FAIRCHILD
SEMICONDUCTOR®

November 2007

FDS6688S

30V N-Channel PowerTrench® SyncFET™

General Description

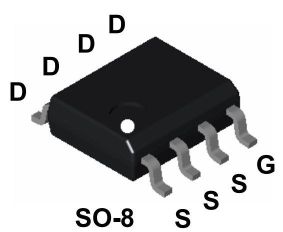
The FDS6688S is designed to replace a single SO-8 MOSFET and Schottky diode in synchronous DC:DC power supplies. This 30V MOSFET is designed to maximize power conversion efficiency, providing a low $R_{DS(ON)}$ and low gate charge. The FDS6688S includes an integrated Schottky diode using Fairchild's monolithic SyncFET technology.

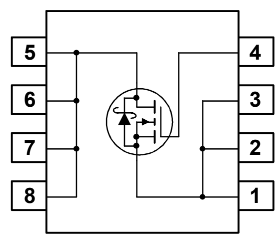
Applications

- DC/DC converter
- Motor drives

Features

- 16 A, 30 V. $R_{DS(ON)}$ = 6.0 mΩ @ V_{GS} = 10 V
  $R_{DS(ON)}$ = 7.5 mΩ @ V_{GS} = 4.5 V
- Includes SyncFET Schottky body diode
- High performance trench technology for extremely low $R_{DS(ON)}$ and fast switching
- High power and current handling capability





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)	16	A
	– Pulsed		50	
P_D	Power Dissipation for Single Operation	(Note 1a)	2.5	W
		(Note 1b)	1.2	
		(Note 1c)	1	
T_J, T_{STG}	Operating and Storage Junction Temperature Range		–55 to +125	°C

Thermal Characteristics

$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	(Note 1a)	50	°C/W
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	(Note 1)	25	

Package Marking and Ordering Information

Device Marking	Device	Reel Size	Tape width	Quantity
FDS6688S	FDS6688S	13''	12mm	2500 units

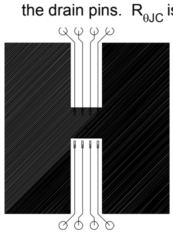
Electrical Characteristics

T_A = 25°C unless otherwise noted

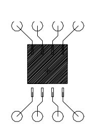
Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
Off Characteristics						
BV_{DSS}	Drain–Source Breakdown Voltage	V_{GS} = 0 V, I_D = 1 mA	30			V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	I_D = 10 mA, Referenced to 25°C		24		mV/°C
I_{DSS}	Zero Gate Voltage Drain 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						
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}$, I_D = 1 mA	1	1.4	3	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate Threshold Voltage Temperature Coefficient	I_D = 10 mA, Referenced to 25°C		–4		mV/°C
$R_{DS(on)}$	Static Drain–Source On–Resistance	V_{GS} = 10 V, I_D = 16 A V_{GS} = 4.5 V, I_D = 14.5 A V_{GS}=10 V, I_D =16 A, T_J=125°C		4.8 5.7 6.5	6.0 7.5	mΩ
g_{FS}	Forward Transconductance	V_{DS} = 10 V, I_D = 16 A		74		S
Dynamic Characteristics						
C_{iss}	Input Capacitance	V_{DS} = 15 V, V_{GS} = 0 V, f = 1.0 MHz		3290		pF
C_{oss}	Output Capacitance			890		pF
C_{rss}	Reverse Transfer Capacitance			290		pF
R_G	Gate Resistance	V_{GS} = 15 mV, f = 1.0 MHz		1.5		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		12	22	ns
t_r	Turn–On Rise Time			12	22	ns
$t_{d(off)}$	Turn–Off Delay Time			30	46	ns
t_f	Turn–Off Fall Time			60	96	ns
$Q_{g(TOT)}$	Total Gate Charge at V_{GS}=10V	V_{DS} = 15 V, I_D = 16 A		56	78	nC
Q_g	Total Gate Charge at V_{GS}=5V			31	44	nC
Q_{gs}	Gate–Source Charge			8.2		nC
Q_{gd}	Gate–Drain Charge			9.0		nC
Drain–Source Diode Characteristics and Maximum Ratings						
V_{SD}	Drain–Source Diode Forward Voltage	V_{GS} = 0 V, I_S = 3.5 A (Note 2)		380	700	mV
t_{rr}	Diode Reverse Recovery Time	I_F = 16 A, d_{iF}/d_t = 300 A/µs (Note 3)		30		ns
I_{RM}	Diode Reverse Recovery Current			2		A
Q_{rr}	Diode Reverse Recovery Charge			31		nC

