

## Description

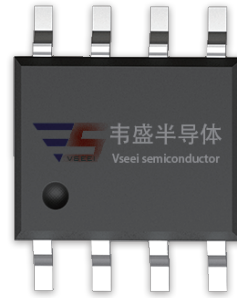
The VSM9N03 uses advanced trench technology and design to provide excellent  $R_{DS(ON)}$  with low gate charge. It can be used in a wide variety of applications.

## General Features

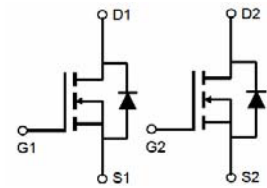
- $V_{DS} = 30V, I_D = 9A$   
 $R_{DS(ON)} < 12m\Omega @ V_{GS} = 10V$   
 $R_{DS(ON)} < 17m\Omega @ V_{GS} = 4.5V$
- High density cell design for ultra low  $R_{DS(ON)}$
- Fully characterized avalanche voltage and current

## Application

- Power switching application
- Hard switched and high frequency circuits
- Uninterruptible power supply



SOP-8



Schematic Diagram

## Package Marking and Ordering Information

Device Marking	Device	Device Package	Reel Size	Tape width	Quantity
VSM9N03-S8	VSM9N03	SOP-8	Ø330mm	12mm	4000 units

## Absolute Maximum Ratings ( $T_A = 25^\circ\text{C}$ unless otherwise noted)

Parameter	Symbol	Limit	Unit
Drain-Source Voltage	$V_{DS}$	30	V
Gate-Source Voltage	$V_{GS}$	$\pm 20$	V
Drain Current-Continuous	$I_D$	9	A
Drain Current-Continuous( $T_C = 100^\circ\text{C}$ )	$I_D(100^\circ\text{C})$	6.4	A
Pulsed Drain Current	$I_{DM}$	40	A
Maximum Power Dissipation	$P_D$	2	W
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	-55 To 150	$^\circ\text{C}$

## Thermal Characteristic

Parameter	Symbol	Typ	Max	Unit
Thermal Resistance, Junction-to-Ambient (Note 2)	$R_{\theta JA}$	62.5	85	$^\circ\text{C/W}$

**Electrical Characteristics ( $T_c=25^{\circ}\text{C}$  unless otherwise noted)**

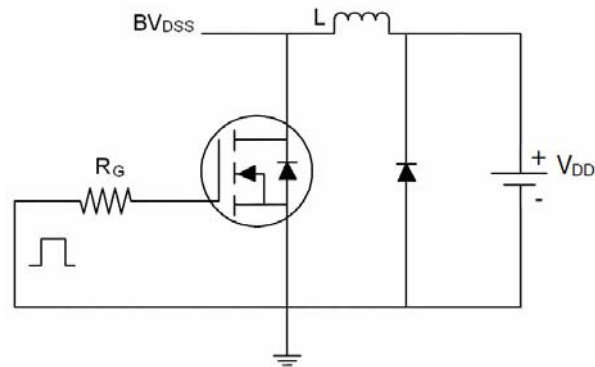
Parameter	Symbol	Condition	Min	Typ	Max	Unit
Off Characteristics						
Drain-Source Breakdown Voltage	BV <sub>DSS</sub>	V <sub>GS</sub> =0V I <sub>D</sub> =250μA	30	-	-	V
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> =30V, V <sub>GS</sub> =0V	-	-	1	μA
Gate-Body Leakage Current	I <sub>GSS</sub>	V <sub>GS</sub> =±20V, V <sub>DS</sub> =0V	-	-	±100	nA
On Characteristics <sup>(Note 3)</sup>						
Gate Threshold Voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA	1.0	1.6	2.2	V
Drain-Source On-State Resistance	R <sub>DS(ON)</sub>	V <sub>GS</sub> =10V, I <sub>D</sub> =6A	-	10.3	12.0	mΩ
		V <sub>GS</sub> =4.5V, I <sub>D</sub> =4A	-	13.9	17.0	mΩ
Forward Transconductance	g <sub>FS</sub>	V <sub>DS</sub> =5V, I <sub>D</sub> =6A	26	-	-	S
Dynamic Characteristics <sup>(Note4)</sup>						
Input Capacitance	C <sub>iss</sub>	V <sub>DS</sub> =15V, V <sub>GS</sub> =0V, F=1.0MHz	-	1210	-	PF
Output Capacitance	C <sub>Oss</sub>		-	160	-	PF
Reverse Transfer Capacitance	C <sub>rss</sub>		-	105	-	PF
Switching Characteristics <sup>(Note 4)</sup>						
Turn-on Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> =15V, R <sub>L</sub> =0.75Ω V <sub>GS</sub> =10V, R <sub>G</sub> =3Ω	-	5	-	nS
Turn-on Rise Time	t <sub>r</sub>		-	12	-	nS
Turn-Off Delay Time	t <sub>d(off)</sub>		-	19	-	nS
Turn-Off Fall Time	t <sub>f</sub>		-	6	-	nS
Total Gate Charge	Q <sub>g</sub>	V <sub>DS</sub> =15V, I <sub>D</sub> =6A, V <sub>GS</sub> =10V	-	17.5		nC
Gate-Source Charge	Q <sub>gs</sub>		-	3		nC
Gate-Drain Charge	Q <sub>gd</sub>		-	4.1		nC
Drain-Source Diode Characteristics						
Diode Forward Voltage <sup>(Note 3)</sup>	V <sub>SD</sub>	V <sub>GS</sub> =0V, I <sub>S</sub> =6A	-		1.2	V
Diode Forward Current <sup>(Note 2)</sup>	I <sub>S</sub>		-	-	9	A
Reverse Recovery Time	t <sub>rr</sub>	T <sub>J</sub> = 25°C, I <sub>F</sub> =6A di/dt = 100A/μs <sup>(Note3)</sup>	-	19	-	nS
Reverse Recovery Charge	Q <sub>rr</sub>		-	10	-	nC
Forward Turn-On Time	t <sub>on</sub>	Intrinsic turn-on time is negligible (turn-on is dominated by LS+LD)				

