

# FCA35N60

## 600V N-Channel MOSFET

### Features

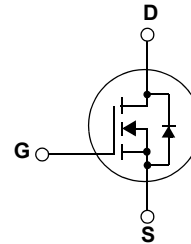
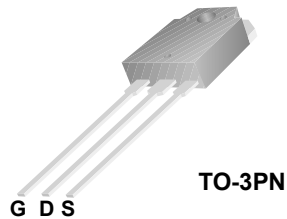
- 650V @  $T_J = 150^\circ\text{C}$
- Typ.  $R_{DS(on)} = 0.079\Omega$
- Ultra low gate charge ( Typ.  $Q_g = 139\text{nC}$  )
- Low effective output capacitance ( Typ.  $C_{oss,eff} = 340\text{pF}$  )
- 100% avalanche tested



### 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.



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

Symbol	Parameter	Ratings	Units
$V_{DSS}$	Drain to Source Voltage	600	V
$V_{GSS}$	Gate-Source voltage	$\pm 30$	V
$I_D$	Drain Current	-Continuous ( $T_C = 25^\circ\text{C}$ )	35
		-Continuous ( $T_C = 100^\circ\text{C}$ )	22.2
$I_{DM}$	Drain Current	- Pulsed (Note 1)	105
$E_{AS}$	Single Pulsed Avalanche Energy	(Note 2)	1455
$I_{AR}$	Avalanche Current	(Note 1)	35
$E_{AR}$	Repetitive Avalanche Energy	(Note 1)	31.25
dv/dt	Peak Diode Recovery dv/dt	(Note 3)	20
$P_D$	Power Dissipation	( $T_C = 25^\circ\text{C}$ )	312.5
		- Derate above $25^\circ\text{C}$	2.5
$T_J, T_{STG}$	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	Typ.	Max.	Units
$R_{\theta JC}$	Thermal Resistance, Junction to Case	-	0.4	$^\circ\text{C/W}$
$R_{\theta CS}$	Thermal Resistance, Case-to-Heat Sink	0.24	-	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	-	42	

**Package Marking and Ordering Information**  $T_C = 25^\circ\text{C}$  unless otherwise noted

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FCA35N60	FCA35N60	TO-3PN	-	-	30

**Electrical Characteristics**

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

$BV_{DSS}$	Drain to Source Breakdown Voltage	$I_D = 250\mu\text{A}, V_{GS} = 0\text{V}, T_J = 25^\circ\text{C}$	600	-	-	V
		$I_D = 250\mu\text{A}, V_{GS} = 0\text{V}, T_J = 150^\circ\text{C}$	-	650	-	V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 250\mu\text{A}$ , Referenced to $25^\circ\text{C}$	-	0.6	-	$\text{V}/^\circ\text{C}$
$BV_{DS}$	Drain-Source Avalanche Breakdown Voltage	$V_{GS} = 0\text{V}, I_D = 16\text{A}$	-	700	-	V
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 600\text{V}, V_{GS} = 0\text{V}$	-	-	1	$\mu\text{A}$
		$V_{DS} = 480\text{V}, T_C = 125^\circ\text{C}$	-	-	10	
$I_{GSS}$	Gate to Body Leakage Current	$V_{GS} = \pm 30\text{V}, V_{DS} = 0\text{V}$	-	-	$\pm 100$	nA

**On Characteristics**

$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 250\mu\text{A}$	3.0	-	5.0	V
$R_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = 10\text{V}, I_D = 17.5\text{A}$	-	0.079	0.098	$\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS} = 40\text{V}, I_D = 17.5\text{A}$	-	28.8	-	S

**Dynamic Characteristics**

$C_{iss}$	Input Capacitance	$V_{DS} = 25\text{V}, V_{GS} = 0\text{V}$ $f = 1\text{MHz}$	-	4990	6640	pF
$C_{oss}$	Output Capacitance		-	2380	3170	pF
$C_{rSS}$	Reverse Transfer Capacitance		-	140	-	pF
$C_{oss}$	Output Capacitance	$V_{DS} = 480\text{V}, V_{GS} = 0\text{V}, f = 1.0\text{MHz}$	-	113	-	pF
$C_{oss\text{ eff.}}$	Effective Output Capacitance	$V_{DS} = 0\text{V to } 480\text{V}, V_{GS} = 0\text{V}$	-	340	-	pF
$Q_g$	Total Gate Charge at 10V	$V_{DS} = 480\text{V}, I_D = 35\text{A}$ $V_{GS} = 10\text{V}$ (Note 4)	-	139	181	nC
$Q_{gs}$	Gate to Source Gate Charge		-	31	-	nC
$Q_{gd}$	Gate to Drain "Miller" Charge		-	69	-	nC
ESR	Equivalent Series Resistance (G-S)	Drain Open, $F = 1\text{MHz}$	-	1.4	-	$\Omega$

