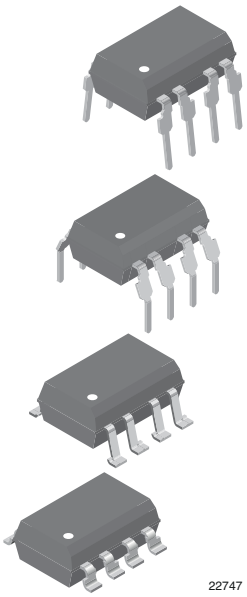
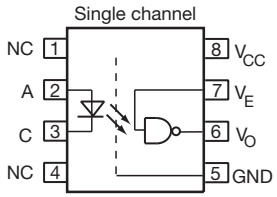
# 6N137, VO2601, VO2611, VO2630, VO2631, VO4661

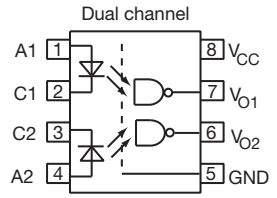
## High Speed Optocoupler, Single and Dual, 10 MBd



22747




6N137, VO2601, VO2611




VO2630, VO2631, VO4661

### 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 ($SO_2$) and IEC 60068-2-43 ($H_2S$) requirements
- Low input current capability of 5 mA
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free

e3

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

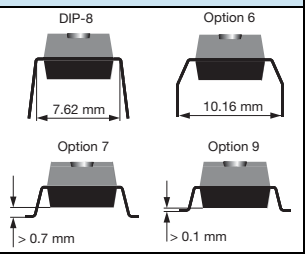
### DESCRIPTION

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

| V | O | 2 | 6 | 0 | 1 | - | X | 0 | # | # | T |
|---|---|---|---|---|---|---|---|---|---|---|---|

PART NUMBER — PACKAGE OPTION — TAPE AND REEL




| 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 °C, unless otherwise specified) | | | | |
|---|---|---|---|---|
| **PARAMETER** | **TEST CONDITION** | **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.

| **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 °C, unless otherwise specified) | | | | | | |
|---|---|---|---|---|---|---|
| **PARAMETER** | **TEST CONDITION** | **SYMBOL** | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| **INPUT** | | | | | | |
| Input forward voltage | $I_F$ = 10 mA | $V_F$ | 1.1 | 1.4 | 1.7 | V |
| Reverse current | $V_R$ = 5 V | $I_R$ | | 0.01 | 10 | µA |
| Input capacitance | f = 1 MHz, $V_F$ = 0 V | $C_I$ | | 55 | | pF |
| **OUTPUT** | | | | | | |
| High level supply current (single channel) | $V_E$ = 0.5 V, $I_F$ = 0 mA | $I_{CCH}$ | | 4.1 | 7 | mA |
| | $V_E$ = $V_{CC}$, $I_F$ = 0 mA | $I_{CCH}$ | | 3.3 | 6 | mA |
| High level supply current (dual channel) | $I_F$ = 0 mA | $I_{CCH}$ | | 6.5 | 12 | mA |
| Low level supply current (single channel) | $V_E$ = 0.5 V, $I_F$ = 10 mA | $I_{CCL}$ | | 4 | 7 | mA |
| | $V_E$ = $V_{CC}$, $I_F$ = 10 mA | $I_{CCL}$ | | 3.3 | 6 | mA |
| Low level supply current (dual channel) | $I_F$ = 10 mA | $I_{CCL}$ | | 6.5 | 12 | mA |
| High level output current | $V_E$ = 2 V, $V_{CC}$ = 5.5 V, $I_F$ = 250 µA | $I_{OH}$ | | 0.002 | 1 | µA |
| Low level output voltage | $V_E$ = 2 V, $I_F$ = 5 mA, $I_{OL}$ (sinking) = 13 mA | $V_{OL}$ | | 0.2 | 0.6 | V |
| Input threshold current | $V_E$ = 2 V, $V_{CC}$ = 5.5 V, $I_{OL}$ (sinking) = 13 mA | $I_{TH}$ | | 2.4 | 5 | mA |
| High level enable current | $V_E$ = 2 V | $I_{EH}$ | | -0.6 | -1.6 | mA |
| Low level enable current | $V_E$ = 0.5 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 Ω, $C_L$ = 15 pF | $t_{PLH}$ | 20 | 48 | 75 (1) | ns |
| | | $t_{PLH}$ | | | 100 | ns |
| Propagation delay time to low output level | $R_L$ = 350 Ω, $C_L$ = 15 pF | $t_{PHL}$ | 25 | 50 | 75 (1) | ns |
| | | $t_{PHL}$ | | | 100 | ns |
| Pulse width disortion | $R_L$ = 350 Ω, $C_L$ = 15 pF | $\|t_{PHL} - t_{PLH}\|$ | | 2.9 | 35 | ns |
| Propagation delay skew | $R_L$ = 350 Ω, $C_L$ = 15 pF | $t_{PSK}$ | | 8 | 40 | ns |
| Output rise time (10 % to 90 %) | $R_L$ = 350 Ω, $C_L$ = 15 pF | $t_r$ | | 23 | | ns |
| Output fall time (90 % to 10 %) | $R_L$ = 350 Ω, $C_L$ = 15 pF | $t_f$ | | 7 | | ns |
| Propagation delay time of enable from $V_{EH}$ to $V_{EL}$ | $R_L$ = 350 Ω, $C_L$ = 15 pF, $V_{EL}$ = 0 V, $V_{EH}$ = 3 V | $t_{ELH}$ | | 12 | | ns |
| Propagation delay time of enable from $V_{EL}$ to $V_{EH}$ | $R_L$ = 350 Ω, $C_L$ = 15 pF, $V_{EL}$ = 0 V, $V_{EH}$ = 3 V | $t_{EHL}$ | | 11 | | ns |

