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November 2013

## FDD4141 F085

# P-Channel PowerTrench<sup>®</sup> MOSFET -40V, -50A, 12.3m $\Omega$

#### **Features**

- Max  $r_{DS(on)} = 12.3 \text{m}\Omega$  at  $V_{GS} = -10 \text{V}$ ,  $I_D = -12.7 \text{A}$
- Max  $r_{DS(on)}$  = 18.0m $\Omega$  at  $V_{GS}$  = -4.5V,  $I_D$  = -10.4A
- High performance trench technology for extremely low r<sub>DS(on)</sub>
- Qualified to AEC Q101
- RoHS Compliant

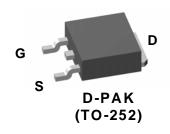


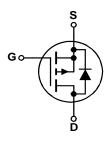
#### **General Description**

This P-Channel MOSFET has been produced using Fairchild Semiconductor's proprietary PowerTrench technology to deliver low  $r_{\text{DS(on)}}$  and optimized Bvdss capability to offer superior performance benefit in the applications. and optimized switching performance capability reducing power dissipation losses in converter/inverter applications.

#### **Applications**

- Inverter
- Power Supplies





#### MOSFET Maximum Ratings T<sub>C</sub> = 25°C unless otherwise noted

Symbol	Parameter		Ratings	Units	
$V_{DS}$	Drain to Source Voltage			-40	V
$V_{GS}$	Gate to Source Voltage			±20	V
	Drain Current -Continuous (Package limited)	T <sub>C</sub> = 25°C		-50	
	-Continuous (Silicon limited)	T <sub>C</sub> = 25°C		-58	^
ID	-Continuous	T <sub>A</sub> = 25°C	(Note 1a)	-10.8	Α
	-Pulsed			-100	
E <sub>AS</sub>	Single Pulse Avalanche Energy		(Note 3)	337	mJ
P <sub>D</sub>	Power Dissipation	T <sub>C</sub> = 25°C		69	W
	Power Dissipation $T_A = 25^{\circ}C$ (Note 1a)		(Note 1a)	2.4	VV
T <sub>J</sub> , T <sub>STG</sub>	Operating and Storage Junction Temperature Range			-55 to +175	°C

#### **Thermal Characteristics**

$R_{\theta JC}$	Maximum Thermal Resistance, Junction to Case	1.8	°C/W
R <sub>e.IA</sub>	Maximum Thermal Resistance, Junction to Ambient (Note 1a	52	C/VV

#### **Package Marking and Ordering Information**

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FDD4141	FDD4141_F085	D-PAK (TO-252)	13"	12mm	2500 units

## **Electrical Characteristics** $T_J = 25^{\circ}C$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Тур	Max	Units
Off Chara	acteristics					
BV <sub>DSS</sub>	Drain to Source Breakdown Voltage	$I_D = -250 \mu A, V_{GS} = 0 V$	-40	-	-	V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D$ = -250 $\mu$ A, referenced to 25°C	-	-29	-	mV/°C
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	$V_{DS} = -32V, V_{GS} = 0V$	-	-	-1	μΑ
I <sub>GSS</sub>	Gate to Source Leakage Current	$V_{GS} = \pm 20V$ , $V_{DS} = 0V$	-	-	±100	nA

#### On Characteristics

$V_{GS(th)}$	Gate to Source Threshold Voltage	$V_{GS} = V_{DS}, I_{D} = -250 \mu A$	-1	-1.8	-3	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate to Source Threshold Voltage Temperature Coefficient	$I_D = -250\mu\text{A}$ , referenced to 25°C	-	5.8	-	mV/°C
	Static Drain to Source On Resistance	$V_{GS} = -10V, I_D = -12.7A$	-	10.1	12.3	
(DO()		$V_{GS} = -4.5V$ , $I_D = -10.4A$	-	14.5	18.0	mΩ
r <sub>DS(on)</sub> Static Drain to Source On Resistance	$V_{GS} = -10V, I_D = -12.7A,$ $T_J = 175$ °C	-	17.3	19.4	11122	
g <sub>FS</sub>	Forward Transconductance	$V_{DS} = -5V, I_{D} = -12.7A$	-	38	-	S

#### **Dynamic Characteristics**

C <sub>iss</sub>	Input Capacitance	201/1/	-	2085	2775	pF
C <sub>oss</sub>	Output Capacitance	V <sub>DS</sub> = -20V, V <sub>GS</sub> = 0V, f = 1MHz	-	360	480	pF
C <sub>rss</sub>	Reverse Transfer Capacitance	1 - 1101112	-	210	310	pF
$R_g$	Gate Resistance	f = 1MHz	-	4.6	-	Ω

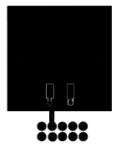
#### **Switching Characteristics**

t <sub>d(on)</sub>	Turn-On Delay Time	.,	-	10	19	ns
t <sub>r</sub>	Rise Time	$V_{DD} = -20V, I_{D} = -12.7A,$ $V_{GS} = -10V, R_{GEN} = 6\Omega$	-	7	13	ns
t <sub>d(off)</sub>	Turn-Off Delay Time	$V_{GS} = -10V$ , $R_{GEN} = 612$	-	38	60	ns
t <sub>f</sub>	Fall Time		-	15	27	ns
$Q_g$	Total Gate Charge	V <sub>GS</sub> = 0V to -10V	-	36	50	nC
Qg	Total Gate Charge	$V_{GS} = 0V \text{ to -5V}$ $V_{DD} = -20V,$ $I_{D} = -12.7A$	-	19	27	nC
$Q_{gs}$	Gate to Source Charge	I <sub>D</sub> = -12.7A	-	7	-	nC
$Q_{gd}$	Gate to Drain "Miller" Charge		-	8	-	nC

