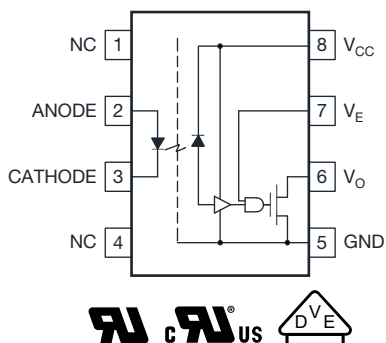
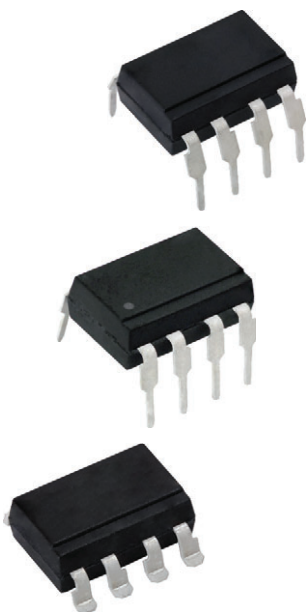


## High Speed Optocoupler, 10 MBd



### DESCRIPTION

The 6N137, VO2601, VO2611 are single channel 10 MBd optocoupler utilizing a high efficient input LED coupled to a high speed integrated photo-detector logic gate with a strobable output. This detector features an open drain output.

### FEATURES

- Common mode rejection (CMR) of 15 kV/ $\mu$ s
- LVTTTL/LVCMOS compatibility
- Low power consumption
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



### APPLICATIONS

- Microprocessor system interface
- Ground loop elimination
- Digital bus systems isolation
- High speed A/D and D/A conversion
- Digital control power supply
- Level shifting

### AGENCY APPROVALS

- [UL1577](#)
- [cUL](#)
- [DIN EN 60747-5-5 \(VDE 0884-5\), available with option 1](#)

### LINKS TO ADDITIONAL RESOURCES



**ORDERING INFORMATION**

|   |   |   |   |   |   |
|---|---|---|---|---|---|
| V | O | 2 | 6 | 0 | 1 |
|---|---|---|---|---|---|

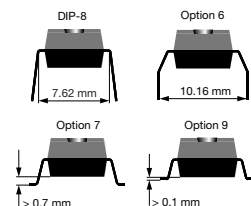
PART NUMBER

|   |   |   |   |   |
|---|---|---|---|---|
| - | X | 0 | # | # |
|---|---|---|---|---|

PACKAGE OPTION

|   |
|---|
| T |
|---|

TAPE  
AND  
REEL



| AGENCY CERTIFIED / PACKAGE     | CMR ( V/μs) |              |               |
|--------------------------------|-------------|--------------|---------------|
| <b>UL, cUL</b>                 | <b>1000</b> | <b>5000</b>  | <b>15 000</b> |
| DIP-8                          | 6N137       | VO2601       | VO2611        |
| DIP-8, 400 mil (option 6)      | 6N137-X006  | VO2601-X006  | VO2611-X006   |
| SMD-8 (option 7)               | 6N137-X007T | VO2601-X007T | VO2611-X007T  |
| <b>UL, cUL, VDE (option 1)</b> | <b>1000</b> | <b>5000</b>  | <b>15 000</b> |
| DIP-8, 400 mil (option 6)      | -           | -            | VO2611-X016   |
| SMD-8 (option 7)               | -           | VO2601-X017T | VO2611-X017T  |

**Note**

- Additional options may be possible, please contact sales office

**ABSOLUTE MAXIMUM RATINGS** ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)

| PARAMETER                                | TEST CONDITION | SYMBOL     | VALUE                   | UNIT               |
|------------------------------------------|----------------|------------|-------------------------|--------------------|
| <b>INPUT</b>                             |                |            |                         |                    |
| Input forward current                    |                | $I_F$      | 20                      | 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                 |
| Input power dissipation                  |                | $P_{diss}$ | 40                      | mW                 |
| <b>OUTPUT</b>                            |                |            |                         |                    |
| Supply voltage                           |                | $V_{CC}$   | 7                       | V                  |
| Output current                           |                | $I_O$      | 50                      | mA                 |
| Output voltage                           |                | $V_O$      | 7                       | V                  |
| Output power dissipation                 |                | $P_{diss}$ | 85                      | mW                 |
| <b>COUPLER</b>                           |                |            |                         |                    |
| Storage temperature                      |                | $T_{stg}$  | -55 to +125             | $^{\circ}\text{C}$ |
| Operating temperature                    |                | $T_{amb}$  | -40 to +100             | $^{\circ}\text{C}$ |
| Solder reflow temperature <sup>(1)</sup> | 5 s            |            | 260                     | $^{\circ}\text{C}$ |

**Notes**

- 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.
- <sup>(1)</sup> Refer to reflow profile for soldering conditions for surface mounted devices (SMD). Refer to wave profile for soldering conditions for through hole devices (DIP).

