

**FDP5N50U / FDPF5N50UT**  
**N-Channel MOSFET, FRFET**  
**500V, 4A, 2.0Ω**

**Features**

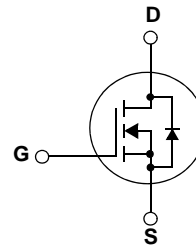
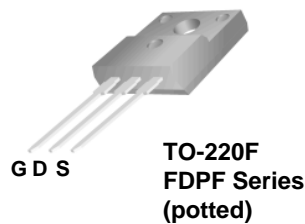
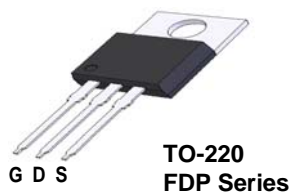
- $R_{DS(on)} = 1.65\Omega$  (Typ.) @  $V_{GS} = 10V, I_D = 2A$
- Low gate charge (Typ. 11nC)
- Low  $C_{rSS}$  (Typ. 5pF)
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability
- RoHS compliant



**Description**

These N-Channel enhancement mode power field effect transistors are produced using Fairchild's proprietary, planar stripe, DOMS technology.

This advance technology has been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode. These devices are well suited for high efficient switched mode power supplies and active power factor correction.



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

Symbol	Parameter	FDP5N50U	FDPF5N50UT	Units
$V_{DSS}$	Drain to Source Voltage	500		V
$V_{GSS}$	Gate to Source Voltage	$\pm 30$		V
$I_D$	Drain Current	-Continuous ( $T_C = 25^\circ\text{C}$ )	4	4*
		-Continuous ( $T_C = 100^\circ\text{C}$ )	2.4	2.4*
$I_{DM}$	Drain Current	- Pulsed (Note 1)	16	16*
$E_{AS}$	Single Pulsed Avalanche Energy (Note 2)	216		mJ
$I_{AR}$	Avalanche Current (Note 1)	4		A
$E_{AR}$	Repetitive Avalanche Energy (Note 1)	8.5		mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	4.5		V/ns
$P_D$	Power Dissipation	( $T_C = 25^\circ\text{C}$ )	85	28
		- Derate above $25^\circ\text{C}$	0.67	0.22
$T_J, T_{STG}$	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		$^\circ\text{C}$

\*Drain current limited by maximum junction temperature

**Thermal Characteristics**

Symbol	Parameter	FDP5N50U	FDPF5N50UT	Units
$R_{\theta JC}$	Thermal Resistance, Junction to Case	1.4	4.5	$^\circ\text{C}/\text{W}$
$R_{\theta CS}$	Thermal Resistance, Case to Sink Typ.	0.5	-	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	62.5	62.5	

## Package Marking and Ordering Information $T_C = 25^\circ\text{C}$ unless otherwise noted

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FDP5N50U	FDP5N50U	TO-220	-	-	50
FDPF5N50UT	FDPF5N50UT	TO-220F	-	-	50

## Electrical Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
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### Off Characteristics

$BV_{DSS}$	Drain to Source Breakdown Voltage	$I_D = 250\mu\text{A}, V_{GS} = 0\text{V}, T_J = 25^\circ\text{C}$	500	-	-	V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 250\mu\text{A}$ , Referenced to $25^\circ\text{C}$	-	0.7	-	$\text{V}/^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 500\text{V}, V_{GS} = 0\text{V}$ $V_{DS} = 400\text{V}, T_C = 125^\circ\text{C}$	-	-	25 250	$\mu\text{A}$
$I_{GSS}$	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	$V_{GS} = V_{DS}, I_D = 250\mu\text{A}$	3	-	5	V
$R_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = 10\text{V}, I_D = 2\text{A}$	-	1.65	2	$\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS} = 40\text{V}, I_D = 2\text{A}$ (Note 4)	-	4.8	-	S

