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SEMICONDUCTOR®

October 2008

QFET®
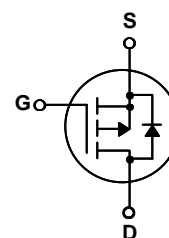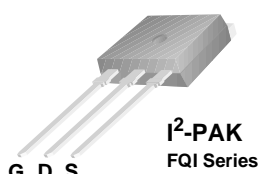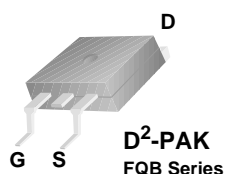
FQB11P06 / FQI11P06

60V P-Channel MOSFET

General Description

These P-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 a high energy pulse in the avalanche and commutation modes. These devices are well suited for low voltage applications such as automotive, DC/DC converters, and high efficiency switching for power management in portable and battery operated products.

Features

- -11.4A, -60V, $R_{DS(on)}$ = 0.175Ω @V_{GS} = -10 V
- Low gate charge (typical 13 nC)
- Low Crss (typical 45 pF)
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability
- 175°C maximum junction temperature rating
- RoHS Compliant

100% LEAD-FREE IMPLEMENTATION

D²-PAK
FQB Series

G   S

D

I²-PAK
FQI Series

G   D   S

S

G

D

Absolute Maximum Ratings
T_C = 25°C unless otherwise noted

Symbol	Parameter			FQB11P06 / FQI11P06	Units
V_{DSS}	Drain-Source Voltage			-60	V
I_D	Drain Current	- Continuous (T_C = 25°C)		-11.4	A
		- Continuous (T_C = 100°C)		-8.05	A
I_{DM}	Drain Current	- Pulsed	(Note 1)	-45.6	A
V_{GSS}	Gate-Source Voltage			± 25	V
E_{AS}	Single Pulsed Avalanche Energy		(Note 2)	160	mJ
I_{AR}	Avalanche Current		(Note 1)	-11.4	A
E_{AR}	Repetitive Avalanche Energy		(Note 1)	5.3	mJ
dv/dt	Peak Diode Recovery dv/dt		(Note 3)	-7.0	V/ns
P_D	Power Dissipation (T_A = 25°C) *			3.13	W
	Power Dissipation (T_C = 25°C)			53	W
	- Derate above 25°C			0.35	W/°C
T_J, T_{STG}	Operating and Storage Temperature Range			-55 to +175	°C
T_L	Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds			300	°C

Thermal Characteristics

Symbol	Parameter	Typ	Max	Units
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	--	2.85	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient *	--	40	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	--	62.5	°C/W

* When mounted on the minimum pad size recommended (PCB Mount)

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Elerical Characteristics T_C = 25°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
Off Characteristics						
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} = 0 V, I_D = -250 μA	-60	--	--	V
ΔBV_{DSS} / ΔT_J	Breakdown Voltage Temperature Coefficient	I_D = -250 μA, Referenced to 25°C	--	-0.07	--	V/°C
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = -60 V, V_{GS} = 0 V	--	--	-1	μA
		V_{DS} = -48 V, T_C = 150°C	--	--	-10	μA
I_{GSSF}	Gate-Body Leakage Current, Forward	V_{GS} = -25 V, V_{DS} = 0 V	--	--	-100	nA
I_{GSSR}	Gate-Body Leakage Current, Reverse	V_{GS} = 25 V, V_{DS} = 0 V	--	--	100	nA
On Characteristics						
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS} = V_{GS}, I_D = -250 μA	-2.0	--	-4.0	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	V_{GS} = -10 V, I_D = -5.7 A	--	0.14	0.175	Ω
g_{FS}	Forward Transconductance	V_{DS} = -30 V, I_D = -5.7 A (Note 4)	--	5.1	--	S
Dynamic Characteristics						
C_{iss}	Input Capacitance	V_{DS} = -25 V, V_{GS} = 0 V, f = 1.0 MHz	--	420	550	pF
C_{oss}	Output Capacitance		--	195	250	pF
C_{rss}	Reverse Transfer Capacitance		--	45	60	pF
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	V_{DD} = -30 V, I_D = -5.7 A, R_G = 25 Ω	--	6.5	25	ns
t_r	Turn-On Rise Time		--	40	90	ns
$t_{d(off)}$	Turn-Off Delay Time		--	15	40	ns
t_f	Turn-Off Fall Time	(Note 4, 5)	--	45	100	ns
Q_g	Total Gate Charge	V_{DS} = -48 V, I_D = -11.4 A, V_{GS} = -10 V	--	13	17	nC
Q_{gs}	Gate-Source Charge		--	2.0	--	nC
Q_{gd}	Gate-Drain Charge	(Note 4, 5)	--	6.3	--	nC
Drain-Source Diode Characteristics and Maximum Ratings						
I_S	Maximum Continuous Drain-Source Diode Forward Current		--	--	-11.4	A
I_{SM}	Maximum Pulsed Drain-Source Diode Forward Current		--	--	-45.6	A
V_{SD}	Drain-Source Diode Forward Voltage	V_{GS} = 0 V, I_S = -11.4 A	--	--	-4.0	V
t_{rr}	Reverse Recovery Time	V_{GS} = 0 V, I_S = -11.4 A,	--	83	--	ns
Q_{rr}	Reverse Recovery Charge	dI_F / dt = 100 A/μs (Note 4)	--	0.26	--	μC

