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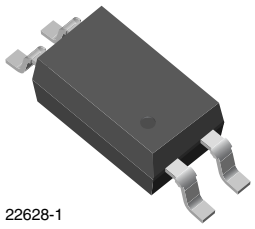
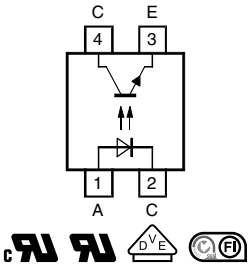
# Optocoupler, Phototransistor Output, Single Channel, Half Pitch Mini-Flat Package




## FEATURES

- Low profile package (half pitch)
- AC isolation test voltage 3750 $V_{RMS}$
- Low coupling capacitance of typical 0.3 pF
- Current transfer ratio (CTR) selected into groups
- Low temperature coefficient of CTR
- Wide ambient temperature range
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free
e3
RoHS COMPLIANT

## DESCRIPTION

The TCMT111X series consist of a phototransistor optically coupled to a gallium arsenide infrared-emitting diode in a 4 pin package.

## APPLICATIONS

- Programmable logic controllers
- Modems
- Answering machines
- General applications

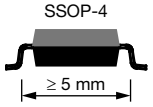
## AGENCY APPROVALS

- UL1577, file no. E76222, double protection
- cUL component acceptance service no. 5A, double protection
- DIN EN 60747-5-5 (VDE 0884-5)
- FIMKO: FI EN 60950-1:2006
- BSI: BS EN60065:2002
  BS EN60950-1:2006
- CQC GB 8898-2011, GB 4943.1-2011 (suitable for installation altitude below 2000 m)

## ORDERING INFORMATION

| T | C | M | T | 1 | 1 | 1 | # |
|---|---|---|---|---|---|---|---|

PART NUMBER




| AGENCY CERTIFIED/PACKAGE | CTR (%) | | | | | |
|---|---|---|---|---|---|---|
| | 5 mA | 10 mA | 5 mA | | | |
| UL, cUL, BSI, VDE | 50 to 600 | 100 to 200 | 100 to 300 | 80 to 160 | 130 to 260 | 200 to 400 |
| SSOP-4 | TCMT1110 | TCMT1113 | TCMT1116 | TCMT1117 | TCMT1118 | TCMT1119 |

## ABSOLUTE MAXIMUM RATINGS ($T_{amb}$ = 25 °C, unless otherwise specified)

| PARAMETER | TEST CONDITION | SYMBOL | VALUE | UNIT |
|---|---|---|---|---|
| **INPUT** | | | | |
| Reverse voltage | | $V_R$ | 6 | V |
| Forward current | | $I_F$ | 50 | mA |
| Forward surge current | $t_P \leq 10$ µs | $I_{FSM}$ | 1.5 | A |
| Power dissipation | | $P_{diss}$ | 80 | mW |
| Junction temperature | | $T_j$ | 125 | °C |

| **ABSOLUTE MAXIMUM RATINGS** ($T_{amb}$ = 25 °C, unless otherwise specified) | | | | |
|---|---|---|---|---|
| **PARAMETER** | **TEST CONDITION** | **SYMBOL** | **VALUE** | **UNIT** |
| **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, $t_p \leq$ 10 ms | $I_{CM}$ | 100 | mA |
| Power dissipation | | $P_{diss}$ | 150 | mW |
| Junction temperature | | $T_j$ | 125 | °C |
| **COUPLER** | | | | |
| Total power dissipation | | $P_{tot}$ | 230 | mW |
| Operating ambient temperature range | | $T_{amb}$ | -40 to +110 | °C |
| Storage temperature range | | $T_{stg}$ | -40 to +125 | °C |
| Soldering temperature [1] | | $T_{sld}$ | 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) Wave soldering three cycles are allowed. Also refer to “Assembly Instructions” (www.vishay.com/doc?80054).

