



# FTP04N60C FTA04N60C

## N-Channel MOSFET

Lead Free Package and Finish

### Applications:

- Adaptor
- Charger
- SMPS Standby Power

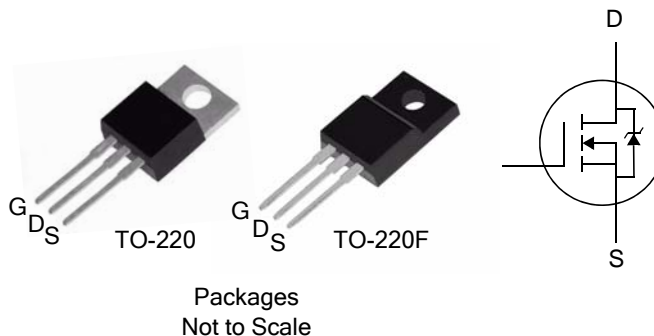
$V_{DSS}$	$R_{DS(ON)}$ (Max.)	$I_D$
600 V	2.2 $\Omega$	4.0 A

### Features:

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

### Ordering Information

PART NUMBER	PACKAGE	BRAND
FTP04N60C	TO-220	FTP04N60C
FTA04N60C	TO-220F	FTA04N60C



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

Symbol	Parameter	FTP04N60C	FTA04N60C	Units
$V_{DSS}$	Drain-to-Source Voltage (NOTE *1)	600		V
$I_D$	Continuous Drain Current	4.0	4.0*	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	86	28	W
	Derating Factor above $25^\circ\text{C}$	0.69	0.22	W/ $^\circ\text{C}$
$V_{GS}$	Gate-to-Source Voltage	$\pm 30$		V
$E_{AS}$	Single Pulse Avalanche Energy $L=10\text{ mH}$ , $I_D=4.0\text{ Amps}$	80		mJ
$I_{AS}$	Pulsed Avalanche Rating	Figure 8		A
dv/dt	Peak Diode Recovery dv/dt (NOTE *3)	3.0		V/ns
$T_L$ $T_{PKG}$	Maximum Temperature for Soldering Leads at 0.063 in (1.6 mm) from Case for 10 seconds	300		$^\circ\text{C}$
	Package Body for 10 seconds	260		
$T_J$ 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	FTP04N60C	FTA04N60C	Units	Test Conditions
$R_{\theta JC}$	Junction-to-Case	1.45	4.5	$^\circ\text{C/W}$	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	100		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	600	--	--	V	$V_{GS}=0V, I_D=250\mu A$
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temperature Coefficient, Figure 11.	--	0.631	--	V/ $^\circ\text{C}$	Reference to $25^\circ\text{C}$ , $I_D=250\mu A$
$I_{DSS}$	Drain-to-Source Leakage Current	--	--	25	$\mu A$	$V_{DS}=600V, V_{GS}=0V$
		--	--	25		$V_{DS}=480V, V_{GS}=0V$ $T_J=125^\circ\text{C}$
$I_{GSS}$	Gate-to-Source Forward Leakage	--	--	100	nA	$V_{GS}=+30V$
	Gate-to-Source Reverse Leakage	--	--	-100		$V_{GS}=-30V$

**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.	--	1.76	2.2	$\Omega$	$V_{GS}=10V, I_D=2.4A$ (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	--	3.75	--	S	$V_{DS}=15V, I_D=4A$ (NOTE *4)

**Dynamic Characteristics** Essentially independent of operating temperature

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
$C_{ISS}$	Input Capacitance	--	720	--	$\mu F$	$V_{GS}=0V$ $V_{DS}=25V$ $f=1.0MHz$ Figure 14
$C_{OSS}$	Output Capacitance	--	66.8	--		
$C_{RSS}$	Reverse Transfer Capacitance	--	9.3	--		
$Q_g$	Total Gate Charge	--	18.7	--	nC	$V_{DD}=300V$ $I_D=4A$ Figure 15
$Q_{GS}$	Gate-to-Source Charge	--	3.7	--		
$Q_{GD}$	Gate-to-Drain ("Miller") Charge	--	8.9	--		

