FAIRCHILD
SEMICONDUCTOR®

December 2006

FDMS8670S
N-Channel PowerTrench® SyncFET™
30V, 42A, 3.5mΩ

Features

- Max $r_{DS(on)}$ = 3.5mΩ at V_{GS} = 10V, I_D = 20A

- Max $r_{DS(on)}$ = 5.0mΩ at V_{GS} = 4.5V, I_D = 17A

- Advanced Package and Silicon combination for low $r_{DS(on)}$ and high efficiency

- SyncFET Schottky Body Diode

- MSL1 robust package design

- RoHS Compliant

General Description

The FDMS8670S has been designed to minimize losses in power conversion application. Advancements in both silicon and package technologies have been combined to offer the lowest $r_{DS(on)}$ while maintaining excellent switching performance. This device has the added benefit of an efficient monolithic Schottky body diode.

Application

- Synchronous Rectifier for DC/DC Converters
- Notebook Vcore/ GPU low side switch
- Networking Point of Load low side switch
- Telecom secondary side rectification

Pin 1

S S S G

D D D D

Power 56 (Bottom view)

D	5		4	G
D	6		3	G
D	7		2	G
D	8		1	S
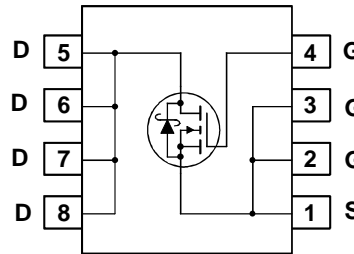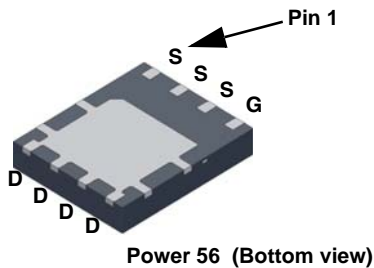
MOSFET Maximum Ratings T_A = 25°C unless otherwise noted

Symbol	Parameter		Ratings	Units
V_{DS}	Drain to Source Voltage		30	V
V_{GS}	Gate to Source Voltage		±20	V
I_D	Drain Current -Continuous (Package limited)	T_C = 25°C	42	A
	-Continuous (Silicon limited)	T_C = 25°C	116	
	-Continuous	T_A = 25°C	20	
	-Pulsed		200	
P_D	Power Dissipation	T_C = 25°C	78	W
	Power Dissipation	T_A = 25°C (Note 1a)	2.5	
T_J, T_{STG}	Operating and Storage Junction Temperature Range		-55 to +150	°C

Thermal Characteristics

$R_{\theta JC}$	Thermal Resistance, Junction to Case		1.6	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	(Note 1a)	50	

Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FDMS8670S	FDMS8670S	Power 56	7"	12mm	3000 units

Electrical Characteristics T_J = 25°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
Off Characteristics						
BV_{DSS}	Drain to Source Breakdown Voltage	I_D = 1mA, V_{GS} = 0V	30			V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	I_D = 50mA, referenced to 25°C		17		mV/°C
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 24V, V_{GS} = 0V			500	μA
I_{GSS}	Gate to Source Leakage Current	V_{GS} = ±20V, V_{DS} = 0V			±100	nA
On Characteristics						
$V_{GS(th)}$	Gate to Source Threshold Voltage	V_{GS} = V_{DS}, I_D = 1mA	1	1.5	3	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate to Source Threshold Voltage Temperature Coefficient	I_D = 50mA, referenced to 25°C		-2.8		mV/°C
$r_{DS(on)}$	Drain to Source On Resistance	V_{GS} = 10V, I_D = 20A		2.8	3.5	mΩ
		V_{GS} = 4.5V, I_D = 17A		3.6	5.0	
		V_{GS} = 10V, I_D = 20A ,T_J = 125°C		3.9	6.0	
g_{FS}	Forward Transconductance	V_{DS} = 10V, I_D = 20A		98		S
Dynamic Characteristics						
C_{iss}	Input Capacitance	V_{DS} = 15V, V_{GS} = 0V f = 1MHz		3005	4000	pF
C_{oss}	Output Capacitance			865	1150	pF
C_{rss}	Reverse Transfer Capacitance			320	480	pF
R_g	Gate Resistance	f = 1MHz		1.4	5.0	Ω
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	V_{DD} = 15V, I_D = 20A V_{GS} = 10V, R_{GEN} = 5Ω		14	26	ns
t_r	Rise Time			19	35	ns
$t_{d(off)}$	Turn-Off Delay Time			37	60	ns
t_f	Fall Time			10	20	ns
$Q_{g(TOT)}$	Total Gate Charge at 10V	V_{GS} = 0V to 10V		52	73	nC
$Q_{g(4.5V)}$	Total Gate Charge at 4.5V	V_{GS} = 0V to 4.5V V_{DS} = 15V		24	34	nC
Q_{gs}	Gate to Source Gate Charge	I_D = 20A		8		nC
Q_{gd}	Gate to Drain "Miller" Charge			10		nC
Drain-Source Diode Characteristics						
V_{SD}	Source to Drain Diode Forward Voltage	V_{GS} = 0V, I_S = 2A		0.4	0.7	V
t_{rr}	Reverse Recovery Time	I_F = 20A, di/dt = 300A/μs		26	42	ns
Q_{rr}	Reverse Recovery Charge			24	39	nC

