Small Signal Transistor (NPN)

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MMBT2222A

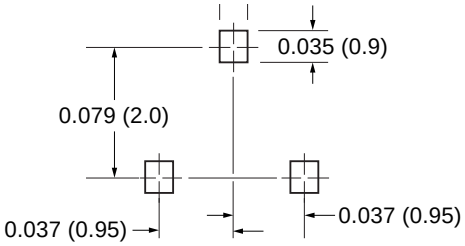
Features

NPN Silicon Epitaxial Planar Transistor for switching and amplifier applications.

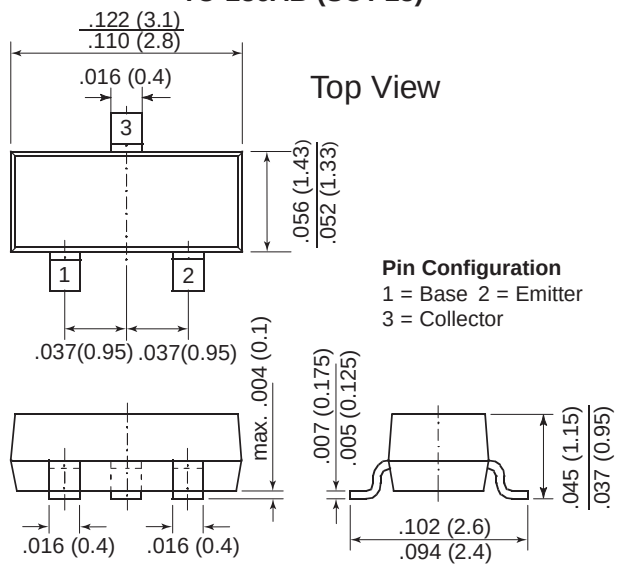
Mechanical Data

Case: SOT-23 Plastic Package
Weight: approx. 0.008g

Mounting Pad Layout



TO-236AB (SOT-23)



Pin Configuration
1 = Base 2 = Emitter
3 = Collector

Dimensions in inches and (millimeters)

Maximum Ratings & Thermal Characteristics

Ratings at 25°C ambient temperature unless otherwise specified.

