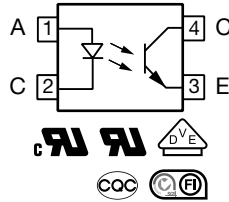
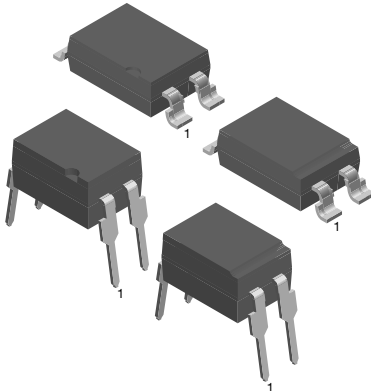


# Optocoupler, Phototransistor Output, Low Input Current



## FEATURES

- Good CTR linearity depending on forward current
- Low CTR degradation
- High collector emitter voltage,  $V_{CE0} = 55\text{ V}$
- Isolation test voltage, 5300  $V_{RMS}$
- Low coupling capacitance
- End stackable, 0.100" (2.54 mm) spacing
- High common mode transient immunity
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS**  
COMPLIANT

## APPLICATIONS

- Telecom
- Industrial controls
- Battery powered equipment
- Office machines

## LINKS TO ADDITIONAL RESOURCES



## DESCRIPTION

The SFH618A (DIP) and SFH6186 (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 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 lead spacing. Creepage and clearance distances of > 8 mm achieved with option 6.

## AGENCY APPROVALS

The safety application model number covering all products in this datasheet is SFH618A. This model number should be used when consulting safety agency documents.

- [UL](#)
- [cUL](#)
- [DIN EN 60747-5-5 \(VDE 0884-5\) available with option 1](#)
- [BSI](#)
- [CQC](#)
- [FIMKO](#)

| ORDERING INFORMATION  |                           |   |                           |   |                     |
|---|---------------------------|---|---------------------------|---|---------------------|
| <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="border: 1px solid black; padding: 2px 5px;">S</div> <div style="border: 1px solid black; padding: 2px 5px;">F</div> <div style="border: 1px solid black; padding: 2px 5px;">H</div> <div style="border: 1px solid black; padding: 2px 5px;">6</div> <div style="border: 1px solid black; padding: 2px 5px;">1</div> <div style="border: 1px solid black; padding: 2px 5px;">8</div> <div style="border: 1px solid black; padding: 2px 5px;">#</div> <div style="border: 1px solid black; padding: 2px 5px;">-</div> <div style="border: 1px solid black; padding: 2px 5px;">#</div> <div style="border: 1px solid black; padding: 2px 5px;">X</div> <div style="border: 1px solid black; padding: 2px 5px;">0</div> <div style="border: 1px solid black; padding: 2px 5px;">#</div> <div style="border: 1px solid black; padding: 2px 5px;">#</div> <div style="border: 1px solid black; padding: 2px 5px;">T</div> </div> | PART NUMBER               |   | CTR<br>BIN                | PACKAGE<br>OPTION                       | TAPE<br>AND<br>REEL |
|   |                           |   |                           |   |                     |
| AGENCY CERTIFIED / PACKAGE  | CTR (%)                   |   |                           |   |                     |
|   | 1 mA                      |   |                           |   |                     |
| <b>UL, cUL, BSI, FIMKO</b>  | <b>63 to 125</b>          | <b>100 to 200</b>                               | <b>160 to 320</b>         | <b>250 to 500</b>                       |                     |
| DIP-4   | SFH618A-2                 | SFH618A-3                                       | SFH618A-4                 | SFH618A-5                               |                     |
| DIP-4, 400 mil, option 6  | -                         | SFH618A-3X006                                   | -                         | -                                       |                     |
| SMD-4, option 7   | -                         | -   | -                         | SFH618A-5X007T <sup>(1)</sup>           |                     |
| SMD-4, option 9   | SFH6186-2T <sup>(1)</sup> | SFH6186-3T <sup>(1)</sup> , SFH6186-3T1         | SFH6186-4T <sup>(1)</sup> | SFH6186-5T <sup>(1)</sup> , SFH6186-5T1 |                     |
| <b>UL, cUL, BSI, FIMKO, VDE (option 1)</b>  | <b>63 to 125</b>          | <b>100 to 200</b>                               | <b>160 to 320</b>         | <b>250 to 500</b>                       |                     |
| DIP-4   | -                         | SFH618A-3X001                                   | SFH618A-4X001             | -                                       |                     |
| DIP-4, 400 mil, option 6  | -                         | SFH618A-3X016                                   | SFH618A-4X016             | SFH618A-5X016                           |                     |
| SMD-4, option 7   | -                         | SFH618A-3X017T <sup>(1)</sup>                   | -                         | SFH618A-5X017T <sup>(1)</sup>           |                     |
| SMD-4, option 9   | -                         | SFH6186-3X001T <sup>(1)</sup> , SFH6186-3X001T1 | SFH6186-4X001T            | SFH6186-5X001T <sup>(1)</sup>           |                     |

