

# FCP22N60N / FCPF22N60NT

## N-Channel SupreMOS® MOSFET

600 V, 22 A, 165 mΩ

### Features

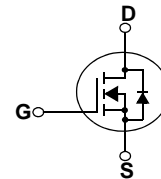
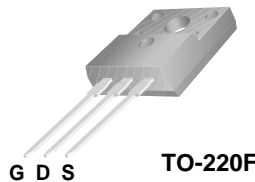
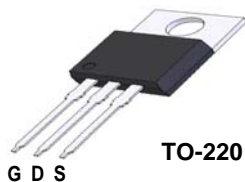
- $BV_{DSS} > 650V$  @  $T_J = 150^\circ C$
- $R_{DS(on)} = 140\ m\Omega$  (Typ.) @  $V_{GS} = 10\ V, I_D = 11\ A$
- Ultra Low Gate Charge (Typ.  $Q_g = 45\ nC$ )
- Low Effective Output Capacitance (Typ.  $C_{oss,eff} = 196.4\ pF$ )
- 100% Avalanche Tested
- RoHS Compliant

### Application

- LCD/LED/PDP TV
- Lighting
- Solar Inverter
- AC-DC Power Supply

### Description

The SupreMOS® MOSFET is Fairchild Semiconductor®'s next generation of high voltage super-junction (SJ) technology employing a deep trench filling process that differentiates it from the conventional SJ MOSFETs. This advanced technology and precise process control provides lowest  $R_{sp}$  on-resistance, superior switching performance and ruggedness. SupreMOS MOSFET is suitable for high frequency switching power converter applications such as PFC, server/telecom power, FPD TV power, ATX power and industrial power applications.



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

Symbol	Parameter	FCP22N60N	FCPF22N60NT	Unit
$V_{DSS}$	Drain to Source Voltage	600		V
$V_{GSS}$	Gate to Source Voltage	±45		V
$I_D$	Drain Current	Continuous ( $T_C = 25^\circ C$ )	22	22*
		Continuous ( $T_C = 100^\circ C$ )	13.8	13.8*
$I_{DM}$	Drain Current	Pulsed (Note 1)	66	66*
$E_{AS}$	Single Pulsed Avalanche Energy (Note 2)	672		mJ
$I_{AR}$	Avalanche Current	7.3		A
$E_{AR}$	Repetitive Avalanche Energy	2.75		mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	20		V/ns
	MOSFET dv/dt	100		
$P_D$	Power Dissipation	( $T_C = 25^\circ C$ )	205	39
		Derate above $25^\circ C$	1.64	0.31
$T_J, T_{STG}$	Operating and Storage Temperature Range	-55 to +150		$^\circ C$
$T_L$	Maximum Lead Temperature for Soldering Purpose, 1/8" from Case for 5 Seconds	300		$^\circ C$

\*Drain current limited by maximum junction temperature

### Thermal Characteristics

Symbol	Parameter	FCP22N60N	FCPF22N60NT	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case	0.61	3.2	$^\circ C/W$
$R_{\theta CS}$	Thermal Resistance, Case to Heat Sink (Typical)	0.5	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
FCP22N60N	FCP22N60N	TO-220	-	-	50
FCPF22N60NT	FCPF22N60NT	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	$I_D = 1\text{ mA}, V_{GS} = 0\text{ V}, T_J = 25^\circ\text{C}$	600	-	-	V
		$I_D = 1\text{ mA}, V_{GS} = 0\text{ V}, T_J = 150^\circ\text{C}$	650	-	-	
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 1\text{ mA}, \text{Referenced to } 25^\circ\text{C}$	-	0.68	-	V/ $^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 480\text{ V}, V_{GS} = 0\text{ V}$	-	-	10	$\mu\text{A}$
		$V_{DS} = 480\text{ V}, T_J = 125^\circ\text{C}$	-	-	100	
$I_{GSS}$	Gate to Body Leakage Current	$V_{GS} = \pm 45\text{ V}, V_{DS} = 0\text{ V}$	-	-	$\pm 100$	nA

### On Characteristics

$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 250\text{ }\mu\text{A}$	2.0	3	4.0	V
$R_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = 10\text{ V}, I_D = 11\text{ A}$	-	0.140	0.165	$\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS} = 20\text{ V}, I_D = 11\text{ A}$	-	22	-	S