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

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
$t_{d(ON)}$	Turn-on Delay Time	--	12	--	ns	$V_{DD}=300V$ $I_D=4A$ $V_{GS}=10V$ $R_G=9.1\Omega$
$t_{rise}$	Rise Time	--	17	--		
$t_{d(OFF)}$	Turn-Off Delay Time	--	28	--		
$t_{fall}$	Fall Time	--	16	--		

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

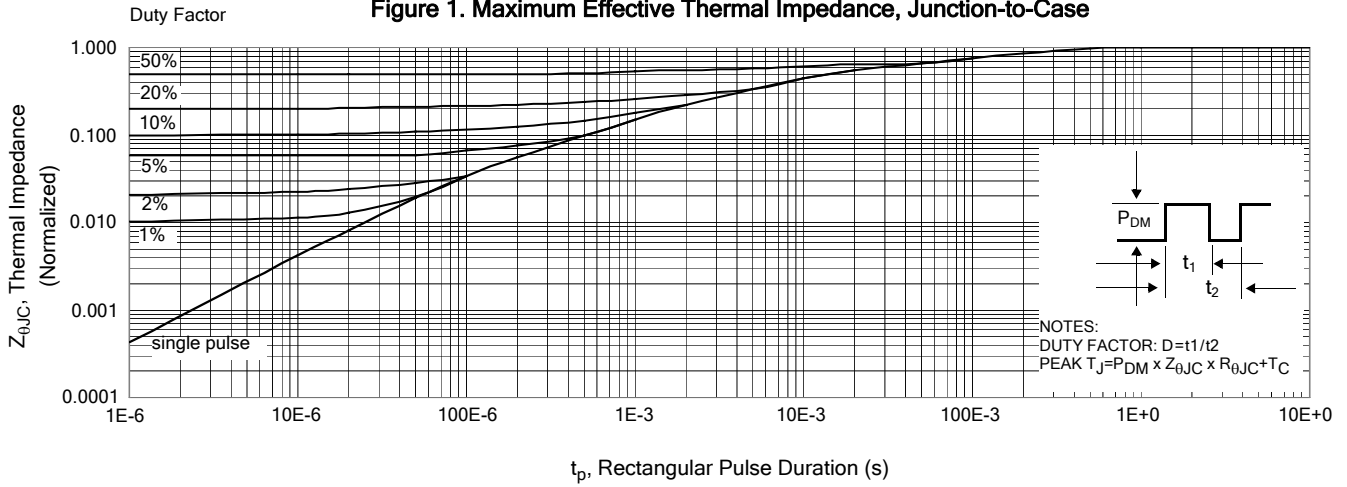
Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
$I_S$	Continuous Source Current (Body Diode)	--	--	4	A	Integral pn-diode in MOSFET
$I_{SM}$	Maximum Pulsed Current (Body Diode)	--	--	16	A	
$V_{SD}$	Diode Forward Voltage	--	--	1.5	V	$I_S=4\text{A}$ , $V_{GS}=0\text{V}$
$t_{rr}$	Reverse Recovery Time	--	258	387	ns	$V_{GS}=0\text{V}$
$Q_{rr}$	Reverse Recovery Charge	--	1280	1920	nC	$I_F=4\text{A}$ , $di/dt=100\text{ A}/\mu\text{s}$

