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[redacted]

March 2010

FDS6990AS
Dual 30V N-Channel PowerTrench® SyncFET™

Features

- 7.5 A, 30 V. $R_{DS(ON)}$ = 22 mΩ @ V_{GS} = 10 V
  $R_{DS(ON)}$ = 28 mΩ @ V_{GS} = 4.5 V
- Includes SyncFET Schottky diode
- Low gate charge (10nC typical)
- High performance trench technology for extremely low $R_{DS(ON)}$
- High power and current handling capability

Applications

- DC/DC converter
- Motor drives

General Description

The FDS6990AS is designed to replace a dual SO-8 MOSFET and two Schottky diodes 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. Each MOSFET includes integrated Schottky diodes using Fairchild's monolithic SyncFET technology. The performance of the FDS6990AS as the low-side switch in a synchronous rectifier is similar to the performance of the FDS6990A in parallel with a Schottky diode.

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)	7.5	A
	– Pulsed		20	
P_D	Power Dissipation for Dual Operation		2	W
	Power Dissipation for Single Operation	(Note 1a)	1.6	
		(Note 1b)	1	
		(Note 1c)	0.9	
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)	78	°C/W
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	(Note 1)	40	°C/W

Package Marking and Ordering Information

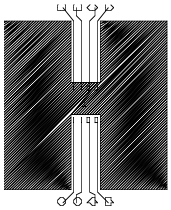
Device Marking	Device	Reel Size	Tape width	Quantity
FDS6990AS	FDS6990AS	13"	12mm	2500 units

Electrical Characteristics T_A = 25°C unless otherwise noted

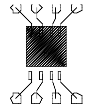
Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
Off Characteristics						
BV_{DSS}	Drain–Source Breakdown Voltage	V_{GS} = 0 V, I_D = 1 mA	30			V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	I_D = 1 mA, Referenced to 25°C		31		mV/°C
I_{DSS}	Zero Gate Voltage Drain 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	1.7	3	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate Threshold Voltage Temperature Coefficient	I_D = 1 mA, Referenced to 25°C		–3		mV/°C
$R_{DS(on)}$	Static Drain–Source On–Resistance	V_{GS} = 10 V, I_D = 7.5 A V_{GS} = 10 V, I_D = 7.5 A, T_J = 125°C V_{GS} = 4.5 V, I_D = 6.5 A		17 26 21	22 35 28	mΩ
$I_{D(on)}$	On–State Drain Current	V_{GS} = 10 V, V_{DS} = 5 V	20			A
g_{FS}	Forward Transconductance	V_{DS} = 15 V, I_D = 10 A		29		S
Dynamic Characteristics						
C_{iss}	Input Capacitance	V_{DS} = 15 V, V_{GS} = 0 V, f = 1.0 MHz		550		pF
C_{oss}	Output Capacitance			162		pF
C_{rss}	Reverse Transfer Capacitance			60		pF
R_G	Gate Resistance	V_{GS} = 15 mV, f = 1.0 MHz		3.1		Ω
Switching Characteristics (Note 2)						
$t_{d(on)}$	Turn–On Delay Time	V_{DS} = 15 V, I_D = 1 A, V_{GS} = 10 V, R_{GEN} = 6 Ω		8	16	ns
t_r	Turn–On Rise Time			5	10	ns
$t_{d(off)}$	Turn–Off Delay Time			24	38	ns
t_f	Turn–Off Fall Time			4	8	n s
$t_{d(on)}$	Turn–On Delay Time	V_{DS} = 15 V, I_D = 1 A, V_{GS} = 4.5 V, R_{GEN} = 6 Ω		9	18	ns
t_r	Turn–On Rise Time			8	16	ns
$t_{d(off)}$	Turn–Off Delay Time			14	24	ns
t_f	Turn–Off Fall Time			5	10	ns
$Q_{g(TOT)}$	Total Gate Charge at Vgs = 10V	V_{DD} = 15 V, I_D = 10 A, V_{GS} = 5 V		10	14	nC
Q_g	Total Gate Charge at Vgs = 5V			6	8	nC
Q_{gs}	Gate–Source Charge			1.5		nC
Q_{gd}	Gate–Drain Charge			2.0		nC
Drain–Source Diode Characteristics and Maximum Ratings						
I_S	Maximum Continuous Drain–Source Diode Forward Current				2.9	A
V_{SD}	Drain–Source Diode Forward Voltage	V_{GS} = 0 V, I_S = 2.3 A (Note 2)		0.6	0.7	V
t_{rr}	Diode Reverse Recovery Time	I_F = 10A,		18		nS
Q_{rr}	Diode Reverse Recovery Charge	d_{iF}/d_t = 300 A/μs (Note 3)		11		nC

