

**Features**

- Low Gate Charge
- 100% UIS Tested, 100%  $R_g$  Tested
- Pb-free Lead Plating
- Halogen-free and RoHS-compliant

**Applications**

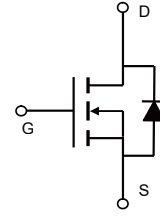
- Power Management in Telecom., Industrial Automation, CE
- Current Switching in DC/DC & AC/DC Sub-systems
- Motor Driving in Power Tool, E-vehicle, Robotics

**Product Summary**

| Parameter                                | Value | Unit       |
|------------------------------------------|-------|------------|
| $V_{DS}$                                 | 100   | V          |
| $V_{GS(th)}_{Typ}$                       | 1.9   | V          |
| $I_D$ (@ $V_{GS} = 10V$ ) <sup>(1)</sup> | 40    | A          |
| $R_{DS(ON)}_{Typ}$ (@ $V_{GS} = 10V$ )   | 14.0  | m $\Omega$ |
| $R_{DS(ON)}_{Typ}$ (@ $V_{GS} = 4.5V$ )  | 18.5  | m $\Omega$ |



TO-252



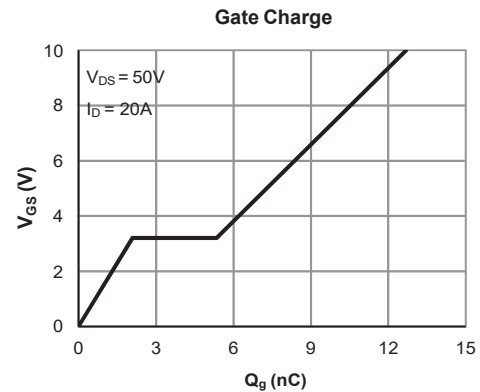
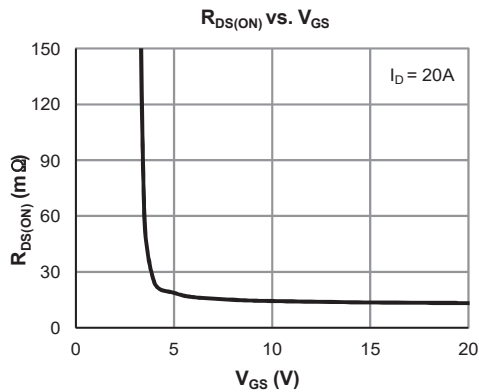
Schematic

**Ordering Information**

| Device      | Package | # of Pins | Marking  | MSL | $T_J$ (°C) | Media        | Quantity (pcs) |
|-------------|---------|-----------|----------|-----|------------|--------------|----------------|
| VSM40N10-T2 | TO-252  | 3         | VSM40N10 | 1   | -55 to 150 | 13-inch Reel | 2500           |

**Absolute Maximum Ratings** (@  $T_A = 25^\circ\text{C}$  unless otherwise specified)

| Parameter                               | Symbol         | Value      | Unit |
|-----------------------------------------|----------------|------------|------|
| Drain-to-Source Voltage                 | $V_{DS}$       | 100        | V    |
| Gate-to-Source Voltage                  | $V_{GS}$       | $\pm 20$   | V    |
| Continuous Drain Current <sup>(1)</sup> | $I_D$          | 40         | A    |
| $T_C = 25^\circ\text{C}$                |                | 25         |      |
| $T_C = 100^\circ\text{C}$               |                |            |      |
| Pulsed Drain Current <sup>(2)</sup>     | $I_{DM}$       | 116        | A    |
| Avalanche Current <sup>(3)</sup>        | $I_{AS}$       | 22         | A    |
| Avalanche Energy <sup>(3)</sup>         | $E_{AS}$       | 24         | mJ   |
| Power Dissipation <sup>(4)</sup>        | $P_D$          | 52         | W    |
| $T_C = 25^\circ\text{C}$                |                | 21         |      |
| $T_C = 100^\circ\text{C}$               |                |            |      |
| Junction & Storage Temperature Range    | $T_J, T_{STG}$ | -55 to 150 | °C   |