**Switching Characteristics**

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 300\text{V}, I_D = 35\text{A}$ $R_G = 4.7\Omega$ (Note 4)	-	34	78	ns
$t_r$	Turn-On Rise Time		-	120	250	ns
$t_{d(off)}$	Turn-Off Delay Time		-	105	220	ns
$t_f$	Turn-Off Fall Time		-	73	155	ns

**Drain-Source Diode Characteristics**

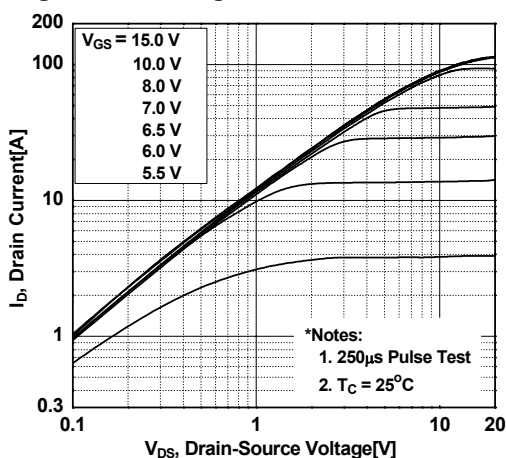
$I_S$	Maximum Continuous Drain to Source Diode Forward Current	-	-	35	A	
$I_{SM}$	Maximum Pulsed Drain to Source Diode Forward Current	-	-	105	A	
$V_{SD}$	Drain to Source Diode Forward Voltage	$V_{GS} = 0\text{V}, I_{SD} = 35\text{A}$	-	-	1.4	V
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0\text{V}, I_{SD} = 35\text{A}$	-	614	-	ns
$Q_{rr}$	Reverse Recovery Charge	$dI_F/dt = 100\text{A}/\mu\text{s}$	-	16.3	-	$\mu\text{C}$

**Notes:**

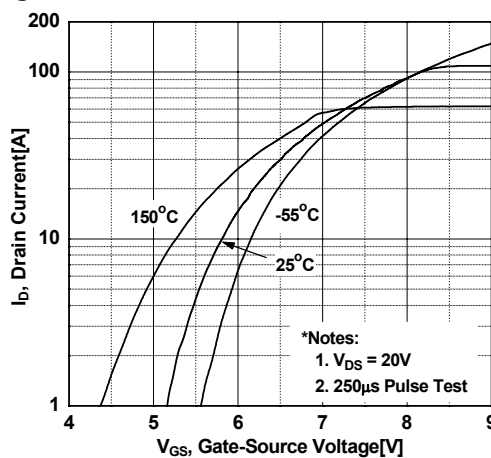
- 1: Repetitive Rating: Pulse width limited by maximum junction temperature
- 2:  $I_{AS} = 17.5\text{A}, V_{DD} = 50\text{V}, R_G = 25\Omega$ , Starting  $T_J = 25^\circ\text{C}$
- 3:  $I_{SD} \leq 35\text{A}, dI/dt \leq 200\text{A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$
- 4: Essentially Independent of Operating Temperature Typical Characteristics

