

# FDMS1D2N03DSD

## POWERTRENCH<sup>®</sup> Power Clip 30 V Asymmetric Dual N-Channel MOSFETs

### General Description

This device includes two specialized N-Channel MOSFETs in a dual 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.

### Features

#### Q1: N-Channel

- Max  $R_{DS(on)}$  = 3.25 mΩ at  $V_{GS} = 10$  V,  $I_D = 19$  A
- Max  $R_{DS(on)}$  = 4 mΩ at  $V_{GS} = 4.5$  V,  $I_D = 17$  A

#### Q2: N-Channel

- Max  $R_{DS(on)}$  = 0.97 mΩ at  $V_{GS} = 10$  V,  $I_D = 37$  A
- Max  $R_{DS(on)}$  = 1.25 mΩ at  $V_{GS} = 4.5$  V,  $I_D = 34$  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

### Applications

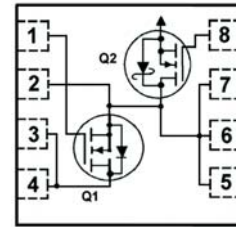
- Computing
- Communications
- General Purpose Point of Load



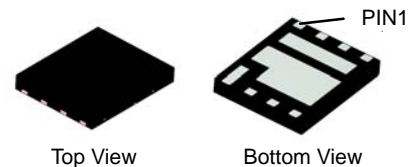
ON Semiconductor<sup>®</sup>

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### ELECTRICAL CONNECTION

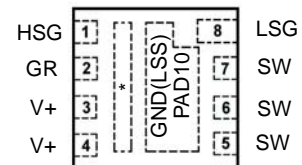


N-Channel MOSFET



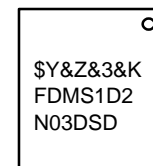
Power Clip 56  
(PQFN8 5x6)  
CASE 483AR

### PIN ASSIGNMENT



\*PAD9 V+(HSD)

### MARKING DIAGRAM



- \$Y = ON Semiconductor Logo
- &Z = Assembly Plant Code
- &3 = Numeric Date Code
- &K = Lot Code
- FDMS1D2N03DSD = Specific Device Code

### ORDERING INFORMATION

See detailed ordering and shipping information on page 2 of this data sheet.

# FDMS1D2N03DSD

## MOSFET MAXIMUM RATINGS (T<sub>A</sub> = 25°C, Unless otherwise specified)

Symbol	Parameter	Q1	Q2	Unit
V <sub>DS</sub>	Drain to Source Voltage	30	30	V
V <sub>GS</sub>	Gate to Source Voltage	+16/-12	+16/-12	V
I <sub>D</sub>	Drain Current – Continuous (T <sub>C</sub> = 25°C) (Note 5)	70	164	A
	– Continuous (T <sub>C</sub> = 85°C) (Note 5)	54	126	
	– Continuous (T <sub>A</sub> = 25°C)	19 (Note 1a)	37 (Note 1b)	
	– Continuous (T <sub>A</sub> = 85°C)	15 (Note 1a)	29 (Note 1b)	
	– Pulsed (T <sub>A</sub> = 25°C) (Note 4)	362	1199	
E <sub>AS</sub>	Single Pulsed Avalanche Energy (Note 3)	121	337	mJ
P <sub>D</sub>	Power Dissipation for Single Operation (T <sub>C</sub> = 25°C) (T <sub>A</sub> = 25°C)	26 2.1 (Note 1a)	42 2.3 (Note 1b)	W
T <sub>J</sub> , T <sub>STG</sub>	Operating and Storage Junction Temperature Range	–55 to +150		°C

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

## THERMAL CHARACTERISTICS

Symbol	Parameter	Q1	Q2	Unit
R <sub>θJC</sub>	Thermal Resistance, Junction to Case	4.8	3.0	°C/W
R <sub>θJA</sub>	Thermal Resistance, Junction to Ambient	60 (Note 1a)	55 (Note 1b)	°C/W
R <sub>θJA</sub>	Thermal Resistance, Junction to Ambient	130 (Note 1c)	120 (Note 1d)	°C/W

## PACKAGE MARKING AND ORDERING INFORMATION

Device	Top Marking	Package	Reel Size	Tape Width	Quantity
FDMS1D2N03DSD	FDMS1D2N03DSD	Power Clip 56 (PGFN8) (Pb-Free / Halogen Free)	13"	12 mm	3,000 Units

## ELECTRICAL CHARACTERISTICS (T<sub>J</sub> = 25°C unless otherwise noted)

Symbol	Parameter	Test Conditions	Type	Min	Typ	Max	Unit
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### OFF CHARACTERISTICS

