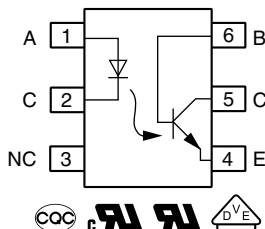


# Optocoupler, Phototransistor Output, With Base Connection



23030



## FEATURES

- Isolation test voltage, 5000 V<sub>RMS</sub>
- Low coupling capacitance
- High common mode transient immunity
- 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  
HALOGEN  
**FREE**  
**GREEN**  
(5-2008)

## APPLICATIONS

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

## AGENCY APPROVALS

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

## DESIGN SUPPORT TOOLS AVAILABLE



3D Models



Design Tools



Related Documents

## DESCRIPTION

The SFH601 has a GaAs infrared emitting diode emitter, which is optically coupled to a silicon planar phototransistor detector, and is incorporated in a plastic DIP-6 package.

It features a high current transfer ratio, low coupling capacitance, and high isolation voltage.

The coupling device is designed for signal transmission between two electrically separated circuits.

## ORDERING INFORMATION

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

| AGENCY CERTIFIED/PACKAGE | CTR (%)  |              |               |               |
|--------------------------|----------|--------------|---------------|---------------|
|                          | 40 to 80 | 63 to 125    | 100 to 200    | 160 to 320    |
| UL, cUL, CQC             |          |              |               |               |
| DIP-6                    | SFH601-1 | SFH601-2     | SFH601-3      | -             |
| SMD-6, option 7          |          |              | SFH601-3X007T | SFH601-4X007T |
| SMD-6, option 9          | -        | -            | SFH601-3X009  | -             |
| VDE, UL, cUL, CQC        |          |              |               |               |
| DIP-6, 400 mil, option 6 | -        | SFH601-2X016 | SFH601-3X016  | -             |
| SMD-6, option 7          | -        | -            | SFH601-3X017T | -             |

### Note

- Additional options may be possible, please contact sales office

| <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                  |
| Forward current                                                                                        |                   | $I_F$      | 60          | mA                 |
| 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                 |
| 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 | $^{\circ}\text{C}$ |
| Soldering temperature                                                                                  | $t = 10\text{ s}$ | $T_{sld}$  | 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

