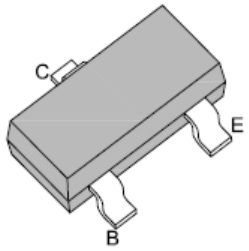
# SMD General Purpose Transistor (PNP)




**SOT-23**

## Features

- PNP Silicon Epitaxial Planar Transistor for Switching and Amplifier Applications
- RoHS compliance

## Mechanical Data

| | |
|---|---|
| **Case:** | SOT-23, Plastic Package |
| **Terminals:** | Solderable per MIL-STD-202G, Method 208 |
| **Weight:** | 0.008 gram |

## Maximum Ratings *(T Ambient=25ºC unless noted otherwise)*

| Symbol | Description | MMBT3906 | Unit | Conditions |
|---|---|---|---|---|
| $V_{CEO}$ | Collector-Emitter Voltage | -40 | V | |
| $V_{CBO}$ | Collector-Base Voltage | -40 | V | |
| $V_{EBO}$ | Emitter-Base Voltage | -5.0 | V | |
| $I_C$ | Collector Current | -200 | mA | |
| $P_D$ | Total Device Power Dissipation(Note 1) | 225 | mW | $T_A$=25 ˚C |
| | | 1.8 | mW/°C | Derate above 25 ˚C |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | 556 | °C /W | |
| $P_D$ | Total Device Power Dissipation, Alumina Substrate (Note 2) | 300 | mW | $T_A$=25 ˚C |
| | | 2.4 | mW/°C | Derate above 25 ˚C |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | 417 | °C /W | |
| $T_J$ | Junction Temperature | -55 to +150 | °C | |
| $T_{STG}$ | Storage Temperature Range | -55 to +150 | °C | |

**Note:** 1. FR-5 Board=25.4 x 19.05 x 1.58 mm (1.0 x 0.75 x 0.062 inches.)
2. Alumina Substrate=10.16 x 7.62 x 0.61 mm (0.4 x 0.3 x 0.024 inches.) 99.5% alumina.

## Electrical Characteristics *($T_{Ambient}$=25ºC unless noted otherwise)*

### Off Characteristics

| Symbol | Description | Min. | Max. | Unit | Conditions |
|---|---|---|---|---|---|
| $V_{(BR)CEO}$ | Collector-Emitter Breakdown Voltage (Pulse width ≤300μs, Duty Cycle ≤2.0%) | -40 | - | V | $I_C$=-1mA, $I_B$=0 |
| $V_{(BR)CBO}$ | Collector-Base Breakdown Voltage | -40 | - | V | $I_C$=-10μA, $I_E$=0 |
| $V_{(BR)EBO}$ | Emitter-Base Breakdown Voltage | -5.0 | - | V | $I_E$=-10μA, $I_C$=0 |
| $I_{BL}$ | Base Cut-off Current | - | -50 | nA | $V_{EB}$=-3V, $V_{CE}$=-30V |
| $I_{CEX}$ | Collector Cut-off Current | - | -50 | nA | $V_{EB}$=-3V, $V_{CE}$=-30V |

### On Characteristics

| Symbol | Description | Min. | Max. | Unit | Conditions |
|---|---|---|---|---|---|
| $h_{FE}$ | D.C. Current Gain | 60 | - | | $V_{CE}$=-1V, $I_C$=-0.1mA |
| | | 80 | - | | $V_{CE}$=-1V, $I_C$=-1mA |
| | | 100 | 300 | | $V_{CE}$=-1V, $I_C$=-10mA |
| | | 60 | - | | $V_{CE}$=-1V, $I_C$=-50mA |
| | | 30 | - | | $V_{CE}$=-1V, $I_C$=-100mA |
| $V_{CE(sat)}$ | Collector-Emitter Saturation Voltage | - | -0.25 | V | $I_C$=-10mA, $I_B$=-1mA |
| | | - | -0.4 | | $I_C$=-50mA, $I_B$=-5mA |
| $V_{BE(sat)}$ | Base-Emitter Saturation Voltage | -0.65 | -0.85 | V | $I_C$=-10mA, $I_B$=-1mA |
| | | - | -0.95 | | $I_C$=-50mA, $I_B$=-5mA |