#### **Drain-Source Diode Characteristics**

$V_{SD}$	Source to Drain Diode Forward Voltage	$V_{GS} = 0V, I_{S} = -12.7A$ (Note 2)	-	-0.8	-1.2	V
t <sub>rr</sub>	Reverse Recovery Time	-I <sub>E</sub> = -12.7A. di/dt = 100A/μs	-	29	44	ns
$Q_{rr}$	Reverse Recovery Charge	$I_{\rm F} = -12.7  \text{A}$ , $u / u t = 100  \text{A} / \mu \text{S}$	-	26	40	nC

<sup>13.</sup> R<sub>0,M</sub> 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<sub>0,M</sub> is guaranteed by design while R<sub>0,M</sub> is determined by the user's board design.



a) 52°C/W when mounted on a 1 in<sup>2</sup> pad of 2 oz copper



b) 100°C/W when mounted on a minimum pad.

- $\begin{array}{ll} \textbf{2:} \ \ \text{Pulse Test: Pulse Width} < 300\mu\text{s}, \ \text{Duty cycle} < 2.0\%. \\ \textbf{3:} \ \ \text{Starting T}_J = 25^\circ\text{C}, \ L = 3\text{mH}, \ I_{AS} = 15\text{A}, \ V_{DD} = 40\text{V}, \ V_{GS} = 10\text{V}. \\ \end{array}$

#### Typical Characteristics T<sub>J</sub> = 25°C unless otherwise noted

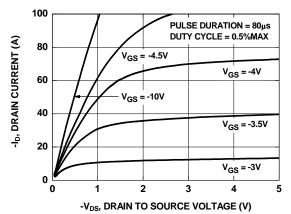


Figure 1. On-Region Characteristics

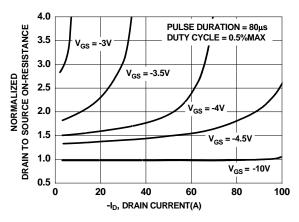


Figure 2. Normalized On-Resistance vs Drain Current and Gate Voltage

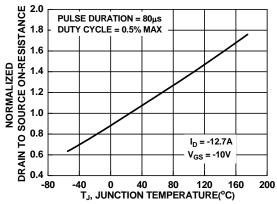


Figure 3. Normalized On-Resistance vs Junction Temperature

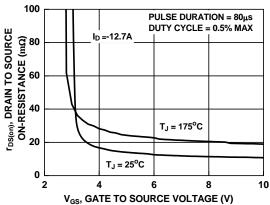
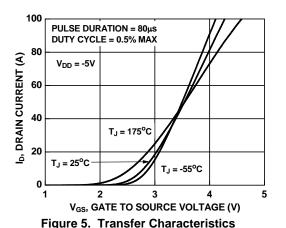


Figure 4. On-Resistance vs Gate to Source Voltage



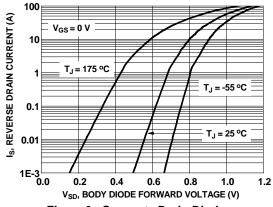


Figure 6. Source to Drain Diode Forward Voltage vs Source Current

#### Typical Characteristics T<sub>J</sub> = 25°C unless otherwise noted

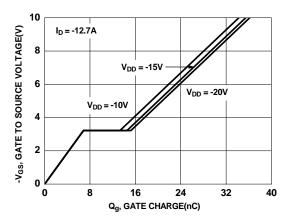


Figure 7. Gate Charge Characteristics

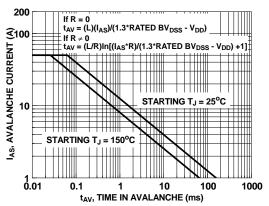
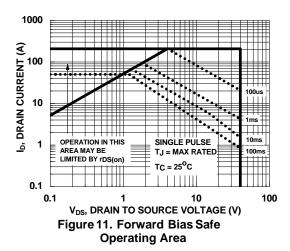


Figure 9. Unclamped Inductive Switching Capability



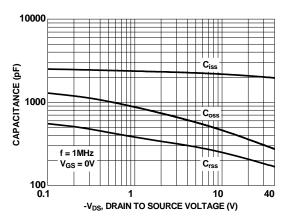


Figure 8. Capacitance vs Drain to Source Voltage

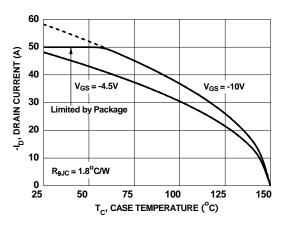


Figure 10. Maximum Continuous Drain Current vs Case Temperature

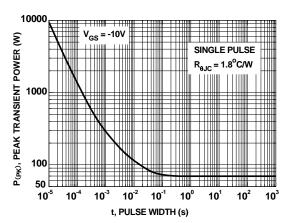


Figure 12. Single Pulse Maximum Power Dissipation

### **Typical Characteristics** T<sub>J</sub> = 25°C unless otherwise noted

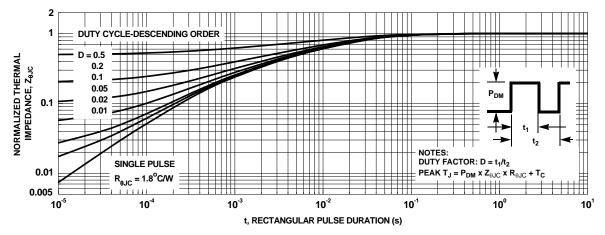


Figure 13. Transient Thermal Response Curve





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