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**FAIRCHILD**  
SEMICONDUCTOR®

 August 2009  
**SupreMOS™**

# FCP11N60N / FCPF11N60NT

## N-Channel MOSFET

600V, 10.8A, 0.299Ω

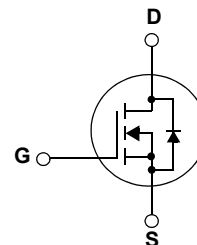
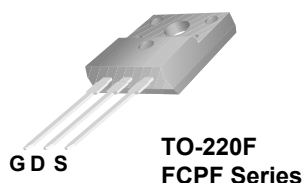
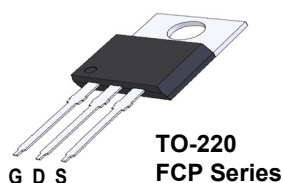
### Features

- $R_{DS(on)} = 0.255\Omega$  (Typ.) @  $V_{GS} = 10V$ ,  $I_D = 5.4A$
- Ultra Low Gate Charge (Typ.  $Q_g = 27.4nC$ )
- Low Effective Output Capacitance
- 100% Avalanche Tested
- RoHS Compliant



### Description

The SupreMOS MOSFET, Fairchild's next generation of high voltage super-junction MOSFETs, employs a deep trench filling process that differentiates it from preceding multi-epi based technologies. By utilizing this advanced technology and precise process control, SupreMOS provides world class  $R_{sp}$ , superior switching performance and ruggedness. This SupreMOS MOSFET fits the industry's AC-DC SMPS requirements for 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	FCP11N60N	FCPF11N60NT	Units
$V_{DSS}$	Drain to Source Voltage	600		V
$V_{GSS}$	Gate to Source Voltage	$\pm 30$		V
$I_D$	Drain Current	-Continuous ( $T_C = 25^\circ C$ )	10.8	A
		-Continuous ( $T_C = 100^\circ C$ )	6.8	
$I_{DM}$	Drain Current	- Pulsed (Note 1)	32.4	A
$E_{AS}$	Single Pulsed Avalanche Energy	(Note 2)	201.7	mJ
$I_{AR}$	Avalanche Current		3.7	A
$E_{AR}$	Repetitive Avalanche Energy		0.94	mJ
dv/dt	MOSFET dv/dt Ruggedness		100	V/ns
	Peak Diode Recovery dv/dt	(Note 3)	20	V/ns
$P_D$	Power Dissipation	( $T_C = 25^\circ C$ )	94.0	W
		- Derate above $25^\circ C$	0.75	
$T_J, T_{STG}$	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	FCP11N60N	FCPF11N60NT	Units
$R_{\theta JC}$	Thermal Resistance, Junction to Case	1.33	3.9	$^\circ C/W$
$R_{\theta CS}$	Thermal Resistance, Case to Heat Sink (Typical)	0.5	0.5	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	62.5	62.5	

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## Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FCP11N60N	FCP11N60N	TO-220	-	-	50
FCPF11N60NT	FCPF11N60NT	TO-220F	-	-	50

## Electrical Characteristics $T_C = 25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
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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
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	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	$V_{GS} = V_{DS}$ , $I_D = 250\mu\text{A}$	2.0	-	4.0	V
$R_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = 10\text{V}$ , $I_D = 5.4\text{A}$	-	0.255	0.299	$\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS} = 40\text{V}$ , $I_D = 5.4\text{A}$	-	13.5	-	S

### Dynamic Characteristics

$C_{iss}$	Input Capacitance	$V_{DS} = 100\text{V}$ , $V_{GS} = 0\text{V}$ $f = 1\text{MHz}$	-	1130	1505	pF
$C_{oss}$	Output Capacitance		-	45	60	pF
$C_{rss}$	Reverse Transfer Capacitance		-	3	5	pF
$C_{oss}$	Output Capacitance	$V_{DS} = 380\text{V}$ , $V_{GS} = 0\text{V}$ , $f = 1\text{MHz}$	-	25	-	pF
$C_{oss\text{eff}}$	Effective Output Capacitance	$V_{DS} = 0\text{V}$ to $480\text{V}$ , $V_{GS} = 0\text{V}$	-	130	-	pF
$Q_{g(tot)}$	Total Gate Charge at 10V	$V_{DS} = 380\text{V}$ , $I_D = 5.4\text{A}$ , $V_{GS} = 10\text{V}$ (Note 4)	-	27.4	35.6	nC
$Q_{gs}$	Gate to Source Gate Charge		-	4.9	-	nC
$Q_{gd}$	Gate to Drain "Miller" Charge		-	8.8	-	nC
ESR	Equivalent Series Resistance (G-S)	Drain Open	-	2.0	-	$\Omega$

### Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 380\text{V}$ , $I_D = 5.4\text{A}$ $R_G = 4.7\Omega$ (Note 4)	-	13.6	37.2	ns
$t_r$	Turn-On Rise Time		-	9.1	28.2	ns
$t_{d(off)}$	Turn-Off Delay Time		-	42.0	94.0	ns
$t_f$	Turn-Off Fall Time		-	10.0	30.0	ns

### Drain-Source Diode Characteristics

I <sub>S</sub>	Maximum Continuous Drain to Source Diode Forward Current		-	-	10.8	A
I <sub>SM</sub>	Maximum Pulsed Drain to Source Diode Forward Current		-	-	32.4	A
V <sub>SD</sub>	Drain to Source Diode Forward Voltage	V <sub>GS</sub> = 0V, I <sub>SD</sub> = 5.4A	-	-	1.2	V
t <sub>rr</sub>	Reverse Recovery Time	V <sub>GS</sub> = 0V, I <sub>SD</sub> = 5.4A dI <sub>F</sub> /dt = 100A/μs	-	268	-	ns
Q <sub>rr</sub>	Reverse Recovery Charge		-	3.1	-	μC

#### Notes:

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2.  $I_{AS} = 3.7\text{A}$ ,  $R_G = 25\Omega$ , Starting  $T_J = 25^\circ\text{C}$
3.  $I_{SD} \leq 10.8\text{A}$ ,  $di/dt \leq 200\text{A}/\mu\text{s}$ ,  $V_{DD} = 380\text{V}$ , Starting  $T_J = 25^\circ\text{C}$
4. Essentially Independent of Operating Temperature Typical Characteristics

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# Typical Performance Characteristics

