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# 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.

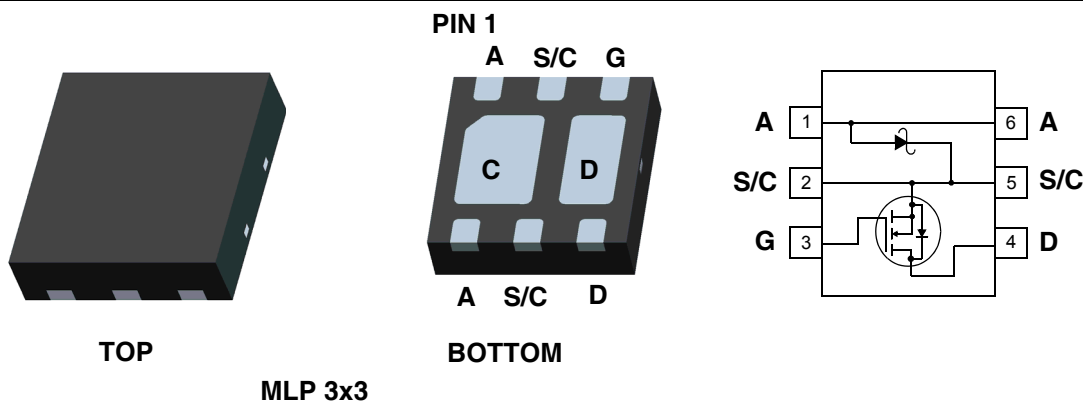
This device is designed specifically as a single package solution for Standard Buck Converter. It features a fast switching, low gate charge MOSFET with very low on-state resistance.

### Applications

- Standard Buck Converter

### Features

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



### Absolute Maximum Ratings $T_A = 25^\circ C$ unless otherwise noted

| Symbol         | Parameter                                        | Ratings     | Units      |
|----------------|--------------------------------------------------|-------------|------------|
| $V_{DSS}$      | Drain-Source Voltage                             | 20          | V          |
| $V_{GSS}$      | Gate-Source Voltage                              | $\pm 12$    | 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 | $^\circ C$ |

### Thermal Characteristics

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

### Package Marking and Ordering Information

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

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

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

**Off Characteristics**

|                                        |                                           |                                                              |    |    |           |                      |
|----------------------------------------|-------------------------------------------|--------------------------------------------------------------|----|----|-----------|----------------------|
| $B_{V_{DS}}$                           | Drain-Source Breakdown Voltage            | $I_D = 250\mu\text{A}$ , $V_{GS} = 0\text{V}$                | 20 | -  | -         | V                    |
| $\frac{\Delta B_{V_{DS}}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D = 250\mu\text{A}$ ,<br>Referenced to $25^\circ\text{C}$ | -  | 12 | -         | mV/ $^\circ\text{C}$ |
| $I_{DSS}$                              | Zero Gate Voltage Drain Current           | $V_{GS} = 0\text{V}$ , $V_{DS} = 16\text{V}$                 | -  | -  | 1         | $\mu\text{A}$        |
| $I_{GSS}$                              | Gate-Body Leakage,                        | $V_{GS} = \pm 12\text{V}$ , $V_{DS} = 0\text{V}$             | -  | -  | $\pm 100$ | nA                   |

