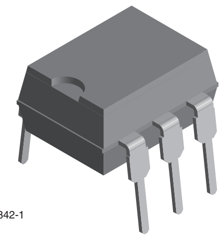
Optocoupler, Phototriac Output, Zero Crossing, High dV/dt, Low Input Current



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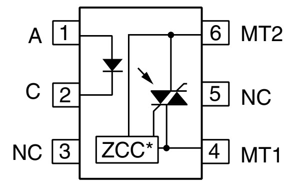


*Zero crossing circuit

i179030_4

DESCRIPTION

The VO4157 and VO4158 consists of a GaAs IRLED optically coupled to a photosensitive zero crossing TRIAC packaged in a DIP-6 package.

High input sensitivity is achieved by using an emitter follower phototransistor and a cascaded SCR predriver resulting in an LED trigger current of 1.6 mA for bin D, 2 mA for bin H, and 3 mA for bin M.

The new phototriac zero crossing family uses a proprietary dV/dt clamp resulting in a static dV/dt of greater than 5 kV/μs.

The VO4157 and VO4158 isolates low-voltage logic from 120 V_{AC}, 240 V_{AC}, and 380 V_{AC} lines to control resistive, inductive, or capacitive loads including motors, solenoids, high current thyristors or TRIAC and relays.

FEATURES

- High static dV/dt 5 kV/μs
- High input sensitivity I_{FT} = 1.6 mA, 2 mA, and 3 mA
- 300 mA on-state current
- Zero voltage crossing detector
- 700 V and 800 V blocking voltage
- Isolation test voltage 5300 V_{RMS}
- Compliant to RoHS Directive 2011/65/EU

Pb-free
e3
RoHS
COMPLIANT

APPLICATIONS

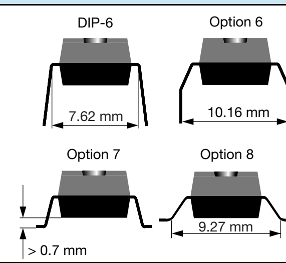
- Solid-state relays
- Industrial controls
- Office equipment
- Consumer appliances

AGENCY APPROVALS

- UL1577, file no. E52744 system code H or J, double protection
- cUL - file no. E52744, equivalent to CSA bulletin 5A
- DIN EN 60747-5-2 (VDE 0884) available with option 1
- FIMKO

ORDERING INFORMATION

V	O	4	1	5	#	X	-	X	0	#	#	T
PART NUMBER								PACKAGE OPTION				TAPE AND REEL



AGENCY CERTIFIED/PACKAGE	V_{DRM} 700			V_{DRM} 800		
	TRIGGER CURRENT, I_{FT} (mA)					
UL, cUL	**1.6**	**2**	**3**	**1.6**	**2**	**3**
DIP-6	VO4157D	VO4157H	VO4157M	VO4158D	VO4158H	VO4158M
DIP-6, 400 mil, option 6	VO4157D-X006	VO4157H-X006	VO4157M-X006	VO4158D-X006	VO4158H-X006	VO4158M-X006
SMD-6, option 7	VO4157D-X007T	VO4157H-X007T	VO4157M-X007T	VO4158D-X007T	VO4158H-X007T	VO4158M-X007T
VDE, UL, cUL	**1.6**	**2**	**3**	**1.6**	**2**	**3**
DIP-6	-	-	VO4157M-X001	-	-	-
DIP-6, 400 mil, option 6	-	-	-	-	-	VO4158M-X016
SMD-6, option 7	VO4157D-X017T	VO4157H-X017T	VO4157M-X017T	-	VO4158H-X017T	-
SMD-6, option 8	-	-	-	-	-	VO4158M-X018T

ABSOLUTE MAXIMUM RATINGS (T_{amb} = 25 °C, unless otherwise specified)					
PARAMETER	**TEST CONDITION**	**PART**	**SYMBOL**	**VALUE**	**UNIT**
INPUT					
Reverse voltage			V_R	6	V
Forward current			I_F	60	mA
Surge current			I_{FSM}	2.5	A
Derate from 25 °C				1.33	mW/°C
OUTPUT					
Peak off-state voltage		VO4157D/H/M	V_{DRM}	700	V
		VO4158D/H/M	V_{DRM}	800	V
RMS on-state current			I_{TM}	300	mA
Derate from 25 °C				6.6	mW/°C
COUPLER					
Isolation test voltage (between emitter and detector, climate per DIN 500414, part 2, Nov. 74)	t = 1 min		V_{ISO}	5300	V_{RMS}
Storage temperature range			T_{stg}	- 55 to + 150	°C
Ambient temperature range			T_{amb}	- 55 to + 100	°C
Soldering temperature	max. ≤ 10 s dip soldering ≥ 0.5 mm from case bottom		T_{sld}	260	°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.
  This phototriac should not be used to drive a load directly. It is intended to be a trigger device only.

