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# FDFMA2P853

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

July 2014

## General Description

This device is designed specifically as a single package solution for the battery charge switch in cellular handset and other ultra-portable applications. It features a MOSFET with low on-state resistance and an independently connected low forward voltage schottky diode for minimum conduction losses.

The MicroFET 2x2 package offers exceptional thermal perfo rmance for it's physical size and is well suited to linear mode applications.

## Features

### MOSFET:

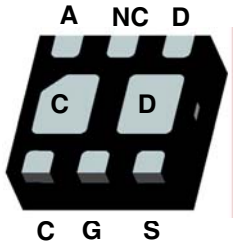
- -3.0 A, -20V. $R_{DS(ON)}$ = 120 mΩ @ $V_{GS}$ = -4.5 V
  $R_{DS(ON)}$ = 160 mΩ @ $V_{GS}$ = -2.5 V
  $R_{DS(ON)}$ = 240 mΩ @ $V_{GS}$ = -1.8 V

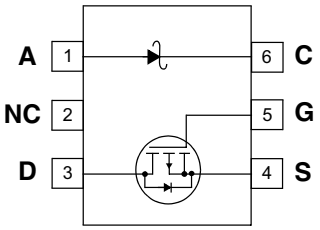
### Schottky:

$V_F$ < 0.46 V @ 500 mA

- Low Profile - 0.8 mm maximun - in the new package MicroFET 2x2 mm
- RoHS Compliant

MicroFET




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

| Symbol | Parameter | | Ratings | Units |
|---|---|---|---|---|
| $V_{DSS}$ | MOSFET Drain-Source Voltage | | -20 | V |
| $V_{GSS}$ | MOSFET Gate-Source Voltage | | ±8 | V |
| $I_D$ | Drain Current -Continuous | (Note 1a) | -3.0 | A |
| | -Pulsed | | -6 | |
| $V_{RRM}$ | Schottky Repetitive Peak Reverse voltage | | 30 | V |
| $I_O$ | Schottky Average Forward Current | (Note 1a) | 1 | A |
| $P_D$ | Power dissipation for Single Operation | (Note 1a) | 1.4 | W |
| | Power dissipation for Single Operation | (Note 1b) | 0.7 | |
| $T_J$, $T_{STG}$ | Operating and Storage Junction Temperature Range | | -55 to +150 | °C |

