

# FMBT2222 / FMBT2222A

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# FMBT2222 / FMBT2222A

## 600mA Silicon NPN Epitaxial Planar Transistor

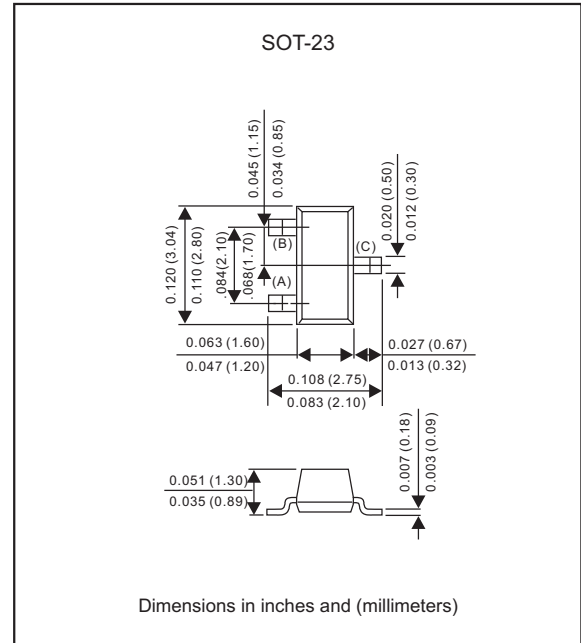
### Features

- High collector-emitterbreakdien voltage. (BV<sub>CEO</sub> = 40V@I<sub>C</sub>=10mA)
- Small load switch transistor with high gain and low stauration voltage, is designed for general purpose amflifier and switching applications at collector current.
- Capable of 225mW power dissipation.
- Lead-free parts for green partner, exceeds environmental standards of MIL-STD-19500 /228
- Suffix "-H" indicates Halogen-free part, ex.FMBT2222-H.

### Mechanical data

- Epoxy:UL94-V0 rated flame retardant
- Case : Molded plastic, SOT-23
- Terminals : Solder plated, solderable per MIL-STD-750, Method 2026
- Mounting Position : Any
- Weight : Approximated 0.008 gram

### Package outline



### Maximum ratings (AT T<sub>A</sub>=25°C unless otherwise noted)

| PARAMETER                                     | CONDITIONS            | Symbol           | FMBT2222   | FMBT2222A | UNIT  |
|---|-----------------------|------------------|------------|-----------|-------|
| Collector-Base voltage                        |                       | V <sub>CBO</sub> | 60         | 75        | V     |
| Collector-Emitter voltage                     |                       | V <sub>CEO</sub> | 30         | 40        | V     |
| Emitter-Base voltage                          |                       | V <sub>EBO</sub> | 5.0        | 6.0       | V     |
| Collector current                             |                       | I <sub>C</sub>   | 600        |           | mA    |
| Total device dissipation FR-5 board (1)       | T <sub>A</sub> = 25°C | P <sub>D</sub>   | 225        |           | mW    |
|   | Derate above 25°C     | P <sub>D</sub>   | 1.8        |           | mW/°C |
| Thermal resistance                            | Junction to ambient   | R <sub>θJA</sub> | 556        |           | °C/W  |
| Total device dissipation alumina substrate(2) | T <sub>A</sub> = 25°C | P <sub>D</sub>   | 300        |           | mW    |
|   | Derate above 25°C     | P <sub>D</sub>   | 2.4        |           | mW/°C |
| Thermal resistance                            | Junction to ambient   | R <sub>θJA</sub> | 417        |           | °C/W  |
| Operating temperature                         |                       | T <sub>J</sub>   | -55 ~ +150 |           | °C    |
| Storage temperature                           |                       | T <sub>STG</sub> | -65 ~ +150 |           |       |

1.FR-5 = 1.0 X 0.75 X 0.062 in.

2.Alumina = 0.4 X 0.3 X 0.024 in. 99.5% alumina.

