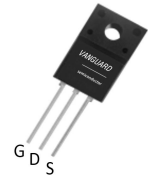


## Features

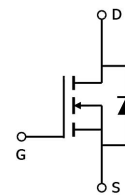
- Enhancement mode
- VitoMOS<sup>®</sup> II Technology
- 100% Avalanche test

$V_{DS}$	100	V
$R_{DS(on),TYP@ V_{GS}=10V}$	10	m $\Omega$
$R_{DS(on),TYP@ V_{GS}=4.5V}$	13.5	m $\Omega$
$I_D$	42	A

## TO-220SF



Part ID	Package Type	Marking	Tube Information
VSF013N10MS3-G	TO-220SF	013N10M	50pcs/Tube



## Maximum ratings, at $T_A = 25^\circ\text{C}$ , unless otherwise specified

Symbol	Parameter	Rating	Unit	
$V_{(BR)DSS}$	Drain-Source breakdown voltage	100	V	
$V_{GS}$	Gate-Source voltage	$\pm 20$	V	
$I_S$	Diode continuous forward current	$T_C = 25^\circ\text{C}$	42	A
$I_D$	Continuous drain current @ $V_{GS}=10V$	$T_C = 25^\circ\text{C}$	42	A
		$T_C = 100^\circ\text{C}$	30	A
$I_{DM}$	Pulse drain current tested ①	$T_C = 25^\circ\text{C}$	168	A
$I_{DSM}$	Continuous drain current @ $V_{GS}=10V$	$T_A = 25^\circ\text{C}$	10	A
		$T_A = 70^\circ\text{C}$	8	A
$E_{AS}$	Avalanche energy, single pulsed ②	16	mJ	
$P_D$	Maximum power dissipation	$T_C = 25^\circ\text{C}$	39	W
$P_{DSM}$	Maximum power dissipation ③	$T_A = 25^\circ\text{C}$	2	W
$T_{STG,TJ}$	Storage and Junction Temperature Range	-55 to 175	$^\circ\text{C}$	

## Thermal Characteristics

Symbol	Parameter	Typical	Max	Unit
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	3.8	4.6	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	62.5	75	$^\circ\text{C/W}$

**Electrical Characteristics**

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
<b>Static Electrical Characteristics @ T<sub>j</sub> = 25°C (unless otherwise stated)</b>						
V <sub>(BR)DSS</sub>	Drain-Source Breakdown Voltage	V <sub>GS</sub> =0V, I <sub>D</sub> =250μA	100	--	--	V
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> =100V, V <sub>GS</sub> =0V	--	--	1	μA
	Zero Gate Voltage Drain Current(T <sub>j</sub> =125°C)	V <sub>DS</sub> =100V, V <sub>GS</sub> =0V	--	--	100	μA
I <sub>GSS</sub>	Gate-Body Leakage Current	V <sub>GS</sub> =±20V, V <sub>DS</sub> =0V	--	--	±100	nA
V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA	1.2	1.7	2.3	V
R <sub>DS(on)</sub>	Drain-Source On-State Resistance ④	V <sub>GS</sub> =10V, I <sub>D</sub> =40A	--	10	13	mΩ
		T <sub>j</sub> =100°C	--	13.5	--	mΩ
R <sub>DS(on)</sub>	Drain-Source On-State Resistance ④	V <sub>GS</sub> =4.5V, I <sub>D</sub> =25A	--	13.5	17.5	mΩ
<b>Dynamic Electrical Characteristics @ T<sub>j</sub>= 25°C (unless otherwise stated)</b>						
C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> =30V, V <sub>GS</sub> =0V, f=1MHz	1135	1515	2015	pF
C <sub>oss</sub>	Output Capacitance		570	760	1010	pF
C <sub>rss</sub>	Reverse Transfer Capacitance		30	40	55	pF
R <sub>g</sub>	Gate Resistance	f=1MHz	0.2	0.6	3	Ω
Q <sub>g(10V)</sub>	Total Gate Charge	V <sub>DS</sub> =50V, I <sub>D</sub> =40A, V <sub>GS</sub> =10V	--	27	36	nC
Q <sub>g(4.5V)</sub>	Total Gate Charge		--	14	19	nC
Q <sub>gs</sub>	Gate-Source Charge		--	5.7	7.6	nC
Q <sub>gd</sub>	Gate-Drain Charge		--	5.8	8.7	nC
<b>Switching Characteristics</b>						
T <sub>d(on)</sub>	Turn-on Delay Time	V <sub>DD</sub> =50V, I <sub>D</sub> =40A, R <sub>G</sub> =3Ω, V <sub>GS</sub> =10V	--	9	--	ns
T <sub>r</sub>	Turn-on Rise Time		--	39	--	ns
T <sub>d(off)</sub>	Turn-Off Delay Time		--	23	--	ns
T <sub>f</sub>	Turn-Off Fall Time		--	64	--	ns
<b>Source- Drain Diode Characteristics @ T<sub>j</sub> = 25°C (unless otherwise stated)</b>						
V <sub>SD</sub>	Forward on voltage	I <sub>SD</sub> =40A, V <sub>GS</sub> =0V	--	0.9	1.2	V
T <sub>rr</sub>	Reverse Recovery Time	I <sub>sd</sub> =30A, V <sub>GS</sub> =0V	--	40	--	ns
Q <sub>rr</sub>	Reverse Recovery Charge	di/dt=100A/μs	--	35	70	nC

