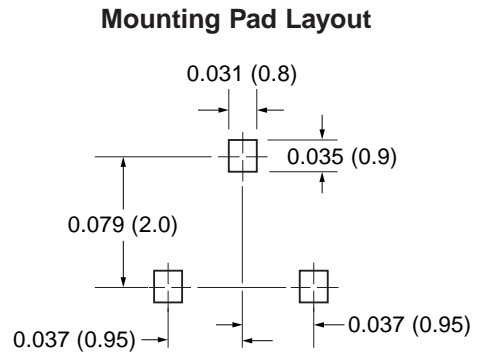
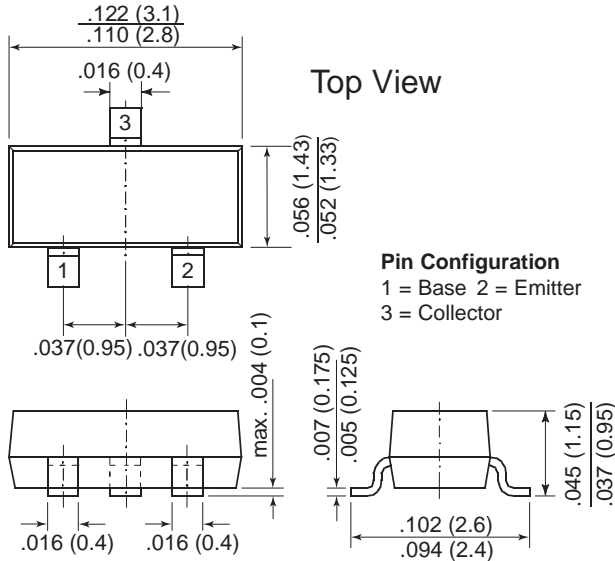




Small Signal Transistor (NPN)



TO-236AB (SOT-23)



Features

- NPN Silicon Epitaxial Planar Transistor for switching and amplifier applications.
- As complementary type, the PNP transistor MMBT3906 is recommended.
- This transistor is also available in the TO-92 case with the type designation 2N3904.

Mechanical Data

- Case:** SOT-23 Plastic Package
- Weight:** approx. 0.008g
- Marking Code:** 1AM
- Packaging Codes/Options:**
E8/10K per 13" reel (8mm tape), 30K/box
E9/3K per 7" reel (8mm tape), 30K/box

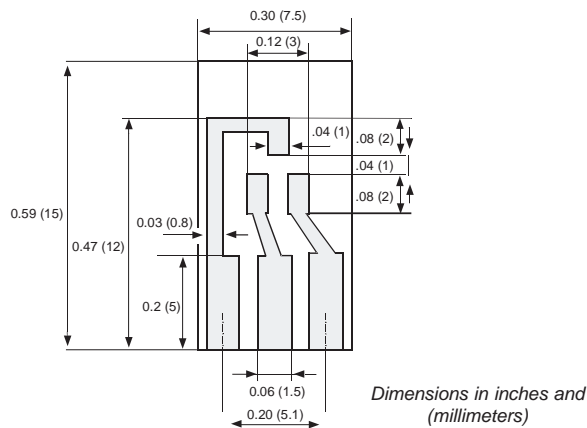
Maximum Ratings & Thermal Characteristics Ratings at 25°C ambient temperature unless otherwise specified.

Parameter	Symbol	Value	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	I _C	200	mA
Power Dissipation at T _A = 25°C	P _{tot}	225 ⁽¹⁾ 300 ⁽²⁾	mW
Thermal Resistance Junction to Substrate Backside	R _{θSB}	320 ⁽¹⁾	°C/W
Thermal Resistance Junction to Ambient Air	R _{θJA}	450 ⁽¹⁾	°C/W
Junction Temperature	T _j	150	°C
Storage Temperature Range	T _s	-65 to +150	°C

Note: (1) Device on fiberglass substrate, see layout.
(2) Device on alumina substrate.

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	40	—	—	—
		V _{CE} = 1 V, I _C = 1 mA	70	—	—	
		V _{CE} = 1 V, I _C = 10 mA	100	—	300	
		V _{CE} = 1 V, I _C = 50 mA	60	—	—	
		V _{CE} = 1 V, I _C = 100 mA	30	—	—	
Collector-Base Breakdown Voltage	V _{(BR)CBO}	I _C = 10 μA, I _E = 0	60	—	—	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	6.0	—	—	V
Collector Saturation Voltage	V _{CEsat}	I _C = 10 mA, I _B = 1 mA	—	—	0.2	V
		I _C = 50 mA, I _B = 5 mA	—	—	0.3	
Base Saturation Voltage	V _{BEsat}	I _C = 10 mA, I _B = 1 mA	—	—	0.85	V
		I _C = 50 mA, I _B = 5 mA	—	—	0.95	
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} = 30 V	—	—	50	nA
Gain-Bandwidth Product	f _T	V _{CE} = 20 V, I _C = 10 mA f = 100 MHz	300	—	—	MHz
Collector-Base Capacitance	C _{CBO}	V _{CB} = 5 V, f = 100 kHz	—	—	4	pF
Emitter-Base Capacitance	C _{EBO}	V _{EB} = 0.5 V, f = 100 kHz	—	—	8	pF



Layout for R_{thJA} test

Thickness: Fiberglass 0.059 in (1.5 mm)

Copper leads 0.012 in (0.3 mm)

Electrical Characteristics ($T_J = 25^\circ\text{C}$ unless otherwise noted)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Noise Figure	NF	$V_{CE} = 5\text{ V}, I_C = 100\ \mu\text{A}, R_G = 1\ \text{k}\Omega, f = 10\dots 15000\ \text{Hz}$	—	—	5	dB
Input Impedance	h_{ie}	$V_{CE} = 10\ \text{V}, I_C = 1\ \text{mA}, f = 1\ \text{kHz}$	1	—	10	$\text{k}\Omega$
Small Signal Current Gain	h_{fe}	$V_{CE} = 10\ \text{V}, I_C = 1\ \text{mA}, f = 1\ \text{kHz}$	100	—	400	—
Voltage Feedback Ratio	h_{re}	$V_{CE} = 10\ \text{V}, I_C = 1\ \text{mA}, f = 1\ \text{kHz}$	$0.5 \cdot 10^{-4}$	—	$8 \cdot 10^{-4}$	—
Output Admittance	h_{oe}	$V_{CE} = 1\ \text{V}, I_C = 1\ \text{mA}, f = 1\ \text{kHz}$	1	—	40	μS
Delay Time (see Fig. 1)	t_d	$I_{B1} = 1\ \text{mA}, I_C = 10\ \text{mA}$	—	—	35	ns
Rise Time (see Fig. 1)	t_r	$I_{B1} = 1\ \text{mA}, I_C = 10\ \text{mA}$	—	—	35	ns
Storage Time (see Fig. 2)	t_s	$-I_{B1} = I_{B2} = 1\ \text{mA}, I_C = 10\ \text{mA}$	—	—	200	ns
Fall Time (see Fig. 2)	t_f	$-I_{B1} = I_{B2} = 1\ \text{mA}, I_C = 10\ \text{mA}$	—	—	50	ns

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

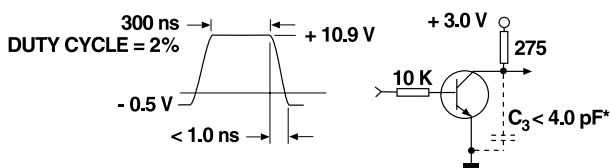


Fig. 2: Test circuit for storage and fall time
 * total shunt capacitance of test jig and connectors

