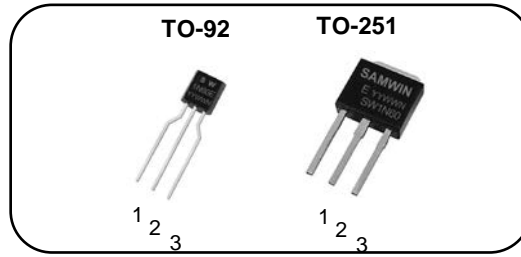# Samwin®

SW1N60E

N-channel Enhanced mode TO-92/TO-251 MOSFET

Features

- High ruggedness
- Low $R_{DS(ON)}$ (Typ7.3Ω)@V_{GS}=10V
- Low Gate Charge (Typ3.7nC)
- Improved dv/dt Capability
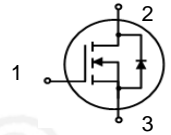- 100% Avalanche Tested
- Application:Charge,Adaptor,LED

TO-92   TO-251

1. Gate 2. Drain 3. Source

BV_{DSS} : 600V
I_D : 1A
$R_{DS(ON)}$: 7.3Ω

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 I 1N60E	SW 1N60E	TO-251	TUBE
2	SW C 1N60E	SW 1N60E	TO-92	TAPE

Absolute maximum ratings

Symbol	Parameter		Value		Unit
			TO-251	TO-92	
V_{DSS}	Drain to source voltage		600		V
I_D	Continuous drain current (@T_C=25ºC)		1.0*		A
	Continuous drain current (@T_C=100ºC)		0.63*		A
I_{DM}	Drain current pulsed	(note 1)	4.		A
V_{GS}	Gate to source voltage		±30		V
E_{AS}	Single pulsed avalanche energy	(note 2)	85		mJ
E_{AR}	Repetitive avalanche energy	(note 1)	29		mJ
dv/dt	Peak diode recovery dv/dt	(note 3)	4.5		V/ns
P_D	Total power dissipation (@T_C=25ºC)		103	3.6	W
	Derating factor above 25ºC		0.8	0.003	W/ºC
T_{STG}, T_J	Operating junction temperature & storage temperature		-55 ~ + 150		ºC
T_L	Maximum lead temperature for soldering purpose, 1/8 from case for 5 seconds.		300		ºC

*. Drain current is limited by junction temperature.

Thermal characteristics

Symbol	Parameter	Value		Unit
		TO-251	TO-92	
R_{thjc}	Thermal resistance, Junction to case	1.2		ºC/W
R_{thja}	Thermal resistance, Junction to ambient	85	110	ºC/W

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Electrical characteristic (T_C = 25°C unless otherwise specified)

Off characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
BV$_{DSS}$	Drain to source breakdown voltage	V$_{GS}$=0V, I$_D$=250uA	600			V
ΔBV$_{DSS}$ / ΔT$_J$	Breakdown voltage temperature coefficient	I$_D$=250uA, referenced to 25°C		0.8		V/°C
I$_{DSS}$	Drain to source leakage current	V$_{DS}$=600V, V$_{GS}$=0V			1	uA
		V$_{DS}$=480V, T$_C$=125°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

On characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V$_{GS(TH)}$	Gate threshold voltage	V$_{DS}$=V$_{GS}$, I$_D$=250uA	2		4	V
R$_{DS(ON)}$	Drain to source on state resistance	V$_{GS}$=10V, I$_D$ = 0.5A		7.3	8	Ω
G$_{fs}$	Forward transconductance	V$_{DS}$= 20 V, I$_D$=0.5A		0.7		S

