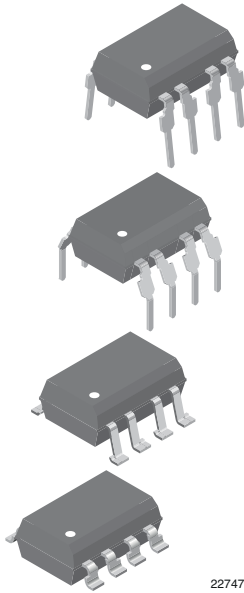
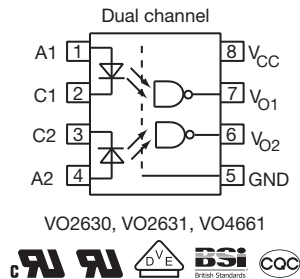
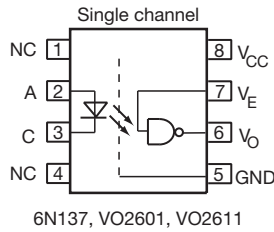


## High Speed Optocoupler, Single and Dual, 10 MBd



22747



### FEATURES

- Choice of CMR performance of 15 kV/μs, 5 kV/μs, and 1000 V/μs
- High speed: 10 MBd typical
- +5 V CMOS compatibility
- Pure tin leads
- Guaranteed AC and DC performance over temperature: -40 °C to +100 °C temperature range
- Meets IEC 60068-2-42 (SO<sub>2</sub>) and IEC 60068-2-43 (H<sub>2</sub>S) requirements
- Low input current capability of 5 mA
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS**  
COMPLIANT

### APPLICATIONS

- Microprocessor system interface
- PLC, ATE input/output isolation
- Computer peripheral interface
- Digital fieldbus isolation: CC-link, DeviceNet, profibus, SDS
- High speed A/D and D/A conversion
- AC plasma display panel level shifting
- Multiplexed data transmission
- Digital control power supply
- Ground loop elimination, noise isolation

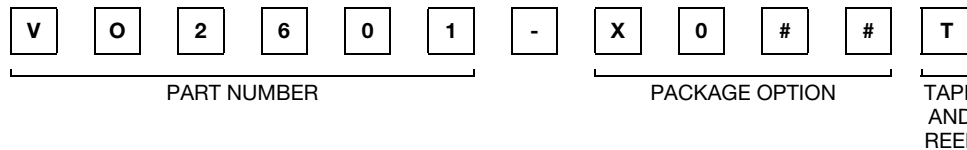
### AGENCY APPROVALS

- UL1577
- cUL
- DIN EN 60747-5-5 (VDE 0884-5) available with option 1
- BS EN 60950-1
- CQC GB8898-2011, GB4943.1-2011

### DESCRIPTION

The 6N137, VO2601, and VO2611 are single channel 10 MBd optocouplers utilizing a high efficient input LED coupled with an integrated optical photodiode IC detector. The detector has an open drain NMOS-transistor output, providing less leakage compared to an open collector Schottky clamped transistor output. The VO2630, VO2631, and VO4661 are dual channel 10 MBd optocouplers. For the single channel type, an enable function on pin 7 allows the detector to be strobed. The internal shield provides a guaranteed common mode transient immunity of 5 kV/μs for the VO2601 and VO2631 and 15 kV/μs for the VO2611 and VO4661. The use of a 0.1 μF bypass capacitor connected between pin 5 and 8 is recommended.

### ORDERING INFORMATION



| AGENCY CERTIFIED/PACKAGE | CHANNELS 1  |              |              | CHANNELS 2   |              |              |
|--------------------------|-------------|--------------|--------------|--------------|--------------|--------------|
|                          | CMR (V/μs)  |              |              | CMR (V/μs)   |              |              |
| BSI, UL, cUL             | 1000        | 5000         | 15 000       | 1000         | 5000         | 15 000       |
| DIP-8                    | 6N137       | VO2601       | VO2611       | VO2630       | VO2631       | VO4661       |
| DIP-8, 400 mil, option 6 | 6N137-X006  | VO2601-X006  | VO2611-X006  | VO2630-X006  | VO2631-X006  | VO4661-X006  |
| SMD-8, option 7          | 6N137-X007T | VO2601-X007T | VO2611-X007T | VO2630-X007T | VO2631-X007T | VO4661-X007T |
| SMD-8, option 9          | 6N137-X009T | -            | -            | VO2630-X009T | -            | -            |
| VDE, BSI, UL, cUL        | 1000        | 5000         | 15 000       | 1000         | 5000         | 15 000       |
| DIP-8, 400 mil, option 6 | -           | VO2601-X016  | VO2611-X016  | -            | VO2631-X016  | -            |
| SMD-8, option 7          | -           | VO2601-X017T | VO2611-X017T | -            | VO2631-X017T | -            |



| TRUTH TABLE (positive logic) |        |        |
|------------------------------|--------|--------|
| LED                          | ENABLE | OUTPUT |
| On                           | H      | L      |
| Off                          | H      | H      |
| On                           | L      | H      |
| Off                          | L      | H      |
| On                           | NC     | L      |
| Off                          | NC     | H      |

