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December 2011

### **FDMS3626S**

# PowerTrench® Power Stage

#### 25V Asymmetric Dual N-Channel MOSFET

#### **Features**

Q1: N-Channel

- Max  $r_{DS(on)} = 5.0 \text{ m}\Omega$  at  $V_{GS} = 10 \text{ V}$ ,  $I_D = 17.5 \text{ A}$
- Max  $r_{DS(on)} = 5.7 \text{ m}\Omega$  at  $V_{GS} = 4.5 \text{ V}$ ,  $I_D = 16 \text{ A}$

Q2: N-Channel

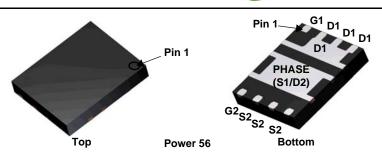
- Max  $r_{DS(on)} = 2.6 \text{ m}\Omega$  at  $V_{GS} = 10 \text{ V}$ ,  $I_D = 25 \text{ A}$
- Max  $r_{DS(on)} = 3.2 \text{ m}\Omega$  at  $V_{GS} = 4.5 \text{ V}$ ,  $I_D = 22 \text{ A}$
- Low inductance packaging shortens rise/fall times, resulting in lower switching losses
- MOSFET integration enables optimum layout for lower circuit inductance and reduced switch node ringing
- RoHS Compliant

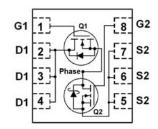
## **General Description**

This device includes two specialized N-Channel MOSFETs in a dual PQFN package. The switch node has been internally connected to enable easy placement and routing of synchronous buck converters. The control MOSFET (Q1) and synchronous SyncFET (Q2) have been designed to provide optimal power efficiency.

#### **Applications**

- Computing
- Communications
- General Purpose Point of Load
- Notebook VCORE





#### MOSFET Maximum Ratings T<sub>A</sub> = 25 °C unless otherwise noted

Symbol	Parameter		Q1	Q2	Units
$V_{DS}$	Drain to Source Voltage		25	25	V
$V_{GS}$	Gate to Source Voltage	(Note 4)	±12	±12	V
	Drain Current -Continuous (Package limited)	T <sub>C</sub> = 25 °C	30	55	
I <sub>D</sub>	-Continuous	T <sub>A</sub> = 25 °C	17.5 <sup>1a</sup>	25 <sup>1b</sup>	Α
	-Pulsed		70	100	
E <sub>AS</sub>	Single Pulse Avalanche Energy	(Note 3)	29	45	mJ
P <sub>D</sub>	Power Dissipation for Single Operation	T <sub>A</sub> = 25 °C	2.2 <sup>1a</sup>	2.5 <sup>1b</sup>	W
	Power Dissipation for Single Operation	T <sub>A</sub> = 25 °C	1.0 <sup>1c</sup>	1.0 <sup>1d</sup>	] vv
T <sub>J</sub> , T <sub>STG</sub>	Operating and Storage Junction Temperature Range		-55 to	+150	°C

#### **Thermal Characteristics**

$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	57 <sup>1a</sup>	50 <sup>1b</sup>	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	125 <sup>1c</sup>	120 <sup>1d</sup>	°C/W
$R_{\theta JC}$	Thermal Resistance, Junction to Case	3.0	3.0	

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

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
08OD 10OD	FDMS3626S	Power 56	13 "	12 mm	3000 units

### Electrical Characteristics T<sub>J</sub> = 25 °C unless otherwise noted

Symbol	Parameter	Test Conditions	Type	Min	Тур	Max	Units
Off Chara	cteristics						
BV <sub>DSS</sub>	Drain to Source Breakdown Voltage	$I_D = 250 \mu A, V_{GS} = 0 V$ $I_D = 1 mA, V_{GS} = 0 V$	Q1 Q2	25 25			V
$\Delta BV_{DSS} \over \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D$ = 250 μA, referenced to 25 °C $I_D$ = 10 mA, referenced to 25 °C	Q1 Q2		12 25		mV/°C
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 20 V, V <sub>GS</sub> = 0 V	Q1 Q2			1 500	μA μA
I <sub>GSS</sub>	Gate to Source Leakage Current	V <sub>GS</sub> = 12 V/-8 V, V <sub>DS</sub> = 0 V	Q1 Q2			±100 ±100	nA nA

