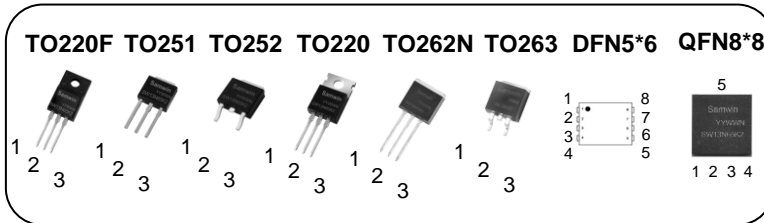


## N-channel Enhanced mode TO-220F/TO-251/TO-252/TO-220/TO-262N/TO-263/DFN5\*6/QFN8\*8 MOSFET

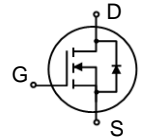
### Features

- High ruggedness
- Low  $R_{DS(ON)}$  (Typ 0.24Ω)  
@ $V_{GS}=10V$
- Low Gate Charge (Typ 28nC)
- Improved dv/dt Capability
- 100% Avalanche Tested
- Application: LED, Charger, Adaptor



TO220F/TO251/TO252/TO220/TO262N/TO263: 1. Gate 2. Drain 3. Source  
DFN5\*6: 4. Gate 5,6,7,8. Drain 1,2,3 Source  
QFN8\*8: 1. Gate 2,3,4. Source 5. Drain

$BV_{DSS}$  : 650V  
 $I_D$  : 13A  
 $R_{DS(ON)}$  : 0.24Ω



### General Description

This power MOSFET is produced with super junction 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 13N65K2	SW13N65K2	TO-220F	TUBE
2	SW I 13N65K2	SW13N65K2	TO-251	TUBE
3	SW D 13N65K2	SW13N65K2	TO-252	REEL
4	SW P 13N65K2	SW13N65K2	TO-220	TUBE
5	SW J 13N65K2	SW13N65K2	TO-262N	TUBE
6	SW B 13N65K2	SW13N65K2	TO-263	TUBE
7	SW HA 13N65K2	SW13N65K2	DFN5*6	REEL
8	SW HC 13N65K2	SW13N65K2	QFN8*8	REEL

### Absolute maximum ratings

Symbol	Parameter	Value								Unit
		TO220 F	TO251	TO252	TO220	TO262 N	TO263	DFN5* 6	QFN8* 8	
$V_{DSS}$	Drain to source voltage	650								V
$I_D$	Continuous drain current (@ $T_C=25^\circ C$ )	13*								A
	Continuous drain current (@ $T_C=100^\circ C$ )	8.2*								A
$I_{DM}$	Drain current pulsed (note 1)	39								A
$V_{GS}$	Gate to source voltage	±30								V
$E_{AS}$	Single pulsed avalanche energy (note 2)	200								mJ
$E_{AR}$	Repetitive avalanche energy (note 1)	21								mJ
dv/dt	MOSFET dv/dt ruggedness (@ $V_{DS}=0\sim 400V$ )	30								V/ns
dv/dt	Peak diode recovery dv/dt (note 3)	20								V/ns
$P_D$	Total power dissipation (@ $T_C=25^\circ C$ )	33.8	143.7	134.4	178.6	168.9	158.2		96	W
	Total power dissipation (@ $T_a=25^\circ C$ )							3.7		W
	Derating factor above 25°C	0.27	1.15	1.08	1.4	1.35	1.27	0.03	0.8	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
		TO220 F	TO251	TO252	TO220	TO262 N	TO263	DFN5* 6	QFN8* 8	
$R_{thjc}$	Thermal resistance, Junction to case	3.7	0.87	0.93	0.7	0.74	0.79		1.3	°C/W
$R_{thja}$	Thermal resistance, Junction to ambient	50	79		54	64		34(Note)		°C/W

Note:  $R_{thja}$  is the sum of the junction-to-case and case-to-ambient thermal resistance where the case thermal reference is defined as the solder mounting surface of the drain pins.  $R_{thjc}$  is guaranteed by design while  $R_{thca}$  is determined by the user's board design.



DFN5\*6  $R_{thja}$  : 34°C/W on a 1 in<sup>2</sup> pad of 2oz copper.

### 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°C		0.56		V/°C
$I_{DSS}$	Drain to source leakage current	$V_{DS}=650V, V_{GS}=0V$			1	uA
		$V_{DS}=520V, T_C=125^\circ\text{C}$			50	uA
$I_{GSS}$	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		4	V
$R_{DS(ON)}$	Drain to source on state resistance	$V_{GS}=10V, I_D=6.5A$		0.24	0.29	Ω
$G_{fs}$	Forward transconductance	$V_{DS}=30V, I_D=6.5A$		13		S
<b>Dynamic characteristics</b>						
$C_{iss}$	Input capacitance	$V_{GS}=0V, V_{DS}=200V, f=1\text{MHz}$		1092		pF
$C_{oss}$	Output capacitance			51		
$C_{rss}$	Reverse transfer capacitance			1.2		
$t_{d(on)}$	Turn on delay time	$V_{DS}=325V, I_D=13A, R_G=25\Omega, V_{GS}=10V$ (note 4,5)		17		ns
$t_r$	Rising time			34		
$t_{d(off)}$	Turn off delay time			97		
$t_f$	Fall time			40		
$Q_g$	Total gate charge	$V_{DS}=520V, V_{GS}=10V, I_D=13A$ (note 4,5)		28		nC
$Q_{gs}$	Gate-source charge			5.5		
$Q_{gd}$	Gate-drain charge			10.5		
$R_g$	Gate resistance	$V_{DS}=0V$ , Scan F mode		3		Ω

