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ON Semiconductor®

# FDA20N50-F109

## N-Channel UniFET™ MOSFET

500 V, 20 A, 230 mΩ

### Features

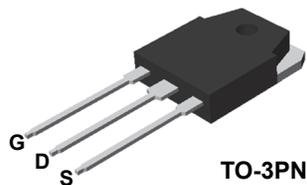
- $R_{DS(on)} = 230 \text{ m}\Omega$  (Max.) @  $V_{GS} = 10 \text{ V}$ ,  $I_D = 10 \text{ A}$
- Low Gate Charge (Typ. 45.6 nC)
- Low  $C_{rss}$  (Typ. 27 pF)
- 100% Avalanche Tested
- Improved dv/dt Capability

### Applications

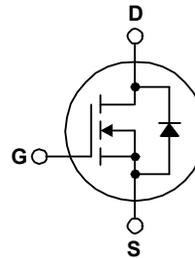
- PDP TV
- Uninterruptible Power Supply
- AC-DC Power Supply

### 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. 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.



TO-3PN



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

Symbol	Parameter		FDA20N50-F109	Unit
$V_{DSS}$	Drain-Source Voltage		500	V
$I_D$	Drain Current	- Continuous ( $T_C = 25^\circ\text{C}$ )	22	A
		- Continuous ( $T_C = 100^\circ\text{C}$ )	13.2	A
$I_{DM}$	Drain Current	- Pulsed (Note 1)	88	A
$V_{GSS}$	Gate-Source voltage		$\pm 30$	V
$E_{AS}$	Single Pulsed Avalanche Energy (Note 2)		1110	mJ
$I_{AR}$	Avalanche Current (Note 1)		22	A
$E_{AR}$	Repetitive Avalanche Energy (Note 1)		28.0	mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)		20	V/ns
$P_D$	Power Dissipation	( $T_C = 25^\circ\text{C}$ )	280	W
		- Derate above $25^\circ\text{C}$	2.3	W/ $^\circ\text{C}$
$T_J, T_{STG}$	Operating and Storage Temperature Range		-55 to +150	$^\circ\text{C}$
$T_L$	Maximum Lead Temperature for Soldering Purpose, 1/8" from Case for 5 Seconds		300	$^\circ\text{C}$

### Thermal Characteristics

Symbol	Parameter	FDA20N50-F109	Unit
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case, Max.	0.44	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient, Max.	40	$^\circ\text{C}/\text{W}$

## Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FDA20N50	FDA20N50-F109	TO-3PN	Tube	N/A	30 units

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

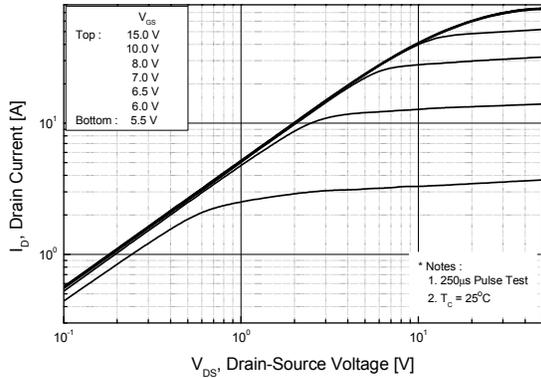
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Off Characteristics</b>						
$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS} = 0V, I_D = 250\mu A, T_J = 25^\circ\text{C}$	500	--	--	V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 250\mu A$ , Referenced to $25^\circ\text{C}$	--	0.50	--	$V/^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 500V, V_{GS} = 0V$ $V_{DS} = 400V, T_C = 125^\circ\text{C}$	--	--	1 10	$\mu A$ $\mu A$
$I_{GSSF}$	Gate-Body Leakage Current, Forward	$V_{GS} = 30V, V_{DS} = 0V$	--	--	100	nA
$I_{GSSR}$	Gate-Body Leakage Current, Reverse	$V_{GS} = -30V, V_{DS} = 0V$	--	--	-100	nA
<b>On Characteristics</b>						
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\mu A$	3.0	--	5.0	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = 10V, I_D = 11A$	--	0.20	0.23	$\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS} = 40V, I_D = 11A$	--	24.6	--	S
<b>Dynamic Characteristics</b>						
$C_{iss}$	Input Capacitance	$V_{DS} = 25V, V_{GS} = 0V,$ $f = 1.0\text{MHz}$	--	2400	3120	pF
$C_{oss}$	Output Capacitance		--	355	465	pF
$C_{rss}$	Reverse Transfer Capacitance		--	27	--	pF
<b>Switching Characteristics</b>						
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 250V, I_D = 20A$ $R_G = 25\Omega$	--	95	200	ns
$t_r$	Turn-On Rise Time		--	375	760	ns
$t_{d(off)}$	Turn-Off Delay Time		--	100	210	ns
$t_f$	Turn-Off Fall Time		(Note 4)	--	105	220
$Q_g$	Total Gate Charge	$V_{DS} = 400V, I_D = 20A$ $V_{GS} = 10V$	--	45.6	59.5	nC
$Q_{gs}$	Gate-Source Charge		--	14.8	--	nC
$Q_{gd}$	Gate-Drain Charge		(Note 4)	--	21.6	--
<b>Drain-Source Diode Characteristics and Maximum Ratings</b>						
$I_S$	Maximum Continuous Drain-Source Diode Forward Current		--	--	20	A
$I_{SM}$	Maximum Pulsed Drain-Source Diode Forward Current		--	--	80	A
$V_{SD}$	Drain-Source Diode Forward Voltage	$V_{GS} = 0V, I_S = 22A$	--	--	1.4	V
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0V, I_S = 20A$ $di_F/dt = 100A/\mu s$	--	507	--	ns
$Q_{rr}$	Reverse Recovery Charge		--	7.20	--	$\mu C$