| **ELECTRICAL CHARACTERISTICS** ($T_{amb}$ = 25 °C, unless otherwise specified) | | | | | | |
|---|---|---|---|---|---|---|
| **PARAMETER** | **TEST CONDITION** | **SYMBOL** | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| **INPUT** | | | | | | |
| Forward voltage | $I_F$ = 5 mA | $V_F$ | - | 1.08 | 1.4 | V |
| Junction capacitance | $V_R$ = 0, f = 1 MHz | $C_j$ | - | 8 | - | pF |
| **OUTPUT** | | | | | | |
| Collector emitter voltage | $I_C$ = 100 µA | $V_{CEO}$ | 70 | - | - | V |
| Emitter collector voltage | $I_E$ = 100 µA | $V_{ECO}$ | 7 | - | - | V |
| Collector dark current | $V_{CE}$ = 20 V, $I_F$ = 0 | $I_{CEO}$ | - | - | 100 | nA |
| **COUPLER** | | | | | | |
| Collector emitter saturation voltage | $I_F$ = 10 mA, $I_C$ = 1 mA | $V_{CEsat}$ | - | 0.1 | 0.3 | V |
| Cut-off frequency | $V_{CE}$ = 5 V, $I_F$ = 10 mA, $R_L$ = 100 Ω | $f_c$ | - | 100 | - | kHz |
| Coupling capacitance | f = 1 MHz | $C_k$ | - | 0.3 | - | 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** |
| $I_C/I_F$ | $V_{CE}$ = 5 V, $I_F$ = 5 mA | TCMT1110 | CTR | 50 | - | 600 | % |
| | $V_{CE}$ = 5 V, $I_F$ = 10 mA | TCMT1113 | CTR | 100 | - | 200 | % |
| | | TCMT1114 | CTR | 160 | - | 320 | % |
| | $V_{CE}$ = 5 V, $I_F$ = 5 mA | TCMT1117 | CTR | 80 | - | 160 | % |
| | | TCMT1118 | CTR | 130 | - | 260 | % |
| | | TCMT1119 | CTR | 200 | - | 400 | % |

| SWITCHING CHARACTERISTICS ($T_{amb}$ = 25 °C, unless otherwise specified) | | | | | | |
|---|---|---|---|---|---|---|
| **PARAMETER** | **TEST CONDITION** | **SYMBOL** | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| Delay time | $V_S$ = 5 V, $I_C$ = 2 mA, $R_L$ = 100 Ω, (see figure 1) | $t_d$ | - | 4 | - | µs |
| Rise time | $V_S$ = 5 V, $I_C$ = 2 mA, $R_L$ = 100 Ω, (see figure 1) | $t_r$ | - | 5.5 | - | µs |
| Fall time | $V_S$ = 5 V, $I_C$ = 2 mA, $R_L$ = 100 Ω, (see figure 1) | $t_f$ | - | 7 | - | µs |
| Storage time | $V_S$ = 5 V, $I_C$ = 2 mA, $R_L$ = 100 Ω, (see figure 1) | $t_s$ | - | 1.5 | - | µs |
| Turn-on time | $V_S$ = 5 V, $I_C$ = 2 mA, $R_L$ = 100 Ω, (see figure 1) | $t_{on}$ | - | 9.5 | - | µs |
| Turn-off time | $V_S$ = 5 V, $I_C$ = 2 mA, $R_L$ = 100 Ω, (see figure 1) | $t_{off}$ | - | 8 | - | µs |
| Turn-on time | $V_S$ = 5 V, $I_F$ = 10 mA, $R_L$ = 1 kΩ, (see figure 2) | $t_{on}$ | - | 3 | - | µs |
| Turn-off time | $V_S$ = 5 V, $I_F$ = 10 mA, $R_L$ = 1 kΩ, (see figure 2) | $t_{off}$ | - | 20 | - | µs |

