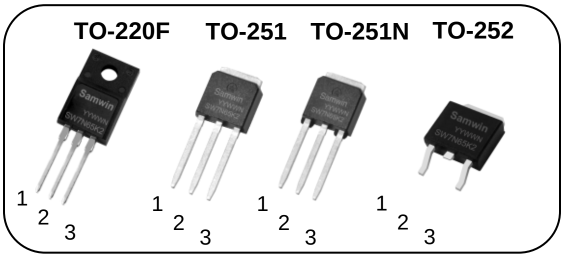
N-channel Enhanced mode TO-220F/TO-251/TO-251N/TO-252 MOSFET

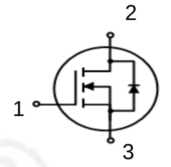
Features

- High ruggedness
- Low $R_{DS(ON)}$ (Typ 0.57Ω)@V_{GS}=10V
- Low Gate Charge (Typ 14.5nC)
- Improved dv/dt Capability
- 100% Avalanche Tested
- Application: Charge,LED,PC Power



1. Gate 2. Drain 3. Source

BV_{DSS} : 650V
I_D : 7A
$R_{DS(ON)}$: 0.57Ω



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 7N65K2	SW7N65K2	TO-220F	TUBE
2	SW I 7N65K2	SW7N65K2	TO-251	TUBE
3	SW N 7N65K2	SW7N65K2	TO-251N	TUBE
4	SW D 7N65K2	SW7N65K2	TO-252	REEL

Absolute maximum ratings

Symbol	Parameter	Value				Unit
		TO-220F	TO-251	TO-251N	TO-252	
V_{DSS}	Drain to source voltage	650				V
I_D	Continuous drain current (@T_C=25°C)	7*				A
	Continuous drain current (@T_C=100°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)	50				mJ
E_{AR}	Repetitive avalanche energy (note 1)	3				mJ
dv/dt	MOSFET dv/dt ruggedness (@VDS=0~400V)	30				V/ns
dv/dt	Peak diode recovery dv/dt (note 3)	20				V/ns
P_D	Total power dissipation (@T_C=25°C)	20.5	125		114	W
	Derating factor above 25°C	0.16	1		0.91	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-251	TO-251N	TO-252	
R_{thjc}	Thermal resistance, Junction to case	6.1	1.0		1.1	°C/W
R_{thja}	Thermal resistance, Junction to ambient	49	89			°C/W

Electrical characteristic (T_C = 25ºC 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=250uA	650			V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown voltage temperature coefficient	I_D=250uA, referenced to 25ºC		0.6		V/ºC
I_{DSS}	Drain to source leakage current	V_{DS}=650V, V_{GS}=0V			1	uA
		V_{DS}=520V, T_C=125ºC			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
On characteristics						
$V_{GS(TH)}$	Gate threshold voltage	V_{DS}=V_{GS}, I_D=250uA	2.5		4.0	V
$R_{DS(ON)}$	Drain to source on state resistance	V_{GS}=10V, I_D=3.5A		0.57	0.65	Ω
G_{fs}	Forward transconductance	V_{DS}=30V, I_D=3.5A		6.4		S
Dynamic characteristics						
C_{iss}	Input capacitance	V_{GS}=0V, V_{DS}=200V, f=1MHz		579		pF
C_{oss}	Output capacitance			32		
C_{rss}	Reverse transfer capacitance			2.4		
$t_{d(on)}$	Turn on delay time	V_{DS}=325V, I_D=7A, R_G=25Ω, V_{GS}=10V (note 4,5)		12		ns
t_r	Rising time			27		
$t_{d(off)}$	Turn off delay time			39		
t_f	Fall time			26		
Q_g	Total gate charge	V_{DS}=520V, V_{GS}=10V, I_D=7A (note 4,5)		14.5		nC
Q_{gs}	Gate-source charge			4		
Q_{gd}	Gate-drain charge			5		
R_g	Gate resistance	V_{DS}=0V, Scan F mode		3.4		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_F/dt=100A/us		224		ns
Q_{rr}	Reverse recovery charge			1.8		uC

