FAIRCHILD
SEMICONDUCTOR®

April 2013

FQP47P06

P-Channel QFET® MOSFET
- 60 V, - 47 A, 26 mΩ

Description

This P-Channel enhancement mode power MOSFET is produced using Fairchild Semiconducto®'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, audio amplifier, DC motor control, and variable switching power applications.

Features

- 47 A, - 60 V, $R_{DS(on)}$ = 26 mΩ @ V_{GS} = - 10 V, I_D = - 23.5 A

• Low Gate Charge (Typ. 84 nC)

• Low Crss (yp. 320 pF)

• 100% Avalanche Tested

• 175°C Maximum Junction Temrature Rating.

G D S **TO-220**

S
G
D
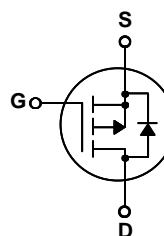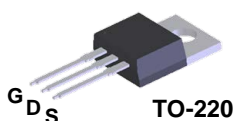
Absolute Maximum Ratings T_C = 25°C unless otherwise noted

Symbol	Parameter		FQP47P06	Unit
V_{DSS}	Drain-Source Voltage		-60	V
I_D	Drain Current - Continuous (T_C = 25°C)		-47	A
	- Continuous (T_C = 100°C)		-33.2	A
I_{DM}	Drain Current - Pulsed	(Note 1)	-188	A
V_{GSS}	Gate-Source Voltage		± 25	V
E_{AS}	Single Pulsed Avalanche Energy	(Note 2)	820	mJ
I_{AR}	Avalanche Current	(Note 1)	-47	A
E_{AR}	Repetitive Avalanche Energy	(Note 1)	16	mJ
dv/dt	Peak Diode Recovery dv/dt	(Note 3)	-7.0	V/ns
P_D	Power Dissipation (T_C = 25°C)		160	W
	- Derate above 25°C		1.06	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	FQP47P06	Unit
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case, Max.	0.94	°C/W
$R_{\theta CS}$	Thermal Resistance, Case-to-Sink, Typ.	0.5	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient, Max.	62.5	°C/W

Elerical Characteristics $T_C = 25°C$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
Off Characteristics						
BV_{DSS}	Drain-Source Breakdown Voltage	$V_{GS} = 0$ V, $I_D = -250$ µA	-60	--	--	V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = -250$ µA, Referenced to 25°C	--	-0.06	--	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, $I_D = -23.5$ A	--	0.021	0.026	Ω
g_{FS}	Forward Transconductance	$V_{DS} = -30$ V, $I_D = -23.5$ A (Note 4)	--	21	--	S
Dynamic Characteristics						
C_{iss}	Input Capacitance	$V_{DS} = -25$ V, $V_{GS} = 0$ V, f = 1.0 MHz	--	2800	3600	pF
C_{oss}	Output Capacitance		--	1300	1700	pF
C_{rss}	Reverse Transfer Capacitance		--	320	420	pF
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = -30$ V, $I_D = -23.5$ A, $R_G = 25$ Ω	--	50	110	ns
t_r	Turn-On Rise Time		--	450	910	ns
$t_{d(off)}$	Turn-Off Delay Time		--	100	210	ns
t_f	Turn-Off Fall Time	(Note 4, 5)	--	195	400	ns
Q_g	Total Gate Charge	$V_{DS} = -48$ V, $I_D = -47$ A, $V_{GS} = -10$ V	--	84	110	nC
Q_{gs}	Gate-Source Charge		--	18	--	nC
Q_{gd}	Gate-Drain Charge	(Note 4, 5)	--	44	--	nC
Drain-Source Diode Characteristics and Maximum Ratings						
I_S	Maximum Continuous Drain-Source Diode Forward Current		--	--	-47	A
I_{SM}	Maximum Pulsed Drain-Source Diode Forward Current		--	--	-188	A
V_{SD}	Drain-Source Diode Forward Voltage	$V_{GS} = 0$ V, $I_S = -47$ A	--	--	-4.0	V
t_{rr}	Reverse Recovery Time	$V_{GS} = 0$ V, $I_S = -47$ A,	--	130	--	ns
Q_{rr}	Reverse Recovery Charge	$dI_F / dt = 100$ A/µs (Note 4)	--	0.55	--	µC