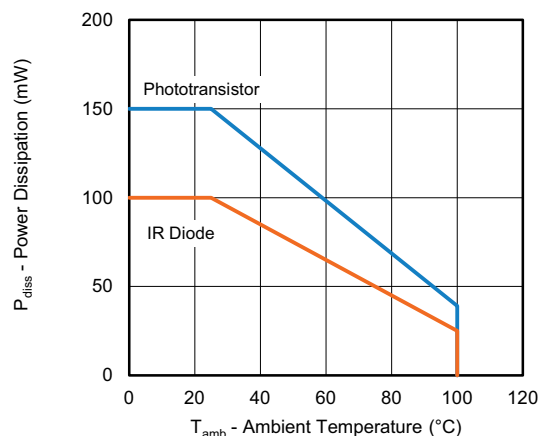


Fig. 1 - Power Dissipation vs. Ambient Temperature

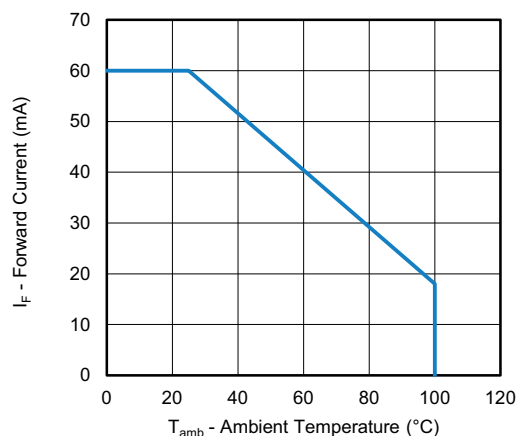


Fig. 2 - Maximum Forward Current vs. Ambient Temperature

| <b>ELECTRICAL CHARACTERISTICS</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified) |                                              |             |      |       |      |               |
|----------------------------------------------------------------------------------------------------------|----------------------------------------------|-------------|------|-------|------|---------------|
| PARAMETER                                                                                                | TEST CONDITION                               | SYMBOL      | MIN. | TYP.  | MAX. | UNIT          |
| <b>INPUT</b>                                                                                             |                                              |             |      |       |      |               |
| Forward voltage                                                                                          | $I_F = 60\text{ mA}$                         | $V_F$       | -    | 1.45  | 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                                                                                              | $V_F = 0\text{ V}$ , $f = 1\text{ kHz}$      | $C_I$       | -    | -     | 100  | pF            |
| <b>OUTPUT</b>                                                                                            |                                              |             |      |       |      |               |
| Collector emitter leakage current                                                                        | $V_{CE} = 10\text{ V}$                       | $I_{CEO}$   | -    | 2     | 50   | nA            |
| <b>COUPLER</b>                                                                                           |                                              |             |      |       |      |               |
| Collector emitter saturation voltage                                                                     | $I_F = 10\text{ mA}$ , $I_C = 2.5\text{ mA}$ | $V_{CEsat}$ | -    | 0.125 | 0.4  | V             |
| Coupling capacitance                                                                                     | $V_{I-O} = 0$ , $f = 1\text{ MHz}$           | $C_{IO}$    | -    | 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 |
|-----------|------------------------------------------------|----------|--------|------|------|------|------|
| $I_C/I_F$ | $I_F = 10 \text{ mA}$ , $V_{CE} = 5 \text{ V}$ | SFH601-1 | CTR    | 40   | -    | 80   | %    |
|           |                                                | SFH601-2 | CTR    | 63   | -    | 125  | %    |
|           |                                                | SFH601-3 | CTR    | 100  | -    | 200  | %    |
|           |                                                | SFH601-4 | CTR    | 160  | -    | 320  | %    |

**SWITCHING CHARACTERISTICS**

| PARAMETER     | TEST CONDITION                                                     | SYMBOL    | MIN. | TYP. | MAX. | UNIT          |
|---------------|--------------------------------------------------------------------|-----------|------|------|------|---------------|
| Turn-on time  | $V_{CC} = 5 \text{ V}$ , $I_C = 2 \text{ mA}$ , $R_L = 100 \Omega$ | $t_{on}$  | -    | 3    | -    | $\mu\text{s}$ |
| Turn-off time | $V_{CC} = 5 \text{ V}$ , $I_C = 2 \text{ mA}$ , $R_L = 100 \Omega$ | $t_{off}$ | -    | 3    | -    | $\mu\text{s}$ |

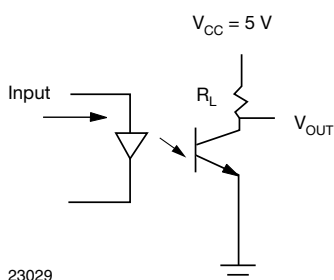


Fig. 3 - Test Circuit for Switching Characteristics

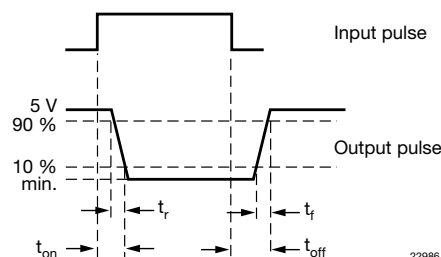


Fig. 4 - Parameter and Limit Definition

**SAFETY AND INSULATION RATINGS**

| PARAMETER                                    | TEST CONDITION                                                    | SYMBOL     | VALUE          | UNIT             |
|----------------------------------------------|-------------------------------------------------------------------|------------|----------------|------------------|
| Climatic classification                      | According to IEC 68 part 1                                        |            | 55 / 115 / 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, $t = 1 \text{ min}$                          | $V_{ISO}$  | 5000           | $V_{RMS}$        |
| 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                         | $T_{amb} = 25 \text{ }^\circ\text{C}$ , $V_{IO} = 500 \text{ V}$  | $R_{IO}$   | $\geq 10^{12}$ | $\Omega$         |
|                                              | $T_{amb} = 100 \text{ }^\circ\text{C}$ , $V_{IO} = 500 \text{ V}$ | $R_{IO}$   | $\geq 10^{11}$ | $\Omega$         |
| 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                            | DIP-6, SMD-6                                                      |            | $\geq 7$       | mm               |
| Clearance distance                           |                                                                   |            | $\geq 7$       | mm               |
| Creepage distance                            | DIP-6, 400 mil                                                    |            | $\geq 8$       | mm               |
| Clearance distance                           |                                                                   |            | $\geq 8$       | 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

