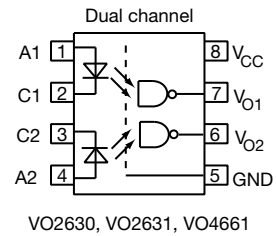
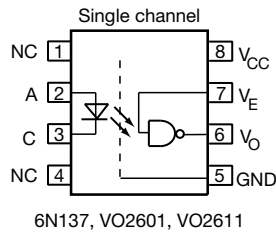


High Speed Optocoupler, Single and Dual, 10 MBd



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.

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
- Meets IEC 60068-2-42 (SO₂) and IEC 60068-2-43 (H₂S) requirements
- Low input current capability of 5 mA
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912



RoHS COMPLIANT

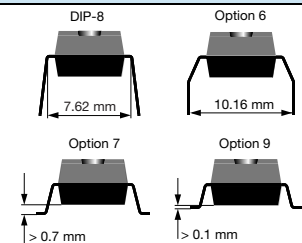
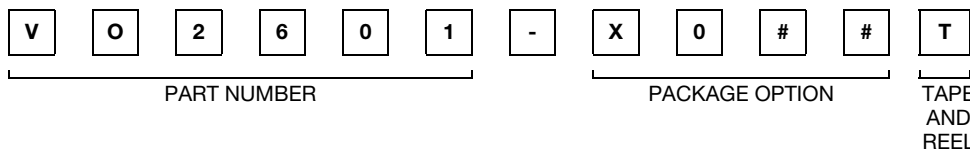
APPLICATIONS

- 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

ORDERING INFORMATION



| AGENCY CERTIFIED/PACKAGE | CHANNELS 1 | | | CHANNELS 2 | | |
|---------------------------|-------------|--------------|---------------|--------------|--------------|---------------|
| | CMR (V/μs) | | | CMR (V/μs) | | |
| | 1000 | 5000 | 15 000 | 1000 | 5000 | 15 000 |
| BSI, UL, cUL | | | | | | |
| 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 °C, unless otherwise specified) | | | | |
|---|---------------|-------------------|-------------------------|------|
| PARAMETER | CONDITIONS | SYMBOL | VALUE | UNIT |
| INPUT | | | | |
| 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 V | V |
| Enable input current | | I _E | 5 | mA |
| Surge current | t = 100 μs | 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 |
| OUTPUT | | | | |
| 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 |
| COUPLER | | | | |
| Storage temperature | | T _{stg} | -55 to +150 | °C |
| Operating temperature | | T _{amb} | -40 to +100 | °C |
| Lead solder temperature | for 10 s | | 260 | °C |
| Solder reflow temperature | | | 260 | °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.

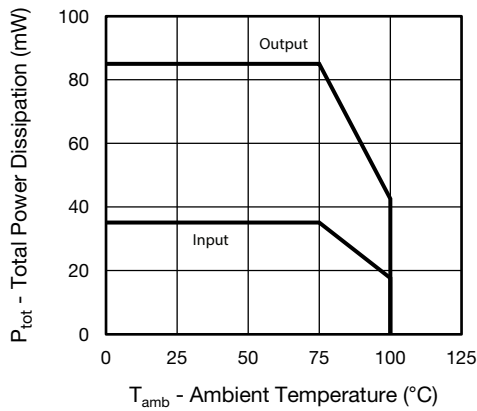


Fig. 1 - Total Power Dissipation vs. Ambient Temperature (single channel)

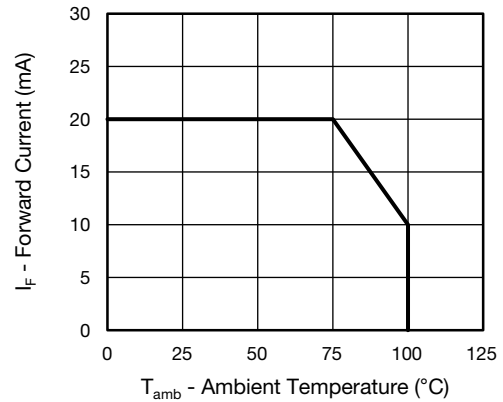


Fig. 3 - Forward Current vs. Ambient Temperature (single channel)

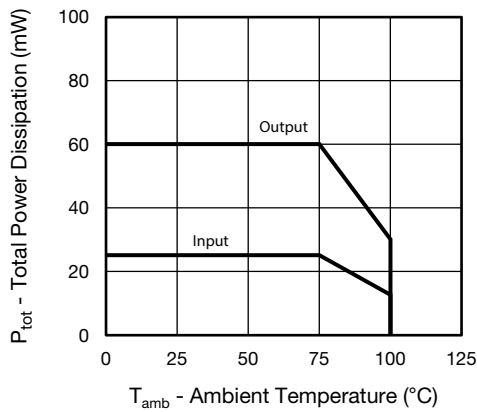


Fig. 2 - Total Power Dissipation vs. Ambient Temperature (dual channel)

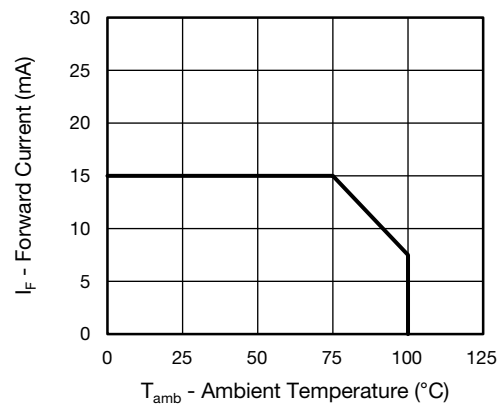


Fig. 4 - Forward Current vs. Ambient Temperature (dual channel)

| RECOMMENDED OPERATING CONDITIONS | | | | | |
|----------------------------------|-----------------------|------------------|------|-----------------|------|
| PARAMETER | TEST CONDITION | 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 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 | Ω |
| Fanout | R _L = 1 kΩ | N | - | 5 | - |



| ELECTRICAL CHARACTERISTICS ($T_{amb} = 25\text{ }^{\circ}\text{C}$, unless otherwise specified) | | | | | | |
|--|--|-----------|------|-------|------|---------------|
| PARAMETER | TEST CONDITION | SYMBOL | MIN. | TYP. | MAX. | UNIT |
| INPUT | | | | | | |
| 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 | μA |
| Input capacitance | $f = 1\text{ MHz}, V_F = 0\text{ V}$ | C_I | - | 55 | - | pF |
| OUTPUT | | | | | | |
| 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 | μA |
| 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.