Notes:
1: $R_{\theta JA}$ is determined with the device mounted on a 1in^2 pad 2 oz copper pad on a 1.5 x 1.5 in. board of FR-4 material. $R_{\theta JC}$ is guaranteed by design while $R_{\theta CA}$ is determined by the user's board design.
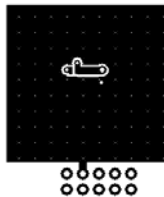
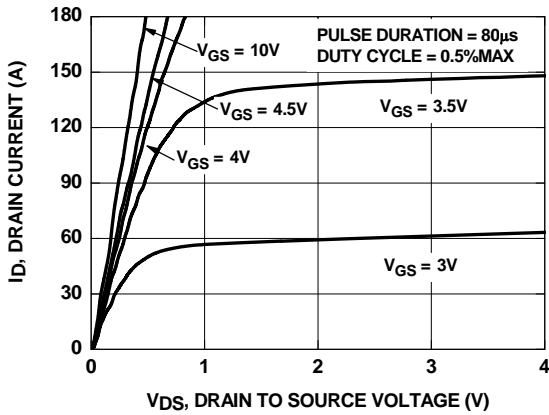a. 50°C/W when mounted on a 1 in^2 pad of 2 oz copper

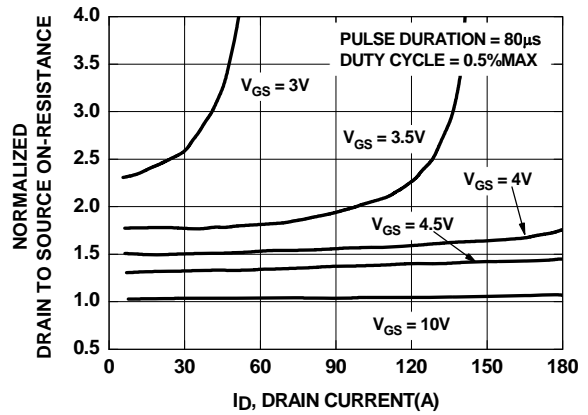b. 125°C/W when mounted on a minimum pad of 2 oz copper

2: Pulse time < 300μs, Duty cycle < 2%.

Typical Characteristics $T_J = 25°C$ unless otherwise noted

Figure 1. On Region Characteristics

PULSE DURATION = 80µs
DUTY CYCLE = 0.5%MAX

$V_{GS} = 10V$
$V_{GS} = 4.5V$
$V_{GS} = 4V$
$V_{GS} = 3.5V$
$V_{GS} = 3V$

V_{DS}, DRAIN TO SOURCE VOLTAGE (V)
I_D, DRAIN CURRENT (A)

Figure 2. Normalized On-Resistance vs Drain Current and Gate Voltage

PULSE DURATION = 80µs
DUTY CYCLE = 0.5%MAX

$V_{GS} = 3V$
$V_{GS} = 3.5V$
$V_{GS} = 4V$
$V_{GS} = 4.5V$
$V_{GS} = 10V$

I_D, DRAIN CURRENT(A)
NORMALIZED DRAIN TO SOURCE ON-RESISTANCE
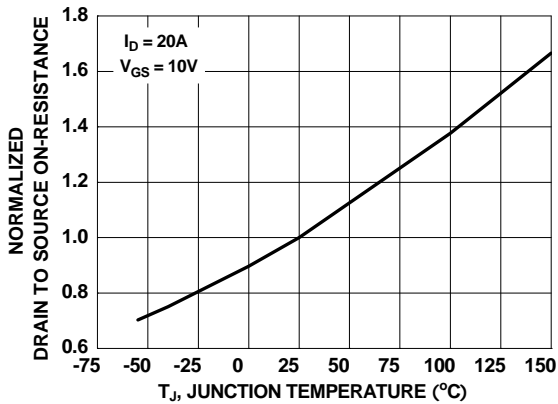
Figure 3. Normalized On Resistance vs Junction Temperature

