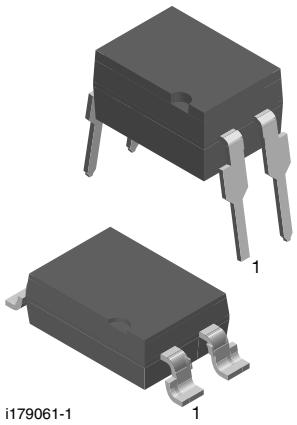
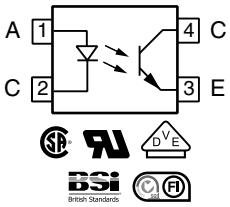
# Optocoupler, Phototransistor Output, Low Input Current




## FEATURES

- Good CTR linearity depending on forward current
- Low CTR degradation
- High collector emitter voltage, $V_{CEO}$ = 55 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

Pb-free

e3

RoHS COMPLIANT

## APPLICATIONS

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

## 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.

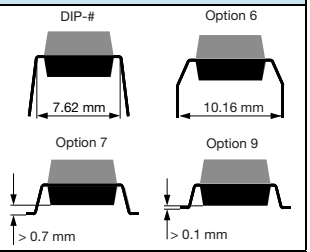
## AGENCY APPROVALS

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

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

## ORDERING INFORMATION

| S | F | H | 6 | 1 | 8 | # | - | # | X | 0 | # | # | T |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PART NUMBER | | | | | | | | CTR BIN | PACKAGE OPTION | | | | TAPE AND REEL |




| AGENCY CERTIFIED/PACKAGE | CTR (%) 1 mA | | | |
|---|---|---|---|---|
| **UL, CUL** | **63 to 125** | **100 to 200** | **160 to 320** | **250 to 500** |
| DIP-4 | SFH618A-2 | SFH618A-3 | SFH618A-4 | SFH618A-5 |
| DIP-4, 400 mil, option 6 | - | SFH618A-3X006 | - | - |
| SMD-4, option 7 | - | - | - | SFH618A-5X007T (1) |
| SMD-4, option 9 | SFH6186-2T (1) | SFH6186-3T (1), SFH6186-3T1 (2), SFH6186-3X002T (1) | SFH6186-4T (1) | SFH6186-5T (1), SFH6186-5T1 (2) |
| **VDE, UL, CUL** | **63 to 125** | **100 to 200** | **160 to 320** | **250 to 500** |
| DIP-4 | - | SFH618A-3X001 | SFH618A-4X001 | - |
| DIP-4, 400 mil, option 6 | - | SFH618A-3X016 | SFH618A-4X016 | SFH618A-5X016 |
| SMD-4, option 7 | - | SFH618A-3X017T (1) | - | SFH618A-5X017T (1) |
| SMD-4, option 9 | - | SFH6186-3X001T (1) | SFH6186-4X001T | SFH6186-5X001T (1) |

**Notes**

- Additional options may be possible, please contact sales office

(1) Also available in tubes, do not put T to the end

(2) Product is rotated 90° in tape and reel cavity

| **ABSOLUTE MAXIMUM RATINGS** ($T_{amb}$ = 25 °C, unless otherwise specified) | | | | |
|---|---|---|---|---|
| **PARAMETER** | **TEST CONDITION** | **SYMBOL** | **VALUE** | **UNIT** |
| **INPUT** | | | | |
| Reverse voltage | | $V_R$ | 6 | V |
| Power dissipation | | $P_{diss}$ | 70 | mW |
| Forward current | | $I_F$ | 60 | mA |
| **OUTPUT** | | | | |
| Collector emitter voltage | | $V_{CEO}$ | 55 | V |
| Emitter collector voltage | | $V_{ECO}$ | 7 | V |
| Collector current | | $I_C$ | 50 | mA |
| | $t_p \leq 1$ 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 |
| Junction temperature | | $T_j$ | 125 | °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).

