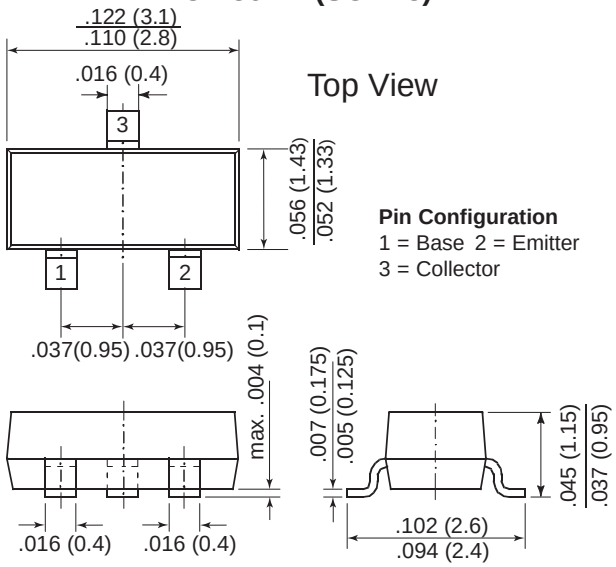
New Product

Vishay Semiconductors
formerly General Semiconductor

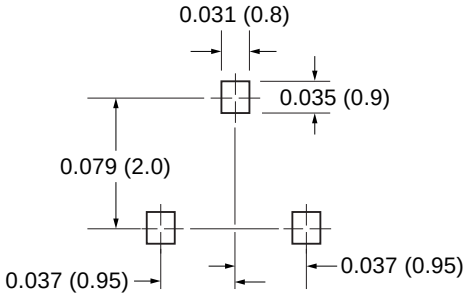
Small Signal Transistor (NPN)

TO-236AB (SOT-23)



Dimensions in inches and (millimeters)

Mounting Pad Layout



Features

- NPN Silicon Epitaxial Planar Transistor for switching and amplifier applications.
- As complementary type, the PNP transistor MMBT4403 is recommended.
- This transistor is also available in the TO-92 case with the type designation 2N4401.

Mechanical Data

Case: SOT-23 Plastic Package
Weight: approx. 0.008g
Marking Code: 2X
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 (continuous)		I_C	200	mA
Power Dissipation	FR-5 Board[1], T_A = 25°C Derate above 25°C	P_{tot}	225 1.8	mW mW/°C
Power Dissipation	Alumina Substrate[2], T_A = 25°C Derate above 25°C	P_{tot}	300 2.4	mW mW/°C
Thermal Resistance Junction to Ambient Air	FR-5 Board Alumina Substrate	$R_{\Theta JA}$	556 417	°C/W
Junction Temperature		T_j	150	°C
Storage Temperature Range		T_S	–55 to +150	°C

Notes: (1) FR-5 = 1.0 x 0.75 x 0.062 in.
(2) Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

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 V_{CE} = 1 V, I_C = 1 mA V_{CE} = 1 V, I_C = 10 mA V_{CE} = 1 V, I_C = 150 mA V_{CE} = 2 V, I_C = 500 mA	20 40 80 100 40	— — — — —	— — — 300 —	—
Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	I_C = 0.1 mA, I_E = 0	60	—	—	V
Collector-Emitter Breakdown Voltage[1]	$V_{(BR)CEO}$	I_C = 1 mA, I_B = 0	40	—	—	V
Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	I_E = 0.1 mA, I_C = 0	6.0	—	—	V
Collector-Emitter Saturation Voltage	V_{CEsat}	I_C = 150 mA, I_B = 15 mA I_C = 500 mA, I_B = 50 mA	— —	— —	0.40 0.75	V
Base-Emitter Saturation Voltage	V_{BEsat}	I_C = 150 mA, I_B = 15 mA I_C = 500 mA, I_B = 50 mA	0.75 —	— —	0.95 1.20	V
Collector Cut-off Current	I_{CEV}	V_{EB} = 0.4 V, V_{CE} = 35 V	—	—	100	nA
Base Cut-off Current	I_{BEV}	V_{EB} = 0.4 V, V_{CE} = 35 V	—	—	100	nA
Input Impedance	h_{ie}	V_{CE} = 10 V, I_C = 1 mA, f = 1 kHz	1	—	15	kΩ
Voltage Feedback Ratio	h_{re}	V_{CE} = 10 V, I_C = 1 mA, f = 1 kHz	$0.1 \cdot 10^{-4}$	—	$8 \cdot 10^{-4}$	—
Output Admittance	h_{oe}	V_{CE} = 10 V, I_C = 1 mA, f = 1 kHz	1.0	—	30	µS
Small Signal Current Gain	h_{fe}	V_{CE} = 10 V, I_C = 1 mA, f = 1 kHz	40	—	500	—
Current Gain-Bandwidth Product	f_T	V_{CE} = 10 V, I_C = 20 mA f = 100 MHz	250	—	—	MHz
Collector-Base Capacitance	C_{CBO}	V_{CB} = 5 V, f = 1 MHz, I_E = 0	—	—	6.5	pF
Emitter-Base Capacitance	C_{EBO}	V_{CB} = 0.5 V, f = 1 MHz, I_C = 0	—	—	30	pF
Delay Time (see Fig. 1)	t_d	I_{B1} = 15 mA, I_C = 150 mA V_{CC} = 30 V V_{BE} = 40 V	—	—	15	ns
Rise Time (see Fig. 1)	t_r	I_{B1} = 15 mA, I_C = 150 mA V_{CC} = 30 V V_{BE} = 40 V	—	—	20	ns
Storage Time (see Fig. 2)	t_s	$I_{B1} = I_{B2}$ = 15 mA, I_C = 150 mA V_{CC} = 30 V	—	—	225	ns
Fall Time (see Fig. 2)	t_f	$I_{B1} = I_{B2}$ = 1 mA, I_C = 150 mA V_{CC} = 30 V	—	—	30	ns

Note: (1) Pulse test: pulse width ≤ 300 µs, cycle ≤ 2.0%

Switching Time Equivalent Test Circuit

Figure 1 - Turn-On Time

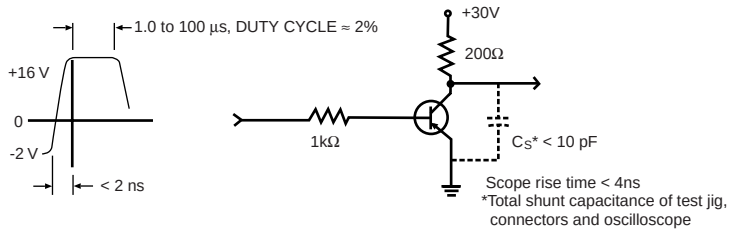


Figure 2 - Turn-Off Time