NOTE: ① Repetitive rating; pulse width limited by max junction temperature.

② Limited by T<sub>Jmax</sub>, starting T<sub>J</sub> = 25°C, L = 0.5mH, R<sub>G</sub> = 25Ω, I<sub>AS</sub> = 8A, V<sub>GS</sub> = 10V. Part not recommended for use above this value

③ The power dissipation P<sub>DSM</sub> is based on R<sub>θJA</sub> and the maximum allowed junction temperature of 150°C.

④ Pulse width ≤ 380μs; duty cycle ≤ 2%.

Typical Characteristics

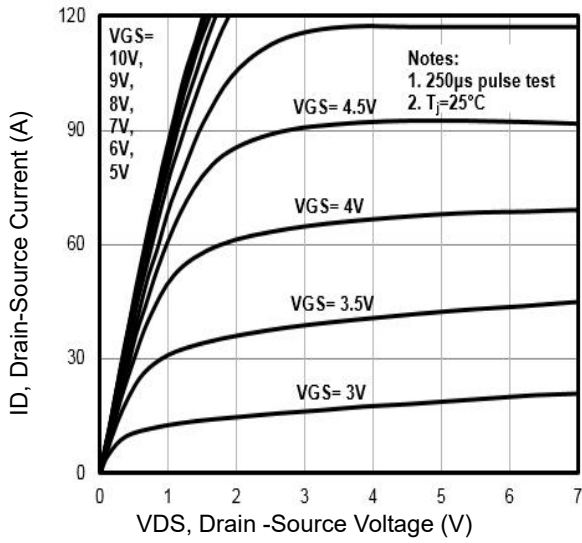


Fig1. Typical Output Characteristics

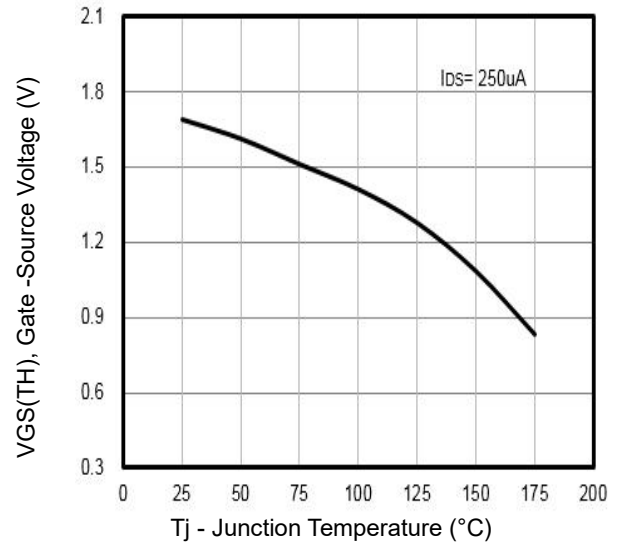


Fig2.  $V_{GS(TH)}$  Gate-Source Voltage Vs.  $T_j$

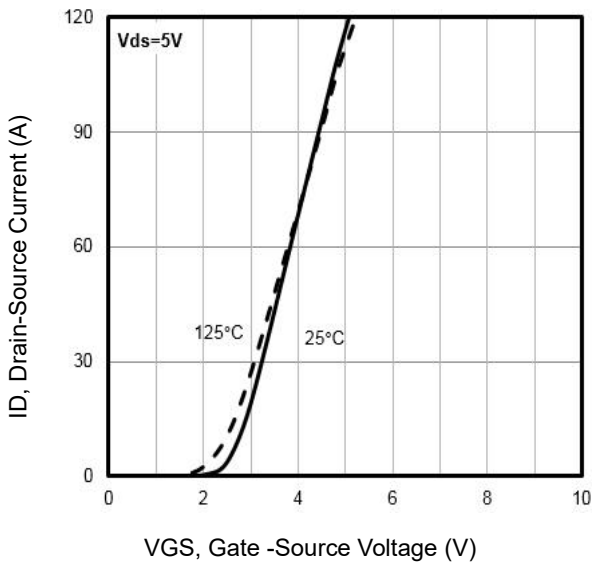


Fig3. Typical Transfer Characteristics

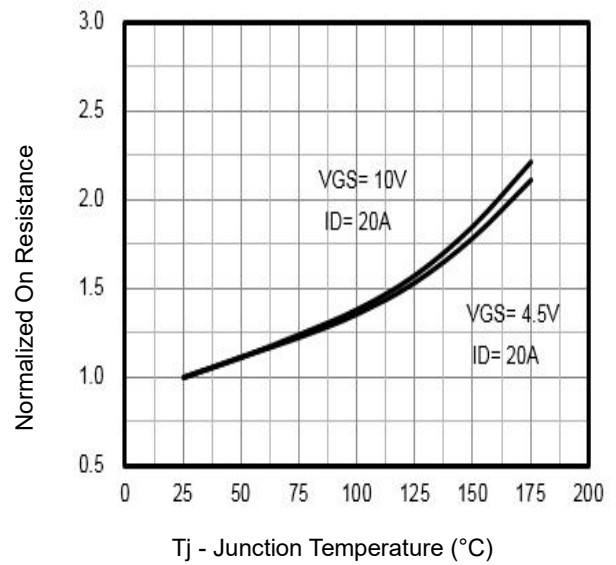