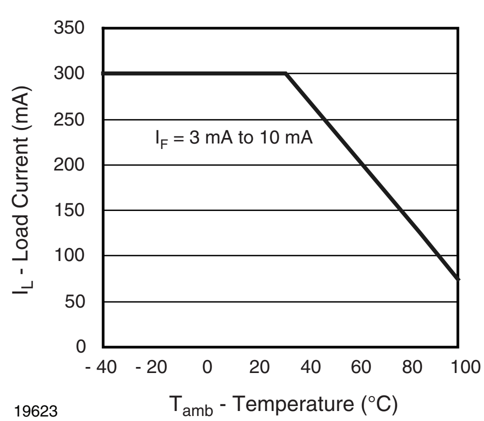
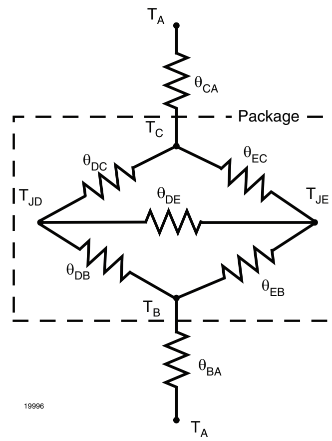


Fig. 1 - Recommended Operating Condition

THERMAL CHARACTERISTICS				
PARAMETER	SYMBOL	VALUE	UNIT	
LED power dissipation	P_{diss}	100	mW	
Output power dissipation	P_{diss}	500	mW	
Total power dissipation	P_{tot}	600	mW	
Maximum LED junction temperature	$T_{jmax.}$	125	°C	
Maximum output die junction temperature	$T_{jmax.}$	125	°C	
Thermal resistance, junction emitter to board	θ_{JEB}	150	°C/W	
Thermal resistance, junction emitter to case	θ_{JEC}	139	°C/W	
Thermal resistance, junction detector to board	θ_{JDB}	78	°C/W	
Thermal resistance, junction detector to case	θ_{JDC}	103	°C/W	
Thermal resistance, junction emitter to junction detector	θ_{JED}	496	°C/W	
Thermal resistance, case to ambient	θ_{CA}	3563	°C/W	

Note

- The thermal characteristics table above were measured at 25 °C and the thermal model is represented in the thermal network below. Each resistance value given in this model can be used to calculate the temperatures at each node for a given operating condition. The thermal resistance from board to ambient will be dependent on the type of PCB, layout and thickness of copper traces. For a detailed explanation of the thermal model, please reference Vishay's Thermal Characteristics of Optocouplers application note.

ELECTRICAL CHARACTERISTICS (T_{amb} = 25 °C, unless otherwise specified)							
PARAMETER	TEST CONDITION	PART	SYMBOL	MIN.	TYP.	MAX.	UNIT
INPUT							
Forward voltage	I_F = 10 mA		V_F		1.2	1.4	V
Reverse current	V_R = 6 V		I_R		0.1	10	µA
Input capacitance	V_F = 0 V, f = 1 MHz		C_I		25		pF
OUTPUT							
Repetitive peak off-state voltage	I_{DRM} = 100 µA	VO4157D/H/M	V_{DRM}	700			V
		VO4158D/H/M	V_{DRM}	800			V
Off-state current	$V_D = V_{DRM}$, I_F = 0		I_{DRM}			100	µA
On-state voltage	I_T = 300 mA		V_{TM}			3	V
On-state current	PF = 1, $V_{T(RMS)}$ = 1.7 V		I_{TM}			300	mA
Off-state current in inhibit state	I_F = 2 mA, V_{DRM}		I_{DINH}			200	µA
Holding current			I_H			500	µA
Zero cross inhibit voltage	I_F = rated I_{FT}		V_{IH}			20	V
Critical rate of rise of off-state voltage	V_D = 0.67 V_{DRM}, T_J = 25 °C		dV/dt_{cr}	5000			V/µs
COUPLER							
LED trigger current, current required to latch output	V_D = 3 V	VO4157D	I_{FT}			1.6	mA
		VO4157H	I_{FT}			2	mA
		VO4157M	I_{FT}			3	mA
		VO4158D	I_{FT}			1.6	mA
		VO4158H	I_{FT}			2	mA
		VO4158M	I_{FT}			3	mA
Common mode coupling capacitance			C_{CM}		0.01		pF
Capacitance (input to output)	f = 1 MHz, V_{IO} = 0 V		C_{IO}		0.8		pF

Note

- Minimum and maximum values were tested requierements. 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.

