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_{CBO} )</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>mW</td>
</tr>
<tr>
<td></td>
<td>Derate above 25°C</td>
<td>5.0</td>
<td>mW/°C</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>°C/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td>357</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>125</td>
<td></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>IC = 1.0 mA, IB = 0</td>
<td>40</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>V_{BRCEO}</td>
<td>Collector-Base Breakdown Voltage</td>
<td>IC = 10 µA, IE = 0</td>
<td>60</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>V_{EBEBO}</td>
<td>Emitter-Base Breakdown Voltage</td>
<td>IE = 10 µA, IC = 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>

### OFF 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>IC = 0.1 mA, V_{CE} = 1.0 V</td>
<td>40</td>
<td>70</td>
<td>300</td>
</tr>
<tr>
<td>V_{CE(sat)}</td>
<td>Collector-Emitter Saturation Voltage</td>
<td>IC = 10 mA, IB = 1.0 mA</td>
<td>0.2</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>V_{BE(sat)}</td>
<td>Base-Emitter Saturation Voltage</td>
<td>IC = 10 mA, IB = 1.0 mA</td>
<td>0.65</td>
<td>0.85</td>
<td></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>f_{T}</td>
<td>Current Gain - Bandwidth Product</td>
<td>IC = 10 mA, V_{CE} = 20 V, f = 100 MHz</td>
<td>300</td>
<td></td>
<td>MHz</td>
</tr>
<tr>
<td>C_{obso}</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_{obso}</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>IC = 100 µA, V_{CE} = 5.0 V, R_{S} = 10 kΩ, f = 10 Hz to 15.7 kHz</td>
<td>5.0</td>
<td></td>
<td>dB</td>
</tr>
</tbody>
</table>

### SMALL SIGNAL CHARACTERISTICS

### 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,</td>
<td>35</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>t_{r}</td>
<td>Rise Time</td>
<td>IC = 10 mA, I_{BS} = 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} = 10 mA</td>
<td>200</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>t_{f}</td>
<td>Fall Time</td>
<td>I_{BS} = I_{BS} = 1.0 mA</td>
<td>50</td>
<td></td>
<td>ns</td>
</tr>
</tbody>
</table>

*Pulse Test: Pulse Width ≤ 300 µs, Duty Cycle ≤ 2.0%*

### Spice Model

NPN (Is=6.734 nA Xti=3 Eg=1.11 Vaf=74.03 Bf=416.4 Ne=1.259 Ise=6.734 Ikl=66.78m Xtb=1.5 Br=7371 Nc=2 Isc=0 Ik=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 Itf=.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)

Storage Time vs Collector Current

Fall Time vs Collector Current

Current Gain

Output Admittance

Input Impedance

Voltage Feedback Ratio

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
TO-92 Tape and Reel Data

TO-92 Packaging
Configuration: Figure 1.0

**TO-92 Tape and Reel Data**

**TAPE and REEL OPTION**
See Fig 2.0 for various Reeling Styles

**AMMO PACK OPTION**
See Fig 3.0 for 2 Ammo Pack Options

---

**BULK OPTION**
See Bulk Packing Information table

---

**UNIT WEIGHT**

- **Reel**
  - Real weight = 0.22 gm
  - Real weight with components = 1.04 kg

- **Ammo**
  - Ammo weight with components = 1.02 kg
  - Max quantity per intermediate box = 10,000 units

---

**LOT:**

- **CBVK741B019**
- **NSID:**
- **PN2222N**
- **D/C1:**
- **D9842**
- **SPEC REV:**
- **B2**
- **SPEC:**
- **QTY:**
- **10000**
- **QA REV:**
- **FAIRCHILD SEMICONDUCTOR CORPORATION**
- **HTB:**
- **B**

---

**TO-92 STANDARD STRAIGHT**

- **92, NO LEADCLIP**
  - 2.0 K / BOX

---

**5 EO70 boxes per Intermediate Box**

---

**CUSTOMIZED Label**

---

**ANTI-STATIC Bubble Sheets**

---

**530mm x 130mm x 83mm Intermediate Box**

---

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March 2001, Rev. B1
TO-92 Reeling Style
Configuration: Figure 2.0

