

## Description

The VSM57N10 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

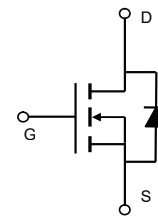
- $V_{DS} = 100V, I_D = 57A$   
 $R_{DS(ON)} < 16m\Omega @ V_{GS}=10V$  (Typ:12m $\Omega$ )
- Special process technology for high ESD capability
- High density cell design for ultra low  $R_{dson}$
- Fully characterized avalanche voltage and current
- Good stability and uniformity with high  $E_{AS}$
- Excellent package for good heat dissipation

## Application

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



TO-252



Schematic

## Package Marking and Ordering Information

| Device Marking | Device      | Device Package | Reel Size | Tape width | Quantity   |
|----------------|-------------|----------------|-----------|------------|------------|
| VSM57N10       | VSM57N10-T2 | TO-252         | Ø330mm    | 12mm       | 2500 units |

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

| Parameter                                        | Symbol              | Limit      | Unit           |
|--------------------------------------------------|---------------------|------------|----------------|
| Drain-Source Voltage                             | $V_{DS}$            | 100        | V              |
| Gate-Source Voltage                              | $V_{GS}$            | $\pm 20$   | V              |
| Drain Current-Continuous                         | $I_D$               | 57         | A              |
| Drain Current-Continuous( $T_C=100^{\circ}C$ )   | $I_D(100^{\circ}C)$ | 40         | A              |
| Pulsed Drain Current                             | $I_{DM}$            | 190        | A              |
| Maximum Power Dissipation                        | $P_D$               | 170        | W              |
| Derating factor                                  |                     | 1.13       | W/ $^{\circ}C$ |
| Single pulse avalanche energy (Note 5)           | $E_{AS}$            | 342        | mJ             |
| Operating Junction and Storage Temperature Range | $T_J, T_{STG}$      | -55 To 175 | $^{\circ}C$    |

## Thermal Characteristic

|                                                          |                 |      |                      |
|----------------------------------------------------------|-----------------|------|----------------------|
| Thermal Resistance, Junction-to-Case <sup>(Note 2)</sup> | $R_{\theta JC}$ | 0.88 | $^{\circ}\text{C/W}$ |
|----------------------------------------------------------|-----------------|------|----------------------|

