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FQP5N60C / FQPF5N60C
N-Channel QFET® MOSFET
600 V, 4.5 A, 2.5 Ω

Description
This N-Channel enhancement mode power MOSFET is produced using Fairchild Semiconductor’s proprietary planar stripe and DMOS technology. This advanced MOSFET technology has been especially tailored to reduce on-state resistance, and to provide superior switching performance and high avalanche energy strength. These devices are suitable for switched mode power supplies, active power factor correction (PFC), and electronic lamp ballasts.

Features
- 4.5 A, 600 V, \( R_{DS(on)} = 2.5 \Omega \) (Max.) @ \( V_{GS} = 10 \) V, \( I_D = 2.25 \) A
- Low Gate Charge (Typ. 15 nC)
- Low Crss (Typ. 6.5 pF)
- 100% Avalanche Tested

Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter Description</th>
<th>FQP5N60C</th>
<th>FQPF5N60C</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>( V_{DSS} )</td>
<td>Drain-Source Voltage</td>
<td>600 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( I_D )</td>
<td>Drain Current - Continuous (( T_C = 25^\circ C ))</td>
<td>4.5 A</td>
<td>4.5 A</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.6 A</td>
<td>2.6 A</td>
<td>A</td>
</tr>
<tr>
<td>( I_{DM} )</td>
<td>Drain Current - Pulsed (Note 1)</td>
<td>18 A</td>
<td>18 A</td>
<td>A</td>
</tr>
<tr>
<td>( V_{GSS} )</td>
<td>Gate-Source Voltage</td>
<td>( \pm 30 ) V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( E_{AS} )</td>
<td>Single Pulsed Avalanche Energy (Note 2)</td>
<td>210 mJ</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( I_{AR} )</td>
<td>Avalanche Current (Note 1)</td>
<td>4.5 A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( E_{AR} )</td>
<td>Repetitive Avalanche Energy (Note 1)</td>
<td>10 mJ</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \frac{dV}{dt} )</td>
<td>Peak Diode Recovery ( \frac{dV}{dt} ) (Note 3)</td>
<td>4.5 V/ns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( P_D )</td>
<td>Power Dissipation (( T_C = 25^\circ C ))</td>
<td>100 W</td>
<td>33 W</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Derate above 25°C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.8 W/°C</td>
<td>0.26 W/°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( T_J, T_{STG} )</td>
<td>Operating and Storage Temperature Range</td>
<td>-55 to +150 °C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( T_L )</td>
<td>Maximum Lead Temperature for Soldering, 1/8” from Case for 5 Seconds</td>
<td>300 °C</td>
<td></td>
<td></td>
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</table>

* Drain current limited by maximum junction temperature.

Thermal Characteristics

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<tr>
<th>Symbol</th>
<th>Parameter Description</th>
<th>FQP5N60C</th>
<th>FQPF5N60C</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>( R_{JUC} )</td>
<td>Thermal Resistance, Junction-to-Case, Max.</td>
<td>1.25 °C/W</td>
<td>3.79 °C/W</td>
<td></td>
</tr>
<tr>
<td>( R_{ICS} )</td>
<td>Thermal Resistance, Case-to-Sink Typ, Max.</td>
<td>0.5 °C/W</td>
<td>-- °C/W</td>
<td></td>
</tr>
<tr>
<td>( R_{JA} )</td>
<td>Thermal Resistance, Junction-to-Ambient, Max.</td>
<td>62.5 °C/W</td>
<td>62.5 °C/W</td>
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## Package Marking and Ordering Information

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<th>Top Mark</th>
<th>Package</th>
<th>Packing Method</th>
<th>Reel Size</th>
<th>Tape Width</th>
<th>Quantity</th>
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</thead>
<tbody>
<tr>
<td>FQP5N60C</td>
<td>FQP5N60C</td>
<td>TO-220</td>
<td>Tube</td>
<td>N/A</td>
<td>N/A</td>
<td>50 units</td>
</tr>
<tr>
<td>FQP5N60C</td>
<td>FQP5N60C</td>
<td>TO-220F</td>
<td>Tube</td>
<td>N/A</td>
<td>N/A</td>
<td>50 units</td>
</tr>
</tbody>
</table>

## Electrical Characteristics

- \( T_C = 25^\circ C \) unless otherwise noted.

### Off Characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Test Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>( B_{VDSS} )</td>
<td>Drain-Source Breakdown Voltage ( V_{GS} = 0 \ V, \ I_D = 250 \mu A )</td>
<td>600</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>V</td>
</tr>
<tr>
<td>( \Delta B_{VDSS} / \Delta T_J )</td>
<td>Breakdown Voltage Temperature Coefficient ( I_D = 250 \mu A, ) Referenced to 25(^\circ C )</td>
<td>-- ( 0.6 )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( I_{DSS} )</td>
<td>Zero Gate Voltage Drain Current ( V_D = 600 \ V, \ V_{GS} = 0 \ V )</td>
<td>-- ( 1 \mu A )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( I_{GSSF} )</td>
<td>Gate-Body Leakage Current, Forward ( V_{GS} = 30 \ V, \ V_D = 0 \ V )</td>
<td>-- ( 100 ) nA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( I_{GSSR} )</td>
<td>Gate-Body Leakage Current, Reverse ( V_D = -30 \ V, \ V_D = 0 \ V )</td>
<td>-- ( -100 ) nA</td>
<td></td>
<td></td>
<td></td>
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</table>