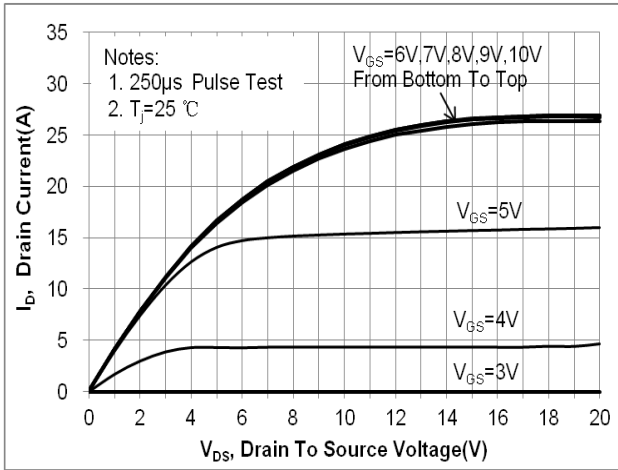
### Source to drain diode ratings characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_S$	Continuous source current	Integral reverse p-n Junction diode in the MOSFET			13	A
$I_{SM}$	Pulsed source current				39	A
$V_{SD}$	Diode forward voltage drop.	$I_S=13A, V_{GS}=0V$			1.4	V
$t_{rr}$	Reverse recovery time	$I_S=13A, V_{GS}=0V,$ $di_f/dt=100A/us$		299		ns
$Q_{rr}$	Reverse recovery charge			3.3		uC

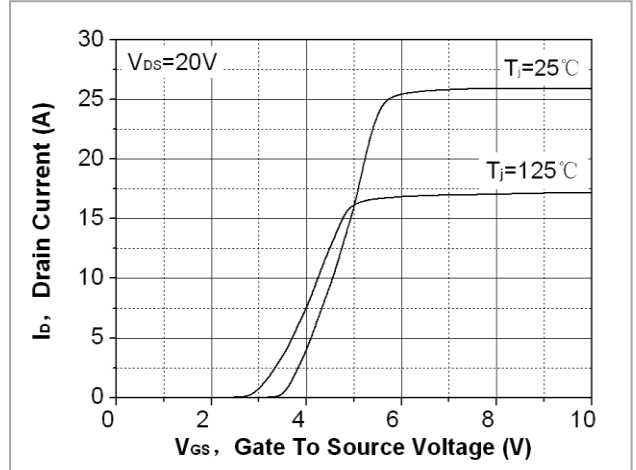
#### ※. Notes

1. Repeitative rating : pulse width limited by junction temperature.
2.  $L=32.7\text{mH}, I_{AS}=3.5A, V_{DD}=50V, R_G=25\Omega$ , Starting  $T_J=25^\circ\text{C}$
3.  $I_{SD} \leq 13A, di/dt = 100A/us, V_{DD} \leq BV_{DSS}$ , Starting  $T_J=25^\circ\text{C}$
4. Pulse Test : Pulse Width  $\leq 300us$ , duty cycle  $\leq 2\%$ .
5. Essentially independent of operating temperature.

