FAIRCHILD™

Is Now Part of

ON Semiconductor®

To learn more about ON Semiconductor, please visit our website at
www.onsemi.com

Please note: As part of the Fairchild Semiconductor integration, some of the Fairchild orderable part numbers will need to change in order to meet ON Semiconductor's system requirements. Since the ON Semiconductor product management systems do not have the ability to manage part nomenclature that utilizes an underscore (_), the underscore (_) in the Fairchild part numbers will be changed to a dash (-). This document may contain device numbers with an underscore (_). Please check the ON Semiconductor website to verify the updated device numbers. The most current and up-to-date ordering information can be found at www.onsemi.com. Please email any questions regarding the system integration to Fairchild_questions@onsemi.com.

April 2014

FDPC8014S

PowerTrench® Power Clip
25V Asymmetric Dual N-Channel MOSFET

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 $r_{DS(on)}$ = 1.2 mΩ at V_{GS} = 10 V, I_D = 41 A
- Max $r_{DS(on)}$ = 1.4 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
- RoHS Compliant

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.

Applications

- Computing
- Communications
- General Purpose Point of Load
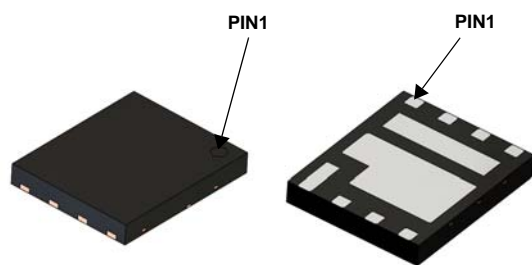
Top   **Power Clip 5X6**   **Bottom**
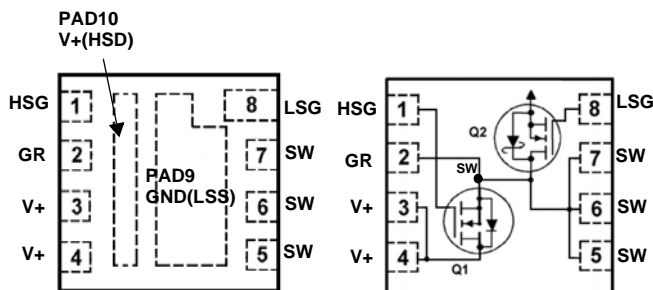
Pin	Name	Description	Pin	Name	Description	Pin	Name	Description
1	HSG	High Side Gate	3,4,10	V+(HSD)	High Side Drain	8	LSG	Low Side Gate
2	GR	Gate Return	5,6,7	SW	Switching Node, Low Side Drain	9	GND(LSS)	Low Side Source

MOSFET Maximum Ratings T_A = 25 °C unless otherwise noted

Symbol	Parameter		Q1	Q2	Units
V_{DS}	Drain to Source Voltage		25[Note5]	25	V
V_{GS}	Gate to Source Voltage		±12	±12	V
I_D	Drain Current -Continuous	T_C = 25 °C	60	110	A
	-Continuous	T_A = 25 °C	20[Note1a]	41[Note1b]	
	-Pulsed	T_A = 25 °C (Note 4)	75	160	
E_{AS}	Single Pulse Avalanche Energy	(Note 3)	73	253	mJ
P_D	Power Dissipation for Single Operation	T_C = 25 °C	21	42	W
	Power Dissipation for Single Operation	T_A = 25 °C	2.1[Note1a]	2.3[Note1b]	
T_J, T_{STG}	Operating and Storage Junction Temperature Range		-55 to +150		°C

Thermal Characteristics

$R_{\theta JC}$	Thermal Resistance, Junction to Case		6.0	3.0	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient		60[Note1a]	55[Note1b]	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient		130[Note1c]	120[Note1d]	

www.fairchildsemi.com

FDPC8014S Rev.C7

Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
05OD/16OD	FDPC8014S	Power Clip 56	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	25 25			V
$\dfrac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	I_D = 250 μA, referenced to 25 °C I_D = 10 mA, referenced to 25 °C	Q1 Q2		24 24		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

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	0.8 1.1	1.3 1.4	2.5 2.5	V
$\dfrac{\Delta V_{GS(th)}}{\Delta T_J}$	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		-4 -3		mV/°C
$r_{DS(on)}$	Drain to Source On Resistance	V_{GS} = 10V, 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		2.8 3.4 3.9	3.8 4.7 5.3	mΩ
		V_{GS} = 10V, I_D = 41 A V_{GS} = 4.5 V, I_D = 37 A V_{GS} = 10 V, I_D = 41 A ,T_J =125 °C	Q2		0.9 1.0 1.1	1.2 1.4 1.5	
g_{FS}	Forward Transconductance	V_{DS} = 5 V, I_D = 20 A V_{DS} = 5 V, I_D = 41 A	Q1 Q2		182 315		S

Dynamic Characteristics

Symbol	Parameter	Test Conditions	Type	Min	Typ	Max	Units
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 6580	2375 9870	pF
C_{oss}	Output Capacitance		Q1 Q2		495 1720	710 2580	pF
C_{rss}	Reverse Transfer Capacitance		Q1 Q2		54 204	100 370	pF
R_g	Gate Resistance		Q1 Q2	0.1 0.1	0.4 0.4	1.2 1.2	Ω

