

## Description

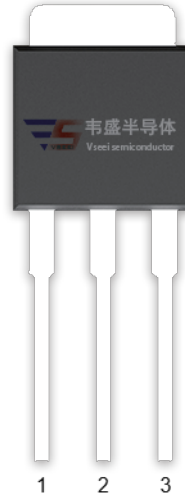
The VSM12N15 uses advanced trench technology and design to provide excellent  $R_{DS(ON)}$  with low gate charge. It can be used in a wide variety of applications.

## General Features

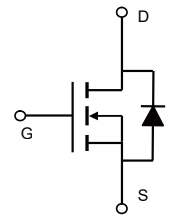
- $V_{DS} = 150V, I_D = 12A$   
 $R_{DS(ON)} < 160m\Omega @ V_{GS}=10V$  (Typ:130m $\Omega$ )
- High density cell design for ultra low  $R_{dson}$
- Fully characterized avalanche voltage and current
- Excellent package for good heat dissipation

## Application

- Power switching application
- Hard switched and high frequency circuits



TO-251



Schematic

## Package Marking and Ordering Information

| Device Marking | Device      | Device Package | Reel Size | Tape width | Quantity |
|----------------|-------------|----------------|-----------|------------|----------|
| VSM12N15       | VSM12N15-T1 | TO-251         | -         | -          | -        |

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

| Parameter                                        | Symbol         | Limit      | Unit             |
|--------------------------------------------------|----------------|------------|------------------|
| Drain-Source Voltage                             | $V_{DS}$       | 150        | V                |
| Gate-Source Voltage                              | $V_{GS}$       | $\pm 20$   | V                |
| Drain Current-Continuous                         | $I_D$          | 12         | A                |
| Drain Current-Pulsed (Note 1)                    | $I_{DM}$       | 50         | A                |
| Maximum Power Dissipation                        | $P_D$          | 55         | W                |
| Operating Junction and Storage Temperature Range | $T_J, T_{STG}$ | -55 To 175 | $^\circ\text{C}$ |

## Thermal Characteristic

|                                               |                 |     |                    |
|-----------------------------------------------|-----------------|-----|--------------------|
| Thermal Resistance, Junction-to-Case (Note 2) | $R_{\theta JC}$ | 2.7 | $^\circ\text{C/W}$ |
|-----------------------------------------------|-----------------|-----|--------------------|

