

# FCP13N60N / FCPF13N60NT N-Channel SupreMOS® MOSFET 600 V, 13 A, 258 mΩ

## Features

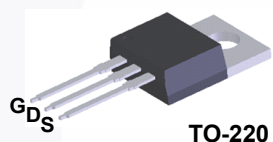
- $R_{DS(on)} = 220 \text{ m}\Omega$  (Typ.) @  $V_{GS} = 10 \text{ V}$ ,  $I_D = 6.5 \text{ A}$
- Ultra Low Gate Charge (Typ.  $Q_g = 30.4 \text{ nC}$ )
- Low Effective Output Capacitance (Typ.  $C_{oss(eff.)} = 145 \text{ pF}$ )
- 100% Avalanche Tested
- RoHS Compliant

## Application

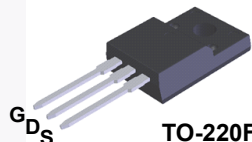
- LCD/LED/PDP TV
- Lighting
- Solar Inverter
- AC-DC Power Supply

## Description

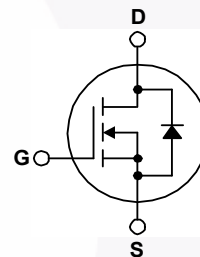
The SupreMOS® MOSFET is Fairchild Semiconductor's next generation of high voltage super-junction (SJ) technology employing a deep trench filling process that differentiates it from the conventional SJ MOSFETs. This advanced technology and precise process control provides lowest  $R_{sp}$  on-resistance,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



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

Symbol	Parameter	FCP13N60N	FCPF13N60NT	Unit
$V_{DSS}$	Drain to Source Voltage	600		V
$V_{GSS}$	Gate to Source Voltage	±30		V
$I_D$	Drain Current	13	13*	A
	- Continuous ( $T_C = 25^\circ\text{C}$ )	8.2	8.2*	
$I_{DM}$	Drain Current - Pulsed (Note 1)	39	39	A
$E_{AS}$	Single Pulsed Avalanche Energy (Note 2)	235		mJ
$I_{AR}$	Avalanche Current (Note 1)	4.3		A
$E_{AR}$	Repetitive Avalanche Energy (Note 1)	1.16		mJ
dv/dt	MOSFET dv/dt	100		V/ns
	Peak Diode Recovery dv/dt (Note 3)	20		V/ns
$P_D$	Power Dissipation	116	33.8	W
	- Derate Above $25^\circ\text{C}$	0.93	0.27	
$T_J, T_{STG}$	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	FCP13N60N	FCPF13N60NT	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	1.07	3.7	$^\circ\text{C/W}$
$R_{\theta JA}$	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
FCP13N60N	FCP13N60N	TO-220	Tube	N/A	N/A	50 units
FCPF13N60NT	FCPF13N60NT	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 $25^\circ\text{C}$	-	0.73	-	$V/^\circ\text{C}$
$I_{DSS}$	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	$V_{GS} = V_{DS}$ , $I_D = 250\text{ }\mu\text{A}$	2.0	-	4.0	V
$R_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = 10\text{ V}$ , $I_D = 6.5\text{ A}$	-	0.220	0.258	$\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS} = 40\text{ V}$ , $I_D = 6.5\text{ A}$	-	16.3	-	S

### Dynamic Characteristics

$C_{iss}$	Input Capacitance	$V_{DS} = 100\text{ V}$ , $V_{GS} = 0\text{ V}$ , $f = 1\text{ MHz}$	-	1325	1765	pF
$C_{oss}$	Output Capacitance		-	50	65	pF
$C_{rss}$	Reverse Transfer Capacitance		-	3	5	pF
$C_{oss}$	Output Capacitance	$V_{DS} = 380\text{ V}$ , $V_{GS} = 0\text{ V}$ , $f = 1\text{ MHz}$	-	30	-	pF
$C_{oss(eff.)}$	Effective Output Capacitance	$V_{DS} = 0\text{ V}$ to $480\text{ V}$ , $V_{GS} = 0\text{ V}$	-	145	-	pF
$Q_{g(tot)}$	Total Gate Charge at 10V	$V_{DS} = 380\text{ V}$ , $I_D = 6.5\text{ A}$ , $V_{GS} = 10\text{ V}$ (Note 4)	-	30.4	39.5	nC
$Q_{gs}$	Gate to Source Gate Charge		-	6.0	-	nC
$Q_{gd}$	Gate to Drain "Miller" Charge		-	9.5	-	nC
ESR	Equivalent Series Resistance (G-S)	$f = 1\text{ MHz}$	-	2.8	-	$\Omega$

### Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 380\text{ V}$ , $I_D = 6.5\text{ A}$ , $V_{GS} = 10\text{ V}$ , $R_G = 4.7\text{ }\Omega$ (Note 4)	-	14.5	39	ns
$t_r$	Turn-On Rise Time		-	10.6	31.2	ns
$t_{d(off)}$	Turn-Off Delay Time		-	45	100	ns
$t_f$	Turn-Off Fall Time		-	9.8	29.6	ns

### Drain-Source Diode Characteristics

I <sub>S</sub>	Maximum Continuous Drain to Source Diode Forward Current	-	-	13*	A	
I <sub>SM</sub>	Maximum Pulsed Drain to Source Diode Forward Current	-	-	39	A	
V <sub>SD</sub>	Drain to Source Diode Forward Voltage	V <sub>GS</sub> = 0 V, I <sub>SD</sub> = 6.5 A	-	-	1.2	V
t <sub>rr</sub>	Reverse Recovery Time	V <sub>GS</sub> = 0 V, I <sub>SD</sub> = 6.5 A, dI <sub>F</sub> /dt = 100 A/μs	-	287	-	ns
Q <sub>rr</sub>	Reverse Recovery Charge		-	3.5	-	μC

#### Notes:

1. Repetitive rating: pulse-width limited by maximum junction temperature.
2.  $I_{AS} = 4.3\text{ A}$ ,  $R_G = 25\text{ }\Omega$ , starting  $T_J = 25^\circ\text{C}$ .
3.  $I_{SD} \leq 13\text{ A}$ ,  $di/dt \leq 200\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ , starting  $T_J = 25^\circ\text{C}$ .
4. Essentially independent of operating temperature typical characteristics.

