



May 2014

FDA24N40F

N-Channel UniFET™ FRFET® MOSFET

400 V, 23 A, 190 mΩ

Features

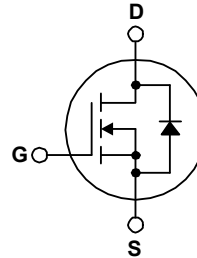
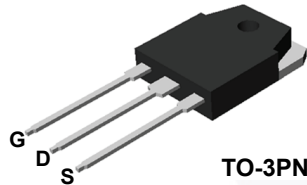
- $R_{DS(on)} = 150 \text{ m}\Omega$ (Typ.) @ $V_{GS} = 10 \text{ V}$, $I_D = 11.5 \text{ A}$
- Low Gate Charge (Typ. 46 nC)
- Low C_{rss} (Typ. 25 pF)
- 100% Avalanche Tested
- RoHS Compliant

Applications

- Uninterruptible Power Supply
- AC-DC Power Supply

Description

UniFET™ MOSFET is Fairchild 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 trr 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	FDA24N40F	Unit
V_{DSS}	Drain to Source Voltage	400	V
V_{GSS}	Gate to Source Voltage	±30	V
I_D	Drain Current	- Continuous ($T_C = 25^\circ\text{C}$)	23
		- Continuous ($T_C = 100^\circ\text{C}$)	13.8
I_{DM}	Drain Current	- Pulsed (Note 1)	92
E_{AS}	Single Pulsed Avalanche Energy (Note 2)	1190	mJ
I_{AR}	Avalanche Current (Note 1)	23	A
E_{AR}	Repetitive Avalanche Energy (Note 1)	23.5	mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	4.5	V/ns
P_D	Power Dissipation ($T_C = 25^\circ\text{C}$)		235
		- Derate Above 25°C	1.8
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	FDA24N40F	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	0.53	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max.	40	

FDA24N40F — N-Channel UniFET™ FRFET® MOSFET

Package Marking and Ordering Information

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FDA24N40F	FDA24N40F	TO-3PN	Tube	N/A	N/A	30 units

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

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

BV_{DSS}	Drain to Source Breakdown Voltage	$I_D = 250 \mu\text{A}$, $V_{GS} = 0 \text{ V}$, $T_J = 25^\circ\text{C}$	400	-	-	V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 250 \mu\text{A}$, Referenced to 25°C	-	0.5	-	$\text{V}/^\circ\text{C}$
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 400 \text{ V}$, $V_{GS} = 0 \text{ V}$ $V_{DS} = 320 \text{ V}$, $T_C = 125^\circ\text{C}$	-	-	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	$V_{GS} = 10 \text{ V}$, $I_D = 11.5 \text{ A}$	-	0.15	0.19	Ω
g_{FS}	Forward Transconductance	$V_{DS} = 20 \text{ V}$, $I_D = 11.5 \text{ A}$	-	29	-	S

Dynamic Characteristics

C_{iss}	Input Capacitance	$V_{DS} = 25 \text{ V}$, $V_{GS} = 0 \text{ V}$, $f = 1 \text{ MHz}$	-	2280	3030	pF
C_{oss}	Output Capacitance		-	370	490	pF
C_{rss}	Reverse Transfer Capacitance		-	25	38	pF
$Q_{g(tot)}$	Total Gate Charge at 10V	$V_{DS} = 320 \text{ V}$, $I_D = 23 \text{ A}$, $V_{GS} = 10 \text{ V}$	-	46	60	nC
Q_{gs}	Gate to Source Gate Charge		-	13	-	nC
Q_{gd}	Gate to Drain "Miller" Charge		(Note 4)	-	18	-

Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DS} = 200 \text{ V}$, $I_D = 23 \text{ A}$, $V_{GS} = 10 \text{ V}$, $R_G = 25 \Omega$	-	40	90	ns	
t_r	Turn-On Rise Time		-	92	195	ns	
$t_{d(off)}$	Turn-Off Delay Time		(Note 4)	-	120	250	ns
t_f	Turn-Off Fall Time		-	75	160	ns	

