

# **FDS6299S**

## **30V N-Channel PowerTrench® SyncFET™**

### **General Description**

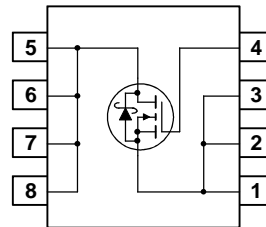
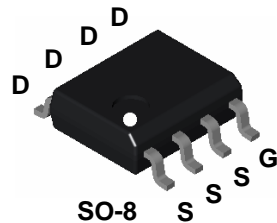
The FDS6299S is designed to replace a single SO-8 MOSFET and Schottky diode in synchronous DC:DC power supplies. This 30V MOSFET is designed to maximize power conversion efficiency, providing a low  $R_{DS(ON)}$  and low gate charge. The FDS6299S includes a patented combination of a MOSFET monolithically integrated with a Schottky diode.

#### **Applications**

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

### **Features**

- 21 A, 30 V.  $R_{DS(ON)} = 3.9\text{ m}\Omega$  @  $V_{GS} = 10\text{ V}$   
 $R_{DS(ON)} = 5.1\text{ m}\Omega$  @  $V_{GS} = 4.5\text{ V}$
- 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
- Termination is Lead-free and RoHS Compliant



### **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	$\pm 20$	V
$I_D$	Drain Current – Continuous (Note 1a) – Pulsed	21	A
		105	
$P_D$	Power Dissipation for Single Operation (Note 1a) (Note 1b) (Note 1c)	2.5	W
		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	$^\circ\text{C/W}$
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case (Note 1)	25	

### **Package Marking and Ordering Information**

Device Marking	Device	Reel Size	Tape width	Quantity
FDS6299S	FDS6299S	13"	12mm	2500 units

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
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**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 $25^\circ\text{C}$		32		mV/ $^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 24\text{ V}, V_{GS} = 0\text{ V}$			500	$\mu\text{A}$
$I_{GSS}$	Gate–Body Leakage	$V_{GS} = \pm 20\text{ V}, V_{DS} = 0\text{ V}$			$\pm 100$	nA

**On Characteristics**

$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 1\text{ mA}$	1	1.7	3	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate Threshold Voltage Temperature Coefficient	$I_D = 1\text{ mA}$ , Referenced to $25^\circ\text{C}$		–4		mV/ $^\circ\text{C}$
$R_{DS(on)}$	Static Drain–Source On–Resistance	$V_{GS} = 10\text{ V}, I_D = 21\text{ A}$ $V_{GS} = 4.5\text{ V}, I_D = 19\text{ A}$ $V_{GS} = 10\text{ V}, I_D = 21\text{ A}, T_J = 125^\circ\text{C}$		3.3 4.1 4.5	3.9 5.1 5.6	m $\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS} = 10\text{ V}, I_D = 21\text{ A}$		94		S

**Dynamic Characteristics**

$C_{iss}$	Input Capacitance	$V_{DS} = 15\text{ V}, V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}$		3880		pF
$C_{oss}$	Output Capacitance			1030		pF
$C_{rss}$	Reverse Transfer Capacitance			310		pF
$R_G$	Gate Resistance	$V_{GS} = 15\text{ mV}, f = 1.0\text{ MHz}$	0.4	1.8	3.1	$\Omega$

**Switching Characteristics (Note 2)**

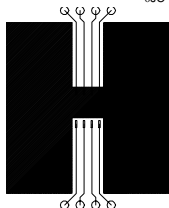
$t_{d(on)}$	Turn–On Delay Time	$V_{DD} = 15\text{ V}, I_D = 1\text{ A}, V_{GS} = 10\text{ V}, R_{GEN} = 6\text{ }\Omega$		12	22	ns
$t_r$	Turn–On Rise Time			12	22	ns
$t_{d(off)}$	Turn–Off Delay Time			60	96	ns
$t_f$	Turn–Off Fall Time			35	56	ns
$Q_{g(TOT)}$	Total Gate Charge at $V_{GS}=10\text{V}$	$V_{DS} = 15\text{ V}, I_D = 21\text{ A}$		58	81	nC
$Q_g$	Total Gate Charge at $V_{GS}=5\text{V}$			31	43	nC
$Q_{gs}$	Gate–Source Charge			11		nC
$Q_{gd}$	Gate–Drain Charge			8		nC

