FAIRCHILD

SEMICONDUCTOR®

November 2013

FDMS015N04B

## N-Channel PowerTrench® MOSFET

40 V, 100 A, 1.5 mΩ

Features

- $R_{DS(on)}$ = 1.13 mΩ (Typ.) @ V_{GS} = 10 V, I_D = 50 A
- Advanced Package and Silicon Combination for Low $R_{DS(on)}$ and High Efficiency
- Fast Switching Speed
- 100% UIL Tested
- RoHS Compliant

Description

This N-Channel MOSFET is produced using Fairchild Semiconductor's advance PowerTrench® process that has been tailored to minimize the on-state resistance while maintaining superior switching performance.

Applications

- Synchronous Rectification for ATX / Server
- Battery Protection Circuit
- Motor Drives and Uninterruptible Power Supplies

Top

Bottom

Pin 1

S
S
S
G

D
D
D
D

Power 56

D	5		4	G
D	6		3	S
D	7		2	S
D	8		1	S
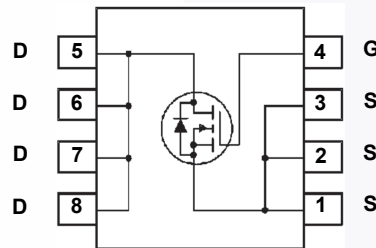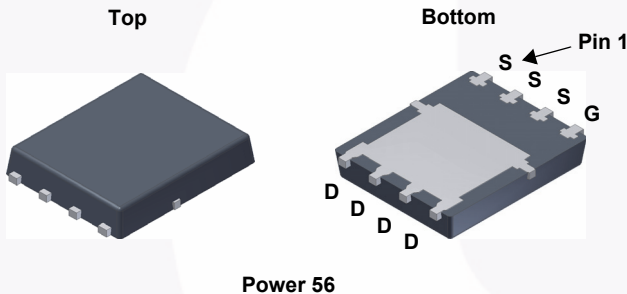
MOSFET Maximum Ratings T_C = 25°C unless otherwise noted.

Symbol	Parameter			FDMS015N04B	Unit
V_{DSS}	Drain to Source Voltage			40	V
V_{GSS}	Gate to Source Voltage			±20	V
I_D	Drain Current	- Continuous (T_C = 25°C)		100	A
		- Continuous (T_A = 25°C)	(Note 1a)	31.3	
I_{DM}	Drain Current	- Pulsed	(Note 2)	400	A
E_{AS}	Single Pulsed Avalanche Energy		(Note 3)	526	mJ
P_D	Power Dissipation	(T_C = 25°C)		104	W
		(T_A = 25°C)	(Note 1a)	2.5	W
T_J, T_{STG}	Operating and Storage Temperature Range			-55 to +150	°C

Thermal Characteristics

Symbol	Parameter		FDMS015N04B	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.		1.2	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max.	(Note 1a)	50	

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Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FDMS015N04B	FDMS015N04B	Power 56	13 "	12 mm	3000 units

Electrical Characteristics T_C = 25°C unless otherwise noted.

