July 2014

# FDFMA3N109

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

### 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 input capacitance, total gate charge and on-state resistance, and an independently connected schottky diode with low forward voltage and reverse leakage current to maximize boost efficiency.

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

### Features

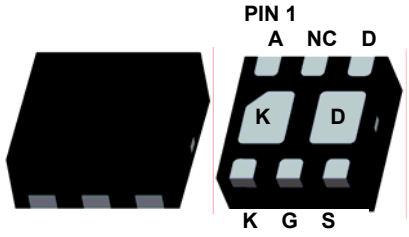
**MOSFET:**

- 2.9 A, 30 V $R_{DS(ON)}$ = 123 mΩ @ $V_{GS}$ = 4.5 V
  $R_{DS(ON)}$ = 140 mΩ @ $V_{GS}$ = 3.0 V
  $R_{DS(ON)}$ = 163 mΩ @ $V_{GS}$ = 2.5 V

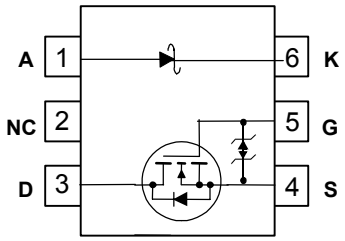
**Schottky:**

- $V_F$ < 0.46 V @ 500mA

- Low profile – 0.8 mm maximum – in the new package MicroFET 2x2 mm
- HBM ESD protection level = 1.8kV typical (Note 3)
- RoHS Compliant




MicroFET 2x2




## Absolute Maximum Ratings

$T_A$=25°C unless otherwise noted

| Symbol | Parameter | | Ratings | Units |
|---|---|---|---|---|
| $V_{DS}$ | Drain-Source Voltage | | 30 | V |
| $V_{GS}$ | Gate-Source Voltage | | ±12 | V |
| $I_D$ | Drain Current – Continuous ($T_C$ = 25°C, $V_{GS}$ = 4.5V) | | 2.9 | A |
| | – Continuous ($T_C$ = 25°C, $V_{GS}$ = 2.5V) | | 2.7 | |
| | – Pulsed | | 10 | |
| $P_D$ | Power Dissipation for Single Operation | (Note 1a) | 1.5 | W |
| | Power Dissipation for Single Operation | (Note 1b) | 0.65 | |
| $T_J$, $T_{STG}$ | Operating and Storage Temperature | | –55 to +150 | °C |
| $V_{RRM}$ | Schottky Repetitive Peak Reverse Voltage | | 28 | V |
| $I_O$ | Schottky Average Forward Current | | 1 | A |

## Thermal Characteristics

| | | | | |
|---|---|---|---|---|
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient | (Note 1a) | 83 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient | (Note 1b) | 193 | |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient | (Note 1c) | 101 | |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient | (Note 1d) | 228 | |

## Package Marking and Ordering Information

| Device Marking | Device | Reel Size | Tape width | Quantity |
|---|---|---|---|---|
| 109 | FDFMA3N109 | 7'' | 8mm | 3000 units |

