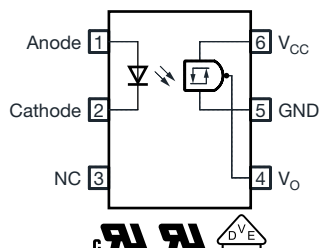


## High Speed Optocoupler, 1 MBd, Schmitt Trigger



23030



### DESIGN SUPPORT TOOLS AVAILABLE



3D Models



Design Tools



Related Documents



SPICE Models

### DESCRIPTION

The VOH1016A is a single channel 1 MBd optocoupler utilizing a high efficient input LED coupled with an integrated optical photodiode IC detector. The detector has an open collector transistor output with Schmitt-Trigger functionality. The low turn-on threshold and low supply current together with a guaranteed common mode transient immunity of 10 kV/ $\mu$ s makes the VOH1016A a perfect solution for galvanic noise isolation or to break up ground loops in digital applications. The wide power supply range up to 15 V enables isolated level shifting in applications using different voltage domains.

### FEATURES

- High data rate 2 MHz (NRZ)
- Latch up and oscillation free
- Low turn-on threshold current 2 mA
- Logic compatible output
- Guaranteed on / off threshold hysteresis
- Wide supply voltage range 3 V to 15 V
- Minimum common mode transient immunity (CMTI) 10 kV/ $\mu$ s
- 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
- Ground loop elimination
- Galvanic noise isolation
- Serial bus systems
- Digital control power supply
- Signal level translation
- PLC, ATE input / output isolation
- Computer peripheral interface

### AGENCY APPROVALS

- [UL 1577](#)
- [cUL 1577](#)
- [DIN EN 60747-5-5 \(VDE 0884-5\) available with option "V"](#)

### ORDERING INFORMATION

|             |   |   |   |   |   |   |   |                |            |               |   |   |
|-------------|---|---|---|---|---|---|---|----------------|------------|---------------|---|---|
| V           | O | H | 1 | 0 | 1 | 6 | A | #              | -          | V             | T | # |
| PART NUMBER |   |   |   |   |   |   |   | PACKAGE OPTION | VDE OPTION | TAPE AND REEL |   |   |

| AGENCY CERTIFIED / PACKAGE | CMTI (kV/ $\mu$ s) |
|----------------------------|--------------------|
| <b>UL, cUL</b>             | <b>10</b>          |
| DIP-6                      | VOH1016AD          |
| DIP-6, 400 mil             | VOH1016AG          |
| SMD-6                      | VOH1016AB-T        |
| SMD-6, 180° oriented       | VOH1016AB-T2       |
| <b>VDE, UL, cUL</b>        | <b>10</b>          |
| DIP-6                      | VOH1016AD-V        |
| DIP-6, 400 mil             | VOH1016AG-V        |
| SMD-6                      | VOH1016AB-VT       |
| SMD-6, 180° oriented       | VOH1016AB-VT2      |

**TRUTH TABLE** (positive logic)

| LED | OUTPUT |
|-----|--------|
| On  | L      |
| Off | H      |

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

| PARAMETER             | CONDITIONS | SYMBOL     | VALUE       | UNIT               |
|-----------------------|------------|------------|-------------|--------------------|
| <b>INPUT</b>          |            |            |             |                    |
| Forward current       |            | $I_F$      | 50          | mA                 |
| Reverse voltage       |            | $V_R$      | 6           | V                  |
| Power dissipation     |            | $P_{diss}$ | 120         | mW                 |
| <b>OUTPUT</b>         |            |            |             |                    |
| Supply voltage        |            | $V_{CC}$   | 16          | V                  |
| Output voltage        |            | $V_O$      | $V_{CC}$    | V                  |
| Output current        |            | $I_O$      | 50          | mA                 |
| Power dissipation     |            | $P_{diss}$ | 130         | mW                 |
| <b>COUPLER</b>        |            |            |             |                    |
| Power dissipation     |            | $P_{diss}$ | 250         | mW                 |
| Storage temperature   |            | $T_{stg}$  | -55 to +150 | $^{\circ}\text{C}$ |
| Operating temperature |            | $T_{amb}$  | -40 to +110 | $^{\circ}\text{C}$ |
| Solder temperature    | For 10 s   | $T_{sld}$  | 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

