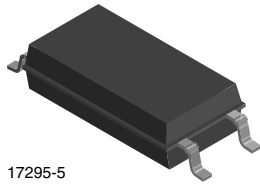




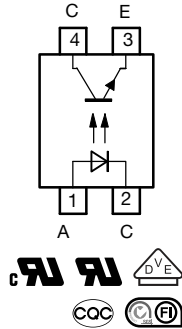
# THE DATASHEET OF TCLT1009



## Optocoupler, Phototransistor Output, SOP-4L, Long Mini-Flat Package



17295-5



### FEATURES

- SMD low profile 4 lead package
- $V_{IORM} = 1050\text{ V}$
- CTR flexibility available see order information
- Special construction
- Extra low coupling capacitance
- DC input with transistor output
- Creepage distance > 8 mm
- Material categorization:  
for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



### LINKS TO ADDITIONAL RESOURCES



### DESCRIPTION

The TCLT100. series consists of a phototransistor optically coupled to a gallium arsenide infrared-emitting diode in a 4-lead SOP4L package.

### APPLICATIONS

- Switchmode power supplies
- Computer peripheral interface
- Microprocessor system interface

### AGENCY APPROVALS

- [UL](#)
- [cUL](#)
- [DIN EN 60747-5-5 \(VDE 0884\)](#)
- [BSI](#)
- [FIMKO](#)
- [CQC](#)

### Note

- See the safety standard approval list "Agency Table" for more detailed information.

ORDERING INFORMATION										
<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="border: 1px solid black; padding: 2px 5px;">T</div> <div style="border: 1px solid black; padding: 2px 5px;">C</div> <div style="border: 1px solid black; padding: 2px 5px;">L</div> <div style="border: 1px solid black; padding: 2px 5px;">T</div> <div style="border: 1px solid black; padding: 2px 5px;">1</div> <div style="border: 1px solid black; padding: 2px 5px;">0</div> <div style="border: 1px solid black; padding: 2px 5px;">0</div> <div style="border: 1px solid black; padding: 2px 5px;">#</div> </div> <p style="text-align: center; margin-top: 5px;">PART NUMBER</p>										
AGENCY CERTIFIED / PACKAGE	CTR (%)									
	5 mA	10 mA				5 mA				
UL, cUL, VDE, BSI, FIMKO	50 to 600	40 to 80	63 to 125	100 to 200	160 to 320	50 to 150	100 to 300	80 to 160	130 to 260	200 to 400
SOP-4L	TCLT1000	TCLT1001	TCLT1002	TCLT1003	TCLT1004	TCLT1005	TCLT1006	TCLT1007	TCLT1008	TCLT1009

### Note

- Available only on tape and reel



<b>ABSOLUTE MAXIMUM RATINGS</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)				
PARAMETER	CONDITION	SYMBOL	VALUE	UNIT
<b>INPUT</b>				
Reverse voltage		$V_R$	6	V
Forward current		$I_F$	60	mA
Forward surge current	$t_p \leq 10\text{ }\mu\text{s}$	$I_{FSM}$	1.5	A
Power dissipation		$P_{diss}$	100	mW
Junction temperature		$T_j$	125	$^{\circ}\text{C}$
<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	$^{\circ}\text{C}$
<b>COUPLER</b>				
Total power dissipation		$P_{tot}$	250	mW
Operating ambient temperature range		$T_{amb}$	-55 to +100	$^{\circ}\text{C}$
Storage temperature range		$T_{stg}$	-55 to +125	$^{\circ}\text{C}$
Soldering temperature		$T_{sld}$	260	$^{\circ}\text{C}$

**Note**

- 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.

<b>ELECTRICAL CHARACTERISTICS</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)						
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 emitter voltage	$I_C = 1\text{ mA}$	$V_{CEO}$	70	-	-	V
Emitter collector voltage	$I_E = 100\text{ }\mu\text{A}$	$V_{ECO}$	7	-	-	V
Collector emitter cut-off current	$V_{CE} = 20\text{ V}, I_F = 0\text{ A}$	$I_{CEO}$	-	10	100	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	$V_{CE} = 5\text{ V}, I_F = 10\text{ mA}, R_L = 100\text{ }\Omega$	$f_c$	-	110	-	kHz
Coupling capacitance	$f = 1\text{ MHz}$	$C_k$	-	0.3	-	pF

**Note**

- 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.



