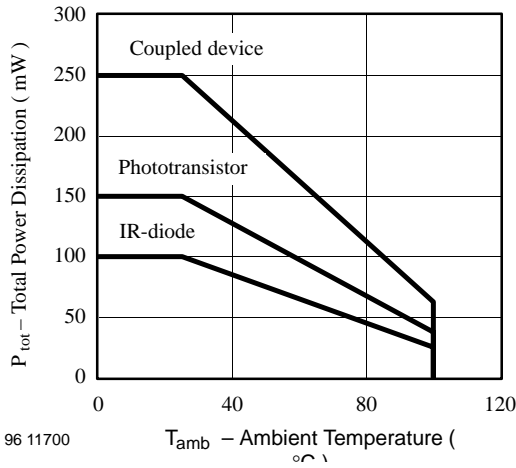


Figure 6. Total Power Dissipation vs. Ambient Temperature

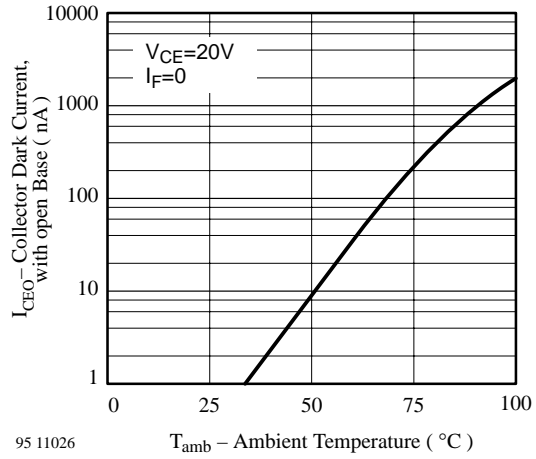


Figure 9. Collector Dark Current vs. Ambient Temperature

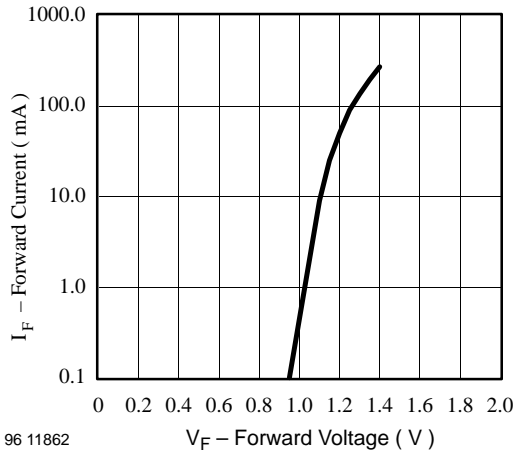


Figure 7. Forward Current vs. Forward Voltage

