

## Description

These N-Channel enhancement mode power field effect transistors are using trench DMOS technology. This advanced technology has been especially tailored to minimize on-state resistance, provide superior switching performance, and with stand high energy pulse in the avalanche and commutation mode. These devices are well suited for high efficiency fast switching applications.

## Features

- ◆ 60V,60A, $R_{DS(ON).max}=11m\Omega@V_{GS}=10V$
- ◆ Improved dv/dt capability
- ◆ Fast switching
- ◆ 100% EAS Guaranteed
- ◆ Green device available

## Applications

- ◆ Motor Drives
- ◆ UPS
- ◆ DC-DC Converter

## Product Summary

$V_{DSS}$	60V
$R_{DS(on).max}@V_{GS}=10V$	11m $\Omega$
$I_D$	60A

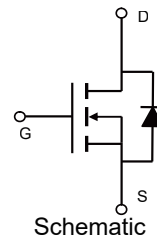
## Pin Configuration



TO-263



TO-220C



Schematic

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

Parameter	Symbol	Value	Unit
Drain-Source Voltage	$V_{DSS}$	60	V
Continuous drain current ( $T_C = 25^\circ\text{C}$ )	$I_D$	60	A
Continuous drain current ( $T_C = 100^\circ\text{C}$ )		39	A
Pulsed drain current <sup>1)</sup>	$I_{DM}$	240	A
Gate-Source voltage	$V_{GSS}$	$\pm 20$	V
Avalanche energy <sup>2)</sup>	$E_{AS}$	132	mJ
Power Dissipation ( $T_C = 25^\circ\text{C}$ )	$P_D$	83	W
Storage Temperature Range	$T_{STG}$	-55 to +150	$^\circ\text{C}$
Operating Junction Temperature Range	$T_J$	-55 to +150	$^\circ\text{C}$

## Thermal Characteristics

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	1.5	$^\circ\text{C/W}$

## Package Marking and Ordering Information

Device	Device Package	Marking
VSM60N06-T3	TO-263	VSM60N06-T3
VSM60N06-TC	TO-220C	VSM60N06-TC

## Electrical Characteristics

 $T_J = 25^{\circ}\text{C}$  unless otherwise noted

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Static characteristics						
Drain-source breakdown voltage	BV <sub>DSS</sub>	V <sub>GS</sub> =0 V, I <sub>D</sub> =250uA	60	---	---	V
Gate threshold voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250uA	1	1.6	2.5	V
Drain-source leakage current	I <sub>DSS</sub>	V <sub>DS</sub> =60V, V <sub>GS</sub> =0V, T <sub>J</sub> = 25°C	---	---	1	μA
		V <sub>DS</sub> =48V, V <sub>GS</sub> =0V, T <sub>J</sub> = 125°C	---	---	30	μA
Gate leakage current, Forward	I <sub>GSSF</sub>	V <sub>GS</sub> =20V, V <sub>DS</sub> =0 V	---	---	100	nA
Gate leakage current, Reverse	I <sub>GSSR</sub>	V <sub>GS</sub> =-20V, V <sub>DS</sub> =0 V	---	---	-100	nA
Drain-source on-state resistance	R <sub>DS(on)</sub>	V <sub>GS</sub> =10V, I <sub>D</sub> =20A	---	8	11	mΩ
		V <sub>GS</sub> =4.5V, I <sub>D</sub> =10A	---	11	14	mΩ
Forward transconductance	g <sub>fs</sub>	V <sub>DS</sub> =5V , I <sub>D</sub> =20A	---	38	---	S
Dynamic characteristics						
Input capacitance	C <sub>iss</sub>	V <sub>DS</sub> = 25V, V <sub>GS</sub> = 0V, F = 1MHz	---	2767	---	pF
Output capacitance	C <sub>oss</sub>		---	209	---	
Reverse transfer capacitance	C <sub>rss</sub>		---	162	---	
Turn-on delay time	t <sub>d(on)</sub>	V <sub>DD</sub> = 30V,V <sub>GS</sub> =10V, I <sub>D</sub> =25A	---	17	---	ns
Rise time	t <sub>r</sub>		---	167.5	---	
Turn-off delay time	t <sub>d(off)</sub>		---	315	---	
Fall time	t <sub>f</sub>		---	73.5	---	
Gate resistance	R <sub>g</sub>	V <sub>GS</sub> =0V, V <sub>DS</sub> =0V, F=1MHz	---	1.7	---	Ω
Gate charge characteristics						
Gate to source charge	Q <sub>gs</sub>	V <sub>DS</sub> =48V, I <sub>D</sub> =25A, V <sub>GS</sub> = 10V	---	11.2	---	nC
Gate to drain charge	Q <sub>gd</sub>		---	12.6	---	
Gate charge total	Q <sub>g</sub>		---	55	---	
Drain-Source diode characteristics and Maximum Ratings						
Continuous Source Current	I <sub>S</sub>		---	---	60	A
Pulsed Source Current <sup>(3)</sup>	I <sub>SM</sub>		---	---	240	A
Diode Forward Voltage	V <sub>SD</sub>	V <sub>GS</sub> =0V, I <sub>S</sub> =20A, T <sub>J</sub> =25°C	---	---	1.2	V
Reverse Recovery Time	t <sub>rr</sub>	I <sub>S</sub> =25A,di/dt=100A/us, T <sub>J</sub> =25°C	---	29.6	---	ns
Reverse Recovery Charge	Q <sub>rr</sub>		---	40.5	---	nC

