



# ITP09N50A

## N-Channel MOSFET

**Pb** Lead Free Package and Finish

### Applications:

- Adaptor
- Charger
- SMPS Standby Power

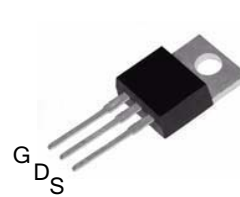
$V_{DSS}$	$R_{DS(ON)}$ (Typ.)	$I_D$
500 V	0.55 $\Omega$	9.0 A

### Features:

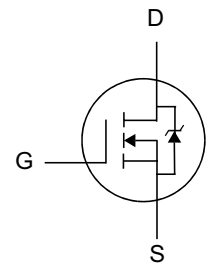
- RoHS Compliant
- Low ON Resistance
- Low Gate Charge
- Peak Current vs Pulse Width Curve

### Ordering Information

PART NUMBER	PACKAGE	BRAND
ITP09N50A	TO-220	ITP09N50A



TO-220  
Not to Scale



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

Symbol	Parameter	ITP09N50A	Units
$V_{DSS}$	Drain-to-Source Voltage (NOTE *1)	500	V
$I_D$	Continuous Drain Current	9.0*	A
$I_{D@100^\circ\text{C}}$	Continuous Drain Current	Figure 3	
$I_{DM}$	Pulsed Drain Current, $V_{GS}@10\text{V}$ (NOTE *2)	Figure 6	
$P_D$	Power Dissipation	140	W
	Derating Factor above $25^\circ\text{C}$	1.12	W/ $^\circ\text{C}$
$V_{GS}$	Gate-to-Source Voltage	$\pm 20$	V
$E_{AS}$	Single Pulse Avalanche Energy L=10 mH	630	mJ
$I_{AS}$	Pulsed Avalanche Rating	Figure 8	A
dv/dt	Peak Diode Recovery dv/dt (NOTE *3)	5.0	V/ns
$T_L$ $T_{PKG}$	Maximum Temperature for Soldering Leads at 0.063 in (1.6 mm) from Case for 10 seconds Package Body for 10 seconds	300 260	$^\circ\text{C}$
$T_J$ and $T_{STG}$	Operating Junction and Storage Temperature Range	-55 to 150	

\* Drain Current Limited by Maximum Junction Temperature

**Caution:** Stresses greater than those listed in the "Absolute Maximum Ratings" Table may cause permanent damage to the device

### Thermal Resistance

Symbol	Parameter	ITP09N50A	Units	Test Conditions
$R_{\theta JC}$	Junction-to-Case	0.89	$^\circ\text{C}/\text{W}$	Drain lead soldered to water cooled heatsink, $P_D$ adjusted for a peak junction temperature of $+150^\circ\text{C}$ .
$R_{\theta JA}$	Junction-to-Ambient	62		1 cubic foot chamber, free air.

**OFF Characteristics**  $T_J=25^\circ\text{C}$  unless otherwise specified

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
$BV_{DSS}$	Drain-to-Source Breakdown Voltage	500	--	--	V	$V_{GS}=0V, I_D=250\mu A$
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temperature Coefficient, Figure 11.	--	0.6	--	V/ $^\circ\text{C}$	Reference to $25^\circ\text{C}$ , $I_D=250\mu A$
$I_{DSS}$	Drain-to-Source Leakage Current	--	--	1.0	$\mu A$	$V_{DS}=500V, V_{GS}=0V$
		--	--	100		$V_{DS}=400V, V_{GS}=0V$ $T_J=125^\circ\text{C}$
$I_{GSS}$	Gate-to-Source Forward Leakage	--	--	1.0	$\mu A$	$V_{GS}=+20V$
	Gate-to-Source Reverse Leakage	--	--	-1.0		$V_{GS}=-20V$

**ON Characteristics**  $T_J=25^\circ\text{C}$  unless otherwise specified

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
$R_{DS(ON)}$	Static Drain-to-Source On-Resistance Figure 9 and 10.	--	0.55	0.75	$\Omega$	$V_{GS}=10V, I_D=5.0A$ (NOTE *4)
$V_{GS(TH)}$	Gate Threshold Voltage, Figure 12.	2.0	--	4.0	V	$V_{DS}=V_{GS}, I_D=250\mu A$
gfs	Forward Transconductance	--	11	--	S	$V_{DS}=20V, I_D=9.0A$ (NOTE *4)