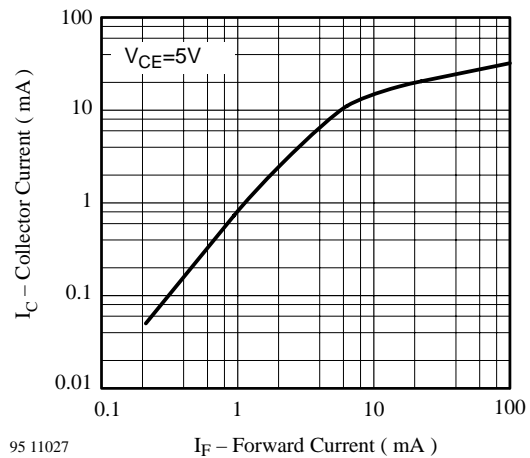


Figure 10. Collector Current vs. Forward Current

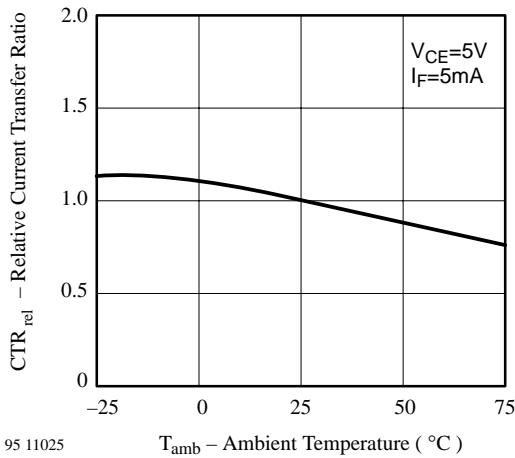


Figure 8. Relative Current Transfer Ratio vs. Ambient Temperature

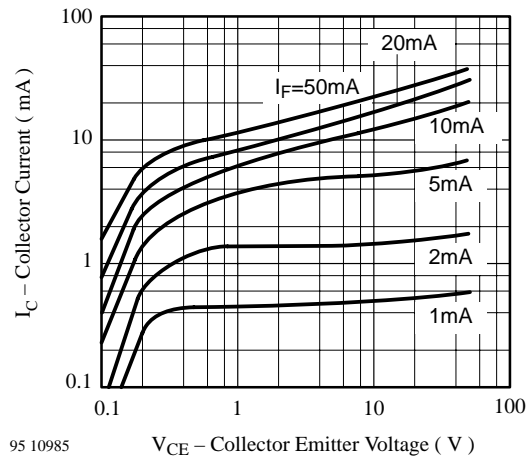
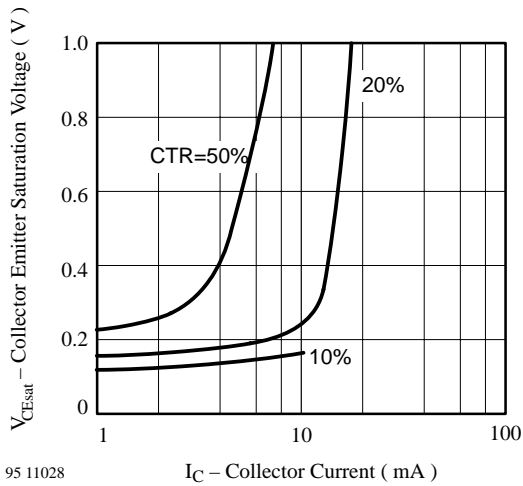
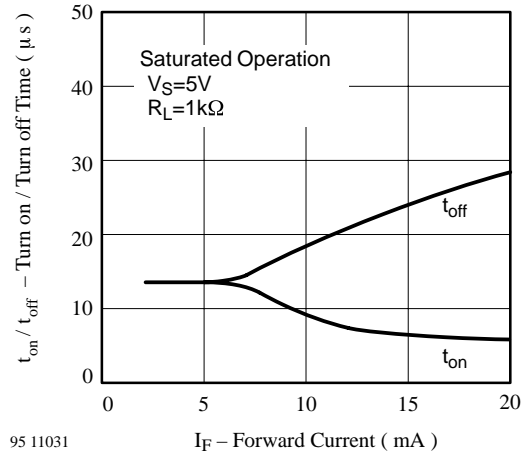