Machine Option “A” (H)

Style “A”, D26Z, D70Z (s/h)

Machine Option “E” (J)

Style “E”, D27Z, D71Z (s/h)

TO-92 Radial Ammo Packaging
Configuration: Figure 3.0

First wire off is emitter
Adhesive tape is on the top side
Flat of transistor is on bottom

First wire off is collector
Adhesive tape is on the top side
Flat of transistor is on bottom

Order style D74Z (M)

Order style D75Z (P)
TO-92 Tape and Reel Data, continued

TO-92 Tape and Reel Taping
Dimension Configuration: Figure 4.0

User Direction of Feed

TO-92 Reel
Configuration: Figure 5.0

Note: All dimensions are in inches.
TO-92 Package Dimensions

TO-92 (FS PKG Code 92, 94, 96)

Dimensions shown below are in:

- inches [millimeters]

Part Weight per unit (gram): 0.1977

Scale 1:1 on letter size paper

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**SOT-23 Tape and Reel Data**

**SOT-23 Packaging Configuration:** Figure 10

**Packaging Description:**
SOT-23 parts are shipped in tape. The carrier tape is made from a dissipative (carbon filled) polycarbonate resin. The cover tape is a multilayer film (Heat Activated Adhesive in nature primarily composed of polyolefin film, adhesive layer, sealant, and anti-static sprayed agent. These rolled parts in standard option are shipped with 3,000 units per 7” or 177cm diameter reel. The reels are dark blue in color and are made of polystyrene plastic anti-static coated. Other option comes in 10,000 units per 13” or 330cm diameter reel. This and some other options are described in the Packaging Information table.

These full reels are individually labeled and placed inside a standard Intermediate made of recyclable corrugated brown paper with a Fairchild logo printing. One pizza box contains eight reels maximum. And these intermediate boxes are placed inside a labeled shipping box which comes in different sizes depending on the number of parts shipped.

---

<table>
<thead>
<tr>
<th><strong>SOT-23 Packaging/Information</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Packaging Option</td>
</tr>
<tr>
<td>Packaging Type</td>
</tr>
<tr>
<td>QTY per Reel/Tub/Bag</td>
</tr>
<tr>
<td>Reel Tape Size</td>
</tr>
<tr>
<td>Box Dimension (mm)</td>
</tr>
<tr>
<td>Max qty per Box</td>
</tr>
<tr>
<td>Weight per unit (gm)</td>
</tr>
<tr>
<td>Weight per Reel (kg)</td>
</tr>
<tr>
<td>Note/Comments</td>
</tr>
</tbody>
</table>

---

**SOT-23 Unit Orientation**

343mm x 342mm x 64mm Intermediate box for L87Z Option

187mm x 107mm x 183mm Intermediate Box for Standard Option

---

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September 1999, Rev. C
SOT-23 Tape and Reel Data, continued

SOT-23 Embossed Carrier Tape
Configuration: Figure 3.0

Dimensions are in millimeter

<table>
<thead>
<tr>
<th>Pkg type</th>
<th>A0</th>
<th>B0</th>
<th>W</th>
<th>D0</th>
<th>D1</th>
<th>E1</th>
<th>E2</th>
<th>F</th>
<th>P1</th>
<th>P0</th>
<th>K0</th>
<th>T</th>
<th>Wc</th>
<th>Tc</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOT-23</td>
<td>3.15</td>
<td>+/-0.10</td>
<td>2.77</td>
<td>+/-0.10</td>
<td>8.0</td>
<td>+/-0.3</td>
<td>1.55</td>
<td>+/-0.05</td>
<td>1.125</td>
<td>+/-0.125</td>
<td>1.75</td>
<td>+/-0.10</td>
<td>6.25</td>
<td>+/-0.05</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: A0, B0, and K0 dimensions are determined with respect to the EIA/Jedec RS-481 rotational and lateral movement requirements (see sketches A, B, and C).

