

# Enhancement Mode N-Channel Power MOSFET

## Features

- ◆ Low  $R_{DS(on)}$  & FOM
- ◆ Extremely low switching loss
- ◆ Excellent stability and uniformity
- ◆ Fast switching and soft recovery

## Applications

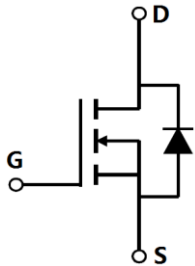

- ◆ Consumer electronic power supply
- ◆ Motor control
- ◆ Synchronous-rectification
- ◆ Isolated DC/DC convertor
- ◆ Invertors

## ■ General Description

SFG60N12FF uses advanced SFGMOST™ technology to provide low  $R_{DS(ON)}$ , low gate charge, fast switching and excellent avalanche characteristics. This device is specially designed to get better ruggedness and suitable to use in motor control applications.

◆ $V_{DS, min}$	120 V
◆ $I_{D, pulse}$	180 A
◆ $R_{DS(ON), max @ V_{GS}=10 V}$	16 mΩ
◆ $Q_g$	68.9 nC

## ■ Schematic and Package Information

SCHEMATIC DIAGRAM	PIN ASSIGNMENT TOP VIEW
	 <p style="text-align: center;"><b>TO220F</b> <b>SFG60N12FF</b></p>

## ■ Absolute Maximum Ratings at $T_j=25^{\circ}C$ unless otherwise noted

Parameter	Symbol	Value	Unit
Drain source voltage	$V_{DS}$	120	V
Gate source voltage	$V_{GS}$	$\pm 20$	V
Continuous drain current <sup>1)</sup> , $T_C=25^{\circ}C$	$I_D$	60	A
Pulsed drain current <sup>2)</sup> , $T_C=25^{\circ}C$	$I_{D, pulse}$	180	A
Power dissipation <sup>3)</sup> , $T_C=25^{\circ}C$	$P_D$	33	W
Single pulsed avalanche energy <sup>5)</sup>	$E_{AS}$	100	mJ
Operation and storage temperature	$T_{stg}, T_j$	-55 to 150	$^{\circ}C$

## ■ Thermal Characteristics

Parameter	Symbol	Value	Unit
Thermal resistance, junction-case	$R_{\theta JC}$	3.8	$^{\circ}\text{C}/\text{W}$
Thermal resistance, junction-ambient <sup>4)</sup>	$R_{\theta JA}$	62.5	$^{\circ}\text{C}/\text{W}$

## ■ Electrical Characteristics at $T_j=25^{\circ}\text{C}$ unless otherwise specified

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test condition
Drain-source breakdown voltage	$BV_{DSS}$	120			V	$V_{GS}=0\text{ V}$ , $I_D=250\ \mu\text{A}$
Gate threshold voltage	$V_{GS(th)}$	1.5		2.5	V	$V_{DS}=V_{GS}$ , $I_D=250\ \mu\text{A}$
Drain-source on-state resistance	$R_{DS(ON)}$		12	16	$\text{m}\Omega$	$V_{GS}=10\text{ V}$ , $I_D=30\text{ A}$
Gate-source leakage current	$I_{GSS}$			100	nA	$V_{GS}=20\text{ V}$
				-100		$V_{GS}=-20\text{ V}$
Drain-source leakage current	$I_{DSS}$			1	$\mu\text{A}$	$V_{DS}=120\text{ V}$ , $V_{GS}=0\text{ V}$

## ■ Dynamic Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test condition
Input capacitance	$C_{iss}$		2809.7		pF	$V_{GS}=0\text{ V}$ , $V_{DS}=50\text{ V}$ , $f=100\text{ kHz}$
Output capacitance	$C_{oss}$		356.1		pF	
Reverse transfer capacitance	$C_{rss}$		8.3		pF	
Turn-on delay time	$t_{d(on)}$		20.4		ns	$V_{GS}=10\text{ V}$ , $V_{DS}=50\text{ V}$ , $R_G=2\ \Omega$ , $I_D=25\text{ A}$
Rise time	$t_r$		5.7		ns	
Turn-off delay time	$t_{d(off)}$		45.1		ns	
Fall time	$t_f$		6.3		ns	

