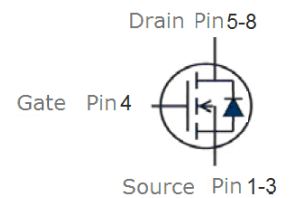## Features

- N-Channel，5V Logic Level Control

- Enhancement mode

- Very low on-resistance $R_{DS(on)}$ @ V_{GS}=4.5 V

- Fast Switching

- Pb-free lead plating; RoHS compliant

- MSL: Level 1 compliant

Pb-Free   RoHS   (HF) Halogen-Free

V_{DS}		60	V
$R_{DS(on),TYP}$@ V_{GS}=10 V		9.5	mΩ
$R_{DS(on),TYP}$@ V_{GS}=4.5V		11.5	mΩ
I_D		13	A

SOP8

Drain Pin 5-8
Gate Pin 4
Source Pin 1-3

Part ID	Package Type	Marking	Tape and reel information
VSO012N06MS	SOP8	012N06M	3000pcs/Reel

Maximum ratings, at T_A=25 °C, unless otherwise specified

Symbol	Parameter		Rating	Unit
$V_{(BR)DSS}$	Drain-Source breakdown voltage		60	V
V_{GS}	Gate-Source voltage		±20	V
I_S	Continuous Source Current (Body Diode)	T_A=25°C	2.5	A
I_{SM}	Maximum Pulsed Current (Body Diode)	T_A=25°C	10	A
I_D	Continuous drain current @V_{GS}=10V	T_A=25°C	13	A
		T_A=100°C	8.3	A
I_{DM}	Pulse drain current tested ①	T_A=25°C	42	A
IAS	Avalanche Current maximum		55	A
EAS	Avalanche energy, single pulsed ②		1229	mJ
P_D	Maximum power dissipation	T_A=25°C	3	W
T_{STG}, T_J	Storage and Junction Temperature Range		-55 to 150	°C

Thermal Characteristics

Symbol	Parameter	Typical	Unit
$R_{\theta JC}$	Thermal Resistance, Junction-to-Lead	24	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	40	°C/W

Typical Characteristics

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
Static Electrical Characteristics @ T_j = 25°C (unless otherwise stated)						
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	V_{GS}=0V, I_D=250µA	60	--	--	V
$\Delta V_{(BR)DSS}$ /ΔT_j	Breakdown voltage Temperature Coefficient	I_D=250µA, Reference 25℃	--	0.052	--	V/℃
I_{DSS}	Zero Gate Voltage Drain Current(Tj=25℃)	V_{DS}=60V,V_{GS}=0V	--	--	1	µA
	Zero Gate Voltage Drain Current(Tj=125℃)	V_{DS}=60V,V_{GS}=0V	--	--	100	µA
I_{GSS}	Gate-Body Leakage Current	V_{GS}=±20V,V_{DS}=0V	--	--	±100	nA
$V_{GS(TH)}$	Gate Threshold Voltage	V_{DS}=V_{GS},I_D=250µA	1.4	1.8	2.5	V
$R_{DS(ON)}$	Drain-Source On-State Resistance③	V_{GS}=10V, I_D=8A	--	9.5	12	mΩ
$R_{DS(ON)}$	Drain-Source On-State Resistance③	V_{GS}=4.5V, I_D=4A	--	11.5	14	mΩ
Dynamic Electrical Characteristics @ T_j= 25°C (unless otherwise stated)						
R_g	Gate Resistance		--	2.8	--	Ω
C_{iss}	Input Capacitance	V_{DS}=30V,V_{GS}=0V, f=1MHz	--	1905	--	pF
C_{oss}	Output Capacitance		--	205	--	pF
C_{rss}	Reverse Transfer Capacitance		--	180	--	pF
Q_g	Total Gate Charge	V_{DS}=30V,I_D=10A, V_{GS}=10V	--	26	--	nC
Q_{gs}	Gate-Source Charge		--	6.5	--	nC
Q_{gd}	Gate-Drain Charge		--	4.5	--	nC
Switching Characteristics						
$t_{d(on)}$	Turn-on Delay Time	V_{DD}=30V, I_D=10A, R_G=6.8Ω, V_{GS}=10V	--	9	--	ns
t_r	Turn-on Rise Time		--	5	--	ns
$t_{d(off)}$	Turn-Off Delay Time		--	28	--	ns
t_f	Turn-Off Fall Time		--	4	--	ns
Source- Drain Diode Characteristics@ T_j = 25°C (unless otherwise stated)						
V_{SD}	Forward on voltage	I_{SD}=2A,V_{GS}=0V	--	0.71	1.2	V
t_{rr}	Reverse Recovery Time	T_j=25 ℃ ,I_{sd}=10A, V_{GS}=0V di/dt=100A/µs	--	23	--	ns
Q_{rr}	Reverse Recovery Charge		--	52	--	nC

