

**FMBT2907 / FMBT2907A****List**

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# FMBT2907 / FMBT2907A

## General Purpose Transistor PNP Silicon

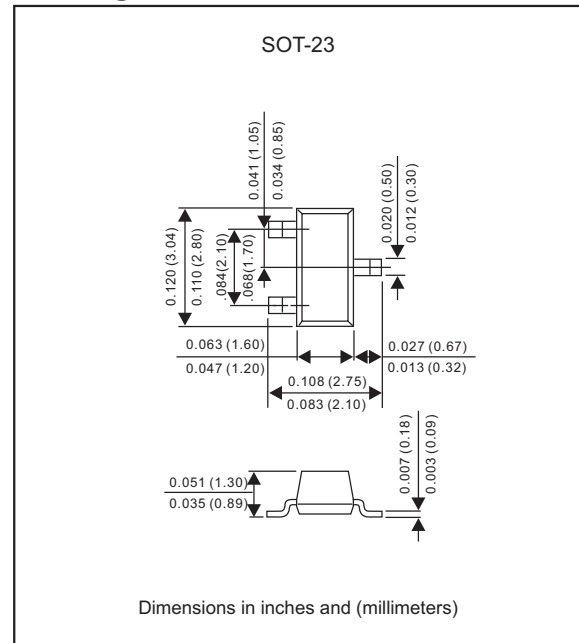
### Features

- High collector-emitter breakdown voltage
- PNP silicon epitaxial planar transistor, is designed for general purpose and amplifier applications
- Capable of 225mW power dissipation
- Lead-free parts meet RoHS requirements
- Suffix "-H" indicates Halogen-free part, ex. FMBT2907-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 $T_A = 25^\circ\text{C}$ unless otherwise noted)

| Parameter                                                           | Symbol          | FMBT2907    | FMBT2907A | Unit                 |
|---------------------------------------------------------------------|-----------------|-------------|-----------|----------------------|
| Collector-emitter voltage                                           | $V_{CEO}$       | -40         | -60       | V                    |
| Collector-base voltage                                              | $V_{CBO}$       | -60         |           | V                    |
| Emitter-base voltage                                                | $V_{EBO}$       | -5.0        |           | V                    |
| Collector current - continuous                                      | $I_C$           | -600        |           | mA                   |
| Total device dissipation FR-5 board $T_A = 25^\circ\text{C}$<br>(1) | $P_D$           | 225         |           | mW                   |
| Derate above $25^\circ\text{C}$                                     |                 | 1.8         |           | mW/ $^\circ\text{C}$ |
| Thermal resistance Junction to ambient                              | $R_{\theta JA}$ | 556         |           | $^\circ\text{C/W}$   |
| Total device dissipation alumina substrate(2)                       | $P_D$           | 300         |           | mW                   |
| Derate above $25^\circ\text{C}$                                     |                 | 2.4         |           | mW/ $^\circ\text{C}$ |
| Thermal resistance Junction to ambient                              | $R_{\theta JA}$ | 417         |           | $^\circ\text{C/W}$   |
| Operating junction temperature range                                | $T_J$           | -55 to +150 |           | $^\circ\text{C}$     |
| Storage temperature range                                           | $T_{STG}$       | -55 to +150 |           | $^\circ\text{C}$     |

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.

## FMBT2907 / FMBT2907A

**Electrical characteristics** (AT  $T_A=25^{\circ}\text{C}$  unless otherwise noted)**Off characteristics**

| Parameter                               | Conditions                                                                                | Symbol        | MIN.       | TYP. | MAX.           | Unit          |
|-----------------------------------------|-------------------------------------------------------------------------------------------|---------------|------------|------|----------------|---------------|
| Collector-emitter breakdown voltage (2) | $I_C = -10\text{mA}$ , $I_B = 0$<br>FMBT2907<br>FMBT2907A                                 | $V_{(BR)CEO}$ | -40<br>-60 |      |                | V             |
| Collector-base breakdown voltage        | $I_C = -10\mu\text{A}$ , $I_E = 0$                                                        | $V_{(BR)CBO}$ | -60        |      |                | V             |
| Emitter-base breakdown voltage          | $I_E = -10\mu\text{A}$ , $I_C = 0$                                                        | $V_{(BR)EBO}$ | -5.0       |      |                | V             |
| Collector cutoff current                | $V_{CB} = -30\text{V}$ , $I_{BE(off)} = -0.5\text{V}$                                     | $I_{CEX}$     |            |      | -50            | nA            |
| Collector cutoff current                | $V_{CB} = -50\text{V}$ , $I_E = 0$<br>FMBT2907<br>FMBT2907A                               | $I_{CBO}$     |            |      | -0.02<br>-0.01 | $\mu\text{A}$ |
|                                         | $V_{CB} = -50\text{V}$ , $I_E = 0$ , $T_A = 125^{\circ}\text{C}$<br>FMBT2907<br>FMBT2907A |               |            |      | -20<br>-10     |               |
| Base current                            | $V_{CE} = -30\text{V}$ , $V_{EB(off)} = -0.5\text{V}$                                     | $I_B$         |            |      | -50            | nA            |

