FAIRCHILD SEMICONDUCTOR®

September 2010

FDMS3604S

Dual N-Channel PowerTrench® MOSFET

N-Channel: 30 V, 30 A, 6.8 mΩ N-Channel: 30 V, 40 A, 2.6 mΩ

Features

Q1: N-Channel

- Max $r_{DS(on)}$ = 6.8 mΩ at V_{GS} = 10 V, I_D = 13 A
- Max $r_{DS(on)}$ = 9.8 mΩ at V_{GS} = 4.5 V, I_D = 11 A

Q2: N-Channel

- Max $r_{DS(on)}$ = 2.6 mΩ at V_{GS} = 10 V, I_D = 23 A
- Max $r_{DS(on)}$ = 3.5 mΩ at V_{GS} = 4.5 V, I_D = 21 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

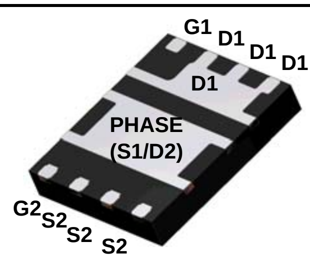
This device includes two specialized N-Channel MOSFETs in a dual PQFN package. The switch node has been internally connected to enable easy placement and routing of synchronous buck converters. The control MOSFET (Q1) and synchronous SyncFET (Q2) have been designed to provide optimal power efficiency.

Applications

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

Top

Power 56



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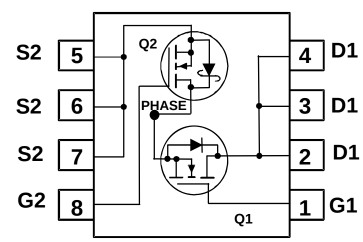


MOSFET Maximum Ratings T_A = 25 °C unless otherwise noted

Symbol	Parameter		Q1	Q2	Units
V_{DS}	Drain to Source Voltage		30	30	V
V_{GS}	Gate to Source Voltage	(Note 3)	±20	±20	V
I_D	Drain Current -Continuous (Package limited)	T_C = 25 °C	30	40	A
	-Continuous (Silicon limited)	T_C = 25 °C	60	130	
	-Continuous	T_A = 25 °C	13[1a]	23[1b]	
	-Pulsed		40	100	
E_{AS}	Single Pulse Avalanche Energy		40[4]	112[5]	mJ
P_D	Power Dissipation for Single Operation	T_A = 25 °C	2.2[1a]	2.5[1b]	W
	Power Dissipation for Single Operation	T_A = 25 °C	1.0[1c]	1.0[1d]	
T_J, T_{STG}	Operating and Storage Junction Temperature Range		-55 to +150		°C

Thermal Characteristics

$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	57[1a]	50[1b]	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	125[1c]	120[1d]	
$R_{\theta JC}$	Thermal Resistance, Junction to Case	3.5	2	

Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
22CA N7CC	FDMS3604S	Power 56	13 ”	12 mm	3000 units

Electrical Characteristics T_J = 25 °C unless otherwise noted

Off Characteristics

Symbol	Parameter	Test Conditions	Type	Min	Typ	Max	Units
BV_{DSS}	Drain to Source Breakdown Voltage	I_D = 250 μA, V_{GS} = 0 V I_D = 1 mA, V_{GS} = 0 V	Q1 Q2	30 30			V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	I_D = 250 μA, referenced to 25 °C I_D = 10 mA, referenced to 25 °C	Q1 Q2		15 12		mV/°C
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 24 V, V_{GS} = 0 V	Q1 Q2			1 500	μA μA
I_{GSS}	Gate to Source Leakage Current, Forwad	V_{GS} = 20 V, V_{DS}= 0 V	Q1 Q2			100 100	nA nA

On Characteristics

Symbol	Parameter	Test Conditions	Type	Min	Typ	Max	Units
$V_{GS(th)}$	Gate to Source Threshold Voltage	$V_{GS} = V_{DS}$, I_D = 250 μA $V_{GS} = V_{DS}$, I_D = 1 mA	Q1 Q2	1.1 1.1	2 1.8	2.7 3	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate to Source Threshold Voltage Temperature Coefficient	I_D = 250 μA, referenced to 25 °C I_D = 10 mA, referenced to 25 °C	Q1 Q2		-6 -5		mV/°C
$r_{DS(on)}$	Drain to Source On Resistance	V_{GS} = 10 V, I_D = 13 A V_{GS} = 4.5 V, I_D = 11 A V_{GS} = 10 V, I_D = 13 A , T_J = 125 °C	Q1		5.2 7.5 6.2	6.8 9.8 9.2	mΩ
		V_{GS} = 10 V, I_D = 23 A V_{GS} = 4.5 V, I_D = 21 A V_{GS} = 10 V, I_D = 23 A , T_J = 125 °C	Q2		2 2.6 2.6	2.6 3.5 4	
g_{FS}	Forward Transconductance	V_{DS} = 5 V, I_D = 13 A V_{DS} = 5 V, I_D = 23 A	Q1 Q2		61 130		S

