

**Features**

- Ultra-low  $R_{DS(ON)}$
- Low Gate Charge
- 100% UIS Tested, 100%  $R_g$  Tested
- Pb-free Lead Plating
- Halogen-free and RoHS-compliant

**Applications**

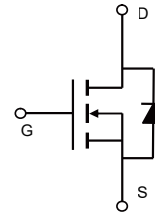
- Motor Driving in Power Tool, E-vehicle, Robotics
- Current Switching in DC/DC & AC/DC (SR) Sub-systems
- Power Management in Telecom., Industrial Automation, CE

**Product Summary**

| Parameter                                | Value | Unit       |
|------------------------------------------|-------|------------|
| $V_{DS}$                                 | 100   | V          |
| $V_{GS(th)}$                             | 3.0   | V          |
| $I_D$ (@ $V_{GS} = 10V$ ) <sup>(1)</sup> | 143   | A          |
| $R_{DS(ON)}$ (@ $V_{GS} = 10V$ )         | 4.1   | m $\Omega$ |



TO-220



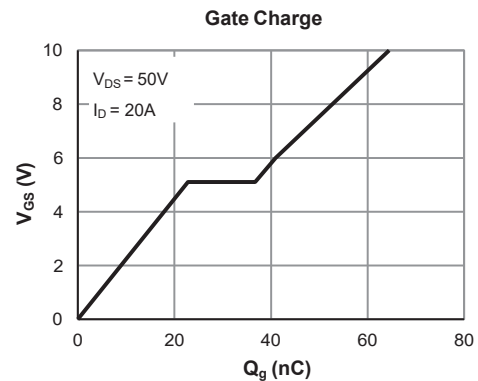
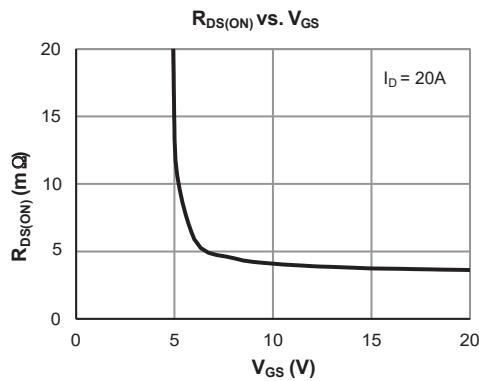
Schematic

**Ordering Information**

| Device       | Package | # of Pins | Marking   | MSL | $T_J$ (°C) | Media | Quantity (pcs) |
|--------------|---------|-----------|-----------|-----|------------|-------|----------------|
| VSM143N10-TC | TO-220  | 3         | VSM143N10 | N/A | -55 to 150 | Tube  | 50             |

**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> | $I_D$          | 143        | A    |
|                                         |                | 90         | A    |
| Pulsed Drain Current <sup>(2)</sup>     | $I_{DM}$       | 572        | A    |
| Avalanche Energy <sup>(3)</sup>         | $E_{AS}$       | 600        | mJ   |
| Power Dissipation <sup>(4)</sup>        | $P_D$          | 192        | W    |
|                                         |                | 76         | W    |
| 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   | $I_{DSS}$     | $V_{DS} = 80\text{V}$ , $V_{GS} = 0\text{V}$<br>$T_J = 55^\circ\text{C}$ |      |      | 1.0<br>5.0 | $\mu\text{A}$    |
| Gate-Body Leakage Current         | $I_{GSS}$     | $V_{DS} = 0\text{V}$ , $V_{GS} = \pm 20\text{V}$                         |      |      | $\pm 100$  | nA               |
| Gate Threshold Voltage            | $V_{GS(th)}$  | $V_{DS} = V_{GS}$ , $I_D = 250\ \mu\text{A}$                             | 2.0  | 3.0  | 4.0        | V                |
| Static Drain-Source ON-Resistance | $R_{DS(ON)}$  | $V_{GS} = 10\text{V}$ , $I_D = 20\text{A}$                               |      | 4.1  | 4.8        | $\text{m}\Omega$ |
|                                   |               | TO-263-3L<br>TO-220-3L                                                   |      | 4.3  | 4.9        | $\text{m}\Omega$ |
| Forward Transconductance          | $g_{FS}$      | $V_{DS} = 5\text{V}$ , $I_D = 20\text{A}$                                |      | 44   |            | S                |
| Diode Forward Voltage             | $V_{SD}$      | $I_S = 1\text{A}$ , $V_{GS} = 0\text{V}$                                 |      | 0.66 | 1.0        | V                |
| Diode Continuous Current          | $I_S$         | $T_C = 25^\circ\text{C}$                                                 |      |      | 143        | A                |