**Dynamic Characteristics** Essentially independent of operating temperature

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
$C_{iss}$	Input Capacitance	--	1253	--	$\mu F$	$V_{GS}=0V$ $V_{DS}=25V$ $f=1.0MHz$ Figure 14
$C_{oss}$	Output Capacitance	--	130	--		
$C_{rss}$	Reverse Transfer Capacitance	--	18	--		
$Q_g$	Total Gate Charge	--	28	--	nC	$V_{DD}=250V$ $I_D=9A$ Figure 15
$Q_{gs}$	Gate-to-Source Charge	--	7	--		
$Q_{gd}$	Gate-to-Drain ("Miller") Charge	--	11	--		

**Resistive Switching Characteristics** Essentially independent of operating temperature

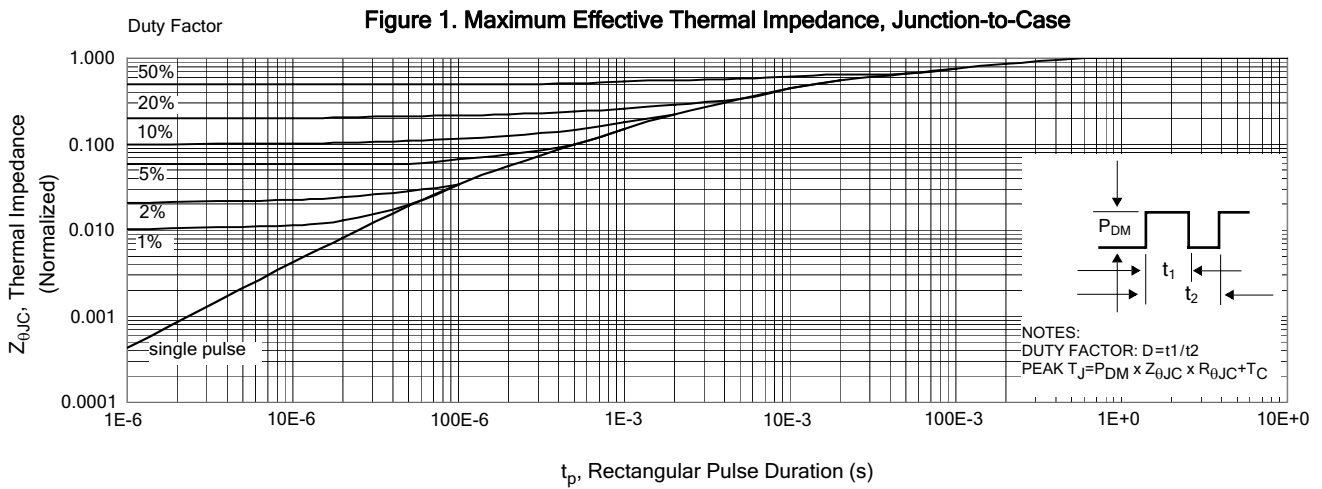
Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
$t_{d(ON)}$	Turn-on Delay Time	--	18	--	ns	$V_{DD}=250V$ $I_D=9A$ $V_{GS}=10V$ $R_G=25\Omega$
$t_{rise}$	Rise Time	--	32	--		
$t_{d(OFF)}$	Turn-Off Delay Time	--	80	--		
$t_{fall}$	Fall Time	--	38	--		

