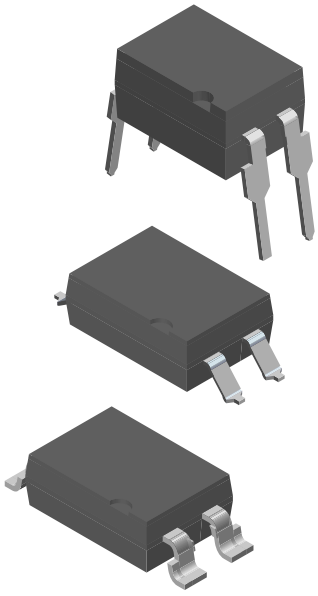
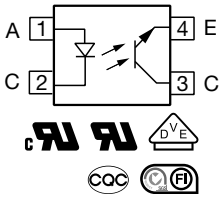
# Optocoupler, Phototransistor Output, High Reliability, 5300 $V_{RMS}$






## DESCRIPTION

The SFH610A and SFH6106 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 and option 8. 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.

## 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
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free

e3

RoHS COMPLIANT

## AGENCY APPROVALS

- UL
- cUL
- DIN EN 60747-5-5 (VDE 0804), available with option 1
- BSI
- CQC
- FIMKO

## LINKS TO ADDITIONAL RESOURCES

Product Page | Design Tools | SPICE Models

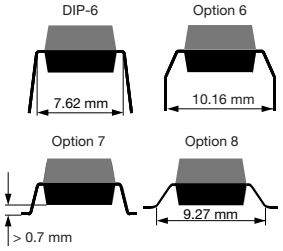


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## ORDERING INFORMATION

| S | F | H | 6 | 1 | 0 | x | - | # | X | 0 | # | # | T |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PART NUMBER | | | | | | | | CTR BIN | PACKAGE OPTION | | | | TAPE AND REEL |




| AGENCY CERTIFIED / PACKAGE | CTR (%) | | | | |
|---|---|---|---|---|---|
| **UL, cUL, BSI, FIMKO, CQC** | **40 to 80** | **63 to 125** | **100 to 200** | **160 to 320** | **250 to 500** |
| DIP-4 | SFH610A-1 | SFH610A-2 | SFH610A-3 | SFH610A-4 | SFH610A-5 |
| DIP-4, 400 mil, option 6 | - | SFH610A-2X006 | SFH610A-3X006 | - | - |
| SMD-4 | SFH6106-1T (1) | SFH6106-2T (1) | SFH6106-3T (1) | SFH6106-4T (1) | SFH6106-5T |
| SMD-4, option 7 | - | - | SFH610A-3X007T | - | - |
| SMD-4, 400 mil, option 8 | - | - | - | SFH610A-4X008T | - |
| **UL, cUL, BSI, FIMKO, CQC, VDE (option 1)** | **40 to 80** | **63 to 125** | **100 to 200** | **160 to 320** | **250 to 500** |
| DIP-4 | SFH610A-1X001 | SFH610A-2X001 | SFH610A-3X001 | SFH610A-4X001 | - |
| DIP-4, 400 mil, option 6 | SFH610A-1X016 | - | SFH610A-3X016 | SFH610A-4X016 | - |
| SMD-4 | SFH6106-1X001T (1) | SFH6106-2X001T (1) | SFH6106-3X001T (1) | SFH6106-4X001T (1) | - |
| SMD-4, 400 mil, option 8 | SFH610A-1X018T | - | - | - | - |

**Notes**

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

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

## 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 | | $V_{CEO}$ | 70 | V |
| Emitter collector voltage | | $V_{ECO}$ | 7 | V |
| Collector current | | $I_C$ | 50 | mA |
| | $t_p$ ≤ 1.0 ms | $I_C$ | 100 | mA |
| Power dissipation | | $P_{diss}$ | 150 | mW |
| coupler | | | | |
| 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.

