

# FCPF11N60;TO220FP;ON SEMICONDUCTOR N-MOSFET;11A;650V;36W;Tranzystor



## Dane techniczne:

Nazwa: FCPF11N60

Typ tranzystora: unipolarny

Kierunek przewodnictwa: N-MOSFET

Prad drenu: 11A

Napięcie dren-źródło: 600V

Moc: 36W

Rezystancja w stanie przewodzenia: 0,380hm

Obudowa: TO220FP

Montaż: przewlekany (THT)

Producent: ON SEMICONDUCTOR



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March 2014

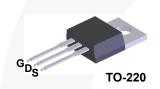
# FCP11N60/FCPF11N60

### **General Description**

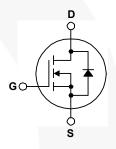
SuperFET® MOSFET is Fairchild Semiconductor's first genera-tion of high voltage super-junction (SJ) MOSFET family that is utilizing charge balance technology for outstanding low on-resistance and lower gate charge performance. This technology is tailored to minimize conduction loss, provide superior switch-ing performance, dv/dt rate and higher avalanche energy. Con-sequently, SuperFET MOSFET is very suitable for the switching power applications such as PFC, server/telecom power, FPD TV power, ATX power and industrial power applications.

### **Features**

- 650V @T<sub>i</sub> = 150°C
- Typ. Rds(on)=0.32Ω
- Ultra low gate charge (typ. Qg=40nC)
- · Low effective output capacitance (typ. Coss.eff=95pF)
- · 100% avalanche tested
- · RoHS Compliant







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

Symbol	Parameter	FCP11N60	FCPF11N60	Units	
I <sub>D</sub>	Drain Current - Continuous (T <sub>C</sub> = 25°C)	11	11*	Α	
	- Continuous (T <sub>C</sub> = 100°C)		7	7*	Α
I <sub>DM</sub>	Drain Current - Pulsed	(Note 1)	33	33*	Α
V <sub>GSS</sub>	Gate-Source Voltage		± 30		V
E <sub>AS</sub>	Single Pulsed Avalanche Energy	(Note 2)	340		mJ
I <sub>AR</sub>	Avalanche Current	(Note 1)	11		Α
E <sub>AR</sub>	Repetitive Avalanche Energy	(Note 1)	12.5		mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)		4.5		V/ns
$P_{D}$	Power Dissipation (T <sub>C</sub> = 25°C)		125	36	W
	- Derate above 25°C	1.0	0.29	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 purposes, 1/8" from case for 5 seconds		300		°C

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

### **Thermal Characteristics**

Symbol	Parameter	FCP11N60	FCPF11N60	Units
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	1.0	3.5	°C/W
$R_{\theta CS}$	Thermal Resistance, Case-to-Sink	0.5		°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient		62.5	°C/W

