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ON Semiconductor®

FDD5N50FTM-WS

N-Channel UniFET™ FRFET® MOSFET 500 V, 3.5 A, 1.55 Ω

Features

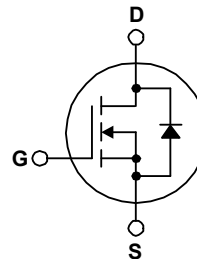
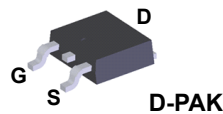
- $R_{DS(on)} = 1.25\Omega$ (Typ.) @ $V_{GS} = 10\text{ V}$, $I_D = 1.75\text{ A}$
- Low Gate Charge (Typ. 11 nC)
- Low C_{rss} (Typ. 5 pF)
- Fast Switching
- 100% Avalanche Tested
- Improved dv/dt Capability
- RoHS Compliant

Applications

- LCD/LED/PDP TV
- Lighting
- Uninterruptible Power Supply
- AC-DC Power Supply

Description

UniFET™ MOSFET is ON Semiconductor's high voltage MOSFET family based on planar stripe and DMOS technology. This MOSFET is tailored to reduce on-state resistance, and to provide better switching performance and higher avalanche energy strength. The body diode's reverse recovery performance of UniFET FRFET® MOSFET has been enhanced by lifetime control. Its t_{rr} is less than 100nsec and the reverse dv/dt immunity is 15V/ns while normal planar MOSFETs have over 200nsec and 4.5V/nsec respectively. Therefore, it can remove additional component and improve system reliability in certain applications in which the performance of MOSFET's body diode is significant. This device family is suitable for switching power converter applications such as power factor correction (PFC), flat panel display (FPD) TV power, ATX and electronic lamp ballasts.



MOSFET Maximum Ratings $T_C = 25^\circ\text{C}$ unless otherwise noted.

Symbol	Parameter	Ratings	Units
V_{DSS}	Drain to Source Voltage	500	V
V_{GSS}	Gate to Source Voltage	±30	V
I_D	Drain Current	- Continuous ($T_C = 25^\circ\text{C}$)	3.5
		- Continuous ($T_C = 100^\circ\text{C}$)	2.1
I_{DM}	Drain Current	- Pulsed (Note 1)	14
E_{AS}	Single Pulsed Avalanche Energy	(Note 2)	257
I_{AR}	Avalanche Current	(Note 1)	3.5
E_{AR}	Repetitive Avalanche Energy	(Note 1)	4
dv/dt	Peak Diode Recovery dv/dt	(Note 3)	4.5
P_D	Power Dissipation	($T_C = 25^\circ\text{C}$)	40
		- Derate Above 25°C	0.3
T_J, T_{STG}	Operating and Storage Temperature Range	-55 to +150	$^\circ\text{C}$
T_L	Maximum Lead Temperature for Soldering, 1/8" from Case for 5 Seconds	300	$^\circ\text{C}$

Thermal Characteristics

Symbol	Parameter	Ratings	Units
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	1.4	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max.	110	

Package Marking and Ordering Information

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FDD5N50FTM-WS	FDD5N50F	D-PAK	Tape and Reel	330 mm	16 mm	2500 units

Electrical Characteristics $T_C = 25^\circ\text{C}$ unless otherwise noted.

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
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Off Characteristics

BV_{DSS}	Drain to Source Breakdown Voltage	$I_D = 250 \mu\text{A}, V_{GS} = 0 \text{ V}, T_J = 25^\circ\text{C}$	500	-	-	V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 250 \mu\text{A}, \text{Referenced to } 25^\circ\text{C}$	-	0.6	-	$\text{V}/^\circ\text{C}$
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 500 \text{ V}, V_{GS} = 0 \text{ V}$ $V_{DS} = 400 \text{ V}, T_C = 125^\circ\text{C}$	-	-	10 100	μA
I_{GSS}	Gate to Body Leakage Current	$V_{GS} = \pm 30 \text{ V}, V_{DS} = 0 \text{ V}$	-	-	± 100	nA

