May 2004

FDZ209N

60V N-Channel PowerTrench® BGA MOSFET

General Description

Combining Fairchild's advanced PowerTrench process with state-of-the-art BGA packaging, the FDZ209N 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 $R_{DS(ON)}$.

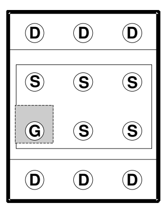
Applications

- Solenoid Drivers

Features

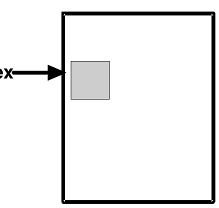
- 4 A, 60 V. $R_{DS(ON)}$ = 80 mΩ @ V_{GS} = 5 V
- Occupies only 5 mm^2 of PCB area: only 55% of the area of SSOT-6
- Ultra-thin package: less than 0.80 mm height when mounted to PCB
- Outstanding thermal transfer characteristics: 4 times better than SSOT-6
- Ultra-low Q_g x $R_{DS(ON)}$ figure-of-merit
- High power and current handling capability

Index slot

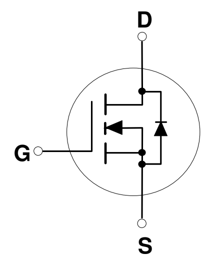


Bottom

Index slot



Top



Absolute Maximum Ratings T_A=25°C unless otherwise noted

Symbol	Parameter	Ratings	Units
V_{DSS}	Drain-Source Voltage	60	V
V_{GSS}	Gate-Source Voltage	±20	V
I_D	Drain Current – Continuous (Note 1a)	4	A
	– Pulsed	20	
P_D	Power Dissipation (Steady State) (Note 1a)	2	W
T_J, T_{STG}	Operating and Storage Junction Temperature Range	–55 to +150	°C

Thermal Characteristics

$R_{θJA}$	Thermal Resistance, Junction-to-Ambient (Note 1a)	64	°C/W
$R_{θJB}$	Thermal Resistance, Junction-to-Ball (Note 1)	8	
$R_{θJC}$	Thermal Resistance, Junction-to-Case (Note 1)	0.7	

Package Marking and Ordering Information

Device Marking	Device	Reel Size	Tape width	Quantity
209N	FDZ209N	7''	8mm	3000 units

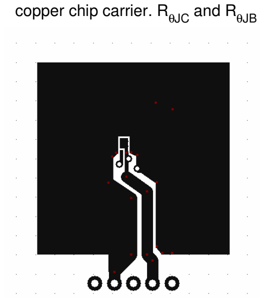
Electrical Characteristics

$T_A = 25°C$ unless otherwise noted

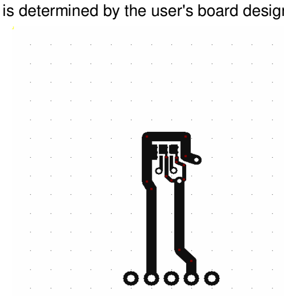
Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
Drain-Source Avalanche Ratings (Note 2)						
W_{DSS}	Drain-Source Avalanche Energy	Single Pulse, $V_{DD} = 30$ V, $I_D = 4$ A			90	mJ
I_{AR}	Drain-Source Avalanche Current				4	A
Off Characteristics						
BV_{DSS}	Drain–Source Breakdown Voltage	$V_{GS} = 0$ V, $I_D = 250$ µA	60			V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 250$ µA, Referenced to 25°C		59		mV/°C
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 48$ V, $V_{GS} = 0$ V			1	µA
I_{GSS}	Gate–Body Leakage.	$V_{GS} = \pm 20$ 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	1	2.5	3	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate Threshold Voltage Temperature Coefficient	$I_D = 250$ µA, Referenced to 25°C		–6		mV/°C
$R_{DS(on)}$	Static Drain–Source On–Resistance	$V_{GS} = 5$ V, $I_D = 4$ A $V_{GS} = 5$ V, $I_D = 4$ A, T_J=125°C		60 91	80 130	mΩ
g_{FS}	Forward Transconductance	$V_{DS} = 5$ V, $I_D = 4$ A		12		S
Dynamic Characteristics						
C_{iss}	Input Capacitance	$V_{DS} = 30$ V, $V_{GS} = 0$ V, f = 1.0 MHz		657		pF
C_{oss}	Output Capacitance			76		pF
C_{rss}	Reverse Transfer Capacitance			32		pF
R_G	Gate Resistance	$V_{GS} = 15$ mV, f = 1.0 MHz		1.5		Ω
Switching Characteristics (Note 2)						
$t_{d(on)}$	Turn–On Delay Time	$V_{DD} = 30$ V, $I_D = 1$ A, $V_{GS} = 5$ V, $R_{GEN} = 6$ Ω		18	32	ns
t_r	Turn–On Rise Time			4	8	ns
$t_{d(off)}$	Turn–Off Delay Time			15	27	ns
t_f	Turn–Off Fall Time			8	16	ns
Q_g	Total Gate Charge	$V_{DS} = 30$ V, $I_D = 4$ A, $V_{GS} = 5$ V		6.3	9	nC
Q_{gs}	Gate–Source Charge			2.5		nC
Q_{gd}	Gate–Drain Charge			2.5		nC
Drain–Source Diode Characteristics and Maximum Ratings						
I_S	Maximum Continuous Drain–Source Diode Forward Current				1.7	A
V_{SD}	Drain–Source Diode Forward Voltage	$V_{GS} = 0$ V, $I_S = 1.7$ A (Note 2)		0.77	1.2	V
t_{rr}	Diode Reverse Recovery Time	$I_F = 4$A, $d_{iF}/d_t = 100$ A/µs (Note 2)		27		nS
Q_{rr}	Diode Reverse Recovery Charge			45		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) 64°C/W when mounted on a 1in² pad of 2 oz copper, 1.5" x 1.5" x 0.062" thick PCB