BV <sub>DSS</sub>	Drain to Source Breakdown Voltage	I <sub>D</sub> = 1 mA, V <sub>GS</sub> = 0 V	Q1 Q2	30 30	– –	– –	V
ΔBV <sub>DSS</sub> /ΔT <sub>J</sub>	Breakdown Voltage Temperature Coefficient	I <sub>D</sub> = 10 mA, referenced to 25°C	Q1 Q2	– –	15 21	– –	mV/°C
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 24 V, V <sub>GS</sub> = 0 V	Q1 Q2	– –	– –	1 500	μA
I <sub>GSS</sub>	Gate to Source Leakage Current, Forward	V <sub>GS</sub> = +16 V/-12 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 <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 320 μA V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 1 mA	Q1 Q2	0.8 1.0	1.3 1.5	2.5 3.0	V
ΔV <sub>GS(th)</sub> /ΔT <sub>J</sub>	Gate to Source Threshold Voltage Temperature Coefficient	I <sub>D</sub> = 1 mA, referenced to 25°C I <sub>D</sub> = 10 mA, referenced to 25°C	Q1 Q2	– –	–3 –3	– –	mV/°C

# FDMS1D2N03DSD

## ELECTRICAL CHARACTERISTICS (T<sub>J</sub> = 25°C unless otherwise noted)

Symbol	Parameter	Test Conditions	Type	Min	Typ	Max	Unit
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### ON CHARACTERISTICS

R <sub>DS(on)</sub>	Drain to Source On Resistance	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 19 A V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 17 A V <sub>GS</sub> = 10 V, I <sub>D</sub> = 19 A, T <sub>J</sub> = 125°C	Q1	–	2.5	3.25	mΩ
		Q2	–	0.73	0.97		
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> = 5 V, I <sub>D</sub> = 19 A V <sub>DS</sub> = 5 V, I <sub>D</sub> = 37 A	Q1	–	95	–	S
			Q2	–	247	–	

### DYNAMIC CHARACTERISTICS

C <sub>iss</sub>	Input Capacitance	Q1: V <sub>DS</sub> = 15 V, V <sub>GS</sub> = 0 V, f = 1 MHz Q2: V <sub>DS</sub> = 15 V, V <sub>GS</sub> = 0 V, f = 1 MHz	Q1	–	1410	–	pF
C <sub>oss</sub>	Output Capacitance		Q2	–	4860	–	
C <sub>rss</sub>	Reverse Transfer Capacitance		Q1	–	564	–	pF
R <sub>g</sub>	Gate Resistance		Q2	–	1845	–	
			Q1	–	40	–	pF
			Q2	–	123	–	
			Q1	–	0.3	–	Ω
			Q2	–	0.3	–	

### SWITCHING CHARACTERISTICS

t <sub>d(on)</sub>	Turn-On Delay Time	Q1: V <sub>DD</sub> = 15 V, I <sub>D</sub> = 19 A, R <sub>GEN</sub> = 6 Ω Q2: V <sub>DD</sub> = 15 V, I <sub>D</sub> = 37 A, R <sub>GEN</sub> = 6 Ω	Q1	–	8	–	ns
t <sub>r</sub>	Rise Time		Q2	–	13	–	
t <sub>d(off)</sub>	Turn-Off Delay Time		Q1	–	2	–	ns
t <sub>f</sub>	Fall Time		Q2	–	5	–	
			Q1	–	22	–	ns
			Q2	–	37	–	
			Q1	–	2	–	ns
			Q2	–	4	–	
Q <sub>g</sub>	Total Gate Charge	V <sub>GS</sub> = 0 V to 10 V Q1: V <sub>DD</sub> = 15 V, I <sub>D</sub> = 19 A Q2: V <sub>DD</sub> = 15 V, I <sub>D</sub> = 37 A	Q1	–	23	33	nC
Q <sub>g</sub>	Total Gate Charge	V <sub>GS</sub> = 0 V to 4.5 V Q1: V <sub>DD</sub> = 15 V, I <sub>D</sub> = 19 A Q2: V <sub>DD</sub> = 15 V, I <sub>D</sub> = 37 A	Q2	–	84	117	
Q <sub>gs</sub>	Gate to Source Gate Charge	Q1: V <sub>DD</sub> = 15 V, I <sub>D</sub> = 19 A Q2: V <sub>DD</sub> = 15 V, I <sub>D</sub> = 37 A	Q1	–	3.1	–	nC
Q <sub>gd</sub>	Gate to Drain "Miller" Charge	Q1: V <sub>DD</sub> = 15 V, I <sub>D</sub> = 19 A Q2: V <sub>DD</sub> = 15 V, I <sub>D</sub> = 37 A	Q2	–	13	–	
			Q1	–	2.5	–	nC
			Q2	–	9	–	

