NPN General Purpose Amplifier

This device is designed as a general purpose amplifier and switch. The useful dynamic range extends to 100 mA as a switch and to 100 MHz as an amplifier.

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>$V_{CEO}$</td>
<td>Collector-Base Voltage</td>
<td>60</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 - 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>
</tr>
</tbody>
</table>

*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  $T_A = 25^\circ C$ unless otherwise noted

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Characteristic</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P_D$</td>
<td>Total Device Dissipation</td>
<td>625</td>
<td>350 mW</td>
</tr>
<tr>
<td></td>
<td>Derate above 25°C</td>
<td>5.0</td>
<td>2.8 mW/°C</td>
</tr>
<tr>
<td>$R_{thJC}$</td>
<td>Thermal Resistance, Junction to Case</td>
<td>83.3</td>
<td>8.0 °C/W</td>
</tr>
<tr>
<td>$R_{thJA}$</td>
<td>Thermal Resistance, Junction to Ambient</td>
<td>200</td>
<td>357 °C/W</td>
</tr>
</tbody>
</table>

* 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.
### Electrical Characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Test Conditions</th>
<th>Min</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{BRCEO}$</td>
<td>Collector-Emitter Breakdown Voltage</td>
<td>$I_C = 1.0 \ mA$, $I_B = 0$</td>
<td>40</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>$V_{BR(CEO)}$</td>
<td>Collector-Base Breakdown Voltage</td>
<td>$I_C = 10 \ \mu A$, $I_B = 0$</td>
<td>60</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>$V_{BR(CEO)}$</td>
<td>Emitter-Base Breakdown Voltage</td>
<td>$I_E = 10 \ \mu A$, $I_C = 0$</td>
<td>6.0</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>$I_{BL}$</td>
<td>Base Cutoff Current</td>
<td>$V_{CE} = 30 \ V$, $V_{EB} = 3V$</td>
<td>50</td>
<td></td>
<td>nA</td>
</tr>
<tr>
<td>$I_{CEX}$</td>
<td>Collector Cutoff Current</td>
<td>$V_{CE} = 30 \ V$, $V_{EB} = 3V$</td>
<td>50</td>
<td></td>
<td>nA</td>
</tr>
</tbody>
</table>

### ON CHARACTERISTICS*

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Test Conditions</th>
<th>Min</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$h_{FE}$</td>
<td>DC Current Gain</td>
<td>$I_C = 0.1 \ mA$, $V_{CE} = 1.0 \ V$</td>
<td>40</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$I_C = 1.0 \ mA$, $V_{CE} = 1.0 \ V$</td>
<td>70</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$I_C = 10 \ mA$, $V_{CE} = 1.0 \ V$</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$I_C = 100 \ mA$, $V_{CE} = 1.0 \ V$</td>
<td>60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$V_{CE(sat)}$</td>
<td>Collector-Emitter Saturation Voltage</td>
<td>$I_C = 10 \ mA$, $I_B = 1.0 \ mA$</td>
<td>0.2</td>
<td>0.3</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$I_C = 50 \ mA$, $I_B = 5.0 \ mA$</td>
<td>0.65</td>
<td>0.85</td>
<td>V</td>
</tr>
<tr>
<td>$V_{BE(sat)}$</td>
<td>Base-Emitter Saturation Voltage</td>
<td>$I_C = 10 \ mA$, $I_B = 1.0 \ mA$</td>
<td>0.65</td>
<td>0.85</td>
<td>V</td>
</tr>
</tbody>
</table>

### SMALL SIGNAL CHARACTERISTICS

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Test Conditions</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>$I_C = 10 \ mA$, $V_{CE} = 20 \ V$, $f = 100 \ MHz$</td>
<td>300</td>
<td></td>
<td>MHz</td>
</tr>
<tr>
<td>$C_{obo}$</td>
<td>Output Capacitance</td>
<td>$V_{CE} = 5.0 \ V$, $I_E = 0$, $f = 1.0 \ MHz$</td>
<td>4.0</td>
<td></td>
<td>pF</td>
</tr>
<tr>
<td>$C_{ibbo}$</td>
<td>Input Capacitance</td>
<td>$V_{EB} = 0.5 \ V$, $I_C = 0$, $f = 1.0 \ MHz$</td>
<td>8.0</td>
<td></td>
<td>pF</td>
</tr>
<tr>
<td>NF</td>
<td>Noise Figure</td>
<td>$I_C = 100 \ \mu A$, $V_{CE} = 5.0 \ V$, $R_S = 1.0k\Omega, f=10 \ Hz \ to \ 15.7kHz$</td>
<td>5.0</td>
<td></td>
<td>dB</td>
</tr>
</tbody>
</table>

### SWITCHING CHARACTERISTICS

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Test Conditions</th>
<th>Min</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$t_d$</td>
<td>Delay Time</td>
<td>$V_{CC} = 3.0 \ V$, $V_{BE} = 0.5 \ V$, $I_C = 10 mA$, $I_{B1} = 1.0 \ mA$</td>
<td>35</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>$t_r$</td>
<td>Rise Time</td>
<td>$I_C = 10 \ mA$, $I_{B1} = 1.0 \ mA$</td>
<td>35</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>$t_s$</td>
<td>Storage Time</td>
<td>$V_{CC} = 3.0 \ V$, $I_C = 10mA$</td>
<td>200</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>$t_f$</td>
<td>Fall Time</td>
<td>$I_{B1} = I_{B2} = 1.0 \ mA$</td>
<td>50</td>
<td></td>
<td>ns</td>
</tr>
</tbody>
</table>

