

## Description

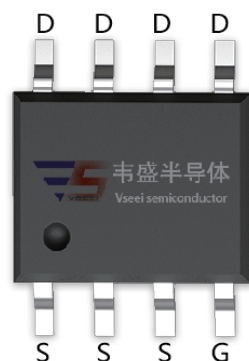
The VSM15N04 uses advanced trench technology and design to provide excellent  $R_{DS(ON)}$  with low gate charge. It can be used in a wide variety of applications.

## General Features

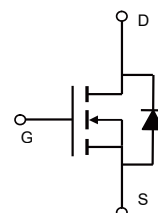
- $V_{DS} = 40V, I_D = 15A$   
 $R_{DS(ON)} < 8.2m\Omega @ V_{GS} = 10V$  (Typ. 6.1 m $\Omega$ )  
 $R_{DS(ON)} < 25m\Omega @ V_{GS} = 4.5V$  (Typ. 11.4 m $\Omega$ )
- High density cell design for ultra low  $R_{DS(ON)}$
- Fully characterized avalanche voltage and current
- Good stability and uniformity with high  $E_{AS}$
- Excellent package for good heat dissipation
- Special process technology for high ESD capability

## Application

- Load switching
- Hard switched and high frequency circuits
- Uninterruptible power supply



SOP-8



Schematic

## Package Marking and Ordering Information

| Device Marking | Device      | Device Package | Reel Size | Tape width | Quantity   |
|----------------|-------------|----------------|-----------|------------|------------|
| VSM15N04       | VSM15N04-S8 | SOP-8          | Ø330mm    | 12mm       | 4000 units |

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

| Parameter                                        | Symbol              | Limit      | Unit       |
|--------------------------------------------------|---------------------|------------|------------|
| Drain-Source Voltage                             | $V_{DS}$            | 40         | V          |
| Gate-Source Voltage                              | $V_{GS}$            | $\pm 20$   | V          |
| Drain Current-Continuous                         | $I_D$               | 15         | A          |
| Drain Current-Continuous( $T_C = 100^\circ C$ )  | $I_D (100^\circ C)$ | 10.6       | A          |
| Pulsed Drain Current                             | $I_{DM}$            | 70         | A          |
| Maximum Power Dissipation                        | $P_D$               | 3.1        | W          |
| Operating Junction and Storage Temperature Range | $T_J, T_{STG}$      | -55 To 150 | $^\circ C$ |

## Thermal Characteristic

|                                                             |                 |    |              |
|-------------------------------------------------------------|-----------------|----|--------------|
| Thermal Resistance, Junction-to-Ambient <sup>(Note 2)</sup> | $R_{\theta JA}$ | 40 | $^\circ C/W$ |
|-------------------------------------------------------------|-----------------|----|--------------|

