

## Description

The VSM250N07 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

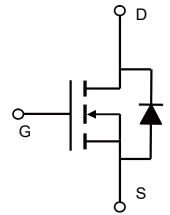
- $V_{DS} = 75V, I_D = 250A$   
 $R_{DS(ON)} < 3m\Omega @ V_{GS}=10V$  (Typ:2.5m $\Omega$ )
- Special process technology for high ESD capability
- High density cell design for ultra low  $R_{DS(ON)}$
- Fully characterized avalanche voltage and current
- Good stability and uniformity with high  $E_{AS}$
- Excellent package for good heat dissipation

## Application

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



TO-220



Schematic

## Package Marking and Ordering Information

| Device Marking | Device       | Device Package | Reel Size | Tape width | Quantity |
|----------------|--------------|----------------|-----------|------------|----------|
| VSM250N07      | VSM250N07-TC | TO-220         | -         | -          | -        |

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

| Parameter                                        | Symbol             | Limit      | Unit          |
|--------------------------------------------------|--------------------|------------|---------------|
| Drain-Source Voltage                             | $V_{DS}$           | 75         | V             |
| Gate-Source Voltage                              | $V_{GS}$           | $\pm 20$   | V             |
| Drain Current-Continuous                         | $I_D$              | 250        | A             |
| Drain Current-Continuous( $T_c=100^\circ C$ )    | $I_D(100^\circ C)$ | 177        | A             |
| Pulsed Drain Current                             | $I_{DM}$           | 1000       | A             |
| Maximum Power Dissipation                        | $P_D$              | 350        | W             |
| Derating factor                                  |                    | 2.33       | W/ $^\circ C$ |
| Single pulse avalanche energy (Note 5)           | $E_{AS}$           | 2880       | 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> | $R_{\theta jc}$ | 0.43 | $^{\circ}\text{C/W}$ |
|----------------------------------------------------------|-----------------|------|----------------------|

