



# FDP5N60NZ / FDPF5N60NZ

## N-Channel UniFET™ II MOSFET

600 V, 4.5 A, 2.0 Ω

### Features

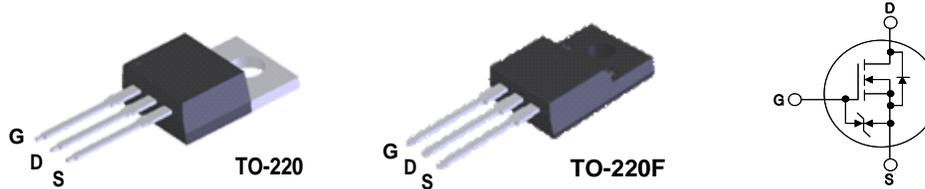
- $R_{DS(on)} = 1.65 \Omega$  (Typ.) @  $V_{GS} = 10 V, I_D = 2.25 A$
- Low Gate Charge (Typ. 10 nC)
- Low  $C_{rss}$  (Typ. 5 pF)
- 100% Avalanche Tested
- Improved dv/dt Capability
- ESD Improved Capability
- RoHS Compliant

### 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.

### Applications

- LCD/LED TV
- Lighting
- Uninterruptible Power Supply
- AC-DC Power Supply



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

Symbol	Parameter	FDP5N60NZ	FDPF5N60NZ	Unit
$V_{DSS}$	Drain to Source Voltage	600		V
$V_{GSS}$	Gate to Source Voltage	±25		V
$I_D$	Drain Current	- Continuous ( $T_C = 25^\circ C$ )	4.5	4.5*
		- Continuous ( $T_C = 100^\circ C$ )	2.7	2.7*
$I_{DM}$	Drain Current	- Pulsed (Note 1)	18	18*
$E_{AS}$	Single Pulsed Avalanche Energy (Note 2)	175		mJ
$I_{AR}$	Avalanche Current (Note 1)	4.5		A
$E_{AR}$	Repetitive Avalanche Energy (Note 1)	10		mJ
dv/dt	MOSFET dv/dt Ruggedness	20		V/ns
	Peak Diode Recovery dv/dt (Note 3)	10		V/ns
$P_D$	Power Dissipation	( $T_C = 25^\circ C$ )	100	33
		- Derate above 25°C	0.8	0.27
$T_J, T_{STG}$	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	FDP5N60NZ	FDPF5N60NZ	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	1.25	3.75	°C/W
$R_{\theta CS}$	Thermal Resistance, Case to Sink, Typ.	0.5	-	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max.	62.5	62.5	

## Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FDP5N60NZ	FDP5N60NZ	TO-220	-	-	50
FDPF5N60NZ	FDPF5N60NZ	TO-220F	-	-	50

## 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	$I_D = 250\mu\text{A}, V_{GS} = 0\text{V}$	600	-	-	V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 250\mu\text{A}$ , Referenced to $25^\circ\text{C}$	-	0.6	-	$\text{V}/^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 600\text{V}, V_{GS} = 0\text{V}$ $V_{DS} = 480\text{V}, T_C = 125^\circ\text{C}$	-	-	1 10	$\mu\text{A}$
$I_{GSS}$	Gate to Body Leakage Current	$V_{GS} = \pm 25\text{V}, V_{DS} = 0\text{V}$	-	-	$\pm 10$	$\mu\text{A}$

### 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	$V_{GS} = 10\text{V}, I_D = 2.25\text{A}$	-	1.65	2.0	$\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS} = 20\text{V}, I_D = 2.25\text{A}$	-	5	-	S

### Dynamic Characteristics

$C_{iss}$	Input Capacitance	$V_{DS} = 25\text{V}, V_{GS} = 0\text{V}$ $f = 1\text{MHz}$	-	450	600	pF
$C_{oss}$	Output Capacitance		-	50	65	pF
$C_{riss}$	Reverse Transfer Capacitance		-	5	7.5	pF
$Q_g$	Total Gate Charge at 10V	$V_{DS} = 480\text{V}, I_D = 4.5\text{A}$ $V_{GS} = 10\text{V}$	-	10	13	nC
$Q_{gs}$	Gate to Source Gate Charge		-	2.5	-	nC
$Q_{gd}$	Gate to Drain "Miller" Charge		(Note 4)	-	4	-

### Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 300\text{V}, I_D = 4.5\text{A}$ $R_G = 25\Omega$	-	15	40	ns
$t_r$	Turn-On Rise Time		-	20	50	ns
$t_{d(off)}$	Turn-Off Delay Time		-	35	80	ns
$t_f$	Turn-Off Fall Time		(Note 4)	-	20	50

### Drain-Source Diode Characteristics

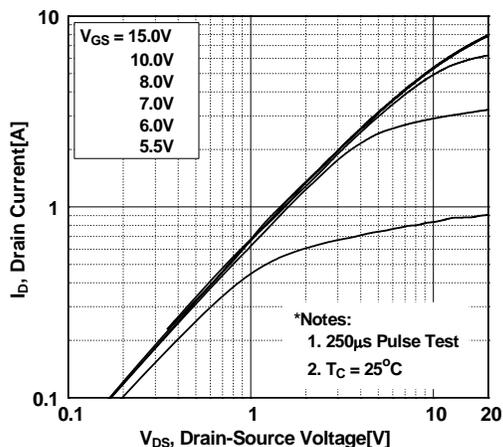
$I_S$	Maximum Continuous Drain to Source Diode Forward Current	-	-	4.5	A	
$I_{SM}$	Maximum Pulsed Drain to Source Diode Forward Current	-	-	18	A	
$V_{SD}$	Drain to Source Diode Forward Voltage	$V_{GS} = 0\text{V}, I_{SD} = 4.5\text{A}$	-	-	1.4	V
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0\text{V}, I_{SD} = 4.5\text{A}$ $di_F/dt = 100\text{A}/\mu\text{s}$	-	230	-	ns
$Q_{rr}$	Reverse Recovery Charge		-	0.9	-	$\mu\text{C}$

#### Notes:

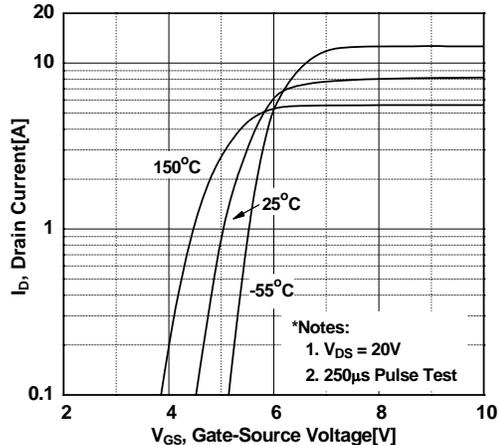
1. Repetitive Rating: Pulse width limited by maximum junction temperature
2.  $L = 17.3\text{mH}, I_{AS} = 4.5\text{A}, V_{DD} = 50\text{V}, R_G = 25\Omega$ , Starting  $T_J = 25^\circ\text{C}$
3.  $I_{SD} \leq 4.5\text{A}, di/dt \leq 200\text{A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$
4. Essentially Independent of Operating Temperature Typical Characteristics