| SWITCHING CHARACTERISTICS | | | | | | |
|--|---|-----------------------|------|------|-------------------|------|
| 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 ⁽¹⁾ | 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 ⁽¹⁾ | 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 $T_{amb} = 25\text{ }^{\circ}\text{C}, V_{CC} = 5\text{ V}$.
- (1) 75 ns applies to the 6N137 only, a JEDEC® registered specification

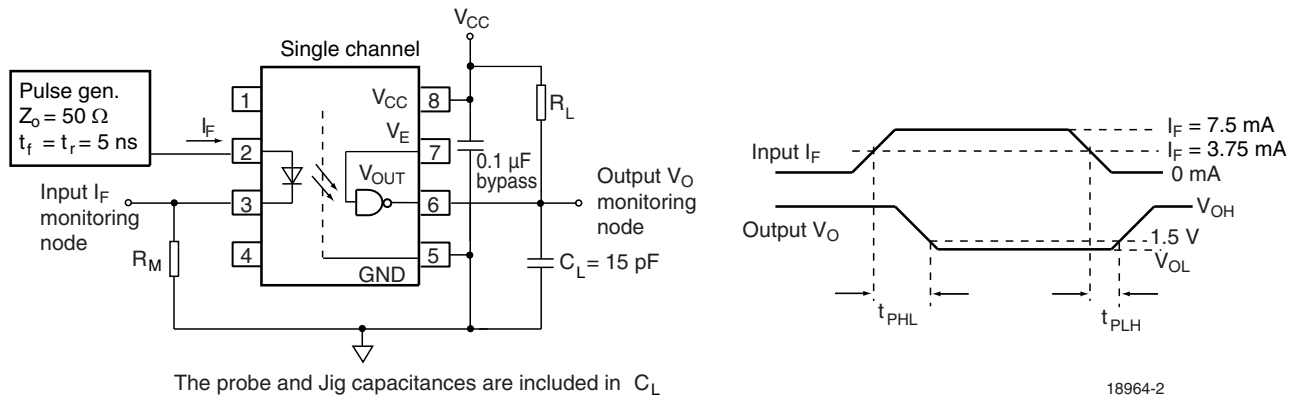


Fig. 5 - Single Channel Test Circuit for t_{PLH} , t_{PHL} , t_r and t_f

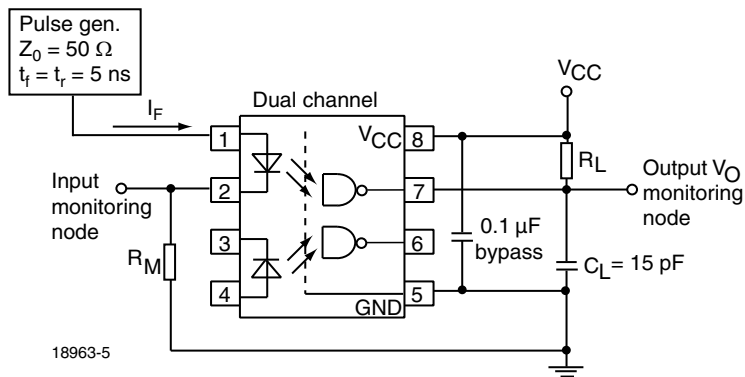


Fig. 6 - Dual Channel Test Circuit for t_{PLH} , t_{PHL} , t_r and t_f

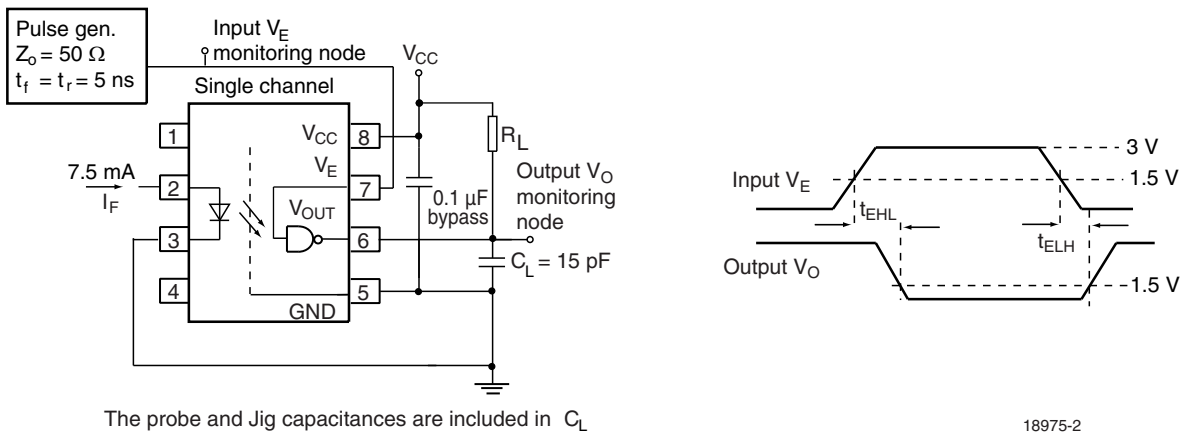


Fig. 7 - Single Channel Test Circuit for t_{EHL} and t_{ELH}

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

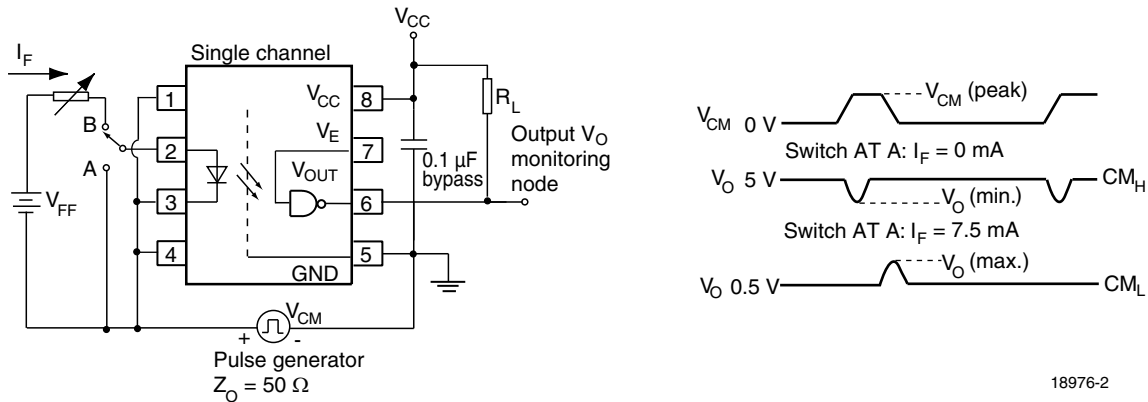


Fig. 8 - Single Channel Test Circuit for Common Mode Transient Immunity

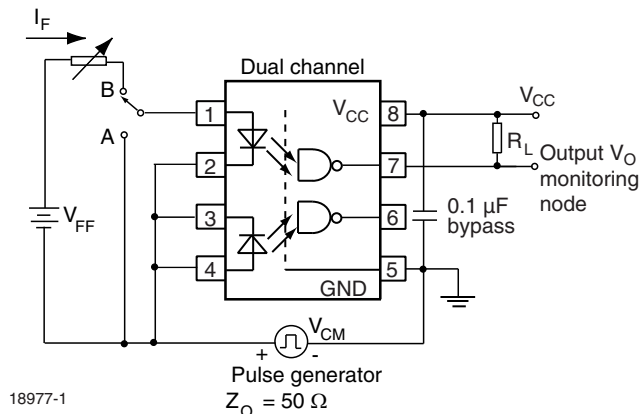


Fig. 9 - Dual Channel Test Circuit for Common Mode Transient Immunity



| SAFETY AND INSULATION RATINGS | | | | |
|--|--|-------------------|--------------------|-------------------|