## ■ Gate Charge Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test condition
Total gate charge	$Q_g$		39.6		nC	$I_D=25\text{ A}$ , $V_{DS}=50\text{ V}$ , $V_{GS}=10\text{ V}$
Gate-source charge	$Q_{gs}$		6.8		nC	
Gate-drain charge	$Q_{gd}$		8.0		nC	
Gate plateau voltage	$V_{\text{plateau}}$		3.5		V	

## ■ Body Diode Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test condition
Diode forward current	$I_S$			60	A	$V_{GS} < V_{th}$
Pulsed source current	$I_{SP}$			180		
Diode forward voltage	$V_{SD}$			1.3	V	$I_S=60\text{ A}$ , $V_{GS}=0\text{ V}$
Reverse recovery time	$t_{rr}$		79.5		ns	$I_S=25\text{ A}$ , $di/dt=100\text{ A}/\mu\text{s}$
Reverse recovery charge	$Q_{rr}$		210		nC	
Peak reverse recovery current	$I_{rrm}$		4.4		A	

## ■ Note

- 1) Calculated continuous current based on maximum allowable junction temperature.
- 2) Repetitive rating; pulse width limited by max. junction temperature.
- 3)  $P_d$  is based on max. junction temperature, using junction-case thermal resistance.
- 4) The value of  $R_{\theta JA}$  is measured with the device mounted on 1 in 2 FR-4 board with 2oz. Copper, in a still air environment with  $T_a=25\text{ }^\circ\text{C}$ .
- 5)  $V_{DD}=50\text{ V}$ ,  $R_G=50\text{ }\Omega$ ,  $L=0.3\text{ mH}$ , starting  $T_j=25\text{ }^\circ\text{C}$ .

