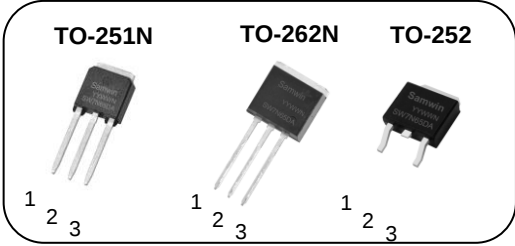


N-channel Enhanced mode TO-251N/TO-262N/TO-252 MOSFET

Features

- High ruggedness
- Low $R_{DS(ON)}$ (Typ 1.4Ω)@ $V_{GS}=10V$
- Low Gate Charge (Typ 25nC)
- Improved dv/dt Capability
- 100% Avalanche Tested
- Application: LED , Charger, PC Power



$BV_{DSS} : 650V$
 $I_D : 7A$
 $R_{DS(ON)} : 1.4\Omega$

1. Gate 2. Drain 3. Source

General Description

This power MOSFET is produced with advanced technology of SAMWIN. This technology enable the power MOSFET to have better characteristics, including fast switching time, low on resistance, low gate charge and especially excellent avalanche characteristics.



Order Codes

Item	Sales Type	Marking	Package	Packaging
1	SW N 7N65DA	SW7N65DA	TO-251N	TUBE
2	SW J 7N65DA	SW7N65DA	TO-262N	TUBE
3	SW D 7N65DA	SW7N65DA	TO-252	REEL

Absolute maximum ratings

Symbol	Parameter	Value			Unit
		TO-251N	TO-262N	TO-252	
V_{DSS}	Drain to source voltage	650			V
I_D	Continuous drain current (@ $T_C=25^{\circ}C$)	7*			A
	Continuous drain current (@ $T_C=100^{\circ}C$)	4.4*			A
I_{DM}	Drain current pulsed (note 1)	28			A
V_{GS}	Gate to source voltage	± 30			V
E_{AS}	Single pulsed avalanche energy (note 2)	323			mJ
E_{AR}	Repetitive avalanche energy (note 1)	25			mJ
dv/dt	Peak diode recovery dv/dt (note 3)	5			V/ns
P_D	Total power dissipation (@ $T_C=25^{\circ}C$)	176	184	154.3	W
	Derating factor above 25°C	1.4	1.5	1.2	W/°C
T_{STG}, T_J	Operating junction temperature & storage temperature	$-55 \sim +150$			°C
T_L	Maximum lead temperature for soldering purpose, 1/8 from case for 5 seconds.	300			°C

*. Drain current is limited by junction temperature.

Thermal characteristics

Symbol	Parameter	Value			Unit
		TO-251N	TO-262N	TO-252	
R_{thjc}	Thermal resistance, Junction to case	0.71	0.68	0.81	°C/W
R_{thja}	Thermal resistance, Junction to ambient	83	65		°C/W

Electrical characteristic ($T_C = 25^\circ\text{C}$ unless otherwise specified)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
Off characteristics						
BV_{DSS}	Drain to source breakdown voltage	$V_{GS}=0V, I_D=250\mu A$	650			V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown voltage temperature coefficient	$I_D=250\mu A$, referenced to 25°C		0.58		V/ $^\circ\text{C}$
I_{DSS}	Drain to source leakage current	$V_{DS}=650V, V_{GS}=0V$			1	μA
		$V_{DS}=520V, T_C=125^\circ\text{C}$			50	μA
I_{GSS}	Gate to source leakage current, forward	$V_{GS}=30V, V_{DS}=0V$			100	nA
	Gate to source leakage current, reverse	$V_{GS}=-30V, V_{DS}=0V$			-100	nA
On characteristics						
$V_{GS(TH)}$	Gate threshold voltage	$V_{DS}=V_{GS}, I_D=250\mu A$	2.5		4.5	V
$R_{DS(ON)}$	Drain to source on state resistance	$V_{GS}=10V, I_D=3A$		1.4	1.7	Ω
G_{fs}	Forward transconductance	$V_{DS}=30V, I_D=3.5A$		5.7		S
Dynamic characteristics						
C_{iss}	Input capacitance	$V_{GS}=0V, V_{DS}=25V, f=1\text{MHz}$		975		pF
C_{oss}	Output capacitance			92		
C_{rss}	Reverse transfer capacitance			9.4		
$t_{d(on)}$	Turn on delay time	$V_{DS}=325V, I_D=7A, R_G=25\Omega, V_{GS}=10V$ (note 4,5)		16		ns
t_r	Rising time			31		
$t_{d(off)}$	Turn off delay time			50		
t_f	Fall time			28		
Q_g	Total gate charge	$V_{DS}=520V, V_{GS}=10V, I_D=7A, I_g=5mA$ (note 4,5)		25		nC
Q_{gs}	Gate-source charge			6.3		
Q_{gd}	Gate-drain charge			11		
R_g	Gate resistance	$V_{DS}=0V$, Scan F mode		2.1		Ω