Notes:

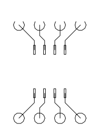
1. $R_{\theta JA}$ is the sum of the junction-to-case and case-to-ambient thermal resistance where the case thermal reference is defined as the solder mounting surface of the drain pins. $R_{\theta JC}$ is guaranteed by design while $R_{\theta CA}$ is determined by the user's board design.



a) 50°/W when mounted on a 1 in² pad of 2 oz copper



b) 105°/W when mounted on a .04 in² pad of 2 oz copper



c) 125°/W when mounted on a minimum pad.

Scale 1 : 1 on letter size paper

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

See "SyncFET Schottky body diode characteristics" below

Typical Characteristics

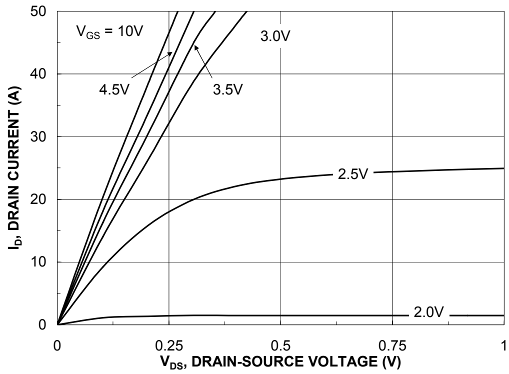


Figure 1. On-Region Characteristics.

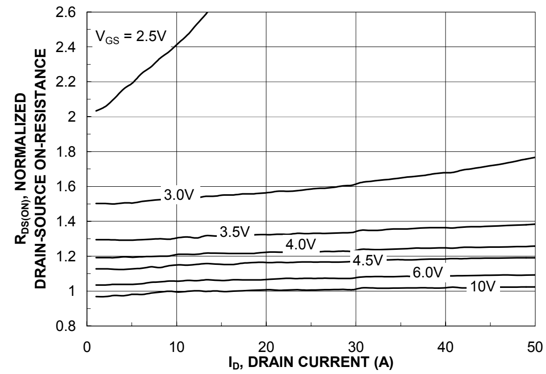


Figure 2. On-Resistance Variation with Drain Current and Gate Voltage.

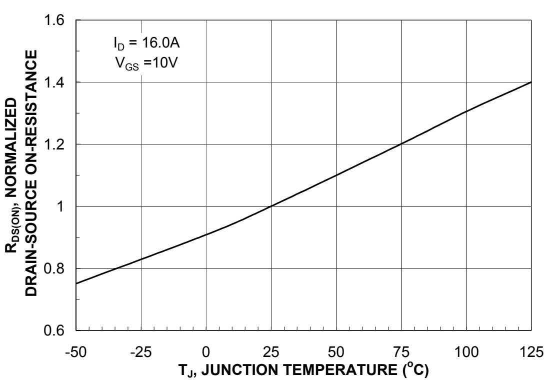


Figure 3. On-Resistance Variation with Temperature.

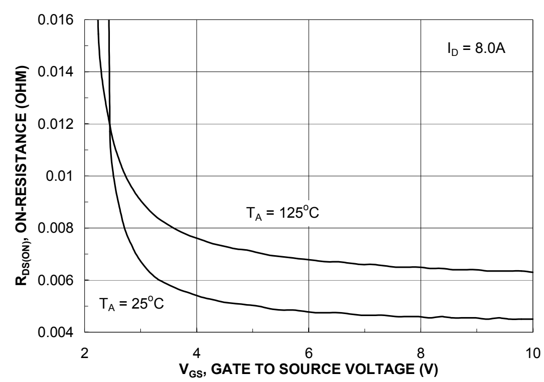


Figure 4. On-Resistance Variation with Gate-to-Source Voltage.