**RECOMMENDED OPERATING CONDITIONS**

| PARAMETER                           | SYMBOL    | MIN. | MAX.     | UNIT      |
|-------------------------------------|-----------|------|----------|-----------|
| Operating temperature               | $T_{amb}$ | -40  | +100     | °C        |
| Supply voltage                      | $V_{CC}$  | 4.5  | 5.5      | V         |
| Input current low level             | $I_{FL}$  | 0    | 250      | μA        |
| Input current high level            | $I_{FH}$  | 5    | 15       | mA        |
| Logic low enable voltage            | $V_{EL}$  | 0    | 0.8      | V         |
| Logic high enable voltage           | $V_{EH}$  | 2    | $V_{CC}$ | V         |
| Output pull up resistor             | $R_L$     | 330  | 4000     | Ω         |
| Fanout ( $R_L = 1\text{ k}\Omega$ ) | N         | -    | 5        | TTL loads |

**TRUTH TABLE** (positive logic)

| LED | ENABLE               | OUTPUT |
|-----|----------------------|--------|
| On  | H                    | L      |
| Off | H                    | H      |
| On  | L                    | H      |
| Off | L                    | H      |
| On  | Not connected / open | L      |
| Off | Not connected / open | H      |

**ELECTRICAL CHARACTERISTICS** ( $T_{amb} = -40\text{ °C}$  to  $+100\text{ °C}$ ,  $4.5\text{ V} \leq V_{CC} \leq 5.5\text{ V}$ ,  $I_F = 7.5\text{ mA}$ , unless otherwise specified; typical values are at  $V_{CC} = 5.0\text{ V}$ ,  $T_{amb} = 25\text{ °C}$ )

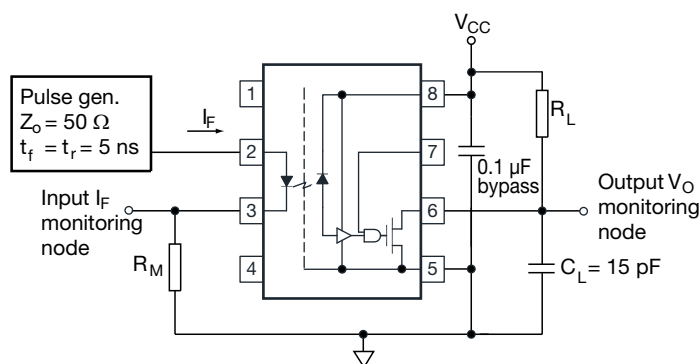
| PARAMETER                                     | TEST CONDITION                                                                                                | SYMBOL                  | MIN. | TYP.  | MAX. | UNIT |
|-----------------------------------------------|---------------------------------------------------------------------------------------------------------------|-------------------------|------|-------|------|------|
| <b>INPUT</b>                                  |                                                                                                               |                         |      |       |      |      |
| Input forward voltage                         | $I_F = 10\text{ mA}$                                                                                          | $V_F$                   | -    | 1.38  | 1.70 | V    |
| Input forward voltage temperature coefficient | $I_F = 10\text{ mA}$                                                                                          | $\Delta V_F / \Delta T$ | -    | -1.5  | -    | mV/K |
| Input reverse voltage                         | $I_R = 10\text{ }\mu\text{A}$                                                                                 | $BV_R$                  | 5    | -     | -    | V    |
| Input threshold current                       | $V_E = 2\text{ V}$ , $V_O = 0.6\text{ V}$ , $V_{CC} = 5.5\text{ V}$ , $I_{OL}(\text{sinking}) = 13\text{ mA}$ | $I_{TH}$                | -    | 2     | 5    | mA   |
| Input capacitance                             | $f = 1\text{ MHz}$ , $V_F = 0\text{ V}$                                                                       | $C_I$                   | -    | 34    | -    | pF   |
| <b>OUTPUT</b>                                 |                                                                                                               |                         |      |       |      |      |
| Low level supply current                      | $I_F = 10\text{ mA}$ , $V_{CC} = 5.5\text{ V}$ , $V_E = 0.5\text{ V}$                                         | $I_{CCL}$               | -    | 3.5   | 5    | mA   |
| High level supply current                     | $I_F = 0\text{ mA}$ , $V_{CC} = 5.5\text{ V}$ , $V_E = 0.5\text{ V}$                                          | $I_{CCH}$               | -    | 3.7   | 5    | mA   |
| Low level enable current                      | $V_{CC} = 5.5\text{ V}$ , $V_E = 0.5\text{ V}$                                                                | $I_{EL}$                | -    | -0.9  | -1.6 | mA   |
| High level enable current                     | $V_{CC} = 5.5\text{ V}$ , $V_E = 2\text{ V}$                                                                  | $I_{EH}$                | -    | -0.19 | -1.6 | mA   |
| Low level enable voltage                      |                                                                                                               | $V_{EL}$                | -    | -     | 0.8  | V    |
| High level enable voltage                     |                                                                                                               | $V_{EH}$                | 2    | -     | -    | V    |
| Low level output voltage                      | $V_{CC} = 5.5\text{ V}$ , $V_E = 2\text{ V}$ , $I_F = 5\text{ mA}$ , $I_{OL}(\text{sinking}) = 13\text{ mA}$  | $V_{OL}$                | -    | 0.20  | 0.60 | V    |
| High level output current                     | $V_{CC} = 5.5\text{ V}$ , $V_E = 2\text{ V}$ , $V_O = 5.5\text{ V}$ , $I_F = 250\text{ }\mu\text{A}$          | $I_{OH}$                | -    | 1     | 10   | μA   |
| <b>COUPLER</b>                                |                                                                                                               |                         |      |       |      |      |
| Input to output capacitance                   | $f = 1\text{ MHz}$ , $T_{amb} = 25\text{ °C}$                                                                 | $C_{IO}$                | -    | 4     | -    | pF   |

**Note**

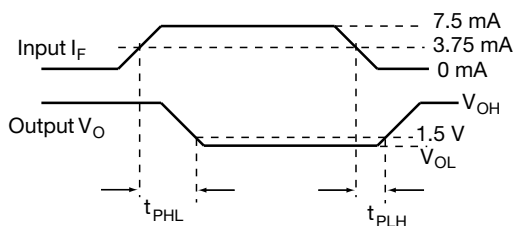
- Minimum and maximum values are testing requirements. Typical values are characteristics of the device and are the result of engineering evaluation. Typical values are for information only and are not part of the testing requirements.