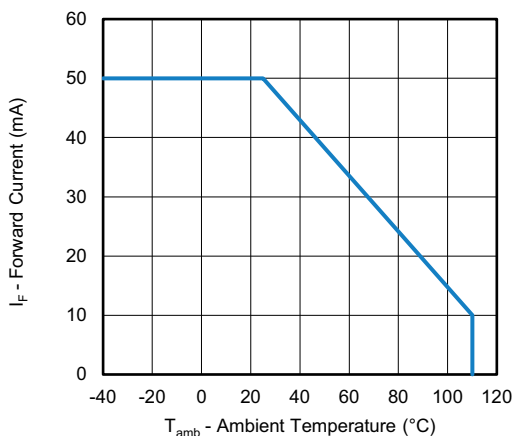


Fig. 1 - Forward Current vs. Ambient Temperature

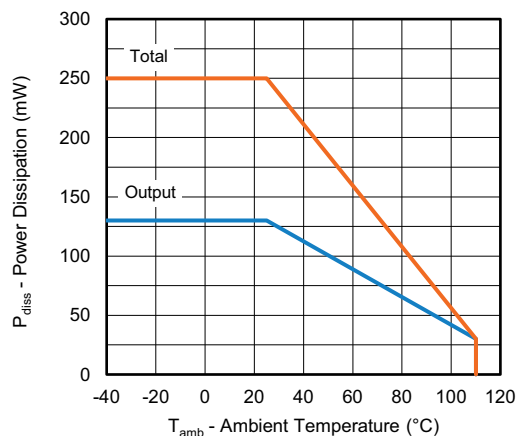


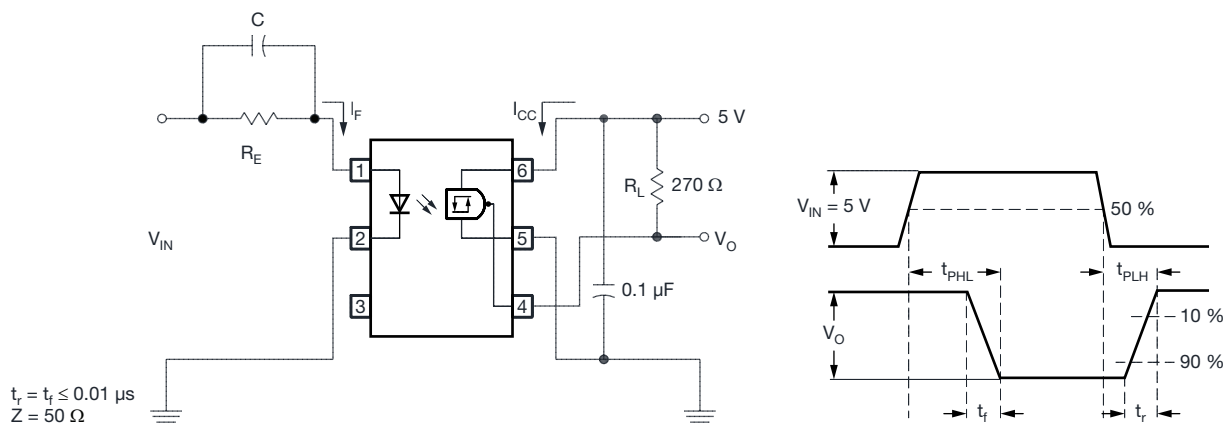
Fig. 2 - Power Dissipation vs. Ambient Temperature

| <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>                                                                                             |                                                                       |                        |      |      |      |               |
| Forward voltage                                                                                          | $I_F = 4\text{ mA}$                                                   | $V_F$                  | -    | 1.1  | 1.4  | V             |
|                                                                                                          | $I_F = 0.3\text{ mA}$                                                 |                        | 0.7  | 1.0  | -    |               |
| Reverse current                                                                                          | $V_R = 3\text{ V}$                                                    | $I_R$                  | -    | -    | 10   | $\mu\text{A}$ |
| Input capacitance                                                                                        | $f = 1\text{ MHz}$ , $V_F = 0\text{ V}$                               | $C_{IN}$               | -    | 30   | 250  | pF            |
| <b>OUTPUT</b>                                                                                            |                                                                       |                        |      |      |      |               |
| Supply voltage                                                                                           |                                                                       | $V_{CC}$               | 3    | -    | 15   | V             |
| High level supply current                                                                                | $I_F = 0\text{ mA}$ , $V_{CC} = 5\text{ V}$                           | $I_{CCH}$              | -    | 0.55 | 1.0  | mA            |
| Low level supply current                                                                                 | $I_F = 4\text{ mA}$ , $V_{CC} = 5\text{ V}$                           | $I_{CCL}$              | -    | 0.55 | 1.0  | mA            |
| High level output current                                                                                | $V_{CC} = V_O = 15\text{ V}$ , $I_F = 0\text{ mA}$                    | $I_{OH}$               | -    | -    | 100  | $\mu\text{A}$ |
| Low level output voltage                                                                                 | $V_{CC} = 5\text{ V}$ , $I_F = 4\text{ mA}$ , $I_{OL} = 16\text{ mA}$ | $V_{OL}$               | -    | 0.2  | 0.4  | V             |
| Turn-On threshold current                                                                                | $V_{CC} = 5\text{ V}$ , $R_L = 280\text{ }\Omega$                     | $I_{F(on)}$            | -    | 0.65 | 2.0  | mA            |
| Turn-Off threshold current                                                                               | $V_{CC} = 5\text{ V}$ , $R_L = 280\text{ }\Omega$                     | $I_{F(off)}$           | 0.4  | 0.6  | -    | mA            |
| Hysteresis ratio                                                                                         | $V_{CC} = 5\text{ V}$ , $R_L = 280\text{ }\Omega$                     | $I_{F(off)}/I_{F(on)}$ | 0.5  | 0.9  | 0.95 |               |

