FAIRCHILD
SEMICONDUCTOR®

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FDZ294N

N-Channel 2.5 V Specified PowerTrench® BGA MOSFET

General Description

Combining Fairchild's advanced 2.5V specified PowerTrench process with state of the art BGA packaging, the FDZ294N minimizes both PCB space and $R_{DS(ON)}$. This BGA MOSFET embodies a breakthrough in packaging technology which enables the device to combine excellent thermal transfer characteristics, high current handling capability, ultra-low profile packaging, low gate charge, and low $R_{DS(ON)}$.

Applications

- Battery management
- Battery protection

Features

- 6 A, 20 V $R_{DS(ON)}$ = 23 mΩ @ V_{GS} = 4.5 V
  $R_{DS(ON)}$ = 34 mΩ @ V_{GS} = 2.5 V

- Occupies only 2.25 mm^2 of PCB area.
  Less than 50% of the area of a SSOT-6

- Ultra-thin package: less than 0.85mm height when mounted to PCB

- Outstanding thermal transfer characteristics:
  4 times better than SSOT-6

- Ultra-low Q_g x $R_{DS(ON)}$ figure-of-merit
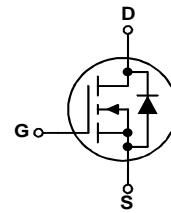
- High power and current handling capability.
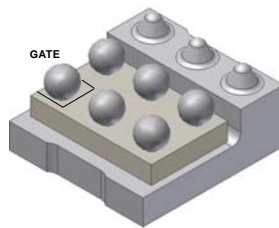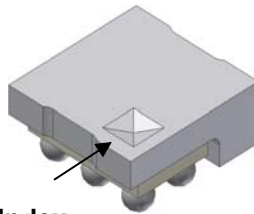
GATE

Index slot

Bottom   Top

Absolute Maximum Ratings T_A=25°C unless otherwise noted

Symbol	Parameter		Ratings	Units
V_{DSS}	Drain-Source Voltage		20	V
V_{GSS}	Gate-Source Voltage		±12	V
I_D	Drain Current – Continuous	(Note 1a)	6	A
	– Pulsed		10	
P_D	Power Dissipation for Single Operation	(Note 1a)	1.7	W
T_J, T_{STG}	Operating and Storage Junction Temperature Range		−55 to +150	°C

Thermal Characteristics

$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	(Note 1a)	72	°C/W

Package Marking and Ordering Information

Device Marking	Device	Reel Size	Tape width	Quantity
E	FDZ294N	7"	8mm	3000 units

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Electrical Characteristics $T_A = 25°C$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
Off Characteristics						
BV_{DSS}	Drain–Source Breakdown Voltage	$V_{GS} = 0$ V, $I_D = 250$ μA	20			V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 250$ μA, Referenced to 25°C		12		mV/°C
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 16$ V, $V_{GS} = 0$ V			1	μA
I_{GSS}	Gate–Body Leakage.	$V_{GS} = \pm12$ V, $V_{DS} = 0$ V			±100	nA
On Characteristics (Note 2)						
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}$, $I_D = 250$ μA	0.6	0.9	1.5	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate Threshold Voltage Temperature Coefficient	$I_D = 250$ μA, Referenced to 25°C		–3		mV/°C
$R_{DS(on)}$	Static Drain–Source On–Resistance	$V_{GS} = 4.5$ V, $I_D = 6$ A, $V_{GS} = 2.5$ V, $I_D = 5$A, $V_{GS} = 4.5$ V, $I_D = 6$ A, $T_J = 125$°C		18 26 24	23 34 31	mΩ
g_{FS}	Forward Transconductance	$V_{DS} = 5$ V, $I_D = 6$ A		24		S
Dynamic Characteristics						
C_{iss}	Input Capacitance	$V_{DS} = 10$ V, $V_{GS} = 0$ V,		670		pF
C_{oss}	Output Capacitance	f = 1.0 MHz		172		pF
C_{rss}	Reverse Transfer Capacitance			105		pF
R_G	Gate Resistance	$V_{GS} = 15$ mV, f = 1.0 MHz		1.4		Ω
Switching Characteristics (Note 2)						
$t_{d(on)}$	Turn–On Delay Time	$V_{DD} = 10$ V, $I_D = 1$ A,		8	16	ns
t_r	Turn–On Rise Time	$V_{GS} = 4.5$ V, $R_{GEN} = 6$ Ω		5	10	ns
$t_{d(off)}$	Turn–Off Delay Time			14	25	ns
t_f	Turn–Off Fall Time			6	12	ns
Q_g	Total Gate Charge	$V_{DS} = 10$V, $I_D = 6$ A,		7	10	nC
Q_{gs}	Gate–Source Charge	$V_{GS} = 4.5$ V		1.4		nC
Q_{gd}	Gate–Drain Charge			2.1		nC
Drain–Source Diode Characteristics and Maximum Ratings						
I_S	Maximum Continuous Drain–Source Diode Forward Current				1.4	A
V_{SD}	Drain–Source Diode Forward Voltage	$V_{GS} = 0$ V, $I_S = 1.4$ A (Note 2)		0.7	1.2	V
t_{rr}	Diode Reverse Recovery Time	$I_F = 6$ A,		15		nS
Q_{rr}	Diode Reverse Recovery Charge	$d_{iF}/d_t = 100$ A/μs		4		nC

