FAIRCHILD SEMICONDUCTOR®

December 2008

# FDFMA2P853T

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

### –20 V, –3.0 A, 120 mΩ

## Features

### MOSFET:

- Max $r_{DS(on)}$ = 120 mΩ at $V_{GS}$ = –4.5 V, $I_D$ = –3.0 A
- Max $r_{DS(on)}$ = 160 mΩ at $V_{GS}$ = –2.5 V, $I_D$ = –2.5 A
- Max $r_{DS(on)}$ = 240 mΩ at $V_{GS}$ = –1.8 V, $I_D$ = –1.0 A

### Schottky:

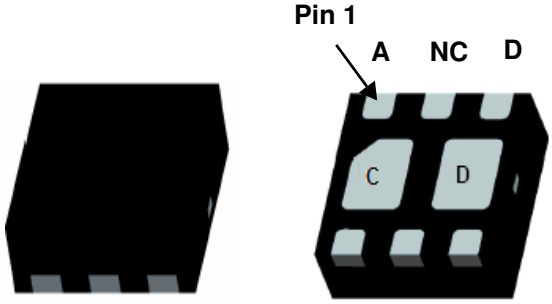
- $V_F$ < 0.46 V @ 500 mA

- Low profile - 0.55 mm maximum - in the new package MicroFET 2x2 **Thin**
- RoHS Compliant
- Free from halogenated compounds and antimony oxides

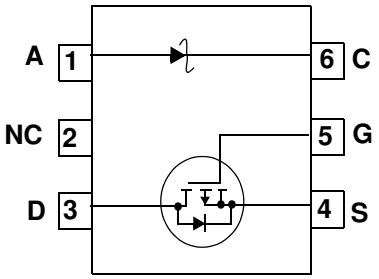
## General Description

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 **Thin** package offers exceptional thermal performance for it's physical size and is well suited to linear mode applications.




MicroFET 2X2 Thin C G S




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

| Symbol | Parameter | | Ratings | Units |
|---|---|---|---|---|
| $V_{DS}$ | Drain to Source Voltage | | –20 | V |
| $V_{GS}$ | Gate to Source Voltage | | ±8 | V |
| $I_D$ | Drain Current -Continuous $T_A$ = 25 °C | (Note 1a) | –3.0 | A |
| | -Pulsed | | –6 | |
| $P_D$ | Power Dissipation $T_A$ = 25 °C | (Note 1a) | 1.4 | W |
| | Power Dissipation $T_A$ = 25 °C | (Note 1b) | 0.7 | |
| $T_J$, $T_{STG}$ | Operating and Storage Junction Temperature Range | | –55 to +150 | °C |
| $V_{RRM}$ | Schottky Repetitive Peak Reverse Voltage | | 30 | V |
| $I_O$ | Schottky Average Forward Current | | 1 | A |

### 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 | Package | Reel Size | Tape Width | Quantity |
|---|---|---|---|---|---|
| 53 | FDFMA2P853T | MicroFET 2x2 **Thin** | 7 ” | 8 mm | 3000 units |