## Typical Performance Characteristics

Figure 1. On-Region Characteristics

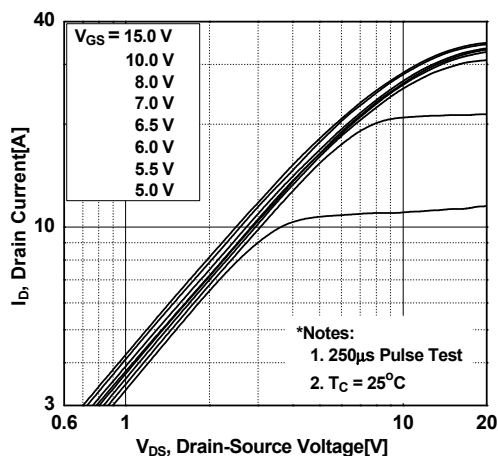


Figure 2. Transfer Characteristics

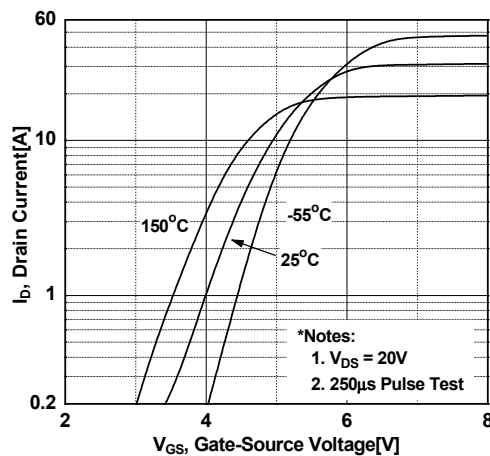


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

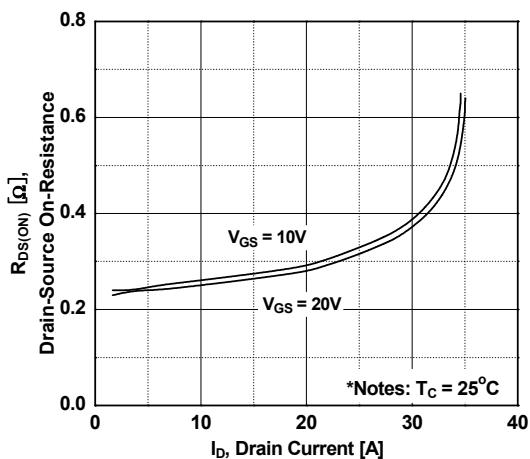


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

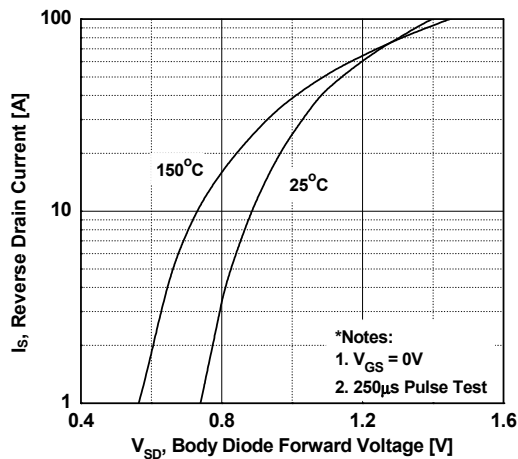


Figure 5. Capacitance Characteristics

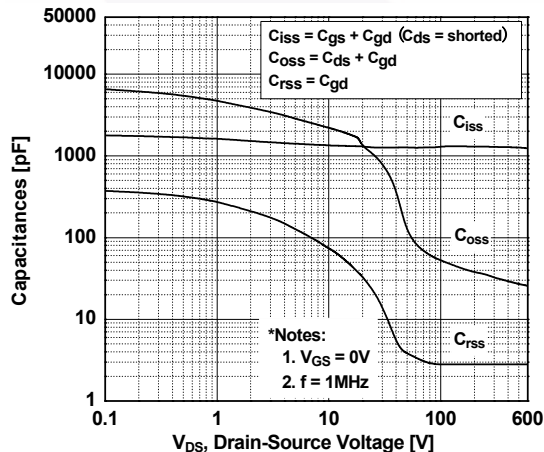
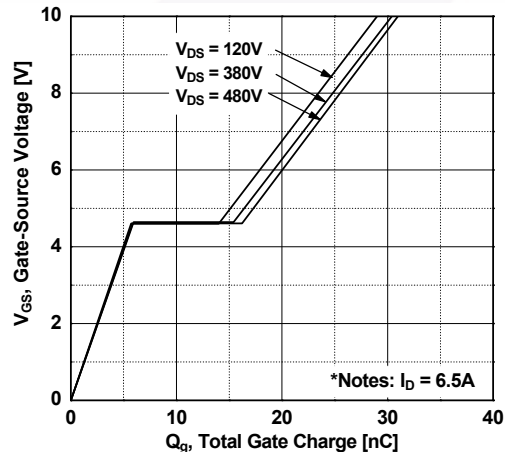
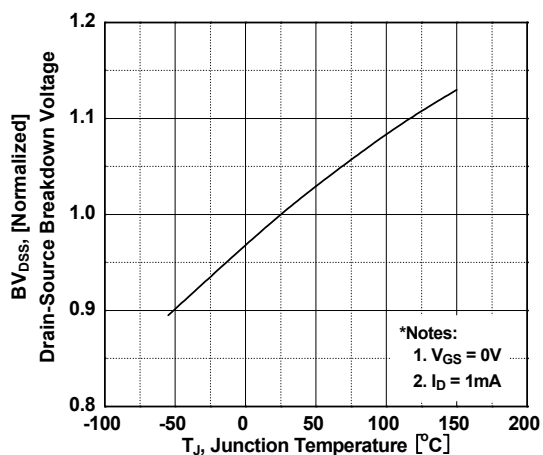


Figure 6. Gate Charge Characteristics

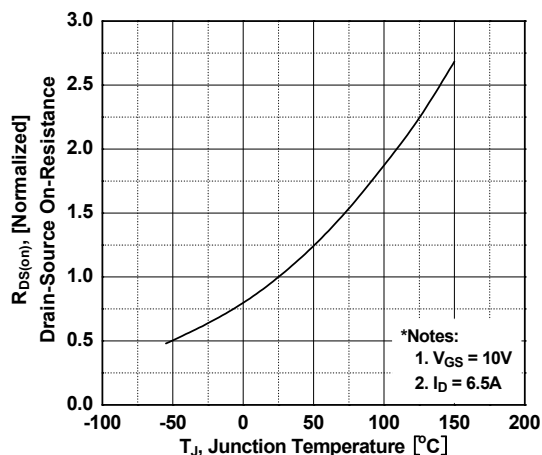


## Typical Performance Characteristics (Continued)

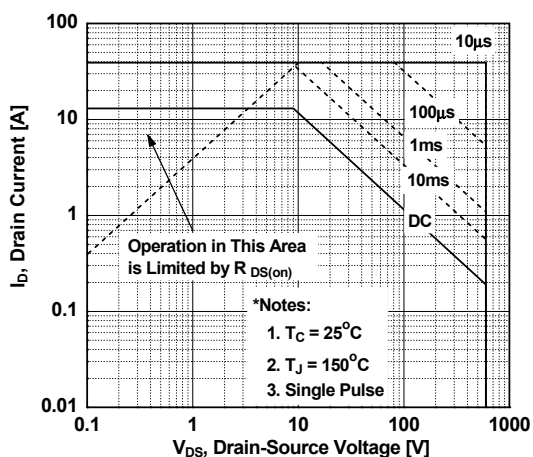
**Figure 7. Breakdown Voltage Variation vs. Temperature**