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

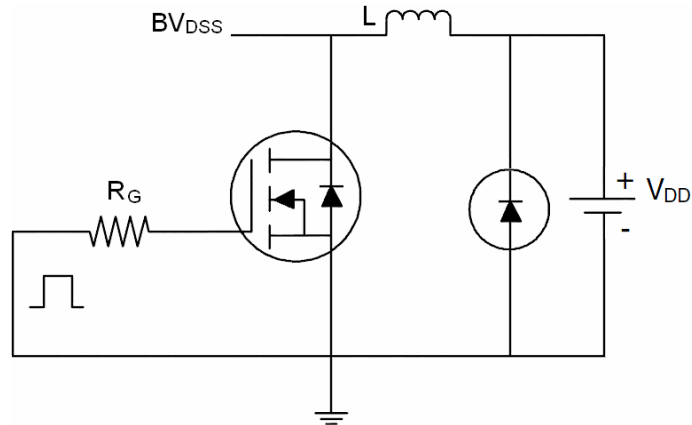
| Parameter                          | Symbol       | Condition                                                       | Min | Typ | Max       | Unit       |
|------------------------------------|--------------|-----------------------------------------------------------------|-----|-----|-----------|------------|
| Off Characteristics                |              |                                                                 |     |     |           |            |
| Drain-Source Breakdown Voltage     | $BV_{DSS}$   | $V_{GS}=0V, I_D=250\mu A$                                       | 150 | -   | -         | V          |
| Zero Gate Voltage Drain Current    | $I_{DSS}$    | $V_{DS}=150V, V_{GS}=0V$                                        | -   | -   | 1         | $\mu A$    |
| Gate-Body Leakage Current          | $I_{GSS}$    | $V_{GS}=\pm 20V, V_{DS}=0V$                                     | -   | -   | $\pm 100$ | nA         |
| On Characteristics (Note 3)        |              |                                                                 |     |     |           |            |
| Gate Threshold Voltage             | $V_{GS(th)}$ | $V_{DS}=V_{GS}, I_D=250\mu A$                                   | 1.5 | 2   | 2.5       | V          |
| Drain-Source On-State Resistance   | $R_{DS(ON)}$ | $V_{GS}=10V, I_D=5A$                                            | -   | 130 | 160       | m $\Omega$ |
| Forward Transconductance           | $g_{FS}$     | $V_{DS}=15V, I_D=10A$                                           | -   | 15  | -         | S          |
| Dynamic Characteristics (Note4)    |              |                                                                 |     |     |           |            |
| Input Capacitance                  | $C_{iss}$    | $V_{DS}=25V, V_{GS}=0V,$<br>$F=1.0MHz$                          | -   | 900 | -         | PF         |
| Output Capacitance                 | $C_{oss}$    |                                                                 | -   | 115 | -         | PF         |
| Reverse Transfer Capacitance       | $C_{rss}$    |                                                                 | -   | 70  | -         | PF         |
| Switching Characteristics (Note 4) |              |                                                                 |     |     |           |            |
| Turn-on Delay Time                 | $t_{d(on)}$  | $V_{DD}=75V, I_D=1A, R_L=75\Omega$<br>$V_{GS}=10V, R_G=6\Omega$ | -   | 8   | -         | nS         |
| Turn-on Rise Time                  | $t_r$        |                                                                 | -   | 10  | -         | nS         |
| Turn-Off Delay Time                | $t_{d(off)}$ |                                                                 | -   | 20  | -         | nS         |
| Turn-Off Fall Time                 | $t_f$        |                                                                 | -   | 15  | -         | nS         |
| Total Gate Charge                  | $Q_g$        | $V_{DS}=75V, I_D=1.5A,$<br>$V_{GS}=10V$                         | -   | 19  |           | nC         |
| Gate-Source Charge                 | $Q_{gs}$     |                                                                 | -   | 5.5 | -         | nC         |
| Gate-Drain Charge                  | $Q_{gd}$     |                                                                 | -   | 7   | -         | nC         |
| Drain-Source Diode Characteristics |              |                                                                 |     |     |           |            |
| Diode Forward Voltage (Note 3)     | $V_{SD}$     | $V_{GS}=0V, I_S=2A$                                             | -   | -   | 1.2       | V          |
| Diode Forward Current (Note 2)     | $I_S$        |                                                                 | -   | -   | 12        | A          |

**Notes:**

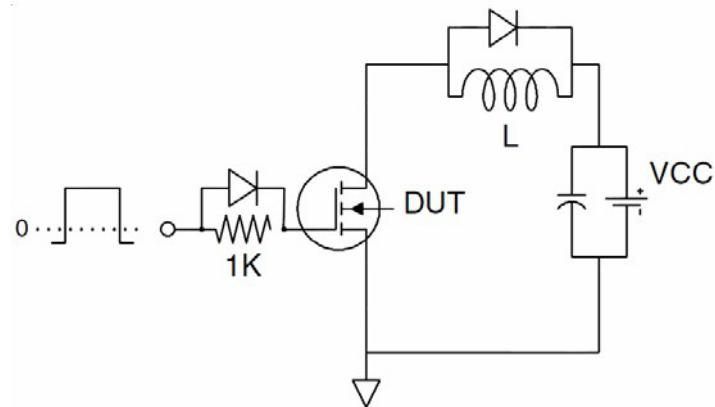
1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board,  $t \leq 10$  sec.
3. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$ .
4. Guaranteed by design, not subject to product

