FDN359AN
N-Channel Logic Level PowerTrench™ MOSFET

General Description
This N-Channel Logic Level MOSFET is produced using Fairchild Semiconductor’s advanced PowerTrench process that has been especially tailored to minimize on-state resistance and yet maintain superior switching performance. These devices are well suited for low voltage and battery powered applications where low in-line power loss and fast switching are required.

Features
- 2.7 A, 30 V, \( R_{DS(ON)} = 0.046 \Omega \) @ \( V_{GS} = 10 \text{ V} \)
- \( R_{DS(ON)} = 0.060 \Omega \) @ \( V_{GS} = 4.5 \text{ V} \)
- Very fast switching.
- Low gate charge (5nC typical).
- High power version of industry standard SOT-23 package. Identical pin out to SOT-23 with 30% higher power handling capability.

Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Ratings</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>( V_{DS} )</td>
<td>Drain-Source Voltage</td>
<td>30</td>
<td>V</td>
</tr>
<tr>
<td>( V_{GS} )</td>
<td>Gate-Source Voltage</td>
<td>( \pm 20 )</td>
<td>V</td>
</tr>
<tr>
<td>( I_D )</td>
<td>Maximum Drain Current - Continuous</td>
<td>2.7</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>- Pulsed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( P_D )</td>
<td>Maximum Power Dissipation</td>
<td>0.5</td>
<td>W</td>
</tr>
<tr>
<td></td>
<td>(Note 1a)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Note 1b)</td>
<td>0.46</td>
<td>W</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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THERMAL CHARACTERISTICS

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<th>Units</th>
</tr>
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<tbody>
<tr>
<td>( R_{JA} )</td>
<td>Thermal Resistance, Junction-to-Ambient</td>
<td>250</td>
<td>°C/W</td>
</tr>
<tr>
<td>( R_{JC} )</td>
<td>Thermal Resistance, Junction-to-Case</td>
<td>75</td>
<td>°C/W</td>
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### Electrical Characteristics (\(T_A = 25^\circ C\) unless otherwise noted)

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<tr>
<th>Symbol</th>
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<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
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<tr>
<td>BV_{DSS}</td>
<td>Drain-Source Breakdown Voltage</td>
<td>(V_{GS} = 0\ V, I_D = 250\ \mu A)</td>
<td>30</td>
<td></td>
<td></td>
<td>V</td>
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<tr>
<td>(\DeltaBV_{DSS}/\Delta T_J)</td>
<td>Breakdown Voltage Temp. Coefficient</td>
<td>(I_D = 250\ \mu A, ) Referenced to (25^\circ C)</td>
<td>23</td>
<td></td>
<td></td>
<td>mV/°C</td>
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<tr>
<td>I_{DSS}</td>
<td>Zero Gate Voltage Drain Current</td>
<td>(V_{GS} = 24\ V, V_{DS} = 0\ V)</td>
<td>1</td>
<td></td>
<td></td>
<td>(\mu A)</td>
</tr>
<tr>
<td>I_{GSSF}</td>
<td>Gate-Body Leakage, Forward</td>
<td>(V_{GS} = 20\ V, V_{DS} = 0\ V)</td>
<td></td>
<td>100</td>
<td></td>
<td>nA</td>
</tr>
<tr>
<td>I_{GSSR}</td>
<td>Gate-Body Leakage, Reverse</td>
<td>(V_{GS} = -20\ V, V_{DS} = 0\ V)</td>
<td></td>
<td>-100</td>
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### ON CHARACTERISTICS (Note)

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<th>Units</th>
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<tr>
<td>V_{GSN}</td>
<td>Gate Threshold Voltage</td>
<td>(V_{DS} = V_{GS}, I_D = 2.7\ A)</td>
<td>1</td>
<td>1.6</td>
<td>3</td>
<td>V</td>
</tr>
<tr>
<td>(\Delta V_{GS}/\Delta T_J)</td>
<td>Gate Threshold Voltage Temp. Coefficient</td>
<td>(I_D = 250\ \mu A, ) Referenced to (25^\circ C)</td>
<td>-4</td>
<td></td>
<td></td>
<td>mV/°C</td>
</tr>
<tr>
<td>R_{DS(ON)}</td>
<td>Static Drain-Source On-Resistance</td>
<td>(V_{GS} = 10\ V, I_D = 2.7\ A)</td>
<td>0.037</td>
<td>0.046</td>
<td></td>
<td>Ω</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(V_{GS} = 4.5\ V, I_D = 2.4\ A)</td>
<td>0.055</td>
<td>0.075</td>
<td></td>
<td>Ω</td>
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<tr>
<td>I_{DS(on)}</td>
<td>On-State Drain Current</td>
<td>(V_{GS} = 10\ V, V_{DS} = 5\ V)</td>
<td>15</td>
<td></td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>g_F</td>
<td>Forward Transconductance</td>
<td>(V_{GS} = 5\ V, I_D = 2.7\ A)</td>
<td>9.5</td>
<td></td>
<td></td>
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### DYNAMIC CHARACTERISTICS