※. Notes

1. Repeatitive rating : pulse width limited by junction temperature.
2. L =25mH, I_{AS} =2A, V_{DD} = 50V, R_G=25Ω, Starting T_J = 25ºC
3. I_{SD} ≤7A, di/dt = 100A/us, V_{DD} ≤ BV_{DSS}, Staring T_J =25ºC
4. Pulse Test : Pulse Width ≤ 300us, duty cycle ≤ 2%
5. Essentially independent of operating temperature.

Fig. 1. On-state characteristics

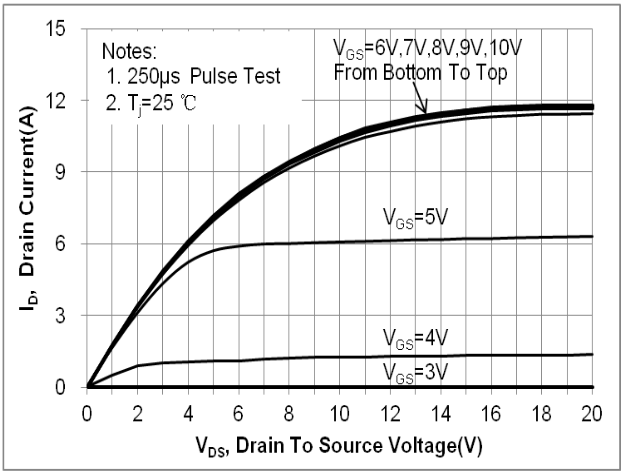


Fig. 2. On-resistance variation vs. drain current and gate voltage

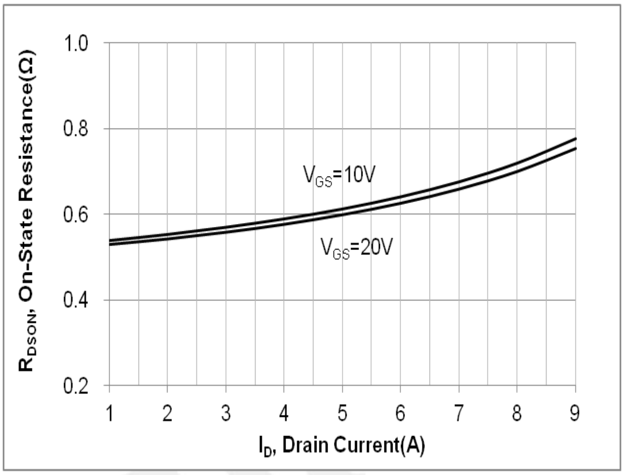