Figure 1. On-Region Characteristics

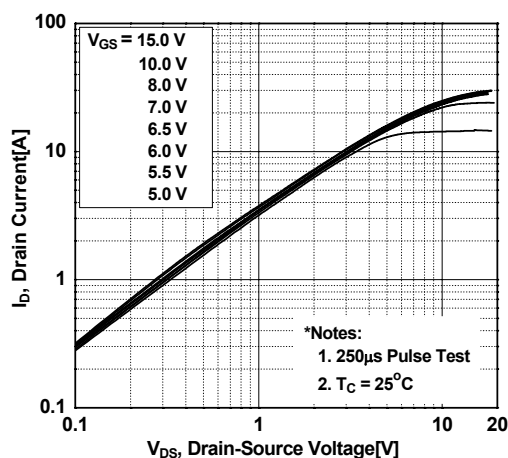


Figure 2. Transfer Characteristics

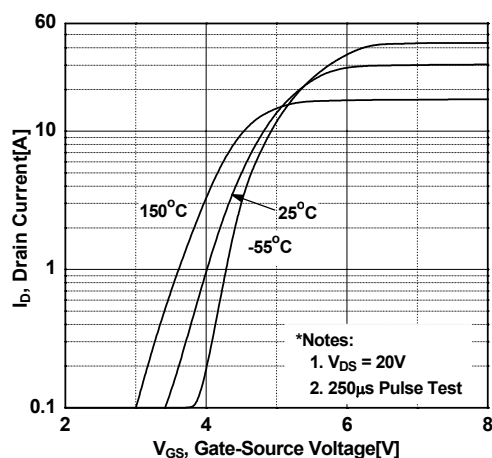


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

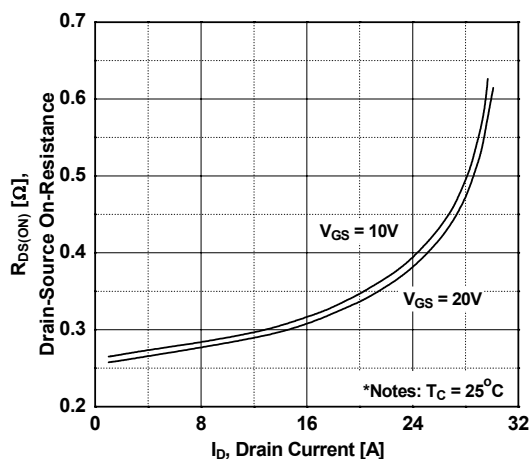


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

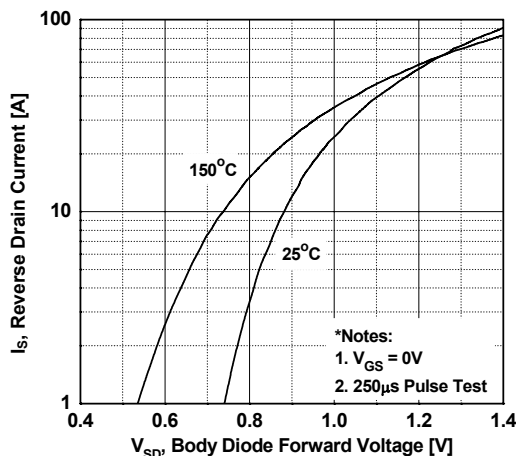


Figure 5. Capacitance Characteristics

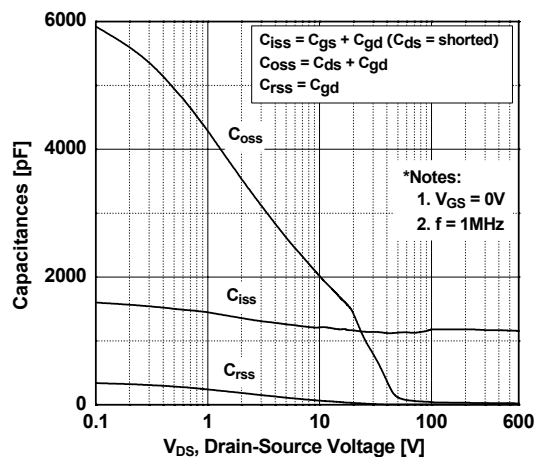
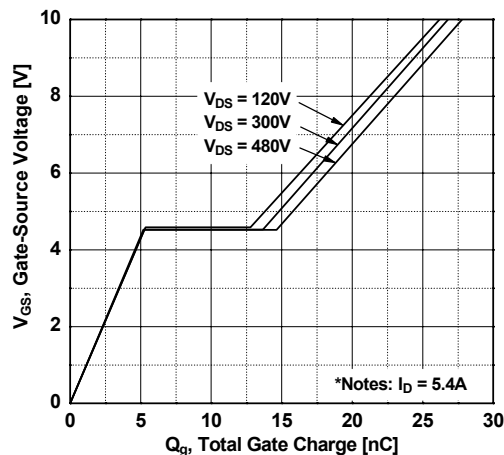


