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March 2015

FDD8424H

Dual N & P-Channel PowerTrench[®] MOSFET
N-Channel: 40V, 20A, 24mΩ P-Channel: -40V, -20A, 54mΩ

Features

Q1: N-Channel

- Max $r_{DS(on)}$ = 24mΩ at V_{GS} = 10V, I_D = 9.0A
- Max $r_{DS(on)}$ = 30mΩ at V_{GS} = 4.5V, I_D = 7.0A

Q2: P-Channel

- Max $r_{DS(on)}$ = 54mΩ at V_{GS} = -10V, I_D = -6.5A
- Max $r_{DS(on)}$ = 70mΩ at V_{GS} = -4.5V, I_D = -5.6A
- Fast switching speed
- RoHS Compliant



General Description

These dual N and P-Channel enhancement mode Power MOSFETs are produced using Fairchild Semiconductor's advanced PowerTrench[®] process that has been especially tailored to minimize on-state resistance and yet maintain superior switching performance.

Application

- Inverter
- H-Bridge



MOSFET Maximum Ratings $T_C = 25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Q1	Q2	Units
V _{DS}	Drain to Source Voltage	40	-40	V
V _{GS}	Gate to Source Voltage	±20	±20	V
I _D	Drain Current - Continuous (Package Limited)	20	-20	A
	- Continuous (Silicon Limited) T _C = 25°C	26	-20	
	- Continuous T _A = 25°C	9.0	-6.5	
	- Pulsed	55	-40	
P _D	Power Dissipation for Single Operation T _C = 25°C (Note 1)	30	35	W
	T _A = 25°C (Note 1a)	3.1		
	T _A = 25°C (Note 1b)	1.3		
E _{AS}	Single Pulse Avalanche Energy (Note 3)	29	33	mJ
T _J , T _{STG}	Operating and Storage Junction Temperature Range	-55 to +150		°C

Thermal Characteristics

$R_{\theta JC}$	Thermal Resistance, Junction to Case, Single Operation for Q1 (Note 1)	4.1	$^\circ\text{C/W}$
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Single Operation for Q2 (Note 1)	3.5	

Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FDD8424H	FDD8424H	TO-252-4L	13"	16mm	2500 units

Electrical Characteristics $T_J = 25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Type	Min	Typ	Max	Units
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Off Characteristics

BV_{DSS}	Drain to Source Breakdown Voltage	$I_D = 250\mu\text{A}$, $V_{GS} = 0\text{V}$ $I_D = -250\mu\text{A}$, $V_{GS} = 0\text{V}$	Q1 Q2	40 -40			V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 250\mu\text{A}$, referenced to 25°C $I_D = -250\mu\text{A}$, referenced to 25°C	Q1 Q2		34 -32		mV/ $^\circ\text{C}$
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 32\text{V}$, $V_{GS} = 0\text{V}$ $V_{DS} = -32\text{V}$, $V_{GS} = 0\text{V}$	Q1 Q2			1 -1	μA
I_{GSS}	Gate to Source Leakage Current	$V_{GS} = \pm 20\text{V}$, $V_{DS} = 0\text{V}$	Q1 Q2			± 100 ± 100	nA

On Characteristics

$V_{GS(th)}$	Gate to Source Threshold Voltage	$V_{GS} = V_{DS}$, $I_D = 250\mu\text{A}$ $V_{GS} = V_{DS}$, $I_D = -250\mu\text{A}$	Q1 Q2	1 -1	1.7 -1.6	3 -3	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate to Source Threshold Voltage Temperature Coefficient	$I_D = 250\mu\text{A}$, referenced to 25°C $I_D = -250\mu\text{A}$, referenced to 25°C	Q1 Q2		-5 4.8		mV/ $^\circ\text{C}$
$r_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = 10\text{V}$, $I_D = 9.0\text{A}$ $V_{GS} = 4.5\text{V}$, $I_D = 7.0\text{A}$ $V_{GS} = 10\text{V}$, $I_D = 9.0\text{A}$, $T_J = 25^\circ\text{C}$ $V_{GS} = -10\text{V}$, $I_D = -9.0\text{A}$ $V_{GS} = -4.5\text{V}$, $I_D = -7.0\text{A}$ $V_{GS} = -10\text{V}$, $I_D = -9.0\text{A}$, $T_J = 125^\circ\text{C}$	Q1 Q2		19 23 23 42 58 42	24 30 37 54 70 60	$m\Omega$
g_{FS}	Forward Transconductance	$V_{DS} = 5\text{V}$, $I_D = 9.0\text{A}$ $V_{DS} = -5\text{V}$, $I_D = -6.5\text{A}$	Q1 Q2		29 13		S