| ABSOLUTE MAXIMUM RATINGS ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified) |                              |            |                         |                    |
|---|------------------------------|------------|-------------------------|--------------------|
| PARAMETER   | TEST CONDITION               | SYMBOL     | VALUE                   | UNIT               |
| <b>INPUT</b>  |                              |            |                         |                    |
| Average forward current (single channel)  |                              | $I_F$      | 20                      | mA                 |
| Average forward current (per channel for dual channel)  |                              | $I_F$      | 15                      | mA                 |
| Reverse input voltage   |                              | $V_R$      | 5                       | V                  |
| Enable input voltage  |                              | $V_E$      | $V_{CC} + 0.5\text{ V}$ | V                  |
| Enable input current  |                              | $I_E$      | 5                       | mA                 |
| Surge current   | $t = 100\text{ }\mu\text{s}$ | $I_{FSM}$  | 200                     | mA                 |
| Output power dissipation (single channel)   |                              | $P_{diss}$ | 35                      | mW                 |
| Output power dissipation (per channel for dual channel)   |                              | $P_{diss}$ | 25                      | mW                 |
| <b>OUTPUT</b>   |                              |            |                         |                    |
| Supply voltage  | 1 min maximum                | $V_{CC}$   | 7                       | V                  |
| Output current  |                              | $I_O$      | 50                      | mA                 |
| Output voltage  |                              | $V_O$      | 7                       | V                  |
| Output power dissipation (single channel)   |                              | $P_{diss}$ | 85                      | mW                 |
| Output power dissipation (per channel for dual channel)   |                              | $P_{diss}$ | 60                      | mW                 |
| <b>COUPLER</b>  |                              |            |                         |                    |
| Storage temperature   |                              | $T_{stg}$  | -55 to +150             | $^{\circ}\text{C}$ |
| Operating temperature   |                              | $T_{amb}$  | -40 to +100             | $^{\circ}\text{C}$ |
| Lead solder temperature   | for 10 s                     |            | 260                     | $^{\circ}\text{C}$ |
| Solder reflow temperature   |                              |            | 260                     | $^{\circ}\text{C}$ |

**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.

| RECOMMENDED OPERATING CONDITIONS |                          |           |      |          |                    |
|----------------------------------|--------------------------|-----------|------|----------|--------------------|
| PARAMETER                        | TEST CONDITION           | SYMBOL    | MIN. | MAX.     | UNIT               |
| Operating temperature            |                          | $T_{amb}$ | -40  | 100      | $^{\circ}\text{C}$ |
| Supply voltage                   |                          | $V_{CC}$  | 4.5  | 5.5      | V                  |
| Input current low level          |                          | $I_{FL}$  | 0    | 250      | $\mu\text{A}$      |
| Input current high level         |                          | $I_{FH}$  | 5    | 15       | mA                 |
| Logic high enable voltage        |                          | $V_{EH}$  | 2    | $V_{CC}$ | V                  |
| Logic low enable voltage         |                          | $V_{EL}$  | 0    | 0.8      | V                  |
| Output pull up resistor          |                          | $R_L$     | 330  | 4K       | $\Omega$           |
| Fanout                           | $R_L = 1\text{ k}\Omega$ | N         |      | 5        | -                  |



| <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>   |  |           |      |       |      |               |
| Input forward voltage  | $I_F = 10\text{ mA}$   | $V_F$     | 1.1  | 1.4   | 1.7  | V             |
| Reverse current  | $V_R = 5\text{ V}$   | $I_R$     |      | 0.01  | 10   | $\mu\text{A}$ |
| Input capacitance  | $f = 1\text{ MHz}, V_F = 0\text{ V}$   | $C_I$     |      | 55    |      | pF            |
| <b>OUTPUT</b>  |  |           |      |       |      |               |
| High level supply current (single channel)   | $V_E = 0.5\text{ V}, I_F = 0\text{ mA}$  | $I_{CCH}$ |      | 4.1   | 7    | mA            |
|  | $V_E = V_{CC}, I_F = 0\text{ mA}$  | $I_{CCH}$ |      | 3.3   | 6    | mA            |
| High level supply current (dual channel)   | $I_F = 0\text{ mA}$  | $I_{CCH}$ |      | 6.5   | 12   | mA            |
| Low level supply current (single channel)  | $V_E = 0.5\text{ V}, I_F = 10\text{ mA}$   | $I_{CCL}$ |      | 4     | 7    | mA            |
|  | $V_E = V_{CC}, I_F = 10\text{ mA}$   | $I_{CCL}$ |      | 3.3   | 6    | mA            |
| Low level supply current (dual channel)  | $I_F = 10\text{ mA}$   | $I_{CCL}$ |      | 6.5   | 12   | mA            |
| High level output current  | $V_E = 2\text{ V}, V_{CC} = 5.5\text{ V}, I_F = 250\text{ }\mu\text{A}$          | $I_{OH}$  |      | 0.002 | 1    | $\mu\text{A}$ |
| Low level output voltage   | $V_E = 2\text{ V}, I_F = 5\text{ mA}, I_{OL}(\text{sinking}) = 13\text{ mA}$     | $V_{OL}$  |      | 0.2   | 0.6  | V             |
| Input threshold current  | $V_E = 2\text{ V}, V_{CC} = 5.5\text{ V}, I_{OL}(\text{sinking}) = 13\text{ mA}$ | $I_{TH}$  |      | 2.4   | 5    | mA            |
| High level enable current  | $V_E = 2\text{ V}$   | $I_{EH}$  |      | -0.6  | -1.6 | mA            |
| Low level enable current   | $V_E = 0.5\text{ V}$   | $I_{EL}$  |      | -0.8  | -1.6 | mA            |
| High level enable voltage  |  | $V_{EH}$  | 2    |       |      | V             |
| Low level enable voltage   |  | $V_{EL}$  |      |       | 0.8  | V             |

