

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



FEATURES

- Excellent CTR linearity depending on forward current
- Isolation test voltage, 5300 V_{RMS}
- Fast switching times
- Low CTR degradation
- Low coupling capacitance
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912



DESCRIPTION

The SFH615A feature a variety of transfer ratios, 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 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 are achieved with option 6. 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.

APPLICATIONS

- Switchmode power supply
- Telecom
- Battery powered equipment

AGENCY APPROVALS

- UL file no. E52744
- cUL tested to CSA 22.2 bulletin 5A
- DIN EN 60747-5-5 (VDE 0884-5) available with option 1
- BSI EN 60950; EN 60065
- FIMKO
- CQC

| 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;">5</div> <div style="border: 1px solid black; padding: 2px 5px;">A</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> <p style="text-align: center;">PART NUMBER</p> | <div style="border: 1px solid black; padding: 2px 5px;">#</div> <p style="text-align: center;">CTR BIN</p> | <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> <p style="text-align: center;">PACKAGE OPTION</p> | <div style="border: 1px solid black; padding: 2px 5px;">T</div> <p style="text-align: center;">TAPE AND REEL</p> | <p style="text-align: center;">DIP-4 7.62 mm</p> <p style="text-align: center;">Option 6 10.16 mm</p> <p style="text-align: center;">Option 7 > 8 mm</p> <p style="text-align: center;">Option 9 8 mm typ.</p> |
| AGENCY CERTIFIED/PACKAGE | CTR (%) | | | |
| UL, cUL, BSI, FIMKO | 40 to 80 | 63 to 125 | 100 to 200 | 160 to 320 |
| DIP-4 | SFH615A-1 | SFH615A-2 | SFH615A-3 | SFH615A-4 |
| DIP-4, 400 mil, option 6 | SFH615A-1X006 | SFH615A-2X006 | SFH615A-3X006 | - |
| SMD-4, option 7 | - | - | SFH615A-3X007T ⁽¹⁾ | - |
| SMD-4, option 9 | - | SFH615A-2X009T | SFH615A-3X009T ⁽¹⁾ | SFH615A-4X009 |
| UL, cUL, VDE, BSI, FIMKO | 40 to 80 | 63 to 125 | 100 to 200 | 160 to 320 |
| DIP-4 | SFH615A-1X001 | SFH615A-2X001 | SFH615A-3X001 | SFH615A-4X001 |
| DIP-4, 400 mil, option 6 | SFH615A-1X016 | SFH615A-2X016 | SFH615A-3X016 | SFH615A-4X016 |
| SMD-4, option 7 | SFH615A-1X017T ⁽¹⁾ | SFH615A-2X017T ⁽¹⁾ | SFH615A-3X017 | SFH615A-4X017T ⁽¹⁾ |
| SMD-4, option 9 | - | SFH615A-2X019T | - | - |
| | | SFH615A-2X019T3 ⁽²⁾ | | |

Notes

- Additional options may be possible, please contact sales office.
- ⁽¹⁾ Also available in tubes; do not add T to end.
- ⁽²⁾ T3 rotation in tape and reel packaging.



| 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 |
| Forward surge current | t _p ≤ 10 μs | I _{FSM} | 2.5 | A |
| LED power dissipation | at 25 °C | P _{diss} | 70 | mW |
| OUTPUT | | | | |
| Collector emitter voltage | | V _{CEO} | 70 | V |
| Emitter collector voltage | | V _{ECO} | 7 | V |
| Collector current | | I _C | 50 | mA |
| Collector peak current | t _p /T = 0.5, t _p ≤ 10 ms | I _{CM} | 100 | mA |
| Output power dissipation | at 25 °C | P _{diss} | 150 | mW |
| COUPLER | | | | |
| Operation temperature | | T _{amb} | -55 to +100 | °C |
| Storage temperature range | | T _{stg} | -55 to +150 | °C |
| Soldering temperature ⁽¹⁾ | 2 mm from case, ≤ 10 s | T _{slid} | 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).

