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March 2015

FDD6688/FDU6688

## FDD6688/FDU6688

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

#### General Description

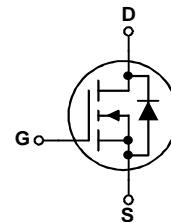
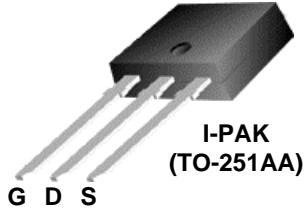
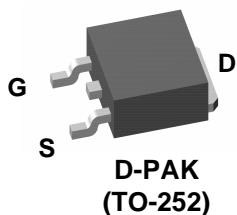
This N-Channel MOSFET has been designed specifically to improve the overall efficiency of DC/DC converters using either synchronous or conventional switching PWM controllers. It has been optimized for low gate charge, low  $R_{DS(ON)}$  and fast switching speed.

#### 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  $R_{DS(ON)}$



#### Absolute Maximum Ratings

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

Symbol	Parameter	Ratings	Units
$V_{DSS}$	Drain-Source Voltage	30	V
$V_{GSS}$	Gate-Source Voltage	$\pm 20$	
$I_D$	Drain Current – Continuous (Note 3)	84	A
	– Pulsed (Note 1a)	100	
$P_D$	Power Dissipation for Single Operation (Note 1)	83	W
		3.8	
		1.6	
$T_J, T_{STG}$	Operating and Storage Junction Temperature Range	-55 to +175	$^\circ\text{C}$

#### Thermal Characteristics

$R_{\theta JC}$	Thermal Resistance, Junction-to-Case (Note 1)	1.8	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient (Note 1a)	40	
		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

## Electrical Characteristics

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
<b>Drain-Source Avalanche Ratings (Note 2)</b>						
$W_{DSS}$	Drain-Source Avalanche Energy	Single Pulse, $V_{DD} = 15\text{ V}$ , $I_D = 21\text{ A}$			370	$\text{mJ}$
$I_{AR}$	Drain-Source Avalanche Current			21		$\text{A}$
<b>Off Characteristics</b>						
$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}$ , $I_D = 250\text{ }\mu\text{A}$	30			$\text{V}$
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 250\text{ }\mu\text{A}$ , Referenced to $25^\circ\text{C}$		24		$\text{mV/}^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 24\text{ V}$ , $V_{GS} = 0\text{ V}$		1		$\mu\text{A}$
$I_{GSS}$	Gate-Body Leakage	$V_{GS} = \pm 20\text{ V}$ , $V_{DS} = 0\text{ V}$			$\pm 100$	$\text{nA}$
<b>On Characteristics (Note 2)</b>						
$V_{GS(\text{th})}$	Gate Threshold Voltage	$V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$	1	1.8	3	$\text{V}$
$\frac{\Delta V_{GS(\text{th})}}{\Delta T_J}$	Gate Threshold Voltage Temperature Coefficient	$I_D = 250\text{ }\mu\text{A}$ , Referenced to $25^\circ\text{C}$		-5		$\text{mV/}^\circ\text{C}$
$R_{DS(\text{on})}$	Static Drain-Source On-Resistance	$V_{GS} = 10\text{ V}$ , $I_D = 18\text{ A}$ $V_{GS} = 4.5\text{ V}$ , $I_D = 16.5\text{ A}$ $V_{GS} = 10\text{ V}$ , $I_D = 18\text{ A}$ , $T_J=125^\circ\text{C}$	4 5 6	5 6 10		$\text{m}\Omega$
$I_{D(\text{on})}$	On-State Drain Current	$V_{GS} = 10\text{ V}$ , $V_{DS} = 5\text{ V}$	50			$\text{A}$
$g_{FS}$	Forward Transconductance	$V_{DS} = 5\text{ V}$ , $I_D = 18\text{ A}$		88		$\text{S}$
<b>Dynamic Characteristics</b>						
$C_{iss}$	Input Capacitance	$V_{DS} = 15\text{ V}$ , $V_{GS} = 0\text{ V}$ , $f = 1.0\text{ MHz}$		3845		$\text{pF}$
$C_{oss}$	Output Capacitance			930		$\text{pF}$
$C_{rss}$	Reverse Transfer Capacitance			368		$\text{pF}$
$R_G$	Gate Resistance	$V_{GS} = 15\text{ mV}$ , $f = 1.0\text{ MHz}$		1.2		$\Omega$
<b>Switching Characteristics (Note 2)</b>						
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 15\text{ V}$ , $I_D = 1\text{ A}$ , $V_{GS} = 10\text{ V}$ , $R_{GEN} = 6\text{ }\Omega$		15	27	$\text{ns}$
$t_r$	Turn-On Rise Time			13	23	$\text{ns}$
$t_{d(off)}$	Turn-Off Delay Time			62	99	$\text{ns}$
$t_f$	Turn-Off Fall Time			36	58	$\text{ns}$
$Q_g$	Total Gate Charge	$V_{DS} = 15\text{ V}$ , $I_D = 18\text{ A}$ , $V_{GS} = 5\text{ V}$		37	56	$\text{nC}$
$Q_{gs}$	Gate-Source Charge			10		$\text{nC}$
$Q_{gd}$	Gate-Drain Charge			14		$\text{nC}$

