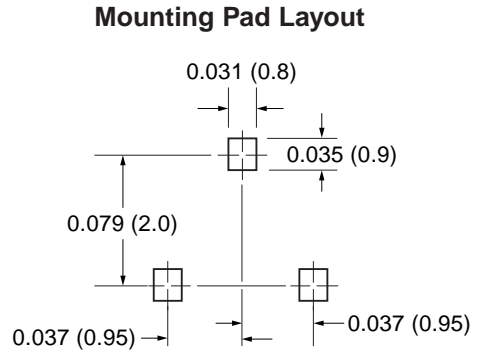
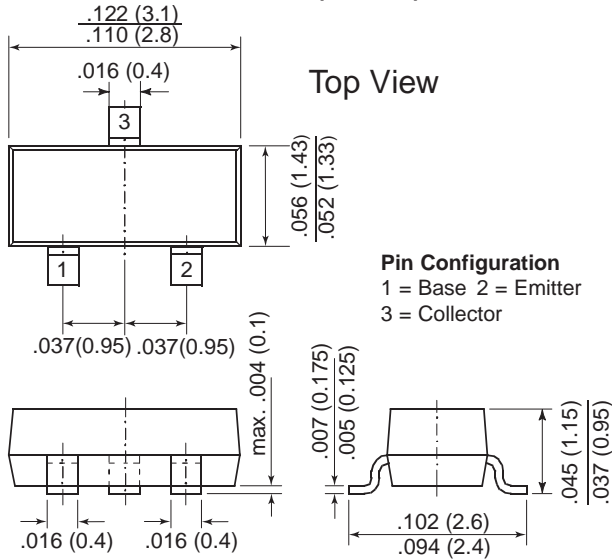




### Small Signal Transistor (NPN)



TO-236AB (SOT-23)



### 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.

### Mechanical Data

**Case:** SOT-23 Plastic Package  
**Weight:** approx. 0.008g  
**Marking Code:** 1P  
**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 <sub>CBO</sub>	75	V
Collector-Emitter Voltage	V <sub>CEO</sub>	40	V
Emitter-Base Voltage	V <sub>EBO</sub>	6.0	V
Collector Current	I <sub>C</sub>	600	mA
Power Dissipation on FR-5 Board <sup>(1)</sup> T <sub>A</sub> = 25°C Derate above 25°C	P <sub>tot</sub>	225	mW
		1.8	mW/°C
Power Dissipation on Alumina Substrate <sup>(2)</sup> T <sub>A</sub> = 25°C Derate above 25°C	P <sub>tot</sub>	300	mW
		2.4	mW/°C
Thermal Resistance Junction to Ambient Air	R <sub>θJA</sub>	FR-5 Board	556
		Alumina Substrate	417
Junction Temperature	T <sub>j</sub>	150	°C
Storage Temperature Range	T <sub>S</sub>	-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** ( $T_J = 25^\circ\text{C}$  unless otherwise noted)