**Source-Drain Diode Characteristics**  $T_C=25^\circ\text{C}$  unless otherwise specified

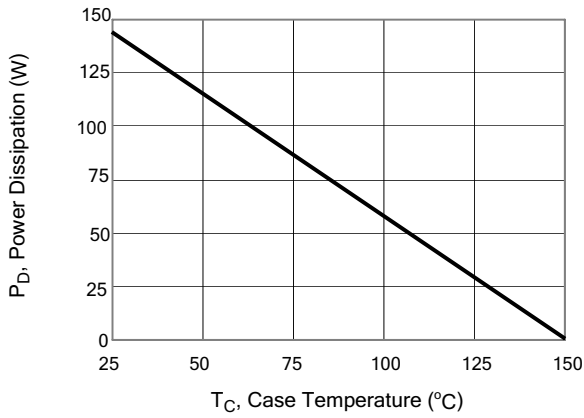
Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
$I_S$	Continuous Source Current (Body Diode)	--	--	9.0	A	Integral pn-diode in MOSFET
$I_{SM}$	Maximum Pulsed Current (Body Diode)	--	--	36	A	
$V_{SD}$	Diode Forward Voltage	--	--	1.5	V	$I_S=9\text{A}$ , $V_{GS}=0\text{V}$
$t_{rr}$	Reverse Recovery Time	--	330	--	ns	$V_{GS}=0\text{V}$ $I_F=9\text{A}$ , $di/dt=100\text{A}/\mu\text{s}$
$Q_{rr}$	Reverse Recovery Charge	--	1550	--	nC	

Notes:

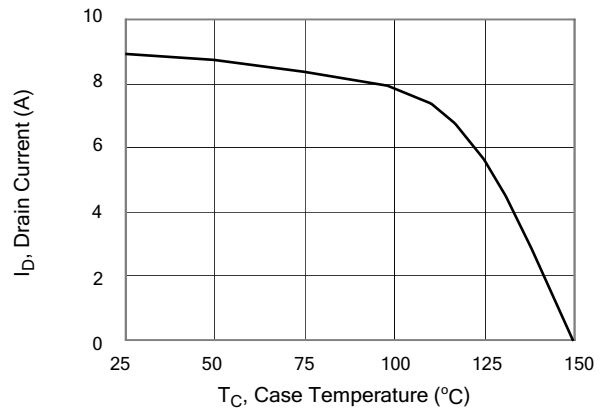
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- \*1.  $T_J = +25^\circ\text{C}$  to  $+150^\circ\text{C}$ .
  - \*2. Repetitive rating; pulse width limited by maximum junction temperature.
  - \*3.  $I_{SD} = 9\text{A}$   $di/dt \leq 100\text{A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ ,  $T_J = +150^\circ\text{C}$ .
  - \*4. Pulse width  $\leq 380\mu\text{s}$ ; duty cycle  $\leq 2\%$ .



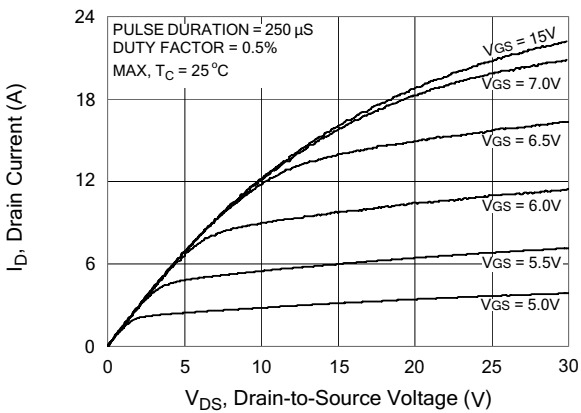
**Figure 2. Maximum Power Dissipation vs Case Temperature**



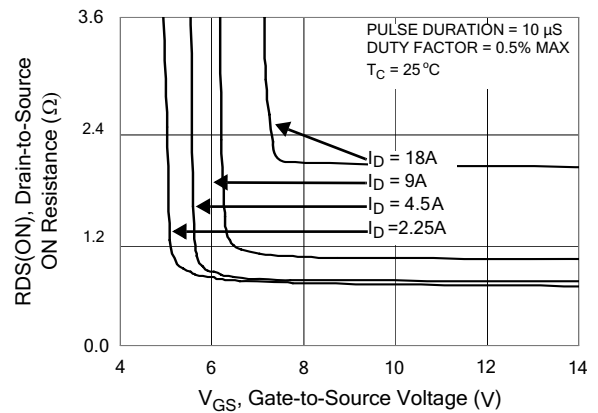
**Figure 3. Maximum Continuous Drain Current vs Case Temperature**



