

# FCP11N60F

## N-Channel SuperFET® FRFET® MOSFET

600 V, 11 A, 380 mΩ

### Features

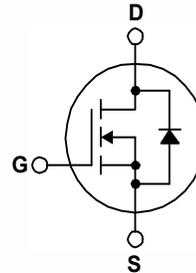
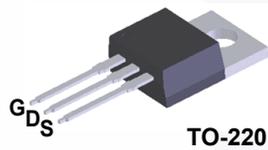
- 650 V @ $T_J = 150^\circ\text{C}$
- Typ.  $R_{DS(on)} = 320\text{ m}\Omega$
- Fast Recovery Type ( $t_{rr} = 120\text{ ns}$ )
- Ultra Low Gate Charge (Typ.  $Q_g = 40\text{ nC}$ )
- Low Effective Output Capacitance (Typ.  $C_{oss,eff} = 95\text{ pF}$ )
- 100% Avalanche Tested
- RoHS compliant

### Application

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

### Description

SuperFET® MOSFET is Fairchild Semiconductor's first generation of high voltage super-junction (SJ) MOSFET family that is utilizing charge balance technology for outstanding low on-resistance and lower gate charge performance. This technology is tailored to minimize conduction loss, provide superior switching performance,  $dv/dt$  rate and higher avalanche energy. Consequently, SuperFET MOSFET is very suitable for the switching power applications such as PFC, server/telecom power, FPD TV power, ATX power and industrial power applications. SuperFET FRFET® MOSFET's optimized body diode reverse recovery performance can remove additional component and improve system reliability.



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

Symbol	Parameter	FCP11N60F	Unit
$V_{DSS}$	Drain to Source Voltage	600	V
$I_D$	Drain Current	- Continuous ( $T_C = 25^\circ\text{C}$ )	11
		- Continuous ( $T_C = 100^\circ\text{C}$ )	7
$I_{DM}$	Drain Current - Pulsed (Note 1)	33	A
$V_{GSS}$	Gate to Source Voltage	$\pm 30$	V
$E_{AS}$	Single Pulsed Avalanche Energy (Note 2)	340	mJ
$I_{AR}$	Avalanche Current (Note 1)	11	A
$E_{AR}$	Repetitive Avalanche Energy (Note 1)	12.5	mJ
$dv/dt$	Peak Diode Recovery $dv/dt$ (Note 3)	4.5	V/ns
$P_D$	Power Dissipation ( $T_C = 25^\circ\text{C}$ ) - Derate above $25^\circ\text{C}$	125	W
		1.0	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 Purpose, 1/8" from Case for 5 Seconds	300	$^\circ\text{C}$

### Thermal Characteristics

Symbol	Parameter	FCP11N60F	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max	1.0	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max	62.5	$^\circ\text{C}/\text{W}$

## Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FCP11N60F	FCP11N60F	TO-220	-	-	50

