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

<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></td>
<td>V</td>
</tr>
<tr>
<td>$V_{DGR}$</td>
<td>Drain-Gate Voltage ($R_{GS} \leq 1M\Omega$)</td>
<td>60</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>$V_{GSS}$</td>
<td>Gate-Source Voltage</td>
<td>± 20</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>$I_D$</td>
<td>Drain Current - Continuous</td>
<td>500</td>
<td>500</td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td>- Pulsed</td>
<td>1200</td>
<td>800</td>
<td>mA</td>
</tr>
<tr>
<td>$T_J$, $T_{STG}$</td>
<td>Operating and Storage Temperature Range</td>
<td>- 55 to 150</td>
<td>-</td>
<td>°C</td>
</tr>
<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></td>
<td>°C</td>
</tr>
</tbody>
</table>

Thermal Characteristics  $T_A = 25^\circ C$ unless otherwise noted

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>BS170</th>
<th>MMBF170</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P_D$</td>
<td>Maximum Power Dissipation</td>
<td>830</td>
<td>300</td>
<td>mW</td>
</tr>
<tr>
<td></td>
<td>Derate above 25°C</td>
<td>6.6</td>
<td>2.4</td>
<td>mW/°C</td>
</tr>
<tr>
<td>$R_{JJA}$</td>
<td>Thermal Resistance, Junction to Ambient</td>
<td>150</td>
<td>417</td>
<td>°C/W</td>
</tr>
</tbody>
</table>
## Electrical Characteristics

<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>
</tr>
</thead>
<tbody>
<tr>
<td>( \text{OFF CHARACTERISTICS} )</td>
<td>( B_{\text{VDS}} )</td>
<td>Drain-Source Breakdown Voltage</td>
<td>( V_{GS} = 0V, I_D = 100\mu A )</td>
<td>All</td>
<td>60</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>( I_{\text{DS}} )</td>
<td>Zero Gate Voltage Drain Current</td>
<td>( V_{DS} = 25V, V_{GS} = 0V )</td>
<td>All</td>
<td>0.5</td>
<td>( \mu A )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( I_{\text{GSSF}} )</td>
<td>Gate - Body Leakage, Forward</td>
<td>( V_{GS} = 15V, V_{DS} = 0V )</td>
<td>All</td>
<td>10</td>
<td>nA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \text{ON CHARACTERISTICS (Notes 1)} )</td>
<td>( V_{\text{GS(th)}} )</td>
<td>Gate Threshold Voltage</td>
<td>( V_{DS} = V_{GS}, I_D = 1mA )</td>
<td>All</td>
<td>0.8</td>
<td>2.1</td>
<td>3</td>
</tr>
<tr>
<td>( R_{\text{DS(ON)}} )</td>
<td>Static Drain-Source On-Resistance</td>
<td>( V_{GS} = 10V, I_D = 200mA )</td>
<td>All</td>
<td>1.2</td>
<td>5</td>
<td>( \Omega )</td>
<td></td>
</tr>
<tr>
<td>( g_{\text{FS}} )</td>
<td>Forward Transconductance</td>
<td>( V_{GS} \geq 2 V_{\text{DS(on)}} ), ( I_D = 200mA )</td>
<td>BS170</td>
<td>320</td>
<td>mS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dynamic Characteristics</td>
<td>( C_{\text{iss}} )</td>
<td>Input Capacitance</td>
<td>( V_{DS} = 10V, V_{GS} = 0V, f = 1.0MHz )</td>
<td>All</td>
<td>24</td>
<td>40</td>
<td>pF</td>
</tr>
<tr>
<td></td>
<td>( C_{\text{oss}} )</td>
<td>Output Capacitance</td>
<td>All</td>
<td>17</td>
<td>30</td>
<td>pF</td>
<td></td>
</tr>
<tr>
<td></td>
<td>( C_{\text{rss}} )</td>
<td>Reverse Transfer Capacitance</td>
<td>All</td>
<td>7</td>
<td>10</td>
<td>pF</td>
<td></td>
</tr>
<tr>
<td>Switching Characteristics (Notes 1)</td>
<td>( t_{\text{on}} )</td>
<td>Turn-On Time</td>
<td>( V_D = 25V, I_D = 200mA, V_{GS} = 10V, R_{GEN} = 25\Omega )</td>
<td>BS170</td>
<td>10</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>( V_D = 25V, I_D = 500mA, V_{GS} = 10V, R_{GEN} = 50\Omega )</td>
<td>MMBF170</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>( t_{\text{off}} )</td>
<td>Turn-Off Time</td>
<td>( V_D = 25V, I_D = 200mA, V_{GS} = 10V, R_{GEN} = 25\Omega )</td>
<td>BS170</td>
<td>10</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>( V_D = 25V, I_D = 500mA, V_{GS} = 10V, R_{GEN} = 50\Omega )</td>
<td>MMBF170</td>
<td>10</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:**