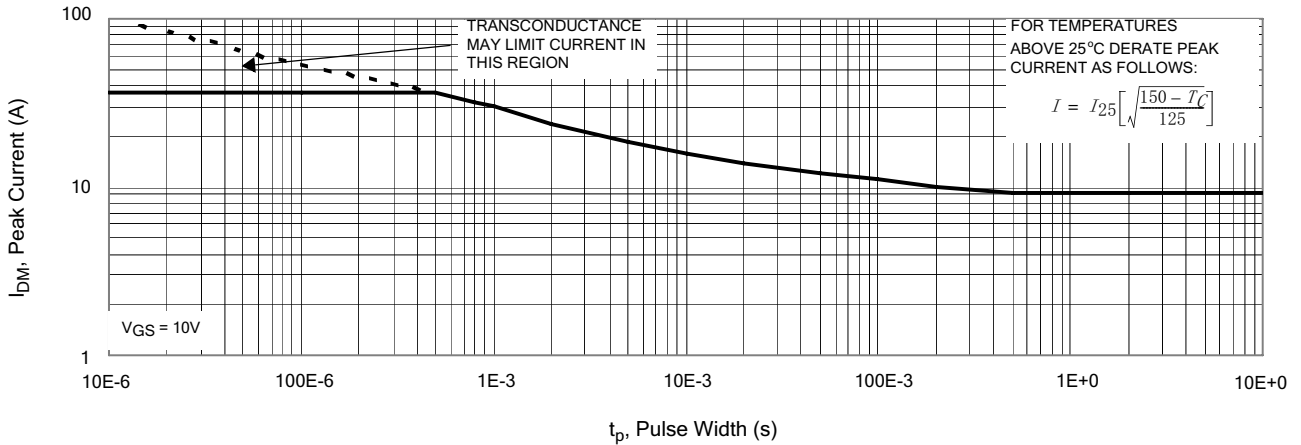
**Figure 4. Typical Output Characteristics**



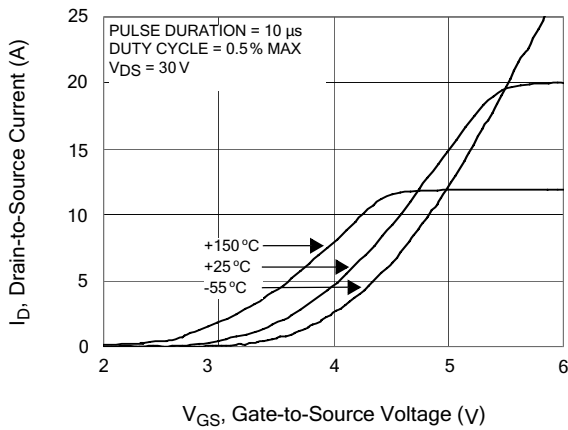
**Figure 5. Typical Drain-to-Source ON Resistance vs Gate Voltage and Drain Current**



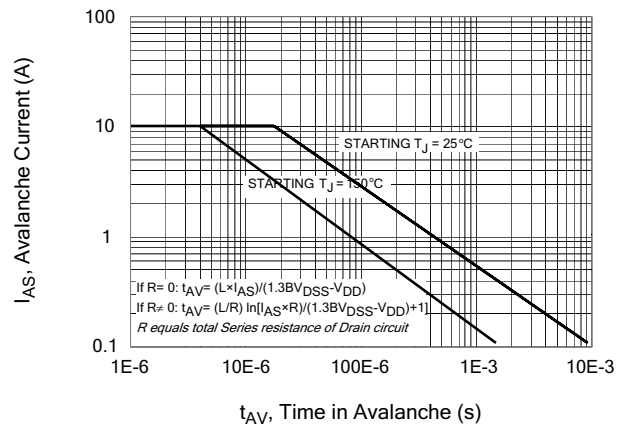
**Figure 6. Maximum Peak Current Capability**