Figure 6. Gate Charge Characteristics



# Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

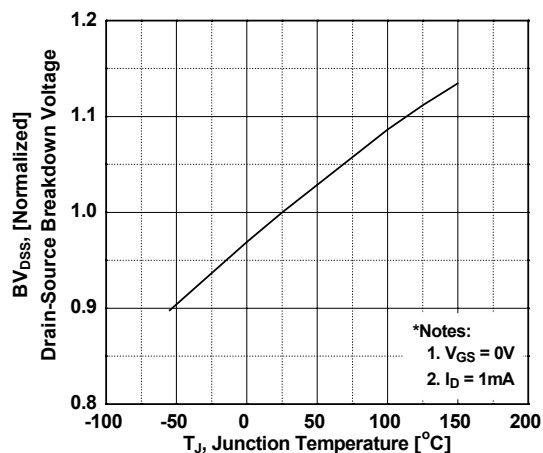


Figure 8. On-Resistance Variation vs. Temperature

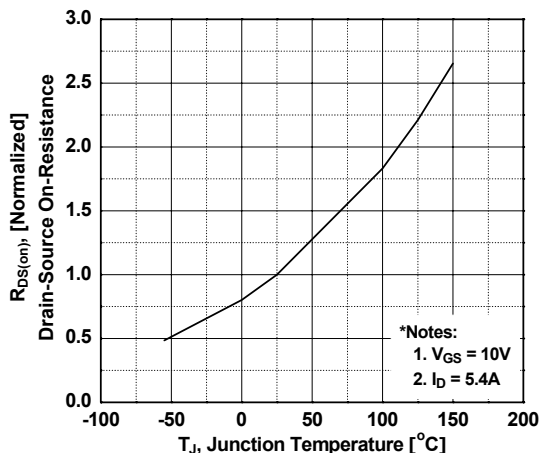


Figure 9. Maximum Safe Operating Area \_FCP11N60N

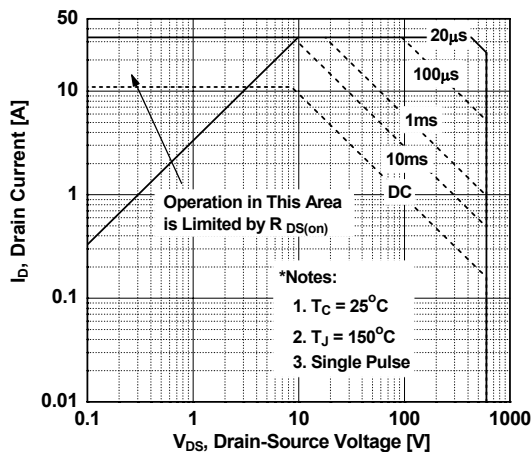


Figure 10. Maximum Safe Operating Area \_FCPF11N60NT

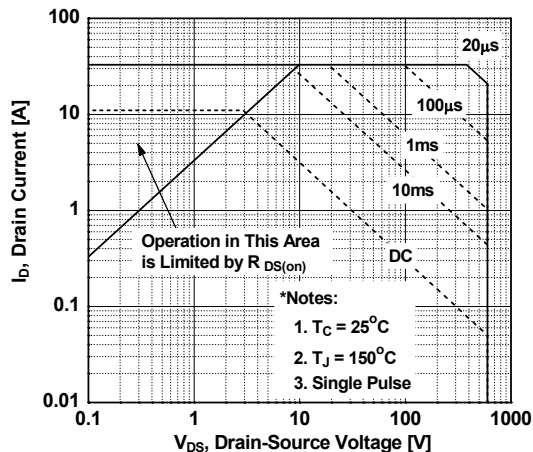
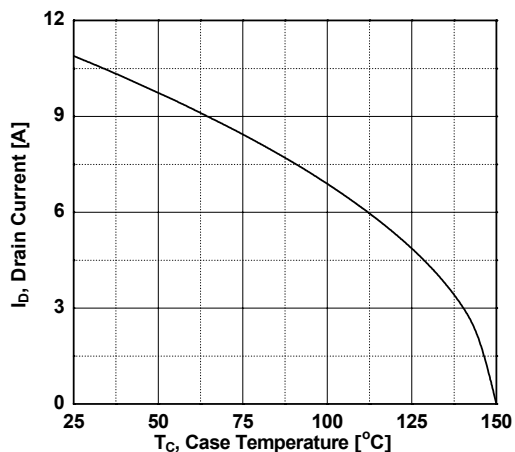


Figure 11. Maximum Drain Current vs. Case Temperature



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# Typical Performance Characteristics (Continued)