Fig4. Normalized On-Resistance Vs. Temperature

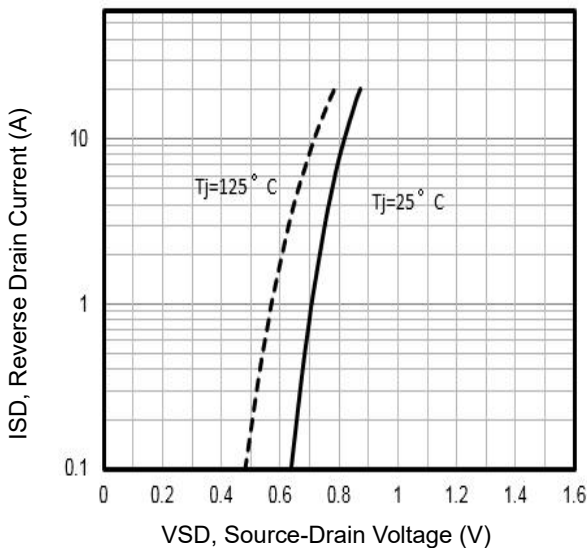


Fig5. Typical Source-Drain Diode Forward Voltage

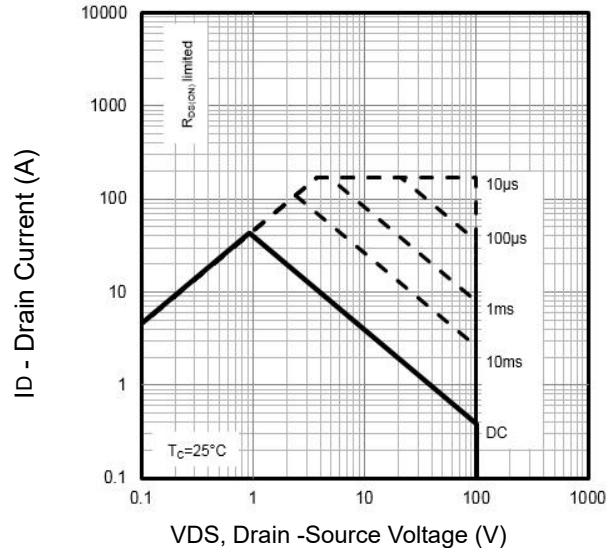


Fig6. Maximum Safe Operating Area

Typical Characteristics

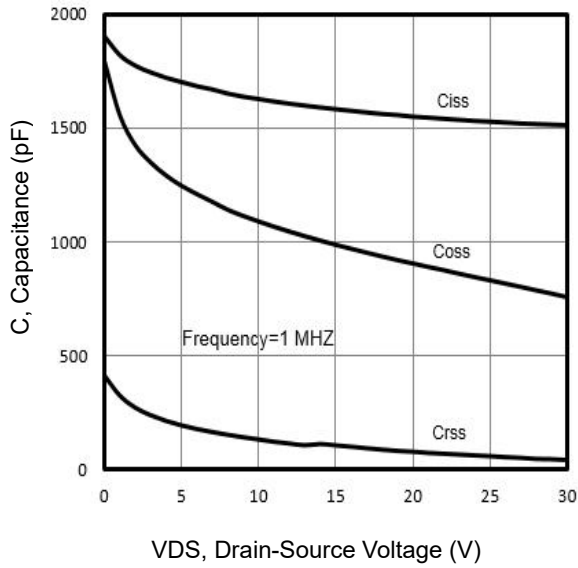


Fig7. Typical Capacitance Vs. Drain-Source Voltage

