Please note: As part of the Fairchild Semiconductor integration, some of the Fairchild orderable part numbers will need to change in order to meet ON Semiconductor’s system requirements. Since the ON Semiconductor product management systems do not have the ability to manage part nomenclature that utilizes an underscore (_), the underscore (_) in the Fairchild part numbers will be changed to a dash (-). This document may contain device numbers with an underscore (_). Please check the ON Semiconductor website to verify the updated device numbers. The most current and up-to-date ordering information can be found at www.onsemi.com. Please email any questions regarding the system integration to Fairchild_questions@onsemi.com.
**FQD11P06 / FQU11P06**  
**P-Channel QFET® MOSFET**  
-60 V, -9.4 A, 185 mΩ

**Description**  
This P-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**
- -9.4 A, -60 V, \( R_{\text{DS(on)}} = 185 \text{ mΩ} \) (Max.) @ \( V_{\text{GS}} = -10 \text{ V} \), \( I_D = -4.7 \text{ A} \)
- Low Gate Charge (Typ. 13 nC)
- Low Crss (Typ. 45 pF)
- 100% Avalanche Tested

**Absolute Maximum Ratings**  
\( T_C = 25°C \) unless otherwise noted.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>FQD11P06TM / FQU11P06TU</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>( V_{\text{DS}} )</td>
<td>Drain-Source Voltage</td>
<td>-60</td>
<td>V</td>
</tr>
<tr>
<td>( I_D )</td>
<td>Drain Current</td>
<td>- Continuous (( T_C = 25°C ))</td>
<td>-9.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Continuous (( T_C = 100°C ))</td>
<td>-5.95</td>
</tr>
<tr>
<td>( I_{\text{DM}} )</td>
<td>Drain Current</td>
<td>- Pulsed (Note 1)</td>
<td>-37.6</td>
</tr>
<tr>
<td>( V_{\text{GSS}} )</td>
<td>Gate-Source Voltage</td>
<td>± 30</td>
<td>V</td>
</tr>
<tr>
<td>( E_{\text{AS}} )</td>
<td>Single Pulsed Avalanche Energy</td>
<td>(Note 2)</td>
<td>160</td>
</tr>
<tr>
<td>( I_{\text{AR}} )</td>
<td>Avalanche Current</td>
<td>(Note 1)</td>
<td>-9.4</td>
</tr>
<tr>
<td>( E_{\text{AR}} )</td>
<td>Repetitive Avalanche Energy</td>
<td>(Note 1)</td>
<td>3.8</td>
</tr>
<tr>
<td>( P_D )</td>
<td>Peak Diode Recovery ( \frac{dv}{dt} )</td>
<td>(Note 3)</td>
<td>-7.0</td>
</tr>
<tr>
<td>( T_J, T_{\text{STG}} )</td>
<td>Operating and Storage Temperature Range</td>
<td></td>
<td>-55 to +150</td>
</tr>
<tr>
<td>( T_L )</td>
<td>Maximum lead temperature for soldering, 1/8&quot; from case for 5 seconds</td>
<td></td>
<td>300</td>
</tr>
</tbody>
</table>

**Thermal Characteristics**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>FQD11P06TM / FQU11P06TU</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>( R_{\text{JUC}} )</td>
<td>Thermal Resistance, Junction to Case, Max.</td>
<td>3.28</td>
<td>°C/W</td>
</tr>
<tr>
<td>( R_{\text{JJA}} )</td>
<td>Thermal Resistance, Junction to Ambient (Minimum Pad of 2-oz Copper), Max.</td>
<td>110</td>
<td>°C/W</td>
</tr>
<tr>
<td></td>
<td>Thermal Resistance, Junction to Ambient (*1 in² Pad of 2-oz Copper), Max.</td>
<td>50</td>
<td>°C/W</td>
</tr>
</tbody>
</table>
### Package Marking and Ordering Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Top Mark</th>
<th>Package</th>
<th>Packing Method</th>
<th>Reel Size</th>
<th>Tape Width</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>FQD11P06TM</td>
<td>FQD11P06</td>
<td>D-PAK</td>
<td>Tape and Reel</td>
<td>330 mm</td>
<td>16 mm</td>
<td>2500 units</td>
</tr>
<tr>
<td>FQU11P06TU</td>
<td>FQU11P06</td>
<td>I-PAK</td>
<td>Tube</td>
<td>N/A</td>
<td>N/A</td>
<td>70 units</td>
</tr>
</tbody>
</table>