On Characteristics

$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 250 \mu\text{A}$	3.0	-	5.0	V
$R_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = 10 \text{ V}, I_D = 1.75 \text{ A}$	-	1.25	1.55	Ω
g_{FS}	Forward Transconductance	$V_{DS} = 20 \text{ V}, I_D = 1.75 \text{ A}$	-	4.3	-	S

Dynamic Characteristics

C_{iss}	Input Capacitance	$V_{DS} = 25 \text{ V}, V_{GS} = 0 \text{ V}$ $f = 1 \text{ MHz}$	-	490	650	pF
C_{oss}	Output Capacitance		-	66	88	pF
C_{rss}	Reverse Transfer Capacitance		-	5	7.5	pF
$Q_{g(tot)}$	Total Gate Charge at 10V	$V_{DS} = 400 \text{ V}, I_D = 5 \text{ A},$ $V_{GS} = 10 \text{ V}$	-	11	15	nC
Q_{gs}	Gate to Source Gate Charge		-	3	-	nC
Q_{gd}	Gate to Drain "Miller" Charge		-	5	-	nC

(Note 4)

Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 250 \text{ V}, I_D = 5 \text{ A}$ $R_G = 25 \Omega$	-	13	36	ns
t_r	Turn-On Rise Time		-	22	54	ns
$t_{d(off)}$	Turn-Off Delay Time		-	28	66	ns
t_f	Turn-Off Fall Time		-	20	50	ns

(Note 4)

Drain-Source Diode Characteristics

I_S	Maximum Continuous Drain to Source Diode Forward Current	-	-	3.5	A	
I_{SM}	Maximum Pulsed Drain to Source Diode Forward Current	-	-	14	A	
V_{SD}	Drain to Source Diode Forward Voltage	$V_{GS} = 0 \text{ V}, I_{SD} = 3.5 \text{ A}$	-	-	1.5	V
t_{rr}	Reverse Recovery Time	$V_{GS} = 0 \text{ V}, I_{SD} = 5 \text{ A}$	-	65	-	ns
Q_{rr}	Reverse Recovery Charge	$di_F/dt = 100 \text{ A}/\mu\text{s}$	-	0.120	-	μC

Notes:

- 1: Repetitive rating; pulse-width limited by maximum junction temperature.
- 2: $L = 42 \text{ mH}, I_{AS} = 3.5 \text{ A}, V_{DD} = 50 \text{ V}, R_G = 25 \Omega$, starting $T_J = 25^\circ\text{C}$.
- 3: $I_{SD} \leq 3.5 \text{ A}, di/dt \leq 200 \text{ A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$, starting $T_J = 25^\circ\text{C}$.
- 4: Essentially independent of operating temperature typical characteristics.

