



November 2009
Ultra FRFET™

FDP5N50U / FDPF5N50UT

N-Channel MOSFET, FRFET

500V, 4A, 2.0Ω

Features

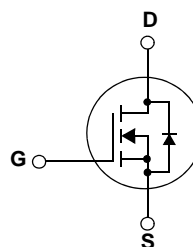
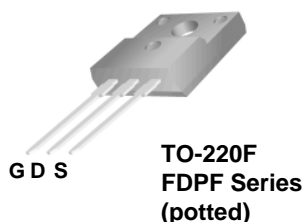
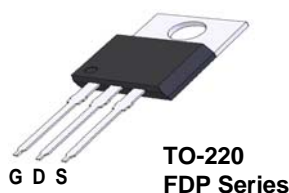
- $R_{DS(on)} = 1.65\Omega$ (Typ.) @ $V_{GS} = 10V$, $I_D = 2A$
- Low gate charge (Typ. 11nC)
- Low C_{rss} (Typ. 5pF)
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability
- RoHS compliant



Description

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

This advance 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 switched mode power supplies and active power factor correction.



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

Symbol	Parameter	FDP5N50U	FDPF5N50UT	Units
V_{DSS}	Drain to Source Voltage	500		V
V_{GSS}	Gate to Source Voltage	± 30		V
I_D	Drain Current	-Continuous ($T_C = 25^\circ\text{C}$)	4	A
		-Continuous ($T_C = 100^\circ\text{C}$)	2.4	
I_{DM}	Drain Current	- Pulsed (Note 1)	16	A
E_{AS}	Single Pulsed Avalanche Energy	(Note 2)	216	mJ
I_{AR}	Avalanche Current	(Note 1)	4	A
E_{AR}	Repetitive Avalanche Energy	(Note 1)	8.5	mJ
dv/dt	Peak Diode Recovery dv/dt	(Note 3)	4.5	V/ns
P_D	Power Dissipation	($T_C = 25^\circ\text{C}$)	85	W
		- Derate above 25°C	0.67	
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	FDP5N50U	FDPF5N50UT	Units
$R_{\theta JC}$	Thermal Resistance, Junction to Case	1.4	4.5	$^\circ\text{C/W}$
$R_{\theta CS}$	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
FDP5N50U	FDP5N50U	TO-220	-	-	50
FDPF5N50UT	FDPF5N50UT	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	$I_D = 250\mu\text{A}$, $V_{GS} = 0\text{V}$, $T_J = 25^\circ\text{C}$	500	-	-	V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 250\mu\text{A}$, Referenced to 25°C	-	0.7	-	$V/^\circ\text{C}$
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 500\text{V}$, $V_{GS} = 0\text{V}$ $V_{DS} = 400\text{V}$, $T_C = 125^\circ\text{C}$	-	-	25 250	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	-	5	V
$R_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = 10\text{V}$, $I_D = 2\text{A}$	-	1.65	2	Ω
g_{FS}	Forward Transconductance	$V_{DS} = 40\text{V}$, $I_D = 2\text{A}$ (Note 4)	-	4.8	-	S

Dynamic Characteristics

C_{iss}	Input Capacitance	$V_{DS} = 25\text{V}$, $V_{GS} = 0\text{V}$ $f = 1\text{MHz}$	-	485	650	pF
C_{oss}	Output Capacitance		-	65	90	pF
C_{rss}	Reverse Transfer Capacitance		-	5	8	pF
$Q_{g(tot)}$	Total Gate Charge at 10V	$V_{DS} = 400\text{V}$, $I_D = 4\text{A}$ $V_{GS} = 10\text{V}$ (Note 4, 5)	-	11	15	nC
Q_{gs}	Gate to Source Gate Charge		-	3	-	nC
Q_{gd}	Gate to Drain "Miller" Charge		-	5	-	nC

Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 250\text{V}$, $I_D = 4\text{A}$ $R_G = 25\Omega$ (Note 4, 5)	-	14	38	ns
t_r	Turn-On Rise Time		-	21	52	ns
$t_{d(off)}$	Turn-Off Delay Time		-	27	64	ns
t_f	Turn-Off Fall Time		-	20	50	ns