Dynamic Characteristics

Symbol	Parameter	Test Conditions	Type	Min	Typ	Max	Units
C_{iss}	Input Capacitance	Q1: V_{DS} = 15 V, V_{GS} = 0 V, f = 1 MHZ Q2: V_{DS} = 15 V, V_{GS} = 0 V, f = 1 MHZ	Q1 Q2		1340 3240	1785 4310	pF
C_{oss}	Output Capacitance		Q1 Q2		485 1230	645 1635	pF
C_{rss}	Reverse Transfer Capacitance		Q1 Q2		53 103	80 155	pF
R_g	Gate Resistance		Q1 Q2	0.2 0.2	0.6 0.8	2.0 3.0	Ω

Switching Characteristics

Symbol	Parameter	Test Conditions	Type	Min	Typ	Max	Units
$t_{d(on)}$	Turn-On Delay Time	Q1: V_{DD} = 15 V, I_D = 13 A, R_{GEN} = 6 Ω Q2: V_{DD} = 15 V, I_D = 23 A, R_{GEN} = 6 Ω	Q1 Q2		8.2 13	16 23	ns
t_r	Rise Time		Q1 Q2		2.5 4.8	10 10	ns
$t_{d(off)}$	Turn-Off Delay Time		Q1 Q2		20 31	32 50	ns
t_f	Fall Time		Q1 Q2		2.2 3.4	10 10	ns
Q_g	Total Gate Charge	V_{GS} = 0 V to 10 V; Q1 V_{DD} = 15 V, I_D = 13 A; Q2 V_{DD} = 15 V, I_D = 23 A	Q1 Q2		21 47	29 66	nC
Q_g	Total Gate Charge	V_{GS} = 0 V to 4.5 V	Q1 Q2		10 22	14 31	nC
Q_{gs}	Gate to Source Gate Charge		Q1 Q2		3.9 9		nC
Q_{gd}	Gate to Drain “Miller” Charge		Q1 Q2		3.1 5.5		nC

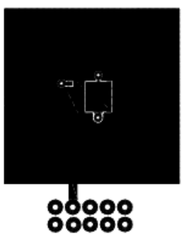
Electrical Characteristics T_J = 25 °C unless otherwise noted

Drain-Source Diode Characteristics

Symbol	Parameter	Test Conditions	Type	Min	Typ	Max	Units
V_{SD}	Source to Drain Diode Forward Voltage	V_{GS} = 0 V, I_S = 13 A (Note 2) V_{GS} = 0 V, I_S = 23A (Note 2)	Q1 Q2		0.8 0.8	1.2 1.2	V
t_{rr}	Reverse Recovery Time	Q1 I_F = 13 A, di/dt = 100 A/μs	Q1 Q2		25 32	40 51	ns
Q_{rr}	Reverse Recovery Charge	Q2 I_F = 23 A, di/dt = 300 A/μs	Q1 Q2		9 39	18 62	nC

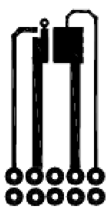
Notes:

1: $R_{\theta JA}$ 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. $R_{\theta JC}$ is guaranteed by design while $R_{\theta CA}$ is determined by the user's board design.

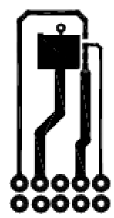


a. 57 °C/W when mounted on a 1 in^2 pad of 2 oz copper

b. 50 °C/W when mounted on a 1 in^2 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 μs, Duty cycle < 2.0%.

3: As an N-ch device, the negative Vgs rating is for low duty cycle pulse ocurrence only. No continuous rating is implied.

4: E_{AS} of 40 mJ is based on starting T_J = 25 ^oC; N-ch: L = 1 mH, I_{AS} = 9 A, V_{DD} = 27 V, V_{GS} = 10 V. 100% test at L= 0.3 mH, I_{AS} = 14 A.

5: E_{AS} of 112 mJ is based on starting T_J = 25 ^oC; N-ch: L = 1 mH, I_{AS} = 15 A, V_{DD} = 27 V, V_{GS} = 10 V. 100% test at L= 0.3 mH, I_{AS} = 22 A.

