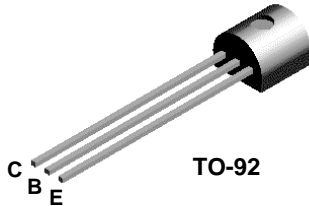
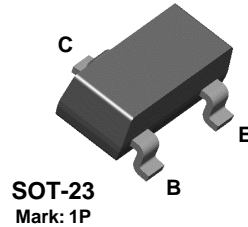


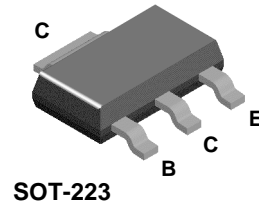
PN2222A



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°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 | 625 | 350 | 1,000 | mW |
| | Derate above 25°C | 5.0 | 2.8 | 8.0 | mW/°C |
| R _{θJC} | Thermal Resistance, Junction to Case | 83.3 | | | °C/W |
| R _{θJA} | 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 cm².

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 | $I_C = 10\ \mu\text{A}, I_E = 0$ | 75 | | V |
| $V_{(BR)EBO}$ | 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 | $V_{CB} = 60\text{ V}, I_E = 0$ $V_{CB} = 60\text{ V}, I_E = 0, T_A = 150^\circ\text{C}$ | | 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 | $I_C = 100\ \mu\text{A}, V_{CE} = 10\text{ V},$ $R_S = 1.0\text{ k}\Omega, f = 1.0\text{ kHz}$ | | 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 | $V_{CC} = 30\text{ V}, V_{BE(OFF)} = 0.5\text{ V},$ $I_C = 150\text{ mA}, I_{B1} = 15\text{ mA}$ | | 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 $\leq 2.0\%$

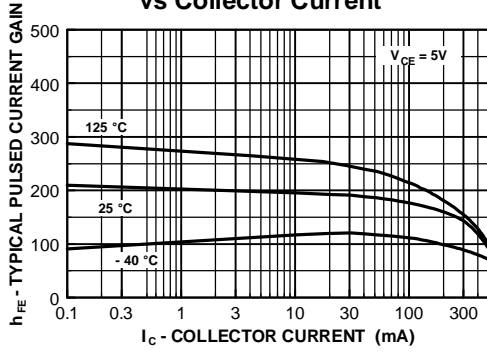
Spice Model

NPN (Is=14.34f Xti=3 Eg=1.11 Vaf=74.03 Bf=255.9 Ne=1.307 Ise=14.34f 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)

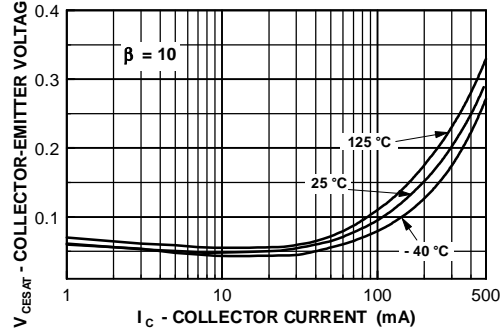
PN2222A / MMBT2222A / PZT2222A

Typical Characteristics

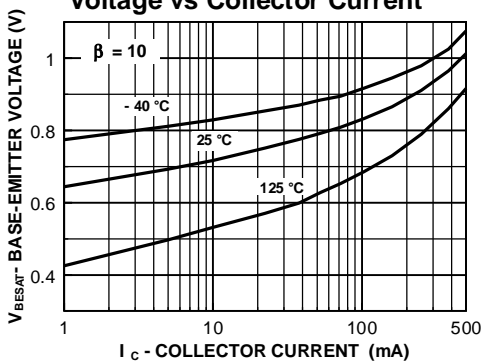
Typical Pulsed Current Gain vs Collector Current