Switching Characteristics

Symbol	Parameter	Test Conditions	Type	Min	Typ	Max	Units
$t_{d(on)}$	Turn-On Delay Time	Q1: V_{DD} = 13 V, I_D = 20 A, R_{GEN} = 6 Ω Q2: V_{DD} = 13 V, I_D = 41 A, R_{GEN} = 6 Ω	Q1 Q2		8 16	16 28	ns
t_r	Rise Time		Q1 Q2		2 6	10 11	ns
$t_{d(off)}$	Turn-Off Delay Time		Q1 Q2		24 47	38 75	ns
t_f	Fall Time		Q1 Q2		2 4	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 = 41 A	Q1 Q2		25 93	35 130	nC
Q_g	Total Gate Charge	V_{GS} = 0 V to 4.5 V	Q1 Q2		11 43	16 60	nC
Q_{gs}	Gate to Source Gate Charge		Q1 Q2		3.4 13		nC
Q_{gd}	Gate to Drain "Miller" Charge		Q1 Q2		2.2 8.5		nC

Electrical Characteristics T_J = 25 °C unless otherwise noted

Symbol	Parameter	Test Conditions	Type	Min	Typ	Max	Units
Drain-Source Diode Characteristics							
V_{SD}	Source to Drain Diode Forward Voltage	V_{GS} = 0 V, I_S = 20 A (Note 2) V_{GS} = 0 V, I_S = 41 A (Note 2)	Q1 Q2		0.8 0.8	1.2 1.2	V
I_S	Diode continuous forward current	T_C = 25 °C	Q1 Q2		60 110		A
$I_{S,Pulse}$	Diode pulse current		Q1 Q2		75 160		A
t_{rr}	Reverse Recovery Time	Q1 I_F = 20 A, di/dt = 100 A/μs	Q1 Q2		25 36	40 58	ns
Q_{rr}	Reverse Recovery Charge	Q2 I_F = 41 A, di/dt = 300 A/μs	Q1 Q2		10 47	20 75	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.
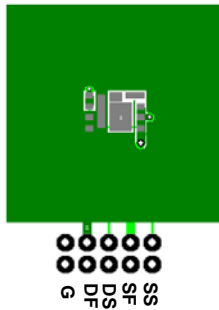
a. 60 °C/W when mounted on a 1 in^2 pad of 2 oz copper
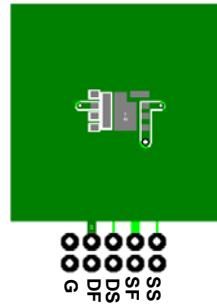
b. 55 °C/W when mounted on a 1 in^2 pad of 2 oz copper
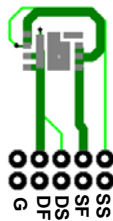
c. 130 °C/W when mounted on a minimum pad of 2 oz copper
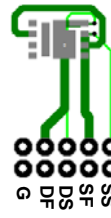
d. 120 °C/W when mounted on a minimum pad of 2 oz copper

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

3. 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 253 mJ is based on starting T_J = 25 °C; N-ch: L = 3 mH, I_{AS} = 13 A, V_{DD} = 25 V, V_{GS} = 10 V. 100% test at L= 0.1 mH, I_{AS} = 43 A.

4. Pulsed Id limited by junction temperature,td<=10 us. Please refer to SOA curve for more details.

5. 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.

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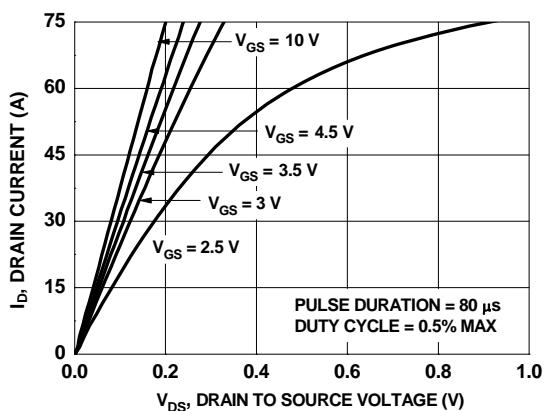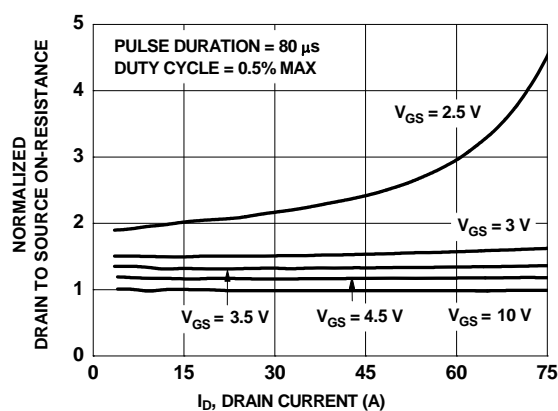