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

|                              |           |                                                                  |  |      |  |          |
|------------------------------|-----------|------------------------------------------------------------------|--|------|--|----------|
| Input Capacitance            | $C_{iss}$ | $V_{GS} = 0\text{V}$ , $V_{DS} = 50\text{V}$ , $f = 1\text{MHz}$ |  | 4335 |  | pF       |
| Output Capacitance           | $C_{oss}$ |                                                                  |  | 678  |  | pF       |
| Reverse Transfer Capacitance | $C_{rss}$ |                                                                  |  | 20.9 |  | pF       |
| Gate Resistance              | $R_g$     | $V_{GS} = 0\text{V}$ , $V_{DS} = 0\text{V}$ , $f = 1\text{MHz}$  |  | 2.0  |  | $\Omega$ |

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

|                                               |              |                                                                                              |  |      |  |    |
|-----------------------------------------------|--------------|----------------------------------------------------------------------------------------------|--|------|--|----|
| Total Gate Charge (@ $V_{GS} = 10\text{V}$ )  | $Q_g$        | $V_{GS} = 0$ to $10\text{V}$<br>$V_{DS} = 50\text{V}$ , $I_D = 20\text{A}$                   |  | 64   |  | nC |
| Total Gate Charge (@ $V_{GS} = 6.0\text{V}$ ) | $Q_g$        |                                                                                              |  | 41   |  | nC |
| Gate Source Charge                            | $Q_{gs}$     |                                                                                              |  | 23   |  | nC |
| Gate Drain Charge                             | $Q_{gd}$     |                                                                                              |  | 13.9 |  | nC |
| Turn-On DelayTime                             | $t_{D(on)}$  | $V_{GS} = 10\text{V}$ , $V_{DS} = 50\text{V}$<br>$R_L = 2.5\ \Omega$ , $R_{GEN} = 3\ \Omega$ |  | 16.7 |  | ns |
| Turn-On Rise Time                             | $t_r$        |                                                                                              |  | 21   |  | ns |
| Turn-Off DelayTime                            | $t_{D(off)}$ |                                                                                              |  | 37   |  | ns |
| Turn-Off Fall Time                            | $t_f$        |                                                                                              |  | 15.6 |  | ns |
| Body Diode Reverse Recovery Time              | $t_{rr}$     | $I_F = 20\text{A}$ , $dI_F/dt = 100\text{A}/\mu\text{s}$                                     |  | 66   |  | ns |
| Body Diode Reverse Recovery Charge            | $Q_{rr}$     | $I_F = 20\text{A}$ , $dI_F/dt = 100\text{A}/\mu\text{s}$                                     |  | 136  |  | nC |

**Thermal Performance**

| Parameter                               | Symbol   | Typ. | Max. | Unit                      |
|-----------------------------------------|----------|------|------|---------------------------|
| Thermal Resistance, Junction-to-Ambient | $R_{JA}$ | 45   | 55   | $^\circ\text{C}/\text{W}$ |
| Thermal Resistance, Junction-to-Case    | $R_{JC}$ | 0.65 | 0.80 | $^\circ\text{C}/\text{W}$ |

**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.  $E_{AS}$  of 600 mJ is based on starting  $T_J = 25^\circ\text{C}$ ,  $L = 3.0\text{mH}$ ,  $I_{AS} = 20\text{A}$ ,  $V_{GS} = 10\text{V}$ ,  $V_{DD} = 50\text{V}$ ; 100% test at  $L = 0.1\text{mH}$ ,  $I_{AS} = 69\text{A}$ .
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