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

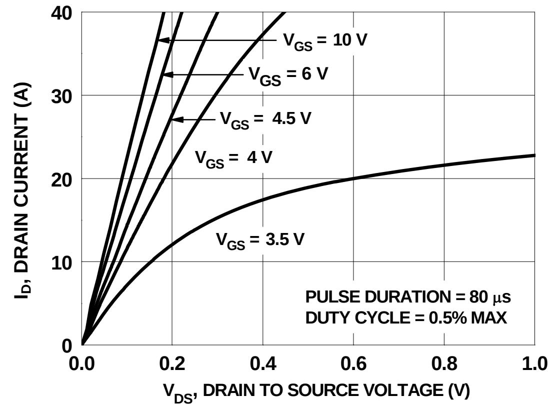

Figure 1. On Region Characteristics

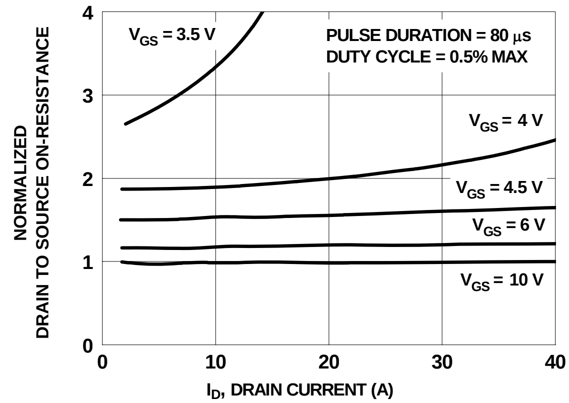

Figure 2. Normalized On-Resistance vs Drain Current and Gate Voltage

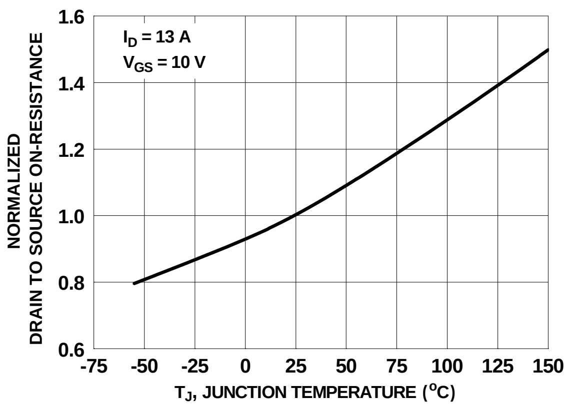

Figure 3. Normalized On Resistance vs Junction Temperature

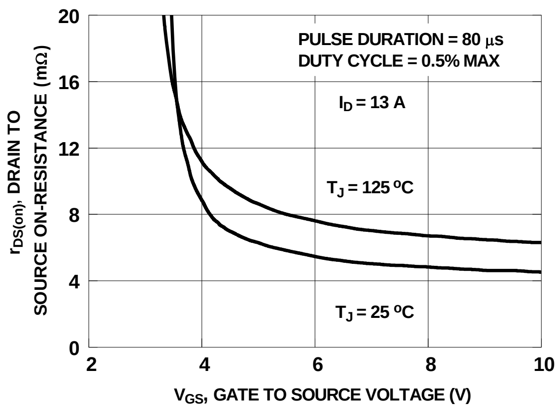

Figure 4. On-Resistance vs Gate to Source Voltage

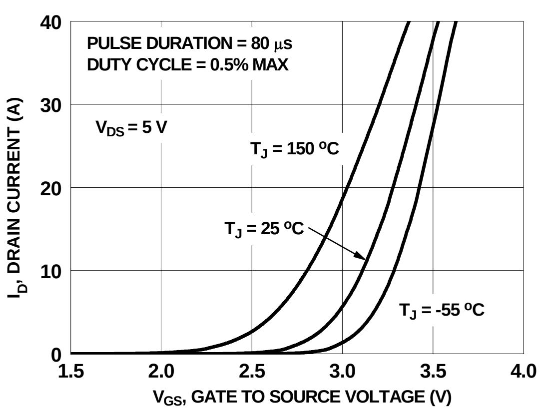

Figure 5. Transfer Characteristics

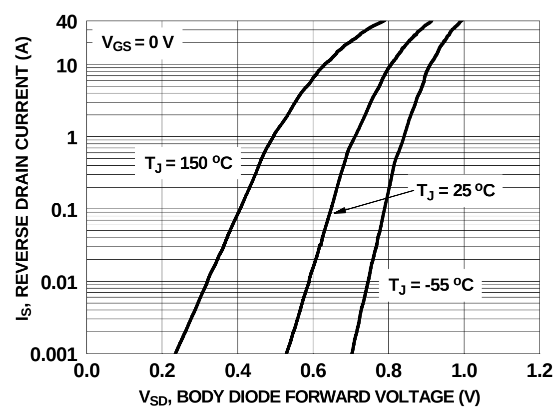

