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November 2013

# FDP24N40

## N-Channel UniFET™ MOSFET

400 V, 24 A, 175 mΩ

### Features

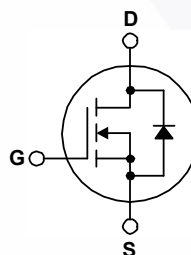
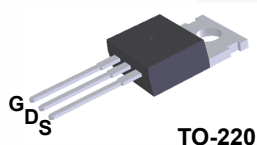
- $R_{DS(on)} = 140 \text{ m}\Omega$  (Typ.) @  $V_{GS} = 10 \text{ V}$ ,  $I_D = 12 \text{ A}$
- Low Gate Charge (Typ. 46 nC)
- Low  $C_{rss}$  (Typ. 25 pF)
- 100% Avalanche Tested
- RoHS Compliant

### 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. 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	FDP24N40	Unit
$V_{DSS}$	Drain to Source Voltage	400	V
$V_{GSS}$	Gate to Source Voltage	$\pm 30$	V
$I_D$	Drain Current	- Continuous ( $T_C = 25^\circ\text{C}$ )	A
		- Continuous ( $T_C = 100^\circ\text{C}$ )	
$I_{DM}$	Drain Current	- Pulsed (Note 1)	A
$E_{AS}$	Single Pulsed Avalanche Energy	(Note 2)	mJ
$I_{AR}$	Avalanche Current	(Note 1)	A
$E_{AR}$	Repetitive Avalanche Energy	(Note 1)	mJ
$dv/dt$	Peak Diode Recovery $dv/dt$	(Note 3)	V/ns
$P_D$	Power Dissipation	( $T_C = 25^\circ\text{C}$ )	W
		- Derate Above $25^\circ\text{C}$	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, 1/8" from Case for 5 Seconds	300	$^\circ\text{C}$

### Thermal Characteristics

Symbol	Parameter	FDP24N40	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	0.55	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max.	62.5	

## Package Marking and Ordering Information

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FDP24N40	FDP24N40	TO-220	Tube	N/A	N/A	50 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 $25^\circ\text{C}$	-	0.4	-	V/ $^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 400\ \text{V}$ , $V_{GS} = 0\ \text{V}$ $V_{DS} = 320\ \text{V}$ , $T_C = 125^\circ\text{C}$	-	-	1 10	$\mu\text{A}$
$I_{GSS}$	Gate to Body Leakage Current	$V_{GS} = \pm 30\ \text{V}$ , $V_{DS} = 0\ \text{V}$	-	-	$\pm 100$	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	$V_{GS} = 10\ \text{V}$ , $I_D = 12\ \text{A}$	-	0.140	0.175	$\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS} = 20\ \text{V}$ , $I_D = 12\ \text{A}$	-	34	-	S

### Dynamic Characteristics

$C_{iss}$	Input Capacitance	$V_{DS} = 25\ \text{V}$ , $V_{GS} = 0\ \text{V}$ , $f = 1\ \text{MHz}$	-	2270	3020	pF
$C_{oss}$	Output Capacitance		-	365	490	pF
$C_{rss}$	Reverse Transfer Capacitance		-	25	38	pF
$Q_{g(tot)}$	Total Gate Charge at 10V	$V_{DS} = 320\ \text{V}$ , $I_D = 24\ \text{A}$ , $V_{GS} = 10\ \text{V}$ (Note 4)	-	46	60	nC
$Q_{gs}$	Gate to Source Gate Charge		-	12	-	nC
$Q_{gd}$	Gate to Drain "Miller" Charge		-	20	-	nC

### Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 200\ \text{V}$ , $I_D = 24\ \text{A}$ , $V_{GS} = 10\ \text{V}$ , $R_G = 25\ \Omega$ (Note 4)	-	40	90	ns
$t_r$	Turn-On Rise Time		-	90	190	ns
$t_{d(off)}$	Turn-Off Delay Time		-	110	230	ns
$t_f$	Turn-Off Fall Time		-	65	140	ns

