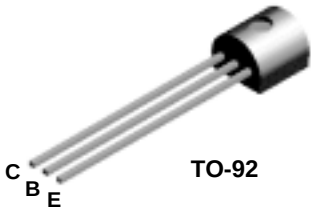
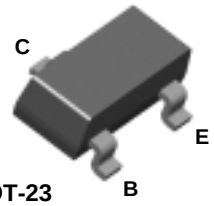
FAIRCHILD
SEMICONDUCTOR TM

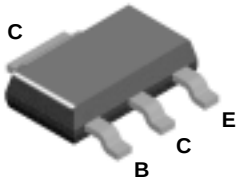
PN2222A MMBT2222A PZT2222A



TO-92



SOT-23
Mark: 1P



SOT-223

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°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 - Continuous	1.0	A
T_J, T_{stg}	Operating and Storage Junction Temperature Range	-55 to +150	°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°C unless otherwise noted

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

Symbol	Parameter	Test Conditions	Min	Max	Units
OFF CHARACTERISTICS					
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage*	I_C = 10 mA, I_B = 0	40		V
$V_{(BR)CBO}$	Collector-Base Breakdown Voltage	I_C = 10 µA, I_E = 0	75		V
$V_{(BR)EBO}$	Emitter-Base Breakdown Voltage	I_E = 10 µA, I_C = 0	6.0		V
I_{CEX}	Collector Cutoff Current	V_{CE} = 60 V, $V_{EB(OFF)}$ = 3.0 V		10	nA
I_{CBO}	Collector Cutoff Current	V_{CB} = 60 V, I_E = 0 V_{CB} = 60 V, I_E = 0, T_A = 150°C		0.01 10	µA µA
I_{EBO}	Emitter Cutoff Current	V_{EB} = 3.0 V, I_C = 0		10	nA
I_{BL}	Base Cutoff Current	V_{CE} = 60 V, $V_{EB(OFF)}$ = 3.0 V		20	nA
ON CHARACTERISTICS					
h_{FE}	DC Current Gain	I_C = 0.1 mA, V_{CE} = 10 V I_C = 1.0 mA, V_{CE} = 10 V I_C = 10 mA, V_{CE} = 10 V I_C = 10 mA, V_{CE} = 10 V, T_A = -55°C I_C = 150 mA, V_{CE} = 10 V* I_C = 150 mA, V_{CE} = 1.0 V* I_C = 500 mA, V_{CE} = 10 V*	35 50 75 35 100 50 40	 300 	
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage*	I_C = 150 mA, I_B = 15 mA I_C = 500 mA, I_B = 50 mA		0.3 1.0	V V
$V_{BE(sat)}$	Base-Emitter Saturation Voltage*	I_C = 150 mA, I_B = 15 mA I_C = 500 mA, I_B = 50 mA	0.6	1.2 2.0	V V
SMALL SIGNAL CHARACTERISTICS					
f_T	Current Gain - Bandwidth Product	I_C= 20 mA, V_{CE}= 20 V, f= 100 MHz	300		MHz
C_{obo}	Output Capacitance	V_{CB} = 10 V, I_E = 0, f = 100 kHz		8.0	pF
C_{ibo}	Input Capacitance	V_{EB} = 0.5 V, I_C = 0, f = 100 kHz		25	pF
$rb'C_C$	Collector Base Time Constant	I_C= 20 mA, V_{CB}= 20 V, f= 31.8 MHz		150	pS
NF	Noise Figure	I_C = 100 µA, V_{CE} = 10 V, R_S = 1.0 kΩ, f = 1.0 kHz		4.0	dB
$Re(h_{ie})$	Real Part of Common-Emitter High Frequency Input Impedance	I_C = 20 mA, V_{CE} = 20 V, f = 300 MHz		60	Ω
SWITCHING CHARACTERISTICS					
t_d	Delay Time	V_{CC} = 30 V, $V_{BE(OFF)}$ = 0.5 V,		10	ns
t_r	Rise Time	I_C = 150 mA, I_{B1} = 15 mA		25	ns
t_s	Storage Time	V_{CC} = 30 V, I_C = 150 mA,		225	ns
t_f	Fall Time	I_{B1} = I_{B2} = 15 mA		60	ns

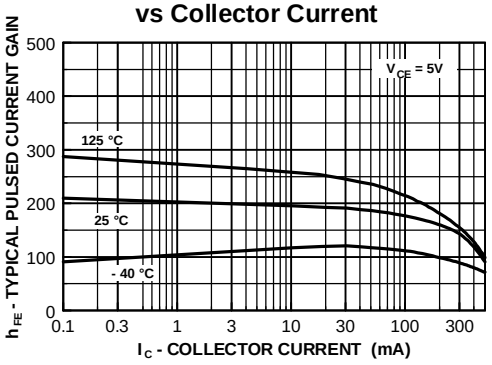
*Pulse Test: Pulse Width ≤ 300 µs, Duty Cycle ≤ 2.0%

