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March 2015

# FDD6688/FDU6688

# 30V N-Channel PowerTrench<sup>O</sup> MOSFET

### **General Description**

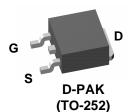
This N-Channel MOSFET has been designed specifically to improve the overall efficiency of DC/DC converters using either synchronous or conventional switching PWM controllers. It has been optimized for low gate charge, low RDS(ON) and fast switching speed.

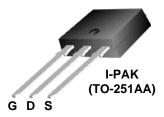
### **Applications**

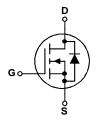
- DC/DC converter
- Motor Drives

#### **Features**

- 84 A, 30 V.  $R_{DS(ON)} = 5 \text{ m}\Omega$  @  $V_{GS} = 10 \text{ V}$   $R_{DS(ON)} = 6 \text{ m}\Omega$  @  $V_{GS} = 4.5 \text{ V}$
- · Low gate charge
- · Fast switching
- High performance trench technology for extremely low  $R_{\mbox{\scriptsize DS(ON)}}$







Absolute Maximum Ratings TA=25°C unless otherwise noted

Symbo I	Parameter		Ratings	Units
V <sub>DSS</sub>	Drain-Source Voltage		30	V
V <sub>GSS</sub>	Gate-Source Voltage		±20	
I <sub>D</sub>	Drain Current - Continuous	(Note 3)	84	A
	– Pulsed	(Note 1a)	100	
P <sub>D</sub>	Power Dissipation for Single Operation	(Note 1)	83	W
		(Note 1a)	3.8	
		(Note 1b)	1.6	
T <sub>J</sub> , T <sub>STG</sub>	Operating and Storage Junction Temperat	ure Range	-55 to +175	°C

### **Thermal Characteristics**

R <sub>eJC</sub>	Thermal Resistance, Junction-to-Case	(Note 1)	1.8	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	(Note 1a)	40	
		(Note 1b)	96	

**Package Marking and Ordering Information** 

Device Marking	Device	Package	Reel Size	Tape width	Quantity
FDD6688	FDD6688	D-PAK (TO-252)	13"	16mm	2500 units
FDU6688	FDU6688	I-PAK (TO-251)	Tube	N/A	75

Symbol	Parameter	Test Conditions	Min	Тур	Max	Units
Drain-Sc	ource Avalanche Ratings (No	ote 2)	II	·		
W <sub>DSS</sub>	Drain-Source Avalanche Energy	Single Pulse, $V_{DD} = 15 \text{ V}$ , $I_D = 21 \text{ A}$			370	mJ
I <sub>AR</sub>	Drain-Source Avalanche Current				21	Α
Off Char	acteristics					
BV <sub>DSS</sub>	Drain–Source Breakdown Voltage	$V_{GS} = 0 \text{ V}, \qquad I_{D} = 250  \mu\text{A}$	30			V
<u>ΔBV<sub>DSS</sub></u> ΔT <sub>J</sub>	Breakdown Voltage Temperature Coefficient	$I_D = 250 \mu A$ , Referenced to $25^{\circ}C$		24		mV/°C
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	$V_{DS} = 24 \text{ V}, \qquad V_{GS} = 0 \text{ V}$			1	μΑ
I <sub>GSS</sub>	Gate-Body Leakage	$V_{GS} = \pm 20 \text{ V}, \qquad V_{DS} = 0 \text{ V}$			±100	nA
On Char	acteristics (Note 2)					
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}$ , $I_D = 250 \mu A$	1	1.8	3	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate Threshold Voltage Temperature Coefficient	$I_D$ = 250 $\mu$ A, Referenced to 25°C		<b>-</b> 5		mV/°C
$R_{DS(on)}$	Static Drain–Source On–Resistance	$ \begin{aligned} &V_{GS} = 10 \text{ V}, & I_{D} = 18 \text{ A} \\ &V_{GS} = 4.5 \text{ V}, & I_{D} = 16.5 \text{ A} \\ &V_{GS} = 10 \text{ V}, & I_{D} = 18 \text{ A}, T_{J} = 125^{\circ}\text{C} \end{aligned} $		4 5 6	5 6 10	mΩ
I <sub>D(on)</sub>	On-State Drain Current	$V_{GS} = 10 \text{ V}, \qquad V_{DS} = 5 \text{ V}$	50			Α
<b>g</b> <sub>FS</sub>	Forward Transconductance	$V_{DS} = 5 \text{ V}, \qquad I_{D} = 18 \text{ A}$		88		S
Dynamic	Characteristics					
C <sub>iss</sub>	Input Capacitance	$V_{DS} = 15 \text{ V}, \qquad V_{GS} = 0 \text{ V},$		3845		pF
Coss	Output Capacitance	f = 1.0 MHz		930		pF
C <sub>rss</sub>	Reverse Transfer Capacitance			368		pF
R <sub>G</sub>	Gate Resistance	V <sub>GS</sub> = 15 mV, f = 1.0 MHz		1.2		Ω
Switchin	g Characteristics (Note 2)					
t <sub>d(on)</sub>	Turn-On Delay Time	$V_{DD} = 15 \text{ V}, \qquad I_{D} = 1 \text{ A},$		15	27	ns
t <sub>r</sub>	Turn-On Rise Time	$V_{GS} = 10 \text{ V}, \qquad R_{GEN} = 6 \Omega$		13	23	ns
t <sub>d(off)</sub>	Turn-Off Delay Time			62	99	ns
t <sub>f</sub>	Turn-Off Fall Time			36	58	ns
Q <sub>g</sub>	Total Gate Charge	$V_{DS} = 15V$ , $I_{D} = 18 A$ ,		37	56	nC
Q <sub>gs</sub>	Gate-Source Charge	$V_{GS} = 5 V$		10		nC
Q <sub>qd</sub>	Gate-Drain Charge			14		nC

