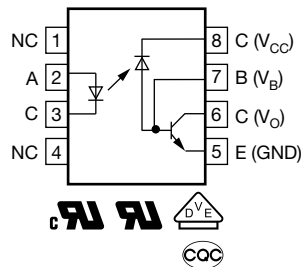
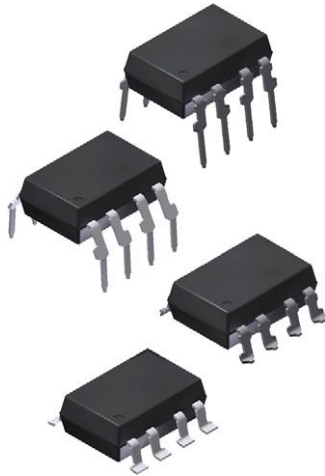


## High Speed Optocoupler, 1 MBd, Photodiode With Transistor Output



### DESCRIPTION

The 6N135 and 6N136 are optocouplers with a GaAlAs infrared emitting diode, optically coupled with an integrated photo detector which consists of a photo diode and a high speed transistor in a DIP-8 plastic package.

Signals can be transmitted between two electrically separated circuits up to frequencies of 2 MHz. The potential difference between the circuits to be coupled should not exceed the maximum permissible reference voltages.

### FEATURES

- Isolation test voltages: 5300 V<sub>RMS</sub>
- TTL compatible
- High bit rates: 1 Mbit/s
- High common-mode interference immunity
- Bandwidth 2 MHz
- Open-collector output
- External base wiring possible
- Material categorization:

for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**  
**GREEN**  
(5-2008)

### AGENCY APPROVALS

- [UL](#)
- [cUL](#)
- [DIN EN 60747-5-5 \(VDE0884-5\) available with option 1](#)
- [CQC](#)

### LINKS TO ADDITIONAL RESOURCES



| AGENCY CERTIFIED / PACKAGE          |                            |  | CTR (%)                    |  |
|-------------------------------------|----------------------------|--|----------------------------|--|
| <b>UL, cUL, CQC</b>                 | $\geq 7$                   |  | $\geq 19$                  |  |
| DIP-8                               | 6N135                      |  | 6N136                      |  |
| DIP-8, 400 mil, option 6            | -                          |  | 6N136-X006                 |  |
| SMD-8, option 7                     | 6N135-X007T <sup>(1)</sup> |  | 6N136-X007T <sup>(1)</sup> |  |
| SMD-8, option 9                     | -                          |  | 6N136-X009T <sup>(1)</sup> |  |
| <b>UL, cUL, CQC, VDE (Option 1)</b> | $\geq 7$                   |  | $\geq 19$                  |  |
| DIP-8                               | -                          |  | 6N136-X001                 |  |
| SMD-8, option 7                     | 6N135-X017T <sup>(1)</sup> |  | 6N136-X017T                |  |
| SMD-8, option 9                     | -                          |  | 6N136-X019T                |  |

**Note**

<sup>(1)</sup> Also available in tubes; do not add T to end

| ABSOLUTE MAXIMUM RATINGS ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified) |  |            |             |                    |
|---|--|------------|-------------|--------------------|
| PARAMETER   | CONDITION  | SYMBOL     | VALUE       | UNIT               |
| <b>INPUT</b>  |  |            |             |                    |
| Reverse voltage   |  | $V_R$      | 5           | V                  |
| Forward current   |  | $I_F$      | 25          | mA                 |
| Peak forward current  | $t = 1\text{ ms}$ , duty cycle 50 %  | $I_{FSM}$  | 50          | mA                 |
| Maximum surge forward current   | $t \leq 1\text{ }\mu\text{s}$ , 300 pulses/s                                     |            | 1           | A                  |
| Thermal resistance  |  | $R_{th}$   | 700         | K/W                |
| Power dissipation   | $T_{amb} = 70\text{ }^{\circ}\text{C}$   | $P_{diss}$ | 45          | mW                 |
| <b>OUTPUT</b>   |  |            |             |                    |
| Supply voltage  |  | $V_S$      | -0.5 to 15  | V                  |
| Output voltage  |  | $V_O$      | -0.5 to 15  | V                  |
| Emitter base voltage  |  | $V_{EBO}$  | 5           | V                  |
| Output current  |  | $I_O$      | 8           | mA                 |
| Maximum output current  |  |            | 16          | mA                 |
| Base current  |  | $I_B$      | 5           | mA                 |
| Thermal resistance  |  |            | 300         | K/W                |
| Power dissipation   | $T_{amb} = 70\text{ }^{\circ}\text{C}$   | $P_{diss}$ | 100         | mW                 |
| <b>COUPLER</b>  |  |            |             |                    |
| Storage temperature range   |  | $T_{stg}$  | -55 to +150 | $^{\circ}\text{C}$ |
| Ambient temperature range   |  | $T_{amb}$  | -55 to +100 | $^{\circ}\text{C}$ |
| Soldering temperature   | Max. $\leq 10\text{ s}$ , dip soldering<br>$\geq 0.5\text{ mm}$ from case bottom | $T_{slid}$ | 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.