**Electrical Characteristics** (@  $T_J = 25^\circ\text{C}$  unless otherwise specified)

| Parameter                         | Symbol        | Conditions                                       | Min. | Typ. | Max.      | Unit             |
|-----------------------------------|---------------|--------------------------------------------------|------|------|-----------|------------------|
| <b>STATIC PARAMETERS</b>          |               |                                                  |      |      |           |                  |
| Drain-Source Breakdown Voltage    | $V_{(BR)DSS}$ | $I_D = 250\ \mu\text{A}$ , $V_{GS} = 0\text{V}$  | 100  |      |           | V                |
| Zero Gate Voltage Drain Current   | $I_{DSS}$     | $V_{DS} = 80\text{V}$ , $V_{GS} = 0\text{V}$     |      |      | 1.0       | $\mu\text{A}$    |
|                                   |               | $T_J = 55^\circ\text{C}$                         |      |      | 5.0       |                  |
| Gate-Body Leakage Current         | $I_{GSS}$     | $V_{DS} = 0\text{V}$ , $V_{GS} = \pm 20\text{V}$ |      |      | $\pm 100$ | nA               |
| Gate Threshold Voltage            | $V_{GS(th)}$  | $V_{DS} = V_{GS}$ , $I_D = 250\ \mu\text{A}$     | 1.2  | 1.9  | 2.5       | V                |
| Static Drain-Source ON-Resistance | $R_{DS(on)}$  | $V_{GS} = 10\text{V}$ , $I_D = 10\text{A}$       |      | 14.0 | 17.0      | $\text{m}\Omega$ |
|                                   |               | $V_{GS} = 4.5\text{V}$ , $I_D = 6\text{A}$       |      | 18.5 | 23        | $\text{m}\Omega$ |
| Forward Transconductance          | $g_{FS}$      | $V_{DS} = 5\text{V}$ , $I_D = 20\text{A}$        |      | 48   |           | S                |
| Diode Forward Voltage             | $V_{SD}$      | $I_S = 1\text{A}$ , $V_{GS} = 0\text{V}$         |      | 0.7  | 1.0       | V                |
| Diode Continuous Current          | $I_S$         | $T_C = 25^\circ\text{C}$                         |      |      | 52        | A                |

**DYNAMIC PARAMETERS** <sup>(5)</sup>

|                              |           |                                                                  |  |     |  |          |
|------------------------------|-----------|------------------------------------------------------------------|--|-----|--|----------|
| Input Capacitance            | $C_{iss}$ | $V_{GS} = 0\text{V}$ , $V_{DS} = 50\text{V}$ , $f = 1\text{MHz}$ |  | 769 |  | pF       |
| Output Capacitance           | $C_{oss}$ |                                                                  |  | 171 |  | pF       |
| Reverse Transfer Capacitance | $C_{rss}$ |                                                                  |  | 5.1 |  | pF       |
| Gate Resistance              | $R_g$     | $V_{GS} = 0\text{V}$ , $V_{DS} = 0\text{V}$ , $f = 1\text{MHz}$  |  | 1.9 |  | $\Omega$ |

**SWITCHING PARAMETERS** <sup>(5)</sup>

|                                               |              |                                                                                              |  |      |  |    |
|-----------------------------------------------|--------------|----------------------------------------------------------------------------------------------|--|------|--|----|
| Total Gate Charge (@ $V_{GS} = 10\text{V}$ )  | $Q_g$        | $V_{GS} = 0$ to $10\text{V}$<br>$V_{DS} = 50\text{V}$ , $I_D = 10\text{A}$                   |  | 12.7 |  | nC |
| Total Gate Charge (@ $V_{GS} = 6.0\text{V}$ ) | $Q_g$        |                                                                                              |  | 6.7  |  | nC |
| Gate Source Charge                            | $Q_{gs}$     |                                                                                              |  | 2.1  |  | nC |
| Gate Drain Charge                             | $Q_{gd}$     |                                                                                              |  | 3.3  |  | nC |
| Turn-On Delay Time                            | $t_{D(on)}$  | $V_{GS} = 10\text{V}$ , $V_{DS} = 50\text{V}$<br>$R_L = 2.5\ \Omega$ , $R_{GEN} = 6\ \Omega$ |  | 4.3  |  | ns |
| Turn-On Rise Time                             | $t_r$        |                                                                                              |  | 5.1  |  | ns |
| Turn-Off Delay Time                           | $t_{D(off)}$ |                                                                                              |  | 16.7 |  | ns |
| Turn-Off Fall Time                            | $t_f$        |                                                                                              |  | 8.7  |  | ns |
| Body Diode Reverse Recovery Time              | $t_{rr}$     | $I_F = 15\text{A}$ , $dI_F/dt = 100\text{A}/\mu\text{s}$                                     |  | 39   |  | ns |
| Body Diode Reverse Recovery Charge            | $Q_{rr}$     | $I_F = 15\text{A}$ , $dI_F/dt = 100\text{A}/\mu\text{s}$                                     |  | 30   |  | nC |

