## N-channel Enhanced mode TO-220F MOSFET

### Features

- High ruggedness
- Low $R_{DS(ON)}$ (Typ 0.57Ω)@V_{GS}=10V
- Low Gate Charge (Typ 57nC)
- Improved dv/dt Capability
- 100% Avalanche Tested
- Application: LED , Charge, PC Power

TO-220F

1. Gate 2. Drain 3. Source

BV_{DSS}	: 650V
I_D	: 15A
$R_{DS(ON)}$	: 0.57Ω

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 15N65D	SW15N65D	TO-220F	TUBE

Absolute maximum ratings

Symbol	Parameter		Value	Unit
V_{DSS}	Drain to source voltage		650	V
I_D	Continuous drain current (@T_C=25ºC)		15*	A
	Continuous drain current (@T_C=100ºC)		9.5*	A
I_{DM}	Drain current pulsed	(note 1)	60	A
V_{GS}	Gate to source voltage		±30	V
E_{AS}	Single pulsed avalanche energy	(note 2)	263	mJ
E_{AR}	Repetitive avalanche energy	(note 1)	25	mJ
dv/dt	Peak diode recovery dv/dt	(note 3)	5	V/ns
P_D	Total power dissipation (@T_C=25ºC)		33	W
	Derating factor above 25ºC		0.26	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
R_{thjc}	Thermal resistance, Junction to case	3.8	ºC/W
R_{thja}	Thermal resistance, Junction to ambient	49	ºC/W

Electrical characteristic (T_C = 25°C 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
ΔBV_{DSS} / ΔT_J	Breakdown voltage temperature coefficient	I_D=250uA, referenced to 25°C		0.68		V/°C
I_{DSS}	Drain to source leakage current	V_{DS}=650V, V_{GS}=0V			1	uA
		V_{DS}=520V, 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						
$V_{GS(TH)}$	Gate threshold voltage	V_{DS}=V_{GS}, I_D=250uA	2.5		4.5	V
$R_{DS(ON)}$	Drain to source on state resistance	V_{GS}=10V, I_D=7.5A		0.57	0.72	Ω
G_{fs}	Forward transconductance	V_{DS}=30V, I_D=7.5A		13		S
Dynamic characteristics						
C_{iss}	Input capacitance	V_{GS}=0V, V_{DS}=25V, f=1MHz		2646		pF
C_{oss}	Output capacitance			195		
C_{rss}	Reverse transfer capacitance			18		
$t_{d(on)}$	Turn on delay time	V_{DS}=325V, I_D=15A, R_G=25Ω, V_{GS}=10V (note 4,5)		35		ns
t_r	Rising time			58		
$t_{d(off)}$	Turn off delay time			117		
t_f	Fall time			50		
Q_g	Total gate charge	V_{DS}=520V, V_{GS}=10V, I_D=15A, Ig=4mA (note 4,5)		57		nC
Q_{gs}	Gate-source charge			15		
Q_{gd}	Gate-drain charge			23		
R_g	Gate resistance	V_{DS}=0V, Scan F mode		1.0		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			15	A
I_{SM}	Pulsed source current				60	A
V_{SD}	Diode forward voltage drop.	I_S=15A, V_{GS}=0V			1.4	V
t_{rr}	Reverse recovery time	I_S=15A, V_{GS}=0V, dI_F/dt=100A/us		499		ns
Q_{rr}	Reverse recovery charge			6.3		uC