#### **On Characteristics**

V <sub>GS(th)</sub>	Gate to Source Threshold Voltage	$V_{GS} = V_{DS}, I_{D} = 250 \mu A$	Q1	0.8	1.2	2.0	V
*GS(th)	Cate to Course Timeericia Vertage	$V_{GS} = V_{DS}$ , $I_D = 1 \text{ mA}$	Q2	1.1	1.4	2.2	•
$\Delta V_{GS(th)}$	Gate to Source Threshold Voltage	$I_D = 250 \mu A$ , referenced to 25 °C	Q1		-4		mV/°C
$\Delta T_{J}$	Temperature Coefficient	I <sub>D</sub> = 10 mA, referenced to 25 °C	Q2		-3		IIIV/ C
		$V_{GS} = 10 \text{ V}, I_D = 17.5 \text{ A}$			3.8	5.0	
	Drain to Source On Resistance	$V_{GS} = 4.5 \text{ V}, I_D = 16 \text{ A}$	Q1		4.4	5.7	
		$V_{GS} = 10 \text{ V}, I_D = 17.5 \text{ A}, T_J = 125 \text{ °C}$			5.4	7.0	mΩ
r <sub>DS(on)</sub>	Diam to Source On Resistance	$V_{GS} = 10 \text{ V}, I_D = 25 \text{ A}$			2.1	2.6	1115.2
		$V_{GS} = 4.5 \text{ V}, I_D = 22 \text{ A}$	Q2		2.6	3.2	
	$V_{GS} = 10 \text{ V}, I_D = 25 \text{ A}, T_J = 125 \text{ °C}$			2.9	3.8		
<b>a</b>	Forward Transconductance	$V_{DS} = 5 \text{ V}, I_{D} = 17.5 \text{ A}$	Q1		100		S
9 <sub>FS</sub>	Forward Transconductance	$V_{DS} = 5 \text{ V}, I_{D} = 25 \text{ A}$	Q2		227		3

### **Dynamic Characteristics**

C <sub>iss</sub>	Input Capacitance	Q1: V <sub>DS</sub> = 13 V, V <sub>GS</sub> = 0 V, f = 1 MHZ	Q1 Q2	1570 2545	pF
C <sub>oss</sub>	Output Capacitance	Q2:	Q1 Q2	448 716	pF
C <sub>rss</sub>	Reverse Transfer Capacitance	$V_{DS} = 13 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ MHZ}$	Q1 Q2	61 103	pF
R <sub>g</sub>	Gate Resistance		Q1 Q2	0.4 0.9	Ω

### **Switching Characteristics**

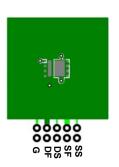
t <sub>d(on)</sub>	Turn-On Delay Time			Q1 Q2	7 8	ns
t <sub>r</sub>	Rise Time	Q1: V <sub>DD</sub> = 13 V, I <sub>D</sub> = 17	$1.5 \text{ A}, R_{\text{GEN}} = 6 \Omega$	Q1 Q2	2 4	ns
t <sub>d(off)</sub>	Turn-Off Delay Time	Q2: V <sub>DD</sub> = 13 V, I <sub>D</sub> = 25	5 A P 6 O	Q1 Q2	23 31	ns
t <sub>f</sub>	Fall Time	VDD = 13 V, ID = 23	7 A, NGEN = 0 12	Q1 Q2	2 3	ns
Qg	Total Gate Charge	V <sub>GS</sub> = 0 V to 10 V	Q1	Q1 Q2	26 41	nC
Qg	Total Gate Charge	V <sub>GS</sub> = 0 V to 4.5 V	V <sub>DD</sub> = 13 V, I <sub>D</sub> = 17.5 A	Q1 Q2	12 19	nC
Q <sub>gs</sub>	Gate to Source Gate Charge		Q2 V <sub>DD</sub> = 13 V,	Q1 Q2	3.3 4.9	nC
Q <sub>gd</sub>	Gate to Drain "Miller" Charge		$I_{D} = 25 \text{ A}$	Q1 Q2	2.7 4.3	nC