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

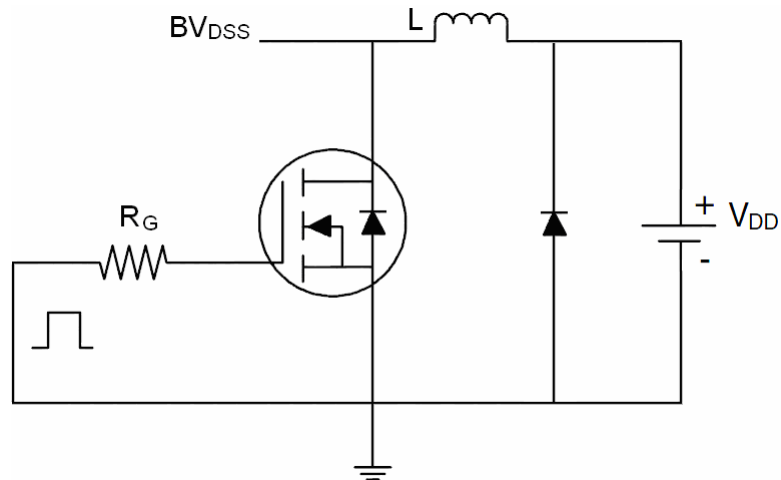
| Parameter                          | Symbol              | Condition                                                                                 | Min | Typ  | Max  | Unit |
|------------------------------------|---------------------|-------------------------------------------------------------------------------------------|-----|------|------|------|
| Off Characteristics                |                     |                                                                                           |     |      |      |      |
| Drain-Source Breakdown Voltage     | BV <sub>DSS</sub>   | V <sub>GS</sub> =0V I <sub>D</sub> =250μA                                                 | 100 | 110  | -    | V    |
| Zero Gate Voltage Drain Current    | I <sub>DSS</sub>    | V <sub>DS</sub> =100V, 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 (Note 3)        |                     |                                                                                           |     |      |      |      |
| Gate Threshold Voltage             | V <sub>GS(th)</sub> | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA                                  | 0.8 | 1.2  | 1.8  | V    |
| Drain-Source On-State Resistance   | R <sub>DS(ON)</sub> | V <sub>GS</sub> =10V, I <sub>D</sub> =20A                                                 | -   | 12   | 16   | mΩ   |
| Forward Transconductance           | g <sub>FS</sub>     | V <sub>DS</sub> =25V, I <sub>D</sub> =20A                                                 | 32  | -    | -    | S    |
| Dynamic Characteristics (Note4)    |                     |                                                                                           |     |      |      |      |
| Input Capacitance                  | C <sub>ISS</sub>    | V <sub>DS</sub> =50V, V <sub>GS</sub> =0V,<br>F=1.0MHz                                    | -   | 4118 | -    | PF   |
| Output Capacitance                 | C <sub>OSS</sub>    |                                                                                           | -   | 210  | -    | PF   |
| Reverse Transfer Capacitance       | C <sub>rss</sub>    |                                                                                           | -   | 169  | -    | PF   |
| Switching Characteristics (Note 4) |                     |                                                                                           |     |      |      |      |
| Turn-on Delay Time                 | t <sub>d(on)</sub>  | V <sub>DD</sub> =50V, I <sub>D</sub> =20A<br>V <sub>GS</sub> =10V, R <sub>GEN</sub> =2.5Ω | -   | 12   | -    | nS   |
| Turn-on Rise Time                  | t <sub>r</sub>      |                                                                                           | -   | 55   | -    | nS   |
| Turn-Off Delay Time                | t <sub>d(off)</sub> |                                                                                           | -   | 45   | -    | nS   |
| Turn-Off Fall Time                 | t <sub>f</sub>      |                                                                                           | -   | 47   | -    | nS   |
| Total Gate Charge                  | Q <sub>g</sub>      | V <sub>DS</sub> =50V, I <sub>D</sub> =20A,<br>V <sub>GS</sub> =10V                        | -   | 111  | -    | nC   |
| Gate-Source Charge                 | Q <sub>gs</sub>     |                                                                                           | -   | 11.5 | -    | nC   |
| Gate-Drain Charge                  | Q <sub>gd</sub>     |                                                                                           | -   | 24   | -    | nC   |
| Drain-Source Diode Characteristics |                     |                                                                                           |     |      |      |      |
| Diode Forward Voltage (Note 3)     | V <sub>SD</sub>     | V <sub>GS</sub> =0V, I <sub>S</sub> =20A                                                  | -   | 0.85 | 1.2  | V    |
| Diode Forward Current (Note 2)     | I <sub>S</sub>      |                                                                                           | -   | -    | 57   | A    |
| Reverse Recovery Time              | t <sub>rr</sub>     | TJ = 25°C, IF = 20A                                                                       | -   | 36   | -    | nS   |
| Reverse Recovery Charge            | Q <sub>rr</sub>     | di/dt = 100A/μs (Note3)                                                                   | -   | 56   | -    | nC   |
| Forward Turn-On Time               | t <sub>on</sub>     | Intrinsic turn-on time is negligible (turn-on is dominated by LS+LD)                      |     |      |      |      |

