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

| PRODUCT SUMMARY | | | |
|---|---|---|---|
| | $V_{DS}$ (V) | $R_{DS(on)}$ (Ω) | $I_D$ (A) |
| N-Channel | 20 | 0.0145 at $V_{GS}$ = 10 V | 9.6 |
| | | 0.017 at $V_{GS}$ = 4.5 V | 8.6 |
| P-Channel | - 20 | 0.033 at $V_{GS}$ = - 4.5 V | - 6.2 |
| | | 0.050 at $V_{GS}$ = - 2.5 V | - 5 |

## FEATURES

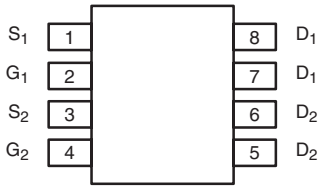
- **Halogen-free According to IEC 61249-2-21 Definition**
- TrenchFET® Power MOSFET
- Compliant to RoHS directive 2002/95/EC

Pb-free
RoHS COMPLIANT
HALOGEN FREE Available

## APPLICATIONS

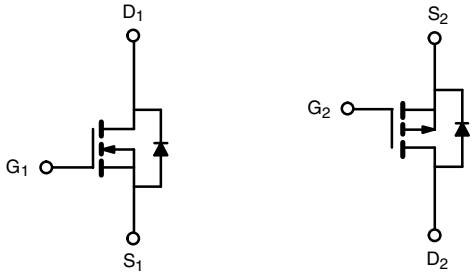
- Level Shift
- Load Switch

**SO-8**




Top View

**Ordering Information:** Si4511DY-T1-E3 (Lead (Pb)-free)
Si4511DY-T1-GE3 (Lead (Pb)-free and Halogen-free)




| ABSOLUTE MAXIMUM RATINGS $T_A$ = 25 °C, unless otherwise noted | | | | | | | |
|---|---|---|---|---|---|---|---|
| Parameter | | Symbol | N-Channel | | P-Channel | | Unit |
| | | | 10 s | Steady State | 10 s | Steady State | |
| Drain-Source Voltage | | $V_{DS}$ | 20 | | - 20 | | V |
| Gate-Source Voltage | | $V_{GS}$ | ± 16 | | ± 12 | | |
| Continuous Drain Current ($T_J$ = 150 °C)[a, b] | $T_A$ = 25 °C | $I_D$ | 9.6 | 7.2 | - 6.2 | - 4.6 | A |
| | $T_A$ = 70 °C | | 7.7 | 5.8 | - 4.9 | - 3.7 | |
| Pulsed Drain Current | | $I_{DM}$ | 40 | | - 40 | | |
| Continuous Source Current (Diode Conduction)[a] | | $I_S$ | 1.7 | 0.9 | - 1.7 | - 0.9 | |
| Maximum Power Dissipation[a] | $T_A$ = 25 °C | $P_D$ | 2 | 1.1 | 2 | 1.1 | W |
| | $T_A$ = 70 °C | | 1.3 | 0.7 | 1.3 | 0.7 | |
| Operating Junction and Storage Temperature Range | | $T_J$, $T_{stg}$ | - 55 to 150 | | | | °C |

| THERMAL RESISTANCE RATINGS | | | | | | | |
|---|---|---|---|---|---|---|---|
| Parameter | | Symbol | N-Channel | | P-Channel | | Unit |
| | | | Typ. | Max. | Typ. | Max. | |
| Maximum Junction-to-Ambient[a] | t ≤ 10 s | $R_{thJA}$ | 50 | 62.5 | 50 | 62.5 | °C/W |
| | Steady State | | 85 | 110 | 90 | 110 | |
| Maximum Junction-to-Foot (Drain) | Steady State | $R_{thJF}$ | 30 | 40 | 30 | 35 | |

