

# FDS9933BZ

## Dual P-Channel 2.5V Specified PowerTrench® MOSFET

-20V, -4.9A, 46mΩ

### Features

- Max  $r_{DS(on)}$  = 46mΩ at  $V_{GS} = -4.5V$ ,  $I_D = -4.9A$
- Max  $r_{DS(on)}$  = 69mΩ at  $V_{GS} = -2.5V$ ,  $I_D = -4.0A$
- Low gate charge (11nC typical).
- High performance trench technology for extremely low  $r_{DS(on)}$ .
- HBM ESD protection level >3kV (Note 3).
- RoHS Compliant



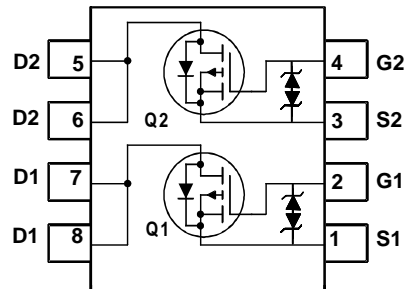
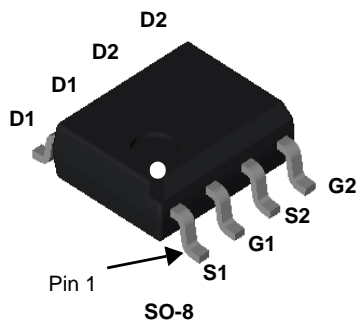
### General Description

These P-Channel 2.5V specified MOSFETs are produced using Fairchild Semiconductor's advanced PowerTrench® process that has been especially tailored to minimize the on-state resistance and yet maintain low gate charge for superior switching performance.

These devices are well suited for portable electronics applications: load switching and power management, battery charging and protection circuits.

### Applications

- Battery Charging
- Load Switching



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

Symbol	Parameter	Ratings	Units
$V_{DS}$	Drain to Source Voltage	-20	V
$V_{GS}$	Gate to Source Voltage	$\pm 12$	V
$I_D$	Drain Current -Continuous	$T_A = 25^\circ\text{C}$ (Note 1a)	-4.9
	-Pulsed		-30
$P_D$	Power Dissipation	(Note 1a)	1.6
	Power Dissipation	(Note 1b)	0.9
$T_J, T_{STG}$	Operating and Storage Junction Temperature Range	-55 to +150	$^\circ\text{C}$

### Thermal Characteristics

$R_{\theta JC}$	Thermal Resistance, Junction to Case	40	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	(Note 1a) 78	

### Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FDS9933BZ	FDS9933BZ	SO-8	330mm	12mm	2500 units

## Electrical Characteristics $T_J = 25^\circ\text{C}$ unless otherwise noted

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

$BV_{DSS}$	Drain to Source Breakdown Voltage	$I_D = -250\mu\text{A}, V_{GS} = 0\text{V}$	-20			V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = -250\mu\text{A}$ , referenced to $25^\circ\text{C}$		-9		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 to Source Leakage Current	$V_{GS} = \pm 12\text{V}, V_{DS} = 0\text{V}$			$\pm 10$	$\mu\text{A}$

### On Characteristics

$V_{GS(th)}$	Gate to Source Threshold Voltage	$V_{GS} = V_{DS}, I_D = -250\mu\text{A}$	-0.4	-0.9	-1.5	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate to Source Threshold Voltage Temperature Coefficient	$I_D = -250\mu\text{A}$ , referenced to $25^\circ\text{C}$		3		mV/ $^\circ\text{C}$
$r_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = -4.5\text{V}, I_D = -4.9\text{A}$		38	46	m $\Omega$
		$V_{GS} = -2.5\text{V}, I_D = -4.0\text{A}$		54	69	
		$V_{GS} = -4.5\text{V}, I_D = -4.9\text{A}, T_J = 125^\circ\text{C}$		52	67	
$g_{FS}$	Forward Transconductance	$V_{DD} = -10\text{V}, I_D = -4.9\text{A}$		17		S

### Dynamic Characteristics

$C_{iss}$	Input Capacitance	$V_{DS} = -10\text{V}, V_{GS} = 0\text{V}, f = 1\text{MHz}$		740	985	pF
$C_{oss}$	Output Capacitance			160	215	pF
$C_{rss}$	Reverse Transfer Capacitance			145	220	pF

### Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = -10\text{V}, I_D = -4.9\text{A}, V_{GS} = -4.5\text{V}, R_{GEN} = 6\Omega$		6.7	14	ns
$t_r$	Rise Time			9.3	19	ns
$t_{d(off)}$	Turn-Off Delay Time			59	95	ns
$t_f$	Fall Time			47	76	ns
$Q_g$	Total Gate Charge		$V_{DD} = -10\text{V}, I_D = -4.9\text{A}$		11	15
$Q_{gs}$	Gate to Source Gate Charge	$V_{GS} = -4.5\text{V}$		1.4		nC
$Q_{gd}$	Gate to Drain "Miller" Charge			3.7		nC

### Drain-Source Diode Characteristics

$I_S$	Maximum continuous Drain-Source Diode Forward Current			-1.3	A	
$V_{SD}$	Source to Drain Diode Forward Voltage	$V_{GS} = 0\text{V}, I_S = -1.3\text{A}$ (Note 2)	-0.8	-1.2	V	
$t_{rr}$	Reverse Recovery Time	$I_F = -4.9\text{A}, di/dt = 100\text{A}/\mu\text{s}$		46	74	ns
$Q_{rr}$	Reverse Recovery Charge			23	37	nC

#### NOTES:

- $R_{\theta JA}$  is determined with the device mounted on a  $1\text{in}^2$  pad 2 oz copper pad on a  $1.5 \times 1.5\text{in.}$  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)  $78^\circ\text{C}/\text{W}$  when mounted on a  $1\text{in}^2$  pad of 2 oz copper

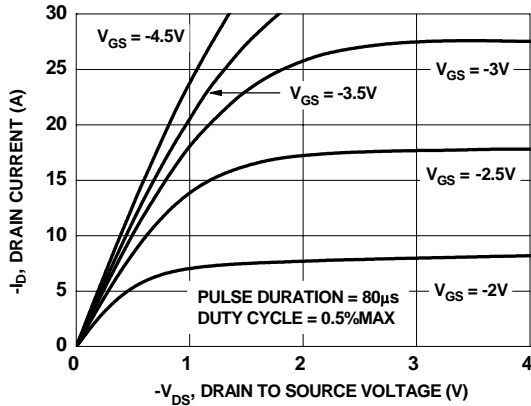


b)  $135^\circ\text{C}/\text{W}$  when mounted on a minimum pad

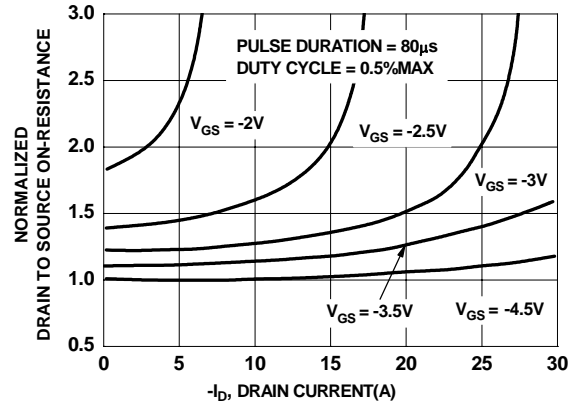
- Pulse Test: Pulse Width  $< 300\mu\text{s}$ , Duty cycle  $< 2.0\%$ .

- The diode connected between the gate and source serves only as protection against ESD. No gate overvoltage rating is implied.

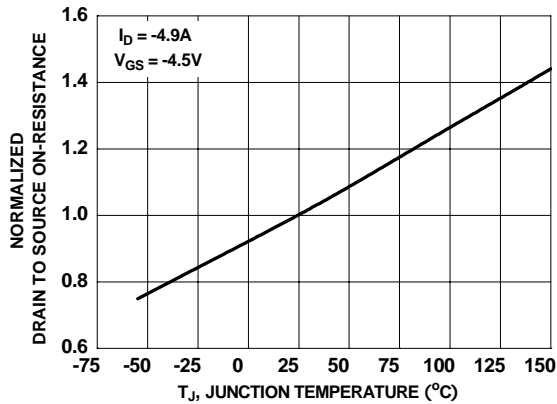
**Typical Characteristics**  $T_J = 25^\circ\text{C}$  unless otherwise noted