**On Characteristics** (Note 2)

|                                        |                                                |                                                                             |     |     |     |                      |
|----------------------------------------|------------------------------------------------|-----------------------------------------------------------------------------|-----|-----|-----|----------------------|
| $V_{GS(TH)}$                           | Gate Threshold Voltage                         | $V_{DS} = V_{GS}$ , $I_D = 250\mu\text{A}$                                  | 0.6 | 1.0 | 1.5 | V                    |
| $\frac{\Delta V_{GS(TH)}}{\Delta T_J}$ | Gate Threshold Voltage Temperature Coefficient | $I_D = 250\mu\text{A}$ ,<br>Referenced to $25^\circ\text{C}$                | -   | -3  | -   | mV/ $^\circ\text{C}$ |
| $R_{DS(ON)}$                           | Static Drain-Source On-Resistance              | $I_D = 4.0\text{A}$ , $V_{GS} = 4.5\text{V}$                                | -   | 54  | 100 | m $\Omega$           |
|                                        |                                                | $I_D = 3.3\text{A}$ , $V_{GS} = 2.5\text{V}$                                | -   | 83  | 150 |                      |
|                                        |                                                | $I_D = 4.0\text{A}$ , $V_{GS} = 4.5\text{V}$ ,<br>$T_J = 125^\circ\text{C}$ | -   | 74  | 147 |                      |
| $I_{D(ON)}$                            | On-State Drain Current                         | $V_{GS} = 2.5\text{V}$ , $V_{DS} = 5\text{V}$                               | 10  | -   | -   | A                    |
| $g_{FS}$                               | Forward Transconductance                       | $I_D = 4\text{A}$ , $V_{DS} = 5\text{V}$                                    | -   | 9.7 | -   | S                    |

**Dynamic Characteristics**

|           |                              |                                                                     |   |     |   |          |
|-----------|------------------------------|---------------------------------------------------------------------|---|-----|---|----------|
| $C_{ISS}$ | Input Capacitance            | $V_{DS} = 10\text{V}$ , $V_{GS} = 0\text{V}$ ,<br>$f = 1\text{MHz}$ | - | 273 | - | pF       |
| $C_{OSS}$ | Output Capacitance           |                                                                     | - | 63  | - | pF       |
| $C_{RSS}$ | Reverse Transfer Capacitance |                                                                     | - | 37  | - | pF       |
| $R_G$     | Gate Resistance              | $V_{GS} = 0\text{V}$ , $f = 1\text{MHz}$                            | - | 1.6 | - | $\Omega$ |

**Switching Characteristics** (Note 2)

|              |                     |                                                                                           |   |     |     |    |
|--------------|---------------------|-------------------------------------------------------------------------------------------|---|-----|-----|----|
| $t_{d(ON)}$  | Turn-On Delay Time  | $V_{DD} = 10\text{V}$ , $I_D = 1\text{A}$<br>$V_{GS} = 4.5\text{V}$ , $R_{GEN} = 6\Omega$ | - | 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   | $V_{DS} = 10\text{V}$ , $I_D = 4.0\text{A}$ ,<br>$V_{GS} = 4.5\text{V}$                   | - | 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 <sub>S</sub>  | Maximum Continuous Drain-Source Diode Forward Current |                                                       | - | -   | 1.4  | A  |
| V <sub>SD</sub> | Drain-Source Diode Forward Voltage                    | V <sub>GS</sub> = 0V, I <sub>S</sub> = 1.4 A (Note 2) | - | 0.8 | -1.2 | V  |
| t <sub>rr</sub> | Diode Reverse Recovery Time                           | I <sub>F</sub> = 4.0A, dI <sub>F</sub> /dt=100A/μs    | - | 11  | -    | ns |
| Q <sub>rr</sub> | Diode Reverse Recovery Charge                         |                                                       | - | 3   | -    | nC |

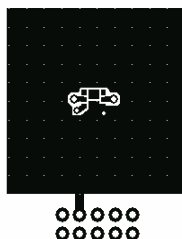
**Schottky Diode Characteristic**

|       |                 |                    |    |      |      |               |
|-------|-----------------|--------------------|----|------|------|---------------|
| $V_R$ | Reverse Voltage | $I_R = 1\text{mA}$ | 20 | -    | -    | V             |
| $I_R$ | Reverse Leakage | $V_R = 5\text{V}$  | -  | -    | 100  | $\mu\text{A}$ |
|       |                 |                    |    |      | 10   | mA            |
| $V_F$ | Forward Voltage | $I_F = 1\text{A}$  | -  | 0.32 | 0.39 | V             |

## Electrical Characteristics $T_A = 25^\circ\text{C}$ 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  $R_{\theta JA}$  is determined by the user's board design.