Notes:

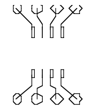
1. $R_{\theta JA}$ is the sum of the junction-to-case and case-to-ambient thermal resistance where the case thermal reference is defined as the solder mounting surface of the drain pins. $R_{\theta JC}$ is guaranteed by design while $R_{\theta CA}$ is determined by the user's board design.



a) 78°C/W when mounted on a 0.5 in^2 pad of 2 oz copper



b) 125°C/W when mounted on a 0.02 in^2 pad of 2 oz copper



c) 135°C/W when mounted on a minimum pad.

Scale 1 : 1 on letter size paper

2. Pulse Test: Pulse Width < 300µs, Duty Cycle < 2.0%
3. See “SyncFET Schottky body diode characteristics” below.

Typical Characteristics

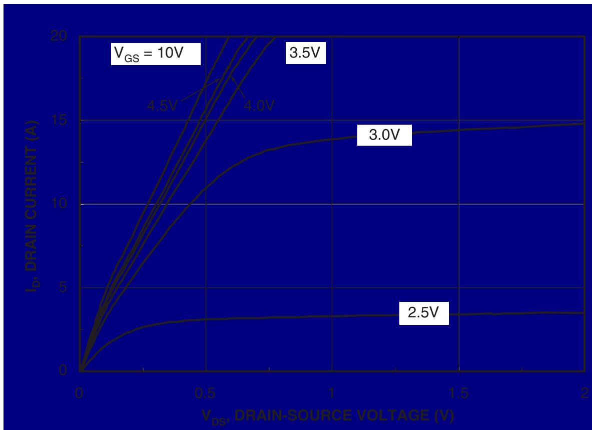


Figure 1. On-Region Characteristics.

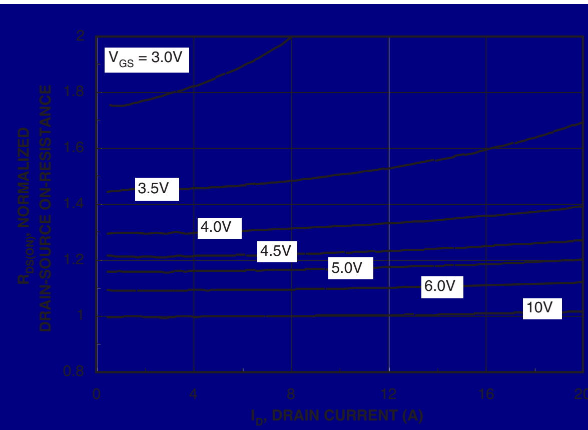


Figure 2. On-Resistance Variation with Drain Current and Gate Voltage.

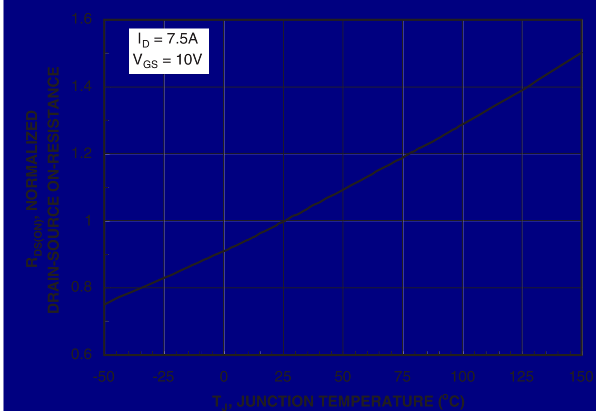


Figure 3. On-Resistance Variation with Temperature.

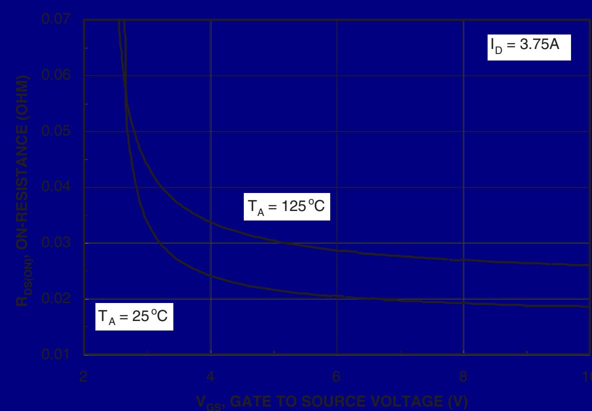


Figure 4. On-Resistance Variation with Gate-to-Source Voltage.

