



# MMBT3904

## NPN GENERAL PURPOSE SWITCHING TRANSISTOR

**VOLTAGE** 40 Volts **POWER** 225 mWatts

**SOT-23** Unit : inch (mm)

### FEATURES

- NPN epitaxial silicon, planar design
- Collector-emitter voltage  $V_{CE} = 40V$
- Collector current  $I_C = 200mA$
- Transition frequency  $f_T > 300MHz$  @  $I_C = 10mA_{dc}$ ,  $V_{CE} = 20V_{dc}$ ,  $f = 100MHz$
- Lead free in compliance with EU RoHS 2011/65/EU directive
- Green molding compound as per IEC61249 Std. . (Halogen Free)

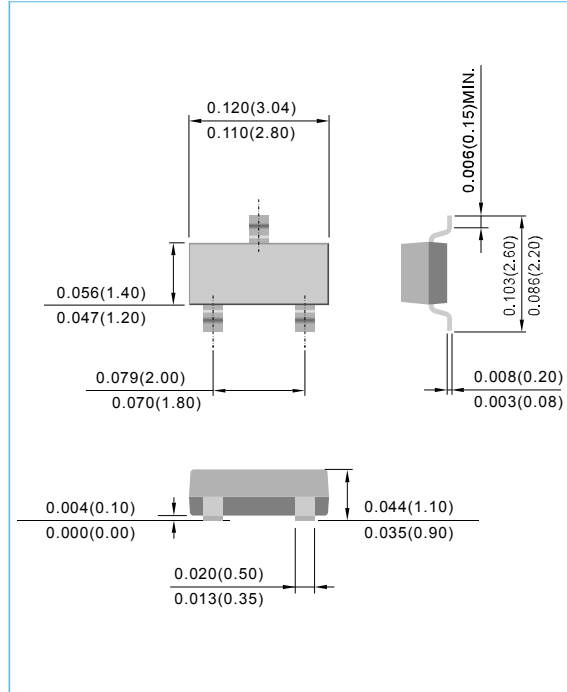
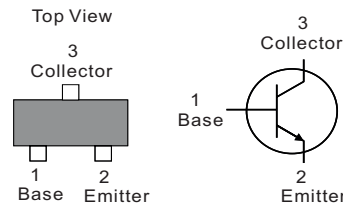
### MECHANICAL DATA

Case: SOT-23, Plastic

Terminals: Solderable per MIL-STD-750, Method 2026

Approx. Weight: 0.0003 ounces, 0.0084 grams

Marking: S1A



### ABSOLUTE RATINGS

| PARAMETER                      | Symbol    | Value | Units |
|--------------------------------|-----------|-------|-------|
| Collector - Emitter Voltage    | $V_{CEO}$ | 40    | V     |
| Collector - Base Voltage       | $V_{CBO}$ | 60    | V     |
| Emitter - Base Voltage         | $V_{EBO}$ | 6.0   | V     |
| Collector Current - Continuous | $I_C$     | 200   | mA    |

### THERMAL CHARACTERISTICS

| PARAMETER                                | Symbol          | Value      | Units         |
|--|-----------------|------------|---------------|
| Max Power Dissipation (Note 1)           | $P_{TOT}$       | 225        | mW            |
| Thermal Resistance , Junction to Ambient | $R_{\theta JA}$ | 556        | $^{\circ}C/W$ |
| Junction Temperature                     | $T_J$           | -55 to 150 | $^{\circ}C$   |
| Storage Temperature                      | $T_{STG}$       | -55 to 150 | $^{\circ}C$   |

Note 1: Transistor mounted on FR-5 board 1.0 x 0.75 x 0.062 in.



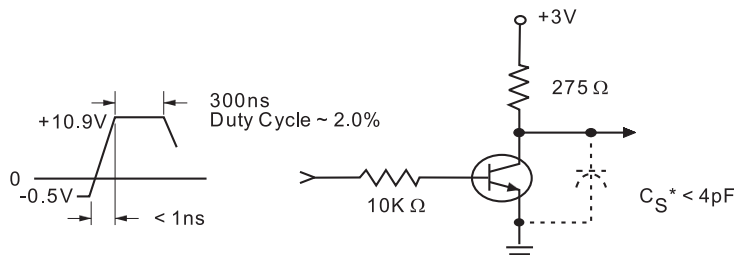
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## ELECTRICAL CHARACTERISTICS