Fig. 3. Gate charge characteristics

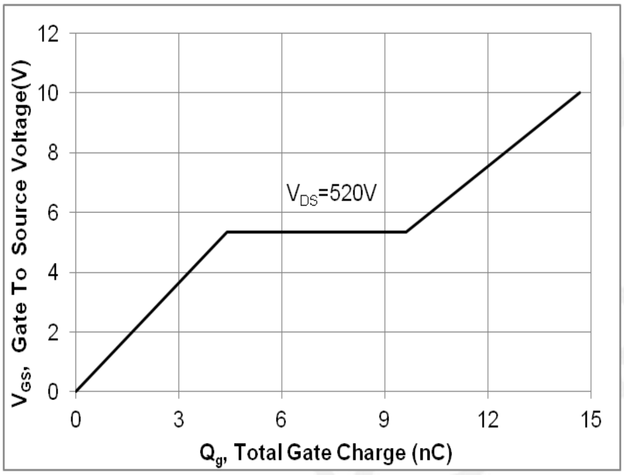


Fig. 4. On-state current vs. diode forward voltage

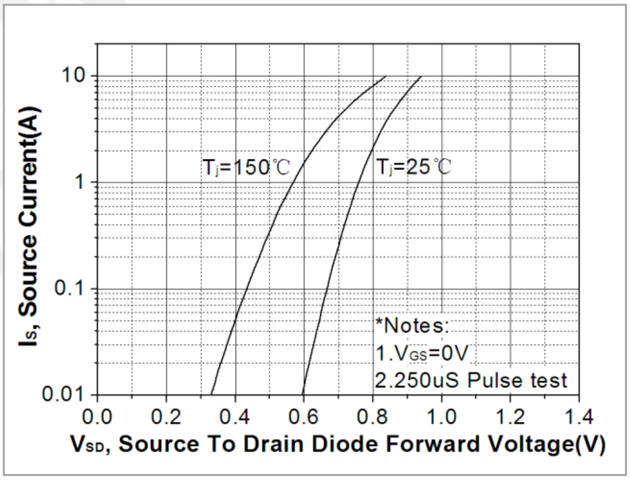


Fig 5. Breakdown voltage variation vs. junction temperature

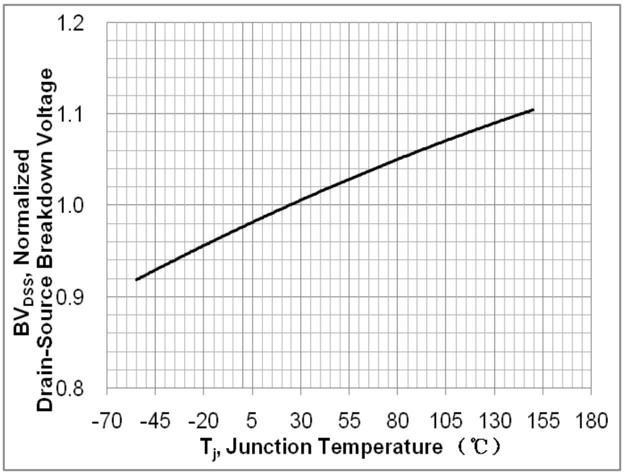


Fig. 6. On-resistance variation vs. junction temperature

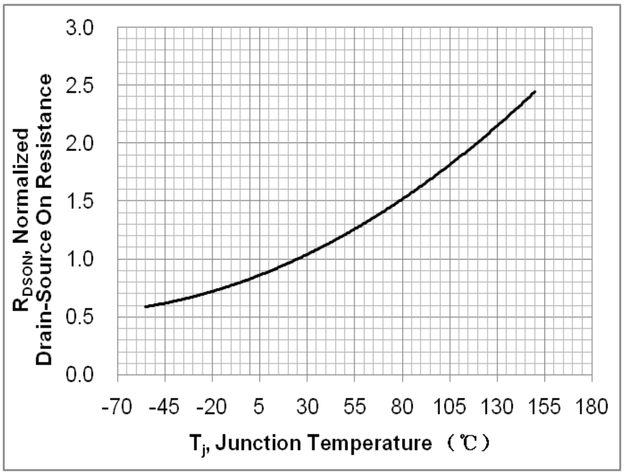


Fig. 7. Maximum safe operating area(TO-220F)

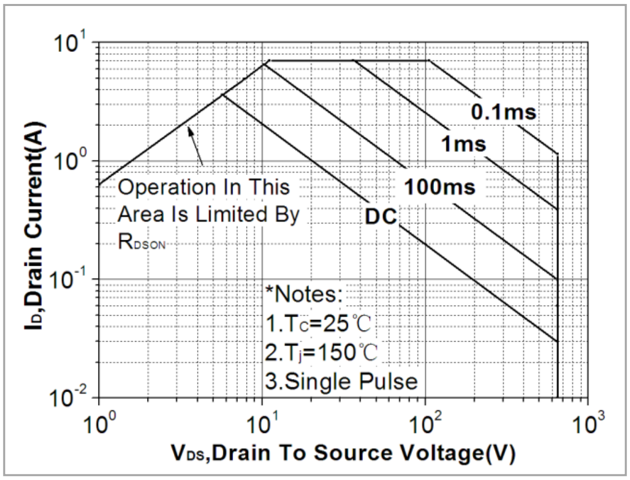


Fig. 8. Maximum safe operating area (TO-251/TO-251N)