Typical Performance Characteristics

Figure 1. On-Region Characteristics

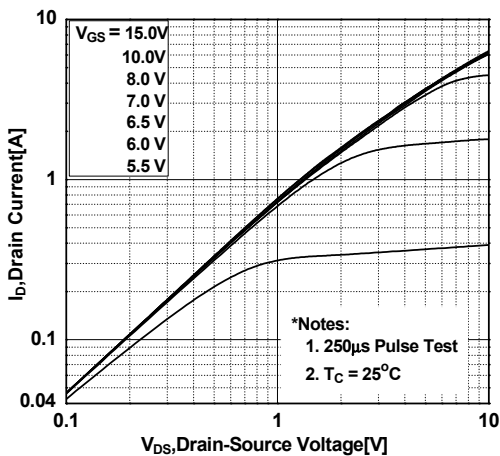


Figure 2. Transfer Characteristics

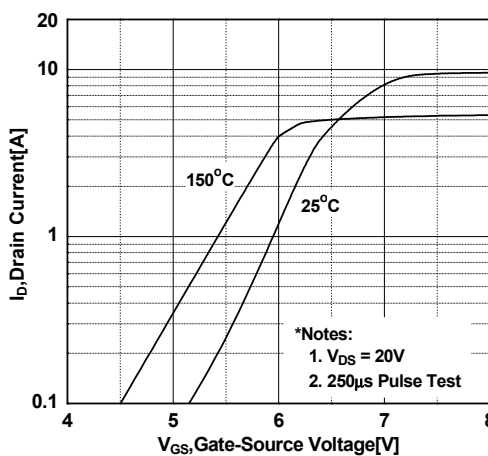


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

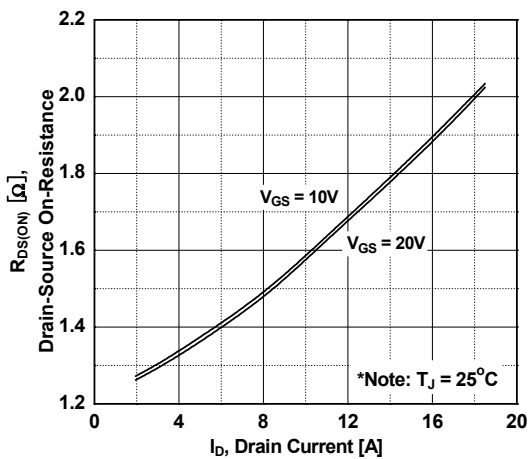


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

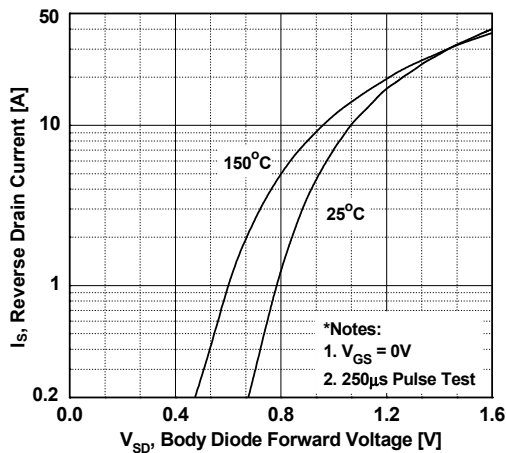


Figure 5. Capacitance Characteristics

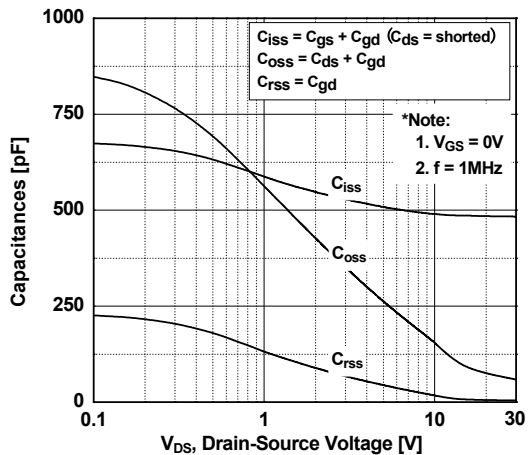
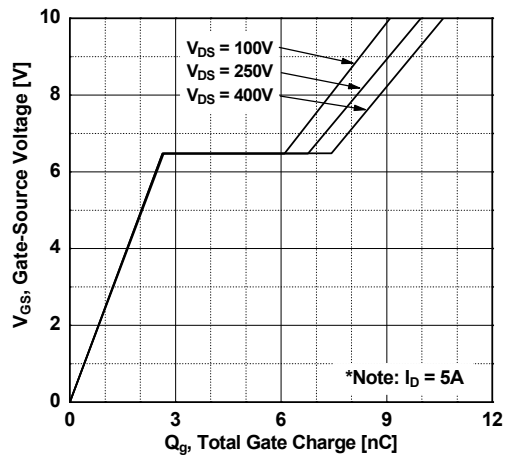


