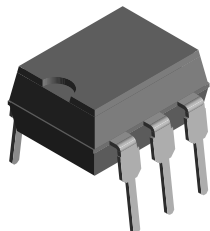
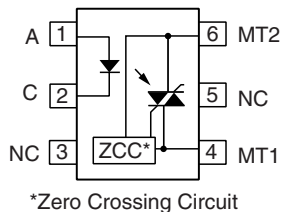


## Optocoupler, Phototriac Output, Zero Crossing, High dV/dt, Low Input Current



I179030



### DESCRIPTION

The VO4154/VO4156 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 VO4154/VO4156 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  $I_{FT} = 1.6, 2, \text{ and } 3 \text{ mA}$
- 300 mA on-state current
- Zero voltage crossing detector
- 400, and 600 V blocking voltage
- Isolation test voltage 5300 V<sub>RMS</sub>


**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

### ORDER INFORMATION

| PART         | REMARKS                                                          |
|--------------|------------------------------------------------------------------|
| VO4154D      | 400 V V <sub>DRM</sub> , I <sub>ft</sub> = 1.6 mA, DIP-6         |
| VO4154D-X006 | 400 V V <sub>DRM</sub> , I <sub>ft</sub> = 1.6 mA, DIP-6 400 mil |
| VO4154D-X007 | 400 V V <sub>DRM</sub> , I <sub>ft</sub> = 1.6 mA, SMD-6         |
| VO4154H      | 400 V V <sub>DRM</sub> , I <sub>ft</sub> = 2 mA, DIP-6           |
| VO4154H-X006 | 400 V V <sub>DRM</sub> , I <sub>ft</sub> = 2 mA, DIP-6 400 mil   |
| VO4154H-X007 | 400 V V <sub>DRM</sub> , I <sub>ft</sub> = 2 mA, SMD-6           |
| VO4154M      | 400 V V <sub>DRM</sub> , I <sub>ft</sub> = 3 mA, DIP-6           |
| VO4154M-X006 | 400 V V <sub>DRM</sub> , I <sub>ft</sub> = 3 mA, DIP-6 400 mil   |
| VO4154M-X007 | 400 V V <sub>DRM</sub> , I <sub>ft</sub> = 3 mA, SMD-6           |
| VO4156D      | 600 V V <sub>DRM</sub> , I <sub>ft</sub> = 1.6 mA, DIP-6         |
| VO4156D-X006 | 600 V V <sub>DRM</sub> , I <sub>ft</sub> = 1.6 mA, DIP-6 400 mil |
| VO4156D-X007 | 600 V V <sub>DRM</sub> , I <sub>ft</sub> = 1.6 mA, SMD-6         |
| VO4156H      | 600 V V <sub>DRM</sub> , I <sub>ft</sub> = 2 mA, DIP-6           |
| VO4156H-X006 | 600 V V <sub>DRM</sub> , I <sub>ft</sub> = 2 mA, DIP-6 400 mil   |
| VO4156H-X007 | 600 V V <sub>DRM</sub> , I <sub>ft</sub> = 2 mA, SMD-6           |
| VO4156M      | 600 V V <sub>DRM</sub> , I <sub>ft</sub> = 3 mA, DIP-6           |
| VO4156M-X006 | 600 V V <sub>DRM</sub> , I <sub>ft</sub> = 3 mA, DIP-6 400 mil   |
| VO4156M-X007 | 600 V V <sub>DRM</sub> , I <sub>ft</sub> = 3 mA, SMD-6           |

### Note

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

| ABSOLUTE MAXIMUM RATINGS                                                                       |                                                                                  |             |            |               |           |
|------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|-------------|------------|---------------|-----------|
| 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         |
| Power dissipation                                                                              |                                                                                  |             | $P_{diss}$ | 100           | mW        |
| Derate from 25 °C                                                                              |                                                                                  |             |            | 1.33          | mW/°C     |
| <b>OUTPUT</b>                                                                                  |                                                                                  |             |            |               |           |
| Peak off-state voltage                                                                         |                                                                                  | VO4154D/H/M | $V_{DRM}$  | 400           | V         |
|                                                                                                |                                                                                  | VO4156D/H/M | $V_{DRM}$  | 600           | V         |
| RMS on-state current                                                                           |                                                                                  |             | $I_{TM}$   | 300           | mA        |
| Total power dissipation                                                                        |                                                                                  |             | $P_{diss}$ | 500           | mW        |
| Derate from 25 °C                                                                              |                                                                                  |             |            | 6.6           | mW/°C     |
| <b>COUPLER</b>                                                                                 |                                                                                  |             |            |               |           |
| Isolation test voltage (between emitter and detector, climate per DIN 500414, part 2, Nov. 74) | $t = 1 \text{ min}$                                                              |             | $V_{ISO}$  | 5300          | $V_{RMS}$ |
| Storage temperature range                                                                      |                                                                                  |             | $T_{stg}$  | - 55 to + 150 | °C        |
| Ambient temperature range                                                                      |                                                                                  |             | $T_{amb}$  | - 55 to + 100 | °C        |
| Soldering temperature                                                                          | max. $\leq 10 \text{ s}$ dip soldering<br>$\geq 0.5 \text{ mm}$ from case bottom |             | $T_{sld}$  | 260           | °C        |

