N-Channel Power MOSFET
60V, 50A, 22 mΩ

These N-Channel power MOSFETs are manufactured using the MegaFET process. This process, which uses feature sizes approaching those of LSI integrated circuits gives optimum utilization of silicon, resulting in outstanding performance. They were designed for use in applications such as switching regulators, switching converters, motor drivers, and relay drivers. These transistors can be operated directly from integrated circuits.

Formerly developmental type TA49018.

Features
- 50A, 60V
- \( r_{DS(ON)} = 0.022 \text{Ω} \)
- Temperature Compensating PSPICE® Model
- Peak Current vs Pulse Width Curve
- UIS Rating Curve
- 175°C Operating Temperature

Symbol

<table>
<thead>
<tr>
<th>PART NUMBER</th>
<th>PACKAGE</th>
<th>BRAND</th>
</tr>
</thead>
<tbody>
<tr>
<td>RFP50N06</td>
<td>TO-220AB</td>
<td>RFP50N06</td>
</tr>
</tbody>
</table>

Packaging
**Absolute Maximum Ratings** $T_C = 25^\circ C$, Unless Otherwise Specified

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>SYMBOL</th>
<th>TEST CONDITIONS</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drain to Source Voltage (Note 1)</td>
<td>$V_{DSS}$</td>
<td>$I_D = 250 \mu A, VGS = 0 \text{V}$ (Figure 11)</td>
<td>60</td>
<td>-</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>Drain to Gate Voltage ($R_{GS} = 20k\Omega$) (Note 1)</td>
<td>$V_{DGR}$</td>
<td>$I_D = 20 \mu A$</td>
<td>60</td>
<td>-</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>Gate to Source Voltage</td>
<td>$V_{GS}$</td>
<td></td>
<td>±20</td>
<td>-</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>Continuous Drain Current (Figure 2)</td>
<td>$I_D$</td>
<td></td>
<td>50</td>
<td>-</td>
<td>-</td>
<td>A</td>
</tr>
<tr>
<td>Pulsed Drain Current (Figure 5)</td>
<td>$I_{DM}$</td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>A</td>
</tr>
<tr>
<td>Pulsed Avalanche Rating (Figure 6)</td>
<td>$E_{AS}$</td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>W</td>
</tr>
<tr>
<td>Power Dissipation</td>
<td>$P_D$</td>
<td></td>
<td>131</td>
<td>-</td>
<td>-</td>
<td>W</td>
</tr>
<tr>
<td>Linear Derating Factor</td>
<td>$0.877$</td>
<td></td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>W/°C</td>
</tr>
<tr>
<td>Operating and Storage Temperature</td>
<td>$T_{J}$, $T_{STG}$</td>
<td></td>
<td>-55</td>
<td>-</td>
<td>175</td>
<td>°C</td>
</tr>
<tr>
<td>Maximum Temperature for Soldering</td>
<td>$T_L$</td>
<td></td>
<td>300</td>
<td>-</td>
<td>-</td>
<td>°C</td>
</tr>
<tr>
<td>Package Body for 10s, see Techbrief 334</td>
<td>$T_{pkg}$</td>
<td></td>
<td>260</td>
<td>-</td>
<td>-</td>
<td>°C</td>
</tr>
</tbody>
</table>