Drain-Source Diode Characteristics

I_S	Maximum Continuous Drain to Source Diode Forward Current	-	-	23	A	
I_{SM}	Maximum Pulsed Drain to Source Diode Forward Current	-	-	92	A	
V_{SD}	Drain to Source Diode Forward Voltage	$V_{GS} = 0 \text{ V}$, $I_{SD} = 23 \text{ A}$	-	-	1.5	V
t_{rr}	Reverse Recovery Time	$V_{GS} = 0 \text{ V}$, $I_{SD} = 23 \text{ A}$, $di_F/dt = 100 \text{ A}/\mu\text{s}$	-	110	-	ns
Q_{rr}	Reverse Recovery Charge		-	0.3	-	μC

Notes:

- 1: Repetitive rating: pulse-width limited by maximum junction temperature.
- 2: $L = 4.5 \text{ mH}$, $I_{AS} = 23 \text{ A}$, $V_{DD} = 50 \text{ V}$, $R_G = 25 \Omega$, starting $T_J = 25^\circ\text{C}$.
- 3: $I_{SD} \leq 23 \text{ A}$, $di/dt \leq 200 \text{ A}/\mu\text{s}$, $V_{DD} \leq BV_{DSS}$, starting $T_J = 25^\circ\text{C}$.
- 4: Essentially independent of operating temperature typical characteristics.