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
Off Characteristics						
BV_{DSS}	Drain to Source Breakdown Voltage	I_D = 250 μA, V_{GS} = 0 V	40	-	-	V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	I_D = 250 μA, Referenced to 25°C	-	37	-	mV/°C
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 32 V, V_{GS} = 0 V	-	-	1	μA
I_{GSS}	Gate to Body Leakage Current	V_{GS} = ±20 V, V_{DS} = 0 V	-	-	±100	nA
On Characteristics						
$V_{GS(th)}$	Gate Threshold Voltage	V_{GS} = V_{DS}, I_D = 250 μA	2.0	-	4.0	V
$R_{DS(on)}$	Static Drain to Source On Resistance	V_{GS} = 10 V, I_D = 50 A	-	1.13	1.5	mΩ
g_{FS}	Forward Transconductance	V_{DS} = 5 V, I_D = 50 A	-	171	-	S
Dynamic Characteristics						
C_{iss}	Input Capacitance	V_{DS} = 20 V, V_{GS} = 0 V f = 1 MHz	-	6560	8725	pF
C_{oss}	Output Capacitance		-	2795	3720	pF
C_{rss}	Reverse Transfer Capacitance		-	162	-	pF
C_{oss}(er)	Energy Releted Output Capacitance	V_{DS} = 20 V, V_{GS} = 0 V	-	3896	-	pF
$Q_{g(tot)}$	Total Gate Charge at 10V	V_{DS} = 20 V, I_D = 50 A V_{GS} = 0 V to 10 V	-	91	118	nC
Q_{gs}	Gate to Source Gate Charge		-	26	-	nC
Q_{gs2}	Gate Charge Threshold to Plateau		-	9	-	nC
Q_{gd}	Gate to Drain "Miller" Charge	(Note 4)	-	16	-	nC
ESR	Equivalent Series Resistance	f = 1 MHz	-	1.4	-	Ω
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	V_{DD} = 20 V, I_D = 50 A V_{GS} = 10 V, R_G = 4.7 Ω	-	34	78	ns
t_r	Turn-On Rise Time		-	24	58	ns
$t_{d(off)}$	Turn-Off Delay Time		-	71	152	ns
t_f	Turn-Off Fall Time	(Note 4)	-	26	62	ns
Drain-Source Diode Characteristics						
I_S	Maximum Continuous Drain to Source Diode Forward Current		-	-	100	A
I_{SM}	Maximum Pulsed Drain to Source Diode Forward Current		-	-	400	A
V_{SD}	Drain to Source Diode Forward Voltage	V_{GS} = 0 V, I_{SD} = 50 A	-	-	1.3	V
t_{rr}	Reverse Recovery Time	V_{GS} = 0 V, I_{SD} = 50 A dI$_F$/dt = 100 A/μs	-	78	-	ns
Q_{rr}	Reverse Recovery Charge		-	90	-	nC

Notes:

1. $R_{\theta JA}$ is determined with the device mounted on a 1in² 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.
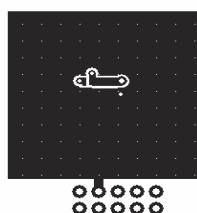
a. 50 °C/W when mounted on a 1 in² pad of 2 oz copper.

b. 125 °C/W when mounted on a minimum pad of 2 oz copper.

2. Repetitive rating: pulse-width limited by maximum junction temperature.
3. L = 3 mH, I_{AS} = 18.72 A, starting T_J = 25°C.
4. Essentially independent of operating temperature typical characteristics.

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FDMS015N04B Rev. C3

Typical Performance Characteristics

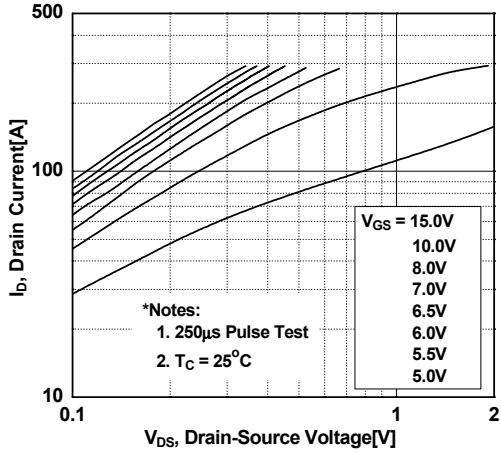### Figure 1. On-Region Characteristics
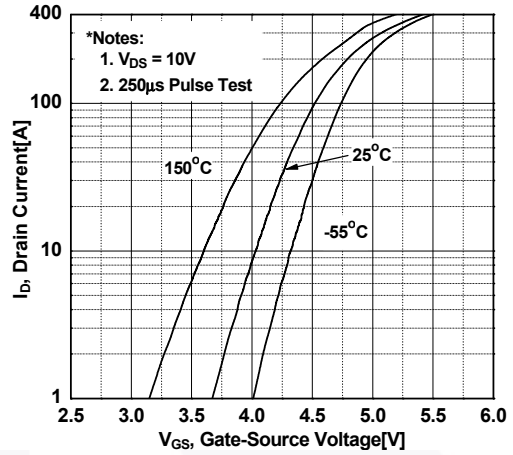

