BS170 / MMBF170
N-Channel Enhancement Mode Field Effect Transistor

General Description
These N-Channel enhancement mode field effect transistors are produced using Fairchild's proprietary, high cell density, DMOS technology. These products have been designed to minimize on-state resistance while providing rugged, reliable, and fast switching performance. They can be used in most applications requiring up to 500mA DC. These products are particularly suited for low voltage, low current applications such as small servo motor control, power MOSFET gate drivers, and other switching applications.

Features
- High density cell design for low $R_{DS(ON)}$.
- Voltage controlled small signal switch.
- Rugged and reliable.
- High saturation current capability.

Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>BS170</th>
<th>MMBF170</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{DSS}$</td>
<td>Drain-Source Voltage</td>
<td>60</td>
<td>60</td>
<td>V</td>
</tr>
<tr>
<td>$V_{DGR}$</td>
<td>Drain-Gate Voltage ($R_{GS} \leq 1M\Omega$)</td>
<td>60</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>$V_{GSS}$</td>
<td>Gate-Source Voltage</td>
<td>$\pm$20</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>$I_D$</td>
<td>Drain Current - Continuous</td>
<td>500</td>
<td>500</td>
<td>mA</td>
</tr>
<tr>
<td>- Pulsed</td>
<td></td>
<td>1200</td>
<td>800</td>
<td>mA</td>
</tr>
<tr>
<td>$P_D$</td>
<td>Maximum Power Dissipation</td>
<td>830</td>
<td>300</td>
<td>mW</td>
</tr>
<tr>
<td>Derate Above 25°C</td>
<td></td>
<td>6.6</td>
<td>2.4</td>
<td>mW/°C</td>
</tr>
<tr>
<td>$T_J$, $T_{STG}$</td>
<td>Operating and Storage Temperature Range</td>
<td>-55 to 150</td>
<td>°C</td>
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<tr>
<td>$T_L$</td>
<td>Maximum Lead Temperature for Soldering Purposes, 1/16&quot; from Case for 10 Seconds</td>
<td>300</td>
<td>°C</td>
<td></td>
</tr>
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</table>

THERMAL CHARACTERISTICS

| $R_{thJA}$ | Thermal Resistance, Junction-to-Ambient | 150   | 417     | °C/W    |

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### Electrical Characteristics