| 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 | | 1.35 | 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 |
| OUTPUT | | | | | | | |
| Collector emitter capacitance | V _{CE} = 5 V, f = 1 MHz | | C _{CE} | | 5.2 | | pF |
| Collector emitter leakage current | V _{CE} = 10 V | SFH615A-1 | I _{CEO} | | 2 | 50 | nA |
| | | SFH615A-2 | I _{CEO} | | 2 | 50 | nA |
| | | SFH615A-3 | I _{CEO} | | 5 | 100 | nA |
| | | SFH615A-4 | I _{CEO} | | 5 | 100 | nA |
| COUPLER | | | | | | | |
| Collector emitter saturation voltage | I _F = 10 mA, f = 1 MHz | | V _{CEsat} | | 0.25 | 0.4 | V |
| Coupling capacitance | | | 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 ($T_{amb} = 25\text{ }^{\circ}\text{C}$, unless otherwise specified) | | | | | | | |
|--|---|-----------|--------|------|------|------|------|
| PARAMETER | TEST CONDITION | PART | SYMBOL | MIN. | TYP. | MAX. | UNIT |
| I_C/I_F | $I_F = 10\text{ mA}, V_{CE} = 5\text{ V}$ | SFH615A-1 | CTR | 40 | | 80 | % |
| | | SFH615A-2 | CTR | 63 | | 125 | % |
| | | SFH615A-3 | CTR | 100 | | 200 | % |
| | | SFH615A-4 | CTR | 160 | | 320 | % |
| | $I_F = 1\text{ mA}, V_{CE} = 5\text{ V}$ | SFH615A-1 | CTR | 13 | 30 | | % |
| | | SFH615A-2 | CTR | 22 | 45 | | % |
| | | SFH615A-3 | CTR | 34 | 70 | | % |
| | | SFH615A-4 | CTR | 56 | 90 | | % |

| SWITCHING CHARACTERISTICS ($T_{amb} = 25\text{ }^{\circ}\text{C}$, unless otherwise specified) | | | | | | | |
|---|---|-----------|-----------|------|------|------|---------------|
| PARAMETER | TEST CONDITION | PART | SYMBOL | MIN. | TYP. | MAX. | UNIT |
| NON-SATURATED | | | | | | | |
| Turn-on time | $I_F = 10\text{ mA}, V_{CC} = 5\text{ V}, R_L = 75\text{ }\Omega$ | | t_{on} | | 3 | | μs |
| Rise time | $I_F = 10\text{ mA}, V_{CC} = 5\text{ V}, R_L = 75\text{ }\Omega$ | | t_r | | 2 | | μs |
| Turn-off time | $I_F = 10\text{ mA}, V_{CC} = 5\text{ V}, R_L = 75\text{ }\Omega$ | | t_{off} | | 2.3 | | μs |
| Fall time | $I_F = 10\text{ mA}, V_{CC} = 5\text{ V}, R_L = 75\text{ }\Omega$ | | t_f | | 2 | | μs |
| Cut-off frequency | $I_F = 10\text{ mA}, V_{CC} = 5\text{ V}, R_L = 75\text{ }\Omega$ | | f_{CO} | | 208 | | kHz |
| SATURATED | | | | | | | |
| Turn-on time | $I_F = 20\text{ mA}$ | SFH615A-1 | t_{on} | | 3 | | μs |
| | $I_F = 10\text{ mA}$ | SFH615A-2 | t_{on} | | 4.2 | | μs |
| | | SFH615A-3 | t_{on} | | 4.2 | | μs |
| | $I_F = 5\text{ mA}$ | SFH615A-4 | t_{on} | | 6 | | μs |
| Rise time | $I_F = 20\text{ mA}$ | SFH615A-1 | t_r | | 2 | | μs |
| | $I_F = 10\text{ mA}$ | SFH615A-2 | t_r | | 3 | | μs |
| | | SFH615A-3 | t_r | | 3 | | μs |
| | $I_F = 5\text{ mA}$ | SFH615A-4 | t_r | | 4 | | μs |
| Turn-off time | $I_F = 20\text{ mA}$ | SFH615A-1 | t_{off} | | 18 | | μs |
| | $I_F = 10\text{ mA}$ | SFH615A-2 | t_{off} | | 23 | | μs |
| | | SFH615A-3 | t_{off} | | 23 | | μs |
| | $I_F = 5\text{ mA}$ | SFH615A-4 | t_{off} | | 25 | | μs |
| Fall time | $I_F = 20\text{ mA}$ | SFH615A-1 | t_f | | 11 | | μs |
| | $I_F = 10\text{ mA}$ | SFH615A-2 | t_f | | 14 | | μs |
| | | SFH615A-3 | t_f | | 14 | | μs |
| | $I_F = 5\text{ mA}$ | SFH615A-4 | t_f | | 15 | | μs |