### SOURCE-DRAIN DIODE CHARACTERISTICS

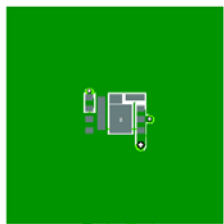
V <sub>SD</sub>	Source to Drain Diode Forward Voltage	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 19 A (Note 2) V <sub>GS</sub> = 0 V, I <sub>S</sub> = 37 A (Note 2)	Q1	–	0.8	1.2	V
t <sub>rr</sub>	Reverse Recovery Time	Q1: I <sub>F</sub> = 19 A, di/dt = 100 A/μs Q2: I <sub>F</sub> = 37 A, di/dt = 300 A/μs	Q2	–	0.8	1.2	
Q <sub>rr</sub>	Reverse Recovery Charge		Q1	–	28	–	ns
			Q2	–	43	–	
			Q1	–	12	–	nC
			Q2	–	63	–	

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

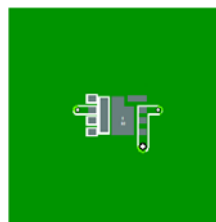
# FDMS1D2N03DSD

## NOTES:

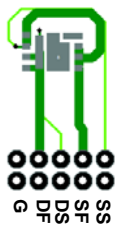
1.  $R_{\theta JA}$  is determined with the device mounted on a 1 in<sup>2</sup> pad 2 oz copper pad on a 1.5 × 1.5 in. board of FR-4 material.  $R_{\theta CA}$  is determined by the user's board design.



a) 60°C/W when mounted on a 1 in<sup>2</sup> pad of 2 oz copper.



b) 55°C/W when mounted on a 1 in<sup>2</sup> pad of 2 oz copper.



c) 130°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 μs, Duty cycle < 2.0%.
3. Q1:  $E_{AS}$  of 121 mJ is based on starting  $T_J = 25^\circ\text{C}$ ; N-ch:  $L = 3\text{ mH}$ ,  $I_{AS} = 9\text{ A}$ ,  $V_{DD} = 30\text{ V}$ . 100% tested at  $L = 0.1\text{ mH}$ ,  $I_{AS} = 29\text{ A}$ .  
Q2:  $E_{AS}$  of 337 mJ is based on starting  $T_J = 25^\circ\text{C}$ ; N-ch:  $L = 3\text{ mH}$ ,  $I_{AS} = 15\text{ A}$ ,  $V_{DD} = 30\text{ V}$ . 100% tested at  $L = 0.1\text{ mH}$ ,  $I_{AS} = 47\text{ A}$ .
4. Pulsed Id please refer to Figure 11 and Figure 24 SOA graphs for more details.
5. Computed continuous current limited to Max Junction Temperature only, actual continuous current will be limited by thermal & electro-mechanical application board design.

# FDMS1D2N03DSD

## TYPICAL CHARACTERISTICS (Q1 N-Channel)

( $T_J = 25^\circ\text{C}$  unless otherwise noted)