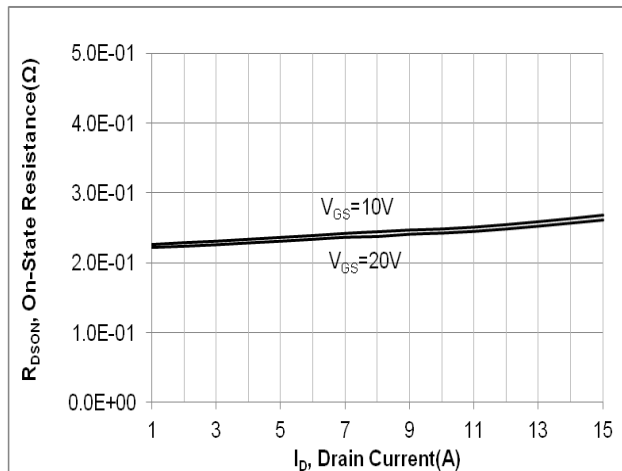
**Fig. 1. On-state characteristics**



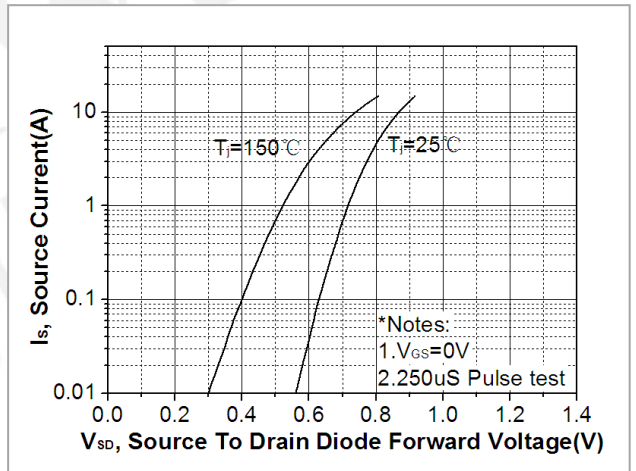
**Fig. 2. Transfer characteristics**



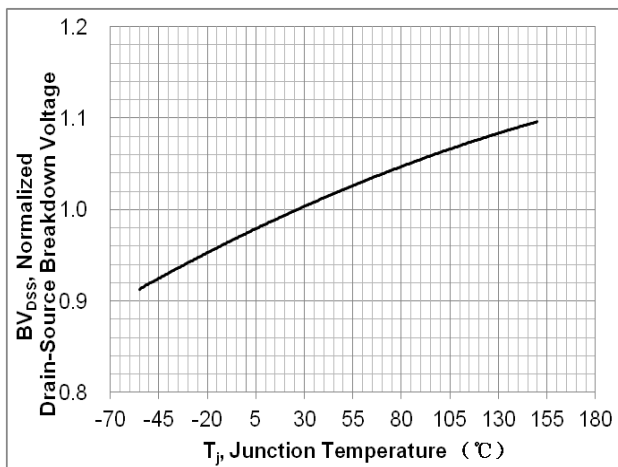
**Fig. 3. On-resistance variation vs. drain current and gate voltage**



**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**

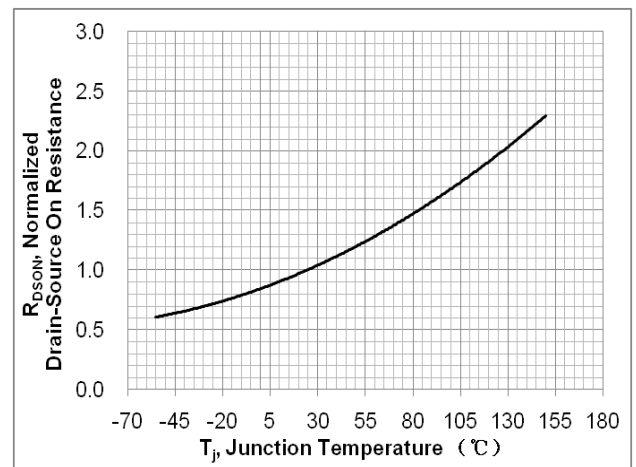


Fig. 7. Gate charge characteristics

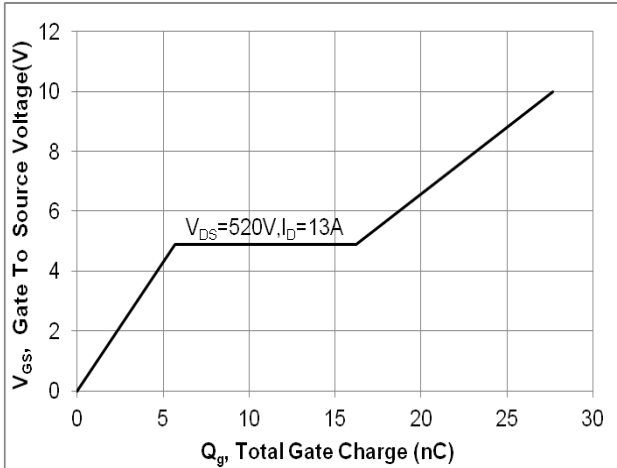


Fig. 8. Capacitance Characteristics

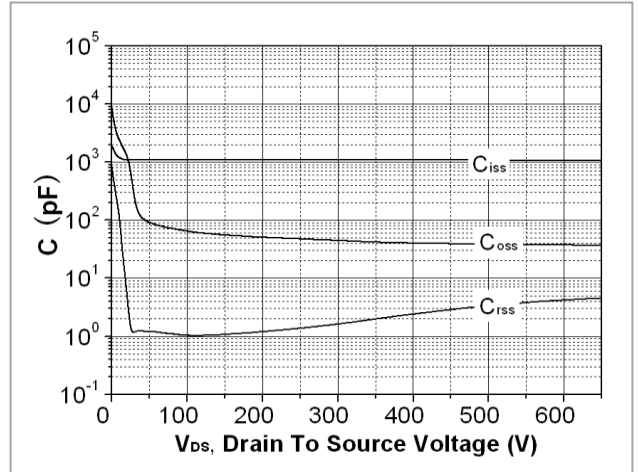


Fig. 9. Maximum safe operating area(TO-220F)

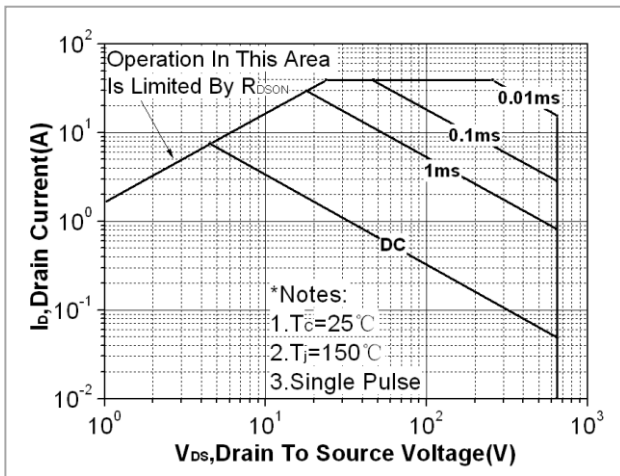


Fig.10. Maximum safe operating area(TO-251)

