

# FDPF13N50FT

## N-Channel UniFET™ FRFET® MOSFET

500 V, 12 A, 540 mΩ

### Features

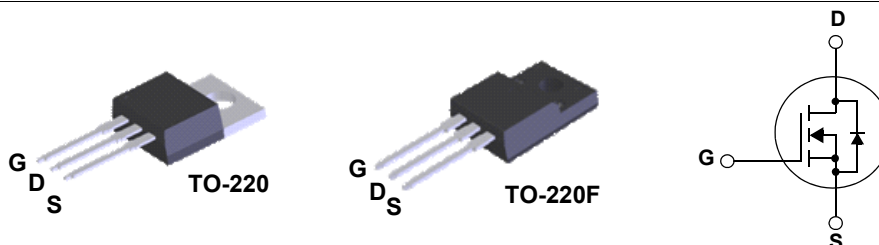
- $R_{DS(on)} = 420\Omega$  (Typ.) @  $V_{GS} = 10\text{ V}$ ,  $I_D = 6\text{ A}$
- Low Gate Charge (Typ. 30 nC)
- Low  $C_{rss}$  (Typ. 14.5 pF)
- 100% Avalanche Tested
- Improved dv/dt Capability
- RoHS Compliant

### Applications

- LCD/LED/PDP TV
- Lighting
- Uninterruptible 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. The body diode's reverse recovery performance of UniFET 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.



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

Symbol	Parameter	FDPF13N50FT	Unit
$V_{DSS}$	Drain to Source Voltage	500	V
$V_{GSS}$	Gate to Source Voltage	±30	V
$I_D$	Drain Current	- Continuous ( $T_C = 25^\circ\text{C}$ )	12*
		- Continuous ( $T_C = 100^\circ\text{C}$ )	7.2*
$I_{DM}$	Drain Current	- Pulsed (Note 1)	48*
$E_{AS}$	Single Pulsed Avalanche Energy (Note 2)	684	mJ
$I_{AR}$	Avalanche Current (Note 1)	12	A
$E_{AR}$	Repetitive Avalanche Energy (Note 1)	19.5	mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	20	V/ns
$P_D$	Power Dissipation	( $T_C = 25^\circ\text{C}$ )	42
		- Derate above $25^\circ\text{C}$	0.33
$T_J, T_{STG}$	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	FDPF13N50FT	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max	3.0	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max	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
FDPF13N50FT	FDPF13N50FT	TO-220F	-	-	50

## Electrical Characteristics

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
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 250\mu\text{A}$ , Referenced to $25^\circ\text{C}$	-	0.7	-	$\text{V}/^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 500\text{V}$ , $V_{GS} = 0\text{V}$	-	-	10	$\mu\text{A}$
		$V_{DS} = 400\text{V}$ , $T_C = 125^\circ\text{C}$	-	-	100	
$I_{GSS}$	Gate to Body Leakage Current	$V_{GS} = \pm 20\text{V}$ , $V_{DS} = 0\text{V}$	-	-	$\pm 100$	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	$V_{GS} = 10\text{V}$ , $I_D = 6\text{A}$	-	0.42	0.54	$\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS} = 20\text{V}$ , $I_D = 6\text{A}$	-	13.3	-	S

### Dynamic Characteristics

$C_{iss}$	Input Capacitance	$V_{DS} = 25\text{V}$ , $V_{GS} = 0\text{V}$ $f = 1\text{MHz}$	-	1450	1930	pF
$C_{oss}$	Output Capacitance		-	198	265	pF
$C_{rss}$	Reverse Transfer Capacitance		-	14.5	22	pF
$Q_{g(tot)}$	Total Gate Charge at 10V	$V_{DS} = 400\text{V}$ , $I_D = 13\text{A}$ $V_{GS} = 10\text{V}$	-	30	39	nC
$Q_{gs}$	Gate to Source Gate Charge		-	8	-	nC
$Q_{gd}$	Gate to Drain "Miller" Charge		-	12	-	nC

(Note 4)

### Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 250\text{V}$ , $I_D = 13\text{A}$ $R_G = 25\Omega$	-	28	65	ns
$t_r$	Turn-On Rise Time		-	54	120	ns
$t_{d(off)}$	Turn-Off Delay Time		-	75	160	ns
$t_f$	Turn-Off Fall Time		-	47	105	ns

(Note 4)