**Notes:**

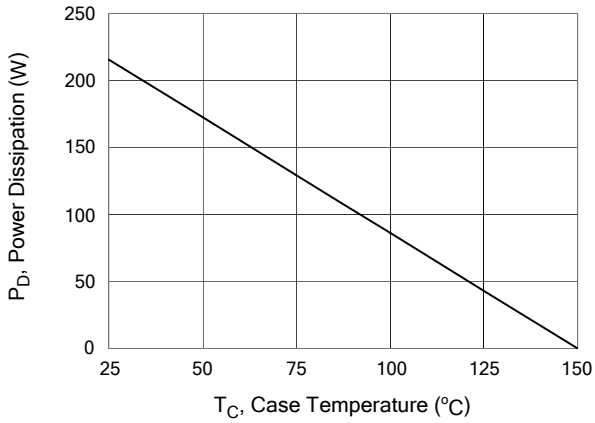
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- \*1.  $T_J = +25^\circ\text{C}$  to  $+150^\circ\text{C}$ .
- \*2. Repetitive rating; pulse width limited by maximum junction temperature.
- \*3.  $I_{SD}=4\text{A}$   $di/dt \leq 100\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ ,  $T_J=+150^\circ\text{C}$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

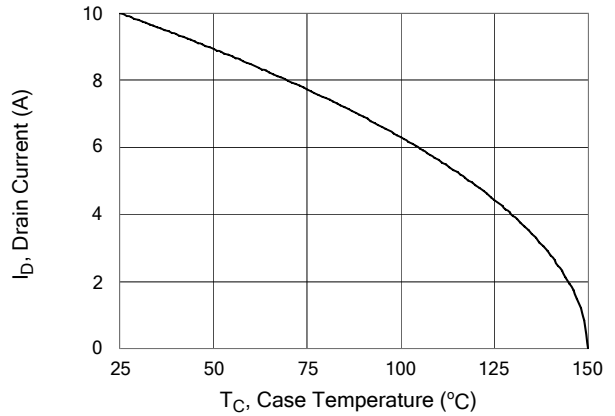
**Figure 1. Maximum Effective Thermal Impedance, Junction-to-Case**



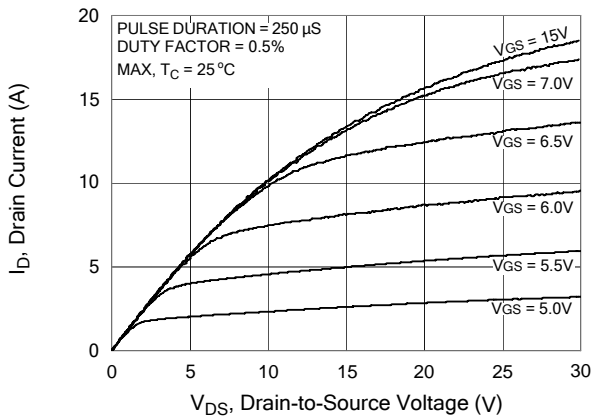
**Figure 2. Maximum Power Dissipation vs Case Temperature**



