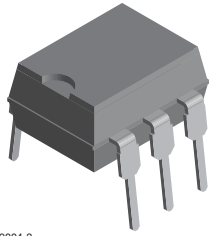
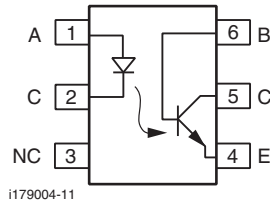


# Optocoupler, Phototransistor Output, with Base Connection



i179004-3



i179004-11

## DESCRIPTION

The SFH601 is an optocoupler with a gallium arsenide LED emitter which is optically coupled with a silicon planar phototransistor detector. The component is packaged in a plastic plug-in case 20 AB DIN 41866.

The coupler transmits signals between two electrically isolated circuits.

## FEATURES

- Isolation test voltage (1.0 s), 5300 V<sub>RMS</sub>
- V<sub>CEsat</sub> 0.25 (≤ 0.4) V, I<sub>F</sub> = 10 mA, I<sub>C</sub> = 2.5 mA
- Built to conform to VDE requirements
- Highest quality premium device
- Long term stability
- Storage temperature, -55 ° to +150 °C
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)

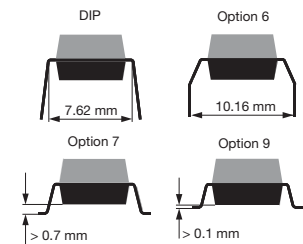
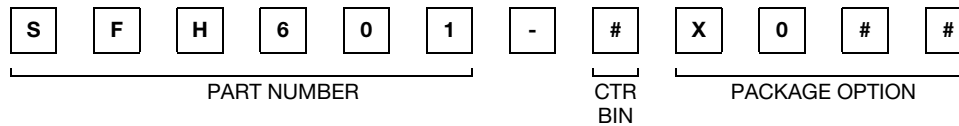


RoHS  
COMPLIANT

## AGENCY APPROVALS

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

## ORDERING INFORMATION



| AGENCY CERTIFIED/PACKAGE | CTR (%)       |                 |                 |                 |
|--------------------------|---------------|-----------------|-----------------|-----------------|
|                          | 40 to 80      | 63 to 125       | 100 to 200      | 160 to 320      |
| UL, BSI, CSA             | 40 to 80      | 63 to 125       | 100 to 200      | 160 to 320      |
| DIP-6                    | SFH601-1      | SFH601-2        | SFH601-3        | SFH601-4        |
| DIP-6, 400 mil, option 6 | SFH601-1X006  | SFH601-2X006    | SFH601-3X006    | SFH601-4X006    |
| SMD-6, option 7          | SFH601-1X007  | SFH601-2X007T   | SFH601-3X007(T) | SFH601-4X007(T) |
| SMD-6, option 9          | SFH601-1X009T | SFH601-2X009    | SFH601-3X009    | SFH601-4X009(T) |
| VDE, cUL, UL, BSI        | 40 to 80      | 63 to 125       | 100 to 200      | 160 to 320      |
| DIP-6, option 1          | SFH601-1X001  | SFH601-2X001    | -               | SFH601-4X001    |
| DIP-6, 400 mil, option 6 | SFH601-1X016  | -               | SFH601-3X016    | SFH601-4X016    |
| SMD-6, option 7          | SFH601-1X017  | SFH601-2X017(T) | SFH601-3X017(T) | -               |
| SMD-6, option 9          | -             | -               | SFH601-3X019(T) | -               |

### Note

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



| ABSOLUTE MAXIMUM RATINGS ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified) |   |            |             |                    |
|---|---|------------|-------------|--------------------|
| PARAMETER   | TEST CONDITION  | SYMBOL     | VALUE       | UNIT               |
| <b>INPUT</b>  |   |            |             |                    |
| Reverse voltage   |   | $V_R$      | 6           | V                  |
| DC forward current  |   | $I_F$      | 60          | mA                 |
| Surge forward current   | $t = 10\text{ }\mu\text{s}$   | $I_{FSM}$  | 2.5         | A                  |
| Total power dissipation   |   | $P_{diss}$ | 100         | mW                 |
| <b>OUTPUT</b>   |   |            |             |                    |
| Collector emitter voltage   |   | $V_{CEO}$  | 100         | V                  |
| Emitter base voltage  |   | $V_{EBO}$  | 7           | V                  |
| Collector current   |   | $I_C$      | 50          | mA                 |
|   | $t = 1.0\text{ ms}$   | $I_C$      | 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  |   | $T_j$      | 100         | $^{\circ}\text{C}$ |
| Soldering temperature <sup>(1)</sup>  | Max. 10 s, dip soldering:<br>distance to seating plane $\geq 1.5\text{ mm}$ | $T_{sld}$  | 260         | $^{\circ}\text{C}$ |

