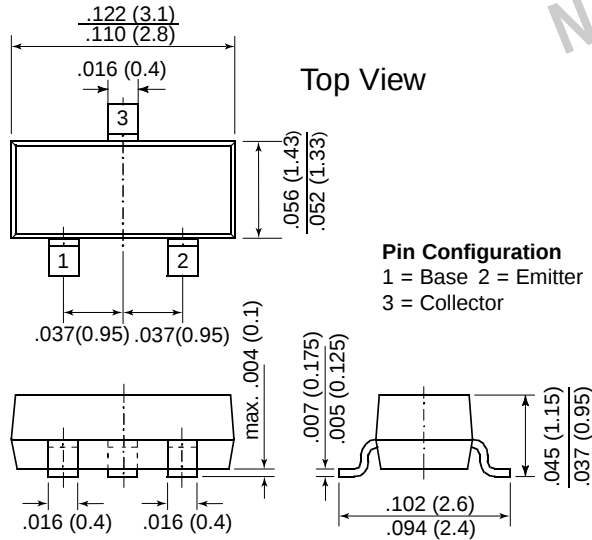


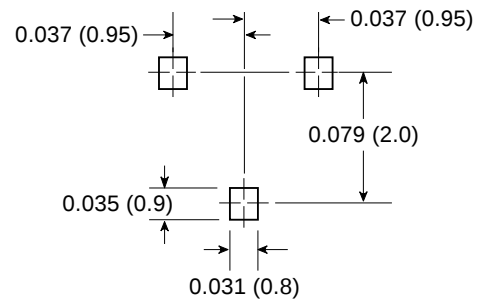
Small Signal Transistor (NPN)



TO-236AB (SOT-23)



Mounting Pad Layout



Mechanical Data

Case: SOT-23 Plastic Package

Weight: approx. 0.008g

Marking Code: 1P

Packaging Codes/Options:

E8/10K per 13" reel (8mm tape)

E9/3K per 7" reel (8mm tape)

Features

- NPN Silicon Epitaxial Planar Transistor for switching and amplifier applications.
- This transistor is also available in the TO-92 case with the type designation MPS2222A.

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

Parameters	Symbols	Value	Units
Collector-Base Voltage	V_{CB0}	75	V
Collector-Emitter Voltage	V_{CE0}	40	V
Emitter-Base Voltage	V_{EB0}	6.0	V
Collector Current	I_C	600	mA
Power Dissipation on FR-5 Board⁽¹⁾ $T_A = 25^\circ\text{C}$ Derate above 25°C	P_{tot}	225 1.8	mW mW/°C
Power Dissipation on Alumina Substrate⁽²⁾ $T_A = 25^\circ\text{C}$ 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.