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


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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 | $I_F$ = 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 |
| | | SFH6106-5 | $I_{CEO}$ | - | 5 | 100 | nA |
| **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 | - | % |


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| 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<br>SFH6106-1 | $I_F$ | - | 20 | - | mA |
| | | SFH610A-2<br>SFH6106-2 | $I_F$ | - | 10 | - | mA |
| | | SFH610A-3<br>SFH6106-3 | $I_F$ | - | 10 | - | mA |
| | | SFH610A-4<br>SFH6106-4 | $I_F$ | - | 5 | - | mA |
| **SATURATED** | | | | | | | |
| Rise time | | SFH610A-1<br>SFH6106-1 | $t_r$ | - | 2 | - | µs |
| | | SFH610A-2<br>SFH6106-2 | $t_r$ | - | 3 | - | µs |
| | | SFH610A-3<br>SFH6106-3 | $t_r$ | - | 3 | - | µs |
| | | SFH610A-4<br>SFH6106-4 | $t_r$ | - | 4 | - | µs |
| Fall time | | SFH610A-1<br>SFH6106-1 | $t_f$ | - | 11 | - | µs |
| | | SFH610A-2<br>SFH6106-2 | $t_f$ | - | 14 | - | µs |
| | | SFH610A-3<br>SFH6106-3 | $t_f$ | - | 14 | - | µs |
| | | SFH610A-4<br>SFH6106-4 | $t_f$ | - | 15 | - | µs |
| Turn-on time | | SFH610A-1<br>SFH6106-1 | $t_{on}$ | - | 3 | - | µs |
| | | SFH610A-2<br>SFH6106-2 | $t_{on}$ | - | 4.2 | - | µs |
| | | SFH610A-3<br>SFH6106-3 | $t_{on}$ | - | 4.2 | - | µs |
| | | SFH610A-4<br>SFH6106-4 | $t_{on}$ | - | 6 | - | µs |
| Turn-off time | | SFH610A-1<br>SFH6106-1 | $t_{off}$ | - | 18 | - | µs |
| | | SFH610A-2<br>SFH6106-2 | $t_{off}$ | - | 23 | - | µs |
| | | SFH610A-3<br>SFH6106-3 | $t_{off}$ | - | 23 | - | µs |
| | | SFH610A-4<br>SFH6106-4 | $t_{off}$ | - | 25 | - | µs |

**Note**

- All values presented are typical values



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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 | |
| Comparative tracking index | Insulation group IIIa | CTI | 175 | |
| Maximum rated withstanding isolation voltage | According to UL1577, t = 1 min | $V_{ISO}$ | 4420 | $V_{RMS}$ |
| Tested withstanding isolation voltage | According to UL1577, t = 1 s | $V_{ISO}$ | 5300 | $V_{RMS}$ |
| Maximum transient isolation voltage | According to DIN EN 60747-5-5 | $V_{IOTM}$ | 10 000 | V |
| Maximum repetitive peak isolation voltage | According to DIN EN 60747-5-5 | $V_{IORM}$ | 890 | V |
| Isolation resistance | $V_{IO}$ = 500 V, $T_{amb}$ = 25 °C | $R_{IO}$ | $\geq 10^{12}$ | Ω |
| | $V_{IO}$ = 500 V, $T_{amb}$ = 100 °C | $R_{IO}$ | $\geq 10^{11}$ | Ω |
| Output safety power | | $P_{SO}$ | 400 | mW |
| Input safety current | | $I_{SI}$ | 275 | mA |
| Input safety temperature | | $T_{SI}$ | 175 | °C |
| Creepage distance | DIP-4 / SMD-4 | | ≥ 7 | mm |
| Clearance distance | | | ≥ 7 | mm |
| Creepage distance | DIP-4, 400 mil / SMD-4, 400 mil | | ≥ 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)

