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November 2013

# FDP12N60NZ / FDPF12N60NZ N-Channel UniFET<sup>TM</sup> II MOSFET 600 V, 12 A, 650 m $\Omega$

### **Features**

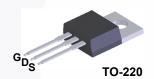
- $R_{DS(on)}$  = 530  $m\Omega$  (Typ.) @  $V_{GS}$  = 10 V,  $I_D$  = 6 A
- Low Gate Charge (Typ. 26 nC)
- Low C<sub>rss</sub> (Typ. 12 pF)
- · 100% Avalanche Tested
- · Improved dv/dt Capability
- · ESD Improved Capability
- RoHS Compliant

### **Applications**

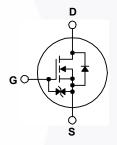
- LCD/ LED/ PDP TV
- Lighting
- · Uninterruptible Power Supply

### Description

UniFET<sup>TM</sup> II MOSFET is Fairchild Semiconductor's high voltage MOSFET family based on advanced planar stripe and DMOS technology. This advanced MOSFET family has the smallest on-state resistance among the planar MOSFET, and also provides superior switching performance and higher avalanche energy strength. In addition, internal gate-source ESD diode allows UniFET II MOSFET to withstand over 2kV HBM surge stress. 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		FDP12N60NZ	FDPF12N60NZ	Unit	
$V_{DSS}$	Drain to Source Voltage	Drain to Source Voltage			600		
$V_{GSS}$	Gate to Source Voltage			±;	30	V	
	Drain Current	- Continuous (T <sub>C</sub> = 25°C)		12	12*	Α	
ID	Drain Current  - Continuous (T <sub>C</sub> = 100°C)		7.2	7.2*	А		
I <sub>DM</sub>	Drain Current - Pulsed (Note 1)		48	48*	Α		
E <sub>AS</sub>	Single Pulsed Avalanche Energy (Note 2)		565		mJ		
I <sub>AR</sub>	Avalanche Current (Note 1		lote 1)	12		Α	
E <sub>AR</sub>	Repetitive Avalanche Energy (Note 1)		ote 1)	24		mJ	
dv/dt	MOSFET dv/dt Ruggedness			20		V/ns	
uv/ut	Peak Diode Recovery dv/dt	(N	ote 3)	9 3) 10		V/ns	
Б	$(T_C = 25^{\circ}C)$		240	39	W		
$P_{D}$	Power Dissipation - Derate Above 25°C		2.0	0.3	W/oC		
T <sub>J</sub> , T <sub>STG</sub>	Operating and Storage Temperature Range -55 to			+150	°C		
T <sub>L</sub>	Maximum Lead Temperature f	or Soldering, 1/8" from Case for 5 Sec	onds	30	00	°C	

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

### Thermal Characteristics

Symbol	Parameter FDP1		FDPF12N60NZ	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	0.52	3.2	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max.	62.5	62.5	- 0/00

### **Package Marking and Ordering Information**

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FDP12N60NZ	FDP12N60NZ	TO-220	Tube	N/A	N/A	50 units
FDPF12N60NZ	FDPF12N60NZ	TO-220F	Tube	N/A	N/A	50 units

### **Electrical Characteristics** T<sub>C</sub> = 25°C unless otherwise noted.

Symbol	Parameter	Test Conditions	Min.	Тур.	Max.	Unit
Off Charac	cteristics					
BV <sub>DSS</sub>	Drain to Source Breakdown Voltage	$I_D = 250 \mu A, V_{GS} = 0 V, T_J = 25^{\circ} C$	600	-	-	V
ΔBV <sub>DSS</sub> / ΔT <sub>J</sub>	Breakdown Voltage Temperature Coefficient	$I_D$ = 250 $\mu$ A, Referenced to 25°C	-	0.6	-	V/°C
1	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 600 V, V <sub>GS</sub> = 0 V	-	-	1	
IDSS	Zero Gate voltage Drain Current	$V_{DS} = 480 \text{ V}, T_{C} = 125^{\circ}\text{C}$	-	-	10	μΑ
I <sub>GSS</sub>	Gate to Body Leakage Current	V <sub>GS</sub> = ±30 V, V <sub>DS</sub> = 0 V	-	-	±10	μΑ

