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August 2016

FDP12N50NZ / FDPF12N50NZ

N-Channel UniFET™ II MOSFET

500 V, 11.5 A, 520 mΩ

Features

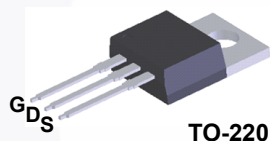
- $R_{DS(on)} = 460 \text{ m}\Omega$ (Typ.) @ $V_{GS} = 10 \text{ V}$, $I_D = 5.75 \text{ A}$
- Low Gate Charge (Typ. 23 nC)
- Low C_{rss} (Typ. 14 pF)
- 100% Avalanche Tested
- ESD Improved Capability
- RoHS Compliant

Applications

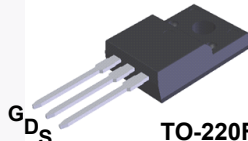
- LCD/LED/PDP TV
- Lighting
- Uninterruptible Power Supply

Description

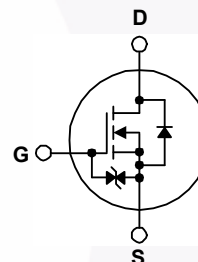
UniFET™ II MOSFET is Fairchild Semiconductor's high voltage MOSFET family based on advanced planar stripe and DMOS technology. This advanced MOSFET family has the smallest on-state resistance among the planar MOSFET, and also provides superior switching performance and higher avalanche energy strength. In addition, internal gate-source ESD diode allows UniFET II MOSFET to withstand over 2kV HBM surge stress. 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-220



TO-220F



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

Symbol	Parameter	FDP12N50NZ	FDPF12N50NZ	Unit
V_{DSS}	Drain to Source Voltage	500		V
V_{GSS}	Gate to Source Voltage	±25		V
I_D	Drain Current	- Continuous ($T_C = 25^\circ\text{C}$)	11.5	11.5*
		- Continuous ($T_C = 100^\circ\text{C}$)	6.9	6.9*
I_{DM}	Drain Current	- Pulsed (Note 1)	46	46*
E_{AS}	Single Pulsed Avalanche Energy	(Note 2)	560	mJ
I_{AR}	Avalanche Current	(Note 1)	11.5	A
E_{AR}	Repetitive Avalanche Energy	(Note 1)	17	mJ
dv/dt	MOSFET dv/dt Ruggedness		20	V/ns
	Peak Diode Recovery dv/dt	(Note 3)	10	V/ns
P_D	Power Dissipation	($T_C = 25^\circ\text{C}$)	170	42
		- Derate above 25°C	1.37	0.33
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		$^\circ\text{C}$

*Drain current limited by maximum junction temperature

Thermal Characteristics

Symbol	Parameter	FDP12N50NZ	FDPF12N50NZ	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	0.73	3.0	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max.	62.5	62.5	

Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FDP12N50NZ	FDP12N50NZ	TO-220	Tube	N/A	50 units
FDPF12N50NZ	FDPF12N50NZ	TO-220F	Tube	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	$I_D = 250\mu\text{A}$, $V_{GS} = 0\text{V}$, $T_J = 25^\circ\text{C}$	500	-	-	V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 250\mu\text{A}$, Referenced to 25°C	-	0.5	-	$V/^\circ\text{C}$
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 500\text{V}$, $V_{GS} = 0\text{V}$ $V_{DS} = 400\text{V}$, $T_C = 125^\circ\text{C}$	-	-	1 10	μA
I_{GSS}	Gate to Body Leakage Current	$V_{GS} = \pm 25\text{V}$, $V_{DS} = 0\text{V}$	-	-	± 10	μA

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	$V_{GS} = 10\text{V}$, $I_D = 5.75\text{A}$	-	0.46	0.52	Ω
g_{FS}	Forward Transconductance	$V_{DS} = 20\text{V}$, $I_D = 5.75\text{A}$	-	12	-	S

Dynamic Characteristics

C_{iss}	Input Capacitance	$V_{DS} = 25\text{V}$, $V_{GS} = 0\text{V}$ $f = 1\text{MHz}$	-	945	1235	pF
C_{oss}	Output Capacitance		-	155	205	pF
C_{rss}	Reverse Transfer Capacitance		-	14	20	pF
Q_g	Total Gate Charge at 10V	$V_{DS} = 400\text{V}$, $I_D = 11.5\text{A}$ $V_{GS} = 10\text{V}$ (Note 4)	-	23	30	nC
Q_{gs}	Gate to Source Gate Charge		-	5.5	-	nC
Q_{gd}	Gate to Drain "Miller" Charge		-	9.6	-	nC

Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 250\text{V}$, $I_D = 11.5\text{A}$ $R_G = 25\Omega$ (Note 4)	-	20	50	ns
t_r	Turn-On Rise Time		-	50	110	ns
$t_{d(off)}$	Turn-Off Delay Time		-	60	130	ns
t_f	Turn-Off Fall Time		-	45	100	ns

Drain-Source Diode Characteristics

I _S	Maximum Continuous Drain to Source Diode Forward Current		-	-	11.5	A
I _{SM}	Maximum Pulsed Drain to Source Diode Forward Current		-	-	46	A
V _{SD}	Drain to Source Diode Forward Voltage	V _{GS} = 0V, I _{SD} = 11.5A	-	-	1.4	V
t _{rr}	Reverse Recovery Time	V _{GS} = 0V, I _{SD} = 11.5A dI _F /dt = 100A/μs	-	315	-	ns
Q _{rr}	Reverse Recovery Charge		-	2.0	-	μC

Notes:

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. $L = 8.5\text{mH}$, $I_{AS} = 11.5\text{A}$, $V_{DD} = 50\text{V}$, $R_G = 25\Omega$, Starting $T_J = 25^\circ\text{C}$
3. $I_{SD} \leq 11.5\text{A}$, $di/dt \leq 200\text{A}/\mu\text{s}$, $V_{DD} \leq BV_{DSS}$, Starting $T_J = 25^\circ\text{C}$
4. Essentially Independent of Operating Temperature Typical Characteristics