**Conditions**: \( T_A = 25^\circ C \) unless otherwise noted.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Type</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
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<td><strong>OFF CHARACTERISTICS</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>BV(_{DSS})</td>
<td>Drain-Source Breakdown Voltage</td>
<td>( V_{GS} = 0 \text{ V}, I_D = 100 \mu \text{A} )</td>
<td>All</td>
<td>60</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>I(_{DSS})</td>
<td>Zero Gate Voltage Drain Current</td>
<td>( V_{GS} = 25 \text{ V}, V_{DS} = 0 \text{ V} )</td>
<td>All</td>
<td>0.5</td>
<td></td>
<td></td>
<td>µA</td>
</tr>
<tr>
<td>I(_{GSF})</td>
<td>Gate-Body Leakage, Forward</td>
<td>( V_{GS} = 15 \text{ V}, V_{DS} = 0 \text{ V} )</td>
<td>All</td>
<td>10</td>
<td></td>
<td></td>
<td>nA</td>
</tr>
<tr>
<td><strong>ON CHARACTERISTICS</strong> (Note 1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( V_{GSM})</td>
<td>Gate Threshold Voltage</td>
<td>( V_{GS} = V_{DS}, I_D = 1 \text{ mA} )</td>
<td>All</td>
<td>0.8</td>
<td>2.1</td>
<td>3</td>
<td>V</td>
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<tr>
<td>( R_{DSSON})</td>
<td>Static Drain-Source On-Resistance</td>
<td>( V_{GS} = 10 \text{ V}, I_D = 200 \text{ mA} )</td>
<td>All</td>
<td>1.2</td>
<td>5</td>
<td></td>
<td>Ω</td>
</tr>
<tr>
<td>( g_{FS})</td>
<td>Forward Transconductance</td>
<td>( V_{GS} = 10 \text{ V}, I_D = 200 \text{ mA} ) BS170</td>
<td></td>
<td>320</td>
<td></td>
<td></td>
<td>mS</td>
</tr>
<tr>
<td>&amp;</td>
<td></td>
<td></td>
<td></td>
<td>( V_{DS} \geq 2 V_{DSSON}, I_D = 200 \text{ mA} ) MMBF170</td>
<td></td>
<td>320</td>
<td></td>
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<tr>
<td><strong>DYNAMIC CHARACTERISTICS</strong></td>
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<tr>
<td>( C_{iss})</td>
<td>Input Capacitance</td>
<td>( V_{GS} = 10 \text{ V}, V_{DS} = 0 \text{ V} )</td>
<td>All</td>
<td>24</td>
<td>40</td>
<td></td>
<td>pF</td>
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<tr>
<td>( C_{oss})</td>
<td>Output Capacitance</td>
<td>( f = 1.0 \text{ MHz} )</td>
<td>All</td>
<td>17</td>
<td>30</td>
<td></td>
<td>pF</td>
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<tr>
<td>( C_{rss})</td>
<td>Reverse Transfer Capacitance</td>
<td></td>
<td>All</td>
<td>7</td>
<td>10</td>
<td></td>
<td>pF</td>
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<td><strong>SWITCHING CHARACTERISTICS</strong> (Note 1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( t_{on})</td>
<td>Turn-On Time</td>
<td>( V_{DD} = 25 \text{ V}, I_o = 200 \text{ mA}, V_{GS} = 10 \text{ V}, R_{GEN} = 25 \Omega ) BS170</td>
<td></td>
<td>10</td>
<td></td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>&amp;</td>
<td></td>
<td></td>
<td></td>
<td>( V_{DD} = 25 \text{ V}, I_o = 500 \text{ mA}, V_{GS} = 10 \text{ V}, R_{GEN} = 50 \Omega ) MMBF170</td>
<td></td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>( t_{off})</td>
<td>Turn-Off Time</td>
<td>( V_{DD} = 25 \text{ V}, I_o = 200 \text{ mA}, V_{GS} = 10 \text{ V}, R_{GEN} = 25 \Omega ) BS170</td>
<td></td>
<td>10</td>
<td></td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>&amp;</td>
<td></td>
<td></td>
<td></td>
<td>( V_{DD} = 25 \text{ V}, I_o = 500 \text{ mA}, V_{GS} = 10 \text{ V}, R_{GEN} = 50 \Omega ) MMBF170</td>
<td></td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

**Note**: 1. Pulse Test: Pulse Width \( < 300 \mu \text{s} \), Duty Cycle \( < 2.0\% \).
Typical Electrical Characteristics

Figure 1. On-Region Characteristics.

Figure 2. On-Resistance Variation with Gate Voltage and Drain Current.

Figure 3. On-Resistance Variation with Temperature.

Figure 4. On-Resistance Variation with Drain Current and Temperature.

Figure 5. Transfer Characteristics.

Figure 6. Gate Threshold Variation with Temperature.
Figure 7. Breakdown Voltage Variation with Temperature.

Figure 8. Body Diode Forward Voltage Variation with Current and Temperature.

Figure 9. Capacitance Characteristics.

Figure 10. Gate Charge Characteristics.

Figure 11. Switching Test Circuit.

Figure 12. Switching Waveforms.
Typical Electrical Characteristics (continued)

Figure 13. BS170 Maximum Safe Operating Area.

Figure 14. MMBF170 Maximum Safe Operating Area.

Figure 15. TO-92, BS170 Transient Thermal Response Curve.

Figure 16. SOT-23, MMBF170 Transient Thermal Response Curve.
TO-92 Tape and Reel Data

TO-92 Packaging
Configuration: Figure 1.0

TO-92 TAPE and REEL OPTION
See Fig 2.0 for various Reeling Styles

TAPE and REEL OPTION
5 Reels per Intermediate Box

AMMO PACK OPTION
See Fig 3.0 for 2 Ammo Pack Options

AMMO PACK OPTION
5 Ammo boxes per Intermediate Box

530mm x 130mm x 83mm Intermediate Box

Unit weight
Real weight with components = 0.22 gm
Ammo weight with components = 1.02 kg
Max quantity per intermediate box = 10,000 units

BULK OPTION
See Bulk Packing Information table

134mm x 102mm x 51mm Immediate Box

F63TNR Label sample

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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)
FIRST WIRE OFF IS EMITTER
ADHESIVE TAPE IS ON THE TOP SIDE
FLAT OF TRANSISTOR IS ON BOTTOM

Machine Option “E” (J)
Style “E”, D27Z, D71Z (s/h)
FIRST WIRE OFF IS COLLECTOR
ADHESIVE TAPE IS ON THE TOP SIDE
FLAT OF TRANSISTOR IS ON BOTTOM