### **On Characteristics**

$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_{D} = 250 \mu\text{A}$	3	-	5	V
R <sub>DS(on)</sub>	Static Drain to Source On Resistance	$V_{GS} = 10 \text{ V}, I_D = 6 \text{ A}$	-	0.53	0.65	Ω
9 <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> = 20 V, I <sub>D</sub> = 6 A	-	13.5	-	S

### **Dynamic Characteristics**

C <sub>iss</sub>	Input Capacitance	V 05.V.V 0.V		-	1260	1676	pF
C <sub>oss</sub>	Output Capacitance		$V_{DS} = 25 \text{ V}, V_{GS} = 0 \text{ V},$ f = 1  MHz		150	200	pF
C <sub>rss</sub>	Reverse Transfer Capacitance	1 - 1 101112	-	- \	12	18	pF
Q <sub>g(tot)</sub>	Total Gate Charge at 10V	V <sub>DS</sub> = 480 V, I <sub>D</sub> = 12 A,		- \	26	34	nC
$Q_{gs}$	Gate to Source Gate Charge	V <sub>GS</sub> = 10 V	-	-	6	-	nC
$Q_{gd}$	Gate to Drain "Miller" Charge	(	(Note 4)	-	10	-	nC

### **Switching Characteristics**

t <sub>d(on)</sub>	Turn-On Delay Time		-	25	60	ns
t <sub>r</sub>		$V_{DD} = 300 \text{ V}, I_D = 12 \text{ A},$	-	50	110	ns
t <sub>d(off)</sub>	Turn-Off Delay Time	$V_{GS}$ = 10 V, $R_G$ = 25 $\Omega$	-	80	170	ns
t <sub>f</sub>	Turn-Off Fall Time	(Note 4)	- /	60	130	ns

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

Is	Maximum Continuous Drain to Source Dioc	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> = 0 V, I <sub>SD</sub> = 12 A	-	-	1.4	V
t <sub>rr</sub>	Reverse Recovery Time	V <sub>GS</sub> = 0 V, I <sub>SD</sub> = 12 A,	-	350	/ -	ns
Q <sub>rr</sub>	Reverse Recovery Charge	dI <sub>F</sub> /dt = 100 A/μs	-	2.2	-	μС

- 1: Repetitive rating: pulse-width limited by maximum junction temperature.
- 2: L = 7.85 mH,  $I_{AS}$  = 12 A,  $V_{DD}$  = 50 V,  $R_{G}$  = 25  $\Omega$ , starting  $T_{J}$  = 25°C. 3:  $I_{SD}$   $\leq$  12 A, di/dt  $\leq$  200 A/ $\mu$ s,  $V_{DD}$   $\leq$  BV $_{DSS}$ , starting  $T_{J}$  = 25°C.
- 4: Essentially independent of operating temperature typical characteristics.

### **Typical Performance Characteristics**

Figure 1. On-Region Characteristics

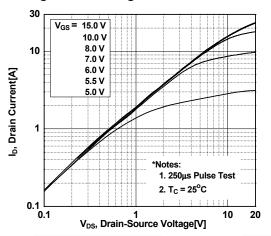
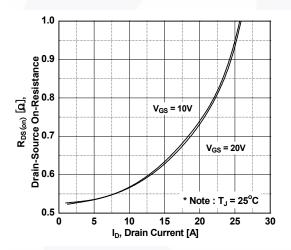


Figure 3. On-Resistance Variation vs.
Drain Current and Gate Voltage



**Figure 5. Capacitance Characteristics** 

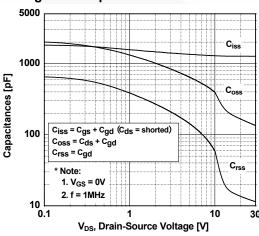


Figure 2. Transfer Characteristics

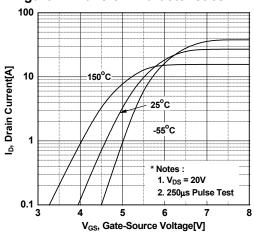


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

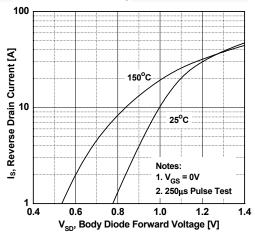
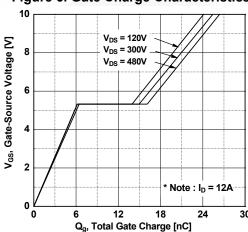