**Note**

$T_{amb} = 25 \text{ °C}$ , 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 Rating for extended periods of the time can adversely affect reliability.

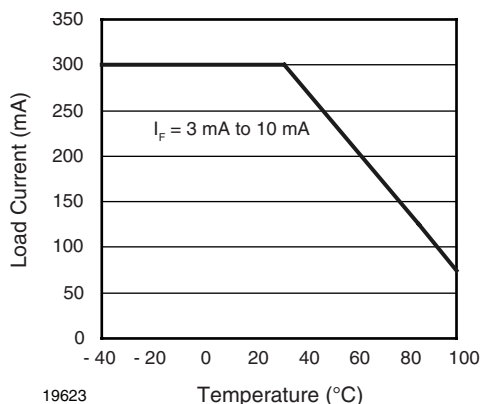


Fig. 1 - Recommended Operating Condition



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

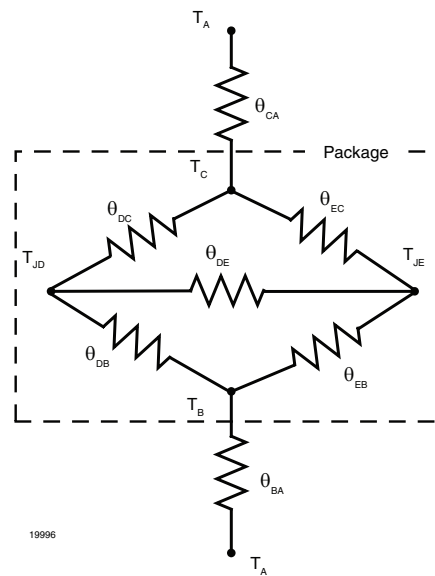
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**THERMAL CHARACTERISTICS**

| 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   |
| Maximum LED junction temperature                          |                | $T_{jmax}$    | 125   | °C   |
| Maximum output die junction temperature                   |                | $T_{jmax}$    | 125   | °C   |
| Thermal resistance, junction emitter to board             |                | $\theta_{EB}$ | 150   | °C/W |
| Thermal resistance, junction emitter to case              |                | $\theta_{EC}$ | 139   | °C/W |
| Thermal resistance, junction detector to board            |                | $\theta_{DB}$ | 78    | °C/W |
| Thermal resistance, junction detector to case             |                | $\theta_{DC}$ | 103   | °C/W |
| Thermal resistance, junction emitter to junction detector |                | $\theta_{ED}$ | 496   | °C/W |
| Thermal resistance, case to ambient                       |                | $\theta_{CA}$ | 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             |
| <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                        | $I_{\text{DRM}} = 100 \mu\text{A}$                     | VO4154D/H/M | $V_{\text{DRM}}$    | 400  |      |      | V                |
|                                                          |                                                        | VO4156D/H/M | $V_{\text{DRM}}$    | 600  |      |      | V                |
| Off-state current                                        | $V_D = V_{\text{DRM}}$ , $I_F = 0$                     |             | $I_{\text{DRM}}$    |      |      | 100  | $\mu\text{A}$    |
| On-state voltage                                         | $I_T = 300 \text{ mA}$                                 |             | $V_{\text{TM}}$     |      |      | 3    | V                |
| On-state current                                         | $\text{PF} = 1$ , $V_{\text{T(RMS)}} = 1.7 \text{ V}$  |             | $I_{\text{TM}}$     |      |      | 300  | mA               |
| Off-state current in inhibit state                       | $I_F = 2 \text{ mA}$ , $V_{\text{DRM}}$                |             | $I_{\text{DINH}}$   |      |      | 200  | $\mu\text{A}$    |
| Holding current                                          |                                                        |             | $I_H$               |      |      | 500  | $\mu\text{A}$    |
| Zero cross inhibit voltage                               | $I_F = \text{rated } I_{\text{FT}}$                    |             | $V_{\text{IH}}$     |      |      | 20   | V                |
| Critical rate of rise of off-state voltage               | $V_D = 0.67 V_{\text{DRM}}$ , $T_J = 25^\circ\text{C}$ |             | $dV/dt_{\text{cr}}$ | 5000 |      |      | V/ $\mu\text{s}$ |
| Critical rate of rise of on-state                        |                                                        |             | $dV/dt_{\text{cr}}$ | 8    |      |      | A/ $\mu\text{s}$ |
| <b>COUPLER</b>                                           |                                                        |             |                     |      |      |      |                  |
| LED trigger current,<br>current required to latch output | $V_D = 3 \text{ V}$                                    | VO4154D     | $I_{\text{FT}}$     |      |      | 1.6  | mA               |
|                                                          |                                                        | VO4154H     | $I_{\text{FT}}$     |      |      | 2    | mA               |
|                                                          |                                                        | VO4154M     | $I_{\text{FT}}$     |      |      | 3    | mA               |
|                                                          |                                                        | VO4156D     | $I_{\text{FT}}$     |      |      | 1.6  | mA               |
|                                                          |                                                        | VO4156H     | $I_{\text{FT}}$     |      |      | 2    | mA               |
|                                                          |                                                        | VO4156M     | $I_{\text{FT}}$     |      |      | 3    | mA               |
| Common mode coupling capacitance                         |                                                        |             | $C_{\text{CM}}$     |      | 0.01 |      | pF               |
| Capacitance (input-output)                               | $f = 1 \text{ MHz}$ , $V_{\text{IO}} = 0 \text{ V}$    |             | $C_{\text{IO}}$     |      | 0.8  |      | pF               |