**Electrical Characteristics (T<sub>A</sub>=25°C unless otherwise noted)**

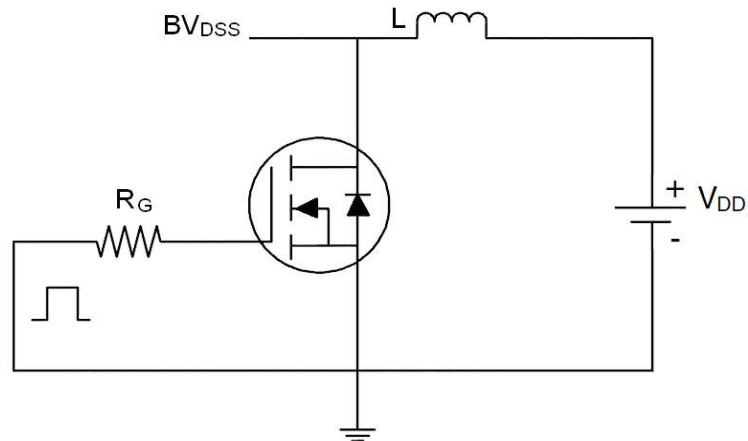
| Parameter                                         | Symbol              | Condition                                                                           | Min | Typ  | Max  | Unit |
|---------------------------------------------------|---------------------|-------------------------------------------------------------------------------------|-----|------|------|------|
| Off Characteristics                               |                     |                                                                                     |     |      |      |      |
| Drain-Source Breakdown Voltage                    | BV <sub>DSS</sub>   | V <sub>GS</sub> =0V I <sub>D</sub> =250μA                                           | 40  | 45   | -    | V    |
| Zero Gate Voltage Drain Current                   | I <sub>DSS</sub>    | V <sub>DS</sub> =40V,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 <small>(Note 3)</small>        |                     |                                                                                     |     |      |      |      |
| Gate Threshold Voltage                            | V <sub>GS(th)</sub> | V <sub>DS</sub> =V <sub>GS</sub> ,I <sub>D</sub> =250μA                             | 1.2 | 1.8  | 2.5  | V    |
| Drain-Source On-State Resistance                  | R <sub>DS(ON)</sub> | V <sub>GS</sub> =10V, I <sub>D</sub> =10A                                           | -   | 6.1  | 8.2  | mΩ   |
|                                                   |                     | V <sub>GS</sub> =4.5V, I <sub>D</sub> =8A                                           | -   | 11.4 | 25   | mΩ   |
| Forward Transconductance                          | g <sub>FS</sub>     | V <sub>DS</sub> =5V,I <sub>D</sub> =10A                                             |     | 80   | -    | S    |
| Dynamic Characteristics <small>(Note4)</small>    |                     |                                                                                     |     |      |      |      |
| Input Capacitance                                 | C <sub>iss</sub>    | V <sub>DS</sub> =20V,V <sub>GS</sub> =0V,<br>F=1.0MHz                               | -   | 3090 | -    | PF   |
| Output Capacitance                                | C <sub>oss</sub>    |                                                                                     | -   | 328  | -    | PF   |
| Reverse Transfer Capacitance                      | C <sub>rss</sub>    |                                                                                     | -   | 273  | -    | PF   |
| Switching Characteristics <small>(Note 4)</small> |                     |                                                                                     |     |      |      |      |
| Turn-on Delay Time                                | t <sub>d(on)</sub>  | V <sub>DD</sub> =20V, R <sub>L</sub> =2Ω<br>V <sub>GS</sub> =10V,R <sub>G</sub> =3Ω | -   | 7    | -    | nS   |
| Turn-on Rise Time                                 | t <sub>r</sub>      |                                                                                     | -   | 20   | -    | nS   |
| Turn-Off Delay Time                               | t <sub>d(off)</sub> |                                                                                     | -   | 34   | -    | nS   |
| Turn-Off Fall Time                                | t <sub>f</sub>      |                                                                                     | -   | 19   | -    | nS   |
| Total Gate Charge                                 | Q <sub>g</sub>      | V <sub>DS</sub> =20V,I <sub>D</sub> =10A,<br>V <sub>GS</sub> =10V                   | -   | 60   |      | nC   |
| Gate-Source Charge                                | Q <sub>gs</sub>     |                                                                                     | -   | 8.1  |      | nC   |
| Gate-Drain Charge                                 | Q <sub>gd</sub>     |                                                                                     | -   | 16.9 |      | nC   |
| Drain-Source Diode Characteristics                |                     |                                                                                     |     |      |      |      |
| Diode Forward Voltage <small>(Note 3)</small>     | V <sub>SD</sub>     | V <sub>GS</sub> =0V,I <sub>S</sub> =10A                                             | -   |      | 1.2  | V    |
| Diode Forward Current <small>(Note 2)</small>     | I <sub>S</sub>      |                                                                                     | -   | -    | 15   | A    |
| Reverse Recovery Time                             | t <sub>rr</sub>     | T <sub>J</sub> = 25°C, I <sub>F</sub> = 10A<br>di/dt = 100A/μs <sup>(Note3)</sup>   | -   | 31   | -    | nS   |
| Reverse Recovery Charge                           | Q <sub>rr</sub>     |                                                                                     | -   | 33   | -    | nC   |

