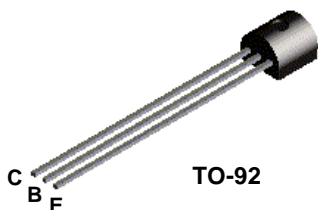
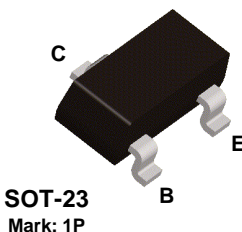


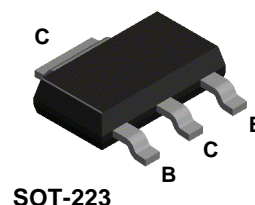
PN2222A



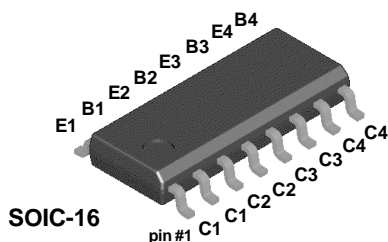
MMBT2222A



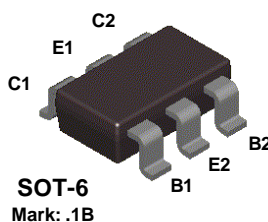
PZT2222A



MMPQ2222



NMT2222



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.

NPN General Purpose Amplifier

(continued)

Electrical Characteristics

TA = 25°C unless otherwise noted

| Symbol | Parameter | Test Conditions | Min | Max | Units |
|----------------------------|--------------------------------------|---|-----|------------|--------------------------------|
| OFF CHARACTERISTICS | | | | | |
| $V_{(BR)CEO}$ | Collector-Emitter Breakdown Voltage* | $I_C = 10 \text{ mA}, I_B = 0$ | 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 (except MMPQ2222 and NMT2222)

| | | | | | |
|--------------|--|---|-----|-----|----------|
| 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 |
| $r_b'C_C$ | 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 (except MMPQ2222 and NMT2222)

| | | | | | |
|-------|--------------|---|--|-----|----|
| 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 / MMPQ2222 / NMT2222 / PZT2222A

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 | 1,000 | mW |
| | | 5.0 | 8.0 | mW/°C |
| R _{θJC} | Thermal Resistance, Junction to Case | 83.3 | | °C/W |
| R _{θJA} | Thermal Resistance, Junction to Ambient | 200 | 125 | °C/W |

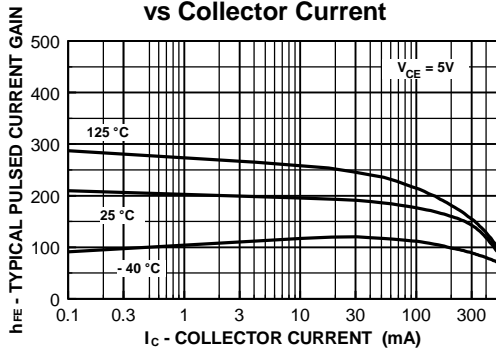
| Symbol | Characteristic | Max | | Units |
|------------------|--|-------------|----------|-------|
| | | **MMBT2222A | MMPQ2222 | |
| P _D | Total Device Dissipation Derate above 25°C | 350 | 1,000 | mW |
| | | 2.8 | 8.0 | mW/°C |
| R _{θJA} | Thermal Resistance, Junction to Ambient Effective 4 Die Each Die | 357 | | °C/W |
| | | | 125 | °C/W |
| | | | 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 cm².

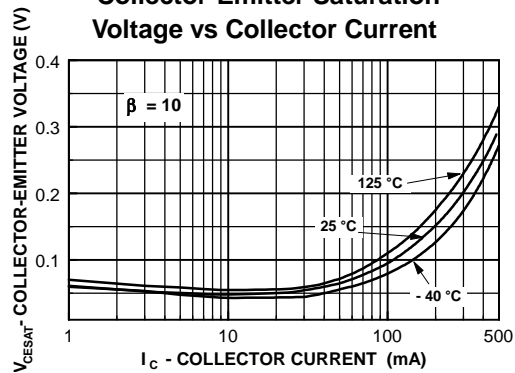
** Device mounted on FR-4 PCB 1.6" X 1.6" X 0.06."

Typical Characteristics

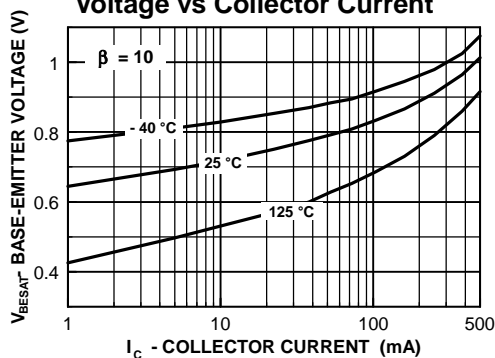
Typical Pulsed Current Gain vs Collector Current



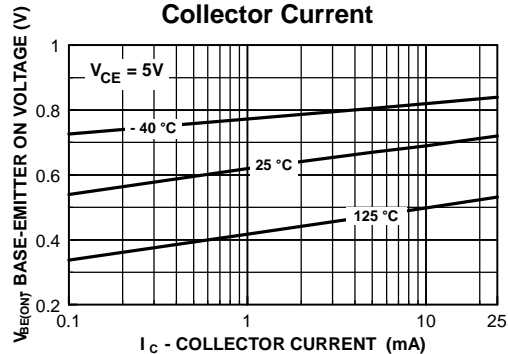
Collector-Emitter Saturation Voltage vs Collector Current