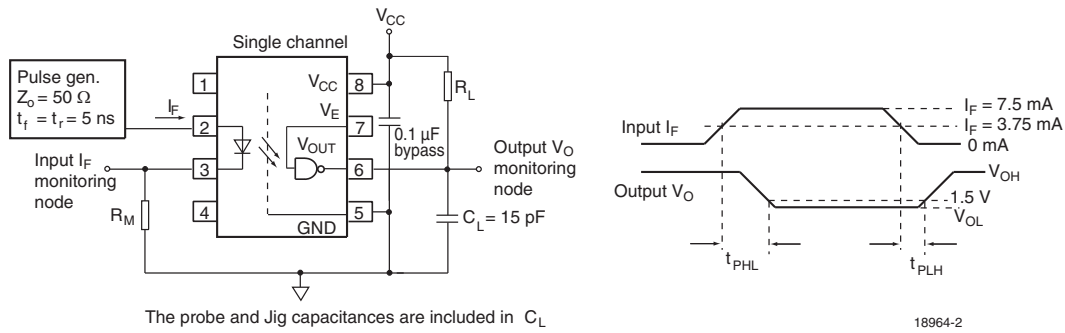
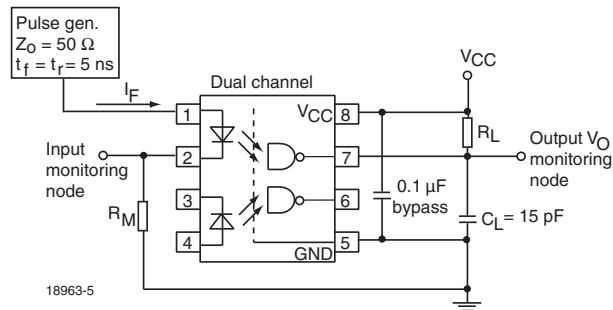
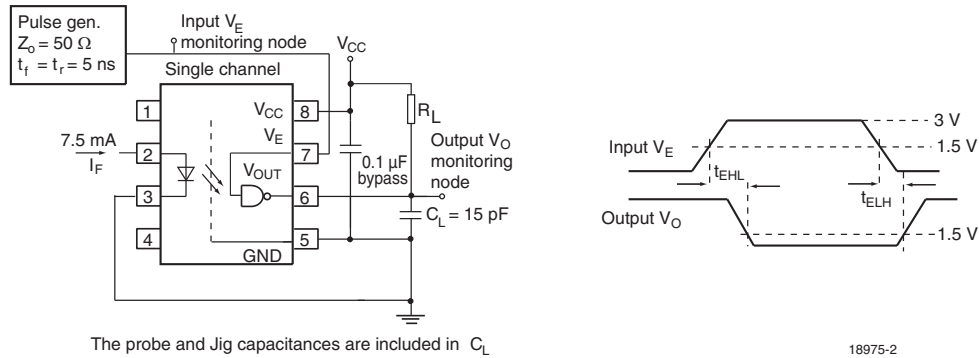
**Note**

- Minimum and maximum values are testing requirements. Typical values are characteristics of the device and are the result of engineering evaluation. Typical values are for information only and are not part of the testing requirements.

| <b>SWITCHING CHARACTERISTICS</b>                           |   |                       |      |      |                   |      |
|--|---|-----------------------|------|------|-------------------|------|
| PARAMETER  | TEST CONDITION  | SYMBOL                | MIN. | TYP. | MAX.              | UNIT |
| Propagation delay time to high output level                | $R_L = 350\text{ }\Omega, C_L = 15\text{ pF}$   | $t_{PLH}$             | 20   | 48   | 75 <sup>(1)</sup> | ns   |
|  |   | $t_{PLH}$             |      |      | 100               | ns   |
| Propagation delay time to low output level                 | $R_L = 350\text{ }\Omega, C_L = 15\text{ pF}$   | $t_{PHL}$             | 25   | 50   | 75 <sup>(1)</sup> | ns   |
|  |   | $t_{PHL}$             |      |      | 100               | ns   |
| Pulse width distortion                                     | $R_L = 350\text{ }\Omega, C_L = 15\text{ pF}$   | $ t_{PHL} - t_{PLH} $ |      | 2.9  | 35                | ns   |
| Propagation delay skew                                     | $R_L = 350\text{ }\Omega, C_L = 15\text{ pF}$   | $t_{PSK}$             |      | 8    | 40                | ns   |
| Output rise time (10 % to 90 %)                            | $R_L = 350\text{ }\Omega, C_L = 15\text{ pF}$   | $t_r$                 |      | 23   |                   | ns   |
| Output fall time (90 % to 10 %)                            | $R_L = 350\text{ }\Omega, C_L = 15\text{ pF}$   | $t_f$                 |      | 7    |                   | ns   |
| Propagation delay time of enable from $V_{EH}$ to $V_{EL}$ | $R_L = 350\text{ }\Omega, C_L = 15\text{ pF}, V_{EL} = 0\text{ V}, V_{EH} = 3\text{ V}$ | $t_{ELH}$             |      | 12   |                   | ns   |
| Propagation delay time of enable from $V_{EL}$ to $V_{EH}$ | $R_L = 350\text{ }\Omega, C_L = 15\text{ pF}, V_{EL} = 0\text{ V}, V_{EH} = 3\text{ V}$ | $t_{EHL}$             |      | 11   |                   | ns   |

**Notes**

- Over recommended temperature ( $T_{amb} = -40\text{ }^{\circ}\text{C}$  to  $+100\text{ }^{\circ}\text{C}$ ),  $V_{CC} = 5\text{ V}, I_F = 7.5\text{ mA}$  unless otherwise specified. All typicals at  $T_{amb} = 25\text{ }^{\circ}\text{C}, V_{CC} = 5\text{ V}$ .
- <sup>(1)</sup> 75 ns applies to the 6N137 only, a JEDEC® registered specification


 Fig. 1 - Single Channel Test Circuit for  $t_{PLH}$ ,  $t_{PHL}$ ,  $t_r$  and  $t_f$ 

 Fig. 2 - Dual Channel Test Circuit for  $t_{PLH}$ ,  $t_{PHL}$ ,  $t_r$  and  $t_f$ 

