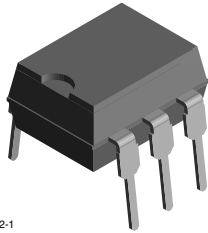
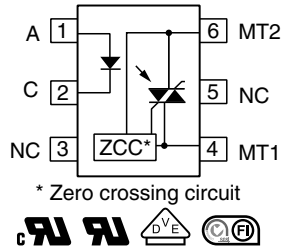


# Optocoupler, Phototriac Output, Zero Crossing, High dV/dt, Low Input Current



21842-1



## LINKS TO ADDITIONAL RESOURCES



3D Models



Design Tools



Related Documents



SPICE Models



Footprints



Schematics

## DESCRIPTION

The 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 VO4158 isolates low-voltage logic from 120 V<sub>AC</sub>, 240 V<sub>AC</sub>, and 380 V<sub>AC</sub> 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<sub>FT</sub> = 1.6 mA, 2 mA, and 3 mA
- 300 mA on-state current
- Zero voltage crossing detector
- 800 V blocking voltage
- Isolation rated voltage 4420 V<sub>RMS</sub>
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS**  
COMPLIANT

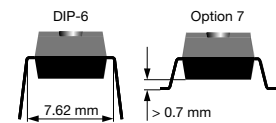
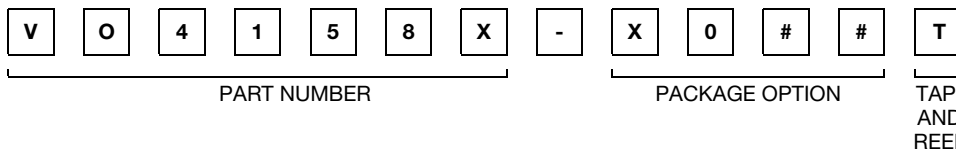
## APPLICATIONS

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

## AGENCY APPROVALS

- [UL](#)
- [cUL](#)
- [DIN EN 60747-5-5 \(VDE 0884-5\)](#), available with option 1
- [FIMKO](#)

## ORDERING INFORMATION



AGENCY CERTIFIED / PACKAGE	V <sub>DRM</sub> 800		
	TRIGGER CURRENT, I <sub>FT</sub> (mA)		
UL, cUL	1.6	2	3
DIP-6	VO4158D	VO4158H	-
SMD-6, option 7	-	VO4158H-X007T	VO4158M-X007T
SMD-6, option 9	VO4158D-X009T	-	-
VDE, UL, cUL	1.6	2	3
SMD-6, option 7	-	VO4158H-X017T	-

<b>ABSOLUTE MAXIMUM RATINGS</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)					
PARAMETER	TEST CONDITION	PART	SYMBOL	VALUE	UNIT
<b>INPUT</b>					
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
<b>OUTPUT</b>					
Peak off-state voltage		VO4158D/H/M	$V_{DRM}$	800	V
RMS on-state current			$I_{TM}$	300	mA
Derate from 25 °C				6.6	mW/°C
<b>COUPLER</b>					
Storage temperature range			$T_{stg}$	-55 to +150	°C
Ambient temperature range			$T_{amb}$	-55 to +100	°C
Soldering temperature	Max. $\leq 10$ s dip soldering $\geq 0.5$ 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

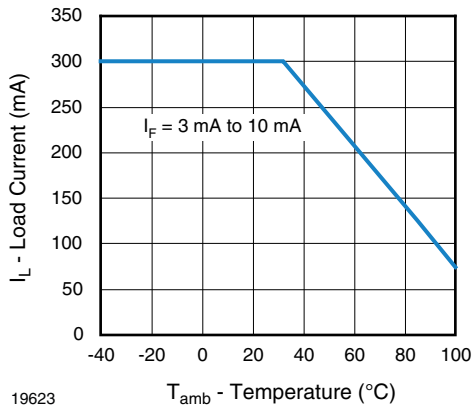
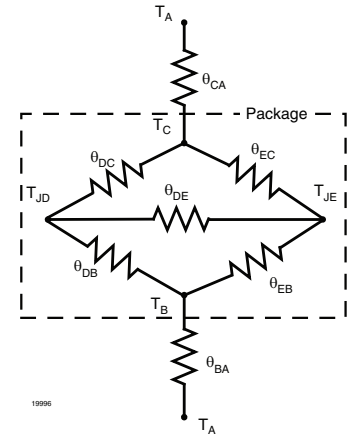


