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**FDP22N50N**

**N-Channel UniFET™ II MOSFET**

500 V, 22 A, 220 mΩ

**Features**

- \( R_{\text{DS(on)}} = 185 \text{ mΩ (Typ.) @ } V_{\text{GS}} = 10 \text{ V, } I_D = 11 \text{ A} \)
- Low Gate Charge (Typ. 49 nC)
- Low \( C_{\text{GS}} \) (Typ. 24 pF)
- 100% Avalanche Tested
- Improve dv/dt Capability
- RoHS Compliant

**Applications**

- PDP TV
- Lighting
- Uninterruptible Power Supply
- AC-DC Power Supply

**Description**

UniFET™ II MOSFET is Fairchild Semiconductor’s high voltage MOSFET family based on advanced planar stripe and DMOS technology. This advanced MOSFET family has the smallest on-state resistance among the planar MOSFET, and also provides superior switching performance and higher avalanche energy strength. In addition, internal gate-source ESD diode allows UniFET II MOSFET to withstand over 2kV HBM surge stress. This device family is suitable for switching power converter applications such as power factor correction (PFC), flat panel display (FPD) TV power, ATX and electronic lamp ballasts.

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**MOSFET Maximum Ratings** \( T_C = 25^\circ \text{C} \) unless otherwise noted.

<table>
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<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>FDP22N50N</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>( V_{\text{DSS}} )</td>
<td>Drain to Source Voltage</td>
<td>500 V</td>
<td></td>
</tr>
<tr>
<td>( V_{\text{GSS}} )</td>
<td>Gate to Source Voltage</td>
<td>±30 V</td>
<td></td>
</tr>
<tr>
<td>( I_D )</td>
<td>Continuous (( T_C = 25^\circ \text{C} ))</td>
<td>22 A</td>
<td></td>
</tr>
<tr>
<td>( I_{DM} )</td>
<td>Continuous (( T_C = 100^\circ \text{C} ))</td>
<td>13.2 A</td>
<td></td>
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<tr>
<td>( E_{AS} )</td>
<td>Single Pulsed Avalanche Energy</td>
<td>1000 mJ</td>
<td></td>
</tr>
<tr>
<td>( I_{AR} )</td>
<td>Avalanche Current (Note 1)</td>
<td>22 A</td>
<td></td>
</tr>
<tr>
<td>( E_{AR} )</td>
<td>Repetitive Avalanche Energy (Note 1)</td>
<td>31.25 mJ</td>
<td></td>
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<tr>
<td>dv/dt</td>
<td>Peak Diode Recovery dv/dt (Note 3)</td>
<td>10 V/ns</td>
<td></td>
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<tr>
<td>( P_D )</td>
<td>Power Dissipation (( T_C = 25^\circ \text{C} ))</td>
<td>312.5 W</td>
<td></td>
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<tr>
<td>( T_J, T_{\text{STG}} )</td>
<td>Operating and Storage Temperature Range</td>
<td>-55 to +150 °C</td>
<td></td>
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<tr>
<td>( T_L )</td>
<td>Maximum Lead Temperature for Soldering, 1/8&quot; from Case for 5 Seconds</td>
<td>300 °C</td>
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**Thermal Characteristics**

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<td>( R_{\text{JC}} )</td>
<td>Thermal Resistance, Junction to Case, Max.</td>
<td>0.4</td>
<td>°C/W</td>
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<td>( R_{\text{JA}} )</td>
<td>Thermal Resistance, Junction to Ambient, Max.</td>
<td>62.5</td>
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<th>Tape Width</th>
<th>Quantity</th>
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<td>FDP22N50N</td>
<td>TO-220</td>
<td>Tube</td>
<td>N/A</td>
<td>N/A</td>
<td>50 units</td>
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### Electrical Characteristics \( T_C = 25^\circ C \) unless otherwise noted.

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<tr>
<td>BV_DSS</td>
<td>Drain to Source Breakdown Voltage</td>
<td>( I_D = 250 \mu A, V_{GS} = 0 ) ( V ), ( V_{DS} = 500 ) ( V ), ( V_{GS} = 0 ) ( V ), ( V_{DS} = 400 ) ( V ), ( T_C = 125^\circ C )</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>( \Delta B V_{DSS} / \Delta T_J )</td>
<td>Breakdown Voltage Temperature Coefficient</td>
<td>( I_D = 250 \mu A, ) Referenced to 25( ^\circ C )</td>
<td>-</td>
<td>0.45</td>
<td>-</td>
<td>( V/\circ C )</td>
</tr>
<tr>
<td>IDSS</td>
<td>Zero Gate Voltage Drain Current</td>
<td>( V_{DS} = 500 ) ( V ), ( V_{GS} = 0 ) ( V ), ( V_{DS} = 400 ) ( V ), ( T_C = 125^\circ C )</td>
<td>-</td>
<td>-</td>
<td>10</td>
<td>( \mu A )</td>
</tr>
<tr>
<td>IGSS</td>
<td>Gate to Body Leakage Current</td>
<td>( V_{GS} = \pm 30 ) ( V ), ( V_{DS} = 0 ) ( V )</td>
<td>-</td>
<td>-</td>
<td>( \pm 100 )</td>
<td>( nA )</td>
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### On Characteristics

