

## Description

The VSM28N04 uses advanced trench technology to provide excellent  $R_{DS(ON)}$  and low gate charge. The complementary MOSFETs may be used to form a level shifted high side switch, and for a host of other applications.

## General Features

### ● N-Channel

$$V_{DS} = 45V, I_D = 28A$$

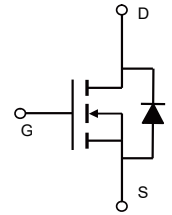
$$R_{DS(ON)} < 15m\Omega @ V_{GS}=10V$$

$$R_{DS(ON)} < 22m\Omega @ V_{GS}=4.5V$$

- High power and current handling capability
- Lead free product is acquired
- Surface mount package



TO-252



Schematic

## Package Marking and Ordering Information

| Device Marking | Device      | Device Package | Reel Size | Tape width | Quantity |
|----------------|-------------|----------------|-----------|------------|----------|
| VSM28N04       | VSM28N04-T2 | TO-252         | -         | -          | -        |

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

| Parameter                                        | Symbol              | Limit      | Unit        |
|--------------------------------------------------|---------------------|------------|-------------|
| Drain-Source Voltage                             | $V_{DS}$            | 45         | V           |
| Gate-Source Voltage                              | $V_{GS}$            | $\pm 20$   | V           |
| Drain Current-Continuous                         | $I_D$               | 28         | A           |
| Drain Current-Continuous( $T_c=100^{\circ}C$ )   | $I_D(100^{\circ}C)$ | 21.2       | A           |
| Pulsed Drain Current (Note 1)                    | $I_{DM}$            | 100        | A           |
| Maximum Power Dissipation                        | $P_D$               | 45         | W           |
| Single pulse avalanche energy (Note 5)           | $E_{AS}$            | 90         | mJ          |
| Operating Junction and Storage Temperature Range | $T_J, T_{STG}$      | -55 To 175 | $^{\circ}C$ |

## Thermal Characteristic

|                                               |                 |     |               |
|-----------------------------------------------|-----------------|-----|---------------|
| Thermal Resistance, Junction-to-Case (Note 2) | $R_{\theta JC}$ | 3.3 | $^{\circ}C/W$ |
|-----------------------------------------------|-----------------|-----|---------------|

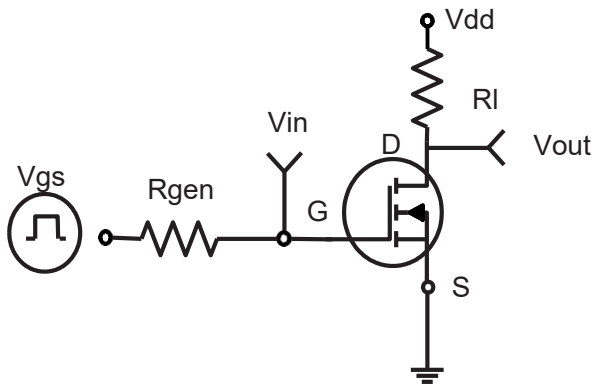
**N-CH Electrical Characteristics ( $T_A=25^{\circ}\text{C}$  unless otherwise noted)**

