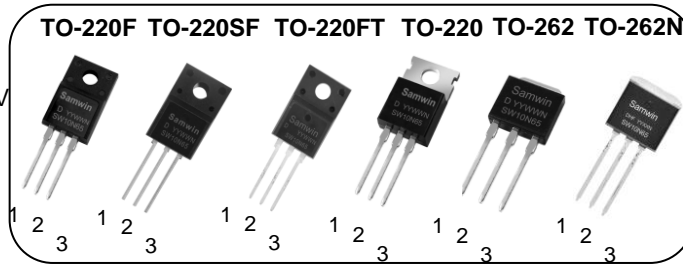


## N-channel Enhanced mode TO-220F/TO-220SF/TO-220FT/TO-220/TO-262/TO-262N MOSFET

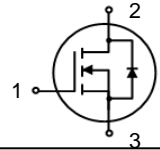
### Features

- High ruggedness
- Low  $R_{DS(ON)}$  (Typ 0.9Ω) @  $V_{GS}=10V$
- Low Gate Charge (Typ 35nC)
- Improved dv/dt Capability
- 100% Avalanche Tested
- Application: UPS, Inverter, PC-POWER



1. Gate 2. Drain 3. Source

$BV_{DSS}$  : 650V  
 $I_D$  : 10A  
 $R_{DS(ON)}$  : 0.9Ω



### 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 F 10N65D	SW10N65D	TO-220F	TUBE
2	SW MN 10N65D	SW10N65D	TO-220SF	TUBE
3	SW Y 10N65D	SW10N65D	TO-220FT	TUBE
4	SW P 10N65D	SW10N65D	TO-220	TUBE
5	SW U 10N65D	SW10N65D	TO-262	TUBE
6	SW J 10N65D	SW10N65D	TO-262N	TUBE

### Absolute maximum ratings

Symbol	Parameter	Value			Unit
		TO-220F/ TO-220SF/TO-220FT	TO-220	TO-262/TO- 262N	
$V_{DSS}$	Drain to Source Voltage	650			V
$I_D$	Continuous drain current (@ $T_C=25^\circ C$ )	10*			A
	Continuous drain current (@ $T_C=100^\circ C$ )	6.3*			A
$I_{DM}$	Drain current pulsed (note 1)	40			A
$V_{GS}$	Gate to source voltage	$\pm 30$			V
$E_{AS}$	Single pulsed avalanche energy (note 2)	427			mJ
$E_{AR}$	Repetitive avalanche energy (note 1)	43			mJ
dv/dt	Peak diode recovery dv/dt (note 3)	5			V/ns
$P_D$	Total power dissipation (@ $T_C=25^\circ C$ )	41.8	181.2	156.3	W
	Derating factor above 25°C	0.33	1.45	1.3	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-220F/ TO-220SF/TO-220FT	TO-220	TO-262/TO- 262N	
$R_{thjc}$	Thermal resistance, Junction to case	2.99	0.69	0.8	°C/W
$R_{thja}$	Thermal resistance, Junction to ambient	47	55	72	°C/W

