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# FDS9933A

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

### General Description

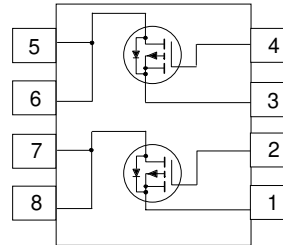
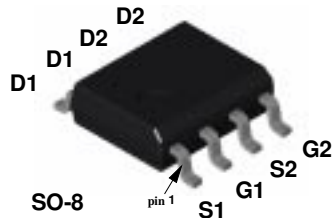
These P-Channel 2.5V specified MOSFETs are produced using Fairchild Semiconductor's advanced PowerTrench process that has been especially tailored to minimize the on-state resistance and yet maintain low gate charge for superior switching performance.

### Applications

- Load switch
- DC/DC converter
- Motor drives

### Features

- -3.8 A, -20 V.  $R_{DS(on)} = 0.075 \Omega @ V_{GS} = -4.5 V$   
 $R_{DS(on)} = 0.105 \Omega @ V_{GS} = -2.5 V$ .
- 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              | $V_{GS} = -4.5\text{ V}, I_D = -3.8\text{ A}$<br>$V_{GS} = -4.5\text{ V}, I_D = -3.8\text{ A}, T_J = 125^\circ\text{C}$<br>$V_{GS} = -2.5\text{ V}, I_D = -3.3\text{ A}$ |      | 0.058<br>0.086<br>0.084 | 0.075<br>0.12<br>0.105 | $\Omega$<br>$\Omega$<br>$\Omega$ |
| $I_{D(on)}$                            | 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 |
| $C_{rss}$ | Reverse Transfer Capacitance |  |  | 80  |  | pF |

### Switching Characteristics (Note 2)

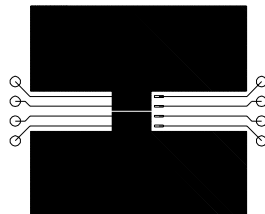
|              |                     |  |  |     |    |    |
|--------------|---------------------|--|--|-----|----|----|
| $t_{d(on)}$  | Turn-On Delay Time  | $V_{DD} = -5\text{ V}, I_D = -0.5\text{ A}$<br>$V_{GS} = -4.5\text{ V}, R_{GEN} = 6.0\ \Omega$ |  | 6   | 12 | ns |
| $t_r$        | Turn-On 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   | $V_{DS} = -10\text{ V}, I_D = -3.8\text{ A}$<br>$V_{GS} = -4.5\text{ V}$                       |  | 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

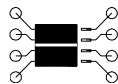
|          |   |   |  |       |      |   |
|----------|---|---|--|-------|------|---|
| $I_S$    | Maximum Continuous Drain-Source Diode Forward Current |   |  | -1.3  | A    |   |
| $V_{SD}$ | Drain-Source Diode Forward Voltage                    | $V_{GS} = 0\text{ V}, I_S = -1.3\text{ A}$ (Note 2)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

**Notes:**

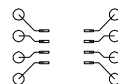
- 1:  $R_{\theta JA}$  is the sum of the junction-to-case and case-to-ambient resistance where the case thermal reference is defined as the solder mounting surface of the drain pins.  $R_{\theta JC}$  is guaranteed by design while  $R_{\theta JA}$  is determined by the user's board design.



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.

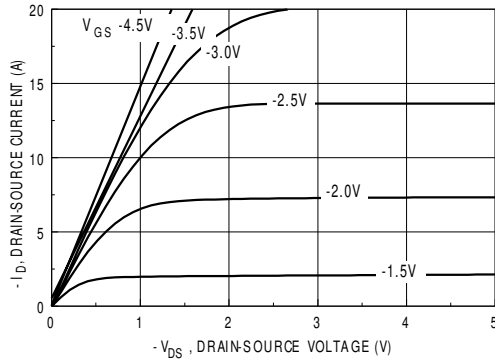


c)  $135^\circ\text{ C/W}$  when mounted on a  $0.003\text{ in}^2$  pad of 2 oz. copper.

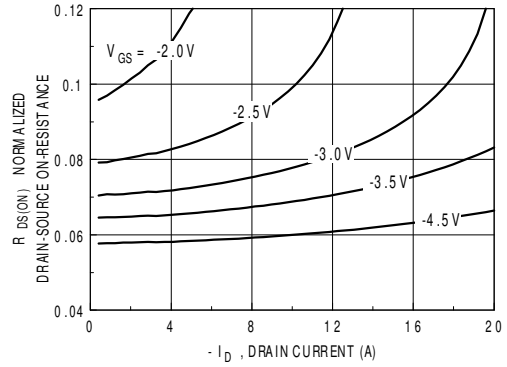
Scale 1 : 1 on letter size paper

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

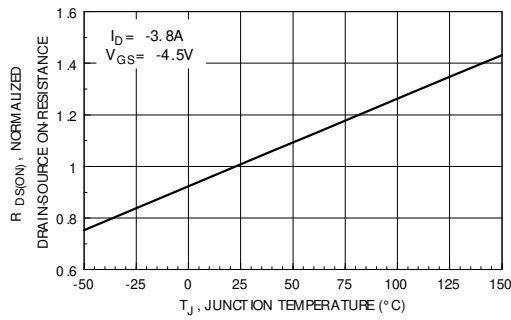
**Typical Characteristics** (continued)