**On characteristics**

| Parameter                                | Conditions                                                                  | Symbol        | MIN.      | TYP. | MAX.     | Unit |
|------------------------------------------|-----------------------------------------------------------------------------|---------------|-----------|------|----------|------|
| DC current gain                          | $I_C = -0.1\text{mA}$ , $V_{CE} = -10\text{V}$<br>FMBT2907<br>FMBT2907A     | $h_{FE}$      | 35<br>75  |      |          |      |
|                                          | $I_C = -1.0\text{mA}$ , $V_{CE} = -10\text{V}$<br>FMBT2907<br>FMBT2907A     |               | 50<br>100 |      |          |      |
|                                          | $I_C = -10\text{mA}$ , $V_{CE} = -10\text{V}$<br>FMBT2907<br>FMBT2907A      |               | 75<br>100 |      |          |      |
|                                          | $I_C = -150\text{mA}$ , $V_{CE} = -10\text{V}$ (2)<br>FMBT2907<br>FMBT2907A |               | -<br>100  |      | -<br>300 |      |
|                                          | $I_C = -500\text{mA}$ , $V_{CE} = -10\text{V}$ (2)<br>FMBT2907<br>FMBT2907A |               | 30<br>50  |      |          |      |
| Collector-emitter saturation voltage (2) | $I_C = -150\text{mA}$ , $I_B = -15\text{mA}$                                | $V_{CE(sat)}$ |           |      | -0.4     | V    |
|                                          | $I_C = -500\text{mA}$ , $I_B = -50\text{mA}$                                |               |           |      | -1.6     |      |
| Base-emitter saturation voltage (2)      | $I_C = -150\text{mA}$ , $I_B = -15\text{mA}$                                | $V_{BE(sat)}$ |           |      | -1.3     | V    |
|                                          | $I_C = -500\text{mA}$ , $I_B = -50\text{mA}$                                |               |           |      | -2.6     |      |

**Small-signal characteristics**

| Parameter                            | Conditions                                                          | Symbol    | MIN. | TYP. | MAX. | Unit |
|--------------------------------------|---------------------------------------------------------------------|-----------|------|------|------|------|
| Current-gain-bandwidth product (2,3) | $I_C = -50\text{mA}$ , $V_{CE} = -20\text{V}$ , $f = 100\text{MHz}$ | $f_r$     | 200  |      |      | MHz  |
| Output capacitance                   | $V_{CB} = -10\text{V}$ , $I_E = 0$ , $f = 1.0\text{MHz}$            | $C_{obo}$ |      |      | 8.0  | pF   |
| Input capacitance                    | $V_{EB} = -2.0\text{V}$ , $I_C = 0$ , $f = 1.0\text{MHz}$           | $C_{ibo}$ |      |      | 30   | pF   |

**Switching characteristics**

| Parameter     | Conditions                                                                         | Symbol    | MIN. | TYP. | MAX. | Unit |
|---------------|------------------------------------------------------------------------------------|-----------|------|------|------|------|
| Turn-on time  | $V_{CC} = -30\text{V}$ , $I_C = -150\text{mA}$ , $I_{B1} = -15\text{mA}$           | $t_{on}$  |      |      | 45   | ns   |
| Delay time    |                                                                                    | $t_d$     |      |      | 10   |      |
| Rise time     |                                                                                    | $t_r$     |      |      | 40   |      |
| Storage time  | $V_{CC} = -6.0\text{V}$ , $I_C = -150\text{mA}$ , $I_{B1} = I_{B2} = -15\text{mA}$ | $t_s$     |      |      | 225  |      |
| Fall time     |                                                                                    | $t_f$     |      |      | 60   |      |
| Turn-off time |                                                                                    | $t_{off}$ |      |      | 280  |      |

2. Pulse test : pulse width  $\leq 300\mu\text{s}$ , duty cycle  $\leq 2.0\%$ .

3.  $f_r$  is defined as the frequency at which  $|h_{fe}|$  extrapolates to unity.