## Notes

- Additional options may be possible, please contact sales office
- <sup>(1)</sup> Also available in tubes, do not put T to the end



| <b>ABSOLUTE MAXIMUM RATINGS</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified) |   |            |             |                    |
|--|---|------------|-------------|--------------------|
| PARAMETER  | TEST CONDITION  | SYMBOL     | VALUE       | UNIT               |
| <b>INPUT</b>   |   |            |             |                    |
| Reverse voltage  |   | $V_R$      | 6           | V                  |
| Power dissipation  |   | $P_{diss}$ | 70          | mW                 |
| Forward current  |   | $I_F$      | 60          | mA                 |
| <b>OUTPUT</b>  |   |            |             |                    |
| Collector emitter voltage  |   | $V_{CEO}$  | 55          | V                  |
| Emitter collector voltage  |   | $V_{ECO}$  | 7           | V                  |
| Collector current  |   | $I_C$      | 50          | mA                 |
|  | $t_p \leq 1\text{ ms}$  | $I_C$      | 100         | mA                 |
| Power dissipation  |   | $P_{diss}$ | 150         | mW                 |
| <b>COUPLER</b>   |   |            |             |                    |
| Storage temperature range  |   | $T_{stg}$  | -55 to +150 | $^{\circ}\text{C}$ |
| Ambient temperature range  |   | $T_{amb}$  | -55 to +100 | $^{\circ}\text{C}$ |
| Junction temperature   |   | $T_j$      | 125         | $^{\circ}\text{C}$ |
| Soldering temperature  | max. 10 s, dip soldering distance to seating plane $\geq 1.5\text{ mm}$ | $T_{sld}$  | 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.



