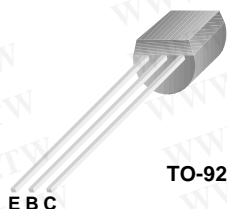
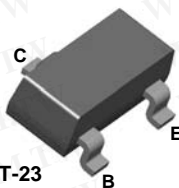


## PN2222A



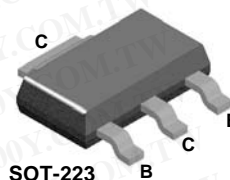
TO-92

## MMBT2222A



SOT-23  
Mark:1P

## PZT2222A



SOT-223

### 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:

- These ratings are based on a maximum junction temperature of 150 degrees C.
- 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
<b>Off Characteristics</b>					
$BV_{(BR)CEO}$	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	$\mu\text{A}$ $\mu\text{A}$
$I_{EBO}$	Emitter Cutoff Current	$V_{EB} = 3.0\text{V}, I_C = 0$		10	$\mu\text{A}$
$I_{BL}$	Base Cutoff Current	$V_{CE} = 60\text{V}, V_{EB(off)} = 3.0\text{V}$		20	$\mu\text{A}$
<b>On Characteristics</b>					
$h_{FE}$	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
<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
$r_b'C_c$	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	$\Omega$
<b>Switching Characteristics</b>					
$t_d$	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 Derate above $25^{\circ}\text{C}$	625 5.0	350 2.8	1,000 8.0	mW mW/ $^{\circ}\text{C}$
$R_{\theta JC}$	Thermal Resistance, Junction to Case	83.3			$^{\circ}\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	200	357	125	$^{\circ}\text{C/W}$

\* 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.  $6\text{cm}^2$ .

