

# FCP4N60

## N-Channel SuperFET® MOSFET

600 V, 3.9 A, 1.2 Ω

### Features

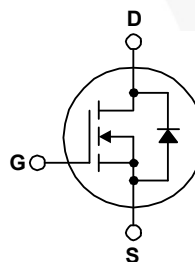
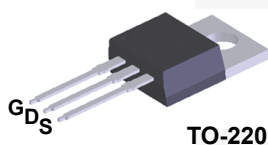
- 650 V @  $T_J = 150^\circ\text{C}$
- Typ.  $R_{DS(on)} = 1.0 \Omega$
- Ultra Low Gate Charge (Typ.  $Q_g = 12.8 \text{ nC}$ )
- Low Effective Output Capacitance (Typ.  $C_{oss(eff.)} = 32 \text{ pF}$ )
- 100% Avalanche Tested
- RoHS Compliant

### Application

- LCD / LED / PDP TV and Monitor Lighting
- Solar Inverter
- 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.



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

Symbol	Parameter	FCP4N60	Unit
$V_{DSS}$	Drain-Source Voltage	600	V
$I_D$	Drain Current - Continuous ( $T_C = 25^\circ\text{C}$ ) - Continuous ( $T_C = 100^\circ\text{C}$ )	3.9 2.5	A A
$I_{DM}$	Drain Current - Pulsed (Note 1)	11.7	A
$V_{GSS}$	Gate-Source voltage	$\pm 30$	V
$E_{AS}$	Single Pulsed Avalanche Energy (Note 2)	128	mJ
$I_{AR}$	Avalanche Current (Note 1)	3.9	A
$E_{AR}$	Repetitive Avalanche Energy (Note 1)	5.0	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 $25^\circ\text{C}$	50 0.4	W 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	$^\circ\text{C}$

### Thermal Characteristics

Symbol	Parameter	FCP4N60	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	2.5	$^\circ\text{C}/\text{W}$
	Thermal Resistance, Junction to Ambient, Max.	83	

$R_{\theta JA}$

## Package Marking and Ordering Information

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FCP4N60	FCP4N60	TO-220	Tube	N/A	N/A	50 units

