



# FCP13N60N / FCPF13N60NT

## N-Channel SupreMOS® MOSFET

### 600 V, 13 A, 258 mΩ

#### Features

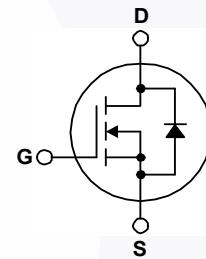
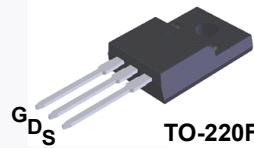
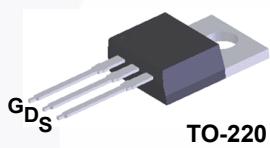
- $R_{DS(on)} = 220 \text{ mΩ}$  (Typ.) @  $V_{GS} = 10 \text{ V}$ ,  $I_D = 6.5 \text{ A}$
- Ultra Low Gate Charge (Typ.  $Q_g = 30.4 \text{ nC}$ )
- Low Effective Output Capacitance (Typ.  $C_{oss(\text{eff.})} = 145 \text{ pF}$ )
- 100% Avalanche Tested
- RoHS Compliant

#### 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.



#### 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			$\pm 30$	V
$I_D$	Drain Current	- Continuous ( $T_C = 25^\circ\text{C}$ )	13	13*	A
		- Continuous ( $T_C = 100^\circ\text{C}$ )	8.2	8.2*	
$I_{DM}$	Drain Current	- Pulsed	(Note 1)	39	A
$E_{AS}$	Single Pulsed Avalanche Energy			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	( $T_C = 25^\circ\text{C}$ )	116	33.8	W
		- Derate Above $25^\circ\text{C}$	0.93	0.27	W/ $^\circ\text{C}$
$T_J, T_{STG}$	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	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max.	62.5	62.5	$^\circ\text{C}/\text{W}$

## 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

$\text{BV}_{\text{DSS}}$	Drain to Source Breakdown Voltage	$I_D = 1 \text{ mA}, V_{GS} = 0 \text{ V}, T_C = 25^\circ\text{C}$	600	-	-	V
$\Delta \text{BV}_{\text{DSS}} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 1 \text{ mA}, \text{Referenced to } 25^\circ\text{C}$	-	0.73	-	$\text{V}^\circ\text{C}$
$I_{\text{DSS}}$	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	
$I_{\text{GSS}}$	Gate to Body Leakage Current	$V_{GS} = \pm 30 \text{ V}, V_{DS} = 0 \text{ V}$	-	-	$\pm 100$	nA

### On Characteristics

$V_{GS(\text{th})}$	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 250 \mu\text{A}$	2.0	-	4.0	V
$R_{DS(\text{on})}$	Static Drain to Source On Resistance	$V_{GS} = 10 \text{ V}, I_D = 6.5 \text{ A}$	-	0.220	0.258	$\Omega$
$g_{\text{FS}}$	Forward Transconductance	$V_{DS} = 40 \text{ V}, I_D = 6.5 \text{ A}$	-	16.3	-	S

### Dynamic Characteristics

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

### Switching Characteristics

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

### Drain-Source Diode Characteristics

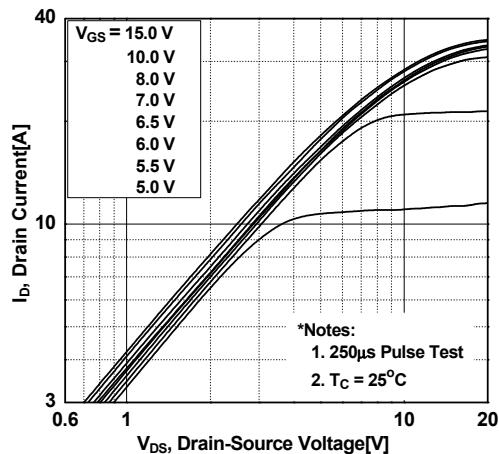
$I_S$	Maximum Continuous Drain to Source Diode Forward Current	$V_{GS} = 0 \text{ V}, I_{SD} = 6.5 \text{ A}$	-	-	13*	A
$I_{\text{SM}}$	Maximum Pulsed Drain to Source Diode Forward Current	$V_{GS} = 0 \text{ V}, I_{SD} = 6.5 \text{ A}$	-	-	39	A
$V_{\text{SD}}$	Drain to Source Diode Forward Voltage	$V_{GS} = 0 \text{ V}, I_{SD} = 6.5 \text{ A}$	-	-	1.2	V
$t_{\text{rr}}$	Reverse Recovery Time	$V_{GS} = 0 \text{ V}, I_{SD} = 6.5 \text{ A}, dI_F/dt = 100 \text{ A}/\mu\text{s}$	-	287	-	ns
$Q_{\text{rr}}$	Reverse Recovery Charge	$dI_F/dt = 100 \text{ A}/\mu\text{s}$	-	3.5	-	$\mu\text{C}$

