FAIRCHILD SEMICONDUCTOR®

April 2010

FDML7610S

Dual N-Channel PowerTrench® MOSFET

N-Channel: 30 V, 30 A, 7.5 mΩ N-Channel: 30 V, 28 A, 4.2 mΩ

Features

Q1: N-Channel

- Max $r_{DS(on)}$ = 7.5 mΩ at V_{GS} = 10 V, I_D = 12 A
- Max $r_{DS(on)}$ = 12 mΩ at V_{GS} = 4.5 V, I_D = 10 A

Q2: N-Channel

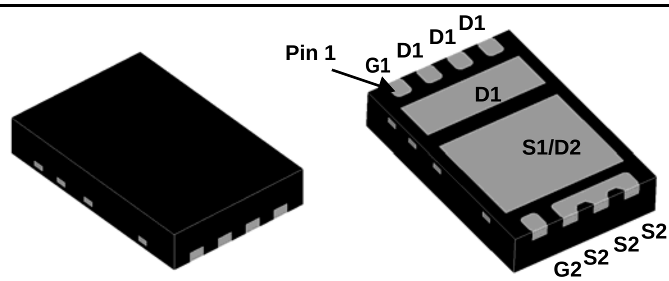
- Max $r_{DS(on)}$ = 4.2 mΩ at V_{GS} = 10 V, I_D = 17 A
- Max $r_{DS(on)}$ = 5.5 mΩ at V_{GS} = 4.5 V, I_D = 14 A
- RoHS Compliant

General Description

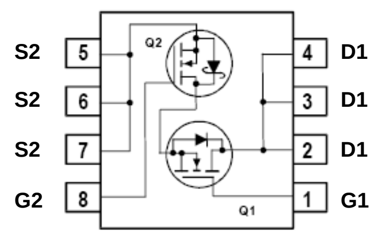
This device includes two specialized N-Channel MOSFETs in a dual MLP package.The switch node has been internally connected to enable easy placement and routing of synchronous buck converters. The control MOSFET (Q1) and synchronous SyncFET (Q2) have been designed to provide optimal power efficiency.

Applications

- Computing
- Communications
- General Purpose Point of Load
- Notebook V_{CORE}



Top MLP 3X4.5 Bottom



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	28	A
	-Continuous (Silicon limited)	T_C = 25 °C	40	60	
	-Continuous	T_A = 25 °C	12[1a]	17[1b]	
	-Pulsed		40	40	
P_D	Power Dissipation for Single Operation	T_A = 25 °C	2.1[1a]	2.2[1b]	W
		T_A = 25 °C	0.8[1c]	0.9[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	60[1a]	56[1b]	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	150[1c]	140[1d]	
$R_{\theta JC}$	Thermal Resistance, Junction to Case	4	3.5	

Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FDML7610S	FDML7610S	MLP3X4.5	13 ”	12 mm	3000 units

Electrical Characteristics T_J = 25 °C unless otherwise noted

Symbol	Parameter	Test Conditions	Type	Min	Typ	Max	Units

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 14		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	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	1.8 1.8	3 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 = 12 A V_{GS} = 4.5 V, I_D = 10 A V_{GS} = 10 V, I_D = 12 A , T_J = 125 °C	Q1		6.0 8.5 8.3	7.5 12 12	mΩ
		V_{GS} = 10 V, I_D = 17 A V_{GS} = 4.5 V, I_D = 14 A V_{GS} = 10 V, I_D = 17 A , T_J = 125 °C	Q2		3.2 4.1 4.1	4.2 5.5 6	
g_{FS}	Forward Transconductance	V_{DS} = 5 V, I_D = 12 A V_{DS} = 5 V, I_D = 17 A	Q1 Q2		63 86		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		1315 2960	1750 3940	pF
C_{oss}	Output Capacitance		Q1 Q2		455 1135	600 1510	pF
C_{rss}	Reverse Transfer Capacitance		Q1 Q2		45 100	70 150	pF
R_g	Gate Resistance		Q1 Q2		0.9 0.6		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 = 12 A, V_{GS} = 10 V, R_{GEN} = 6 Ω Q2: V_{DD} = 15 V, I_D = 17 A, V_{GS} = 10 V, R_{GEN} = 6 Ω		Q1 Q2		8.6 13	18 23	ns
t_r	Rise Time			Q1 Q2		2.5 4	10 10	ns
$t_{d(off)}$	Turn-Off Delay Time			Q1 Q2		20 31	32 49	ns
t_f	Fall Time			Q1 Q2		2.3 3.1	10 10	ns
Q_g	Total Gate Charge	V_{GS} = 0 V to 10 V	Q1 V_{DD} = 15 V, I_D = 12 A Q2 V_{DD} = 15 V, I_D = 17A	Q1 Q2		20 43	28 60	nC
Q_g	Total Gate Charge	V_{GS} = 0 V to 4.5 V		Q1 Q2		9.3 20	13 28	nC
Q_{gs}	Gate to Source Gate Charge			Q1 Q2		4.3 8.9		nC
Q_{gd}	Gate to Drain “Miller” Charge			Q1 Q2		2.2 4.7		nC

