

■ Features

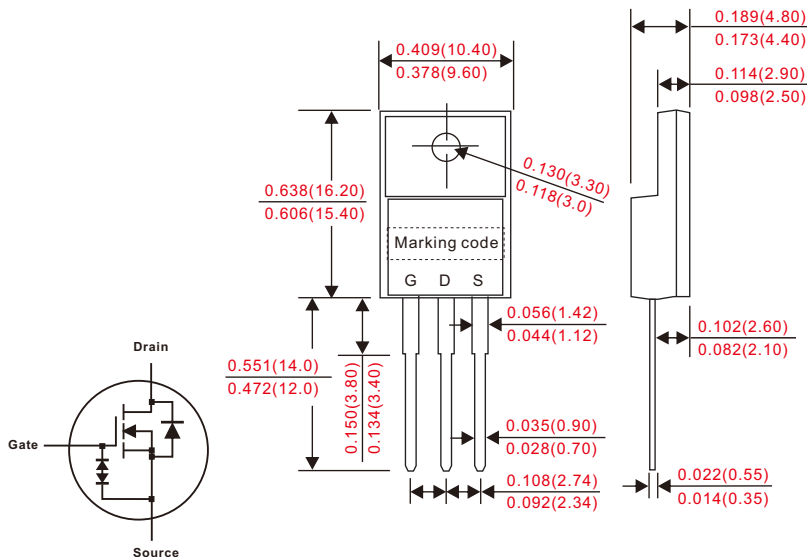
- Fast switching.
- ESD improved capability.
- Low gate charge.
- Low reverse transfer capacitances.
- 100% single pulse avalanche energy test.

■ Mechanical data

- Epoxy : UL94-V0 rated flame retardant.
- Case : JEDEC TO-220F molded plastic body.
- Terminals : Solder plated, solderable per MIL-STD-750, Method 2026.
- Polarity: As marked.
- Mounting Position : Any.
- Weight : Approximated 2.25 gram.

■ Outline

TO-220F



■ Absolute($T_c = 25^\circ\text{C}$ unless otherwise specified)

PARAMETER	CONDITIONS	Symbol	CS10N60FA9HD	UNIT
Drain-Source Voltage		V_{DS}	600	V
Continuous Drain Current		I_D	10	A
Continuous Drain Current	$T_c = 100^\circ\text{C}$		8	
Pulsed Drain Current(1)			40	
Gate-Source Voltage		V_{GS}	± 30	V
Single Pulse Avalanche Energy(2)		E_{AS}	800	mJ
Avalanche Current(1)		I_{AR}	4.0	A
Repetitive Avalanche Energy(1)		E_{AR}	80	mJ
Power Dissipation		P_D	50	W
	Derating factor above 25°C		0.4	W/ $^\circ\text{C}$
Peak Diode Recovery dv/dt (3)		dV/dt	5.0	V/ns
Gate source ESD	HBM-C = 100pf, R = 1.5k Ω	$V_{ESD(G-S)}$	4000	V
Operating and Storage Temperature Range		T_J, T_{STG}	-55 ~ +150	$^\circ\text{C}$
Maximum temperature for soldering		T_L	300	$^\circ\text{C}$

NOTE : 1.Repetitive rating; pulse width limited by maximum junction temperature.
 2.L=10.0mH, $I_o = 12.6\text{A}$, Start $T_J = 25^\circ\text{C}$.
 3. $I_{SP} = 10\text{A}$, $di/dt \leq 100\text{A/us}$, $V_{DS} \leq BV_{DS}$, Start $T_J = 25^\circ\text{C}$.

