FAIRCHILD SEMICONDUCTOR®

July 2009

FDFMA2P859T

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

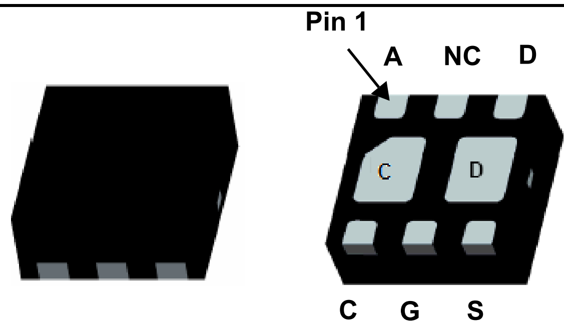
Schottky:

- V_F < 0.54 V @ 1 A
- Low profile - 0.55 mm maximum - in the new package MicroFET 2x2 **Thin**
- Free from halogenated compounds and antimony oxides
- RoHS compliant

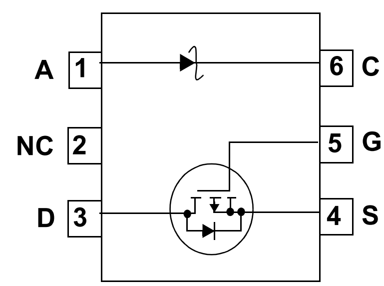
General Description

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 its physical size and is well suited to linear mode applications.



MicroFET 2x2 Thin



MOSFET Maximum Ratings T_A = 25 °C unless otherwise noted

Symbol	Parameter		Ratings	Units
V_{DSS}	Drain to Source Voltage		–20	V
V_{GSS}	Gate to Source Voltage		±8	V
I_D	Drain Current -Continuous	(Note 1a)	–3	A
	-Pulsed		–6	
P_D	Power Dissipation	(Note 1a)	1.4	W
	Power Dissipation	(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
59	FDFMA2P859T	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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
$V_{GS(th)}$	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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
$t_{d(on)}$	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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
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

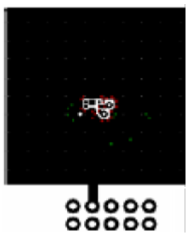
Symbol	Parameter	Test Conditions		Min	Typ	Max	Units
I_R	Reverse Leakage	V_R = 10 V	T_J = 25 °C		0.3	1.0	μA
			T_J = 85 °C		25	40	μA
			T_J = 125 °C		0.28	0.37	mA
I_R	Reverse Leakage	V_R = 20 V	T_J = 25 °C		1.0	2.5	μA
			T_J = 85 °C		74	110	μA
			T_J = 125 °C		0.73	1.00	mA
V_F	Forward Voltage	I_F = 100 mA	T_J = 25 °C		0.40	0.41	V
			T_J = 85 °C		0.31	0.33	V
			T_J = 125 °C		0.26	0.27	V
V_F	Forward Voltage	I_F = 1 A	T_J = 25 °C		0.52	0.54	V
			T_J = 85 °C		0.45	0.47	V
			T_J = 125 °C		0.41	0.43	V

Electrical Characteristics T_A = 25 °C unless otherwise noted

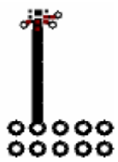
Notes:

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 $R_{\theta CA}$ is determined by the user's board design.

(a) MOSFET $R_{\theta JA}$ = 86 ^{o}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 ^{o}C/W when mounted on a minimum pad of 2 oz copper.
(c) Schottky $R_{\theta JA}$ = 86 ^{o}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 ^{o}C/W when mounted on a minimum pad of 2 oz copper.

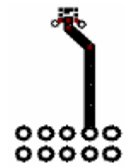


a)86 ^{o}C/W when mounted on a 1 in^2 pad of 2 oz copper.



b)173 ^{o}C/W when mounted on a minimum pad of 2 oz copper.

c)86 ^{o}C/W when mounted on a 1 in^2 pad of 2 oz copper.



