

November 2013

## FQP4P40

# P-Channel QFET® MOSFET

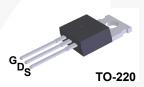
-400 V, -3.5 A, 3.1  $\Omega$ 

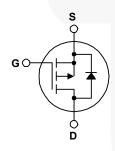
### **Description**

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 • Low Crss (Typ. 11 pF) and high avalanche energy strength. These devices are suitable for switched mode power supplies, audio amplifier, • 100% Avalanche Tested DC motor control, and variable switching power applications.

#### **Features**

- -3.5 A, -400 V,  $R_{DS(on)}$  = 3.1  $\Omega$  (Max.) @  $V_{GS}$  = -10 V,  $I_D = -1.75 A$
- Low Gate Charge (Typ. 18 nC)





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

Symbol	Parameter		FQP4P40	Unit
V <sub>DSS</sub>	Drain-Source Voltage		-400	V
I <sub>D</sub>	Drain Current - Continuous (T <sub>C</sub> = 25°C)		-3.5	А
	- Continuous (T <sub>C</sub> = 100°C)		-2.2	А
I <sub>DM</sub>	Drain Current - Pulsed	Note 1)	-14	Α
V <sub>GSS</sub>	Gate-Source Voltage		± 30	V
E <sub>AS</sub>	Single Pulsed Avalanche Energy	Note 2)	260	mJ
I <sub>AR</sub>	Avalanche Current (Note 1) -3.5		-3.5	A
E <sub>AR</sub>	Repetitive Avalanche Energy	Note 1)	8.5	mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)		-4.5	V/ns
$P_{D}$	Power Dissipation (T <sub>C</sub> = 25°C)		85	W
	- Derate above 25°C		0.68	W/°C
T <sub>J</sub> , T <sub>STG</sub>	Operating and Storage Temperature Range		-55 to +150	°C
Tı	Maximum lead temperature for soldering,	300		°C
.r	1/8" from case for 5 seconds		300	C

### **Thermal Characteristics**

Symbol	Parameter	FQP4P40	Unit	
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case, Max.	1.47	°C/W	
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient, Max.	62.5	°C/W	

## **Package Marking and Ordering Information**

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FQP4P40	FQP4P40	TO-220	Tube	N/A	N/A	50 units

### **Flectrical Characteristics**

Symbol	Parameter	Test Conditions	Min.	Тур.	Max.	Unit
Off Cha	racteristics					
BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	$V_{GS} = 0 \text{ V}, I_{D} = -250 \mu\text{A}$				V
ΔBV <sub>DSS</sub>	Breakdown Voltage Temperature Coefficient	I <sub>D</sub> = -250 μA, Referenced to 25°C		0.36		V/°(
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = -400 V, V <sub>GS</sub> = 0 V			-1	μΑ
		V <sub>DS</sub> = -320 V, T <sub>C</sub> = 125°C			-10	μΑ
I <sub>GSSF</sub>	Gate-Body Leakage Current, Forward	V <sub>GS</sub> = -30 V, V <sub>DS</sub> = 0 V			-100	nA
I <sub>GSSR</sub>	Gate-Body Leakage Current, Reverse	V <sub>GS</sub> = 30 V, V <sub>DS</sub> = 0 V			100	nA
On Cha	racteristics					
V <sub>GS(th)</sub>	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_{D} = -250 \mu\text{A}$	-3.0		-5.0	V
R <sub>DS(on)</sub>	Static Drain-Source On-Resistance	V <sub>GS</sub> = -10 V, I <sub>D</sub> = -1.75 A		2.44	3.1	Ω
9FS	Forward Transconductance	$V_{DS} = -50 \text{ V}, I_{D} = -1.75 \text{ A}$		2.7		S
Dynam	ic Characteristics					
C <sub>iss</sub>	Input Capacitance	$V_{DS} = -25 \text{ V}, V_{GS} = 0 \text{ V},$		520	680	pF
C <sub>oss</sub>	Output Capacitance	f = 1.0 MHz		80	105	pF
C <sub>rss</sub>	Reverse Transfer Capacitance			11	15	pF
Switchi	ng Characteristics					
t <sub>d(on)</sub>	Turn-On Delay Time	V 000 V I 0.5 A		13	35	ns
t <sub>r</sub>	Turn-On Rise Time	$V_{DD} = -200 \text{ V}, I_{D} = -3.5 \text{ A},$ $R_{G} = 25 \Omega$		55	120	ns
t <sub>d(off)</sub>	Turn-Off Delay Time	$R_G = 25.52$		35	80	ns
t <sub>f</sub>	Turn-Off Fall Time	(Note 4)		37	85	ns
Qg	Total Gate Charge	V <sub>DS</sub> = -320 V, I <sub>D</sub> = -3.5 A,		18	23	nC
Q <sub>gs</sub>	Gate-Source Charge	V <sub>GS</sub> = -10 V	/	3.8		nC
Q <sub>gd</sub>	Gate-Drain Charge	(Note 4)		9.4		nC
Drain-S	ource Diode Characteristics a	nd Maximum Ratings				
Is	Maximum Continuous Drain-Source Diode Forward Current				-3.5	Α
I <sub>SM</sub>	Maximum Pulsed Drain-Source Diode Forward Current				-14	Α
V <sub>SD</sub>	Drain-Source Diode Forward Voltage	$V_{GS} = 0 \text{ V}, I_{S} = -3.5 \text{ A}$			-5.0	V
t <sub>rr</sub>	Reverse Recovery Time	$V_{GS} = 0 \text{ V}, I_{S} = -3.5 \text{ A},$		260		ns
Q <sub>rr</sub>	Reverse Recovery Charge	dl <sub>F</sub> / dt = 100 A/μs		1.4	//	μC