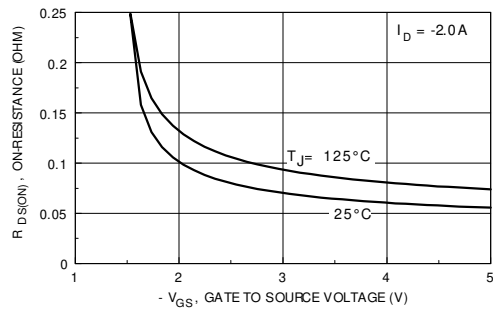
**Figure 1. On-Region Characteristics.**



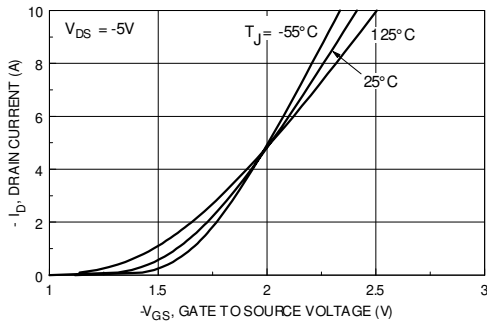
**Figure 2. On-Resistance Variation with Drain Current and Gate Voltage.**



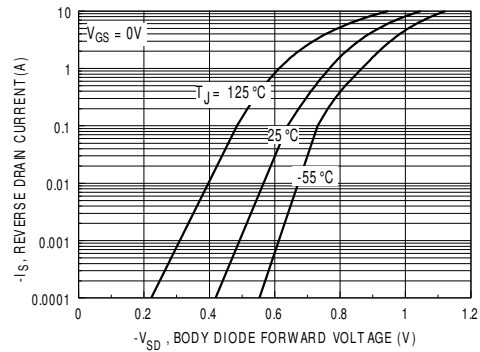
**Figure 3. On-Resistance Variation with Temperature.**



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

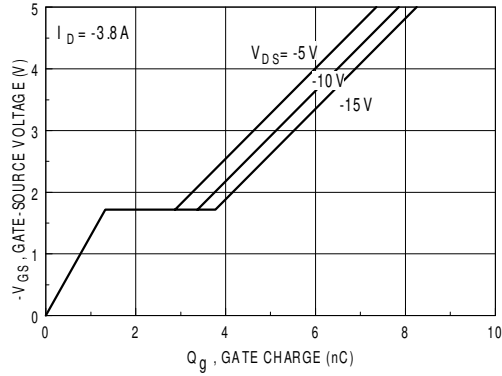


**Figure 5. Transfer Characteristics.**

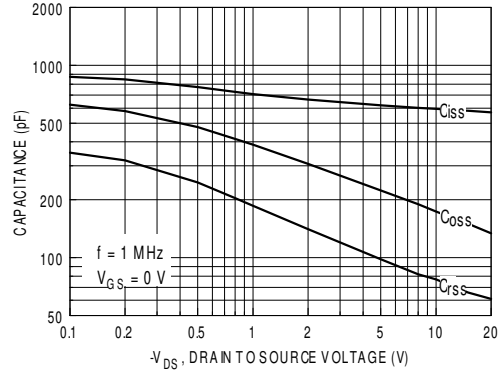


**Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature.**

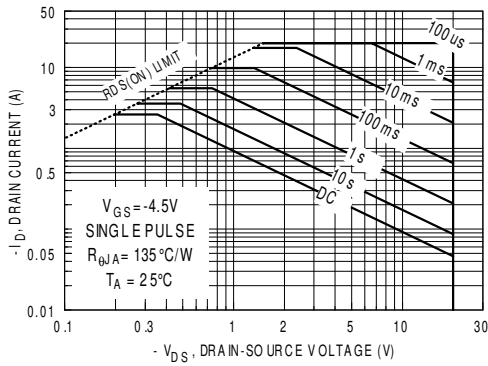
**Typical Characteristics** (continued)



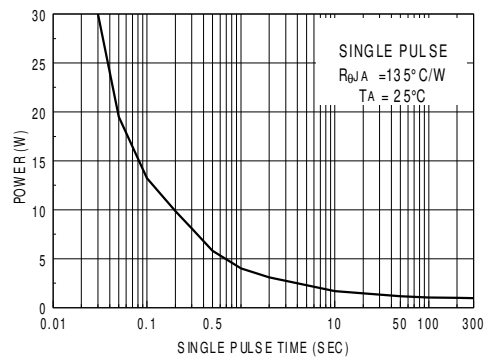
**Figure 7. Gate Charge Characteristics.**



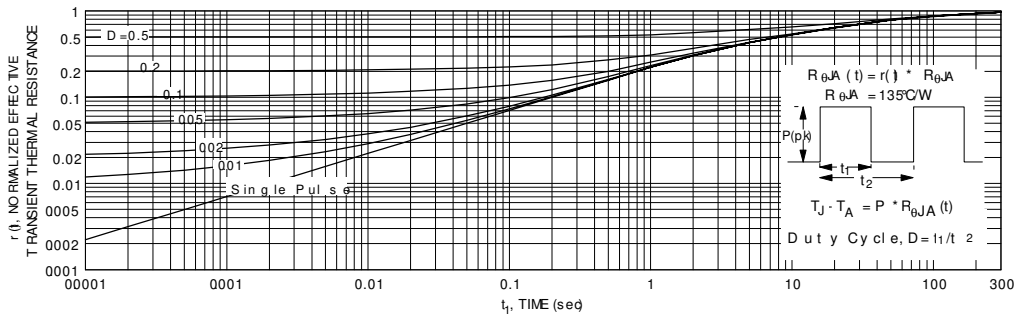
**Figure 8. Capacitance Characteristics.**



**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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