December 2013

# FQP6N40C

# N-Channel QFET® MOSFET

400 V, 6.0 A, 1.0 Ω

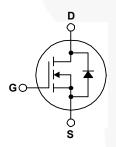
## **Description**

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, active power factor correction (PFC), and electronic lamp ballasts.

### **Features**

- 6.0 A, 400 V,  $R_{DS(on)} = 1.0 \Omega$  (Max.) @  $V_{GS} = 10 \text{ V}$ ,  $I_{D} = 3 \text{ A}$
- Low Gate Charge (Typ. 16 nC)
- · Low Crss (Typ. 15 pF)
- 100% Avalanche Tested





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

Symbol	Parameter		FQP6N40C	Unit
$V_{DSS}$	Drain-Source Voltage		400	V
I <sub>D</sub>	Drain Current - Continuous (T <sub>C</sub> = 25°C)		6	Α
	- Continuous (T <sub>C</sub> = 100°C)		3.6	Α
I <sub>DM</sub>	Drain Current - Pulsed	Note 1)	24	А
V <sub>GSS</sub>	Gate-Source Voltage		± 30	V
E <sub>AS</sub>	Single Pulsed Avalanche Energy	Note 2)	270	mJ
I <sub>AR</sub>	Avalanche Current	Note 1)	6	А
E <sub>AR</sub>	Repetitive Avalanche Energy		7.3	mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)		4.5	V/ns
$P_{D}$	Power Dissipation (T <sub>C</sub> = 25°C)		73	W
	- Derate above 25°C		0.58	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	FQP6N40C	Unit	
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case, Max.	1.71	°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
FQP6N40C	FQP6N40C	TO-220	Tube	N/A	N/A	50 units

Symbol	Parameter	Test Conditions	Min.	Тур.	Max.	Unit
Off Cha	aracteristics					
BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	$V_{GS} = 0 \text{ V}, I_D = 250 \mu\text{A}$	400			V
ΔBV <sub>DSS</sub>	Breakdown Voltage Temperature Coefficient	I <sub>D</sub> = 250 μA, Referenced to 25°C		0.54		V/°C
I <sub>DSS</sub>	Zero Ooto Vellana Brain Ourant	V <sub>DS</sub> = 400 V, V <sub>GS</sub> = 0 V			1	μΑ
Ze	Zero Gate Voltage Drain Current	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	$V_{GS} = -30 \text{ V}, V_{DS} = 0 \text{ V}$			-100	nA
On Cha	aracteristics				I	
V <sub>GS(th)</sub>	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_{D} = 250 \mu\text{A}$	2.0		4.0	V
R <sub>DS(on)</sub>	Static Drain-Source On-Resistance	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 3A		0.83	1	Ω
9 <sub>FS</sub>	Forward Transconductance	$V_{DS} = 40 \text{ V}, I_{D} = 3 \text{A}$		4.7		S
<b>Dynam</b> C <sub>iss</sub>	ic Characteristics Input Capacitance	V 25 V V 0 V		480	625	pF
Coss	Output Capacitance	$V_{DS} = 25 \text{ V}, V_{GS} = 0 \text{ V},$		80	105	pF
C <sub>rss</sub>	Reverse Transfer Capacitance	f = 1.0 MHz		15	20	рF
						μ.
	Ing Characteristics Turn-On Delay Time			13	35	ns
t <sub>d(on)</sub>	Turn-On Rise Time	$V_{DD} = 200 \text{ V}, I_D = 6A,$		65	140	ns
t <sub>d(off)</sub>	Turn-Off Delay Time	$R_G = 25 \Omega$		21	55	ns
t <sub>f</sub>	Turn-Off Fall Time	(Note 4)		38	85	ns
Q <sub>q</sub>	Total Gate Charge	V - 220 V I - 6A		16	20	nC
Q <sub>gs</sub>	Gate-Source Charge	$V_{DS} = 320 \text{ V}, I_D = 6A,$ $V_{GS} = 10 \text{ V}$		2.3		nC
Q <sub>gd</sub>	Gate-Drain Charge	(Note 4)	/	8.2		nC
gu	Cate Diam Charge	, ,		0.2		
	Source Diode Characteristics at					
l <sub>S</sub>	Maximum Continuous Drain-Source Did				6	A
I <sub>SM</sub>	Maximum Pulsed Drain-Source Diode F				24	A
V <sub>SD</sub>	Drain-Source Diode Forward Voltage	$V_{GS} = 0 \text{ V}, I_{S} = 6 \text{ A}$			1.4	V
t <sub>rr</sub>	Reverse Recovery Time	$V_{GS} = 0 \text{ V}, I_S = 6 \text{ A},$		230		ns
$Q_{rr}$	Reverse Recovery Charge	$dI_F / dt = 100 A/\mu s$		1.7	//	μC