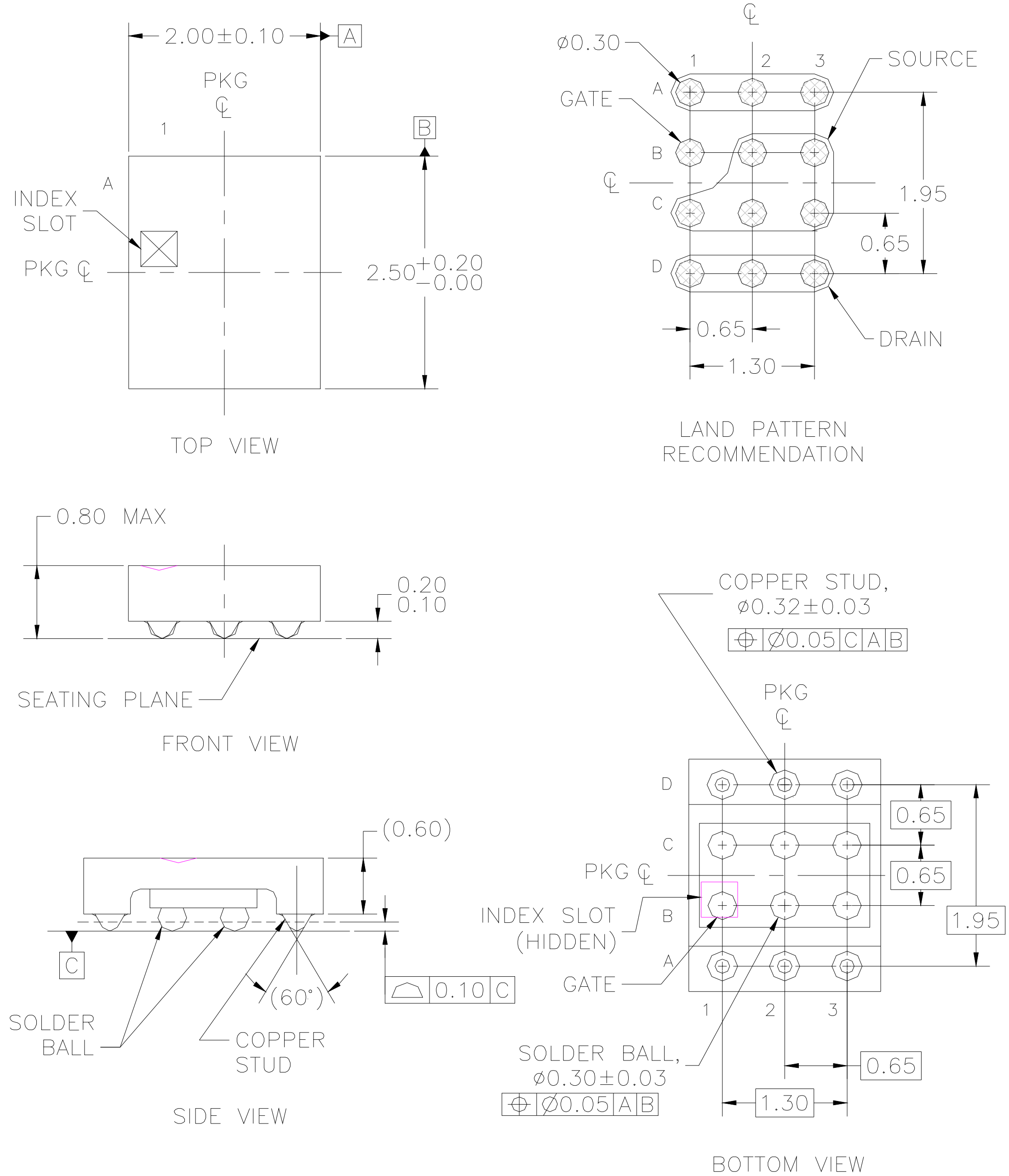


b) 128°C/W when mounted on a minimum pad of 2 oz copper

Scale 1 : 1 on letter size paper

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

Dimensional Outline and Pad Layout



NOTES: UNLESS OTHERWISE SPECIFIED

A) ALL DIMENSIONS ARE IN MILLIMETERS.
B) NO JEDEC REGISTRATION REFERENCE AS OF JULY 1999.
C) TERMINAL CONFIGURATION TABLE.

POSITION	DESIGNATION	TYPE
A1,A2,A3, D1,D2,D3	DRAIN	COPPER STUD
B1	GATE	SOLDER BALL
B2,B3,C1,C2,C3	SOURCE	