## Electrical characteristic ( T<sub>J</sub> = 25°C unless otherwise specified )

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
<b>Off characteristics</b>						
BV <sub>DSS</sub>	Drain to source breakdown voltage	V <sub>GS</sub> =0V, I <sub>D</sub> =250uA	650			V
ΔBV <sub>DSS</sub> / ΔT <sub>J</sub>	Breakdown voltage temperature coefficient	I <sub>D</sub> =250uA, referenced to 25°C		0.51		V/°C
I <sub>DSS</sub>	Drain to source leakage current	V <sub>DS</sub> =650V, V <sub>GS</sub> =0V			1	uA
		V <sub>DS</sub> =520V, T <sub>J</sub> =125°C			50	uA
I <sub>GSS</sub>	Gate to source leakage current, forward	V <sub>GS</sub> =30V, V <sub>DS</sub> =0V			100	nA
	Gate to source leakage current, reverse	V <sub>GS</sub> =-30V, V <sub>DS</sub> =0V			-100	nA
<b>On characteristics</b>						
V <sub>GS(TH)</sub>	Gate threshold voltage	V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250uA	2.5		4.5	V
R <sub>DS(ON)</sub>	Drain to source on state resistance	V <sub>GS</sub> =10V, I <sub>D</sub> =5A, T <sub>J</sub> =25°C		0.9	1.1	Ω
		V <sub>GS</sub> =10V, I <sub>D</sub> =5A, T <sub>J</sub> =125°C		1.93		Ω
G <sub>fs</sub>	Forward transconductance	V <sub>DS</sub> =30V, I <sub>D</sub> =5A		7.3		S
<b>Dynamic characteristics</b>						
C <sub>iss</sub>	Input capacitance	V <sub>GS</sub> =0V, V <sub>DS</sub> =25V, f=1MHz		1450		pF
C <sub>oss</sub>	Output capacitance			132		
C <sub>rss</sub>	Reverse transfer capacitance			14		
t <sub>d(on)</sub>	Turn on delay time	V <sub>DS</sub> =325V, I <sub>D</sub> =10A, R <sub>G</sub> =25Ω V <sub>GS</sub> =10V (note 4,5)		17		ns
t <sub>r</sub>	Rising time			43		
t <sub>d(off)</sub>	Turn off delay time			88		
t <sub>f</sub>	Fall time			46		
Q <sub>g</sub>	Total gate charge	V <sub>DS</sub> =520V, V <sub>GS</sub> =10V, I <sub>D</sub> =10A (note 4,5)		35		nC
Q <sub>gs</sub>	Gate-source charge			6		
Q <sub>gd</sub>	Gate-drain charge			17		
R <sub>g</sub>	Gate resistance	V <sub>DS</sub> =0V, Scan F mode		1.9		Ω

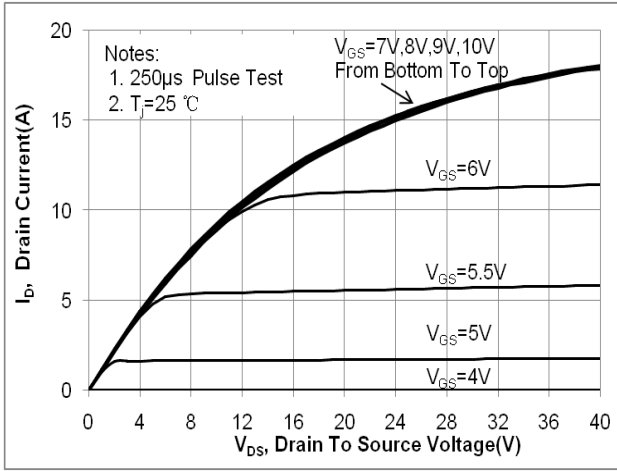
## Source to drain diode ratings characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I <sub>S</sub>	Continuous source current	Integral reverse p-n Junction diode in the MOSFET			10	A
I <sub>SM</sub>	Pulsed source current				40	A
V <sub>SD</sub>	Diode forward voltage drop.	I <sub>S</sub> =10A, V <sub>GS</sub> =0V			1.4	V
t <sub>rr</sub>	Reverse recovery time	I <sub>S</sub> =10A, V <sub>GS</sub> =0V, di <sub>f</sub> /dt=100A/us		506		ns
Q <sub>rr</sub>	Reverse recovery charge				4.7	uC

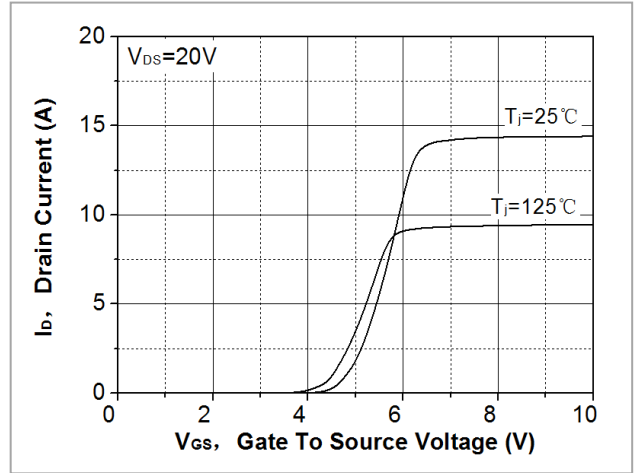
### ※. Notes

1. Repetitive rating : pulse width limited by junction temperature.
2. L = 8.5mH, I<sub>AS</sub>=10A, V<sub>DD</sub>=50V, R<sub>G</sub>=25Ω, Starting T<sub>J</sub> = 25°C
3. I<sub>SD</sub> ≤ 10A, di/dt = 100A/us, V<sub>DD</sub> ≤ BV<sub>DSS</sub>, Starting T<sub>J</sub> = 25°C
4. Pulse Test : Pulse Width ≤ 300us, duty cycle ≤ 2%
5. Essentially independent of operating temperature.

