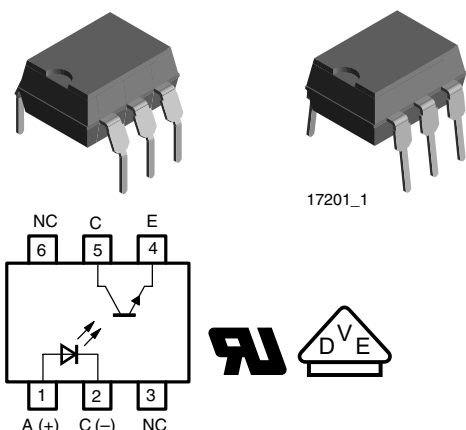


Optocoupler, Phototransistor Output



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. 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 pending**
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
- Four CTR groups available
- Lead (Pb)-free component
- Component in accordance with RoHS 2002/95/EC and 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. E76222 system code A, double protection
- BSI IEC 60950 IEC 60065
- DIN EN 60747-5-5
- FIMKO

ORDER INFORMATION

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

For additional information on the available options refer to option information.

ABSOLUTE MAXIMUM RATINGS ⁽¹⁾				
PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
INPUT				
Reverse voltage		V_R	5	V
Forward current		I_F	60	mA
Forward surge current	$t_p \leq 10 \mu s$	I_{FSM}	3	A
Power dissipation		P_{diss}	100	mW
Junction temperature		T_j	125	°C
OUTPUT				
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	$t_p/T = 0.5, t_p \leq 10 ms$	I_{CM}	100	mA
Power dissipation		P_{diss}	150	mW
Junction temperature		T_j	125	°C
COUPLER				
Isolation test voltage (RMS)	$t = 1 min$	V_{ISO}	5300	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, $t \leq 10 s$	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						
PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
INPUT						
Forward voltage	$I_F = 50 mA$	V_F		1.25	1.6	V
Junction capacitance	$V_R = 0 V, f = 1 MHz$	C_j		50		pF
OUTPUT						
Collector base voltage	$I_C = 100 \mu A$	V_{CBO}	90			V
Collector emitter voltage	$I_C = 1 mA$	V_{CEO}	90			V
Emitter collector voltage	$I_E = 100 \mu A$	V_{ECO}	7			V
Collector emitter cut-off current	$V_{CE} = 20 V, I_F = 0 A$	I_{CEO}			150	nA
COUPLER						
Collector emitter saturation voltage	$I_F = 10 mA, I_C = 1 mA$	V_{CEsat}			0.3	V
Cut-off frequency	$V_{CE} = 5 V, I_F = 10 mA, R_L = 100 \Omega$	f_c		110		kHz
Coupling capacitance	$f = 1 MHz$	C_k		0.3		pF

Note

$T_{amb} = 25 \text{ }^\circ\text{C}$, 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_C/I_F	$V_{CE} = 5\text{ V}, I_F = 1\text{ mA}$	TCDT1120	CTR	10			%
		TCDT1120G					
		TCDT1122	CTR	15			%
		TCDT1122G					
		TCDT1123	CTR	30			%
		TCDT1123G					
		TCDT1124	CTR	60			%
		TCDT1124G					
	$V_{CE} = 5\text{ V}, I_F = 10\text{ mA}$	TCDT1120	CTR	40			%
		TCDT1120G					
		TCDT1122	CTR	63		125	%
		TCDT1122G					
		TCDT1123	CTR	100		200	%
		TCDT1123G					
		TCDT1124	CTR	160		320	%
		TCDT1124G					

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}			6	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 %, $t_{test} = 1\text{ s}$	V_{pd}	1.6			kV
Partial discharge test voltage - lot test (sample test)	$t_{Tr} = 60\text{ s}, t_{test} = 10\text{ s}$, (see figure 2)	V_{IOTM}	6			kV
		V_{pd}	1.3			kV
Insulation resistance	$V_{IO} = 500\text{ V}$	R_{IO}	10^{12}			Ω
	$V_{IO} = 500\text{ V}, T_{amb} \leq 100\text{ °C}$	R_{IO}	10^{11}			Ω
	$V_{IO} = 500\text{ V}, T_{amb} \leq 150\text{ °C}$ (construction test only)	R_{IO}	10^9			Ω

