

## Description

The VSM25NP03 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

### N channel

- $V_{DS}=30V, I_D=25A$   
 $R_{DS(ON)} < 12m\Omega @ V_{GS}=10V$   
 $R_{DS(ON)} < 18m\Omega @ V_{GS}=4.5V$

### p channel

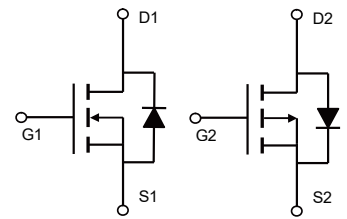
- $V_{DS}=-30V, I_D=-19A$   
 $R_{DS(ON)} < 35m\Omega @ V_{GS}=-10V$   
 $R_{DS(ON)} < 65m\Omega @ V_{GS}=-4.5V$
- High density cell design for ultra low  $R_{ds}$
- Fully characterized avalanche voltage and current
- Good stability and uniformity with high  $E_{AS}$
- Excellent package for good heat dissipation
- Special process technology for high ESD capability

## Application

- H-bridge
- Inverters



TO-252



Schematic

## Package Marking and Ordering Information

| Device Marking | Device       | Device Package | Reel Size | Tape width | Quantity |
|----------------|--------------|----------------|-----------|------------|----------|
| VSM25NP03      | VSM25NP03-T2 | TO-252         | -         | -          | -        |

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

| Parameter                                        |                         | Symbol         | N-Channel  | P-Channel | Unit             |
|--------------------------------------------------|-------------------------|----------------|------------|-----------|------------------|
| Drain-Source Voltage                             |                         | $V_{DS}$       | 30         | -30       | V                |
| Gate-Source Voltage                              |                         | $V_{GS}$       | $\pm 20$   | $\pm 20$  | V                |
| Continuous Drain Current                         | $T_c=25^\circ\text{C}$  | $I_D$          | 25         | -19       | A                |
|                                                  | $T_c=100^\circ\text{C}$ |                | 17.7       | -13.4     |                  |
| Pulsed Drain Current (Note 1)                    |                         | $I_{DM}$       | 90         | -60       | A                |
| Maximum Power Dissipation                        | $T_c=25^\circ\text{C}$  | $P_D$          | 21         |           | W                |
| Operating Junction and Storage Temperature Range |                         | $T_J, T_{STG}$ | -55 To 175 |           | $^\circ\text{C}$ |

## Thermal Characteristic

|                                               |                 |   |                    |
|-----------------------------------------------|-----------------|---|--------------------|
| Thermal Resistance, Junction-to-Case (Note 2) | $R_{\theta JC}$ | 7 | $^\circ\text{C/W}$ |
|-----------------------------------------------|-----------------|---|--------------------|

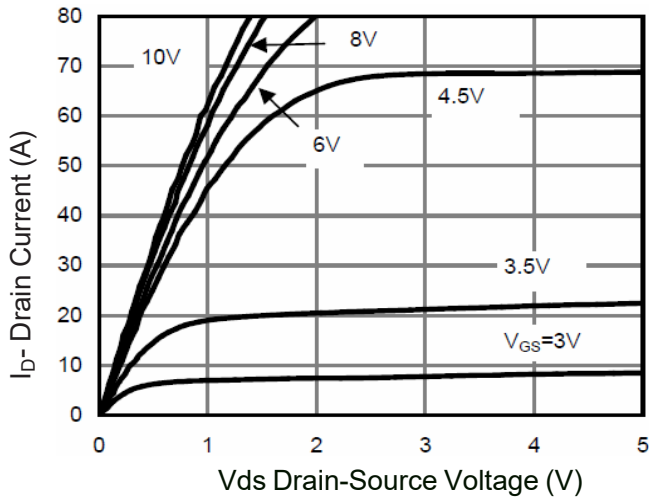
**N-Channel Electrical Characteristics ( $T_c=25^{\circ}\text{C}$  unless otherwise noted)**