<table>
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<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
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<tr>
<td>V_GS(th)</td>
<td>Gate Threshold Voltage</td>
<td>( V_{GS} = V_{DS}, I_D = 250 \mu A )</td>
<td>3.0</td>
<td>-</td>
<td>5.0</td>
<td>( V )</td>
</tr>
<tr>
<td>R_DS(on)</td>
<td>Static Drain to Source On Resistance</td>
<td>( V_{GS} = 10 ) ( V ), ( I_D = 11 ) ( A )</td>
<td>-</td>
<td>0.185</td>
<td>0.220</td>
<td>( \Omega )</td>
</tr>
<tr>
<td>gFS</td>
<td>Forward Transconductance</td>
<td>( V_{DS} = 20 ) ( V ), ( I_D = 11 ) ( A )</td>
<td>-</td>
<td>24.4</td>
<td>-</td>
<td>( S )</td>
</tr>
</tbody>
</table>

### Dynamic Characteristics

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<tr>
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<th>Test Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
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</thead>
<tbody>
<tr>
<td>Ciss</td>
<td>Input Capacitance</td>
<td>( V_{DS} = 25 ) ( V ), ( V_{GS} = 0 ) ( V ), ( f = 1 ) ( MHz )</td>
<td>-</td>
<td>2456</td>
<td>3200</td>
<td>( pF )</td>
</tr>
<tr>
<td>Coss</td>
<td>Output Capacitance</td>
<td>-</td>
<td>351</td>
<td>460</td>
<td>-</td>
<td>( pF )</td>
</tr>
<tr>
<td>Crss</td>
<td>Reverse Transfer Capacitance</td>
<td>-</td>
<td>24</td>
<td>50</td>
<td>-</td>
<td>( pF )</td>
</tr>
<tr>
<td>Q(tot)</td>
<td>Total Gate Charge at 10V</td>
<td>( V_{DS} = 400 ) ( V ), ( I_D = 22 ) ( A ), ( V_{GS} = 10 ) ( V )</td>
<td>-</td>
<td>49</td>
<td>65</td>
<td>( nC )</td>
</tr>
<tr>
<td>Qgs</td>
<td>Gate to Source Gate Charge</td>
<td>-</td>
<td>15</td>
<td>-</td>
<td>-</td>
<td>( nC )</td>
</tr>
<tr>
<td>Qgd</td>
<td>Gate to Drain &quot;Miller&quot; Charge</td>
<td>-</td>
<td>19</td>
<td>-</td>
<td>-</td>
<td>( nC )</td>
</tr>
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### Switching Characteristics

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<th>Symbol</th>
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<th>Test Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
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</thead>
<tbody>
<tr>
<td>Id(on)</td>
<td>Turn-On Delay Time</td>
<td>( V_{DD} = 250 ) ( V ), ( I_D = 22 ) ( A ), ( R_G = 4.7 ) ( \Omega )</td>
<td>-</td>
<td>22</td>
<td>55</td>
<td>( ns )</td>
</tr>
<tr>
<td>tr</td>
<td>Turn-On Rise Time</td>
<td>-</td>
<td>50</td>
<td>110</td>
<td>-</td>
<td>( ns )</td>
</tr>
<tr>
<td>Id(.off)</td>
<td>Turn-Off Delay Time</td>
<td>( V_{DD} = 250 ) ( V ), ( I_D = 22 ) ( A ), ( R_G = 4.7 ) ( \Omega )</td>
<td>-</td>
<td>48</td>
<td>110</td>
<td>( ns )</td>
</tr>
<tr>
<td>tf</td>
<td>Turn-Off Fall Time</td>
<td>-</td>
<td>35</td>
<td>80</td>
<td>-</td>
<td>( ns )</td>
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### Drain-Source Diode Characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
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<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
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<tr>
<td>IS</td>
<td>Maximum Continuous Drain to Source Diode Forward Current</td>
<td>-</td>
<td>-</td>
<td>22</td>
<td>( A )</td>
</tr>
<tr>
<td>ISM</td>
<td>Maximum Pulsed Drain to Source Diode Forward Current</td>
<td>-</td>
<td>-</td>
<td>88</td>
<td>( A )</td>
</tr>
<tr>
<td>V_SD</td>
<td>Drain to Source Diode Forward Voltage</td>
<td>( V_{GS} = 0 ) ( V ), ( I_{SD} = 22 ) ( A )</td>
<td>-</td>
<td>-</td>
<td>1.4</td>
</tr>
<tr>
<td>tr</td>
<td>Reverse Recovery Time</td>
<td>( V_{GS} = 0 ) ( V ), ( I_{SD} = 22 ) ( A )</td>
<td>-</td>
<td>472</td>
<td>-</td>
</tr>
<tr>
<td>Qr</td>
<td>Reverse Recovery Charge d( I_{F} / dt ) = 100 ( A/\mu s )</td>
<td>-</td>
<td>6.5</td>
<td>-</td>
<td>( \mu C )</td>
</tr>
</tbody>
</table>