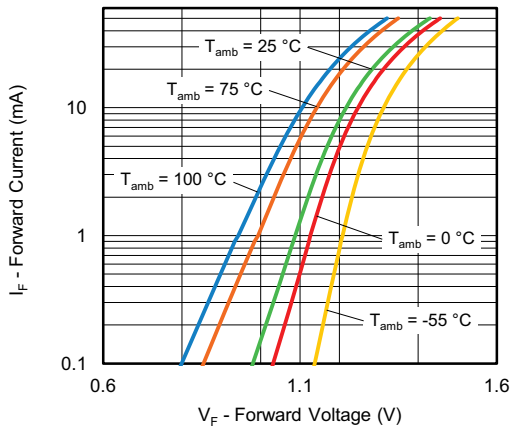
**TYPICAL CHARACTERISTICS** ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)


Fig. 5 - Forward Current vs. Forward Voltage

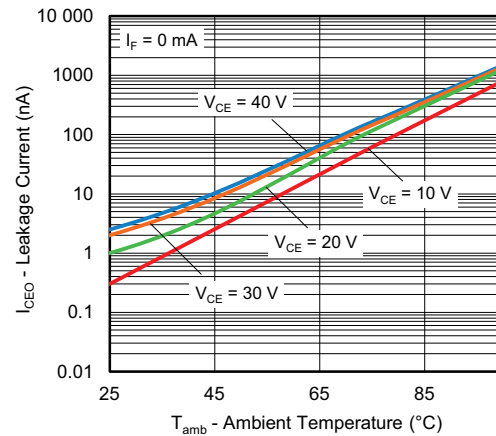


Fig. 8 - Leakage Current vs. Ambient Temperature

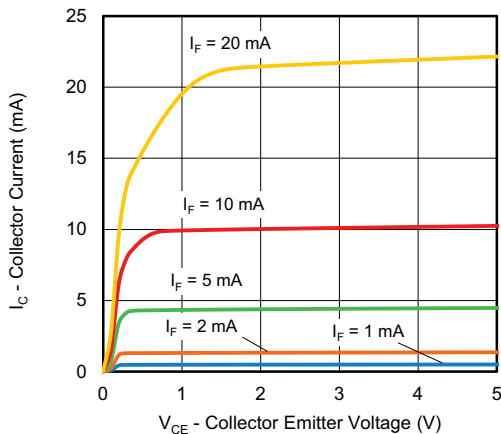


Fig. 6 - Collector Current vs. Collector Emitter Voltage (non-saturated)

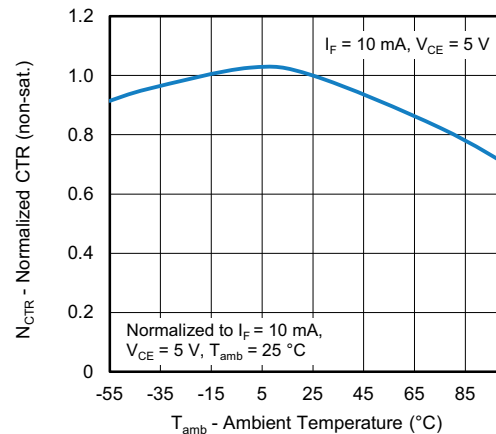


Fig. 9 - Normalized CTR vs. Ambient Temperature (non-saturated)

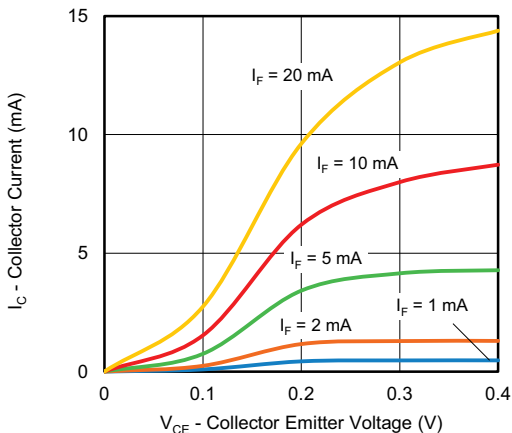


Fig. 7 - Collector Current vs. Collector Emitter Voltage (saturated)