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<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>C_{iss}</td>
<td>Input Capacitance</td>
<td>(V_{DS} = 10\ V, V_{GS} = 0\ V, f = 1.0\ MHz)</td>
<td>480</td>
<td></td>
<td></td>
<td>pF</td>
</tr>
<tr>
<td>C_{oss}</td>
<td>Output Capacitance</td>
<td>(f = 1.0\ MHz)</td>
<td>120</td>
<td></td>
<td></td>
<td>pF</td>
</tr>
<tr>
<td>C_{rss}</td>
<td>Reverse Transfer Capacitance</td>
<td></td>
<td>45</td>
<td></td>
<td></td>
<td>pF</td>
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### SWITCHING CHARACTERISTICS (Note)

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<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>t_{D(on)}</td>
<td>Turn-On Delay Time</td>
<td>(V_{DD} = 5\ V, I_D = 1\ A, V_{GS} = 4.5\ V, R_{GEN} = 6\ Ω)</td>
<td>6</td>
<td>12</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>t_{r}</td>
<td>Turn-On Rise Time</td>
<td>(V_{DD} = 4.5\ V, R_{GEN} = 6\ Ω)</td>
<td>13</td>
<td>24</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>t_{D(off)}</td>
<td>Turn-Off Delay Time</td>
<td></td>
<td>15</td>
<td>27</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>t_{f}</td>
<td>Turn-Off Fall Time</td>
<td></td>
<td>4</td>
<td>10</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>Q_{g}</td>
<td>Total Gate Charge</td>
<td>(V_{GS} = 10\ V, I_D = 2.7\ A, V_{DS} = 5\ V)</td>
<td>5</td>
<td>7</td>
<td></td>
<td>nC</td>
</tr>
<tr>
<td>Q_{gs}</td>
<td>Gate-Source Charge</td>
<td></td>
<td>1.4</td>
<td></td>
<td></td>
<td>nC</td>
</tr>
<tr>
<td>Q_{gd}</td>
<td>Gate-Drain Charge</td>
<td></td>
<td>1.6</td>
<td></td>
<td></td>
<td>nC</td>
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### DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS

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<tr>
<th>Symbol</th>
<th>Parameter Description</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>I_S</td>
<td>Maximum Continuous Drain-Source Diode Forward Current</td>
<td></td>
<td>0.42</td>
<td></td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>V_{SD}</td>
<td>Drain-Source Diode Forward Voltage</td>
<td>(V_{GS} = 0\ V, I_D = 0.42\ A) (Note)</td>
<td>0.65</td>
<td>1.2</td>
<td></td>
<td>V</td>
</tr>
</tbody>
</table>

**Note:**
1. \(R_{JA}\) is the sum of the junction-to-case and case-to-ambient thermal resistance where the case thermal reference is defined as the solder mounting surface of the drain pins. \(R_{JA}\) is guaranteed by design while \(R_{CA}\) is determined by the user's board design.

Typical \(R_{JA}\) using the board layouts shown below on FR-4 PCB in a still air environment:

- a. 250°C/W when mounted on a 0.02 in² pad of 2oz Cu.
- b. 270°C/W when mounted on a minimum pad.

Scale 1 : 1 on letter size paper

2. Pulse Test: Pulse Width \(\leq 300\ \mu s\), Duty Cycle \(\leq 2.0\%\).
Typical Electrical Characteristics

Figure 1. On-Region Characteristics.

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

Figure 3. On-Resistance Variation with Temperature.

Figure 4. On-Resistance Variation with Gate-to-Source Voltage.

Figure 5. Transfer Characteristics.

Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature.
Typical Electrical Characteristics

Figure 7. Gate Charge Characteristics.

Figure 8. Capacitance Characteristics.

Figure 9. Maximum Safe Operating Area.

Figure 10. Single Pulse Maximum Power Dissipation.

Figure 11. Transient Thermal Response Curve.

