FAIRCHILD
SEMICONDUCTOR®

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FDD6676AS

## 30V N-Channel PowerTrench® SyncFET™

General Description

The FDD6676AS is designed to replace a single 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 FDD6676AS includes a patented combination of a MOSFET monolithically integrated with a Schottky diode using Fairchild's monolithic SyncFET technology.

Applications

- DC/DC converter
- Low side notebook

Features

- 90 A, 30 V $R_{DS(ON)}$ = 5.7 mΩ @ V_{GS} = 10 V
  $R_{DS(ON)}$ = 7.1 mΩ @ V_{GS} = 4.5 V

- Includes SyncFET schottky body diode

- Low gate charge (46nC typical)

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

- High power and current handling capability

- RoHS Compliant

**D-PAK
(TO-252)**
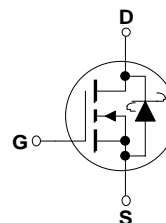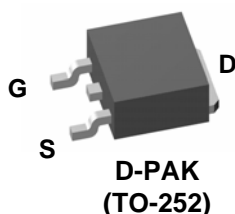
Absolute Maximum Ratings T_A=25°C unless otherwise noted

Symbol	Parameter		Ratings	Units
V_{DSS}	Drain-Source Voltage		30	V
V_{GSS}	Gate-Source Voltage		±20	V
I_D	Drain Current – Continuous	(Note 3)	90	A
	– Pulsed	(Note 1a)	100	
P_D	Power Dissipation for Single Operation	(Note 1)	70	W
		(Note 1a)	3.1	
		(Note 1b)	1.3	
T_J, T_{STG}	Operating and Storage Junction Temperature Range		−55 to +150	°C

Thermal Characteristics

$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	(Note 1)	1.8	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	(Note 1a)	40	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	(Note 1b)	96	°C/W

Package Marking and Ordering Information

Device Marking	Device	Reel Size	Tape width	Quantity
FDD6676AS	FDD6676AS	13''	12mm	2500 units

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Electrical Characteristics

$T_A = 25°C$ unless otherwise noted

| Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
Drain-Source Avalanche Ratings (Note 2)						
W_{DSS}	Drain-Source Avalanche Energy	Single Pulse, $V_{DD} = 15$ V, $I_D = 16A$		108	250	mJ
I_{AR}	Drain-Source Avalanche Current				16	A
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		31		mV/°C
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 24$ V, $V_{GS} = 0$ V			500	μA
		$V_{DS} = 24$ V, $V_{GS} = 0$ V, $T_J = 125°C$		11		mA
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	1.5	3	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate Threshold Voltage Temperature Coefficient	$I_D = 10$ mA, Referenced to 25°C		–3.6		mV/°C
$R_{DS(on)}$	Static Drain–Source On–Resistance	$V_{GS} = 10$ V, $I_D = 16$ A $V_{GS} = 4.5$ V, $I_D = 15$ A $V_{GS} = 10$ V, $I_D = 16$ A, $T_J = 125°C$		4.7 5.8 6.7	5.7 7.1 8.4	mΩ
g_{FS}	Forward Transconductance	$V_{DS} = 5$ V, $I_D = 16$ A		61		S
Dynamic Characteristics						
C_{iss}	Input Capacitance	$V_{DS} = 15$ V, $V_{GS} = 0$ V, $f = 1.0$ MHz		2500		pF
C_{oss}	Output Capacitance			710		pF
C_{rss}	Reverse Transfer Capacitance			270		pF
R_G	Gate Resistance	$V_{GS} = 0$ V, $f = 1.0$ MHz		1.6		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	21	ns
t_r	Turn–On Rise Time			12	22	ns
$t_{d(off)}$	Turn–Off Delay Time			46	74	ns
t_f	Turn–Off Fall Time			28	44	ns
$t_{d(on)}$	Turn–On Delay Time	$V_{DD} = 15$ V, $I_D = 1$ A, $V_{GS} = 4.5$ V, $R_{GEN} = 6$ Ω		20	32	ns
t_r	Turn–On Rise Time			24	38	ns
$t_{d(off)}$	Turn–Off Delay Time			35	56	ns
t_f	Turn–Off Fall Time			27	43	ns
$Q_{g(TOT)}$	Total Gate Charge, Vgs = 10V	$V_{DS} = 15$ V, $I_D = 16$ A		46	64	nC
Q_g	Total Gate Charge, Vgs = 5V			25	35	nC
Q_{gs}	Gate–Source Charge			7		nC
Q_{gd}	Gate–Drain Charge			9		nC

