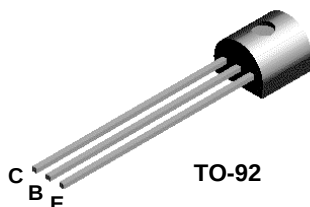
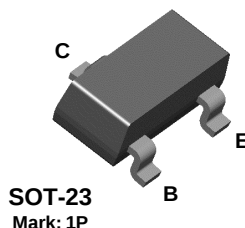


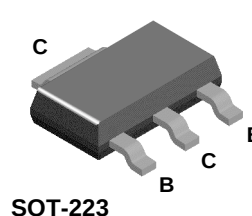
PN2222A



MMBT2222A



PZT2222A



NPN General Purpose Amplifier

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

Absolute Maximum Ratings*

$T_A = 25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Value	Units
V_{CE0}	Collector-Emitter Voltage	40	V
V_{CBO}	Collector-Base Voltage	75	V
V_{EBO}	Emitter-Base Voltage	6.0	V
I_C	Collector Current - Continuous	1.0	A
T_J, T_{stg}	Operating and Storage Junction Temperature Range	-55 to +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.

Thermal Characteristics

$T_A = 25^\circ\text{C}$ unless otherwise noted

Symbol	Characteristic	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	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" X 1.6" X 0.06."

**Device mounted on FR-4 PCB 36 mm X 18 mm X 1.5 mm; mounting pad for the collector lead min. 6 cm^2 .

NPN General Purpose Amplifier

(continued)

Electrical Characteristics

$T_A = 25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Max	Units
OFF CHARACTERISTICS					
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage*	$I_C = 10\text{ mA}$, $I_B = 0$	40		V
$V_{(BR)CBO}$	Collector-Base Breakdown Voltage	$I_C = 10\text{ }\mu\text{A}$, $I_E = 0$	75		V
$V_{(BR)EBO}$	Emitter-Base Breakdown Voltage	$I_E = 10\text{ }\mu\text{A}$, $I_C = 0$	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	$V_{CB} = 60\text{ V}$, $I_E = 0$ $V_{CB} = 60\text{ V}$, $I_E = 0$, $T_A = 150^\circ\text{C}$		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	$I_C = 0.1\text{ mA}$, $V_{CE} = 10\text{ V}$ $I_C = 1.0\text{ mA}$, $V_{CE} = 10\text{ V}$ $I_C = 10\text{ mA}$, $V_{CE} = 10\text{ V}$ $I_C = 10\text{ mA}$, $V_{CE} = 10\text{ V}$, $T_A = -55^\circ\text{C}$ $I_C = 150\text{ mA}$, $V_{CE} = 10\text{ V}^*$ $I_C = 150\text{ mA}$, $V_{CE} = 1.0\text{ V}^*$ $I_C = 500\text{ mA}$, $V_{CE} = 10\text{ V}^*$	35 50 75 35 100 50 40	300	
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage*	$I_C = 150\text{ mA}$, $I_B = 15\text{ mA}$ $I_C = 500\text{ mA}$, $I_B = 50\text{ mA}$		0.3 1.0	V V
$V_{BE(sat)}$	Base-Emitter Saturation Voltage*	$I_C = 150\text{ mA}$, $I_B = 15\text{ mA}$ $I_C = 500\text{ mA}$, $I_B = 50\text{ mA}$	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	$V_{CB} = 10\text{ V}$, $I_E = 0$, $f = 100\text{ kHz}$		8.0	pF
C_{ibo}	Input Capacitance	$V_{EB} = 0.5\text{ V}$, $I_C = 0$, $f = 100\text{ kHz}$		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	Ω

SWITCHING CHARACTERISTICS

t_d	Delay Time	$V_{CC} = 30\text{ V}$, $V_{BE(OFF)} = 0.5\text{ V}$,		10	ns
t_r	Rise Time	$I_C = 150\text{ mA}$, $I_{B1} = 15\text{ mA}$		25	ns
t_s	Storage Time	$V_{CC} = 30\text{ V}$, $I_C = 150\text{ mA}$,		225	ns
t_f	Fall Time	$I_{B1} = I_{B2} = 15\text{ mA}$		60	ns

*Pulse Test: Pulse Width $\leq 300\text{ }\mu\text{s}$, 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=14.34f Ikf=.2847 Xtb=1.5 Br=6.092 Nc=2 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)

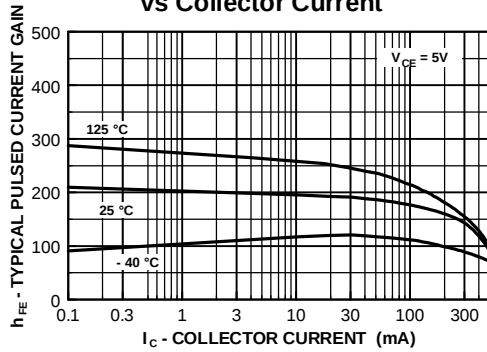
PN2222A / MMBT2222A / PZT2222A

NPN General Purpose Amplifier (continued)

