

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

| PRODUCT SUMMARY |                     |                                  |                     |
|-----------------|---------------------|----------------------------------|---------------------|
|                 | V <sub>DS</sub> (V) | R <sub>DS(on)</sub> (Ω)          | I <sub>D</sub> (mA) |
| N-Channel       | 20                  | 0.70 at V <sub>GS</sub> = 4.5 V  | 600                 |
|                 |                     | 0.85 at V <sub>GS</sub> = 2.5 V  | 500                 |
|                 |                     | 1.25 at V <sub>GS</sub> = 1.8 V  | 350                 |
| P-Channel       | - 20                | 1.2 at V <sub>GS</sub> = - 4.5 V | - 400               |
|                 |                     | 1.6 at V <sub>GS</sub> = - 2.5 V | - 300               |
|                 |                     | 2.7 at V <sub>GS</sub> = - 1.8 V | - 150               |

### FEATURES

- Halogen-free Option Available
- TrenchFET<sup>®</sup> Power MOSFETs
- 2000 V ESD Protection
- Very Small Footprint
- High-Side Switching
- Low On-Resistance:  
N-Channel, 0.7 Ω  
P-Channel, 1.2 Ω
- Low Threshold: ± 0.8 V (Typ.)
- Fast Switching Speed: 14 ns
- 1.8 V Operation

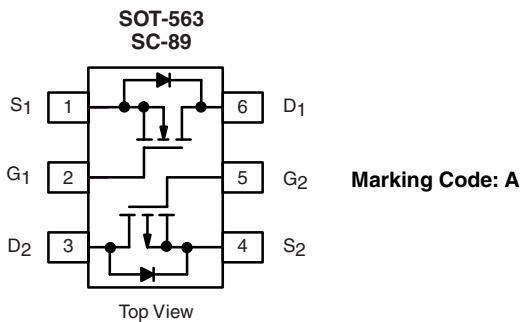

**RoHS**  
COMPLIANT

### 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, Pagers



**Ordering Information:** Si1016X-T1-E3 (Lead (Pb)-free)  
Si1016X-T1-GE3 (Lead (Pb)-free and Halogen-free)

| ABSOLUTE MAXIMUM RATINGS T <sub>A</sub> = 25 °C, unless otherwise noted |                                   |                        |              |           |              |       |     |
|---|-----------------------------------|------------------------|--------------|-----------|--------------|-------|-----|
| Parameter   | Symbol                            | N-Channel              |              | P-Channel |              | Unit  |     |
|   |                                   | 5 s                    | Steady State | 5 s       | Steady State |       |     |
| Drain-Source Voltage  | V <sub>DS</sub>                   | 20                     |              | - 20      |              | V     |     |
| Gate-Source Voltage   | V <sub>GS</sub>                   | ± 6                    |              |           |              |       |     |
| Continuous Drain Current (T <sub>J</sub> = 150 °C) <sup>a</sup>         | I <sub>D</sub>                    | T <sub>A</sub> = 25 °C | 515          | 485       | - 390        | - 370 | mA  |
|   |                                   | T <sub>A</sub> = 85 °C | 370          | 350       | - 280        | - 265 |     |
| 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        | mW    |     |
| Maximum Power Dissipation <sup>a</sup>                                  | P <sub>D</sub>                    | T <sub>A</sub> = 25 °C | 280          | 250       | 280          |       | 250 |
|   |                                   | 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:

- a. Surface Mounted on FR4 board.  
b. Pulse width limited by maximum junction temperature.