**Drain–Source Diode Characteristics and Maximum Ratings**

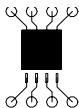
$V_{SD}$	Drain–Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_S = 3.5\text{ A}$ (Note 2)		420	700	mV
$t_{rr}$	Diode Reverse Recovery Time	$I_F = 21\text{ A}, di_F/dt = 300\text{ A}/\mu\text{s}$ (Note 3)		32		ns
$I_{RM}$	Diode Reverse Recovery Current			2.1		A
$Q_{rr}$	Diode Reverse Recovery Charge			34		nC

**Notes:**

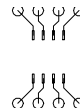
1.  $R_{\theta JA}$  is the sum of the junction-to-case and case-to-ambient thermal resistance where the case thermal reference is defined as the solder mounting surface of the drain pins.  $R_{\theta JC}$  is guaranteed by design while  $R_{\theta CA}$  is determined by the user's board design.



a) 50°/W when mounted on a 1 in<sup>2</sup> pad of 2 oz copper



b) 105°/W when mounted on a .04 in<sup>2</sup> pad of 2 oz copper



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

Scale 1 : 1 on letter size paper

2. Pulse Test: Pulse Width < 300 $\mu\text{s}$ , Duty Cycle < 2.0%.

3. See "SyncFET Schottky body diode characteristics" below.

## Typical Characteristics

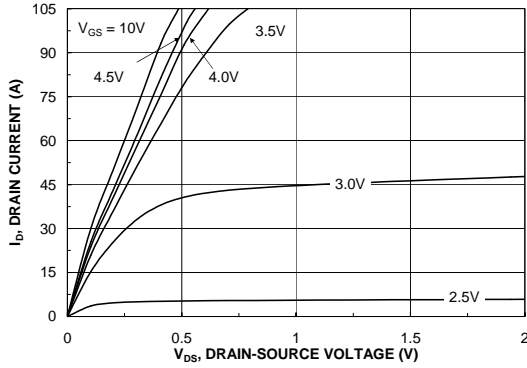


Figure 1. On-Region Characteristics.

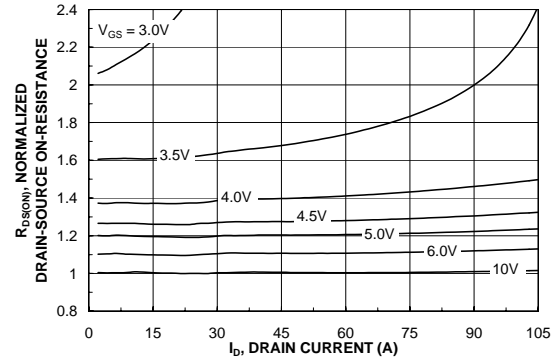


Figure 2. On-Resistance Variation with Drain Current and Gate Voltage.

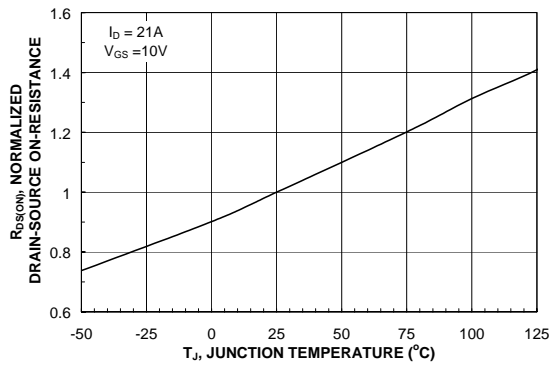


Figure 3. On-Resistance Variation with Temperature.