※. Notes
1.   Repeatitive rating : pulse width limited by junction temperature.
2.   L =2.33mH, IAS =15A, VDD=50V, RG=25Ω, Starting TJ = 25°C
3. I_{SD} ≤ 15A, 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
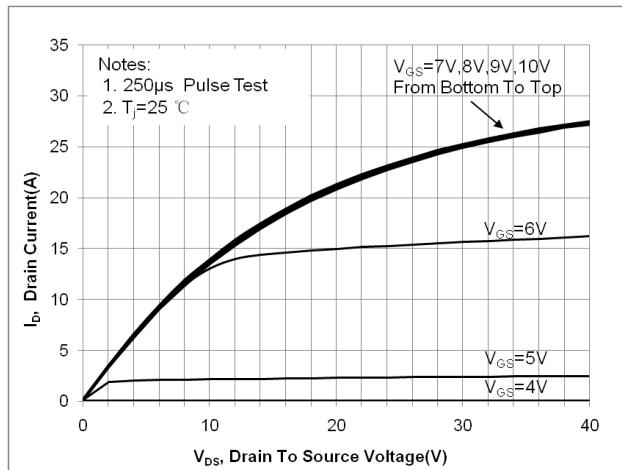
### Fig. 2. Transfer Characteristics
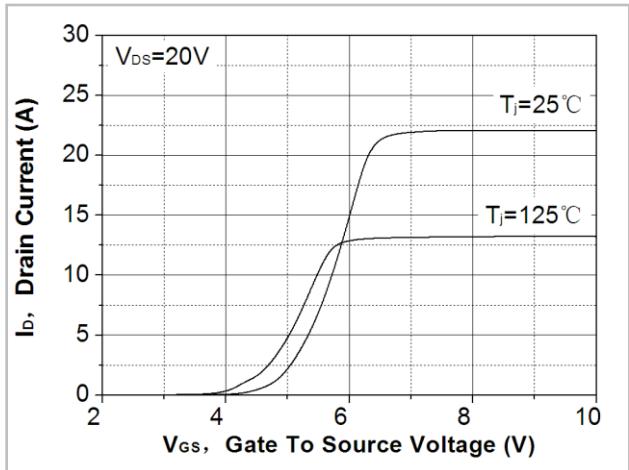
Fig. 3. On-resistance variation vs. drain current and gate voltage
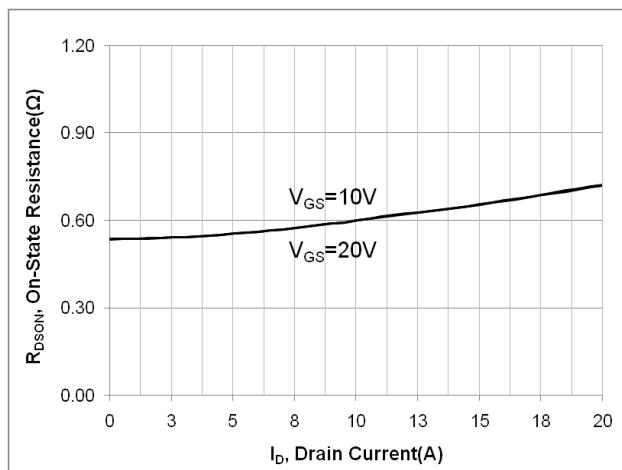
Fig. 4. On-state current vs. diode forward voltage
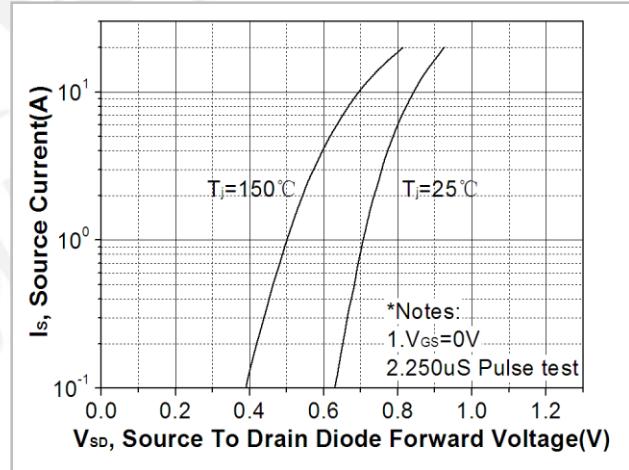
Fig 5. Breakdown voltage variation vs. junction temperature
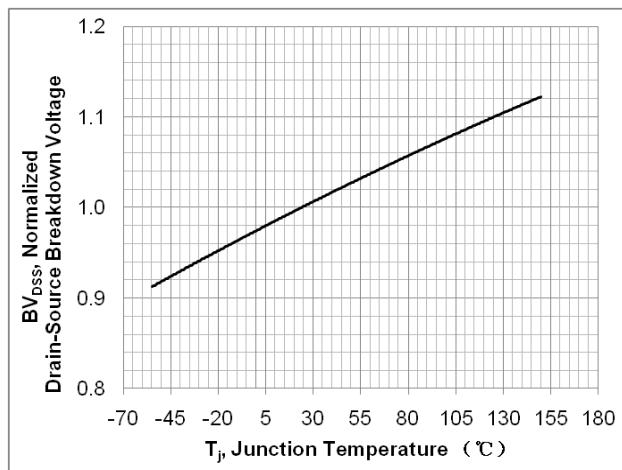
### Fig. 6. On-resistance variation vs. junction temperature
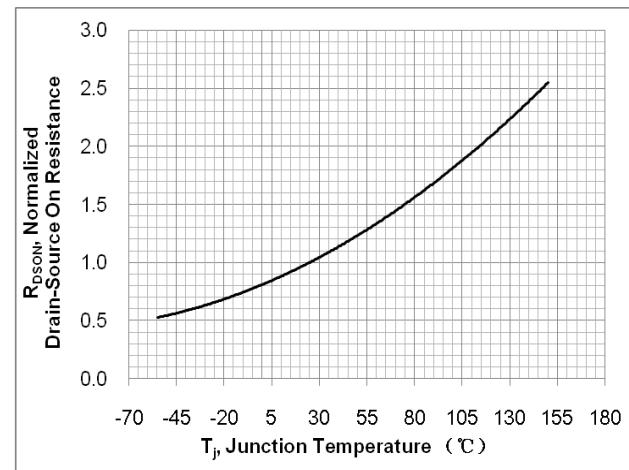
Fig. 7. Gate charge characteristics