### Dynamic Characteristics

$C_{iss}$	Input Capacitance	$V_{DS} = 100\text{ V}, V_{GS} = 0\text{ V}$ $f = 1\text{ MHz}$	-	1950	-	pF
$C_{oss}$	Output Capacitance		-	75.9	-	pF
$C_{rss}$	Reverse Transfer Capacitance		-	3	-	pF
$C_{oss}$	Output Capacitance	$V_{DS} = 380\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	-	43.2	-	pF
$C_{oss\text{eff}}$	Effective Output Capacitance	$V_{DS} = 0\text{ V to } 480\text{ V}, V_{GS} = 0\text{ V}$	-	196.4	-	pF
$Q_{g(tot)}$	Total Gate Charge at 10V	$V_{DS} = 380\text{ V}, I_D = 11\text{ A},$ $V_{GS} = 10\text{ V}$ (Note 4)	-	45	-	nC
$Q_{gs}$	Gate to Source Gate Charge		-	8.7	-	nC
$Q_{gd}$	Gate to Drain "Miller" Charge		-	14.5	-	nC
ESR	Equivalent Series Resistance (G-S)		Drain Open, $f=1\text{ MHz}$	-	1	-

### Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 380\text{ V}, I_D = 11\text{ A}$ $R_G = 4.7\text{ }\Omega$ (Note 4)	-	16.9	-	ns
$t_r$	Turn-On Rise Time		-	16.7	-	ns
$t_{d(off)}$	Turn-Off Delay Time		-	49	-	ns
$t_f$	Turn-Off Fall Time		-	4	-	ns

### Drain-Source Diode Characteristics

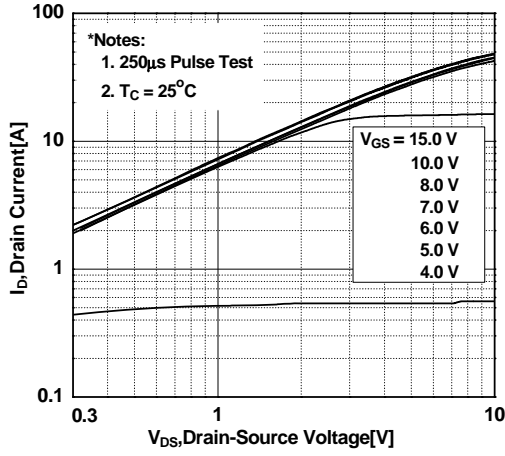
$I_S$	Maximum Continuous Drain to Source Diode Forward Current	-	-	22	A	
$I_{SM}$	Maximum Pulsed Drain to Source Diode Forward Current	-	-	66	A	
$V_{SD}$	Drain to Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_{SD} = 11\text{ A}$	-	-	1.2	V
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0\text{ V}, I_{SD} = 11\text{ A}$ $di_F/dt = 100\text{ A}/\mu\text{s}$	-	350	-	ns
$Q_{rr}$	Reverse Recovery Charge		-	6	-	$\mu\text{C}$

#### Notes:

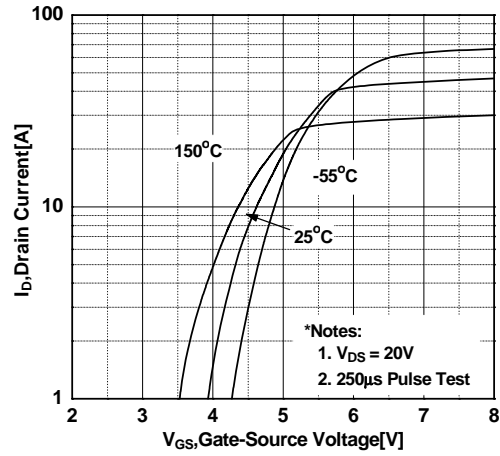
1. Repetitive Rating: Pulse width limited by maximum junction temperature
2.  $I_{AS} = 7.3\text{ A}, R_G = 25\text{ }\Omega$ , Starting  $T_J = 25^\circ\text{C}$
3.  $I_{SD} \leq 22\text{ A}, di/dt \leq 200\text{ A}/\mu\text{s}, V_{DD} \leq 380\text{ V}$ , Starting  $T_J = 25^\circ\text{C}$
4. Essentially Independent of Operating Temperature Typical Characteristics