Figure 12. Transient Thermal Response Curve \_ FCP11N60N

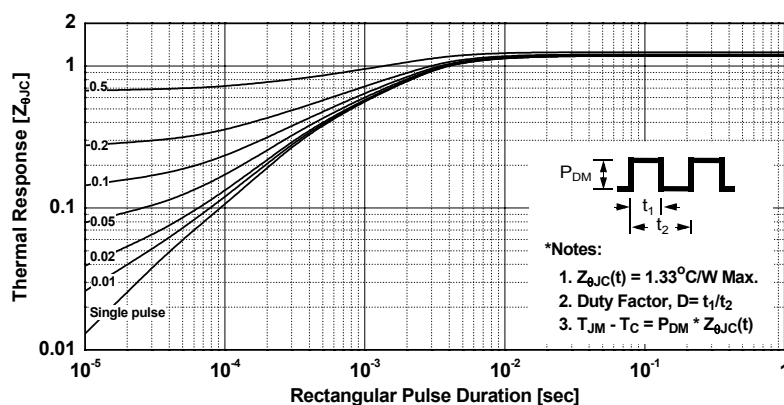
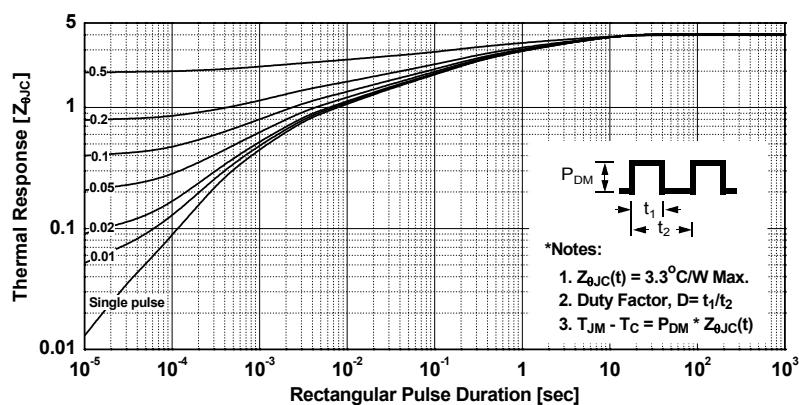
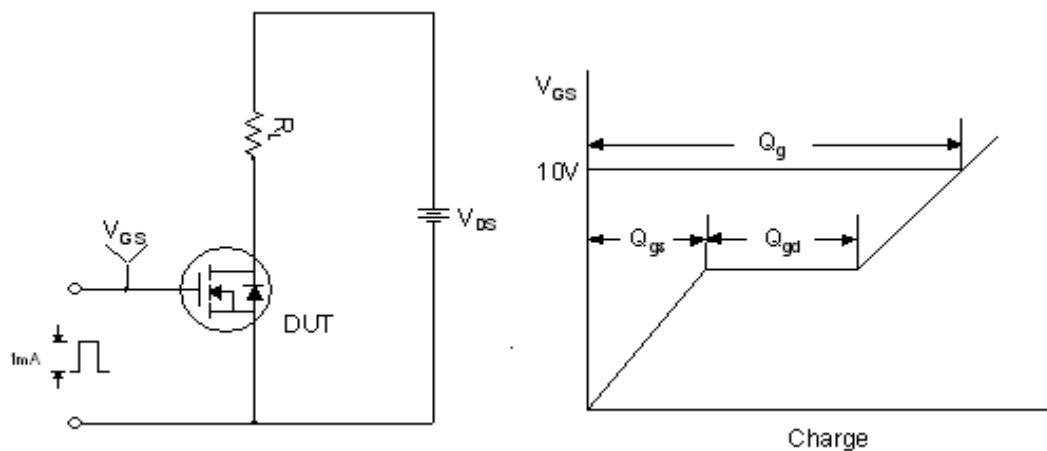


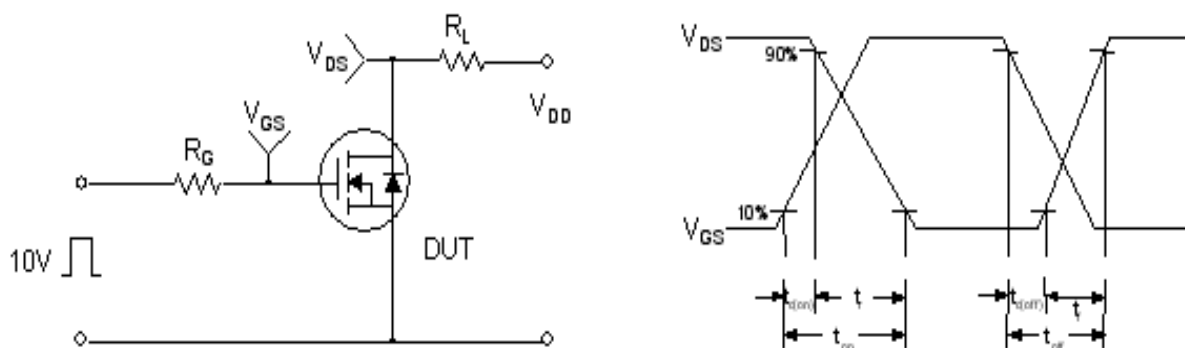
Figure 13. Transient Thermal Response Curve \_ FCPF11N60NT



