August 2004

FAIRCHILD SEMICONDUCTOR®

FDS7088SN3

30V N-Channel PowerTrench® SyncFET™

General Description

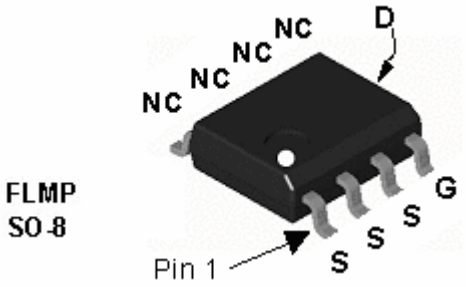
The FDS7088SN3 is designed to replace a single SO-8 FLMP MOSFET and Schottky diode in synchronous DC:DC power supplies. This 30V MOSFET is designed to maximize power conversion efficiency, providing a low $R_{DS(ON)}$ and low gate charge. The FDS7088SN3 includes an integrated Schottky diode using Fairchild's monolithic SyncFET technology. The performance of the FDS7088SN3 as the low-side switch in a synchronous rectifier is close to the performance of the FDS7088N3 in parallel with a Schottky diode.

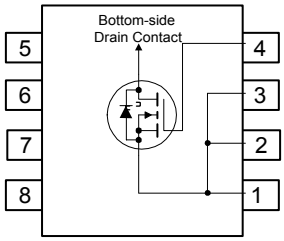
Applications

- DC/DC converter
- Motor drives

Features

- 21 A, 30 V $R_{DS(ON)}$ = 4.0 mΩ @ V_{GS} = 10 V
  $R_{DS(ON)}$ = 4.9 mΩ @ V_{GS} = 4.5 V
- High performance trench technology for extremely low $R_{DS(ON)}$
- High power and current handling capability
- Fast switching
- FLMP SO-8 package: Enhanced thermal performance in industry-standard package size





Absolute Maximum Ratings

T_A=25°C unless otherwise noted

Symbol	Parameter		Ratings	Units
V_{DSS}	Drain-Source Voltage		30	V
V_{GSS}	Gate-Source Voltage		±20	V
I_D	Drain Current – Continuous	(Note 1a)	21	A
	– Pulsed		60	
P_D	Power Dissipation for Single Operation	(Note 1a)	3.0	W
		(Note 1b)	1.7	
T_J, T_{STG}	Operating and Storage Junction Temperature Range		–55 to +150	°C

Thermal Characteristics

$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	(Note 1a)	40	°C/W
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	(Note 1)	0.5	°C/W

Package Marking and Ordering Information

Device Marking	Device	Reel Size	Tape width	Quantity
FDS7088SN3	FDS7088SN3	13''	12mm	2500 units