### Drain-Source Diode Characteristics

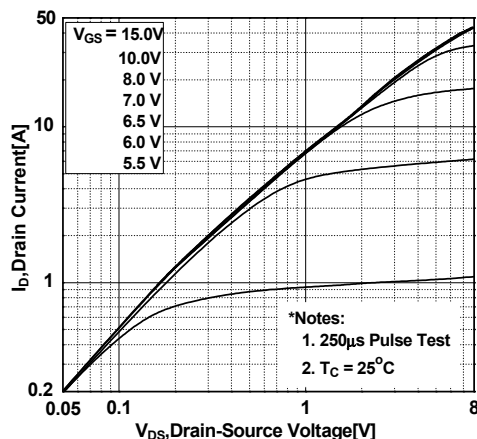
I <sub>S</sub>	Maximum Continuous Drain to Source Diode Forward Current	-	-	24	A	
I <sub>SM</sub>	Maximum Pulsed Drain to Source Diode Forward Current	-	-	96	A	
V <sub>SD</sub>	Drain to Source Diode Forward Voltage	V <sub>GS</sub> = 0 V, I <sub>SD</sub> = 24 A	-	-	1.4	V
t <sub>rr</sub>	Reverse Recovery Time	V <sub>GS</sub> = 0 V, I <sub>SD</sub> = 24 A,	-	360	-	ns
Q <sub>rr</sub>	Reverse Recovery Charge	dI <sub>F</sub> /dt = 100 A/μs	-	4.7	-	μC

#### Notes:

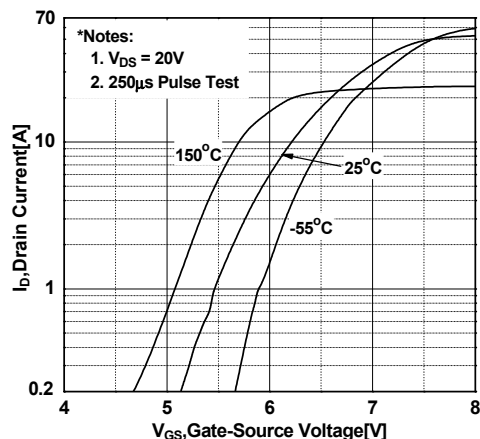
1. Repetitive rating; pulse-width limited by maximum junction temperature.
2.  $L = 4.5\ \text{mH}$ ,  $I_{AS} = 24\ \text{A}$ ,  $V_{DD} = 50\ \text{V}$ ,  $R_G = 25\ \Omega$ , starting  $T_J = 25^\circ\text{C}$ .
3.  $I_{SD} \leq 24\ \text{A}$ ,  $di/dt \leq 200\ \text{A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ , starting  $T_J = 25^\circ\text{C}$ .
4. Essentially independent of operating temperature typical characteristics.

## Typical Performance Characteristics

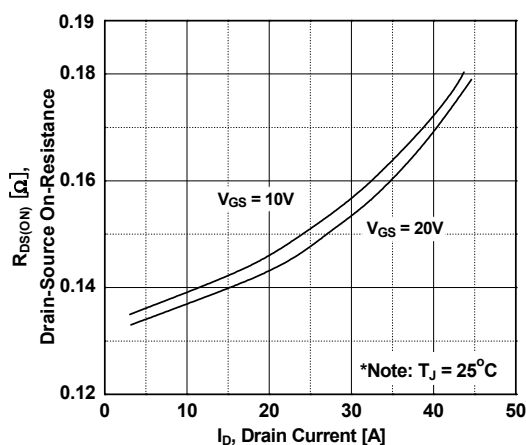
**Figure 1. On-Region Characteristics**



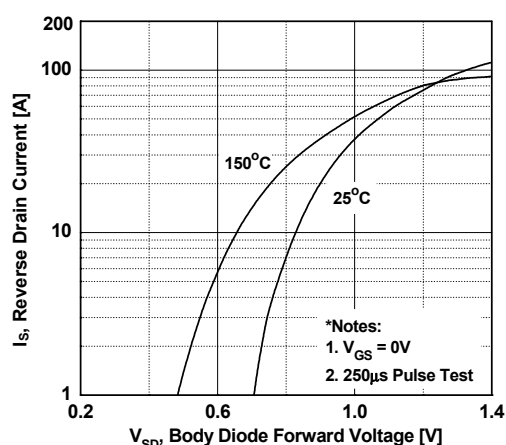
**Figure 2. Transfer Characteristics**



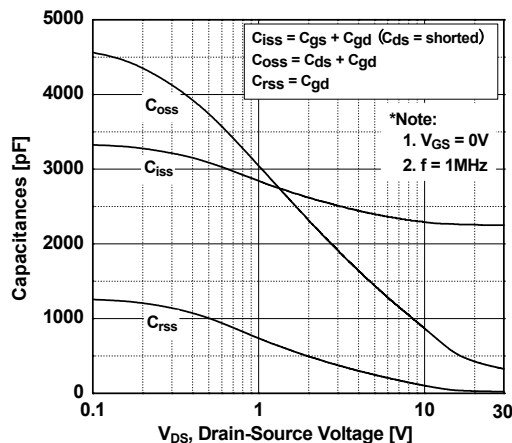
**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**