Notes:
1. Repetitive Rating : Pulse width limited by maximum junction temperature
2. L = 1.44mH, I_{AS} = -11.4A, V_{DD} = -25V, R_G = 25 Ω, Starting T_J = 25°C
3. I_{SD} ≤ -11.4A, di/dt ≤ 300A/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

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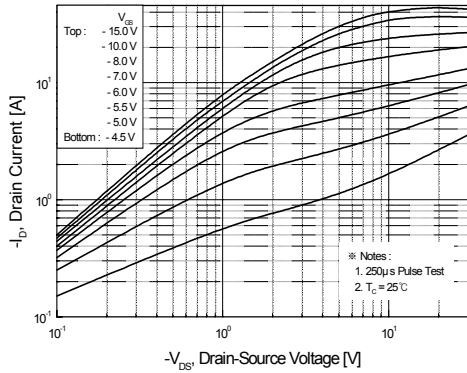
Typical Characteristics

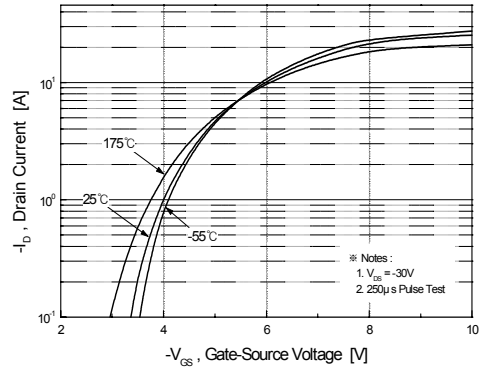**Figure 1. On-Region Characteristics**

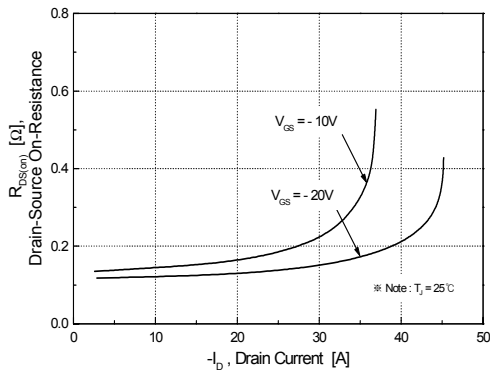**Figure 2. Transfer Characteristics**

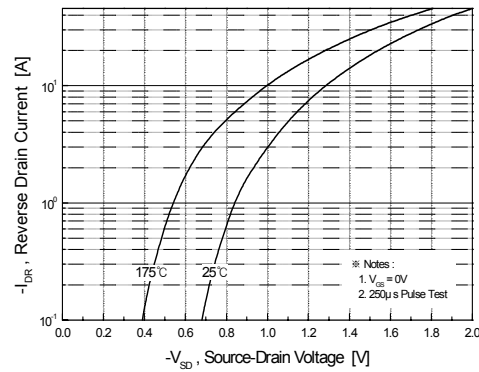**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**

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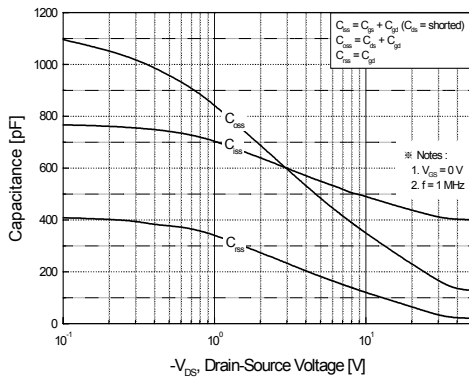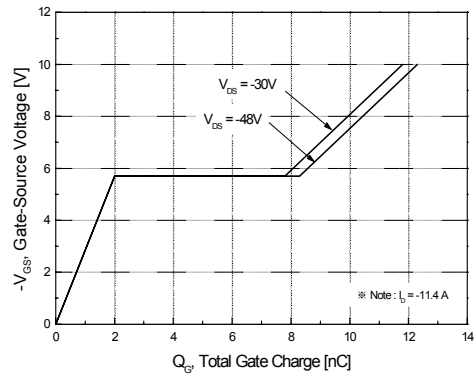

