



January 2004

# FDS6688

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

### General Description

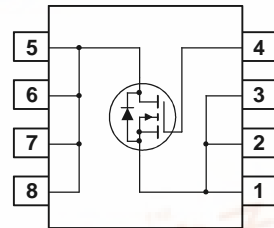
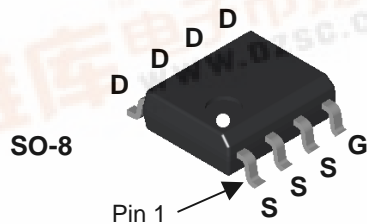
This N-Channel MOSFET has been designed specifically to improve the overall efficiency of DC/DC converters using either synchronous or conventional switching PWM controllers. It has been optimized for "low side" synchronous rectifier operation, providing an extremely low  $R_{DS(ON)}$  in a small package.

### Applications

- DC/DC converter

### Features

- 16 A, 30 V.  $R_{DS(ON)} = 6 \text{ m}\Omega$  @  $V_{GS} = 10 \text{ V}$   
 $R_{DS(ON)} = 7 \text{ m}\Omega$  @  $V_{GS} = 4.5 \text{ V}$
- Ultra-low gate charge (40 nC typical)
- High performance trench technology for extremely low  $R_{DS(ON)}$
- High power and current handling capability



### 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	$\pm 20$	V
$I_D$	Drain Current – Continuous (Note 1a)	16	A
	– Pulsed	50	
$P_D$	Power Dissipation for Single Operation (Note 1a)	2.5	W
	(Note 1b)	1.4	
	(Note 1c)	1.2	
$T_J, T_{STG}$	Operating and Storage Junction Temperature Range	$-55$ to $+175$	$^\circ\text{C}$

### Thermal Characteristics

$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient (Note 1a)	50	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient (Note 1c)	125	$^\circ\text{C/W}$
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case (Note 1)	25	$^\circ\text{C/W}$

### Package Marking and Ordering Information

Device Marking	Device	Reel Size	Tape width	Quantity
FDS6688	FDS6688	13"	12mm	2500 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	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$	30			V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 250\text{ }\mu\text{A}$ , Referenced to $25^\circ\text{C}$		21		mV/ $^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 24\text{ V}, V_{GS} = 0\text{ V}$			10	$\mu\text{A}$
$I_{GSS}$	Gate–Body Leakage	$V_{GS} = \pm 20\text{ V}, V_{DS} = 0\text{ V}$			$\pm 100$	nA

**On Characteristics** (Note 2)

$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$	1	1.8	3	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate Threshold Voltage Temperature Coefficient	$I_D = 250\text{ }\mu\text{A}$ , Referenced to $25^\circ\text{C}$		–6		mV/ $^\circ\text{C}$
$R_{DS(on)}$	Static Drain–Source On–Resistance	$V_{GS} = 10\text{ V}, I_D = 16\text{ A}$ $V_{GS} = 4.5\text{ V}, I_D = 15\text{ A}$ $V_{GS} = 10\text{ V}, I_D = 16\text{ A}, T_J = 125^\circ\text{C}$		4.5 5.2 6.2	6 7 9	m $\Omega$
$I_{D(on)}$	On–State Drain Current	$V_{GS} = 10\text{ V}, V_{DS} = 5\text{ V}$	50			A
$g_{FS}$	Forward Transconductance	$V_{DS} = 5\text{ V}, I_D = 16\text{ A}$		84		S

**Dynamic Characteristics**

$C_{iss}$	Input Capacitance	$V_{DS} = 15\text{ V}, V_{GS} = 0\text{ V},$		3888		pF
$C_{oss}$	Output Capacitance	$f = 1.0\text{ MHz}$		931		pF
$C_{rss}$	Reverse Transfer Capacitance			401		pF
$R_G$	Gate Resistance	$V_{GS} = 15\text{ mV}, f = 1.0\text{ MHz}$		1.3		$\Omega$

**Switching Characteristics** (Note 2)

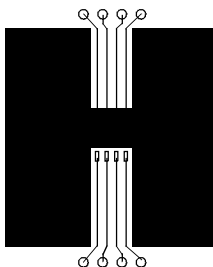
$t_{d(on)}$	Turn–On Delay Time	$V_{DD} = 15\text{ V}, I_D = 1\text{ A},$		14	25	ns
$t_r$	Turn–On Rise Time	$V_{GS} = 10\text{ V}, R_{GEN} = 6\text{ }\Omega$		11	20	ns
$t_{d(off)}$	Turn–Off Delay Time			69	110	ns
$t_f$	Turn–Off Fall Time			32	51	ns
$Q_g$	Total Gate Charge	$V_{DS} = 15\text{ V}, I_D = 16\text{ A},$		40	56	nC
$Q_{gs}$	Gate–Source Charge	$V_{GS} = 5\text{ V}$		11		nC
$Q_{gd}$	Gate–Drain Charge			15		nC