**Thermal Performance**

| Parameter                               | Symbol   | Typ. | Max. | Unit                      |
|-----------------------------------------|----------|------|------|---------------------------|
| Thermal Resistance, Junction-to-Ambient | $R_{JA}$ | 42   | 50   | $^\circ\text{C}/\text{W}$ |
| Thermal Resistance, Junction-to-Case    | $R_{JC}$ | 1.8  | 2.4  | $^\circ\text{C}/\text{W}$ |

**Notes:**

1. Computed continuous current assumes the condition of  $T_{J\_Max}$  while the actual continuous current depends on the thermal & electro-mechanical application board design.
2. This single-pulse measurement was taken under  $T_{J\_Max} = 150^\circ\text{C}$ .
3. This single-pulse measurement was taken under the following condition [ $L = 100\ \mu\text{H}$ ,  $V_{GS} = 10\text{V}$ ,  $V_{DD} = 50\text{V}$ ] while its value is limited by  $T_{J\_Max} = 150^\circ\text{C}$ .
4. The power dissipation  $P_D$  is based on  $T_{J\_Max} = 150^\circ\text{C}$ .
5. This value is guaranteed by design hence it is not included in the production test.

### Typical Electrical & Thermal Characteristics

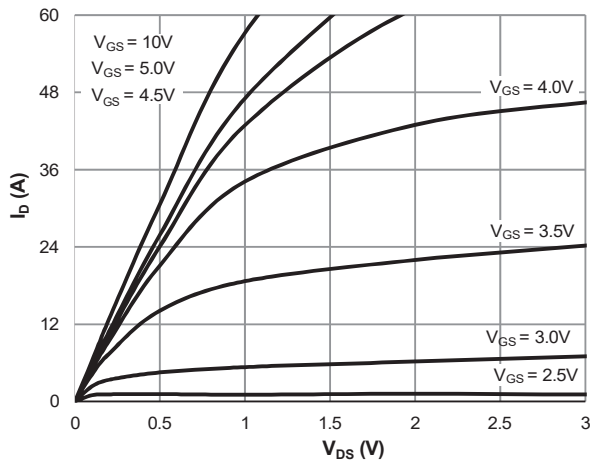


Figure 1: Saturation Characteristics

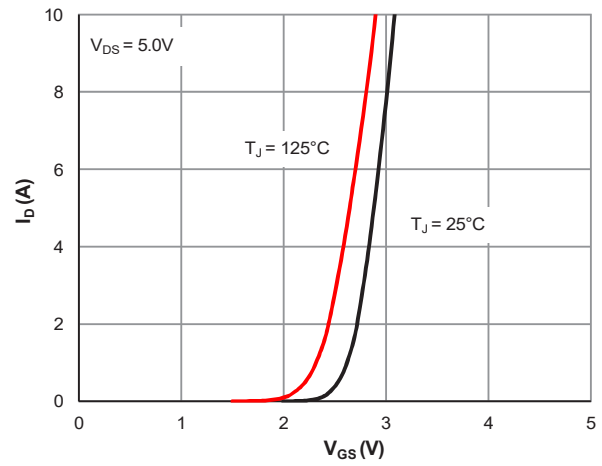


Figure 2: Transfer Characteristics

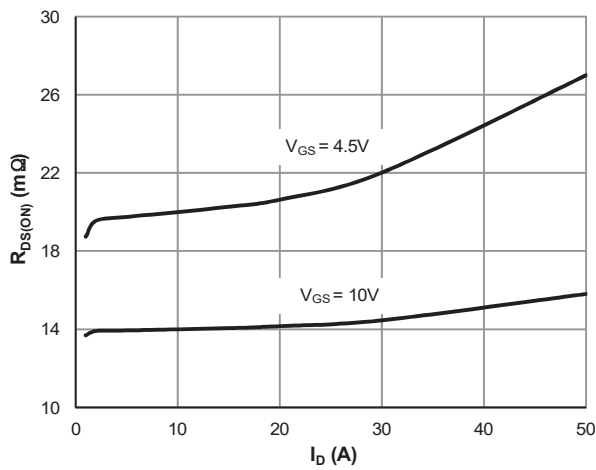


Figure 3:  $R_{DS(ON)}$  vs. Drain Current

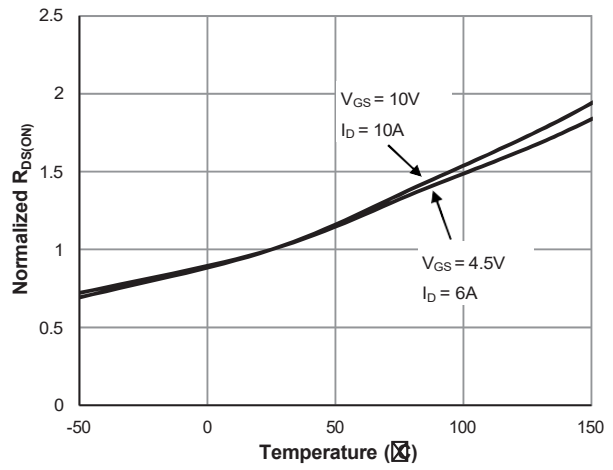