### Drain-Source Diode Characteristics

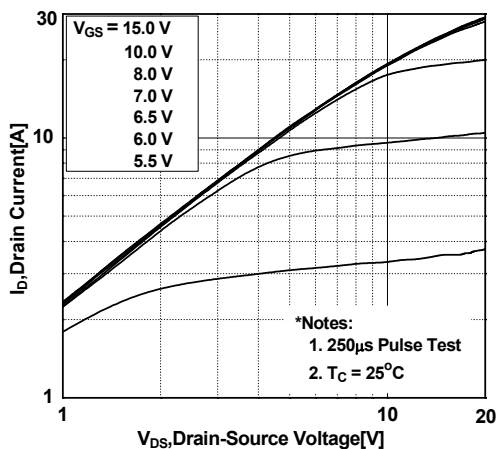
$I_S$	Maximum Continuous Drain to Source Diode Forward Current	-	-	12	A	
$I_{SM}$	Maximum Pulsed Drain to Source Diode Forward Current	-	-	48	A	
$V_{SD}$	Drain to Source Diode Forward Voltage	$V_{GS} = 0\text{V}$ , $I_{SD} = 12\text{A}$	-	-	1.5	V
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0\text{V}$ , $I_{SD} = 12\text{A}$	-	154	-	ns
$Q_{rr}$	Reverse Recovery Charge	$dI_F/dt = 100\text{A}/\mu\text{s}$	-	0.45	-	$\mu\text{C}$

#### Notes:

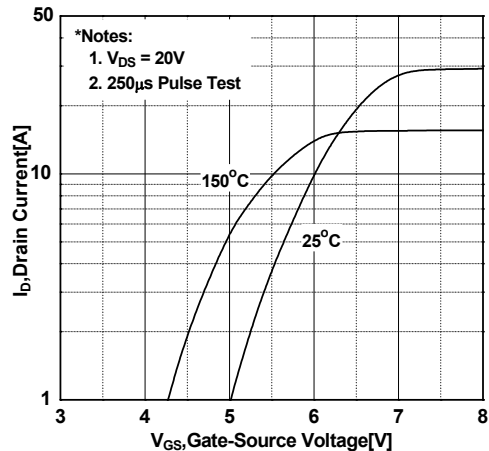
1. Repetitive Rating: Pulse width limited by maximum junction temperature
2.  $L = 9.5\text{mH}$ ,  $I_{AS} = 12\text{A}$ ,  $V_{DD} = 50\text{V}$ ,  $R_G = 25\Omega$ , Starting  $T_J = 25^\circ\text{C}$
3.  $I_{SD} \leq 12\text{A}$ ,  $di/dt \leq 200\text{A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$
4. Essentially Independent of Operating Temperature Typical Characteristics

## Typical Performance Characteristics

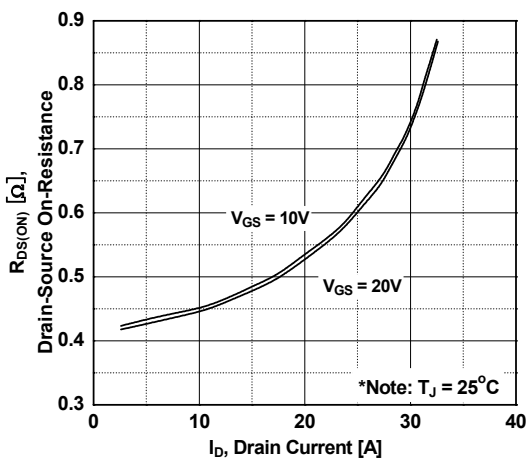
**Figure 1. On-Region Characteristics**



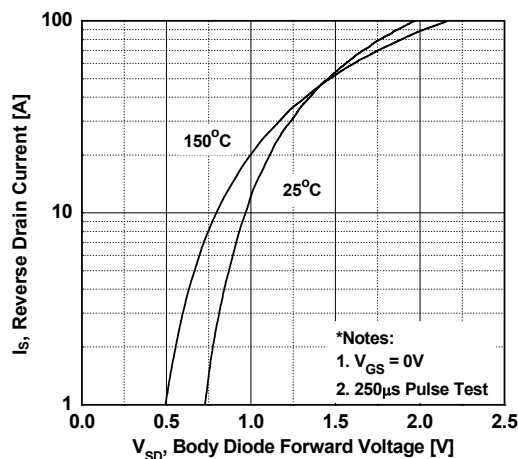
**Figure 2. Transfer Characteristics**



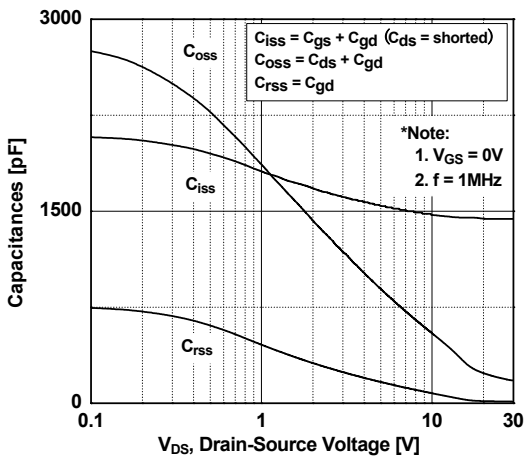
**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**