**Notes**

- Over recommended temperature ($T_{amb}$ = - 40 °C to + 100 °C), $V_{CC}$ = 5 V, $I_F$ = 7.5 mA unless otherwise specified. All typicals at $T_{amb}$ = 25 °C, $V_{CC}$ = 5 V.

(1) 75 ns applies to the 6N137 only, a JEDEC® registered specification

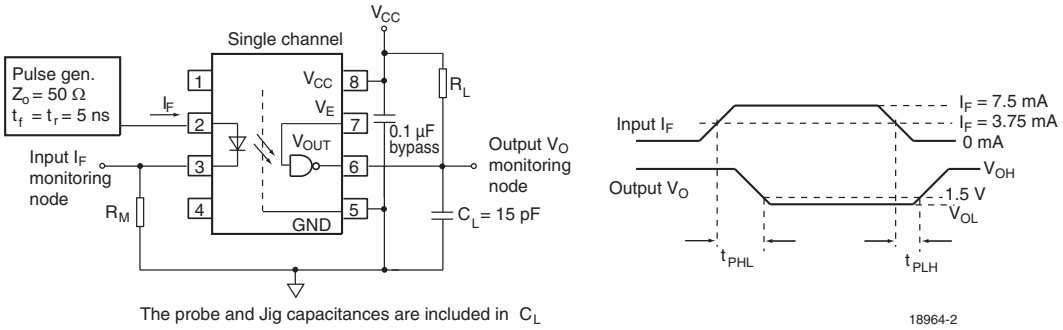



Fig. 1 - Single Channel Test Circuit for $t_{PLH}$, $t_{PHL}$, $t_r$ and $t_f$

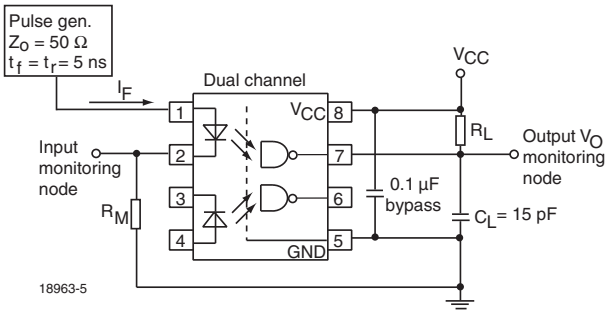



Fig. 2 - Dual Channel Test Circuit for $t_{PLH}$, $t_{PHL}$, $t_r$ and $t_f$

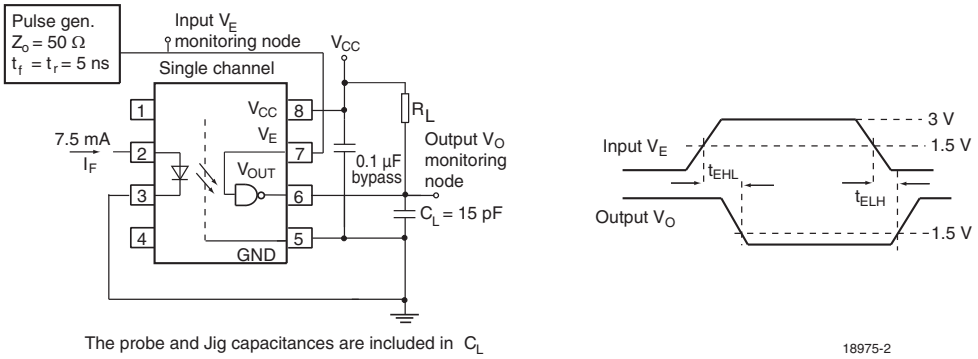



Fig. 3 - Single Channel Test Circuit for $t_{EHL}$, and $t_{ELH}$

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

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

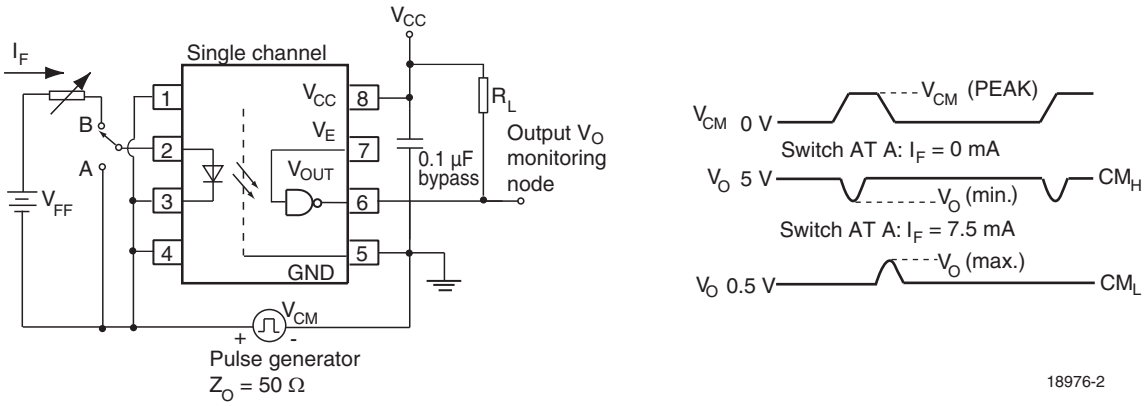



Fig. 4 - Single Channel Test Circuit for Common Mode Transient Immunity