Typical Characteristics

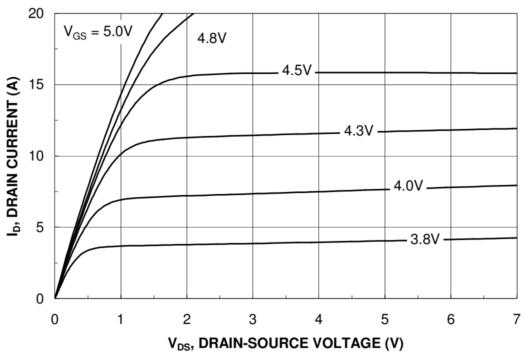


Figure 1. On-Region Characteristics.

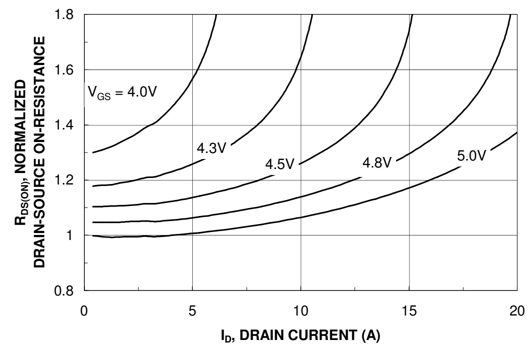


Figure 2. On-Resistance Variation with Drain Current and Gate Voltage.

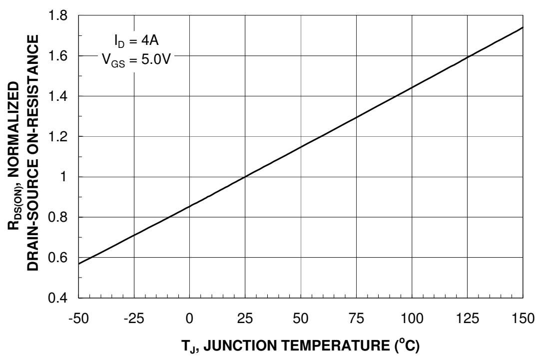


Figure 3. On-Resistance Variation with Temperature.

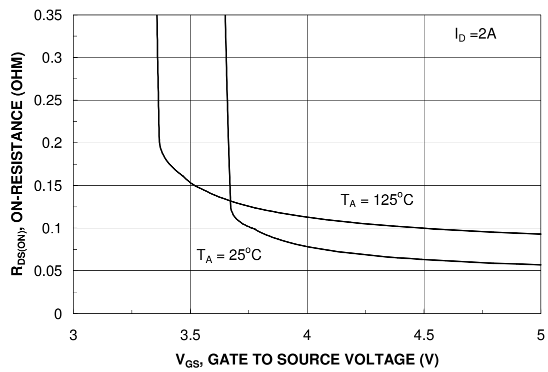


Figure 4. On-Resistance Variation with Gate-to-Source Voltage.

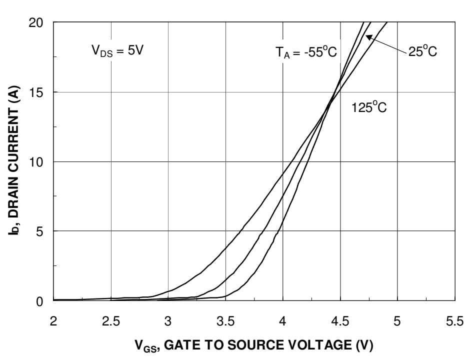


Figure 5. Transfer Characteristics.