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

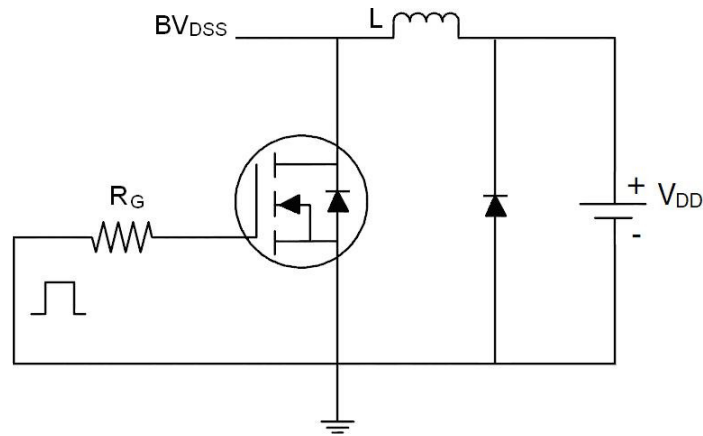
| Parameter                          | Symbol              | Condition                                                                                | Min | Typ   | Max  | Unit |
|------------------------------------|---------------------|------------------------------------------------------------------------------------------|-----|-------|------|------|
| Off Characteristics                |                     |                                                                                          |     |       |      |      |
| Drain-Source Breakdown Voltage     | BV <sub>DSS</sub>   | V <sub>GS</sub> =0V I <sub>D</sub> =250μA                                                | 75  | -     | -    | V    |
| Zero Gate Voltage Drain Current    | I <sub>DSS</sub>    | V <sub>DS</sub> =85V, 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                                 | 1   | 1.5   | 2    | V    |
| Drain-Source On-State Resistance   | R <sub>DS(ON)</sub> | V <sub>GS</sub> =10V, I <sub>D</sub> =20A                                                | -   | 2.5   | 3    | mΩ   |
|                                    |                     | V <sub>GS</sub> =4.5V, I <sub>D</sub> =20A                                               | -   | 3.5   | 4.2  | mΩ   |
| Forward Transconductance           | g <sub>FS</sub>     | V <sub>DS</sub> =20V, I <sub>D</sub> =20A                                                | -   | 70    | -    | S    |
| Dynamic Characteristics (Note4)    |                     |                                                                                          |     |       |      |      |
| Input Capacitance                  | C <sub>iss</sub>    | V <sub>DS</sub> =35V, V <sub>GS</sub> =0V,<br>F=1.0MHz                                   | -   | 14722 | -    | PF   |
| Output Capacitance                 | C <sub>oss</sub>    |                                                                                          | -   | 932   | -    | PF   |
| Reverse Transfer Capacitance       | C <sub>rss</sub>    |                                                                                          | -   | 812   | -    | PF   |
| Switching Characteristics (Note 4) |                     |                                                                                          |     |       |      |      |
| Turn-on Delay Time                 | t <sub>d(on)</sub>  | V <sub>DD</sub> =35V, R <sub>L</sub> =1Ω<br>V <sub>GS</sub> =10V, R <sub>GEN</sub> =2.5Ω | -   | 65    | -    | nS   |
| Turn-on Rise Time                  | t <sub>r</sub>      |                                                                                          | -   | 69    | -    | nS   |
| Turn-Off Delay Time                | t <sub>d(off)</sub> |                                                                                          | -   | 96    | -    | nS   |
| Turn-Off Fall Time                 | t <sub>f</sub>      |                                                                                          | -   | 36    | -    | nS   |
| Total Gate Charge                  | Q <sub>g</sub>      | V <sub>DS</sub> =35V, I <sub>D</sub> =20A,<br>V <sub>GS</sub> =10V                       | -   | 311   | -    | nC   |
| Gate-Source Charge                 | Q <sub>gs</sub>     |                                                                                          | -   | 161   | -    | nC   |
| Gate-Drain Charge                  | Q <sub>gd</sub>     |                                                                                          | -   | 186   | -    | nC   |
| Drain-Source Diode Characteristics |                     |                                                                                          |     |       |      |      |
| Diode Forward Voltage (Note 3)     | V <sub>SD</sub>     | V <sub>GS</sub> =0V, I <sub>S</sub> =20A                                                 | -   | -     | 1.2  | V    |
| Diode Forward Current (Note 2)     | I <sub>S</sub>      | -                                                                                        | -   | -     | 250  | A    |
| Reverse Recovery Time              | t <sub>rr</sub>     | T <sub>J</sub> = 25°C, I <sub>F</sub> = 20A                                              | -   | 104   | -    | nS   |
| Reverse Recovery Charge            | Q <sub>rr</sub>     | di/dt = 100A/μs (Note3)                                                                  | -   | 220   | -    | nC   |

## Notes:

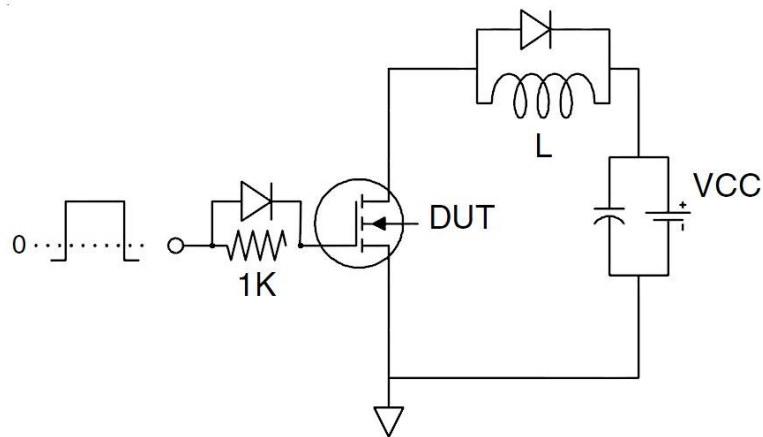
1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board,  $t \leq 10$  sec.
3. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$ .
4. Guaranteed by design, not subject to production
5. EAS condition:  $T_J=25^{\circ}\text{C}, V_{DD}=50V,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

