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July 2014

# FDFMA2P853

## Integrated P-Channel PowerTrench<sup>®</sup> MOSFET and Schottky Diode<sup>®</sup>

### 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 performance for its size and is well suited to linear mode applications.

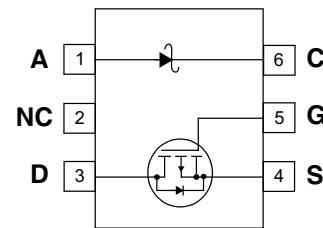
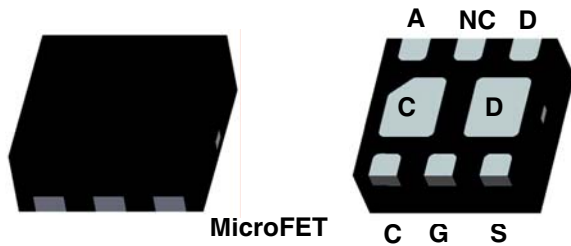
### Features

#### MOSFET:

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

#### Schottky:

- $V_F < 0.46\text{ V @ } 500\text{ mA}$
- Low Profile - 0.8 mm maximum - in the new package MicroFET 2x2 mm
- RoHS Compliant



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

Symbol	Parameter	Ratings	Units
$V_{DSS}$	MOSFET Drain-Source Voltage	-20	V
$V_{GSS}$	MOSFET Gate-Source Voltage	$\pm 8$	V
$I_D$	Drain Current -Continuous (Note 1a) -Pulsed	-3.0	A
		-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 Power dissipation for Single Operation	(Note 1a)	W
		(Note 1b)	
$T_J, T_{STG}$	Operating and Storage Junction Temperature Range	-55 to +150	$^\circ\text{C}$

### Thermal Characteristics

$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient (Note 1a)	86	$^\circ\text{C/W}$
$R_{\theta JA}$	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**  $T_A = 25^\circ\text{C}$  unless otherwise noted

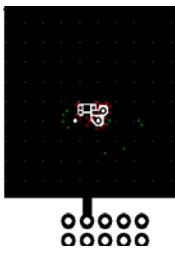
Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
<b>Off Characteristics</b>						
$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = -250\ \mu\text{A}$	-20			V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = -250\ \mu\text{A}$ , Referenced to $25^\circ\text{C}$		-12		mV/ $^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = -16\text{ V}, V_{GS} = 0\text{ V}$			-1	$\mu\text{A}$
$I_{GSS}$	Gate-Body Leakage	$V_{GS} = \pm 8\text{ V}, V_{DS} = 0\text{ V}$			$\pm 100$	nA
<b>On Characteristics (Note 2)</b>						
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = -250\ \mu\text{A}$	-0.4	-0.7	-1.3	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate Threshold Voltage Temperature Coefficient	$I_D = -250\ \mu\text{A}$ , Referenced to $25^\circ\text{C}$		2		mV/ $^\circ\text{C}$
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = -4.5\text{ V}, I_D = -3.0\text{ A}$ $V_{GS} = -2.5\text{ V}, I_D = -2.5\text{ A}$ $V_{GS} = -1.8\text{ V}, I_D = -1.0\text{ A}$ $V_{GS} = -4.5\text{ V}, I_D = -3.0\text{ A}, T_J = 125^\circ\text{C}$		90 120 172 118	120 160 240 160	m $\Omega$
$I_{D(on)}$	On-State Drain Current	$V_{GS} = -4.5\text{ V}, V_{DS} = -5\text{ V}$	-20			A
$g_{FS}$	Forward Transconductance	$V_{DS} = -5\text{ V}, I_D = -3.0\text{ A}$		7		S
<b>Dynamic Characteristics</b>						
$C_{iss}$	Input Capacitance	$V_{DS} = -10\text{ V}, V_{GS} = 0\text{ V},$ $f = 1.0\text{ MHz}$		435		pF
$C_{oss}$	Output Capacitance			80		pF
$C_{rss}$	Reverse Transfer Capacitance			45		pF
<b>Switching Characteristics (Note 2)</b>						
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = -10\text{ V}, I_D = -1\text{ A},$ $V_{GS} = -4.5\text{ V}, R_{GEN} = 6\ \Omega$		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	$V_{DS} = -10\text{ V}, I_D = -3.0\text{ A},$ $V_{GS} = -4.5\text{ V}$		4	6	nC
$Q_{gs}$	Gate-Source Charge			0.8		nC
$Q_{gd}$	Gate-Drain Charge			0.9		nC
<b>Drain-Source Diode Characteristics and Maximum Ratings</b>						
$I_S$	Maximum Continuous Drain-Source Diode Forward Current				-1.1	A
$V_{SD}$	Drain-Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_S = -1.1\text{ A}$ (Note 2)		-0.8	-1.2	V
$t_{rr}$	Diode Reverse Recovery Time	$I_F = -3.0\text{ A},$ $dI_F/dt = 100\text{ A}/\mu\text{s}$		17		ns
$Q_{rr}$	Diode Reverse Recovery Charge			6		nC
<b>Schottky Diode Characteristics</b>						
$I_R$	Reverse Leakage	$V_R = 5\text{ V}$	$T_J = 25^\circ\text{C}$ $T_J = 125^\circ\text{C}$	9.9 2.3	50 10	$\mu\text{A}$ mA
$I_R$	Reverse Leakage	$V_R = 20\text{ V}$	$T_J = 25^\circ\text{C}$ $T_J = 85^\circ\text{C}$ $T_J = 125^\circ\text{C}$	9.9 0.3 2.3	100 1 10	$\mu\text{A}$ mA mA
$V_F$	Forward Voltage	$I_F = 500\text{ mA}$	$T_J = 25^\circ\text{C}$ $T_J = 125^\circ\text{C}$	0.4 0.3	0.46 0.35	V
$V_F$	Forward Voltage	$I_F = 1\text{ A}$	$T_J = 25^\circ\text{C}$ $T_J = 125^\circ\text{C}$	0.5 0.49	0.55 0.54	V