## Typical Performance Characteristics

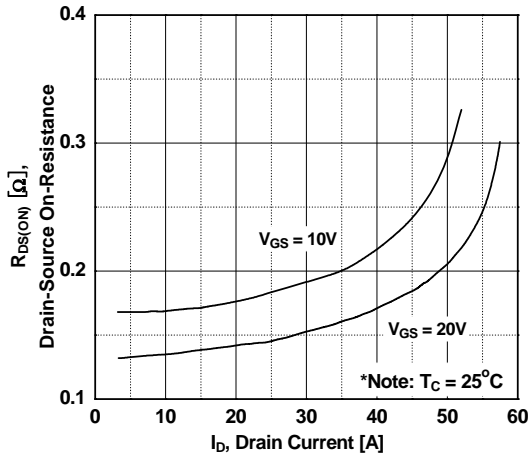
**Figure 1. On-Region Characteristics**



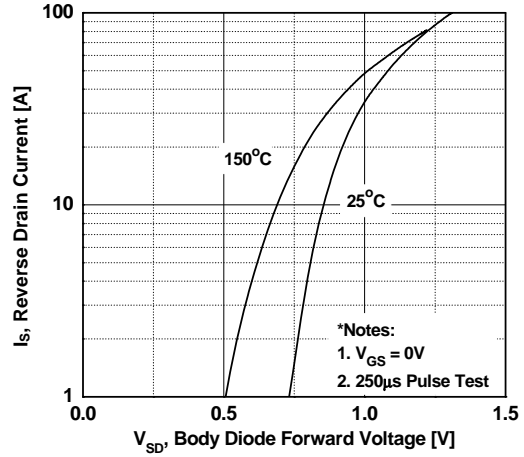
**Figure 2. Transfer Characteristics**



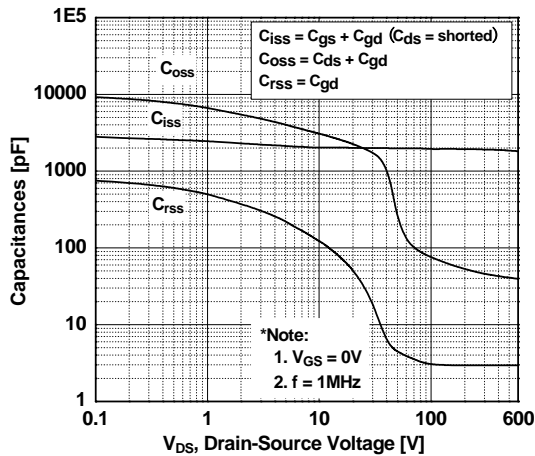
**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**



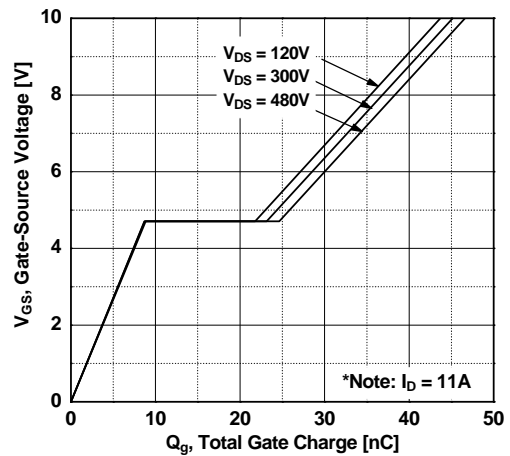
**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**