Gate To Source Voltage(V), V_{GS} vs Q_g, Total Gate Charge (nC)

V_{DS}=520V, I_D=15A
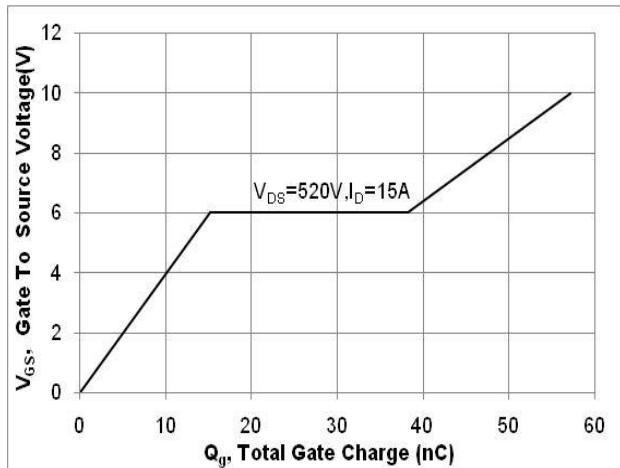
Fig. 8. Capacitance Characteristics

C (pF) vs V_{DS}, Drain To Source Voltage (V)

C_{iss}

C_{oss}

C_{rss}
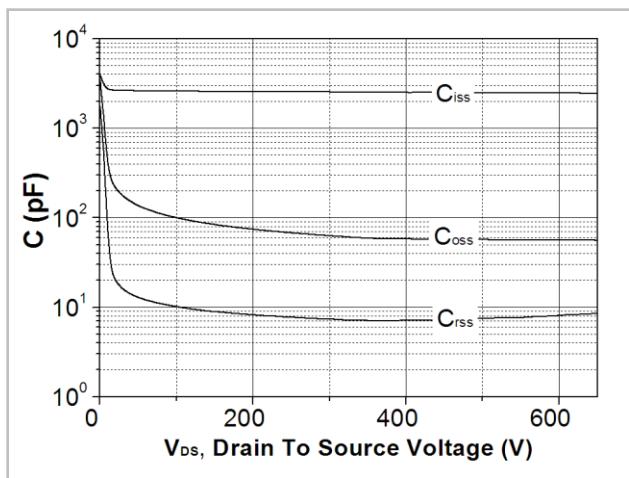
Fig. 9. Maximum safe operating area

I_D, Drain Current(A) vs V_{DS}, Drain To Source Voltage(V)

Operation In This Area Is Limited By R_{DSON}

0.1ms
1ms
100ms
DC

*Notes:
1. T_C=25℃
2. T_J=150℃
3. Single Pulse
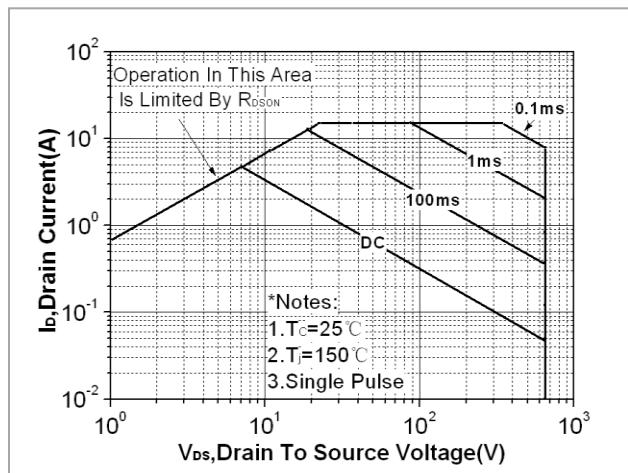
Fig. 10. Transient thermal response curve

$Z_{\theta jc(t)}$, Thermal Impedance (℃/W) vs T_1, Square Wave Pulse Duration(Sec)