Fig. 1 - Recommended Operating Condition

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	$\theta_{JEB}$	150	°C/W
Thermal resistance, junction emitter to case	$\theta_{JEC}$	139	°C/W
Thermal resistance, junction detector to board	$\theta_{JDB}$	78	°C/W
Thermal resistance, junction detector to case	$\theta_{JDC}$	103	°C/W
Thermal resistance, junction emitter to junction detector	$\theta_{JED}$	496	°C/W
Thermal resistance, case to ambient	$\theta_{CA}$	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 ( $T_{amb} = 25\text{ °C}$ , unless otherwise specified)							
PARAMETER	TEST CONDITION	PART	SYMBOL	MIN.	TYP.	MAX.	UNIT
<b>INPUT</b>							
Forward voltage	$I_F = 10\text{ mA}$		$V_F$	-	1.2	1.4	V
Reverse current	$V_R = 6\text{ V}$		$I_R$	-	0.1	10	$\mu\text{A}$
Input capacitance	$V_F = 0\text{ V}$ , $f = 1\text{ MHz}$		$C_I$	-	25	-	pF
<b>OUTPUT</b>							
Repetitive peak off-state voltage	$I_{DRM} = 100\text{ }\mu\text{A}$	VO4158D/H/M	$V_{DRM}$	800	-	-	V
Off-state current	$V_D = V_{DRM}$ , $I_F = 0$		$I_{DRM}$	-	-	100	$\mu\text{A}$
On-state voltage	$I_T = 300\text{ mA}$		$V_{TM}$	-	-	3	V
On-state current	$PF = 1$ , $V_{T(RMS)} = 1.7\text{ V}$		$I_{TM}$	-	-	300	mA
Off-state current in inhibit state	$I_F = 2\text{ mA}$ , $V_{DRM}$		$I_{DINH}$	-	-	200	$\mu\text{A}$
Holding current			$I_H$	-	-	500	$\mu\text{A}$
Zero cross inhibit voltage	$I_F = \text{rated } I_{FT}$		$V_{IH}$	-	-	20	V
Critical rate of rise of off-state voltage	$V_D = 0.67 V_{DRM}$ , $T_J = 25\text{ °C}$		$dV/dt_{cr}$	5000	-	-	V/ $\mu\text{s}$
<b>COUPLER</b>							
LED trigger current, current required to latch output	$V_D = 3\text{ V}$	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)	$f = 1\text{ MHz}$ , $V_{IO} = 0\text{ V}$		$C_{IO}$	-	0.8	-	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

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	$V_{ISO}$	4420	$V_{RMS}$
Maximum transient isolation voltage		$V_{IOTM}$	8000	$V_{peak}$
Maximum repetitive peak isolation voltage		$V_{IORM}$	890	$V_{peak}$
Isolation resistance	$V_{IO} = 500\text{ V}, T_{amb} = 25\text{ }^{\circ}\text{C}$	$R_{IO}$	$\geq 10^{12}$	$\Omega$
	$V_{IO} = 500\text{ V}, T_{amb} = 100\text{ }^{\circ}\text{C}$	$R_{IO}$	$\geq 10^{11}$	$\Omega$
Output safety power		$P_{SO}$	500	mW
Input safety current		$I_{SI}$	250	mA
Safety temperature		$T_S$	175	$^{\circ}\text{C}$
Creepage distance	Standard DIP-4		$\geq 7$	mm
Clearance distance	Standard DIP-4		$\geq 7$	mm
Insulation thickness		DTI	$\geq 0.4$	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

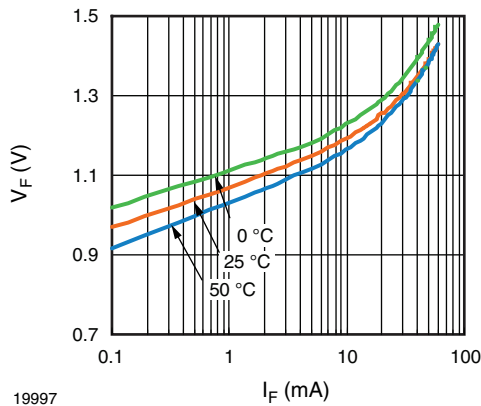
**TYPICAL CHARACTERISTICS** ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)