## FMBT2222 / FMBT2222A

## ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted)

| Characteristics  |                       | Symbol   | Min        | Max    | Unit |
|--|-----------------------|----------|------------|--------|------|
| <b>OFF CHARACTERISTICS</b>                               |                       |          |            |        |      |
| Collector-Emitter Breakdown Voltage (IC=10 mAdc, IB=0)   | FMBT2222<br>FMBT2222A | V(BR)CEO | 30<br>40   | -<br>- | Vdc  |
| Collector-Base Breakdown Voltage (IC=10 µAdc, IE=0)      | FMBT2222<br>FMBT2222A | V(BR)CBO | 60<br>75   | -<br>- | Vdc  |
| Emitter-Base Breakdown Voltage (IE=10 µAdc, IC=0)        | FMBT2222<br>FMBT2222A | V(BR)EBO | 5.0<br>6.0 | -<br>- | Vdc  |
| Collector Cutoff Current (VCE=60 Vdc, VEB (off)=3.0 Vdc) | FMBT2222A             | ICEX     | -          | 10     | nAdc |
| Collector Cutoff Current (VCB=50 Vdc, IE=0)              | FMBT2222              | ICBO     | -          | 0.01   | µAdc |
| (VCB=60Vdc, IE=0)  | FMBT2222A             |          | -          | 0.01   |      |
| (VCB=50Vdc, IE=0, TA=125 °C)                             | FMBT2222              |          | -          | 10     |      |
| (VCB=60Vdc, IE=0, TA=125 °C)                             | FMBT2222A             |          | -          | 10     |      |
| Emitter Cutoff Current (VEB=3.0 Vdc, IC=0)               | FMBT2222A             | IEBO     | -          | 100    | nAdc |
| Base Cutoff Current (VCE=60Vdc, VEB(off)=3.0Vdc)         | FMBT2222A             | IBL      | -          | 20     | nAdc |

## ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted) (Continued)

| Characteristics                          |                       | Symbol   | Min    | Max        | Unit |
|--|-----------------------|----------|--------|------------|------|
| <b>ON CHARACTERISTICS</b>                |                       |          |        |            |      |
| DC Current Gain                          |                       | hFE      |        |            |      |
| (IC=0.1 mAdc, VCE=10 Vdc)                |                       |          | 35     | -          |      |
| (IC=1.0 mAdc, VCE=10 Vdc)                |                       |          | 50     | -          |      |
| (IC=10 mAdc, VCE=10 Vdc)                 |                       |          | 75     | -          |      |
| (IC=10 mAdc, VCE=10 Vdc, TA=-55°C)       | FMBT2222A ONLY        |          | 35     | -          |      |
| (IC=150 mAdc, VCE=10 Vdc) (3)            |                       |          | 100    | 300        |      |
| (IC=150 mAdc, VCE=1.0Vdc) (3)            |                       |          | 50     | -          |      |
| (IC=500 mAdc, VCE=10 Vdc) (3)            | FMBT2222<br>FMBT2222A | 30<br>40 | -<br>- |            |      |
| Collector-Emitter Saturation Voltage (3) | FMBT2222<br>FMBT2222A | VCE(sat) | -      | 0.4        | Vdc  |
| (IC=150 mAdc, IB=15mAdc)                 |                       |          | -      | 0.3        |      |
| (IC=500 mAdc, IB=50mAdc)                 | FMBT2222<br>FMBT2222A | -        | -      | 1.6<br>1.0 |      |
| Base-Emitter Saturation Voltage (3)      | FMBT2222<br>FMBT2222A | VBE(sat) | -      | 1.3        | Vdc  |
| (IC=150 mAdc, IB=15mAdc)                 |                       |          | 0.6    | 1.2        |      |
| (IC=500 mAdc, IB=50mAdc)                 | FMBT2222<br>FMBT2222A | -        | -      | 2.6<br>2.0 |      |