Drain-Source Diode Characteristics

I _S	Maximum Continuous Drain to Source Diode Forward Current		-	-	4	A
I _{SM}	Maximum Pulsed Drain to Source Diode Forward Current		-	-	16	A
V _{SD}	Drain to Source Diode Forward Voltage	V _{GS} = 0V, I _{SD} = 4A	-	-	1.6	V
t _{rr}	Reverse Recovery Time	V _{GS} = 0V, I _{SD} = 4A	-	36	-	ns
Q _{rr}	Reverse Recovery Charge	dI _F /dt = 100A/μs (Note 4)	-	33	-	nC

Notes:

- 1: Repetitive Rating: Pulse width limited by maximum junction temperature
- 2: $L = 27\text{mH}$, $I_{AS} = 4\text{A}$, $V_{DD} = 50\text{V}$, $R_G = 25\Omega$, Starting $T_J = 25^\circ\text{C}$
- 3: $I_{SD} \leq 4\text{A}$, $dI/dt \leq 200\text{A}/\mu\text{s}$, $V_{DD} \leq BV_{DSS}$, 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

Figure 1. On-Region Characteristics

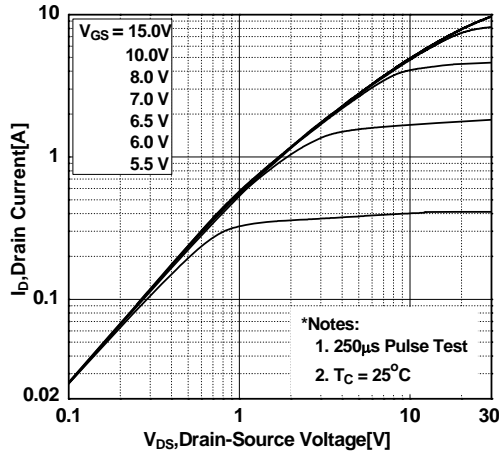


Figure 2. Transfer Characteristics

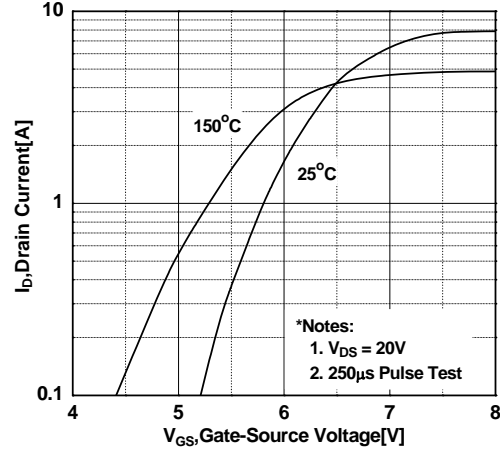


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

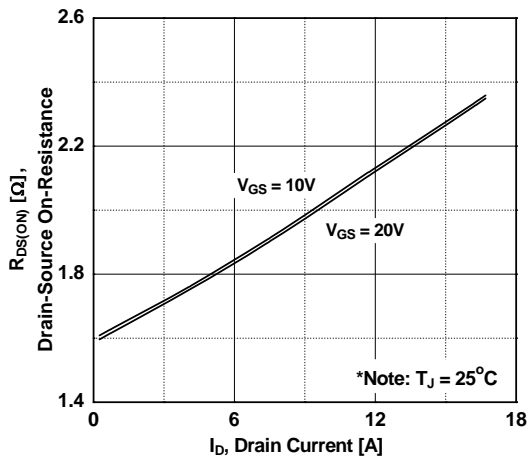


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

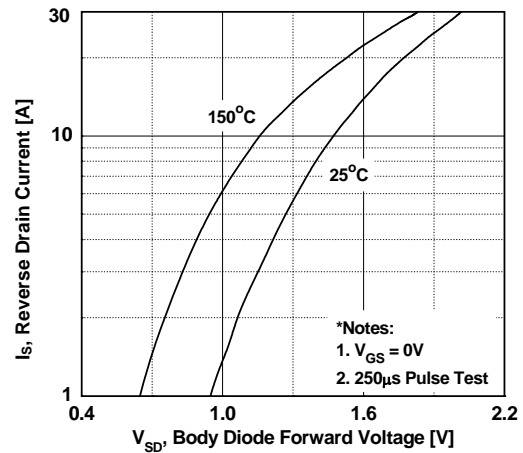


Figure 5. Capacitance Characteristics

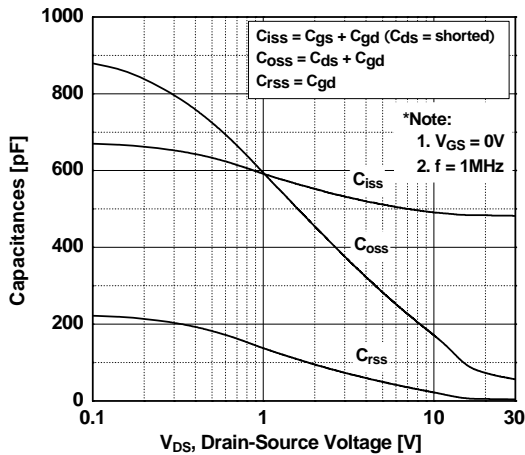
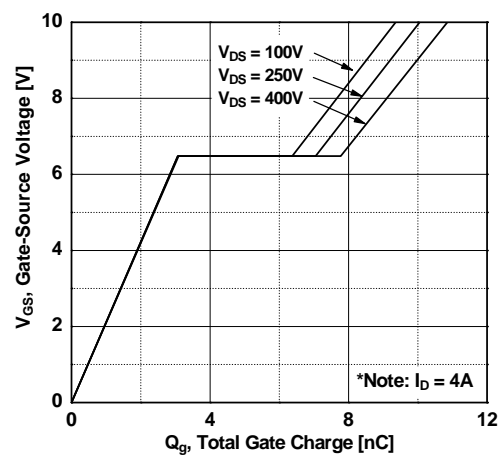


