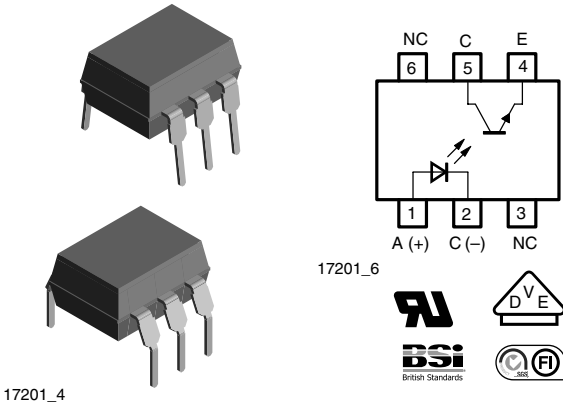


## Optocoupler, Phototransistor Output



### 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  $\leq 300$  V
  - for appl. class I - III at mains voltage  $\leq 600$  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 <sup>(1)</sup>	
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

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

ABSOLUTE MAXIMUM RATINGS (1)				
PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
<b>INPUT</b>				
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
<b>OUTPUT</b>				
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
<b>COUPLER</b>				
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
<b>INPUT</b>						
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
<b>OUTPUT</b>						
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
<b>COUPLER</b>						
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 <sub>C</sub> /I <sub>F</sub>	V <sub>CE</sub> = 5 V, I <sub>F</sub> = 1 mA	TCDT1120	CTR	10			%	
		TCDT1120G						
		TCDT1122	CTR	15			%	
		TCDT1122G						
		TCDT1123	CTR	30			%	
		TCDT1123G						
		TCDT1124	CTR	60			%	
		TCDT1124G						
	V <sub>CE</sub> = 5 V, I <sub>F</sub> = 10 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
<b>INPUT</b>						
Forward current		I <sub>F</sub>			130	mA
<b>OUTPUT</b>						
Power dissipation		P <sub>diss</sub>			265	mW
<b>COUPLER</b>						
Rated impulse voltage		V <sub>IOTM</sub>			6	kV
Safety temperature		T <sub>si</sub>			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 <sub>test</sub> = 1 s	V <sub>pd</sub>	1.6			kV
Partial discharge test voltage - lot test (sample test)	t <sub>Tr</sub> = 60 s, t <sub>test</sub> = 10 s, (see figure 2)	V <sub>IOTM</sub>	6			kV
		V <sub>pd</sub>	1.3			kV
Insulation resistance	V <sub>IO</sub> = 500 V	R <sub>IO</sub>	10 <sup>12</sup>			Ω
	V <sub>IO</sub> = 500 V, T <sub>amb</sub> ≤ 100 °C	R <sub>IO</sub>	10 <sup>11</sup>			Ω
	V <sub>IO</sub> = 500 V, T <sub>amb</sub> ≤ 150 °C (construction test only)	R <sub>IO</sub>	10 <sup>9</sup>			Ω

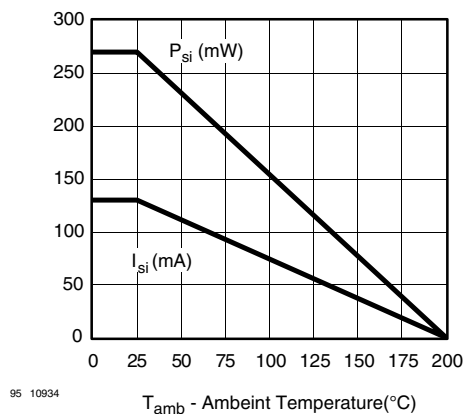


Fig. 1 - Derating Diagram

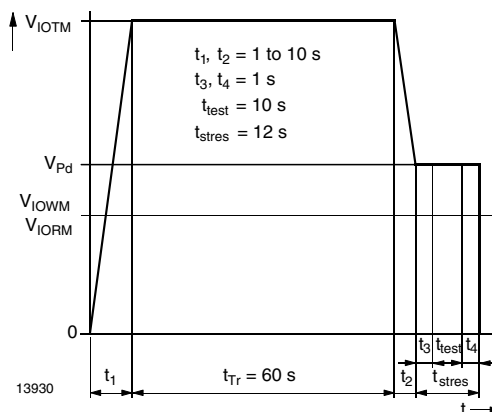


Fig. 2 - Test Pulse Diagram for Sample Test According to DIN EN 60747-5-5/DIN EN 60747-; IEC 60747