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

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | |
| $BV_{DSS}$ | Drain to Source Breakdown Voltage | $I_D$ = –250 μA, $V_{GS}$ = 0 V | –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 to Source Leakage Current | $V_{GS}$ = ±8 V, $V_{DS}$ = 0 V | | | ±100 | nA |
| **On Characteristics** | | | | | | |
| $V_{GS(th)}$ | Gate to Source Threshold Voltage | $V_{GS}$ = $V_{DS}$, $I_D$ = –250 μA | –0.4 | –0.7 | –1.3 | V |
| $\frac{\Delta V_{GS(th)}}{\Delta T_J}$ | Gate to Source Threshold Voltage Temperature Coefficient | $I_D$ = –250 μA, referenced to 25 °C | | 2 | | mV/°C |
| $r_{DS(on)}$ | Static Drain to Source On Resistance | $V_{GS}$ = –4.5 V, $I_D$ = –3.0 A | | 90 | 120 | mΩ |
| | | $V_{GS}$ = –2.5 V, $I_D$ = –2.5 A | | 120 | 160 | |
| | | $V_{GS}$ = –1.8 V, $I_D$ = –1.0 A | | 172 | 240 | |
| | | $V_{GS}$ = –4.5 V, $I_D$ = –3.0 A, $T_J$ = 125 °C | | 118 | 160 | |
| $g_{FS}$ | 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** | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD}$ = –10 V, $I_D$ = –1.0 A, $V_{GS}$ = –4.5 V, $R_{GEN}$ = 6 Ω | | 9 | 18 | ns |
| $t_r$ | Rise Time | | | 11 | 19 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 15 | 27 | ns |
| $t_f$ | Fall Time | | | 6 | 12 | ns |
| $Q_{g(TOT)}$ | Total Gate Charge | $V_{DD}$= –10 V, $I_D$ = –3.0 A, $V_{GS}$ = –4.5 V | | 4 | 6 | nC |
| $Q_{gs}$ | Gate to Source Gate Charge | | | 0.8 | | nC |
| $Q_{gd}$ | Gate to Drain “Miller” Charge | | | 0.9 | | nC |
| **Drain-Source Diode Characteristics** | | | | | | |
| $I_S$ | Maximum Continuous Drain-Source Diode Forward Current | | | | –1.1 | A |
| $V_{SD}$ | Source to Drain Diode Forward Voltage | $V_{GS}$ = 0 V, $I_S$ = –1.1 A (Note 2) | | –0.8 | –1.2 | V |
| $t_{rr}$ | Reverse Recovery Time | $I_F$ = –3.0 A, di/dt = 100 A/μs | | 17 | | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | | 6 | | nC |

## Schottky Diode Characteristics

| | | | | | | |
|---|---|---|---|---|---|---|
| $I_R$ | Reverse Leakage | $V_R$ = 5 V | $T_J$ = 25 °C | 9.9 | 50 | μA |
| | | | $T_J$ = 125 °C | 2.3 | 10 | mA |
| $I_R$ | Reverse Leakage | $V_R$ = 20 V | $T_J$ = 25 °C | 9.9 | 100 | μA |
| | | | $T_J$ = 85 °C | 0.3 | 1 | mA |
| | | | $T_J$ = 125 °C | 2.3 | 10 | mA |
| $V_F$ | Forward Voltage | $I_F$ = 500 mA | $T_J$ = 25 °C | 0.4 | 0.46 | V |
| | | | $T_J$ = 125 °C | 0.3 | 0.35 | V |
| $V_F$ | Forward Voltage | $I_F$ = 1 A | $T_J$ = 25 °C | 0.5 | 0.55 | V |
| | | | $T_J$ = 125 °C | 0.49 | 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.

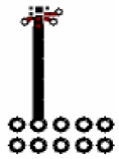
(a) MOSFET $R_{\theta JA}$ = 86 °C/W when mounted on a 1 $in^2$ pad of 2 oz copper, 1.5 ” x 1.5 ” x 0.062 ” thick PCB.

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

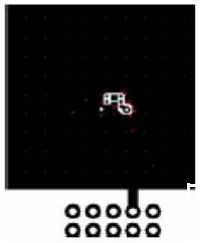
(c) Schottky $R_{\theta JA}$ = 86 °C/W when mounted on a 1 $in^2$ pad of 2 oz copper, 1.5 ” x 1.5 ” x 0.062 ” thick PCB.

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

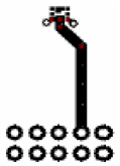
a)86 °C/W when mounted on a 1 $in^2$ pad of 2 oz copper.



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.