### Small-signal Characteristics

| Symbol | Description | Min. | Max. | Unit | Conditions |
|---|---|---|---|---|---|
| $f_T$ | Current Gain-Bandwidth Product | 250 | - | MHz | $V_{CE}$=-20V, $I_C$=-10mA, f=100MHz |
| $C_{OBO}$ | Output Capacitance | - | 4.5 | pF | $V_{CB}$=-5V, f=1.0MHz, $I_E$=0 |
| $C_{IBO}$ | Input Capacitance | - | 10 | pF | $V_{EB}$=-0.5V, f=1.0MHz, $I_C$=0 |
| $h_{ie}$ | Input Impedance | 2.0 | 12 | kohms | $V_{CE}$=-10V, $I_C$=-1mA, f=1kHz |
| $h_{re}$ | Voltage Feedback Ratio | 0.1 | 10 | x $10^{-4}$ | $V_{CE}$=-10V, $I_C$=-1mA, f=1kHz |
| $h_{fe}$ | Small-Signal Current Gain | 100 | 400 | - | $V_{CE}$=10V, $I_C$=-1mA, f=1kHz |
| $h_{oe}$ | Output Admittance | 3.0 | 60 | UMHOS | $V_{CE}$=-10V, $I_C$=-1mA, f=1kHz |
| NF | Noise Figure | - | 4.0 | dB | $V_{CE}$=-5V, $I_C$=-100μA, Rs=1.0kohms, f=1kHz |

## Switching Characteristics

| Symbol | Description | Min. | Max. | Unit | Conditions |
|---|---|---|---|---|---|
| $t_d$ | Delay Time | - | 35 | ns | $V_{CC}$=-3V, $V_{BE}$=0.5V<br>$I_C$=-10mA, $I_{B1}$=-1mA |
| $t_r$ | Rise Time | - | 35 | | |
| $t_s$ | Storage Time | - | 225 | | $V_{CC}$=-3V, $I_C$=-10mA,<br>$I_{B1}$= $I_{B2}$=-1mA |
| $t_f$ | Fall Time | - | 75 | | |

## Equivalent Test Circuit

**Fig.1- Delay and Rise Time**

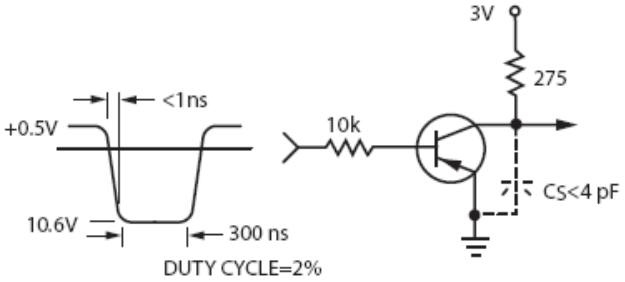
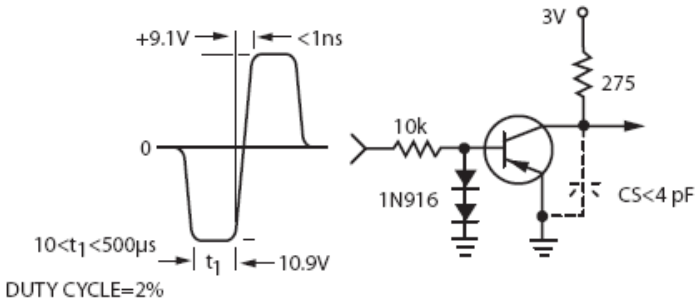