## Typical Performance Characteristics

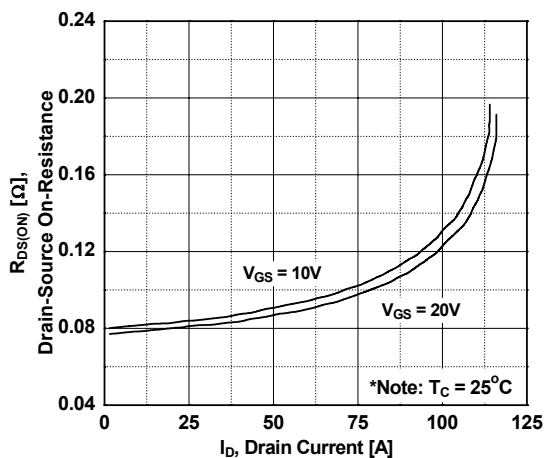
**Figure 1. On-Region Characteristics**



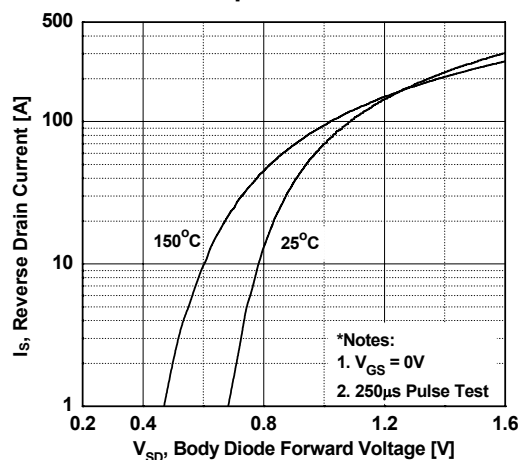
**Figure 2. Transfer Characteristics**



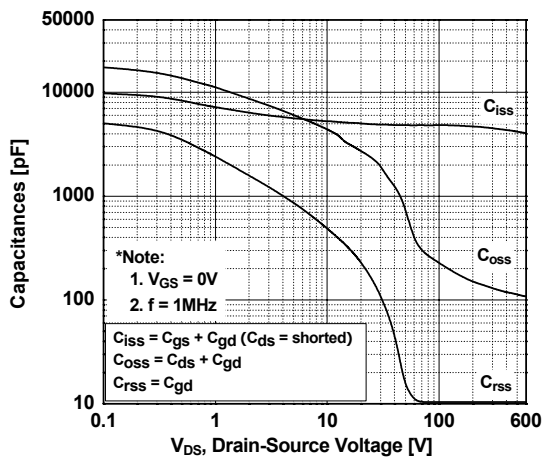
**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**



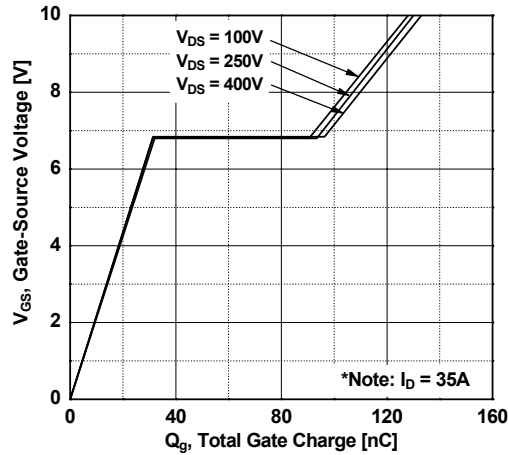
**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**