**Notes:**

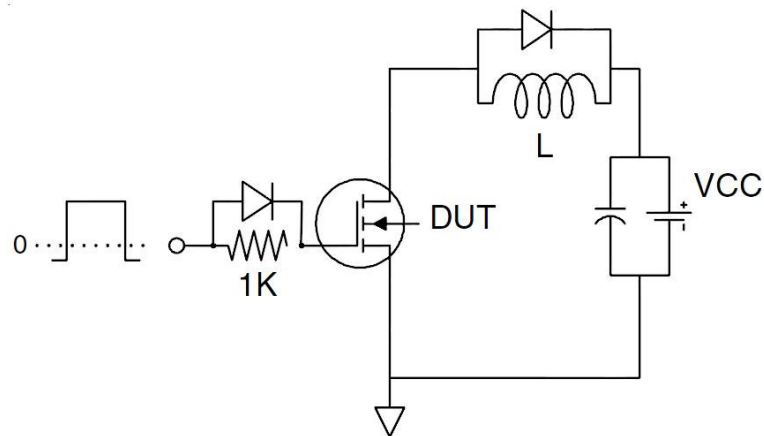
1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board, t ≤ 10 sec.
3. Pulse Test: Pulse Width ≤ 300μs, Duty Cycle ≤ 2%.
4. Guaranteed by design, not subject to production

