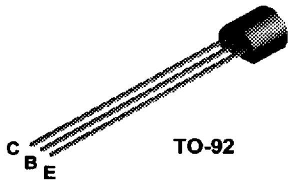
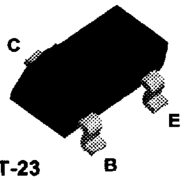
PN2222A / MMBT2222A / MMPQ2222 / NMT2222 / PZT2222A

PN2222A



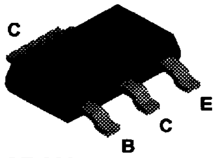
TO-92

MMBT2222A



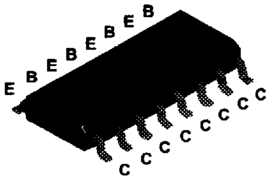
SOT-23
Mark: 1P

PZT2222A



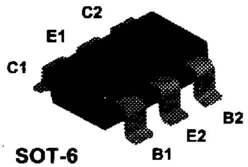
SOT-223

MMPQ2222



SOIC-16

NMT2222



SOT-6
Mark: .1B

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*

TA = 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.

Electrical Characteristics

TA = 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		0.01	μA
		V_{CB} = 60 V, I_E = 0, T_A = 150°C		10	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	35		
		I_C = 1.0 mA, V_{CE} = 10 V	50		
		I_C = 10 mA, V_{CE} = 10 V	75		
		I_C = 10 mA, V_{CE} = 10 V, T_A = -55°C	35		
		I_C = 150 mA, V_{CE} = 10 V*	100	300	
		I_C = 150 mA, V_{CE} = 1.0 V*	50		
		I_C = 500 mA, V_{CE} = 10 V*	40		
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage*	I_C = 150 mA, I_B = 15 mA		0.3	V
		I_C = 500 mA, I_B = 50 mA		1.0	V
$V_{BE(sat)}$	Base-Emitter Saturation Voltage*	I_C = 150 mA, I_B = 1.0 mA	0.6	1.2	V
		I_C = 500 mA, I_B = 5.0 mA		2.0	V
SMALL SIGNAL CHARACTERISTICS (except MMPQ2222 and NMT2222)					
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 (except MMPQ2222 and NMT2222)					
t_d	Delay Time	V_{CC} = 30 V, $V_{BE(OFF)}$ = 0.5 V, I_C = 150 mA, I_{B1} = 15 mA		10	ns
t_r	Rise Time			25	ns
t_s	Storage Time	V_{CC} = 30 V, I_C = 150 mA, I_{B1} = I_{B2} = 15 mA		225	ns
t_f	Fall Time			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)

NPN General Purpose Amplifier

(continued)

Thermal Characteristics

TA = 25°C unless otherwise noted

Symbol	Characteristic	Max		Units
		PN2222A	*PZT2222A	
P_D	Total Device Dissipation Derate above 25°C	625 5.0	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	125	°C/W

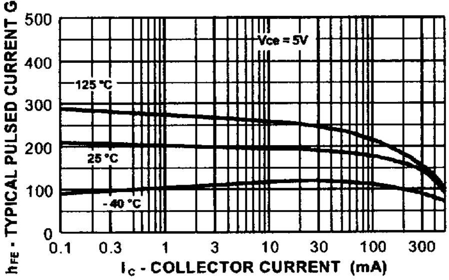
Symbol	Characteristic	Max		Units
		**MMBT2222A	MMPQ2222	
P_D	Total Device Dissipation Derate above 25°C	350 2.8	1,000 8.0	mW mW/°C
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	357		°C/W
	Effective 4 Die		125	°C/W
	Each Die		240	°C/W

*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.

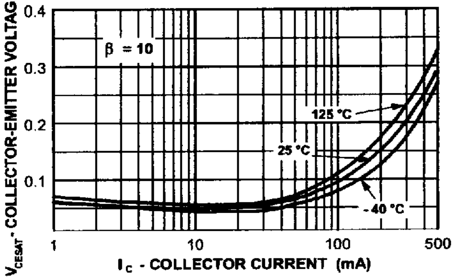
**Device mounted on FR-4 PCB 1.6" X 1.6" X 0.06."

