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# FCP190N60 / FCPF190N60

## N-Channel SuperFET® II MOSFET

600 V, 20.2 A, 199 mΩ

### Features

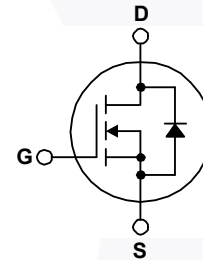
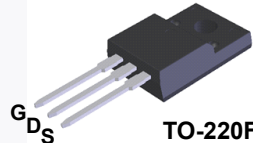
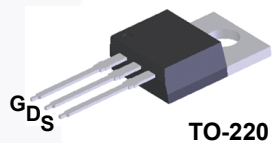
- 650 V @  $T_J = 150^\circ\text{C}$
- Typ.  $R_{DS(on)} = 170\text{ m}\Omega$
- Ultra Low Gate Charge (Typ.  $Q_g = 57\text{ nC}$ )
- Low Effective Output Capacitance (Typ.  $C_{oss(eff.)} = 160\text{ pF}$ )
- 100% Avalanche Tested
- RoHS Compliant

### Applications

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

### Description

SuperFET® II MOSFET is Fairchild Semiconductor's brand-new 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 II MOSFET is very suitable for the switching power applications such as PFC, server/telecom power, FPD TV power, ATX power and industrial power applications.



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

Symbol	Parameter	FCP190N60	FCPF190N60	Unit	
$V_{DSS}$	Drain to Source Voltage	600		V	
$V_{GSS}$	Gate to Source Voltage	- DC	$\pm 20$	V	
		- AC ( $f > 1\text{ Hz}$ )	$\pm 30$		
$I_D$	Drain Current	- Continuous ( $T_C = 25^\circ\text{C}$ )	20.2	20.2*	A
		- Continuous ( $T_C = 100^\circ\text{C}$ )	12.7	12.7*	
$I_{DM}$	Drain Current	- Pulsed (Note 1)	60.6	60.6*	A
$E_{AS}$	Single Pulsed Avalanche Energy (Note 2)	400		mJ	
$I_{AR}$	Avalanche Current (Note 1)	4.0		A	
$E_{AR}$	Repetitive Avalanche Energy (Note 1)	2.1		mJ	
$dv/dt$	MOSFET $dv/dt$	100		V/ns	
	Peak Diode Recovery $dv/dt$ (Note 3)	20			
$P_D$	Power Dissipation	( $T_C = 25^\circ\text{C}$ )	208	39	W
		- Derate Above $25^\circ\text{C}$	1.67	0.31	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	FCP190N60	FCPF190N60	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	0.6	3.2	$^\circ\text{C/W}$
$R_{\theta JA}$	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
FCP190N60	FCP190N60	TO-220	Tube	N/A	N/A	50 units
FCPF190N60	FCPF190N60	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	$V_{GS} = 0\text{ V}, I_D = 10\text{ mA}, T_J = 25^\circ\text{C}$	600	-	-	V
		$V_{GS} = 0\text{ V}, I_D = 10\text{ mA}, T_J = 150^\circ\text{C}$	650	-	-	
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 10\text{ mA}$ , Referenced to $25^\circ\text{C}$	-	0.67	-	$\text{V}/^\circ\text{C}$
$BV_{DS}$	Drain to Source Avalanche Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 20\text{ A}$	-	700	-	V
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 600\text{ V}, V_{GS} = 0\text{ V}$	-	-	1	$\mu\text{A}$
		$V_{DS} = 480\text{ V}, T_C = 125^\circ\text{C}$	-	1.3	-	
$I_{GSS}$	Gate to Body Leakage Current	$V_{GS} = \pm 20\text{ V}, V_{DS} = 0\text{ V}$	-	-	$\pm 100$	nA

### On Characteristics

$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 250\ \mu\text{A}$	2.5	-	3.5	V
$R_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = 10\text{ V}, I_D = 10\text{ A}$	-	0.17	0.199	$\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS} = 20\text{ V}, I_D = 10\text{ A}$	-	21	-	S