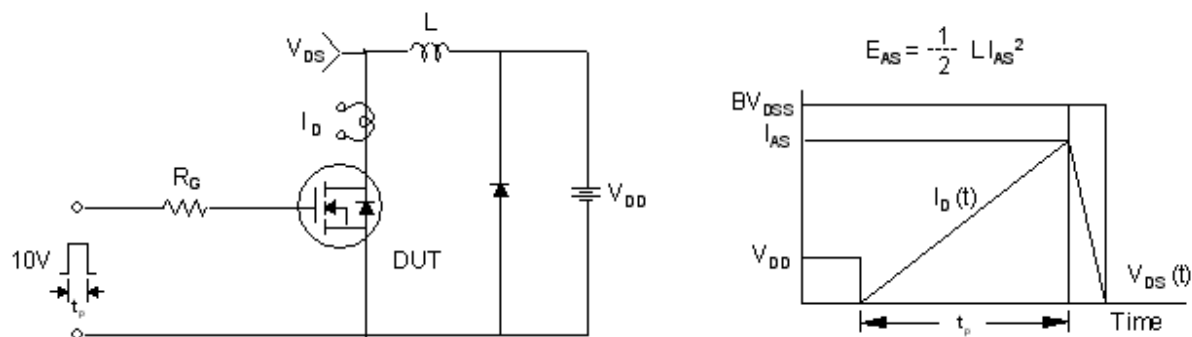
Gate Charge Test Circuit & Waveform



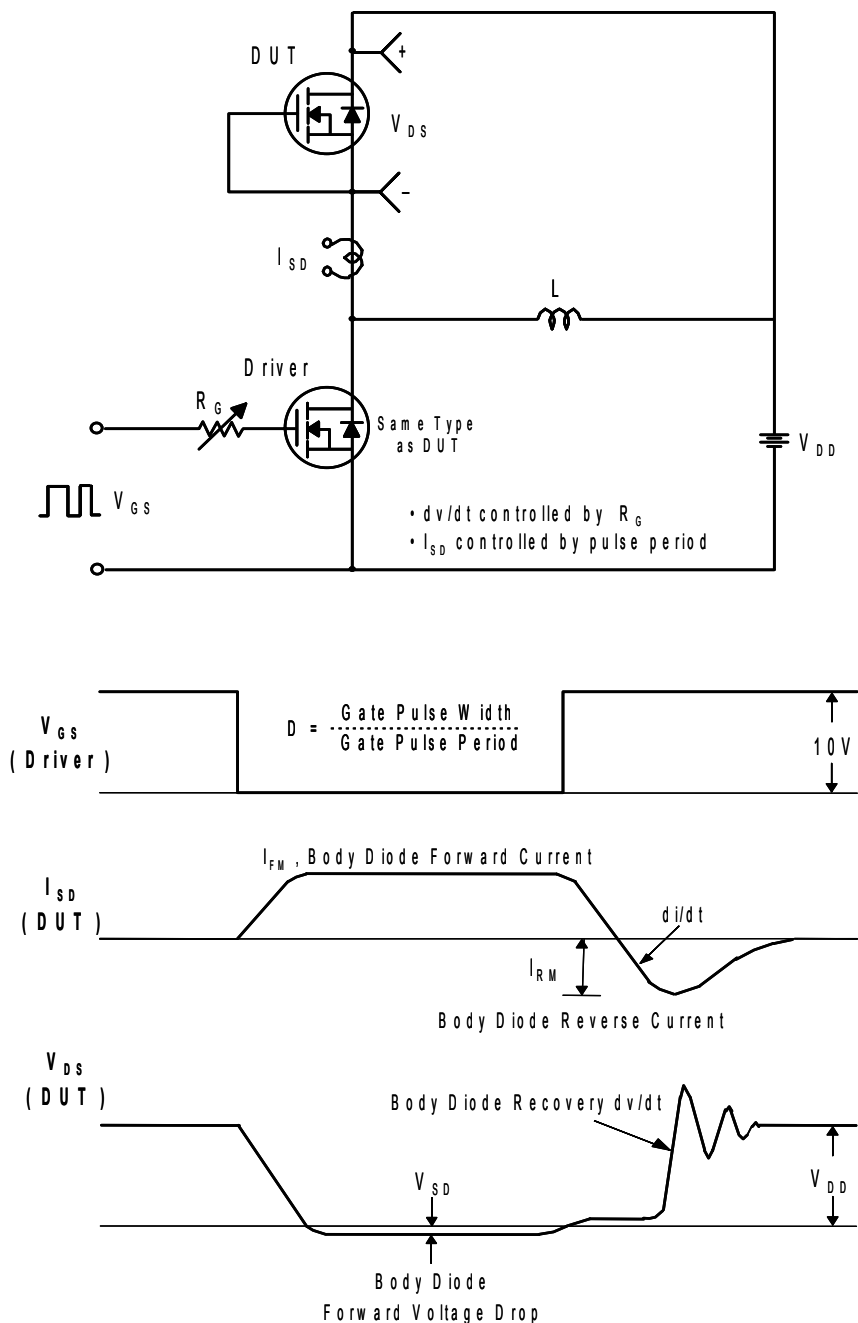
Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching Test Circuit & Waveforms