| <b>ELECTRICAL CHARACTERISTICS</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified) |  |       |                         |      |      |      |                        |
|--|--|-------|-------------------------|------|------|------|------------------------|
| PARAMETER  | TEST CONDITION   | PART  | SYMBOL                  | MIN. | TYP. | MAX. | UNIT                   |
| <b>INPUT</b>   |  |       |                         |      |      |      |                        |
| Forward voltage  | $I_F = 16\text{ mA}$   |       | $V_F$                   | -    | 1.33 | 1.9  | V                      |
| Breakdown voltage  | $I_R = 10\text{ }\mu\text{A}$  |       | $V_{BR}$                | 5    | -    | -    | V                      |
| Reverse current  | $V_R = 5\text{ V}$   |       | $I_R$                   | -    | 0.5  | 10   | $\mu\text{A}$          |
| Capacitance  | $V_R = 0\text{ V}$ , $f = 1\text{ MHz}$                                |       | $C_O$                   | -    | 30   | -    | pF                     |
| Temperature coefficient, forward voltage   | $I_F = 16\text{ mA}$   |       | $\Delta V_F/\Delta T_A$ | -    | -1.7 | -    | mV/ $^{\circ}\text{C}$ |
| <b>OUTPUT</b>  |  |       |                         |      |      |      |                        |
| Logic low supply current   | $I_F = 16\text{ mA}$ , $V_O = \text{open}$ , $V_{CC} = 15\text{ V}$    |       | $I_{CCL}$               | -    | 150  | -    | $\mu\text{A}$          |
| Logic high supply current  | $I_F = 0\text{ mA}$ , $V_O = \text{open}$ , $V_{CC} = 15\text{ V}$     |       | $I_{CCH}$               | -    | 0.01 | 1    | $\mu\text{A}$          |
| Output voltage, output low   | $I_F = 16\text{ mA}$ , $I_O = 1.1\text{ mA}$ , $V_{CC} = 4.5\text{ V}$ | 6N135 | $V_{OL}$                | -    | 0.1  | 0.4  | V                      |
|  | $I_F = 16\text{ mA}$ , $I_O = 3.0\text{ mA}$ , $V_{CC} = 4.5\text{ V}$ | 6N136 | $V_{OL}$                | -    | 0.1  | 0.4  | V                      |
| Output current, output high  | $I_F = 0\text{ mA}$ , $V_O = V_{CC} = 5.5\text{ V}$                    |       | $I_{OH}$                | -    | 3    | 500  | nA                     |
|  | $I_F = 0\text{ mA}$ , $V_O = V_{CC} = 15\text{ V}$                     |       | $I_{OH}$                | -    | 0.01 | 1    | $\mu\text{A}$          |
| <b>COUPLER</b>   |  |       |                         |      |      |      |                        |
| Capacitance (input to output)  | $f = 1\text{ MHz}$   |       | $C_{IO}$                | -    | 0.6  | -    | 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.