Dynamic characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C$_{iss}$	Input capacitance	V$_{GS}$=0V, V$_{DS}$=25V, f=1MHz		270		pF
C$_{oss}$	Output capacitance			60		
C$_{rss}$	Reverse transfer capacitance			17		
t$_{d(on)}$	Turn on delay time	V$_{DS}$=300V, I$_D$=1.0A, V$_{GS}$=10V, R$_G$=25Ω (note 4,5)		5		ns
t$_r$	Rising time			20		
t$_{d(off)}$	Turn off delay time			9.5		
t$_f$	Fall time			24.5		
Q$_g$	Total gate charge	V$_{DS}$=480V, V$_{GS}$=10V, I$_D$=1.0A (note 4,5)		3.7		nC
Q$_{gs}$	Gate-source charge			1.5		
Q$_{gd}$	Gate-drain charge			1		

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			1	A
I$_{SM}$	Pulsed source current				4	A
V$_{SD}$	Diode forward voltage drop.	I$_S$=1.0A, V$_{GS}$=0V			1.4	V
t$_{rr}$	Reverse recovery time	I$_S$=1.0A, V$_{GS}$=0V, dI$_F$/dt=100A/us		225		ns
Q$_{rr}$	Reverse recovery charge			0.5		uC

※. Notes
1. Repeatitive rating : pulse width limited by junction temperature.
2. L = 170mH, I$_{AS}$ = 1.0A. V$_{DD}$ = 50V, R$_G$=25Ω, Starting T$_J$ = 25°C
3. I$_{SD}$ ≤ 1.0A, di/dt = 100A/us, V$_{DD}$ ≤ BV$_{DSS}$, Staring T$_J$ =25°C
4. Pulse Test : Pulse Width ≤ 300us, duty cycle ≤ 2%.
5. Essentially independent of operating temperature.
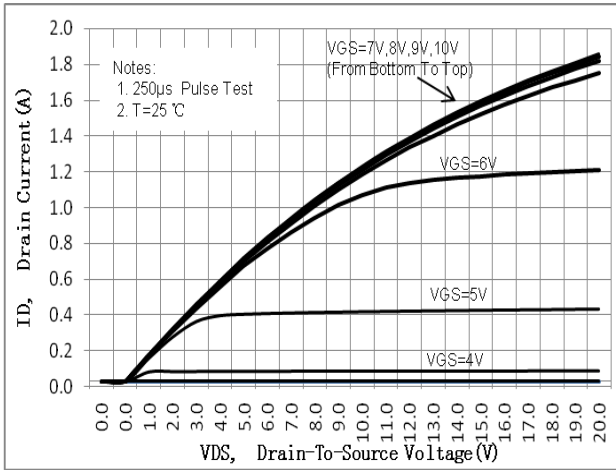
Fig. 1. On-state characteristics

Notes:
1. 250µs Pulse Test
2. T=25℃

VGS=7V,8V,9V,10V (From Bottom To Top)

VGS=6V

VGS=5V

VGS=4V

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

VGS=10V

VGS=20V
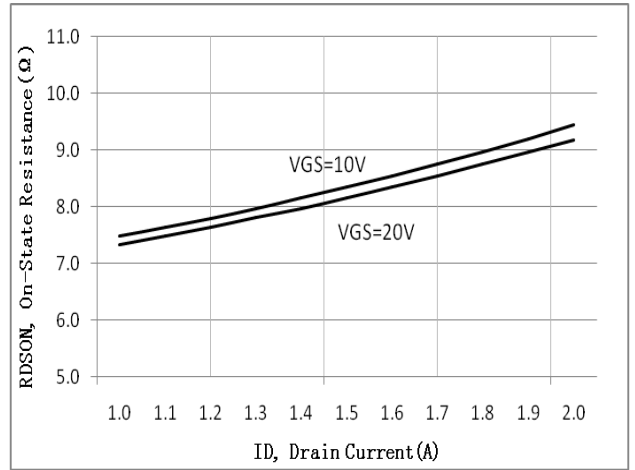
Fig. 3. Gate charge characteristics