### NOTES:

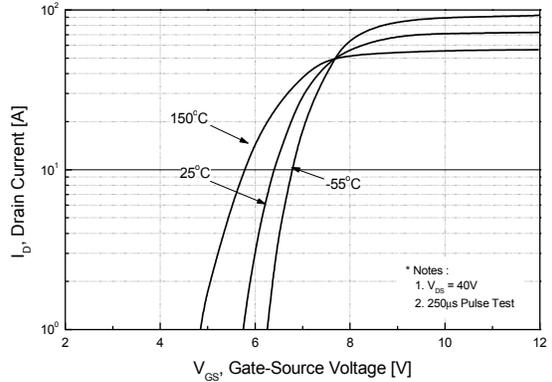
1. Repetitive Rating: Pulse width limited by maximum junction temperature
2.  $L = 4.1\text{mH}, I_{AS} = 22A, V_{DD} = 50V, R_G = 25\Omega$ , Starting  $T_J = 25^\circ\text{C}$
3.  $I_{SD} \leq 22A, di/dt \leq 200A/\mu s, V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$
4. Essentially Independent of Operating Temperature Typical Characteristics

## Typical Characteristics

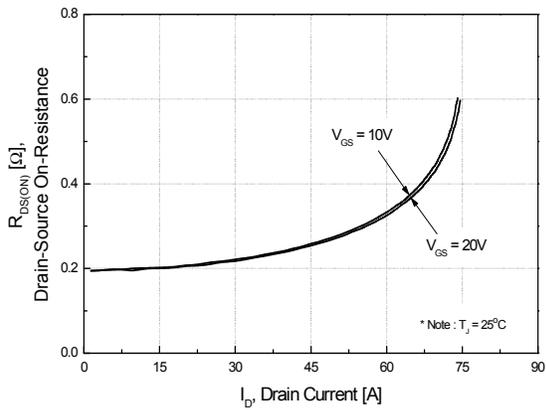
**Figure 1. On-Region Characteristics**



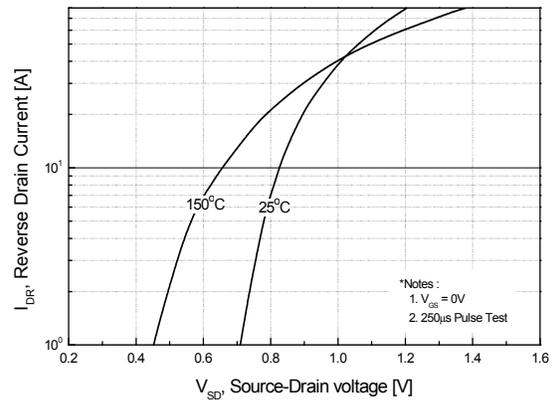
**Figure 2. Transfer Characteristics**



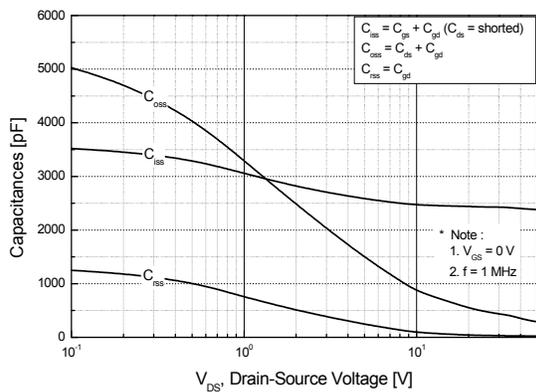
**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**