| <b>CURRENT TRANSFER RATIO</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified) |   |       |        |      |      |      |      |
|--|---|-------|--------|------|------|------|------|
| PARAMETER  | TEST CONDITION  | PART  | SYMBOL | MIN. | TYP. | MAX. | UNIT |
| Current transfer ratio   | $I_F = 16\text{ mA}$ , $V_O = 0.4\text{ V}$ , $V_{CC} = 4.5\text{ V}$ | 6N135 | CTR    | 7    | 16   | -    | %    |
|  |   | 6N136 | CTR    | 19   | 35   | -    | %    |
|  | $I_F = 16\text{ mA}$ , $V_O = 0.5\text{ V}$ , $V_{CC} = 4.5\text{ V}$ | 6N135 | CTR    | 5    | -    | -    | %    |
|  |   | 6N136 | CTR    | 15   | -    | -    | %    |

| <b>SWITCHING CHARACTERISTICS</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified) |   |       |           |      |      |      |               |
|---|---|-------|-----------|------|------|------|---------------|
| PARAMETER   | TEST CONDITION  | PART  | SYMBOL    | MIN. | TYP. | MAX. | UNIT          |
| High to low   | $I_F = 16\text{ mA}$ , $V_{CC} = 5\text{ V}$ , $R_L = 4.1\text{ k}\Omega$ | 6N135 | $t_{PHL}$ | -    | 0.3  | 1.5  | $\mu\text{s}$ |
|   | $I_F = 16\text{ mA}$ , $V_{CC} = 5\text{ V}$ , $R_L = 1.9\text{ k}\Omega$ | 6N136 | $t_{PHL}$ | -    | 0.2  | 0.8  | $\mu\text{s}$ |
| Low to high   | $I_F = 16\text{ mA}$ , $V_{CC} = 5\text{ V}$ , $R_L = 4.1\text{ k}\Omega$ | 6N135 | $t_{PLH}$ | -    | 0.3  | 1.5  | $\mu\text{s}$ |
|   | $I_F = 16\text{ mA}$ , $V_{CC} = 5\text{ V}$ , $R_L = 1.9\text{ k}\Omega$ | 6N136 | $t_{PLH}$ | -    | 0.2  | 0.8  | $\mu\text{s}$ |

| <b>COMMON MODE TRANSIENT IMMUNITY</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified) |  |       |          |      |      |      |                  |
|--|--|-------|----------|------|------|------|------------------|
| PARAMETER  | TEST CONDITION   | PART  | SYMBOL   | MIN. | TYP. | MAX. | UNIT             |
| High   | $I_F = 0\text{ mA}$ , $V_{CM} = 10\text{ V}_{P-P}$ , $V_{CC} = 5\text{ V}$ , $R_L = 4.1\text{ k}\Omega$  | 6N135 | $ CM_H $ | -    | 1000 | -    | V/ $\mu\text{s}$ |
|  | $I_F = 0\text{ mA}$ , $V_{CM} = 10\text{ V}_{P-P}$ , $V_{CC} = 5\text{ V}$ , $R_L = 1.9\text{ k}\Omega$  | 6N136 | $ CM_H $ | -    | 1000 | -    | V/ $\mu\text{s}$ |
| Low  | $I_F = 16\text{ mA}$ , $V_{CM} = 10\text{ V}_{P-P}$ , $V_{CC} = 5\text{ V}$ , $R_L = 4.1\text{ k}\Omega$ | 6N135 | $ CM_L $ | -    | 1000 | -    | V/ $\mu\text{s}$ |
|  | $I_F = 16\text{ mA}$ , $V_{CM} = 10\text{ V}_{P-P}$ , $V_{CC} = 5\text{ V}$ , $R_L = 1.9\text{ k}\Omega$ | 6N136 | $ CM_L $ | -    | 1000 | -    | V/ $\mu\text{s}$ |