| PARAMETER | TEST CONDITION | SYMBOL | VALUE | UNIT |
| Climatic classification | According to IEC 68 part 1 | | 55 / 100 / 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 _{ISO} | 5300 | V _{RMS} |
| Maximum transient isolation voltage | According to DIN EN 60747-5-5 | V _{IOTM} | 8000 | V _{peak} |
| Maximum repetitive peak isolation voltage | According to DIN EN 60747-5-5 | V _{IORM} | 890 | V _{peak} |
| Isolation resistance | T _{amb} = 25 °C, V _{IO} = 500 V | R _{IO} | ≥ 10 ¹² | Ω |
| | T _{amb} = 100 °C, V _{IO} = 500 V | R _{IO} | ≥ 10 ¹¹ | Ω |
| Output safety power | | P _{SO} | 500 | mW |
| Input safety current | | I _{SI} | 300 | mA |
| Input safety temperature | | T _S | 175 | °C |
| Creepage distance | DIP-8 | | ≥ 7 | mm |
| Clearance distance | | | ≥ 7 | mm |
| Creepage distance | DIP-8, 400 mil (option 6) | | ≥ 8 | mm |
| Clearance distance | | | ≥ 8 | mm |
| Creepage distance | SMD-8 (option 7) | | ≥ 8 | mm |
| Clearance distance | | | ≥ 8 | mm |
| Creepage distance | SMD-8 (option 9) | | ≥ 8 | mm |
| Clearance distance | | | ≥ 8 | mm |
| Insulation thickness | | DTI | ≥ 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_{amb} = 25 °C, unless otherwise specified)

