

# FDP24N40 / FDPF24N40

## N-Channel MOSFET

400V, 24A, 0.175Ω

### Features

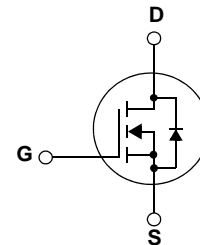
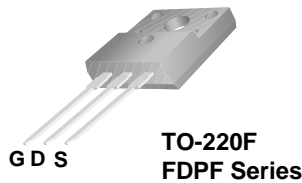
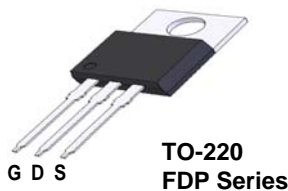
- $R_{DS(on)} = 0.140\Omega$  (Typ.) @  $V_{GS} = 10V, I_D = 12A$
- Low gate charge (Typ. 46nC)
- Low  $C_{RSS}$  (Typ. 25pF)
- Fast switching
- 100% avalanche tested
- Improve dv/dt capability
- RoHS compliant



### Description

These N-Channel enhancement mode power field effect transistors are produced using Fairchild's proprietary, planar stripe, DMOS technology.

This advanced technology has been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode. These devices are well suited for high efficient switching mode power supplies and active power factor correction.



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

Symbol	Parameter	FDP24N40	FDPF24N40	Units
$V_{DSS}$	Drain to Source Voltage	400		V
$V_{GSS}$	Gate to Source Voltage	±30		V
$I_D$	Drain Current	-Continuous ( $T_C = 25^\circ\text{C}$ )	24	24*
		-Continuous ( $T_C = 100^\circ\text{C}$ )	14.4	14.4*
$I_{DM}$	Drain Current	- Pulsed (Note 1)	96	96*
$E_{AS}$	Single Pulsed Avalanche Energy (Note 2)	1296		mJ
$I_{AR}$	Avalanche Current (Note 1)	24		A
$E_{AR}$	Repetitive Avalanche Energy (Note 1)	22.7		mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	4.5		V/ns
$P_D$	Power Dissipation	( $T_C = 25^\circ\text{C}$ )	227	40
		- Derate above $25^\circ\text{C}$	1.8	0.3
$T_J, T_{STG}$	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		$^\circ\text{C}$

\*Drain current limited by maximum junction temperature

### Thermal Characteristics

Symbol	Parameter	FDP24N40	FDPF24N40	Units
$R_{\theta JC}$	Thermal Resistance, Junction to Case	0.55	3.0	$^\circ\text{C/W}$
$R_{\theta CS}$	Thermal Resistance, Case to Sink Typ.	0.5	-	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	62.5	62.5	

## Package Marking and Ordering Information $T_C = 25^\circ\text{C}$ unless otherwise noted

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FDP24N40	FDP24N40	TO-220	-	-	50
FDPF24N40	FDPF24N40	TO-220F	-	-	50

## Electrical Characteristics

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

$BV_{DSS}$	Drain to Source Breakdown Voltage	$I_D = 250\mu\text{A}, V_{GS} = 0\text{V}, T_J = 25^\circ\text{C}$	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	$V_{DS} = 400\text{V}, V_{GS} = 0\text{V}$	-	-	1	$\mu\text{A}$
		$V_{DS} = 320\text{V}, T_C = 125^\circ\text{C}$	-	-	10	
$I_{GSS}$	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	$V_{DS} = 20\text{V}, I_D = 12\text{A}$ (Note 4)	-	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, 5)	-	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	$V_{DD} = 200\text{V}, I_D = 24\text{A}$ $R_G = 25\Omega$ (Note 4, 5)	-	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

$I_S$	Maximum Continuous Drain to Source Diode Forward Current	-	-	24	A	
$I_{SM}$	Maximum Pulsed Drain to Source Diode Forward Current	-	-	96	A	
$V_{SD}$	Drain to Source Diode Forward Voltage	$V_{GS} = 0\text{V}, I_{SD} = 24\text{A}$	-	-	1.4	V
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0\text{V}, I_{SD} = 24\text{A}$	-	360	-	ns
$Q_{rr}$	Reverse Recovery Charge	$di_F/dt = 100\text{A}/\mu\text{s}$ (Note 4)	-	4.7	-	$\mu\text{C}$