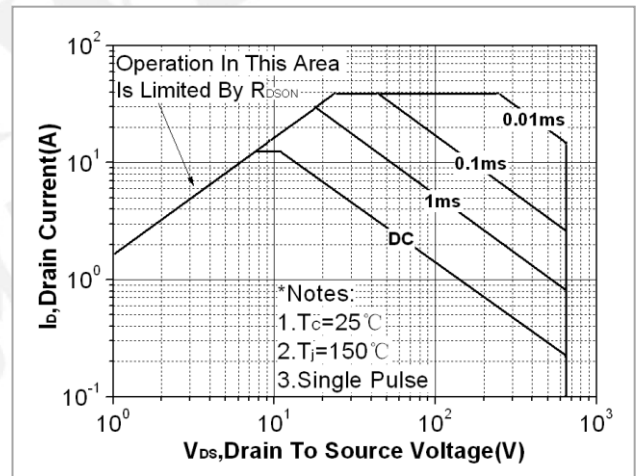


Fig. 11. Maximum safe operating area(TO-252)

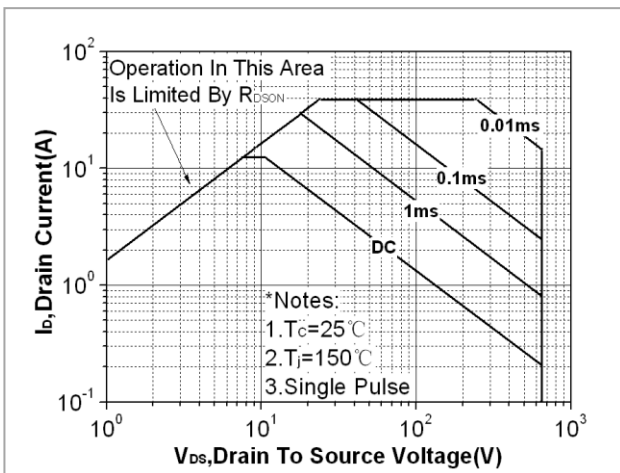


Fig. 12. Maximum safe operating area(TO-220)

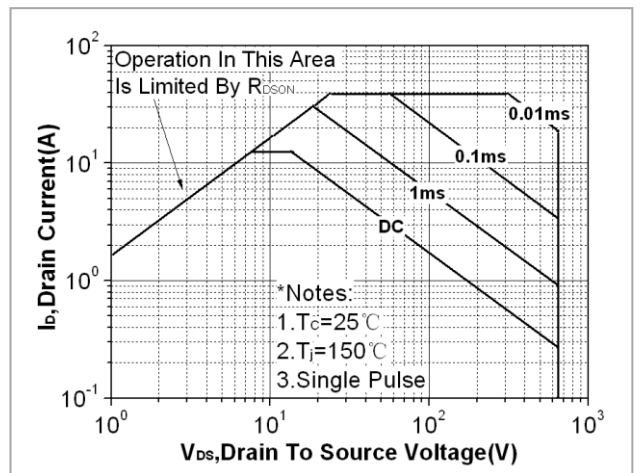


Fig. 13. Maximum safe operating area(TO-262N)

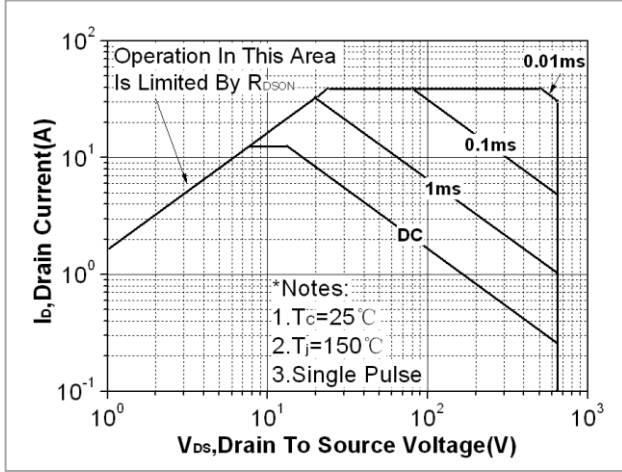


Fig.14. Maximum safe operating area(TO-263)

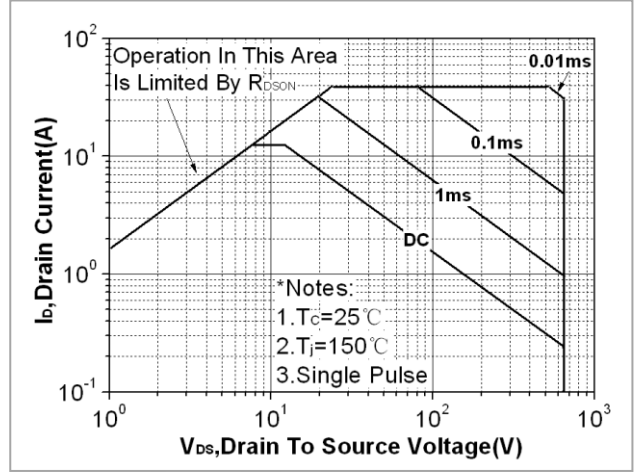


Fig. 15. Maximum safe operating area(DFN5\*6)

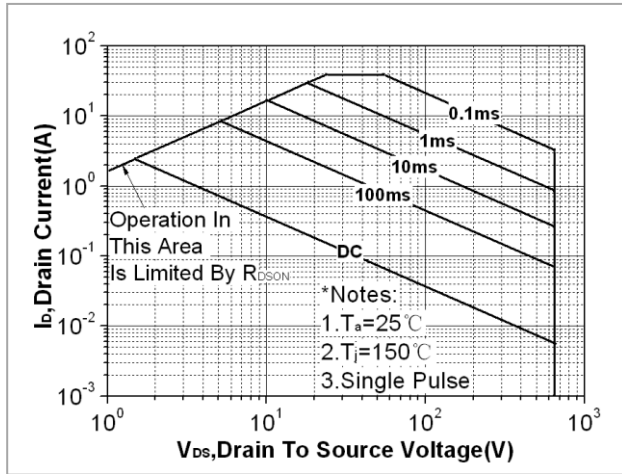


Fig. 16. Maximum safe operating area(QFN8\*8)