NOTE:

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

② Limited by T_{Jmax}, starting T_J = 25°C, L = 0.5mH, R_G = 25Ω, I_{AS} = 55A, V_{GS} =10V. Part not recommended for use above this value

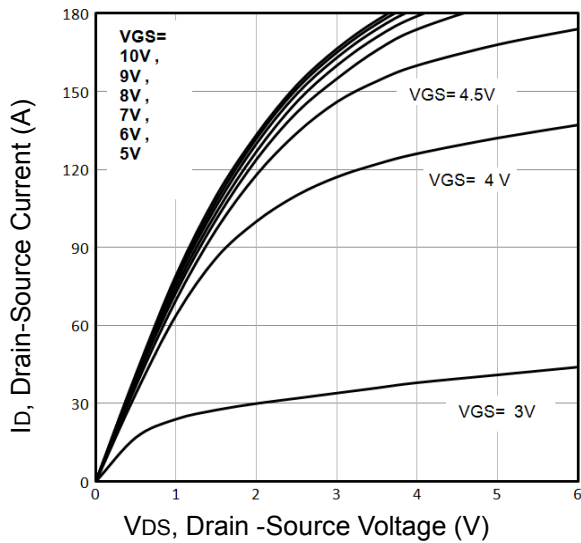③ Pulse width ≤ 300µs; duty cycle≤ 2%.

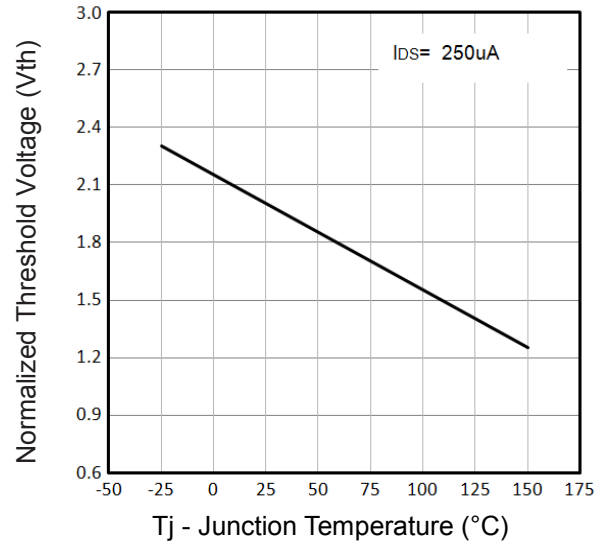## Typical Characteristics

Fig1. Typical Output Characteristics

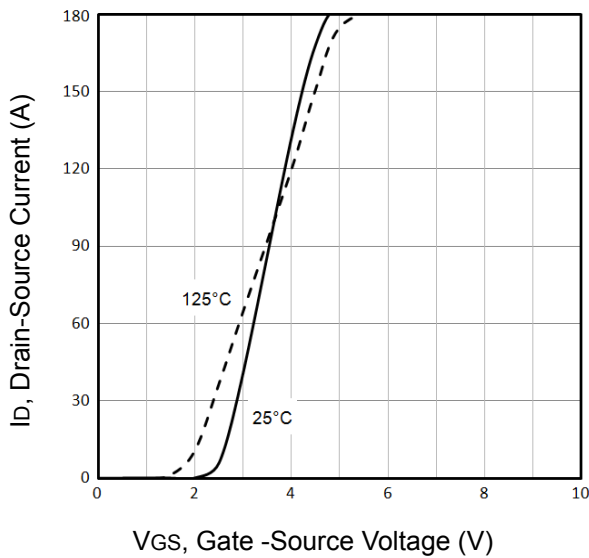**Fig2.** Normalized Threshold Voltage Vs. Temperature