## Typical Performance Characteristics

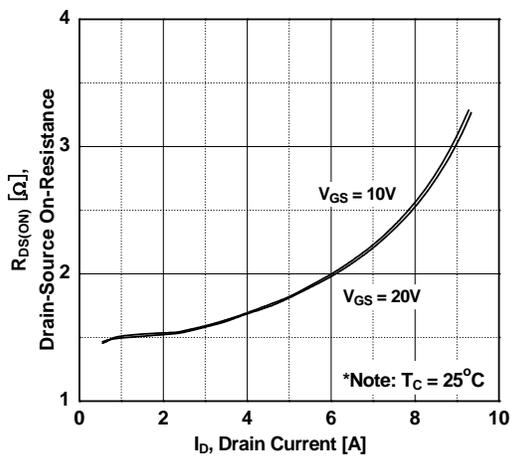
**Figure 1. On-Region Characteristics**



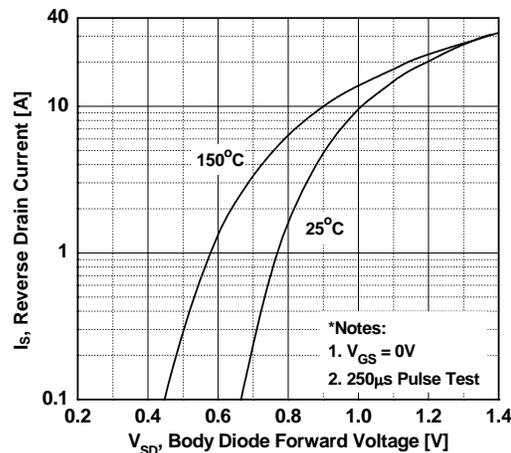
**Figure 2. Transfer Characteristics**



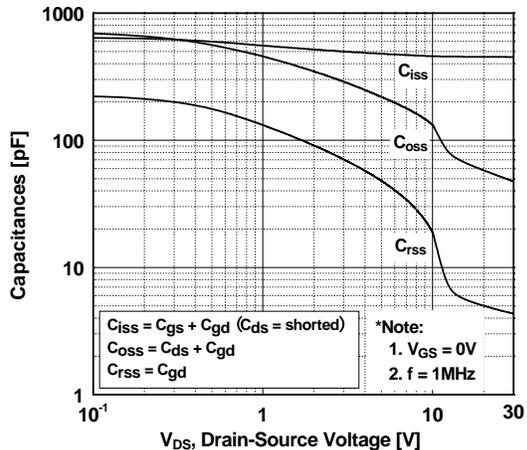
**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**



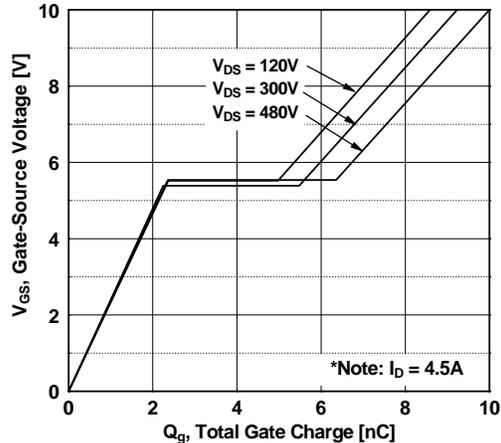
**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**



**Figure 5. Capacitance Characteristics**

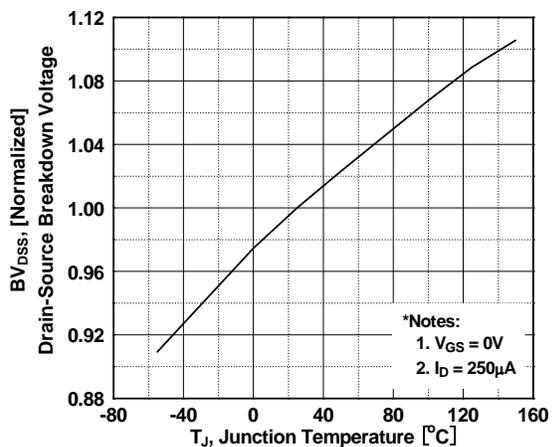


**Figure 6. Gate Charge Characteristics**

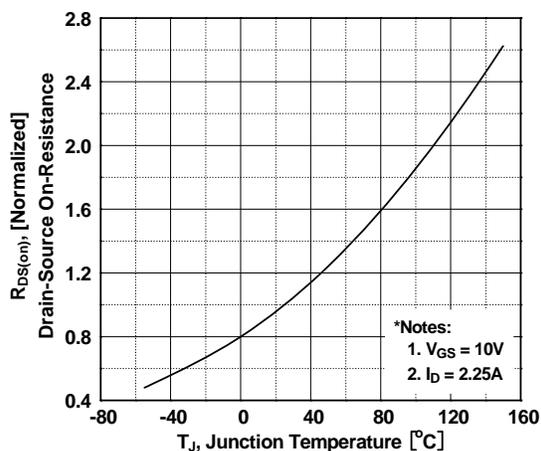


**Typical Performance Characteristics** (Continued)

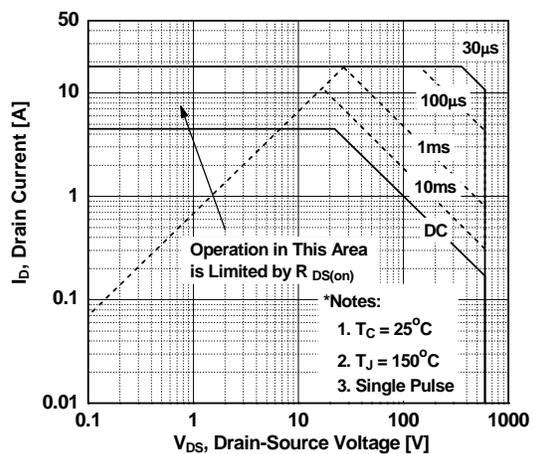
**Figure 7. Breakdown Voltage Variation vs. Temperature**