Figure 1. On Region Characteristics

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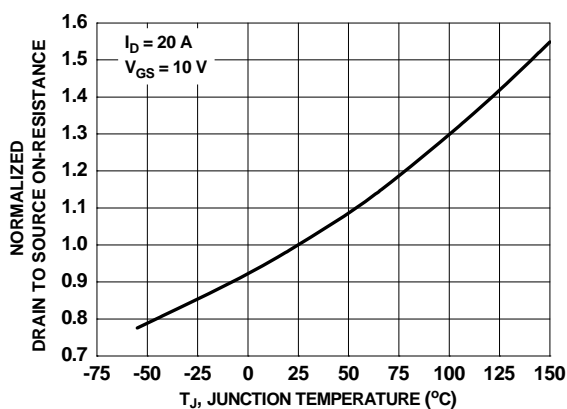

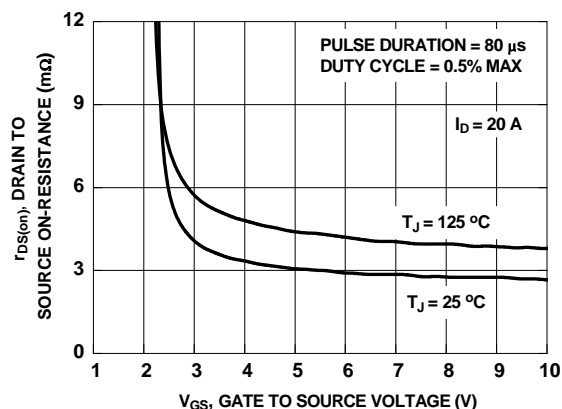Figure 3. Normalized On Resistance vs. Junction Temperature
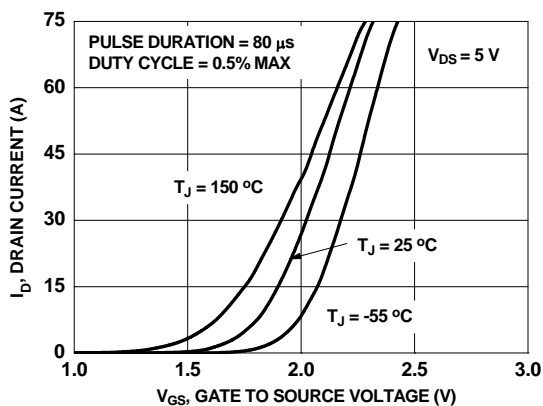

Figure 4. On-Resistance vs. Gate to Source Voltage

Figure 5. Transfer Characteristics
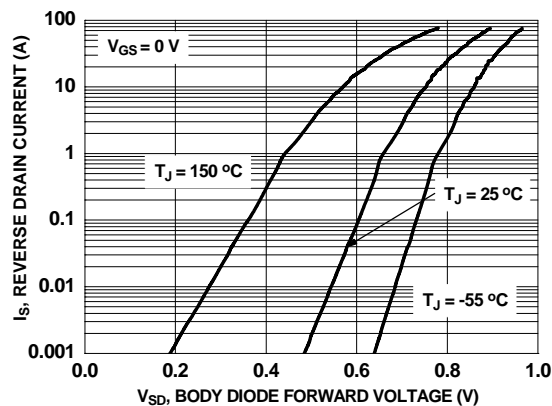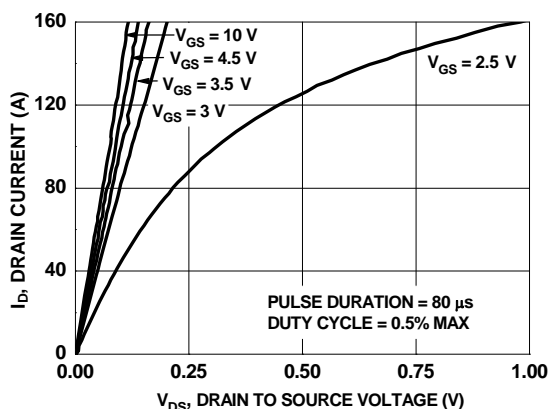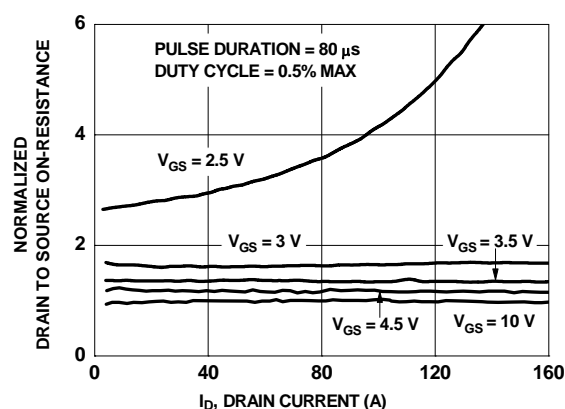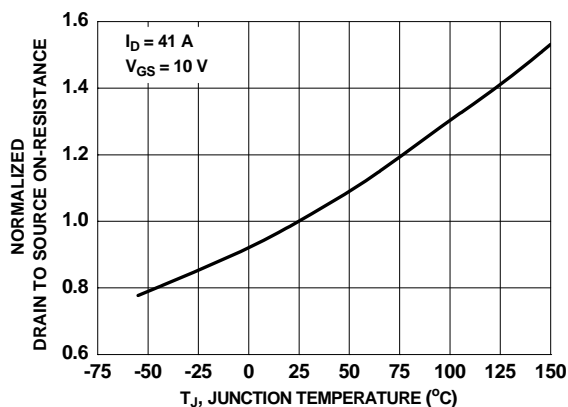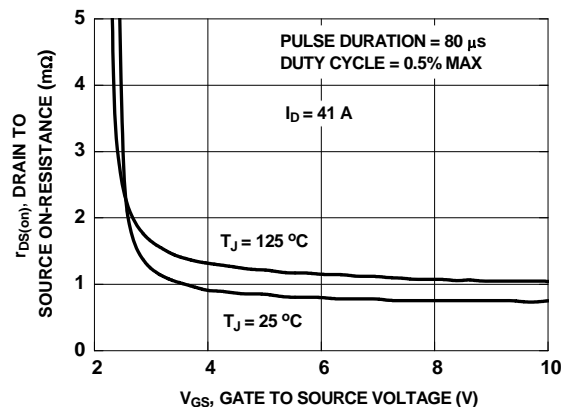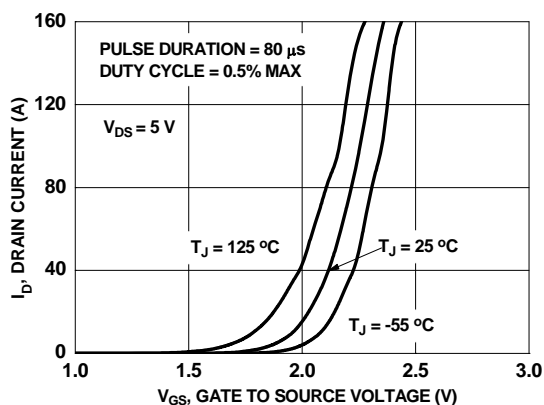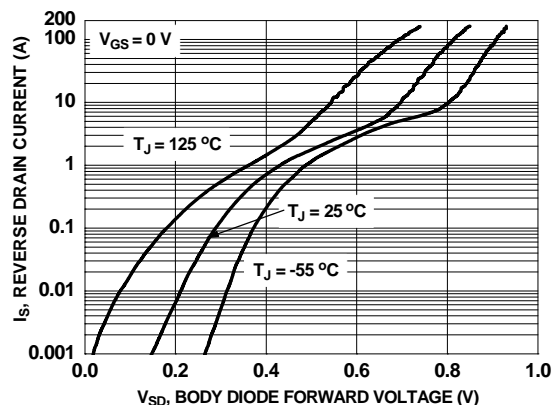