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Electrical Characteristics (continued) 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)		0.4	0.7	V
t_{RR}	Diode Reverse Recovery Time			25		ns
I_{RM}	Maximum Recovery Current	dI_F/dt = 300A/us, I_F = 16A		1.9		A
Q_{RR}	Diode Reverse Recovery Charge			24		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.
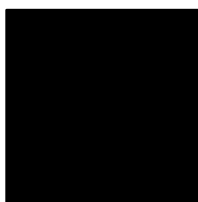
a) $R_{\theta JA}$ = 40°C/W when mounted on a 1in^2 pad of 2 oz copper

b) $R_{\theta JA}$ = 96°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. Maximum current is calculated as: $\sqrt{\dfrac{P_D}{R_{DS(ON)}}}$

where P_D is maximum power dissipation at T_C = 25°C and $R_{DS(on)}$ is at $T_{J(max)}$ and V_{GS} = 10V. Package current limitation is 21A

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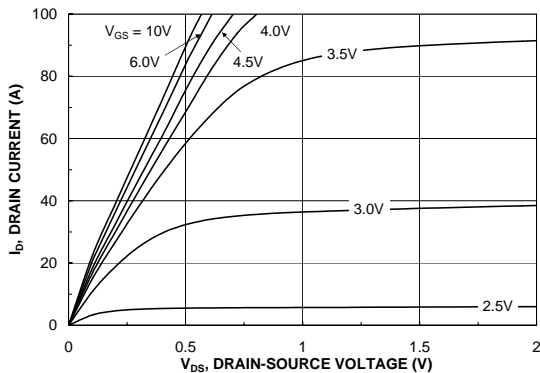## Typical Characteristics

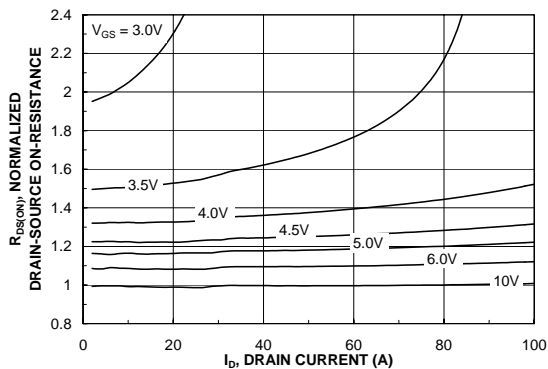Figure 1. On-Region Characteristics

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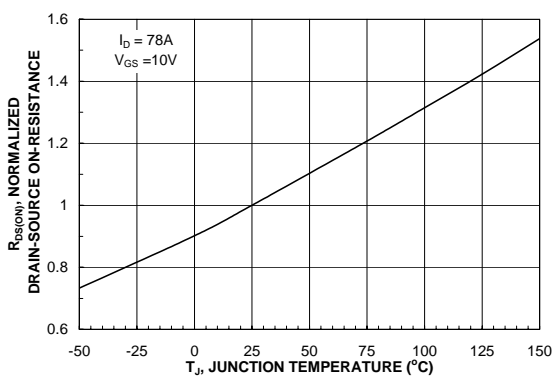Drain Current and Gate Voltage

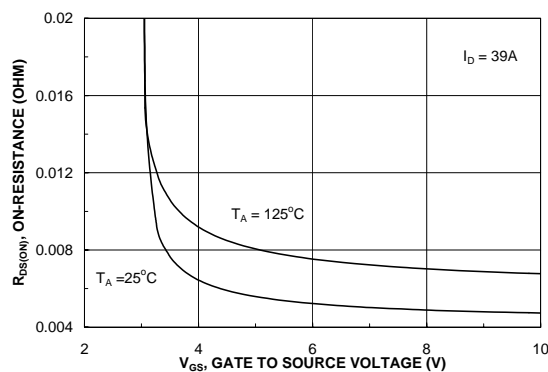Figure 3. On-Resistance Variation
with Temperature

