

**Features**

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

**Applications**

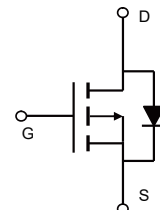
- LED Back-lighting Application
- DC/DC Power Management
- High Side Switch for Full Bridge Converter

**Product Summary**

| Parameter                                 | Value | Unit       |
|-------------------------------------------|-------|------------|
| $V_{DS}$                                  | -60   | V          |
| $V_{GS(th\_Typ)}$                         | -2.0  | V          |
| $I_D$ (@ $V_{GS} = -10V$ ) <sup>(1)</sup> | -24   | A          |
| $R_{DS(ON\_Typ)}$ (@ $V_{GS} = -10V$ )    | 40    | m $\Omega$ |
| $R_{DS(ON\_Typ)}$ (@ $V_{GS} = -4.5V$ )   | 55    | m $\Omega$ |



DFN5x6



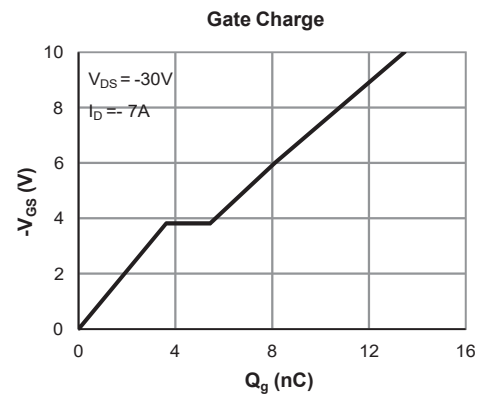
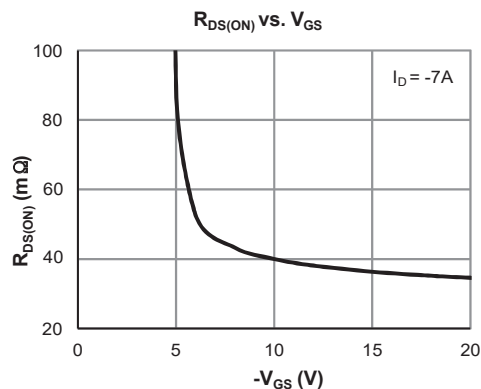
Schematic

**Ordering Information**

| Device       | Package | # of Pins | Marking  | MSL | $T_J$ (°C) | Media        | Quantity (pcs) |
|--------------|---------|-----------|----------|-----|------------|--------------|----------------|
| VSM24P06-D56 | DFN5x6  | 8         | VSM24P06 | 1   | -55 to 150 | 13-inch Reel | 5000           |

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

| Parameter                               | Symbol         | Value                     | Unit |
|-----------------------------------------|----------------|---------------------------|------|
| Drain-to-Source Voltage                 | $V_{DS}$       | -60                       | V    |
| Gate-to-Source Voltage                  | $V_{GS}$       | $\pm 20$                  | V    |
| Continuous Drain Current <sup>(1)</sup> | $I_D$          | $T_C = 25^\circ\text{C}$  | -24  |
|                                         |                | $T_C = 100^\circ\text{C}$ | -15  |
| Pulsed Drain Current <sup>(2)</sup>     | $I_{DM}$       | -96                       | A    |
| Avalanche Energy <sup>(3)</sup>         | $E_{AS}$       | 75                        | mJ   |
| Power Dissipation <sup>(4)</sup>        | $P_D$          | $T_C = 25^\circ\text{C}$  | 50   |
|                                         |                | $T_C = 100^\circ\text{C}$ | 20   |
| 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    | $V_{(BR)DSS}$ | $I_D = -250\ \mu\text{A}$ , $V_{GS} = 0\text{V}$                          | -60  |       |              | V                |
| Zero Gate Voltage Drain Current   | $I_{DSS}$     | $V_{DS} = -48\text{V}$ , $V_{GS} = 0\text{V}$<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            | $V_{GS(th)}$  | $V_{DS} = V_{GS}$ , $I_D = -250\ \mu\text{A}$                             | -1.0 | -2.0  | -3.0         | V                |
| Static Drain-Source ON-Resistance | $R_{DS(on)}$  | $V_{GS} = -10\text{V}$ , $I_D = -7\text{A}$                               |      | 40    | 50           | $\text{m}\Omega$ |
|                                   |               | $V_{GS} = -4.5\text{V}$ , $I_D = -5\text{A}$                              |      | 55    | 72           | $\text{m}\Omega$ |
| Forward Transconductance          | $g_{FS}$      | $V_{DS} = -5\text{V}$ , $I_D = -7\text{A}$                                |      | 20    |              | S                |
| Diode Forward Voltage             | $V_{SD}$      | $I_S = -1\text{A}$ , $V_{GS} = 0\text{V}$                                 |      | -0.77 | -1.0         | V                |
| Diode Continuous Current          | $I_S$         | $T_C = 25^\circ\text{C}$                                                  |      |       | -24          | A                |

