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July 2014

# MMBT2222A / PZT2222A NPN General-Purpose Amplifier

## Features

- This device is for use as a medium power amplifier and switch requiring collector currents up to 500mA.
- Sourced from process 19.

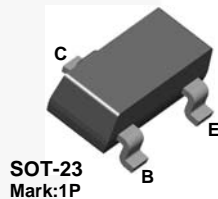


Figure 1. MMBT2222A Device Package

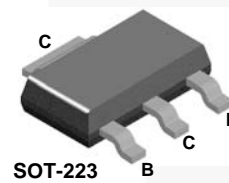


Figure 2. PZT2222A Device Package

## Ordering Information

Part Number	Top Mark	Package	Packing Method
MMBT2222A	1P	SOT-23 3L	Tape and Reel
PZT2222A	2222A	SOT-223 4L	Tape and Reel

## Absolute Maximum Ratings<sup>(1), (2)</sup>

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only. Values are at  $T_A = 25^\circ\text{C}$  unless otherwise noted.

Symbol	Parameter	Value	Unit
$V_{CEO}$	Collector-Emitter Voltage	40	V
$V_{CBO}$	Collector-Base Voltage	75	V
$V_{EBO}$	Emitter-Base Voltage	6.0	V
$I_C$	Collector Current	1.0	A
$T_{STG}$	Operating and Storage Junction Temperature Range	-55 to 150	$^\circ\text{C}$

### Note:

1. These rating are based on a maximum junction temperature of 150  $^\circ\text{C}$ .
2. These are steady-state limits. Fairchild Semiconductor should be consulted on applications involving pulsed or low-duty-cycle operation.

## Thermal Characteristics

Values are at  $T_A = 25^\circ\text{C}$  unless otherwise noted.

Symbol	Parameter	Max.		Unit
		MMBT2222A <sup>(3)</sup>	PZT2222A <sup>(4)</sup>	
$P_D$	Total Device Dissipation	350	1000	mW
	Derate Above $25^\circ\text{C}$	2.8	8.0	mW/ $^\circ\text{C}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	357	125	$^\circ\text{C}/\text{W}$

### Notes:

- Device is mounted on FR-4 PCB 1.6 inch x 1.6 inch x 0.06 inch.
- Device is mounted on FR-4 PCB 36 mm x 18 mm x 1.5 mm, mounting pad for the collector lead minimum 6 cm<sup>2</sup>.

## Electrical Characteristics

Values are at  $T_A = 25^\circ\text{C}$  unless otherwise noted.

