2N4403 / MMBT4403
PNP General-Purpose Amplifier

Description
This device is designed for use as a general-purpose amplifier and switch for collector currents to 500 mA.

Ordering Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Marking</th>
<th>Package</th>
<th>Packing Method</th>
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<tr>
<td>2N4403BU</td>
<td>2N4403</td>
<td>TO-92 3L</td>
<td>Bulk</td>
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<td>2N4403TF</td>
<td>2N4403</td>
<td>TO-92 3L</td>
<td>Tape and Reel</td>
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<tr>
<td>2N4403TFR</td>
<td>2N4403</td>
<td>TO-92 3L</td>
<td>Tape and Reel</td>
</tr>
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<td>2N4403TA</td>
<td>2N4403</td>
<td>TO-92 3L</td>
<td>Ammo</td>
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<tr>
<td>2N4403TAR</td>
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<td>TO-92 3L</td>
<td>Ammo</td>
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<tr>
<td>MMBT4403</td>
<td>2T</td>
<td>SOT-23 3L</td>
<td>Tape and Reel</td>
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Absolute Maximum Ratings\(^{(1),(2)}\)

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only. Values are at \( T_A = 25^\circ C \) unless otherwise noted.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Value</th>
<th>Unit</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>-40</td>
<td>V</td>
</tr>
<tr>
<td>( V_{EBO} )</td>
<td>Emitter-Base Voltage</td>
<td>-5.0</td>
<td>V</td>
</tr>
<tr>
<td>( I_C )</td>
<td>Collector Current - Continuous</td>
<td>-600</td>
<td>mA</td>
</tr>
<tr>
<td>( T_{J, TSTG} )</td>
<td>Operating and Storage Junction Temperature Range</td>
<td>-55 to +150</td>
<td>°C</td>
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</tbody>
</table>

Notes:
1. These ratings are based on a maximum junction temperature of 150°C.
2. These are steady-state limits. Fairchild Semiconductor should be consulted on applications involving pulsed or low-duty cycle operations.

Thermal Characteristics

Values are at \( T_A = 25^\circ C \) unless otherwise noted.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>( P_D )</td>
<td>Total Device Dissipation</td>
<td>( 2N4403^{(3)} )</td>
<td>625</td>
</tr>
<tr>
<td></td>
<td>Derate Above 25°C</td>
<td>( 2N4403^{(3)} )</td>
<td>5.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( MMBT4403^{(4)} )</td>
<td>2.8</td>
</tr>
<tr>
<td>( R_{\theta JC} )</td>
<td>Thermal Resistance, Junction to Case</td>
<td>83.3</td>
<td>°C/W</td>
</tr>
<tr>
<td>( R_{\theta JA} )</td>
<td>Thermal Resistance, Junction to Ambient</td>
<td>200</td>
<td>°C/W</td>
</tr>
</tbody>
</table>

Notes:
3. PCB size: FR-4, 76 mm x 114 mm x 1.57 mm (3.0 inch x 4.5 inch x 0.062 inch) with minimum land pattern size.
4. Device mounted on FR-4 PCB 1.6 inch x 1.6 inch x 0.06 inch.
## Electrical Characteristics

Values are at $T_A = 25^\circ\text{C}$ unless otherwise noted.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{(BR)CEO}$</td>
<td>Collector-Emitter Breakdown Voltage(5)</td>
<td>$I_C = -1.0, \text{mA}, I_B = 0$</td>
<td>-40</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>$V_{(BR)CBO}$</td>
<td>Collector-Base Breakdown Voltage</td>
<td>$I_C = -0.1, \text{mA}, I_E = 0$</td>
<td>-40</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>$V_{(BR)EBO}$</td>
<td>Emitter-Base Breakdown Voltage</td>
<td>$I_E = -0.1, \text{mA}, I_C = 0$</td>
<td>-5.0</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>$I_{BL}$</td>
<td>Base Cut-Off Current</td>
<td>$V_{CE} = -35, \text{V}, V_{EB} = -0.4, \text{V}$</td>
<td>-0.1</td>
<td>$\mu\text{A}$</td>
<td></td>
</tr>
<tr>
<td>$I_{CEX}$</td>
<td>Collector Cut-Off Current</td>
<td>$V_{CE} = -35, \text{V}, V_{EB} = -0.4, \text{V}$</td>
<td>-0.1</td>
<td>$\mu\text{A}$</td>
<td></td>
</tr>
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</table>