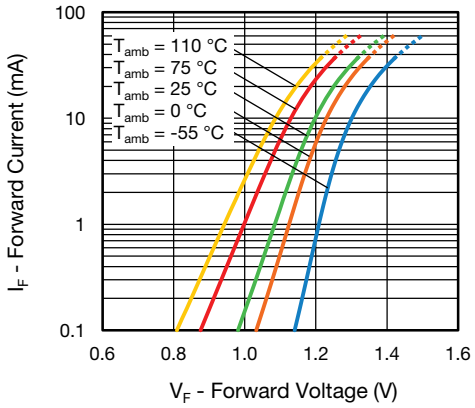



Fig. 1 - Forward Voltage vs. Forward Current

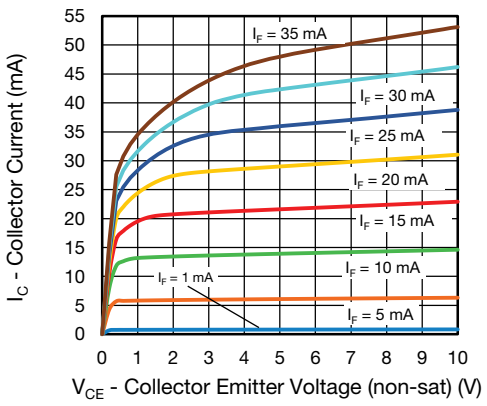



Fig. 2 - Collector Current vs. Collector Emitter Voltage (NS)



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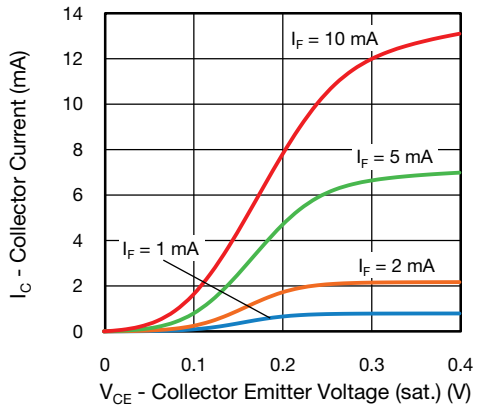



Fig. 3 - Collector Current vs. Collector Emitter Voltage (saturated)

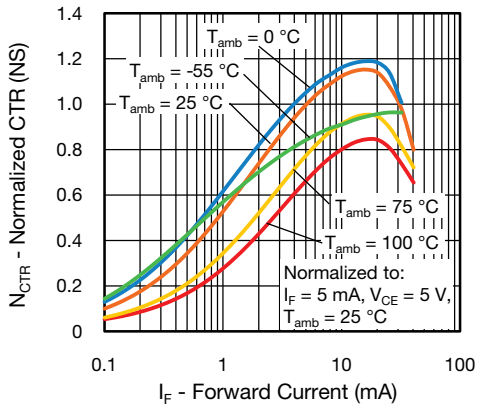



Fig. 6 - Normalized CTR (non-saturated) vs. Forward Current

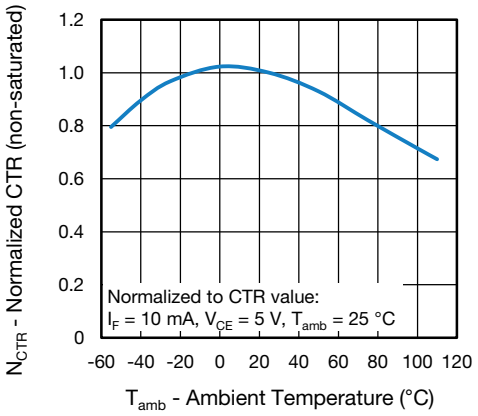



Fig. 4 - Normalized Current Transfer Ratio (non-saturated) vs. Ambient Temperature