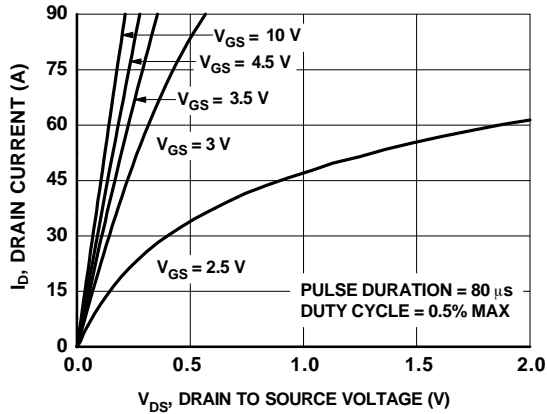


Figure 1. On-Region Characteristics

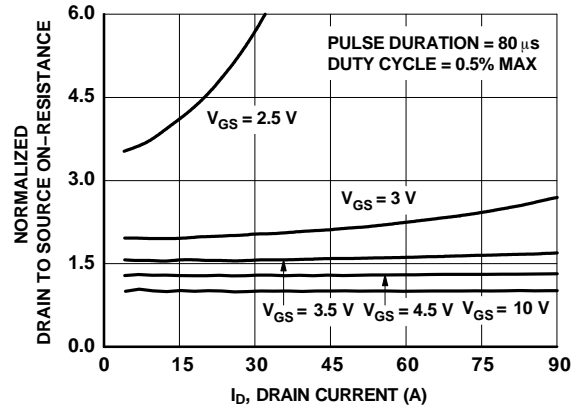


Figure 2. Normalized On-Resistance vs. Drain Current and Gate Voltage

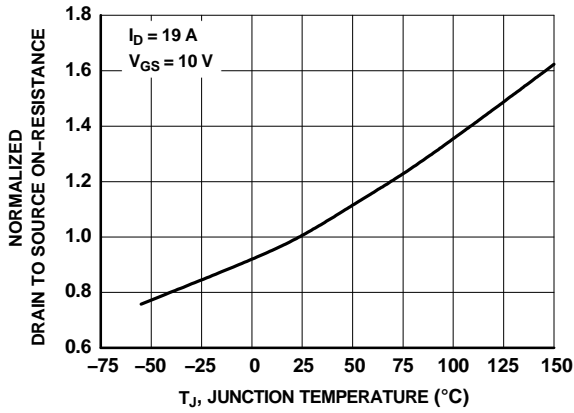


Figure 3. Normalized On-Resistance vs. Junction Temperature

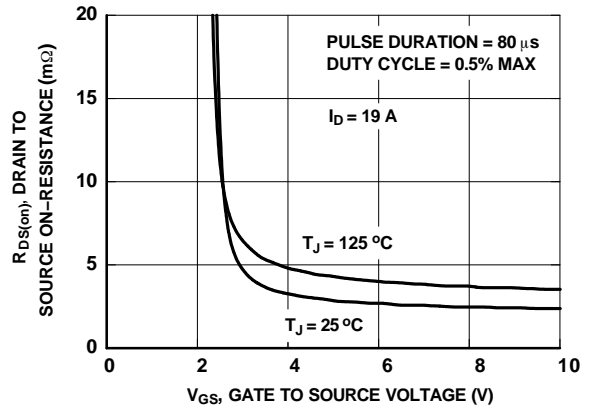


Figure 4. On-Resistance vs. Gate to Source Voltage

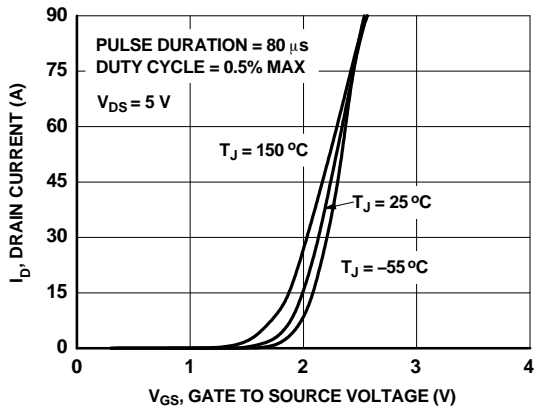


Figure 5. Transfer Characteristics

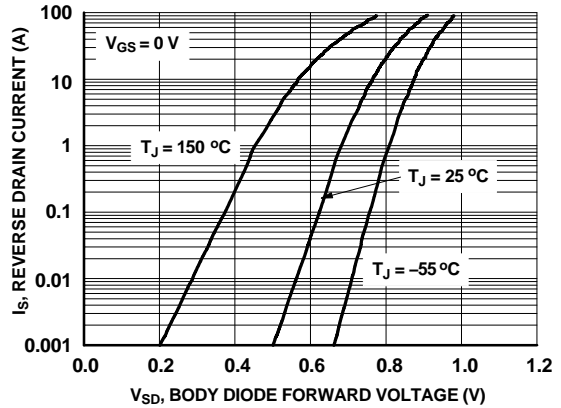


Figure 6. Source to Drain Diode Forward Voltage vs. Source Current

# FDMS1D2N03DSD

## TYPICAL CHARACTERISTICS (Q1 N-Channel)

( $T_J = 25^\circ\text{C}$  unless otherwise noted)