**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**

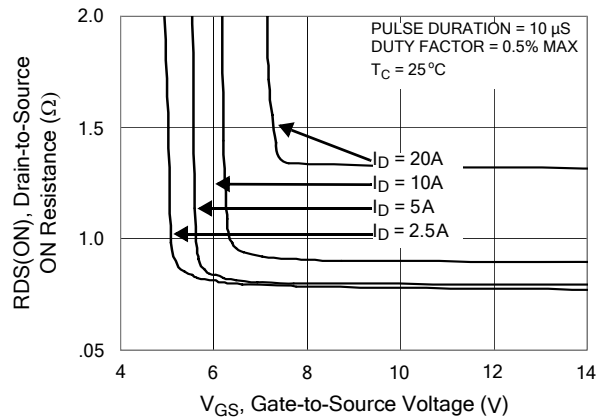


Figure 6. Maximum Peak Current Capability

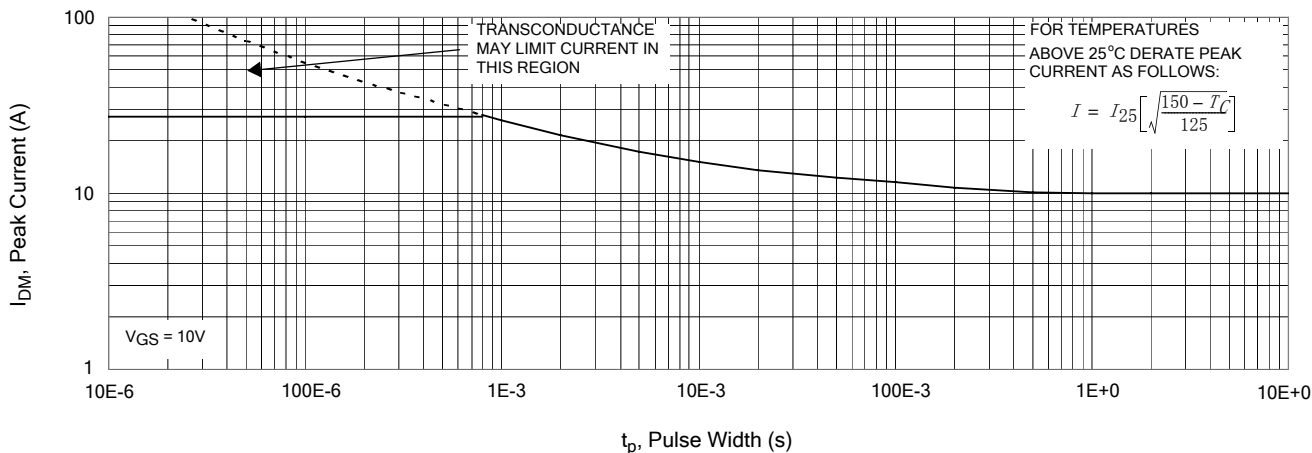


Figure 7. Typical Transfer Characteristics

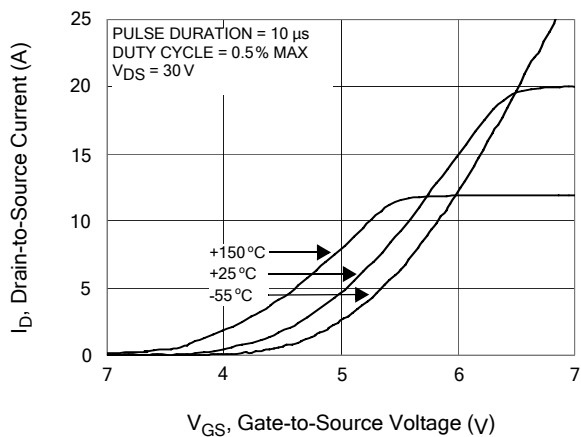


Figure 8. Unclamped Inductive Switching Capability

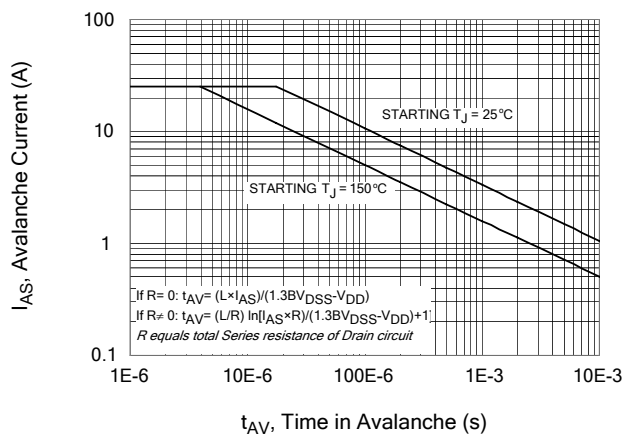