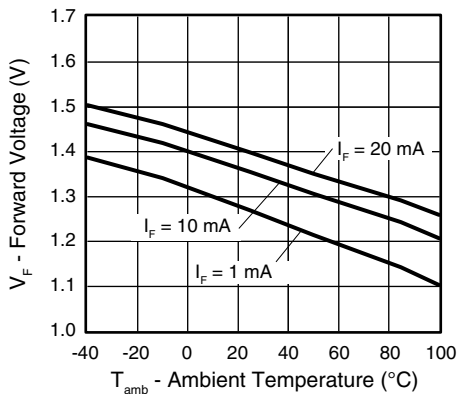


Fig. 10 - Forward Voltage vs. Ambient Temperature



Fig. 11 - Forward Voltage vs. Forward Current



Fig. 12 - Reverse Current vs. Ambient Temperature



Fig. 15 - Input Threshold On Current vs. Ambient Temperature

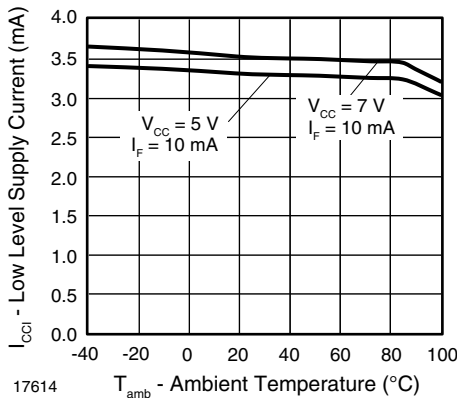


Fig. 13 - Low Level Supply Current vs. Ambient Temperature

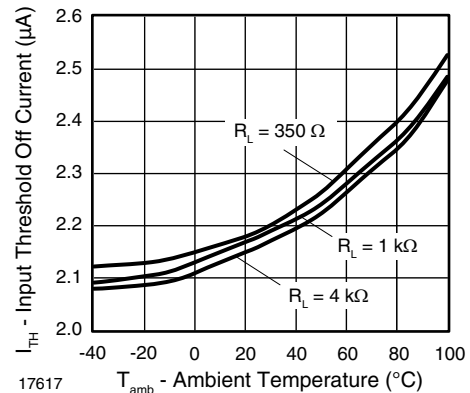


Fig. 16 - Input Threshold Off Current vs. Ambient Temperature

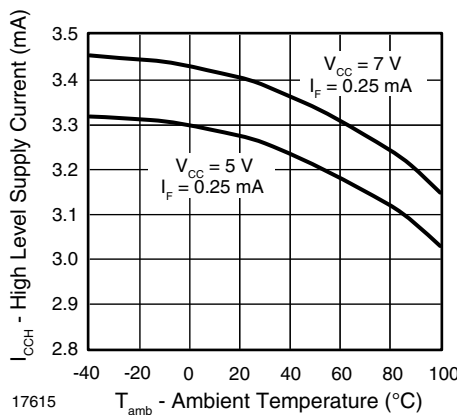


Fig. 14 - High Level Supply Current vs. Ambient Temperature

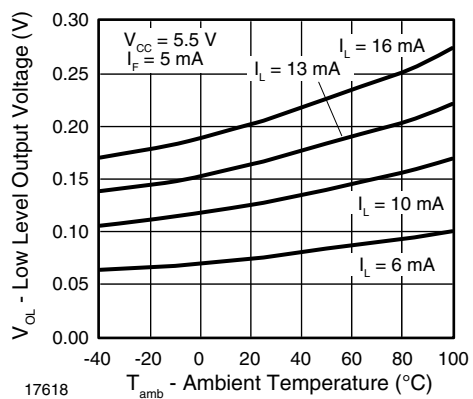


Fig. 17 - Low Level Output Voltage vs. Ambient Temperature

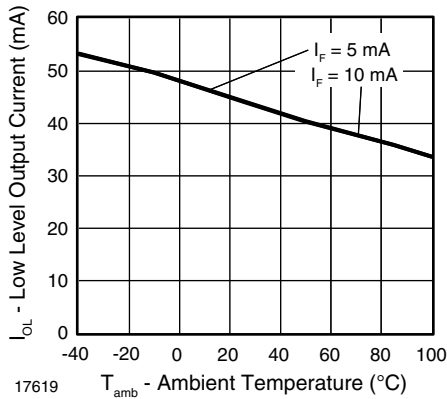


Fig. 18 - Low Level Output Current vs. Ambient Temperature

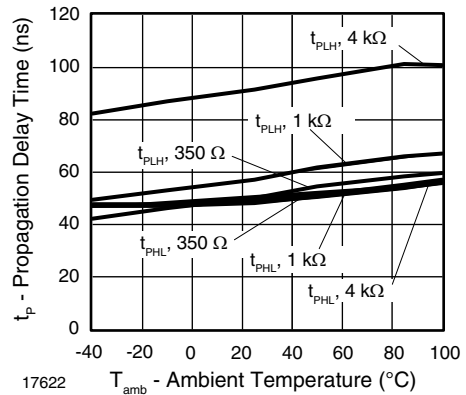


Fig. 21 - Propagation Delay vs. Ambient Temperature