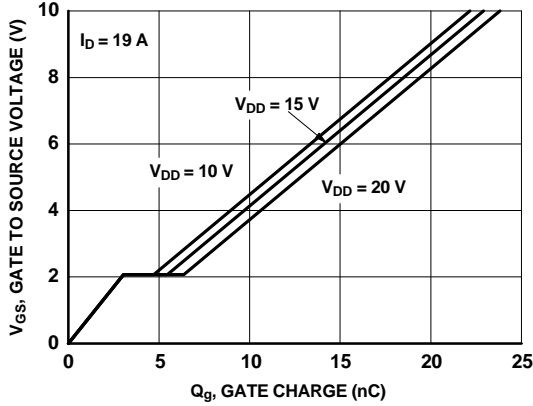


Figure 7. Gate Charge Characteristics

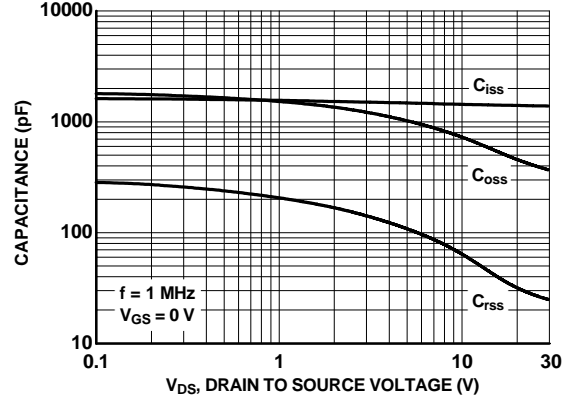


Figure 8. Capacitance vs. Drain to Source Voltage

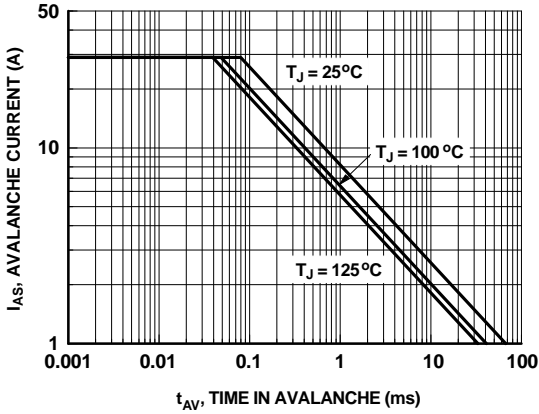


Figure 9. Unclamped Inductive Switching Capability

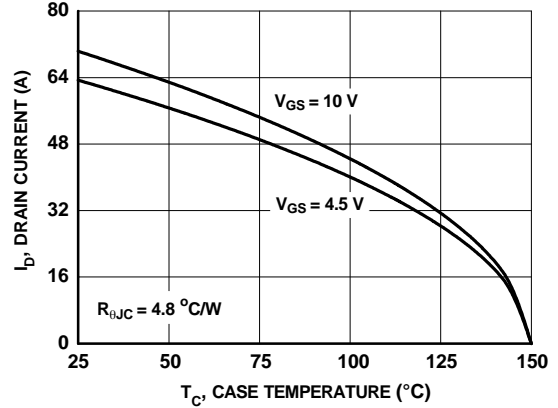


Figure 10. Maximum Continuous Drain Current vs. Case Temperature

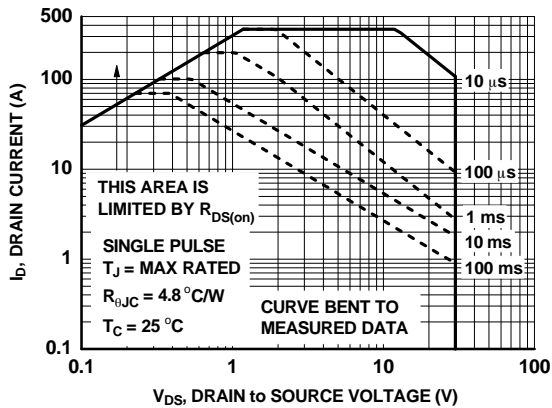


Figure 11. Forward Bias Safe Operating Area

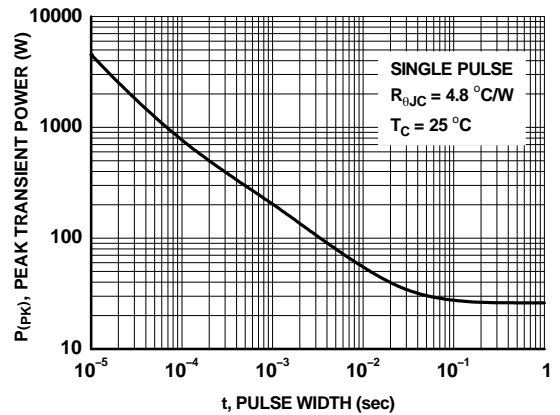


Figure 12. Single Pulse Maximum Power Dissipation

# FDMS1D2N03DSD

## TYPICAL CHARACTERISTICS (Q1 N-Channel)

( $T_J = 25^\circ\text{C}$  unless otherwise noted)

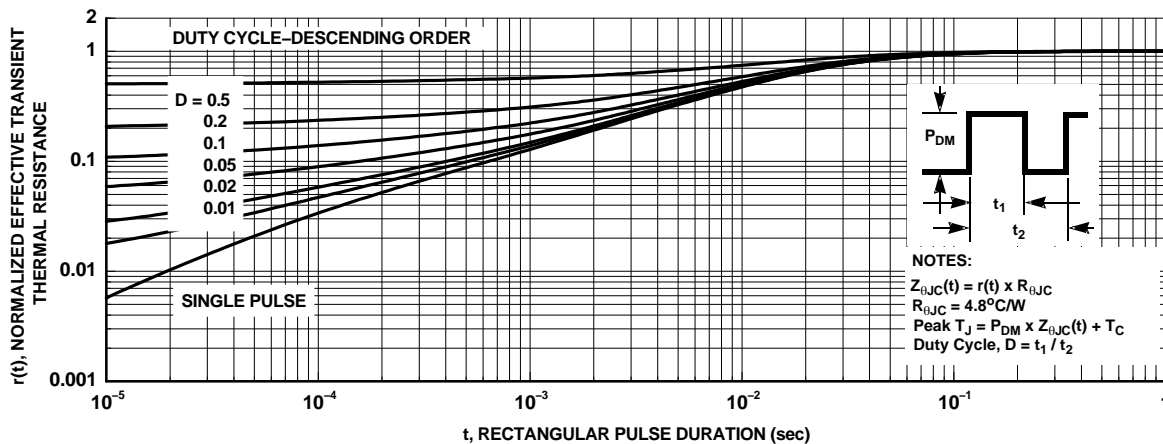


Figure 13. Junction-to-Case Transient Thermal Response Curve

# FDMS1D2N03DSD

## TYPICAL CHARACTERISTICS (Q2 N-Channel)

( $T_J = 25^\circ\text{C}$  unless otherwise noted)

