General Description
These N-Channel enhancement mode power field effect transistors are produced using Fairchild's proprietary, planar stripe, DMOS technology. This advanced technology has been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode. These devices are well suited for high efficiency switched mode power supplies, active power factor correction, electronic lamp ballasts based on half bridge topology.

Features
- 5.5A, 600V, \( R_{DS(on)} = 2.0 \Omega \) \( @V_{GS} = 10 \ V \)
- Low gate charge ( typical 16 nC)
- Low Crss ( typical 7 pF)
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability

Absolute Maximum Ratings \( T_C = 25^\circ C \) unless otherwise noted

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>FQP6N60C</th>
<th>FQPF6N60C</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>( V_{DSS} )</td>
<td>Drain-Source Voltage</td>
<td>600</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>( I_D )</td>
<td>Drain Current - Continuous ( (T_C = 25^\circ C) )</td>
<td>5.5</td>
<td>5.5 *</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>- Continuous ( (T_C = 100^\circ C) )</td>
<td>3.3</td>
<td>3.3 *</td>
<td>A</td>
</tr>
<tr>
<td>( I_{DM} )</td>
<td>Drain Current - Pulsed ( (Note 1) )</td>
<td>22</td>
<td>22 *</td>
<td>A</td>
</tr>
<tr>
<td>( V_{GSS} )</td>
<td>Gate-Source Voltage</td>
<td>( \pm 30 )</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>( E_{AS} )</td>
<td>Single Pulsed Avalanche Energy ( (Note 2) )</td>
<td>300</td>
<td></td>
<td>mJ</td>
</tr>
<tr>
<td>( I_{AR} )</td>
<td>Avalanche Current ( (Note 1) )</td>
<td>5.5</td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>( E_{AR} )</td>
<td>Repetitive Avalanche Energy ( (Note 1) )</td>
<td>12.5</td>
<td></td>
<td>mJ</td>
</tr>
<tr>
<td>( \text{d}v/\text{d}t )</td>
<td>Peak Diode Recovery ( \text{d}v/\text{d}t ) ( (Note 3) )</td>
<td>4.5</td>
<td></td>
<td>V/ns</td>
</tr>
<tr>
<td>( P_D )</td>
<td>Power Dissipation ( (T_C = 25^\circ C) )</td>
<td>125</td>
<td>40</td>
<td>W</td>
</tr>
<tr>
<td></td>
<td>- Derate above 25°C</td>
<td>1.0</td>
<td>0.31</td>
<td>W/°C</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, 1/8&quot; from case for 5 seconds</td>
<td>300</td>
<td></td>
<td>°C</td>
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</table>

* Drain current limited by maximum junction temperature.