Figure 11. Collector Current vs. Collector Emitter Voltage



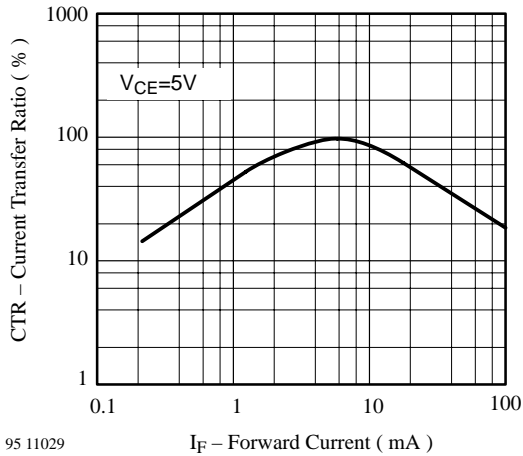
95 11028

Figure 12. Collector Emitter Saturation Voltage vs. Collector Current



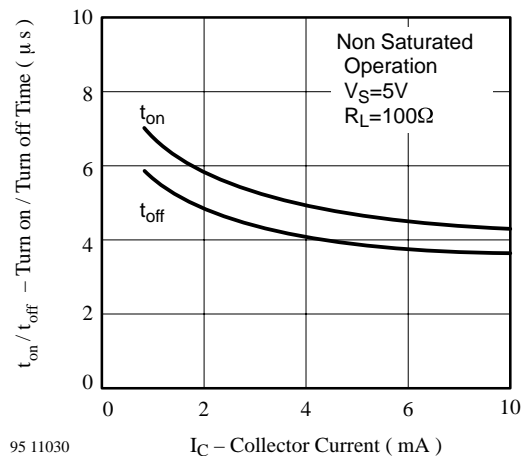
95 11031

Figure 14. Turn on / off Time vs. Forward Current



95 11029

Figure 13. Current Transfer Ratio vs. Forward Current



95 11030

Figure 15. Turn on / off Time vs. Collector Current

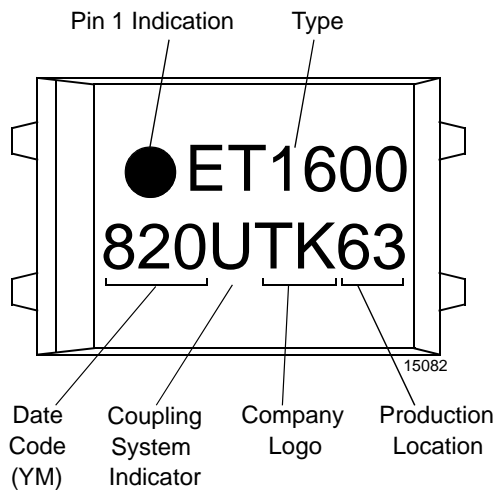


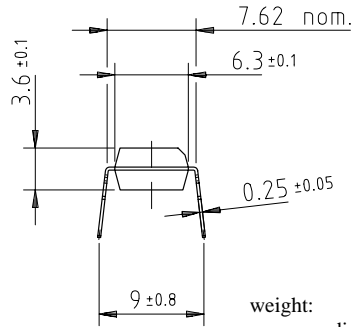
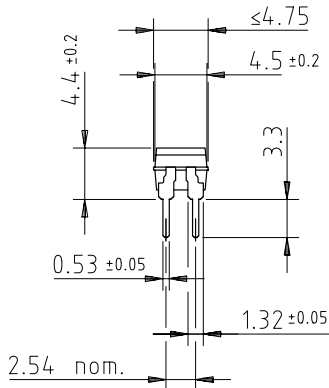
Figure 16. Marking example

# TCET1600 up to TCET4600

Vishay Telefunken



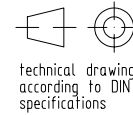
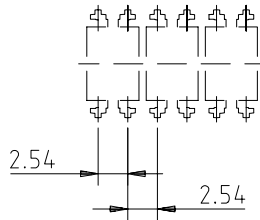
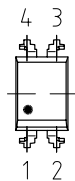
## Dimensions of TCET1600 in mm



weight: ca. 0.25 g  
 creepage distance:  $\cong 6$  mm  
 air path:  $\cong 6$  mm

after mounting on PC board

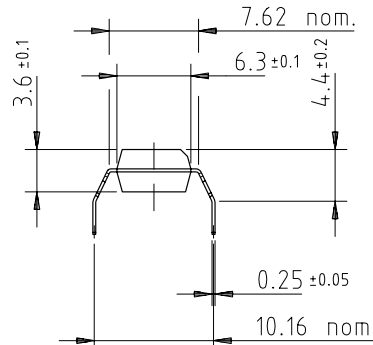
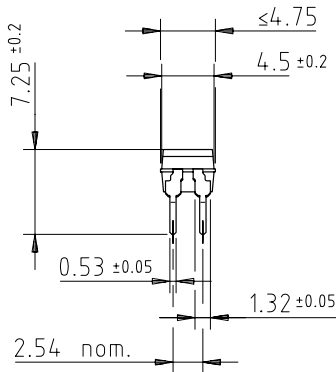
E.g.:  
 special Features: endstackable  
 to 2.54mm ( .100" ) spacing



