



## Complementary N- and P-Channel 20-V (D-S) MOSFET

**TrenchFET®**

MOSFETs

**1.5-V Rated**



**ESD Protected  
2000 V**

| PRODUCT SUMMARY |                     |                               |                     |
|-----------------|---------------------|-------------------------------|---------------------|
|                 | V <sub>DS</sub> (V) | r <sub>DS(on)</sub> (Ω)       | I <sub>D</sub> (mA) |
| N-Channel       | 20                  | 5 @ V <sub>GS</sub> = 4.5 V   | 200                 |
|                 |                     | 7 @ V <sub>GS</sub> = 2.5 V   | 175                 |
|                 |                     | 9 @ V <sub>GS</sub> = 1.8 V   | 150                 |
|                 |                     | 10 @ V <sub>GS</sub> = 1.5 V  | 50                  |
| P-Channel       | -20                 | 8 @ V <sub>GS</sub> = -4.5 V  | -150                |
|                 |                     | 12 @ V <sub>GS</sub> = -2.5 V | -125                |
|                 |                     | 15 @ V <sub>GS</sub> = -1.8 V | -100                |
|                 |                     | 20 @ V <sub>GS</sub> = -1.5 V | -30                 |

### FEATURES

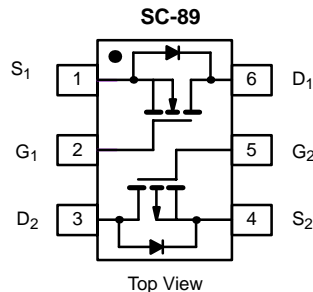
- Very Small Footprint
- High-Side Switching
- Low On-Resistance:  
N-Channel, 5 Ω  
P-Channel, 8 Ω
- Low Threshold: ±0.9 V (typ)
- Fast Switching Speed: 45 ns (typ)
- 1.5-V Operation
- Gate-Source ESD Protection

### BENEFITS

- Ease in Driving Switches
- Low Offset (Error) Voltage
- Low-Voltage Operation
- High-Speed Circuits
- Low Battery Voltage Operation

### APPLICATIONS

- Replace Digital Transistor, Level-Shifter
- Battery Operated Systems
- Power Supply Converter Circuits
- Load/Power Switching Cell Phones, Pages



Marking Code: M

| ABSOLUTE MAXIMUM RATINGS (T <sub>A</sub> = 25° C UNLESS OTHERWISE NOTED) |                                   |                       |              |           |              |      |    |
|--|-----------------------------------|-----------------------|--------------|-----------|--------------|------|----|
| Parameter  | Symbol                            | N-Channel             |              | P-Channel |              | Unit |    |
|  |                                   | 5 secs                | Steady State | 5 secs    | Steady State |      |    |
| Drain-Source Voltage   | V <sub>DS</sub>                   | 20                    |              | -20       |              | V    |    |
| Gate-Source Voltage  | V <sub>GS</sub>                   | ± 5                   |              |           |              |      |    |
| Continuous Drain Current (T <sub>J</sub> = 150°C) <sup>a</sup>           | I <sub>D</sub>                    | T <sub>A</sub> = 25°C | 190          | 180       | -155         | -145 | mA |
|  |                                   | T <sub>A</sub> = 85°C | 140          | 130       | -110         | -105 |    |
| Pulsed Drain Current <sup>b</sup>  | I <sub>DM</sub>                   | 650                   |              | -650      |              |      |    |
| Continuous Source Current (Diode Conduction) <sup>a</sup>                | I <sub>S</sub>                    | 450                   | 380          | -450      | -380         |      |    |
| Maximum Power Dissipation <sup>a</sup>                                   | P <sub>D</sub>                    | T <sub>A</sub> = 25°C | 280          | 250       | 280          | 250  | mW |
|  |                                   | T <sub>A</sub> = 85°C | 145          | 130       | 145          | 130  |    |
| Operating Junction and Storage Temperature Range                         | T <sub>J</sub> , T <sub>stg</sub> | -55 to 150            |              |           |              | °C   |    |
| Gate-Source ESD Rating (HBM, Method 3015)                                | ESD                               | 2000                  |              |           |              | V    |    |

Notes

- Surface Mounted on FR4 Board.
- Pulse width limited by maximum junction temperature.