1. Pulse Test: Pulse Width \( \leq 300\mu s \), Duty Cycle \( \leq 2.0\% \).

## Ordering Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
<th>Package Type</th>
<th>Lead Frame</th>
<th>Pin array</th>
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<tbody>
<tr>
<td>BS170</td>
<td>TO-92</td>
<td>BULK</td>
<td>STRAIGHT</td>
<td>D G S</td>
</tr>
<tr>
<td>BS170_D26Z</td>
<td>TO-92</td>
<td>Tape and Reel</td>
<td>FORMING</td>
<td>D G S</td>
</tr>
<tr>
<td>BS170_D27Z</td>
<td>TO-92</td>
<td>Tape and Reel</td>
<td>FORMING</td>
<td>D G S</td>
</tr>
<tr>
<td>BS170_D74Z</td>
<td>TO-92</td>
<td>AMMO</td>
<td>FORMING</td>
<td>D G S</td>
</tr>
<tr>
<td>BS170_D75Z</td>
<td>TO-92</td>
<td>AMMO</td>
<td>FORMING</td>
<td>D G S</td>
</tr>
<tr>
<td>MMBF170</td>
<td>SOT-23</td>
<td>Tape and Reel</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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.
Typical Electrical Characteristics (continued)

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

TAPE and REEL OPTION
See Fig 2.0 for various Reeling Styles

AMMO PACK OPTION
See Fig 5.0 for 2 Ammo Pack Options

BULK OPTION
See Bulk Packing Information table

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### TO-92 Tape and Reel Data, continued

**Information:** Figure 2.0

#### TO-92 TN/RAMMO PACKING INFORMATION TABLE

<table>
<thead>
<tr>
<th>Packing</th>
<th>Style</th>
<th>Quantity</th>
<th>EOL code</th>
</tr>
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<tbody>
<tr>
<td>Reel</td>
<td>A</td>
<td>2,000</td>
<td>D262</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>2,000</td>
<td>D112</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>2,000</td>
<td>D382</td>
</tr>
<tr>
<td></td>
<td>D</td>
<td>2,000</td>
<td>D102</td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>2,000</td>
<td>D272</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>2,000</td>
<td>D912</td>
</tr>
<tr>
<td></td>
<td>G</td>
<td>2,000</td>
<td>D292</td>
</tr>
<tr>
<td></td>
<td>H</td>
<td>2,000</td>
<td>D192</td>
</tr>
<tr>
<td>Ammo</td>
<td>M</td>
<td>2,000</td>
<td>D742</td>
</tr>
<tr>
<td></td>
<td>P</td>
<td>2,000</td>
<td>D752</td>
</tr>
</tbody>
</table>

- Unit weight: 0.02 g
- Reel weight with components: 1.04 kg
- Ammo weight with components: 1.02 kg
- Max quantity per intermediate box: 10,000 units

#### TO-92 BULK PACKING INFORMATION TABLE

<table>
<thead>
<tr>
<th>EOL CODE / FLOW OPTION</th>
<th>DESCRIPTION</th>
<th>LEADCLIP DIMENSION</th>
<th>MINIMUM ORDER QTY</th>
<th>LEADFORM OUTLINE</th>
</tr>
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<tr>
<td>NO EOL CODE</td>
<td>STRAIGHT LEADS</td>
<td>NO LEAD CLIP</td>
<td>2.0K / BOX</td>
<td></td>
</tr>
<tr>
<td>J18Z</td>
<td>TO-18 OPTION STD</td>
<td>NO LEAD CLIP</td>
<td>2.0K / BOX</td>
<td></td>
</tr>
<tr>
<td>J35Z</td>
<td>TO-18 OPTION REVERSE</td>
<td>NO LEAD CLIP</td>
<td>2.0K / BOX</td>
<td></td>
</tr>
<tr>
<td>J05Z</td>
<td>TO-5 OPTION STD</td>
<td>NO LEAD CLIP</td>
<td>1.5K / BOX</td>
<td></td>
</tr>
<tr>
<td>J60Z</td>
<td>TO-5 OPTION REVERSE</td>
<td>NO LEAD CLIP</td>
<td>1.5K / BOX</td>
<td></td>
</tr>
<tr>
<td>J61Z</td>
<td>IN LINE 0.200 SPACING</td>
<td>NO LEAD CLIP</td>
<td>1.5K / BOX</td>
<td></td>
</tr>
</tbody>
</table>
TO-92 Tape and Reel Data, continued