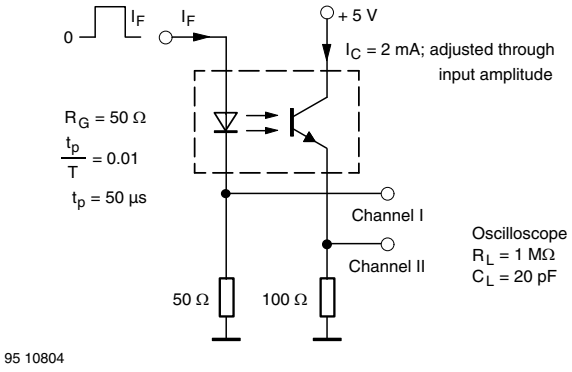



Fig. 1 - Test Circuit, Non-Saturated Operation

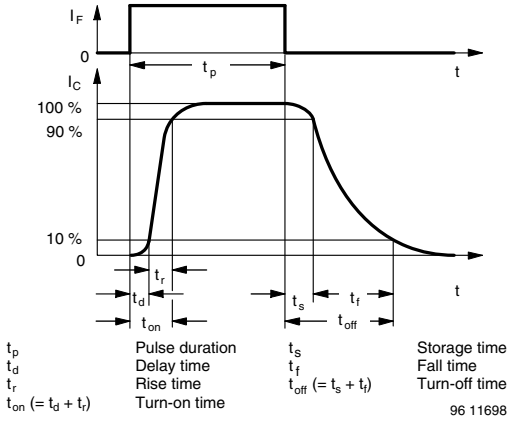



Fig. 3 - Switching Times

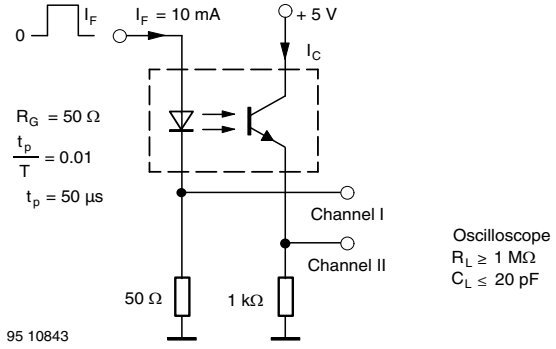



Fig. 2 - Test Circuit, Saturated Operation

| SAFETY AND INSULATION RATINGS | | | | |
|---|---|---|---|---|
| **PARAMETER** | **TEST CONDITION** | **SYMBOL** | **VALUE** | **UNIT** |
| Climatic classification (according to IEC 68 part 1) | | | 55/110/21 | |
| Comparative tracking index | | CTI | 175 | |
| Maximum rated withstanding isolation voltage | 40 % to 60 % RH, AC test of 1 min | $V_{ISO}$ | 3750 | $V_{RMS}$ |
| Maximum transient isolation voltage | | $V_{IOTM}$ | 6000 | V |
| Maximum repetitive peak isolation voltage | | $V_{IORM}$ | 707 | V |
| Insulation resistance | $V_{IO}$ = 500 V, $T_{amb}$ = 100 °C | $R_{IO}$ | $10^{11}$ | Ω |
| Isolation resistance (under fault conditions) | $V_{IO}$ = 500 V, $T_{amb}$ = $T_{SI}$ | $R_{IO}$ | $10^{9}$ | Ω |
| Output safety power | | $P_{SO}$ | 350 | mW |
| Input safety current | | $I_{SI}$ | 200 | mA |
| Input safety temperature | | $T_{SI}$ | 175 | °C |
| Apparent charge test voltage (method A) | $V_{IORM}$ x 1.6 = $V_{PR}$, type and sample test $t_m$ = 60 s, partial discharge < 5 pC | $V_{PR}$ | 1132 | $V_{peak}$ |
| Apparent charge test voltage (method B) | $V_{IORM}$ x 1.875 = $V_{PR}$, 100 % production test with $t_m$ = 1 s, partial discharge < 5 pC | $V_{PR}$ | 1326 | $V_{peak}$ |
| Creepage distance | | | ≥ 5 | mm |
| Clearance distance | | | ≥ 5 | mm |
| Insulation thickness | | DTI | ≥ 0.4 | mm |
| Environment (pollution degree in accordance to DIN VDE 0109) | | | 2 | |