| Parameter                          | Symbol       | Condition                                                | Min | Typ  | Max       | Unit       |
|------------------------------------|--------------|----------------------------------------------------------|-----|------|-----------|------------|
| Off Characteristics                |              |                                                          |     |      |           |            |
| Drain-Source Breakdown Voltage     | $BV_{DSS}$   | $V_{GS}=0V, I_D=250\mu A$                                | 30  | -    | -         | V          |
| Zero Gate Voltage Drain Current    | $I_{DSS}$    | $V_{DS}=30V, V_{GS}=0V$                                  | -   | -    | 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 | 2.0  | 3.0       | V          |
| Drain-Source On-State Resistance   | $R_{DS(ON)}$ | $V_{GS}=10V, I_D=7A$                                     | -   | 8.5  | 12        | m $\Omega$ |
|                                    |              | $V_{GS}=4.5V, I_D=6A$                                    | -   | 11.8 | 18        | m $\Omega$ |
| Forward Transconductance           | $g_{FS}$     | $V_{DS}=10V, I_D=7A$                                     | -   | 29   | -         | S          |
| Dynamic Characteristics (Note4)    |              |                                                          |     |      |           |            |
| Input Capacitance                  | $C_{iss}$    | $V_{DS}=15V, V_{GS}=0V,$<br>$F=1.0MHz$                   | -   | 450  | -         | PF         |
| Output Capacitance                 | $C_{oss}$    |                                                          | -   | 150  | -         | PF         |
| Reverse Transfer Capacitance       | $C_{rss}$    |                                                          | -   | 90   | -         | PF         |
| Switching Characteristics (Note 4) |              |                                                          |     |      |           |            |
| Turn-on Delay Time                 | $t_{d(on)}$  | $V_{DD}=15V, R_L=2.5\Omega$<br>$V_{GS}=10V, R_G=3\Omega$ | -   | 5    | -         | nS         |
| Turn-on Rise Time                  | $t_r$        |                                                          | -   | 12   | -         | nS         |
| Turn-Off Delay Time                | $t_{d(off)}$ |                                                          | -   | 19   | -         | nS         |
| Turn-Off Fall Time                 | $t_f$        |                                                          | -   | 6    | -         | nS         |
| Total Gate Charge                  | $Q_g$        | $V_{DS}=15V, I_D=6A,$<br>$V_{GS}=10V$                    | -   | 9.5  |           | nC         |
| Gate-Source Charge                 | $Q_{gs}$     |                                                          | -   | 2.0  |           | nC         |
| Gate-Drain Charge                  | $Q_{gd}$     |                                                          | -   | 1.9  |           | nC         |
| Drain-Source Diode Characteristics |              |                                                          |     |      |           |            |
| Diode Forward Voltage (Note 3)     | $V_{SD}$     | $V_{GS}=0V, I_S=25A$                                     | -   |      | 1.2       | V          |
| Diode Forward Current (Note 2)     | $I_S$        |                                                          | -   | -    | 25        | A          |

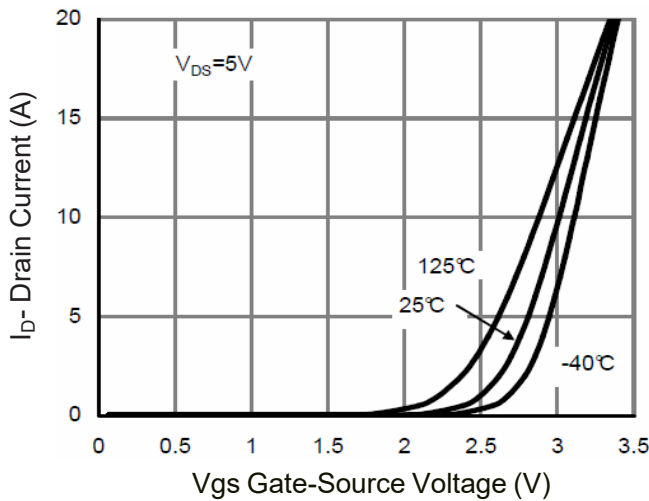
**Notes:**

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:  $T_J=25^{\circ}\text{C}$ ,  $V_{DD}=30V$ ,  $V_G=10V$ ,  $L=0.5mH$ ,  $R_g=25\Omega$

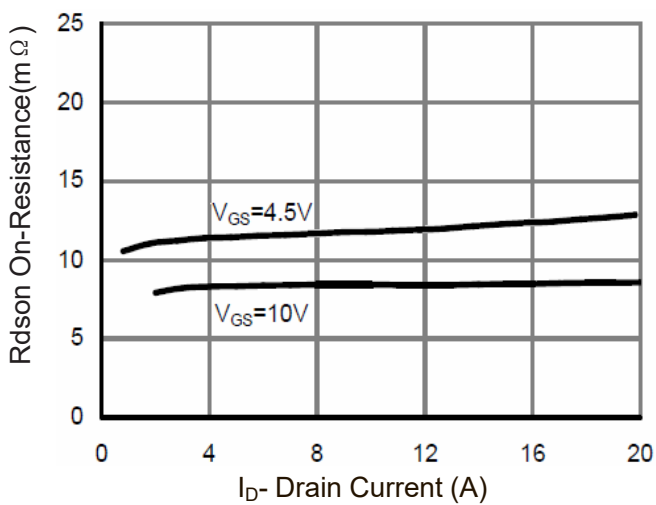
## N-Channel Typical Electrical and Thermal Characteristics (Curves)