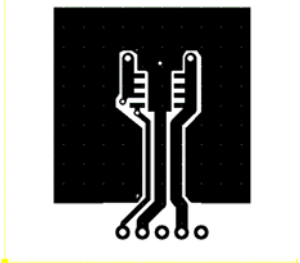
Electrical Characteristics

T_A = 25°C unless otherwise noted

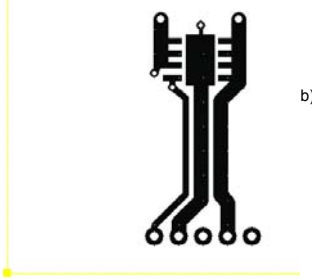
Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
Off Characteristics						
BV_{DSS}	Drain–Source Breakdown Voltage	V_{GS} = 0 V, I_D = 1 mA	30			V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	I_D = 15 mA, Referenced to 25°C		28		mV/°C
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 24 V, V_{GS} = 0 V			500	µA
I_{GSS}	Gate–Body Leakage	V_{GS} = ±20 V, V_{DS} = 0 V			±100	nA
On Characteristics (Note 2)						
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS} = V_{GS}, I_D = 1 mA	1	1.5	3	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate Threshold Voltage Temperature Coefficient	I_D = 15 mA, Referenced to 25°C		–3		mV/°C
$R_{DS(on)}$	Static Drain–Source On–Resistance	V_{GS} = 10 V, I_D = 21 A V_{GS} = 4.5 V, I_D = 19 A V_{GS} = 10 V, I_D = 21 A, T_J = 125°C		3.4 4.0 5	4.0 4.9	mΩ
g_{FS}	Forward Transconductance	V_{DS} = 10 V, I_D = 21 A		85		S
Dynamic Characteristics						
C_{iss}	Input Capacitance	V_{DS} = 15 V, V_{GS} = 0 V, f = 1.0 MHz		3230		pF
C_{oss}	Output Capacitance			890		pF
C_{rss}	Reverse Transfer Capacitance			300		pF
R_G	Gate Resistance	V_{GS} = 15 mV, f = 1.0 MHz		1.6		Ω
Switching Characteristics (Note 2)						
$t_{d(on)}$	Turn–On Delay Time	V_{DD} = 15 V, I_D = 1 A, V_{GS} = 10 V, R_{GEN} = 6 Ω		20	32	ns
t_r	Turn–On Rise Time			21	34	ns
$t_{d(off)}$	Turn–Off Delay Time			45	72	ns
t_f	Turn–Off Fall Time			33	53	ns
$Q_{g(TOT)}$	Total Gate Charge at V_{GS}=10V	V_{DD} = 15 V, I_D = 10 A		57	80	nC
Q_g	Total Gate Charge	V_{DD} = 15 V, I_D = 10 A, V_{GS} = 5 V		31	44	nC
Q_{gs}	Gate–Source Charge			8		nC
Q_{gd}	Gate–Drain Charge			10		nC
Drain–Source Diode Characteristics and Maximum Ratings						
I_S	Maximum Continuous Drain–Source Schottky Diode Forward Current				4.3	A
V_{SD}	Drain–Source Schottky Diode Forward Voltage	V_{GS} = 0 V, I_S = 4.3 A (Note 2)		0.4	0.7	V
t_{RR}	Reverse Recovery Time	I_F = 21 A, diF/dt = 300 A/us		28		ns
Q_{RR}	Reverse Recovery Charge			29		nC

Notes:

1. $R_{\theta JA}$ is the sum of the junction-to-case and case-to-ambient thermal resistance where the case thermal reference is defined as the solder mounting surface of the drain pins. $R_{\theta JC}$ is guaranteed by design while $R_{\theta CA}$ is determined by the user's board design.



a) 40°C/W when mounted on a 1in^2 pad of 2 oz copper



b) 85°C/W when mounted on a minimum pad of 2 oz copper

Scale 1 : 1 on letter size paper

2. Pulse Test: Pulse Width < 300µs, Duty Cycle < 2.0%

Typical Characteristics

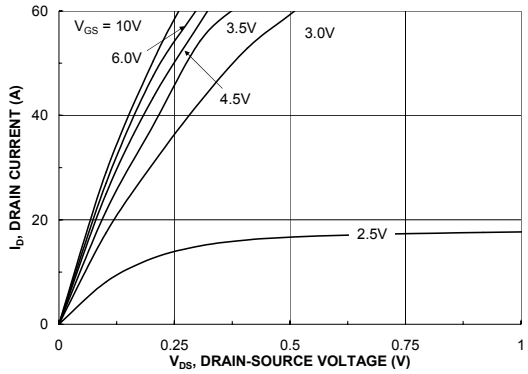


Figure 1. On-Region Characteristics.