Symbol	Parameter	Conditions	Min.	Max.	Unit
<b>Off Characteristics</b>					
$BV_{(BR)CEO}$	Collector-Emitter Breakdown Voltage <sup>(5)</sup>	$I_C = 10\text{ mA}, I_B = 0$	40		V
$BV_{(BR)CBO}$	Collector-Base Breakdown Voltage	$I_C = 10\text{ }\mu\text{A}, I_E = 0$	75		V
$BV_{(BR)EBO}$	Emitter-Base Breakdown Voltage	$I_E = 10\text{ }\mu\text{A}, I_C = 0$	6.0		V
$I_{CEX}$	Collector Cut-Off Current	$V_{CE} = 60\text{ V}, V_{EB(off)} = 3.0\text{ V}$		10	nA
$I_{CBO}$	Collector Cut-Off Current	$V_{CB} = 60\text{ V}, I_E = 0$		0.01	$\mu\text{A}$
		$V_{CB} = 60\text{ V}, I_E = 0, T_A = 125^\circ\text{C}$		10	
$I_{EBO}$	Emitter Cut-Off Current	$V_{EB} = 3.0\text{ V}, I_C = 0$		10	nA
$I_{BL}$	Base Cut-Off Current	$V_{CE} = 60\text{ V}, V_{EB(off)} = 3.0\text{ V}$		20	nA
<b>On Characteristics</b>					
$h_{FE}$	DC Current Gain	$I_C = 0.1\text{ mA}, V_{CE} = 10\text{ V}$	35		
		$I_C = 1.0\text{ mA}, V_{CE} = 10\text{ V}$	50		
		$I_C = 10\text{ mA}, V_{CE} = 10\text{ V}$	75		
		$I_C = 10\text{ mA}, V_{CE} = 10\text{ V}, T_A = -55^\circ\text{C}$	35		
		$I_C = 150\text{ mA}, V_{CE} = 10\text{ V}^{(5)}$	100	300	
		$I_C = 150\text{ mA}, V_{CE} = 1\text{ V}^{(5)}$	50		
		$I_C = 500\text{ mA}, V_{CE} = 10\text{ V}^{(5)}$	40		
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage <sup>(5)</sup>	$I_C = 150\text{ mA}, I_B = 15\text{ mA}$		0.3	V
		$I_C = 500\text{ mA}, I_B = 50\text{ mA}$		1.0	
$V_{BE(sat)}$	Base-Emitter Saturation Voltage <sup>(5)</sup>	$I_C = 150\text{ mA}, I_B = 15\text{ mA}$	0.6	1.2	V
		$I_C = 500\text{ mA}, I_B = 50\text{ mA}$		2.0	
<b>Small Signal Characteristics</b>					
$f_T$	Current Gain Bandwidth Product	$I_C = 20\text{ mA}, V_{CE} = 20\text{ V}, f = 100\text{ MHz}$	300		MHz
$C_{obo}$	Output Capacitance	$V_{CB} = 10\text{ V}, I_E = 0, f = 1\text{ MHz}$		8.0	pF
$C_{ibo}$	Input Capacitance	$V_{EB} = 0.5\text{ V}, I_C = 0, f = 1\text{ MHz}$		25	pF
$rb'C_c$	Collector Base Time Constant	$I_C = 20\text{ mA}, V_{CB} = 20\text{ V}, f = 31.8\text{ MHz}$		150	pS
NF	Noise Figure	$I_C = 100\text{ }\mu\text{A}, V_{CE} = 10\text{ V}, R_S = 1.0\text{ k}\Omega, f = 1.0\text{ kHz}$		4.0	dB
$Re(h_{ie})$	Real Part of Common-Emitter High Frequency Input Impedance	$I_C = 20\text{ mA}, V_{CE} = 20\text{ V}, f = 300\text{ MHz}$		60	$\Omega$
<b>Switching Characteristics</b>					
$t_d$	Delay Time	$V_{CC} = 30\text{ V}, V_{EB(off)} = 0.5\text{ V}, I_C = 150\text{ mA}, I_{B1} = 15\text{ mA}$		10	ns
$t_r$	Rise Time			25	ns
$t_s$	Storage Time	$V_{CC} = 30\text{ V}, I_C = 150\text{ mA}, I_{B1} = I_{B2} = 15\text{ mA}$		225	ns
$t_f$	Fall Time			60	ns