Figure 6. Gate Charge Characteristics



Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

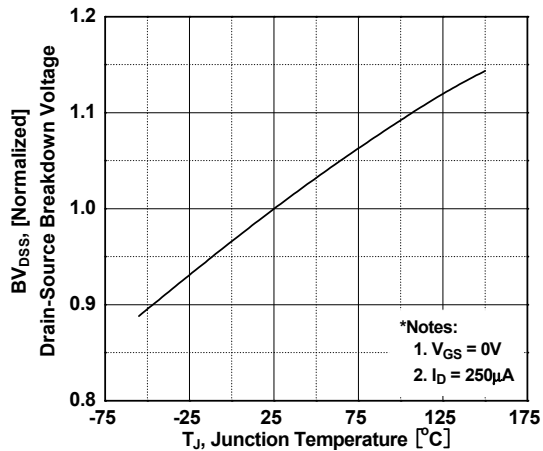


Figure 8. Maximum Safe Operating Area

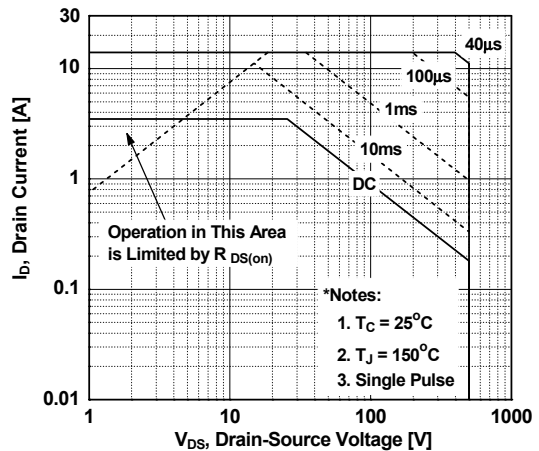


Figure 9. Maximum Drain Current

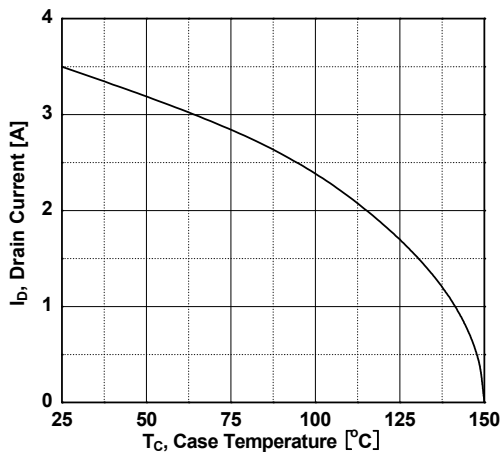
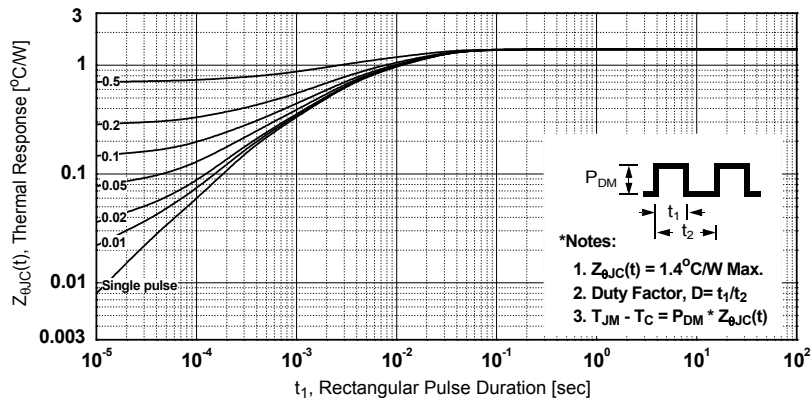