<b>CURRENT TRANSFER RATIO</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)							
PARAMETER	TEST CONDITION	PART	SYMBOL	MIN.	TYP.	MAX.	UNIT
$I_C/I_F$	$V_{CE} = 5\text{ V}, I_F = 5\text{ mA}$	TCLT1000	CTR	50	-	600	%
		TCLT1001	CTR	40	-	80	%
	$V_{CE} = 5\text{ V}, I_F = 10\text{ mA}$	TCLT1002	CTR	63	-	125	%
		TCLT1003	CTR	100	-	200	%
		TCLT1004	CTR	160	-	320	%
		TCLT1001	CTR	13	30	-	%
	$V_{CE} = 5\text{ V}, I_F = 1\text{ mA}$	TCLT1002	CTR	22	45	-	%
		TCLT1003	CTR	34	70	-	%
		TCLT1004	CTR	56	100	-	%
		TCLT1005	CTR	50	-	150	%
	$V_{CE} = 5\text{ V}, I_F = 5\text{ mA}$	TCLT1006	CTR	100	-	300	%
		TCLT1007	CTR	80	-	160	%
		TCLT1008	CTR	130	-	260	%
		TCLT1009	CTR	200	-	400	%

<b>SAFETY AND INSULATION RATINGS</b>				
PARAMETER	CONDITION	SYMBOL	VALUE	UNIT
Partial discharge test voltage - routine test	100 %, $t_{test} = 1\text{ s}$	$V_{pd}$	2	kV
Partial discharge test voltage - lot test (sample test)	$t_{Tr} = 60\text{ s}, t_{test} = 10\text{ s},$ (see Fig. 2)	$V_{IOTM}$	8	$kV_{peak}$
		$V_{pd}$	1.68	$kV_{peak}$
Isolation test voltage (RMS)		$V_{ISO}$	5000	$V_{RMS}$
Insulation resistance	$V_{IO} = 500\text{ V}$	$R_{IO}$	$10^{12}$	$\Omega$
	$V_{IO} = 500\text{ V}, T_{amb} = 100\text{ }^{\circ}\text{C}$	$R_{IO}$	$10^{11}$	$\Omega$
	$V_{IO} = 500\text{ V}, T_{amb} = 150\text{ }^{\circ}\text{C}$ (construction test only)	$R_{IO}$	$10^9$	$\Omega$
Forward current		$I_{si}$	130	mA
Power dissipation		$P_{so}$	265	mW
Rated impulse voltage		$V_{IOTM}$	8	kV
Safety temperature		$T_{si}$	150	$^{\circ}\text{C}$
Comparative tracking index		CTI	175	
Clearance distance			8.0	mm
Creepage distance			8.0	mm
Insulation distance (internal)			0.40	mm

**Note**

- According to DIN EN 60747-5-2 (VDE 0884) (see Fig. 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. Fig.