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

|                              |           |                                                                   |  |     |  |          |
|------------------------------|-----------|-------------------------------------------------------------------|--|-----|--|----------|
| Input Capacitance            | $C_{iss}$ | $V_{GS} = 0\text{V}$ , $V_{DS} = -30\text{V}$ , $f = 1\text{MHz}$ |  | 855 |  | pF       |
| Output Capacitance           | $C_{oss}$ |                                                                   |  | 189 |  | pF       |
| Reverse Transfer Capacitance | $C_{rss}$ |                                                                   |  | 9.5 |  | pF       |
| Gate Resistance              | $R_g$     | $V_{GS} = 0\text{V}$ , $V_{DS} = 0\text{V}$ , $f = 1\text{MHz}$   |  | 9.8 |  | $\Omega$ |

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

|                                                |              |                                                                                                |  |      |  |    |
|------------------------------------------------|--------------|------------------------------------------------------------------------------------------------|--|------|--|----|
| Total Gate Charge (@ $V_{GS} = -10\text{V}$ )  | $Q_g$        | $V_{GS} = 0$ to $-10\text{V}$<br>$V_{DS} = -30\text{V}$ , $I_D = -7\text{A}$                   |  | 13.5 |  | nC |
| Total Gate Charge (@ $V_{GS} = -4.5\text{V}$ ) | $Q_g$        |                                                                                                |  | 6.4  |  | nC |
| Gate Source Charge                             | $Q_{gs}$     |                                                                                                |  | 3.6  |  | nC |
| Gate Drain Charge                              | $Q_{gd}$     |                                                                                                |  | 1.8  |  | nC |
| Turn-On Delay Time                             | $t_{D(on)}$  | $V_{GS} = -10\text{V}$ , $V_{DS} = -30\text{V}$<br>$R_L = 4.3\ \Omega$ , $R_{GEN} = 3\ \Omega$ |  | 5.4  |  | ns |
| Turn-On Rise Time                              | $t_r$        |                                                                                                |  | 1.9  |  | ns |
| Turn-Off Delay Time                            | $t_{D(off)}$ |                                                                                                |  | 23   |  | ns |
| Turn-Off Fall Time                             | $t_f$        |                                                                                                |  | 4.2  |  | ns |
| Body Diode Reverse Recovery Time               | $t_{rr}$     | $I_F = -7\text{A}$ , $dI_F/dt = -100\text{A}/\mu\text{s}$                                      |  | 27   |  | ns |
| Body Diode Reverse Recovery Charge             | $Q_{rr}$     | $I_F = -7\text{A}$ , $dI_F/dt = -100\text{A}/\mu\text{s}$                                      |  | 28   |  | nC |

**Thermal Performance**

| Parameter                               | Symbol   | Typ. | Max. | Unit                      |
|-----------------------------------------|----------|------|------|---------------------------|
| Thermal Resistance, Junction-to-Ambient | $R_{JA}$ | 60   | 69   | $^\circ\text{C}/\text{W}$ |
| Thermal Resistance, Junction-to-Case    | $R_{JC}$ | 2.5  | 2.9  | $^\circ\text{C}/\text{W}$ |

**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 75 mJ is based on starting  $T_J = 25^\circ\text{C}$ ,  $L = 3.0\text{mH}$ ,  $I_{AS} = -7.1\text{A}$ ,  $V_{GS} = -10\text{V}$ ,  $V_{DD} = -30\text{V}$ ; 100% test at  $L = 0.1\text{mH}$ ,  $I_{AS} = -25\text{A}$ ,  $T_{J\_Max} = 150^\circ\text{C}$ .
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