Figure 6. Source to Drain Diode Forward Voltage vs. Source Current

www.fairchildsemi.com

FDPC8014S Rev.C7

Typical Characteristics (Q1 N-Channel) T_J = 25°C unless otherwise noted
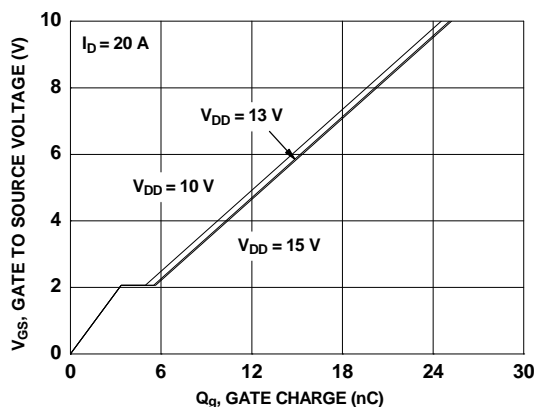
Figure 7. Gate Charge Characteristics

Graph axes: V_{GS}, GATE TO SOURCE VOLTAGE (V) vs Q_g, GATE CHARGE (nC); I_D = 20 A; V_{DD} = 13 V; V_{DD} = 10 V; V_{DD} = 15 V
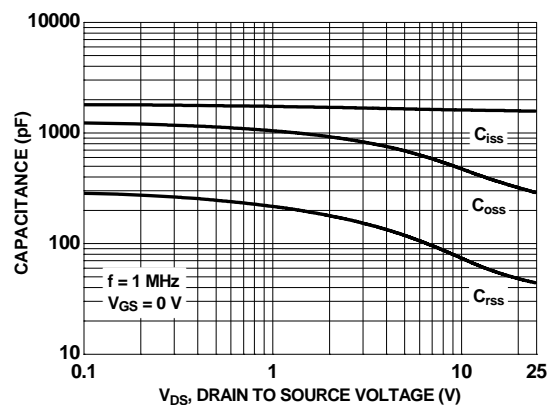
Figure 8. Capacitance vs. Drain to Source Voltage

Graph axes: CAPACITANCE (pF) vs V_{DS}, DRAIN TO SOURCE VOLTAGE (V); C_{iss}; C_{oss}; C_{rss}; f = 1 MHz; V_{GS} = 0 V
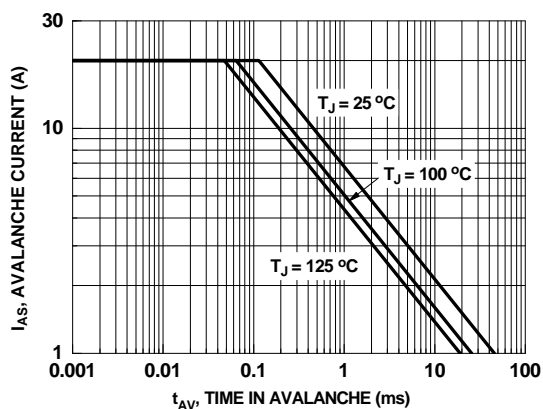
Figure 9. Unclamped Inductive Switching Capability