### Dynamic Characteristics

$C_{iss}$	Input Capacitance	$V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V}$ $f = 1\text{ MHz}$	-	2220	2950	pF
$C_{oss}$	Output Capacitance		-	1630	2165	
$C_{rss}$	Reverse Transfer Capacitance		-	85	128	
$C_{oss}$	Output Capacitance	$V_{DS} = 380\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	-	42	-	pF
$C_{oss(eff.)}$	Effective Output Capacitance	$V_{DS} = 0\text{ V to } 480\text{ V}, V_{GS} = 0\text{ V}$	-	160	-	pF
$Q_{g(tot)}$	Total Gate Charge at 10V	$V_{DS} = 380\text{ V}, I_D = 10\text{ A},$ $V_{GS} = 10\text{ V}$	-	57	74	nC
$Q_{gs}$	Gate to Source Gate Charge		-	9	-	
$Q_{gd}$	Gate to Drain "Miller" Charge		(Note 4)	-	21	
ESR	Equivalent Series Resistance	$f = 1\text{ MHz}$	-	1	-	$\Omega$

### Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 380\text{ V}, I_D = 10\text{ A},$ $V_{GS} = 10\text{ V}, R_G = 4.7\ \Omega$	-	20	50	ns
$t_r$	Turn-On Rise Time		-	10	30	
$t_{d(off)}$	Turn-Off Delay Time		-	64	138	
$t_f$	Turn-Off Fall Time		(Note 4)	-	5	

### Drain-Source Diode Characteristics

$I_S$	Maximum Continuous Drain to Source Diode Forward Current	-	-	20.2	A	
$I_{SM}$	Maximum Pulsed Drain to Source Diode Forward Current	-	-	60.6	A	
$V_{SD}$	Drain to Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_{SD} = 10\text{ A}$	-	-	1.2	V
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0\text{ V}, I_{SD} = 10\text{ A},$ $di_F/dt = 100\text{ A}/\mu\text{s}$	-	320	-	ns
$Q_{rr}$	Reverse Recovery Charge		-	5.1	-	$\mu\text{C}$

#### Notes:

1. Repetitive rating: pulse-width limited by maximum junction temperature.
2.  $I_{AS} = 4\text{ A}, V_{DD} = 50\text{ V}, R_G = 25\ \Omega$ , starting  $T_J = 25^\circ\text{C}$ .
3.  $I_{SD} \leq 10\text{ A}, di/dt \leq 200\text{ A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$ , starting  $T_J = 25^\circ\text{C}$ .
4. Essentially independent of operating temperature typical characteristics.

