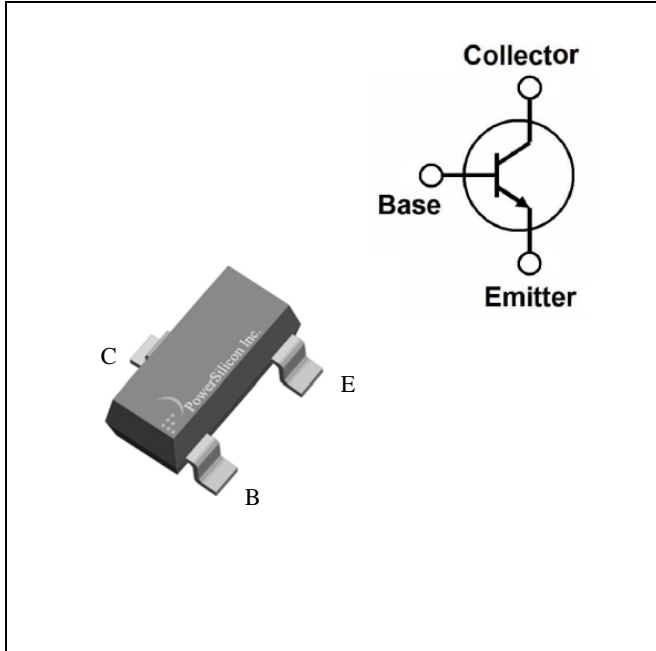


## GENERAL PURPOSE TRANSISTORS NPN Silicon



### FEATURES

- NPN Silicon Epitaxial Planar Transistor For Switching And Amplifier Applications
- Collector-emitter Voltage  $V_{CE}=40V$
- Collector Current  $I_C=200mA$

### MECHANICAL DATA

- Available in SOT-23 Package
- Solderability : MIL-STD-202, Method 208
- Full RoHS Compliance

### ORDERING INFORMATION

| PART NUMBER  | PACKAGE | SHIPPING  | MARKING CODE |
|--------------|---------|-----------|--------------|
| MMBT3904□-T3 | SOT-23  | Tape Reel | 1AM          |

**Notes:**

1. □: none is for Lead Free package;  
"G" is for Halogen Free package.

### THERMAL DATA

| PARAMETER                               | SYMBOL          | VALUES | UNIT |
|---|-----------------|--------|------|
| Thermal Resistance, Junction-to-Ambient | $R_{\theta JA}$ | 357    | °C/W |
| Thermal Resistance, Junction-to-Case    | $R_{\theta JC}$ | 90     | °C/W |

**Notes:**

2.  $R_{\theta JA}$  is the sum of the junction-to-case and case-to-ambient thermal resistance where the case thermal reference is defined as the solder mounting surface of the drain pins.  $R_{\theta JC}$  is guaranteed by design while  $R_{\theta CA}$  is determined by the user's board design. The value of  $R_{\theta JA}$  is measured with device mounted on 1 in<sup>2</sup> FR-4 board with 2 oz copper.

**ABSOLUTE MAXIMUM RATINGS**
 $T_A = 25^\circ\text{C}$ , unless otherwise specified. (Note 4)

| PARAMETER                   | SYMBOL    | RATINGS     | UNIT             |
|-----------------------------|-----------|-------------|------------------|
| Collector-Emitter Voltage   | $V_{CEO}$ | 40          | V                |
| Collector-Base Voltage      | $V_{CBO}$ | 60          | V                |
| Emitter-Base Voltage        | $V_{EBO}$ | 6           | V                |
| Collector Current           | $I_C$     | 0.2         | A                |
| Collector Power Dissipation | $P_C$     | 225         | mW               |
| Junction Temperature        | $T_J$     | 150         | $^\circ\text{C}$ |
| Storage Temperature Range   | $T_{stg}$ | - 55 ~ +150 | $^\circ\text{C}$ |

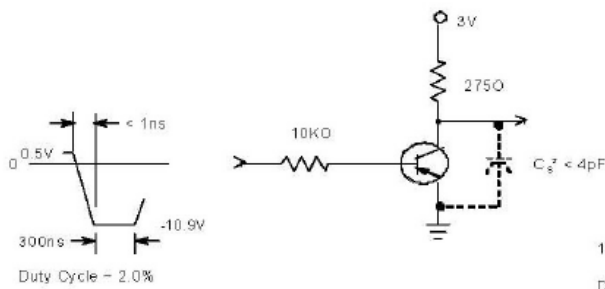
**Notes:**

2. Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.