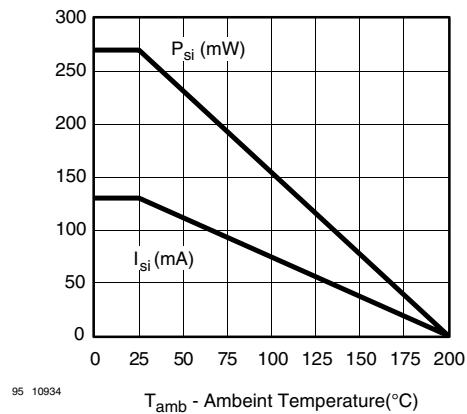


Fig. 1 - Derating Diagram

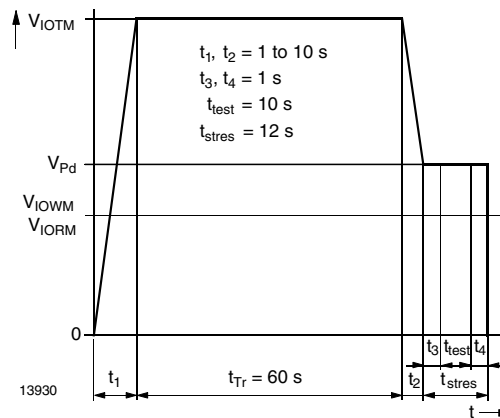


Fig. 2 - Test Pulse Diagram for Sample Test According to DIN EN 60747-5-5/DIN EN 60747-; IEC 60747

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	I_F		10		mA
		TCDT1124G					
Delay time	$V_S = 5 \text{ V}$, $R_L = 100 \Omega$, (see figure 3)	TCDT1120	t_D		2.5		μs
		TCDT1120G					
		TCDT1123	t_D		2.8		μs
		TCDT1123G					
		TCDT1124	t_D		2.0		μs
		TCDT1124G					
Rise time	$V_S = 5 \text{ V}$, $R_L = 100 \Omega$, (see figure 3)	TCDT1120	t_r		3.0		μs
		TCDT1120G					
		TCDT1123	t_r		4.2		μs
		TCDT1123G					
		TCDT1124	t_r		4.0		μs
		TCDT1124G					
Storage time	$V_S = 5 \text{ V}$, $R_L = 100 \Omega$, (see figure 3)	TCDT1120	t_s		0.3		μs
		TCDT1120G					
		TCDT1123	t_s		0.3		μs
		TCDT1123G					
		TCDT1124	t_s		0.3		μs
		TCDT1124G					
Fall time	$V_S = 5 \text{ V}$, $R_L = 100 \Omega$, (see figure 3)	TCDT1120	t_f		3.7		μs
		TCDT1120G					
		TCDT1123	t_f		4.7		μs
		TCDT1123G					
		TCDT1124	t_f		4.7		μs
		TCDT1124G					

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		μs
		TCDT1120G					
		TCDT1123	t_{on}		7.0		μs
		TCDT1123G					
		TCDT1124	t_{on}		6.0		μs
		TCDT1124G					
Turn-off time	$V_S = 5\text{ V}$, $R_L = 100\ \Omega$, (see figure 3)	TCDT1120	t_{off}		4.0		μs
		TCDT1120G					
		TCDT1123	t_{off}		5.0		μs
		TCDT1123G					
		TCDT1124	t_{off}		5.0		μs
		TCDT1124G					
Turn-on time	$V_S = 5\text{ V}$, $R_L = 1\text{ k}\Omega$, (see figure 4)	TCDT1120	t_{on}		16.5		μs
		TCDT1120G					
		TCDT1123	t_{on}		21.5		μs
		TCDT1123G					
		TCDT1124	t_{on}		20		μs
		TCDT1124G					
Turn-off time	$V_S = 5\text{ V}$, $R_L = 1\text{ k}\Omega$, (see figure 4)	TCDT1120	t_{off}		22.5		μs
		TCDT1120G					
		TCDT1123	t_{off}		37.5		μs
		TCDT1123G					
		TCDT1124	t_{off}		50.0		μs
		TCDT1124G					

