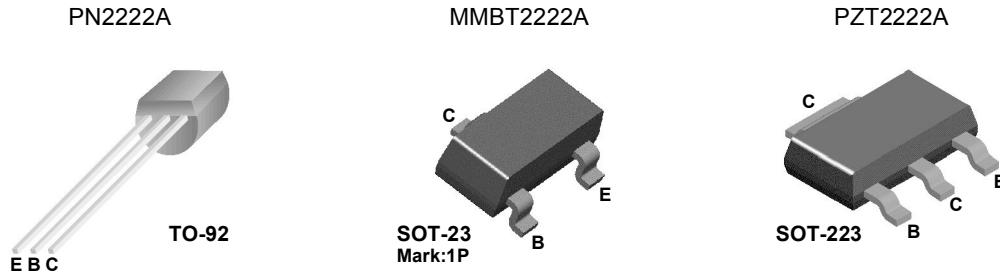


PN2222A/MMBT2222A/PZT2222A

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	Ratings	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	$^\circ\text{C}$

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

NOTES:

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

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	350	1,000	mW
		5.0	2.8	8.0	
$R_{\theta JC}$	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 36mm \times 18mm \times 1.5mm; mounting pad for the collector lead min. 6cm².

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	nA
I_{BL}	Base Cutoff Current	$V_{CE} = 60\text{V}, V_{EB(off)} = 3.0\text{V}$		20	nA
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
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
$rb'C_c$	Collector Base Time Constant	$I_C = 20\text{mA}, V_{CB} = 20\text{V}, f = 31.8\text{MHz}$		150	pS
NF	Noise Figure	$I_C = 100\mu\text{A}, V_{CE} = 10\text{V},$ $R_S = 1.0\text{K}\Omega, f = 1.0\text{KHz}$		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	Ω
Switching Characteristics					
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

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

NPN (Is = 14.34f Xti = 3 Eg = 1.11 Vaf = 74.03 Bf = 255.9 Ne = 1.307 Ise = 14.34 Ikf = .2847 Xtb = 1.5 Br = 6.092 Isc = 0
Ikr = 0 Rc = 1 Cjc = 7.306p Mjc = .3416 Vjc = .75 Fc = .5 Cje = 22.01p Mje = .377 Vje = .75 Tr = 46.91n Tf = 411.1p Itf = .6
Vtf = 1.7 Xtf = 3 Rb = 10)