Figure 10. Transient Thermal Response Curve



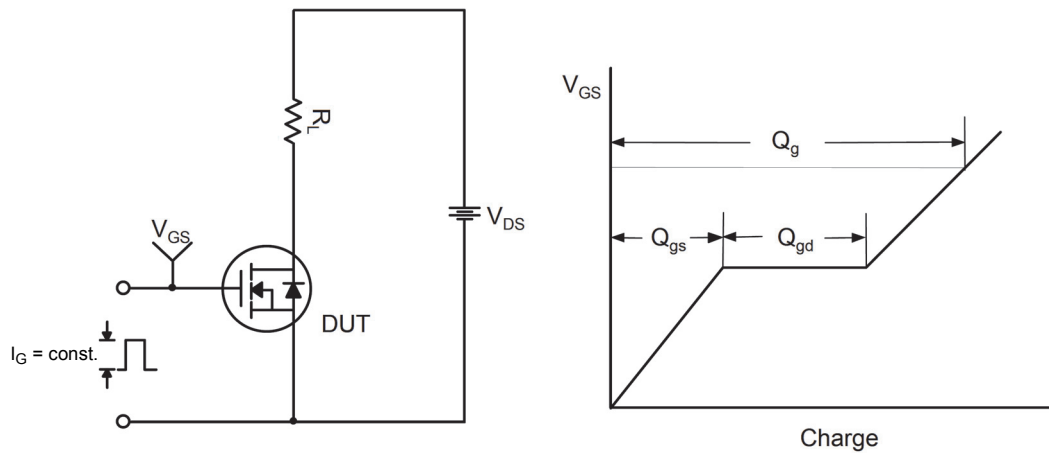


Figure 11. Gate Charge Test Circuit & Waveform

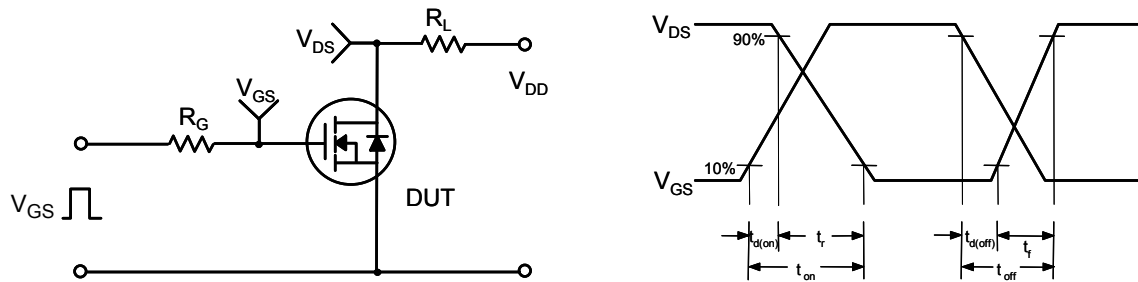


Figure 12. Resistive Switching Test Circuit & Waveforms