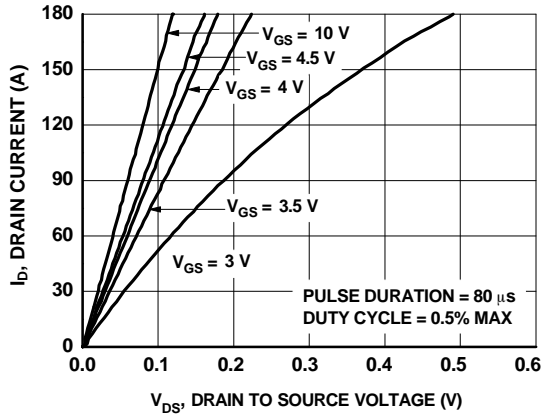


Figure 14. On-Region Characteristics

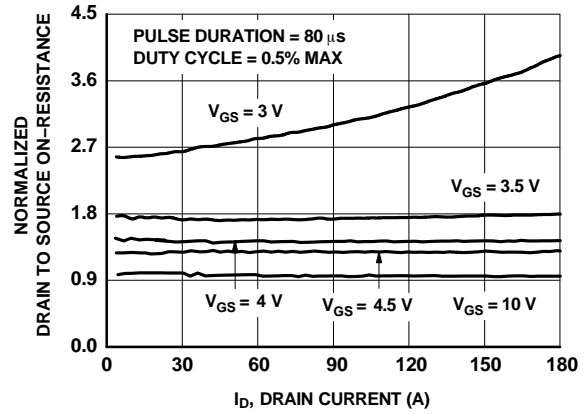


Figure 15. Normalized On-Resistance vs. Drain Current and Gate Voltage

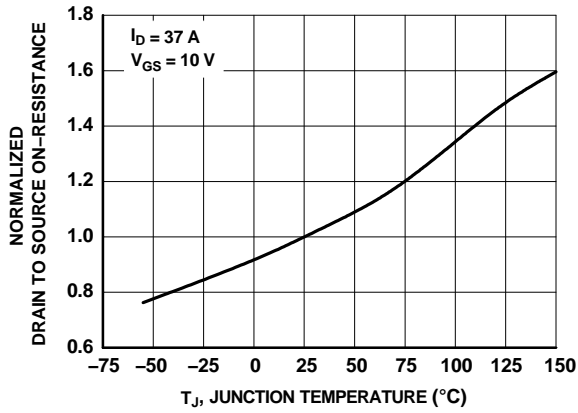


Figure 16. Normalized On-Resistance vs. Junction Temperature

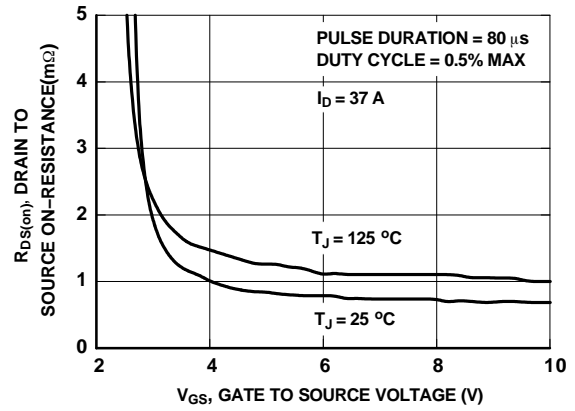


Figure 17. On-Resistance vs. Gate to Source Voltage

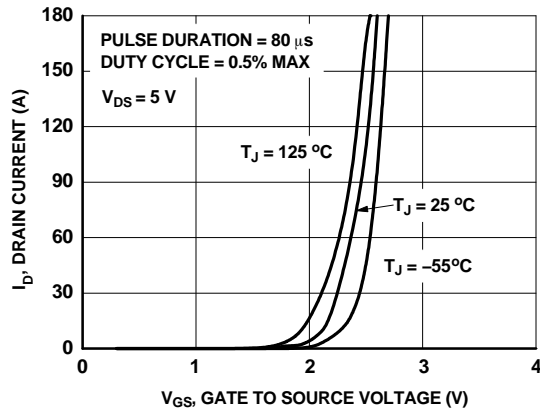


Figure 18. Transfer Characteristics

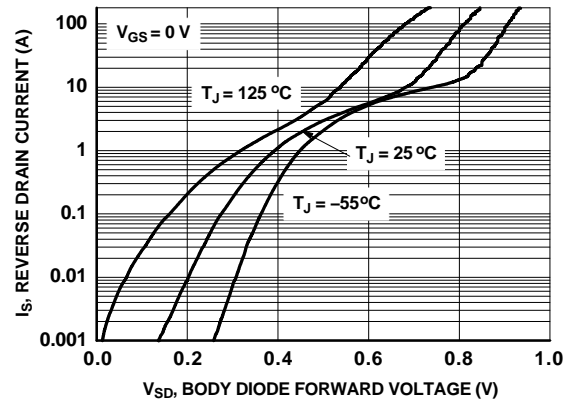


Figure 19. Source to Drain Diode Forward Voltage vs. Source Current



# FDMS1D2N03DSD

## TYPICAL CHARACTERISTICS (Q2 N-Channel)

( $T_J = 25^\circ\text{C}$  unless otherwise noted)

