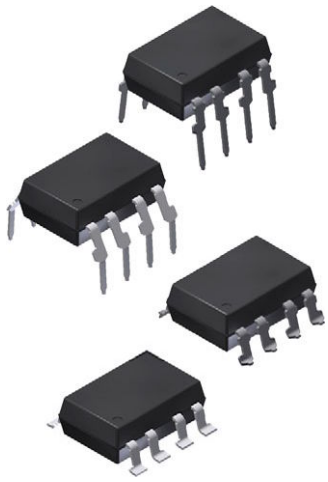
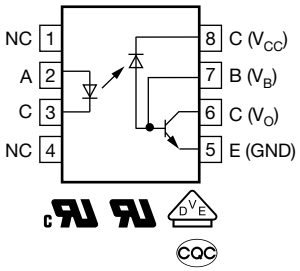
# High Speed Optocoupler, 1 MBd, Photodiode With Transistor Output






## 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 $V_{RMS}$
- 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

Pb-free

e3

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

Product Page | Design Tools | SPICE Models



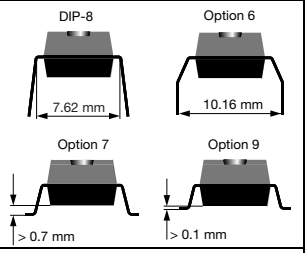
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## ORDERING INFORMATION

| 6 | N | 1 | 3 | # | - | X | 0 | # | # | T |
|---|---|---|---|---|---|---|---|---|---|---|

PART NUMBER — PACKAGE OPTION — TAPE AND REEL




| AGENCY CERTIFIED / PACKAGE | CTR (%) | |
|---|---|---|
| **UL, cUL, CQC** | ≥ **7** | ≥ **19** |
| DIP-8 | 6N135 | 6N136 |
| DIP-8, 400 mil, option 6 | - | 6N136-X006 |
| SMD-8, option 7 | 6N135-X007T (1) | 6N136-X007T (1) |
| SMD-8, option 9 | - | 6N136-X009T (1) |
| **UL, cUL, CQC, VDE (Option 1)** | ≥ **7** | ≥ **19** |
| DIP-8 | - | 6N136-X001 |
| SMD-8, option 7 | 6N135-X017T (1) | 6N136-X017T |
| SMD-8, option 9 | - | 6N136-X019T |

**Note**

(1) Also available in tubes; do not add T to end

## ABSOLUTE MAXIMUM RATINGS ($T_{amb}$ = 25 °C, unless otherwise specified)

| PARAMETER | CONDITION | SYMBOL | VALUE | UNIT |
|---|---|---|---|---|
| **INPUT** | | | | |
| Reverse voltage | | $V_R$ | 5 | V |
| Forward current | | $I_F$ | 25 | mA |
| Peak forward current | t = 1 ms, duty cycle 50 % | $I_{FSM}$ | 50 | mA |
| Maximum surge forward current | t ≤ 1 µs, 300 pulses/s | | 1 | A |
| Thermal resistance | | $R_{th}$ | 700 | K/W |
| Power dissipation | $T_{amb}$ = 70 °C | $P_{diss}$ | 45 | mW |
| **OUTPUT** | | | | |
| 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 °C | $P_{diss}$ | 100 | mW |
| **COUPLER** | | | | |
| Storage temperature range | | $T_{stg}$ | -55 to +150 | °C |
| Ambient temperature range | | $T_{amb}$ | -55 to +100 | °C |
| Soldering temperature | Max. ≤ 10 s, dip soldering<br>≥ 0.5 mm from case bottom | $T_{sld}$ | 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.