Sketch A (Side or Front Sectional View)
Component Rotation

Sketch B (Top View)
Component Rotation

Sketch C (Top View)
Component lateral movement

SOT-23 Reel Configuration: Figure 4.0

Dimensions are in inches and millimeters

<table>
<thead>
<tr>
<th>Tape Size</th>
<th>Reel Option</th>
<th>Dim A</th>
<th>Dim B</th>
<th>Dim C</th>
<th>Dim D</th>
<th>Dim N</th>
<th>Dim W1</th>
<th>Dim W2</th>
<th>Dim W3 (LSL-USL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8mm</td>
<td>7&quot; Dia</td>
<td>0.059</td>
<td>0.030-0.10</td>
<td>0.086</td>
<td>0.030-0.10</td>
<td>0.059</td>
<td>0.030-0.10</td>
<td>0.086</td>
<td>0.030-0.10</td>
</tr>
<tr>
<td>8mm</td>
<td>13&quot; Dia</td>
<td>0.059</td>
<td>0.030-0.10</td>
<td>0.086</td>
<td>0.030-0.10</td>
<td>0.059</td>
<td>0.030-0.10</td>
<td>0.086</td>
<td>0.030-0.10</td>
</tr>
</tbody>
</table>

See detail AA

User Direction of Feed

September 1999, Rev. C
SOT-23 Package Dimensions

SOT-23 (FS PKG Code 49)

Part Weight per unit (gram): 0.0082

Dimensions shown below are in:
- inches [millimeters]

Scale 1:1 on letter size paper

CONTROLLING DIMENSION IS INCH
VALUES IN [ ] ARE MILLIMETERS

NOTE: UNLESS OTHERWISE SPECIFIED
1. STANDARD LEAD FINISH: 150 MICROINCHES / 3.81 MICROMETERS
   MINIMUM TIN / LEAD (SOLDER) ON ALLOY 42
2. REFERENCE JEDEC REGISTRATION TO-236, VARIATION AB, ISSUE G, DATED JUL 1993
SOT-223 Tape and Reel Data

SOT-223 Packaging Configuration: Figure 1.0

- Leader Tape: 500mm minimum or 62 empty pockets
- Trailer Tape: 300mm minimum or 38 empty pockets

SOT-223 Tape Leader and Trailer Configuration: Figure 2.0

- Carrier Tape
- Cover Tape
- Trailer Tape: 300mm minimum or 38 empty pockets
- Components
- Leader Tape: 500mm minimum or 62 empty pockets

Packaging Description:
SOT-223 parts are shipped in tape. The carrier tape is made from a dissipative (carbon filled) polycarbonate resin. The cover tape is a multilayer film (Heat Activated Adhesive in nature) primarily composed of polyester film, adhesive layer, sealant, and anti-static sprayed agent. These reel packs in standard option are shipped with 2,500 units per 13" or 330mm diameter reel. The reels are dark blue in color and is made of polystyrene plastic (anti-static coated). Other option comes in 500 units per 7" or 177cm diameter reel. This and some other options are further described in the Packaging Information table.

These full reels are individually barcode labeled and placed inside a standard intermediate box (illustrated in figure 1.0) made of recyclable corrugated brown paper. One box contains two reels maximum. And these boxes are placed inside a barcode labeled shipping box which comes in different sizes depending on the number of parts shipped.

SOT-223 Unit Orientation

- 343mm x 342mm x 64mm
- Intermediate box for Standard

- 184mm x 184mm x 47mm
- Pizza Box for D84Z Option

SOT-223 Tape and Reel Data

<table>
<thead>
<tr>
<th>Packaging Option</th>
<th>Flow Code 1</th>
<th>Flow Code 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,500 units per reel</td>
<td>D84Z</td>
<td>N/F</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reel Size</th>
<th>Box Dimension (mm)</th>
<th>Max Quantity per Box</th>
</tr>
</thead>
<tbody>
<tr>
<td>13&quot; Dia</td>
<td>343x64x243</td>
<td>5,000</td>
</tr>
<tr>
<td>7&quot; Dia</td>
<td>184x184x47</td>
<td>1,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Weight per unit (gm)</th>
<th>Weight per Reel (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1246</td>
<td>0.1246</td>
</tr>
<tr>
<td>0.7250</td>
<td>0.1332</td>
</tr>
</tbody>
</table>