**Figure 5. Capacitance Characteristics**



**Figure 6. Gate Charge Characteristics**



Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

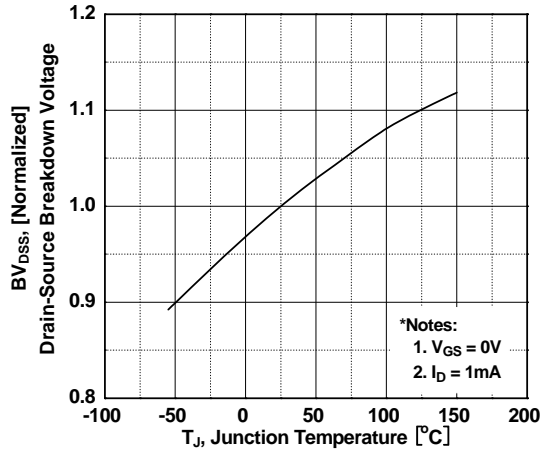


Figure 8. On-Resistance Variation vs. Temperature

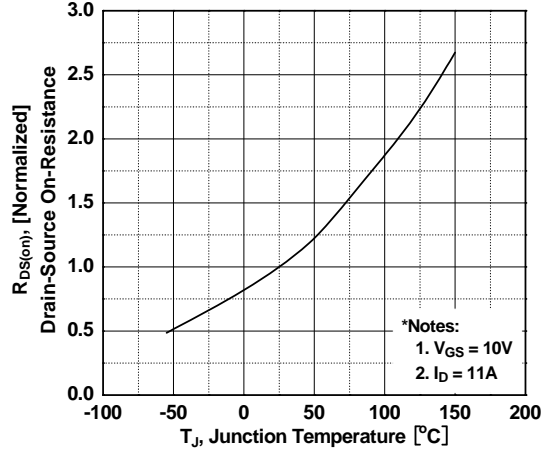


Figure 9. Maximum Safe Operating Area - FCP22N60N

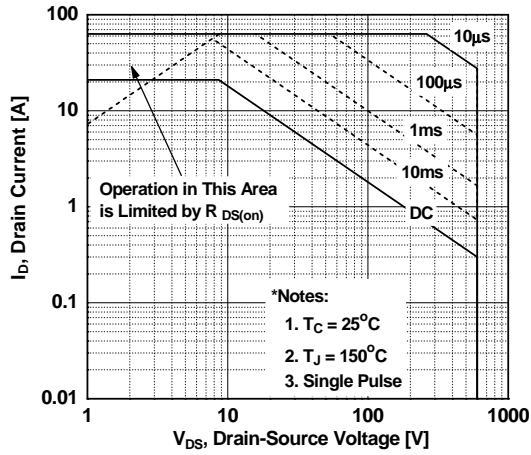


Figure 10. Maximum Safe Operating Area - FCPF22N60NT

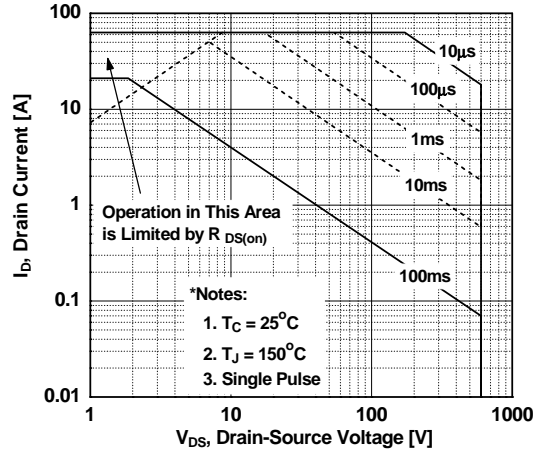
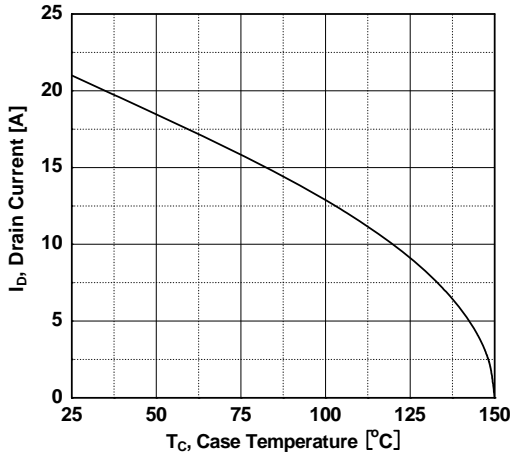


