

## Description

The VSM90N03 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

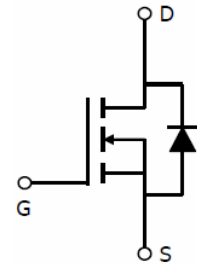
- $V_{DS} = 30V, I_D = 90A$   
 $R_{DS(ON)} = 3.4m\Omega$  (typical) @  $V_{GS} = 10V$   
 $R_{DS(ON)} = 6.9m\Omega$  (typical) @  $V_{GS} = 4.5V$
- High density cell design for ultra low  $R_{dson}$
- Fully characterized avalanche voltage and current
- Good stability and uniformity with high  $E_{AS}$
- Excellent package for good heat dissipation
- Special process technology for high ESD capability

## Application

- DC/DC converters
- Synchronous Rectifier



TO-252



Schematic Diagram

## Package Marking and Ordering Information

| Device Marking | Device   | Device Package | Reel Size | Tape width | Quantity   |
|----------------|----------|----------------|-----------|------------|------------|
| VSM90N03-T2    | VSM90N03 | TO-252         | Ø330mm    | 12mm       | 2500 units |

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

| Parameter   | Symbol             | Limit      | Unit          |
|---|--------------------|------------|---------------|
| Drain-Source Voltage                              | $V_{DS}$           | 30         | V             |
| Gate-Source Voltage                               | $V_{GS}$           | $\pm 20$   | V             |
| Drain Current-Continuous                          | $I_D$              | 90         | A             |
| Drain Current-Continuous( $T_C = 100^\circ C$ )   | $I_D(100^\circ C)$ | 63.6       | A             |
| Pulsed Drain Current <sup>(Note 1)</sup>          | $I_{DM}$           | 200        | A             |
| Maximum Power Dissipation                         | $P_D$              | 105        | W             |
| Derating factor                                   |                    | 0.7        | W/ $^\circ C$ |
| Single pulse avalanche energy <sup>(Note 5)</sup> | $E_{AS}$           | 380        | 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> | $R_{\theta JC}$ | 1.43 | $^\circ C/W$ |
|--|-----------------|------|--------------|

