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# FCP9N60N / FCPF9N60NT

## N-Channel SupreMOS® MOSFET

600 V, 9 A, 385 mΩ

### Features

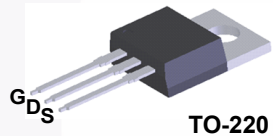
- $R_{DS(on)} = 330 \text{ m}\Omega$  (Typ.) @  $V_{GS} = 10 \text{ V}$ ,  $I_D = 4.5 \text{ A}$
- Ultra Low Gate Charge (Typ.  $Q_g = 22 \text{ nC}$ )
- Low Effective Output Capacitance (Typ.  $C_{oss(eff.)} = 106 \text{ pF}$ )
- 100% Avalanche Tested
- RoHS Compliant

### Application

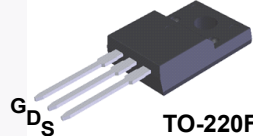
- LCD/LED/PDP TV
- Lighting
- Solar Inverter
- AC-DC Power Supply

### Description

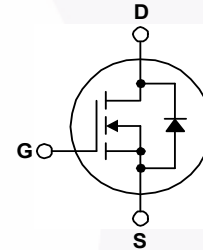
The SupreMOS® MOSFET is Fairchild Semiconductor's next generation of high voltage super-junction (SJ) technology employing a deep trench filling process that differentiates it from the conventional SJ MOSFETs. This advanced technology and precise process control provides lowest  $R_{sp}$  on-resistance, 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.



TO-220



TO-220F



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

Symbol	Parameter	FCP9N60N	FCPF9N60NT	Unit
$V_{DSS}$	Drain to Source Voltage	600		V
$V_{GSS}$	Gate to Source Voltage	±30		V
$I_D$	Drain Current	- Continuous ( $T_C = 25^\circ\text{C}$ )	9.0	9.0*
		- Continuous ( $T_C = 100^\circ\text{C}$ )	5.7	5.7*
$I_{DM}$	Drain Current	- Pulsed (Note 1)	27	27*
$E_{AS}$	Single Pulsed Avalanche Energy (Note 2)	135		mJ
$I_{AR}$	Avalanche Current (Note 1)	3		A
$E_{AR}$	Repetitive Avalanche Energy (Note 1)	0.83		mJ
dv/dt	MOSFET dv/dt	100		V/ns
	Peak Diode Recovery dv/dt (Note 3)	20		V/ns
$P_D$	Power Dissipation	( $T_C = 25^\circ\text{C}$ )	83.3	29.8
		- Derate Above $25^\circ\text{C}$	0.67	0.24
$T_J, T_{STG}$	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	FCP9N60N	FCPF9N60NT	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	1.5	4.2	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max.	62.5	62.5	

## Package Marking and Ordering Information

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FCP9N60N	FCP9N60N	TO-220	Tube	N/A	N/A	50 units
FCPF9N60NT	FCPF9N60NT	TO-220F	Tube	N/A	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	$I_D = 1\text{ mA}, V_{GS} = 0\text{ V}, T_C = 25^\circ\text{C}$	600	-	-	V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 1\text{ mA}$ , Referenced to $25^\circ\text{C}$	-	0.72	-	$V/^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 480\text{ V}, V_{GS} = 0\text{ V}$	-	-	10	$\mu\text{A}$
		$V_{DS} = 480\text{ V}, V_{GS} = 0\text{ V}, T_C = 125^\circ\text{C}$	-	-	100	
$I_{GSS}$	Gate to Body Leakage Current	$V_{GS} = \pm 30\text{ V}, V_{DS} = 0\text{ V}$	-	-	$\pm 100$	nA

### On Characteristics

$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 250\ \mu\text{A}$	2.0	-	4.0	V
$R_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = 10\text{ V}, I_D = 4.5\text{ A}$	-	0.33	0.385	$\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS} = 40\text{ V}, I_D = 4.5\text{ A}$	-	7.5	-	S

### Dynamic Characteristics

$C_{iss}$	Input Capacitance	$V_{DS} = 100\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	-	930	1240	pF
$C_{oss}$	Output Capacitance		-	35	50	pF
$C_{rss}$	Reverse Transfer Capacitance		-	2	4	pF
$C_{oss}$	Output Capacitance	$V_{DS} = 380\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	-	20	-	pF
$C_{oss(eff.)}$	Effective Output Capacitance	$V_{DS} = 0\text{ V to } 480\text{ V}, V_{GS} = 0\text{ V}$	-	106	-	pF
$Q_{g(tot)}$	Total Gate Charge at 10V	$V_{DS} = 380\text{ V}, I_D = 4.5\text{ A}, V_{GS} = 10\text{ V}$ (Note 4)	-	22.0	29	nC
$Q_{gs}$	Gate to Source Gate Charge		-	4.1	-	nC
$Q_{gd}$	Gate to Drain "Miller" Charge		-	7.1	-	nC
ESR	Equivalent Series Resistance (G-S)	$f = 1\text{ MHz}$	-	2.9	-	$\Omega$

### Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 380\text{ V}, I_D = 4.5\text{ A}, V_{GS} = 10\text{ V}, R_G = 4.7\ \Omega$ (Note 4)	-	12.7	35.4	ns
$t_r$	Turn-On Rise Time		-	8.7	27.4	ns
$t_{d(off)}$	Turn-Off Delay Time		-	36.9	83.8	ns
$t_f$	Turn-Off Fall Time		-	10.2	30.4	ns

### Drain-Source Diode Characteristics

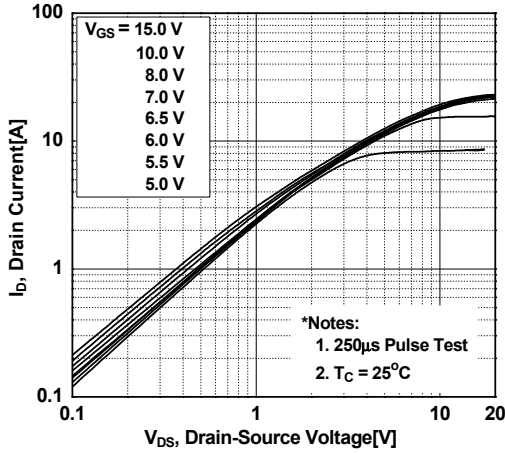
$I_S$	Maximum Continuous Drain to Source Diode Forward Current	-	-	9.0	A	
$I_{SM}$	Maximum Pulsed Drain to Source Diode Forward Current	-	-	27	A	
$V_{SD}$	Drain to Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_{SD} = 4.5\text{ A}$	-	-	1.2	V
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0\text{ V}, I_{SD} = 4.5\text{ A}, di_F/dt = 100\text{ A}/\mu\text{s}$	-	213	-	ns
$Q_{rr}$	Reverse Recovery Charge		-	2.2	-	$\mu\text{C}$

**Notes:**

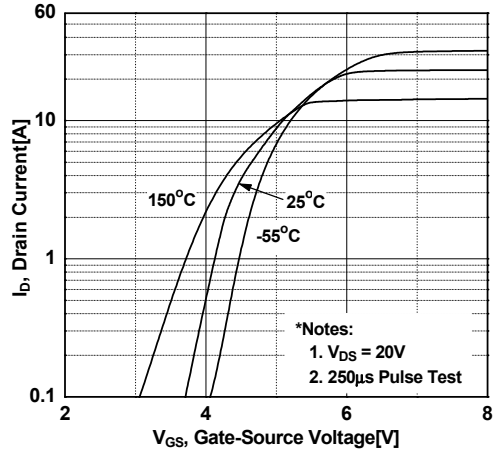
1. Repetitive rating: pulse-width limited by maximum junction temperature.
2.  $I_{AS} = 3\text{ A}, R_G = 25\ \Omega$ , starting  $T_J = 25^\circ\text{C}$ .
3.  $I_{SD} \leq 9\text{ A}, di/dt \leq 200\text{ A}/\mu\text{s}, V_{DD} = 380\text{ V}$ , starting  $T_J = 25^\circ\text{C}$ .
4. Essentially independent of operating temperature typical characteristics.