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
<b>Drain-Source Diode Characteristics and Maximum Ratings</b>						
$V_{SD}$	Drain-Source Diode Forward Voltage	$V_{GS} = 0 \text{ V}$ , $I_S = 3.2 \text{ A}$ (Note 2)		0.7	1.2	V
$t_{rr}$	Diode Reverse Recovery Time	$I_F = 18 \text{ A}$ , $dI_F/dt = 100 \text{ A}/\mu\text{s}$		39		nS
$Q_{rr}$	Diode Reverse Recovery Charge			31		nC

**Notes:8**

1.  $R_{\theta JA}$  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.  $R_{\theta JC}$  is guaranteed by design while  $R_{\theta CA}$  is determined by the user's board design.



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



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

Scale 1 : 1 on letter size paper

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

3. Maximum current is calculated as:

$$\sqrt{\frac{P_D}{R_{DS(ON)}}}$$

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

## Typical Characteristics

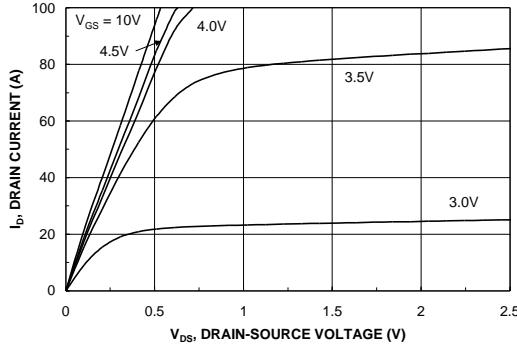


Figure 1. On-Region Characteristics.

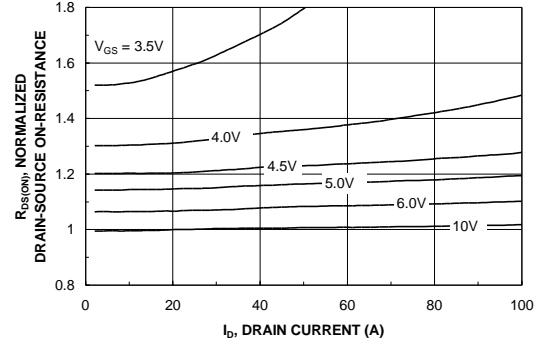


Figure 2. On-Resistance Variation with Drain Current and Gate Voltage.

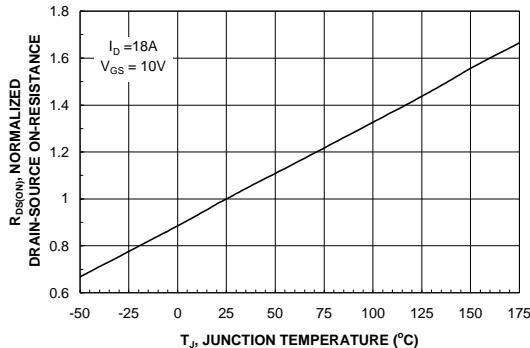


Figure 3. On-Resistance Variation with Temperature.