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

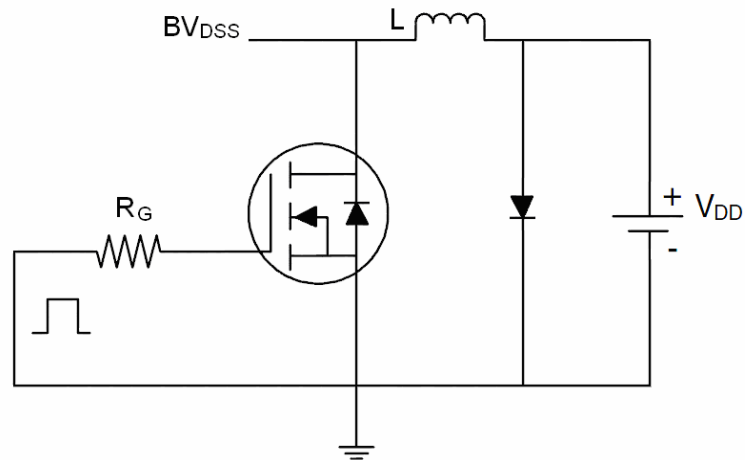
| Parameter                                     | Symbol              | Condition   | Min | Typ  | Max  | Unit |
|---|---------------------|---|-----|------|------|------|
| Off Characteristics                           |                     |   |     |      |      |      |
| Drain-Source Breakdown Voltage                | BV <sub>DSS</sub>   | V <sub>GS</sub> =0V I <sub>D</sub> =250μA   | 30  | 38   | -    | V    |
| Zero Gate Voltage Drain Current               | I <sub>DSS</sub>    | V <sub>DS</sub> =30V, 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 <sup>(Note 3)</sup>        |                     |   |     |      |      |      |
| Gate Threshold Voltage                        | V <sub>GS(th)</sub> | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA                                | 1   | 1.7  | 2.5  | V    |
| Drain-Source On-State Resistance              | R <sub>DS(ON)</sub> | V <sub>GS</sub> =10V, I <sub>D</sub> =20A   | -   | 3.4  | 4.2  | mΩ   |
|   |                     | V <sub>GS</sub> =4.5V, I <sub>D</sub> =20A  |     | 6.9  | 9.5  |      |
| Forward Transconductance                      | g <sub>FS</sub>     | V <sub>DS</sub> =5V, I <sub>D</sub> =20A  | 20  | -    | -    | S    |
| Dynamic Characteristics <sup>(Note4)</sup>    |                     |   |     |      |      |      |
| Input Capacitance                             | C <sub>Iss</sub>    | V <sub>DS</sub> =15V, V <sub>GS</sub> =0V,<br>F=1.0MHz                                  | -   | 3568 | -    | PF   |
| Output Capacitance                            | C <sub>Oss</sub>    |   | -   | 422  | -    | PF   |
| Reverse Transfer Capacitance                  | C <sub>rss</sub>    |   | -   | 341  | -    | PF   |
| Switching Characteristics <sup>(Note 4)</sup> |                     |   |     |      |      |      |
| Turn-on Delay Time                            | t <sub>d(on)</sub>  | V <sub>DD</sub> =15V, I <sub>D</sub> =20A<br>V <sub>GS</sub> =10V, R <sub>GEN</sub> =3Ω | -   | 12   | -    | nS   |
| Turn-on Rise Time                             | t <sub>r</sub>      |   | -   | 15   | -    | nS   |
| Turn-Off Delay Time                           | t <sub>d(off)</sub> |   | -   | 40   | -    | nS   |
| Turn-Off Fall Time                            | t <sub>f</sub>      |   | -   | 14   | -    | nS   |
| Total Gate Charge                             | Q <sub>g</sub>      | V <sub>DS</sub> =15V, I <sub>D</sub> =45A,<br>V <sub>GS</sub> =10V                      | -   | 67   | -    | nC   |
| Gate-Source Charge                            | Q <sub>gs</sub>     |   | -   | 13.7 | -    | nC   |
| Gate-Drain Charge                             | Q <sub>gd</sub>     |   | -   | 10.3 | -    | nC   |
| Drain-Source Diode Characteristics            |                     |   |     |      |      |      |
| Diode Forward Voltage <sup>(Note 3)</sup>     | V <sub>SD</sub>     | V <sub>GS</sub> =0V, I <sub>S</sub> =20A  | -   | -    | 1.2  | V    |
| Diode Forward Current <sup>(Note 2)</sup>     | I <sub>S</sub>      |   | -   | -    | 90   | A    |
| Reverse Recovery Time                         | t <sub>rr</sub>     | TJ = 25°C, IF = 20A   | -   | 29   | -    | nS   |
| Reverse Recovery Charge                       | Q <sub>rr</sub>     | di/dt = 100A/μs <sup>(Note3)</sup>  | -   | 32   | -    | nC   |

**Notes:**

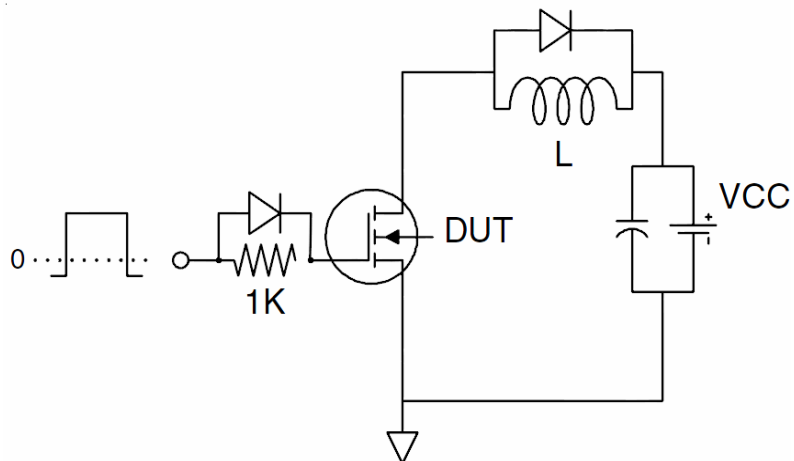
1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board,  $t \leq 10$  sec.
3. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$ .
4. Guaranteed by design, not subject to production
5. EAS condition:  $T_J=25^{\circ}\text{C}$ ,  $V_{DD}=15V, V_G=10V, L=0.5mH$ ,  $R_g=25\Omega$ ;