Figure 9. Typical Drain-to-Source ON Resistance vs Drain Current

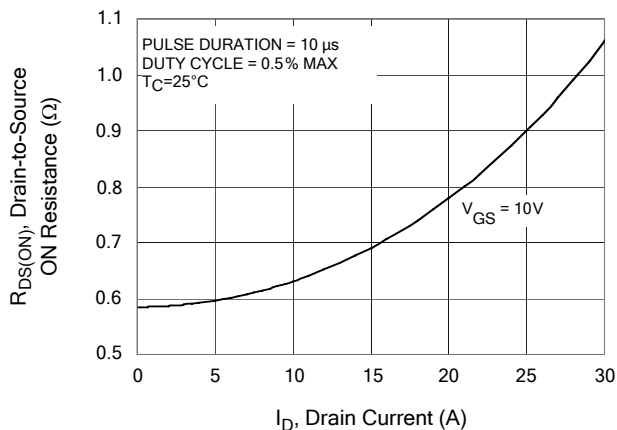
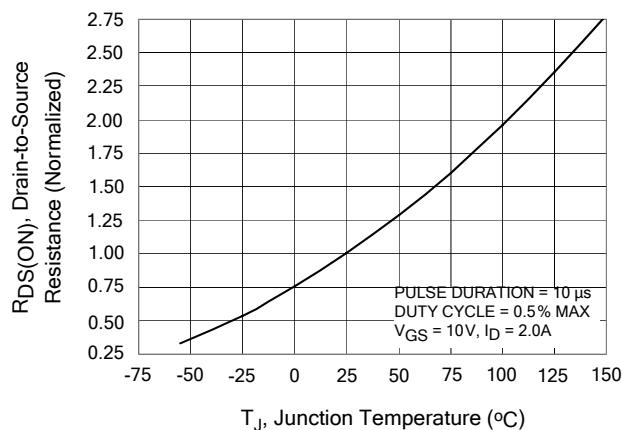
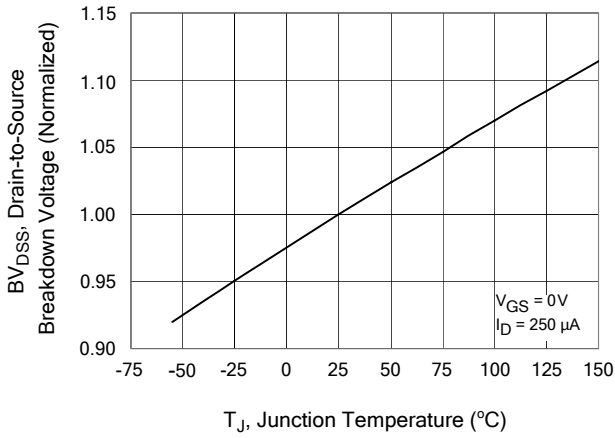


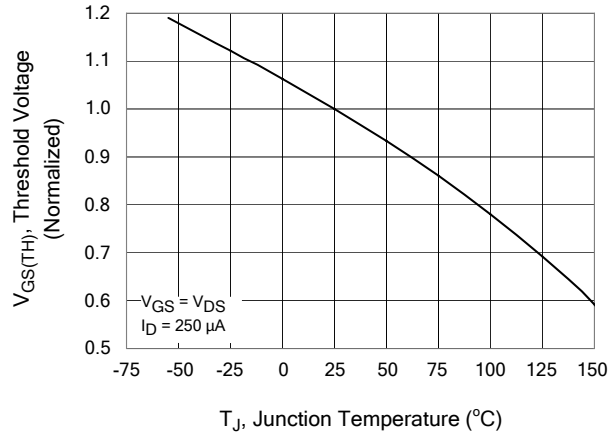
Figure 10. Typical Drain-to-Source ON Resistance vs Junction Temperature



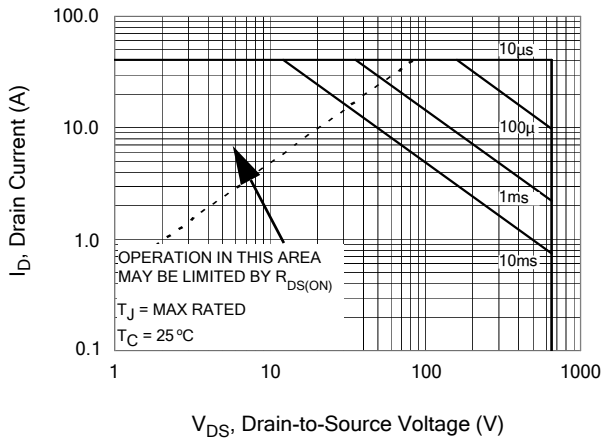
**Figure 11. Typical Breakdown Voltage vs Junction Temperature**



