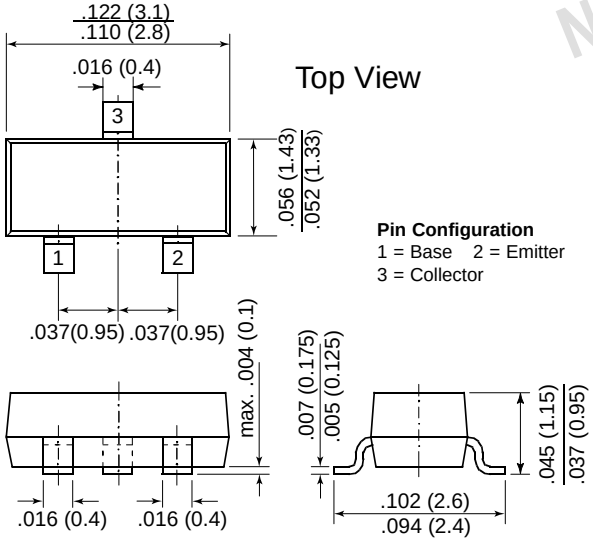
GENERAL SEMICONDUCTOR®

# MMBT3906

## Small Signal Transistor (PNP)

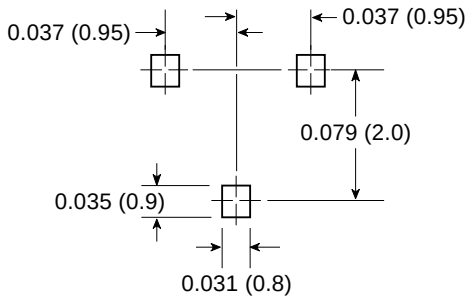
New Product

**TO-263 (SOT-23)**




*Dimensions in inches and (millimeters)*

**Mounting Pad Layout**




## Mechanical Data

**Case:** SOT-23 Plastic Package

**Weight:** approx. 0.008g

**Marking Code:** 2A

**Packaging Code/Options:**

E8/10K per 13” reel (8mm tape)

E9/3K per 7” reel (8mm tape)

## Features

- PNP Silicon Epitaxial Planar Transistor for switching and amplifier applications.
- As complementary type, the NPN transistor MMBT3904 is recommended.
- This transistor is also available in the TO-92 case with the type designation 2N3906.

## Maximum Ratings & Thermal Characteristics

Ratings at 25°C ambient temperature unless otherwise specified.

| Parameters | Symbols | Value | Units |
|---|---|---|---|
| Collector-Base Voltage | $-V_{CBO}$ | 40 | V |
| Collector-Emitter Voltage | $-V_{CEO}$ | 40 | V |
| Emitter-Base Voltage | $-V_{EBO}$ | 5.0 | V |
| Collector Current | $-I_C$ | 200 | mA |
| Power Dissipation at $T_A$ = 25°C | $P_{tot}$ | 225(1)<br>300(2) | mW |
| Thermal Resistance Junction to Ambient Air | $R_{\Theta JA}$ | 450(1) | °C/W |
| Thermal Resistance Junction to Substrate Backside | $R_{\Theta SB}$ | 320(1) | °C/W |
| Junction Temperature | $T_j$ | 150 | °C |
| Storage Temperature Range | $T_S$ | – 55 to +150 | °C |

**Notes:** (1) Device on fiberglass substrate, see layout.

(2) Device on alumina substrate.

**2/21/00**

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## Small Signal Transistor (PNP)

