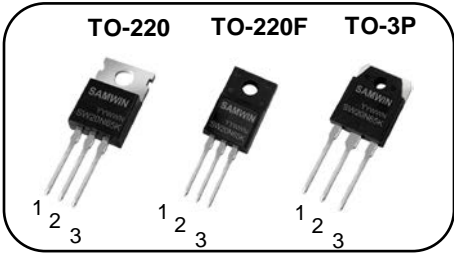


N-channel Enhanced mode TO-220/TO-220F/TO-3P MOSFET

Features

- High ruggedness
- Low  $R_{DS(ON)}$  (Typ 0.16Ω) @  $V_{GS}=10V$
- Low Gate Charge (Typ 60nC)
- Improved dv/dt Capability
- 100% Avalanche Tested
- Application: LED, Charge, PC Power



1. Gate 2. Drain 3. Source

**$BV_{DSS}$  : 650V**  
 **$I_D$  : 20A**  
 **$R_{DS(ON)}$  : 0.16 Ω**

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 P 20N65K	SW20N65K	TO-220	TUBE
2	SW F 20N65K	SW20N65K	TO-220F	TUBE
3	SW W 20N65K	SW20N65K	TO-3P	TUBE

Absolute maximum ratings

Symbol	Parameter	Value			Unit
		TO-220	TO-220F	TO-3P	
$V_{DSS}$	Drain to source voltage	650			V
$I_D$	Continuous drain current (@ $T_C=25^{\circ}C$ )	20*			A
	Continuous drain current (@ $T_C=100^{\circ}C$ )	12.6*			A
$I_{DM}$	Drain current pulsed (note 1)	80			A
$V_{GS}$	Gate to source voltage	$\pm 30$			V
$E_{AS}$	Single pulsed avalanche energy (note 2)	500			mJ
$E_{AR}$	Repetitive avalanche energy (note 1)	24			mJ
dv/dt	Peak diode recovery dv/dt (note 3)	5			V/ns
$P_D$	Total power dissipation (@ $T_C=25^{\circ}C$ )	341.5	35.9	403.2	W
	Derating factor above 25°C	2.7	0.3	3.2	W/°C
$T_{STG}, T_J$	Operating junction temperature & storage temperature	-55 ~ + 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-220	TO-220F	TO-3P	
$R_{thjc}$	Thermal resistance, Junction to case	0.36	3.48	0.31	°C/W
$R_{thja}$	Thermal resistance, Junction to ambient	55.7	47.3	41.6	°C/W

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

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
<b>Off characteristics</b>						
$BV_{DSS}$	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 $25^\circ\text{C}$		0.64		$V/^\circ\text{C}$
$I_{DSS}$	Drain to source leakage current	$V_{DS}=650V, V_{GS}=0V$			1	$\mu A$
		$V_{DS}=520V, T_C=125^\circ\text{C}$			50	$\mu A$
$I_{GSS}$	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
<b>On characteristics</b>						
$V_{GS(TH)}$	Gate threshold voltage	$V_{DS}=V_{GS}, I_D=250\mu A$	2		5	V
$R_{DS(ON)}$	Drain to source on state resistance	$V_{GS}=10V, I_D=10A$		0.16	0.19	$\Omega$
$G_{fs}$	Forward transconductance	$V_{DS}=30V, I_D=10A$		14		S
<b>Dynamic characteristics</b>						
$C_{iss}$	Input capacitance	$V_{GS}=0V, V_{DS}=25V, f=1\text{MHz}$		2170		pF
$C_{oss}$	Output capacitance			1470		
$C_{rss}$	Reverse transfer capacitance			27		
$t_{d(on)}$	Turn on delay time	$V_{DS}=325V, I_D=20A, R_G=25\Omega, V_{GS}=10V$ (note 4,5)		28		ns
$t_r$	Rising time			52		
$t_{d(off)}$	Turn off delay time			116		
$t_f$	Fall time			40		
$Q_g$	Total gate charge	$V_{DS}=520V, V_{GS}=10V, I_D=20A$ (note 4,5)		60		nC
$Q_{gs}$	Gate-source charge			17		
$Q_{gd}$	Gate-drain charge			26		