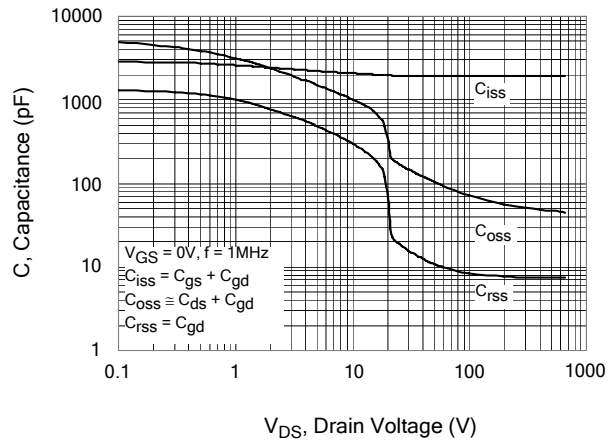
**Figure 12. Typical Threshold Voltage vs Junction Temperature**



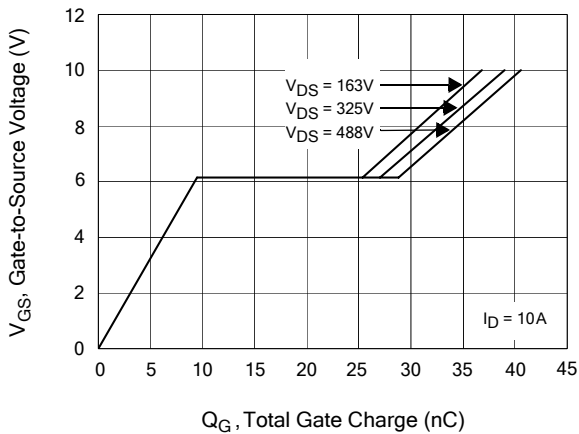
**Figure 13. Maximum Forward Bias Safe Operating Area**



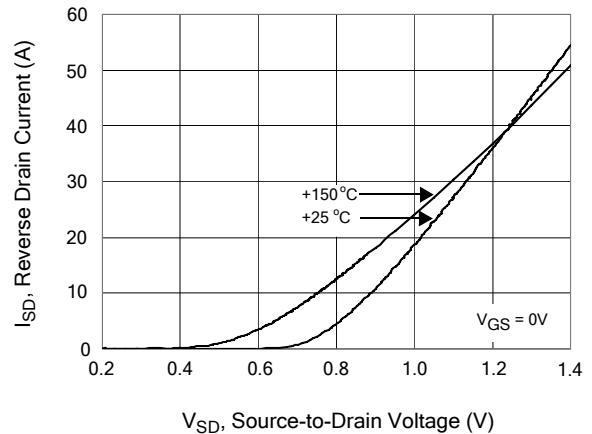
**Figure 14. Typical Capacitance vs Drain-to-Source Voltage**