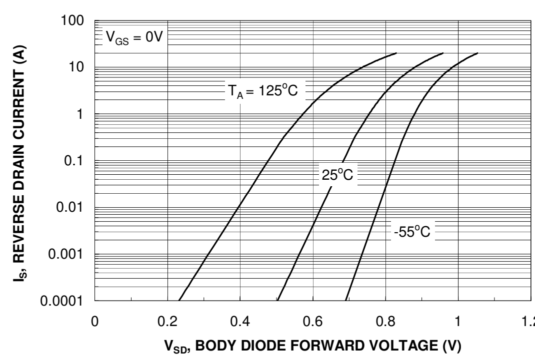


Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature.

Typical Characteristics

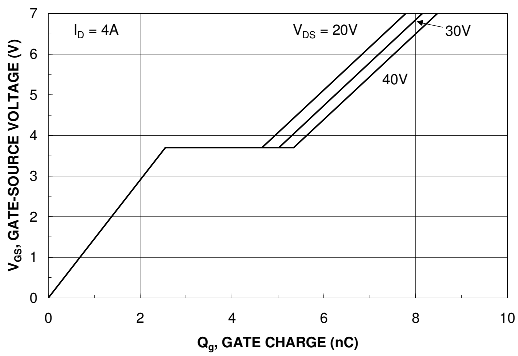


Figure 7. Gate Charge Characteristics.

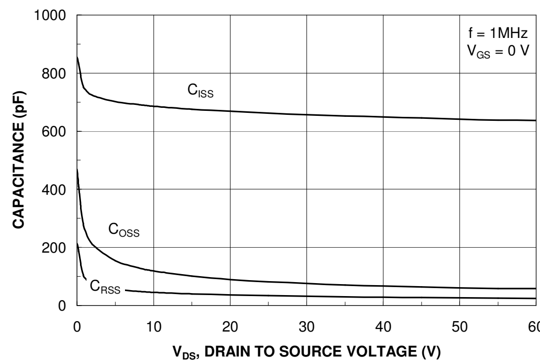


Figure 8. Capacitance Characteristics.

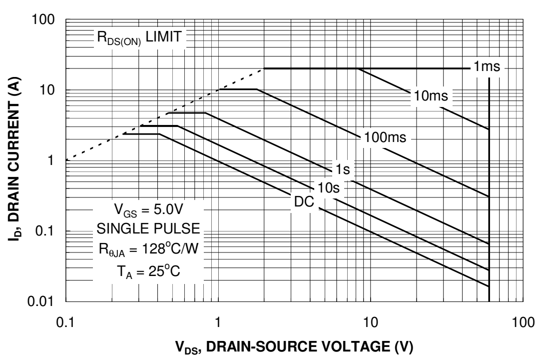


Figure 9. Maximum Safe Operating Area.

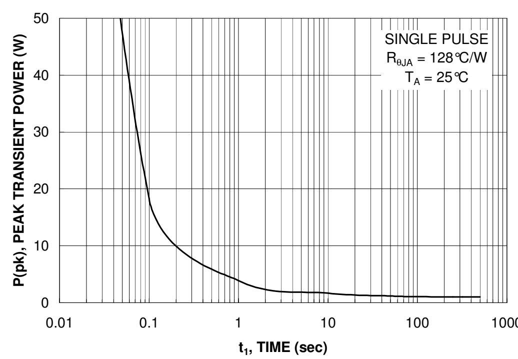


Figure 10. Single Pulse Maximum Power Dissipation.

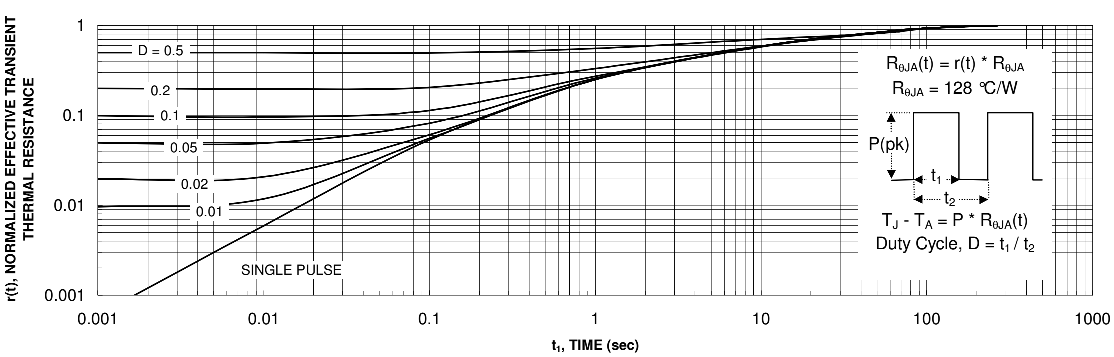


Figure 11. Transient Thermal Response Curve.

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

PRODUCT STATUS DEFINITIONS

Definition of Terms

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.
Preliminary	First Production	This datasheet contains preliminary data, and supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice in order to improve design.
No Identification Needed	Full Production	This datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice in order to improve design.
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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