Fig. 1 - Permissible Power Dissipation vs. Ambient Temperature



| <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  | $I_F = 5\text{ mA}$                       |           | $V_F$       | -    | 1.1  | 1.5  | V             |
| Reverse current  | $V_R = 6\text{ V}$                        |           | $I_R$       | -    | 0.01 | 10   | $\mu\text{A}$ |
| Capacitance  | $V_R = 0\text{ V}, f = 1\text{ MHz}$      |           | $C_O$       | -    | 25   | -    | pF            |
| Thermal resistance   |   |           | $R_{thja}$  | -    | 1070 | -    | K/W           |
| <b>OUTPUT</b>  |   |           |             |      |      |      |               |
| Collector emitter leakage current  | $V_{CE} = 10\text{ V}$                    |           | $I_{CEO}$   | -    | 10   | 200  | nA            |
| Collector emitter capacitance  | $V_{CE} = 5\text{ V}, f = 1\text{ MHz}$   |           | $C_{CE}$    | -    | 7    | -    | pF            |
| Thermal resistance   |   |           | $R_{thja}$  | -    | 500  | -    | K/W           |
| <b>COUPLER</b>   |   |           |             |      |      |      |               |
| Collector emitter saturation voltage   | $I_C = 0.32\text{ mA}, I_F = 1\text{ mA}$ | SFH618A-2 | $V_{CEsat}$ | -    | 0.25 | 0.4  | V             |
|  |   | SFH6186-2 | $V_{CEsat}$ | -    | 0.25 | 0.4  | V             |
|  | $I_C = 0.5\text{ mA}, I_F = 1\text{ mA}$  | SFH618A-3 | $V_{CEsat}$ | -    | 0.25 | 0.4  | V             |
|  |   | SFH6186-3 | $V_{CEsat}$ | -    | 0.25 | 0.4  | V             |
|  | $I_C = 0.8\text{ mA}, I_F = 1\text{ mA}$  | SFH618A-4 | $V_{CEsat}$ | -    | 0.25 | 0.4  | V             |
|  |   | SFH6186-4 | $V_{CEsat}$ | -    | 0.25 | 0.4  | V             |
|  | $I_C = 1.25\text{ mA}, I_F = 1\text{ mA}$ | SFH618A-5 | $V_{CEsat}$ | -    | 0.25 | 0.4  | V             |
|  |   | SFH6186-5 | $V_{CEsat}$ | -    | 0.25 | 0.4  | V             |
| Coupling capacitance   |   |           | $C_C$       | -    | 0.25 | -    | 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 |
| $I_C/I_F$  | $I_F = 1\text{ mA}, V_{CE} = 0.5\text{ V}$   | SFH618A-2 | CTR    | 63   | -    | 125  | %    |
|  |  | SFH6186-2 | CTR    | 63   | -    | 125  | %    |
|  | $I_F = 0.5\text{ mA}, V_{CE} = 1.5\text{ V}$ | SFH618A-2 | CTR    | 32   | 75   | -    | %    |
|  |  | SFH6186-2 | CTR    | 32   | 75   | -    | %    |
|  | $I_F = 1\text{ mA}, V_{CE} = 0.5\text{ V}$   | SFH618A-3 | CTR    | 100  | -    | 200  | %    |
|  |  | SFH6186-3 | CTR    | 100  | -    | 200  | %    |
|  | $I_F = 0.5\text{ mA}, V_{CE} = 1.5\text{ V}$ | SFH618A-3 | CTR    | 50   | 120  | -    | %    |
|  |  | SFH6186-3 | CTR    | 50   | 120  | -    | %    |
|  | $I_F = 1\text{ mA}, V_{CE} = 0.5\text{ V}$   | SFH618A-4 | CTR    | 160  | -    | 320  | %    |
|  |  | SFH6186-4 | CTR    | 160  | -    | 320  | %    |
|  | $I_F = 0.5\text{ mA}, V_{CE} = 1.5\text{ V}$ | SFH618A-4 | CTR    | 80   | 200  | -    | %    |
|  |  | SFH6186-4 | CTR    | 80   | 200  | -    | %    |
|  | $I_F = 1\text{ mA}, V_{CE} = 0.5\text{ V}$   | SFH618A-5 | CTR    | 250  | -    | 500  | %    |
|  |  | SFH6186-5 | CTR    | 250  | -    | 500  | %    |
|  | $I_F = 0.5\text{ mA}, V_{CE} = 1.5\text{ V}$ | SFH618A-5 | CTR    | 125  | 300  | -    | %    |
|  |  | SFH6186-5 | CTR    | 125  | 300  | -    | %    |