Notes:

1. $R_{\theta JA}$ is determined with the device mounted on a 1 in² 2 oz. copper pad on a 1.5 x 1.5 in. board of FR-4 material. The thermal resistance from the junction to the circuit board side of the solder ball, $R_{\theta JB}$, is defined for reference. For $R_{\theta JC}$, the thermal reference point for the case is defined as the top surface of the copper chip carrier. $R_{\theta JC}$ and $R_{\theta JB}$ are guaranteed by design while $R_{\theta JA}$ is determined by the user's board design.
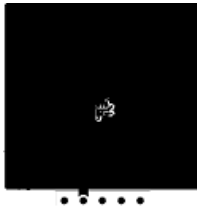
a)   72°C/W when mounted on a 1in² pad of 2 oz copper, 1.5" x 1.5" x 0.062" thick PCB
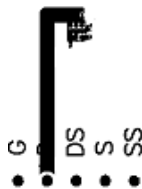
b)   157°C/W when mounted on a minimum pad of 2 oz copper

2. Pulse Test: Pulse Width < 300μs, Duty Cycle < 2.0%
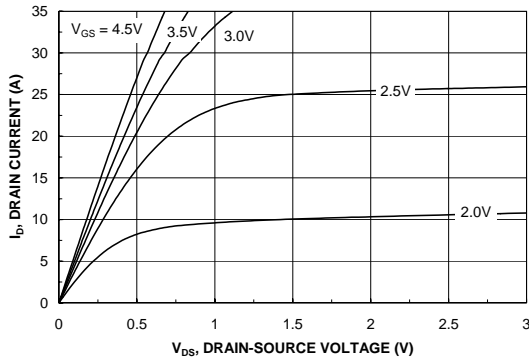
Typical Characteristics
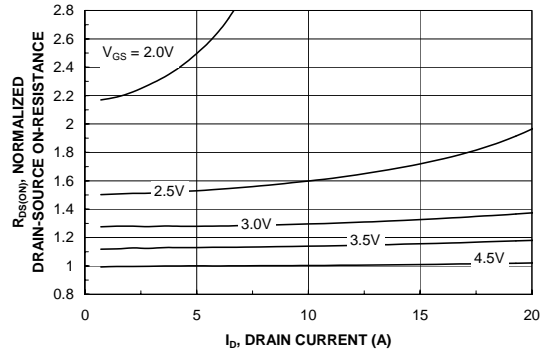

Figure 1. On-Region Characteristics.

Figure 2. On-Resistance Variation with
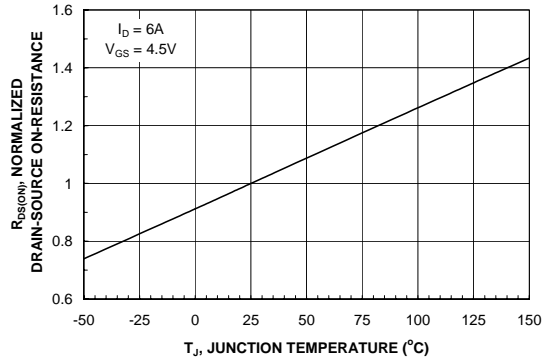Drain Current and Gate Voltage.