Notes: 
1. Repetitive rating : pulse-width limited by maximum junction temperature. 
2. L = 13.7 mH,  $I_{AS}$  = 6 A,  $V_{DD}$  = 50 V,  $R_G$  = 25  $\Omega$ , starting  $T_J$  = 25°C . 
3.  $I_{SD} \le 6$  A, di/dt  $\le 200$  A/ $\mu$ s,  $V_{DD} \le BV_{DSS}$ , starting  $T_J$  = 25°C. 
4. Essentially independent of operating temperature.

# **Typical Characteristics**

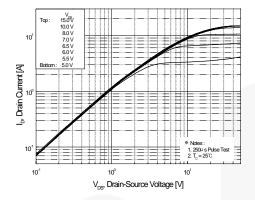


Figure 1. On-Region Characteristics

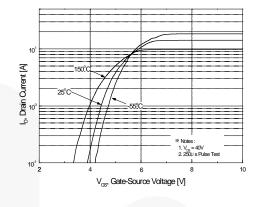


Figure 2. Transfer Characteristics

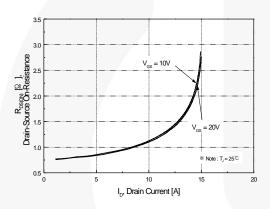


Figure 3. On-Resistance Variation vs Drain Current and Gate Voltage

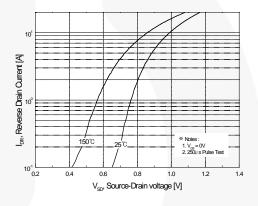


Figure 4. Body Diode Forward Voltage Variation with Source Current and Temperature

