FAIRCHILD
SEMICONDUCTOR®

October 2013

FDPF5N50NZF

## N-Channel UniFET™ II FRFET® MOSFET
500 V, 4.2 A, 1.75 Ω

Features

- $R_{DS(on)}$ = 1.57 Ω (Typ.) @ V_{GS} = 10 V, I_D = 2.1 A
- Low Gate Charge (Typ. 9 nC)
- Low C_{rss} (Typ. 4 pF)
- 100% Avalanche Tested
- Improved dv/dt Capability
- ESD Improved Capability
- RoHS Compliant

Applications

- LCD/LED TV
- Lighting
- Uninterruptible Power Supply
- AC-DC 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. The body diode's reverse recovery performance of UniFET II FRFET® MOSFET has been enhanced by lifetime control. Its t_{rr} 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.

TO-220F

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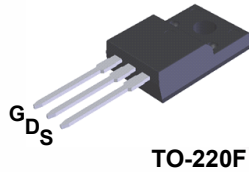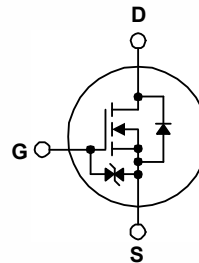
MOSFET Maximum Ratings T_C = 25°C unless otherwise noted.

Symbol	Parameter			FDPF5N50NZF	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°C)		4.2*	A
		- Continuous (T_C = 100°C)		2.5*	
I_{DM}	Drain Current	- Pulsed	(Note 1)	16*	A
E_{AS}	Single Pulsed Avalanche Energy	(Note 2)		165	mJ
I_{AR}	Avalanche Current	(Note 1)		4.2	A
E_{AR}	Repetitive Avalanche Energy	(Note 1)		7.8	mJ
dv/dt	Peak Diode Recovery dv/dt	(Note 3)		20	V/ns
P_D	Power Dissipation	(T_C = 25°C)		30	W
		- Derate above 25°C		0.24	W/°C
T_J, T_{STG}	Operating and Storage Temperature Range			-55 to +150	°C
T_L	Maximum Lead Temperature for Soldering Purpose, 1/8" from Case for 5 Seconds			300	°C

*Drain current limited by maximum junction temperature

Thermal Characteristics

Symbol	Parameter	FDPF5N50NZF	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	4.1	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max.	62.5	

Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FDPF5N50NZF	FDPF5N50NZF	TO-220F	Tube	N/A	50 units

Electrical Characteristics $T_C = 25^oC$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
Off Characteristics						
BV_{DSS}	Drain to Source Breakdown Voltage	$I_D = 250\mu A$, $V_{GS} = 0V$, $T_C = 25^oC$	500	-	-	V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 250\mu A$, Referenced to 25^oC	-	0.5	-	V/^oC
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 500V$, $V_{GS} = 0V$	-	-	10	μA
		$V_{DS} = 400V$, $V_{GS} = 0V$, $T_C = 125^oC$	-	-	100	
I_{GSS}	Gate to Body Leakage Current	$V_{GS} = \pm25V$, $V_{DS} = 0V$	-	-	±10	μA
On Characteristics						
$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}$, $I_D = 250\mu A$	3.0	-	5.0	V
$R_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = 10V$, $I_D = 2.1A$	-	1.57	1.75	Ω
g_{FS}	Forward Transconductance	$V_{DS} = 20V$, $I_D = 2.1A$	-	4.2	-	S
Dynamic Characteristics						
C_{iss}	Input Capacitance	$V_{DS} = 25V$, $V_{GS} = 0V$ f = 1MHz	-	365	485	pF
C_{oss}	Output Capacitance		-	50	65	pF
C_{rss}	Reverse Transfer Capacitance		-	4	8	pF
$Q_{g(tot)}$	Total Gate Charge at 10V	$V_{DS} = 400V$ $I_D = 4.2A$ $V_{GS} = 10V$ (Note 4)	-	9	12	nC
Q_{gs}	Gate to Source Gate Charge		-	2	-	nC
Q_{gd}	Gate to Drain "Miller" Charge		-	4	-	nC
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 250V$, $I_D = 4.2A$ $V_{GS} = 10V$, $R_{GEN} = 25\Omega$ (Note 4)	-	12	35	ns
t_r	Turn-On Rise Time		-	19	50	ns
$t_{d(off)}$	Turn-Off Delay Time		-	31	70	ns
t_f	Turn-Off Fall Time		-	22	55	ns
Drain-Source Diode Characteristics						
I_S	Maximum Continuous Drain to Source Diode Forward Current		-	-	4.2	A
I_{SM}	Maximum Pulsed Drain to Source Diode Forward Current		-	-	16	A
V_{SD}	Drain to Source Diode Forward Voltage	$V_{GS} = 0V$, $I_{SD} = 4.2A$	-	-	1.5	V
t_{rr}	Reverse Recovery Time	$V_{GS} = 0V$, $I_{SD} = 4.2A$ $dI_F/dt = 100A/\mu s$	-	87	-	ns
Q_{rr}	Reverse Recovery Charge		-	0.15	-	μC

