FAIRCHILD

SEMICONDUCTOR ™

May 2000

QFET™

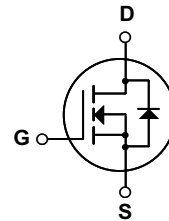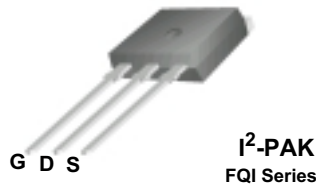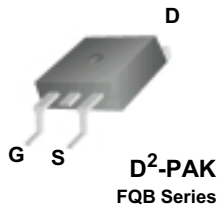# FQB27N25 / FQI27N25

250V N-Channel MOSFET

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 switching DC/DC converters, switch mode power supply.

Features

- 25.5A, 250V, $R_{DS(on)}$ = 0.11Ω @V_{GS} = 10 V
- Low gate charge (typical 50 nC)
- Low Crss (typical 45 pF)
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability

D

G S   **D²-PAK**
FQB Series

G D S   **I²-PAK**
FQI Series

D

G

S

Absolute Maximum Ratings T_C = 25°C unless otherwise noted

Symbol	Parameter			FQB27N25 / FQI27N25	Units
V_{DSS}	Drain-Source Voltage			250	V
I_D	Drain Current	- Continuous (T_C = 25°C)		25.5	A
		- Continuous (T_C = 100°C)		16.2	A
I_{DM}	Drain Current	- Pulsed	(Note 1)	102	A
V_{GSS}	Gate-Source Voltage			± 30	V
E_{AS}	Single Pulsed Avalanche Energy		(Note 2)	600	mJ
I_{AR}	Avalanche Current		(Note 1)	25.5	A
E_{AR}	Repetitive Avalanche Energy		(Note 1)	18	mJ
dv/dt	Peak Diode Recovery dv/dt		(Note 3)	5.5	V/ns
P_D	Power Dissipation (T_A = 25°C) *			3.13	W
	Power Dissipation (T_C = 25°C)			180	W
	- Derate above 25°C			1.43	W/°C
T_J, T_{STG}	Operating and Storage Temperature Range			-55 to +150	°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	--	0.7	°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)

Electrical 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	250	--	--	V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 250$ μA, Referenced to 25°C	--	0.29	--	V/°C
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 250$ V, $V_{GS} = 0$ V	--	--	1	μA
		$V_{DS} = 200$ V, $T_C = 125°C$	--	--	10	μA
I_{GSSF}	Gate-Body Leakage Current, Forward	$V_{GS} = 30$ V, $V_{DS} = 0$ V	--	--	100	nA
I_{GSSR}	Gate-Body Leakage Current, Reverse	$V_{GS} = -30$ V, $V_{DS} = 0$ V	--	--	-100	nA
On Characteristics						
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}$, $I_D = 250$ μA	3.0	--	5.0	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = 10$ V, $I_D = 12.75$ A	--	0.083	0.11	Ω
g_{FS}	Forward Transconductance	$V_{DS} = 50$ V, $I_D = 12.75$ A (Note 4)	--	24	--	S
Dynamic Characteristics						
C_{iss}	Input Capacitance	$V_{DS} = 25$ V, $V_{GS} = 0$ V, f = 1.0 MHz	--	1900	2450	pF
C_{oss}	Output Capacitance		--	360	470	pF
C_{rss}	Reverse Transfer Capacitance		--	45	60	pF
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 125$ V, $I_D = 27$ A, $R_G = 25$ Ω	--	32	75	ns
t_r	Turn-On Rise Time		--	270	550	ns
$t_{d(off)}$	Turn-Off Delay Time		--	80	170	ns
t_f	Turn-Off Fall Time	(Note 4, 5)	--	120	250	ns
Q_g	Total Gate Charge	$V_{DS} = 200$ V, $I_D = 27$ A, $V_{GS} = 10$ V	--	50	65	nC
Q_{gs}	Gate-Source Charge		--	12.5	--	nC
Q_{gd}	Gate-Drain Charge	(Note 4, 5)	--	26	--	nC
Drain-Source Diode Characteristics and Maximum Ratings						
I_S	Maximum Continuous Drain-Source Diode Forward Current		--	--	25.5	A
I_{SM}	Maximum Pulsed Drain-Source Diode Forward Current		--	--	102	A
V_{SD}	Drain-Source Diode Forward Voltage	$V_{GS} = 0$ V, $I_S = 25.5$ A	--	--	1.5	V
t_{rr}	Reverse Recovery Time	$V_{GS} = 0$ V, $I_S = 27$ A, $dI_F / dt = 100$ A/μs (Note 4)	--	220	--	ns
Q_{rr}	Reverse Recovery Charge		--	1.8	--	μC