D=0.9
0.7
0.5
0.3
0.1
0.05
0.02

Single Pulse

*Notes:
1. T_j-T_c=P_{DM}*$Z_{\theta jc(t)}$
2. Duty Factor D=T_1/T_2

P_{DM}
T_1
T_2
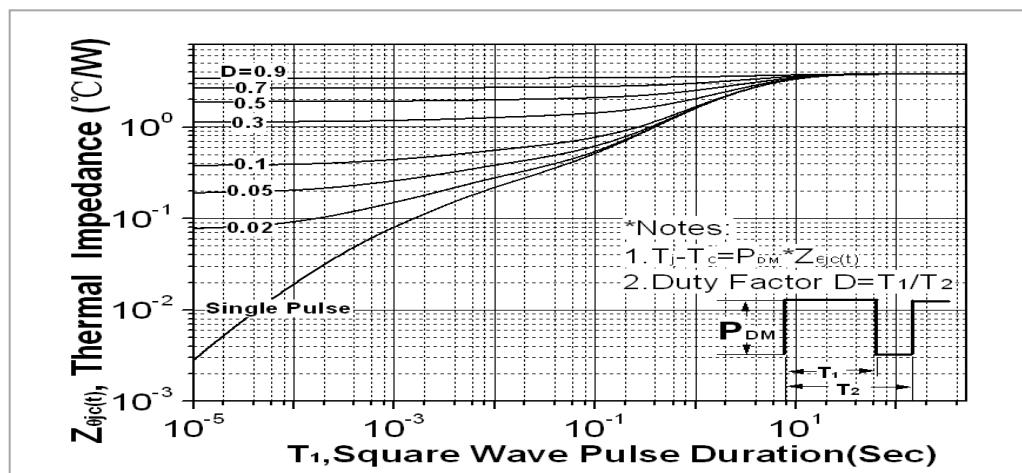
Fig. 11. Gate charge test circuit & waveform
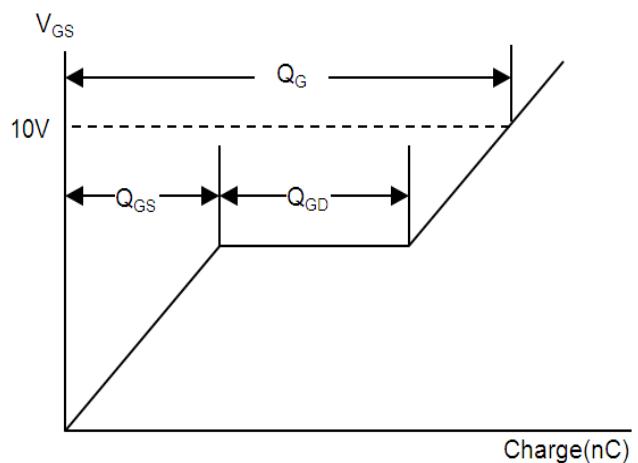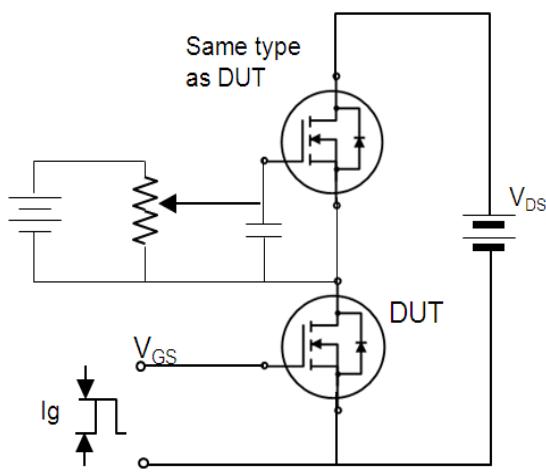
Fig. 12. Switching time test circuit & waveform
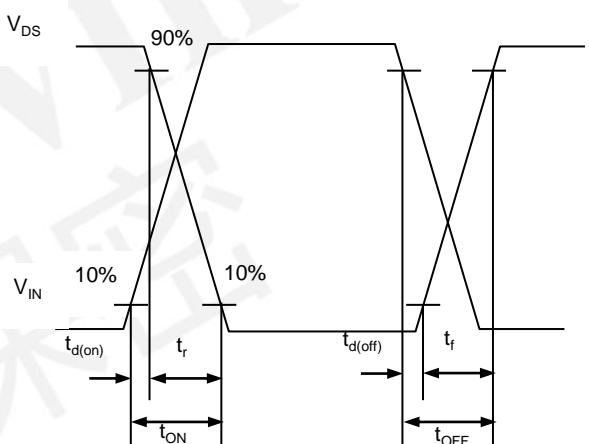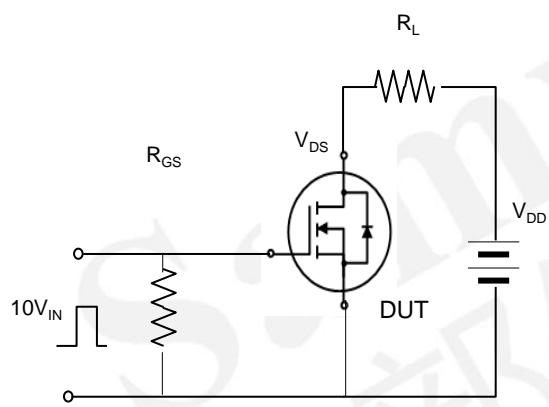
Fig. 13. Unclamped Inductive switching test circuit & waveform