**Fig.2- Storage and Fall Time**




**Total Shunt Capacitance of test jig and connectors**

## Typical Characteristics Curves ( ▬ $T_J$ =25°C --- $T_J$ =125°C )

**Fig.3- Capacitance**

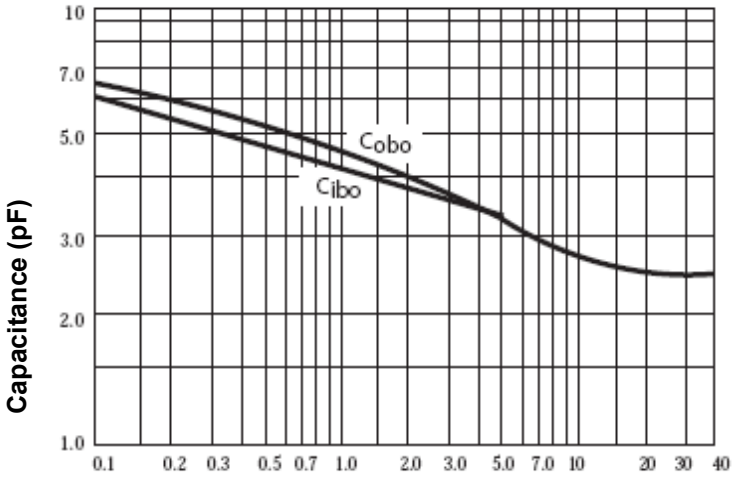



**Fig.4- Charge Data**

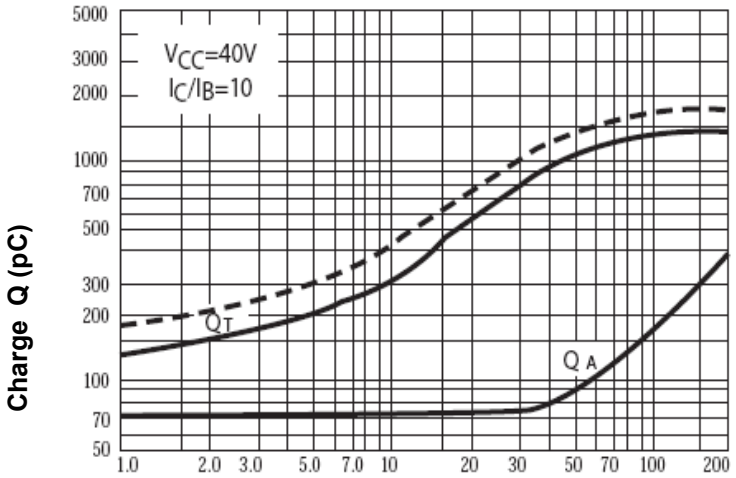



**Fig.5- Turn-On Time**

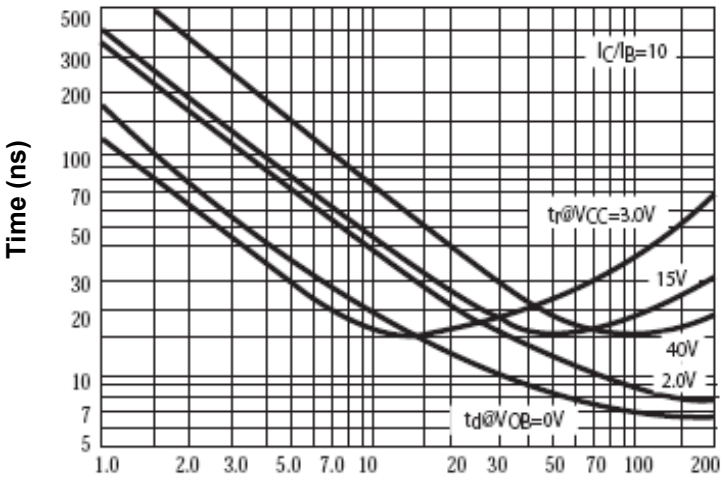
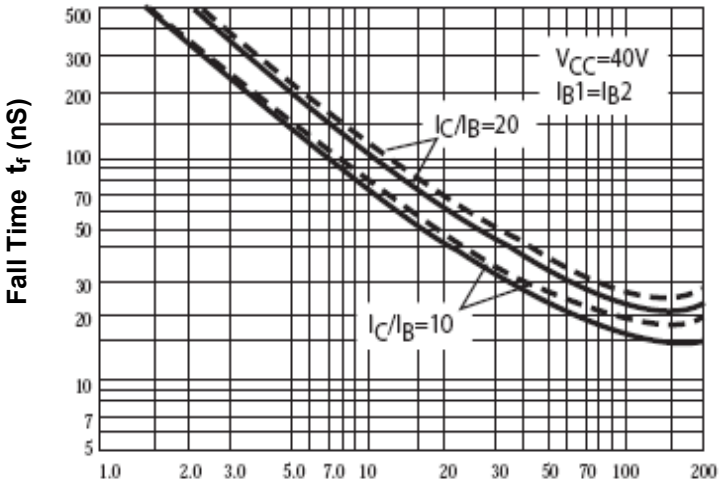