Figure 6. Gate Charge Characteristics



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

Figure 7. Breakdown Voltage Variation vs. Temperature

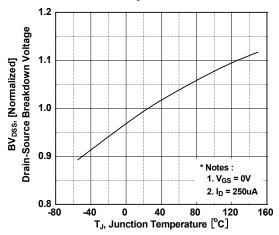


Figure 9. Maximum Safe Operating Area - FDPF12N60NZ

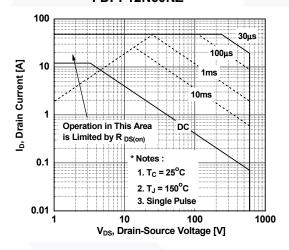


Figure 8. On-Resistance Variation vs Temperature

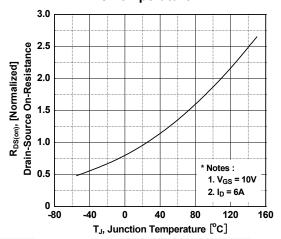


Figure 10. Maximum Safe Operating Area - FDP12N60NZ

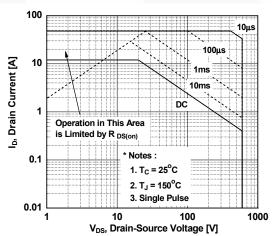
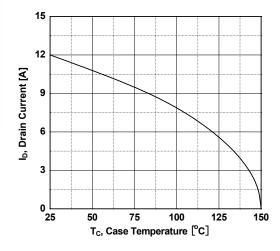


Figure 11. Maximum Drain Current vs. Case Temperature



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

Figure 12. Transient Thermal Response Curve - FDPF12N60NZ

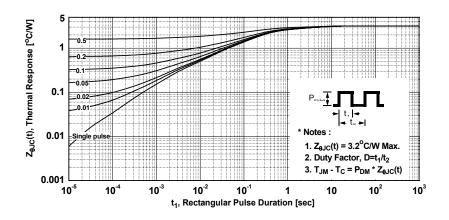
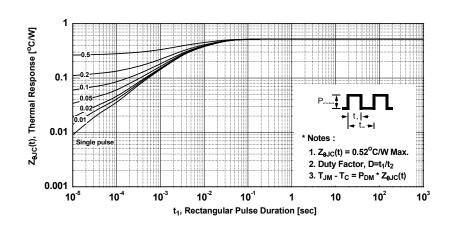