**CAUTION:** Stresses above those listed in “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

**NOTE:**
1. $T_J = 25^\circ C$ to $150^\circ C$.

**Electrical Specifications** $T_C = 25^\circ C$, Unless Otherwise Specified

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>SYMBOL</th>
<th>TEST CONDITIONS</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drain to Source Breakdown Voltage</td>
<td>$B_{V_{DSS}}$</td>
<td>$I_D = 250 \mu A, VGS = 0 \text{V}$ (Figure 11)</td>
<td>60</td>
<td>-</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>Gate to Source Threshold Voltage</td>
<td>$V_{GSS(TH)}$</td>
<td>$V_{GS} = V_{DS}, I_D = 250 \mu A$ (Figure 10)</td>
<td>2</td>
<td>-</td>
<td>4</td>
<td>V</td>
</tr>
<tr>
<td>Zero Gate Voltage Drain Current</td>
<td>$I_{DSS}$</td>
<td>$V_{DD} = 60 \text{V, } V_{GS} = 0 \text{V}$</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>μA</td>
</tr>
<tr>
<td>Gate to Source Leakage Current</td>
<td>$I_{GSS}$</td>
<td>$V_{GS} = \pm 20 \text{V}$</td>
<td>-</td>
<td>-</td>
<td>±100</td>
<td>μA</td>
</tr>
<tr>
<td>Drain to Source On Resistance</td>
<td>$R_{DS(ON)}$</td>
<td>$I_D = 50A, V_{GS} = 10\text{V}$ (Figures 9)</td>
<td>-</td>
<td>-</td>
<td>0.022</td>
<td>Ω</td>
</tr>
<tr>
<td>Turn-On Time</td>
<td>$t_{ON}$</td>
<td>$V_{DD} = 30 \text{V, } I_D = 50A$</td>
<td>-</td>
<td>-</td>
<td>95</td>
<td>ns</td>
</tr>
<tr>
<td>Turn-On Delay Time</td>
<td>$t_{d(ON)}$</td>
<td>$R_{G} = 3.6 \Omega, V_{GS} = 10 \text{V}$ (Figure 13)</td>
<td>-</td>
<td>-</td>
<td>12</td>
<td>ns</td>
</tr>
<tr>
<td>Rise Time</td>
<td>$t_{r}$</td>
<td></td>
<td>-</td>
<td>55</td>
<td>-</td>
<td>ns</td>
</tr>
<tr>
<td>Turn-Off Delay Time</td>
<td>$t_{d(OFF)}$</td>
<td></td>
<td>-</td>
<td>37</td>
<td>-</td>
<td>ns</td>
</tr>
<tr>
<td>Fall Time</td>
<td>$t_{f}$</td>
<td></td>
<td>-</td>
<td>13</td>
<td>-</td>
<td>ns</td>
</tr>
<tr>
<td>Turn-Off Time</td>
<td>$t_{OFF}$</td>
<td></td>
<td>-</td>
<td>75</td>
<td>-</td>
<td>ns</td>
</tr>
<tr>
<td>Total Gate Charge</td>
<td>$Q_{g(TOT)}$</td>
<td>$V_{GS} = 0 \text{ to } 20 \text{V}$</td>
<td>-</td>
<td>125</td>
<td>150</td>
<td>nC</td>
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<tr>
<td>Gate Charge at 10V</td>
<td>$Q_{g(10)}$</td>
<td>$V_{GS} = 0 \text{ to } 10 \text{V}$</td>
<td>-</td>
<td>67</td>
<td>80</td>
<td>nC</td>
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<tr>
<td>Threshold Gate Charge</td>
<td>$Q_{g(TH)}$</td>
<td>$V_{GS} = 0 \text{ to } 2 \text{V}$</td>
<td>-</td>
<td>3.7</td>
<td>4.5</td>
<td>nC</td>
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<tr>
<td>Input Capacitance</td>
<td>$C_{ISS}$</td>
<td>$V_{GS} = 25 \text{V, } V_{DS} = 0 \text{V}$ (Figure 12)</td>
<td>-</td>
<td>2020</td>
<td>-</td>
<td>pF</td>
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<tr>
<td>Output Capacitance</td>
<td>$C_{OSS}$</td>
<td>$f = 1 \text{MHz}$</td>
<td>-</td>
<td>600</td>
<td>-</td>
<td>pF</td>
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<tr>
<td>Reverse Transfer Capacitance</td>
<td>$C_{RSS}$</td>
<td></td>
<td>-</td>
<td>200</td>
<td>-</td>
<td>pF</td>
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<tr>
<td>Thermal Resistance Junction to Case</td>
<td>$R_{JJC}$</td>
<td></td>
<td>-</td>
<td>-</td>
<td>1.14</td>
<td>°C/W</td>
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<tr>
<td>Thermal Resistance Junction to Ambient</td>
<td>$R_{JJA}$</td>
<td></td>
<td>-</td>
<td>-</td>
<td>62</td>
<td>°C/W</td>
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</tbody>
</table>

**Source to Drain Diode Specifications**

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>SYMBOL</th>
<th>TEST CONDITIONS</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>UNITS</th>
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</thead>
<tbody>
<tr>
<td>Source to Drain Diode Voltage</td>
<td>$V_{SD}$</td>
<td>$I_{SD} = 50A$</td>
<td>-</td>
<td>-</td>
<td>1.5</td>
<td>V</td>
</tr>
<tr>
<td>Reverse Recovery Time</td>
<td>$t_{rr}$</td>
<td>$I_{SD} = 50A, dI_{SD}/dt = 100A/\mu s$</td>
<td>-</td>
<td>-</td>
<td>125</td>
<td>ns</td>
</tr>
</tbody>
</table>
**Typical Performance Curves**  Unless Otherwise Specified

**FIGURE 1. NORMALIZED POWER DISSIPATION vs CASE TEMPERATURE**

**FIGURE 2. MAXIMUM CONTINUOUS DRAIN CURRENT vs CASE TEMPERATURE**

**FIGURE 3. NORMALIZED MAXIMUM TRANSIENT THERMAL IMPEDANCE**

**FIGURE 4. FORWARD BIAS SAFE OPERATING AREA**

**FIGURE 5. PEAK CURRENT CAPABILITY**
NOTE: Refer to Fairchild Application Notes 9321 and 9322.

FIGURE 6. UNCLAMPED INDUCTIVE SWITCHING CAPABILITY

FIGURE 7. SATURATION CHARACTERISTICS

FIGURE 8. TRANSFER CHARACTERISTICS

FIGURE 9. NORMALIZED DRAIN TO SOURCE ON RESISTANCE vs JUNCTION TEMPERATURE

FIGURE 10. NORMALIZED GATE THRESHOLD VOLTAGE vs JUNCTION TEMPERATURE

FIGURE 11. NORMALIZED DRAIN TO SOURCE BREAKDOWN VOLTAGE vs JUNCTION TEMPERATURE
Typical Performance Curves  Unless Otherwise Specified  (Continued)

FIGURE 12. CAPACITANCE vs DRAIN TO SOURCE VOLTAGE

NOTE: Refer to Fairchild Application Notes AN7254 and AN7260.