■ **Electrical Characteristics Diagrams**

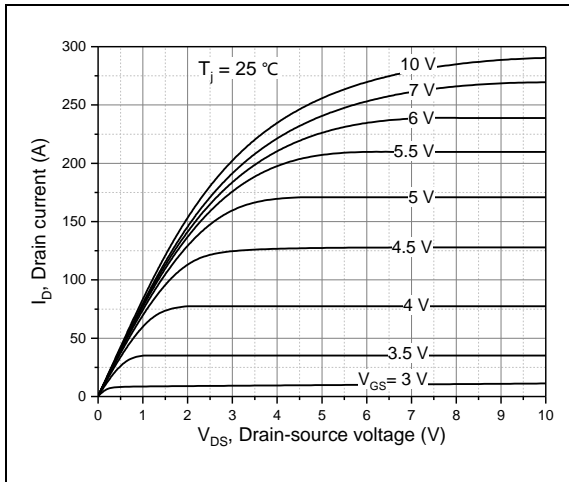


Figure 1, Typ. output characteristics

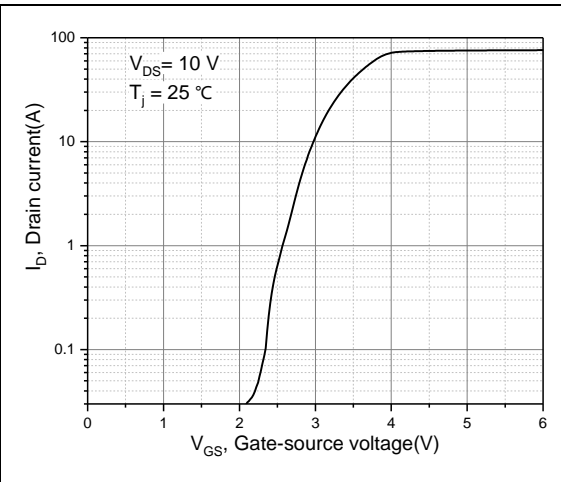


Figure 2, Typ. transfer characteristics

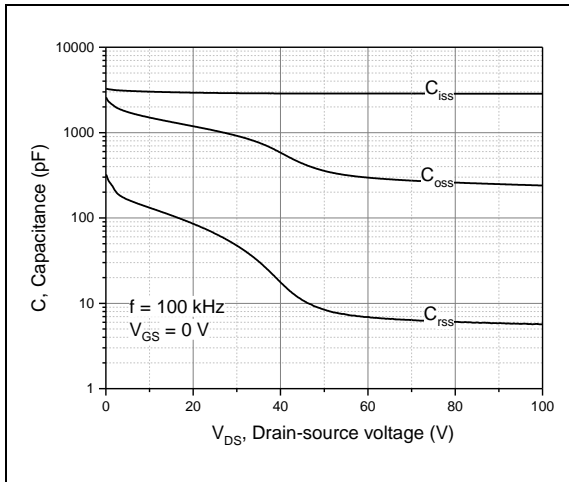


Figure 3, Typ. capacitances