TO-92 Reeling Style
Configuration: Figure 3.0

Machine Option “A” (H)
- Style “A”, D20Z
- Style “B”, D11Z
- Style “C”, D28Z
- Style “D”, D10Z

Machine Option “E” (J)
- Style “E”, D27Z
- Style “F”, D81Z
- Style “G”, D29Z
- Style “H”, D88Z

TO-92 Radial Ammo Packaging
Configuration: Figure 4.0

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

ORDER STYLE D74Z (M)

First wire off is Collector
Adhesive tape is on bottom side
Flat of transistor is on bottom

ORDER STYLE D75Z (P)

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

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TO-92 Tape and Reel Data, continued

TO-92 Tape and Reel Taping
Dimension Configuration: Figure 5.0

User Direction of Feed

TO-92 Reel
Configuration: Figure 6.0

BS170 / MMBF170 — N-Channel Enhancement Mode Field Effect Transistor

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Item Description | Symbol | Dimension
--- | --- | ---
Base of Package to Lead Bend | b | 0.069 (min)
Component Height | H8 | 0.053 (+/- 0.025)
Lead Upper Height | H0 | 0.030 (+/- 0.025)
Component (Side) Height | H1 | 0.140 (+/- 0.025)
Component Alignment, front to back | Pm | 0.042 (max)
Component Alignment, front to side | Pm | 0.031 (max)
Component Width | P | 0.500 (+/- 0.025)
Feed Hole Distance | R0 | 0.250 (+/- 0.025)
Hole Center to Pin Lead | R1 | 0.150 (+/- 0.025)
Hole Center to Component Center | R0 | 0.150 (+/- 0.025)
Lead Spread | F1,F2 | 0.10 (+/- 0.025)
Lead Thickness | d | 0.010 (+/- 0.003)
Cut Lead Length | L | 0.423 (min)
Taped Lead Length | L1 | 0.228 (+/- 0.025)
Taped Lead Thickness | L1 | 0.025 (+/- 0.025)
Contact Tape Thickness | T1 | 0.025 (+/- 0.003)
Contact Inner Width | W | 0.176 (+/- 0.025)
Host - Inner Tape Width | W2 | 0.236 (+/- 0.025)
Host - Inner Tape Position | W1 | 0.025 (max)
Feed Rate Distance | W1 | 0.001 (+/- 0.025)
Outer Inner Diameter | D2 | 0.167 (+/- 0.025)
Lead Spring Cut | S | 0.001 (max)

Note: All dimensions are in inches.

Item Description | Symbol | Minimum | Maximum
--- | --- | --- | ---
Reel Diameter | D1 | 13.975 | 14.625
Anchor Hole Diameter (Standard) | D2 | 1.182 | 1.205
Anchor Hole Diameter (Small Hole) | D2 | 0.995 | 1.005
Cable Diameter | D3 | 0.020 | 0.025
Hole Location Inner Diameter | D4 | 2.700 | 3.000
Hole Location Inner Depth | D1 | 0.075 | 0.100
Hole to Hole Center Width | V2 | 1.600 | 1.690
Hole to Hole Center Width | V3 | 2.000

Note: All dimensions are in inches.
Mechanical Dimensions (TO-92)

TO-92

NOTES: UNLESS OTHERWISE SPECIFIED
A) DRAWING WITH REFERENCE TO JEDEC TO-92 RECOMMENDATIONS.
B) ALL DIMENSIONS ARE IN MILLIMETERS.
C) DRAWING CONFORMS TO ASME Y14.5M-1994.
D) TO-92 (92,94,96,97,98) PN CONFIGURATION:

<table>
<thead>
<tr>
<th>PS</th>
<th>PS</th>
<th>PS</th>
<th>PS</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

LEGEND:
P = Bipolar  E = Emitter  G = Drain
F = JFET  M = Base  S = Source
W = DMOS  C = Collector  D = Gate

E) FOR PACKAGE 92, 94, 96, 97 AND 98
PN CONFIGURATION DRAW "2" AND SOURCE "5"
ARE INTERCHANGEABLE AT JFET "P" OPTION.
F) DRAWING FILENAME: WKT-2ADJ3REV3.