**Notes:**

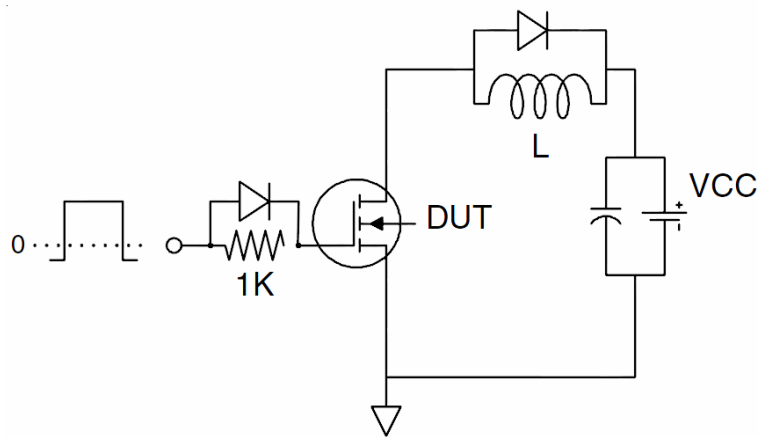
1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board,  $t \leq 10$  sec.
3. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$ .
4. Guaranteed by design, not subject to production
5. EAS condition:  $T_J=25^{\circ}\text{C}, V_{DD}=15V, V_G=10V, L=0.5mH, R_g=25\Omega$

## Test circuit

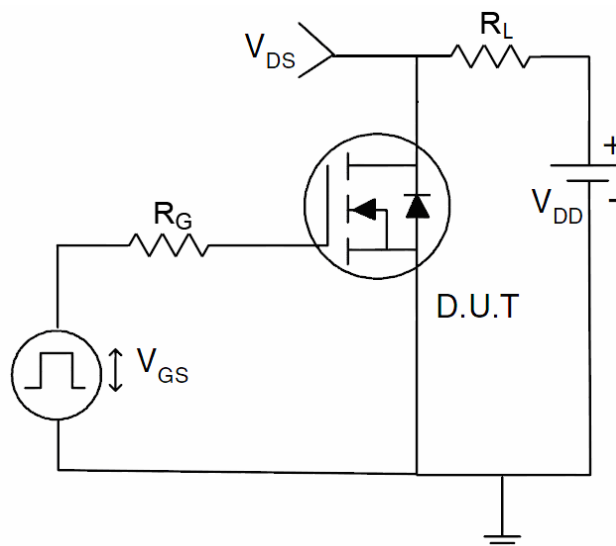
### 1) $E_{AS}$ test Circuits



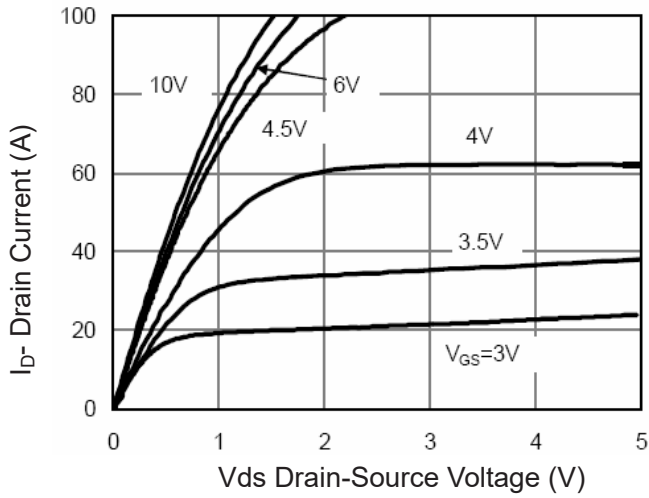
### 2) Gate charge test Circuit:



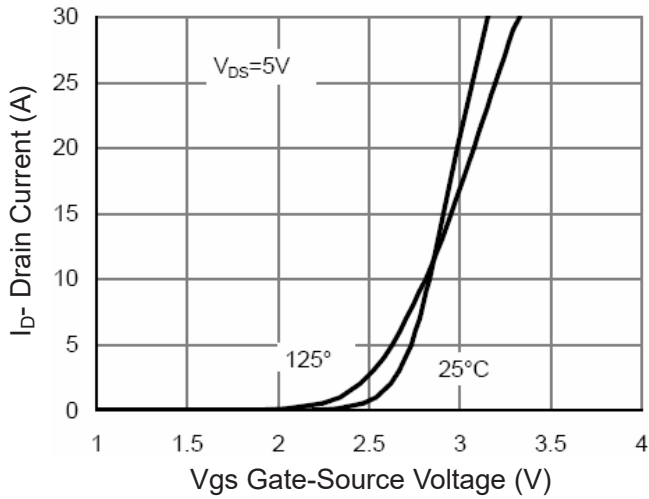
### 3) Switch Time Test Circuit:



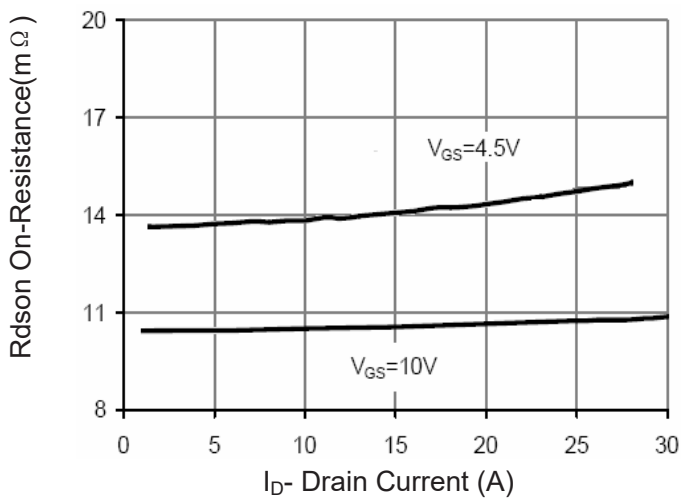
## Typical Electrical and Thermal Characteristics (Curves)