## Typical Performance Characteristics

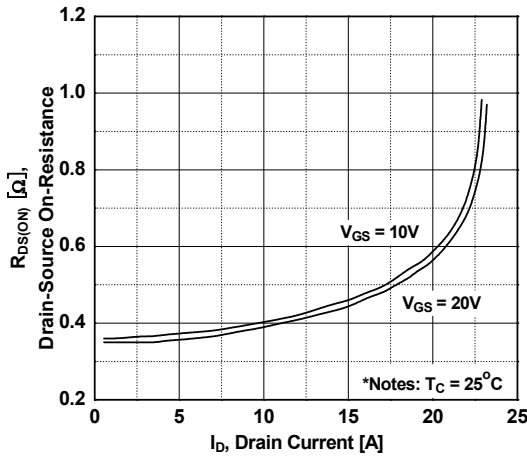
**Figure 1. On-Region Characteristics**



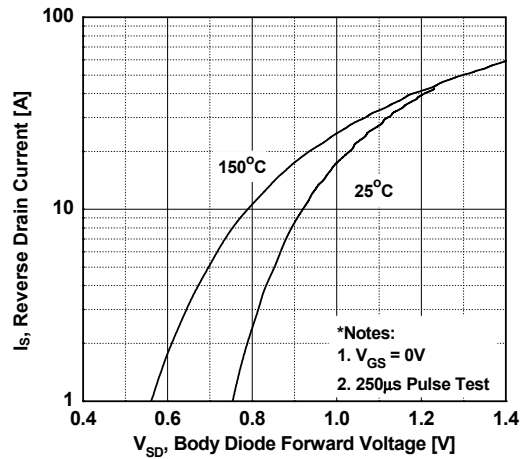
**Figure 2. Transfer Characteristics**



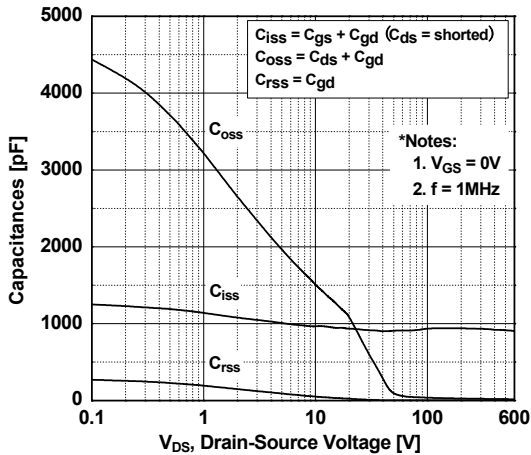
**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**



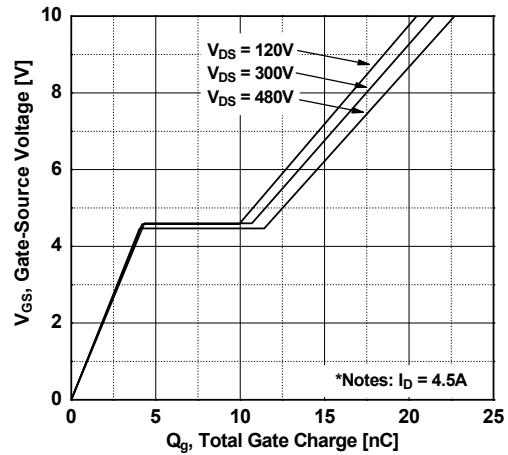
**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**