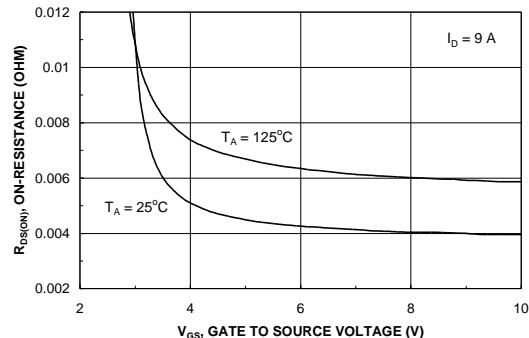


Figure 4. On-Resistance Variation with Gate-to-Source Voltage.

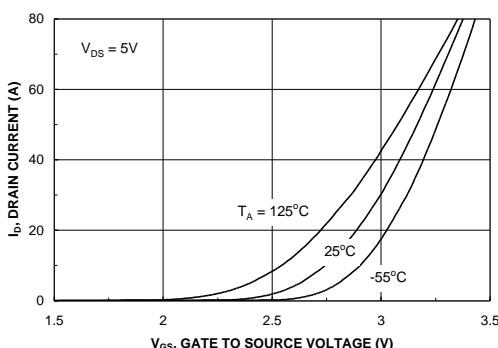


Figure 5. Transfer Characteristics

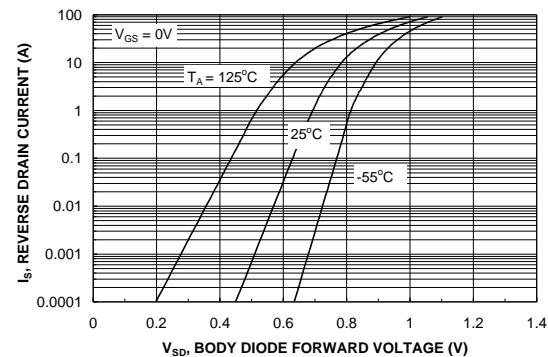


Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature

## Typical Characteristics

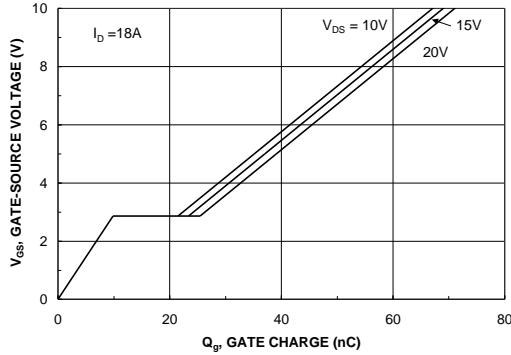


Figure 7. Gate Charge Characteristics