Figure 11. Maximum Drain Current vs. Case Temperature



Typical Performance Characteristics

Figure 12. Transient Thermal Response Curve - FCP22N60N

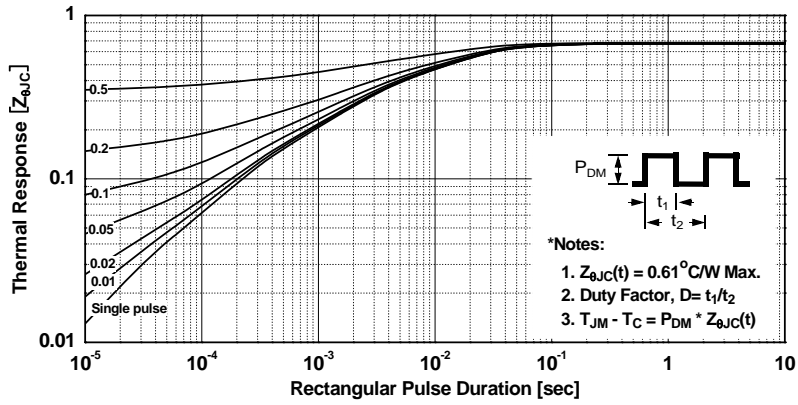
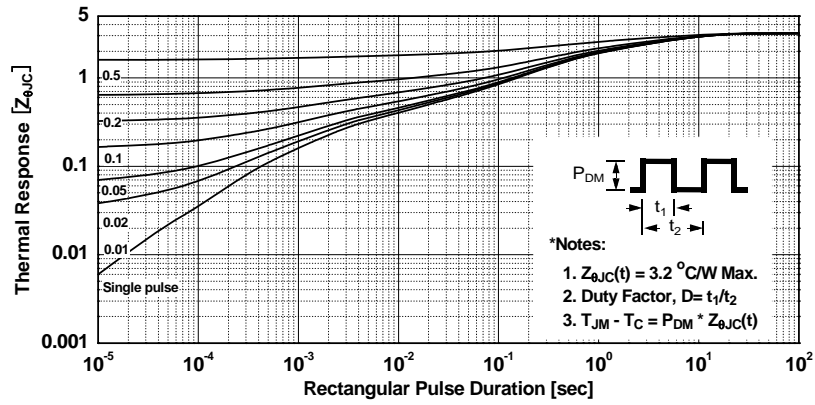
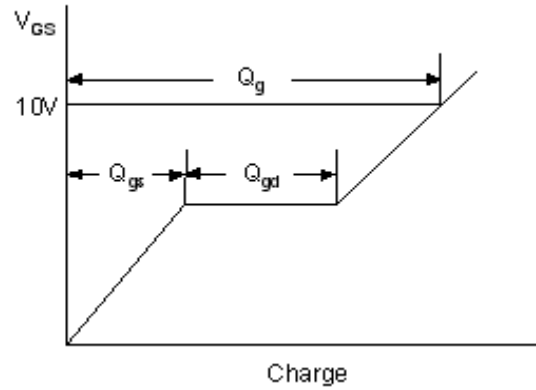
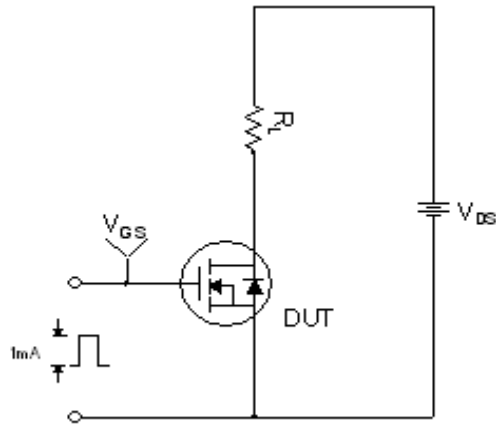


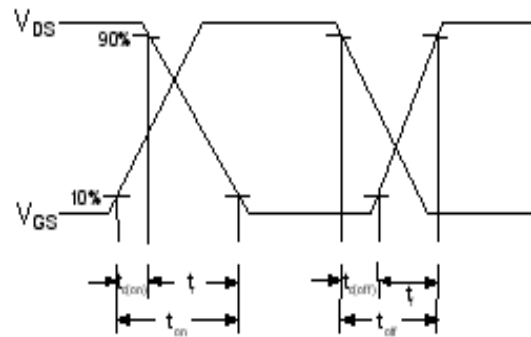
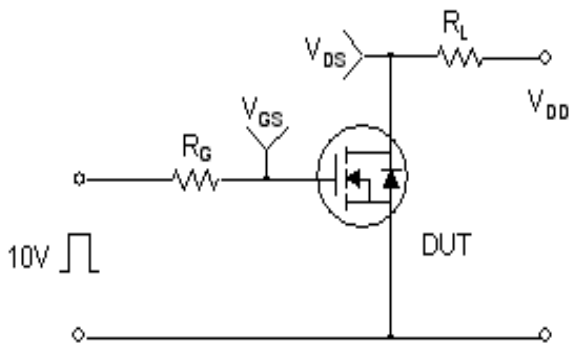
Figure 13. Transient Thermal Response Curve - FCPF22N60NT



