

October 2013

### FQD13N06L / FQU13N06L

## N-Channel QFET® MOSFET

60 V, 11 A, 115 mΩ

#### **Description**

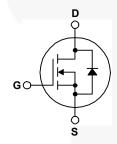
This N-Channel enhancement mode power MOSFET is produced using Fairchild Semiconductor's proprietary planar stripe and DMOS technology. This advanced MOSFET technology has been especially tailored to reduce on-state resistance, and to provide superior switching performance and high avalanche energy strength. These devices are suitable for switched mode power supplies, audio amplifier, DC motor control, and variable switching power applications.

#### **Features**

- 11 A, 60 V,  $R_{DS(on)}$  = 115 m $\Omega$  (Max) @  $V_{GS}$  = 10 V,  $I_{D}$  = 5.5 A
- Low Gate Charge (Typ. 4.8 nC)
- · Low Crss (Typ. 17 pF)
- · 100% Avalanche Tested
- Low Level Gate Drive Requirements Allowing Direct Operation form Logic Drivers







#### Absolute Maximum Ratings T<sub>C</sub> = 25°C unless otherwise noted.

Symbol	Parameter		FQD13N06LTM / FQU13N06LTU FQU13N06LTU_WS	Unit
V <sub>DSS</sub>	Drain-Source Voltage		60	V
I <sub>D</sub>	Drain Current - Continuous (T <sub>C</sub> = 25°C)		11	Α
	- Continuous (T <sub>C</sub> = 100°C)		7	Α
I <sub>DM</sub>	Drain Current - Pulsed	(Note 1)	44	Α
V <sub>GSS</sub>	Gate-Source Voltage		± 20	V
E <sub>AS</sub>	Single Pulsed Avalanche Energy (No		90	mJ
I <sub>AR</sub>	Avalanche Current	(Note 1)	11	Α
E <sub>AR</sub>	Repetitive Avalanche Energy (Not		2.8	mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)		7.0	V/ns
$P_{D}$	Power Dissipation (T <sub>A</sub> = 25°C) *		2.5	W
	Power Dissipation (T <sub>C</sub> = 25°C)		28	W
	- Derate above 25°C		0.22	W/°C
T <sub>J</sub> , T <sub>STG</sub>	Operating and Storage Temperature Range		-55 to +150	°C
T <sub>L</sub>	Maximum Lead Temperature for Soldering, 1/8" from Case for 5 Seconds		300	°C

#### **Thermal Characteristics**

Symbol	Parameter	FQD13N06LTM FQU13N06LTU FQU13N06LTU_WS	Unit			
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	4.5				
В	Thermal Resistance, Junction to Ambient (Minimum Pad of 2-oz Copper), Max.	110	°C/W			
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (*1 in <sup>2</sup> Pad of 2-oz Copper), Max.	50				

### **Package Marking and Ordering Information**

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FQD13N06LTM	FQD13N06L	D-PAK	Tape and Reel	330 mm	16 mm	2500 units
FQU13N06LTU	FQU13N06L	I-PAK	Tube	N/A	N/A	70 units
FQU13N06LTU_WS	FQU13N06LS	I-PAK	Tube	N/A	N/A	75 units