## FMBT2222 / FMBT2222A

ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25°C unless otherwise noted) (Continued)

| Characteristics  | Symbol                 | Min                             | Max         | Unit                             |
|--|------------------------|---------------------------------|-------------|----------------------------------|
| <b>SMALL-SIGNAL CHARACTERISTICS</b>  |                        |                                 |             |                                  |
| Current-Gain-Bandwidth Product (4)<br>(I <sub>C</sub> =20 mAdc, V <sub>CE</sub> =20 Vdc, f=100MHz)   | FMBT2222<br>FMBT2222A  | f <sub>T</sub>                  | 250<br>300  | -<br>-<br>MHz                    |
| Output Capacitance<br>(V <sub>CB</sub> =10 Vdc, I <sub>E</sub> =0, f=1.0MHz)   | FMBT2222<br>FMBT2222A  | C <sub>obo</sub>                | -           | 8.0<br>pF                        |
| Input Capacitance<br>(V <sub>EB</sub> =0.5 Vdc, I <sub>C</sub> =0, f=1.0MHz)   | FMBT2222<br>FMBT2222A  | C <sub>ibo</sub>                | -           | 30<br>25<br>pF                   |
| Input Impedance<br>(I <sub>C</sub> =1.0 mAdc, V <sub>CE</sub> =10 Vdc, f=1.0 kHz)<br>(I <sub>C</sub> =10 mAdc, V <sub>CE</sub> =10 Vdc, f=1.0 kHz)         | FMBT2222A<br>FMBT2222A | h <sub>ie</sub>                 | 2.0<br>0.25 | 8.0<br>1.25<br>kW                |
| Voltage Feedback Ratio<br>(I <sub>C</sub> =1.0 mAdc, V <sub>CE</sub> =10 Vdc, f=1.0 kHz)<br>(I <sub>C</sub> =10 mAdc, V <sub>CE</sub> =10 Vdc, f=1.0 kHz)  | FMBT2222A<br>FMBT2222A | h <sub>re</sub>                 | -           | 8.0<br>4.0<br>x 10 <sup>-4</sup> |
| Small-Signal Current Gain<br>(I <sub>C</sub> =1.0 mAdc, V <sub>CE</sub> =10Vdc, f=1.0 kHz)<br>(I <sub>C</sub> =10 mAdc, V <sub>CE</sub> =10Vdc, f=1.0 kHz) | FMBT2222A<br>FMBT2222A | h <sub>fe</sub>                 | 50<br>75    | 300<br>375<br>-                  |
| Output Admittance<br>(I <sub>C</sub> =1.0 mAdc, V <sub>CE</sub> =10Vdc, f=-1.0kHz)<br>(I <sub>C</sub> =10 mAdc, V <sub>CE</sub> =10Vdc, f=-1.0kHz)         | FMBT2222A<br>FMBT2222A | h <sub>oe</sub>                 | 5.0<br>25   | 35<br>200<br>mhos                |
| Collector Base Time Constant<br>(I <sub>E</sub> =20 mAdc, V <sub>CB</sub> =20 Vdc, f=31.8 MHz)   | FMBT2222A              | r <sub>b</sub> , C <sub>C</sub> | -           | 150<br>ps                        |
| Noise Figure<br>(I <sub>C</sub> =100 A dc, V <sub>CE</sub> =10Vdc, R <sub>S</sub> =1.0kW, f=1.0kHz)  | FMBT2222A              | NF                              | -           | 4.0<br>dB                        |

