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# FDS9933A

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

### General Description

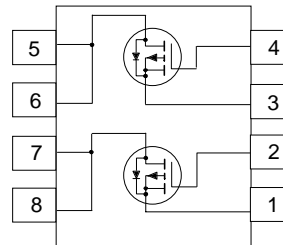
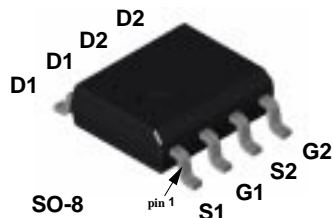
These P-Channel 2.5V specified MOSFETs are produced using Fairchild Semiconductor's advanced PowerTrench process that has been especially tailored to minimize the on-state resistance and yet maintain low gate charge for superior switching performance.

### Applications

- Load switch
- DC/DC converter
- Motor drives

### Features

- -3.8 A, -20 V.  $R_{DS(on)} = 0.075 \Omega @ V_{GS} = -4.5 \text{ V}$   
 $R_{DS(on)} = 0.105 \Omega @ V_{GS} = -2.5 \text{ V}$ .
- Low gate charge ( 7nC typical ).
- Fast switching speed.
- High performance trench technology for extremely low  $R_{DS(on)}$ .
- High power and current handling capability.



### Absolute Maximum Ratings T<sub>A</sub>=25°C unless otherwise noted

Symbol	Parameter	FDS9933A	Units
V <sub>DSS</sub>	Drain-Source Voltage	-20	V
V <sub>GSS</sub>	Gate-Source Voltage	± 8	V
I <sub>D</sub>	Drain Current - Continuous (Note 1a)	-3.8	A
	- Pulsed	-20	
P <sub>D</sub>	Power Dissipation for Dual Operation	2.0	W
	Power Dissipation for Single Operation (Note 1a)	1.6	
	(Note 1b)	1.0	
	(Note 1c)	0.9	
T <sub>J</sub> , T <sub>stg</sub>	Operating and Storage Junction Temperature Range	-55 to +150	°C

### Thermal Characteristics

R <sub>θJA</sub>	Thermal Resistance, Junction-to-Ambient (Note 1a)	78	°C/W
R <sub>θJC</sub>	Thermal Resistance, Junction-to-Case (Note 1)	40	°C/W

### Package Marking and Ordering Information

Device Marking	Device	Reel Size	Tape width	Quantity
FDS9933A	FDS9933A	13"	12mm	2500 units

## DMOS Electrical Characteristics

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
<b>Off Characteristics</b>						
$BV_{DSS}$	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 $25^\circ\text{C}$		-16		mV/ $^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = -16\text{ V}, V_{GS} = 0\text{ V}$			-1	$\mu\text{A}$
$I_{GSSF}$	Gate-Body Leakage, Forward	$V_{GS} = 8\text{ V}, V_{DS} = 0\text{ V}$			100	nA
$I_{GSSR}$	Gate-Body Leakage, Reverse	$V_{GS} = -8\text{ V}, V_{DS} = 0\text{ V}$			-100	nA

### On Characteristics (Note 2)

$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = -250\ \mu\text{A}$	-0.4	-0.8	-1.5	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate Threshold Voltage Temperature Coefficient	$I_D = -250\ \mu\text{A}$ , Referenced to $25^\circ\text{C}$		2.5		mV/ $^\circ\text{C}$
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = -4.5\text{ V}, I_D = -3.8\text{ A}$ $V_{GS} = -4.5\text{ V}, I_D = -3.8\text{ A}, T_J = 125^\circ\text{C}$ $V_{GS} = -2.5\text{ V}, I_D = -3.3\text{ A}$		0.058 0.086 0.084	0.075 0.12 0.105	$\Omega$ $\Omega$ $\Omega$
$I_{D(on)}$	On-State Drain Current	$V_{GS} = -4.5\text{ V}, V_{DS} = -5.0\text{ V}$	-10			A
$g_{FS}$	Forward Transconductance	$V_{DS} = -4.5\text{ V}, I_D = -3.8\text{ A}$		10		S

### Dynamic Characteristics

$C_{iss}$	Input Capacitance	$V_{DS} = -10\text{ V}, V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}$		600		pF
$C_{oss}$	Output Capacitance			175		pF
$C_{rfs}$	Reverse Transfer Capacitance			80		pF