# Peak Diode Recovery dv/dt Test Circuit & Waveforms

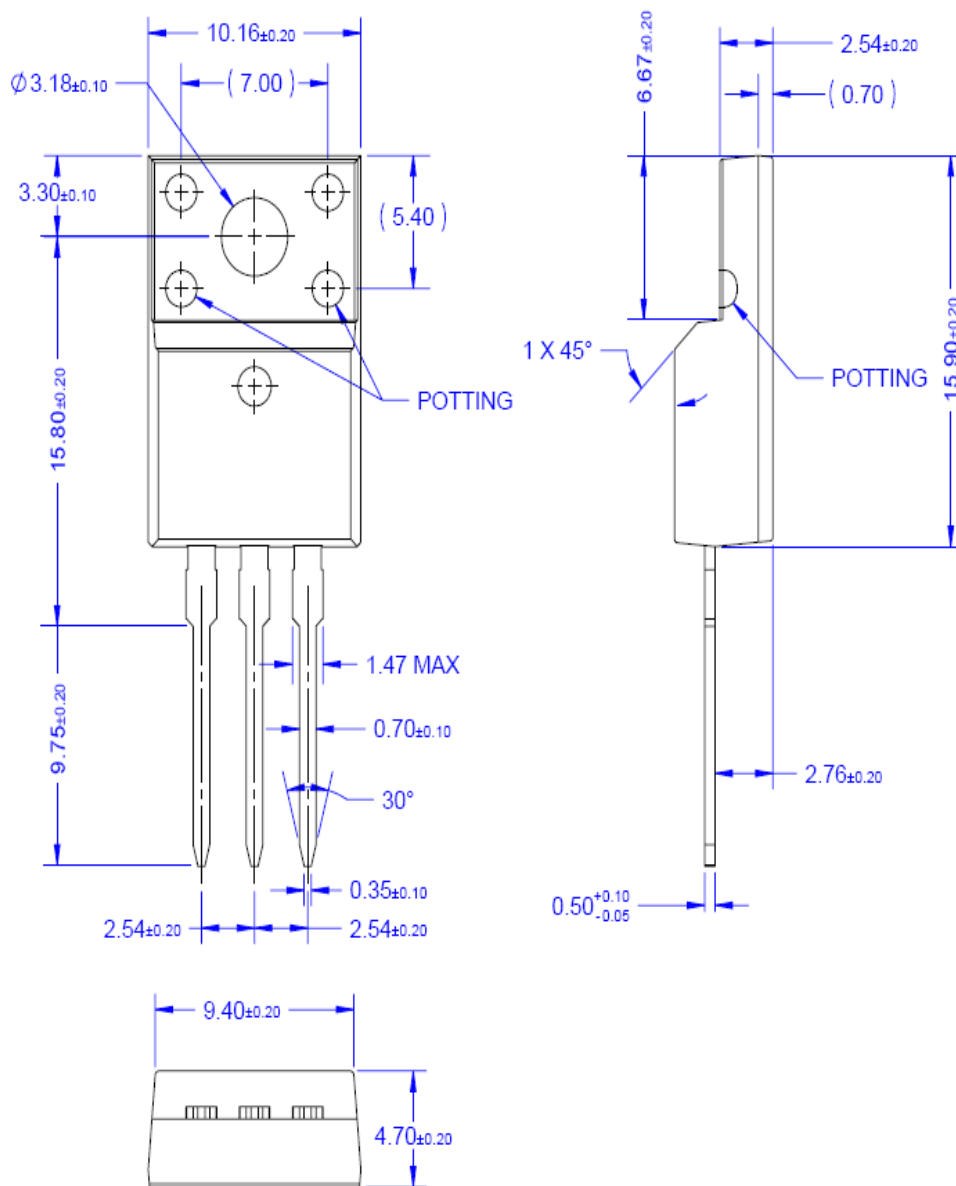


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# Mechanical Dimensions

## TO-220F





Dimensions in Millimeters

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