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

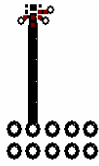
**Notes:**

1.  $R_{\theta JA}$  is determined with the device mounted on a 1 in<sup>2</sup> 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  $R_{\theta JA} = 86^\circ\text{C/W}$  when mounted on a 1 in<sup>2</sup> pad of 2 oz copper, 1.5" x 1.5" x 0.062" thick PCB
- (b) MOSFET  $R_{\theta JA} = 173^\circ\text{C/W}$  when mounted on a minimum pad of 2 oz copper
- (c) Schottky  $R_{\theta JA} = 86^\circ\text{C/W}$  when mounted on a 1 in<sup>2</sup> pad of 2 oz copper, 1.5" x 1.5" x 0.062" thick PCB
- (d) Schottky  $R_{\theta JA} = 140^\circ\text{C/W}$  when mounted on a minimum pad of 2 oz copper



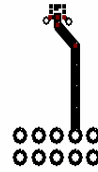
a)  $86^\circ\text{C/W}$  when mounted on a 1 in<sup>2</sup> pad of 2 oz copper



b)  $173^\circ\text{C/W}$  when mounted on a minimum pad of 2 oz copper



c)  $86^\circ\text{C/W}$  when mounted on a 1 in<sup>2</sup> pad of 2 oz copper

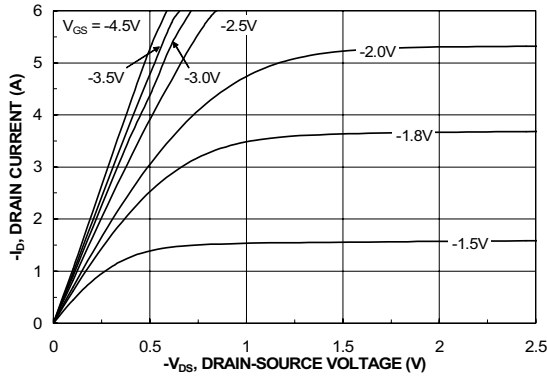


d)  $140^\circ\text{C/W}$  when mounted on a minimum pad of 2 oz copper

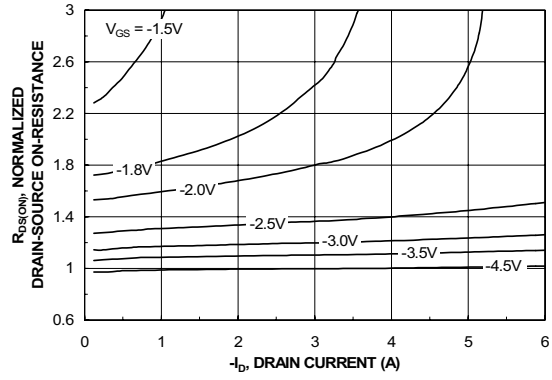
Scale 1: 1 on letter size paper

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

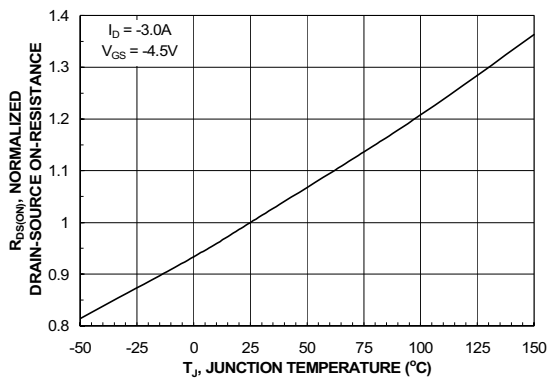
**Typical Characteristics**



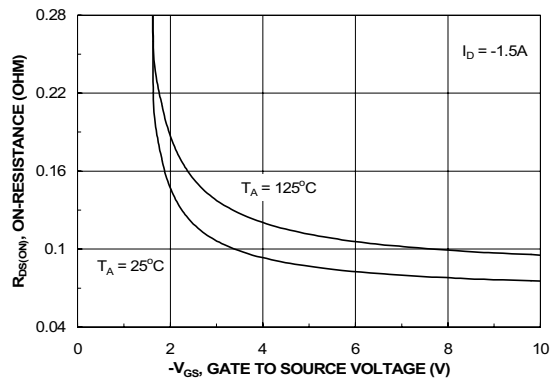
**Figure 1. On-Region Characteristics**



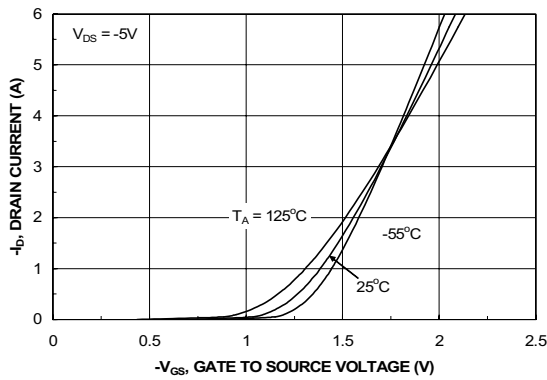
**Figure 2. On-Resistance Variation with Drain Current and Gate Voltage**



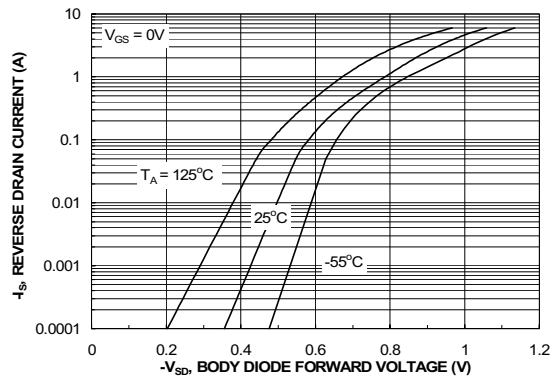
**Figure 3. On-Resistance Variation with Temperature**