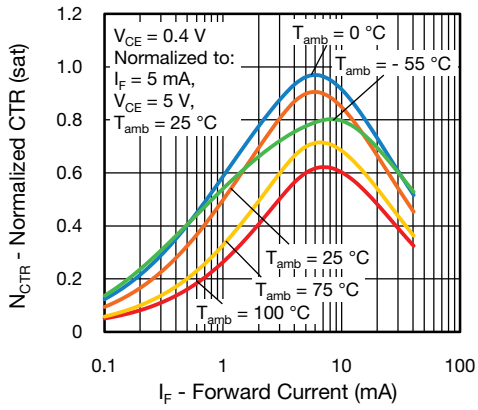



Fig. 7 - Normalized CTR (saturated) vs. Forward Current

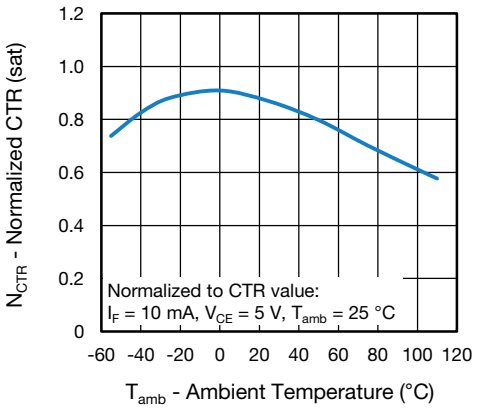



Fig. 5 - Normalized Current Transfer Ratio (saturated) vs. Ambient Temperature

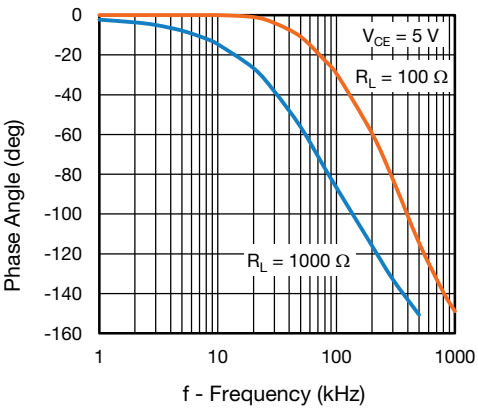



Fig. 8 - Phase Angle vs. Frequency


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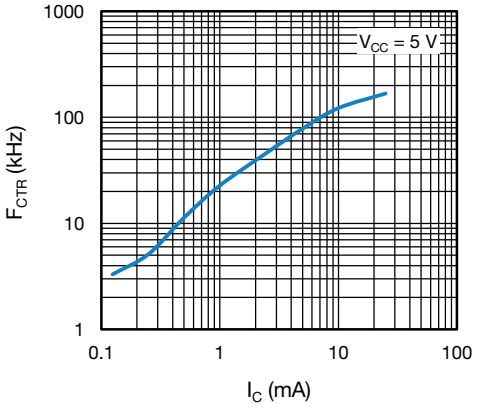