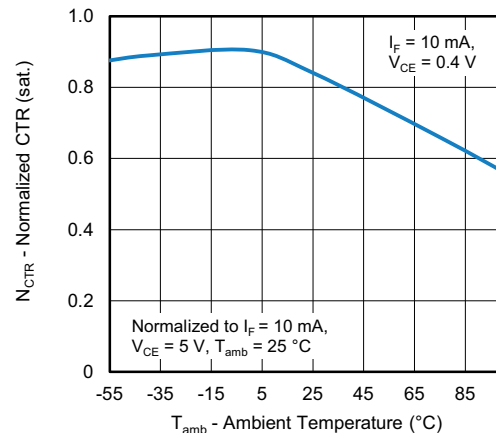


Fig. 10 - Normalized CTR vs. Ambient Temperature (saturated)

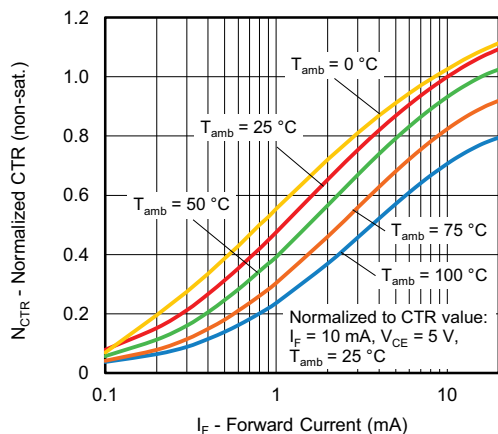


Fig. 11 - Normalized CTR vs. Forward Current (non-saturated)

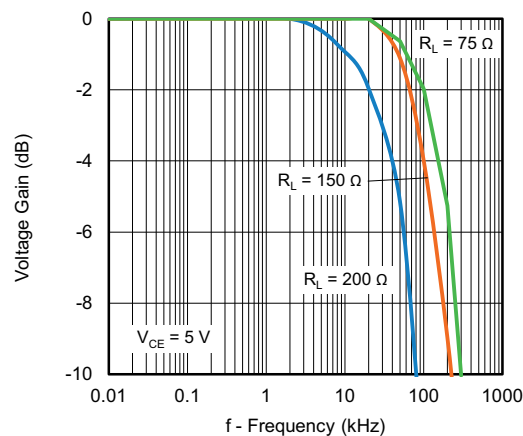


Fig. 13 - Voltage Gain vs. Frequency

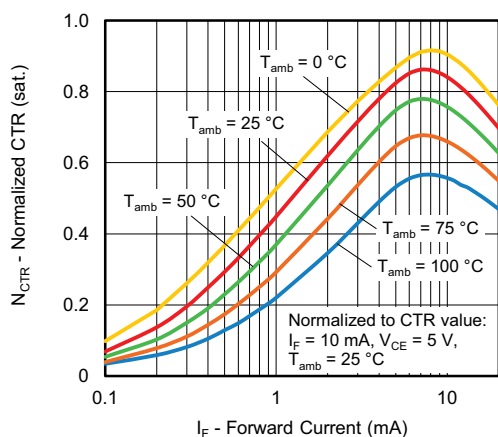


Fig. 12 - Normalized CTR vs. Forward Current (saturated)