## Spice Model

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

## Typical Characteristics

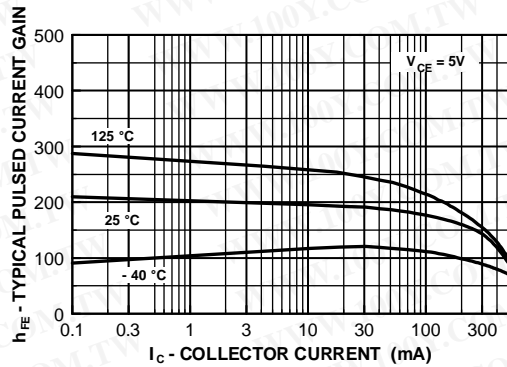


Figure 1. Typical Pulsed Current Gain vs Collector Current

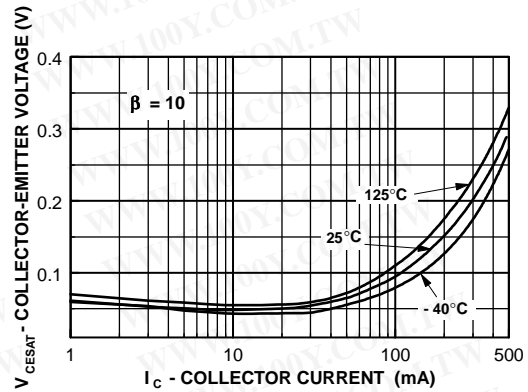


Figure 2. Collector-Emitter Saturation Voltage vs Collector Current

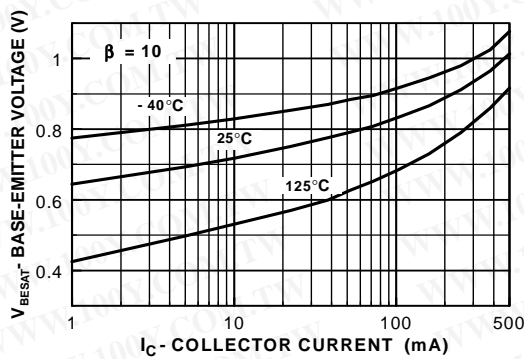


Figure 3. Base-Emitter Saturation Voltage vs Collector Current

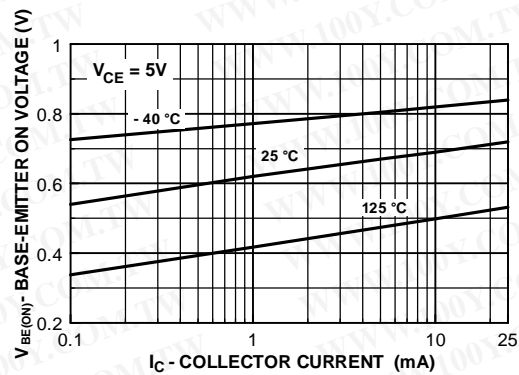


Figure 4. Base-Emitter On Voltage vs Collector Current

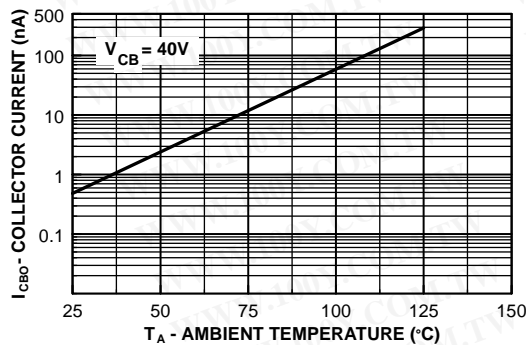


Figure 5. Collector Cutoff Current vs Ambient Temperature

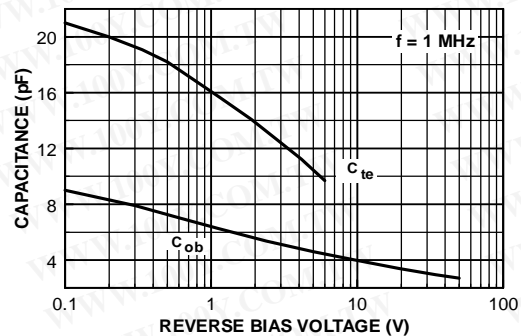