Graph axes: I_{AS}, AVALANCHE CURRENT (A) vs t_{AV}, TIME IN AVALANCHE (ms); T_J = 25 °C; T_J = 100 °C; T_J = 125 °C
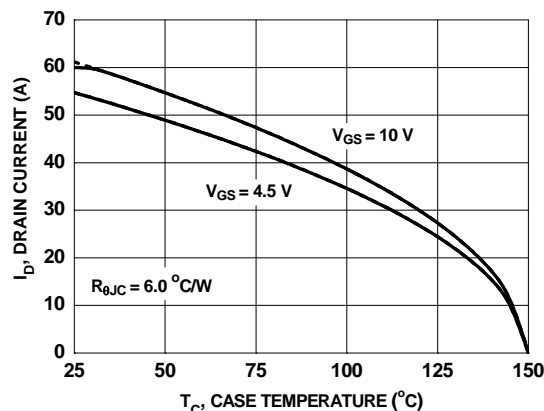
Figure 10. Maximum Continuous Drain Current vs. Case Temperature

Graph axes: I_D, DRAIN CURRENT (A) vs T_C, CASE TEMPERATURE (°C); V_{GS} = 10 V; V_{GS} = 4.5 V; $R_{\theta JC}$ = 6.0 °C/W
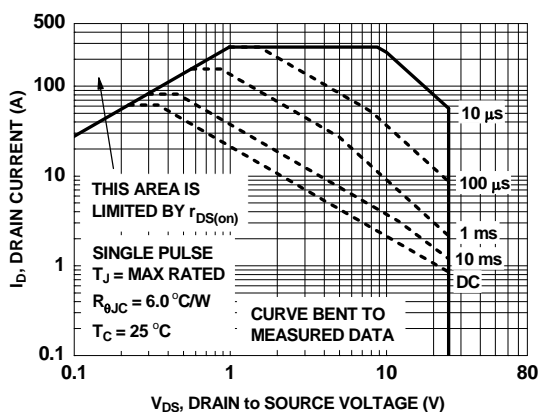
Figure 11. Forward Bias Safe Operating Area

Graph axes: I_D, DRAIN CURRENT (A) vs V_{DS}, DRAIN to SOURCE VOLTAGE (V); 10 µs; 100 µs; 1 ms; 10 ms; DC; THIS AREA IS LIMITED BY $r_{DS(on)}$; SINGLE PULSE; T_J = MAX RATED; $R_{\theta JC}$ = 6.0 °C/W; T_C = 25 °C; CURVE BENT TO MEASURED DATA
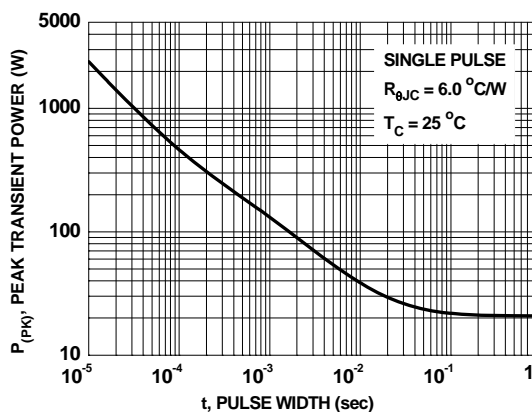
Figure 12. Single Pulse Maximum Power Dissipation

Graph axes: $P_{(PK)}$, PEAK TRANSIENT POWER (W) vs t, PULSE WIDTH (sec); SINGLE PULSE; $R_{\theta JC}$ = 6.0 °C/W; T_C = 25 °C

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

DUTY CYCLE-DESCENDING ORDER

D = 0.5
0.2
0.1
0.05
0.02
0.01

SINGLE PULSE

r(t), NORMALIZED EFFECTIVE TRANSIENT THERMAL RESISTANCE

t, RECTANGULAR PULSE DURATION (sec)