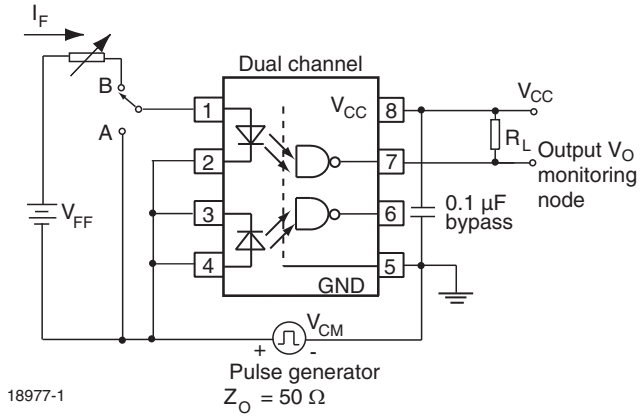



Fig. 5 - Dual Channel Test Circuit for Common Mode Transient Immunity

| 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 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 V, $T_{amb}$ = 25 °C | $R_{IO}$ | ≥ $10^{12}$ | Ω |
| | $V_{IO}$ = 500 V, $T_{amb}$ = 100 °C | $R_{IO}$ | ≥ $10^{11}$ | Ω |
| Output safety power | | $P_{SO}$ | 500 | mW |
| Input safety current | | $I_{SI}$ | 300 | mA |
| Input safety temperature | | $T_{SI}$ | 175 | °C |
| Creepage distance | Standard DIP-4 | | ≥ 8 | mm |
| Clearance distance | Standard DIP-4 | | ≥ 8 | mm |
| Creepage distance | 400 mil DIP-4 | | ≥ 8 | mm |
| Clearance distance | 400 mil DIP-4 | | ≥ 8 | mm |
| Insulation thickness, reinforced rated | per BSI 60950 | 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)

