

November 2013

# FDP51N25 / FDPF51N25 N-Channel UniFET<sup>TM</sup> MOSFET 250 V, 51 A, 60 m $\Omega$

#### **Features**

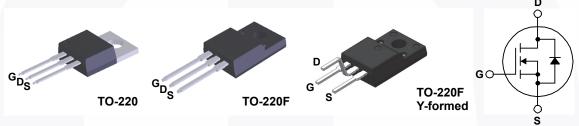
- $R_{DS(on)}$  = 48 m $\Omega$  (Typ.) @  $V_{GS}$  = 10 V,  $I_{D}$  = 25.5 A
- Low Gate Charge (Typ. 55 nC)
- Low C<sub>rss</sub> (Typ. 63 pF)

# **Applications**

- PDP TV
- Lighting
- · Uninterruptible Power Supply
- · AC-DC Power Supply

## Description

UniFET<sup>TM</sup> MOSFET is Fairchild Semiconductor'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. 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.



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

Symbol	Parameter		FDP51N25	FDPF51N25 / FDPF51N25YDTU	Unit
$V_{DSS}$	Drain-Source Voltage		250		V
I <sub>D</sub>	Drain Current	- Continuous (T <sub>C</sub> = 25°C) - Continuous (T <sub>C</sub> = 100°C)	51 30	51* 30*	A A
I <sub>DM</sub>	Drain Current	- Pulsed (Note 1)	204	204*	Α
$V_{GSS}$	Gate-Source voltage		± 30		V
E <sub>AS</sub>	Single Pulsed Avalanche Energy (Note 2)		1111		mJ
I <sub>AR</sub>	Avalanche Current (Note 1)		51		Α
E <sub>AR</sub>	Repetitive Avalanche Energy (Note 1)		32		mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)		4.5		V/ns
$P_{D}$	Power Dissipation	(T <sub>C</sub> = 25°C) - Derate Above 25°C	320 3.7	38 0.3	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

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

## **Thermal Characteristics**

Symbol	Parameter	FDP51N25	FDPF51N25 / FDPF51N25YDTU	Unit
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case, Max.	0.39	3.3	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient, Max.	62.5	62.5	°C/W

# **Package Marking and Ordering Information**

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FDP51N25	FDP51N25	TO-220	Tube	N/A	N/A	50 units
FDPF51N25	FDPF51N25	TO-220F	Tube	N/A	N/A	50 units
FDPF51N25YDTU	FDPF51N25	TO-220F (Y-formed)	Tube	N/A	N/A	50 units

# **Electrical Characteristics** $T_C = 25^{\circ}C$ unless otherwise noted.

Symbol	Parameter	Conditions	Min.	Тур.	Max.	Unit
Off Charac	cteristics				11.	
BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	$V_{GS} = 0 \text{ V, } I_D = 250  \mu\text{A, } T_J = 25 ^{\circ}\text{C}$	250			V
ΔBV <sub>DSS</sub> / ΔT <sub>J</sub>	Breakdown Voltage Temperature Coefficient	I <sub>D</sub> = 250 μA, Referenced to 25°C		0.25		V/°C
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 250 V, V <sub>GS</sub> = 0 V V <sub>DS</sub> = 200 V, T <sub>C</sub> = 125°C			1 10	μA μA
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> = 0V			-100	nA
On Charac	teristics					
V <sub>GS(th)</sub>	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_{D} = 250 \mu A$	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> = 25.5 A		0.048	0.060	Ω
9 <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> = 40 V, I <sub>D</sub> = 25.5 A		43		S
Dynamic C	Characteristics					
C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> = 25 V, V <sub>GS</sub> = 0 V, f = 1 MHz		2620	3410	pF
C <sub>oss</sub>	Output Capacitance			530	690	pF
C <sub>rss</sub>	Reverse Transfer Capacitance			63	90	pF
Switching	Characteristics				1	
t <sub>d(on)</sub>	Turn-On Delay Time	$V_{DD}$ = 125 V, $I_{D}$ = 51 A, $V_{GS}$ = 10 V, $R_{G}$ = 25 $\Omega$ (Note 4)		62	135	ns
t <sub>r</sub>	Turn-On Rise Time			465	940	ns
t <sub>d(off)</sub>	Turn-Off Delay Time			98	205	ns
t <sub>f</sub>	Turn-Off Fall Time			130	270	ns
Qg	Total Gate Charge	V <sub>DS</sub> = 200 V, I <sub>D</sub> = 51 A,	/	55	70	nC
Q <sub>gs</sub>	Gate-Source Charge	V <sub>GS</sub> = 10 V		16		nC
Q <sub>gd</sub>	Gate-Drain Charge	(Note 4)		27		nC
Drain-Sou	rce Diode Characteristics and Maximur	n Ratings				
Maximum Continuous Drain-Source Diode Forward Current					51	Α
I <sub>SM</sub>	Maximum Pulsed Drain-Source Diode Forward Current				204	Α
V <sub>SD</sub>	Drain-Source Diode Forward Voltage	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 51 A			1.4	V
t <sub>rr</sub>	Reverse Recovery Time	$V_{GS} = 0 \text{ V, } I_{S} = 51 \text{ A,}$ $dI_{F}/dt = 100 \text{ A/}\mu\text{s}$		178		ns
Q <sub>rr</sub>	Reverse Recovery Charge			4.0		μС