## Electrical Characteristics

$T_A$ = 25°C unless otherwise noted

| Symbol | Parameter | Test Conditions | | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | | |
| $BV_{DSS}$ | Drain–Source Breakdown Voltage | $V_{GS}$ = 0 V, $I_D$ = 250 μA | | 30 | | | V |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D$ = 250 μA, Referenced to 25°C | | | 25 | | mV/°C |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 24 V, $V_{GS}$ = 0 V | | | | 1 | μA |
| $I_{GSS}$ | Gate–Body Leakage Current | $V_{GS}$ = ± 12 V, $V_{DS}$ = 0 V | | | | ±10 | μA |
| **On Characteristics** | | | | | | | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 μA | | 0.4 | 1.0 | 1.5 | V |
| $\frac{\Delta V_{GS(th)}}{\Delta T_J}$ | Gate Threshold Voltage Temperature Coefficient | $I_D$ = 250 μA, Referenced to 25°C | | | –3 | | mV/°C |
| $R_{DS(on)}$ | Static Drain–Source On–Resistance | $V_{GS}$ = 4.5V, $I_D$ = 2.9A | | | 75 | 123 | mΩ |
| | | $V_{GS}$ = 3.0V, $I_D$ = 2.7A | | | 84 | 140 | |
| | | $V_{GS}$ = 2.5V, $I_D$ = 2.5A | | | 92 | 163 | |
| | | $V_{GS}$ = 4.5V, $I_D$ = 2.9A, $T_C$ = 85°C | | | 95 | 166 | |
| | | $V_{GS}$ = 3.0V, $I_D$ = 2.7A, $T_C$ = 150°C | | | 138 | 203 | |
| | | $V_{GS}$ = 2.5V, $I_D$ = 2.5A, $T_C$ = 150°C | | | 150 | 268 | |
| **Dynamic Characteristics** | | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = 15 V, $V_{GS}$ = 0 V, f = 1.0 MHz | | | 190 | 220 | pF |
| $C_{oss}$ | Output Capacitance | | | | 30 | 40 | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | | | 20 | 30 | pF |
| $R_G$ | Gate Resistance | $V_{GS}$ = 0 V, f = 1.0 MHz | | | 4.6 | | Ω |
| **Switching Characteristics** (Note 2) | | | | | | | |
| $t_{d(on)}$ | Turn–On Delay Time | $V_{DD}$ = 15 V, $I_D$ = 1 A, $V_{GS}$ = 4.5 V, $R_{GEN}$ = 6 Ω | | | 6 | 12 | ns |
| $t_r$ | Turn–On Rise Time | | | | 8 | 16 | ns |
| $t_{d(off)}$ | Turn–Off Delay Time | | | | 12 | 21 | ns |
| $t_f$ | Turn–Off Fall Time | | | | 2 | 4 | ns |
| $Q_g$ | Total Gate Charge | $V_{DS}$ = 15 V, $I_D$ = 2.9 A, $V_{GS}$ = 4.5 V | | | 2.4 | 3.0 | nC |
| $Q_{gs}$ | Gate–Source Charge | | | | 0.35 | | nC |
| $Q_{gd}$ | Gate–Drain Charge | | | | 0.75 | | nC |
| **Drain–Source Diode Characteristics and Maximum Ratings** | | | | | | | |
| $I_S$ | Maximum Continuous Drain–Source Diode Forward Current | | | | | 2.9 | A |
| $V_{SD}$ | Drain–Source Diode Forward Voltage | $I_S$ = 2.0 A | | | 0.9 | 1.2 | V |
| | | $I_S$ = 1.1 A | | | 0.8 | 1.2 | |
| $t_{rr}$ | Diode Reverse Recovery Time | $I_F$ = 2.9 A, $dI_F/dt$ = 100 A/μs | | | 10 | | ns |
| $Q_{rr}$ | Diode Reverse Recovery Charge | | | | 2 | | nC |
| **Schottky Diode Characteristics** | | | | | | | |
| $I_R$ | Reverse Leakage | $V_R$ = 28 V | $T_J$ = 25°C | | 10 | 100 | μA |
| | | | $T_J$ = 85°C | | 0.07 | 4.7 | mA |
| $V_F$ | Forward Voltage | $I_F$ = 1 A | $T_J$ = 25°C | | 0.50 | 0.57 | V |
| | | | $T_J$ = 85°C | | 0.49 | 0.60 | |
| $V_F$ | Forward Voltage | $I_F$ = 500 mA | $T_J$ = 25°C | | 0.40 | 0.46 | V |
| | | | $T_J$ = 85°C | | 0.36 | 0.43 | |

## Electrical Characteristics

$T_A$ = 25°C unless otherwise noted

**Notes:**

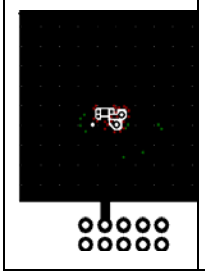
**1.** $R_{\theta JA}$ is determined with the device mounted on a 1 $in^2$ oz. copper pad on a 1.5 x 1.5 in. board of FR-4 material. $R_{\theta JC}$ is guaranteed by design while $R_{\theta JA}$ is determined by the user's board design.