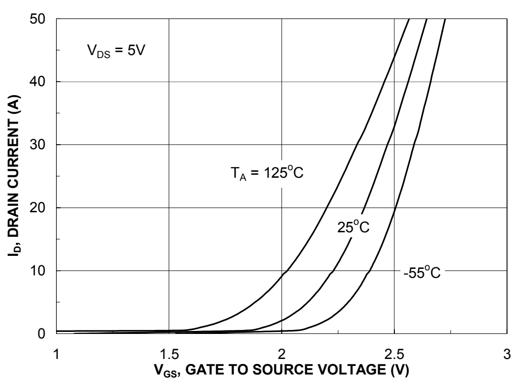


Figure 5. Transfer Characteristics.

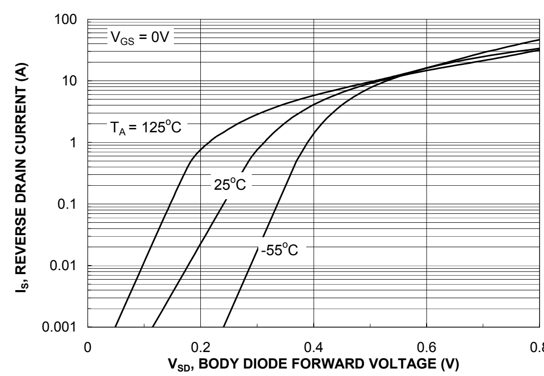


Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature.

Typical Characteristics (continued)

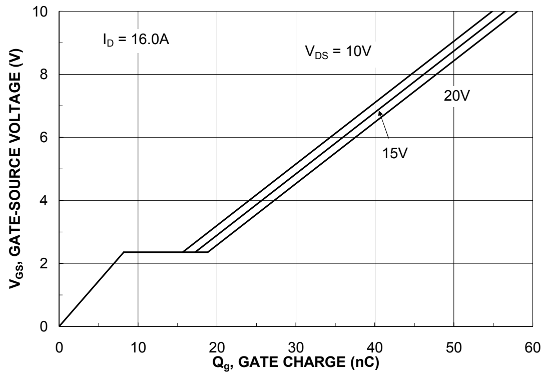


Figure 7. Gate Charge Characteristics.

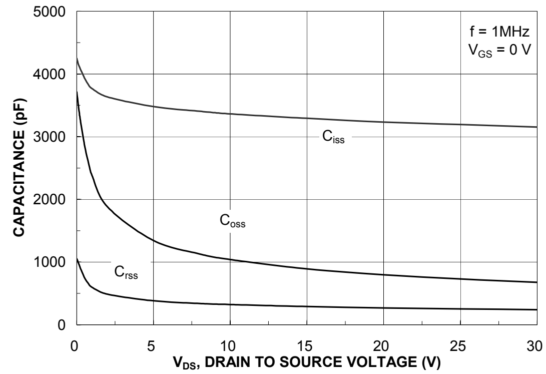


Figure 8. Capacitance Characteristics.

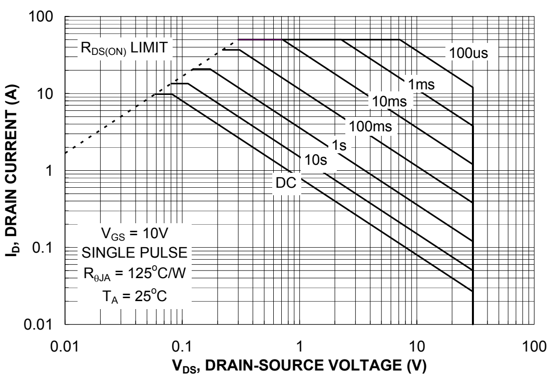


Figure 9. Maximum Safe Operating Area.