**Figure 5. Capacitance Characteristics**



**Figure 6. Gate Charge Characteristics**



Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

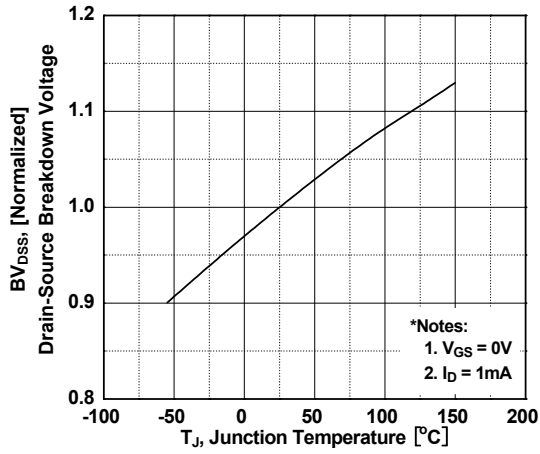


Figure 8. On-Resistance Variation vs. Temperature

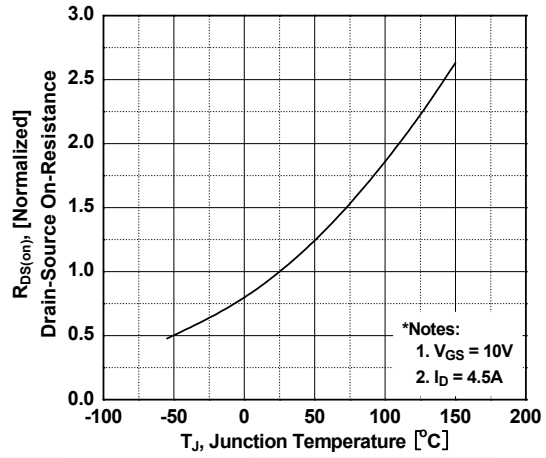


Figure 9. Maximum Safe Operating Area for FCPF9N60N

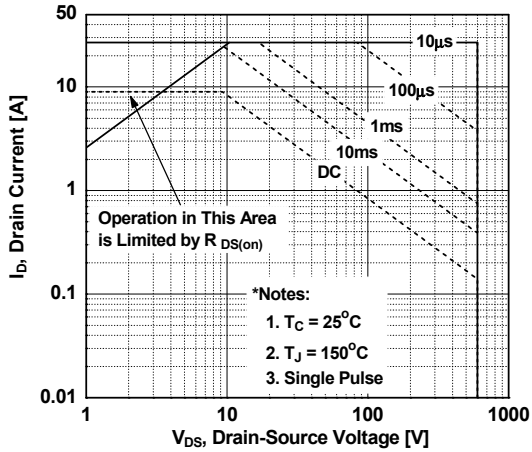


Figure 10. Maximum Safe Operating Area for FCPF9N60NT

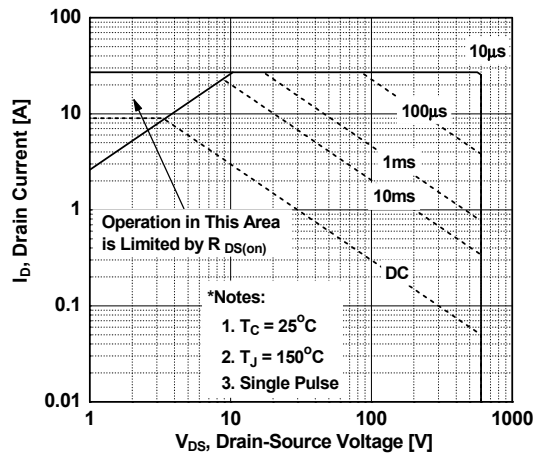
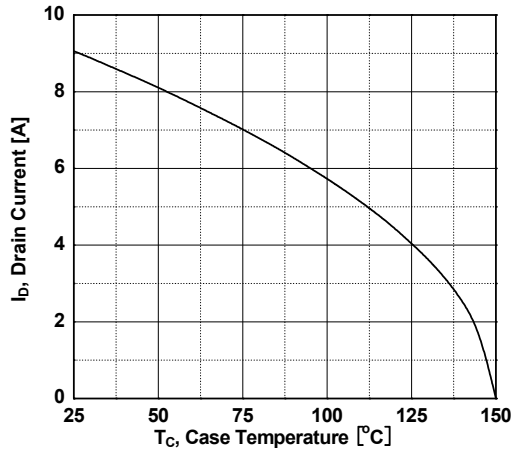


Figure 11. Maximum Drain Current vs. Case Temperature



Typical Performance Characteristics (Continued)