## Notes:

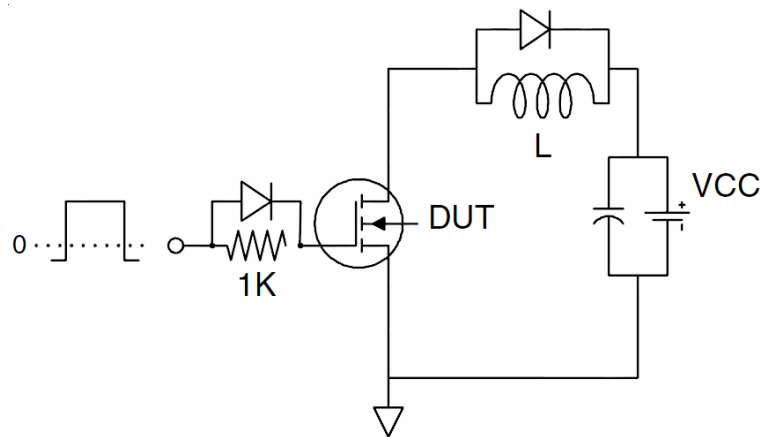
1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board,  $t \leq 10$  sec.
3. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$ .
4. Guaranteed by design, not subject to production
5. EAS condition:  $T_J=25^{\circ}\text{C}, V_{DD}=50V, V_G=10V, L=0.5mH, R_g=25\Omega$