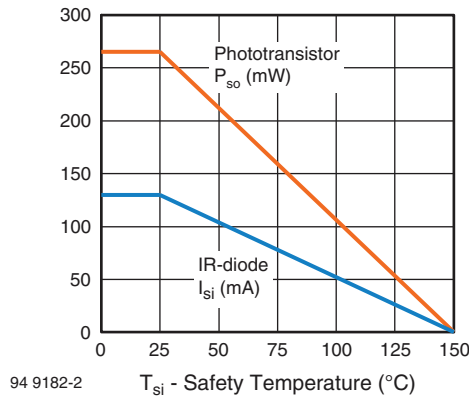


Fig. 1 - Derating Diagram

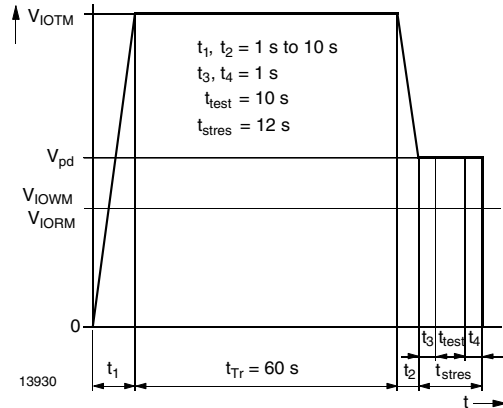


Fig. 2 - Test Pulse Diagram for Sample Test according to DIN EN 60747-5-2 (VDE 0884); IEC60747-5-5

SWITCHING CHARACTERISTICS ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)						
PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Delay time	$V_S = 5\text{ V}$ , $I_C = 2\text{ mA}$ , $R_L = 100\text{ }\Omega$ , (see Fig. 3)	$t_d$	-	3	-	$\mu\text{s}$
Rise time	$V_S = 5\text{ V}$ , $I_C = 2\text{ mA}$ , $R_L = 100\text{ }\Omega$ , (see Fig. 3)	$t_r$	-	3	-	$\mu\text{s}$
Fall time	$V_S = 5\text{ V}$ , $I_C = 2\text{ mA}$ , $R_L = 100\text{ }\Omega$ , (see Fig. 3)	$t_f$	-	4.7	-	$\mu\text{s}$
Storage time	$V_S = 5\text{ V}$ , $I_C = 2\text{ mA}$ , $R_L = 100\text{ }\Omega$ , (see Fig. 3)	$t_s$	-	0.3	-	$\mu\text{s}$
Turn-on time	$V_S = 5\text{ V}$ , $I_C = 2\text{ mA}$ , $R_L = 100\text{ }\Omega$ , (see Fig. 3)	$t_{on}$	-	6	-	$\mu\text{s}$
Turn-off time	$V_S = 5\text{ V}$ , $I_C = 2\text{ mA}$ , $R_L = 100\text{ }\Omega$ , (see Fig. 3)	$t_{off}$	-	5	-	$\mu\text{s}$
Turn-on time	$V_S = 5\text{ V}$ , $I_F = 10\text{ mA}$ , $R_L = 1\text{ k}\Omega$ , (see Fig. 4)	$t_{on}$	-	9	-	$\mu\text{s}$
Turn-off time	$V_S = 5\text{ V}$ , $I_F = 10\text{ mA}$ , $R_L = 1\text{ k}\Omega$ , (see Fig. 4)	$t_{off}$	-	10	-	$\mu\text{s}$