Source to drain diode ratings characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_S	Continuous source current	Integral reverse p-n Junction diode in the MOSFET			7	A
I_{SM}	Pulsed source current				28	A
V_{SD}	Diode forward voltage drop.	$I_S=7A, V_{GS}=0V$			1.4	V
t_{rr}	Reverse recovery time	$I_S=7A, V_{GS}=0V, di/dt=100A/\mu s$		468		ns
Q_{rr}	Reverse recovery charge			3.5		μC

※. Notes

1. Repeattive rating : pulse width limited by junction temperature.
2. $L = 13.2mH, I_{AS} = 7A, V_{DD} = 50V, R_G = 25\Omega$, Starting $T_J = 25^\circ\text{C}$
3. $I_{SD} \leq 7A, di/dt = 100A/\mu s, V_{DD} \leq BV_{DSS}$, Starting $T_J = 25^\circ\text{C}$
4. Pulse Test : Pulse Width $\leq 300\mu s$, duty cycle $\leq 2\%$.
5. Essentially independent of operating temperature.

Fig. 1. On-state characteristics

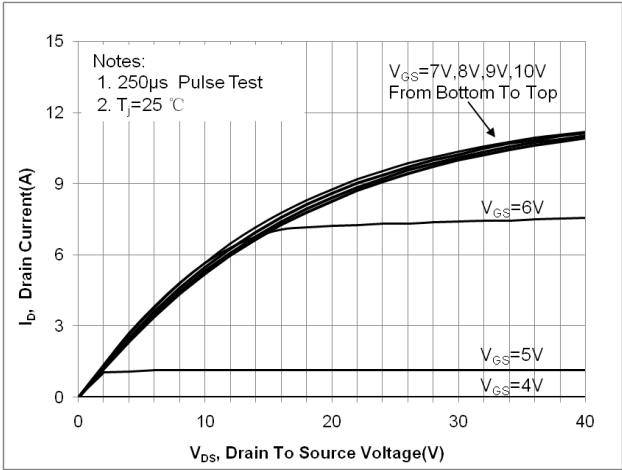


Fig. 2. Transfer Characteristics

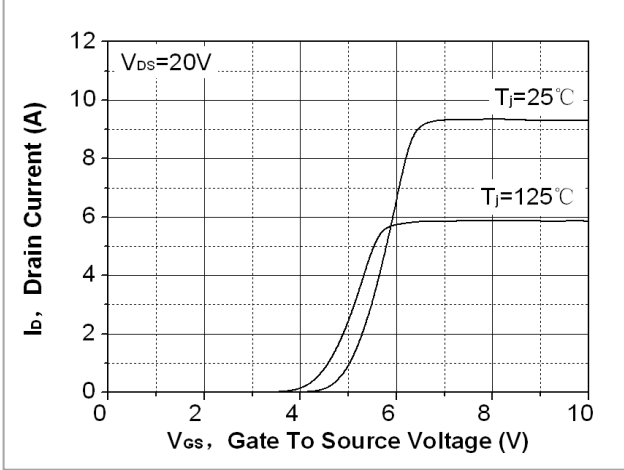


Fig. 3. On-resistance variation vs. drain current and gate voltage

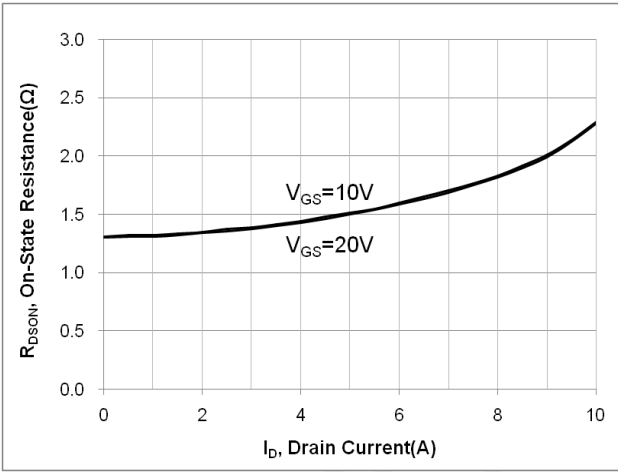


Fig. 4. On-state current vs. diode forward voltage

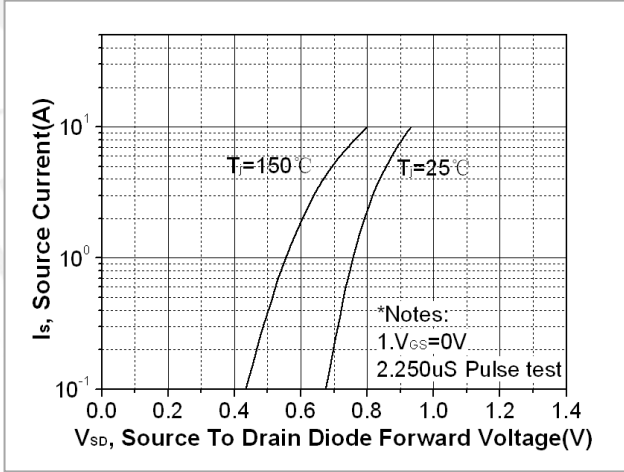