## Test Circuit

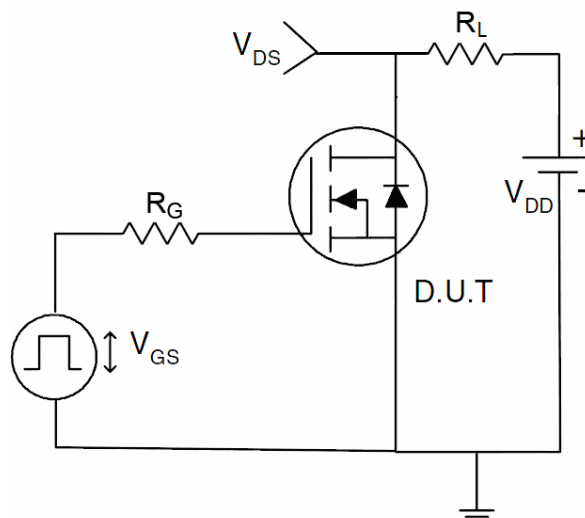
### 1) $E_{AS}$ Test Circuit



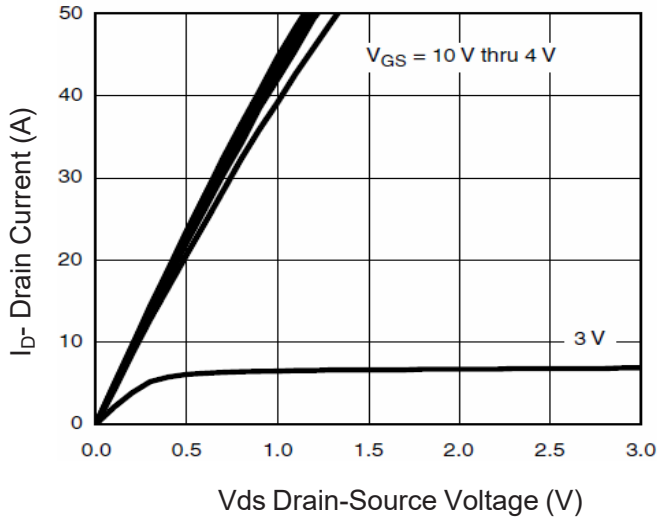
### 2) Gate Charge Test Circuit



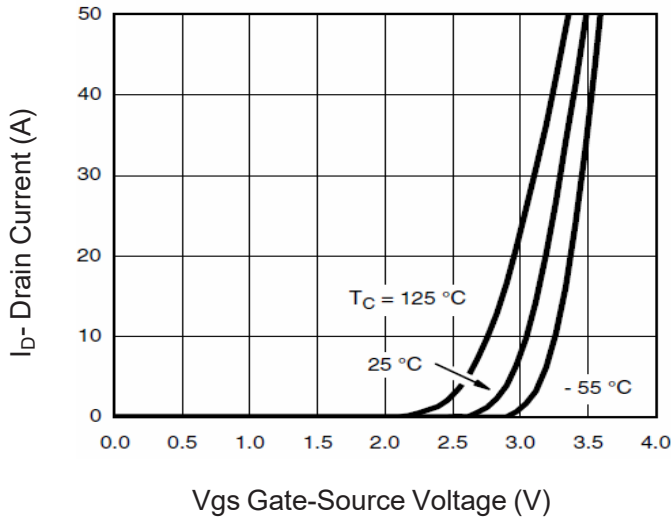
### 3) Switch Time Test Circuit



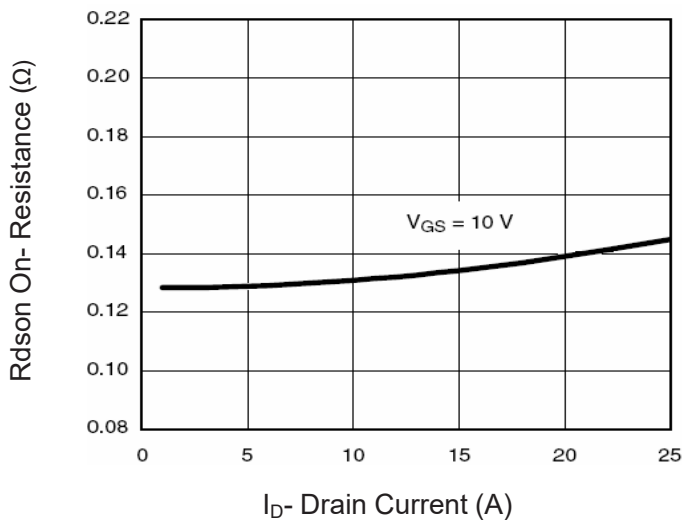
