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September 2015

# FDS89161LZ

## Dual N-Channel Shielded Gate PowerTrench® MOSFET

100 V, 2.7 A, 105 mΩ

### Features

- Shielded Gate MOSFET Technology
- Max  $r_{DS(on)}$  = 105 mΩ at  $V_{GS} = 10$  V,  $I_D = 2.7$  A
- Max  $r_{DS(on)}$  = 160 mΩ at  $V_{GS} = 4.5$  V,  $I_D = 2.1$  A
- High performance trench technology for extremely low  $r_{DS(on)}$
- High power and current handling capability in a widely used surface mount package
- CDM ESD protection level > 2KV typical (Note 4)
- 100% UIL Tested
- RoHS Compliant

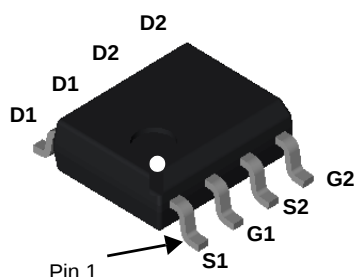


### General Description

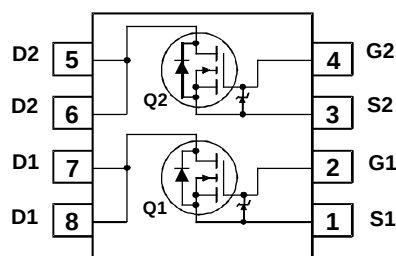
This N-Channel logic Level MOSFETs are produced using Fairchild Semiconductor's advanced PowerTrench® process that incorporates Shielded Gate technology. This process has been optimized for the on-state resistance and yet maintain superior switching performance. G-S zener has been added to enhance ESD voltage level.

### Application

- DC-DC conversion



SO-8



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

| Symbol         | Parameter                                            | Ratings     | Units            |
|----------------|------------------------------------------------------|-------------|------------------|
| $V_{DS}$       | Drain to Source Voltage                              | 100         | V                |
| $V_{GS}$       | Gate to Source Voltage                               | $\pm 20$    | V                |
| $I_D$          | Drain Current -Continuous                            | 2.7         | A                |
|                | -Pulsed                                              | 15          |                  |
| $E_{AS}$       | Single Pulse Avalanche Energy (Note 3)               | 13          | mJ               |
| $P_D$          | Power Dissipation $T_C = 25^\circ\text{C}$           | 31          | W                |
|                | Power Dissipation $T_A = 25^\circ\text{C}$ (Note 1a) | 1.6         |                  |
| $T_J, T_{STG}$ | Operating and Storage Junction Temperature Range     | -55 to +150 | $^\circ\text{C}$ |

### Thermal Characteristics

|                 |                                                   |    |                    |
|-----------------|---------------------------------------------------|----|--------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case (Note 1)     | 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   |
|----------------|------------|---------|-----------|------------|------------|
| FDS89161LZ     | FDS89161LZ | SO-8    | 13 "      | 12 mm      | 2500 units |

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

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|--------|-----------|-----------------|-----|-----|-----|-------|
|--------|-----------|-----------------|-----|-----|-----|-------|

**Off Characteristics**

|                                      |                                           |                                                             |     |    |          |                      |
|--------------------------------------|-------------------------------------------|-------------------------------------------------------------|-----|----|----------|----------------------|
| $BV_{DSS}$                           | Drain to Source Breakdown Voltage         | $I_D = 250\ \mu\text{A}$ , $V_{GS} = 0\ \text{V}$           | 100 |    |          | V                    |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D = 250\ \mu\text{A}$ , referenced to $25^\circ\text{C}$ |     | 68 |          | mV/ $^\circ\text{C}$ |
| $I_{DSS}$                            | Zero Gate Voltage Drain Current           | $V_{DS} = 80\ \text{V}$ , $V_{GS} = 0\ \text{V}$            |     |    | 1        | $\mu\text{A}$        |
| $I_{GSS}$                            | Gate to Source Leakage Current            | $V_{GS} = \pm 20\ \text{V}$ , $V_{DS} = 0\ \text{V}$        |     |    | $\pm 10$ | $\mu\text{A}$        |