Figure 6. Gate Charge Characteristics



Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

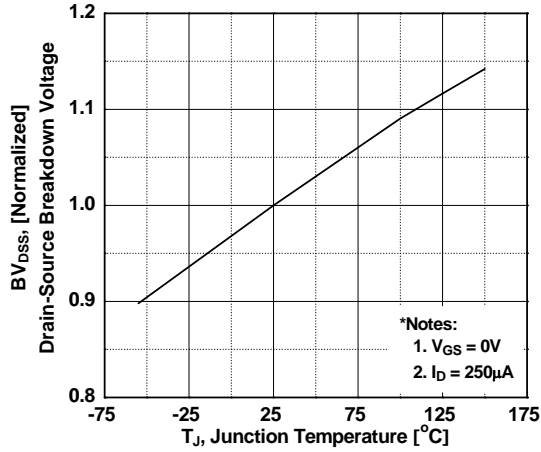


Figure 8. Maximum Safe Operating Area - FDP5N50U

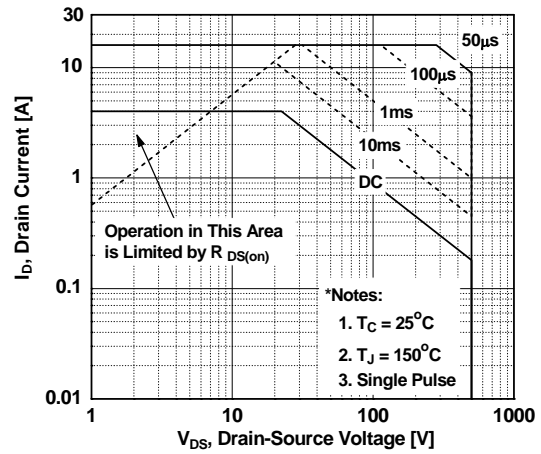


Figure 9. Maximum Safe Operating Area - FDPF5N50UT

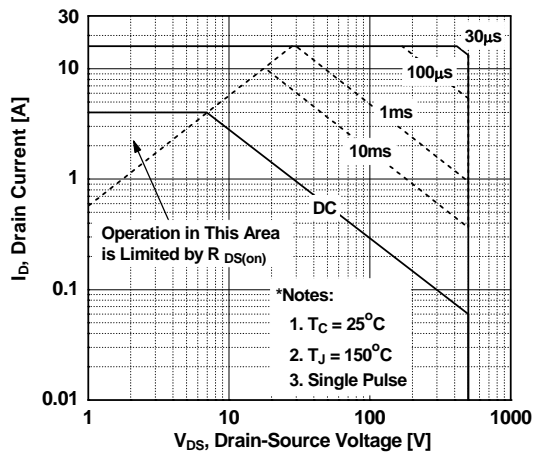


Figure 10. Maximum Drain Current vs. Case Temperature

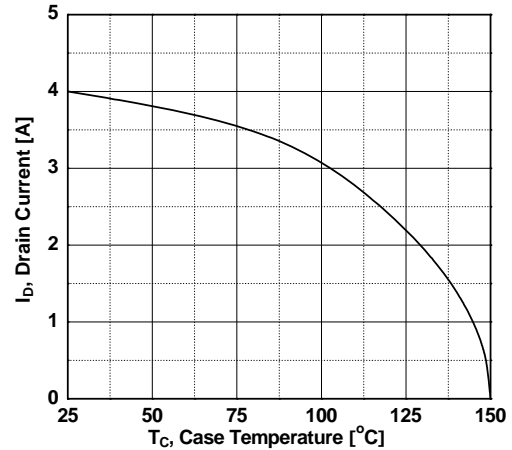
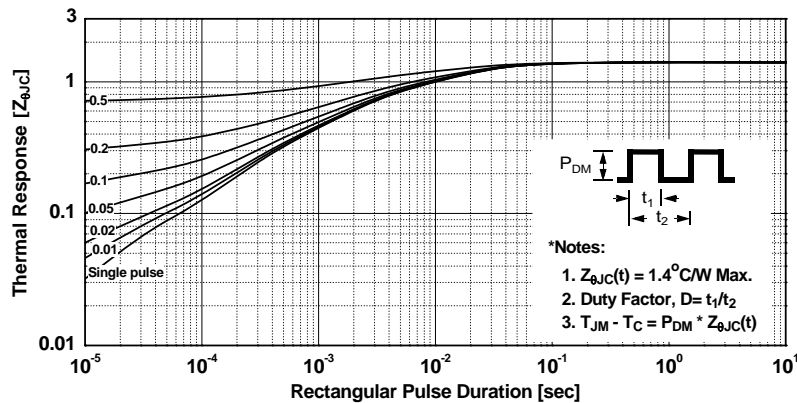
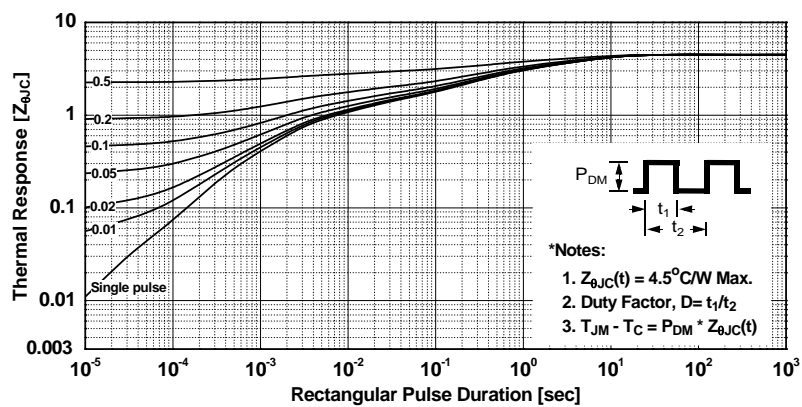