Dynamic Characteristics

C_{iss}	Input Capacitance	$V_{DS} = 20\text{V}$, $V_{GS} = 0\text{V}$, $f = 1\text{MHz}$	Q1 Q2		750 1000	1000 1330	pF
C_{oss}	Output Capacitance	$V_{GS} = 10\text{V}$, $V_{DS} = 20\text{V}$, $f = 1\text{MHz}$	Q1 Q2		115 140	155 185	pF
C_{rss}	Reverse Transfer Capacitance	$V_{DS} = -20\text{V}$, $V_{GS} = 0\text{V}$, $f = 1\text{MHz}$	Q1 Q2		75 75	115 115	pF
R_g	Gate Resistance	$f = 1\text{MHz}$	Q1 Q2	0.1 0.1	1.1 3.3	3.3 9.9	Ω

Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	Q1 $V_{DD} = 20\text{V}$, $I_D = 9.0\text{A}$, $V_{GS} = 10\text{V}$, $R_{GEN} = 6\Omega$	Q1 Q2		7 7	14 14	ns
t_r	Rise Time	Q2 $V_{DD} = 20\text{V}$, $I_D = 9.0\text{A}$, $V_{GS} = 10\text{V}$, $R_{GEN} = 6\Omega$	Q1 Q2		13 3	24 10	ns
$t_{d(off)}$	Turn-Off Delay Time	Q2 $V_{DD} = -20\text{V}$, $I_D = -6.5\text{A}$, $V_{GS} = -10\text{V}$, $R_{GEN} = 6\Omega$	Q1 Q2		17 20	31 36	ns
t_f	Fall Time	Q1 $V_{DD} = -20\text{V}$, $I_D = -6.5\text{A}$, $V_{GS} = -10\text{V}$, $R_{GEN} = 6\Omega$	Q1 Q2		6 3	12 10	ns
$Q_{g(TOT)}$	Total Gate Charge	Q1 $V_{GS} = 10\text{V}$, $V_{DD} = 20\text{V}$, $I_D = 9.0\text{A}$	Q1 Q2		14 17	20 24	nC
Q_{gs}	Gate to Source Charge	Q2 $V_{GS} = 10\text{V}$, $V_{DD} = 20\text{V}$, $I_D = 9.0\text{A}$	Q1 Q2		2.3 3.0		nC
Q_{gd}	Gate to Drain "Miller" Charge	Q1 $V_{GS} = -10\text{V}$, $V_{DD} = -20\text{V}$, $I_D = -6.5\text{A}$	Q1 Q2		3.2 3.6		nC

Electrical Characteristics $T_J = 25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Type	Min	Typ	Max	Units
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Drain-Source Diode Characteristics

I_S	Maximum Continuous Drain to Source Diode Forward Current		Q1 Q2			20 -20	A
I_{SM}	Maximum Pulsed Drain to Source Diode Forward Current (Note 2)		Q1 Q2			55 -40	A
V_{SD}	Source to Drain Diode Forward Voltage	$V_{GS} = 0\text{V}$, $I_S = 9.0\text{A}$ (Note 2) $V_{GS} = 0\text{V}$, $I_S = -6.5\text{A}$ (Note 2)	Q1 Q2		0.87 0.88	1.2 -1.2	V
t_{rr}	Reverse Recovery Time	Q1 $I_F = 9.0\text{A}$, $di/dt = 100\text{A/s}$	Q1 Q2		25 29	38 44	ns
Q_{rr}	Reverse Recovery Charge	Q2 $I_F = -6.5\text{A}$, $di/dt = 100\text{A/s}$	Q1 Q2		18 29	29 44	nC

Notes:

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

Q1

a. 40°C/W when mounted on a 1in^2 pad of 2 oz copper



b. 36°C/W when mounted on a minimum pad of 2 oz copper

Q2

a. 40°C/W when mounted on a 1in^2 pad of 2 oz copper



b. 36°C/W when mounted on a minimum pad of 2 oz copper

2. Pulse Test: Pulse Width $< 300\mu\text{s}$, Duty cycle $< 2\%$.

3. Staying $T_J = 25^\circ\text{C}$, N-ch: $L = 0.3\text{mH}$, $I_{AS} = 14\text{A}$, $V_{DD} = 40\text{V}$, $V_{GS} = 10\text{V}$; P-ch: $L = 0.3\text{mH}$, $I_{AS} = -15\text{A}$, $V_{DD} = -40\text{V}$, $V_{GS} = -10\text{V}$.

Typical Characteristics (Q1 N-Channel) $T_J = 25^\circ\text{C}$ unless otherwise noted

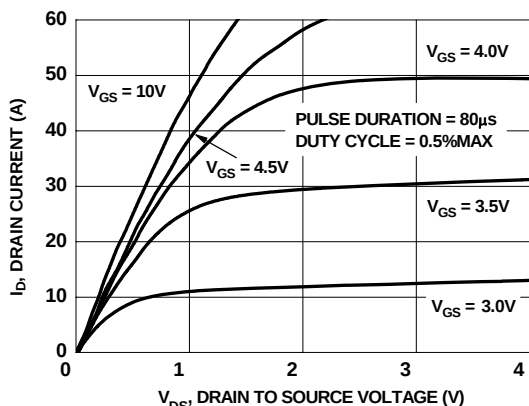


Figure 1. On-Region Characteristics

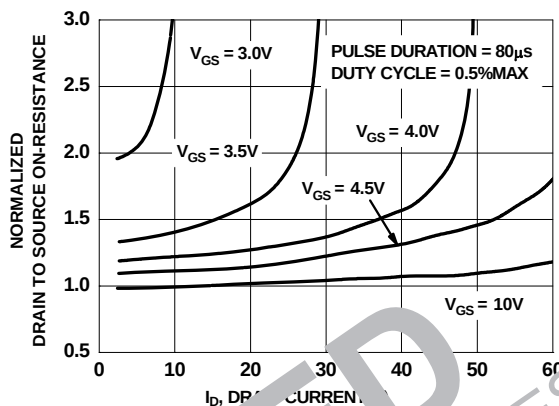


Figure 2. Normalized On-Resistance vs Drain Current and Gate Voltage

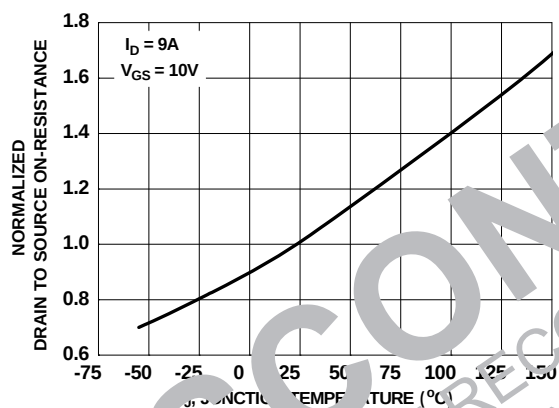


Figure 3. Normalized On-Resistance vs Junction Temperature

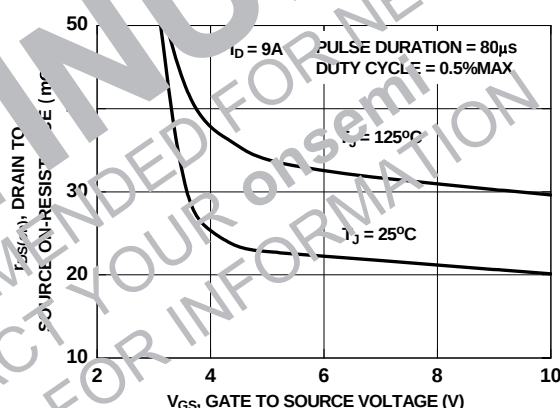


Figure 4. On-Resistance vs Gate to Source Voltage

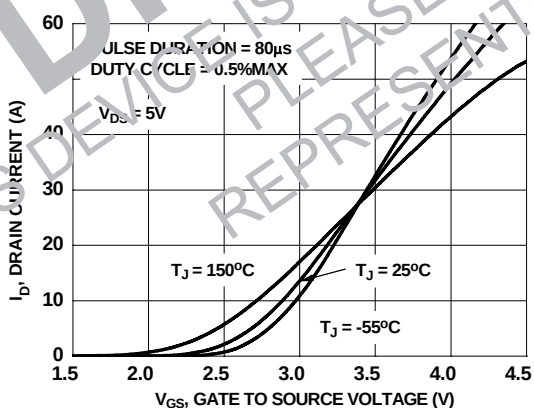


Figure 5. Transfer Characteristics

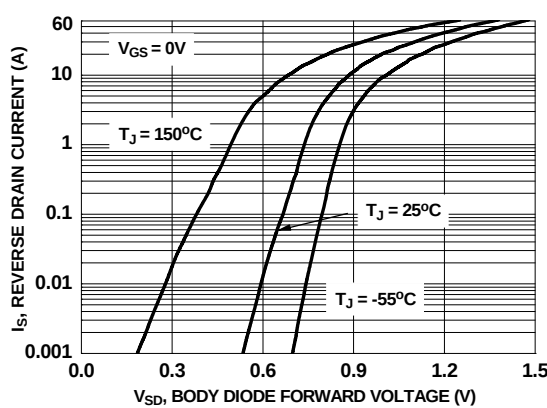


Figure 6. Source to Drain Diode Forward Voltage vs Source Current

Typical Characteristics (Q1 N-Channel) $T_J = 25^\circ\text{C}$ unless otherwise noted