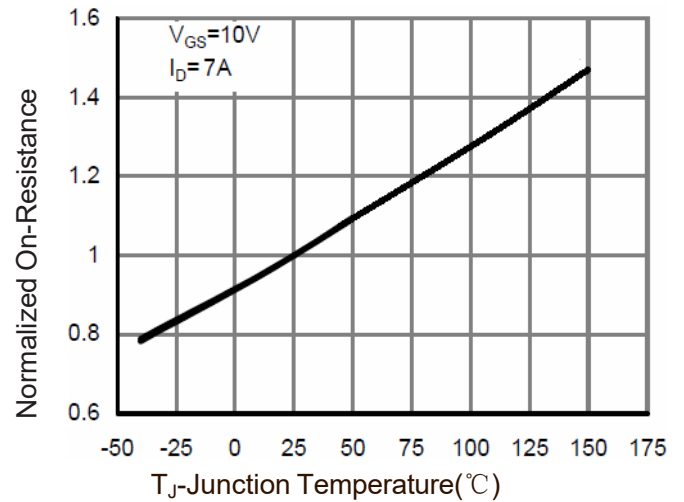
**Figure 1 Output Characteristics**



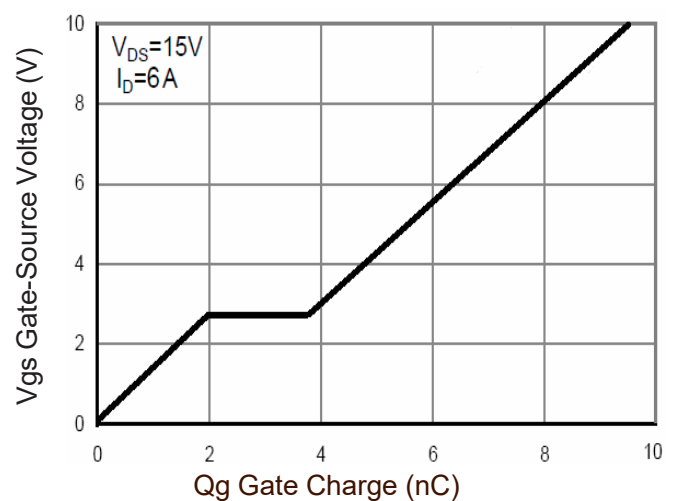
**Figure 2 Transfer Characteristics**



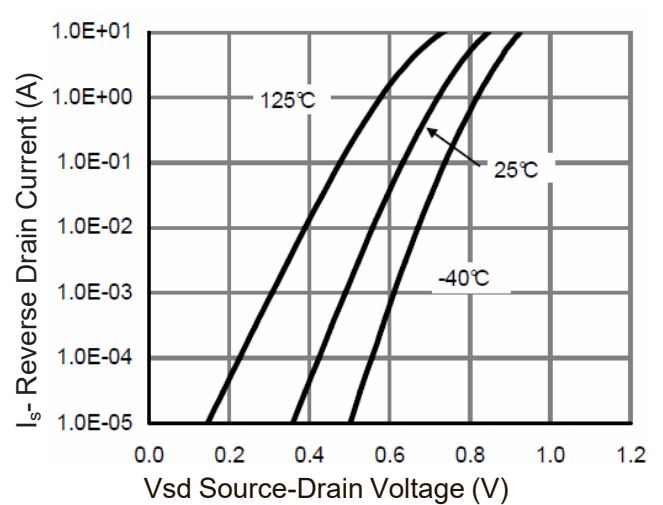
**Figure 3 Rdson- Drain Current**