## Test Circuit

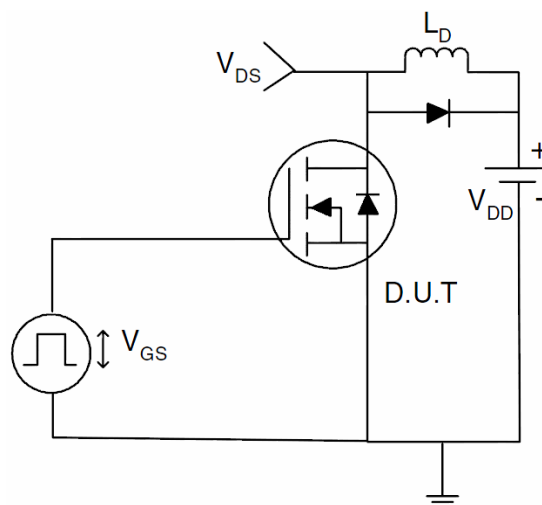
### 1) $E_{AS}$ Test Circuit



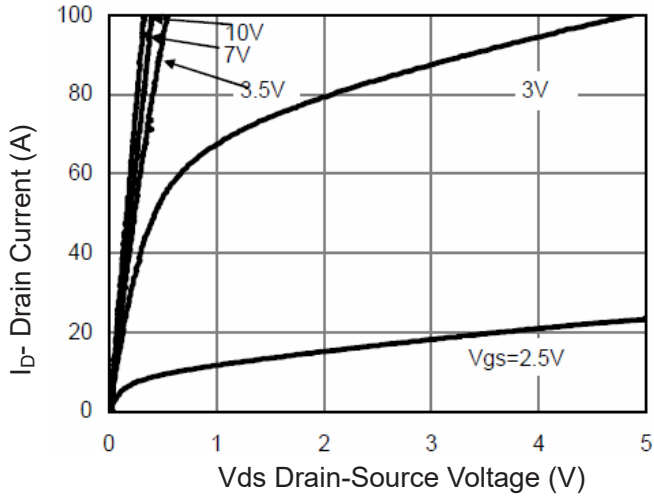
### 2) Gate Charge Test Circuit



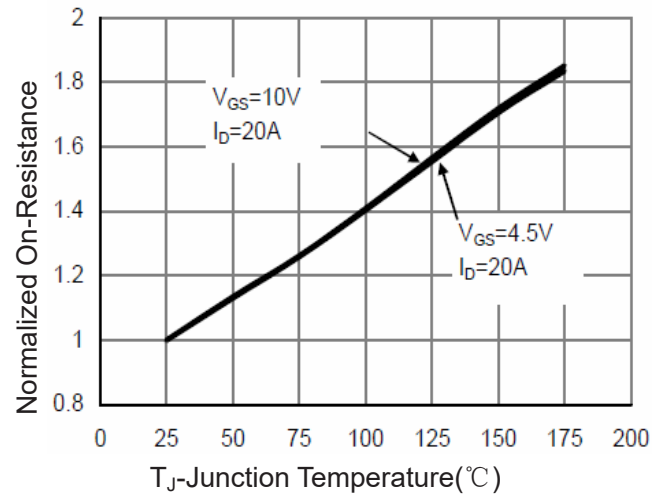
### 3) Switch Time Test Circuit



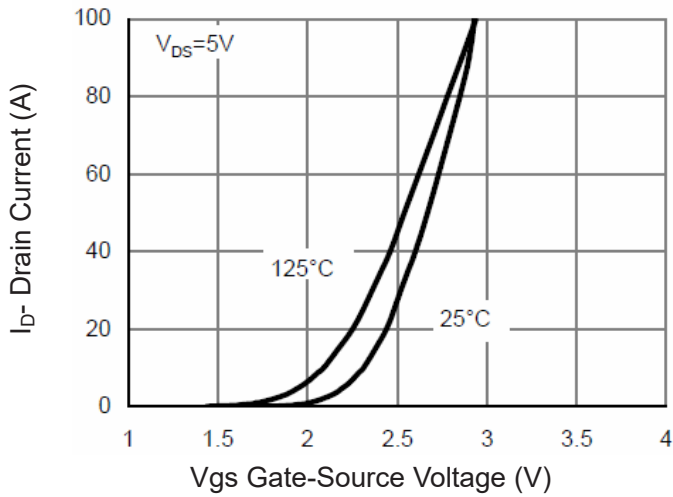
### Typical Electrical and Thermal Characteristics (Curves)