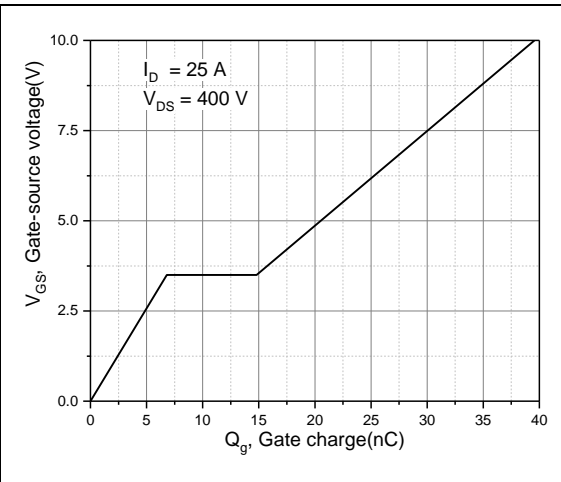


Figure 4, Typ. gate charge

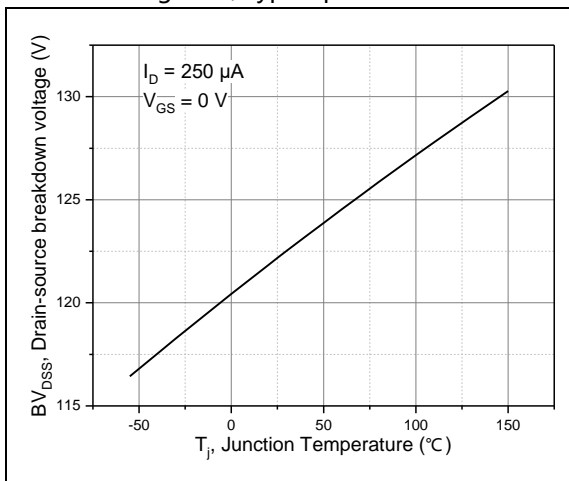


Figure 5, Drain-source breakdown voltage

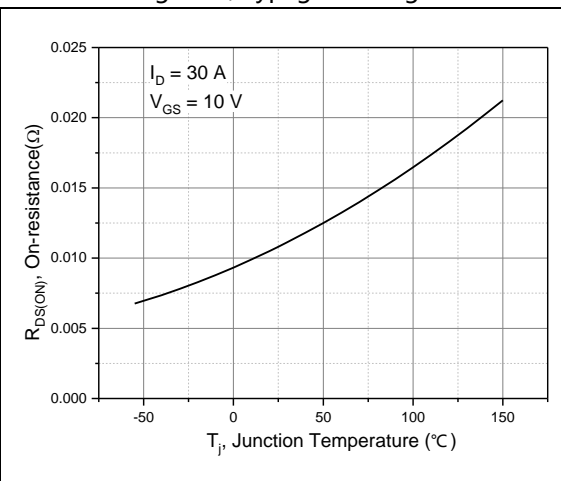


Figure 6, Drain-source on-state resistance

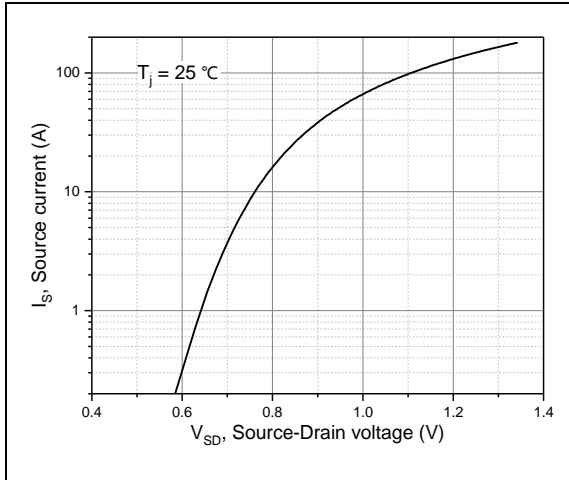


Figure 7, Forward characteristic of body diode