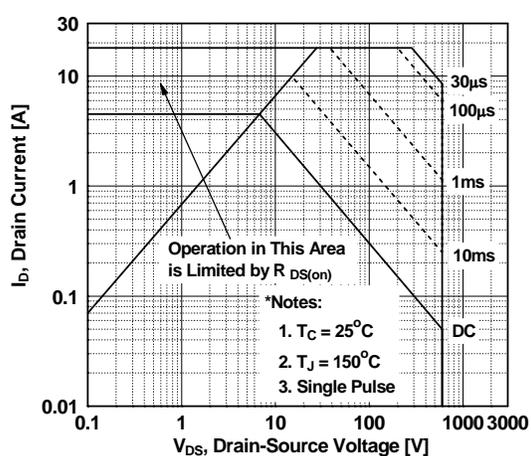
**Figure 8. On-Resistance Variation vs. Temperature**



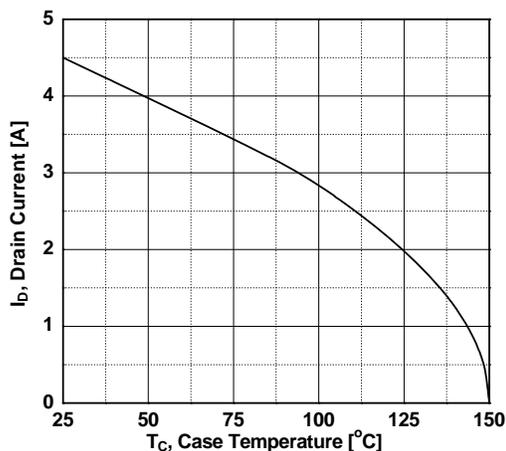
**Figure 9. Maximum Safe Operating Area -FDP5N60NZ**



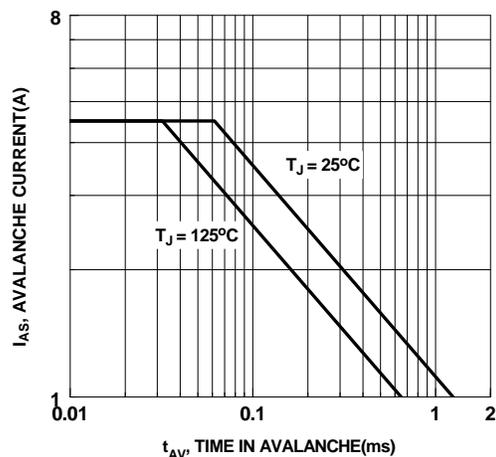
**Figure 10. Maximum Safe Operating Area -FDPF5N60NZ**



**Figure 11. Maximum Drain Current vs. Case Temperature**



**Figure 12. Unclamped Inductive Switching Capability**



Typical Performance Characteristics (Continued)