**SWITCHING CHARACTERISTICS** ( $T_{amb} = -40\text{ }^{\circ}\text{C}$  to  $+100\text{ }^{\circ}\text{C}$ ,  $4.5\text{ V} \leq V_{CC} \leq 5.5\text{ V}$ ,  $I_F = 7.5\text{ mA}$ , unless otherwise specified; typical values are at  $V_{CC} = 5.0\text{ V}$ ,  $T_{amb} = 25\text{ }^{\circ}\text{C}$ )

| PARAMETER                                                  | TEST CONDITION                                                                                   | SYMBOL                | MIN. | TYP. | MAX. | UNIT |
|------------------------------------------------------------|--------------------------------------------------------------------------------------------------|-----------------------|------|------|------|------|
| Propagation delay time to high output level                | $R_L = 350\text{ }\Omega$ , $C_L = 15\text{ pF}$ , $T_{amb} = 25\text{ }^{\circ}\text{C}$        | $t_{PLH}$             | 25   | 50   | 90   | ns   |
|                                                            | $R_L = 350\text{ }\Omega$ , $C_L = 15\text{ pF}$                                                 | $t_{PLH}$             | -    | -    | 100  | ns   |
| Propagation delay time to low output level                 | $R_L = 350\text{ }\Omega$ , $C_L = 15\text{ pF}$ , $T_{amb} = 25\text{ }^{\circ}\text{C}$        | $t_{PHL}$             | 25   | 40   | 90   | ns   |
|                                                            | $R_L = 350\text{ }\Omega$ , $C_L = 15\text{ pF}$                                                 | $t_{PHL}$             | -    | -    | 100  | ns   |
| Pulse width distortion                                     | $R_L = 350\text{ }\Omega$ , $C_L = 15\text{ pF}$                                                 | $ t_{PLH} - t_{PHL} $ | -    | 10   | -    | ns   |
| Propagation delay skew                                     | $R_L = 350\text{ }\Omega$ , $C_L = 15\text{ pF}$                                                 | $t_{PSK}$             | -    | -    | 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 %)                            | $R_L = 350\text{ }\Omega$ , $C_L = 15\text{ pF}$                                                 | $t_f$                 | -    | 10   | -    | ns   |
| Propagation delay time of enable from $V_{EH}$ to $V_{EL}$ | $R_L = 350\text{ }\Omega$ , $C_L = 15\text{ pF}$ , $V_{EL} = 0\text{ V}$ , $V_{EH} = 3\text{ V}$ | $t_{ELH}$             | -    | 15   | -    | ns   |
| Propagation delay time of enable from $V_{EL}$ to $V_{EH}$ | $R_L = 350\text{ }\Omega$ , $C_L = 15\text{ pF}$ , $V_{EL} = 0\text{ V}$ , $V_{EH} = 3\text{ V}$ | $t_{EHL}$             | -    | 15   | -    | ns   |

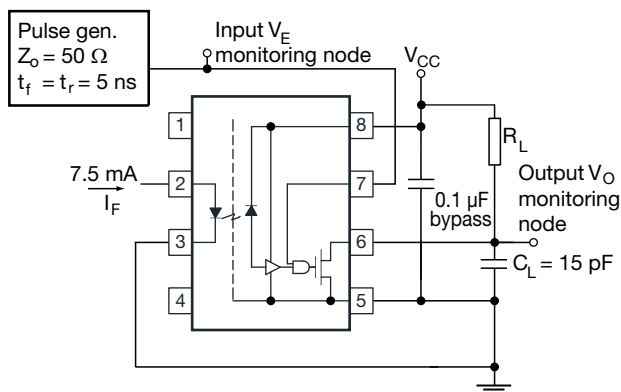


The probe and jig capacitances are included in  $C_L$

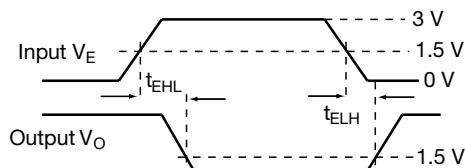


18964-7

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



The probe and jig capacitances are included in  $C_L$



18975-5

Fig. 2 - Test Circuit for  $t_{EHL}$  and  $t_{ELH}$

| COMMON MODE TRANSIENT IMMUNITY ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified) |                                                                                                                                 |           |          |        |      |      |                  |
|-------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|-----------|----------|--------|------|------|------------------|
| PARAMETER                                                                                             | TEST CONDITION                                                                                                                  | PART NAME | SYMBOL   | MIN.   | TYP. | MAX. | UNIT             |
| Logic high common mode transient immunity                                                             | $V_{CC} = 5\text{ V}$ , $ V_{CM}  = 1000\text{ V}$ , $I_F = 0\text{ mA}$ ,<br>$V_O > 2.0\text{ V}$ , $R_L = 350\text{ }\Omega$  | 6N137     | $ CM_H $ | 1000   | -    | -    | V/ $\mu\text{s}$ |
|                                                                                                       |                                                                                                                                 | VO2601    |          | 5000   | -    | -    |                  |
|                                                                                                       |                                                                                                                                 | VO2611    |          | 15 000 | -    | -    |                  |
| Logic low common mode transient immunity                                                              | $V_{CC} = 5\text{ V}$ , $ V_{CM}  = 1000\text{ V}$ , $I_F = 10\text{ mA}$ ,<br>$V_O < 0.8\text{ V}$ , $R_L = 350\text{ }\Omega$ | 6N137     | $ CM_L $ | 1000   | -    | -    |                  |
|                                                                                                       |                                                                                                                                 | VO2601    |          | 5000   | -    | -    |                  |
|                                                                                                       |                                                                                                                                 | VO2611    |          | 15 000 | -    | -    |                  |

## Notes

- No external pull up is required for a high logic state on the enable input. If the enable pin is not used, connect it to  $V_{CC}$ .