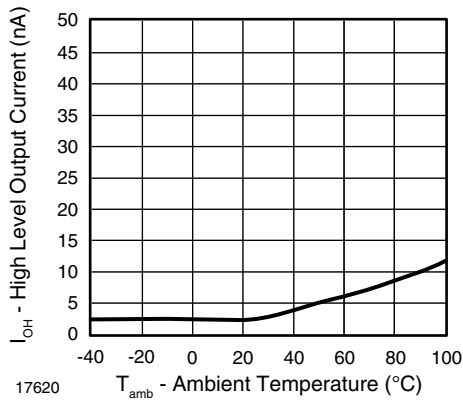


Fig. 19 - High Level Output Current vs. Ambient Temperature

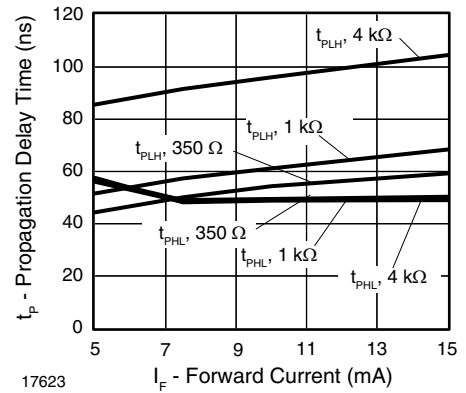


Fig. 22 - Propagation Delay vs. Forward Current

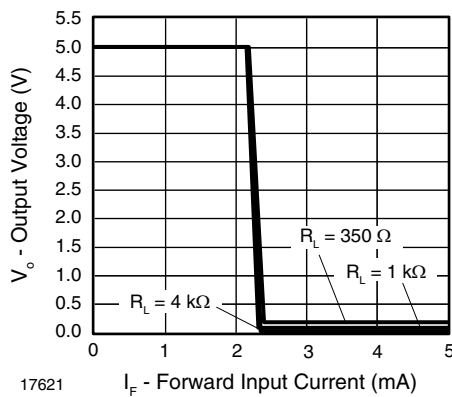


Fig. 20 - Output Voltage vs. Forward Input Current

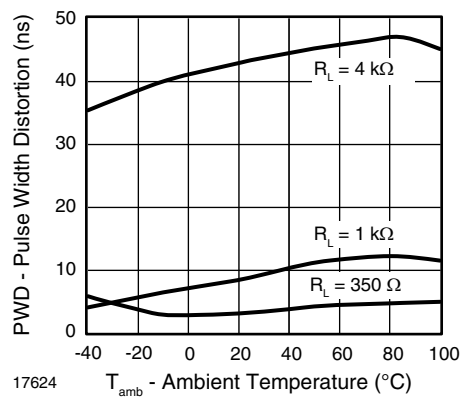


Fig. 23 - Pulse Width Distortion vs. Ambient Temperature

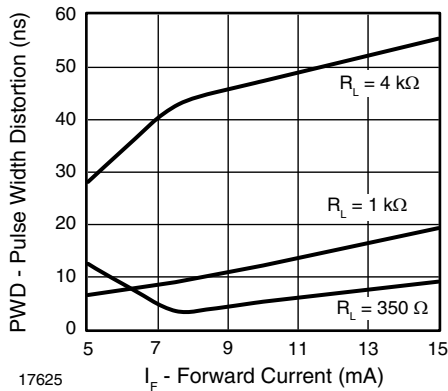


Fig. 24 - Pulse Width Distortion vs. Forward Current

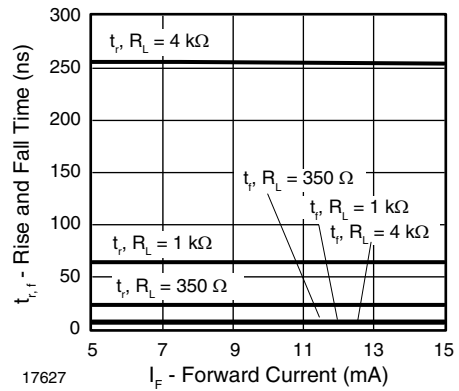


Fig. 26 - Rise and Fall Time vs. Forward Current

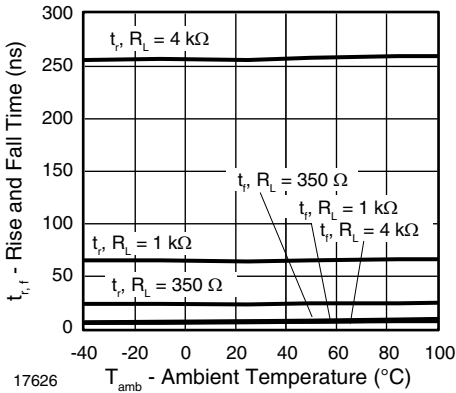


Fig. 25 - Rise and Fall Time vs. Ambient Temperature

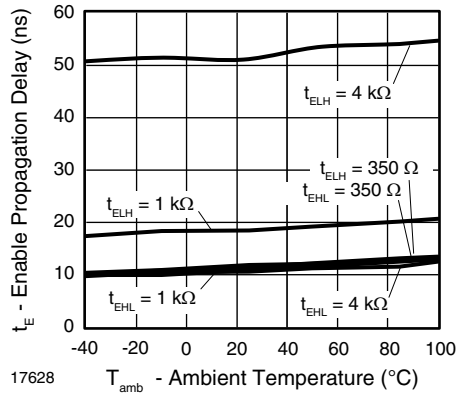
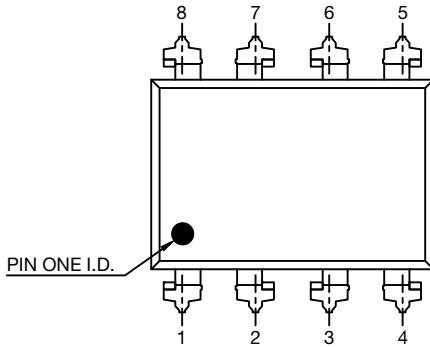
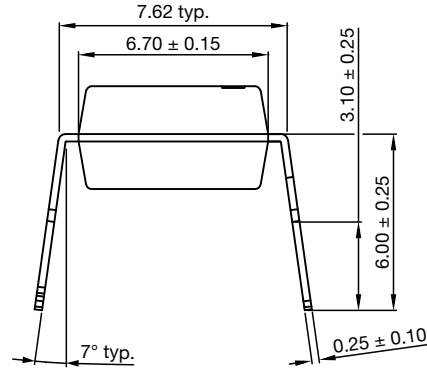
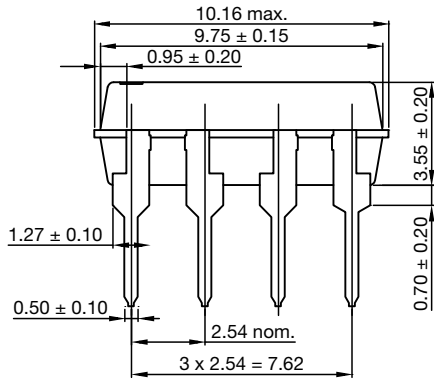