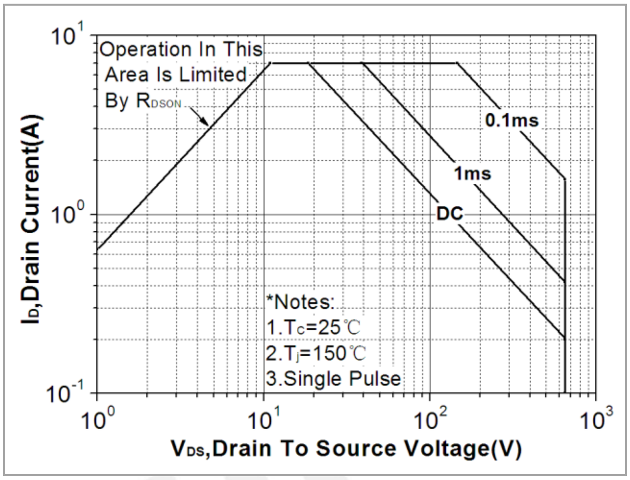


Fig. 9. Maximum safe operating area(TO-252)

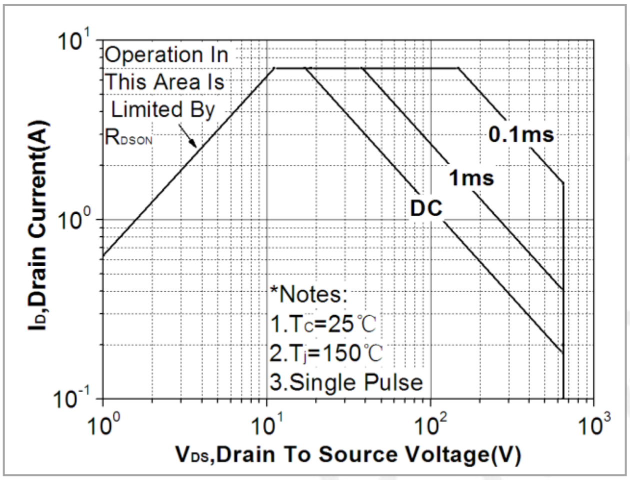


Fig. 10. Capacitance Characteristics

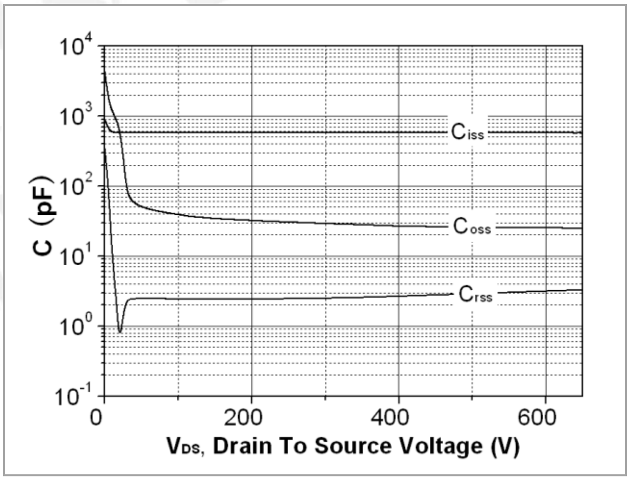


Fig. 11. Transient thermal response curve(TO-220F)