d)140 ^{o}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

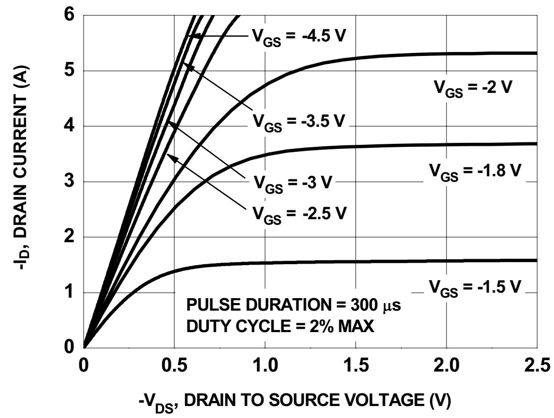


Figure 1. On-Region Characteristics

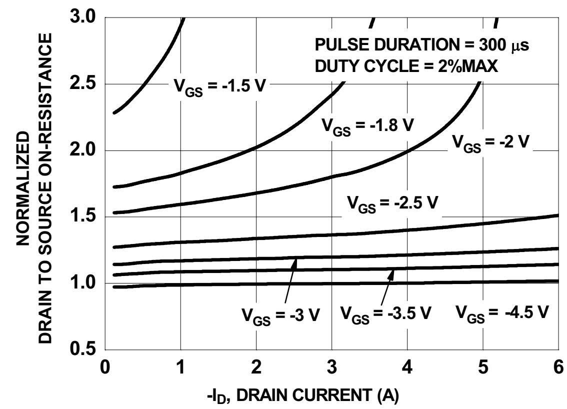


Figure 2. Normalized On-Resistance vs Drain Current and Gate Voltage

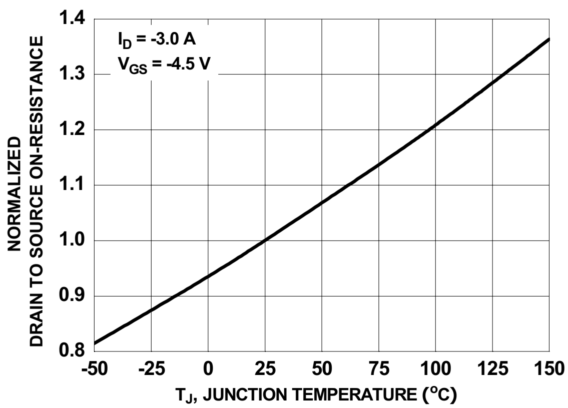


Figure 3. Normalized On-Resistance vs Junction Temperature

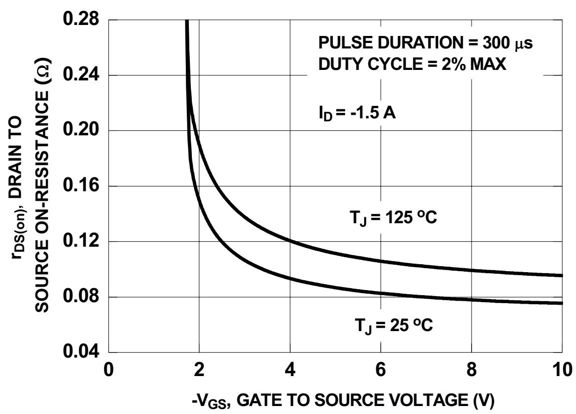


Figure 4. On-Resistance vs Gate to Source Voltage

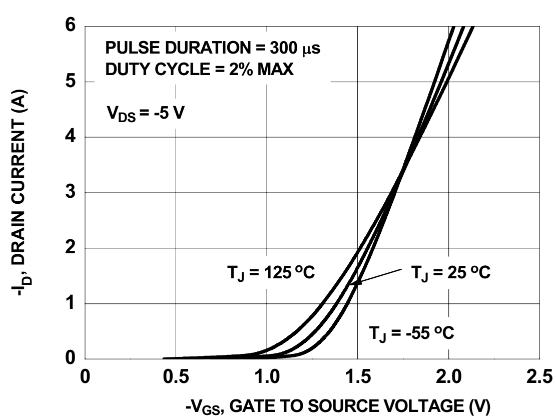


Figure 5. Transfer Characteristics

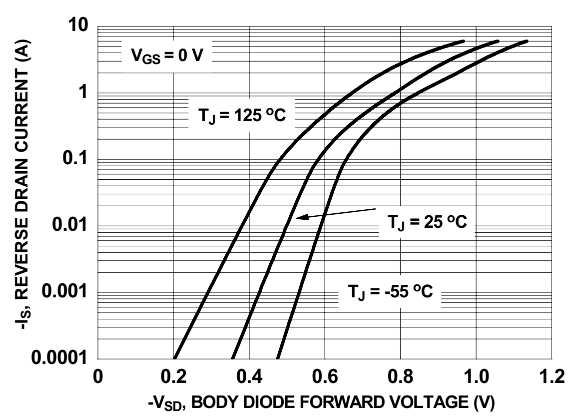