**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 °C, unless otherwise specified)

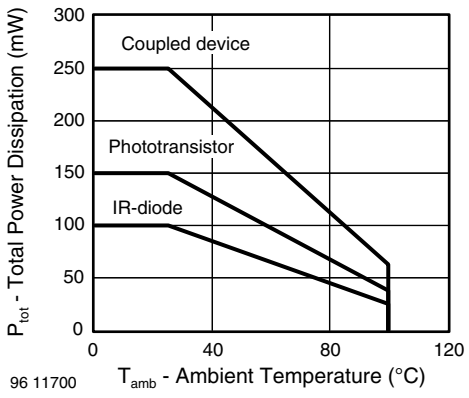



Fig. 4 - Total Power Dissipation vs. Ambient Temperature

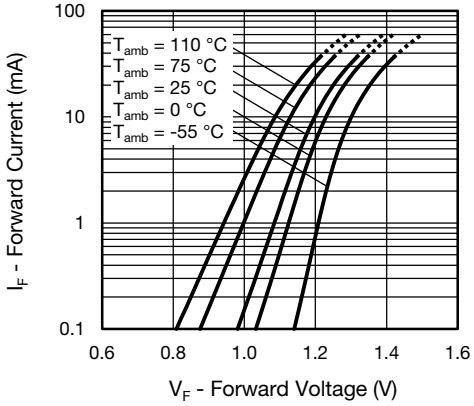



Fig. 5 - Forward Voltage vs. Forward Current

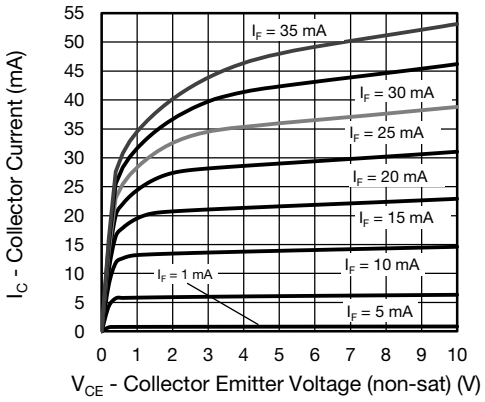



Fig. 6 - Collector Current vs. Collector Emitter Voltage

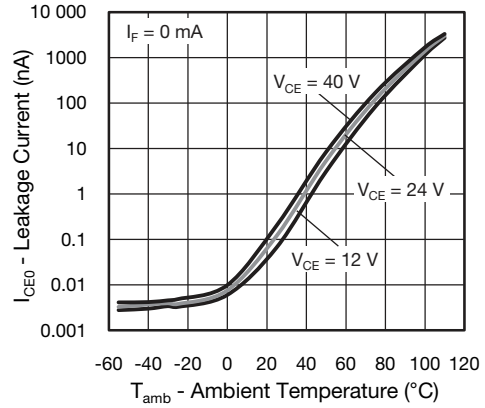



Fig. 7 - Leakage Current vs. Ambient Temperature

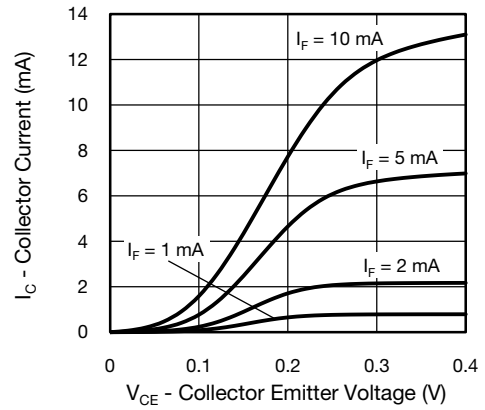



Fig. 8 - Collector Current vs. Collector Emitter Voltage

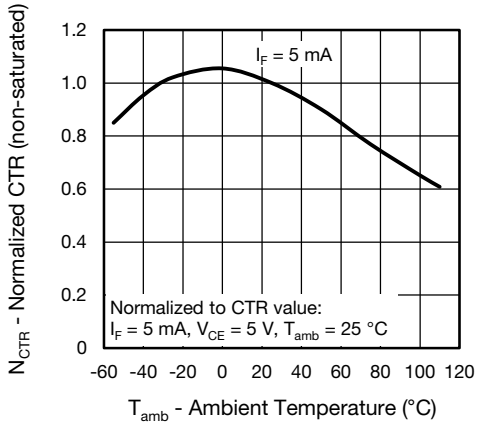



Fig. 9 - Normalized Current Transfer Ratio (non-saturated) vs. Ambient Temperature