## Rating and characteristic curves (FMBT2907 / FMBT2907A)

Figure 1. Delay and Rise Time Test Circuit

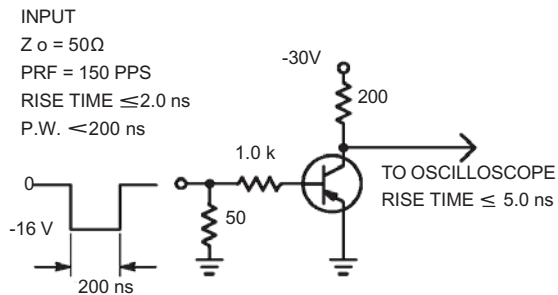


Figure 2. Storage and Fall Time Test Circuit

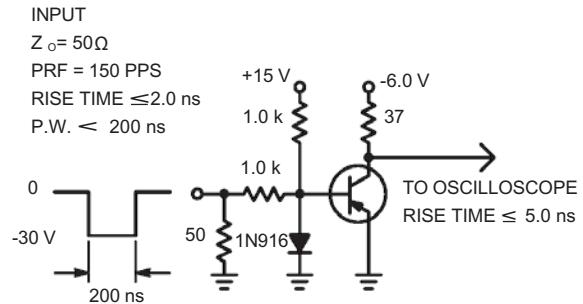


Figure 3. DC Current Gain

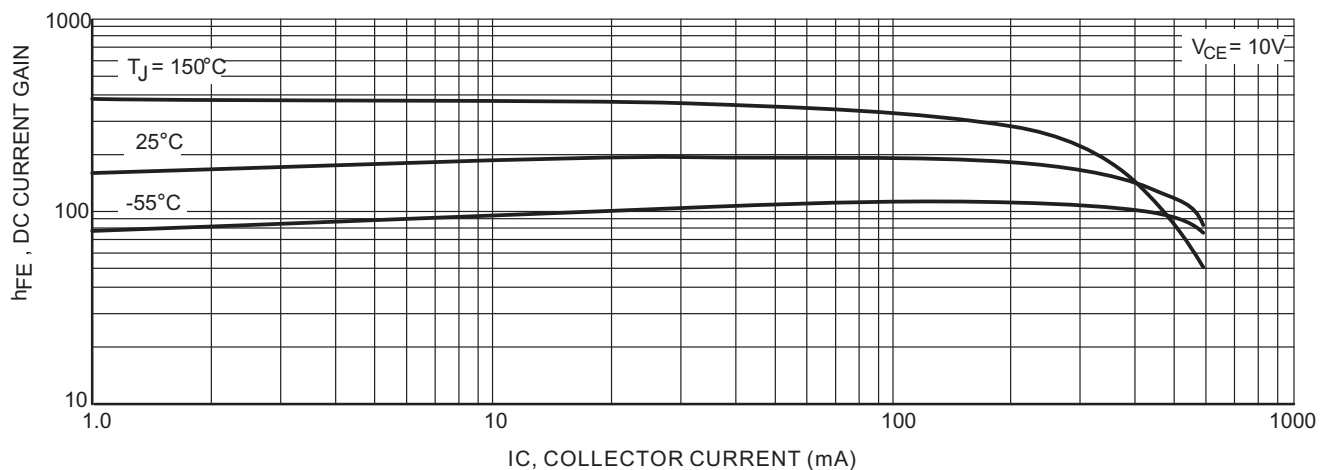
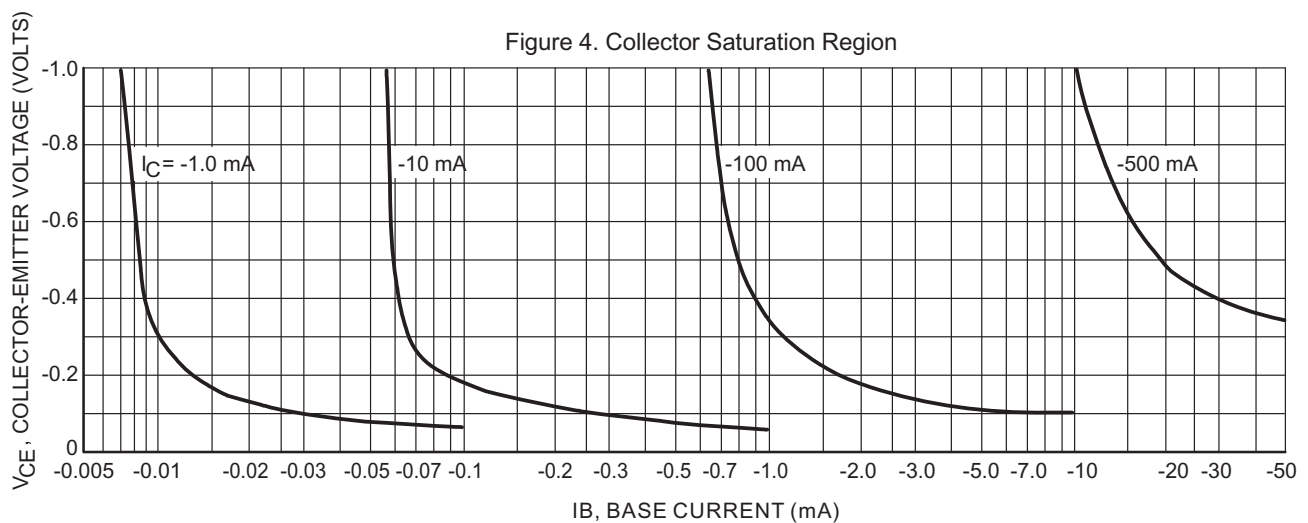