Figure 6. Emitter Transition and Output Capacitance vs Reverse Bias Voltage

## Typical Characteristics

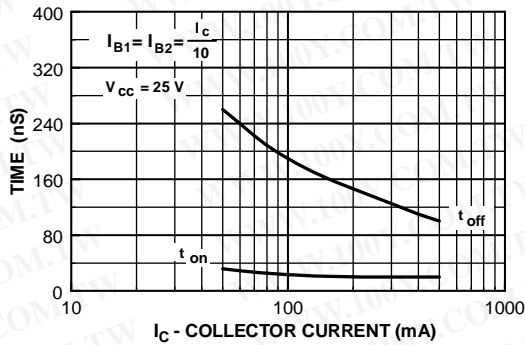


Figure 7. Turn On and Turn Off Times vs Collector Current

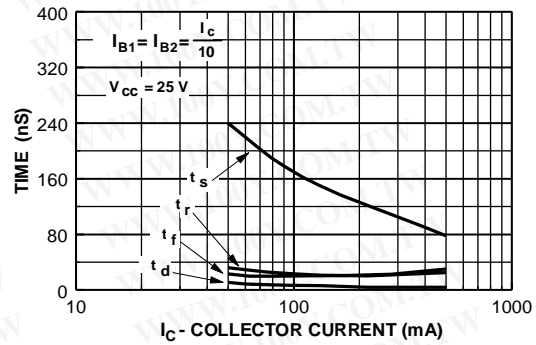


Figure 8. Switching Times vs Collector Current

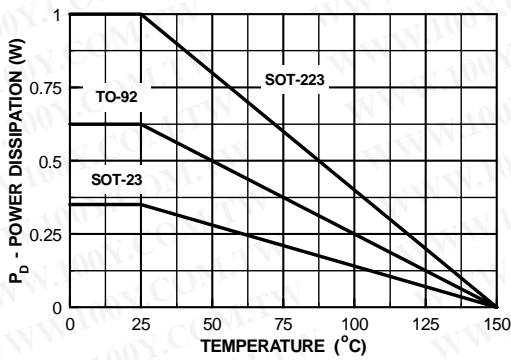


Figure 9. Power Dissipation vs Ambient Temperature

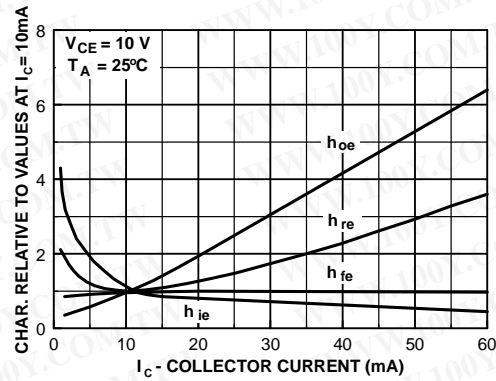


Figure 10. Common Emitter Characteristics

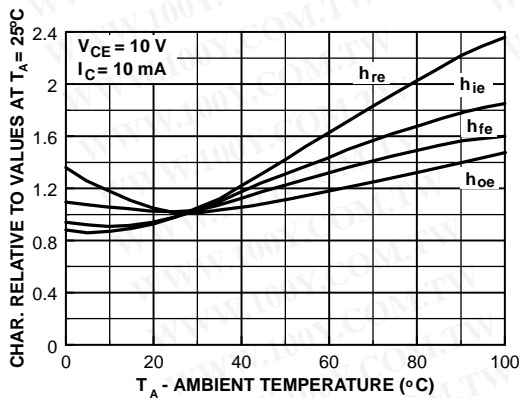


Figure 11. Common Emitter Characteristics

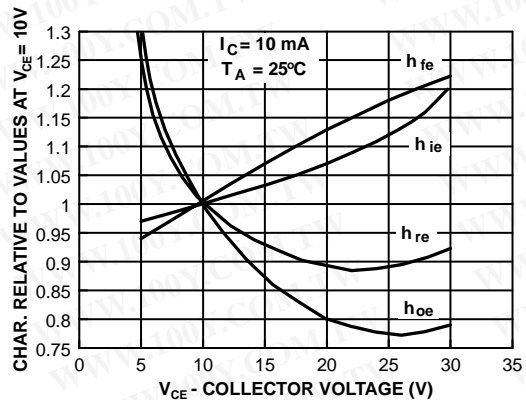
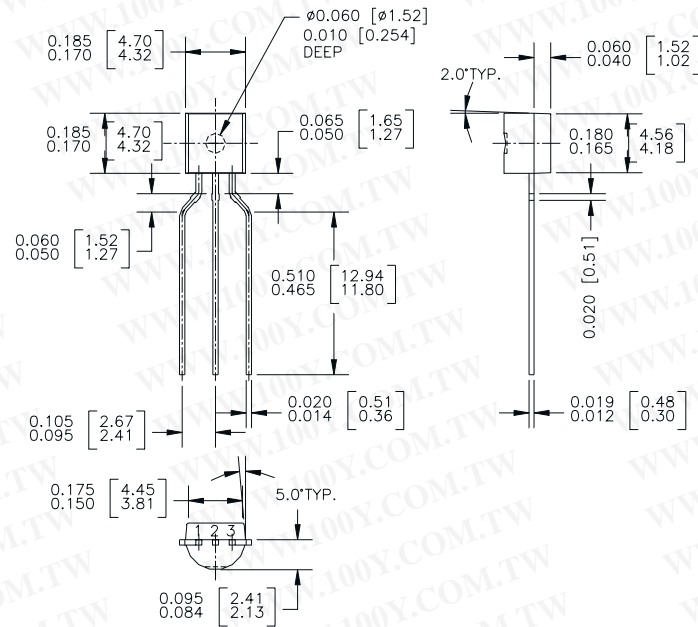