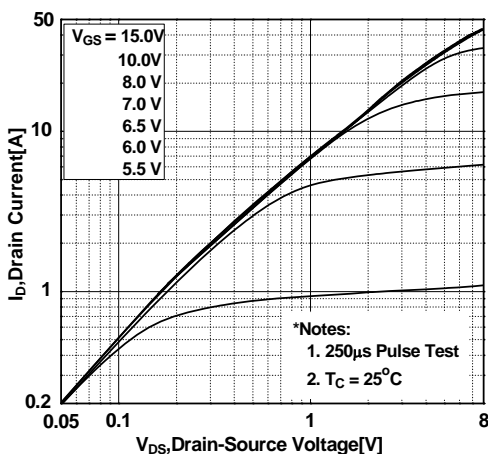
#### Notes:

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. Pulse Test: Pulse width  $\leq 300\mu\text{s}$ , Duty Cycle  $\leq 2\%$
5. Essentially Independent of Operating Temperature Typical Characteristics

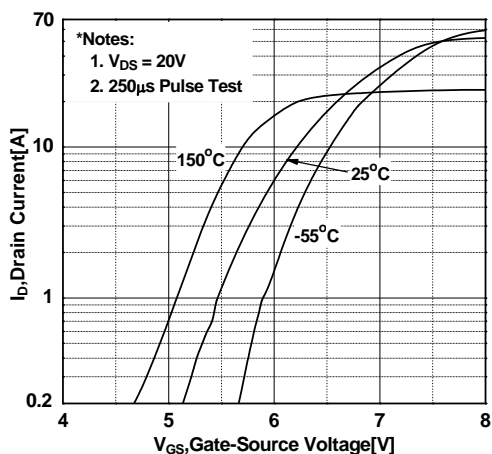
## Typical Performance Characteristics

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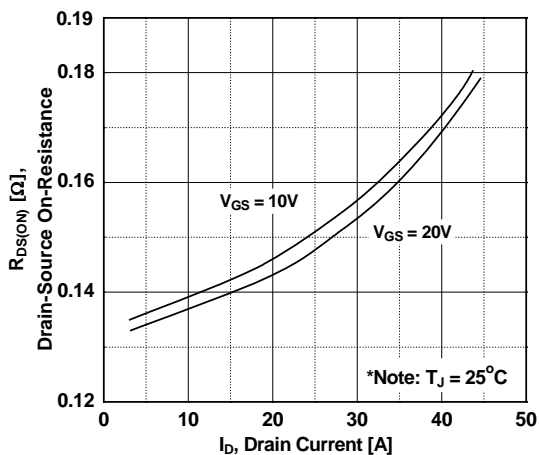
**Figure 1. On-Region Characteristics**



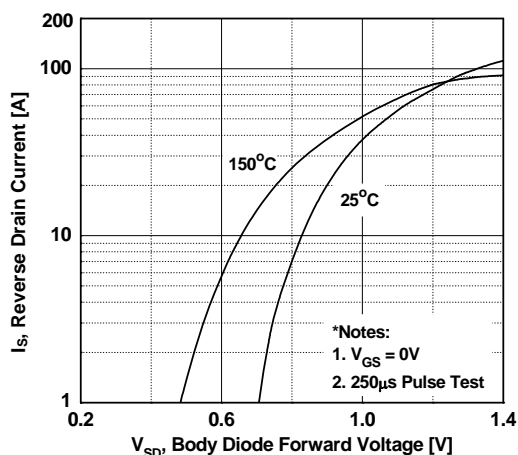
**Figure 2. Transfer Characteristics**



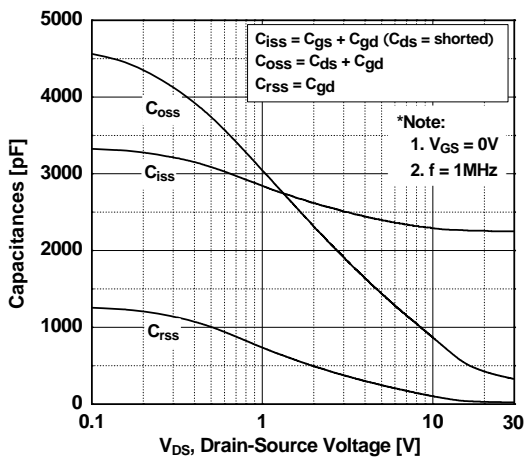
**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**