- 1. Repetitive rating : pulse-width limited by maximum junction temperature.
- 2. L = 37 mH,  $I_{AS}$  = -3.5 A,  $V_{DD}$  = -50 V,  $R_G$  = 25  $\Omega$ , starting  $T_J$  = 25°C. 3.  $I_{SD}$   $\leq$  -3.5 A, di/dt  $\leq$  200 A/ $\mu$ s ,  $V_{DD}$   $\leq$  BV $_{DSS}$ , starting  $T_J$  = 25°C.
- 4. Essentially independent of operating temperature.

## **Typical Characteristics**

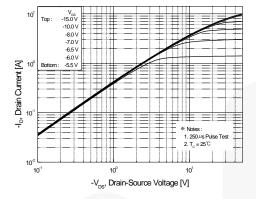


Figure 1. On-Region Characteristics

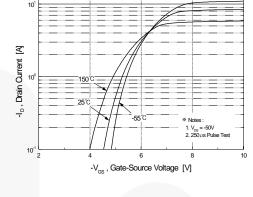


Figure 2. Transfer Characteristics

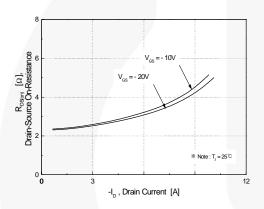


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

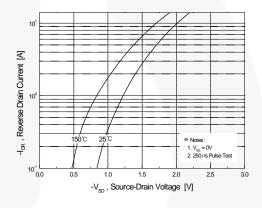


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

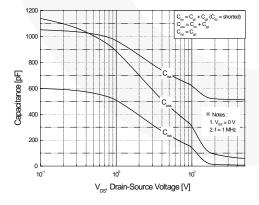


Figure 5. Capacitance Characteristics

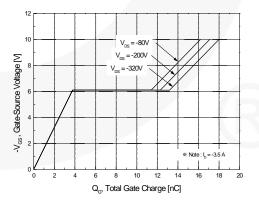


Figure 6. Gate Charge Characteristics

## Typical Characteristics (Continued)

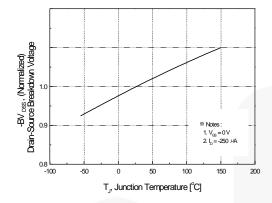