■ Electrical characteristics(T _c = 25°C unless otherwise specified)						
PARAMETER	CONDITIONS	Symbol	MIN.	TYP.	MAX.	UNIT
Drain-Source Breakdown Voltage	V _{GS} = 0V, I _D = 250μA	V _{DSS}	600			V
Bvdss Temperature Coefficient	I _D = 250uA, Reference 25°C	BV _{DSS} / T _J		0.74		V/°C
Drain-Source Leakage Current	V _{DS} = 600V, V _{GS} = 0V, T _a = 25°C	I _{DSS}			1	uA
	V _{DS} = 480V, V _{GS} = 0V, T _a = 125°C				100	
Gate-Source Leakage Current, Forward	V _{GS} = 20V	I _{GSS(F)}			10	uA
Gate-Source Leakage Current, Reverse	V _{GS} = -20V	I _{GSS(R)}			-10	
■ ON Characteristics						
PARAMETER	CONDITIONS	Symbol	MIN.	TYP.	MAX.	UNIT
Gate Threshold Voltage	V _{DS} = V _{GS} , I _D = 250μA	V _{GS(th)}	2.0		4.0	V
Static Drain-Source On-Resistance	V _{GS} = 10V, I _D = 5A	R _{DS(on)}		0.6	0.75	Ω
■ Dynamic Characteristics						
PARAMETER	CONDITIONS	Symbol	MIN.	TYP.	MAX.	UNIT
Forward Transconductance	V _{DS} = 15V, I _D = 5A	g _{fs}		9		S
Input Capacitance	V _{DS} = 25V, V _{GS} = 0V, f = 1.0MHz	C _{iss}		1556		pF
Output Capacitance		C _{oss}		158		
Reverse Transfer Capacitance		C _{rss}		16		
■ Resistive Switching Characteristics						
PARAMETER	CONDITIONS	Symbol	MIN.	TYP.	MAX.	UNIT
Turn-on Delay Time	I _D = 10A, V _{DD} = 300V, V _{GS} = 10V, R _G = 4.7Ω	td _(ON)		12		ns
Rise Time		tr		16		
Turn-off Delay Time		td _(OFF)		39		
Fall Time		tf		17		
Total Gate Charge	I _D = 10A, V _{DD} = 300V, V _{GS} = 10V	Q _g		39		nC
Gate-Source Charge		Q _{gs}		7.4		
Gate-Drain Charge		Q _{gd}		16		
■ Source-Drain Diode Characteristics						
PARAMETER	CONDITIONS	Symbol	MIN.	TYP.	MAX.	UNIT
Continuous Source-Drain Diode Current	Boby Diode	I _S			10	A
Pulse Diode Forward Current	Boby Diode	I _{SM}			40	
Body Diode Voltage	I _S = 10A, V _{GS} = 0V	V _{SD}			1.5	V
Reverse recovery time	I _S = 10A, T _J = 25°C, dI _F /dt = 100A/μs, V _{GS} = 0V	t _{rr}		262		ns
Reverse recovery charge		Q _{rr}		1727		uC
■ Thermal characteristics						
PARAMETER	CONDITIONS	Symbol	MIN.	TYP.	MAX.	UNIT
Thermal Resistance	Junction to Case	R _{θJC}		2.5		°C/W
	Junction to Ambient	R _{θJA}		100		
■ Thermal characteristics						
PARAMETER	CONDITIONS	Symbol	MIN.	TYP.	MAX.	UNIT
Gate-Source Breakdown Voltage	I _{GS} = ±1mA(open Drain)	V _{GSO}	30			V

