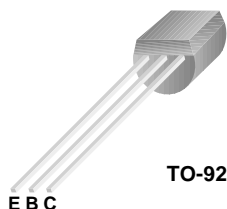
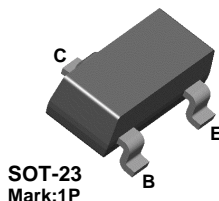


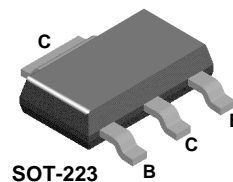
PN2222A



MMBT2222A



PZT2222A



NPN General Purpose Amplifier

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

Absolute Maximum Ratings * $T_a=25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Value	Units
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 ~ 150	$^\circ\text{C}$

* These ratings are limiting values above which the serviceability of any semiconductor device may be impaired

NOTES:

- 1) These ratings are based on a maximum junction temperature of 150 degrees C.
- 2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations

Electrical Characteristics $T_a=25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Test Condition	Min.	Max.	Units
Off Characteristics					
$BV_{(BR)CEO}$	Collector-Emitter Breakdown Voltage *	$I_C = 10\text{mA}, I_B = 0$	40		V
$BV_{(BR)CBO}$	Collector-Base Breakdown Voltage	$I_C = 10\mu\text{A}, I_E = 0$	75		V
$BV_{(BR)EBO}$	Emitter-Base Breakdown Voltage	$I_E = 10\mu\text{A}, I_C = 0$	6.0		V
I_{CEX}	Collector Cutoff Current	$V_{CE} = 60\text{V}, V_{EB(off)} = 3.0\text{V}$		10	nA
I_{CBO}	Collector Cutoff Current	$V_{CB} = 60\text{V}, I_E = 0$ $V_{CB} = 60\text{V}, I_E = 0, T_a = 125^\circ\text{C}$		0.01 10	μA μA
I_{EBO}	Emitter Cutoff Current	$V_{EB} = 3.0\text{V}, I_C = 0$		10	μA
I_{BL}	Base Cutoff Current	$V_{CE} = 60\text{V}, V_{EB(off)} = 3.0\text{V}$		20	μA
On Characteristics					
h_{FE}	DC Current Gain	$I_C = 0.1\text{mA}, V_{CE} = 10\text{V}$ $I_C = 1.0\text{mA}, V_{CE} = 10\text{V}$ $I_C = 10\text{mA}, V_{CE} = 10\text{V}$ $I_C = 10\text{mA}, V_{CE} = 10\text{V}, T_a = -55^\circ\text{C}$ $I_C = 150\text{mA}, V_{CE} = 10\text{V} *$ $I_C = 150\text{mA}, V_{CE} = 10\text{V} *$ $I_C = 500\text{mA}, V_{CE} = 10\text{V} *$	35 50 75 35 100 50 40	300	
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage *	$I_C = 150\text{mA}, V_{CE} = 10\text{V}$ $I_C = 500\text{mA}, V_{CE} = 10\text{V}$		0.3 1.0	V V
$V_{BE(sat)}$	Base-Emitter Saturation Voltage *	$I_C = 150\text{mA}, V_{CE} = 10\text{V}$ $I_C = 500\text{mA}, V_{CE} = 10\text{V}$	0.6	1.2 2.0	V V

* Pulse Test: Pulse Width $\leq 300\mu\text{s}$, Duty Cycle $\leq 2.0\%$

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

Symbol	Parameter	Test Condition	Min.	Max.	Units
Small Signal Characteristics					
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
$r_b'C_C$	Collector Base Time Constant	$I_C = 20\text{mA}$, $V_{CB} = 20\text{V}$, $f = 31.8\text{MHz}$		150	pS
NF	Noise Figure	$I_C = 100\mu\text{A}$, $V_{CE} = 10\text{V}$, $R_S = 1.0\text{K}\Omega$, $f = 1.0\text{KHz}$		4.0	dB
$\text{Re}(h_{ie})$	Real Part of Common-Emitter High Frequency Input Impedance	$I_C = 20\text{mA}$, $V_{CE} = 20\text{V}$, $f = 300\text{MHz}$		60	Ω
Switching Characteristics					
t_d	Delay Time	$V_{CC} = 30\text{V}$, $V_{EB(\text{off})} = 0.5\text{V}$, $I_C = 150\text{mA}$, $I_{B1} = 15\text{mA}$		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