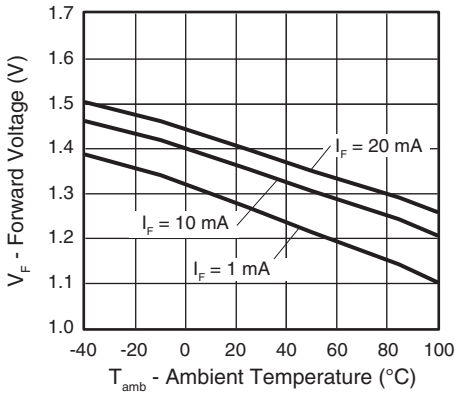



Fig. 6 - Forward Voltage vs. Ambient Temperature

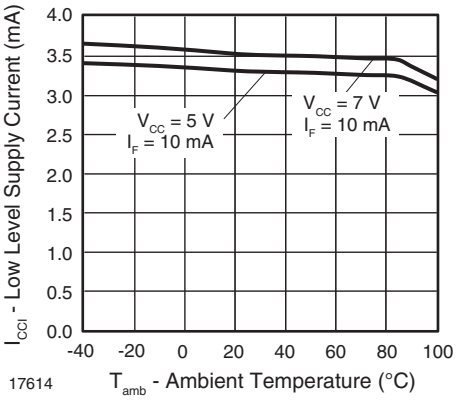



Fig. 9 - Low Level Supply Current vs. Ambient Temperature

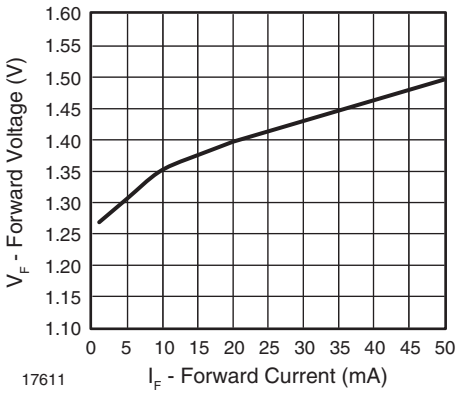



Fig. 7 - Forward Voltage vs. Forward Current

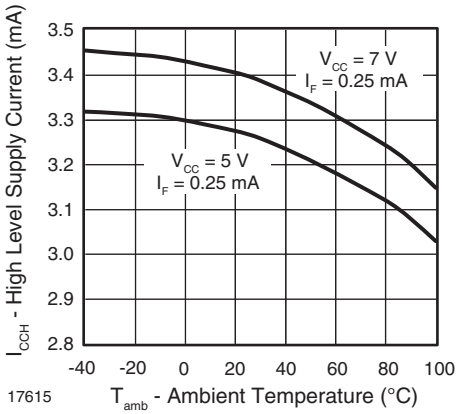



Fig. 10 - High Level Supply Current vs. Ambient Temperature

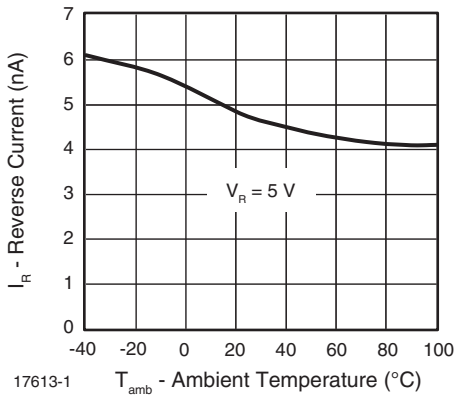



Fig. 8 - Reverse Current vs. Ambient Temperature

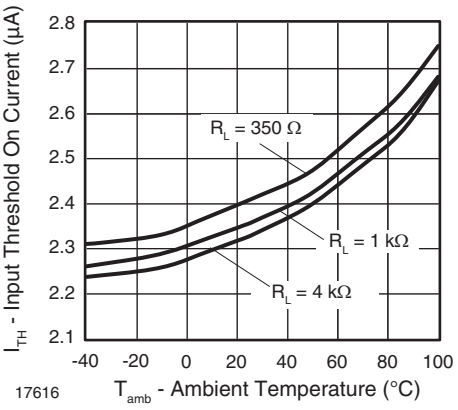



Fig. 11 - Input Threshold On Current vs. Ambient Temperature