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Fig. 1 - Test Circuit, Non-Saturated Operation

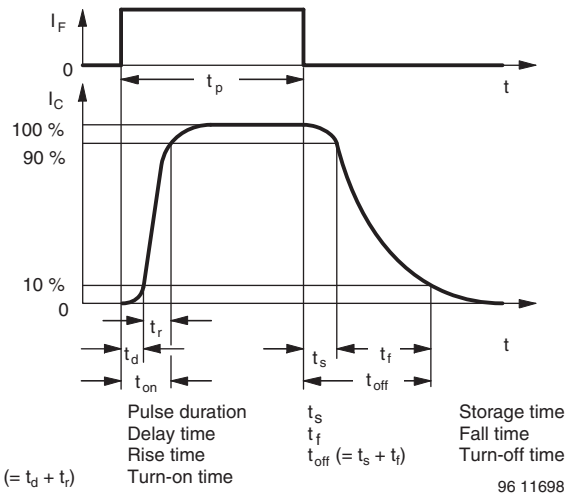
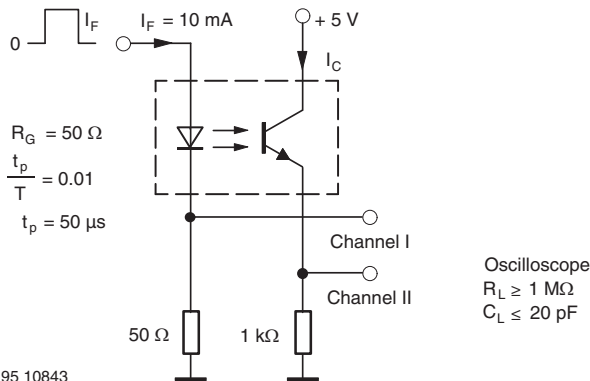


Fig. 3 - Switching Times



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Fig. 2 - Test Circuit, Saturated Operation

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



Fig. 4 - Forward Voltage vs. Forward Current

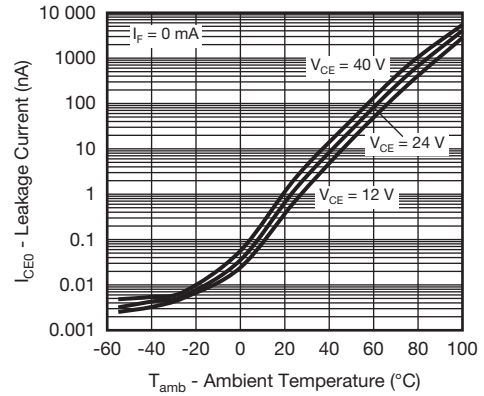


Fig. 7 - Leakage Current vs. Ambient Temperature

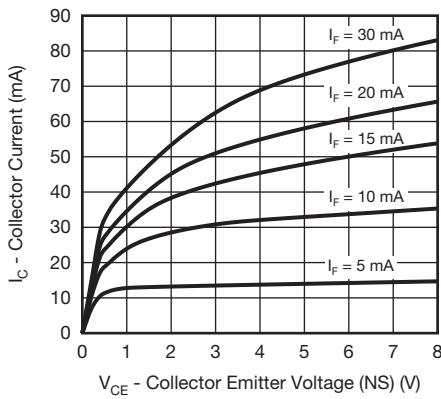


Fig. 5 - Collector Current vs. Collector Emitter Voltage (non-saturated)