NOTES:
$Z_{\theta JC}(t) = r(t) \times R_{\theta Jc}$
$R_{\theta JC} = 6.0 \ °C/W$
DUTY FACTOR: $D = t_1/t_2$
$T_J - T_C = P_{DM} \times Z_{\theta JC}(t)$
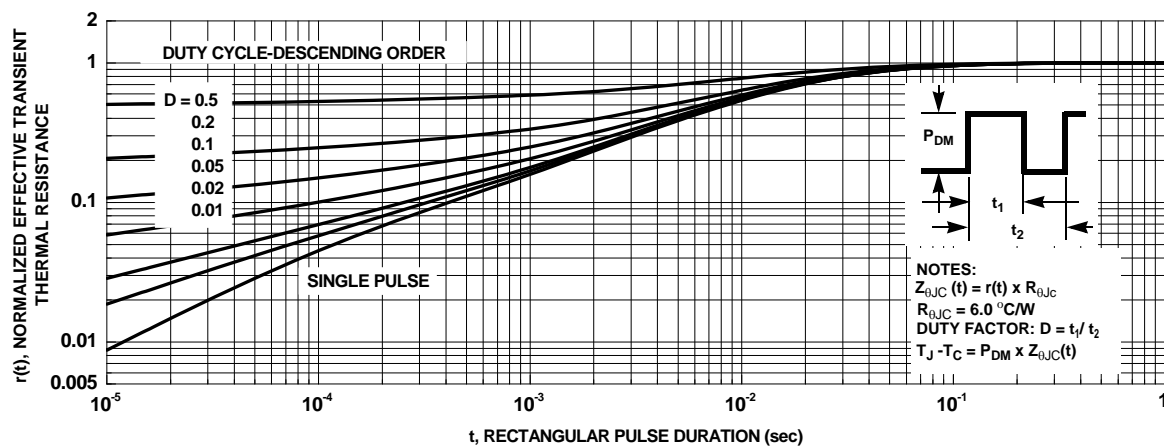
Figure 13. Junction-to-Case Transient Thermal Response Curve

6

FDPC8014S Rev.C7

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
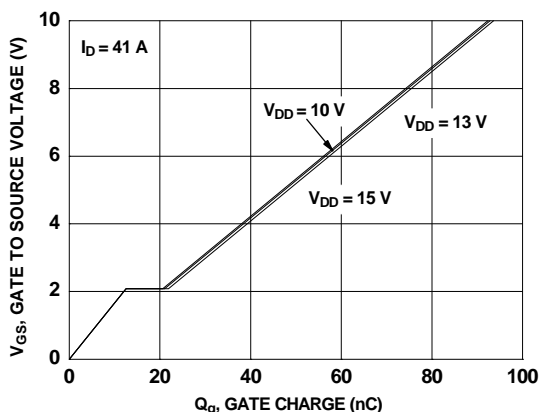
Figure 20. Gate Charge Characteristics
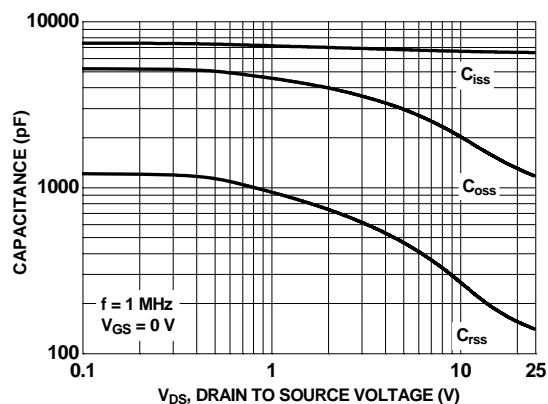
Figure 21. Capacitance vs. Drain to Source Voltage
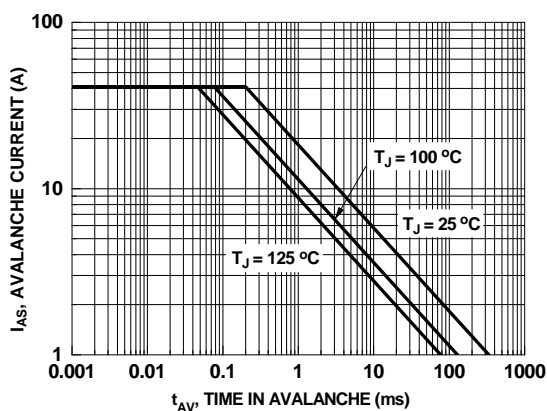
Figure 22. Unclamped Inductive Switching Capability
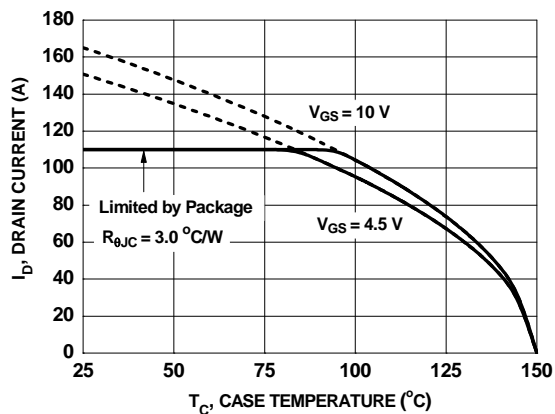
Figure 23. Maximum Continuous Drain Current vs. Case Temperature
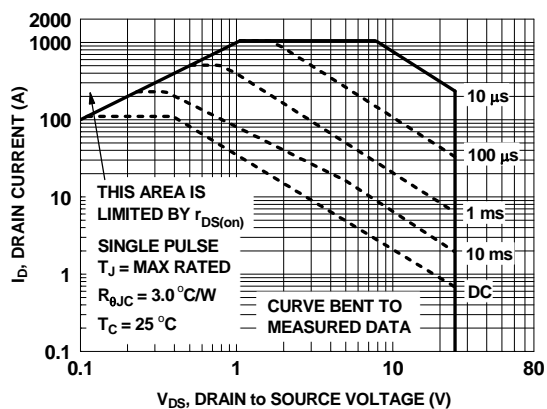
Figure 24. Forward Bias Safe Operating Area
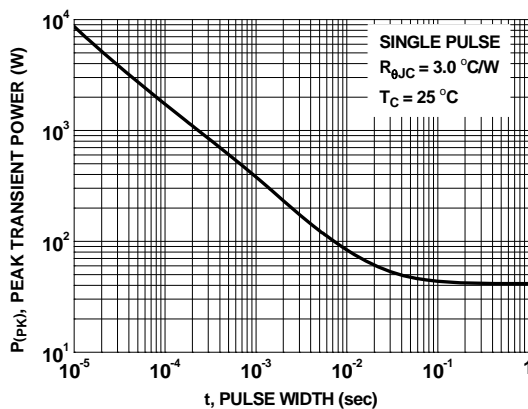
Figure 25. Single Pulse Maximum Power Dissipation