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					
TCDT1124G	$I_F$		10		mA		
Delay time	$V_S = 5\text{ V}, R_L = 100\ \Omega$ , (see figure 3)	TCDT1120	$t_D$		2.5		$\mu\text{s}$
		TCDT1120G					
		TCDT1123	$t_D$		2.8		$\mu\text{s}$
		TCDT1123G					
		TCDT1124					
TCDT1124G	$t_D$		2		$\mu\text{s}$		
Rise time	$V_S = 5\text{ V}, R_L = 100\ \Omega$ , (see figure 3)	TCDT1120	$t_r$		3		$\mu\text{s}$
		TCDT1120G					
		TCDT1123	$t_r$		4.2		$\mu\text{s}$
		TCDT1123G					
		TCDT1124					
TCDT1124G	$t_r$		4		$\mu\text{s}$		
Storage time	$V_S = 5\text{ V}, R_L = 100\ \Omega$ , (see figure 3)	TCDT1120	$t_s$		0.3		$\mu\text{s}$
		TCDT1120G					
		TCDT1123	$t_s$		0.3		$\mu\text{s}$
		TCDT1123G					
		TCDT1124					
TCDT1124G	$t_s$		0.3		$\mu\text{s}$		
Fall time	$V_S = 5\text{ V}, R_L = 100\ \Omega$ , (see figure 3)	TCDT1120	$t_f$		3.7		$\mu\text{s}$
		TCDT1120G					
		TCDT1123	$t_f$		4.7		$\mu\text{s}$
		TCDT1123G					
		TCDT1124					
TCDT1124G	$t_f$		4.7		$\mu\text{s}$		

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		$\mu\text{s}$
		TCDT1120G					
		TCDT1123	$t_{on}$		7		$\mu\text{s}$
		TCDT1123G					
		TCDT1124					
TCDT1124G							
Turn-off time	$V_S = 5\text{ V}, R_L = 100\ \Omega$ , (see figure 3)	TCDT1120	$t_{off}$		4		$\mu\text{s}$
		TCDT1120G					
		TCDT1123	$t_{off}$		5		$\mu\text{s}$
		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		$\mu\text{s}$
		TCDT1120G					
		TCDT1123	$t_{on}$		21.5		$\mu\text{s}$
		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		$\mu\text{s}$
		TCDT1120G					
		TCDT1123	$t_{off}$		37.5		$\mu\text{s}$
		TCDT1123G					
		TCDT1124					
TCDT1124G							