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

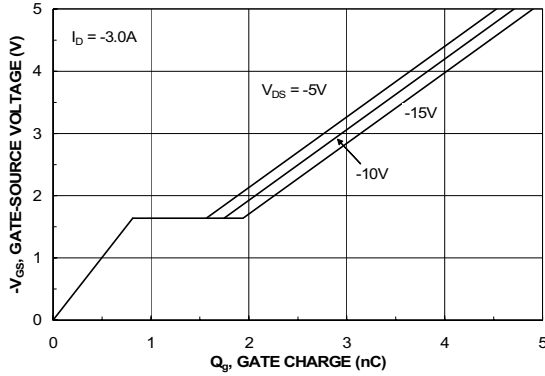


**Figure 5. Transfer Characteristics**

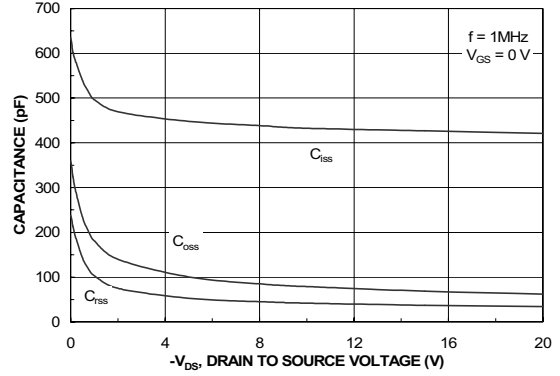


**Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature**

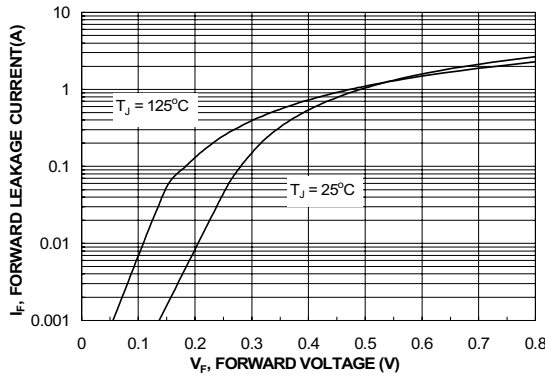
**Typical Characteristics**



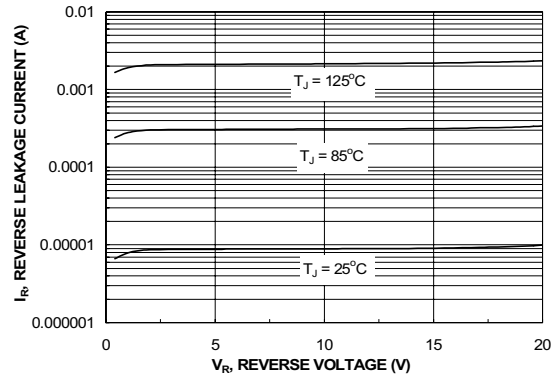
**Figure 7. Gate Charge Characteristics**



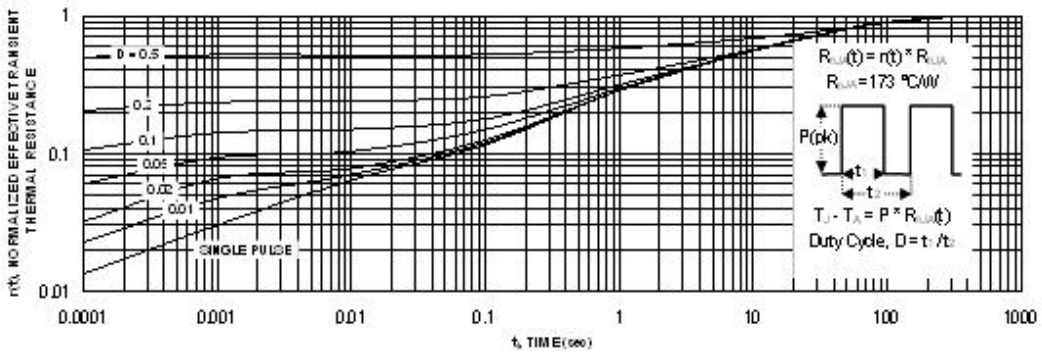
**Figure 8. Capacitance Characteristics**



**Figure 9. Schottky Diode Forward Voltage**



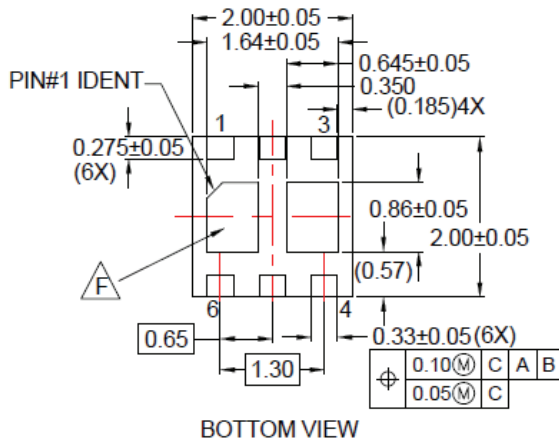
