

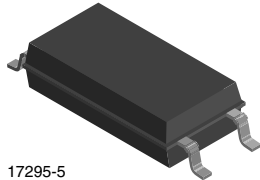


**THE DATASHEET OF  
TCLT1013**

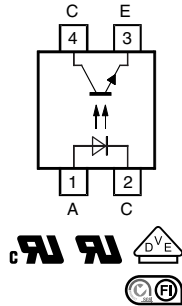




# Optocoupler, Phototransistor Output, LSOP-4, 110 °C Rated, Long Mini-Flat Package



17295-5



### FEATURES

- SMD low profile 4 lead package
- High isolation 5000 V<sub>RMS</sub>
- CTR flexibility available see order information
- Extra low coupling capacitance
- Connected base
- DC input with transistor output
- Temperature range -55 °C to +110 °C
- Creepage distance > 8 mm
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



### DESCRIPTION

The TCLT101. series consists of a phototransistor optically coupled to a gallium arsenide infrared-emitting diode in a 4-lead LSOP package.

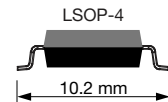
### APPLICATIONS

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

### AGENCY APPROVALS

- UL1577, file no. E76222
- cUL - file no. E76222, equivalent to CSA bulletin 5A
- DIN EN 60747-5-5
- FIMKO: EN 60950

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;">1</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, FIMKO	50 to 600	63 to 125	100 to 200	50 to 150	100 to 300	80 to 160	130 to 260	200 to 400
LSOP-4	TCLT1010	TCLT1012	TCLT1013	TCLT1015	TCLT1016	TCLT1017	TCLT1018	TCLT1019



ABSOLUTE MAXIMUM RATINGS (T <sub>amb</sub> = 25 °C, unless otherwise specified)				
PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
<b>INPUT</b>				
Reverse voltage		V <sub>R</sub>	6	V
Forward current		I <sub>F</sub>	60	mA
Forward surge current	t <sub>p</sub> ≤ 10 μs	I <sub>FSM</sub>	1.5	A
Power dissipation		P <sub>diss</sub>	100	mW
Junction temperature		T <sub>j</sub>	125	°C
<b>OUTPUT</b>				
Collector emitter voltage		V <sub>CEO</sub>	70	V
Emitter collector voltage		V <sub>ECO</sub>	7	V
Collector current		I <sub>C</sub>	50	mA
Collector peak current	t <sub>p</sub> /T = 0.5, t <sub>p</sub> ≤ 10 ms	I <sub>CM</sub>	100	mA
Power dissipation		P <sub>diss</sub>	150	mW
Junction temperature		T <sub>j</sub>	125	°C



ABSOLUTE MAXIMUM RATINGS (T <sub>amb</sub> = 25 °C, unless otherwise specified)				
PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
<b>COUPLER</b>				
Total power dissipation		P <sub>tot</sub>	250	mW
Operating ambient temperature range		T <sub>amb</sub>	-55 to +110	°C
Storage temperature range		T <sub>stg</sub>	-55 to +125	°C
Soldering temperature <sup>(1)</sup>		T <sub>slid</sub>	260	°C

**Notes**

- 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.
- <sup>(1)</sup> Wave soldering three cycles are allowed. Also refer to "Assembly Instruction" ([www.vishay.com/doc?80054](http://www.vishay.com/doc?80054)).