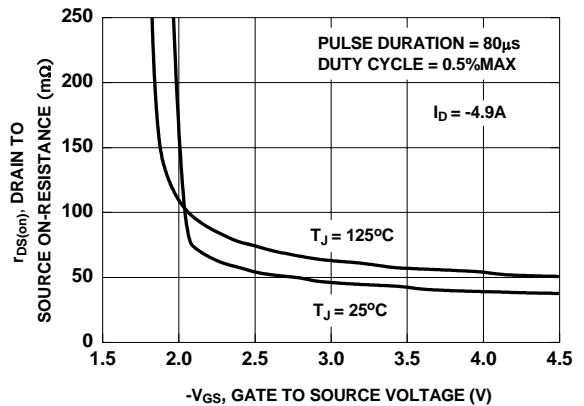
**Figure 1. On-Region Characteristics**



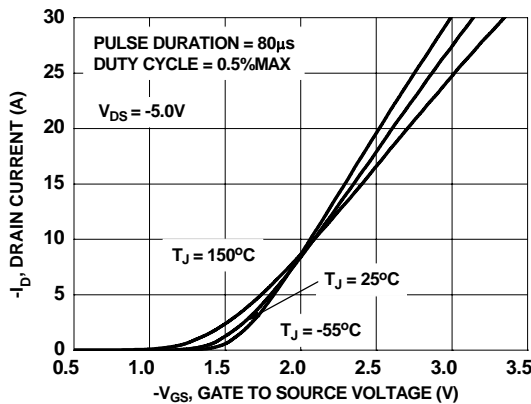
**Figure 2. Normalized On-Resistance vs Drain Current and Gate Voltage**



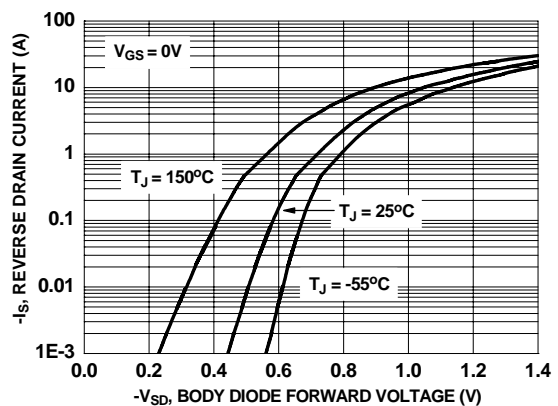
**Figure 3. Normalized On-Resistance vs Junction Temperature**



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

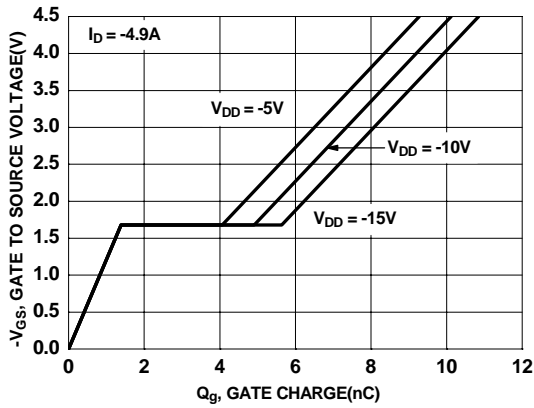


**Figure 5. Transfer Characteristics**

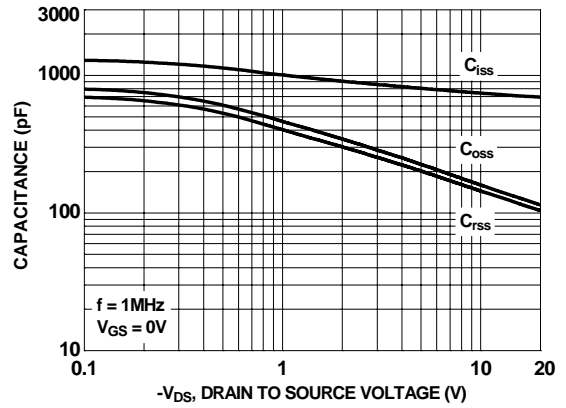


**Figure 6. Source to Drain Diode Forward Voltage vs Source Current**

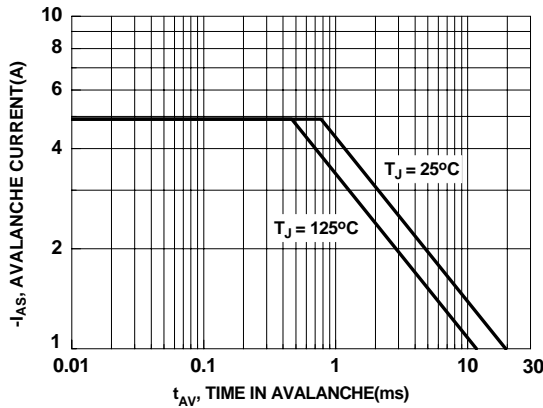
**Typical Characteristics**  $T_J = 25^\circ\text{C}$  unless otherwise noted