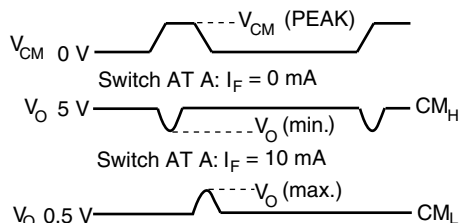
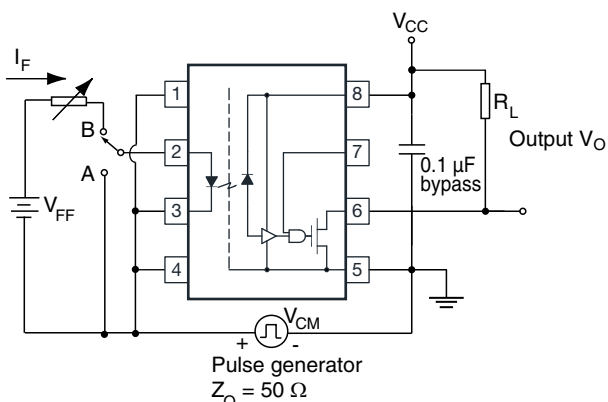


Fig. 3 - Test Circuit for Common Mode Transient Immunity

18976-8

| SAFETY AND INSULATION RATINGS                |                                                   |                   |                    |                   |
|----------------------------------------------|---------------------------------------------------|-------------------|--------------------|-------------------|
| PARAMETER                                    | TEST CONDITION                                    | SYMBOL            | VALUE              | UNIT              |
| Climatic classification                      | According to IEC 68 part 1                        |                   | 55 / 110 / 21      |                   |
| Pollution degree                             | According to DIN VDE 0109                         |                   | 2                  |                   |
| Comparative tracking index                   | Insulation group IIIa                             | CTI               | 175                |                   |
| Maximum rated withstanding isolation voltage | According to UL1577, t = 1 min                    | V <sub>ISO</sub>  | 5000               | V <sub>RMS</sub>  |
| Maximum transient isolation voltage          | According to DIN EN 60747-5-5                     | V <sub>IOTM</sub> | 6000               | V <sub>peak</sub> |
| Maximum repetitive peak isolation voltage    | According to DIN EN 60747-5-5                     | V <sub>IORM</sub> | 630                | V <sub>peak</sub> |
| Isolation resistance                         | T <sub>amb</sub> = 25 °C, V <sub>IO</sub> = 500 V | R <sub>IO</sub>   | ≥ 10 <sup>12</sup> | Ω                 |
| Maximum output power dissipation             |                                                   | P <sub>SO</sub>   | 600                | mW                |
| Maximum input current                        |                                                   | I <sub>SI</sub>   | 230                | mA                |
| Maximum ambient temperature (derated)        |                                                   | T <sub>S</sub>    | 175                | °C                |
| Creepage distance                            | DIP-8, SMD-8                                      |                   | ≥ 7                | mm                |
|                                              | DIP-8, 400 mil                                    |                   | ≥ 8                | mm                |
| Clearance distance                           | DIP-8, SMD-8                                      |                   | ≥ 7                | mm                |
|                                              | DIP-8, 400 mil                                    |                   | ≥ 8                | mm                |
| Insulation thickness                         |                                                   | DTI               | ≥ 0.4              | mm                |

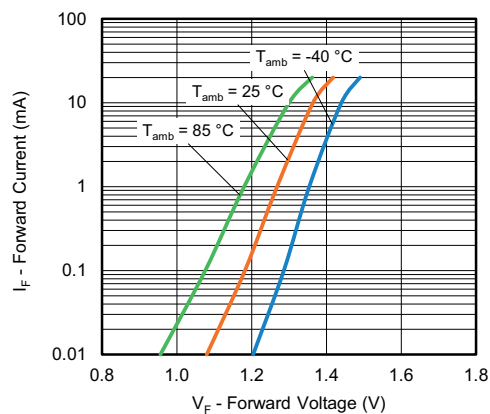
**TYPICAL CHARACTERISTICS** ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)