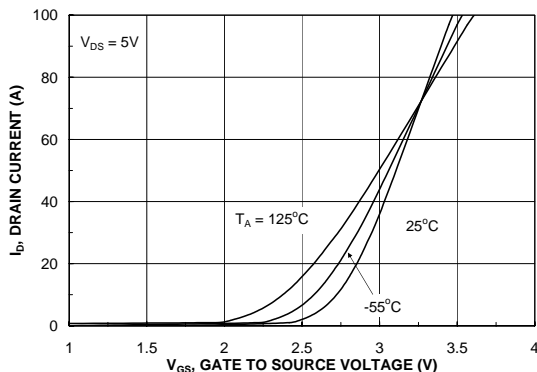Figure 4. On-Resistance Variation with
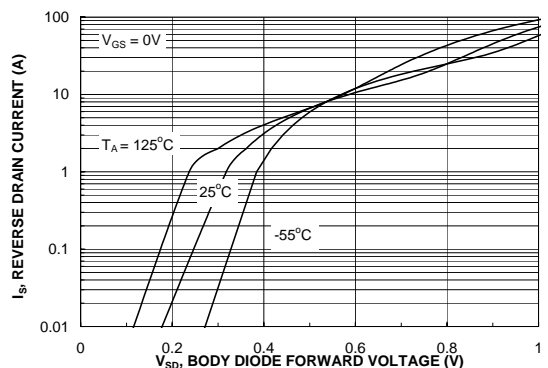Gate-to-Source Voltage

Figure 5. Transfer Characteristics

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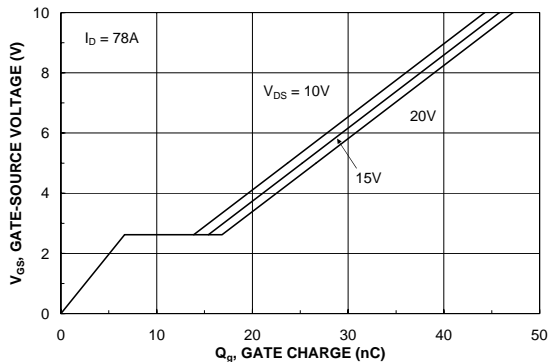with Source Current and Temperature

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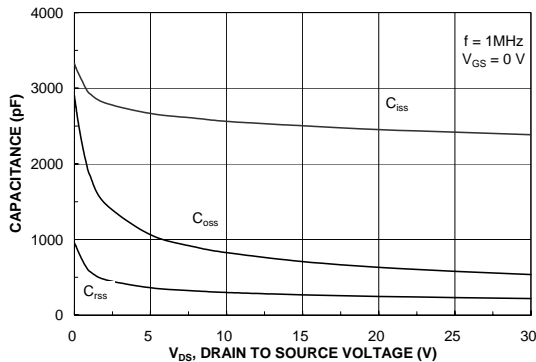
Typical Characteristics