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

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

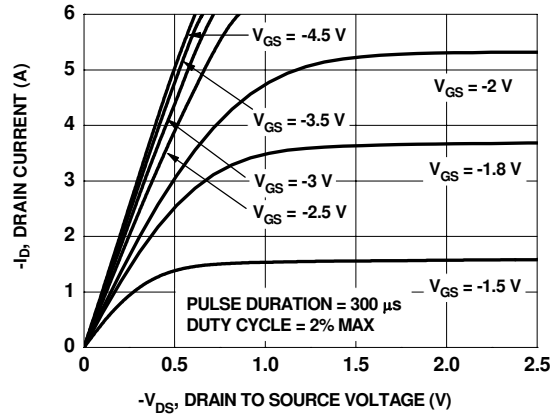



**Figure 1. On-Region Characteristics**

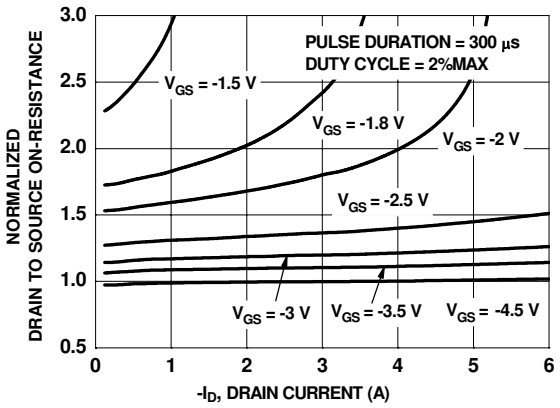



**Figure 2. Normalized On-Resistance vs Drain Current and Gate Voltage**

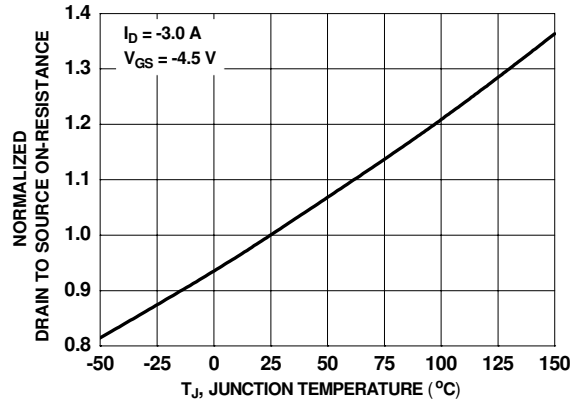



**Figure 3. Normalized On- Resistance vs Junction Temperature**

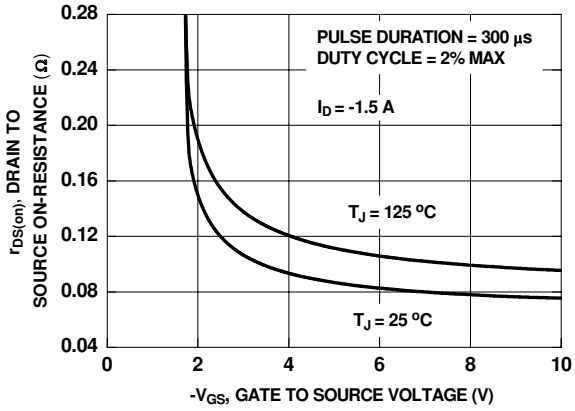



**Figure 4. On-Resistance vs Gate to Source Voltage**

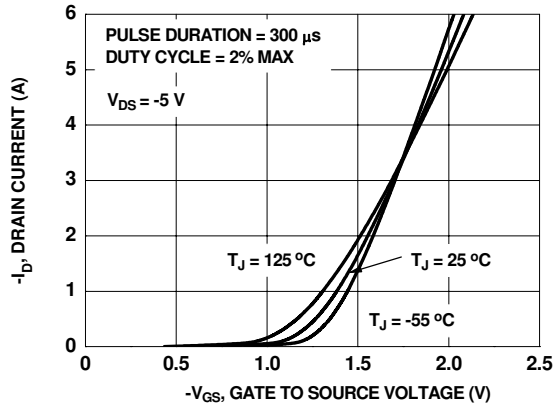



**Figure 5. Transfer Characteristics**

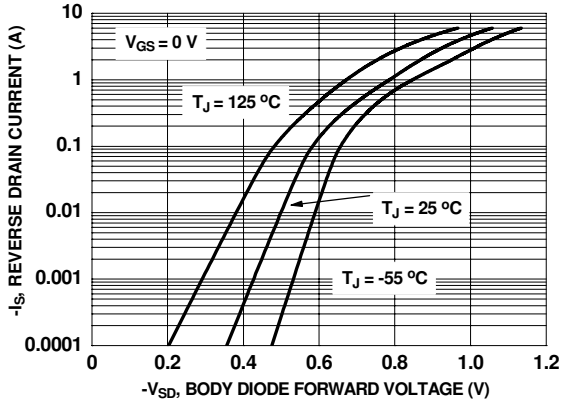