Figure 3. On-Resistance Variation with
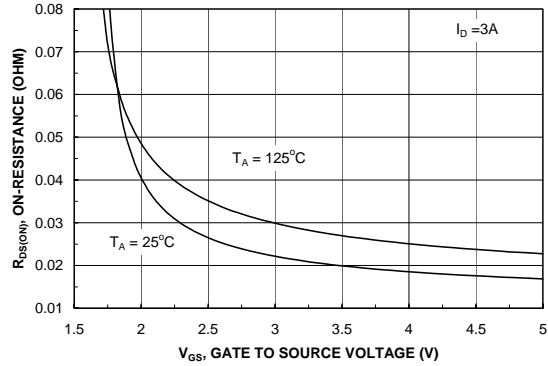Temperature.

Figure 4. On-Resistance Variation with
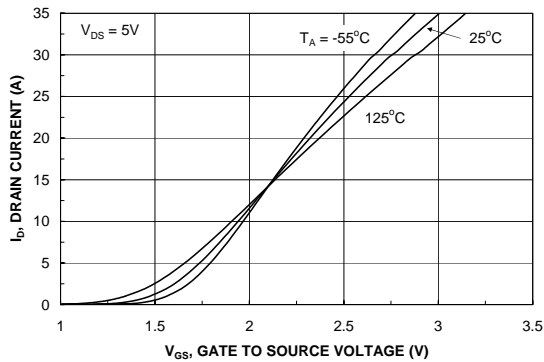Gate-to-Source Voltage.
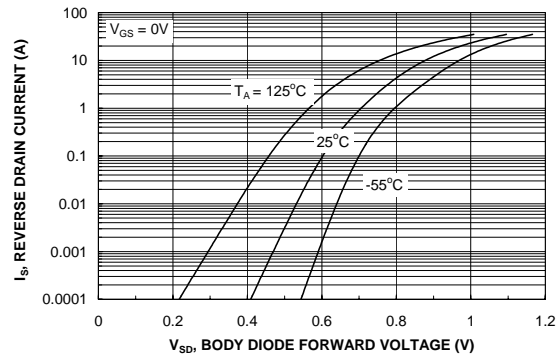

Figure 5. Transfer Characteristics.

Figure 6. Body Diode Forward Voltage Variation
with Source Current and Temperature.

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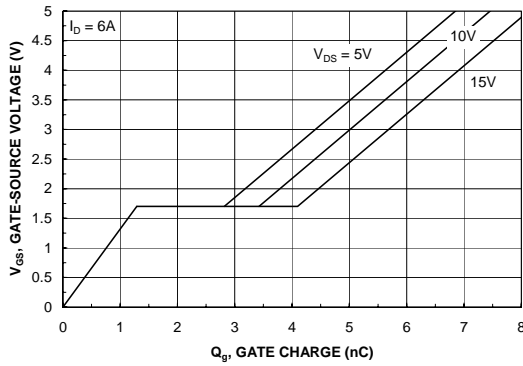
Typical Characteristics
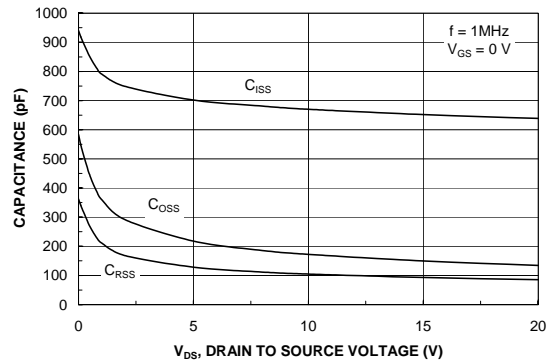
Figure 7. Gate Charge Characteristics.