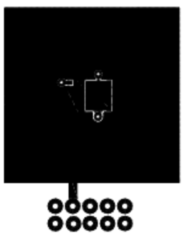
Electrical Characteristics T_J = 25 °C unless otherwise noted

Drain-Source Diode Characteristics

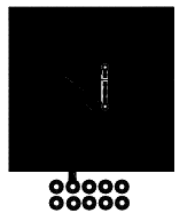
Symbol	Parameter	Test Conditions	Type	Min	Typ	Max	Units
V_{SD}	Source to Drain Diode Forward Voltage	V_{GS} = 0 V, I_S = 12 A (Note 2) V_{GS} = 0 V, I_S = 17 A (Note 2)	Q1 Q2		0.8 0.8	1.2 1.2	V
t_{rr}	Reverse Recovery Time	Q1 I_F = 12 A, di/dt = 100 A/μs	Q1 Q2		27 35	43 56	ns
Q_{rr}	Reverse Recovery Charge	Q2 I_F = 17 A, di/dt = 300 A/μs	Q1 Q2		10 40	18 64	nC

Notes:

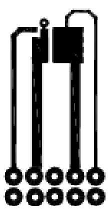
1: $R_{\theta JA}$ is determined with the device mounted on a 1 in^2 pad 2 oz copper pad on a 1.5 x 1.5 in. board of FR-4 material. $R_{\theta JC}$ is guaranteed by design while $R_{\theta CA}$ is determined by the user's board design.



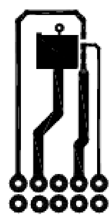
a. 60 °C/W when mounted on a 1 in^2 pad of 2 oz copper



b. 56 °C/W when mounted on a 1 in^2 pad of 2 oz copper



c. 150 °C/W when mounted on a minimum pad of 2 oz copper



d. 140 °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.