**On Characteristics**

|                                        |                                                          |                                                                             |   |     |     |                      |
|----------------------------------------|----------------------------------------------------------|-----------------------------------------------------------------------------|---|-----|-----|----------------------|
| $V_{GS(th)}$                           | Gate to Source Threshold Voltage                         | $V_{GS} = V_{DS}$ , $I_D = 250\ \mu\text{A}$                                | 1 | 1.7 | 2.2 | V                    |
| $\frac{\Delta V_{GS(th)}}{\Delta T_J}$ | Gate to Source Threshold Voltage Temperature Coefficient | $I_D = 250\ \mu\text{A}$ , referenced to $25^\circ\text{C}$                 |   | -6  |     | mV/ $^\circ\text{C}$ |
| $r_{DS(on)}$                           | Static Drain to Source On Resistance                     | $V_{GS} = 10\ \text{V}$ , $I_D = 2.7\ \text{A}$                             |   | 81  | 105 | m $\Omega$           |
|                                        |                                                          | $V_{GS} = 4.5\ \text{V}$ , $I_D = 2.1\ \text{A}$                            |   | 110 | 160 |                      |
|                                        |                                                          | $V_{GS} = 10\ \text{V}$ , $I_D = 2.7\ \text{A}$ , $T_J = 125^\circ\text{C}$ |   | 140 | 182 |                      |
| $g_{FS}$                               | Forward Transconductance                                 | $V_{DS} = 10\ \text{V}$ , $I_D = 2.7\ \text{A}$                             |   | 7.8 |     | S                    |

**Dynamic Characteristics**

|           |                              |                                                                           |  |     |     |          |
|-----------|------------------------------|---------------------------------------------------------------------------|--|-----|-----|----------|
| $C_{iss}$ | Input Capacitance            | $V_{DS} = 50\ \text{V}$ , $V_{GS} = 0\ \text{V}$ ,<br>$f = 1\ \text{MHz}$ |  | 227 | 302 | pF       |
| $C_{oss}$ | Output Capacitance           |                                                                           |  | 44  | 58  | pF       |
| $C_{rss}$ | Reverse Transfer Capacitance |                                                                           |  | 3   | 4   | pF       |
| $R_g$     | Gate Resistance              |                                                                           |  | 0.9 |     | $\Omega$ |

**Switching Characteristics**

|              |                               |                                                                                                      |                                                    |     |     |    |
|--------------|-------------------------------|------------------------------------------------------------------------------------------------------|----------------------------------------------------|-----|-----|----|
| $t_{d(on)}$  | Turn-On Delay Time            | $V_{DD} = 50\ \text{V}$ , $I_D = 2.7\ \text{A}$ ,<br>$V_{GS} = 10\ \text{V}$ , $R_{GEN} = 6\ \Omega$ |                                                    | 3.8 | 10  | ns |
| $t_r$        | Rise Time                     |                                                                                                      |                                                    | 1.2 | 10  | ns |
| $t_{d(off)}$ | Turn-Off Delay Time           |                                                                                                      |                                                    | 9.5 | 17  | ns |
| $t_f$        | Fall Time                     |                                                                                                      |                                                    | 1.6 | 10  | ns |
| $Q_{g(TOT)}$ | Total Gate Charge             | $V_{GS} = 0\ \text{V}$ to $10\ \text{V}$                                                             | $V_{DD} = 50\ \text{V}$ ,<br>$I_D = 2.7\ \text{A}$ | 3.8 | 5.3 | nC |
| $Q_{g(TOT)}$ | Total Gate Charge             | $V_{GS} = 0\ \text{V}$ to $5\ \text{V}$                                                              |                                                    | 2.1 | 2.9 | nC |
| $Q_{gs}$     | Gate to Source Charge         |                                                                                                      |                                                    | 0.7 |     | nC |
| $Q_{gd}$     | Gate to Drain "Miller" Charge |                                                                                                      |                                                    | 0.7 |     | nC |