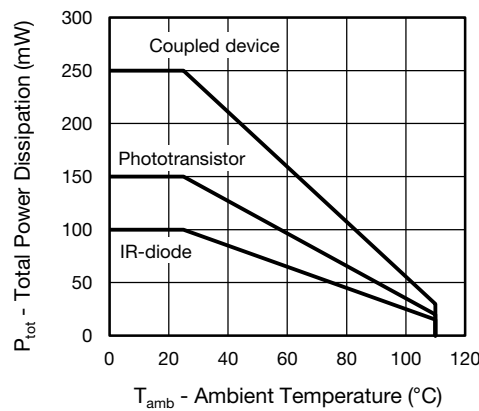


Fig. 1 - Total Power Dissipation vs. Ambient Temperature

ELECTRICAL CHARACTERISTICS (T <sub>amb</sub> = 25 °C, unless otherwise specified)						
PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
<b>INPUT</b>						
Forward voltage	I <sub>F</sub> = 50 mA	V <sub>F</sub>	-	1.25	1.6	V
Junction capacitance	V <sub>R</sub> = 0 V, f = 1 MHz	C <sub>j</sub>	-	50	-	pF
<b>OUTPUT</b>						
Collector emitter voltage	I <sub>C</sub> = 1 mA	V <sub>CEO</sub>	70	-	-	V
Emitter collector voltage	I <sub>E</sub> = 100 μA	V <sub>ECO</sub>	7	-	-	V
Collector emitter leakage current	V <sub>CE</sub> = 20 V, I <sub>F</sub> = 0 A	I <sub>CEO</sub>	-	10	100	nA
<b>COUPLER</b>						
Collector emitter saturation voltage	I <sub>F</sub> = 10 mA, I <sub>C</sub> = 1 mA	V <sub>CEsat</sub>	-	-	0.3	V
Cut-off frequency	V <sub>CE</sub> = 5 V, I <sub>F</sub> = 10 mA, R <sub>L</sub> = 100 Ω	f <sub>c</sub>	-	110	-	kHz
Coupling capacitance	f = 1 MHz	C <sub>k</sub>	-	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.

CURRENT TRANSFER RATIO ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)							
PARAMETER	TEST CONDITION	PART	SYMBOL	MIN.	TYP.	MAX.	UNIT
$I_C/I_F$	$V_{CE} = 5\text{ V}, I_F = 5\text{ mA}$	TCLT1010	CTR	50	-	600	%
	$V_{CE} = 5\text{ V}, I_F = 10\text{ mA}$	TCLT1012	CTR	63	-	125	%
		TCLT1013	CTR	100	-	200	%
	$V_{CE} = 5\text{ V}, I_F = 1\text{ mA}$	TCLT1012	CTR	22	45	-	%
		TCLT1013	CTR	34	70	-	%
	$V_{CE} = 5\text{ V}, I_F = 5\text{ mA}$	TCLT1015	CTR	50	-	150	%
		TCLT1016	CTR	100	-	300	%
		TCLT1017	CTR	80	-	160	%
		TCLT1018	CTR	130	-	260	%
TCLT1019		CTR	200	-	400	%	

SAFETY AND INSULATION RATINGS				
PARAMETER	TEST CONDITION	SYMBOL	VALUE	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)	$V_{IOTM}$	8	kV
		$V_{pd}$	1.3	kV
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	$^{\circ}\text{C}$
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 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.

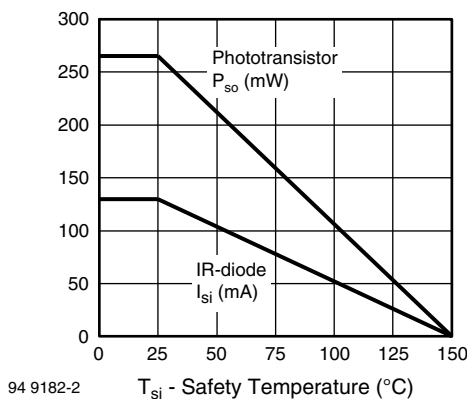


Fig. 2 - Derating Diagram

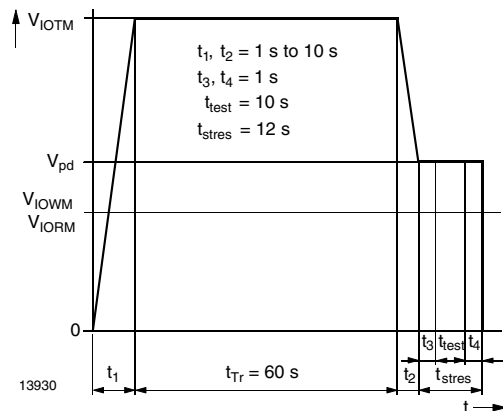


Fig. 3 - Test Pulse Diagram for Sample Test According to DIN EN 60747-5-2 (VDE 0884); IEC 60747-5-5

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 figure 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 figure 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 figure 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 figure 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 figure 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 figure 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 figure 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 figure 4)	$t_{off}$	-	10	-	$\mu\text{s}$