 Fig. 3 - Single Channel Test Circuit for  $t_{EHL}$  and  $t_{ELH}$ 

| COMMON MODE TRANSIENT IMMUNITY        |  |          |        |        |      |                        |
|---------------------------------------|--|----------|--------|--------|------|------------------------|
| PARAMETER                             | TEST CONDITION   | SYMBOL   | MIN.   | TYP.   | MAX. | UNIT                   |
| Common mode transient immunity (high) | $ V_{CM}  = 10 \text{ V}$ , $V_{CC} = 5 \text{ V}$ , $I_F = 0 \text{ mA}$ , $V_{O(\min.)} = 2 \text{ V}$ , $R_L = 350 \Omega$ , $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$ (1)     | $ CM_H $ | 1000   |        |      | $\text{V}/\mu\text{s}$ |
|                                       | $ V_{CM}  = 50 \text{ V}$ , $V_{CC} = 5 \text{ V}$ , $I_F = 0 \text{ mA}$ , $V_{O(\min.)} = 2 \text{ V}$ , $R_L = 350 \Omega$ , $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$ (2)     | $ CM_H $ | 5000   | 10 000 |      | $\text{V}/\mu\text{s}$ |
|                                       | $ V_{CM}  = 1 \text{ kV}$ , $V_{CC} = 5 \text{ V}$ , $I_F = 0 \text{ mA}$ , $V_{O(\min.)} = 2 \text{ V}$ , $R_L = 350 \Omega$ , $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$ (3)     | $ CM_H $ | 15 000 | 25 000 |      | $\text{V}/\mu\text{s}$ |
|                                       | $ V_{CM}  = 10 \text{ V}$ , $V_{CC} = 5 \text{ V}$ , $I_F = 7.5 \text{ mA}$ , $V_{O(\max.)} = 0.8 \text{ V}$ , $R_L = 350 \Omega$ , $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$ (1) | $ CM_L $ | 1000   |        |      | $\text{V}/\mu\text{s}$ |
|                                       | $ V_{CM}  = 50 \text{ V}$ , $V_{CC} = 5 \text{ V}$ , $I_F = 7.5 \text{ mA}$ , $V_{O(\max.)} = 0.8 \text{ V}$ , $R_L = 350 \Omega$ , $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$ (2) | $ CM_L $ | 5000   | 10 000 |      | $\text{V}/\mu\text{s}$ |
|                                       | $ V_{CM}  = 1 \text{ kV}$ , $V_{CC} = 5 \text{ V}$ , $I_F = 7.5 \text{ mA}$ , $V_{O(\max.)} = 0.8 \text{ V}$ , $R_L = 350 \Omega$ , $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$ (3) | $ CM_L $ | 15 000 | 25 000 |      | $\text{V}/\mu\text{s}$ |

**Notes**

- (1) For 6N137 and VO2630
- (2) For VO2601 and VO2631
- (3) For VO2611 and VO4661

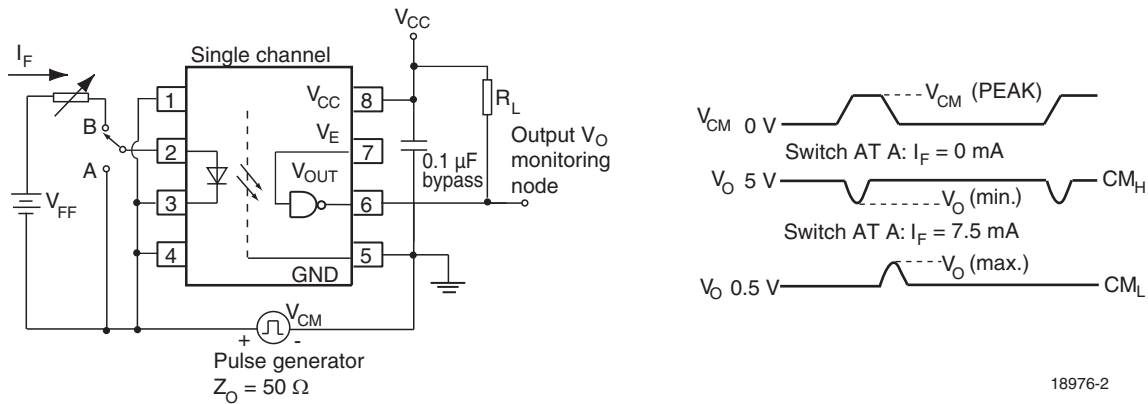


Fig. 4 - Single Channel Test Circuit for Common Mode Transient Immunity

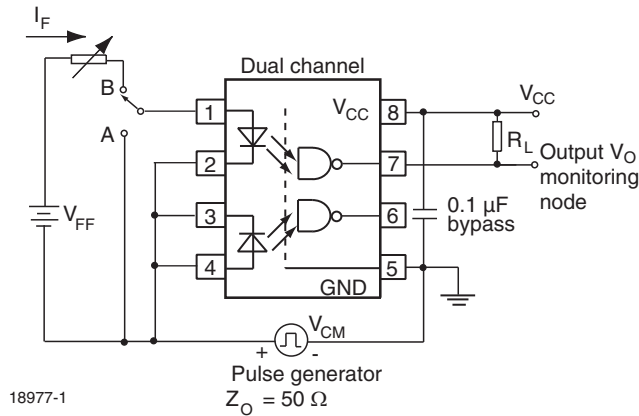


Fig. 5 - Dual Channel Test Circuit for Common Mode Transient Immunity

| SAFETY AND INSULATION RATINGS                        |  |            |                |                  |
|--|--|------------|----------------|------------------|
| PARAMETER  | TEST CONDITION   | SYMBOL     | VALUE          | UNIT             |
| Climatic classification (according to IEC 68 part 1) |  |            | 40/100/21      |                  |
| Comparative tracking index                           |  | CTI        | 175            |                  |
| Rated isolation voltage                              | $t = 1 \text{ min}$  | $V_{ISO}$  | 5300           | $V_{RMS}$        |
| Maximum transient isolation voltage                  |  | $V_{IOTM}$ | 8000           | V                |
| Maximum repetitive peak isolation voltage            |  | $V_{IORM}$ | 890            | V                |
| 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                                 |  | $I_{SI}$   | 300            | mA               |
| Input safety temperature                             |  | $T_{SI}$   | 175            | $^\circ\text{C}$ |
| Creepage distance                                    | Standard DIP-4   |            | $\geq 8$       | mm               |
| Clearance distance                                   | Standard DIP-4   |            | $\geq 8$       | mm               |
| Creepage distance                                    | 400 mil DIP-4  |            | $\geq 8$       | mm               |
| Clearance distance                                   | 400 mil DIP-4  |            | $\geq 8$       | mm               |
| Insulation thickness, reinforced rated               | per BSI 60950  | 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<sub>amb</sub> = 25 °C, unless otherwise specified)