$I_D = 20A$
$V_{GS} = 10V$

T_J, JUNCTION TEMPERATURE (°C)
NORMALIZED DRAIN TO SOURCE ON-RESISTANCE
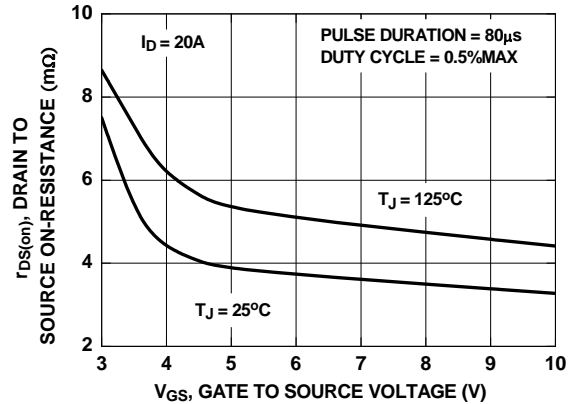
Figure 4. On-Resistance vs Gate to Source Voltage

$I_D = 20A$
PULSE DURATION = 80µs
DUTY CYCLE = 0.5%MAX

$T_J = 125°C$
$T_J = 25°C$

V_{GS}, GATE TO SOURCE VOLTAGE (V)
$r_{DS(on)}$, DRAIN TO SOURCE ON-RESISTANCE (mΩ)
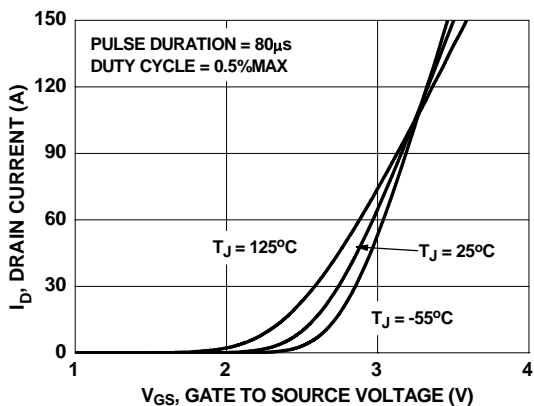
Figure 5. Transfer Characteristics

PULSE DURATION = 80µs
DUTY CYCLE = 0.5%MAX

$T_J = 125°C$
$T_J = 25°C$
$T_J = -55°C$

V_{GS}, GATE TO SOURCE VOLTAGE (V)
I_D, DRAIN CURRENT (A)
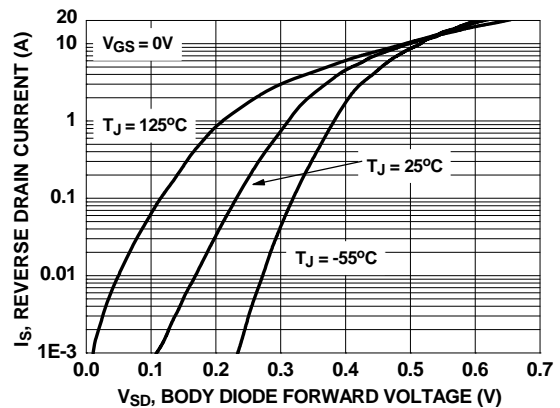
Figure 6. Source to Drain Diode Forward Voltage vs Source Current

$V_{GS} = 0V$
$T_J = 125°C$
$T_J = 25°C$
$T_J = -55°C$

V_{SD}, BODY DIODE FORWARD VOLTAGE (V)
I_S, REVERSE DRAIN CURRENT (A)