| <b>SWITCHING CHARACTERISTICS</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified) |   |           |      |      |      |               |  |
|---|---|-----------|------|------|------|---------------|--|
| PARAMETER   | TEST CONDITION  | SYMBOL    | MIN. | TYP. | MAX. | UNIT          |  |
| Turn on time  | $V_{CC} = 5\text{ V}, I_C = 2\text{ mA}, R_L = 100\text{ }\Omega$ | $t_{on}$  | -    | 6    | -    | $\mu\text{s}$ |  |
| Rise time   | $V_{CC} = 5\text{ V}, I_C = 2\text{ mA}, R_L = 100\text{ }\Omega$ | $t_r$     | -    | 3.5  | -    | $\mu\text{s}$ |  |
| Turn off time   | $V_{CC} = 5\text{ V}, I_C = 2\text{ mA}, R_L = 100\text{ }\Omega$ | $t_{off}$ | -    | 5.5  | -    | $\mu\text{s}$ |  |
| Fall time   | $V_{CC} = 5\text{ V}, I_C = 2\text{ mA}, R_L = 100\text{ }\Omega$ | $t_f$     | -    | 5    | -    | $\mu\text{s}$ |  |

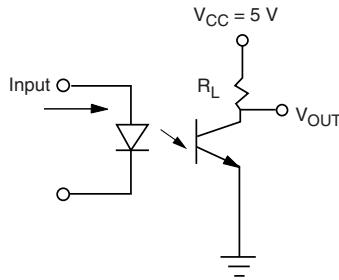


Fig. 2 - Test Circuit

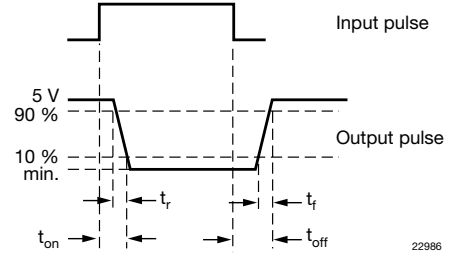


Fig. 3 - Parameter and Limit Definition

| 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>  | 4420               | V <sub>RMS</sub>  |
| Tested withstanding isolation voltage        | According to UL1577, t = 1 s                       | V <sub>ISO</sub>  | 5300               | V <sub>RMS</sub>  |
| Maximum transient isolation voltage          | According to DIN EN 60747-5-5                      | V <sub>IOTM</sub> | 10 000             | 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>   | 400                | mW                |
| Input safety current                         |  | I <sub>SI</sub>   | 400                | mA                |
| Input safety temperature                     |  | T <sub>SI</sub>   | 275                | °C                |
| Creepage distance                            | DIP-4  |                   | ≥ 7                | mm                |
| Clearance distance                           |  |                   | ≥ 7                | mm                |
| Creepage distance                            | DIP-4, 400 mil, option 6                           |                   | ≥ 8                | mm                |
| Clearance distance                           |  |                   | ≥ 8                | mm                |
| Creepage distance                            | SMD-4, option 7 and option 9                       |                   | ≥ 7                | mm                |
| Clearance distance                           |  |                   | ≥ 7                | mm                |
| Insulation thickness                         |  | DTI               | ≥ 0.4              | mm                |

**Note**

- As per DIN EN 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)