### Dynamic Characteristics

$C_{iss}$	Input Capacitance	$V_{DS} = 25\text{V}, V_{GS} = 0\text{V}$ $f = 1\text{MHz}$	-	485	650	pF
$C_{oss}$	Output Capacitance		-	65	90	pF
$C_{rss}$	Reverse Transfer Capacitance		-	5	8	pF
$Q_{g(tot)}$	Total Gate Charge at 10V	$V_{DS} = 400\text{V}, I_D = 4\text{A}$ $V_{GS} = 10\text{V}$	-	11	15	nC
$Q_{gs}$	Gate to Source Gate Charge		-	3	-	nC
$Q_{gd}$	Gate to Drain "Miller" Charge		-	5	-	nC

### Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 250\text{V}, I_D = 4\text{A}$ $R_G = 25\Omega$	-	14	38	ns
$t_r$	Turn-On Rise Time		-	21	52	ns
$t_{d(off)}$	Turn-Off Delay Time		-	27	64	ns
$t_f$	Turn-Off Fall Time		-	20	50	ns

### Drain-Source Diode Characteristics

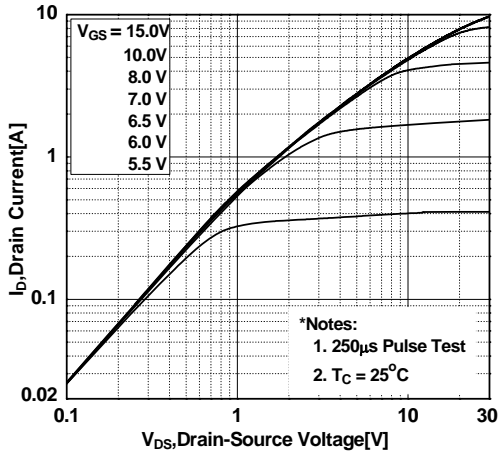
$I_S$	Maximum Continuous Drain to Source Diode Forward Current	-	-	4	A	
$I_{SM}$	Maximum Pulsed Drain to Source Diode Forward Current	-	-	16	A	
$V_{SD}$	Drain to Source Diode Forward Voltage	$V_{GS} = 0\text{V}, I_{SD} = 4\text{A}$	-	-	1.6	V
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0\text{V}, I_{SD} = 4\text{A}$ $di_F/dt = 100\text{A}/\mu\text{s}$	-	36	-	ns
$Q_{rr}$	Reverse Recovery Charge		-	33	-	nC

#### Notes:

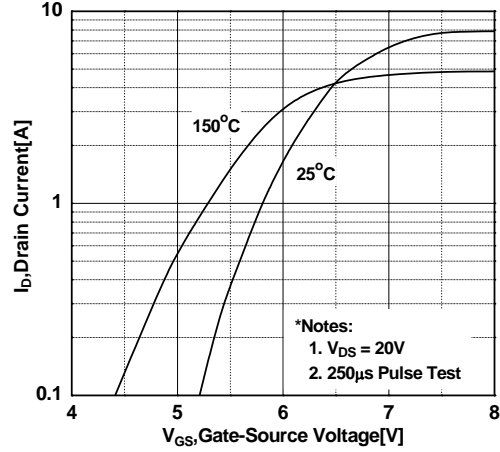
- 1: Repetitive Rating: Pulse width limited by maximum junction temperature
- 2:  $L = 27\text{mH}, I_{AS} = 4\text{A}, V_{DD} = 50\text{V}, R_G = 25\Omega$ , Starting  $T_J = 25^\circ\text{C}$
- 3:  $I_{SD} \leq 4\text{A}, di/dt \leq 200\text{A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$
- 4: Pulse Test: Pulse width  $\leq 300\mu\text{s}$ , Duty Cycle  $\leq 2\%$
- 5: Essentially Independent of Operating Temperature Typical Characteristics