Thermal Characteristics $T_a=25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Max.			Units
		PN2222A	*MMBT2222A	**PZT2222A	
P_D	Total Device Dissipation	625	350	1,000	mW
	Derate above 25°C	5.0	2.8	8.0	$\text{mW}/^\circ\text{C}$
$R_{\theta JC}$	Thermal Resistance, Junction to Case	83.3			$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	200	357	125	$^\circ\text{C}/\text{W}$

* Device mounted on FR-4 PCB $1.6" \times 1.6" \times 0.06"$.

** Device mounted on FR-4 PCB $36\text{mm} \times 18\text{mm} \times 1.5\text{mm}$; mounting pad for the collector lead min. 6cm^2 .

Spice Model

NPN ($I_s = 14.34\text{f}$ $X_{ti} = 3$ $E_g = 1.11$ $V_{af} = 74.03$ $B_f = 255.9$ $N_e = 1.307$ $I_{se} = 14.34$ $I_{kf} = .2847$ $X_{tb} = 1.5$ $B_r = 6.092$ $I_{sc} = 0$ $I_{kr} = 0$ $R_c = 1$ $C_{jc} = 7.306\text{p}$ $M_{jc} = .3416$ $V_{jc} = .75$ $F_c = .5$ $C_{je} = 22.01\text{p}$ $M_{je} = .377$ $V_{je} = .75$ $T_r = 46.91\text{n}$ $T_f = 411.1\text{p}$ $I_{tf} = .6$ $V_{tf} = 1.7$ $X_{tf} = 3$ $R_b = 10$)