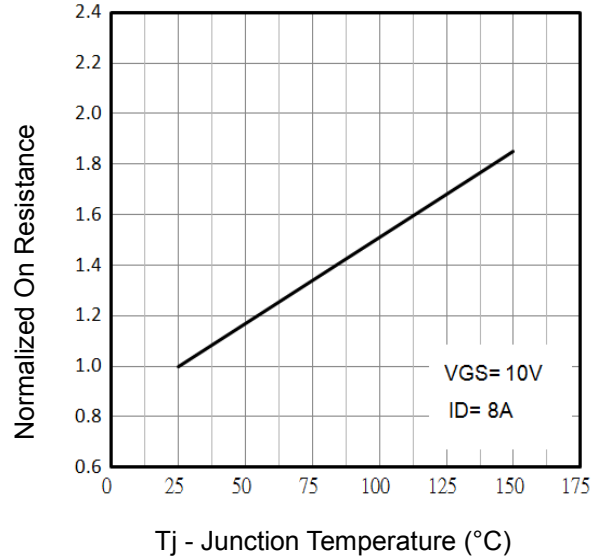**Fig3.** Typical Transfer Characteristics

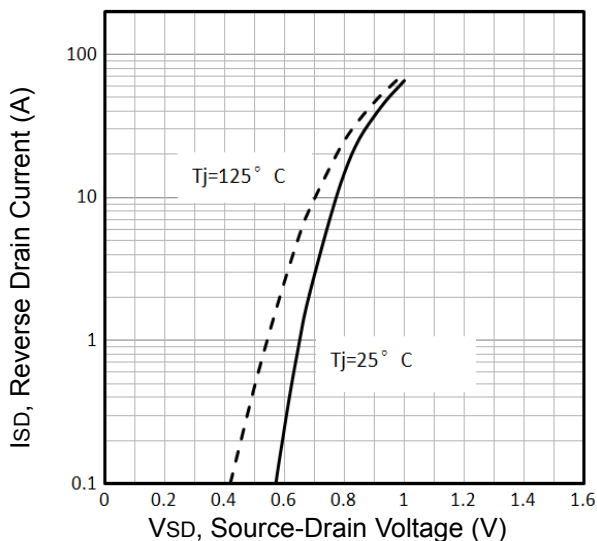**Fig4.** Normalized On-Resistance Vs. Temperature

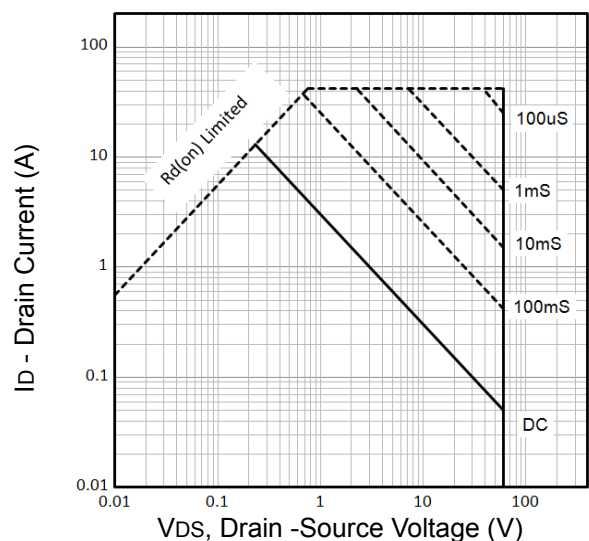**Fig5.** Typical Source-Drain Diode Forward Voltage