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

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

| **SWITCHING CHARACTERISTICS** ($T_{amb}$ = 25 °C, unless otherwise specified) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PARAMETER** | **TEST CONDITION** | **PART** | **SYMBOL** | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| High to low | $I_F$ = 16 mA, $V_{CC}$ = 5 V, $R_L$ = 4.1 kΩ | 6N135 | $t_{PHL}$ | - | 0.3 | 1.5 | µs |
| | $I_F$ = 16 mA, $V_{CC}$ = 5 V, $R_L$ = 1.9 kΩ | 6N136 | $t_{PHL}$ | - | 0.2 | 0.8 | µs |
| Low to high | $I_F$ = 16 mA, $V_{CC}$ = 5 V, $R_L$ = 4.1 kΩ | 6N135 | $t_{PLH}$ | - | 0.3 | 1.5 | µs |
| | $I_F$ = 16 mA, $V_{CC}$ = 5 V, $R_L$ = 1.9 kΩ | 6N136 | $t_{PLH}$ | - | 0.2 | 0.8 | µs |

| **COMMON MODE TRANSIENT IMMUNITY** ($T_{amb}$ = 25 °C, unless otherwise specified) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PARAMETER** | **TEST CONDITION** | **PART** | **SYMBOL** | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| High | $I_F$ = 0 mA, $V_{CM}$ = 10 $V_{P-P}$, $V_{CC}$ = 5 V, $R_L$ = 4.1 kΩ | 6N135 | $\|CM_H\|$ | - | 1000 | - | V/µs |
| | $I_F$ = 0 mA, $V_{CM}$ = 10 $V_{P-P}$, $V_{CC}$ = 5 V, $R_L$ = 1.9 kΩ | 6N136 | $\|CM_H\|$ | - | 1000 | - | V/µs |
| Low | $I_F$ = 16 mA, $V_{CM}$ = 10 $V_{P-P}$, $V_{CC}$ = 5 V, $R_L$ = 4.1 kΩ | 6N135 | $\|CM_L\|$ | - | 1000 | - | V/µs |
| | $I_F$ = 16 mA, $V_{CM}$ = 10 $V_{P-P}$, $V_{CC}$ = 5 V, $R_L$ = 1.9 kΩ | 6N136 | $\|CM_L\|$ | - | 1000 | - | V/µs |


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| 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 | $R_{IO}$ | $\geq 10^{12}$ | Ω |
| | $T_{amb}$ = 100 °C, $V_{IO}$ = 500 V | $R_{IO}$ | $\geq 10^{11}$ | 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 | 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 ($T_{amb}$ = 25 °C, unless otherwise specified)

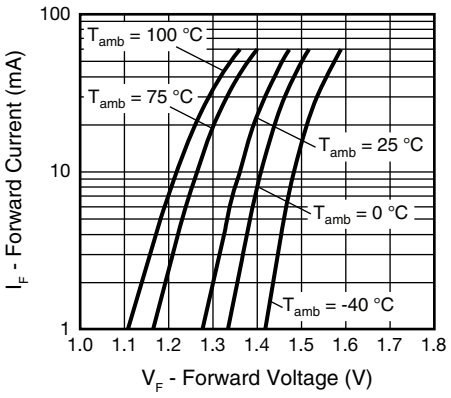



Fig. 1 - LED Forward Current vs. Forward Voltage

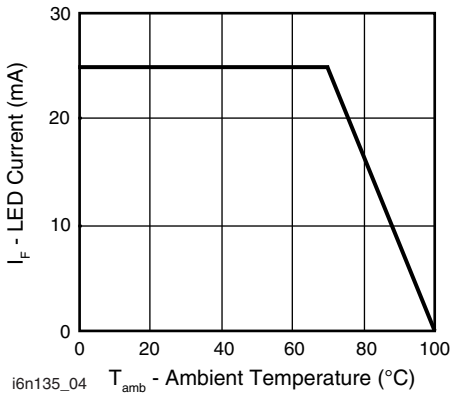



Fig. 2 - Permissible Forward LED Current vs. Temperature



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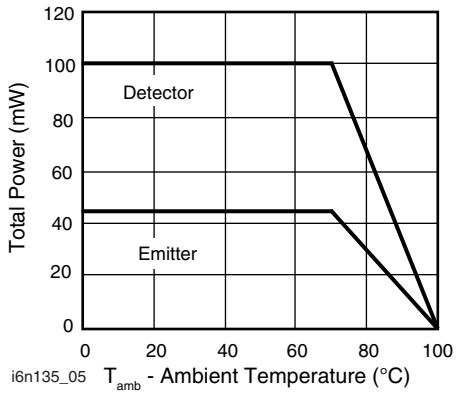