TYPICAL CHARACTERISTICS

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

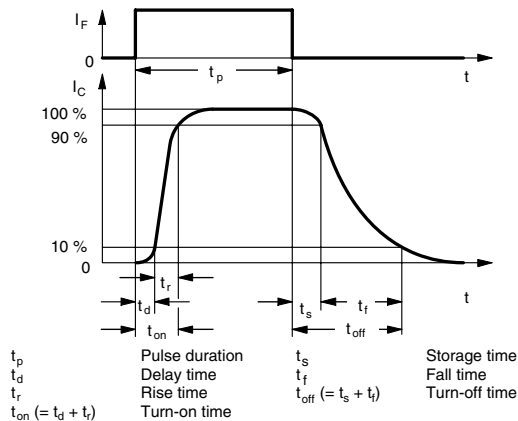


Fig. 3 - Switching Times

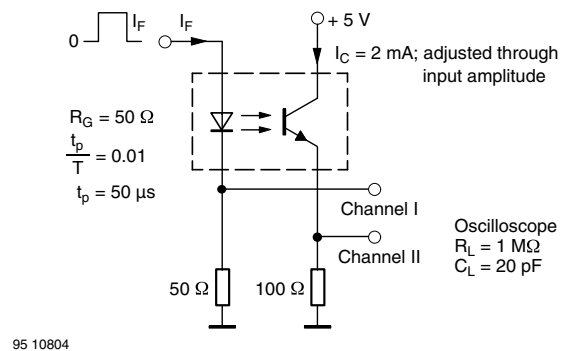


Fig. 4 - Test Circuit, Non-Saturated Operation

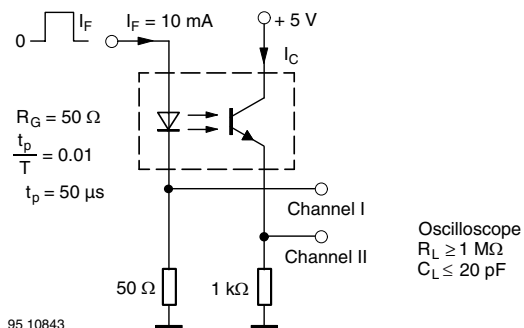


Fig. 5 - Test Circuit, Saturated Operation

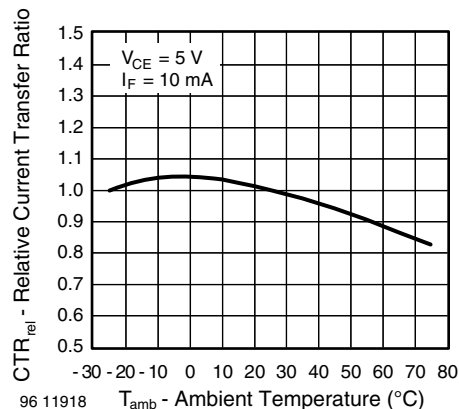


Fig. 8 - Relative Current Transfer Ratio vs. Ambient Temperature

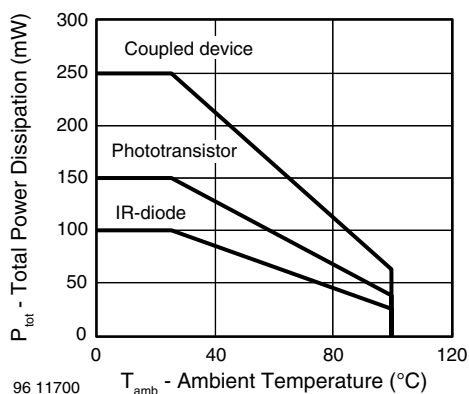