#### Notes:

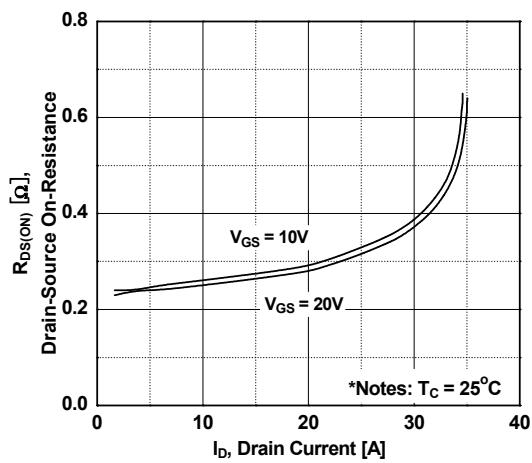
1. Repetitive rating: pulse-width limited by maximum junction temperature.
2.  $I_{AS} = 4.3 \text{ A}, R_G = 25 \Omega$ , starting  $T_J = 25^\circ\text{C}$ .
3.  $I_{SD} \leq 13 \text{ A}, dI/dt \leq 200 \text{ A}/\mu\text{s}, V_{DD} \leq \text{BV}_{\text{DSS}}$ , starting  $T_J = 25^\circ\text{C}$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

## Typical Performance Characteristics

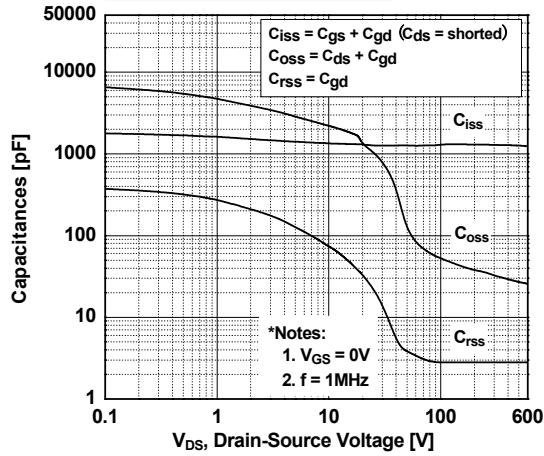
**Figure 1. On-Region Characteristics**



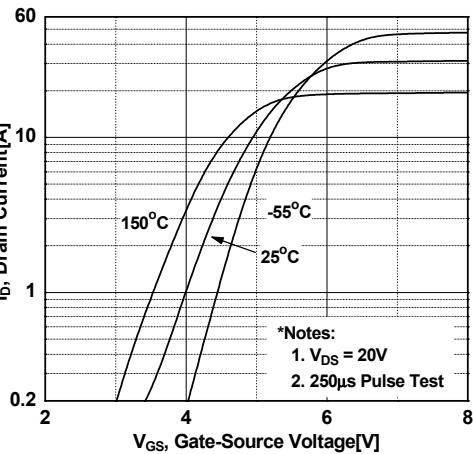
**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**