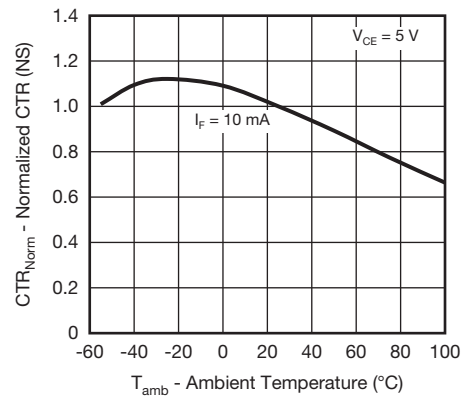


Fig. 8 - Normalized CTR (non-saturated) vs. Ambient Temperature

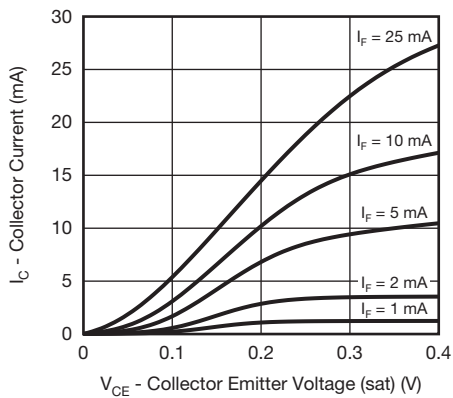


Fig. 6 - Collector Current vs. Collector Emitter Voltage (saturated)

