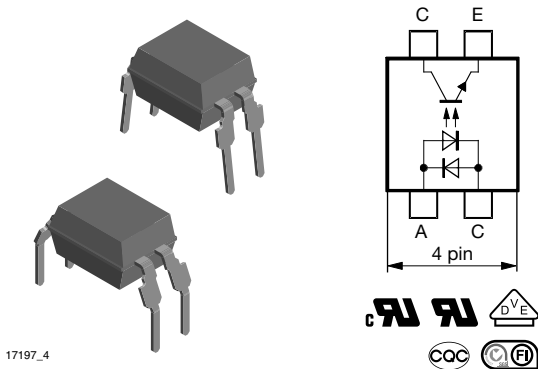


# Optocoupler, Phototransistor Output, AC Input



17197\_4

## LINKS TO ADDITIONAL RESOURCES



## VDE STANDARDS

These couplers perform safety functions according to the following equipment standards:

- **DIN EN 60747-5-5 (VDE 0884-5)**  
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
- **VDE 0700 / IEC 335**  
Household equipment
- **VDE 0160**  
Electronic equipment for electrical power installation
- **VDE 0750 / IEC 60601**  
Medical equipment

## DESCRIPTION

The TCET1600, TCET1600G consists of a phototransistor optically coupled to 2 gallium arsenide infrared-emitting diodes in a single (4 pin) package.

## FEATURES

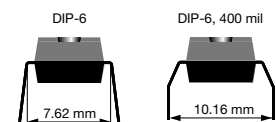
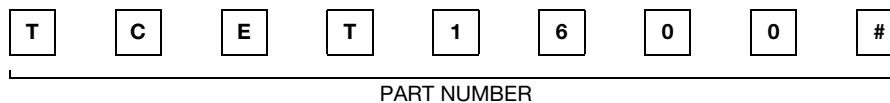
- Isolation materials according to UL 94 V-0
- Pollution degree 2 (DIN / VDE 0110 / resp. IEC 60664)
- Climatic classification 55/100/21 (IEC 60068 part 1)
- Special construction: therefore, extra low coupling capacity of typical 0.2 pF, high common mode rejection
- Low temperature coefficient of CTR
- Rated impulse voltage (transient overvoltage)  $V_{IOTM} = 10 kV_{peak}$
- Isolation test voltage (partial discharge test voltage)  $V_{pd} = 1.6 kV_{peak}$
- Rated isolation voltage (RMS includes DC)  $V_{IOWM} = 600 V_{RMS}$
- Rated recurring peak voltage (repetitive)  $V_{IORM} = 890 V_{peak}$
- Thickness through insulation  $\geq 0.75$  mm
- Creepage current resistance according to VDE 0303 / IEC 60112 comparative tracking index: CTI  $\geq 175$
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS**  
COMPLIANT

## AGENCY APPROVALS

- [UL](#)
- [cUL](#)
- [DIN EN 60747-5-5 \(VDE 0884-5\)](#)
- [FIMKO](#)
- [CQC GB4943.1](#)
- [CQC GB8898](#)

## ORDERING INFORMATION



AGENCY CERTIFIED / PACKAGE	CTR (%)
	$\pm 5$ mA
UL, cUL, VDE, FIMKO	20 to 300
DIP-4, single channel	TCET1600
DIP-4, single channel, 400 mil	TCET1600G

### Note

- G = leadform 10.16 mm; G is not marked on the body



<b>ABSOLUTE MAXIMUM RATINGS</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)				
PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
<b>INPUT</b>				
Reverse voltage		$V_R$	6	V
Forward current		$I_F$	$\pm 60$	mA
Forward surge current	$t_p \leq 10\text{ }\mu\text{s}$	$I_{FSM}$	$\pm 1.5$	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 +150	$^{\circ}\text{C}$
Soldering temperature <sup>(1)</sup>	2 mm from case, $t \leq 10\text{ s}$	$T_{sld}$	260	$^{\circ}\text{C}$

**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> Refer to wave profile for soldering conditions for through hole devices (DIP)

<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	$I_F = \pm 50\text{ mA}$	$V_F$	-	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	$I_C = 100\text{ }\mu\text{A}$	$V_{CEO}$	70	-	-	V
Emitter collector voltage	$I_E = 100\text{ }\mu\text{A}$	$V_{ECO}$	7	-	-	V
Collector dark current	$V_{CE} = 20\text{ V}, I_F = 0, E = 0$	$I_{CEO}$	-	-	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	$V_{CE} = 5\text{ V}, I_F = 10\text{ mA}, R_L = 100\text{ }\Omega$	$f_c$	-	100	-	kHz
Coupling capacitance	$f = 1\text{ MHz}$	$C_k$	-	0.3	-	pF

**Note**

- Minimum and maximum values were 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.