Figure 7. Gate Charge Characteristics
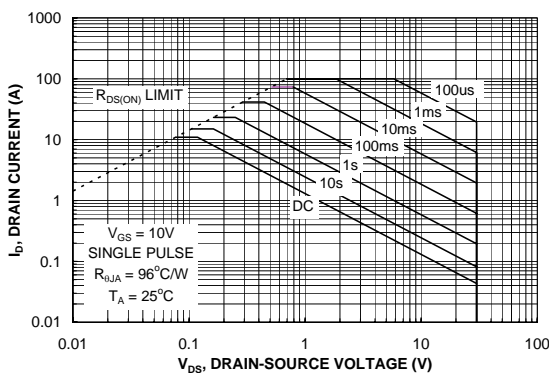

Figure 8. Capacitance Characteristics
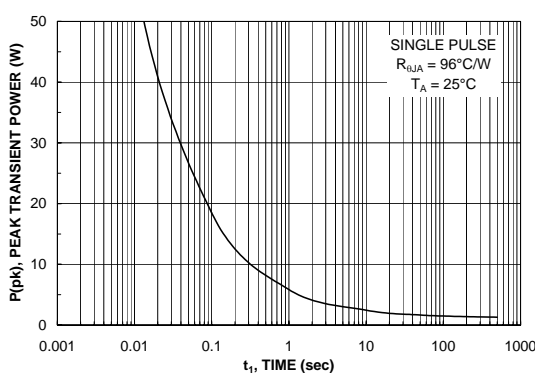

Figure 9. Maximum Safe Operating Area

Figure 10. Single Pulse Maximum Power Dissipation

$$R_{\theta JA}(t) = r(t) * R_{\theta JA}$$
$$R_{\theta JA} = 96°C/W$$
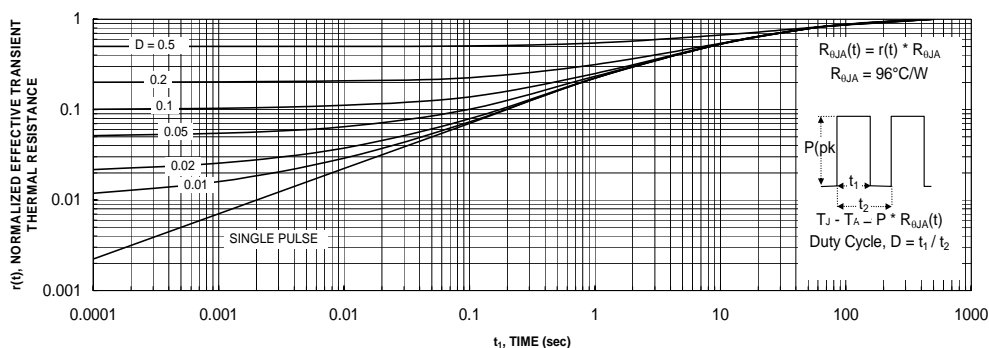
$$T_J - T_A = P * R_{\theta JA}(t)$$
Duty Cycle, D = t_1 / t_2

Figure 11. Transient Thermal Response Curve

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

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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 FDD6676AS.


TIME : 12.5ns/div
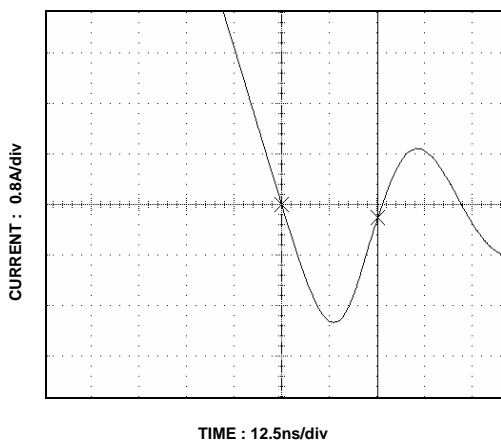
Figure 12. FDD6676AS SyncFET body diode reverse recovery characteristic.

For comparison purposes, Figure 13 shows the reverse recovery characteristics of the body diode of an equivalent size MOSFET produced without SyncFET (FDD6676A).

TIME : 12.5ns/div
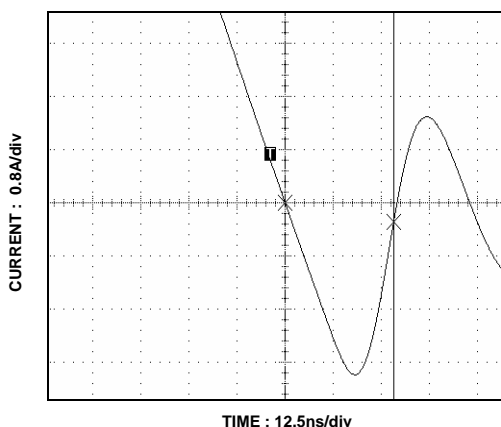
Figure 13. Non-SyncFET (FDD6676A) body diode reverse recovery characteristic.