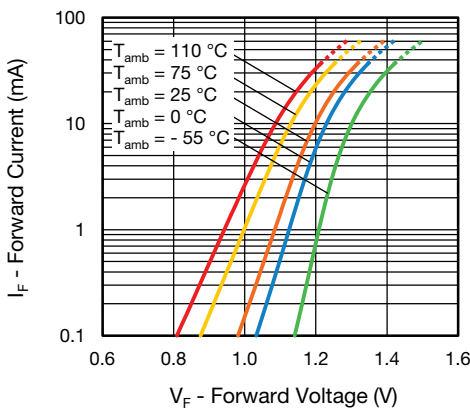


Fig. 4 - Forward Voltage vs. Forward Current

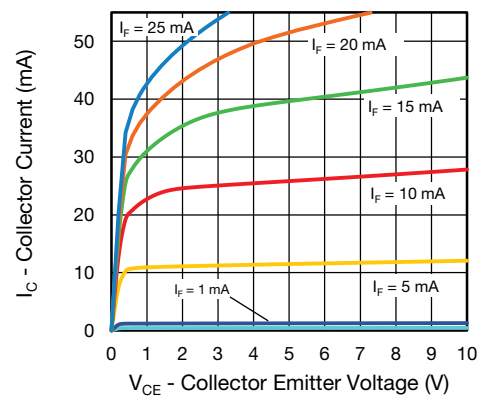


Fig. 5 - Collector Current vs. Collector Emitter Voltage

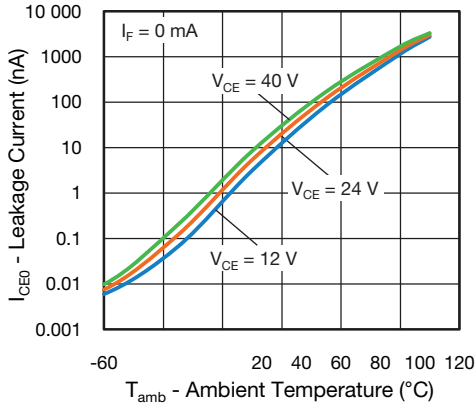


Fig. 6 - Collector-Emitter Current vs. Ambient Temperature

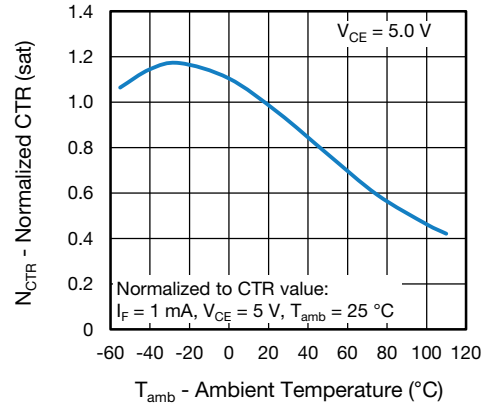


Fig. 9 - Normalized Current Transfer Ratio vs. Ambient Temperature (sat.)



Fig. 7 - Collector Current vs. Collector-Emitter Voltage

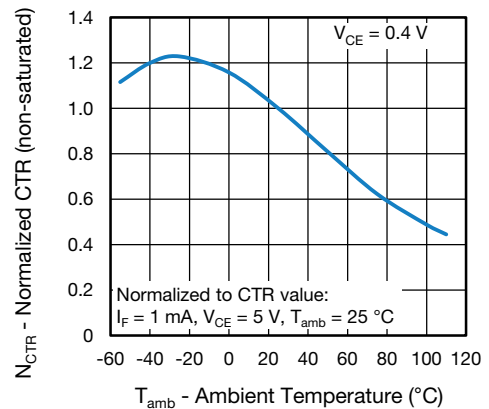


Fig. 10 - Normalized Current Transfer Ratio vs. Ambient Temperature (non-sat.)

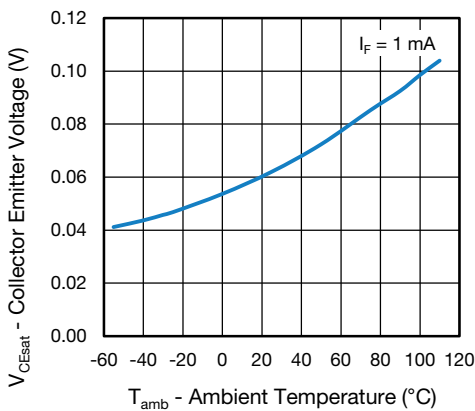


Fig. 8 - Collector-Emitter Voltage vs. Ambient Temperature

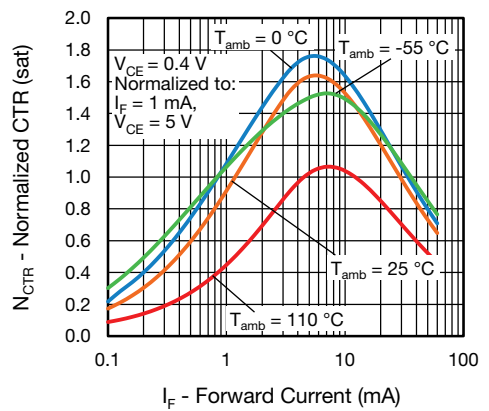


Fig. 11 - Current Transfer Ratio vs. Forward Current (sat.)