## Typical Performance Characteristics

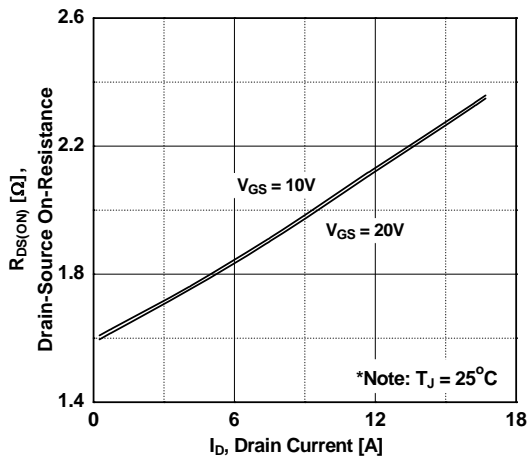
**Figure 1. On-Region Characteristics**



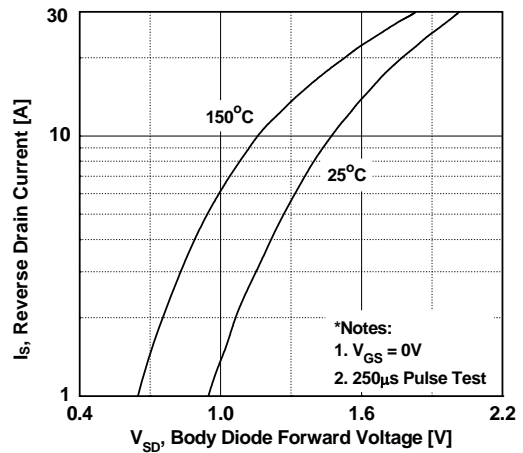
**Figure 2. Transfer Characteristics**



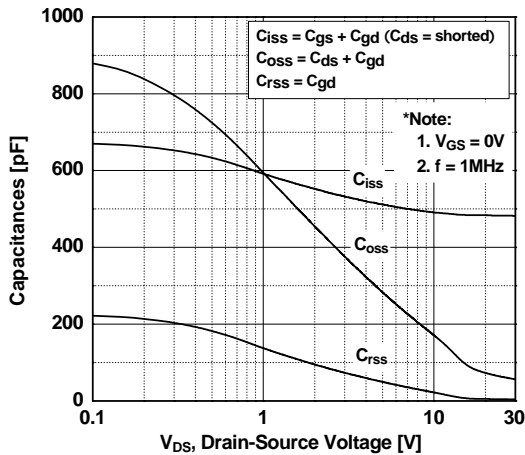
**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**



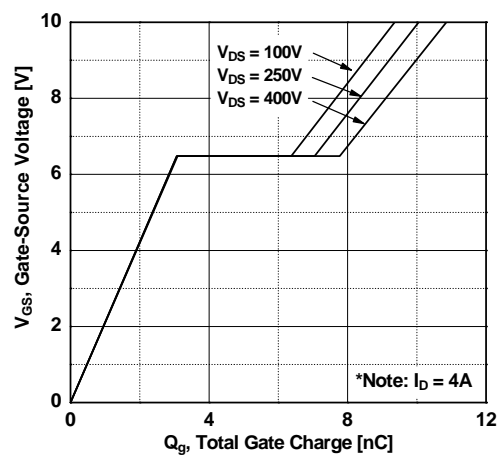
**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**