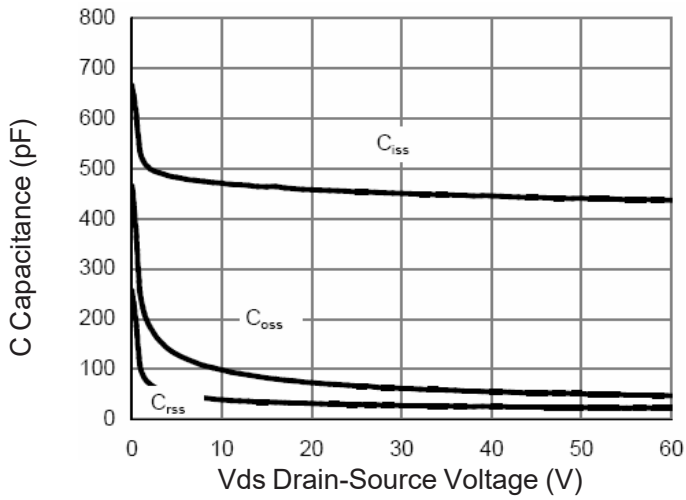
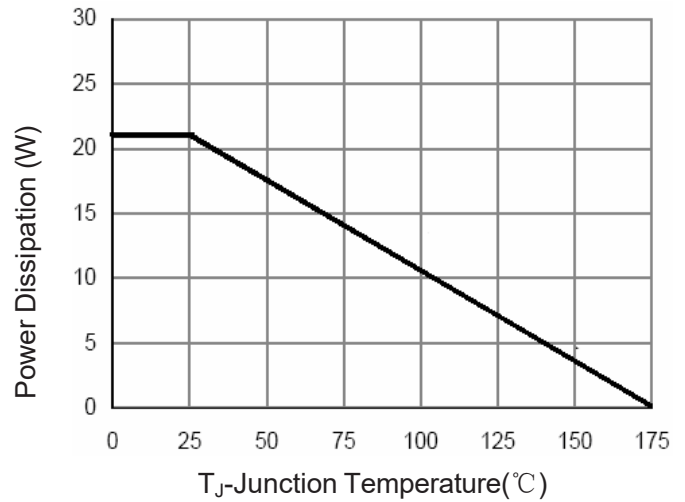
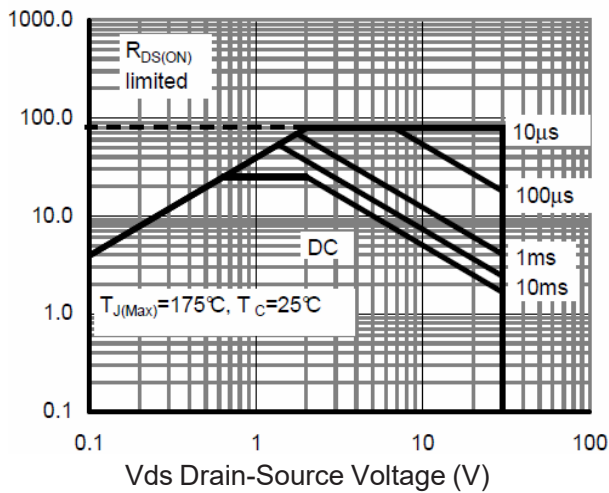
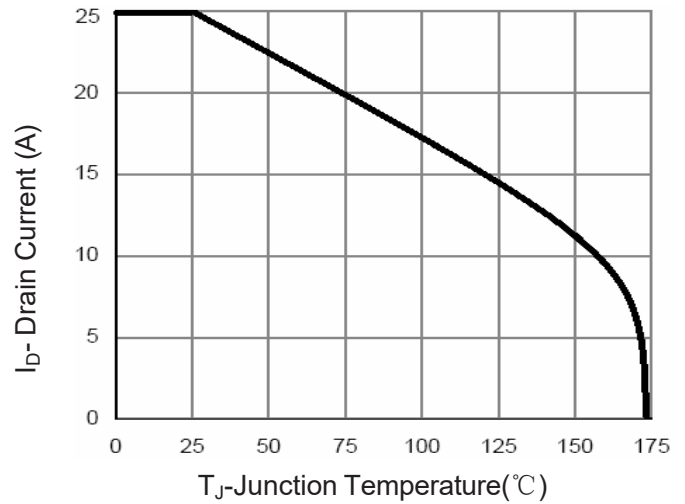
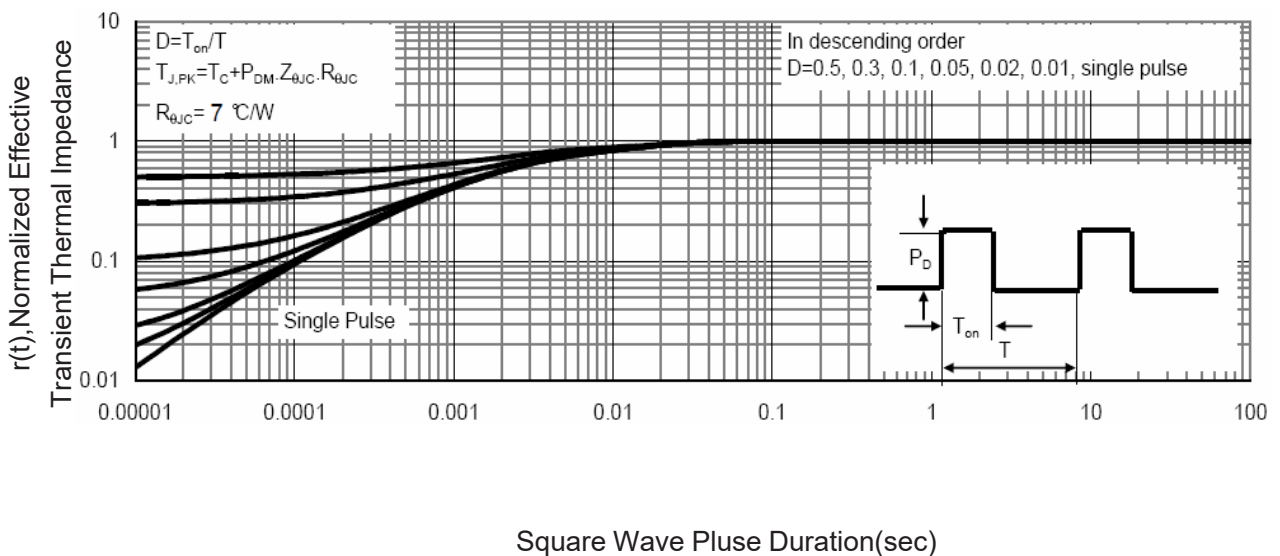
**Figure 4 Rdson-Junction Temperature**