■ Rating and characteristic curves

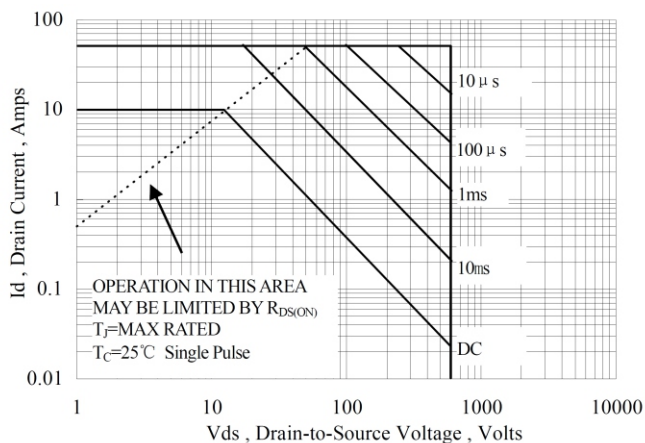


Figure 1 Maximum Forward Bias Safe Operating Area

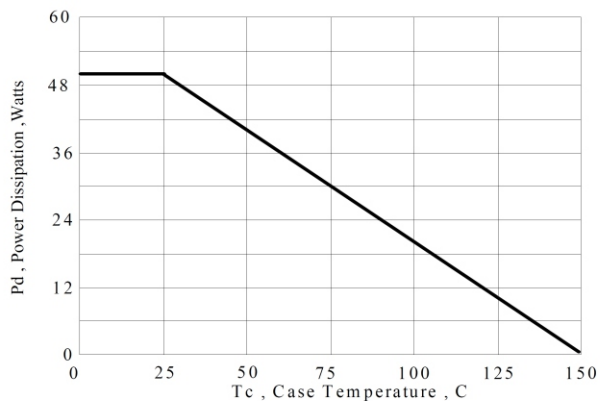


Figure 2 Maximum Power Dissipation vs Case Temperature

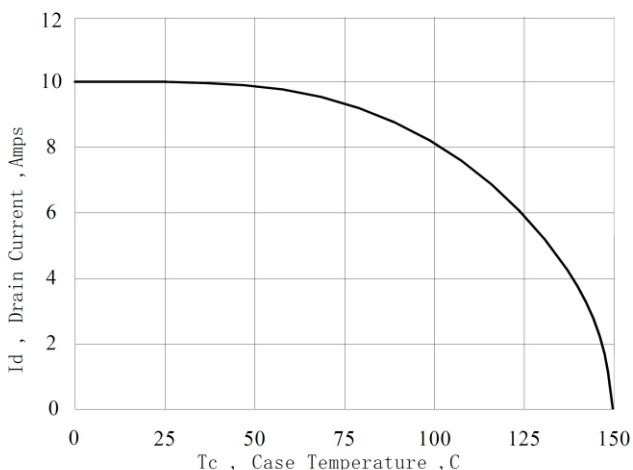


Figure 3 Maximum Continuous Drain Current vs Case Temperature

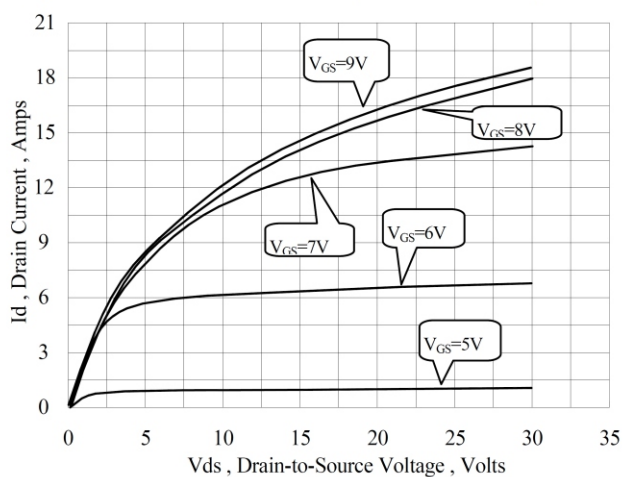


Figure 4 Typical Output Characteristics