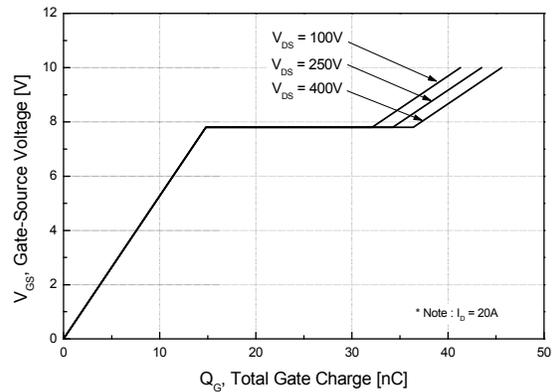
**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**



**Figure 5. Capacitance Characteristics**

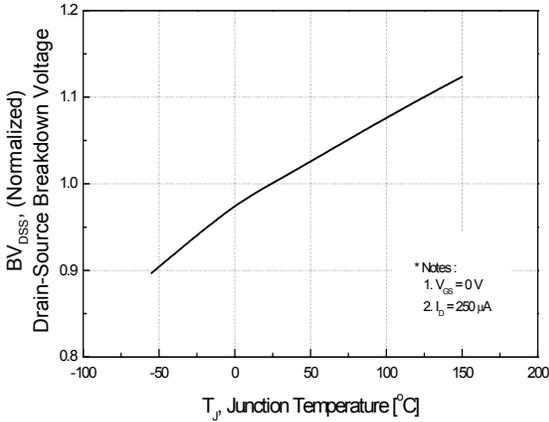


**Figure 6. Gate Charge Characteristics**

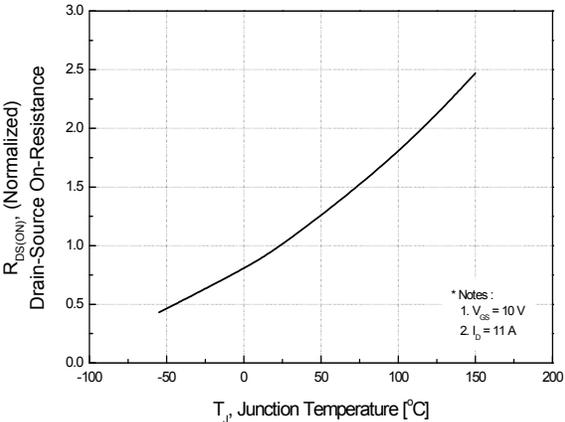


**Typical Characteristics** (Continued)

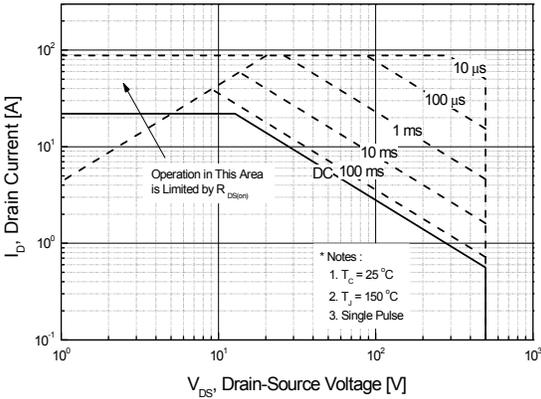
**Figure 7. Breakdown Voltage Variation vs. Temperature**



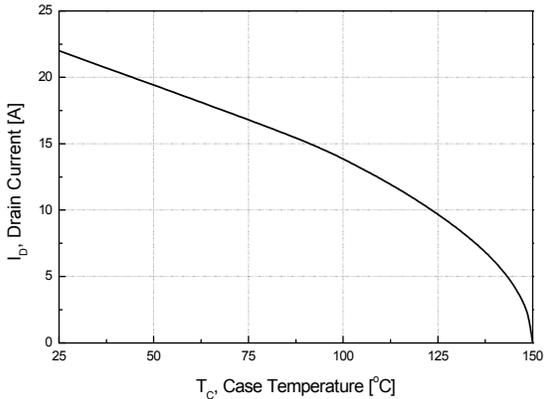
**Figure 8. On-Resistance Variation vs. Temperature**