## Thermal Characteristics

| | | | | |
|---|---|---|---|---|
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient | (Note 1a) | 86 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient | (Note 1b) | 173 | |
| $R_{\theta JA}$ | 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 | Reel Size | Tape Width | Quantity |
|---|---|---|---|---|
| .853 | FDFMA2P853 | 7inch | 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 | | –20 | | | V |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D$ = –250 μA, Referenced to 25°C | | | –12 | | mV/°C |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = –16 V, $V_{GS}$ = 0 V | | | | –1 | μA |
| $I_{GSS}$ | Gate–Body Leakage | $V_{GS}$ = ± 8 V, $V_{DS}$ = 0 V | | | | ±100 | nA |
| **On Characteristics** (Note 2) | | | | | | | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = –250 μA | | –0.4 | –0.7 | –1.3 | V |
| $\frac{\Delta V_{GS(th)}}{\Delta T_J}$ | Gate Threshold Voltage Temperature Coefficient | $I_D$ = –250 μA, Referenced to 25°C | | | 2 | | mV/°C |
| $R_{DS(on)}$ | Static Drain–Source On–Resistance | $V_{GS}$ = –4.5 V, $I_D$ = –3.0 A<br>$V_{GS}$ = –2.5 V, $I_D$ = –2.5 A<br>$V_{GS}$ = –1.8 V, $I_D$ = –1.0 A<br>$V_{GS}$= –4.5 V, $I_D$ = –3.0 A, $T_J$=125°C | | | 90<br>120<br>172<br>118 | 120<br>160<br>240<br>160 | mΩ |
| $I_{D(on)}$ | On–State Drain Current | $V_{GS}$ = –4.5 V, $V_{DS}$ = –5 V | | –20 | | | A |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = –5 V, $I_D$ = –3.0 A | | | 7 | | S |
| **Dynamic Characteristics** | | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = –10 V, $V_{GS}$ = 0 V, f = 1.0 MHz | | | 435 | | pF |
| $C_{oss}$ | Output Capacitance | | | | 80 | | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | | | 45 | | pF |
| **Switching Characteristics** (Note 2) | | | | | | | |
| $t_{d(on)}$ | Turn–On Delay Time | $V_{DD}$ = –10 V, $I_D$ = –1 A, $V_{GS}$ = –4.5 V, $R_{GEN}$ = 6 Ω | | | 9 | 18 | ns |
| $t_r$ | Turn–On Rise Time | | | | 11 | 19 | ns |
| $t_{d(off)}$ | Turn–Off Delay Time | | | | 15 | 27 | ns |
| $t_f$ | Turn–Off Fall Time | | | | 6 | 12 | ns |
| $Q_g$ | Total Gate Charge | $V_{DS}$ = –10 V, $I_D$ = –3.0 A, $V_{GS}$ = –4.5 V | | | 4 | 6 | nC |
| $Q_{gs}$ | Gate–Source Charge | | | | 0.8 | | 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 | | | | | –1.1 | A |
| $V_{SD}$ | Drain–Source Diode Forward Voltage | $V_{GS}$ = 0 V, $I_S$ = –1.1 A (Note 2) | | | –0.8 | –1.2 | V |
| $t_{rr}$ | Diode Reverse Recovery Time | $I_F$ = –3.0 A, $dI_F/dt$ = 100 A/μs | | | 17 | | ns |
| $Q_{rr}$ | Diode Reverse Recovery Charge | | | | 6 | | nC |
| **Schottky Diode Characteristics** | | | | | | | |
| $I_R$ | Reverse Leakage | $V_R$ = 5 V | $T_J$ = 25°C<br>$T_J$ = 125°C | | 9.9<br>2.3 | 50<br>10 | μA<br>mA |
| $I_R$ | Reverse Leakage | $V_R$ = 20 V | $T_J$ = 25°C<br>$T_J$ = 85°C<br>$T_J$ = 125°C | | 9.9<br>0.3<br>2.3 | 100<br>1<br>10 | μA<br>mA<br>mA |
| $V_F$ | Forward Voltage | $I_F$ = 500mA | $T_J$ = 25°C<br>$T_J$ = 125°C | | 0.4<br>0.3 | 0.46<br>0.35 | V |
| $V_F$ | Forward Voltage | $I_F$ = 1A | $T_J$ = 25°C<br>$T_J$ = 125°C | | 0.5<br>0.49 | 0.55<br>0.54 | V |

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

**Notes:**

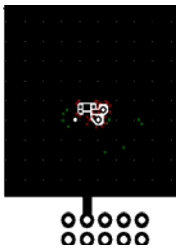
**1.** $R_{\theta JA}$ is determined with the device mounted on a 1 $in^2$ oz. copper pad on a 1.5 x 1.5 in. board of FR-4 material. $R_{\theta JC}$ is guaranteed by design while $R_{\theta JA}$ is determined by the user's board design.

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

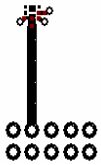
(b) MOSFET $R_{\theta JA}$ = 173°C/W when mounted on a minimum pad of 2 oz copper

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

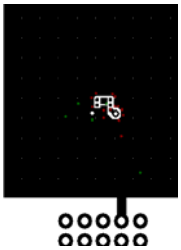
(d) Schottky $R_{\theta JA}$ = 140°C/W when mounted on a minimum pad of 2 oz copper