DC Typical Characteristics

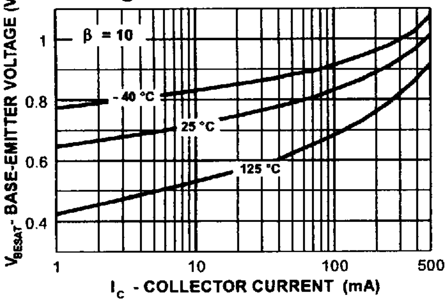
Typical Pulsed Current Gain vs Collector Current



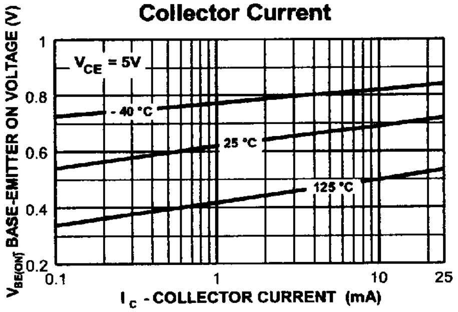
Collector-Emitter Saturation Voltage vs Collector Current



Base-Emitter Saturation Voltage vs Collector Current

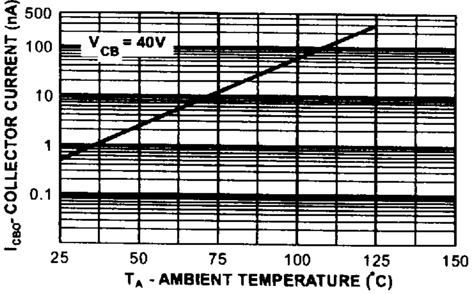


Base-Emitter ON Voltage vs Collector Current



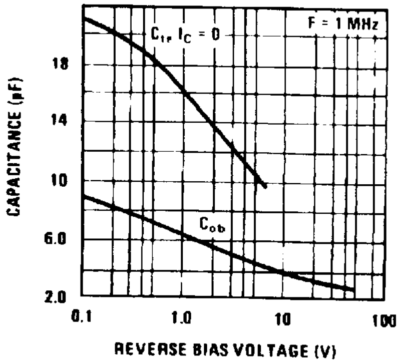
DC Typical Characteristics (continued)

Collector-Cutoff Current vs Ambient Temperature

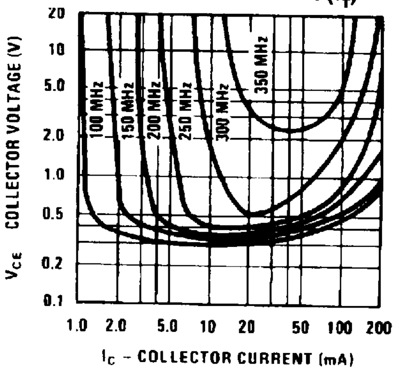


AC Typical Characteristics

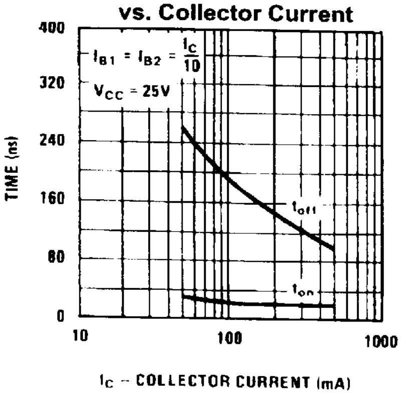
Emitter Transition and Output Capacitance vs. Reverse Bias Voltage



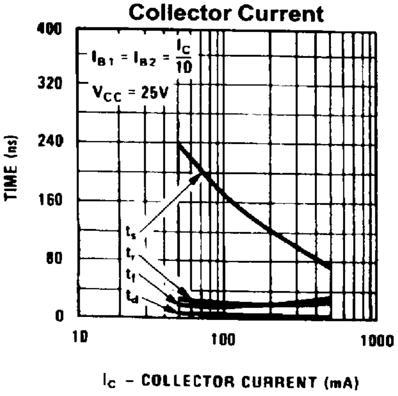
Contours of Constant Gain Bandwidth Product (f_T)