<b>CURRENT TRANSFER RATIO</b>						
PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
$I_C/I_F$	$V_{CE} = 5\text{ V}, I_F = \pm 5\text{ mA}$	CTR	20	-	300	%

INSULATION RATED PARAMETERS						
PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Partial discharge test voltage - routine test	100 %, $t_{test} = 1$ s	$V_{pd}$	1.669	-	-	kV
Partial discharge test voltage - lot test (sample test)	$t_{Tr} = 60$ s, $t_{test} = 10$ s, (see Fig. 2)	$V_{IOTM}$	10	-	-	kV
		$V_{pd}$	1.424	-	-	kV
Insulation resistance	$V_{IO} = 500$ V	$R_{IO}$	$10^{12}$	-	-	$\Omega$
	$V_{IO} = 500$ V, $T_{amb} = 100$ °C	$R_{IO}$	$10^{11}$	-	-	$\Omega$
	$V_{IO} = 500$ V, $T_{amb} = 150$ °C (construction test only)	$R_{IO}$	$10^9$	-	-	$\Omega$

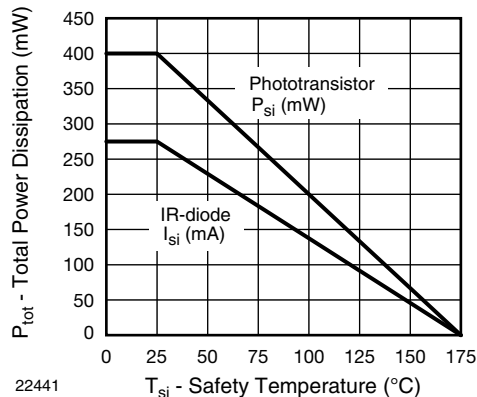


Fig. 1 - Derating Diagram

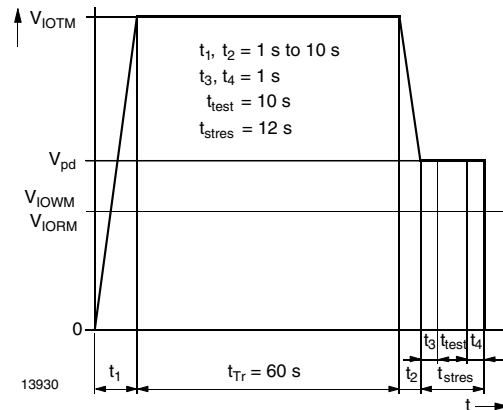


Fig. 2 - Test Pulse Diagram for Sample Test according to DIN EN 60747-5-2 (VDE 0884); IEC60747-5-5