Fig. 3 - Permissible Power Dissipation vs. Temperature

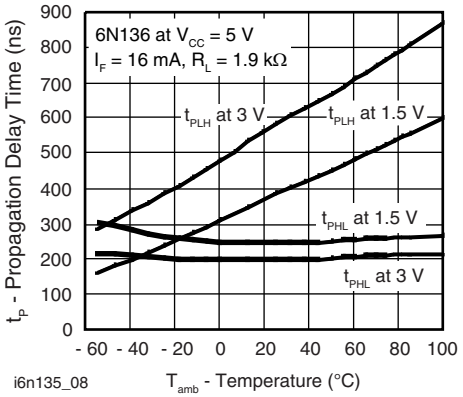



Fig. 6 - Propagation Delay vs. Ambient Temperature

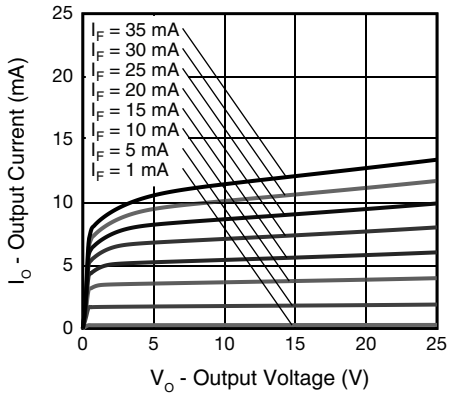



Fig. 4 - Output Current vs. Output Voltage

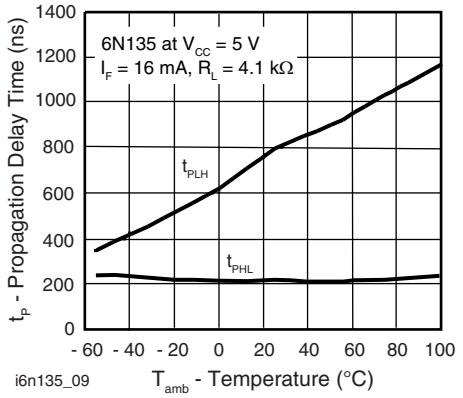



Fig. 7 - Propagation Delay vs. Ambient Temperature

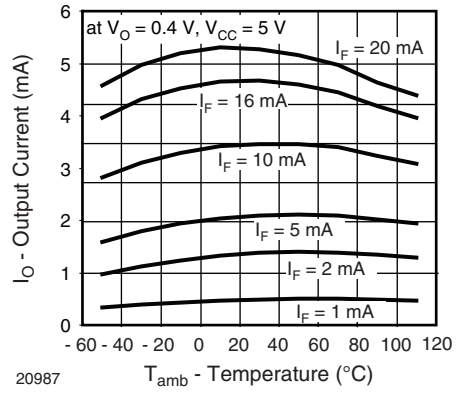



Fig. 5 - Output Current vs. Temperature

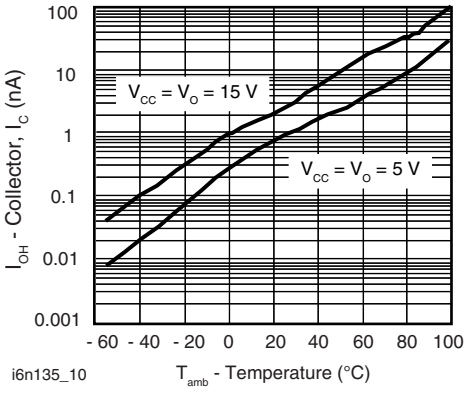



Fig. 8 - Logic High Output Current vs. Temperature


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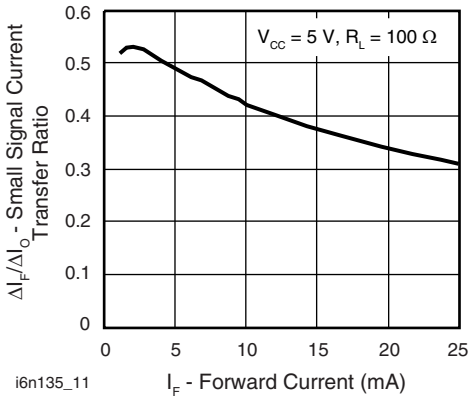