Figure 12. Transient Thermal Response Curve for FCP9N60N

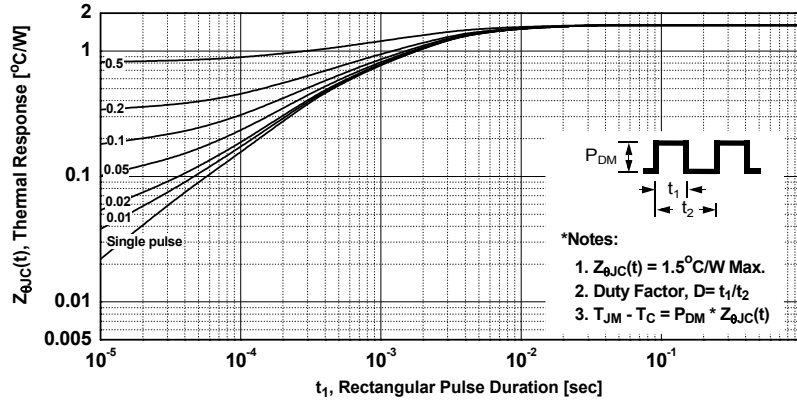


Figure 13. Transient Thermal Response Curve for FCPF9N60NT

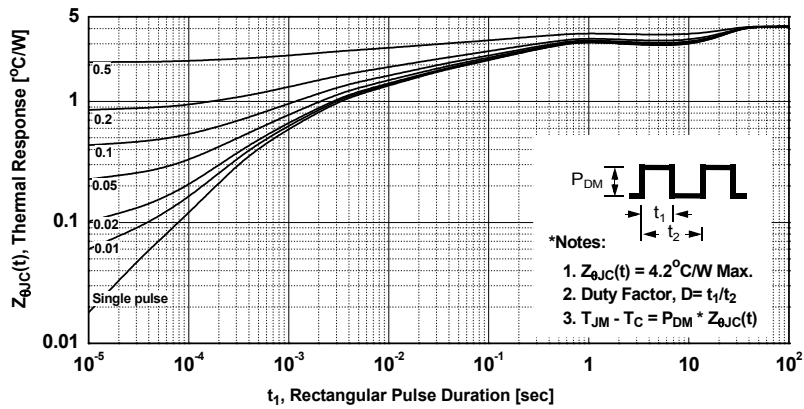




Figure 14. Gate Charge Test Circuit & Waveform



Figure 15. Resistive Switching Test Circuit & Waveforms



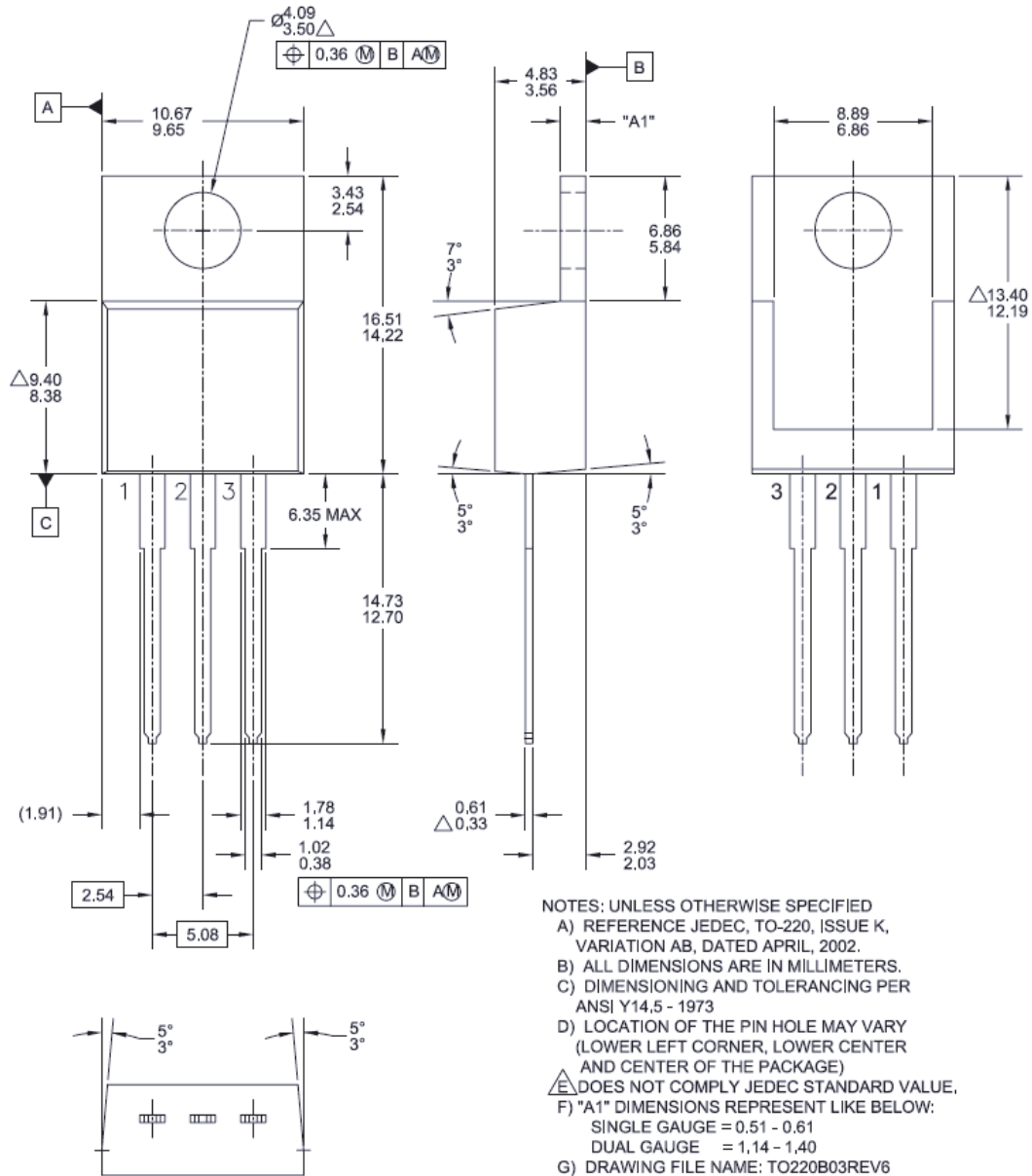
Figure 16. Unclamped Inductive Switching Test Circuit & Waveforms