Figure 6. Source to Drain Diode Forward Voltage vs Source Current

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

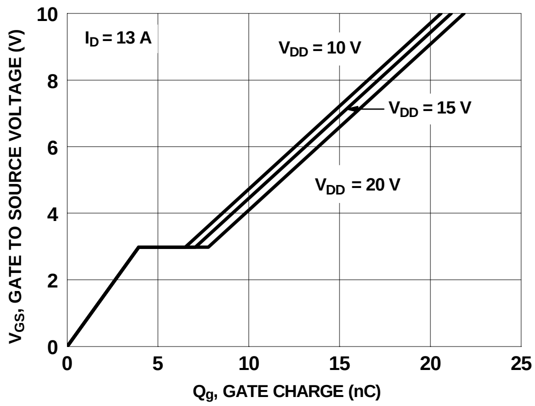

Figure 7. Gate Charge Characteristics

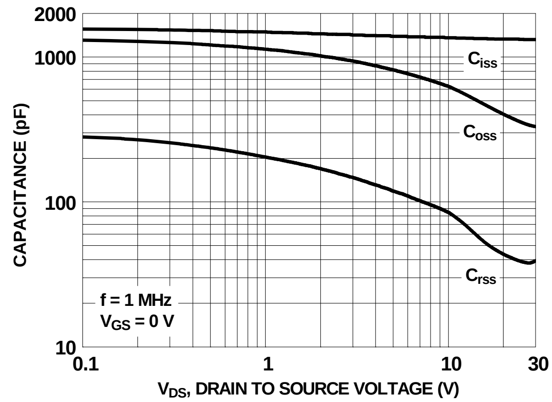

Figure 8. Capacitance vs Drain to Source Voltage

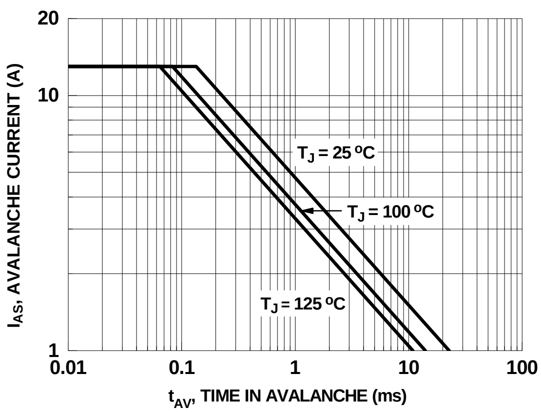

Figure 9. Unclamped Inductive Switching Capability

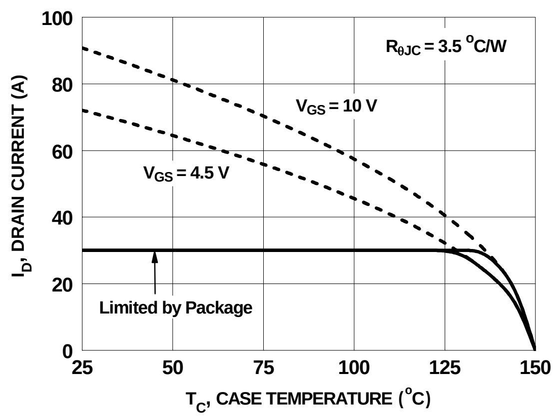

Figure 10. Maximum Continuous Drain Current vs Case Temperature

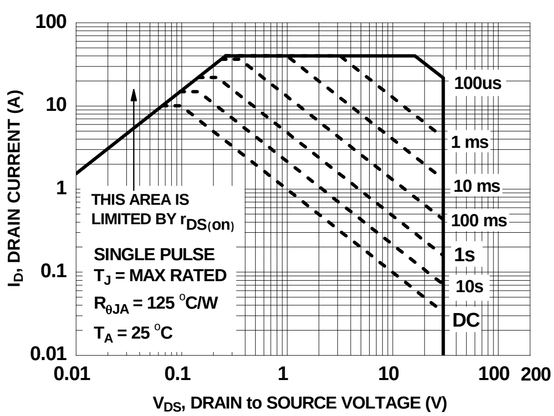

Figure 11. Forward Bias Safe Operating Area

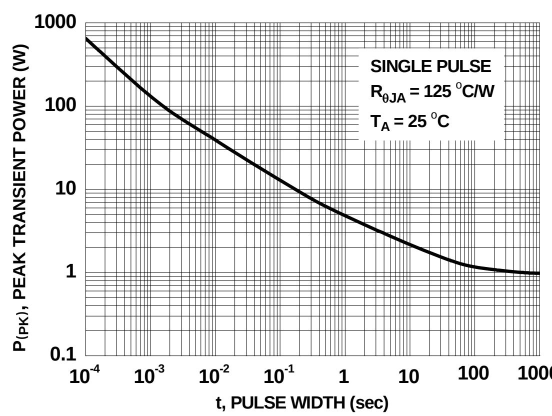