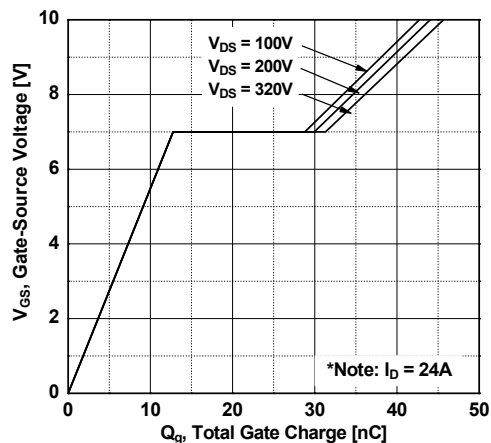
**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**



**Figure 5. Capacitance Characteristics**

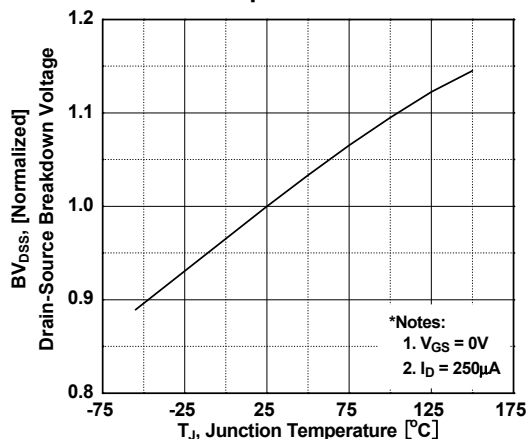


**Figure 6. Gate Charge Characteristics**

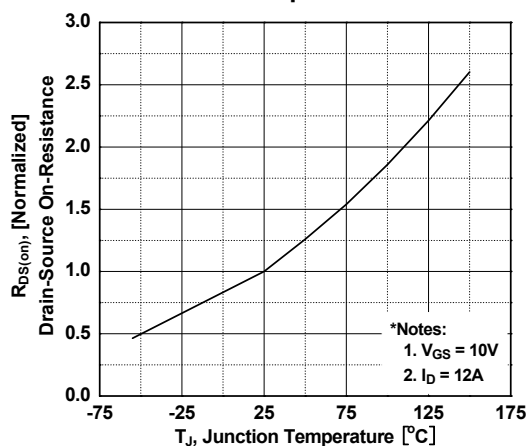


## Typical Performance Characteristics (Continued)

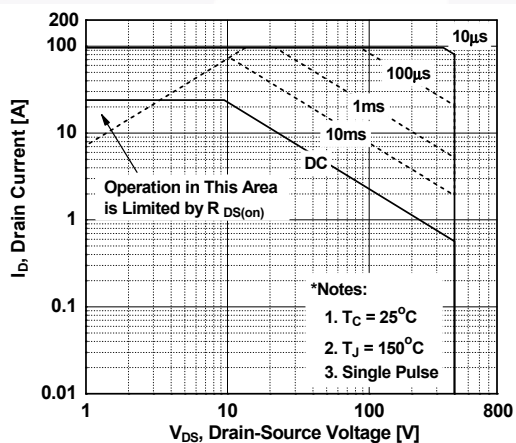
**Figure 7. Breakdown Voltage Variation vs. Temperature**



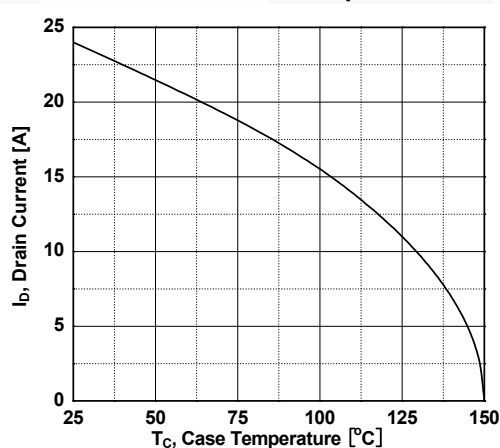
**Figure 8. On-Resistance Variation vs. Temperature**