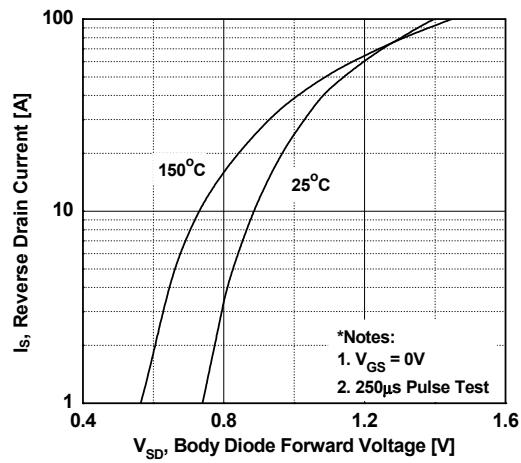
**Figure 5. Capacitance Characteristics**



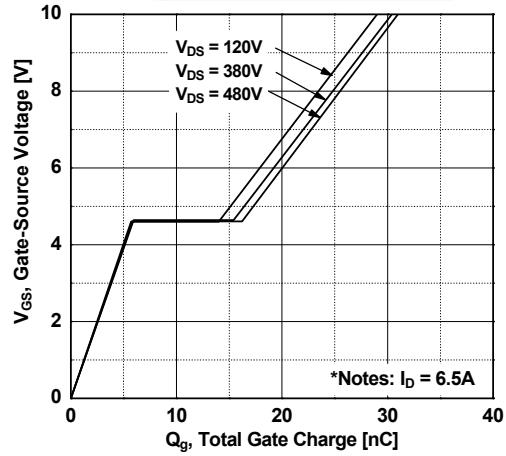
**Figure 2. Transfer Characteristics**



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

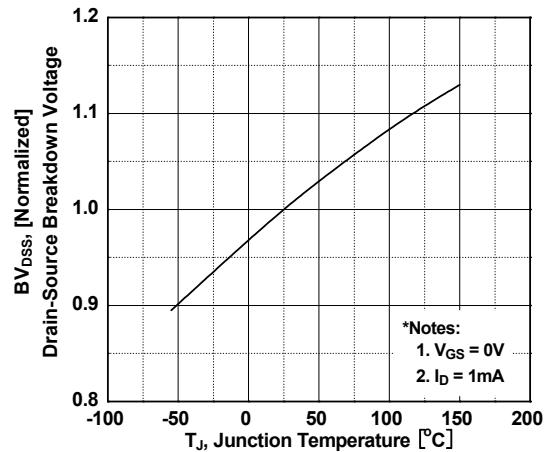


**Figure 6. Gate Charge Characteristics**

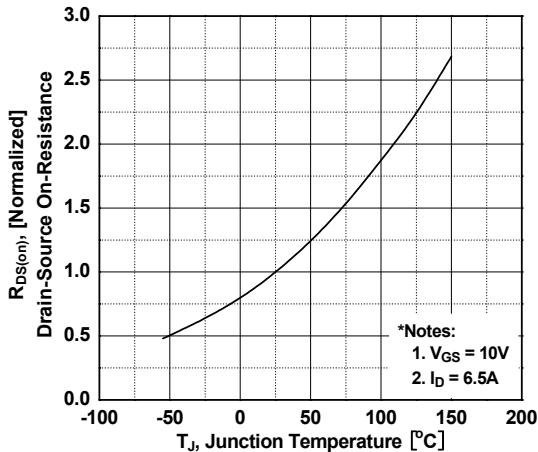


## Typical Performance Characteristics (Continued)

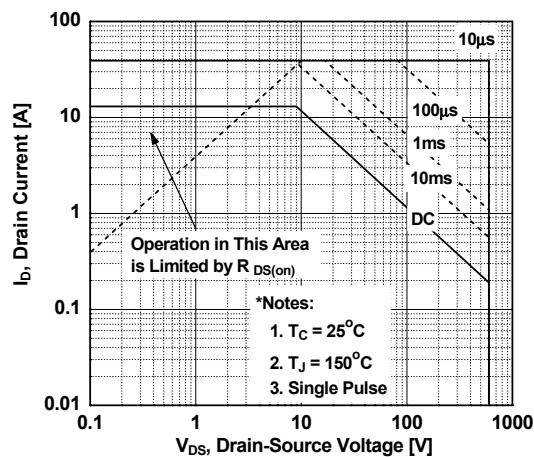
**Figure 7. Breakdown Voltage Variation vs. Temperature**



