# MMBT3904T

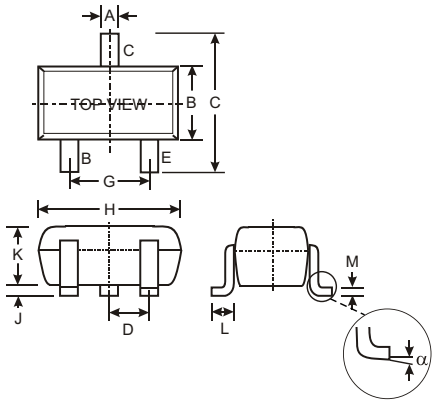
## NPN SMALL SIGNAL SURFACE MOUNT TRANSISTOR

## Features

- Epitaxial Planar Die Construction
- Complementary PNP Type Available (MMBT3906T)
- Ultra-Small Surface Mount Package

## Mechanical Data

- Case: SOT-523, Molded Plastic
- Case material - UL Flammability Rating 94V-0
- Moisture sensitivity: Level 1 per J-STD-020A
- Terminals: Solderable per MIL-STD-202, Method 208
- Terminal Connections: See Diagram
- Marking (See Page 2): 1N
- Ordering & Date Code Information, See Page 2
- Weight: 0.002 grams (approx.)




| SOT-523 | | | |
|---|---|---|---|
| **Dim** | **Min** | **Max** | **Typ** |
| **A** | 0.15 | 0.30 | 0.22 |
| **B** | 0.75 | 0.85 | 0.80 |
| **C** | 1.45 | 1.75 | 1.60 |
| **D** | | | 0.50 |
| **G** | 0.90 | 1.10 | 1.00 |
| **H** | 1.50 | 1.70 | 1.60 |
| **J** | 0.00 | 0.10 | 0.05 |
| **K** | 0.60 | 0.80 | 0.75 |
| **L** | 0.10 | 0.30 | 0.22 |
| **M** | 0.10 | 0.20 | 0.12 |
| **N** | 0.45 | 0.65 | 0.50 |
| | 0 | 8 | |
| **All Dimensions in mm** | | | |

## Maximum Ratings @ $T_A$ = 25 C unless otherwise specified

| Characteristic | Symbol | MMBT3904T | Unit |
|---|---|---|---|
| Collector-Base Voltage | $V_{CBO}$ | 60 | V |
| Collector-Emitter Voltage | $V_{CEO}$ | 40 | V |
| Emitter-Base Voltage | $V_{EBO}$ | 6.0 | V |
| Collector Current - Continuous | $I_C$ | 200 | mA |
| Power Dissipation (Note 1) | $P_d$ | 150 | mW |
| Thermal Resistance, Junction to Ambient (Note 1) | $R_{JA}$ | 833 | C/W |
| Operating and Storage and Temperature Range | $T_j$, $T_{STG}$ | -55 to +150 | C |

Notes: 1. Device mounted on FR-4 PCB, 1 inch x 0.85 inch x 0.062 inch; pad layout as shown on Diodes Inc. suggested pad layout document AP02001, which can be found on our website at http://www.diodes.com/datasheets/ap02001.pdf.