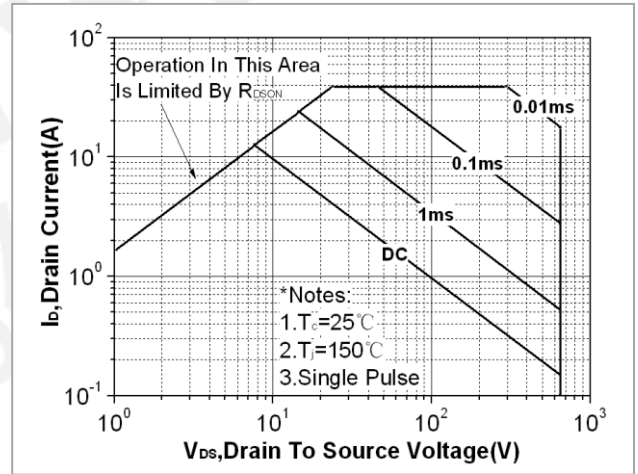


Fig. 17. Transient thermal response curve(TO-220F)

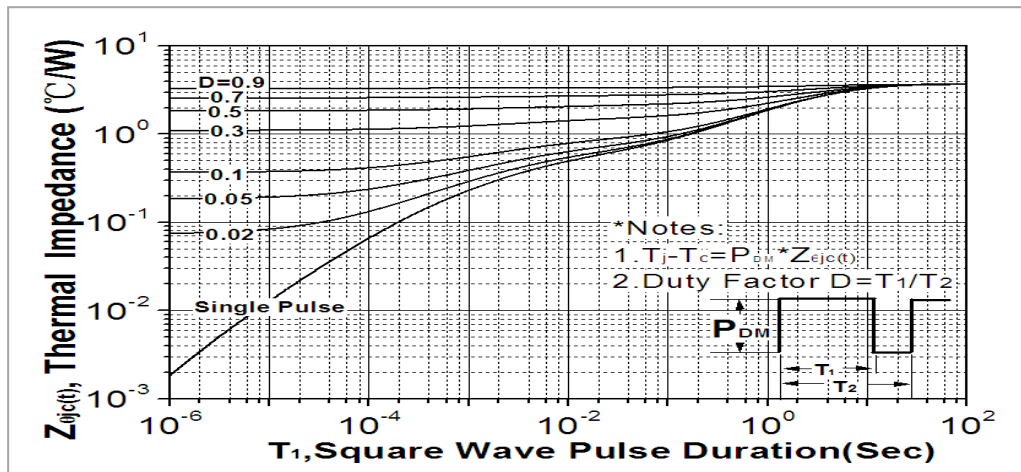


Fig. 18. Transient thermal response curve(TO-251)

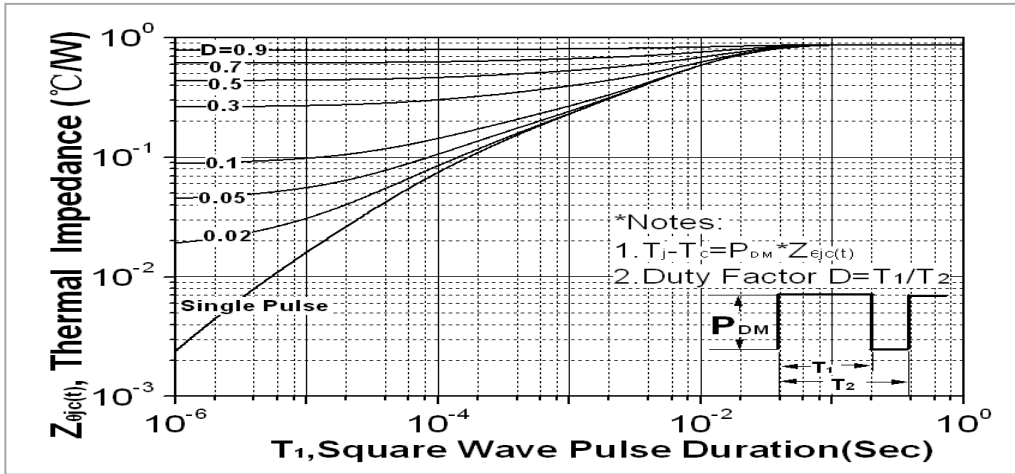


Fig. 19. Transient thermal response curve(TO-252)