| 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 <sub>ISO</sub>  | 5300               | V <sub>RMS</sub>  |
| Maximum transient isolation voltage          | According to DIN EN 60747-5-5                      | V <sub>IOTM</sub> | 8000               | V <sub>peak</sub> |
| Maximum repetitive peak isolation voltage    | According to DIN EN 60747-5-5                      | V <sub>IORM</sub> | 890                | 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                 |
|  | T <sub>amb</sub> = 100 °C, V <sub>IO</sub> = 500 V | R <sub>IO</sub>   | ≥ 10 <sup>11</sup> | Ω                 |
| Output safety power                          |  | P <sub>SO</sub>   | 500                | mW                |
| Input safety current                         |  | I <sub>SI</sub>   | 300                | mA                |
| Input safety temperature                     |  | T <sub>S</sub>    | 175                | °C                |
| Creepage distance                            | DIP-8  |                   | ≥ 7                | mm                |
| Clearance distance                           | DIP-8  |                   | ≥ 7                | mm                |
| Creepage distance                            | DIP-8, 400 mil, option 6                           |                   | ≥ 8                | mm                |
| Clearance distance                           | DIP-8, 400 mil, option 6                           |                   | ≥ 8                | mm                |
| Creepage distance                            | SMD-8, option 7                                    |                   | ≥ 8                | mm                |
| Clearance distance                           | SMD-8, option 7                                    |                   | ≥ 8                | mm                |
| Creepage distance                            | SMD-8, option 9                                    |                   | ≥ 8                | mm                |
| Clearance distance                           | SMD-8, option 9                                    |                   | ≥ 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.

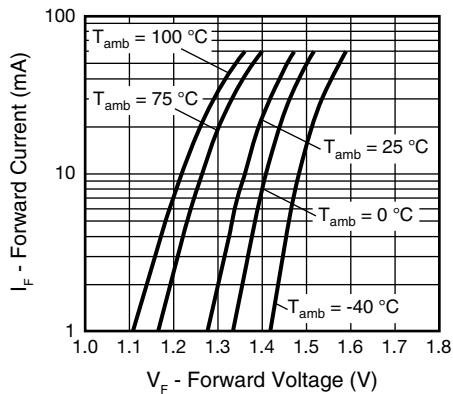
**TYPICAL CHARACTERISTICS** (T<sub>amb</sub> = 25 °C, unless otherwise specified)