**Fig.6- Fall Time**



## Typical Audio Small-Signal Characteristics Noise Figure Variations

($V_{CE}$=-5.0 V. $T_A$=25°C, Bandwidth=1.0Hz)

**Fig.7- Noise Figure**

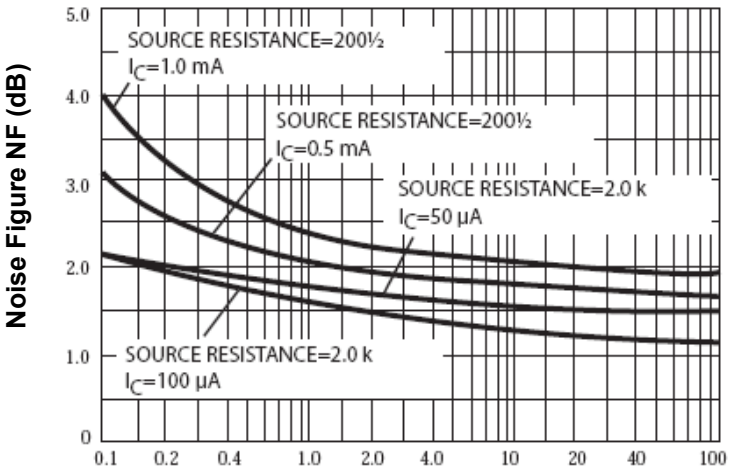
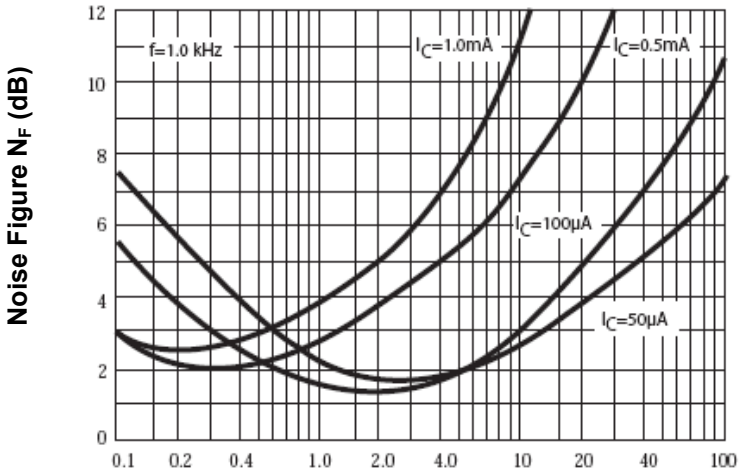