Typical Performance Characteristics

Figure 1. On-Region Characteristics

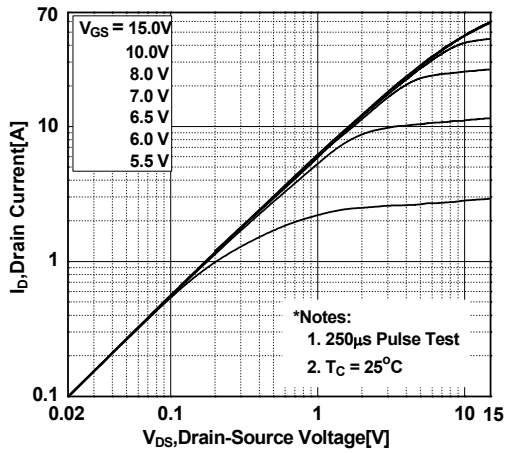


Figure 2. Transfer Characteristics

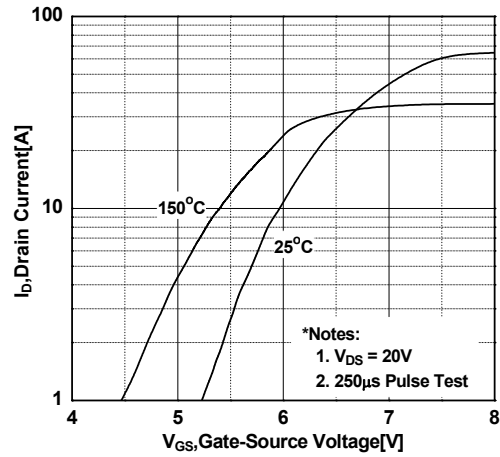


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

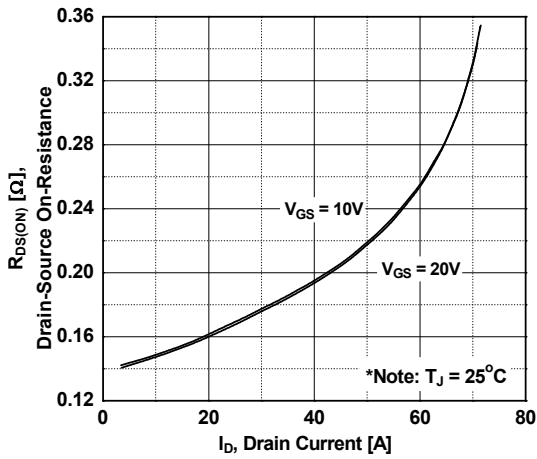


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

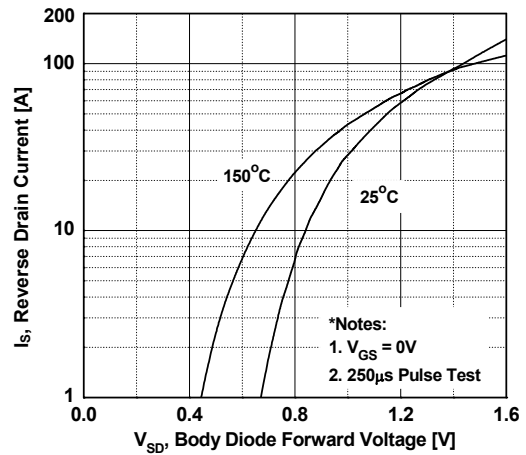


Figure 5. Capacitance Characteristics

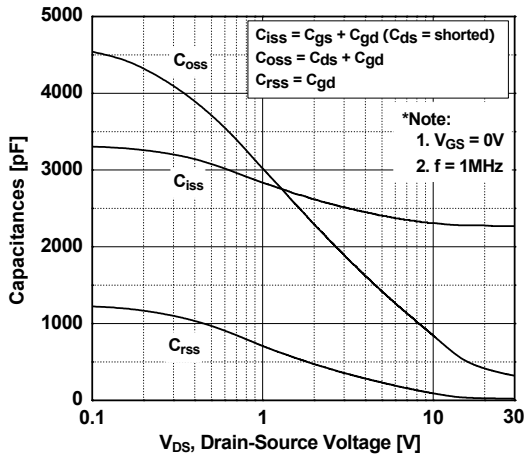
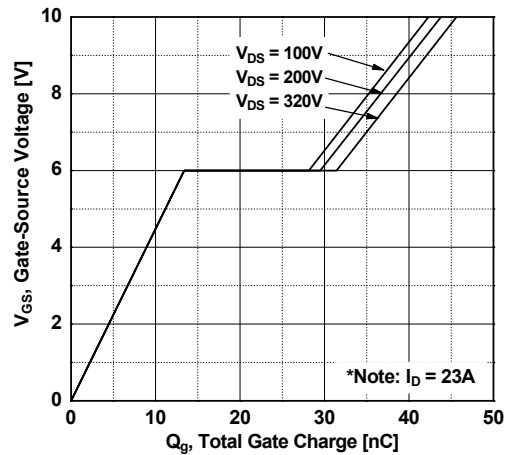


