**FAIRCHILD**

SEMICONDUCTOR®

December 2006

# FDFMA2N028Z

## Integrated N-Channel PowerTrench® MOSFET and Schottky Diode

### 20V, 3.7A, 68mΩ

### Features

**MOSFET**

- Max $r_{DS(on)}$ = 68mΩ at $V_{GS}$ = 4.5V, $I_D$ = 3.7A

- Max $r_{DS(on)}$ = 86mΩ at $V_{GS}$ = 2.5V, $I_D$ = 3.3A

**Schottky**

- $V_F$ < 0.37V @ 500mA

- Low profile - 0.8 mm maximum - in the new package MicroFET 2x2 mm

- RoHS Compliant

### General Description

This device is designed specifically as a single package solution for a boost topology in cellular handset and other ultra-portable applications. It features a MOSFET with low on-state resistance, and an independently connected schottky diode with low forward voltage.

The MicroFET 2x2 package offers exceptional thermal performance for its physical size and is well suited to switching and linear mode applications.

### Application

- DC - DC Conversion

**Pin 1**

A  NC  D

C  G  S
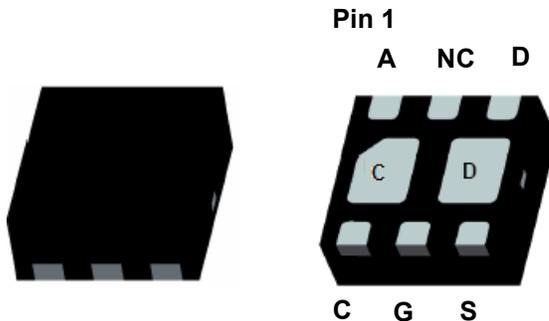
**MicroFET 2X2**
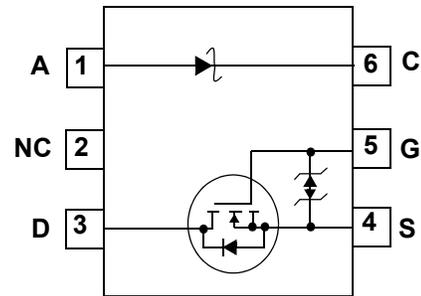
### MOSFET Maximum Ratings $T_J$ = 25°C unless otherwise noted

| Symbol | Parameter | | Ratings | Units |
|---|---|---|---|---|
| $V_{DS}$ | Drain to Source Voltage | | 20 | V |
| $V_{GS}$ | Gate to Source Voltage | | ±12 | V |
| $I_D$ | Drain Current   -Continuous | (Note 1a) | 3.7 | A |
| | -Pulsed | | 6 | |
| $P_D$ | Power Dissipation | (Note 1a) | 1.4 | W |
| | Power Dissipation | (Note 1b) | 0.7 | |
| $T_J$, $T_{STG}$ | Operating and Storage Junction Temperature Range | | -55 to +150 | °C |
| $V_{RR}$ | Schottky Repetitive Peak Reverse Voltage | | 20 | V |
| $I_O$ | Schottky Average Forward Current | | 2 | A |

### Thermal Characteristics

| | | | | |
|---|---|---|---|---|
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | (Note 1a) | 86 | |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | (Note 1b) | 173 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | (Note 1c) | 86 | |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | (Note 1d) | 140 | |

### Package Marking and Ordering Information

| Device Marking | Device | Package | Reel Size | Tape Width | Quantity |
|---|---|---|---|---|---|
| .N28 | FDFMA2N028Z | MicroFET 2X2 | 7'' | 8mm | 3000 units |

## Electrical Characteristics $T_J$ = 25°C unless otherwise noted

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

### Off Characteristics

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|--------|-----------|-----------------|-----|-----|-----|-------|
| $BV_{DSS}$ | Drain to Source Breakdown Voltage | $I_D$ = 250µA, $V_{GS}$ = 0V | 20 | | | V |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D$ = 250µA, referenced to 25°C | | 15 | | mV/°C |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 16V, $V_{GS}$ = 0V | | | 1 | µA |
| $I_{GSS}$ | Gate to Source Leakage Current | $V_{GS}$ = ±12V, $V_{DS}$ = 0V | | | ±10 | µA |

