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FAIRCHILD SEMICONDUCTOR®

August 2005

# FDFM2N111

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

### General Description

FDFM2N111 combines the exceptional performance of Fairchild's PowerTrench MOSFET technology with a very low forward voltage drop Schottky barrier rectifier in a MicroFET package.

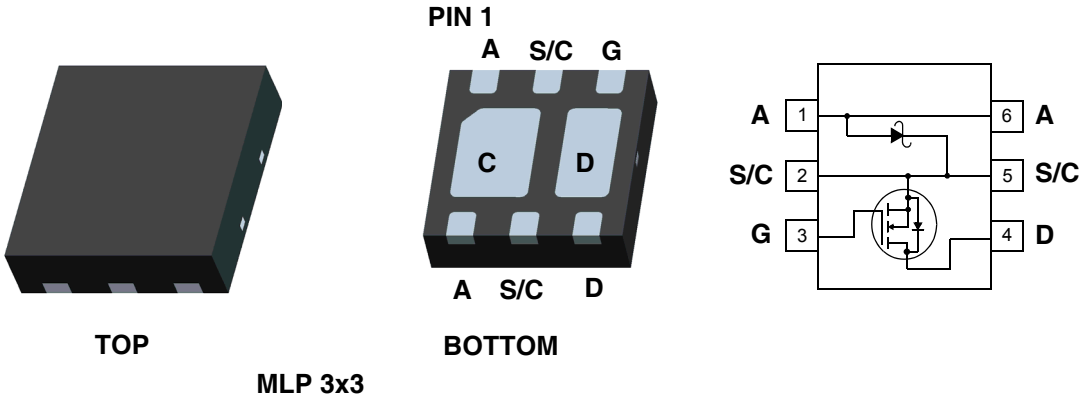
This device is designed specifically as a single package solution for Standard Buck Converter. It features a fast switching, low gate charge MOSFET with very low on-state resistance.

### Applications

- Standard Buck Converter

### Features

- 4 A, 20 V $R_{DS(ON)}$ = 100mΩ @ $V_{GS}$ = 4.5 V
  $R_{DS(ON)}$ = 150mΩ @ $V_{GS}$ = 2.5 V
- Low Profile - 0.8 mm maximun - in the new package MicroFET 3x3 mm




TOP BOTTOM

MLP 3x3

### Absolute Maximum Ratings $T_A$ = 25°C unless otherwise noted

| Symbol | Parameter | | Ratings | Units |
|---|---|---|---|---|
| $V_{DSS}$ | Drain-Source Voltage | | 20 | V |
| $V_{GSS}$ | Gate-Source Voltage | | ±12 | V |
| $I_D$ | Drain Current -Continuous | (Note 1a) | 4 | A |
| | -Pulsed | | 10 | |
| $V_{RRM}$ | Schottky Repetitive Peak Reverse voltage | | 20 | V |
| $I_O$ | Schottky Average Forward Current | (Note 1a) | 2 | A |
| $P_D$ | Power dissipation (Steady State) | (Note 1a) | 1.7 | W |
| | Power dissipation (Steady State) | (Note 1b) | 0.8 | |
| $T_J$, $T_{STG}$ | Operating and Storage Junction Temperature Range | | -55 to +150 | °C |

### Thermal Characteristics

| | | | | |
|---|---|---|---|---|
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient | (Note 1a) | 70 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient | (Note 1b) | 150 | °C/W |

### Package Marking and Ordering Information

| Device Marking | Device | Reel Size | Tape Width | Quantity |
|---|---|---|---|---|
| 2N111 | FDFM2N111 | 7inch | 12mm | 3000 units |