Notes:

1: Repetitive Rating: Pulse width limited by maximum junction temperature.

2:  $V_{DD}=25\text{V}, V_{GS}=10\text{V}, L=0.5\text{mH}, I_{AS}=23\text{A}, R_G=25\Omega$ , Starting  $T_J=25^{\circ}\text{C}$ .

3: Pulse Test: Pulse Width  $\leq 300\mu\text{s}$ , Duty Cycle  $\leq 2\%$ .

## Electrical Characteristics Diagrams

Figure 1. Typ. Output Characteristics

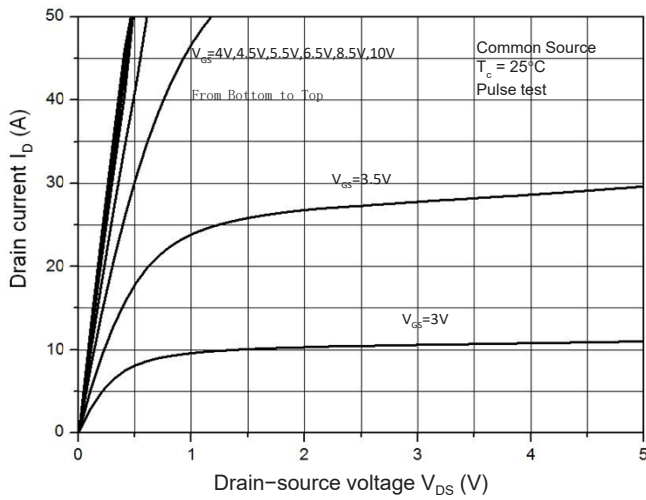