**Drain-Source Diode Characteristics**

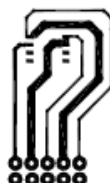
|          |                                       |                                                             |  |     |     |    |
|----------|---------------------------------------|-------------------------------------------------------------|--|-----|-----|----|
| $V_{SD}$ | Source to Drain Diode Forward Voltage | $V_{GS} = 0\ \text{V}$ , $I_S = 2.7\ \text{A}$ (Note 2)     |  | 0.8 | 1.3 | V  |
|          |                                       | $V_{GS} = 0\ \text{V}$ , $I_S = 2\ \text{A}$ (Note 2)       |  | 0.8 | 1.2 |    |
| $t_{rr}$ | Reverse Recovery Time                 | $I_F = 2.7\ \text{A}$ , $di/dt = 100\ \text{A}/\mu\text{s}$ |  | 31  | 56  | ns |
| $Q_{rr}$ | Reverse Recovery Charge               |                                                             |  | 20  | 36  | nC |

## NOTES:

1.  $R_{\theta JA}$  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

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

3. Starting  $T_J = 25^\circ\text{C}$ ,  $L = 0.3\ \text{mH}$ ,  $I_{AS} = 25\ \text{A}$ ,  $V_{DD} = 27\ \text{V}$ ,  $V_{GS} = 10\ \text{V}$ .