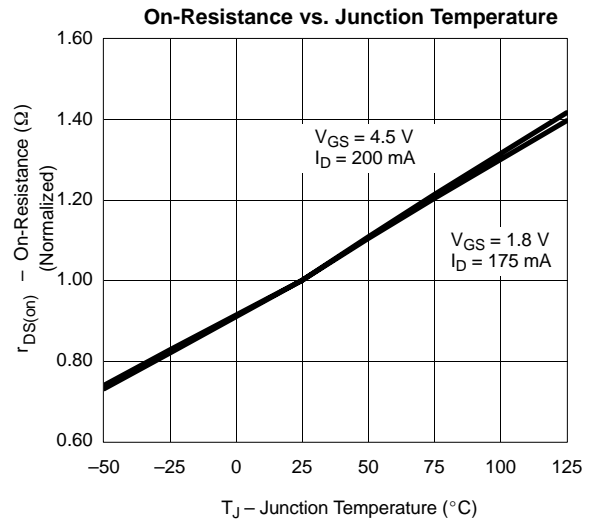
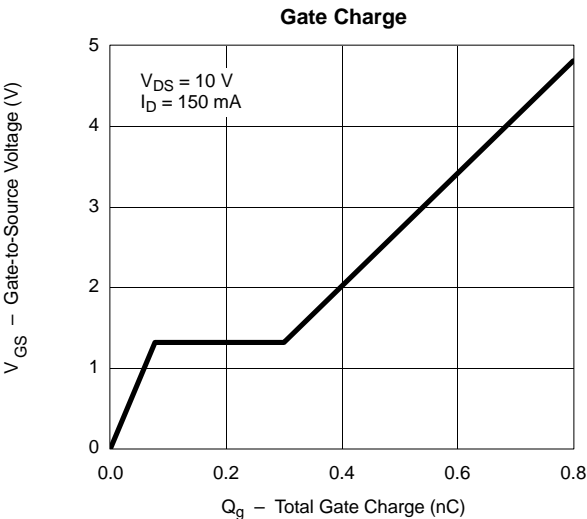
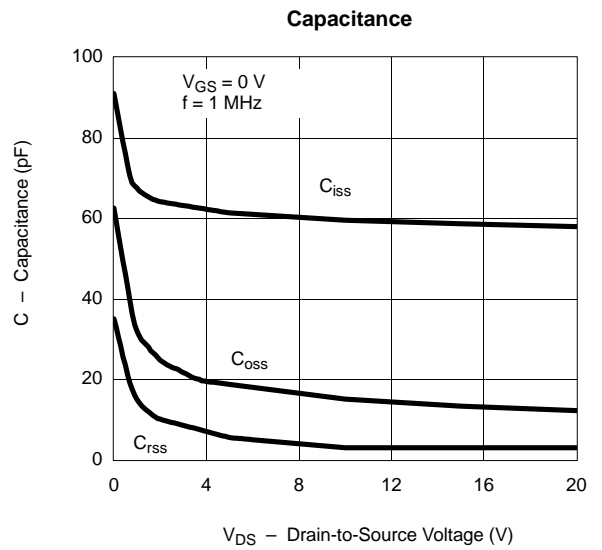
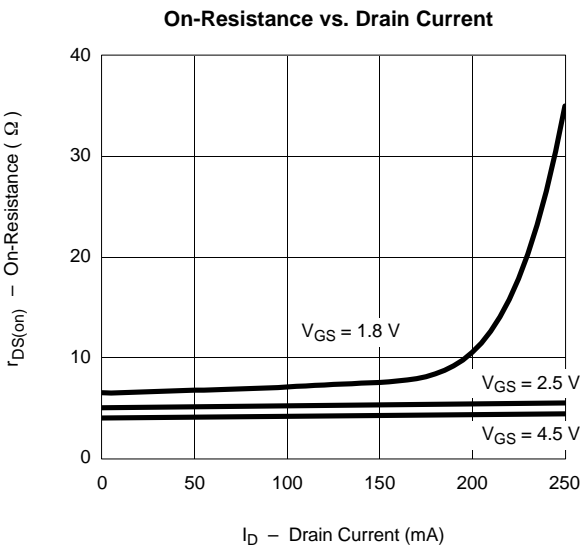
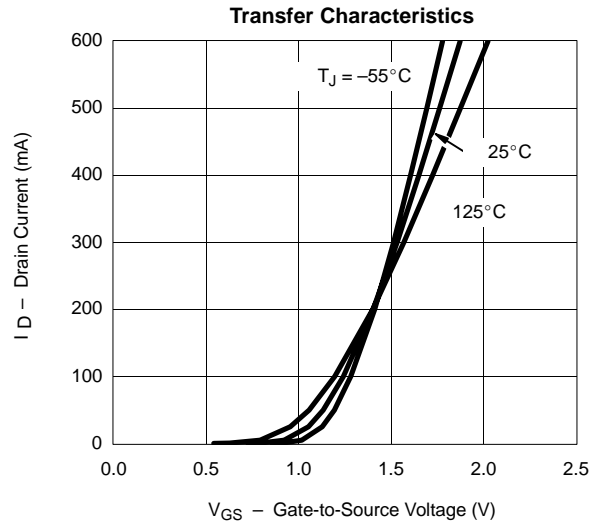
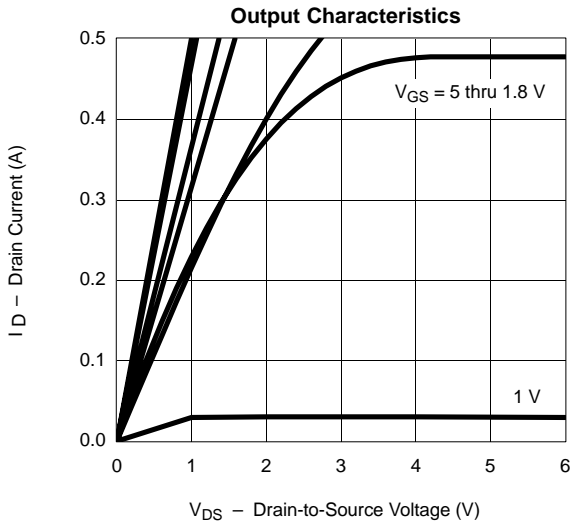
| SPECIFICATIONS (T <sub>J</sub> = 25 °C UNLESS OTHERWISE NOTED) |                     |   |      |       |      |      |    |
|--|---------------------|---|------|-------|------|------|----|
| Parameter  | Symbol              | Test Condition  | Min  | Typ   | Max  | Unit |    |
| <b>Static</b>  |                     |   |      |       |      |      |    |
| Gate Threshold Voltage   | V <sub>GS(th)</sub> | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA   | N-Ch | 0.40  |      |      | V  |
|  |                     | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -250 μA  | P-Ch | -0.40 |      |      |    |
| Gate-Body Leakage  | I <sub>GSS</sub>    | V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ±2.8 V   | N-Ch |       | ±0.5 | ±1.0 | μA |
|  |                     |   | P-Ch |       | ±0.5 | ±1.0 |    |
|  |                     | V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ±4.5 V   | N-Ch |       | ±1.5 | ±3.0 |    |
|  |                     |   | P-Ch |       | ±1.0 | ±3.0 |    |
| Zero Gate Voltage Drain Current                                | I <sub>DSS</sub>    | V <sub>DS</sub> = 16 V, V <sub>GS</sub> = 0 V   | N-Ch |       | 1    | 500  | nA |
|  |                     | V <sub>DS</sub> = -16 V, V <sub>GS</sub> = 0 V  | P-Ch |       | -1   | -500 |    |
|  |                     | V <sub>DS</sub> = 16 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 85 °C   | N-Ch |       |      | 10   | μA |