Figure 13. Transient Thermal Response Curve - FDP12N60NZ



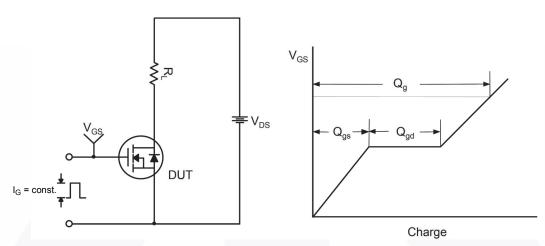


Figure 14. Gate Charge Test Circuit & Waveform

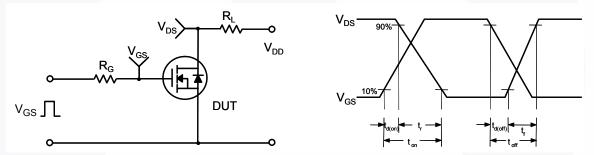


Figure 15. Resistive Switching Test Circuit & Waveforms

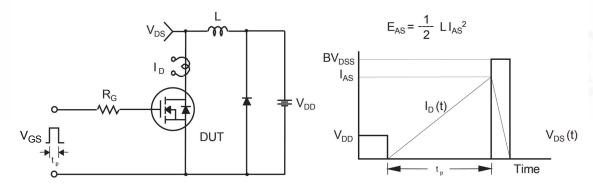


Figure 16. Unclamped Inductive Switching Test Circuit & Waveforms

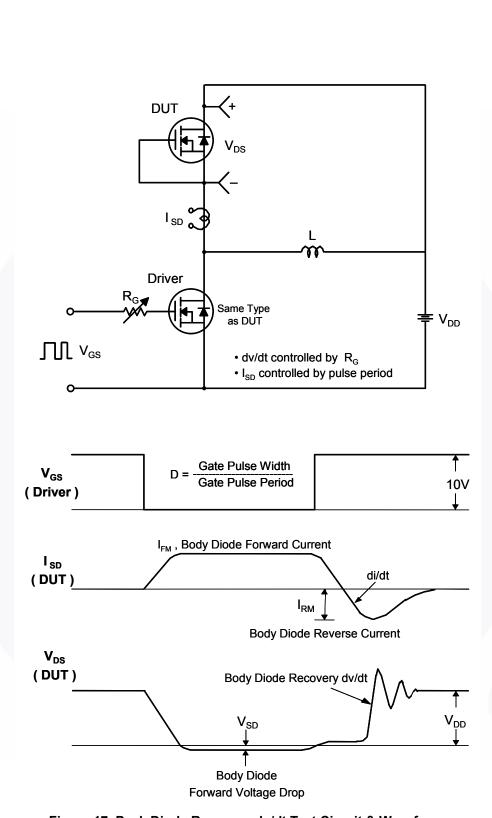


Figure 17. Peak Diode Recovery dv/dt Test Circuit & Waveforms

### **Mechanical Dimensions**

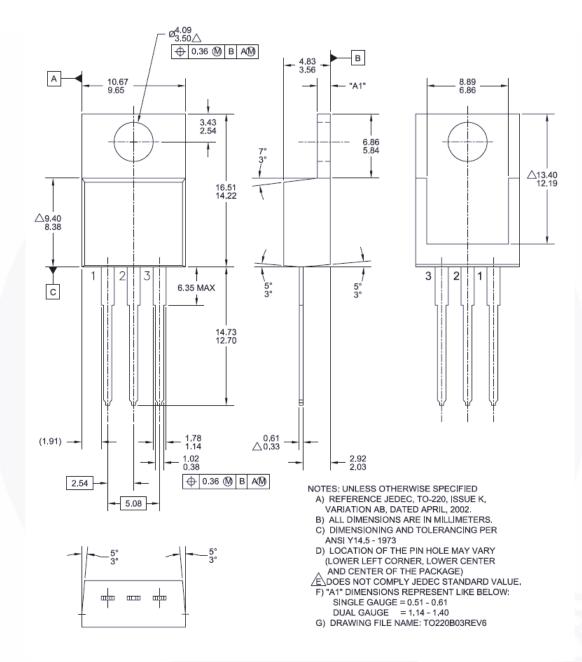


Figure 18. TO-220, Molded, 3-Lead, Jedec Variation AB

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### **Mechanical Dimensions**

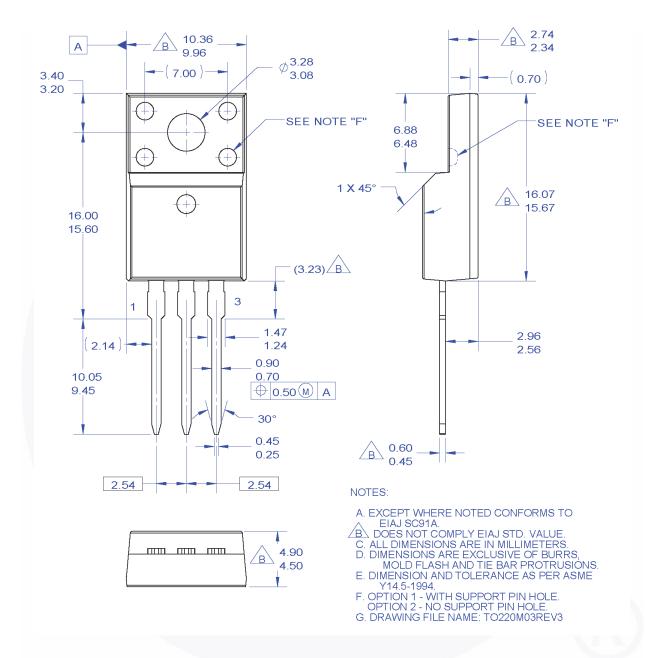


Figure 19. TO220, Molded, 3-Lead, Full Pack, EIAJ SC91, Straight Lead

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