*Pulse Test: Pulse Width $\leq 300 \ \mu s$, Duty Cycle $\leq 2.0%$

### Spice Model

NPN ($I_s=6.734f$ $Xti=3$  $Eg=1.11$  $Val=74.03$  $Bf=416.4$  $Ne=1.259$  $Is=6.734$  $Ikb=66.78m$  $Xtb=1.5$  $Br=7.371$  $Nc=2$  $Is=0$  $Ikr=0$  $Rc=1$  $Cjc=3.638p$  $Mjc=3085$  $Vjc=.75$  $Fc=.5$  $Cje=4.493p$  $Mje=.2593$  $Vje=.75$  $Tr=239.5n$  $Tf=301.2p$  $ltf=.4$  $Vtf=4$  $Xtf=2$  $Rb=10$)
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

Capacitance vs Reverse Bias Voltage
Typical Characteristics (continued)

- **Noise Figure vs Frequency**
  - Typical Characteristics
- **Noise Figure vs Source Resistance**
- **Current Gain and Phase Angle vs Frequency**
- **Power Dissipation vs Ambient Temperature**
- **Turn-On Time vs Collector Current**
- **Rise Time vs Collector Current**

---

**Power Dissipation vs Ambient Temperature**

- **Temperature (°C)**
- **Power Dissipation (W)**

**Noise Figure vs Frequency**

- **Frequency (kHz)**
- **Noise Figure (dB)**

**Current Gain and Phase Angle vs Frequency**

- **Frequency (MHz)**
- **Current Gain (dB)**

**Turn-On Time vs Collector Current**

- **Collector Current (mA)**
- **Time (ns)**

**Rise Time vs Collector Current**

- **Collector Current (mA)**
- **Rise Time (ns)**

---

**Noise Figure vs Source Resistance**

- **Source Resistance (kΩ)**
- **Noise Figure (dB)**

---

**Noise Figure vs Frequency**

- **Frequency (kHz)**
- **Noise Figure (dB)**

---

**Power Dissipation vs Ambient Temperature**

- **Temperature (°C)**
- **Power Dissipation (W)**

---

**Current Gain and Phase Angle vs Frequency**

- **Frequency (MHz)**
- **Current Gain (dB)**

---

**Turn-On Time vs Collector Current**

- **Collector Current (mA)**
- **Time (ns)**

---

**Rise Time vs Collector Current**

- **Collector Current (mA)**
- **Rise Time (ns)**

---

**Noise Figure vs Frequency**

- **Frequency (kHz)**
- **Noise Figure (dB)**

---

**Power Dissipation vs Ambient Temperature**

- **Temperature (°C)**
- **Power Dissipation (W)**

---

**Current Gain and Phase Angle vs Frequency**

- **Frequency (MHz)**
- **Current Gain (dB)**

---

**Turn-On Time vs Collector Current**

- **Collector Current (mA)**
- **Time (ns)**

---

**Rise Time vs Collector Current**

- **Collector Current (mA)**
- **Rise Time (ns)**
Typical Characteristics (continued)

Storage Time vs Collector Current

Fall Time vs Collector Current

Current Gain

Output Admittance

Input Impedance

Voltage Feedback Ratio
Test Circuits

FIGURE 1: Delay and Rise Time Equivalent Test Circuit

FIGURE 2: Storage and Fall Time Equivalent Test Circuit

NPN General Purpose Amplifier
(continued)
TRADEMARKS

The following are registered and unregistered trademarks Fairchild Semiconductor owns or is authorized to use and is not intended to be an exhaustive list of all such trademarks.

- ACEx™
- Bottomless™
- CoolFET™
- CROSSVOLT™
- DOME™
- E²CMOS™
- EnSigna™
- FACT™
- FACT Quiet Series™
- FAST®
- GlobalOptoisolator™
- GTO™
- HiSeC™
- ISPLANAR™
- MICROWIRE™
- OPTOLOGIC™
- OPTOPLANAR™
- PACMAN™
- POP™
- PowerTrench®
- QFET™
- QS™
- QT Optoelectronics™
- Quiet Series™
- SMART START™
- SuperSOT™-3
- SuperSOT™-6
- SuperSOT™-8
- SyncFET™
- TinyLogic™
- UHC™
- VCX™

DISCLAIMER

FAIRCHILD SEMICONDUCTOR RESERVES THE RIGHT TO MAKE CHANGES WITHOUT FURTHER NOTICE TO ANY PRODUCTS HEREIN TO IMPROVE RELIABILITY, FUNCTION OR DESIGN. FAIRCHILD DOES NOT ASSUME ANY LIABILITY ARISING OUT OF THE APPLICATION OR USE OF ANY PRODUCT OR CIRCUIT DESCRIBED HEREIN; NEITHER DOES IT CONVEY ANY LICENSE UNDER ITS PATENT RIGHTS, NOR THE RIGHTS OF OTHERS.

LIFE SUPPORT POLICY

FAIRCHILD’S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF FAIRCHILD SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, or (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in significant injury to the user.

2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

PRODUCT STATUS DEFINITIONS

Definition of Terms

<table>
<thead>
<tr>
<th>Datasheet Identification</th>
<th>Product Status</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advance Information</td>
<td>Formative or In Design</td>
<td>This datasheet contains the design specifications for product development. Specifications may change in any manner without notice.</td>
</tr>
<tr>
<td>Preliminary</td>
<td>First Production</td>
<td>This datasheet contains preliminary data, and supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice in order to improve design.</td>
</tr>
<tr>
<td>No Identification Needed</td>
<td>Full Production</td>
<td>This datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice in order to improve design.</td>
</tr>
<tr>
<td>Obsolete</td>
<td>Not In Production</td>
<td>This datasheet contains specifications on a product that has been discontinued by Fairchild semiconductor. The datasheet is printed for reference information only.</td>
</tr>
</tbody>
</table>