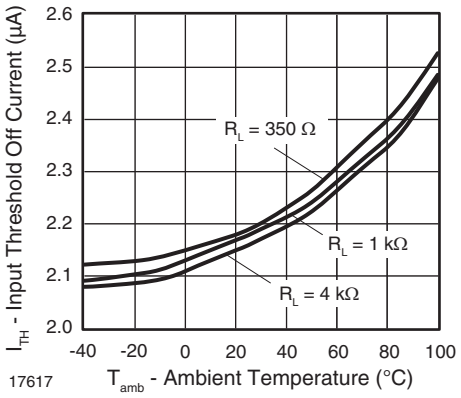



Fig. 12 - Input Threshold Off Current vs. Ambient Temperature

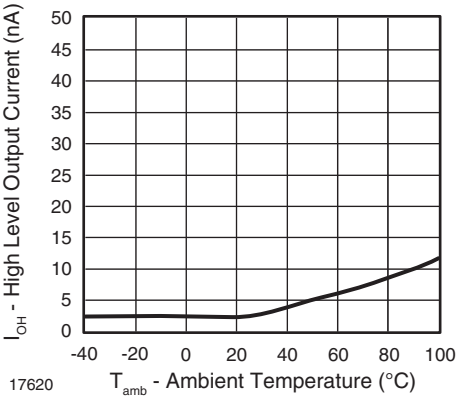



Fig. 15 - High Level Output Current vs. Ambient Temperature

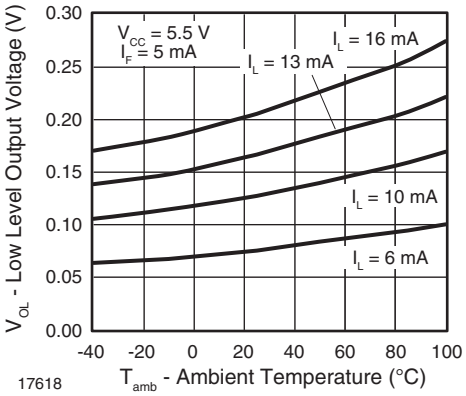



Fig. 13 - Low Level Output Voltage vs. Ambient Temperature

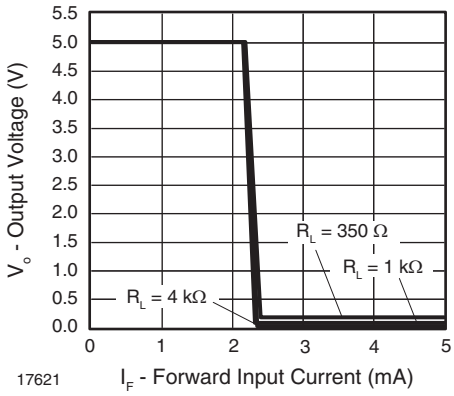



Fig. 16 - Output Voltage vs. Forward Input Current

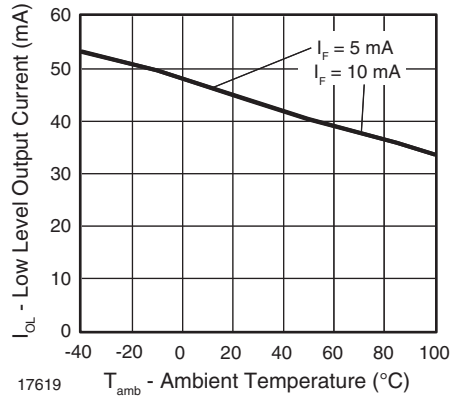



Fig. 14 - Low Level Output Current vs. Ambient Temperature

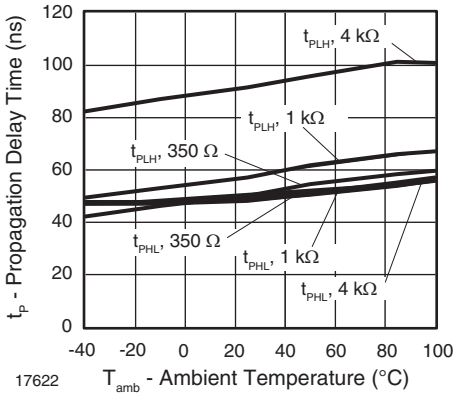



Fig. 17 - Propagation Delay vs. Ambient Temperature