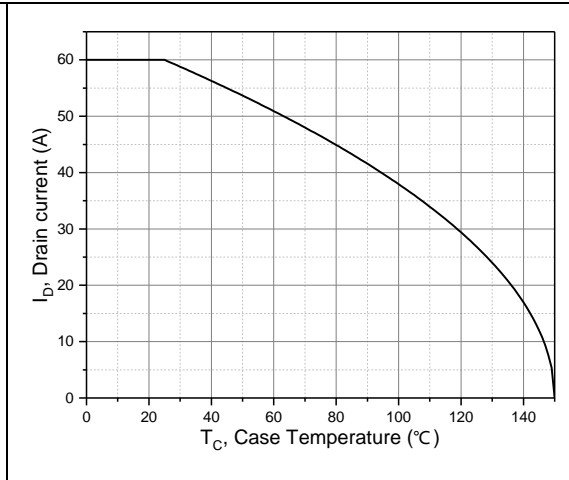


Figure 8, Drain current

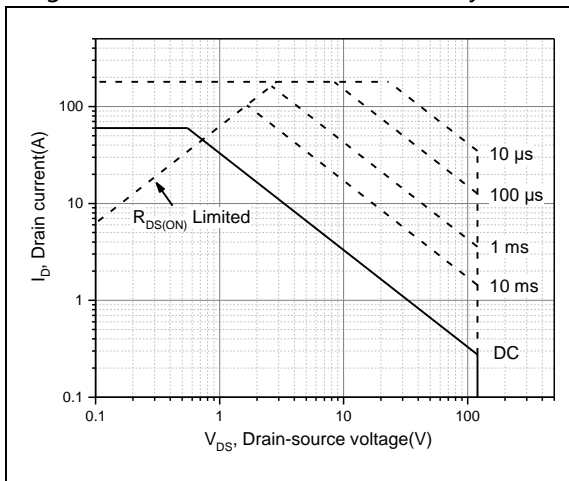
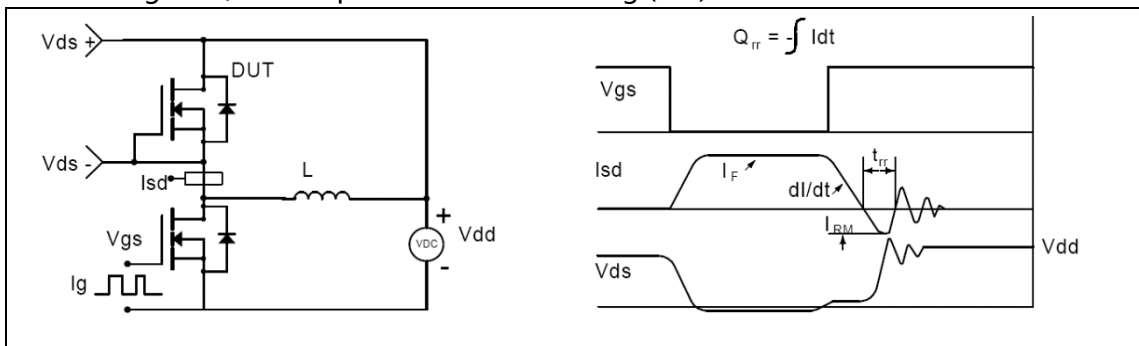
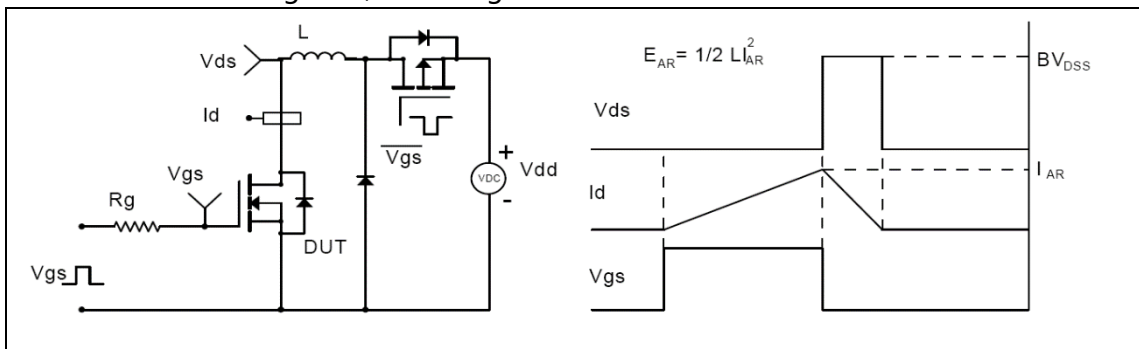
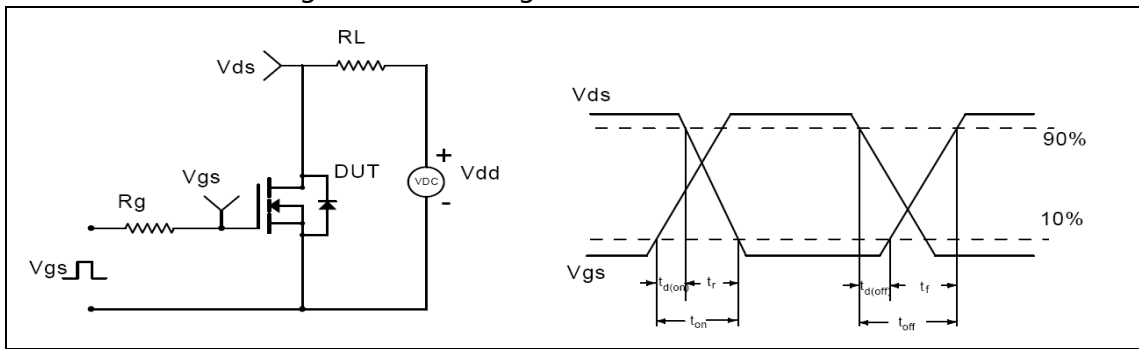
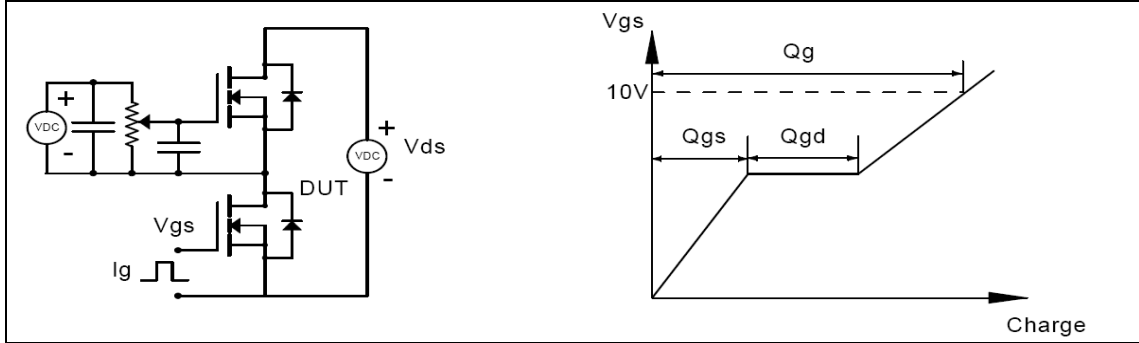