Schottky barrier diodes exhibit significant leakage at high temperature and high reverse voltage. This will increase the power in the device.
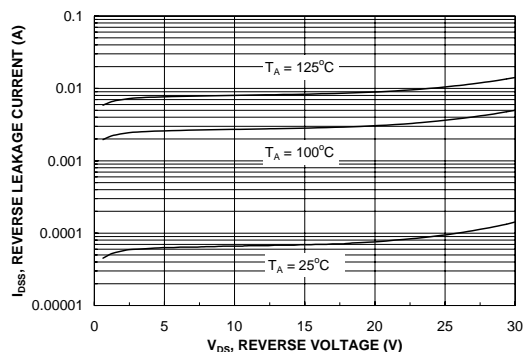
Figure 14. SyncFET body diode reverse leakage versus drain-source voltage and temperature.
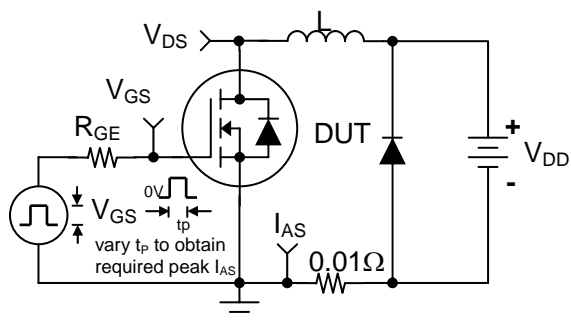
Typical Characteristics

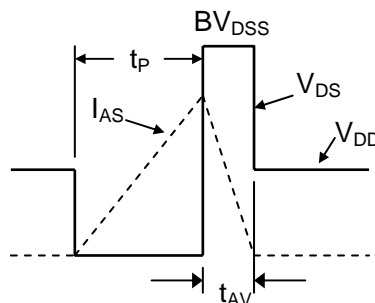Figure 15. Unclamped Inductive Load Test Circuit

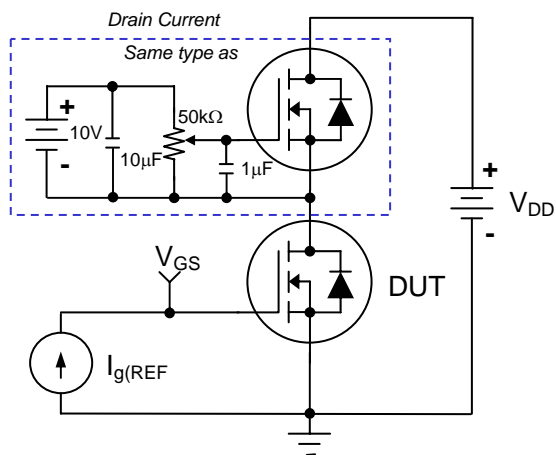
Figure 16. Unclamped Inductive Waveforms
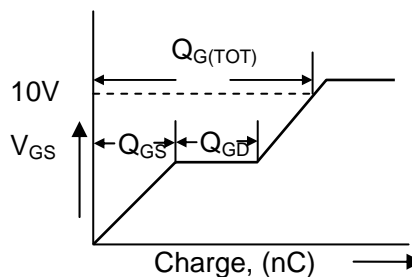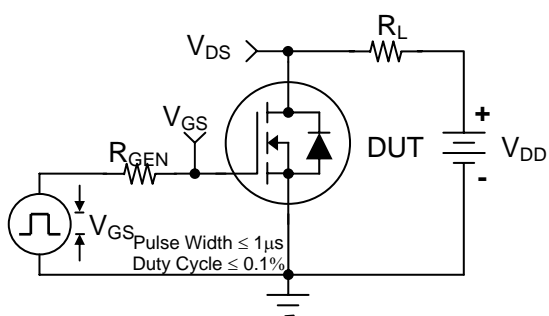

Figure 17. Gate Charge Test Circuit

Figure 18. Gate Charge Waveform

Figure 19. Switching Time Test Circuit
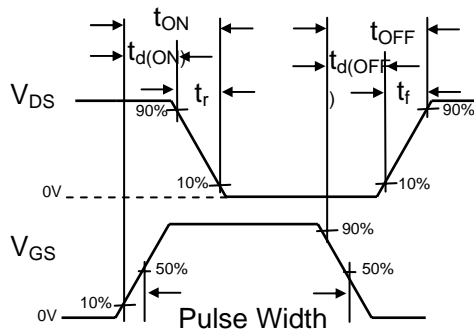
Figure 20. Switching Time Waveforms

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