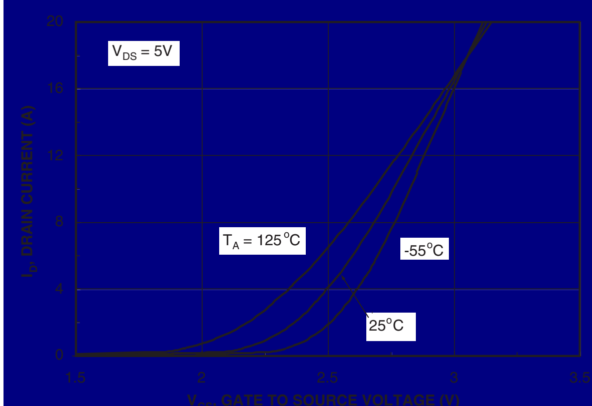


Figure 5. Transfer Characteristics.

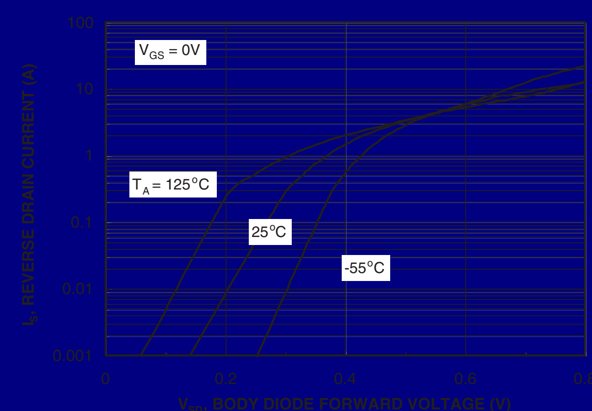


Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature.

Typical Characteristics

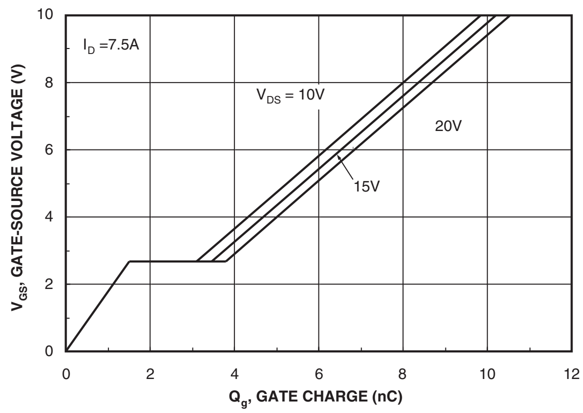


Figure 7. Gate Charge Characteristics.

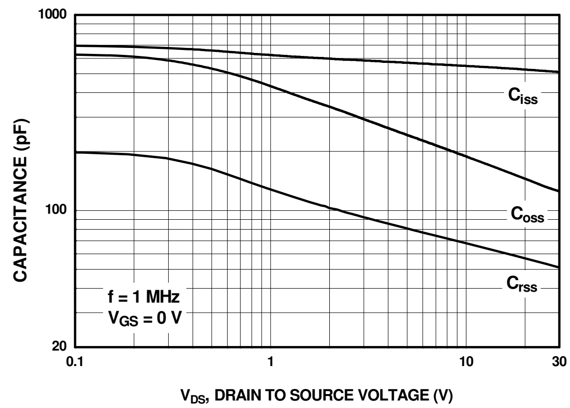


Figure 8. Capacitance Characteristics.

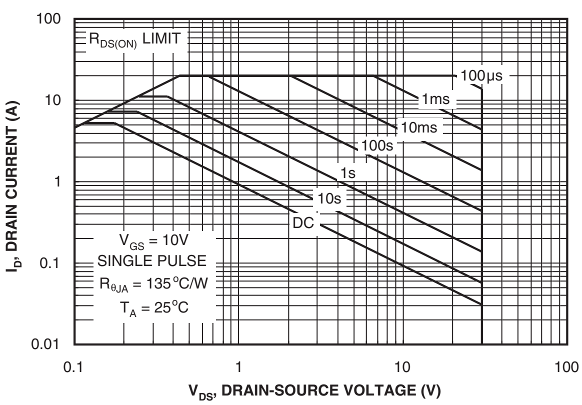


Figure 9. Maximum Safe Operating Area.