Notes:
1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. $L = 18.7mH$, $I_{AS} = 4.2A$, $V_{DD} = 50V$, $R_G = 25\Omega$, Starting $T_J = 25°C$
3. $I_{SD} \leq 4.2A$, $di/dt \leq 200A/\mu s$, $V_{DD} \leq BV_{DSS}$, Starting $T_J = 25°C$
4. Essentially Independent of Operating Temperature Typical Characteristics

Typical Characteristics

Figure 1. On-Region Characteristics
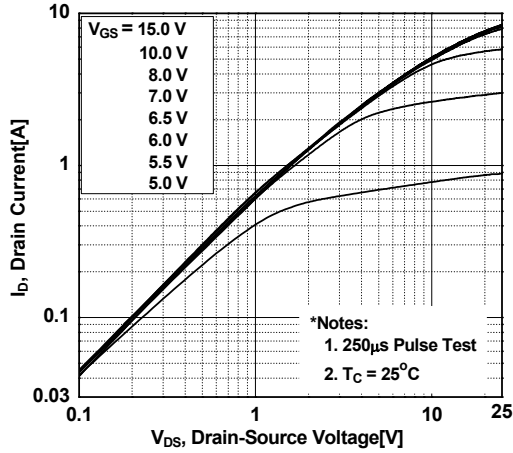
Figure 2. Transfer Characteristics
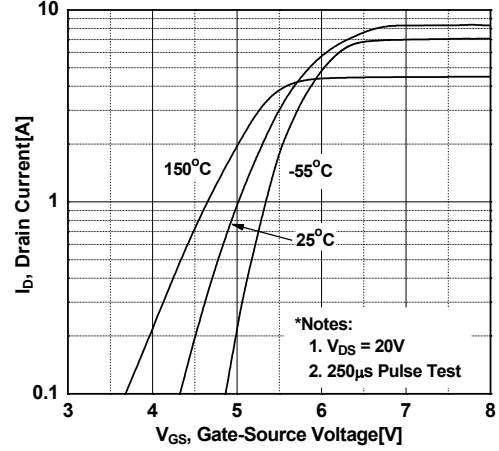
Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage
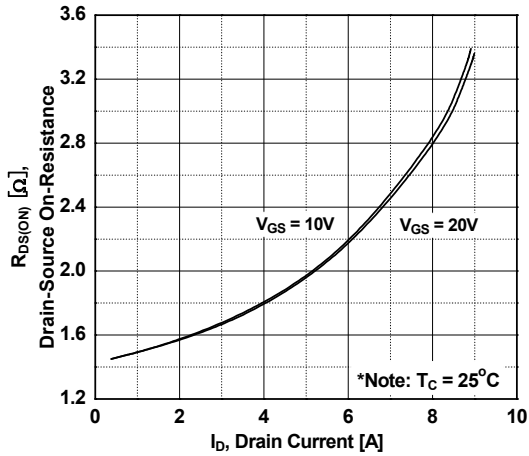
Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature
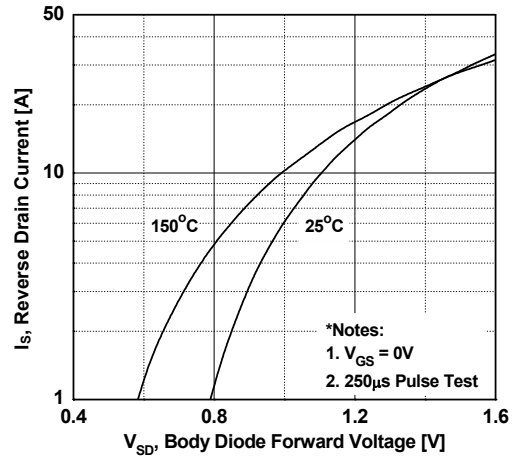
Figure 5. Capacitance Characteristics
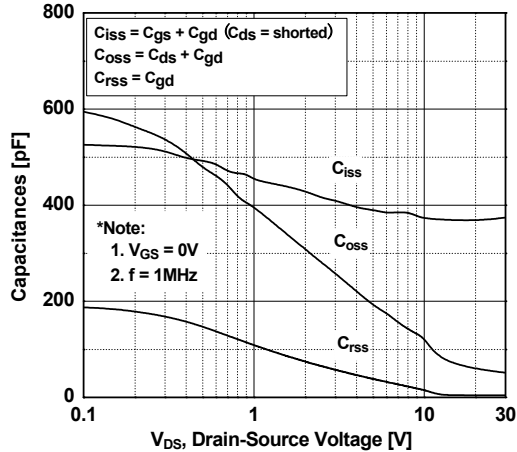
Figure 6. Gate Charge Characteristics
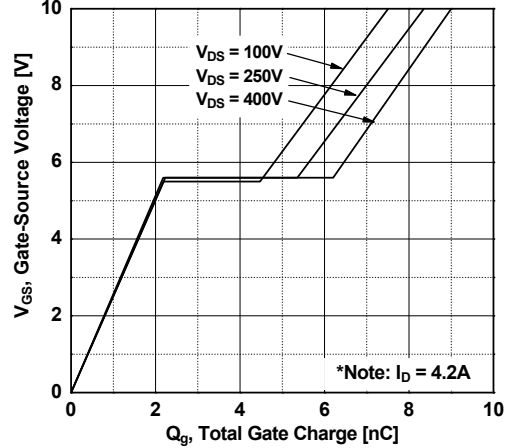
Typical Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