Figure 4. Collector Saturation Region



## Rating and characteristic curves (FMBT2907 / FMBT2907A)

Figure 5. Turn-on Time

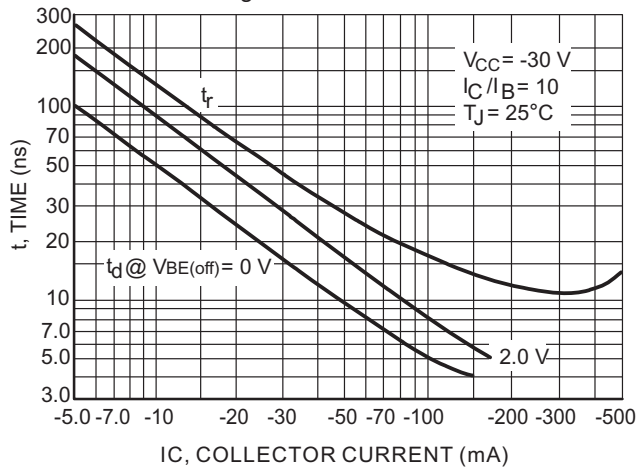
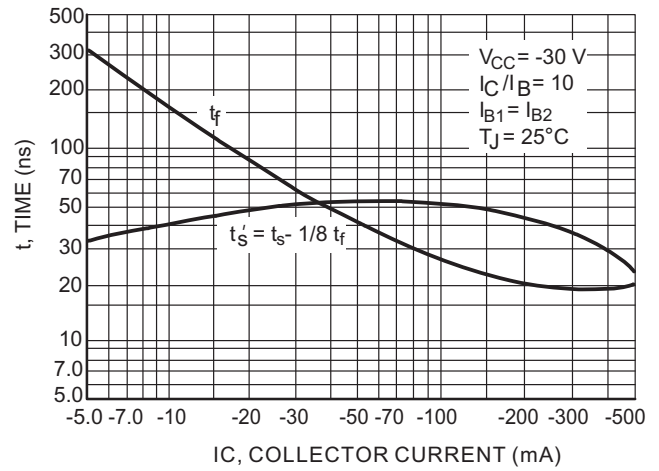