VDS=480V
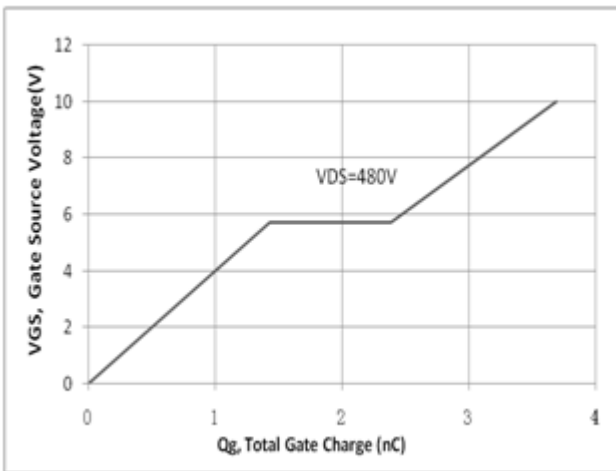
Fig. 4. On state current vs. diode forward voltage

Tj=150℃

TJ=25℃

*Notes:
1.VGS=0V
2.250uS Pusle test
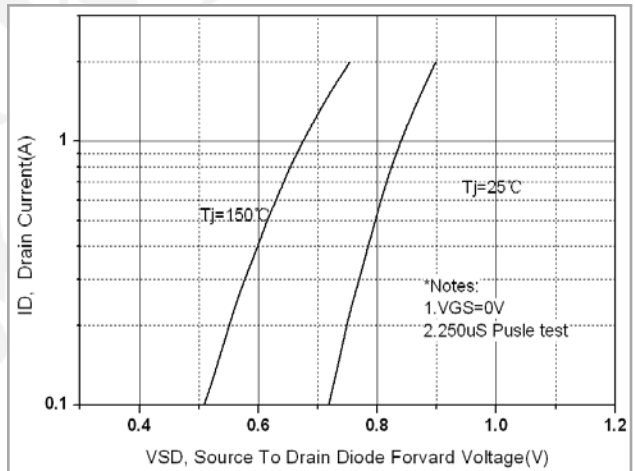
Fig 5. Breakdown Voltage Variation vs. Junction Temperature
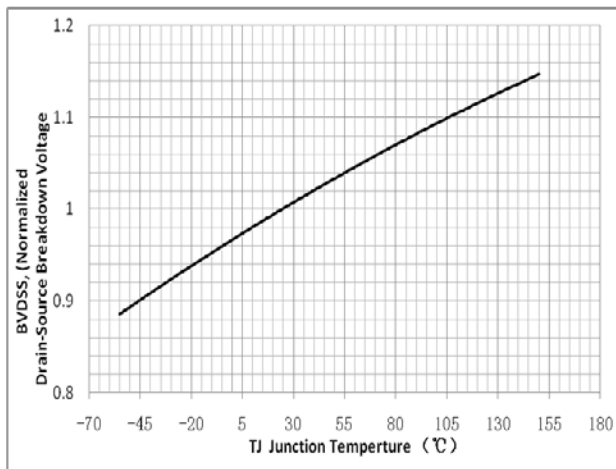
Fig. 6. On resistance variation vs. junction temperature