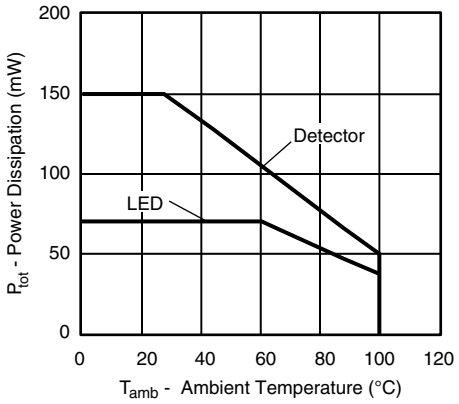



Fig. 1 - Permissible Power Dissipation vs. Ambient Temperature

| **ELECTRICAL CHARACTERISTICS** ($T_{amb}$ = 25 °C, unless otherwise specified) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PARAMETER** | **TEST CONDITION** | **PART** | **SYMBOL** | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| **INPUT** | | | | | | | |
| Forward voltage | $I_F$ = 5 mA | | $V_F$ | | 1.1 | 1.5 | V |
| Reverse current | $V_R$ = 6 V | | $I_R$ | | 0.01 | 10 | µA |
| Capacitance | $V_R$ = 0 V, f = 1 MHz | | $C_O$ | | 25 | | pF |
| Thermal resistance | | | $R_{thja}$ | | 1070 | | K/W |
| **OUTPUT** | | | | | | | |
| Collector emitter leakage current | $V_{CE}$ = 10 V | | $I_{CEO}$ | | 10 | 200 | nA |
| Collector emitter capacitance | $V_{CE}$ = 5 V, f = 1 MHz | | $C_{CE}$ | | 7 | | pF |
| Thermal resistance | | | $R_{thja}$ | | 500 | | K/W |
| **COUPLER** | | | | | | | |
| Collector emitter saturation voltage | $I_C$ = 0.32 mA, $I_F$ = 1 mA | SFH618A-2 | $V_{CEsat}$ | | 0.25 | 0.4 | V |
| | | SFH6186-2 | $V_{CEsat}$ | | 0.25 | 0.4 | V |
| | $I_C$ = 0.5 mA, $I_F$ = 1 mA | SFH618A-3 | $V_{CEsat}$ | | 0.25 | 0.4 | V |
| | | SFH6186-3 | $V_{CEsat}$ | | 0.25 | 0.4 | V |
| | $I_C$ = 0.8 mA, $I_F$ = 1 mA | SFH618A-4 | $V_{CEsat}$ | | 0.25 | 0.4 | V |
| | | SFH6186-4 | $V_{CEsat}$ | | 0.25 | 0.4 | V |
| | $I_C$ = 1.25 mA, $I_F$ = 1 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.

| **CURRENT TRANSFER RATIO** ($T_{amb}$ = 25 °C, unless otherwise specified) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PARAMETER** | **TEST CONDITION** | **PART** | **SYMBOL** | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| $I_C/I_F$ | $I_F$ = 1 mA, $V_{CE}$ = 0.5 V | SFH618A-2 | CTR | 63 | | 125 | % |
| | | SFH6186-2 | CTR | 63 | | 125 | % |
| | $I_F$ = 0.5 mA, $V_{CE}$ = 1.5 V | SFH618A-2 | CTR | 32 | 75 | | % |
| | | SFH6186-2 | CTR | 32 | 75 | | % |
| | $I_F$ = 1 mA, $V_{CE}$ = 0.5 V | SFH618A-3 | CTR | 100 | | 200 | % |
| | | SFH6186-3 | CTR | 100 | | 200 | % |
| | $I_F$ = 0.5 mA, $V_{CE}$ = 1.5 V | SFH618A-3 | CTR | 50 | 120 | | % |
| | | SFH6186-3 | CTR | 50 | 120 | | % |
| | $I_F$ = 1 mA, $V_{CE}$ = 0.5 V | SFH618A-4 | CTR | 160 | | 320 | % |
| | | SFH6186-4 | CTR | 160 | | 320 | % |
| | $I_F$ = 0.5 mA, $V_{CE}$ = 1.5 V | SFH618A-4 | CTR | 80 | 200 | | % |
| | | SFH6186-4 | CTR | 80 | 200 | | % |
| | $I_F$ = 1 mA, $V_{CE}$ = 0.5 V | SFH618A-5 | CTR | 250 | | 500 | % |
| | | SFH6186-5 | CTR | 250 | | 500 | % |
| | $I_F$ = 0.5 mA, $V_{CE}$ = 1.5 V | SFH618A-5 | CTR | 125 | 300 | | % |
| | | SFH6186-5 | CTR | 125 | 300 | | % |

| **SWITCHING CHARACTERISTICS** ($T_{amb}$ = 25 °C, unless otherwise specified) | | | | | | |
|---|---|---|---|---|---|---|
| **PARAMETER** | **TEST CONDITION** | **SYMBOL** | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| Turn on time | $V_{CC}$ = 5 V, $I_C$ = 2 mA, $R_L$ = 100 Ω | $t_{on}$ | | 6 | | µs |
| Rise time | $V_{CC}$ = 5 V, $I_C$ = 2 mA, $R_L$ = 100 Ω | $t_r$ | | 3.5 | | µs |
| Turn off time | $V_{CC}$ = 5 V, $I_C$ = 2 mA, $R_L$ = 100 Ω | $t_{off}$ | | 5.5 | | µs |
| Fall time | $V_{CC}$ = 5 V, $I_C$ = 2 mA, $R_L$ = 100 Ω | $t_f$ | | 5 | | µs |