**Figure 5. Capacitance Characteristics**



**Figure 6. Gate Charge Characteristics**



Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

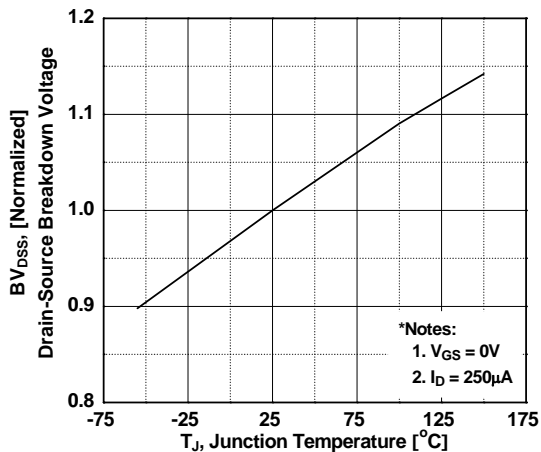


Figure 8. Maximum Safe Operating Area - FDP5N50U

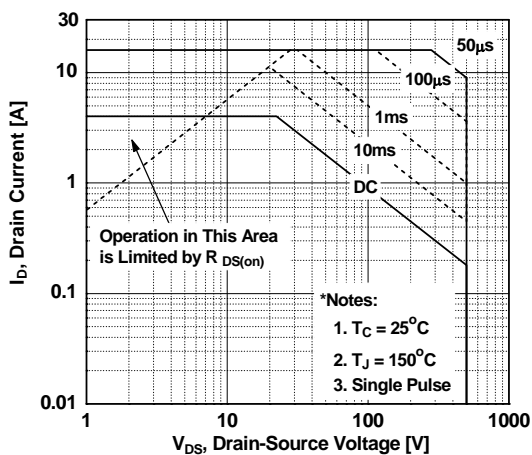


Figure 9. Maximum Safe Operating Area - FDPF5N50UT

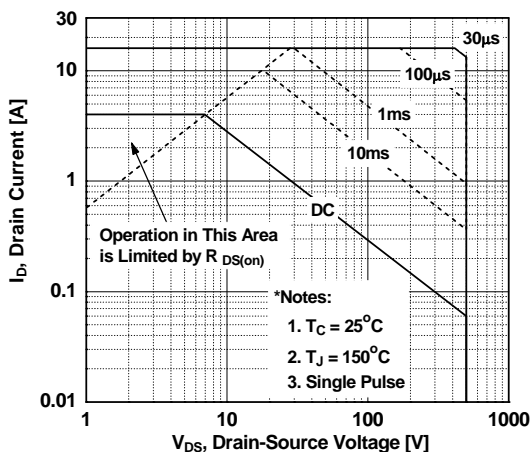


Figure 10. Maximum Drain Current vs. Case Temperature

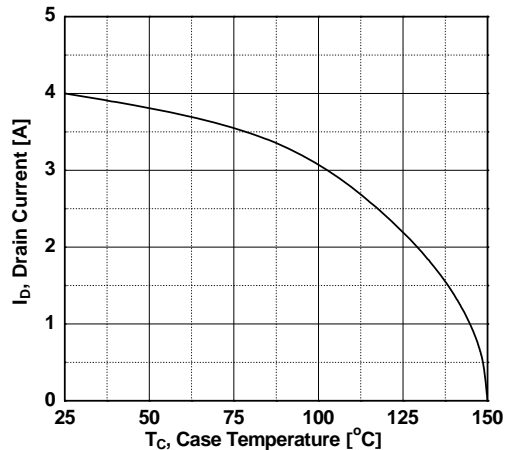
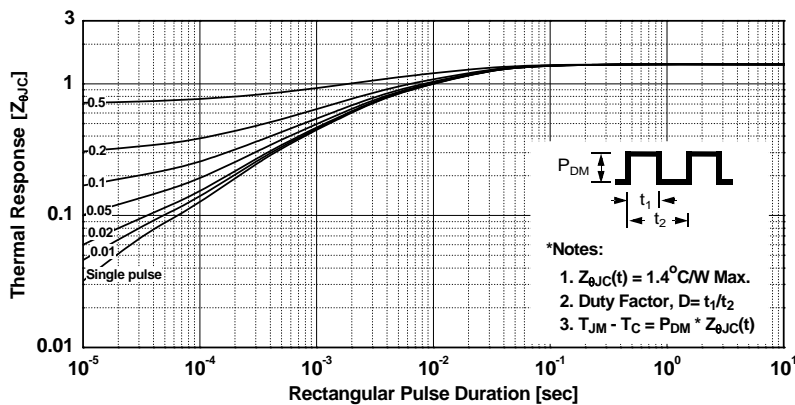
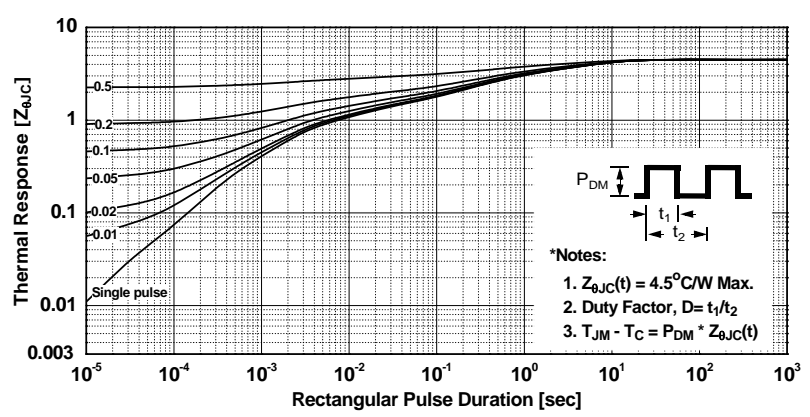