## 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			20	A
$I_{SM}$	Pulsed source current				80	A
$V_{SD}$	Diode forward voltage drop.	$I_S=20A, V_{GS}=0V$			1.4	V
$t_{rr}$	Reverse recovery time	$I_S=20A, V_{GS}=0V, di/dt=100A/\mu s$		366		ns
$Q_{rr}$	Reverse recovery charge			6.8		$\mu C$

※. Notes

1. Repeitative rating : pulse width limited by junction temperature.
2.  $L = 62.5\text{mH}, I_{AS} = 4A, V_{DD} = 50V, R_G=25\Omega$ , Starting  $T_J = 25^\circ\text{C}$
3.  $I_{SD} \leq 20A, di/dt = 100A/\mu s, V_{DD} \leq BV_{DSS}$ , 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

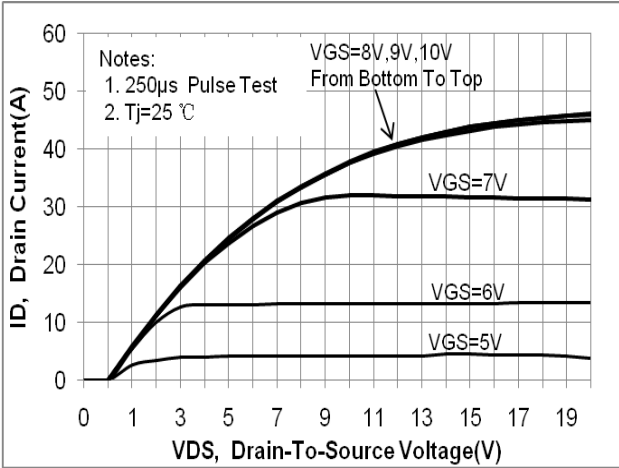