### TYPICAL CHARACTERISTICS

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

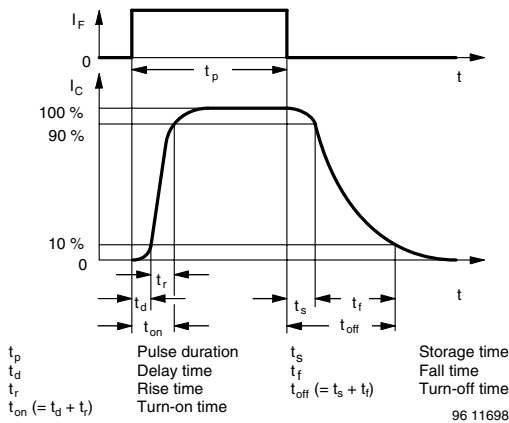


Fig. 3 - Switching Times

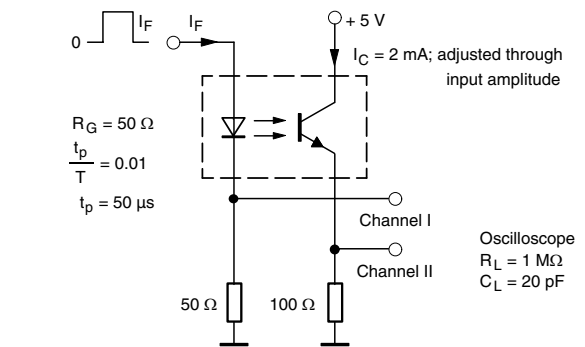


Fig. 4 - Test Circuit, Non-Saturated Operation

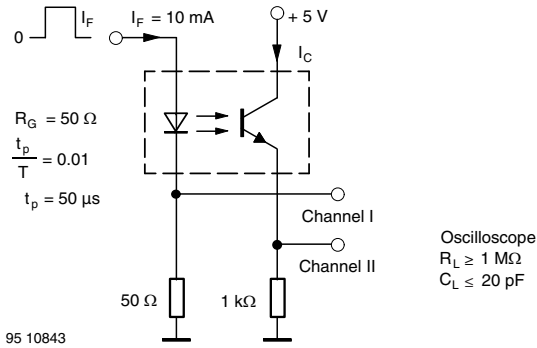


Fig. 5 - Test Circuit, Saturated Operation

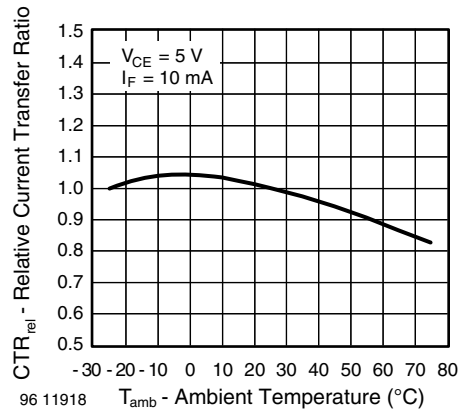


Fig. 8 - Relative Current Transfer Ratio vs. Ambient Temperature

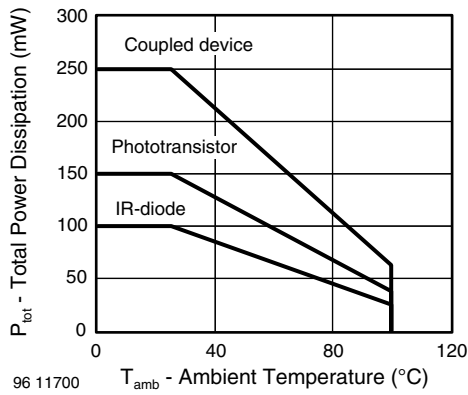


Fig. 6 - Total Power Dissipation vs. Ambient Temperature

