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November 2013

FQPF5N40

N-Channel QFET® MOSFET

400 V, 3.0 A, 1.6 Ω

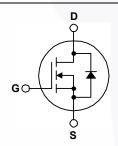
Description

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

- 3.0 A, 400 V, $R_{DS(on)}$ = 1.6 Ω (Max.) @ V_{GS} = 10 V, I_D = 1.5 A
- Low Gate Charge (Typ. 10 nC)
- · Low Crss (Typ. 7 pF)
- · 100% Avalanche Tested





Absolute Maximum Ratings T_C = 25°C unless otherwise noted.

Symbol	Parameter	FQPF5N40	Unit
V_{DSS}	Drain-Source Voltage	400	V
I _D	Drain Current - Continuous (T _C = 25°C)	3.0	Α
	- Continuous (T _C = 100°C)	1.9	Α
I _{DM}	Drain Current - Pulsed (Note 1)	12	Α
V _{GSS}	Gate-Source Voltage	± 30	V
E _{AS}	Single Pulsed Avalanche Energy (Note 2)	290	mJ
I _{AR}	Avalanche Current (Note 1)	3.0	Α
E _{AR}	Repetitive Avalanche Energy (Note 1)	3.5	mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	4.5	V/ns
P_{D}	Power Dissipation (T _C = 25°C)	35	W
	- Derate Above 25°C	0.28	W/°C
T _J , T _{STG}	Operating and Storage Temperature Range	-55 to +150	°C
T _L	Maximum Lead Temperature for Soldering, 1/8" from Case for 5 seconds	300	°C

Thermal Characteristics

Symbol	Parameter	FQPF5N40	Unit
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case, Max.	3.57	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient, Max.	62.5	C/VV

Package Marking and Ordering Information

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FQPF5N40	FQPF5N40	TO-220F	Tube	N/A	N/A	50 units

