

FCA20N60F

600V N-CHANNEL FRFET

Features

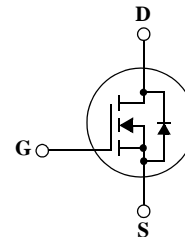
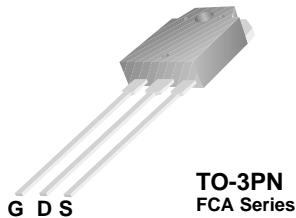
- 650V @ $T_J = 150^\circ\text{C}$
- Typ. $R_{ds(on)} = 0.15\Omega$
- Fast Recovery Type ($t_{rr} = 160\text{ns}$)
- Ultra low gate charge (typ. $Q_g = 75\text{nC}$)
- Low effective output capacitance (typ. $C_{oss,eff} = 165\text{pF}$)
- 100% avalanche tested
- RoHS Compliant



Description

SuperFET™ 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 is very suitable for various AC/DC power conversion in switching mode operation for system miniaturization and higher efficiency.



Absolute Maximum Ratings

Symbol	Parameter	FCA20N60F	Unit
V_{DSS}	Drain-Source Voltage	600	V
I_D	Drain Current	- Continuous ($T_C = 25^\circ\text{C}$)	20
		- Continuous ($T_C = 100^\circ\text{C}$)	12.5
I_{DM}	Drain Current - Pulsed (Note 1)	60	A
V_{GSS}	Gate-Source voltage	± 30	V
E_{AS}	Single Pulsed Avalanche Energy (Note 2)	690	mJ
I_{AR}	Avalanche Current (Note 1)	20	A
E_{AR}	Repetitive Avalanche Energy (Note 1)	20.8	mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	50	V/ns
P_D	Power Dissipation ($T_C = 25^\circ\text{C}$)	- Derate above 25°C	208
			1.67
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	$^\circ\text{C}$

Thermal Characteristics

Symbol	Parameter	FCA20N60F	Unit
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	0.6	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	40	$^\circ\text{C/W}$

* When mounted on the minimum pad size recommended (PCB Mount)

Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FCA20N60F	FCA20N60F	TO-3PN	--	--	30

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

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Off Characteristics						
BV_{DSS}	Drain-Source Breakdown Voltage	$V_{GS} = 0V, I_D = 250\mu A, T_J = 25^\circ\text{C}$	600	--	--	V
		$V_{GS} = 0V, I_D = 250\mu A, T_J = 150^\circ\text{C}$	--	650	--	V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 250\mu A$, Referenced to 25°C	--	0.6	--	$^\circ\text{C}^{-1}$
BV_{DSS}	Drain-Source Avalanche Breakdown Voltage	$V_{GS} = 0V, I_D = 20A$	--	700	--	V
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 600V, V_{GS} = 0V$ $V_{DS} = 480V, T_C = 125^\circ\text{C}$	--	--	10 100	μA μA
I_{GSSF}	Gate-Body Leakage Current, Forward	$V_{GS} = 30V, V_{DS} = 0V$	--	--	100	nA
I_{GSSR}	Gate-Body Leakage Current, Reverse	$V_{GS} = -30V, V_{DS} = 0V$	--	--	-100	nA
On Characteristics						
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\mu A$	3.0	--	5.0	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = 10V, I_D = 10A$	--	0.15	0.19	Ω
g_{FS}	Forward Transconductance	$V_{DS} = 40V, I_D = 10A$ (Note 4)	--	17	--	S
Dynamic Characteristics						
C_{iss}	Input Capacitance	$V_{DS} = 25V, V_{GS} = 0V,$ $f = 1.0\text{MHz}$	--	2370	3080	pF
C_{oss}	Output Capacitance		--	1280	1665	pF
C_{rss}	Reverse Transfer Capacitance		--	95	--	pF
C_{oss}	Output Capacitance	$V_{DS} = 480V, V_{GS} = 0V, f = 1.0\text{MHz}$	--	65	85	pF
$C_{oss\ eff.}$	Effective Output Capacitance	$V_{DS} = 0V \text{ to } 400V, V_{GS} = 0V$	--	165	--	pF
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 300V, I_D = 20A$ $R_G = 25\Omega$	--	62	135	ns
t_r	Turn-On Rise Time		--	140	290	ns
$t_{d(off)}$	Turn-Off Delay Time		--	230	470	ns
t_f	Turn-Off Fall Time		(Note 4, 5)	--	65	140
Q_g	Total Gate Charge	$V_{DS} = 480V, I_D = 20A$ $V_{GS} = 10V$	--	75	98	nC
Q_{gs}	Gate-Source Charge		--	13.5	18	nC
Q_{gd}	Gate-Drain Charge		(Note 4, 5)	--	36	--
Drain-Source Diode Characteristics and Maximum Ratings						
I_S	Maximum Continuous Drain-Source Diode Forward Current		--	--	20	A
I_{SM}	Maximum Pulsed Drain-Source Diode Forward Current		--	--	60	A
V_{SD}	Drain-Source Diode Forward Voltage	$V_{GS} = 0V, I_S = 20A$	--	--	1.4	V
t_{rr}	Reverse Recovery Time	$V_{GS} = 0V, I_S = 20A$ $di_f/dt = 100A/\mu s$	--	160	--	ns
Q_{rr}	Reverse Recovery Charge		(Note 4)	--	1.1	--