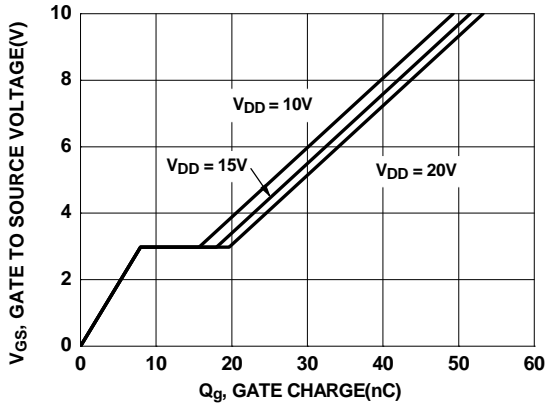## Typical Characteristics T_J = 25°C unless otherwise noted
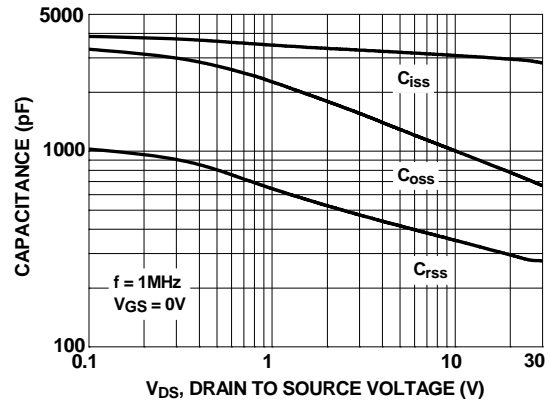

Figure 7. Gate Charge Characteristics

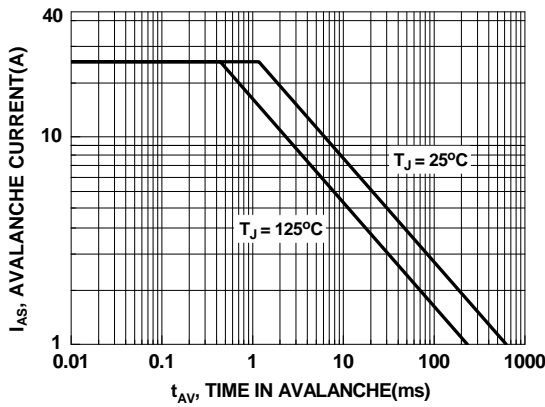Figure 8. Capacitance vs Drain to Source Voltage

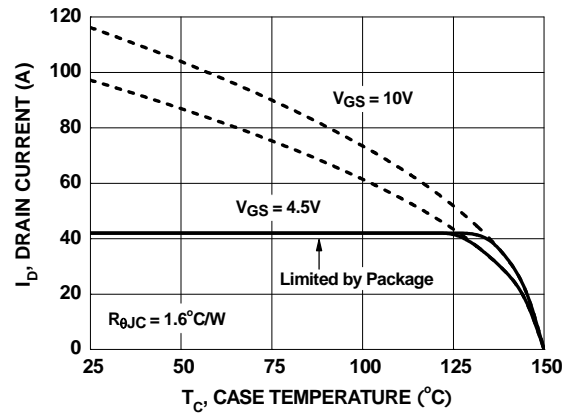Figure 9. Unclamped Inductive Switching Capability

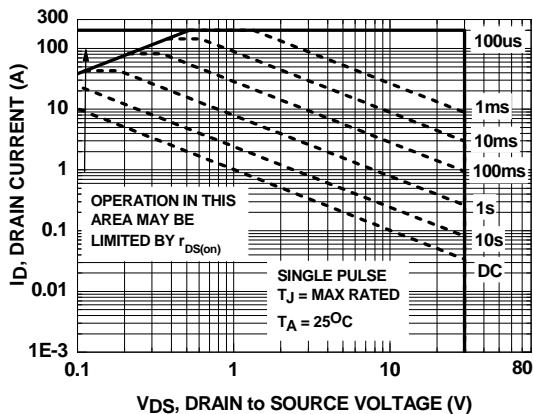Figure 10. Maximum Continuous Drain Current vs Case Temperature