a)  $70^\circ\text{C/W}$  when mounted on a  $1\text{ in}^2$  pad of 2 oz copper



b)  $150^\circ\text{C/W}$  when mounted on a minimum pad of 2 oz copper

Scale 1: 1 on letter size paper

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

## Typical Characteristics

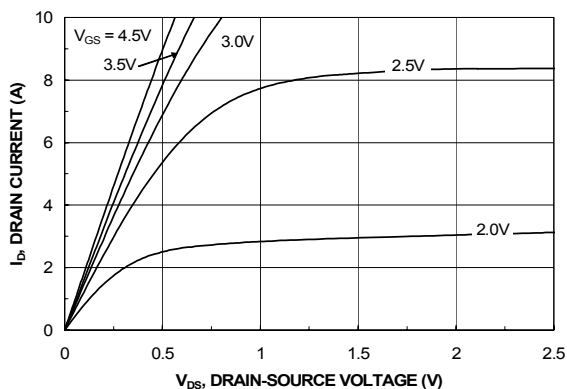


Figure 1. On-Region Characteristics

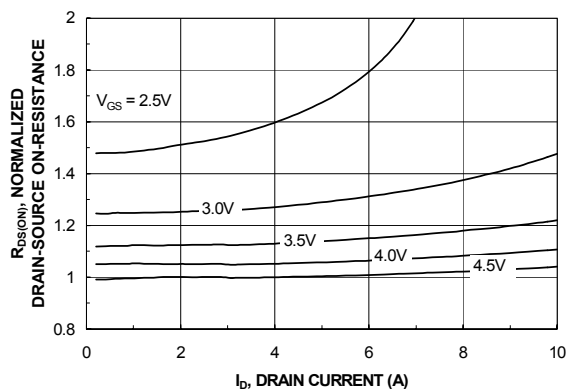


Figure 2. On-Resistance Variation with Drain Current and Gate Voltage

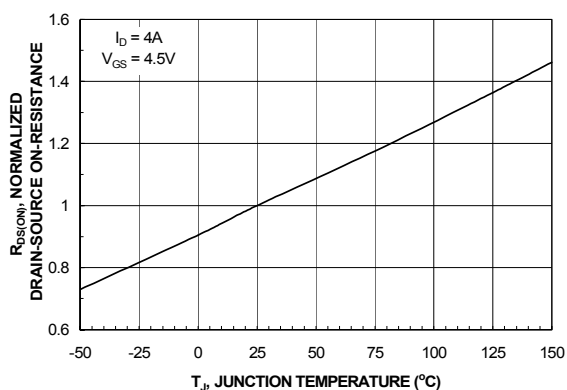


Figure 3. On-Resistance Variation with Temperature

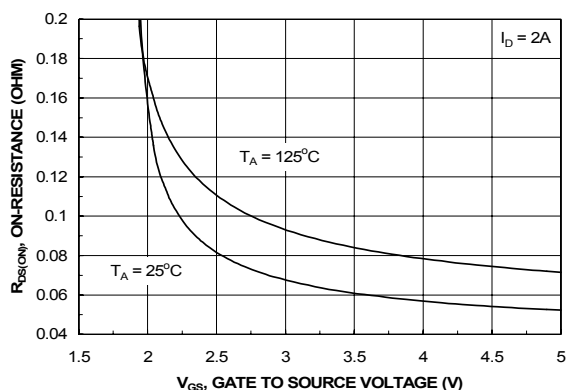