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

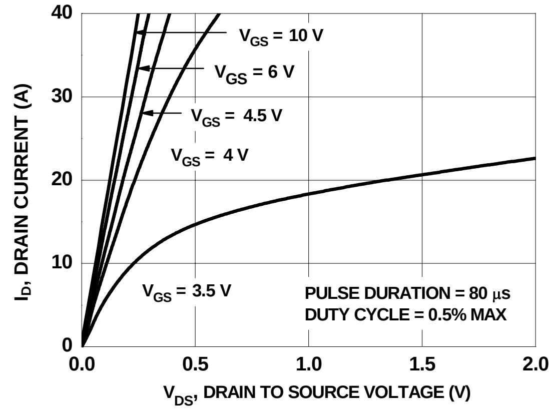


Figure 1. On Region Characteristics

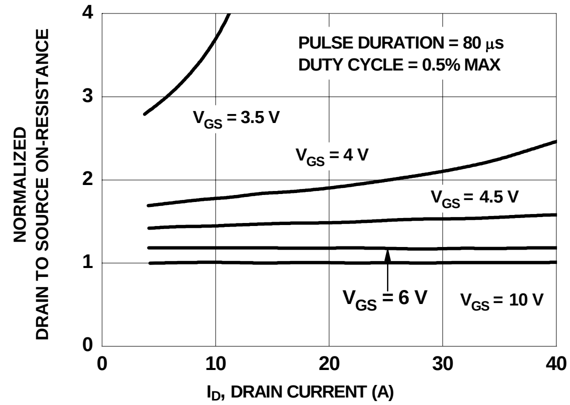


Figure 2. Normalized On-Resistance vs Drain Current and Gate Voltage

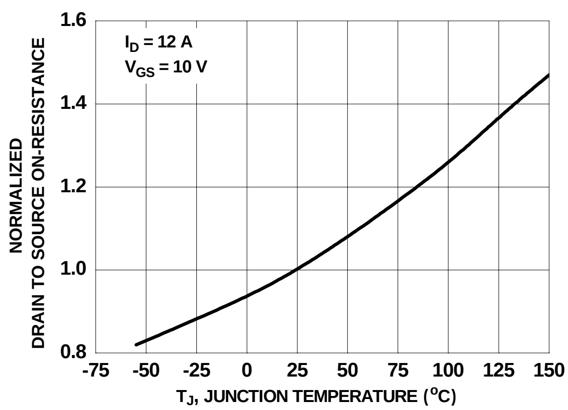


Figure 3. Normalized On Resistance vs Junction Temperature

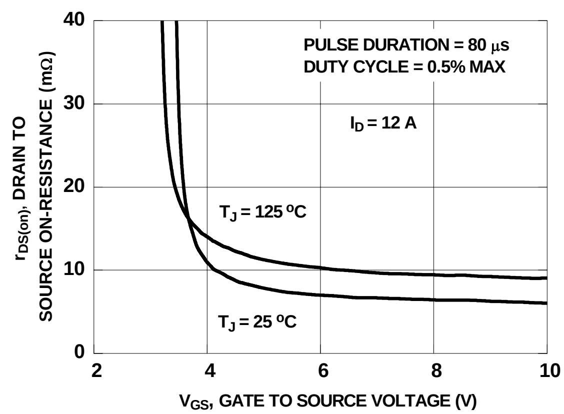


Figure 4. On-Resistance vs Gate to Source Voltage

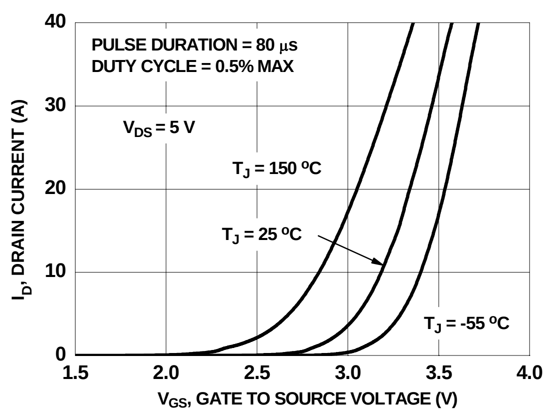


Figure 5. Transfer Characteristics

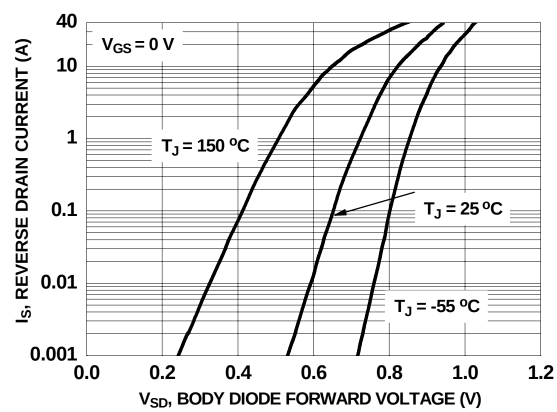