Electrical Characteristics

c = 25°C unless otherwise noted

BV _{DSS} ΔBV _{DSS} / ΔT _J I _{DSS} I _{GSSF} I _{GSSR} On Chart V _{GS(th)} R _{DS(on)} GFS Dynamic C _{iss} C _{oss}	Practeristics Drain-Source Breakdown Voltage Breakdown Voltage Temperature Coefficient Zero Gate Voltage Drain Current Gate-Body Leakage Current, Forward Gate-Body Leakage Current, Reverse Practeristics Gate Threshold Voltage Static Drain-Source On-Resistance Forward Transconductance	$\begin{split} &V_{GS} = 0 \text{ V, } I_D = 250 \mu\text{A} \\ &I_D = 250 \mu\text{A, Referenced to } 25^{\circ}\text{C} \\ &V_{DS} = 400 \text{ V, } V_{GS} = 0 \text{ V} \\ &V_{DS} = 320 \text{ V, } T_C = 125^{\circ}\text{C} \\ &V_{GS} = 30 \text{ V, } V_{DS} = 0 \text{ V} \\ &V_{GS} = -30 \text{ V, } V_{DS} = 0 \text{ V} \\ \end{split}$ $&V_{DS} = V_{GS}, I_D = 250 \mu\text{A} \\ &V_{GS} = 10 \text{ V, } I_D = 1.5 \text{ A} \\ &V_{DS} = 50 \text{ V, } I_D = 1.5 \text{ A} \end{split}$	400 3.0	 0.38 1.27	 1 10 100 -100 5.0	V V/°C μA μA nA nA
ABV _{DSS} / AT _J I _{DSS} I _{GSSF} I _{GSSR} On Chara V _{GS(th)} R _{DS(on)} 9FS Dynamic C _{iss} C _{OSS}	Breakdown Voltage Temperature Coefficient Zero Gate Voltage Drain Current Gate-Body Leakage Current, Forward Gate-Body Leakage Current, Reverse racteristics Gate Threshold Voltage Static Drain-Source On-Resistance	I_D = 250 μA, Referenced to 25°C V_{DS} = 400 V, V_{GS} = 0 V V_{DS} = 320 V, T_C = 125°C V_{GS} = 30 V, V_{DS} = 0 V V_{GS} = -30 V, V_{DS} = 0 V V_{DS} = -30 V, V_{DS} = 1 V	3.0	0.38	 1 10 100 -100	V/°C μA μA nA nA
/ ΔT_J IDSS IGSSF IGSSR On Chart VGS(th) RDS(on) 9FS Dynamic Ciss Coss	Coefficient Zero Gate Voltage Drain Current Gate-Body Leakage Current, Forward Gate-Body Leakage Current, Reverse racteristics Gate Threshold Voltage Static Drain-Source On-Resistance	$V_{DS} = 400 \text{ V}, V_{GS} = 0 \text{ V}$ $V_{DS} = 320 \text{ V}, T_{C} = 125^{\circ}\text{C}$ $V_{GS} = 30 \text{ V}, V_{DS} = 0 \text{ V}$ $V_{GS} = -30 \text{ V}, V_{DS} = 0 \text{ V}$ $V_{DS} = V_{GS}, I_{D} = 250 \mu\text{A}$ $V_{GS} = 10 \text{ V}, I_{D} = 1.5 \text{ A}$	3.0	 1.27	1 10 100 -100	μA μA nA nA
I _{GSSF} I _{GSSR} On Chara V _{GS(th)} R _{DS(on)} 9FS Dynamic C _{iss} C _{oss}	Gate-Body Leakage Current, Forward Gate-Body Leakage Current, Reverse racteristics Gate Threshold Voltage Static Drain-Source On-Resistance	$V_{DS} = 320 \text{ V}, T_{C} = 125^{\circ}\text{C}$ $V_{GS} = 30 \text{ V}, V_{DS} = 0 \text{ V}$ $V_{GS} = -30 \text{ V}, V_{DS} = 0 \text{ V}$ $V_{DS} = V_{GS}, I_{D} = 250 \mu\text{A}$ $V_{GS} = 10 \text{ V}, I_{D} = 1.5 \text{ A}$	3.0	1.27	10 100 -100	μA nA nA
I _{GSSF} I _{GSSR} On Chara V _{GS(th)} R _{DS(on)} 9FS Dynamic C _{iss} C _{oss}	Gate-Body Leakage Current, Forward Gate-Body Leakage Current, Reverse racteristics Gate Threshold Voltage Static Drain-Source On-Resistance	$V_{GS} = 30 \text{ V}, V_{DS} = 0 \text{ V}$ $V_{GS} = -30 \text{ V}, V_{DS} = 0 \text{ V}$ $V_{DS} = V_{GS}, I_{D} = 250 \mu\text{A}$ $V_{GS} = 10 \text{ V}, I_{D} = 1.5 \text{ A}$	3.0	1.27	100 -100 5.0	nA nA
On Chara V _{GS(th)} R _{DS(on)} g _{FS} Dynamic C _{iss} C _{oss}	Gate-Body Leakage Current, Reverse racteristics Gate Threshold Voltage Static Drain-Source On-Resistance	$V_{GS} = -30 \text{ V}, V_{DS} = 0 \text{ V}$ $V_{DS} = V_{GS}, I_{D} = 250 \mu\text{A}$ $V_{GS} = 10 \text{ V}, I_{D} = 1.5 \text{ A}$	3.0	1.27	-100	nA V
On Chara V _{GS(th)} R _{DS(on)} 9FS Dynamic C _{iss} C _{oss}	Facteristics Gate Threshold Voltage Static Drain-Source On-Resistance	$V_{DS} = V_{GS}, I_D = 250 \mu A$ $V_{GS} = 10 \text{ V}, I_D = 1.5 \text{ A}$	3.0	1.27	5.0	V
V _{GS(th)} R _{DS(on)} 9FS Dynamic C _{iss} C _{oss}	Gate Threshold Voltage Static Drain-Source On-Resistance	V _{GS} = 10 V, I _D = 1.5 A		1.27		
V _{GS(th)} R _{DS(on)} 9FS Dynamic C _{iss} C _{oss}	Gate Threshold Voltage Static Drain-Source On-Resistance	V _{GS} = 10 V, I _D = 1.5 A		1.27		
R _{DS(on)} g _{FS} Dynamic C _{iss} C _{oss}	Static Drain-Source On-Resistance	V _{GS} = 10 V, I _D = 1.5 A		1.27		
Dynamic C _{iss} C _{oss}	Forward Transconductance	V _{DS} = 50 V, I _D = 1.5 A		2.8		
Dynamic C _{iss} C _{oss}		D3 / D				S
C _{oss}	C Characteristics Input Capacitance			350	460	pF
	Output Capacitance	$V_{DS} = 25 \text{ V}, V_{GS} = 0 \text{ V},$		60	80	pF
155	Reverse Transfer Capacitance	f = 1 MHz		7	9	рF
						-
1	ng Characteristics		1			
-()	Turn-On Delay Time	V _{DD} = 200 V, I _D = 4.5 A,		12	30	ns
t _r	Turn-On Rise Time	$R_G = 25 \Omega$		60	130	ns
t _{d(off)}	Turn-Off Delay Time			20	50	ns
	Turn-Off Fall Time	(Note 4)		30	70	ns
Qg	Total Gate Charge	V _{DS} = 320 V, I _D = 4.5 A,		10	13	nC
	Gate-Source Charge	V _{GS} = 10 V		3.0		nC
Q _{gd}	Gate-Drain Charge	(Note 4)		4.5		nC
Drain-So		nd Maximum Datings				