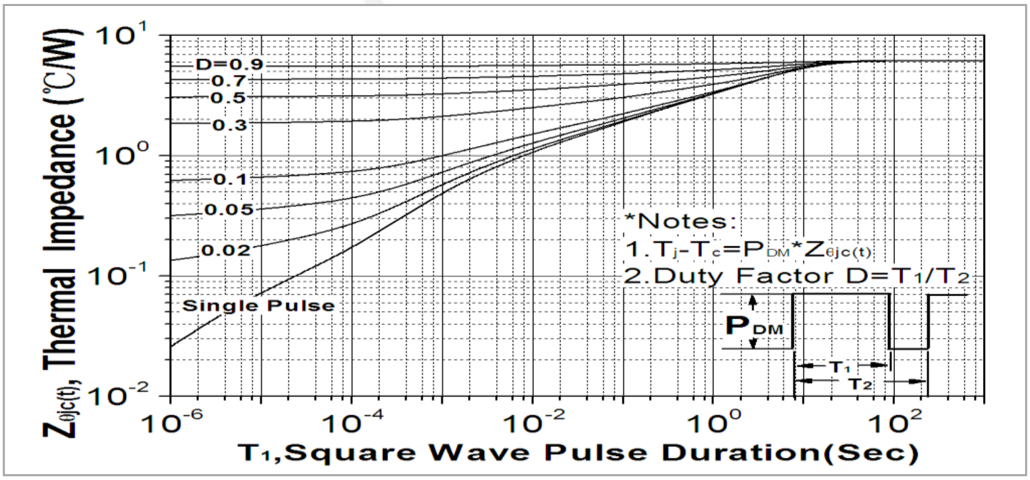


Fig. 12. Transient thermal response curve(TO-251/TO-251N)

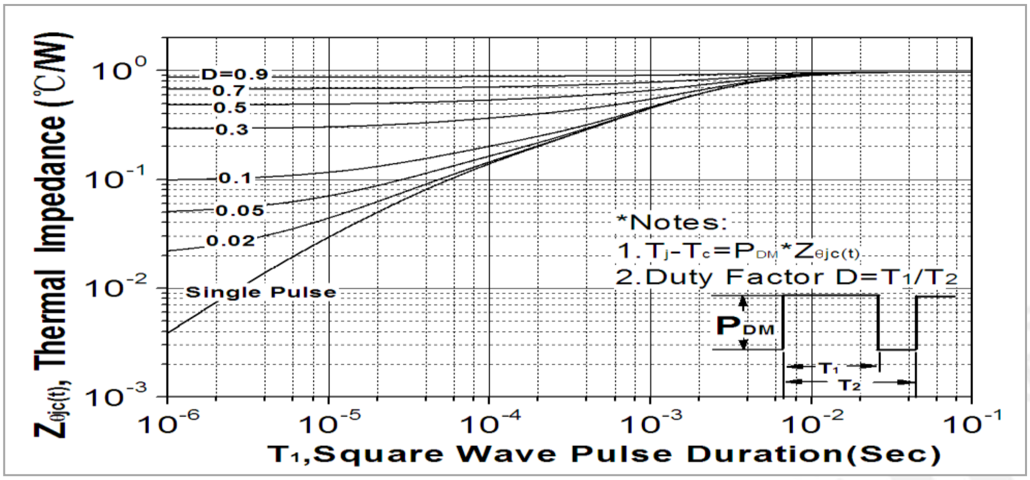


Fig. 13. Transient thermal response curve(TO-252)