Figure 4. On-Resistance Variation with Gate-to-Source Voltage

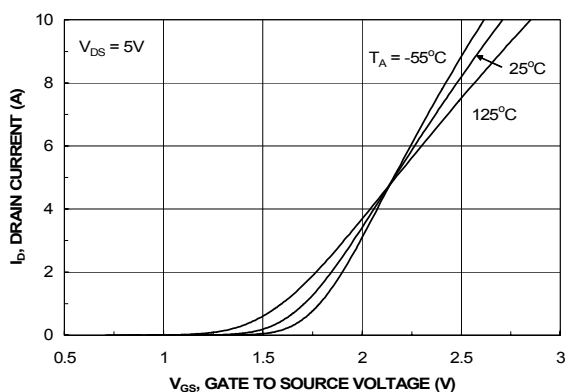


Figure 5. Transfer Characteristics

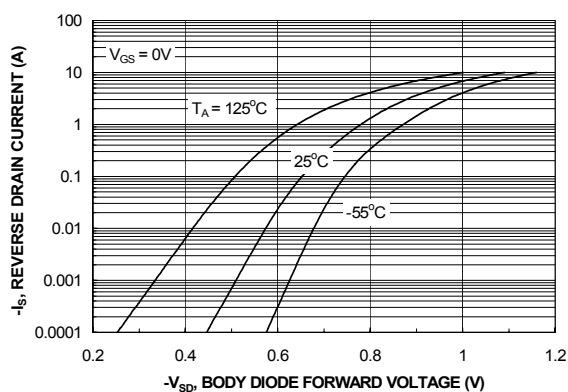


Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature

## Typical Characteristics

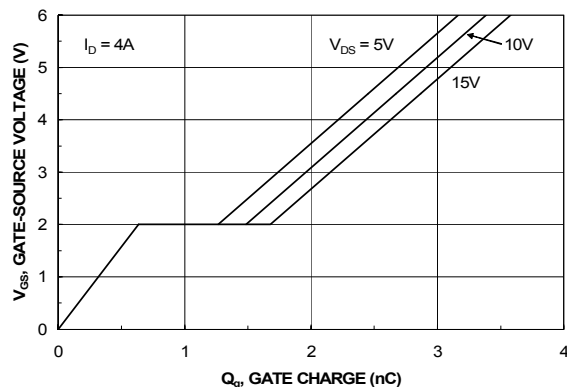


Figure 7. Gate Charge Characteristics

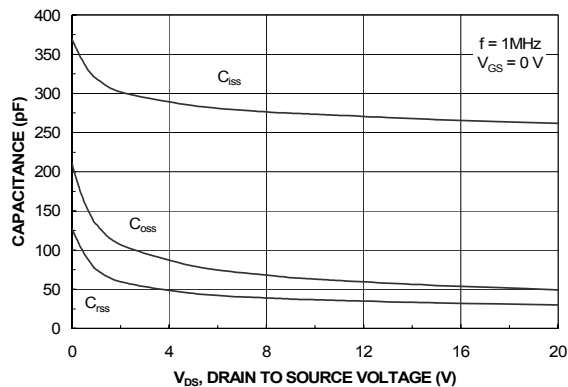


Figure 8. Capacitance Characteristics

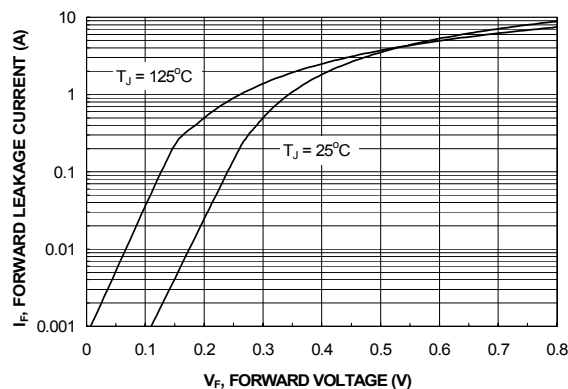


Figure 9. Schottky Diode Forward Voltage

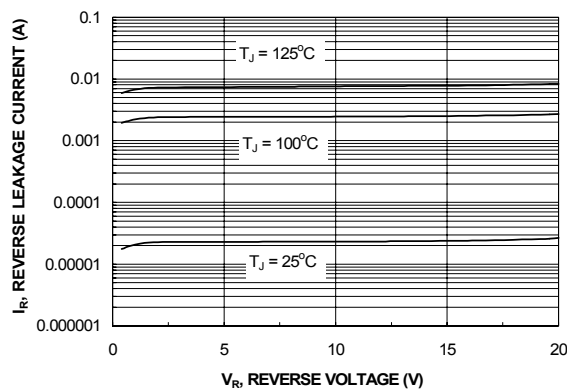


Figure 10. Schottky Diode Reverse Current