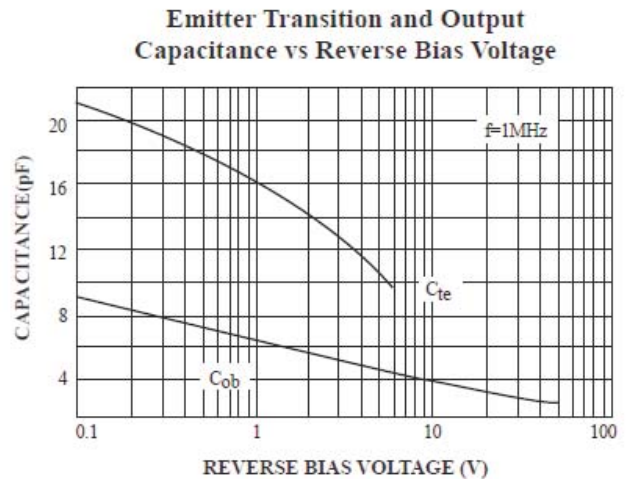
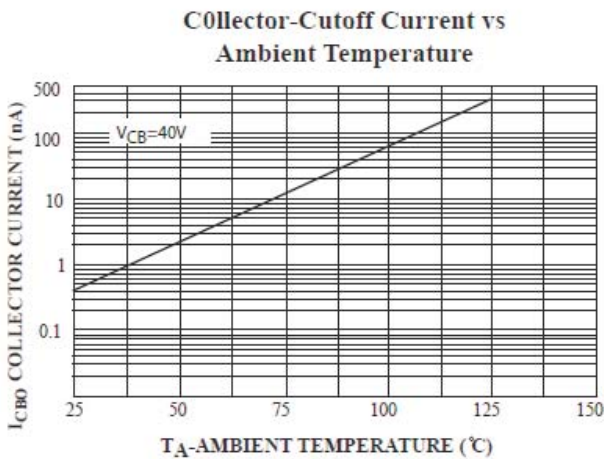
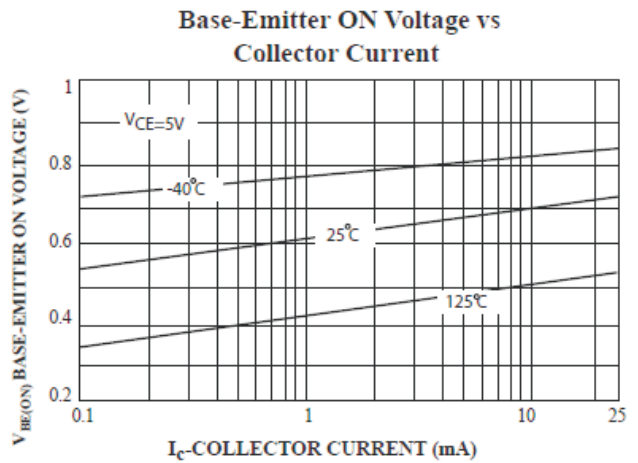
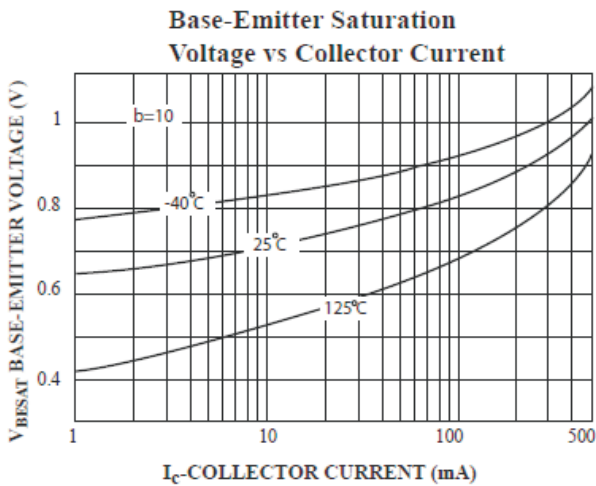
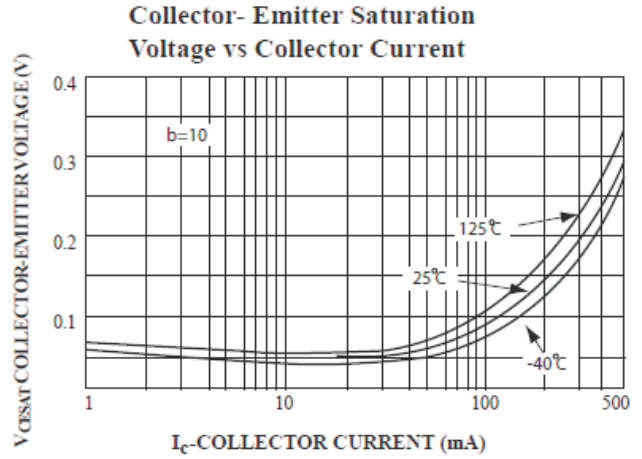
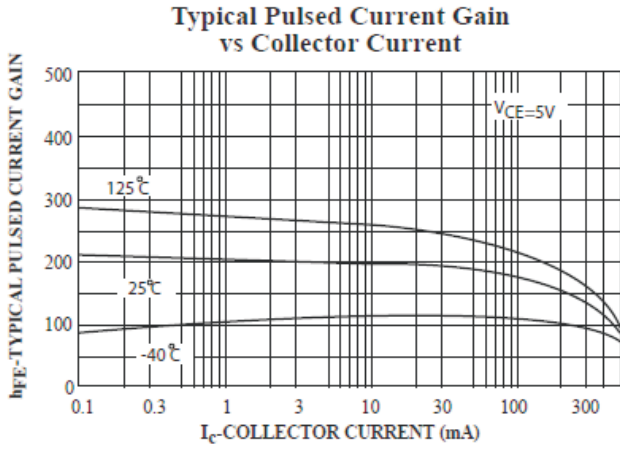
## SWITCHING CHARACTERISTICS(FMBT2222A only)