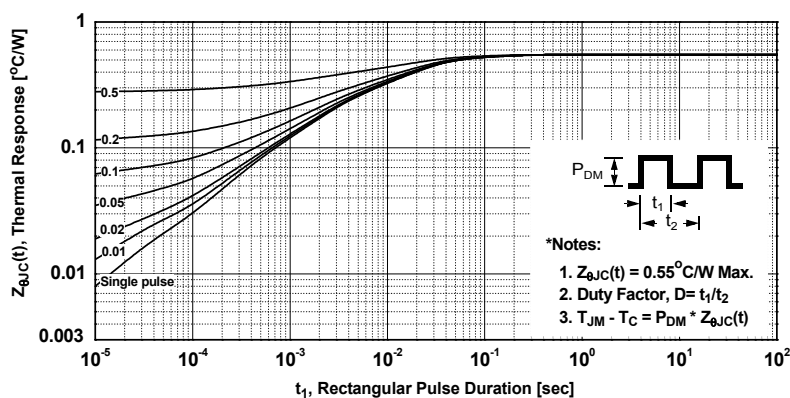
**Figure 9. Maximum Safe Operating Area**

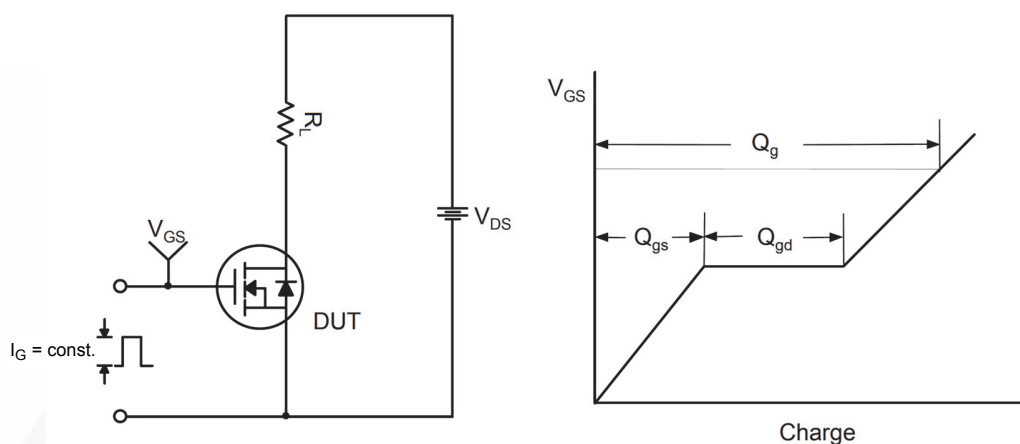


**Figure 10. Maximum Drain Current vs. Case Temperature**

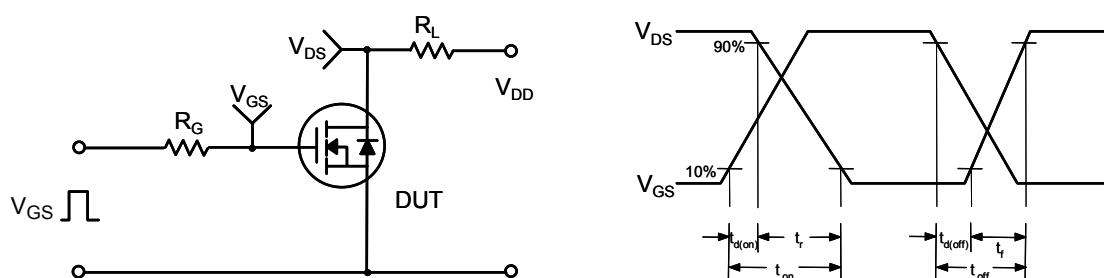


**Figure 11. Transient Thermal Response Curve**

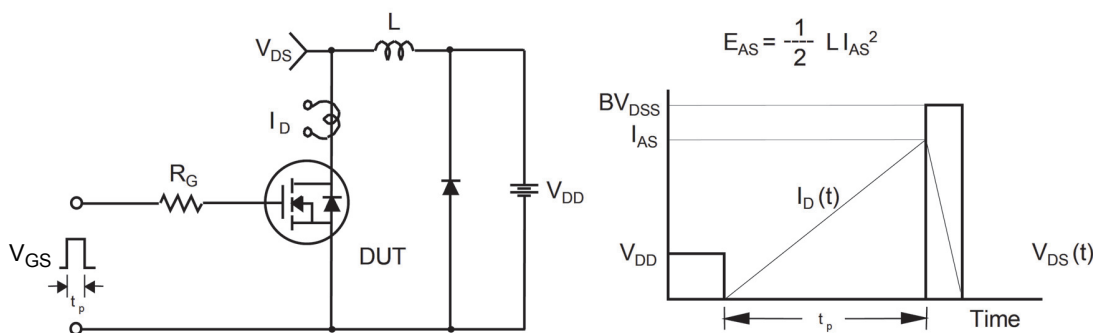