## Test circuit

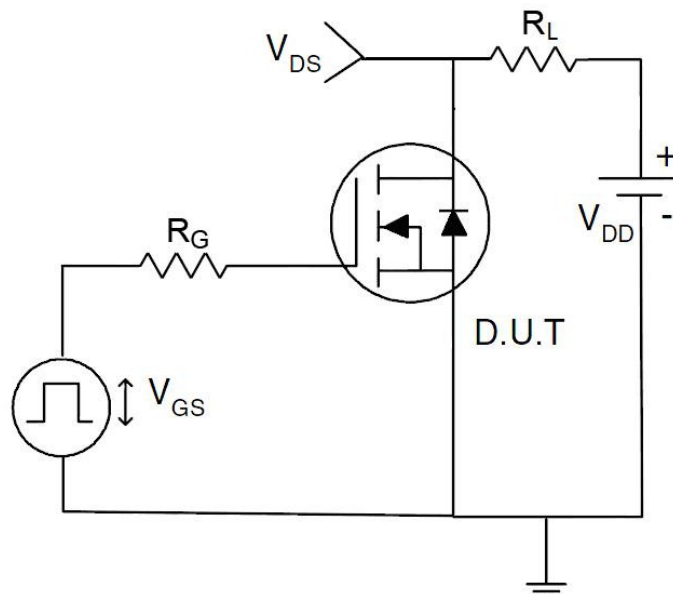
### 1) $E_{AS}$ test Circuit



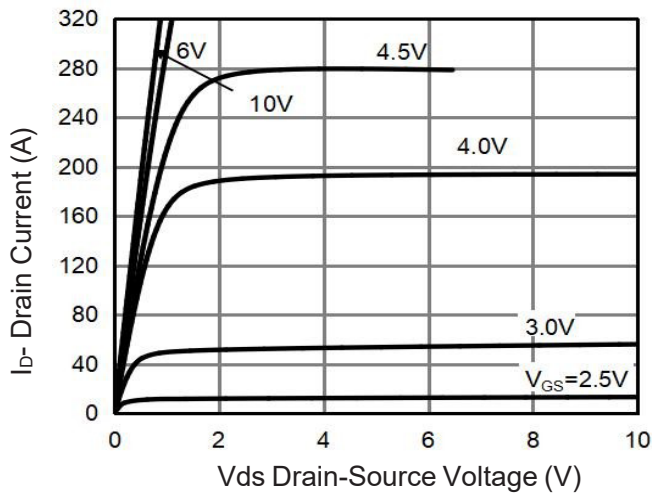
### 2) Gate charge test Circuit



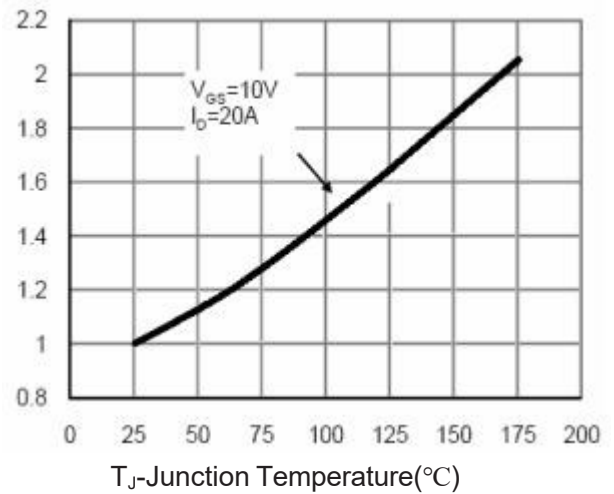
### 3) Switch Time Test Circuit



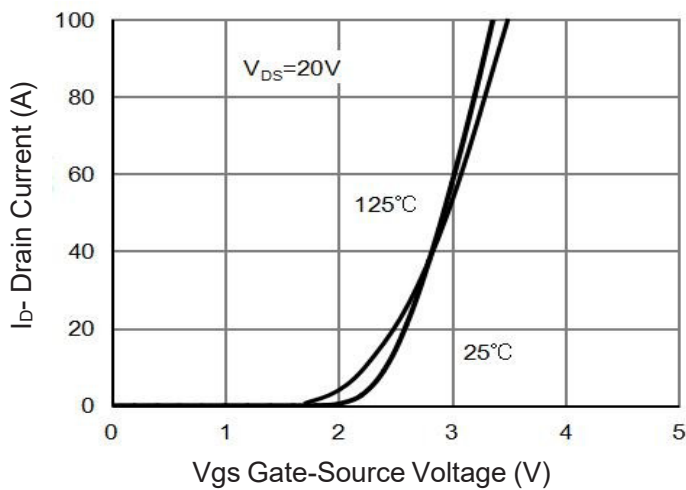