Typical Characteristics

Figure 1. On-Region Characteristics

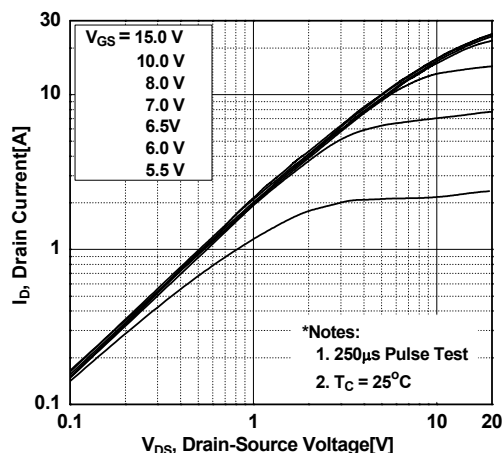


Figure 2. Transfer Characteristics

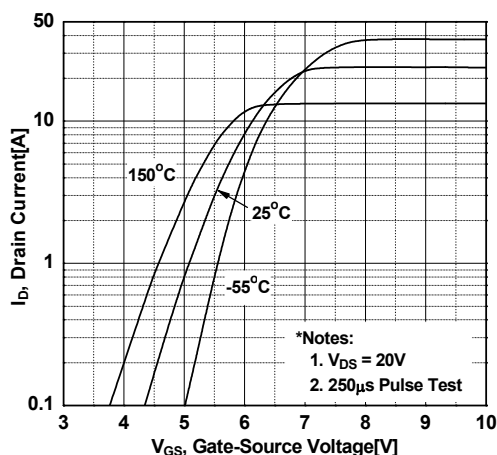


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

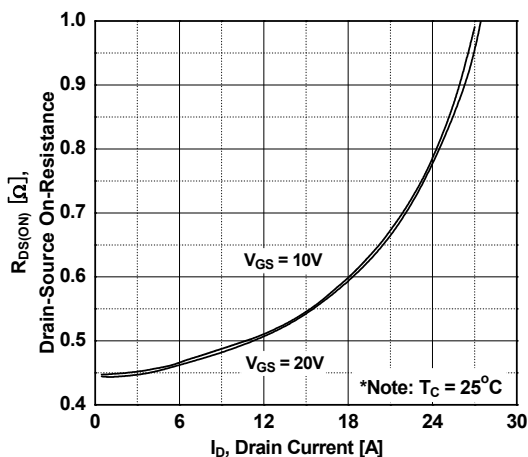


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

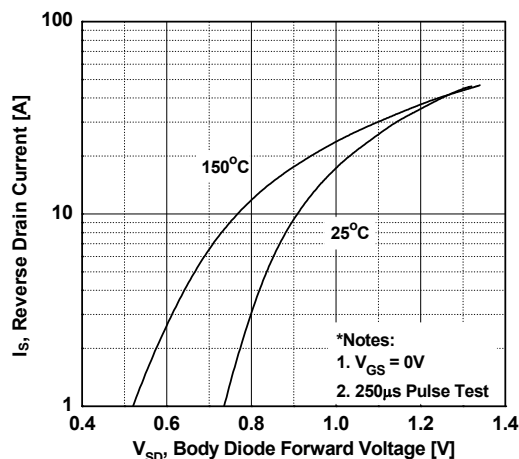


Figure 5. Capacitance Characteristics

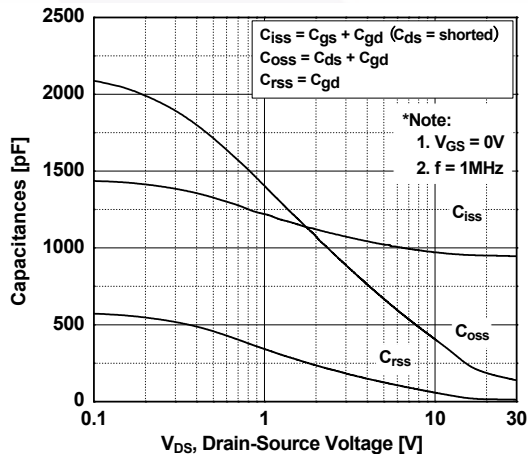
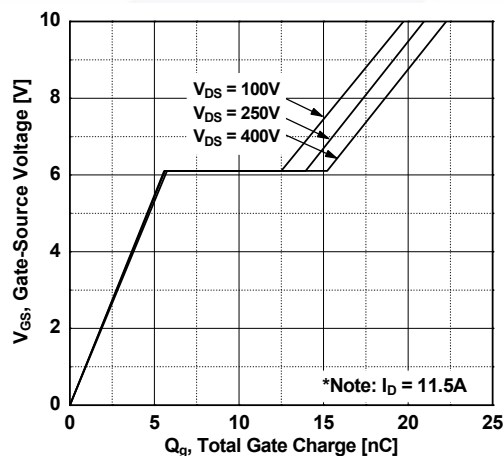