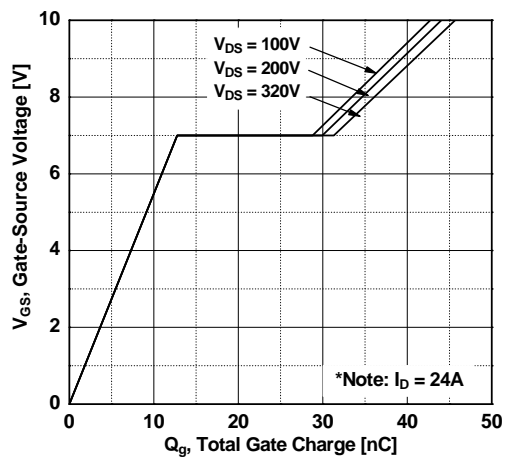
**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**



**Figure 5. Capacitance Characteristics**



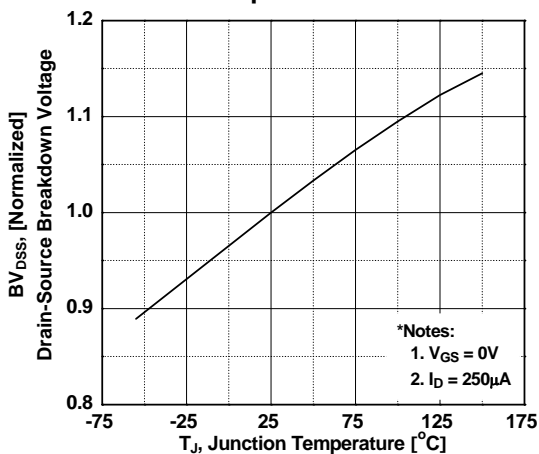
**Figure 6. Gate Charge Characteristics**



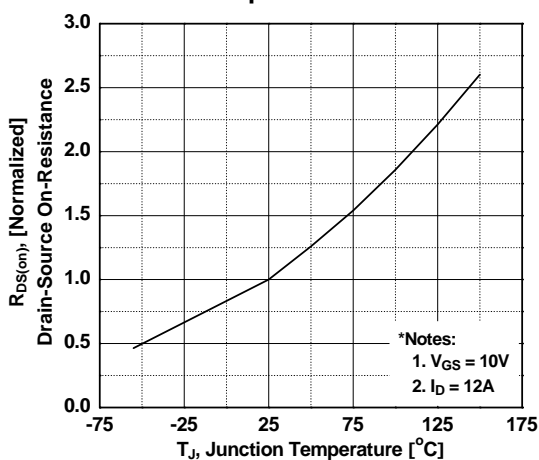
**Typical Performance Characteristics** (Continued)

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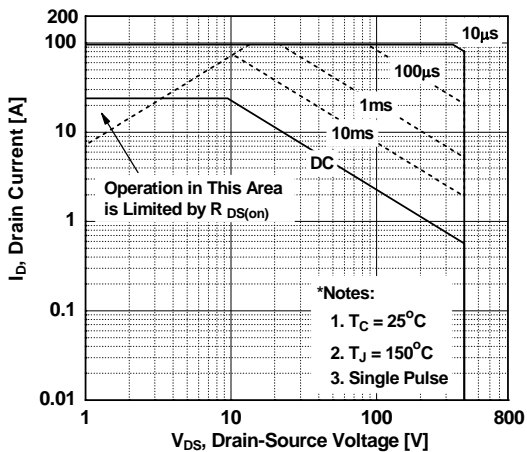
**Figure 7. Breakdown Voltage Variation vs. Temperature**



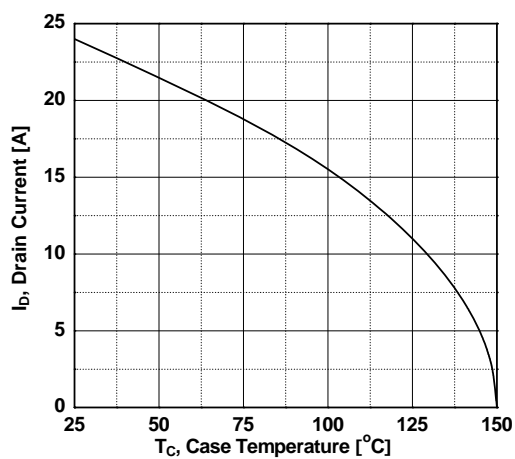
**Figure 8. On-Resistance Variation vs. Temperature**