Q_{rr}

 I_{SM}

 V_{SD}

 t_{rr}

Drain-Source Diode Forward Voltage

Maximum Pulsed Drain-Source Diode Forward Current

Reverse Recovery Time

Reverse Recovery Charge

12

1.5

190

Α

V

ns

μС

 $V_{GS} = 0 \text{ V}, I_{S} = 3.0 \text{ A}$

 $V_{GS} = 0 \text{ V}, I_{S} = 4.5 \text{ A},$

 $dI_F / dt = 100 A/\mu s$

 $^{{\}bf 1.}\ {\bf Repetitive}\ {\bf rating: pulse-width\ limited\ by\ maximum\ junction\ temperature.}$

^{2.} L = 56 mH, I_{AS} = 3.0 A, V_{DD} = 50 V, R_G = 25 Ω , starting T_J = 25°C.

^{3.} $I_{SD} \leq$ 4.5 A, di/dt \leq 200 A/ μ s, $V_{DD} \leq$ BV $_{DSS}$, starting T_J = 25°C.

^{4.} Essentially independent of operating temperature.

Typical Characteristics

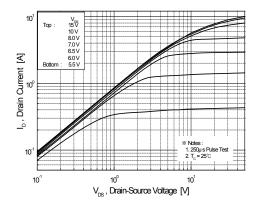


Figure 1. On-Region Characteristics

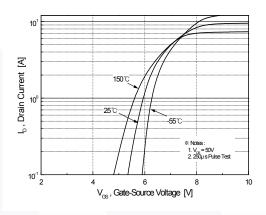


Figure 2. Transfer Characteristics

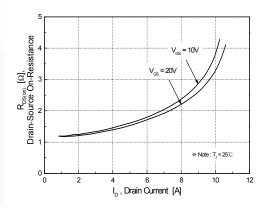


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

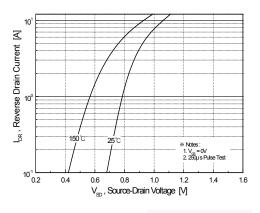


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

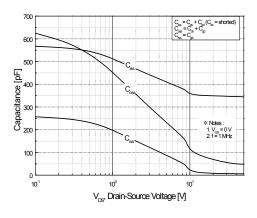


Figure 5. Capacitance Characteristics

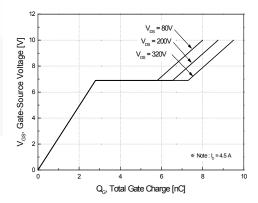


Figure 6. Gate Charge Characteristics

Typical Characteristics (continued) BV_{DSS}, (Normalized) Drain-Source Breakdown Voltage R_{DS(ON)}, (Normalized) Drain-Source On-Resistance 0.8 | -100 0.0 L -100 -50 100 150 200 150 200 T,, Junction Temperature [°C] T_{J} , Junction Temperature [°C] Figure 7. Breakdown Voltage Variation Figure 8. On-Resistance Variation vs. Temperature vs. Temperature Operation in This Area Drain Current [A] I_D, Drain Current [A] 0.5 T_c, Case Temperature [°C] V_{DS}, Drain-Source Voltage [V] Figure 9. Maximum Safe Operating Area Figure 10. Maximum Drain Current vs. Case Temperature Z_{θJC}(t), Thermal Response [°C/W] 10 10 10 -2 10 10 10 $t_{\scriptscriptstyle 1}$, Square W ave Pulse Duration [sec] Figure 11. Transient Thermal Response Curve