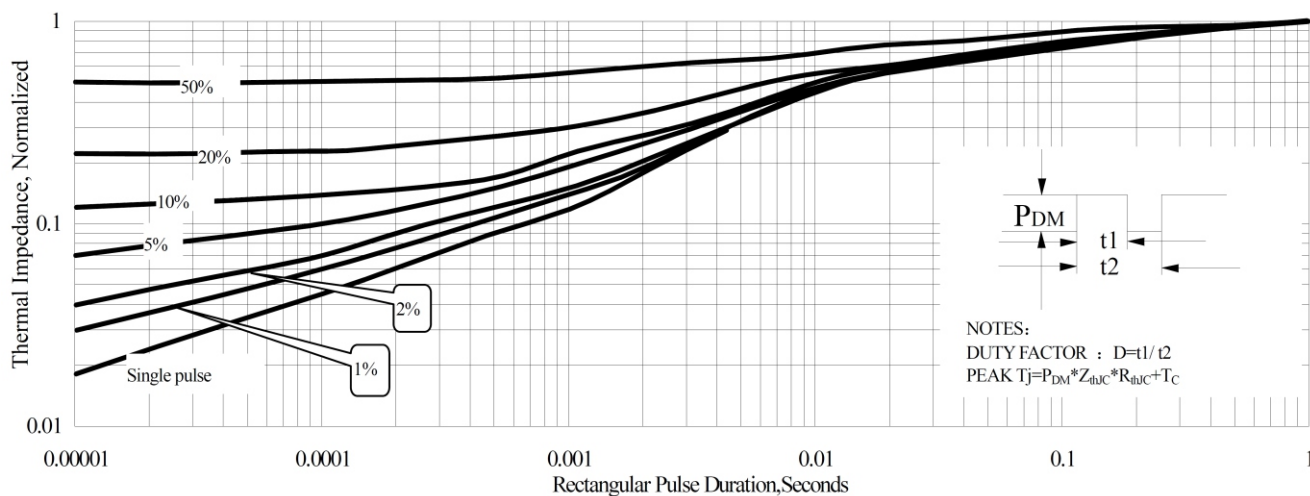


Figure 5 Maximum Effective Thermal Impedance, Junction to Case

■ Rating and characteristic curves

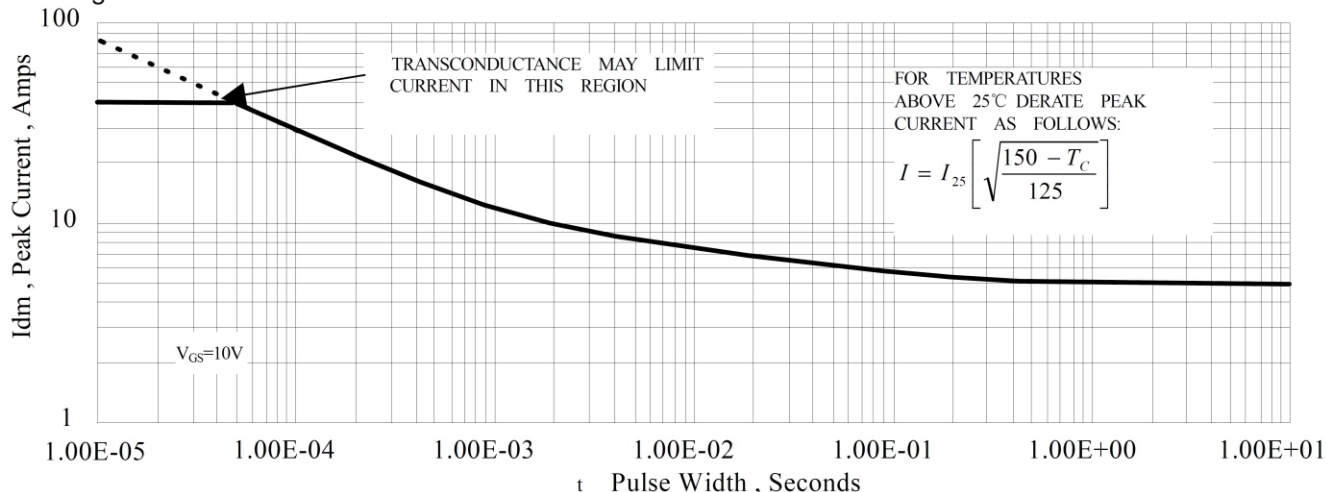


Figure 6 Maximum Peak Current Capability

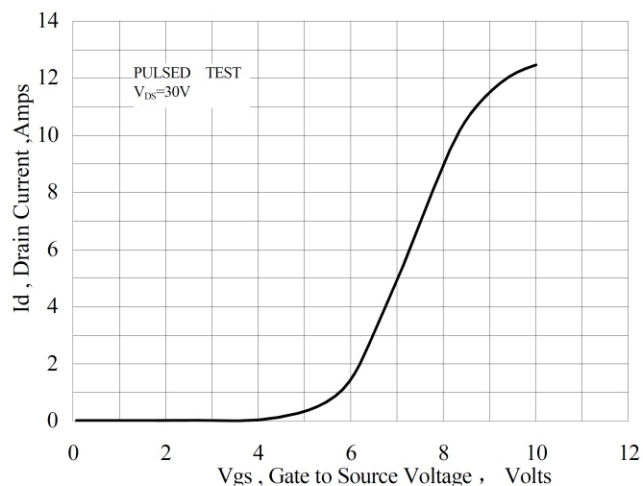


Figure 7 Typical Transfer Characteristics

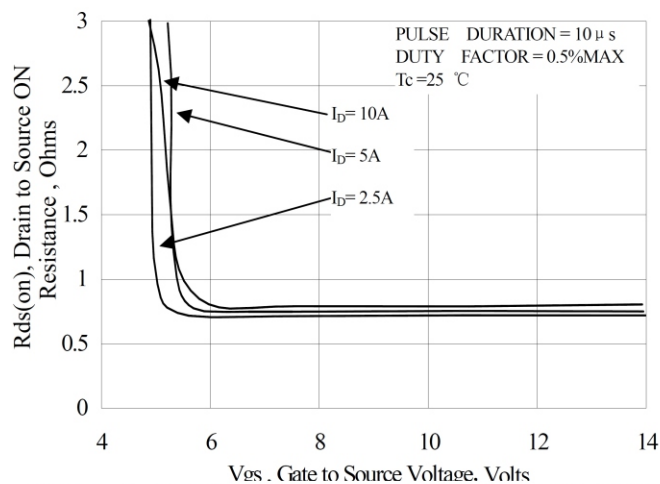


Figure 8 Typical Drain to Source ON Resistance vs. Gate Voltage and Drain Current

