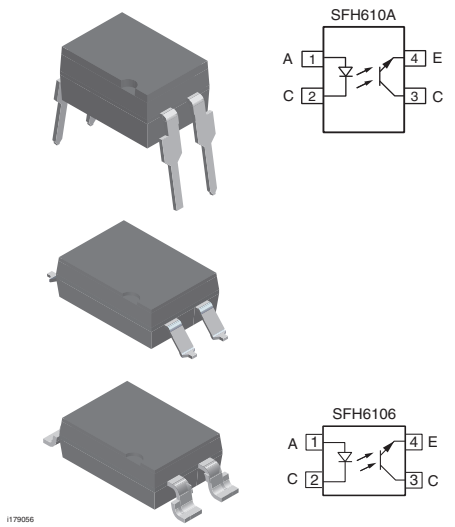
# Optocoupler, Phototransistor Output, High Reliability, 5300 $V_{RMS}$




## FEATURES

- Good CTR linearity depending on forward current
- Isolation test voltage, 5300 $V_{RMS}$
- High collector emitter voltage, $V_{CEO}$ = 70 V
- Low saturation voltage
- Fast switching times
- Low CTR degradation
- Temperature stable
- Low coupling capacitance
- End stackable, 0.100" (2.54 mm) spacing
- High common mode interference immunity
- Lead (Pb)-free component
- Material categorization: For definitions of compliance please see www.vishay.com/doc?99912

Pb-free

e3

RoHS COMPLIANT

## DESCRIPTION

The SFH610A (DIP) and SFH6106 (SMD) feature a high current transfer ratio, low coupling capacitance and high isolation voltage. These couplers have a GaAs infrared diode emitter, which is optically coupled to a silicon planar phototransistor detector, and is incorporated in a plastic DIP-4 or SMD package.

The coupling devices are designed for signal transmission between two electrically separated circuits.

The couplers are end-stackable with 2.54 mm spacing.

Creepage and clearance distances of > 8.0 mm are achieved with option 6. This version complies with IEC 60950 (DIN VDE 0805) for reinforced insulation up to an operation voltage of 400 $V_{RMS}$ or DC. Specifications subject to change.

## AGENCY APPROVALS

- UL1577, file no. E52744 system code H or J, double protection
- DIN EN 60747-5-5 (VDE 0884) available with option 1
- CSA 93751
- BSI IEC 60950; IEC 60065

## ORDERING INFORMATION

| PART | REMARKS |
|---|---|
| SFH610A-1 | CTR 40 % to 80 %, DIP-4 |
| SFH610A-2 | CTR 63 % to 125 %, DIP-4 |
| SFH610A-3 | CTR 100 % to 200 %, DIP-4 |
| SFH610A-4 | CTR 160 % to 320 %, DIP-4 |
| SFH610A-5 | CTR 250 % to 500 %, DIP-4 |
| SFH6106-1 | CTR 40 % to 80 %, SMD-4 |
| SFH6106-2 | CTR 63 % to 125 %, SMD-4 |
| SFH6106-3 | CTR 100 % to 200 %, SMD-4 |
| SFH6106-4 | CTR 160 % to 320 %, SMD-4 |
| SFH6106-5T | CTR 250 % to 500 %, SMD-4, tape and reel |
| SFH610A-1X006 | CTR 40 % to 80 %, DIP-4 400 mil |
| SFH610A-1X018T | CTR 40 % to 80 %, SMD-4 400 mil, wide leadspread |
| SFH610A-2X006 | CTR 63 % to 125 %, DIP-4 400 mil |
| SFH610A-3X006 | CTR 100 % to 200 %, DIP-4 400 mil |
| SFH610A-3X007 | CTR 100 % to 200 %, SMD-4 |
| SFH610A-4X006 | CTR 160 % to 320 %, DIP-4 400 mil |

**Note**

- For additional information on the available options refer to option information.