### Note:

5. Pulse test: pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2.0\%$ .

## Typical Performance Characteristics

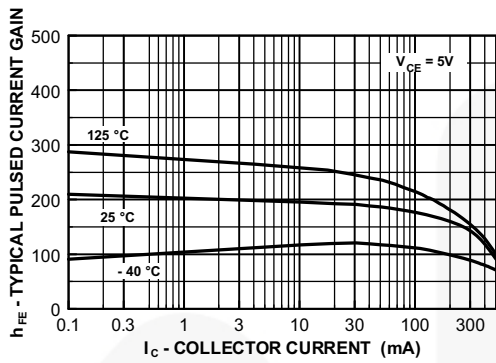


Figure 3. Typical Pulsed Current Gain vs. Collector Current

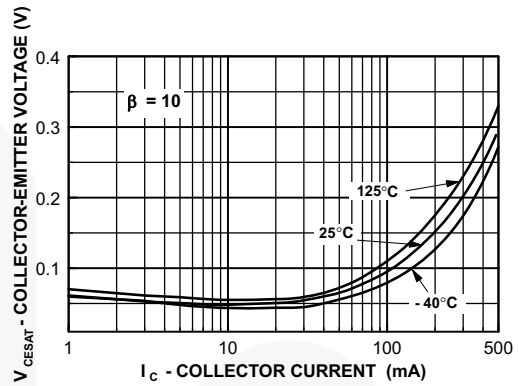


Figure 4. Collector-Emitter Saturation Voltage vs. Collector Current

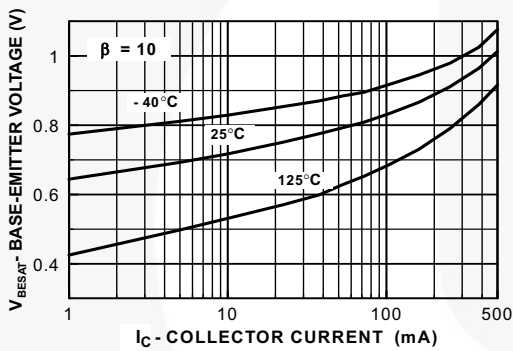


Figure 5. Base-Emitter Saturation Voltage vs. Collector Current

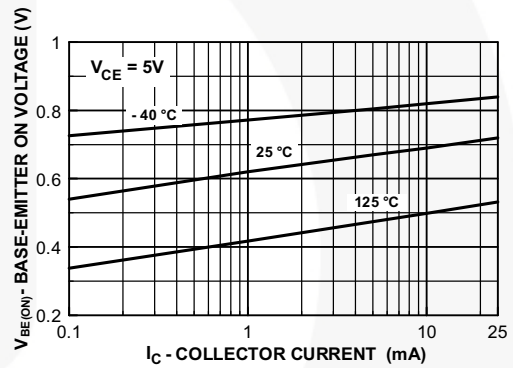


Figure 6. Base-Emitter On Voltage vs. Collector Current

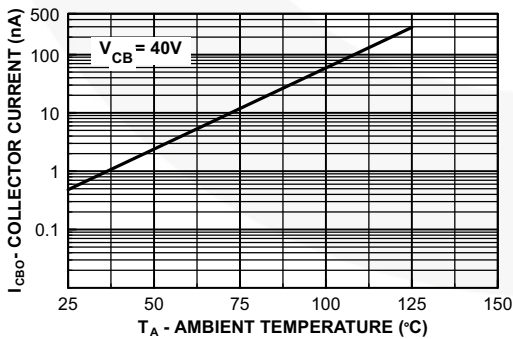


Figure 7. Collector Cut-Off Current vs. Ambient Temperature

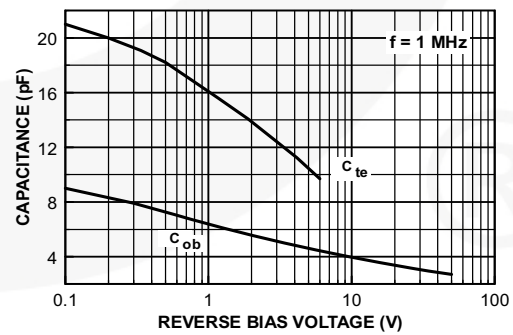


Figure 8. Emitter Transition and Output Capacitance vs. Reverse Bias Voltage

Typical Performance Characteristics (Continued)