NOTES:

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. $I_{AS} = 10A, V_{DD} = 50V, R_G = 25\Omega$, Starting $T_J = 25^\circ\text{C}$
3. $I_{SD} \leq 20A, di/dt \leq 1200A/\mu s, V_{DD} \leq BV_{DSS}$, Starting $T_J = 25^\circ\text{C}$
4. Pulse Test: Pulse width $\leq 300\mu s$, Duty Cycle $\leq 2\%$
5. Essentially Independent of Operating Temperature Typical Characteristics

Typical Performance Characteristics

Figure 1. On-Region Characteristics

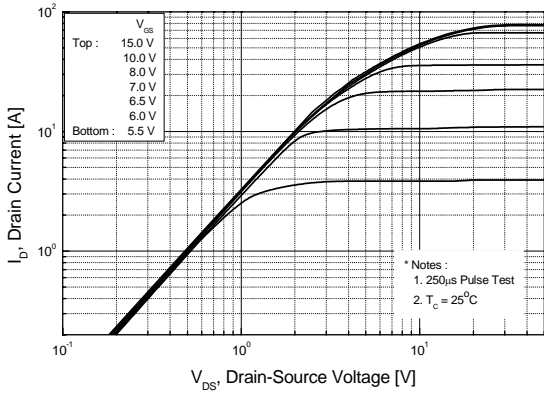


Figure 2. Transfer Characteristics

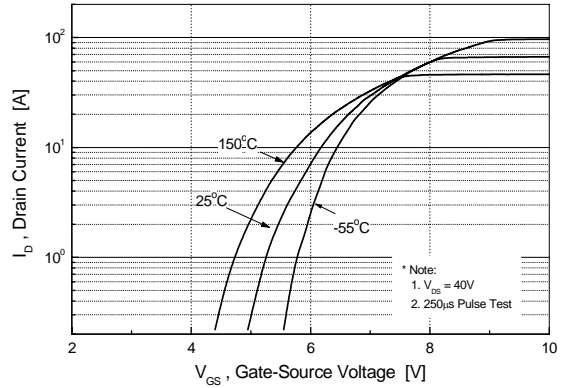


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

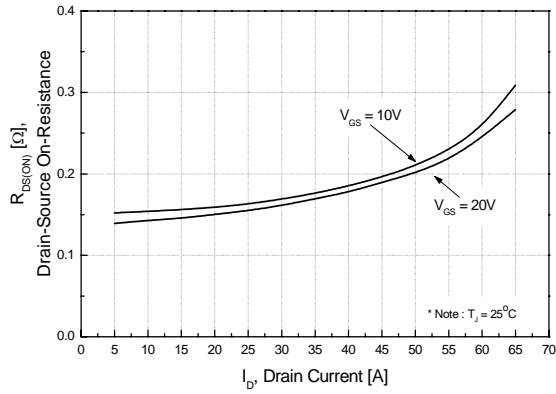


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

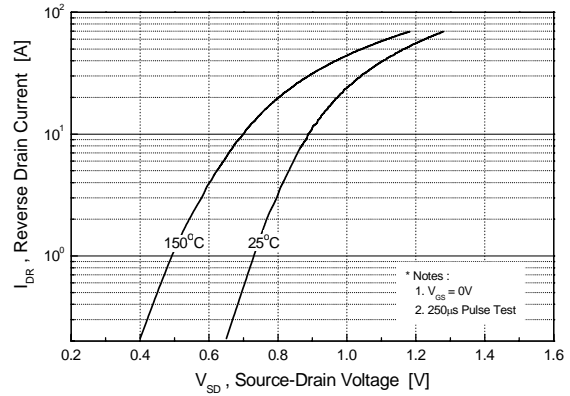


Figure 5. Capacitance Characteristics

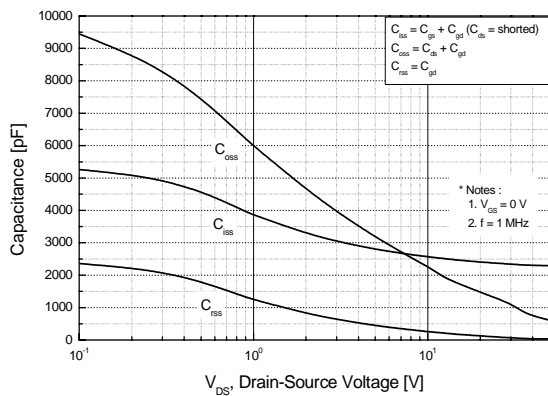
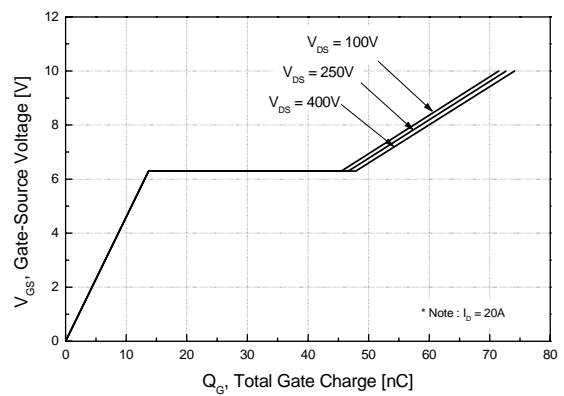