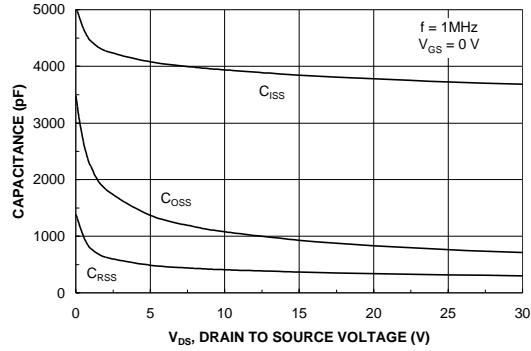


Figure 8. Capacitance Characteristics

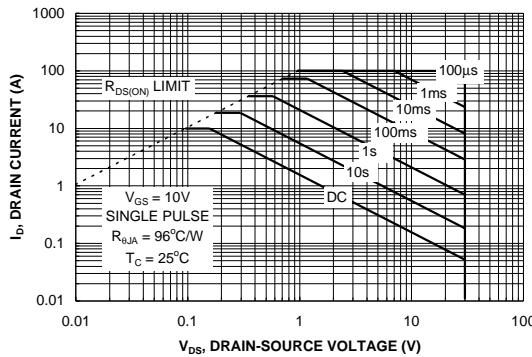


Figure 9. Maximum Safe Operating Area

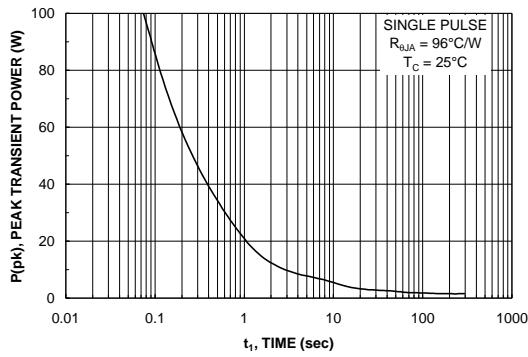


Figure 10. Single Pulse Maximum Power Dissipation

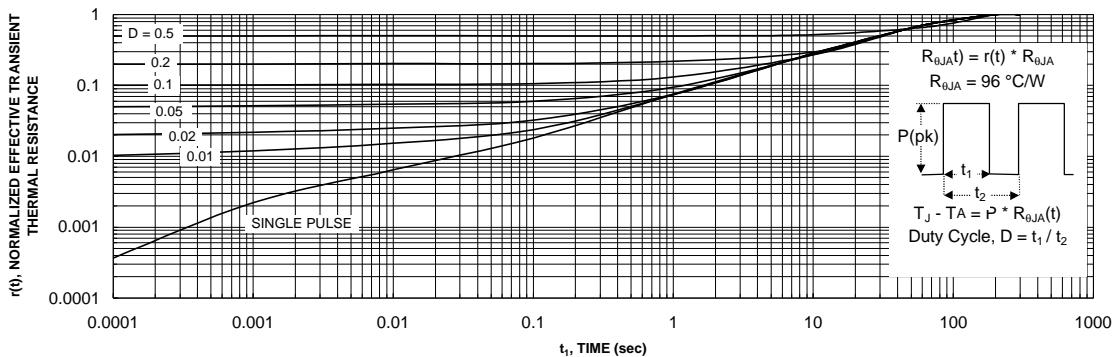
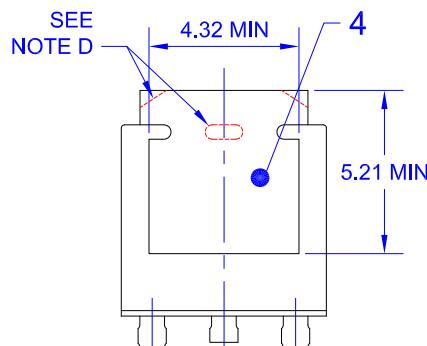
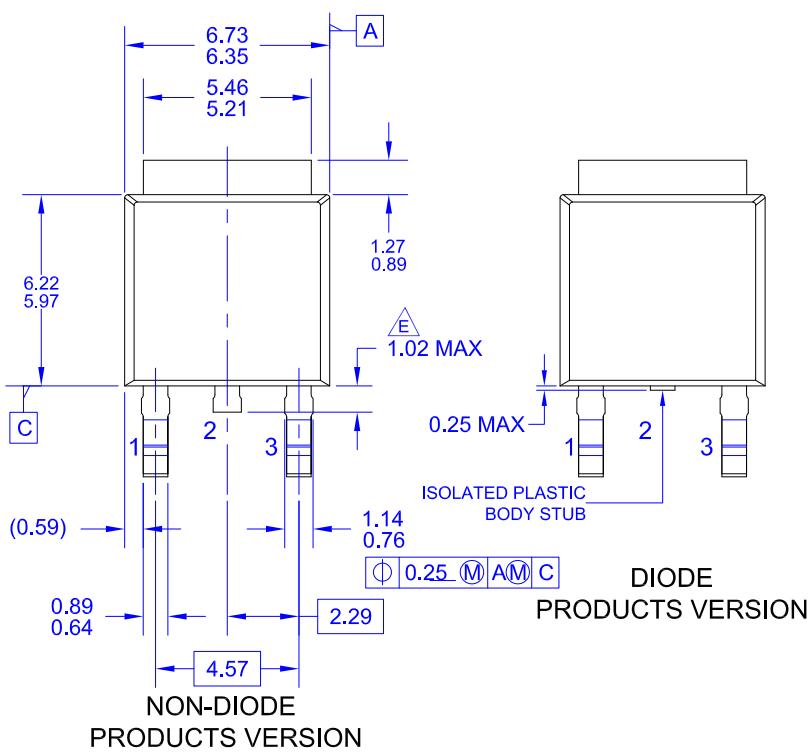
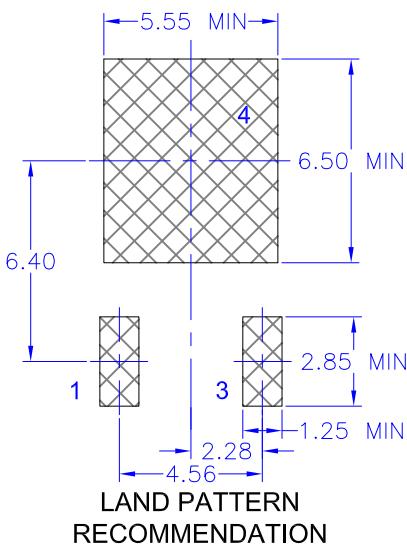