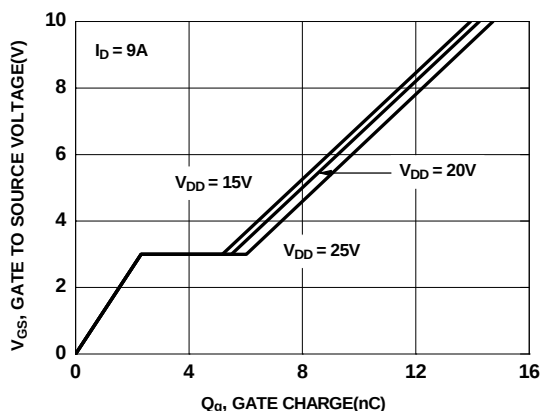


Figure 7. Gate Charge Characteristics

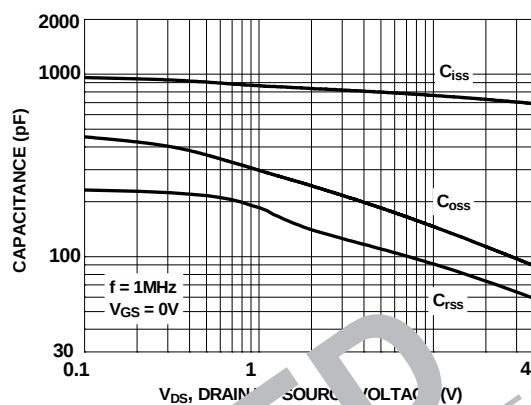


Figure 8. Capacitance vs Drain to Source Voltage

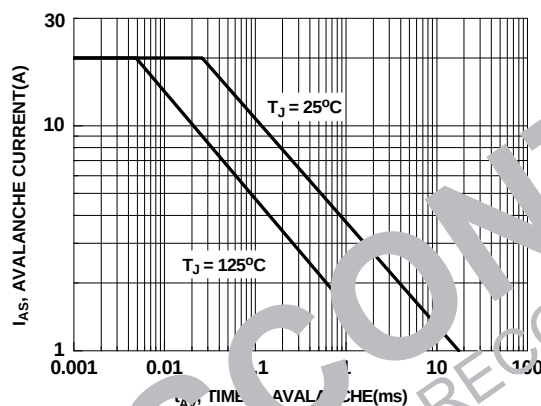


Figure 9. Unclamped Inductive Switching Capability

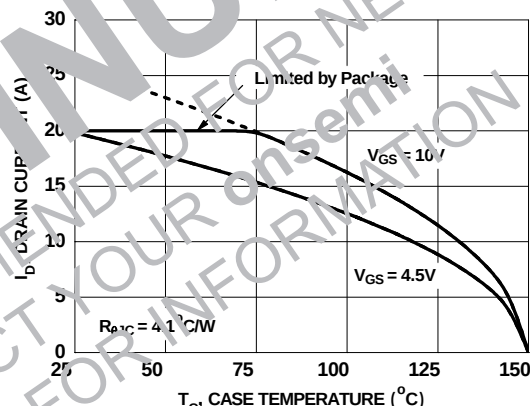


Figure 10. Maximum Continuous Drain Current vs Case Temperature

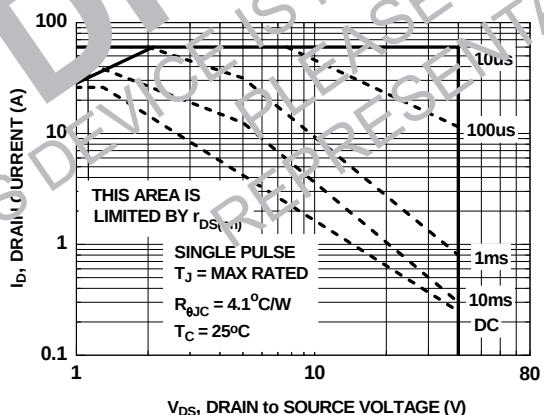