## Electrical Characteristics @ $T_A$ = 25 C unless otherwise specified

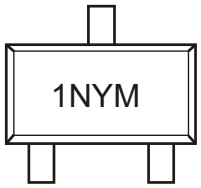
| Characteristic | Symbol | Min | Max | Unit | Test Condition |
|---|---|---|---|---|---|
| **OFF CHARACTERISTICS (Note 2)** | | | | | |
| Collector-Base Breakdown Voltage | $V_{(BR)CBO}$ | 60 | | V | $I_C$ = 10 A, $I_E$ = 0 |
| Collector-Emitter Breakdown Voltage | $V_{(BR)CEO}$ | 40 | | V | $I_C$ = 1.0mA, $I_B$ = 0 |
| Emitter-Base Breakdown Voltage | $V_{(BR)EBO}$ | 6.0 | | V | $I_E$ = 10 A, $I_C$ = 0 |
| Collector Cutoff Current | $I_{CEX}$ | | 50 | nA | $V_{CE}$ = 30V, $V_{EB(OFF)}$ = 3.0V |
| Base Cutoff Current | $I_{BL}$ | | 50 | nA | $V_{CE}$ = 30V, $V_{EB(OFF)}$ = 3.0V |
| **ON CHARACTERISTICS (Note 2)** | | | | | |
| DC Current Gain | $h_{FE}$ | 40<br>70<br>100<br>60<br>30 | 300 | | $I_C$ = 100µA, $V_{CE}$ = 1.0V<br>$I_C$ = 1.0mA, $V_{CE}$ = 1.0V<br>$I_C$ = 10mA, $V_{CE}$ = 1.0V<br>$I_C$ = 50mA, $V_{CE}$ = 1.0V<br>$I_C$ = 100mA, $V_{CE}$ = 1.0V |
| Collector-Emitter Saturation Voltage | $V_{CE(SAT)}$ | | 0.20<br>0.30 | V | $I_C$ = 10mA, $I_B$ = 1.0mA<br>$I_C$ = 50mA, $I_B$ = 5.0mA |
| Base- Emitter Saturation Voltage | $V_{BE(SAT)}$ | 0.65 | 0.85<br>0.95 | V | $I_C$ = 10mA, $I_B$ = 1.0mA<br>$I_C$ = 50mA, $I_B$ = 5.0mA |
| **SMALL SIGNAL CHARACTERISTICS** | | | | | |
| Output Capacitance | $C_{obo}$ | | 4.0 | pF | $V_{CB}$ = 5.0V, f = 1.0MHz, $I_E$ = 0 |
| Input Capacitance | $C_{ibo}$ | | 8.0 | pF | $V_{EB}$ = 0.5V, f = 1.0MHz, $I_C$ = 0 |
| Input Impedance | $h_{ie}$ | 1.0 | 10 | k | $V_{CE}$ = 10V, $I_C$ = 1.0mA, f = 1.0kHz |
| Voltage Feedback Ratio | $h_{re}$ | 0.5 | 8.0 | x $10^{-4}$ | |
| Small Signal Current Gain | $h_{fe}$ | 100 | 400 | | |
| Output Admittance | $h_{oe}$ | 1.0 | 40 | S | |
| Current Gain-Bandwidth Product | $f_T$ | 300 | | MHz | $V_{CE}$ = 20V, $I_C$ = 10mA, f = 100MHz |
| Noise Figure | NF | | 5.0 | dB | $V_{CE}$ = 5.0Vdc, $I_C$ = 100 Adc, $R_S$ = 1.0K , f = 1.0MHz |
| **SWITCHING CHARACTERISTICS** | | | | | |
| Delay Time | $t_d$ | | 35 | ns | $V_{CC}$ = 3.0V, $I_C$ = 10mA, $V_{BE(off)}$ = - 0.5V, $I_{B1}$ = 1.0mA |
| Rise Time | $t_r$ | | 35 | ns | |
| Storage Time | $t_s$ | | 200 | ns | $V_{CC}$ = 3.0V, $I_C$ = 10mA |
| Fall Time | $t_f$ | | 50 | ns | $I_{B1}$ = $I_{B2}$ = 1.0mA |

## Ordering Information (Note 3)

| Device | Packaging | Shipping |
|---|---|---|
| MMBT3904T-7 | SOT-523 | 3000/Tape & Reel |

Notes: 2. Short duration test pulse used to minimize self-heating effect.
3. For Packaging Details, go to our website at http://www.diodes.com/datasheets/ap02007.pdf.

## Marking Information




1N = Product Type Marking Code
YM = Date Code Marking
Y = Year (ex: N = 2002)
M = Month (ex: 9 = September)

Date Code Key

| Year | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|---|---|
| Code | J | K | L | M | N | P | R |

| Month | Jan | Feb | March | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Code | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | O | N | D |