Notes:
1. Repetitive Rating : Pulse width limited by maximum junction temperature
2. L = 1.5mH, $I_{AS} = 25.5$A, $V_{DD} = 50$V, $R_G = 25$ Ω, Starting $T_J = 25°C$
3. $I_{SD} \leq 27$A, di/dt ≤ 300A/μs, $V_{DD} \leq BV_{DSS}$, Starting $T_J = 25°C$
4. Pulse Test : Pulse width ≤ 300μs, Duty cycle $\leq 2\%$
5. Essentially independent of operating temperature
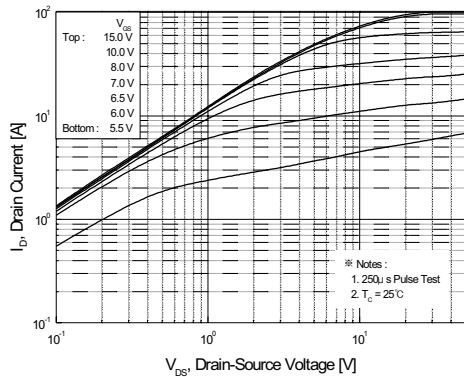
Typical Characteristics

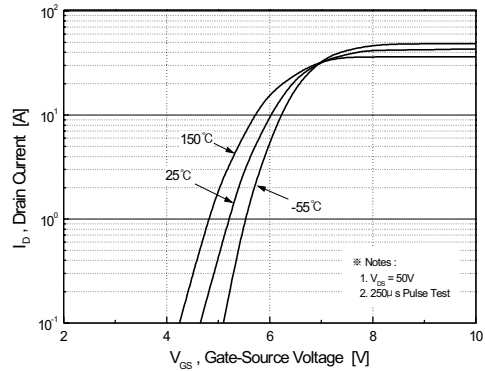Figure 1. On-Region Characteristics
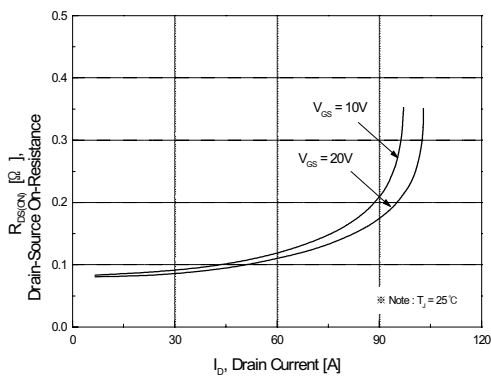

Figure 2. Transfer Characteristics

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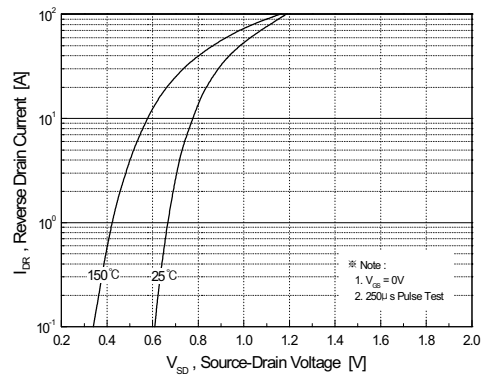Drain Current and Gate Voltage

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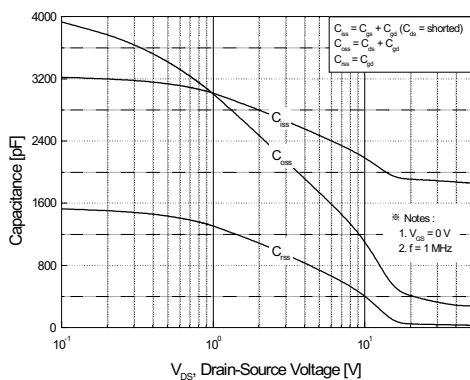Variation vs. Source Current
and Temperature