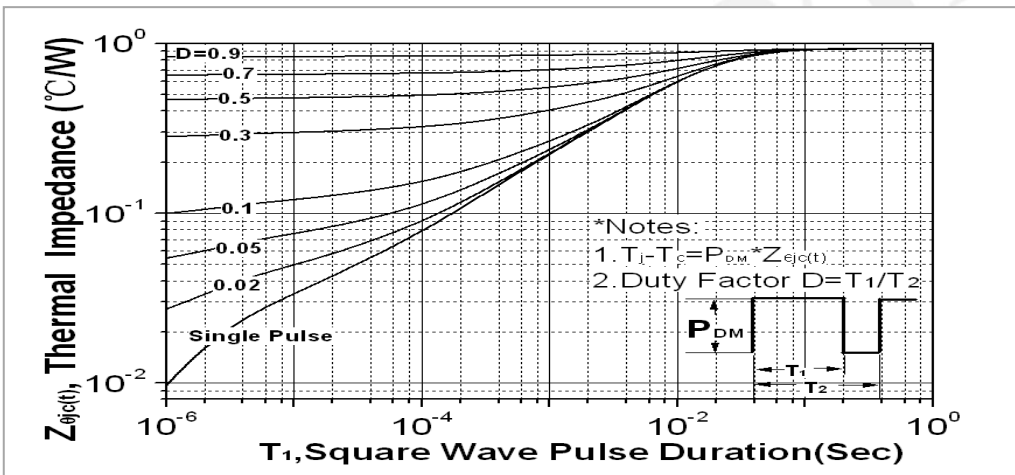


Fig. 20. Transient thermal response curve(TO-220)

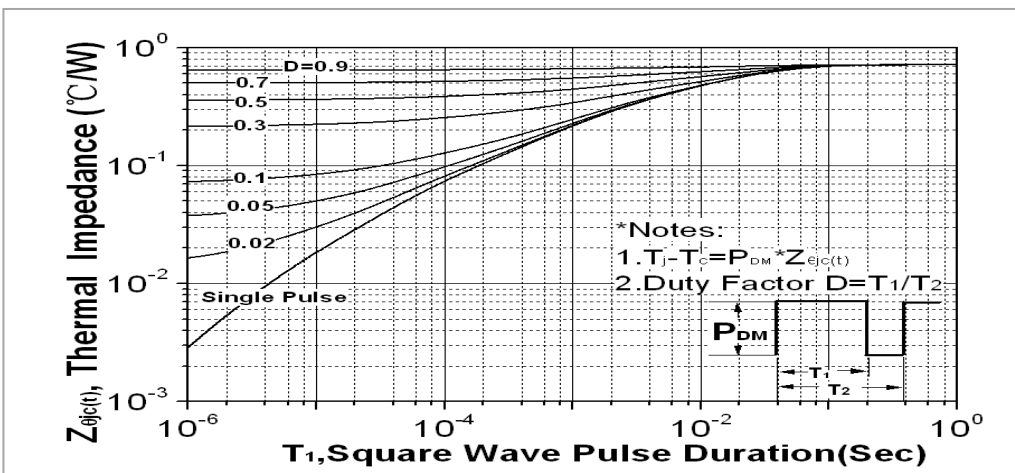


Fig. 21. Transient thermal response curve(TO-262N)

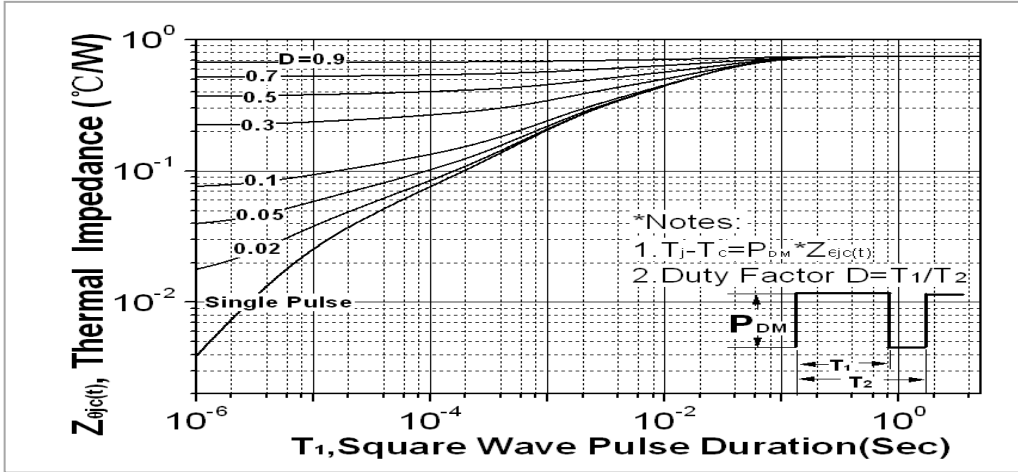


Fig. 22. Transient thermal response curve(TO-263)

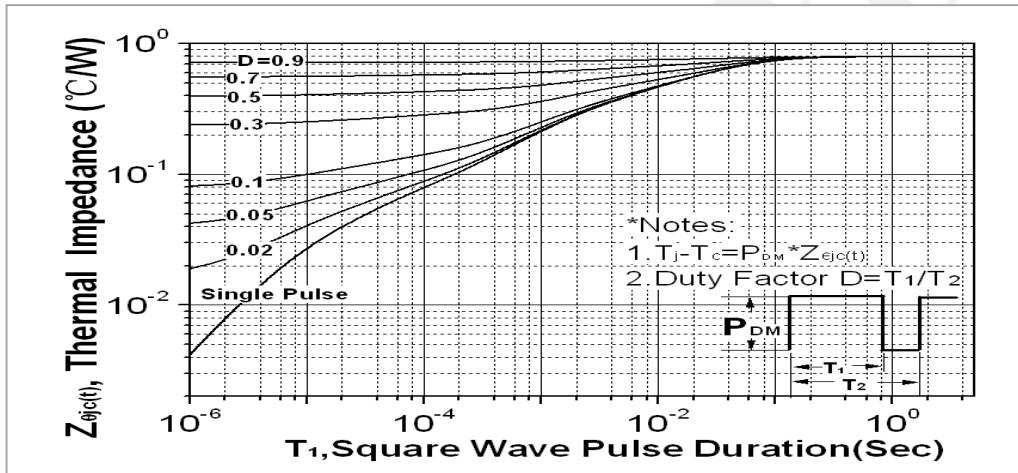


Fig. 23. Transient thermal response curve(DFN5\*6)