Fig. 9 - Small Signal Current Transfer Ratio vs. Quiescent Input Current

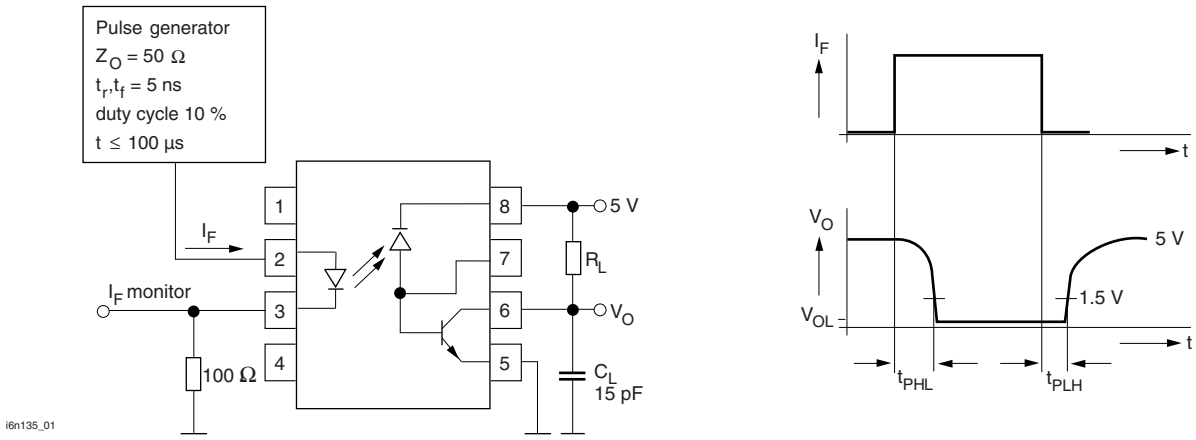