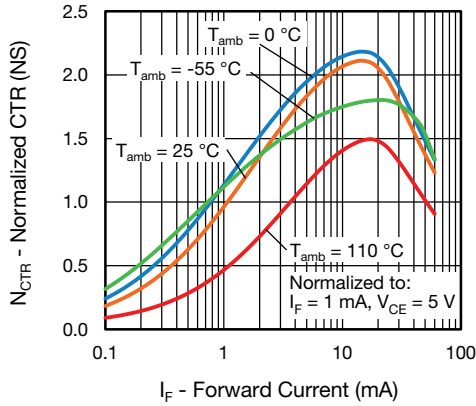


Fig. 12 - Current Transfer Ratio vs. Forward Current (non-sat.)



Fig. 15 - Switching Time vs. Load Resistance



Fig. 13 - Cut-Off Frequency vs. Collector Current



Fig. 16 - Voltage Gain vs. Frequency

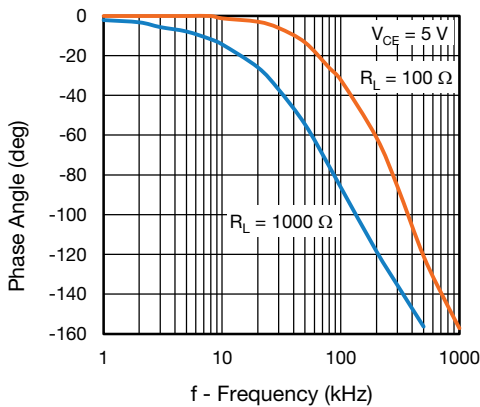
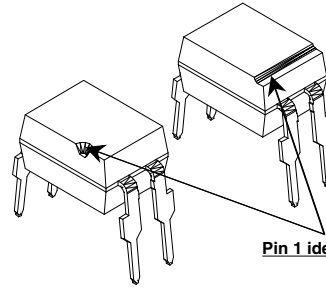
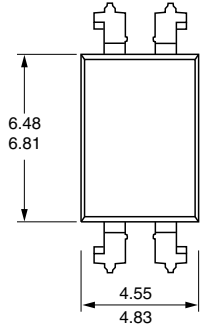


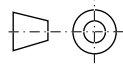
Fig. 14 - Phase Angle vs. Frequency



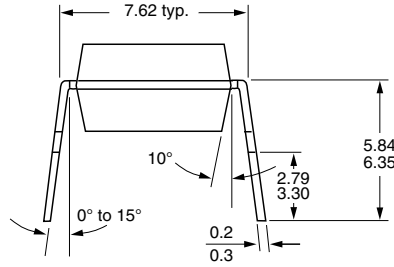
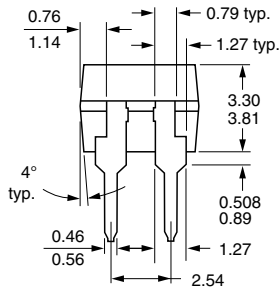
### PACKAGE DIMENSIONS (in millimeters)



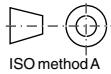
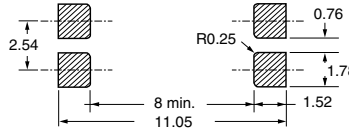
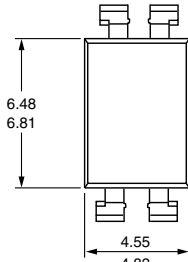
Pin 1 identification