| Parameter                          | Symbol       | Condition                                                    | Min | Typ  | Max       | Unit       |
|------------------------------------|--------------|--------------------------------------------------------------|-----|------|-----------|------------|
| Off Characteristics                |              |                                                              |     |      |           |            |
| Drain-Source Breakdown Voltage     | $BV_{DSS}$   | $V_{GS}=0V, I_D=250\mu A$                                    | 45  | -    | -         | V          |
| Zero Gate Voltage Drain Current    | $I_{DSS}$    | $V_{DS}=45V, V_{GS}=0V$                                      | -   | -    | 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             | $V_{GS(th)}$ | $V_{DS}=V_{GS}, I_D=250\mu A$                                | 1.0 | 1.5  | 2.0       | V          |
| Drain-Source On-State Resistance   | $R_{DS(ON)}$ | $V_{GS}=10V, I_D=20A$                                        | -   | 13   | 15        | m $\Omega$ |
|                                    |              | $V_{GS}=4.5V, I_D=15A$                                       | -   | 18   | 22        | m $\Omega$ |
| Forward Transconductance           | $g_{FS}$     | $V_{DS}=5V, I_D=20A$                                         | 33  | -    | -         | S          |
| Dynamic Characteristics (Note4)    |              |                                                              |     |      |           |            |
| Input Capacitance                  | $C_{iss}$    | $V_{DS}=20V, V_{GS}=0V,$<br>$F=1.0MHz$                       | -   | 964  | -         | PF         |
| Output Capacitance                 | $C_{oss}$    |                                                              | -   | 109  | -         | PF         |
| Reverse Transfer Capacitance       | $C_{rss}$    |                                                              | -   | 96   | -         | PF         |
| Switching Characteristics (Note 4) |              |                                                              |     |      |           |            |
| Turn-on Delay Time                 | $t_{d(on)}$  | $V_{DD}=20V, R_L=2.5\Omega$<br>$V_{GS}=10V, R_{GEN}=3\Omega$ | -   | 5.5  | -         | nS         |
| Turn-on Rise Time                  | $t_r$        |                                                              | -   | 14   | -         | nS         |
| Turn-Off Delay Time                | $t_{d(off)}$ |                                                              | -   | 24   | -         | nS         |
| Turn-Off Fall Time                 | $t_f$        |                                                              | -   | 12   | -         | nS         |
| Total Gate Charge                  | $Q_g$        | $V_{DS}=20V, I_D=20A,$<br>$V_{GS}=10V$                       | -   | 22.9 | -         | nC         |
| Gate-Source Charge                 | $Q_{gs}$     |                                                              | -   | 3.5  | -         | nC         |
| Gate-Drain Charge                  | $Q_{gd}$     |                                                              | -   | 5.3  | -         | nC         |
| Drain-Source Diode Characteristics |              |                                                              |     |      |           |            |
| Diode Forward Voltage (Note 3)     | $V_{SD}$     | $V_{GS}=0V, I_S=20A$                                         | -   | 0.8  | 1.2       | V          |

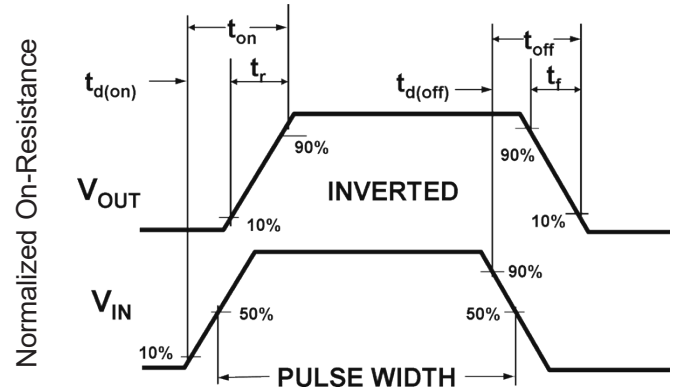
**Notes:**

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:  $T_J=25^{\circ}\text{C}$ ,  $V_{DD}=20V$ ,  $V_G=10V$ ,  $L=0.5mH$ ,  $R_g=25\Omega$

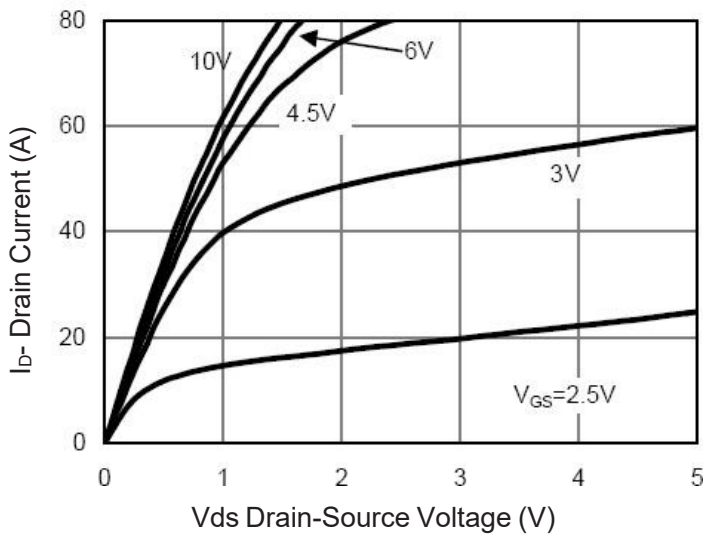
## N-Channel Typical Electrical and Thermal Characteristics (Curves)



