

March 2013

### FDPF13N50FT

# N-Channel UniFET<sup>TM</sup> FRFET<sup>®</sup> MOSFET 500 V, 12 A, 540 m $\Omega$

#### **Features**

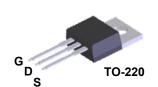
- $R_{DS(on)}$  = 420 $\Omega$  (Typ.) @  $V_{GS}$  = 10 V,  $I_D$  = 6 A
- Low Gate Charge (Typ. 30 nC)
- Low C<sub>rss</sub> (Typ. 14.5 pF)
- · 100% Avalanche Tested
- · Improved dv/dt Capability
- · RoHS Compliant

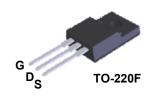
### **Applications**

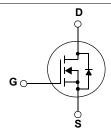
- LCD/LED/PDP TV
- Lighting
- · Uninterruptible Power Supply

### **Description**

UniFET<sup>TM</sup> MOSFET is Fairchild Semiconductor<sup>®</sup>'s high voltage MOSFET family based on planar stripe and DMOS technology. This MOSFET is tailored to reduce on-state resistance, and to provide better switching performance and higher avalanche energy strength. The body diode's reverse recovery performance of UniFET FRFET<sup>®</sup> MOSFET has been enhanced by lifetime control. Its t<sub>rr</sub> is less than 100nsec and the reverse dv/dt immunity is 15V/ns while normal planar MOSFETs have over 200nsec and 4.5V/nsec respectively. Therefore, it can remove additional component and improve system reliability in certain applications in which the performance of MOSFET's body diode is significant. This device family is suitable for switching power converter applications such as power factor correction (PFC), flat panel display (FPD) TV power, ATX and electronic lamp ballasts.







### MOSFET Maximum Ratings T<sub>C</sub> = 25°C unless otherwise noted\*

Symbol		Parameter		FDPF13N50FT	Unit
$V_{DSS}$	Drain to Source Voltage			500	V
$V_{GSS}$	Gate to Source Voltage			±30	V
	Drain Current	- Continuous (T <sub>C</sub> = 25°C)		12*	^
'D	Drain Current	- Continuous (T <sub>C</sub> = 100°C)		7.2*	Α
I <sub>DM</sub>	Drain Current	- Pulsed	(Note 1)	48*	Α
E <sub>AS</sub>	Single Pulsed Avalanche Energy (Note 2)			684	mJ
I <sub>AR</sub>	Avalanche Current (Note		(Note 1)	12	Α
E <sub>AR</sub>	Repetitive Avalanche Energy (Note		(Note 1)	19.5	mJ
dv/dt	Peak Diode Recovery dv/dt		(Note 3)	20	V/ns
Б	Davis Dissipation	$(T_C = 25^{\circ}C)$		42	W
$P_{D}$	Power Dissipation	- Derate above 25°C		0.33	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 Purpose, 1/8" from Case for 5 Seconds			300	°C

<sup>\*</sup>Drain current limited by maximum junction temperature

#### **Thermal Characteristics**

Symbol	Parameter	FDPF13N50FT	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max	3.0	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max	62.5	C/VV

### Package Marking and Ordering Information $T_C = 25^{\circ}C$ unless otherwise noted

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FDPF13N50FT	FDPF13N50FT	TO-220F	-	-	50

### **Electrical Characteristics**

Symbol	Parameter Test Conditions		Min.	Тур.	Max.	Unit
Off Charac	cteristics					
BV <sub>DSS</sub>	Drain to Source Breakdown Voltage	$I_D = 250\mu A$ , $V_{GS} = 0V$ , $T_J = 25^{\circ}C$	500	-	-	V
ΔBV <sub>DSS</sub> ΔΤ <sub>J</sub>	Breakdown Voltage Temperature Coefficient	I <sub>D</sub> = 250μA, Referenced to 25°C	-	0.7	-	V/°C
	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 500V, V <sub>GS</sub> = 0V	-	-	10	
IDSS	Zero Gate voltage Drain Current	$V_{DS} = 400V, T_C = 125^{\circ}C$	-	-	100	μΑ
I <sub>GSS</sub>	Gate to Body Leakage Current	$V_{GS} = \pm 20V, V_{DS} = 0V$	-	-	±100	nA

#### On Characteristics

V <sub>GS(th)</sub>	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_{D} = 250 \mu A$	3.0	-	5.0	V
R <sub>DS(on)</sub>	Static Drain to Source On Resistance	$V_{GS} = 10V, I_D = 6A$	-	0.42	0.54	Ω
9 <sub>FS</sub>	Forward Transconductance	$V_{DS} = 20V, I_{D} = 6A$	ı	13.3	-	S

