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FDS6699S

30V N-Channel PowerTrench® SyncFET™

Features

- 21 A, 30 V Max $R_{DS(ON)} = 3.6 \text{ m}\Omega @ V_{GS} = 10 \text{ V}$
Max $R_{DS(ON)} = 4.5 \text{ m}\Omega @ V_{GS} = 4.5 \text{ V}$
- Includes SyncFET Schottky body diode
- High performance trench technology for extremely low $R_{DS(ON)}$ and fast switching
- High power and current handling capability
- 100% R_G (Gate Resistance) tested

Applications

- Synchronous Rectifier for DC/DC Converters –
 - Notebook Vcore low side switch
 - Point of Load low side switch

General Description

The FDS6699S 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 FDS6699S includes an integrated Schottky diode using Fairchild's monolithic SyncFET technology.



Absolute Maximum Ratings $T_A=25^\circ\text{C}$ 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	105		
E_{AS}	Single Pulse Avalanche Energy (Note 4)	541	mJ	
P_D	Power Dissipation for Single Operation (Note 1a)	(Note 1b)	2.5	W
		(Note 1c)	1.2	
			1	
T_J, T_{STG}	Operating and Storage Junction Temperature Range	-55 to $+150$	$^\circ\text{C}$	
Thermal Characteristics				
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient (Note 1a)	50	$^\circ\text{C}/\text{W}$	
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case (Note 1)	25		

Package Marking and Ordering Information

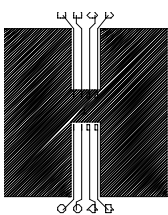
Device Marking	Device	Reel Size	Tape width	Quantity
FDS6699S	FDS6699S	13"	12mm	2500 units

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

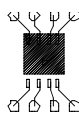
Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
Off Characteristics						
BV_{DSS}	Drain–Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$	30			V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 1\text{ mA}$, Referenced to 25°C		28		$\text{mV}/^\circ\text{C}$
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 24\text{ V}, V_{GS} = 0\text{ V}$			500	μA
I_{GSS}	Gate–Body Leakage	$V_{GS} = \pm 20\text{ V}, V_{DS} = 0\text{ V}$			± 100	nA
On Characteristics (Note 2)						
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 1\text{ mA}$	1	1.4	3	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate Threshold Voltage Temperature Coefficient	$I_D = 1\text{ mA}$, Referenced to 25°C		-3.2		$\text{mV}/^\circ\text{C}$
$R_{DS(on)}$	Static Drain–Source On–Resistance	$V_{GS} = 10\text{ V}, I_D = 21\text{ A}$ $V_{GS} = 4.5\text{ V}, I_D = 19\text{ A}$ $V_{GS} = 10\text{ V}, I_D = 21\text{ A}, T_J = 150^\circ\text{C}$		3.0 3.6 4.6	3.6 4.5 5.6	$\text{m}\Omega$
g_{FS}	Forward Transconductance	$V_{DS} = 10\text{ V}, I_D = 21\text{ A}$		100		S
Dynamic Characteristics						
C_{iss}	Input Capacitance	$V_{DS} = 15\text{ V}, V_{GS} = 0\text{ V},$ $f = 1.0\text{ MHz}$		3610	4800	pF
C_{oss}	Output Capacitance			1080	1435	pF
C_{rss}	Reverse Transfer Capacitance			340	680	pF
R_G	Gate Resistance	$V_{GS} = 15\text{ mV}, f = 1.0\text{ MHz}$	0.4	1.8	3.1	Ω
Switching Characteristics (Note 2)						
$t_{d(on)}$	Turn–On Delay Time	$V_{DD} = 15\text{ V}, I_D = 1\text{ A},$ $V_{GS} = 10\text{ V}, R_{GEN} = 6\ \Omega$		11	20	ns
t_r	Turn–On Rise Time			12	22	ns
$t_{d(off)}$	Turn–Off Delay Time			73	117	ns
t_f	Turn–Off Fall Time			38	61	ns
$Q_{g(TOT)}$	Total Gate Charge at $V_{GS} = 10\text{ V}$	$V_{DD} = 15\text{ V}, I_D = 21\text{ A},$		65	91	nC
Q_g	Total Gate Charge at $V_{GS} = 5\text{ V}$			35	49	nC
Q_{gs}	Gate–Source Charge			9		nC
Q_{gd}	Gate–Drain Charge			11		nC
Drain–Source Diode Characteristics and Maximum Ratings						
V_{SD}	Drain–Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_S = 3.5\text{ A}$ (Note 2)		0.36	0.7	V
t_{rr}	Diode Reverse Recovery Time	$I_F = 21\text{ A},$ $dI_F/dt = 300\text{ A}/\mu\text{s}$ (Note 3)		32		ns
I_{RM}	Diode Reverse Recovery Current			2.2		A
Q_{rr}	Diode Reverse Recovery Charge			35		nC