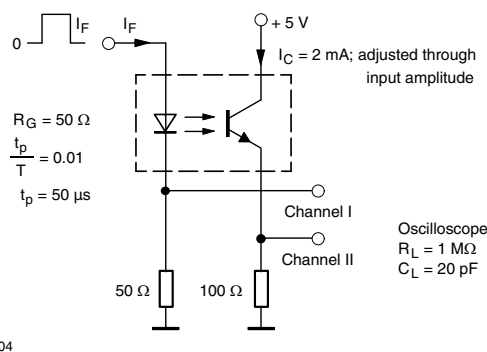


Fig. 3 - Test Circuit, Non-Saturated Operation

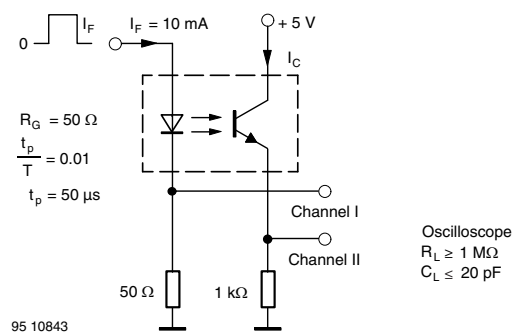


Fig. 4 - Test Circuit, Saturated Operation

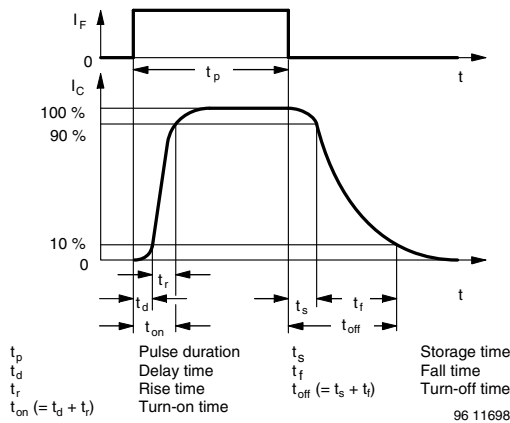


Fig. 5 - Switching Times

**TYPICAL CHARACTERISTICS** ( $T_{amb} = 25\text{ }^\circ\text{C}$ , unless otherwise specified)

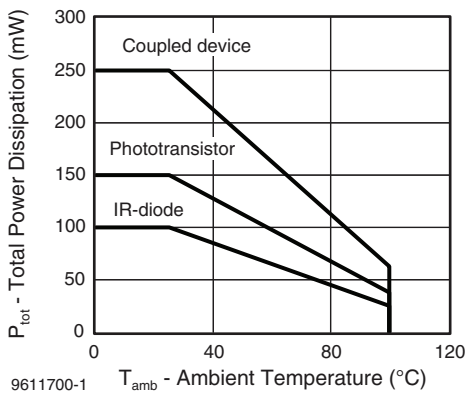


Fig. 6 - Total Power Dissipation vs. Ambient Temperature

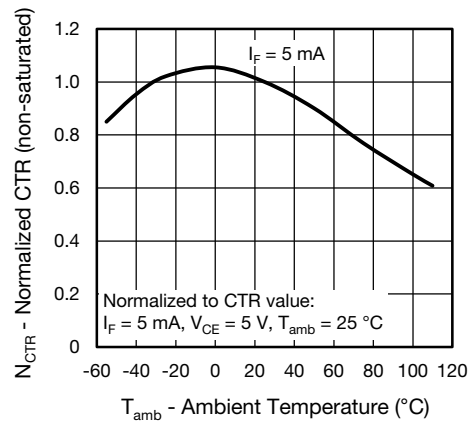


Fig. 8 - Normalized Current Transfer Ratio (non-saturated) vs. Ambient Temperature