## Typical Electrical and Thermal Characteristics (Curves)



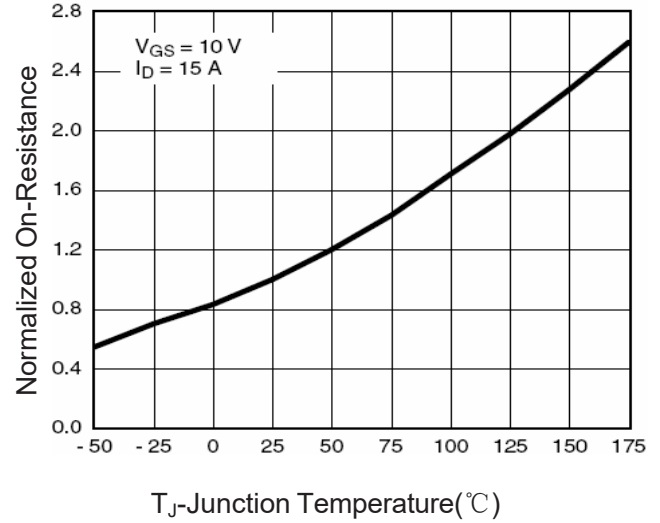
**Figure 1 Output Characteristics**



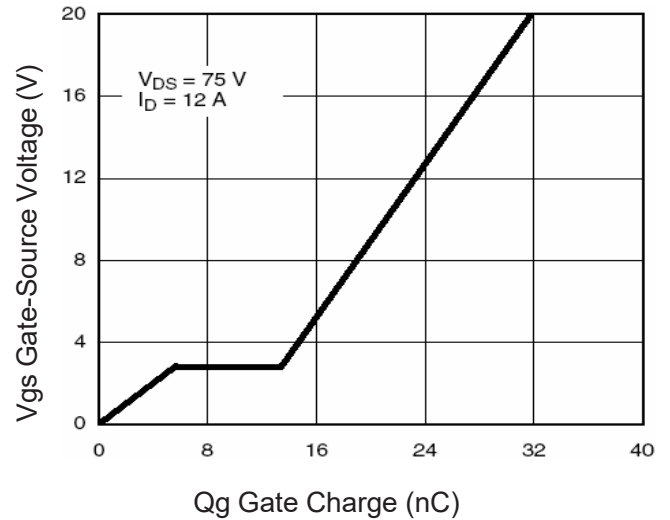
**Figure 2 Transfer Characteristics**



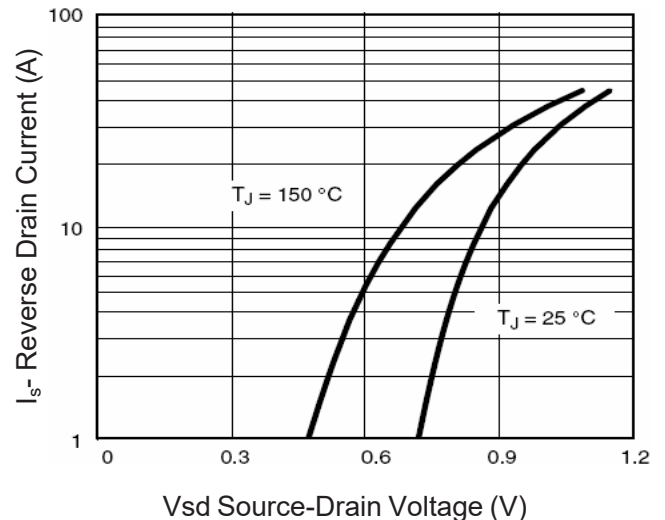
**Figure 3  $R_{DS(on)}$ - Drain Current**