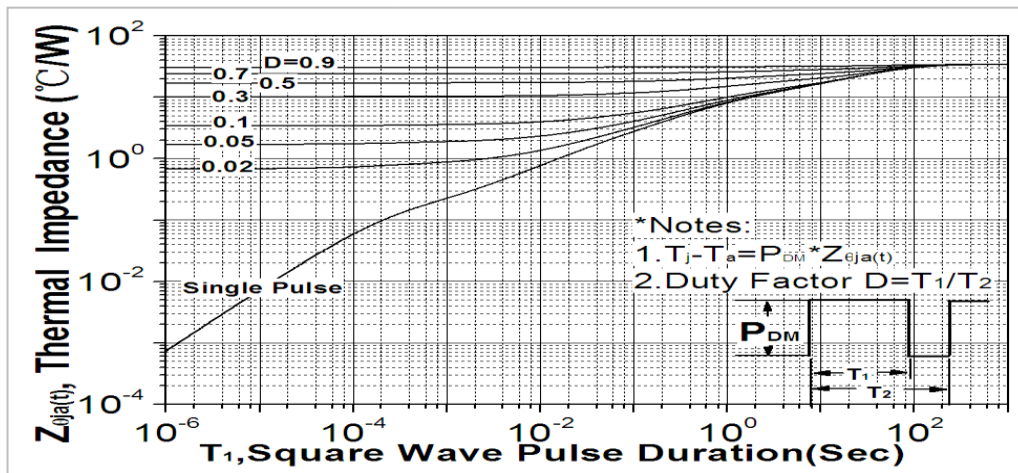


Fig. 24. Transient thermal response curve(QFN8\*8)