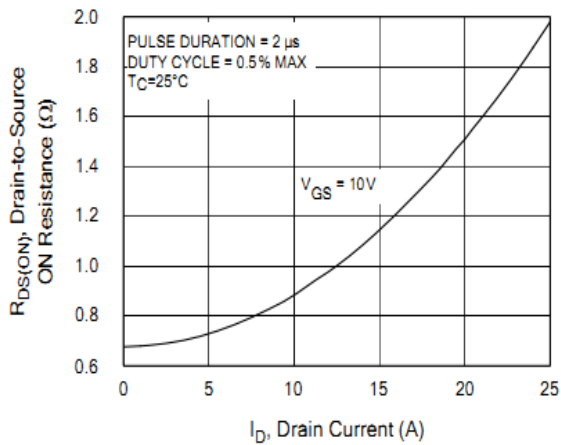
**Figure 7. Typical Transfer Characteristics**



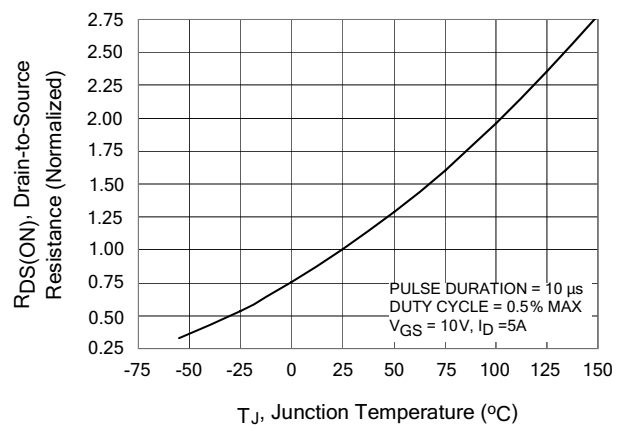
**Figure 8. Unclamped Inductive Switching Capability**



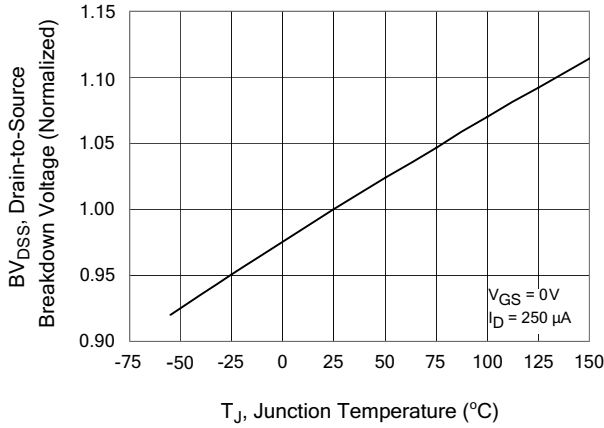
**Figure 9. Typical Drain-to-Source ON Resistance vs Drain Current**



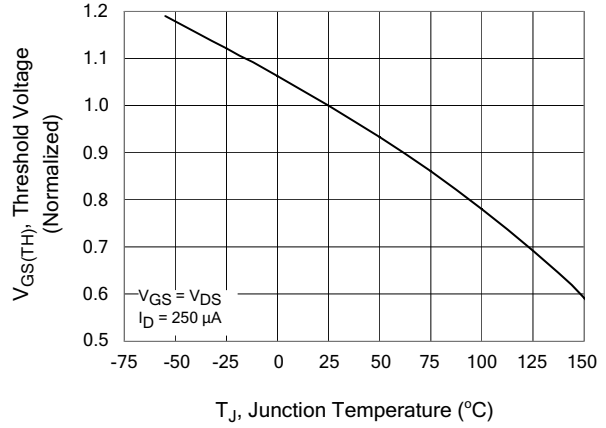
**Figure 10. Typical Drain-to-Source ON Resistance vs Junction Temperature**