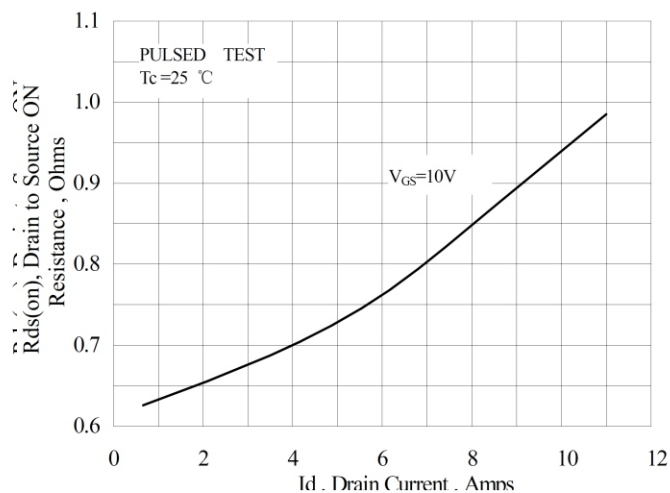


Figure 9 Typical Drain to Source ON Resistance vs. Drain Current

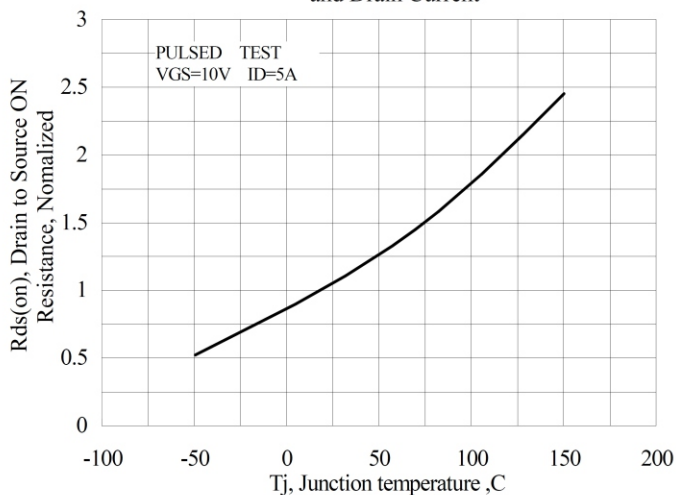


Figure 10 Typical Drain to Source on Resistance vs. Junction Temperature

■ Rating and characteristic curves

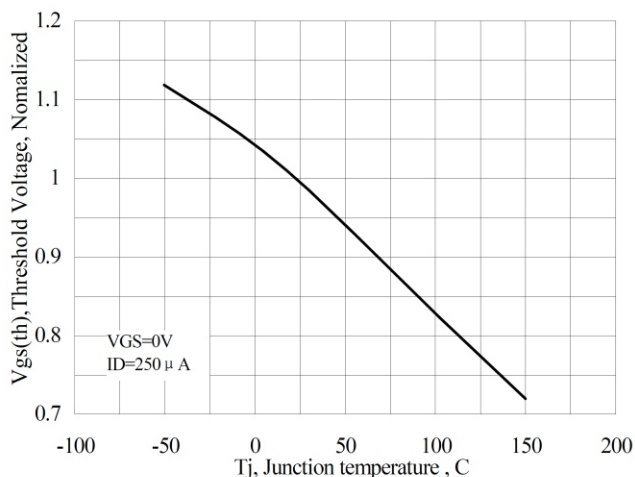


Figure 11 Typical Theshold Voltage vs Junction Temperature

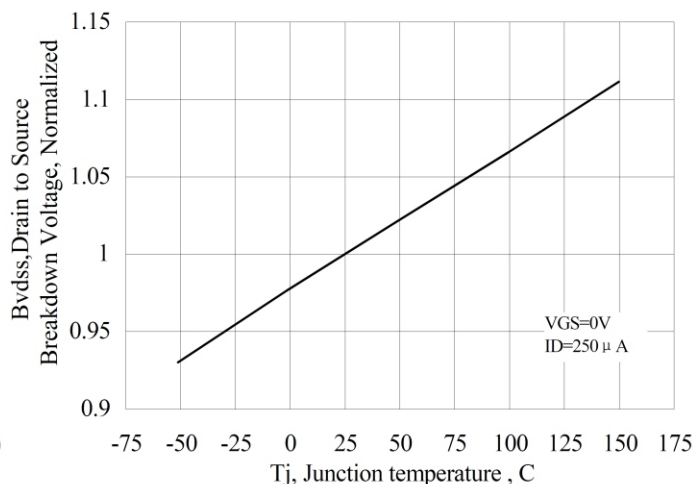


