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May 2004

FDS4770

40V N-Channel PowerTrench[®] MOSFET

General Description

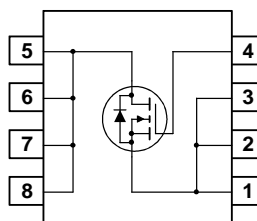
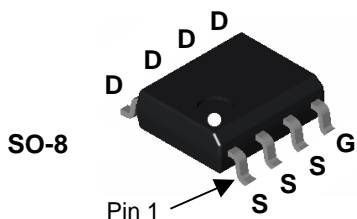
This N-Channel MOSFET has been designed specifically to improve the overall efficiency of DC/DC converters using either synchronous or conventional switching PWM controllers. It has been optimized for low gate charge, low $R_{DS(ON)}$ and fast switching speed.

Applications

- DC/DC converter

Features

- 13.2 A, 40 V. $R_{DS(ON)} = 7.5 \text{ m}\Omega @ V_{GS} = 10 \text{ V}$
- Low gate charge
- 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	40	V
V_{GSS}	Gate-Source Voltage	± 20	V
I_D	Drain Current – Continuous (Note 1a)	13.2	A
	– Pulsed	45	
P_D	Power Dissipation for Single Operation (Note 1a), (Note 1b), (Note 1c)	2.5	W
		1.4	
		1.2	
T_J, T_{STG}	Operating and Storage Junction Temperature Range	-55 to $+150$	$^\circ\text{C}$

Thermal Characteristics

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

Package Marking and Ordering Information

Device Marking	Device	Reel Size	Tape width	Quantity
FDS4770	FDS4770	13"	11mm	2500 units

Electrical Characteristics						
<small>T_A = 25°C unless otherwise noted</small>						
Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
Drain-Source Avalanche Ratings (Note 2)						
E _{AS}	Drain-Source Avalanche Energy	Single Pulse, V _{DD} =20V, I _D =13.2A			370	mJ
I _{AS}	Drain-Source Avalanche Current				13.2	A
Off Characteristics						
BV _{DSS}	Drain-Source Breakdown Voltage	V _{GS} = 0 V, I _D = 250 μA	40			V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	I _D = 250 μA, Referenced to 25°C		42		mV/°C
I _{DSS}	Zero Gate Voltage Drain Current	V _{DS} = 32 V, V _{GS} = 0 V			1	μA
I _{GSSF}	Gate-Body Leakage, Forward	V _{GS} = 20 V, V _{DS} = 0 V			100	nA
I _{GSSR}	Gate-Body Leakage, Reverse	V _{GS} = -20 V, V _{DS} = 0 V			-100	nA
On Characteristics (Note 2)						
V _{GS(th)}	Gate Threshold Voltage	V _{DS} = V _{GS} , I _D = 250 μA	2	3.9	5	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate Threshold Voltage Temperature Coefficient	I _D = 250 μA, Referenced to 25°C		-8		mV/°C
R _{DS(on)}	Static Drain-Source On-Resistance	V _{GS} = 10 V, I _D = 13.2 A V _{GS} = 10 V, I _D = 13.2 A, T _J =125°C		6 9	7.5 10	mΩ
I _{D(on)}	On-State Drain Current	V _{GS} = 10 V, V _{DS} = 5 V	30			A
g _{FS}	Forward Transconductance	V _{DS} = 10 V, I _D = 13.2 A		45		S
Dynamic Characteristics						
C _{iss}	Input Capacitance	V _{DS} = 20 V, V _{GS} = 0 V, f = 1.0 MHz		2819		pF
C _{oss}	Output Capacitance			600		pF
C _{rss}	Reverse Transfer Capacitance			291		pF
Switching Characteristics (Note 2)						
t _{d(on)}	Turn-On Delay Time	V _{DD} = 20 V, I _D = 1 A, V _{GS} = 10 V, R _{GEN} = 6 Ω		16	29	ns
t _r	Turn-On Rise Time			12	22	ns
t _{d(off)}	Turn-Off Delay Time			41	66	ns
t _f	Turn-Off Fall Time			29	46	ns
Q _g	Total Gate Charge	V _{DS} = 20 V, I _D = 13.2 A, V _{GS} = 10 V		47	67	nC
Q _{gs}	Gate-Source Charge			15		nC
Q _{gd}	Gate-Drain Charge			14		nC