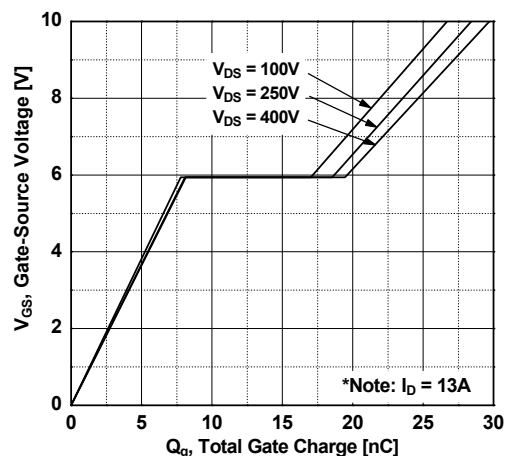
**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**



**Figure 5. Capacitance Characteristics**

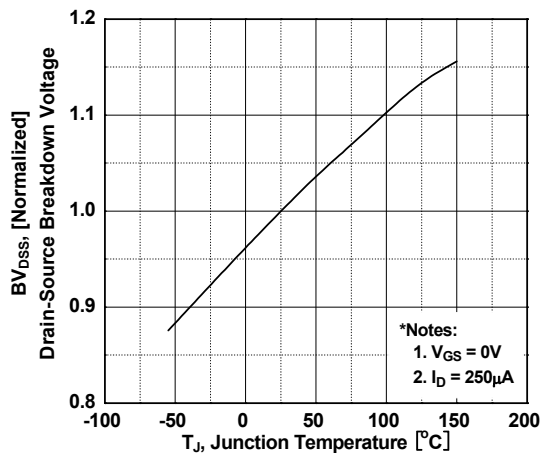


**Figure 6. Gate Charge Characteristics**

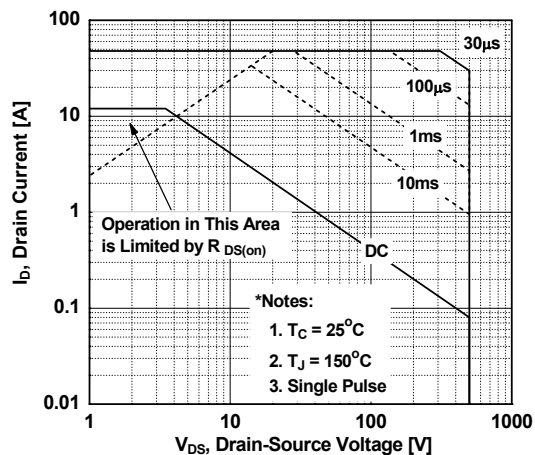


**Typical Performance Characteristics** (Continued)

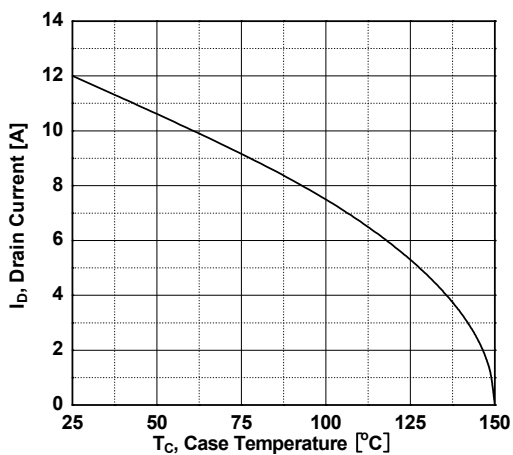
**Figure 7. Breakdown Voltage Variation vs. Temperature**