### Electrical Characteristics

TC = 25°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>BV_DSS</td>
<td>Drain-Source Breakdown Voltage</td>
<td>VGS = 0 V, ID = -250 µA</td>
<td>-60</td>
<td>--</td>
<td>--</td>
<td>V</td>
</tr>
<tr>
<td>△BV_DSS / △T_J</td>
<td>Breakdown Voltage Temperature Coefficient</td>
<td>ID = -250 µA, Referenced to 25°C</td>
<td>--</td>
<td>-0.07</td>
<td>--</td>
<td>V/°C</td>
</tr>
<tr>
<td>IDSS</td>
<td>Zero Gate Voltage Drain Current</td>
<td>VDS = -60 V, VGS = 0 V</td>
<td>--</td>
<td>--</td>
<td>-1</td>
<td>µA</td>
</tr>
<tr>
<td>IBSS</td>
<td>Gate-Body Leakage Current, Forward</td>
<td>VGS = -25 V, VDS = 0 V</td>
<td>--</td>
<td>--</td>
<td>-100</td>
<td>nA</td>
</tr>
<tr>
<td>IGSSR</td>
<td>Gate-Body Leakage Current, Reverse</td>
<td>VGS = 25 V, VDS = 0 V</td>
<td>--</td>
<td>--</td>
<td>100</td>
<td>nA</td>
</tr>
</tbody>
</table>

### Off Characteristics

### 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>VGS(th)</td>
<td>Gate Threshold Voltage</td>
<td>VDS = VGS, ID = -250 µA</td>
<td>-2.0</td>
<td>--</td>
<td>-4.0</td>
<td>V</td>
</tr>
<tr>
<td>RDS(on)</td>
<td>Static Drain-Source On-Resistance</td>
<td>VGS = -10 V, ID = -4.7 A</td>
<td>--</td>
<td>0.15</td>
<td>0.185</td>
<td>Ω</td>
</tr>
<tr>
<td>gFS</td>
<td>Forward Transconductance</td>
<td>VDS = -30 V, ID = -4.7 A</td>
<td>--</td>
<td>4.9</td>
<td>--</td>
<td>S</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>Ciss</td>
<td>Input Capacitance</td>
<td>VDS = -25 V, VGS = 0 V, f = 1.0 MHz</td>
<td>--</td>
<td>420</td>
<td>550</td>
<td>pF</td>
</tr>
<tr>
<td>Coss</td>
<td>Output Capacitance</td>
<td>--</td>
<td>195</td>
<td>250</td>
<td>pF</td>
<td></td>
</tr>
<tr>
<td>Crss</td>
<td>Reverse Transfer Capacitance</td>
<td>--</td>
<td>45</td>
<td>60</td>
<td>pF</td>
<td></td>
</tr>
</tbody>
</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</td>
<td>VDD = -30 V, ID = -5.7 A, RG = 25 Ω</td>
<td>--</td>
<td>6.5</td>
<td>25</td>
<td>ns</td>
</tr>
<tr>
<td>t_r</td>
<td>Turn-On Rise Time</td>
<td>--</td>
<td>40</td>
<td>90</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>t_d(off)</td>
<td>Turn-Off Delay Time</td>
<td>VDS = -48 V, ID = -11.4 A, (Note 4)</td>
<td>--</td>
<td>15</td>
<td>40</td>
<td>ns</td>
</tr>
<tr>
<td>t_f</td>
<td>Turn-Off Fall Time</td>
<td>--</td>
<td>45</td>
<td>100</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>Q_g</td>
<td>Total Gate Charge</td>
<td>VDS = -48 V, ID = -11.4 A, VGS = -10 V</td>
<td>--</td>
<td>13</td>
<td>17</td>
<td>nC</td>
</tr>
<tr>
<td>Q_gss</td>
<td>Gate-Source Charge</td>
<td>--</td>
<td>2.0</td>
<td>--</td>
<td>nC</td>
<td></td>
</tr>
<tr>
<td>Q_gd</td>
<td>Gate-Drain Charge</td>
<td>--</td>
<td>6.3</td>
<td>--</td>
<td>nC</td>
<td></td>
</tr>
</tbody>
</table>