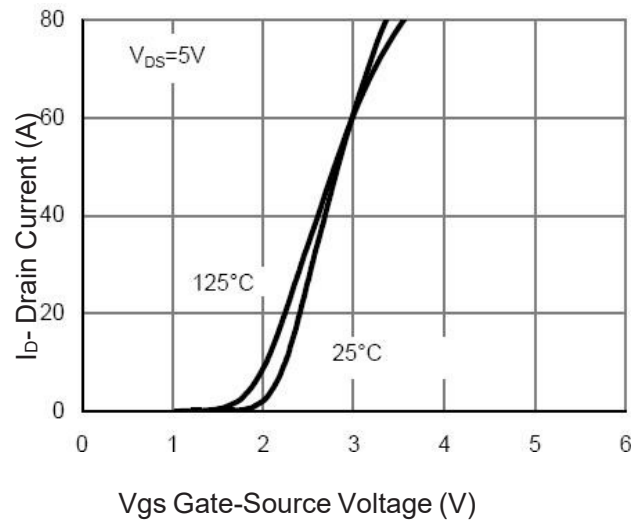
**Figure 1: Switching Test Circuit**



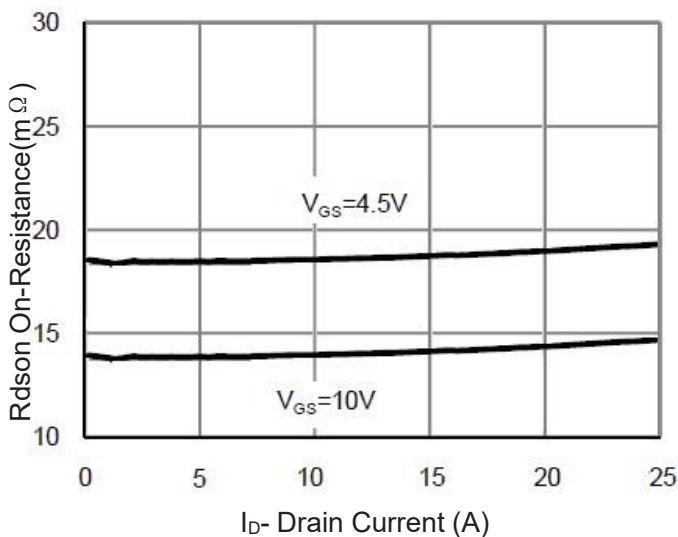
**Figure 2: Switching Waveforms**



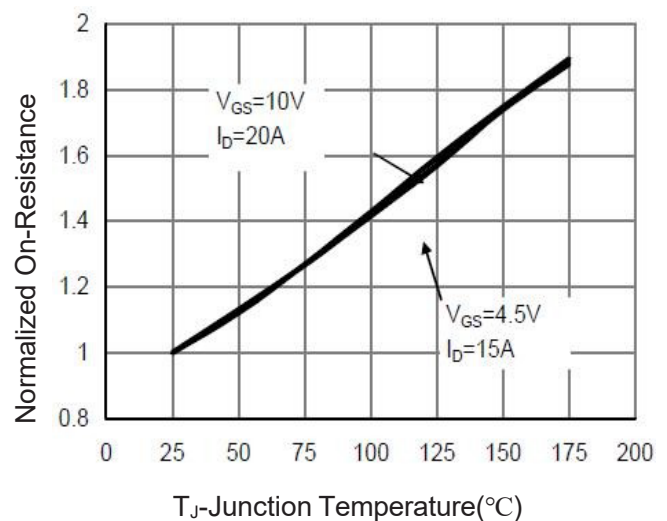
**Figure 3 Output Characteristics**



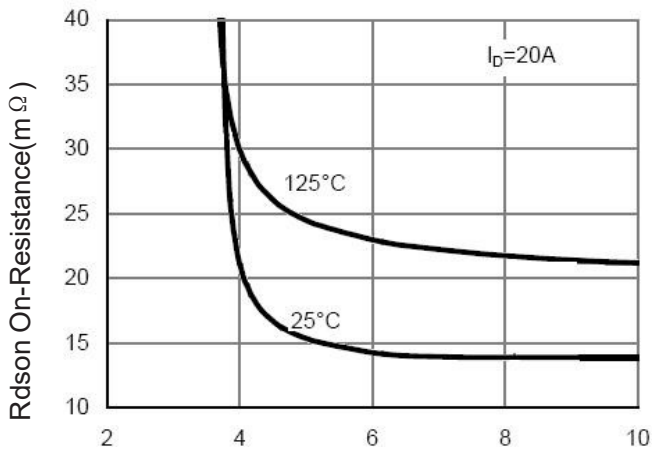