Figure 2. Transfer Characteristics

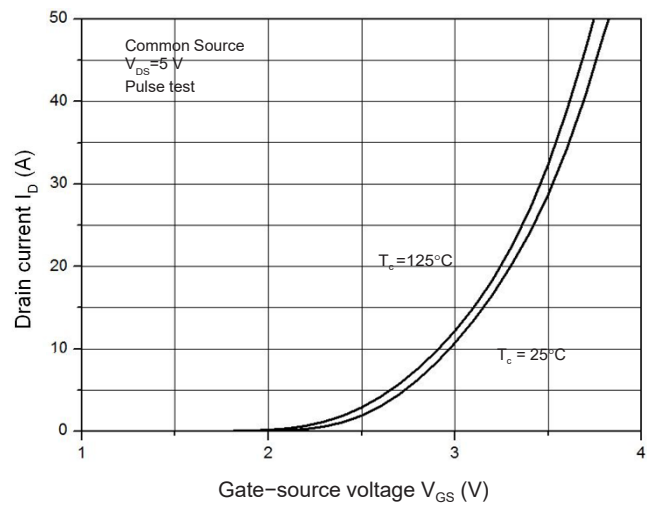


Figure 3. Capacitance Characteristics

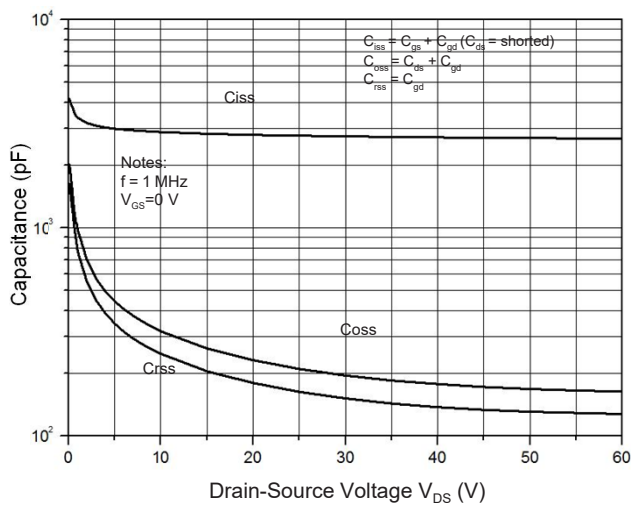


Figure 4. Gate Charge Waveform

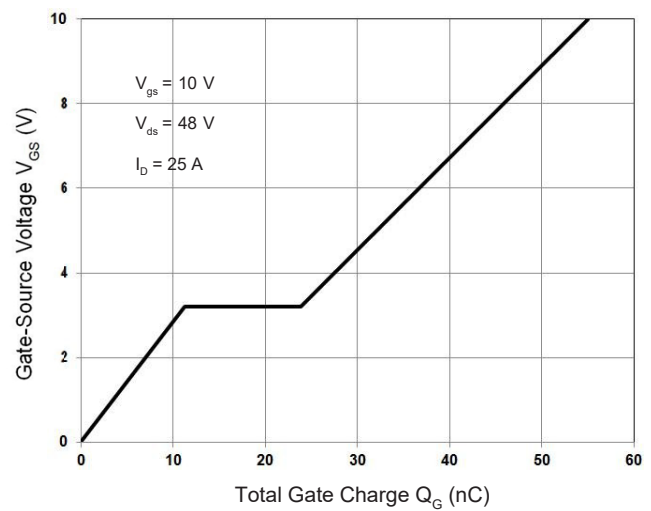


Figure 5. Body-Diode Characteristics

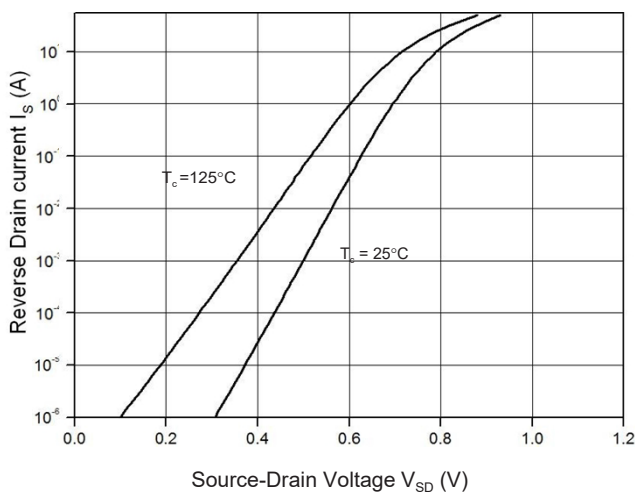


Figure 6. Rdson-Drain Current

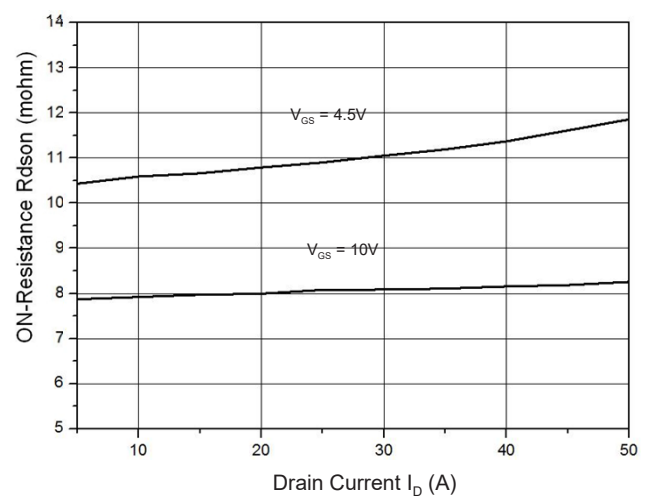


Figure 7. Rdson-Junction Temperature(°C)