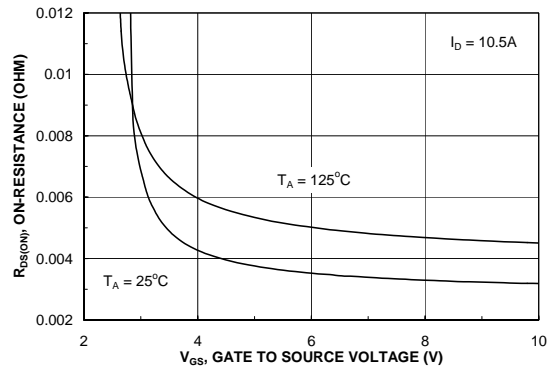


Figure 4. On-Resistance Variation with Gate-to-Source Voltage.

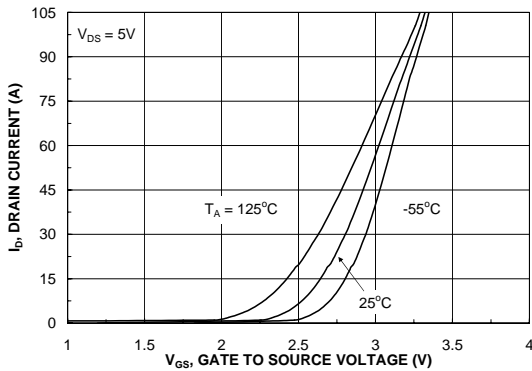


Figure 5. Transfer Characteristics.

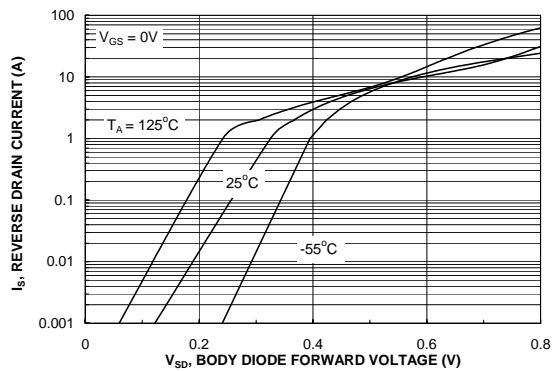


Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature.

# Typical Characteristics (continued)

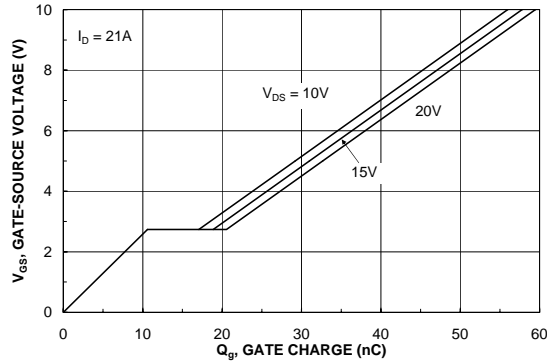


Figure 7. Gate Charge Characteristics.

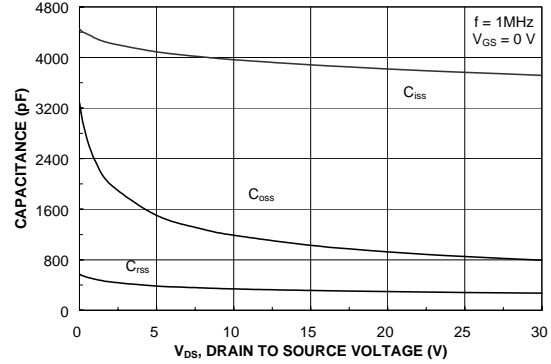


Figure 8. Capacitance Characteristics.