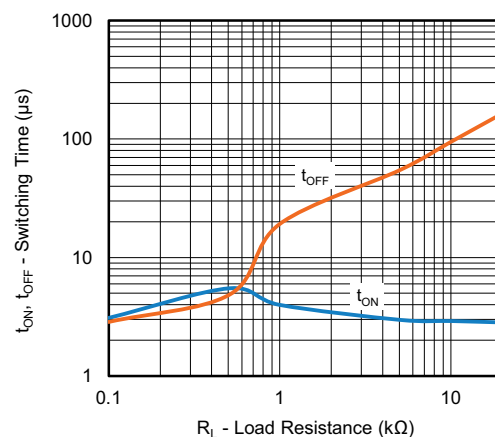
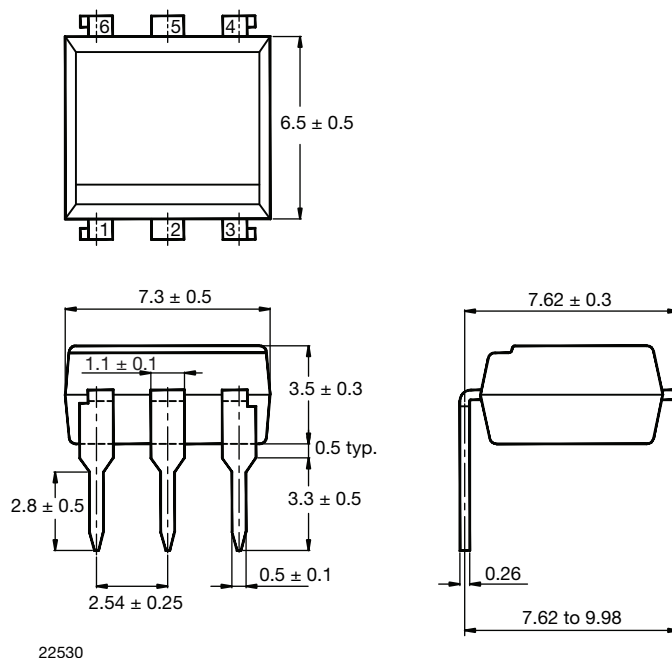
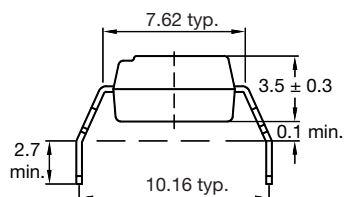
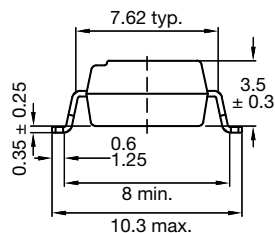
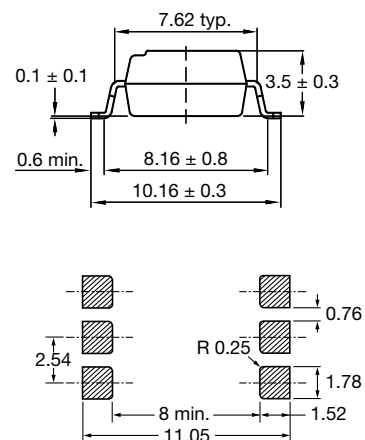


Fig. 14 - Switching Time vs. Load Resistance

**PACKAGE DIMENSIONS** in millimeters

**6 Pin Package**

**Option 6**

**Option 7**

**Option 9**


20802-52

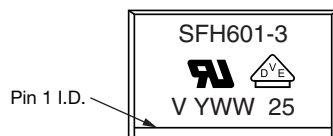
**PACKAGE MARKING**


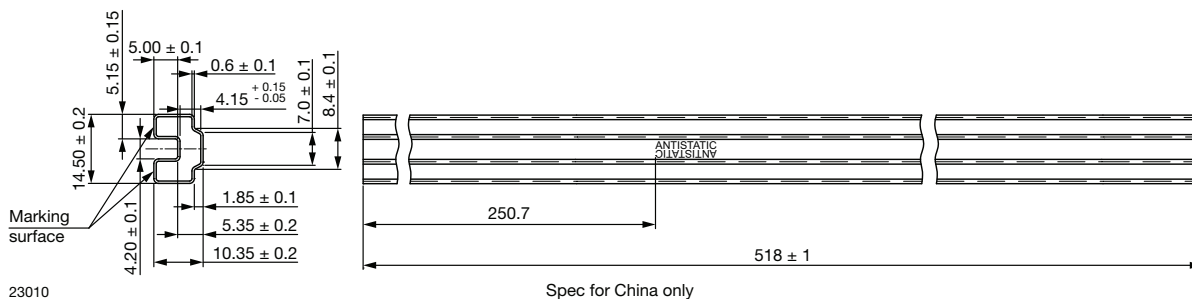
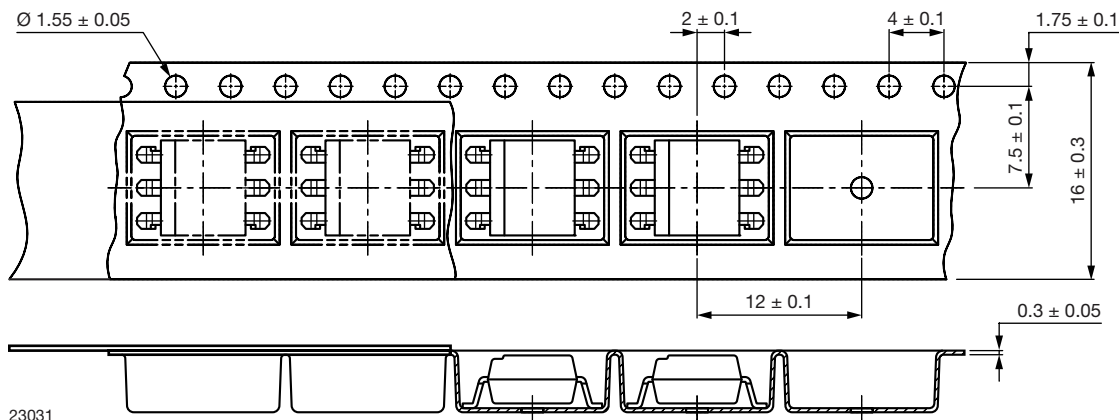
Fig. 15 - Example of SFH601