Typical Characteristics

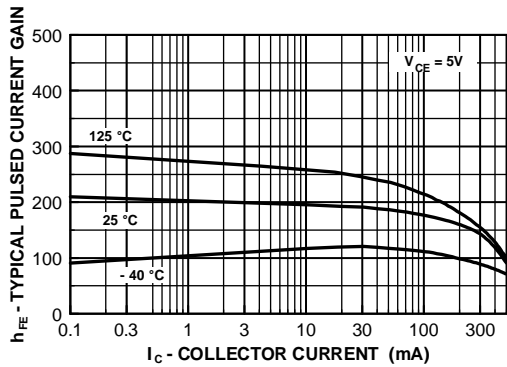


Figure 1. Typical Pulsed Current Gain vs Collector Current

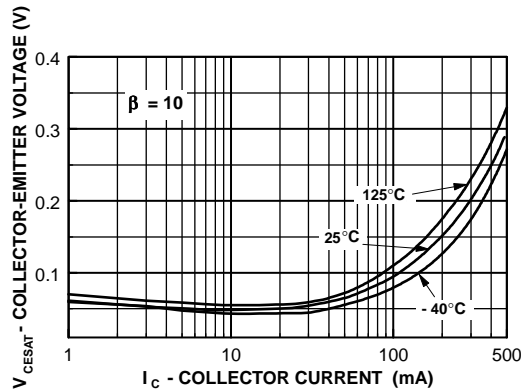


Figure 2. Collector-Emitter Saturation Voltage vs Collector Current

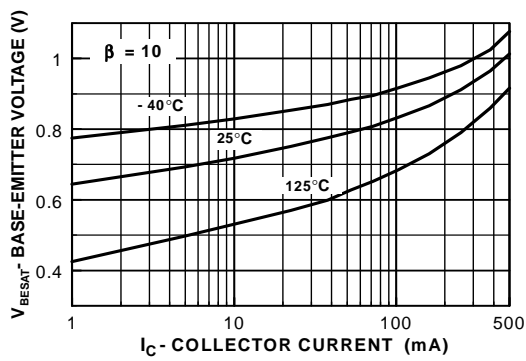


Figure 3. Base-Emitter Saturation Voltage vs Collector Current

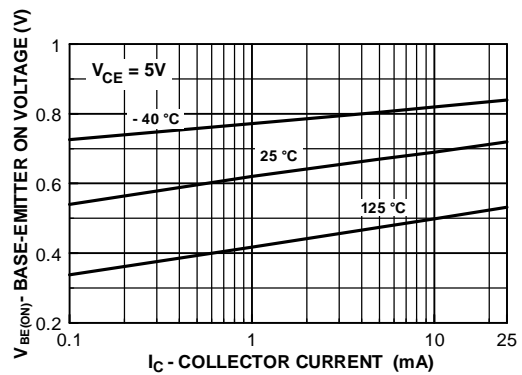


Figure 4. Base-Emitter On Voltage vs Collector Current

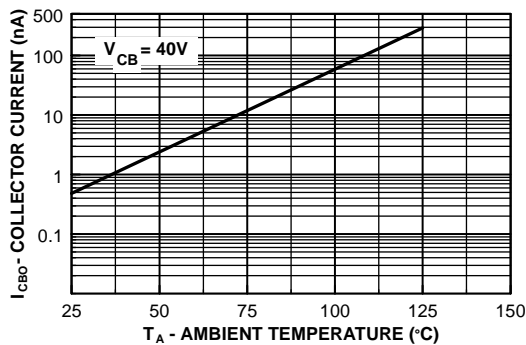


Figure 5. Collector Cutoff Current vs Ambient Temperature

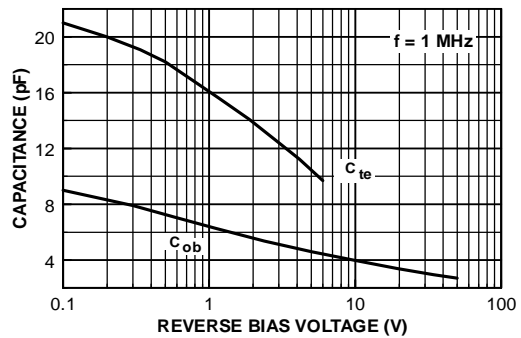