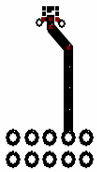
a) 86°C/W when mounted on a 1$in^2$ pad of 2 oz copper



b) 173°C/W when mounted on a minimum pad of 2 oz copper



c) 86°C/W when mounted on a 1$in^2$ pad of 2 oz copper



d) 140°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%

## Typical Characteristics

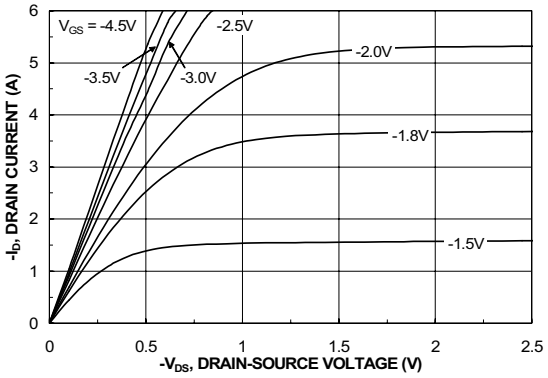



**Figure 1. On-Region Characteristics**

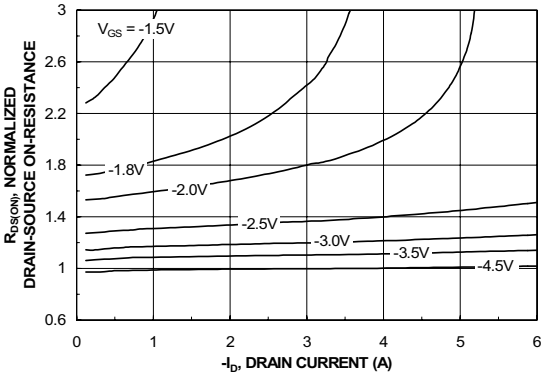



**Figure 2. On-Resistance Variation with Drain Current and Gate Voltage**

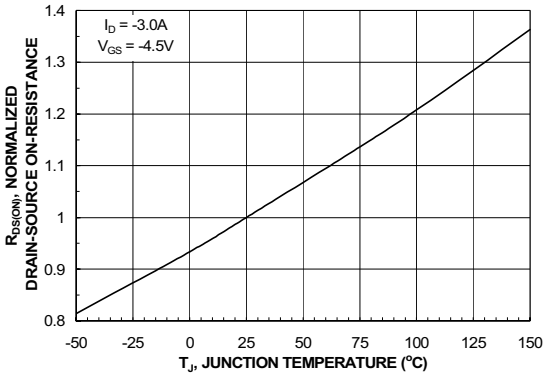



**Figure 3. On-Resistance Variation with Temperature**

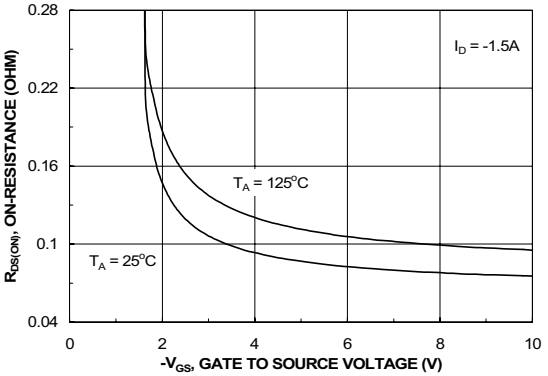