**Fig.8- Noise Figure**



## h Parameters ($V_{CE}$=-10V, f=1.0kHz, $T_A$=25°C)

**Fig.9- Current Gain**

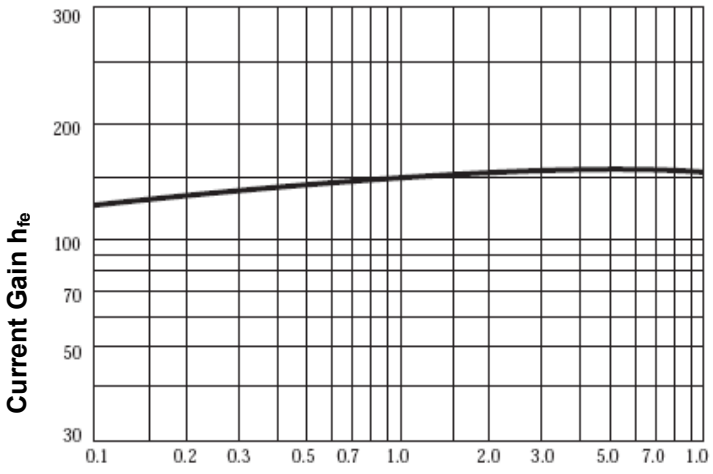



**Fig.10- Output Admittance**

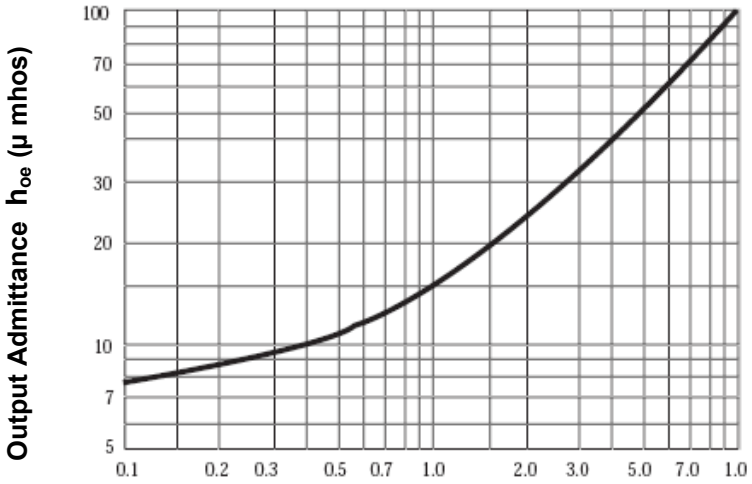



**Fig.11- Input Impedance**

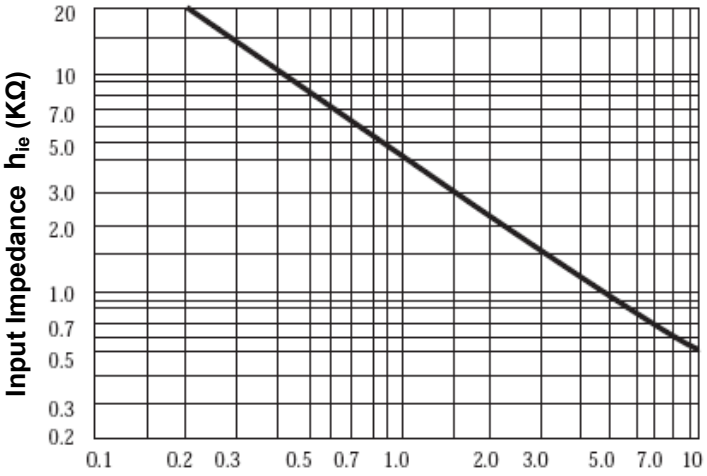
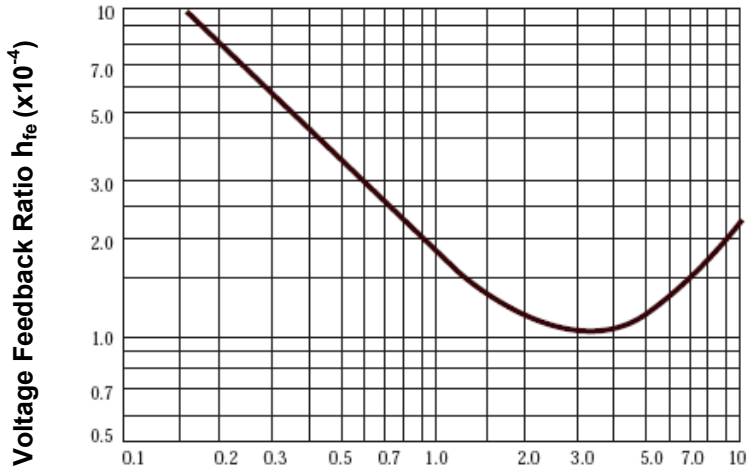