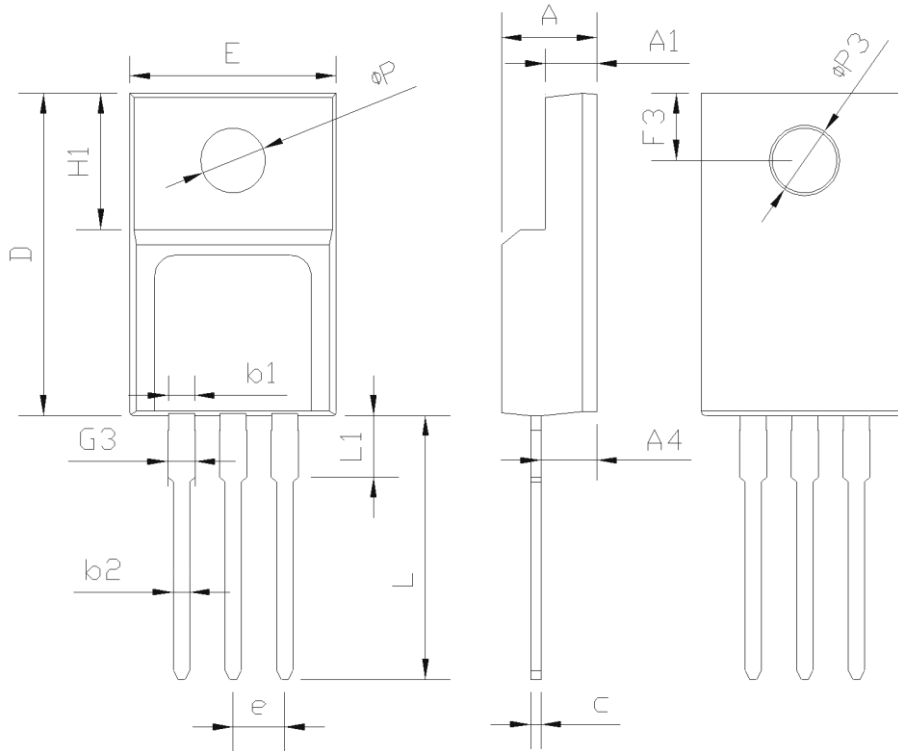
Figure 9, Safe operation area  $T_C=25\text{ }^\circ\text{C}$

■ Test circuits and waveforms



**■ Package Information**

Figure1, TO220F package outline dimension



SYMBOL	mm		
	MIN	NOM	MAX
E	9.96	10.16	10.36
A	4.50	4.70	4.90
A1	2.34	2.54	2.74
A4	2.56	2.76	2.96
c	0.40	0.50	0.65
D	15.57	15.87	16.17
H1	6.70REF		
e	2.54BSC		
L	12.68	12.98	13.28
L1	2.88	3.03	3.18
ΦP	3.03	3.18	3.38
ΦP3	3.15	3.45	3.65
F3	3.15	3.30	3.45
G3	1.25	1.35	1.55
b1	1.18	1.28	1.43
b2	0.70	0.80	0.95



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**■ Ordering Information**

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Package	Units/Tube	Tubes/Inner Box	Units/Inner Box	Inner Box/Carton Box	Units/Carton Box
TO220F	50	20	1000	6	6000

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**■ Product Information**

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Product	Package	Pb Free	RoHS	Halogen Free
SFG60N12FF	TO220F	yes	yes	yes