technical drawings  
 according to DIN  
 specifications

14789

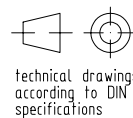
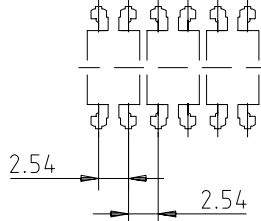
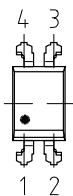
## Dimensions of TCET1600G in mm



weight: ca. 0.25 g  
 creepage distance:  $\cong 8$  mm  
 air path:  $\cong 8$  mm

after mounting on PC board

E.g.:  
 special Features: endstackable  
 to 2.54mm ( .100" ) spacing

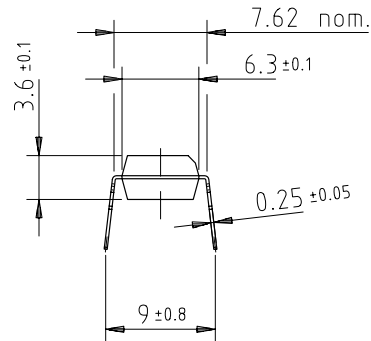
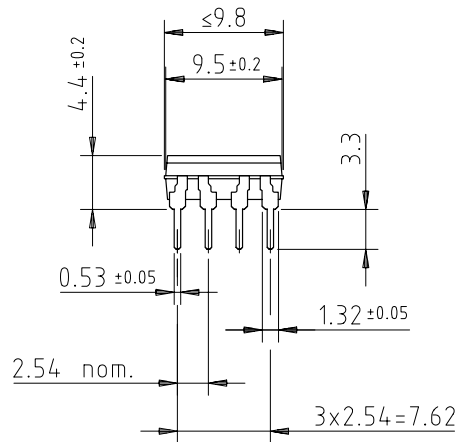


technical drawings  
 according to DIN  
 specifications

14792

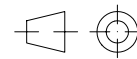
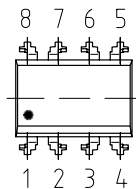


## Dimensions of TCET2600 in mm



weight: ca. 0.55 g  
 creepage distance:  $\geq 6$  mm  
 air path:  $\geq 6$  mm

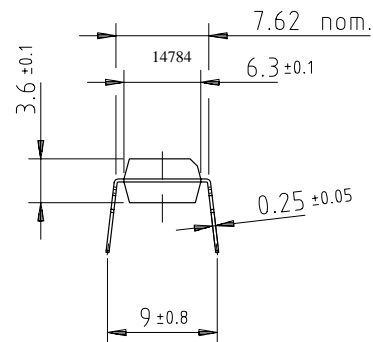
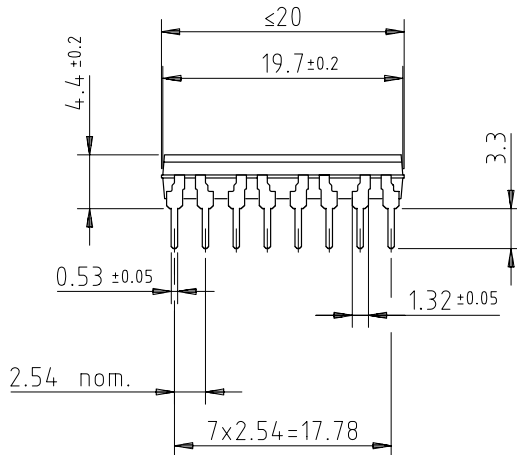
after mounting on PC board



technical drawings according to DIN specifications

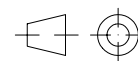
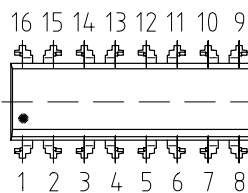
14784

## Dimensions of TCET4600 in mm



weight: ca. 1.0 g  
 creepage distance:  $\geq 6$  mm  
 air path:  $\geq 6$  mm

after mounting on PC board



technical drawings according to DIN specifications

14783