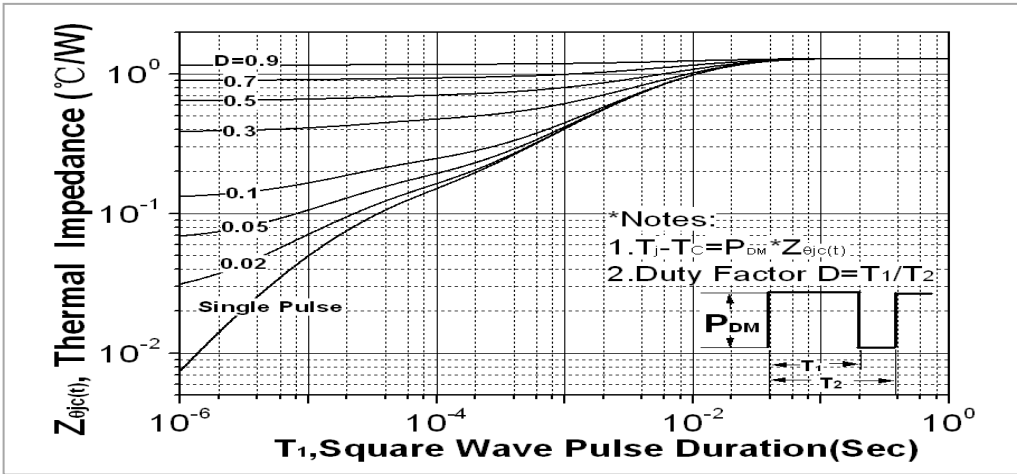


Fig. 25. Gate charge test circuit & waveform

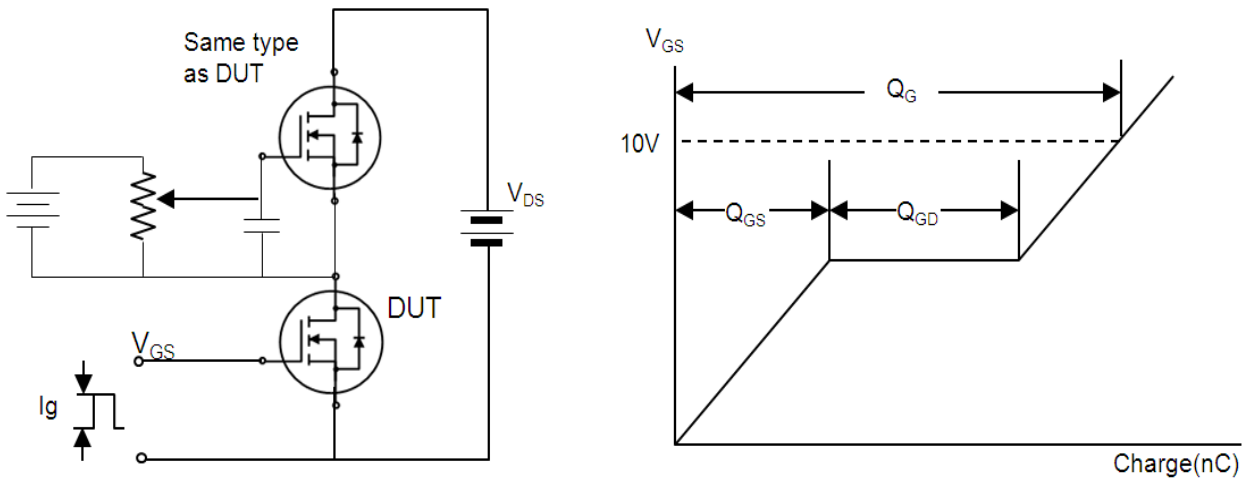


Fig. 26. Switching time test circuit & waveform

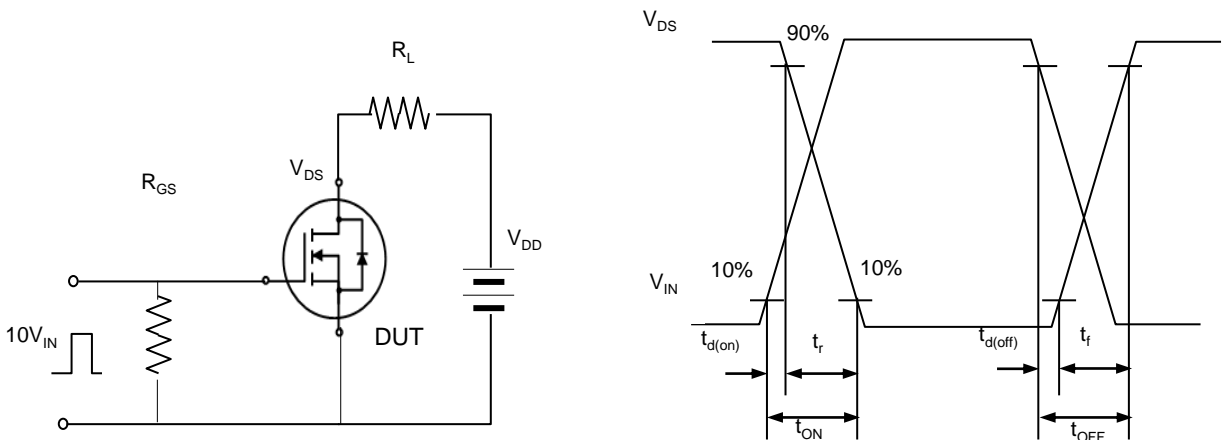




Fig. 27. Unclamped Inductive switching test circuit & waveform

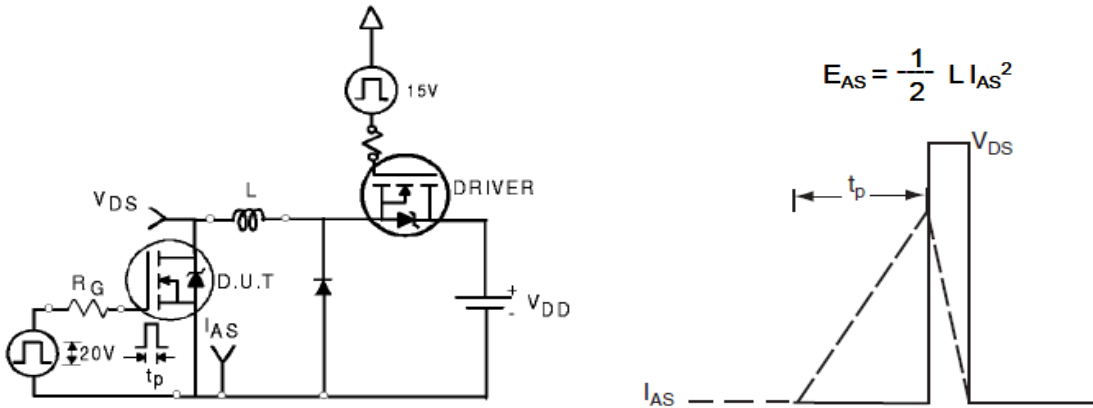
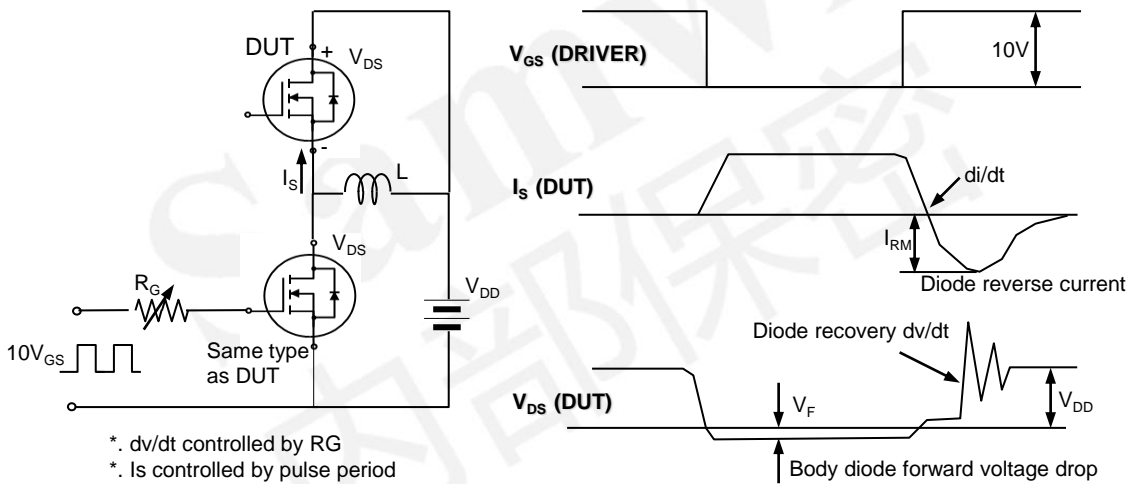



Fig. 28. Peak diode recovery dv/dt test circuit & waveform



### 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)