|  |                     | V <sub>DS</sub> = -16 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 85 °C  | P-Ch |       |      | -10  |    |
| On-State Drain Current <sup>a</sup>                            | I <sub>D(on)</sub>  | V <sub>DS</sub> = 5 V, V <sub>GS</sub> = 4.5 V  | N-Ch | 250   |      |      | mA |
|  |                     | V <sub>DS</sub> = -5 V, V <sub>GS</sub> = -4.5 V  | P-Ch | -200  |      |      |    |
| Drain-Source On-State Resistance <sup>a</sup>                  | r <sub>DS(on)</sub> | V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 200 mA  | N-Ch |       |      | 5    | Ω  |
|  |                     | V <sub>GS</sub> = -4.5 V, I <sub>D</sub> = -150 mA  | P-Ch |       |      | 8    |    |
|  |                     | V <sub>GS</sub> = 2.5 V, I <sub>D</sub> = 175 mA  | N-Ch |       |      | 7    |    |
|  |                     | V <sub>GS</sub> = -2.5 V, I <sub>D</sub> = -125 mA  | P-Ch |       |      | 12   |    |
|  |                     | V <sub>GS</sub> = 1.8 V, I <sub>D</sub> = 150 mA  | N-Ch |       |      | 9    |    |
|  |                     | V <sub>GS</sub> = -1.8 V, I <sub>D</sub> = -100 mA  | P-Ch |       |      | 15   |    |
|  |                     | V <sub>GS</sub> = 1.5 V, I <sub>D</sub> = 40 mA   | N-Ch |       |      | 10   |    |
|  |                     | V <sub>GS</sub> = -1.5 V, I <sub>D</sub> = -30 mA   | P-Ch |       |      | 20   |    |
| Forward Transconductance <sup>a</sup>                          | g <sub>fs</sub>     | V <sub>DS</sub> = 10 V, I <sub>D</sub> = 200 mA   | N-Ch |       | 0.5  |      | S  |