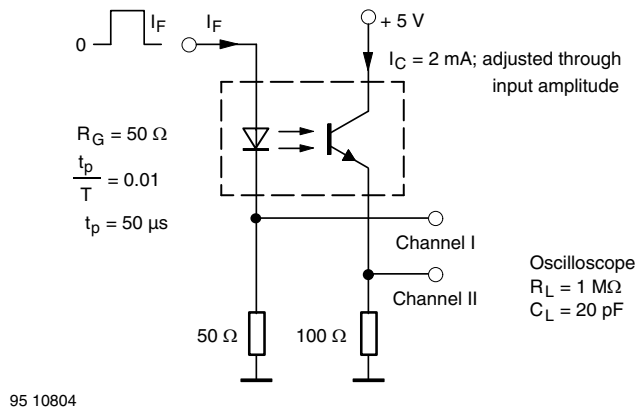


Fig. 4 - Test Circuit, Non-Saturated Operation

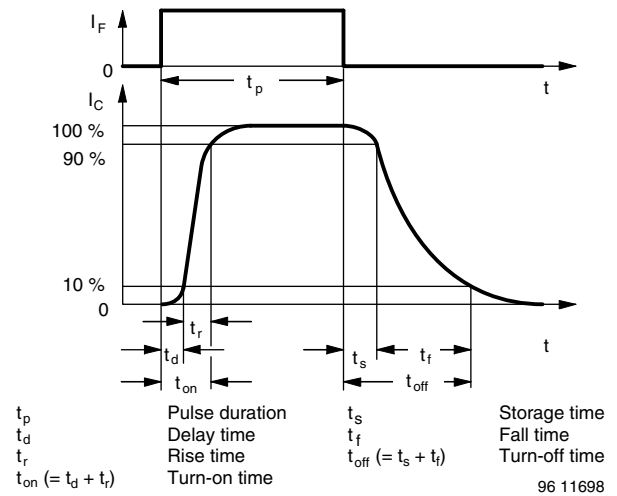


Fig. 6 - Switching Times

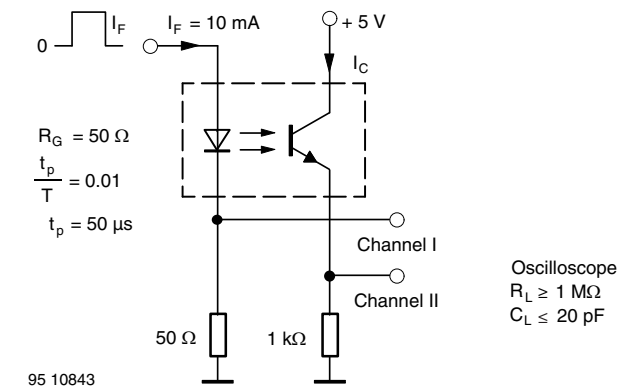


Fig. 5 - Test Circuit, Saturated Operation



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

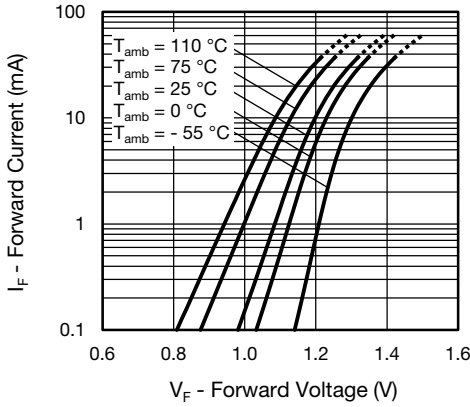


Fig. 7 - Forward Voltage vs. Forward Current

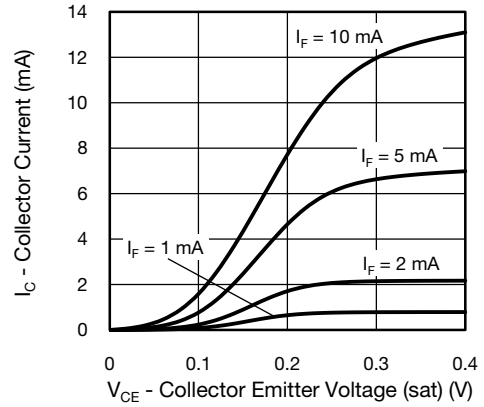


Fig. 10 - Collector Current vs. Collector Emitter Voltage (saturated)