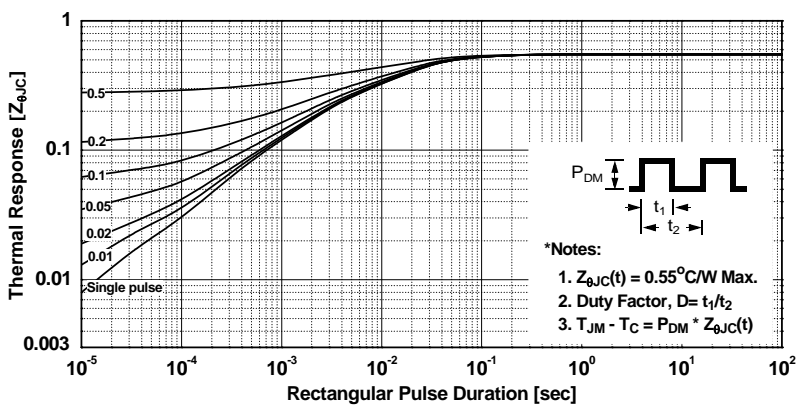
**Figure 9. Maximum Safe Operating Area - FDP24N40**



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

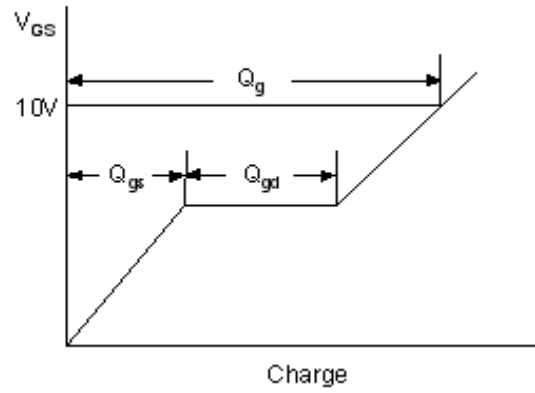
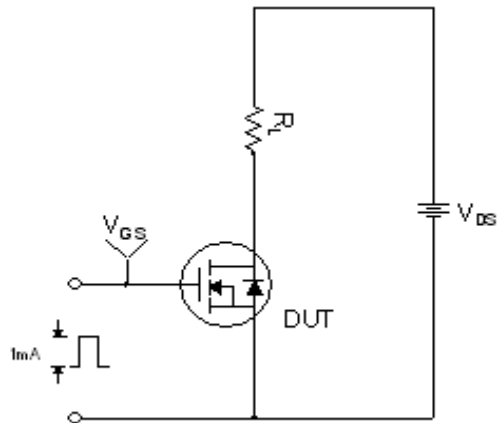


**Figure 10. Transient Thermal Response Curve - FDP24N40**

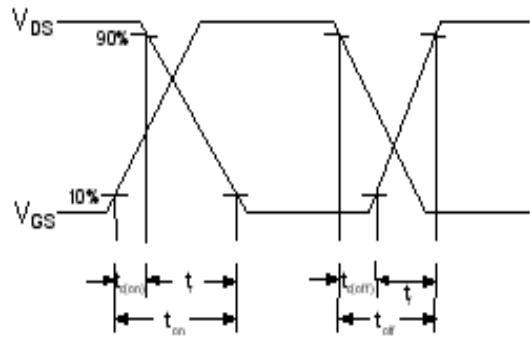
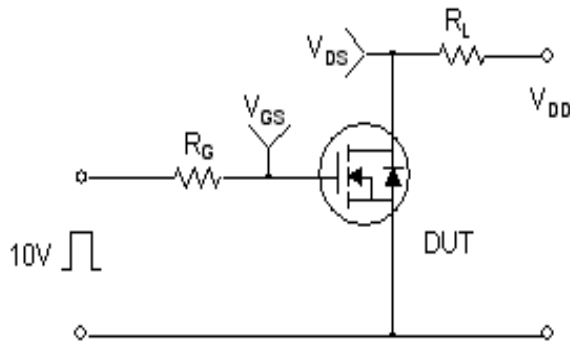