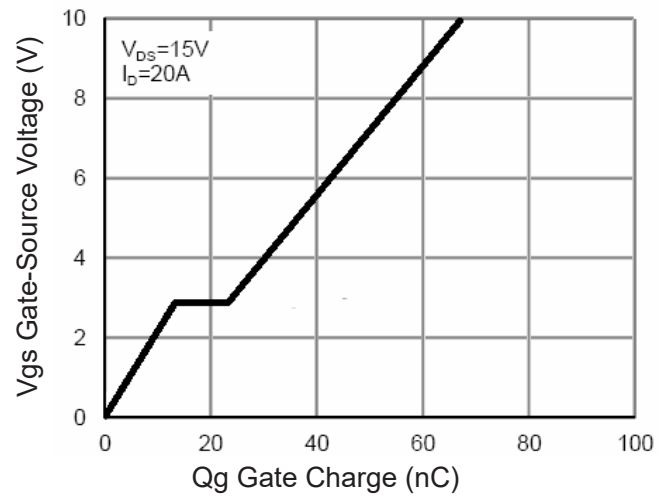
**Figure 1 Output Characteristics**



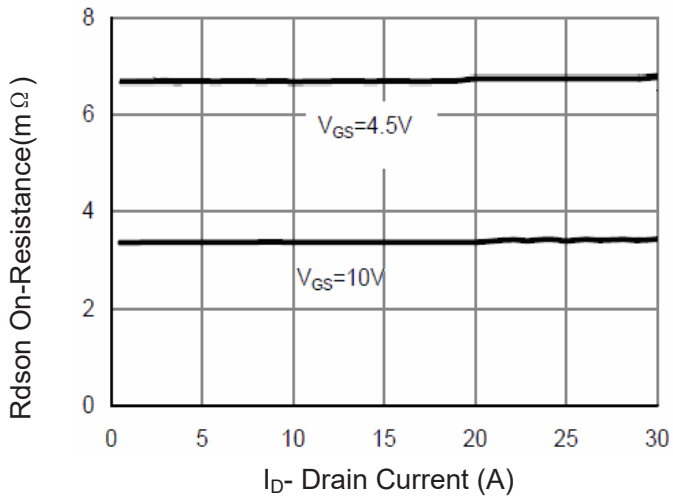
**Figure 4 Rdson-Junction Temperature**



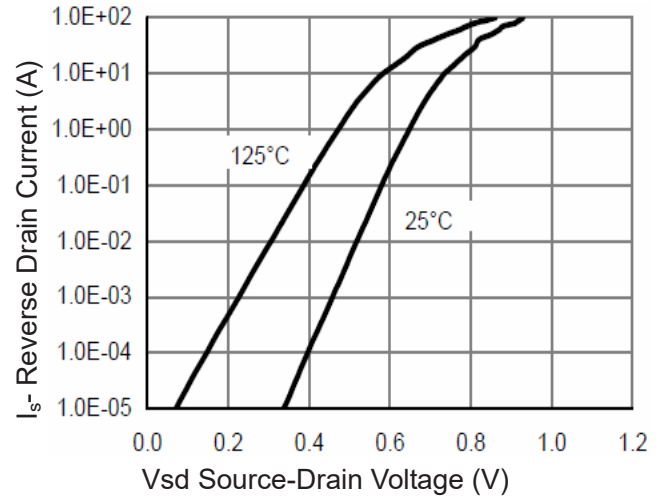