Figure 11. Transient Thermal Response Curve - FDP5N50U

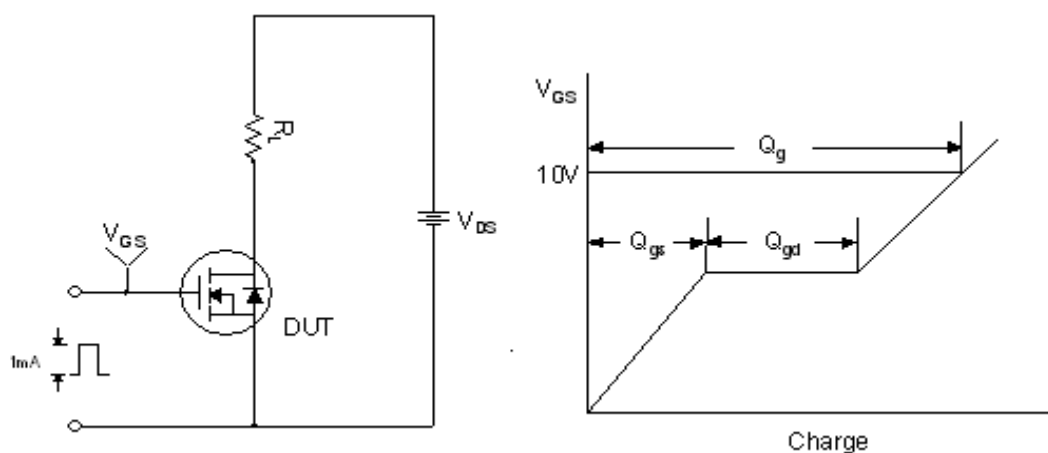


Typical Performance Characteristics (Continued)

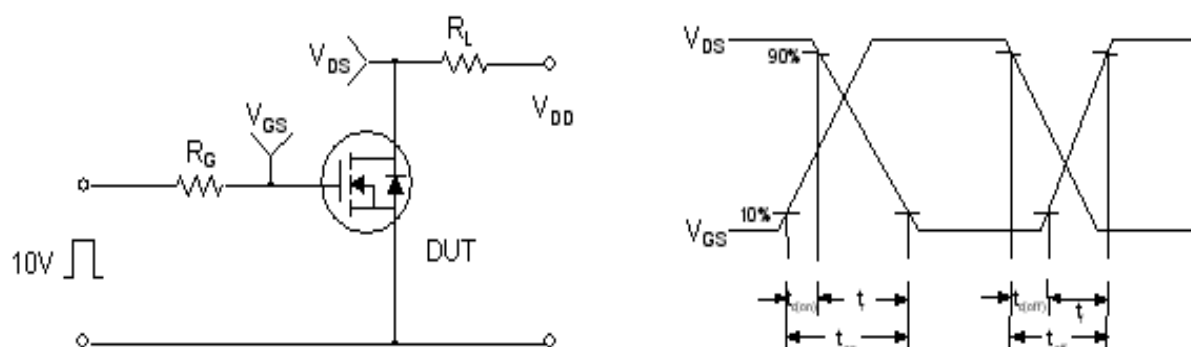
Figure 12. Transient Thermal Response Curve - FDPF5N50UT