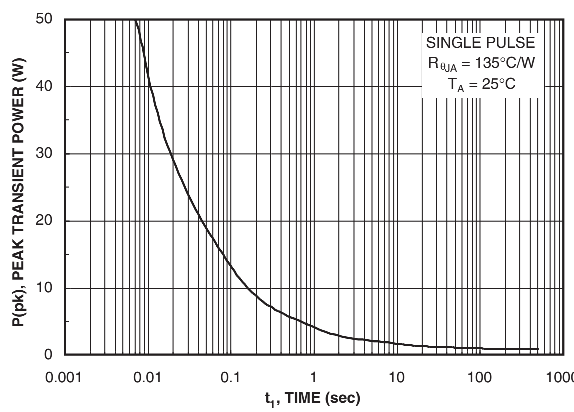


Figure 10. Single Pulse Maximum Power Dissipation.

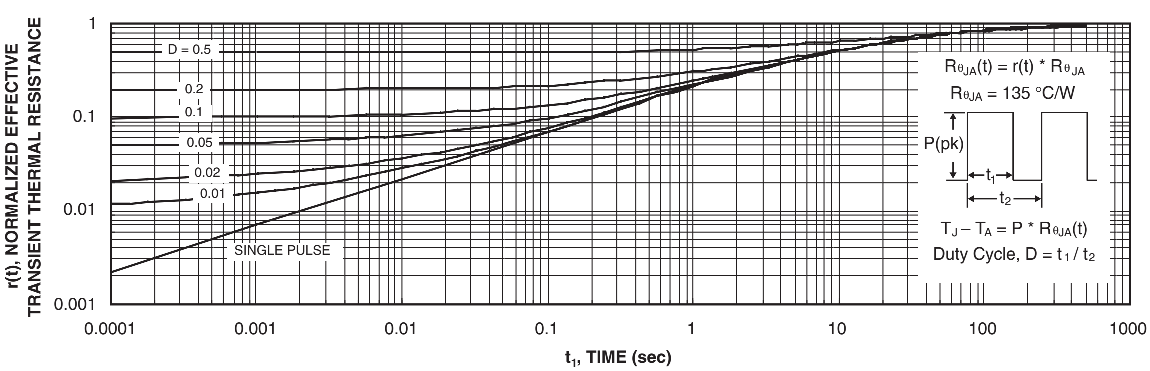


Figure 11. Transient Thermal Response Curve.

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 FDS6990AS.

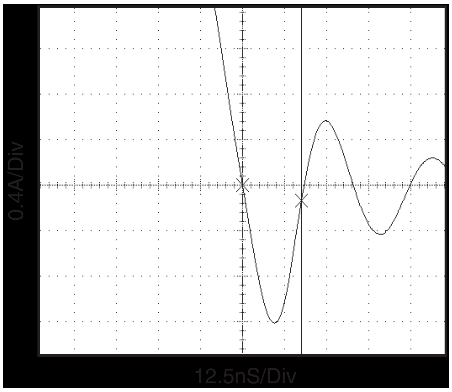


Figure 12. FDS6990AS SyncFET body diode reverse recovery characteristic.

For comparison purposes, Figure 13 shows the reverse recovery characteristics of the body diode of an equivalent size MOSFET produced without SyncFET (FDS6990A).

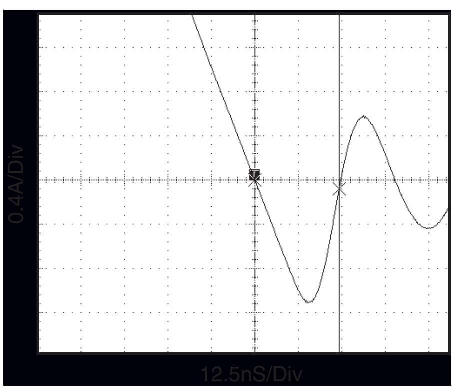


Figure 13. Non-SyncFET (FDS6990A) body diode reverse recovery characteristic.