**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> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified) |                                                                            |           |      |      |      |               |
|---------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|-----------|------|------|------|---------------|
| PARAMETER                                                                                               | TEST CONDITION                                                             | SYMBOL    | MIN. | TYP. | MAX. | UNIT          |
| Propagation delay time to high output level                                                             | $R_L = 280\text{ }\Omega$ , $V_{CC} = 5\text{ V}$ ,<br>$I_F = 4\text{ mA}$ | $t_{PLH}$ | -    | 0.25 | 2    | $\mu\text{s}$ |
| Propagation delay time to low output level                                                              |                                                                            | $t_{PHL}$ | -    | 0.05 | 1.2  | $\mu\text{s}$ |
| Rise time                                                                                               |                                                                            | $t_r$     | -    | 0.05 | 0.5  | $\mu\text{s}$ |
| Fall time                                                                                               |                                                                            | $t_f$     | -    | 0.04 | 0.5  | $\mu\text{s}$ |
| Data rate                                                                                               |                                                                            |           | -    | 2    | -    | MHz           |


Fig. 3 - Test Circuit for  $t_{on}$ ,  $t_{off}$ ,  $t_r$ , and  $t_f$

| <b>COMMON MODE TRANSIENT IMMUNITY</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified) |                                                                                                                   |          |      |      |      |                   |
|--------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|----------|------|------|------|-------------------|
| PARAMETER                                                                                                    | TEST CONDITION                                                                                                    | SYMBOL   | MIN. | TYP. | MAX. | UNIT              |
| Common mode transient immunity                                                                               | $R_L = 270\text{ }\Omega$ , $V_{CC} = 5\text{ V}$ , $V_{CM} = 1000\text{ V}$ ,<br>$I_F = 0\text{ mA}$             | $ CM_H $ | 10   | -    | -    | kV/ $\mu\text{s}$ |
|                                                                                                              | $R_L = 270\text{ }\Omega$ , $V_{CC} = 5\text{ V}$ , $V_{CM} = 1000\text{ V}$ ,<br>$I_F = I_{F(on)}\text{ (max.)}$ | $ CM_L $ | 10   | -    | -    | kV/ $\mu\text{s}$ |