### Switching Characteristics (Note 2)

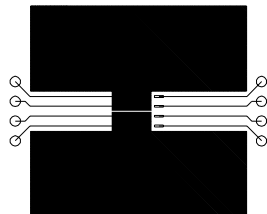
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = -5\text{ V}, I_D = -0.5\text{ A}$ $V_{GS} = -4.5\text{ V}, R_{GEN} = 6.0\ \Omega$		6	12	ns
$t_r$	Turn-On Rise Time			9	18	ns
$t_{d(off)}$	Turn-Off Delay Time			31	50	ns
$t_f$	Turn-Off Fall Time			28	42	ns
$Q_g$	Total Gate Charge	$V_{DS} = -10\text{ V}, I_D = -3.8\text{ A}$ $V_{GS} = -4.5\text{ V}$		7	10	nC
$Q_{gs}$	Gate-Source Charge			1.3		nC
$Q_{gd}$	Gate-Drain Charge			2		nC

### Drain-Source Diode Characteristics and Maximum Ratings

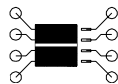
$I_S$	Maximum Continuous Drain-Source Diode Forward Current			-1.3	A	
$V_{SD}$	Drain-Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_S = -1.3\text{ A}$ (Note 2)		-0.75	-1.2	V

**Notes:**

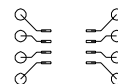
- 1:  $R_{\theta JA}$  is the sum of the junction-to-case and case-to-ambient resistance where the case thermal reference is defined as the solder mounting surface of the drain pins.  $R_{\theta JC}$  is guaranteed by design while  $R_{\theta JA}$  is determined by the user's board design.



a)  $78^\circ\text{C/W}$  when mounted on a  $0.5\text{ in}^2$  pad of 2 oz. copper.



b)  $125^\circ\text{C/W}$  when mounted on a  $0.02\text{ in}^2$  pad of 2 oz. copper.



c)  $135^\circ\text{C/W}$  when mounted on a  $0.003\text{ in}^2$  pad of 2 oz. copper.

Scale 1 : 1 on letter size paper

- 2: Pulse Test: Pulse Width  $\leq 300\ \mu\text{s}$ , Duty Cycle  $\leq 2.0\%$

Typical Characteristics (continued)

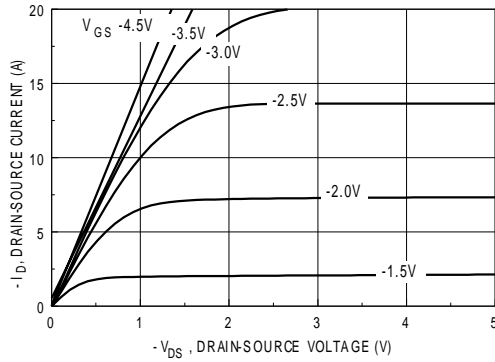


Figure 1. On-Region Characteristics.

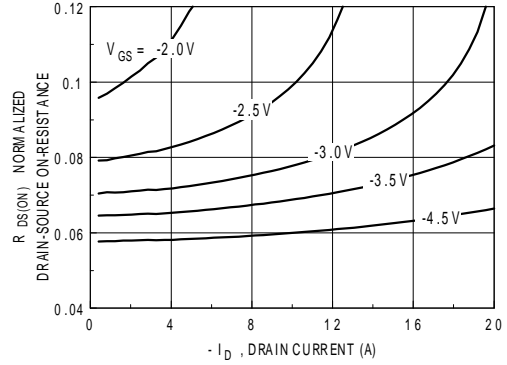


Figure 2. On-Resistance Variation with Drain Current and Gate Voltage.

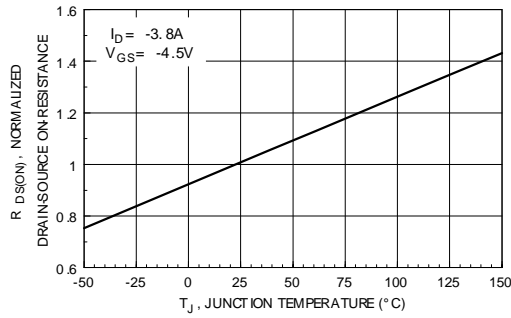


Figure 3. On-Resistance Variation with Temperature.

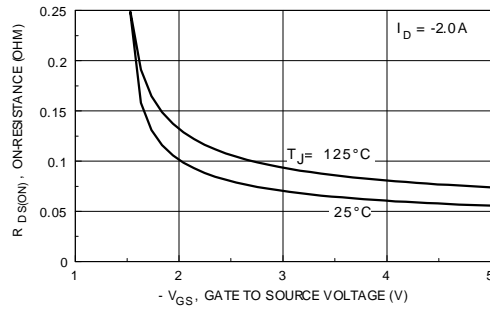


Figure 4. On-Resistance Variation with Gate-to-Source Voltage.