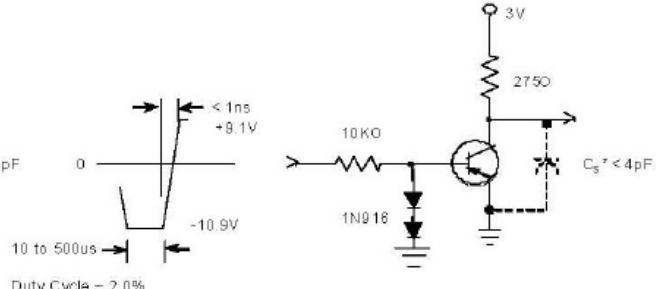
**ELECTRICAL CHARACTERISTICS**
 $T_A = 25^\circ\text{C}$ , unless otherwise noted.

| PARAMETER                            | SYMBOL        | TEST CONDITIONS  | MIN | TYP | MAX  | UNIT          |
|--------------------------------------|---------------|--|-----|-----|------|---------------|
| <b>OFF CHARACTERISTICS</b>           |               |  |     |     |      |               |
| Collector-Emitter Breakdown Voltage  | $V_{(BR)CEO}$ | $I_C = 1\text{mA}, I_B = 0$  | 40  |     |      | V             |
| Collector-Base Breakdown Voltage     | $V_{(BR)CBO}$ | $I_C = 10\mu\text{A}, I_E = 0$   | 60  |     |      | V             |
| Emitter-Base Breakdown Voltage       | $V_{(BR)EBO}$ | $I_E = 10\mu\text{A}, I_C = 0$   | 6   |     |      | V             |
| Collector Cut-off Current            | $I_{CEO}$     | $V_{CE} = 40\text{V}, I_B = 0$   |     |     | 0.1  | $\mu\text{A}$ |
| Collector Cut-off Current            | $I_{CBO}$     | $V_{CB} = 60\text{V}, I_E = 0$   |     |     | 0.1  | $\mu\text{A}$ |
| Emitter Cut-off Current              | $I_{EBO}$     | $V_{EB} = 5\text{V}, I_C = 0$  |     |     | 0.1  | $\mu\text{A}$ |
| <b>ON CHARACTERISTICS</b>            |               |  |     |     |      |               |
| Dc Current Gain                      | $h_{FE(1)}$   | $V_{CE} = 1\text{V}, I_C = 10\text{mA}$  | 100 |     | 300  | -             |
|                                      | $h_{FE(2)}$   | $V_{CE} = 1\text{V}, I_C = 50\text{mA}$  | 60  |     |      | -             |
| Collector-Emitter Saturation Voltage | $V_{CE(sat)}$ | $I_C = 50\text{mA}, I_B = 5\text{mA}$  |     |     | 0.3  | V             |
| Base-Emitter Saturation Voltage      | $V_{BE(sat)}$ | $I_C = 50\text{mA}, I_B = 5\text{mA}$  |     |     | 0.95 | V             |
| <b>DYNAMIC CHARACTERISTICS</b>       |               |  |     |     |      |               |
| Transition Frequency                 | $f_T$         | $V_{CE} = -20\text{V}, I_C = -10\text{mA}, f = 100\text{MHz}$                      | 250 |     |      | MHz           |
| <b>SWITCHING CHARACTERISTICS</b>     |               |  |     |     |      |               |
| Delay Time                           | $t_d$         | $V_{CC} = 3\text{V}, V_{BE} = 0.5\text{V}, I_C = 10\text{mA}, I_{B1} = 1\text{mA}$ |     |     | 35   | nS            |
| Rise Time                            | $t_r$         |  |     |     | 35   | nS            |
| Storage Time                         | $t_s$         | $V_{CC} = 3\text{V}, I_C = 10\text{mA}, I_{B1} = I_{B2} = 1\text{mA}$              |     |     | 200  | nS            |
| Fall Time                            | $t_f$         |  |     |     | 50   | nS            |

SWITCHING TIME EQUIVALENT TEST CIRCUITS



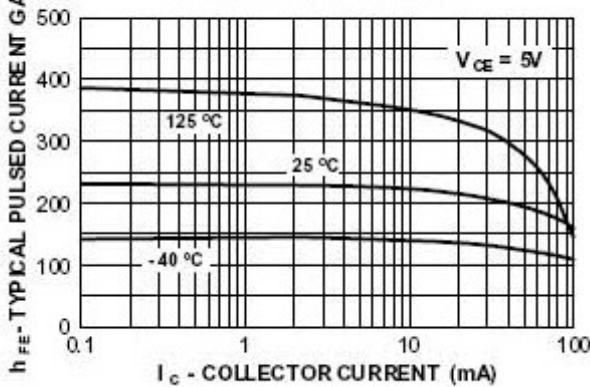
Delay and Rise Time Equivalent Test Circuit



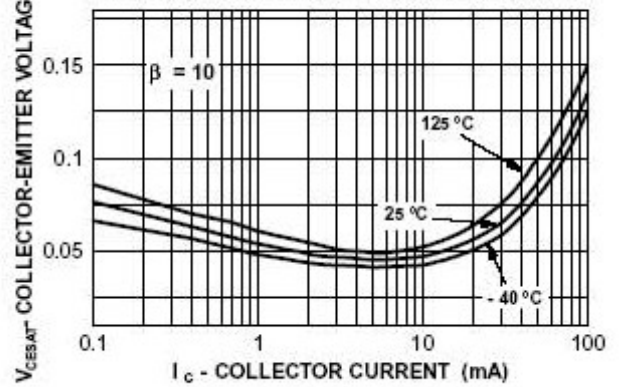
Storage and Fall Time Equivalent Test Circuit