Fig. 27 - Enable Propagation Delay vs. Ambient Temperature

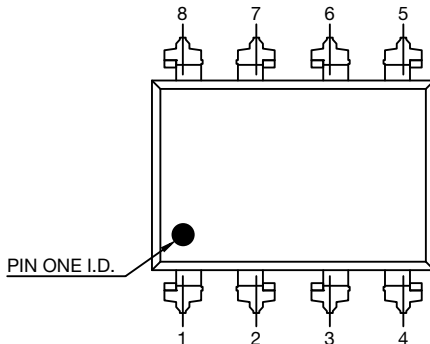
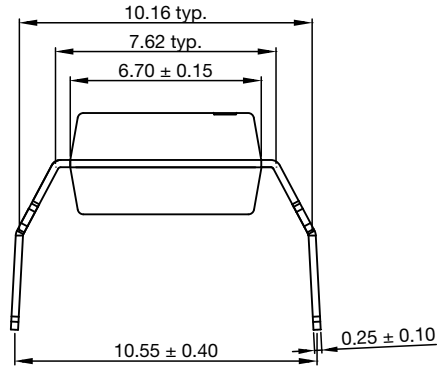
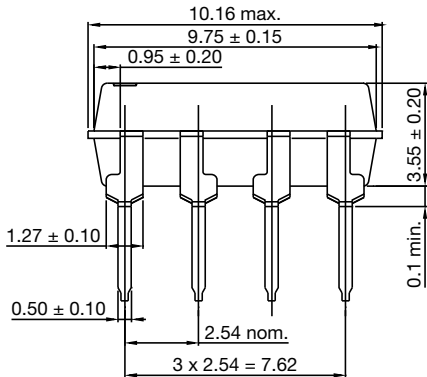


PACKAGE DIMENSIONS (in millimeters)

DIP-8

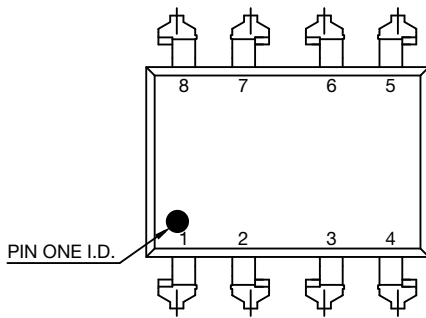
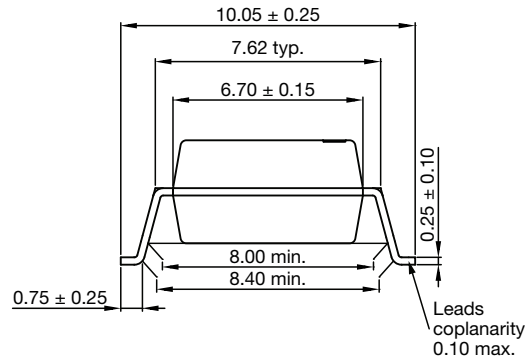


DIP-8, 400 mil (option 6)

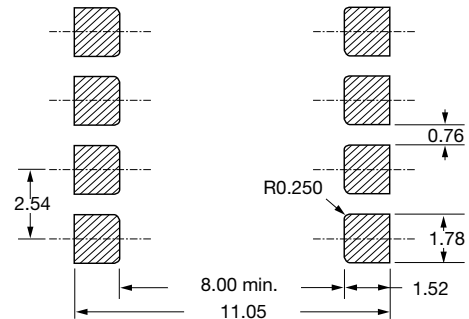




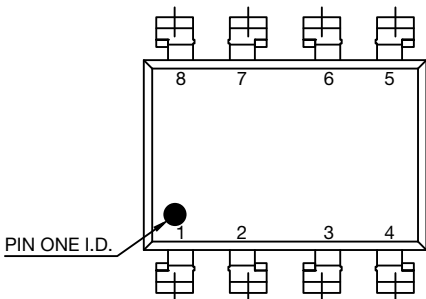
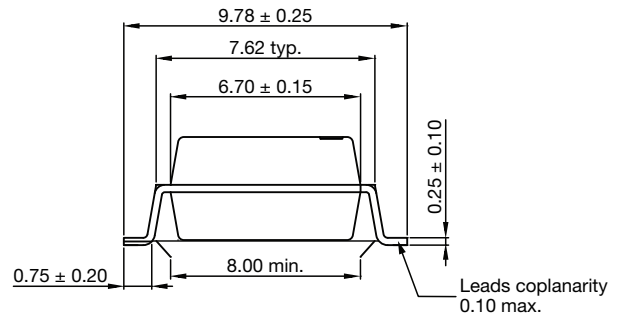
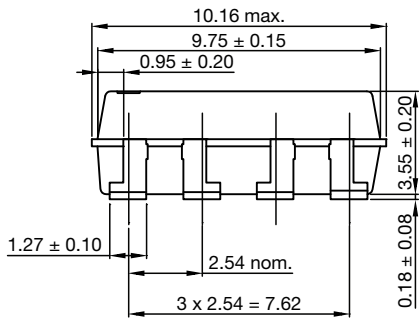
SMD-8 (option 7)



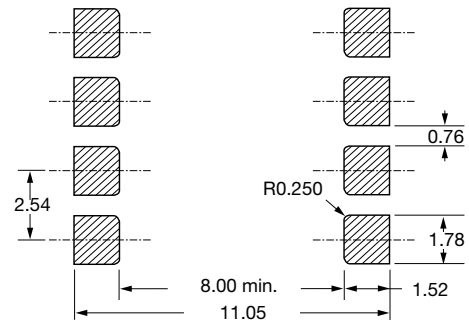
Recommended Footprint



SMD-8 (option 9)



Recommended Footprint



PACKAGE MARKING

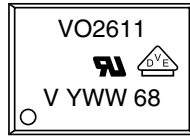


Fig. 28 - Example of VO2611-X017T

Notes

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

PACKING INFORMATION (in millimeters)