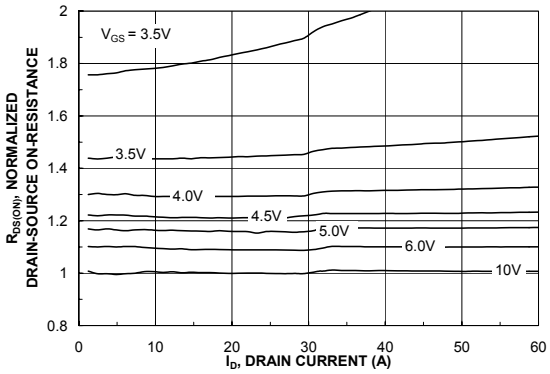


Figure 2. On-Resistance Variation with Drain Current and Gate Voltage.

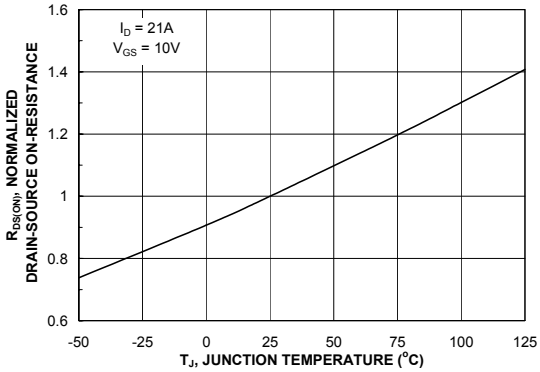


Figure 3. On-Resistance Variation withTemperature.

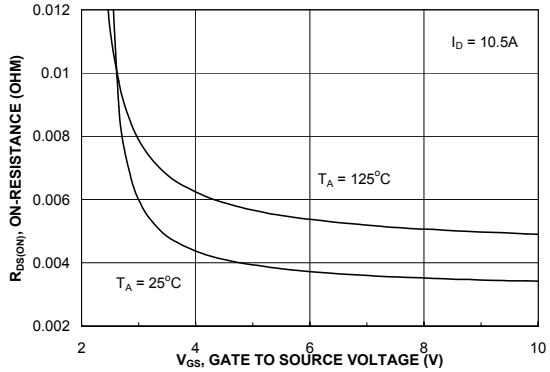


Figure 4. On-Resistance Variation with Gate-to-Source Voltage.

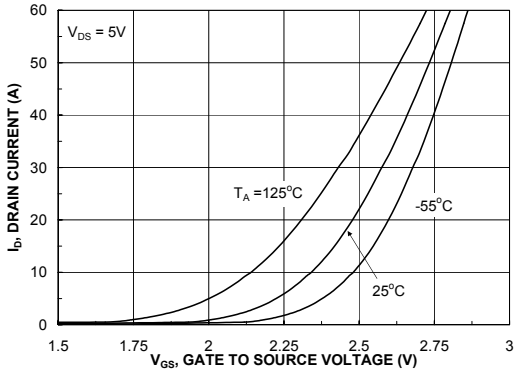


Figure 5. Transfer Characteristics.

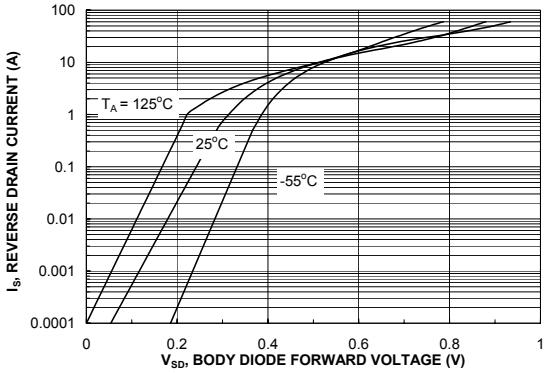


Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature.

Typical Characteristics

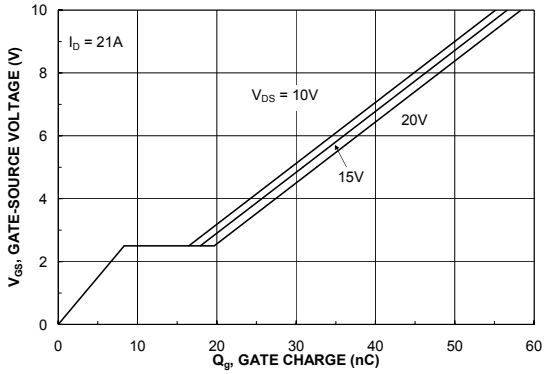


Figure 7. Gate Charge Characteristics.