#### Notes

<sup>1.</sup> Repetitive rating: pulse-width limited by maximum junction temperature.

<sup>2.</sup> L = 0.68 mH, I  $_{AS}$  = 51 A, V  $_{DD}$  = 50 V, R  $_{G}$  = 25  $\Omega,$  starting T  $_{J}$  = 25  $^{\circ}C.$ 

<sup>3.</sup>  $I_{SD} \le 51$  A, di/dt  $\le 200$  A/ $\mu$ s,  $V_{DD} \le BV_{DSS}$ , starting  $T_J$  = 25°C.

<sup>4.</sup> Essentially independent of operating temperature typical characteristics.

# **Typical Performance Characteristics**

Figure 1. On-Region Characteristics

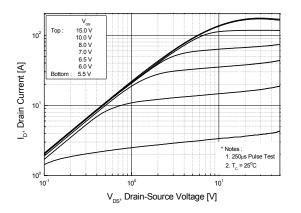


Figure 3. On-Resistance Variation vs.

Drain Current and Gate Voltage

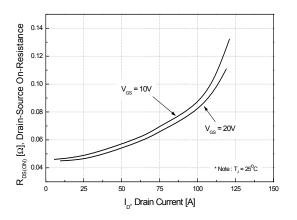


Figure 5. Capacitance Characteristics

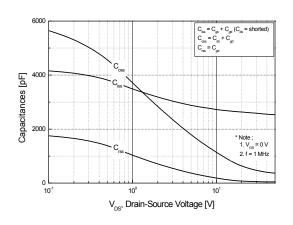


Figure 2. Transfer Characteristics

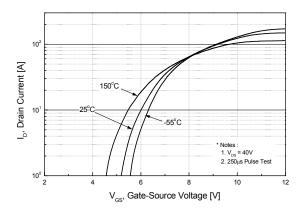


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperatue

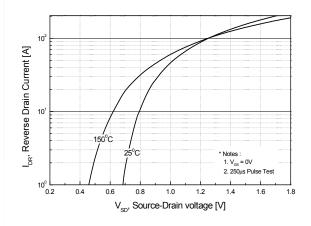
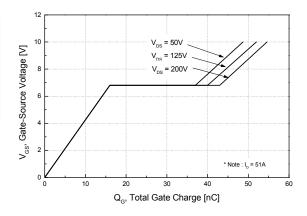


Figure 6. Gate Charge Characteristics



# Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

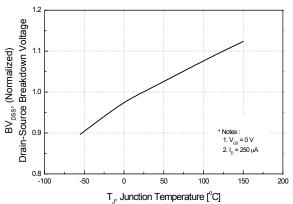


Figure 9-1. Maximum Safe Operating Area for FDP51N25



Drain-Source On-Resistance R<sub>DS(ON)</sub>, (Normalized) 0.5

T,, Junction Temperature [°C]