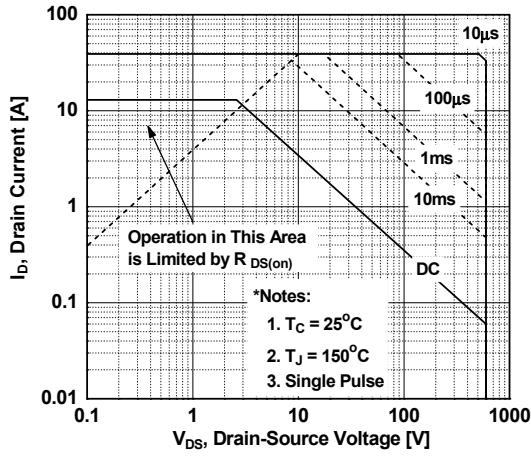
**Figure 8. On-Resistance Variation vs. Temperature**



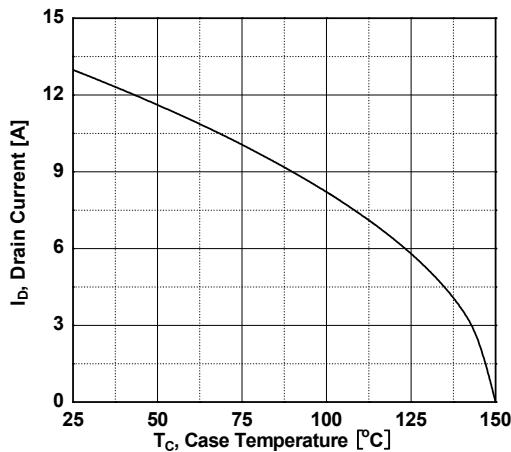
**Figure 9. Maximum Safe Operating Area - FCP13N60N**



**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

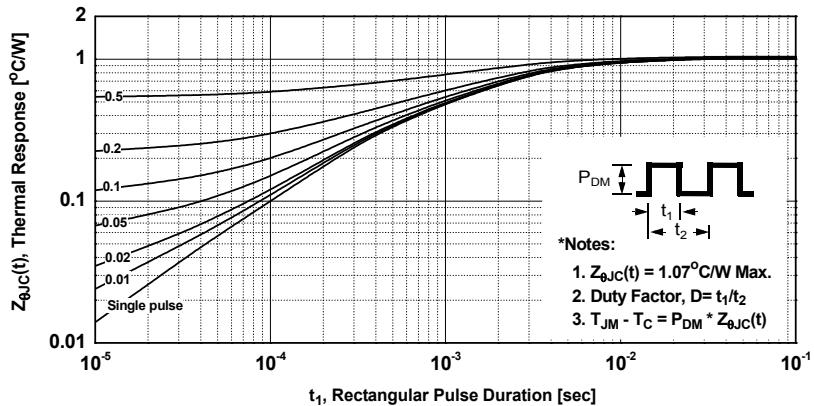
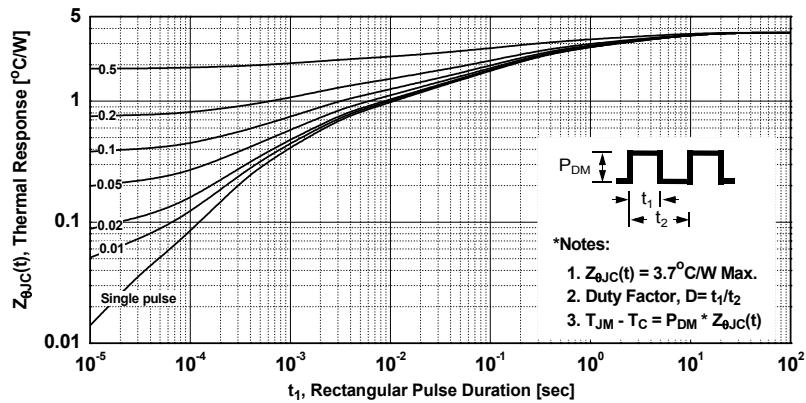


