FAIRCHILD SEMICONDUCTOR®

September 2005

FDU6676AS

FDU6676AS

N-Channel PowerTrench® SyncFET™
30V, 90A, 5.8mΩ

General Description

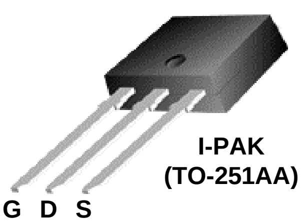
The FDU6676AS is designed to replace a single MOSFET and Schottky diode in synchronous DC/DC power supplies. This 30V MOSFET is designed to maximize power conversion efficiency, providing a low $R_{DS(ON)}$ and low gate charge. The FDU6676AS includes a patented combination of a MOSFET monolithically integrated with a Schottky diode using Fairchild's monolithic SyncFET technology.

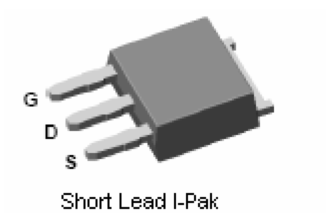
Applications

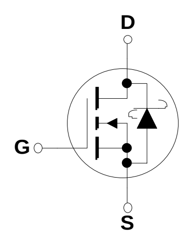
- DC/DC converter

Features

- $R_{DS(ON)}$ = 5.8mΩ Max, VGS = 10V
- $R_{DS(ON)}$ = 7.3mΩ Max, VGS = 4.5V
- High performance trench technology for extremely low $R_{DS(ON)}$
- Low Gate Charge
- High power and current handling capability
- Includes SyncFET 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)	90	A
	–Pulsed		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)	45	
$R_{\theta JA}$	Thermal Resistance junction to Ambient	(Note 1b)	96	

Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape width	Quantity
FDU6676AS	FDU6676AS	I-PAK (TO-251)	Tube	N/A	75
FDU6676AS	FDU6676AS_NL (Note 4)	I-PAK (TO-251)	Tube	N/A	75
FDU6676AS	FDU6676AS_F071 (Note 5)	I-PAK (TO-251)	Tube	N/A	75

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} = 15V, 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 = 250 μA	30			V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	I_D = 250 μA, Referenced to 25°C		29		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		13		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 = 250 μA	1	1.5	3	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate Threshold Voltage Temperature Coefficient	I_D = 250 μA, Referenced to 25°C		–4		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 = 10 A V_{GS} = 10 V, I_D = 16 A, T_J=125°C		4.8 5.8 7.7	5.8 7.3 9.6	mΩ
g_{FS}	Forward Transconductance	V_{DS} = 10 V, I_D = 16 A		67		S
Dynamic Characteristics						
C_{iss}	Input Capacitance	V_{DS} = 15 V, V_{GS} = 0 V, f = 1.0 MHz		2470		pF
C_{oss}	Output Capacitance			710		pF
C_{rss}	Reverse Transfer Capacitance			260		pF
R_G	Gate Resistance	V_{GS} = 100 mV, f = 1.0 MHz		1.8		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	22	ns
t_r	Turn–On Rise Time			12	22	ns
$t_{d(off)}$	Turn–Off Delay Time			50	80	ns
t_f	Turn–Off Fall Time			25	40	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			34	54	ns
t_f	Turn–Off Fall Time			26	42	ns
Q_g	Total Gate Charge, V_{GS} = 10V	V_{DS} = 15V, I_D = 16 A		46	64	nC
Q_g	Total Gate Charge, V_{GS} = 5V			25	35	nC
Q_{gs}	Gate–Source Charge			6		nC
Q_{gd}	Gate–Drain Charge			7		nC

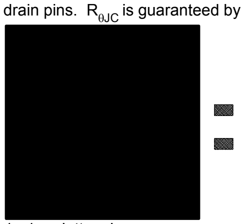
Electrical Characteristics

T_A = 25°C unless otherwise noted

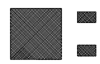
Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
Drain–Source Diode Characteristics and Maximum Ratings						
I_S	Maximum Continuous Drain–Source Diode Forward Current				2.3	A
V_{SD}	Drain–Source Diode Forward Voltage	V_{GS} = 0 V, I_S = 2.3 A (Note 2)		0.4	1.2	V
t_{rr}	Diode Reverse Recovery Time	I_F = 16 A, dI_F/dt = 100 A/µs		28		ns
Q_{rr}	Diode Reverse Recovery Charge			19		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) $R_{\theta JA}$ = 45°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: $\sqrt{\frac{P_D}{R_{DS(ON)}}}$