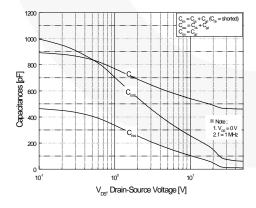


Figure 5. Capacitance Characteristics

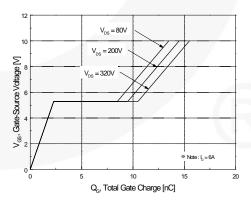


Figure 6. Gate Charge Characteristics

# Typical Characteristics (Continued)

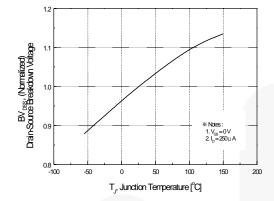


Figure 7. Breakdown Voltage Variation vs Temperature

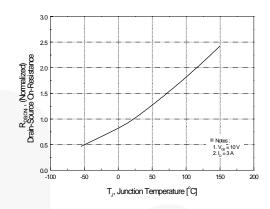


Figure 8. On-Resistance Variation vs Temperature

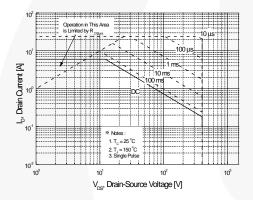


Figure 9. Maximum Safe Operating Area

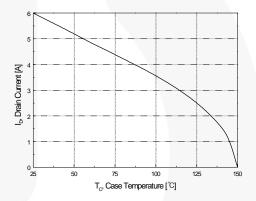


Figure 10. Maximum Drain Current vs Case Temperature

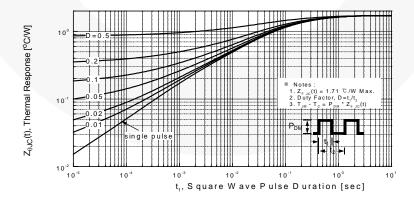


Figure 11. Transient Thermal Response Curve

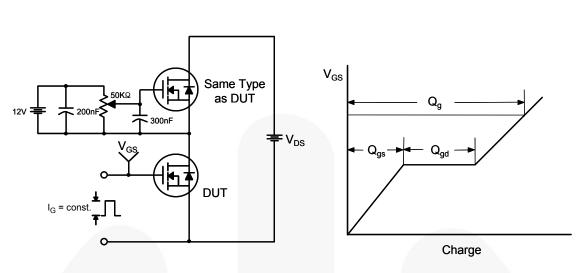


Figure 12. Gate Charge Test Circuit & Waveform

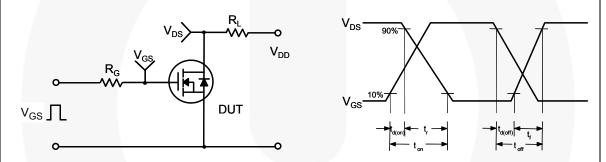


Figure 13. Resistive Switching Test Circuit & Waveforms

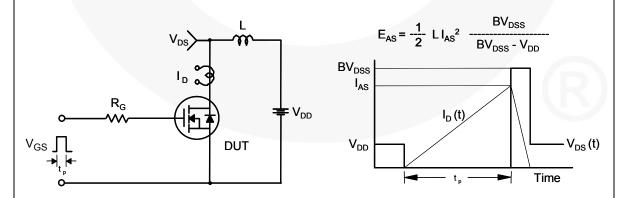
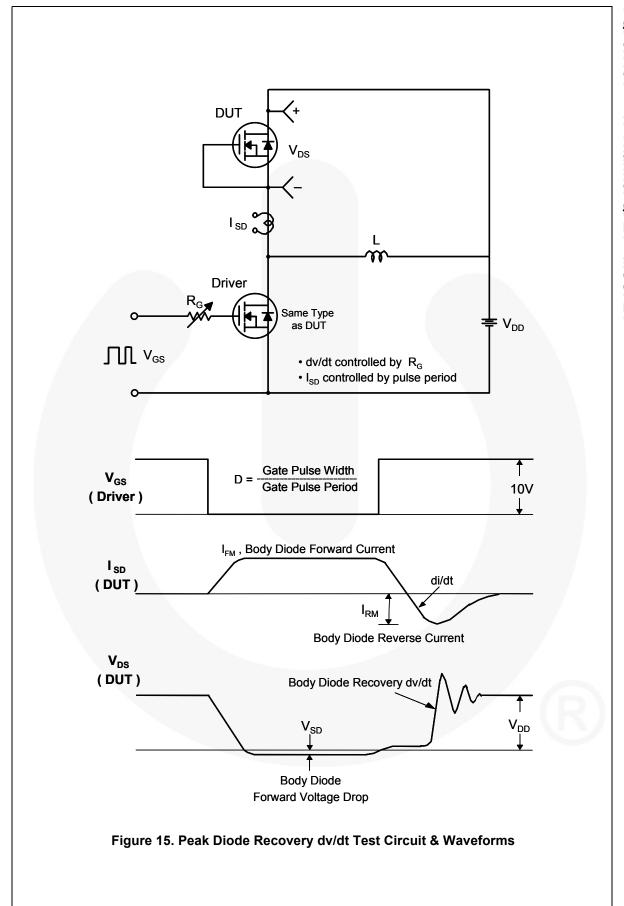


Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms



### **Mechanical Dimensions**

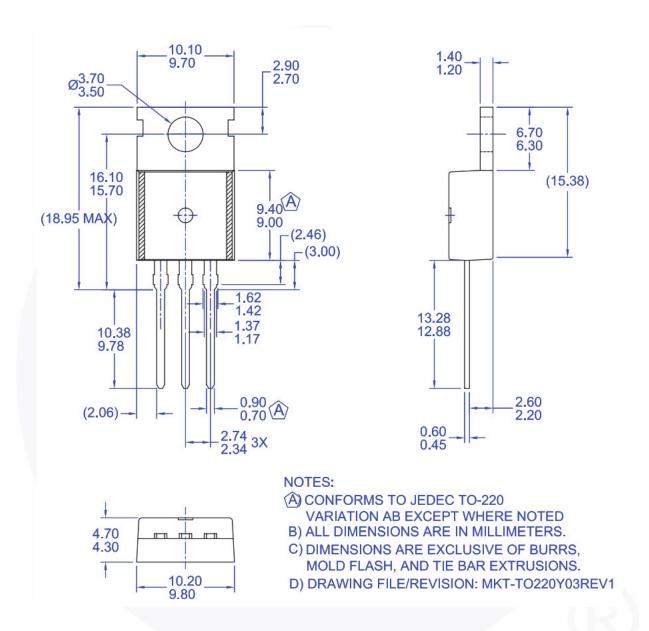


Figure 16. TO220, Molded, 3-Lead, Jedec Variation AB

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