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

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
<b>Off Characteristics</b>						
BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}, T_J = 25^\circ\text{C}$	600	--	--	V
		$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}, T_J = 150^\circ\text{C}$	--	650	--	V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 250\ \mu\text{A}$ , Referenced to $25^\circ\text{C}$	--	0.6	--	V/ $^\circ\text{C}$
BV <sub>DS</sub>	Drain-Source Avalanche Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 3.9\text{ A}$	--	700	--	V
I <sub>DSS</sub>	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	$\mu\text{A}$
I <sub>GSSF</sub>	Gate-Body Leakage Current, Forward	$V_{GS} = 30\text{ V}, V_{DS} = 0\text{ V}$	--	--	100	nA
I <sub>GSSR</sub>	Gate-Body Leakage Current, Reverse	$V_{GS} = -30\text{ V}, V_{DS} = 0\text{ V}$	--	--	-100	nA
<b>On Characteristics</b>						
V <sub>GS(th)</sub>	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\ \mu\text{A}$	3.0	--	5.0	V
R <sub>DS(on)</sub>	Static Drain-Source On-Resistance	$V_{GS} = 10\text{ V}, I_D = 2.0\text{ A}$	--	1.0	1.2	$\Omega$
g <sub>FS</sub>	Forward Transconductance	$V_{DS} = 40\text{ V}, I_D = 2.0\text{ A}$	--	3.2	--	S
<b>Dynamic Characteristics</b>						
C <sub>iss</sub>	Input Capacitance	$V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}$	--	415	540	pF
C <sub>oss</sub>	Output Capacitance		--	210	275	pF
C <sub>riss</sub>	Reverse Transfer Capacitance		--	19.5	--	pF
C <sub>oss</sub>	Output Capacitance	$V_{DS} = 480\text{ V}, V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}$	--	12	16	pF
C <sub>oss eff.</sub>	Effective Output Capacitance	$V_{DS} = 0\text{ V to } 400\text{ V}, V_{GS} = 0\text{ V}$	--	32	--	pF
<b>Switching Characteristics</b>						
t <sub>d(on)</sub>	Turn-On Delay Time	$V_{DD} = 300\text{ V}, I_D = 3.9\text{ A}$ $R_G = 25\ \Omega$	--	16	45	ns
t <sub>r</sub>	Turn-On Rise Time		--	45	100	ns
t <sub>d(off)</sub>	Turn-Off Delay Time		--	36	85	ns
t <sub>f</sub>	Turn-Off Fall Time		(Note 4)	--	30	70
Q <sub>g</sub>	Total Gate Charge	$V_{DS} = 480\text{ V}, I_D = 3.9\text{ A}$ $V_{GS} = 10\text{ V}$	--	12.8	16.6	nC
Q <sub>gs</sub>	Gate-Source Charge		--	2.4	--	nC
Q <sub>gd</sub>	Gate-Drain Charge		(Note 4)	--	7.1	--
<b>Drain-Source Diode Characteristics and Maximum Ratings</b>						
I <sub>S</sub>	Maximum Continuous Drain-Source Diode Forward Current		--	--	3.9	A
I <sub>SM</sub>	Maximum Pulsed Drain-Source Diode Forward Current		--	--	11.7	A
V <sub>SD</sub>	Drain-Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_S = 3.9\text{ A}$	--	--	1.4	V
t <sub>rr</sub>	Reverse Recovery Time	$V_{GS} = 0\text{ V}, I_S = 3.9\text{ A}$ $di_f/dt = 100\text{ A}/\mu\text{s}$	--	277	--	ns
Q <sub>rr</sub>	Reverse Recovery Charge		--	2.07	--	$\mu\text{C}$

### Notes:

1. Repetitive rating; pulse-width limited by maximum junction temperature.
2.  $I_{AS} = 1.9\text{ A}, V_{DD} = 50\text{ V}, R_G = 25\ \Omega$ , starting  $T_J = 25^\circ\text{C}$ .
3.  $I_{SD} \leq 3.9\text{ A}, di/dt \leq 200\text{ A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$ , starting  $T_J = 25^\circ\text{C}$ .
4. Essentially independent of operating temperature typical characteristics.