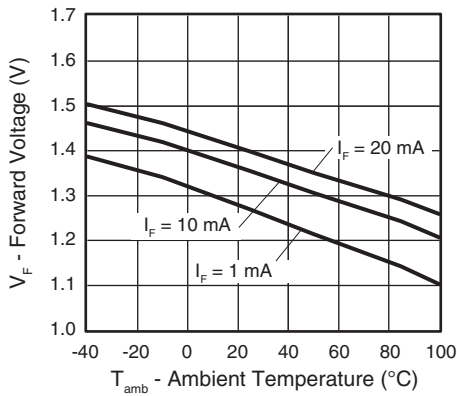


Fig. 6 - Forward Voltage vs. Ambient Temperature

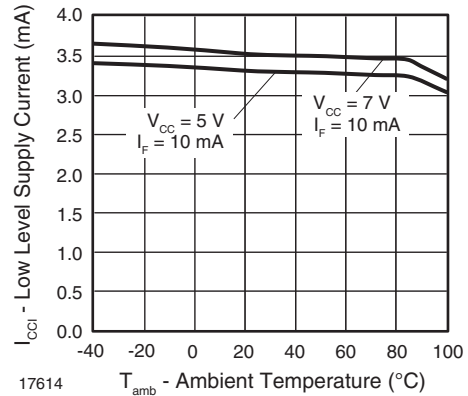


Fig. 9 - Low Level Supply Current vs. Ambient Temperature

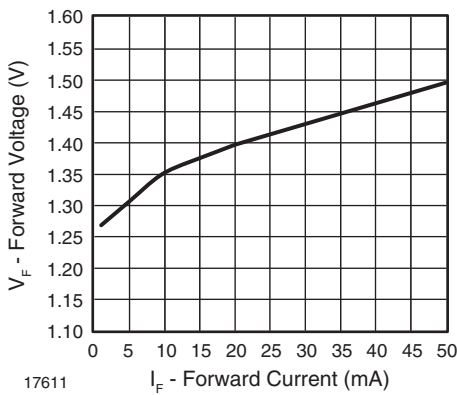


Fig. 7 - Forward Voltage vs. Forward Current

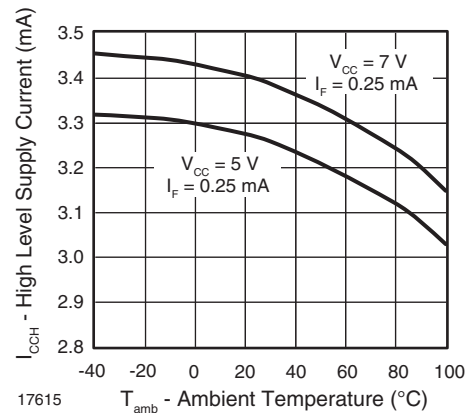


Fig. 10 - High Level Supply Current vs. Ambient Temperature

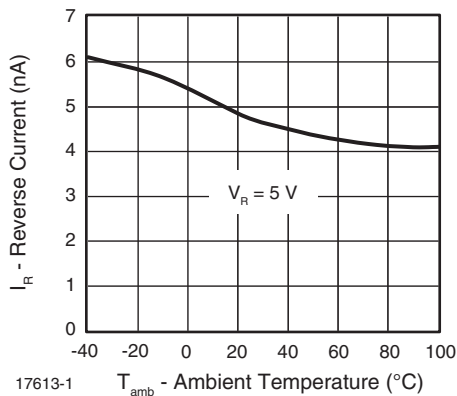


Fig. 8 - Reverse Current vs. Ambient Temperature

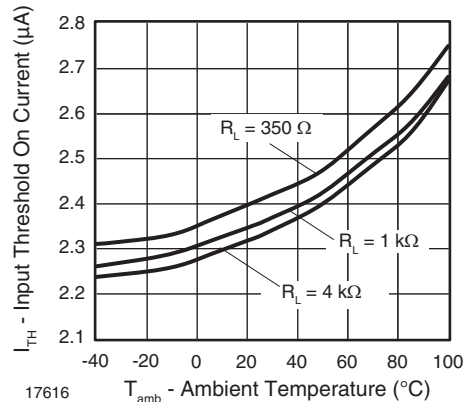


Fig. 11 - Input Threshold On Current vs. Ambient Temperature