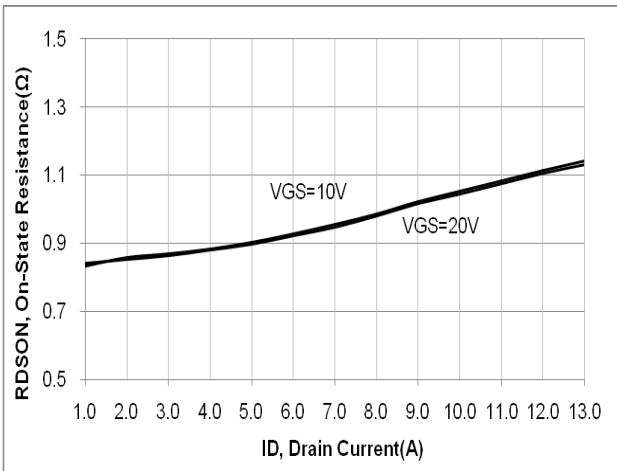
**Fig. 1. On-state characteristics**



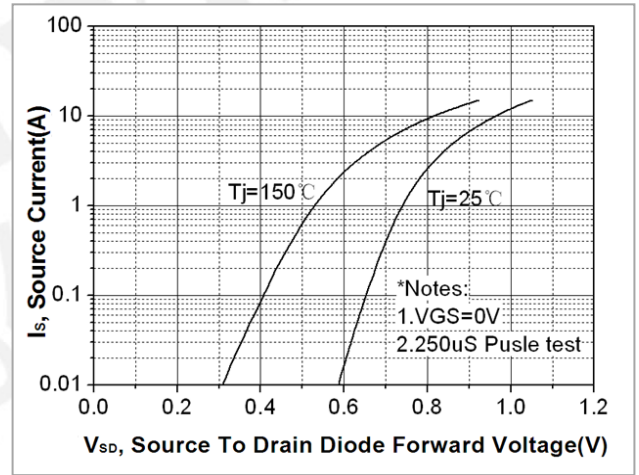
**Fig. 2. Transfer characteristics**



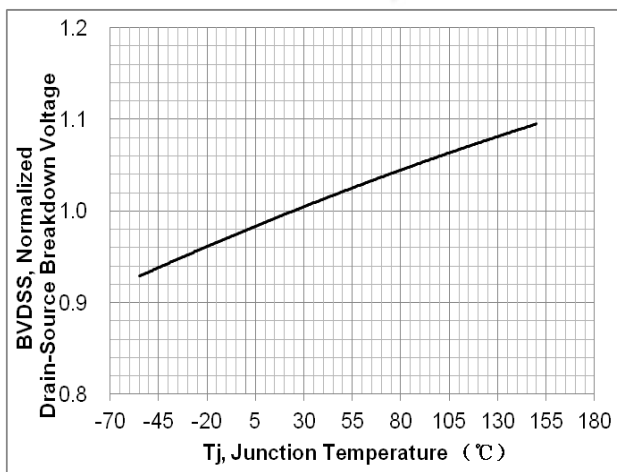
**Fig. 3. On-resistance variation vs. drain current and gate voltage**



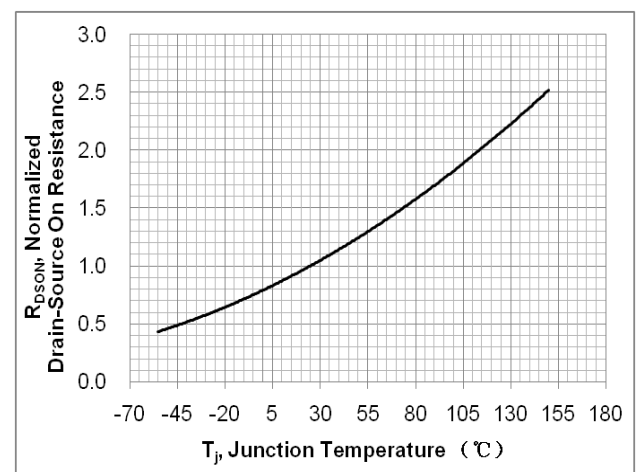
**Fig. 4. On-state current vs. diode forward voltage**