Figure 13. Transient Thermal Response Curve - FCPF13N60NT



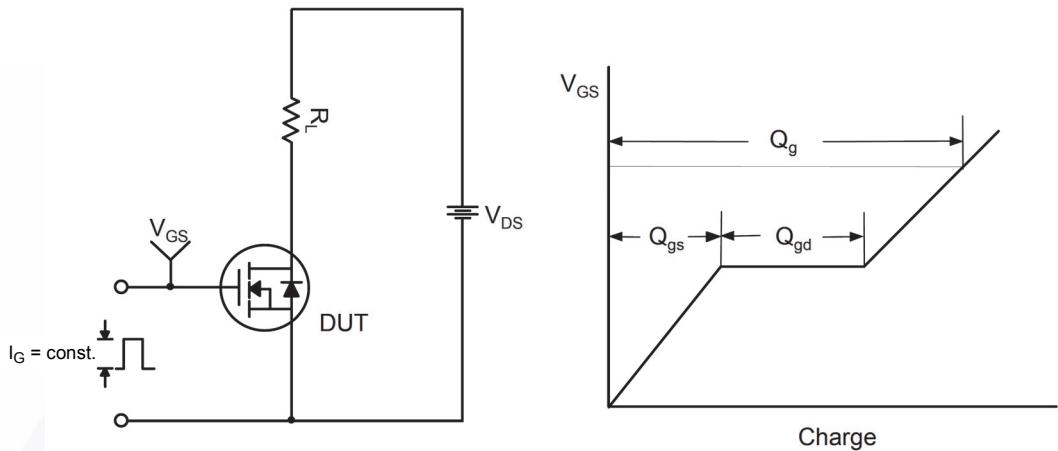


Figure 14. Gate Charge Test Circuit & Waveform

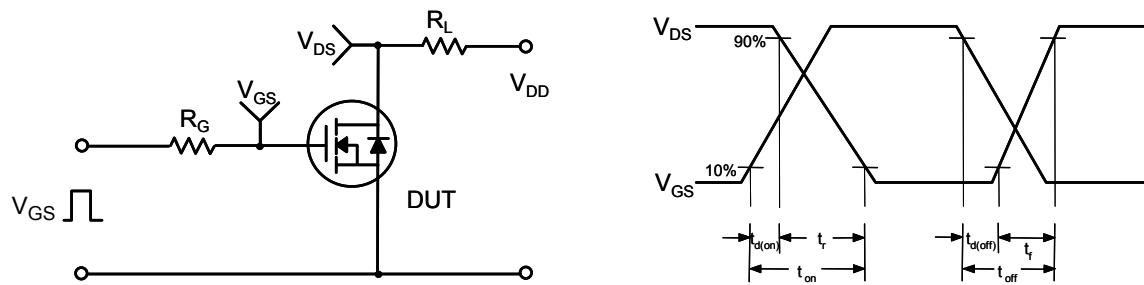


Figure 15. Resistive Switching Test Circuit & Waveforms