## Typical Performance Characteristics

Figure 1. On-Region Characteristics

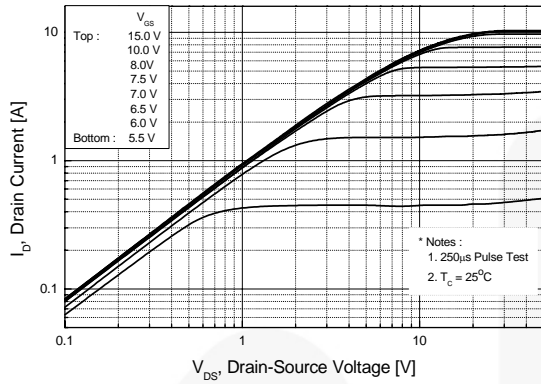


Figure 2. Transfer Characteristics

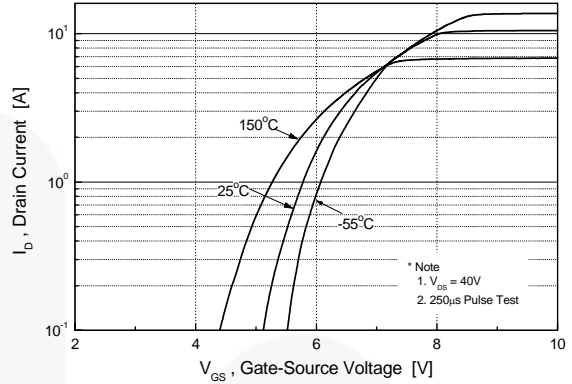


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

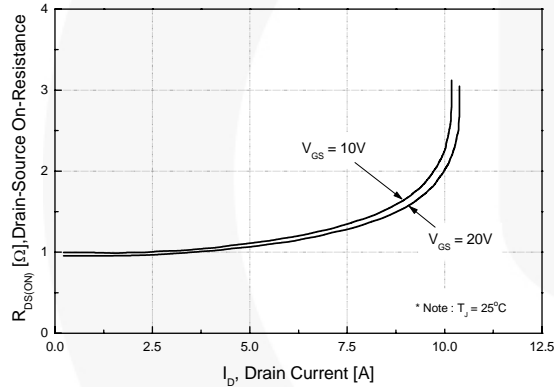


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

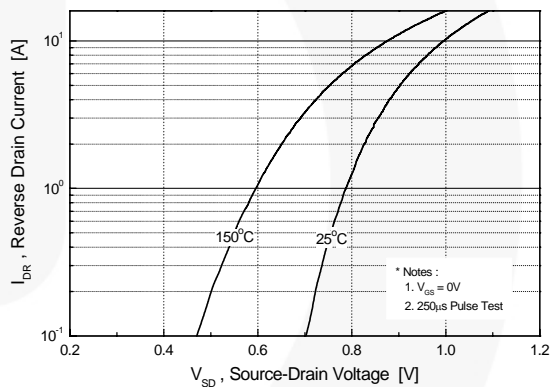


Figure 5. Capacitance Characteristics

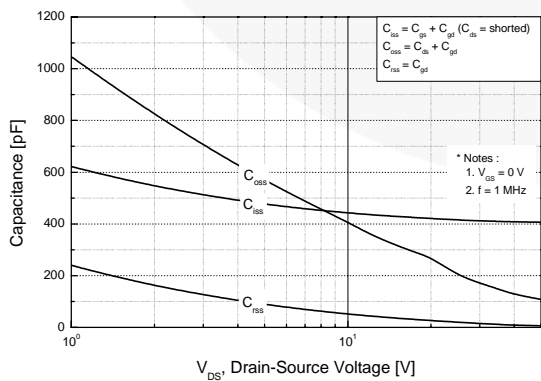
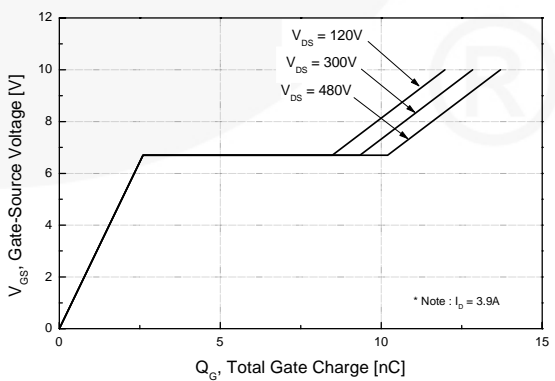