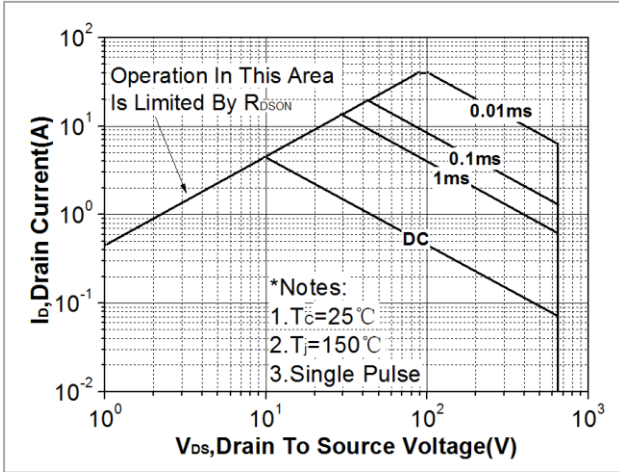
**Fig 5. Breakdown voltage variation vs. junction temperature**



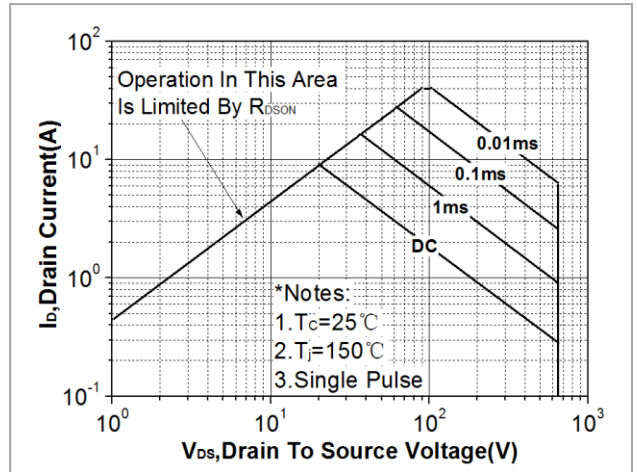
**Fig. 6. On-resistance variation vs. junction temperature**



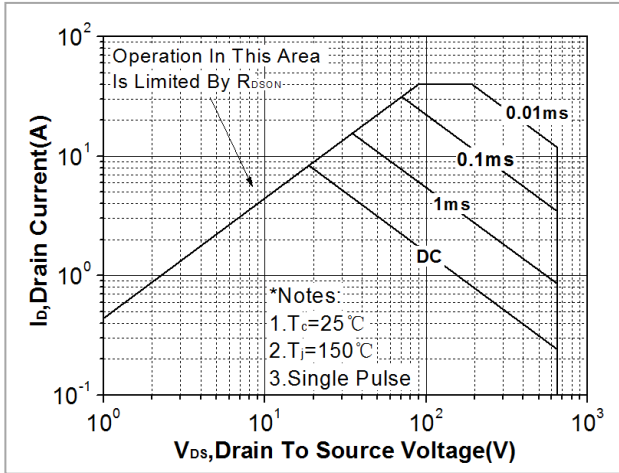
**Fig. 7. Maximum safe operating area (TO-220F/TO-220SF/TO-220FT)**



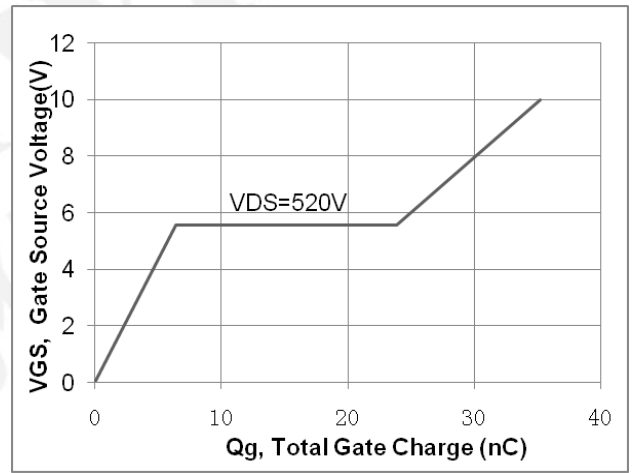
**Fig. 8. Maximum safe operating area(TO-220)**