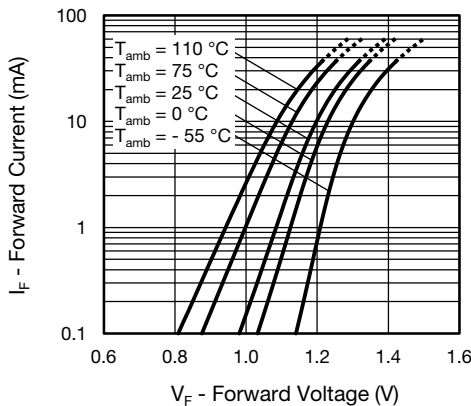


Fig. 7 - Forward Current vs. Forward Voltage

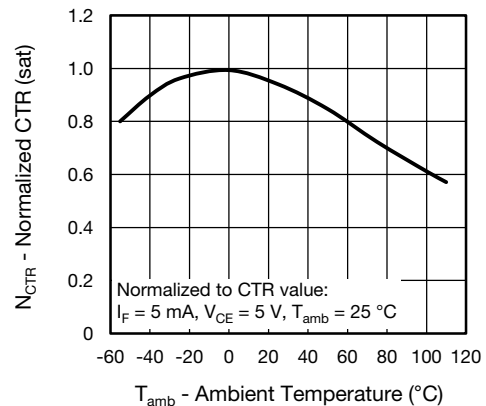


Fig. 9 - Normalized Current Transfer Ratio (saturated) vs. Ambient Temperature

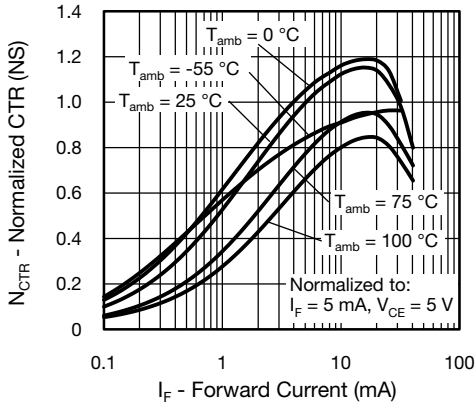


Fig. 10 - Normalized Current Transfer Ratio (non-saturated) vs. Forward Current

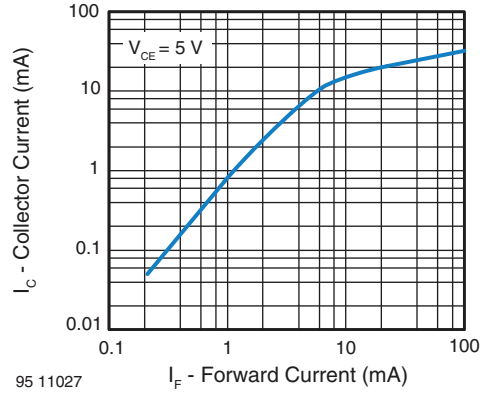


Fig. 13 - Collector Current vs. Forward Current

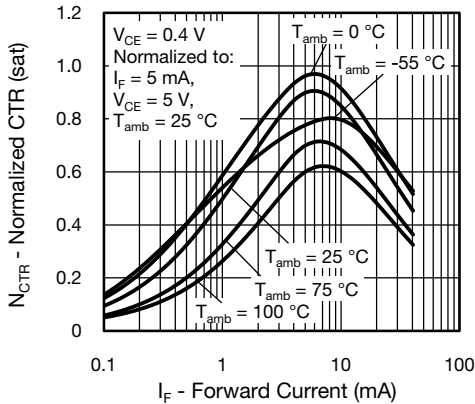


Fig. 11 - Normalized Current Transfer Ratio (saturated) vs. Forward Current

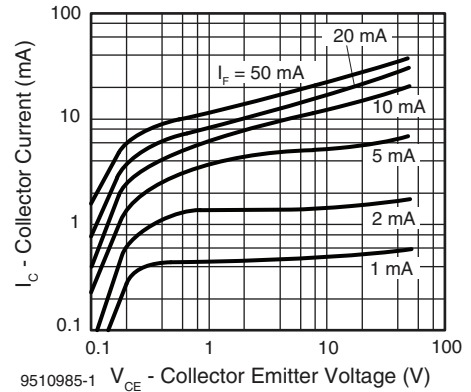