### Electrical Characteristics T<sub>J</sub> = 25 °C unless otherwise noted

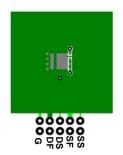
Symbol	Parameter	Test Conditions	Туре	Min	Тур	Max	Units
Drain-Sou	rce Diode Characteristics						
V <sub>SD</sub>	Source to Drain Diode Forward Voltage	$V_{GS} = 0 \text{ V}, I_S = 17.5 \text{ A}$ (Note 2) $V_{GS} = 0 \text{ V}, I_S = 25 \text{ A}$ (Note 2)	Q1 Q2		0.8 0.8	1.2 1.2	V
t <sub>rr</sub>	Reverse Recovery Time	Q1 I <sub>F</sub> = 17.5 A, di/dt = 100 A/μs	Q1 Q2		23 23		ns
Q <sub>rr</sub>	Reverse Recovery Charge	Q2 I <sub>F</sub> = 25 A, di/dt = 300 A/μs	Q1 Q2		9 22		nC

#### Notes:

 $1.R_{\theta,IA}$  is determined with the device mounted on a 1 in  $^2$  pad 2 oz copper pad on a 1.5 x 1.5 in. board of FR-4 material.  $R_{\theta,IC}$  is guaranteed by design while  $R_{\theta,CA}$  is determined by the user's board design.



a. 57 °C/W when mounted on a 1 in<sup>2</sup> pad of 2 oz copper



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



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



d. 120 °C/W when mounted on a minimum pad of 2 oz copper

- 2 Pulse Test: Pulse Width < 300  $\mu$ s, Duty cycle < 2.0%.
- 3. Q1 :EAS of 29 mJ is based on starting  $T_J = 25$  °C; N-ch: L = 1.2 mH,  $I_{AS} = 7$  A,  $V_{DD} = 23$  V,  $V_{GS} = 10$  V. 100% test at L = 0.1 mH,  $I_{AS} = 16$  A. Q2:  $E_{AS}$  of 45 mJ is based on starting  $T_J = 25$  °C; N-ch: L = 0.4 mH,  $I_{AS} = 15$  A,  $V_{DD} = 23$  V,  $V_{GS} = 10$  V. 100% test at L = 0.1 mH,  $I_{AS} = 23.8$  A.
- 4. As an N-ch device, the negative Vgs rating is for low duty cycle pulse occurrence only. No continuous rating is implied.