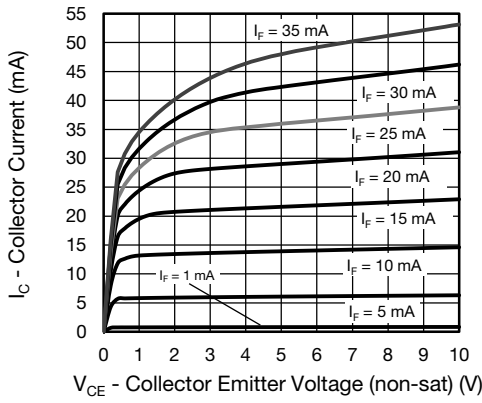


Fig. 8 - Collector Current vs. Collector Emitter Voltage (NS)

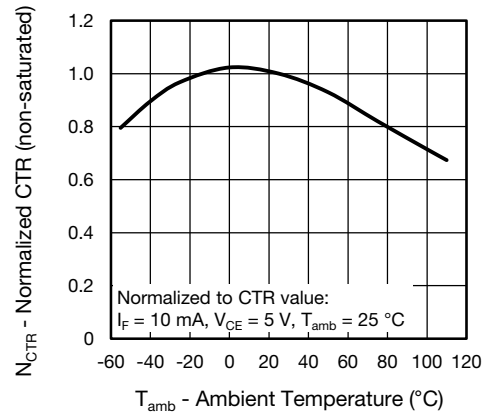


Fig. 11 - Normalized Current Transfer Ratio (non-saturated) vs. Ambient Temperature