### Drain-Source Diode Characteristics and Maximum Ratings

<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>IS</td>
<td>Maximum Continuous Drain-Source Diode Forward Current</td>
<td>--</td>
<td>--</td>
<td>-9.4</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>ISM</td>
<td>Maximum Pulsed Drain-Source Diode Forward Current</td>
<td>--</td>
<td>--</td>
<td>-37.6</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>VSD</td>
<td>Drain-Source Diode Forward Voltage</td>
<td>VGS = 0 V, IS = -9.4 A</td>
<td>--</td>
<td>--</td>
<td>-4.0</td>
<td>V</td>
</tr>
<tr>
<td>t_tr</td>
<td>Reverse Recovery Time</td>
<td>VGS = 0 V, IS = -11.4 A, dVDS / dt ≤ 100 A/µs</td>
<td>--</td>
<td>83</td>
<td>--</td>
<td>ns</td>
</tr>
<tr>
<td>Q_tr</td>
<td>Reverse Recovery Charge</td>
<td>dVDS / dt ≤ 100 A/µs</td>
<td>0.26</td>
<td>--</td>
<td>--</td>
<td>µC</td>
</tr>
</tbody>
</table>

**Notes:**
1. Repetitive rating : pulse-width limited by maximum junction temperature.
2. L = 2.1 mH, IGS = -9.4 A, VDD = -25 V, RG = 25 Ω, starting TJ = 25°C.
3. IGS ≤ -11.4 A, dVDS / dt ≤ 300 A/µs, VDS ≤ BV_DSS, starting TJ = 25°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**

Notes:
1. $Z_{\theta JC}(t) = 3.28 \text{ W/Max.}$
2. Duty Factor, $D = \frac{t_1}{t_2}$
3. Single Pulse

Notes:
1. $V_{GS} = -10 \text{ V}$
2. $I_D = -4.7 \text{ A}$
3. $V_{DS} = -25 \text{ V}$
4. $R_{DS(on)}$ (Normalized)
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

- $V_{GS}$ (Driver)
- $I_{SD}$ (DUT)
- $V_{DS}$ (DUT)
- $V_{DD}$
- $R_G$
- $L$
- $I_{RM}$
- $I_{FM}$, Body Diode Forward Current
- $V_{SD}$
- $V_{DD}$
- Body Diode Recovery dv/dt
- Gate Pulse Width
- Gate Pulse Period
- $D = \frac{\text{Gate Pulse Width}}{\text{Gate Pulse Period}}$
- $10V$
- dv/dt controlled by $R_G$
- $I_{SD}$ controlled by pulse period
- $10V$
Mechanical Dimensions

Figure 16. TO252 (D-PAK), Molded, 3-Lead, Option AA&AB

Package drawings are provided as a service to customers considering Fairchild components. Drawings may change in any manner without notice. Please note the revision and/or date on the drawing and contact a Fairchild Semiconductor representative to verify or obtain the most recent revision. Package specifications do not expand the terms of Fairchild’s worldwide terms and conditions, specifically the warranty therein, which covers Fairchild products.

Always visit Fairchild Semiconductor’s online packaging area for the most recent package drawings:

http://www.fairchildsemi.com/package/packageDetails.html?id=PN_TT252-003
Figure 17. TO251 (I-PAK), Molded, 3-Lead

Package drawings are provided as a service to customers considering Fairchild components. Drawings may change in any manner without notice. Please note the revision and/or date on the drawing and contact a Fairchild Semiconductor representative to verify or obtain the most recent revision. Package specifications do not expand the terms of Fairchild’s worldwide terms and conditions, specifically the warranty therein, which covers Fairchild products.

Always visit Fairchild Semiconductor’s online packaging area for the most recent package drawings:

http://www.fairchildsemi.com/package/packageDetails.html?id=PN_TO251-003
TRADEMARKS
The following includes registered and unregistered trademarks and service marks, owned by Fairchild Semiconductor and/or its global subsidiaries, and is not intended to be an exhaustive list of all such trademarks.