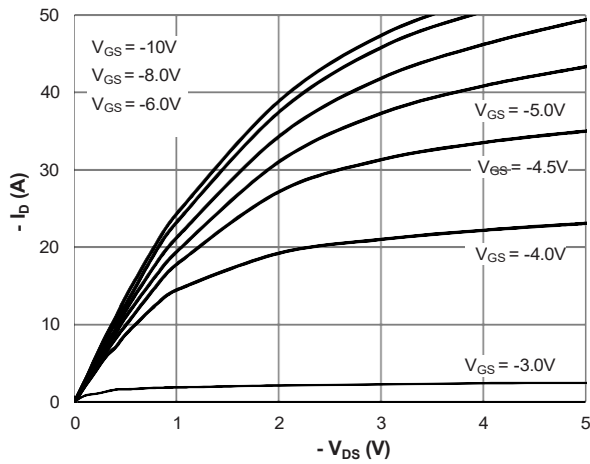


Figure 1: Saturation Characteristics

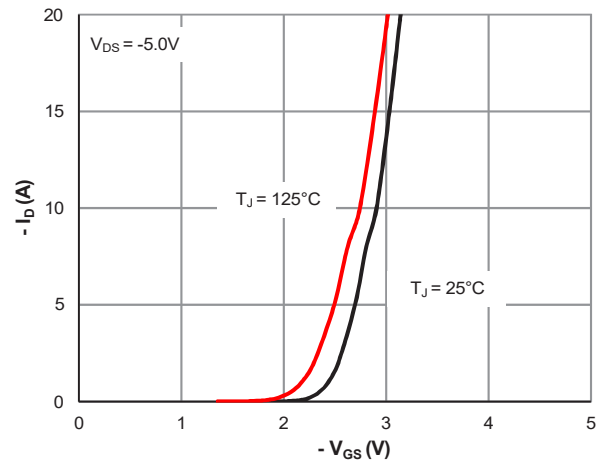


Figure 2: Transfer Characteristics

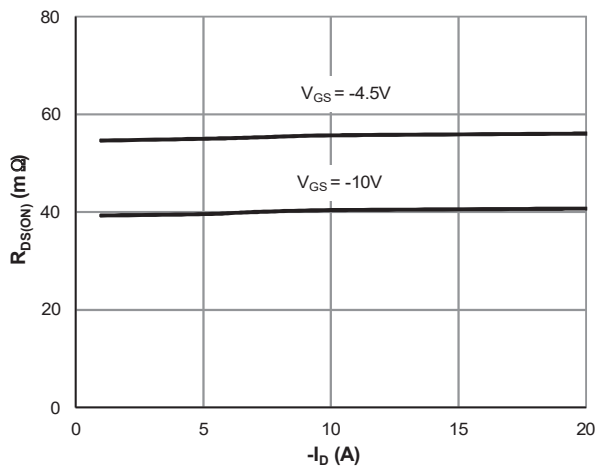


Figure 3:  $R_{DS(ON)}$  vs. Drain Current

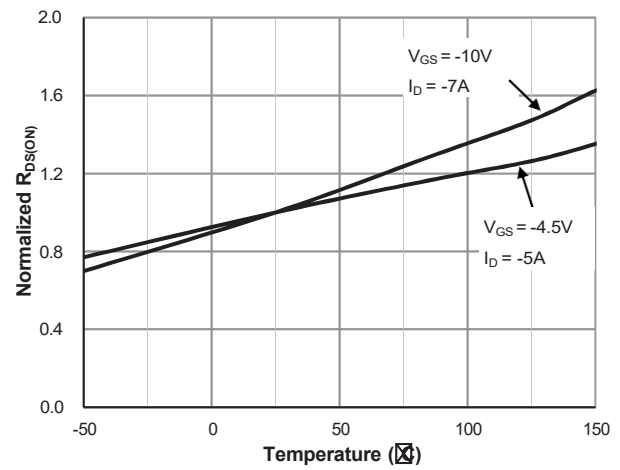


Figure 4:  $R_{DS(ON)}$  vs. Junction Temperature

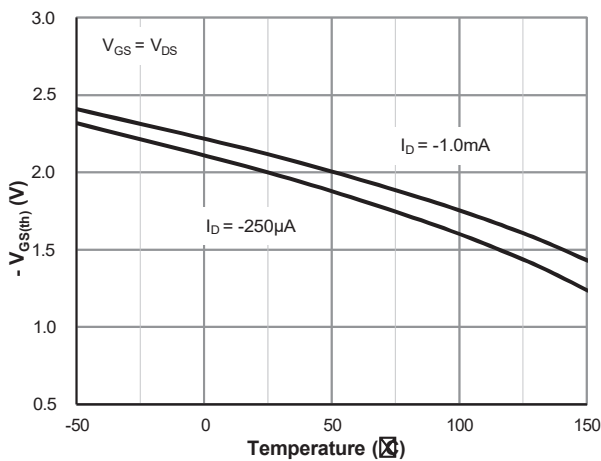


