MOSFET – Dual, N-Channel, POWERTRENCH®, Power Clip, Asymmetric
25 V

FDPC8014AS

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 $r_{DS(on)}$ = 3.8 mΩ at V_{GS} = 10 V, I_D = 20 A
  - Max $r_{DS(on)}$ = 4.7 mΩ at V_{GS} = 4.5 V, I_D = 18 A
- Q2: N−Channel
  - Max $r_{DS(on)}$ = 1.0 mΩ at V_{GS} = 10 V, I_D = 40 A
  - Max $r_{DS(on)}$ = 1.2 mΩ at V_{GS} = 4.5 V, I_D = 37 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
- These Devices are Pb−Free, Halogen Free/BFR Free and are RoHS Compliant

Applications

- Computing
- Communications
- General Purpose Point of Load

PIN DESCRIPTION

Pin	Name	Description
1	HSG	High Side Gate
2	GR	Gate Return
3, 4, 9	V+ (HSD)	High Side Drain
5, 6, 7	SW	Switching Node, Low Side Drain
8	LSG	Low Side Gate
10	GND (LSS)	Low Side Source

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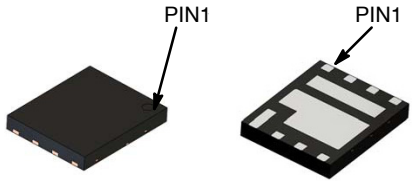
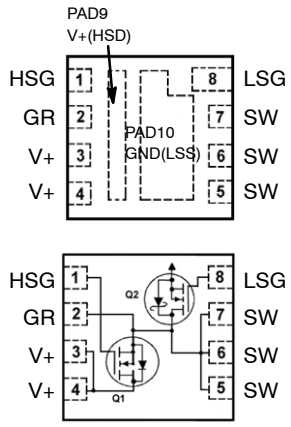


Power Clip 5x6
PDFN8 5x6, 1.27P,
CASE 483AR

MARKING DIAGRAM

FDPC8014AS	= Specific Device Code
$Y	= ON semiconductor Logo
&Z	= Assembly Plant Code
&3	= 3−Digit Date Code
&K	= 2−Digits Lot Run Traceability Code



N−Channel MOSFET

ORDERING INFORMATION

See detailed ordering and shipping information on page 10 of this data sheet.

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MOSFET MAXIMUM RATINGS (T_A = 25°C, unless otherwise noted)

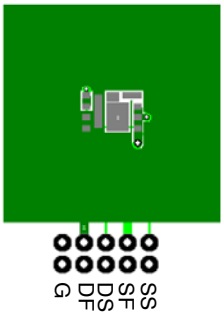
Symbol	Parameter		Q1	Q2	Unit
V_{DS}	Drain to Source Voltage		25 (Note 4)	25	V
V_{GS}	Gate to Source Voltage		±12	±12	V
I_D	Drain Current –Continuous	T_C = 25°C (Note 5)	59	159	A
	–Continuous	T_C = 100°C (Note 5)	37	100	
	–Continuous	T_A = 25°C	20 (Note 1a)	40 (Note 1b)	
	–Pulsed	(Note 3)	266	1116	
E_{AS}	Single Pulse Avalanche Energy	(Note 2)	73	294	mJ
P_D	Power Dissipation for Single Operation	T_C = 25°C	21	37	W
	Power Dissipation for Single Operation	T_A = 25°C	2.1 (Note 1a)	2.3 (Note 1b)	
T_J, T_{STG}	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.

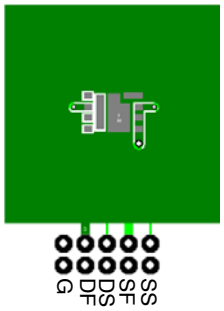
THERMAL CHARACTERISTICS (T_A = 25°C, unless otherwise noted)

Symbol	Parameter	Q1	Q2	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case	6.0	3.3	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	60 (Note 1a)	55 (Note 1b)	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	130 (Note 1c)	120 (Note 1d)	

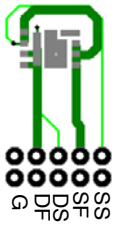
1. $R_{\theta JA}$ is determined with the device mounted on a 1 in^2 pad 2 oz copper pad on a 1.5 x 1.5 in. board of FR–4 material. $R_{\theta JC}$ is guaranteed by design while $R_{\theta CA}$ is determined by the user's board design.



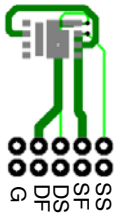
a. 60°C/W when mounted on a 1 in^2 pad of 2 oz copper



b. 55°C/W when mounted on a 1 in^2 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. Q1: E_{AS} of 73 mJ is based on starting T_J = 25°C; N–ch: L = 3 mH, I_{AS} = 7 A, V_{DD} = 30 V, V_{GS} = 10 V. 100% test at L = 0.1 mH, I_{AS} = 24 A.
   Q2: E_{AS} of 294 mJ is based on starting T_J = 25°C; N–ch: L = 3 mH, I_{AS} = 14 A, V_{DD} = 25 V, V_{GS} = 10 V. 100% test at L = 0.1 mH, I_{AS} = 46 A.
3. Pulsed Id please refer to Figure 11 and Figure 24 SOA graph for more details.
4. The continuous V_{DS} rating is 25 V; However, a pulse of 30 V peak voltage for no longer than 100 ns duration at 600 kHz frequency can be applied.
5. Computed continuous current limited to Max Junction Temperature only, actual continuous current will be limited by thermal & electro–mechanical application board design.

ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise noted)

Symbol	Parameter	Test Condition	Type	Min	Typ	Max	Unit
OFF CHARACTERISTICS							
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	25 25	– –	– –	V
ΔBV_{DSS} / ΔT_J	Breakdown Voltage Temperature Coefficient	I_D = 250 μA, referenced to 25°C I_D = 10 mA, referenced to 25°C	Q1 Q2	– –	24 25	– –	mV/°C
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 20 V, V_{GS} = 0 V V_{DS} = 20 V, V_{GS} = 0 V	Q1 Q2	– –	– –	1 500	μA μA
I_{GSS}	Gate to Source Leakage Current, Forward	V_{GS} = 12 V / −8 V, V_{DS} = 0 V V_{GS} = 12 V / −8 V, V_{DS} = 0 V	Q1 Q2	– –	– –	±100 ±100	nA nA
ON CHARACTERISTICS							
$V_{GS(th)}$	Gate to Source Threshold Voltage	V_{GS} = V_{DS}, I_D = 250 μA V_{GS} = V_{DS}, I_D = 1 mA	Q1 Q2	0.8 1.0	1.3 1.5	2.5 3.0	V
$\Delta V_{GS(th)}$ / ΔT_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	– –	−4 −3	– –	mV/°C
$r_{DS(on)}$	Drain to Source On Resistance	V_{GS} = 10 V, I_D = 20 A V_{GS} = 4.5 V, I_D = 18 A V_{GS} = 10 V, I_D = 20 A, T_J =125°C	Q1	– – –	2.9 3.6 3.9	3.8 4.7 5.3	mΩ
		V_{GS} = 10 V, I_D = 40 A V_{GS} = 4.5 V, I_D = 37 A V_{GS} = 10 V, I_D = 40 A , T_J =125°C	Q2	– – –	0.75 0.9 1.0	1.0 1.2 1.5	
g_{FS}	Forward Transconductance	V_{DS} = 5 V, I_D = 20 A V_{DS} = 5 V, I_D = 40 A	Q1 Q2	– –	182 296	– –	S
DYNAMIC CHARACTERISTICS							
C_{iss}	Input Capacitance	Q1: V_{DS} = 13 V, V_{GS} = 0 V, f = 1 MHZ Q2: V_{DS} = 13 V, V_{GS} = 0 V, f = 1 MHZ	Q1 Q2	– –	1695 6985	2375 9780	pF
C_{oss}	Output Capacitance		Q1 Q2	– –	495 2170	710 3040	pF
C_{rss}	Reverse Transfer Capacitance		Q1 Q2	– –	54 172	100 245	pF
R_g	Gate Resistance		Q1 Q2	0.1 0.1	0.4 0.4	1.2 1.2	Ω
SWITCHING CHARACTERISTICS							
$t_{d(on)}$	Turn−On Delay Time	Q1: V_{DD} = 13 V, I_D = 20 A, R_{GEN} = 6 Ω Q2: V_{DD} = 13 V, I_D = 40 A, R_{GEN} = 6 Ω	Q1 Q2	– –	8 16	16 29	ns
t_r	Rise Time		Q1 Q2	– –	2 6	10 12	ns
$t_{d(off)}$	Turn−Off Delay Time		Q1 Q2	– –	24 48	38 76	ns
t_f	Fall Time		Q1 Q2	– –	2 5	10 10	ns
Q_g	Total Gate Charge	V_{GS} = 0 V to 10 V Q1: V_{DD} = 13 V, I_D = 20 A Q2: V_{DD} = 13 V, I_D = 40 A	Q1 Q2	– –	25 97	35 135	nC
Q_g	Total Gate Charge	V_{GS} = 0 V to 4.5 V Q1: V_{DD} = 13 V, I_D = 20 A Q2: V_{DD} = 13 V, I_D = 40 A	Q1 Q2	– –	11 44	16 62	nC
Q_{gs}	Gate to Source Gate Charge	Q1: V_{DD} = 13 V, I_D = 20 A Q2: V_{DD} = 13 V, I_D = 40 A	Q1 Q2	– –	3.4 14	– –	nC
Q_{gd}	Gate to Drain “Miller” Charge		Q1 Q2	– –	2.2 9	– –	nC

ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise noted) (continued)

Symbol	Parameter	Test Condition	Type	Min	Typ	Max	Unit
DRAIN−SOURCE DIODE CHARACTERISTICS							
V_{SD}	Source to Drain Diode Forward Voltage	V_{GS} = 0 V, I_S = 20 A (Note 6) V_{GS} = 0 V, I_S = 40 A (Note 6)	Q1 Q2	– –	0.8 0.8	1.2 1.2	V
I_S	Diode Continuous Forward Current	T_C = 25°C	Q1 Q2	– –	59 159	– –	A
$I_{S,Pulse}$	Diode Pulse Current		Q1 Q2	– –	266 1116	– –	A
t_{rr}	Reverse Recovery Time	Q1: I_F = 20 A, di/dt = 100 A/μs Q2: I_F = 40 A, di/dt = 300 A/μs	Q1 Q2	– –	25 44	40 70	ns
Q_{rr}	Reverse Recovery Charge		Q1 Q2	– –	10 78	20 125	nC

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.