**Drain–Source Diode Characteristics and Maximum Ratings**

I <sub>S</sub>	Maximum Continuous Drain–Source Diode Forward Current				2.1	A
V <sub>SD</sub>	Drain–Source Diode Forward Voltage	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 2.1 A (Note 2)		0.7	1.2	V
t <sub>rr</sub>	Diode Reverse Recovery Time	I <sub>F</sub> = 16 A, d <sub>I</sub> F/d <sub>t</sub> = 100 A/μs		38		nS
Q <sub>rr</sub>	Diode Reverse Recovery Charge			53		nC

**Notes:**

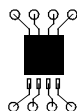
1.  $R_{\theta JA}$  is the sum of the junction-to-case and case-to-ambient thermal resistance where the case thermal reference is defined as the solder mounting surface of the drain pins.  $R_{\theta JC}$  is guaranteed by design while  $R_{\theta CA}$  is determined by the user's board design.



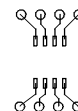
Scale 1 : 1 on letter size paper

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

a) 50 $^\circ\text{C}/\text{W}$  when mounted on a 1in<sup>2</sup> pad of 2 oz copper



b) 105 $^\circ\text{C}/\text{W}$  when mounted on a .04 in<sup>2</sup> pad of 2 oz copper



c) 125 $^\circ\text{C}/\text{W}$  when mounted on a minimum pad.

## Typical Characteristics

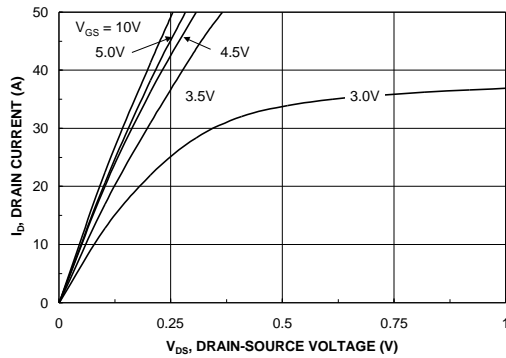


Figure 1. On-Region Characteristics.

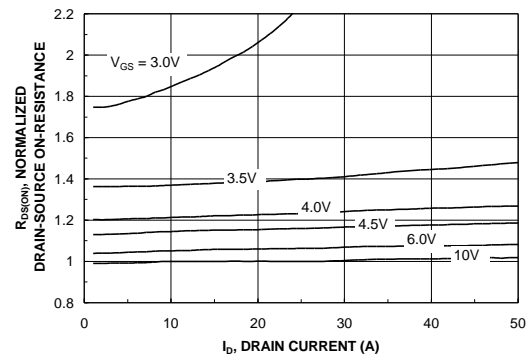


Figure 2. On-Resistance Variation with Drain Current and Gate Voltage.

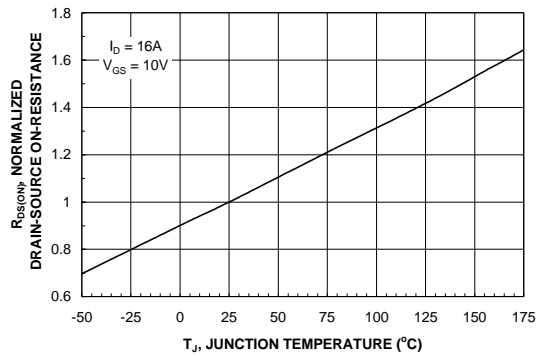


Figure 3. On-Resistance Variation with Temperature.

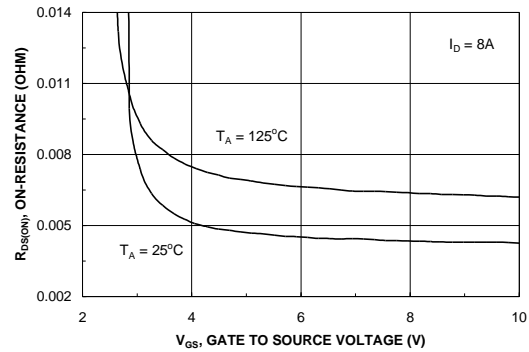


Figure 4. On-Resistance Variation with Gate-to-Source Voltage.

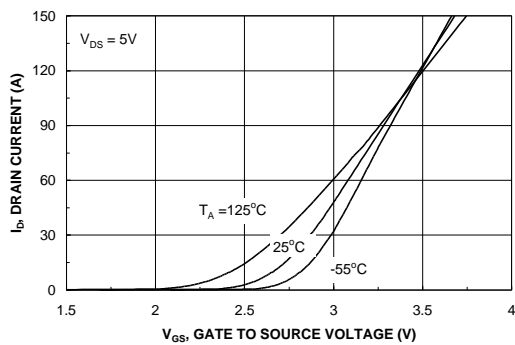


Figure 5. Transfer Characteristics.