|  |                     | V <sub>DS</sub> = -10 V, I <sub>D</sub> = -150 mA   | P-Ch |       | 0.4  |      |    |
| Diode Forward Voltage <sup>a</sup>                             | V <sub>SD</sub>     | I <sub>S</sub> = 150 mA, V <sub>GS</sub> = 0 V  | N-Ch |       |      | 1.2  | V  |
|  |                     | I <sub>S</sub> = -150 mA, V <sub>GS</sub> = 0 V   | P-Ch |       |      | -1.2 |    |
| <b>Dynamic<sup>b</sup></b>                                     |                     |   |      |       |      |      |    |
| Total Gate Charge  | Q <sub>g</sub>      | N-Channel<br>V <sub>DS</sub> = 10 V, V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 150 mA<br>P-Channel<br>V <sub>DS</sub> = -10 V, V <sub>GS</sub> = -4.5 V, I <sub>D</sub> = -150 mA | N-Ch |       | 750  |      | pC |
| Gate-Source Charge   | Q <sub>gs</sub>     |   | N-Ch |       | 75   |      |    |
|  |                     |   | P-Ch |       | 150  |      |    |
| Gate-Drain Charge  | Q <sub>gd</sub>     |   | N-Ch |       | 225  |      |    |
|  |                     | P-Ch  |      | 450   |      |      |    |
| Turn-On Time   | t <sub>ON</sub>     | N-Channel<br>V <sub>DD</sub> = 10 V, R <sub>L</sub> = 47 Ω<br>I <sub>D</sub> ≅ 200 mA, V <sub>GEN</sub> = 4.5 V, R <sub>G</sub> = 10 Ω  | N-Ch |       |      | 75   | ns |
|  |                     |   | P-Ch |       |      | 80   |    |
| Turn-Off Time  | t <sub>OFF</sub>    | P-Channel<br>V <sub>DD</sub> = -10 V, R <sub>L</sub> = 65 Ω<br>I <sub>D</sub> ≅ -150 A, V <sub>GEN</sub> = -4.5 V, R <sub>G</sub> = 10 Ω  | N-Ch |       |      | 75   |    |
|  |                     |   | P-Ch |       |      | 90   |    |