| ABSOLUTE MAXIMUM RATINGS ($T_{amb}$ = 25 °C, unless otherwise specified) | | | | |
|---|---|---|---|---|
| **PARAMETER** | **TEST CONDITION** | **SYMBOL** | **VALUE** | **UNIT** |
| **INPUT** | | | | |
| Reverse voltage | | $V_R$ | 6 | V |
| DC forward current | | $I_F$ | 60 | mA |
| Surge forward current | t ≤ 10 µs | $I_{FSM}$ | 2.5 | A |
| Power dissipation | | $P_{diss}$ | 100 | mW |
| **OUTPUT** | | | | |
| Collector emitter voltage | | $V_{CE}$ | 70 | V |
| Emitter collector voltage | | $V_{EC}$ | 7 | V |
| Collector current | | $I_C$ | 50 | mA |
| | $t_p$ ≤ 1.0 ms | $I_C$ | 100 | mA |
| Power dissipation | | $P_{diss}$ | 150 | mW |
| **COUPLER** | | | | |
| Isolation test voltage between emitter and detector | | $V_{ISO}$ | 5300 | $V_{RMS}$ |
| Creepage distance | | | ≥ 7 | mm |
| Clearance distance | | | ≥ 7 | mm |
| Insulation thickness between emitter and detector | | | ≥ 0.4 | mm |
| Comparative tracking index per DIN IEC112/VDE 0303 part 1 | | | ≥ 175 | |
| 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 |
| Storage temperature range | | $T_{stg}$ | - 55 to + 150 | °C |
| Ambient temperature range | | $T_{amb}$ | - 55 to + 100 | °C |
| Soldering temperature (1) | max. 10 s, dip soldering distance to seating plane ≥ 1.5 mm | $T_{sld}$ | 260 | °C |

**Notes**

- 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.

(1) Refer to reflow profile for soldering conditions for surface mounted devices (SMD). Refer to wave profile for soldering conditions for through hole devices (DIP).

| ELECTRICAL CHARACTERISTICS ($T_{amb}$ = 25 °C, unless otherwise specified) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PARAMETER** | **TEST CONDITION** | **PART** | **SYMBOL** | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| **INPUT** | | | | | | | |
| Forward voltage | $I_F$ = 60 mA | | $V_F$ | | 1.25 | 1.65 | V |
| Reverse current | $V_R$ = 6 V | | $I_R$ | | 0.01 | 10 | µA |
| Capacitance | $V_R$ = 0 V, f = 1 MHz | | $C_O$ | | 13 | | pF |
| Thermal resistance | | | $R_{thja}$ | | 750 | | K/W |
| **OUTPUT** | | | | | | | |
| Collector emitter capacitance | $V_{CE}$ = 5 V, f = 1 MHz | | $C_{CE}$ | | 5.2 | | pF |
| Thermal resistance | | | $R_{thja}$ | | 500 | | K/W |
| Collector emitter leakage current | $V_{CE}$ = 10 V | SFH610A-1 | $I_{CEO}$ | | 2 | 50 | nA |
| | | SFH6106-1 | $I_{CEO}$ | | 2 | 50 | nA |
| | | SFH610A-2 | $I_{CEO}$ | | 2 | 50 | nA |
| | | SFH6106-2 | $I_{CEO}$ | | 2 | 50 | nA |
| | | SFH610A-3 | $I_{CEO}$ | | 5 | 100 | nA |
| | | SFH6106-3 | $I_{CEO}$ | | 5 | 100 | nA |
| | | SFH610A-4 | $I_{CEO}$ | | 5 | 100 | nA |
| | | SFH6106-4 | $I_{CEO}$ | | 5 | 100 | nA |
| | | SFH610A-5 | $I_{CEO}$ | | 5 | 100 | nA |
| | | SFH6106-5T | $I_{CEO}$ | | 5 | 100 | nA |