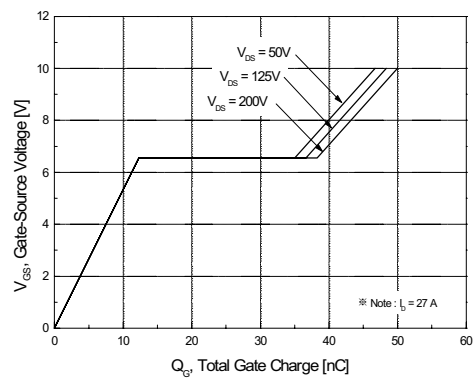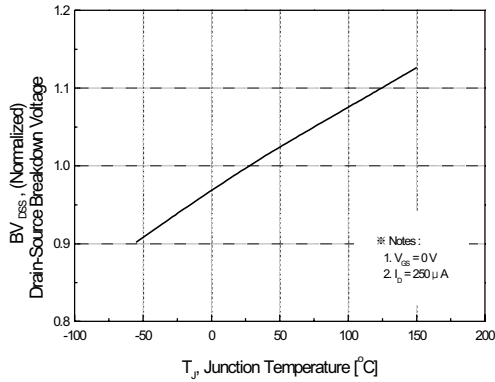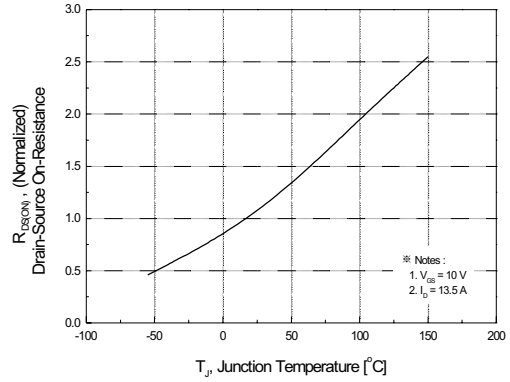Figure 5. Capacitance Characteristics

Figure 6. Gate Charge Characteristics

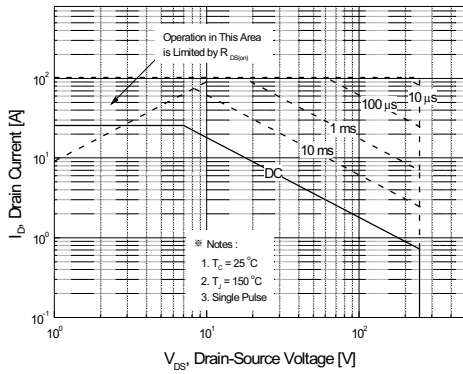## Typical Characteristics (Continued)
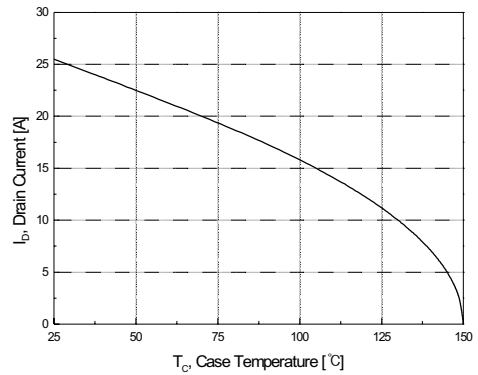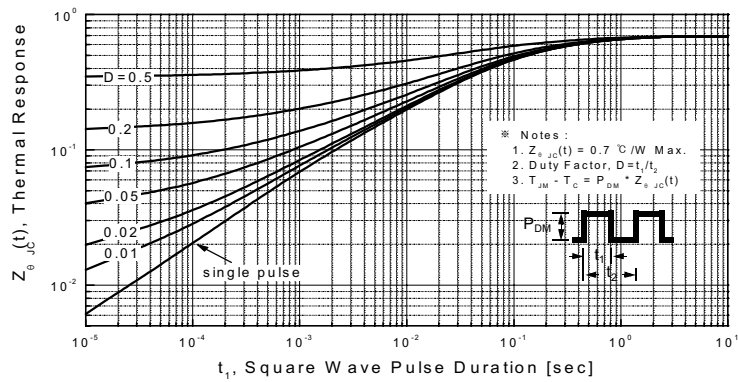
Figure 7. Breakdown Voltage Variation
vs. Temperature