6. Pulse Test: Pulse Width < 300 μs, Duty cycle < 2.0%.

TYPICAL CHARACTERISTICS (Q1 N−CHANNEL) (T_J = 25°C unless otherwise noted)

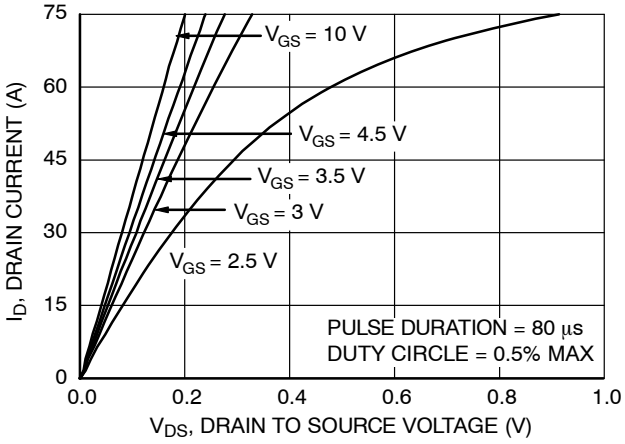


Figure 1. On Region Characteristics

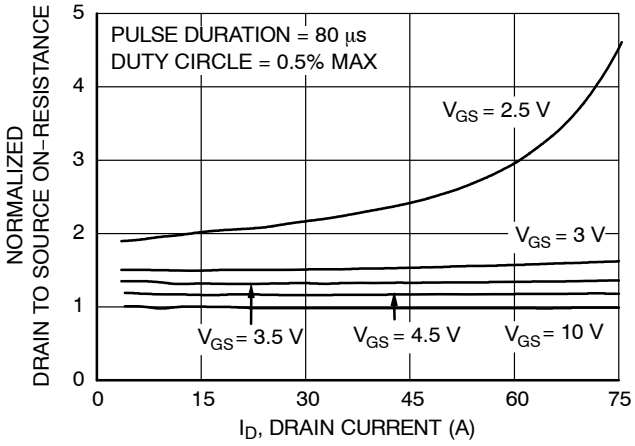


Figure 2. Normalized On−Resistance vs. Drain Current and Gate Voltage

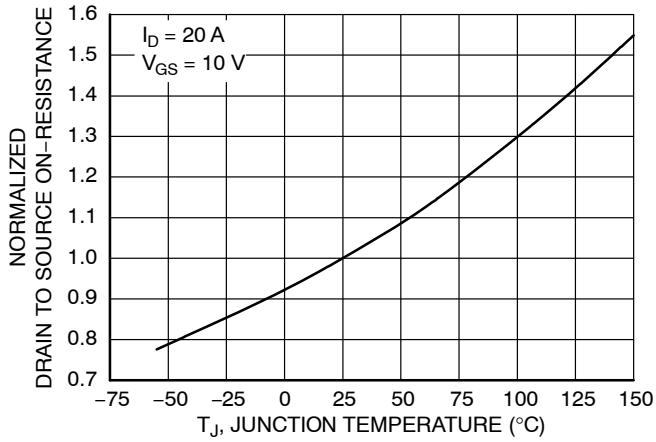


Figure 3. Normalized On Resistance vs. Junction Temperature

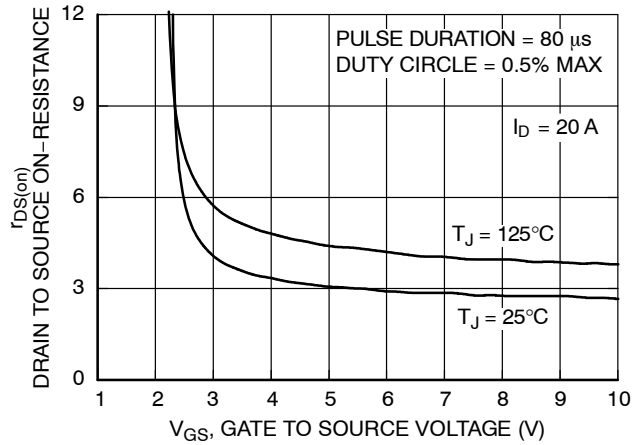


Figure 4. On−Resistance vs. Gate to Source Voltage

TYPICAL CHARACTERISTICS (Q1 N−CHANNEL) (T_J = 25°C unless otherwise noted) (continued)