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

DUTY CYCLE-DESCENDING ORDER

D = 0.5
0.2
0.1
0.05
0.02
0.01

SINGLE PULSE

r(t), NORMALIZED EFFECTIVE TRANSIENT THERMAL RESISTANCE

t, RECTANGULAR PULSE DURATION (sec)

NOTES:
$Z_{\theta JC}(t) = r(t) \times R_{\theta Jc}$
$R_{\theta JC}$ = 3.0 °C/W
DUTY FACTOR: $D = t_1 / t_2$
$T_J - T_C = P_{DM} \times Z_{\theta JC}(t)$
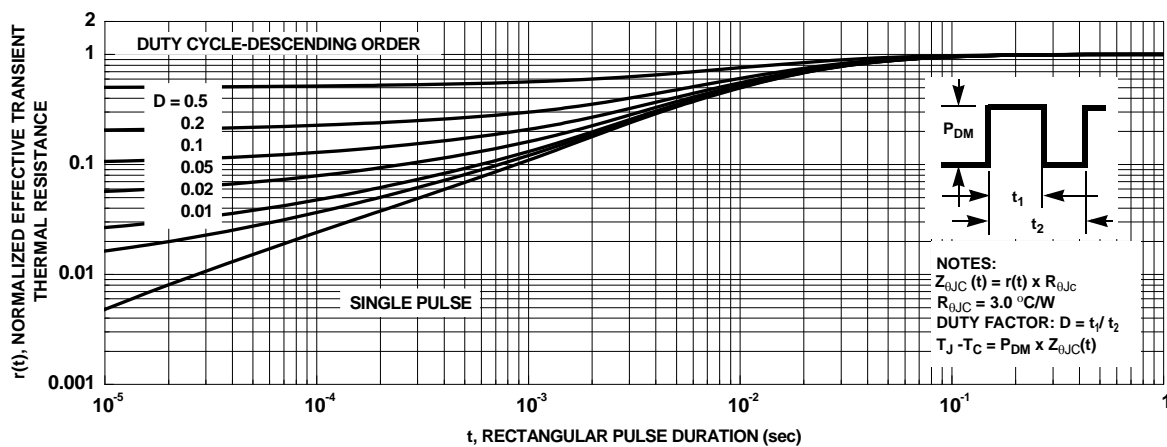
Figure 26. Junction-to-Case Transient Thermal Response Curve

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 reverses recovery characteristic of the FDPC8014S.

Schottky barrier diodes exhibit significant leakage at high temperature and high reverse voltage. This will increase the power in the device.
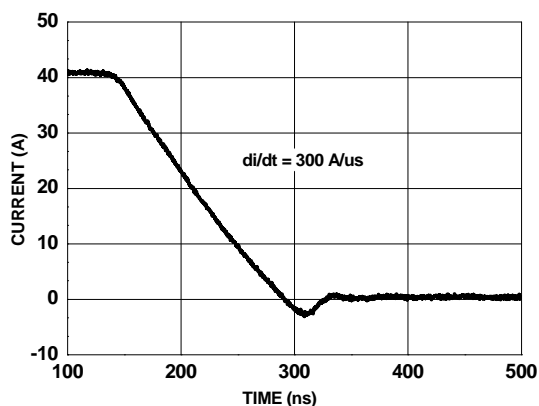
Figure 27. FDPC8014S SyncFET™ Body Diode Reverse Recovery Characteristic
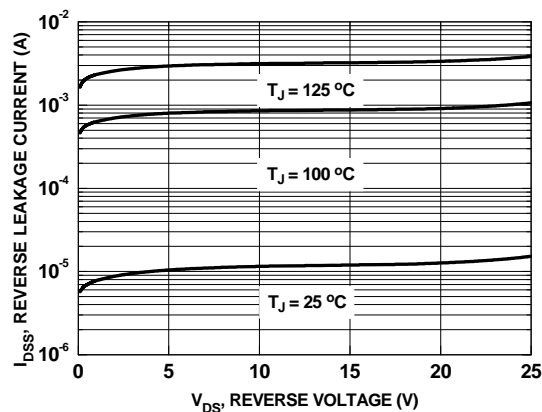
Figure 28. SyncFET™ Body Diode Reverse Leakage vs. Drain-source Voltage