Figure 11. Transient Thermal Response Curve

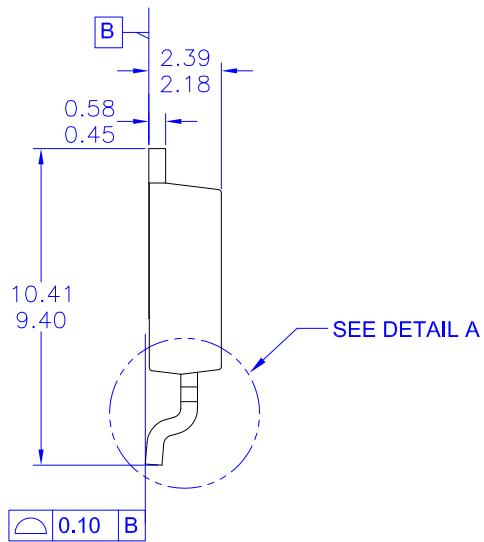
Thermal characterization performed using the conditions described in Note 1b.  
Transient thermal response will change depending on the circuit board design.



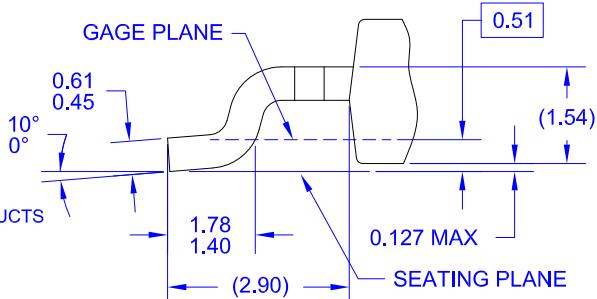
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PRODUCTS VERSION



LAND PATTERN  
RECOMMENDATION



DETAIL A  
(ROTATED -90°)  
SCALE: 12X



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B) ALL DIMENSIONS ARE IN MILLIMETERS.  
C) DIMENSIONING AND TOLERANCING PER

ASME Y14.5M-2009.

D) SUPPLIER DEPENDENT MOLD LOCKING HOLES OR CHAMFERED  
CORNERS OR EDGE PROTRUSION.

E) TRIMMED METAL CENTER LEAD IS PRESENT ON FOR NON-DIODE PRODUCTS

F) DIMENSIONS ARE EXCLUSIVE OF BURS,  
MOLD FLASH AND TIE BAR EXTRUSIONS.

G) LAND PATTERN RECOMMENDATION IS BASED ON IPC7351A STD  
TO228P991X239-3N.

H) DRAWING NUMBER AND REVISION: MKT-TO252A03REV11

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