#### **Dynamic Characteristics**

C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> = 25V, V <sub>GS</sub> = 0V f = 1MHz		1450	1930	pF
C <sub>oss</sub>	Output Capacitance			198	265	pF
C <sub>rss</sub>	Reverse Transfer Capacitance			14.5	22	pF
Q <sub>g(tot)</sub>	Total Gate Charge at 10V		-	30	39	nC
Q <sub>gs</sub>	Gate to Source Gate Charge	$V_{DS} = 400V, I_{D} = 13A$	-	8	-	nC
Q <sub>gd</sub>	Gate to Drain "Miller" Charge	V <sub>GS</sub> = 10V (Note 4)	-	12	-	nC

#### **Switching Characteristics**

t <sub>d(on)</sub>	Turn-On Delay Time			-	28	65	ns
t <sub>r</sub>	Turn-On Rise Time	$V_{DD} = 250V, I_{D} = 13A$		-	54	120	ns
t <sub>d(off)</sub>	Turn-Off Delay Time	$R_G = 25\Omega$		-	75	160	ns
t <sub>f</sub>	Turn-Off Fall Time		(Note 4)	-	47	105	ns

#### **Drain-Source Diode Characteristics**

$I_S$	Maximum Continuous Drain to Source Diode Forward Current		-	-	12	Α
I <sub>SM</sub>	Maximum Pulsed Drain to Source Diode Forward Current		-	-	48	Α
$V_{SD}$	Drain to Source Diode Forward Voltage	V <sub>GS</sub> = 0V, I <sub>SD</sub> = 12A	-	-	1.5	V
t <sub>rr</sub>	Reverse Recovery Time	V <sub>GS</sub> = 0V, I <sub>SD</sub> = 12A	-	154	-	ns
Q <sub>rr</sub>	Reverse Recovery Charge	$dI_F/dt = 100A/\mu s$	-	0.45	-	μС

#### Notes

- ${\bf 1.}\ {\bf Repetitive}\ {\bf Rating:}\ {\bf Pulse}\ {\bf width}\ {\bf limited}\ {\bf by}\ {\bf maximum}\ {\bf junction}\ {\bf temperature}$
- 2. L = 9.5mH, I\_{AS} = 12A, V\_{DD} = 50V, R\_G = 25 $\Omega$ , Starting T\_J = 25 $^{\circ}$ C
- 3.  $I_{SD} \le$  12A, di/dt  $\le$  200A/ $\mu$ s,  $V_{DD} \le$  BV $_{DSS}$ , Starting  $T_J$  = 25°C
- 4. Essentially Independent of Operating Temperature Typical Characteristics

### **Typical Performance Characteristics**

Figure 1. On-Region Characteristics

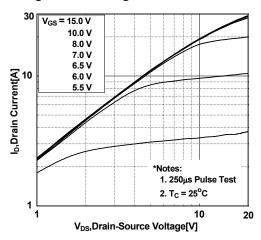


Figure 3. On-Resistance Variation vs.

Drain Current and Gate Voltage

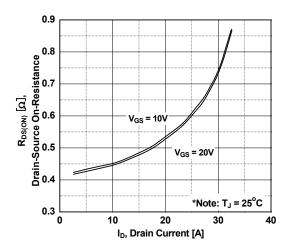


Figure 5. Capacitance Characteristics

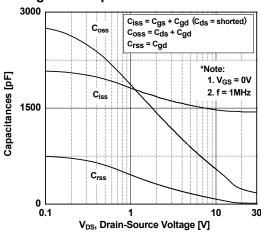


Figure 2. Transfer Characteristics

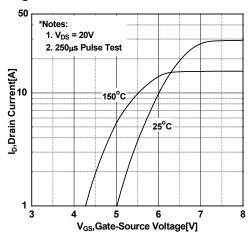


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

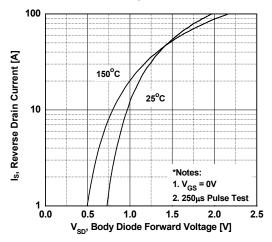
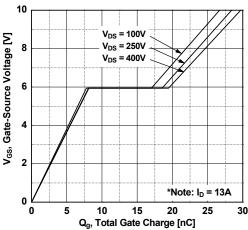