Figure 6. Gate Charge Characteristics



Typical Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

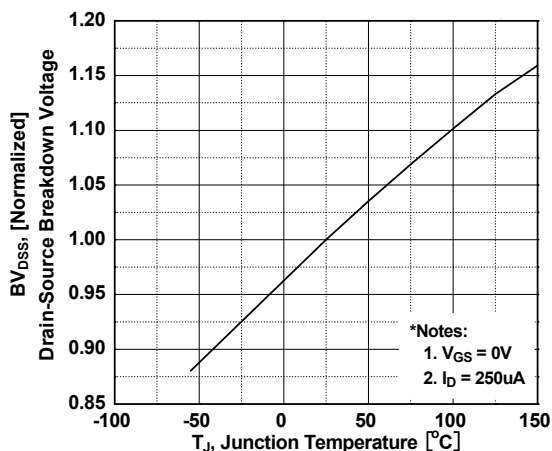


Figure 8. On-Resistance Variation vs. Temperature

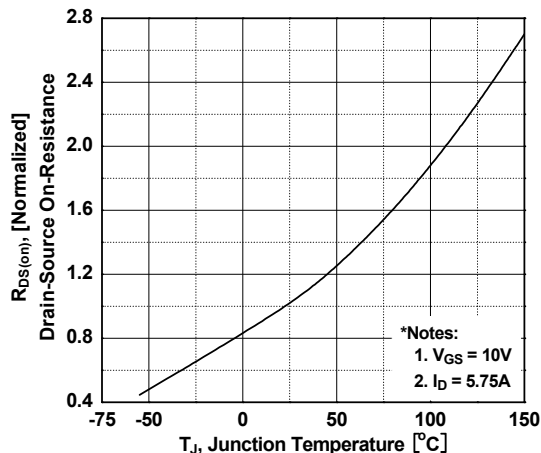


Figure 9. Maximum Safe Operating Area - FDP12N50NZ

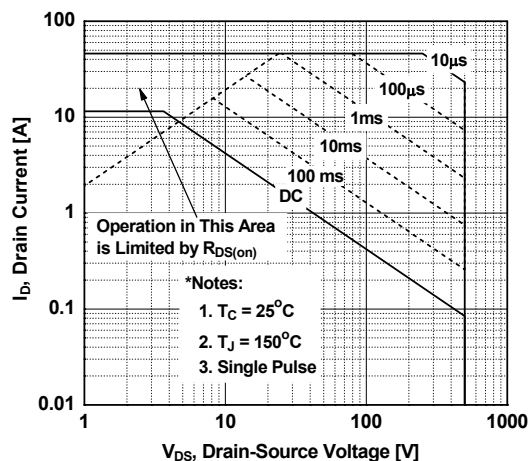


Figure 10. Maximum Safe Operating Area - FDP12N50NZ

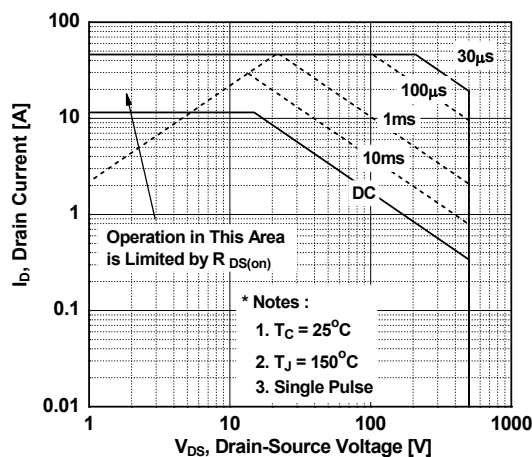
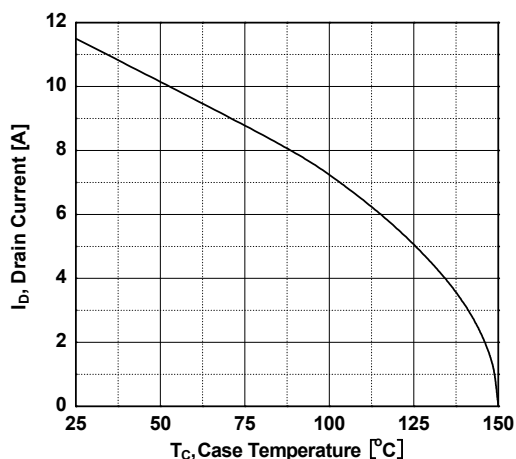


Figure 11. Maximum Drain Current vs. Case Temperature



Typical Characteristics (Continued)