## Notes

- a. Pulse test; pulse width ≤ 300 μs, duty cycle ≤ 2%.  
 b. Guaranteed by design, not subject to production testing.



**TYPICAL CHARACTERISTICS (T<sub>A</sub> = 25°C UNLESS NOTED) N-CHANNEL**

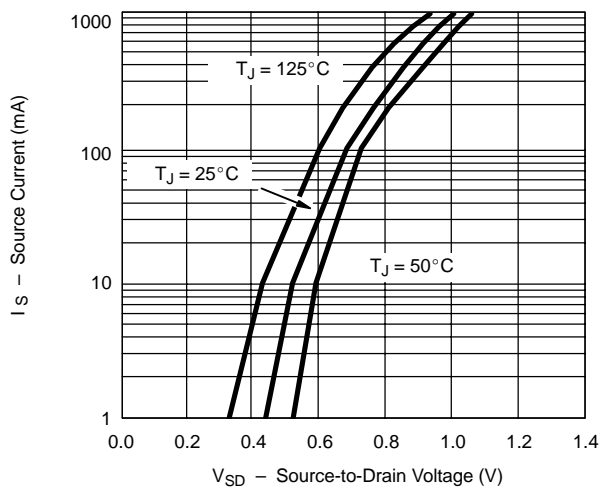




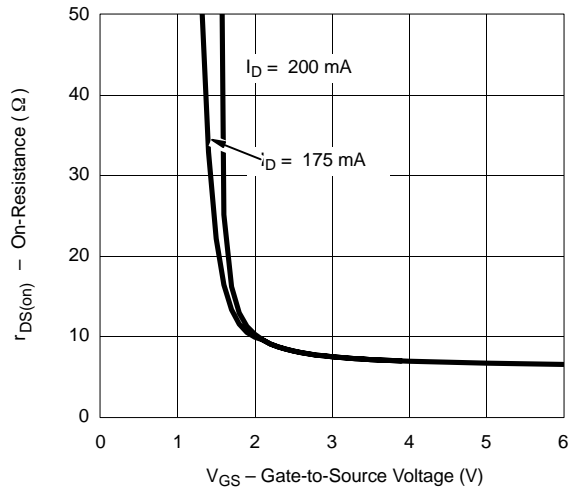
#### TYPICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ UNLESS NOTED)

#### N-CHANNEL

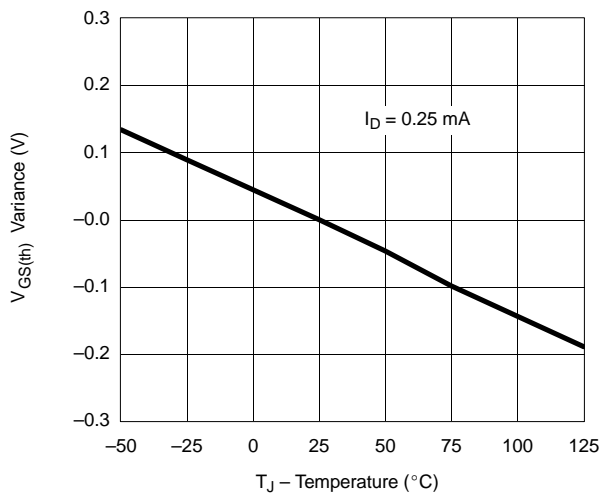
Source-Drain Diode Forward Voltage



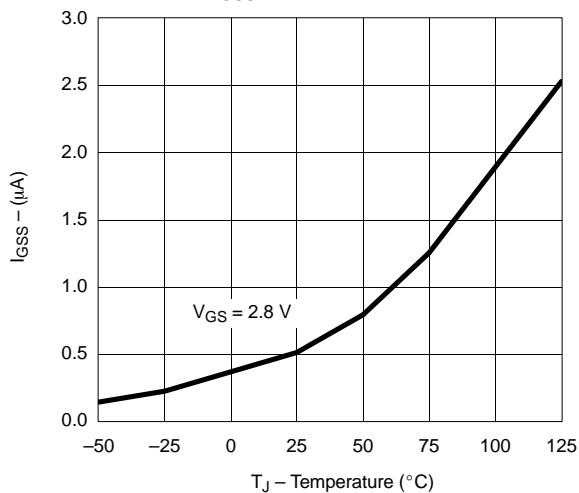
On-Resistance vs. Gate-to-Source Voltage