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

# Typical Characteristics ( N-Channel) $T_J = 25^\circ\text{C}$ unless otherwise noted

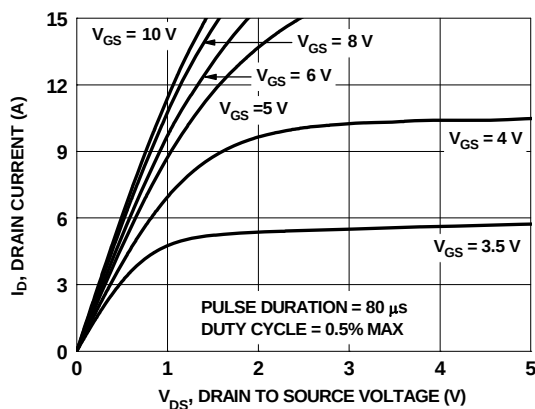


Figure 1. On-Region Characteristics

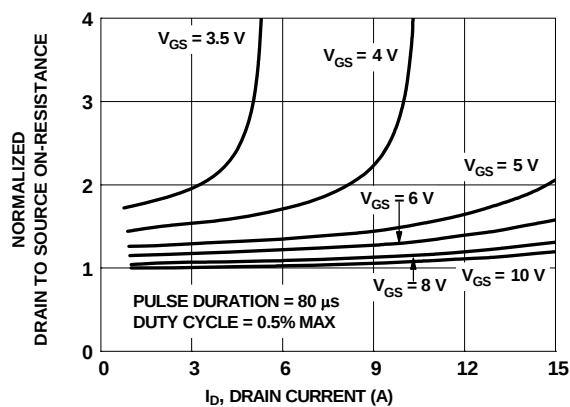


Figure 2. Normalized On-Resistance vs Drain Current and Gate Voltage

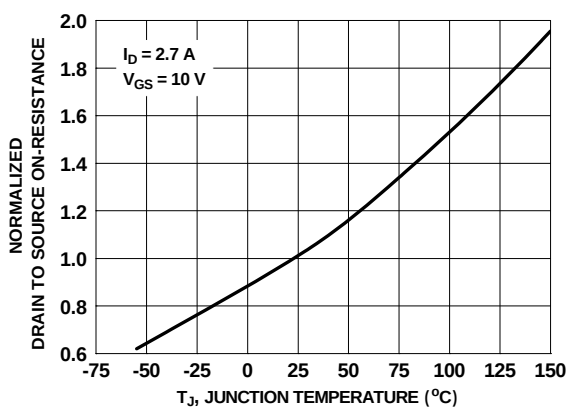


Figure 3. Normalized On-Resistance vs Junction Temperature

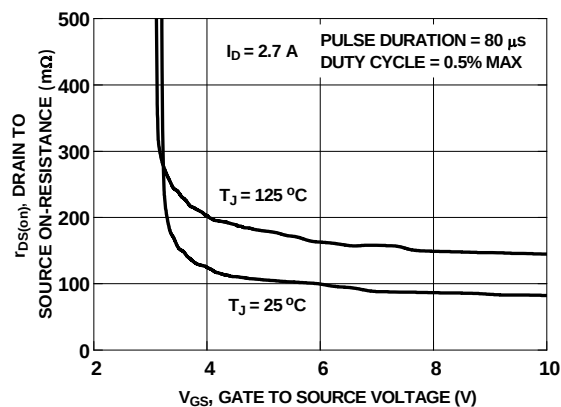


Figure 4. On-Resistance vs Gate to Source Voltage

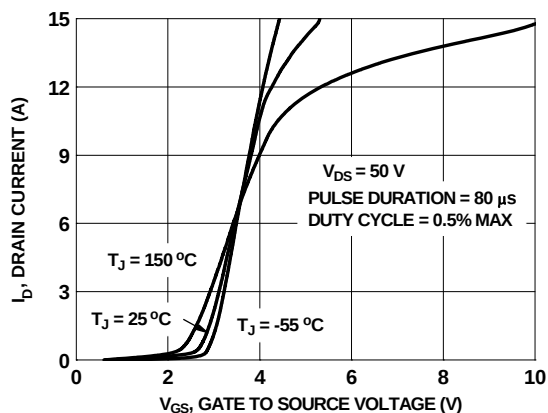