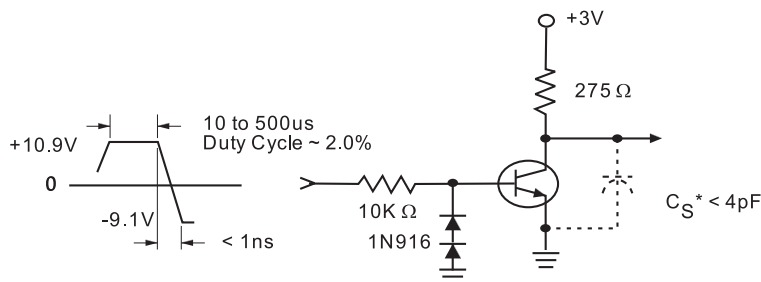
| PARAMETER                                       | Symbol        | Test Condition                                 | MIN.      | TYP.   | MAX.         | Units |
|---|---------------|--|-----------|--------|--------------|-------|
| Collector - Emitter Breakdown Voltage           | $V_{(BR)CEO}$ | $I_C=1.0mA, I_B=0$                             | 40        | -      | -            | V     |
| Collector - Base Breakdown Voltage              | $V_{(BR)CBO}$ | $I_C=10\mu A, I_E=0$                           | 60        | -      | -            | V     |
| Emitter - Base Breakdown Voltage                | $V_{(BR)EBO}$ | $I_E=10\mu A, I_C=0$                           | 6.0       | -      | -            | V     |
| Base Cutoff Current                             | $I_{BL}$      | $V_{CE}=30V, V_{EB}=3.0V$                      | -         | -      | 50           | nA    |
| Collector Cutoff Current                        | $I_{CEX}$     | $V_{CE}=30V, V_{EB}=3.0V$                      | -         | -      | 50           | nA    |
| DC Current Gain (Note 2)                        | $h_{FE}$      | $I_C=0.1mA, V_{CE}=1.0V$                       | 40        | -      | -            | -     |
|   |               | $I_C=1.0mA, V_{CE}=1.0V$                       | 70        | -      | -            |       |
|   |               | $I_C=10mA, V_{CE}=1.0V$                        | 100       | -      | 300          |       |
|   |               | $I_C=50mA, V_{CE}=1.0V$                        | 60        | -      | -            |       |
|   |               | $I_C=100mA, V_{CE}=1.0V$                       | 30        | -      | -            |       |
| Collector - Emitter Saturation Voltage (Note 2) | $V_{CE(SAT)}$ | $I_C=10mA, I_B=1.0mA$<br>$I_C=50mA, I_B=5.0mA$ | -         | -      | 0.2<br>0.3   | V     |
| Base - Emitter Saturation Voltage (Note 2)      | $V_{BE(SAT)}$ | $I_C=10mA, I_B=1.0mA$<br>$I_C=50mA, I_B=5.0mA$ | 0.65<br>- | -<br>- | 0.85<br>0.95 | V     |
| Collector - Base Capacitance                    | $C_{CBO}$     | $V_{CB}=5V, I_E=0, f=1MHz$                     | -         | -      | 4.0          | pF    |
| Emitter - Base Capacitance                      | $C_{EBO}$     | $V_{EB}=0.5V, I_C=0, f=1MHz$                   | -         | -      | 8.0          | pF    |
| Delay Time                                      | $t_d$         | $V_{CC}=3V, V_{BE}=-0.5V, I_C=10mA, I_B=1.0mA$ | -         | -      | 35           | ns    |
| Rise Time                                       | $t_r$         | $V_{CC}=3V, V_{BE}=-0.5V, I_C=10mA, I_B=1.0mA$ | -         | -      | 35           | ns    |
| Storage Time                                    | $t_s$         | $V_{CC}=3V, I_C=10mA, I_{B1}=I_{B2}=1.0mA$     | -         | -      | 200          | ns    |
| Fall Time                                       | $t_f$         | $V_{CC}=3V, I_C=10mA, I_{B1}=I_{B2}=1.0mA$     | -         | -      | 50           | ns    |

Note 2: Pulse Test: Pulse Width < 300 us, Duty Cycle < 2.0%.