Figure 12. Single Pulse Maximum Power Dissipation

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

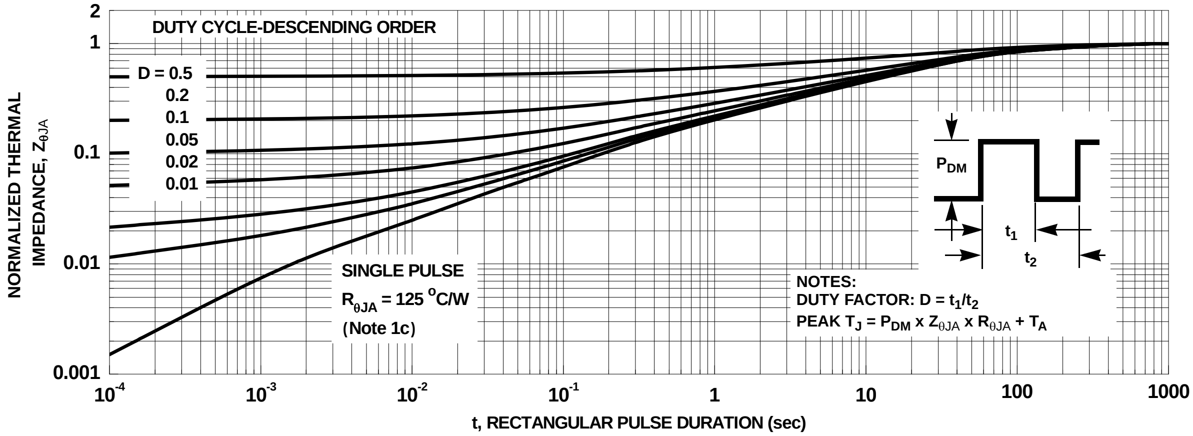

Figure 13. Junction-to-Ambient Transient Thermal Response Curve

Typical Characteristics (Q2 N-Channel) T_J = 25 °C unlenss otherwise noted

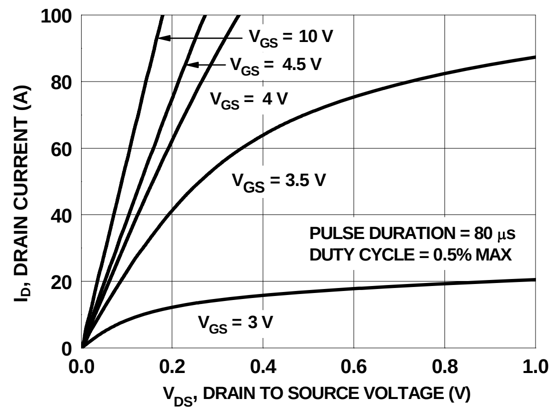

Figure 14. On-Region Characteristics

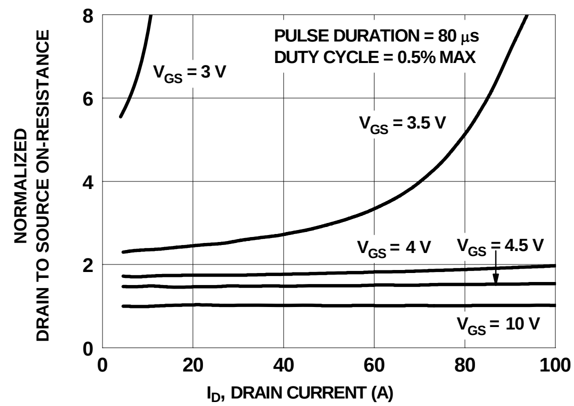

Figure 15. Normalized on-Resistance vs Drain Current and Gate Voltage

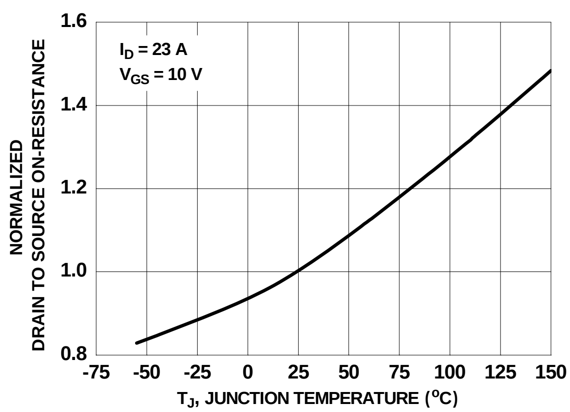

Figure 16. Normalized On-Resistance vs Junction Temperature