**Figure 5. Capacitance Characteristics**



**Figure 6. Gate Charge Characteristics**



Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

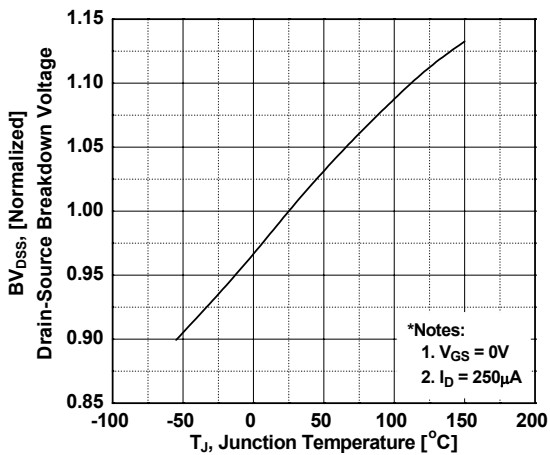


Figure 8. On-Resistance Variation vs. Temperature

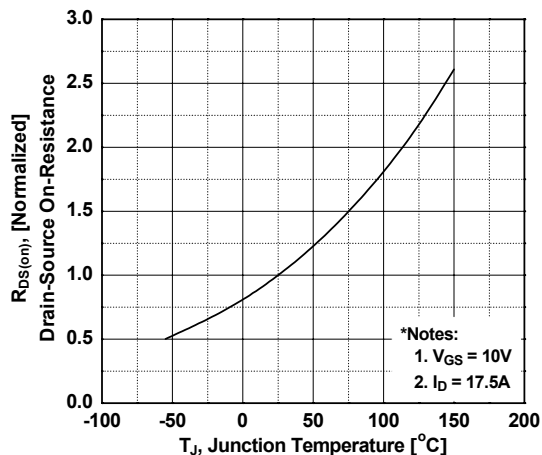


Figure 9. Maximum Safe Operating Area

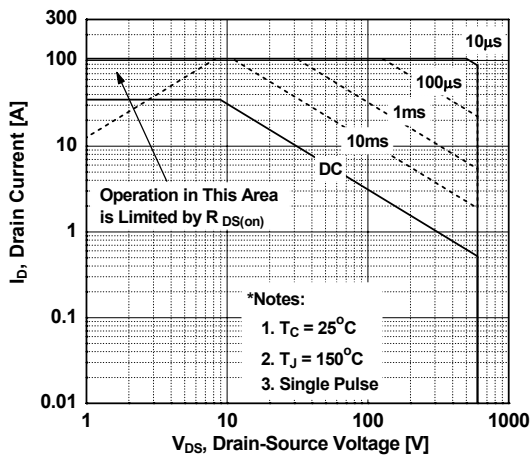


Figure 10. Maximum Drain Current vs. Case Temperature

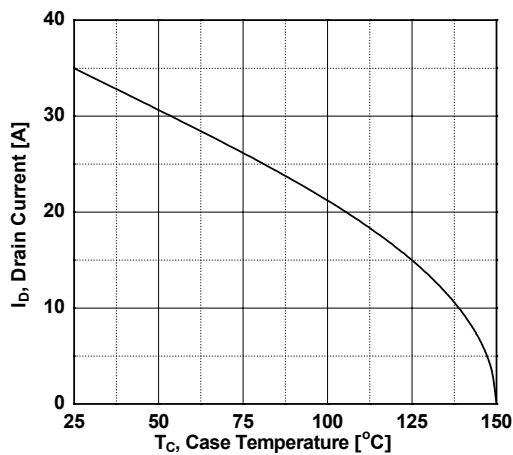
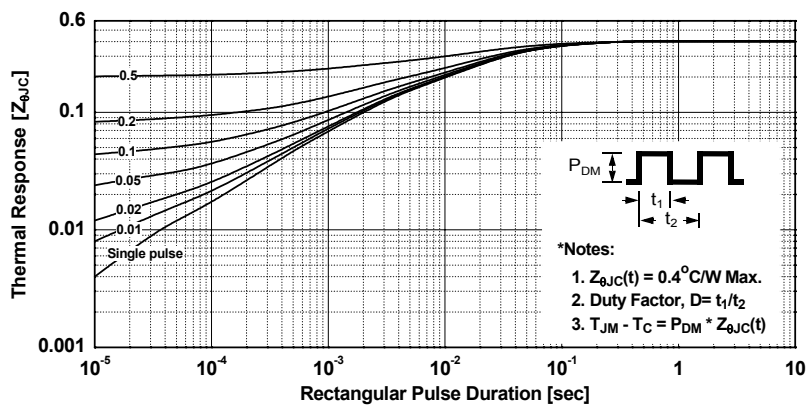
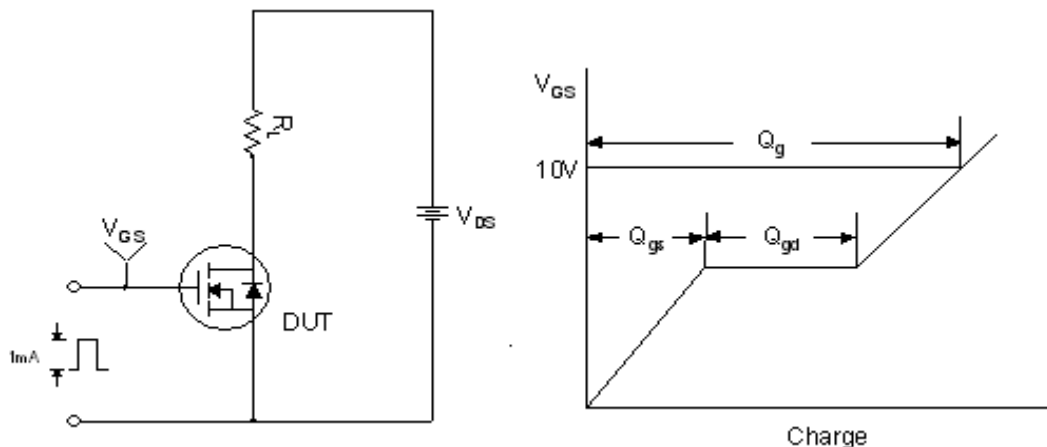


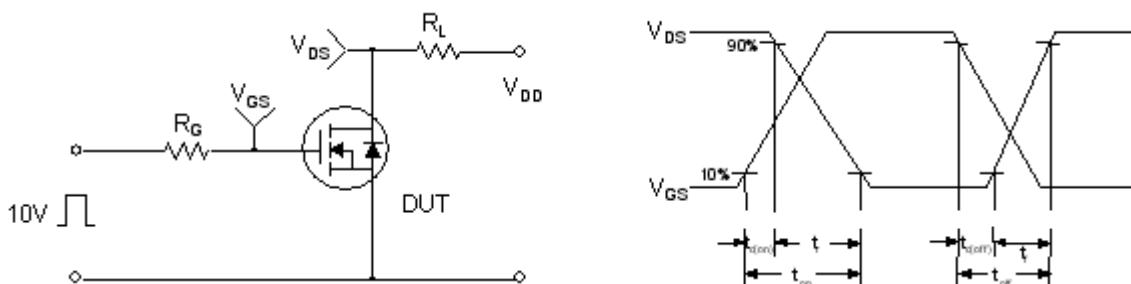
Figure 11. Transient Thermal Response Curve