**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.
- <sup>(1)</sup> 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 ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified) |  |          |             |      |      |      |               |
|---|--|----------|-------------|------|------|------|---------------|
| PARAMETER   | TEST CONDITION                               | PART     | SYMBOL      | MIN. | TYP. | MAX. | UNIT          |
| <b>INPUT</b>  |  |          |             |      |      |      |               |
| Forward voltage   | $I_F = 60\text{ mA}$                         |          | $V_F$       | -    | 1.25 | 1.65 | V             |
| Breakdown voltage   | $I_R = 10\text{ }\mu\text{A}$                |          | $V_{BR}$    | 6    | -    | -    | V             |
| Reverse current   | $V_R = 6\text{ V}$                           |          | $I_R$       | -    | 0.01 | 10   | $\mu\text{A}$ |
| Capacitance   | $V_F = 0\text{ V}$ , $f = 1\text{ MHz}$      |          | $C_O$       | -    | 25   | -    | pF            |
| Thermal resistance  |  |          | $R_{thja}$  | -    | 750  | -    | K/W           |
| <b>OUTPUT</b>   |  |          |             |      |      |      |               |
| Collector emitter capacitance   | $f = 1\text{ MHz}$ , $V_{CE} = 5\text{ V}$   |          | $C_{CE}$    | -    | 6.8  | -    | pF            |
| Collector base capacitance  | $f = 1\text{ MHz}$ , $V_{CB} = 5\text{ V}$   |          | $C_{CB}$    | -    | 8.5  | -    | pF            |
| Emitter base capacitance  | $f = 1\text{ MHz}$ , $V_{EB} = 5\text{ V}$   |          | $C_{EB}$    | -    | 11   | -    | pF            |
| Thermal resistance  |  |          | $R_{thja}$  | -    | 500  | -    | K/W           |
| Collector emitter leakage current   | $V_{CE} = 10\text{ V}$                       | SFH601-1 | $I_{CEO}$   | -    | 2    | 50   | nA            |
|   |  | SFH601-2 | $I_{CEO}$   | -    | 2    | 50   | nA            |
|   |  | SFH601-3 | $I_{CEO}$   | -    | 5    | 100  | nA            |
|   |  | SFH601-4 | $I_{CEO}$   | -    | 5    | 100  | nA            |
| <b>COUPLER</b>  |  |          |             |      |      |      |               |
| Saturation voltage collector emitter  | $I_F = 10\text{ mA}$ , $I_C = 2.5\text{ mA}$ |          | $V_{CEsat}$ | -    | 0.25 | 0.4  | V             |
| Capacitance (input to output)   | $V_{I-O} = 0$ , $f = 1\text{ MHz}$           |          | $C_{IO}$    | -    | 0.6  | -    | pF            |

**Note**

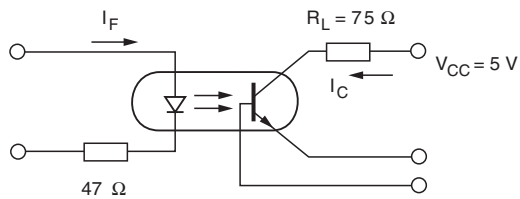
- Minimum and maximum values are testing requirements. Typical values are characteristics of the device and are the result of engineering evaluation. Typical values are for information only and are not part of the testing requirements.

| CURRENT TRANSFER RATIO        |                |          |        |      |      |      |      |
|-------------------------------|----------------|----------|--------|------|------|------|------|
| PARAMETER                     | TEST CONDITION | PART     | SYMBOL | MIN. | TYP. | MAX. | UNIT |
| $I_C/I_F$ at $V_{CE} = 5.0$ V | $I_F = 10$ mA  | SFH601-1 | CTR    | 40   | -    | 80   | %    |
|                               |                | SFH601-2 | CTR    | 63   | -    | 125  | %    |
|                               |                | SFH601-3 | CTR    | 100  | -    | 200  | %    |
|                               |                | SFH601-4 | CTR    | 160  | -    | 320  | %    |
|                               | $I_F = 1$ mA   | SFH601-1 | CTR    | 13   | 30   | -    | %    |
|                               |                | SFH601-2 | CTR    | 22   | 45   | -    | %    |
|                               |                | SFH601-3 | CTR    | 34   | 70   | -    | %    |
|                               |                | SFH601-4 | CTR    | 56   | 90   | -    | %    |