Figure 6. Gate Charge Characteristics



Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

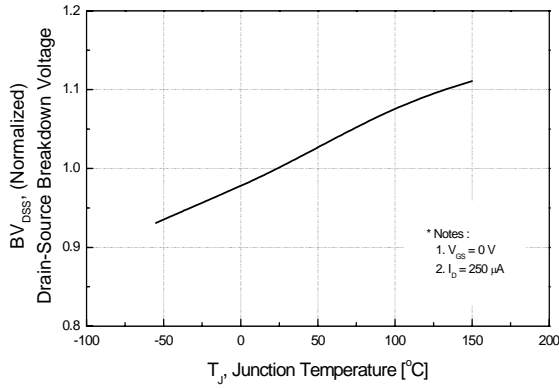


Figure 8. On-Resistance Variation vs. Temperature

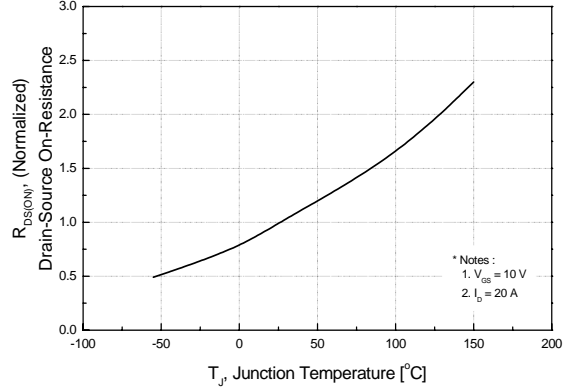


Figure 9-1. Maximum Safe Operating Area

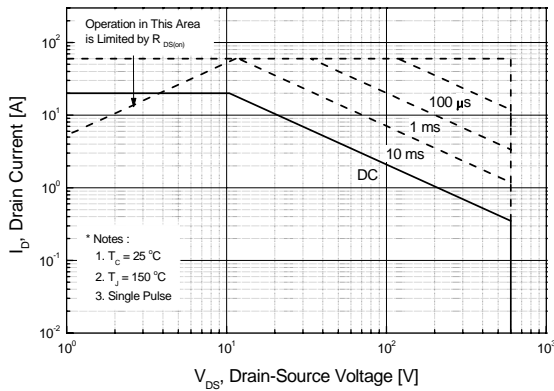


Figure 10. Maximum Drain Current vs. Case Temperature