## **Package Marking and Ordering Information**

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FCP11N60	FCP11N60	TO-220	Tube	N/A	N/A	50 units
FCPF11N60	FCPF11N60	TO-220F	Tube	N/A	N/A	50 units
FCPF11N60T	FCPF11N60T	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 Cha	aracteristics					
D) /	5 : 0 5 11 1/4	$V_{GS} = 0 \text{ V}, I_D = 250 \mu\text{A}, T_J = 25^{\circ}\text{C}$	600			V
BV <sub>DSS</sub> Drain-Source Breakdown Voltage	$V_{GS} = 0 \text{ V}, I_D = 250 \mu\text{A}, T_J = 150^{\circ}\text{C}$	-	650		V	
ΔBV <sub>DSS</sub> / ΔT <sub>J</sub>	Breakdown Voltage Temperature Coefficient	I <sub>D</sub> = 250 μA, Referenced to 25°C	-	0.6		V/°C
BV <sub>DS</sub>	Drain-Source Avalanche Breakdown Voltage	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 11 A		700		V
I <sub>DSS</sub>	Zoro Cata Valtaga Drain Current	V <sub>DS</sub> = 600 V, V <sub>GS</sub> = 0 V			1	μΑ
	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 480 V, T <sub>C</sub> = 125°C			10	μΑ
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> = 0 V			-100	nA
On Cha	aracteristics					
V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA	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> = 5.5 A		0.32	0.38	Ω
9 <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> = 40 V, I <sub>D</sub> = 5.5 A (Note 4)		9.7		S
	ic Characteristics			44.40	1400	
Ciss	Input Capacitance	$V_{DS} = 25 \text{ V}, V_{GS} = 0 \text{ V},$ f = 1.0 MHz		1148	1490	pF
Coss	Output Capacitance			671	870	pF
C <sub>rss</sub>	Reverse Transfer Capacitance	\\ -400\\\\ -0\\		63	82	pF
C <sub>oss</sub>	Output Capacitance	$V_{DS} = 480 \text{ V}, V_{GS} = 0 \text{ V},$ f = 1.0 MHz		35		pF
C <sub>oss</sub> eff.	Effective Output Capacitance	V <sub>DS</sub> = 0V to 480 V, V <sub>GS</sub> = 0 V		95		pF
Switchi	ing Characteristics					
t <sub>d(on)</sub>	Turn-On Delay Time	V 000 V I 44 A		34	80	ns
t <sub>r</sub>	Turn-On Rise Time	$V_{DD} = 300 \text{ V}, I_{D} = 11 \text{ A},$ $R_{G} = 25 \Omega$		98	205	ns
t <sub>d(off)</sub>	Turn-Off Delay Time	(Note 4, 5)		119	250	ns
t <sub>f</sub>	Turn-Off Fall Time			56	120	ns
Qg	Total Gate Charge	$V_{DS}$ = 480 V, $I_{D}$ = 11 A, $V_{GS}$ = 10 V (Note 4, 5)		40	52	nC
Q <sub>gs</sub>	Gate-Source Charge			7.2	-	nC
Q <sub>gd</sub>	Gate-Drain Charge			21	\ \	nC
	Source Diode Characteristics on	nd Maximum Patings		•		
l <sub>S</sub>	Source Diode Characteristics and Maximum Ratings  Maximum Continuous Drain-Source Diode Forward Current				11	Α
I <sub>SM</sub>	Maximum Pulsed Drain-Source Diode Forward Current				33	A
V <sub>SD</sub>	Drain-Source Diode Forward Voltage	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 11 A			1.4	V
1	Danier Danier Time	VGS 0 V, IS 1174		000		-

# $Q_{rr}$

- Notes: 1. Repetitive Rating : Pulse width limited by maximum junction temperature 2.  $I_{AS} = 5.5A$ ,  $V_{DD} = 50V$ ,  $R_G = 25 \Omega$ , Starting  $T_J = 25^{\circ}C$  3.  $I_{SD} \le 11A$ ,  $di/dt \le 200A/\mu s$ ,  $V_{DD} \le BV_{DSS}$ , Starting  $T_J = 25^{\circ}C$  4. Pulse Test : Pulse width  $\le 300\mu s$ , Duty cycle  $\le 2\%$  5. Essentially independent of operating temperature

Reverse Recovery Time

Reverse Recovery Charge

 $V_{GS} = 0 \text{ V, } I_S = 11 \text{ A,}$ 

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

ns

μС

390

(Note 4)