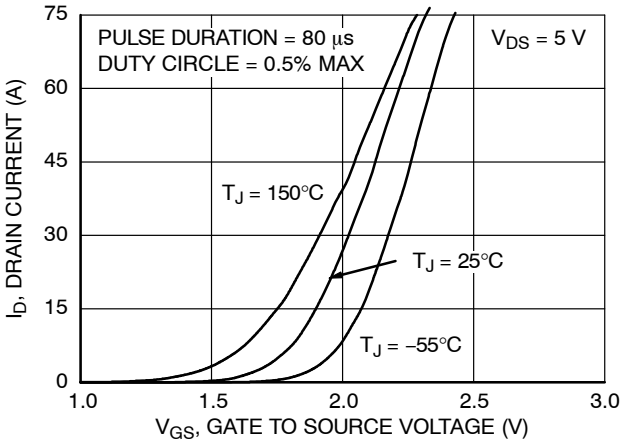


Figure 5. Transfer Characteristics

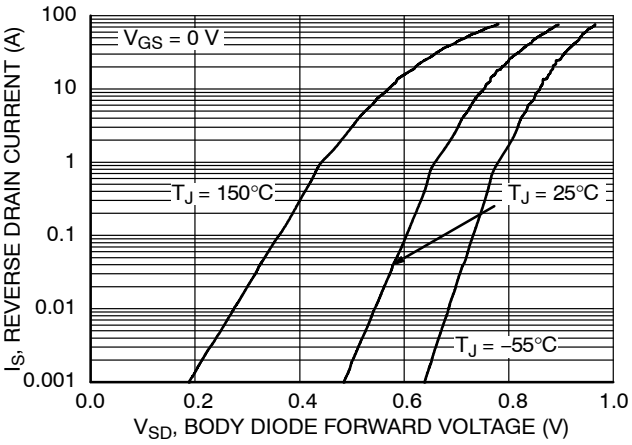


Figure 6. Source to Drain Diode Forward Voltage vs. Source Current

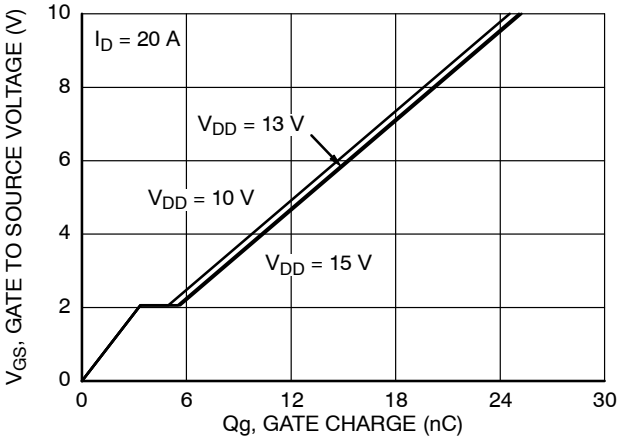


Figure 7. Gate Charge Characteristics

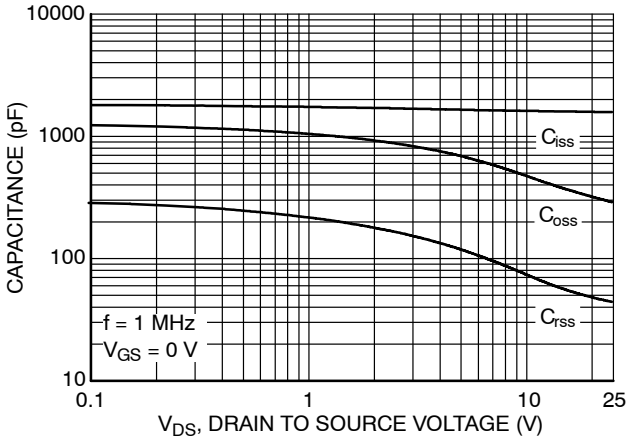


Figure 8. Capacitance vs. Drain to Source Voltage

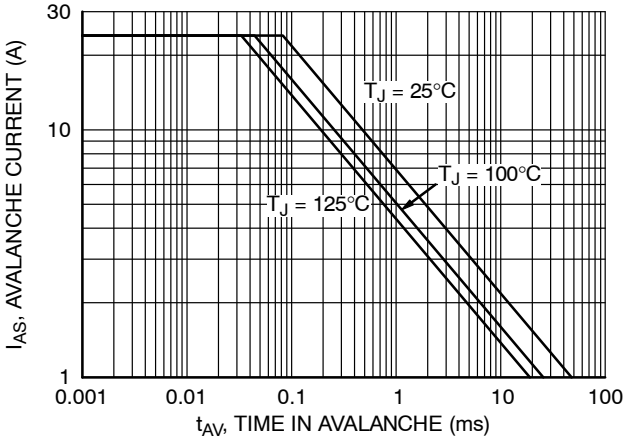


Figure 9. Unclamped Inductive Switching Capability

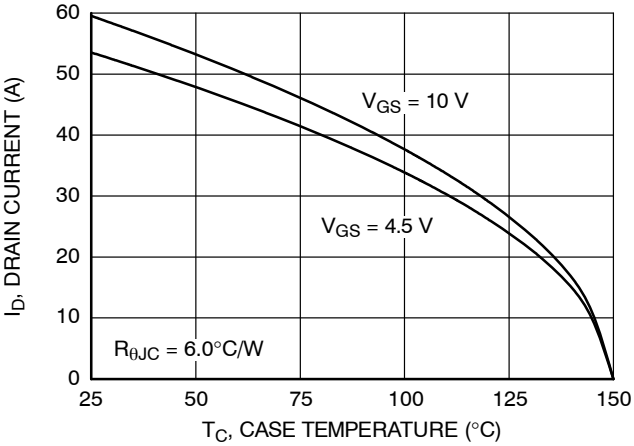


Figure 10. Maximum Continuous Drain Current vs. Case Temperature

TYPICAL CHARACTERISTICS (Q1 N−CHANNEL) (T_J = 25°C unless otherwise noted) (continued)

