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July 2013

# FDMS8558SDC

# N-Channel PowerTrench® SyncFET<sup>TM</sup>

**25 V, 90 A, 1.5 m**Ω

#### **Features**

- Dual Cool<sup>TM</sup> PQFN package
- Max  $r_{DS(on)}$  = 1.5 m $\Omega$  at  $V_{GS}$  = 10 V,  $I_D$  = 38 A
- Max  $r_{DS(on)} = 1.7 \text{ m}\Omega$  at  $V_{GS} = 4.5 \text{ V}$ ,  $I_D = 36 \text{ A}$
- High performance technology for extremely low r<sub>DS(on)</sub>
- SyncFET<sup>TM</sup> Schottky Body Diode
- RoHS Compliant

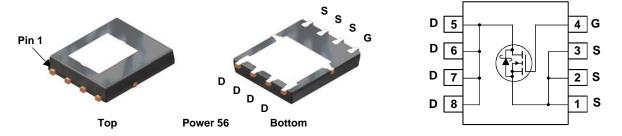


#### **General Description**

This N-Channel SyncFET<sup>TM</sup> is produced using Fairchild Semiconductor's advanced PowerTrench<sup>®</sup> process. Advancements in both silicon and package technologies have been combined to offer the lowest  $r_{DS(on)}$  while maintaining excellent switching performance by extremely low Junction-to-Ambient thermal resistance. This device has the added benefit of an efficient monolithic Schottky body diode.

#### **Applications**

- Synchronous Rectifier for DC/DC Converters
- Telecom Secondary Side Rectification
- High End Server/Workstation Vcore Low Side



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

Symbol	Parameter			Ratings	Units
V <sub>DS</sub>	Drain to Source Voltage			25	V
$V_{GS}$	Gate to Source Voltage			12	V
	Drain Current -Continuous (Package limited)	T <sub>C</sub> = 25 °C		90	
I <sub>D</sub>	-Continuous	T <sub>A</sub> = 25 °C	(Note 1a)	38	Α
	-Pulsed			140	
E <sub>AS</sub>	Single Pulse Avalanche Energy		(Note 3)	145	mJ
D	Power Dissipation	T <sub>C</sub> = 25 °C		89	W
$P_{D}$	Power Dissipation	T <sub>A</sub> = 25 °C	(Note 1a)	3.3	VV
T <sub>J</sub> , T <sub>STG</sub>	Operating and Storage Junction Temperature Ra	ange		-55 to +150	°C

#### **Thermal Characteristics**

$R_{\theta JC}$	Thermal Resistance, Junction to Case	(Top Source)	2.8	
$R_{\theta JC}$	Thermal Resistance, Junction to Case	(Bottom Drain)	1.4	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	(Note 1a)	38	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	(Note 1b)	81	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	(Note 1i)	16	10/00
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	(Note 1j)	23	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	(Note 1k)	11	

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

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
09DC	FDMS8558SDC	Power 56	13"	12 mm	3000 units

# **Electrical Characteristics** $T_J = 25$ °C unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Тур	Max	Units
Off Chara	acteristics					
BV <sub>DSS</sub>	Drain to Source Breakdown Voltage	$I_D = 1 \text{ mA}, V_{GS} = 0 \text{ V}$	25			V
$\frac{\Delta BV_{DSS}}{\Delta T_{J}}$	Breakdown Voltage Temperature Coefficient	I <sub>D</sub> = 10 mA, referenced to 25 °C		24		mV/°C
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 20 V, V <sub>GS</sub> = 0 V			500	μΑ
I <sub>GSS</sub>	Gate to Source Leakage Current	V <sub>GS</sub> = +12 V/-8 V, V <sub>DS</sub> = 0 V			±100	nA

#### **On Characteristics**

V <sub>GS(th)</sub>	Gate to Source Threshold Voltage	$V_{GS} = V_{DS}$ , $I_D = 1 \text{ mA}$	1.1	1.4	2.2	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate to Source Threshold Voltage Temperature Coefficient	I <sub>D</sub> = 10 mA, referenced to 25 °C		-3		mV/°C
		V <sub>GS</sub> = 10 V, I <sub>D</sub> = 38 A		1.1	1.5	
r <sub>DS(on)</sub>	DS(on) Static Drain to Source On Resistance	V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 36 A		1.3	1.7	mΩ
		$V_{GS} = 10 \text{ V}, I_D = 38 \text{ A}, T_J = 125 ^{\circ}\text{C}$		1.6	2.1	
9 <sub>FS</sub>	Forward Transconductance	$V_{DS} = 5 \text{ V}, I_{D} = 38 \text{ A}$		317		S