Figure 6. Source to Drain Diode Forward Voltage vs Source Current

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

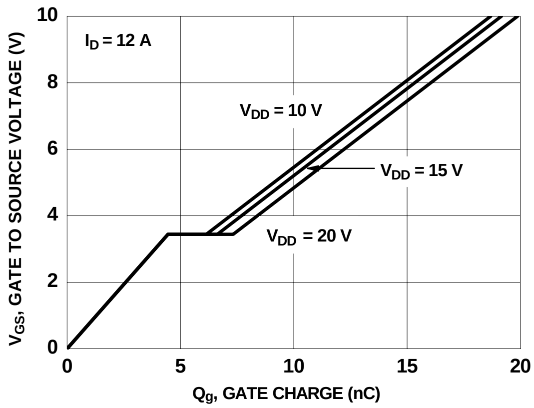


Figure 7. Gate Charge Characteristics

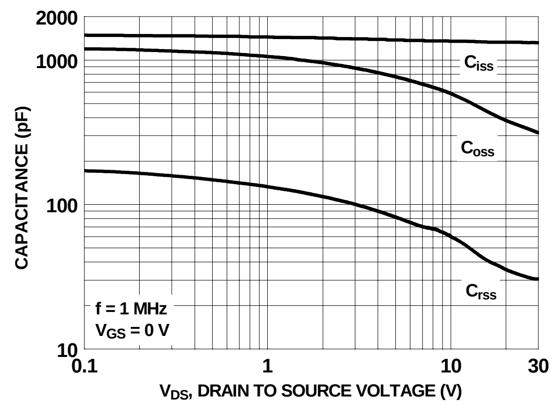


Figure 8. Capacitance vs Drain to Source Voltage

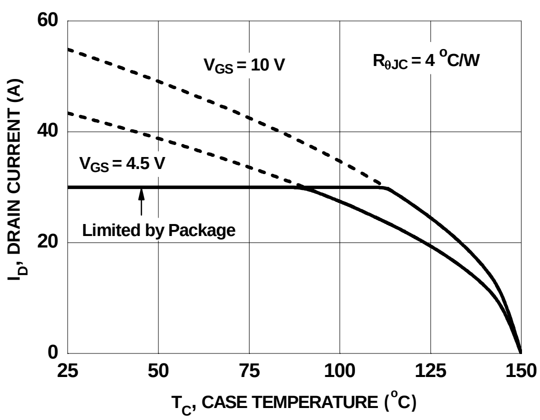


Figure 9. Maximum Continuous Drain Current vs Case Temperature

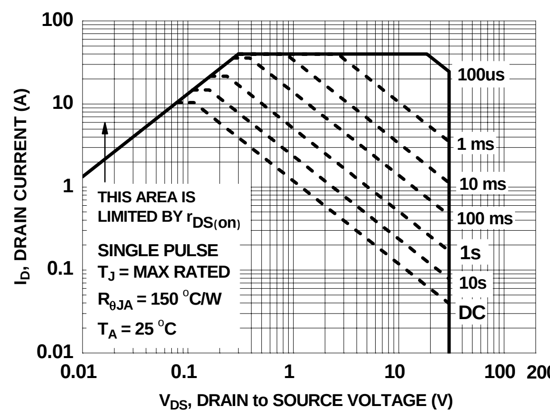


Figure 10. Forward Bias Safe Operating Area

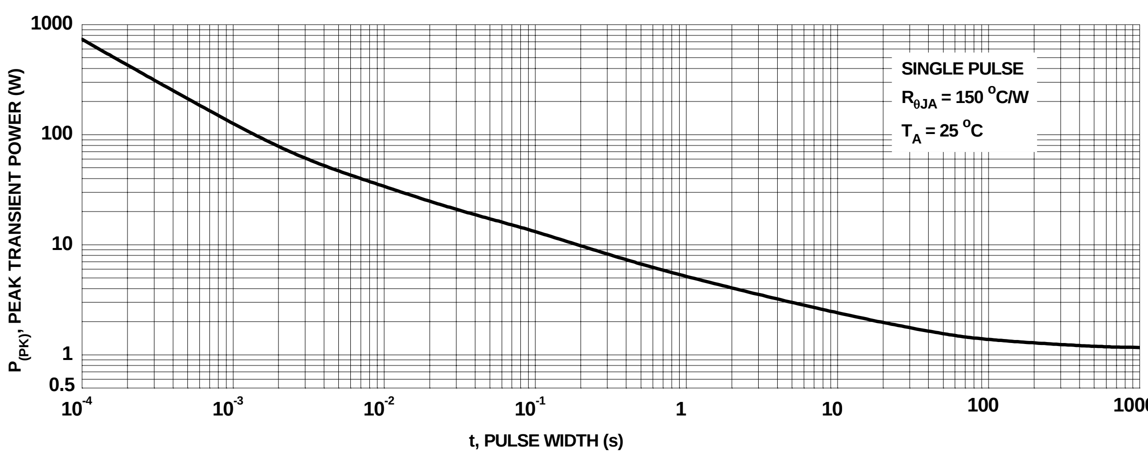