**Note**

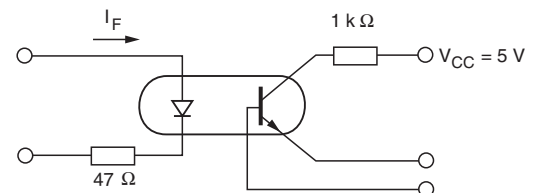
- Current transfer ratio and collector emitter leakage current by dash number.

| SWITCHING CHARACTERISTICS |                                     |          |           |      |      |      |         |
|---------------------------|-------------------------------------|----------|-----------|------|------|------|---------|
| PARAMETER                 | TEST CONDITION                      | PART     | SYMBOL    | MIN. | TYP. | MAX. | UNIT    |
| <b>NON-SATURATED</b>      |                                     |          |           |      |      |      |         |
| Current                   | $V_{CC} = 5$ V, $R_L = 75$ $\Omega$ |          | $I_F$     | -    | 10   | -    | mA      |
| Rise time                 | $V_{CC} = 5$ V, $R_L = 75$ $\Omega$ |          | $t_r$     | -    | 2    | -    | $\mu$ s |
| Fall time                 | $V_{CC} = 5$ V, $R_L = 75$ $\Omega$ |          | $t_f$     | -    | 2    | -    | $\mu$ s |
| Turn-on time              | $V_{CC} = 5$ V, $R_L = 75$ $\Omega$ |          | $t_{on}$  | -    | 3    | -    | $\mu$ s |
| Turn-off time             | $V_{CC} = 5$ V, $R_L = 75$ $\Omega$ |          | $t_{off}$ | -    | 2.3  | -    | $\mu$ s |
| <b>SATURATED</b>          |                                     |          |           |      |      |      |         |
| Current                   |                                     | SFH601-1 | $I_F$     | -    | 20   | -    | mA      |
|                           |                                     | SFH601-2 | $I_F$     | -    | 10   | -    | mA      |
|                           |                                     | SFH601-3 | $I_F$     | -    | 10   | -    | mA      |
|                           |                                     | SFH601-4 | $I_F$     | -    | 0.5  | -    | mA      |
| Rise time                 |                                     | SFH601-1 | $t_r$     | -    | 2    | -    | $\mu$ s |
|                           |                                     | SFH601-2 | $t_r$     | -    | 3    | -    | $\mu$ s |
|                           |                                     | SFH601-3 | $t_r$     | -    | 3    | -    | $\mu$ s |
|                           |                                     | SFH601-4 | $t_r$     | -    | 4.6  | -    | $\mu$ s |
| Fall time                 |                                     | SFH601-1 | $t_f$     | -    | 11   | -    | $\mu$ s |
|                           |                                     | SFH601-2 | $t_f$     | -    | 14   | -    | $\mu$ s |
|                           |                                     | SFH601-3 | $t_f$     | -    | 14   | -    | $\mu$ s |
|                           |                                     | SFH601-4 | $t_f$     | -    | 15   | -    | $\mu$ s |
| Turn-on time              |                                     | SFH601-1 | $t_{on}$  | -    | 3    | -    | $\mu$ s |
|                           |                                     | SFH601-2 | $t_{on}$  | -    | 4.2  | -    | $\mu$ s |
|                           |                                     | SFH601-3 | $t_{on}$  | -    | 4.2  | -    | $\mu$ s |
|                           |                                     | SFH601-4 | $t_{on}$  | -    | 6    | -    | $\mu$ s |
| Turn-off time             |                                     | SFH601-1 | $t_{off}$ | -    | 18   | -    | $\mu$ s |
|                           |                                     | SFH601-2 | $t_{off}$ | -    | 23   | -    | $\mu$ s |
|                           |                                     | SFH601-3 | $t_{off}$ | -    | 23   | -    | $\mu$ s |
|                           |                                     | SFH601-4 | $t_{off}$ | -    | 25   | -    | $\mu$ s |



