

## Optocoupler, Phototransistor Output

### Features

- Extra low coupling capacity - typical 0.2 pF
- High Common Mode Rejection
- Four CTR groups available
- Lead-free component
- Component in accordance to RoHS 2002/95/EC and WEEE 2002/96/EC

### Agency Approvals

- UL1577, File No. E76222 System Code A, Double Protection
- BSI IEC60950 IEC60065
- DIN EN 60747-5-2 (VDE0884)  
DIN EN 60747-5-5 pending
- FIMKO

### Applications

Switch-mode power supplies

Line receiver

Computer peripheral interface

Microprocessor system interface

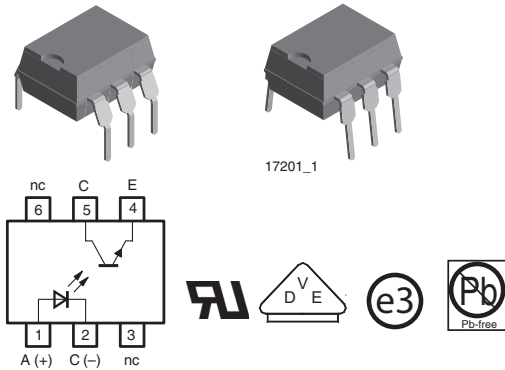
Reinforced Isolation provides circuit protection against electrical shock (Safety Class II)

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

- For appl. class I - IV at mains voltage  $\leq 300$  V
- For appl. class I - III at mains voltage  $\leq 600$  V according to DIN EN 60747-5-2(VDE0884)/ DIN EN 60747-5-5 pending, table 2.

### Description

The TCDT1120(G) series consists of a phototransistor optically coupled to a gallium arsenide infrared-emitting diode in a 6-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 60747-5-2(VDE0884)/ DIN EN 60747-5-5 pending**

Optocoupler for electrical safety requirements  
**IEC 60950/EN 60950**

Office machines (applied for reinforced isolation for mains voltage  $\leq 400$  VRMS)

**VDE 0804**

Telecommunication apparatus and data processing  
**IEC 60065**

Safety for mains-operated electronic and related household apparatus

### Order Information

| Part      | Remarks                |
|-----------|------------------------|
| TCDT1120  | CTR > 40 %, DIP-6      |
| TCDT1122  | CTR 63 - 125 %, DIP-6  |
| TCDT1123  | CTR 100 - 200 %, DIP-6 |
| TCDT1124  | CTR 160 - 320 %, DIP-6 |
| TCDT1120G | CTR > 40 %, DIP-6      |
| TCDT1122G | CTR 63 - 125 %, DIP-6  |
| TCDT1123G | CTR 100 - 200 %, DIP-6 |
| TCDT1124G | CTR 160 - 320 %, DIP-6 |

G = Leadform 10.16 mm; G is not marked on the body

### Absolute Maximum Ratings

$T_{amb} = 25\text{ }^{\circ}\text{C}$ , 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 Rating for extended periods of the time can adversely affect reliability.

### Input

| Parameter             | Test condition                   | Symbol     | Value | Unit               |
|-----------------------|----------------------------------|------------|-------|--------------------|
| Reverse voltage       |                                  | $V_R$      | 5     | V                  |
| Forward current       |                                  | $I_F$      | 60    | mA                 |
| Forward surge current | $t_p \leq 10\text{ }\mu\text{s}$ | $I_{FSM}$  | 3     | A                  |
| Power dissipation     |                                  | $P_{diss}$ | 100   | mW                 |
| Junction temperature  |                                  | $T_j$      | 125   | $^{\circ}\text{C}$ |

### Output

| Parameter                 | Test condition                       | Symbol     | Value | Unit               |
|---------------------------|--------------------------------------|------------|-------|--------------------|
| Collector base voltage    |                                      | $V_{CBO}$  | 90    | V                  |
| Collector emitter voltage |                                      | $V_{CEO}$  | 90    | 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   | $^{\circ}\text{C}$ |