Notes:
1. Repetitive Rating : Pulse width limited by maximum junction temperature
2. L = 0.43mH, $I_{AS} = -47$A, $V_{DD} = -25$V, $R_G = 25$ Ω, Starting $T_J = 25°C$
3. $I_{SD} \leq -47$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

FQP47P06 P-Channel QFET® MOSFET
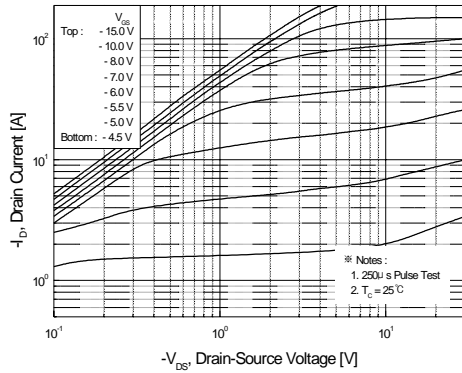
Typical Characteristics

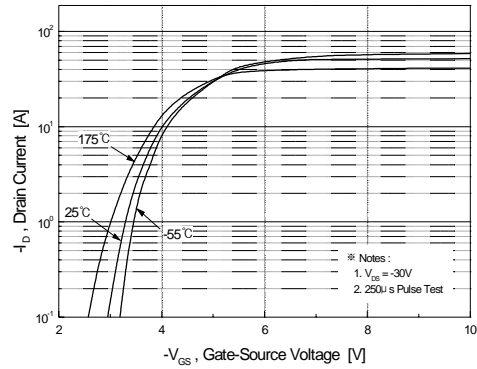
Figure 1. On-Region Characteristics

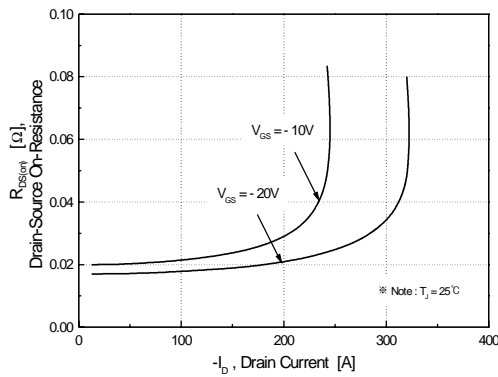**Figure 2. Transfer Characteristics**

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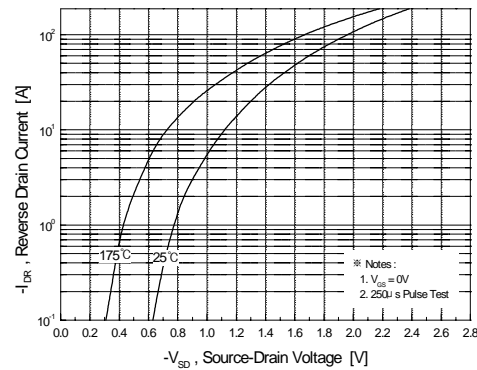Drain Current and Gate Voltage**

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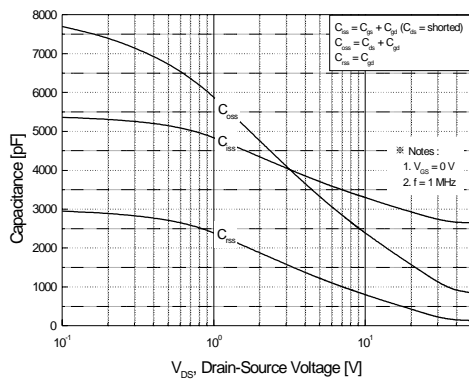Variation vs. Source Current
and Temperature**
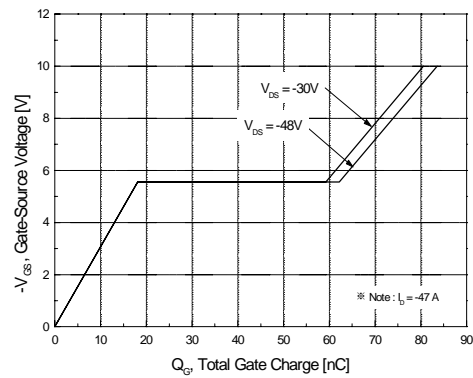