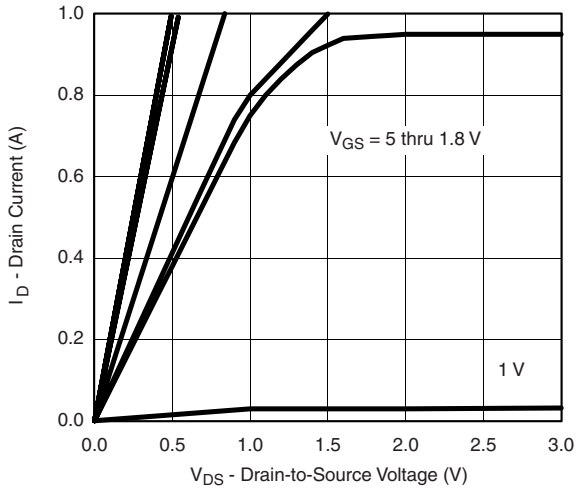
| <b>SPECIFICATIONS</b> $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted |              |   |              |       |                        |                        |               |
|---|--------------|---|--------------|-------|------------------------|------------------------|---------------|
| Parameter   | Symbol       | Test Conditions   | Min.         | Typ.  | Max.                   | Unit                   |               |
| <b>Static</b>   |              |   |              |       |                        |                        |               |
| Gate Threshold Voltage  | $V_{GS(th)}$ | $V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$   | N-Ch         | 0.45  |                        | 1                      | V             |
|   |              | $V_{DS} = V_{GS}, I_D = -250\text{ }\mu\text{A}$  | P-Ch         | -0.45 |                        | -1                     |               |
| Gate Body Leakage   | $I_{GSS}$    | $V_{DS} = 0\text{ V}, V_{GS} = \pm 4.5\text{ V}$  | N-Ch<br>P-Ch |       | $\pm 0.5$<br>$\pm 1.0$ | $\pm 1.0$<br>$\pm 2.0$ | $\mu\text{A}$ |
| Zero Gate Voltage Drain Current   | $I_{DSS}$    | $V_{DS} = 16\text{ V}, V_{GS} = 0\text{ V}$   | N-Ch         |       | 0.3                    | 100                    | nA            |
|   |              | $V_{DS} = -16\text{ V}, V_{GS} = 0\text{ V}$  | P-Ch         |       | -0.3                   | -100                   |               |
|   |              | $V_{DS} = 16\text{ V}, V_{GS} = 0\text{ V}, T_J = 85\text{ }^\circ\text{C}$   | N-Ch         |       |                        | 5                      | $\mu\text{A}$ |
|   |              | $V_{DS} = -16\text{ V}, V_{GS} = 0\text{ V}, T_J = 85\text{ }^\circ\text{C}$  | P-Ch         |       |                        | -5                     |               |
| On State Drain Current <sup>a</sup>   | $I_{D(on)}$  | $V_{DS} = 5\text{ V}, V_{GS} = 4.5\text{ V}$  | N-Ch         | 700   |                        |                        | mA            |
|   |              | $V_{DS} = -5\text{ V}, V_{GS} = -4.5\text{ V}$  | P-Ch         | -700  |                        |                        |               |
| Drain-Source On-State Resistance <sup>a</sup>                                   | $R_{DS(on)}$ | $V_{GS} = 4.5\text{ V}, I_D = 600\text{ mA}$  | N-Ch         |       | 0.41                   | 0.70                   | $\Omega$      |
|   |              | $V_{GS} = -4.5\text{ V}, I_D = -350\text{ mA}$  | P-Ch         |       | 0.80                   | 1.2                    |               |
|   |              | $V_{GS} = 2.5\text{ V}, I_D = 500\text{ mA}$  | N-Ch         |       | 0.53                   | 0.85                   |               |
|   |              | $V_{GS} = -2.5\text{ V}, I_D = -300\text{ mA}$  | P-Ch         |       | 1.20                   | 1.6                    |               |
|   |              | $V_{GS} = 1.8\text{ V}, I_D = 350\text{ mA}$  | N-Ch         |       | 0.70                   | 1.25                   |               |
|   |              | $V_{GS} = -1.8\text{ V}, I_D = -150\text{ mA}$  | P-Ch         |       | 1.80                   | 2.7                    |               |
| Forward Transconductance <sup>a</sup>   | $g_{fs}$     | $V_{DS} = 10\text{ V}, I_D = 400\text{ mA}$   | N-Ch         |       | 1.0                    |                        | S             |
|   |              | $V_{DS} = -10\text{ V}, I_D = -250\text{ mA}$   | P-Ch         |       | 0.4                    |                        |               |
| Diode Forward Voltage <sup>a</sup>  | $V_{SD}$     | $I_S = 150\text{ mA}, V_{GS} = 0\text{ V}$  | N-Ch         |       | 0.8                    | 1.2                    | V             |
|   |              | $I_S = -150\text{ mA}, V_{GS} = 0\text{ V}$   | P-Ch         |       | -0.8                   | -1.2                   |               |
| <b>Dynamic<sup>b</sup></b>  |              |   |              |       |                        |                        |               |
| Total Gate Charge   | $Q_g$        | N-Channel<br>$V_{DS} = 10\text{ V}, V_{GS} = 4.5\text{ V}, I_D = 250\text{ mA}$<br>P-Channel<br>$V_{DS} = -10\text{ V}, V_{GS} = -4.5\text{ V}, I_D = -250\text{ mA}$   | N-Ch         |       | 750                    |                        | pC            |
| Gate-Source Charge  | $Q_{gs}$     |   | N-Ch         |       | 75                     |                        |               |
|   |              |   | P-Ch         |       | 150                    |                        |               |
| Gate-Drain Charge   | $Q_{gd}$     | N-Ch  |              | 225   |                        |                        |               |
|   |              | P-Ch  |              | 450   |                        |                        |               |
| Turn-On Time  | $t_{ON}$     | N-Channel<br>$V_{DD} = 10\text{ V}, R_L = 47\text{ }\Omega$<br>$I_D \cong 200\text{ mA}, V_{GEN} = 4.5\text{ V}, R_G = 10\text{ }\Omega$<br>P-Channel<br>$V_{DD} = -10\text{ V}, R_L = 47\text{ }\Omega$<br>$I_D \cong -200\text{ mA}, V_{GEN} = -4.5\text{ V}, R_G = 10\text{ }\Omega$ | N-Ch         |       | 5                      |                        | ns            |
| Turn-Off Time   | $t_{OFF}$    |   | N-Ch         |       | 25                     |                        |               |
|   |              | P-Ch  |              | 35    |                        |                        |               |