Figure 5. Capacitance Characteristics

Figure 6. Gate Charge Characteristics
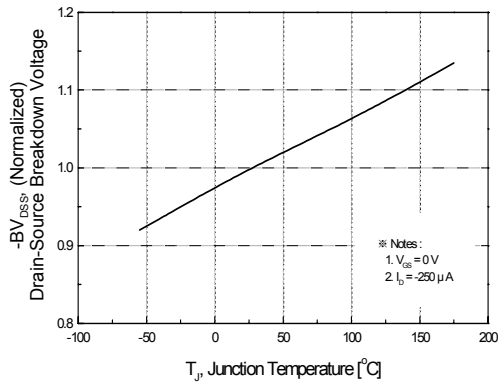
Typical Characteristics (Continued)
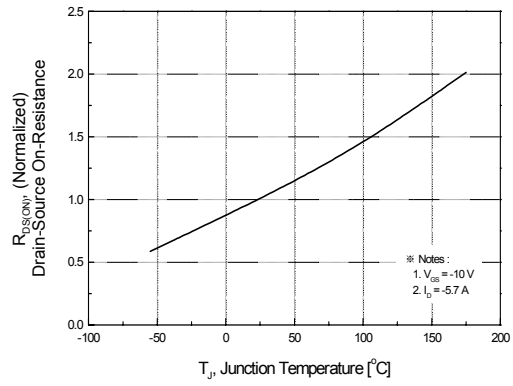

Figure 7. Breakdown Voltage Variation
vs. Temperature

Figure 8. On-Resistance Variation
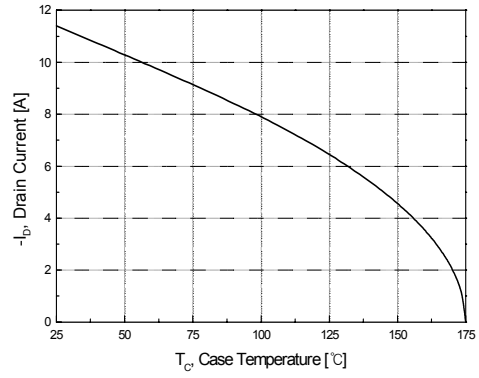vs. Temperature
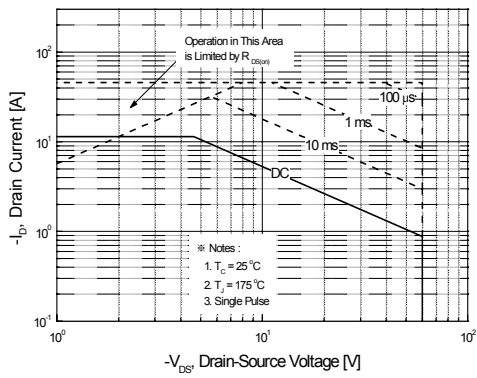
Figure 9. Maximum Safe Operating Area
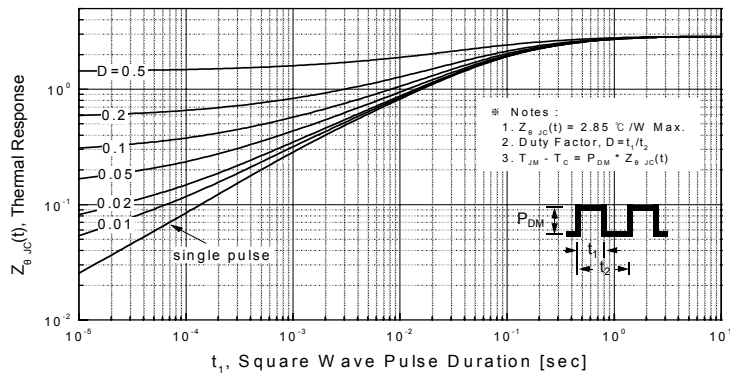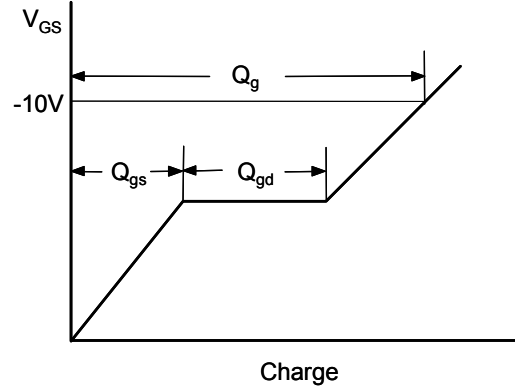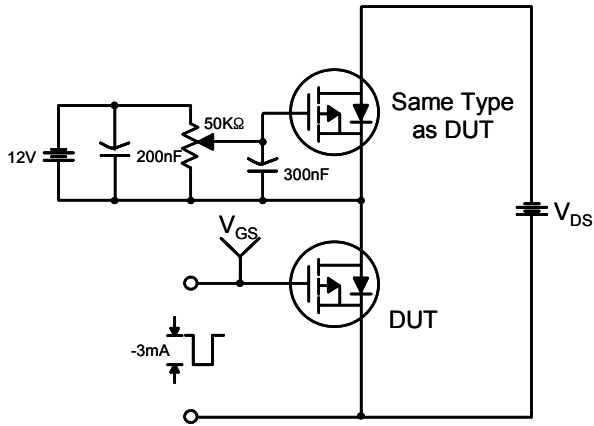