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

4. FDU6676AS_NL is a lead free product. The FDU6676AS_NL marking will appear on the reel label.

5. FDU6676AS_F071 is a lead free product. The FDU6676AS_F071 marking will appear on the reel label.

Typical Characteristics

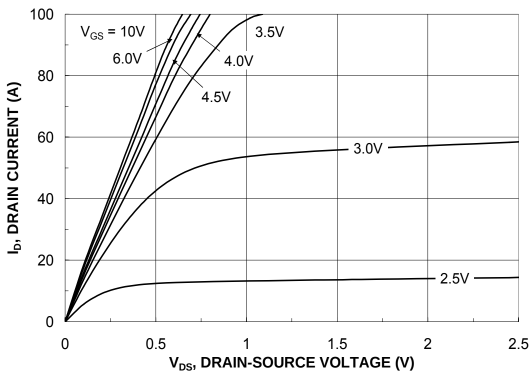


Figure 1. On-Region Characteristics

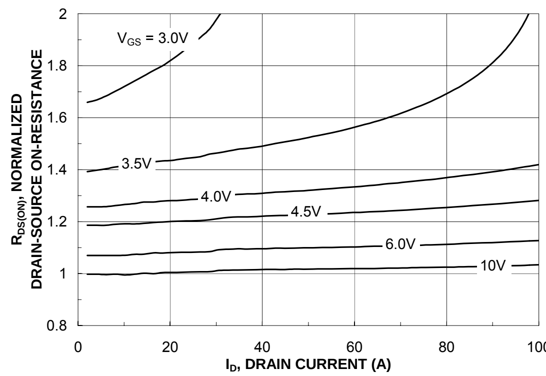


Figure 2. On-Resistance Variation with Drain Current and Gate Voltage

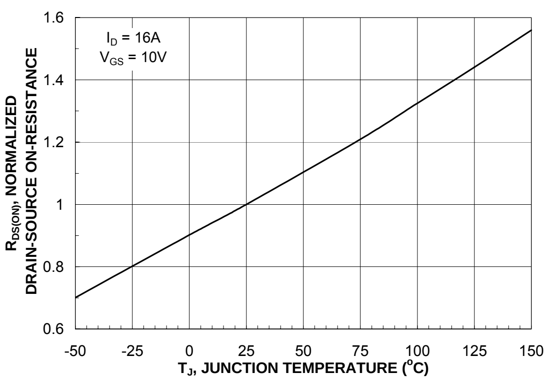


Figure 3. On-Resistance Variation with Temperature

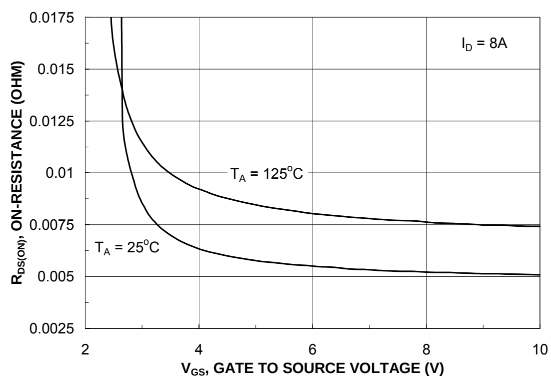


Figure 4. On-Resistance Variation with Gate-to-Source Voltage

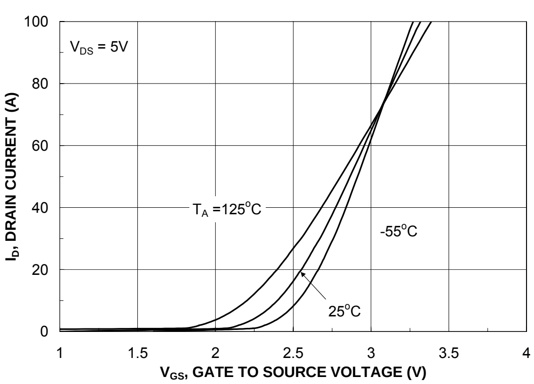