Fig. 9 - CTR Frequency vs. Collector Current

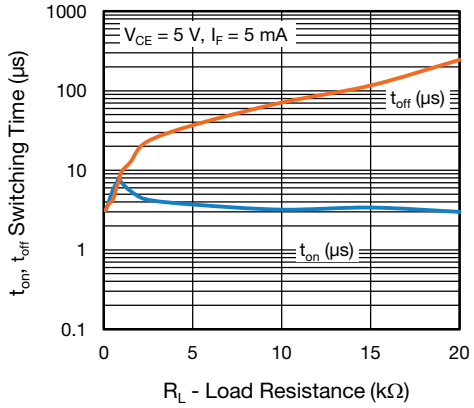



Fig. 10 - Switching Time vs. Load Resistance

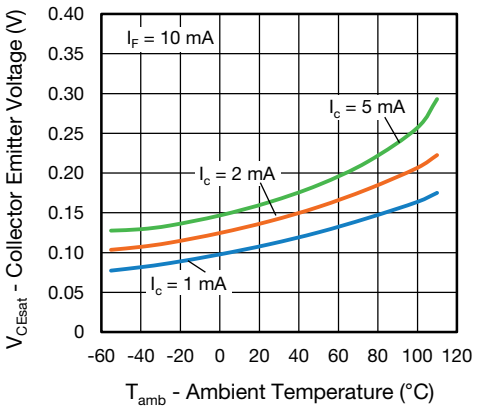
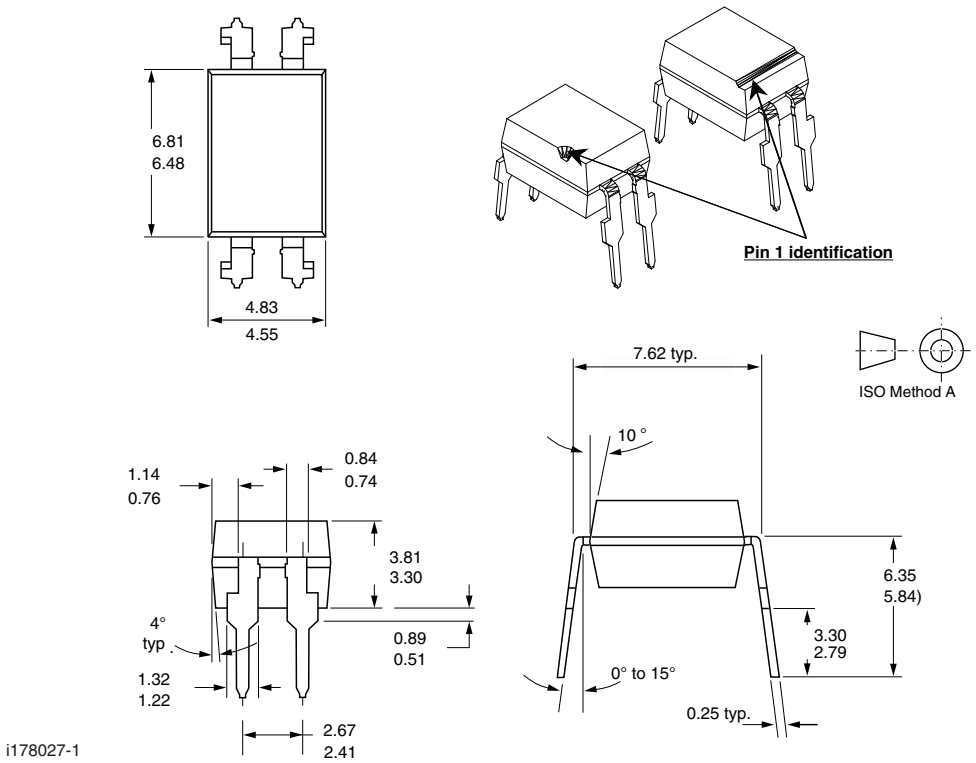