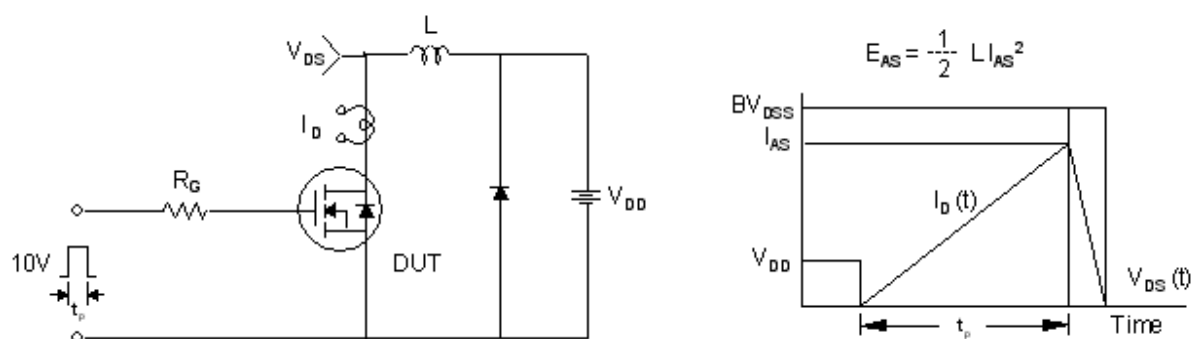
Gate Charge Test Circuit & Waveform



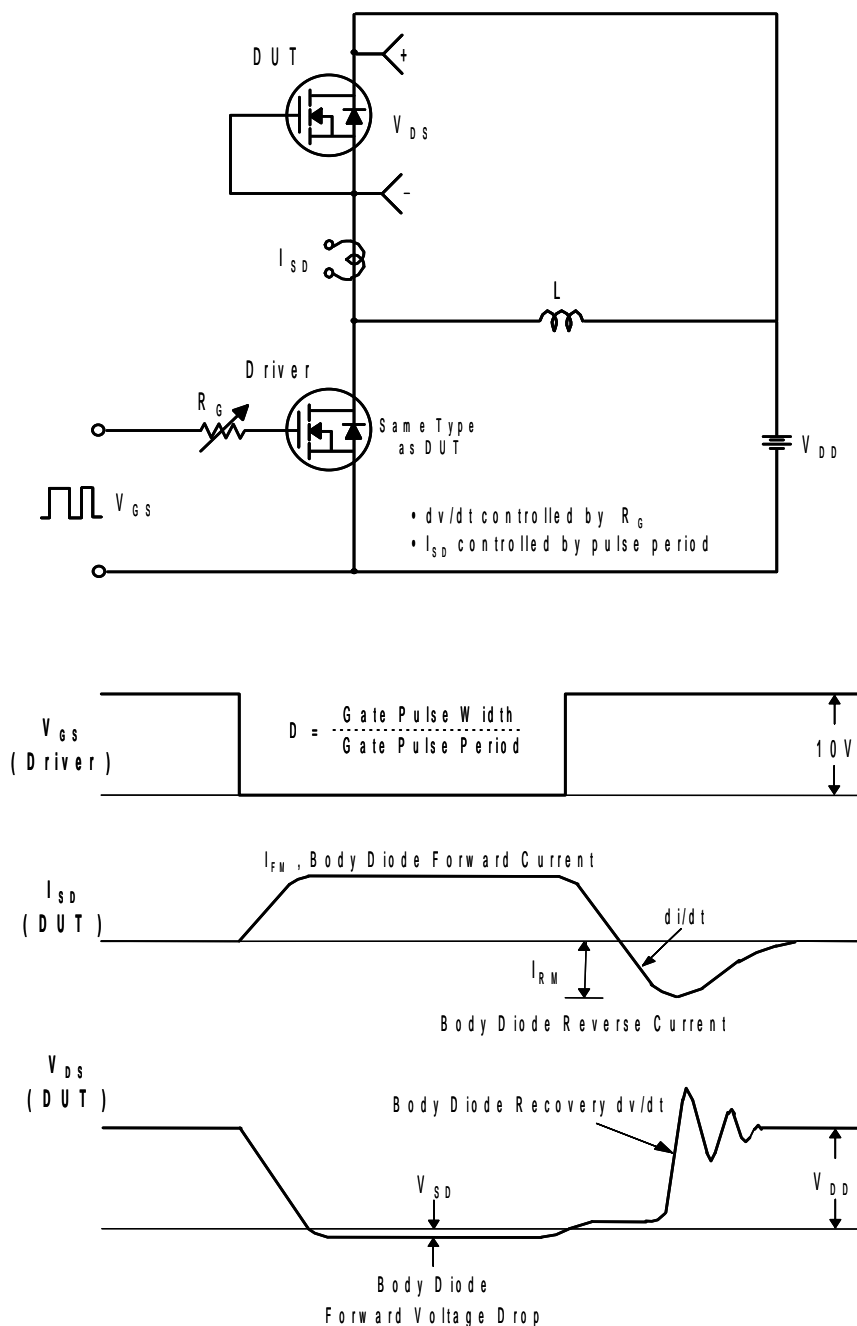
Resistive Switching Test Circuit & Waveforms