Fig. 6 - Total Power Dissipation vs. Ambient Temperature

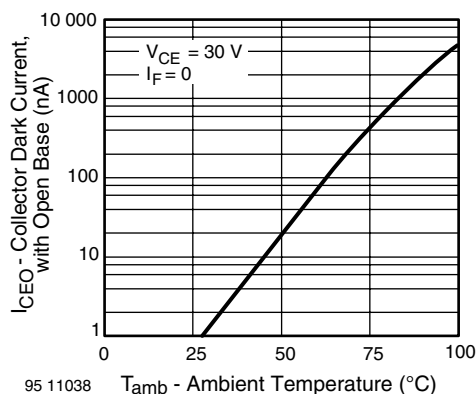


Fig. 9 - Collector Dark Current vs. Ambient Temperature

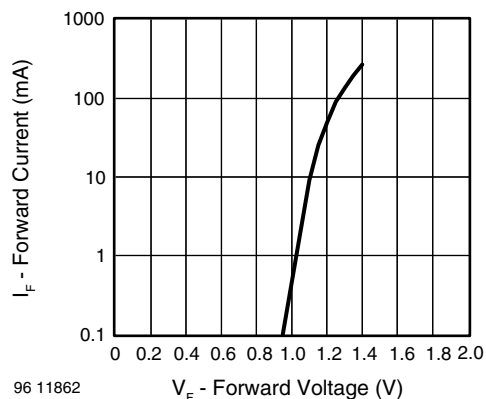


Fig. 7 - Forward Current vs. Forward Voltage

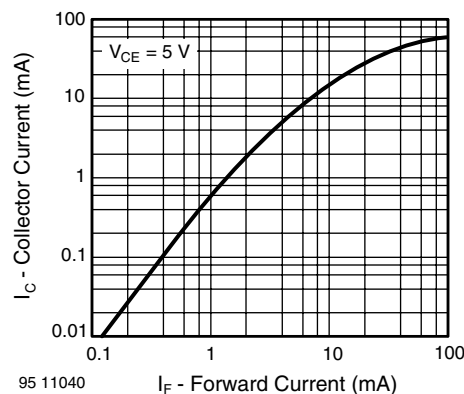


Fig. 10 - Collector Current vs. Forward Current

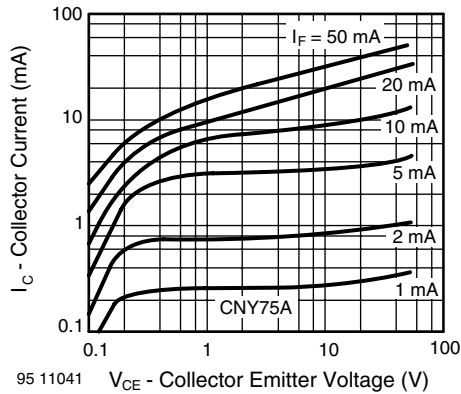


Fig. 11 - Collector Current vs. Collector Emitter Voltage

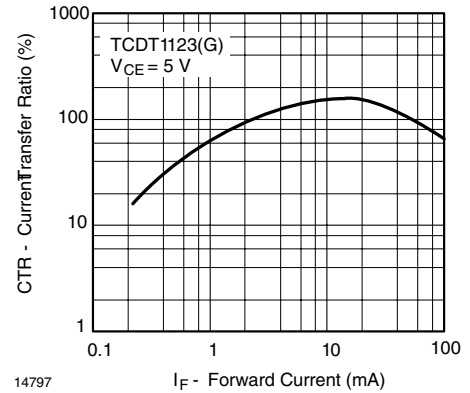