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

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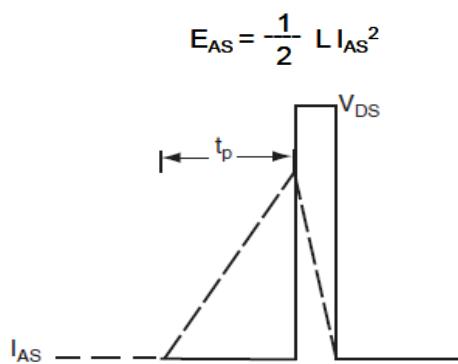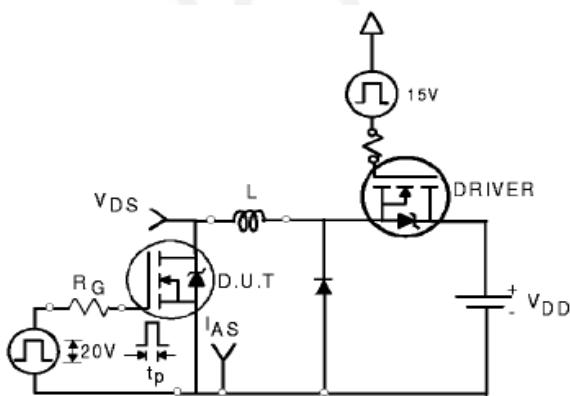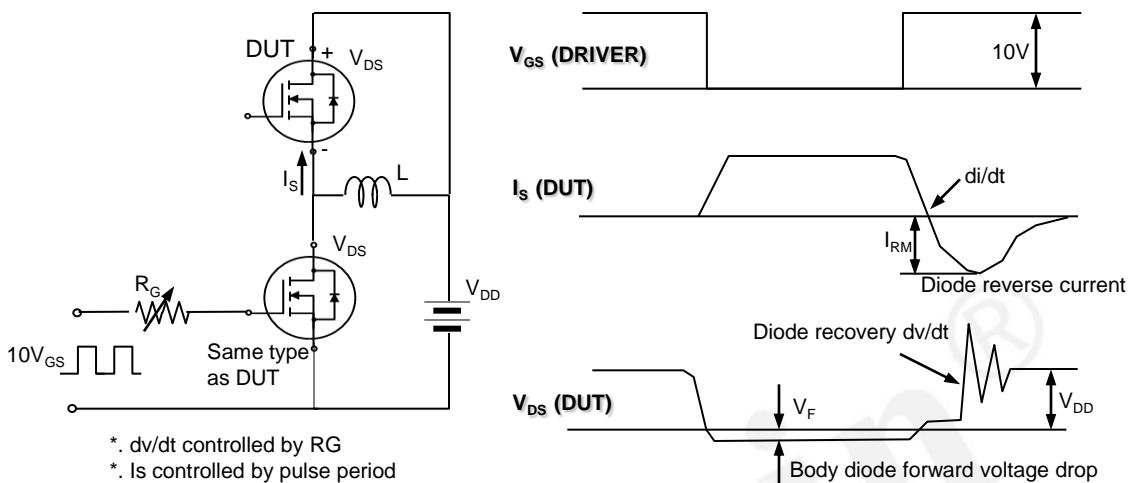
Fig. 14. Peak diode recovery dv/dt test circuit & waveform

DUT

V_{DS}

I_S L

V_{DS}

R_G

V_{DD}

$10V_{GS}$ Same type
as DUT

*. 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.**

 * Suggestions for improvement are appreciated, Please send your suggestions to **samwin@samwinsemi.com**

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