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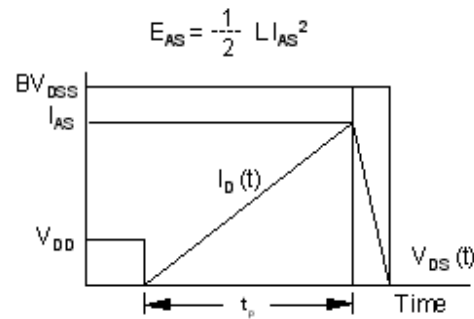
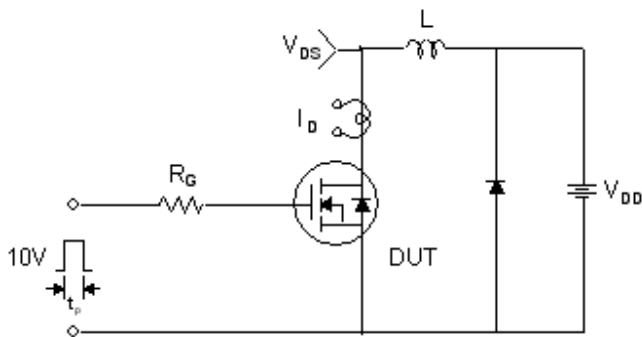
**Gate Charge Test Circuit & Waveform**



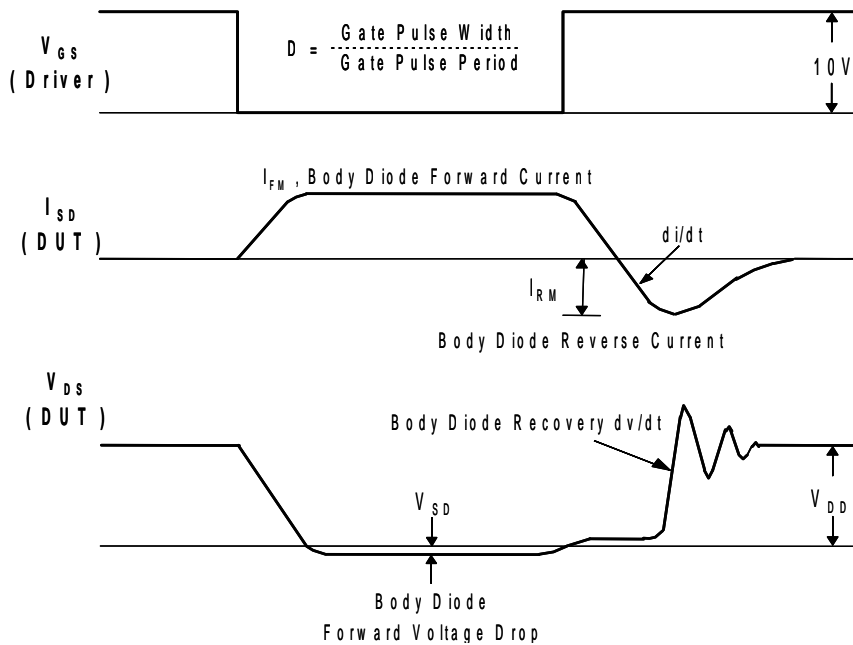
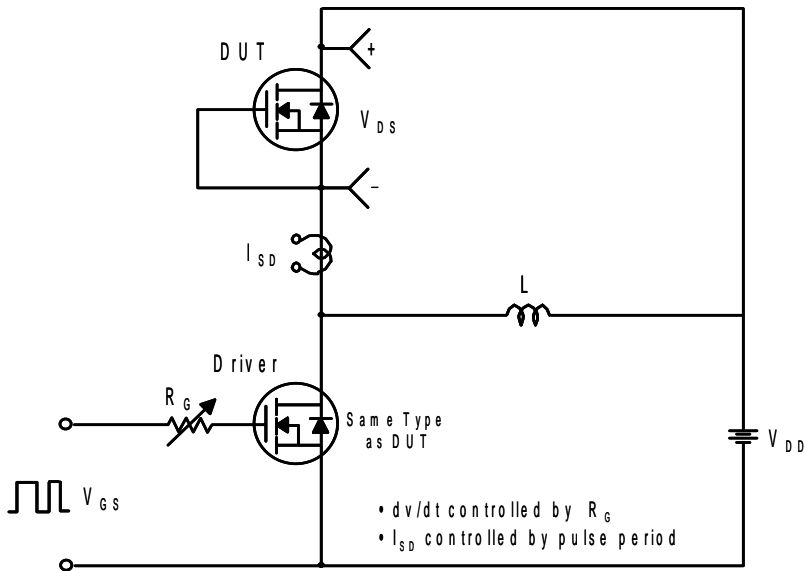
**Resistive Switching Test Circuit & Waveforms**