Typical Characteristics

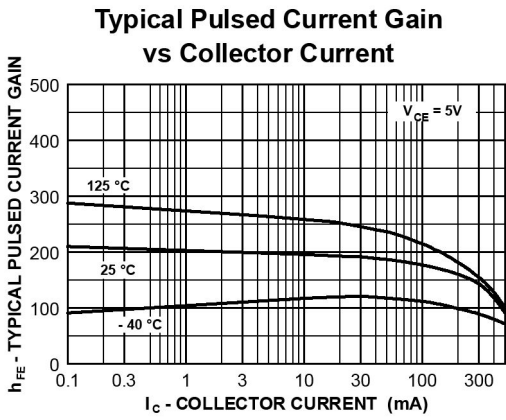


Figure 1. Typical Pulsed Current Gain vs Collector Current

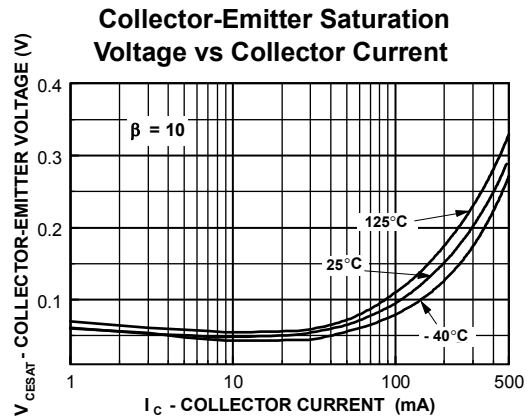


Figure 2. Collector-Emitter Saturation Voltage vs Collector Current

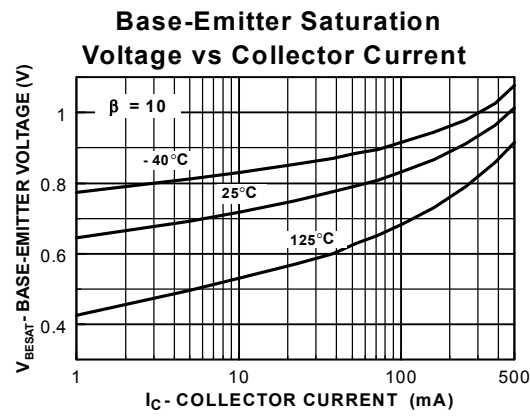


Figure 3. Base-Emitter Saturation Voltage vs Collector Current

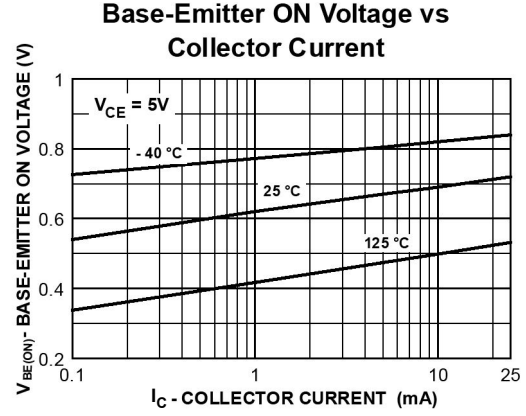


Figure 4. Base-Emitter On Voltage vs Collector Current

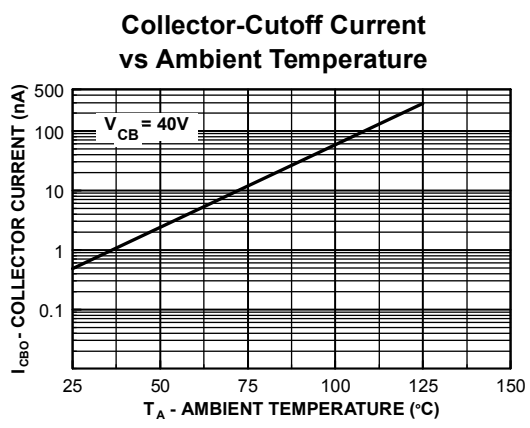


Figure 5. Collector Cutoff Current vs Ambient Temperature

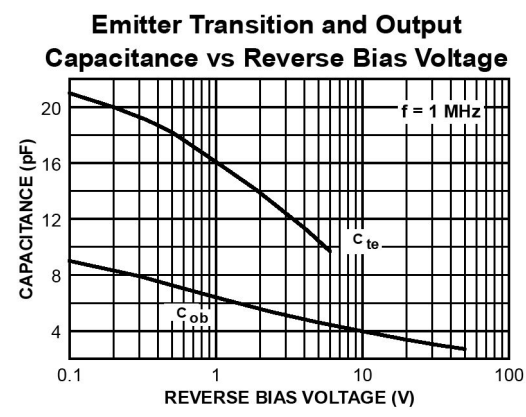


Figure 6. Emitter Transition and Output Capacitance vs Reverse Bias Voltage

Typical Characteristics

Turn On and Turn Off Times vs Collector Current