Fig. 4 - Diode Forward Current vs. Forward Voltage

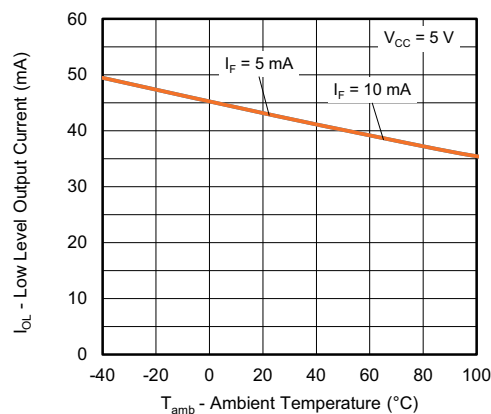


Fig. 7 - Low Level Output Current vs. Ambient Temperature

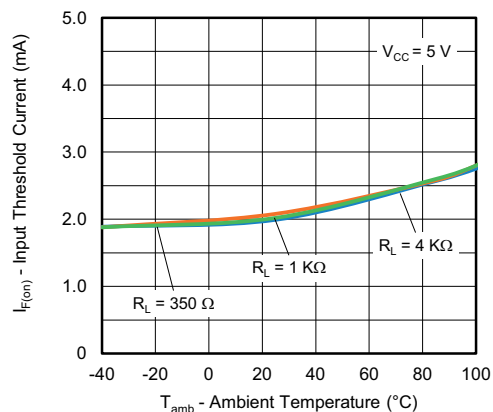


Fig. 5 - Input Threshold Current vs. Ambient Temperature

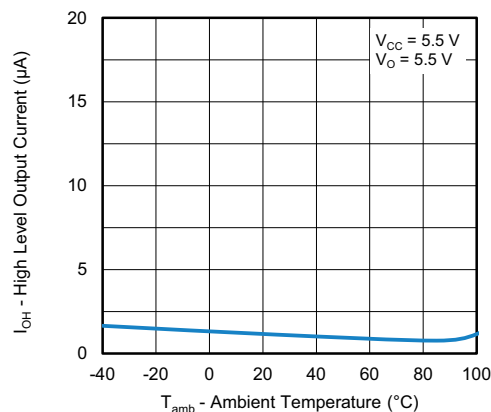


Fig. 8 - High Level Output Current vs. Ambient Temperature

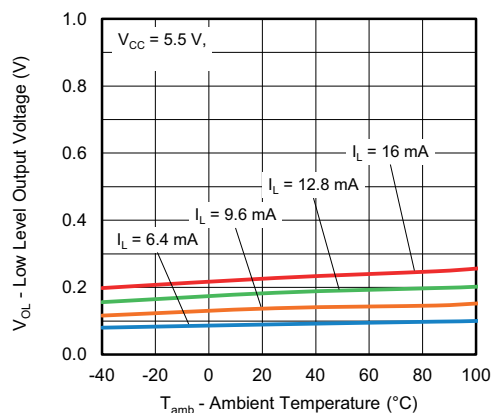


Fig. 6 - Low Level Output Voltage vs. Ambient Temperature

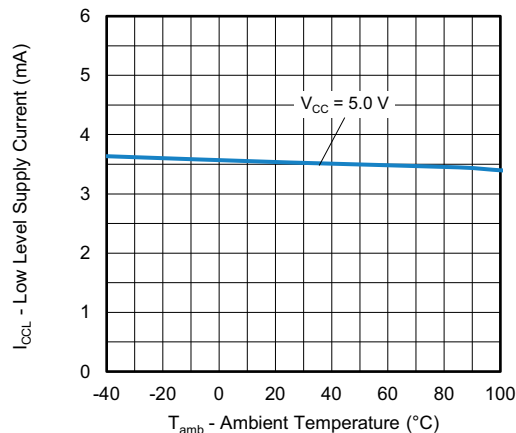


Fig. 9 - Low Level Supply Current vs. Ambient Temperature

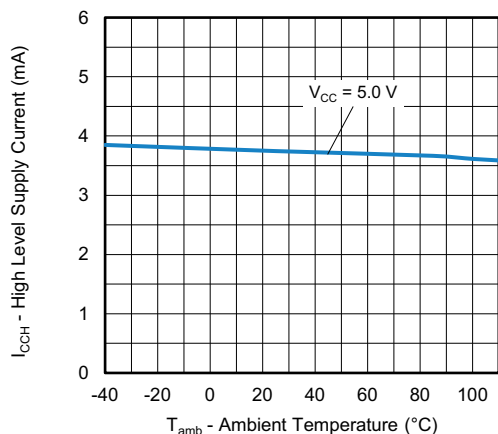


Fig. 10 - High Level Supply Current vs. Ambient Temperature