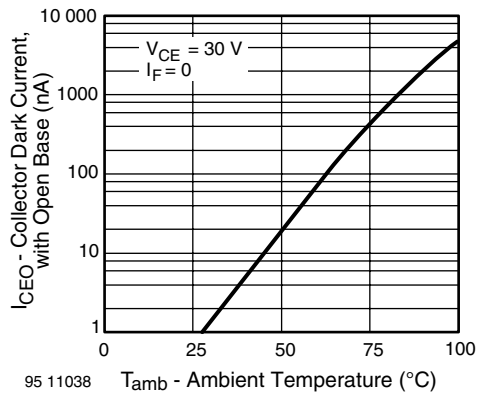


Fig. 9 - Collector Dark Current vs. Ambient Temperature

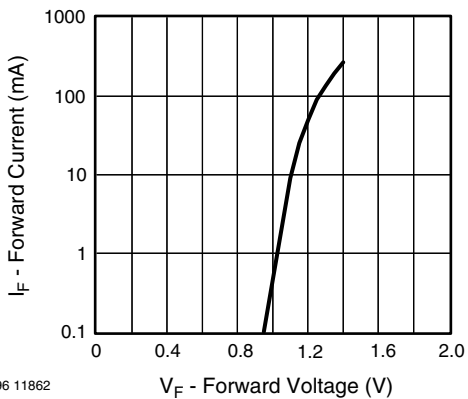


Fig. 7 - Forward Current vs. Forward Voltage

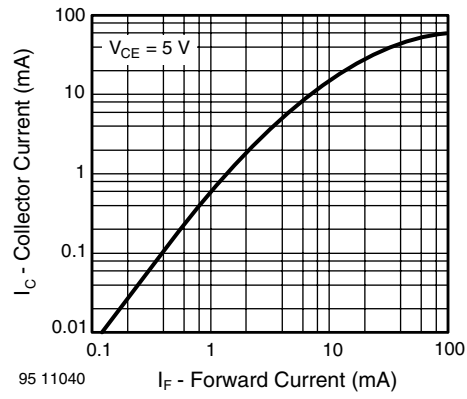


Fig. 10 - Collector Current vs. Forward Current

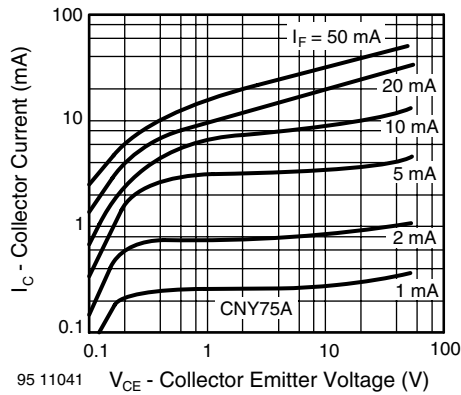


Fig. 11 - Collector Current vs. Collector Emitter Voltage

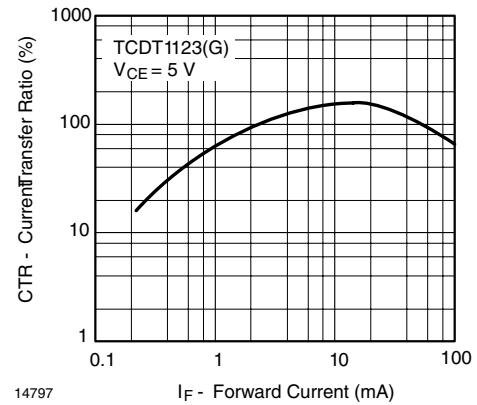


Fig. 14 - Current Transfer Ratio vs. Forward Current

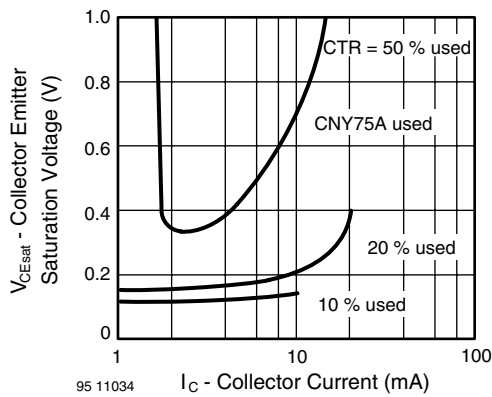


Fig. 12 - Collector Emitter Saturation Voltage vs. Collector Current