**Notes**

- "YWW" is the date code marking (Y = year code, WW = week code)
- VDE logo is only marked on VDE option parts
- Tape and reel suffix (T) is not part of the package marking

**PACKAGING INFORMATION** (in millimeters)

| DEVICES PER TUBE |            |           |           |
|------------------|------------|-----------|-----------|
| TYPE             | UNITS/TUBE | TUBES/BOX | UNITS/BOX |
| DIP-6            | 50         | 40        | 2000      |
| DIP-6, option 6  | 50         | 40        | 2000      |
| SMD-6, option 9  | 50         | 40        | 2000      |

**DIP-6**

**SMD-6**


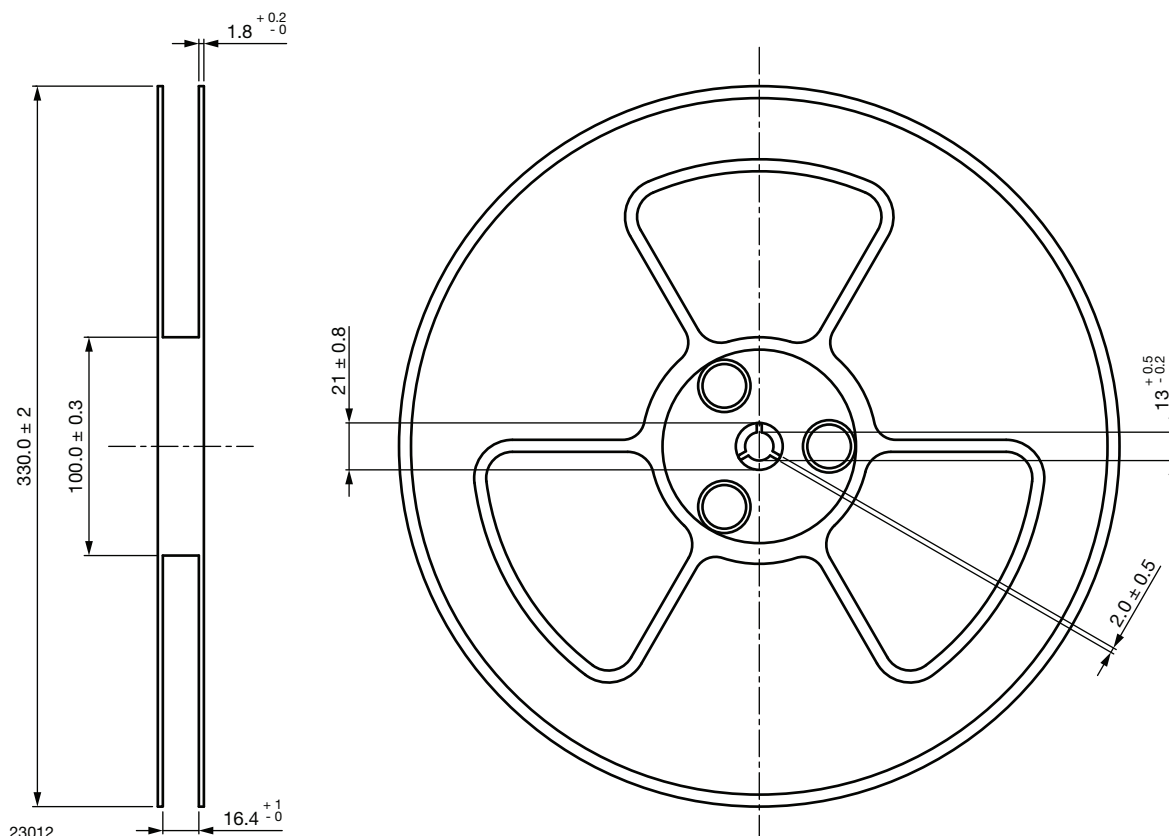
**Reel**


Fig. 18 - Tape and Reel Shipping Medium

**SOLDER PROFILES**
**IR Reflow Soldering (JEDEC® J-STD-020C compliant)**

One time soldering reflow is recommended within the condition of temperature and time profile shown below. Do not solder more than three times.

| PROFILE ITEM                                   | CONDITIONS       |
|------------------------------------------------|------------------|
| Preheat                                        |                  |
| - Temperature minimum ( $T_{S \text{ min.}}$ ) | 150 °C           |
| - Temperature maximum ( $T_{S \text{ max.}}$ ) | 200 °C           |