Fig. 10 - Switching Times

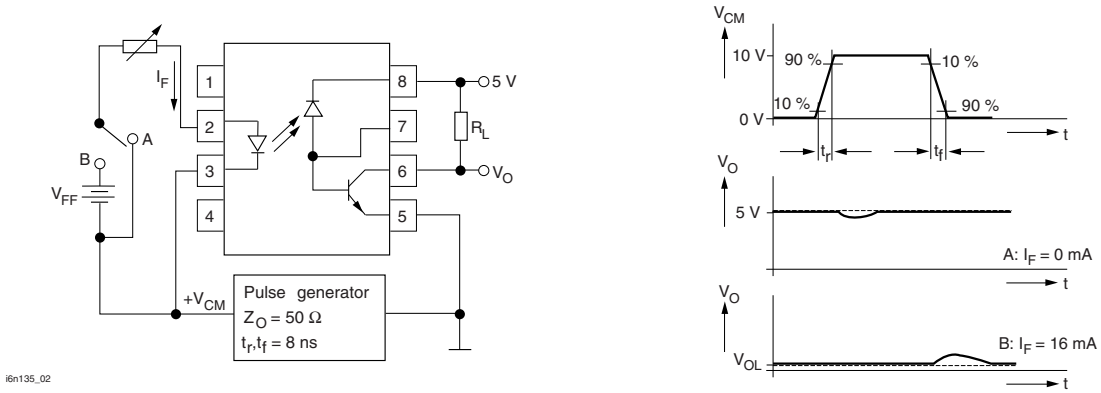
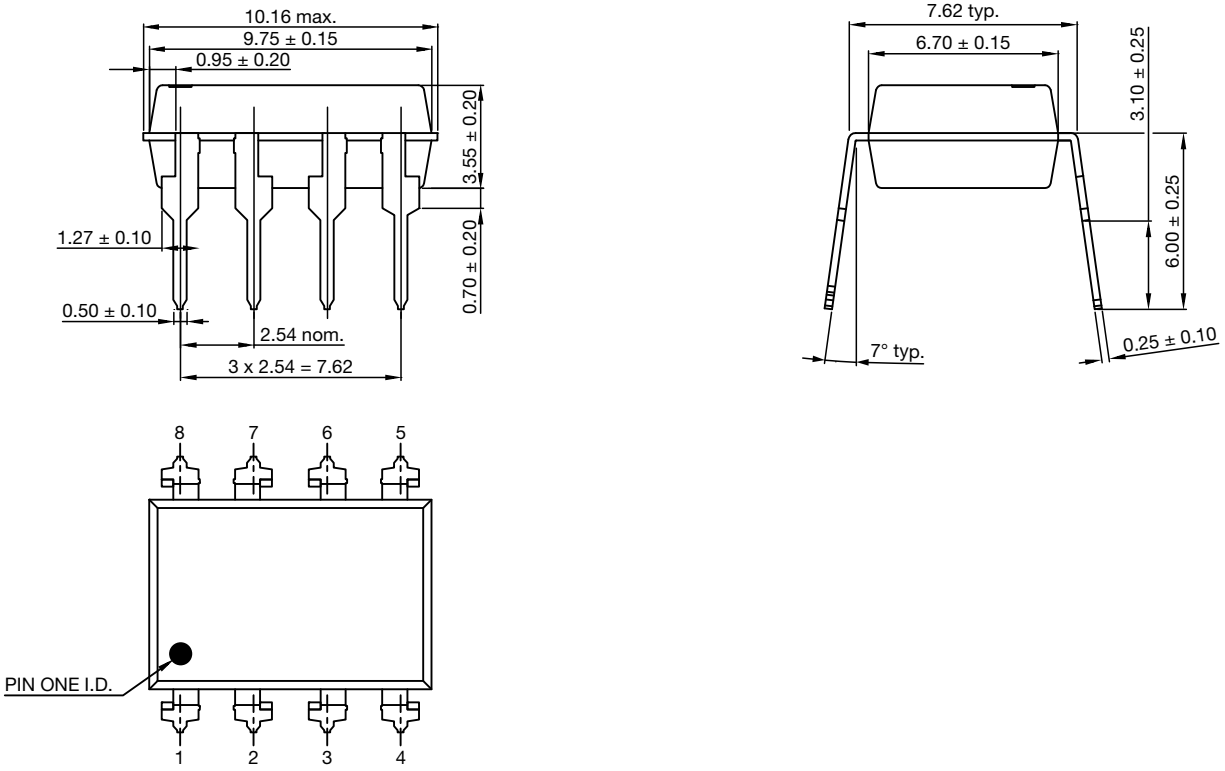