Fig 5. Breakdown voltage variation vs. junction temperature

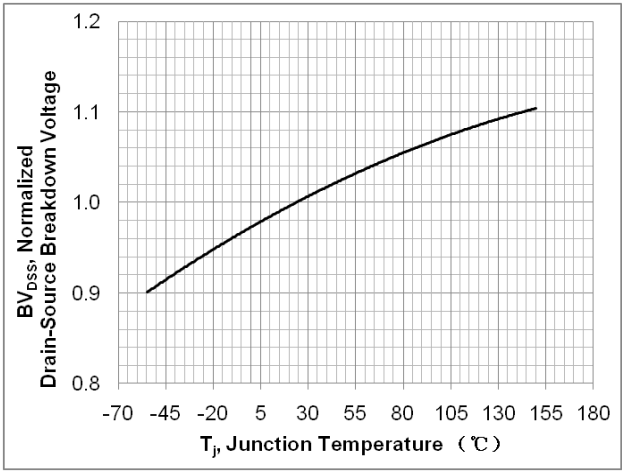


Fig. 6. On-resistance variation vs. junction temperature

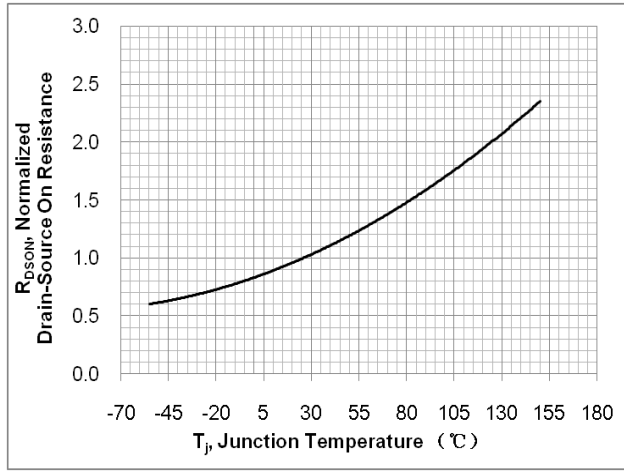


Fig. 7. Gate charge characteristics

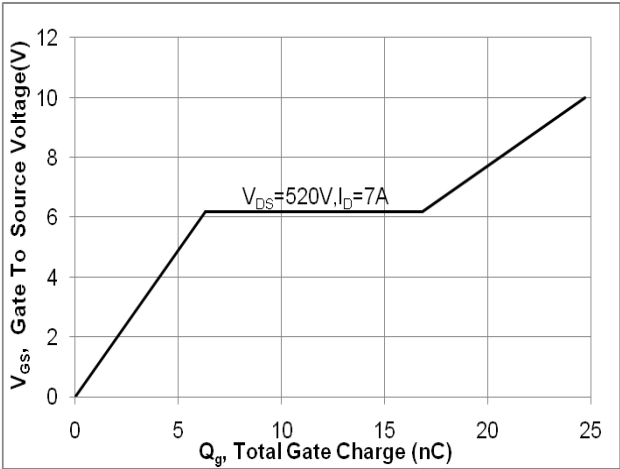


Fig. 8. Capacitance Characteristics

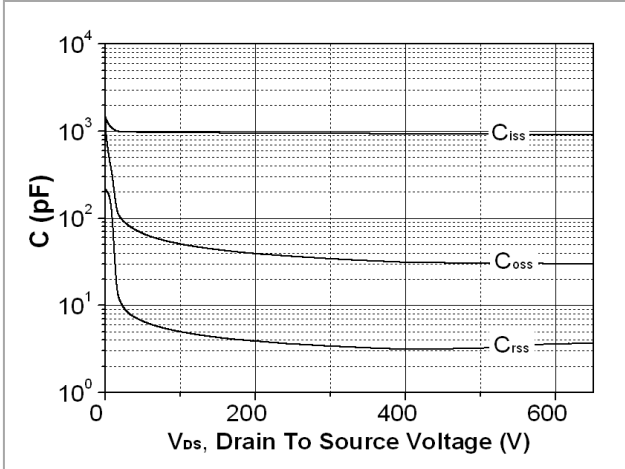


Fig. 9. Maximum safe operating area(TO-251N)

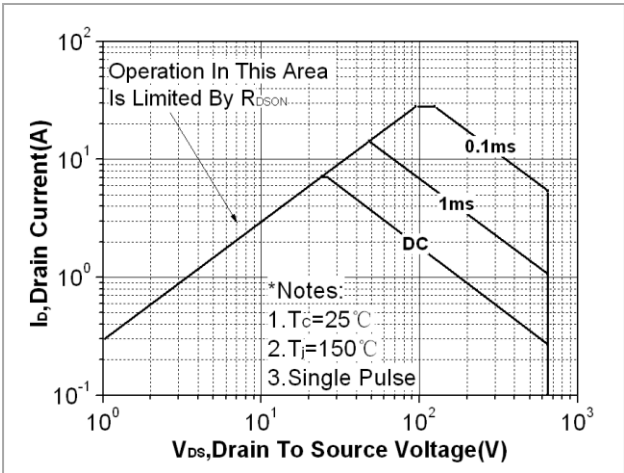


Fig. 10. Maximum safe operating area(TO-262N)

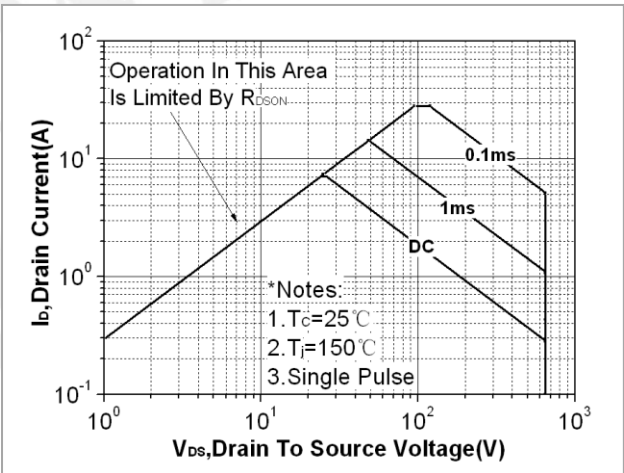


Fig. 11. Maximum safe operating area(TO-252)