Figure 6. Emitter Transition and Output Capacitance vs Reverse Bias Voltage

Typical Characteristics

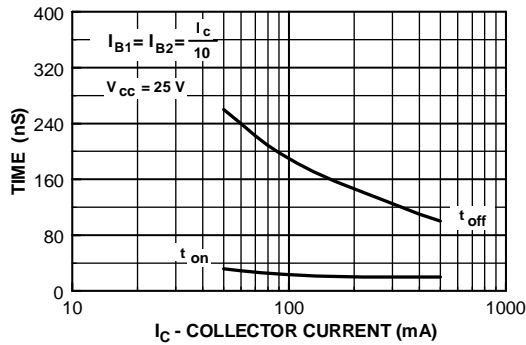


Figure 7. Turn On and Turn Off Times vs Collector Current

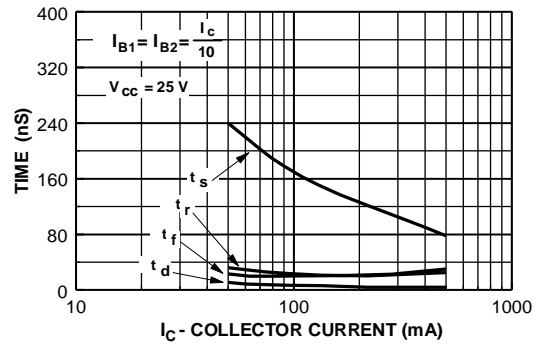


Figure 8. Switching Times vs Collector Current

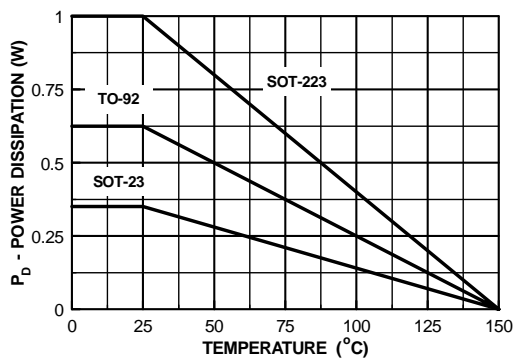


Figure 9. Power Dissipation vs Ambient Temperature

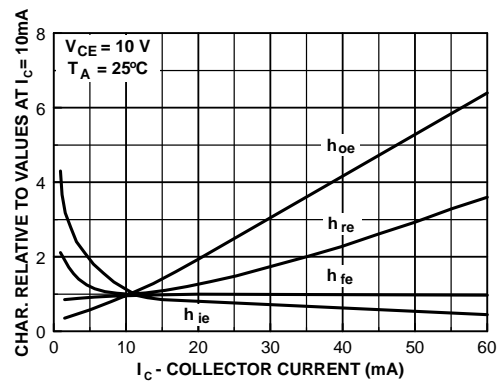


Figure 10. Common Emitter Characteristics

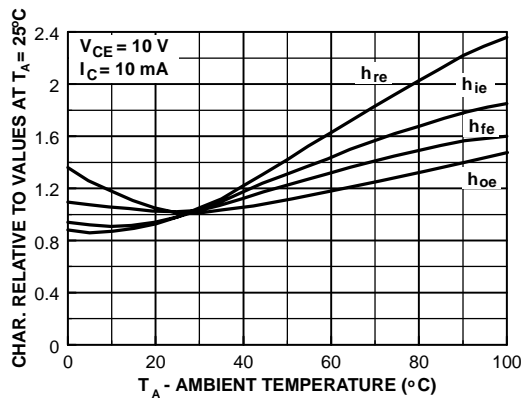


Figure 11. Common Emitter Characteristics

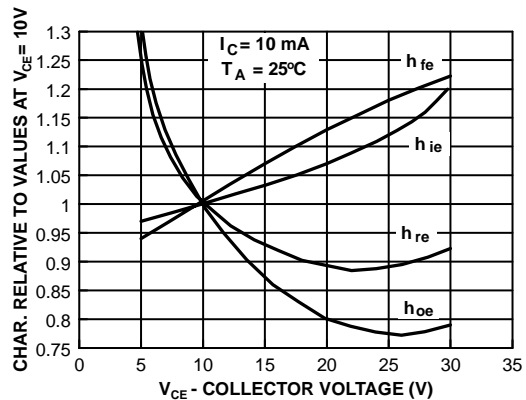
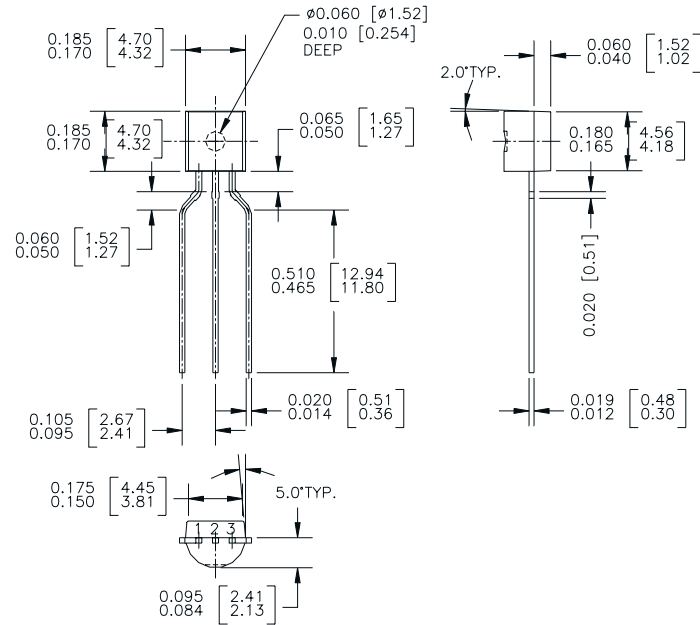