Figure 6. Turn-off Time



## Rating and characteristic curves (FMBT2907 / FMBT2907A)

### TYPICAL SMALL-SIGNAL CHARACTERISTICS

#### NOISE FIGURE

$V_{CE} = 10 \text{ Vdc}$ ,  $T_A = 25^\circ\text{C}$

Figure 7. Frequency Effects

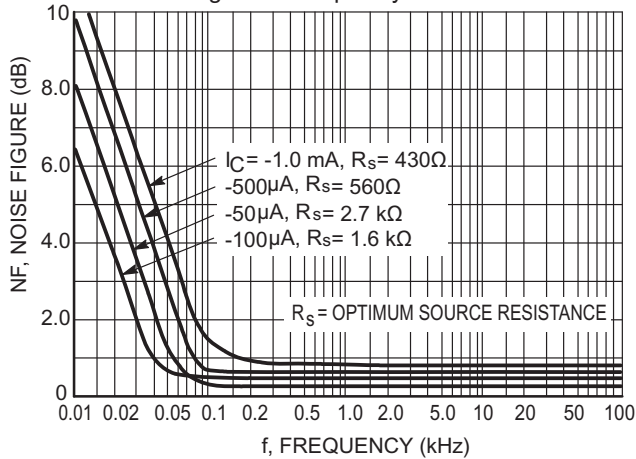


Figure 8. Source Resistance Effects

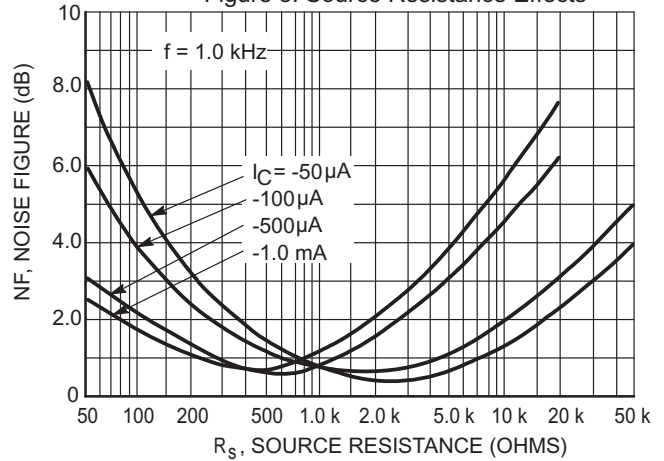


Figure 9. Capacitances

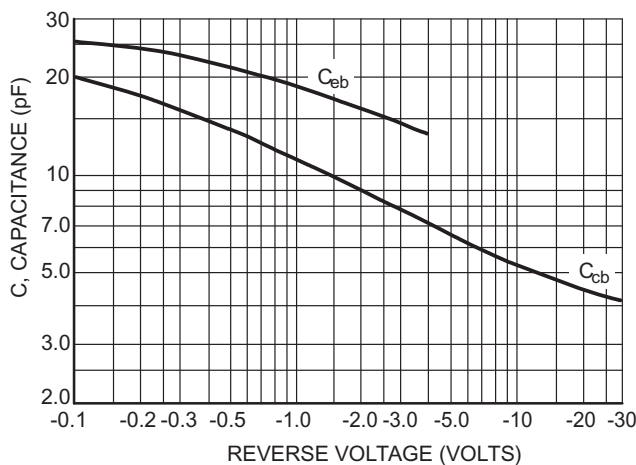


Figure 10. Current- Gain - Bandwidth Product

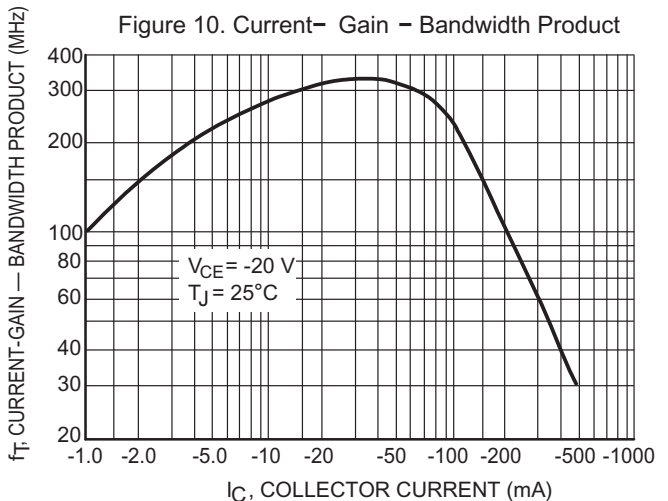


Figure 11. Collector Emitter Saturation Voltage vs. Collector Current

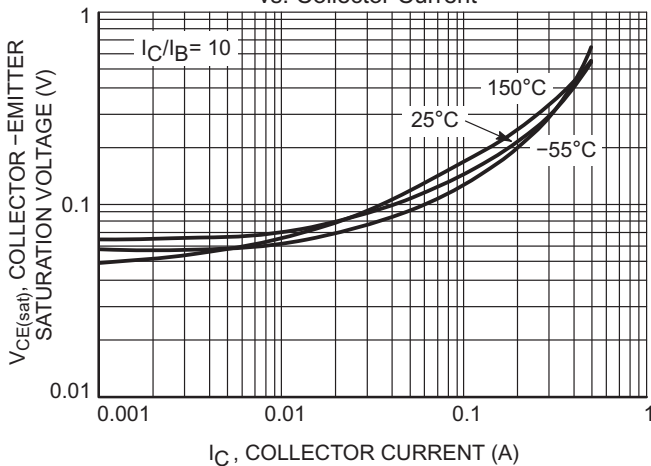