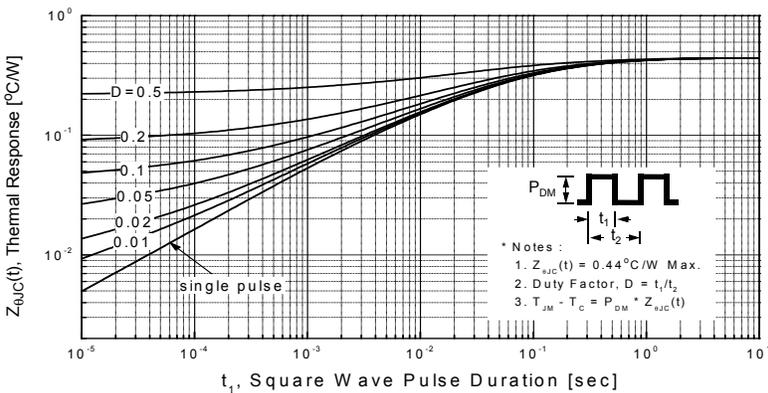
**Figure 9. Safe Operating Area**



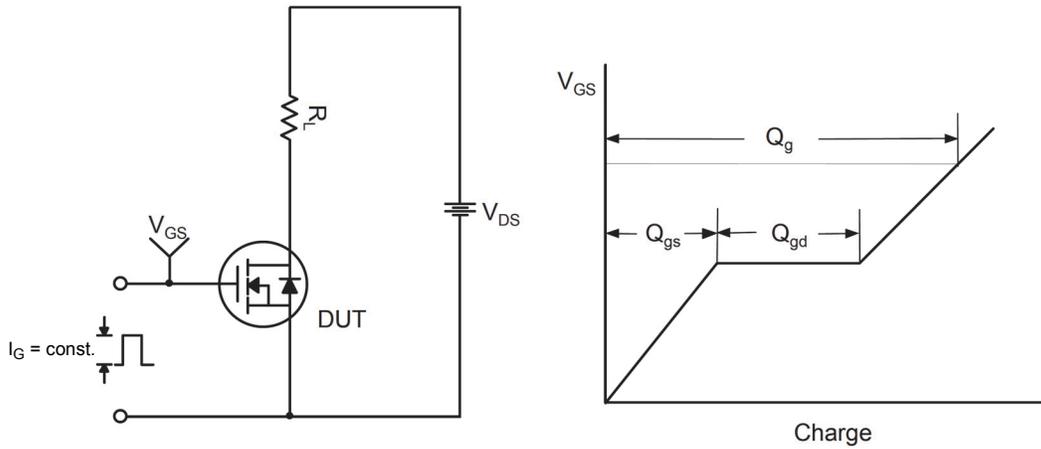
**Figure 10. Maximum Drain Current vs. Case Temperature**



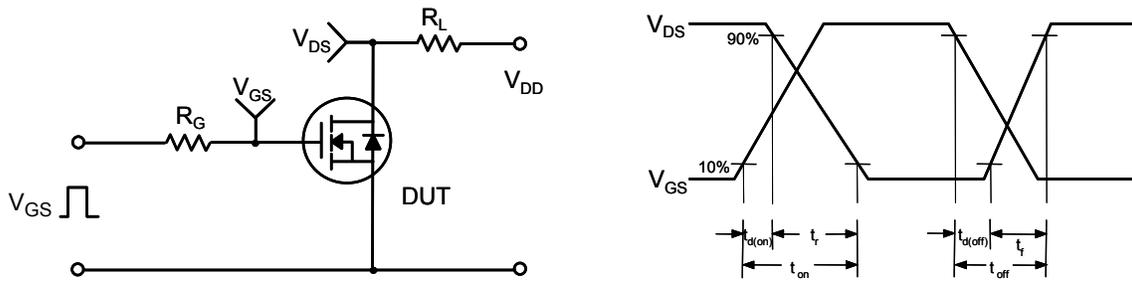
**Figure 11. Transient Thermal Response Curve**