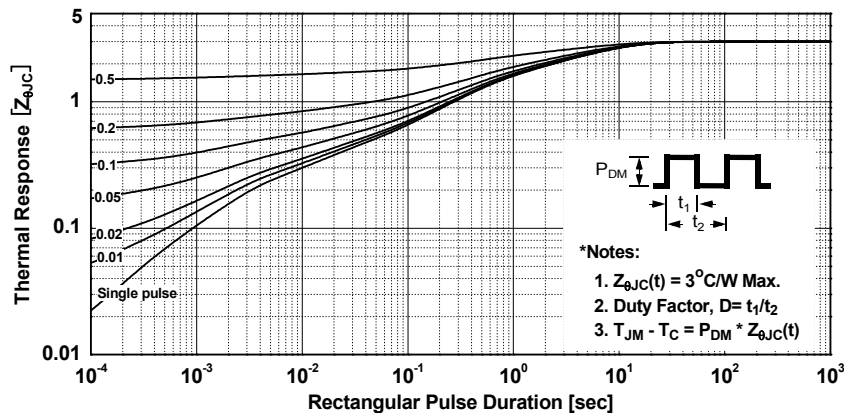
**Figure 8. Maximum Safe Operating Area - FDPF13N50FT**



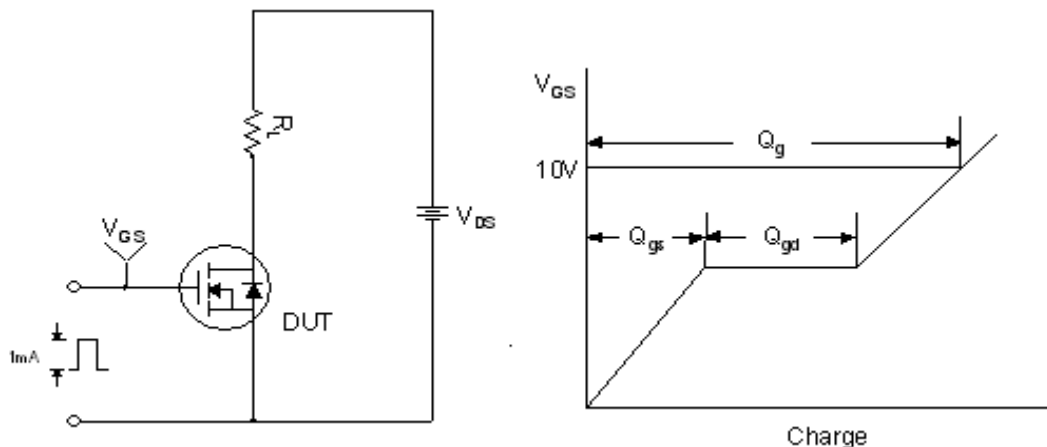
**Figure 9. Maximum Drain Current vs. Case Temperature**



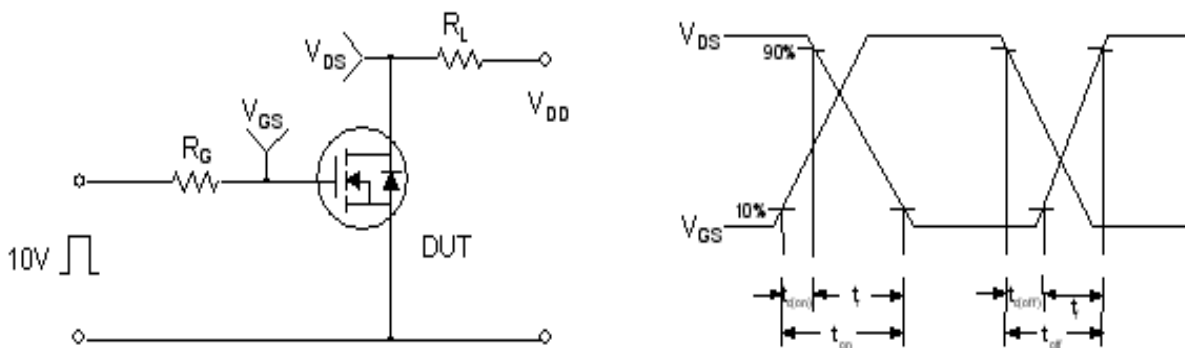
**Figure 10. Transient Thermal Response Curve - FDPF13N50FT**