Figure 12. Transient Thermal Response Curve - FDP12N50NZ

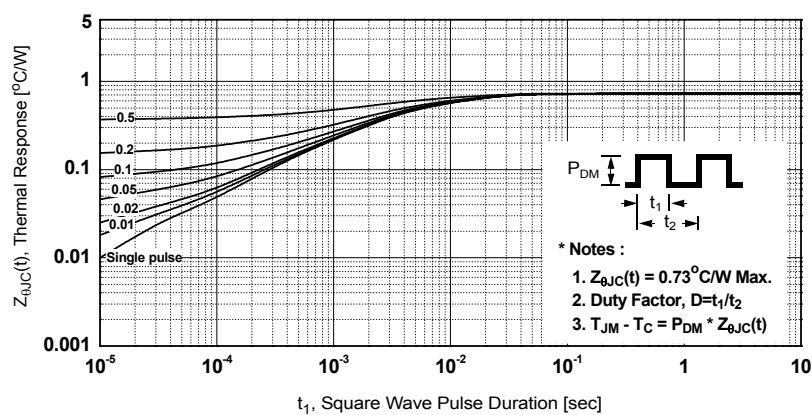


Figure 13. Transient Thermal Response Curve - FDPF12N50NZ

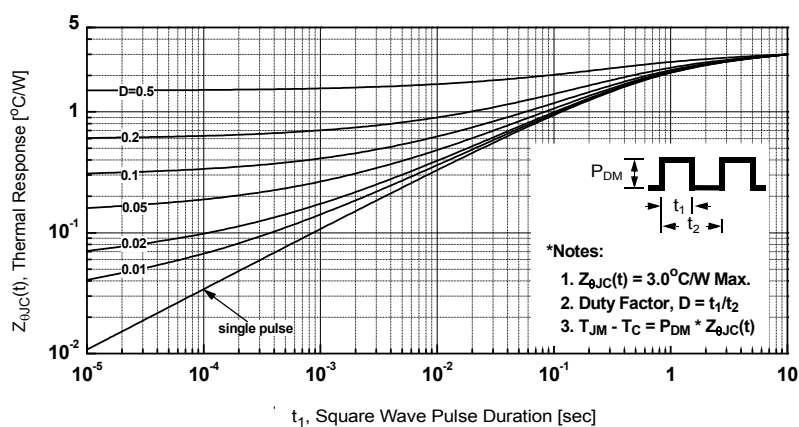