**Figure 4. On-Resistance Variation with Gate-to-Source Voltage**

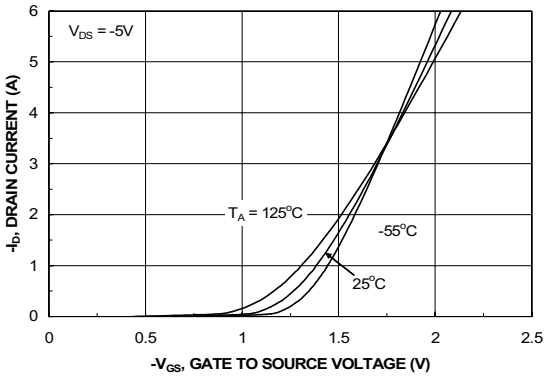



**Figure 5. Transfer Characteristics**

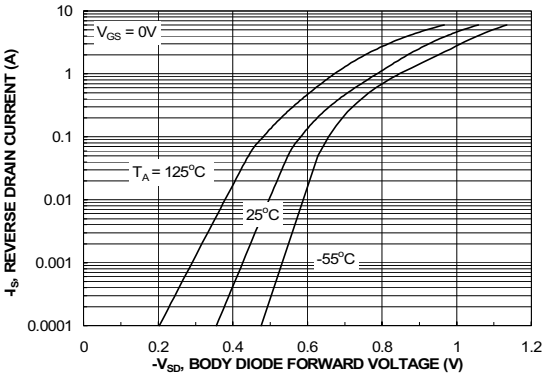



**Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature**

## Typical Characteristics

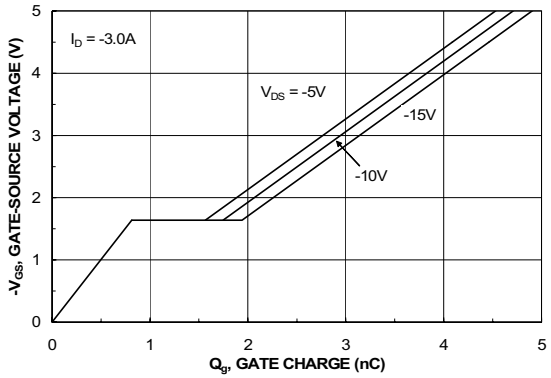



**Figure 7. Gate Charge Characteristics**

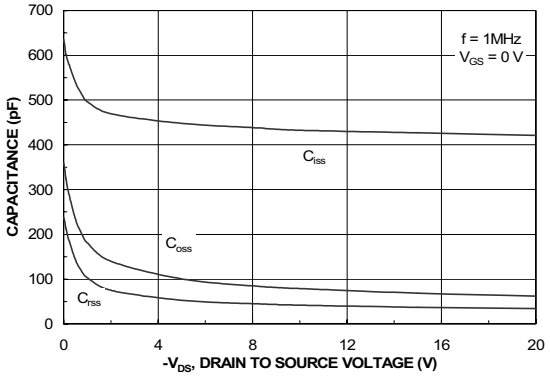



**Figure 8. Capacitance Characteristics**

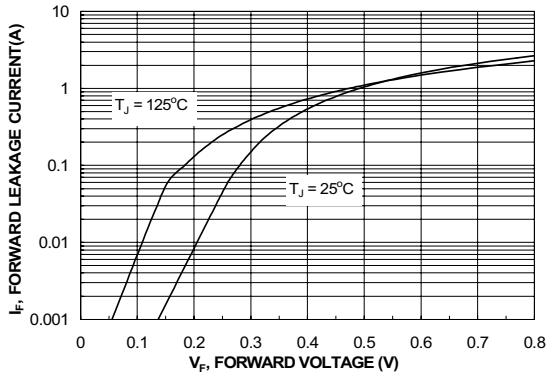



**Figure 9. Schottky Diode Forward Voltage**

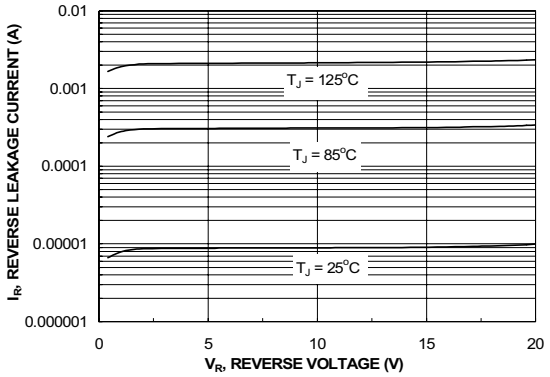



**Figure 10. Schottky Diode Reverse Current**

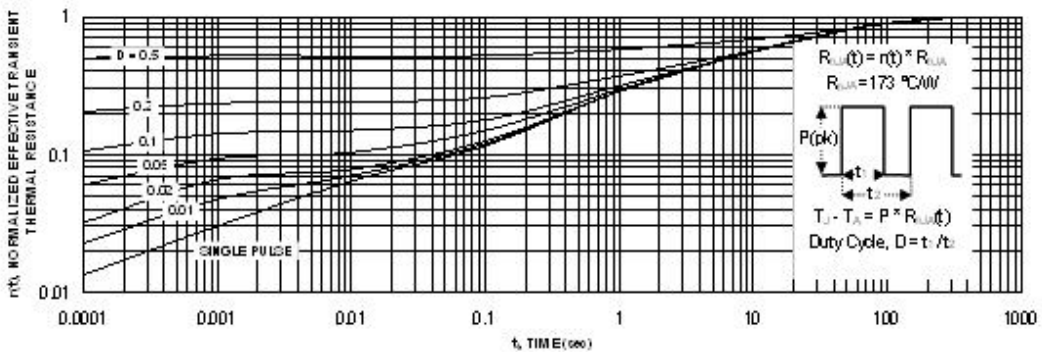
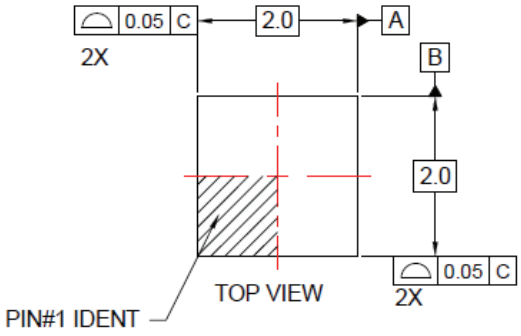