Figure 12 Typical Breakdown Voltage vs Junction Temperature

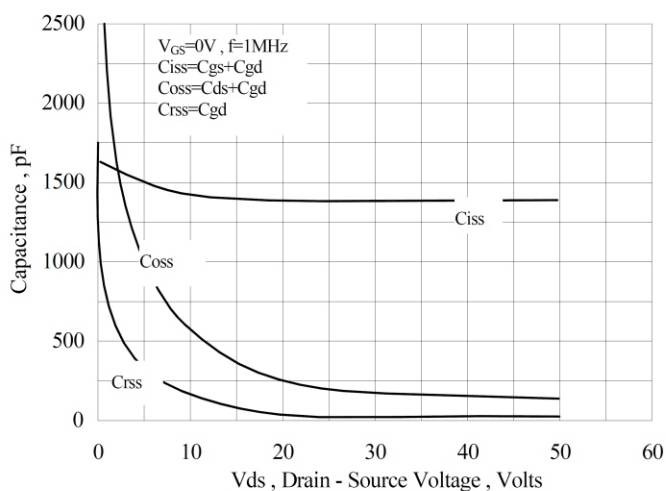


Figure 13 Typical Capacitance vs Drain to Source Voltage

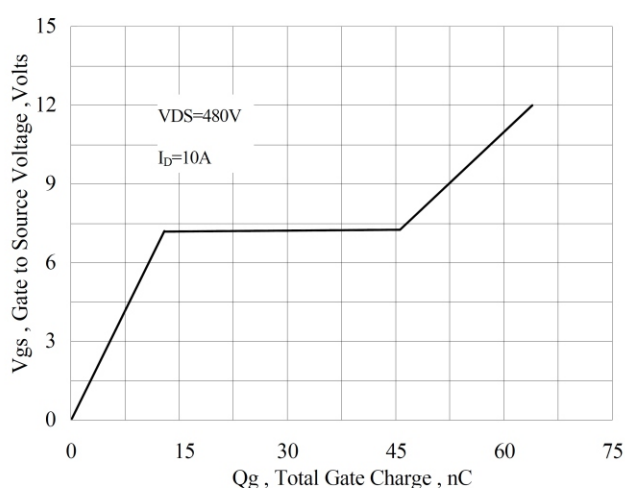


Figure 14 Typical Gate Charge vs Gate to Source Voltage

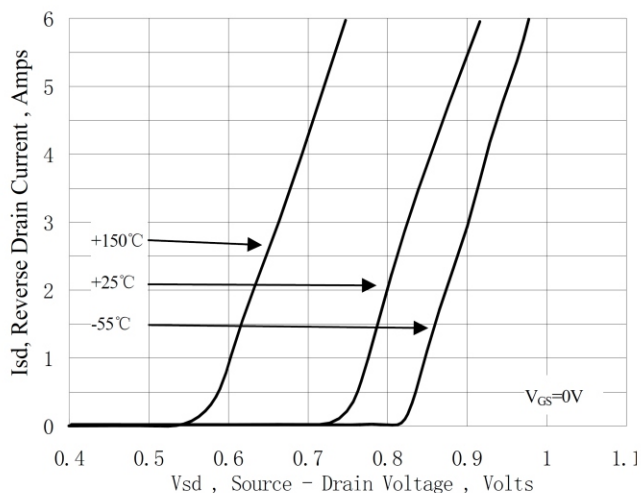


Figure 15 Typical Body Diode Transfer Characteristics

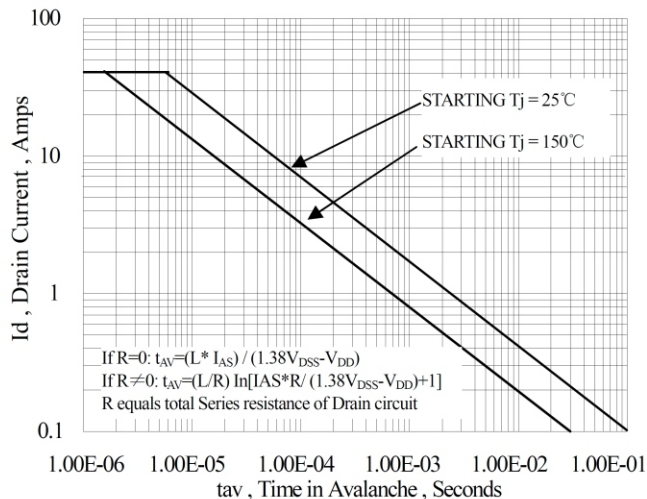


