FAIRCHILD

SEMICONDUCTOR®

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FDS7764S

30V N-Channel PowerTrench® SyncFET™
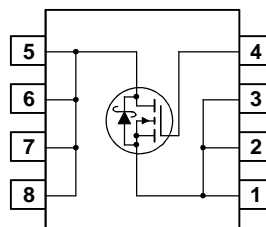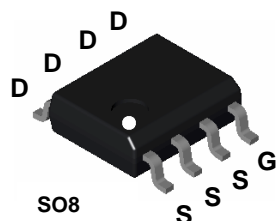
General Description

The FDS7764S 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 FDS7764S includes an integrated Schottky diode using Fairchild's monolithic SyncFET technology.

Applications

- DC/DC converter
- Motor drives

Features

- 13.5 A, 30 V. $R_{DS(ON)} = 7.5\ m\Omega$ @ $V_{GS} = 10$ V
  $R_{DS(ON)} = 9.0\ m\Omega$ @ $V_{GS} = 4.5$ V

- Includes SyncFET Schottky body diode

- Low gate charge (25 nC typical)

- High performance trench technology for extremely low $R_{DS(ON)}$ and fast switching

- High power and current handling capability

SO8

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		±16	V
I_D	Drain Current – Continuous	(Note 1a)	13.5	A
	– Pulsed		50	
P_D	Power Dissipation for Single Operation	(Note 1a)	2.5	W
		(Note 1b)	1.2	
		(Note 1c)	1.0	
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)	50	°C/W
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	(Note 1)	30	

Package Marking and Ordering Information

Device Marking	Device	Reel Size	Tape width	Quantity
FDS7764S	FDS7764S	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		23		mV/°C
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 24$ V, $V_{GS} = 0$ V			500	μA
I_{GSSF}	Gate–Body Leakage, Forward	$V_{GS} = 16$ V, $V_{DS} = 0$ V			100	nA
I_{GSSR}	Gate–Body Leakage, Reverse	$V_{GS} = -16$ 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	0.8	1.4	2	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate Threshold Voltage Temperature Coefficient	$I_D = 10$ mA, Referenced to 25°C		−2		mV/°C
$R_{DS(on)}$	Static Drain–Source On–Resistance	$V_{GS} = 10$ V, $I_D = 13.5$ A $V_{GS} = 4.5$ V, $I_D = 12$ A $V_{GS} = 10$ V, I_D=13.5A, $T_J = 125°C$		6 7 8	7.5 9 10	mΩ
g_{FS}	Forward Transconductance	$V_{DS} = 10$ V, $I_D = 13.5$ A		72		S
Dynamic Characteristics						
C_{iss}	Input Capacitance	$V_{DS} = 15$ V, $V_{GS} = 0$ V, f = 1.0 MHz		2800		pF
C_{oss}	Output Capacitance			530		pF
C_{rss}	Reverse Transfer Capacitance			195		pF
R_G	Gate Resistance	$V_{GS} = 15$ mV, f = 1.0 MHz		1.4		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		9	18	ns
t_r	Turn–On Rise Time			7	14	ns
$t_{d(off)}$	Turn–Off Delay Time			46	74	ns
t_f	Turn–Off Fall Time			16	29	ns
Q_g	Total Gate Charge	$V_{DS} = 15$ V, $I_D = 13.5$ A, $V_{GS} = 5$ V		25	35	nC
Q_{gs}	Gate–Source Charge			6		nC
Q_{gd}	Gate–Drain Charge			6		nC

FDS7764S

Electrical Characteristics $T_A = 25°C$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
Drain–Source Diode Characteristics and Maximum Ratings						
I_S	Maximum Continuous Drain–Source Diode Forward Current				3.5	A
V_{SD}	Drain–Source Diode Forward Voltage	$V_{GS} = 0$ V, $I_S = 3.5$ A (Note 2)		450	700	mV
t_{rr}	Diode Reverse Recovery Time	$I_F = 3.5$ A,		25		ns
Q_{rr}	Diode Reverse Recovery Charge	$d_{iF}/d_t = 300$ A/µs (Note 2)		40		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 1in^2 pad of 2 oz copper

b) 105°/W when mounted on a .04 in^2 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 < 300µs, Duty Cycle < 2.0%

FDS7764S Rev D (W)
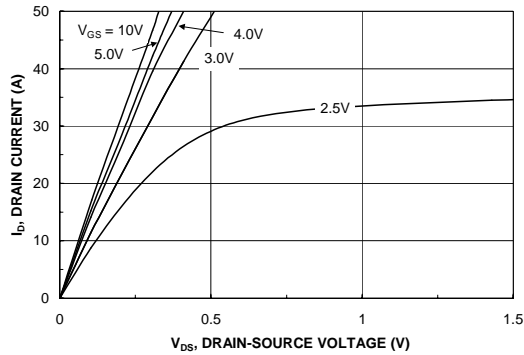
Typical Characteristics