Notes:

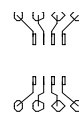
- $R_{\theta JA}$ is the sum of the junction-to-case and case-to-ambient thermal resistance where the case thermal reference is defined as the solder mounting surface of the drain pins. $R_{\theta JC}$ is guaranteed by design while $R_{\theta CA}$ is determined by the user's board design.



a) 50°W when mounted on a 1 in^2 pad of 2 oz copper



b) 105°W when mounted on a $.04\text{ in}^2$ 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 < $300\mu\text{s}$, Duty Cycle < 2.0%
- See "SyncFET Schottky body diode characteristics" below.
- E_{AS} of 541 mJ is based on starting $T_J = 25^\circ\text{C}$, $L = 3\text{ mH}$, $I_{AS} = 19\text{ A}$, $V_{DD} = 30\text{ V}$, $V_{GS} = 10\text{ V}$. 100% test at $L = 1\text{ mH}$, $I_{AS} = 25\text{ A}$.

Typical Characteristics

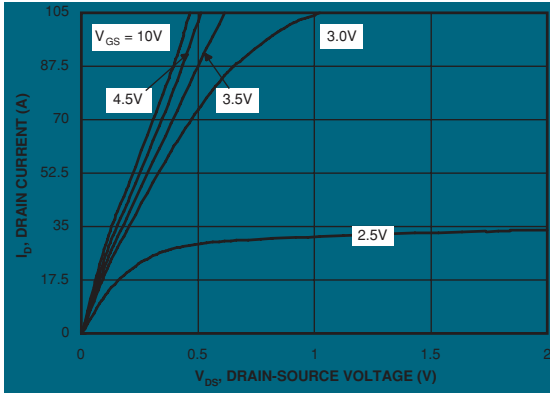


Figure 1. On-Region Characteristics.

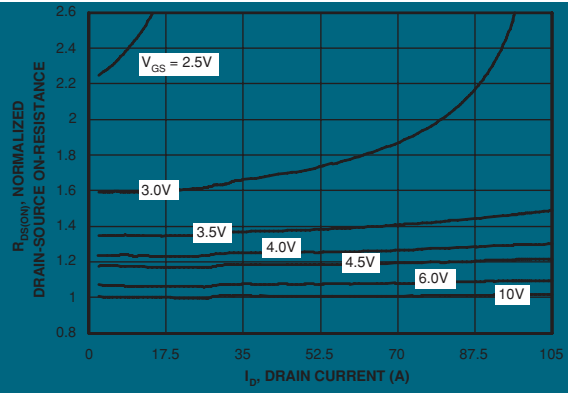


Figure 2. On-Resistance Variation with Drain Current and Gate Voltage.

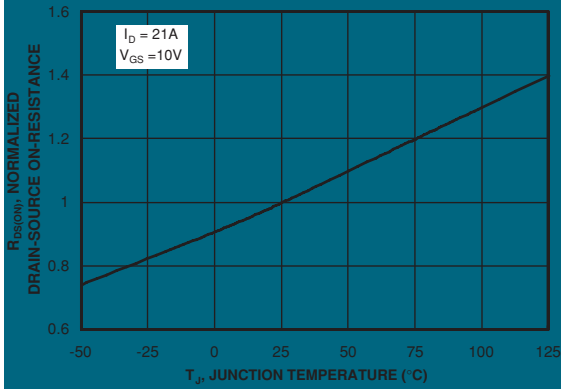


Figure 3. On-Resistance Variation with Temperature.