Fig. 2 - Diode Forward Voltage vs. Forward Current

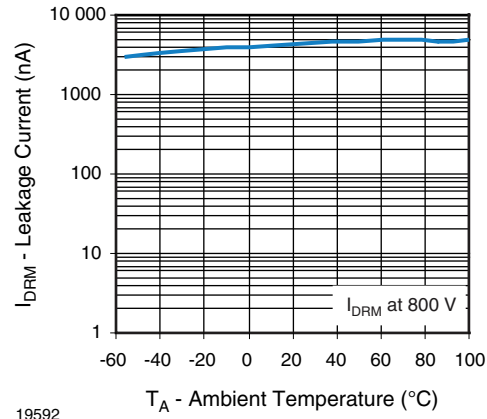


Fig. 4 - Leakage Current vs. Ambient Temperature

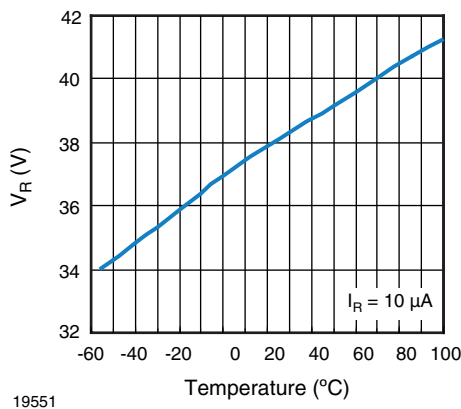


Fig. 3 - Diode Reverse Voltage vs. Temperature

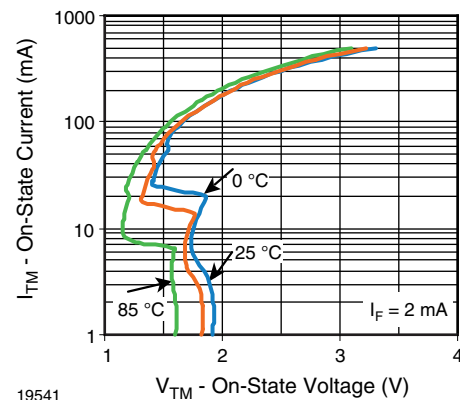
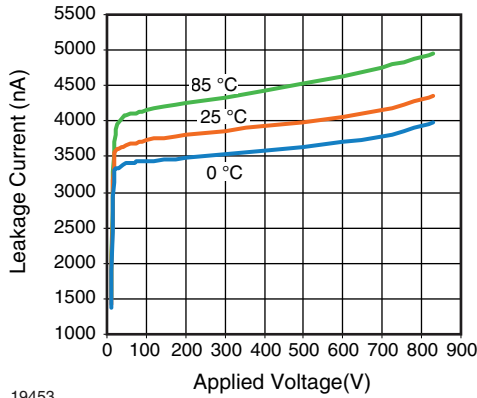
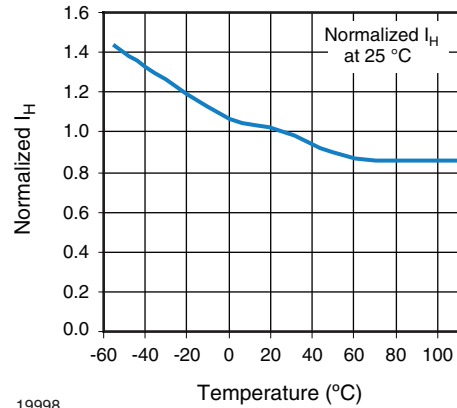


Fig. 5 - On State Current vs. On State Voltage



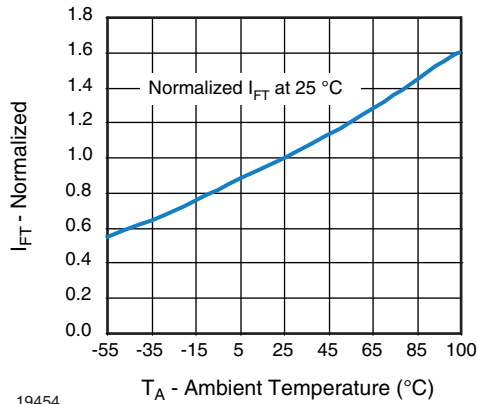
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Fig. 6 - Output Off Current (Leakage) vs. Voltage



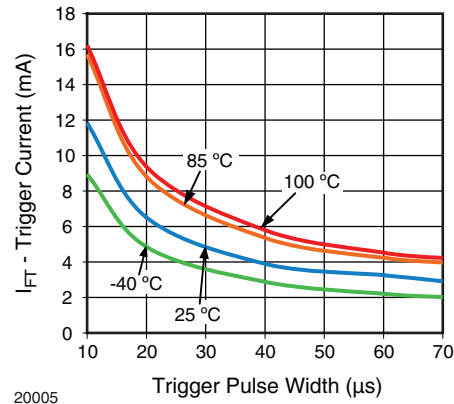
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Fig. 9 - Normalized Holding Current vs. Temperature



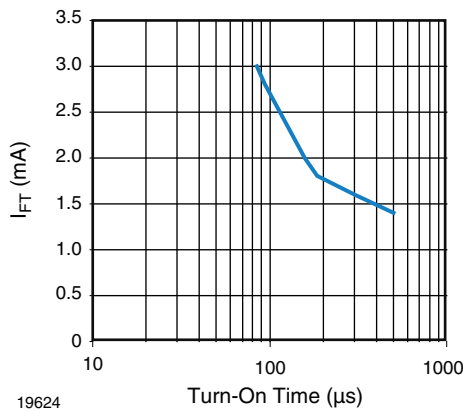
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Fig. 7 - Normalized Trigger Input Current vs. Temperature