**Notes:**
1. Repetitive rating: pulse-width limited by maximum junction temperature.
2. \( L = 4.1 \) \( mH \), \( I_{AS} = 22 \) \( A \), \( V_{DD} = 50 \) \( V \), \( R_G = 25 \) \( \Omega \), starting \( T_J = 25^\circ C \).
3. \( I_{SD} = 22 \) \( A \), \( dI_d/dt \leq 200 \) \( A/\mu s \), \( V_{DD} = BV_{DSS} \) starting \( T_J = 25^\circ C \).
4. Essentially independent of operating temperature typical characteristics.
Typical Performance Characteristics

Figure 1. On-Region Characteristics

Figure 2. Transfer Characteristics

Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

Figure 5. Capacitance Characteristics

Figure 6. Gate Charge Characteristics

*Notes:
1. 250 μs Pulse Test
2. TC = 25°C

VGS = 15.0V
10.0V
8.0V
7.0V
6.5V
6.0V
5.5V

VDS, Drain-Source Voltage [V]
0.1
1
10

I0, Drain Current [A]
0.2
0.1
0.05
0.1
1
10

RDS(ON) [Ω], Drain-Source On-Resistance
0.30
0.25
0.20
0.15
0.1
0
10
20
30
40
50
I0, Drain Current [A]

VDS = 10V
VDS = 20V

*Circuit: TJ = 25°C

VGS = 0V
2. f = 1MHz

Ciss = Cgs + Cgd (Cgs = shorted)
Coss = Cds + Cgd
Crss = Cgd

Coss

VDS, Drain-Source Voltage [V]
0.1
0.5
1
10
30

Capacitances [pF]
5000
4000
3000
2000
1000
0.1
0.5
1
10

VGS, Gate-Source Voltage [V]
0.1
0.5
1
10

Qg, Total Gate Charge [nC]
0
2
4
6
8
10

VGS = 100V
VGS = 250V
VGS = 400V

*Note: I0 = 22A
Typical Performance Characteristics (Continued)

**Figure 7. Breakdown Voltage Variation vs. Temperature**

![Graph showing Breakdown Voltage Variation](image)

*Notes:
1. $V_{GS} = 0\,\text{V}$
2. $I_{D} = 250\,\mu\text{A}$

**Figure 8. On-Resistance Variation vs. Temperature**

![Graph showing On-Resistance Variation](image)

*Notes:
1. $V_{GS} = 10\,\text{V}$
2. $I_{D} = 11\,\text{A}$

**Figure 9. Maximum Safe Operating Area**

![Graph showing Maximum Safe Operating Area](image)

*Notes:
1. $T_{C} = 25^\circ\text{C}$
2. $T_{J} = 150^\circ\text{C}$
3. Single Pulse

**Figure 10. Maximum Drain Current vs. Case Temperature**

![Graph showing Maximum Drain Current](image)

**Figure 11. Transient Thermal Response Curve**

![Graph showing Transient Thermal Response](image)

*Notes:
1. $Z_{\theta JC}(t) = 0.4\,^\circ\text{C/W}$ Max.
2. Duty Factor, $D = t_{1}/t_{2}$
3. $T_{JM} - T_{C} = P_{DM} \cdot Z_{\theta JC}(t)$
Figure 12. Gate Charge Test Circuit & Waveform

Figure 13. Resistive Switching Test Circuit & Waveforms

Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms
Figure 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms

- D = Gate Pulse Width
- Gate Pulse Period
- $V_{GS}$ (Driver)
- $V_{DS}$ (DUT)
- $I_{SD}$ (DUT)
- $I_{FM}$, Body Diode Forward Current
- $I_{RM}$, Body Diode Reverse Current
- $V_{DD}$
- $V_{SD}$
- Body Diode Recovery dv/dt
- Body Diode Forward Voltage Drop
Mechanical Dimensions

Figure 16. TO220, Molded, 3-Lead, Jedec Variation AB

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2. A critical component in any component of a life support device or system, or to affecting its safety or effectiveness.

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<th>Datasheet Identification</th>
<th>Product Status</th>
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<td>Datasheet contains the design specifications for product development. Specifications may change in any manner without notice.</td>
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