Figure 6. Source to Drain Diode Forward Voltage vs Source Current

Typical Characteristics T_J = 25 °C unless otherwise noted

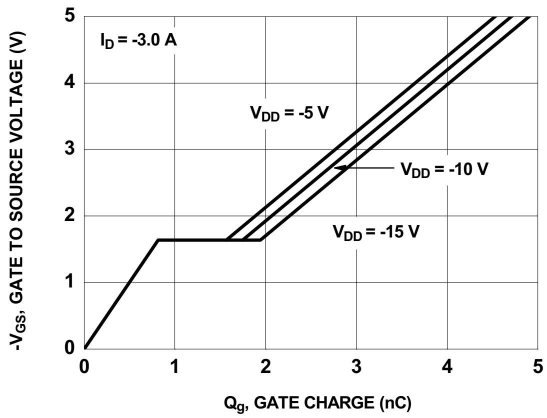


Figure 7. Gate Charge Characteristics

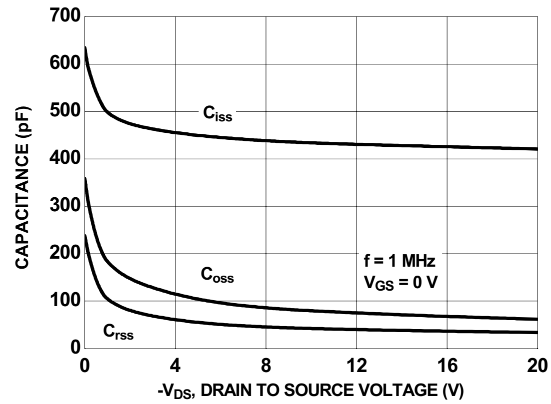


Figure 8. Capacitance vs Drain to Source Voltage

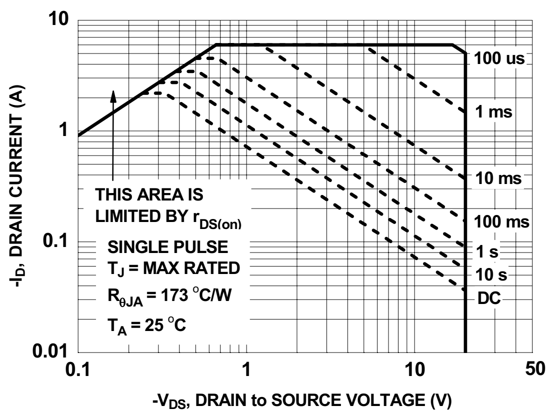


Figure 9. Forward Bias Safe Operating Area

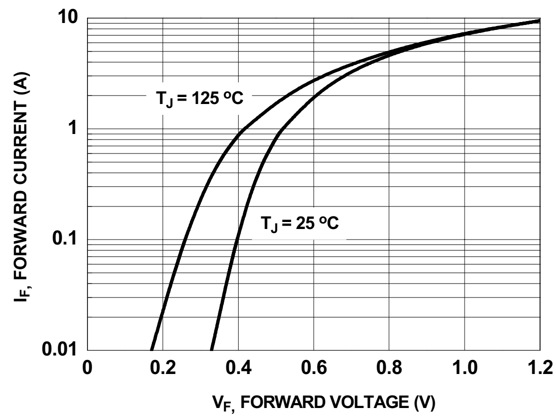


Figure 10. Schottky Diode Foward Voltage

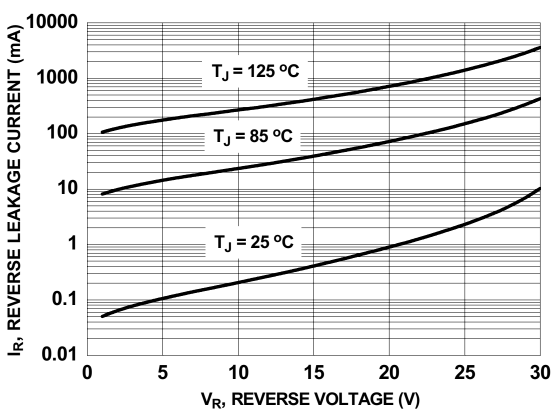


Figure 11. Schottky Diode Reverse Current

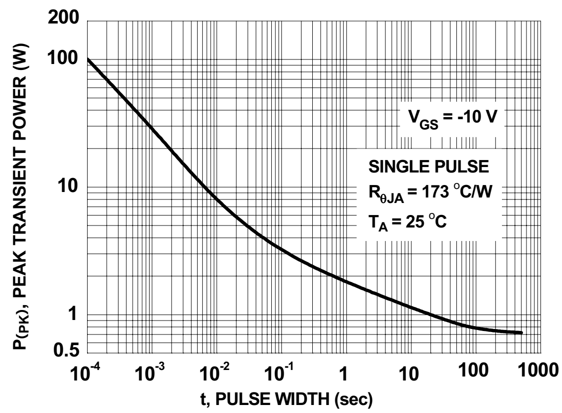


Figure 12. Single Pulse Maximum Power Dissipation