Figure 6. Gate Charge Characteristics



Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

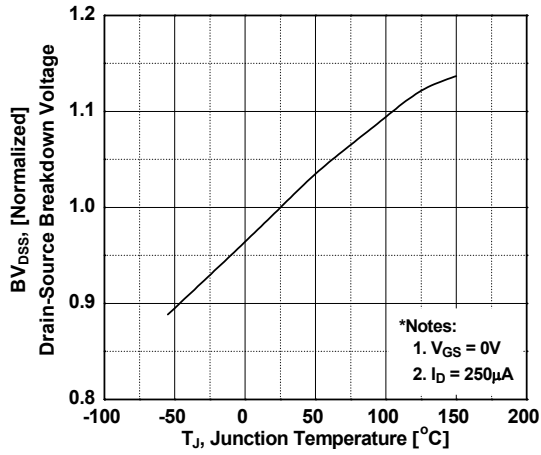


Figure 8. Maximum Safe Operating Area

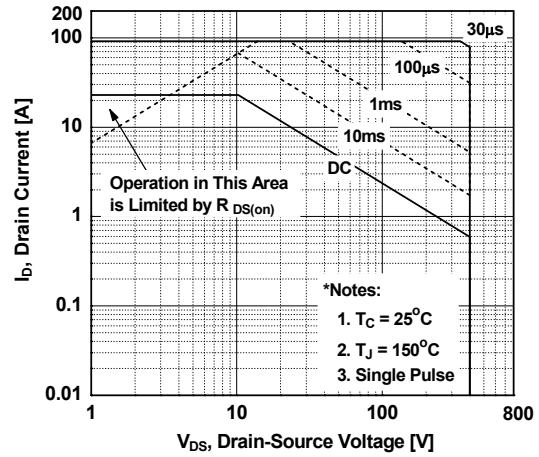


Figure 9. Maximum Drain Current vs. Case Temperature

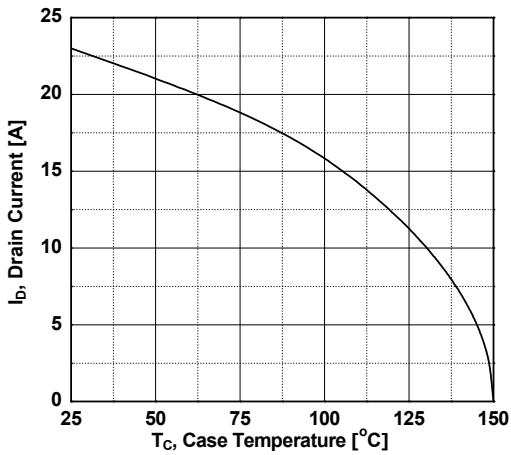
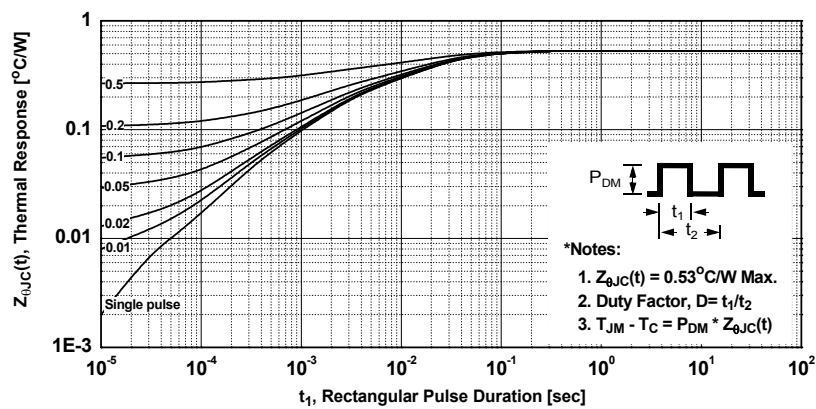