Fig. 11 - Common-Mode Interference Immunity

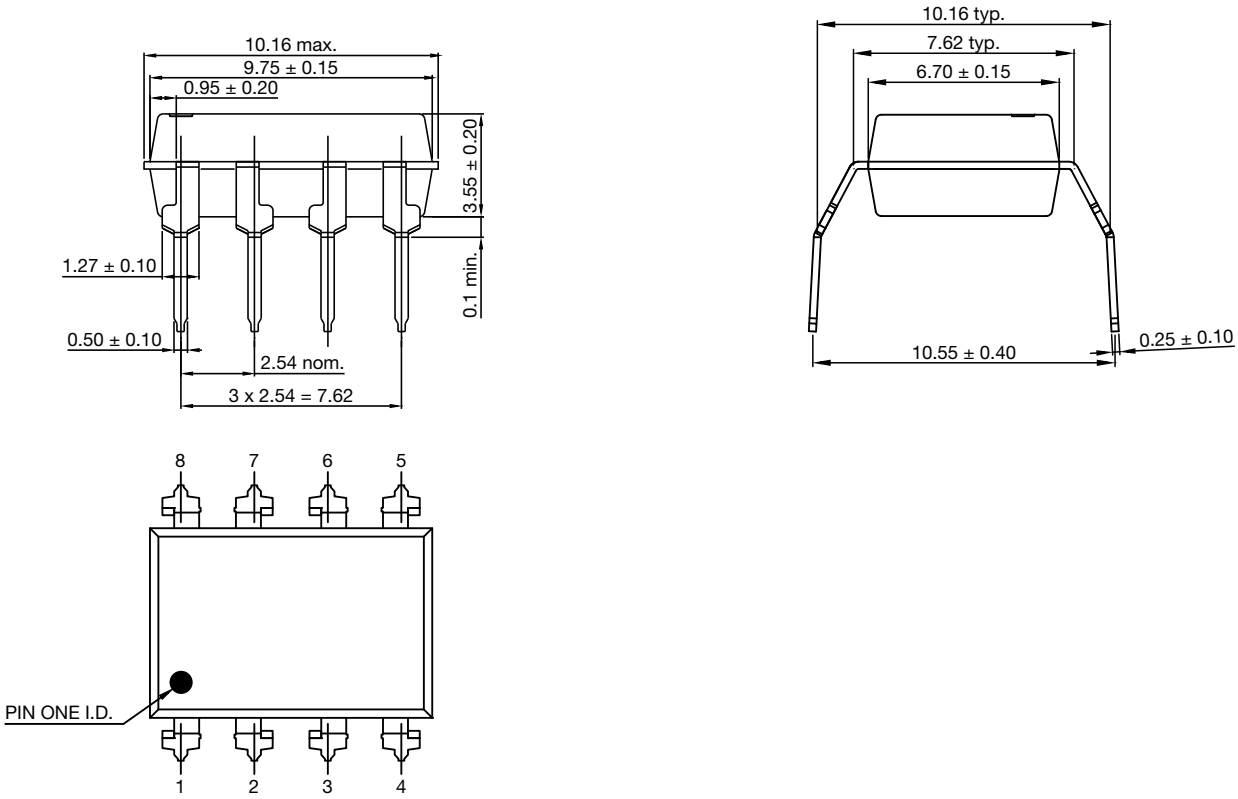

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## PACKAGE DIMENSIONS (in millimeters)

### DIP-8, Standard



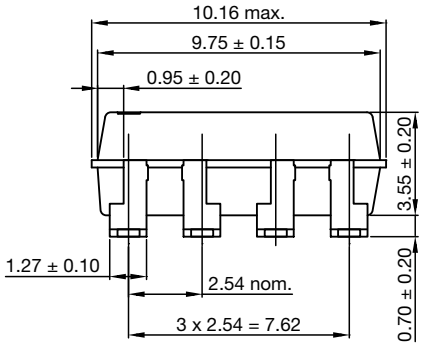

### DIP-8, Option 6

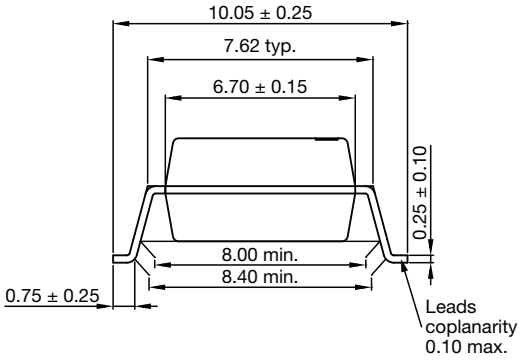


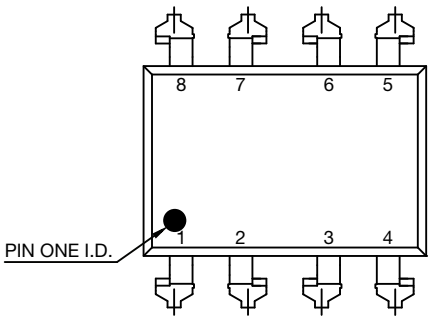


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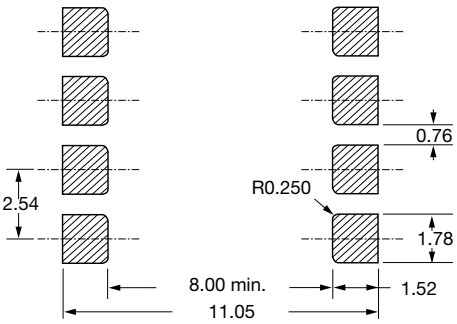
**DIP-8, Option 7**