### SWITCHING TIME EQUIVALENT TEST CIRCUITS



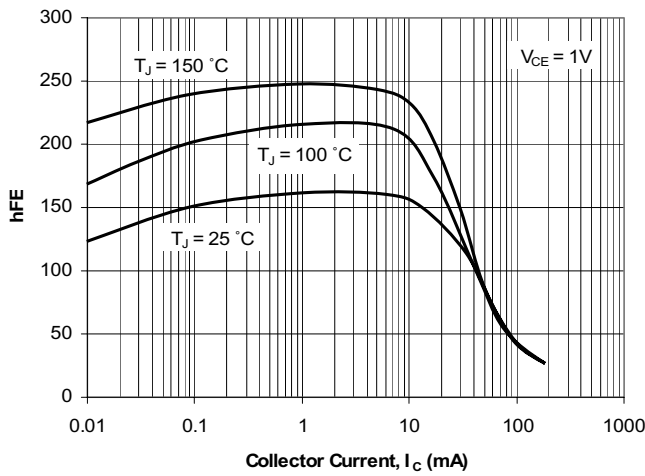
Delay and Rise Time Equivalent Test Circuit



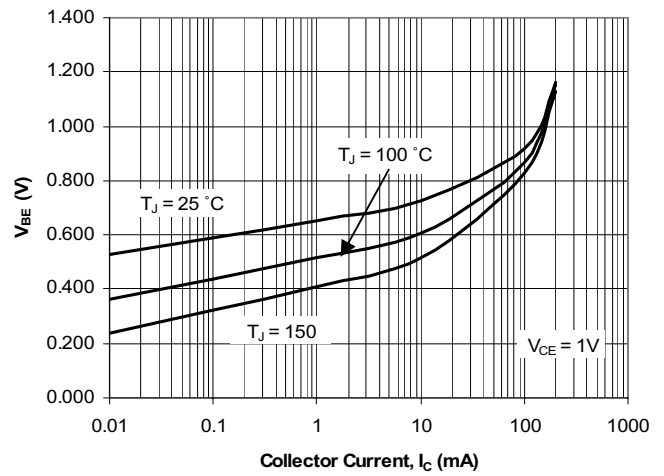
Storage and Fall Time Equivalent Test Circuit



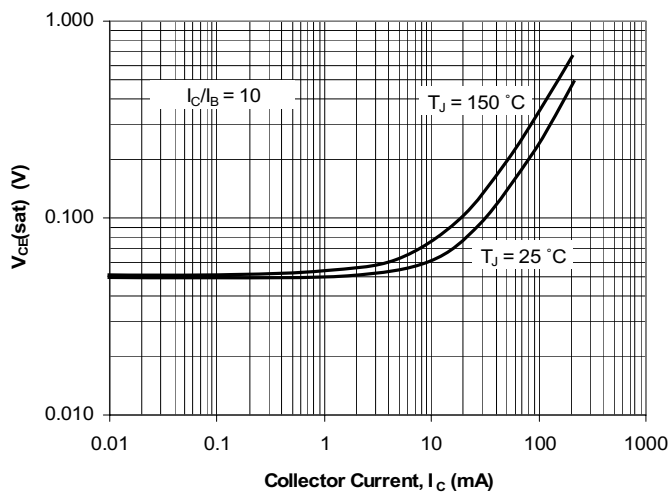
**ELECTRICAL CHARACTERISTICS CURVE**



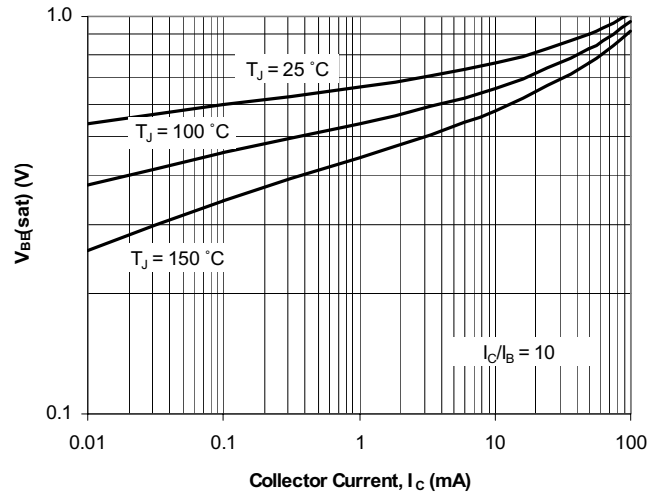
**Fig. 1. Typical h<sub>FE</sub> vs Collector Current**