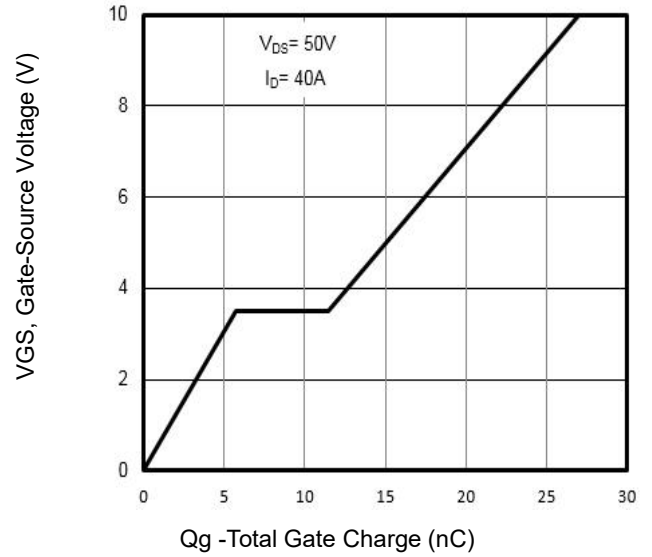


Fig8. Typical Gate Charge Vs. Gate-Source Voltage

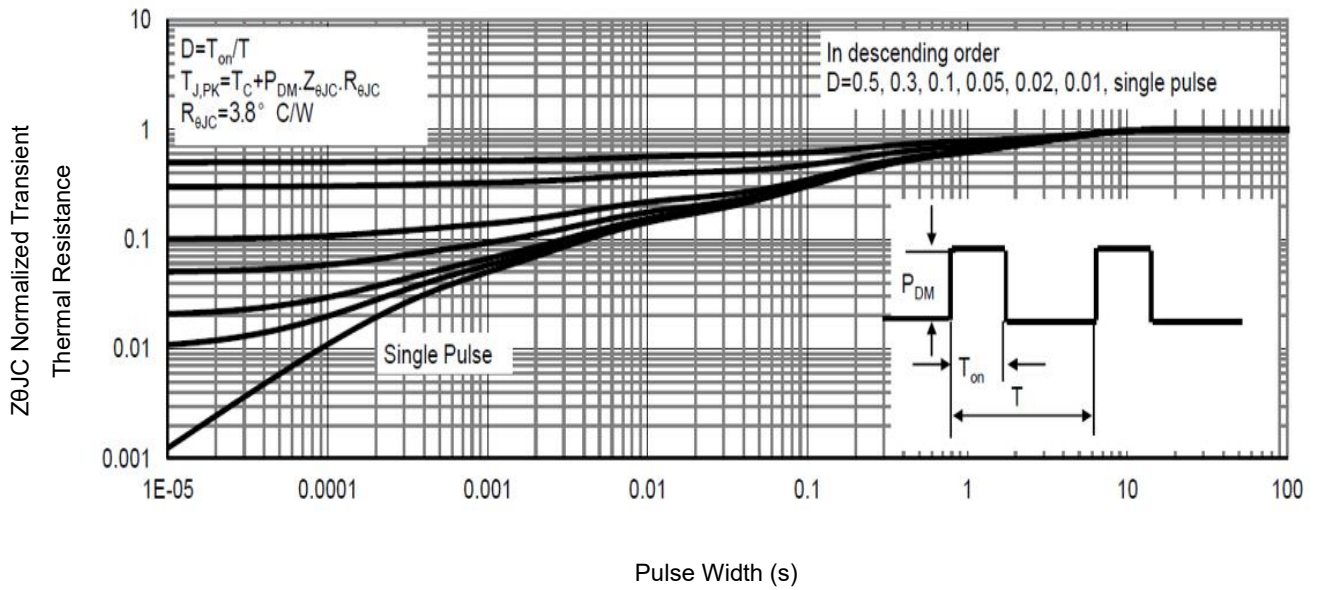


Fig9. Normalized Maximum Transient Thermal Impedance

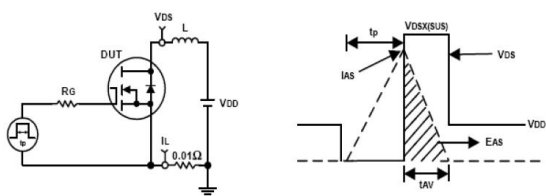


Fig10. Unclamped Inductive Test Circuit and waveforms

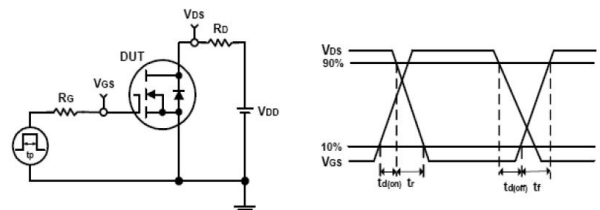
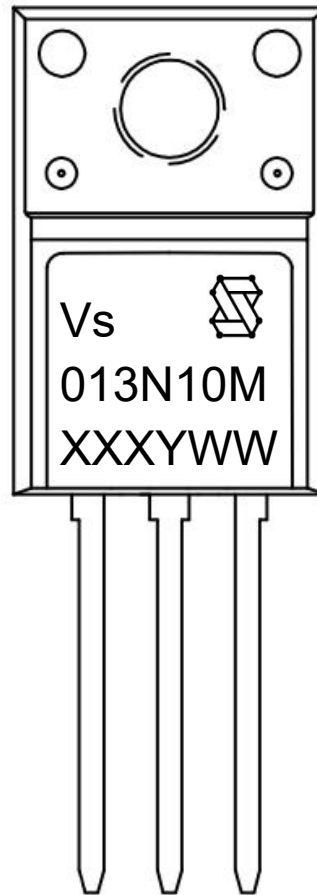