# **Typical Characteristics**

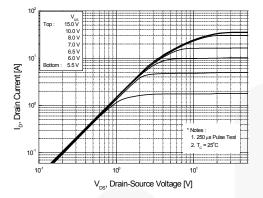


Figure 1. On-Region Characteristics

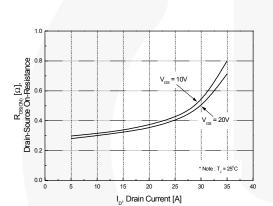


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

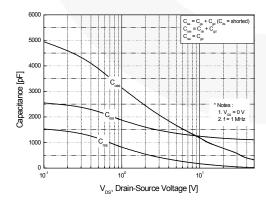


Figure 5. Capacitance Characteristics

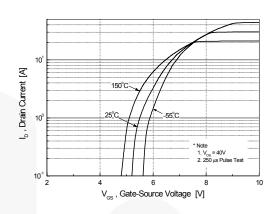


Figure 2. Transfer Characteristics

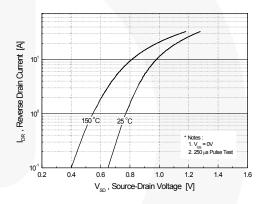


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

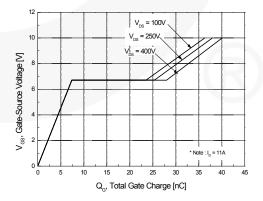


Figure 6. Gate Charge Characteristics

# Typical Characteristics (Continued)

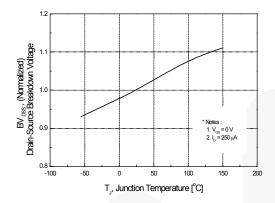


Figure 7. Breakdown Voltage Variation vs. Temperature

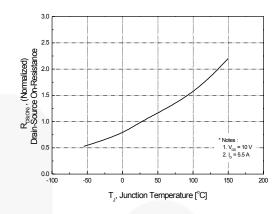


Figure 8. On-Resistance Variation vs. Temperature

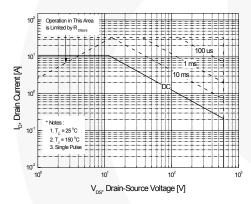


Figure 9-1. Maximum Safe Operating Area for FCP11N60

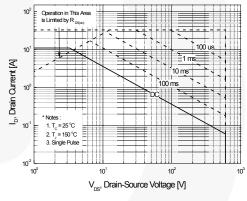


Figure 9-2. Maximum Safe Operating Area for FCPF11N60

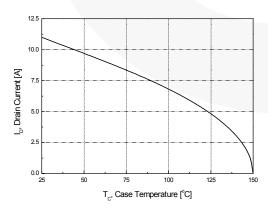


Figure 10. Maximum Drain Current vs. Case Temperature

# Typical Characteristics (Continued)

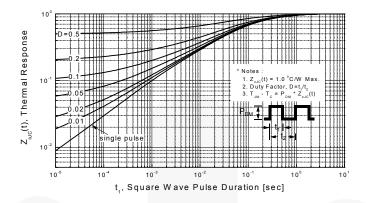


Figure 11-1. Transient Thermal Response Curve for FCP11N60

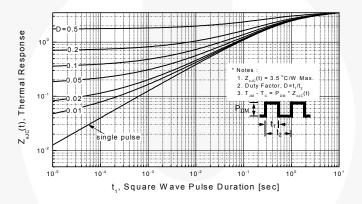


Figure 11-2. Transient Thermal Response Curve for FCPF11N60



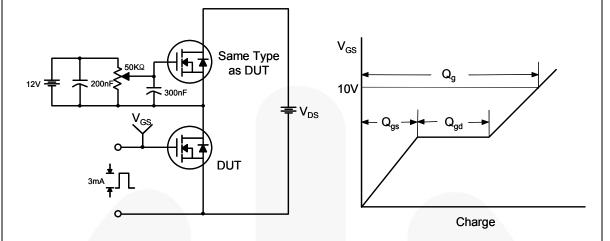


Figure 13. Resistive Switching Test Circuit & Waveforms

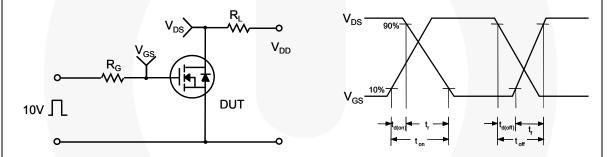
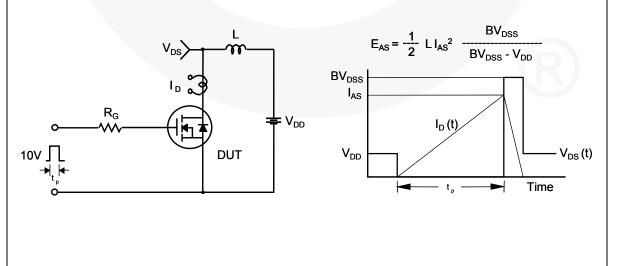
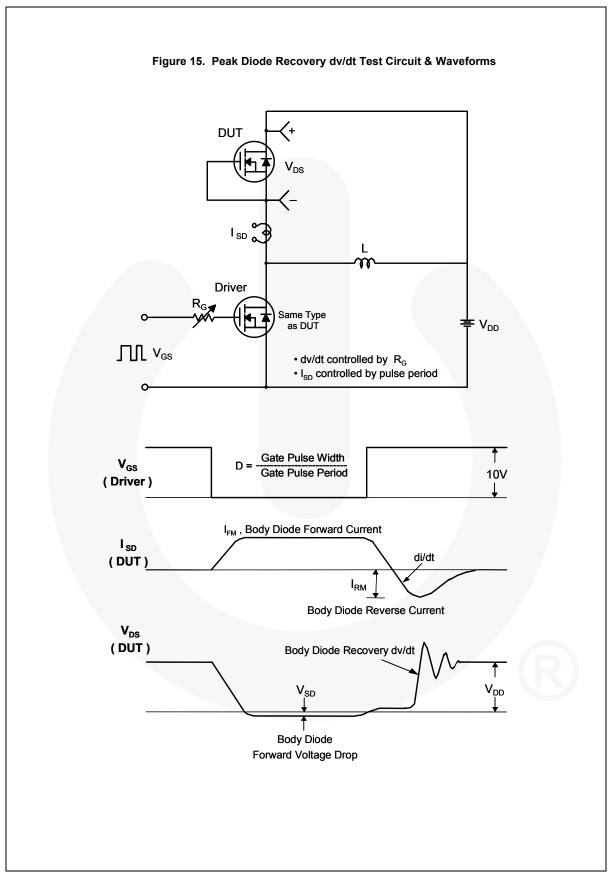


Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms





### **Mechanical Dimensions**

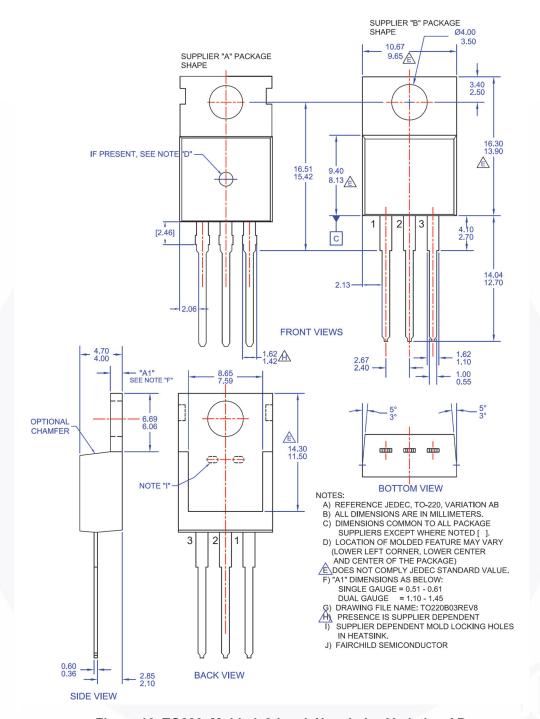


Figure 16. TO220, Molded, 3-Lead, Non Jedec Variation AB

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### **Mechanical Dimensions**

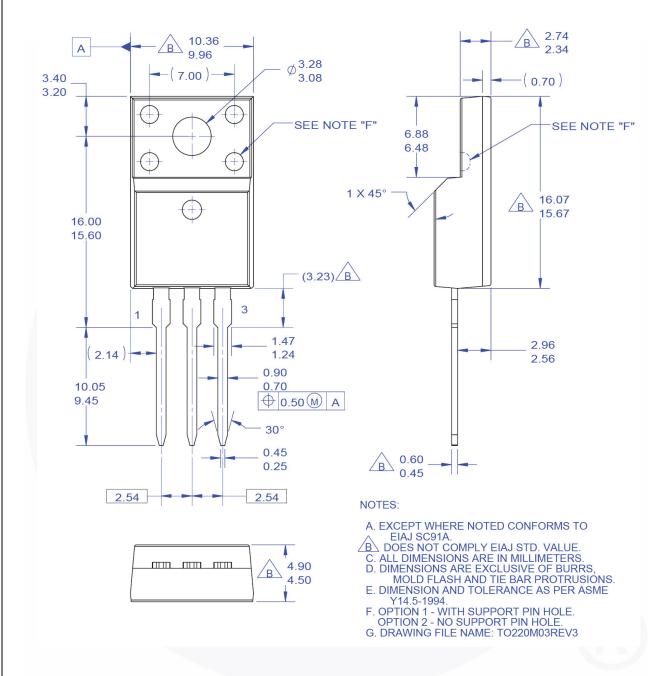


Figure 17. TO220, Molded, 3-Lead, Full Pack, EIAJ SC91, Straight Lead

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