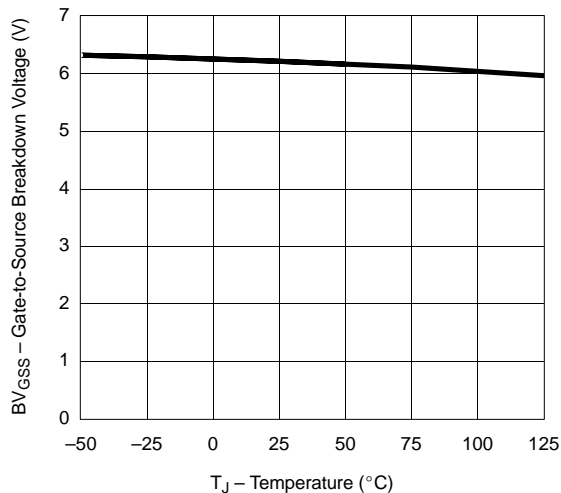
Threshold Voltage Variance vs. Temperature



IGSS vs. Temperature



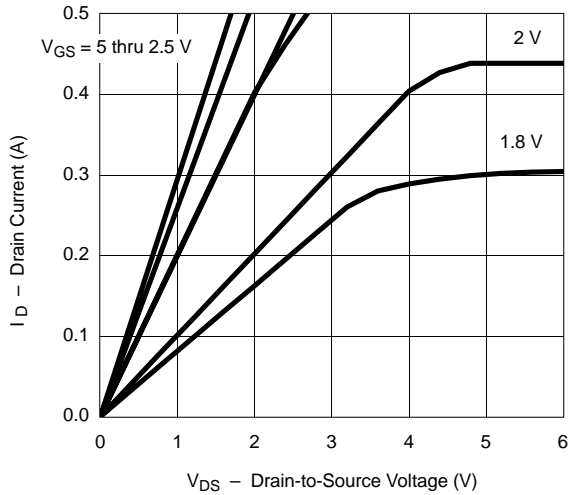
BVGSS vs. Temperature



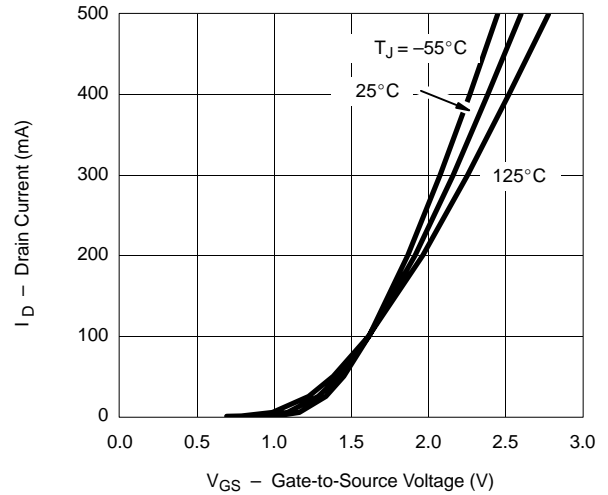


**TYPICAL CHARACTERISTICS (T<sub>A</sub> = 25°C UNLESS NOTED) P-CHANNEL**

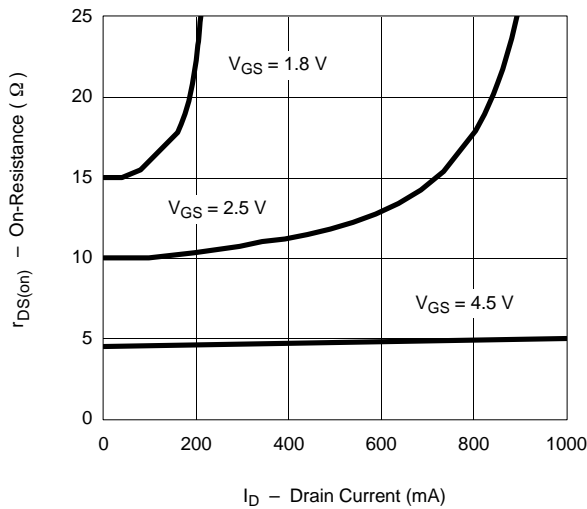
Output Characteristics



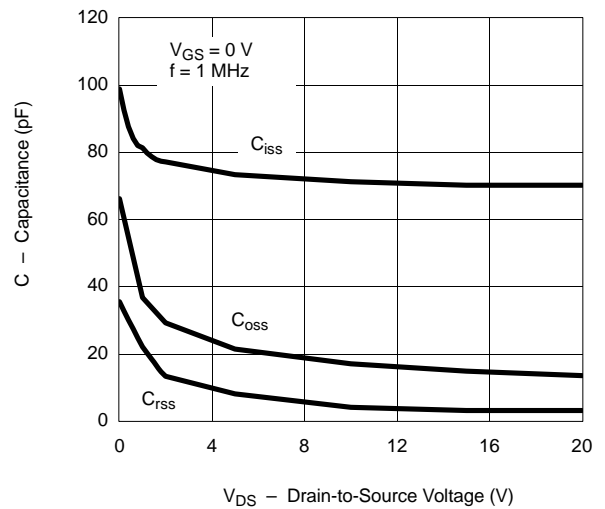