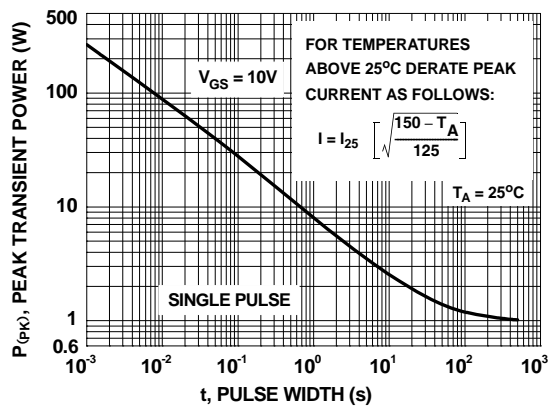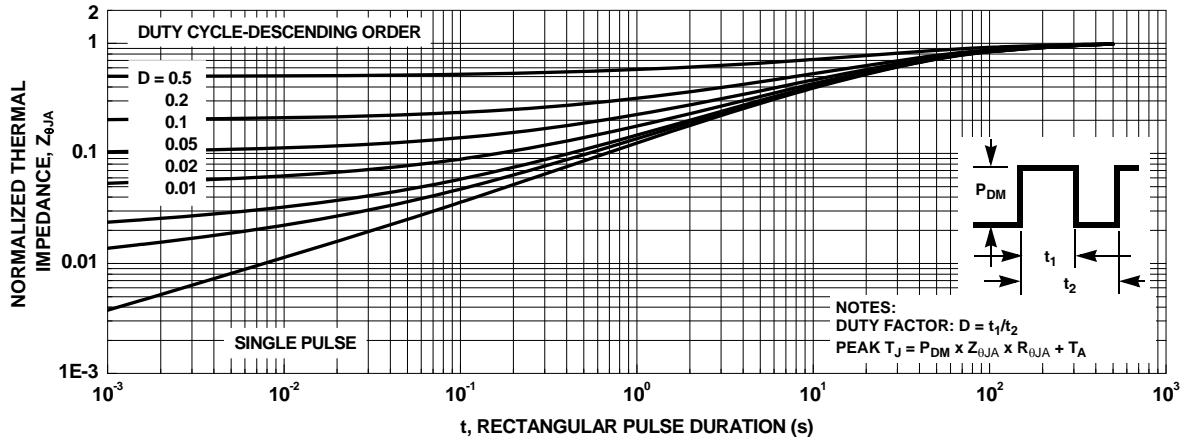Figure 11. Forward Bias Safe Operating Area

Figure 12. Single Pulse Maximum Power Dissipation

Typical Characteristics $T_J = 25°C$ unless otherwise noted

Figure 13. Transient Thermal Response Curve

NOTES:
DUTY FACTOR: $D = t_1/t_2$
PEAK $T_J = P_{DM} \times Z_{\theta JA} \times R_{\theta JA} + T_A$

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 14 shows the reverses recovery characteristic of the FDMS8670S.