### On Characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Test Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>( V_{GS(th)} )</td>
<td>Gate Threshold Voltage ( V_D = V_{GS}, \ I_D = 250 \mu A )</td>
<td>2.0 ( 4.0 ) V</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( R_{DS(on)} )</td>
<td>Static Drain-Source On-Resistance ( V_D = 10 \ V, \ I_D = 2.25 ) A</td>
<td>-- ( 2.0 ) ( 2.5 ) ( \Omega )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( g_{FS} )</td>
<td>Forward Transconductance ( V_D = 40 \ V, \ I_D = 2.25 ) A</td>
<td>-- ( 4.7 ) ( S )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Dynamic Characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Test Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>( C_{iss} )</td>
<td>Input Capacitance ( V_D = 25 \ V, \ V_{GS} = 0 \ V, )</td>
<td>-- ( 515 ) ( 670 ) pF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( C_{oss} )</td>
<td>Output Capacitance ( f = 1.0 ) MHz, ( V_D = V_{GS} = 0 ) ( \mu A )</td>
<td>-- ( 55 ) ( 72 ) pF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( C_{rss} )</td>
<td>Reverse Transfer Capacitance ( f = 1.0 ) MHz, ( V_D = V_{GS} = 0 ) ( \mu A )</td>
<td>-- ( 6.5 ) ( 8.5 ) pF</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</table>

### Switching Characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Test Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>( t_{D(on)} )</td>
<td>Turn-On Delay Time ( V_D = 300 \ V, \ I_D = 4.5 ) A</td>
<td>-- ( 10 ) ( 30 ) ns</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( t_r )</td>
<td>Turn-On Rise Time ( A, R_G = 25 ) ( \Omega )</td>
<td>-- ( 42 ) ( 90 ) ns</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( t_{D(off)} )</td>
<td>Turn-Off Delay Time ( V_D = 480 \ V, I_D = 4.5 ) A</td>
<td>-- ( 38 ) ( 85 ) ns</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( t_f )</td>
<td>Turn-Off Fall Time ( A, R_G = 25 ) ( \Omega )</td>
<td>-- ( 46 ) ( 100 ) ns</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( Q_g )</td>
<td>Total Gate Charge ( V_D = 480 \ V, I_D = 4.5 ) A</td>
<td>-- ( 15 ) ( 19 ) nC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( Q_{gs} )</td>
<td>Gate-Source Charge ( V_D = 10 ) V</td>
<td>-- ( 2.5 ) ( nC )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( Q_{gd} )</td>
<td>Gate-Drain Charge ( V_D = 480 \ V, I_D = 4.5 ) A</td>
<td>-- ( 6.6 ) ( nC )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Drain-Source Diode Characteristics and Maximum Ratings

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>( I_D )</td>
<td>Maximum Continuous Drain-Source Diode Forward Current</td>
<td>--</td>
<td>--</td>
<td>4.5</td>
<td>A</td>
</tr>
<tr>
<td>( I_{SM} )</td>
<td>Maximum Pulsed Drain-Source Diode Forward Current</td>
<td>--</td>
<td>--</td>
<td>18</td>
<td>A</td>
</tr>
<tr>
<td>( V_{SD} )</td>
<td>Drain-Source Diode Forward Voltage ( V_D = 0 ) V, ( I_D = 4.5 ) A</td>
<td>--</td>
<td>--</td>
<td>1.4</td>
<td>V</td>
</tr>
<tr>
<td>( t_r )</td>
<td>Reverse Recovery Time ( V_D = 0 ) V, ( I_D = 4.5 ) A, ( dI_F / dt = 100 ) ( A / \mu s )</td>
<td>--</td>
<td>300</td>
<td>--</td>
<td>ns</td>
</tr>
<tr>
<td>( Q_{rr} )</td>
<td>Reverse Recovery Charge ( dI_F / dt = 100 ) ( A / \mu s )</td>
<td>--</td>
<td>2.2</td>
<td>--</td>
<td>( \mu C )</td>
</tr>
</tbody>
</table>

**Notes:**
1. Repetitive rating: pulse-width limited by maximum junction temperature.
2. \( L = 18.9 \) \( mH \), \( I_{DS} = 4.5 \) A, \( V_{DD} = 50 \) V, \( R_G = 25 \) \( \Omega \), starting \( T_J = 25^\circ C \).
3. \( I_{DS} = 4.5 \) A, \( di/dt \leq 200 \) \( A / \mu s \), \( V_{DD} \leq B_{VDS}, \) starting \( T_J = 25^\circ C \).
4. Essentially independent of operating temperature.
Typical 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 with Source Current and Temperature

Figure 5. Capacitance Characteristics

Figure 6. Gate Charge Characteristics
Typical Characteristics

Figure 7. Breakdown Voltage Variation vs Temperature

Figure 8. On-Resistance Variation vs Temperature

Figure 9-1. Maximum Safe Operating Area for FQP5N60C

Figure 9-2. Maximum Safe Operating Area for FQPF5N60C

Figure 10. Maximum Drain Current vs Case Temperature
Typical Characteristics (Continued)

Figure 11-1. Transient Thermal Response Curve for FQP5N60C

Figure 11-2. Transient Thermal Response Curve for FQPF5N60C
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
Figure 16. TO-220, Molded, 3-Lead, Jedec Variation AB

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Figure 17. TO220, Molded, 3-Lead, Full Pack, EIAJ SC91, Straight Lead

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<th>Product Status</th>
<th>Definition</th>
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