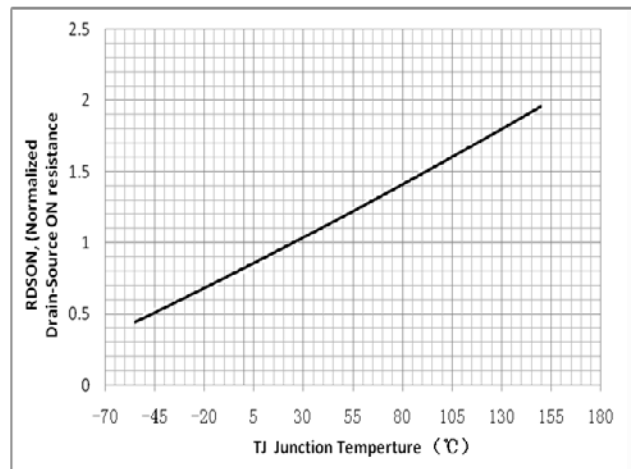
Fig. 7. Maximum safe operating area(TO-251)
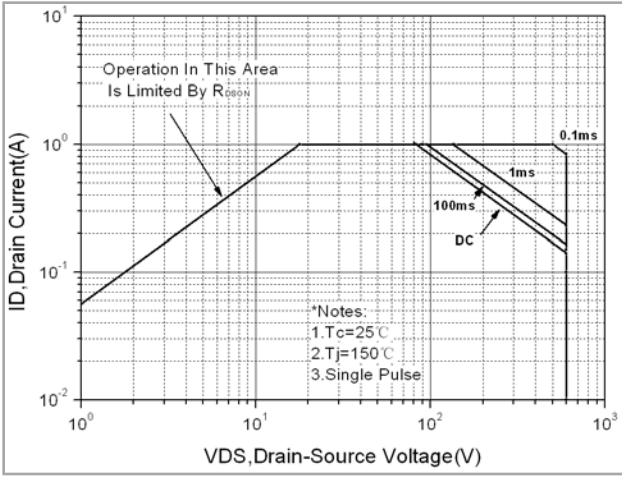
Fig. 8. Maximum safe operating area(TO-92)
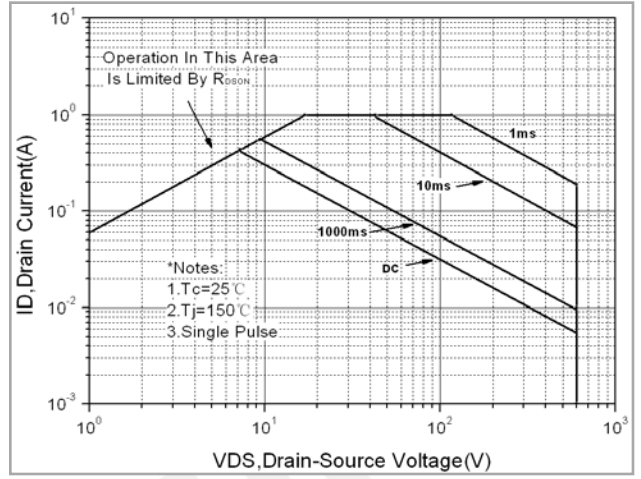
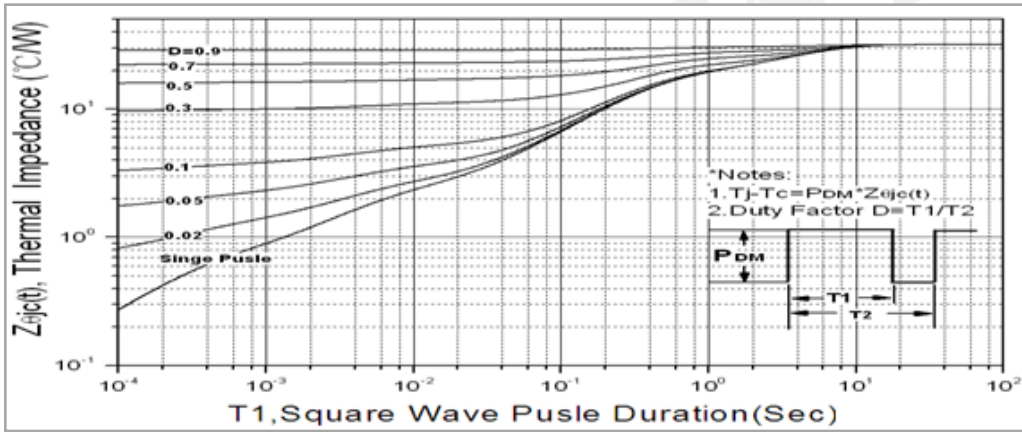**Fig. 10. Transient thermal response curve(TO-92)**