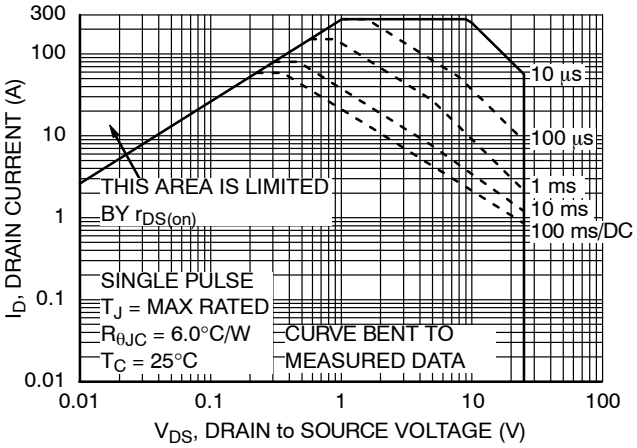


Figure 11. Forward Bias Safe Operating Area

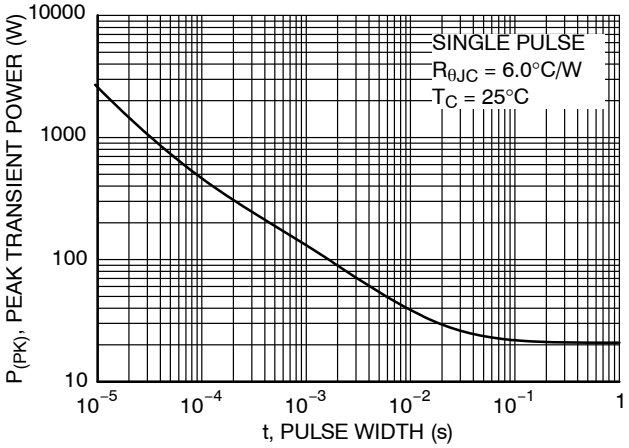


Figure 12. Single Pulse Maximum Power Dissipation

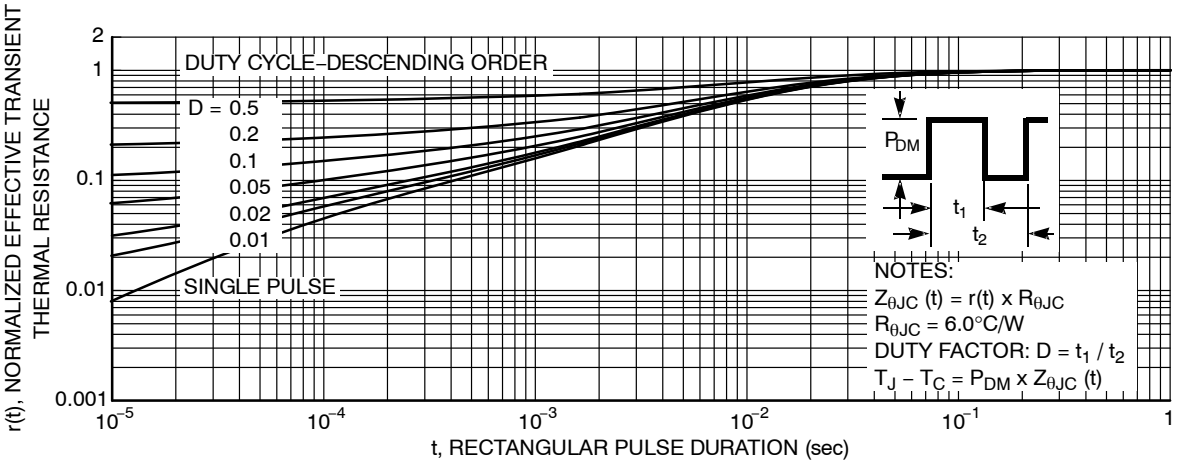


Figure 13. Junction−to−Case Transient Thermal Response Curve

TYPICAL CHARACTERISTICS (Q2 N−CHANNEL) (T_J = 25°C unless otherwise noted)