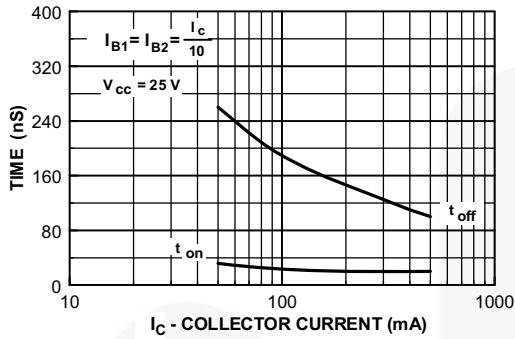


Figure 9. Turn-On and Turn-Off Times vs. Collector Current

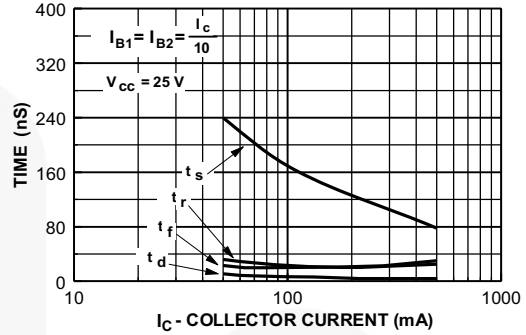


Figure 10. Switching Times vs. Collector Current

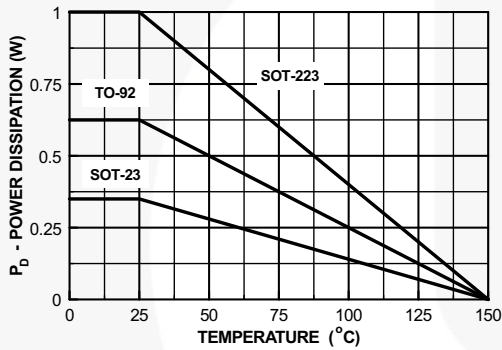


Figure 11. Power Dissipation vs. Ambient Temperature

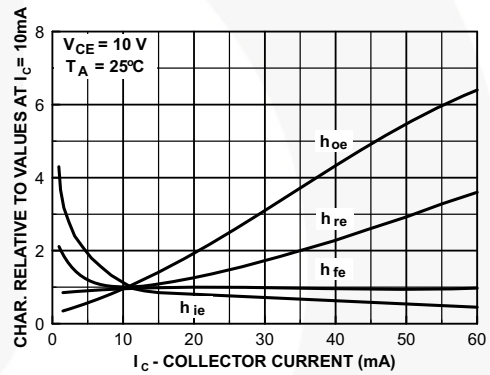


Figure 12. Common Emitter Characteristics

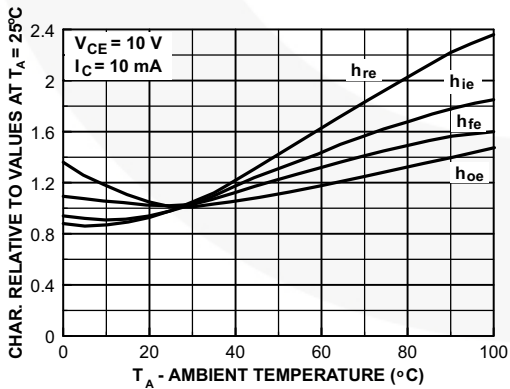


Figure 13. Common Emitter Characteristics