Fig. 2. On-resistance variation vs. drain current and gate voltage

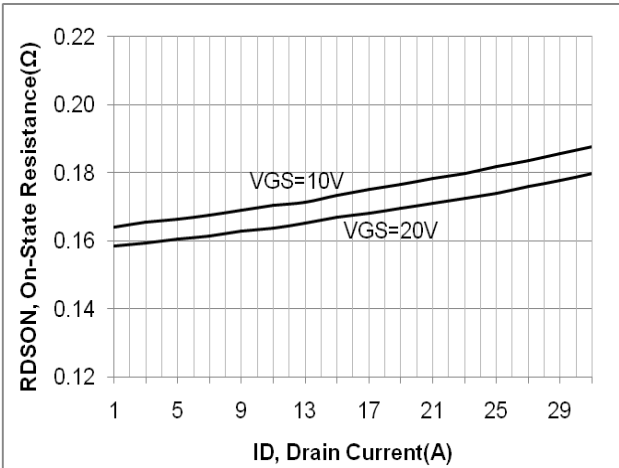


Fig. 3. Gate charge characteristics

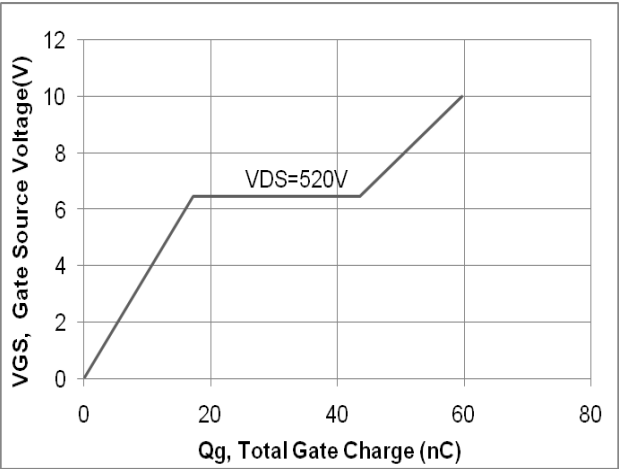


Fig. 4. On state current vs. diode forward voltage

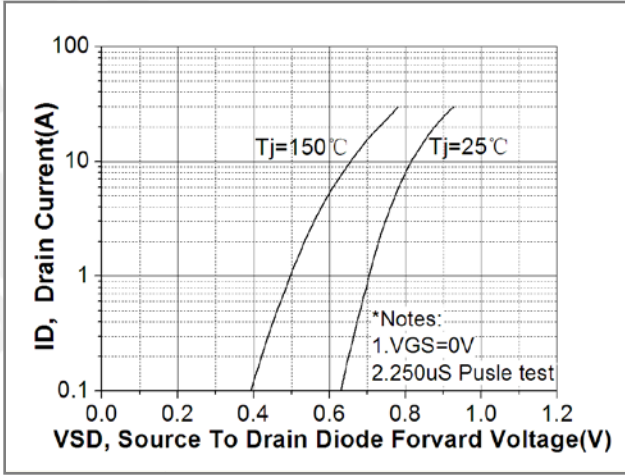


Fig 5. Breakdown Voltage Variation vs. Junction Temperature

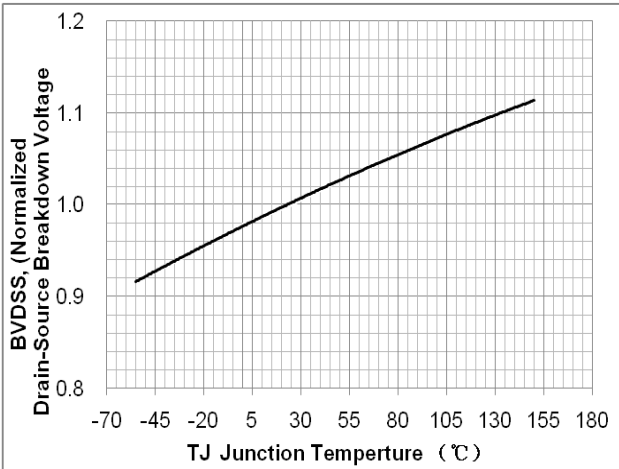


Fig. 6. On resistance variation vs. junction temperature

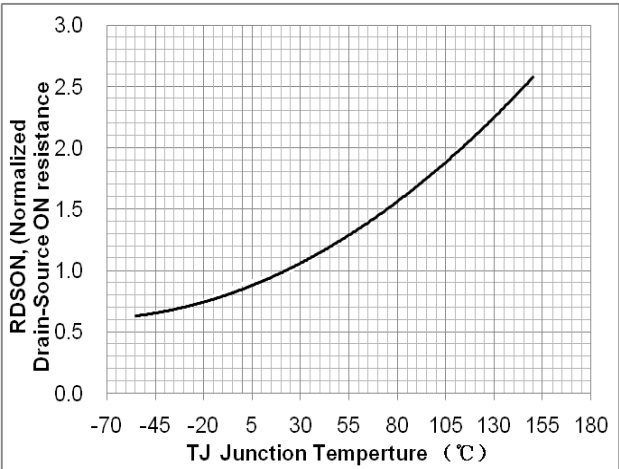


Fig. 7. Maximum safe operating area(TO-220)

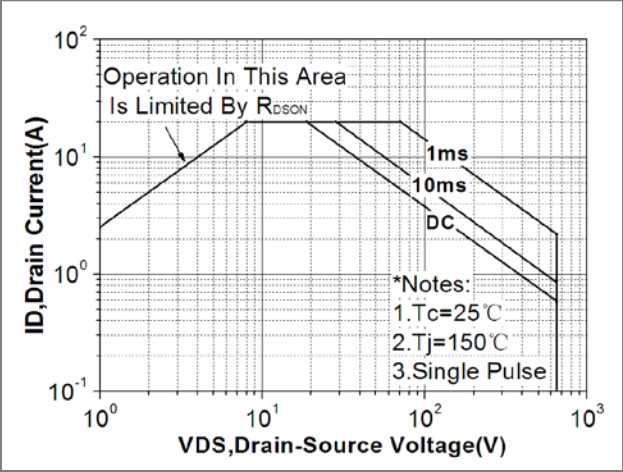


Fig. 8. Maximum safe operating area(TO-220F)