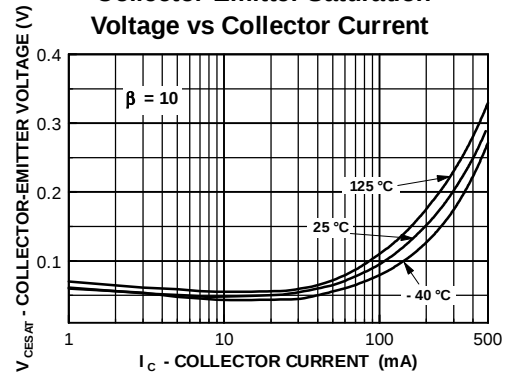
PN2222A / MMBT2222A / PZT2222A

Typical Characteristics

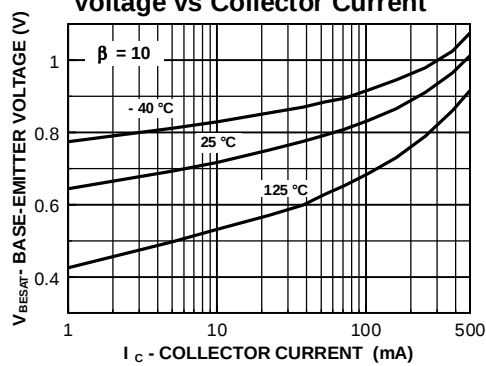
Typical Pulsed Current Gain
vs Collector Current



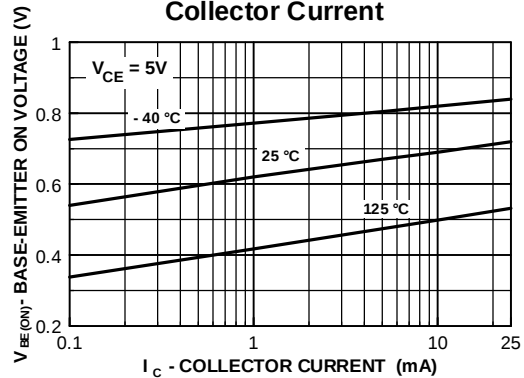
Collector-Emitter Saturation
Voltage vs Collector Current



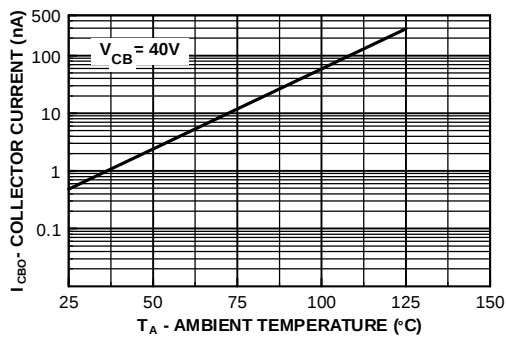
Base-Emitter Saturation
Voltage vs Collector Current



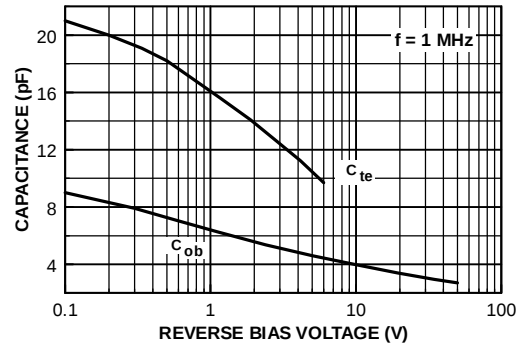
Base-Emitter ON Voltage vs
Collector Current



Collector-Cutoff Current
vs Ambient Temperature



Emitter Transition and Output
Capacitance vs Reverse Bias Voltage

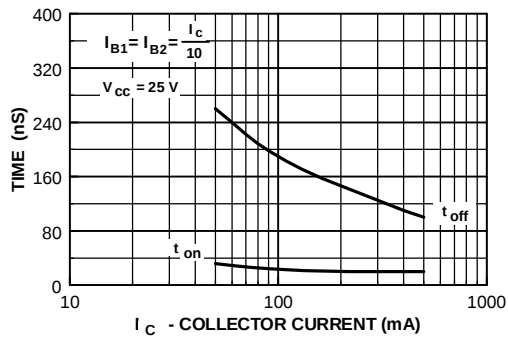


NPN General Purpose Amplifier (continued)

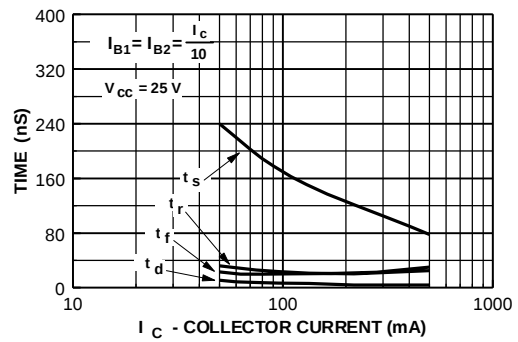
PN2222A / MMBT2222A / PZT2222A

Typical Characteristics (continued)