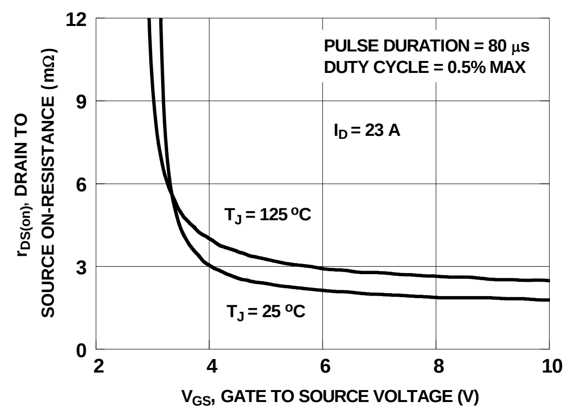

Figure 17. On-Resistance vs Gate to Source Voltage

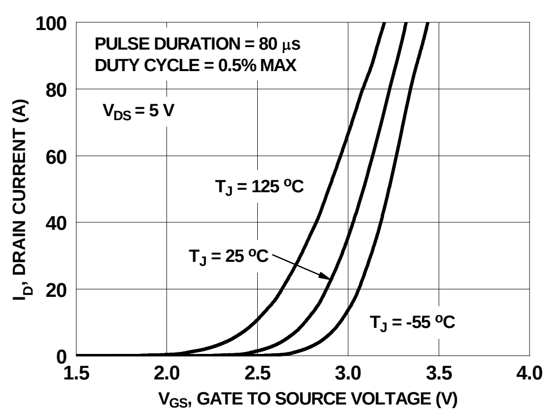

Figure 18. Transfer Characteristics

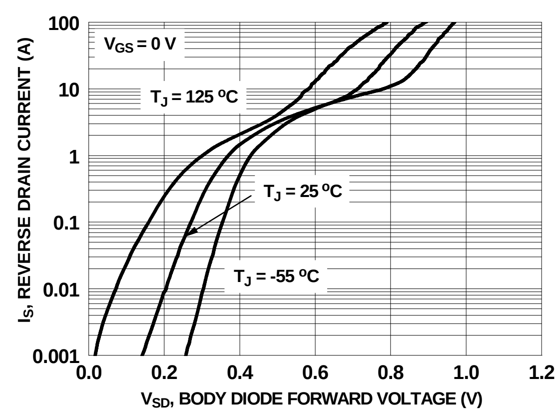

Figure 19. Source to Drain Diode Forward Voltage vs Source Current

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

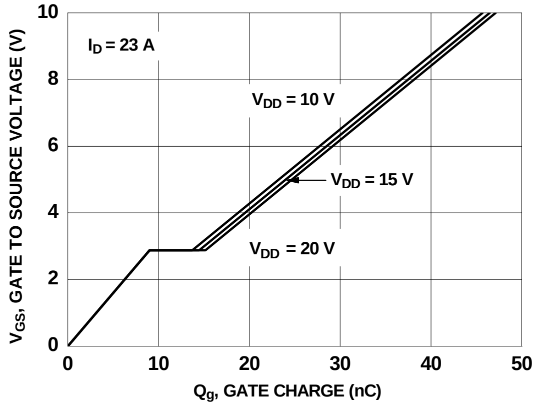

Figure 20. Gate Charge Characteristics

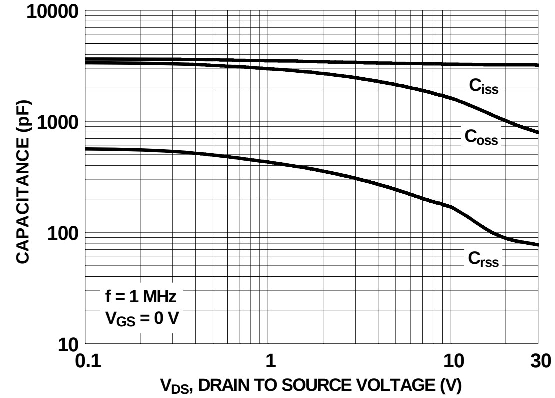

Figure 21. Capacitance vs Drain to Source Voltage

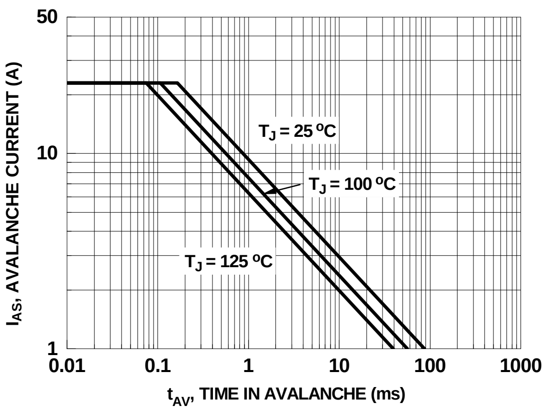

Figure 22. Unclamped Inductive Switching Capability