Figure 6. Gate Charge Characteristics



Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

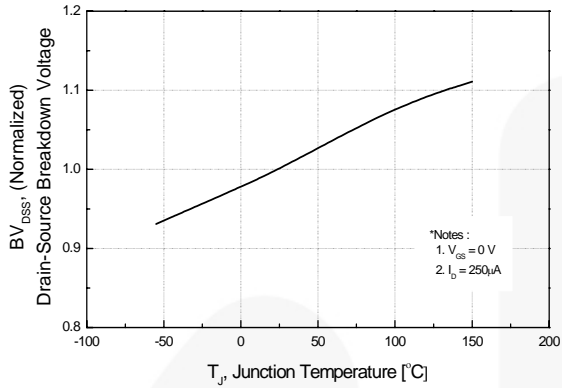


Figure 8. On-Resistance Variation vs. Temperature

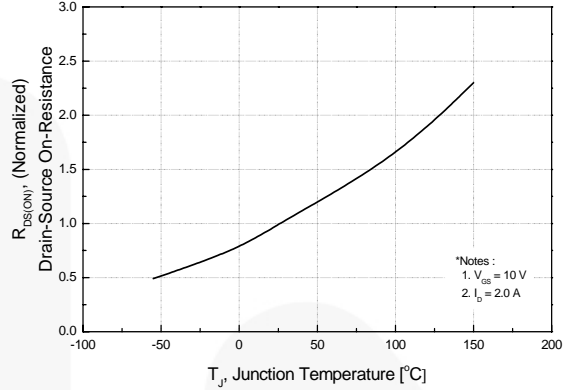


Figure 9. Maximum Safe Operating Area

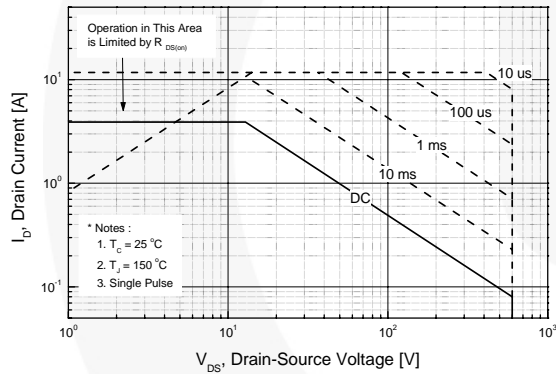


Figure 10. Maximum Drain Current vs. Case Temperature

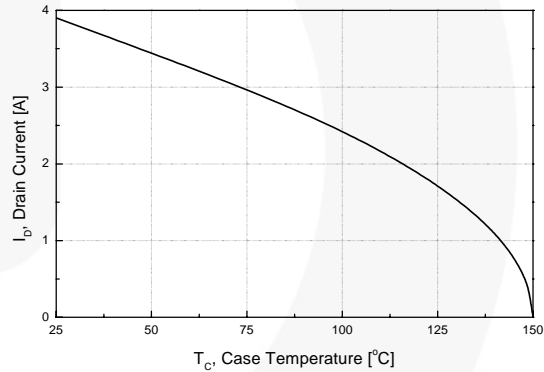
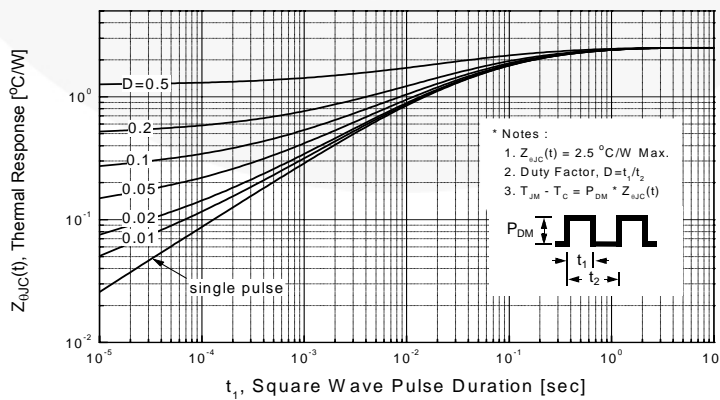