**Figure 4 Transfer Characteristics**



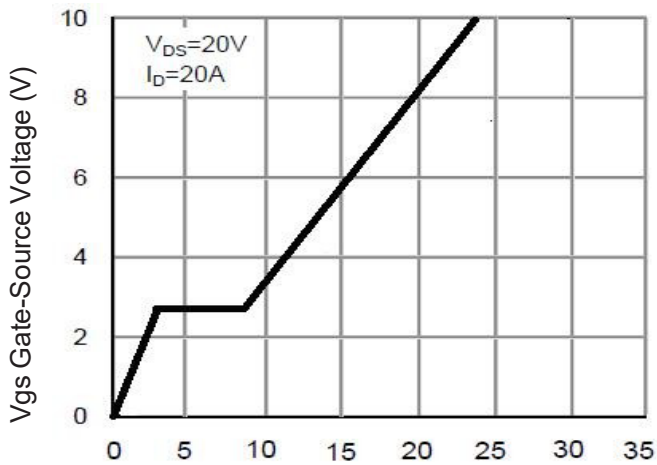
**Figure 5 Drain-Source On-Resistance**



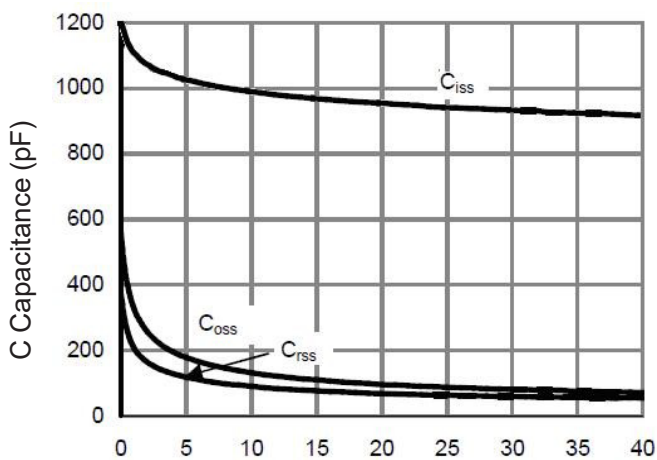
**Figure 6 Drain-Source On-Resistance**



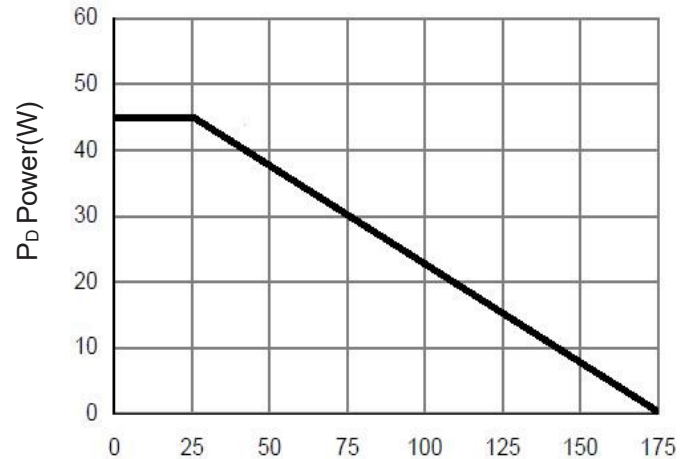
Vgs Gate-Source Voltage (V)