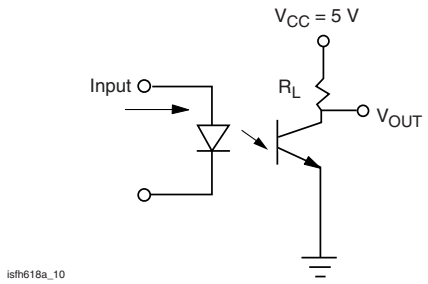



Fig. 2 - Test Circuit

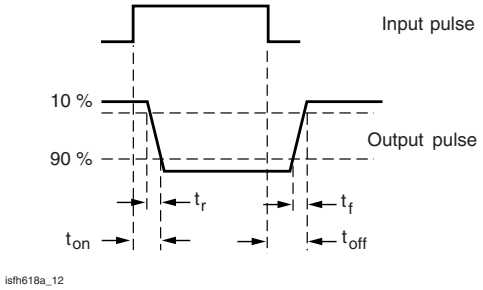



Fig. 3 - Test Circuit and Waveforms

| 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 min | $V_{ISO}$ | 4470 | $V_{RMS}$ |
| 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 | $V_{IOTM}$ | 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 °C, $V_{IO}$ = 500 V | $R_{IO}$ | ≥ $10^{12}$ | Ω |
| | $T_{amb}$ = 100 °C, $V_{IO}$ = 500 V | $R_{IO}$ | ≥ $10^{11}$ | Ω |
| Output safety power | | $P_{SO}$ | 700 | mW |
| Input safety current | | $I_{SI}$ | 400 | mA |
| Input safety temperature | | $T_S$ | 175 | °C |
| Creepage distance | DIP-4 | | ≥ 7 | mm |
| Clearance distance | DIP-4 | | ≥ 7 | mm |
| Creepage distance | DIP-4, 400 mil, option 6 | | ≥ 8 | mm |
| Clearance distance | DIP-4, 400 mil, option 6 | | ≥ 8 | mm |
| Creepage distance | SMD-4, option 7 and option 9 | | ≥ 7 | mm |
| Clearance distance | SMD-4, option 7 and option 9 | | ≥ 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 ($T_{amb}$ = 25 °C, unless otherwise specified)

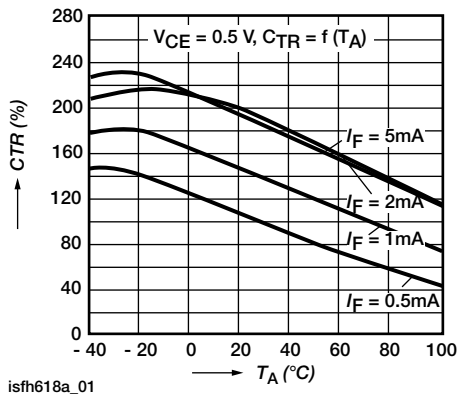



Fig. 4 - Current Transfer Ratio (typ.)

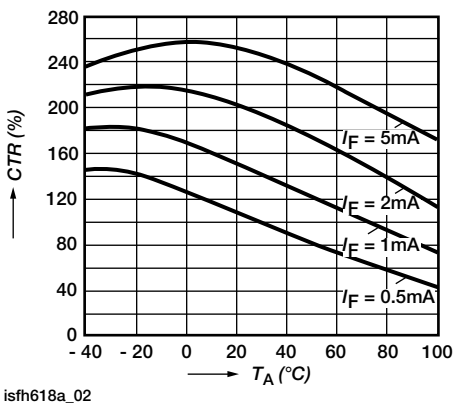



Fig. 5 - Current Transfer Ratio (typ.)