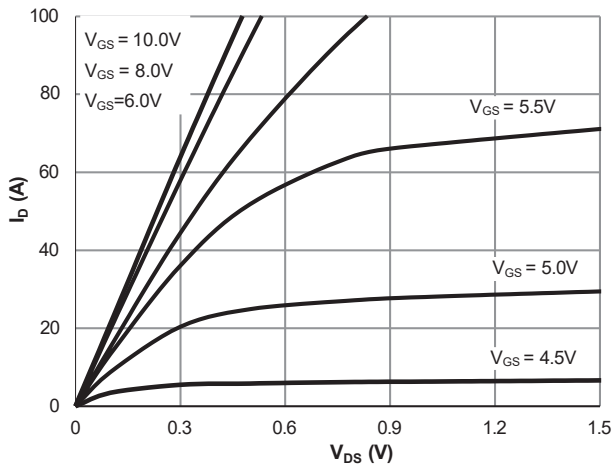


Figure 1: Saturation Characteristics

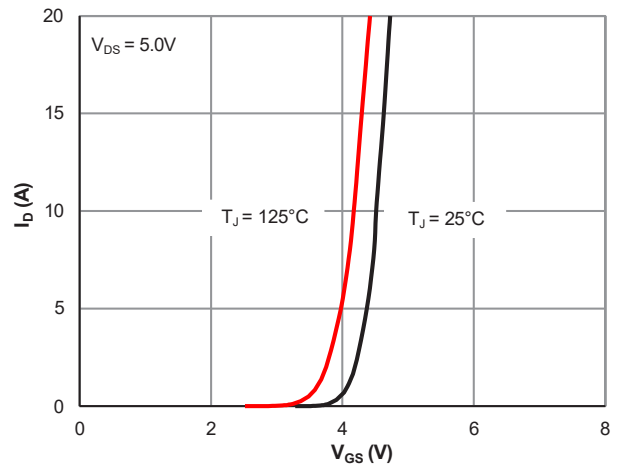


Figure 2: Transfer Characteristics

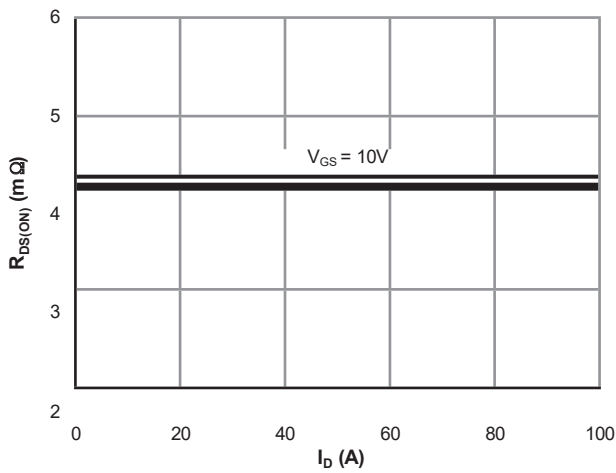


Figure 3:  $R_{DS(on)}$  vs. Drain Current

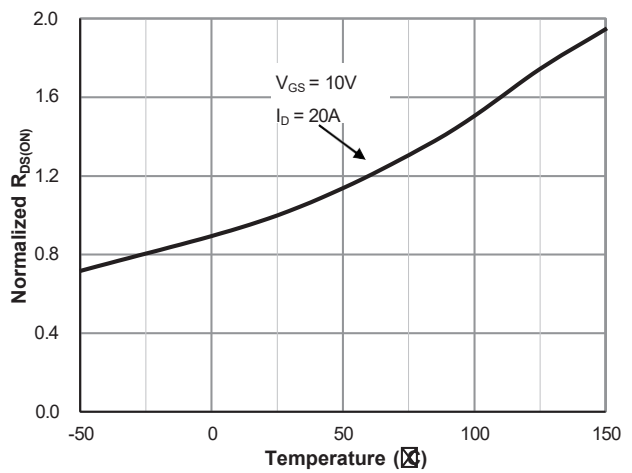


Figure 4:  $R_{DS(on)}$  vs. Junction Temperature

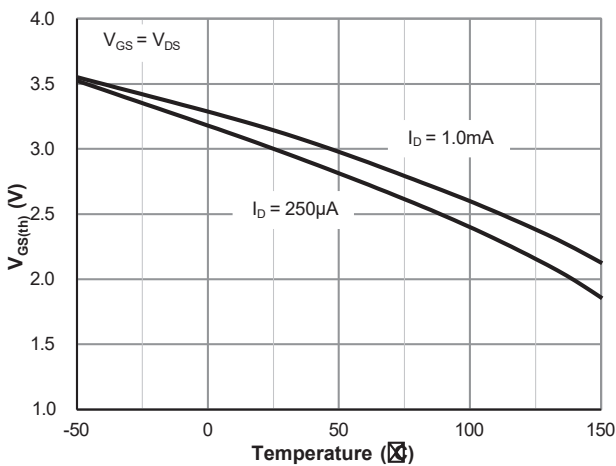


Figure 5:  $V_{GS(th)}$  vs. Junction Temperature

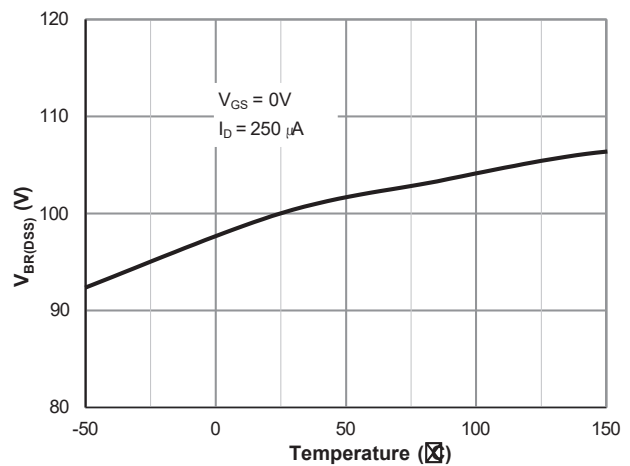


Figure 6:  $V_{BR(DSS)}$  vs. Junction Temperature

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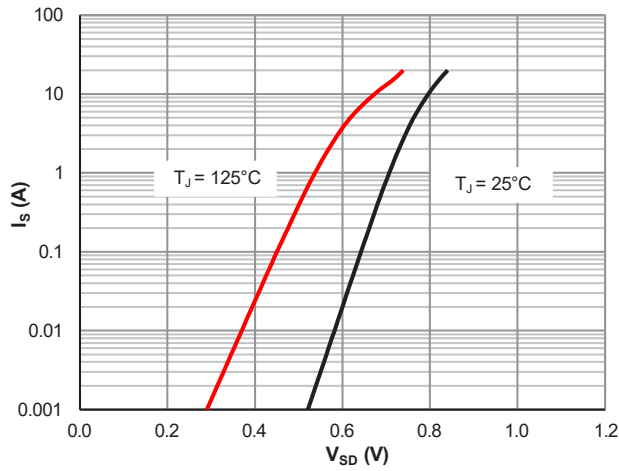