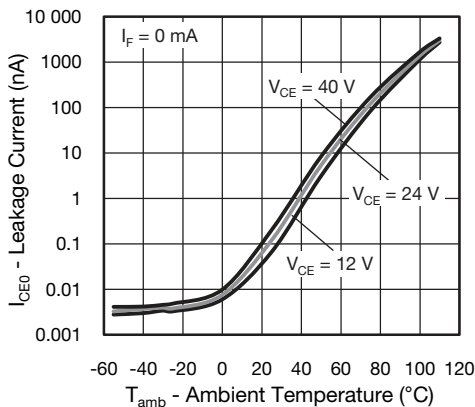


Fig. 9 - Leakage Current vs. Ambient Temperature

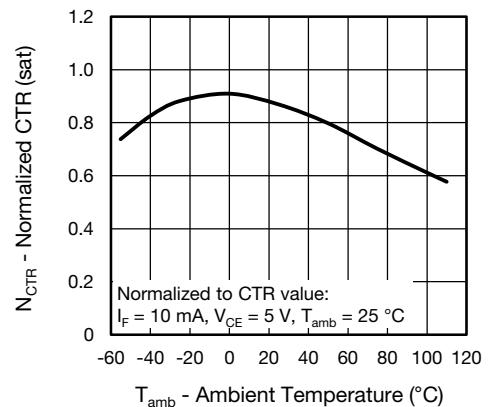


Fig. 12 - Normalized Current Transfer Ratio (saturated) vs. Ambient Temperature

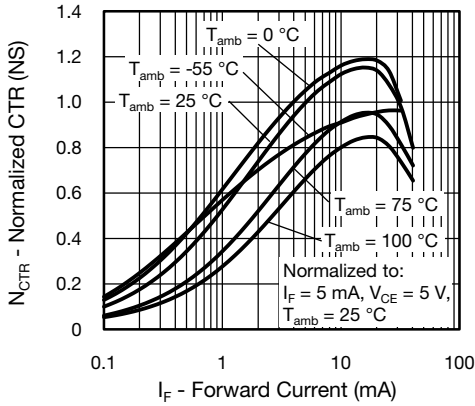


Fig. 13 - Normalized CTR (non-saturated) vs. Forward Current

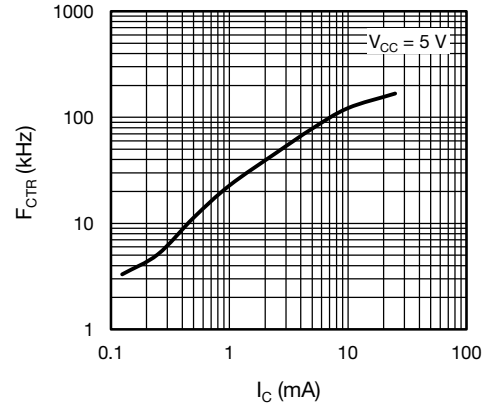


Fig. 16 - CTR Frequency vs. Collector Current

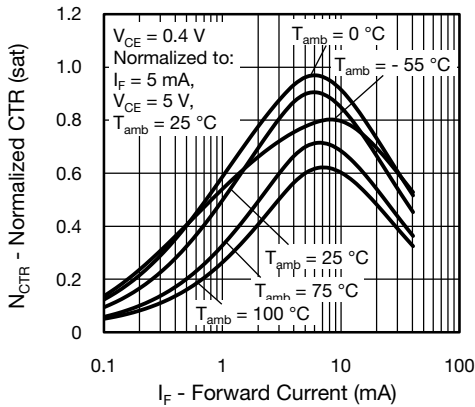


Fig. 14 - Normalized CTR (saturated) vs. Forward Current

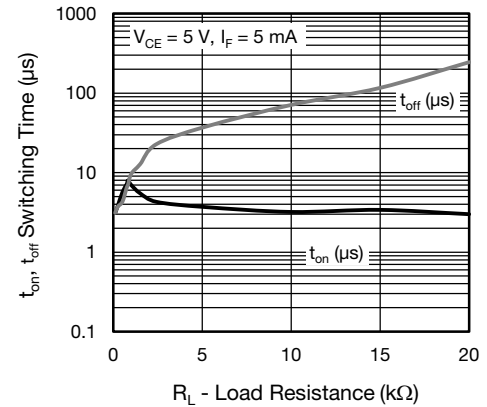


Fig. 17 - Switching Time vs. Load Resistance

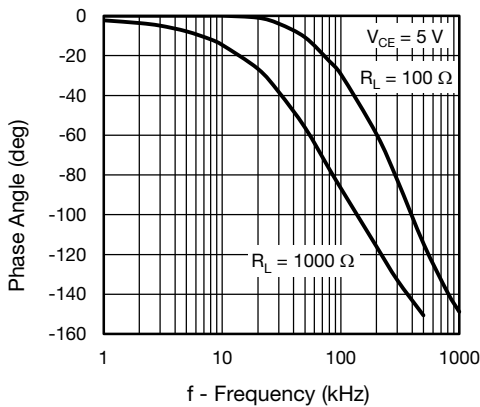


Fig. 15 - Phase Angle vs. Frequency

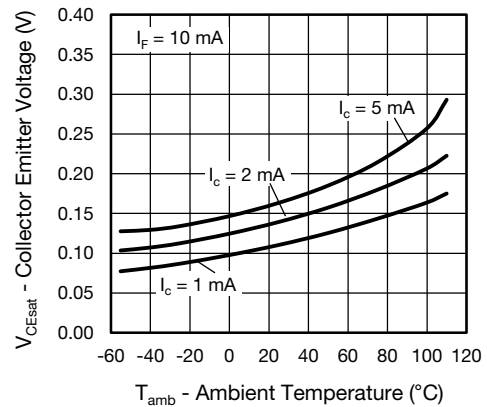
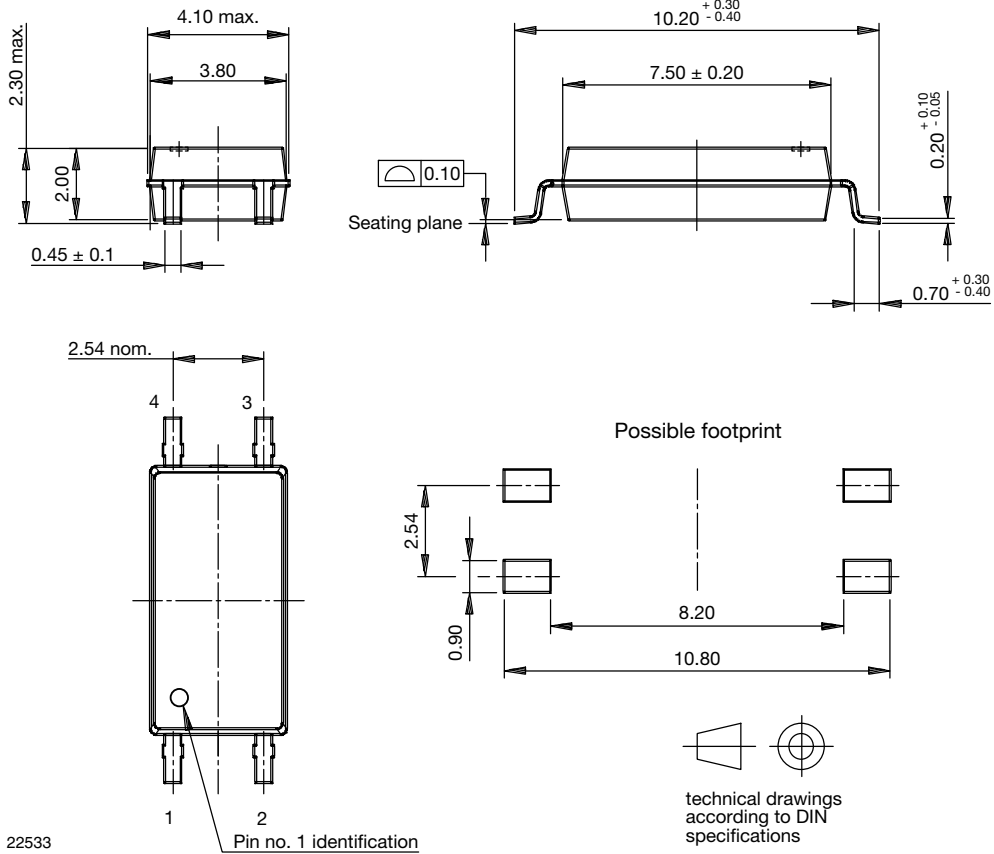
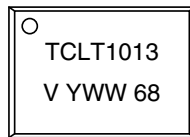