*Notes:
1. $V_{GS} = 0V$
2. $I_D = 250\mu A$
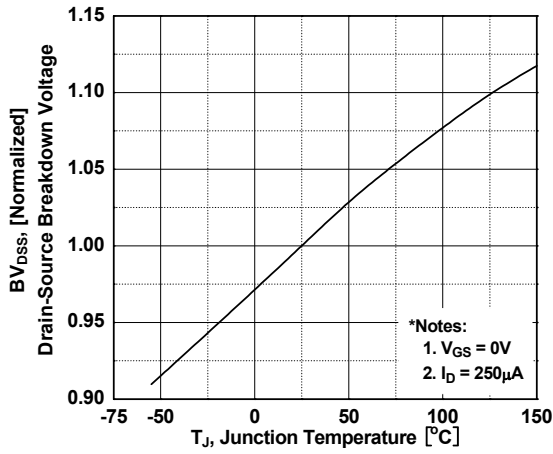
Figure 8. Maximum Safe Operating Area vs. Case Temperature-FDPF5N50NZF

Operation in This Area is Limited by $R_{DS(on)}$

*Notes:
1. $T_C = 25^oC$
2. $T_J = 150^oC$
3. Single Pulse
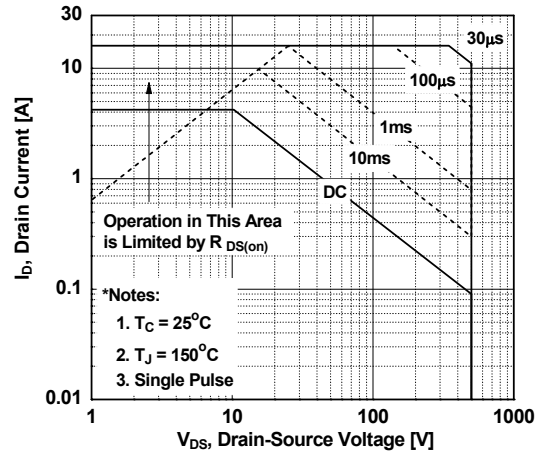
Figure 9. Maximum Drain Current
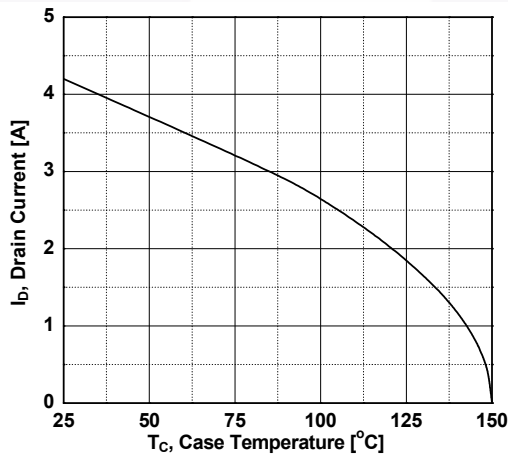
Figure 10. Transient Thermal Response Curve-FDPF5N50NZF