Figure 6. Gate Charge Characteristics



### **Typical Performance Characteristics** (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

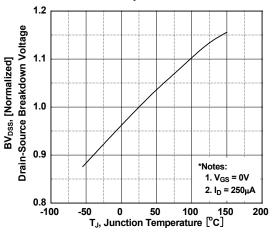


Figure 8. Maximum Safe Operating Area - FDPF13N50FT

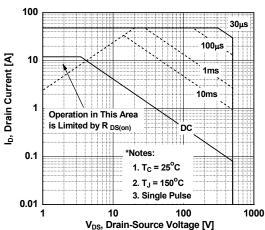


Figure 9. Maximum Drain Current vs. Case Temperature

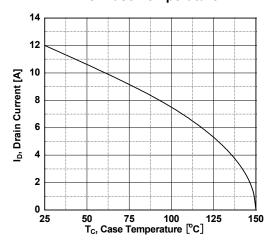
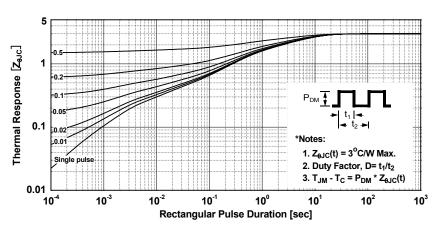
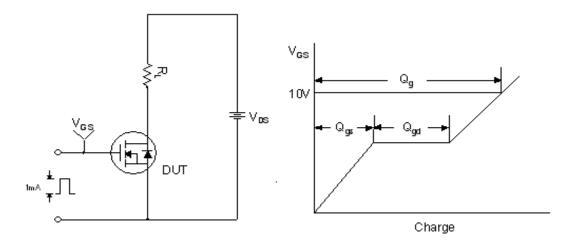


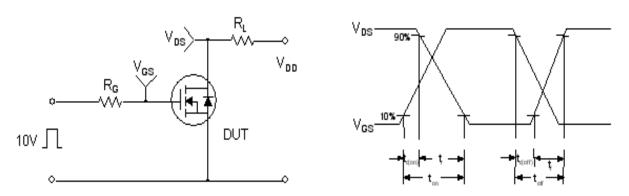
Figure 10. Transient Thermal Response Curve - FDPF13N50FT



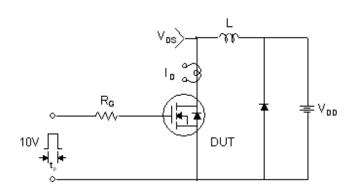
#### **Gate Charge Test Circuit & Waveform**

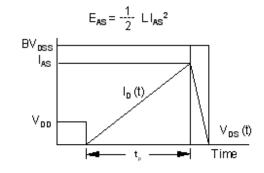


#### **Resistive Switching Test Circuit & Waveforms**

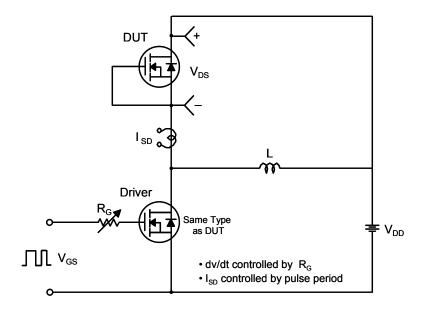


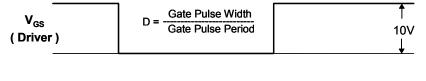
**Unclamped Inductive Switching Test Circuit & Waveforms** 

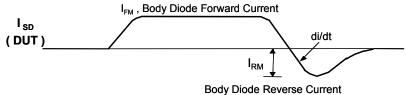


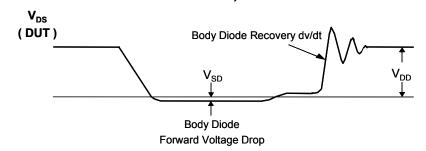


#### Peak Diode Recovery dv/dt Test Circuit & Waveforms



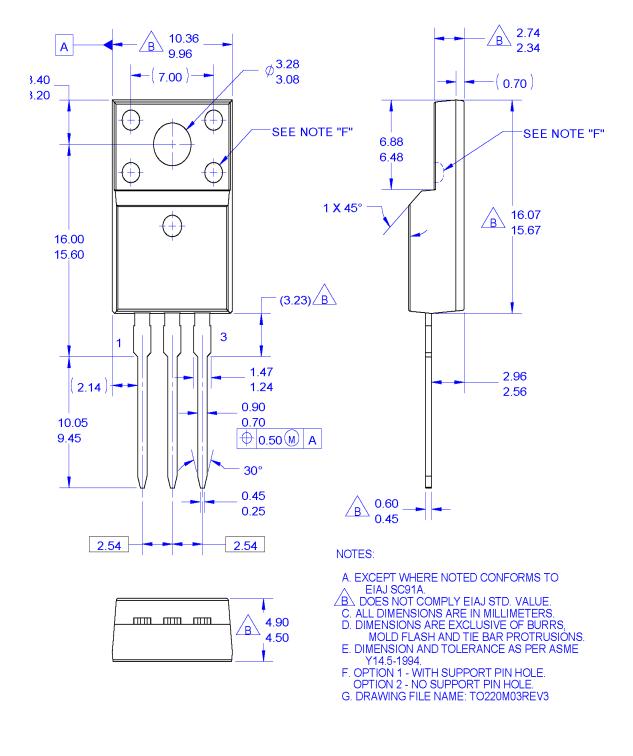






### **Package Dimensions**

## TO-220M03







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