Figure 11. Single Pulse Maximum Power Dissipation

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

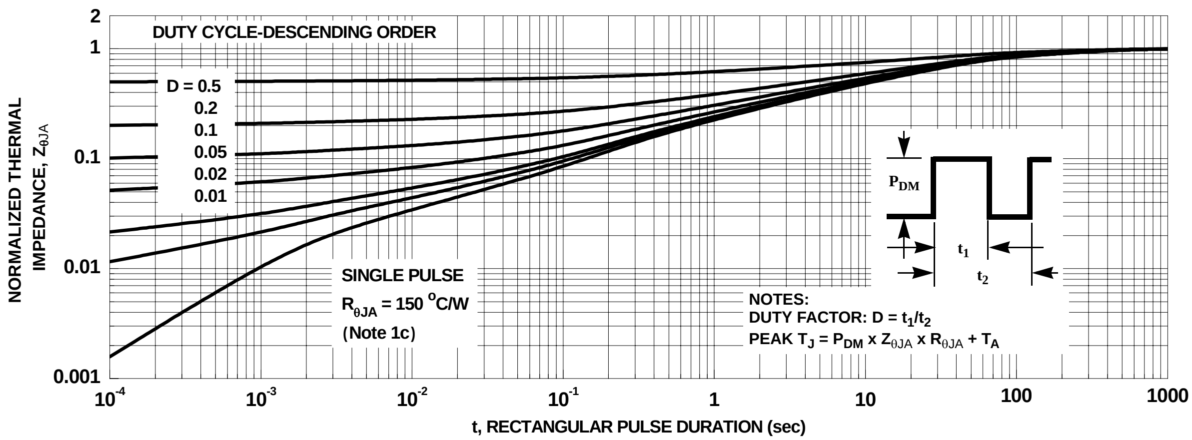


Figure 12. Junction-to-Ambient Transient Thermal Response Curve

Typical Characteristics (Q2 SyncFET) T_J = 25 °C unlenss otherwise noted

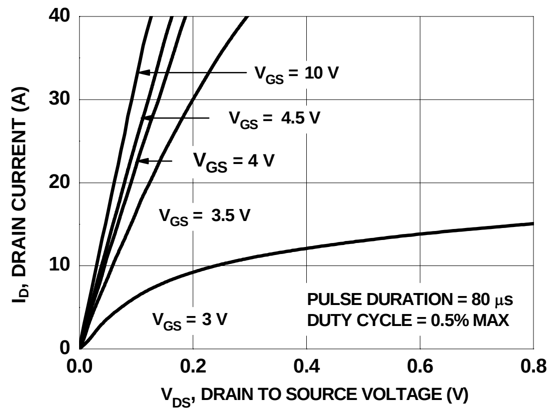


Figure 13. On-Region Characteristics

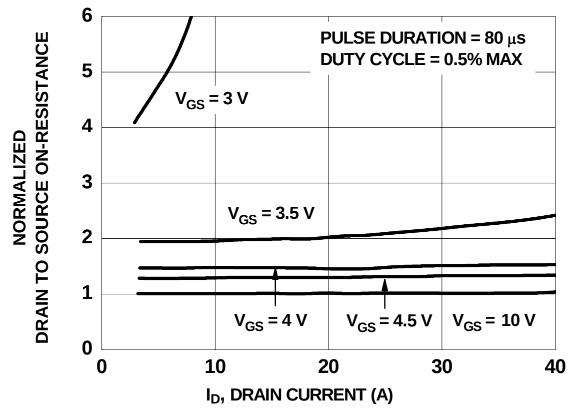


Figure 14. Normalized on-Resistance vs Drain Current and Gate Voltage

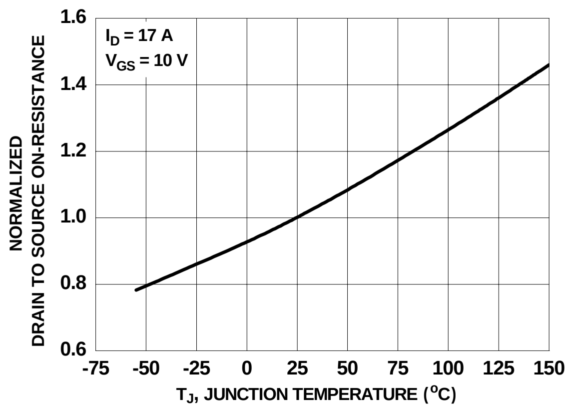


Figure 15. Normalized On-Resistance vs Junction Temperature