Figure 2. Transfer Characteristics

Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage
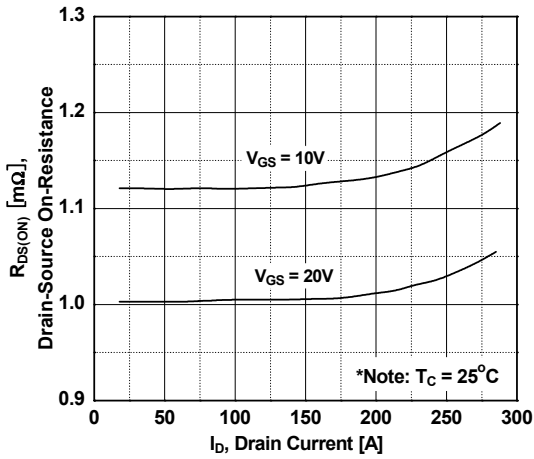

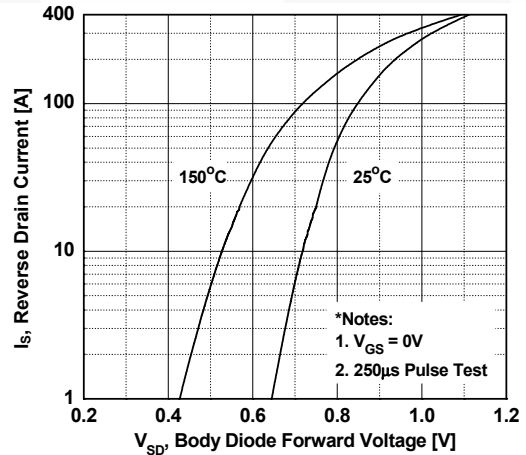### Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

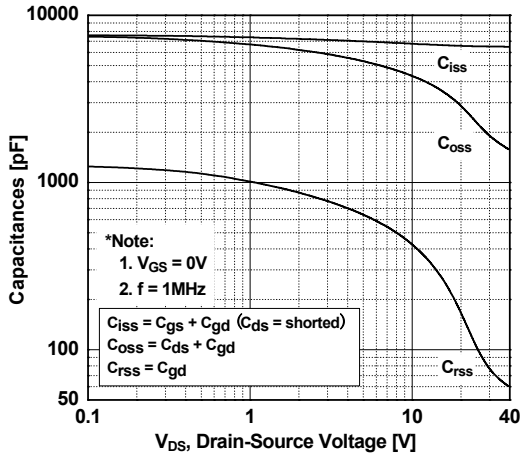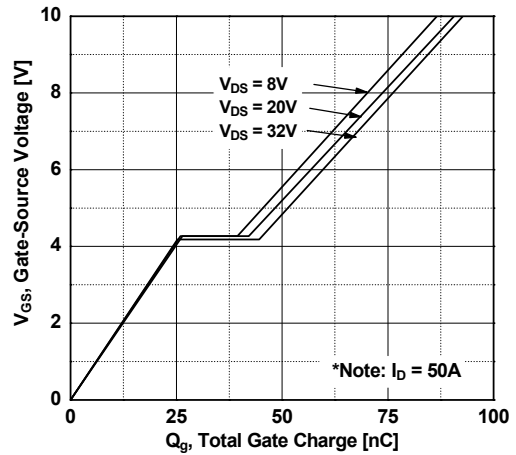### Figure 5. Capacitance Characteristics

Figure 6. Gate Charge Characteristics

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Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