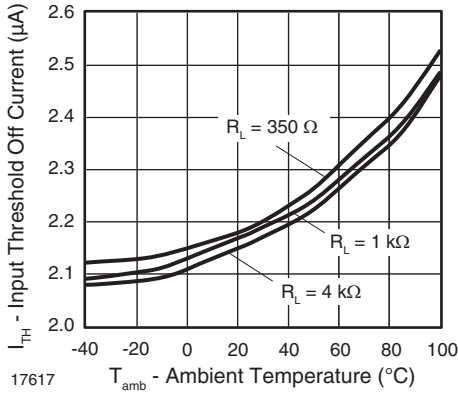


Fig. 12 - Input Threshold Off Current vs. Ambient Temperature

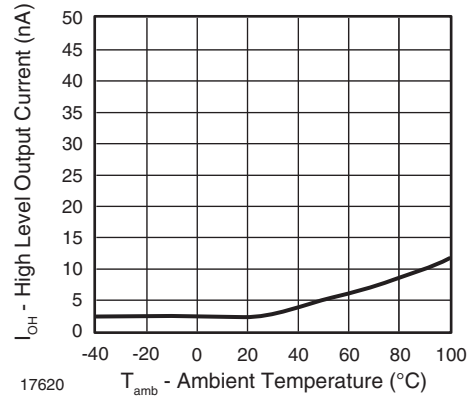


Fig. 15 - High Level Output Current vs. Ambient Temperature

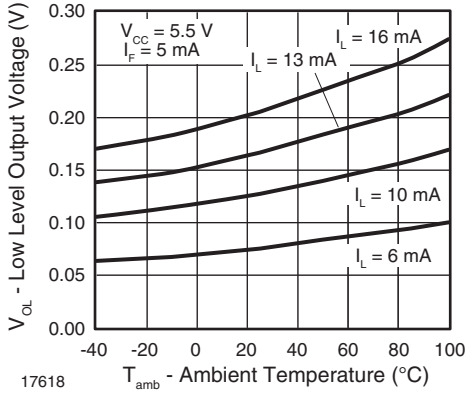


Fig. 13 - Low Level Output Voltage vs. Ambient Temperature

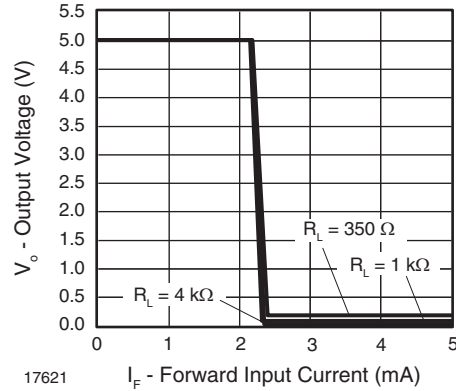


Fig. 16 - Output Voltage vs. Forward Input Current

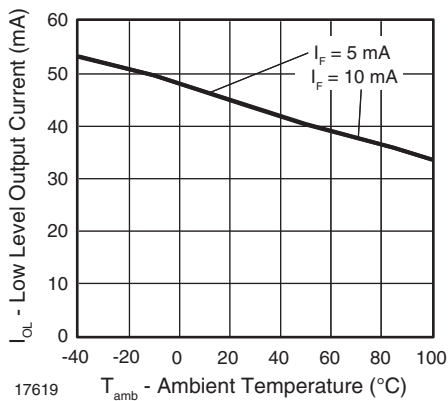


Fig. 14 - Low Level Output Current vs. Ambient Temperature

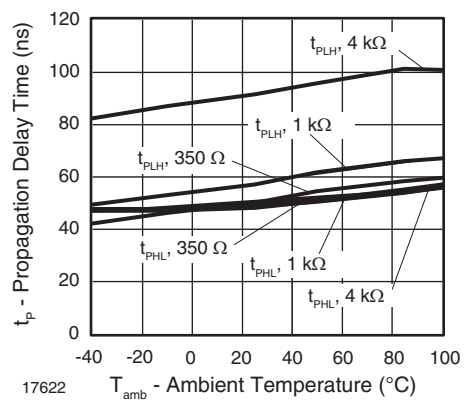


Fig. 17 - Propagation Delay vs. Ambient Temperature