| ELECTRICAL CHARACTERISTICS ($T_{amb}$ = 25 °C, unless otherwise specified) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PARAMETER** | **TEST CONDITION** | **PART** | **SYMBOL** | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| **COUPLER** | | | | | | | |
| Collector emitter saturation voltage | $I_F$ = 10 mA, $I_C$ = 2.5 mA | | $V_{CEsat}$ | | 0.25 | 0.4 | V |
| Coupling capacitance | f = 1 MHz | | $C_C$ | | 0.4 | | 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 | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PARAMETER** | **TEST CONDITION** | **PART** | **SYMBOL** | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| $I_C/I_F$ | $I_F$ = 10 mA, $V_{CE}$ = 5.0 V | SFH610A-1 | CTR | 40 | | 80 | % |
| | | SFH6106-1 | CTR | 40 | | 80 | % |
| | | SFH610A-2 | CTR | 63 | | 125 | % |
| | | SFH6106-2 | CTR | 63 | | 125 | % |
| | | SFH610A-3 | CTR | 100 | | 200 | % |
| | | SFH6106-3 | CTR | 100 | | 200 | % |
| | | SFH610A-4 | CTR | 160 | | 320 | % |
| | | SFH6106-4 | CTR | 160 | | 320 | % |
| | | SFH610A-5 | CTR | 250 | | 500 | % |
| | | SFH6106-5T | CTR | 250 | | 500 | % |
| | $I_F$ = 1 mA, $V_{CE}$ = 5 V | SFH610A-1 | CTR | 13 | 30 | | % |
| | | SFH6106-1 | CTR | 13 | 30 | | % |
| | | SFH610A-2 | CTR | 22 | 45 | | % |
| | | SFH6106-2 | CTR | 22 | 45 | | % |
| | | SFH610A-3 | CTR | 34 | 70 | | % |
| | | SFH6106-3 | CTR | 34 | 70 | | % |
| | | SFH610A-4 | CTR | 56 | 90 | | % |
| | | SFH6106-4 | CTR | 56 | 90 | | % |

| SWITCHING CHARACTERISTICS | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PARAMETER** | **TEST CONDITION** | **PART** | **SYMBOL** | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| **NON-SATURATED** | | | | | | | |
| Current | $V_{CC}$ = 5 V, $R_L$ = 75 Ω | | $I_F$ | | 10 | | mA |
| Rise time | $V_{CC}$ = 5 V, $R_L$ = 75 Ω | | $t_r$ | | 2 | | µs |
| Fall time | $V_{CC}$ = 5 V, $R_L$ = 75 Ω | | $t_f$ | | 2 | | µs |
| Turn-on time | $V_{CC}$ = 5 V, $R_L$ = 75 Ω | | $t_{on}$ | | 3 | | µs |
| Turn-off time | $V_{CC}$ = 5 V, $R_L$ = 75 Ω | | $t_{off}$ | | 2.3 | | µs |
| Cut-off frequency | $V_{CC}$ = 5 V | | $F_{CO}$ | | 250 | | kHz |
| **SATURATED** | | | | | | | |
| Current | | SFH610A-1 | $I_F$ | | 20 | | mA |
| | | SFH6106-1 | | | | | |
| | | SFH610A-2 | $I_F$ | | 10 | | mA |
| | | SFH6106-2 | | | | | |
| | | SFH610A-3 | $I_F$ | | 10 | | mA |
| | | SFH6106-3 | | | | | |
| | | SFH610A-4 | $I_F$ | | 5 | | mA |
| | | SFH6106-4 | | | | | |

