



# FCP190N60E / FCPF190N60E

## 600V N-Channel MOSFET

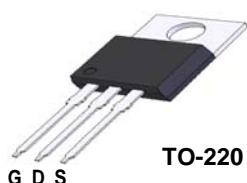
### Features

- 650V @  $T_J = 150^\circ\text{C}$
- Max.  $R_{DS(on)} = 190\text{m}\Omega$
- Ultra Low Gate Charge (Typ.  $Q_g = 63\text{nC}$ )
- Low Effective Output Capacitance (Typ.  $C_{oss,\text{eff}} = 178\text{pF}$ )
- 100% Avalanche Tested

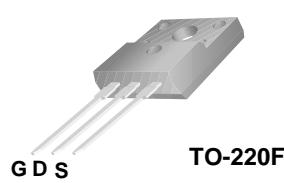
### Description

SuperFET®II is, Fairchild's proprietary, new generation of high voltage MOSFET family that is utilizing an advanced charge balance mechanism for outstanding low on-resistance and lower gate charge performance.

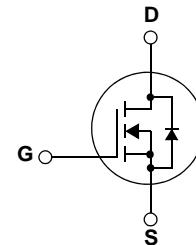
This advanced technology has been tailored to minimize conduction loss, provide superior switching performance, and withstand extreme dv/dt rate and higher avalanche energy. Consequently, SuperFET®II is very suitable for various AC/DC power conversion in switching mode operation for system miniaturization and higher efficiency.



TO-220



TO-220F



### MOSFET Maximum Ratings $T_C = 25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter		FCP190N60E	FCPF190N60E	Units
$V_{DSS}$	Drain to Source Voltage		600		V
$V_{GSS}$	Gate to Source Voltage	- DC	$\pm 20$		V
		- AC ( $f > 1\text{Hz}$ )	$\pm 30$		V
$I_D$	Drain Current	-Continuous ( $T_C = 25^\circ\text{C}$ )	20.6	20.6*	A
		-Continuous ( $T_C = 100^\circ\text{C}$ )	13.1	13.1*	
$I_{DM}$	Drain Current	- Pulsed (Note 1)	61.8	61.8*	A
$E_{AS}$	Single Pulsed Avalanche Energy (Note 2)		400		mJ
$I_{AR}$	Avalanche Current (Note 1)		4.0		A
$E_{AR}$	Repetitive Avalanche Energy (Note 1)		2.1		mJ
$dv/dt$	Peak Diode Recovery $dv/dt$ (Note 3)		20		V/ns
	MOSFET $dv/dt$		100		
$P_D$	Power Dissipation ( $T_C = 25^\circ\text{C}$ )		208	39	W
	- Derate above $25^\circ\text{C}$	1.67	0.31	$\text{W}/^\circ\text{C}$	
$T_J, T_{STG}$	Operating and Storage Temperature Range		-55 to +150		$^\circ\text{C}$
$T_L$	Maximum Lead Temperature for Soldering Purpose, 1/8" from Case for 5 Seconds		300		$^\circ\text{C}$

\*Drain current limited by maximum junction temperature

### Thermal Characteristics

Symbol	Parameter		FCP190N60E	FCPF190N60E	Units
$R_{\theta JC}$	Thermal Resistance, Junction to Case	$^\circ\text{C/W}$	0.6	3.2	$^\circ\text{C/W}$
$R_{\theta CS}$	Thermal Resistance, Case to Heat Sink (Typical)		0.5	0.5	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient		62.5	62.5	

## Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FCP190N60E	FCP190N60E	TO-220	-	-	50
FCPF190N60E	FCPF190N60E	TO-220F	-	-	50

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
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### Off Characteristics

$\text{BV}_{\text{DSS}}$	Drain to Source Breakdown Voltage	$V_{\text{GS}} = 0\text{V}, I_D = 10\text{mA}, T_J = 25^\circ\text{C}$ $V_{\text{GS}} = 0\text{V}, I_D = 10\text{mA}, T_J = 150^\circ\text{C}$	600	-	-	V
$\Delta \text{BV}_{\text{DSS}}/\Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 10\text{mA}$ , Referenced to $25^\circ\text{C}$	-	0.67	-	$\text{V}/^\circ\text{C}$
$\text{BV}_{\text{DS}}$	Drain-Source Avalanche Breakdown Voltage	$V_{\text{GS}} = 0\text{V}, I_D = 20\text{A}$	-	700	-	V
$I_{\text{DSS}}$	Zero Gate Voltage Drain Current	$V_{\text{DS}} = 480\text{V}, V_{\text{GS}} = 0\text{V}$	-	-	1	$\mu\text{A}$
		$V_{\text{DS}} = 480\text{V}, T_C = 125^\circ\text{C}$	-	-	10	
$I_{\text{GSS}}$	Gate to Body Leakage Current	$V_{\text{GS}} = \pm 20\text{V}, V_{\text{DS}} = 0\text{V}$	-	-	$\pm 100$	nA