Fig. 14 - Current Transfer Ratio vs. Forward Current

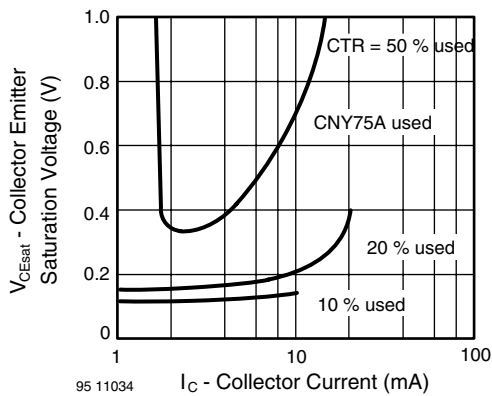


Fig. 12 - Collector Emitter Saturation Voltage vs. Collector Current

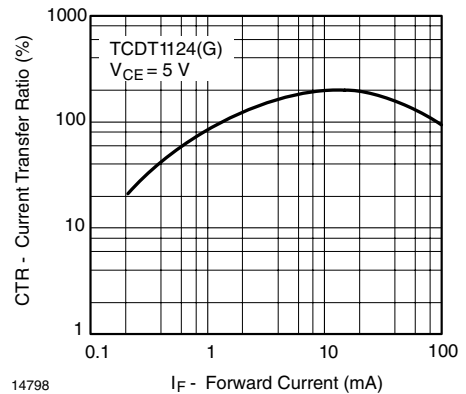


Fig. 15 - Current Transfer Ratio vs. Forward Current

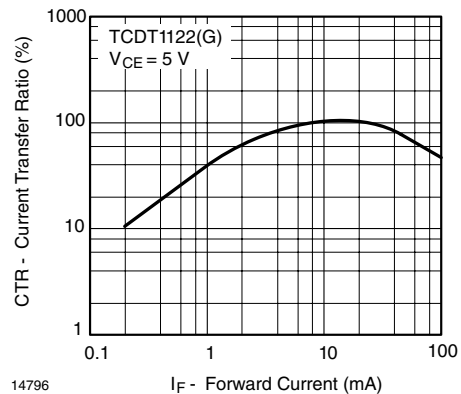


Fig. 13 - Current Transfer Ratio vs. Forward Current

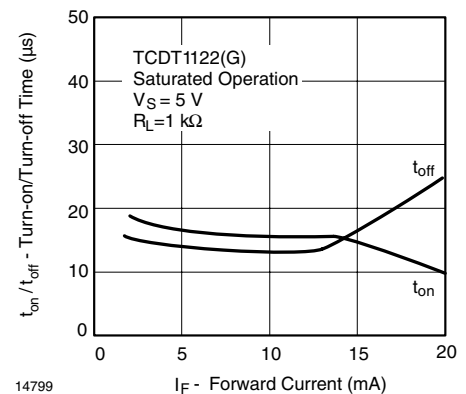


Fig. 16 - Turn-on/off Time vs. Forward Current