150

Figure 8. On-Resistance Variation

3.0

2.5

2.0

0.0 L -100

-50

vs. Temperature

Figure 9-2. Maximum Safe Operating Area for FDPF51N25 / FDPF51N25YDTU

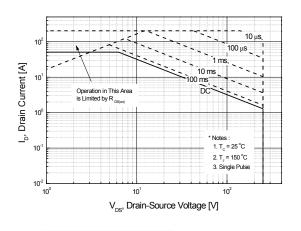
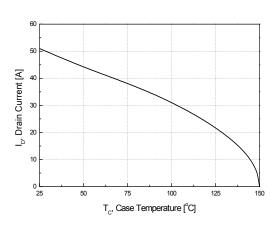
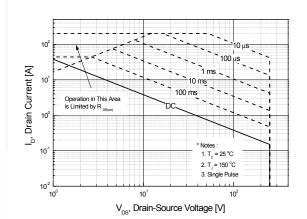


Figure 10. Maximum Drain Current vs. Case Temperature





# **Typical Performance Characteristics** (Continued)

Figure 11-1. Transient Thermal Response Curve for FDP51N25

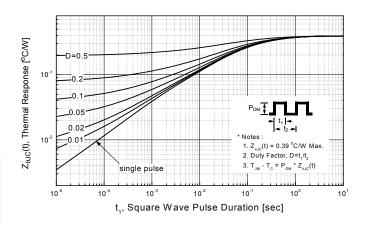
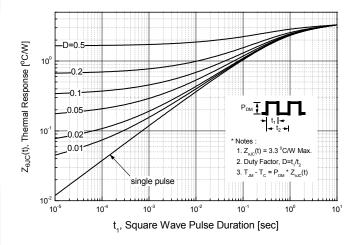