Figure 5. Capacitance Characteristics

Figure 6. Gate Charge Characteristics
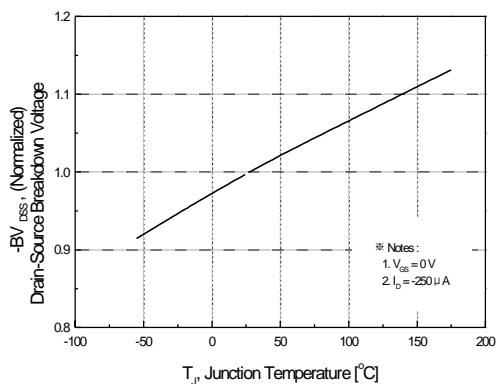
Typical Characteristics (Continued)

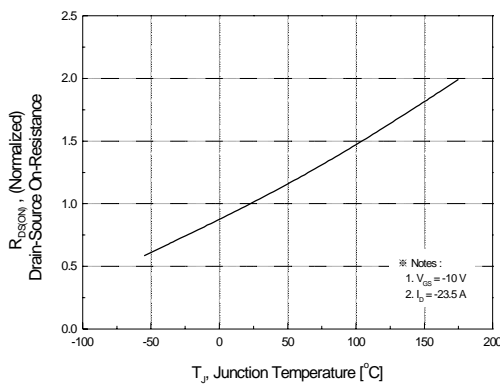**Figure 7. Breakdown Voltage Variation vs. Temperature**

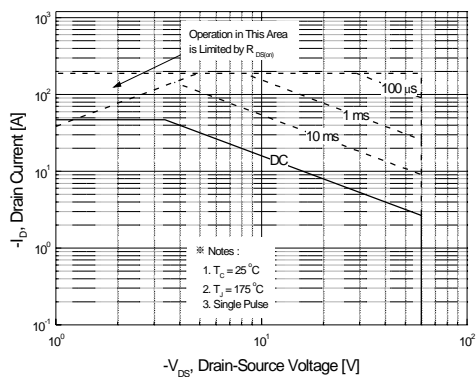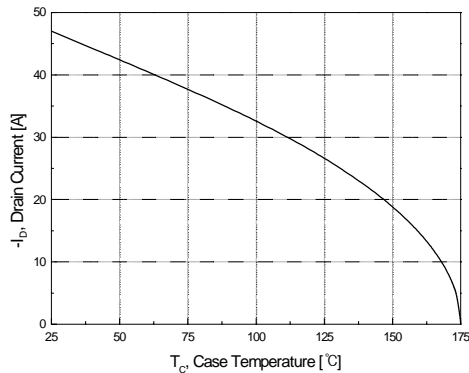**Figure 8. On-Resistance Variation vs. Temperature**

Figure 9. Maximum Safe Operating Area

Figure 10. Maximum Drain Current vs. Case Temperature
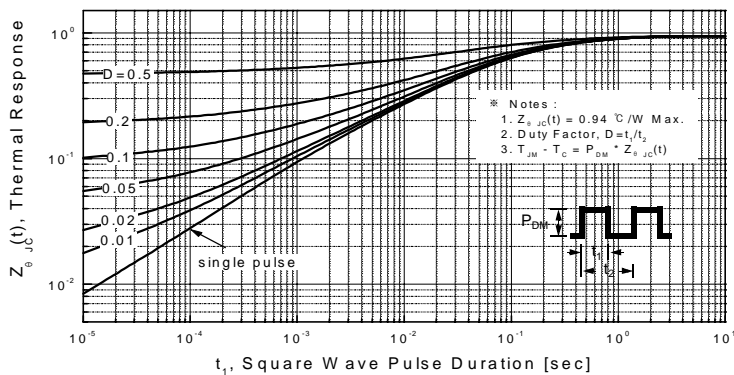
Figure 11. Transient Thermal Response Curve