Fig. 14 - Collector Current vs. Collector Emitter Voltage

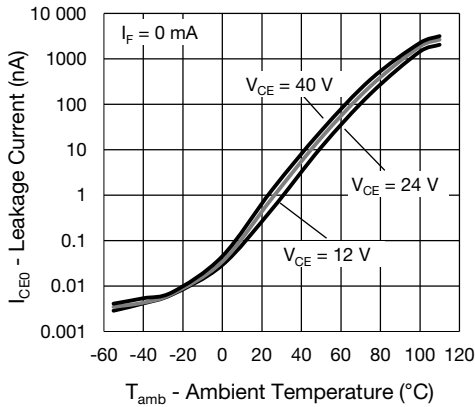


Fig. 12 - Collector Dark Current vs. Ambient Temperature

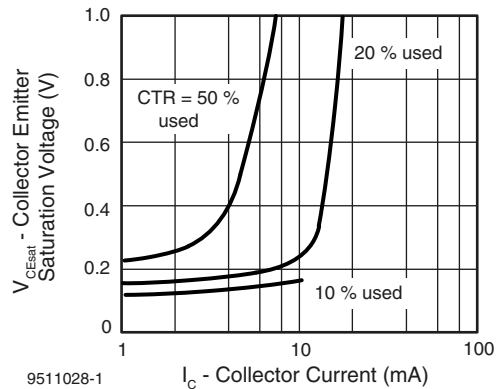


Fig. 15 - Collector Emitter Saturation Voltage vs. Collector Current

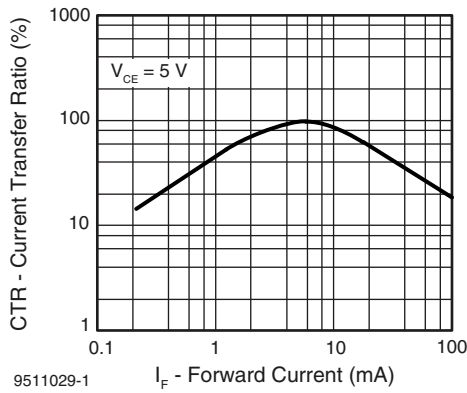


Fig. 16 - Current Transfer Ratio vs. Forward Current

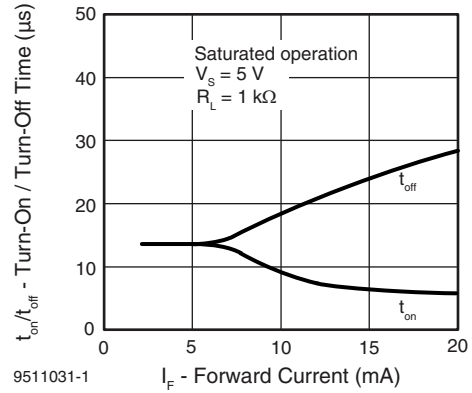


Fig. 18 - Turn-On / Turn-Off Time vs. Forward Current

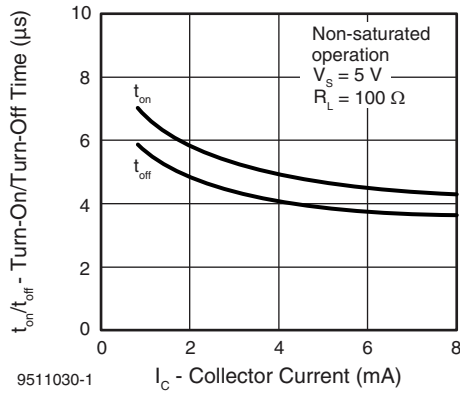
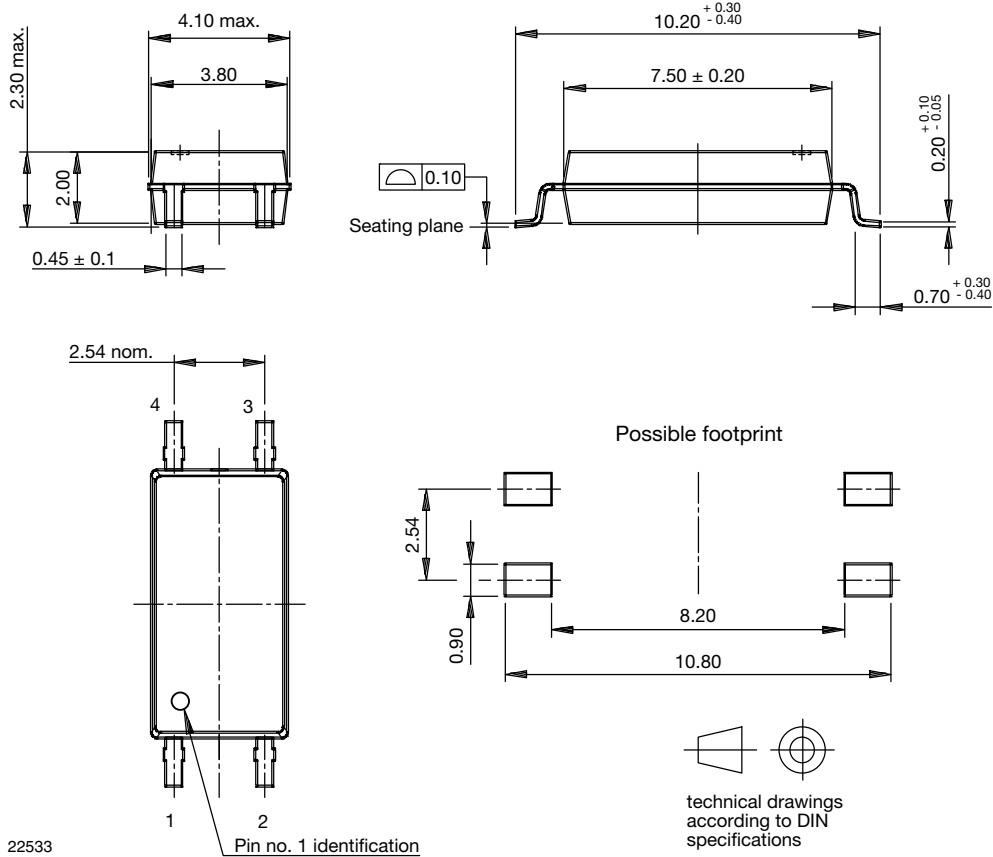
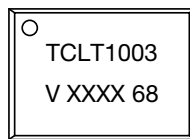