## Test circuit

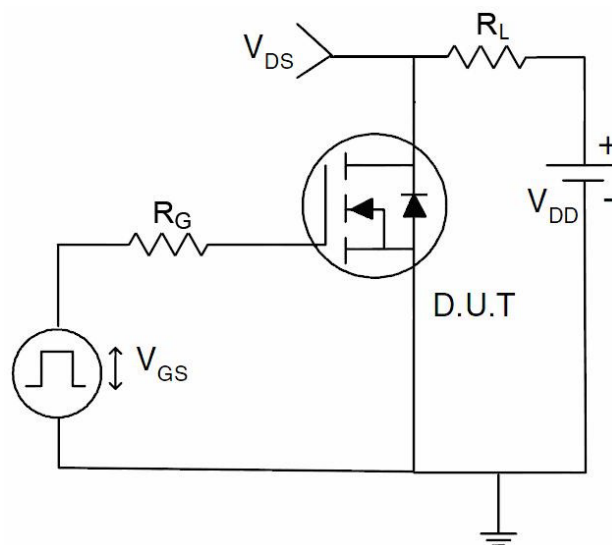
### 1) $E_{AS}$ Test Circuit



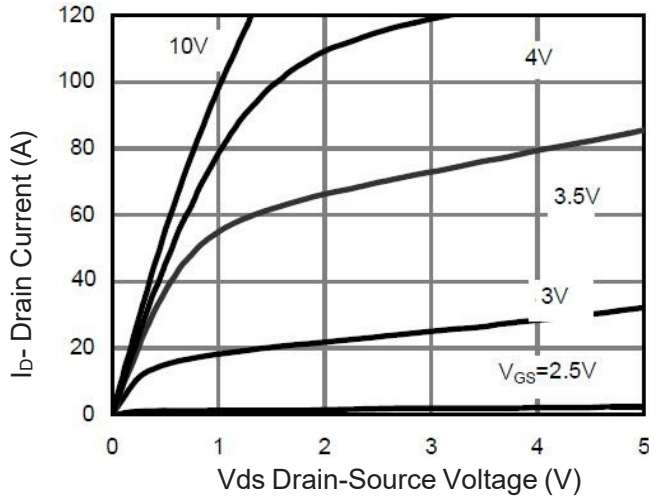
### 2) Gate Charge Test Circuit



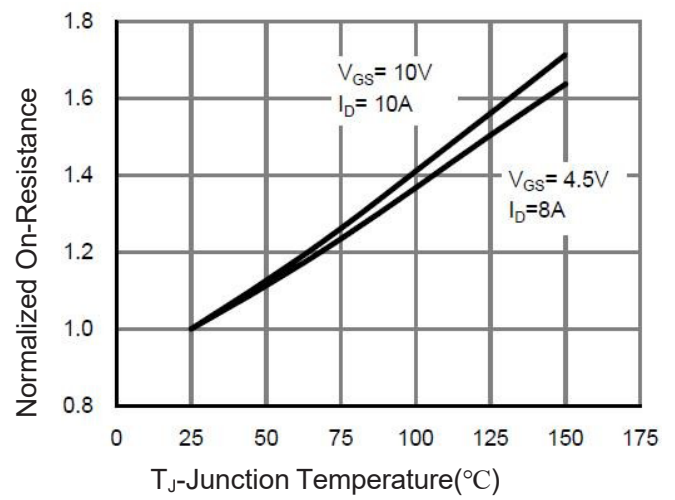
### 3) Switch Time Test Circuit



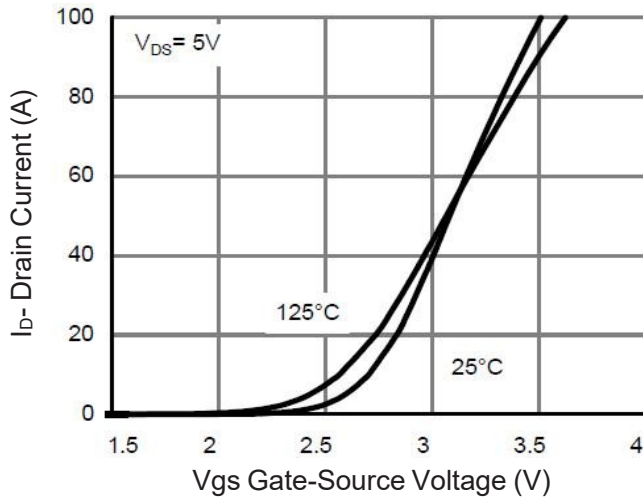
## Typical Electrical and Thermal Characteristics (Curves)



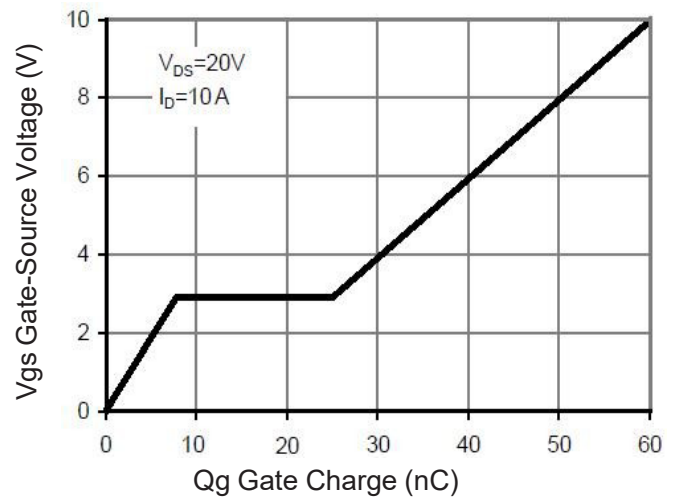
**Figure 1 Output Characteristics**



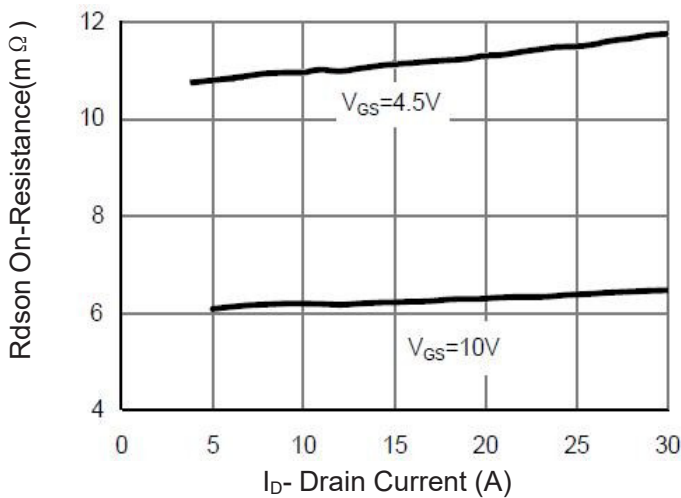
**Figure 4  $R_{DS(on)}$ -Junction Temperature**