*Notes:
1. $Z_{\theta JC}(t) = 4.1^oC/W$ Max.
2. Duty Factor, $D = t_1/t_2$
3. $T_{JM} - T_C = P_{DM} * Z_{\theta JC}(t)$
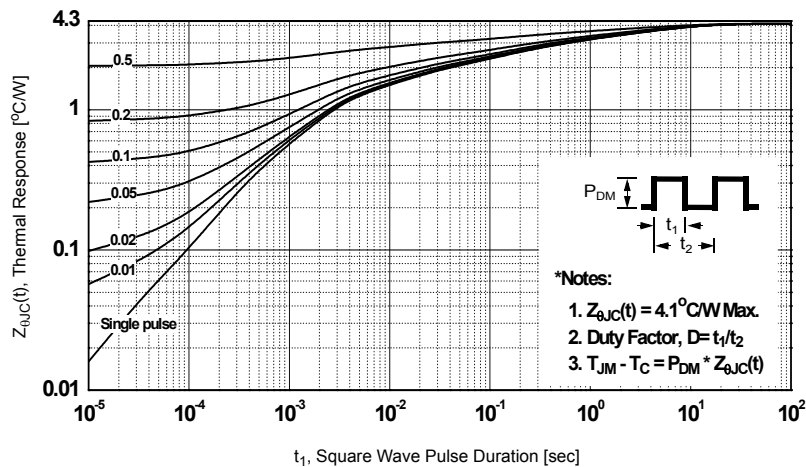
Figure 11. Gate Charge Test Circuit & Waveform
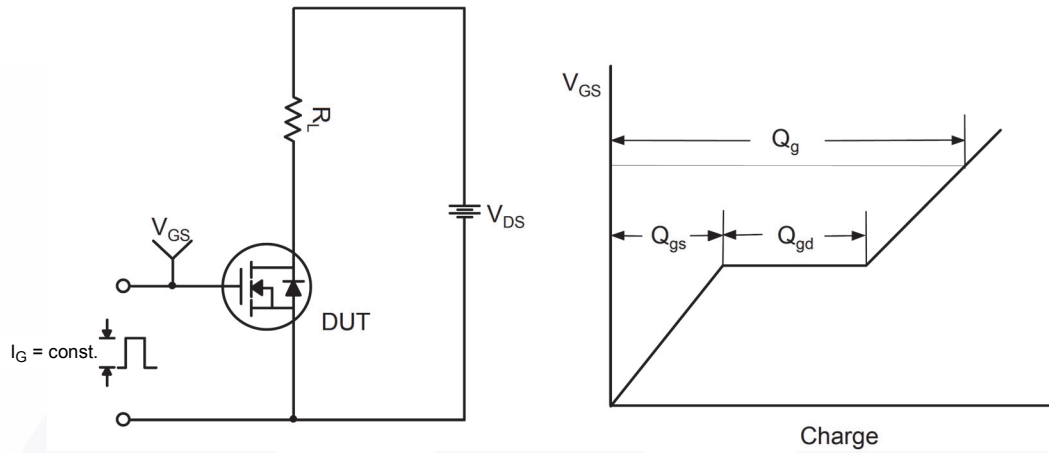
Figure 12. Resistive Switching Test Circuit & Waveforms
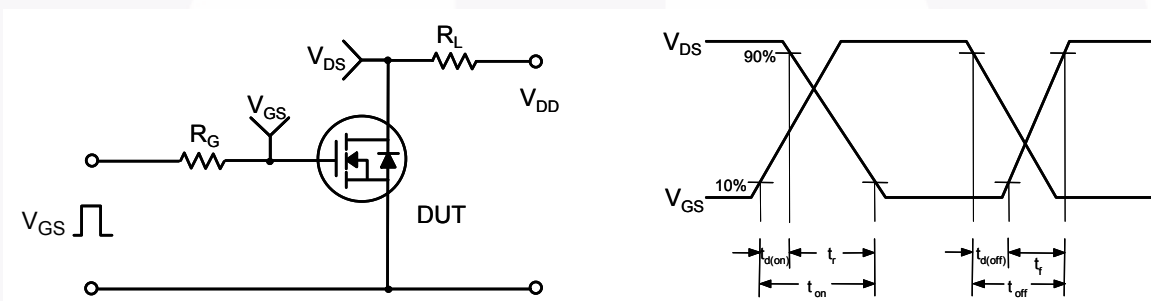
Figure 13. Unclamped Inductive Switching Test Circuit & Waveforms