Figure 11-2. Transient Thermal Response Curve for FDPF51N25 / FDPF51N25YDTU



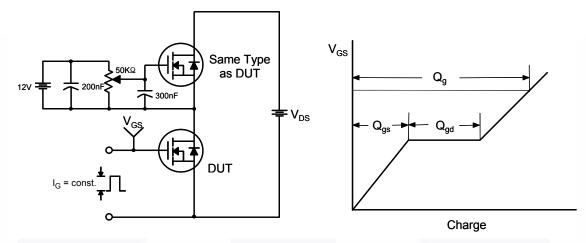


Figure 12. Gate Charge Test Circuit & Waveform

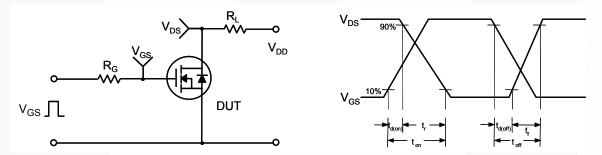


Figure 13. Resistive Switching Test Circuit & Waveforms

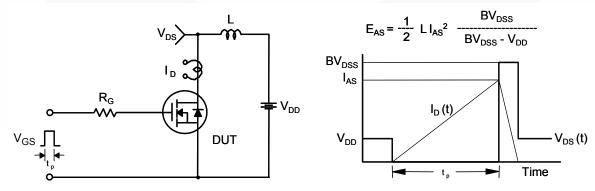


Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms

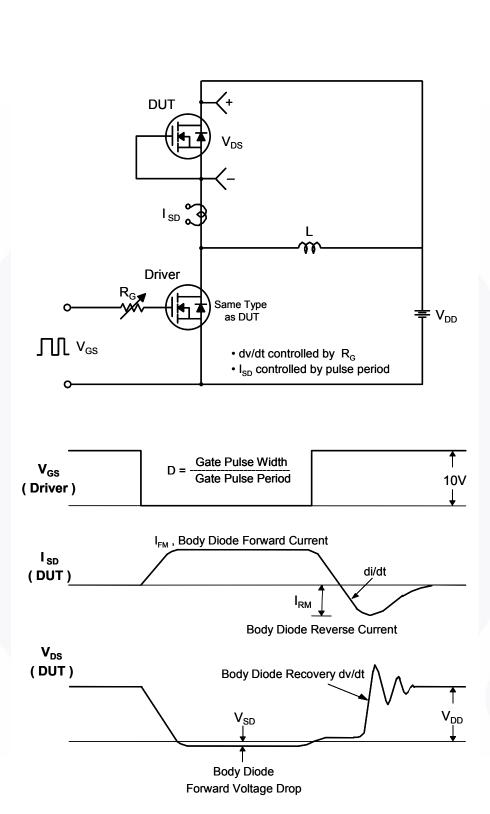


Figure 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms

## **Mechanical Dimensions**

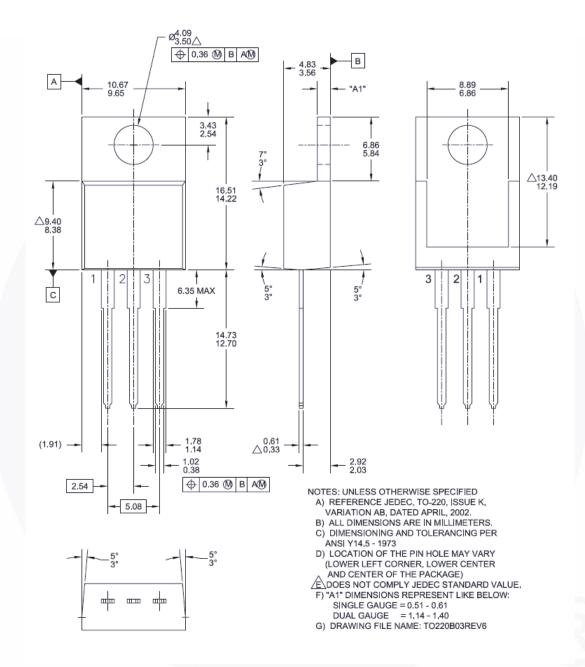


Figure 16. TO-220, Molded, 3-Lead, Jedec Variation AB

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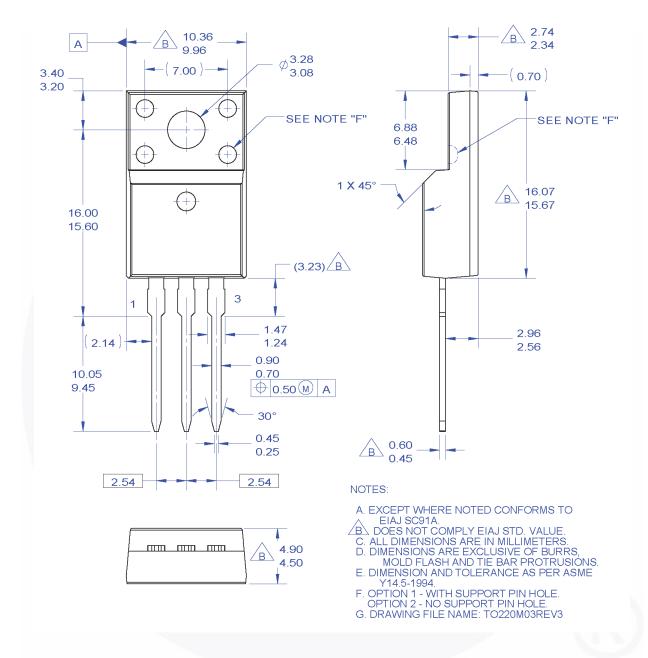


Figure 17. TO220, Molded, 3-Lead, Full Pack, EIAJ SC91, Straight Lead

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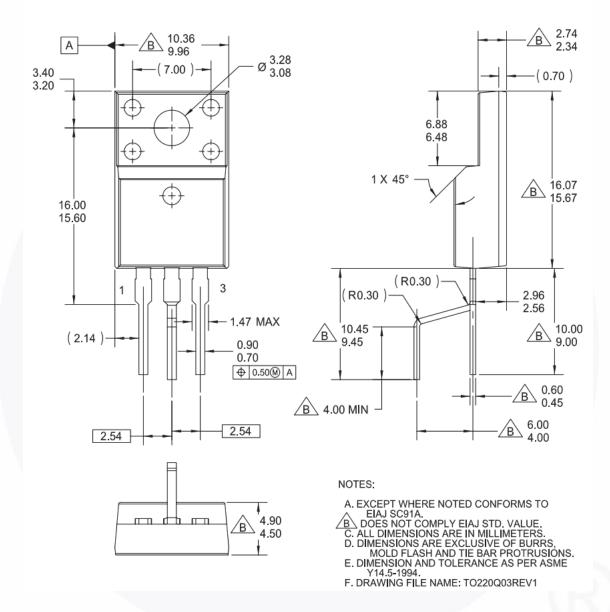


Figure 18. TO220, Molded, 3-Lead, Full Pack, EIAJ SC91, Y-Formed

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