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



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



Test Circuits and Waveforms

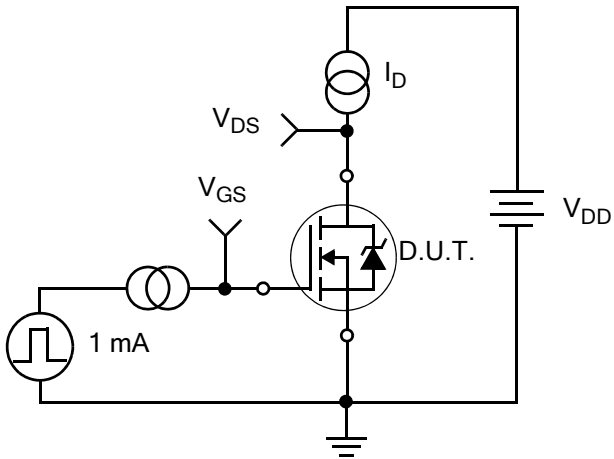


Figure 17. Gate Charge Test Circuit

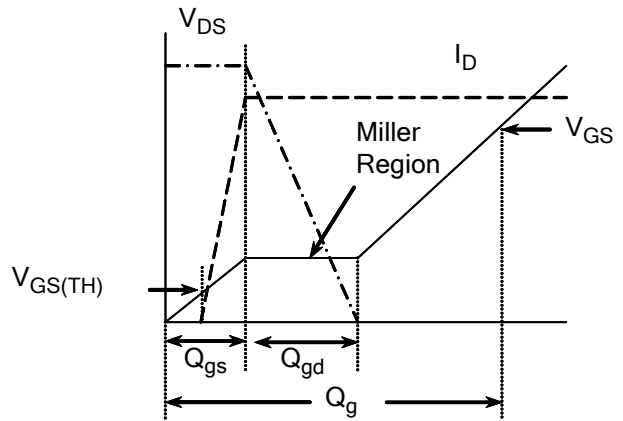


Figure 18. Gate Charge Waveform

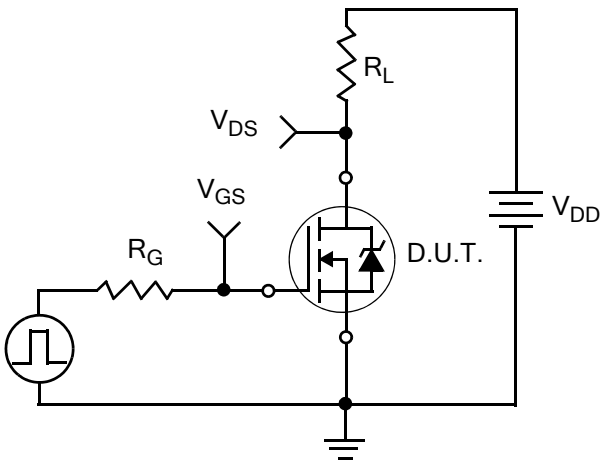


Figure 19. Resistive Switching Test Circuit

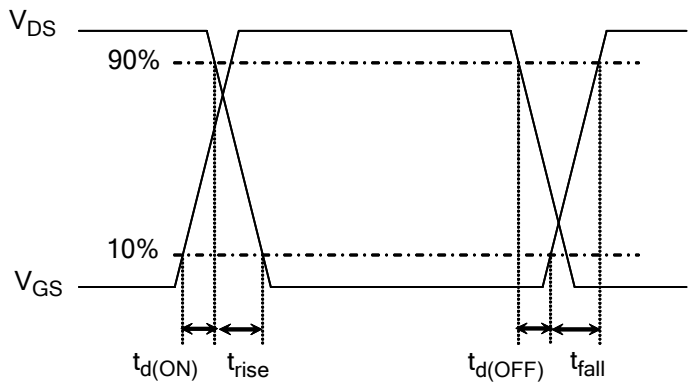


Figure 20. Resistive Switching Waveforms