$$E_{AS} = \frac{1}{2} L I_{AS}^2$$
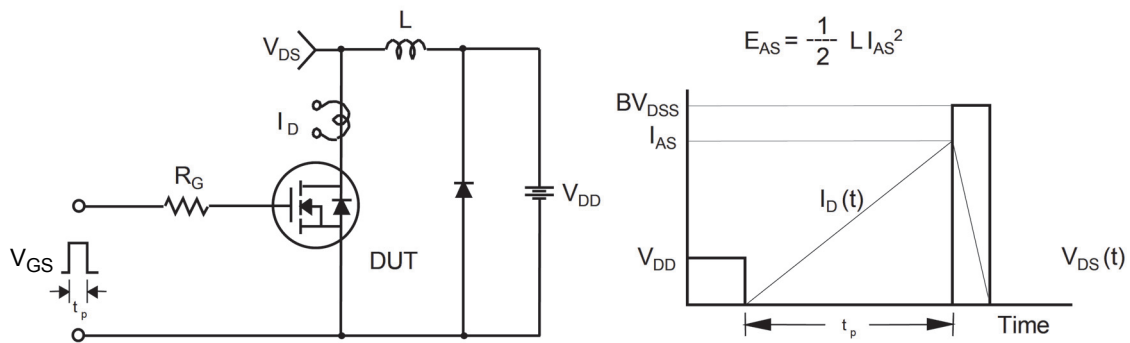
Figure 14. Peak Diode Recovery dv/dt Test Circuit & Waveforms

DUT

V_{DS}

I_{SD}

L

Driver

R_G

Same Type
as DUT

V_{DD}

V_{GS}

• dv/dt controlled by R_G
• I_{SD} controlled by pulse period

V_{GS}
(Driver)

$$D = \frac{Gate\ Pulse\ Width}{Gate\ Pulse\ Period}$$

10V

I_{SD}
(DUT)

I_{FM} , Body Diode Forward Current

di/dt

I_{RM}

Body Diode Reverse Current

V_{DS}
(DUT)