TO-92 Radial Ammo Packaging
Configuration: Figure 3.0

ORDER STYLE
D74Z (M)
FIRST WIRE OFF IS EMITTER (ON PKG. 92)
ADHESIVE TAPE IS ON BOTTOM SIDE
FLAT OF TRANSISTOR IS ON BOTTOM

ORDER STYLE
D75Z (P)
FIRST WIRE OFF IS COLLECTOR (ON PKG. 92)
ADHESIVE TAPE IS ON BOTTOM SIDE
FLAT OF TRANSISTOR IS ON TOP
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.

July 1999, Rev. A
TO-92 Package Dimensions

TO-92; TO-18 Reverse Lead Form (J35Z Option)
(FS PKG Code 92, 94, 96)

Part Weight per unit (gram): 0.22

Note: All package 97 or 98 transistors are leadformed to this configuration prior to bulk shipment. Order L34Z option if in-line leads are preferred on package 97 or 98.

* Standard Option on 97 & 98 package code
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 primarly composed of polystyrene film, adhesive layer, sealant, and anti-static sprayed agent. These reels with empty pockets are shipped with 3,000 units per 7” or 177cm diameter reel. The reels are dark blue in color and made of polystyrene plastic (anti-static coated). Other option come 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. These intermediate boxes are placed inside a labeled shipping box which comes in different sizes depending on the number of parts shipped.

SOT-23 Tape Leader and Trailer
Configuration: Figure 20

<table>
<thead>
<tr>
<th>SOT-23 Packaging Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Packaging/Option</td>
</tr>
<tr>
<td>Packaging/Type</td>
</tr>
<tr>
<td>Qty per Reel/Tube/Bag</td>
</tr>
<tr>
<td>Real Tape</td>
</tr>
<tr>
<td>Box Dimension (mm)</td>
</tr>
<tr>
<td>Max qty per Box</td>
</tr>
<tr>
<td>Weight per unit (g)</td>
</tr>
<tr>
<td>Weight per Reel (kg)</td>
</tr>
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</table>

Note/Comments

Human Readable Label sample

Human Readable Label

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

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<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>
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</thead>
<tbody>
<tr>
<td>SOT-23</td>
<td>3.15</td>
<td>2.77</td>
<td>8.0</td>
<td>1.55</td>
<td>1.126</td>
<td>1.75</td>
<td>6.25</td>
<td>2.50</td>
<td>4.0</td>
<td>4.0</td>
<td>1.35</td>
<td>3.50</td>
<td>4.0</td>
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</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).
- **20 deg maximum component rotation**
- **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>
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</thead>
<tbody>
<tr>
<td>8mm</td>
<td>7” Dia</td>
<td>7.00</td>
<td>0.059</td>
<td>0.795</td>
<td>3.165</td>
<td>0.331</td>
<td>0.567</td>
<td>0.311 – 0.429</td>
<td>7.9 – 10.9</td>
</tr>
<tr>
<td></td>
<td>13” Dia</td>
<td>13.00</td>
<td>0.059</td>
<td>0.795</td>
<td>4.00</td>
<td>0.331</td>
<td>0.567</td>
<td>0.311 – 0.429</td>
<td>7.9 – 10.9</td>
</tr>
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*September 1999, Rev. C*
SOT-23 Package Dimensions

SOT-23 (FS PKG Code 49)

Scale 1:1 on letter size paper
Dimensions shown below are in:
  inches [millimeters]
Part Weight per unit (gram): 0.0082

Part Weight per unit (gram): 0.0082

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- FAST™
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- GTO™
- HiSeC™
- ISOPLANAR™
- MICROWIRE™
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- OPTOPLANAR™
- PACMAN™
- POP™
- PowerTrench®
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- QS™
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- SuperSOT™-6
- SuperSOT™-8
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- POP™
- PowerTrench®
- QFET™
- QS™
- QT Optoelectronics™
- Quiet Series™
- SILENT SWITCHER®
- SMART START™
- SuperSOT™-3
- SuperSOT™-6
- SuperSOT™-8
- SyncFET™
- TinyLogic™
- UHC™
- VCX™
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- E²CMOS™
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- FACT Quiet Series™
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Definition of Terms

<table>
<thead>
<tr>
<th>Datasheet Identification</th>
<th>Product Status</th>
<th>Definition</th>
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<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>
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