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
DC Current Gain	h_{FE}	$V_{CE} = 10\text{ V}, I_C = 0.1\text{ mA}$	35	—	—	—
		$V_{CE} = 10\text{ V}, I_C = 1\text{ mA}$	50	—	—	
		$V_{CE} = 10\text{ V}, I_C = 10\text{ mA}$	75	—	—	
		$V_{CE} = 10\text{ V}, I_C = 10\text{ mA}$ $T_A = -55^\circ\text{C}$	35	—	—	
		$V_{CE} = 10\text{ V}, I_C = 150\text{ mA}^{(1)}$	100	—	300	
		$V_{CE} = 10\text{ V}, I_C = 500\text{ mA}^{(1)}$	40	—	—	
		$V_{CE} = 1.0\text{ V}, I_C = 150\text{ mA}^{(1)}$	50	—	—	
Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C = 10\text{ }\mu\text{A}, I_E = 0$	75	—	—	V
Collector-Emitter Breakdown Voltage ⁽¹⁾	$V_{(BR)CEO}$	$I_C = 10\text{ mA}, I_B = 0$	40	—	—	V
Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	$I_C = 10\text{ }\mu\text{A}, I_C = 0$	6.0	—	—	V
Collector-Emitter Saturation Voltage ⁽¹⁾	V_{CEsat}	$I_C = 150\text{ mA}, I_B = 15\text{ mA}$	—	—	0.3	V
		$I_C = 500\text{ mA}, I_B = 50\text{ mA}$	—	—	1.0	
Base-Emitter Saturation Voltage ⁽¹⁾	V_{BEsat}	$I_C = 150\text{ mA}, I_B = 15\text{ mA}$	0.6	—	1.2	V
		$I_C = 500\text{ mA}, I_B = 50\text{ mA}$	—	—	2.0	
Collector Cut-off Current	I_{CEX}	$V_{EB} = 3\text{ V}, V_{CE} = 60\text{ V}$	—	—	10	nA
Collector Cut-off Current	I_{CBO}	$V_{CB} = 60\text{ V}, I_E = 0$	—	—	10	nA
		$V_{CB} = 50\text{ V}, I_E = 0\text{ V}$	—	—	10	μA
		$T_A = 125^\circ\text{C}$	—	—	—	—
Base Cut-off Current	I_{BL}	$V_{EB} = 3\text{ V}, V_{CE} = 60\text{ V}$	—	—	20	nA
Emitter Cut-off Current	I_{EBO}	$V_{EB} = 3\text{ V}_{DC}, I_C = 0$	—	—	100	nA
Current Gain-Bandwidth Product	f_T	$V_{CE} = 20\text{ V}, I_C = 20\text{ mA}$ $f = 100\text{ MHz}$	300	—	—	MHz
Output Capacitance	C_{obo}	$V_{CB} = 10\text{ V}, f = 1\text{ MHz}, I_E = 0$	—	—	8	pF
Input Capacitance	C_{ibo}	$V_{EB} = 0.5\text{ V}, f = 1\text{ MHz}, I_C = 0$	—	—	25	pF
Noise Figure	NF	$V_{CE} = 10\text{ V}, I_C = 100\text{ }\mu\text{A}$, $R_S = 1\text{ k}\Omega, f = 1\text{ kHz}$	—	—	4.0	dB
Input Impedance	h_{ie}	$V_{CE} = 10\text{ V}, I_C = 1\text{ mA}$ $f = 1\text{ kHz}$	2	—	8.0	$\text{k}\Omega$
		$V_{CE} = 10\text{ V}, I_C = 10\text{ mA}$ $f = 1\text{ kHz}$	0.25	—	1.25	
Small Signal Current Gain	h_{fe}	$V_{CE} = 10\text{ V}, I_C = 1\text{ mA}$, $f = 1\text{ kHz}$	50	—	300	—
		$V_{CE} = 10\text{ V}, I_C = 10\text{ mA}$, $f = 1\text{ kHz}$	75	—	375	
Voltage Feedback Ratio	h_{re}	$V_{CE} = 10\text{ V}, I_C = 1\text{ mA}$, $f = 1\text{ kHz}$	50	—	300	—
			75	—	375	
Output Admittance	h_{oe}	$V_{CE} = 10\text{ V}, I_C = 1\text{ mA}$, $f = 1\text{ kHz}$	5.0	—	35	μS
		$V_{CE} = 10\text{ V}, I_C = 10\text{ mA}$, $f = 1\text{ kHz}$	25	—	200	

Note:

 (1) Pulse Test: Pulse width $\leq 300\text{ }\mu\text{s}$ - Duty cycle $\leq 2\%$

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

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

Switching Time Equivalent Test Circuit

Figure 1. Turn-ON Time

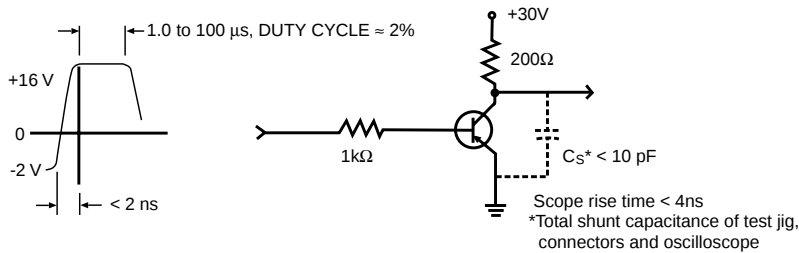


Figure 2. Turn-OFF Time