Tube

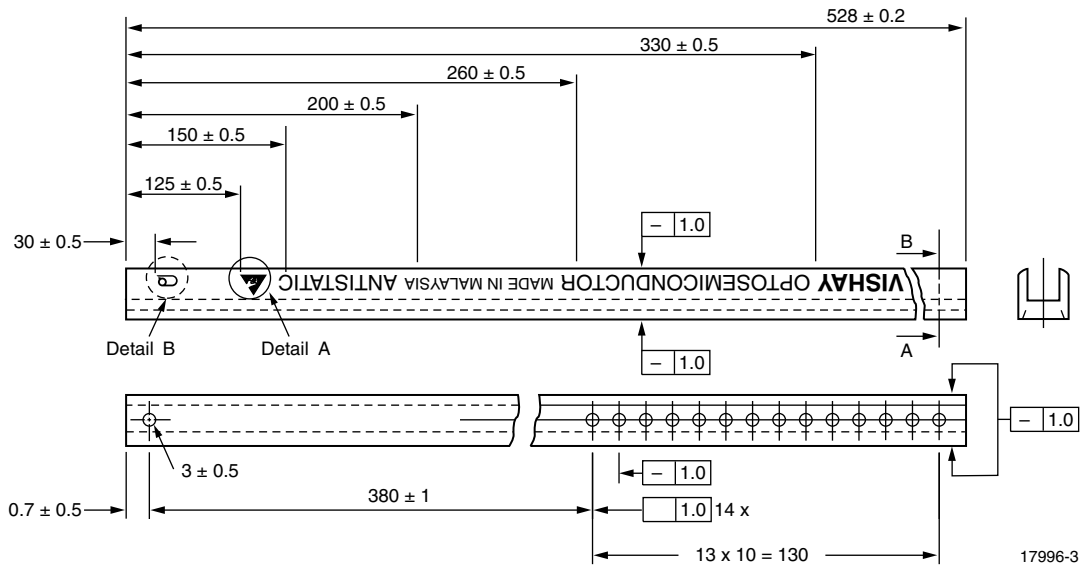


Fig. 29 - Shipping Tube Specifications for DIP-8 Packages

| DEVICES PER TUBS | | | |
|------------------|------------|-----------|-----------|
| TYPE | UNITS/TUBE | TUBES/BOX | UNITS/BOX |
| DIP-8 | 50 | 40 | 2000 |

DIP-8

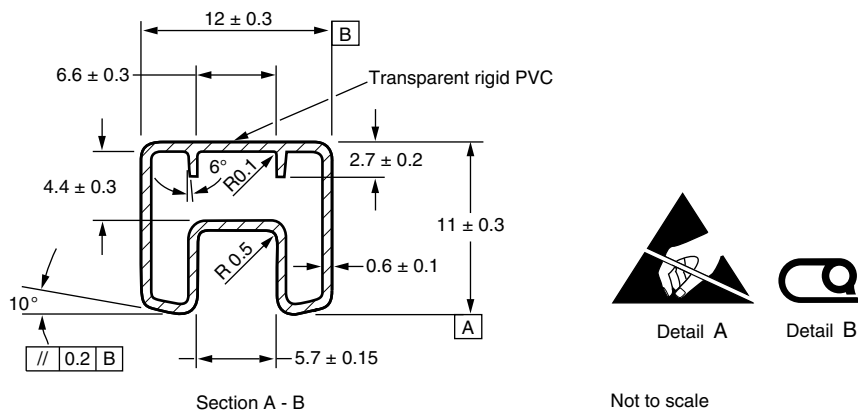


Fig. 30 - Tube Shipping Medium

DIP-8, 400 mil (option 6)

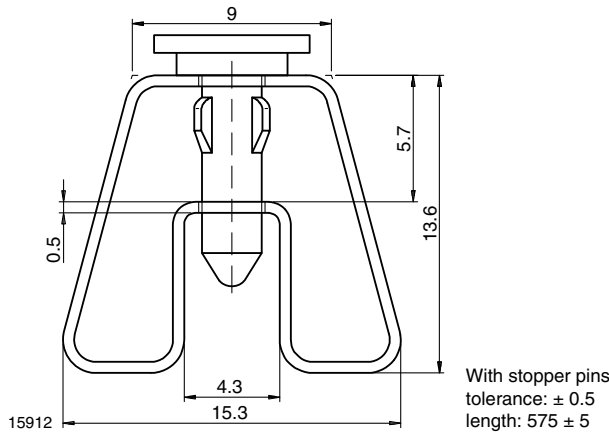


Fig. 31 - Tube Shipping Medium

Tape and Reel

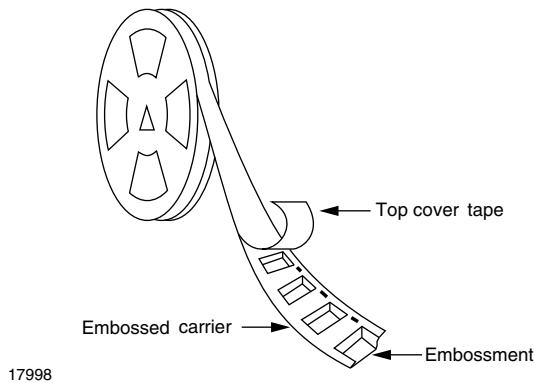


Fig. 32 - Tape and Reel Shipping Medium

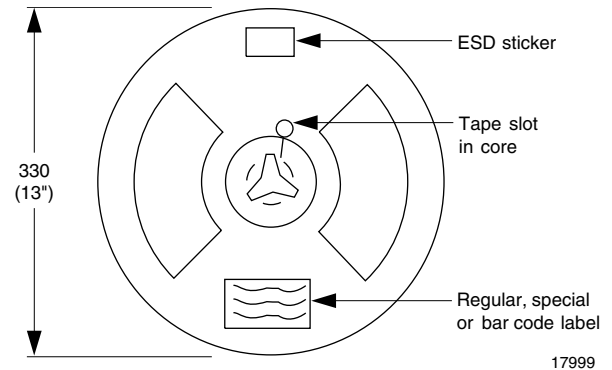


Fig. 33 - Tape and Reel Shipping Medium

SMD-8 (option 7)