SAFETY AND INSULATION RATINGS						
PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Climatic classification (according to IEC68 part 1)				55/100/21		
Pollution degree (DIN VDE 0109)				2		
Comparative tracking index per DIN IEC112/VDE 0303 part 1, group IIIa per DIN VDE 6110 175 399			175		399	
V_{IOTM}		V_{IOTM}	8000			V
V_{IORM}		V_{IORM}	890			V
P_{SO}		P_{SO}			500	mW
I_{SI}		I_{SI}			250	mA
T_{SI}		T_{SI}			175	°C
Creepage distance			7			mm

TYPICAL CHARACTERISTICS (T_{amb} = 25 °C, unless otherwise specified)

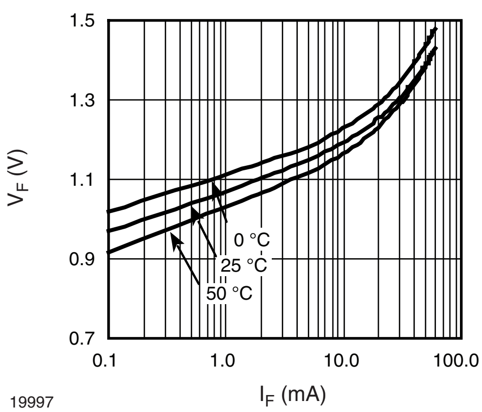


Fig. 2 - Diode Forward Voltage vs. Forward Current

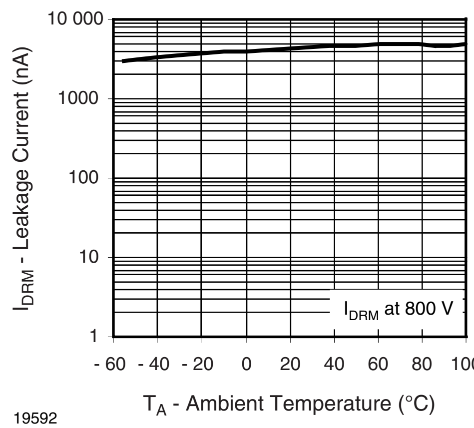


Fig. 4 - Leakage Current vs. Ambient Temperature

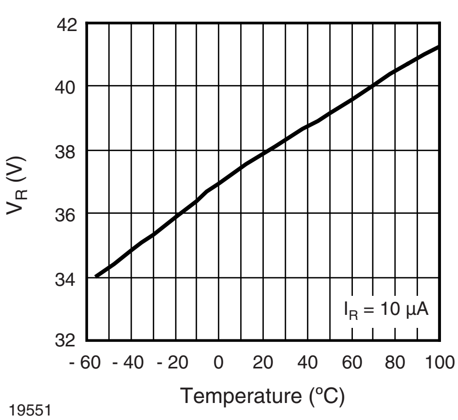


Fig. 3 - Diode Reverse Voltage vs. Temperature

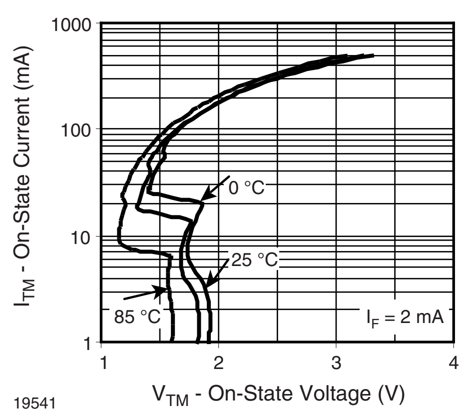


Fig. 5 - On State Current vs. On State Voltage

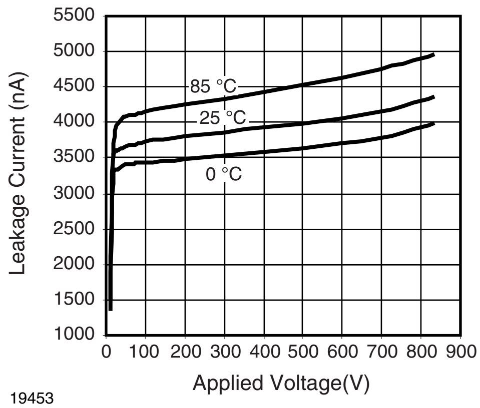


