



**THE DATASHEET OF**  
**2509NZ**



# FDM2509NZ

## Monolithic Common Drain N-Channel 2.5V Specified PowerTrench® MOSFET

### General Description

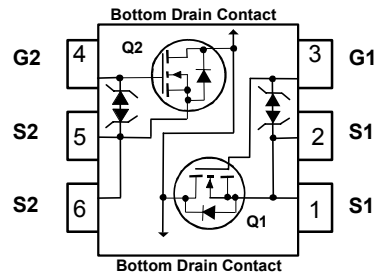
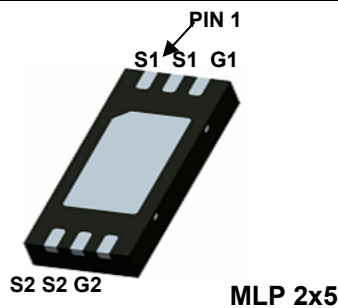
This dual N-Channel MOSFET has been designed using Fairchild Semiconductor's advanced Power Trench process to optimize the  $R_{DS(ON)}$  @  $V_{GS} = 2.5V$  on special MicroFET lead frame with all the drains on one side of the package.

### Applications

- Li-Ion Battery Pack

### Features

- 8.7 A, 20 V  $R_{DS(ON)} = 18\text{ m}\Omega$  @  $V_{GS} = 4.5\text{ V}$   
 $R_{DS(ON)} = 24\text{ m}\Omega$  @  $V_{GS} = 2.5\text{ V}$
- ESD protection diode (note 3)
- Low Profile – 0.8mm maximum – in the new package MicroFET 2x5 mm



### Absolute Maximum Ratings $T_A=25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Ratings	Units
$V_{DSS}$	Drain-Source Voltage	20	V
$V_{GSS}$	Gate-Source Voltage	$\pm 12$	V
$I_D$	Drain Current – Continuous (Note 1a)	8.7	A
		30	
$P_D$	Power Dissipation (Steady State) (Note 1a)	2.2	W
		0.8	
$T_J, T_{STG}$	Operating and Storage Junction Temperature Range	$-55$ to $+150$	$^\circ\text{C}$

### Thermal Characteristics

$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient (Note 1a)	55	$^\circ\text{C/W}$
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case (Drain)	2	

### Package Marking and Ordering Information

Device Marking	Device	Reel Size	Tape width	Quantity
2509Z	FDM2509NZ	7"	12mm	3000 units

### Electrical Characteristics

$T_A = 25^\circ\text{C}$  unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
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#### Off Characteristics

$BV_{DSS}$	Drain–Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$	20			V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 250\ \mu\text{A}$ , Referenced to $25^\circ\text{C}$		12		mV/ $^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 16\text{ V}, V_{GS} = 0\text{ V}$			1	$\mu\text{A}$
$I_{GSS}$	Gate–Body Leakage,	$V_{GS} = \pm 12\text{ V}, V_{DS} = 0\text{ V}$			$\pm 10$	$\mu\text{A}$

#### On Characteristics (Note 2)

$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\ \mu\text{A}$	0.6	0.9	1.5	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate Threshold Voltage Temperature Coefficient	$I_D = 250\ \mu\text{A}$ , Referenced to $25^\circ\text{C}$		-3		mV/ $^\circ\text{C}$
$R_{D(on)}$	Static Drain–Source On–Resistance	$V_{GS} = 4.5\text{ V}, I_D = 8.7\text{ A}$ $V_{GS} = 4.0\text{ V}, I_D = 8.5\text{ A}$ $V_{GS} = 3.1\text{ V}, I_D = 8.1\text{ A}$ $V_{GS} = 2.5\text{ V}, I_D = 7.6\text{ A}$ $V_{GS} = 4.5\text{ V}, I_D = 8.7\text{ A}, T_J = 125^\circ\text{C}$		13 13.5 15.5 18 18.4	18 19 21 24 25	m $\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS} = 5\text{ V}, I_D = 8.7\text{ A}$		36		S

#### Dynamic Characteristics

$C_{iss}$	Input Capacitance	$V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V},$ $f = 1.0\text{ MHz}$		1200		pF
$C_{oss}$	Output Capacitance			320		pF
$C_{riss}$	Reverse Transfer Capacitance			185		pF
$R_G$	Gate Resistance		$V_{GS} = 50\text{ mV}, f = 1.0\text{ MHz}$	2		$\Omega$