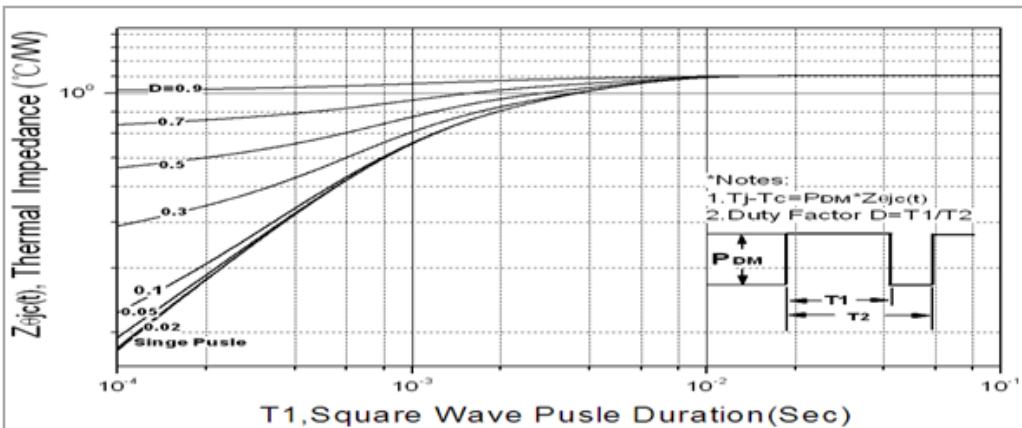**Fig. 11. Transient thermal response curve(TO-251)**

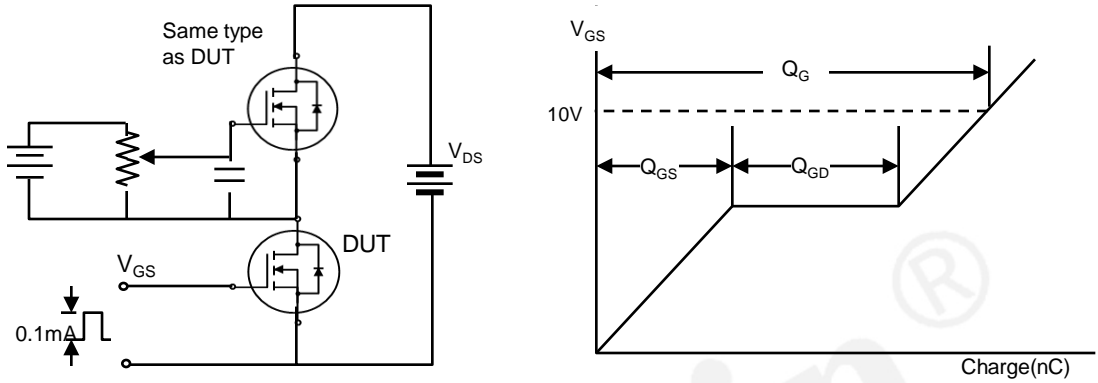**Fig. 12. Gate charge test circuit & waveform**