Figure 11. Forward Bias Safe Operating Area

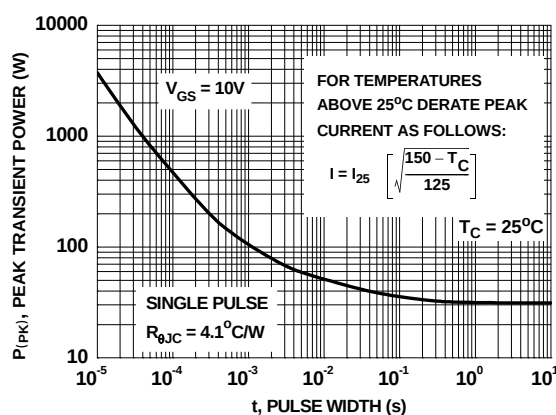


Figure 12. Single Pulse Maximum Power Dissipation

Typical Characteristics (Q1 N-Channel) $T_J = 25^\circ\text{C}$ unless otherwise noted

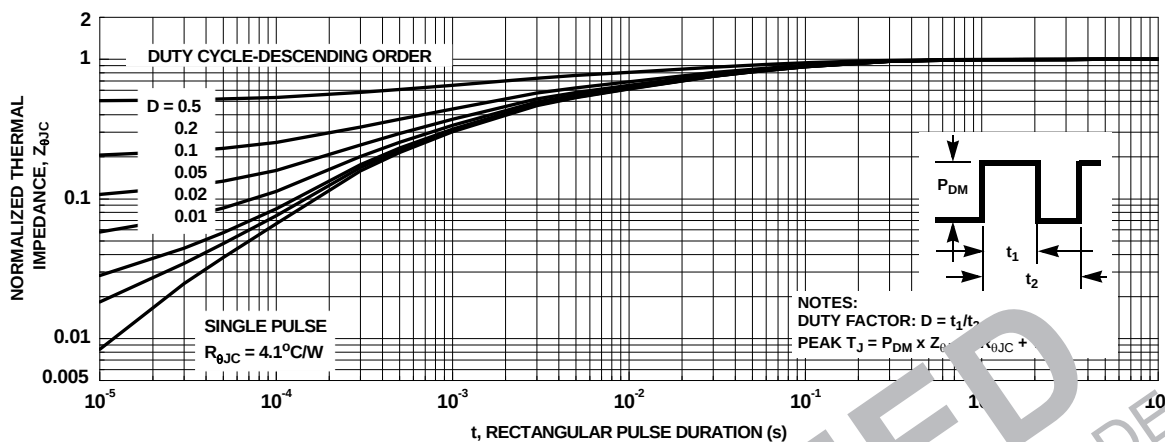


Figure 13. Transient Thermal Response Curve

Typical Characteristics (Q2 P-Channel) $T_J = 25^\circ\text{C}$ unless otherwise noted