Transfer Characteristics



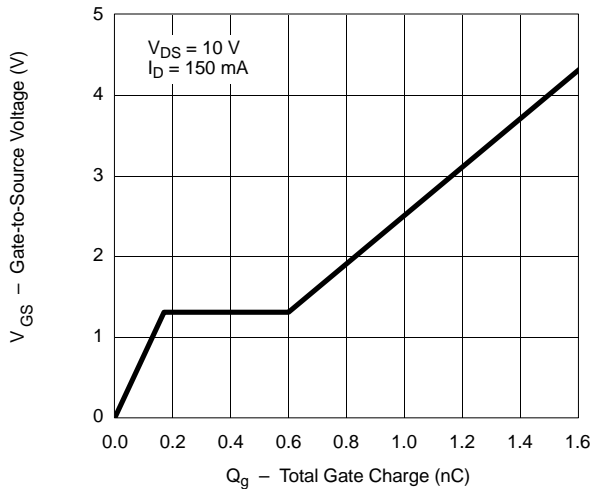
On-Resistance vs. Drain Current



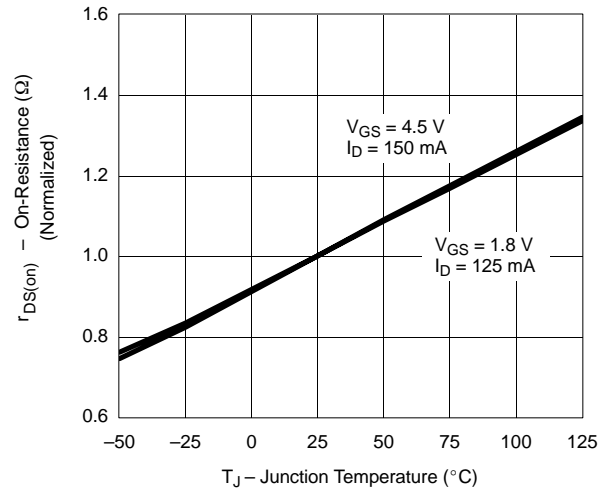
Capacitance



Gate Charge



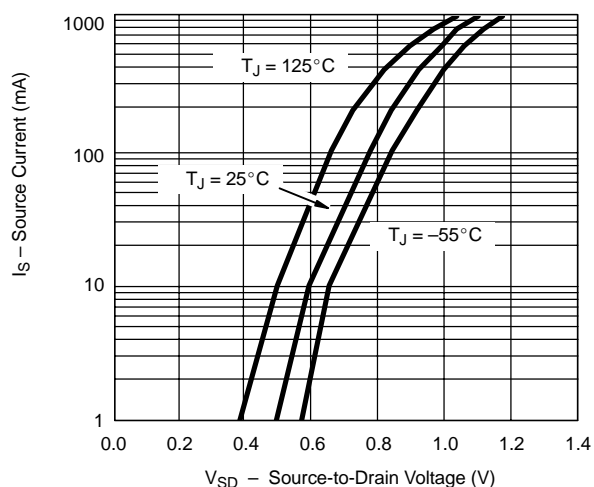
On-Resistance vs. Junction Temperature



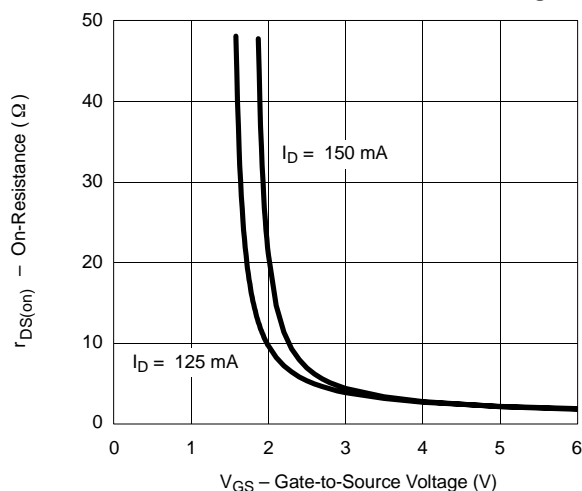
### TYPICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ UNLESS NOTED)

### P-CHANNEL

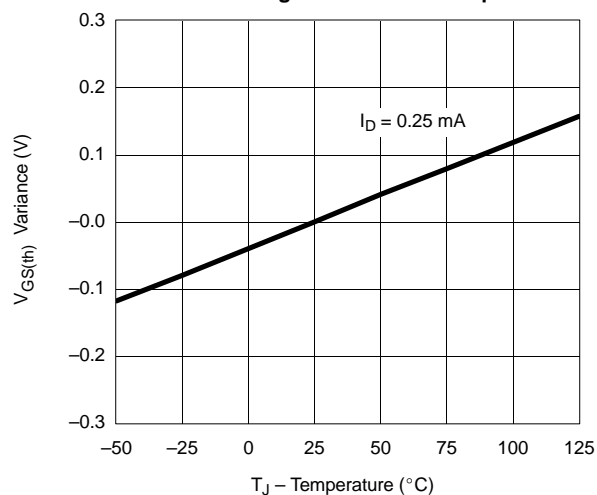