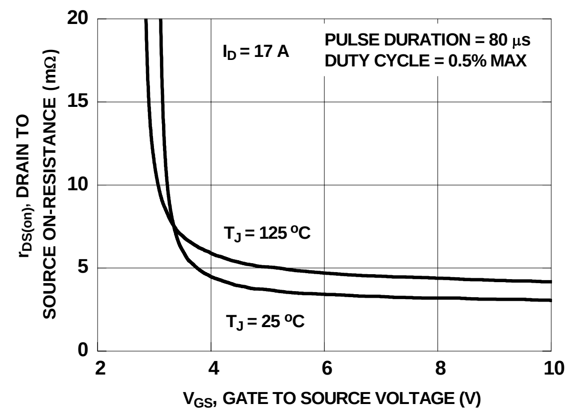


Figure 16. On-Resistance vs Gate to Source Voltage

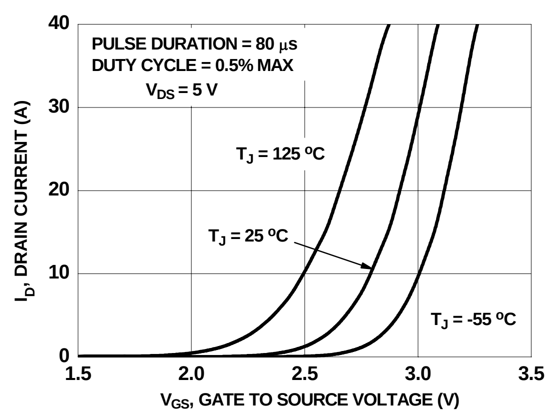


Figure 17. Transfer Characteristics

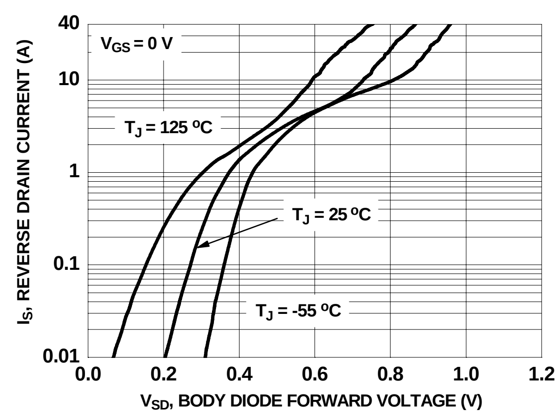


Figure 18. Source to Drain Diode Forward Voltage vs Source Current

Typical Characteristics (Q2 SyncFET) $T_J = 25\ ^oC$ unless otherwise noted

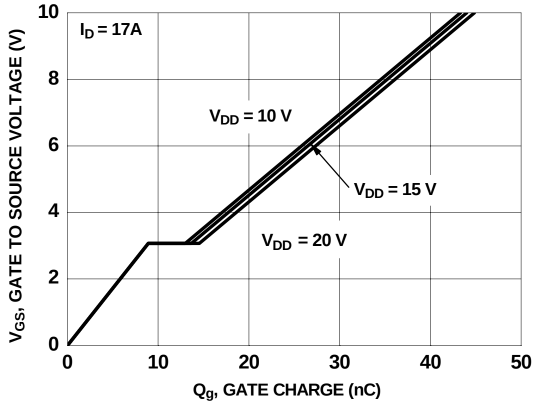


Figure 19. Gate Charge Characteristics

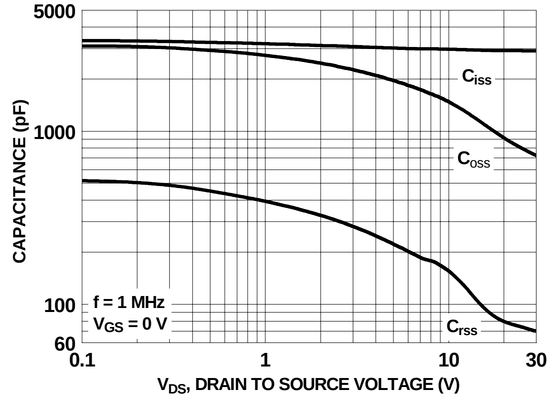


Figure 20. Capacitance vs Drain to Source Voltage

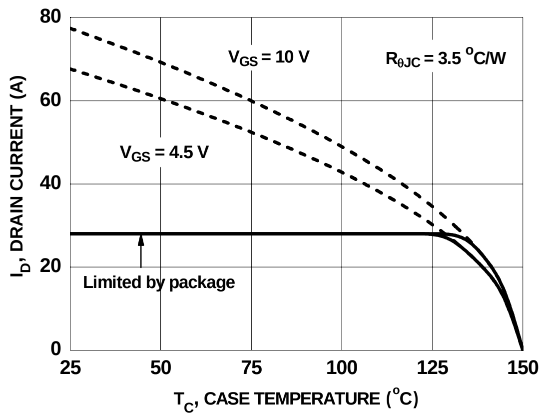