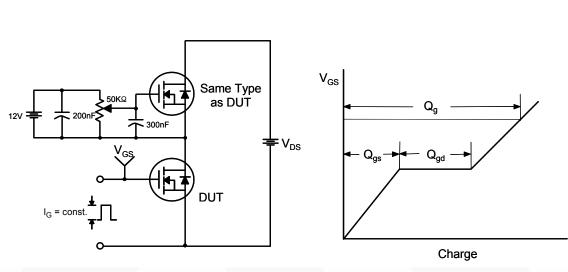


Figure 12. Gate Charge Test Circuit & Waveform

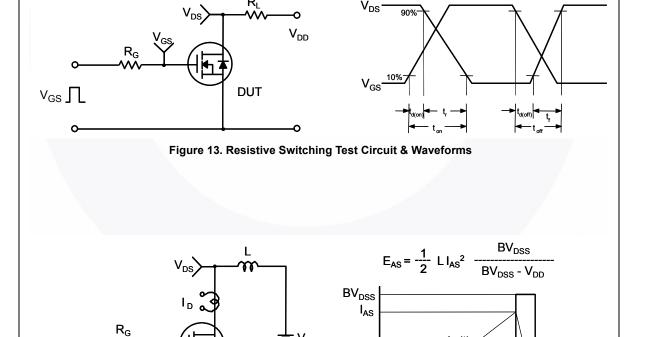


Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms

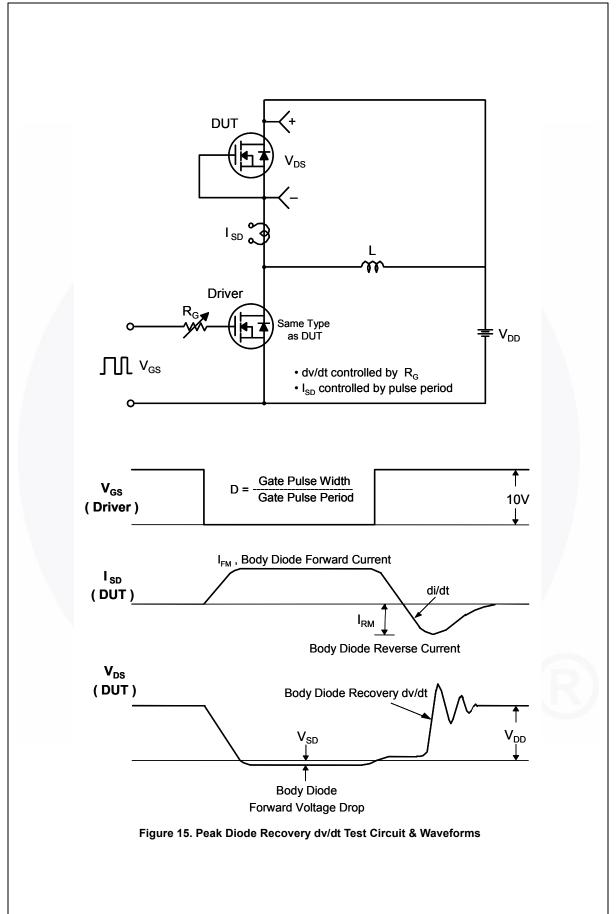
 V_{DD}

 V_{DD}

DUT

Time

 $V_{DS}(t)$



Mechanical Dimensions

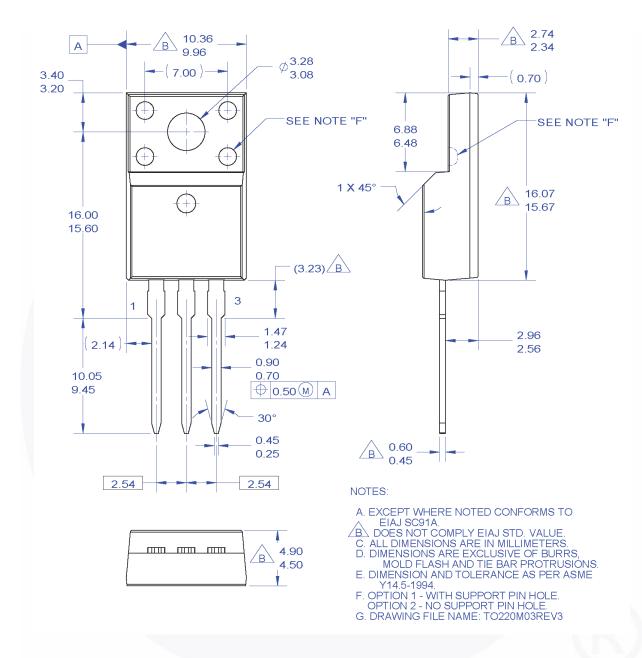


Figure 16. TO220, Molded, 3-Lead, Full Pack, EIAJ SC91, Straight Lead

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