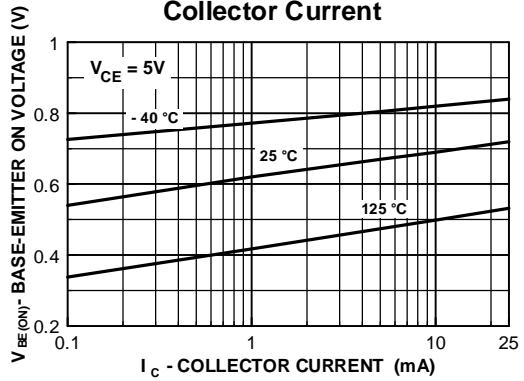
Collector-Emitter Saturation Voltage vs Collector Current



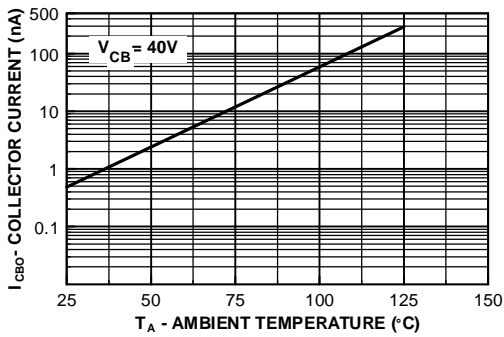
Base-Emitter Saturation Voltage vs Collector Current



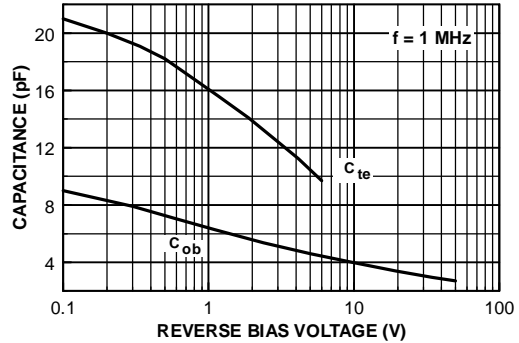
Base-Emitter ON Voltage vs Collector Current



Collector-Cutoff Current vs Ambient Temperature



Emitter Transition and Output Capacitance vs Reverse Bias Voltage



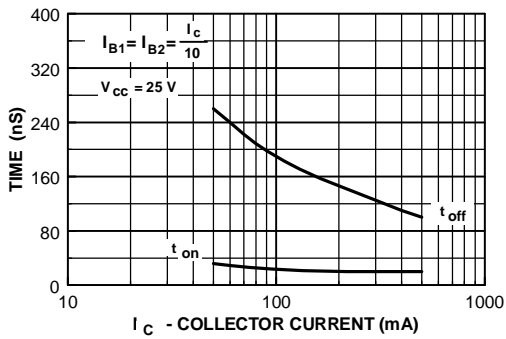
NPN General Purpose Amplifier

(continued)

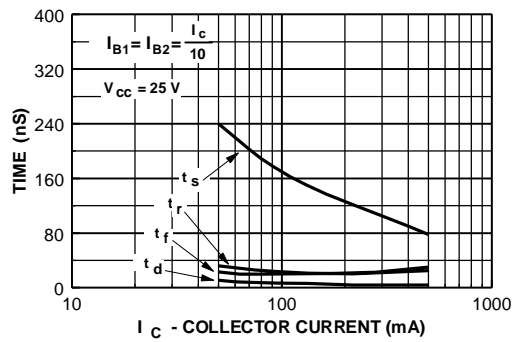
PN2222A / MMBT2222A / PZT2222A

Typical Characteristics (continued)

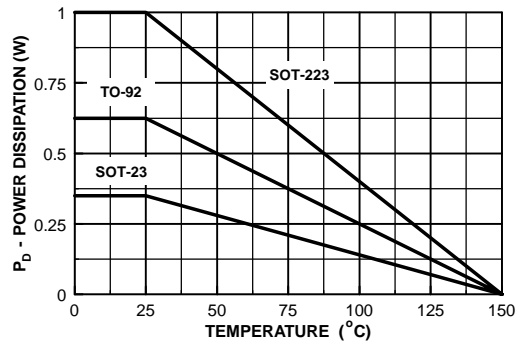
Turn On and Turn Off Times vs Collector Current