isfh601\_01

Fig. 1 - Linear Operation (without Saturation)



isfh601\_02

Fig. 2 - Switching Operation (with Saturation)

| SAFETY AND INSULATION RATINGS                |  |            |                |                    |
|--|--|------------|----------------|--------------------|
| PARAMETER                                    | TEST CONDITION   | SYMBOL     | VALUE          | UNIT               |
| Climatic classification                      | According to IEC 68 part 1                                     |            | 55 / 100 / 21  |                    |
| Comparative tracking index                   |  | CTI        | 175            |                    |
| Maximum rated withstanding isolation voltage | t = 1 min  | $V_{ISO}$  | 4420           | $V_{RMS}$          |
| Maximum transient isolation voltage          |  | $V_{IOTM}$ | 8000           | V                  |
| Maximum repetitive peak isolation voltage    |  | $V_{IORM}$ | 890            | V                  |
| Isolation resistance                         | $V_{IO} = 500\text{ V}, T_{amb} = 25\text{ }^{\circ}\text{C}$  | $R_{IO}$   | $\geq 10^{12}$ | $\Omega$           |
|  | $V_{IO} = 500\text{ V}, T_{amb} = 100\text{ }^{\circ}\text{C}$ | $R_{IO}$   | $\geq 10^{11}$ | $\Omega$           |
| Output safety power                          |  | $P_{SO}$   | 700            | mW                 |
| Input safety current                         |  | $I_{SI}$   | 400            | mA                 |
| Input safety temperature                     |  | $T_{SI}$   | 175            | $^{\circ}\text{C}$ |
| Creepage distance                            | Standard DIP-4   |            | $\geq 7$       | mm                 |
| Clearance distance                           | Standard DIP-4   |            | $\geq 7$       | mm                 |
| Creepage distance                            | 400 mil DIP-4  |            | $\geq 8$       | mm                 |
| Clearance distance                           | 400 mil DIP-4  |            | $\geq 8$       | mm                 |
| Insulation thickness                         |  | DTI        | $\geq 0.4$     | 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.

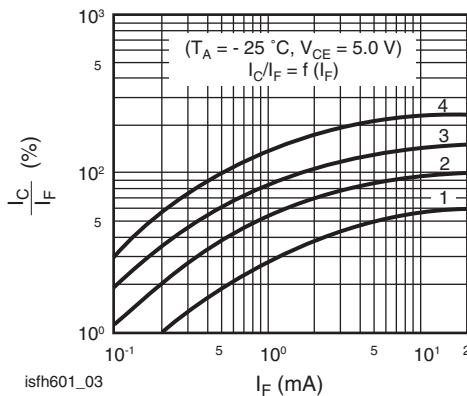
**TYPICAL CHARACTERISTICS** ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)