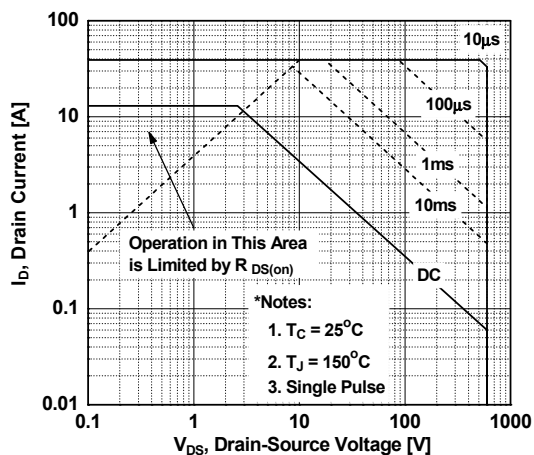
**Figure 8. On-Resistance Variation vs. Temperature**



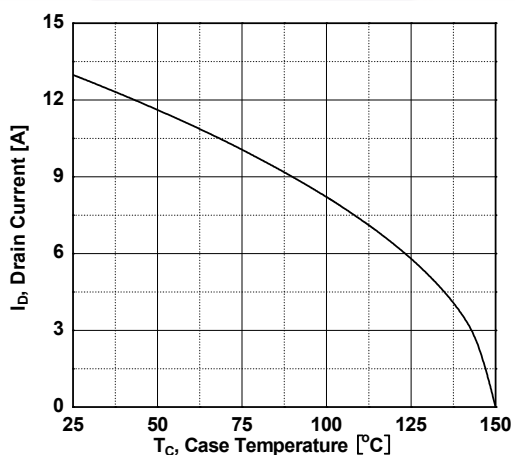
**Figure 9. Maximum Safe Operating Area - FCP13N60N**