**Fig. 9. Maximum safe operating area (TO-262/TO-262N)**



**Fig. 10. Gate charge characteristics**



**Fig. 11. Capacitance Characteristics**

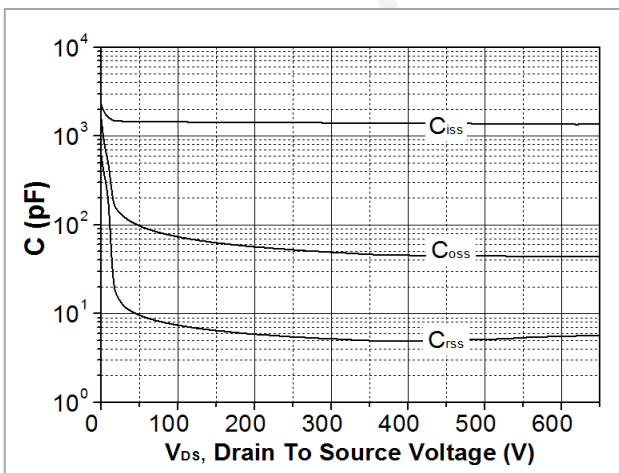


Fig. 12. Transient thermal response curve(TO-220F/TO-220SF/TO-220FT)

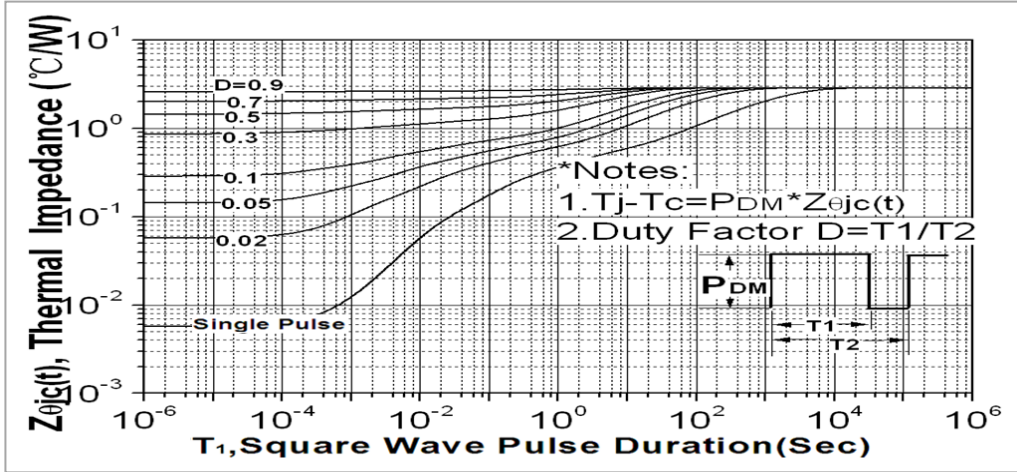


Fig. 13. Transient thermal response curve(TO-220)

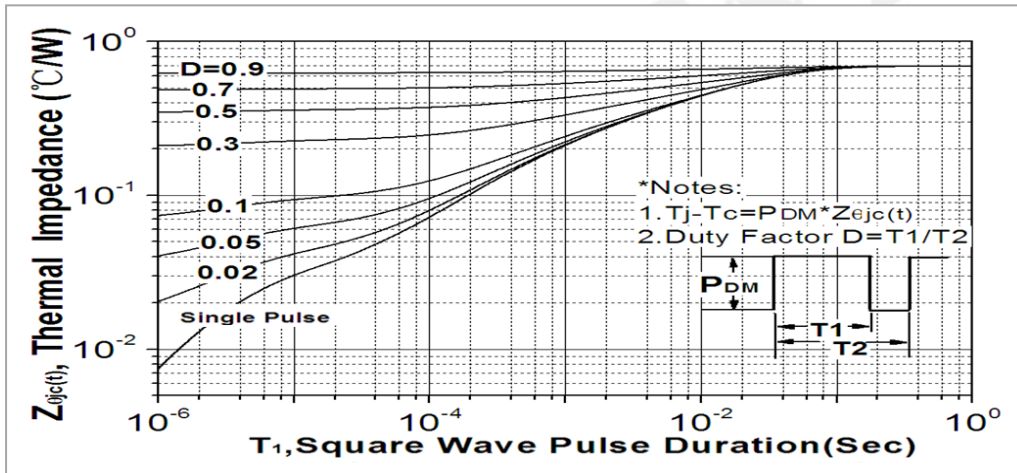


Fig. 14. Transient thermal response curve(TO-262/TO-262N)