Thermal characterization performed using the conditions described in note 1b. Transient thermal response will change depending on the circuit board design.
SuperSOT™-3 Tape and Reel Data and Package Dimensions

SSOT-3 Packaging
Configuration: Figure 1.0

SSOT-3 Std Unit Orientation
Conductive Embossed
Carrier Tape
Customize Label
Antistatic Cover Tape

SSOT-3 Std Packaging Information

<table>
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<tr>
<th>Packaging Option</th>
<th>Standard No Flow Code</th>
<th>D87Z</th>
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<tr>
<td>Packaging Type</td>
<td>TNR</td>
<td>TNR</td>
</tr>
<tr>
<td>Qty per Reel/Tube/Bag</td>
<td>3,000</td>
<td>10,000</td>
</tr>
<tr>
<td>Reel Size</td>
<td>7&quot; Dia</td>
<td>13&quot;</td>
</tr>
<tr>
<td>Box Dimension (mm)</td>
<td>343x343x64</td>
<td>343x343x64</td>
</tr>
<tr>
<td>Max qty per size</td>
<td>9,000</td>
<td>20,000</td>
</tr>
<tr>
<td>Weight per unit (gm)</td>
<td>0.0097</td>
<td>0.0097</td>
</tr>
<tr>
<td>Weight per Reel (kg)</td>
<td>0.1230</td>
<td>0.4150</td>
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<tr>
<td>Notes/Comments</td>
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SSOT-3 Std Unit Orientation

343mm x 342mm x 64mm
Intermediate box for D87Z Option

Human Readable Label sample

Human Readable Label

SuperSOT™-3 Tape Leader and Trailer
Configuration: Figure 2.0

SSOT-23 Tape Leader and Trailer
Configuration: Figure 2.0

Carrier Tape
Cover Tape
Human Readable Label

3P

Human Readable Label

107mm x 87mm x 183mm
Intermediate Box for Standard Option

3P

Human Readable Label

December 1998, Rev. B
SuperSOT™-3 Tape and Reel Data and Package Dimensions, continued

SSOT-3 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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<tbody>
<tr>
<td>SSOT-3</td>
<td>3.15</td>
<td>2.77</td>
<td>4.0</td>
<td>1.55</td>
<td>1.00</td>
<td>1.75</td>
<td>6.25</td>
<td>3.00</td>
<td>4.0</td>
<td>4.0</td>
<td>1.30</td>
<td>0.228</td>
<td>5.2</td>
<td>0.06</td>
</tr>
<tr>
<td>(8mm)</td>
<td>+/-0.10</td>
<td>+/-0.10</td>
<td>+/-0.2</td>
<td>+/-0.05</td>
<td>+/-0.10</td>
<td>+/-0.10</td>
<td>+/-0.3</td>
<td>+/-0.05</td>
<td>+/-0.1</td>
<td>+/-0.1</td>
<td>+/-0.10</td>
<td>+/-0.05</td>
<td>+/-0.3</td>
<td>+/-0.02</td>
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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

Sketch A (Side or Front Sectional View)
Component Rotation

Sketch B (Top View)
Component Rotation

SSOT-3 Reel Configuration: Figure 4.0

Dimensions are in inches and millimeters

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<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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<tbody>
<tr>
<td>8mm</td>
<td>7&quot; Dia</td>
<td>7.20</td>
<td>0.059</td>
<td>15.7</td>
<td>0.292</td>
<td>20.2</td>
<td>0.231-0.050-0.000</td>
<td>5.647</td>
<td>0.311 – 0.429</td>
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<tr>
<td></td>
<td>13&quot; Dia</td>
<td>9.00</td>
<td>0.059</td>
<td>23.1</td>
<td>0.292</td>
<td>20.2</td>
<td>0.231-0.050-0.000</td>
<td>5.647</td>
<td>0.311 – 0.429</td>
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See detail AA

Dec 1998, Rev. B
SuperSOT™-3 Tape and Reel Data and Package Dimensions, continued

SuperSOT™-3 (FS PKG Code 32)

Part Weight per unit (gram): 0.0097

NOTES: UNLESS OTHERWISE SPECIFIED
1. STANDARD LEAD FINISH TO BE 150 MICRONCHES / 3.81 MICROMETERS MINIMUM IN/LEAD (SOLDER) ON COPPER
2. NO JEDC REGISTRATION AS OF DEC. 1995.
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<td>CoolFET™</td>
<td>MICROWIRE™</td>
</tr>
<tr>
<td>CROSSVOLT™</td>
<td>POP™</td>
</tr>
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<td>E²CMOS™</td>
<td>PowerTrench™</td>
</tr>
<tr>
<td>FACT™</td>
<td>QS™</td>
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<td>FACT Quiet Series™</td>
<td>Quiet Series™</td>
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<td>FAST®</td>
<td>SuperSOT™-3</td>
</tr>
<tr>
<td>FASTr™</td>
<td>SuperSOT™-6</td>
</tr>
<tr>
<td>GTO™</td>
<td>SuperSOT™-8</td>
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<tr>
<td>HiSeC™</td>
<td>TinyLogic™</td>
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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

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