Fig. 3 - Current Transfer Ratio vs. Diode Current

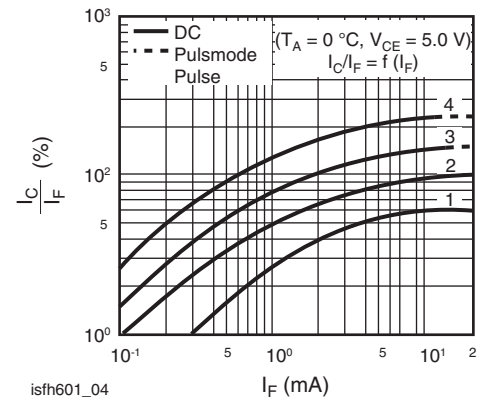


Fig. 4 - Current Transfer Ratio vs. Diode Current

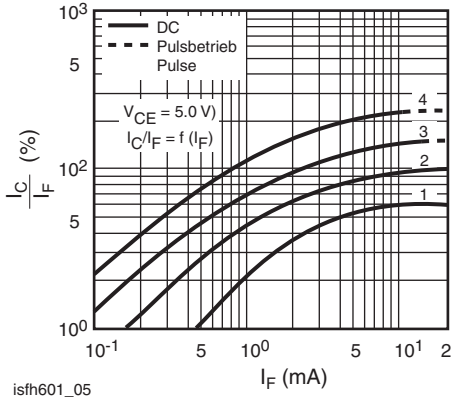


Fig. 5 - Current Transfer Ratio vs. Diode Current

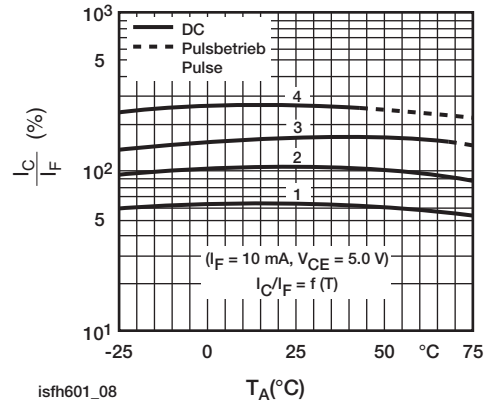


Fig. 8 - Current Transfer Ratio vs. Diode Current

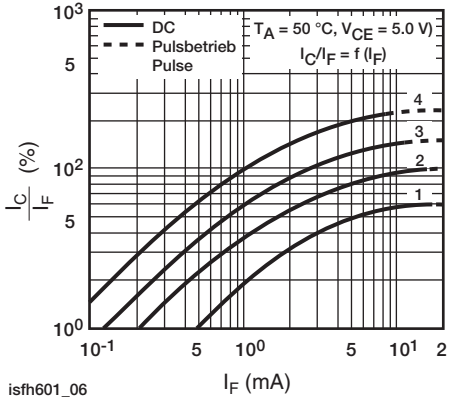


Fig. 6 - Current Transfer Ratio vs. Diode Current

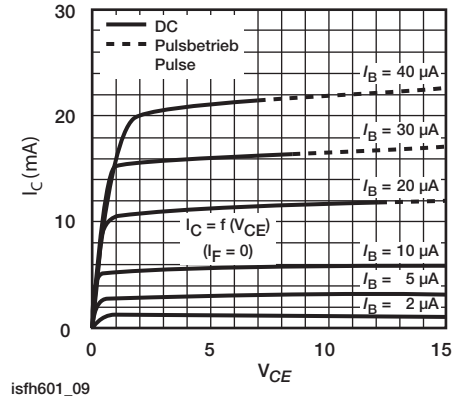


Fig. 9 - Transistor Characteristics

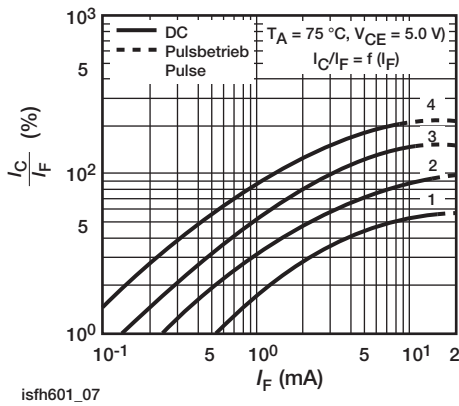


Fig. 7 - Current Transfer Ratio vs. Diode Current

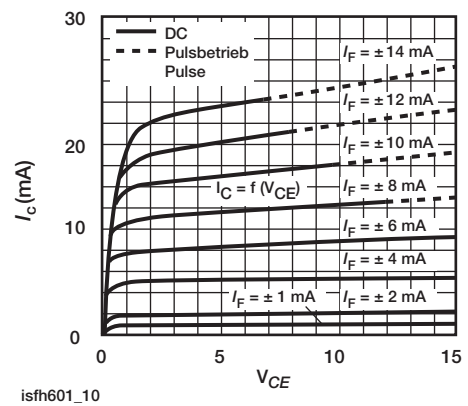


Fig. 10 - Output Characteristics