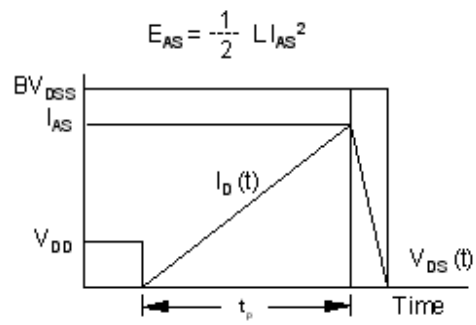
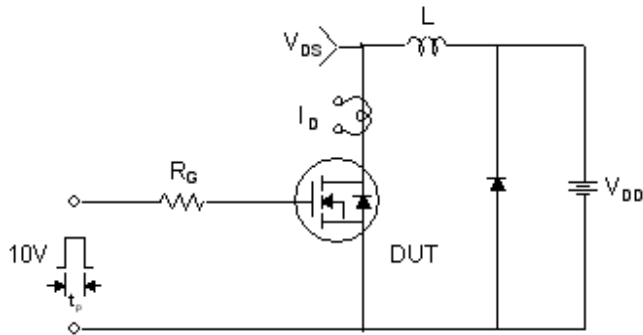
Gate Charge Test Circuit & Waveform



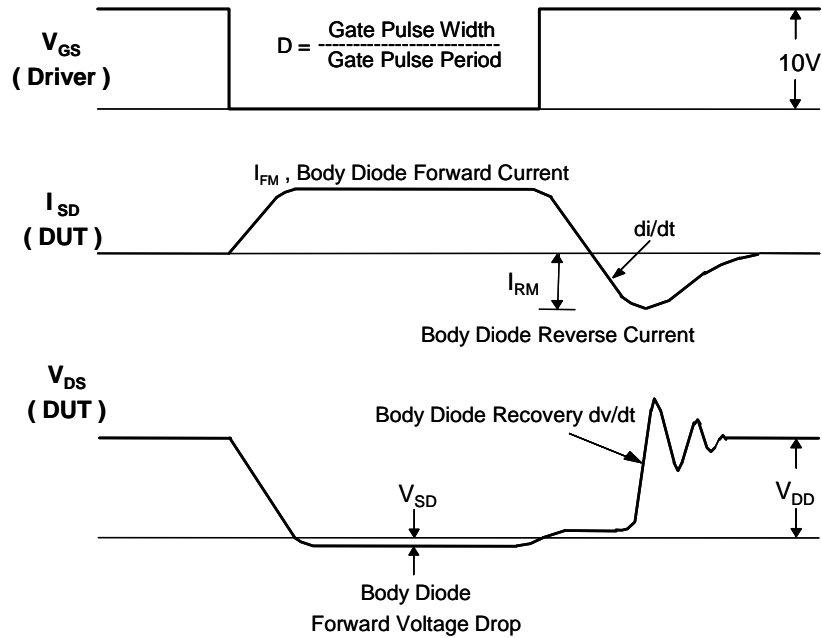
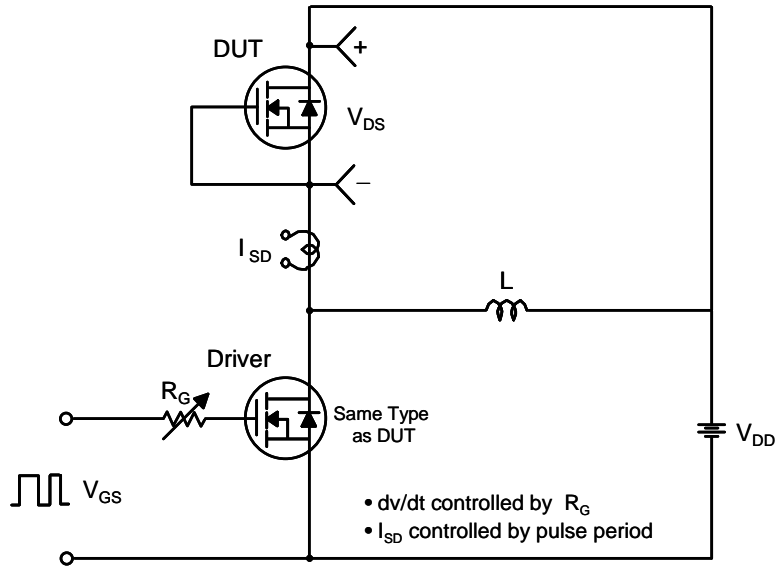
Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching Test Circuit & Waveforms