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

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | |
| $B_{VDSS}$ | Drain-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 | - | 12 | - | mV/°C |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{GS}$ = 0V, $V_{DS}$ = 16V | - | - | 1 | μA |
| $I_{GSS}$ | Gate-Body Leakage, | $V_{GS}$ = ±12V, $V_{DS}$ = 0V | - | - | ±100 | nA |
| **On Characteristics** (Note 2) | | | | | | |
| $V_{GS(TH)}$ | Gate Threshold Voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 250μA | 0.6 | 1.0 | 1.5 | V |
| $\frac{\Delta V_{GS(TH)}}{\Delta T_J}$ | Gate Threshold Voltage Temperature Coefficient | $I_D$ = 250μA, Referenced to 25°C | - | -3 | - | mV/°C |
| $R_{DS(ON)}$ | Static Drain-Source On-Resistance | $I_D$ = 4.0A, $V_{GS}$ = 4.5V | - | 54 | 100 | mΩ |
| | | $I_D$ = 3.3A, $V_{GS}$ = 2.5V | - | 83 | 150 | |
| | | $I_D$ = 4.0A, $V_{GS}$ = 4.5V, $T_J$ = 125°C | - | 74 | 147 | |
| $I_{D(ON)}$ | On-State Drain Current | $V_{GS}$ = 2.5V, $V_{DS}$ = 5V | 10 | - | - | A |
| $g_{FS}$ | Forward Transconductance | $I_D$ = 4A, $V_{DS}$ = 5V | - | 9.7 | - | S |
| **Dynamic Characteristics** | | | | | | |
| $C_{ISS}$ | Input Capacitance | $V_{DS}$ = 10V, $V_{GS}$ = 0V, f = 1MHz | - | 273 | - | pF |
| $C_{OSS}$ | Output Capacitance | | - | 63 | - | pF |
| $C_{RSS}$ | Reverse Transfer Capacitance | | - | 37 | - | pF |
| $R_G$ | Gate Resistance | $V_{GS}$ = 0V, f = 1MHz, | - | 1.6 | - | Ω |
| **Switching Characteristics** (Note 2) | | | | | | |
| $t_{d(ON)}$ | Turn-On Delay Time | $V_{DD}$ = 10V, $I_D$ = 1A, $V_{GS}$ = 4.5V, $R_{GEN}$ = 6Ω | - | 6 | 12 | ns |
| $t_r$ | Turn-On Rise Time | | - | 7 | 14 | ns |
| $t_{d(OFF)}$ | Turn-Off Delay Time | | - | 11 | 20 | ns |
| $t_f$ | Turn-Off Fall Time | | - | 1.7 | 3.4 | ns |
| $Q_g$ | Total Gate Charge | $V_{DS}$ = 10V, $I_D$ = 4.0A, $V_{GS}$ = 4.5V | - | 2.7 | 3.8 | nC |
| $Q_{gs}$ | Gate-Source Charge | | - | 0.6 | - | nC |
| $Q_{gd}$ | Gate-Drain Charge | | - | 0.9 | - | nC |
| **Drain-Source Diode Characteristics and Maximum Ratings** | | | | | | |
| $I_S$ | Maximum Continuous Drain-Source Diode Forward Current | | - | - | 1.4 | A |
| $V_{SD}$ | Drain-Source Diode Forward Voltage | $V_{GS}$ = 0V, $I_S$ = 1.4 A (Note 2) | - | 0.8 | -1.2 | V |
| $t_{rr}$ | Diode Reverse Recovery Time | $I_F$= 4.0A, $dI_F/dt$=100A/μs | - | 11 | - | ns |
| $Q_{rr}$ | Diode Reverse Recovery Charge | | - | 3 | - | nC |

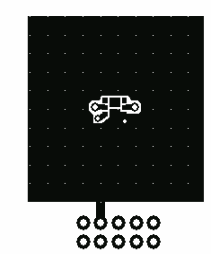
### Schottky Diode Characteristic

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $V_R$ | Reverse Voltage | $I_R$ = 1mA | | 20 | - | - | V |
| $I_R$ | Reverse Leakage | $V_R$ = 5V | $T_J$ = 25°C | - | - | 100 | μA |
| | | | $T_J$ = 100°C | | | 10 | mA |
| $V_F$ | Forward Voltage | $I_F$ = 1A | $T_J$ = 25°C | - | 0.32 | 0.39 | V |

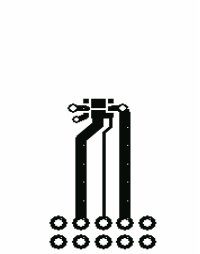
## Electrical Characteristics $T_A$ = 25°C unless otherwise noted