## Typical Electrical and Thermal Characteristics (Curves)



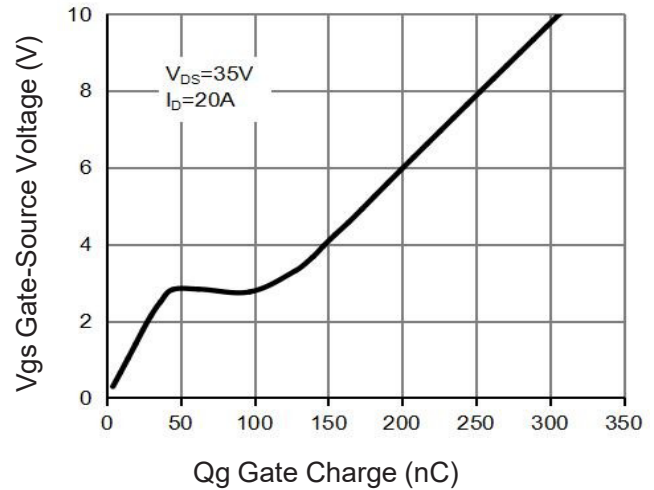
**Figure 1 Output Characteristics**



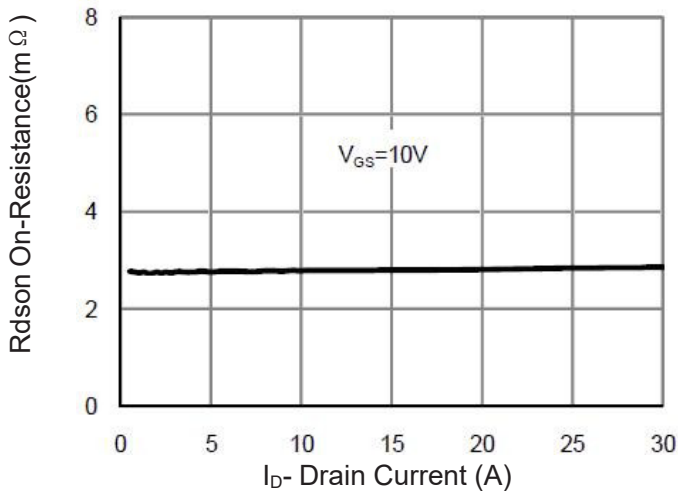
**Figure 4  $R_{DS(on)}$ -Junction Temperature**