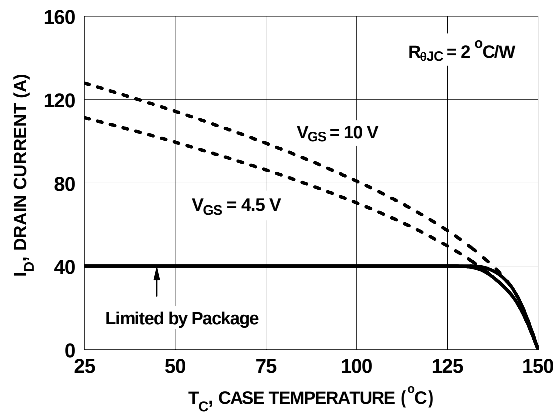

Figure 23. Maximun Continuous Drain Current vs Case Temperature

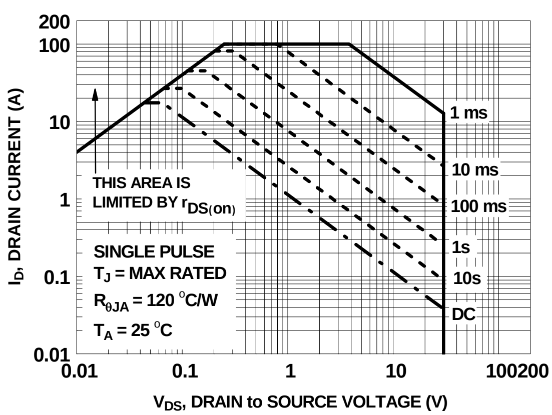

Figure 24. Forward Bias Safe Operating Area

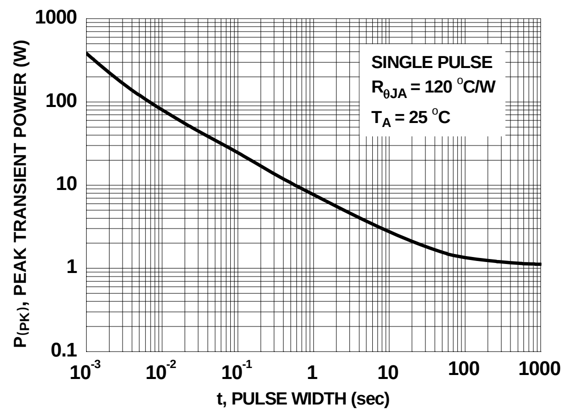

Figure 25. Single Pulse Maximum Power Dissipation

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Typical Characteristics (Q2 N-Channel) $T_J = 25\ ^oC$ unless otherwise noted

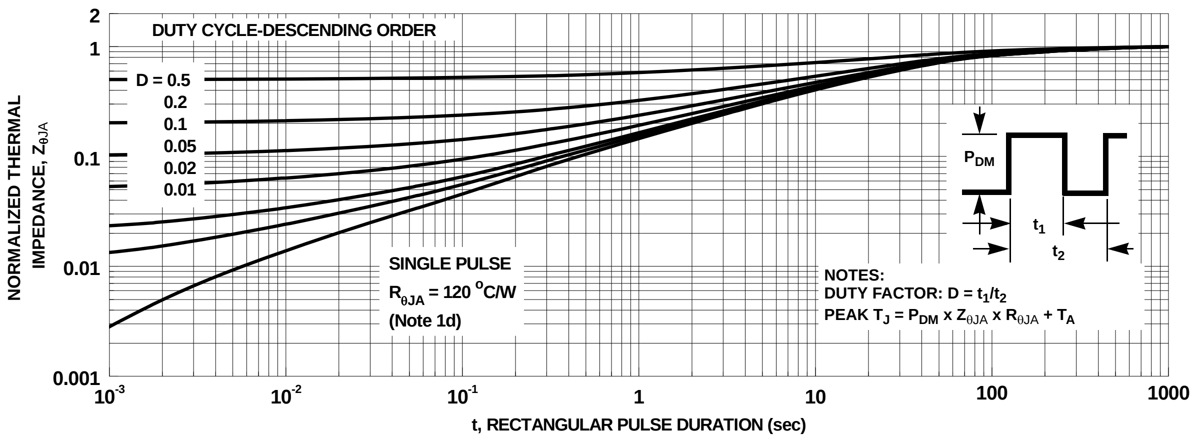


Figure 26. Junction-to-Ambient Transient Thermal Response Curve

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 FDMS3604S.