### Coupler

| Parameter                    | Test condition                       | Symbol    | Value         | Unit               |
|------------------------------|--------------------------------------|-----------|---------------|--------------------|
| Isolation test voltage (RMS) | $t = 1\text{ min}$                   | $V_{ISO}$ | 3750          | $V_{RMS}$          |
| Total power dissipation      |                                      | $P_{tot}$ | 250           | mW                 |
| Ambient temperature range    |                                      | $T_{amb}$ | - 55 to + 100 | $^{\circ}\text{C}$ |
| Storage temperature range    |                                      | $T_{stg}$ | - 55 to + 125 | $^{\circ}\text{C}$ |
| Soldering temperature        | 2 mm from case, $t \leq 10\text{ s}$ | $T_{sld}$ | 260           | $^{\circ}\text{C}$ |

### Electrical Characteristics

$T_{amb} = 25\text{ }^{\circ}\text{C}$ , 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.

### Input

| Parameter            | Test condition              | Symbol | Min | Typ. | Max | Unit |
|----------------------|-----------------------------|--------|-----|------|-----|------|
| 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

| Parameter                         | Test condition                   | Symbol    | Min | Typ. | Max | Unit |
|-----------------------------------|----------------------------------|-----------|-----|------|-----|------|
| Collector base voltage            | $I_C = 100 \mu A$                | $V_{CBO}$ | 90  |      |     | V    |
| Collector emitter voltage         | $I_C = 1 \text{ mA}$             | $V_{CEO}$ | 90  |      |     | V    |
| Emitter collector voltage         | $I_E = 100 \mu A$                | $V_{ECO}$ | 7   |      |     | V    |
| Collector-emitter cut-off current | $V_{CE} = 20 \text{ V}, I_f = 0$ | $I_{CEO}$ |     |      | 150 | nA   |

## Coupler

| Parameter                            | Test condition  | Symbol      | Min | Typ. | Max | Unit |
|--------------------------------------|---|-------------|-----|------|-----|------|
| 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   |

## 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<br>TCDT1120G | CTR    | 10  |      |     | %    |
|           |   | TCDT1122<br>TCDT1122G | CTR    | 15  |      |     | %    |
|           |   | TCDT1123<br>TCDT1123G | CTR    | 30  |      |     | %    |
|           |   | TCDT1124<br>TCDT1124G | CTR    | 60  |      |     | %    |
|           | $V_{CE} = 5 \text{ V}, I_F = 10 \text{ mA}$ | TCDT1120<br>TCDT1120G | CTR    | 40  |      |     | %    |
|           |   | TCDT1122<br>TCDT1122G | CTR    | 63  |      | 125 | %    |
|           |   | TCDT1123<br>TCDT1123G | CTR    | 100 |      | 200 | %    |
|           |   | TCDT1124<br>TCDT1124G | CTR    | 160 |      | 320 | %    |

## Maximum Safety Ratings

(according to DIN EN 60747-5-2(VDE0884)/ DIN EN 60747-5-5 pending) 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.

## Input

| Parameter       | Test condition | Symbol | Min | Typ. | Max | Unit |
|-----------------|----------------|--------|-----|------|-----|------|
| Forward current |                | $I_F$  |     |      | 130 | mA   |

## Output

| Parameter         | Test condition | Symbol     | Min | Typ. | Max | Unit |
|-------------------|----------------|------------|-----|------|-----|------|
| Power dissipation |                | $P_{diss}$ |     |      | 265 | mW   |

### Coupler

| Parameter             | Test condition | Symbol     | Min | Typ. | Max | Unit |
|-----------------------|----------------|------------|-----|------|-----|------|
| Rated impulse voltage |                | $V_{IOTM}$ |     |      | 6   | kV   |
| Safety temperature    |                | $T_{si}$   |     |      | 150 | °C   |