#### Switching Characteristics (Note 2)

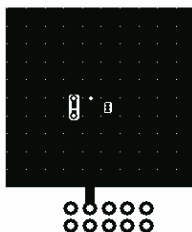
$t_{d(on)}$	Turn–On Delay Time	$V_{DD} = 10\text{ V}, I_D = 1\text{ A},$ $V_{GS} = 4.5\text{ V}, R_{GEN} = 6\ \Omega$		11	20	ns
$t_r$	Turn–On Rise Time			15	27	ns
$t_{d(off)}$	Turn–Off Delay Time			27	43	ns
$t_f$	Turn–Off Fall Time			12	22	ns
$Q_g$	Total Gate Charge	$V_{DS} = 10\text{ V}, I_D = 8.7\text{ A},$ $V_{GS} = 4.5\text{ V}$		12	17	nC
$Q_{gs}$	Gate–Source Charge			2		nC
$Q_{gd}$	Gate–Drain Charge			4		nC

#### Drain–Source Diode Characteristics and Maximum Ratings

$I_S$	Maximum Continuous Drain–Source Diode Forward Current			1.8		A
$V_{SD}$	Drain–Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_S = 1.8\text{ A}$ (Note 2)		0.7	1.2	V
$t_{rr}$	Diode Reverse Recovery Time	$I_F = 8.7\text{ A},$		20		nS
$Q_{rr}$	Diode Reverse Recovery Charge	$di_F/dt = 100\text{ A}/\mu\text{s}$		6.4		nC

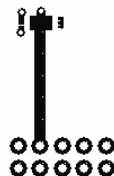
#### Notes:

- $R_{\theta JA}$  is the sum of the junction-to-case and case-to-ambient thermal resistance where the case thermal reference is defined as the solder mounting surface of the drain pins.  $R_{\theta JC}$  is guaranteed by design while  $R_{\theta CA}$  is determined by the user's board design.



- a)  $55^\circ\text{C/W}$  when mounted on a 1in<sup>2</sup> pad of 2 oz copper

Scale 1 : 1 on letter size paper



- b)  $145^\circ\text{C/W}$  when mounted on a minimum pad of 2 oz copper
- Pulse Test: Pulse Width < 300 $\mu\text{s}$ , Duty Cycle < 2.0%
  - The diode connected between the gate and the source serves only as protection against ESD. No gate overvoltage rating is implied.

## Typical Characteristics

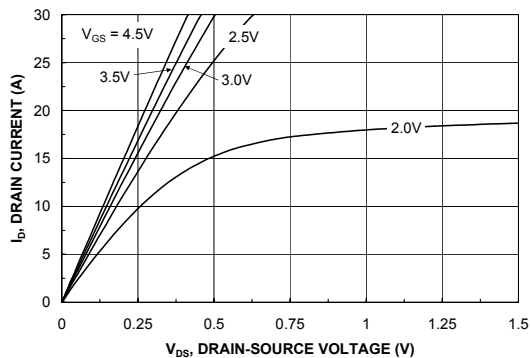


Figure 1. On-Region Characteristics.

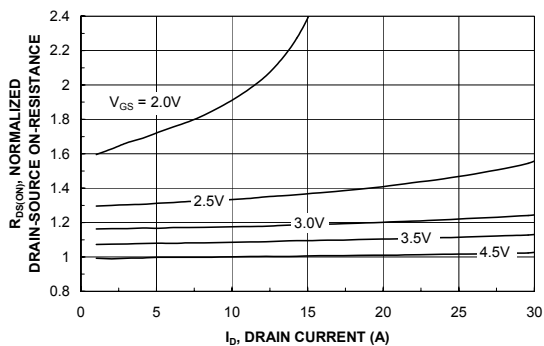


Figure 2. On-Resistance Variation with Drain Current and Gate Voltage.

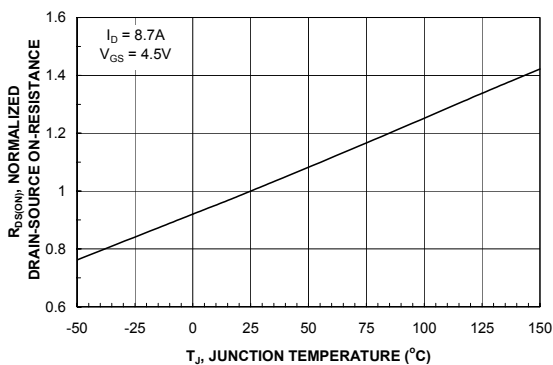


Figure 3. On-Resistance Variation with Temperature.

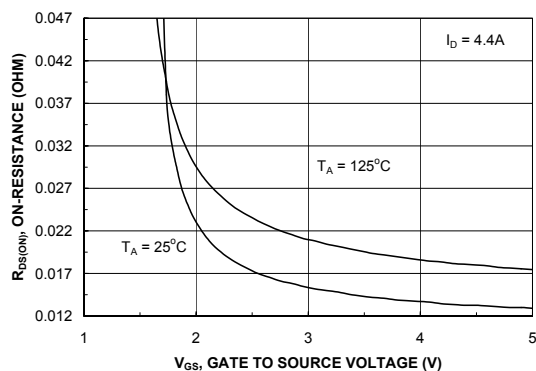


Figure 4. On-Resistance Variation with Gate-to-Source Voltage.