Thermal Characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>FQP6N60C</th>
<th>FQPF6N60C</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>( R_{JUC} )</td>
<td>Thermal Resistance, Junction-to-Case</td>
<td>1.0</td>
<td>3.2</td>
<td>°C/W</td>
</tr>
<tr>
<td>( R_{JCS} )</td>
<td>Thermal Resistance, Case-to-Sink Typ.</td>
<td>0.5</td>
<td>--</td>
<td>°C/W</td>
</tr>
<tr>
<td>( R_{JUA} )</td>
<td>Thermal Resistance, Junction-to-Ambient</td>
<td>62.5</td>
<td>62.5</td>
<td>°C/W</td>
</tr>
<tr>
<td>Symbol</td>
<td>Parameter</td>
<td>Test Conditions</td>
<td>Min</td>
<td>Typ</td>
</tr>
<tr>
<td>-------------</td>
<td>------------------------------------</td>
<td>--------------------------</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>BV_{DSS}</td>
<td>Drain-Source Breakdown Voltage</td>
<td>V_{GS} = 0 V, I_{D} = 250 μA</td>
<td>600</td>
<td>--</td>
</tr>
<tr>
<td>\Delta BV_{DSS} / \Delta T_{J}</td>
<td>Breakdown Voltage Temperature Coefficient</td>
<td>I_{D} = 250 μA, Referenced to 25°C</td>
<td>--</td>
<td>0.6</td>
</tr>
<tr>
<td>I_{DSS}</td>
<td>Zero Gate Voltage Drain Current</td>
<td>V_{DS} = 600 V, V_{GS} = 0 V</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V_{DS} = 480 V, T_{J} = 125°C</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>I_{GSSF}</td>
<td>Gate-Body Leakage Current, Forward</td>
<td>V_{GS} = 30 V, V_{DS} = 0 V</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>I_{GSRR}</td>
<td>Gate-Body Leakage Current, Reverse</td>
<td>V_{GS} = -30 V, V_{DS} = 0 V</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V_{GS(th)}</td>
<td>Gate Threshold Voltage</td>
<td>V_{DS} = V_{GS}, I_{D} = 250 μA</td>
<td>2.0</td>
<td>--</td>
</tr>
<tr>
<td>R_{DS(on)}</td>
<td>Static Drain-Source On-Resistance</td>
<td>V_{GS} = 10 V, I_{D} = 2.75 A</td>
<td>--</td>
<td>1.7</td>
</tr>
<tr>
<td>g_{FS}</td>
<td>Forward Transconductance</td>
<td>V_{DS} = 40 V, I_{D} = 2.75 A</td>
<td>--</td>
<td>4.8</td>
</tr>
<tr>
<td>C_{iss}</td>
<td>Input Capacitance</td>
<td>V_{DS} = 25 V, V_{GS} = 0 V, f = 1.0 MHz</td>
<td>--</td>
<td>620</td>
</tr>
<tr>
<td>C_{oss}</td>
<td>Output Capacitance</td>
<td></td>
<td>--</td>
<td>65</td>
</tr>
<tr>
<td>C_{rss}</td>
<td>Reverse Transfer Capacitance</td>
<td></td>
<td>--</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>t_{on}</td>
<td>Turn-On Delay Time</td>
<td>V_{DD} = 300 V, I_{D} = 5.5 A, R_{G} = 25 Ω</td>
<td>--</td>
<td>15</td>
</tr>
<tr>
<td>t_{r}</td>
<td>Turn-On Rise Time</td>
<td></td>
<td>--</td>
<td>45</td>
</tr>
<tr>
<td>t_{off}</td>
<td>Turn-Off Delay Time</td>
<td></td>
<td>--</td>
<td>45</td>
</tr>
<tr>
<td>t_{f}</td>
<td>Turn-Off Fall Time</td>
<td></td>
<td>--</td>
<td>45</td>
</tr>
<tr>
<td>Q_{g}</td>
<td>Total Gate Charge</td>
<td>V_{DS} = 480 V, I_{D} = 5.5 A, V_{GS} = 10 V</td>
<td>--</td>
<td>16</td>
</tr>
<tr>
<td>Q_{gs}</td>
<td>Gate-Source Charge</td>
<td></td>
<td>--</td>
<td>3.5</td>
</tr>
<tr>
<td>Q_{gd}</td>
<td>Gate-Drain Charge</td>
<td></td>
<td>--</td>
<td>6.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I_{S}</td>
<td>Maximum Continuous Drain-Source Diode Forward Current</td>
<td>--</td>
<td>--</td>
<td>5.5</td>
</tr>
<tr>
<td>I_{SM}</td>
<td>Maximum Pulsed Drain-Source Diode Forward Current</td>
<td>--</td>
<td>--</td>
<td>22</td>
</tr>
<tr>
<td>V_{SD}</td>
<td>Drain-Source Diode Forward Voltage</td>
<td>V_{GS} = 0 V, I_{S} = 5.5 A</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>t_{rr}</td>
<td>Reverse Recovery Time</td>
<td>V_{GS} = 0 V, I_{S} = 5.5 A, dI_{F} / dt = 100 A/μs</td>
<td>--</td>
<td>310</td>
</tr>
<tr>
<td>Q_{rr}</td>
<td>Reverse Recovery Charge</td>
<td></td>
<td>--</td>
<td>2.1</td>
</tr>
</tbody>
</table>

Notes:
1. Repetitive Rating : Pulse width limited by maximum junction temperature.
2. L = 18.2mH, I_{DSS} = 5.5 A, V_{DD} = 50V, R_{G} = 25 Ω, Starting T_{J} = 25°C
3. I_{GS} ≤ 5.5 A, dI_{G} / dt ≤ 200A/μs, V_{DD} = BV_{DSS}, Starting T_{J} = 25°C
4. Pulse Test : Pulse width ≤ 300μs, Duty cycle ≤ 2%
5. Essentially independent of operating temperature.
Typical Characteristics (Continued)