**Notes:**

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



a) 70°C/W when mounted on a 1in$^2$ pad of 2 oz copper



b) 150°C/W whe mounted on a minimum pad of 2 oz copper

Scale 1: 1 on letter size paper

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

## Typical Characteristics

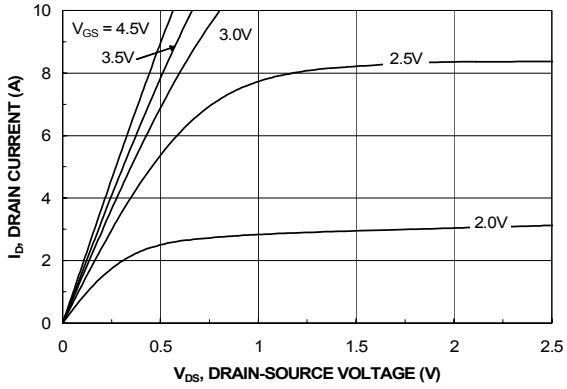



**Figure 1. On-Region Characteristics**

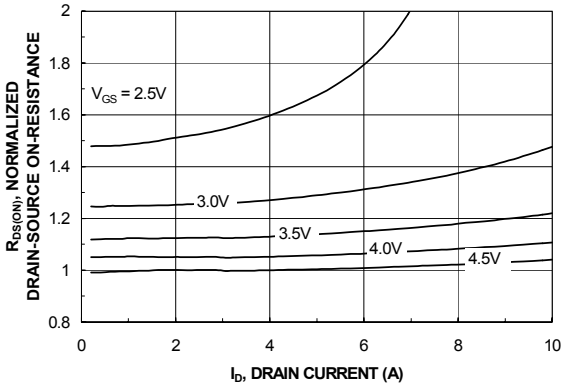



**Figure 2. On-Resistance Variation with Drain Current and Gate Voltage**

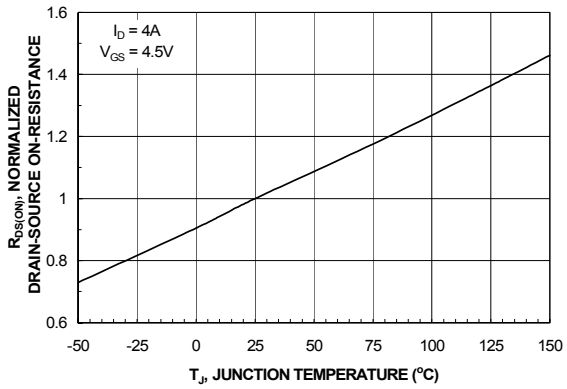



**Figure 3. On-Resistance Variation with Temperature**

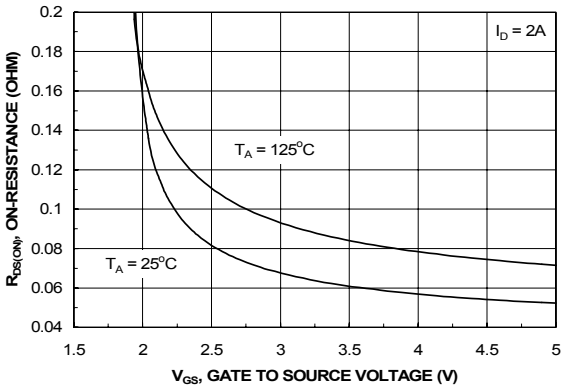



**Figure 4. On-Resistance Variation with Gate-to-Source Voltage**

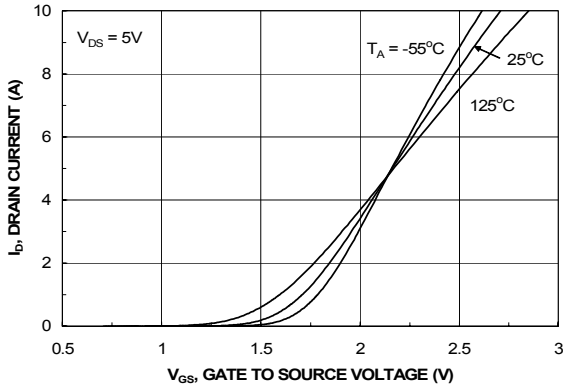