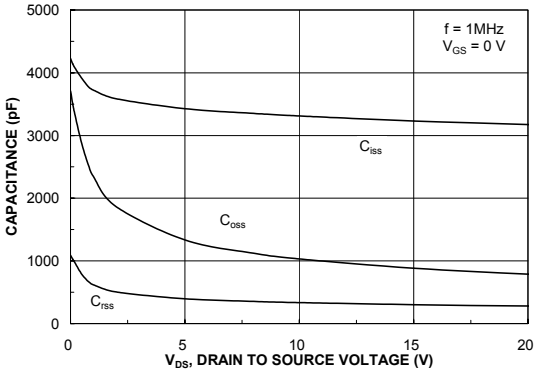


Figure 8. Capacitance Characteristics.

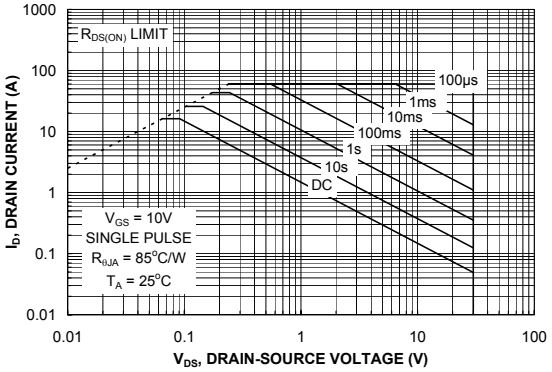


Figure 9. Maximum Safe Operating Area.

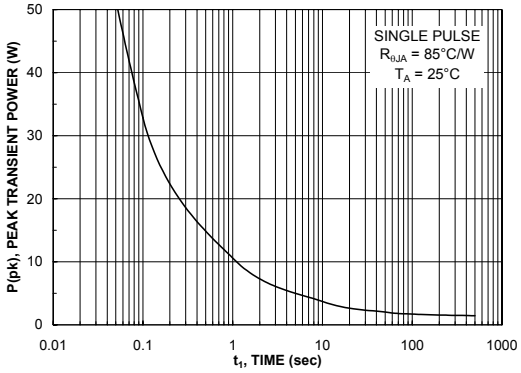


Figure 10. Single Pulse Maximum Power Dissipation.

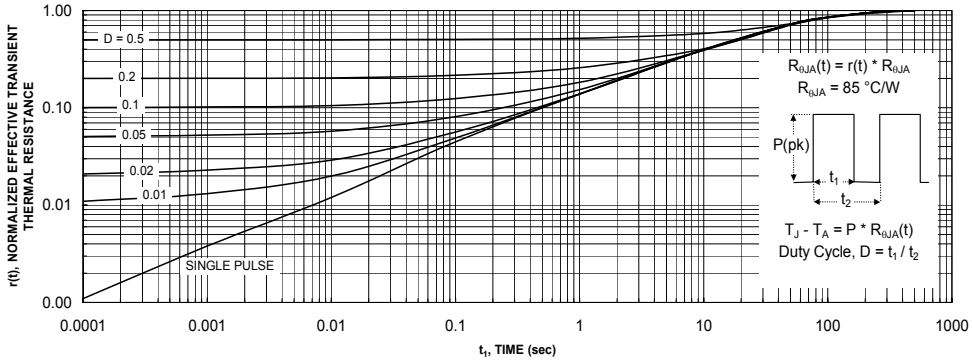


Figure 11. Transient Thermal Response Curve.

Thermal characterization performed using the conditions described in Note 1b.
Transient thermal response will change depending on the circuit board design.