### On Characteristics

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|--------|-----------|-----------------|-----|-----|-----|-------|
| $V_{GS(th)}$ | Gate to Source Threshold Voltage | $V_{GS}$ = $V_{DS}$, $I_D$ = 250µA | 0.6 | 1.0 | 1.5 | V |
| $\frac{\Delta V_{GS(th)}}{\Delta T_J}$ | Gate to Source Threshold Voltage Temperature Coefficient | $I_D$ = 250µA, referenced to 25°C | | –4 | | mV/°C |
| $r_{DS(on)}$ | Static Drain to Source On Resistance | $V_{GS}$ = 4.5V, $I_D$ = 3.7A | | 37 | 68 | mΩ |
| | | $V_{GS}$ = 2.5V, $I_D$ = 3.3A | | 50 | 86 | |
| | | $V_{GS}$ = 4.5V, $I_D$ = 3.7A, $T_J$ = 125°C | | 53 | 90 | |
| $g_{FS}$ | Forward Trans conductance | $V_{DS}$ = 10V, $I_D$ = 3.7A | | 16 | | S |

### Dynamic Characteristics

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|--------|-----------|-----------------|-----|-----|-----|-------|
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = 10V, $V_{GS}$ = 0V, f = 1.0MHz | | 340 | 455 | pF |
| $C_{oss}$ | Output Capacitance | | | 80 | 110 | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | | 60 | 90 | pF |

### Switching Characteristics

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|--------|-----------|-----------------|-----|-----|-----|-------|
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD}$ = 10V, $I_D$ = 1A, $V_{GS}$ = 4.5V, $R_{GEN}$ = 6Ω | | 8 | 16 | ns |
| $t_r$ | Rise Time | | | 8 | 16 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 14 | 26 | ns |
| $t_f$ | Fall Time | | | 3 | 6 | ns |
| $Q_{g(TOT)}$ | Total Gate Charge | $V_{DS}$ = 10V  $I_D$ = 3.7A $V_{GS}$ = 4.5V | | 4 | 6 | nC |
| $Q_{gs}$ | Gate to Source Gate Charge | | | 0.7 | | nC |
| $Q_{gd}$ | Gate to Drain "Miller" Charge | | | 1.1 | | nC |

### Drain-Source Diode Characteristics

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|--------|-----------|-----------------|-----|-----|-----|-------|
| $I_S$ | Maximum Continuous Drain-Source Diode Forward Current | | | | 1.1 | A |
| $V_{SD}$ | Source to Drain Diode  Forward Voltage | $V_{GS}$ = 0V, $I_S$ = 1.1A    (Note 2) | | 0.7 | 1.2 | V |
| $t_{rr}$ | Reverse Recovery Time | $I_F$ = 3.7A, di/dt = 100A/µs | | 11 | | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | | 2 | | nC |

### Schottky Diode Characteristics

| Symbol | Parameter | Test Conditions | | Min | Typ | Max | Units |
|--------|-----------|-----------------|--|-----|-----|-----|-------|
| $V_R$ | Reverse Voltage | $I_R$ = 1mA | $T_J$ = 25°C | 20 | | | V |
| $I_R$ | Reverse Leakage | $V_R$ = 20V | $T_J$ = 25°C | | 30 | 300 | µA |
| | | | $T_J$ = 125°C | | 10 | 45 | mA |
| $V_F$ | Forward Voltage | $I_F$ = 500mA | $T_J$ = 25°C | | 0.32 | 0.37 | V |
| | | | $T_J$ = 125°C | | 0.21 | 0.26 | |
| | | $I_F$ = 1A | $T_J$ = 25°C | | 0.37 | 0.435 | |
| | | | $T_J$ = 125°C | | 0.28 | 0.33 | |

# Electrical Characteristics $T_J$ = 25°C unless otherwise noted

**Notes:**

**1:** $R_{\theta JA}$ is determined with the device mounted on a 1in² pad 2 oz. copper pad on a 1.5 x 1.5 in. board of FR-4 material. $R_{\theta JC}$ is guaranteed by design while $R_{\theta JA}$ is determined by the user's board design.