Figure 14. Gate Charge Test Circuit & Waveform

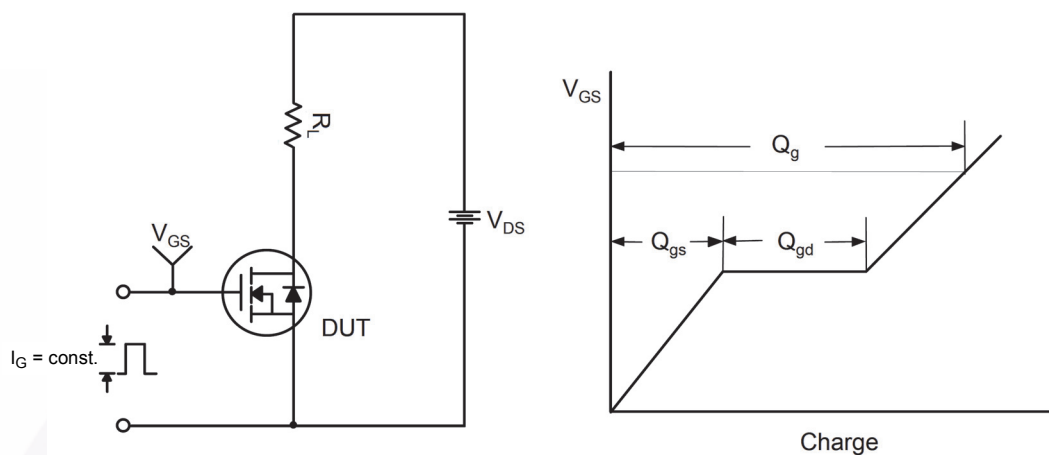


Figure 15. Resistive Switching Test Circuit & Waveforms

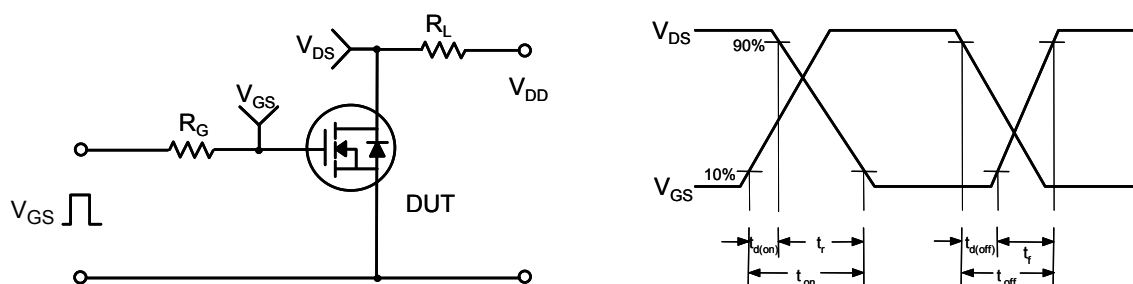