Fig. 18 - Collector Emitter Voltage vs. Ambient Temperature (saturated)

## PACKAGE DIMENSIONS (in millimeters)



## PACKAGE MARKING (example of TCLT1013)



## TAPE AND REEL DIMENSIONS (in millimeters)

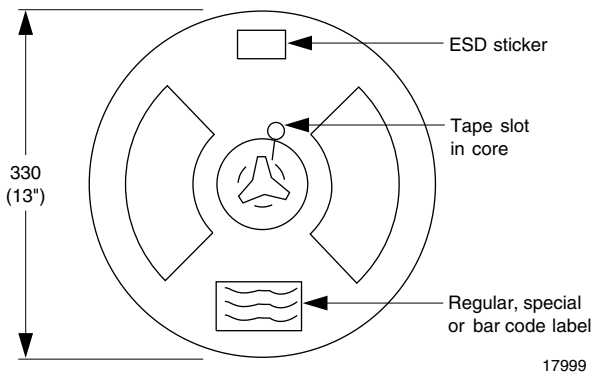


Fig. 19 - Reel Dimensions (3000 units per reel)

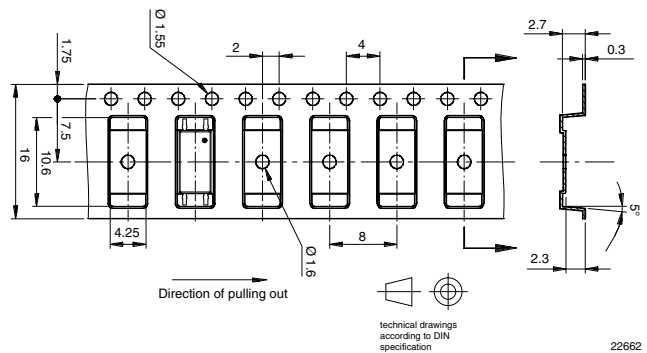
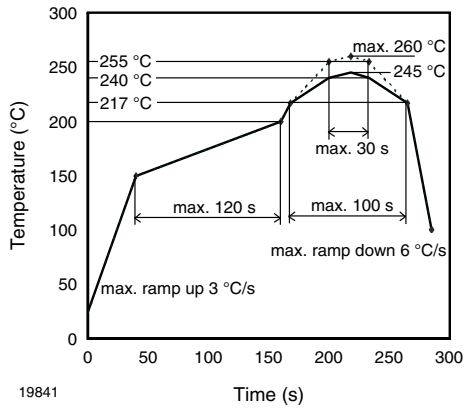


Fig. 20 - Tape Dimensions

**SOLDER PROFILE**



19841

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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