**Figure 6. Source to Drain Diode Forward Voltage vs Source Current**

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

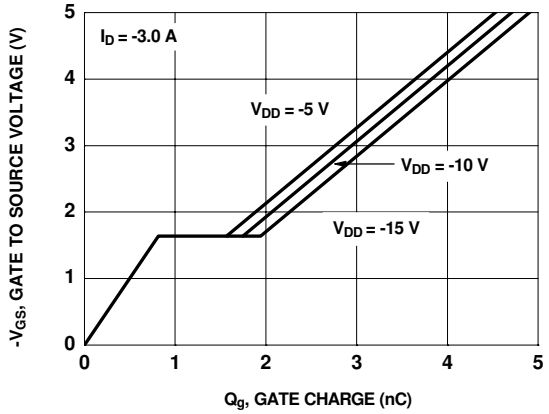



**Figure 7. Gate Charge Characteristics**

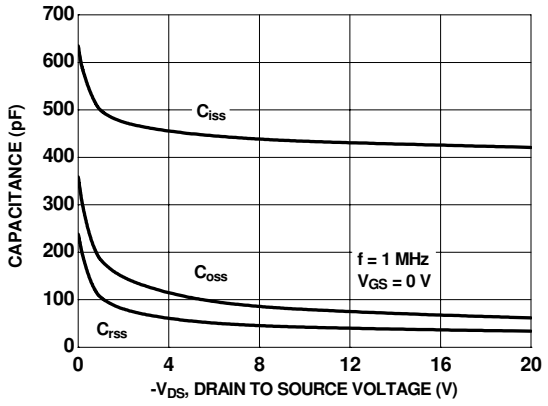



**Figure 8. Capacitance vs Drain to Source Voltage**

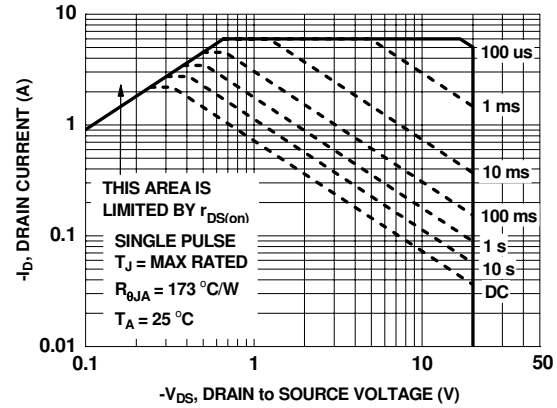



**Figure 9. Forward Bias Safe Operating Area**

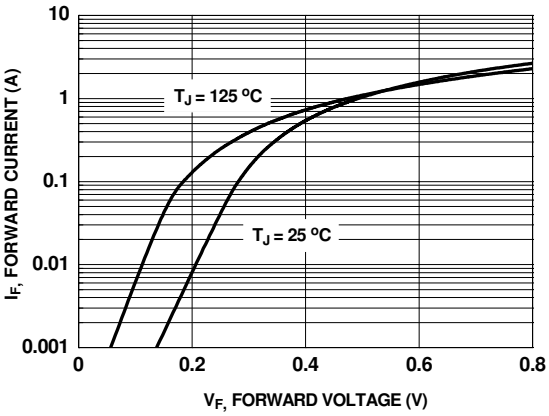



**Figure 10. Schottky Diode Foward Voltage**

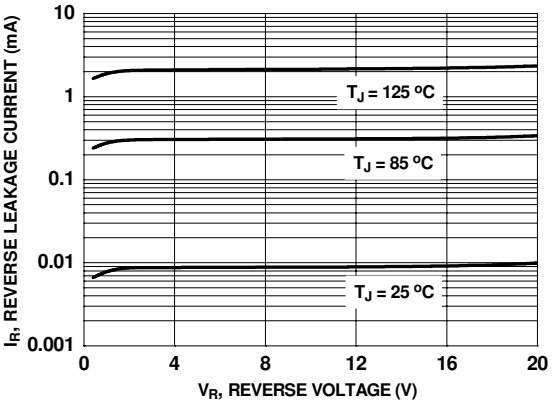



**Figure 11. Schottky Diode Reverse Current**

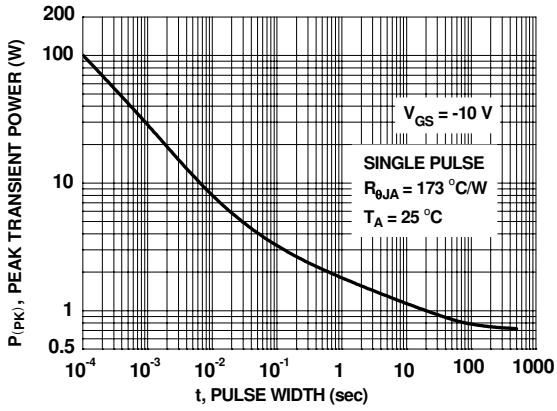



**Figure 12. Single Pulse Maximum Power Dissipation**

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