|              |   |                |   |     |    |
|--------------|---|----------------|---|-----|----|
| Delay Time   | (V <sub>CC</sub> =30 Vdc, V <sub>BE</sub> (off)=-0.5Vdc,<br>I <sub>C</sub> =150 mAdc, I <sub>B1</sub> =15 mAdc) | t <sub>d</sub> | - | 10  | ns |
| Rise Time    |   | t <sub>r</sub> | - | 25  |    |
| Storage Time | (V <sub>CC</sub> =30 Vdc, I <sub>C</sub> =150 mAdc,<br>I <sub>B1</sub> =I <sub>B2</sub> =15 mAdc)               | t <sub>s</sub> | - | 225 | ns |
| Fall Time    |   | t <sub>f</sub> | - | 60  |    |

3. Pulse Test: Pulse Width 300 μs, Duty Cycle ≤ 2.0%.

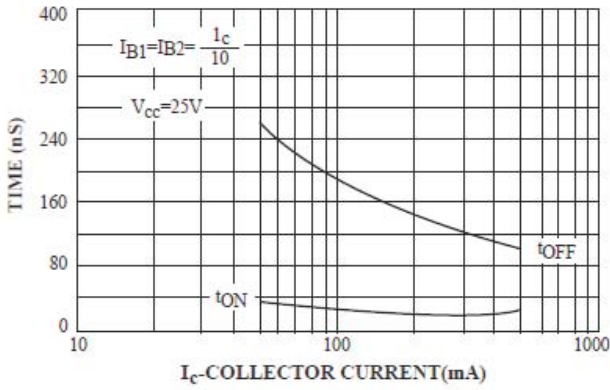
4. f<sub>T</sub> is defined as the frequency at which I<sub>hfe</sub> extrapolates to unity.

Rating and characteristic curves (FMBT2222 / FMBT2222A)