Base-Emitter Saturation Voltage vs Collector Current



Base-Emitter ON Voltage vs Collector Current



PN2222A / MMBT2222A / MMPQ2222 / NMT2222 / PZT2222A

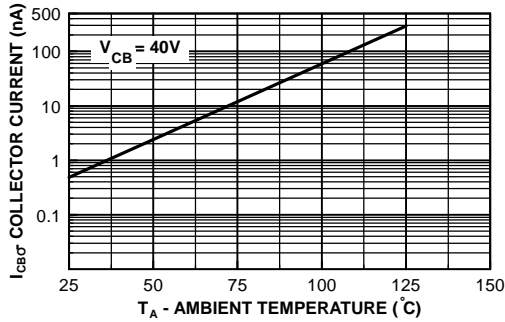
NPN General Purpose Amplifier

(continued)

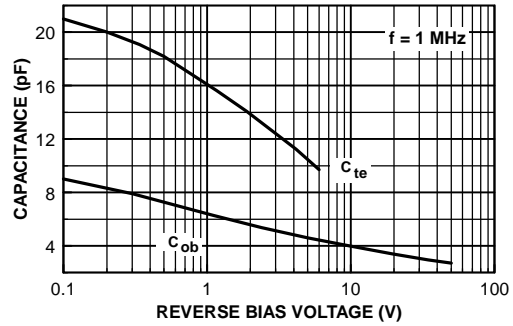
PN2222A / MMBT2222A / NMMPQ2222 / NMT2222 / PZT2222A

Typical Characteristics (continued)

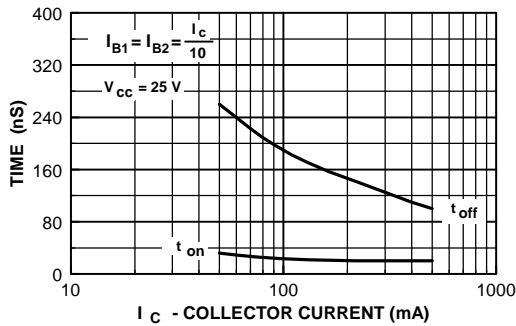
Collector-Cutoff Current vs Ambient Temperature



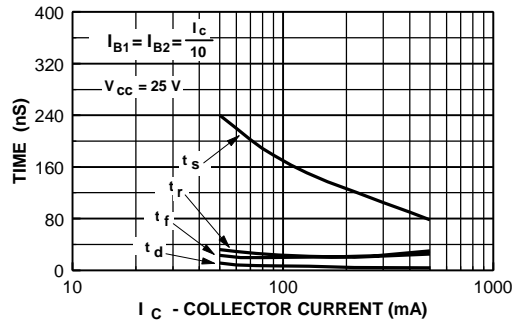
Emitter Transition and Output Capacitance vs Reverse Bias Voltage



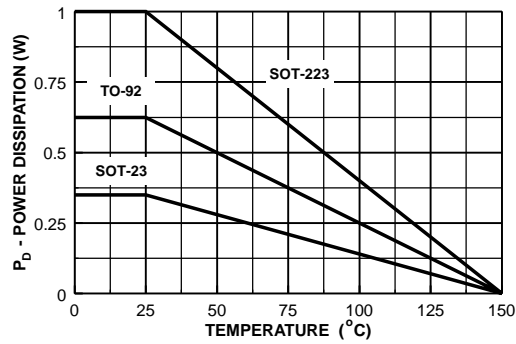
Turn On and Turn Off Times vs Collector Current



Switching Times vs Collector Current



Power Dissipation vs Ambient Temperature



Test Circuits

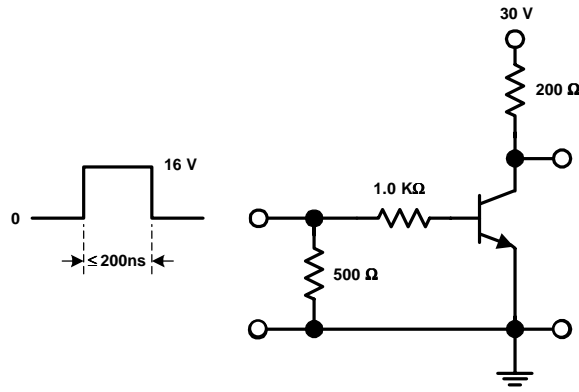


FIGURE 1: Saturated Turn-On Switching Time

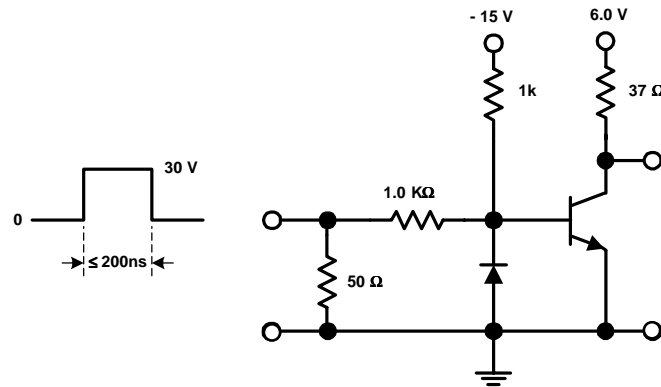


FIGURE 2: Saturated Turn-Off Switching Time

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