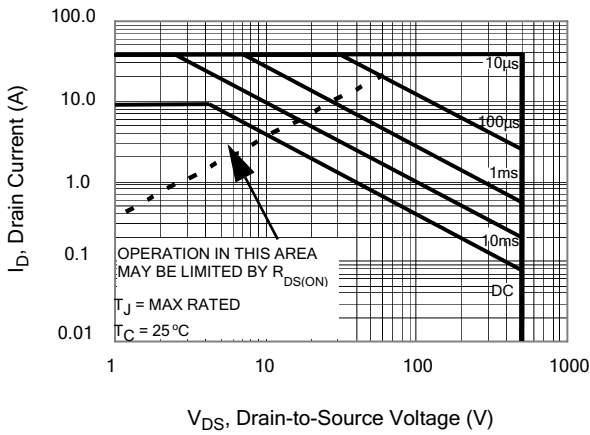
**Figure 11. Typical Breakdown Voltage vs Junction Temperature**



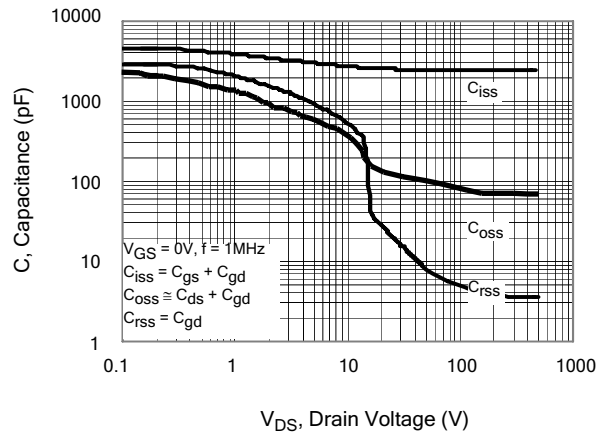
**Figure 12. Typical Threshold Voltage vs Junction Temperature**



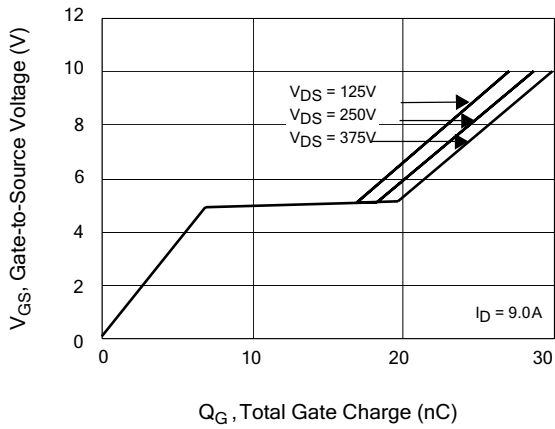
**Figure 13. Maximum Forward Bias Safe Operating Area**



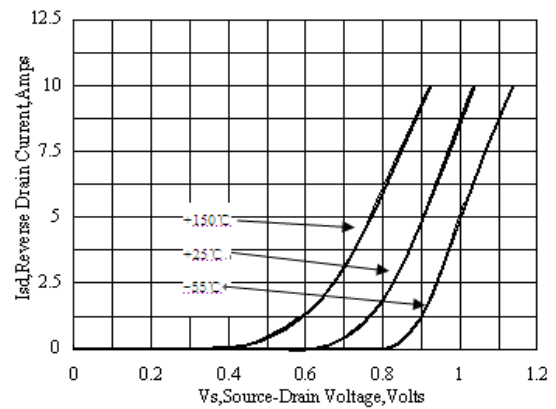
**Figure 14. Typical Capacitance vs Drain-to-Source Voltage**