Fig. 17 - Turn-On / Turn-Off Time vs. Collector Current

## PACKAGE DIMENSIONS (in millimeters)



## PACKAGE MARKING (example)



### Note

- XXXX = LMC (lot marking code)

## TAPE AND REEL DIMENSIONS (in millimeters)

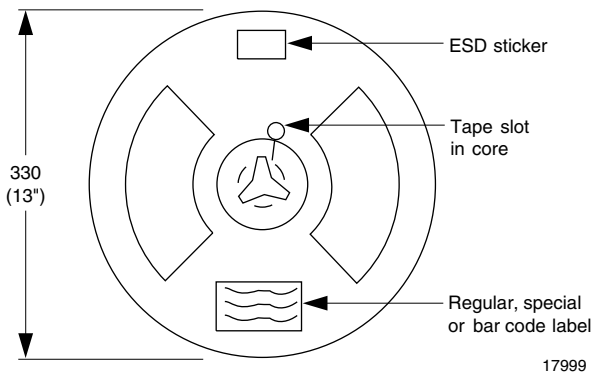


Fig. 19 - Reel Dimensions (3000 units per reel)

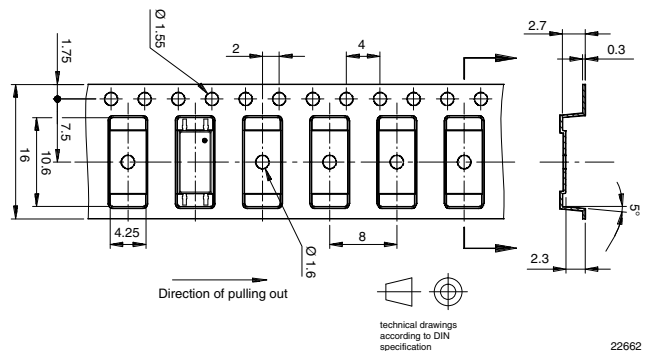
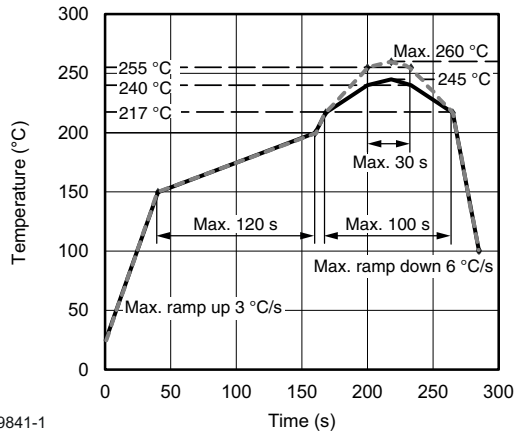


Fig. 20 - Tape Dimensions



**SOLDER PROFILE**



19841-1

Fig. 21 - Lead (Pb)-free Reflow Solder Profile according to J-STD-020

**HANDLING AND STORAGE CONDITIONS**

ESD level: HBM class 2

Floor life: unlimited

Conditions:  $T_{amb} < 30\text{ °C}$ ,  $RH < 85\%$

Moisture sensitivity level 1, according to J-STD-020



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