## Test Circuit

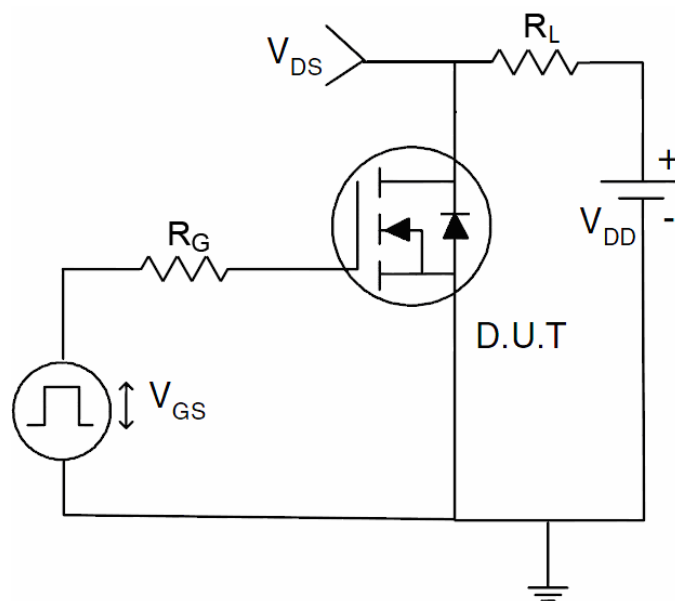
### 1) $E_{AS}$ test Circuit



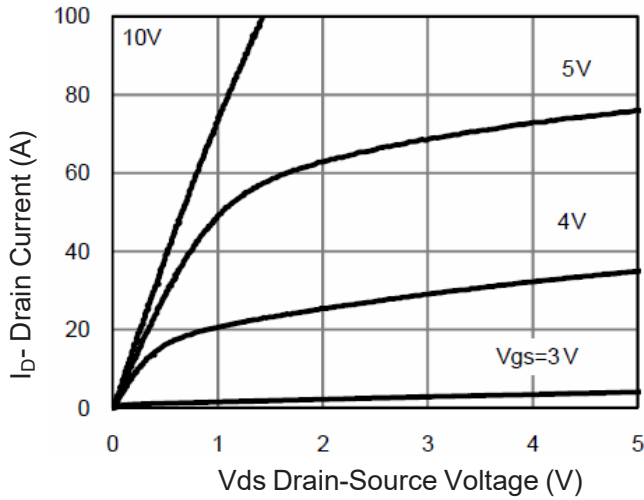
### 2) Gate charge test Circuit



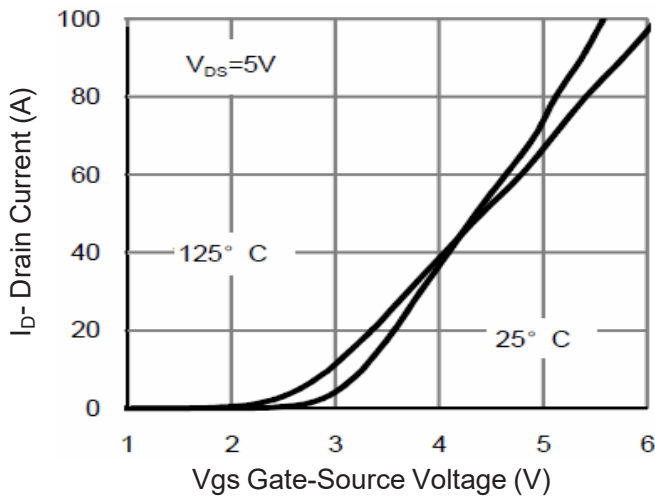
### 3) Switch Time Test Circuit



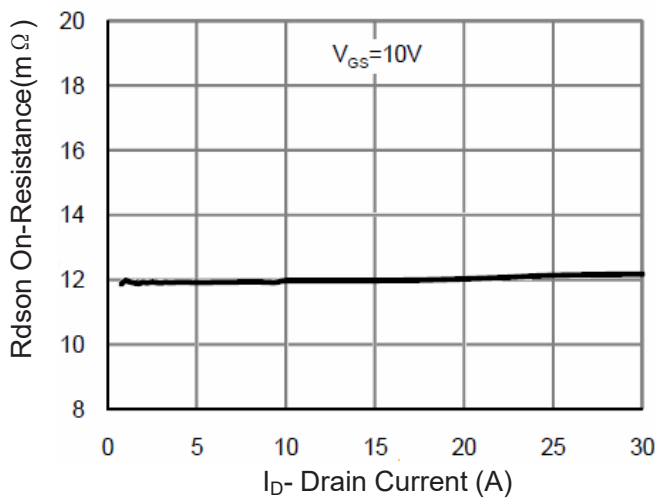
## Typical Electrical and Thermal Characteristics (Curves)