**Figure 15. Typical Gate Charge vs Gate-to-Source Voltage**



**Figure 16. Typical Body Diode Transfer Characteristics**



Test Circuits and Waveforms

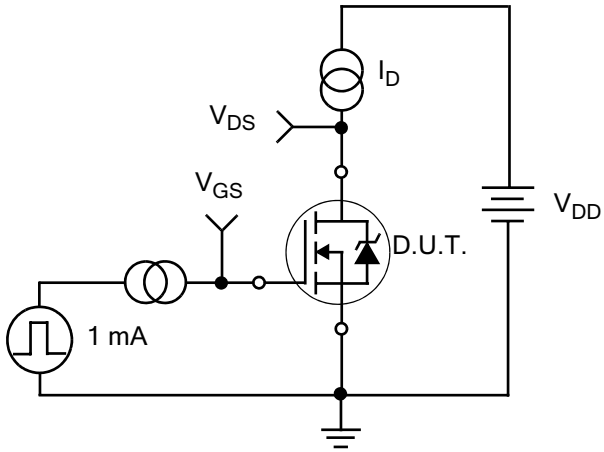


Figure 17. Gate Charge Test Circuit

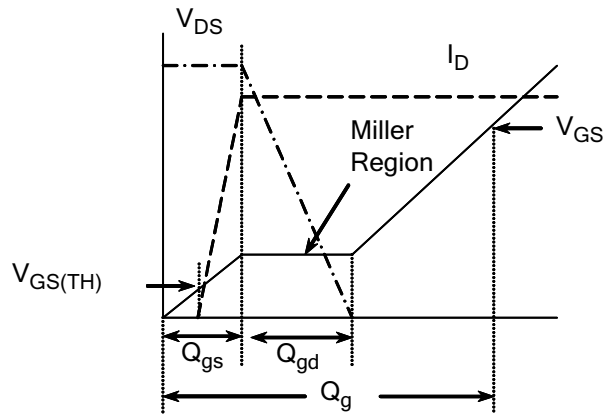


Figure 18. Gate Charge Waveform

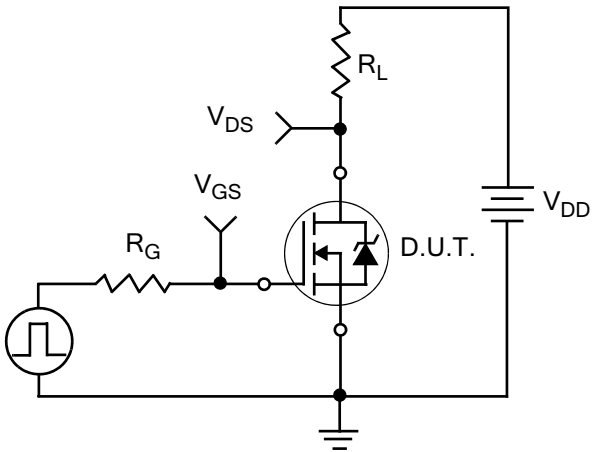


Figure 19. Resistive Switching Test Circuit

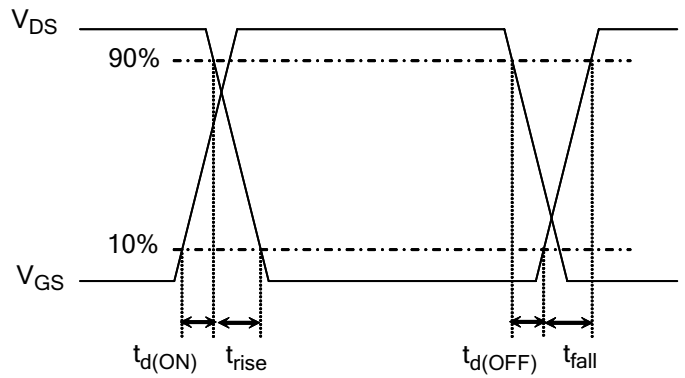


Figure 20. Resistive Switching Waveforms