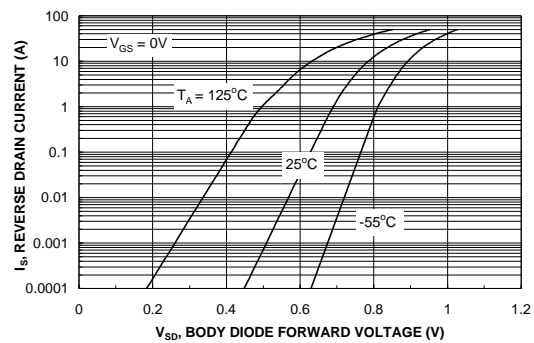


Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature.

## Typical Characteristics

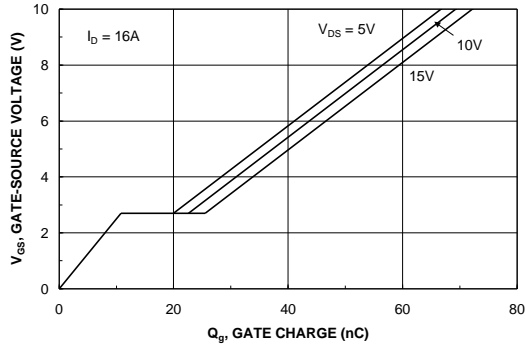


Figure 7. Gate Charge Characteristics.

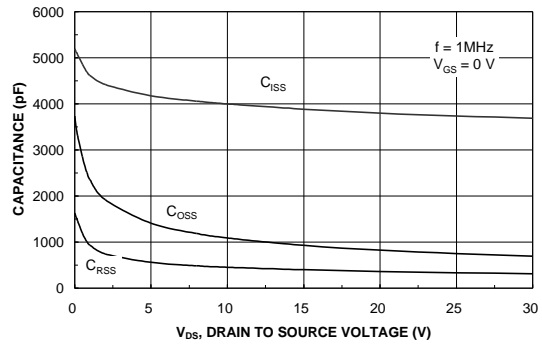


Figure 8. Capacitance Characteristics.

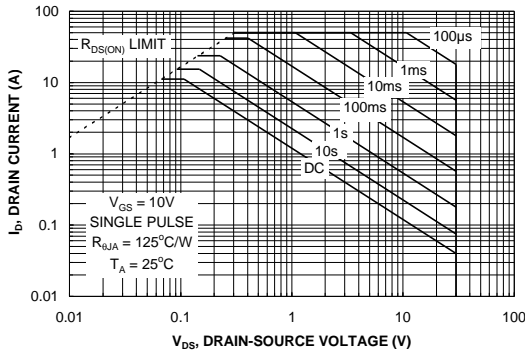


Figure 9. Maximum Safe Operating Area.

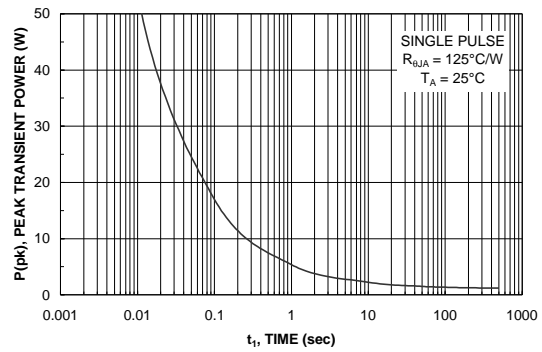


Figure 10. Single Pulse Maximum Power Dissipation.

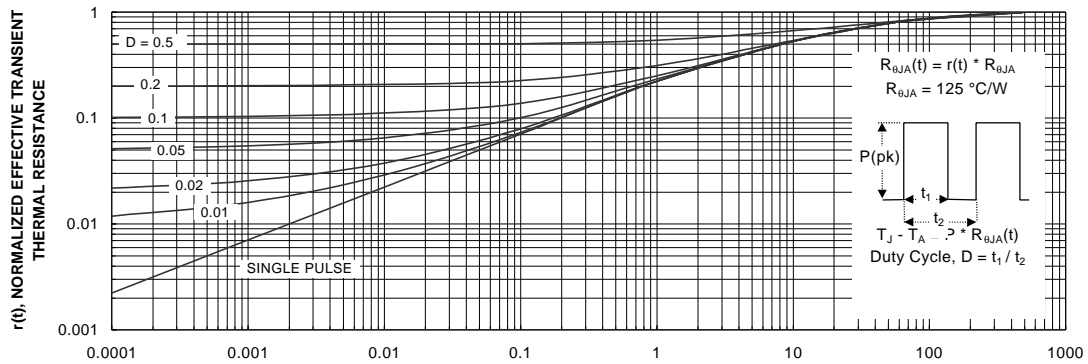


Figure 11. Transient Thermal Response Curve.

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

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