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September 1999, Rev. B
SOT-223 Tape and Reel Data, continued

SOT-223 Embossed Carrier Tape Configuration: Figure 3.0

Dimensions are in millimeter

<table>
<thead>
<tr>
<th>Pkg type</th>
<th>A0</th>
<th>B0</th>
<th>W</th>
<th>D0</th>
<th>D1</th>
<th>E0</th>
<th>E1</th>
<th>E2</th>
<th>F</th>
<th>P1</th>
<th>P0</th>
<th>K0</th>
<th>T</th>
<th>Wc</th>
<th>Tc</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOT-223</td>
<td>0.63</td>
<td>7.42</td>
<td>12.0</td>
<td>1.55</td>
<td>1.75</td>
<td>10.25</td>
<td>5.50</td>
<td>9.0</td>
<td>8.0</td>
<td>4.0</td>
<td>1.88</td>
<td>0.292</td>
<td>0.313</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>12mm</td>
<td>+/-0.10</td>
<td>+/-0.10</td>
<td>+/-0.3</td>
<td>+/-0.05</td>
<td>+/-0.10</td>
<td>min</td>
<td>+/-0.05</td>
<td>+/-0.1</td>
<td>+/-0.10</td>
<td>+/-0.10</td>
<td>+/-0.05</td>
<td>+/-0.10</td>
<td>+/-0.05</td>
<td>+/-0.02</td>
<td></td>
</tr>
</tbody>
</table>

Notes: A0, B0, and K0 dimensions are determined with respect to the EIA/Jedec RS-481 rotational and lateral movement requirements (see sketches A, B, and C).

SOT-223 Reel Configuration: Figure 4.0

Dimensions are in inches and millimeters

<table>
<thead>
<tr>
<th>Tape Size</th>
<th>Reel Dimension</th>
<th>Dim A</th>
<th>Dim B</th>
<th>Dim C</th>
<th>Dim D</th>
<th>Dim N</th>
<th>Dim W</th>
<th>Dim W2</th>
</tr>
</thead>
<tbody>
<tr>
<td>12mm</td>
<td>7&quot; Dia</td>
<td>0.059</td>
<td>0.512</td>
<td>+0.020</td>
<td>-0.008</td>
<td>20.2</td>
<td>5.096</td>
<td>0.488</td>
</tr>
<tr>
<td>12mm</td>
<td>13&quot; Dia</td>
<td>0.059</td>
<td>0.512</td>
<td>+0.020</td>
<td>-0.008</td>
<td>20.2</td>
<td>5.096</td>
<td>0.488</td>
</tr>
</tbody>
</table>

July 1999, Rev. B
SOT-223 Package Dimensions

SOT-223 (FS PKG Code 47)

Part Weight per unit (gram): 0.1246

Scale 1:1 on letter size paper

NOTES: UNLESS OTHERWISE SPECIFIED
1. STANDARD LEAD FINISH TO BE 150 MICROINCHES/3.81 MICROMETERS
   MINIMUM TIN/LEAD (SOLDER) ON COPPER.
2. REFERENCE JEDEC REGISTRATION TO-261, VARIATION AA, ISSUE A, DATED JAN 1990

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September 1999, Rev. C
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- E²CMOS™
- EnSigna™
- FACT™
- FACT Quiet Series™
- FAST®
- FAST™
- GlobalOptoisolator™
- GTO™
- HiSeC™
- ISOPLANAR™
- MICROWIRE™
- OPTOLOGIC™
- OPTOPLANAR™
- PACMAN™
- POP™
- PowerTrench®
- QFET™
- QS™
- QT Optoelectronics™
- Quiet Series™
- SMART START™
- SuperSOT™-3
- SuperSOT™-6
- SuperSOT™-8
- SyncFET™
- TinyLogic™
- UHC™
- VCX™

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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>
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<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>
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