TYPICAL PERFORMANCE CHARACTERISTICS

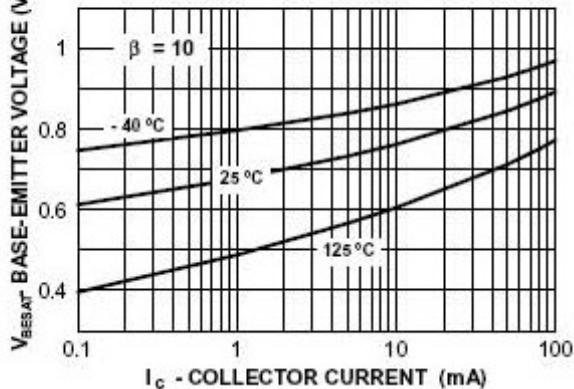
Typical Pulsed Current Gain vs Collector Current



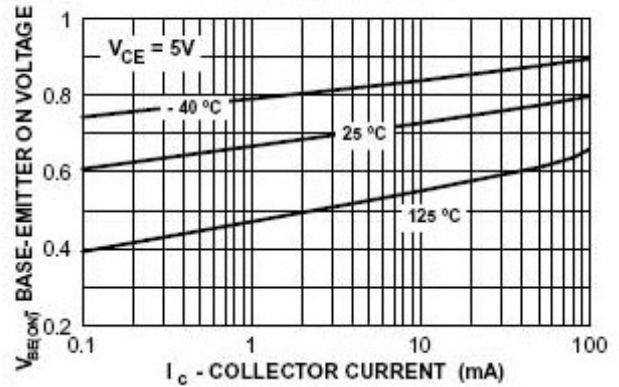
Collector-Emitter Saturation Voltage vs Collector Current

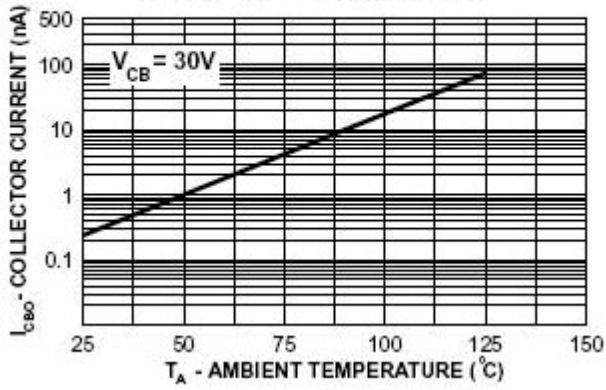
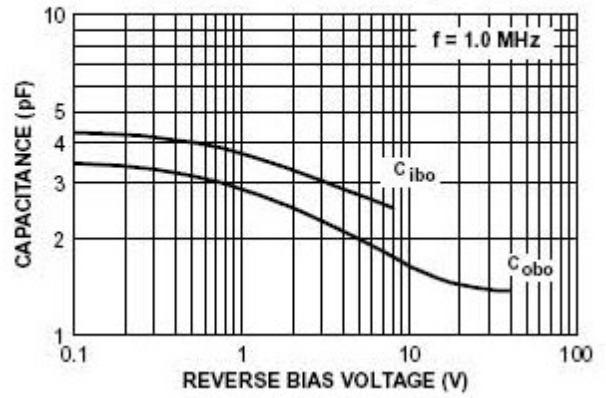
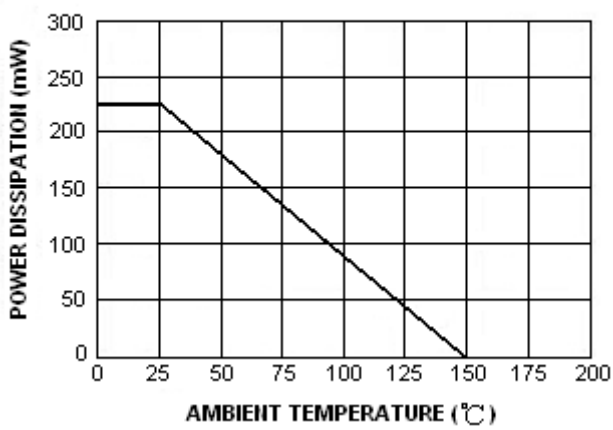


Base-Emitter Saturation Voltage vs Collector Current



Base-Emitter ON Voltage vs Collector Current



**Collector-Cutoff Current vs Ambient Temperature**

**Capacitance vs Reverse Bias Voltage**

**Max Power Dissipation vs Ambient Temperature**


**PHYSICAL DIMENSION**

Unit : Inch(Millimeter)