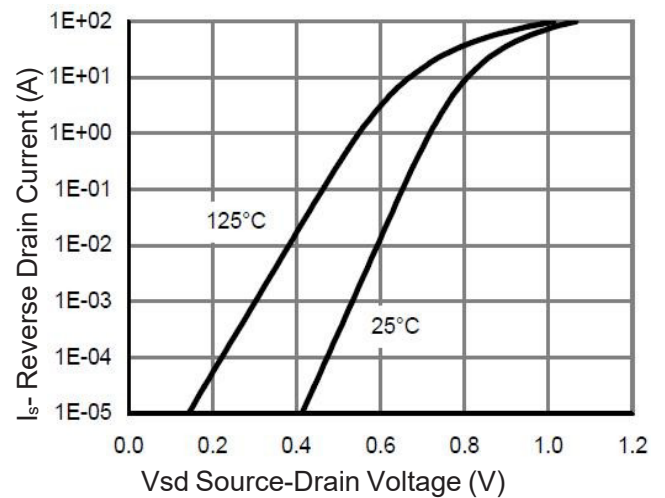
**Figure 2 Transfer Characteristics**



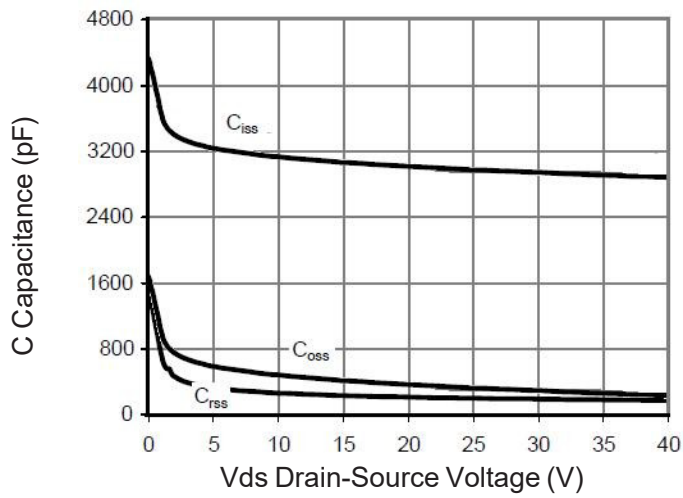
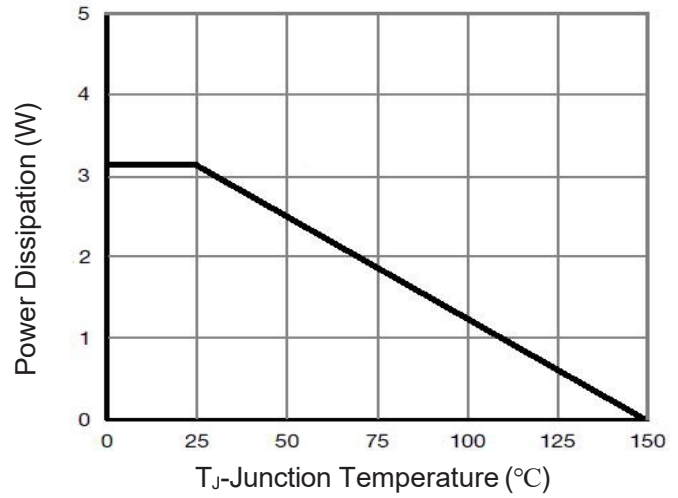
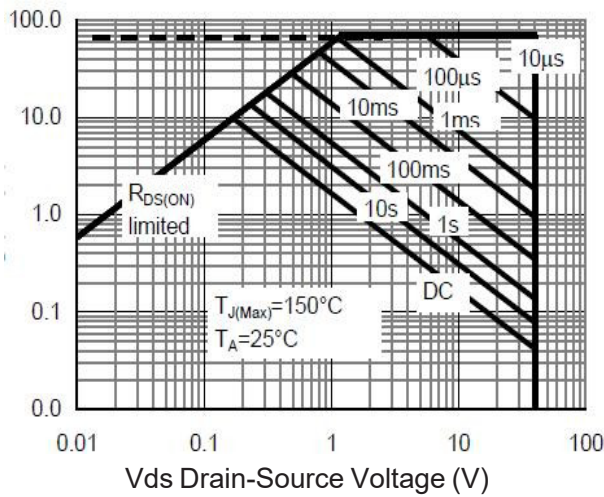
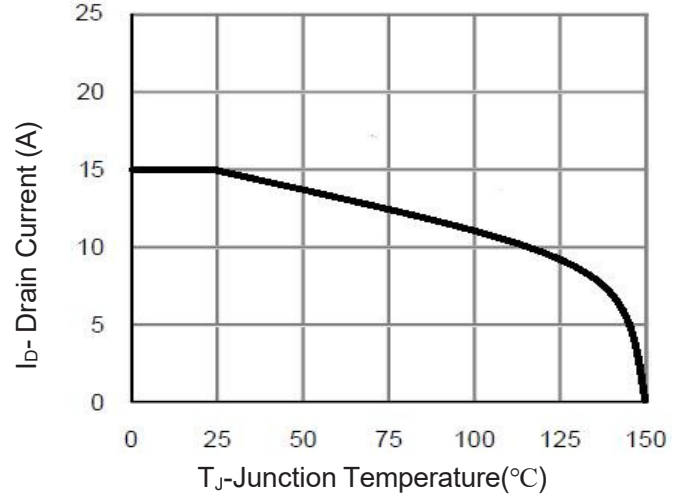
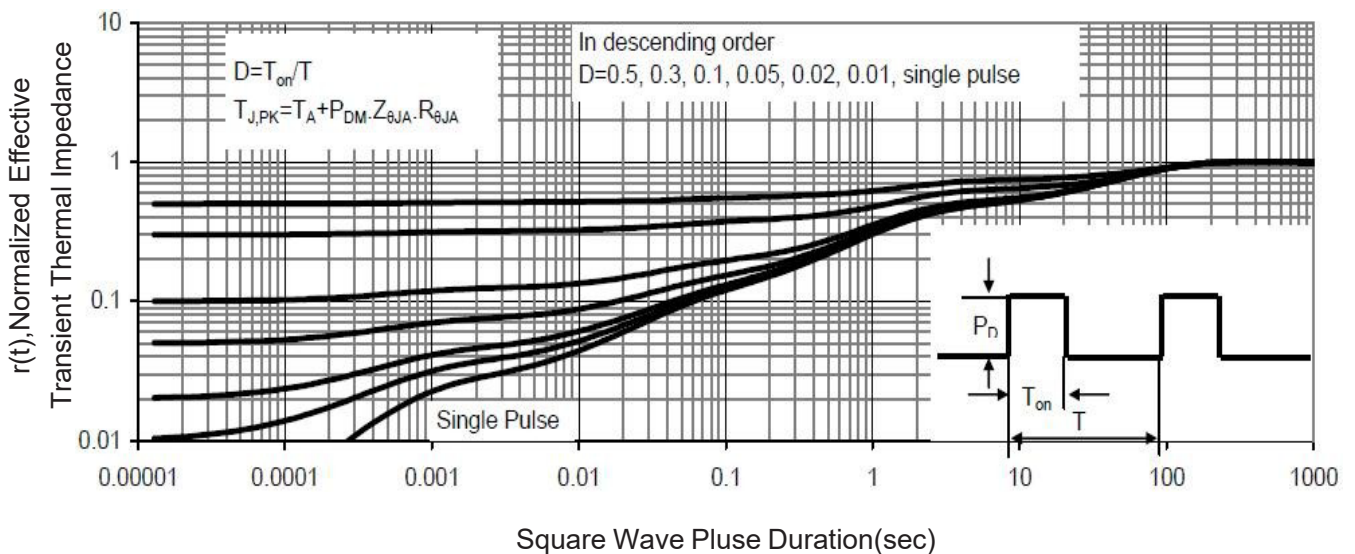
**Figure 5 Gate Charge**



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



**Figure 6 Source- Drain Diode Forward**


**Figure 7 Capacitance vs Vds**

**Figure 9 Power De-rating**

**Figure 8 Safe Operation Area**

**Figure 10 Current De-rating**

**Figure 11 Normalized Maximum Transient Thermal Impedance**