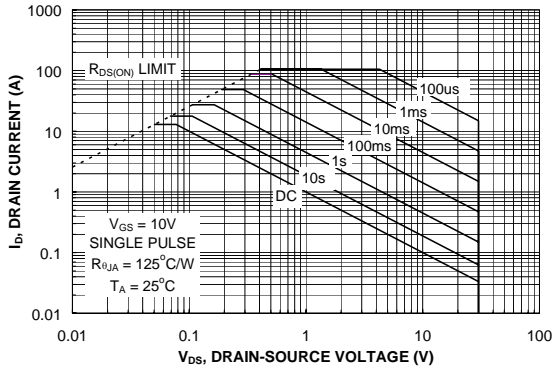


Figure 9. Maximum Safe Operating Area.

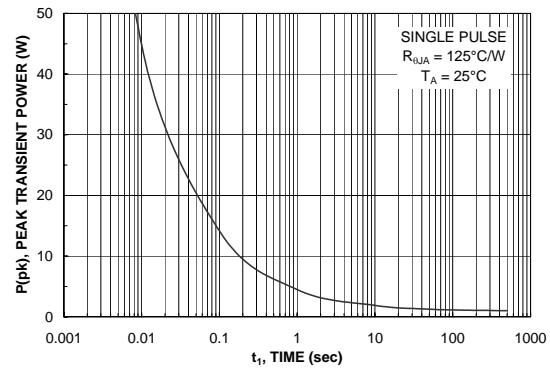


Figure 10. Single Pulse Maximum Power Dissipation.

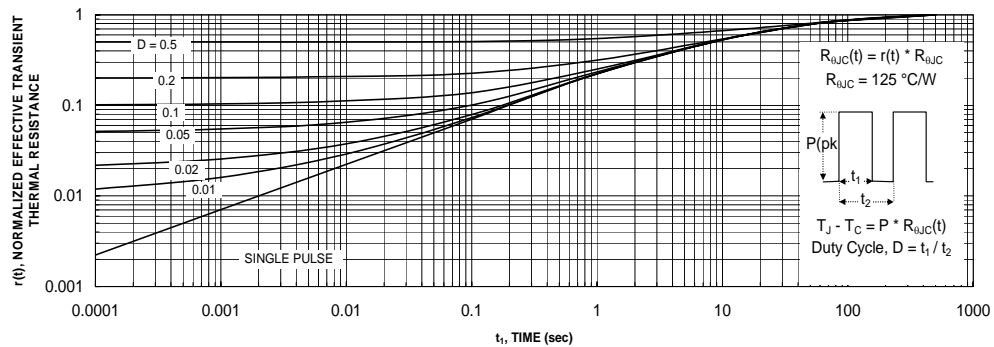


Figure 11. Transient Thermal Response Curve.

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 FDS6299S.

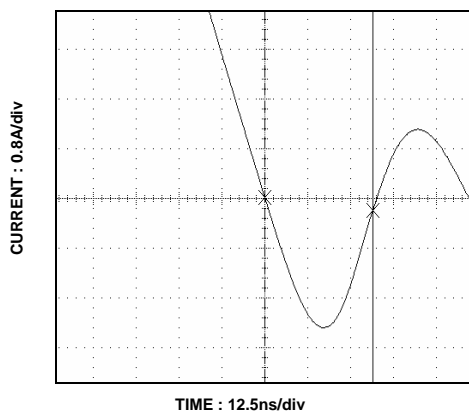


Figure 12. FDS6299S SyncFET body diode reverse recovery characteristic.

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

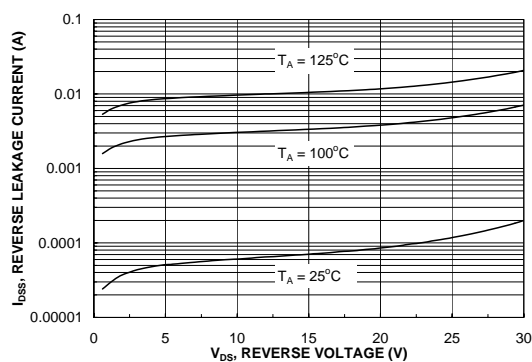


Figure 13. SyncFET body diode reverse leakage versus drain-source voltage and temperature.

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