**Figure 2 Transfer Characteristics**



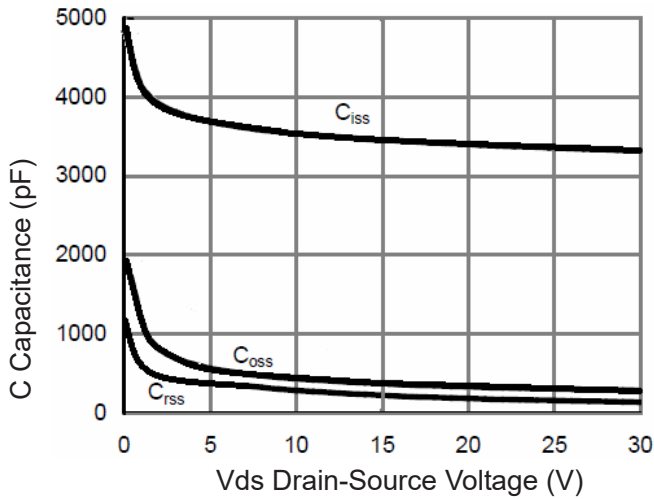
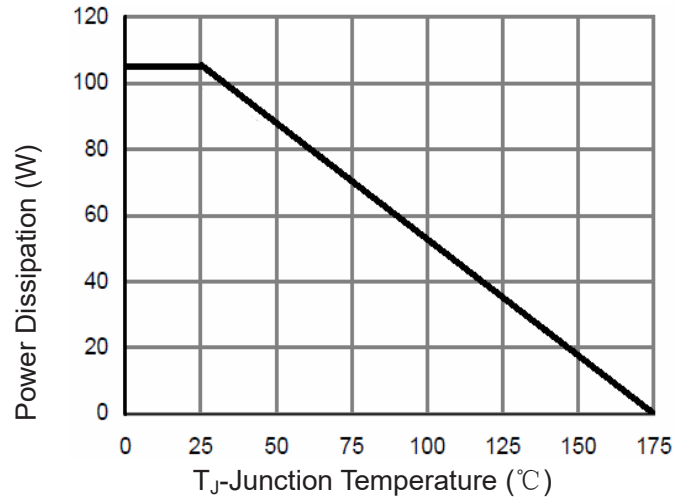
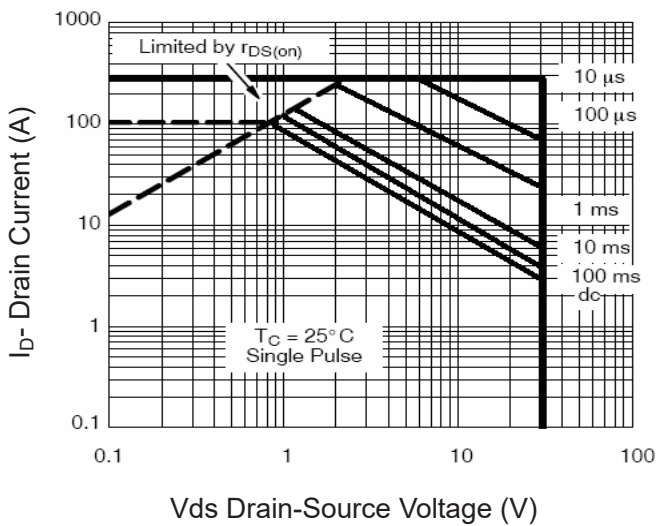
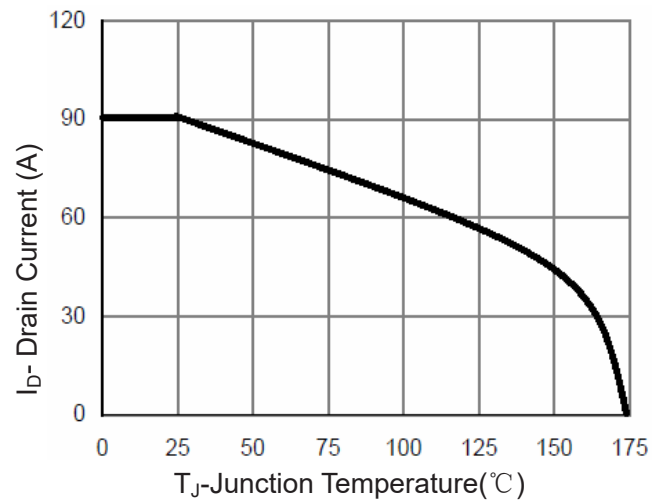