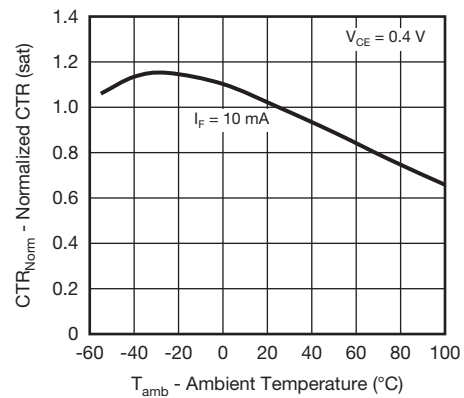


Fig. 9 - Normalized CTR (saturated) vs. Ambient Temperature



Fig. 10 - Normalized CTR (non-saturated) vs. Forward Current

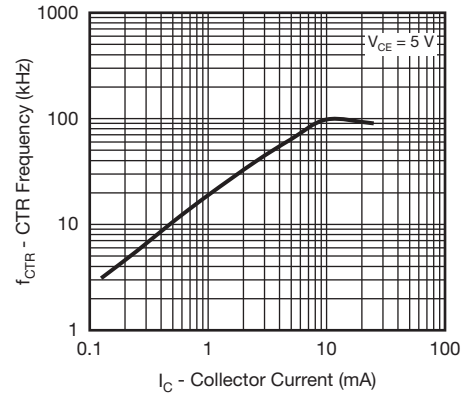


Fig. 13 - Cut-Off Frequency vs. Collector Current

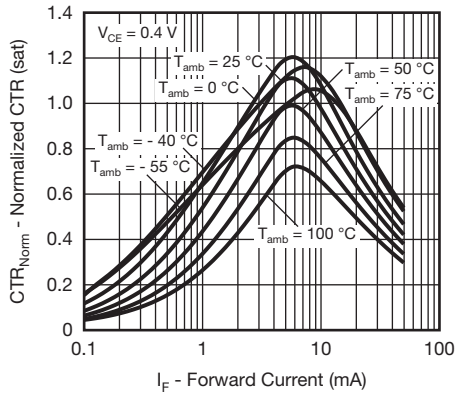


Fig. 11 - Normalized CTR (saturated) vs. Forward Current

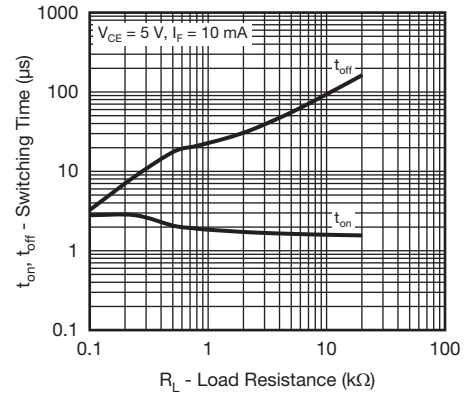


Fig. 14 - Switching Time vs. Load Resistance

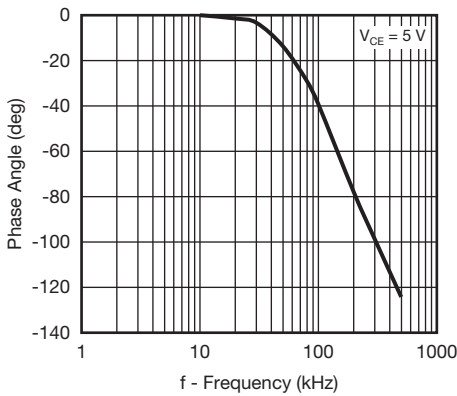


Fig. 12 - Phase Angle vs. Frequency

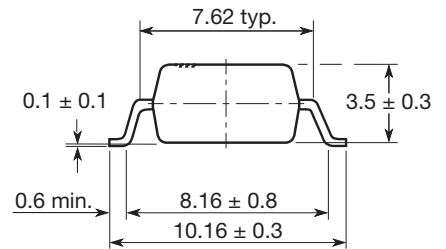
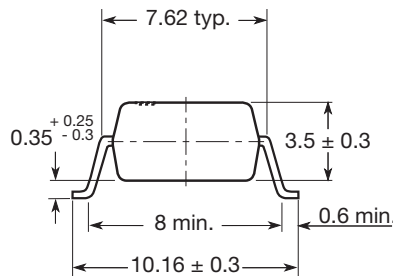
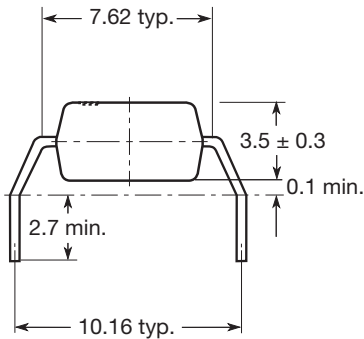
PACKAGE DIMENSIONS in millimeters



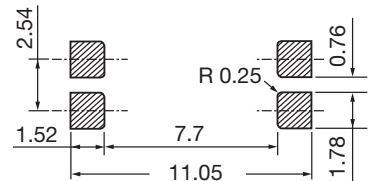
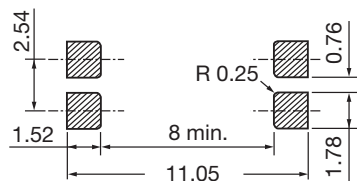
Option 6

Option 7

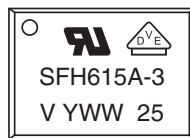
Option 9



20802-28



PACKAGE MARKING (Example)



Notes

- VDE logo is only marked on option 1 parts. Option information is not marked on the part.
- Tape and reel suffix (T) is not part of the package marking.

PACKING INFORMATION

| DEVICE PER TUBE | | | |
|-----------------|------------|-----------|-----------|
| TYPE | UNITS/TUBE | TUBES/BOX | UNITS/BOX |
| DIP-4 | 100 | 40 | 4000 |