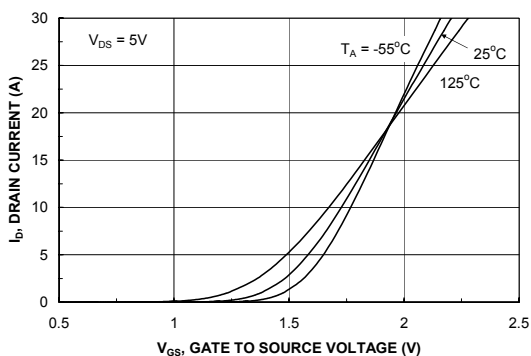


Figure 5. Transfer Characteristics.

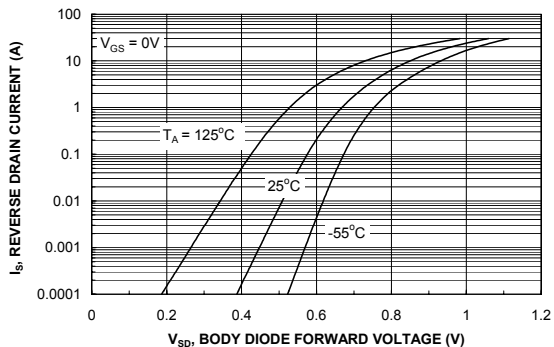


Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature.

### Typical Characteristics

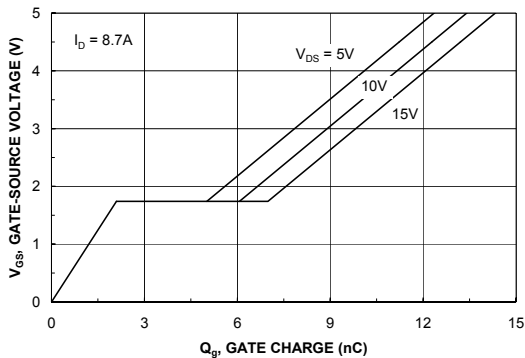


Figure 7. Gate Charge Characteristics.

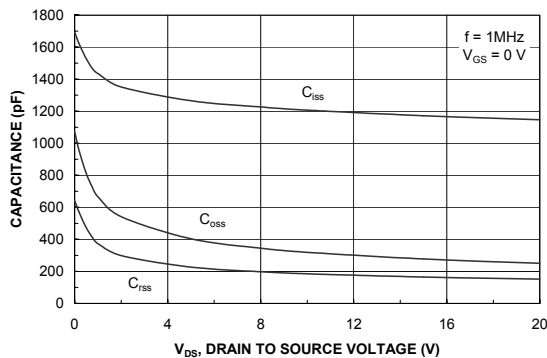


Figure 8. Capacitance Characteristics.

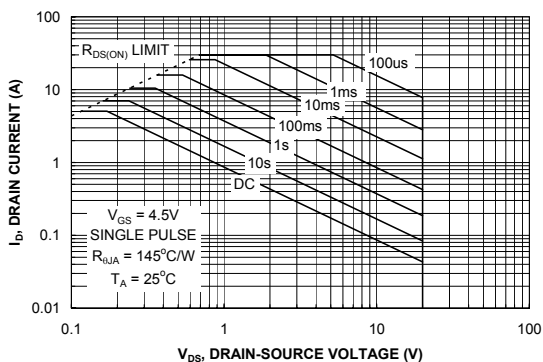


Figure 9. Maximum Safe Operating Area.

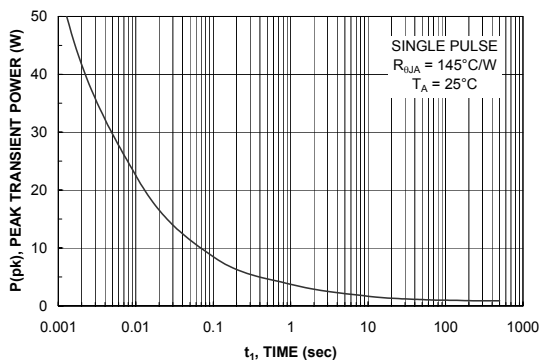


Figure 10. Single Pulse Maximum Power Dissipation.