### Test Circuits and Waveforms

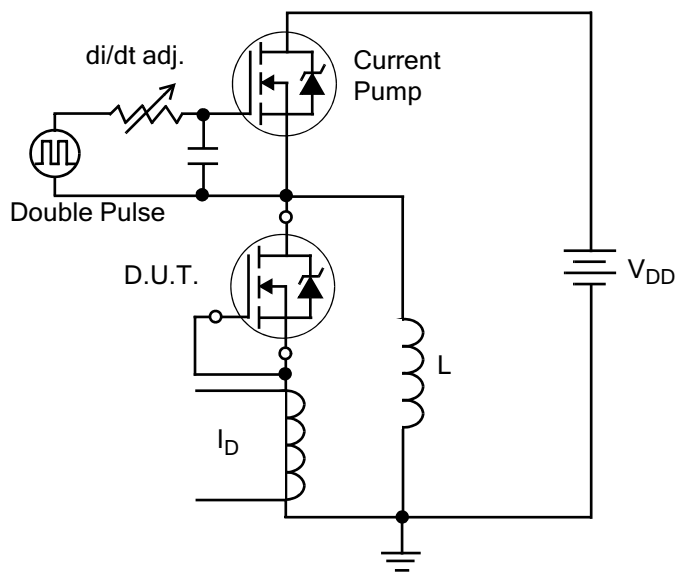


Figure 21. Diode Reverse Recovery Test Circuit

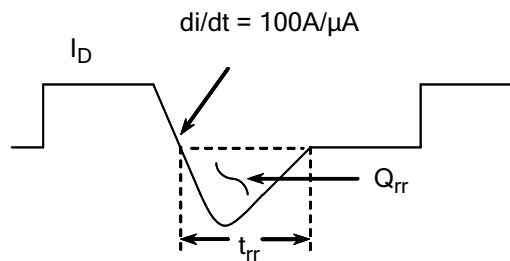


Figure 22. Diode Reverse Recovery Waveform

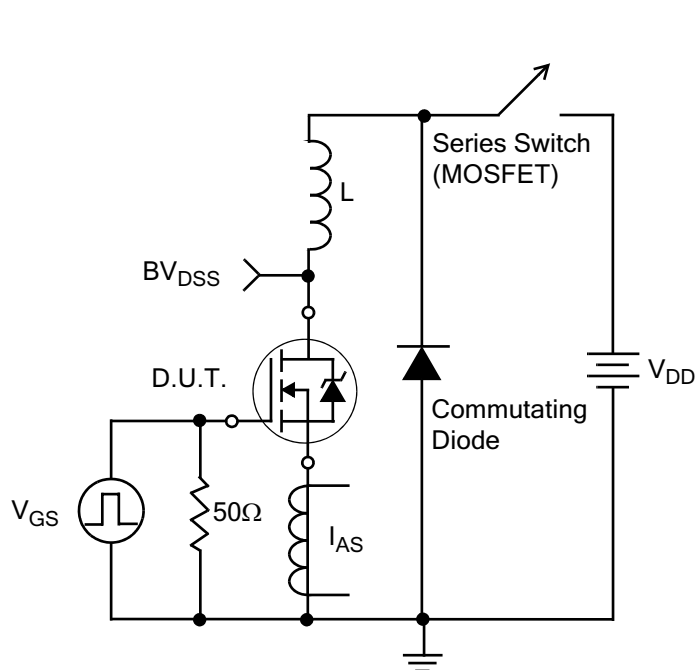


Figure 23. Unclamped Inductive Switching Test Circuit

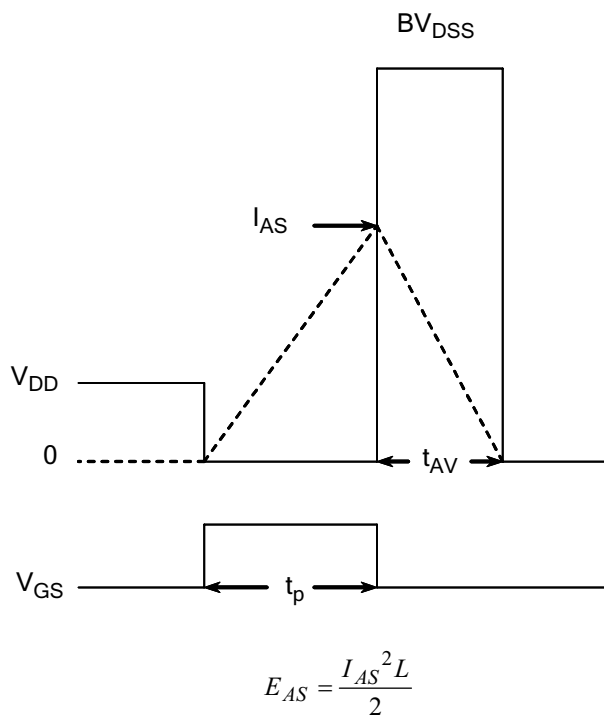


Figure 24. Unclamped Inductive Switching Waveforms



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