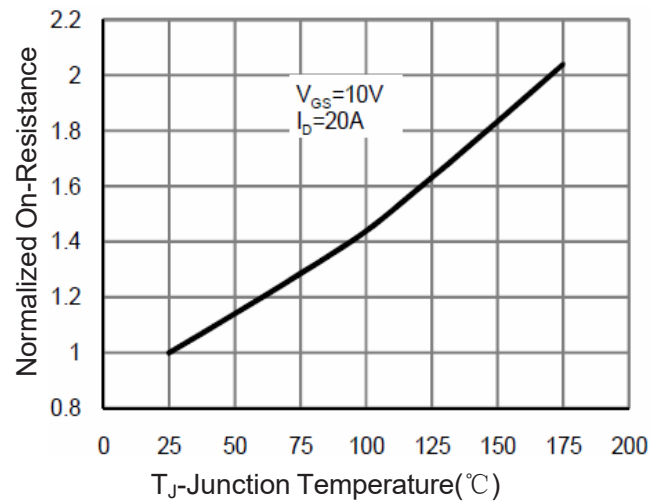
**Figure 1 Output Characteristics**



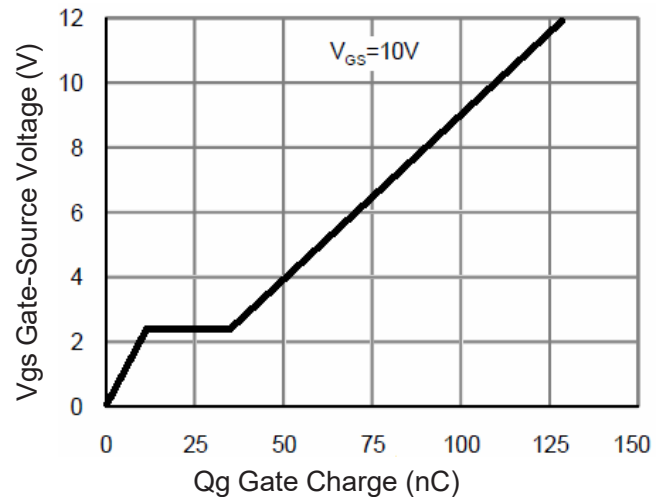
**Figure 2 Transfer Characteristics**



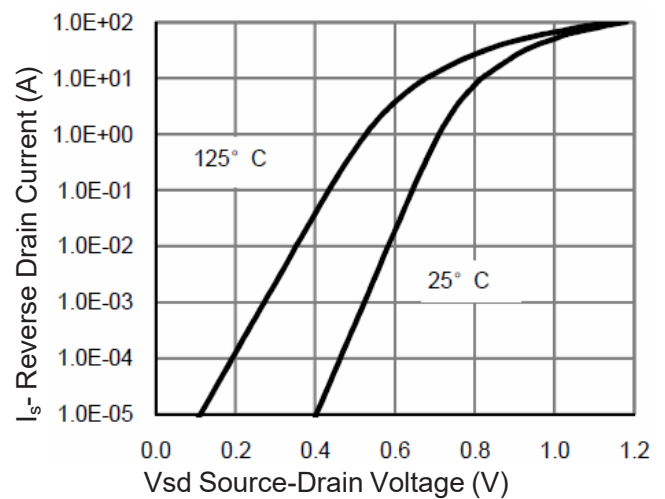
**Figure 3  $R_{ds(on)}$ - Drain Current**