Gate Charge Test Circuit & Waveform

12V | 200nF | 50KΩ | 300nF

Same Type as DUT

V_{GS}

DUT

-3mA

V_{DS}

V_{GS}

-10V

Q_g

Q_{gs} Q_{gd}

Charge

Resistive Switching Test Circuit & Waveforms

V_{DS} R_L

V_{GS}

R_G

-10V

DUT

V_{DD}

t_{on} t_{off}

$t_{d(on)}$ t_r $t_{d(off)}$ t_f

V_{GS} 10%

V_{DS} 90%
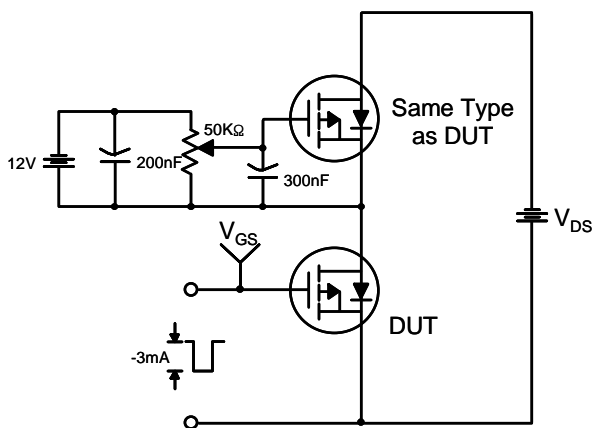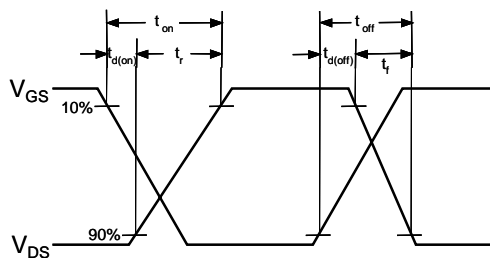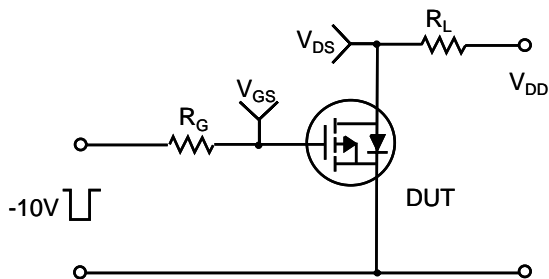
Unclamped Inductive Switching Test Circuit & Waveforms

V_{DS} L

I_D

R_G

-10V t_p

DUT

V_{DD}

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

t_p Time

V_{DD}

$I_D (t)$

$V_{DS} (t)$

I_{AS}

BV_{DSS}
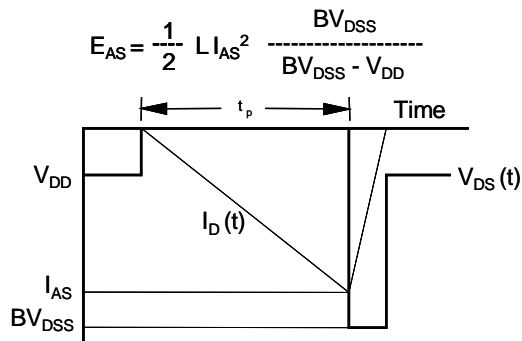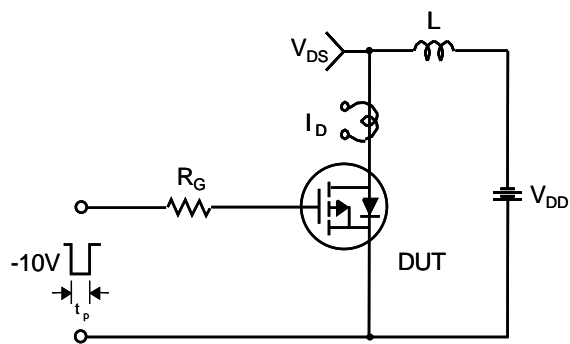
Peak Diode Recovery dv/dt Test Circuit & Waveforms

V_{DS}

DUT

I_{SD}

L

Driver

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)

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

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

V_{DD}

Body Diode Recovery dv/dt

Mechanical Dimensions

TO-220B03

NOTES: UNLESS OTHERWISE SPECIFIED
A) REFERENCE JEDEC, TO-220, ISSUE K,
   VARIATION AB, DATED APRIL, 2002.
B) ALL DIMENSIONS ARE IN MILLIMETERS.
C) DIMENSIONING AND TOLERANCING PER
   ANSI Y14.5 - 1973
D) LOCATION OF THE PIN HOLE MAY VARY
   (LOWER LEFT CORNER, LOWER CENTER
   AND CENTER OF THE PACKAGE)
E) DOES NOT COMPLY JEDEC STANDARD VALUE.
F) "A1" DIMENSIONS REPRESENT LIKE BELOW:
   SINGLE GAUGE = 0.51 - 0.61
   DUAL GAUGE   = 1,14 - 1,40
G) DRAWING FILE NAME: TO220B03REV6

Dimensions in Millimeters

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Rev. I64