### 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)               | $V_{IOTM}$ | 6         |      |     | kV       |
|   |  | $V_{pd}$   | 1.3       |      |     | kV       |
| Insulation resistance                                   | $V_{IO} = 500$ V   | $R_{IO}$   | $10^{12}$ |      |     | $\Omega$ |
|   | $V_{IO} = 500$ V, $T_{amb} \leq 100$ °C                          | $R_{IO}$   | $10^{11}$ |      |     | $\Omega$ |
|   | $V_{IO} = 500$ V, $T_{amb} \leq 150$ °C (construction test only) | $R_{IO}$   | $10^9$    |      |     | $\Omega$ |



Figure 1. Derating diagram



Figure 2. Test pulse diagram for sample test according to DIN EN 60747-5-2(VDE0884)/ DIN EN 60747-; IEC60747

### Switching Characteristics

| Parameter             | Current  | Delay   | Rise time | Storage | Fall time | Turn-on time | Turn-off time                                    | Turn-on time | Turn-off time |
|-----------------------|--|---------|-----------|---------|-----------|--------------|--|--------------|---------------|
| Test condition        | $V_S = 5$ V, $R_L = 100$ $\Omega$ (see figure 3) |         |           |         |           |              | $V_S = 5$ V, $R_L = 1$ k $\Omega$ (see figure 4) |              |               |
| Symbol                | $I_F$  | $t_D$   | $t_r$     | $t_S$   | $t_f$     | $t_{on}$     | $t_{off}$  | $t_{on}$     | $t_{off}$     |
| Unit                  | mA   | $\mu$ s | $\mu$ s   | $\mu$ s | $\mu$ s   | $\mu$ s      | $\mu$ s  | $\mu$ s      | $\mu$ s       |
| TCDT1120<br>TCDT1120G | 10   | 2.5     | 3.0       | 0.3     | 3.7       | 5.5          | 4.0  | 16.5         | 22.5          |
|                       | 10   | 2.5     | 3.0       | 0.3     | 3.7       | 5.5          | 4.0  | 16.5         | 22.5          |
| TCDT1123<br>TCDT1123G | 10   | 2.8     | 4.2       | 0.3     | 4.7       | 7.0          | 5.0  | 21.5         | 37.5          |
| TCDT1124<br>TCDT1124G | 10   | 2.0     | 4.0       | 0.3     | 4.7       | 6.0          | 5.0  | 20.0         | 50.0          |