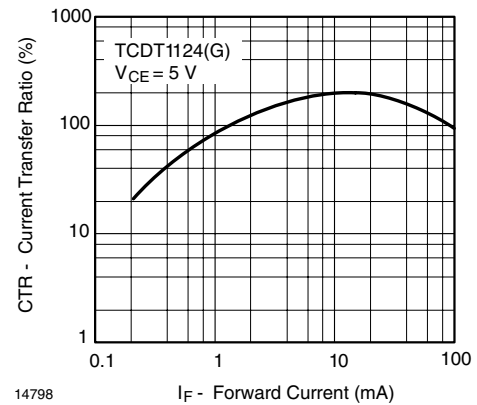


Fig. 15 - Current Transfer Ratio vs. Forward Current

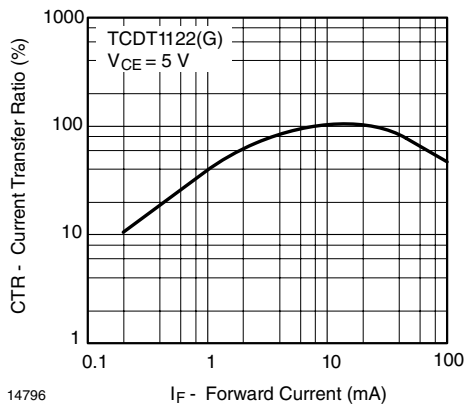


Fig. 13 - Current Transfer Ratio vs. Forward Current

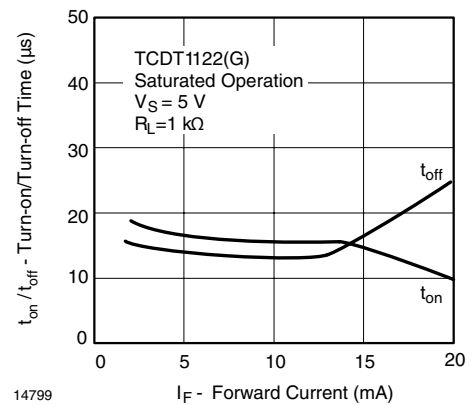


Fig. 16 - Turn-on/off Time vs. Forward Current

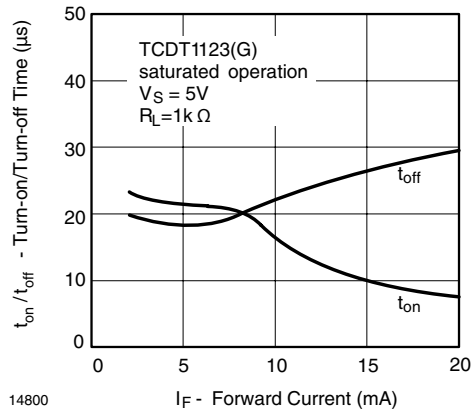


Fig. 17 - Turn-on/off Time vs. Forward Current

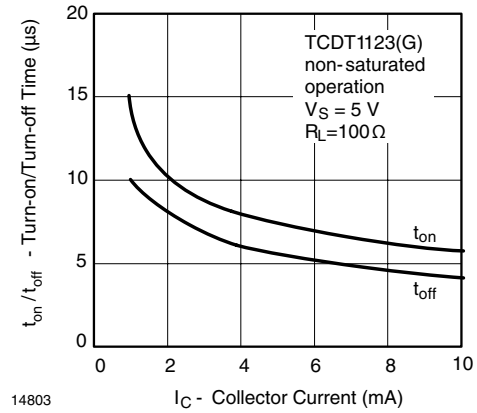


Fig. 20 - Turn-on/off Time vs. Collector Current

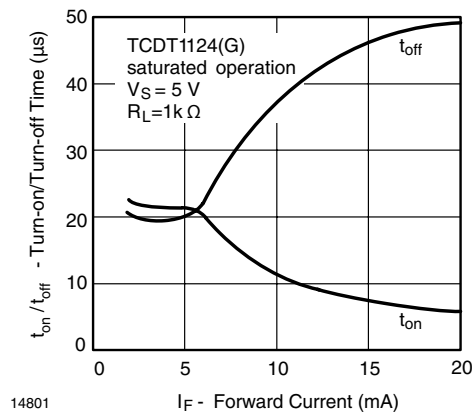


Fig. 18 - Turn-on/off Time vs. Forward Current