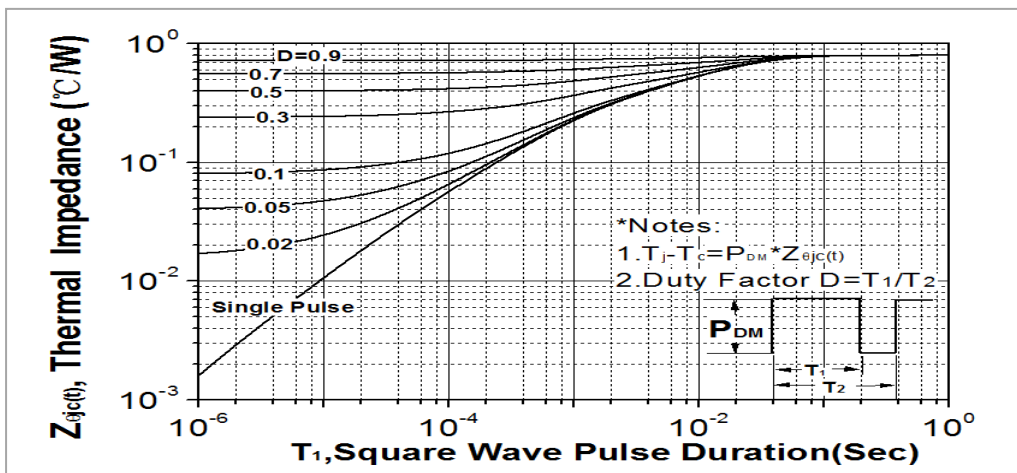


Fig. 15. Gate charge test circuit & waveform

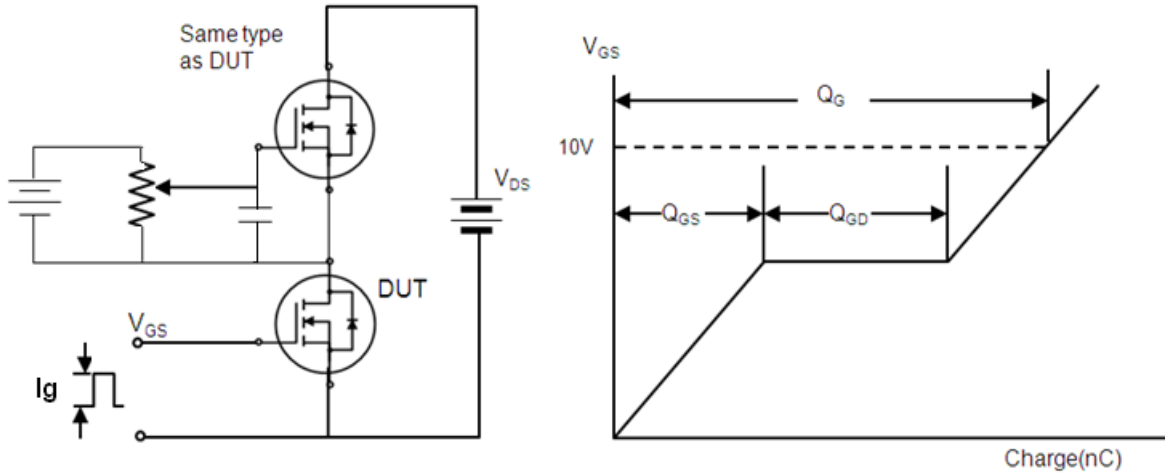


Fig. 16. Switching time test circuit & waveform

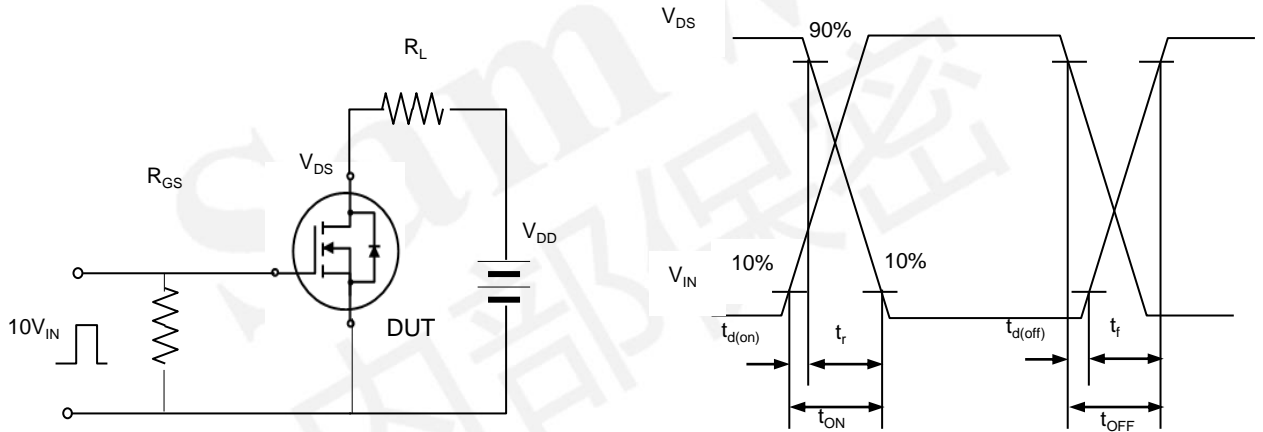


Fig. 17. Unclamped Inductive switching test circuit & waveform