Body Diode Recovery dv/dt

V_{SD}

V_{DD}

Body Diode
Forward Voltage Drop
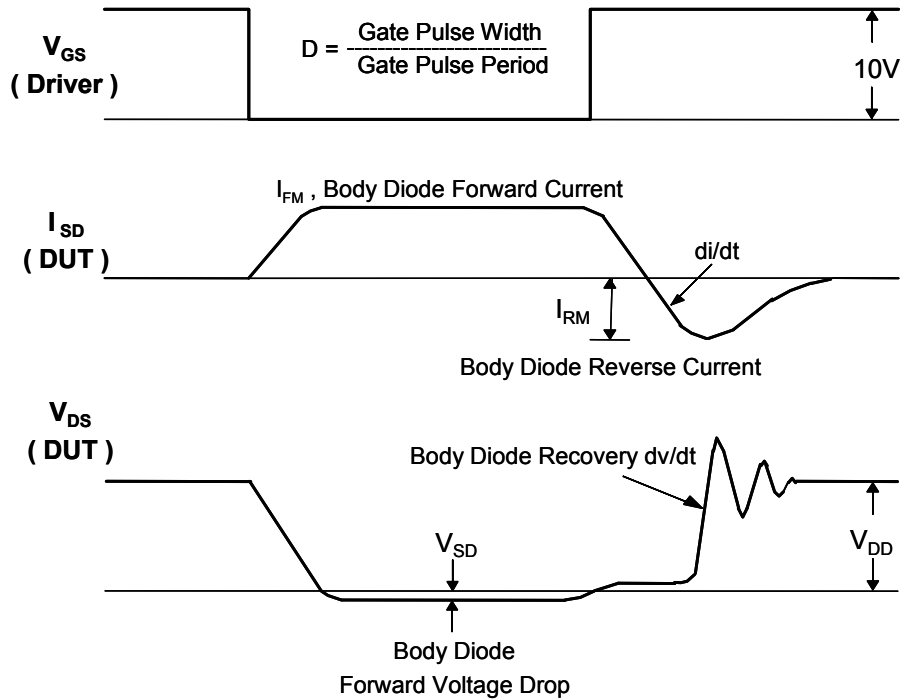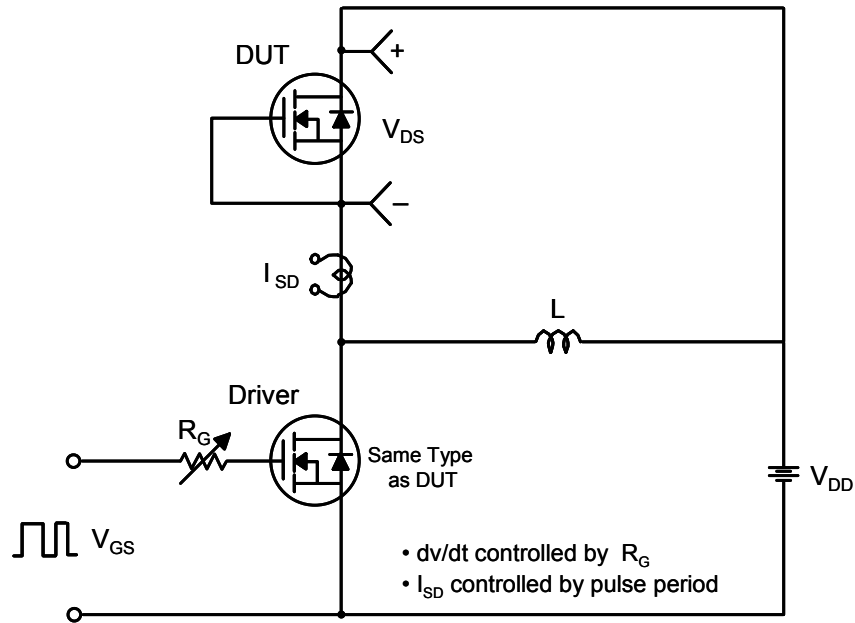
Mechanical Dimensions