Spice Model

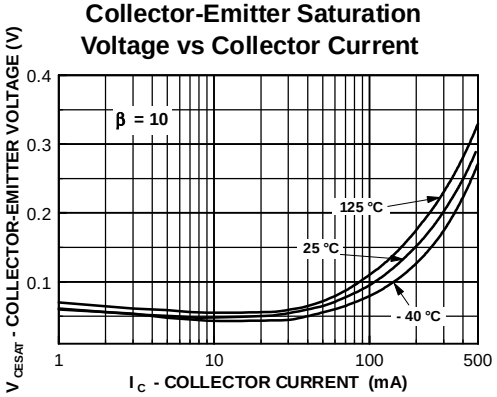
NPN (Is=14.34f Xti=3 Eg=1.11 Vaf=74.03 Bf=255.9 Ne=1.307 Ise=14.34f Ikf=.2847 Xtb=1.5 Br=6.092 Nc=2 Isc=0 Ikr=0 Rc=1 Cjc=7.306p Mjc=.3416 Vjc=.75 Fc=.5 Cje=22.01p Mje=.377 Vje=.75 Tr=46.91n Tf=411.1p Itf=.6 Vtf=1.7 Xtf=3 Rb=10)

Typical Characteristics

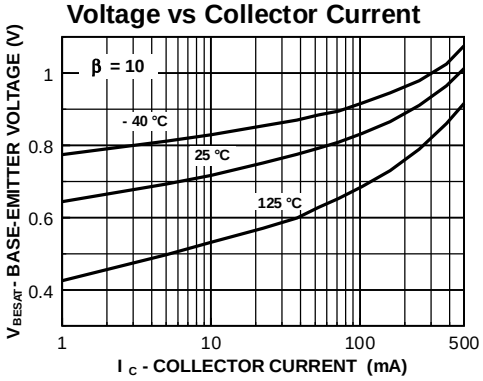
Typical Pulsed Current Gain vs Collector Current



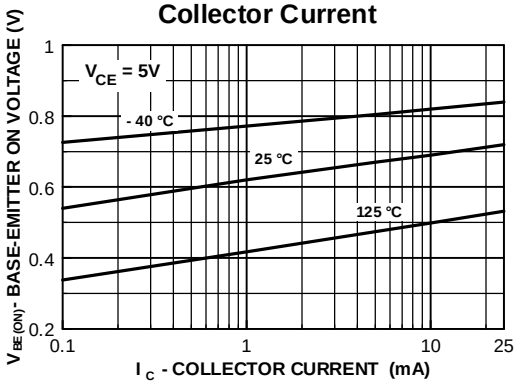
Collector-Emitter Saturation Voltage vs Collector Current



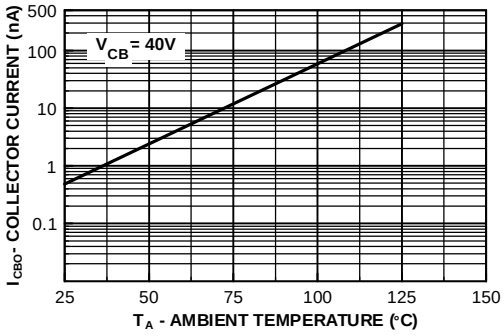
Base-Emitter Saturation Voltage vs Collector Current



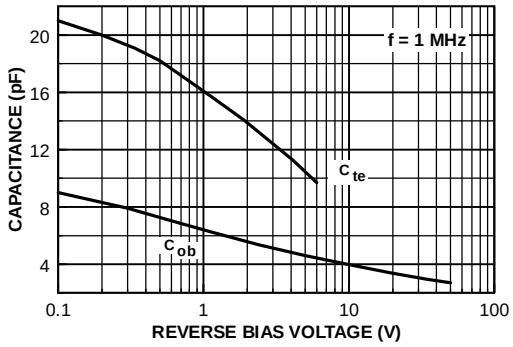
Base-Emitter ON Voltage vs Collector Current



Collector-Cutoff Current vs Ambient Temperature

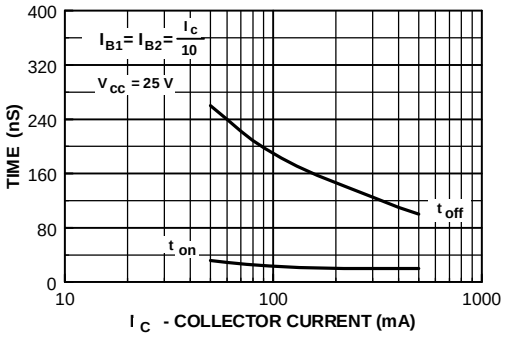


Emitter Transition and Output Capacitance vs Reverse Bias Voltage

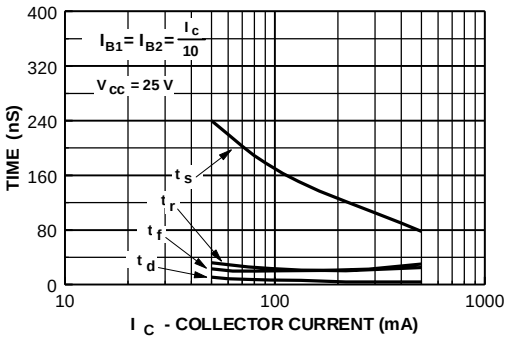


Typical Characteristics (continued)