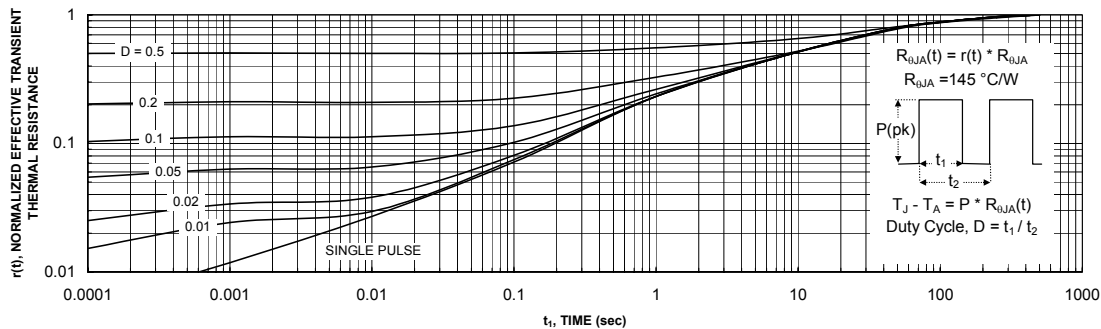
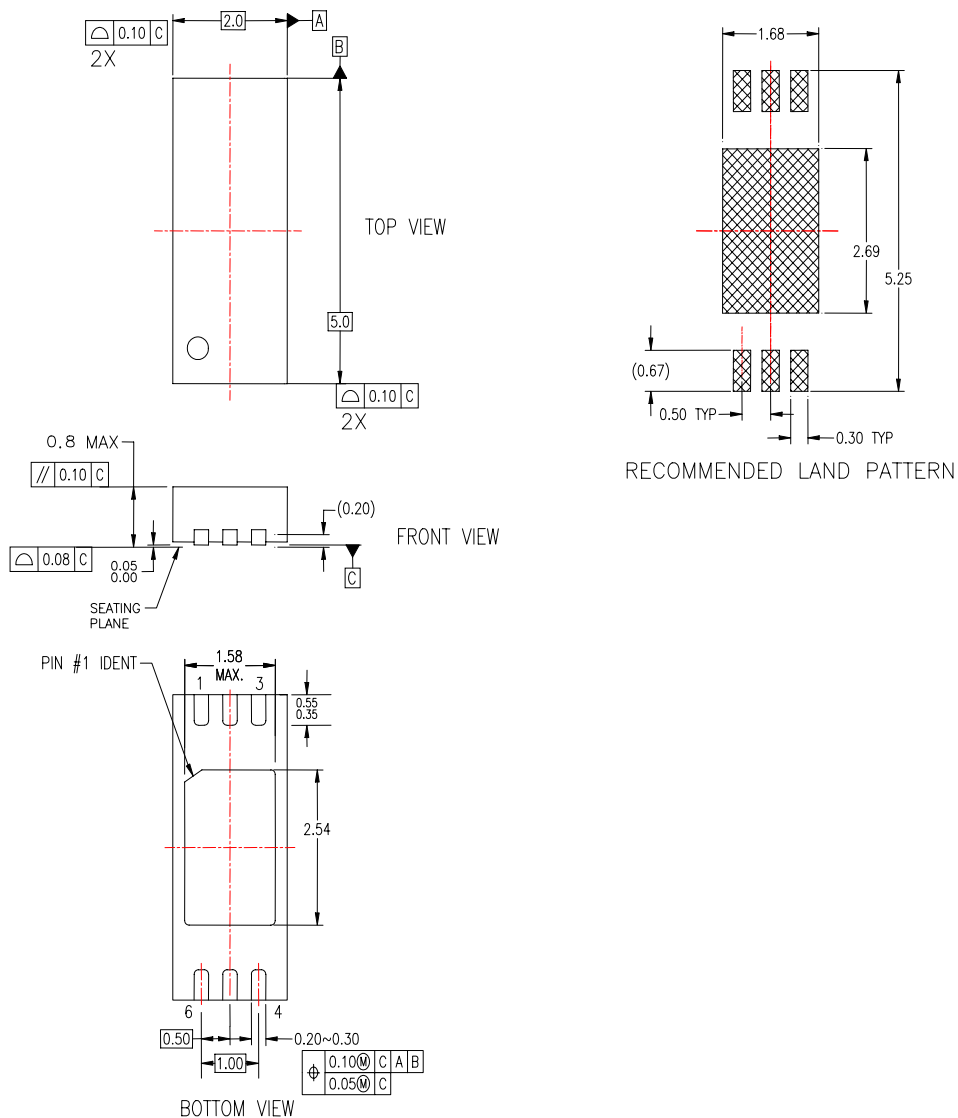


Figure 11. Transient Thermal Response Curve.

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

Dimensional Outline and Pad Layout



NOTES:

- A. NON-STANDARD JEDEC REGISTERED MOLDED PACKAGE OUTLINE.
- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994

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