Parameter		Symbol	Value	Unit
Collector-Base Voltage		V_{CBO}	75	V
Collector-Emitter Voltage		V_{CEO}	40	V
Emitter-Base Voltage		V_{EBO}	6.0	V
Collector Current		I_C	600	mA
Power Dissipation	on FR-5 Board[1] T_A = 25°C Derate above 25°C	P_{tot}	225 1.8	mW mW/°C
Power Dissipation	on 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} = 10 V, I_C = 0.1 mA	35	—	—	—
		V_{CE} = 10 V, I_C = 1 mA	50	—	—	
		V_{CE} = 10 V, I_C = 10 mA	75	—	—	
		V_{CE} = 10 V, I_C = 10 mA T_A = -55°C	35	—	—	
		V_{CE} = 10 V, I_C = 150 mA(1)	100	—	300	
		V_{CE} = 10 V, I_C = 500 mA(1)	40	—	—	
		V_{CE} = 1.0 V, I_C = 150 mA(1)	50	—	—	
Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	I_C = 10 µA, I_E = 0	75	—	—	V
Collector-Emitter Breakdown Voltage(1)	$V_{(BR)CEO}$	I_C = 10 mA, I_B = 0	40	—	—	V
Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	I_C = 10 µA, I_C = 0	6.0	—	—	V
Collector-Emitter Saturation Voltage(1)	V_{CEsat}	I_C = 150 mA, I_B = 15 mA	—	—	0.3	V
		I_C = 500 mA, I_B = 50 mA	—	—	1.0	
Base-Emitter Saturation Voltage(1)	V_{BEsat}	I_C = 150 mA, I_B = 15 mA	0.6	—	1.2	V
		I_C = 500 mA, I_B = 50 mA	—	—	2.0	
Collector Cut-off Current	I_{CEX}	V_{EB} = 3 V, V_{CE} = 60 V	—	—	10	nA
Collector Cut-off Current	I_{CBO}	V_{CB} = 60 V, I_E = 0	—	—	10	nA
		V_{CB} = 50 V, I_E = 0 V T_A = 125°C	—	—	10	µA
Base Cut-off Current	I_{BL}	V_{EB} = 3 V, V_{CE} = 60 V	—	—	20	nA
Emitter Cut-off Current	I_{EBO}	V_{EB} = 3 V_{DC}, I_C = 0	—	—	100	nA
Current Gain-Bandwidth Product	f_T	V_{CE} = 20 V, I_C = 20 mA f = 100 MHz	300	—	—	MHz
Output Capacitance	C_{obo}	V_{CB} = 10 V, f = 1 MHz, I_E = 0	—	—	8	pF
Input Capacitance	C_{ibo}	V_{EB} = 0.5 V, f = 1 MHz, I_C = 0	—	—	25	pF
Noise Figure	NF	V_{CE} = 10 V, I_C = 100 µA, R_S = 1 kΩ, f = 1 kHz	—	—	4.0	dB
Input Impedance	h_{ie}	V_{CE} = 10 V, I_C = 1 mA f = 1 kHz	2	—	8.0	kΩ
		V_{CE} = 10 V, I_C = 10 mA f = 1 kHz	0.25	—	1.25	
Small Signal Current Gain	h_{fe}	V_{CE} = 10 V, I_C = 1 mA, f = 1 kHz	50	—	300	—
		V_{CE} = 10 V, I_C = 10 mA, f = 1 kHz	75	—	375	
Voltage Feedback Ratio	h_{re}	V_{CE} = 10 V, I_C = 1 mA, f = 1 kHz	50	—	300	—
			75	—	375	
Output Admittance	h_{oe}	V_{CE} = 10 V, I_C = 1 mA, f = 1 kHz	5.0	—	35	µS
		V_{CE} = 10 V, I_C = 10 mA, f = 1 kHz	25	—	200	

Note:
(1) Pulse Test: Pulse width ≤ 300 µs - Duty cycle ≤ 2%

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Collector Base Time Constant	$r_b'C_C$	I_E = 20 mA, V_{CB} = 20 V, f = 31.8 MHz	—	—	150	ps
Delay Time (see fig. 1)	t_d	I_{B1} = 15 mA, I_C = 150 mA, V_{CC} = 30V, V_{BE} = -0.5 V	—	—	10	ns
Rise Time (see fig. 1)	t_r	I_{B1} = 15 mA, I_C = 150 mA, V_{CC} = 30V, V_{BE} = -0.5 V	—	—	25	ns
Storage Time (see fig. 2)	t_s	I_{B1} = I_{B2} = 15 mA, I_C = 150 mA, V_{CC} = 30V	—	—	225	ns
Fall Time (see fig. 2)	t_f	I_{B1} = I_{B2} = 15 mA, I_C = 150 mA, V_{CC} = 30V	—	—	60	ns

Switching Time Equivalent Test Circuit

Figure 1. Turn-ON Time

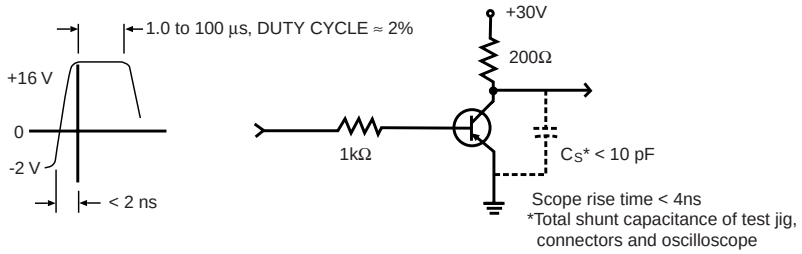


Figure 2. Turn-OFF Time