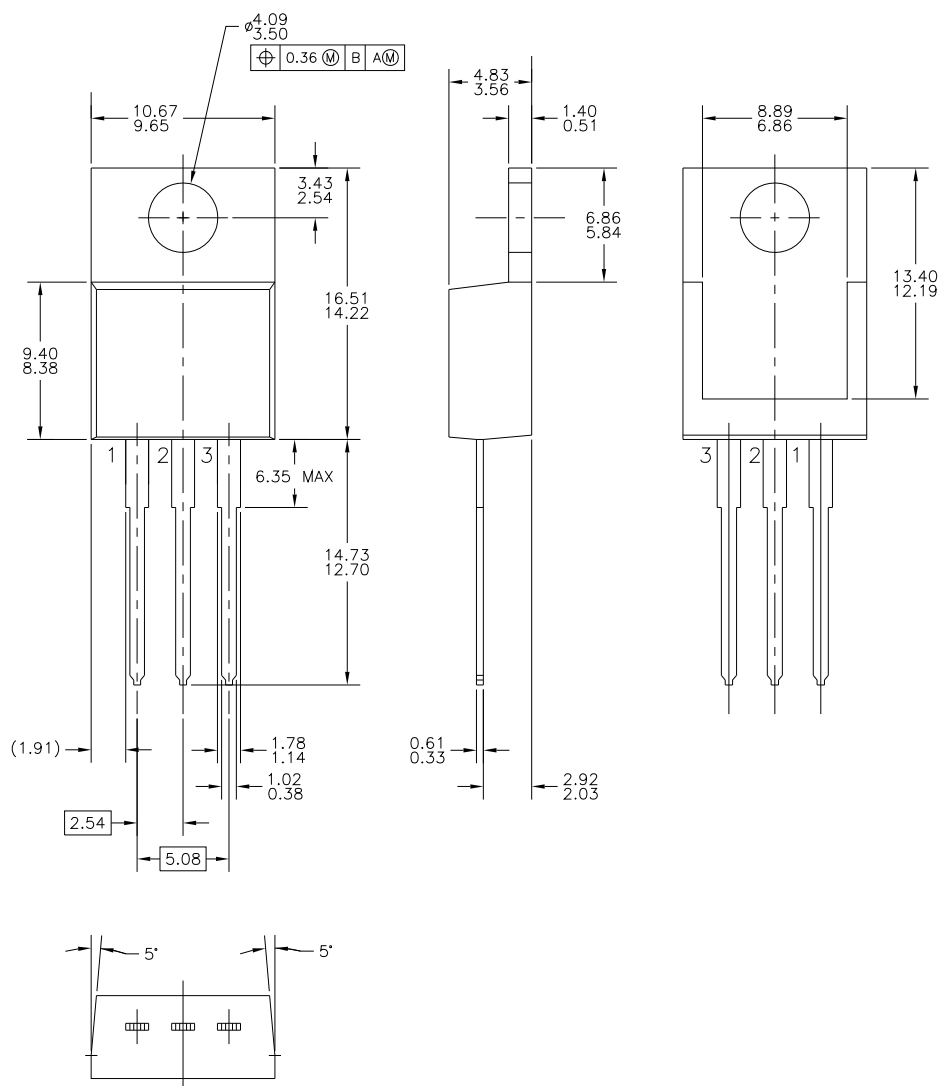
Unclamped Inductive Switching Test Circuit & Waveforms