## Typical Performance Characteristics

Figure 1. On-Region Characteristics

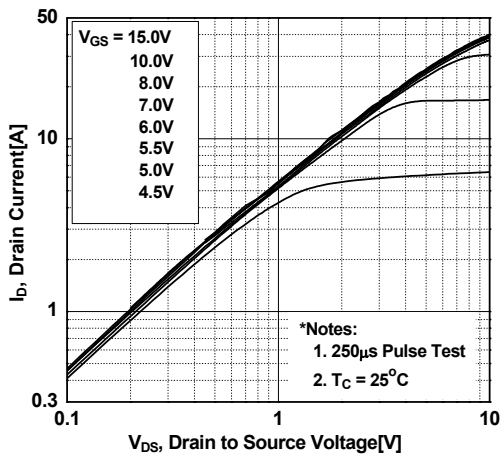


Figure 2. Transfer Characteristics

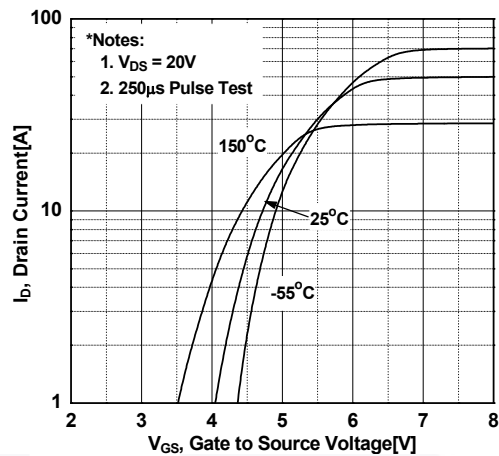


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

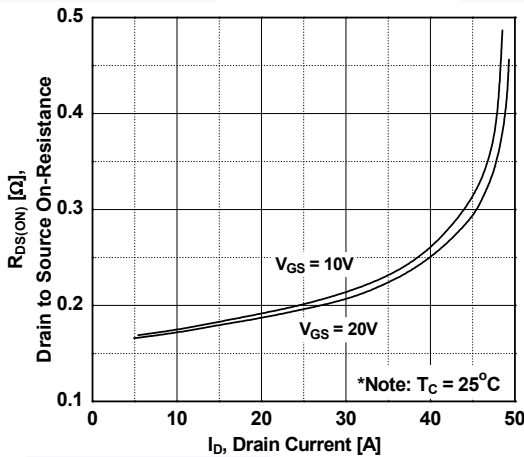


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

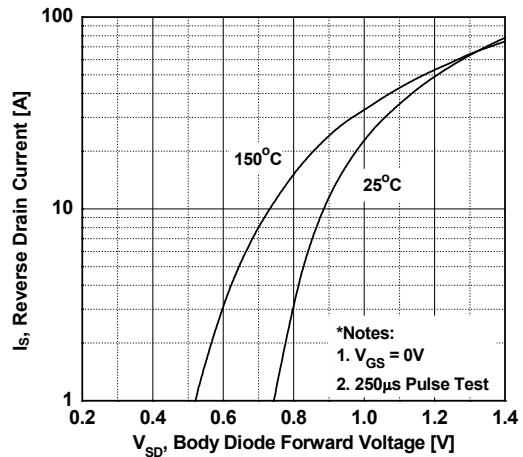


Figure 5. Capacitance Characteristics

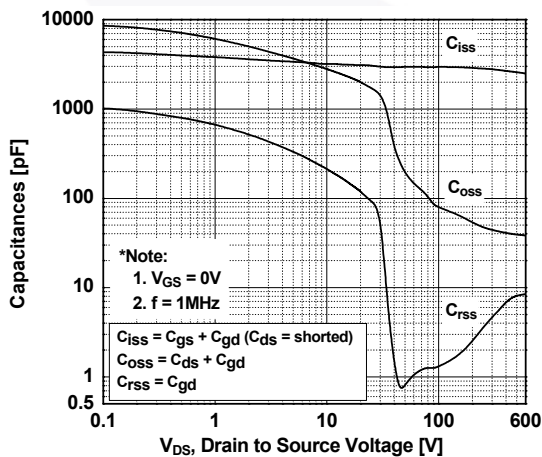
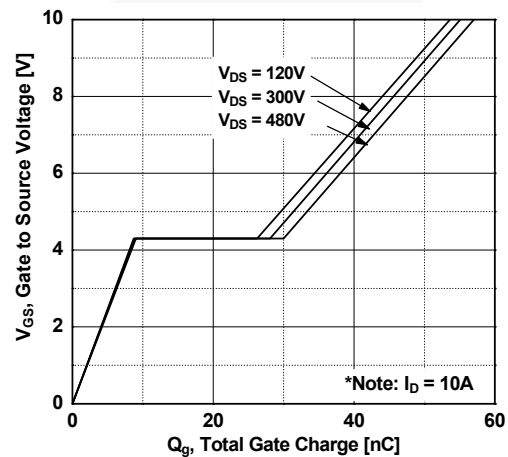
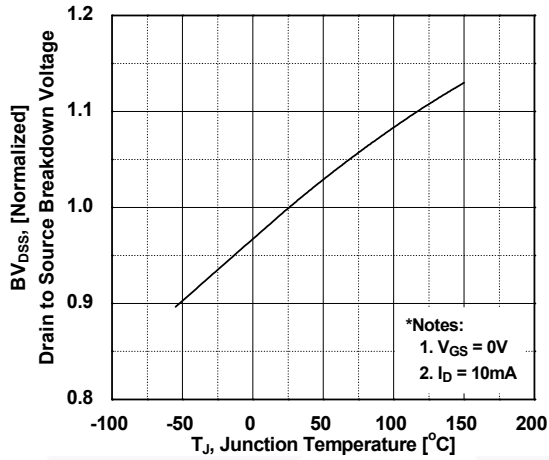