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

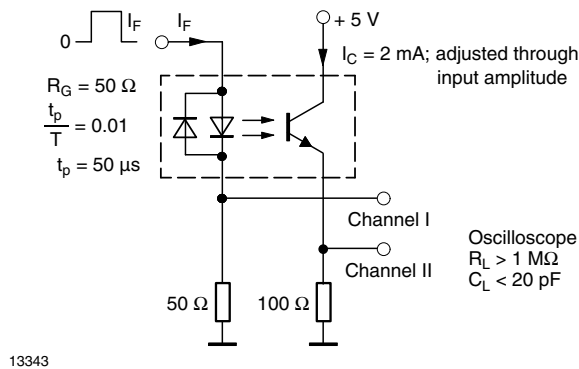


Fig. 3 - Test Circuit, Non-Saturated Operation

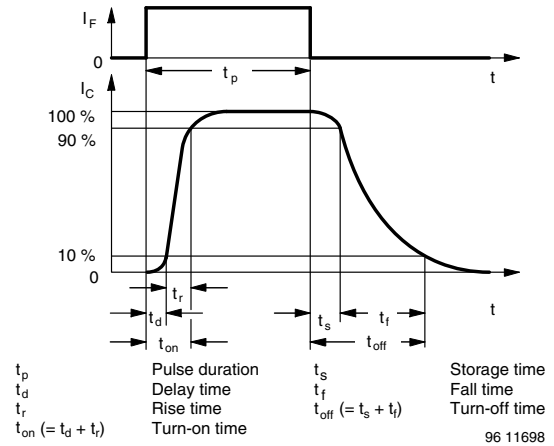


Fig. 5 - Switching Times

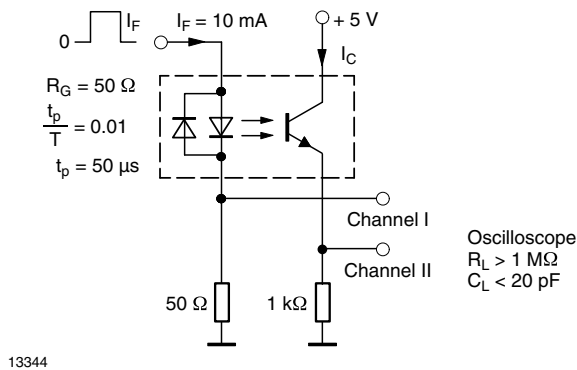


Fig. 4 - Test Circuit, Saturated Operation

SAFETY AND INSULATION RATINGS				
PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Climatic classification	According to IEC 68 part 1		55 / 100 / 21	
Comparative tracking index		CTI	175	
Maximum rated withstanding isolation voltage	t = 1 min	V <sub>ISO</sub>	4420	V <sub>RMS</sub>
Maximum transient isolation voltage		V <sub>IOTM</sub>	10 000	V <sub>peak</sub>
Maximum repetitive peak isolation voltage		V <sub>IORM</sub>	890	V <sub>peak</sub>
Isolation resistance	V <sub>IO</sub> = 500 V, T <sub>amb</sub> = 25 °C	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
Output safety power		P <sub>SO</sub>	400	mW
Input safety current		I <sub>SI</sub>	275	mA
Safety temperature		T <sub>S</sub>	175	°C
Creepage distance			≥ 7	mm
Clearance distance			≥ 7	mm
Insulation thickness		DTI	≥ 0.4	mm

**Note**

- As per IEC 60747-5-5, § 7.4.3.8.2, this optocoupler is suitable for “safe electrical insulation” only within the safety ratings. Compliance with the safety ratings shall be ensured by means of protective circuits.

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

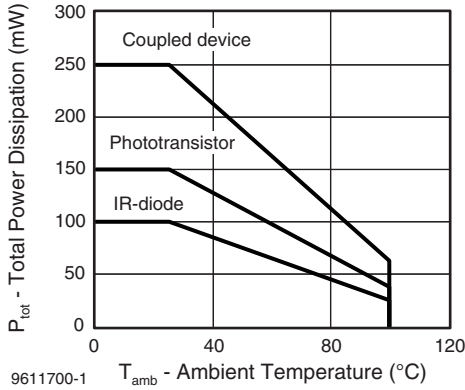


Fig. 6 - Total Power Dissipation vs. Ambient Temperature

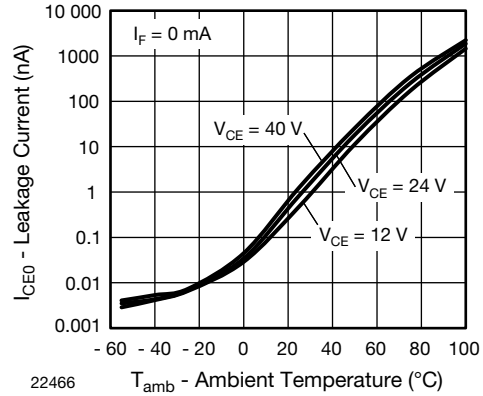


Fig. 9 - Leakage Current vs. Ambient Temperature

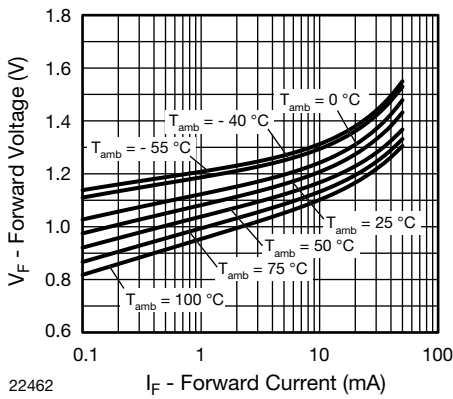


Fig. 7 - Forward Current vs. Forward Voltage

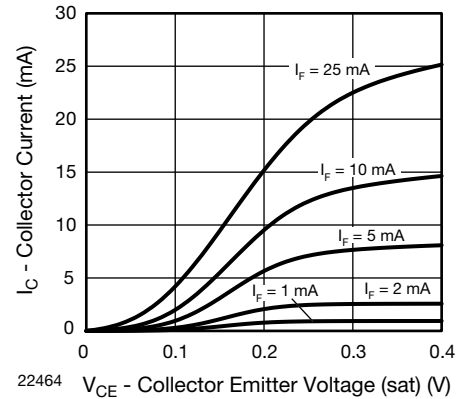


Fig. 10 - Collector Current vs. Collector Emitter Voltage (saturated)