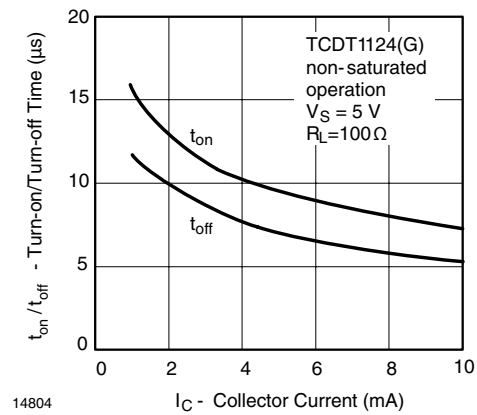


Fig. 21 - Turn-on/off Time vs. Collector Current

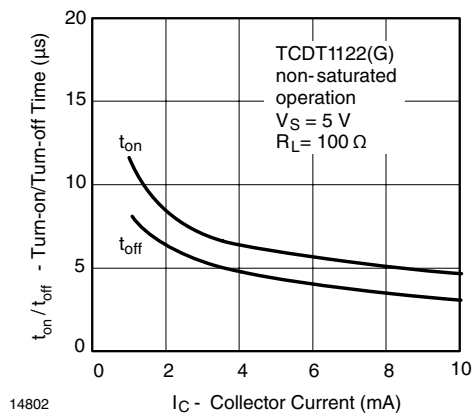
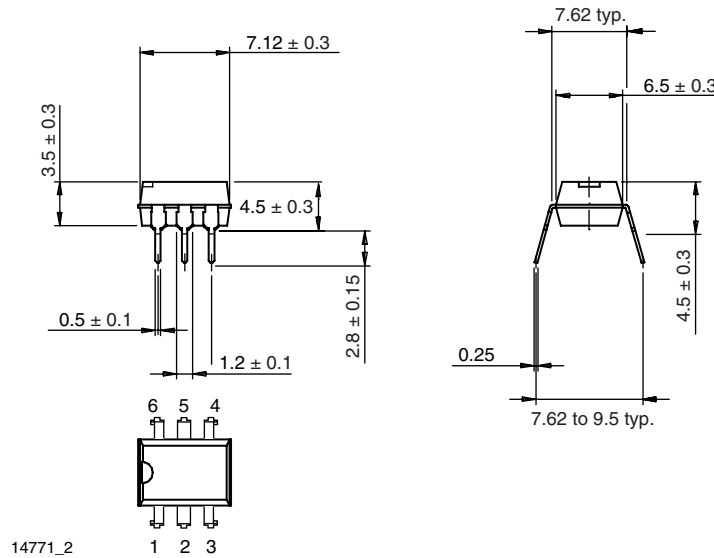


Fig. 19 - Turn-on/off Time vs. Collector Current

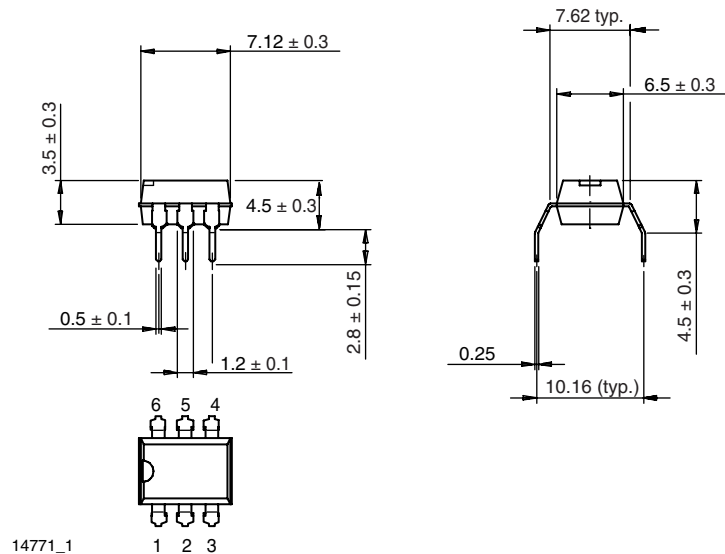


## PACKAGE DIMENSIONS in millimeters

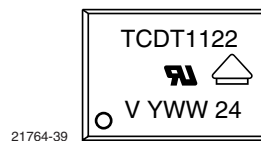
### DIP-6



### DIP-6, 400 mil



## PACKAGE MARKING



### Note

Example of marking used for the TCDT1122 and TCDT1122G



## Disclaimer

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