TO-220F 3L
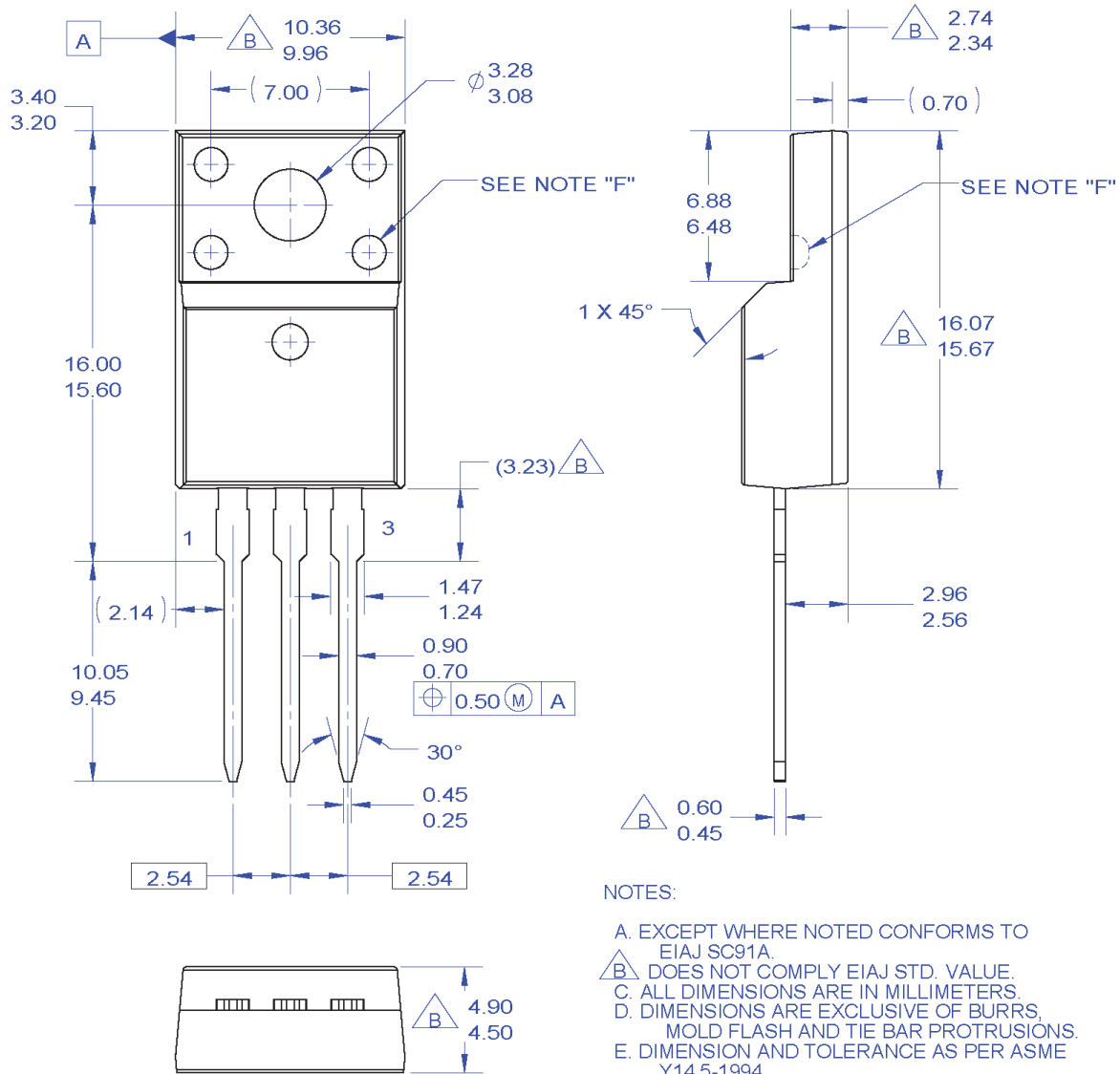
NOTES:

A. EXCEPT WHERE NOTED CONFORMS TO EIAJ SC91A.
B. DOES NOT COMPLY EIAJ STD. VALUE.
C. ALL DIMENSIONS ARE IN MILLIMETERS.
D. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR PROTRUSIONS.
E. DIMENSION AND TOLERANCE AS PER ASME Y14.5-1994.
F. OPTION 1 - WITH SUPPORT PIN HOLE.
   OPTION 2 - NO SUPPORT PIN HOLE.
G. DRAWING FILE NAME: TO220M03REV3

Figure 15. TO220, Molded, 3LD, Full Pack, EIAJ SC91, Straight Lead

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Dimension in Millimeters

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