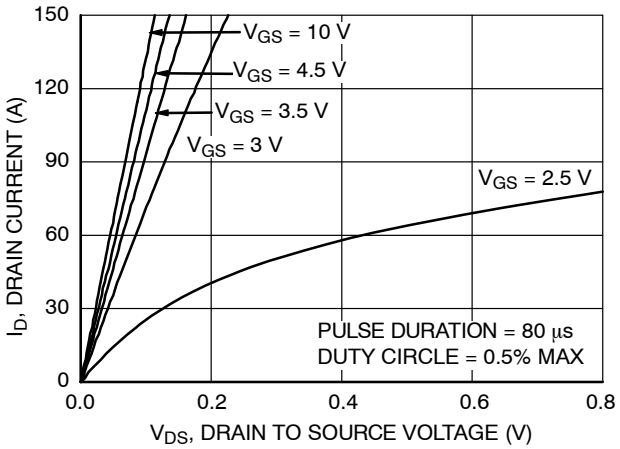


Figure 14. On−Region Characteristics

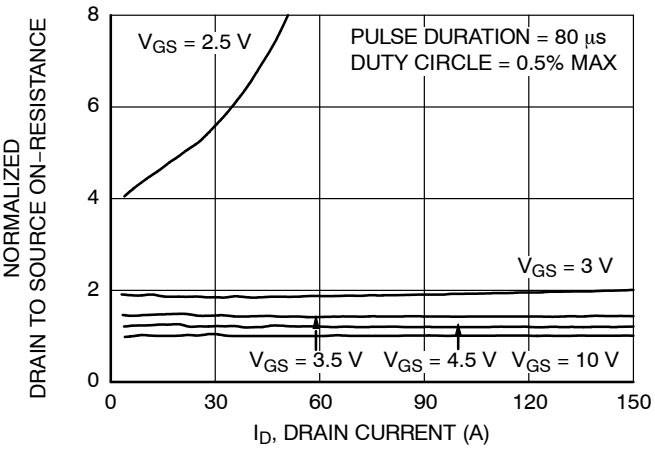


Figure 15. Normalized on−Resistance vs. Drain Current and Gate Voltage

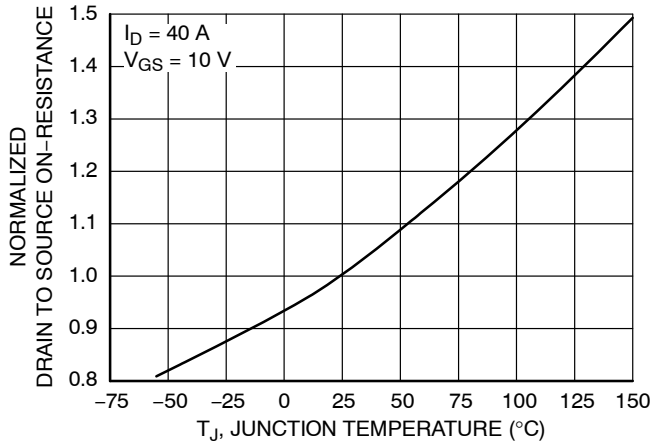


Figure 16. Normalized On−Resistance vs. Junction Temperature

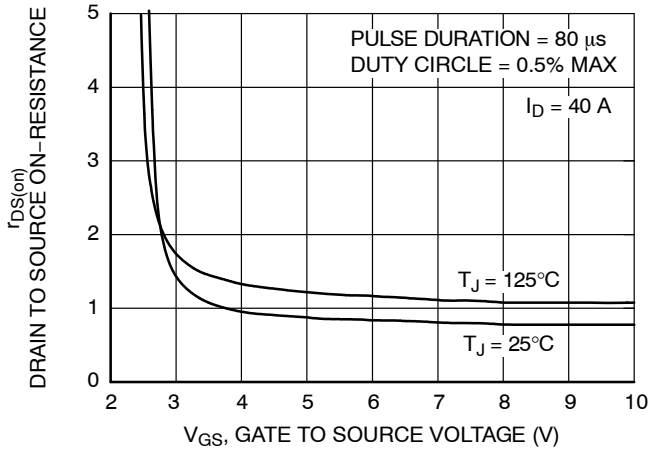


Figure 17. On−Resistance vs. Gate to Source Voltage

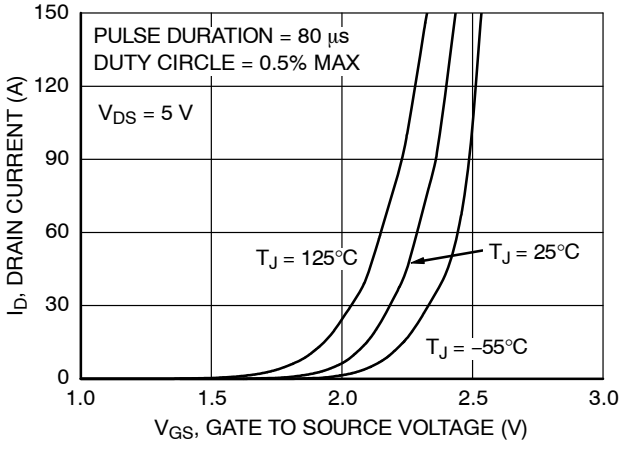


Figure 18. Transfer Characteristics

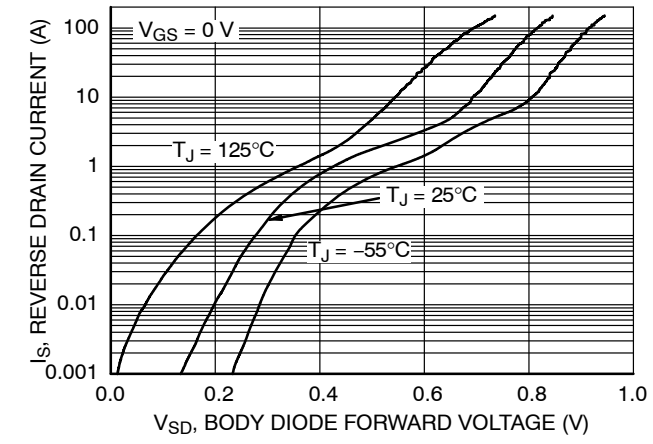


Figure 19. Source to Drain Diode Forward Voltage vs. Source Current

TYPICAL CHARACTERISTICS (Q2 N−CHANNEL) (T_J = 25°C unless otherwise noted) (continued)