Schottky barrier diodes exhibit significant leakage at high temperature and high reverse voltage. This will increase the power in the device.
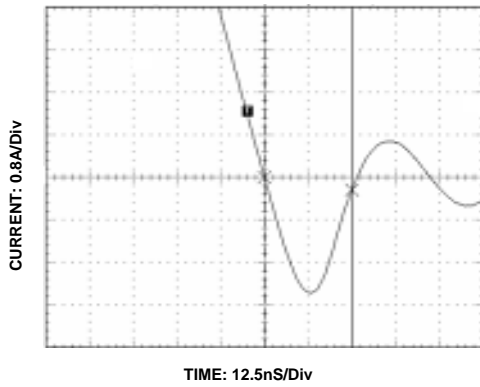
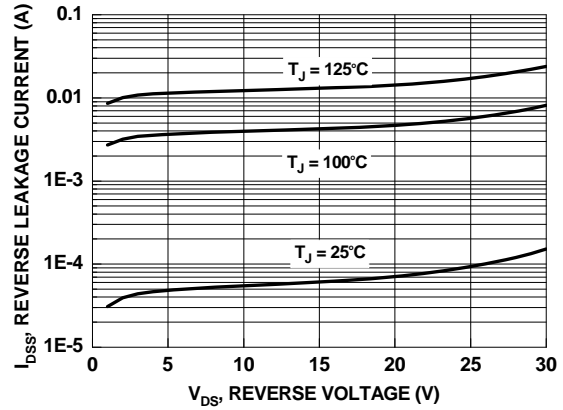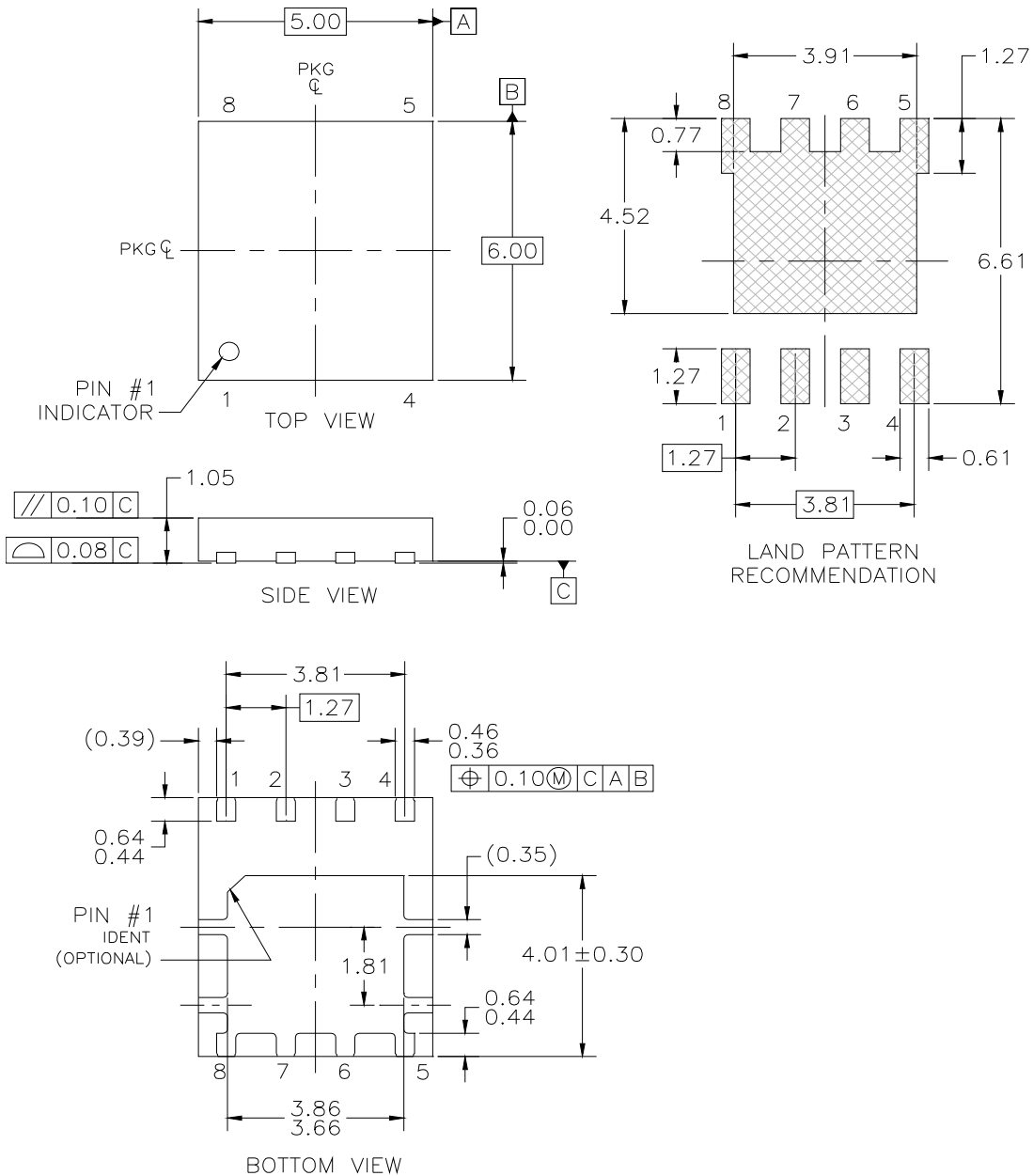**Figure 14. FDMS8670S SyncFET Body Diode reverse recovery characteristics**

Figure 15. SyncFET Body Diode reverse leakage vs drain to source voltage

5.00 [A]

PKG ₵

8   5   [B]

PKG ₵   6.00

PIN #1
INDICATOR   1   4

TOP VIEW

// 0.10 C   1.05

⌒ 0.08 C

0.06
0.00

SIDE VIEW   [C]

3.91   1.27

0.77   8   7   6   5

4.52   6.61

1.27   1   2   3   4

1.27   0.61

3.81

LAND PATTERN
RECOMMENDATION

3.81

1.27

(0.39)   0.46
0.36

1   2   3   4   ⊕ 0.10Ⓜ C A B

0.64
0.44

PIN #1
IDENT
(OPTIONAL)   (0.35)

1.81   4.01±0.30

0.64
0.44

8   7   6   5

3.86
3.66

BOTTOM VIEW

NOTES: UNLESS OTHERWISE SPECIFIED
    A)   ALL DIMENSIONS ARE IN MILLIMETERS.
    B)   NO JEDEC REFERENCE AS OF
        FEBRUARY 2006
    C)   DIMENSIONING AND TOLERANCING PER
        ASME Y14.5M 1994

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