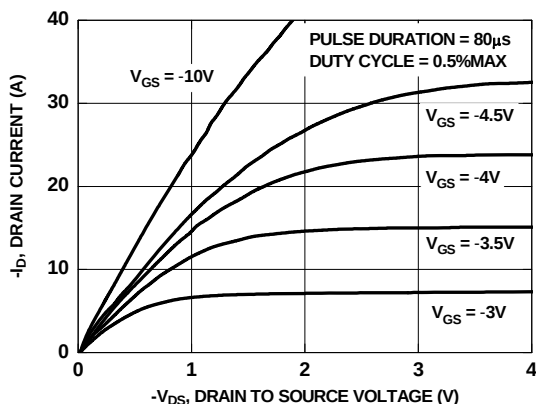


Figure 14. On-Region Characteristics

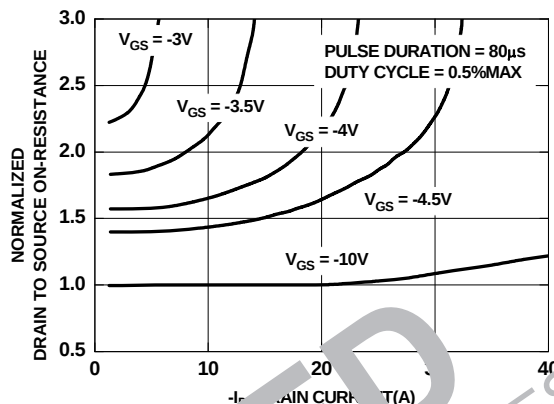


Figure 15. Normalized On-Resistance vs Drain Current and Gate Voltage

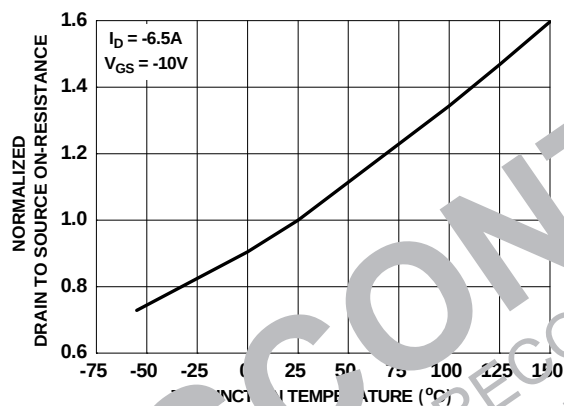


Figure 16. Normalized On-Resistance vs Junction Temperature

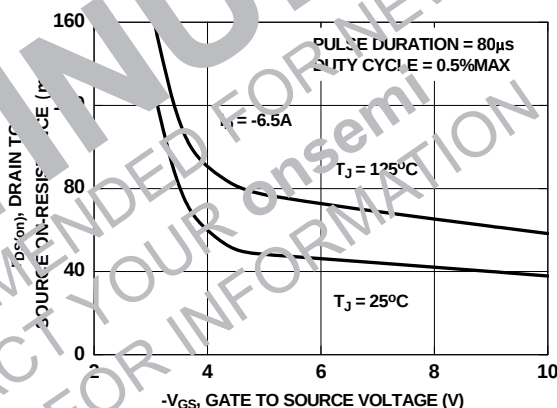


Figure 17. On-Resistance vs Gate to Source Voltage

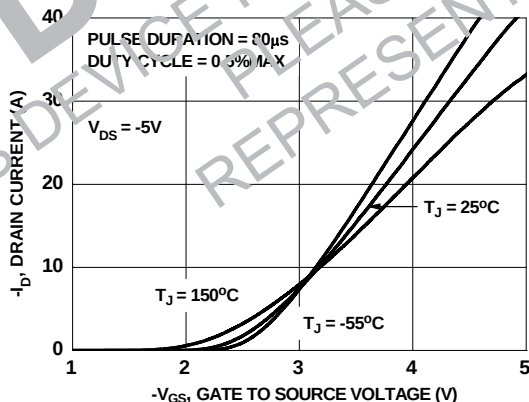


Figure 18. Transfer Characteristics

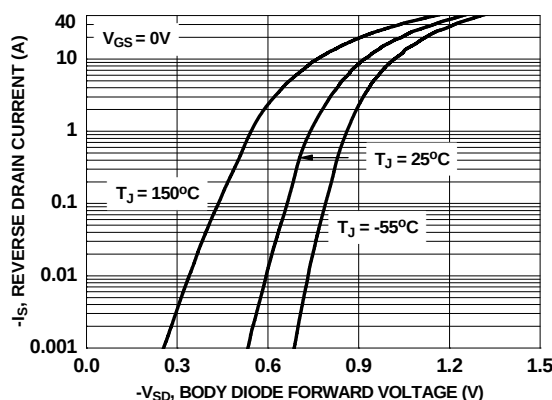


Figure 19. Source to Drain Diode Forward Voltage vs Source Current

Typical Characteristics (Q2 P-Channel) $T_J = 25^\circ\text{C}$ unless otherwise noted