BV$_{DSS}$, [Normalized] Drain-Source Breakdown Voltage vs. T$_J$, Junction Temperature [°C]

*Notes:
1. V$_{GS}$ = 0V
2. I$_D$ = 250µA
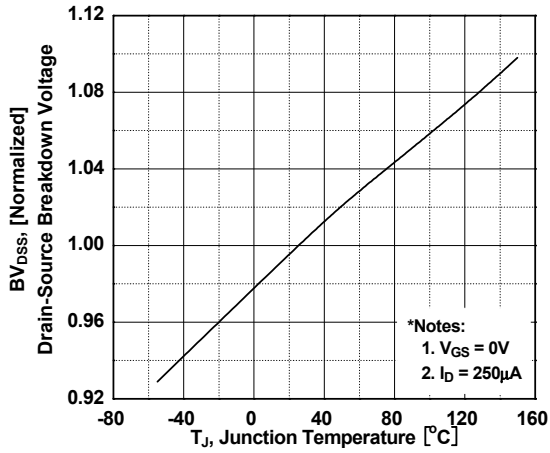
Figure 8. On-Resistance Variation vs. Temperature

R$_{DS(on)}$, [Normalized] Drain-Source On-Resistance vs. T$_J$, Junction Temperature [°C]

*Notes:
1. V$_{GS}$ = 10V
2. I$_D$ = 50A
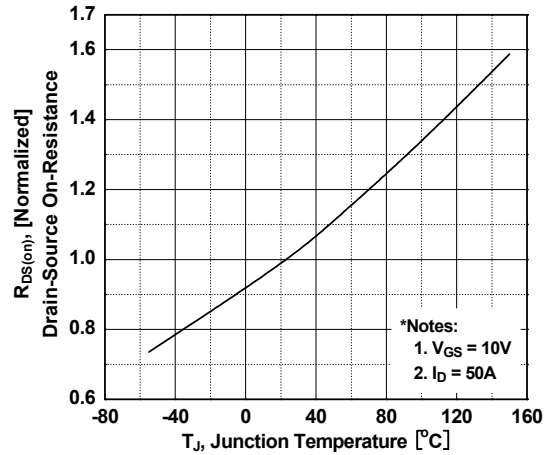
Figure 9. Maximum Safe Operating Area

I$_D$, Drain Current [A] vs. V$_{DS}$, Drain-Source Voltage [V]

1ms
10ms
100ms
DC

Operation in This Area is Limited by R$_{DS(on)}$

*Notes:
1. T$_C$ = 25°C
2. T$_J$ = 150°C
3. Single Pulse
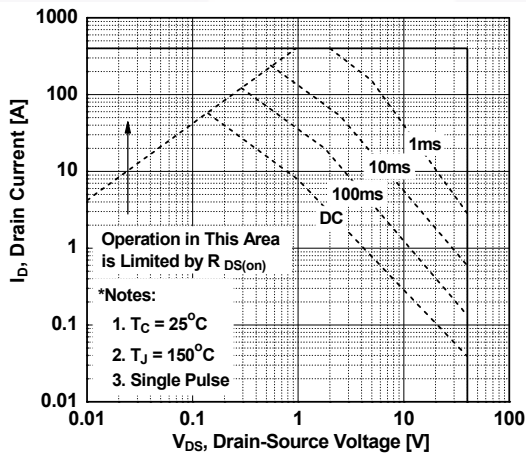
Figure 10. Maximum Drain Current vs. Case Temperature

I$_D$, Drain Current [A] vs. T$_C$, Case Temperature [°C]