**Figure 12. Gate Charge Test Circuit & Waveform**



**Figure 13. Resistive Switching Test Circuit & Waveforms**



**Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms**

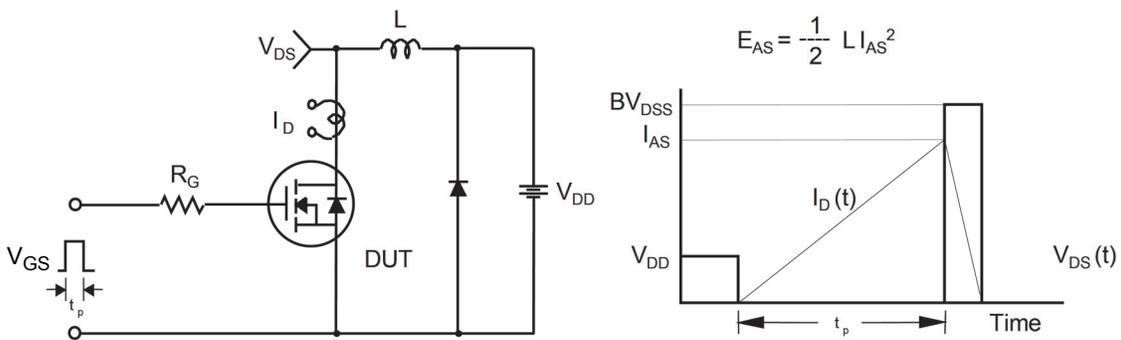
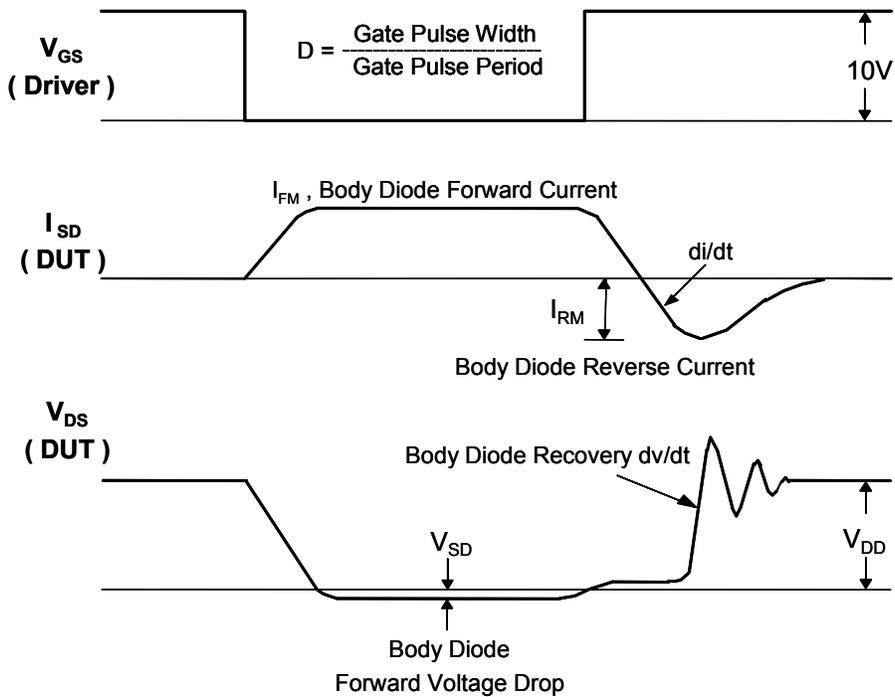
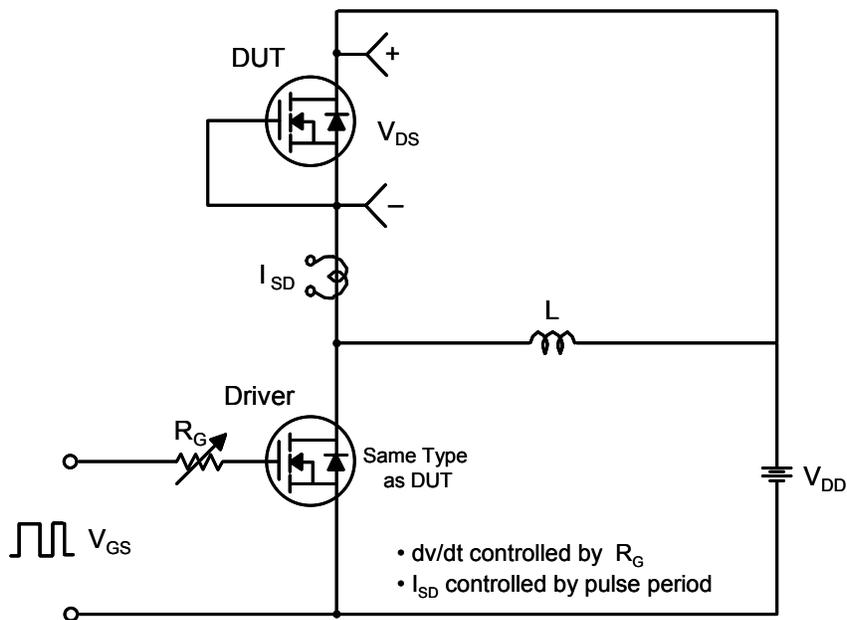


Figure 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms





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