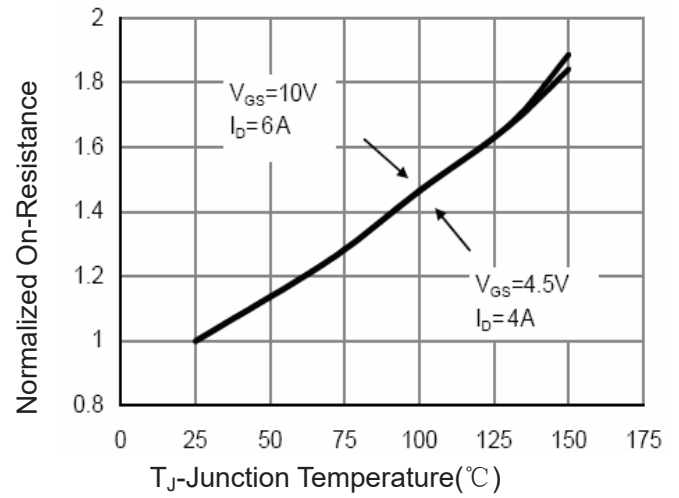
**Figure 1 Output Characteristics**



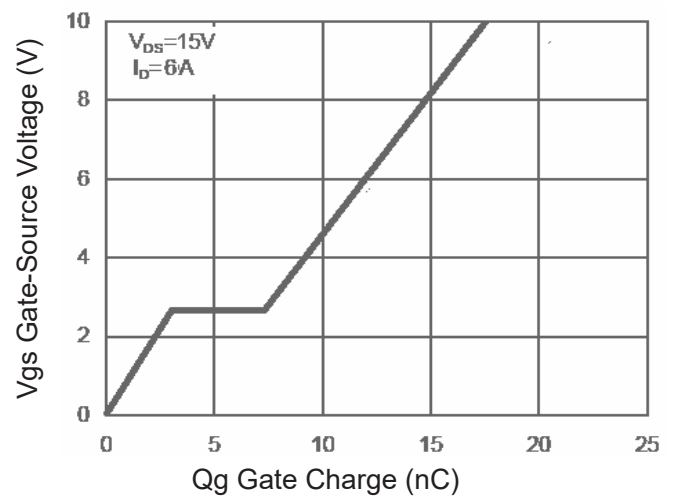
**Figure 2 Transfer Characteristics**



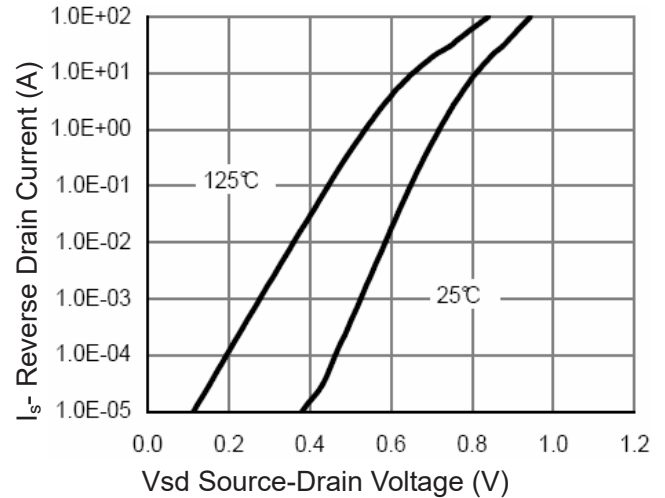
**Figure 3 Rdson- Drain Current**



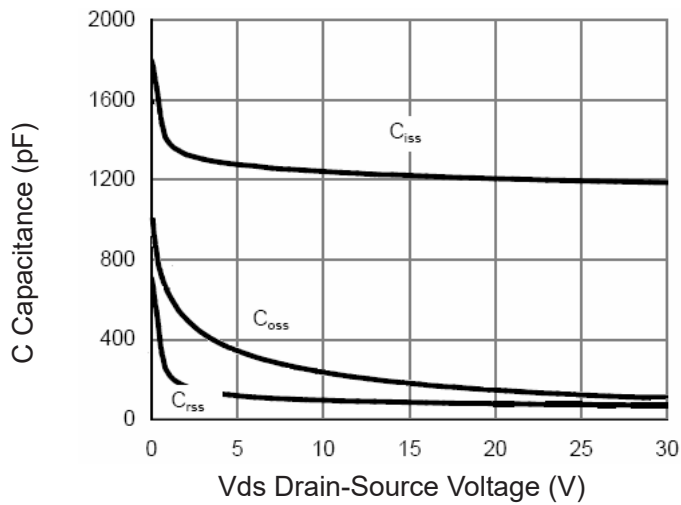
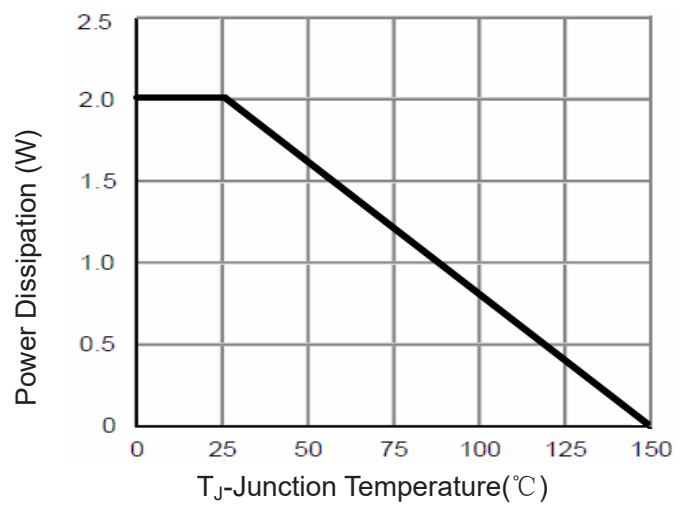
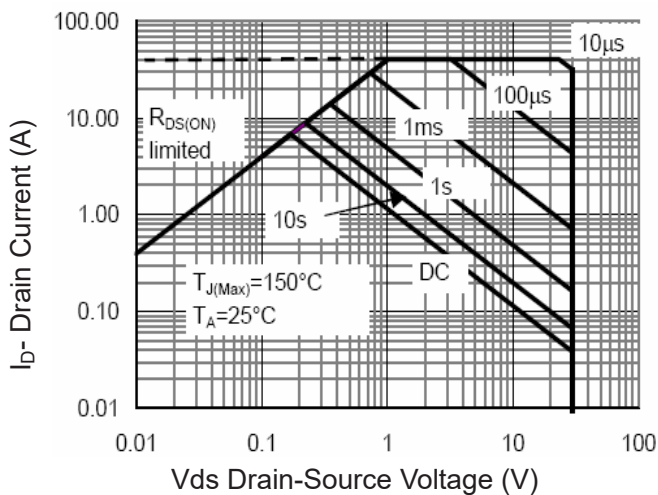