### **Dynamic Characteristics**

C <sub>iss</sub>	Input Capacitance	V 42 V V 0 V	5118	pF
Coss	Output Capacitance	V <sub>DS</sub> = 13 V, V <sub>GS</sub> = 0 V, f = 1 MHz	1508	pF
C <sub>rss</sub>	Reverse Transfer Capacitance	- 1 1011 12	195	pF
$R_g$	Gate Resistance		0.9	Ω

### **Switching Characteristics**

t <sub>d(on)</sub>	Turn-On Delay Time		14	ns
t <sub>r</sub>	Rise Time	V <sub>DD</sub> = 13 V, I <sub>D</sub> = 38 A,	8	ns
t <sub>d(off)</sub>	Turn-Off Delay Time	$V_{GS}$ = 10 V, $R_{GEN}$ = 6 $\Omega$	51	ns
t <sub>f</sub>	Fall Time		7	ns
$Q_q$	Total Gate Charge	V <sub>GS</sub> = 0 V to 10 V	81	nC
$Q_q$	Total Gate Charge	$V_{GS} = 0 \text{ V to } 4.5 \text{ V} V_{DD} = 13 \text{ V},$	38	nC
$Q_{gs}$	Gate to Source Gate Charge	I <sub>D</sub> = 38 A	10	nC
$Q_{gd}$	Gate to Drain "Miller" Charge		9.7	nC

#### **Drain-Source Diode Characteristics**

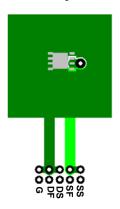
	$V_{GS} = 0 \text{ V}, I_{S} = 2 \text{ A}$ (Note 2)	0.6	0.8	V	
V SD	Source to Drain Diode Forward voltage	$V_{GS} = 0 \text{ V}, I_{S} = 38 \text{ A}$ (Note 2)	0.8	1.2	V
t <sub>rr</sub>	Reverse Recovery Time	-I <sub>F</sub> = 38 A, di/dt = 300 A/μs	35		ns
Q <sub>rr</sub>	Reverse Recovery Charge	I <sub>F</sub> = 38 A, α//αι = 300 A/μs 49			nC

#### **Thermal Characteristics**

$R_{\theta JC}$	Thermal Resistance, Junction to Case	(Top Source)	2.8	
$R_{\theta JC}$	Thermal Resistance, Junction to Case	(Bottom Drain)	1.4	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	(Note 1a)	38	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	(Note 1b)	81	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	(Note 1c)	27	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	(Note 1d)	34	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	(Note 1e)	16	°C // //
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	(Note 1f)	19	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	(Note 1g)	26	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	(Note 1h)	61	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	(Note 1i)	16	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	(Note 1j)	23	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	(Note 1k)	11	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	(Note 1I)	13	

#### NOTES:

<sup>1.</sup> R<sub>0JA</sub> is determined with the device mounted on a FR-4 board using a specified pad of 2 oz copper as shown below. R<sub>0JC</sub> is guaranteed by design while R<sub>0CA</sub> is determined by the user's board design.