| SWITCHING CHARACTERISTICS | | | | | | | |
|---|---|---|---|---|---|---|---|
| PARAMETER | TEST CONDITION | PART | SYMBOL | MIN. | TYP. | MAX. | UNIT |
| SATURATED | | | | | | | |
| Rise time | | SFH610A-1 | $t_r$ | | 2 | | µs |
| | | SFH6106-1 | | | | | |
| | | SFH610A-2 | $t_r$ | | 3 | | µs |
| | | SFH6106-2 | | | | | |
| | | SFH610A-3 | $t_r$ | | 3 | | µs |
| | | SFH6106-3 | | | | | |
| | | SFH610A-4 | $t_r$ | | 4 | | µs |
| | | SFH6106-4 | | | | | |
| Fall time | | SFH610A-1 | $t_f$ | | 11 | | µs |
| | | SFH6106-1 | | | | | |
| | | SFH610A-2 | $t_f$ | | 14 | | µs |
| | | SFH6106-2 | | | | | |
| | | SFH610A-3 | $t_f$ | | 14 | | µs |
| | | SFH6106-3 | | | | | |
| | | SFH610A-4 | $t_f$ | | 15 | | µs |
| | | SFH6106-4 | | | | | |
| Turn-on time | | SFH610A-1 | $t_{on}$ | | 3 | | µs |
| | | SFH6106-1 | | | | | |
| | | SFH610A-2 | $t_{on}$ | | 4.2 | | µs |
| | | SFH6106-2 | | | | | |
| | | SFH610A-3 | $t_{on}$ | | 4.2 | | µs |
| | | SFH6106-3 | | | | | |
| | | SFH610A-4 | $t_{on}$ | | 6 | | µs |
| | | SFH6106-4 | | | | | |
| Turn-off time | | SFH610A-1 | $t_{off}$ | | 18 | | µs |
| | | SFH6106-1 | | | | | |
| | | SFH610A-2 | $t_{off}$ | | 23 | | µs |
| | | SFH6106-2 | | | | | |
| | | SFH610A-3 | $t_{off}$ | | 23 | | µs |
| | | SFH6106-3 | | | | | |
| | | SFH610A-4 | $t_{off}$ | | 25 | | µs |
| | | SFH6106-4 | | | | | |

**Note**

- All values presented are typical values.

| SAFETY AND INSULATIO RATINGS | | | | | | |
|---|---|---|---|---|---|---|
| **PARAMETER** | **TEST CONDITION** | **SYMBOL** | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| Climatic classification (according to IEC 68 part 1) | | | | 55/100/21 | | |
| Comparative tracking index | | CTI | 175 | | 399 | |
| $V_{IOTM}$ | | | 10000 | | | V |
| $V_{IORM}$ | | | 890 | | | V |
| $P_{SO}$ | | | | | 400 | mW |
| $I_{SI}$ | | | | | 275 | mA |
| $T_{SI}$ | | | | | 175 | °C |
| Creepage distance | standard DIP-4 | | 7 | | | mm |
| Clearance distance | standard DIP-4 | | 7 | | | mm |
| Creepage distance | 400 mil DIP-4 | | 8 | | | mm |
| Clearance distance | 400 mil DIP-4 | | 8 | | | mm |
| Insulation thickness, reinforced rated | per IEC 60950 2.10.5.1 | | 0.4 | | | mm |

**Note**

- As per IEC 60747-5-2, § 7.4.3.8.1, 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)

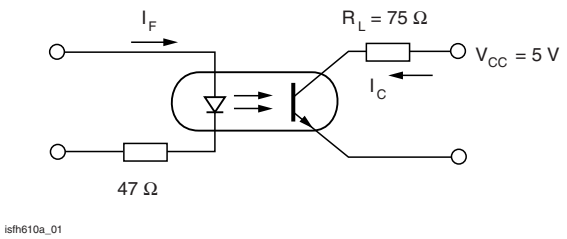



Fig. 1 - Linear Operation (without saturation)

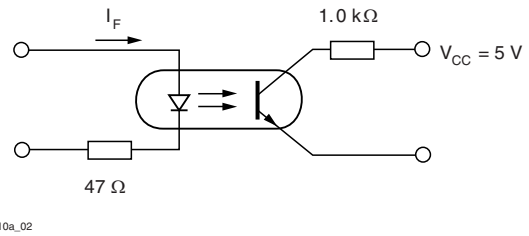



Fig. 3 - Switching Operation (with saturation)