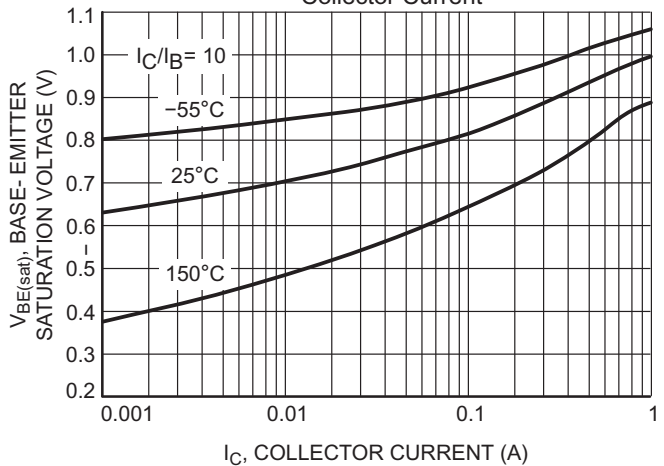


Figure 12. Base Emitter Saturation Voltage vs. Collector Current



## Rating and characteristic curves (FMBT2907 / FMBT2907A)

### TYPICAL SMALL –SIGNAL Characteristics NOISE FIGURE

$V_{CE} = 10 \text{ Vdc}$ ,  $T_A = 25^\circ\text{C}$

Figure 13. Base Emitter Voltage vs. Collector Current

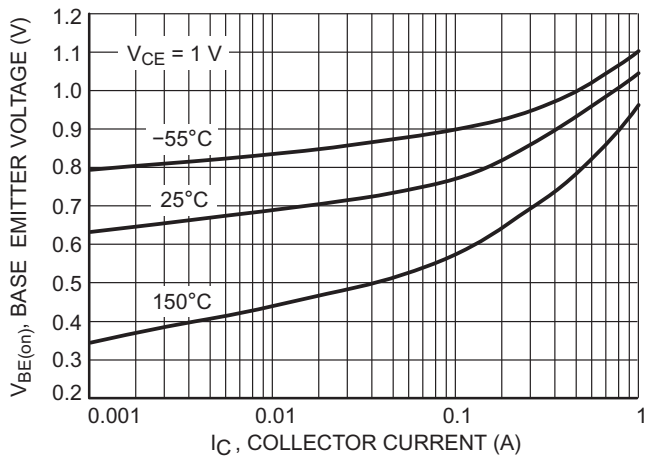


Figure 14. Temperature Coefficients

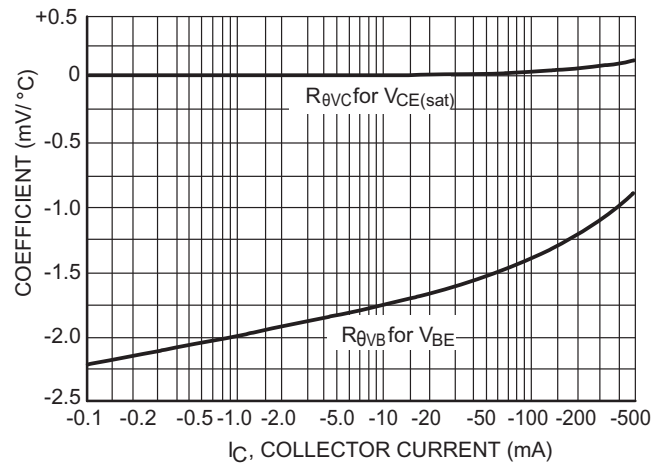
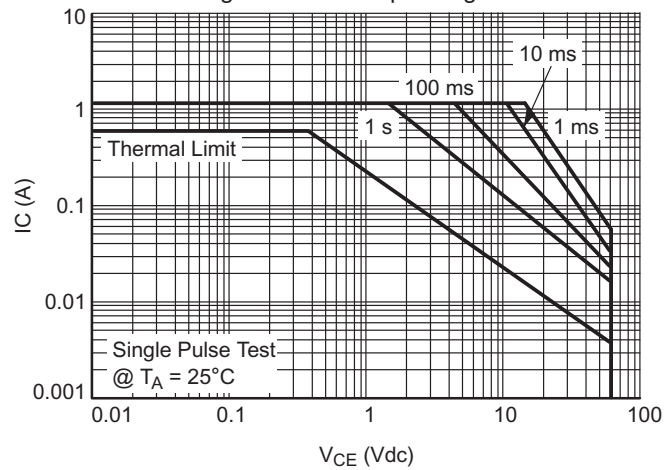
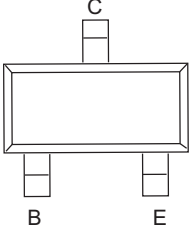
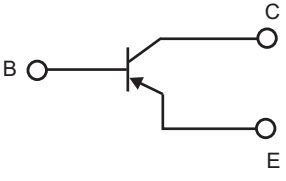