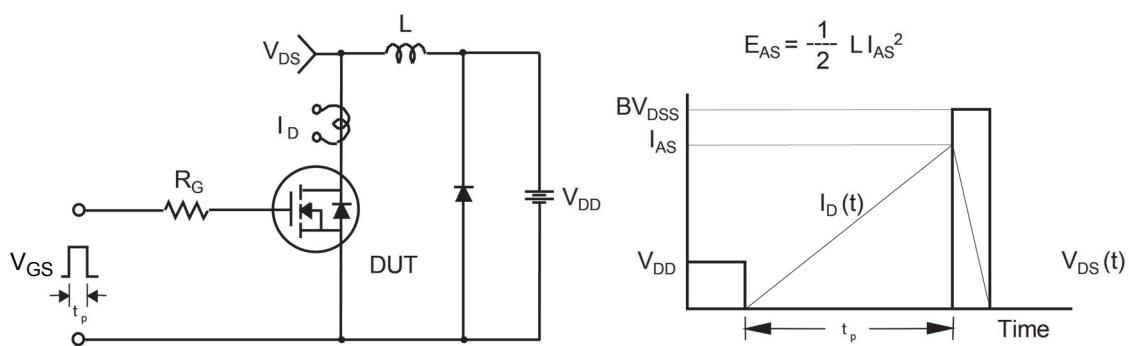


Figure 16. Unclamped Inductive Switching Test Circuit & Waveforms

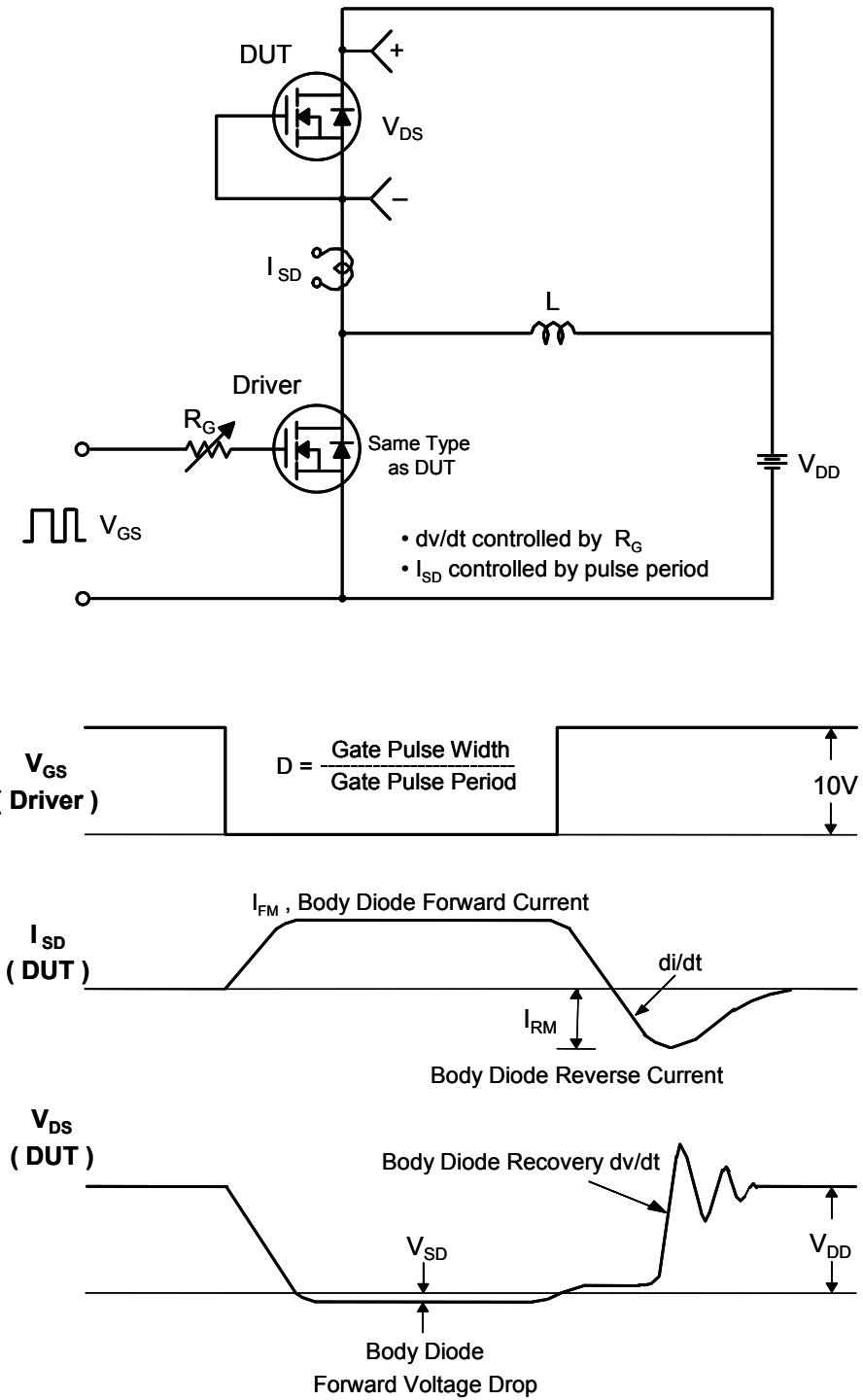


Figure 17. Peak Diode Recovery  $dv/dt$  Test Circuit & Waveforms