Figure 13. Transient Thermal Response Curve -FDP5N60NZ

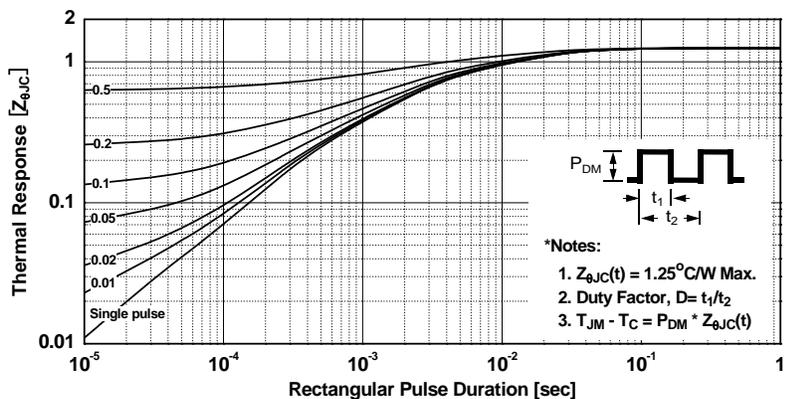
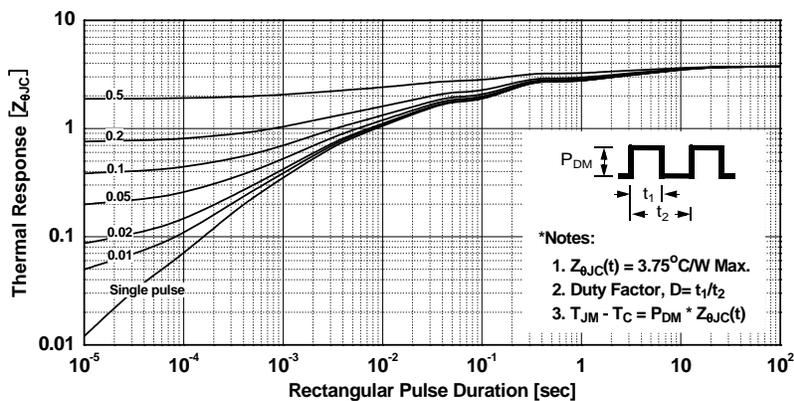
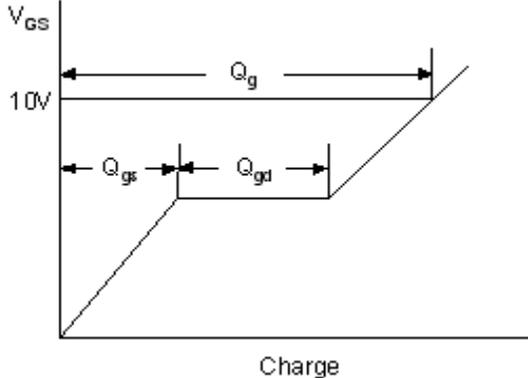
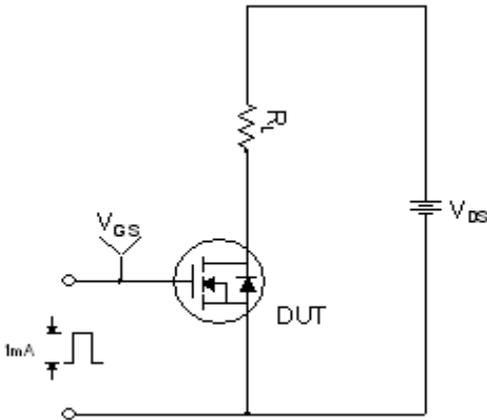


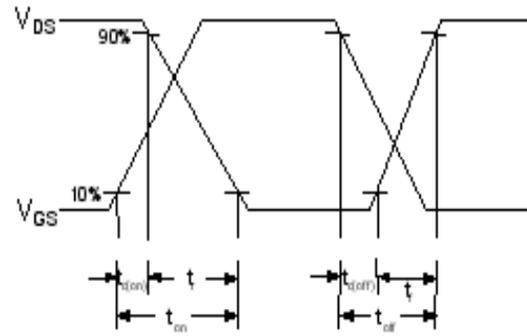
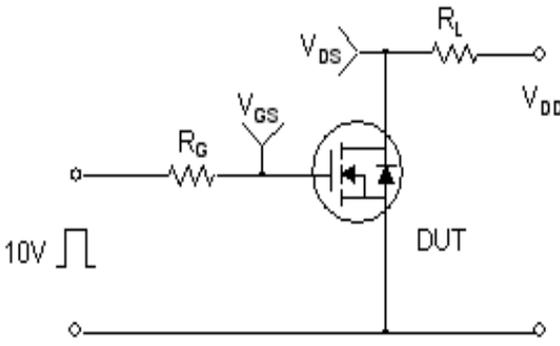
Figure 14. Transient Thermal Response Curve -FDPF5N60NZ