Test Circuits and Waveforms

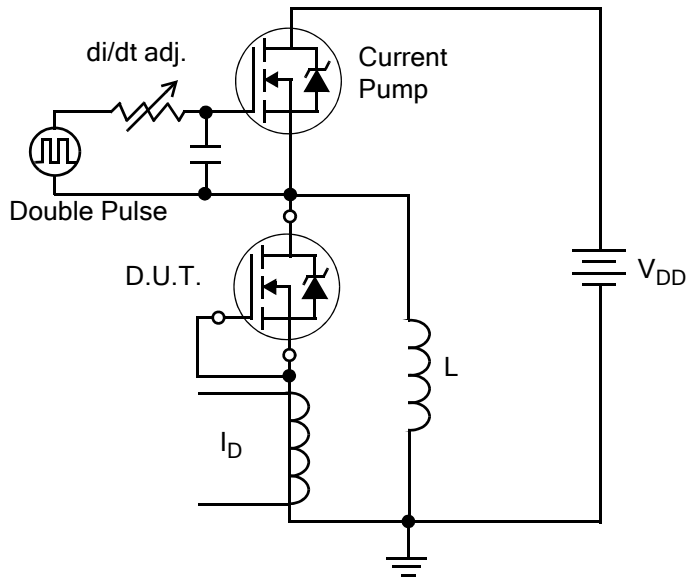


Figure 21. Diode Reverse Recovery Test Circuit

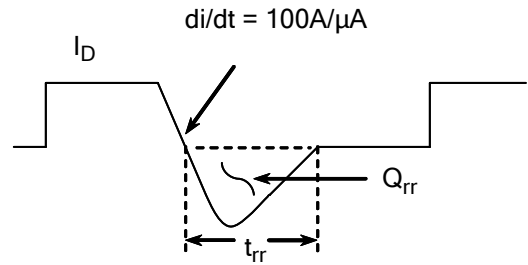


Figure 22. Diode Reverse Recovery Waveform

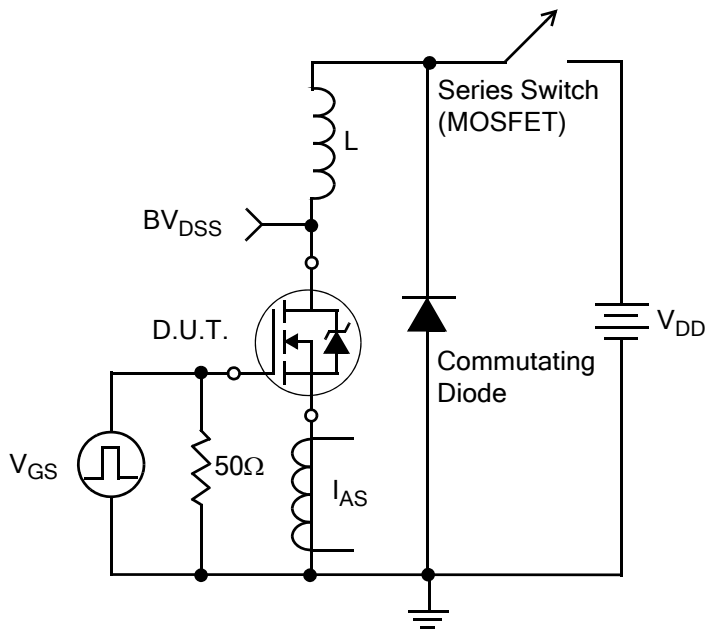


Figure 23. Unclamped Inductive Switching Test Circuit

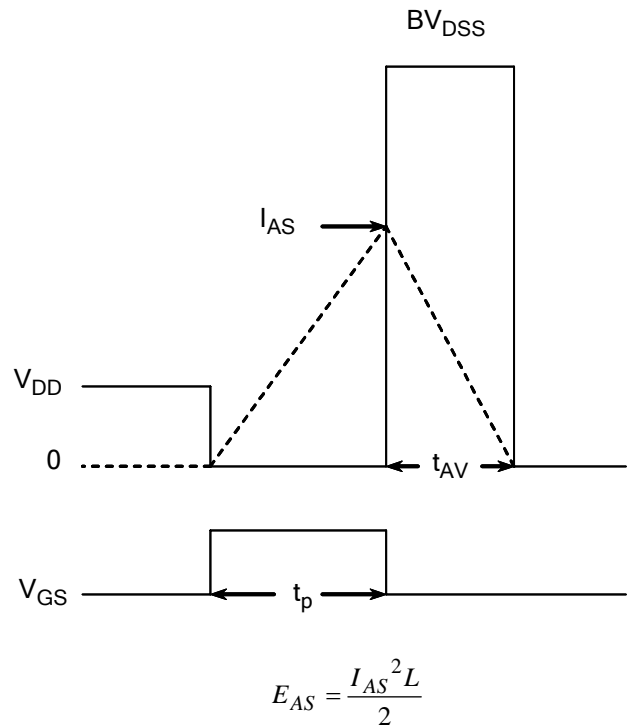


Figure 24. Unclamped Inductive Switching Waveforms



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