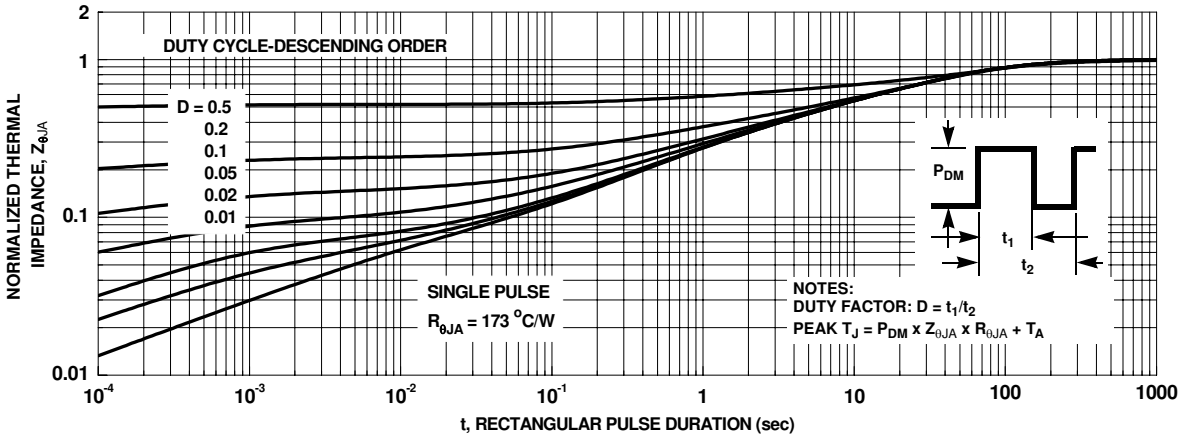
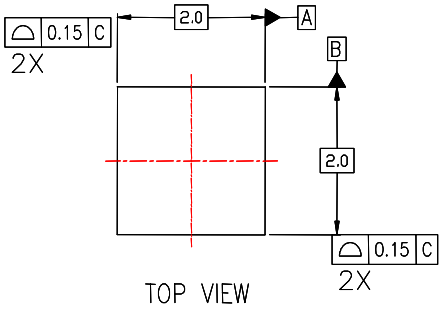
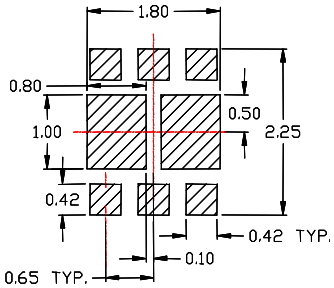



**Figure 13. Junction to Ambient Transient Thermal Response Curve**

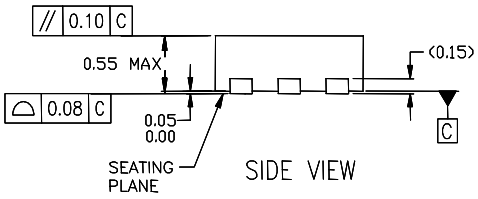
## Dimensional Outline and Pad Layout



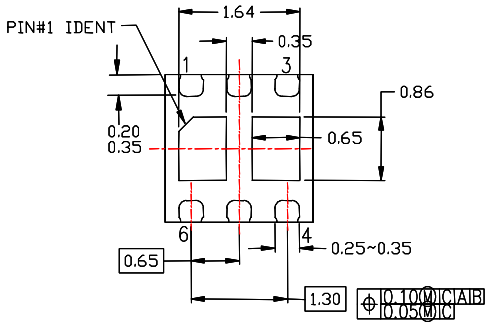

TOP VIEW




RECOMMENDED LAND PATTERN




SIDE VIEW




BOTTOM VIEW

NOTES:

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B. DIMENSIONS ARE IN MILLIMETERS.
C. DIMENSIONS AND TOLERANCES PER
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| Datasheet Identification | Product Status | Definition |
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