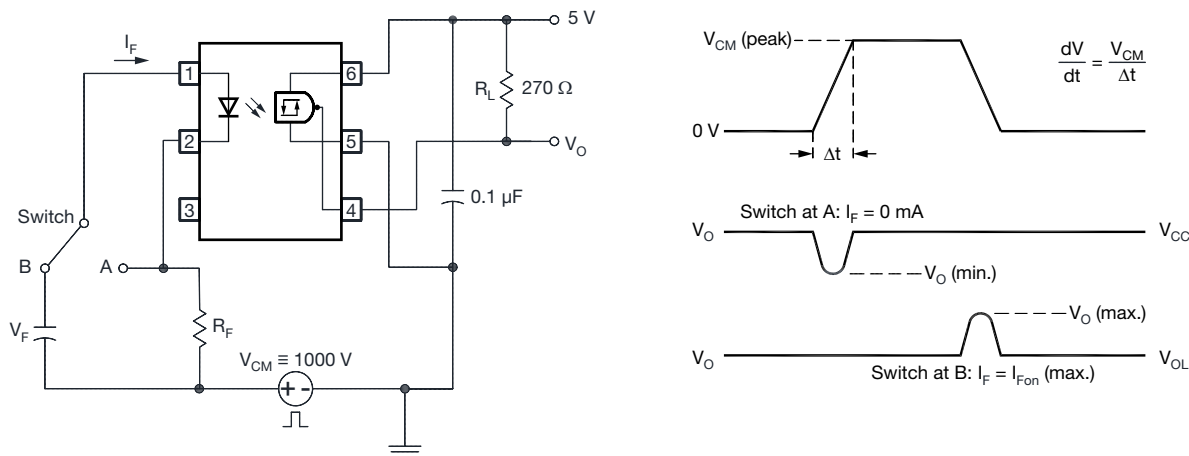


Fig. 4 - Test Circuit for Common Mode Transient Immunity

| <b>SAFETY AND INSULATION RATINGS</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified) |                                                                   |            |           |                    |
|-------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|------------|-----------|--------------------|
| PARAMETER                                                                                                   | TEST CONDITION                                                    | SYMBOL     | VALUE     | UNIT               |
| Comparative tracking index                                                                                  | Insulation group IIIa                                             | CTI        | 175       |                    |
| Maximum rated withstanding isolation voltage                                                                | According to UL1577, $t = 1\text{ min}$                           | $V_{ISO}$  | 5000      | $V_{RMS}$          |
| Maximum transient isolation voltage                                                                         | According to DIN EN 60747-5-5                                     | $V_{IOTM}$ | 6000      | $V_{peak}$         |
| Maximum repetitive peak isolation voltage                                                                   | According to DIN EN 60747-5-5                                     | $V_{IORM}$ | 630       | $V_{peak}$         |
| Isolation resistance                                                                                        | $T_{amb} = 25\text{ }^{\circ}\text{C}$ , $V_{IO} = 500\text{ V}$  | $R_{IO}$   | $10^{12}$ | $\Omega$           |
|                                                                                                             | $T_{amb} = 100\text{ }^{\circ}\text{C}$ , $V_{IO} = 500\text{ V}$ | $R_{IO}$   | $10^{11}$ | $\Omega$           |
| Output safety power                                                                                         |                                                                   | $P_{SO}$   | 150       | mW                 |
| Input safety current                                                                                        |                                                                   | $I_{SI}$   | 20        | mA                 |
| Input safety temperature                                                                                    |                                                                   | $T_S$      | 175       | $^{\circ}\text{C}$ |
| Creepage distance                                                                                           |                                                                   |            | > 7       | mm                 |
| Clearance distance                                                                                          |                                                                   |            | > 7       | mm                 |
| Insulation thickness                                                                                        |                                                                   | DTI        | > 0.4     | mm                 |



