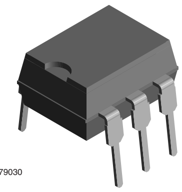
Optocoupler, Phototriac Output, Zero Crossing, High dV/dt, Low Input Current



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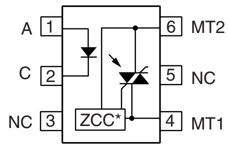


*Zero crossing circuit

DESCRIPTION

The VO4157/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/VO4158 isolates low-voltage logic from 120, 240, and 380 VAC 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, 2, 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}

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 60747-5-5 (VDE 0884) available with option 1

ORDER INFORMATION	
PART	REMARKS
VO4157D	700 V V_{DRM}, I_{ft} = 1.6 mA, DIP-6,
VO4157D-X006	700 V V_{DRM}, I_{ft} = 1.6 mA, DIP-6 400 mil
VO4157D-X007	700 V V_{DRM}, I_{ft} = 1.6 mA, SMD-6
VO4157H	700 V V_{DRM}, I_{ft} = 2 mA, DIP-6
VO4157H-X006	700 V V_{DRM}, I_{ft} = 2 mA, DIP-6 400 mil
VO4157H-X007	700 V V_{DRM}, I_{ft} = 2 mA, SMD-6
VO4157M	700 V V_{DRM}, I_{ft} = 3 mA, DIP-6
VO4157M-X006	700 V V_{DRM}, I_{ft} = 3 mA, DIP-6 400 mil
VO4157M-X007	700 V V_{DRM}, I_{ft} = 3 mA, SMD-6
VO4158D	800 V V_{DRM}, I_{ft} = 1.6 mA, DIP-6
VO4158D-X006	800 V V_{DRM}, I_{ft} = 1.6 mA, DIP-6 400 mil
VO4158D-X007	800 V V_{DRM}, I_{ft} = 1.6 mA, SMD-6
VO4158H	800 V V_{DRM}, I_{ft} = 2 mA, DIP-6
VO4158H-X006	800 V V_{DRM}, I_{ft} = 2 mA, DIP-6 400 mil
VO4158H-X007	800 V V_{DRM}, I_{ft} = 2 mA, SMD-6
VO4158M	800 V V_{DRM}, I_{ft} = 3 mA, DIP-6
VO4158M-X006	800 V V_{DRM}, I_{ft} = 3 mA, DIP-6 400 mil
VO4158M-X007	800 V V_{DRM}, I_{ft} = 3 mA, SMD-6

Note

For additional information on the available options refer to option information.

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

ABSOLUTE MAXIMUM RATINGS					
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

T_{amb} = 25 °C, unless otherwise specified.
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.

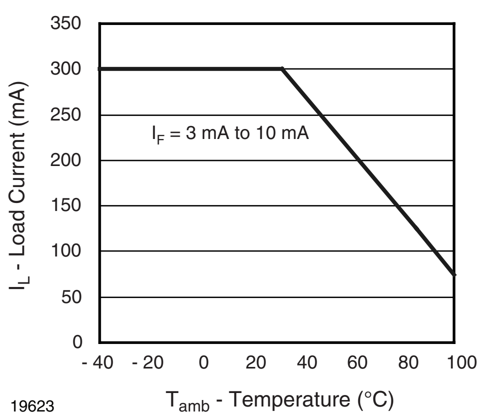
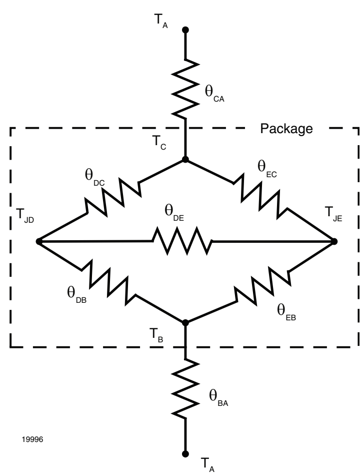


Fig. 1 - Recommended Operating Condition

THERMAL CHARACTERISTICS				
PARAMETER	**TEST CONDITION**	**SYMBOL**	**VALUE**	**UNIT**
LED power dissipation	at 25 °C	P_{diss}	100	mW
Output power dissipation	at 25 °C	P_{diss}	500	mW
Total power dissipation	at 25 °C	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 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							
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

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

ELECTRICAL CHARACTERISTICS							
PARAMETER	TEST CONDITION	PART	SYMBOL	MIN.	TYP.	MAX.	UNIT
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

T_{amb} = 25 °C, unless otherwise specified.
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 IEC 68 part 1)				55/100/21		
Pollution degree (DIN VDE 0109)				2		
Comparative tracking index per DIN IEC 112/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