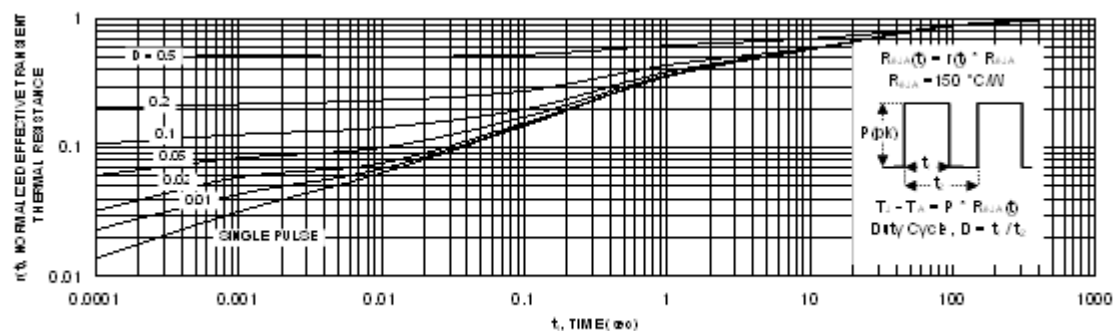
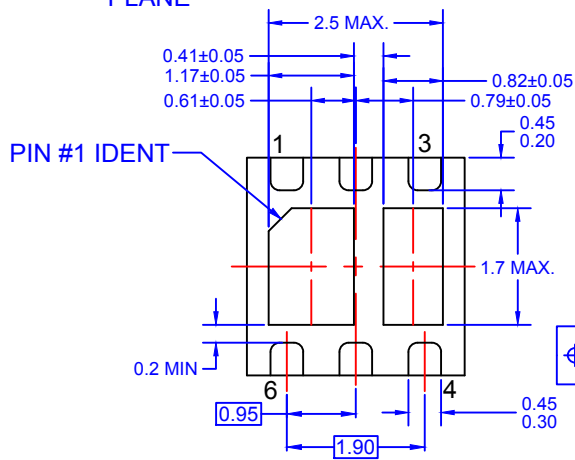
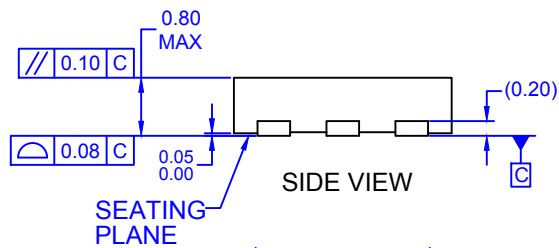
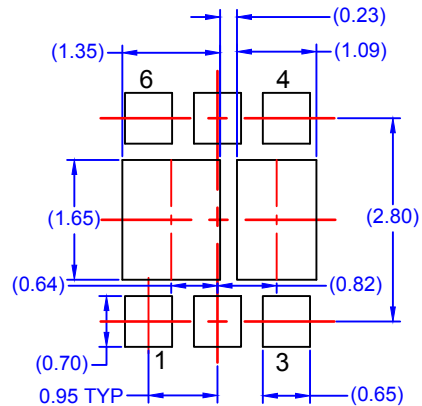
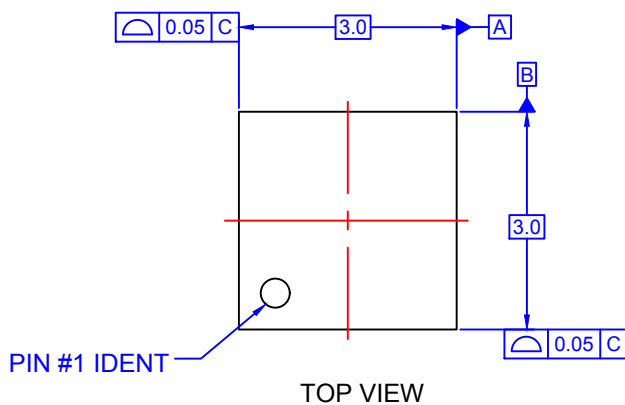


Figure 11. Transient Thermal Response Curve

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



|          |   |   |   |
|----------|---|---|---|
| 0.10 (M) | C | A | B |
| 0.05 (M) | C |   |   |

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- 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



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