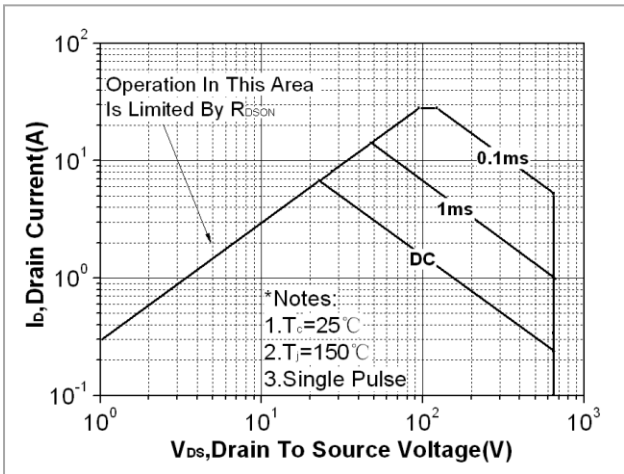


Fig. 12. Transient thermal response curve(TO-251N)

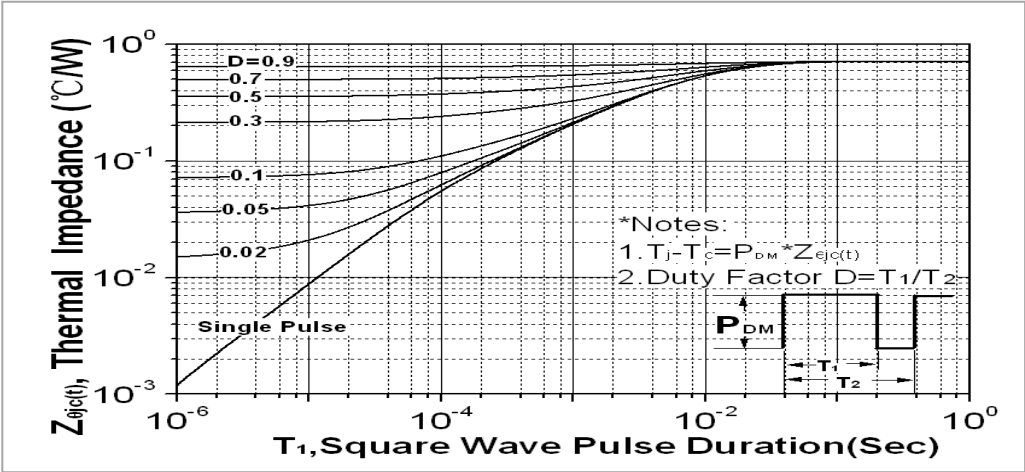


Fig. 13. Transient thermal response curve(TO-262N)

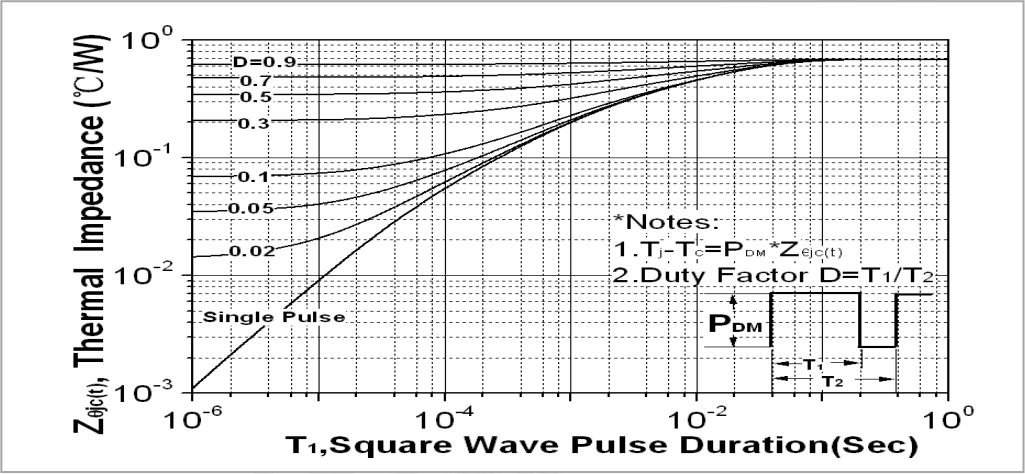


Fig. 14. Transient thermal response curve(TO-252)