### Electrical Characteristics T<sub>c</sub> = 25°C unless otherwise noted.

Symbol	Parameter	Test Conditions	Min	Тур	Max	Unit
Off Cha	aracteristics					
BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	$V_{GS}$ = 0 V, $I_{D}$ = 250 $\mu$ A	60			V
ΔBV <sub>DSS</sub> / ΔT <sub>J</sub>	Breakdown Voltage Temperature Coefficient	$I_D$ = 250 μA, Referenced to 25°C		0.05		V/°C
I <sub>DSS</sub> Ze	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 60 V, V <sub>GS</sub> = 0 V			1	μΑ
		V <sub>DS</sub> = 48 V, T <sub>C</sub> = 150°C			10	μΑ
I <sub>GSSF</sub>	Gate-Body Leakage Current, Forward	V <sub>GS</sub> = 20 V, V <sub>DS</sub> = 0 V			100	nA
I <sub>GSSR</sub>	Gate-Body Leakage Current, Reverse	V <sub>GS</sub> = -20 V, V <sub>DS</sub> = 0 V			-100	nA
On Cha	aracteristics					
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_{D} = 250 \mu A$	1.0		2.5	V
R <sub>DS(on)</sub>	Static Drain-Source	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 5.5 A	·	0.092	0.115	0
· /	On-Resistance $V_{GS} = 5 \text{ V}, I_D = 5.5 \text{ A}$			0.115	0.145	Ω
9 <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> = 25 V, I <sub>D</sub> = 5.5 A		6		S
	ic Characteristics					
C <sub>iss</sub>	Input Capacitance	$V_{DS} = 25 \text{ V}, V_{GS} = 0 \text{ V},$		270	350	pF
C <sub>oss</sub>	Output Capacitance	f = 1.0 MHz		95	125	pF
C <sub>rss</sub>	Reverse Transfer Capacitance			17	23	pF
Switch	ing Characteristics					
t <sub>d(on)</sub>	Turn-On Delay Time	V <sub>DD</sub> = 30 V, I <sub>D</sub> = 6.8 A,		8	25	ns
t <sub>r</sub>	Turn-On Rise Time	$R_G = 25 \Omega$		90	190	ns
t <sub>d(off)</sub>	Turn-Off Delay Time	- 1.6 - 20 - 2		20	50	ns
t <sub>f</sub>	Turn-Off Fall Time	(Note 4)		40	90	ns
Qg	Total Gate Charge	V <sub>DS</sub> = 48 V, I <sub>D</sub> = 13.6 A,	/	4.8	6.4	nC
$Q_{gs}$	Gate-Source Charge	V <sub>GS</sub> = 5 V		1.6		nC
Q <sub>gd</sub>	Gate-Drain Charge	(Note 4)		2.7		nC
Drain-S	Source Diode Characteristics a	nd Maximum Ratings				
I <sub>S</sub>	Maximum Continuous Drain-Source Diode Forward Current				11	Α
I <sub>SM</sub>	Maximum Pulsed Drain-Source Diode Forward Current				44	Α
V <sub>SD</sub>	Drain-Source Diode Forward Voltage	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 11 A			1.5	V
t <sub>rr</sub>	Reverse Recovery Time	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 13.6 A,		45		ns
		dI <sub>E</sub> / dt = 100 A/μs				1

- **Notes:** 1. Repetitive rating : pulse-width limited by maximum junction temperature. 2. L = 870  $\mu$ H, I<sub>AS</sub> = 11 A, V<sub>DD</sub> = 25 V, R<sub>G</sub> = 25  $\Omega$ , starting T<sub>J</sub> = 25°C. 3. I<sub>SD</sub>  $\leq$  13.6 A, di/dt  $\leq$  300 A/ $\mu$ s, V<sub>DD</sub>  $\leq$  BV<sub>DSS</sub>, starting T<sub>J</sub> = 25°C. 4. Essentially independent of operating temperature.