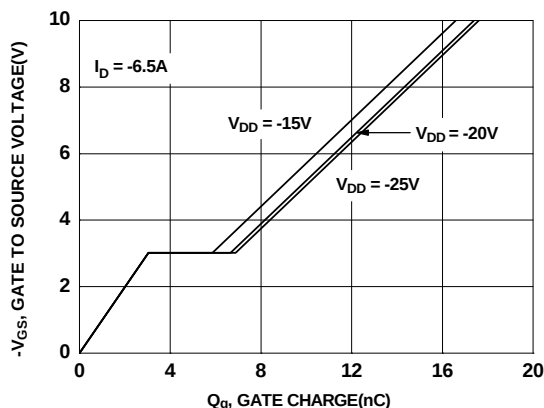


Figure 20. Gate Charge Characteristics

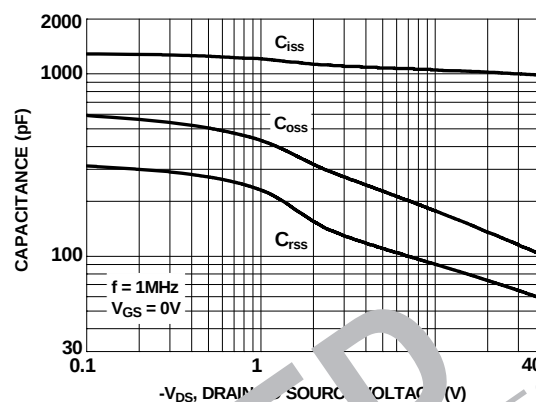


Figure 21. Capacitance vs Drain to Source Voltage

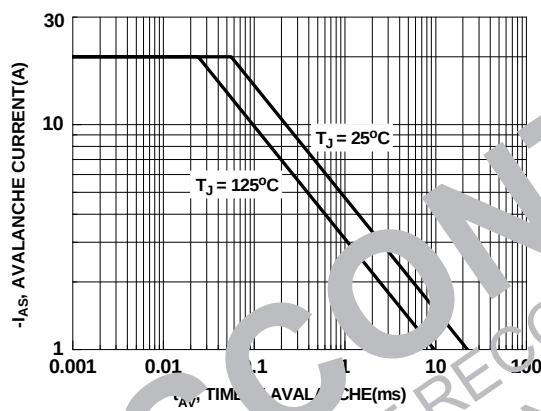


Figure 22. Unclamped Inductive Switching Capability

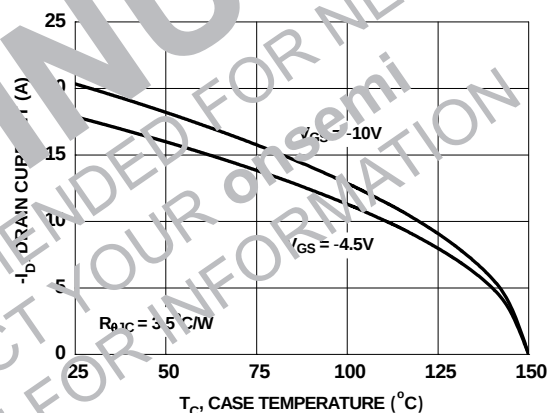


Figure 23. Maximum Continuous Drain Current vs Case Temperature

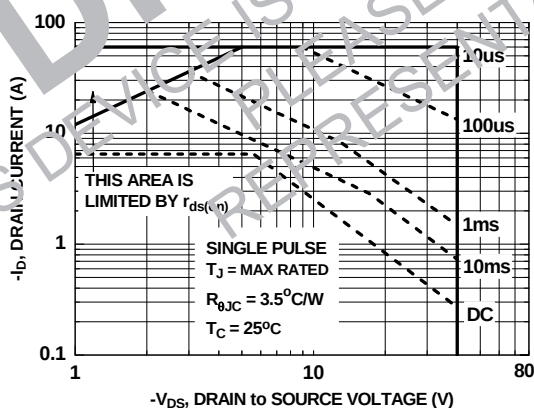


Figure 24. Forward Bias Safe Operating Area

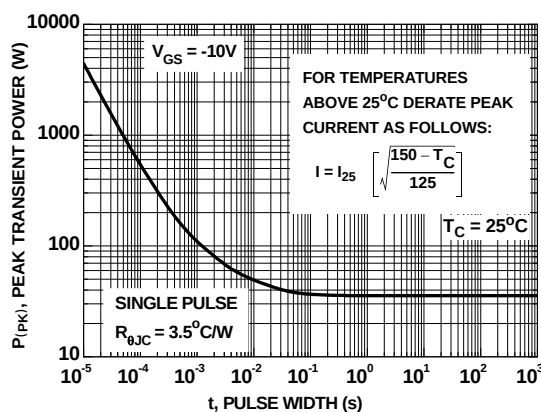