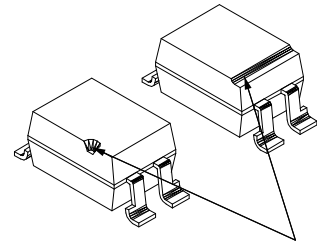
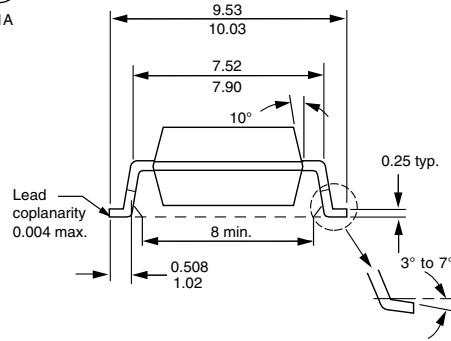
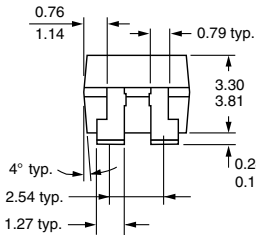
ISO method A



i178027-8

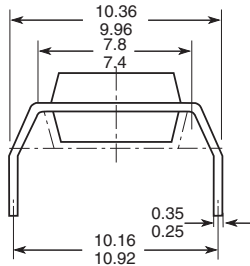


ISO method A



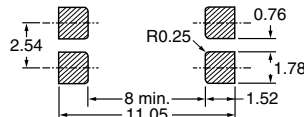
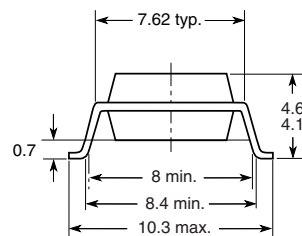
Pin 1 identification

#### Option 6

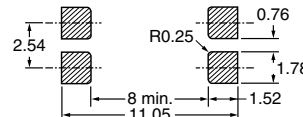
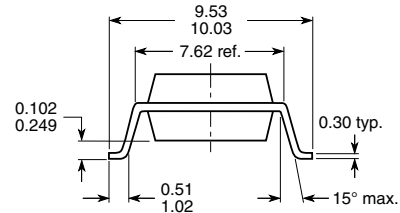