Fig. 1 - LED Forward Current vs. Forward Voltage

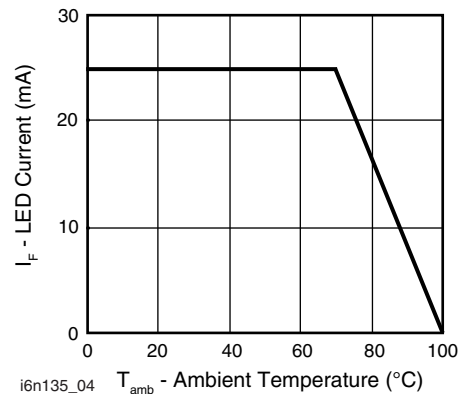


Fig. 2 - Permissible Forward LED Current vs. Temperature

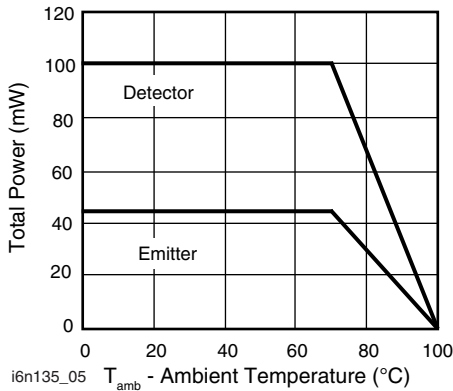


Fig. 3 - Permissible Power Dissipation vs. Temperature

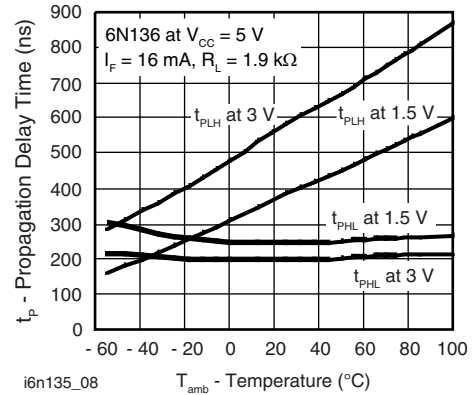


Fig. 6 - Propagation Delay vs. Ambient Temperature

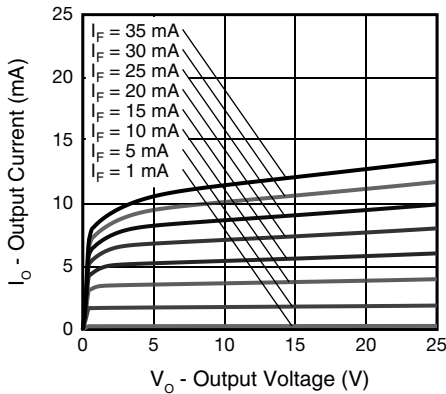


Fig. 4 - Output Current vs. Output Voltage

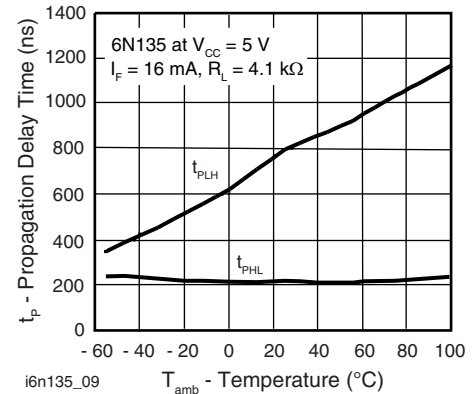


Fig. 7 - Propagation Delay vs. Ambient Temperature

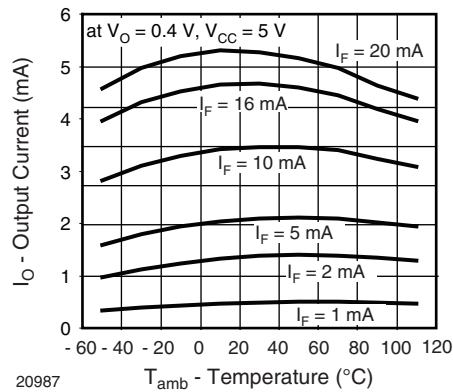


Fig. 5 - Output Current vs. Temperature

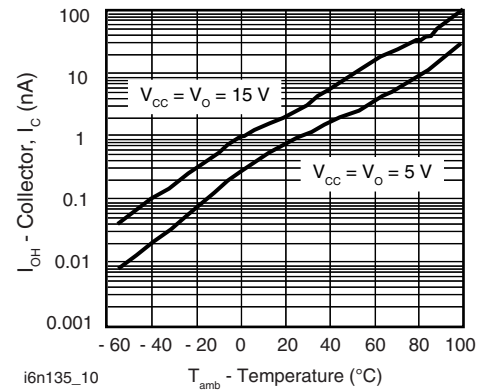


Fig. 8 - Logic High Output Current vs. Temperature

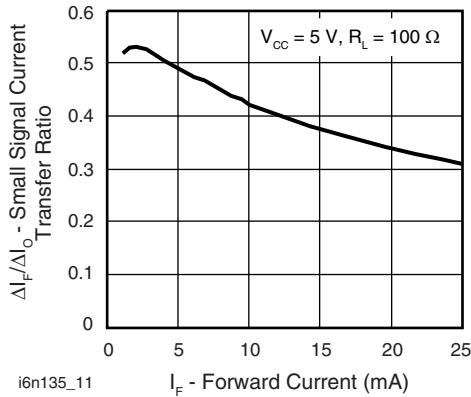


Fig. 9 - Small Signal Current Transfer Ratio vs. Quiescent Input Current

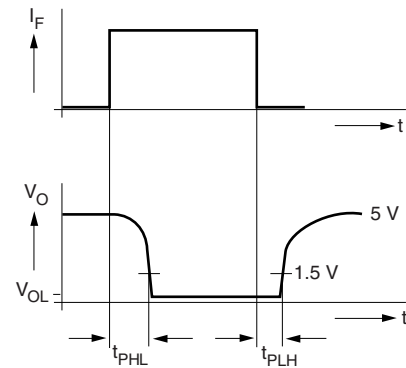
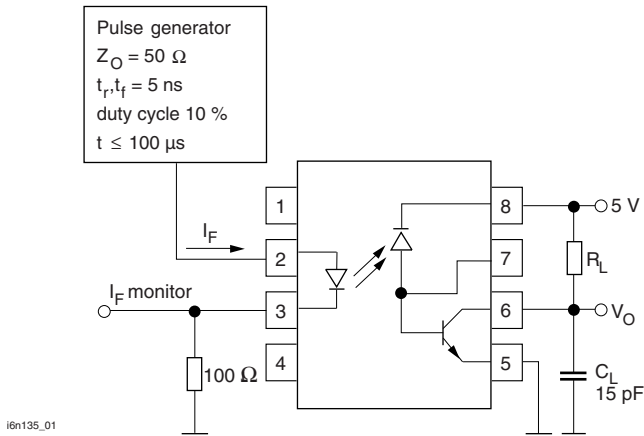