**Figure 5 Gate Charge**



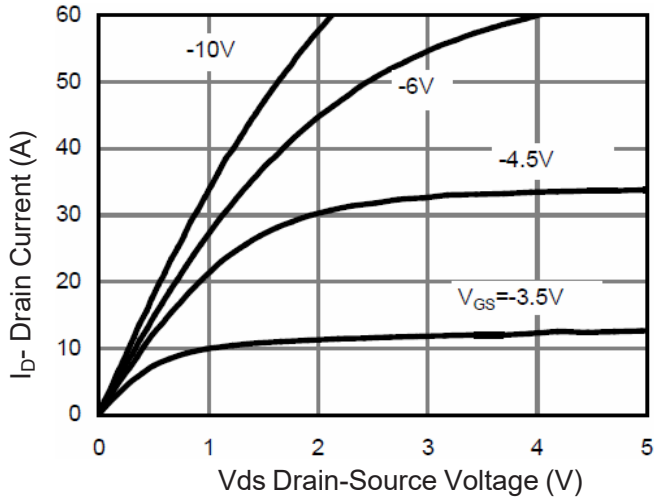
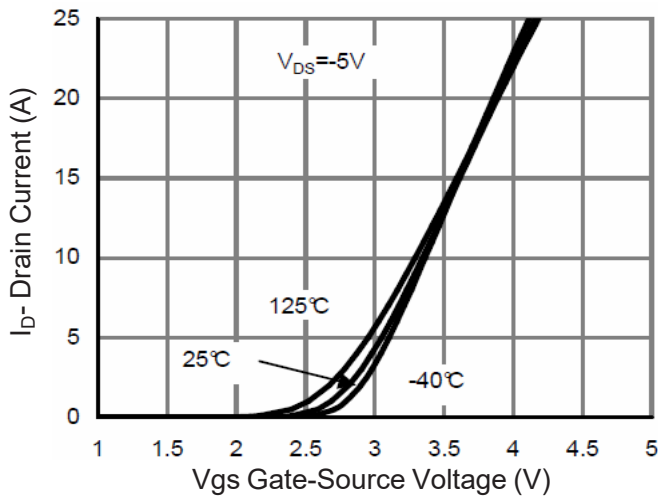
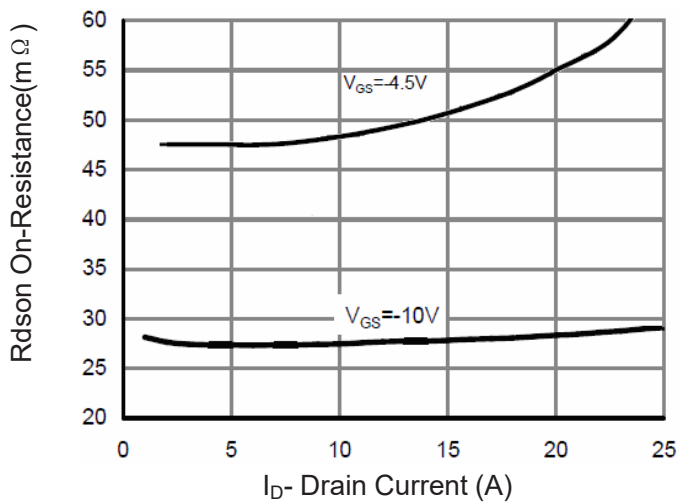