V$_{GS}$ = 10V

R$_{\theta JC}$ = 1.2°C/W
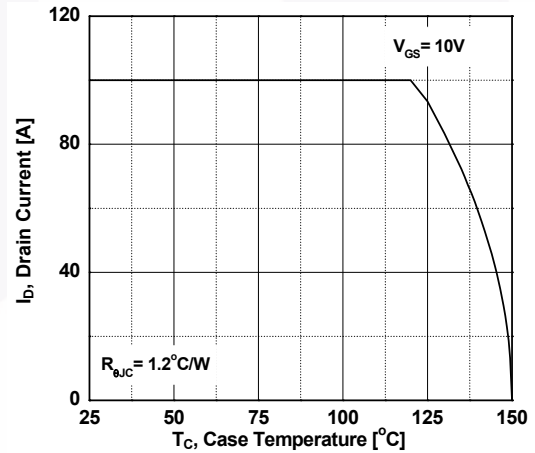
Figure 11. Eoss vs. Drain to Source Voltage

E$_{OSS}$, [µJ] vs. V$_{DS}$, Drain to Source Voltage [V]
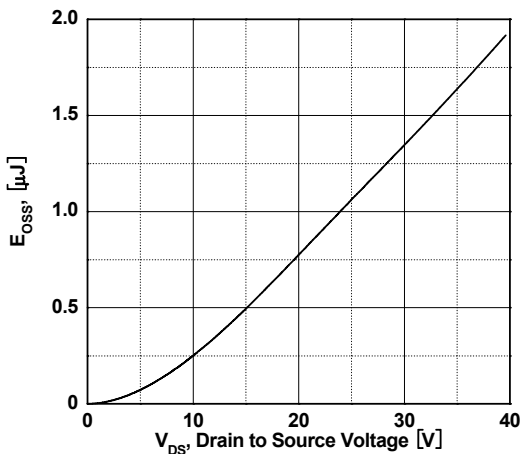
Figure 12. Unclamped Inductive Switching Capability

I$_{AS}$, Avalanche Current [A] vs. t$_{AV}$, Time In Avalanche [ms]

If R = 0
t$_{AV}$ = (L) (I$_{AS}$)/ (1.3*RATED BV$_{DSS}$-V$_{DD}$)
If R = 0
t$_{AV}$ = (L/R)ln[(I$_{AS}$*R)/ (1.3*RATED BV$_{DSS}$-V$_{DD}$)+1]

STARTING T$_J$ = 25°C

STARTING T$_J$ = 125°C
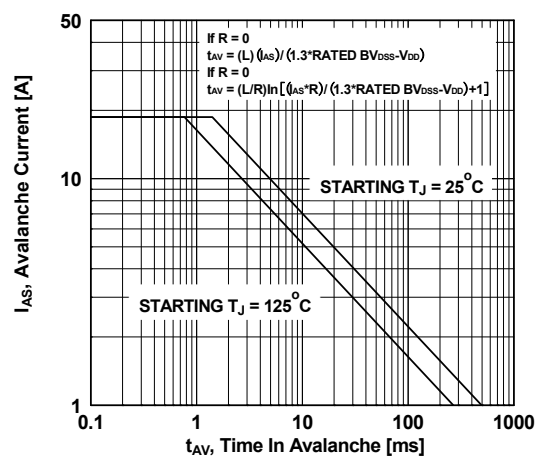
Typical Performance Characteristics (Continued)

Figure 13. Transient Thermal Response Curve

*Notes:
1. $Z_{\theta JA}(t) = 125^{\circ}C/W$ Max.
2. Duty Factor, $D= t_1/t_2$
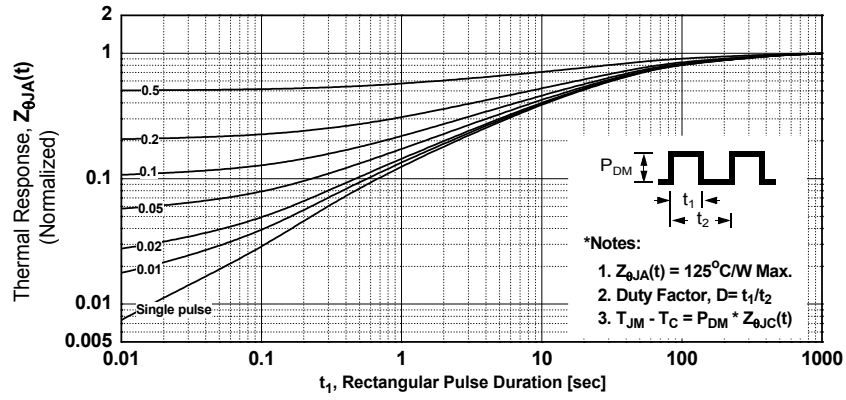3. $T_{JM} - T_C = P_{DM} * Z_{\theta JC}(t)$