**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**

Notes:
1. VGS = 0V
2. 250µs Pulse Test
3. TC = 25°C
4. VDS = 40V
5. ID = 5.5A
6. Notes: 1. VGS = 10V 2. VGS = 20V 3. VGS = 30V 4. VGS = 48V 5. Note: 1 = 5.5A

Capacitances [pF]:
- Ciss = Cgs + Cgd (Cds = shorted)
- Coss = Cds + Cgd
- Crss = Cgd

Notes:
- VDS = 300V
- VDS = 120V
- VDS = 480V

RDS(ON), Drain-Source On-Resistance
- ID, Drain Current [A]
- VDS, Drain-Source Voltage [V]
Typical Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs Temperature

Figure 8. On-Resistance Variation vs Temperature

Figure 9-1. Maximum Safe Operating Area for FQP6N60C

Figure 9-2. Maximum Safe Operating Area for FQP6N60C

Figure 10. Maximum Drain Current vs Case Temperature

Notes:
1. VGS = 0 V
2. ID = 250 µA
3. Single Pulse

BVDSS, (Normalized)
Drain-Source Breakdown Voltage
TJ, Junction Temperature [°C]

25 50 75 100 125 150
0 1 2 3
ID, Drain Current [A]

10^-2 10^-1 10^0 10^1 10^2

Operation in This Area is Limited by RDS(on)

Notes:
1. TC = 25°C
2. TJ = 150°C
3. Single Pulse

VDS, Drain-Source Voltage [V]

10^-2 10^-1 10^0 10^1 10^2

10^0 10^-1 10^-2

ID, Drain Current [A]

10^-2 10^-1 10^0 10^1 10^2

Operation in This Area is Limited by RDS(on)

Notes:
1. TC = 25°C
2. TJ = 150°C
3. Single Pulse

VDS, Drain-Source Voltage [V]

10^-2 10^-1 10^0 10^1 10^2

10^0 10^-1 10^-2

ID, Drain Current [A]

10^-2 10^-1 10^0 10^1 10^2

Operation in This Area is Limited by RDS(on)

Notes:
1. VGS = 10 V
2. ID = 2.5 A
3. Single Pulse
Typical Characteristics (Continued)

Figure 11-1. Transient Thermal Response Curve for FQP6N60C

Figure 11-2. Transient Thermal Response Curve for FQPF6N60C

Notes:
1. $Z_{\theta JC}(t) = 1.00 \text{ W Max.}$
2. Duty Factor, $D = t_1 / t_2$
3. $T_JM - T_C = P_{DM} * Z_{\theta JC}(t)$

$Z_{\theta JC}(t)$, Thermal Response

$t_1$, Square Wave Pulse Duration [sec]
Gate Charge Test Circuit & Waveform

Resistive Switching Test Circuit & Waveforms

Unclamped Inductive Switching Test Circuit & Waveforms
Peak Diode Recovery dv/dt Test Circuit & Waveforms

- **DUT**
- **VDS**
- **Driver**
- **RG**
- **Same Type as DUT**
- **VGS** • dv/dt controlled by **RG**
- • **I SD** controlled by pulse period
- **VDD**
- **L**
- **I SD**
- **10V**
- **VGS (Driver)**
- **D = Gate Pulse Width**
- **Gate Pulse Period**
- **VDD**
- **Body Diode**
- **Forward Voltage Drop**
- **VSD**
- **Body Diode Forward Current**
- **IRM**
- **Body Diode Reverse Current**
- **VDS (DUT)**
- **Body Diode Recovery dv/dt**
- **VSD**
- **VDD**
- **Body Diode Forward Voltage Drop**
Package Dimensions (Continued)

TO-220F

Dimensions in Millimeters
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- MicroPak™
- MICRO WIRE™
- MSX™
- MSXPro™
- OCX™
- OCXPro™
- OptoLOGIC®
- OptoPLANAR™
- POP™
- Power247™
- PowerSaver™
- PowerTrench®
- QFET®
- QS™
- QT Optoelectronics™
- Quiet Series™
- RapidConfigure™
- RapidConnect™
- Silent Switcher®
- SMART START™
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- SuperSOT™
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- UHC™
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- VCX™

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PRODUCT STATUS DEFINITIONS

Definition of Terms

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<th>Datasheet Identification</th>
<th>Product Status</th>
<th>Definition</th>
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<tr>
<td>Advance Information</td>
<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>First Production</td>
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