Figure 16. Unclamped Inductive Switching Test Circuit & Waveforms

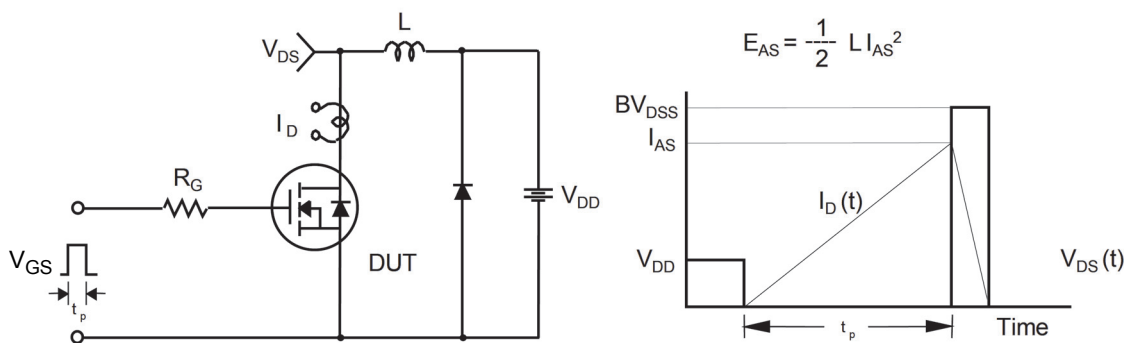
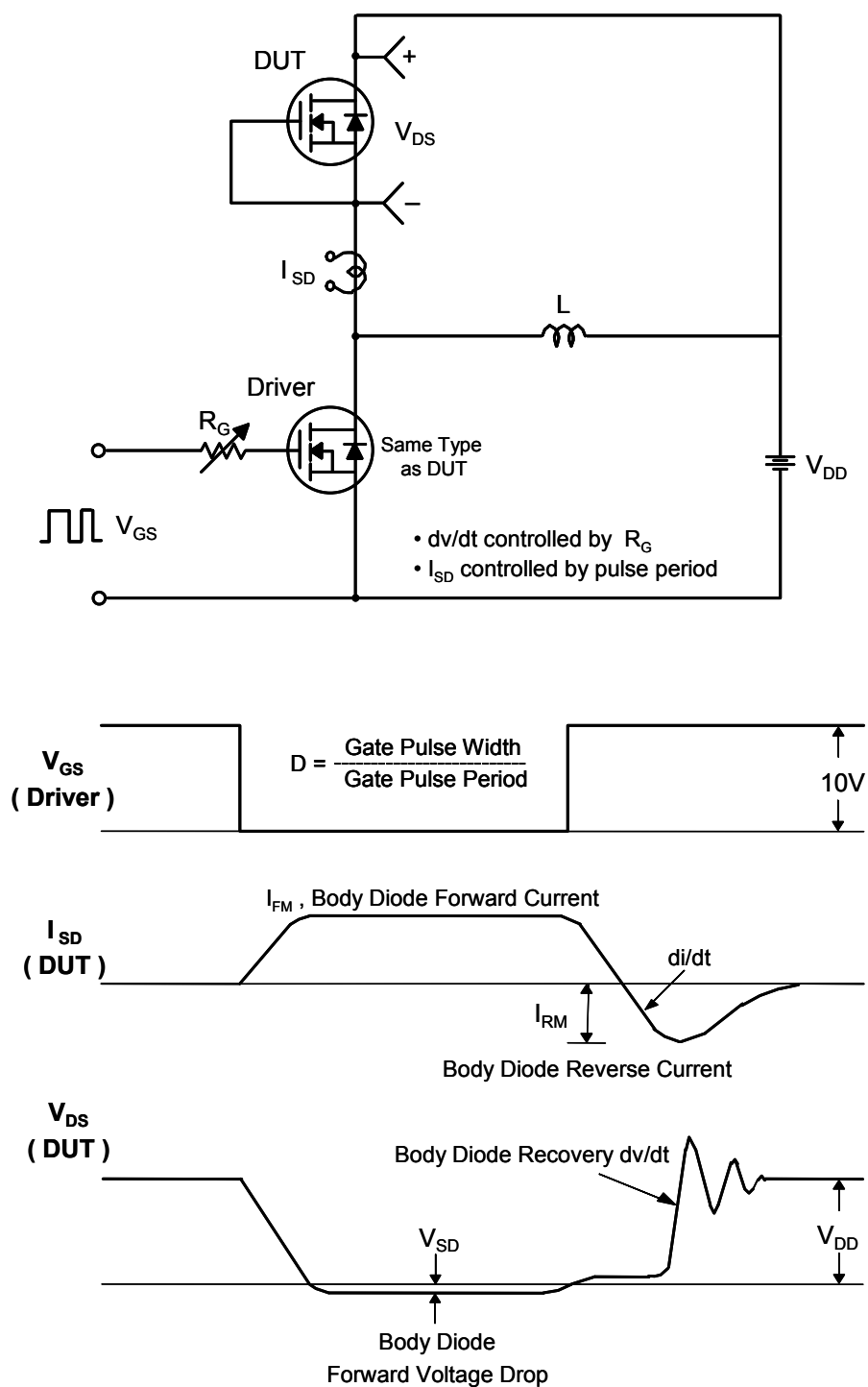
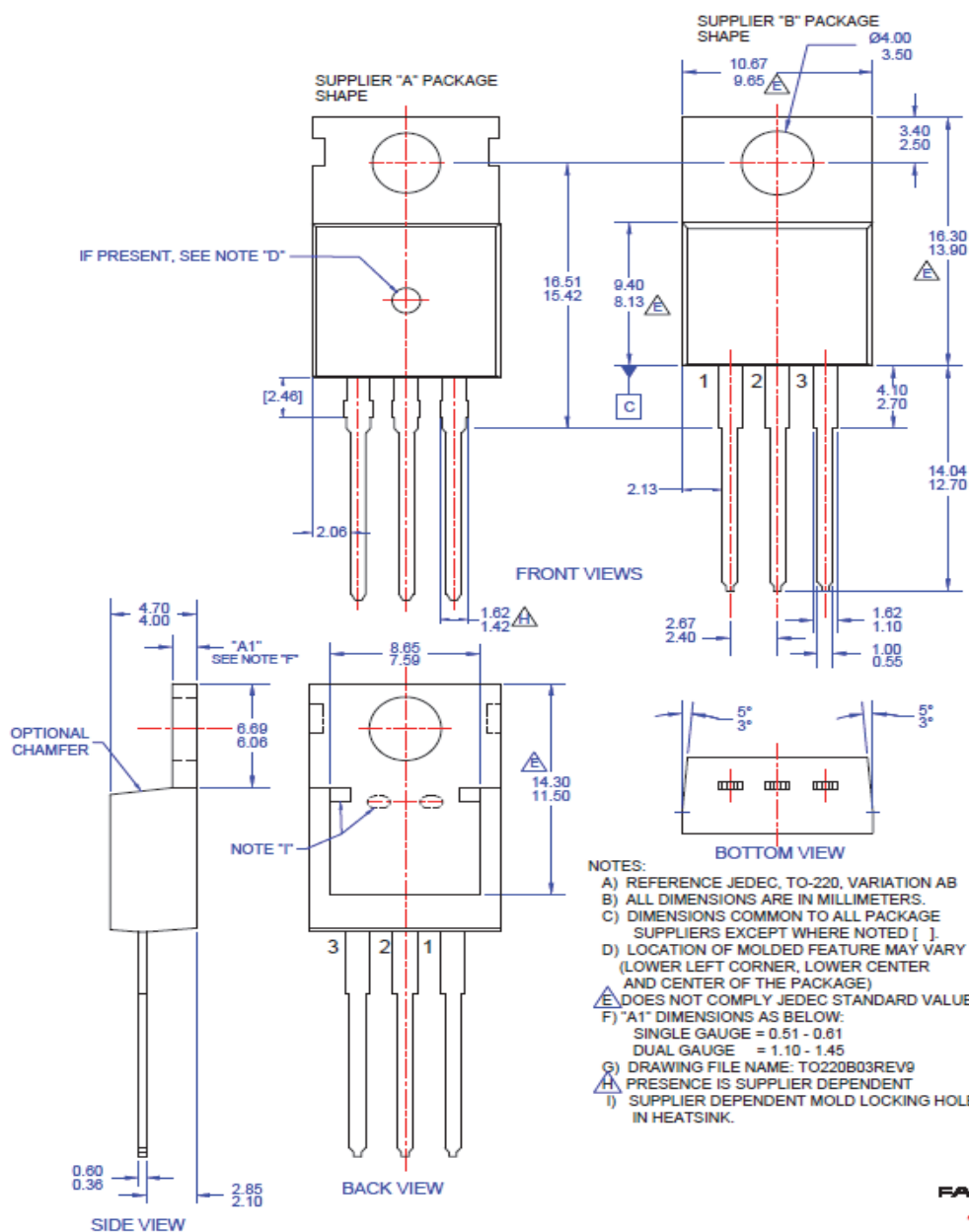