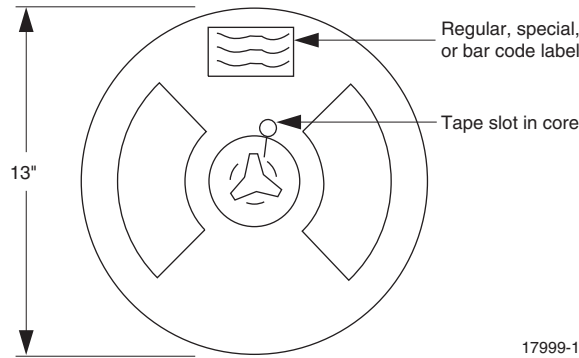


Fig. 15 - Tape and Reel Shipping Medium



Fig. 16 - Tape and Packing for Option 7 and Option 9

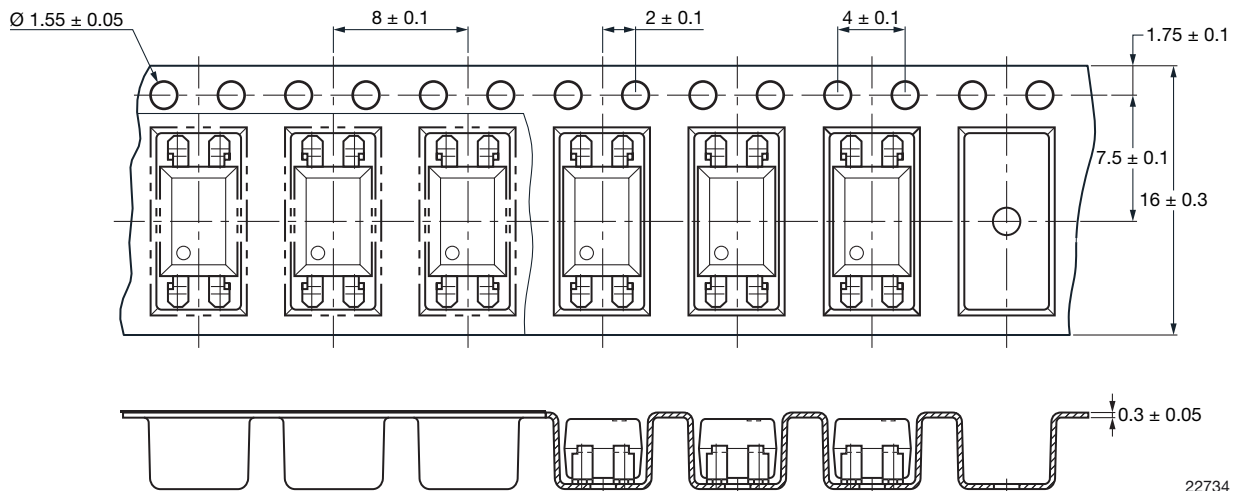


Fig. 17 - Tape Packing for Option 7 and Option 9, T3 Rotation (2000 units per reel)

SOLDER PROFILES

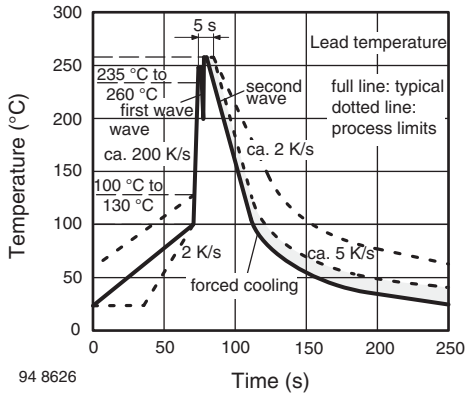


Fig. 18 - Wave Soldering Double Wave Profile According to J-STD-020 for DIP-8 Devices

HANDLING AND STORAGE CONDITIONS

ESD level: HBM class 2

Floor life: unlimited

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

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

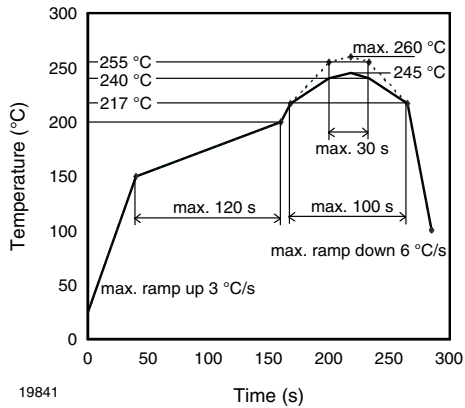


Fig. 19 - Lead (Pb)-free Reflow Solder Profile According to J-STD-020 for SMD-8 Devices



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