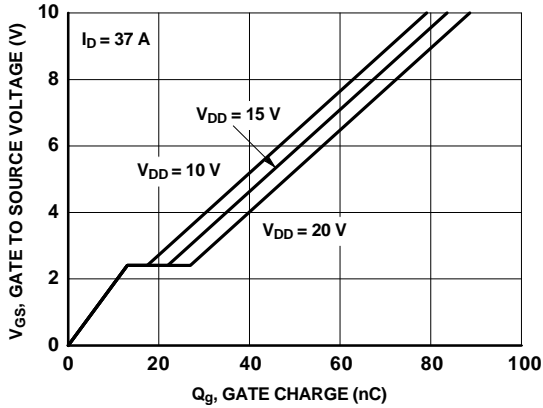


Figure 20. Gate Charge Characteristics

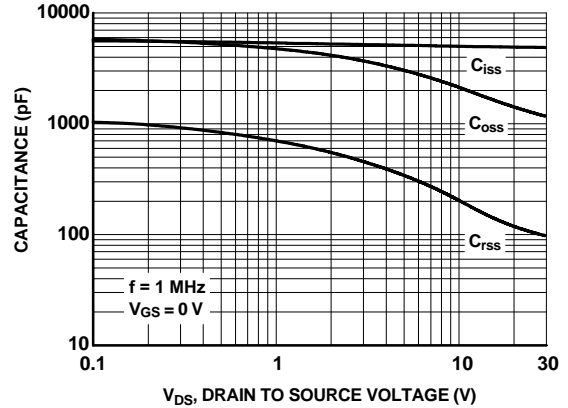


Figure 21. Capacitance vs. Drain to Source Voltage

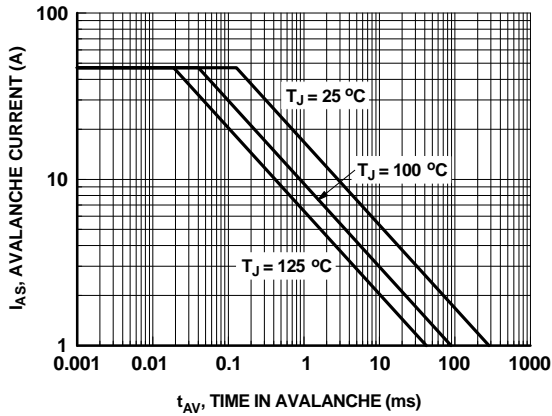


Figure 22. Unclamped Inductive Switching Capability

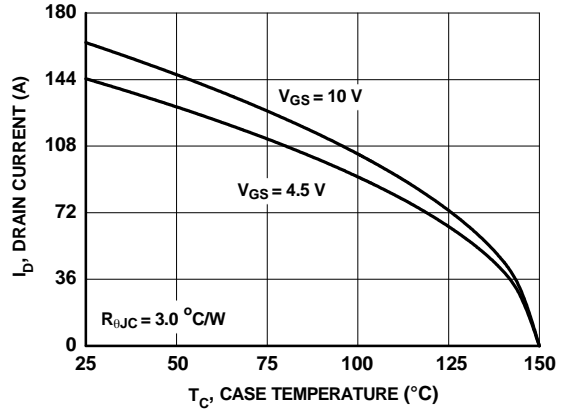


Figure 23. Maximum Continuous Drain Current vs. Case Temperature

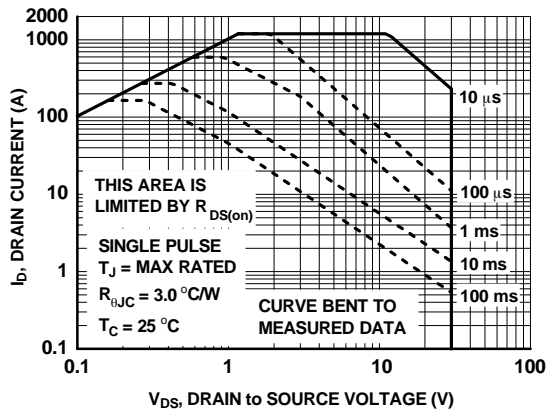


Figure 24. Forward Bias Safe Operating Area

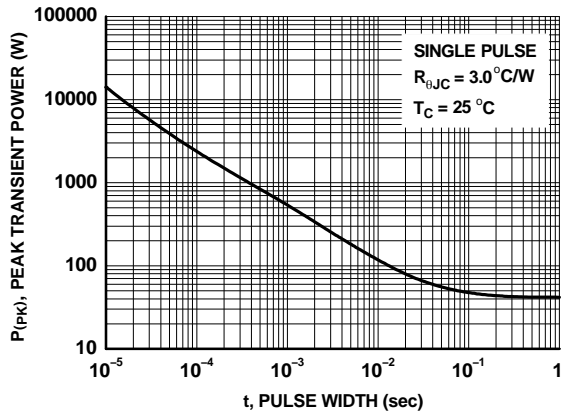


Figure 25. Single Pulse Maximum Power Dissipation

# FDMS1D2N03DSD

## TYPICAL CHARACTERISTICS (Q2 N-Channel)

( $T_J = 25^\circ\text{C}$  unless otherwise noted)