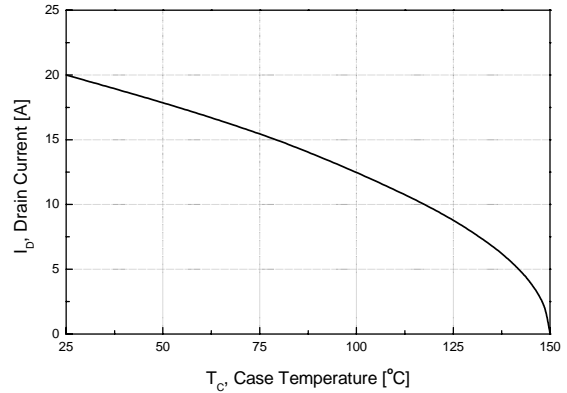
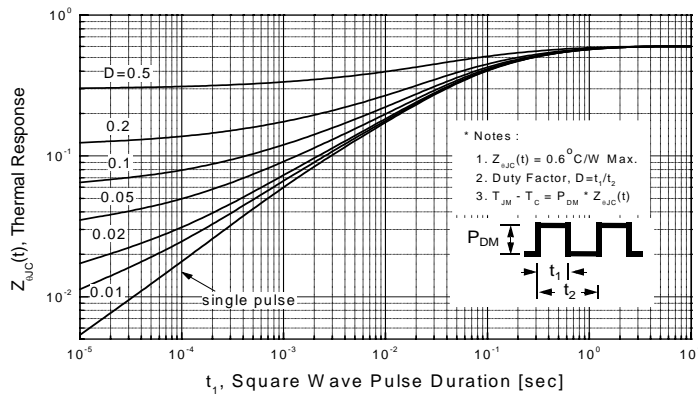


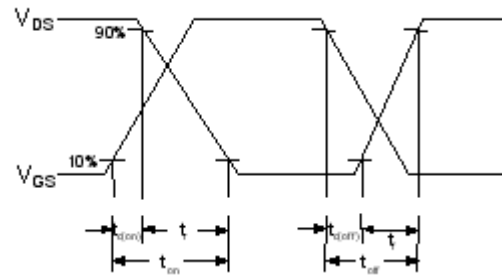
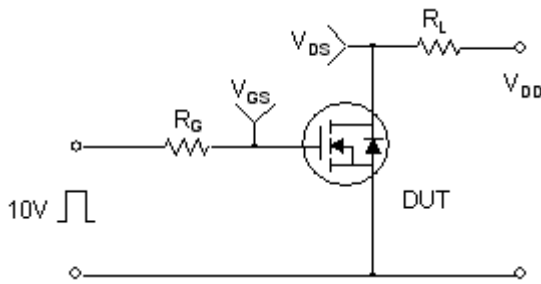
Figure 11. Transient Thermal Response Curve



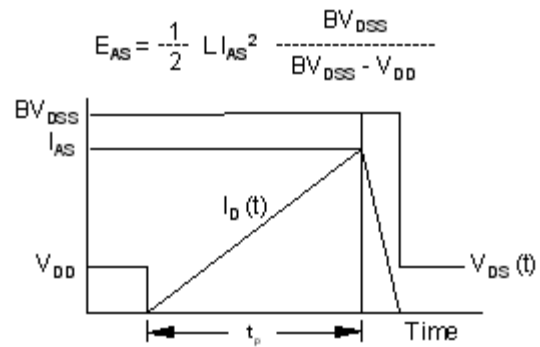
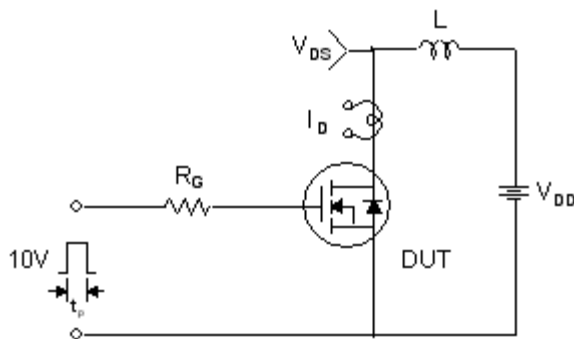
Gate Charge Test Circuit & Waveform



Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching Test Circuit & Waveforms

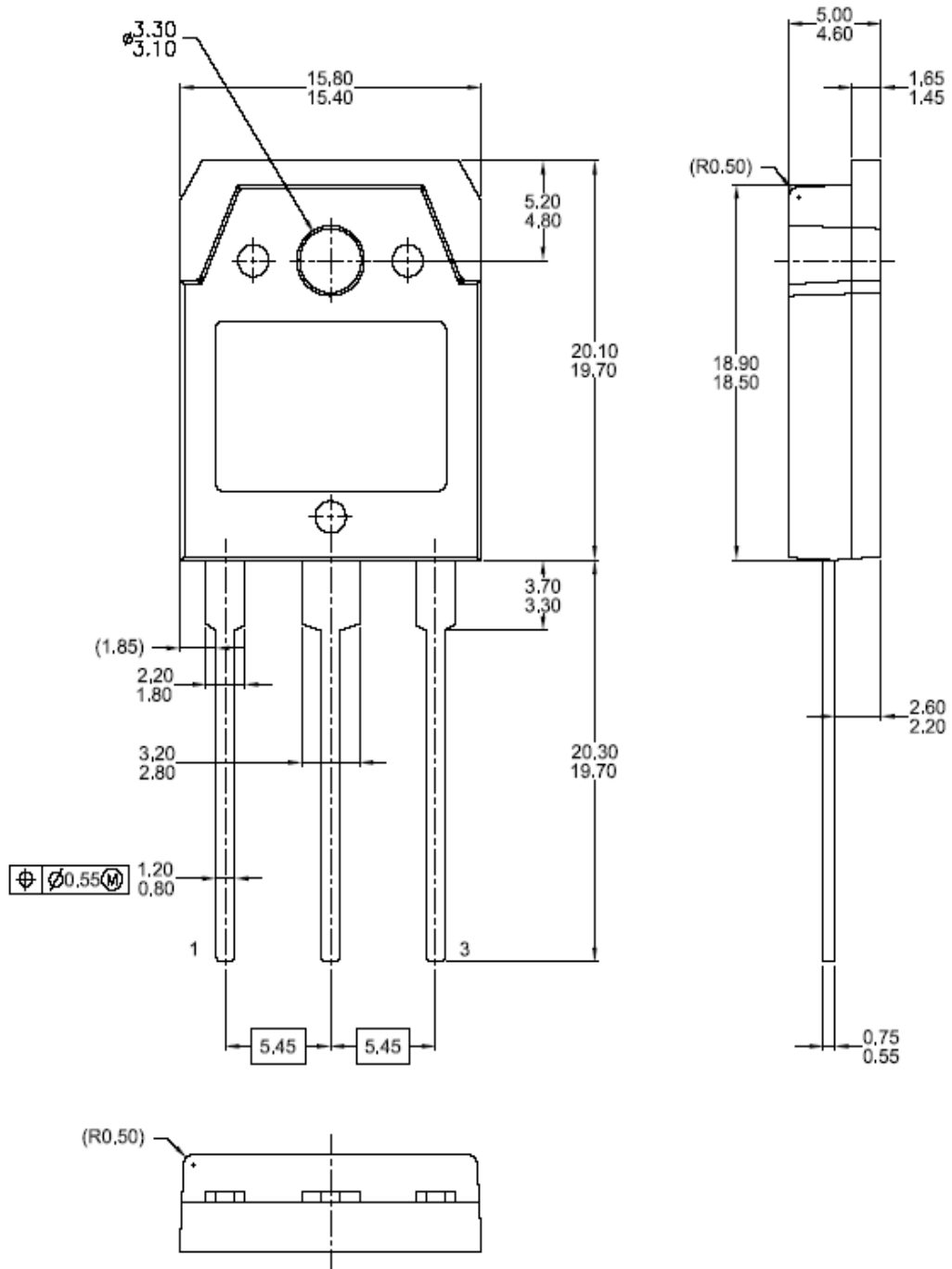


Peak Diode Recovery dv/dt Test Circuit & Waveforms



Mechanical Dimensions

TO-3PN





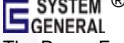


Dimensions in Millimeters



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