FIGURE 13. NORMALIZED SWITCHING WAVEFORMS FOR CONSTANT GATE CURRENT

Test Circuits and Waveforms

FIGURE 14. UNCLAMPED ENERGY TEST CIRCUIT

VARY tP TO OBTAIN REQUIRED PEAK IAS

FIGURE 15. UNCLAMPED ENERGY WAVEFORMS

FIGURE 16. SWITCHING TIME TEST CIRCUIT

FIGURE 17. SWITCHING WAVEFORMS
Test Circuits and Waveforms (Continued)

![Gate Charge Test Circuit](image1)

![Gate Charge Waveforms](image2)

FIGURE 18. GATE CHARGE TEST CIRCUIT

FIGURE 19. GATE CHARGE WAVEFORMS
PSPICE Electrical Model

SUBCKT RFP50N06 2 1 3
REV 2/22/93
*NOM TEMP = 25°C

CA 12 8 3.68e-9
CB 15 14 3.625e-9
CIN 6 8 1.98e-9
DBODY 7 5 DBDMOD
DBREAK 5 11 DBKMOD
DPLCAP 10 5 DPLCAPMOD
EBREAK 11 7 17 18 64.59
EDS 14 8 5 8 1
EGS 13 8 8 1
ESG 6 10 6 8 1
EVTO 20 6 18 8 1
IT 8 17 1
LDRAIN 2 5 1e-9
LGATE 1 9 5.65e-9
LSOURCE 3 7 4.13e-9
MOS1 16 6 8 8 MOSMOD M=0.99
MOS2 16 21 8 8 MOSMOD M=0.01
RBREAK 17 18 RBKMOD 1
RDRAIN 5 16 RDSMOD 1e-4
RGATE 9 20 0.690
RIN 6 8 1e9
RSOURCE 8 7 RDSMOD 12e-3
RVTO 18 19 RVTOMOD 1
S1A 6 12 13 8 S1AMOD
S1B 13 12 13 8 S1BMOD
S2A 6 15 14 13 S2AMOD
S2B 13 15 14 13 S2BMOD
VBAT 8 19 DC 1
VTO 21 6 0.678

.MODEL DBDMOD D (IS=9.85e-13 RS=4.91e-3 TRS1=2.07e-3 TRS2=2.51e-7 CJO=2.05e-9 TT=4.33e-8)
.MODEL DBKMOD D (RS=1.98e-1 TRS1=2.35E-4 TRS2=-3.83e-6)
.MODEL DPLCAPMOD D (CJO=1.42e-9 IS=1e-30 N=10)
.MODEL MOSMOD NMOS (VTO=3.65 KP=35 IS=1e-30 N=10 TOX=1 L=1u W=1u)
.MODEL RBSMOD RES (TC1=1.23e-3 TC2=2.34e-7)
.MODEL RDSMOD RES (TC1=1.50e-3 TC2=1.49e-5)
.MODEL RVTOMOD RES (TC1=5.03e-3 TC2=5.16e-6)
.MODEL S1AMOD VSWITCH (RON=1e-5 ROFF=0.1 VON=6.75 VOFF=-2.5)
.MODEL S1BMOD VSWITCH (RON=1e-5 ROFF=0.1 VON=2.5 VOFF=-6.75)
.MODEL S2AMOD VSWITCH (RON=1e-5 ROFF=0.1 VON=2.7 VOFF=2.3)
.MODEL S2BMOD VSWITCH (RON=1e-5 ROFF=0.1 VON=2.3 VOFF=-2.7)

.ENDS

NOTE: For further discussion of the PSPICE model consult A New PSPICE Sub-Circuit for the Power MOSFET Featuring Global Temperature Options; authors, William J. Hepp and C. Frank Wheatley.
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<table>
<thead>
<tr>
<th>Datasheet Identification</th>
<th>Product Status</th>
<th>Definition</th>
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<tr>
<td>Advance Information</td>
<td>Formative / In Design</td>
<td>Datasheet contains the design specifications for product development. Specifications may change in any manner without notice.</td>
</tr>
<tr>
<td>Preliminary</td>
<td>First Production</td>
<td>Datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.</td>
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<tr>
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