Figure 8. On-Resistance Variation
vs. Temperature

Figure 9. Maximum Safe Operating Area

Figure 10. Maximum Drain Current
vs. Case Temperature

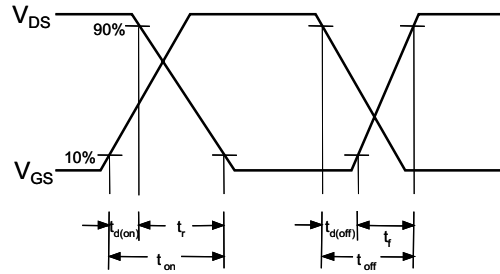Figure 11. Transient Thermal Response Curve

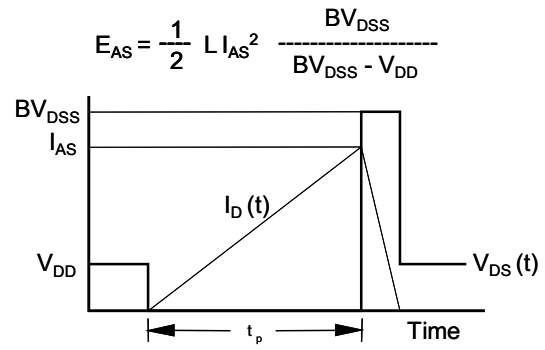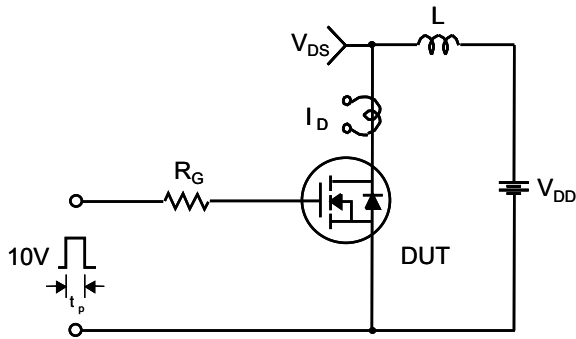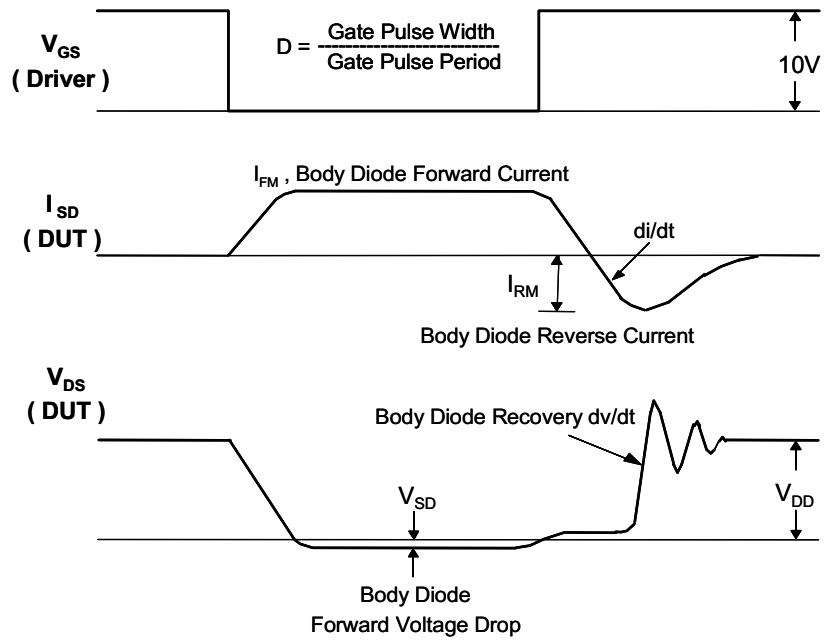**Gate Charge Test Circuit & Waveform**