**Fig.12- Voltage Feedback Ratio**



## Typical Static Characteristics

**Fig.13- DC Current Gain**

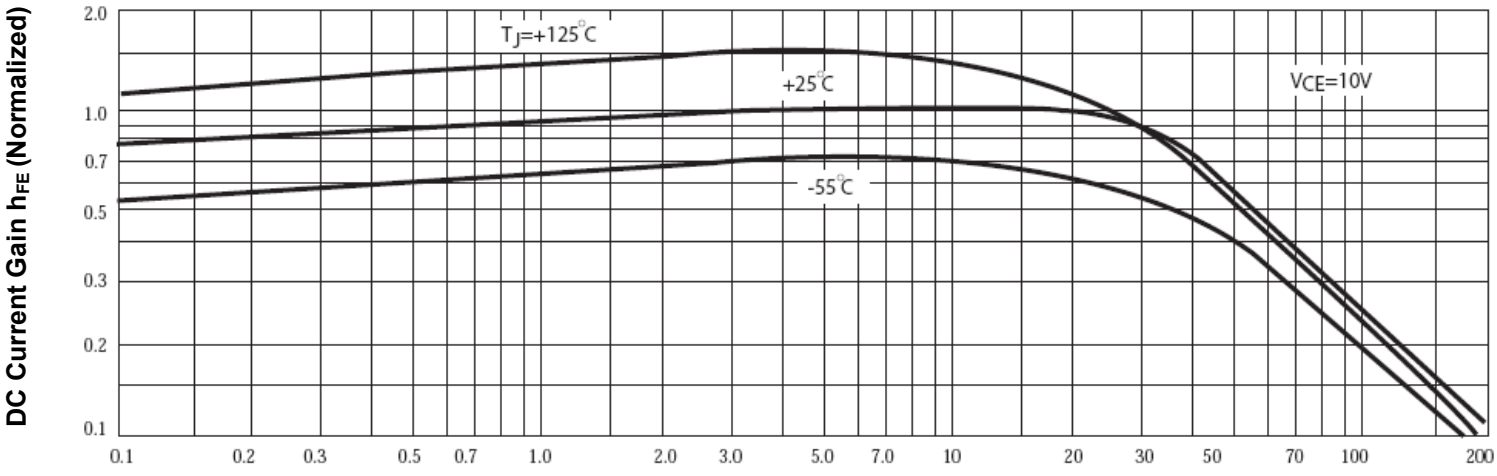



**Fig.14- Collector Saturation Region**

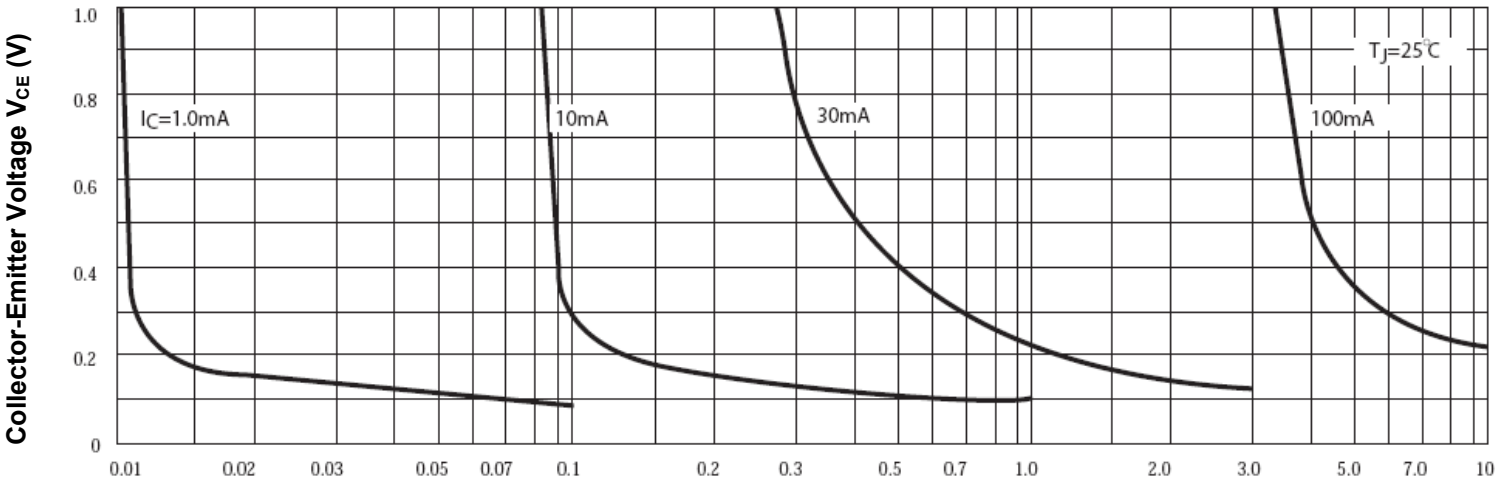


**Fig.15- "On" Voltage**

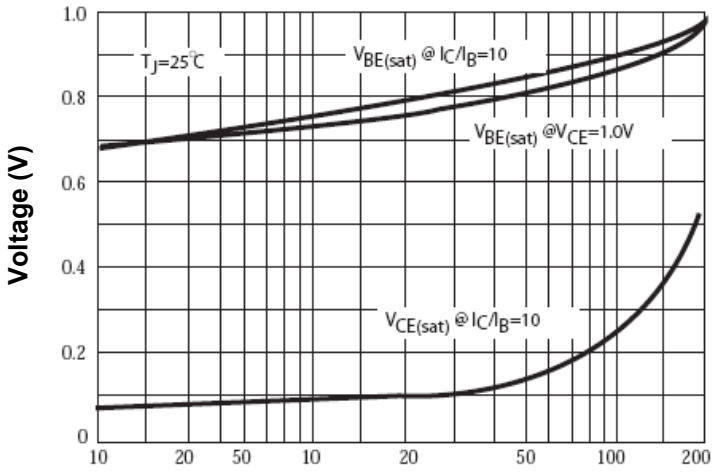