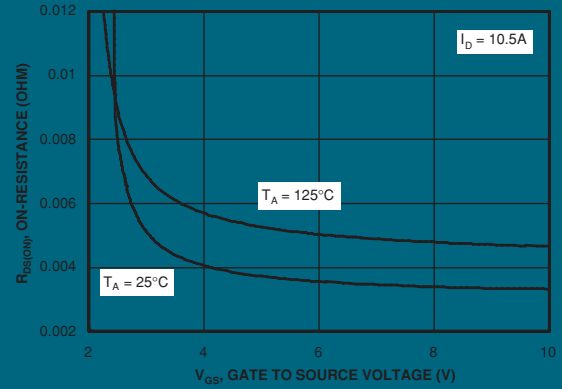


Figure 4. On-Resistance Variation with Gate-to-Source Voltage.

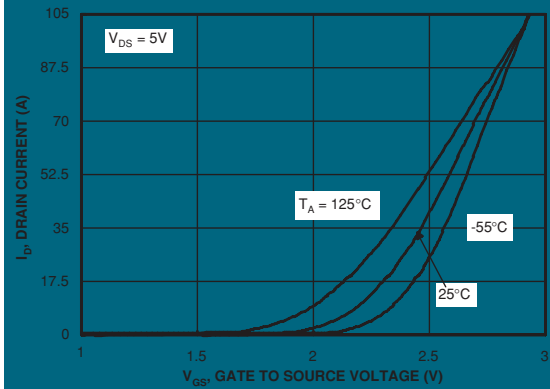


Figure 5. Transfer Characteristics.

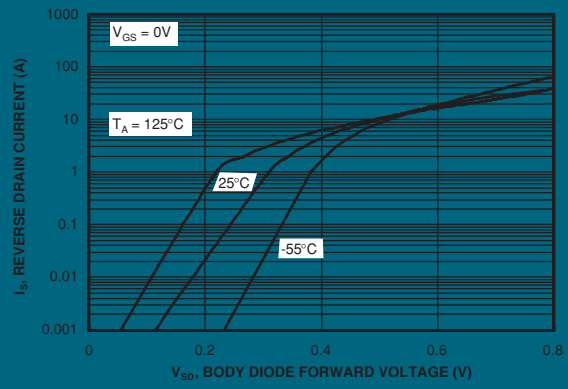


Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature.

Typical Characteristics (continued)

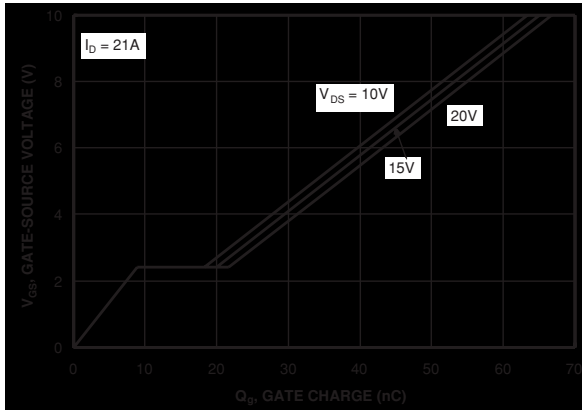


Figure 7. Gate Charge Characteristics.

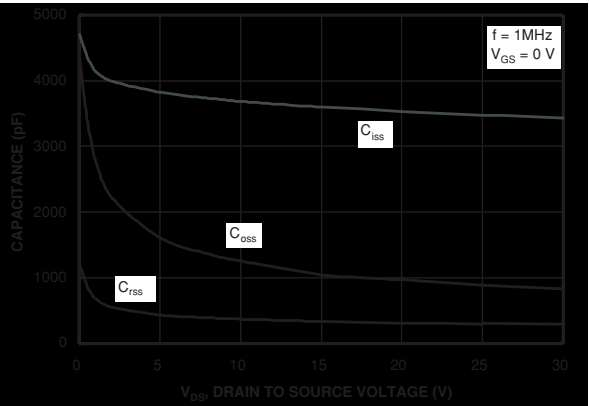


Figure 8. Capacitance Characteristics.