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

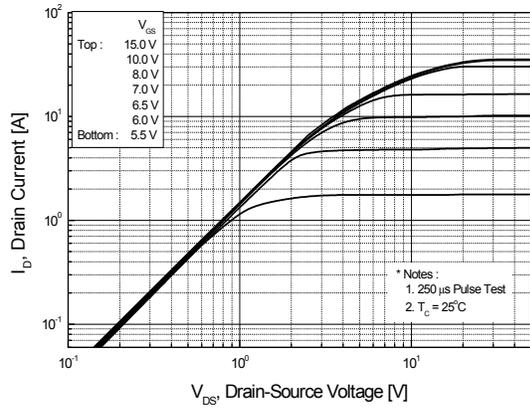
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit	
<b>Off Characteristics</b>							
$BV_{DSS}$	Drain to Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}, T_C = 25^\circ\text{C}$	600	-	-	V	
		$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}, T_C = 150^\circ\text{C}$	-	650	-	V	
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 250\ \mu\text{A}$ , Referenced to $25^\circ\text{C}$	-	0.6	-	$\text{V}/^\circ\text{C}$	
$BV_{DS}$	Drain-Source Avalanche Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 11\text{ A}$	-	700	-	V	
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 600\text{ V}, V_{GS} = 0\text{ V}$	-	-	1	$\mu\text{A}$	
		$V_{DS} = 480\text{ V}, T_C = 125^\circ\text{C}$	-	-	10		
$I_{GSS}$	Gate to Body Leakage Current	$V_{GS} = \pm 30\text{ V}, V_{DS} = 0\text{ V}$	-	-	$\pm 100$	nA	
<b>On Characteristics</b>							
$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 250\ \mu\text{A}$	3.0	-	5.0	V	
$R_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = 10\text{ V}, I_D = 5.5\text{ A}$	-	0.32	0.38	$\Omega$	
$g_{FS}$	Forward Transconductance	$V_{DS} = 40\text{ V}, I_D = 5.5\text{ A}$	-	6	-	S	
<b>Dynamic Characteristics</b>							
$C_{iss}$	Input Capacitance	$V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V}$ $f = 1.0\text{ MHz}$	-	1148	1490	pF	
$C_{oss}$	Output Capacitance		-	671	870	pF	
$C_{riss}$	Reverse Transfer Capacitance		-	63	82	pF	
$C_{oss}$	Output Capacitance	$V_{DS} = 480\text{ V}, V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}$	-	35	-	pF	
$C_{oss\text{eff}}$	Effective Output Capacitance	$V_{DS} = 0\text{ V to } 400\text{ V}, V_{GS} = 0\text{ V}$	-	95	-	pF	
<b>Switching Characteristics</b>							
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 300\text{ V}, I_D = 11\text{ A}$ $R_G = 25\ \Omega$	-	34	80	ns	
$t_r$	Turn-On Rise Time		-	98	205	ns	
$t_{d(off)}$	Turn-Off Delay Time		-	119	250	ns	
$t_f$	Turn-Off Fall Time		(Note 4)	-	56	120	ns
$Q_{g(tot)}$	Total Gate Charge at 10V		$V_{DS} = 480\text{ V}, I_D = 11\text{ A},$ $V_{GS} = 10\text{ V}$	-	40	52	nC
$Q_{gs}$	Gate to Source Gate Charge	(Note 4)	-	7.2	-	nC	
$Q_{gd}$	Gate to Drain "Miller" Charge		-	21	-	nC	
<b>Drain-Source Diode Characteristics Maximum Ratings</b>							
$I_S$	Maximum Continuous Drain to Source Diode Forward Current		-	-	11	A	
$I_{SM}$	Maximum Pulsed Drain to Source Diode Forward Current		-	-	33	A	
$V_{SD}$	Drain to Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_{SD} = 11\text{ A}$	-	-	1.4	V	
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0\text{ V}, I_{SD} = 11\text{ A}$	-	120	-	ns	
$Q_{rr}$	Reverse Recovery Charge	$di_F/dt = 100\text{ A}/\mu\text{s}$	-	0.8	-	$\mu\text{C}$	

### Notes:

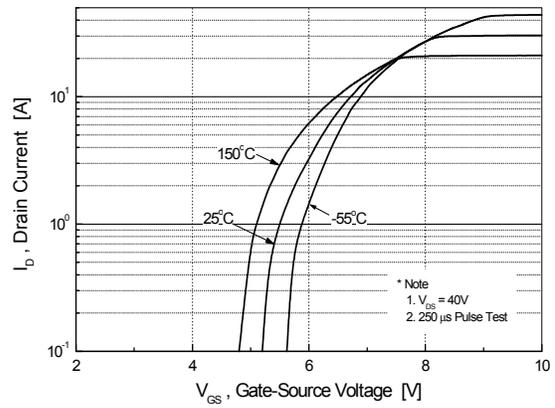
1. Repetitive Rating : Pulse width limited by maximum junction temperature.
2.  $I_{AS} = 5.5\text{ A}, V_{DD} = 50\text{ V}, R_G = 25\ \Omega$ , Starting  $T_J = 25^\circ\text{C}$ .
3.  $I_{SD} \leq 11\text{ A}, di/dt \leq 200\text{ A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$ , starting  $T_J = 25^\circ\text{C}$ .
4. Essentially independent of operating temperature.