Figure 5. Transfer Characteristics

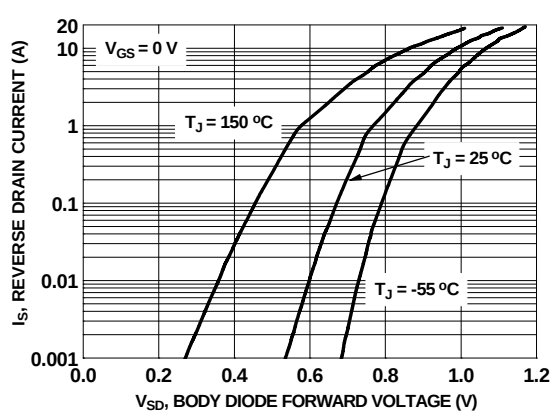


Figure 6. Source to Drain Diode Forward Voltage vs Source Current

# Typical Characteristics ( N-Channel) $T_J = 25^\circ\text{C}$ unless otherwise noted

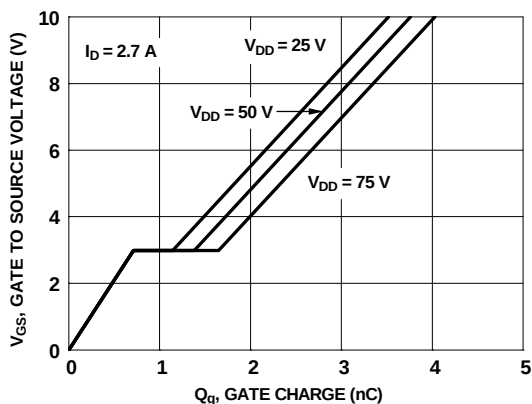


Figure 7. Gate Charge Characteristics

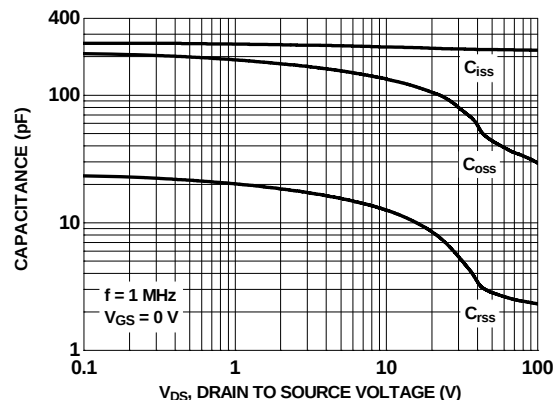


Figure 8. Capacitance vs Drain to Source Voltage

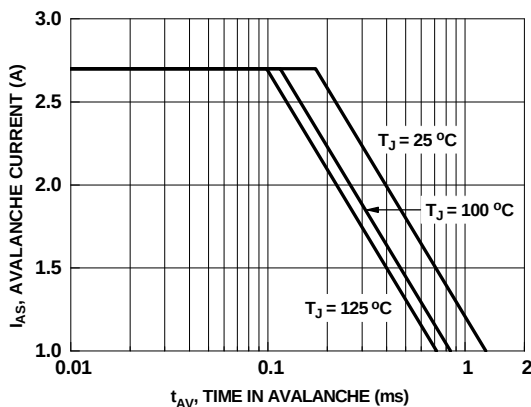


Figure 9. Unclamped Inductive Switching Capability

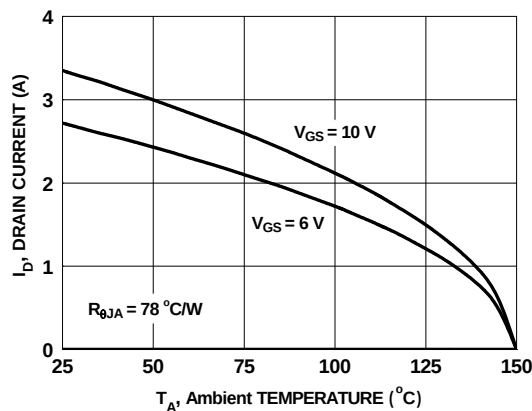