Figure 11. Transient Thermal Response Curve



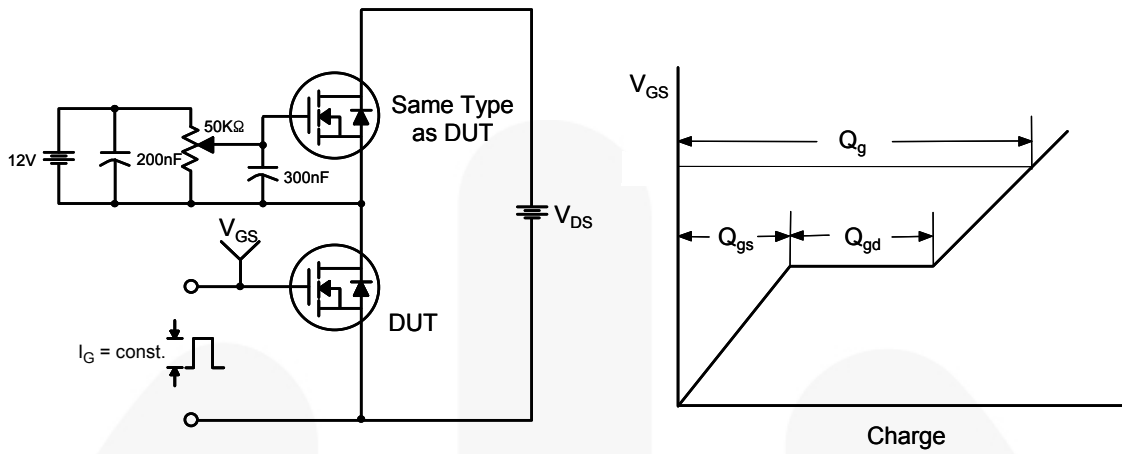


Figure 12. Gate Charge Test Circuit & Waveform

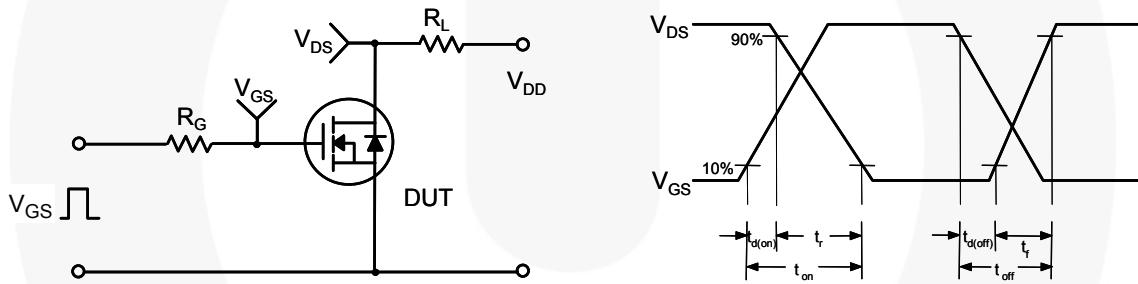