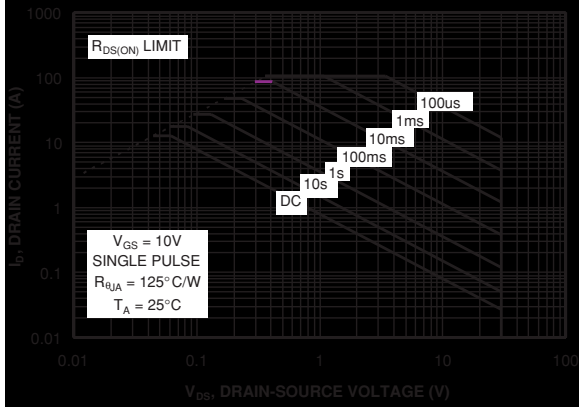


Figure 9. Maximum Safe Operating Area.

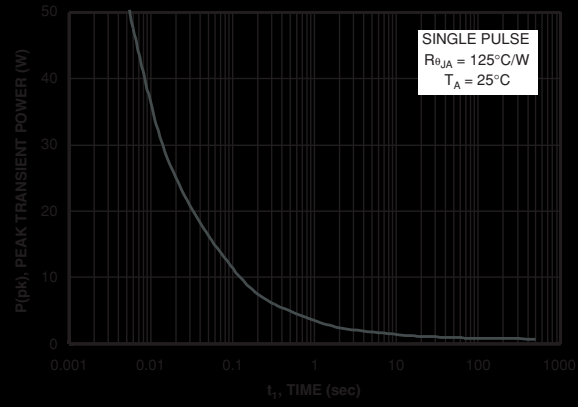


Figure 10. Single Pulse Maximum Power Dissipation.

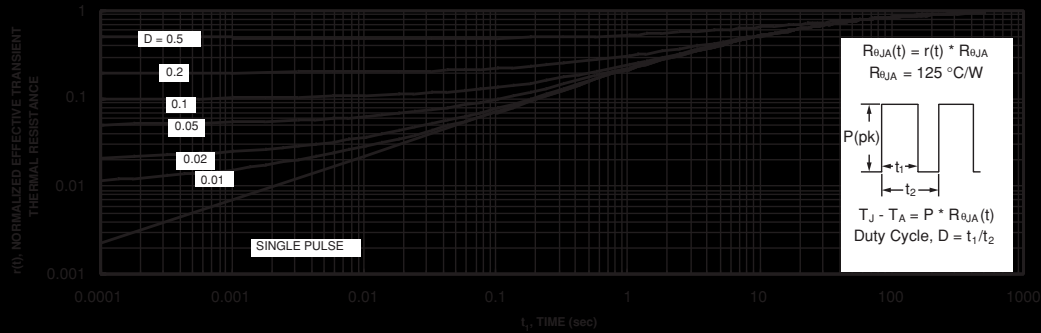


Figure 11. Transient Thermal Response Curve.

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 FDS6699S.

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

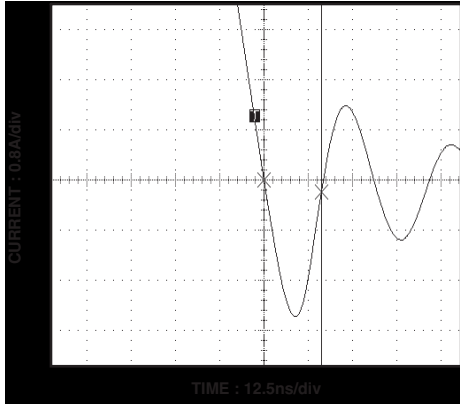


Figure 12. FDS6699S SyncFET body diode reverse recovery characteristic.

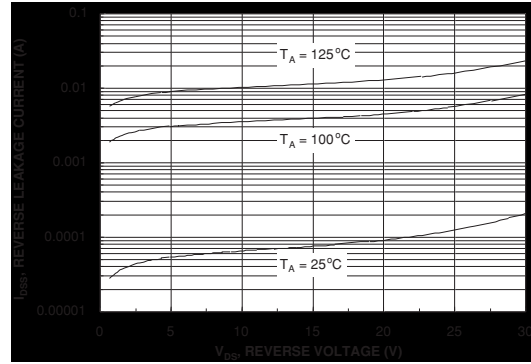


Figure 13. SyncFET body diode reverse leakage versus drain-source voltage and temperature.



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