**(a)** MOSFET $R_{\theta JA}$ = 83°C/W when mounted on a 1$in^2$ pad of 2 oz copper, 1.5” x 1.5” x 0.062” thick PCB

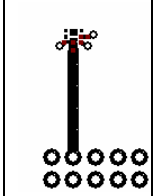
**(b)** MOSFET $R_{\theta JA}$ = 193°C/W when mounted on a minimum pad of 2 oz copper

**(c)** Schottky $R_{\theta JA}$ = 101°C/W when mounted on a 1$in^2$ pad of 2 oz copper, 1.5” x 1.5” x 0.062” thick PCB

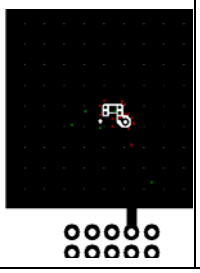
**(d)** Schottky $R_{\theta JA}$ = 228°C/W when mounted on a minimum pad of 2 oz copper



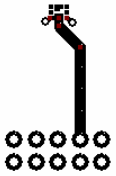
a) 83°C/W when mounted on a 1$in^2$ pad of 2 oz copper



b) 193°C/W when mounted on a minimum pad of 2 oz copper



c)101 °C/W when mounted on a 1$in^2$ pad of 2 oz copper



b) 228°C/W when mounted on a minimum pad of 2 oz copper

Scale 1 : 1 on letter size paper

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

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