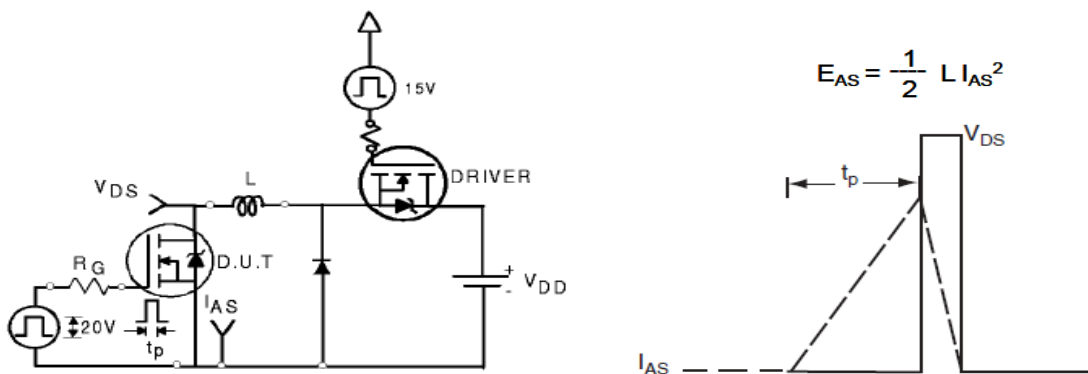
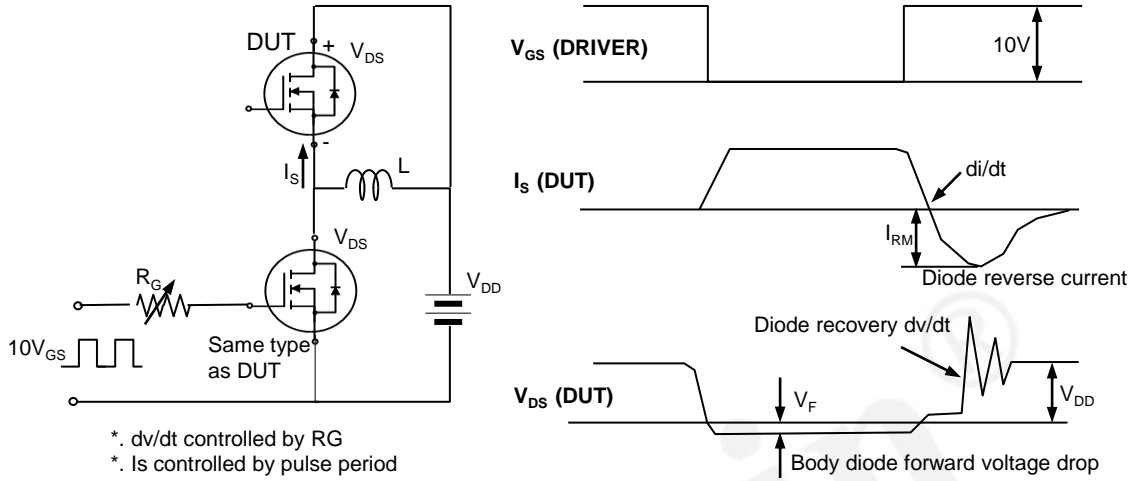



Fig. 18. Peak diode recovery dv/dt test circuit & waveform



## DISCLAIMER

- \* All the data & curve in this document was tested in 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)

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