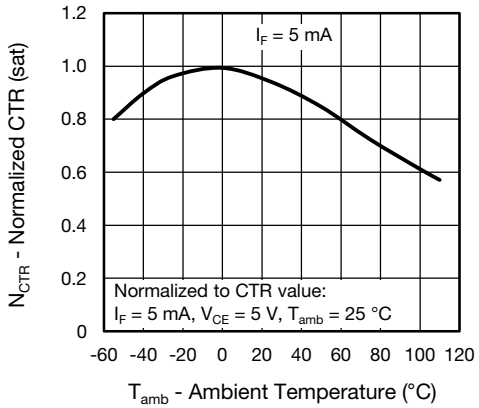



Fig. 10 - Normalized Current Transfer Ratio (saturated) vs. Ambient Temperature

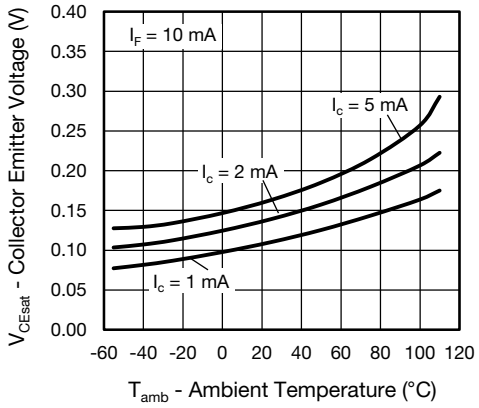



Fig. 11 - Collector Emitter Voltage vs. Ambient Temperature

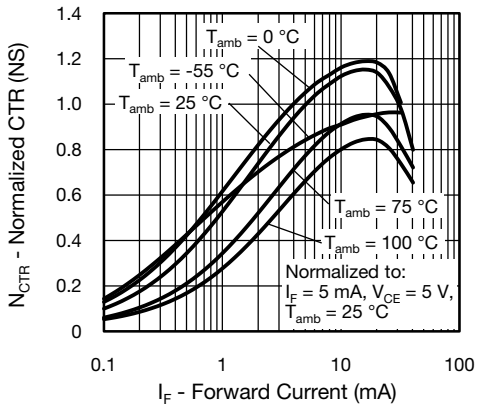



Fig. 12 - Normalized CTR (non-saturated) vs. Forward Current

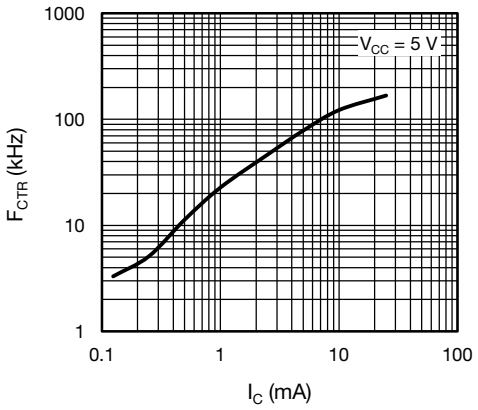