### Small Signal Characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
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<th>Conditions</th>
<th>Min.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$f_T$</td>
<td>Current Gain - Bandwidth Product</td>
<td>$I_C = -20, \text{mA}, V_{CE} = -10, \text{V}$, $f = 100, \text{MHz}$</td>
<td>200</td>
<td>MHz</td>
<td></td>
</tr>
<tr>
<td>$C_{cb}$</td>
<td>Collector-Base Capacitance</td>
<td>$V_{CB} = -10, \text{V}, I_E = 0$, $f = 140, \text{kHz}$</td>
<td>8.5</td>
<td>pF</td>
<td></td>
</tr>
<tr>
<td>$C_{eb}$</td>
<td>Emitter-Base Capacitance</td>
<td>$V_{BE} = -0.5, \text{V}, I_C = 0$, $f = 140, \text{kHz}$</td>
<td>30</td>
<td>pF</td>
<td></td>
</tr>
<tr>
<td>$h_{ie}$</td>
<td>Input Impedance</td>
<td>$I_C = -1.0, \text{mA}, V_{CE} = -10, \text{V}$, $f = 1.0, \text{kHz}$</td>
<td>1.5</td>
<td>15.0</td>
<td>k$\Omega$</td>
</tr>
<tr>
<td>$h_{re}$</td>
<td>Voltage Feedback Ratio</td>
<td>$I_C = -1.0, \text{mA}, V_{CE} = -10, \text{V}$, $f = 1.0, \text{kHz}$</td>
<td>0.1</td>
<td>8.0</td>
<td>$\times 10^{-4}$</td>
</tr>
<tr>
<td>$h_{fe}$</td>
<td>Small-Signal Current Gain</td>
<td>$I_C = -1.0, \text{mA}, V_{CE} = -10, \text{V}$, $f = 1.0, \text{kHz}$</td>
<td>60</td>
<td>500</td>
<td></td>
</tr>
<tr>
<td>$h_{oe}$</td>
<td>Output Admittance</td>
<td>$I_C = -1.0, \text{mA}, V_{CE} = -10, \text{V}$, $f = 1.0, \text{kHz}$</td>
<td>1</td>
<td>100</td>
<td>$\mu\text{mhos}$</td>
</tr>
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</table>

### Switching Characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
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<th>Conditions</th>
<th>Min.</th>
<th>Max.</th>
<th>Unit</th>
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<tbody>
<tr>
<td>$t_d$</td>
<td>Delay Time</td>
<td>$V_{CC} = -30, \text{V}, I_C = -150, \text{mA}$, $I_{B1} = -15, \text{mA}$</td>
<td>15</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>$t_r$</td>
<td>Rise Time</td>
<td></td>
<td>20</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>$t_s$</td>
<td>Storage Time</td>
<td>$V_{CC} = -30, \text{V}, I_C = -150, \text{mA}$, $I_{B1} = I_{B2} = -15, \text{mA}$</td>
<td>225</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>$t_f$</td>
<td>Fall Time</td>
<td></td>
<td>30</td>
<td>ns</td>
<td></td>
</tr>
</tbody>
</table>

**Note:**

5. Pulse test: pulse width $\leq 300\, \mu\text{s}$, duty cycle $\leq 2.0\%$. 

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Typical Performance Characteristics

Figure 3. Typical Pulsed Current Gain vs. Collector Current

Figure 4. Collector-Emitter Saturation Voltage vs. Collector Current

Figure 5. Base-Emitter Saturation Voltage vs. Collector Current

Figure 6. Base-Emitter On Voltage vs. Collector Current

Figure 7. Collector Cut-Off Current vs. Ambient Temperature

Figure 8. Input and Output Capacitance vs. Reverse Bias Voltage
Typical Performance Characteristics (Continued)

Figure 9. Switching Times vs. Collector Current

Figure 10. Turn-On and Turn-Off Times vs. Collector Current

Figure 11. Rise Time vs. Collector and Turn-On Base Currents

Figure 12. Power Dissipation vs. Ambient Temperature

Figure 13. Common Emitter Characteristics

Figure 14. Common Emitter Characteristics
Typical Performance Characteristics (Continued)

Figure 15. Common Emitter Characteristics
Physical Dimensions

Figure 16. 3-Lead, TO-92, Molded 0.200 in Line Spacing LD Form (J61Z Option) (Active)

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For current tape and reel specifications, visit Fairchild Semiconductor’s online packaging area:
http://www.fairchildsemi.com/packing_dwg/PKG-ZA03F_BK.pdf
Figure 17. 3-LEAD, JEDEC TO-92 COMPLIANT STRAGHIT LEAD CONFIGURATION (OLD TO92AM3)

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Physical Dimensions (Continued)

SOT-23 3L

Figure 18. 3-LEAD, SOT23, JEDEC TO-236, LOW PROFILE (ACTIVE)

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NOTES: UNLESS OTHERWISE SPECIFIED
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B) ALL DIMENSIONS ARE IN MILLIMETERS.
C) DIMENSIONS ARE INCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR EXTRUSIONS.
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<th>Datasheet Identification</th>
<th>Product Status</th>
<th>Definition</th>
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<td>Advance Information</td>
<td>Formative / In Design</td>
<td>Datasheet contains the design specifications for product development. Specifications may change in any manner without notice.</td>
</tr>
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