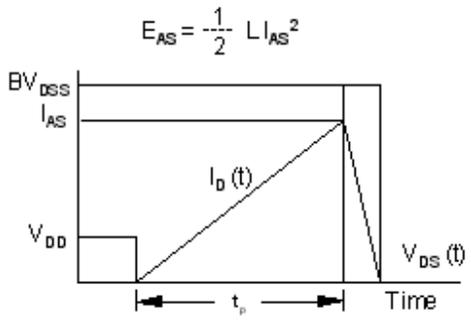
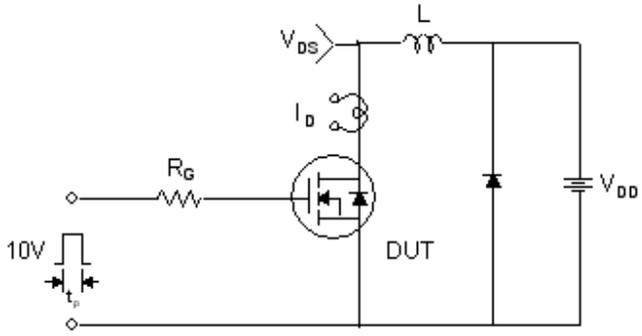
**Gate Charge Test Circuit & Waveform**



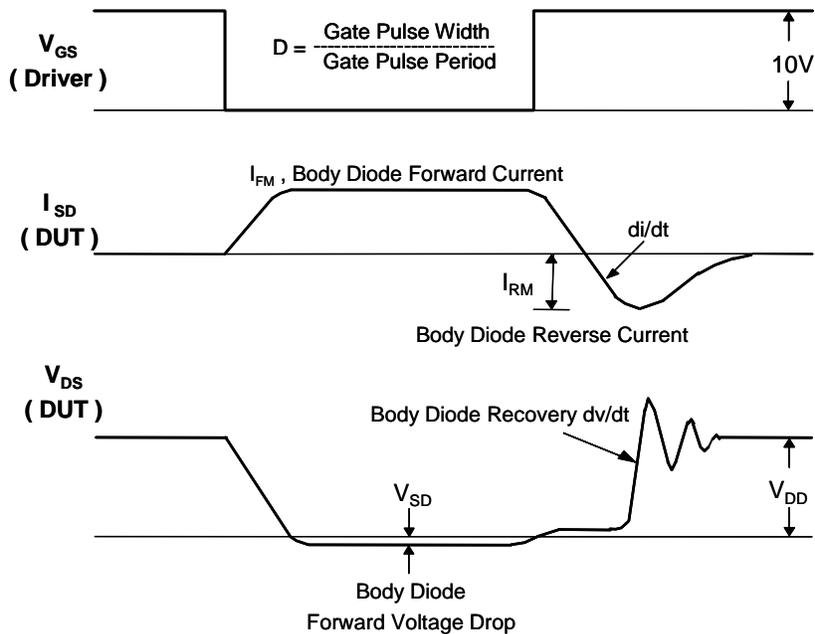
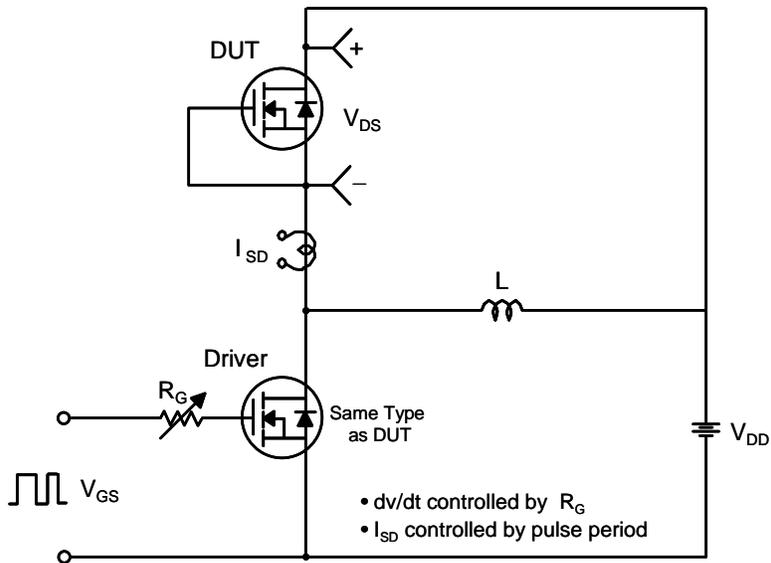
**Resistive Switching Test Circuit & Waveforms**