## Typical Performance Characteristics

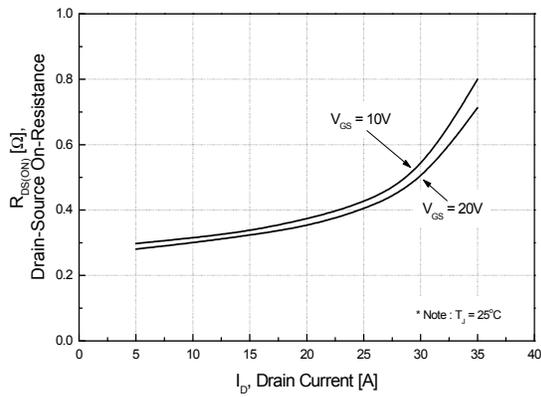
**Figure 1. On-Region Characteristics**



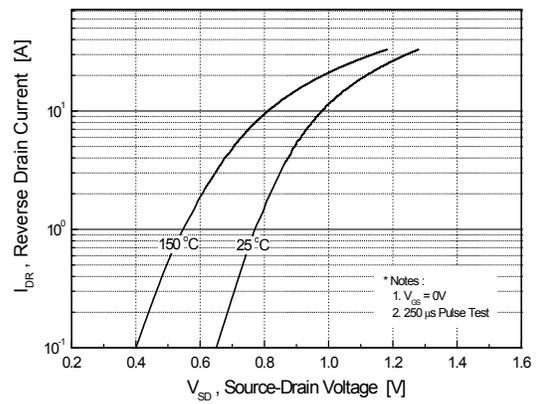
**Figure 2. Transfer Characteristics**



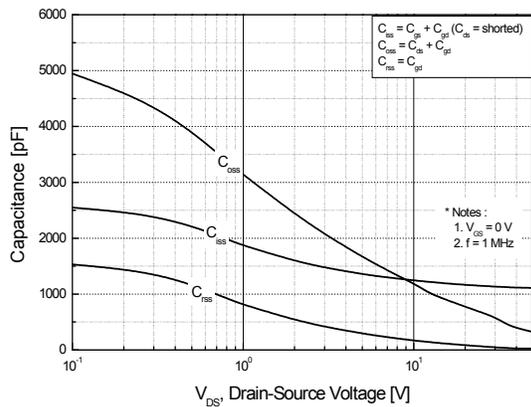
**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**



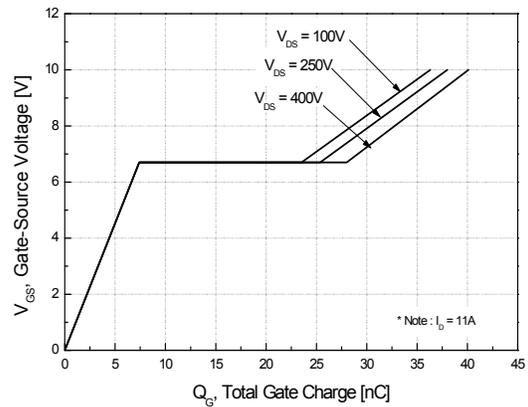
**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**



