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FQP30N06L

N-Channel QFET® MOSFET

60 V, 32 A, 35 mΩ

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, audio amplifier, DC motor control, and variable switching power applications.

Features

• 32 A, 60 V, \( R_{DS(on)} = 35 \text{ mΩ} \) (Max.) @ \( V_{GS} = 10 \text{ V}, I_D = 16 \text{ A} \)
• Low Gate Charge (Typ. 15 nC)
• Low Crss (Typ. 50 pF)
• 100% Avalanche Tested
• 175°C Maximum Junction Temperature Rating

Absolute Maximum Ratings

\( T_C = 25°C \) unless otherwise noted.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>FQP30N06L</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>( V_{DSS} )</td>
<td>Drain-Source Voltage</td>
<td>60</td>
<td>V</td>
</tr>
<tr>
<td>( I_D )</td>
<td>Drain Current</td>
<td>32</td>
<td>A</td>
</tr>
<tr>
<td>( V_{GSS} )</td>
<td>Gate-Source Voltage</td>
<td>±20</td>
<td>V</td>
</tr>
<tr>
<td>( E_{AS} )</td>
<td>Single Pulsed Avalanche Energy</td>
<td>350</td>
<td>mJ</td>
</tr>
<tr>
<td>( I_{AR} )</td>
<td>Avalanche Current</td>
<td>32</td>
<td>A</td>
</tr>
<tr>
<td>( E_{AR} )</td>
<td>Repetitive Avalanche Energy</td>
<td>7.9</td>
<td>mJ</td>
</tr>
<tr>
<td>( d\text{v/dt} )</td>
<td>Peak Diode Recovery dv/dt</td>
<td>7.0</td>
<td>V/ns</td>
</tr>
<tr>
<td>( P_D )</td>
<td>Power Dissipation (( T_C = 25°C ))</td>
<td>79</td>
<td>W</td>
</tr>
<tr>
<td>( R_{\theta JC} )</td>
<td>Thermal Resistance, Junction-to-Case, Max.</td>
<td>1.90</td>
<td>°C/W</td>
</tr>
<tr>
<td>( T_J, T_{STG} )</td>
<td>Operating and Storage Temperature Range</td>
<td>-55 to +175</td>
<td>°C</td>
</tr>
<tr>
<td>( T_L )</td>
<td>Maximum Lead Temperature for Soldering, 1/8” from Case for 5 seconds</td>
<td>300</td>
<td>°C</td>
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Thermal Characteristics

<table>
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<th>Unit</th>
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<tbody>
<tr>
<td>( R_{\theta JC} )</td>
<td>Thermal Resistance, Junction-to-Case, Max.</td>
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<td>°C/W</td>
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<td>( R_{\theta JA} )</td>
<td>Thermal Resistance, Junction-to-Ambient, Max.</td>
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<td>°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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<tbody>
<tr>
<td>FQP30N06L</td>
<td>FQP30N06L</td>
<td>TO-220</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.

<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>( BVDSS )</td>
<td>Drain-Source Breakdown Voltage</td>
<td>( V_{GS} = 0 ), ( I_D = 250 , \mu A )</td>
<td>60</td>
<td>--</td>
<td>--</td>
<td>V</td>
</tr>
</tbody>
</table>
| \( \Delta BVDSS \)  
\( / \Delta T_J \)  
\( I_DSS \)  
\( I_{GSSF} \)  
\( I_{GSSR} \) | Breakdown Voltage Temperature Coefficient \( I_D = 250 \, \mu A \), Referenced to 25°C \( V_{DS} = 60 \, V \), \( V_{GS} = 0 \, V \) \( I_D = 25 \, A \), \( V_{DS} = 48 \, V \), \( T_C = 150^\circ C \) \( V_{GS} = 20 \, V \), \( V_{DS} = 0 \, V \) \( V_{GS} = -20 \, V \), \( V_{DS} = 0 \, V \) | -- | 0.06 | -- | V/°C |
| \( I_{GSSF} \)  
\( I_{GSSR} \) | Zero Gate Voltage Drain Current   | \( V_{GS} = 0 \, V \), \( I_D = 250 \, \mu A \) | -- | 1   | -- | \( \mu A \) |
| \( I_{GSSR} \) | Gate-Body Leakage Current, Reverse  | \( V_{GS} = 0 \, V \), \( V_{DS} = 0 \, V \) | -- | 100 | -- | nA   |
| \( I_{GSSF} \) | Gate-Body Leakage Current, Forward | \( V_{GS} = 0 \, V \), \( V_{DS} = 0 \, V \) | -- | 100 | -- | nA   |