Figure 5:  $V_{GS(th)}$  vs. Junction Temperature

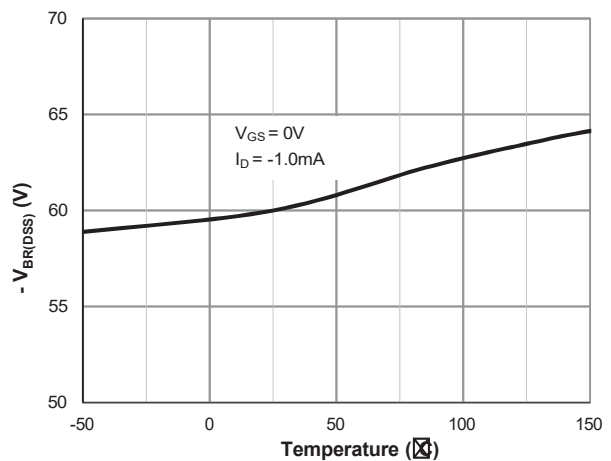


Figure 6:  $V_{BR(DSS)}$  vs. Junction Temperature

### Typical Electrical & Thermal Characteristics

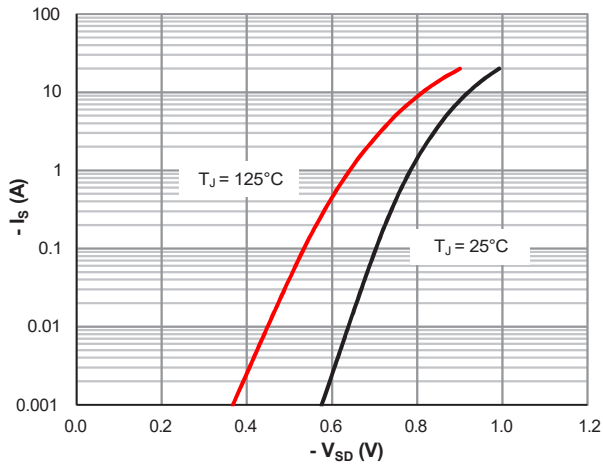


Figure 7: Body-Diode Characteristics

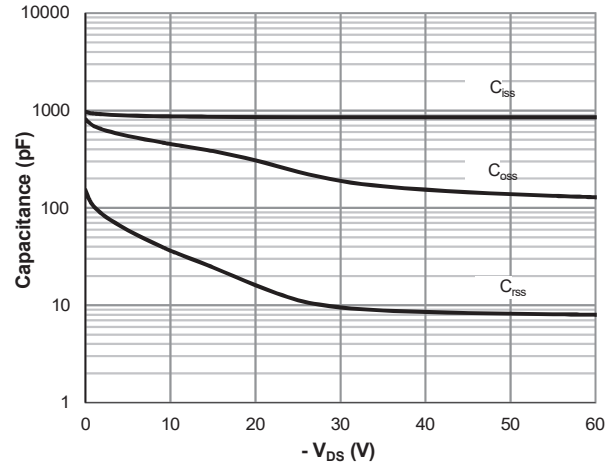


Figure 8: Capacitance Characteristics

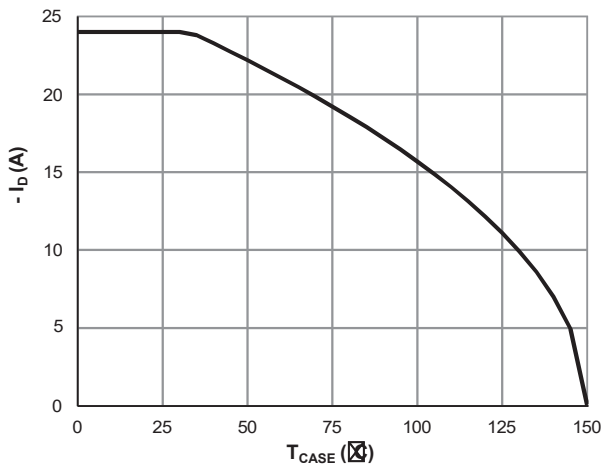


Figure 9: Current De-rating