18450-11

#### Option 7

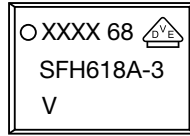


#### Option 9 or SFH6186





### PACKAGE MARKING (example of SFH618A-3X001)



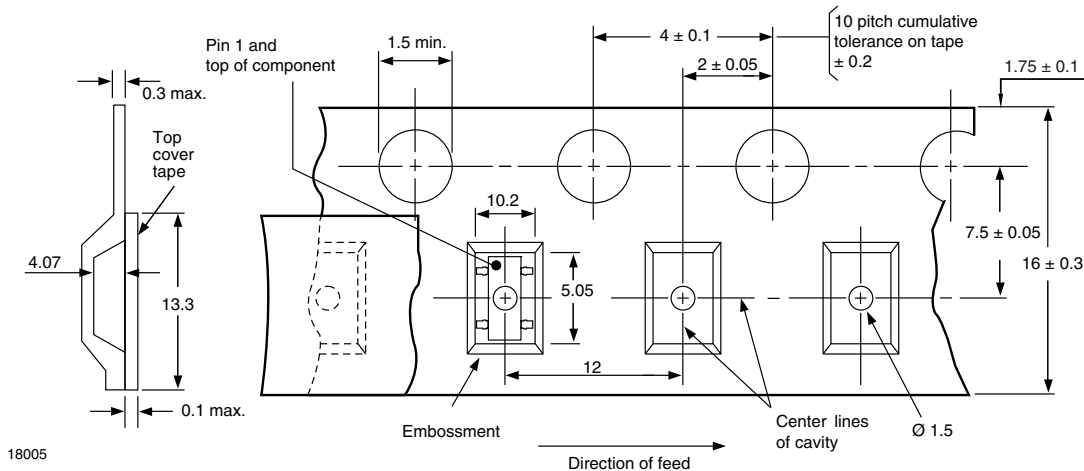
#### Notes

- 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

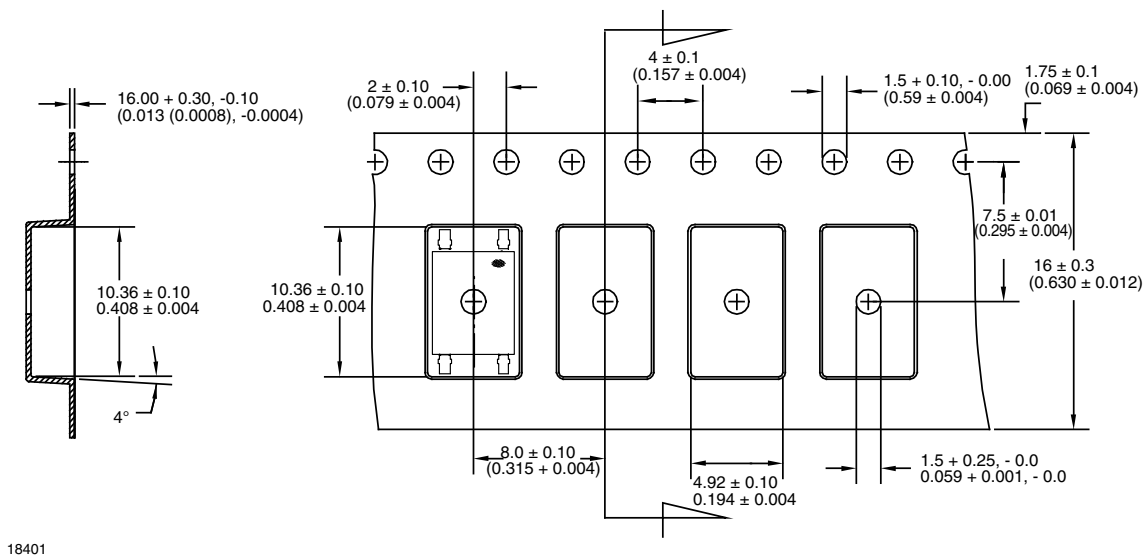
### TAPE AND REEL PACKAGING (in millimeters)

The tape is 16 mm and is wound on a 33 cm reel. There are 1000 parts per reel. Taped and reeled 4 pin optocouplers conform to EIA-481-2 and IEC60286-3.

#### SMD-4 ("T")

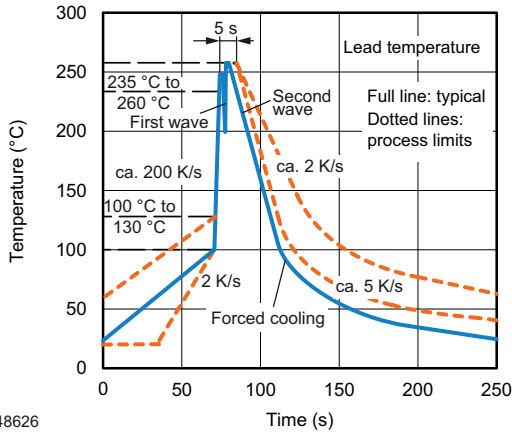


#### SMD-4, 90° Rotation ("T1")





**SOLDER PROFILES**



948626

Fig. 17 - Recommended Wave Soldering Double Wave Profile for DIP Devices

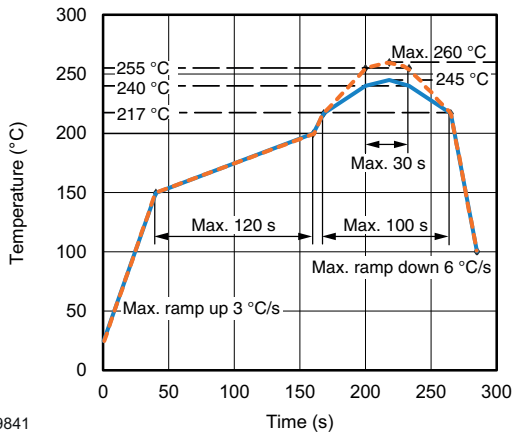
**HANDLING AND STORAGE CONDITIONS**

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



19841

Fig. 18 - Recommended Lead (Pb)-free Reflow Solder Profile for SMD Devices



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