Figure 11. Transient Thermal Response Curve - FDP5N50U

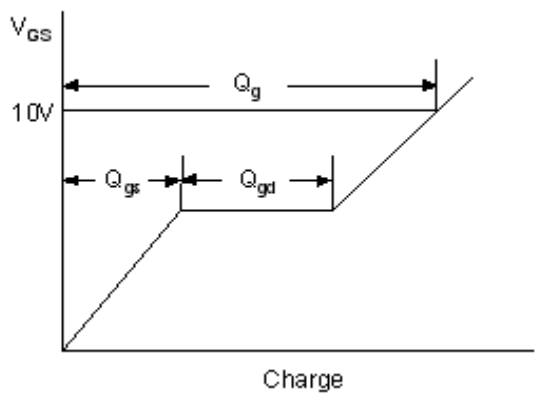
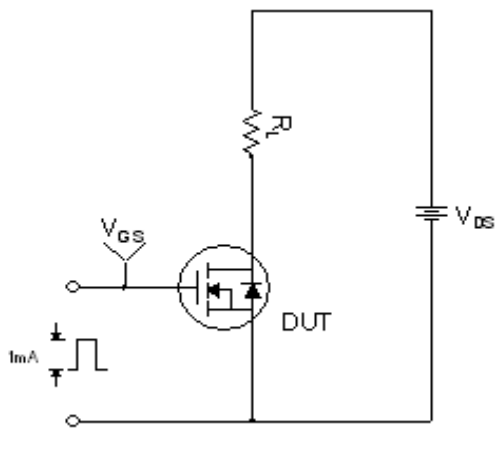


Typical Performance Characteristics (Continued)

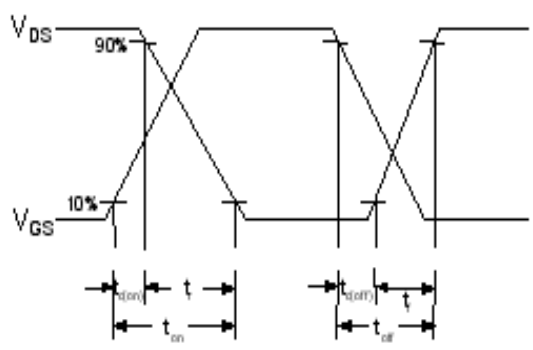
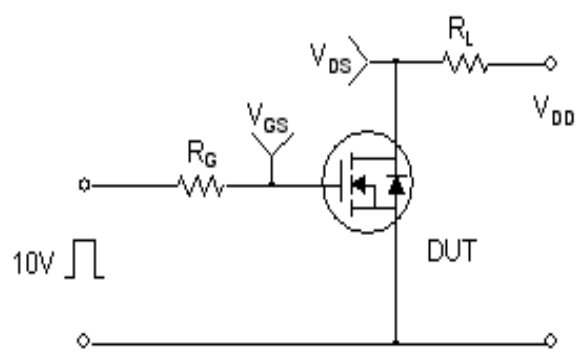
Figure 12. Transient Thermal Response Curve - FDPF5N50UT



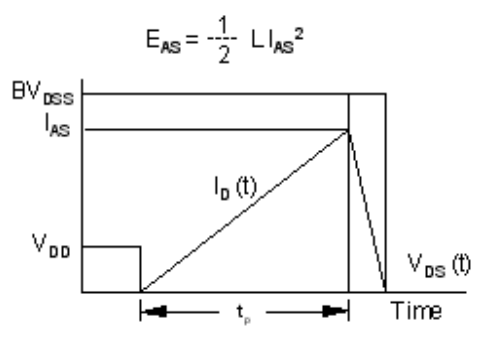
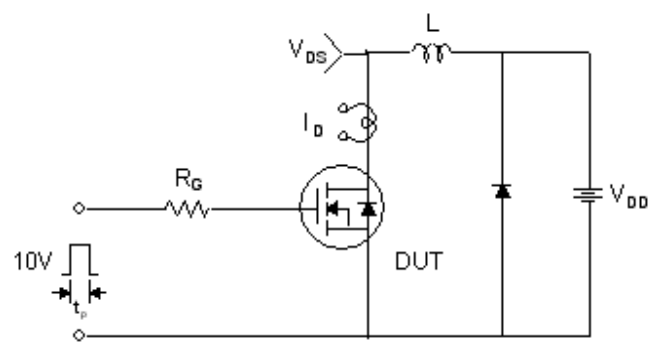
**Gate Charge Test Circuit & Waveform**