(a) MOSFET $R_{\theta JA}$ = 86°C/W when mounted on a 1in² pad of 2 oz copper, 1.5" x 1.5" x 0.062" thick PCB.

(b) MOSFET $R_{\theta JA}$ = 173°C/W when mounted on a minimum pad of 2 oz copper.

(c) Schottky $R_{\theta JA}$ = 86°C/W when mounted on a 1in² pad of 2 oz copper, 1.5" x 1.5" x 0.062" thick PCB.

(d) Schottky $R_{\theta JA}$ = 140°C/W when mounted on a minimum pad of 2 oz copper.
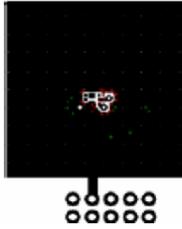
a)86°C/W when mounted on a 1in² pad of 2 oz copper.
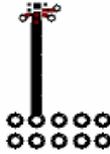
b)173°C/W when mounted on a minimum pad of 2 oz copper.

c)86°C/W when mounted on a 1in² pad of 2 oz copper.
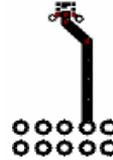
d)140°C/W when mounted on a minimum pad of 2 oz copper.

**2:** Pulse Test: Pulse Width < 300µs, Duty cycle < 2.0%.

## Typical Characteristics $T_J$ = 25°C unless otherwise noted
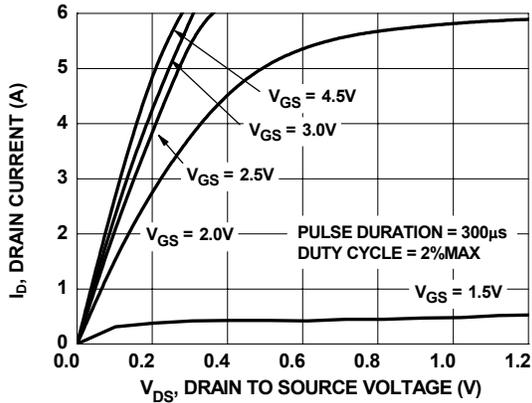


**Figure 1. On-Region Characteristics**
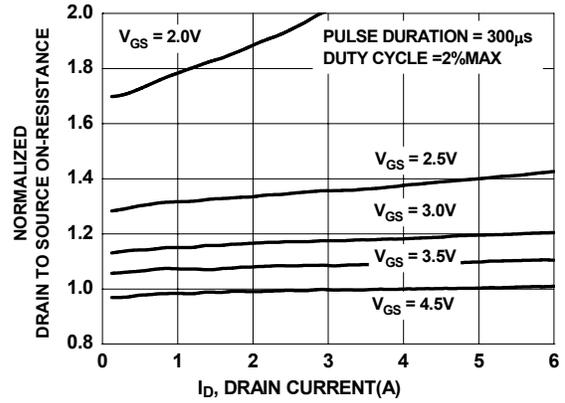


**Figure 2. Normalized On-Resistance vs Drain Current and Gate Voltage**
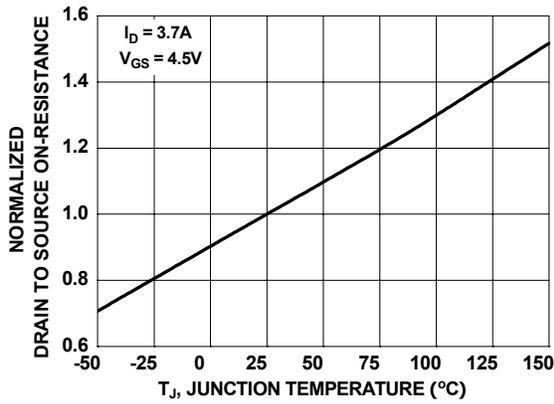


**Figure 3. Normalized On-Resistance vs Junction Temperature**
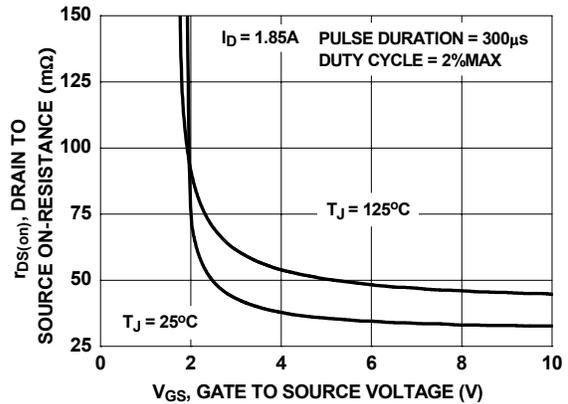


**Figure 4. On-Resistance vs Gate to Source Voltage**
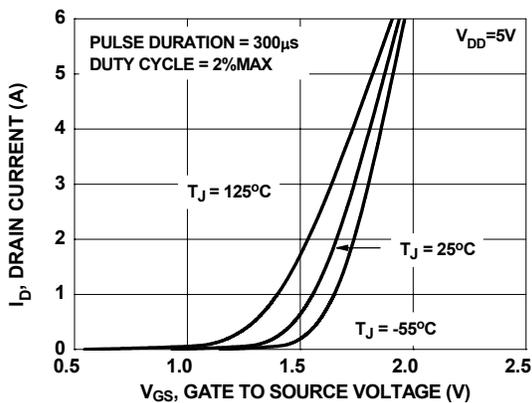


**Figure 5. Transfer Characteristics**
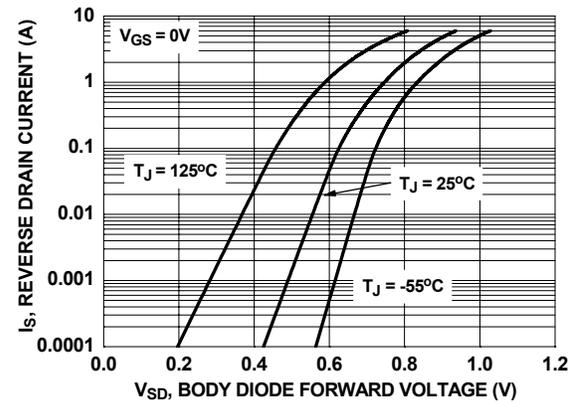


