2N3906 / MMBT3906 / PZT3906
PNP General-Purpose Amplifier

Description
This device is designed for general-purpose amplifier and switching applications at collector currents of 10 mA to 100 mA.

Ordering Information

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<th>Packing Method</th>
<th>Pack Quantity</th>
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<td>2N3906</td>
<td>TO-92 3L</td>
<td>Bulk</td>
<td>10000</td>
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<td>2N3906TA</td>
<td>2N3906</td>
<td>TO-92 3L</td>
<td>Ammo</td>
<td>2000</td>
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<tr>
<td>2N3906TAR</td>
<td>2N3906</td>
<td>TO-92 3L</td>
<td>Ammo</td>
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<td>2N3906TF</td>
<td>2N3906</td>
<td>TO-92 3L</td>
<td>Tape and Reel</td>
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<td>2N3906TFR</td>
<td>2N3906</td>
<td>TO-92 3L</td>
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<td>MMBT3906</td>
<td>2A</td>
<td>SOT-23 3L</td>
<td>Tape and Reel</td>
<td>3000</td>
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<td>PZT3906</td>
<td>3906</td>
<td>SOT-223 4L</td>
<td>Tape and Reel</td>
<td>2500</td>
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Absolute Maximum Ratings\(^{(1)}\)

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>-200</td>
<td>mA</td>
</tr>
<tr>
<td>(T_J, T_{STG})</td>
<td>Operating and Storage Junction Temperature Range</td>
<td>-55 to +150</td>
<td>°C</td>
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</table>

Note:
1. These ratings are based on a maximum junction temperature of 150°C.
   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>
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<th>Symbol</th>
<th>Parameter</th>
<th>Maximum</th>
<th>Unit</th>
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<tr>
<td>(P_D)</td>
<td>Total Device Dissipation</td>
<td>625</td>
<td>350</td>
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<td></td>
<td>Derate Above 25°C</td>
<td>5.0</td>
<td>2.8</td>
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<tr>
<td>(R_{JUC})</td>
<td>Thermal Resistance, Junction to Case</td>
<td>83.3</td>
<td></td>
</tr>
<tr>
<td>(R_{JUA})</td>
<td>Thermal Resistance, Junction to Ambient</td>
<td>200</td>
<td>357</td>
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Notes:
2. Device is mounted on FR-4 PCB 1.6 inch X 1.6 inch X 0.06 inch.
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.
### Electrical Characteristics