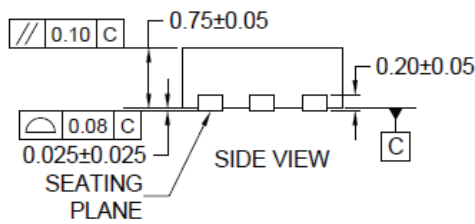
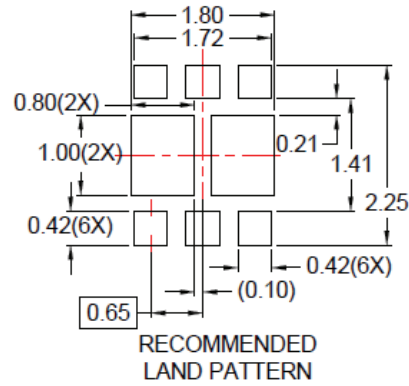
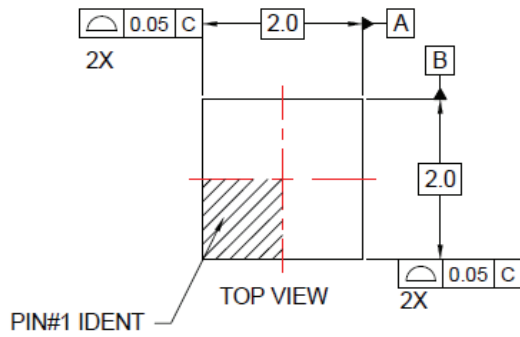
**Figure 10. Schottky Diode Reverse Current**



**Figure 11. Transient Thermal Response Curve**

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

## Dimensional Outline and Pad Layout



### NOTES:

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  - B. DIMENSIONS ARE IN MILLIMETERS.
  - C. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 2009.
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