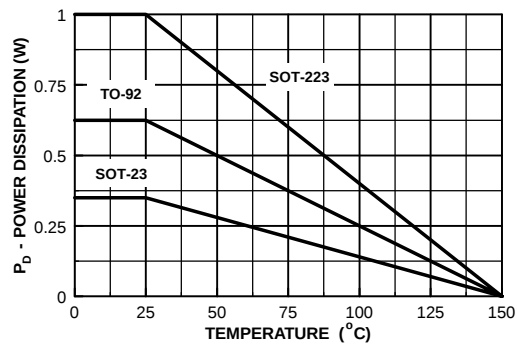
Turn On and Turn Off Times
vs Collector Current



Switching Times
vs Collector Current

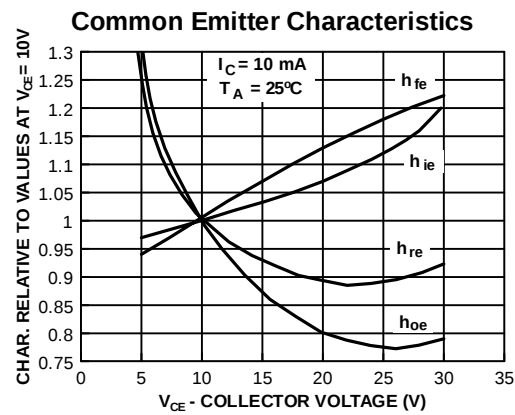
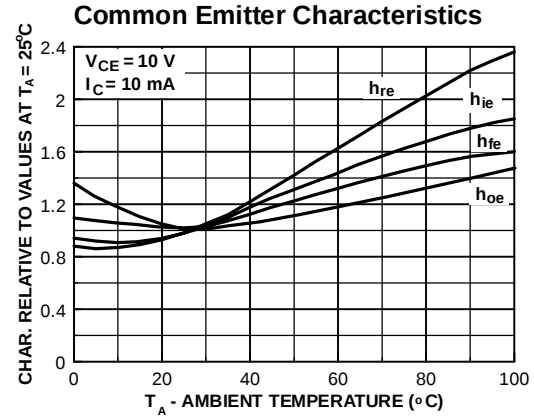
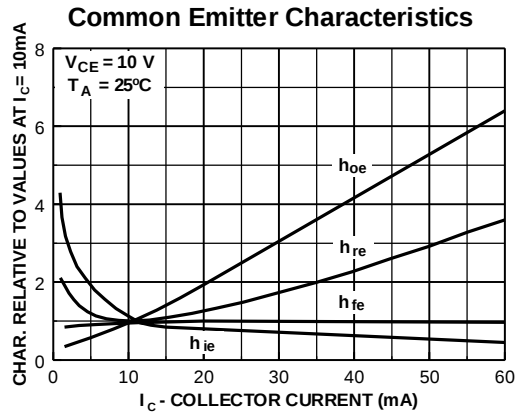


Power Dissipation vs
Ambient Temperature



NPN General Purpose Amplifier (continued)

Typical Common Emitter Characteristics ($f = 1.0\text{kHz}$)



PN2222A / MMBT2222A / PZT2222A

Test Circuits

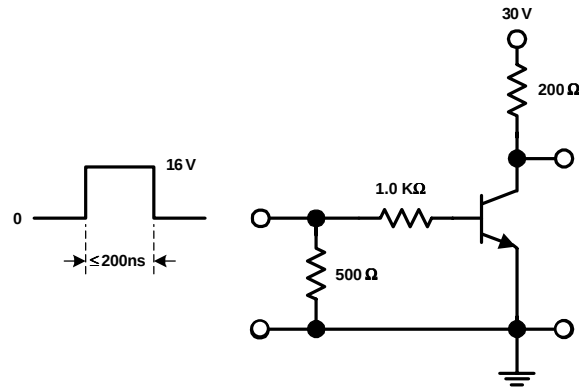


FIGURE 1: Saturated Turn-On Switching Time

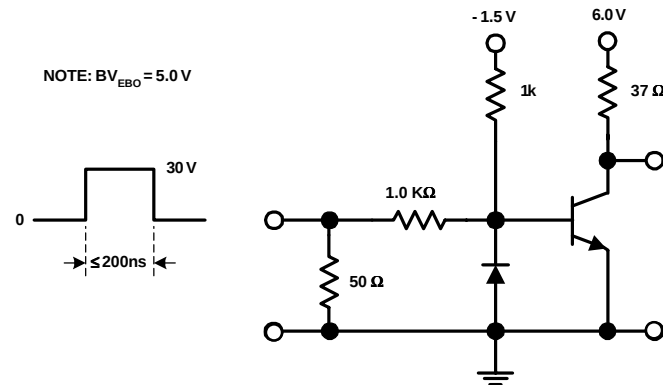


FIGURE 2: Saturated Turn-Off Switching Time