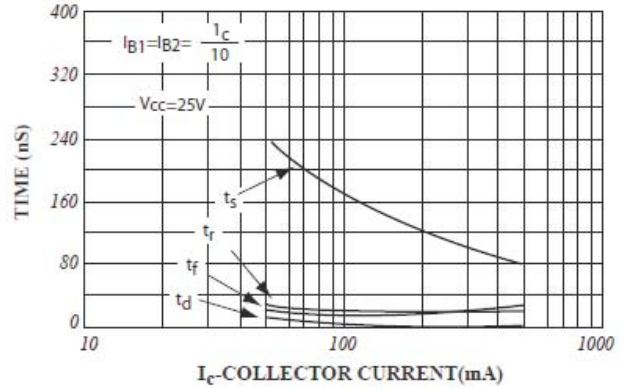


## Rating and characteristic curves (FMBT2222 / FMBT2222A)

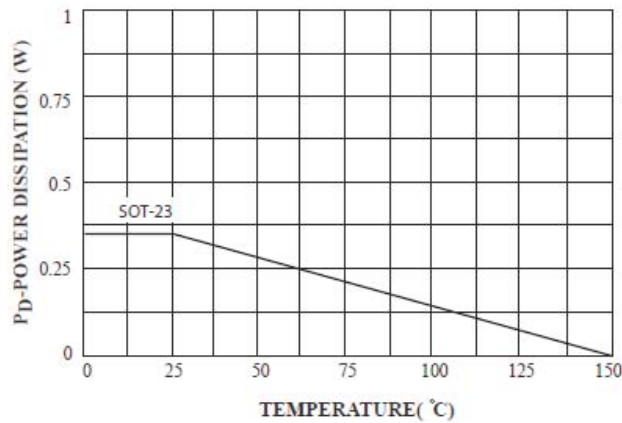
Turn On and Turn Off Times vs Collector Current



Switching Times vs Collector Current

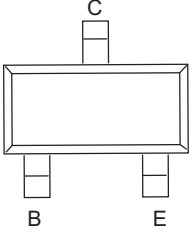
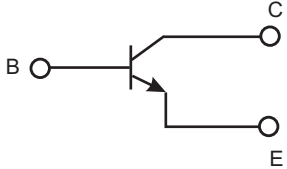


Power Dissipation vs Ambient Temperature



# FMBT2222 / FMBT2222A

## Pinning information

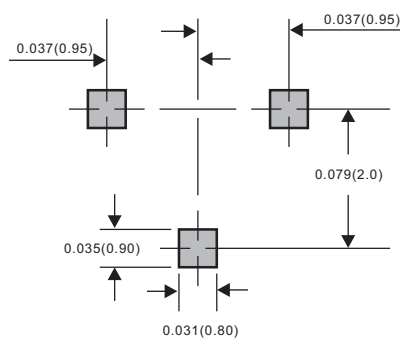
| Pin   | Simplified outline  | Symbol  |
|---|---|---|
| PinB Base<br>PinC Collector<br>PinE Emitter |  |  |

## Marking

| Type number | Marking code |
|-------------|--------------|
| FMBT2222    | M1B          |
| FMBT2222A   | 1P           |