Notes:

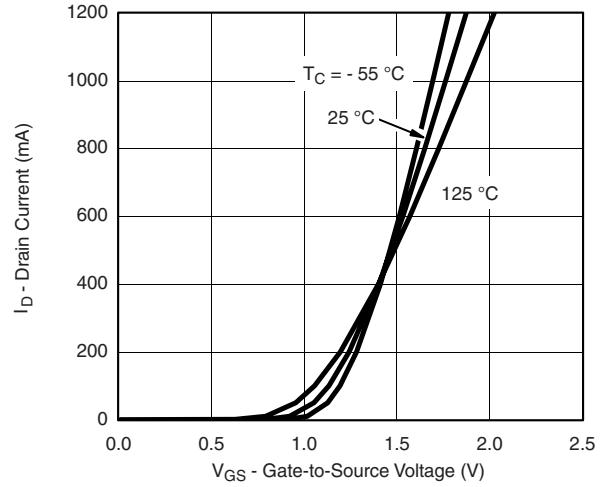
- a. Pulse test; pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .  
b. Guaranteed by design, not subject to production testing.

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

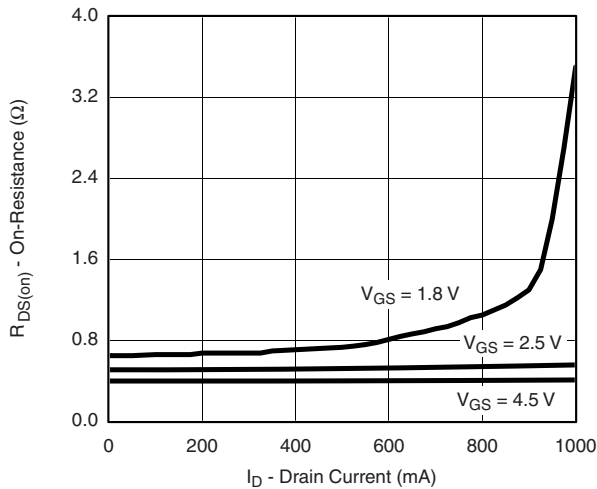
## N-CHANNEL TYPICAL CHARACTERISTICS $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted



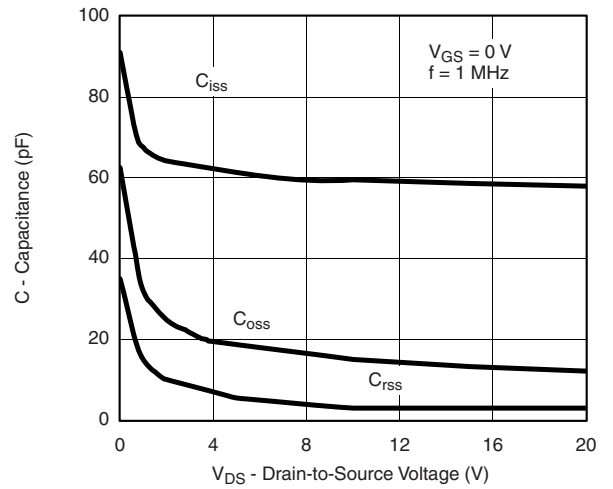
**Output Characteristics**



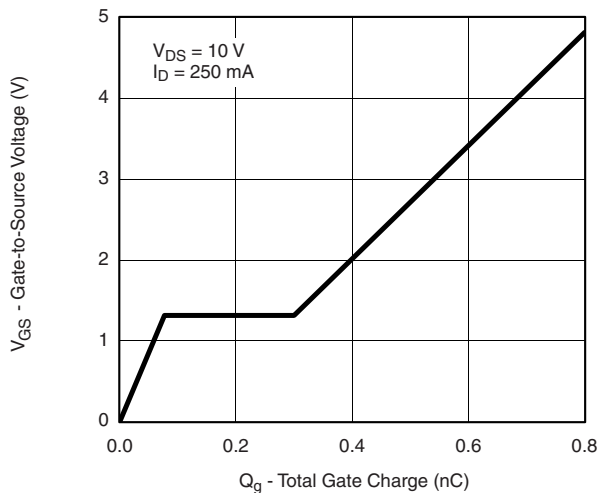
**Transfer Characteristics**



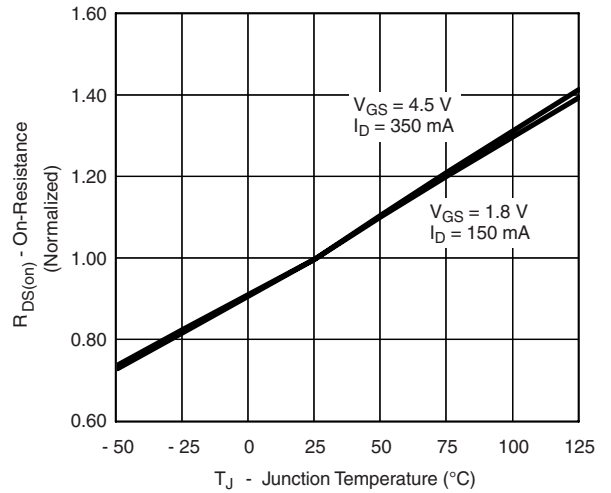
**On-Resistance vs. Drain Current**



**Capacitance**

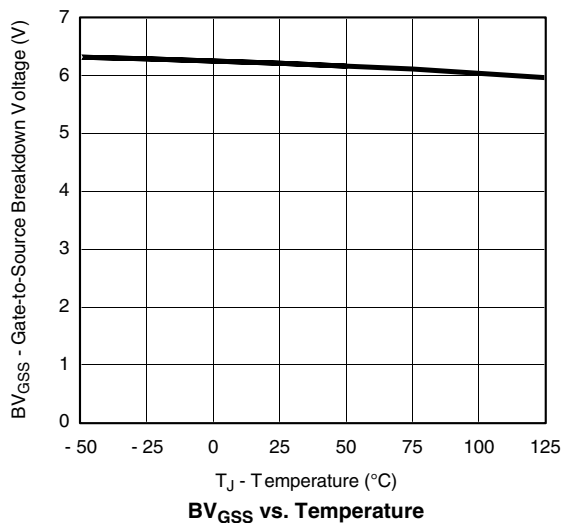
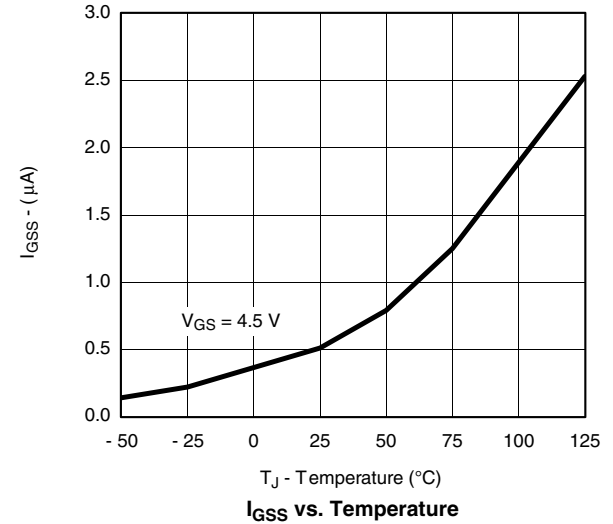
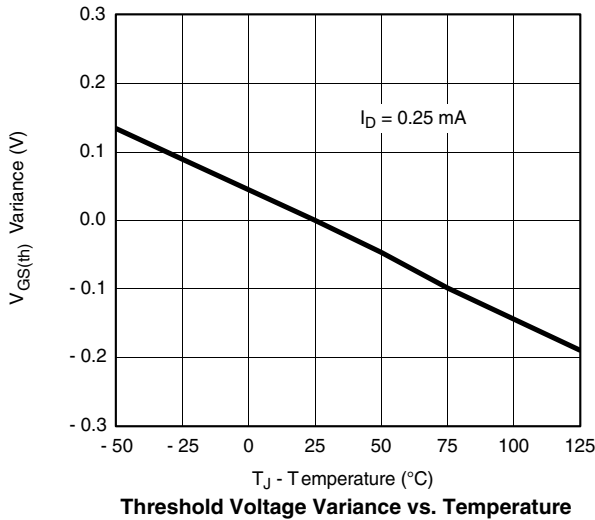
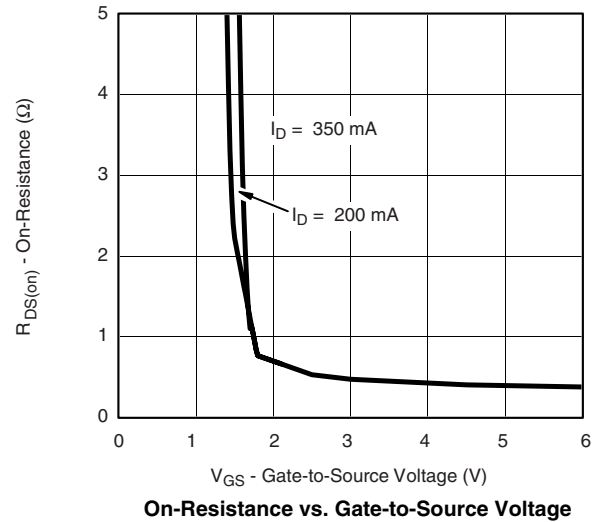
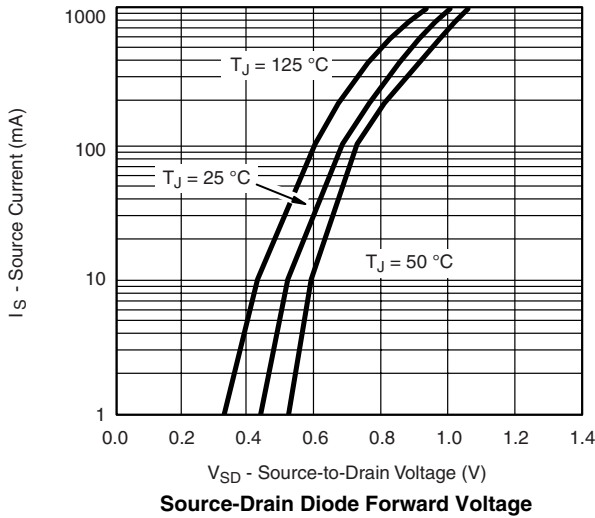