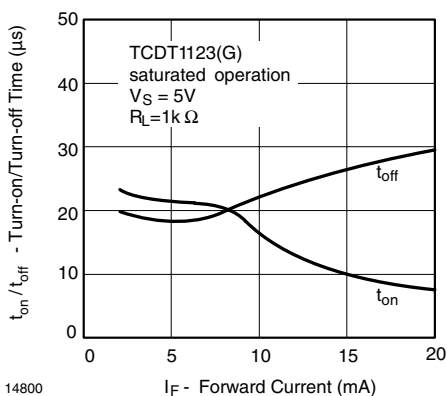


Fig. 17 - Turn-on/off Time vs. Forward Current

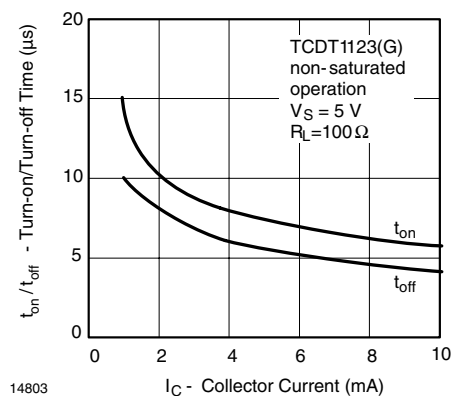


Fig. 20 - Turn-on/off Time vs. Collector Current

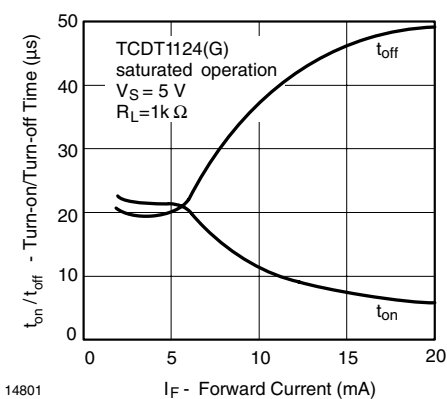


Fig. 18 - Turn-on/off Time vs. Forward Current

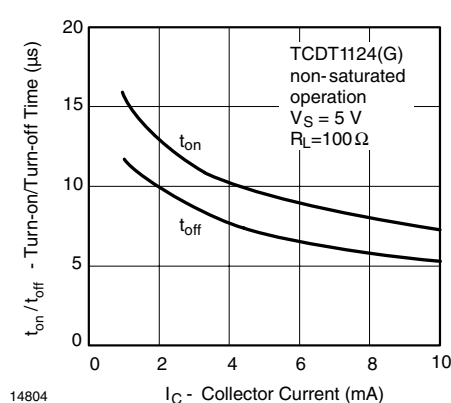


Fig. 21 - Turn-on/off Time vs. Collector Current

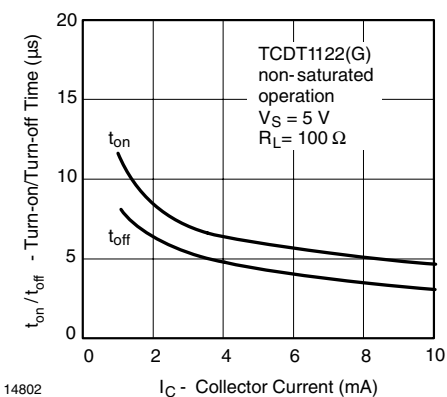
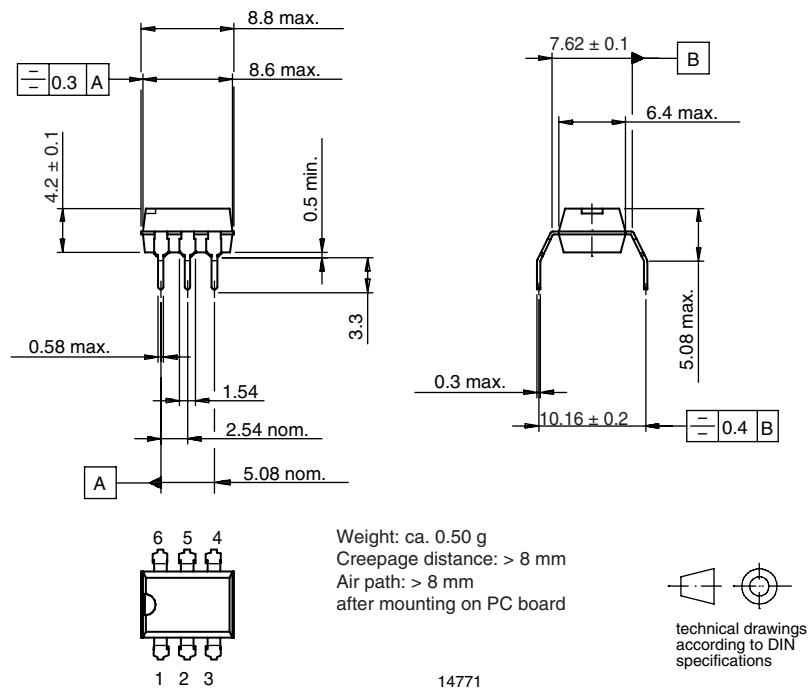
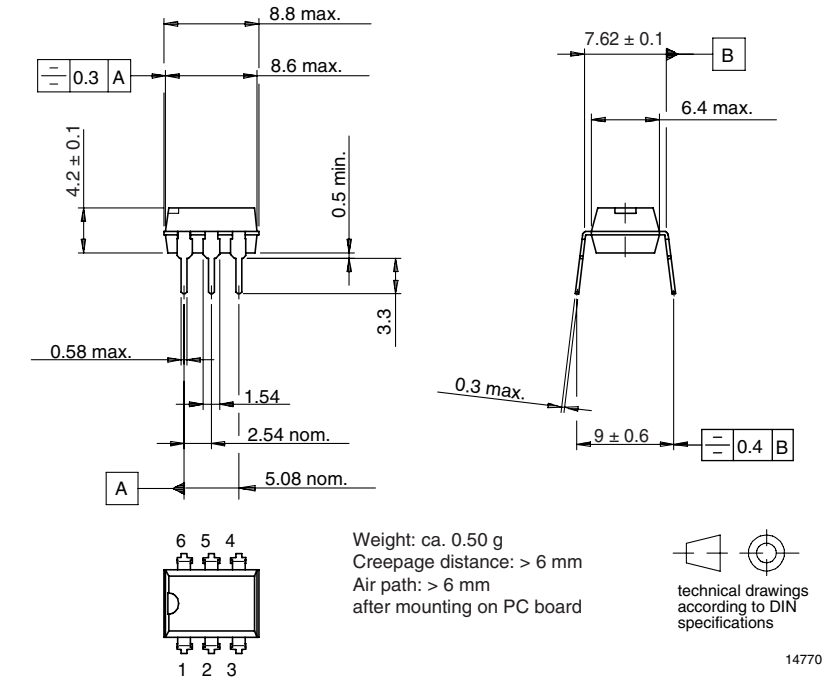