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

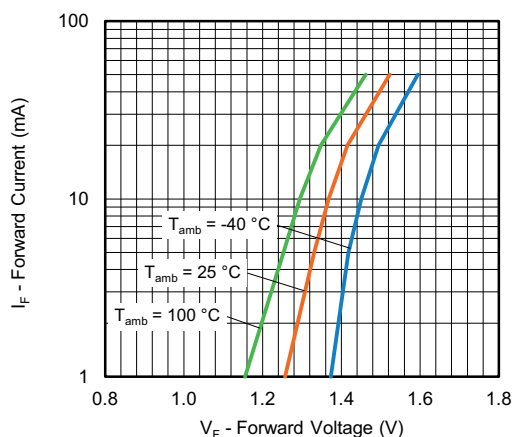


Fig. 5 - Forward Current vs. Forward Voltage

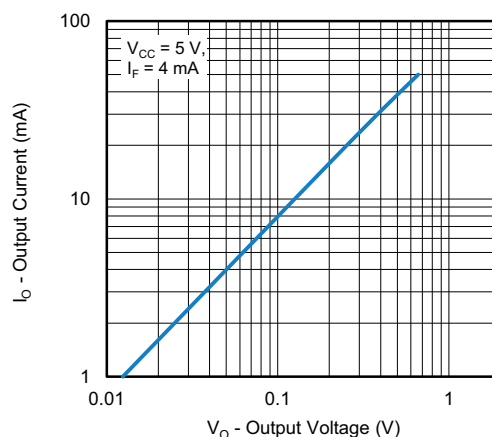


Fig. 8 - Output Current vs. Output Voltage

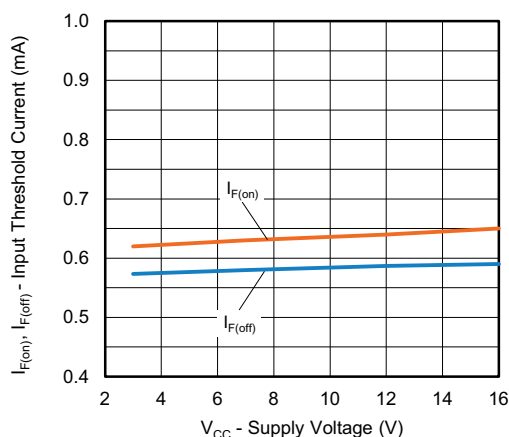


Fig. 6 - Input Threshold Current vs. Supply Voltage

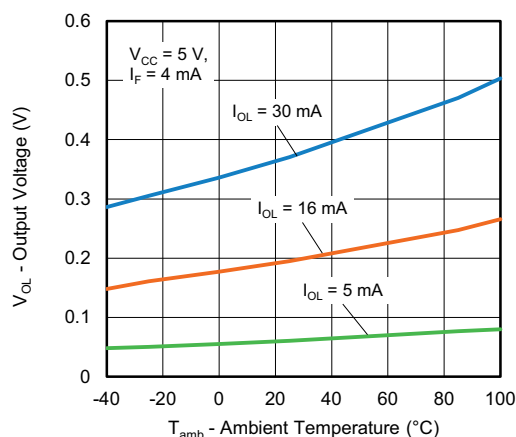


Fig. 9 - Output Voltage vs. Ambient Temperature

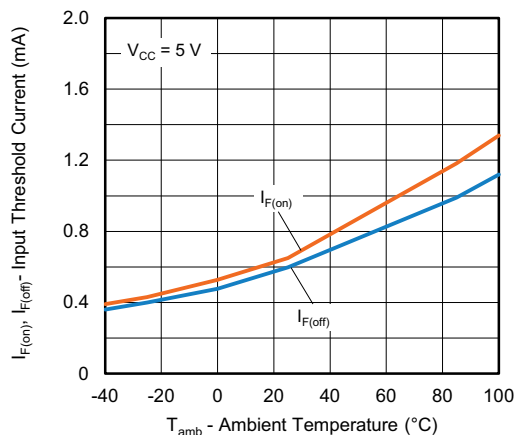


Fig. 7 - Input Threshold Current vs. Ambient Temperature

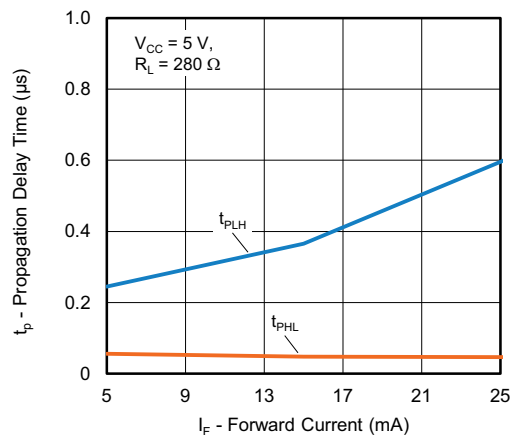


Fig. 10 - Propagation Delay Time vs. Forward Current

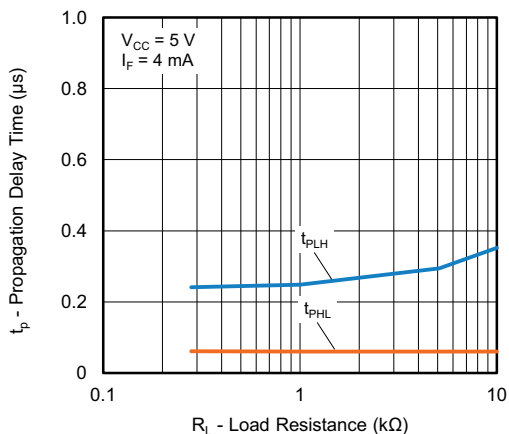


Fig. 11 - Propagation Delay Time vs. Load Resistance

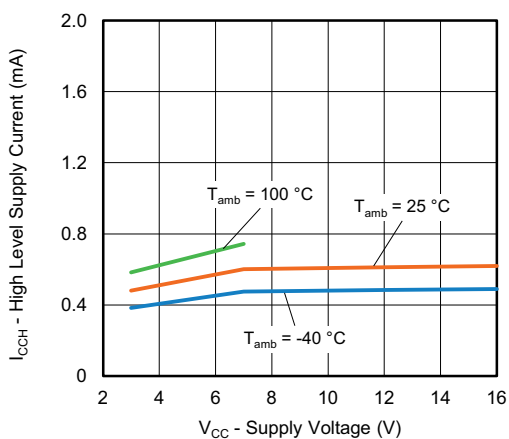


Fig. 12 - High Level Supply Current vs. Supply Voltage