Figure 5. Transfer Characteristics

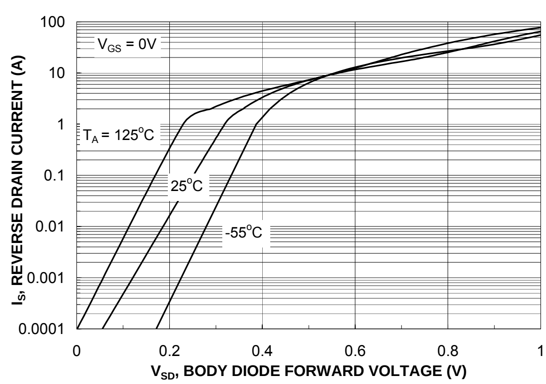


Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature

Typical Characteristics

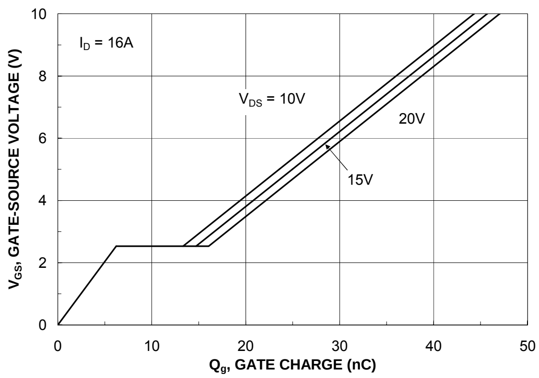


Figure 7. Gate Charge Characteristics

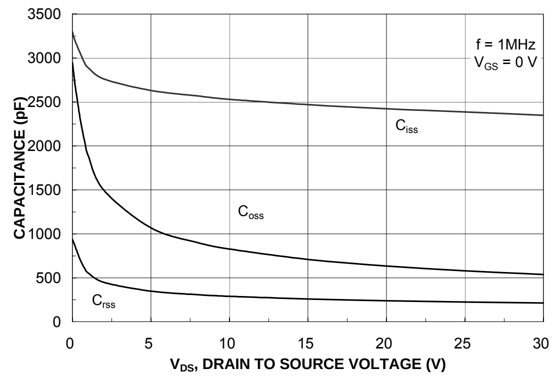


Figure 8. Capacitance Characteristics

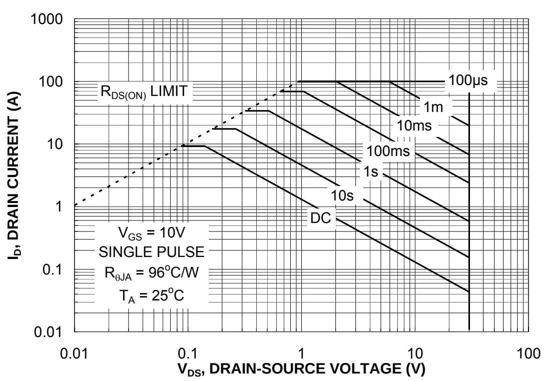


Figure 9. Maximum Safe Operating Area

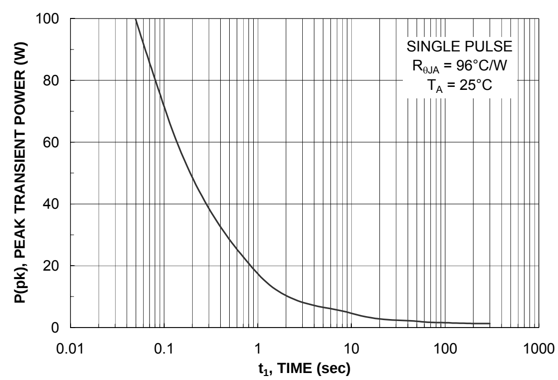


Figure 10. Single Pulse Maximum Power Dissipation

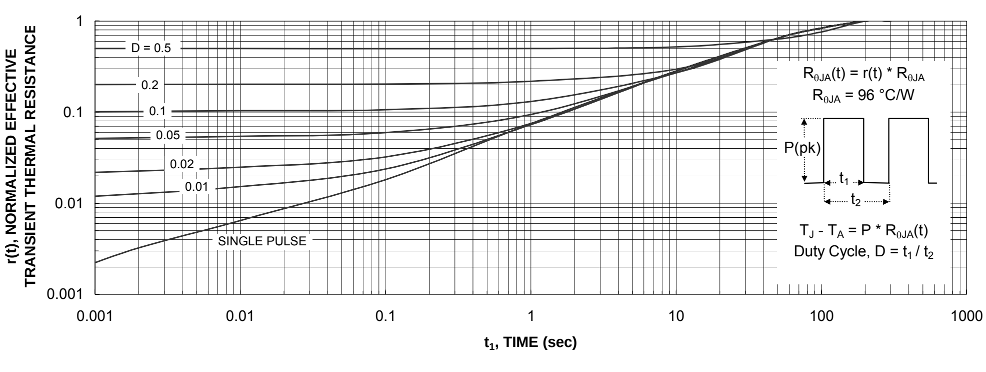


Figure 11. Transient Thermal Response Curve

Thermal characterization performed using the conditions described in Note 1b.
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 FDU6676AS.