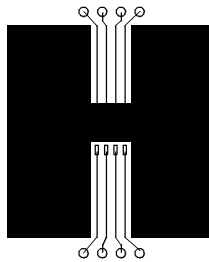
Electrical Characteristics

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

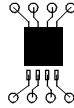
Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
Drain-Source Diode Characteristics and Maximum Ratings						
I_S	Maximum Continuous Drain-Source Diode Forward Current				2.1	A
V_{SD}	Drain-Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_S = 2.1\text{ A}$ (Note 2)		0.7	1.2	V
t_{rr}	Diode Reverse Recovery Time	$I_F = 13.2\text{ A}, dI_F/dt = 100\text{ A}/\mu\text{s}$		32		nS
Q_{rr}	Diode Reverse Recovery Charge			39		nC

Notes:

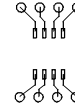
1. $R_{\theta JA}$ is the sum of the junction-to-case and case-to-ambient thermal resistance where the case thermal reference is defined as the solder mounting surface of the drain pins. $R_{\theta JC}$ is guaranteed by design while $R_{\theta CA}$ is determined by the user's board design.



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



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



c) $125^\circ\text{C}/\text{W}$ 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%

Typical Characteristics

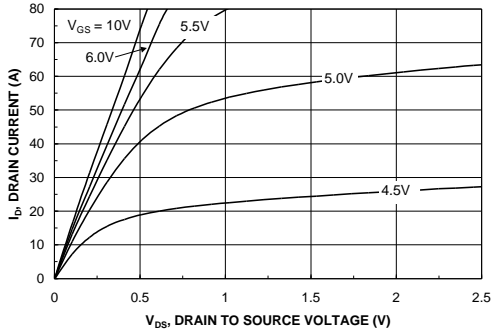


Figure 1. On-Region Characteristics.

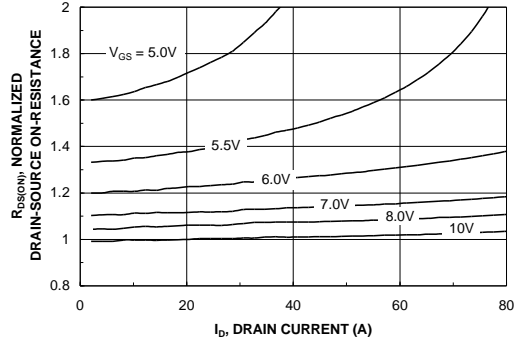


Figure 2. On-Resistance Variation with Drain Current and Gate Voltage.

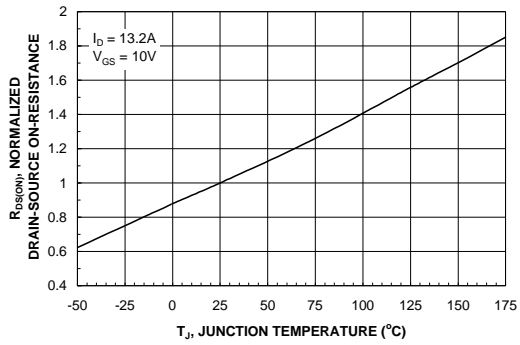


Figure 3. On-Resistance Variation with Temperature.

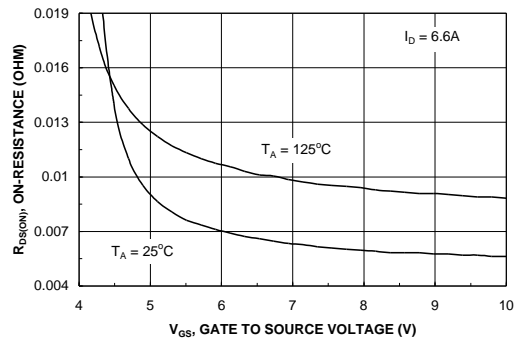


Figure 4. On-Resistance Variation with Gate-to-Source Voltage.

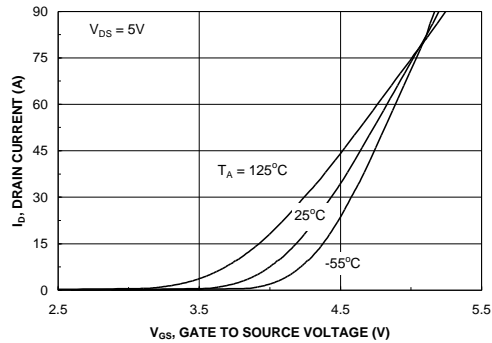


Figure 5. Transfer Characteristics.