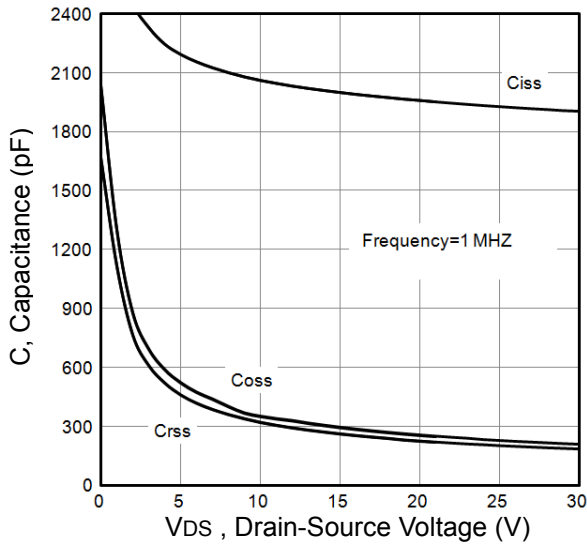**Fig6.** Maximum Safe Operating Area

Typical Characteristics

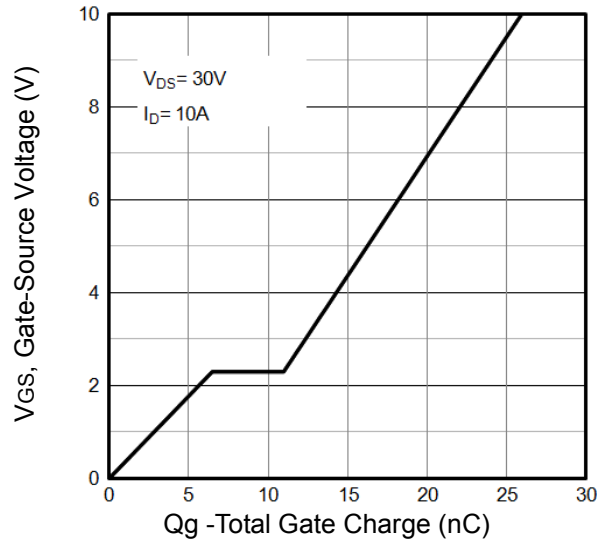**Fig7.** Typical Capacitance Vs.Drain-Source Voltage

Fig8. Typical Gate Charge Vs.Gate-Source

$D=T_{on}/T$
$T_{J,PK}=T_A+P_{DM}\cdot Z_{\theta JA}\cdot R_{\theta JA}$
$R_{\theta JA}=40 °C/W$

In descending order
D=0.5, 0.3, 0.1, 0.05, 0.02, 0.01, single pulse
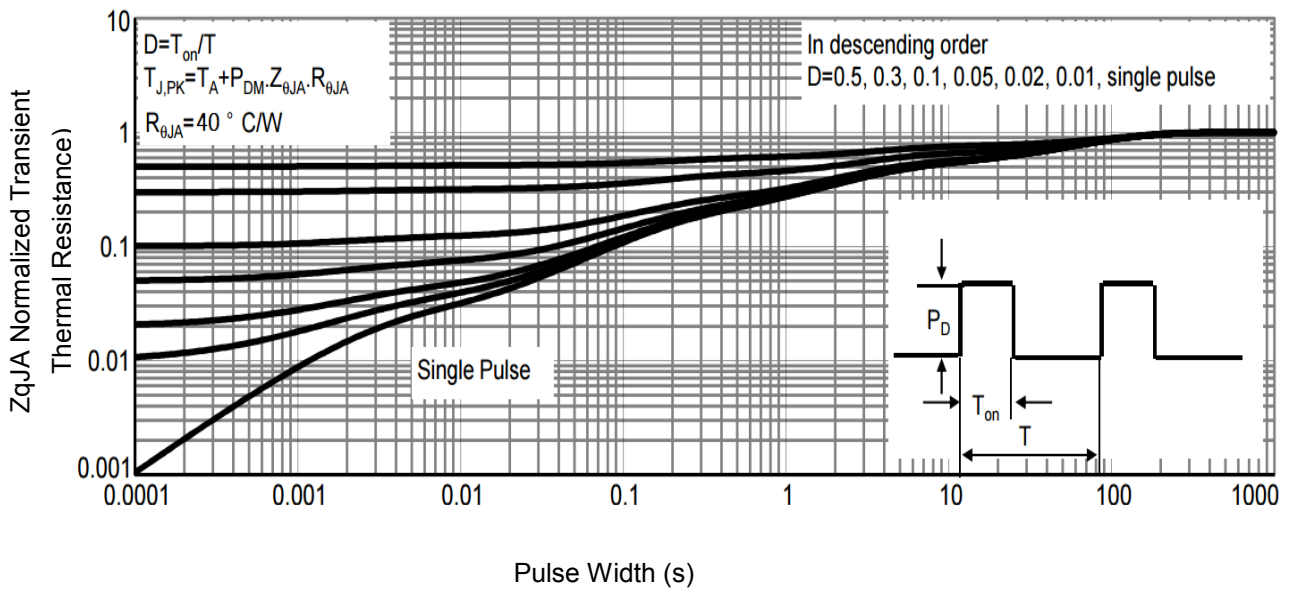
Single Pulse