Figure 13. Resistive Switching Test Circuit & Waveforms

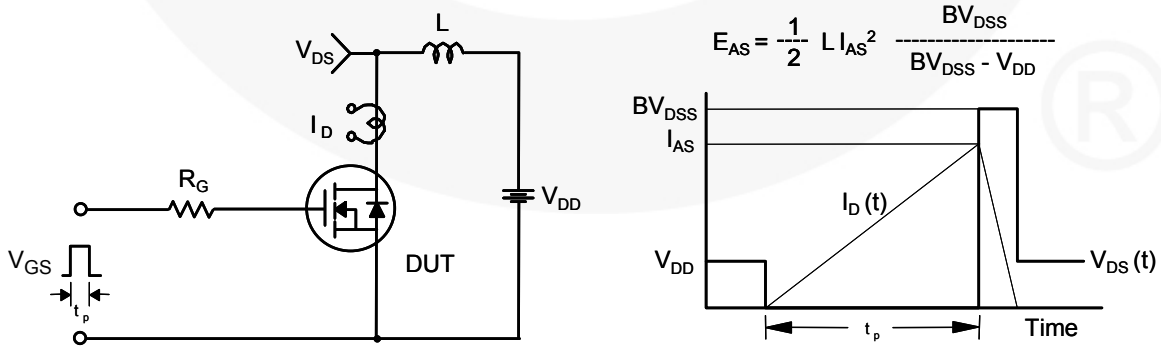


Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms

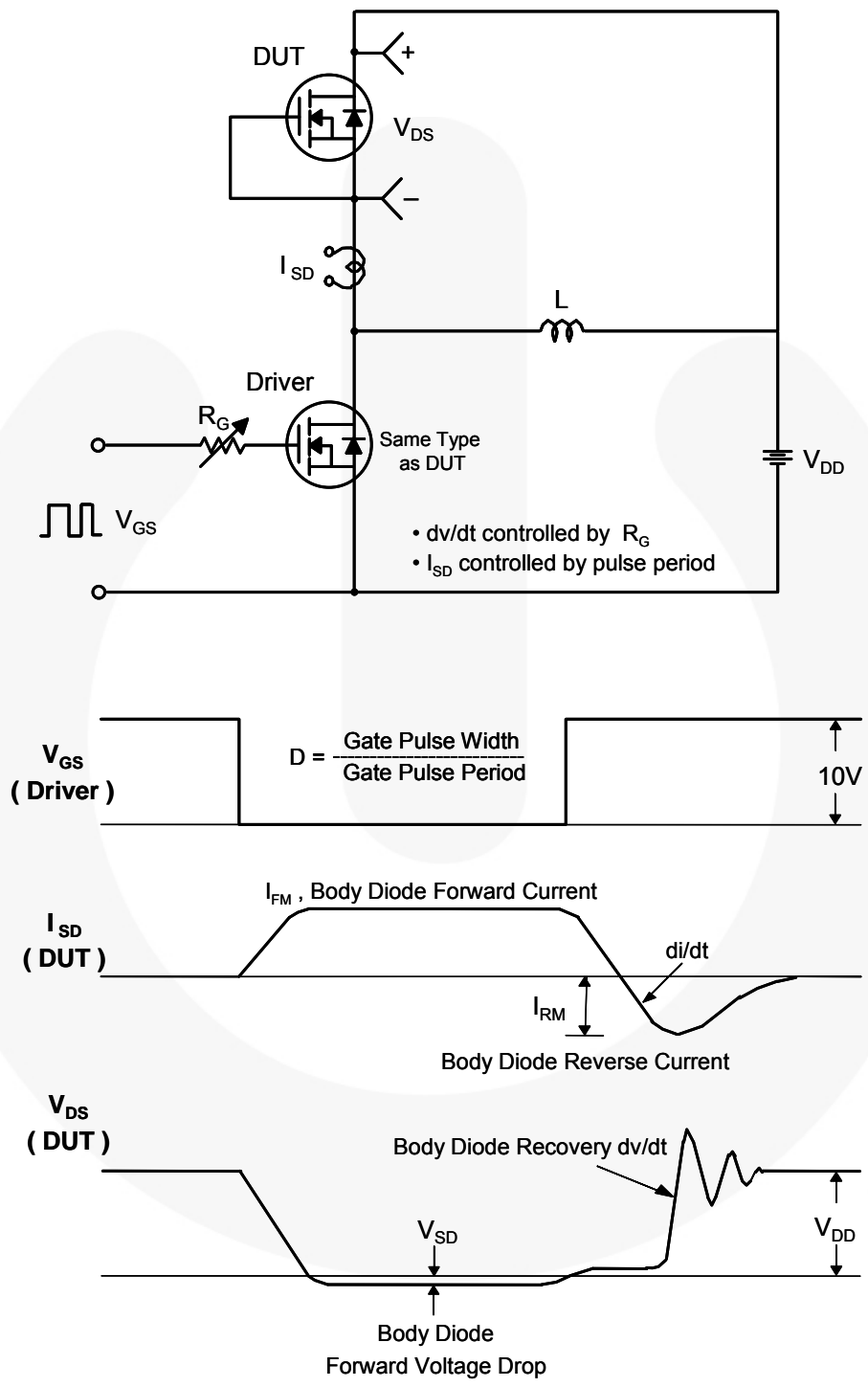