Dimensions in Millimeters
SOT-23 Std Tape and Reel Data

SOT23-3L Packaging
Configuration: Figure 1.0

Packaging Description:
SOT-23-3L parts are shipped in tape. The carrier tape is made from a dissipation (carbon filled) polycarbonate resin. The cover tape is a multilayer film (heat activated adhesive in certain layers) composed of polyester film, adhesive layer, sealant, and antistatic sprayed agent. These molded parts in standard option are shipped with 3,000 units per 7” or 177mm diameter reel. The reels are dark blue in color and are made of polystyrene plastic (antistatic coated). Other option can comes with 10,000 units per 13” or 330mm diameter reel. This is one of the other option on described in the Packaging Information table. These full reel is individually labeled and placed inside a standard immediate box made from recyclable, corrugated brown paper with a Fairchild logo printing. One box contains five reels maximum. And these immediate boxes are placed inside a labeled shipping box which comes in different sizes depending on the number of parts shipped.

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<tr>
<th>Packaging Option</th>
<th>QTY</th>
<th>Flow Code</th>
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<tr>
<td>Standard</td>
<td>3,000</td>
<td>D87Z</td>
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<tr>
<td>Customized</td>
<td>10,000</td>
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<table>
<thead>
<tr>
<th>Packaging Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Packaging Option</td>
</tr>
<tr>
<td>Standard</td>
</tr>
<tr>
<td>Customized</td>
</tr>
</tbody>
</table>

Barcode Label

SOT23-3L Tape Leader and Trailer
Configuration: Figure 2.0

Barcode Label sample

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October 2004, Rev. D1
SOT-23 Std Tape and Reel Data, continued

SOT23-3L 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>
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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>1.125</td>
<td>1.75</td>
<td>6.15</td>
<td>min</td>
<td>3.50</td>
<td>4.0</td>
<td>4.0</td>
<td>1.30</td>
<td>0.228</td>
<td>5.2</td>
</tr>
<tr>
<td>(8mm)</td>
<td>+/-0.1</td>
<td>+/-0.1</td>
<td>+/-0.25</td>
<td>+/-0.125</td>
<td>+/-0.10</td>
<td></td>
<td>min</td>
<td>+/-0.05</td>
<td>+/-0.1</td>
<td>+/-0.1</td>
<td>+/-0.3</td>
<td></td>
<td>+/-0.013</td>
<td>+/-0.3</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

SOT23-3L Reel Configuration: Figure 4.0

Dimensions are in inches and millimeters

<table>
<thead>
<tr>
<th>Tape Size</th>
<th>Reel Diameter</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>7.00</td>
<td>0.059</td>
<td>0.512 x 0.020-0.006</td>
<td>0.795</td>
<td>2.165</td>
<td>0.331 x 0.020-0.006</td>
<td>0.567</td>
<td>0.311 - 0.429</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>177.8</td>
<td>1.5</td>
<td>13+0/5-0.2</td>
<td>20.2</td>
<td>55</td>
<td>8.4 + 1.50</td>
<td>14.4</td>
</tr>
<tr>
<td>8mm</td>
<td>13&quot; Dia</td>
<td>13.00</td>
<td>0.059</td>
<td>0.512 x 0.020-0.008</td>
<td>0.795</td>
<td>4.000</td>
<td>0.331 x 0.020-0.006</td>
<td>0.567</td>
<td>0.311 - 0.429</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>330</td>
<td>1.5</td>
<td>13+0/5-0.2</td>
<td>30.3</td>
<td>100</td>
<td>8.4 + 1.50</td>
<td>14.4</td>
</tr>
</tbody>
</table>

October 2004, Rev. D1
Mechanical Dimensions (SOT-23)

**SOT-23**

**Dimensions in Millimeters**

- **A**: 2.92 ± 0.20
- **B**: 0.95
- **1.40**: 1.00
- **2.20**:
- **0.50**:
- **1.30**:
- **0.20**:
- **0.20**:
- **0.10**:
- **0.00**:
- **2.40 ± 0.30**

**Notes:**

- **A)** Reference JEDF registration TO-236, variation A0, issue H.
- **B)** All dimensions are in millimeters.
- **C)** Dimensions are inclusive of burrs, mold flash and tie bar extensions.
- **D)** Dimensioning and tolerancing per ASME Y14.5M - 1994.
- **E)** Drawing file name: WAD320R2S

**Gage Plane**

**Seating Plane**

Dimensions in Millimeters
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