**Figure 5. Transfer Characteristics**

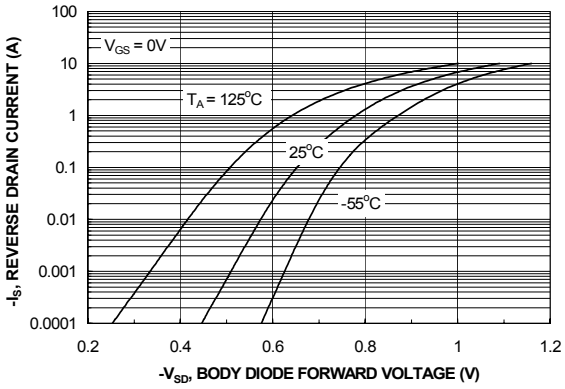



**Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature**

## Typical Characteristics

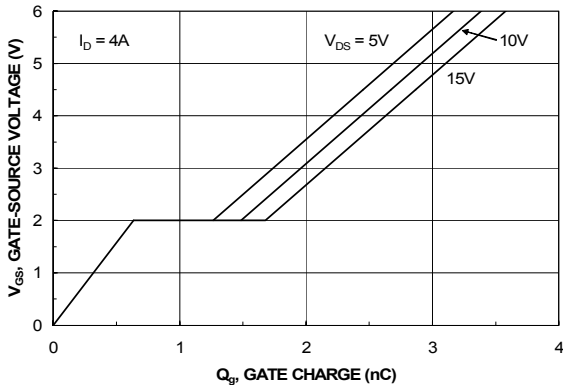



**Figure 7. Gate Charge Characteristics**

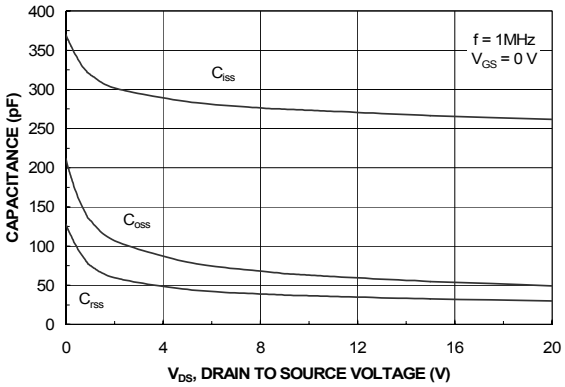



**Figure 8. Capacitance Characteristics**

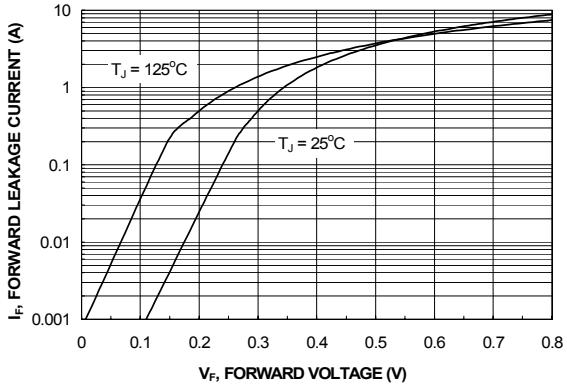



**Figure 9. Schottky Diode Forward Voltage**

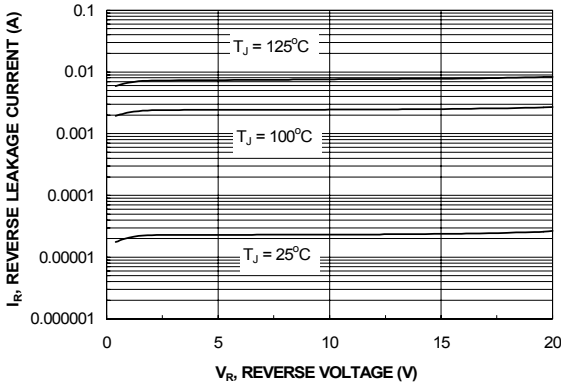



**Figure 10. Schottky Diode Reverse Current**

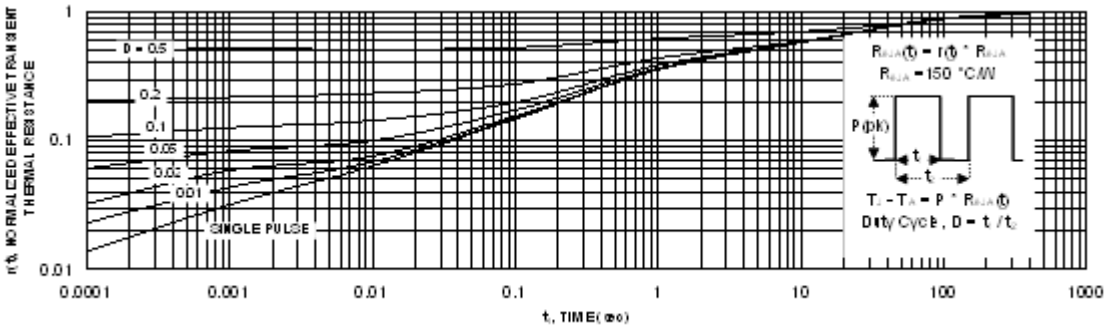
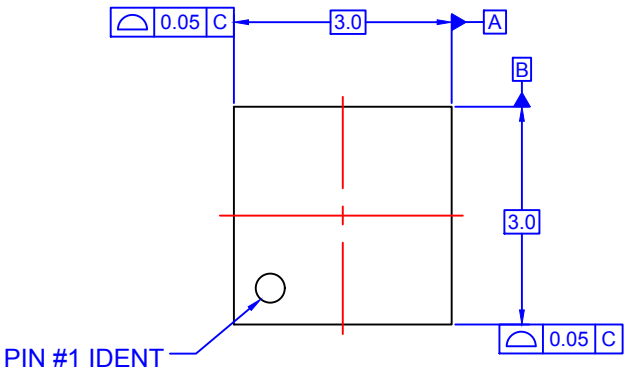
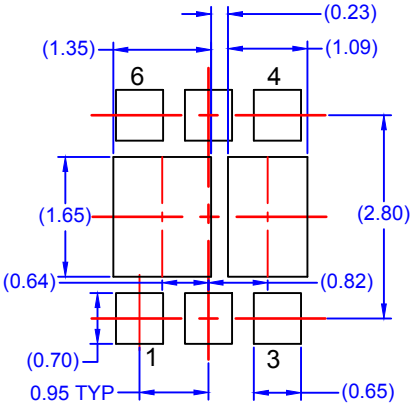