**Figure 6. Source to Drain Diode Forward Voltage vs Source Current**

## Typical Characteristics $T_J$ = 25°C unless otherwise noted
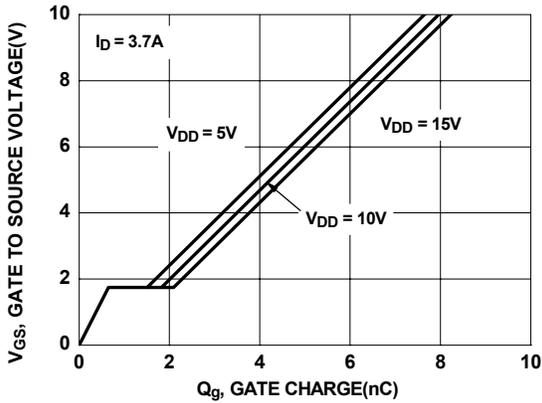


**Figure 7. Gate Charge Characteristics**
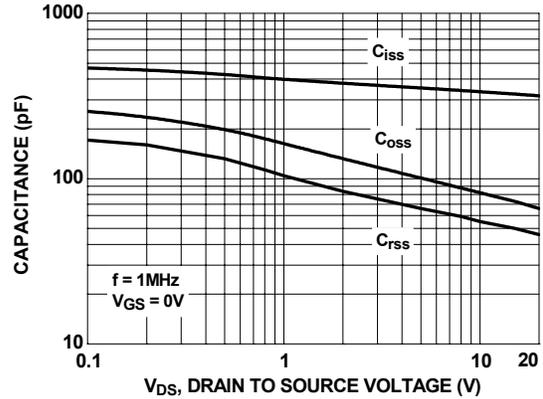


**Figure 8. Capacitance Characteristics**
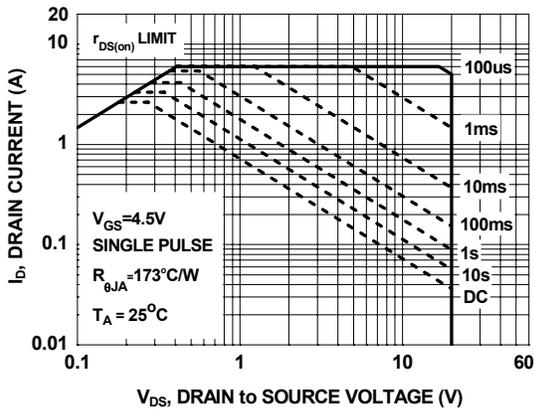


**Figure 9. Forward Bias Safe Operating Area**
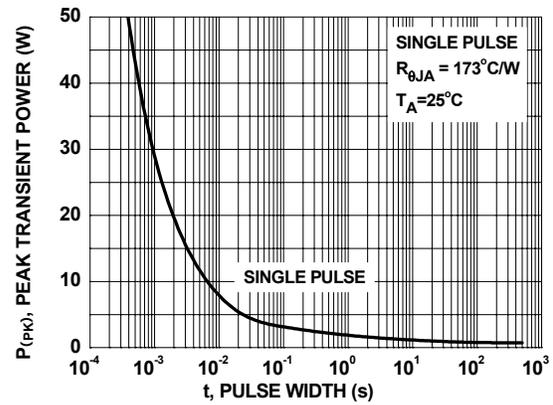


**Figure 10. Single Pulse Maximum Power Dissipation**
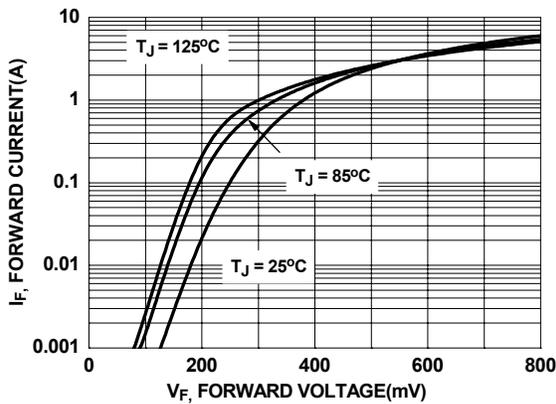


**Figure 11. Schottky Diode Forward Current**
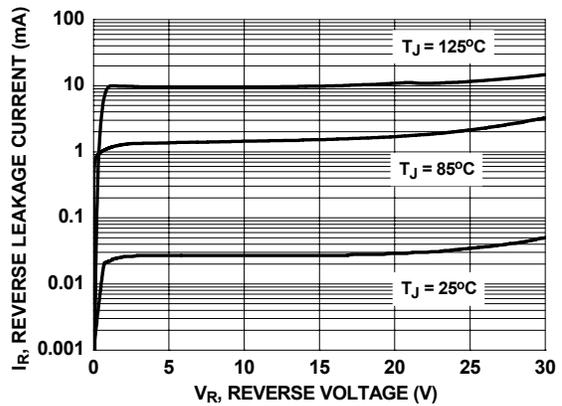