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

DUT

V_{DS}

I_{SD}

L

Driver

R_G

Same Type
as DUT

V_{DD}

V_{GS}

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

V_{GS}
(Driver)

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

10V

I_{SD}
(DUT)

I_{FM} , Body Diode Forward Current

di/dt

I_{RM}

Body Diode Reverse Current

V_{DS}
(DUT)

Body Diode Recovery dv/dt

V_{SD}

V_{DD}

Body Diode
Forward Voltage Drop

Package 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

4

9.65
8.38

1.78 MAX

2

1

3

(2.12)

1.78
1.14

0.99
0.51

5.08

⊕ | 0.25 Ⓜ | B | A Ⓜ

6.22 MIN

4

6.86 MIN

2

3

1

-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

8°
0°

⌓ | 0.10 | B

.25 MAX

2.79
1.78

(5.38)

SEATING
PLANE

DETAIL A, ROTATED 90°
SCALE: 10X

Dimensions in Millimeters

Package Dimensions (Continued)

I² - PAK

Dimensions in Millimeters

TRADEMARKS

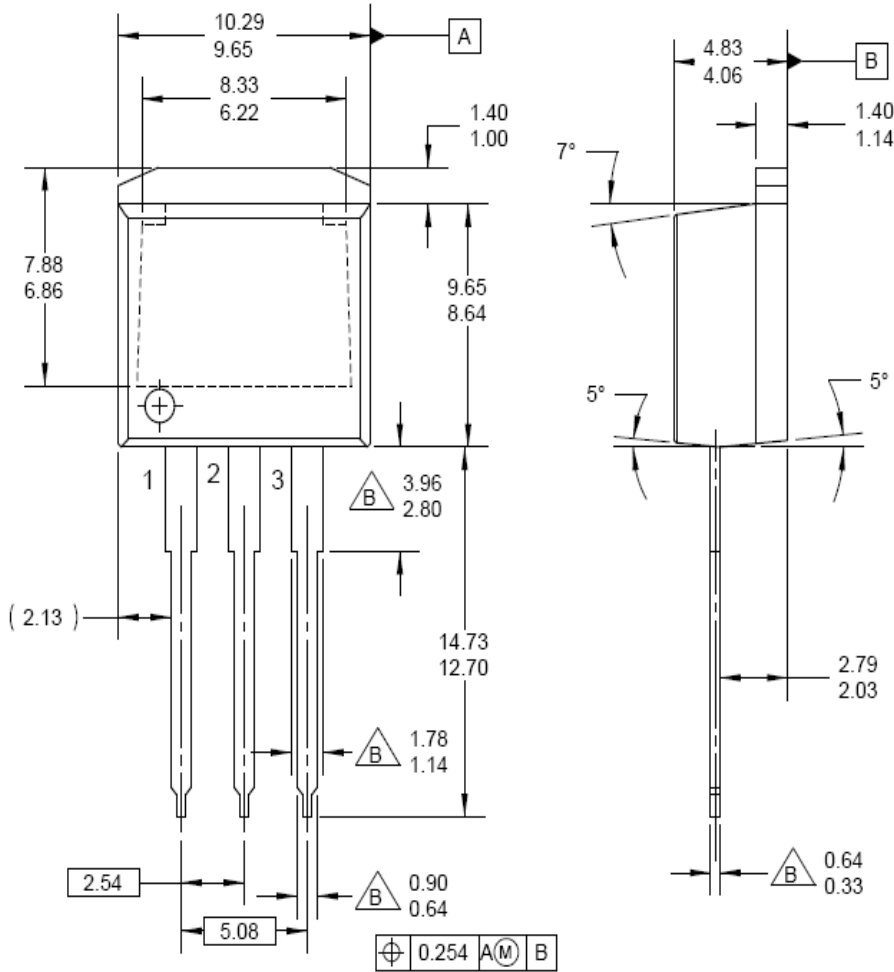The following are registered and unregistered trademarks Fairchild Semiconductor owns or is authorized to use and is not intended to be an exhaustive list of all such trademarks.

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GTO™	SuperSOT™-6	

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