Figure 25. Single Pulse Maximum Power Dissipation

Typical Characteristics (Q2 P-Channel) $T_J = 25^\circ\text{C}$ unless otherwise noted

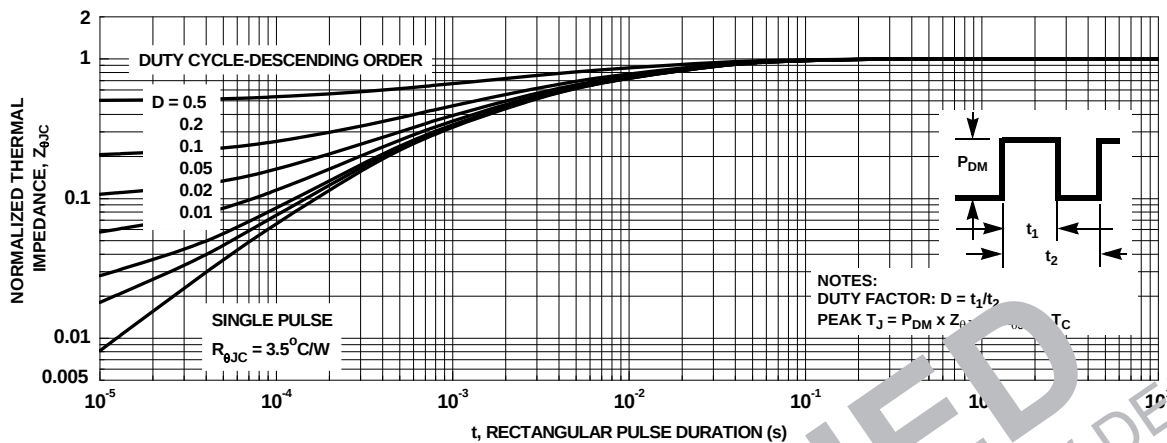


Figure 26. Transient Thermal Response Curve

DETAIL A
SCALE 2:1

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- B. ALL DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR PROTRUSIONS
- D. HEATSINK TOP EDGE COULD BE IN CHAMFERED CORNERS OR EDGE PROTRUSION.
- E. DIMENSIONS AND TOLERANCES AS PER ASME Y14.5-2009.
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