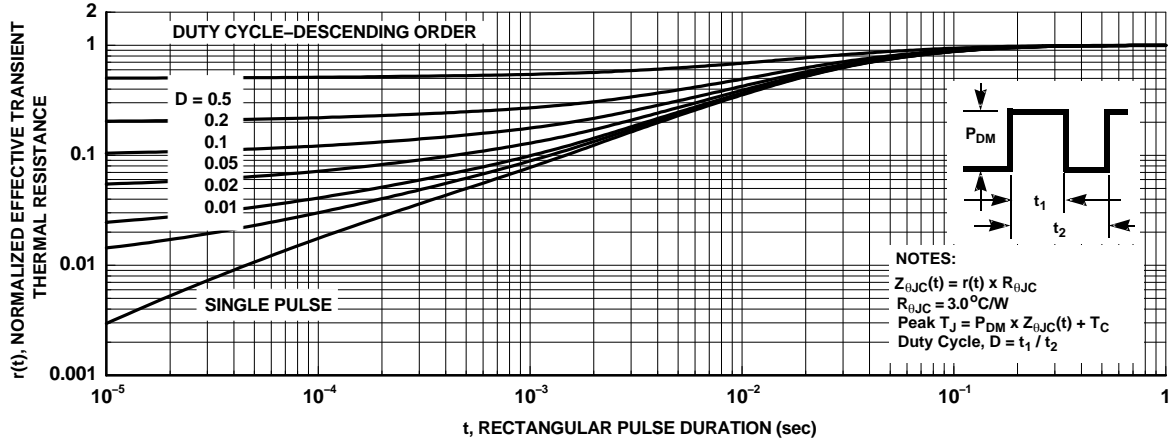


Figure 26. Junction-to-Case Transient Thermal Response Curve

# FDMS1D2N03DSD

## TYPICAL CHARACTERISTICS (continued)

### SyncFET Schottky Body Diode Characteristics

ON'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 FDMS1D2N03DSD.

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

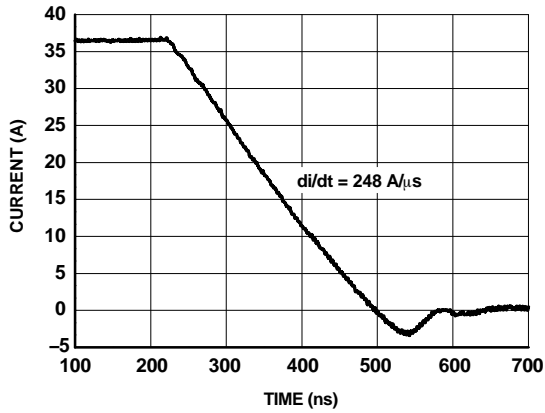


Figure 27. FDMS1D2N03DSD SyncFET Body Diode Reverse Recovery Characteristic

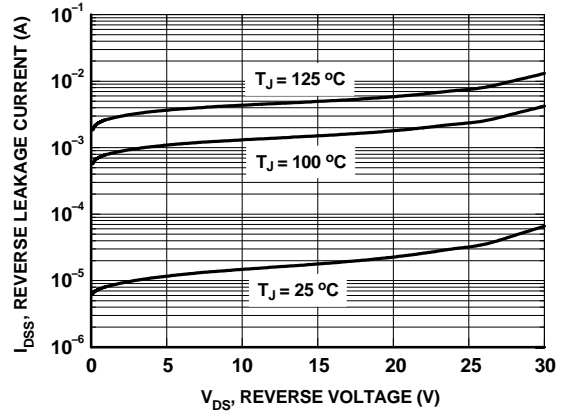



Figure 28. SyncFET Body Diode Reverse Leakage vs. Drain-Source Voltage





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