Typical Characteristics T_J = 25 °C unless otherwise noted

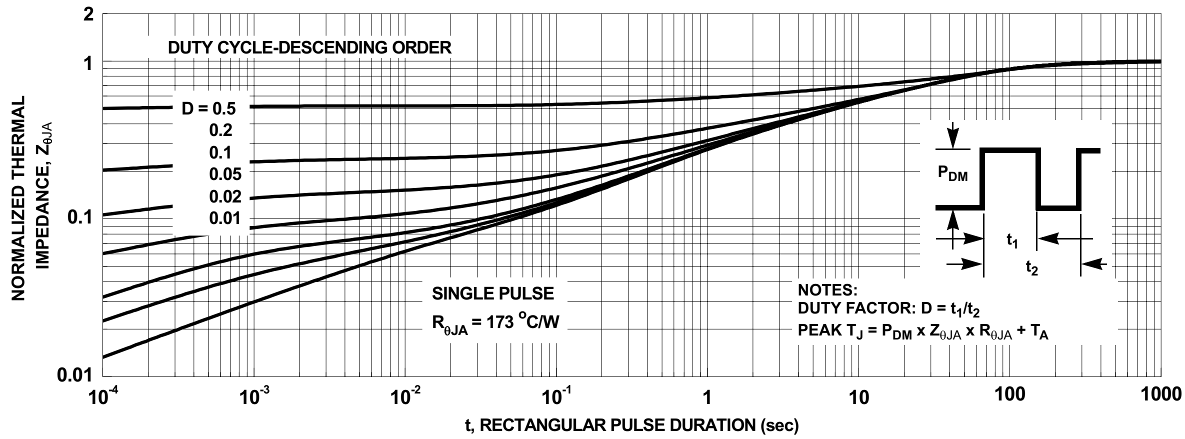
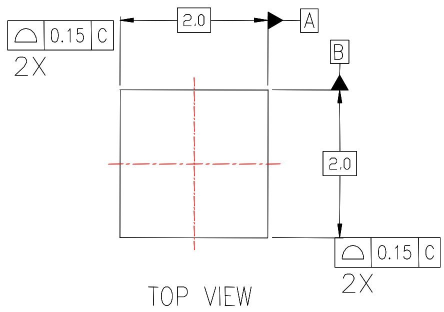
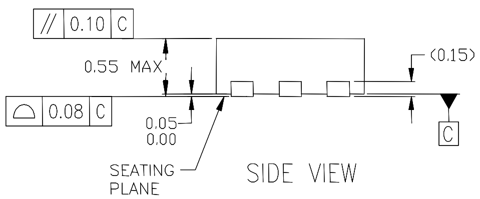
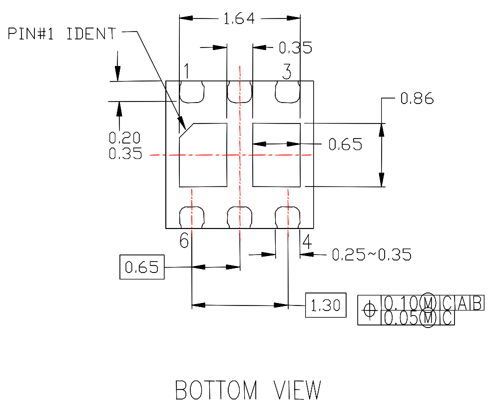


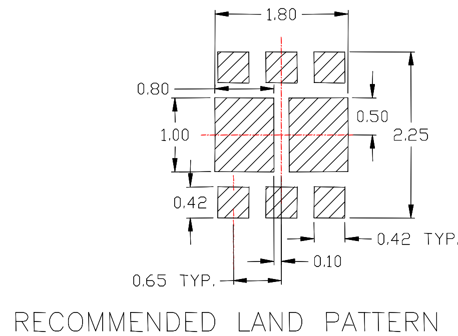
Figure 13. Junction to Ambient Transient Thermal Response Curve

Dimensional Outline and Pad Layout









NOTES:

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B. DIMENSIONS ARE IN MILLIMETERS.

C. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994

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