**Figure 5. Capacitance Characteristics**

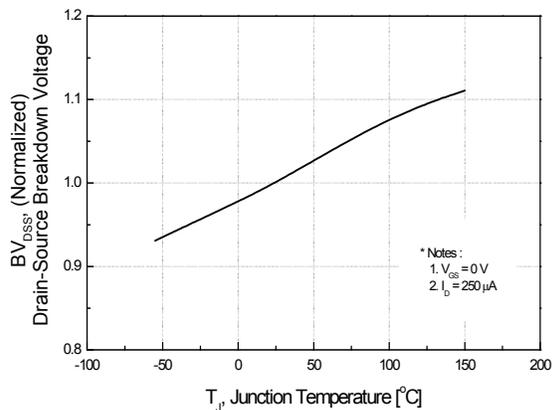


**Figure 6. Gate Charge Characteristics**

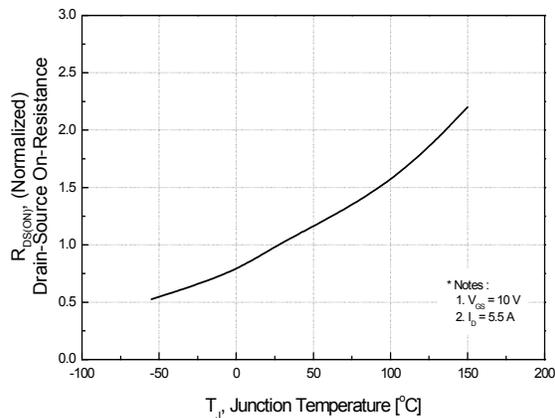


## Typical Performance Characteristics (Continued)

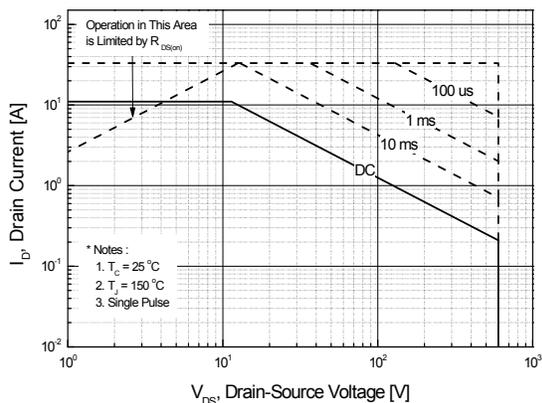
**Figure 7. Breakdown Voltage Variation vs. Temperature**



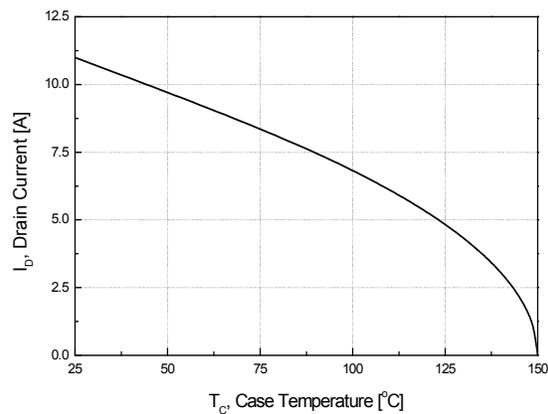
**Figure 8. On-Resistance Variation vs. Temperature**