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

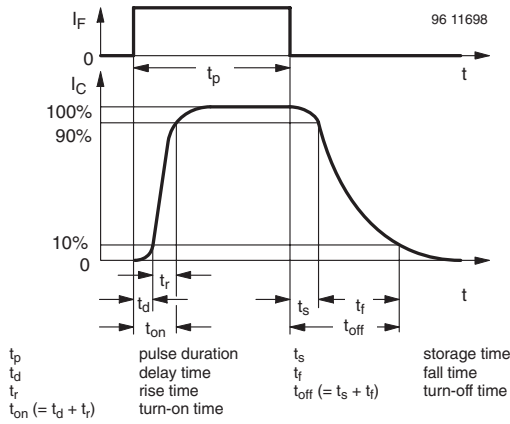


Figure 3. Switching Times

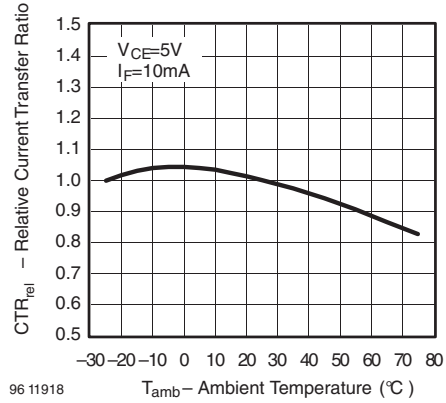


Figure 6. Relative Current Transfer Ratio vs. Ambient Temperature



Figure 4. Total Power Dissipation vs. Ambient Temperature

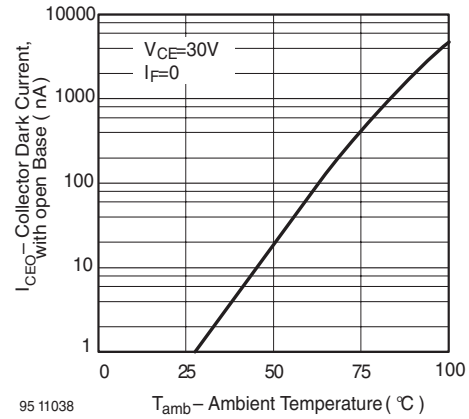


Figure 7. Collector Dark Current vs. Ambient Temperature



Figure 5. Forward Current vs. Forward Voltage

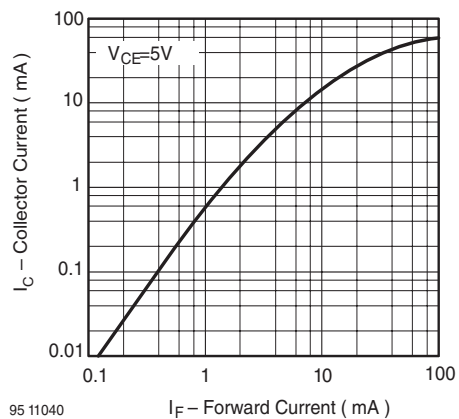


Figure 8. Collector Current vs. Forward Current



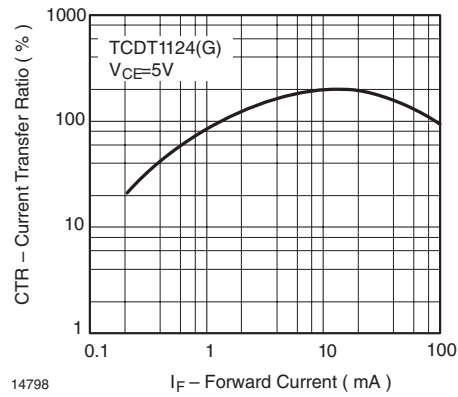
95 11041  
Figure 9. Collector Current vs. Collector Emitter Voltage



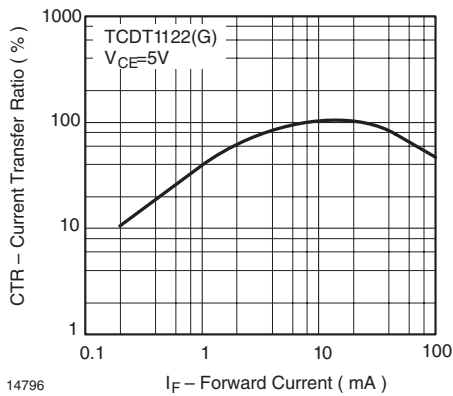
14797  
Figure 12. Current Transfer Ratio vs. Forward Current



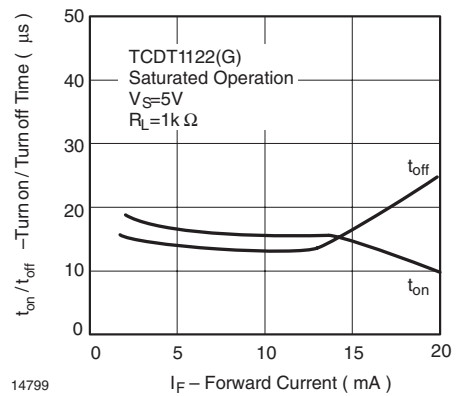
95 11034  
Figure 10. Collector Emitter Saturation Voltage vs. Collector Current