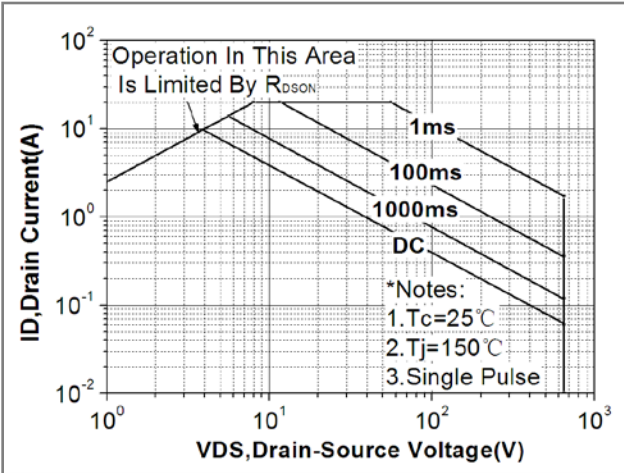


Fig. 9. Maximum safe operating area(TO-3P)

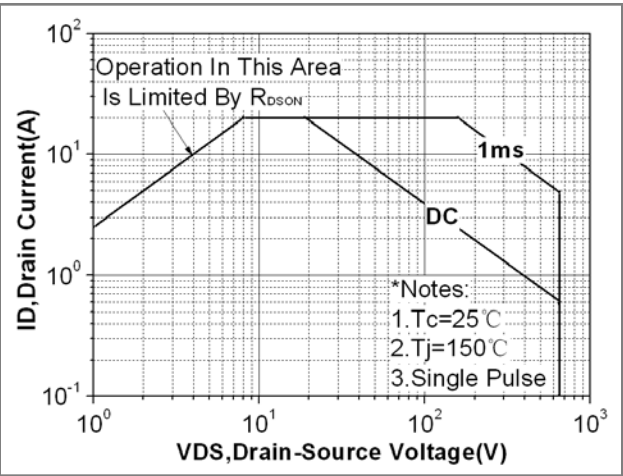


Fig. 10. Capacitance Characteristics

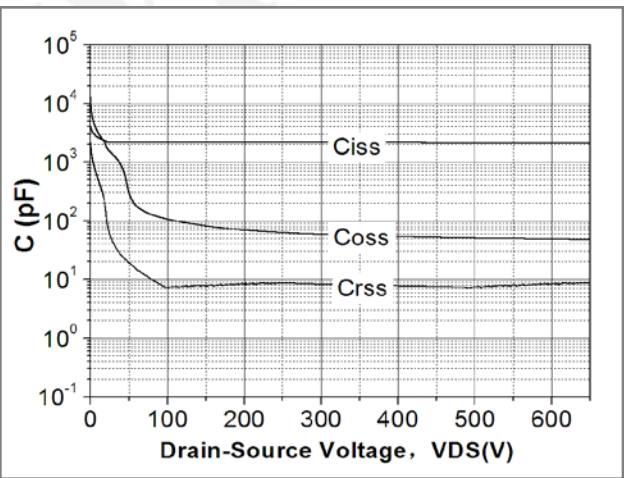


Fig. 11. Transient thermal response curve(TO-220)