### Typical Characteristics (Q1 N-Channel) T<sub>J</sub> = 25°C unless otherwise noted

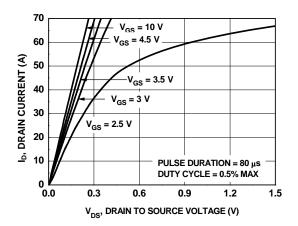


Figure 1. On Region Characteristics

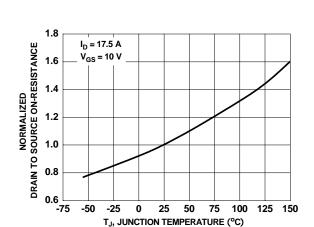


Figure 3. Normalized On Resistance vs Junction Temperature

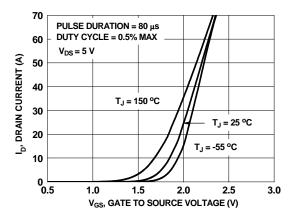


Figure 5. Transfer Characteristics

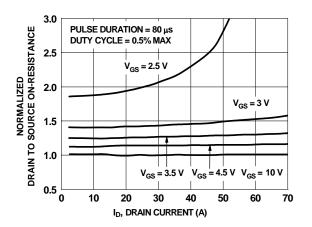


Figure 2. Normalized On-Resistance vs Drain Current and Gate Voltage

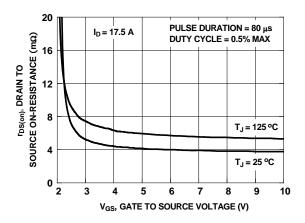


Figure 4. On-Resistance vs Gate to Source Voltage

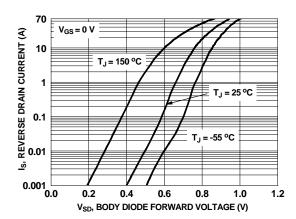


Figure 6. Source to Drain Diode Forward Voltage vs Source Current

### Typical Characteristics (Q1 N-Channel) T<sub>J</sub> = 25°C unless otherwise noted

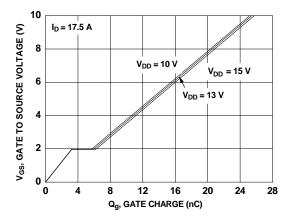


Figure 7. Gate Charge Characteristics

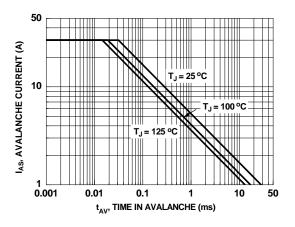


Figure 9. Unclamped Inductive Switching Capability

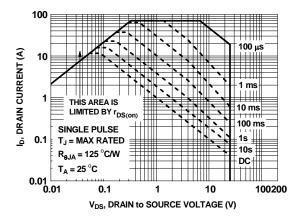


Figure 11. Forward Bias Safe Operating Area

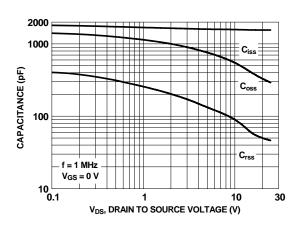


Figure 8. Capacitance vs Drain to Source Voltage

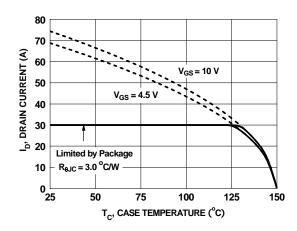


Figure 10. Maximum Continuous Drain Current vs Case Temperature

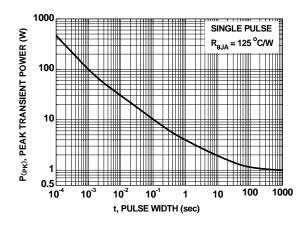


Figure 12. Single Pulse Maximum Power Dissipation

### Typical Characteristics (Q1 N-Channel) $T_J = 25$ °C unless otherwise noted

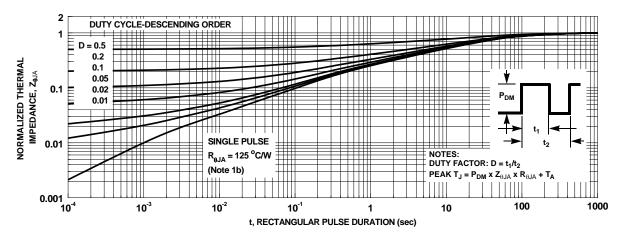


Figure 13. Junction-to-Ambient Transient Thermal Response Curve