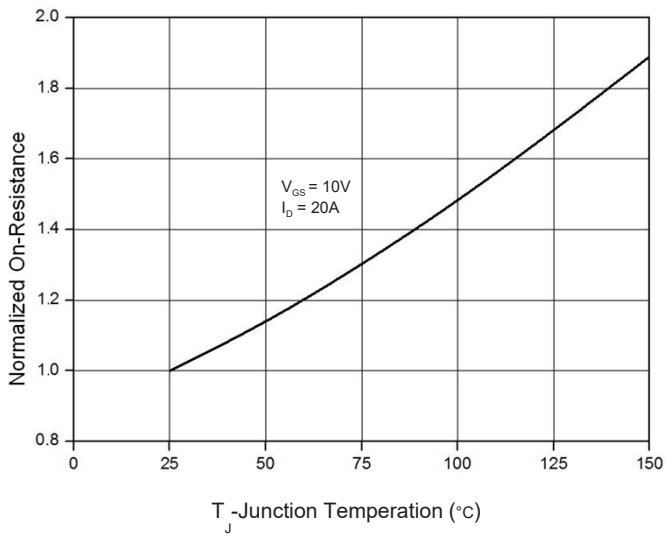


Figure 8. Maximum Safe Operating Area

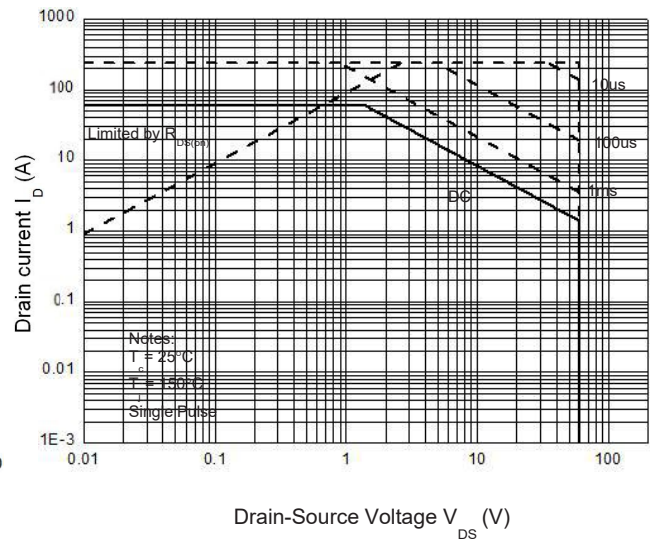
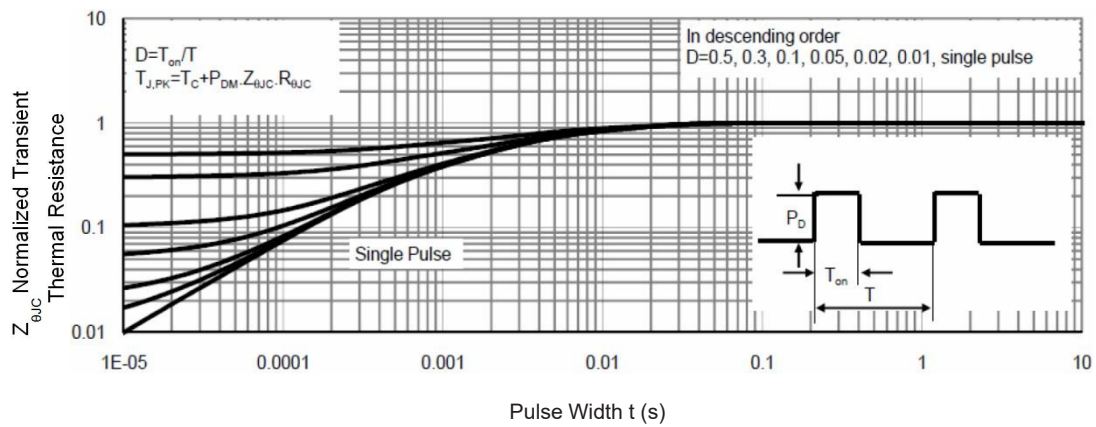