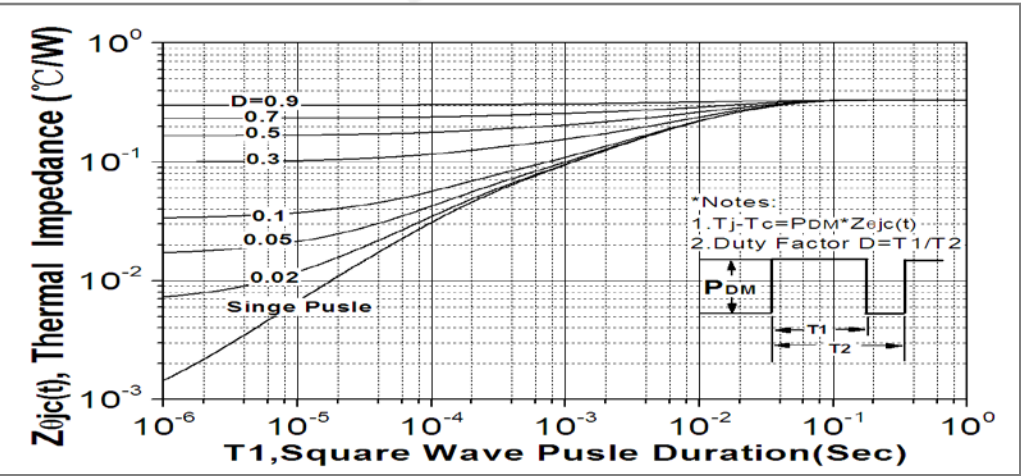


Fig. 12. Transient thermal response curve(TO-220F)

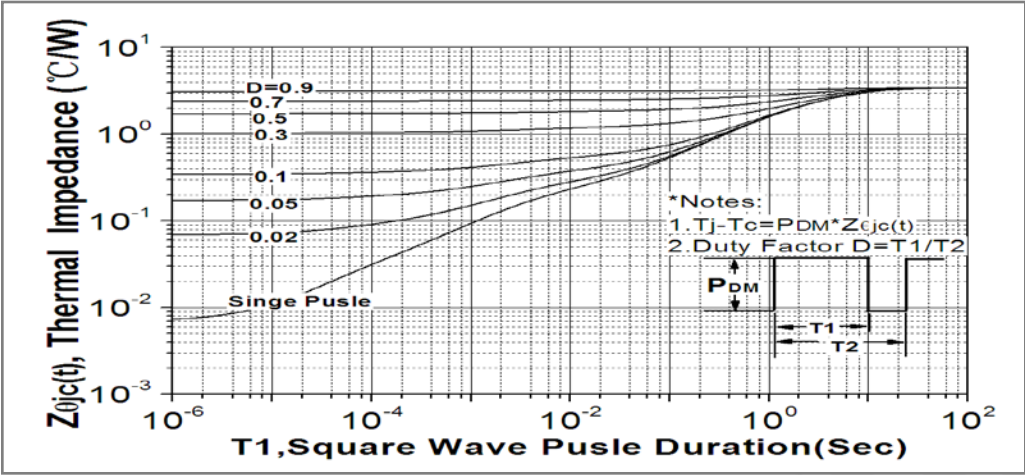


Fig. 13. Transient thermal response curve(TO-3P)