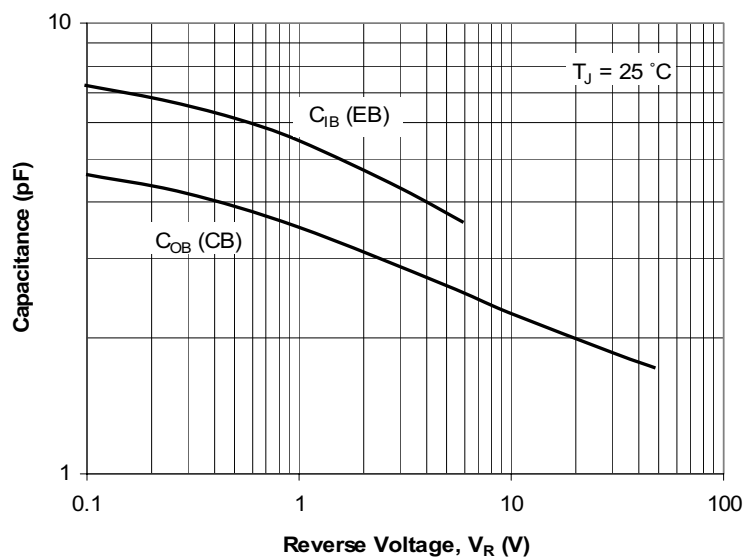
**Fig. 2. Typical V<sub>BE</sub> vs Collector Current**



**Fig. 3. Typical V<sub>CE</sub> (sat) vs Collector Current**



**Fig. 4. Typical V<sub>BE</sub> (sat) vs Collector Current**

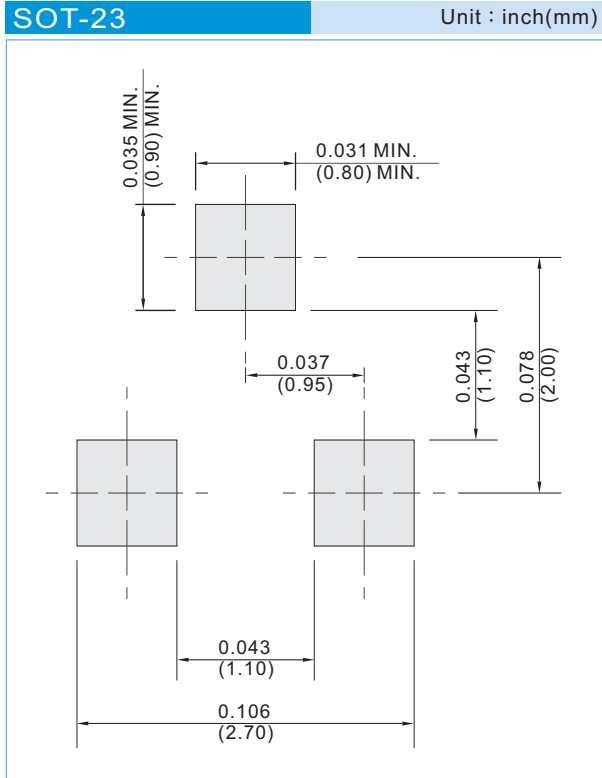


**Fig. 5. Typical Capacitances vs Reverse Voltage**



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## MOUNTING PAD LAYOUT



## ORDER INFORMATION

- Packing information
  - T/R - 12K per 13" plastic Reel
  - T/R - 3K per 7" plastic Reel



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## Part No\_packing code\_Version

MMBT3904\_R1\_00001

MMBT3904\_R2\_00001

For example :

**RB500V-40\_R2\_00001**



| Packing Code <b>XX</b>               |                      |                                  |                      | Version Code <b>XXXXX</b> |                      |                                       |
|--------------------------------------|----------------------|----------------------------------|----------------------|---------------------------|----------------------|---------------------------------------|
| Packing type                         | 1 <sup>st</sup> Code | Packing size code                | 2 <sup>nd</sup> Code | HF or RoHS                | 1 <sup>st</sup> Code | 2 <sup>nd</sup> ~5 <sup>th</sup> Code |
| Tape and Ammunition Box (T/B)        | <b>A</b>             | N/A                              | <b>0</b>             | <b>HF</b>                 | <b>0</b>             | serial number                         |
| Tape and Reel (T/R)                  | <b>R</b>             | 7"                               | <b>1</b>             | <b>RoHS</b>               | <b>1</b>             | serial number                         |
| Bulk Packing (B/P)                   | <b>B</b>             | 13"                              | <b>2</b>             |                           |                      |                                       |
| Tube Packing (T/P)                   | <b>T</b>             | 26mm                             | <b>X</b>             |                           |                      |                                       |
| Tape and Reel (Right Oriented) (TRR) | <b>S</b>             | 52mm                             | <b>Y</b>             |                           |                      |                                       |
| Tape and Reel (Left Oriented) (TRL)  | <b>L</b>             | PANASERT T/B CATHODE UP (PBCU)   | <b>U</b>             |                           |                      |                                       |
| FORMING                              | <b>F</b>             | PANASERT T/B CATHODE DOWN (PBCD) | <b>D</b>             |                           |                      |                                       |



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