### **Typical Characteristics**

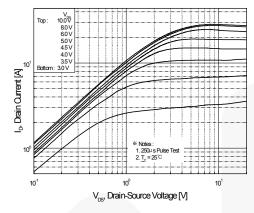


Figure 1. On-Region Characteristics

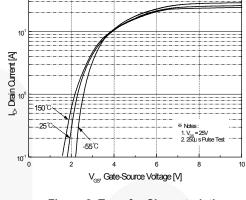


Figure 2. Transfer Characteristics

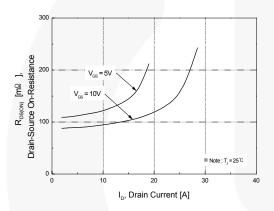


Figure 3. On-Resistance Variation vs.
Drain Current and Gate Voltage

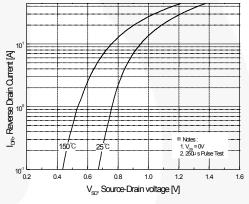


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

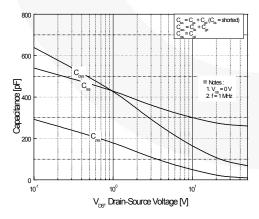


Figure 5. Capacitance Characteristics

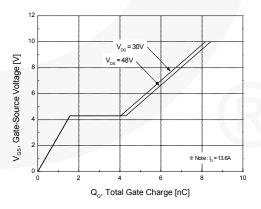


Figure 6. Gate Charge Characteristics

# Typical Characteristics (Continued)

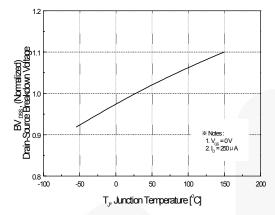


Figure 7. Breakdown Voltage Variation vs. Temperature

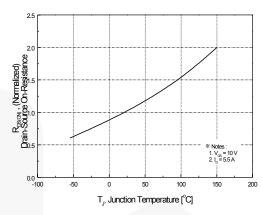


Figure 8. On-Resistance Variation vs. Temperature

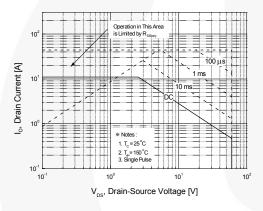


Figure 9. Maximum Safe Operating Area

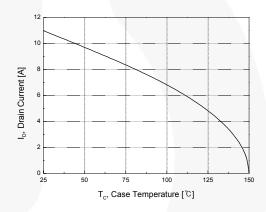


Figure 10. Maximum Drain Current vs. Case Temperature

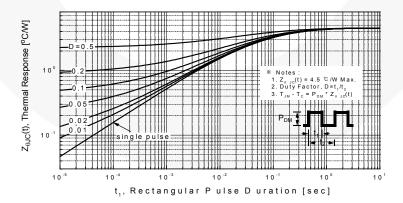


Figure 11. Transient Thermal Response Curve

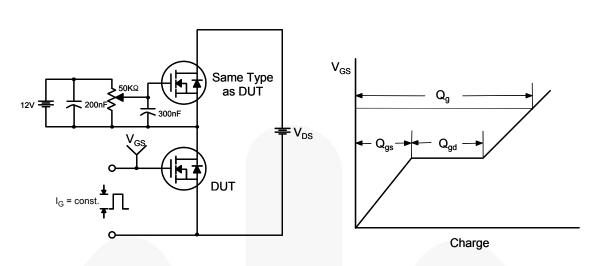


Figure 12. Gate Charge Test Circuit & Waveform

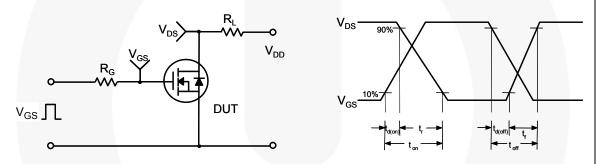


Figure 13. Resistive Switching Test Circuit & Waveforms

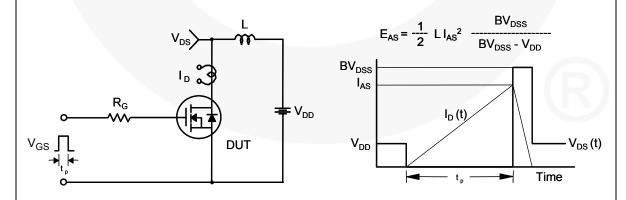
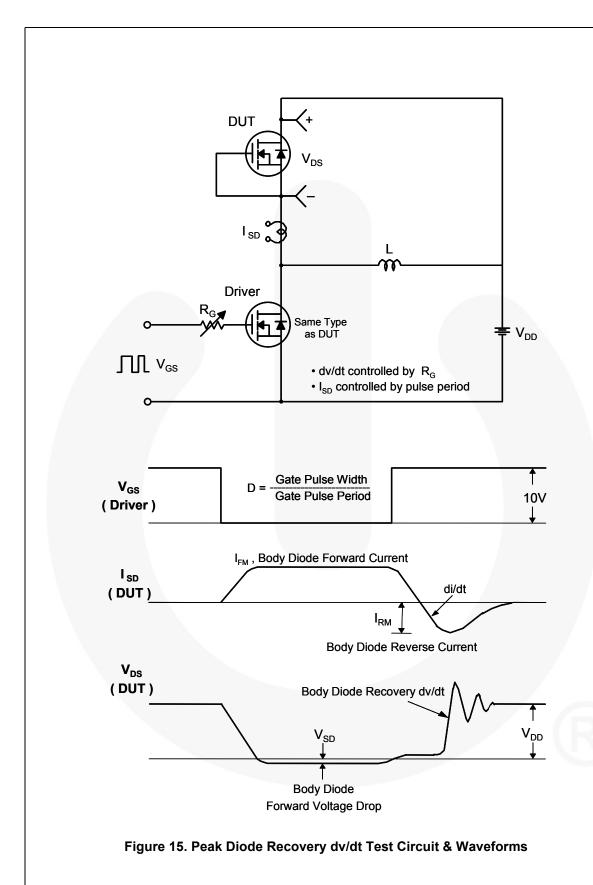


Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms



#### **Mechanical Dimensions**

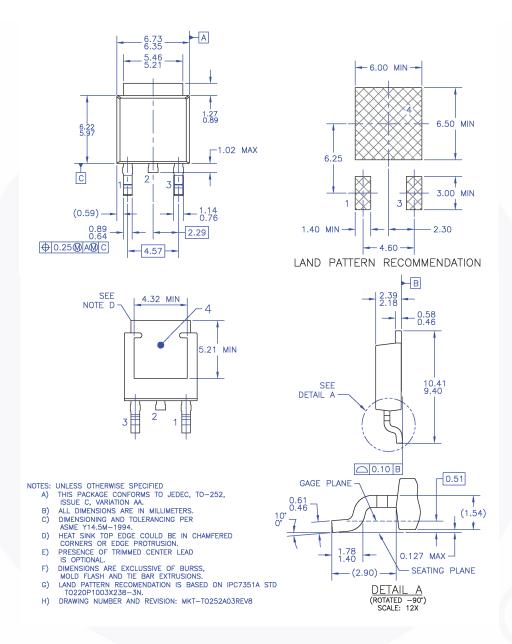


Figure 16. TO252 (D-PAK), Molded, 3-Lead, Option AA&AB

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#### **Mechanical Dimensions**

### FQU13N06LTU

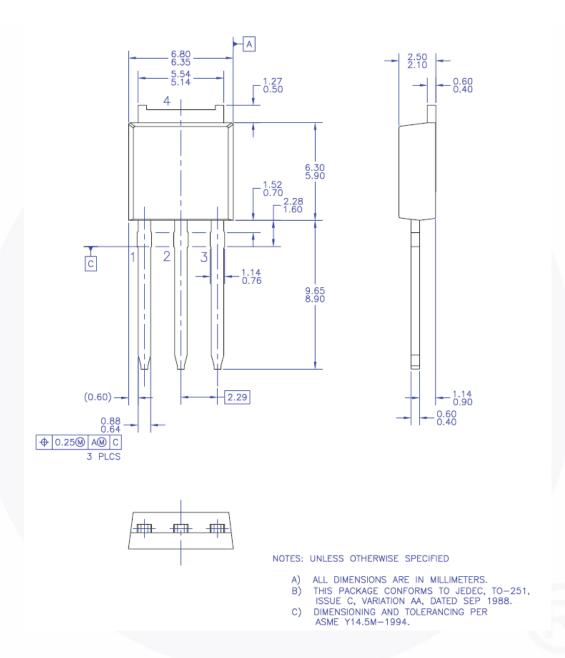


Figure 17. TO251 (I-PAK), Molded, 3-Lead

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#### **Mechanical Dimensions**

## FQU13N06LTU\_WS

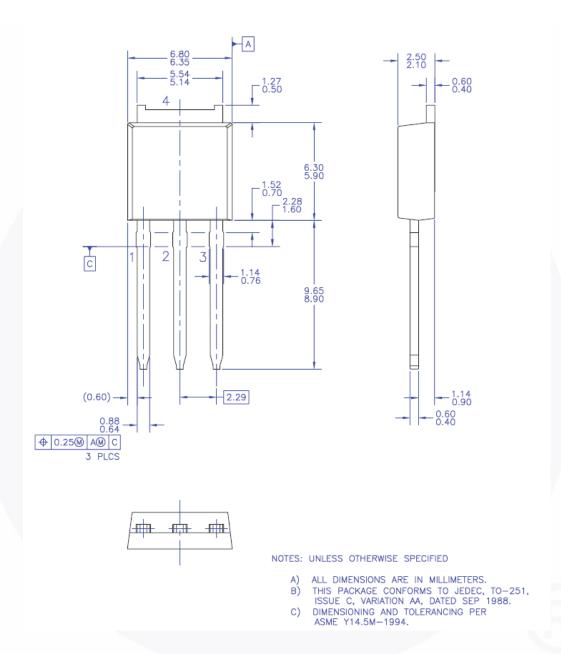


Figure 18. TO-251 (I-PAK), Molded, 3-Lead, Option AA

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