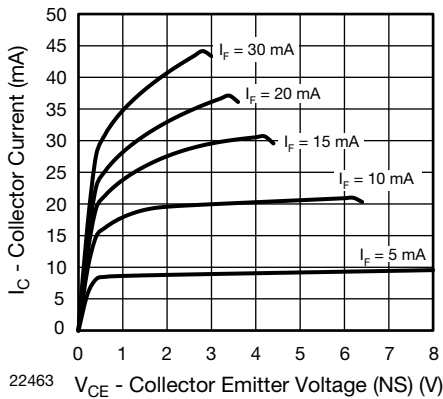


Fig. 8 - Collector Current vs. Collector Emitter Voltage (non-saturated)

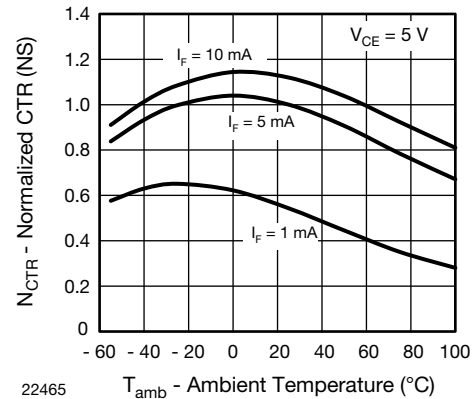


Fig. 11 - Normalized CTR (non-saturated) vs. Ambient Temperature

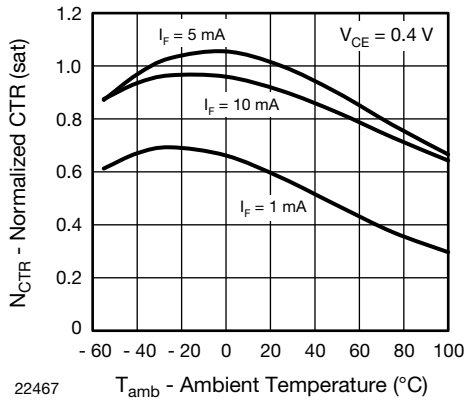


Fig. 12 - Normalized CTR (saturated) vs. Ambient Temperature

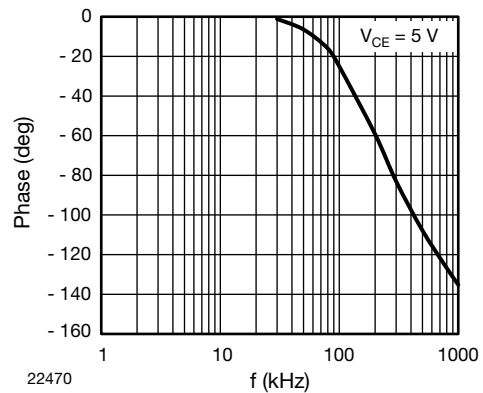


Fig. 15 -  $F_{CTR}$  vs. Phase Angle

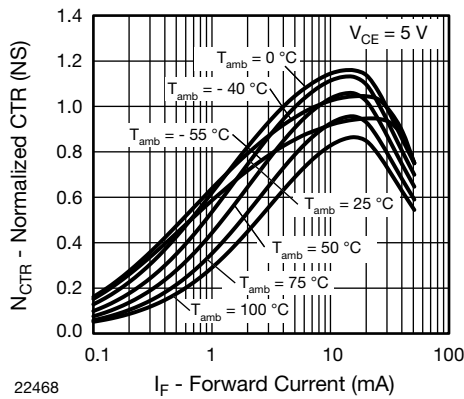


Fig. 13 - Normalized CTR (non-saturated) vs. Forward Current

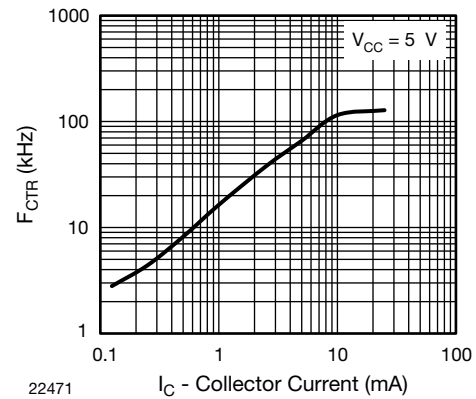


Fig. 16 -  $F_{CTR}$  vs.  $I_C$