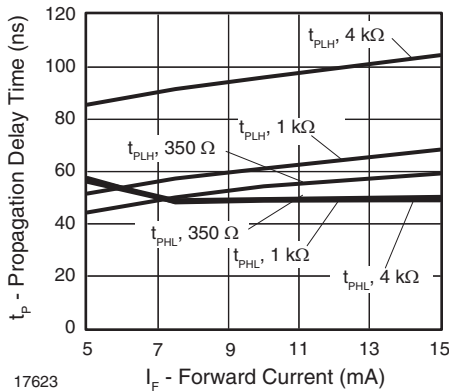


Fig. 18 - Propagation Delay vs. Forward Current

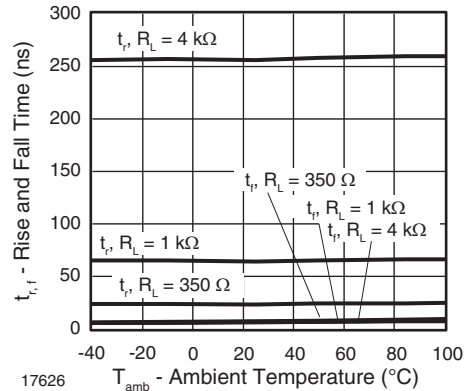


Fig. 21 - Rise and Fall Time vs. Ambient Temperature

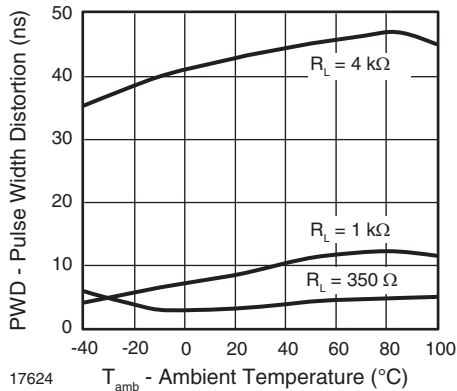


Fig. 19 - Pulse Width Distortion vs. Ambient Temperature

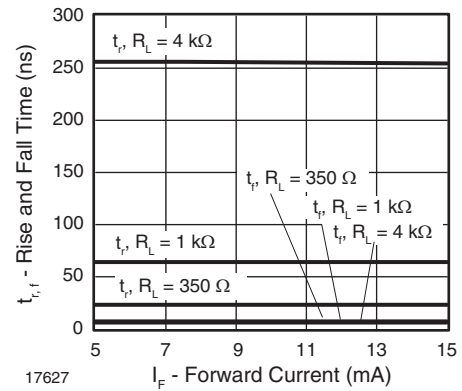


Fig. 22 - Rise and Fall Time vs. Forward Current

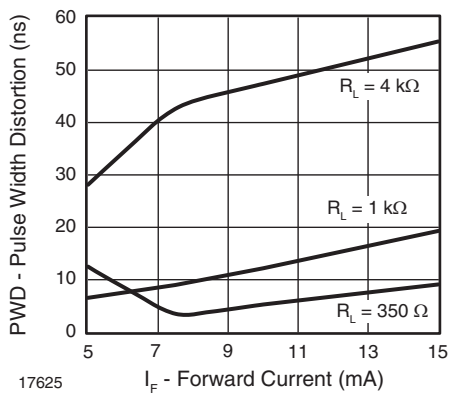


Fig. 20 - Pulse Width Distortion vs. Forward Current

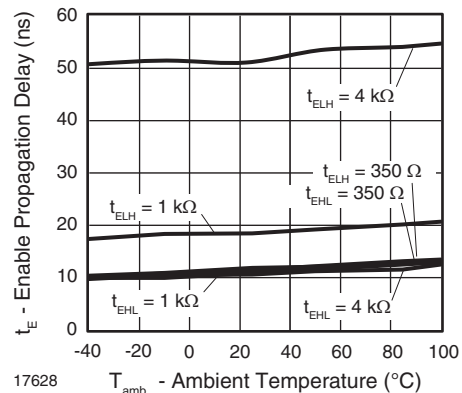


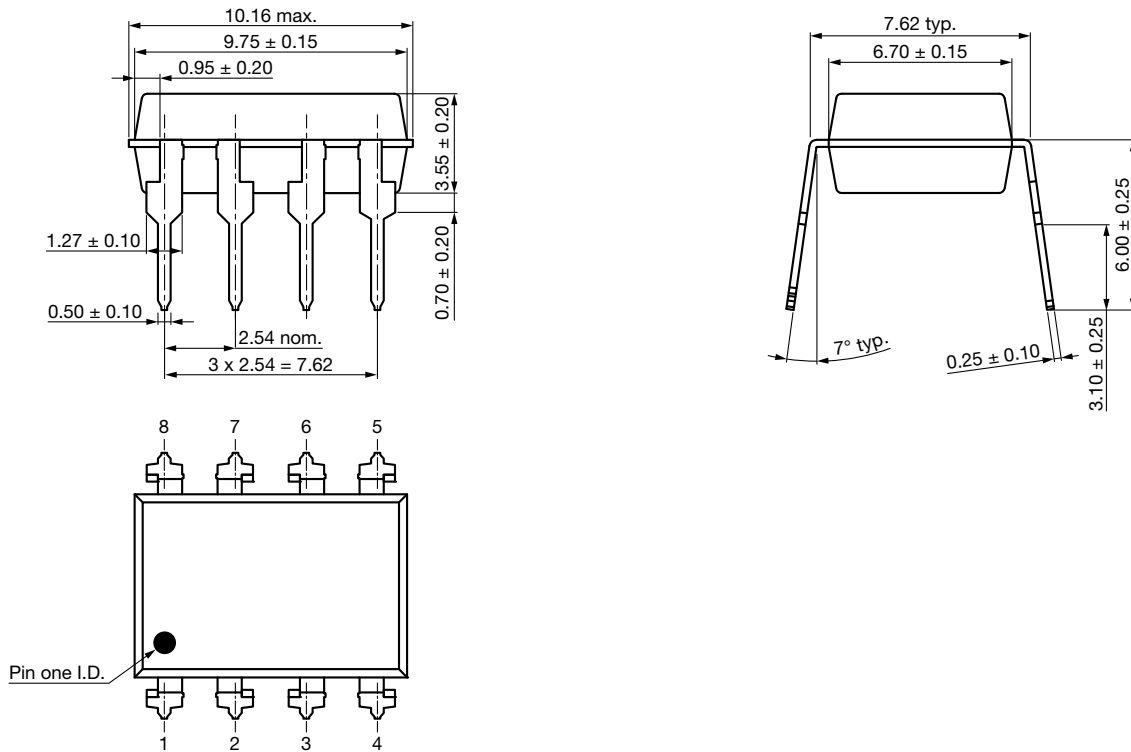
Fig. 23 - Enable Propagation Delay vs. Ambient Temperature