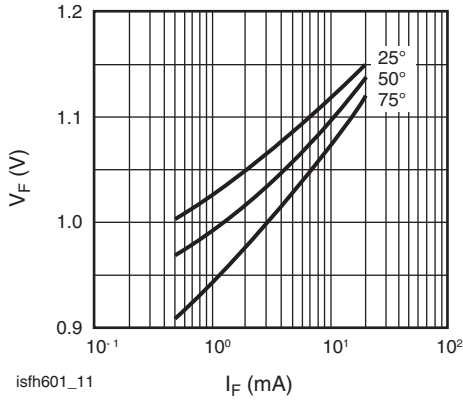


Fig. 11 - Forward Voltage

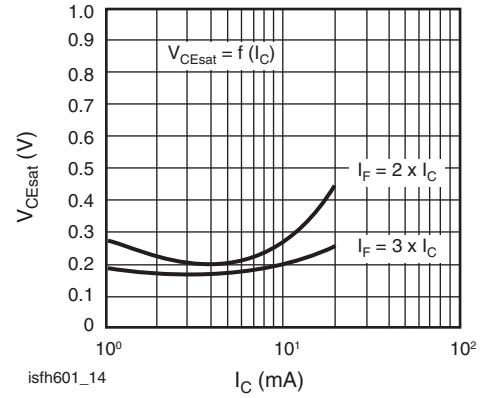


Fig. 14 - Saturation Voltage vs. Collector Current and Modulation Depth SFH601-2

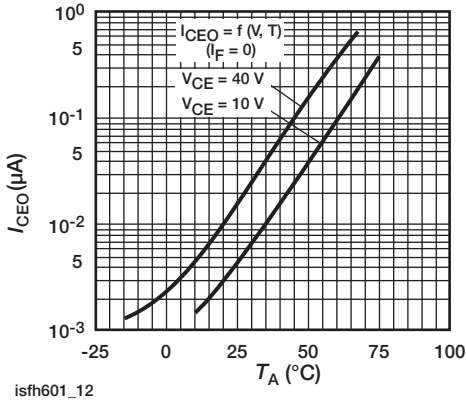


Fig. 12 - Collector Emitter Off-state Current

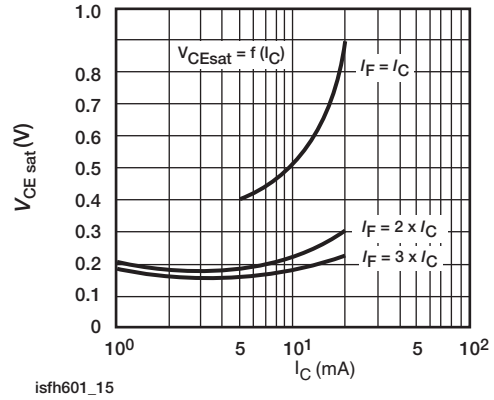


Fig. 15 - Saturation Voltage vs. Collector Current and Modulation Depth SFH601-3

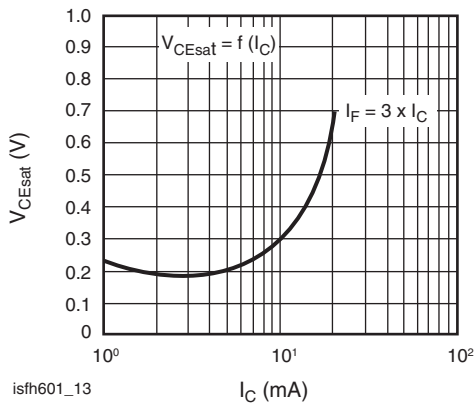


Fig. 13 - Saturation Voltage vs. Collector Current and Modulation Depth SFH601-1

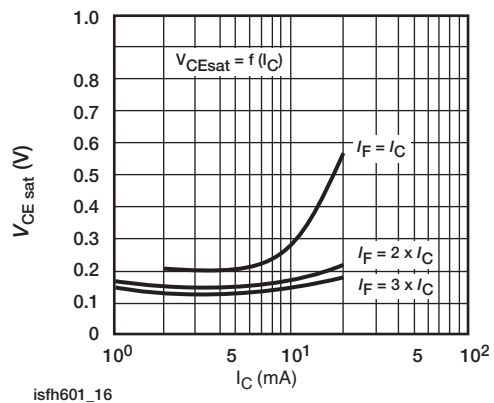


Fig. 16 - Saturation Voltage vs. Collector Current and Modulation Depth SFH601-4

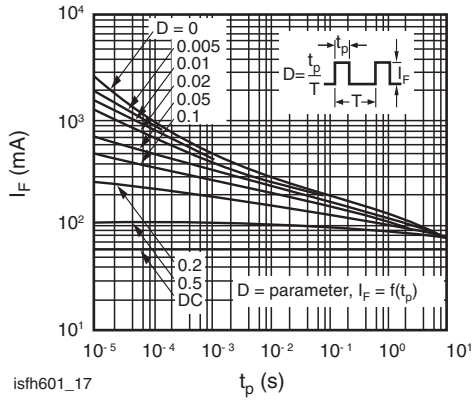