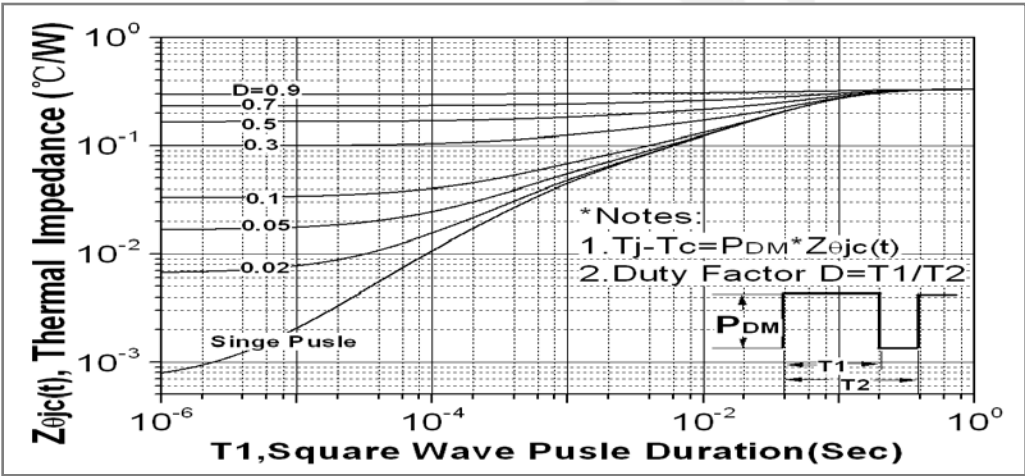


Fig. 14. Gate charge test circuit & waveform

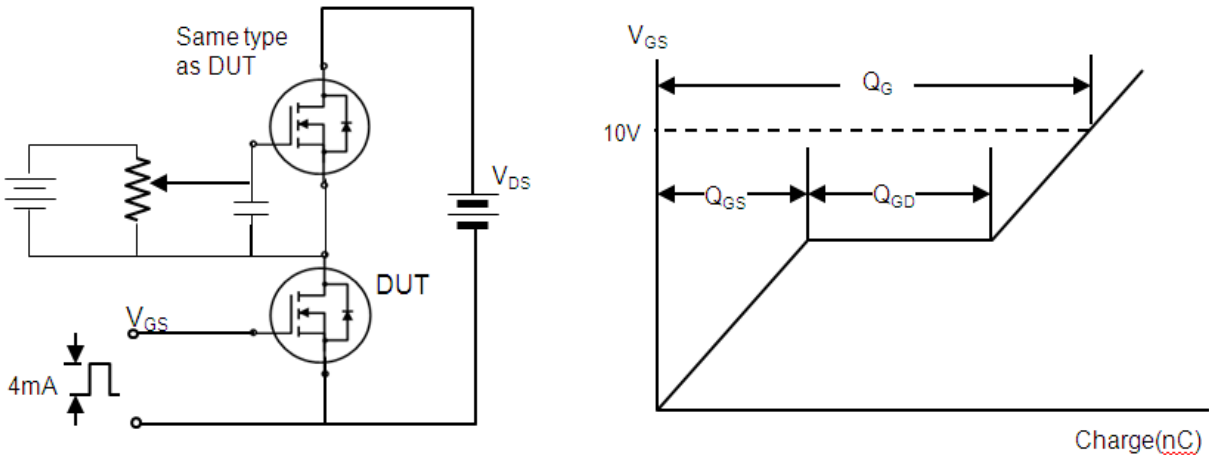


Fig. 15. Switching time test circuit & waveform

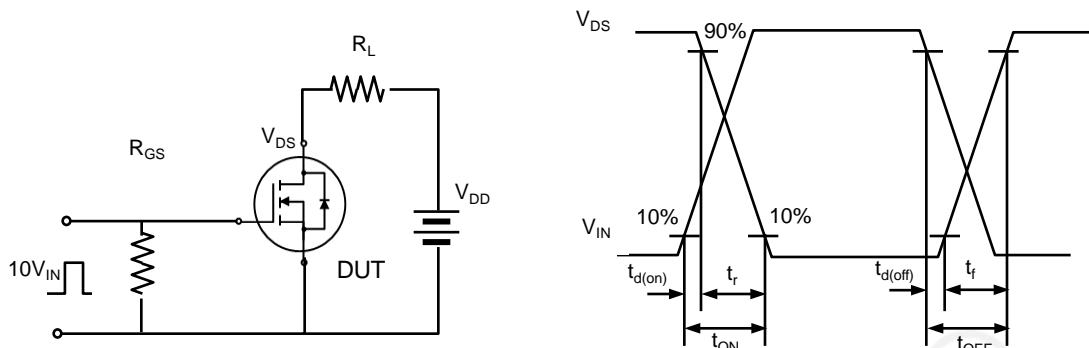


Fig. 16. Unclamped Inductive switching test circuit & waveform

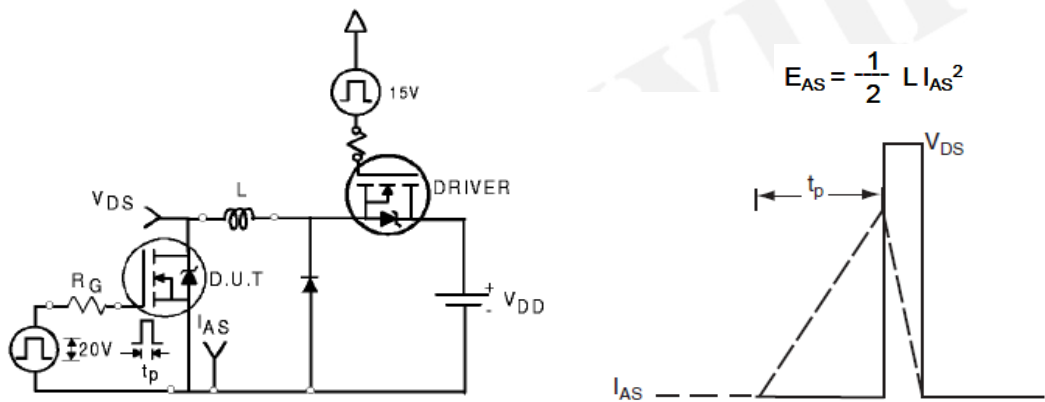
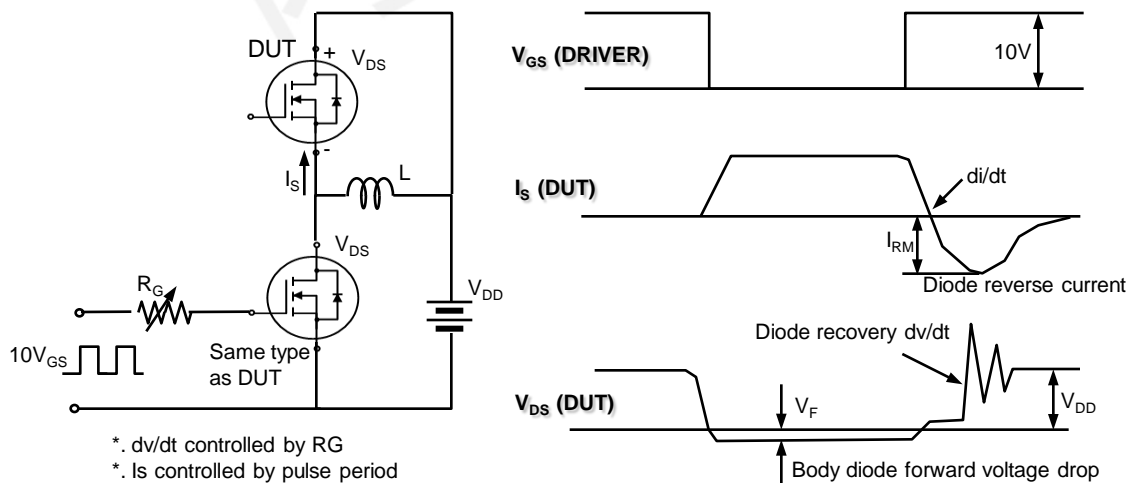



Fig. 17. Peak diode recovery dv/dt test circuit & waveform



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### DISCLAIMER

- \* All the data & curve in this document was tested in XI'AN SEMIPOWER TESTING & APPLICATION CENTER.
- \* This product has passed the PCT,TC,HTRB,HTGB,HAST,PC and Solderdunk reliability testing.
- \* Qualification standards can also be found on the Web site (<http://www.semipower.com.cn>) 
- \* Suggestions for improvement are appreciated, Please send your suggestions to [samwin@samwinsemi.com](mailto:samwin@samwinsemi.com)