### Typical Characteristics (Q2 N-Channel) T<sub>J</sub> = 25 °C unless otherwise noted

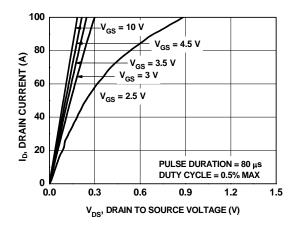


Figure 14. On-Region Characteristics

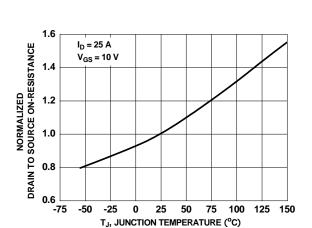


Figure 16. Normalized On-Resistance vs Junction Temperature

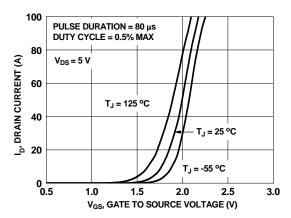


Figure 18. Transfer Characteristics

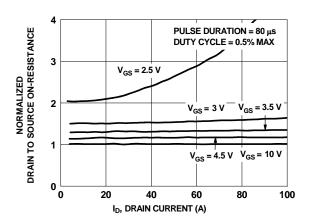


Figure 15. Normalized on-Resistance vs Drain Current and Gate Voltage

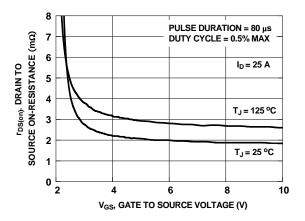


Figure 17. On-Resistance vs Gate to Source Voltage

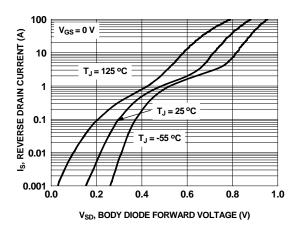


Figure 19. Source to Drain Diode Forward Voltage vs Source Current

#### Typical Characteristics (Q2 N-Channel) T<sub>.I</sub> = 25°C unless otherwise noted

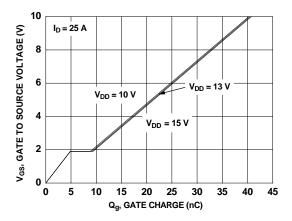


Figure 20. Gate Charge Characteristics

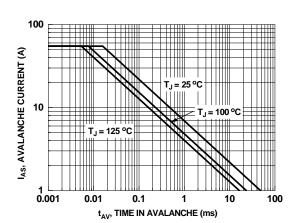


Figure 22. Unclamped Inductive Switching Capability

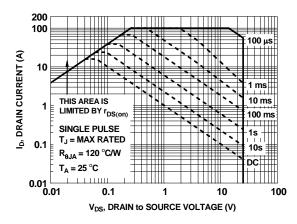


Figure 24. Forward Bias Safe Operating Area

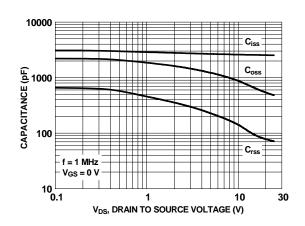


Figure 21. Capacitance vs Drain to Source Voltage

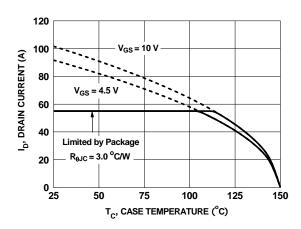


Figure 23. Maximum Continuous Drain Current vs Case Temperature

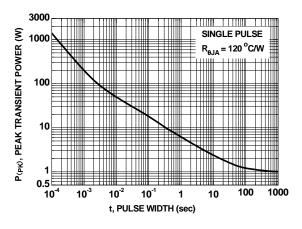


Figure 25. Single Pulse Maximum Power Dissipation

### Typical Characteristics (Q2 N-Channel) $T_J = 25$ °C unless otherwise noted

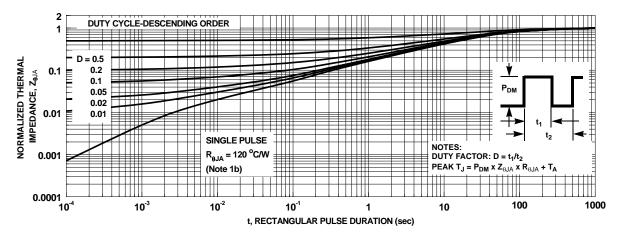


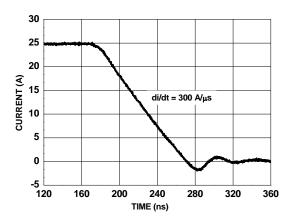
Figure 26. Junction-to-Ambient Transient Thermal Response Curve