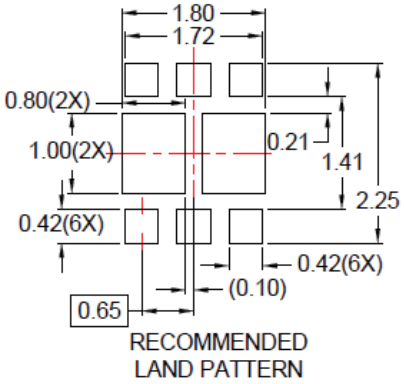


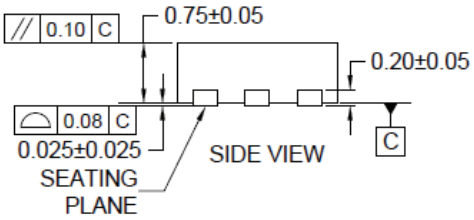

**Figure 11. Transient Thermal Response Curve**

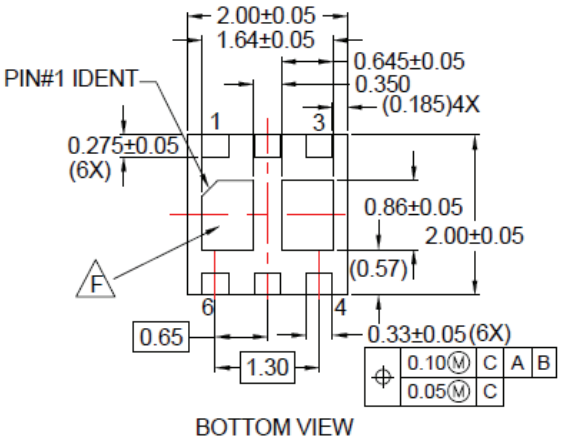
Thermal characterization performed using the conditions described in Note 1c.
Transient thermal response will change depending on the circuit board design.

## Dimensional Outline and Pad Layout

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

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**Definition of Terms**

| Datasheet Identification | Product Status | Definition |
|---|---|---|
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Rev. I68

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