### Electrical Characteristics ($T_J$ = 25°C unless otherwise noted)

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| DC Current Gain | $h_{FE}$ | $-V_{CE}$ = 1 V, $-I_C$ = 0.1 mA<br>$-V_{CE}$ = 1 V, $-I_C$ = 1 mA<br>$-V_{CE}$ = 1 V, $-I_C$ = 10 mA<br>$-V_{CE}$ = 1 V, $-I_C$ = 50 mA<br>$-V_{CE}$ = 1 V, $-I_C$ = 100 mA | 60<br>80<br>100<br>60<br>30 | —<br>—<br>—<br>—<br>— | —<br>—<br>300<br>—<br>— | — |
| Collector-Base Breakdown Voltage | $-V_{(BR)CBO}$ | $-I_C$ = 10 μA, $I_E$ = 0 | 40 | — | — | V |
| Collector-Emitter Breakdown Voltage | $-V_{(BR)CEO}$ | $-I_C$ = 1 mA, $I_B$ = 0 | 40 | — | — | V |
| Emitter-Base Breakdown Voltage | $-V_{(BR)EBO}$ | $-I_E$ = 10 μA, $I_C$ = 0 | 5 | — | — | V |
| Collector Saturation Voltage | $-V_{CEsat}$ | $-I_C$ = 10 mA, $-I_B$ = 1 mA<br>$-I_C$ = 50 mA, $-I_B$ = 5 mA | —<br>— | —<br>— | 0.25<br>0.4 | V |
| Base Saturation Voltage | $-V_{BEsat}$ | $-I_C$ = 10 mA, $-I_B$ = 1 mA<br>$-I_C$ = 50 mA, $-I_B$ = 5 mA | —<br>— | —<br>— | 0.85<br>0.95 | V |
| Collector-Emitter Cut-off Current | $-I_{CEV}$ | $-V_{EB}$ = 3 V, $-V_{CE}$ = 30 V | — | — | 50 | nA |
| Emitter-Base Cut-off Current | $-I_{EBV}$ | $-V_{EB}$ = 3 V, $V_{CE}$ = 30V | — | — | 50 | nA |
| Gain-Bandwidth Product | $f_T$ | $-V_{CE}$ = 20 V, $-I_C$ = 10 mA<br>f = 100 MHz | 250 | — | — | MHz |
| Collector-Base Capacitance | $C_{CBO}$ | $-V_{CB}$ = 5 V, f = 100 kHz | — | — | 4.5 | pF |
| Emitter-Base Capacitance | $C_{EBO}$ | $-V_{CB}$ = 0.5 V, f = 100 kHz | — | — | 10 | pF |
| Noise Figure | NF | $-V_{CE}$ = 5 V, $-I_C$ = 100 μA,<br>$R_G$ = 1 kΩ, f = 10...15000 Hz | — | — | 4 | dB |
| Input Impedance | $h_{ie}$ | $-V_{CE}$ = 10 V, $-I_C$ = 1 mA<br>f = 1 kHz | 1 | — | 10 | kΩ |
| Small Signal Current Gain | $h_{fe}$ | $-V_{CE}$ = 10 V, $-I_C$ = 1 mA,<br>f = 1 kHz | 100 | — | 400 | — |
| Voltage Feedback Ratio | $h_{re}$ | $-V_{CE}$ = 10 V, $-I_C$ = 1 mA,<br>f = 1 kHz | $0.5 \cdot 10^{-4}$ | — | $8 \cdot 10^{-4}$ | — |
| Output Admittance | $h_{oe}$ | $-V_{CE}$ = 1 V, $-I_C$ = 1 mA,<br>f = 1 kHz | 1 | — | 40 | μS |

# MMBT3906

## Small Signal Transistors (PNP)

## Electrical Characteristics ($T_J$ = 25°C unless otherwise noted)

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Delay Time (see fig. 1) | $t_d$ | $-I_{B1}$ = 1 mA, $-I_C$ = 10 mA | — | — | 35 | ns |
| Rise Time (see fig. 1) | $t_r$ | $-I_{B1}$ = 1 mA, $-I_C$ = 10 mA, | — | — | 35 | ns |
| Storage Time (see fig. 2) | $t_s$ | $I_{B1} = -I_{B2} = 1$ mA, $-I_C$ = 10 mA | — | — | 225 | ns |
| Fall Time (see fig. 2) | $t_f$ | $I_{B1} = -I_{B2} = 1$ mA, $-I_C$ = 10 mA | — | — | 75 | ns |

**Fig. 1:** Test circuit for delay and rise time
* total shunt capacitance of test jig and connectors

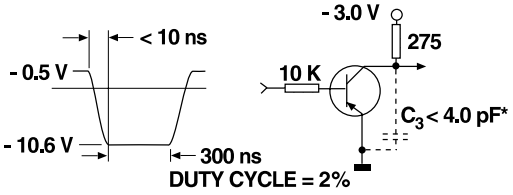
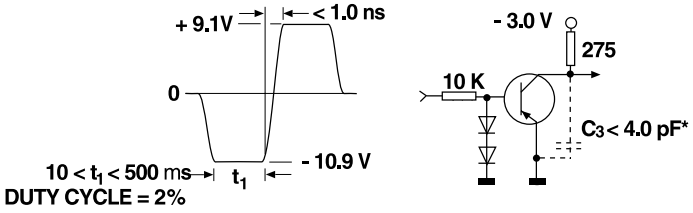
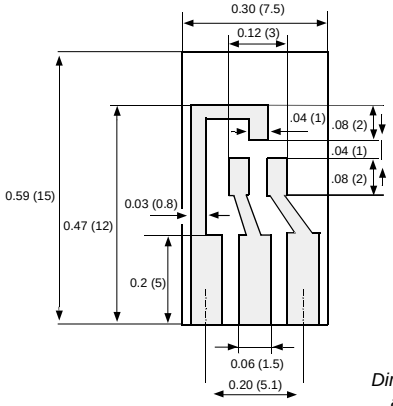



**Fig. 2:** Test circuit for storage and fall time
* total shunt capacitance of test jig and connectors




*Dimensions in inches and (millimeters)*

**Layout for $R_{thJA}$ test**
Thickness: Fiberglass 0.059 in (1.5 mm)
Copper leads 0.012 in (0.3 mm)