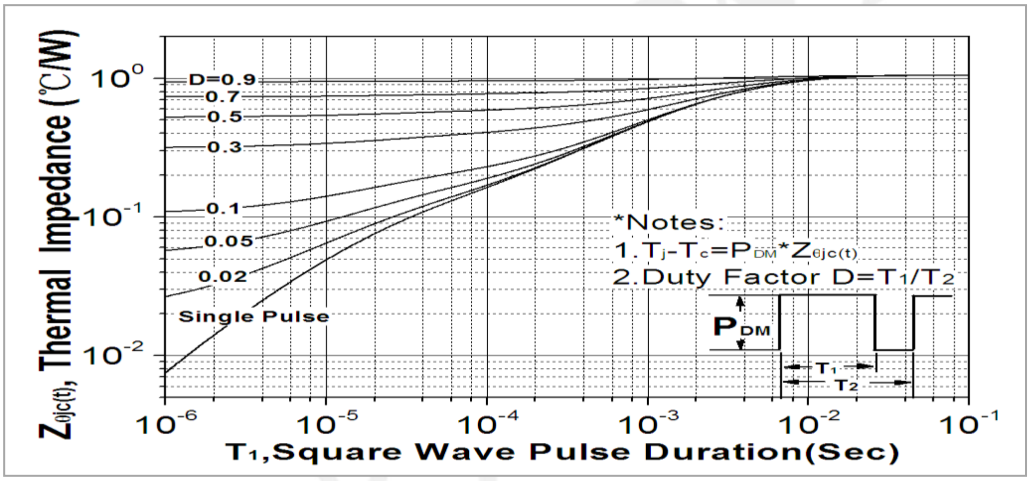


Fig. 14. Gate charge test circuit & waveform

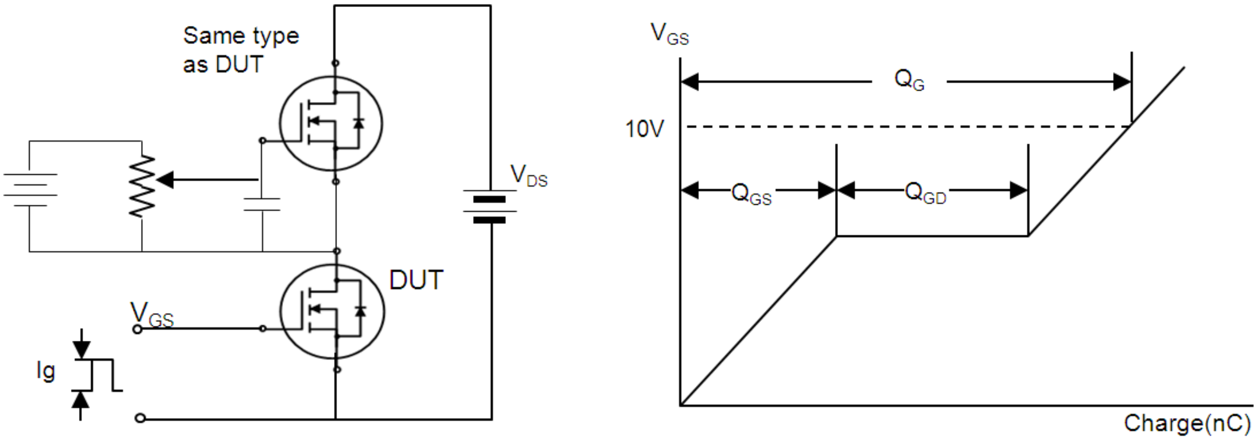


Fig. 15. Switching time test circuit & waveform