### On Characteristics

$V_{\text{GS(th)}}$	Gate Threshold Voltage	$V_{\text{GS}} = V_{\text{DS}}, I_D = 250\mu\text{A}$	2.5	-	3.5	V
$R_{\text{DS(on)}}$	Static Drain to Source On Resistance	$V_{\text{GS}} = 10\text{V}, I_D = 10\text{A}$	-	0.16	0.19	$\Omega$
$g_{\text{FS}}$	Forward Transconductance	$V_{\text{DS}} = 20\text{V}, I_D = 10\text{A}$	-	20	-	S

### Dynamic Characteristics

$C_{\text{iss}}$	Input Capacitance	$V_{\text{DS}} = 25\text{V}, V_{\text{GS}} = 0\text{V}$ $f = 1\text{MHz}$	-	2385	3175	pF
$C_{\text{oss}}$	Output Capacitance		-	1795	2396	pF
$C_{\text{rss}}$	Reverse Transfer Capacitance		-	110	165	pF
$C_{\text{oss}}$	Output Capacitance	$V_{\text{DS}} = 380\text{V}, V_{\text{GS}} = 0\text{V}, f = 1.0\text{MHz}$	-	42	-	pF
$C_{\text{oss eff.}}$	Effective Output Capacitance	$V_{\text{DS}} = 0\text{V} \text{ to } 480\text{V}, V_{\text{GS}} = 0\text{V}$	-	178	-	pF
$Q_{\text{g(tot)}}$	Total Gate Charge at 10V		-	63	82	nC
$Q_{\text{gs}}$	Gate to Source Gate Charge	$V_{\text{DS}} = 380\text{V}, I_D = 10\text{A}$ $V_{\text{GS}} = 10\text{V}$	-	10	-	nC
$Q_{\text{gd}}$	Gate to Drain "Miller" Charge		(Note 4)	24	-	nC
ESR	Equivalent Series Resistance	Drain open	-	5	-	$\Omega$

### Switching Characteristics

$t_{\text{d(on)}}$	Turn-On Delay Time	$V_{\text{DD}} = 380\text{V}, I_D = 10\text{A}$ $V_{\text{GS}} = 10\text{V}, R_G = 4.7\Omega$	-	23	56	ns
$t_r$	Turn-On Rise Time		-	14	38	ns
$t_{\text{d(off)}}$	Turn-Off Delay Time		-	101	212	ns
$t_f$	Turn-Off Fall Time		(Note 4)	15	40	ns

### Drain-Source Diode Characteristics

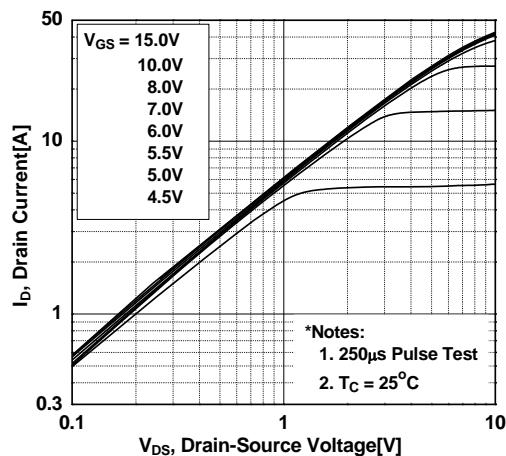
$I_S$	Maximum Continuous Drain to Source Diode Forward Current	-	-	20.6	A	
$I_{\text{SM}}$	Maximum Pulsed Drain to Source Diode Forward Current	-	-	61.8	A	
$V_{\text{SD}}$	Drain to Source Diode Forward Voltage	$V_{\text{GS}} = 0\text{V}, I_{\text{SD}} = 10\text{A}$	-	-	1.2	V
$t_{\text{rr}}$	Reverse Recovery Time	$V_{\text{GS}} = 0\text{V}, I_{\text{SD}} = 10\text{A}$ $dI/dt = 100\text{A}/\mu\text{s}$	-	308	-	ns
$Q_{\text{rr}}$	Reverse Recovery Charge		-	4.8	-	$\mu\text{C}$