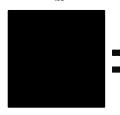
## **Electrical Characteristics** (continued)

T<sub>A</sub> = 25°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Тур	Max	Units			
Drain-Se	Drain-Source Diode Characteristics and Maximum Ratings								
$V_{SD}$	Drain–Source Diode Forward Voltage	$V_{GS} = 0 \text{ V},  I_S = 3.2 \text{ A}  \text{(Note 2)}$		0.7	1.2	V			
t <sub>rr</sub>	Diode Reverse Recovery Time	$I_F = 18 \text{ A} , d_{iF}/d_t = 100 \text{ A/}\mu\text{s}$		39		nS			
Q <sub>rr</sub>	Diode Reverse Recovery Charge			31		nC			

#### Notes:8

 R<sub>8JA</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>8JC</sub> is guaranteed by design while R<sub>8CA</sub> is determined by the user's board design.



a)  $R_{\theta JA} = 40$  °C/W when mounted on a  $1 \text{in}^2$  pad of 2 oz copper



b)  $R_{\theta JA} = 96^{\circ}C/W$  when mounted on a minimum pad.

Scale 1:1 on letter size paper

- **2.** Pulse Test: Pulse Width <  $300\mu$ s, Duty Cycle < 2.0%
- 3. Maximum current is calculated as:  $\sqrt{\frac{P_D}{R_{DS(0)}}}$

where  $P_D$  is maximum power dissipation at  $T_C$  = 25°C and  $R_{DS(cn)}$  is at  $T_{J(max)}$  and  $V_{GS}$  = 10V. Package current limitation is 21A

# **Typical Characteristics**

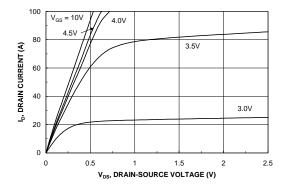


Figure 1. On-Region Characteristics.

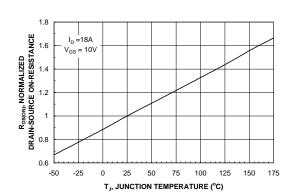


Figure 3. On-Resistance Variation with Temperature.

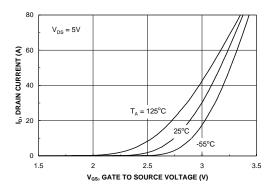


Figure 5. Transfer Characteristics

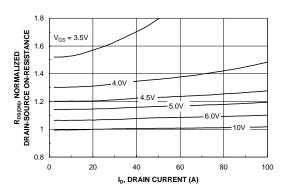


Figure 2. On-Resistance Variation with Drain Current and Gate Voltage.

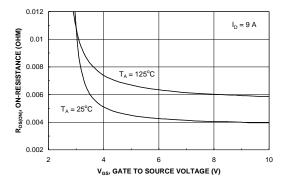


Figure 4. On-Resistance Variation with Gate-to-Source Voltage.