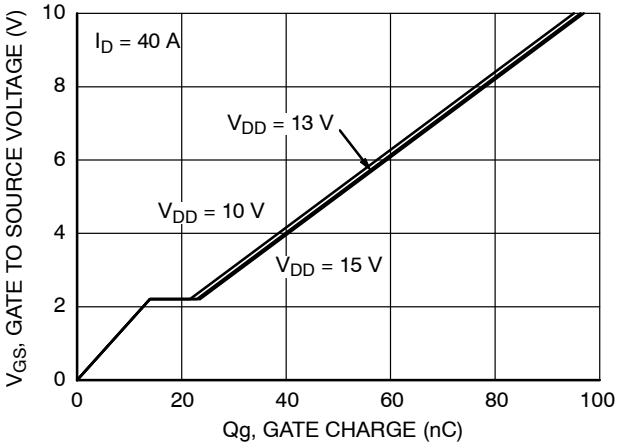


Figure 20. Gate Charge Characteristics

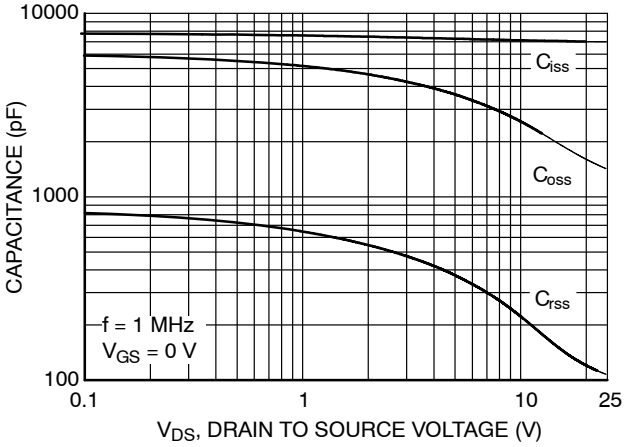


Figure 21. Capacitance vs. Drain to Source Voltage

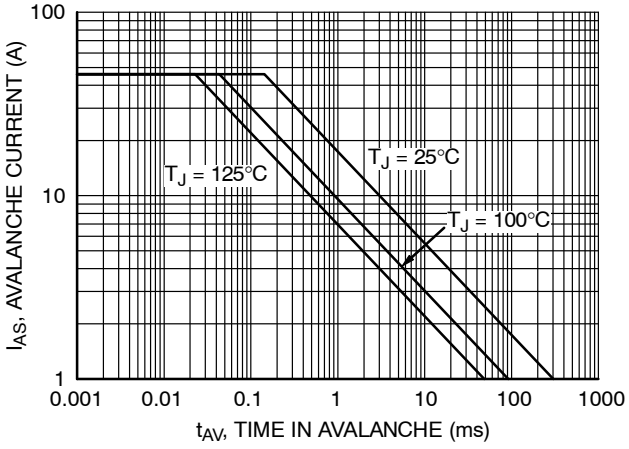


Figure 22. Unclamped Inductive Switching Capability

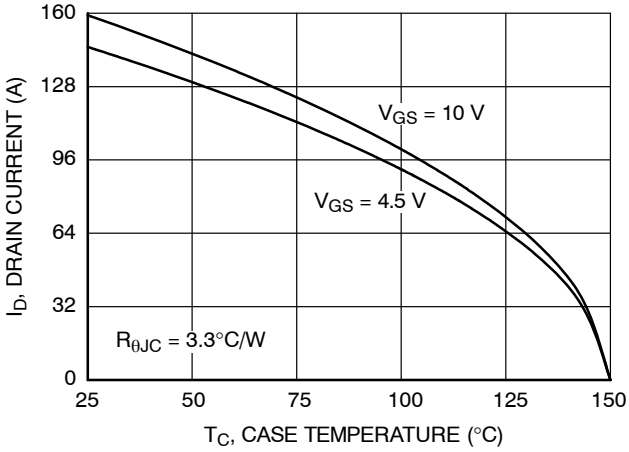


Figure 23. Maximum Continuous Drain Current vs. Case Temperature

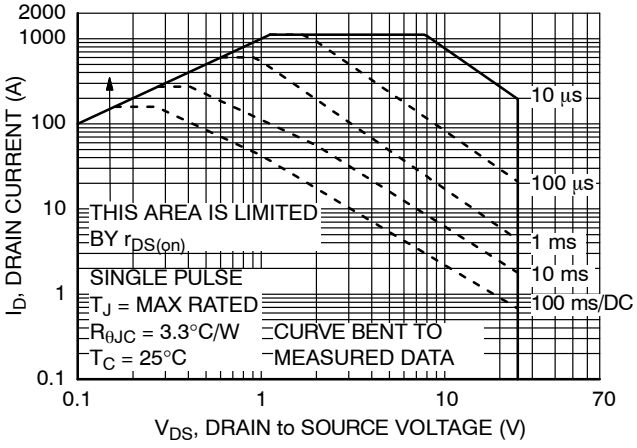


Figure 24. Forward Bias Safe Operating Area

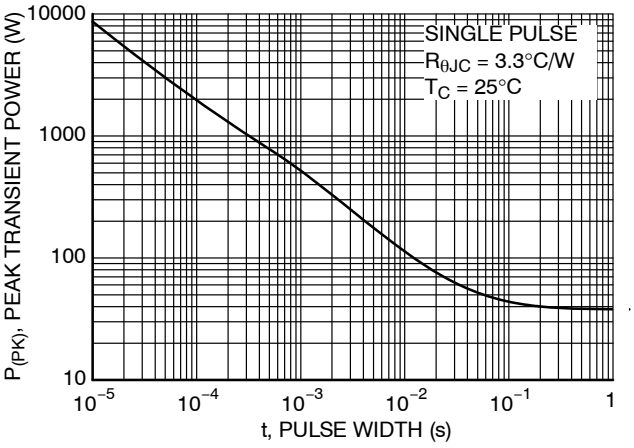


Figure 25. Single Pulse Maximum Power Dissipation

TYPICAL CHARACTERISTICS (Q2 N−CHANNEL) (T_J = 25°C unless otherwise noted) (continued)

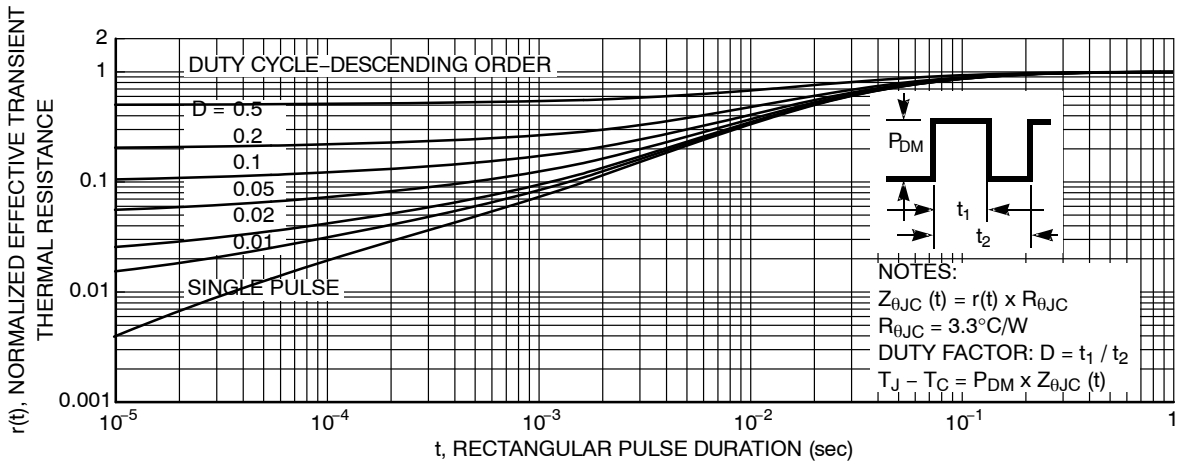


Figure 26. Junction−to−Case Transient Thermal Response Curve

TYPICAL CHARACTERISTICS

SyncFET Schottky Body Diode Characteristics

ON Semiconductor'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 reverses recovery characteristic of the FDPC8014AS.