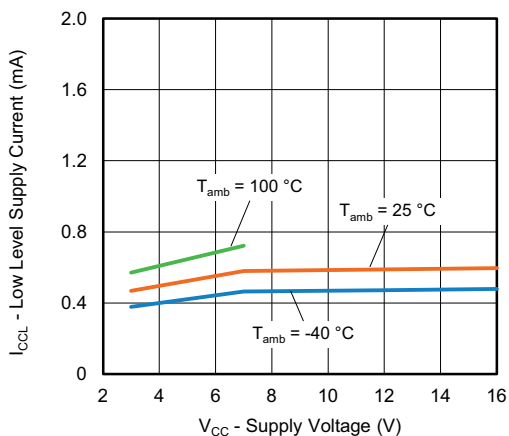


Fig. 13 - Low Level Supply Current vs. Supply Voltage



## PACKAGE DIMENSIONS (in millimeters)

### DIP-6

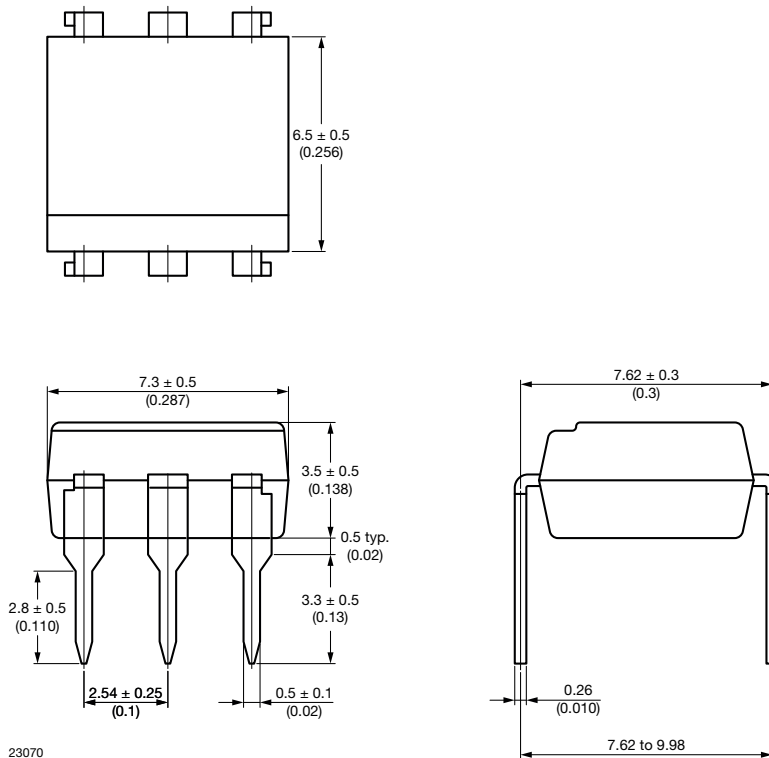


Fig. 1

### DIP-6, 400 mil

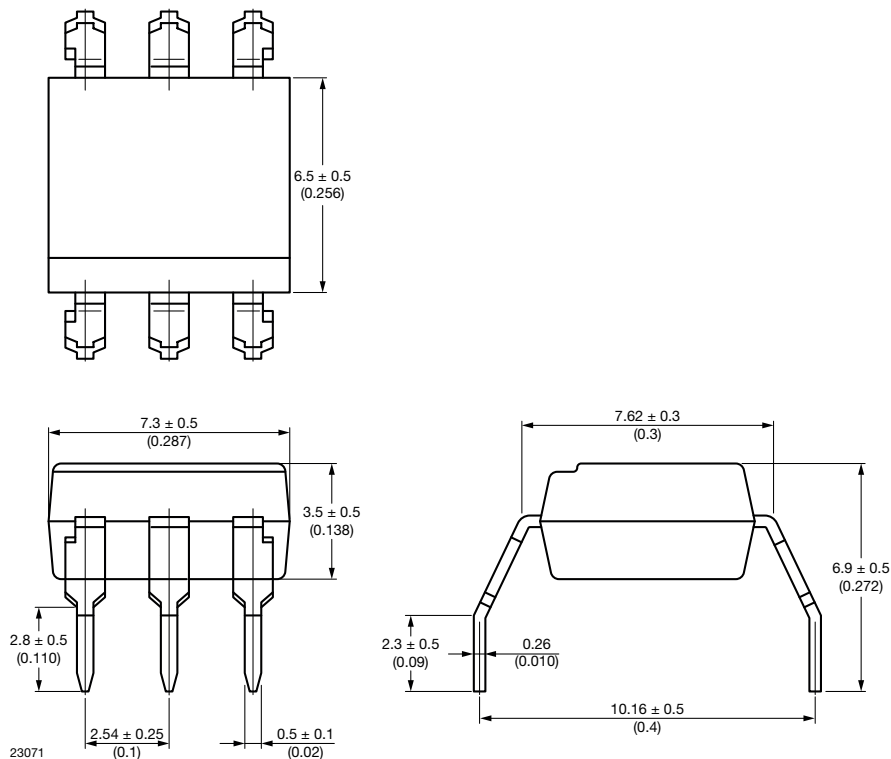


Fig. 2



## SMD-6

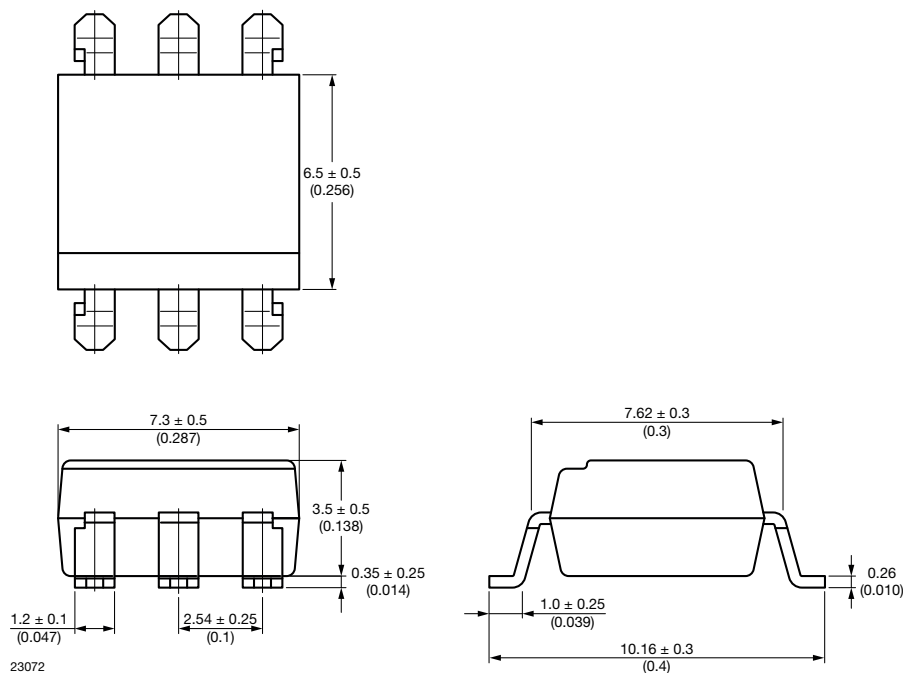


Fig. 3

## PACKAGE MARKING

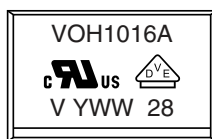


Fig. 14 - Example of VOH1016AB-VT

## Notes

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


**PACKING INFORMATION** (in millimeters)

| DEVICES PER TUBES |            |           |           |
|-------------------|------------|-----------|-----------|
| TYPE              | UNITS/TUBE | TUBES/BOX | UNITS/BOX |
| DIP-6             | 50         | 40        | 2000      |
| DIP-6, 400 mil    | 50         | 40        | 2000      |