TOP VIEW

2X △ 0.10 C

5.10 / 4.90

PKG ℄

A

B

4   1

PKG ℄   6.10 / 5.90

5   8

2X △ 0.10 C

PIN #1 INDICATOR

SIDE VIEW

SEE DETAIL A

RECOMMENDED LAND PATTERN

5.00
4.56
4.20
1.27

4 3   2 1

3.30
2.48
2.08

1.01

6.60

0.00

0.40

2.65

0.83
1.43
1.98
2.48
3.30

0.82

0.75

5 6 7 8

1.53
1.01
0.00
1.08
1.48
1.53
2.29

BOTTOM VIEW

⊕ | 0.10 Ⓜ | C | A | B
  | 0.05 Ⓜ | C

3.15±.05
3.81
1.27
0.51

5 6 7 8

0.65±.05

1.57±.05

2.46±.05

0.65±.05

1.37±.05

0.91±.05

0.53±.05

0.49±.05

0.48±.05

4 3 2 1

0.51±.05
3.90±.05
4.22±.05
5.00±.05
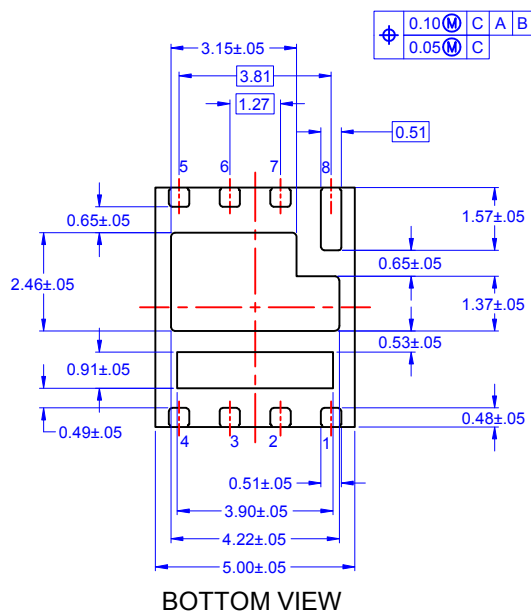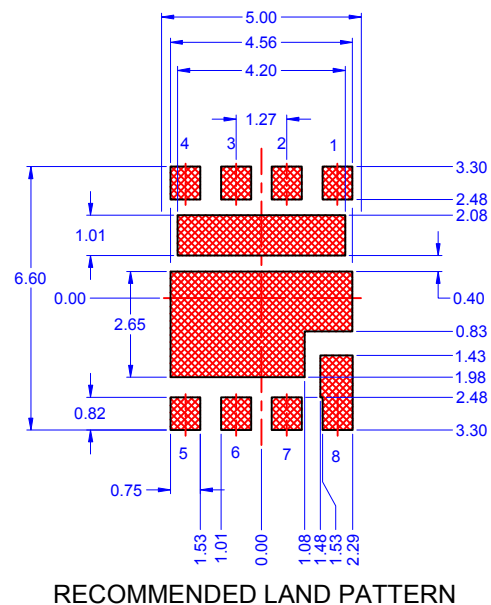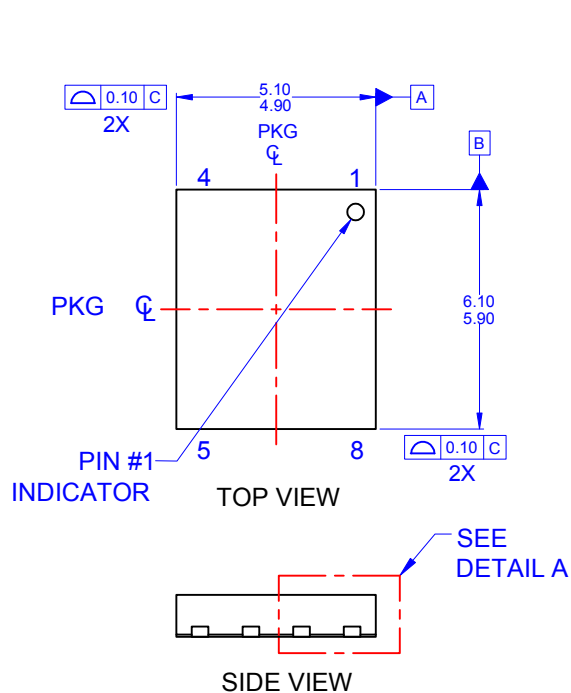
NOTES: UNLESS OTHERWISE SPECIFIED

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.
E) DRAWING FILE NAME: PQFN08KREV2

DETAIL A
(SCALE: 2X)

∥ | 0.10 | C

△ | 0.08 | C

0.80 / 0.70

0.30 / 0.20

0.05 / 0.00

C

SEATING PLANE

PUBLICATION ORDERING INFORMATION
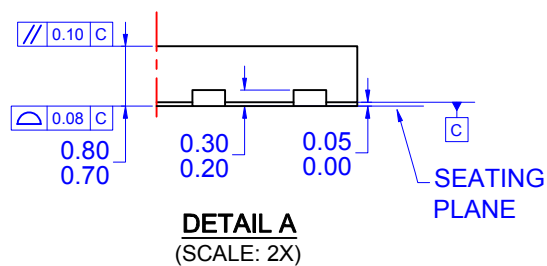
© Semiconductor Components Industries, LLC

www.onsemi.com