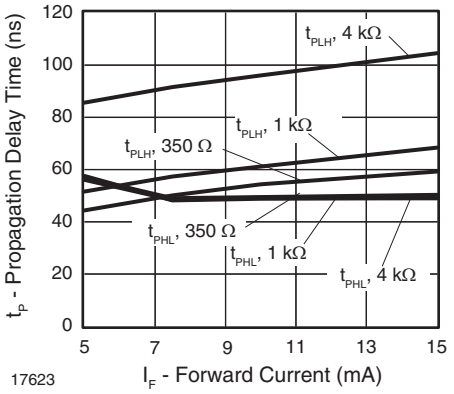



Fig. 18 - Propagation Delay vs. Forward Current

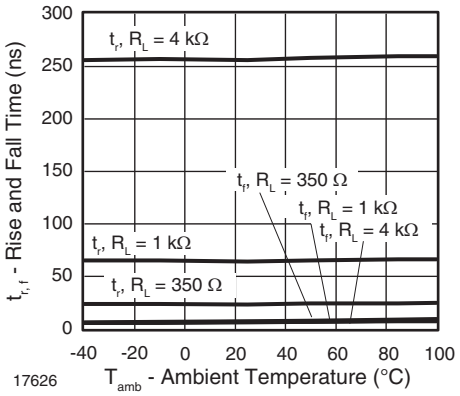



Fig. 21 - Rise and Fall Time vs. Ambient Temperature

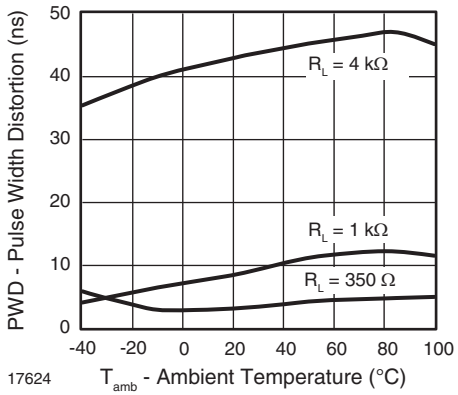



Fig. 19 - Pulse Width Distortion vs. Ambient Temperature

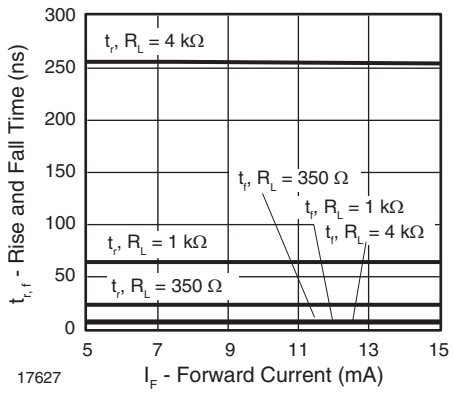



Fig. 22 - Rise and Fall Time vs. Forward Current

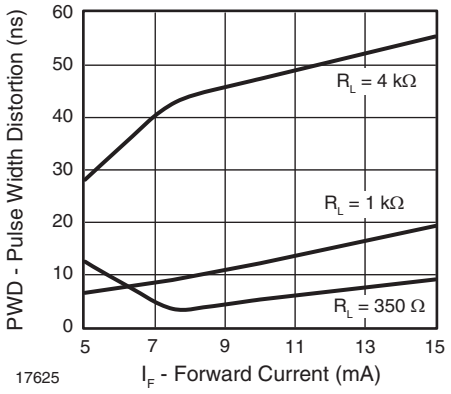



Fig. 20 - Pulse Width Distortion vs. Forward Current

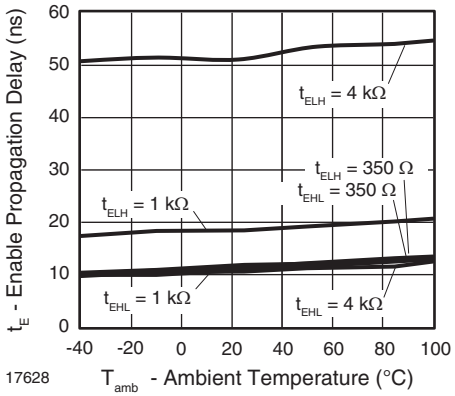
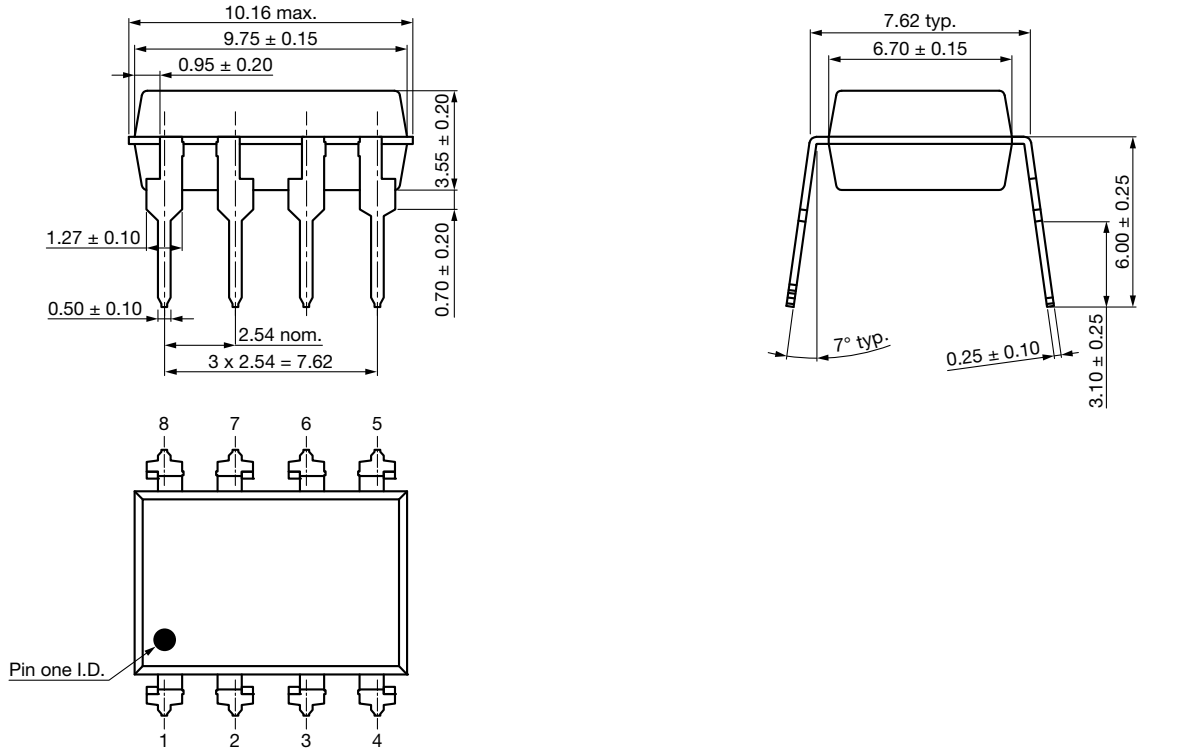