Figure 10. Maximum Drain Current
vs. Case Temperature

Figure 11. Transient Thermal Response Curve

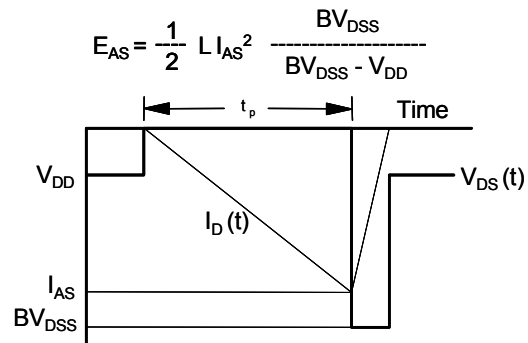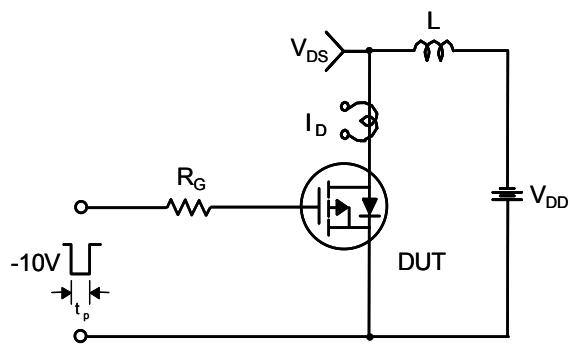©2008 Fairchild Semiconductor Corporation

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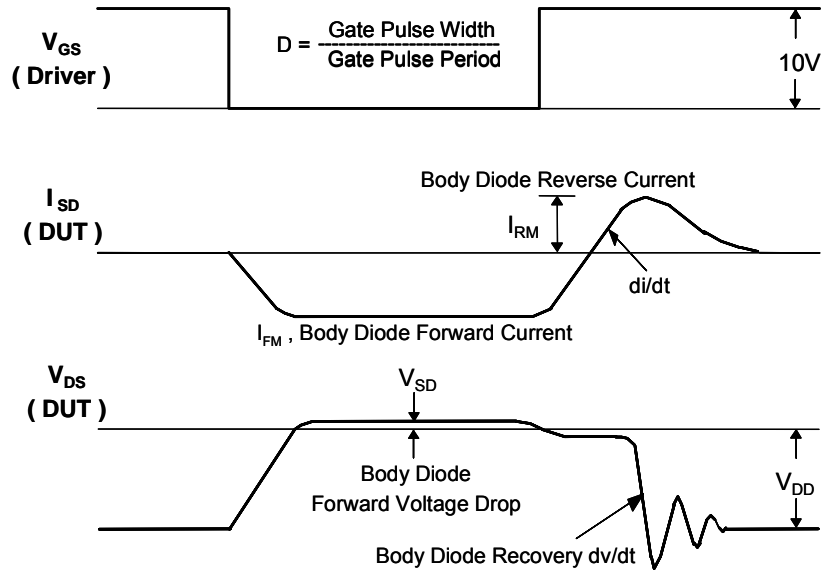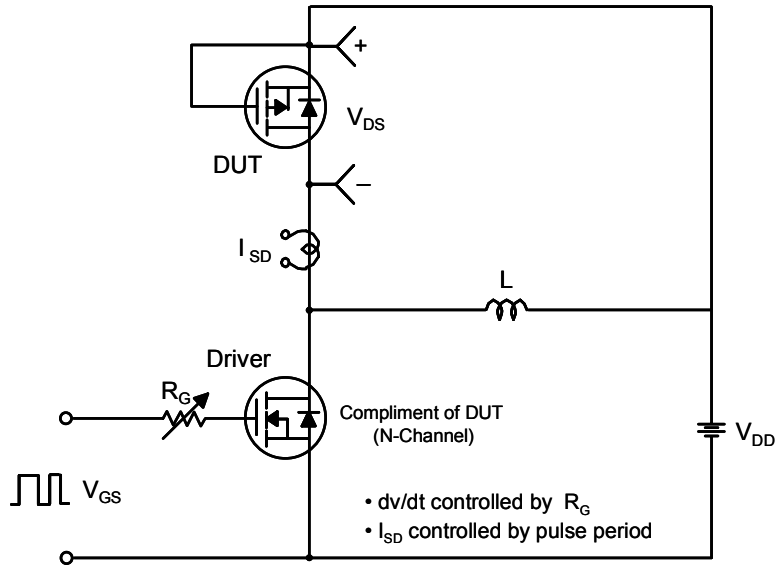**Gate Charge Test Circuit & Waveform**