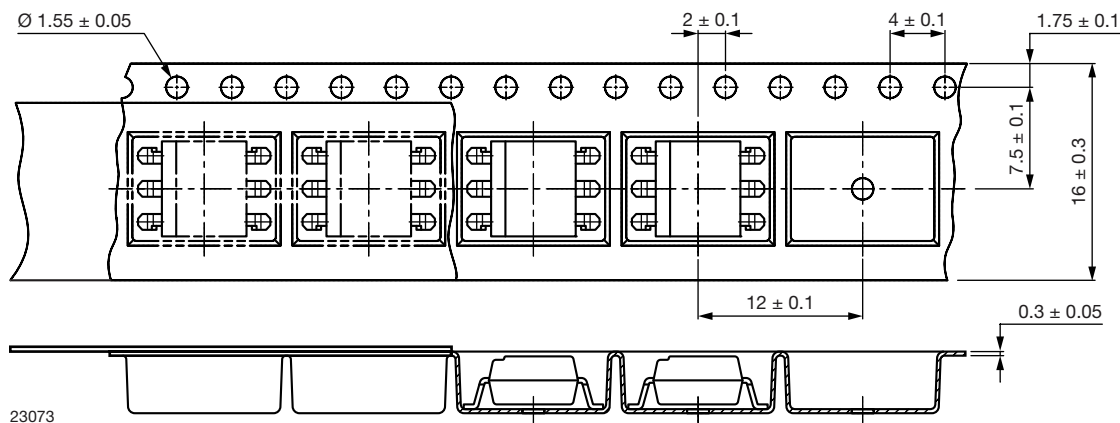
**Tape SMD-6**


Fig. 15 - Tape and Reel Packaging (1000 pieces on reel)

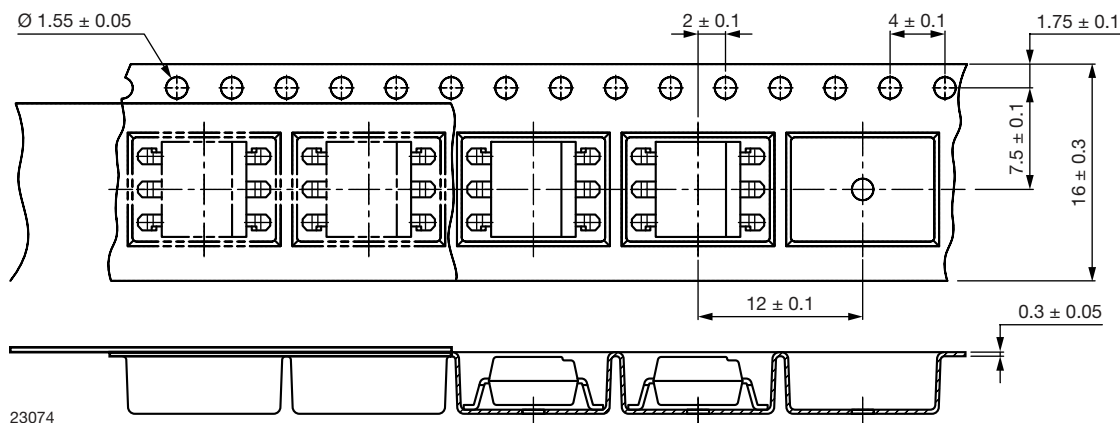
**Tape SMD-6, 180° orientation**


Fig. 16 - Tape and Reel Packaging (1000 pieces on reel)