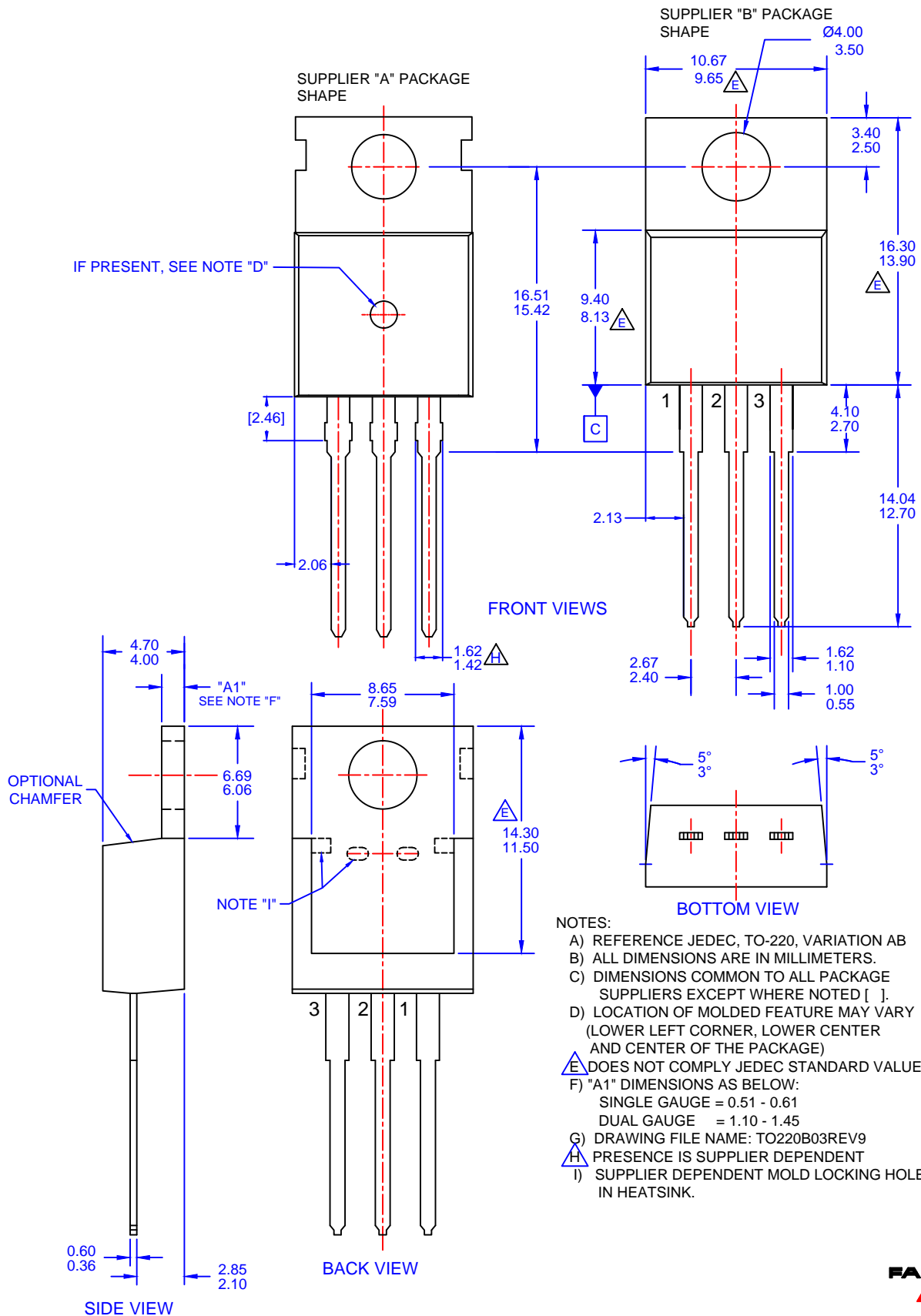


Figure 15. Peak Diode Recovery  $dv/dt$  Test Circuit & Waveforms



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