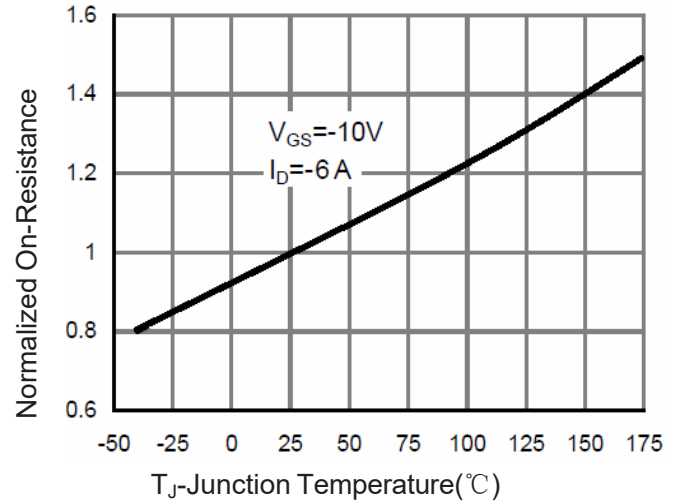
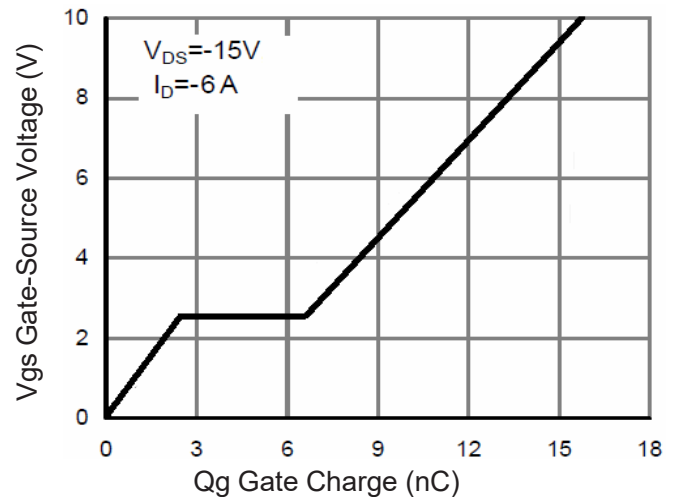
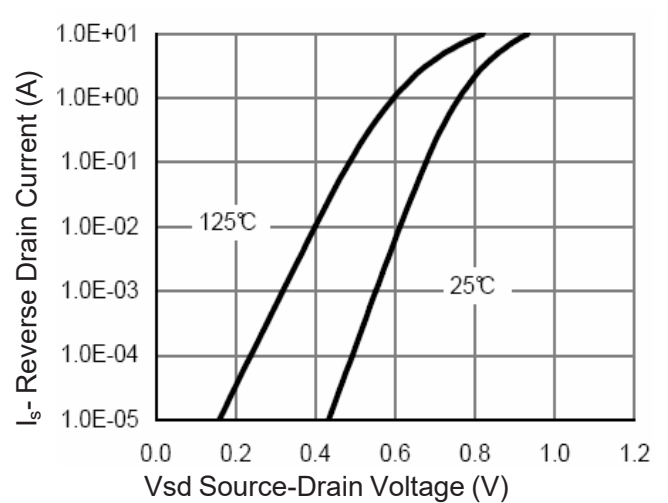
**Figure 6 Source- Drain Diode Forward**