**Unclamped Inductive Switching Test Circuit & Waveforms**

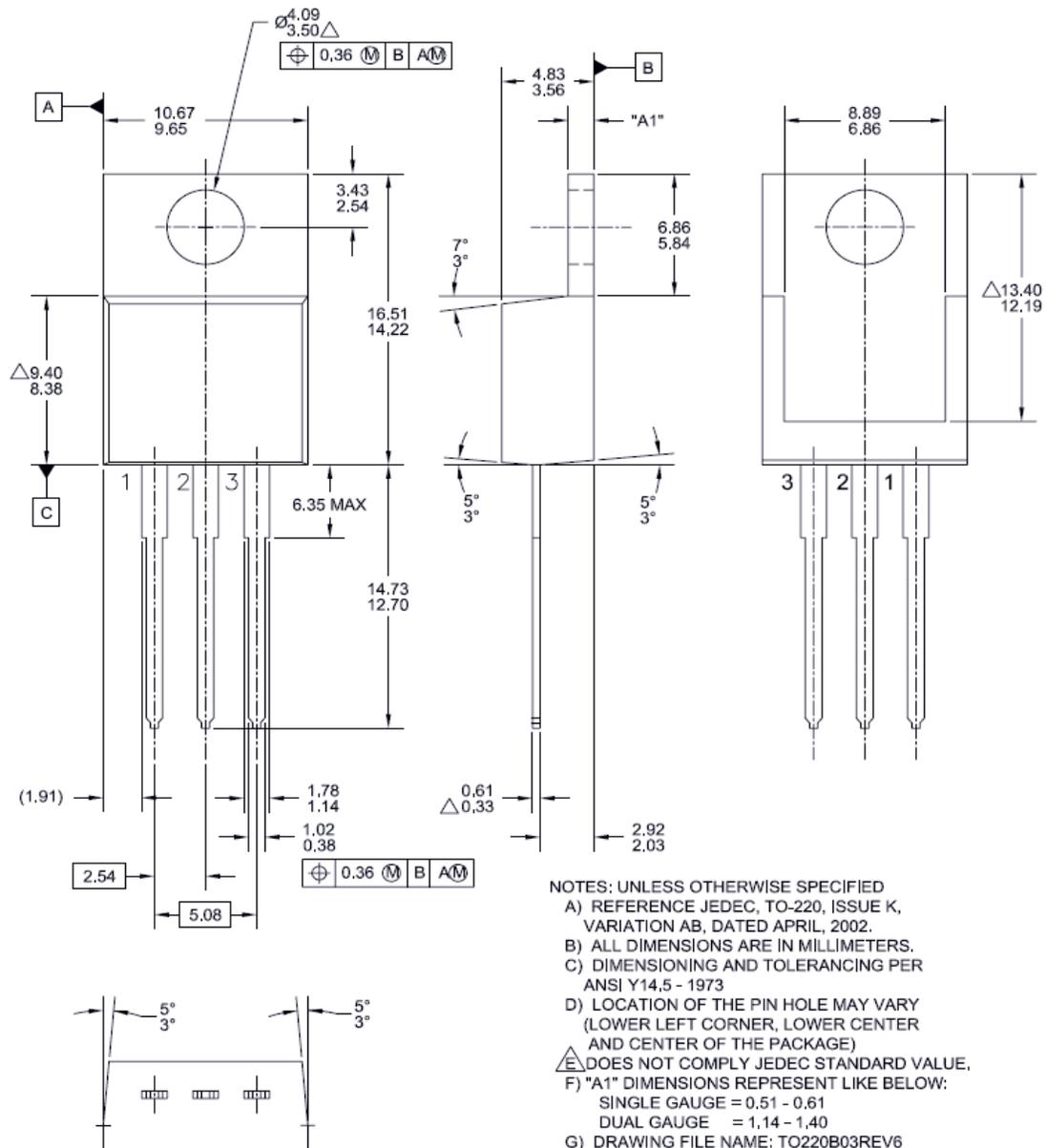


Peak Diode Recovery dv/dt Test Circuit & Waveforms



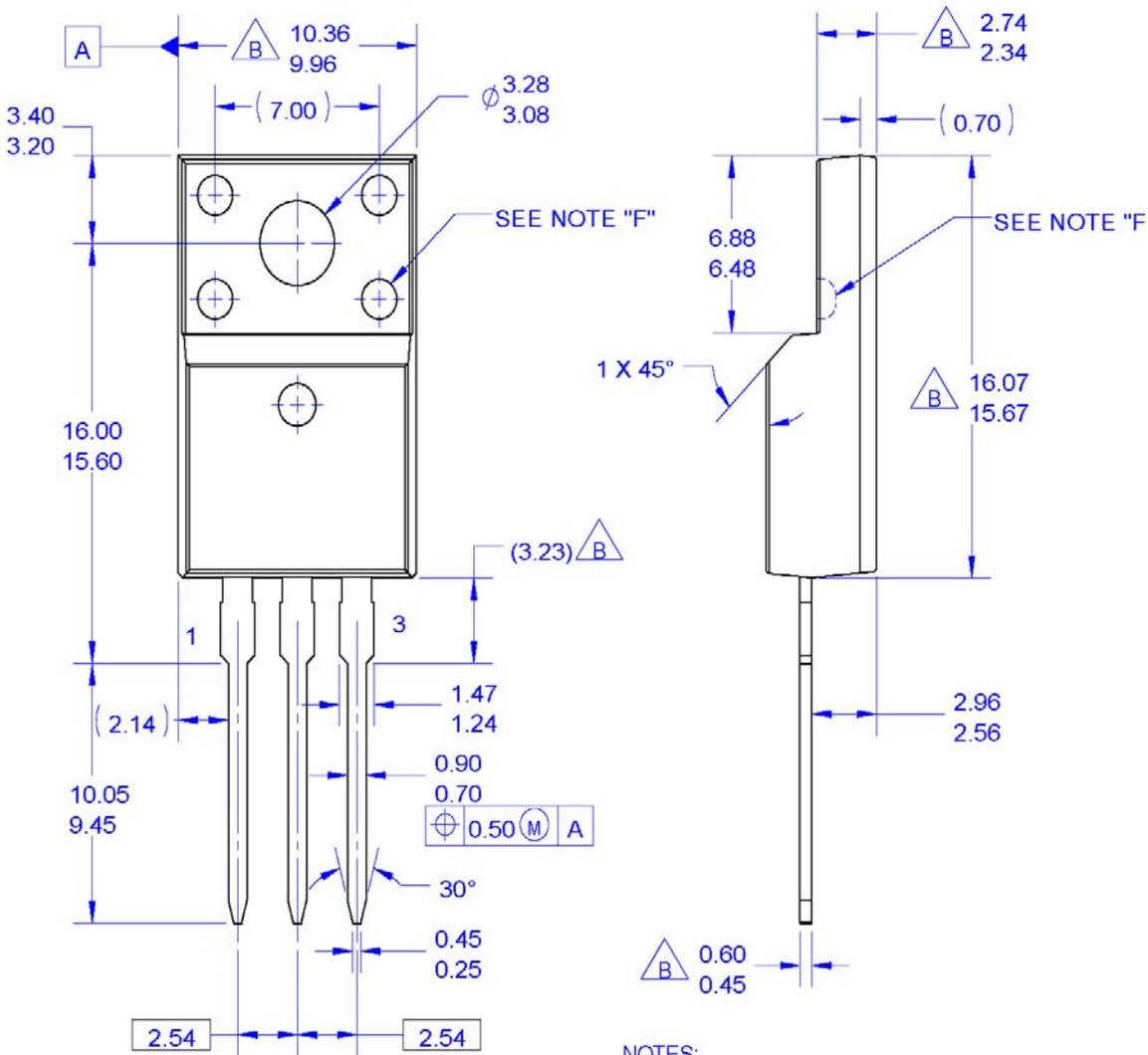
**Mechanical Dimensions**

**TO-220B03**



**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®       |
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|  | MicroPak™                                       | SuperFET®                             | Ultra FRFET™     |
| Fairchild®  | MicroPak2™                                      | SuperSOT™-3                           | UnifET™          |
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| FAST®   | OptoHit™  | SyncFET™                              | XS™              |
| FastvCore™  | OPTOLOGIC®                                      |                                       |                  |
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**Definition of Terms**

Datasheet Identification	Product Status	Definition
Advance Information	Formative / In Design	Datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
Preliminary	First Production	Datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
No Identification Needed	Full Production	Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design.
Obsolete	Not In Production	Datasheet contains specifications on a product that is discontinued by Fairchild Semiconductor. The datasheet is for reference information only.

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