**Gate Charge**

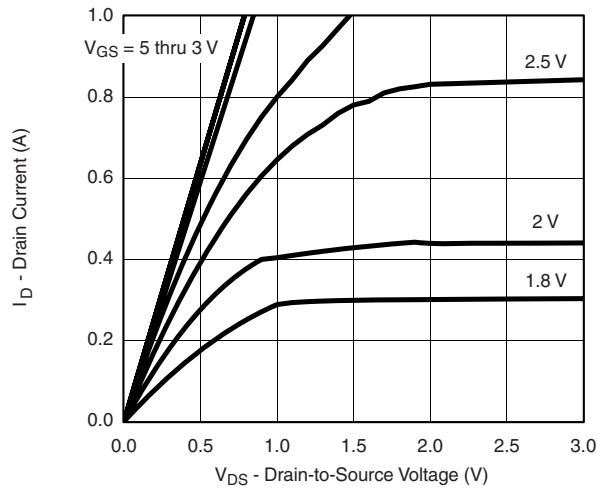


**On-Resistance vs. Junction Temperature**

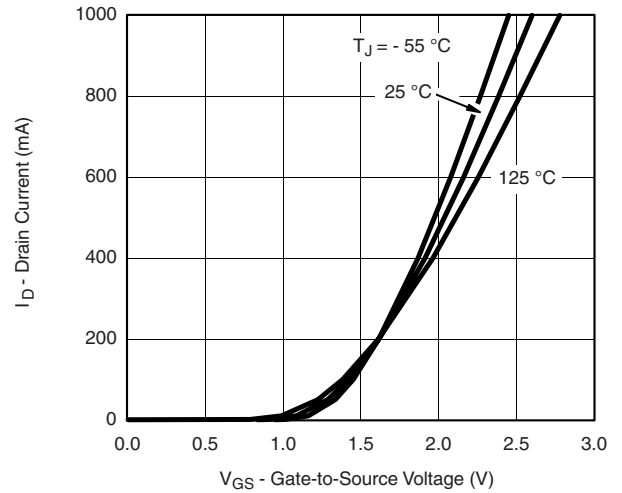
## N-CHANNEL TYPICAL CHARACTERISTICS $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted



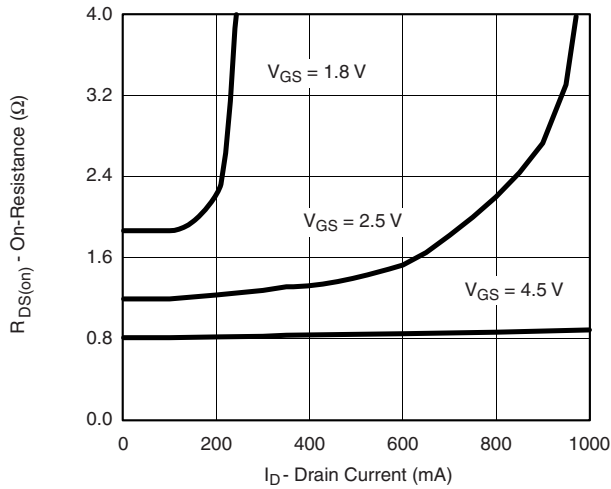
## P-CHANNEL TYPICAL CHARACTERISTICS $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted



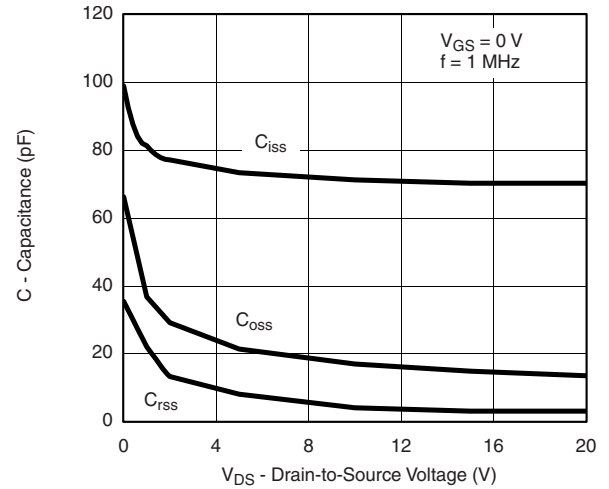
**Output Characteristics**



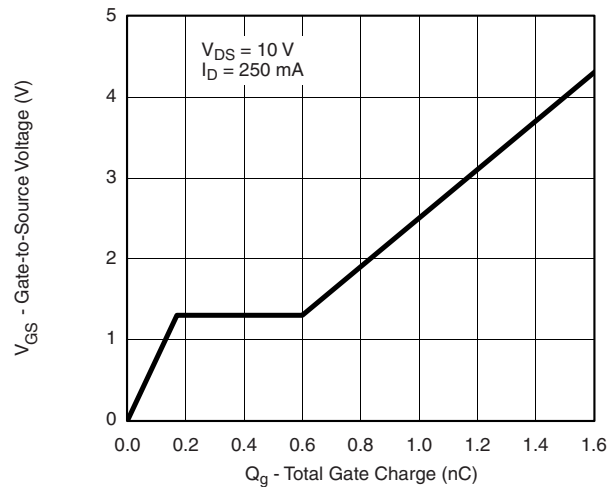
**Transfer Characteristics**



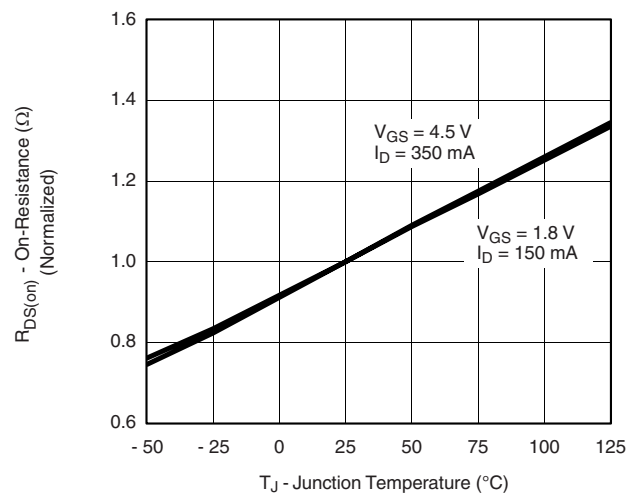
**On-Resistance vs. Drain Current**