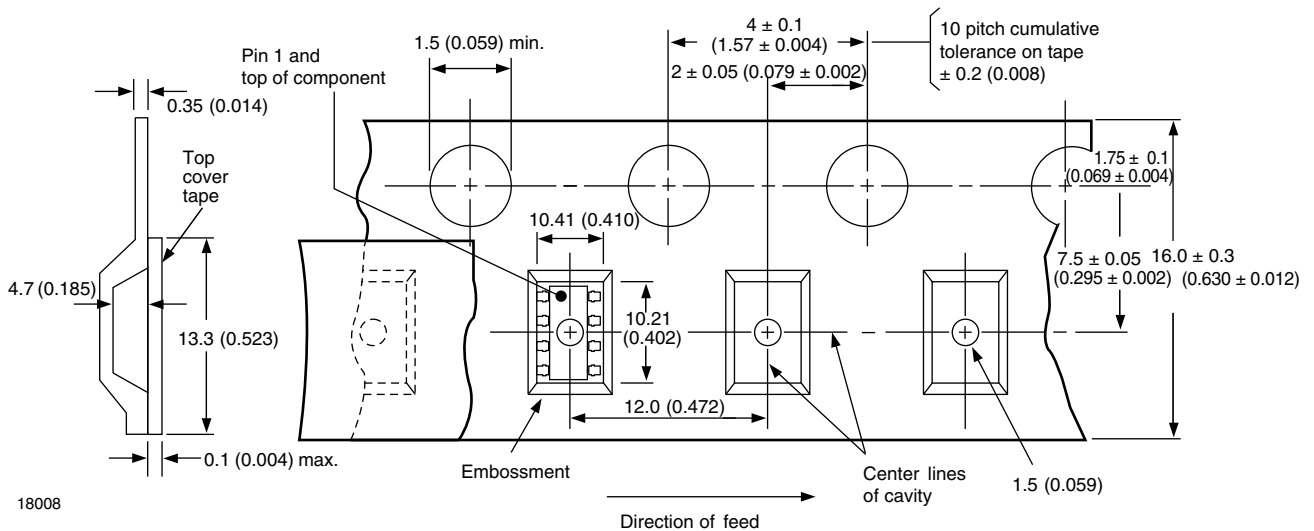


Fig. 34 - Tape and Reel Packing (1000 pieces on Reel)

SMD-8 (option 9)

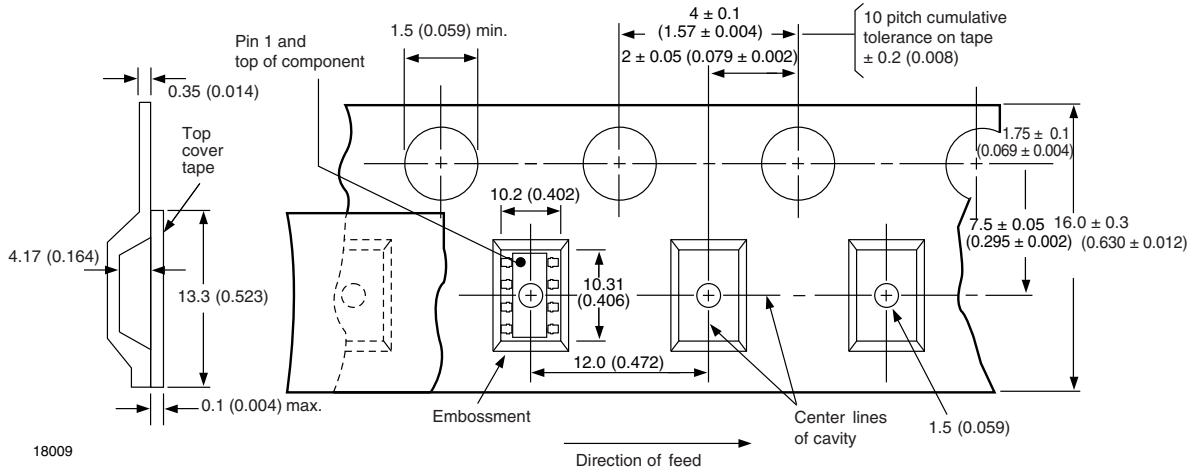


Fig. 35 - Tape and Reel Shipping Medium

SOLDER PROFILES

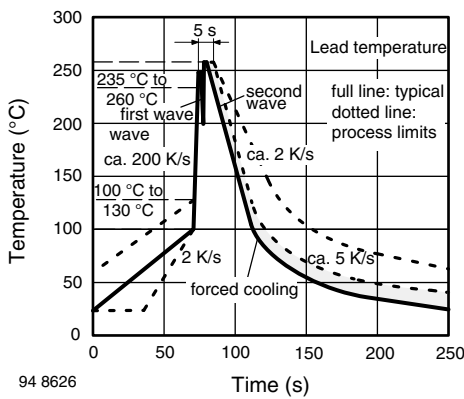


Fig. 36 - Wave Soldering Double Wave Profile According to J-STD-020 for DIP Devices

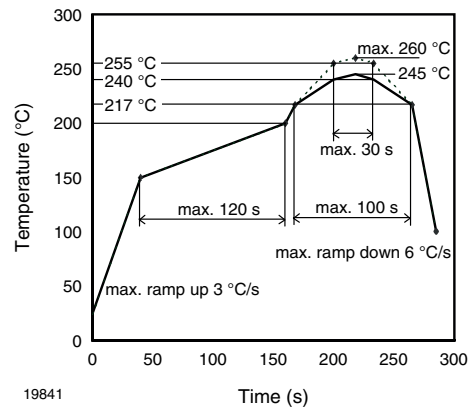


Fig. 37 - Lead (Pb)-free Reflow Solder Profile According to J-STD-020 for SMD Devices

HANDLING AND STORAGE CONDITIONS

ESD level: HBM class 2

Floor life: unlimited

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

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



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