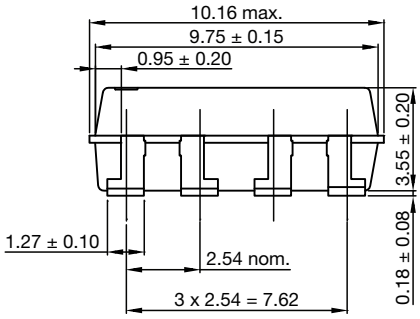



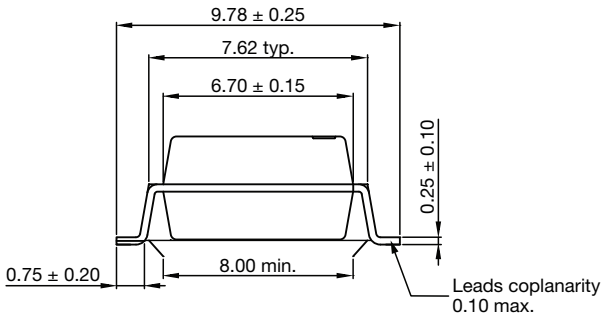



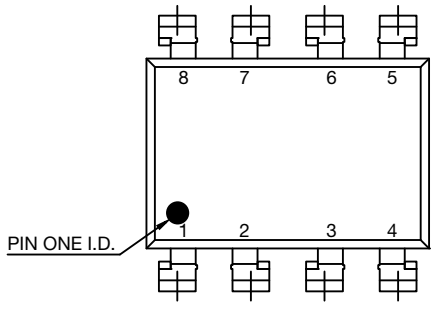

Recommended Footprint



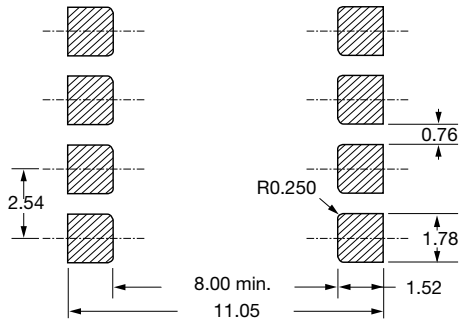

**DIP-8, Option 9**




Recommended Footprint





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## PACKAGE MARKING

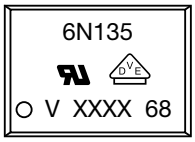



Fig. 12 - 6N135

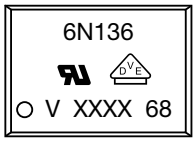



Fig. 13 - 6N136

**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

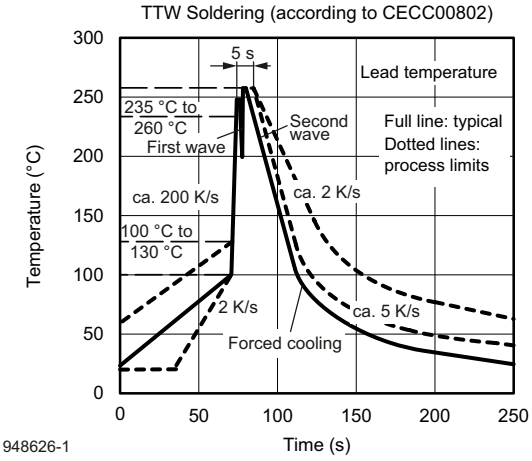



Fig. 14 - Wave Soldering Double Wave Profile According to J-STD-020 for DIP-8 Devices

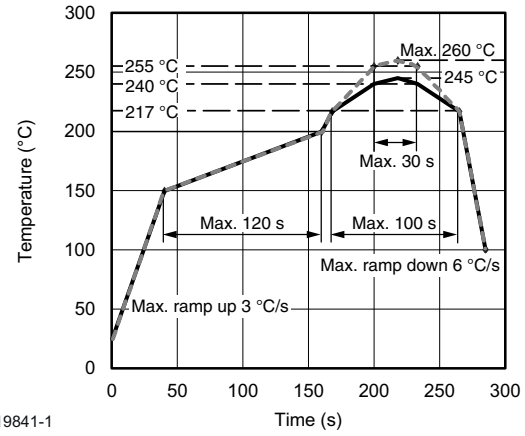



Fig. 15 - Lead (Pb)-free Reflow Solder Profile According to J-STD-020 for SMD-8 Devices

## HANDLING AND STORAGE CONDITIONS

ESD level: HBM class 2

Floor life: unlimited

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

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



For technical questions, contact: optocoupleranswers@vishay.com

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