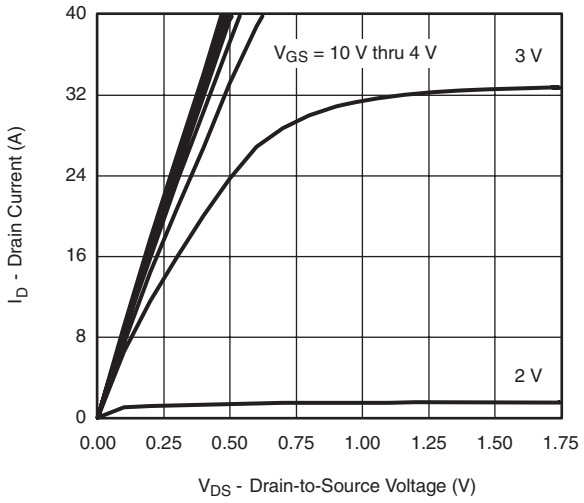
Notes:
a. Surface Mounted on 1" x 1" FR4 board.
b. t ≤ 10 s.

| **SPECIFICATIONS** $T_J$ = 25 °C, unless otherwise noted | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Parameter** | **Symbol** | **Test Conditions** | | **Min.** | **Typ.** | **Max.** | **Unit** |
| **Static** | | | | | | | |
| Gate Threshold Voltage | $V_{GS(th)}$ | $V_{DS} = V_{GS}$, $I_D$ = 250 µA | N-Ch | 0.6 | | 1.8 | V |
| | | $V_{DS} = V_{GS}$, $I_D$ = - 250 µA | P-Ch | - 0.6 | | - 1.4 | |
| Gate-Body Leakage | $I_{GSS}$ | $V_{DS}$ = 0 V, $V_{GS}$ = ± 16 V | N-Ch | | | ± 100 | nA |
| | | $V_{DS}$ = 0 V, $V_{GS}$ = ± 12 V | P-Ch | | | ± 100 | |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$ = 20 V, $V_{GS}$ = 0 V | N-Ch | | | 1 | µA |
| | | $V_{DS}$ = - 20 V, $V_{GS}$ = 0 V | P-Ch | | | - 1 | |
| | | $V_{DS}$ = 20 V, $V_{GS}$ = 0 V, $T_J$ = 55 °C | N-Ch | | | 5 | |
| | | $V_{DS}$ = - 20 V, $V_{GS}$ = 0 V, $T_J$ = 55 °C | P-Ch | | | - 5 | |
| On-State Drain Current[b] | $I_{D(on)}$ | $V_{DS}$ = 5 V, $V_{GS}$ = 10 V | N-Ch | 40 | | | A |
| | | $V_{DS}$ = - 5 V, $V_{GS}$ = - 4.5 V | P-Ch | - 40 | | | |
| Drain-Source On-State Resistance[b] | $R_{DS(on)}$ | $V_{GS}$ = 10 V, $I_D$ = 9.6 A | N-Ch | | 0.0115 | 0.0145 | Ω |
| | | $V_{GS}$ = - 4.5 V, $I_D$ = - 6.2 A | P-Ch | | 0.022 | 0.033 | |
| | | $V_{GS}$ = 4.5 V, $I_D$ = 8.6 A | N-Ch | | 0.0135 | 0.017 | |
| | | $V_{GS}$ = - 2.5 V, $I_D$ = - 5 A | P-Ch | | 0.035 | 0.050 | |
| Forward Transconductance[b] | $g_{fs}$ | $V_{DS}$ = 15 V, $I_D$ = 9.6 A | N-Ch | | 33 | | S |
| | | $V_{DS}$ = - 15 V, $I_D$ = - 6.2 A | P-Ch | | 17 | | |
| Diode Forward Voltag[b] | $V_{SD}$ | $I_S$ = 1.7 A, $V_{GS}$ = 0 V | N-Ch | | 0.8 | 1.2 | V |
| | | $I_S$ = - 1.7 A, $V_{GS}$ = 0 V | P-Ch | | - 0.8 | - 1.2 | |
| **Dynamic[a]** | | | | | | | |
| Total Gate Charge | $Q_g$ | N-Channel<br>$V_{DS}$ = 10 V, $V_{GS}$ = 4.5 V, $I_D$ = 9.6 A<br>P-Channel<br>$V_{DS}$ = - 10 V, $V_{GS}$ = - 4.5 V, $I_D$ = - 6.2 A | N-Ch | | 11.5 | 18 | nC |
| | | | P-Ch | | 17 | 20 | |
| Gate-Source Charge | $Q_{gs}$ | | N-Ch | | 3.7 | | |
| | | | P-Ch | | 4.1 | | |
| Gate-Drain Charge | $Q_{gd}$ | | N-Ch | | 3.3 | | |
| | | | P-Ch | | 4.3 | | |
| Turn-On Delay Time | $t_{d(on)}$ | N-Channel<br>$V_{DD}$ = 10 V, $R_L$ = 10 Ω<br>$I_D \cong$ 1 A, $V_{GEN}$ = 10 V, $R_g$ = 6 Ω<br>P-Channel<br>$V_{DD}$ = - 10 V, $R_L$ = 10 Ω<br>$I_D \cong$ - 1 A, $V_{GEN}$ = - 4.5 V, $R_g$ = 6 Ω | N-Ch | | 12 | 20 | ns |
| | | | P-Ch | | 25 | 40 | |
| Rise Time | $t_r$ | | N-Ch | | 12 | 20 | |
| | | | P-Ch | | 30 | 45 | |
| Turn-Off Delay Time | $t_{d(off)}$ | | N-Ch | | 55 | 85 | |
| | | | P-Ch | | 70 | 105 | |
| Fall Time | $t_f$ | | N-Ch | | 15 | 25 | |
| | | | P-Ch | | 50 | 75 | |
| Source-Drain Reverse Recovery Time | $t_{rr}$ | $I_F$ = 1.7 A, dI/dt = 100 A/µs | N-Ch | | 50 | 100 | |
| | | $I_F$ = - 1.7 A, dI/dt = 100 A/µs | P-Ch | | 40 | 80 | |