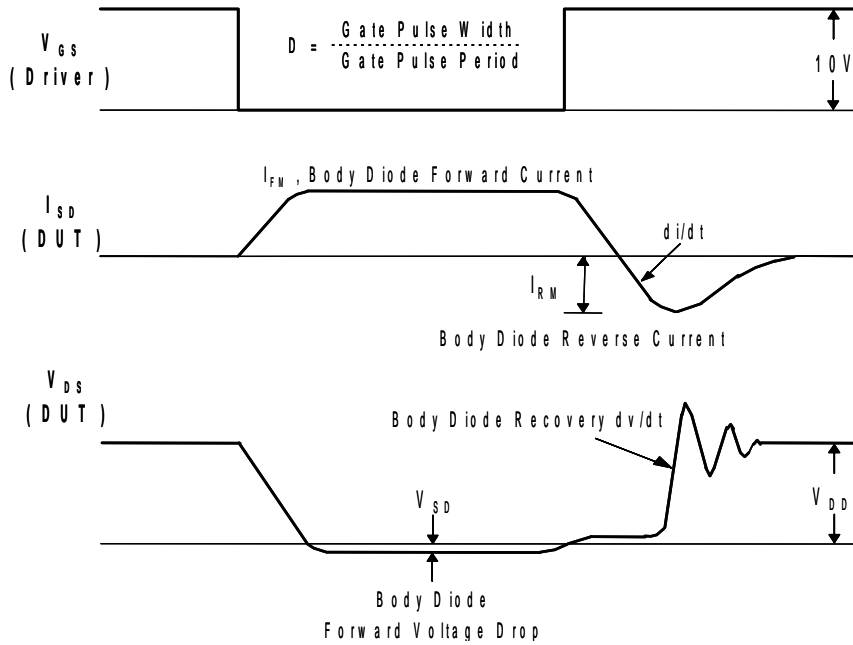
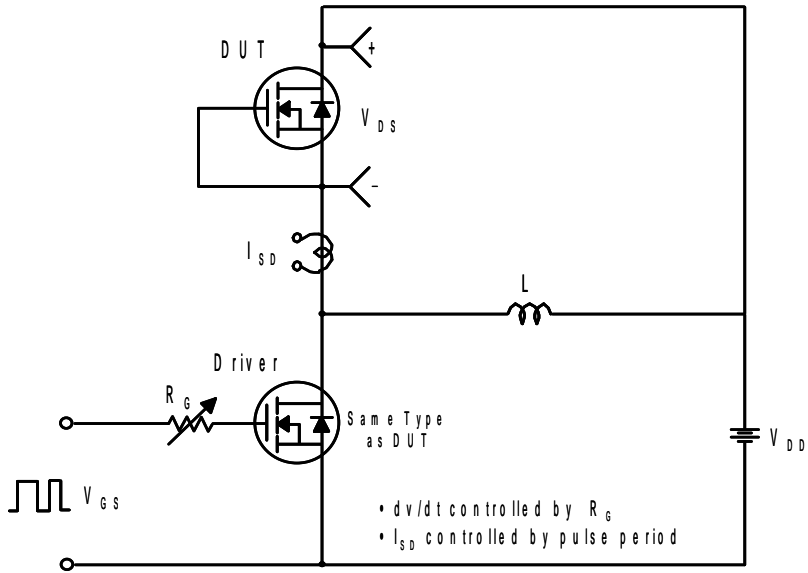
**Resistive Switching Test Circuit & Waveforms**



**Unclamped Inductive Switching Test Circuit & Waveforms**



Peak Diode Recovery dv/dt Test Circuit & Waveforms















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