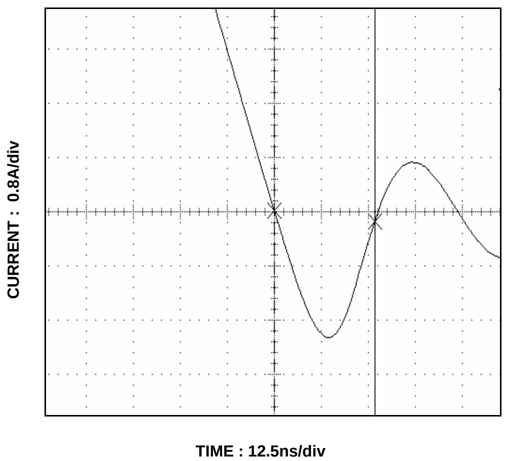


Figure 12. FDU6676AS SyncFET Body Diode Reverse Recovery Characteristic.

For comparison purposes, Figure 13 shows the reverse recovery characteristics of the body diode of an equivalent size MOSFET produced without SyncFET (FDU6676A).

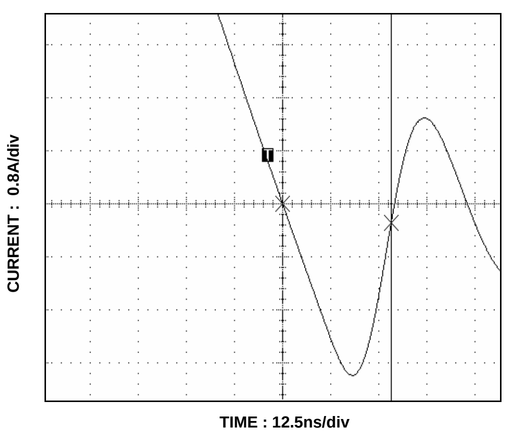


Figure 13. Non-SyncFET (FDU6676A) Body Biode Reverse Recovery Characteristic.

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

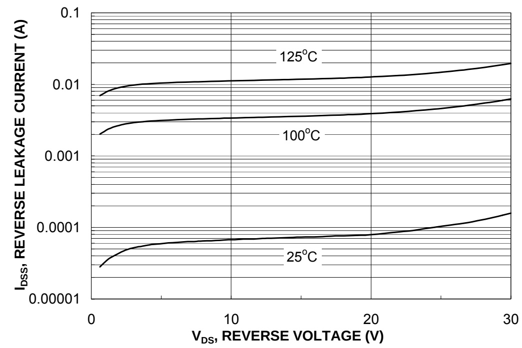


Figure 14. SyncFET Body Diode Reverse Leakage Versus Drain-Source Voltage and Temperature.

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Rev. I17

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