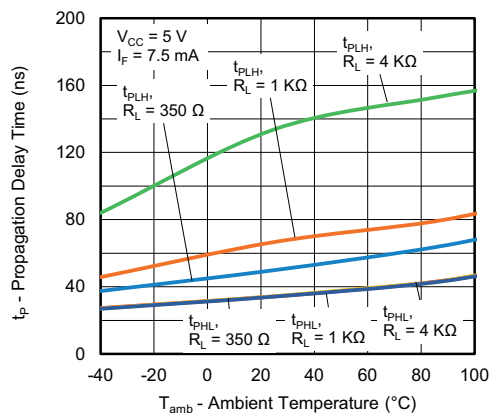


Fig. 12 - Propagation Delay Time vs. Ambient Temperature

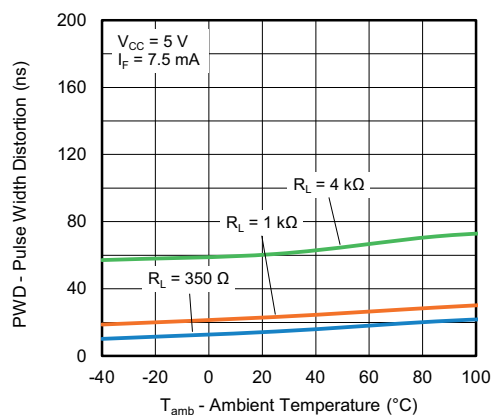


Fig. 11 - Pulse Width Distortion vs. Ambient Temperature

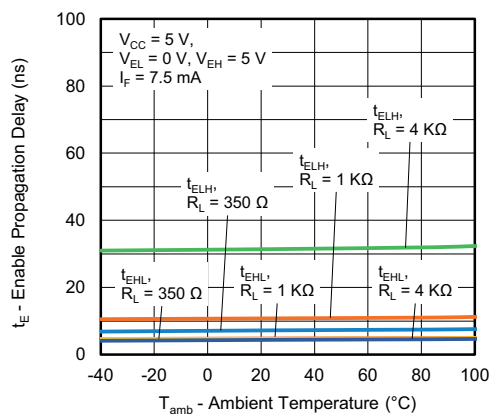


Fig. 13 - Enable Propagation Delay vs. Ambient Temperature



**PACKAGE DIMENSIONS** (in millimeters)

**DIP-8**

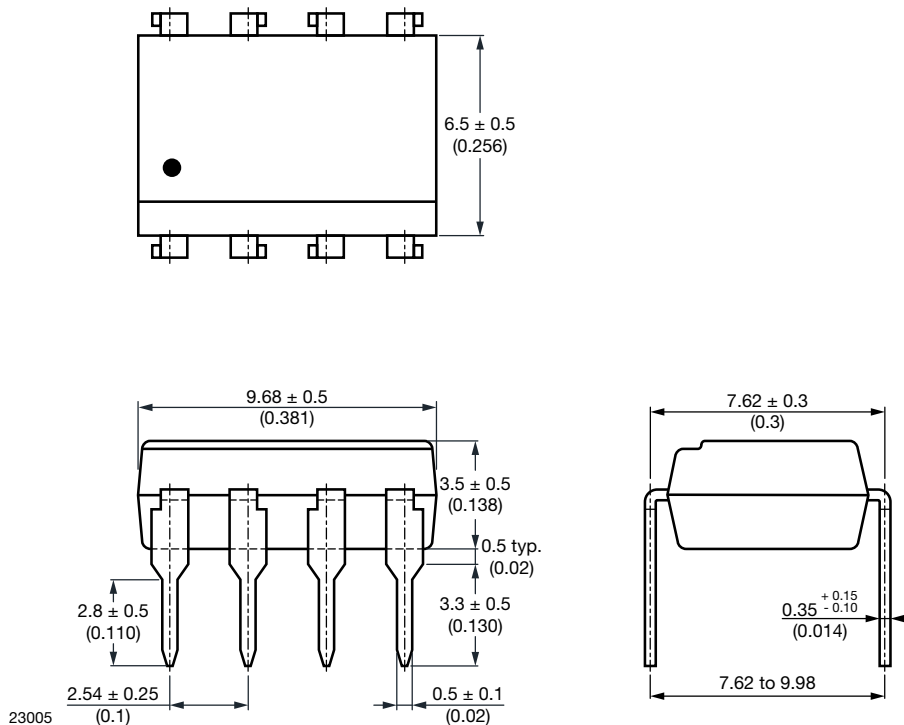


Fig. 14

**DIP-8, 400 mil**

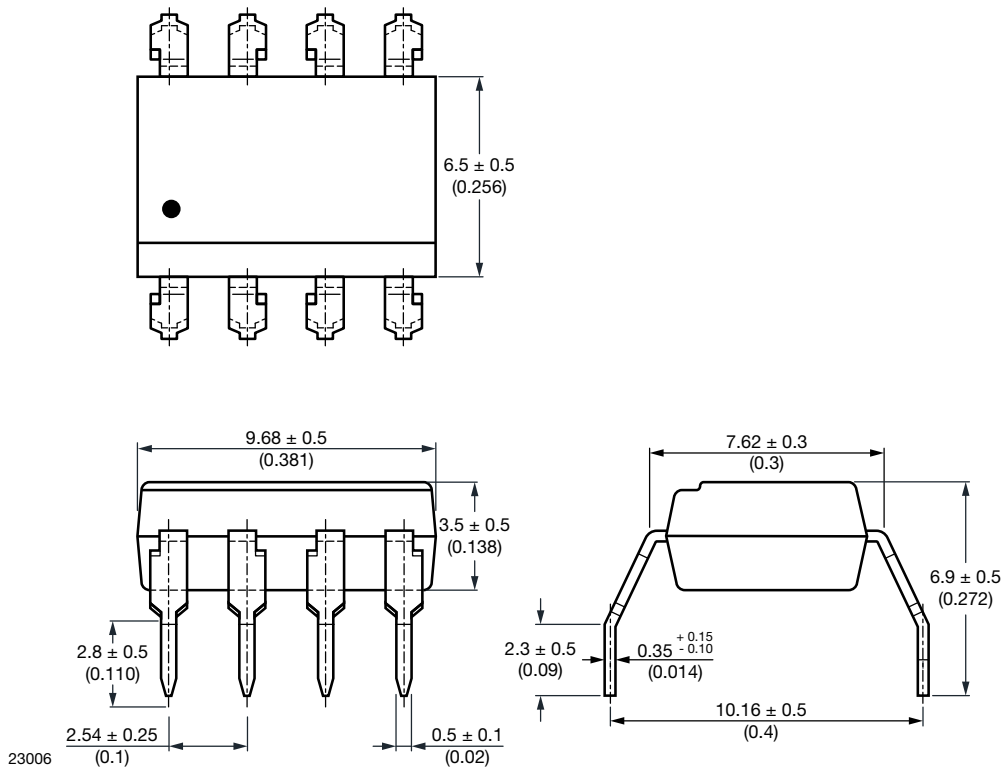


Fig. 15

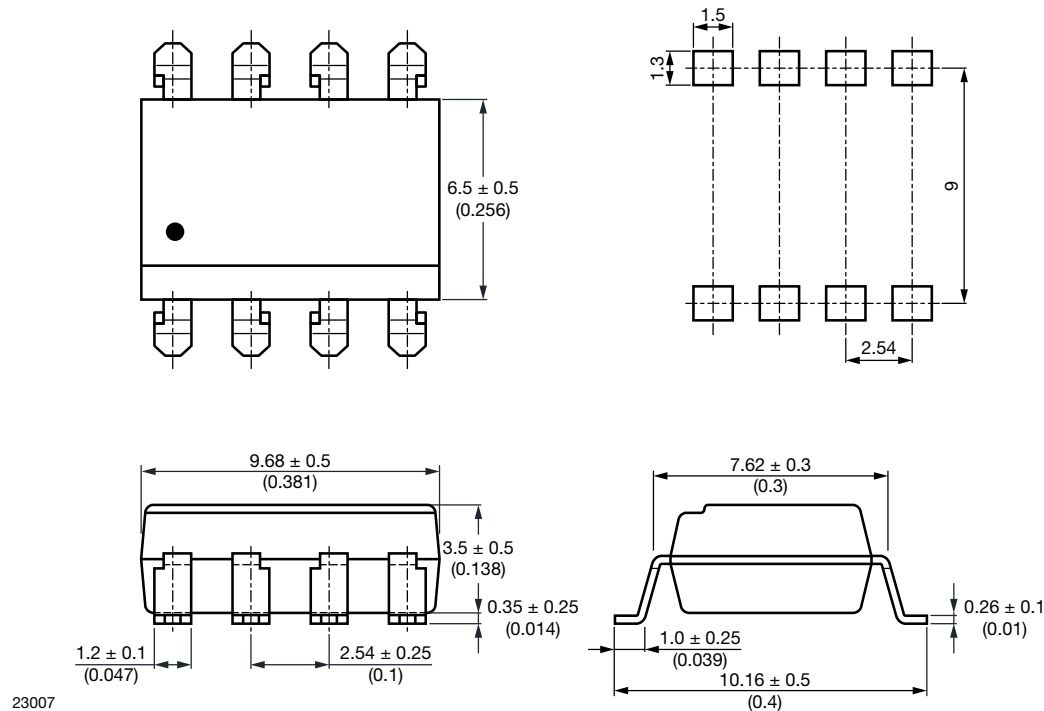
**SMD-8**


Fig. 16

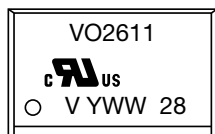
**PACKAGE MARKING**


Fig. 17 - Example of VO2611

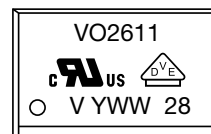