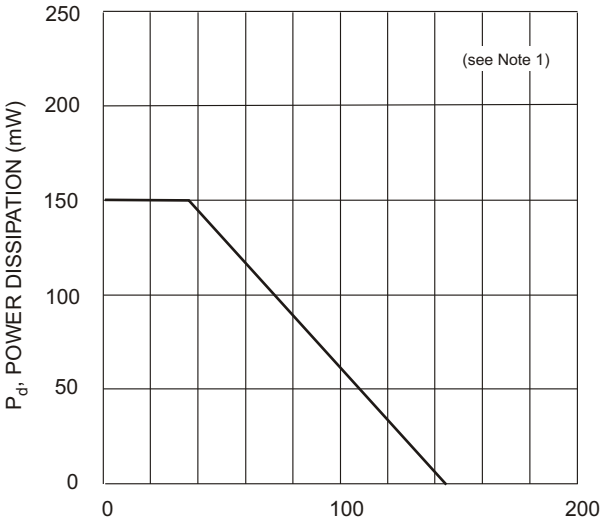



Fig. 1, Power Derating Curve

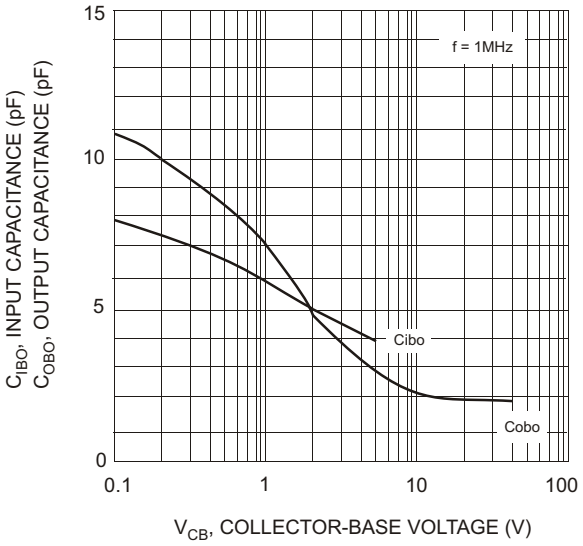



Fig. 2, Input and Output Capacitance vs. Collector-Base Voltage

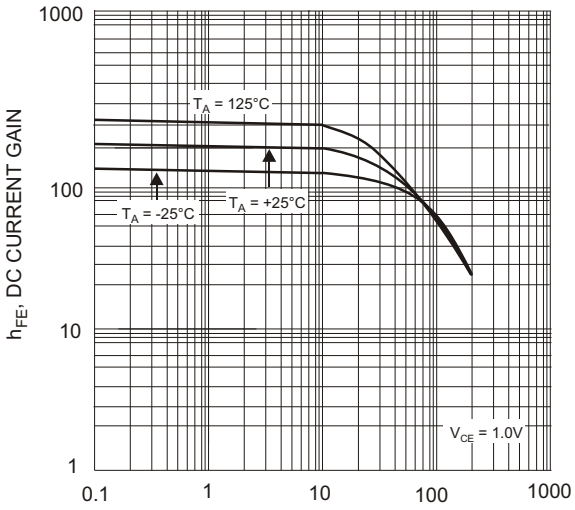



Fig. 3, Typical DC Current Gain vs Collector Current

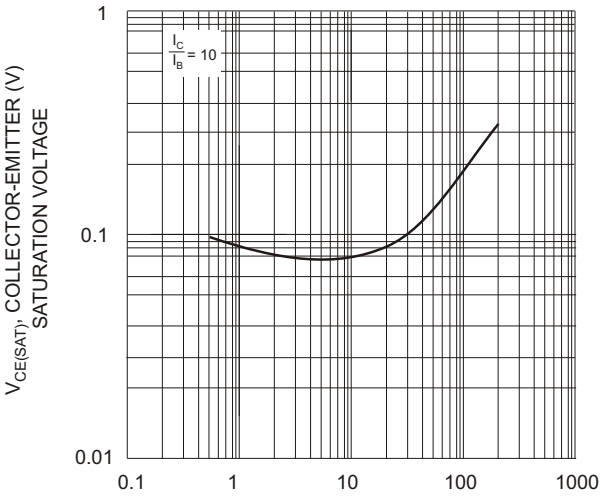



Fig. 4, Typical Collector-Emitter Saturation Voltage vs. Collector Current

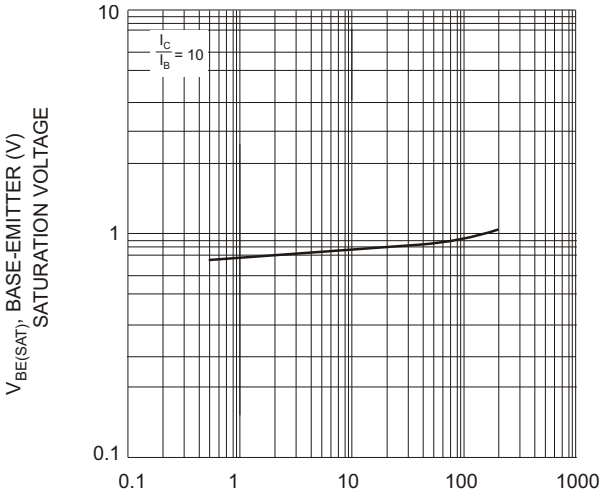



Fig. 5, Typical Base-Emitter Saturation Voltage vs. Collector Current