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



## Mechanical Dimensions



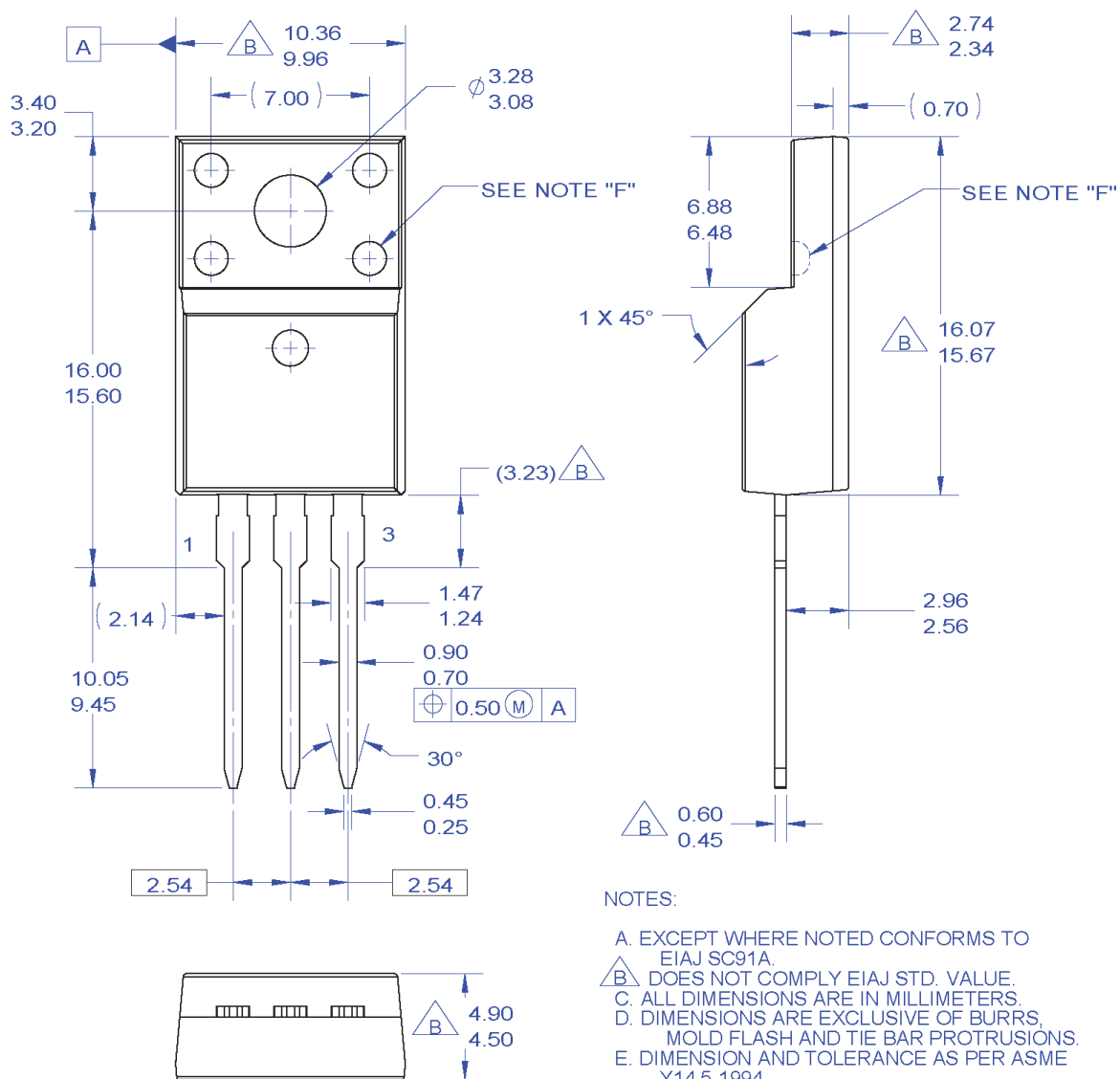
**Figure 18. TO-220, Molded, 3-Lead, Jedec Variation AB**

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## Mechanical Dimensions



### 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 19. TO220, Molded, 3-Lead, Full Pack, EIAJ SC91, Straight Lead**

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