Fig. 15 - $F_{CTR}$ vs. Collector Current

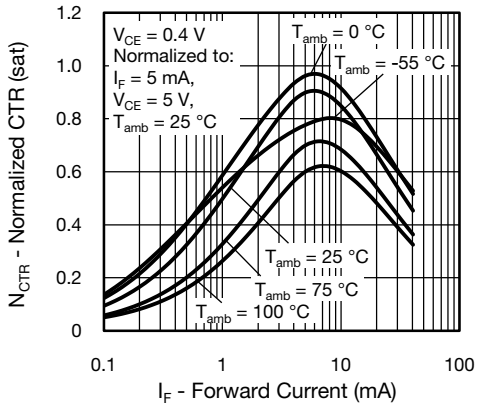



Fig. 13 - Normalized CTR (saturated) vs. Forward Current

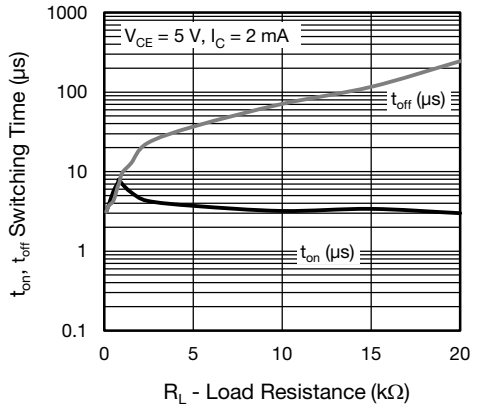



Fig. 16 - Switching Time vs. Load Resistance

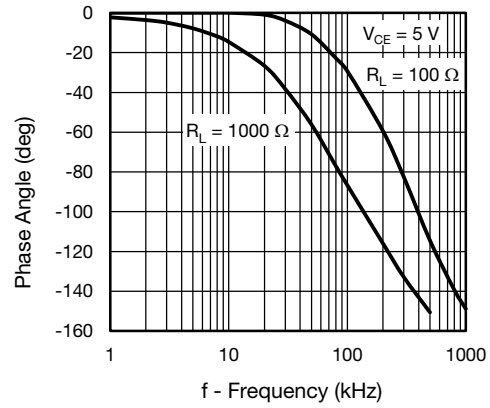
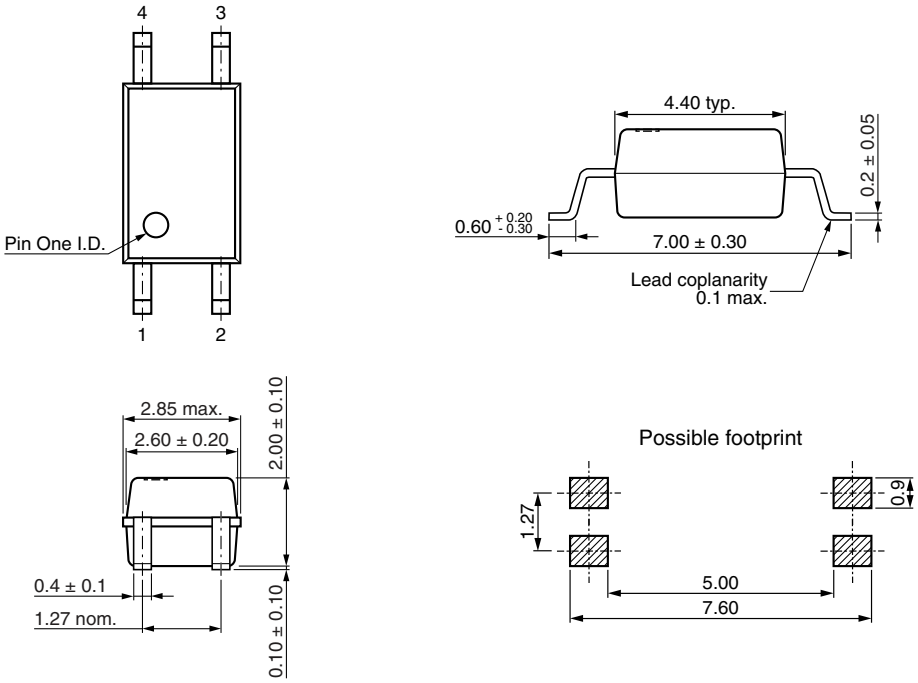
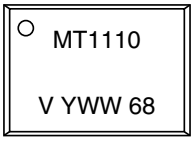