## Mechanical Dimensions

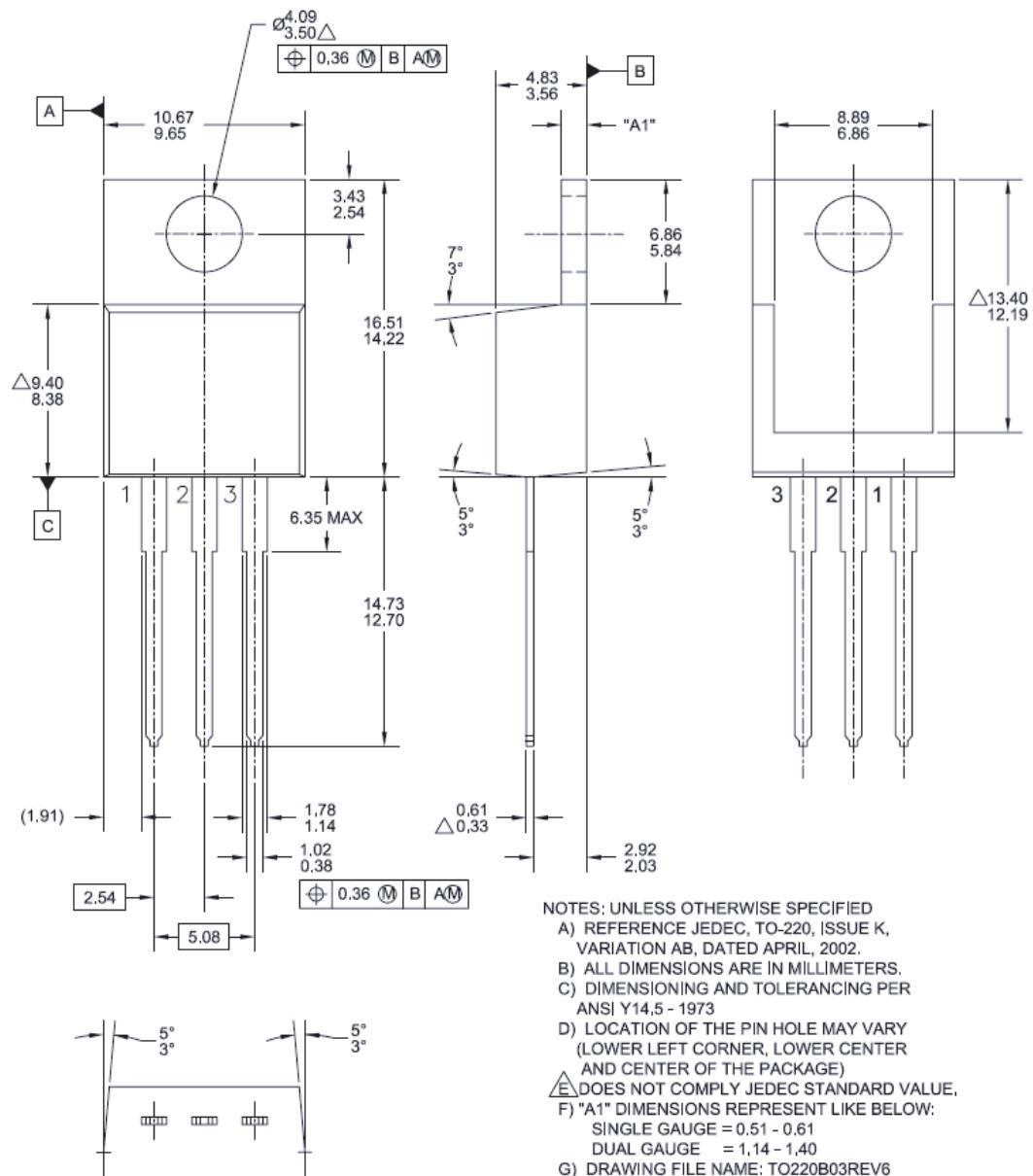


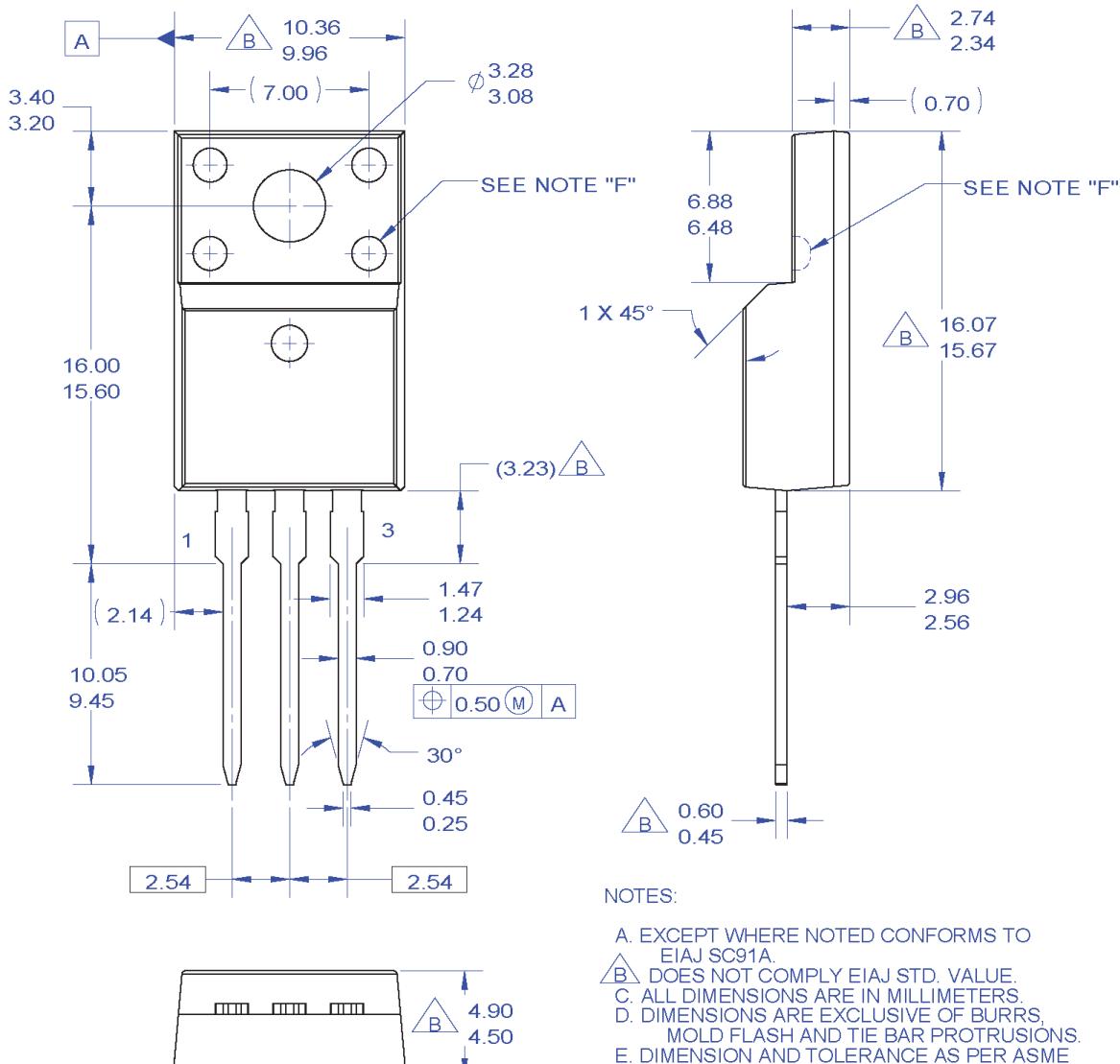
Figure 18. TO-220, Molded, 3-Lead, Jedec Variation AB

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## Mechanical Dimensions



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

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Datasheet Identification	Product Status	Definition
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