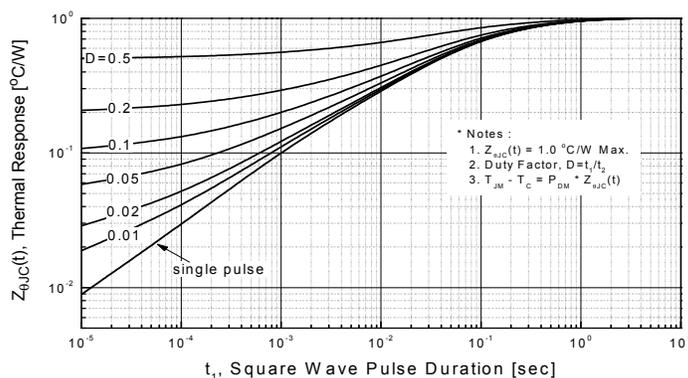
**Figure 9. Safe Operating Area**



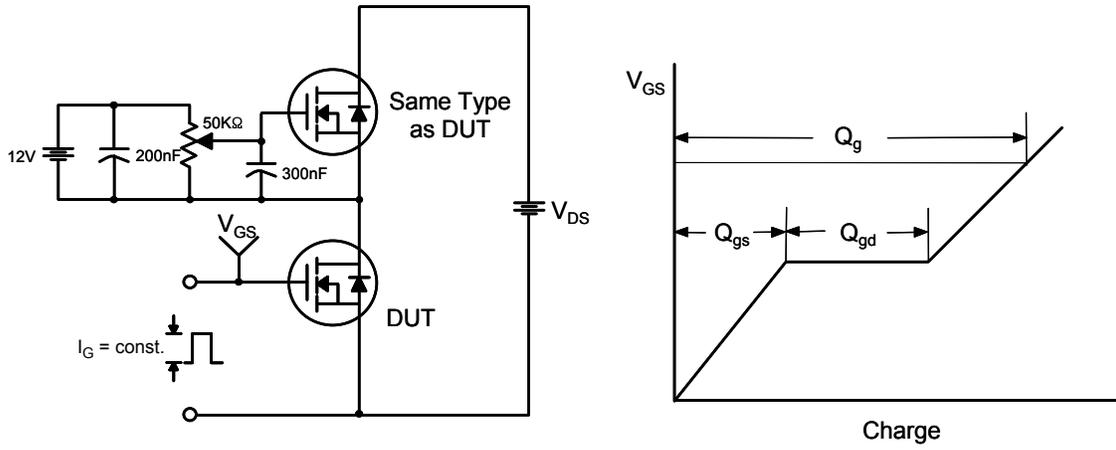
**Figure 10. Maximum Drain Current vs. Case Temperature**



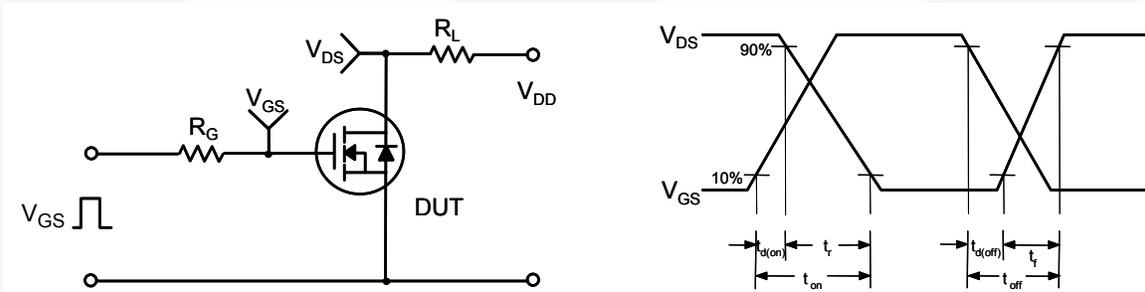
**Figure 11. Transient Thermal Response Curve**