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

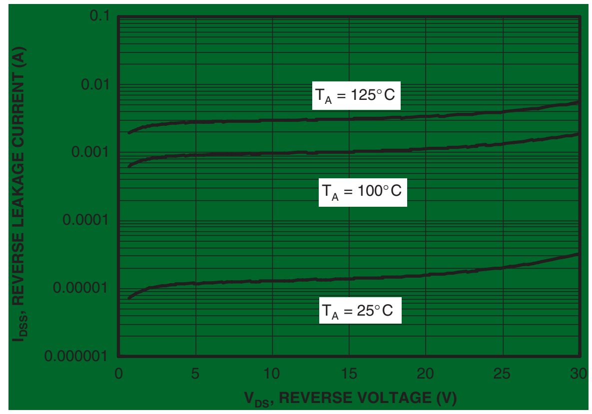


Figure 14. SyncFET body diode reverse leakage versus drain-source voltage and temperature.

Typical Characteristics (continued)

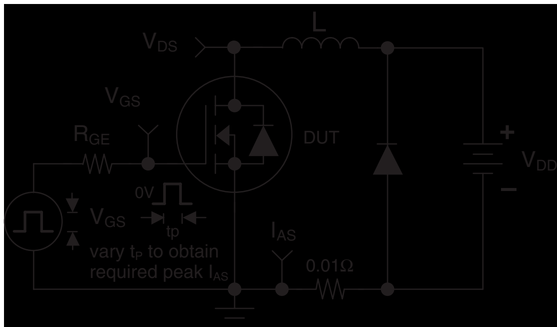


Figure 15. Unclamped Inductive Load Test Circuit

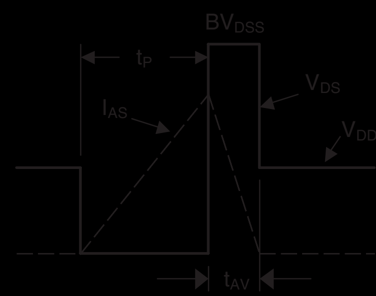


Figure 16. Unclamped Inductive Waveforms

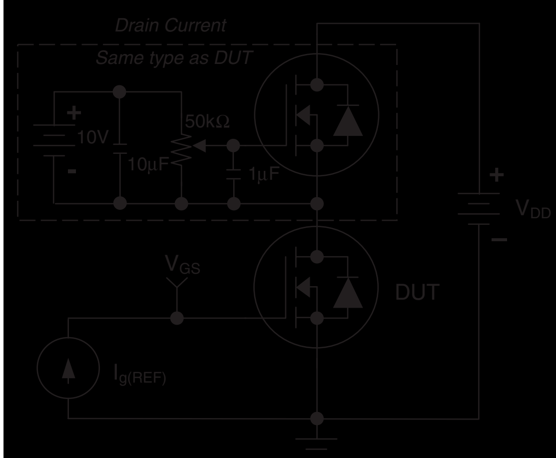


Figure 17. Gate Charge Test Circuit

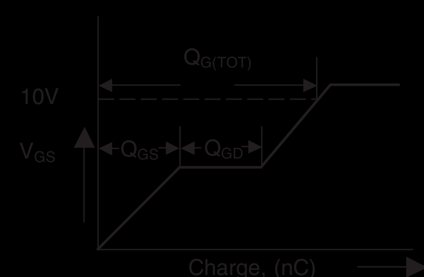


Figure 18. Gate Charge Waveform

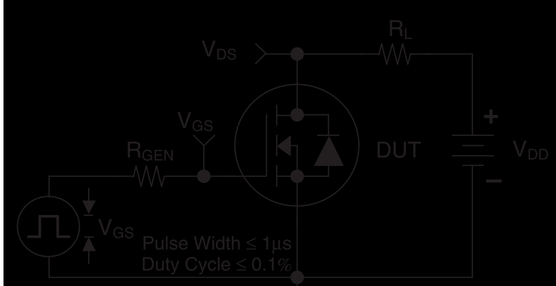


Figure 19. Switching Time Test Circuit

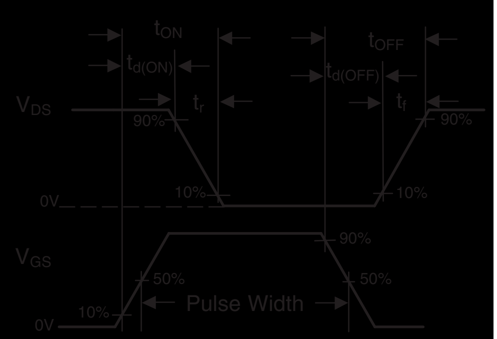


Figure 20. Switching Time Waveforms

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Preliminary	First Production	Datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
No Identification Needed	Full Production	Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design.
Obsolete	Not In Production	Datasheet contains specifications on a product that is discontinued by Fairchild Semiconductor. The datasheet is for reference information only.

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