Figure 6. Gate Charge Characteristics

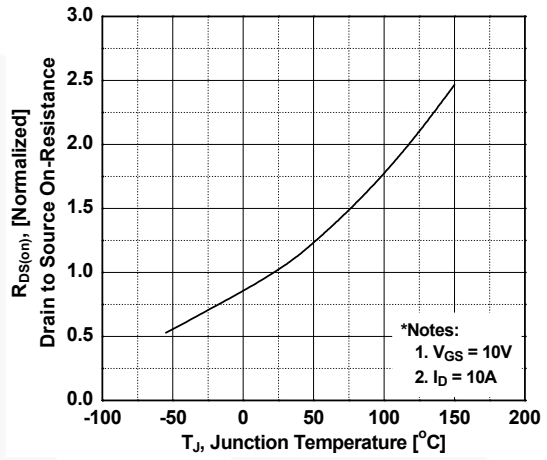


## Typical Performance Characteristics (Continued)

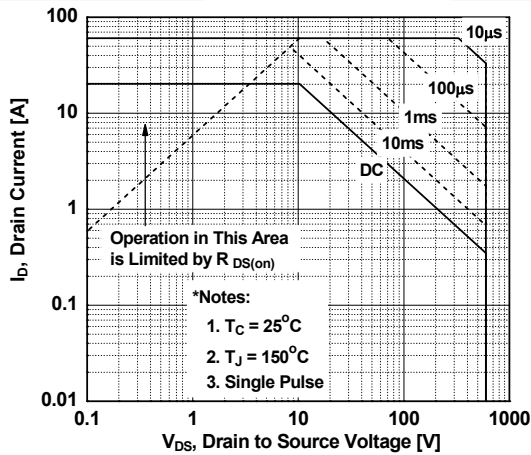
**Figure 7. Breakdown Voltage Variation vs. Temperature**



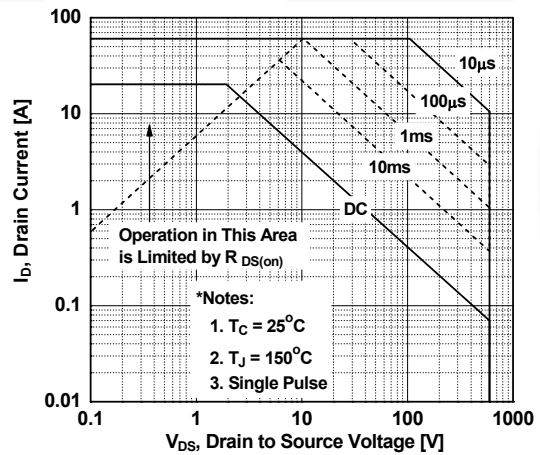
**Figure 8. On-Resistance Variation vs. Temperature**



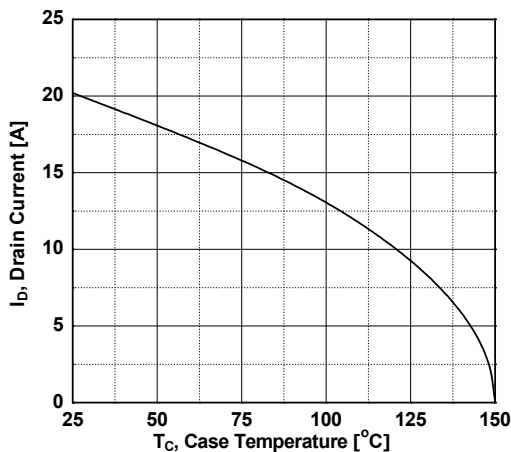
**Figure 9. Maximum Safe Operating Area for FCP190N60**



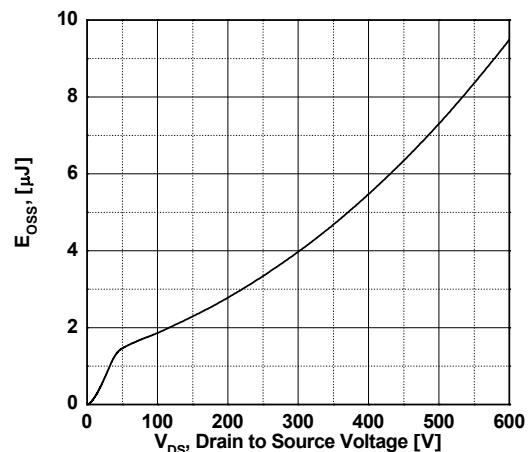
**Figure 10. Maximum Safe Operating Area for FCPF190N60**