Fig. 10 - Switching Times

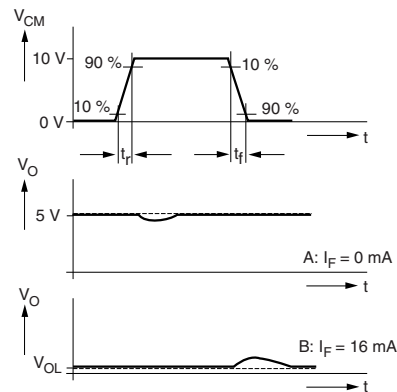
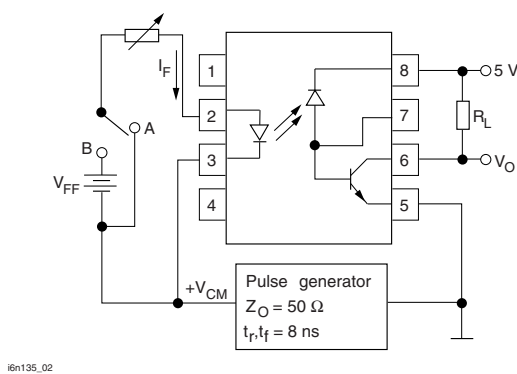
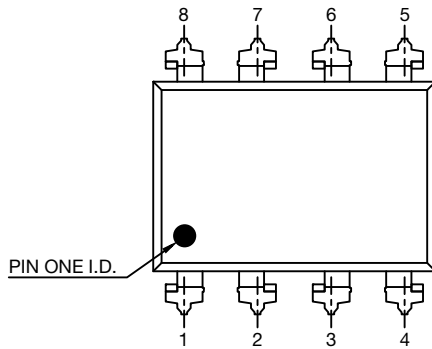
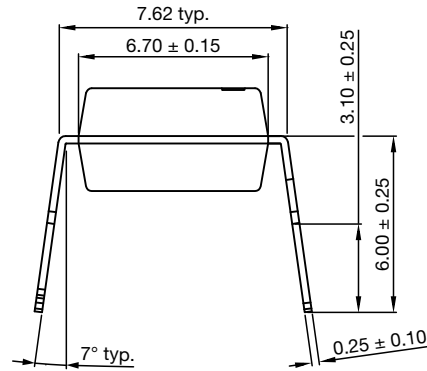
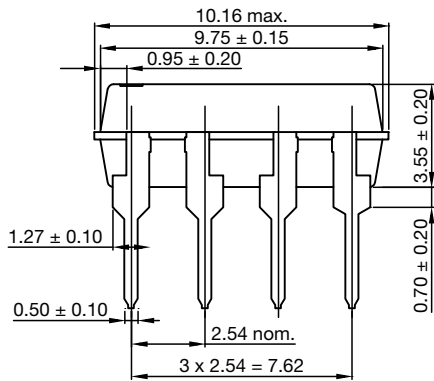