**Figure 10. Maximum Safe Operating Area - FCPF13N60NT**



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



## Typical Performance Characteristics (Continued)

Figure 12. Transient Thermal Response Curve - FCP13N60N

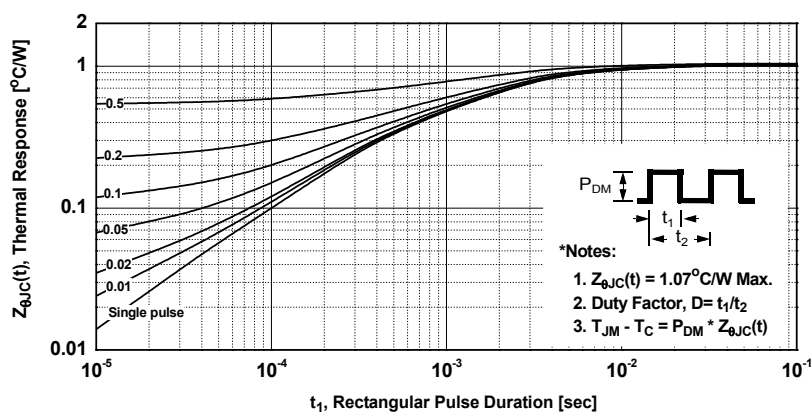


Figure 13. Transient Thermal Response Curve - FCPF13N60NT

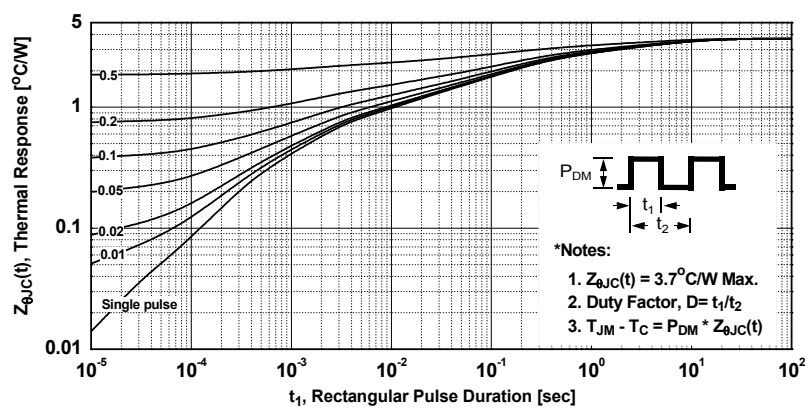




Figure 14. Gate Charge Test Circuit & Waveform



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

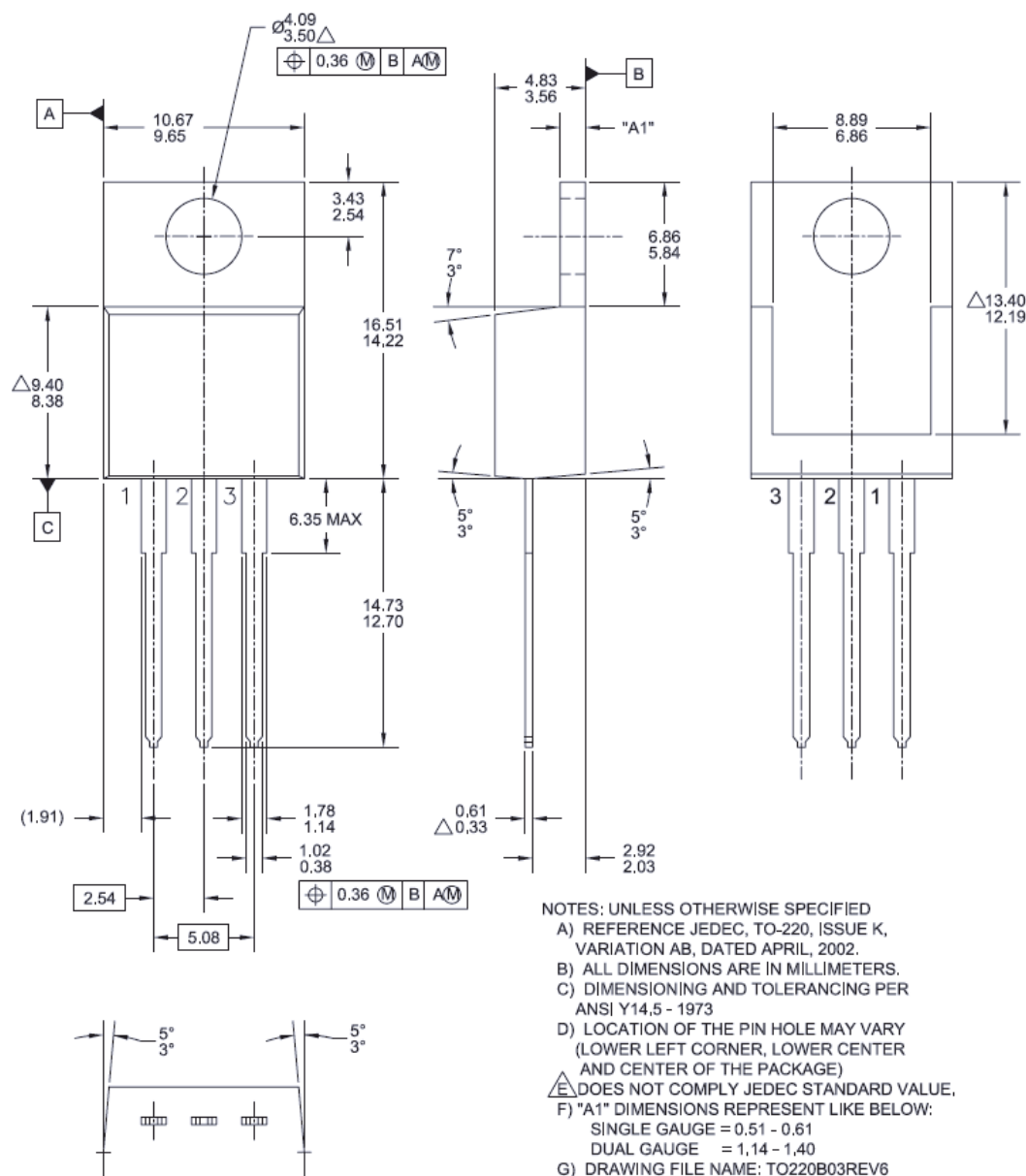


Figure 18. TO-220, Molded, 3-Lead, Jedec Variation AB

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