Resistive Switching Test Circuit & Waveforms
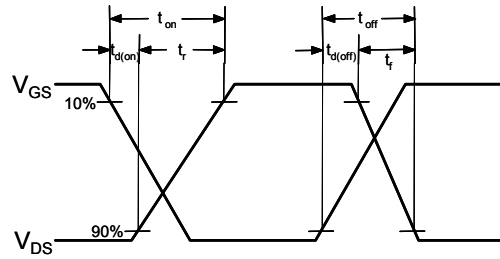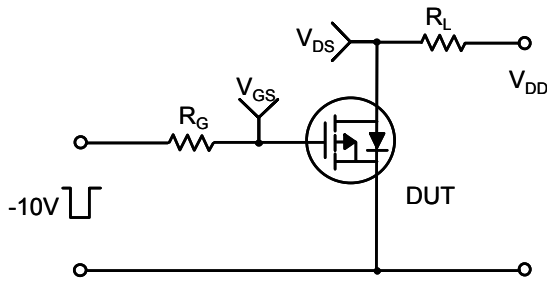
Unclamped Inductive Switching Test Circuit & Waveforms

$$E_{AS} = \frac{1}{2} L I_{AS}^2 \ \frac{BV_{DSS}}{BV_{DSS} - V_{DD}}$$

Peak Diode Recovery dv/dt Test Circuit & Waveforms

V_{DS}

DUT

I_{SD}

Driver

L

R_G

Compliment of DUT
(N-Channel)

V_{DD}

V_{GS}

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

V_{GS}
(Driver)

$D = \dfrac{\text{Gate Pulse Width}}{\text{Gate Pulse Period}}$

10V

I_{SD}
(DUT)

Body Diode Reverse Current

I_{RM}

di/dt

I_{FM} , Body Diode Forward Current

V_{DS}
(DUT)

V_{SD}

Body Diode
Forward Voltage Drop

Body Diode Recovery dv/dt

V_{DD}

Mechanical Dimensions

D^2 - PAK

9.50 MIN
9.00 MIN
10.00
4.00 MIN
1.50 MIN
5.08

LAND PATTERN RECOMMENDATION

10.67
9.65
1.68
1.00
9.65
8.38
1.78 MAX
(2.12)
1.78
1.14
0.99
0.51
5.08
⊕ 0.25 Ⓜ B AⓂ

6.22 MIN
6.86 MIN

-B-
4.83
4.06
1.65
1.14
15.88
14.61
SEE DETAIL A

GAGE PLANE
0.74
0.33
8°
0°
0.25
2.79
1.78
8°
0°
0.10 B
.25 MAX
(5.38)
SEATING PLANE

DETAIL A, ROTATED 90°
SCALE: 10X

Dimensions in Millimeters

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Mechanical Dimensions

I^2 - PAK

10.29
9.65

8.33
6.22

1.40
1.00

7.88
6.86

9.65
8.64

7°

4.83
4.06

1.40
1.14

5°

5°

1   2   3

B   3.96
    2.80

(2.13)

14.73
12.70

2.79
2.03

B   1.78
    1.14

2.54

B   0.90
    0.64

5.08

⊕ 0.254 A(M) B

B   0.64
    0.33

Dimensions in Millimeters

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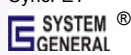FAST®
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