Figure 21. Maximun Continuous Drain Current vs Case Temperature

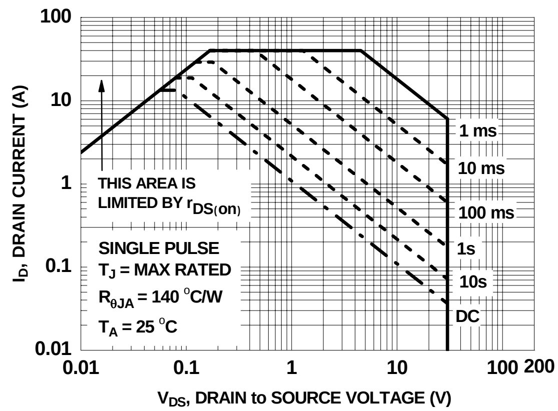


Figure 22. Forward Bias Safe Operating Area

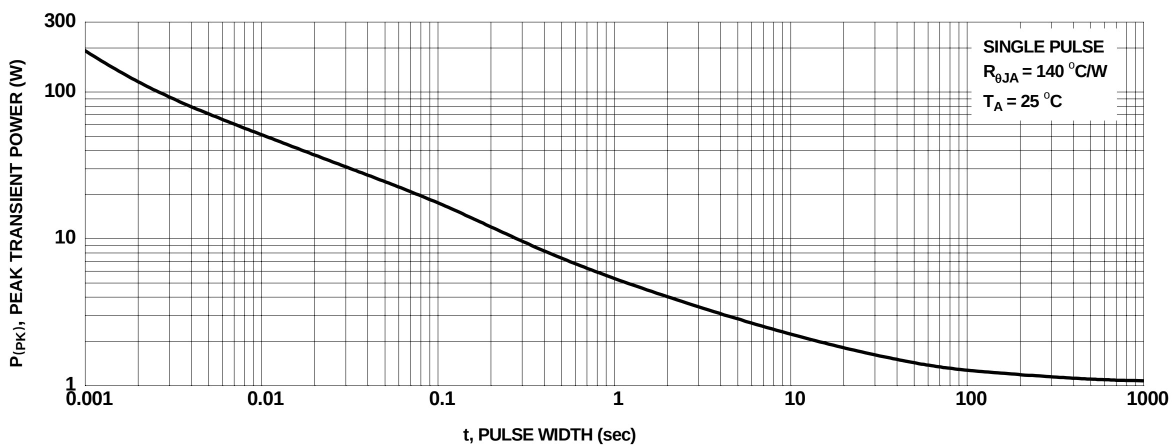


Figure 23. Single Pulse Maximum Power Dissipation

Typical Characteristics (Q2 SyncFET) T_J = 25 °C unless otherwise noted

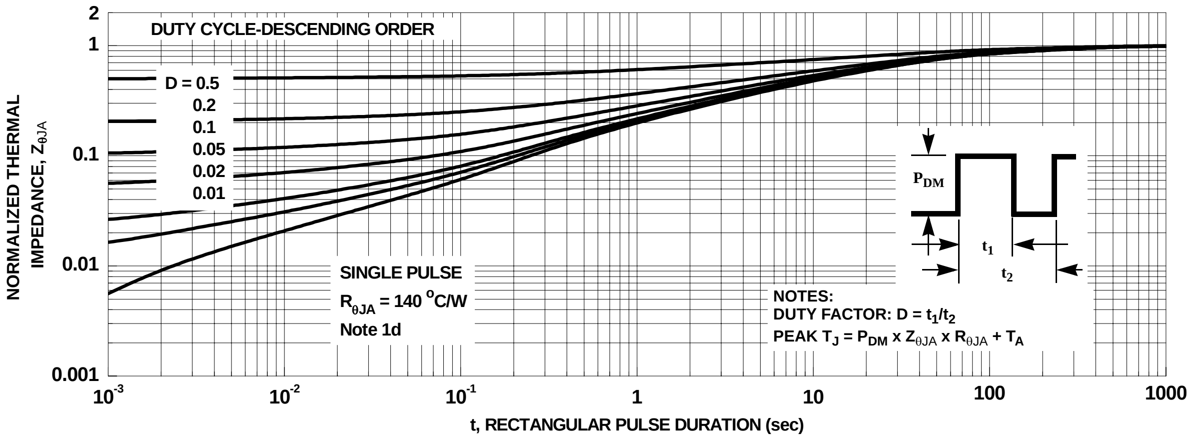


Figure24. Junction-to-Ambient Transient Thermal Response Curve

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 25 shows the reverse recovery characteristic of the FDML7610S.