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

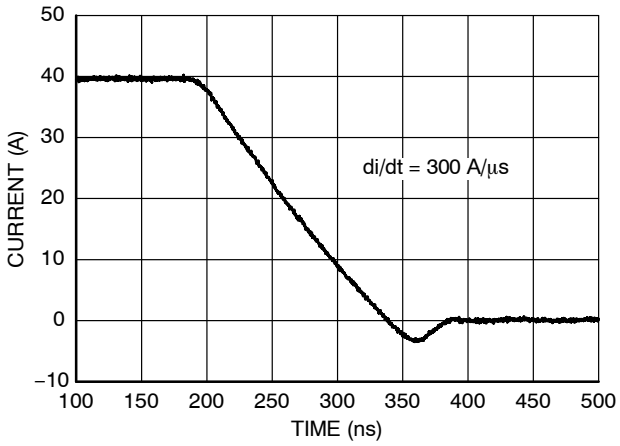


Figure 27. FDPC8014AS SyncFET Body Diode Reverse Recovery Characteristic

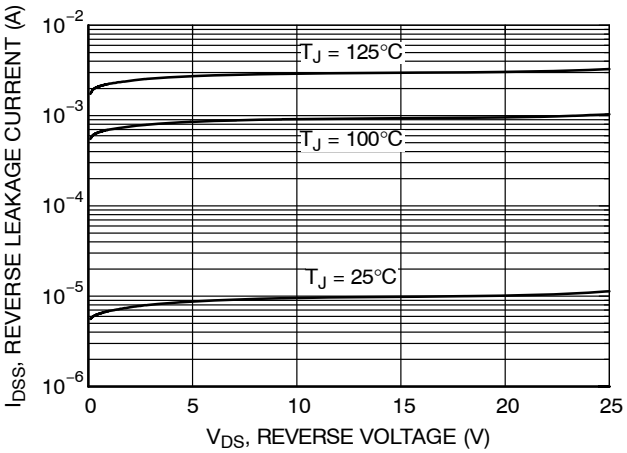


Figure 28. SyncFET Body Diode Reverse Leakage vs. Drain−source Voltage

ORDERING INFORMATION

Device	Device Marking	Package	Reel Size	Tape Width	Shipping†
FDPC8014AS	FDPC8014AS	Power Clip 56 PDFN8 5x6, 1.27P (Pb−Free)	13”	12 mm	2000 / Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

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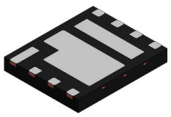

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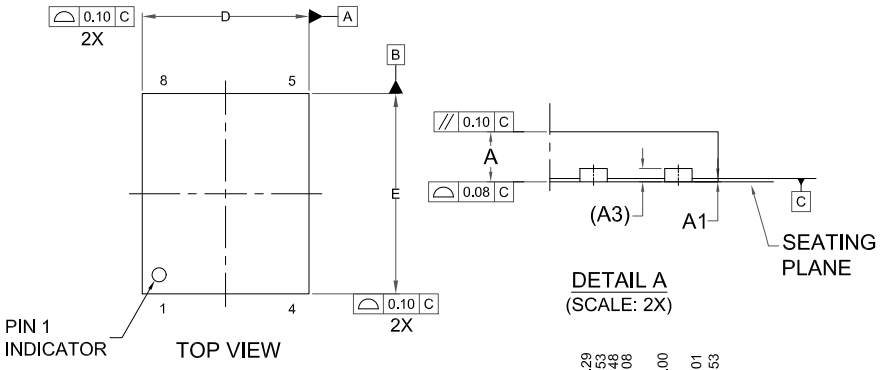

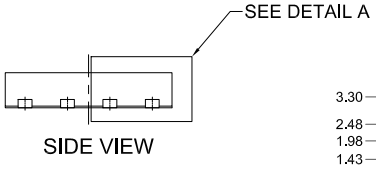

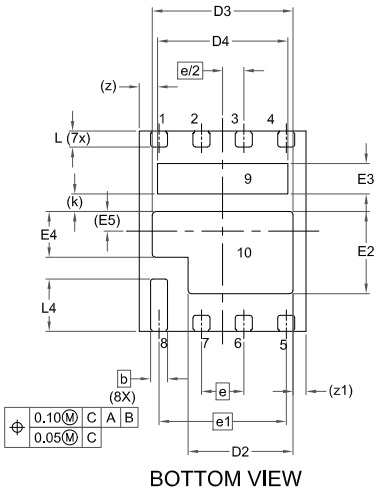

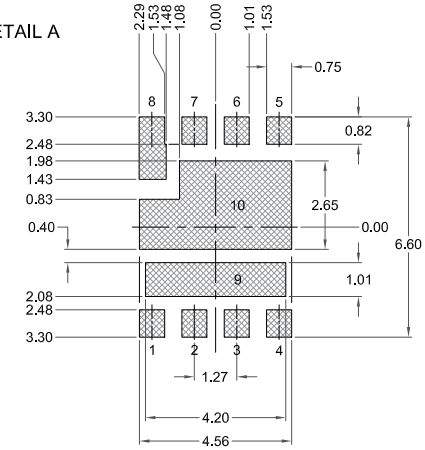

RECOMMENDED LAND PATTERN

*FOR ADDITIONAL INFORMATION ON OUR PB-FREE STRATEGY AND SOLDERING DETAILS, PLEASE DOWNLOAD THE ON SEMICONDUCTOR SOLDERING AND MOUNTING TECHNIQUES REFERENCE MANUAL, SOLDERRM/D.

NOTES: UNLESS OTHERWISE SPECIFIED

A) DOES NOT FULLY CONFORM TO JEDEC REGISTRATION, MO-229, DATED 11/2001.
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.

DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	0.70	0.75	0.80
A1	0.00	-	0.05
A3		0.20 REF	
b		0.51 BSC	
D	4.90	5.00	5.10
D2	3.05	3.15	3.25
D3	4.12	4.22	4.32
D4	3.80	3.90	4.00
E	5.90	6.00	6.10
E2	2.36	2.46	2.56
E3	0.81	0.91	1.01
E4	1.27	1.37	1.47
E5		0.59 REF	
e		1.27 BSC	
e/2		0.635 BSC	
e1		3.81 BSC	
k		0.52 REF	
L	0.38	0.48	0.58
L4	1.47	1.57	1.67
z		0.55 REF	
z1		0.39 REF	

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DESCRIPTION:	**PQFN8 5.00x6.00x0.75, 1.27P**		**PAGE 1 OF 1**

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