Figure 15. Safe Operating Area

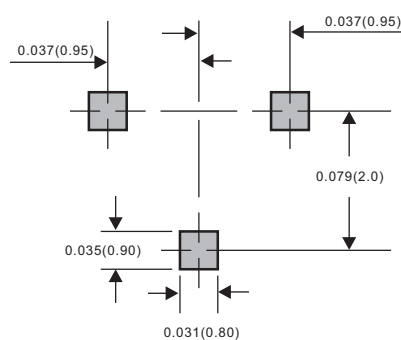


**FMBT2907 / FMBT2907A****Pinning information**

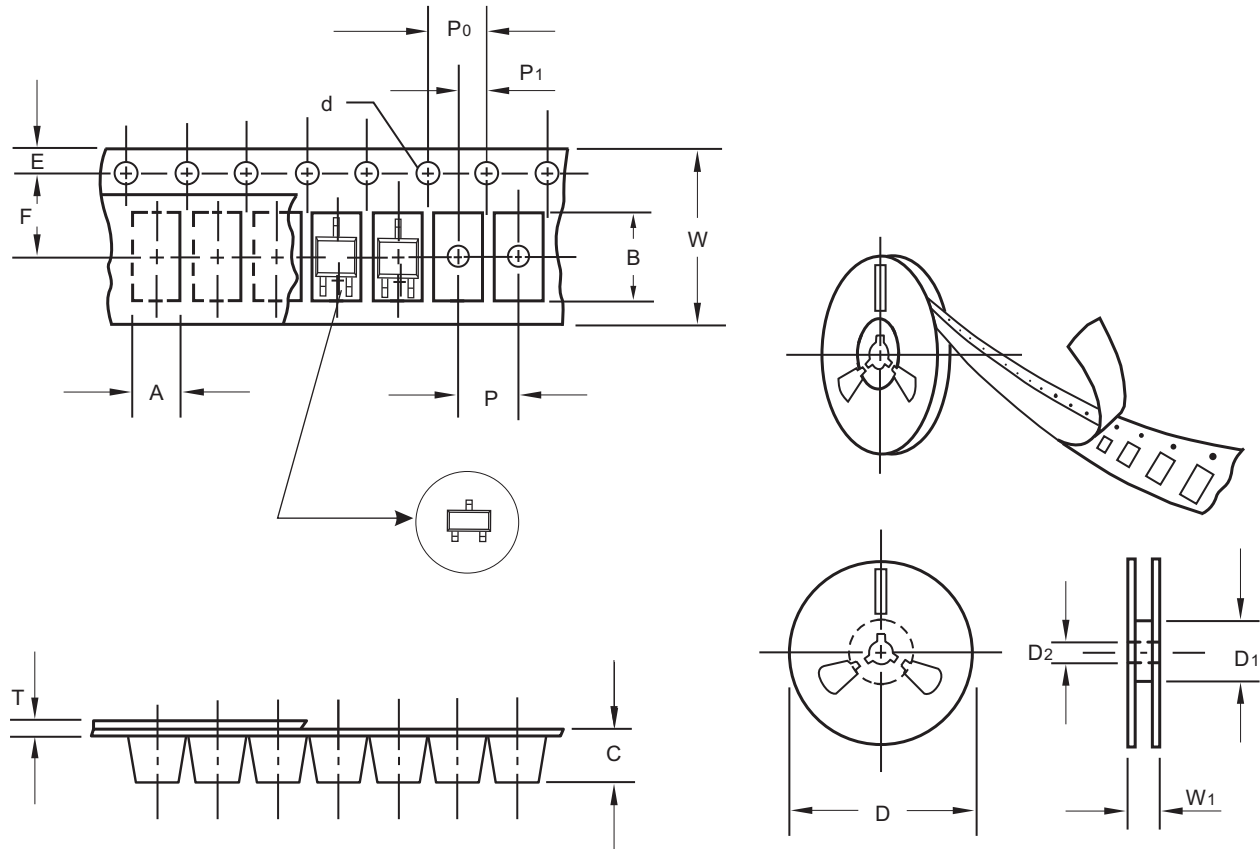
| Pin                                         | Simplified outline                                                                | Symbol                                                                              |
|---------------------------------------------|-----------------------------------------------------------------------------------|---------------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