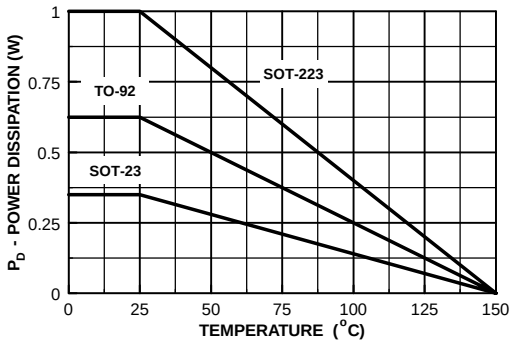
Turn On and Turn Off Times vs Collector Current



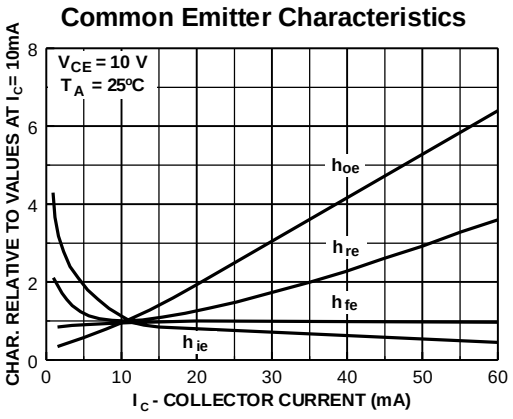
Switching Times vs Collector Current

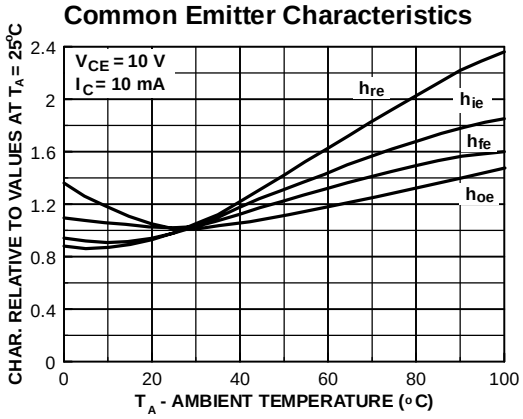


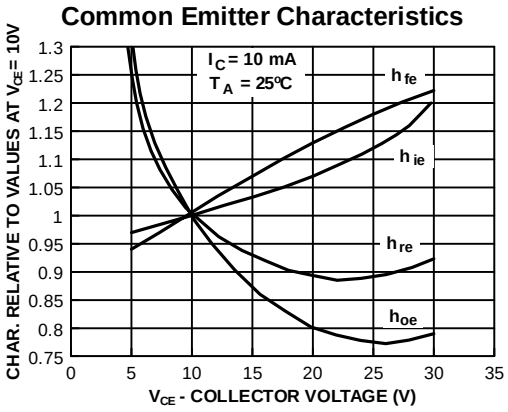
Power Dissipation vs Ambient Temperature



Typical Common Emitter Characteristics (f = 1.0kHz)







Test Circuits

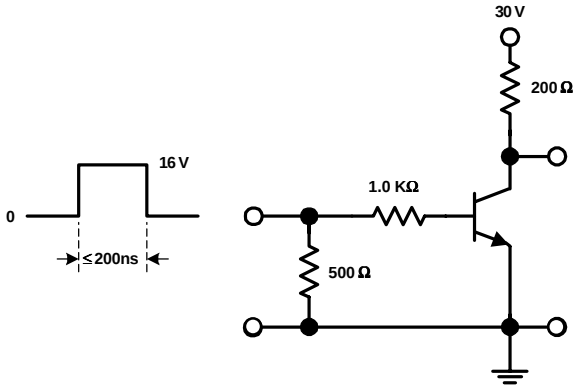


FIGURE 1: Saturated Turn-On Switching Time

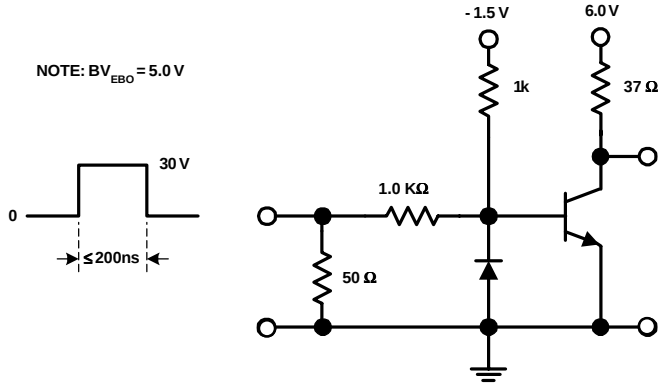


FIGURE 2: Saturated Turn-Off Switching Time