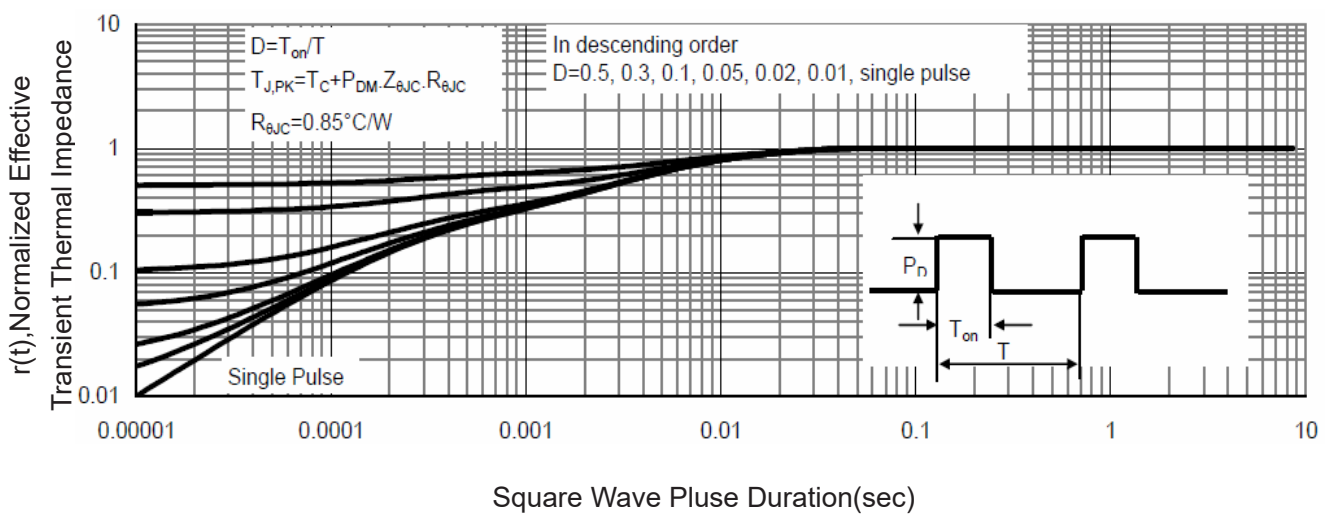
**Figure 5 Gate Charge**



**Figure 3 Rdson- 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 ID Current Derating**

**Figure 11 Normalized Maximum Transient Thermal Impedance**