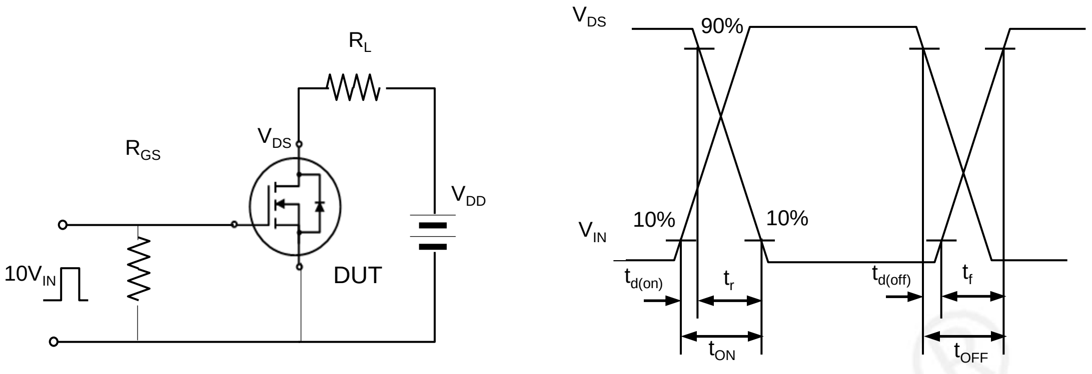


Fig. 16. Unclamped Inductive switching test circuit & waveform

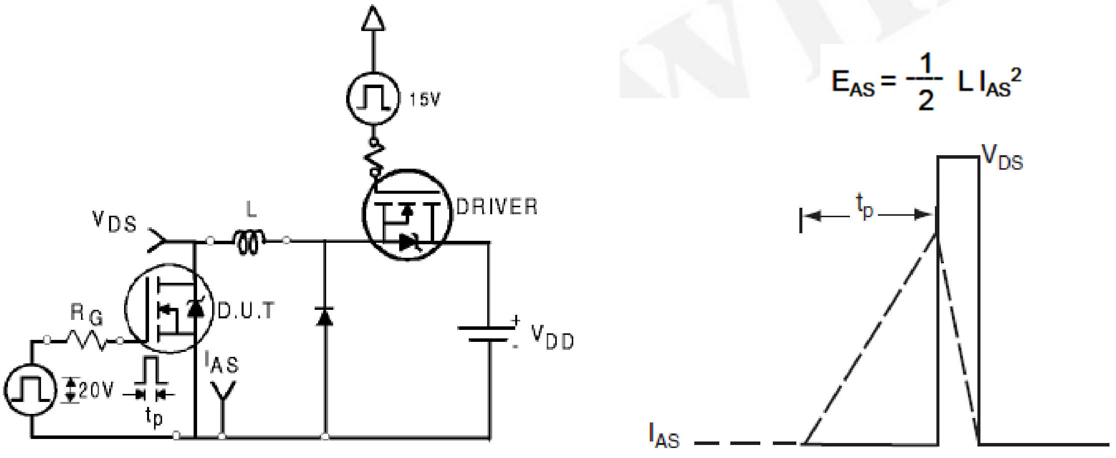
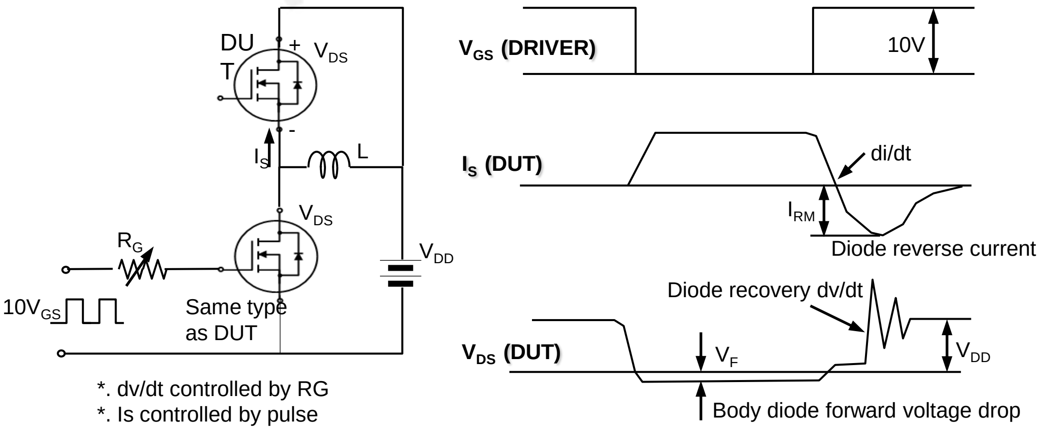