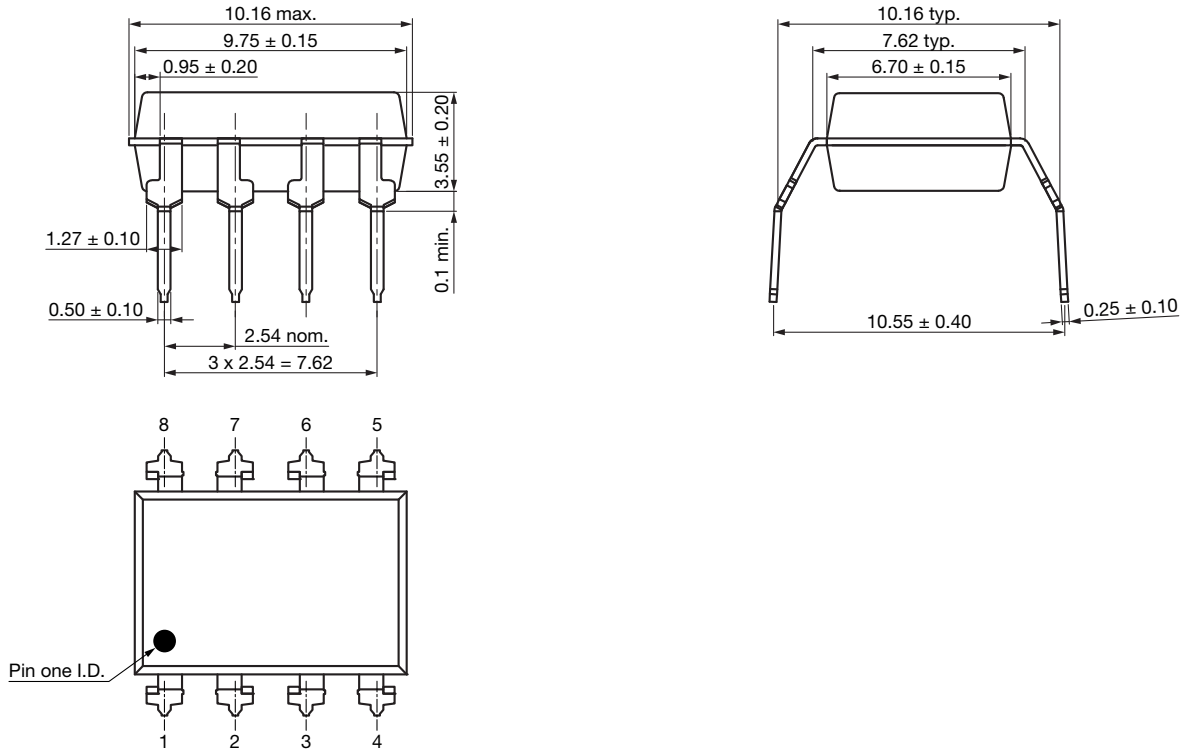

Fig. 23 - Enable Propagation Delay vs. Ambient Temperature

## PACKAGE DIMENSIONS in millimeters

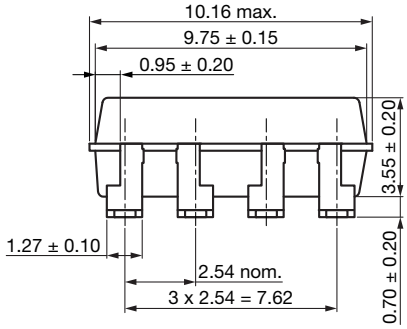
### DIP-8, Standard

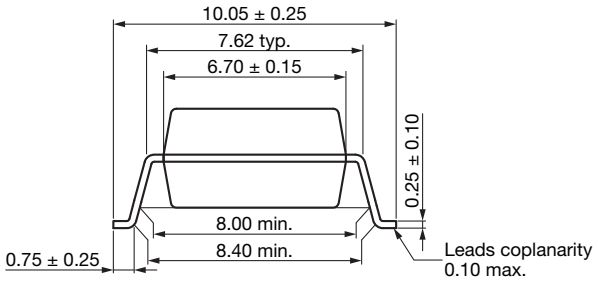


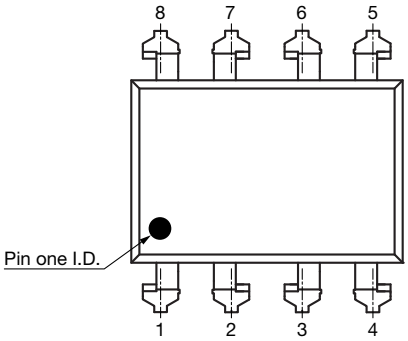

### DIP-8, Option 6

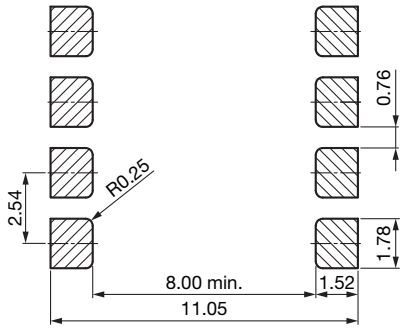


**SMD-8, Option 7**

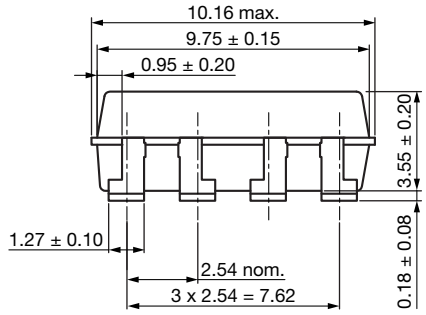


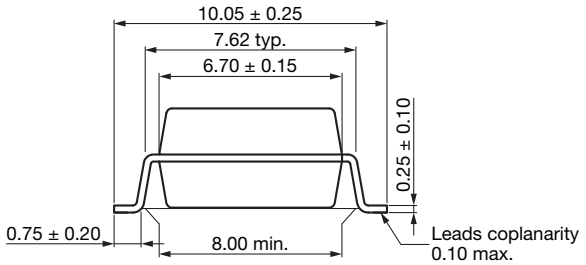



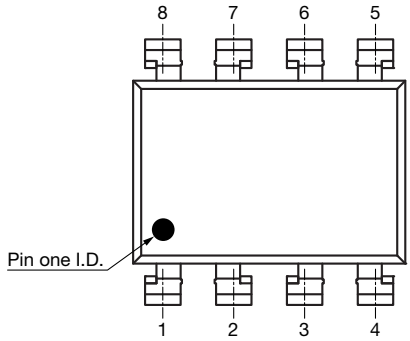



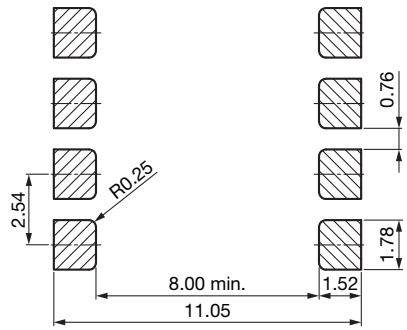




**SMD-8, Option 9**

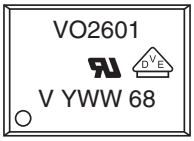


## PACKAGE MARKING (example of VO2601-X017T)




**Notes**

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

## SOLDER PROFILES

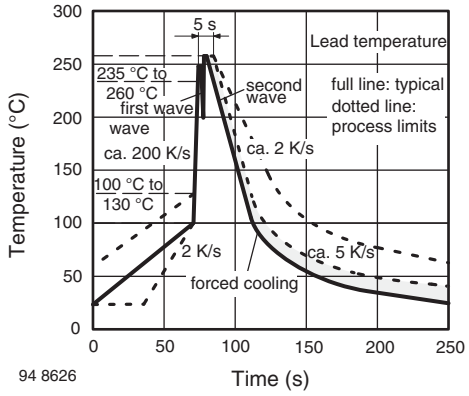



Fig. 24 - Wave Soldering Double Wave Profile According to J.STD-020 for DIP-8 Devices

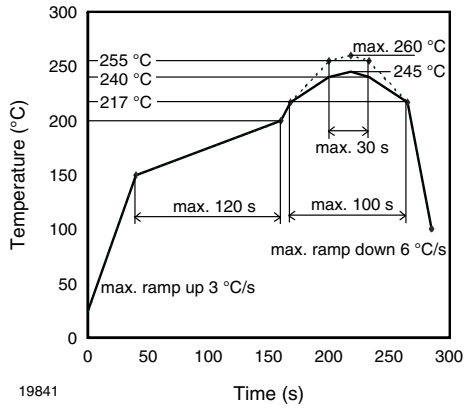



Fig. 25 - Lead (Pb)-free Reflow Solder Profile According to J-STD-020 for SMD-8 Devices

## HANDLING AND STORAGE CONDITIONS

ESD level: HBM class 2

Floor life: unlimited

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

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

# Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, “Vishay”), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay’s knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer’s responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and/or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer’s technical experts. Product specifications do not expand or otherwise modify Vishay’s terms and conditions of purchase, including but not limited to the warranty expressed therein.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.

# Material Category Policy

**Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as RoHS-Compliant fulfill the definitions and restrictions defined under Directive 2011/65/EU of The European Parliament and of the Council of June 8, 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (EEE) - recast, unless otherwise specified as non-compliant.**

**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.**

**Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as Halogen-Free follow Halogen-Free requirements as per JEDEC JS709A standards. Please note that some Vishay documentation may still make reference to the IEC 61249-2-21 definition. We confirm that all the products identified as being compliant to IEC 61249-2-21 conform to JEDEC JS709A standards.**