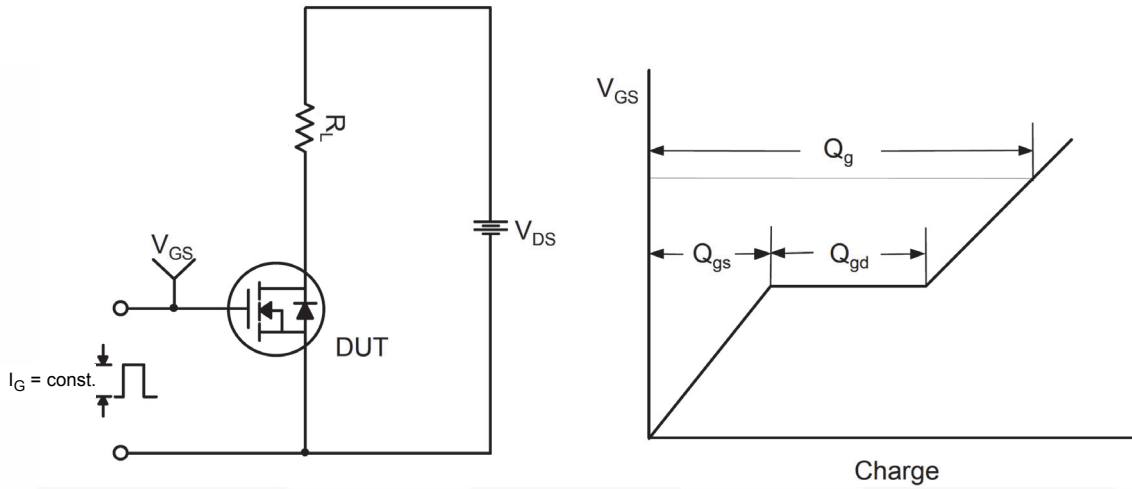## Figure 14. Gate Charge Test Circuit & Waveform

Figure 15. Resistive Switching Test Circuit & Waveforms
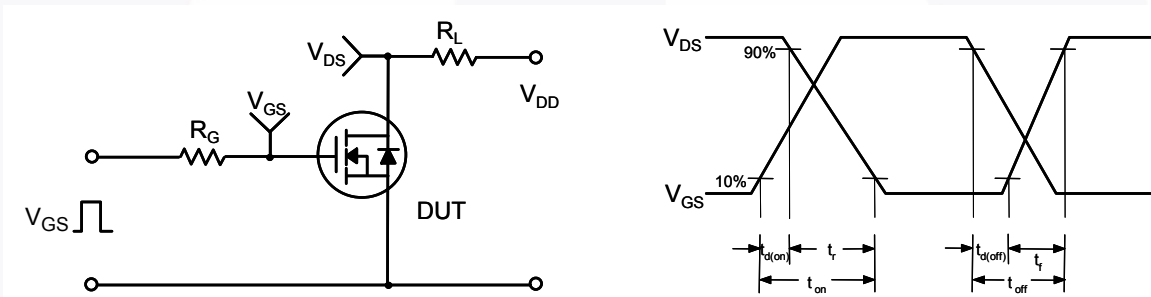
Figure 16. Unclamped Inductive Switching Test Circuit & Waveforms