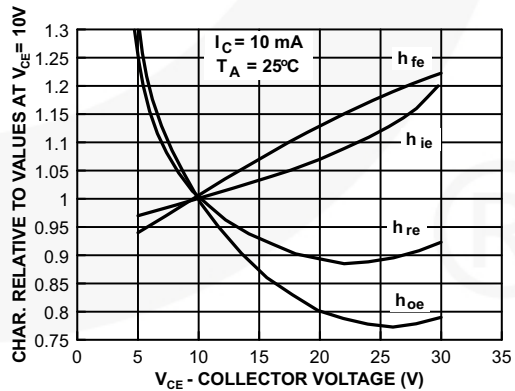


Figure 14. Common Emitter Characteristics

Physical Dimensions

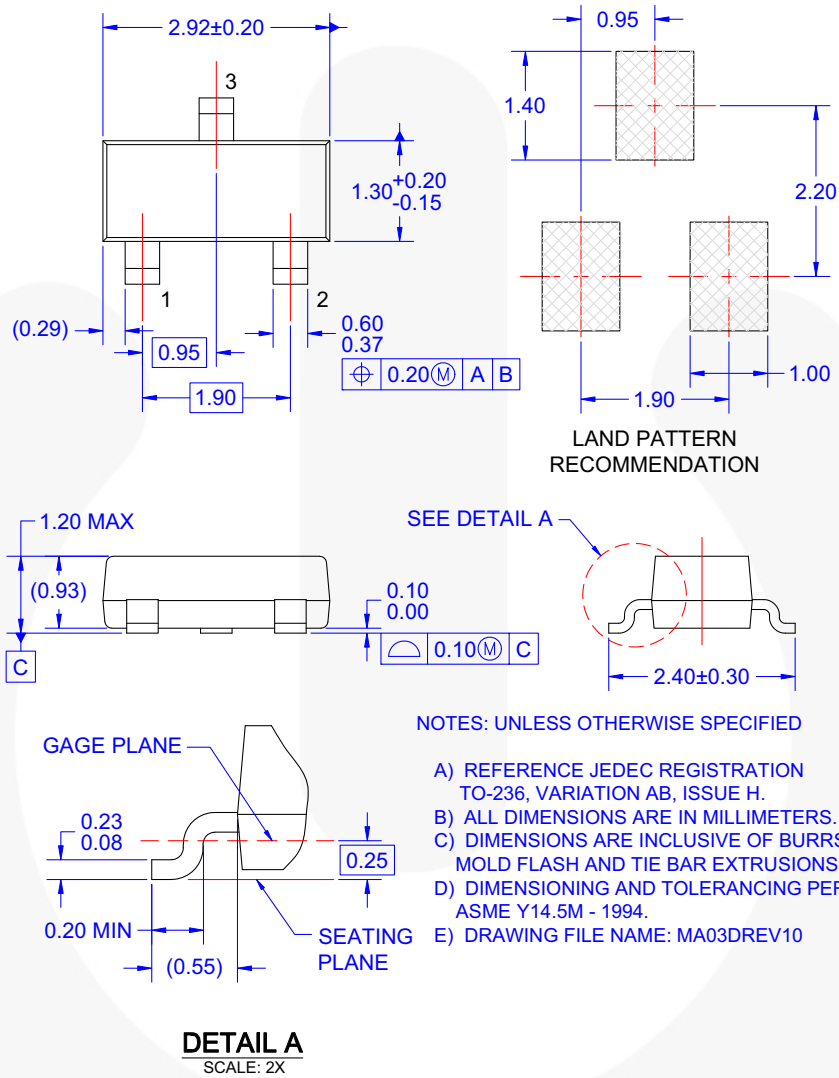


Figure 15. 3-LEAD, SOT23, JEDEC TO-236, LOW PROFILE (ACTIVE)

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Physical Dimensions (Continued)

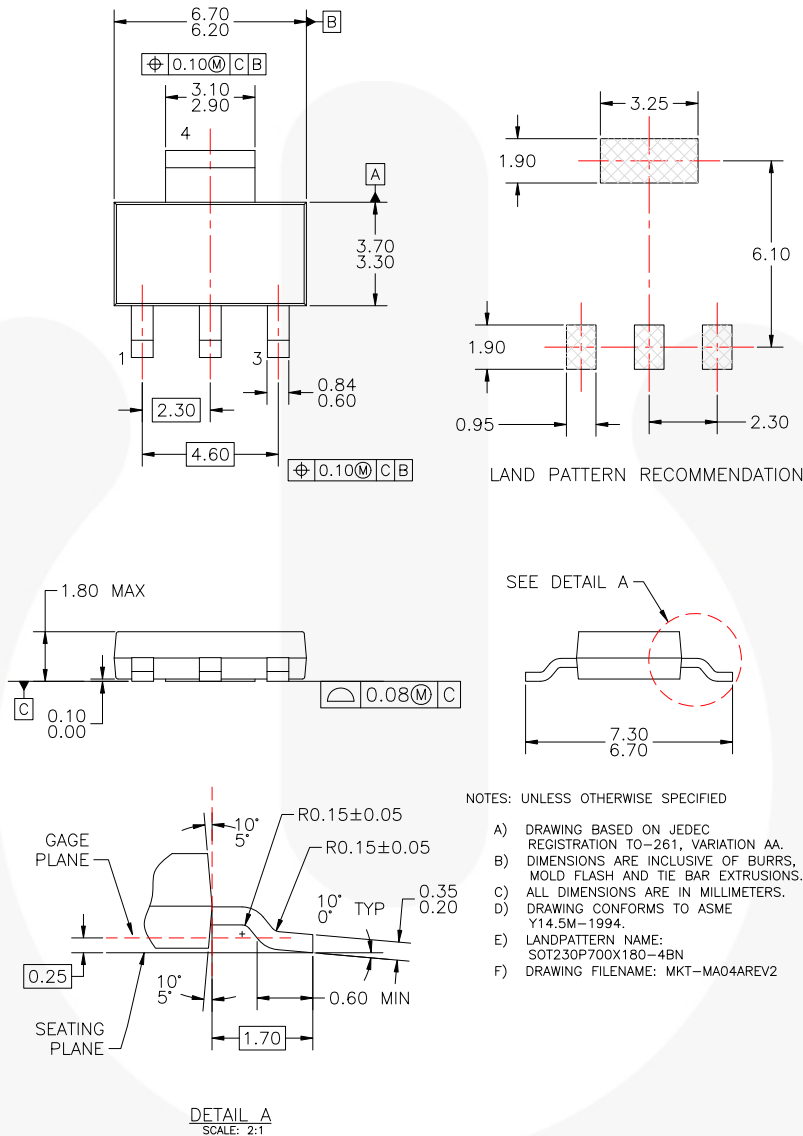


Figure 16. MOLDED PACKAGING, SOT-223, 4-LEAD (ACTIVE)

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