14798  
Figure 13. Current Transfer Ratio vs. Forward Current



14796  
Figure 11. Current Transfer Ratio vs. Forward Current



14799  
Figure 14. Turn on / off Time vs. Forward Current

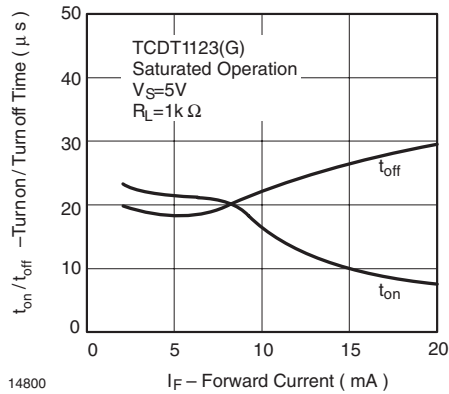


Figure 15. Turn on / off Time vs. Forward Current



Figure 18. Turn on / off Time vs. Collector Current

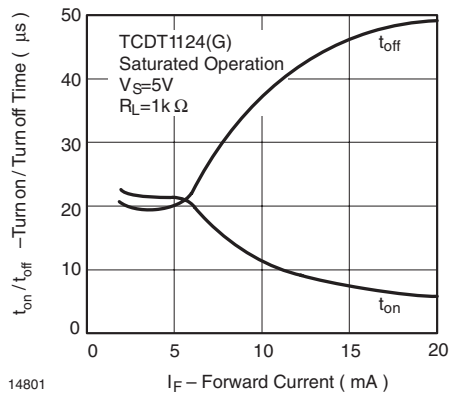


Figure 16. Turn on / off Time vs. Forward Current

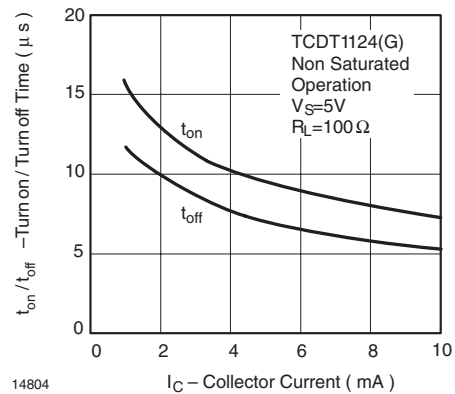


Figure 19. Turn on / off Time vs. Collector Current

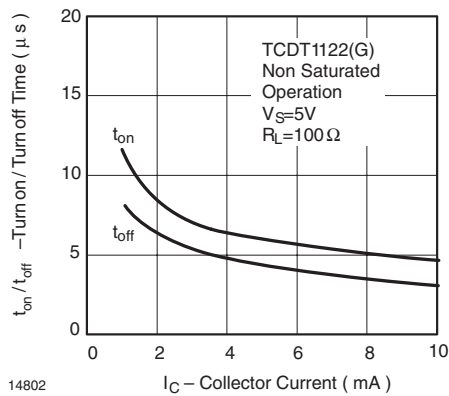


Figure 17. Turn on / off Time vs. Collector Current

# TCDT1120/ TCDT1120G

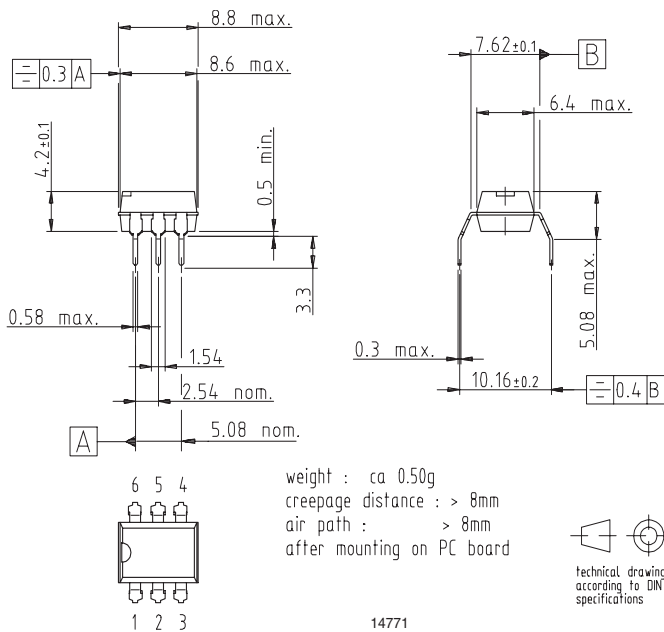


Vishay Semiconductors

## Package Dimensions in mm



## Package Dimensions in mm







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