$$E_{AS} = \frac{1}{2} L I_{AS}^2$$
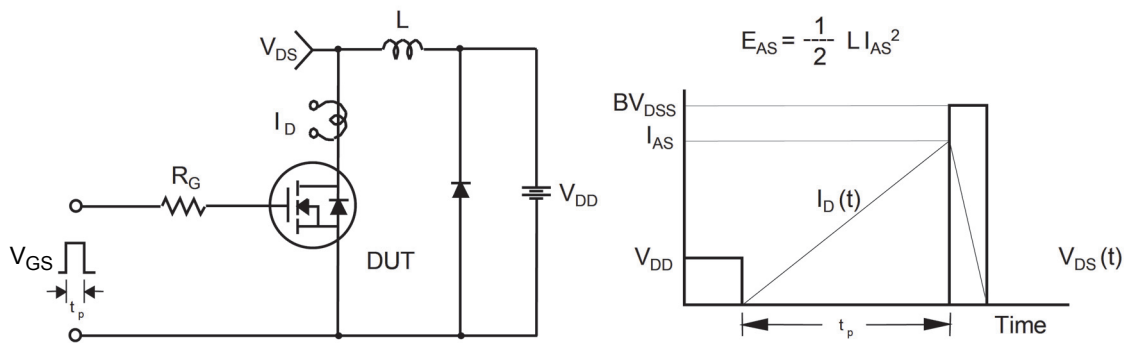
Figure 17. Peak Diode Recovery dv/dt Test Circuit & Waveforms

DUT

V_{DS}

I_{SD}

L

Driver

R_G

Same Type
as DUT

V_{DD}

V_{GS}

• dv/dt controlled by R_G
• I_{SD} controlled by pulse period

V_{GS}
(Driver)

$$D = \frac{\text{Gate Pulse Width}}{\text{Gate Pulse Period}}$$

10V

I_{SD}
(DUT)

I_{FM} , Body Diode Forward Current

di/dt

I_{RM}

Body Diode Reverse Current

V_{DS}
(DUT)

Body Diode Recovery dv/dt

V_{SD}

V_{DD}

Body Diode
Forward Voltage Drop

TOP VIEW

5.10 — A

PKG ℄

PKG ℄

8   5

1   4

6.15

SEE DETAIL B

5.85
5.65
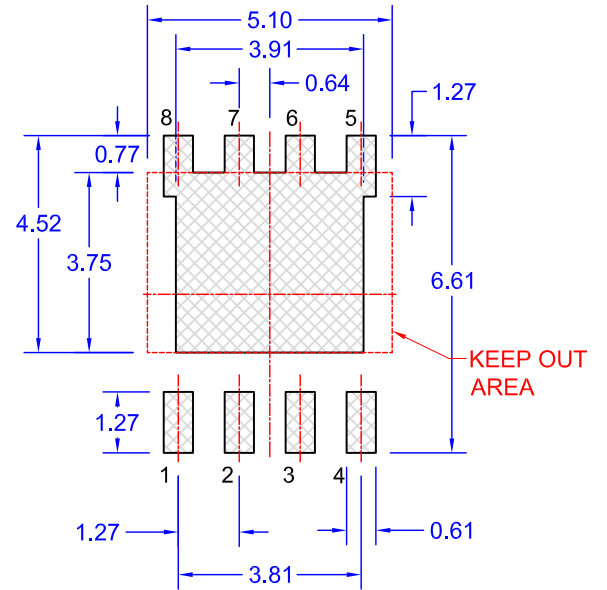
LAND PATTERN RECOMMENDATION

5.10
3.91
0.64
1.27

8 7 6 5

0.77
4.52
3.75

6.61

1.27

1 2 3 4

0.61
1.27
3.81

KEEP OUT AREA

SIDE VIEW

5.00
4.80

SEE DETAIL C

BOTTOM VIEW

5.20
4.80

3.81

1.27

(0.34)

0.51
0.31 (8X)

1 2 3 4

⊕ 0.10 Ⓜ C A B

0.76
0.51

(0.52)

(0.50)

(0.30)
(2X)