$$E_{AS} = \frac{1}{2} L I_{AS}^2$$

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



*. dv/dt controlled by RG
*. Is controlled by pulse period

DISCLAIMER

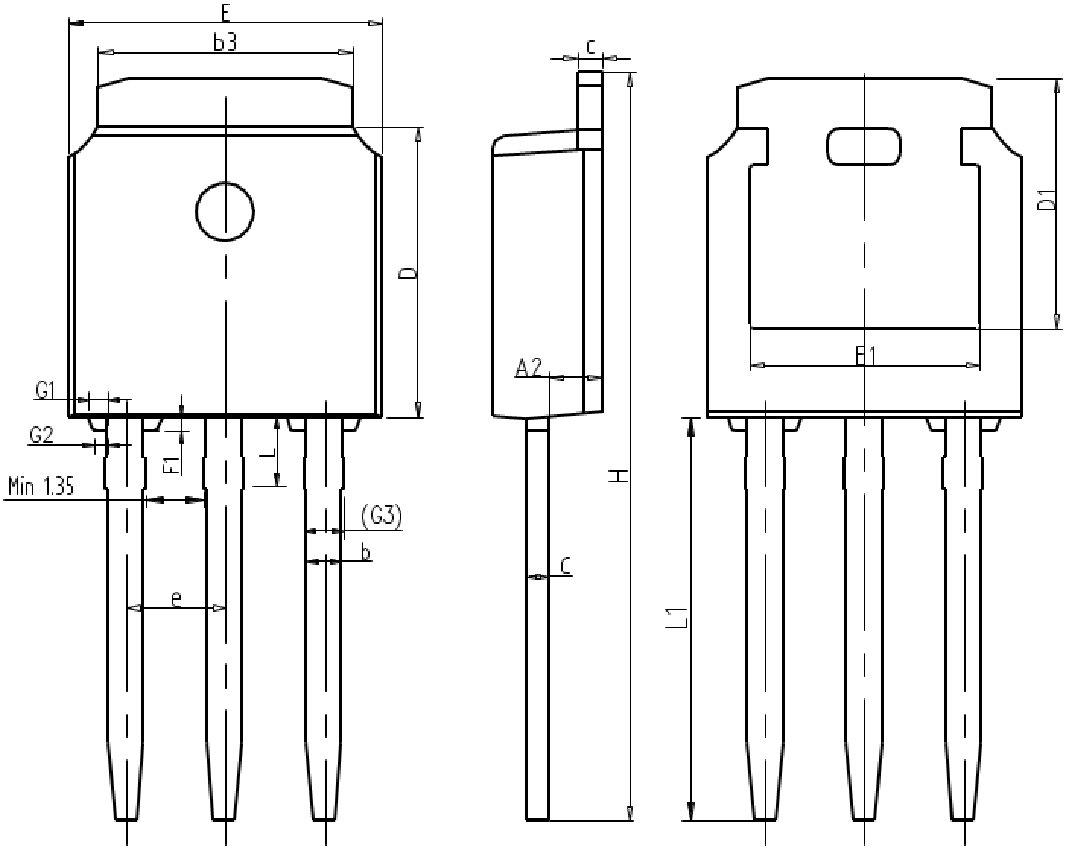
* All the data & curve in this document was tested in XI' AN SEMIPOWER TESTING & APPLICATION CENTER.

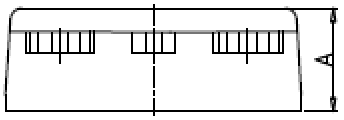
* This product has passed the PCT,TC,HTRB,HTGB,HAST,PC and Solderdunk reliability test

* 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**

TO-251N PACKAGE DIMENSION





SYMBOL	MM		
	MIN	NOM	MAX
A	2.20	2.30	2.4
A2	0.97	1.07	1.17
b	0.58	0.68	0.80
b3	5.20	5.33	5.50
c	0.43	0.53	0.63
D	5.98	6.10	6.22
D1	5.30REF		
E	6.40	6.60	6.80
E1	4.63	-	-
e	2.286BSC		
F1	0.23	0.30	0.37
G1	0.33	0.40	0.47
G2	0.23	0.30	0.37
G3	0.60	0.74	0.88
H	16.22	16.52	16.82
L	1.15	1.35	1.55
L1	9.15	9.40	9.65

Remark:

1.Do not include mold flash or protrusions.
未包括毛刺。

2. The tolerance is ± 0.15mm which in package dimension are not marked tolerance .
尺寸图中未标注公差为± 0.15mm。