Figure 1. On-Region Characteristics.
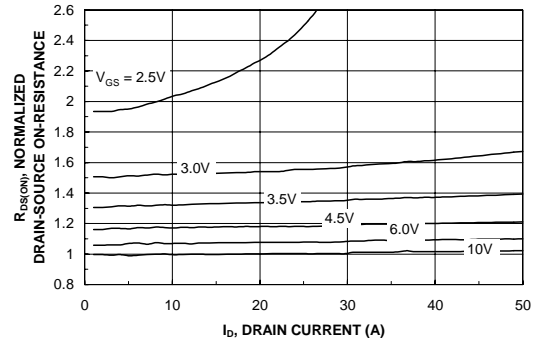

Figure 2. On-Resistance Variation with Drain Current and Gate Voltage.
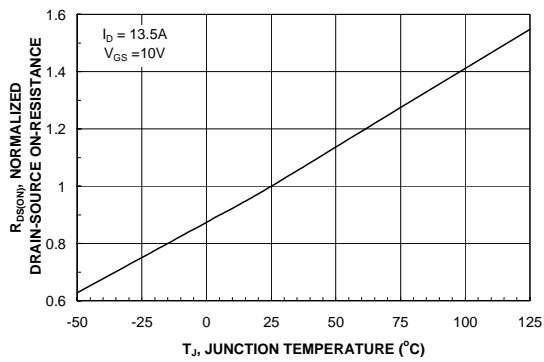

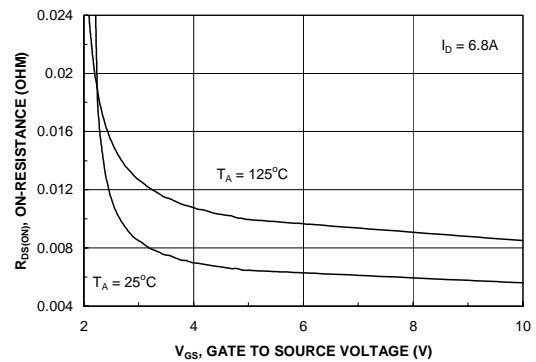**Figure 3. On-Resistance Variation withTemperature.**

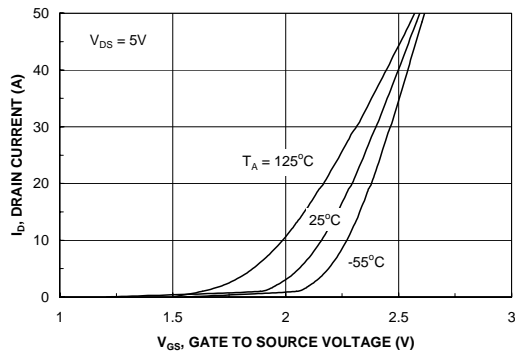**Figure 4. On-Resistance Variation with Gate-to-Source Voltage.**

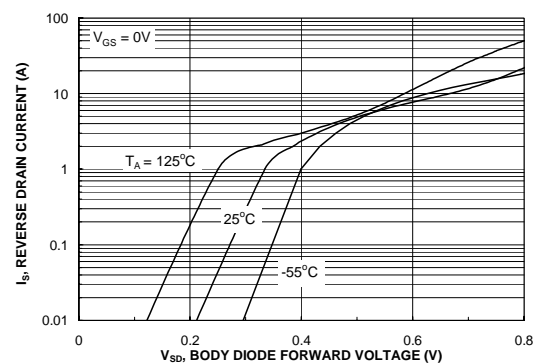**Figure 5. Transfer Characteristics.**

Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature.
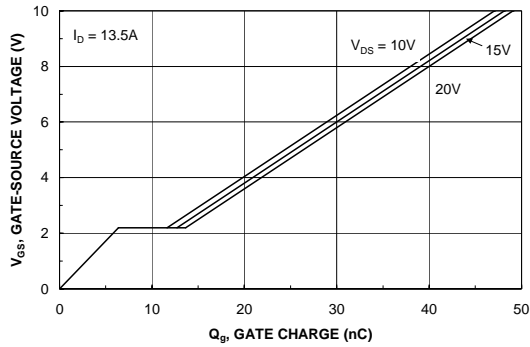
Typical Characteristics
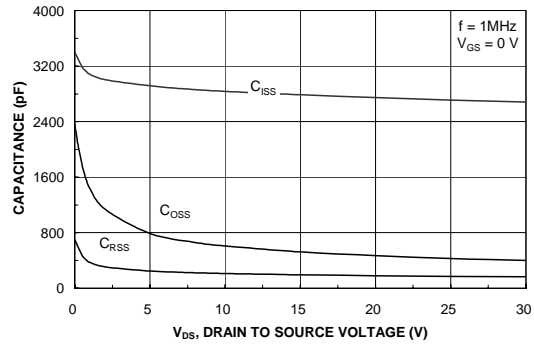
Figure 7. Gate Charge Characteristics.
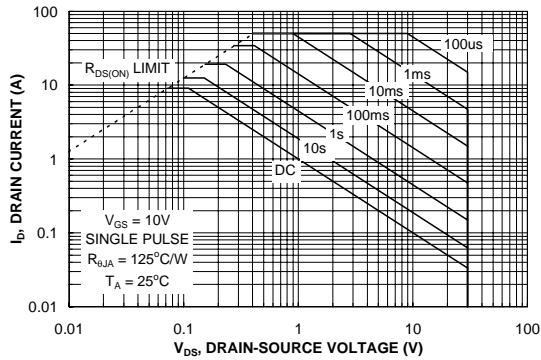
Figure 8. Capacitance Characteristics.