Fig. 17 - Permissible Pulse Load

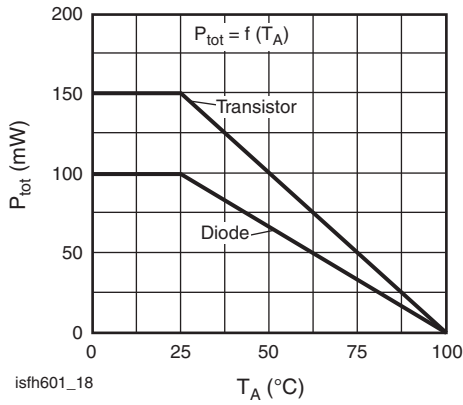


Fig. 18 - Permissible Power Dissipation for Transistor and Diode

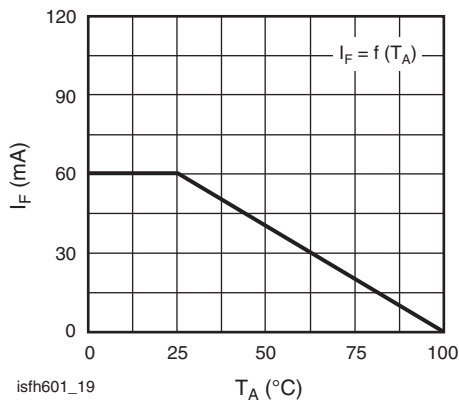
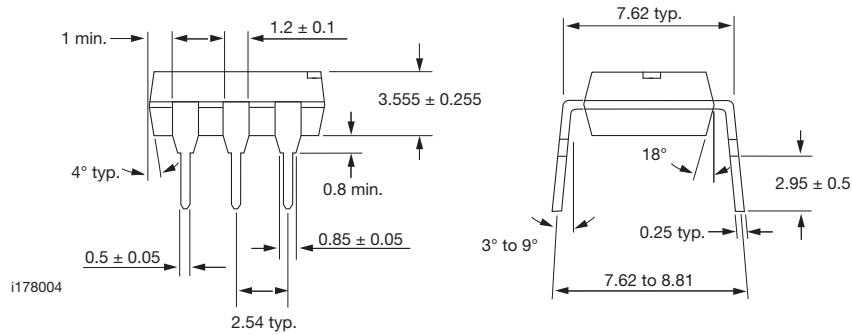
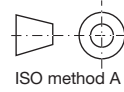
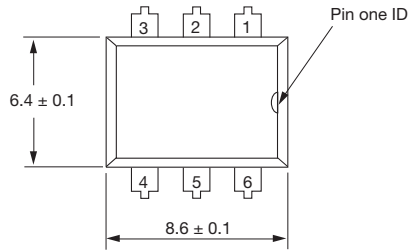


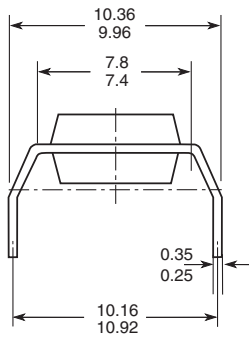
Fig. 19 - Permissible Forward Current Diode



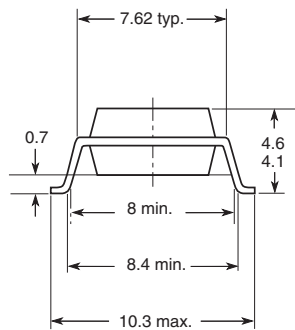
PACKAGE DIMENSIONS in inches (millimeters)



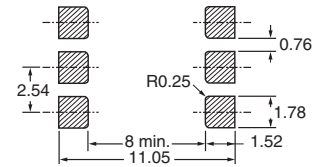
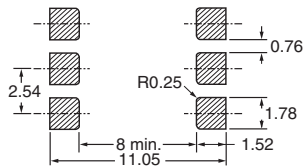
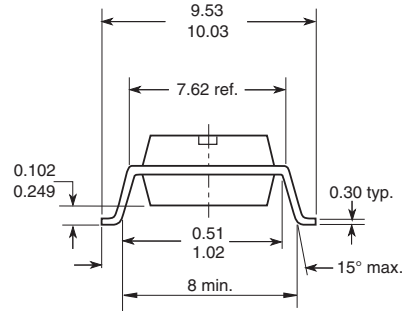
Option 6



Option 7



Option 9



18450-16







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