Typical Characteristics (continued)

SyncFET Schottky Body Diode Characteristics

Fairchild's SyncFET process embeds a Schottky diode in parallel with PowerTrench MOSFET. This diode exhibits similar characteristics to a discrete external Schottky diode in parallel with a MOSFET. Figure 12 shows the reverse recovery characteristic of the FDS7088SN3.

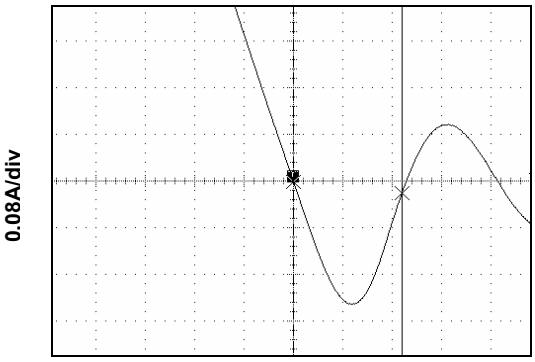


Figure 12. FDS7088SN3 SyncFET body diode reverse recovery characteristic.

For comparison purposes, Figure 13 shows the reverse recovery characteristics of the body diode of an equivalent size MOSFET produced without SyncFET (FDS7088N3).

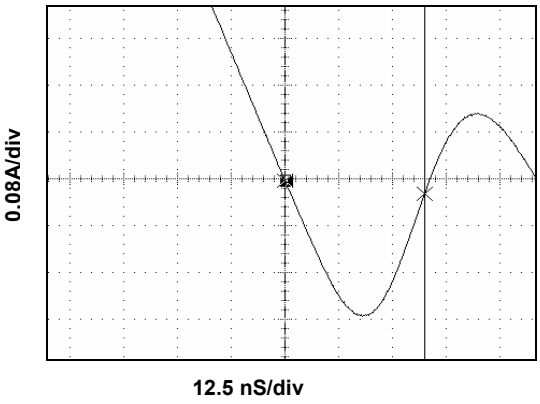


Figure 13. Non-SyncFET (FDS7088N3) body diode reverse recovery characteristic.

Schottky barrier diodes exhibit significant leakage at high temperature and high reverse voltage. This will increase the power in the device.