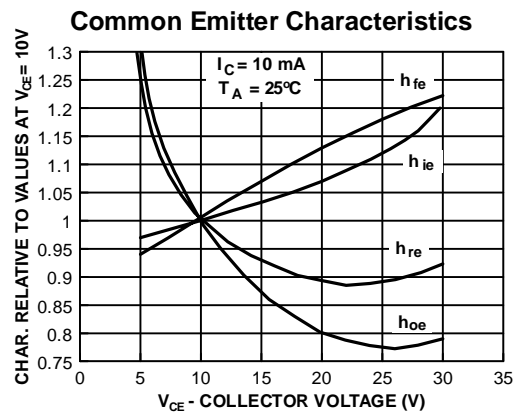
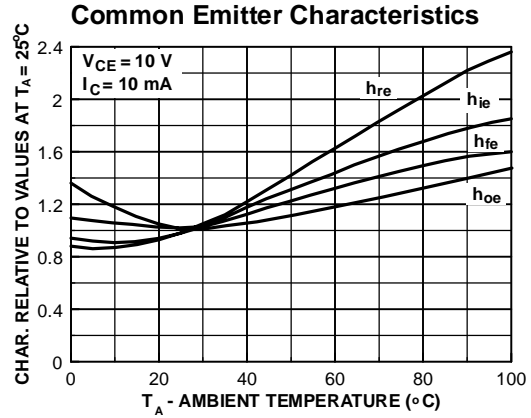
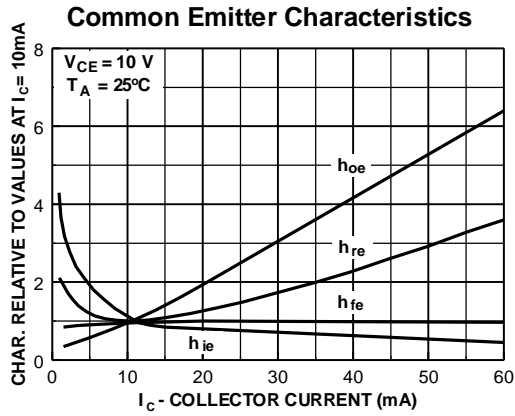
Switching Times vs Collector Current



Power Dissipation vs Ambient Temperature



Typical Common Emitter Characteristics (f = 1.0kHz)



Test Circuits

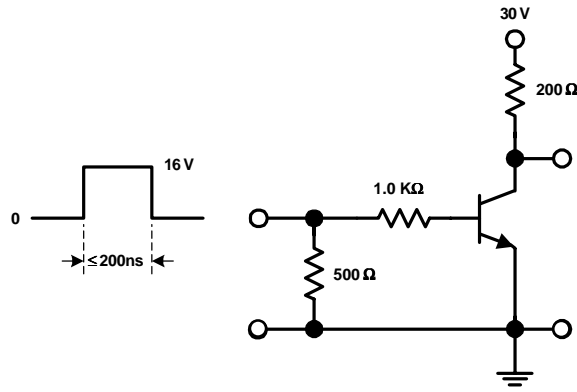


FIGURE 1: Saturated Turn-On Switching Time

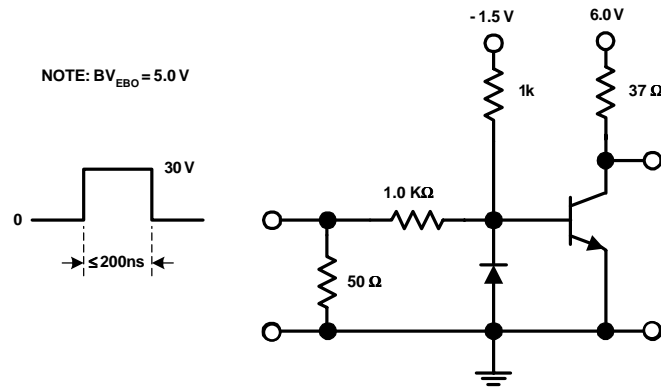


FIGURE 2: Saturated Turn-Off Switching Time

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