Peak Diode Recovery dv/dt Test Circuit & Waveforms

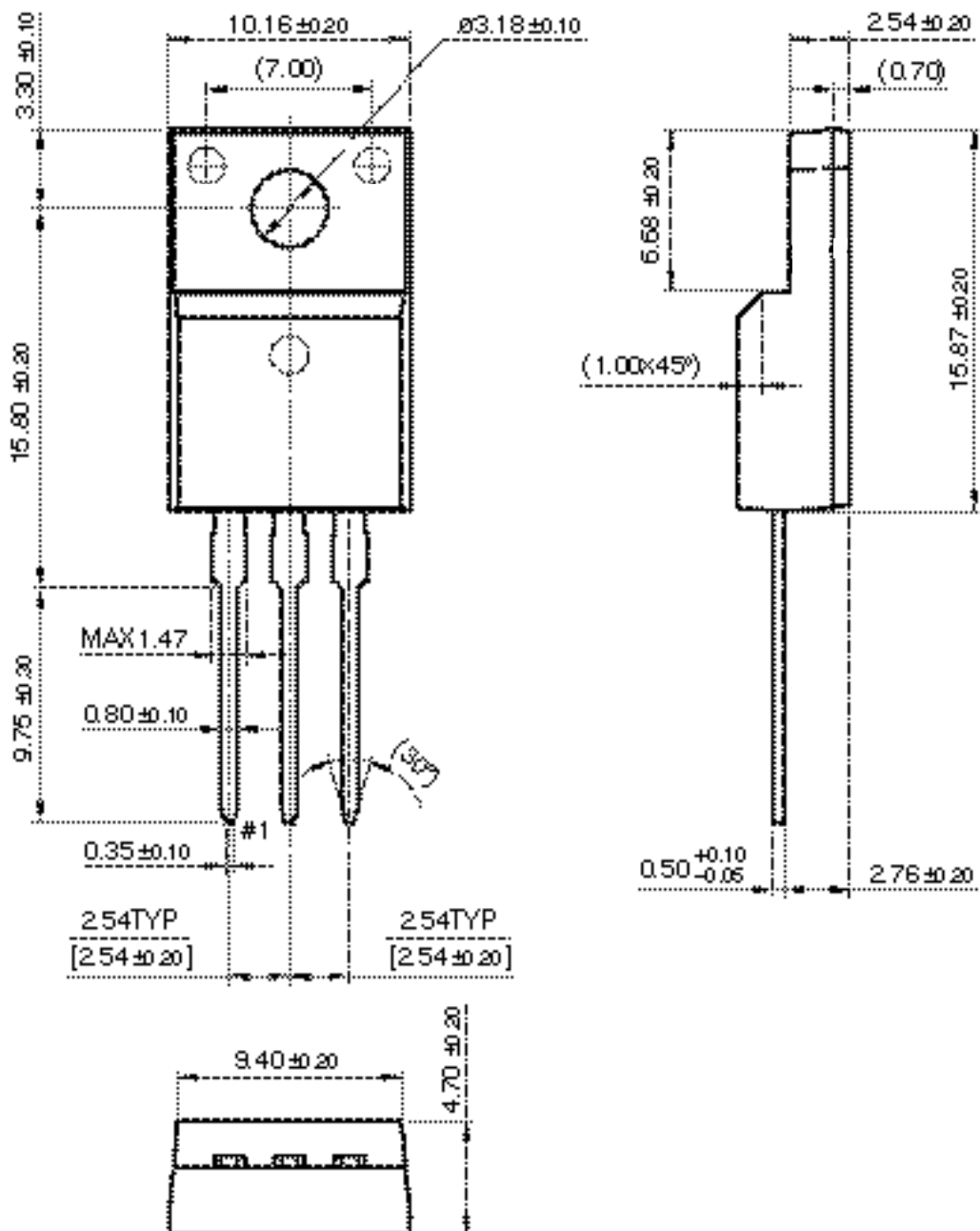


TO-220



Package Dimensions (Continued)

TO-220F





* Front/Back Side Isolation Voltage : 2500V


Dimensions in Millimeters





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