Figure 8. Capacitance Characteristics.
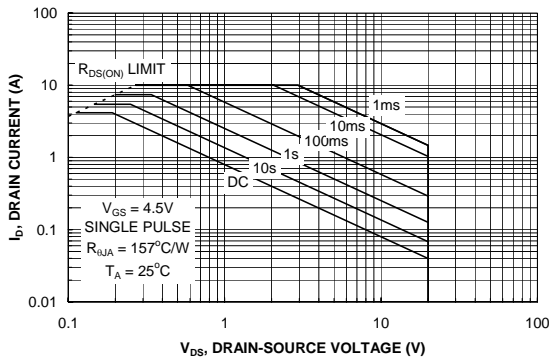
Figure 9. Maximum Safe Operating Area.
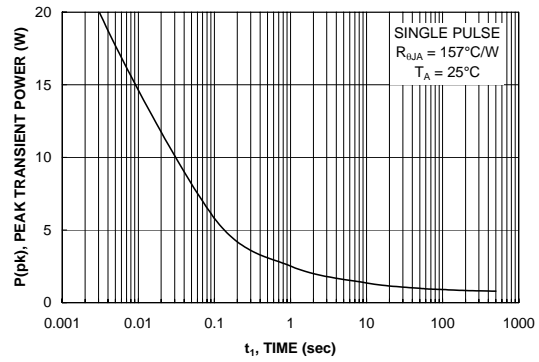
Figure 10. Single Pulse Maximum Power Dissipation.

$R_{\theta JA}(t) = r(t) * R_{\theta JA}$

$R_{\theta JA} = 157 \,°C/W$

$T_J - T_A = P * R_{\theta JA}(t)$

Duty Cycle, $D = t_1 / t_2$
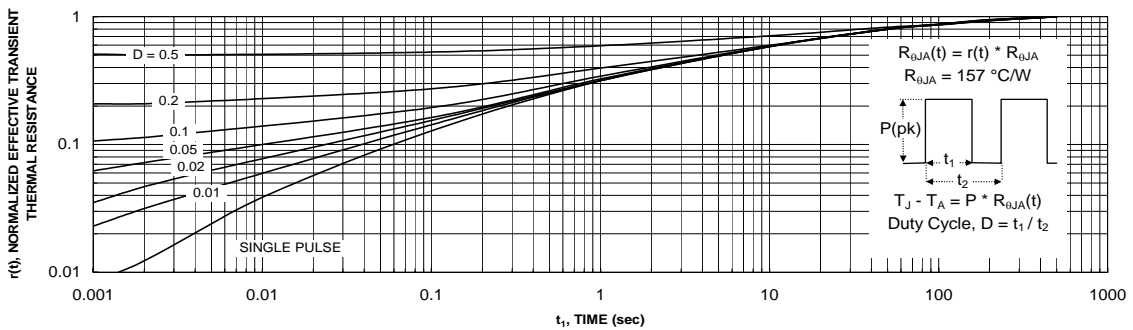
Figure 11. Transient Thermal Response Curve.

Thermal characterization performed using the conditions described in Note 1b.
Transient thermal response will change depending on the circuit board design.

Dimensional Outline and Pad Layout

1.50±0.10

INDEX
SLOT

C̶L̶

1

A

B

PKG C̶L̶

1.70
1.50

0.038±0.025

TOP VIEW

C̶L̶

GATE

SOUCE

Ø0.25

A

1   2   3

BALL C̶L̶

B

1.00

C

0.50

0.50

DRAIN

1.00

LAND PATTERN
RECOMMENDATION

0.90 MAX

SEATING
PLANE

C

FRONT VIEW

⌓ 0.10 C

STUD, Ø0.30±0.02

⊕ Ø0.050 C A B

C̶L̶

BALL C̶L̶

C

PKG C̶L̶

B

1.00

0.04

0.50

A

GATE

1   2   3

BALL,
Ø0.30±0.02

INDEX SLOT
(HIDDEN)

0.50

⊕ Ø0.050 A B

1.00

BOTTOM VIEW

(0.28)

(0.60)

0.21
0.16

0.31
0.26

SOLDER
BALL

(66°)