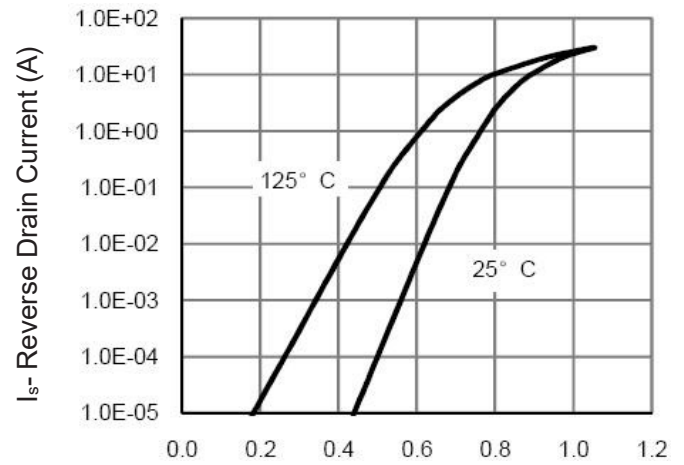
**Figure7 Rdson vs Vgs**


Qg Gate Charge (nC)

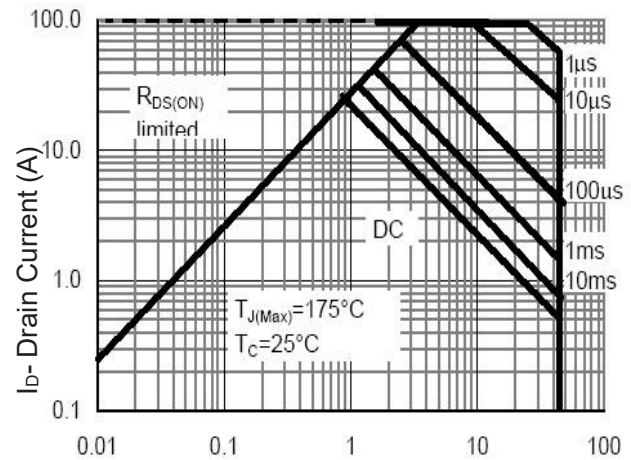
**Figure 9 Gate Charge**


Vds Drain-Source Voltage (V)

**Figure 11 Capacitance vs Vds**

T<sub>J</sub>-Junction Temperature(°C)

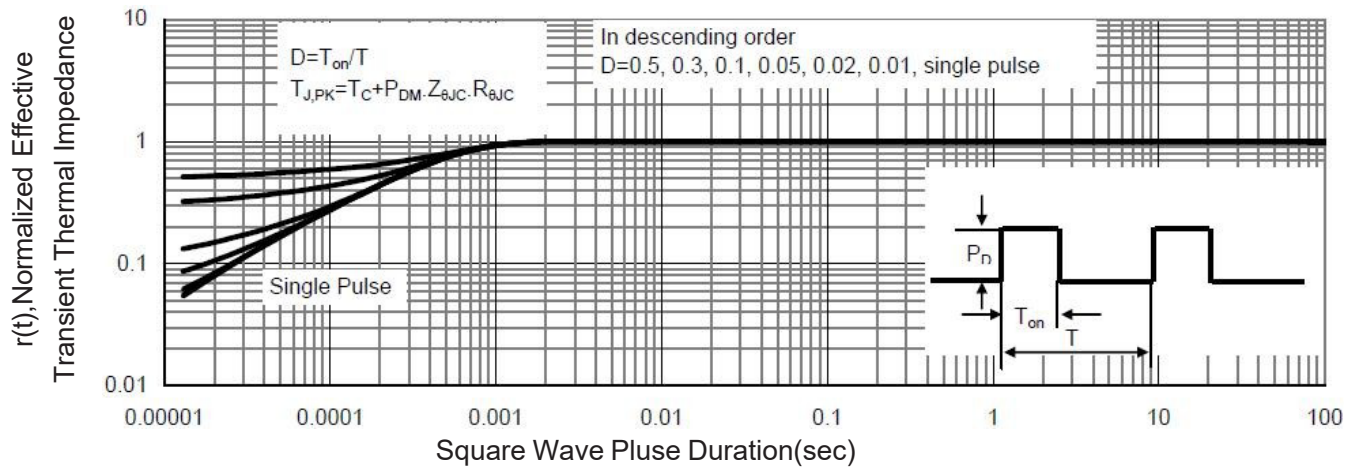
**Figure 8 Power Dissipation**


Vds Drain-Source Voltage (V)

**Figure 10 Source- Drain Diode Forward**


Vds Drain-Source Voltage (V)

**Figure 12 Safe Operation Area**



**Figure 13 Normalized Maximum Transient Thermal Impedance**