### 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 27 shows the reverse recovery characteristic of the FDMS3626S.

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



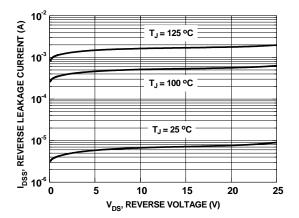
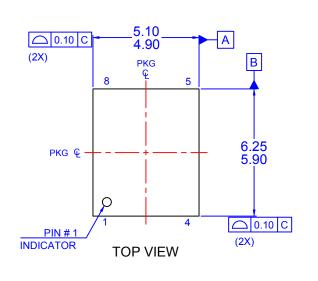
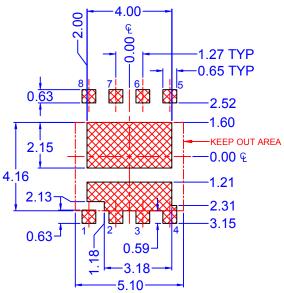
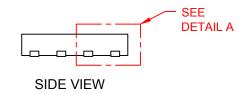


Figure 27. FDMS3626S SyncFET body diode reverse recovery characteristic

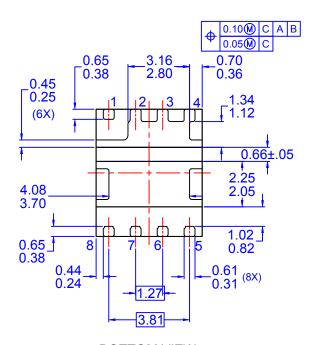
Figure 28. SyncFET body diode reverse leakage versus drain-source voltage

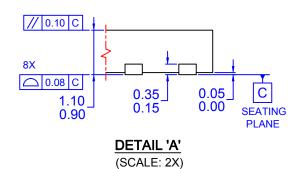




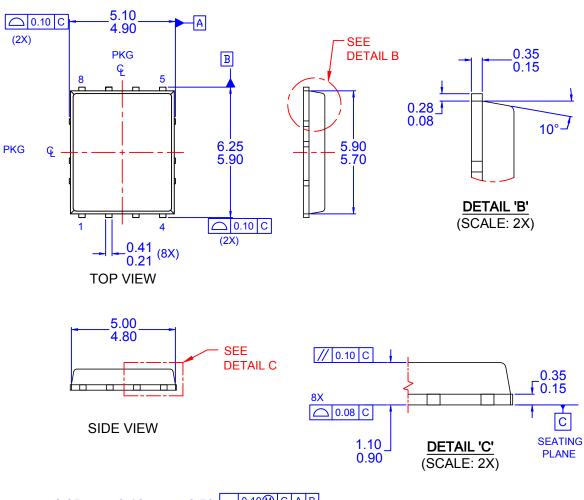


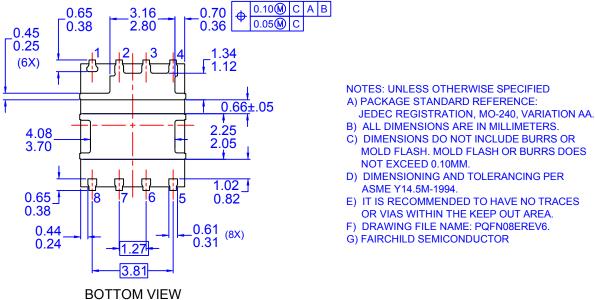
RECOMMENDED LAND PATTERN FOR SAWN / PUNCHED TYPE





BOTTOM VIEW
OPTION - A (SAWN TYPE)





**OPTION - B (PUNCHED TYPE)** 

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