Fig. 14 - $F_{CTR}$ vs. Phase Angle

**PACKAGE DIMENSIONS** in millimeters




**PACKAGE MARKING** (example of TCMT1110)



## PACKAGING INFORMATION (TAPE AND REEL) in millimeters

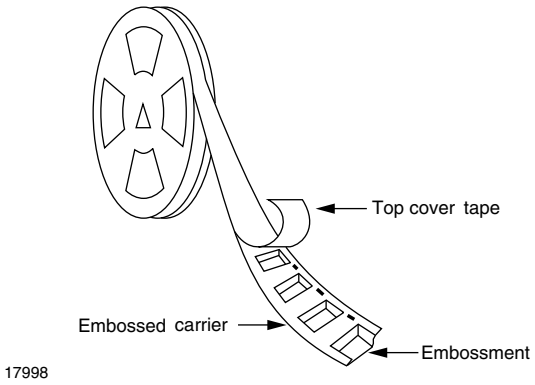



Fig. 17 - Tape and Reel Shipping Medium

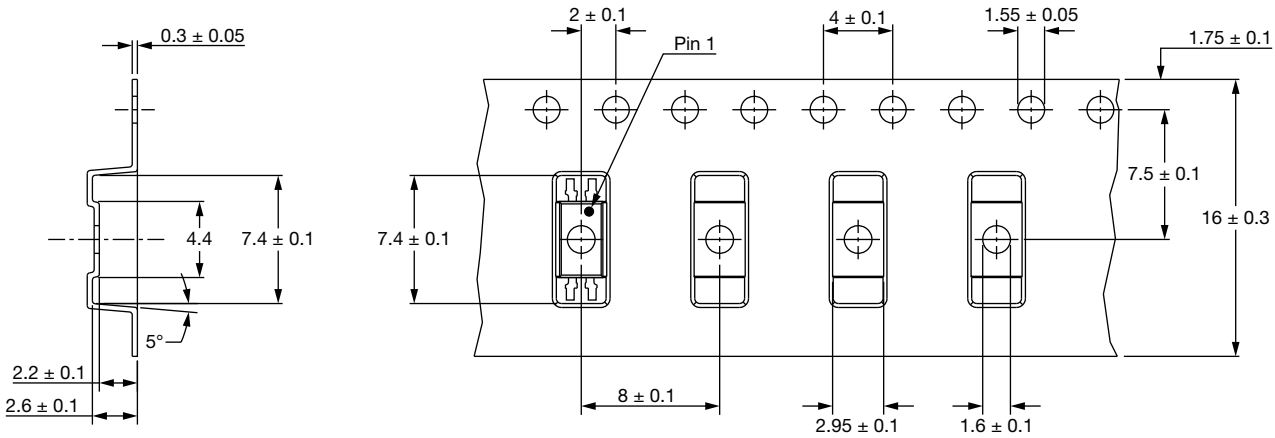



Fig. 18 - Tape and Reel Packing (3000 parts per reel)

## SOLDER PROFILES

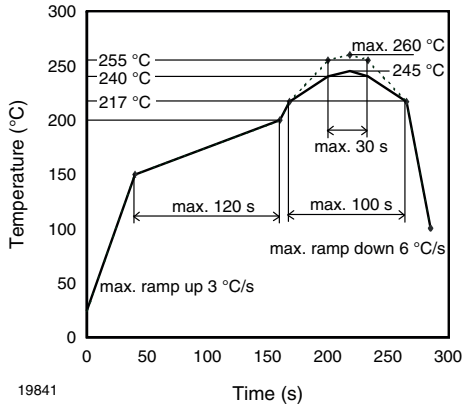



Fig. 19 - Lead (Pb)-free Reflow Solder Profile According to J-STD-020 for SMD Devices

## 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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