Fig. 18 - Example of VO2611-X017T

**Notes**

- "YWW" is the date code marking (Y = year code, WW = week code)
- VDE logo is only marked on VDE option parts
- Tape and reel suffix (T) is not part of the package marking


**PACKAGING INFORMATION** (in millimeters)

| DEVICES PER TUBES |            |           |           |
|-------------------|------------|-----------|-----------|
| TYPE              | UNITS/TUBE | TUBES/BOX | UNITS/BOX |
| DIP-8             | 50         | 40        | 2000      |
| DIP-8, 400 mil    | 50         | 40        | 2000      |

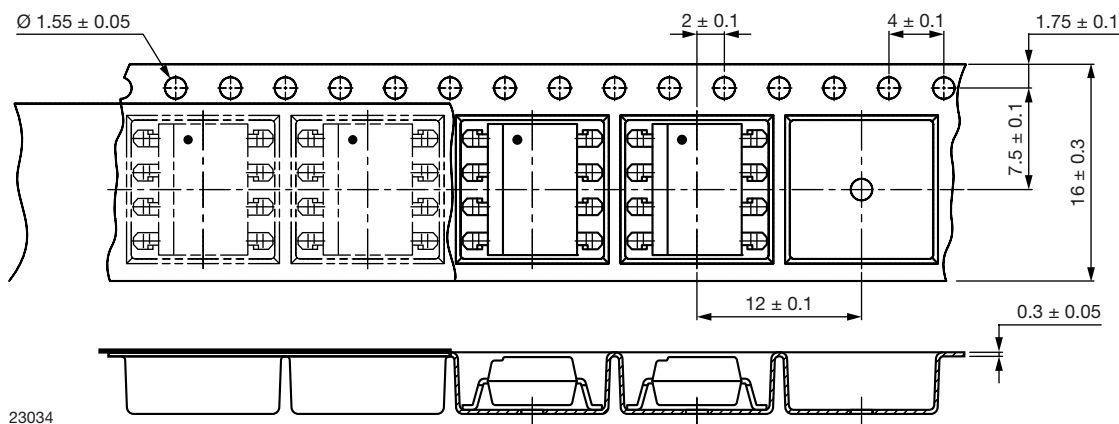
**SMD-8 Tape**


Fig. 19 - Tape and Reel Packaging (1000 pieces on reel)