Figure 12. Common Emitter Characteristics

Package Dimensions

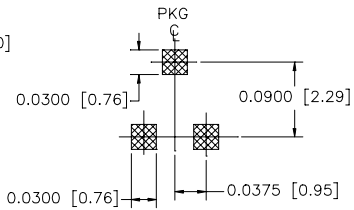
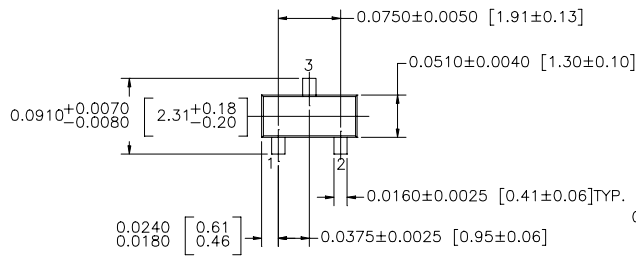
TO-92



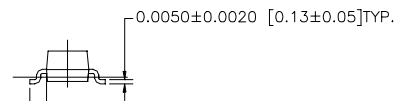
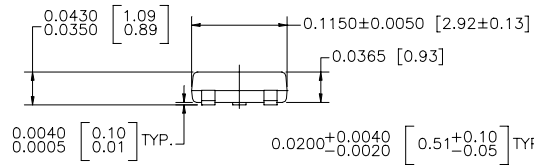
Dimensions in Millimeters

Package Dimensions (Continued)

SOT-23



LAND PATTERN RECOMMENDATION



SOT 23, 3 LEADS LOW PROFILE

CONTROLLING DIMENSION IS INCH
VALUES IN [] ARE MILLIMETERS

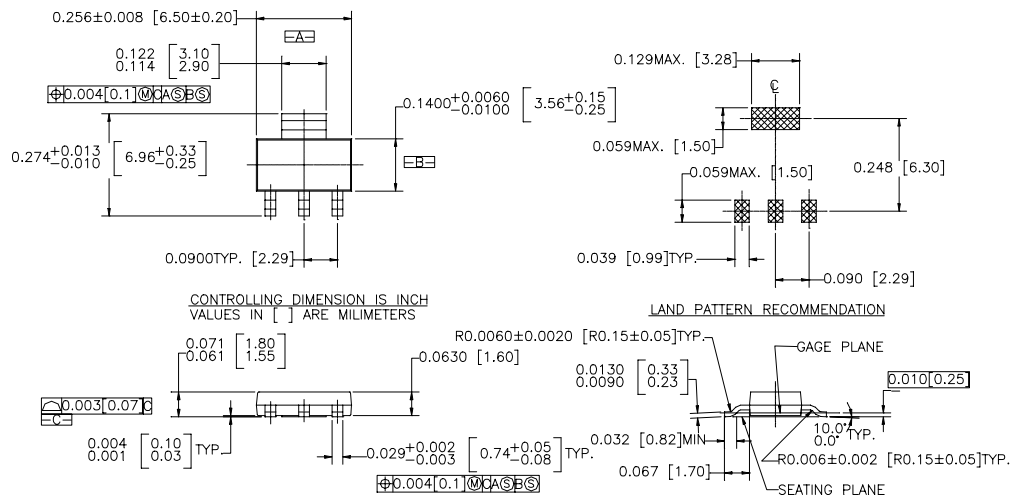
NOTE : UNLESS OTHERWISE SPECIFIED

1. STANDARD LEAD FINISH 150 MICROINCHES / 3.81 MICROMETERS
MINIMUM TIN / LEAD (SOLDER) ON ALLOY 42
2. REFERENCE JEDEC REGISTRATION TO-236, VARIATION AB, ISSUE G, DATED JUL 1993

Dimensions in Millimeters

Package Dimensions (Continued)

SOT-223



- NOTES : UNLESS OTHERWISE SPECIFIED
1. STANDARD LEAD FINISH TO BE 150 MICROINCHES/ 3.81 MICROMETERS MINIMUM TIN/LEAD (SOLDER) ON COPPER.
 2. REFERENCE JEDEC REGISTRATION TO-261, VARIATION AA, ISSUE A, DATED JAN 1990

SOT223, 4 LEADS

Dimensions in Millimeters

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