Fig. 13. Switching time test circuit & waveform

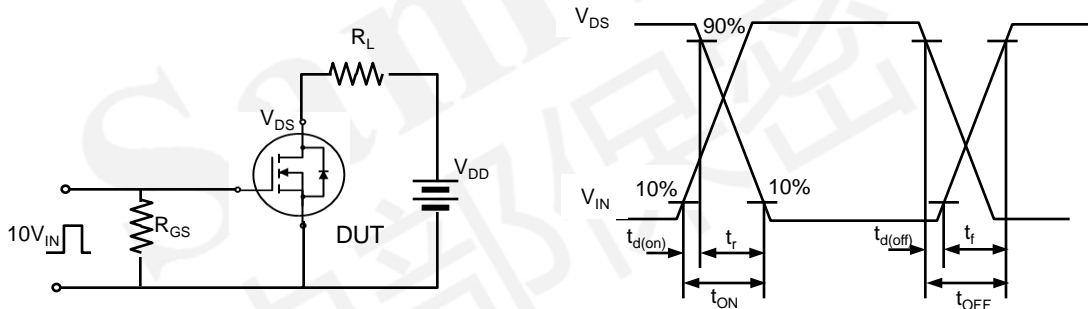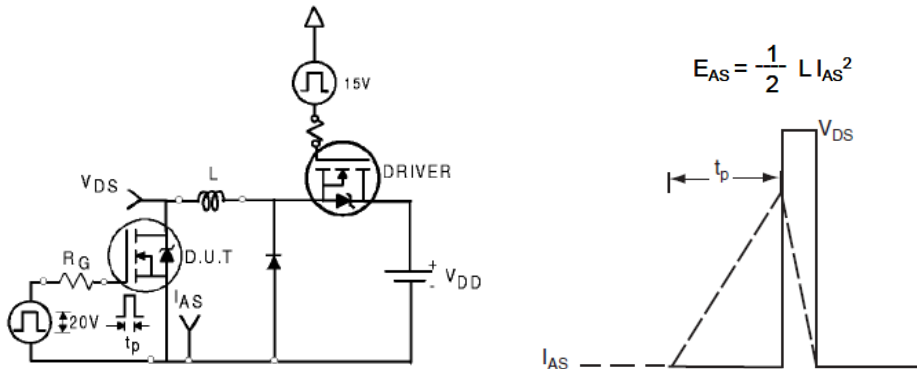**Fig. 14. Unclamped Inductive switching test circuit & waveform**

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

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Fig. 15. Peak diode recovery dv/dt test circuit & waveform

DUT

+ V_DS

I_S

L

V_DS

R_G

10V_GS

Same type
as DUT

V_DD

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

V_GS (DRIVER)

10V

I_S (DUT)

di/dt

I_RM

Diode reverse current

Diode recovery dv/dt

V_DS (DUT)

V_F

V_DD

Body diode forward voltage drop
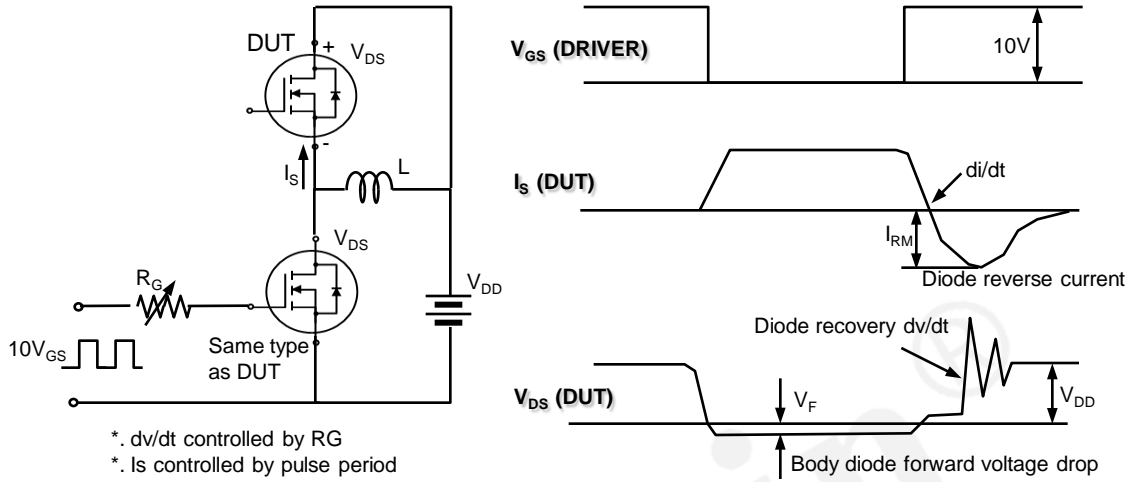
DISCLAIMER

 * 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**