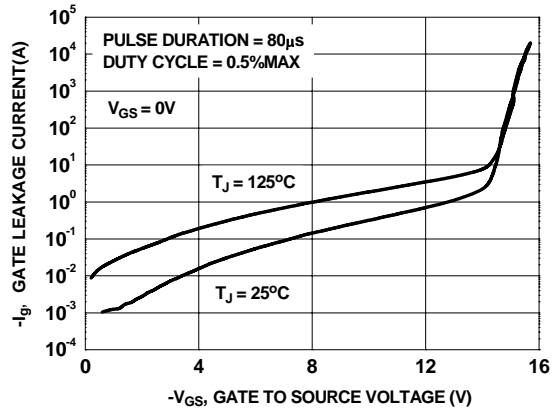
**Figure 7. Gate Charge Characteristics**



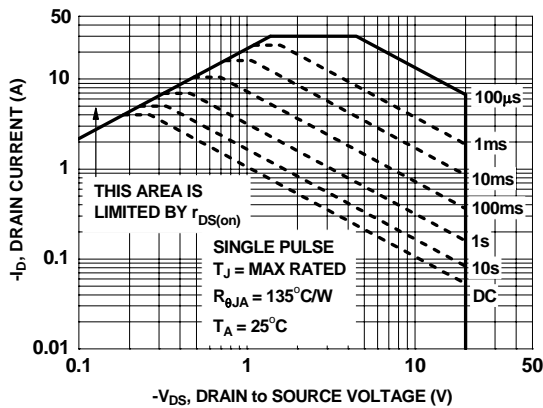
**Figure 8. Capacitance vs Drain to Source Voltage**



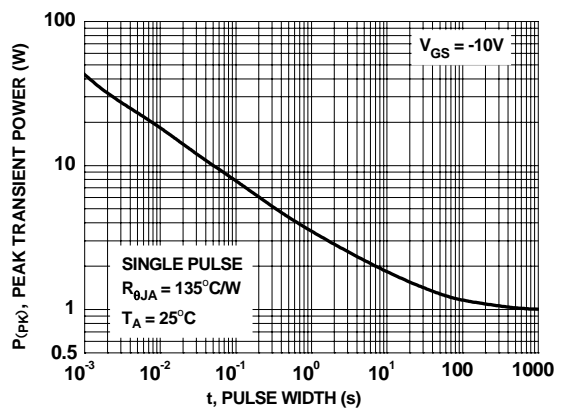
**Figure 9. Unclamped Inductive Switching Capability**



**Figure 10. Gate Leakage Current vs Gate to Source Voltage**

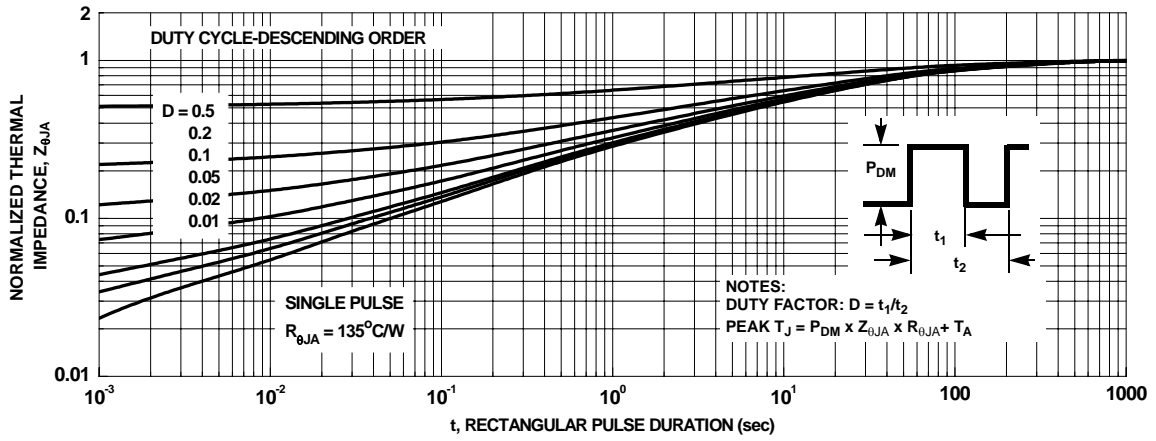


**Figure 11. Forward Bias Safe Operating Area**



**Figure 12. Single Pulse Maximum Power Dissipation**

**Typical Characteristics**  $T_J = 25^\circ\text{C}$  unless otherwise noted




**Figure 13. Transient Thermal Response Curve**



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