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



**Figure 12. E<sub>oss</sub> vs. Drain to Source Voltage**



Typical Performance Characteristics (Continued)

Figure 13. Transient Thermal Response Curve for FCP190N60

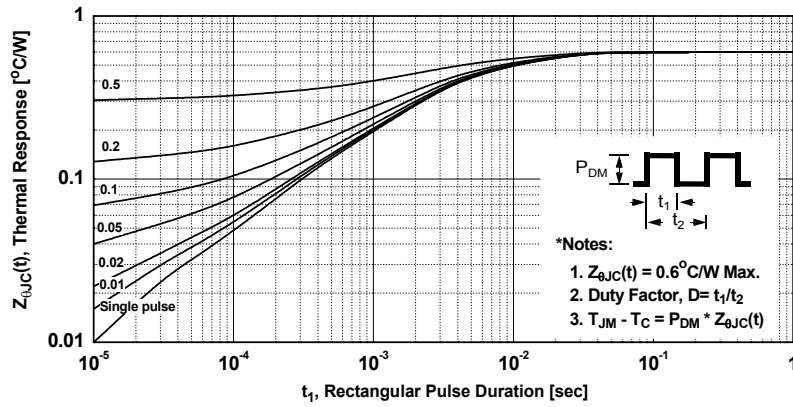
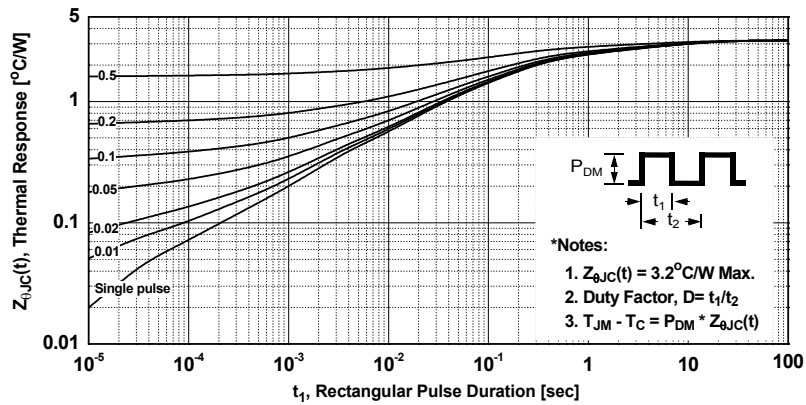
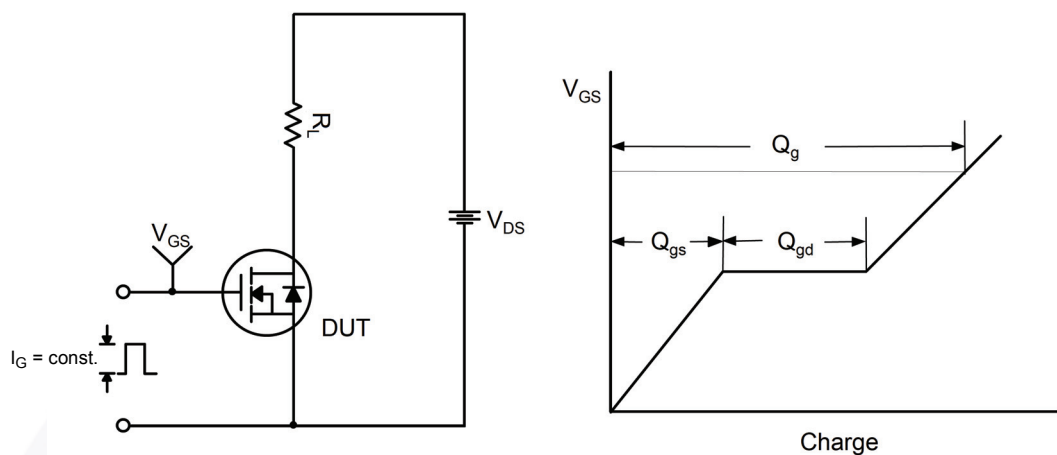
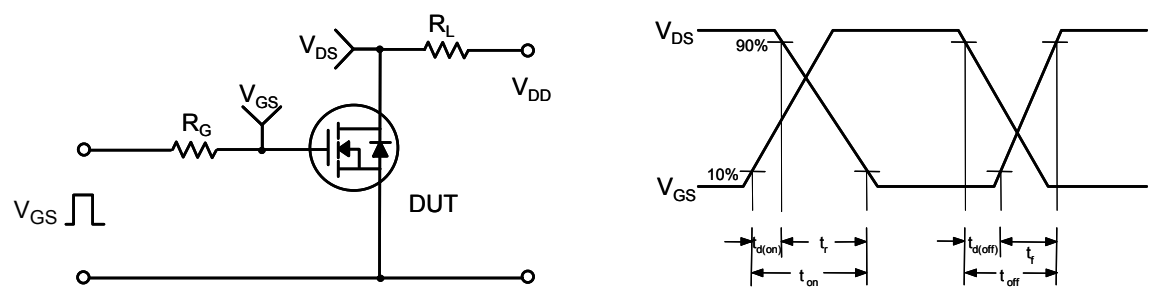