Fig. 6 - Output Off Current (Leakage) vs. Voltage

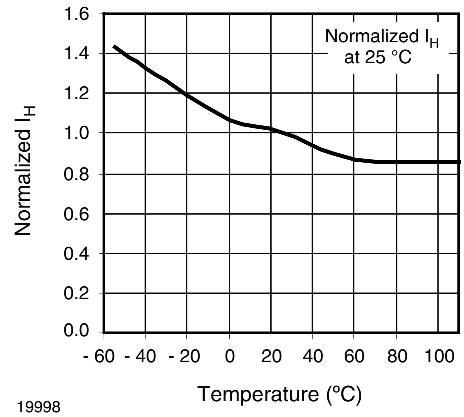


Fig. 9 - Normalized Holding Current vs. Temperature

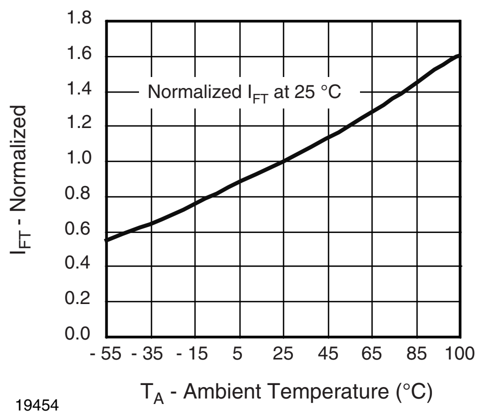


Fig. 7 - Normalized Trigger Input Current vs. Temperature

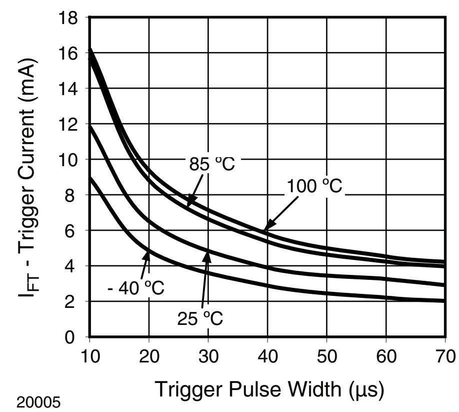


Fig. 10 - I_{FT} vs. LED Pulse Width

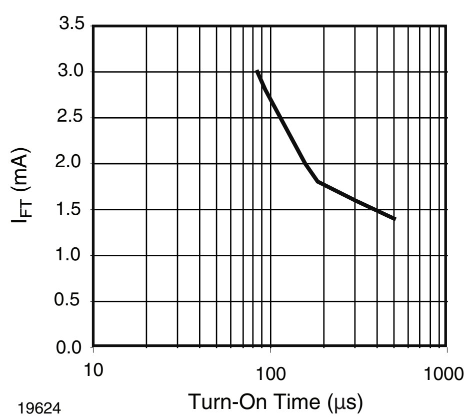


Fig. 8 - Trigger Current vs. Turn-On Time

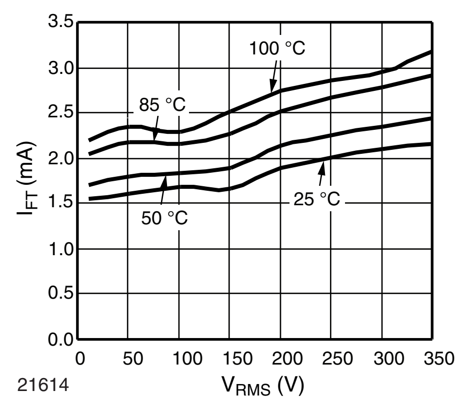


Fig. 11 - I_{FT} vs. V_{RMS} and Temperature

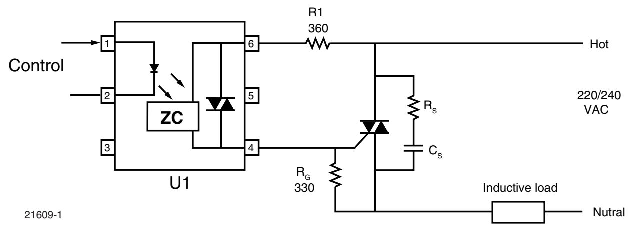


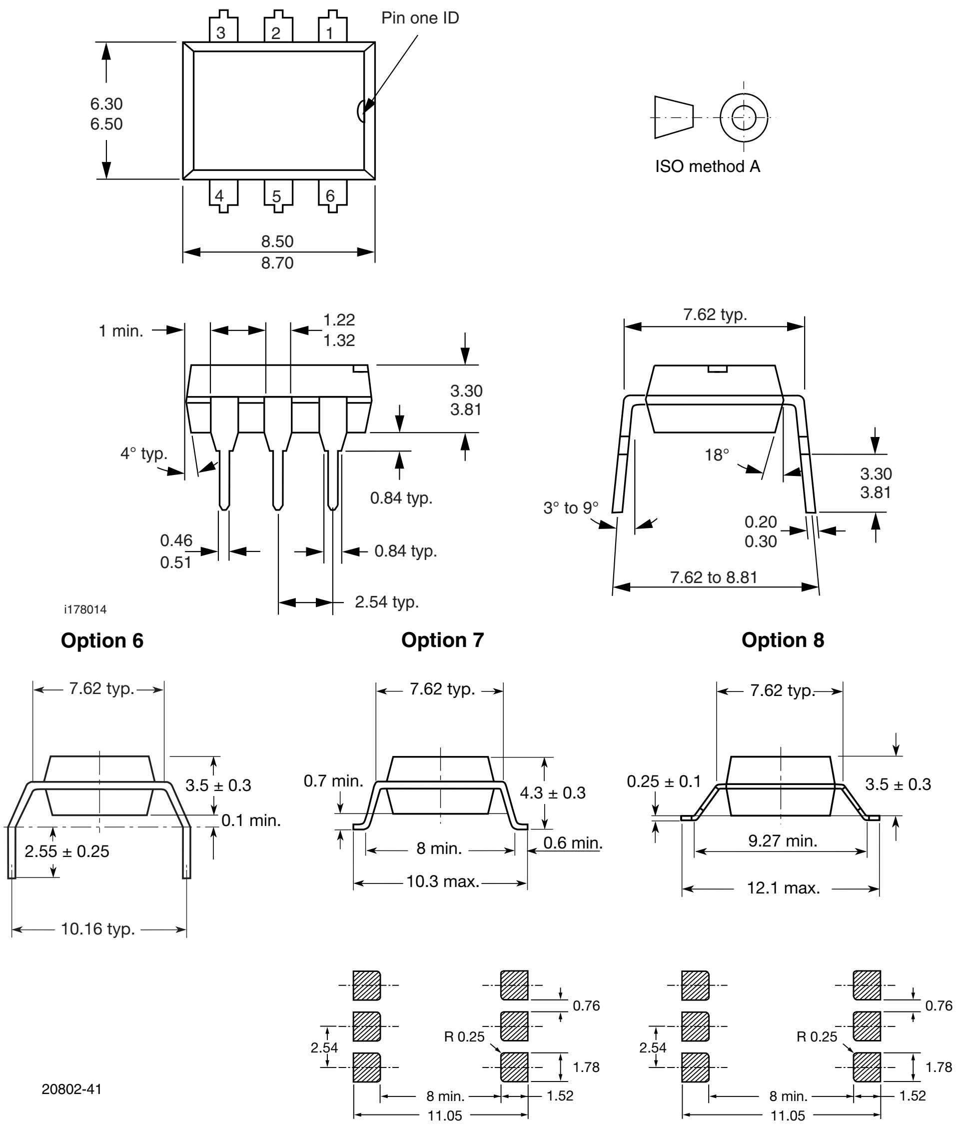
Fig. 12 - Basic Power Triac Driver Circuit

POWER FACTOR CONSIDERATIONS

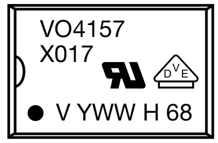
As a zero voltage crossing optotriac, the commutating dV/dt spikes can inhibit one half of the TRIAC from turning on. If the spike potential exceeds the inhibit voltage of the zero-cross detection circuit, half of the TRIAC will be held-off and not turn-on. This hold-off condition can be eliminated by using a capacitor or RC snubber placed directly across the power triac as shown in fig. 11. Note that the value of the capacitor increases as a function of the load current.

The hold-off condition also can be eliminated by providing a higher level of LED drive current. The higher LED drive provides a larger photocurrent which causes the phototransistor to turn-on before the commutating spike has activated the zero-cross detection circuit. For example, if a device requires 1.5 mA for a resistive load, then 2.7 mA (1.8 times) may be required to control an inductive load whose power factor is less than 0.3.

PACKAGE DIMENSIONS in millimeters



PACKAGE MARKING (example)



Notes

- VDE logo is only marked on option 1 parts. Tape and reel suffix (T) is not part of the package marking.

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