Figure 7: Body-Diode Characteristics

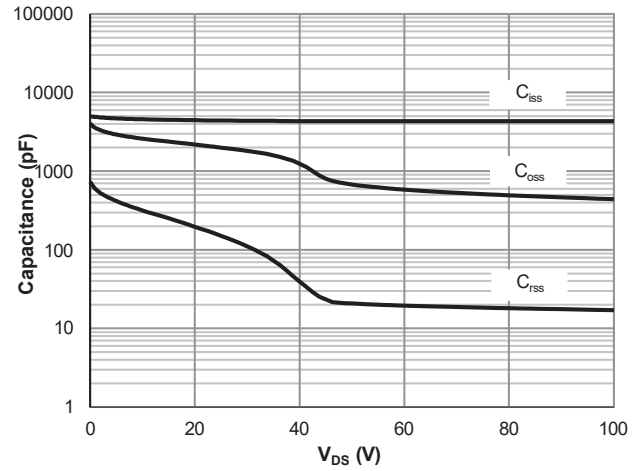


Figure 8: Capacitance Characteristics

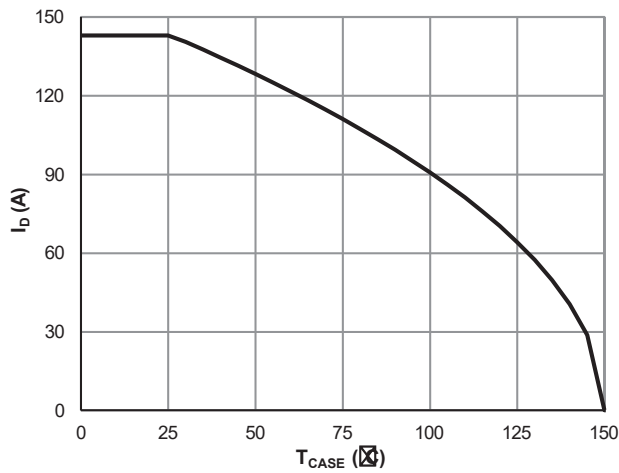


Figure 9: Current De-rating

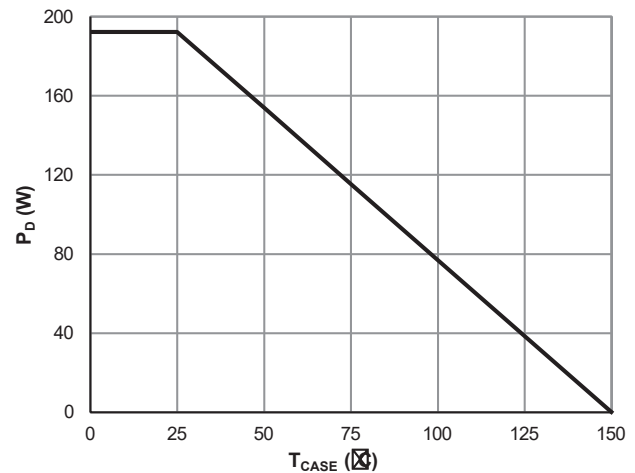


Figure 10: Power De-rating

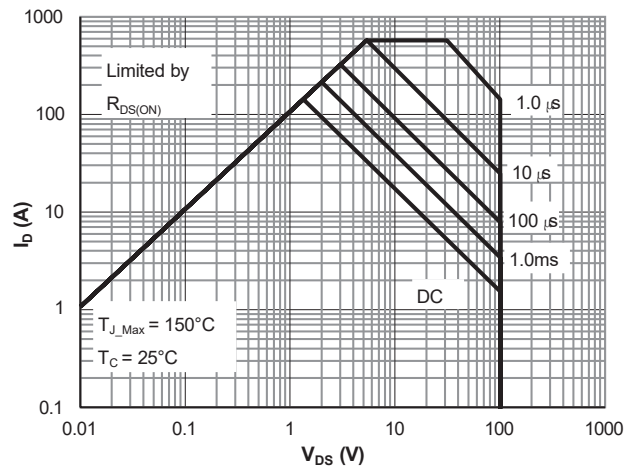