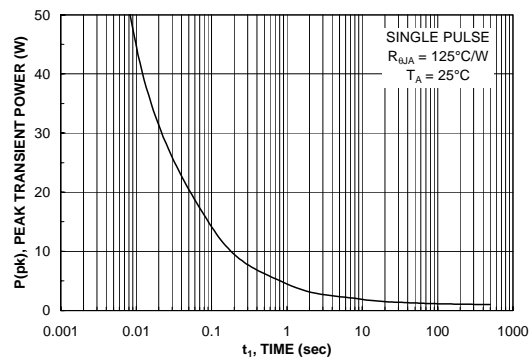**Figure 9. Maximum Safe Operating Area.**

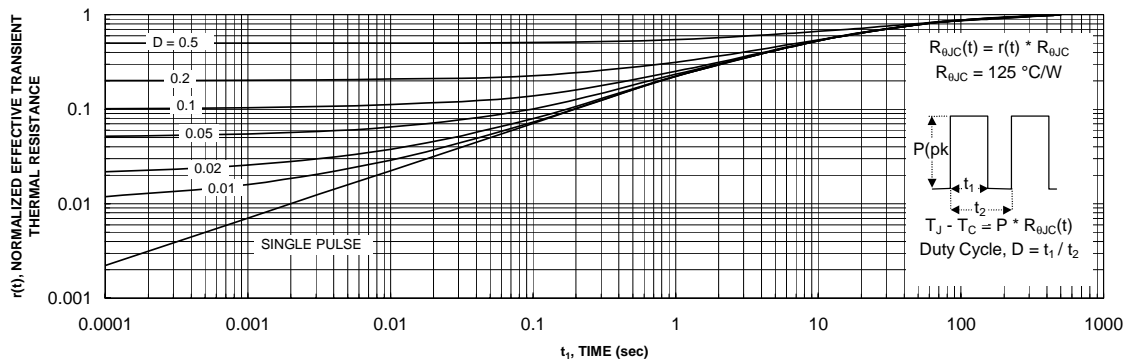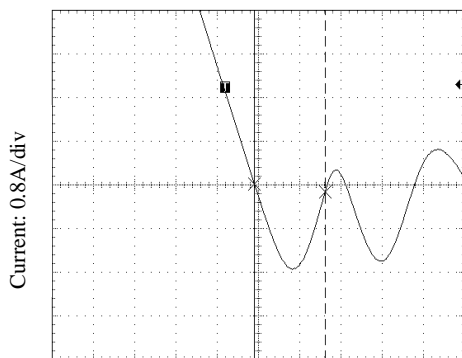**Figure 10. Single Pulse Maximum Power Dissipation.**

Figure 11. Transient Thermal Response Curve.

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

Typical Characteristics (continued)

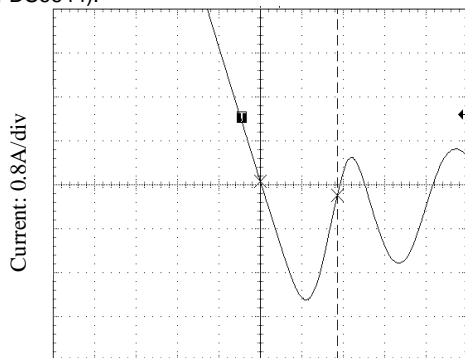### SyncFET Schottky Body Diode Characteristics

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 FDS7764S.

Current: 0.8A/div

Time: 12.5ns/div

Figure 12. FDS7764S 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 (FDS6644).

Current: 0.8A/div

Time: 12.5ns/div

Figure 13. Non-SyncFET (FDS6644) 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.
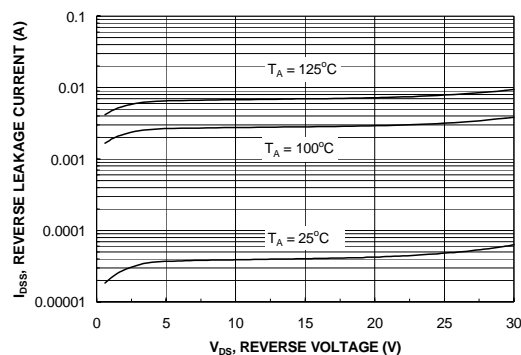
I_{DSS}, REVERSE LEAKAGE CURRENT (A)

$T_A = 125^oC$

$T_A = 100^oC$

$T_A = 25^oC$

V_{DS}, REVERSE VOLTAGE (V)

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

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