Fig. 11 - Common-Mode Interference Immunity

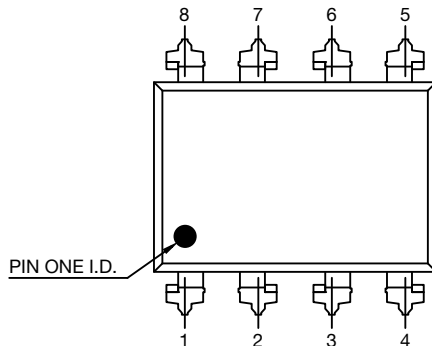
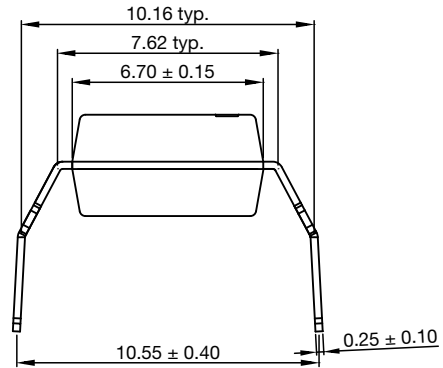
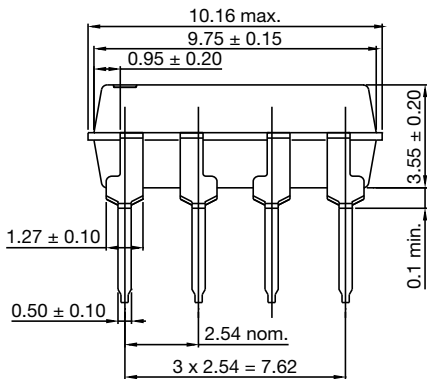


**PACKAGE DIMENSIONS** (in millimeters)

**DIP-8, Standard**

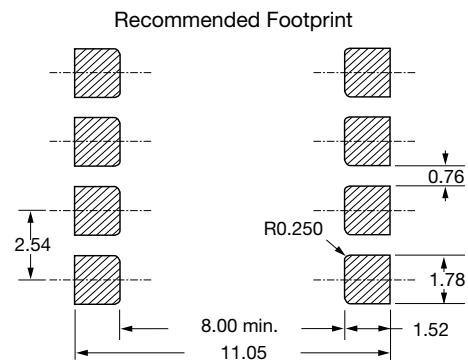
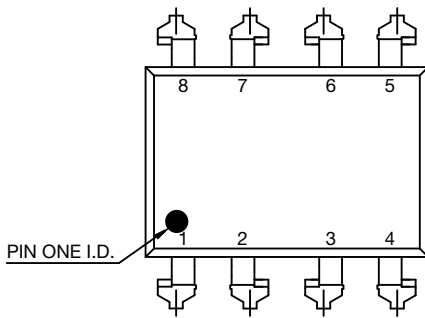
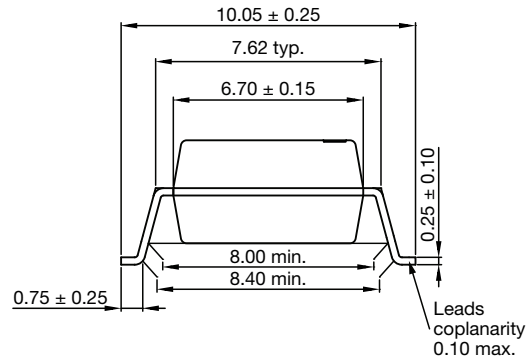
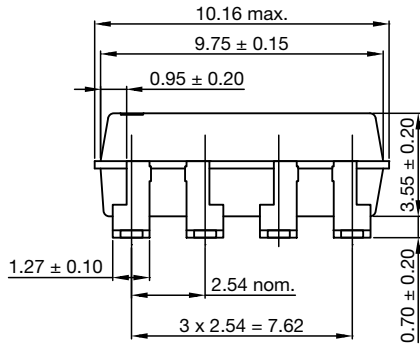