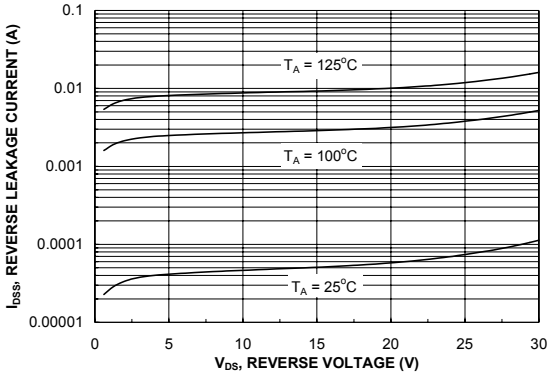
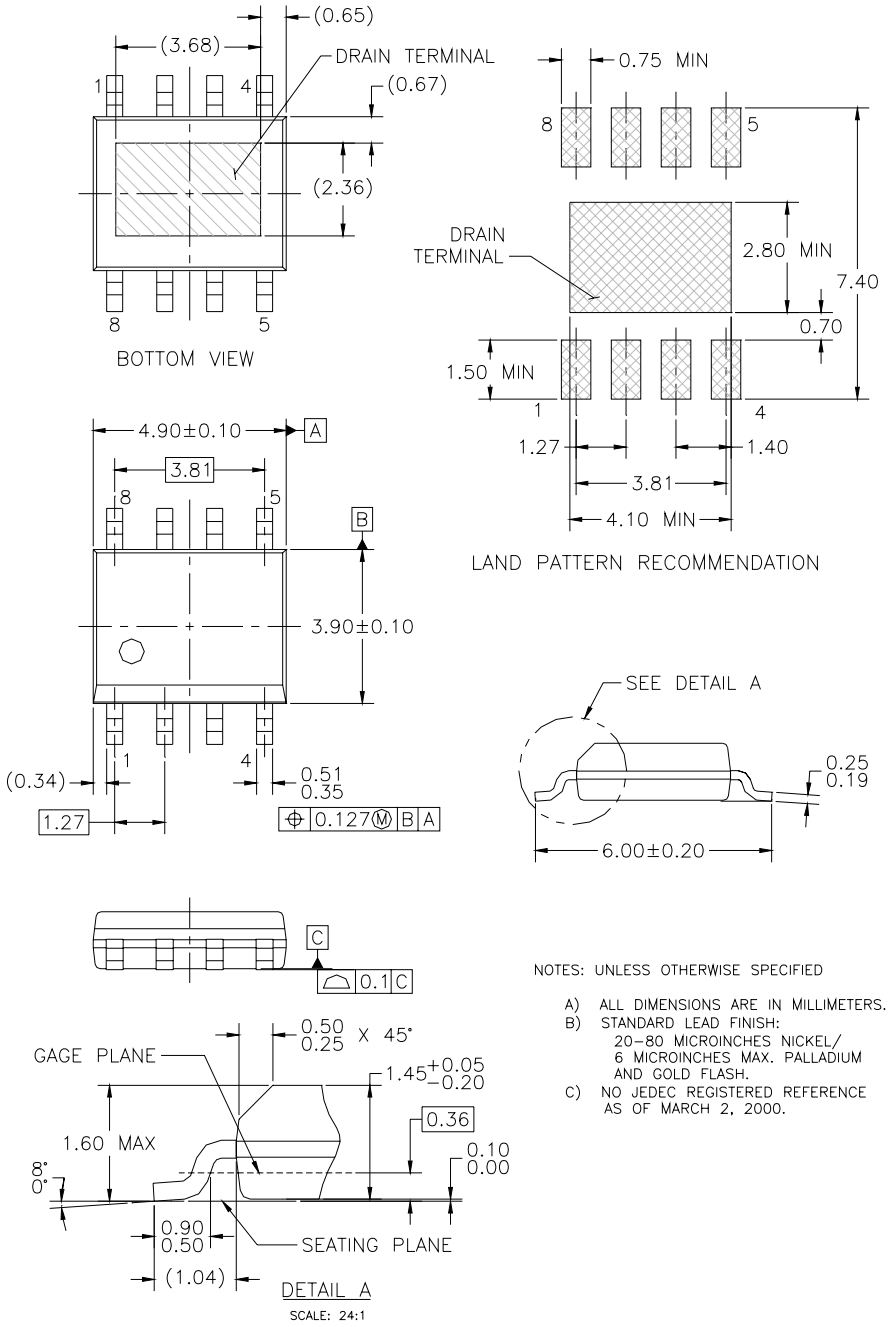


Figure 14. SyncFET body diode reverse leakage versus drain-source voltage and temperature

Dimensional Outline and Pad Layout



NOTES: UNLESS OTHERWISE SPECIFIED

A) ALL DIMENSIONS ARE IN MILLIMETERS.
B) STANDARD LEAD FINISH:
20–80 MICROINCHES NICKEL/
6 MICROINCHES MAX. PALLADIUM
AND GOLD FLASH.
C) NO JEDEC REGISTERED REFERENCE
AS OF MARCH 2, 2000.

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CROSSVOLT™	GlobalOptoisolator™	MicroPak™	QS™	SyncFET™
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E²CMOS™	I²C™	MSXPro™	RapidConfigure™	TruTranslation™
EnSigna™	*i-Lo*™	OCX™	RapidConnect™	UHC™
FACT™	ImpliedDisconnect™	OCXPro™	µSerDes™	UltraFET®
FACT Quiet Series™		OPTOLOGIC®	SILENT SWITCHER®	VCX™
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The Power Franchise®		PACMAN™	SPM™	
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