Figure 11: Maximum Safe Operating Area

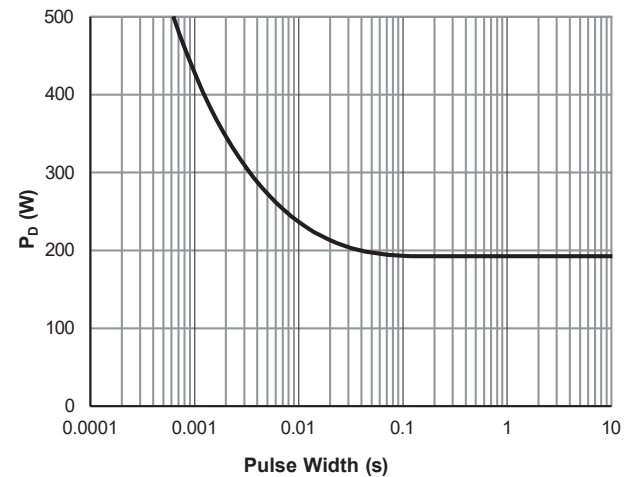


Figure 12: Single Pulse Power Rating, Junction-to-Case

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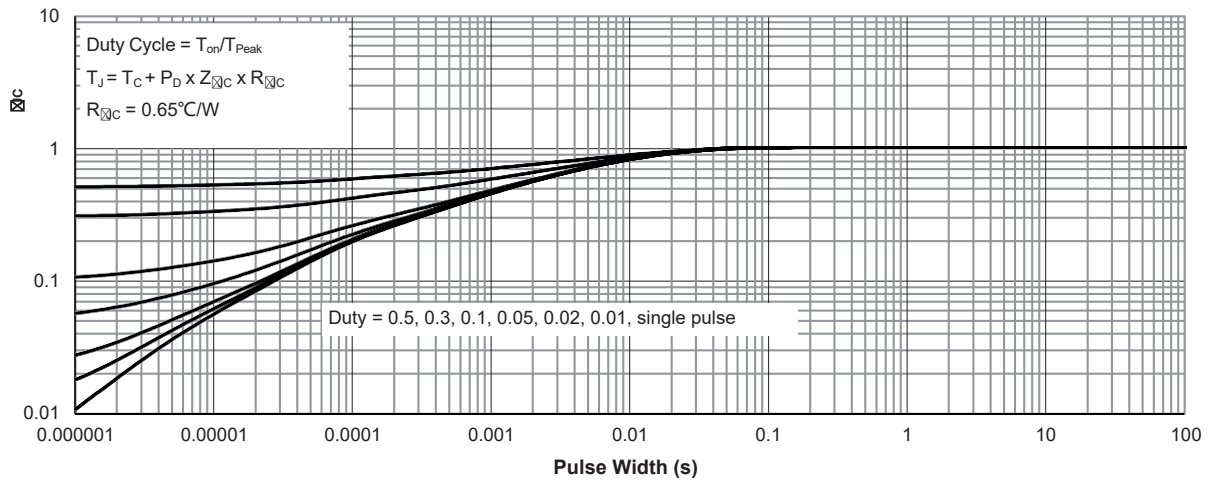


Figure 13: Normalized Maximum Transient Thermal Impedance