Figure 16 Unclamped Inductive Switching Capability

■ Test circuit and waveform

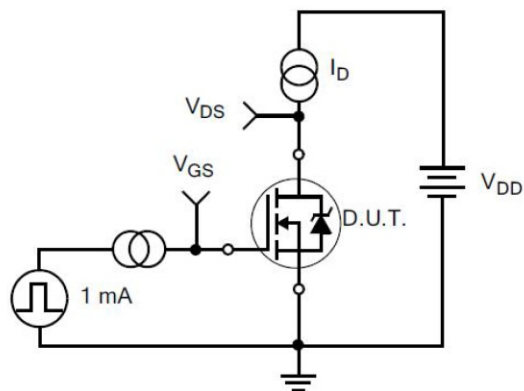


Figure 17. Gate Charge Test Circuit

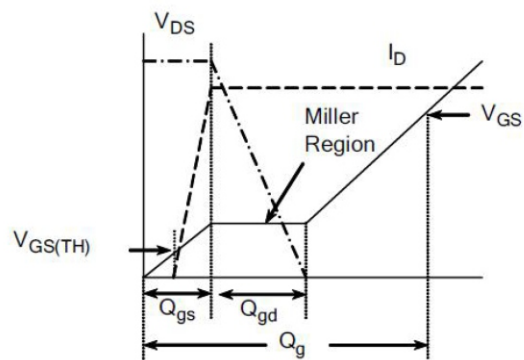


Figure 18. Gate Charge Waveform

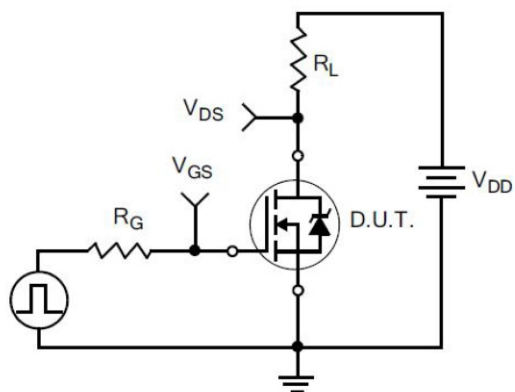


Figure 19. Resistive Switching Test Circuit

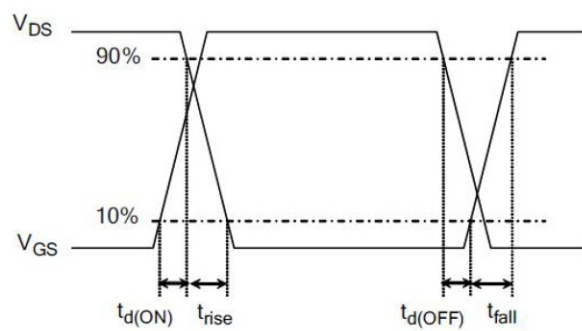


Figure 20. Resistive Switching Waveforms

■ Test circuit and waveform