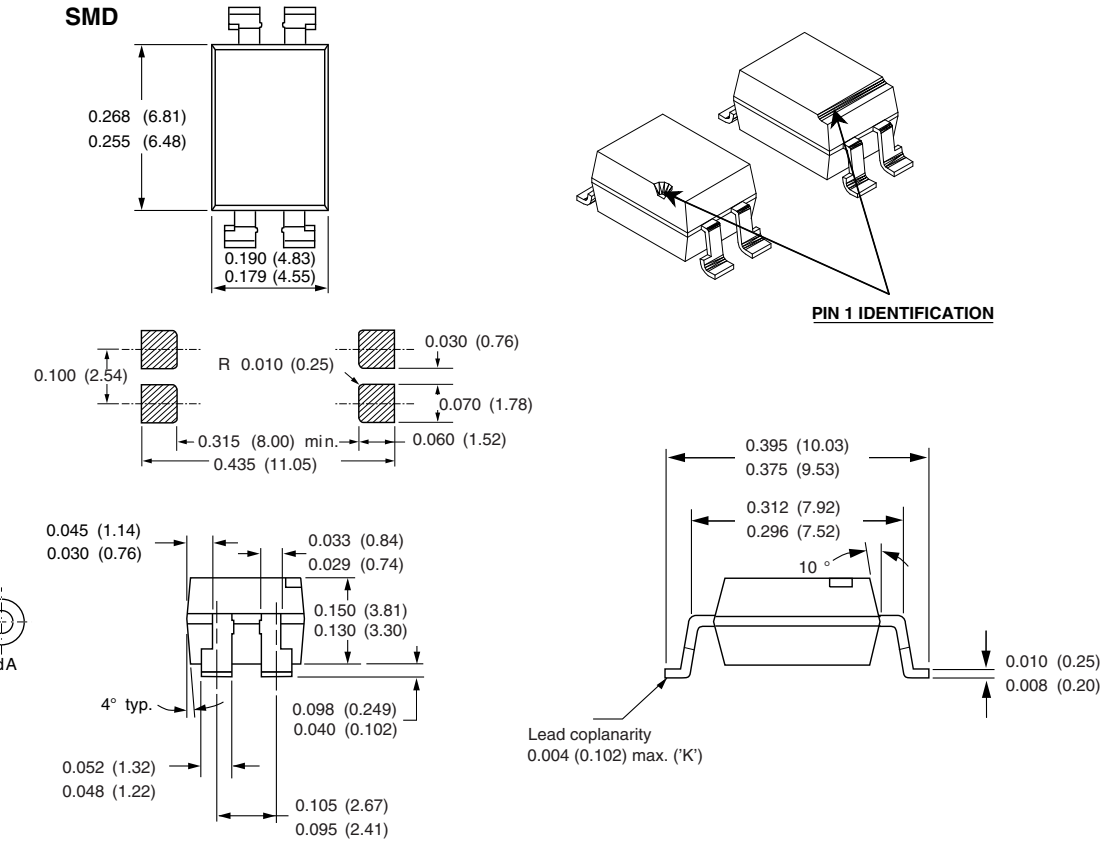

Fig. 11 - Collector Emitter Voltage vs. Ambient Temperature (saturated)


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**PACKAGE DIMENSIONS** in inches (millimeters)




**SMD**

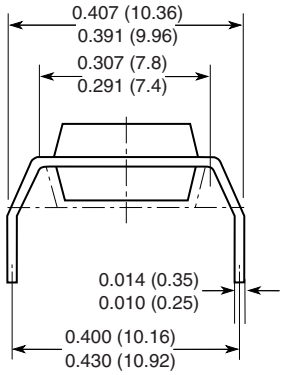




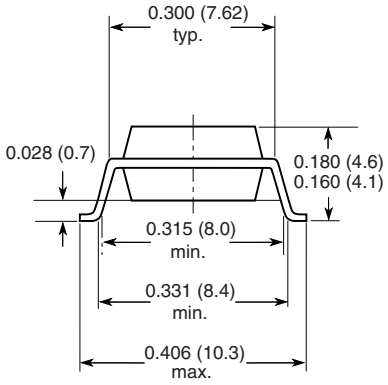

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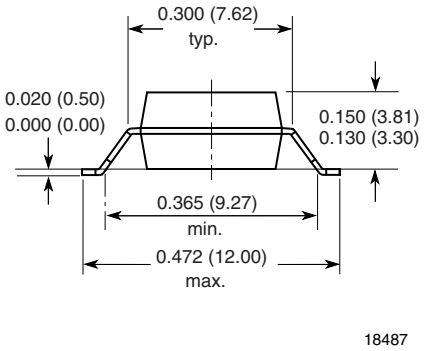
**Option 6**



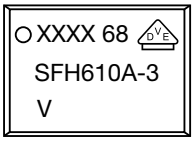

**Option 7**




**Option 8**




**PACKAGE MARKING** (example of SFH610A-3X001)




**Notes**

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


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