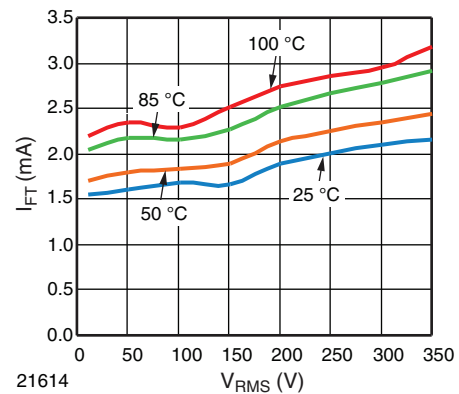
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Fig. 10 -  $I_{FT}$  vs. LED Pulse Width



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



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

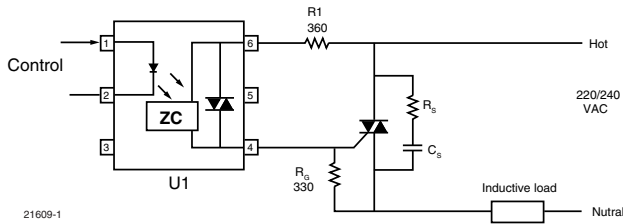


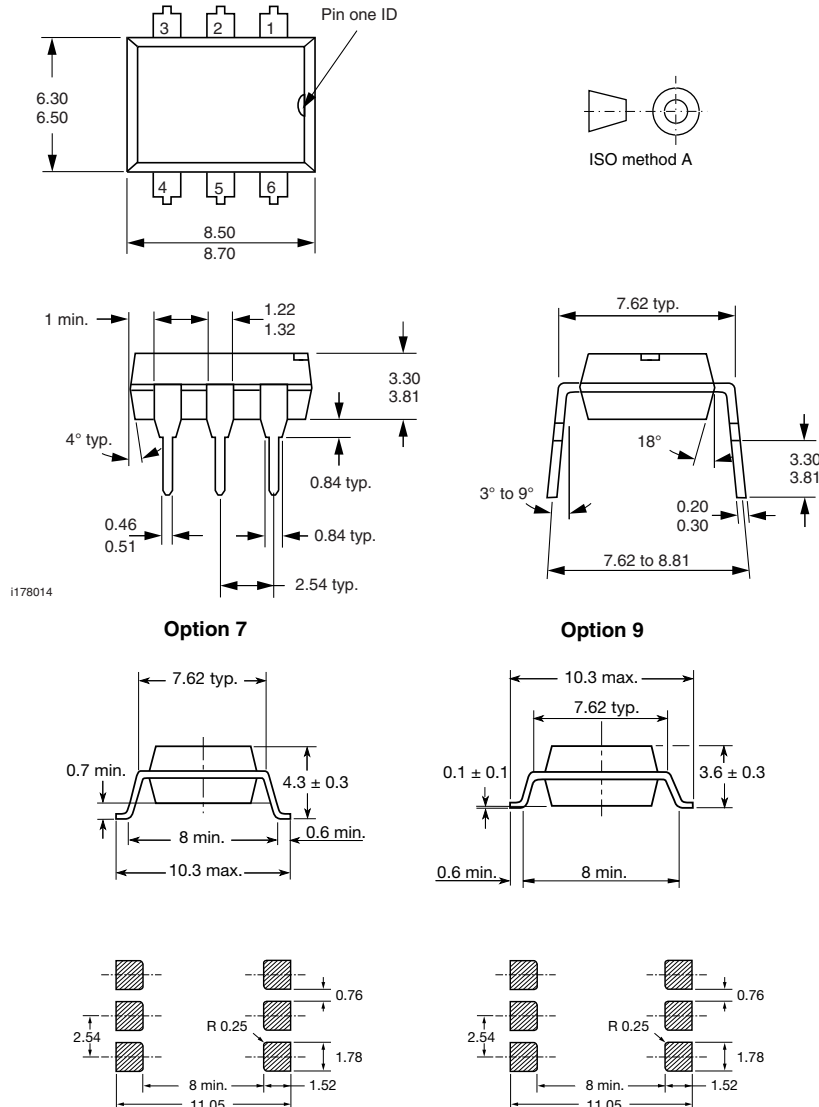
Fig. 12 - Basic Power Triac Driver Circuit

**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.

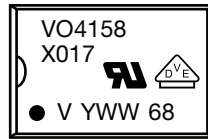
The hold-off condition also can be eliminated by providing a higher level of LED drive current. The higher LED drive provides a larger photocurrent which causes the phototransistor to turn-on before the commutating spike has activated the zero-cross detection circuit. For example, if a device requires 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**

- “YWW” is the date code marking (Y = year code, WW = week code)
- 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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