Turn On / Turn Off Times vs. Collector Current



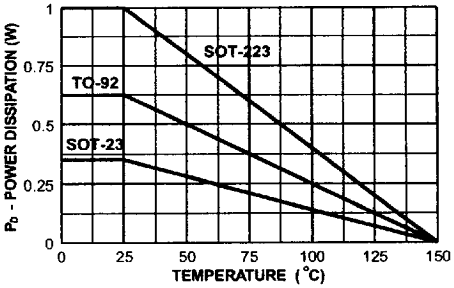
Switching Times vs. Collector Current



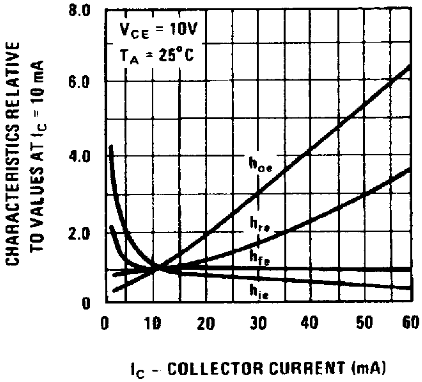
NPN General Purpose Amplifier
(continued)

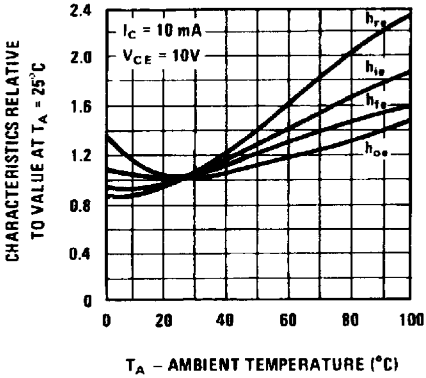
AC Typical Characteristics (continued)

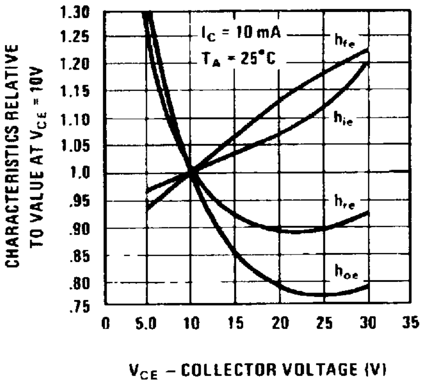
POWER DISSIPATION vs AMBIENT TEMPERATURE



Typical Common Emitter Characteristics (f = 1.0 kHz)







Test Circuits

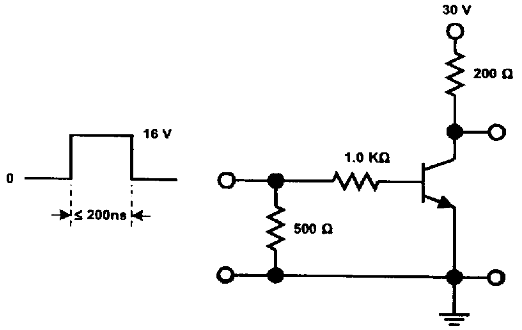


FIGURE 1: Saturated Turn-On Switching Time

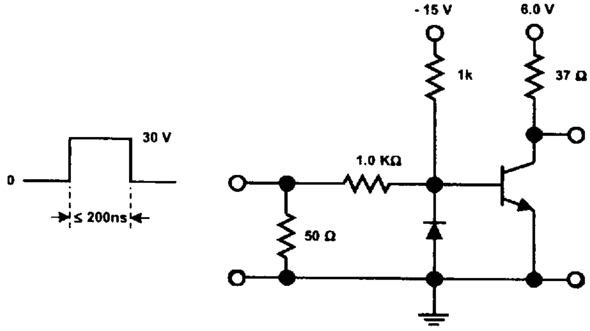


FIGURE 2: Saturated Turn-Off Switching Time