Fig11. Switching Time Test Circuit and waveforms

## Marking Information



1st line: Vanguard Code (Vs), Vanguard Logo

2nd line: Part Number (013N10M)

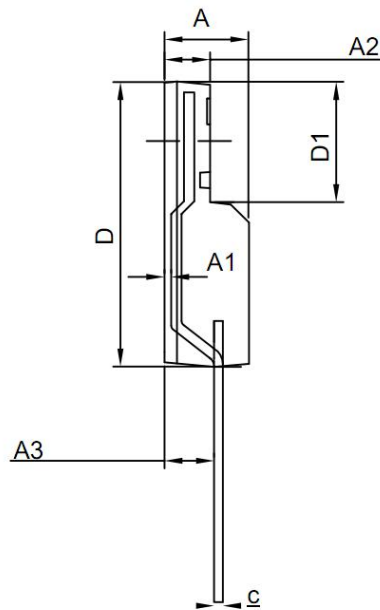
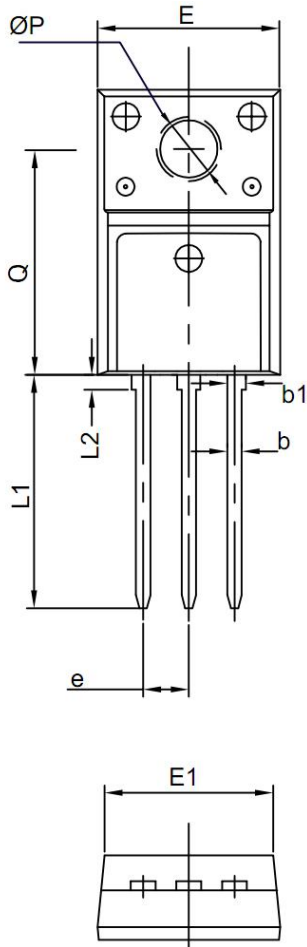
3rd line: Date code (XXXYWW)

XXX: Wafer Lot Number Code, code changed with Lot Number

Y: Year Code, (e.g. H=2020, J=2021, K=2022, L=2023, etc)

WW: Week Code (01 to 53)

### TO-220SF Package Outline Data



Symbol	Dimensions (unit: mm)		
	Min	Typ	Max
A	4.50	4.70	4.90
A1	--	0.43	--
A2	2.34	2.54	2.74
A3	2.66	2.76	2.86
b	0.59	0.69	0.79
b1	1.04	1.14	1.24
c	0.45	0.50	0.60
D	15.57	15.87	16.17
D1	6.50	6.70	6.90
e	2.44	2.54	2.64
E	9.96	10.16	10.36
E1	9.20	9.40	9.60
L1	12.70	13.00	13.30
L2	--	--	0.95
Q	12.27	12.57	12.87
ØP	3.03	3.18	3.33

Note:

1. Dimensions do NOT include mold flash, protrusions or gate burrs.

### Customer Service

**Sales and Service:**

[sales@vgsemi.com](mailto:sales@vgsemi.com)

**Vanguard Semiconductor CO., LTD**

**TEL:** (86-755) -26902410

**FAX:** (86-755) -26907027

**WEB:** [www.vgsemi.com](http://www.vgsemi.com)