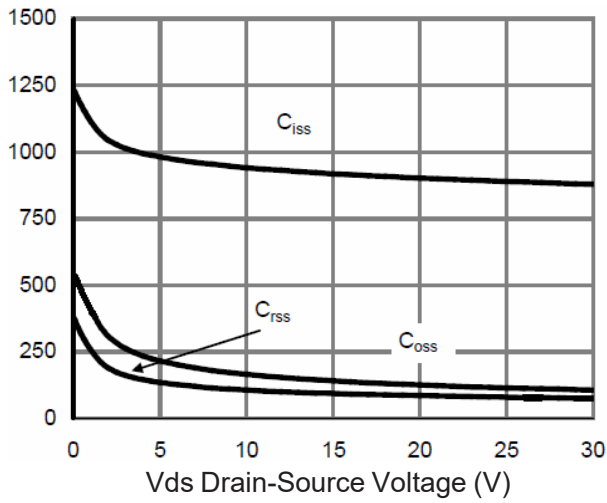
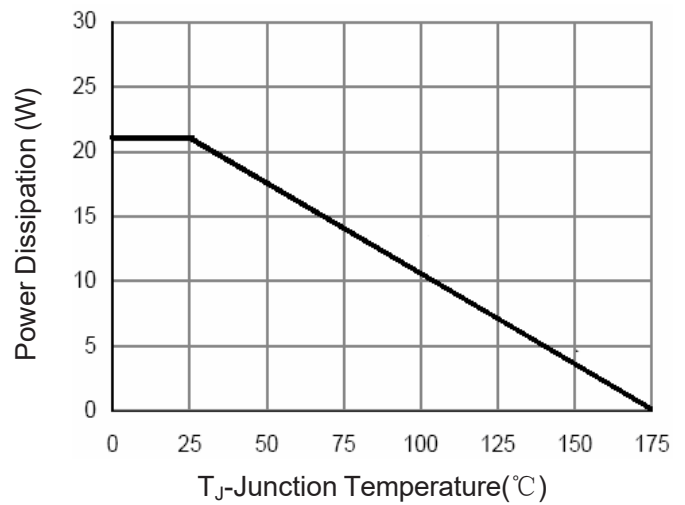
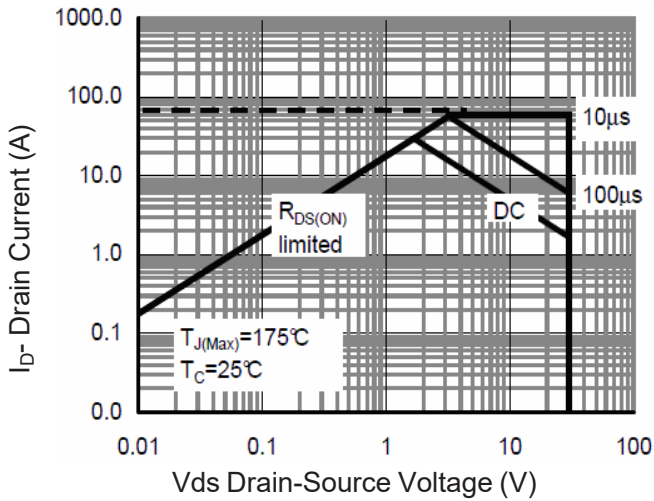
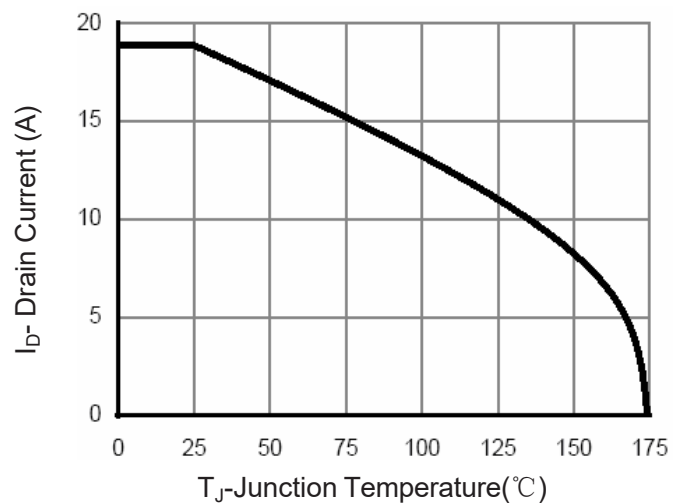
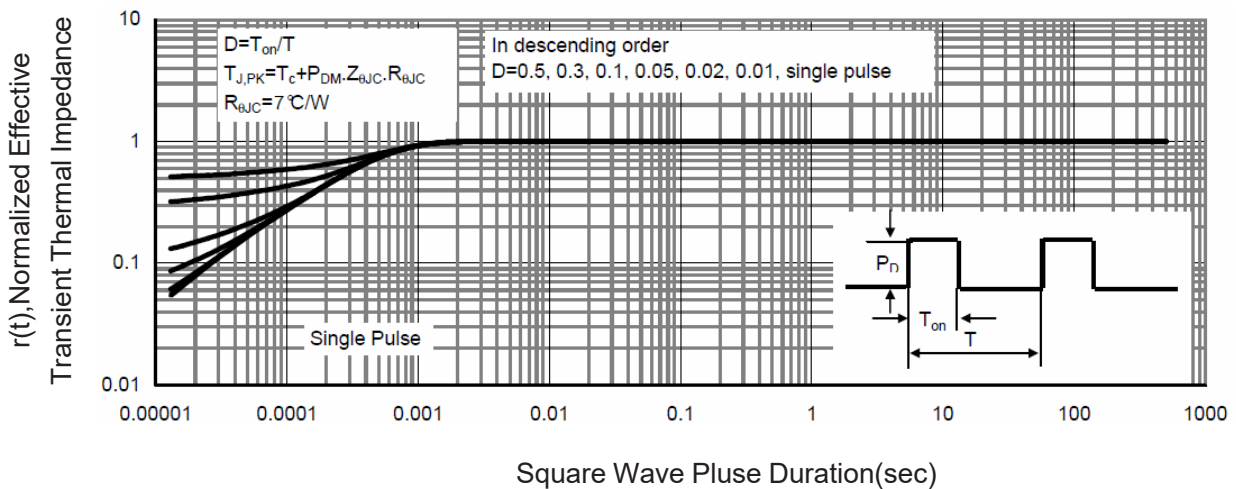