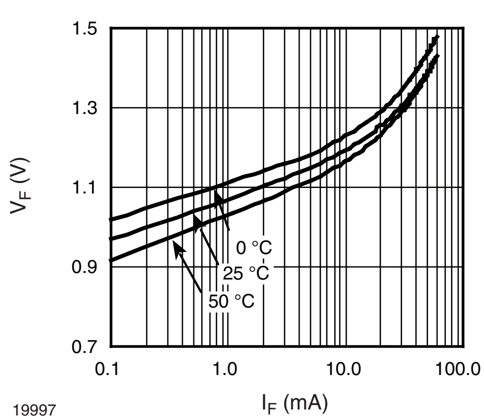


Fig. 2 - Diode Forward Voltage vs. Forward Current

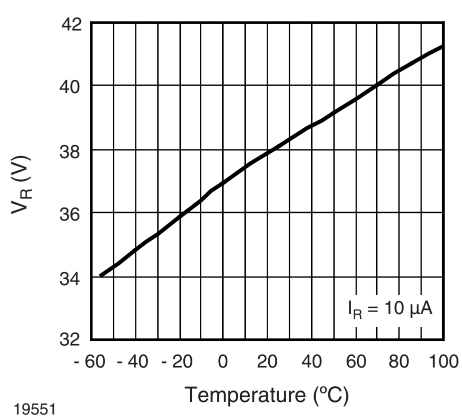


Fig. 3 - Diode Reverse Voltage vs. Temperature

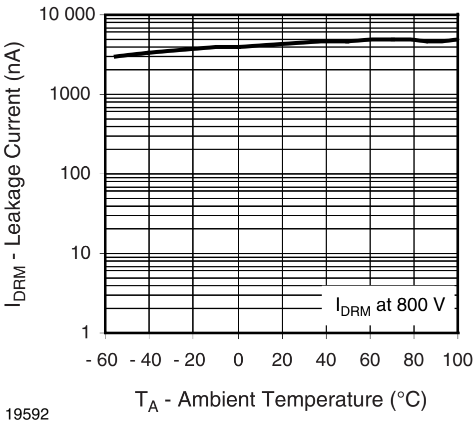


Fig. 4 - Leakage Current vs. Ambient Temperature

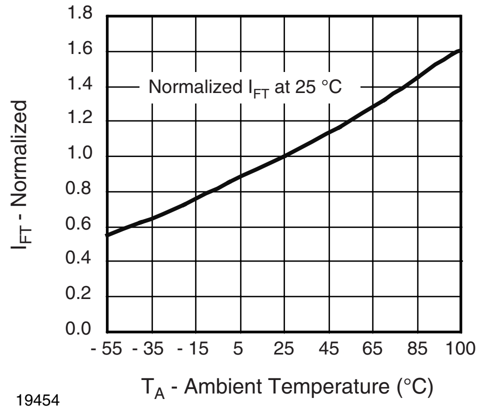


Fig. 7 - Normalized Trigger Input Current vs. Temperature

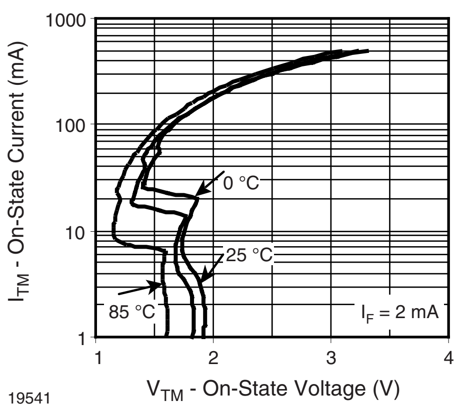


Fig. 5 - On State Current vs. On State Voltage

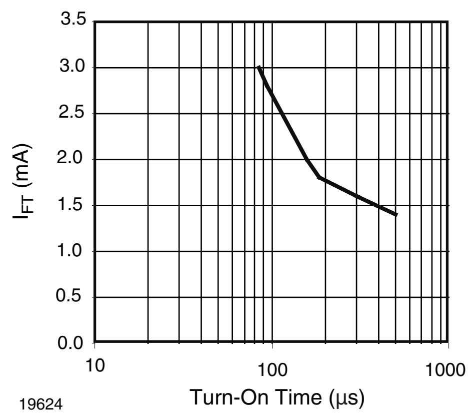


Fig. 8 - Trigger Current vs. Turn-On Time

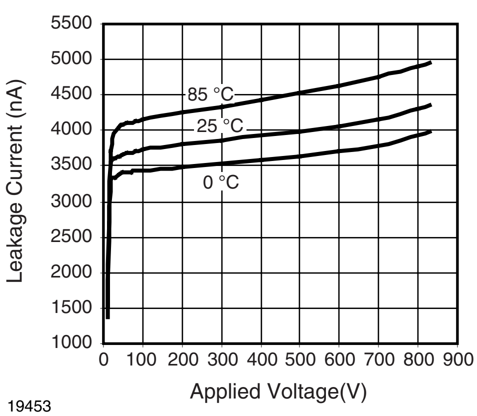


Fig. 6 - Output Off Current (Leakage) vs. Voltage

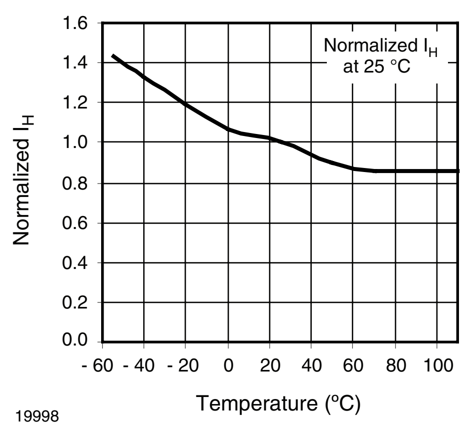


Fig. 9 - Normalized Holding Current vs. Temperature

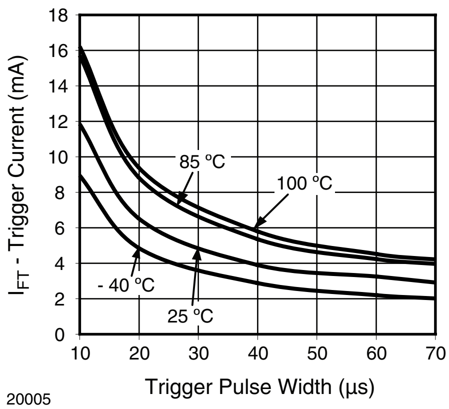


Fig. 10 - I_{FT} vs. LED Pulse Width

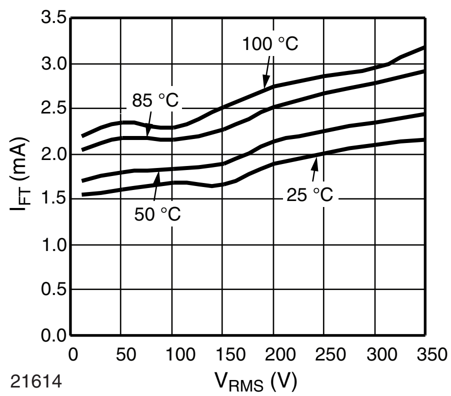


Fig. 11 - I_{FT} vs. V_{RMS} and Temperature

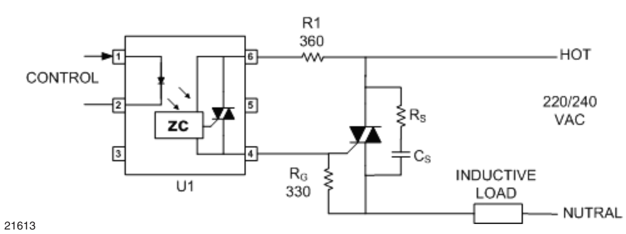


Fig. 12 - Basic Power Triac Driver Circuit

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 figure 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.

OZONE DEPLETING SUBSTANCES POLICY STATEMENT

It is the policy of Vishay Semiconductor GmbH to

1. Meet all present and future national and international statutory requirements.
2. Regularly and continuously improve the performance of our products, processes, distribution and operating systems with respect to their impact on the health and safety of our employees and the public, as well as their impact on the environment.

It is particular concern to control or eliminate releases of those substances into the atmosphere which are known as ozone depleting substances (ODSs).

The Montreal Protocol (1987) and its London Amendments (1990) intend to severely restrict the use of ODSs and forbid their use within the next ten years. Various national and international initiatives are pressing for an earlier ban on these substances.

Vishay Semiconductor GmbH has been able to use its policy of continuous improvements to eliminate the use of ODSs listed in the following documents.

1. Annex A, B and list of transitional substances of the Montreal Protocol and the London Amendments respectively.
2. Class I and II ozone depleting substances in the Clean Air Act Amendments of 1990 by the Environmental Protection Agency (EPA) in the USA
3. Council Decision 88/540/EEC and 91/690/EEC Annex A, B and C (transitional substances) respectively.

Vishay Semiconductor GmbH can certify that our semiconductors are not manufactured with ozone depleting substances and do not contain such substances.

Vishay Semiconductor GmbH, P.O.B. 3535, D-74025 Heilbronn, Germany

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