**Capacitance**

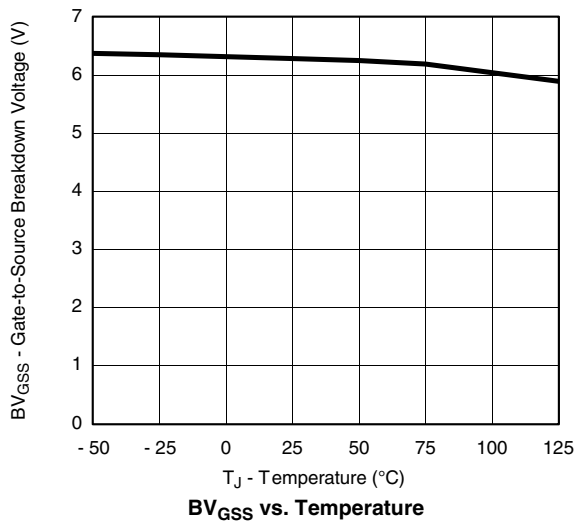
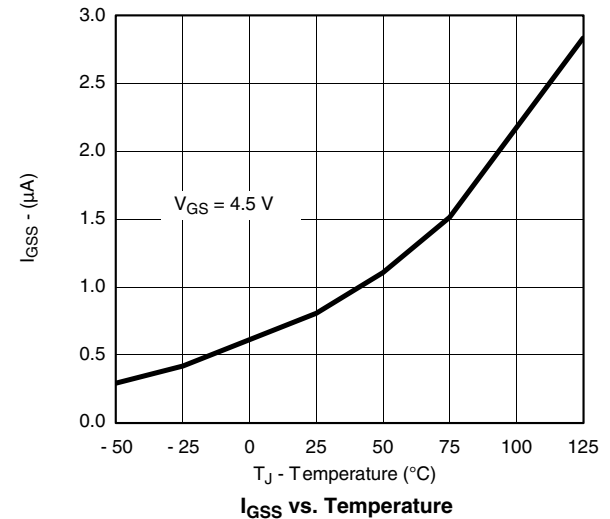
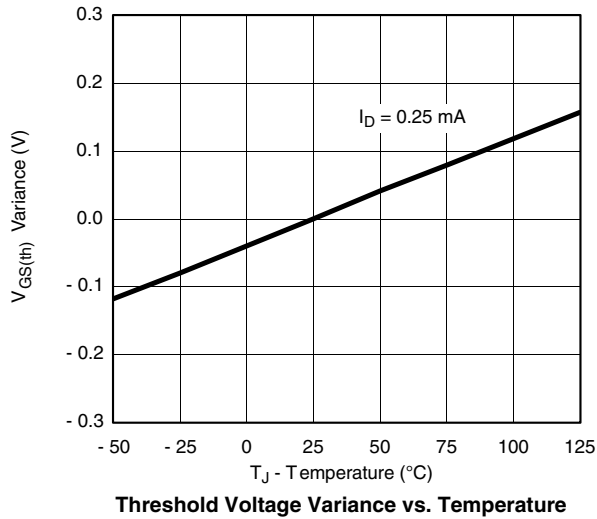
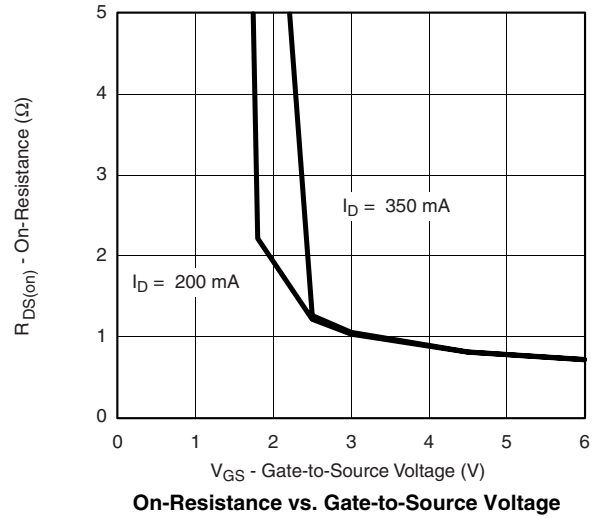
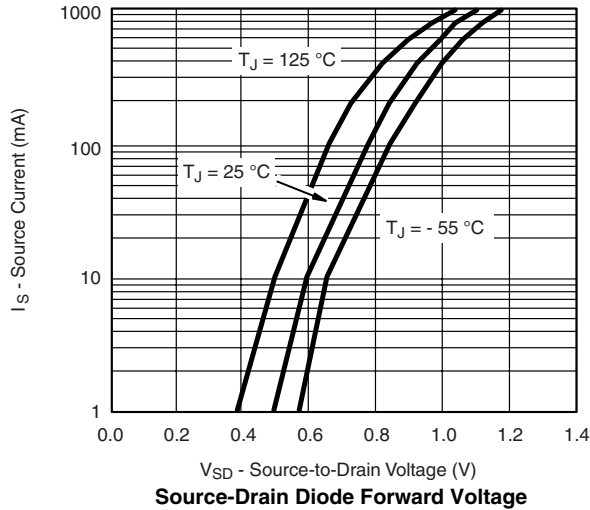