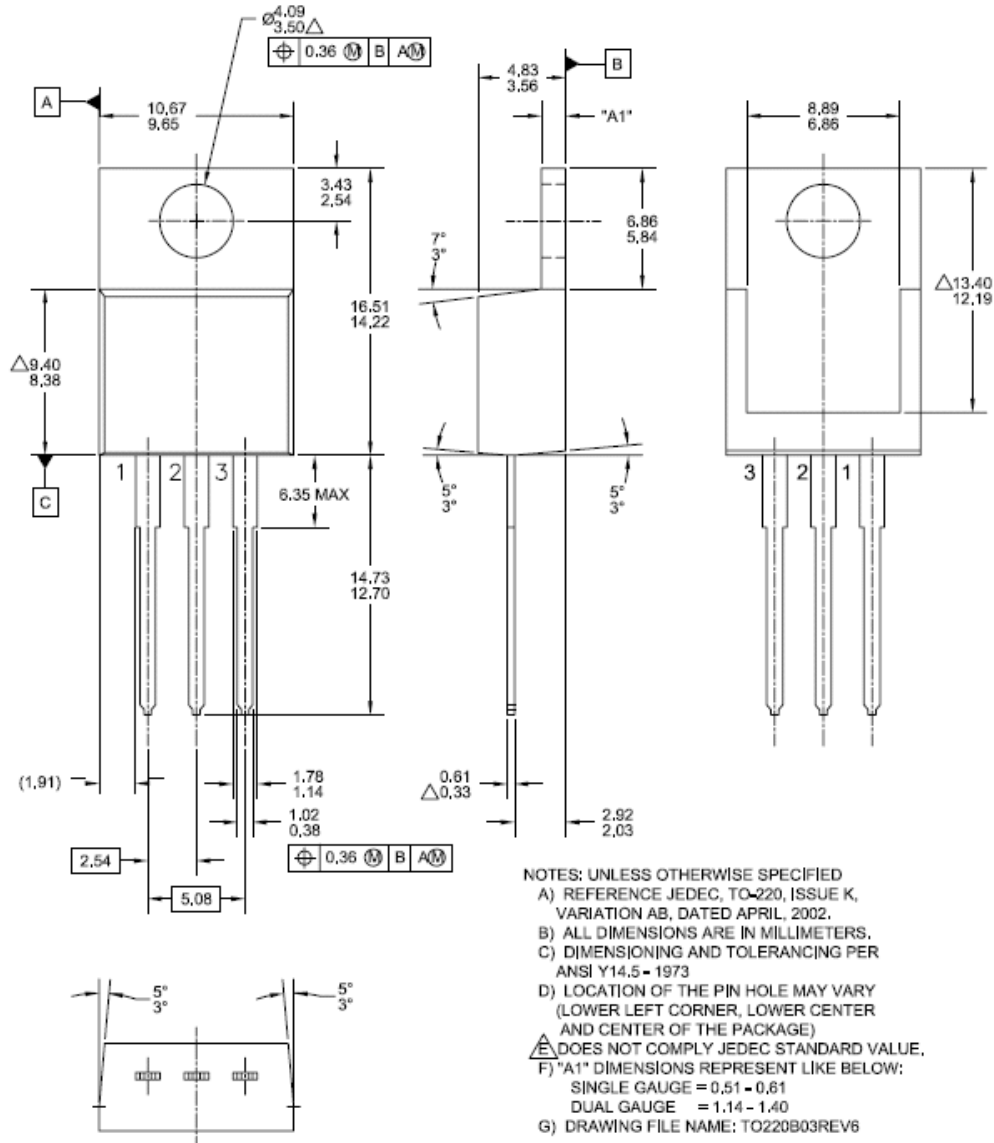


Peak Diode Recovery dv/dt Test Circuit & Waveforms



Mechanical Dimensions

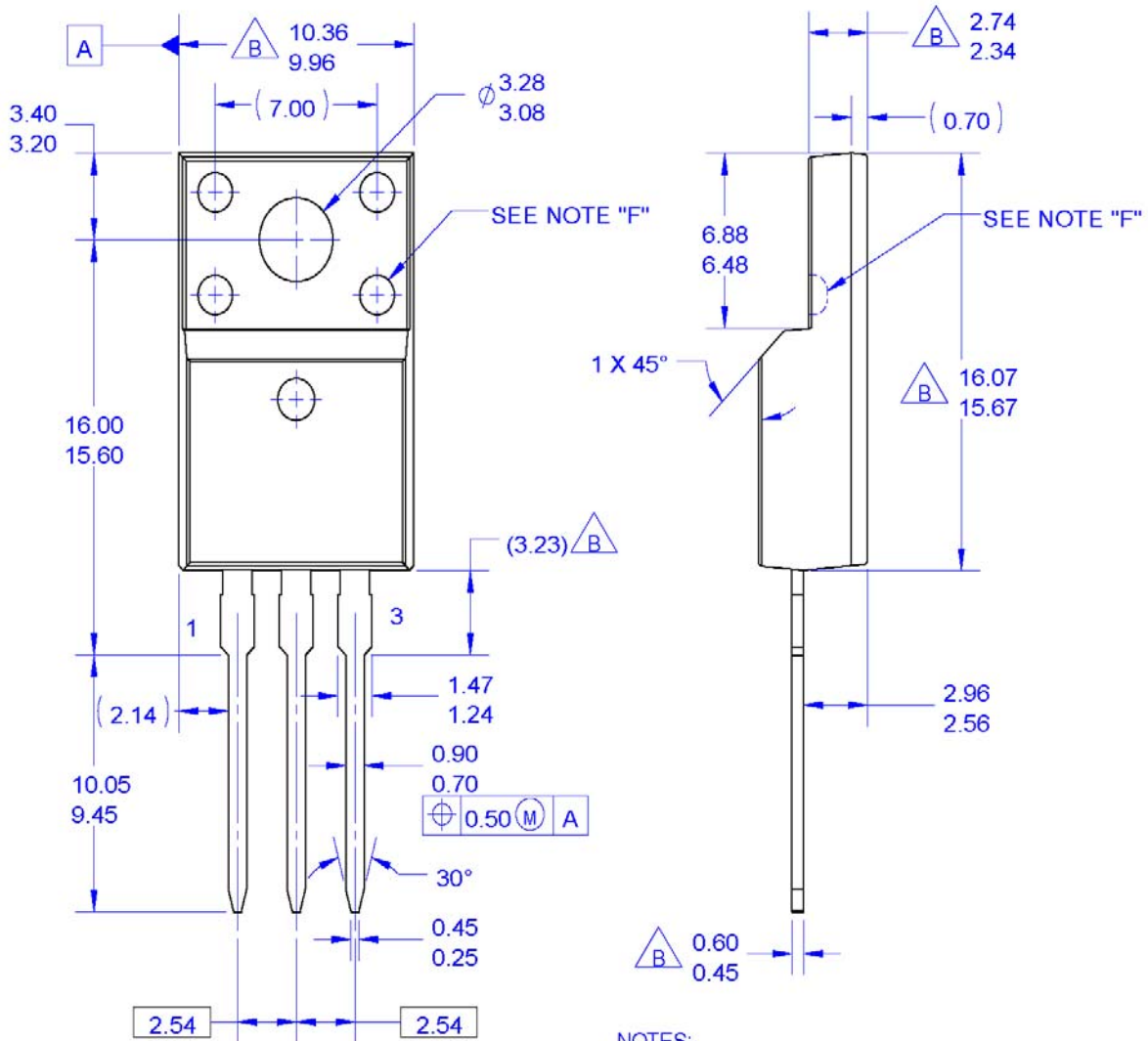
TO-220AB





Mechanical Dimensions

TO-220M03



NOTES:



- A. EXCEPT WHERE NOTED CONFORMS TO EIAJ SC91A.
- $\triangle B$  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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| AccuPower™   | F-PFST™   | PowerXS™                              | SYSTEM GENERAL®*  |
| 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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| EfficientMax™  | MICROCOUPLER™                                   | SPM®                                  | µSerDes™  |
| ESBC™  | MicroFET™                                       | STEALTH™                              |  SerDes™ |
|  Fairchild® | MicroPak™                                       | SuperFET®                             | UHC®  |
| Fairchild Semiconductor®   | MicroPak2™                                      | SuperSOT™-3                           | Ultra FRFET™  |
| FACT Quiet Series™   | MillerDrive™                                    | SuperSOT™-6                           | UniFET™   |
| FACT®  | MotionMax™                                      | SuperSOT™-8                           | VCX™  |
| FAST®  | mWSaver™  | SupreMOS®                             | VisualMax™  |
| FastvCore™   | OptoHit™  | SyncFET™                              | VoltagePlus™  |
| FETBench™  | OPTOLOGIC®                                      |                                       | XST™  |
|  | OPTOPLANAR®                                     |                                       |   |

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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.
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