Figure 6. Normalized Maximum Transient Thermal Impedance (RthJC)



## Test Circuit & Waveform

Figure 8. Gate Charge Test Circuit & Waveform

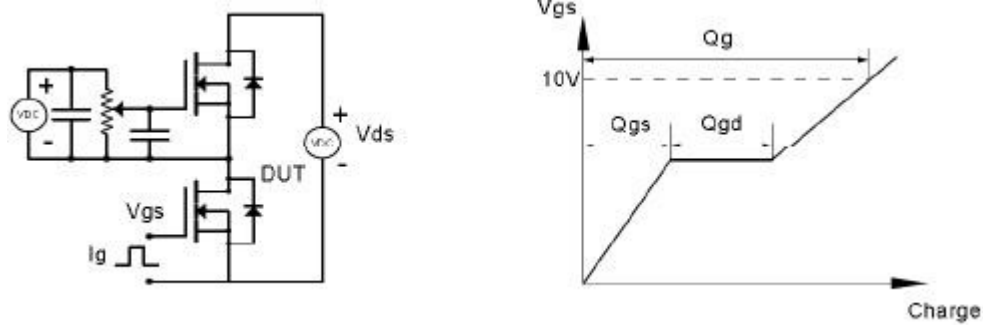


Figure 9. Resistive Switching Test Circuit & Waveforms

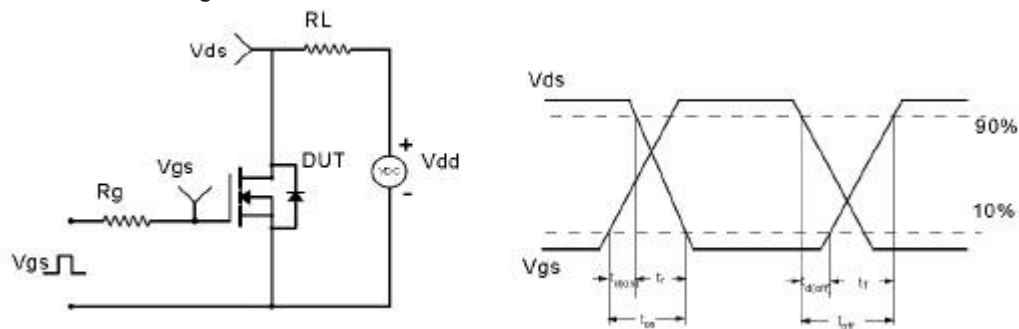


Figure 10. Unclamped Inductive Switching (UIS) Test Circuit & Waveform

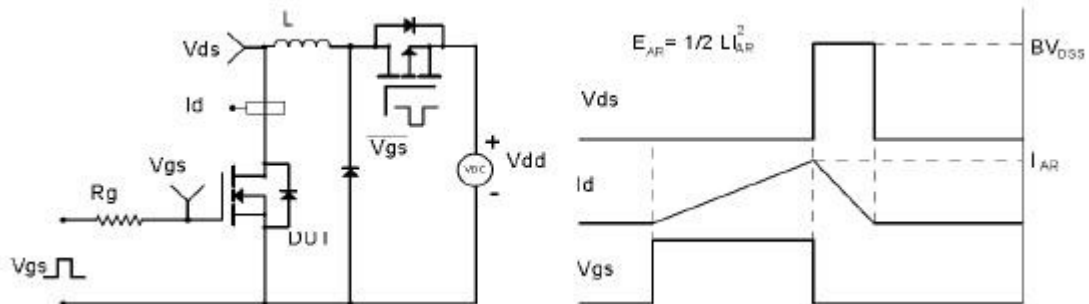


Figure 11. Diode Recovery Circuit & Waveform