Figure 4:  $R_{DS(ON)}$  vs. Junction Temperature

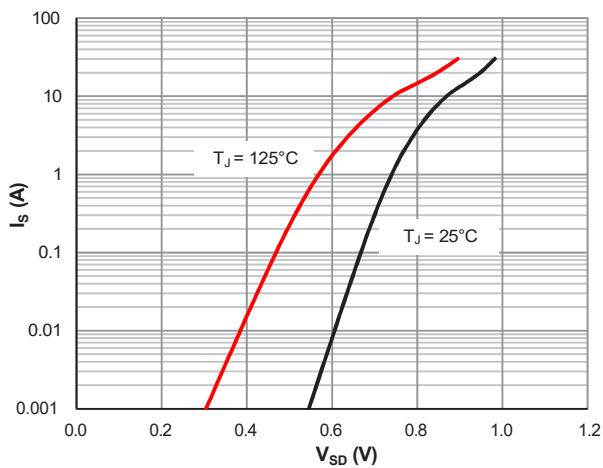


Figure 5: Body-Diode Characteristics

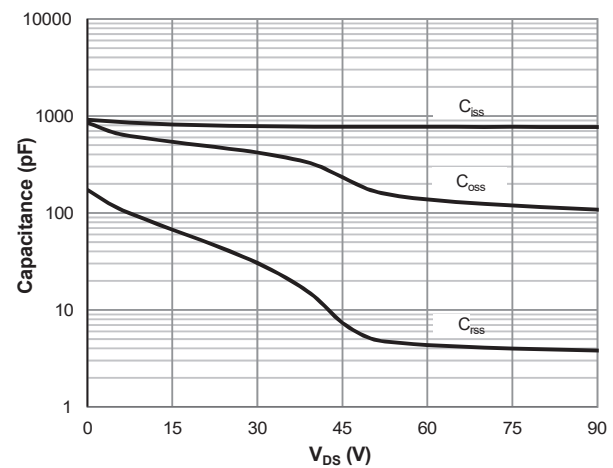


Figure 6: Capacitance Characteristics

### Typical Electrical & Thermal Characteristics

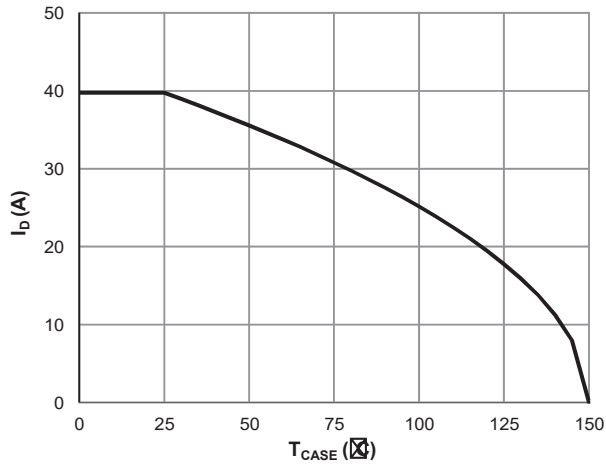


Figure 7: Current De-rating

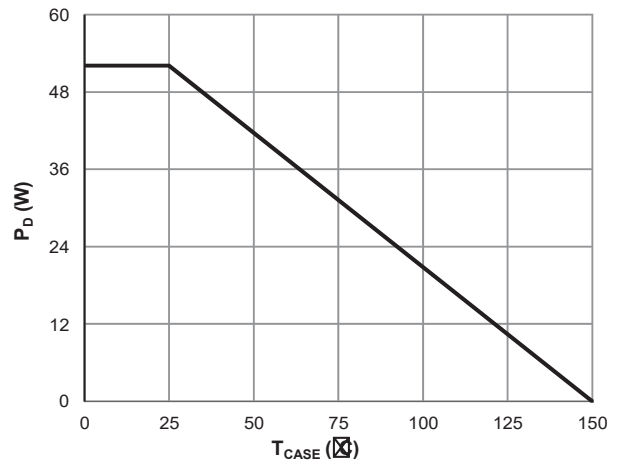


Figure 8: Power De-rating

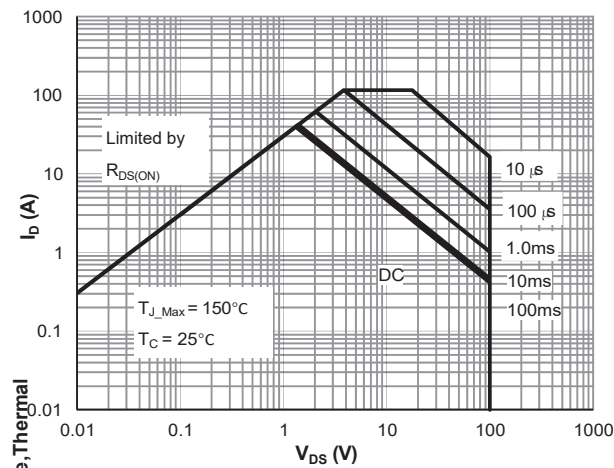


Figure 9: Maximum Safe Operating Area

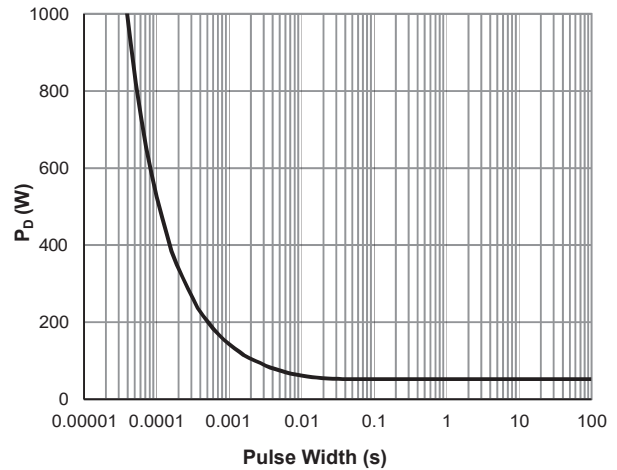


Figure 10: Single Pulse Power Rating, Junction-to-Case

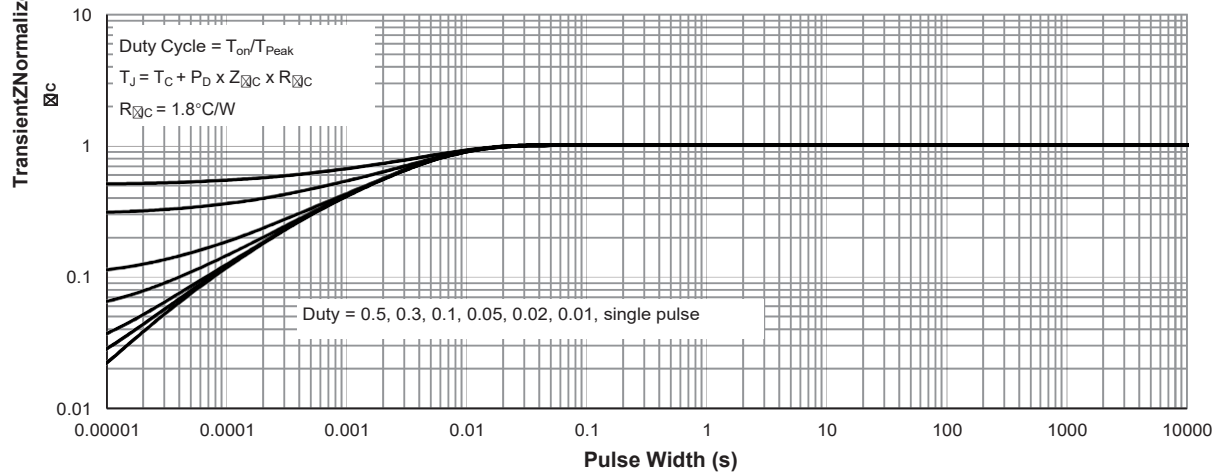


Figure 11: Normalized Maximum Transient Thermal Impedance