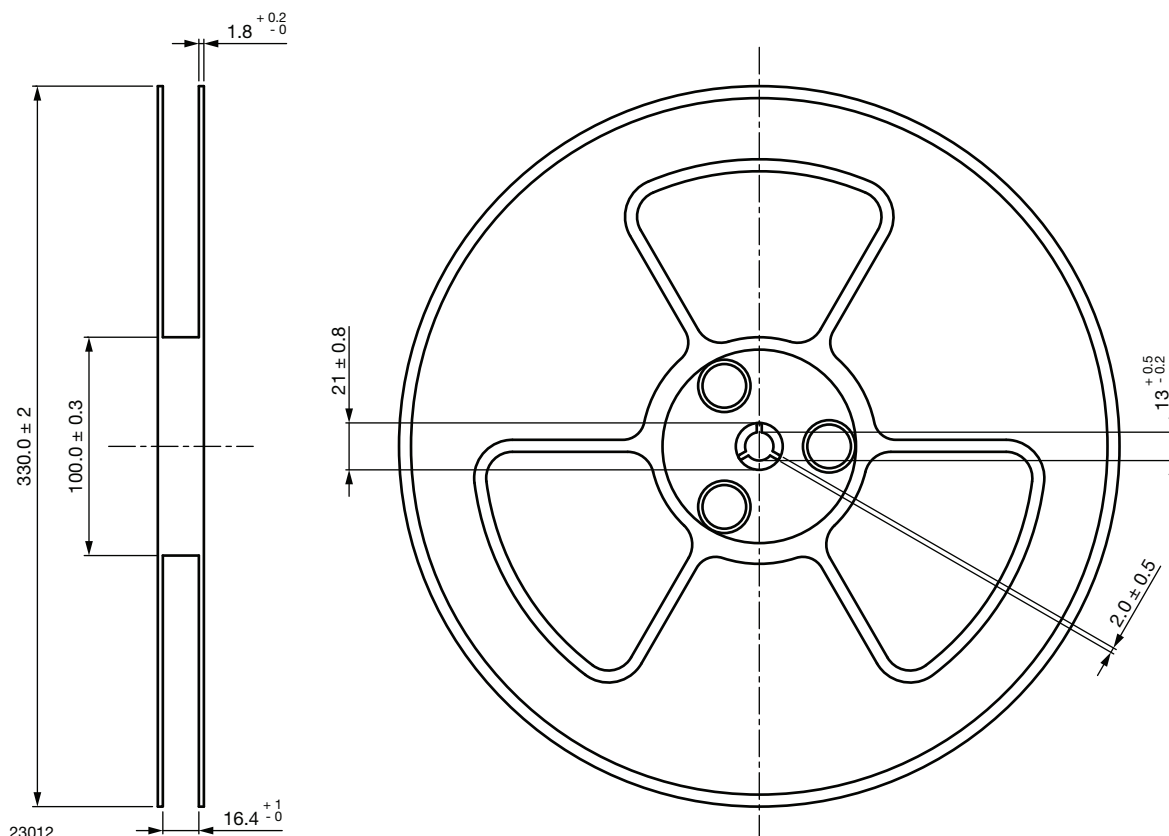
**Reel**


Fig. 17 - 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 ± 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 |

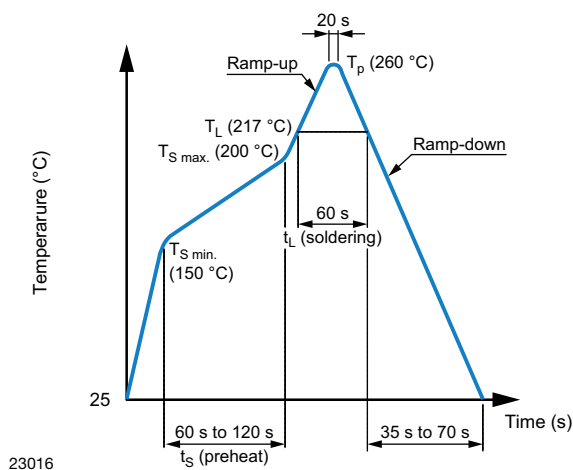


Fig. 18



## Wave Soldering (JEDEC JESD22-A111 compliant)

One time soldering is recommended within the condition of temperature.

Temperature:  $260\text{ }^{\circ}\text{C} + 0\text{ }^{\circ}\text{C} / - 5\text{ }^{\circ}\text{C}$

Time: 10 s

Preheat temperature:  $25\text{ }^{\circ}\text{C}$  to  $140\text{ }^{\circ}\text{C}$

Preheat time: 30 s to 80 s

## Hand Soldering by Soldering Iron

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

Temperature:  $380\text{ }^{\circ}\text{C} + 0\text{ }^{\circ}\text{C} / - 5\text{ }^{\circ}\text{C}$

Time: 3 s max.

## HANDLING AND STORAGE CONDITIONS

ESD level: HBM class 2

Floor life: unlimited

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

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

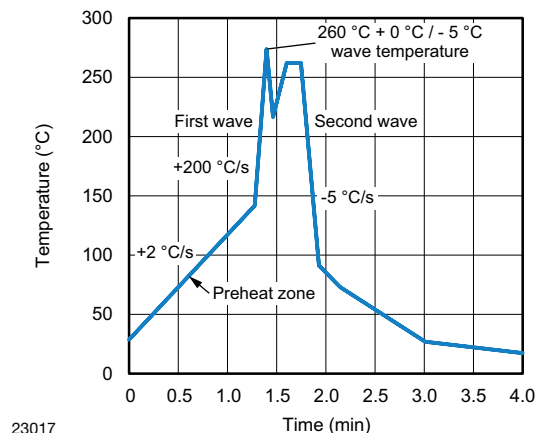


Fig. 19



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