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

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<thead>
<tr>
<th>Symbol</th>
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<th>Min.</th>
<th>Max.</th>
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<td>OFF CHARACTERISTICS</td>
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<td></td>
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<tr>
<td>$V_{(BR)CEO}$</td>
<td>Collector-Emitter Breakdown Voltage</td>
<td>$I_C = -1.0 \text{ mA, } I_B = 0$</td>
<td>-40</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>$V_{(BR)CBO}$</td>
<td>Collector-Base Breakdown Voltage</td>
<td>$I_C = -10 \mu\text{A, } I_E = 0$</td>
<td>-40</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>$V_{(BR)EBO}$</td>
<td>Emitter-Base Breakdown Voltage</td>
<td>$I_E = -10 \mu\text{A, } I_C = 0$</td>
<td>-5.0</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>$I_{BL}$</td>
<td>Base Cut-Off Current</td>
<td>$V_{CE} = -30 \text{ V, } V_{BE} = 3.0 \text{ V}$</td>
<td>-50</td>
<td></td>
<td>nA</td>
</tr>
<tr>
<td>$I_{CEX}$</td>
<td>Collector Cut-Off Current</td>
<td>$V_{CE} = -30 \text{ V, } V_{BE} = 3.0 \text{ V}$</td>
<td>-50</td>
<td></td>
<td>nA</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Symbol</th>
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<th>Min.</th>
<th>Max.</th>
<th>Unit</th>
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<tr>
<td></td>
<td>ON CHARACTERISTICS</td>
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<tr>
<td>$h_{FE}$</td>
<td>DC Current Gain$^{(4)}$</td>
<td>$I_C = -0.1 \text{ mA, } V_{CE} = -1.0 \text{ V}$</td>
<td>60</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$I_C = -1.0 \text{ mA, } V_{CE} = -1.0 \text{ V}$</td>
<td>80</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$I_C = -10 \text{ mA, } V_{CE} = -1.0 \text{ V}$</td>
<td>100</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>$I_C = -50 \text{ mA, } V_{CE} = -1.0 \text{ V}$</td>
<td>60</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$I_C = -100 \text{ mA, } V_{CE} = -1.0 \text{ V}$</td>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$V_{CE(sat)}$</td>
<td>Collector-Emitter Saturation Voltage</td>
<td>$I_C = -10 \text{ mA, } I_B = -1.0 \text{ mA}$</td>
<td></td>
<td>-0.25</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$I_C = -50 \text{ mA, } I_B = -5.0 \text{ mA}$</td>
<td></td>
<td>-0.40</td>
<td>V</td>
</tr>
<tr>
<td>$V_{BE(sat)}$</td>
<td>Base-Emitter Saturation Voltage</td>
<td>$I_C = -10 \text{ mA, } I_B = -1.0 \text{ mA}$</td>
<td></td>
<td>-0.65</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$I_C = -50 \text{ mA, } I_B = -5.0 \text{ mA}$</td>
<td></td>
<td>-0.95</td>
<td>V</td>
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<table>
<thead>
<tr>
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<th>Unit</th>
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<td>SMALL SIGNAL CHARACTERISTICS</td>
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<tr>
<td>$f_T$</td>
<td>Current Gain - Bandwidth Product</td>
<td>$I_C = -10 \text{ mA, } V_{CE} = -20 \text{ V, } f = 100 \text{ MHz}$</td>
<td>250</td>
<td></td>
<td>MHz</td>
</tr>
<tr>
<td>$C_{obo}$</td>
<td>Output Capacitance</td>
<td>$V_{CB} = -5.0 \text{ V, } I_E = 0, f = 100 \text{ kHz}$</td>
<td>4.5</td>
<td></td>
<td>pF</td>
</tr>
<tr>
<td>$C_{ibo}$</td>
<td>Input Capacitance</td>
<td>$V_{EB} = -0.5 \text{ V, } I_C = 0, f = 100 \text{ kHz}$</td>
<td>10.0</td>
<td></td>
<td>pF</td>
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<tr>
<td>$NF$</td>
<td>Noise Figure</td>
<td>$I_C = -100 \mu\text{A, } V_{CE} = -5.0 \text{ V, } R_S = 1.0 \text{ k\Omega, } f = 10 \text{ Hz to } 15.7 \text{ kHz}$</td>
<td>4.0</td>
<td></td>
<td>dB</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
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<th>Max.</th>
<th>Unit</th>
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<td>SWITCHING CHARACTERISTICS</td>
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<tr>
<td>$t_d$</td>
<td>Delay Time</td>
<td>$V_{CC} = -3.0 \text{ V, } V_{BE} = -0.5 \text{ V}$</td>
<td>35</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>$t_r$</td>
<td>Rise Time</td>
<td>$I_C = -10 \text{ mA, } I_{B1} = -1.0 \text{ mA}$</td>
<td>35</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>$t_s$</td>
<td>Storage Time</td>
<td>$V_{CC} = -3.0 \text{ V, } I_C = -10 \text{ mA, } I_{B1} = I_{B2} = -1.0 \text{ mA}$</td>
<td>225</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>$t_f$</td>
<td>Fall Time</td>
<td></td>
<td></td>
<td>75</td>
<td>ns</td>
</tr>
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</table>

**Note:**

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

Figure 1. Typical Pulsed Current Gain vs. Collector Current

Figure 2. Collector-Emitter Saturation Voltage vs. Collector Current

Figure 3. Base-Emitter Saturation Voltage vs. Collector Current

Figure 4. Base-Emitter On Voltage vs. Collector Current

Figure 5. Collector Cut-Off Current vs. Ambient Temperature

Figure 6. Common-Base Open Circuit Input and Output Capacitance vs. Reverse Bias Voltage
Typical Performance Characteristics (Continued)

Figure 7. Noise Figure vs. Frequency

Figure 8. Noise Figure vs. Source Resistance

Figure 9. Switching Times vs. Collector Current

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

Figure 11. Power Dissipation vs. Ambient Temperature
Typical Performance Characteristics (Continued)

**Figure 12. Voltage Feedback Ratio**

![Voltage Feedback Ratio Graph](image1)

**Figure 13. Input Impedance**

![Input Impedance Graph](image2)

**Figure 14. Output Admittance**

![Output Admittance Graph](image3)

**Figure 15. Current Gain**

![Current Gain Graph](image4)
Physical Dimensions

TO-92 (Bulk)

Figure 16. 3-LEAD, TO92, JEDEC TO-92 COMPLIANT STRAIGHT LEAD CONFIGURATION (OLD TO92AM3)

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Physical Dimensions (Continued)

TO-92 (Ammo, Tape and Reel)

Figure 17. 3-LEAD, TO92, MOLDED 0.200 IN LINE SPACING LEAD FORM (J61Z OPTION)

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

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Figure 19. MOLDED PACKAGE, SOT-223, 4-LEAD

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Definition of Terms

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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>
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<tr>
<td>Preliminary</td>
<td>First Production</td>
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<td>No Identification Needed</td>
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