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

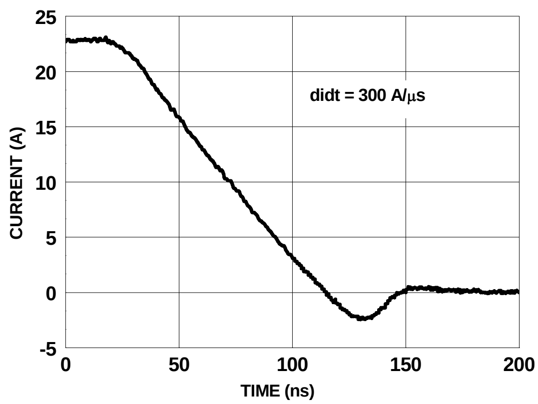


Figure 27. FDMS3604S SyncFET body diode reverse recovery characteristic

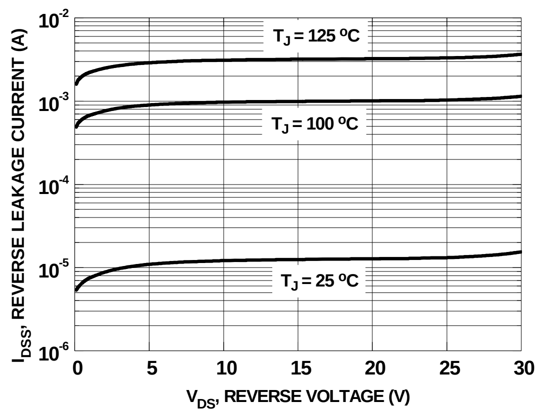
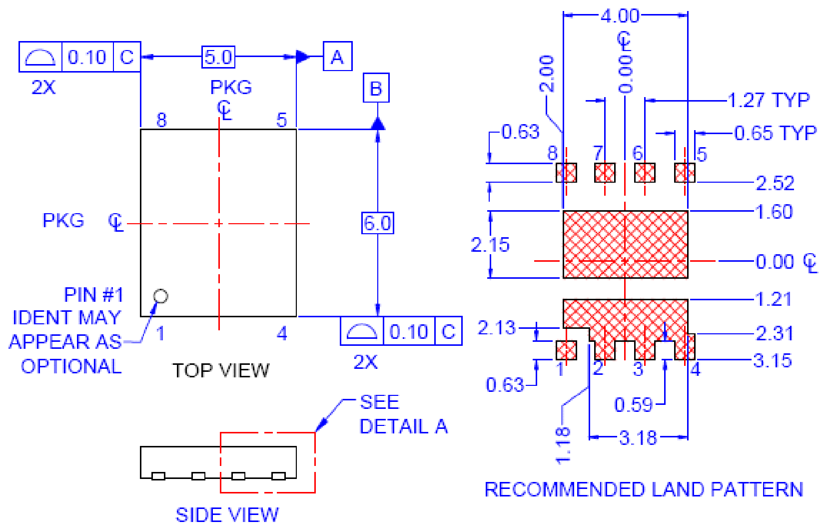
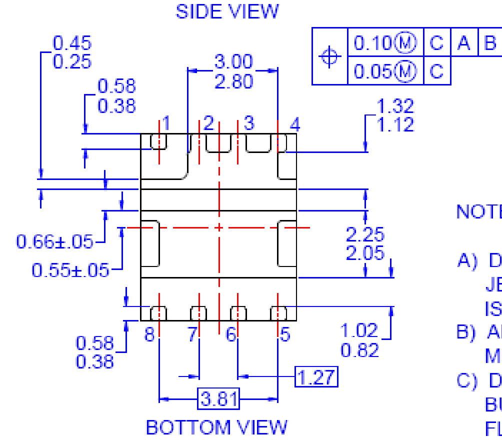
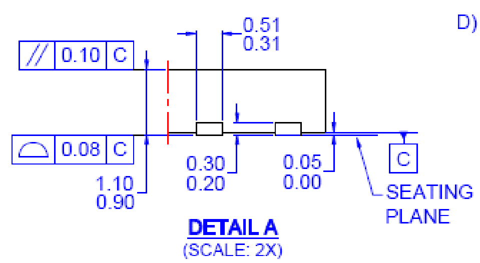


Figure 28. SyncFET body diode reverse leakage versus drain-source voltage

Dimensional Outline and Pad Layout







NOTES: UNLESS OTHERWISE SPECIFIED

A) DOES NOT FULLY CONFORM TO JEDEC REGISTRATION, MO-240, ISSUE B DATED 10/2009.
B) ALL DIMENSIONS ARE IN MILLIMETERS.
C) DIMENSIONS DO NOT INCLUDE BURRS OR MOLD FLASH. MOLD FLASH OR BURRS DOES NOT EXCEED 0.10MM.
D) DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994.

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2. A critical component in any component of a life support, device, or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

ANTI-COUNTERFEITING POLICY

Fairchild Semiconductor Corporation's Anti-Counterfeiting Policy. Fairchild's Anti-Counterfeiting Policy is also stated on our external website, www.Fairchildsemi.com, under Sales Support.

Counterfeiting of semiconductor parts is a growing problem in the industry. All manufactures of semiconductor products are experiencing counterfeiting of their parts. Customers who inadvertently purchase counterfeit parts experience many problems such as loss of brand reputation, substandard performance, failed application, and increased cost of production and manufacturing delays. Fairchild is taking strong measures to protect ourselves and our customers from the proliferation of counterfeit parts. Fairchild strongly encourages customers to purchase Fairchild parts either directly from Fairchild or from Authorized Fairchild Distributors who are listed by country on our web page cited above. Products customers buy either from Fairchild directly or from Authorized Fairchild Distributors are genuine parts, have full traceability, meet Fairchild's quality standards for handing and storage and provide access to Fairchild's full range of up-to-date technical and product information. Fairchild and our Authorized Distributors will stand behind all warranties and will appropriately address and warranty issues that may arise. Fairchild will not provide any warranty coverage or other assistance for parts bought from Unauthorized Sources. Fairchild is committed to combat this global problem and encourage our customers to do their part in stopping this practice by buying direct or from authorized distributors.

PRODUCT STATUS DEFINITIONS

Definition of Terms

Datasheet Identification	Product Status	Definition
Advance Information	Formative / In Design	Datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
Preliminary	First Production	Datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
No Identification Needed	Full Production	Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design.
Obsolete	Not In Production	Datasheet contains specifications on a product that is discontinued by Fairchild Semiconductor. The datasheet is for reference information only.

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