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

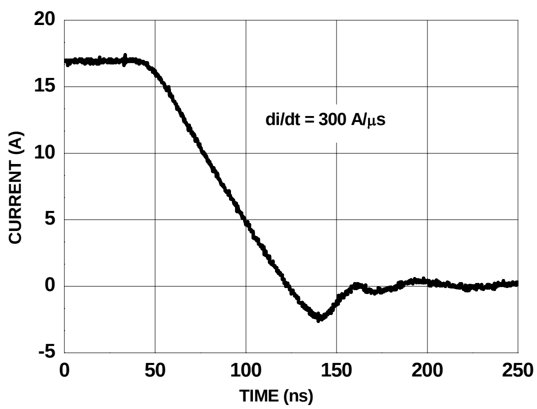


Figure 25. FDML7610S SyncFET body diode reverse recovery characteristic

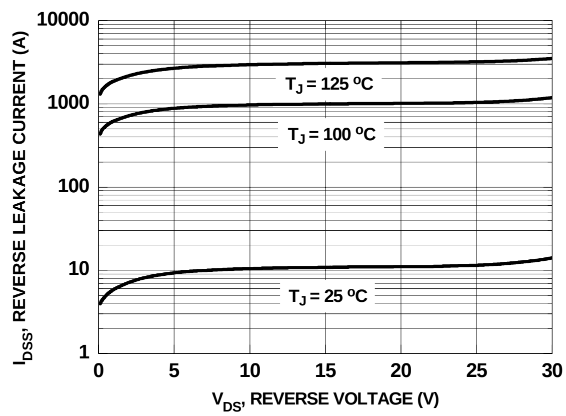
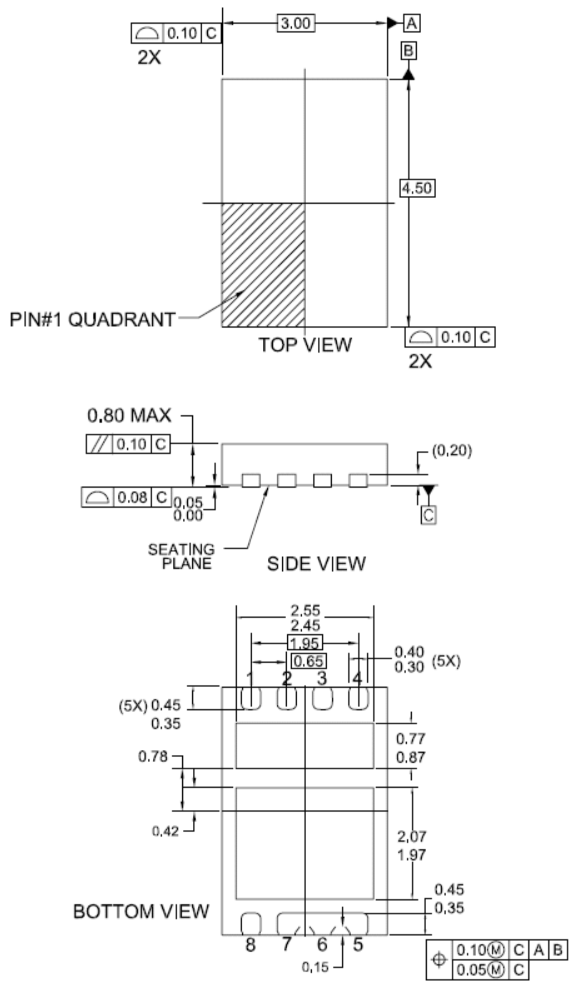
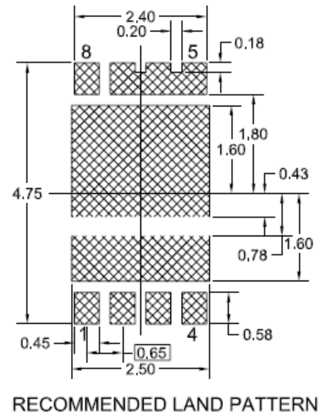


Figure 26. SyncFET body diode reverse leakage versus drain-source voltage

Dimensional Outline and Pad Layout





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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.

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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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