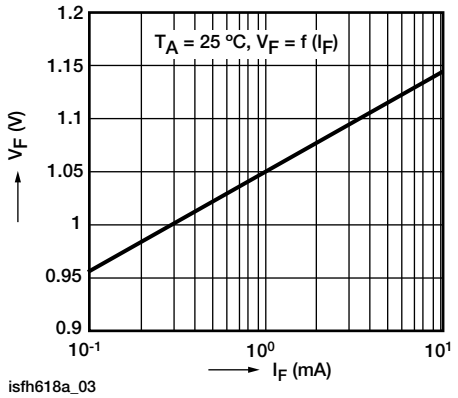



Fig. 6 - Diode Forward Voltage (typ.)

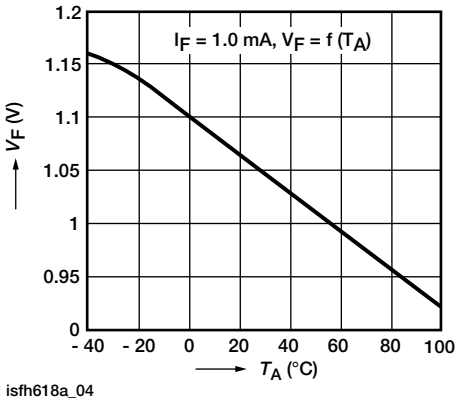



Fig. 7 - Diode Forward Voltage (typ.)