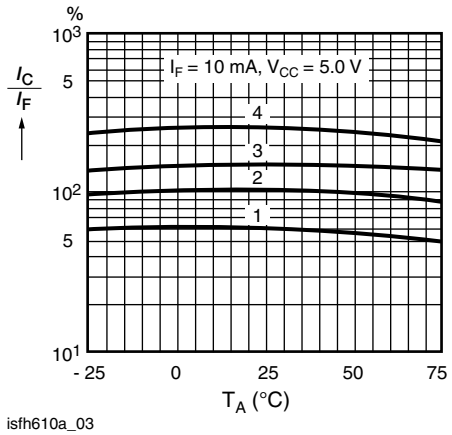



Fig. 2 - Current Transfer Ratio (CTR) vs. Temperature

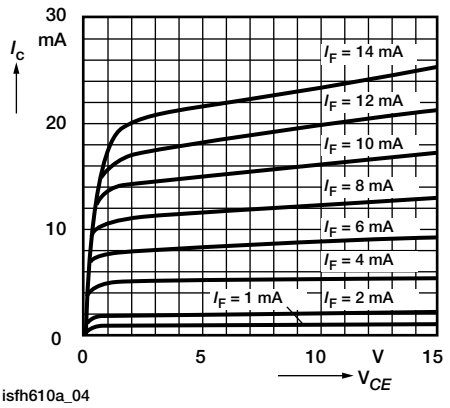



Fig. 4 - Output Characteristics (typ.) Collector Current vs. Collector Emitter Voltage