Fig. 19 - Turn-on/off Time vs. Collector Current



PACKAGE DIMENSIONS in millimeters





OZONE DEPLETING SUBSTANCES POLICY STATEMENT

It is the policy of Vishay Semiconductor GmbH to

1. Meet all present and future national and international statutory requirements.
2. Regularly and continuously improve the performance of our products, processes, distribution and operating systems with respect to their impact on the health and safety of our employees and the public, as well as their impact on the environment.

It is particular concern to control or eliminate releases of those substances into the atmosphere which are known as ozone depleting substances (ODSs).

The Montreal Protocol (1987) and its London Amendments (1990) intend to severely restrict the use of ODSs and forbid their use within the next ten years. Various national and international initiatives are pressing for an earlier ban on these substances.

Vishay Semiconductor GmbH has been able to use its policy of continuous improvements to eliminate the use of ODSs listed in the following documents.

1. Annex A, B and list of transitional substances of the Montreal Protocol and the London Amendments respectively.
2. Class I and II ozone depleting substances in the Clean Air Act Amendments of 1990 by the Environmental Protection Agency (EPA) in the USA.
3. Council Decision 88/540/EEC and 91/690/EEC Annex A, B and C (transitional substances) respectively.

Vishay Semiconductor GmbH can certify that our semiconductors are not manufactured with ozone depleting substances and do not contain such substances.

We reserve the right to make changes to improve technical design
and may do so without further notice.

Parameters can vary in different applications. All operating parameters must be validated for each customer application by the customer. Should the buyer use Vishay Semiconductors products for any unintended or unauthorized application, the buyer shall indemnify Vishay Semiconductors against all claims, costs, damages, and expenses, arising out of, directly or indirectly, any claim of personal damage, injury or death associated with such unintended or unauthorized use.

Vishay Semiconductor GmbH, P.O.B. 3535, D-74025 Heilbronn, Germany



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