## Suggested solder pad layout

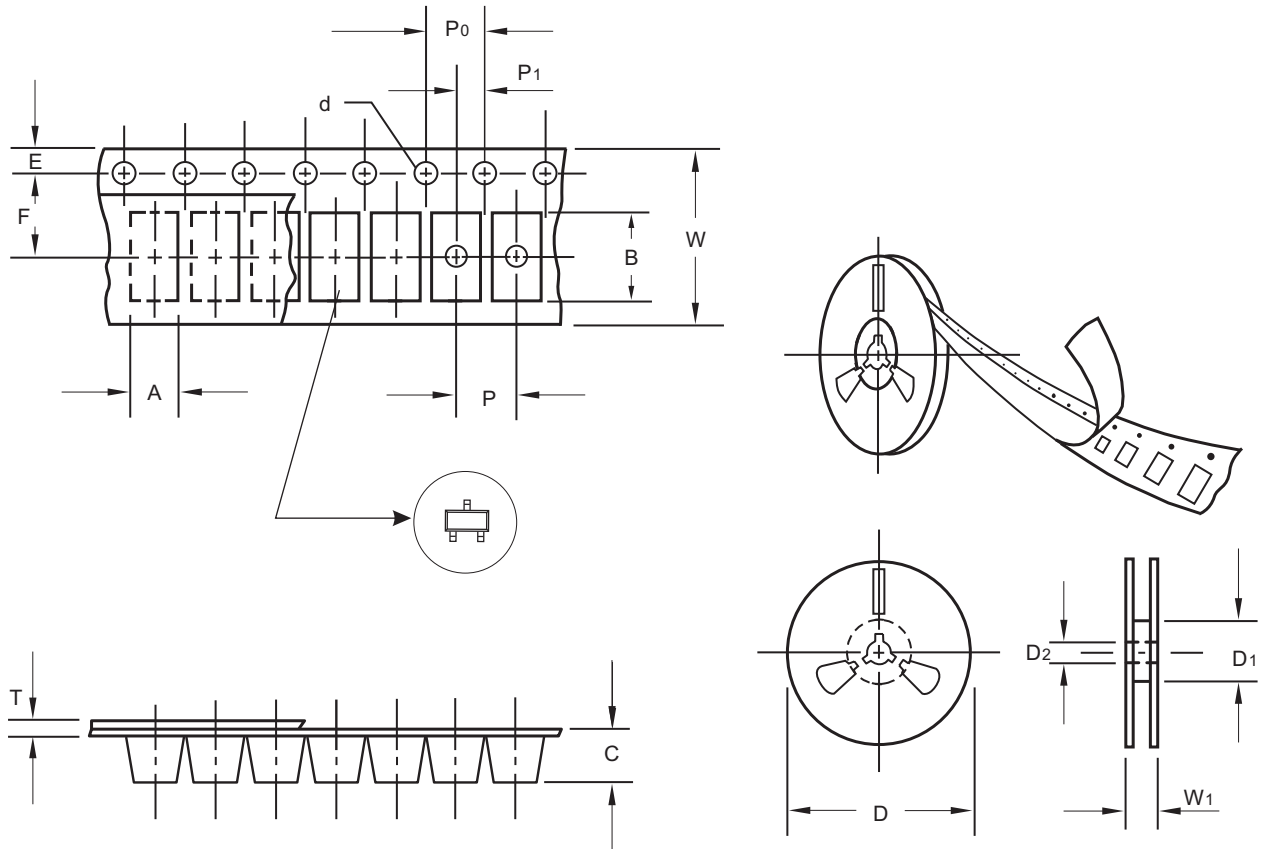
### SOT-23



Dimensions in inches and (millimeters)

# FMBT2222 / FMBT2222A

## Packing information



unit:mm

| Item                      | Symbol | Tolerance | SOT-23 |
|---------------------------|--------|-----------|--------|
| Carrier width             | A      | 0.1       | 3.15   |
| Carrier length            | B      | 0.1       | 2.77   |
| Carrier depth             | C      | 0.1       | 1.22   |
| Sprocket hole             | d      | 0.1       | 1.50   |
| 13" Reel outside diameter | D      | 2.0       | -      |
| 13" Reel inner diameter   | D1     | min       | -      |
| 7" Reel outside diameter  | D      | 2.0       | 178.00 |
| 7" Reel inner diameter    | D1     | min       | 55.00  |
| Feed hole diameter        | D2     | 0.5       | 13.00  |
| Sprocket hole position    | E      | 0.1       | 1.75   |
| Punch hole position       | F      | 0.1       | 3.50   |
| Punch hole pitch          | P      | 0.1       | 4.00   |
| Sprocket hole pitch       | P0     | 0.1       | 4.00   |
| Embossment center         | P1     | 0.1       | 2.00   |
| Overall tape thickness    | T      | 0.1       | 0.23   |
| Tape width                | W      | 0.3       | 8.00   |
| Reel width                | W1     | 1.0       | 12.0   |

Note: Devices are packed in accordance with EIA standard RS-481-A and specifications listed above.