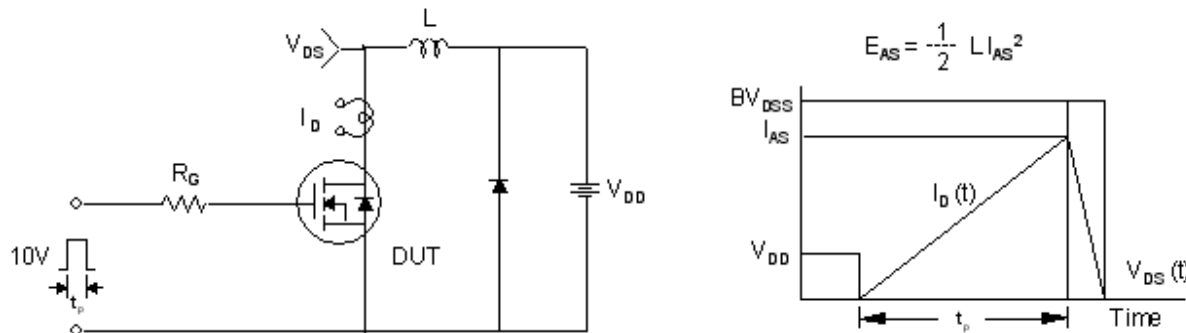
**Gate Charge Test Circuit & Waveform**



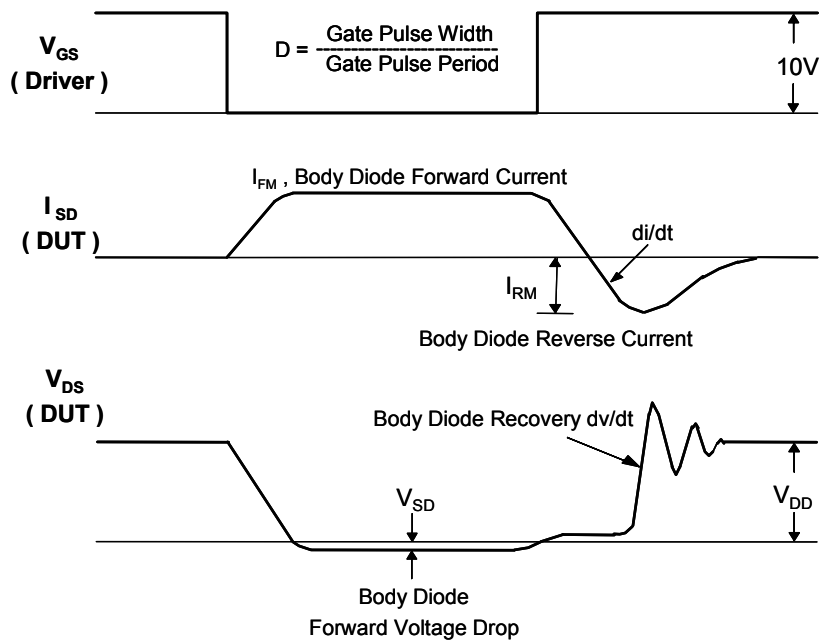
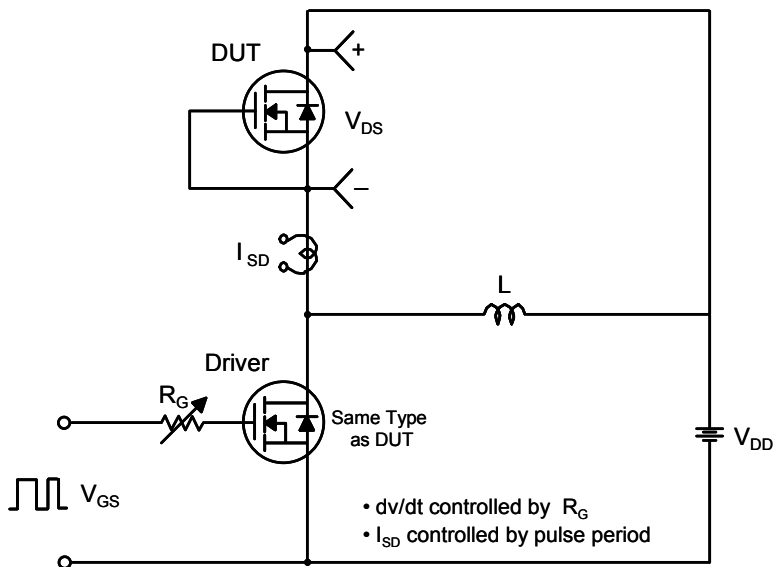
**Resistive Switching Test Circuit & Waveforms**