SIDE VIEW
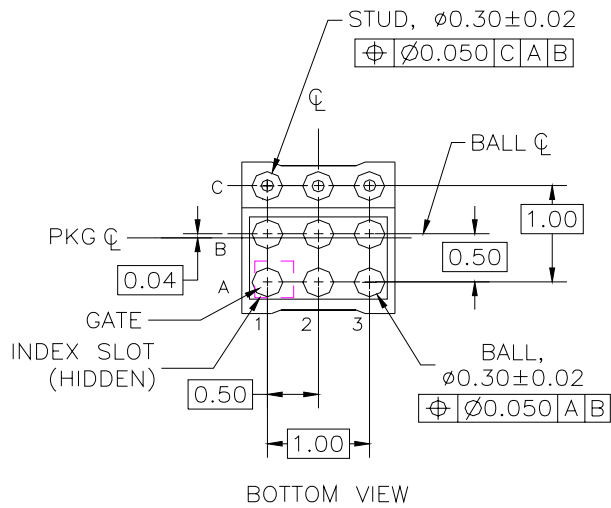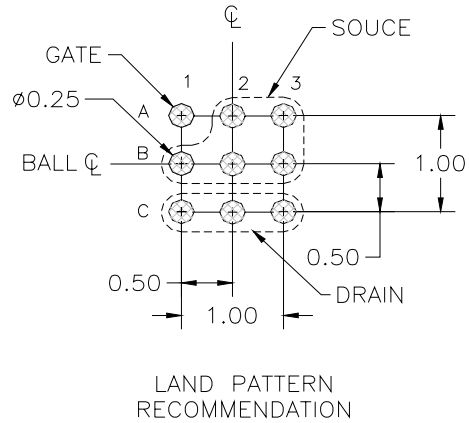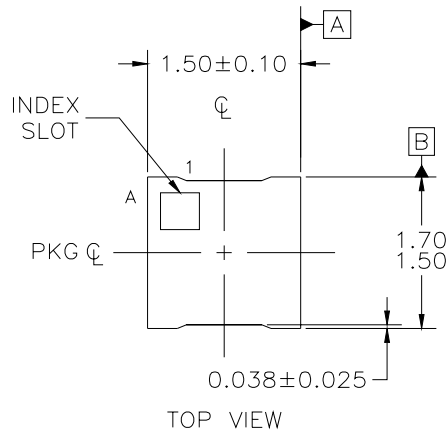
NOTES: UNLESS OTHERWISE SPECIFIED
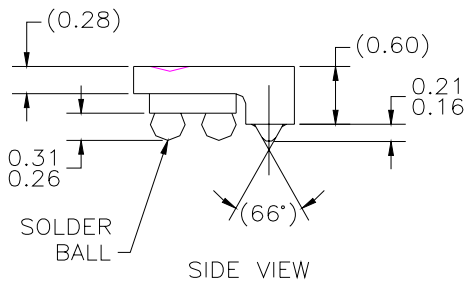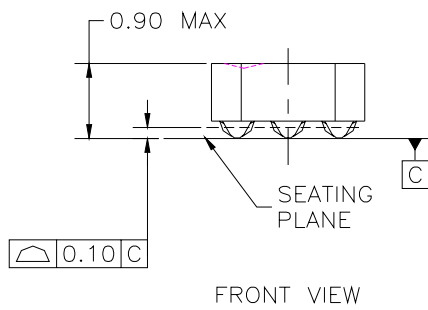
A) ALL DIMENSIONS ARE IN MILLIMETERS.
B) NO JEDEC REGISTRATION REFERENCE AS
    OF SEPTEMBER 2003.
C) BALL/STUD CONFIGURATION TABLE

TERMINAL ID	DESIGNATION	TERMINAL TYPE
C1,C2,C3	DRAIN	COPPER STUD
A1	GATE	BALL
A2,A3,B1,B2,B3	SOURCE	BALL

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EnSigna™	ImpliedDisconnect™	OCXPro™	SILENT SWITCHER®	Wire™
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FACT Quiet Series™		OPTOPLANAR™	SPM™	

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POP™	SuperFET™
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PRODUCT STATUS DEFINITIONS

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Datasheet Identification	Product Status	Definition
Advance Information	Formative or In Design	This datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
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Obsolete	Not In Production	This datasheet contains specifications on a product that has been discontinued by Fairchild semiconductor. The datasheet is printed for reference information only.

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