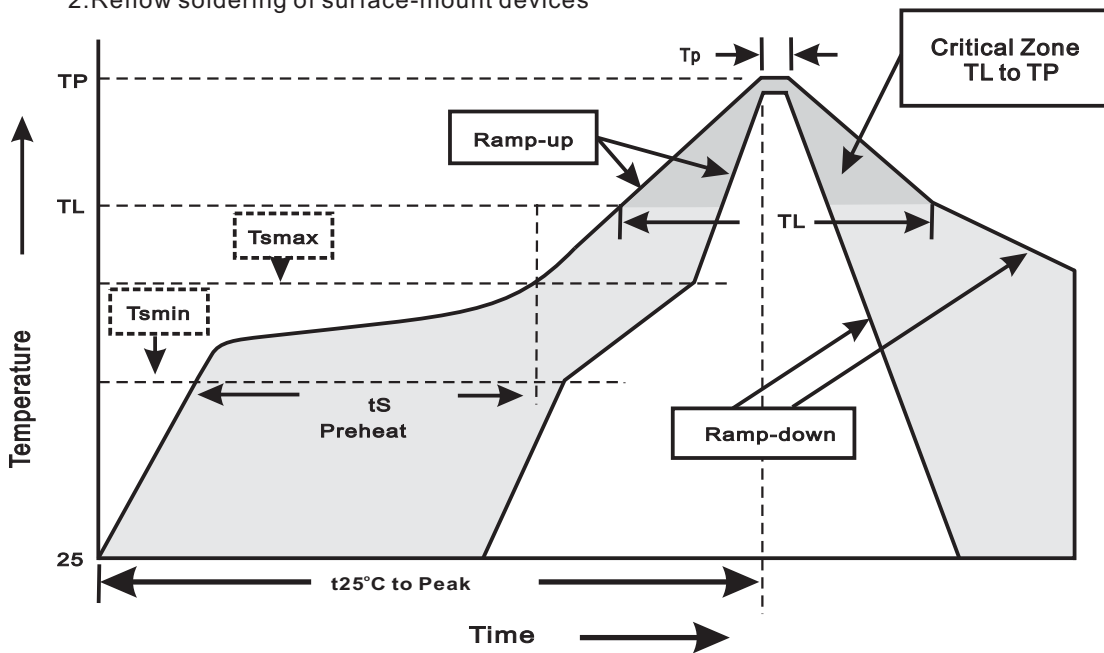
# FMBT2222 / FMBT2222A

## Reel packing

| PACKAGE | REEL SIZE | REEL (pcs) | COMPONENT SPACING (m/m) | BOX (pcs) | INNER BOX (m/m) | REEL DIA, (m/m) | CARTON SIZE (m/m) | CARTON (pcs) | APPROX. GROSS WEIGHT (kg) |
|---------|-----------|------------|-------------------------|-----------|-----------------|-----------------|-------------------|--------------|---------------------------|
| SOT-23  | 7"        | 3000       | 4.0                     | 30,000    | 183*183*123     | 178             | 383*262*387       | 240,000      | 11.6                      |

## Suggested thermal profiles for soldering processes

- 1.Storage environment: Temperature=5°C~40°C Humidity=55%±25%
- 2.Reflow soldering of surface-mount devices



### 3.Reflow soldering

| Profile Feature   | Soldering Condition         |
|---|-----------------------------|
| Average ramp-up rate(T <sub>L</sub> to T <sub>P</sub> )   | <3°C/sec                    |
| Preheat<br>-Temperature Min(T <sub>smmin</sub> )<br>-Temperature Max(T <sub>smmax</sub> )<br>-Time(min to max)(t <sub>s</sub> ) | 150°C<br>200°C<br>60~120sec |
| T <sub>smmax</sub> to T <sub>L</sub><br>-Ramp-upRate  | <3°C/sec                    |
| Time maintained above:<br>-Temperature(T <sub>L</sub> )<br>-Time(t <sub>L</sub> )   | 217°C<br>60~260sec          |
| Peak Temperature(T <sub>P</sub> )   | 255°C-0/+5°C                |
| Time within 5°C of actual Peak Temperature(t <sub>P</sub> )   | 10~30sec                    |
| Ramp-down Rate  | <6°C/sec                    |
| Time 25°C to Peak Temperature   | <6minutes                   |