**Figure 12. Gate Charge Test Circuit & Waveform**



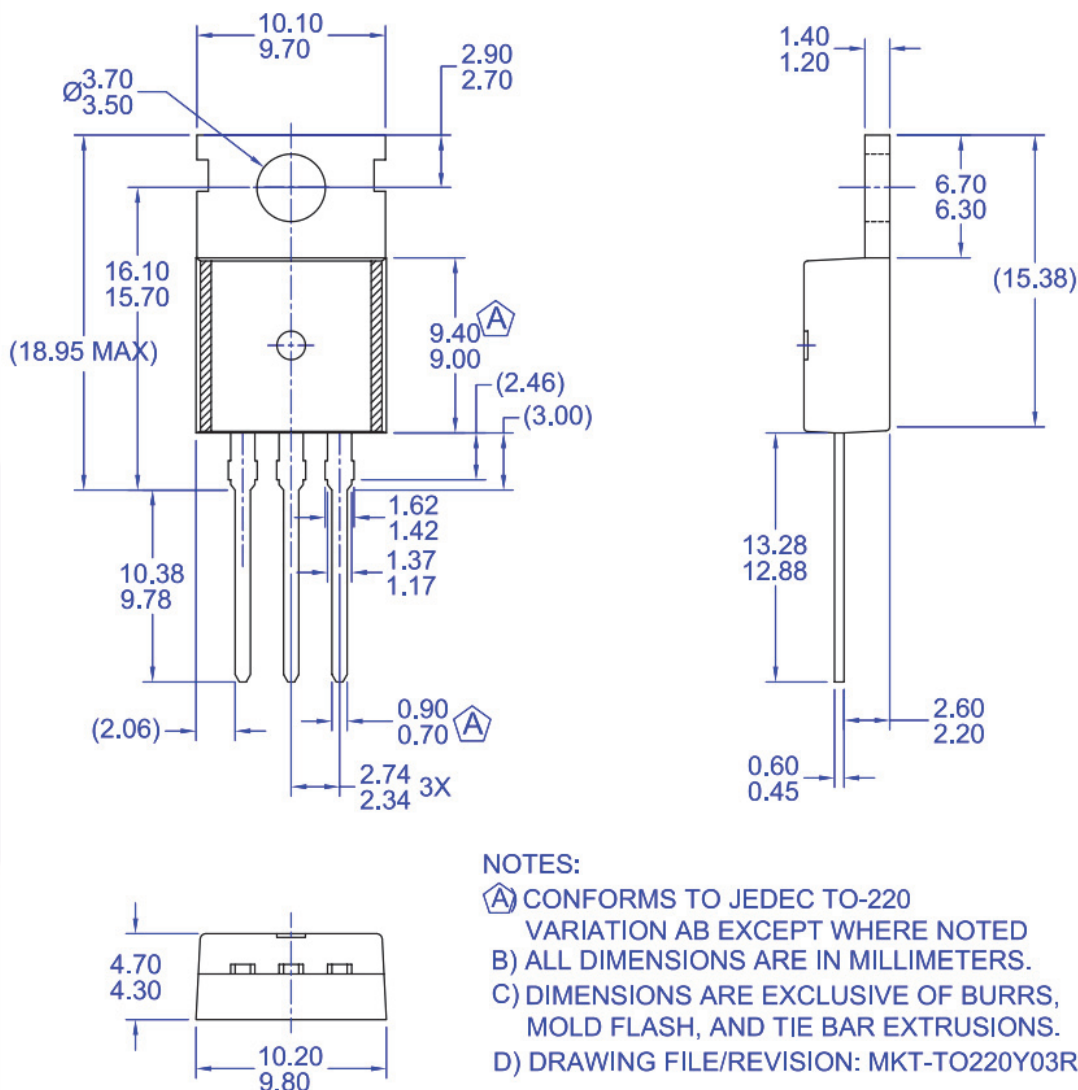
**Figure 13. Resistive Switching Test Circuit & Waveforms**



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

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

## Mechanical Dimensions



**Figure 16. TO220, Molded, 3-Lead, Jedec Variation AB**

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