**Figure 12. Gate Charge Test Circuit & Waveform**



**Figure 13. Resistive Switching Test Circuit & Waveforms**



**Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms**

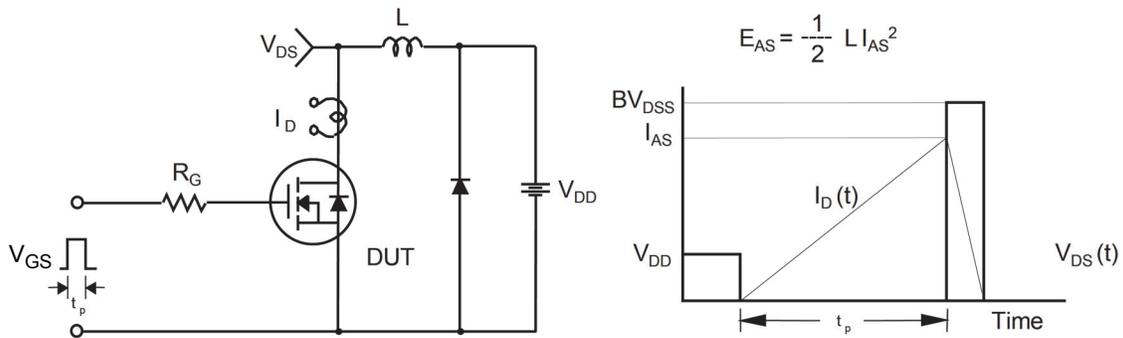