Figure 14. Transient Thermal Response Curve for FCPF190N60

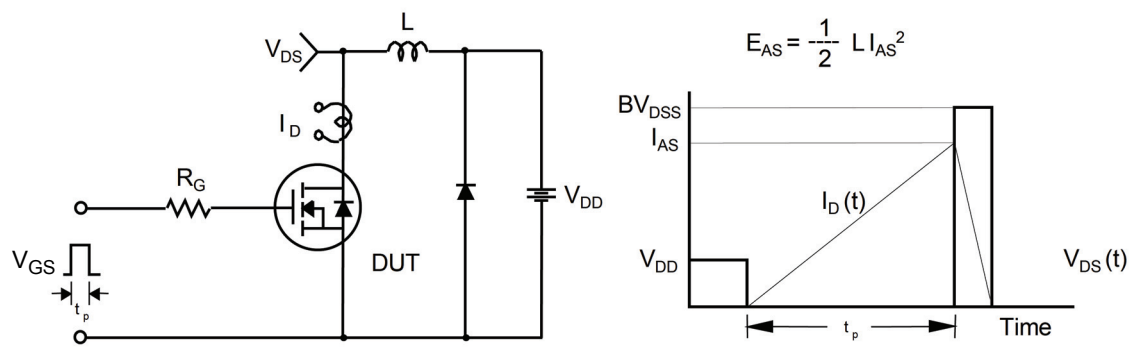




**Figure 15. Gate Charge Test Circuit & Waveform**



**Figure 16. Resistive Switching Test Circuit & Waveforms**



**Figure 17. Unclamped Inductive Switching Test Circuit & Waveforms**

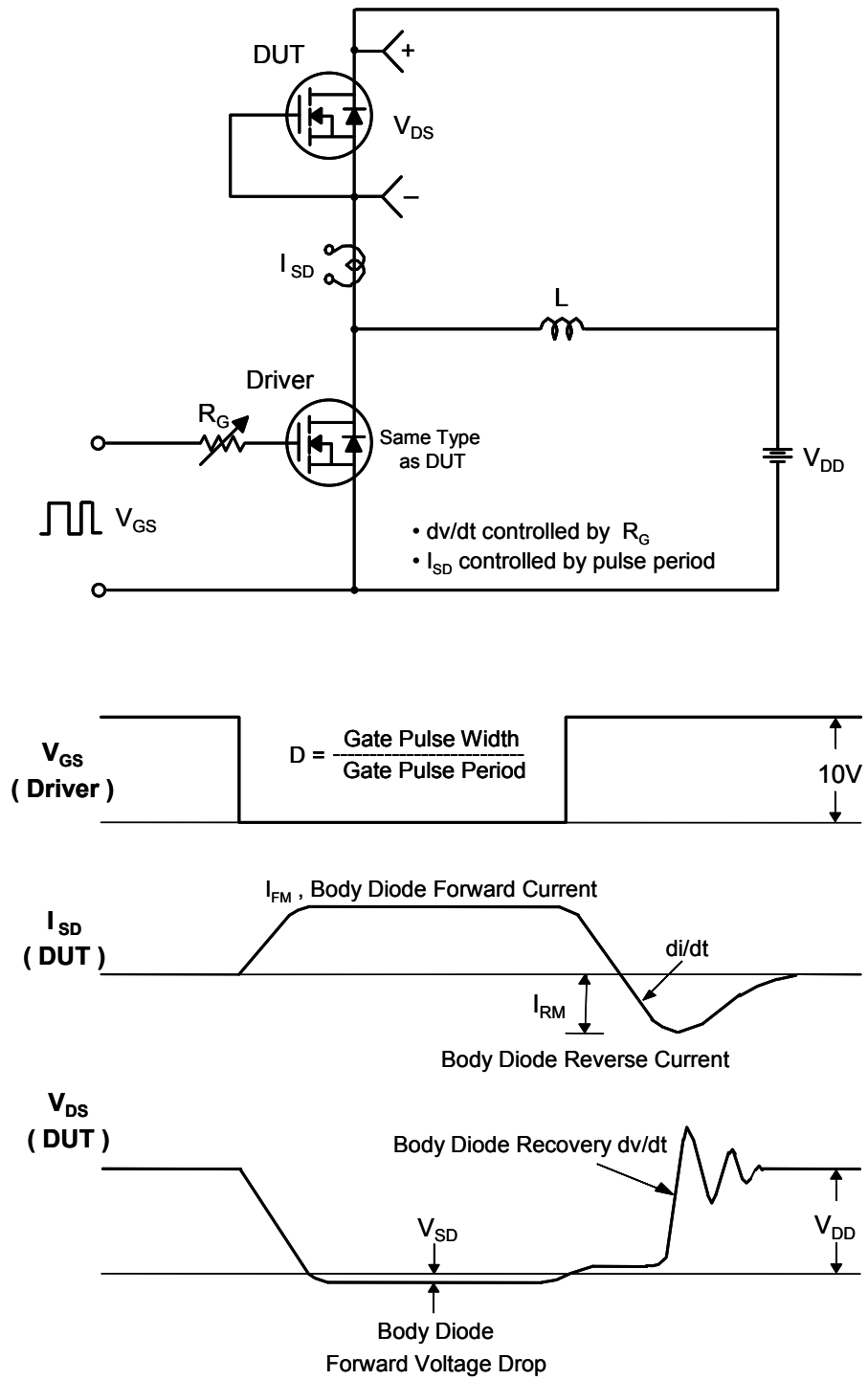


Figure 18. Peak Diode Recovery  $dv/dt$  Test Circuit & Waveforms





- NOTES:
- A) REFERENCE JEDEC, TO-220, VARIATION AB
  - B) ALL DIMENSIONS ARE IN MILLIMETERS.
  - C) DIMENSIONS COMMON TO ALL PACKAGE SUPPLIERS EXCEPT WHERE NOTED [ ].
  - D) LOCATION OF MOLDED FEATURE MAY VARY (LOWER LEFT CORNER, LOWER CENTER AND CENTER OF THE PACKAGE)
  - E) DOES NOT COMPLY JEDEC STANDARD VALUE.
  - F) "A1" DIMENSIONS AS BELOW:  
 SINGLE GAUGE = 0.51 - 0.61  
 DUAL GAUGE = 1.10 - 1.45
  - G) DRAWING FILE NAME: TO220B03REV9
  - H) PRESENCE IS SUPPLIER DEPENDENT
  - I) SUPPLIER DEPENDENT MOLD LOCKING HOLES IN HEATSINK.



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NOTES:

- A. EXCEPT WHERE NOTED CONFORMS TO EIAJ SC91A.
- B. DOES NOT COMPLY EIAJ STD. VALUE.
- C. ALL DIMENSIONS ARE IN MILLIMETERS.
- D. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR PROTRUSIONS.
- E. DIMENSION AND TOLERANCE AS PER ASME Y14.5-1994.
- F. OPTION 1 - WITH SUPPORT PIN HOLE.  
OPTION 2 - NO SUPPORT PIN HOLE.
- G. DRAWING FILE NAME: TO220M03REV5

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