Figure 7. Breakdown Voltage Variation vs. Temperature

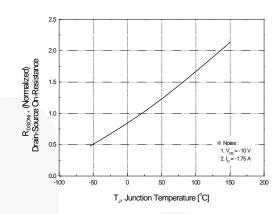


Figure 8. On-Resistance Variation vs. Temperature

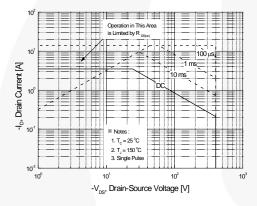


Figure 9. Maximum Safe Operating Area

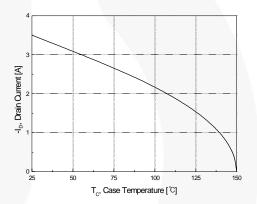


Figure 10. Maximum Drain Current vs. Case Temperature

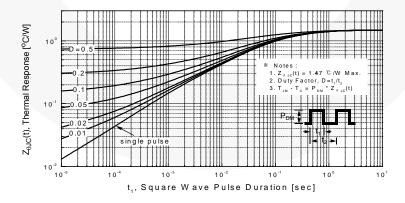


Figure 11. Transient Thermal Response Curve

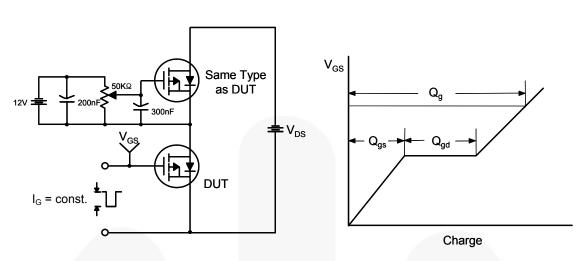


Figure 12. Gate Charge Test Circuit & Waveform

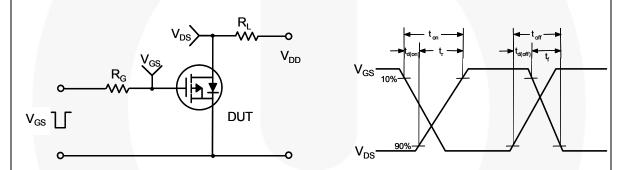


Figure 13. Resistive Switching Test Circuit & Waveforms

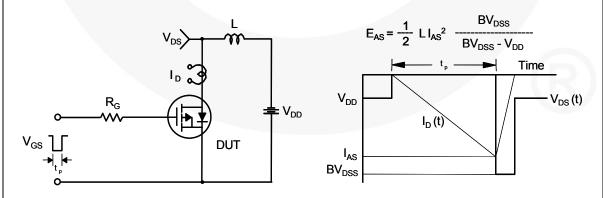
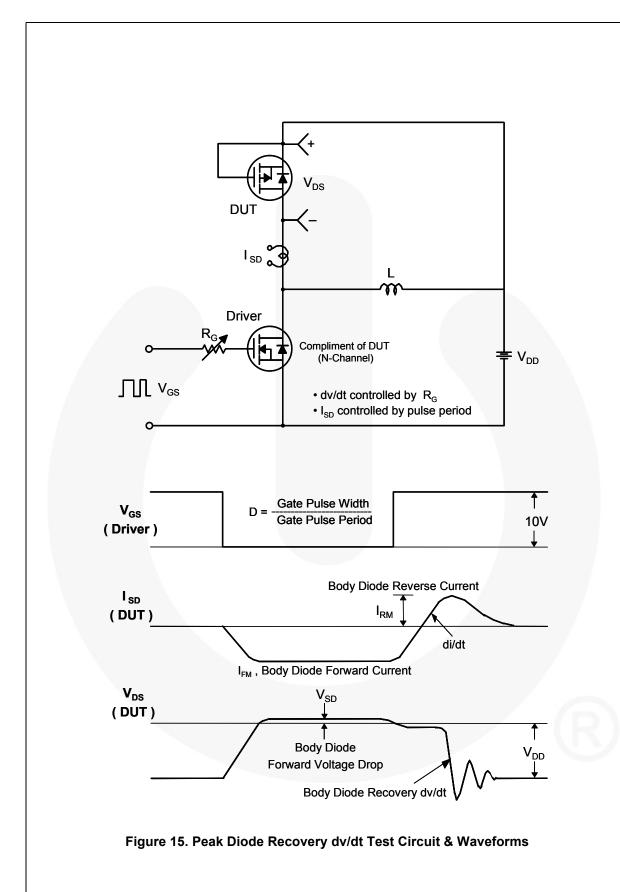


Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms



### **Mechanical Dimensions**

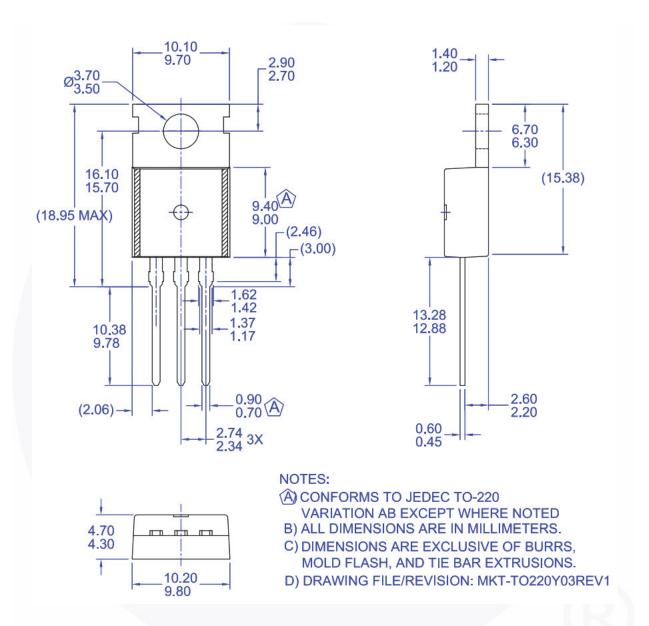


Figure 16. TO220, Molded, 3-Lead, Jedec Variation AB

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