**DIP-8, Option 6**

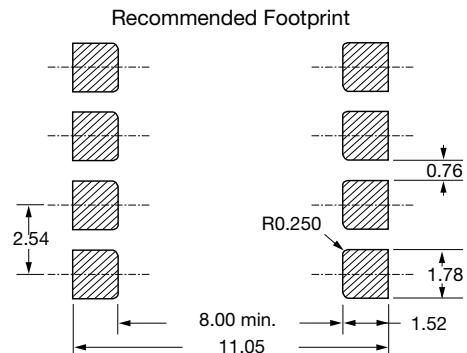
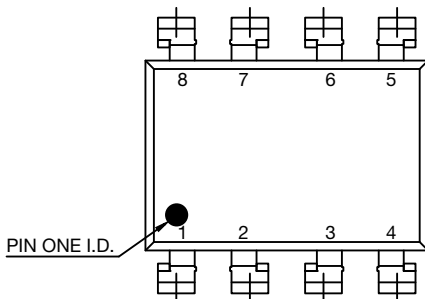
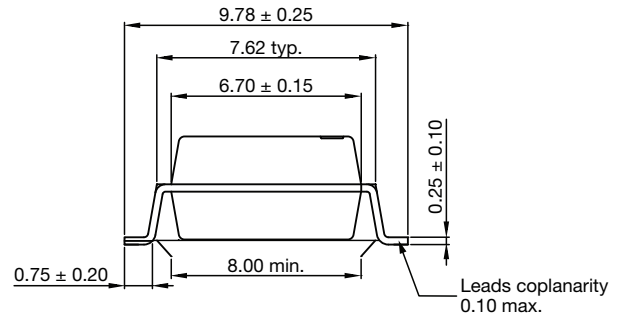
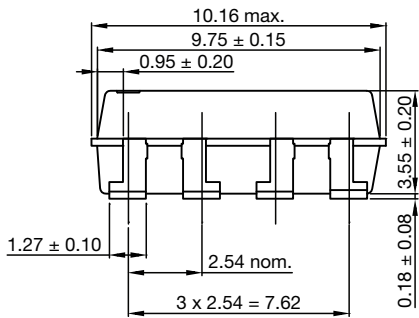




DIP-8, Option 7



DIP-8, Option 9





**PACKAGE MARKING**

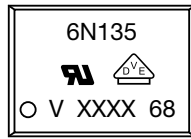


Fig. 12 - 6N135

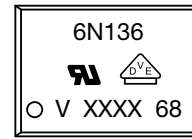
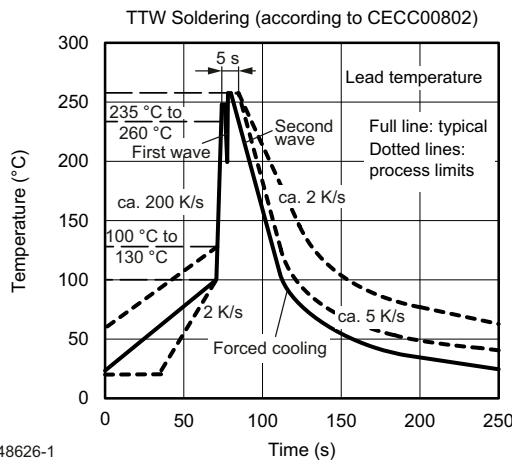


Fig. 13 - 6N136

**Notes**

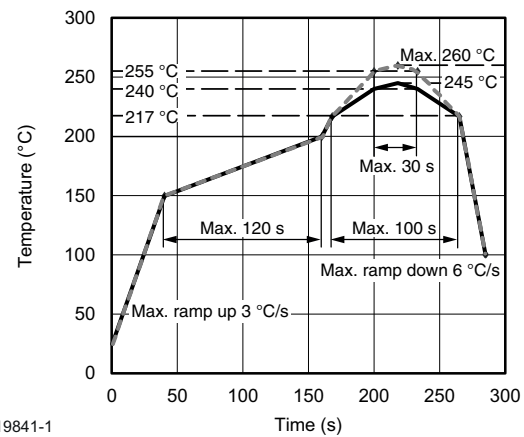
- XXXX = LMC (lot marking code)
- The VDE logo is only marked on option 1 parts
- Tape and reel suffix (T) is not part of the package marking

**SOLDER PROFILES**



948626-1

Fig. 14 - Wave Soldering Double Wave Profile According to J-STD-020 for DIP-8 Devices



19841-1

Fig. 15 - 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:  $T_{amb} < 30\text{ }^{\circ}\text{C}$ , 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.

Hyperlinks included in this datasheet may direct users to third-party websites. These links are provided as a convenience and for informational purposes only. Inclusion of these hyperlinks does not constitute an endorsement or an approval by Vishay of any of the products, services or opinions of the corporation, organization or individual associated with the third-party website. Vishay disclaims any and all liability and bears no responsibility for the accuracy, legality or content of the third-party website or for that of subsequent links.

Vishay products are not designed for use in life-saving or life-sustaining applications or any application in which the failure of the Vishay product could result in personal injury or death unless specifically qualified in writing by Vishay. 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.