**Marking**

| Type number | Marking code |
|-------------|--------------|
| FMBT2907    | M2B          |
| FMBT2907A   | 2F           |

**Suggested solder pad layout****SOT-23**

Dimensions in inches and (millimeters)

**FMBT2907 / FMBT2907A****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   |

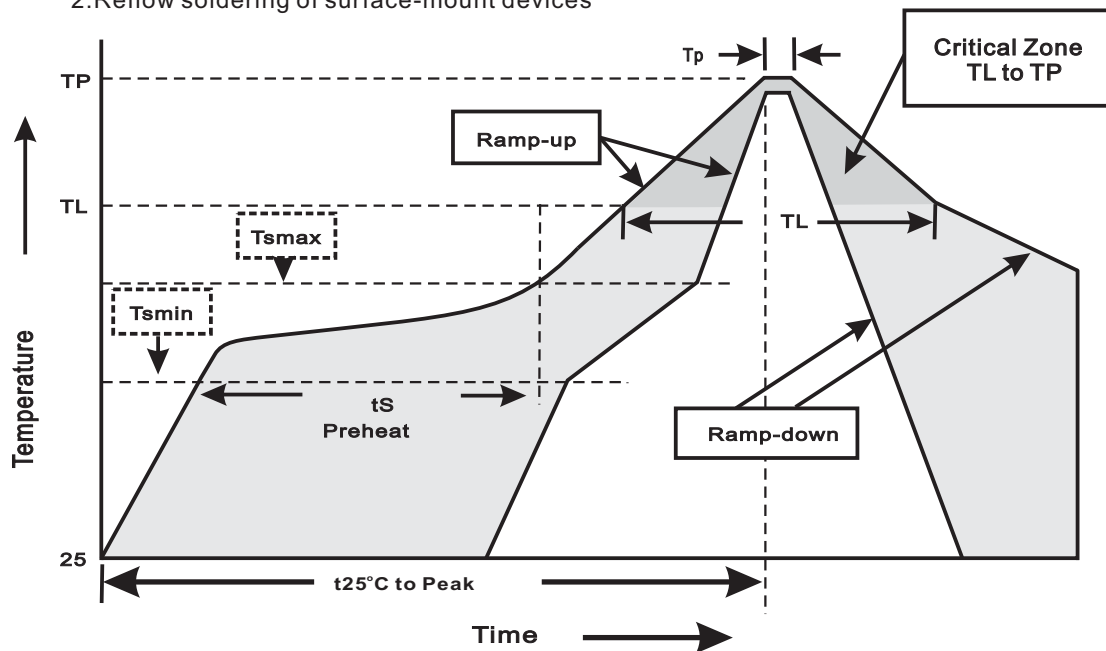
Note: Devices are packed in accordance with EIA standard RS-481-A and specifications listed above.

**FMBT2907 / FMBT2907A****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"        | 3,000      | 4.0                     | 30,000    | 183*123*183     | 178             | 382*257*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                   |

**FMBT2907 / FMBT2907A****High reliability test capabilities**

| Item Test                                      | Conditions                                                                                                         |
|------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|
| 1. Steady State Operating Life                 | $P_D=225\text{mW}$ Test Duration:1000hrs                                                                           |
| 2. High Temperature Reverse Bias               | $T_J=150^\circ\text{C}$ , $V_{CE}=80\%$ related volage, 1000hrs                                                    |
| 3. Temperature Cycle                           | $-55^\circ\text{C}$ (15min) to $150^\circ\text{C}$ (15min) Air to Air Transition Time<20sec Test Cycles: 1000cycle |
| 4. Autoclave                                   | $P=2\text{atm}$ $T_a=121^\circ\text{C}$ $RH=100\%$ Test Duration: 96hrs                                            |
| 5. High Temperature Storage Life               | $T_a=150^\circ\text{C}$ Test Duration: 1000hrs                                                                     |
| 6. Solderability                               | $245^\circ\text{C}$ ,5sec                                                                                          |
| 7. High Temperature High Humidity Reverse Bias | $T_a=85^\circ\text{C}$ , 85%RH, $V_{CE}=80\%$ related volage, 1000hrs                                              |
| 8. Resistance to Soldering Heat                | $260^\circ\text{C}$ ,10sec                                                                                         |