## Typical Characteristics

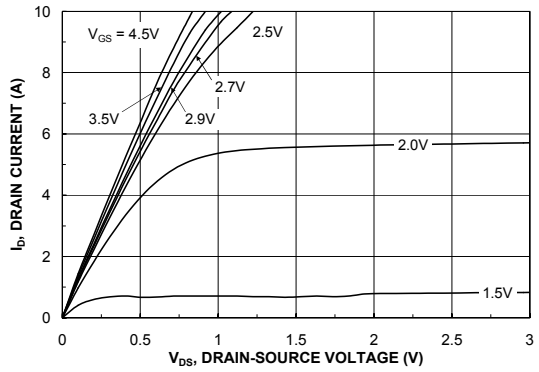



**Figure 1. On-Region Characteristics.**

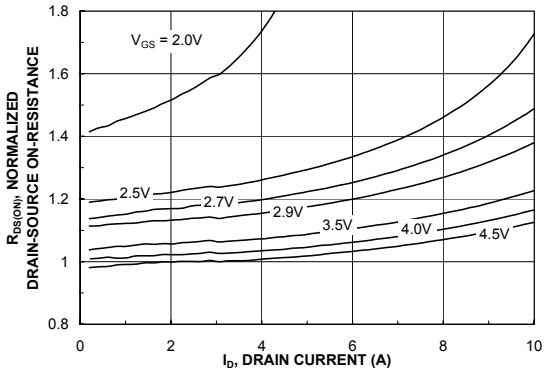



**Figure 2. On-Resistance Variation with Drain Current and Gate Voltage.**

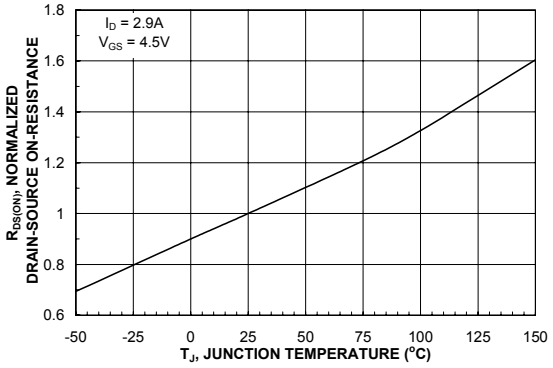



**Figure 3. On-Resistance Variation with Temperature.**

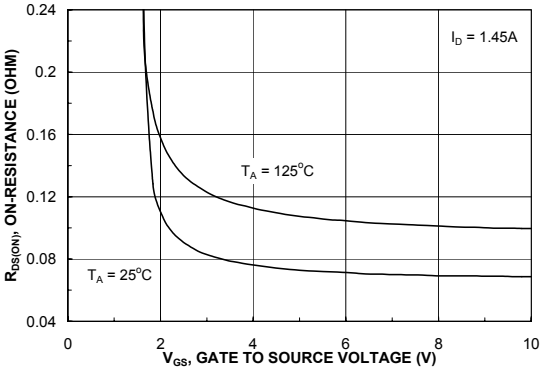



**Figure 4. On-Resistance Variation with Gate-to-Source Voltage.**

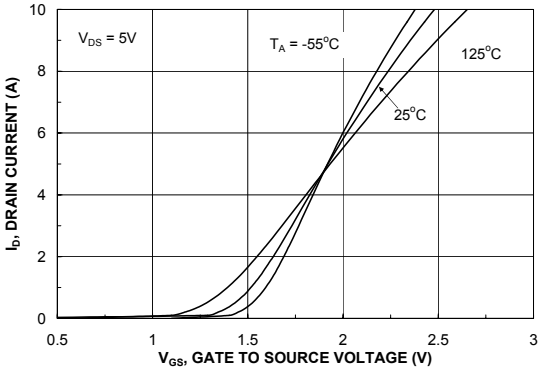



**Figure 5. Transfer Characteristics.**

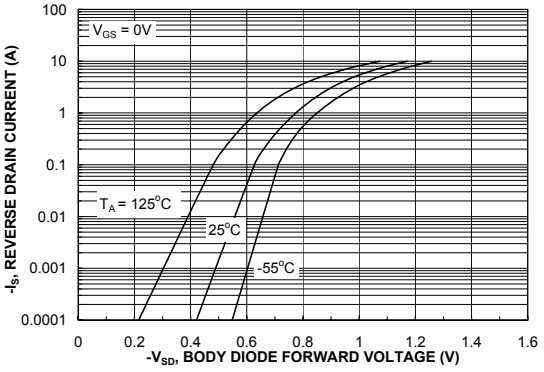



**Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature.**

## Typical Characteristics

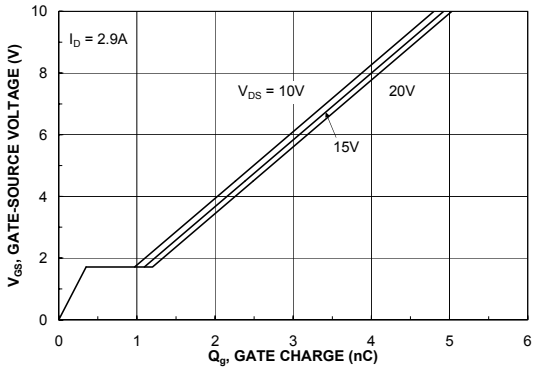



**Figure 7. Gate Charge Characteristics.**

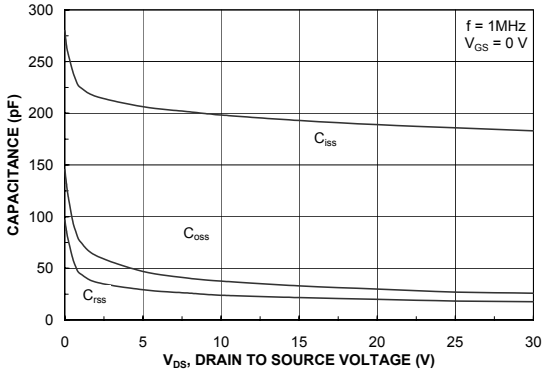



**Figure 8. Capacitance Characteristics.**

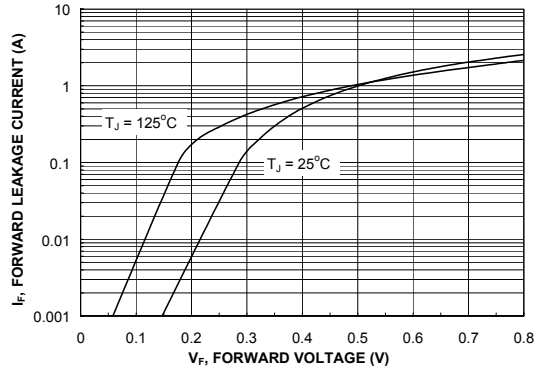