| - Time (min. to max.) ( $t_s$ )                | 90 s ± 30 s      |
| Soldering zone                                 |                  |
| - Temperature ( $T_L$ )                        | 217 °C           |
| - Time ( $t_L$ )                               | 60 s             |
| Peak temperature ( $T_p$ )                     | 260 °C           |
| Ramp-up rate                                   | 3 °C/s max.      |
| Ramp-down rate                                 | 3 °C/s to 6 °C/s |

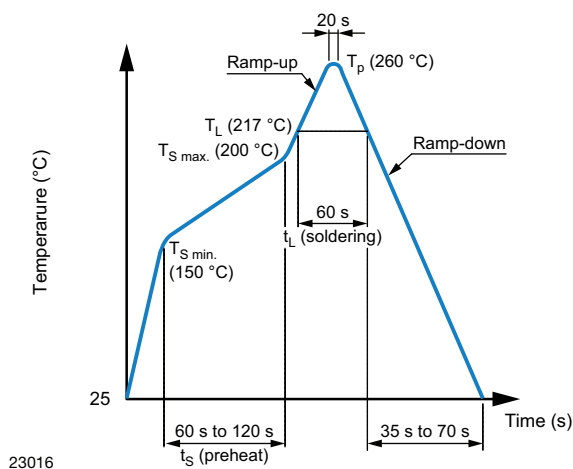


Fig. 19



### Wave Soldering (JEDEC JESD22-A111 compliant)

One time soldering is recommended within the condition of temperature.

Temperature:  $260\text{ }^{\circ}\text{C} + 0\text{ }^{\circ}\text{C} / - 5\text{ }^{\circ}\text{C}$

Time: 10 s

Preheat temperature:  $25\text{ }^{\circ}\text{C}$  to  $140\text{ }^{\circ}\text{C}$

Preheat time: 30 s to 80 s

### Hand Soldering by Soldering Iron

Allow single lead soldering in every single process. One time soldering is recommended.

Temperature:  $380\text{ }^{\circ}\text{C} + 0\text{ }^{\circ}\text{C} / - 5\text{ }^{\circ}\text{C}$

Time: 3 s max.

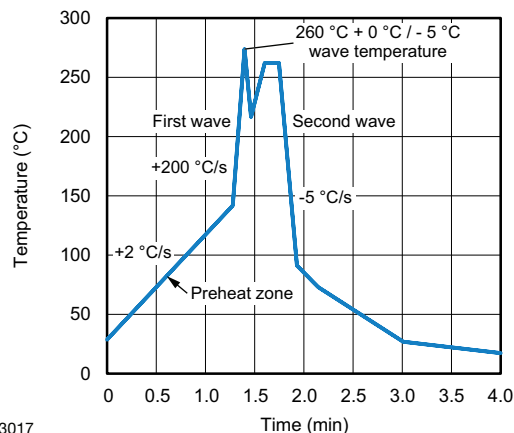


Fig. 20



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