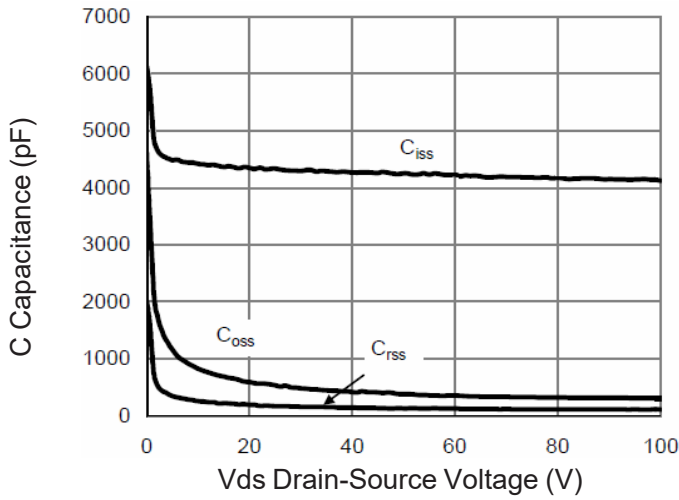
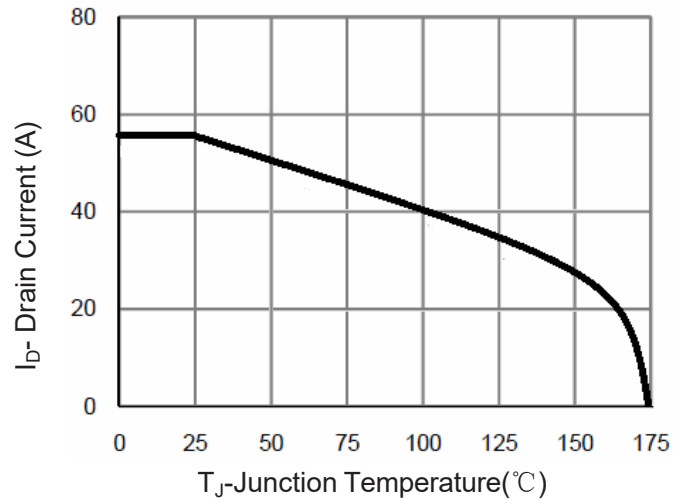
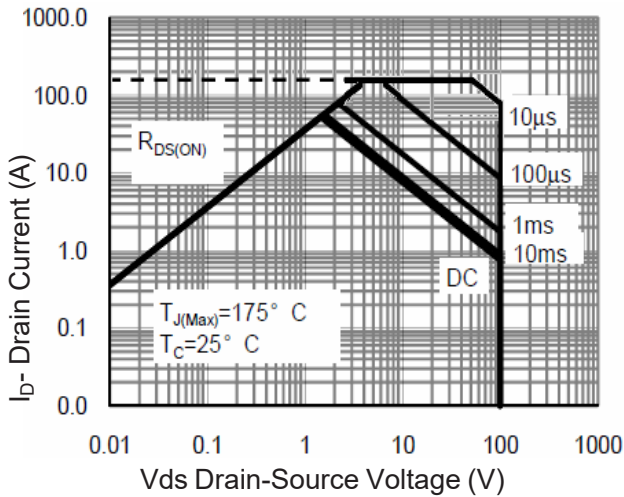
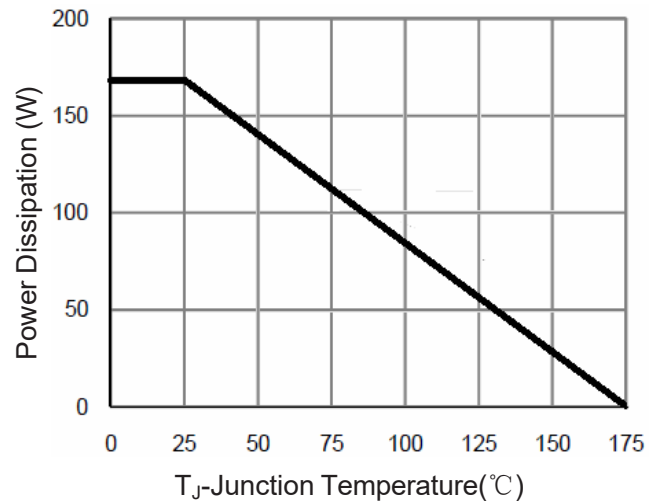
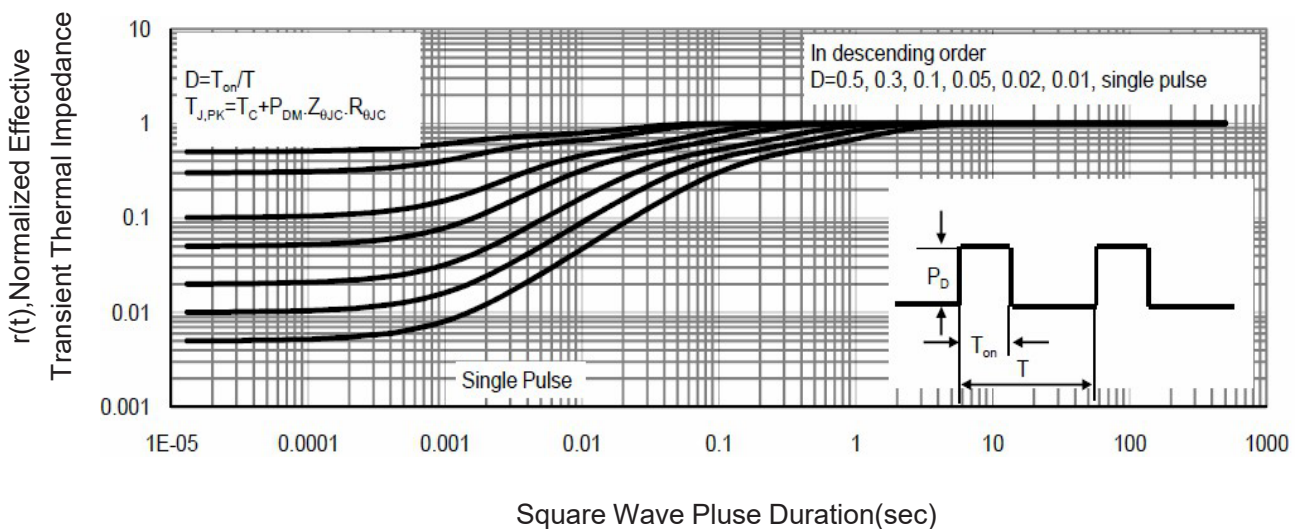
**Figure 4  $R_{ds(on)}$ -Junction Temperature**



**Figure 5 Gate Charge**



**Figure 6 Source- Drain Diode Forward**


**Figure 7 Capacitance vs Vds**

**Figure 9 ID Current De-rating**

**Figure 8 Safe Operation Area**

**Figure 10 Power De-rating**

**Figure 11 Normalized Maximum Transient Thermal Impedance**