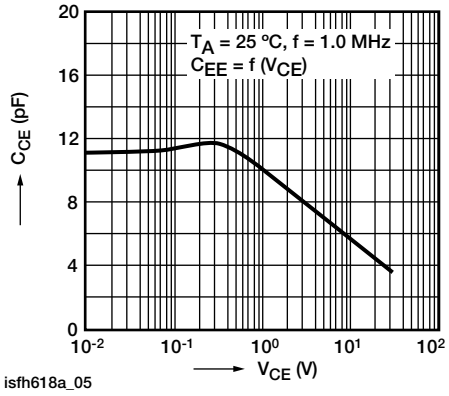



Fig. 8 - Transistor Capacitance

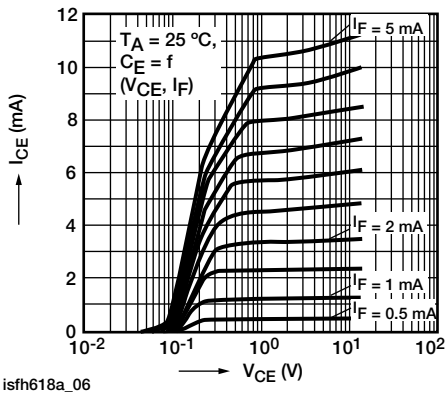



Fig. 9 - Output Characteristics

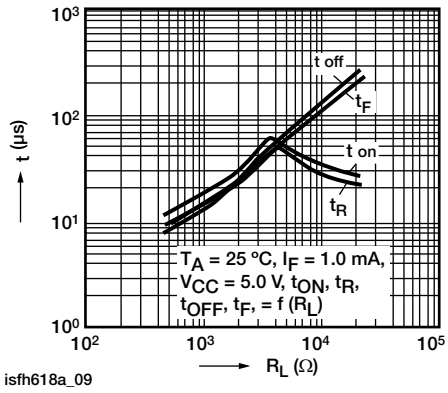
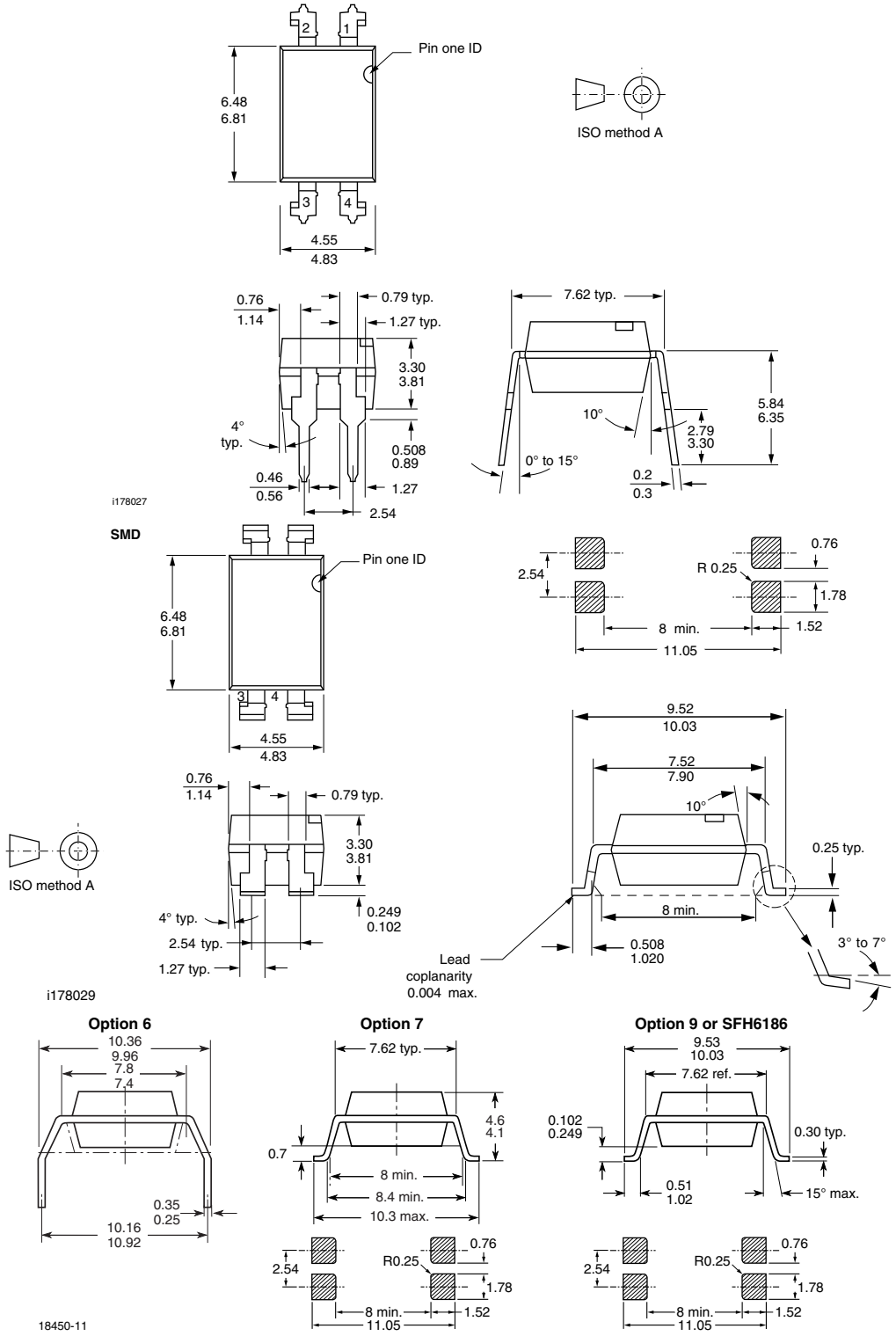
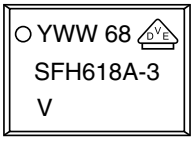



Fig. 10 - Switching Times (typ.)

## PACKAGE DIMENSIONS in millimeters




## PACKAGE MARKING (example)



## SOLDER PROFILES

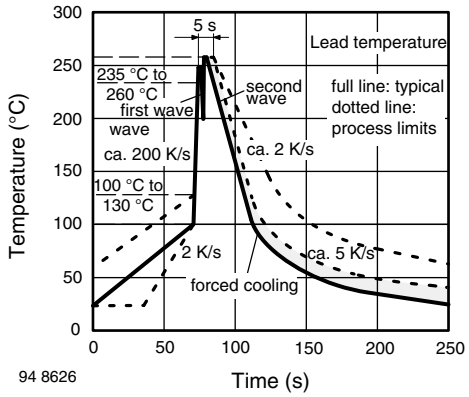



Fig. 11 - Wave Soldering Double Wave Profile According to J-STD-020 for DIP-8 Devices

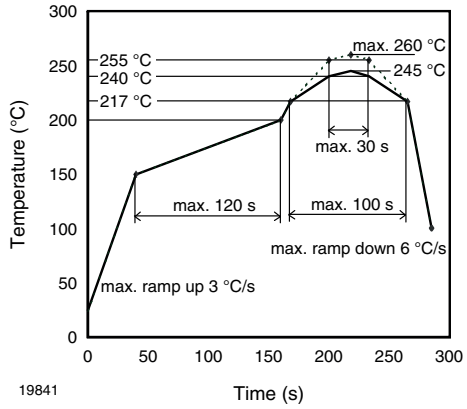



Fig. 12 - Lead (Pb)-free Reflow Solder Profile According to J-STD-020 for SMD-8 Devices

## HANDLING AND STORAGE CONDITIONS

ESD level: HBM class 2

Floor life: unlimited

Conditions: $T_{amb}$ < 30 °C, RH < 85 %

Moisture sensitivity level 1, according to J-STD-020

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