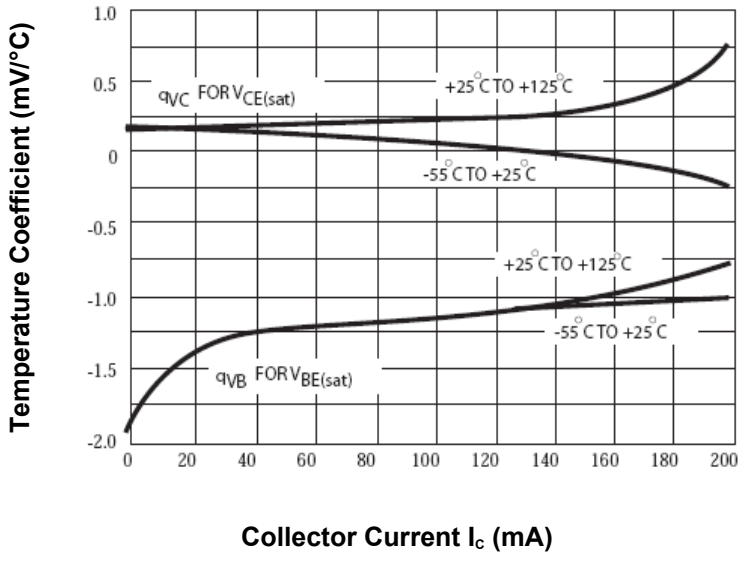


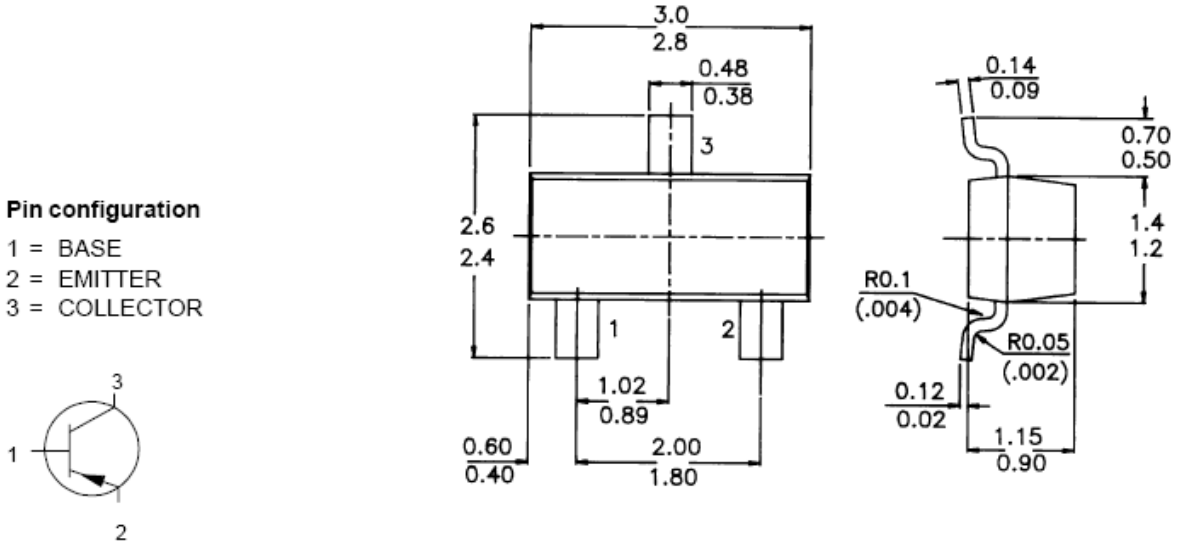

**Fig.16- Temperature Coefficients**




## Device Marking: MMBT3906=2A

## Dimensions in mm

**SOT-23**



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