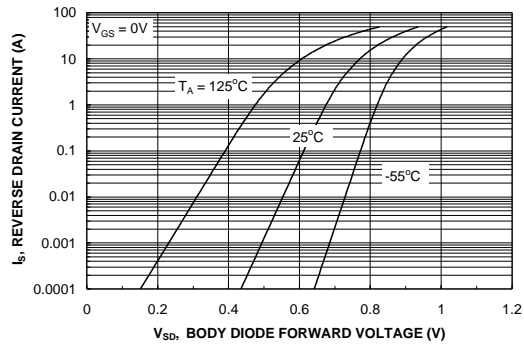


Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature.

Typical Characteristics

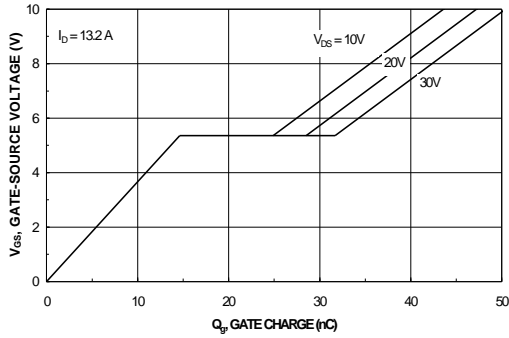


Figure 7. Gate Charge Characteristics.

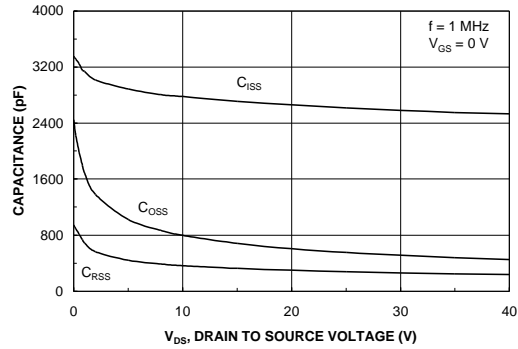


Figure 8. Capacitance Characteristics.

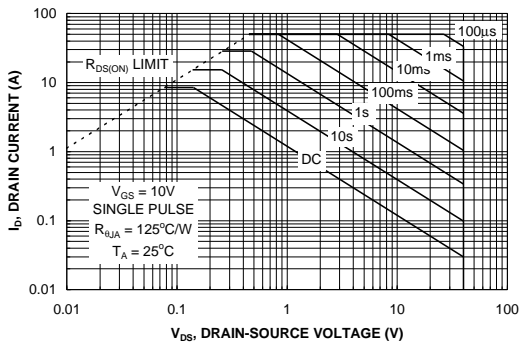


Figure 9. Maximum Safe Operating Area.

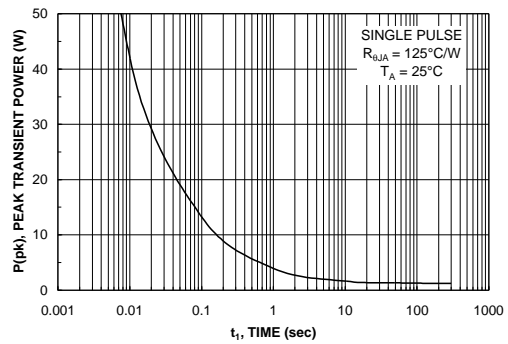


Figure 10. Single Pulse Maximum Power Dissipation.

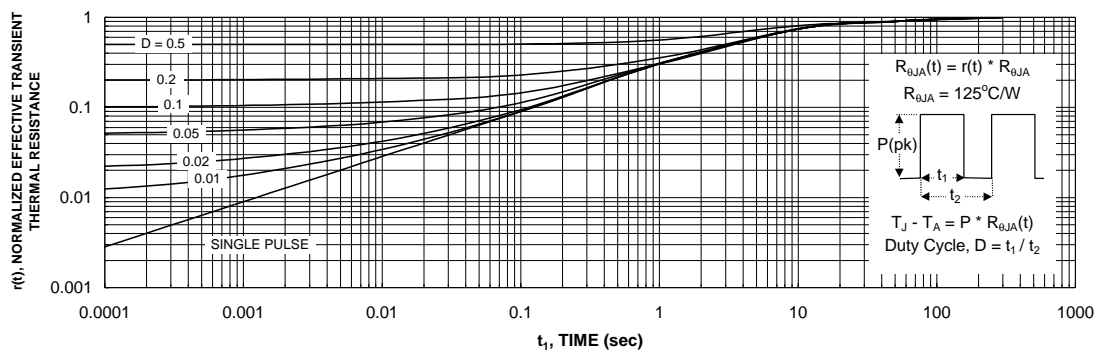


Figure 11. Transient Thermal Response Curve.

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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