**Gate Charge**

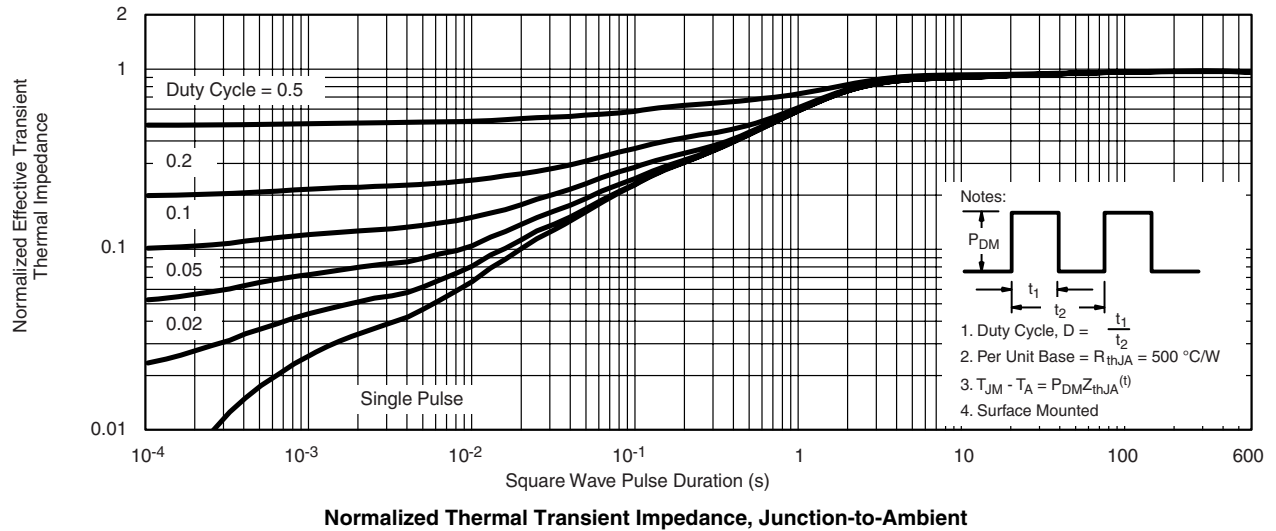


**On-Resistance vs. Junction Temperature**

**P-CHANNEL TYPICAL CHARACTERISTICS**  $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted



**N- OR P-CHANNEL TYPICAL CHARACTERISTICS**  $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted



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