**Figure 9. Schottky Diode Forward Voltage.**

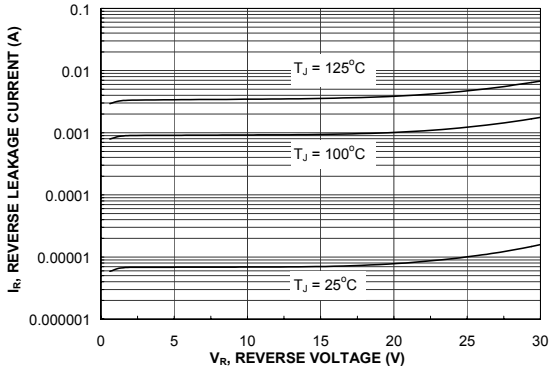



**Figure 10. Schottky Diode Reverse Current.**

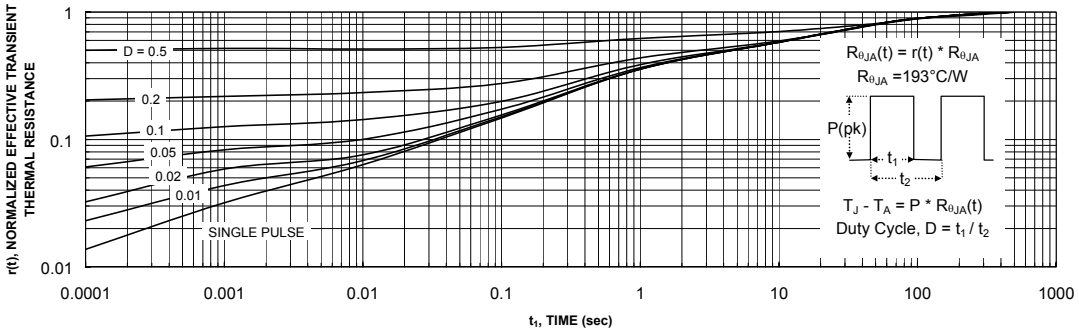
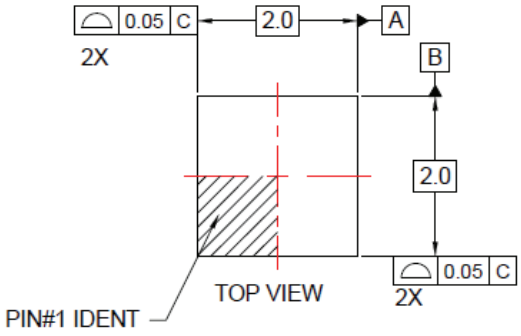
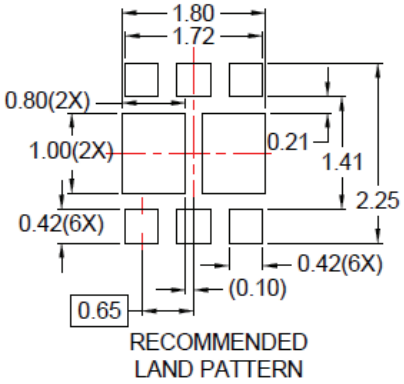


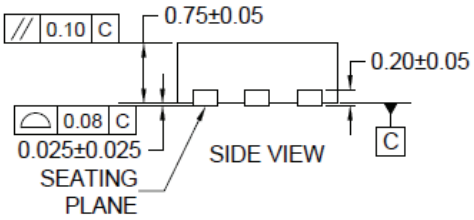

**Figure 11. Transient Thermal Response Curve.**

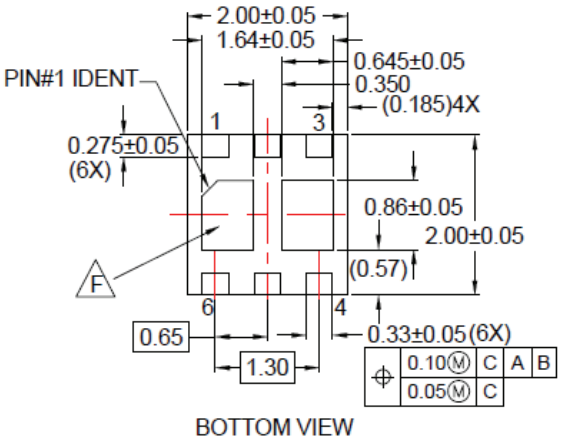
**Thermal characterization performed using the conditions described in Note 1b.**
**Transient thermal response will change depending on the circuit board design.**

## Dimensional Outline and Pad Layout




NOTES:

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C. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 2009.

D. LAND PATTERN RECOMMENDATION IS EXISTING INDUSTRY LAND PATTERN.

E. DRAWING FILENAME: MKT-UMLP16Erev4

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