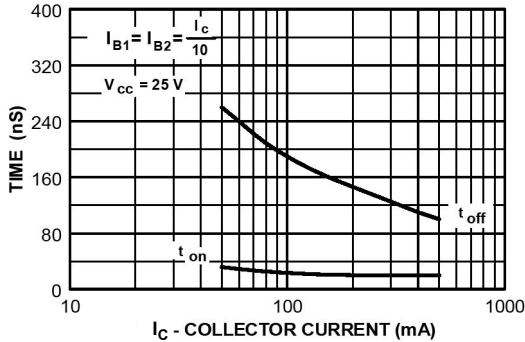


Figure 1. Turn On and Turn Off Times vs Collector Current

Switching Times vs Collector Current

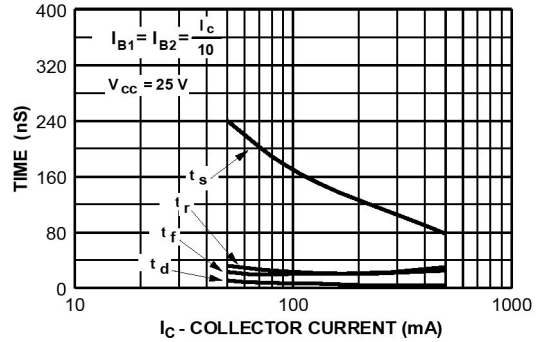


Figure 2. Switching Times vs Collector Current

Power Dissipation vs Ambient Temperature

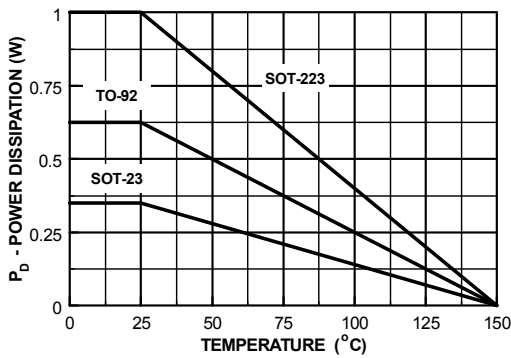


Figure 3. Power Dissipation vs Ambient Temperature

Common Emitter Characteristics

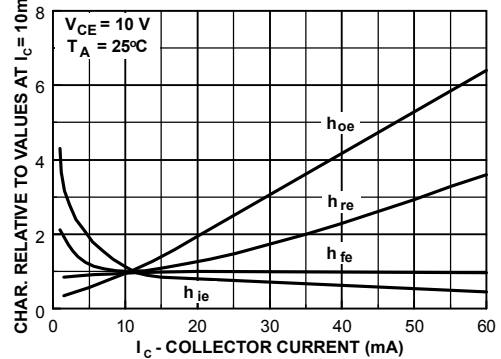


Figure 4. Common Emitter Characteristics

Common Emitter Characteristics

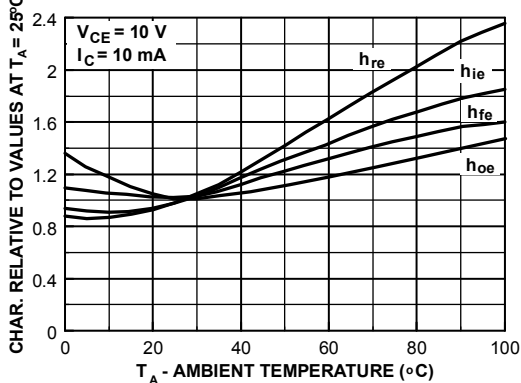


Figure 5. Common Emitter Characteristics

Common Emitter Characteristics

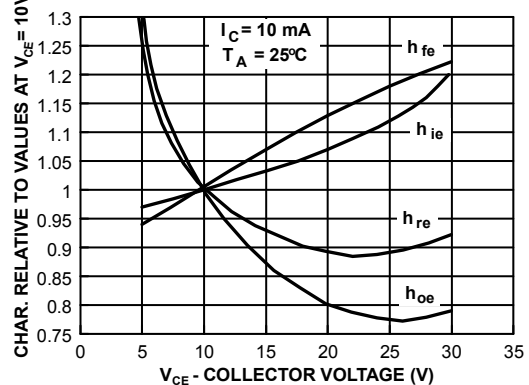



Figure 6. Common Emitter Characteristics



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