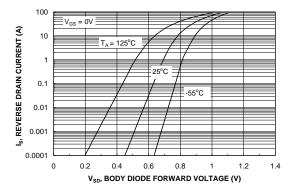
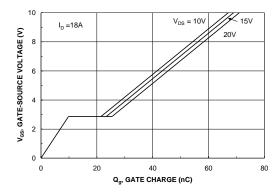


Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature

## **Typical Characteristics**



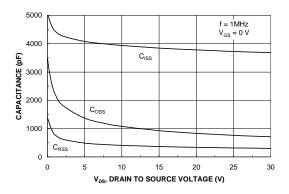
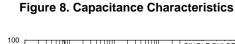
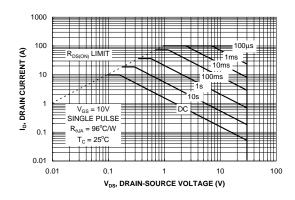


Figure 7. Gate Charge Characteristics





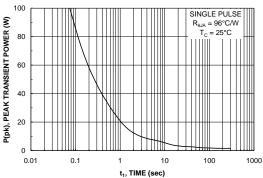


Figure 9. Maximum Safe Operating Area



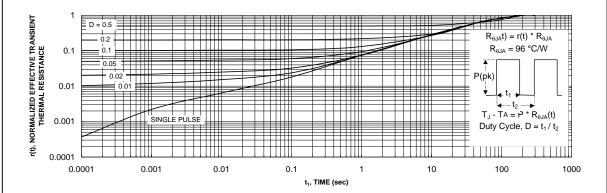
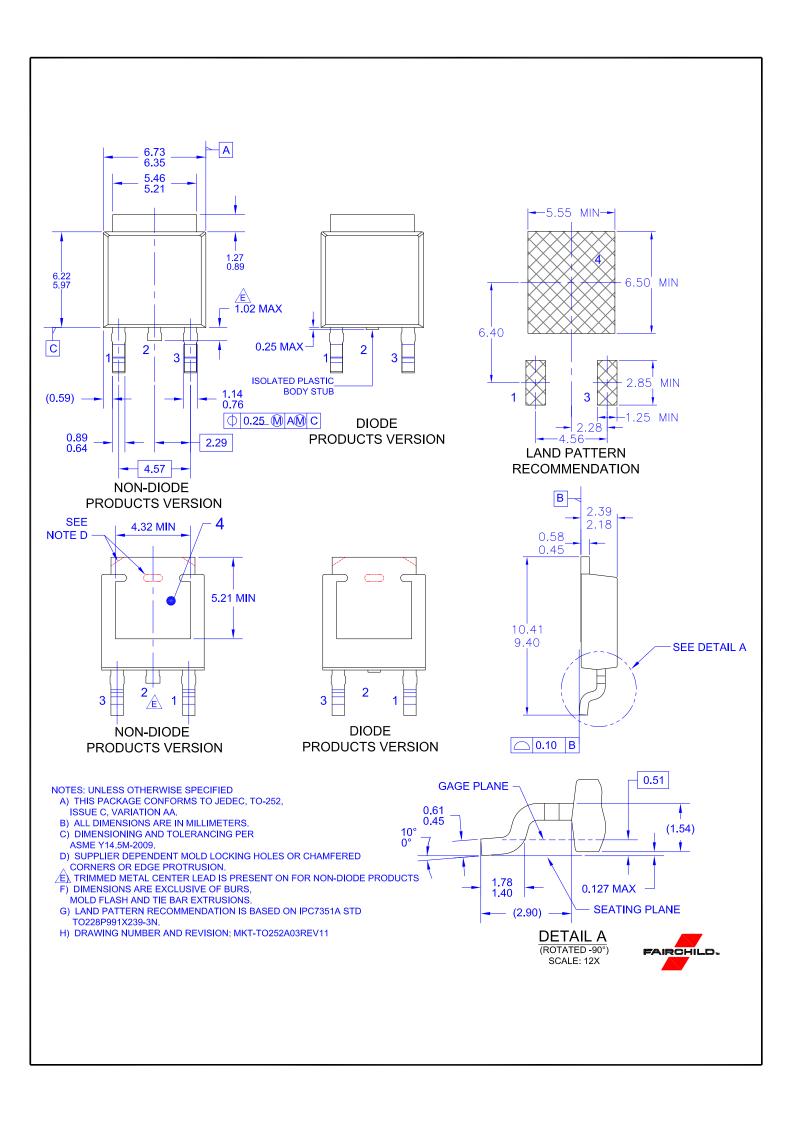


Figure 11. Transient Thermal Response Curve

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



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