**Unclamped Inductive Switching Test Circuit & Waveforms**



Peak Diode Recovery dv/dt Test Circuit & Waveforms

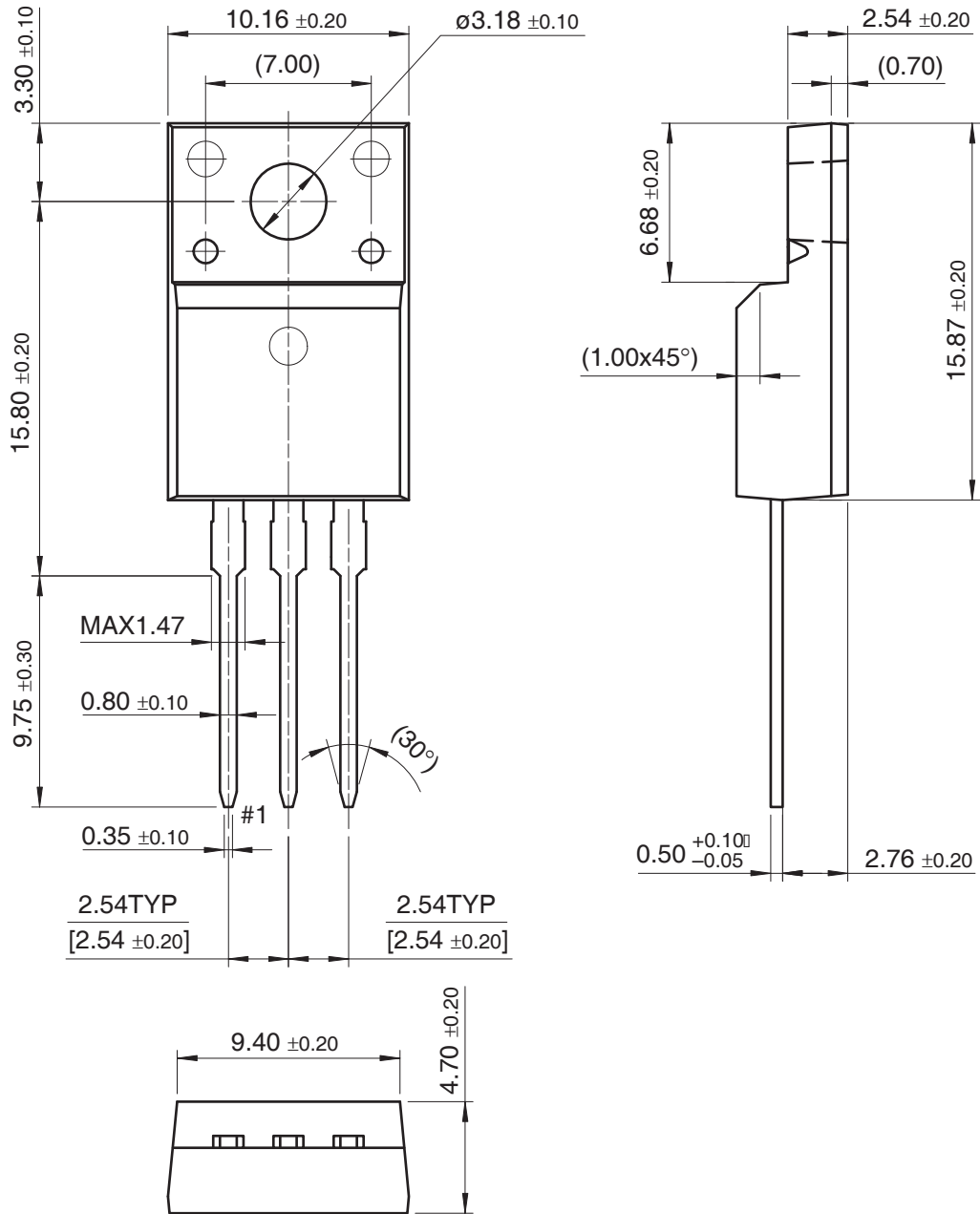




# Mechanical Dimensions

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## TO-220F



Dimensions in Millimeters

FDP24N40 / FDPF24N40 N-Channel MOSFET





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