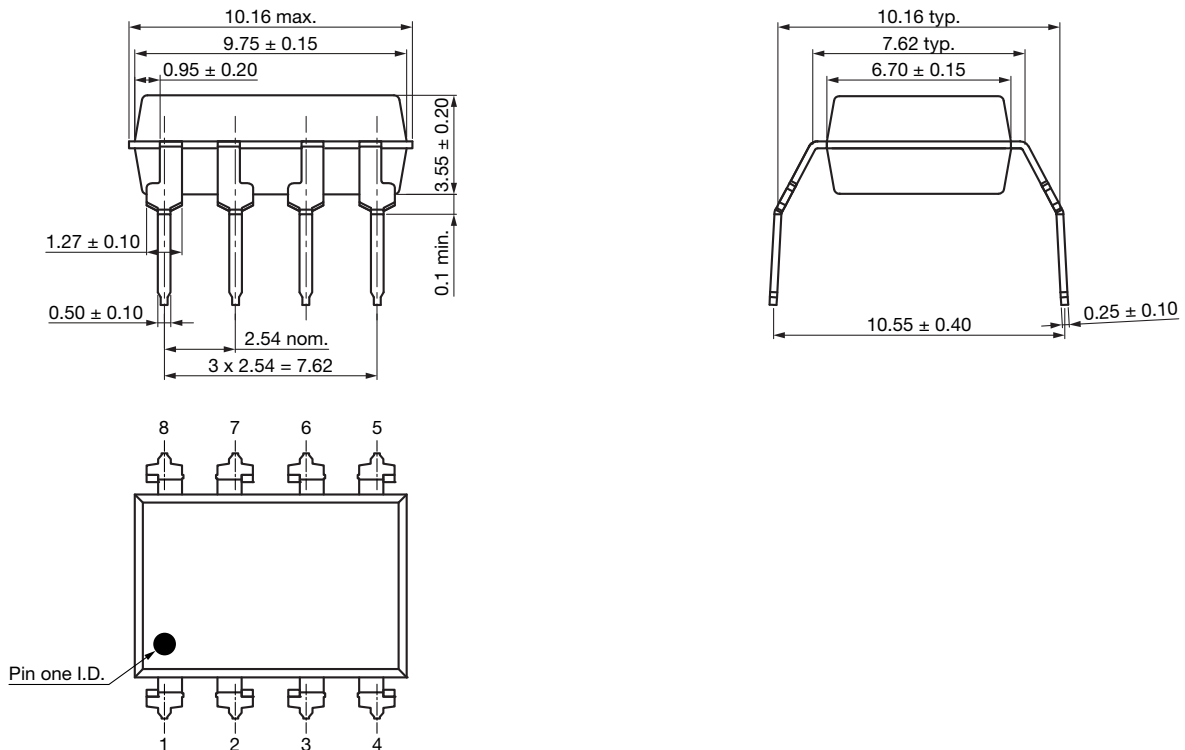


**PACKAGE DIMENSIONS** in millimeters

**DIP-8, Standard**

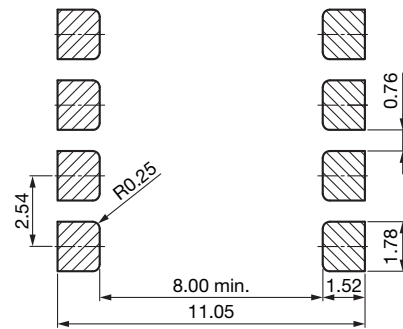
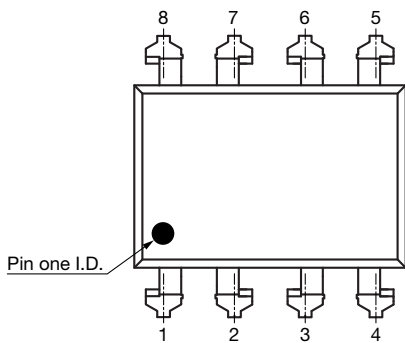
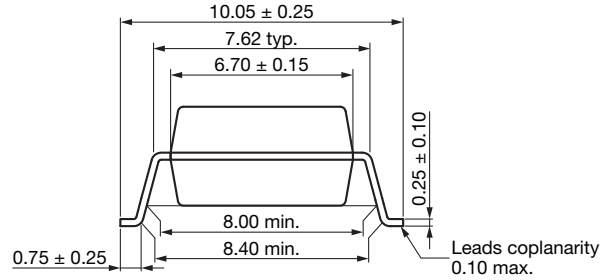
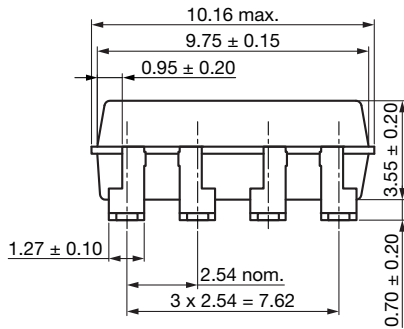


**DIP-8, Option 6**

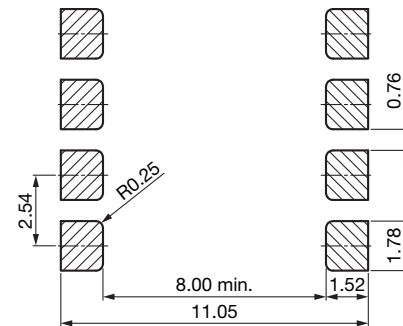
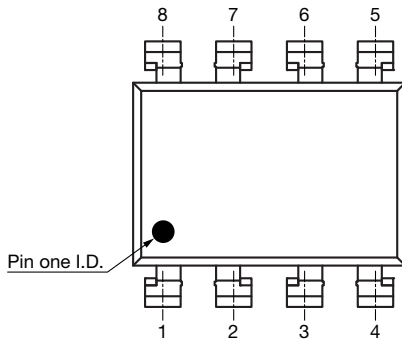
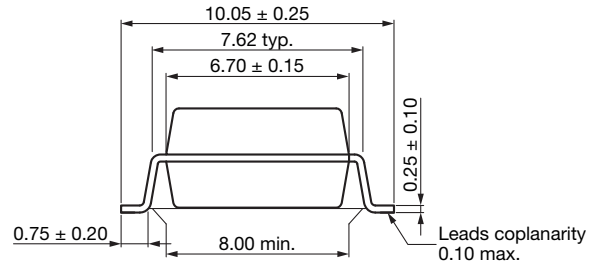
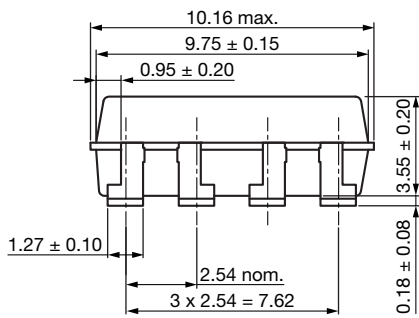




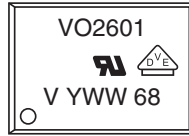
SMD-8, Option 7



SMD-8, Option 9



## PACKAGE MARKING (example of VO2601-X017T)



### Notes

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

## SOLDER PROFILES

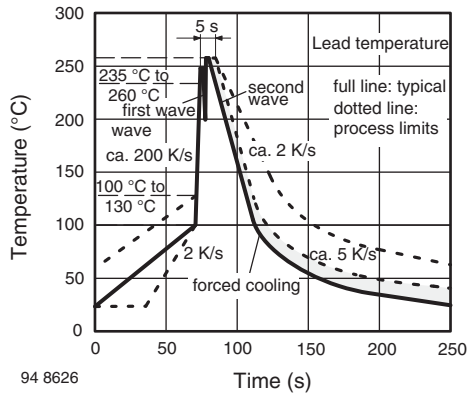


Fig. 24 - Wave Soldering Double Wave Profile According to J.STD-020 for DIP-8 Devices

## HANDLING AND STORAGE CONDITIONS

ESD level: HBM class 2

Floor life: unlimited

Conditions:  $T_{amb} < 30\text{ }^{\circ}\text{C}$ , RH < 85 %

Moisture sensitivity level 1, according to J-STD-020

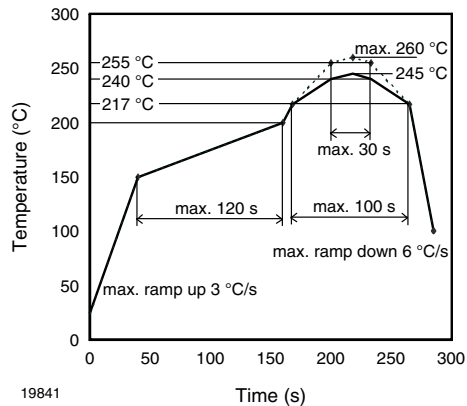


Fig. 25 - Lead (Pb)-free Reflow Solder Profile According to J-STD-020 for SMD-8 Devices



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**Please note that some Vishay documentation may still make reference to RoHS Directive 2002/95/EC. We confirm that all the products identified as being compliant to Directive 2002/95/EC conform to Directive 2011/65/EU.**

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