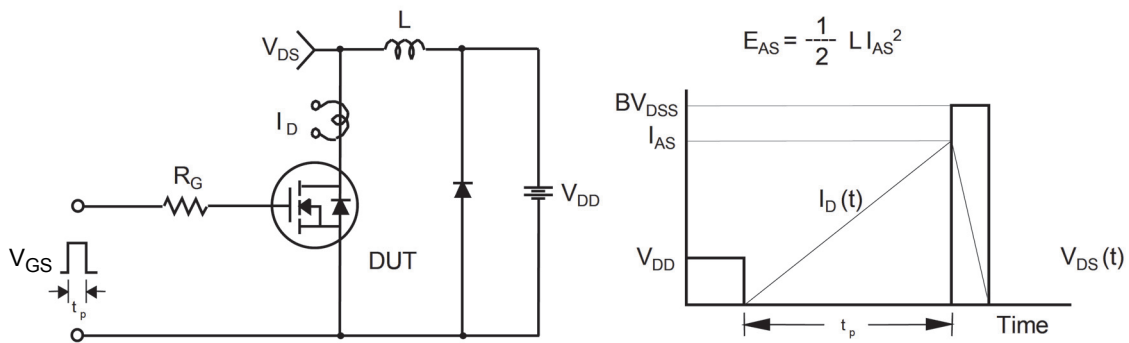


Figure 13. Unclamped Inductive Switching Test Circuit & Waveforms

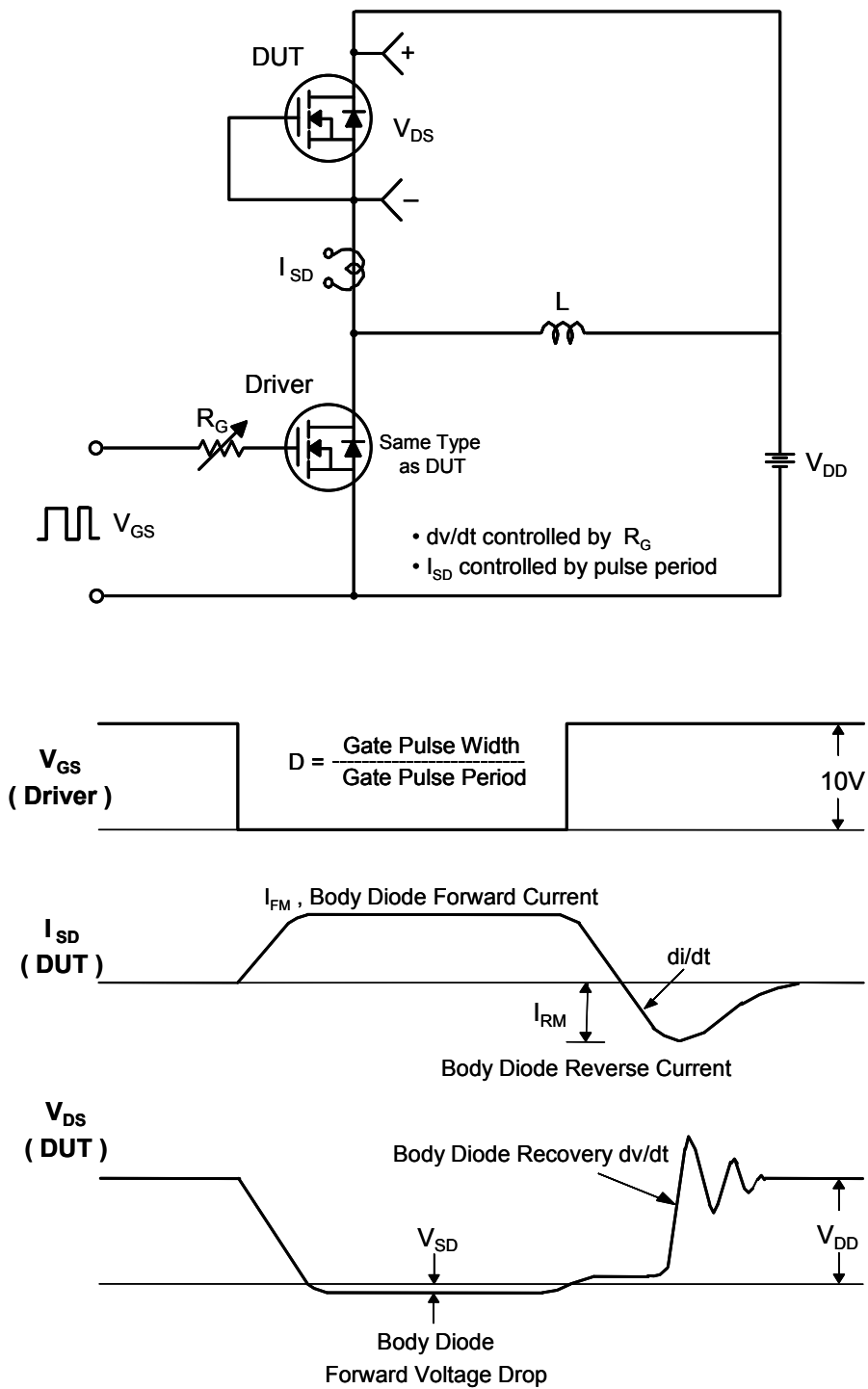


Figure 14. Peak Diode Recovery dv/dt Test Circuit & Waveforms

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