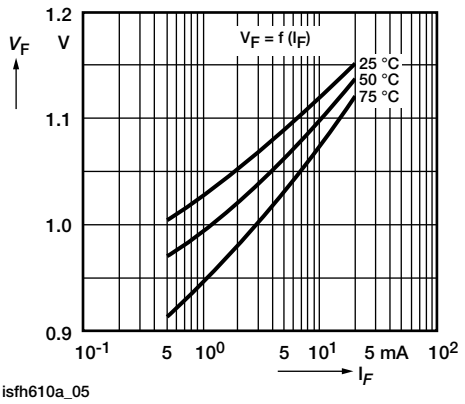



Fig. 5 - Diode Forward Voltage vs. Forward Current

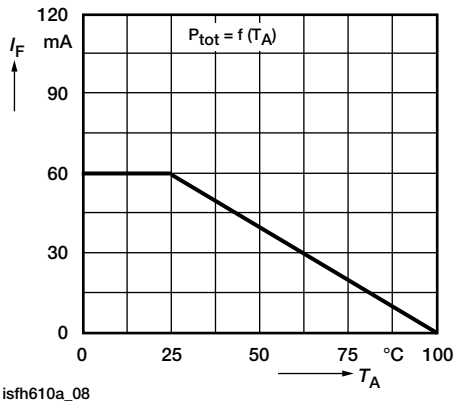



Fig. 8 - Permissible Power Dissipation vs. Temperature

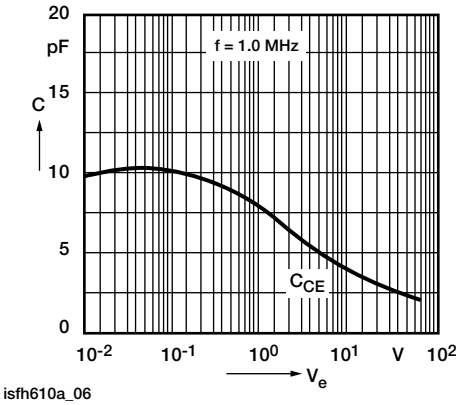



Fig. 6 - Transistor Capacitance (typ.) vs. Collector Emitter Voltage

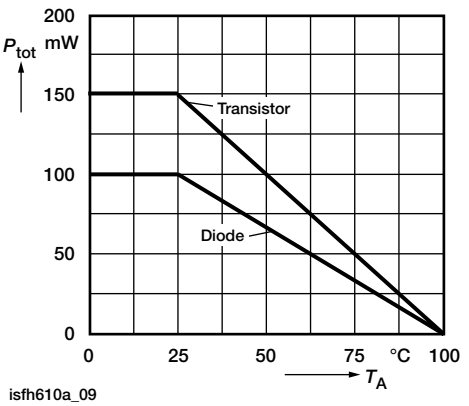



Fig. 9 - Permissible Diode Forward Current vs. Ambient Temperature

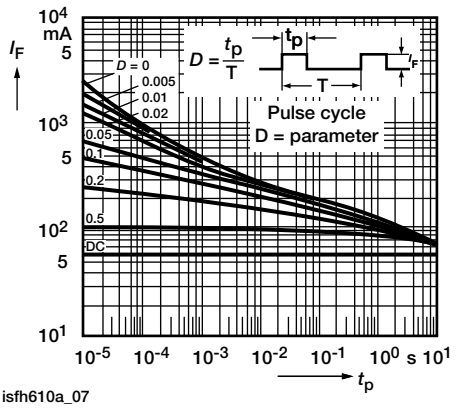
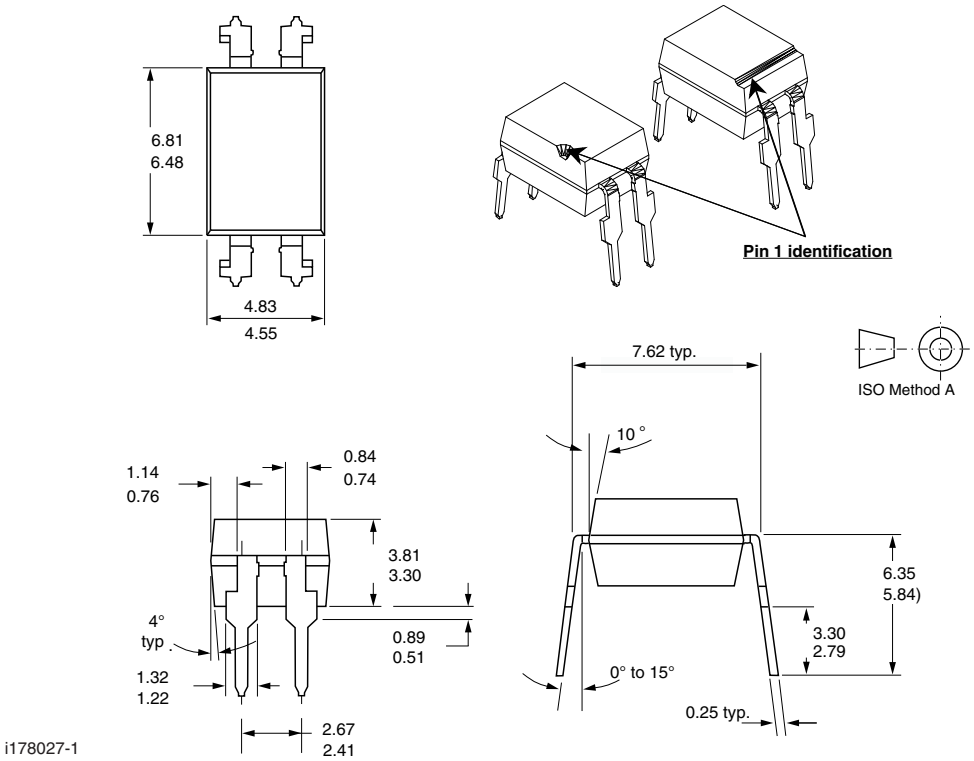
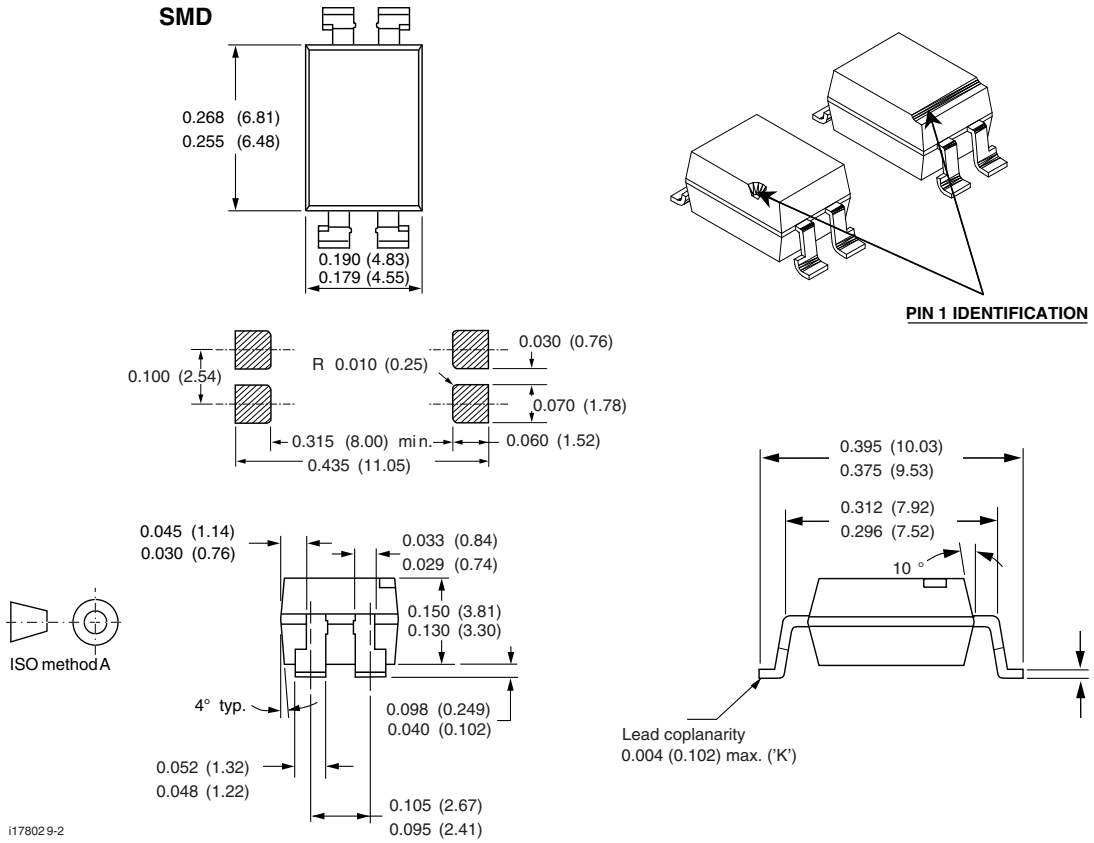