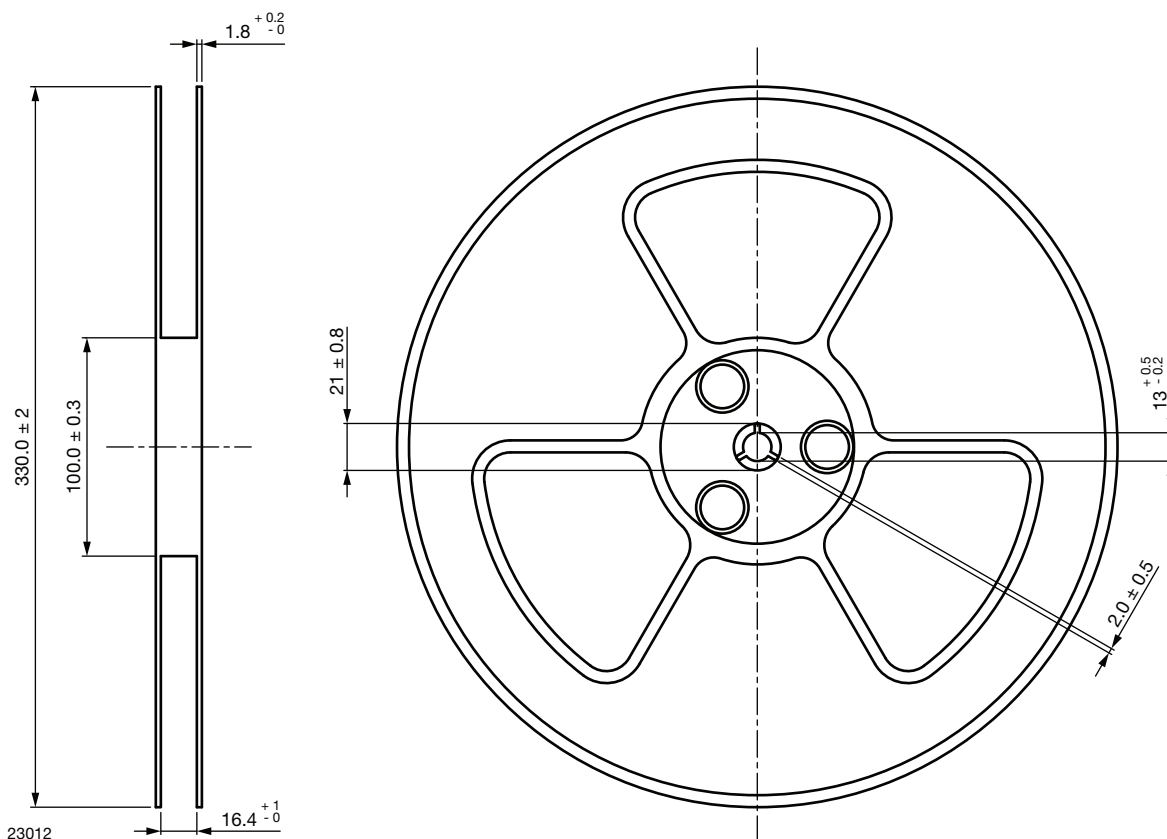
**Reel**


Fig. 20 - Tape and Reel Shipping Medium

## SOLDER PROFILES

### IR Reflow Soldering (JEDEC® J-STD-020C compliant)

One time soldering reflow is recommended within the condition of temperature and time profile shown below. Do not solder more than three times.

| PROFILE ITEM                                   | CONDITIONS       |
|------------------------------------------------|------------------|
| Preheat                                        |                  |
| - Temperature minimum ( $T_{S \text{ min.}}$ ) | 150 °C           |
| - Temperature maximum ( $T_{S \text{ max.}}$ ) | 200 °C           |
| - Time (min. to max.) ( $t_S$ )                | 90 s $\pm$ 30 s  |
| Soldering zone                                 |                  |
| - Temperature ( $T_L$ )                        | 217 °C           |
| - Time ( $t_L$ )                               | 60 s             |
| Peak temperature ( $T_p$ )                     | 260 °C           |
| Ramp-up rate                                   | 3 °C/s max.      |
| Ramp-down rate                                 | 3 °C/s to 6 °C/s |

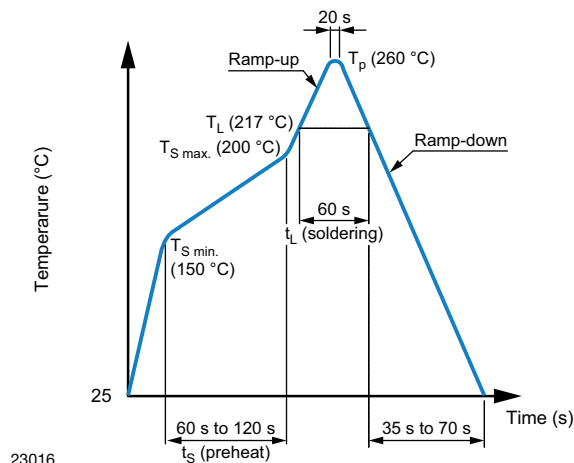


Fig. 21

### Wave Soldering (JEDEC JESD22-A111 compliant)

One time soldering is recommended within the condition of temperature.

Temperature: 260 °C + 0 °C / - 5 °C

Time: 10 s

Preheat temperature: 25 °C to 140 °C

Preheat time: 30 s to 80 s

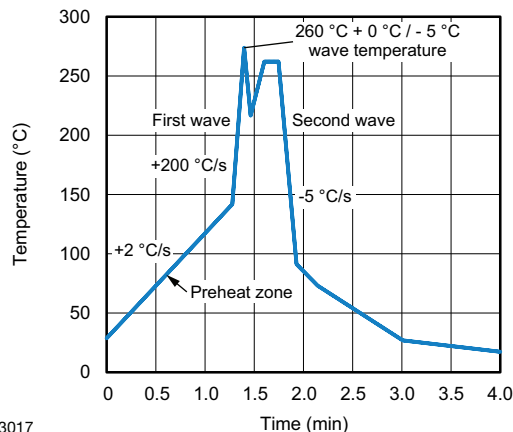


Fig. 22

### Hand Soldering by Soldering Iron

Allow single lead soldering in every single process. One time soldering is recommended.

Temperature: 380 °C + 0 °C / - 5 °C

Time: 3 s max.

## HANDLING AND STORAGE CONDITIONS

ESD level: HBM class 2

Floor life: unlimited

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

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



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