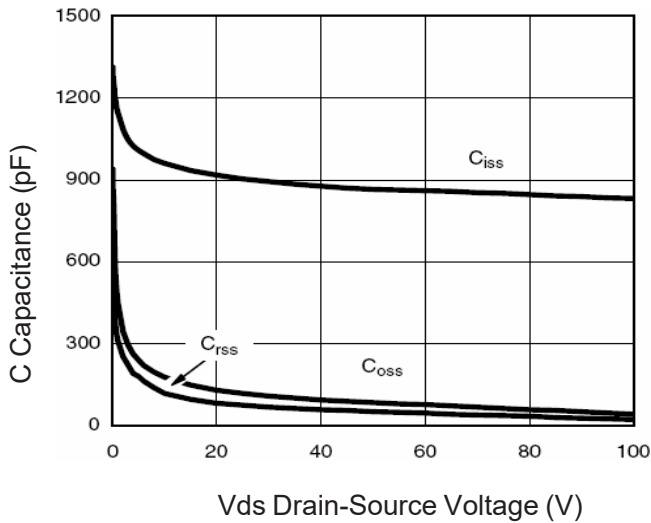
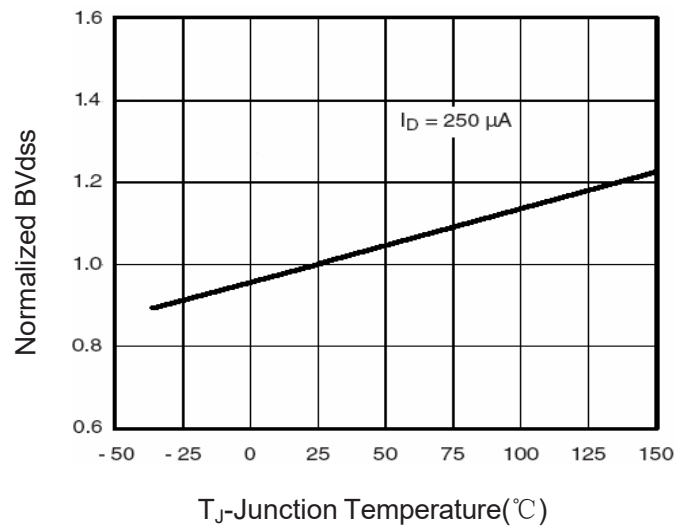
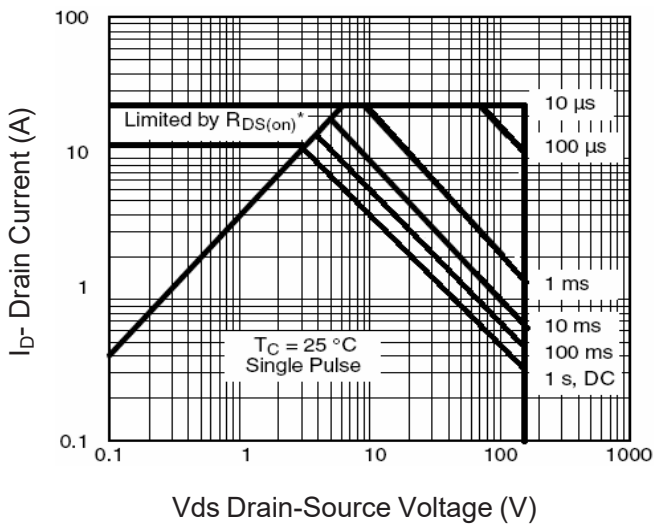
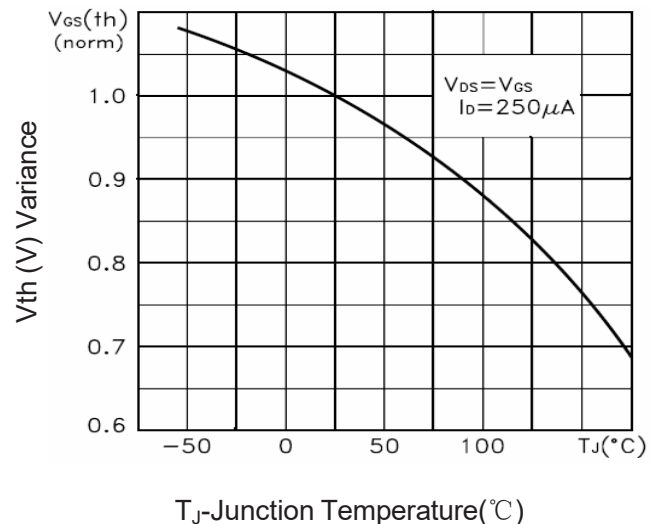
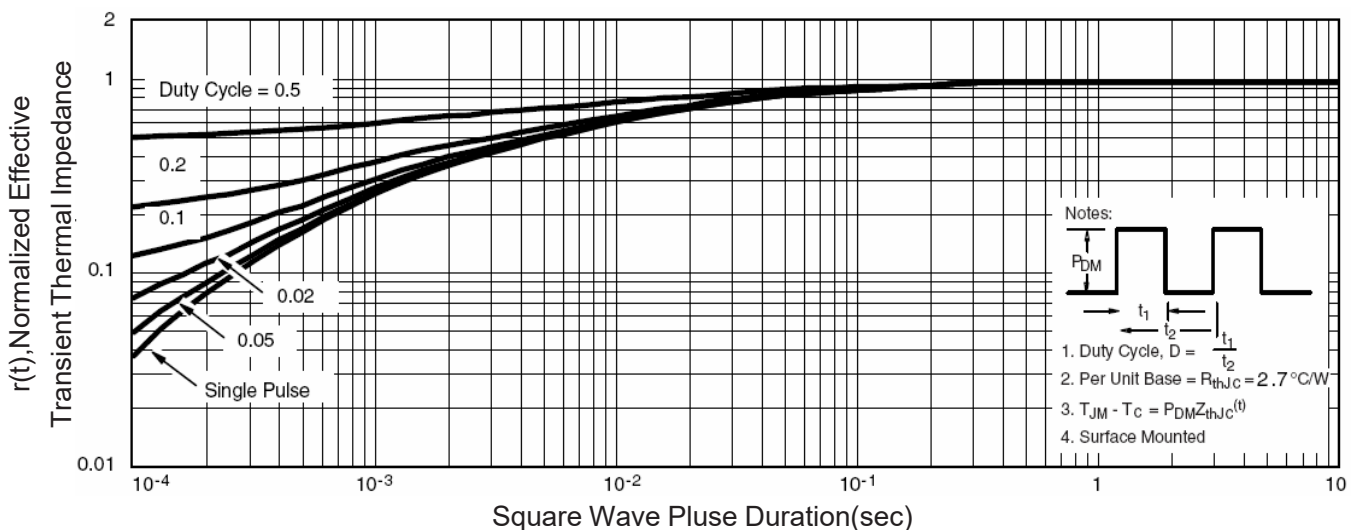
**Figure 4  $R_{DS(on)}$ - Junction Temperature**



**Figure 5 Gate Charge**



**Figure 6 Source- Drain Diode Forward**


**Figure 7 Capacitance vs Vds**

**Figure 9 BV<sub>DSS</sub> vs Junction Temperature**

**Figure 8 Safe Operation Area**

**Figure 10 V<sub>GS(th)</sub> vs Junction Temperature**

**Figure 11 Normalized Maximum Transient Thermal Impedance**