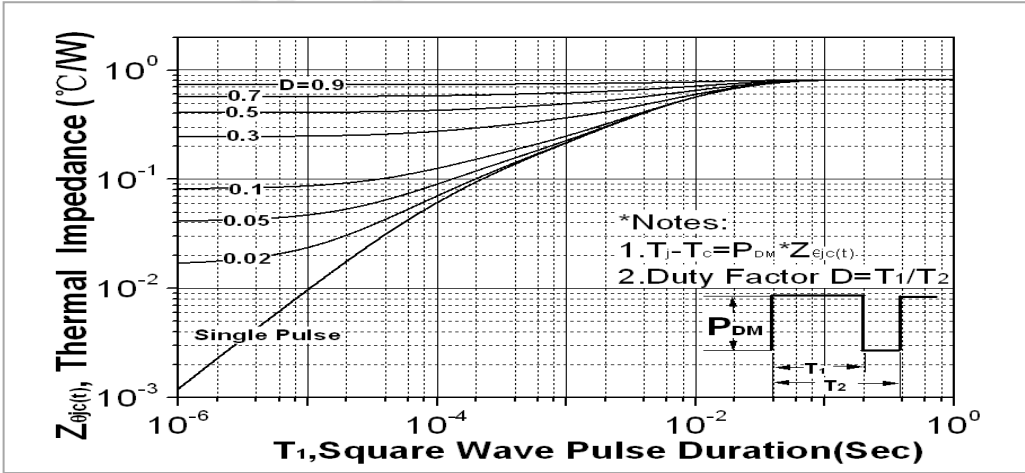


Fig. 15. Gate charge test circuit & waveform

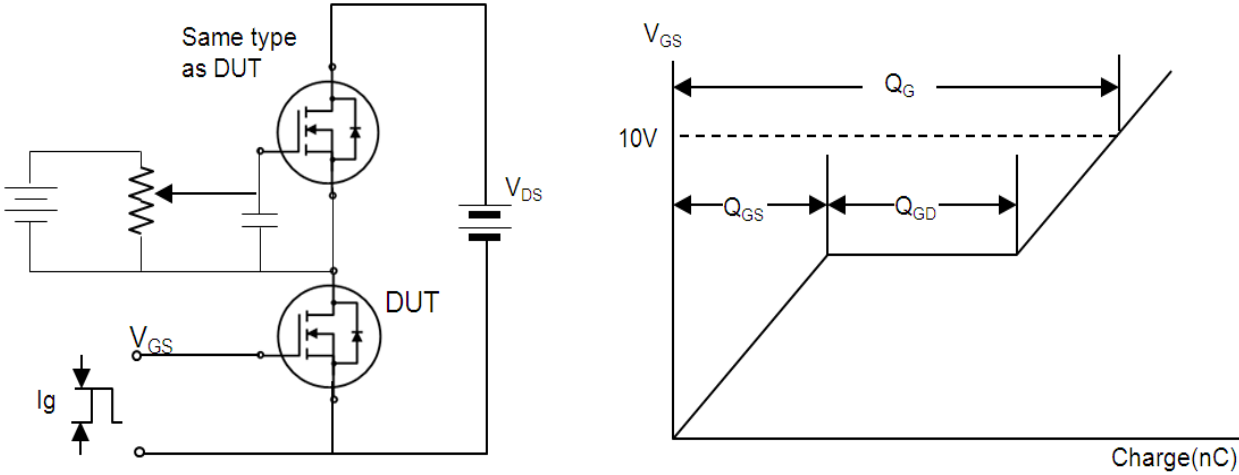


Fig. 16. Switching time test circuit & waveform

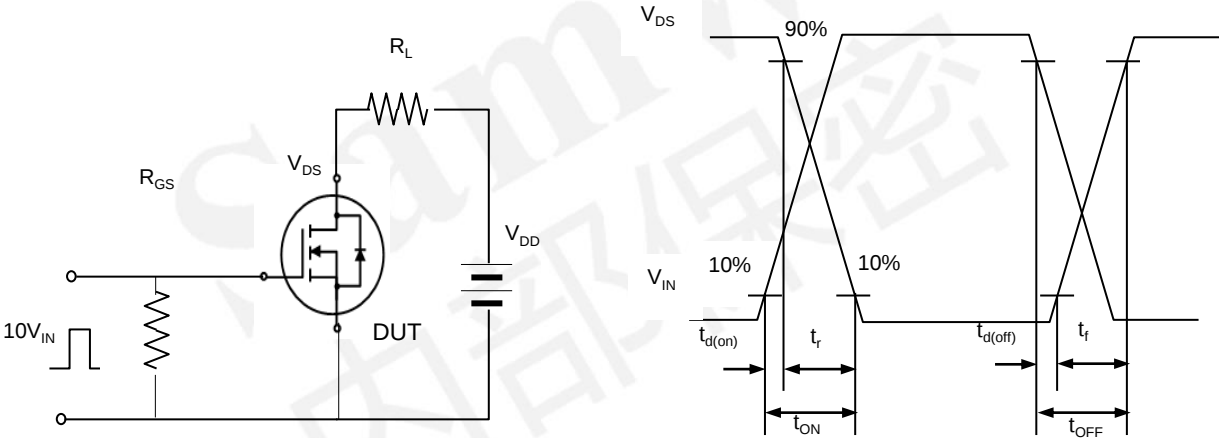
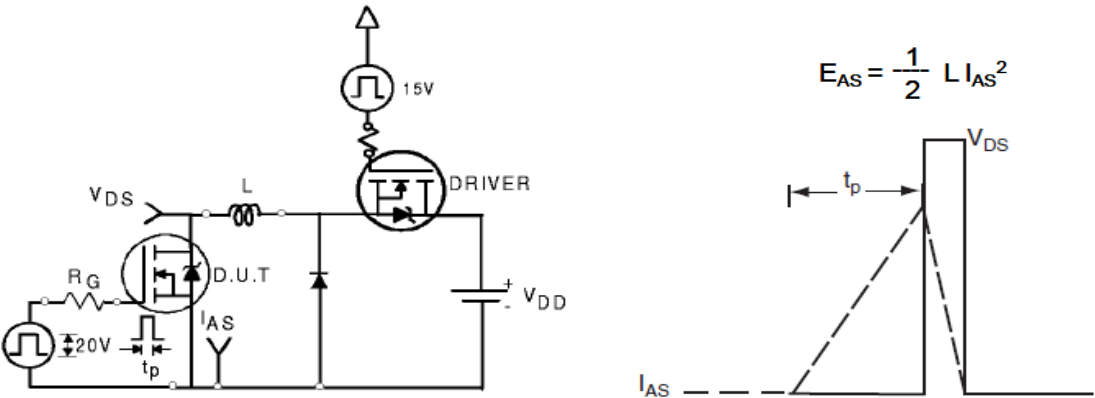


Fig. 17. Unclamped Inductive switching test circuit & waveform



The diagram illustrates a test setup for a diode switching circuit and its corresponding waveforms.

Circuit Diagram: A MOSFET (DUT) is connected in series with an inductor L and a diode (DUT). The MOSFET's gate is driven by a $10V_{GS}$ pulse. The MOSFET's drain is connected to the inductor, and the inductor's other end is connected to the diode's anode. The diode's cathode is connected to ground. The MOSFET's source is connected to ground. The diode's anode is also connected to ground. The MOSFET's drain voltage is V_{DS} , the MOSFET's source current is I_S , and the diode's drain voltage is V_{DS} . The MOSFET is labeled "Same type as DUT".

Waveforms:

- V_{GS} (DRIVER): A square wave pulse with a 10V amplitude.
- I_S (DUT): The MOSFET source current, showing a rise during the MOSFET turn-on, a steady-state plateau, and a fall during the MOSFET turn-off. The fall is labeled di/dt .
- V_{DS} (DUT): The MOSFET drain voltage, showing a drop during the MOSFET turn-on, a steady-state plateau at V_F (Body diode forward voltage drop), and a rise during the MOSFET turn-off. The rise is labeled "Diode recovery dv/dt ".

Additional labels in the waveform section include I_{RRM} (Diode reverse current) and V_{DD} (Supply voltage).

*. dv/dt controlled by R_G
 *. I_S controlled by pulse period

* Suggestions for improvement are appreciated, Please send your suggestions to samwin@samwinsemi.com