- AccuPower™
- AX-CAP™
- BitSC™
- Build It Now™
- CorePLUS™
- CorePOWER™
- CROSSVOLT™
- CTL™
- Current Transfer Logic™
- DEUXPEED®
- Dual Cool™
- EcoSPARK™
- EffcientMax™
- ESBC™
- Fairchild®
- Fairchild Semiconductor®
- FACT Quiet Series™
- FACT®
- FAST®
- FastvCore™
- FETBench™
- FPS™
- F-PFS™
- FRFET®
- Global Power ResourceSM
- GreenBridge™
- Green FPS™
- Green FPS™ e-Series™
- Gmax™
- GT™
- IntelliMAX™
- ISOPLANAR™
- Marking Small Speakers Sound Louder and Better™
- MegaBuck™
- MICROCOUPLER™
- MicroFET™
- MicroPak™
- MicroPak2™
- MillerDrive™
- MotionMax™
- mWSaver®
- OptoHIT™
- OPTOLOGIC®
- OPTOPLANAR®
- PowerTrench®
- PowerXS™
- Programmable Active Drop™
- QFET®
- QST™
- Quiet Series™
- RapidConfigure™
- F-PFS™
- FRFET®
- Global Power ResourceSM
- GreenBridge™
- Green FPS™
- Green FPS™ e-Series™
- Gmax™
- GT™
- IntelliMAX™
- ISOPLANAR™
- Marking Small Speakers Sound Louder and Better™
- MegaBuck™
- MICROCOUPLER™
- MicroFET™
- MicroPak™
- MicroPak2™
- MillerDrive™
- MotionMax™
- mWSaver®
- OptoHIT™
- OPTOLOGIC®
- OPTOPLANAR®
- PowerTrench®
- PowerXS™
- Programmable Active Drop™
- QFET®
- QST™
- Quiet Series™
- RapidConfigure™

*Trademarks of System General Corporation, used under license by Fairchild Semiconductor.

DISCLAIMER
FAIRCHILD SEMICONDUCTOR RESERVES THE RIGHT TO MAKE CHANGES WITHOUT FURTHER NOTICE TO ANY PRODUCTS HEREIN TO IMPROVE RELIABILITY, FUNCTION, OR DESIGN. FAIRCHILD DOES NOT ASSUME ANY LIABILITY ARISING OUT OF THE APPLICATION OR USE OF ANY PRODUCT OR CIRCUIT DESCRIBED HEREIN; NEITHER DOES IT CONVEY ANY LICENSE UNDER ITS PATENT RIGHTS, NOR THE RIGHTS OF OTHERS.

THESE SPECIFICATIONS DO NOT EXPAND THE TERMS OF FAIRCHILD’S WORLDWIDE TERMS AND CONDITIONS, SPECIFICALLY THE WARRANTY THEREIN, WHICH COVERS THESE PRODUCTS.

LIFE SUPPORT POLICY
FAIRCHILD’S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF FAIRCHILD SEMICONDUCTOR CORPORATION.

As used here in:
1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body or (b) support or sustain life, and (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury of the user.
2. A critical component in any component of a life support, device, 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.

ANTI-COUNTERFEITING POLICY
Fairchild Semiconductor Corporation’s Anti-Counterfeiting Policy. Fairchild’s Anti-Counterfeiting Policy is also stated on our external website, www.Fairchildsemi.com, under Sales Support.

Counterfeiting of semiconductor parts is a growing problem in the industry. All manufacturers of semiconductor products are experiencing counterfeiting of their parts. Customers who inadvertently purchase counterfeit parts experience many problems such as loss of brand reputation, substandard performance, failed warranty issues that may arise. Fairchild will not provide any warranty coverage or other assistance for parts bought from Unauthorized Sources. Fairchild is committed to combat this global problem and encourage our customers to do their part in stopping this practice by buying direct or from authorized distributors.

PRODUCT STATUS DEFINITIONS

<table>
<thead>
<tr>
<th>Datasheet Identification</th>
<th>Product Status</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<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>
</tr>
<tr>
<td>No Identification Needed</td>
<td>Full Production</td>
<td>Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design.</td>
</tr>
<tr>
<td>Obsolete</td>
<td>Not In Production</td>
<td>Datasheet contains specifications on a product that is discontinued by Fairchild Semiconductor. The datasheet is for reference information only.</td>
</tr>
</tbody>
</table>