**Figure 7 Capacitance vs Vds**

**Figure 9 Power De-rating**

**Figure 8 Safe Operation Area**

**Figure 10 Current De-rating**

**Figure 11 Normalized Maximum Transient Thermal Impedance**

**P-Channel 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  | -    | -    | 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 (Note 3)        |                     |                                                                                          |      |      |      |      |
| Gate Threshold Voltage             | V <sub>GS(th)</sub> | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =-250μA                                | -1.0 | -1.8 | -2.5 | V    |
| Drain-Source On-State Resistance   | R <sub>DS(ON)</sub> | V <sub>GS</sub> =-10V, I <sub>D</sub> =-6A                                               | -    | 28   | 35   | mΩ   |
|                                    |                     | V <sub>GS</sub> =-4.5V, I <sub>D</sub> =-5A                                              |      | 48   | 65   |      |
| Forward Transconductance           | g <sub>FS</sub>     | V <sub>DS</sub> =-5V, I <sub>D</sub> =-6A                                                | -    | 15   | -    | S    |
| Dynamic Characteristics (Note4)    |                     |                                                                                          |      |      |      |      |
| Input Capacitance                  | C <sub>iss</sub>    | V <sub>DS</sub> =-30V, V <sub>GS</sub> =0V,<br>F=1.0MHz                                  | -    | 920  | -    | PF   |
| Output Capacitance                 | C <sub>oss</sub>    |                                                                                          | -    | 140  | -    | PF   |
| Reverse Transfer Capacitance       | C <sub>rss</sub>    |                                                                                          | -    | 90   | -    | PF   |
| Switching Characteristics (Note 4) |                     |                                                                                          |      |      |      |      |
| Turn-on Delay Time                 | t <sub>d(on)</sub>  | V <sub>DD</sub> =-15V ,R <sub>L</sub> =2.5Ω<br>V <sub>GS</sub> =-10V, R <sub>G</sub> =3Ω | -    | 8    | -    | nS   |
| Turn-on Rise Time                  | t <sub>r</sub>      |                                                                                          | -    | 30   | -    | nS   |
| Turn-Off Delay Time                | t <sub>d(off)</sub> |                                                                                          | -    | 22   | -    | nS   |
| Turn-Off Fall Time                 | t <sub>f</sub>      |                                                                                          | -    | 26   | -    | nS   |
| Total Gate Charge                  | Q <sub>g</sub>      | V <sub>DS</sub> =-15V, I <sub>D</sub> =-6A,<br>V <sub>GS</sub> =-10V                     | -    | 16.2 |      | nC   |
| Gate-Source Charge                 | Q <sub>gs</sub>     |                                                                                          | -    | 2.9  |      | nC   |
| Gate-Drain Charge                  | Q <sub>gd</sub>     |                                                                                          | -    | 3.6  |      | nC   |
| Drain-Source Diode Characteristics |                     |                                                                                          |      |      |      |      |
| Diode Forward Voltage (Note 3)     | V <sub>SD</sub>     | V <sub>GS</sub> =0V, I <sub>S</sub> =-6A                                                 | -    |      | -1.2 | V    |
| Diode Forward Current (Note 2)     | I <sub>S</sub>      |                                                                                          | -    | -    | -19  | A    |
| Reverse Recovery Time              | t <sub>rr</sub>     | TJ = 25°C, IF =-6A<br>di/dt = 100A/μs (Note3)                                            | -    | 23   | -    | nS   |
| Reverse Recovery Charge            | Q <sub>rr</sub>     |                                                                                          | -    | 14   | -    | nC   |

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


**Figure 1 Output Characteristics**

**Figure 2 Transfer Characteristics**

**Figure 3 Rdson- Drain Current**

**Figure 4 Rdson-Junction Temperature**

**Figure 5 Gate Charge**

**Figure 6 Source- Drain Diode Forward**


**Figure 7 Capacitance vs Vds**

**Figure 9 Power De-rating**

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**Figure 11 Normalized Maximum Transient Thermal Impedance**