Fig. 7 - Permissible Pulse Handling Capability Forward Current vs. Pulse Width

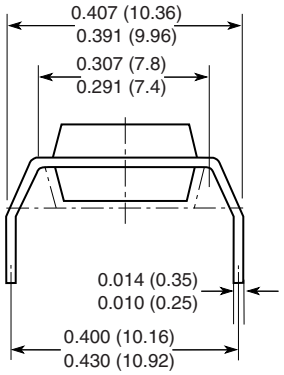
**PACKAGE DIMENSIONS** in inches (millimeters)



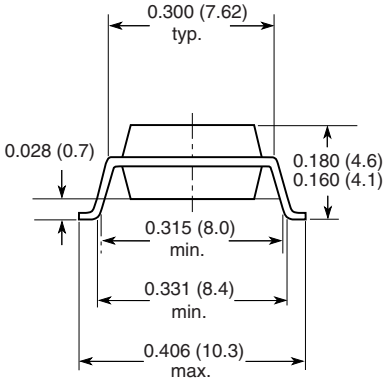

**SMD**



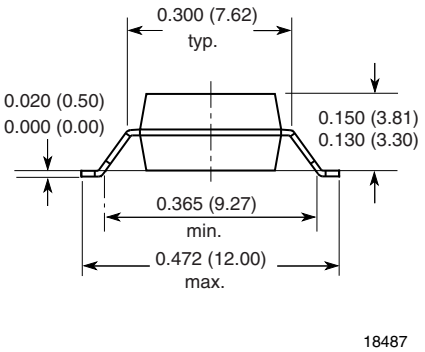
**Option 6**




**Option 7**




**Option 8**



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