Pulse Width (s)
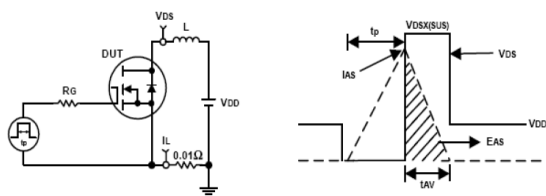
Fig9. Normalized Maximum Transient Thermal Impedance

Fig10. Unclamped Inductive Test Circuit and waveforms

Fig11. Switching Time Test Circuit and waveforms

Marking Information

```
Vs
012N06M
LOTYWW
```

1ˢᵗ line：Vanguard Code（Vs），Vanguard Logo
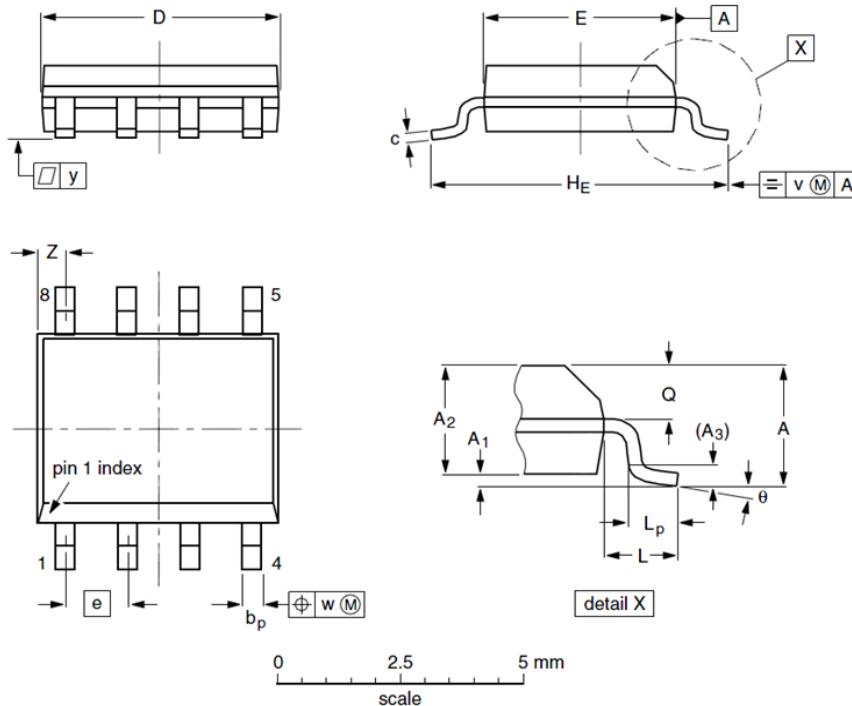2ⁿᵈ line：Part Number（012N06M）
3ʳᵈ line：Date code （LOTYWW）
  LOT：Wafer Lot Number
  Y：Year Code，e.g. E means 2017
  WW：Week Code

SOP8 Package Outline Data

Label	Dimensions (unit: mm)		
	Min	Typ	Max
A	--	--	1.75
A$_1$	0.10	0.18	0.25
A$_2$	1.25	1.35	1.50
A$_3$	--	0.25	--
b$_p$	0.36	0.42	0.51
c	0.19	0.22	0.25
D	4.80	4.92	5.00
E	3.80	3.90	4.00
e	--	1.27	--
H$_E$	5.80	6.00	6.20
L	--	1.05	--
L$_p$	0.40	0.68	1.00
Q	0.60	0.65	0.725
v	--	0.25	--
w	--	0.25	--
y	--	0.10	--
Z	0.30	0.50	0.70
θ	0°		8°

Notes:

1. Follow JEDEC MS-012.

2. Dimension "D" does NOT include mold flash, protrusions or gate burrs. Mold flash, protrusions or gate burrs shall not exceed 0.15mm per side.

3. Dimension "E" does NOT include interlead flash or protrusion. Interlead flash or protrusion shall not exceed 0.25mm per side.

4. Dimension "bp" does NOT include dambar protrusion. Allowable dambar protrusion shall be 0.1mm total in excess of "bp" dimension at maximum material condition. The dambar cannot be located on the lower radius of the foot.

Customer Service

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