**Figure 11. Transient Thermal Response Curve**

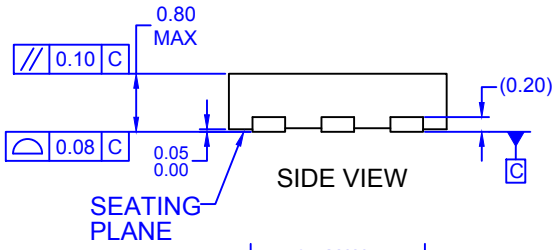
Thermal characterization performed using the conditions described in Note 1b.
Transient thermal response will change depending on the circuit board design.




TOP VIEW

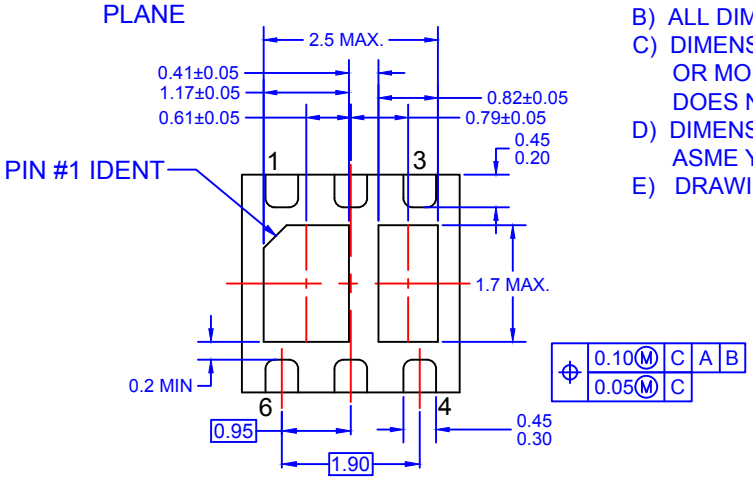



RECOMMENDED LAND PATTERN




SIDE VIEW

NOTES: UNLESS OTHERWISE SPECIFIED
A) CONFORMS TO JEDEC REGISTRATION, MO-229, VARIATION WEEA
B) ALL DIMENSIONS ARE IN MILLIMETERS.
C) DIMENSIONS DO NOT INCLUDE BURRS OR MOLD FLASH. MOLD FLASH OR BURRS DOES NOT EXCEED 0.10MM.
D) DIMENSIONING AND TOLERANCING PER ASME Y14.5M-2009.
E) DRAWING FILE NAME: MKT-MLP06HREV2




BOTTOM VIEW

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