Figure 12. Common Emitter Characteristics

## Package Dimensions

# TO-92

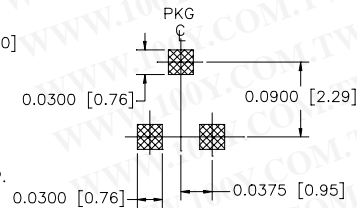
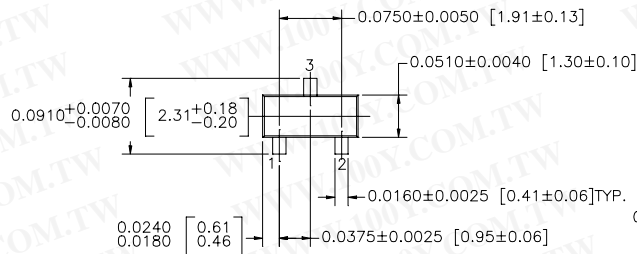
勝特力材料 886-3-5753170  
勝特力电子(上海) 86-21-54151736  
勝特力电子(深圳) 86-755-83298787  
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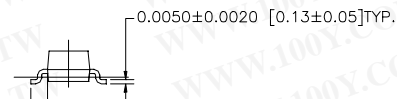
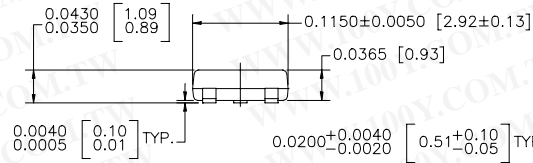
Dimensions in Millimeters

## Package Dimensions (Continued)

### SOT-23



LAND PATTERN RECOMMENDATION



CONTROLLING DIMENSION IS INCH  
VALUES IN [ ] ARE MILLIMETERS

SOT 23, 3 LEADS LOW PROFILE

NOTE : UNLESS OTHERWISE SPECIFIED

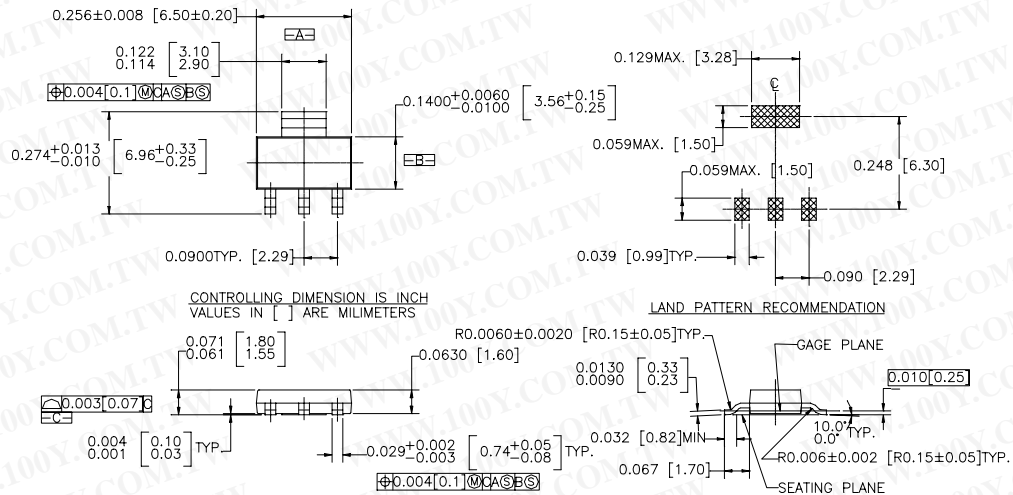
1. STANDARD LEAD FINISH 150 MICRONS / 3.81 MICROMETERS  
MINIMUM TIN / LEAD (SOLDER) ON ALLOY 42
2. REFERENCE JEDEC REGISTRATION TO-236, VARIATION AB, ISSUE G, DATED JUL 1993

Dimensions in Millimeters



## Package Dimensions (Continued)

### SOT-223



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

Dimensions in Millimeters

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