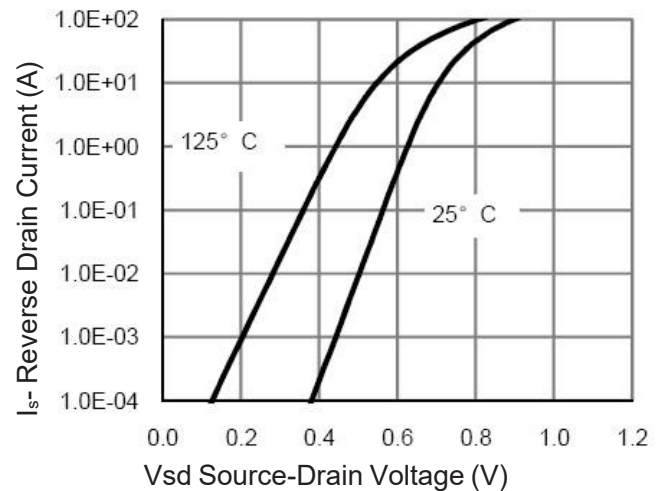
**Figure 2 Transfer Characteristics**



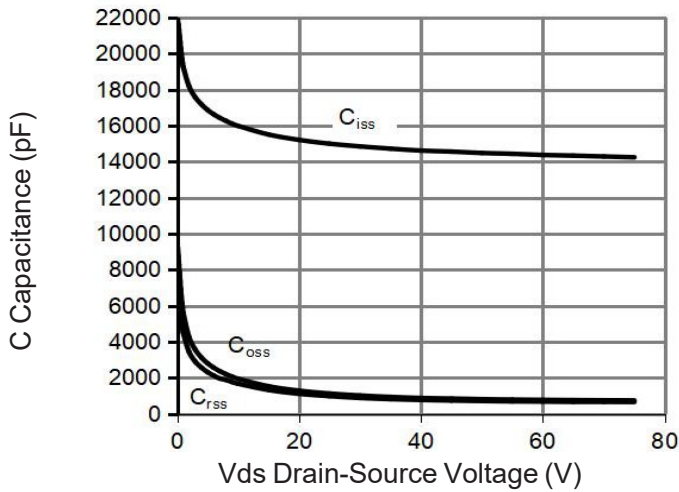
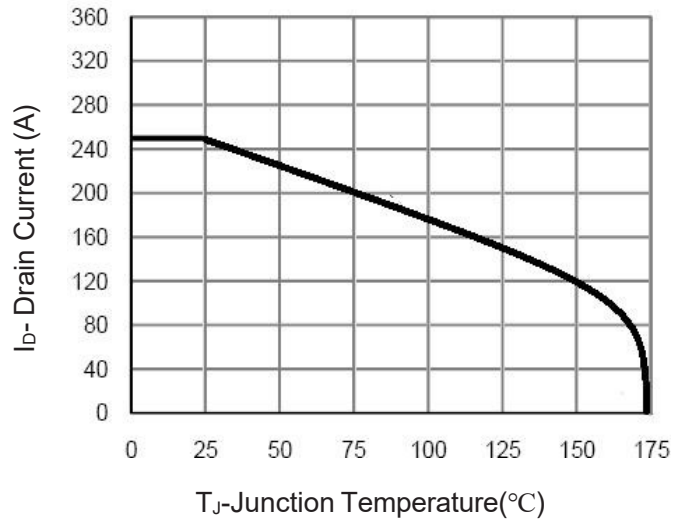
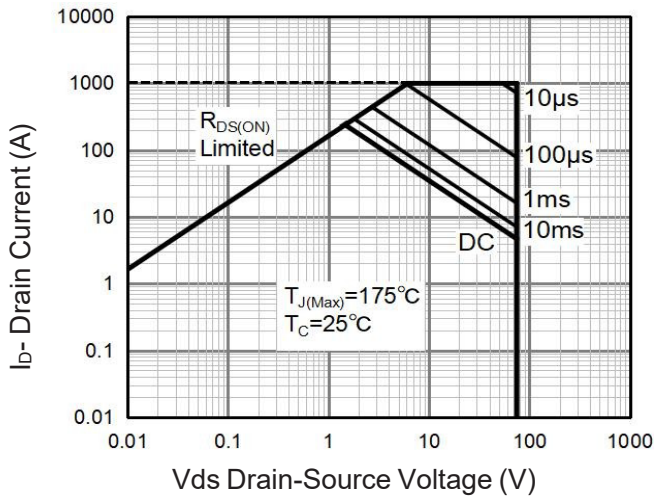
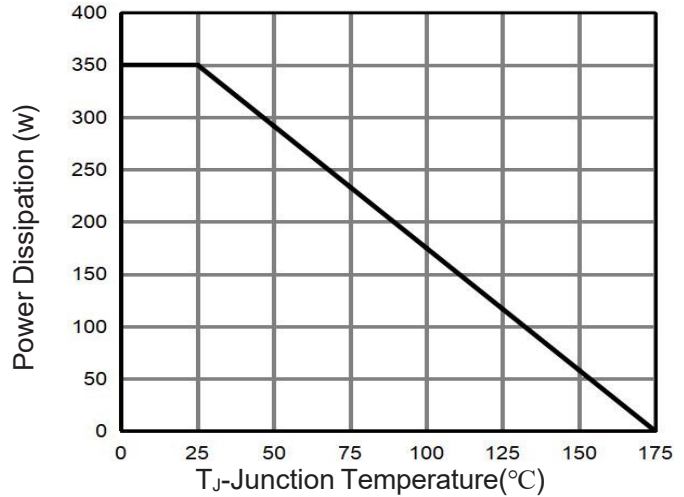
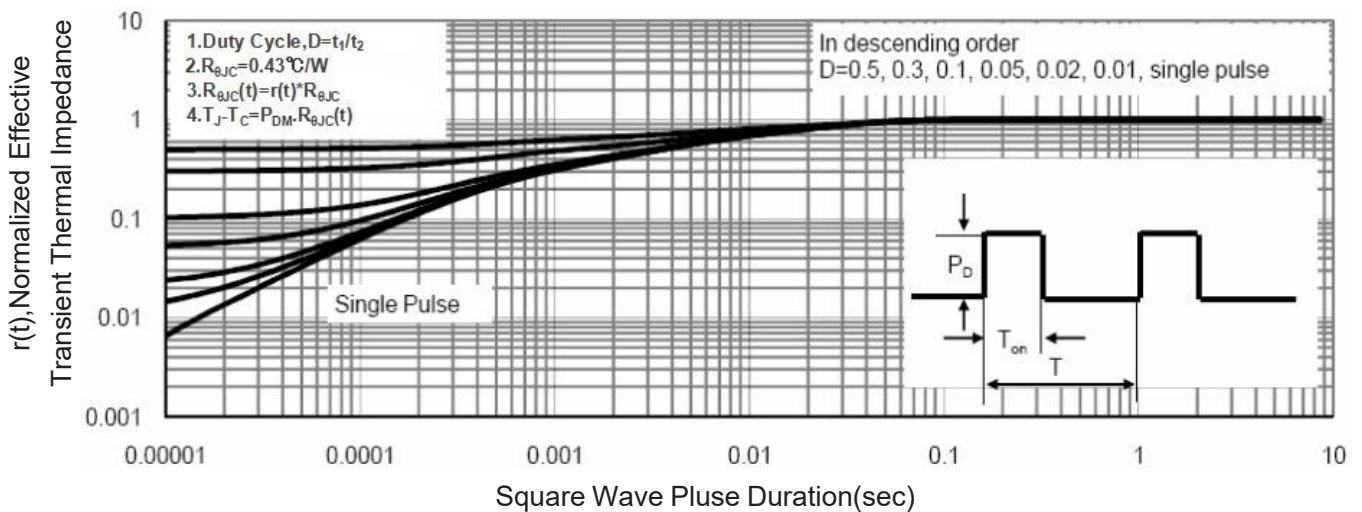
**Figure 5 Gate Charge**



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



**Figure 6 Source- Drain Diode Forward**


**Figure 7 Capacitance vs Vds**

**Figure 9 Current De-rating**

**Figure 8 Safe Operation Area**

**Figure 10 Power De-rating**

**Figure 11 Normalized Maximum Transient Thermal Impedance**