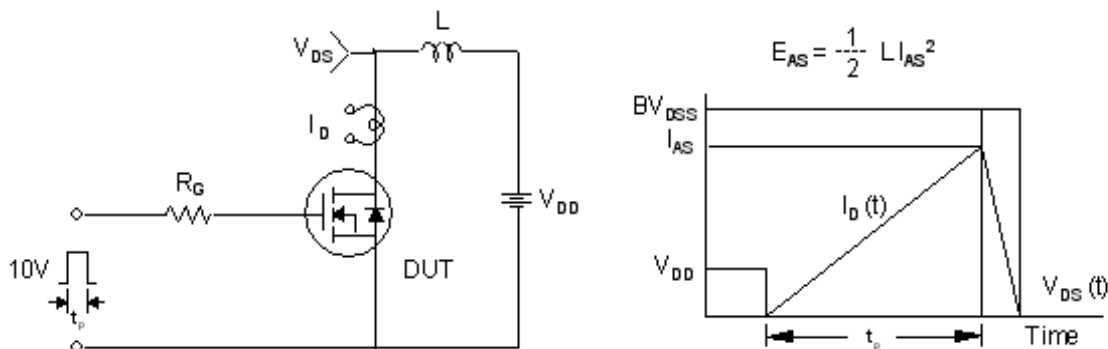
**Gate Charge Test Circuit & Waveform**



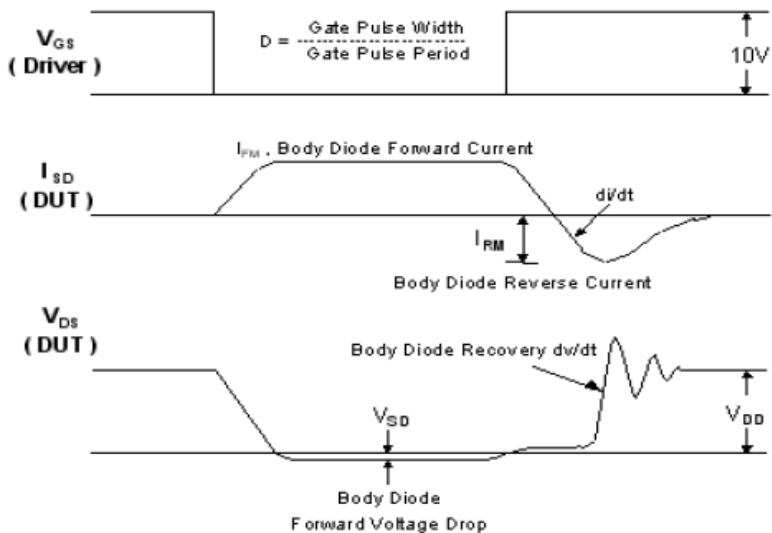
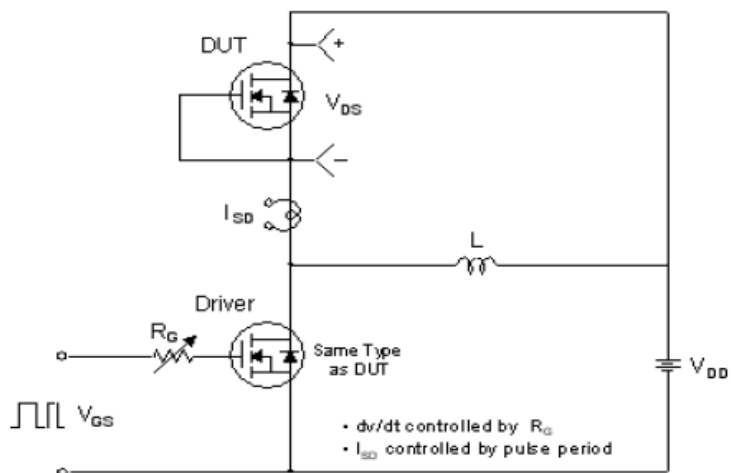
**Resistive Switching Test Circuit & Waveforms**



**Unclamped Inductive Switching Test Circuit & Waveforms**



Peak Diode Recovery dv/dt Test Circuit & Waveforms





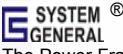






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