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</td>
<td>( V_{DS} = V_{GS}, I_D = 250 , \mu A )</td>
<td>1.0</td>
<td>--</td>
<td>2.5</td>
<td>V</td>
</tr>
<tr>
<td>( R_{DS(on)} )</td>
<td>Static Drain-Source On-Resistance</td>
<td>( V_{GS} = 10 , V ), ( I_D = 16 , A ) ( V_{GS} = 5 , V ), ( I_D = 16 , A )</td>
<td>--</td>
<td>0.027</td>
<td>0.035</td>
<td>( \Omega )</td>
</tr>
<tr>
<td>( g_{FS} )</td>
<td>Forward Transconductance</td>
<td>( V_{DS} = 25 , V ), ( I_D = 16 , A )</td>
<td>--</td>
<td>24</td>
<td>--</td>
<td>S</td>
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</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</td>
<td>( V_{DS} = 25 , V ), ( V_{GS} = 0 , V ), ( f = 1.0 , MHz )</td>
<td>--</td>
<td>800</td>
<td>1040</td>
<td>pF</td>
</tr>
<tr>
<td>( C_{oss} )</td>
<td>Output Capacitance</td>
<td></td>
<td>--</td>
<td>270</td>
<td>350</td>
<td>pF</td>
</tr>
<tr>
<td>( C_{rss} )</td>
<td>Reverse Transfer Capacitance</td>
<td></td>
<td>--</td>
<td>50</td>
<td>65</td>
<td>pF</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_{(on)} )</td>
<td>Turn-On Delay Time</td>
<td>( V_{DD} = 30 , V ), ( I_D = 16 , A ), ( R_G = 25 , \Omega )</td>
<td>--</td>
<td>15</td>
<td>40</td>
<td>ns</td>
</tr>
<tr>
<td>( t_r )</td>
<td>Turn-On Rise Time</td>
<td></td>
<td>--</td>
<td>210</td>
<td>430</td>
<td>ns</td>
</tr>
<tr>
<td>( t_{(off)} )</td>
<td>Turn-Off Delay Time</td>
<td></td>
<td>--</td>
<td>60</td>
<td>130</td>
<td>ns</td>
</tr>
<tr>
<td>( t_f )</td>
<td>Turn-Off Fall Time</td>
<td></td>
<td>--</td>
<td>110</td>
<td>230</td>
<td>ns</td>
</tr>
<tr>
<td>( Q_g )</td>
<td>Total Gate Charge</td>
<td>( V_{DS} = 48 , V ), ( I_D = 32 , A ), ( V_{GS} = 5 , V )</td>
<td>--</td>
<td>15</td>
<td>20</td>
<td>nC</td>
</tr>
<tr>
<td>( Q_{gs} )</td>
<td>Gate-Source Charge</td>
<td></td>
<td>--</td>
<td>3.5</td>
<td>--</td>
<td>nC</td>
</tr>
<tr>
<td>( Q_{gd} )</td>
<td>Gate-Drain Charge</td>
<td></td>
<td>--</td>
<td>8.5</td>
<td>--</td>
<td>nC</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_S )</td>
<td>Maximum Continuous Drain-Source Diode Forward Current</td>
<td>--</td>
<td>--</td>
<td>32</td>
<td>A</td>
</tr>
<tr>
<td>( I_{DM} )</td>
<td>Maximum Pulsed Drain-Source Diode Forward Current</td>
<td>--</td>
<td>--</td>
<td>128</td>
<td>A</td>
</tr>
<tr>
<td>( V_{SD} )</td>
<td>Drain-Source Diode Forward Voltage</td>
<td>( V_{GS} = 0 , V ), ( I_S = 32 , A )</td>
<td>--</td>
<td>1.5</td>
<td>V</td>
</tr>
<tr>
<td>( t_r )</td>
<td>Reverse Recovery Time</td>
<td>( V_{GS} = 0 , V ), ( I_S = 32 , A )</td>
<td>--</td>
<td>60</td>
<td>--</td>
</tr>
<tr>
<td>( Q_{r} )</td>
<td>Reverse Recovery Charge</td>
<td>( dI_{r} / dt = 100 , A/\mu s )</td>
<td>--</td>
<td>90</td>
<td>--</td>
</tr>
</tbody>
</table>

Notes:
1. Repetitive Rating : Pulse width limited by maximum junction temperature.
2. \( L = 400 \, \mu H, I_{DS} = 32 \, A, f = 32 \, A \), \( V_{DD} = 25 \, V \), \( R_G = 25 \, \Omega \), starting \( T_J = 25^\circ C \).
3. \( V_{SS} = 32 \, A, dI/dt \leq 300 \, A/\mu s, V_{DD} = BVDSS, \) 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 vs. Source Current and Temperature

Figure 5. Capacitance Characteristics

Figure 6. Gate Charge Characteristics
Typical Characteristics (continued)

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

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

**Figure 9.** Maximum Safe Operating Area

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

**Figure 11.** Transient Thermal Response Curve
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

- $V_G$ (Driver)
- $I_{SD}$ (DUT)
- $V_{DS}$ (DUT)

- $V_{GS}$
- $V_{DD}$
- $L$
- $R_G$
- $D$ = Gate Pulse Width
- $D$ = Gate Pulse Period
- $V_{DD}$
- $V_{GS}$ (Driver)
- $I_{SD}$ (DUT)
- $V_{DS}$ (DUT)

- $I_{FM}$, Body Diode Forward Current
- $I_{RM}$, Body Diode Reverse Current
- $V_{SD}$, Body Diode Forward Voltage Drop

- dv/dt controlled by $R_G$
- $I_{SD}$ controlled by pulse period

- $V_{DD}$
- $10V$
- Body Diode Recovery dv/dt
- Body Diode Forward Voltage Drop
Mechanical Dimensions

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

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Gmax™
GTO™
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SuperSOT®-8
SupreMOS®
SyncFET™
Sync-Lock™

TinyBoost®
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TINYOPTO™
TinyPower™
TinyPWM™
TinyWire™
TranSiC®
TriFault Detect™
TRUECURRENT®
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VCX™
VisualMax™
VoltagePlus™
XS™

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2. A critical component in any component of a life support device or system, 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.

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PRODUCT STATUS DEFINITIONS

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<th>Product Status</th>
<th>Definition</th>
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<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>
<td>No Identification Needed</td>
<td>Full Production</td>
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