**Figure 12. Schottky Diode Reverse Current**

**Typical Characteristics** $T_J = 25°C$ unless otherwise noted



**Figure 13.  Transient Thermal Response Curve**

TOP VIEW

2X

SIDE VIEW

0.8 MAX

SEATING PLANE

PIN#1 IDENT
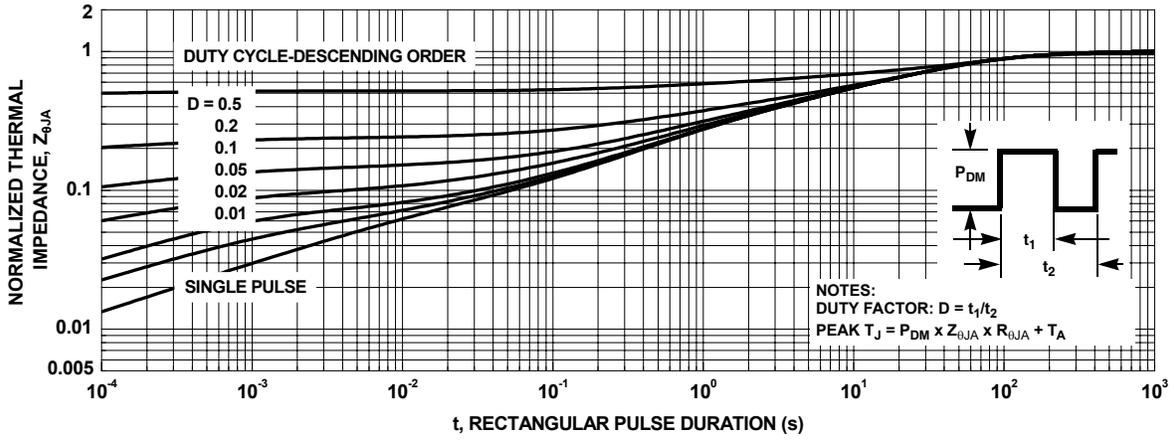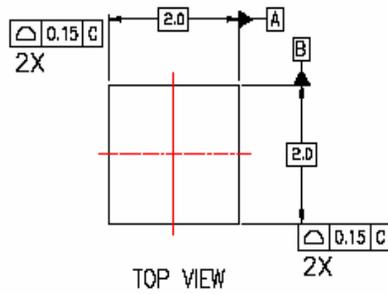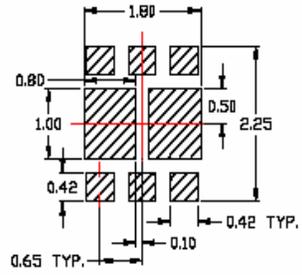
BOTTOM VIEW

RECOMMENDED LAND PATTERN
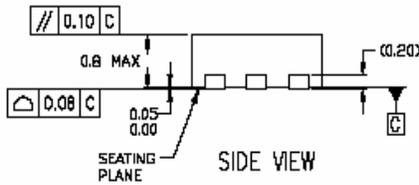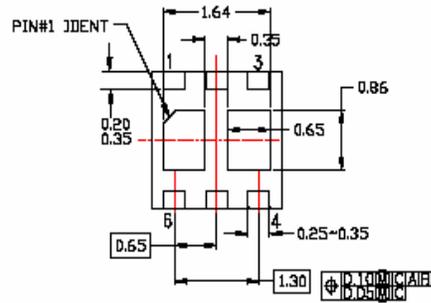
NOTES:

A. CONFORMS TO JEDEC REGISTRATION MO—229, VARIATION VCCC, DATED 11/2001
B. DIMENSIONS ARE IN MILLIMETERS.
C. DIMENSIONS AND TOLERANCES PER
   ASME Y14.5M, 1994

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