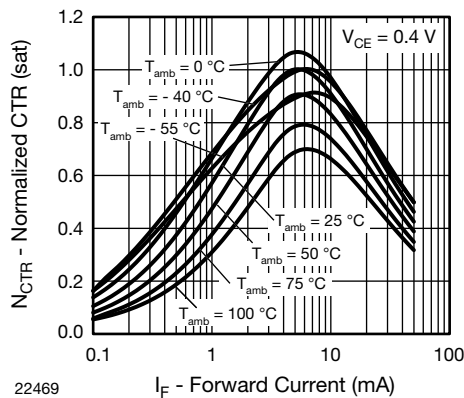


Fig. 14 - Normalized CTR (saturated) vs. Forward Current

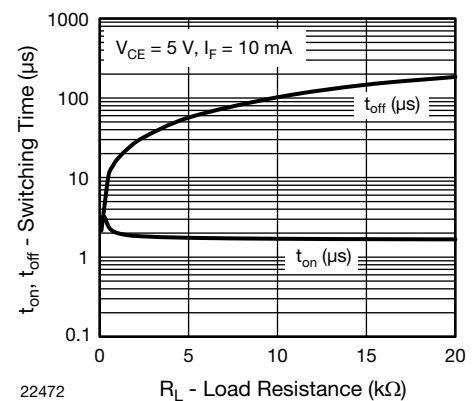
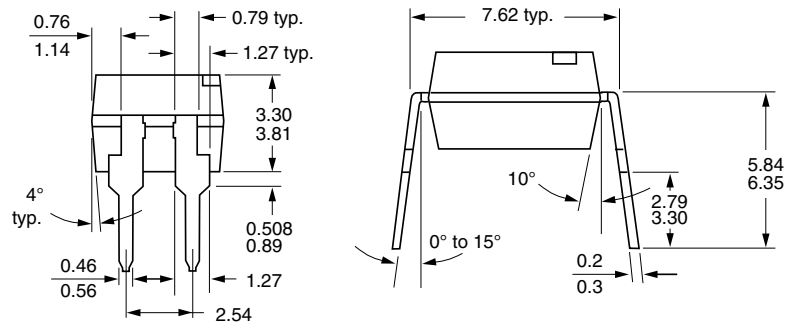
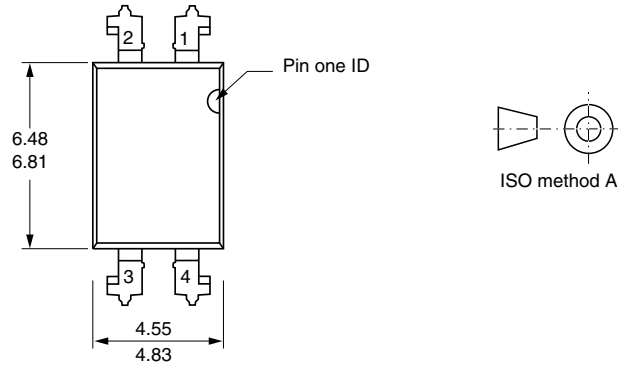


Fig. 17 - Switching Time vs. Load Resistance

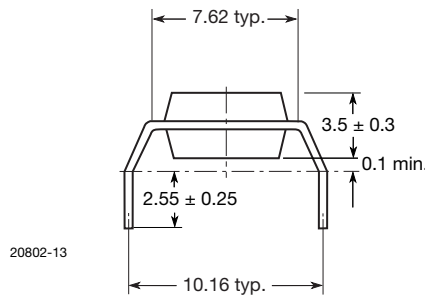


## PACKAGE DIMENSIONS in millimeters

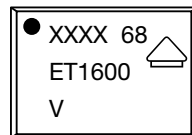


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### Option 6



## PACKAGE MARKING (example)



### Note

- XXXX = LMC (lot marking code)



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