Source-Drain Diode Forward Voltage



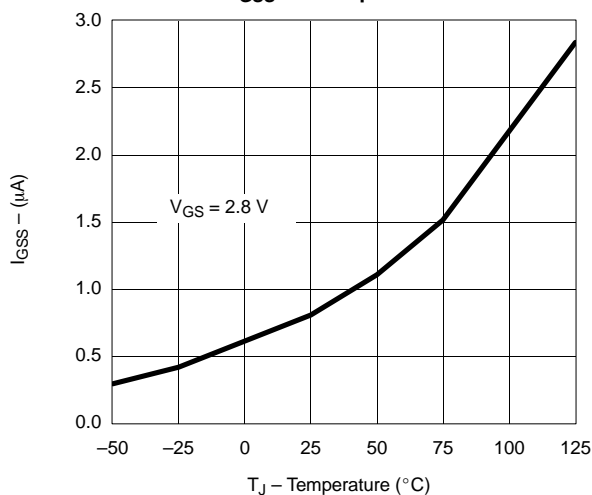
On-Resistance vs. Gate-to-Source Voltage



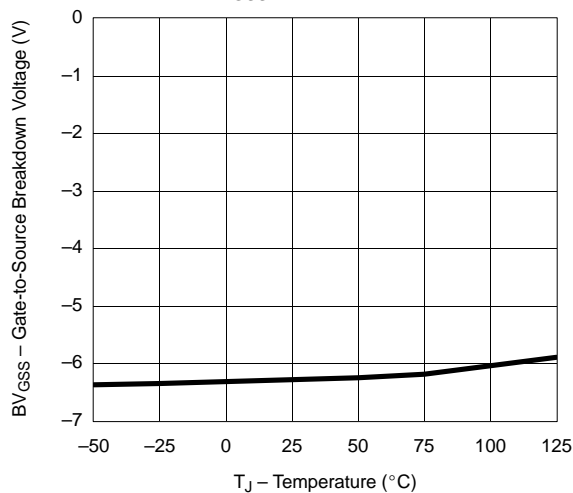
Threshold Voltage Variance vs. Temperature



$I_{GSS}$  vs. Temperature



$BV_{GSS}$  vs. Temperature





**TYPICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$  UNLESS NOTED) N- OR P-CHANNEL**