Figure 10. Maximum Continuous Drain Current vs Ambient Temperature

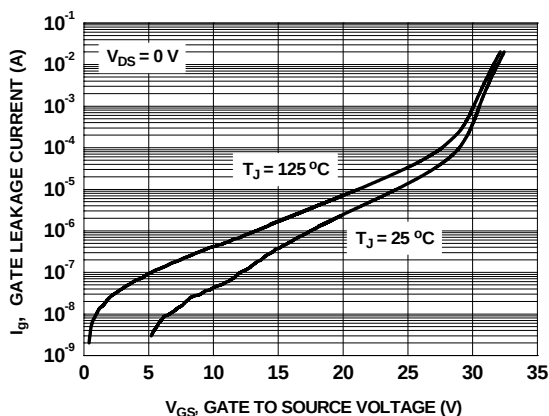


Figure 11. Gate Leakage Current vs Gate to Source Voltage

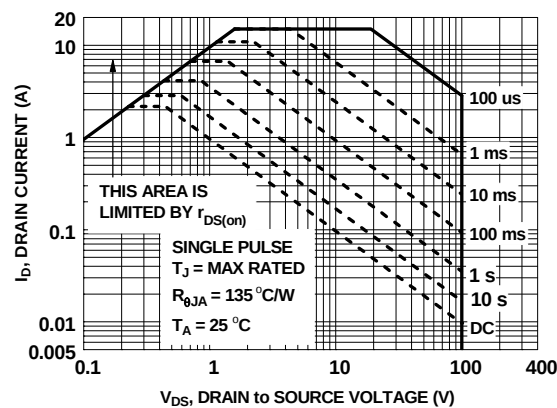


Figure 12. Forward Bias Safe Operating Area

# Typical Characteristics ( N-Channel) $T_J = 25^\circ\text{C}$ unless otherwise noted

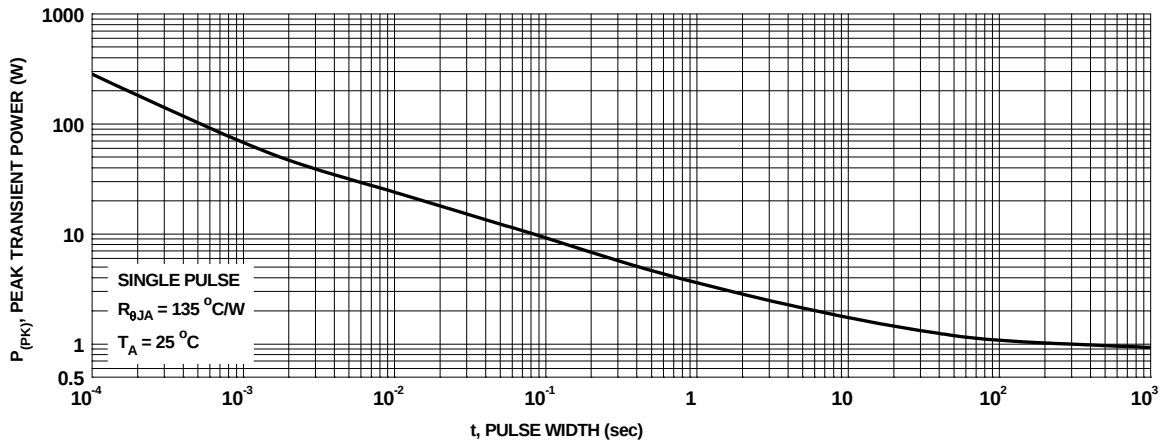


Figure 13. Single Pulse Maximum Power Dissipation

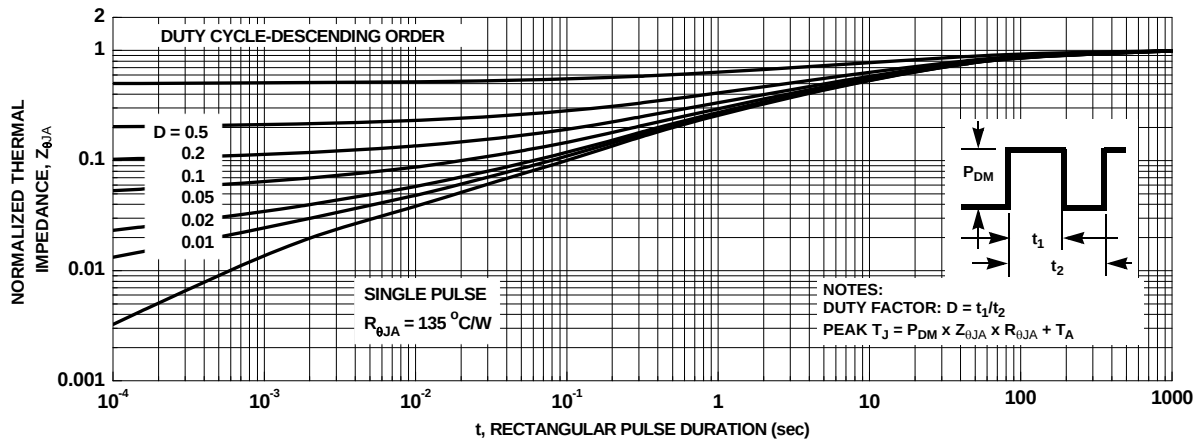


Figure 14. Junction-to-Ambient Transient Thermal Response Curve



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