**Unclamped Inductive Switching Test Circuit & Waveforms**

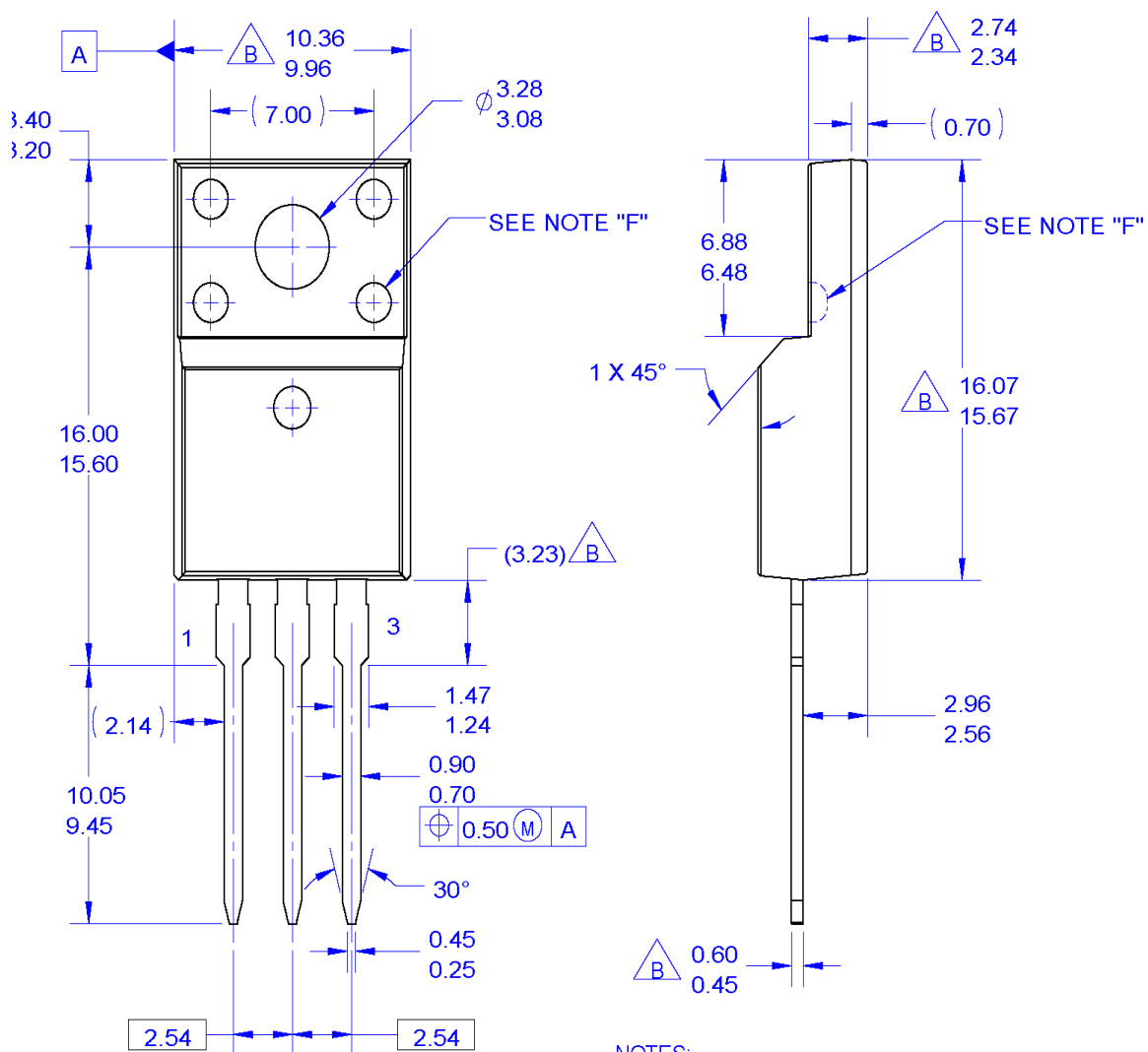


Peak Diode Recovery dv/dt Test Circuit & Waveforms



**Package Dimensions**

**TO-220M03**



**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

Dimensions in Millimeters



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- |                          |   |   |                  |
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| AX-CAP®*                 | FRFET®  | Programmable Active Droop™                      | TinyBoost™       |
| BitSiC™                  | Global Power Resource <sup>SM</sup>             | QFET®   | TinyBuck™        |
| Build it Now™            | Green Bridge™                                   | QS™   | TinyCalc™        |
| CorePLUS™                | Green FPS™                                      | Quiet Series™                                   | TinyLogic®       |
| CorePOWER™               | Green FPS™ e-Series™                            | RapidConfigure™                                 | TINYOPTO™        |
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| FACT®                    |   |   | VoltagePlus™     |
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