Figure 10. Transient Thermal Response Curve



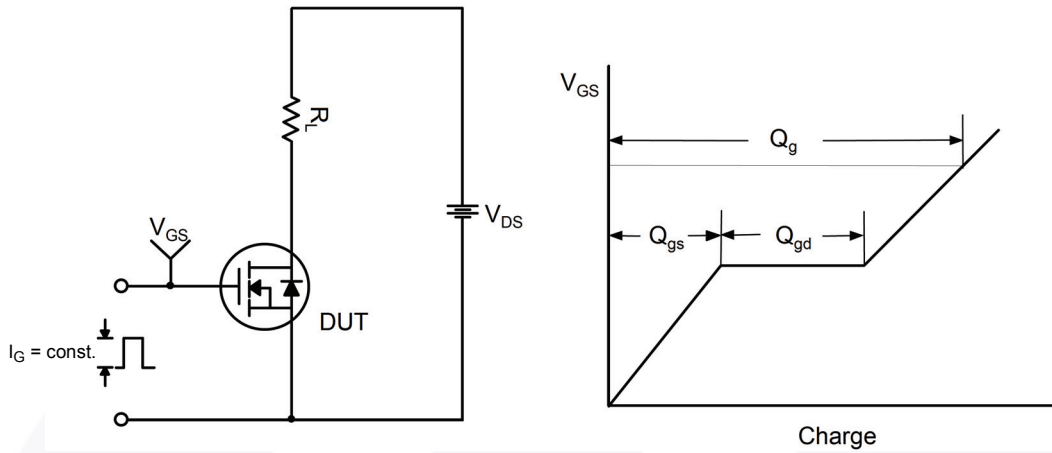


Figure 11. Gate Charge Test Circuit & Waveform



Figure 12. Resistive Switching Test Circuit & Waveforms

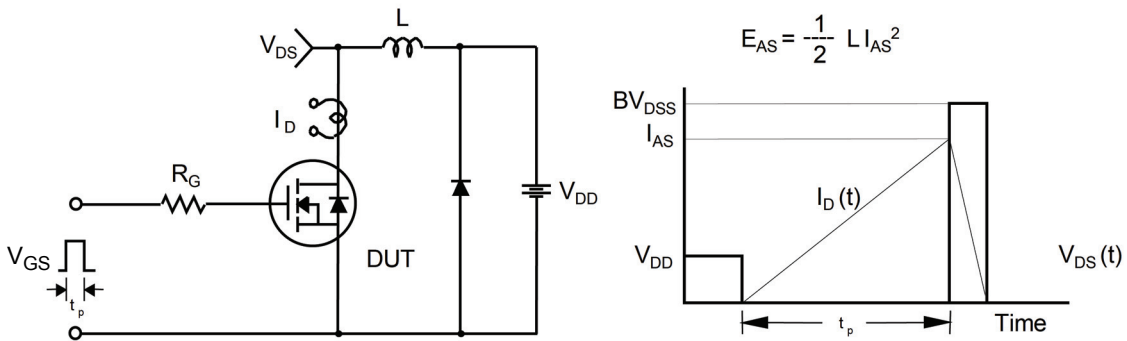
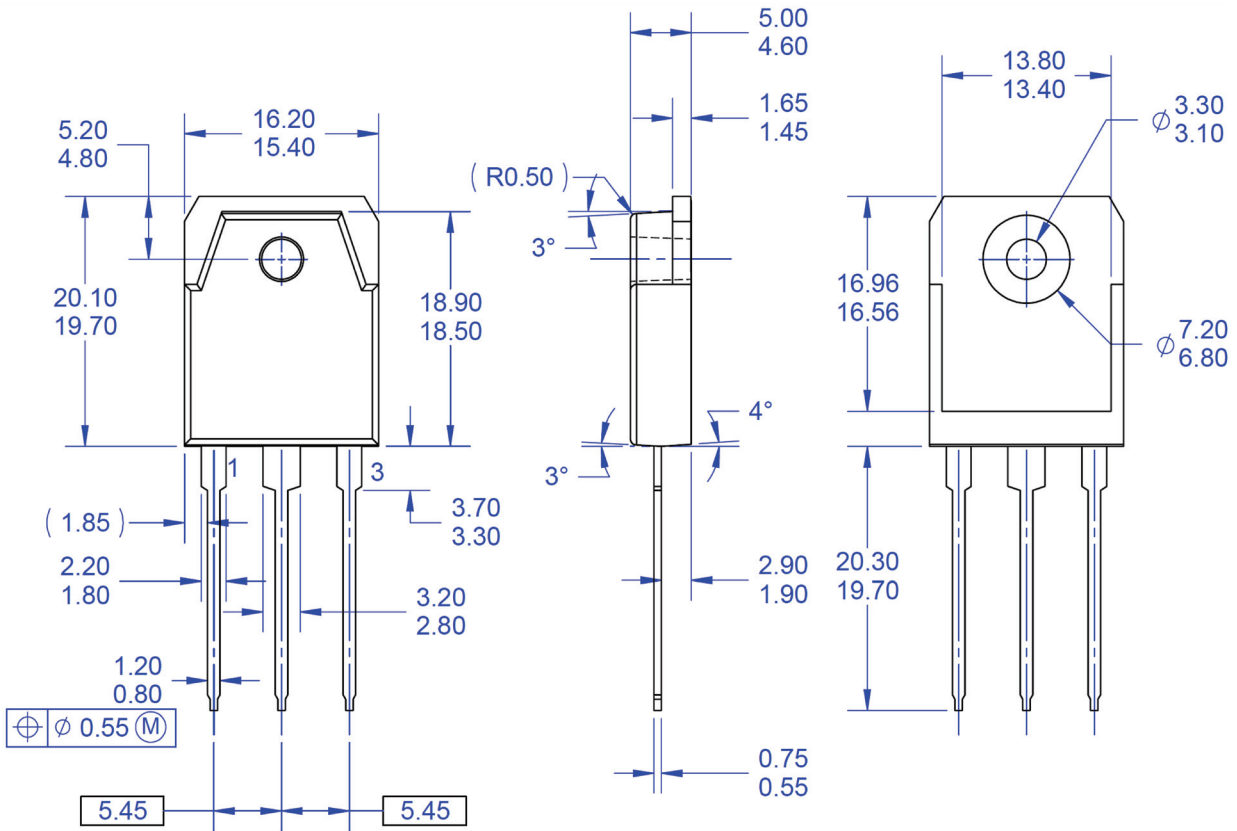


Figure 13. Unclamped Inductive Switching Test Circuit & Waveforms



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

Mechanical Dimensions



NOTES: UNLESS OTHERWISE SPECIFIED

- A) THIS PACKAGE CONFORMS TO EIAJ SC-65 PACKAGING STANDARD.
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSION AND TOLERANCING PER ASME14.5-2009.
- D) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
- E) DRAWING FILE NAME: TO3PN03AREV1.
- F) FAIRCHILD SEMICONDUCTOR.

Figure 15. TO3PN, 3-Lead, Plastic, EIAJ SC-65

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