6.25
5.90

3.48 +0.30 −0.10

8 7 6 5

0.20 +0.10 −0.15 (8X)

3.96
3.61

0.44±0.10
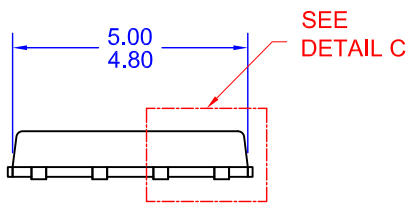
DETAIL C
SCALE: 2:1

OPTIONAL DRAFT ANGLE MAY APPEAR ON FOUR SIDES OF THE PACKAGE

0°-12°

// 0.10 C

8X

⌒ 0.08 C

0.05
0.00

0.35
0.15

1.10
0.90

C

SEATING PLANE

DETAIL B
SCALE: 2:1

0.35
0.15

0.30
0.05

0°-12°
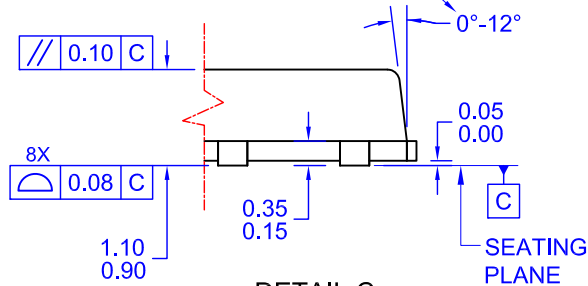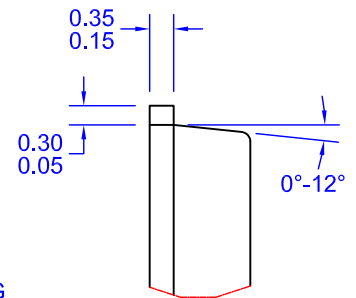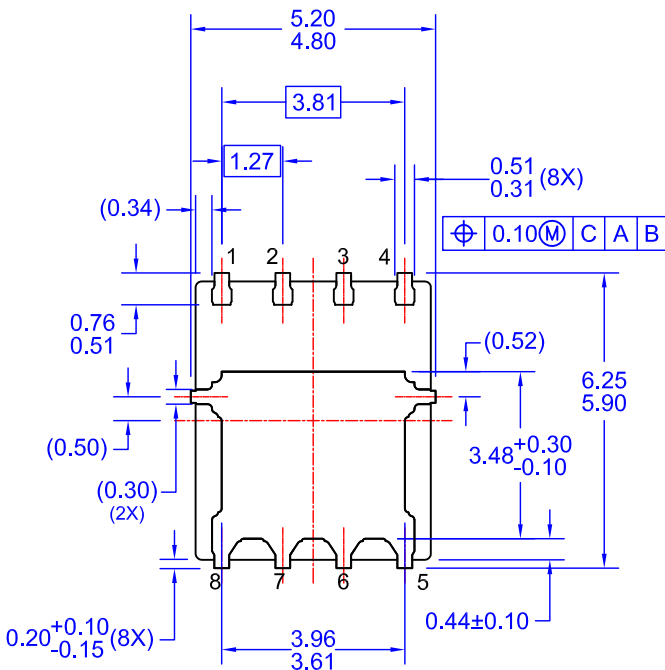
NOTES: UNLESS OTHERWISE SPECIFIED

A. PACKAGE STANDARD REFERENCE: JEDEC MO-240, ISSUE A, VAR. AA, DATED OCTOBER 2002.
B. DIMENSIONS DO NOT INCLUDE BURRS OR MOLD FLASH. MOLD FLASH OR BURRS DOES NOT EXCEED 0.10MM.
C. ALL DIMENSIONS ARE IN MILLIMETERS.
D. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-2009.
E. IT IS RECOMMENDED TO HAVE NO TRACES OR VIAS WITHIN THE KEEP OUT AREA.
F. DRAWING FILE NAME: PQFN08AREV10

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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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