a. 38 °C/W when mounted on a 1 in<sup>2</sup> pad of 2 oz copper



b. 81 °C/W when mounted on a minimum pad of 2 oz copper

- c. Still air, 20.9x10.4x12.7mm Aluminum Heat Sink, 1 in<sup>2</sup> pad of 2 oz copper
- d. Still air, 20.9x10.4x12.7mm Aluminum Heat Sink, minimum pad of 2 oz copper
- e. Still air, 45.2x41.4x11.7mm Aavid Thermalloy Part # 10-L41B-11 Heat Sink, 1 in<sup>2</sup> pad of 2 oz copper
- f. Still air, 45.2x41.4x11.7mm Aavid Thermalloy Part # 10-L41B-11 Heat Sink, minimum pad of 2 oz copper
- g. 200FPM Airflow, No Heat Sink,1 in<sup>2</sup> pad of 2 oz copper
- h. 200FPM Airflow, No Heat Sink, minimum pad of 2 oz copper
- i. 200FPM Airflow, 20.9x10.4x12.7mm Aluminum Heat Sink, 1 in<sup>2</sup> pad of 2 oz copper
- j. 200FPM Airflow, 20.9x10.4x12.7mm Aluminum Heat Sink, minimum pad of 2 oz copper
- k. 200FPM Airflow, 45.2x41.4x11.7mm Aavid Thermalloy Part # 10-L41B-11 Heat Sink, 1 in  $^2$  pad of 2 oz copper
- I. 200FPM Airflow, 45.2x41.4x11.7mm Aavid Thermalloy Part # 10-L41B-11 Heat Sink, minimum pad of 2 oz copper
- 2. Pulse Test: Pulse Width < 300  $\mu$ s, Duty cycle < 2.0%. 3. E<sub>AS</sub> of 145 mJ is based on starting T<sub>J</sub> = 25 °C, L = 0.9 mH, I<sub>AS</sub> = 18 A, V<sub>DD</sub> = 23 V, V<sub>GS</sub> = 10 V. 100% test at L = 0.1 mH, I<sub>AS</sub> = 39 A.