**Notes:**

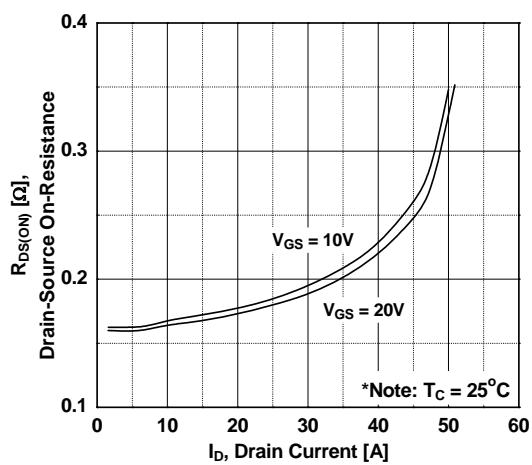
1. Repetitive Rating: Pulse width limited by maximum junction temperature
2.  $I_{\text{AS}} = 4\text{A}, V_{\text{DD}} = 50\text{V}, R_G = 25\Omega, \text{Starting } T_J = 25^\circ\text{C}$
3.  $I_{\text{SD}} \leq 10\text{A}, di/dt \leq 200\text{A}/\mu\text{s}, V_{\text{DD}} \leq \text{BV}_{\text{DSS}}, \text{Starting } T_J = 25^\circ\text{C}$
4. Essentially Independent of Operating Temperature Typical Characteristics

## Typical Performance Characteristics

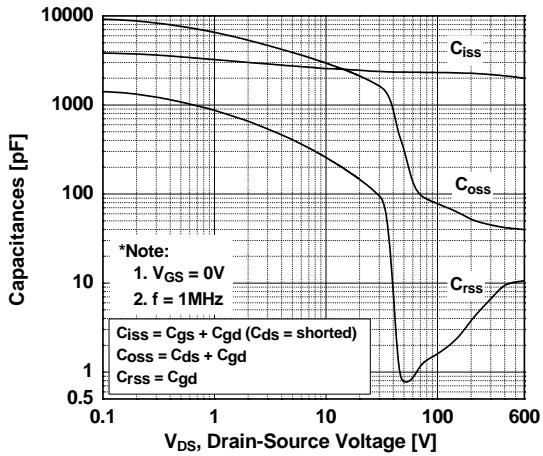
**Figure 1. On-Region Characteristics**



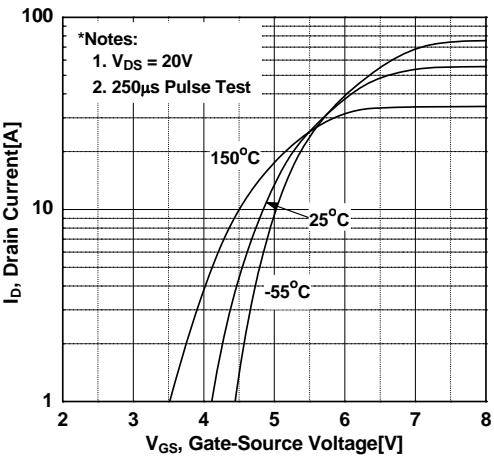
**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**



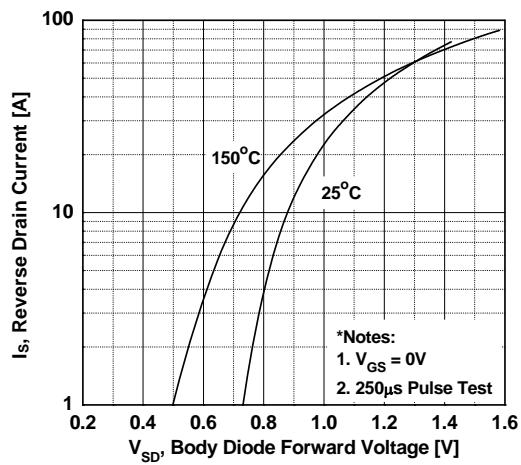
**Figure 5. Capacitance Characteristics**



**Figure 2. Transfer Characteristics**



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



**Figure 6. Gate Charge Characteristics**