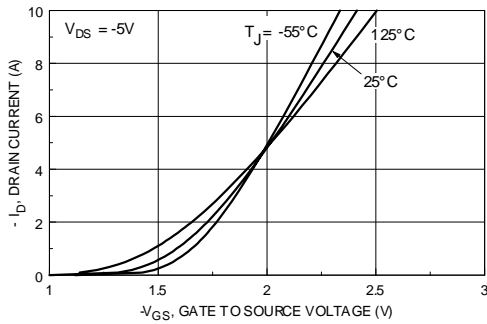


Figure 5. Transfer Characteristics.

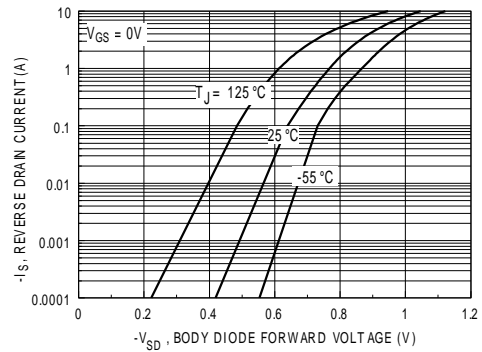
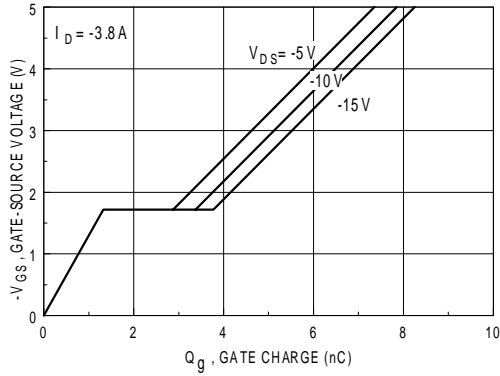
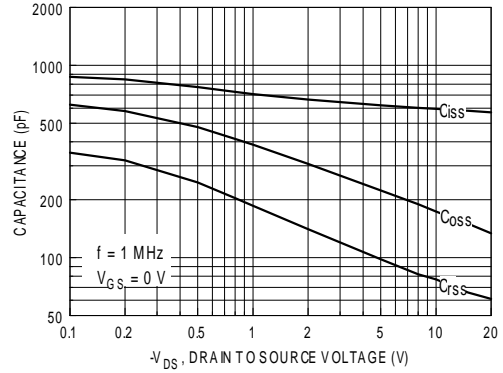


Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature.

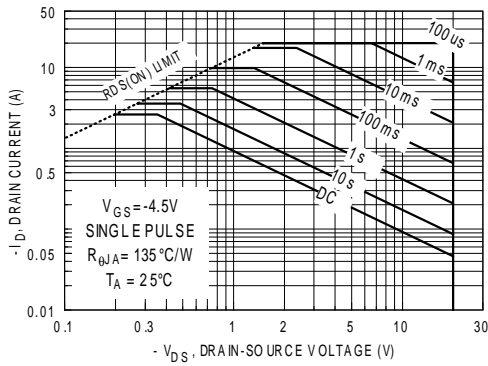
**Typical Characteristics** (continued)



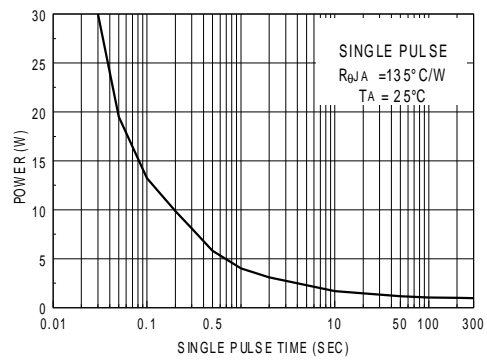
**Figure 7. Gate Charge Characteristics.**



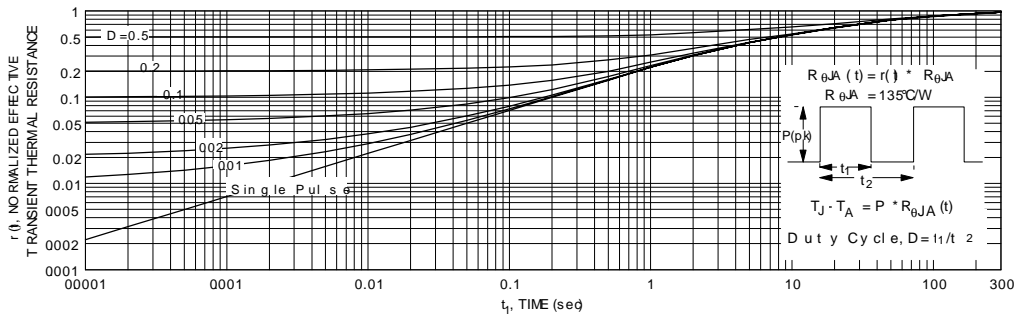
**Figure 8. Capacitance Characteristics.**



**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 1c. Transient thermal response will change depending on the circuit board design.

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