Figure 17. Peak Diode Recovery dv/dt Test Circuit & Waveforms



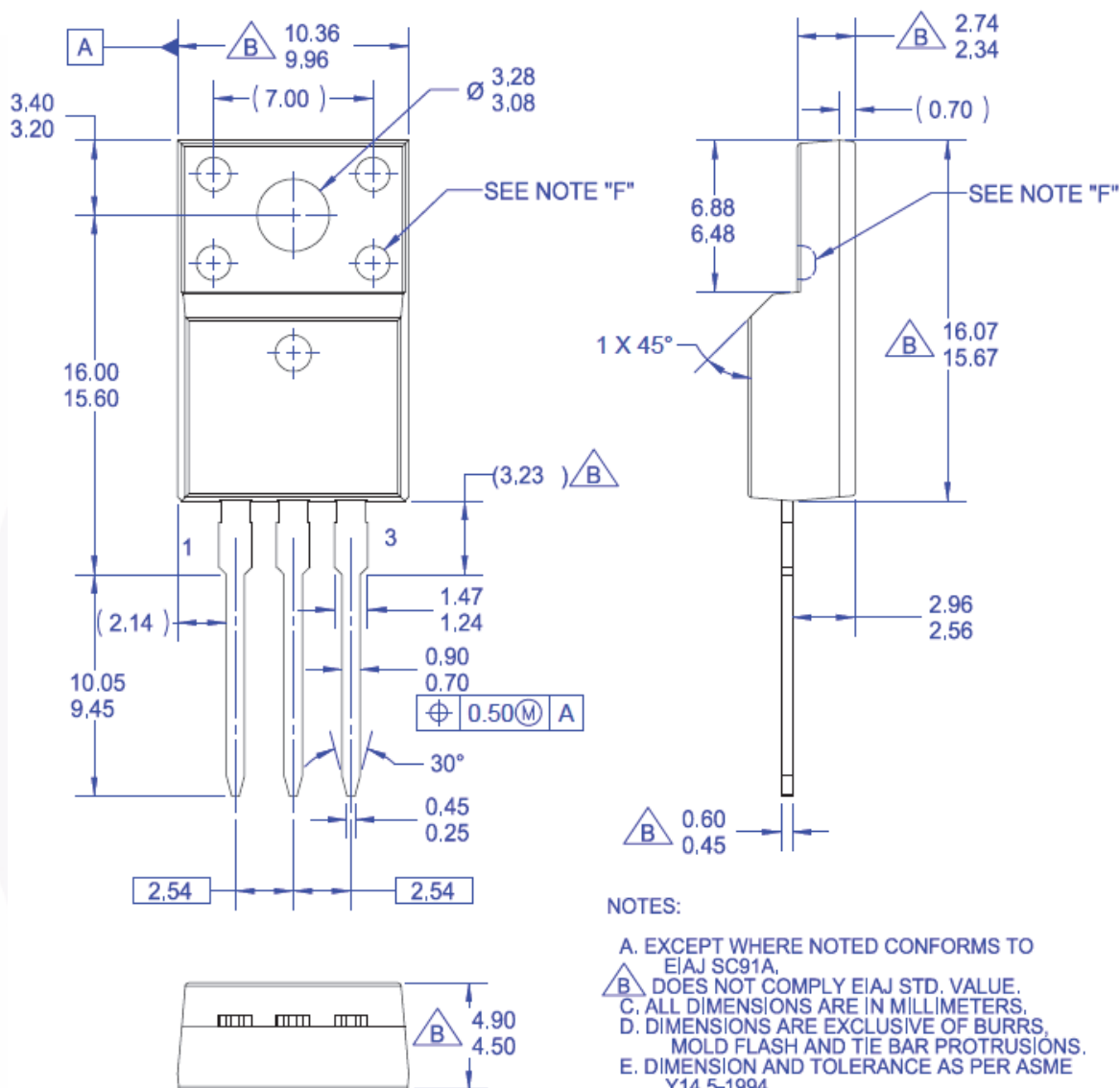
Mechanical Dimensions

TO-220 3L



Mechanical Dimensions

TO-220F 3L



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