PN2222A / MMBT2222A / PZT2222A — NPN General Purpose Amplifier

Features

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

Absolute Maximum Ratings * $T_a = 25^\circ C$ unless otherwise noted

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{CEO}$</td>
<td>Collector-Emitter Voltage</td>
<td>40</td>
<td>V</td>
</tr>
<tr>
<td>$V_{CBO}$</td>
<td>Collector-Base Voltage</td>
<td>75</td>
<td>V</td>
</tr>
<tr>
<td>$V_{EBO}$</td>
<td>Emitter-Base Voltage</td>
<td>6.0</td>
<td>V</td>
</tr>
<tr>
<td>$I_C$</td>
<td>Collector Current</td>
<td>1.0</td>
<td>A</td>
</tr>
<tr>
<td>$T_{STG}$</td>
<td>Operating and Storage Junction Temperature Range</td>
<td>-55 ~ 150</td>
<td>°C</td>
</tr>
</tbody>
</table>

NOTES:

1) These ratings are based on a maximum junction temperature of 150 degrees C.
2) These are steady limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

Thermal Characteristics $T_a = 25^\circ C$ unless otherwise noted

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P_D$</td>
<td>Total Device Dissipation</td>
<td>PN2222A</td>
<td>625</td>
</tr>
<tr>
<td></td>
<td>Derate above 25°C</td>
<td>*MMBT2222A</td>
<td>350</td>
</tr>
<tr>
<td></td>
<td></td>
<td>**PZT2222A</td>
<td>1,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>8.0</td>
</tr>
<tr>
<td>$R_{JUC}$</td>
<td>Thermal Resistance, Junction to Case</td>
<td>83.3</td>
<td>°C/W</td>
</tr>
<tr>
<td>$R_{JUA}$</td>
<td>Thermal Resistance, Junction to Ambient</td>
<td>200</td>
<td>357</td>
</tr>
</tbody>
</table>

* Device mounted on FR-4 PCB 1.6” × 1.6” × 0.06”.
** Device mounted on FR-4 PCB 36mm × 18mm × 1.5mm; mounting pad for the collector lead min. 6cm².
# Electrical Characteristics

$T_a = 25°C$ unless otherwise noted

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Test Condition</th>
<th>Min.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$BV_{(BR)CEO}$</td>
<td>Collector-Emitter Breakdown Voltage</td>
<td>* $I_C = 10mA, I_B = 0$</td>
<td>40</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>$BV_{(BR)CBO}$</td>
<td>Collector-Base Breakdown Voltage</td>
<td>$I_C = 10μA, I_E = 0$</td>
<td>75</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>$BV_{(BR)EBO}$</td>
<td>Emitter-Base Breakdown Voltage</td>
<td>$I_E = 10μA, I_C = 0$</td>
<td>6.0</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>$I_{CEX}$</td>
<td>Collector Cutoff Current</td>
<td>$V_{CE} = 60V, V_{EB(off)} = 3.0V$</td>
<td>10</td>
<td></td>
<td>nA</td>
</tr>
<tr>
<td>$I_{CBO}$</td>
<td>Collector Cutoff Current</td>
<td>$V_{CB} = 60V, I_E = 0$</td>
<td>0.01</td>
<td>10</td>
<td>μA</td>
</tr>
<tr>
<td>$I_{EBO}$</td>
<td>Emitter Cutoff Current</td>
<td>$V_{EB} = 3.0V, I_C = 0$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$I_{BL}$</td>
<td>Base Cutoff Current</td>
<td>$V_{CE} = 60V, V_{EB(off)} = 3.0V$</td>
<td>20</td>
<td></td>
<td>nA</td>
</tr>
</tbody>
</table>

## Off Characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Test Condition</th>
<th>Min.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{CE(sat)}$</td>
<td>Collector-Emitter Saturation Voltage</td>
<td>* $I_C = 150mA, I_B = 15mA$</td>
<td>0.3</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>$V_{BE(sat)}$</td>
<td>Base-Emitter Saturation Voltage</td>
<td>* $I_C = 150mA, I_B = 15mA$</td>
<td>0.6</td>
<td></td>
<td>V</td>
</tr>
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</table>

## Small Signal Characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Test Condition</th>
<th>Min.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$f_T$</td>
<td>Current Gain Bandwidth Product</td>
<td>$I_C = 20mA, V_{CE} = 20V, f = 100MHz$</td>
<td>300</td>
<td></td>
<td>MHz</td>
</tr>
<tr>
<td>$C_{oob}$</td>
<td>Output Capacitance</td>
<td>$V_{CB} = 10V, I_C = 0, f = 1MHz$</td>
<td>8.0</td>
<td></td>
<td>pF</td>
</tr>
<tr>
<td>$C_{bbo}$</td>
<td>Input Capacitance</td>
<td>$V_{EB} = 0.5V, I_C = 0, f = 1MHz$</td>
<td>25</td>
<td></td>
<td>pF</td>
</tr>
<tr>
<td>$r_b'C_C$</td>
<td>Collector Base Time Constant</td>
<td>$I_C = 20mA, V_{CB} = 20V, f = 31.8MHz$</td>
<td>150</td>
<td></td>
<td>pS</td>
</tr>
<tr>
<td>$NF$</td>
<td>Noise Figure</td>
<td>$I_C = 100μA, V_{CE} = 10V,$</td>
<td>4.0</td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>$Re(h_{ie})$</td>
<td>Real Part of Common-Emitter High Frequency Input Impedance</td>
<td>$I_C = 20mA, V_{CE} = 20V, f = 300MHz$</td>
<td>60</td>
<td></td>
<td>Ω</td>
</tr>
</tbody>
</table>

## Switching Characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Test Condition</th>
<th>Min.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$t_d$</td>
<td>Delay Time</td>
<td>$V_{CC} = 30V, V_{EB(off)} = 0.5V,$</td>
<td>10</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>$t_r$</td>
<td>Rise Time</td>
<td>$I_C = 150mA, I_B1 = 15mA$</td>
<td>25</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>$t_s$</td>
<td>Storage Time</td>
<td>$V_{CC} = 30V, I_C = 150mA,$</td>
<td>225</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>$t_f$</td>
<td>Fall Time</td>
<td>$I_B1 = I_B2 = 15mA$</td>
<td>60</td>
<td></td>
<td>ns</td>
</tr>
</tbody>
</table>

* Pulse Test: Pulse Width $\leq 300μs$, Duty Cycle $\leq 2.0%$
Typical Performance Characteristics

**Typical Pulsed Current Gain vs Collector Current**

![Typical Pulsed Current Gain vs Collector Current](image1)

**Collector-Emitter Saturation Voltage vs Collector Current**

![Collector-Emitter Saturation Voltage vs Collector Current](image2)

**Base-Emitter Saturation Voltage vs Collector Current**

![Base-Emitter Saturation Voltage vs Collector Current](image3)

**Base-Emitter ON Voltage vs Collector Current**

![Base-Emitter ON Voltage vs Collector Current](image4)

**Collector-Cutoff Current vs Ambient Temperature**

![Collector-Cutoff Current vs Ambient Temperature](image5)

**Emitter Transition and Output Capacitance vs Reverse Bias Voltage**

![Emitter Transition and Output Capacitance vs Reverse Bias Voltage](image6)
Typical Performance Characteristics

Figure 7. Turn On and Turn Off Times vs Collector Current

Figure 8. Switching Times vs Collector Current

Figure 9. Power Dissipation vs Ambient Temperature

Figure 10. Common Emitter Characteristics

Figure 11. Common Emitter Characteristics

Figure 12. Common Emitter Characteristics
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