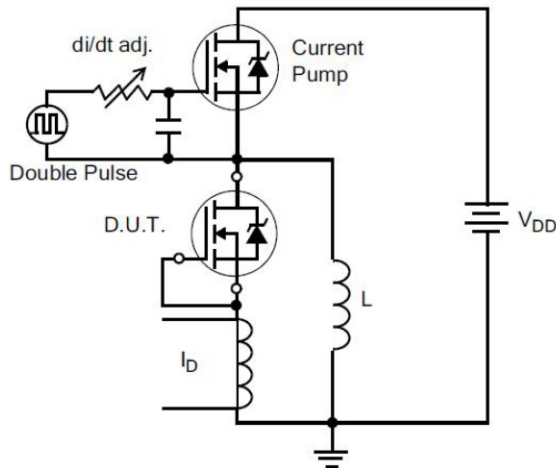


Figure 21. Diode Reverse Recovery Test Circuit

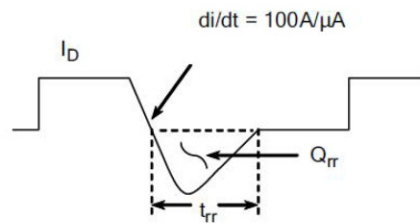


Figure 22. Diode Reverse Recovery Waveform

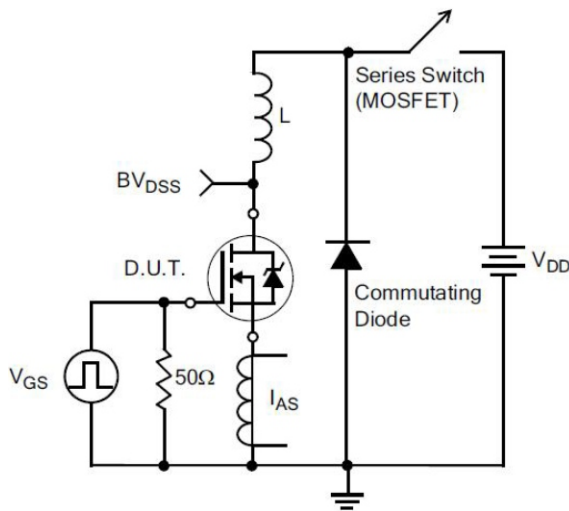


Figure 23. Unclamped Inductive Switching Test Circuit

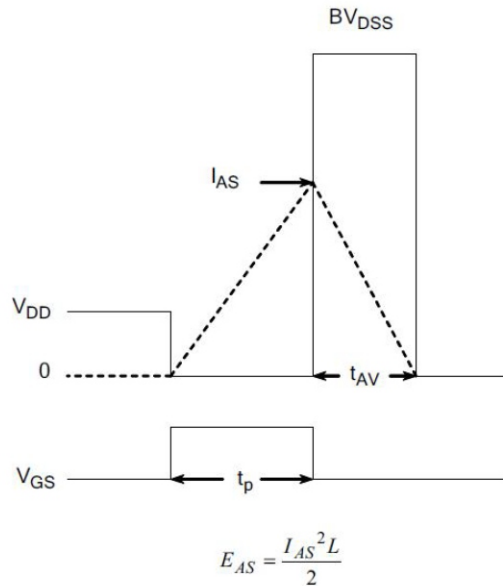


Figure 24. Unclamped Inductive Switching Waveforms

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