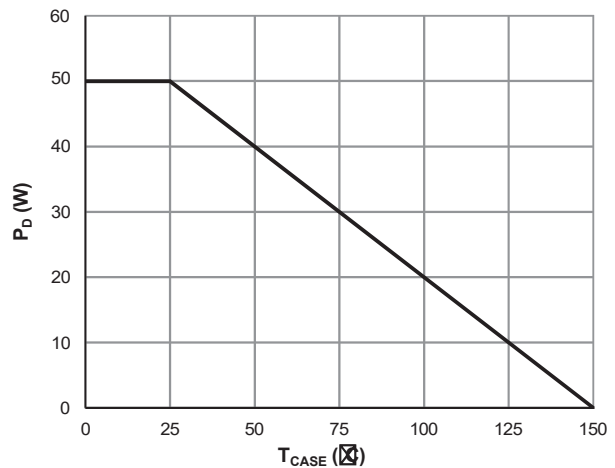


Figure 10: Power De-rating

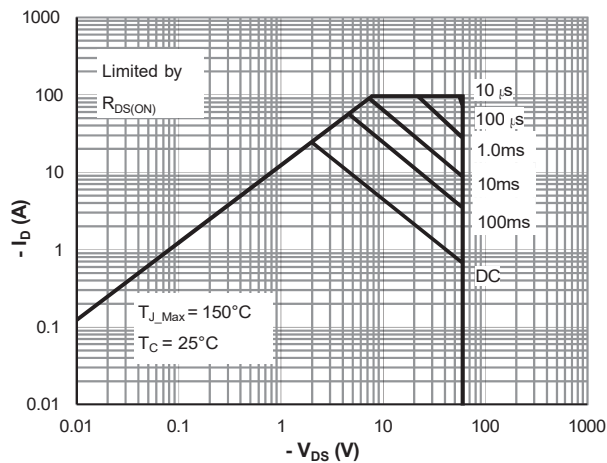


Figure 11: Maximum Safe Operating Area

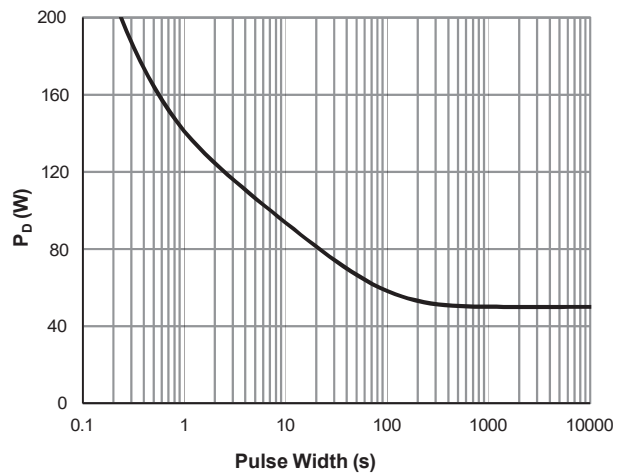


Figure 12: Single Pulse Power Rating, Junction-to-Case

### Typical Electrical & Thermal Characteristics

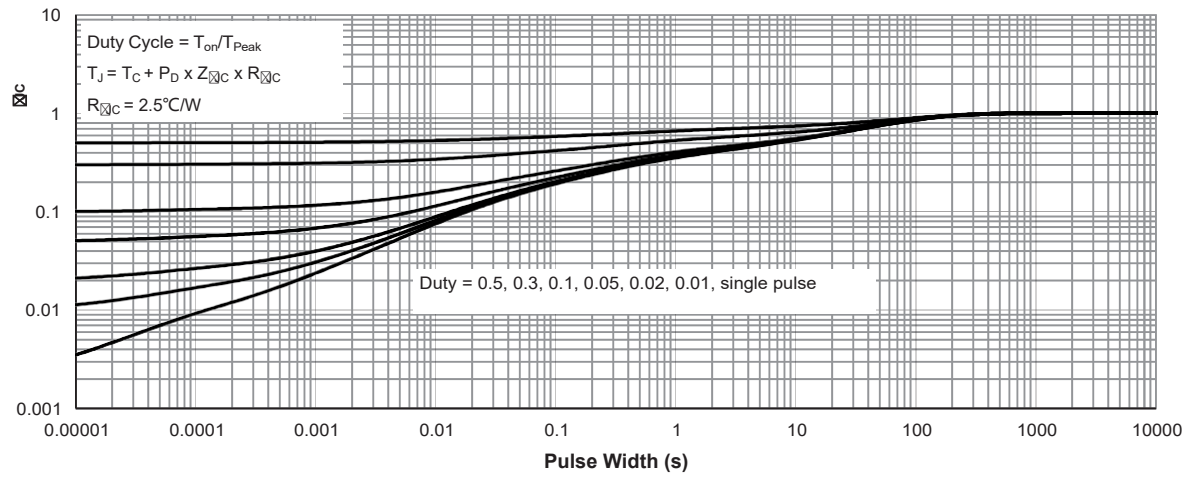


Figure 13: Normalized Maximum Transient Thermal Impedance