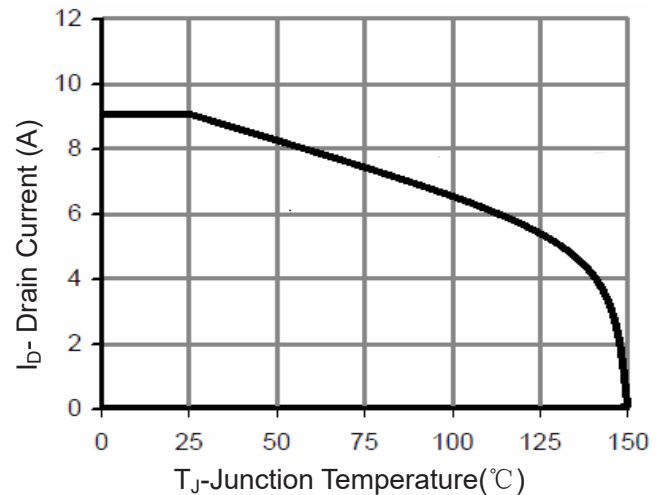
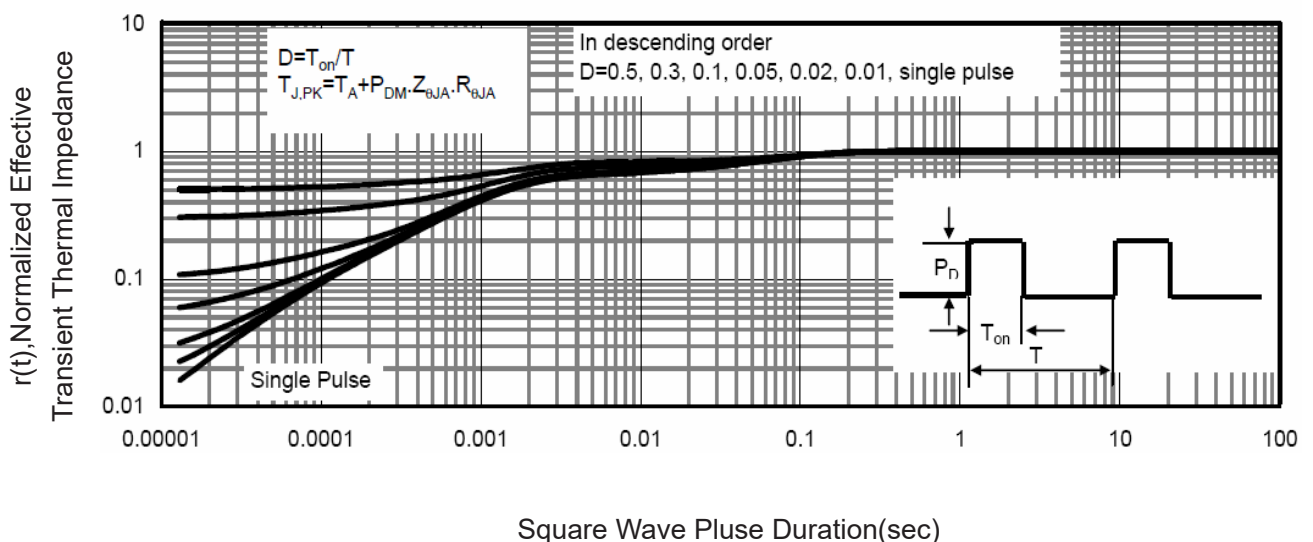
**Figure 4 Rdson-Junction Temperature**



**Figure 5 Gate Charge**



**Figure 6 Source- Drain Diode Forward**


**Figure 7 Capacitance vs Vds**

**Figure 9 Power De-rating**

**Figure 8 Safe Operation Area**

**Figure 10  $I_D$  Current De-rating**

**Figure 11 Normalized Maximum Transient Thermal Impedance**