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

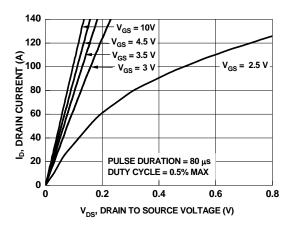


Figure 1. On Region Characteristics

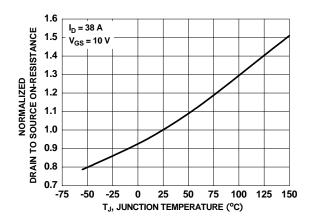


Figure 3. Normalized On Resistance vs Junction Temperature

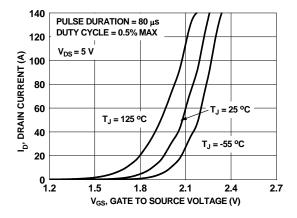


Figure 5. Transfer Characteristics

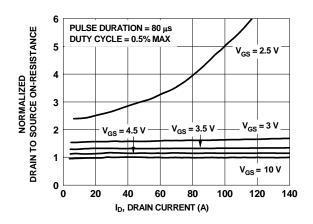


Figure 2. Normalized On-Resistance vs Drain Current and Gate Voltage

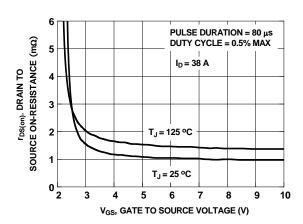


Figure 4. On-Resistance vs Gate to Source Voltage

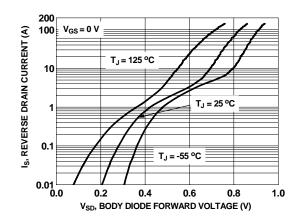


Figure 6. Source to Drain Diode Forward Voltage vs Source Current

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

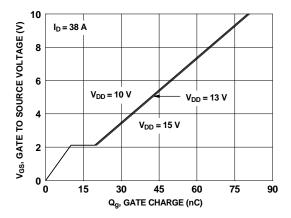


Figure 7. Gate Charge Characteristics

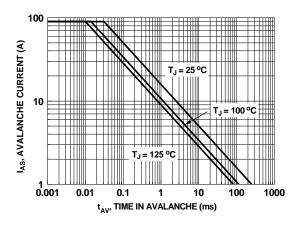


Figure 9. Unclamped Inductive Switching Capability

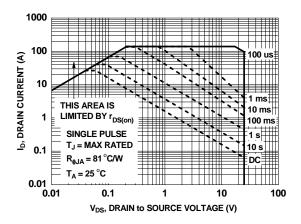


Figure 11. Forward Bias Safe Operating Area

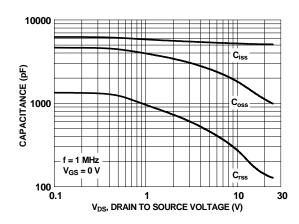


Figure 8. Capacitance vs Drain to Source Voltage

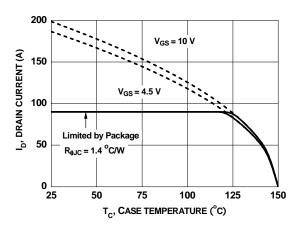


Figure 10. Maximum Continuous Drain Current vs Ambient Temperature

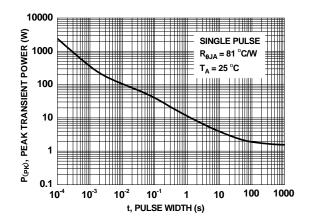


Figure 12. Single Pulse Maximum Power Dissipation

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

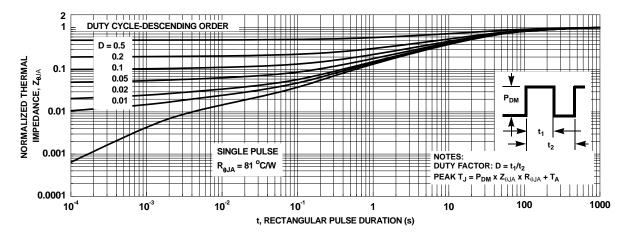


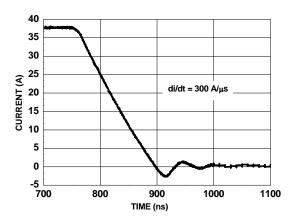
Figure 13. Junction-to-Ambient Transient Thermal Response Curve

## Typical Characteristics (continued)

# SyncFET<sup>TM</sup> Schottky body diode Characteristics

Fairchild's SyncFET<sup>TM</sup> 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 reverse recovery characteristic of the FDMS8558SDC.

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



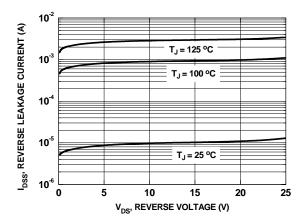
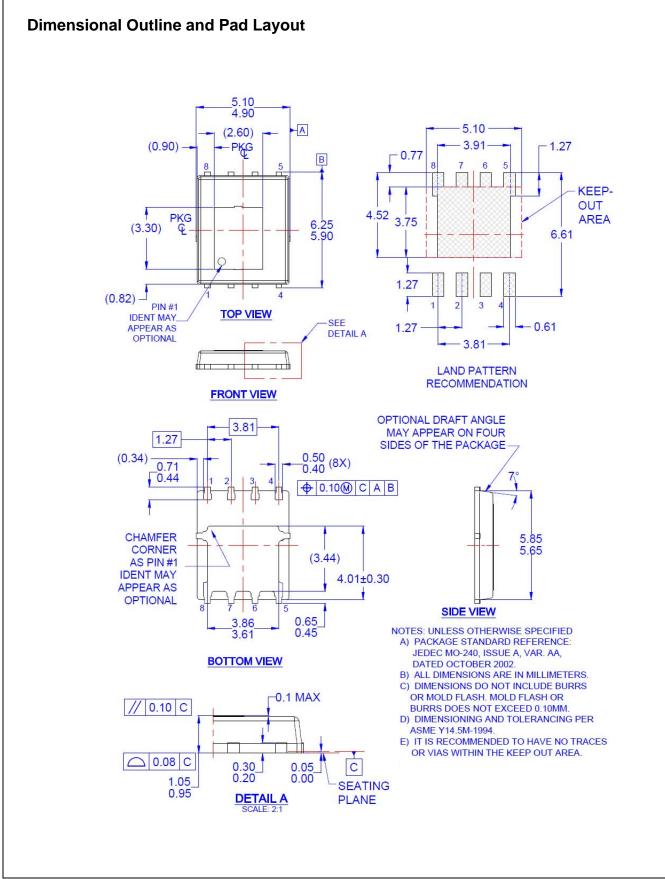


Figure 14. FDMS8558SDC SyncFET<sup>TM</sup> body diode reverse recovery characteristic

Figure 15. SyncFET<sup>TM</sup> body diode reverse leakage versus drain-source voltage







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