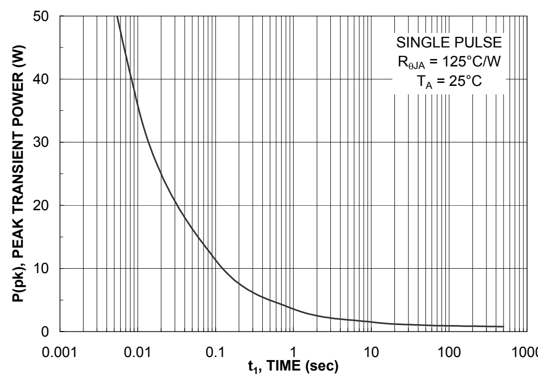


Figure 10. Single Pulse Maximum Power Dissipation.

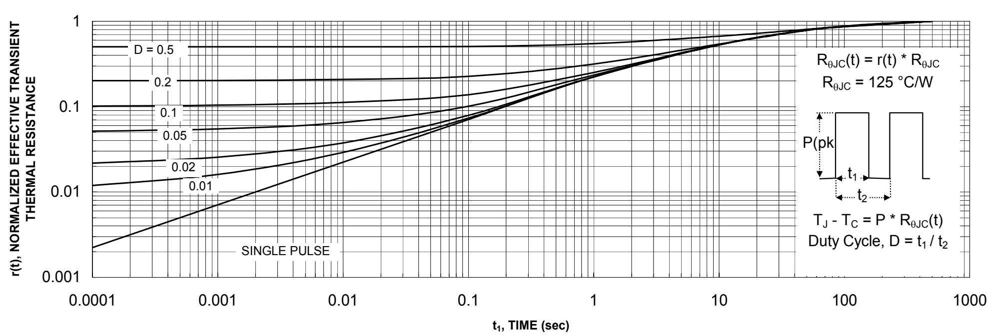


Figure 11. Transient Thermal Response Curve.

Thermal characterization performed using the conditions described in Note 1c. 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 FDS6688S.

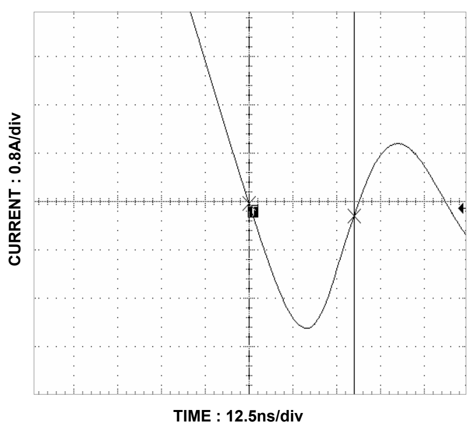


Figure 12. FDS6688S SyncFET body diode reverse recovery characteristic.

For comparison purposes, Figure 13 shows the reverse recovery characteristics of the body diode of an equivalent size MOSFET produced without SyncFET (FDS6688).

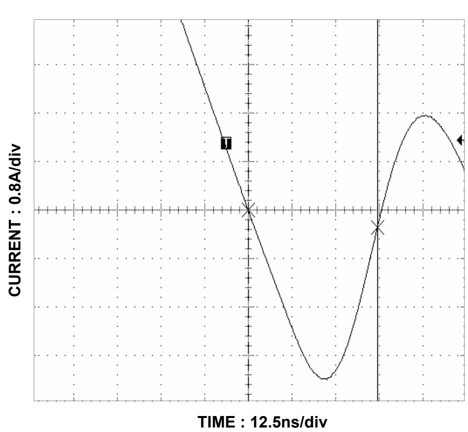


Figure 13. Non-SyncFET (FDS6688) body diode reverse recovery characteristic.

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

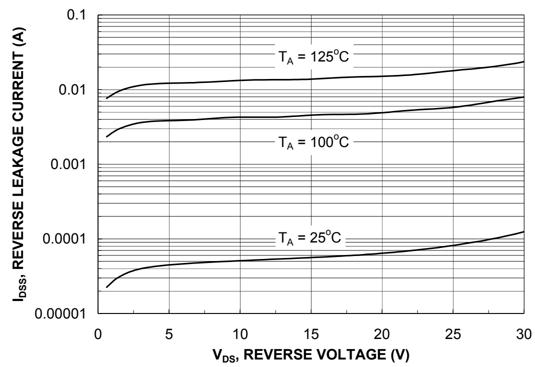


Figure 14. SyncFET body diode reverse leakage versus drain-source voltage and temperature.

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Rev. I31