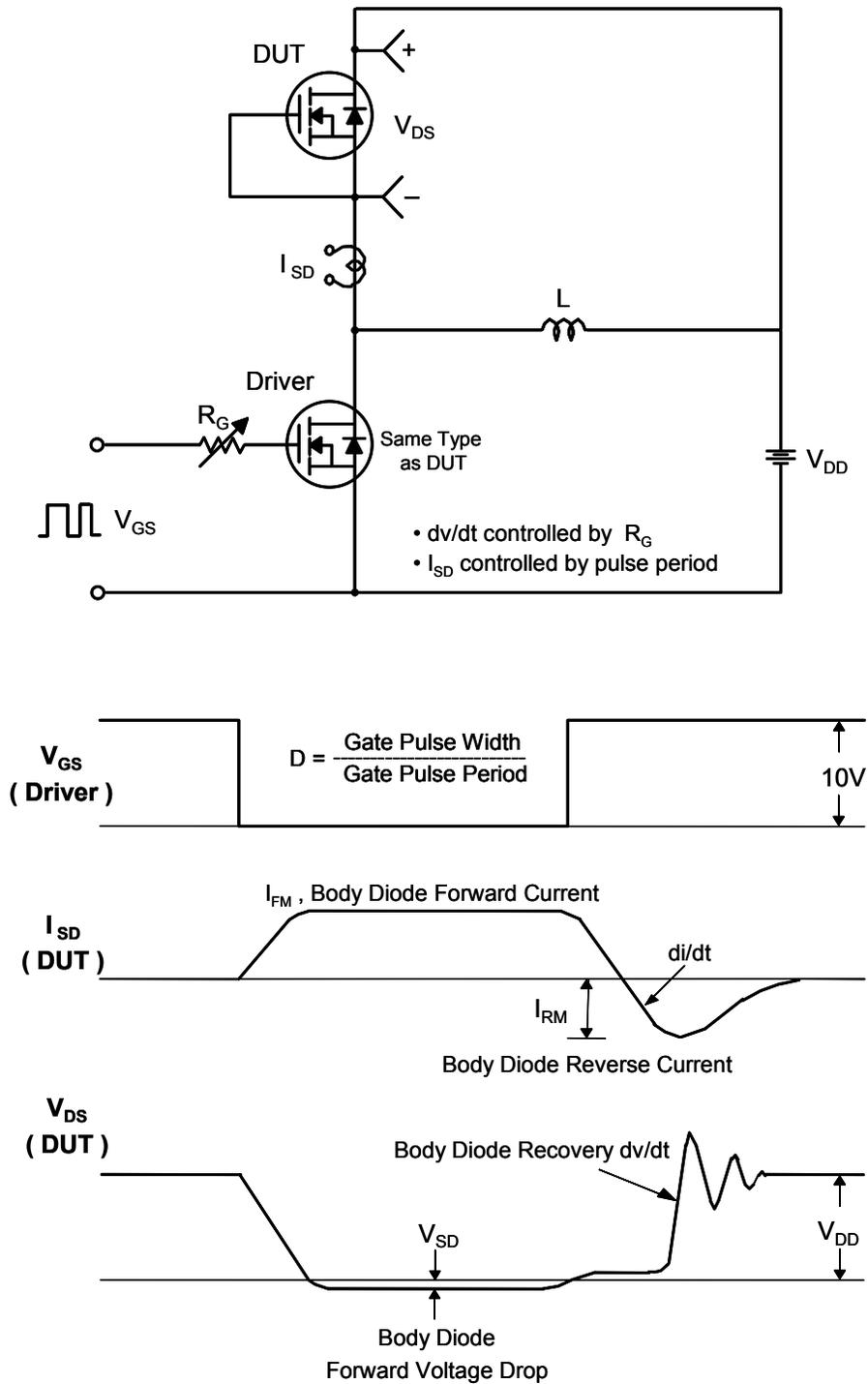
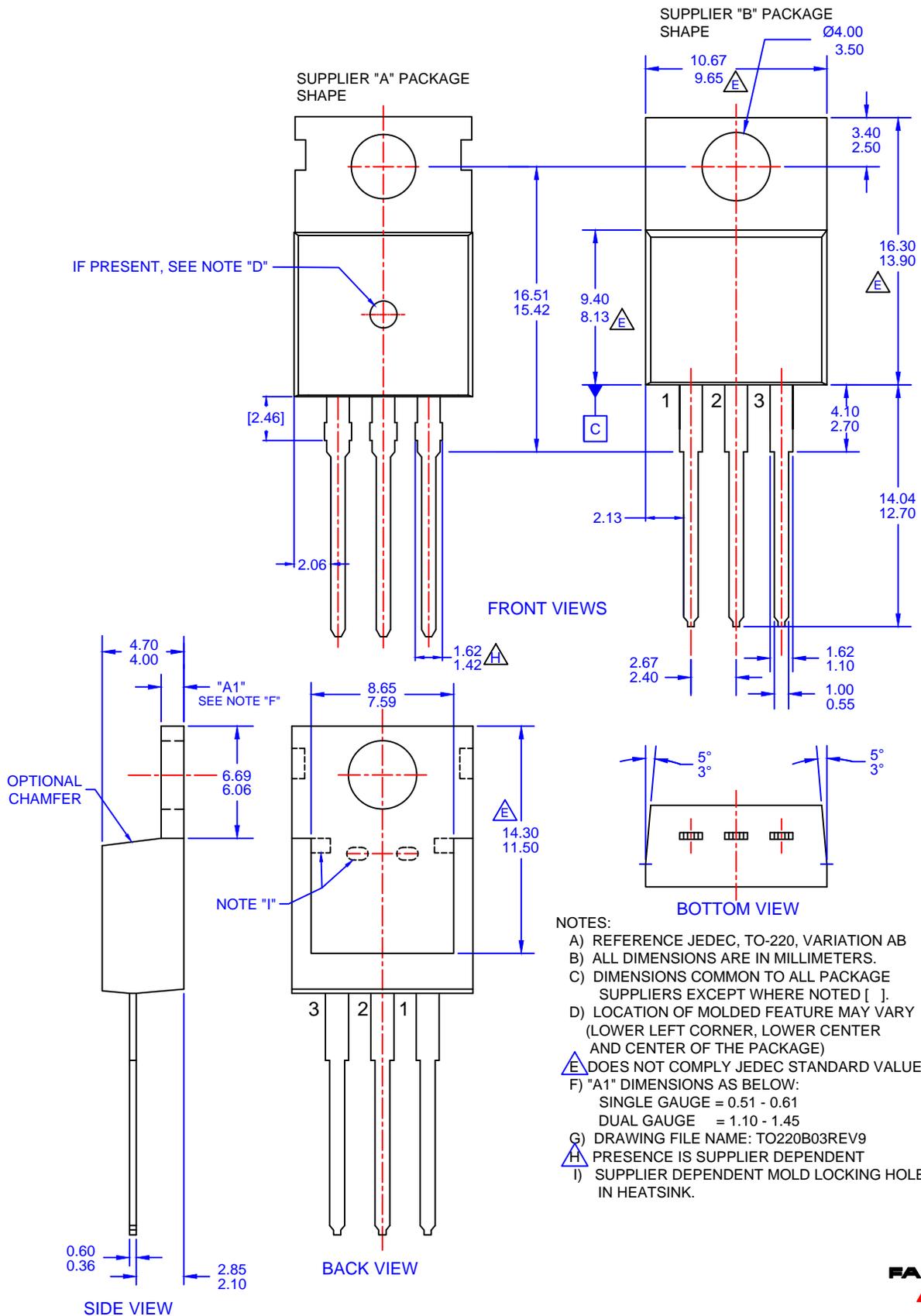


Figure 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms







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