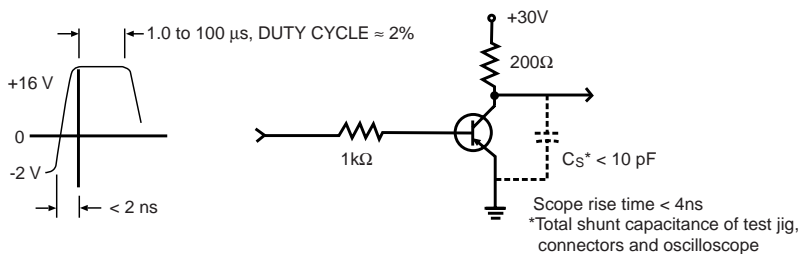
Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
DC Current Gain	h <sub>FE</sub>	V <sub>CE</sub> = 10 V, I <sub>C</sub> = 0.1 mA	35	—	—	—
		V <sub>CE</sub> = 10 V, I <sub>C</sub> = 1 mA	50	—	—	
		V <sub>CE</sub> = 10 V, I <sub>C</sub> = 10 mA	75	—	—	
		V <sub>CE</sub> = 10 V, I <sub>C</sub> = 10 mA T <sub>A</sub> = -55°C	35	—	—	
		V <sub>CE</sub> = 10 V, I <sub>C</sub> = 150 mA <sup>(1)</sup>	100	—	300	
		V <sub>CE</sub> = 10 V, I <sub>C</sub> = 500 mA <sup>(1)</sup> V <sub>CE</sub> = 1.0 V, I <sub>C</sub> = 150 mA <sup>(1)</sup>	40 50	—	—	
Collector-Base Breakdown Voltage	V <sub>(BR)CBO</sub>	I <sub>C</sub> = 10 μA, I <sub>E</sub> = 0	75	—	—	V
Collector-Emitter Breakdown Voltage <sup>(1)</sup>	V <sub>(BR)CEO</sub>	I <sub>C</sub> = 10 mA, I <sub>B</sub> = 0	40	—	—	V
Emitter-Base Breakdown Voltage	V <sub>(BR)EBO</sub>	I <sub>C</sub> = 10 μA, I <sub>C</sub> = 0	6.0	—	—	V
Collector-Emitter Saturation Voltage <sup>(1)</sup>	V <sub>CEsat</sub>	I <sub>C</sub> = 150 mA, I <sub>B</sub> = 15 mA	—	—	0.3	V
		I <sub>C</sub> = 500 mA, I <sub>B</sub> = 50 mA	—	—	1.0	
Base-Emitter Saturation Voltage <sup>(1)</sup>	V <sub>BEsat</sub>	I <sub>C</sub> = 150 mA, I <sub>B</sub> = 15 mA	0.6	—	1.2	V
		I <sub>C</sub> = 500 mA, I <sub>B</sub> = 50 mA	—	—	2.0	
Collector Cut-off Current	I <sub>CEX</sub>	V <sub>EB</sub> = 3 V, V <sub>CE</sub> = 60 V	—	—	10	nA
Collector Cut-off Current	I <sub>CBO</sub>	V <sub>CB</sub> = 60 V, I <sub>E</sub> = 0	—	—	10	nA
		V <sub>CB</sub> = 50 V, I <sub>E</sub> = 0 V T <sub>A</sub> = 125°C	—	—	10	μA
Base Cut-off Current	I <sub>BL</sub>	V <sub>EB</sub> = 3 V, V <sub>CE</sub> = 60 V	—	—	20	nA
Emitter Cut-off Current	I <sub>EBO</sub>	V <sub>EB</sub> = 3 V <sub>DC</sub> , I <sub>C</sub> = 0	—	—	100	nA
Current Gain-Bandwidth Product	f <sub>T</sub>	V <sub>CE</sub> = 20 V, I <sub>C</sub> = 20 mA f = 100 MHz	300	—	—	MHz
Output Capacitance	C <sub>obo</sub>	V <sub>CB</sub> = 10 V, f = 1 MHz, I <sub>E</sub> = 0	—	—	8	pF
Input Capacitance	C <sub>ibo</sub>	V <sub>EB</sub> = 0.5 V, f = 1 MHz, I <sub>C</sub> = 0	—	—	25	pF
Noise Figure	NF	V <sub>CE</sub> = 10 V, I <sub>C</sub> = 100 μA, R <sub>S</sub> = 1 kΩ, f = 1 kHz	—	—	4.0	dB
Input Impedance	h <sub>ie</sub>	V <sub>CE</sub> = 10 V, I <sub>C</sub> = 1 mA f = 1 kHz	2	—	8.0	kΩ
		V <sub>CE</sub> = 10 V, I <sub>C</sub> = 10 mA f = 1 kHz	0.25	—	1.25	
Small Signal Current Gain	h <sub>fe</sub>	V <sub>CE</sub> = 10 V, I <sub>C</sub> = 1 mA, f = 1 kHz	50	—	300	—
		V <sub>CE</sub> = 10 V, I <sub>C</sub> = 10 mA, f = 1 kHz	75	—	375	
Voltage Feedback Ratio	h <sub>re</sub>	V <sub>CE</sub> = 10 V, I <sub>C</sub> = 1 mA, f = 1 kHz	50 75	— —	300 375	—
Output Admittance	h <sub>oe</sub>	V <sub>CE</sub> = 10 V, I <sub>C</sub> = 1 mA, f = 1 kHz	5.0	—	35	μS
		V <sub>CE</sub> = 10 V, I <sub>C</sub> = 10 mA, f = 1 kHz	25	—	200	

**Note:**

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

**Electrical Characteristics** (T<sub>J</sub> = 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**