**Note**

$T_{\text{amb}} = 25^\circ\text{C}$ , unless otherwise specified.

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            | 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 <sub>IOTM</sub>                                                                               |                | V <sub>IOTM</sub> | 8000 |           |      | V    |
| V <sub>IORM</sub>                                                                               |                | V <sub>IORM</sub> | 890  |           |      | V    |
| P <sub>SO</sub>                                                                                 |                | P <sub>SO</sub>   |      |           | 500  | mW   |
| I <sub>SI</sub>                                                                                 |                | I <sub>SI</sub>   |      |           | 250  | mA   |
| T <sub>SI</sub>                                                                                 |                | T <sub>SI</sub>   |      |           | 175  | °C   |
| Creepage                                                                                        |                |                   | 7    |           |      | mm   |
| Crearance                                                                                       |                |                   | 7    |           |      | mm   |

# **TYPICAL CHARACTERISTICS**

$T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified

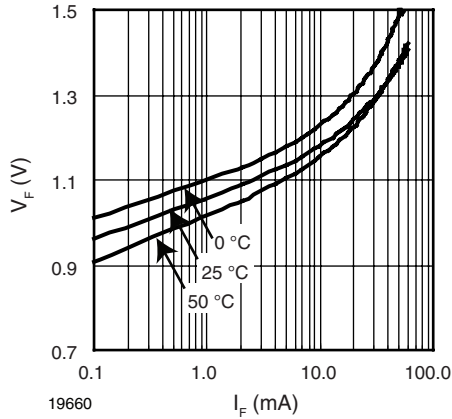


Fig. 2 - Diode Forward Voltage vs. Forward Current

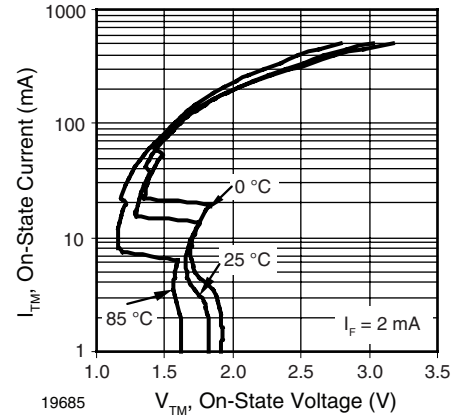


Fig. 5 - On-State Current vs. On-State Voltage

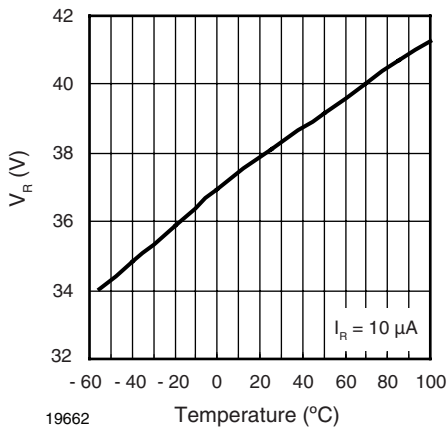


Fig. 3 - Diode Reverse Voltage vs. Temperature

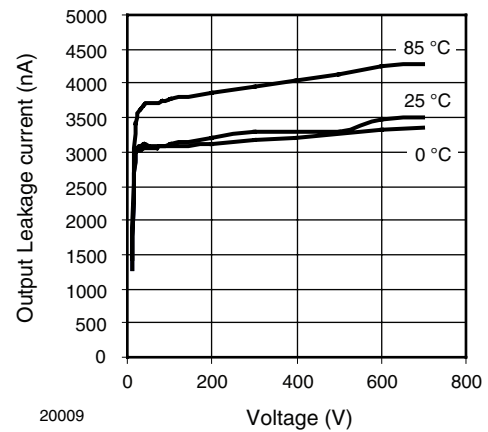


Fig. 6 - Output Off Current (Leakage) vs. Voltage

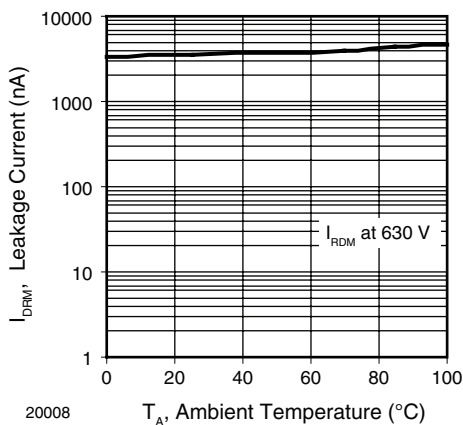


Fig. 4 - Leakage Current vs. Ambient Temperature

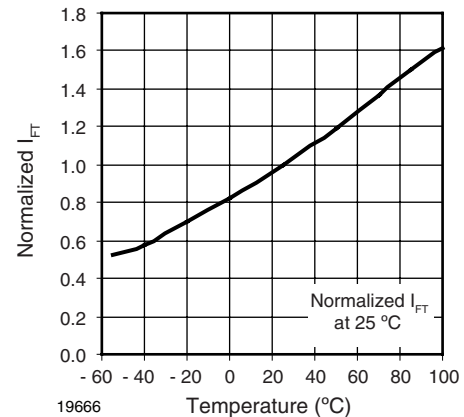


Fig. 7 - Normalized Trigger Input Current vs. Temperature

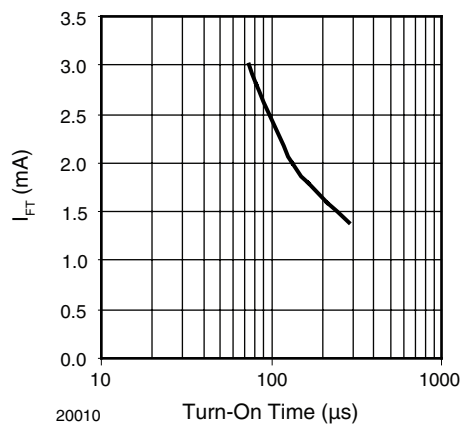


Fig. 8 -  $I_{FT}$  (mA) vs. Turn-On Time (μs)

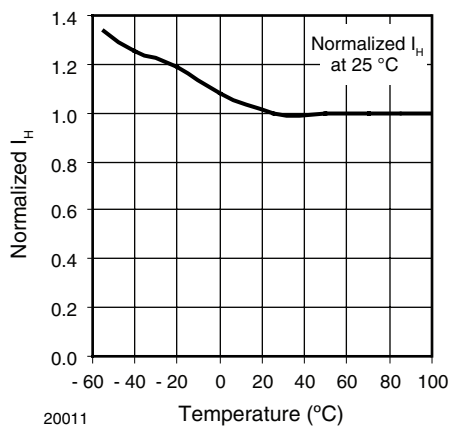


Fig. 9 - Normalized Holding Current vs. Temperature

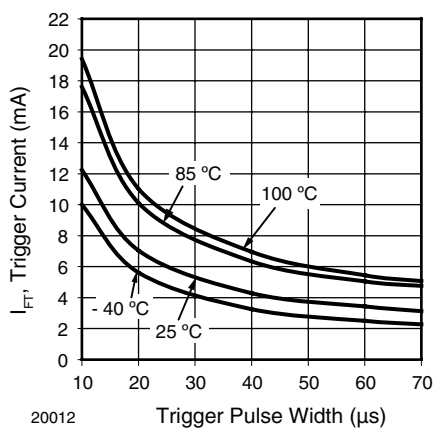


Fig. 10 -  $I_{FT}$  vs. LED Pulse Width



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

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**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.

We reserve the right to make changes to improve technical design  
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