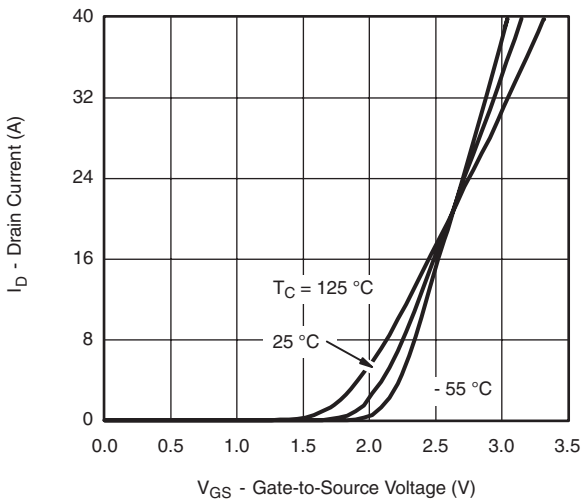
Notes:
a. Guaranteed by design, not subject to production testing.
b. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %.

*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.*

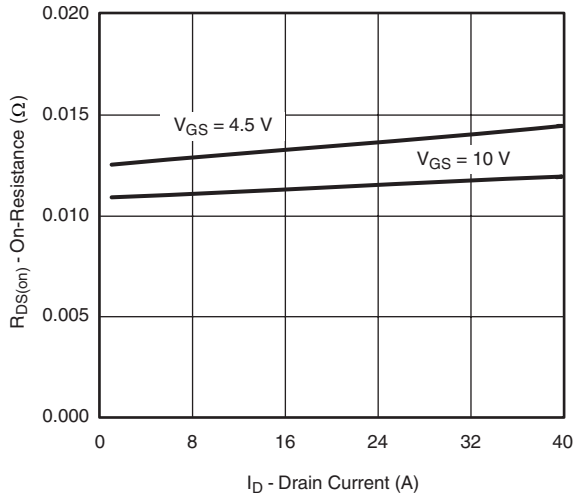
## N-CHANNEL TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



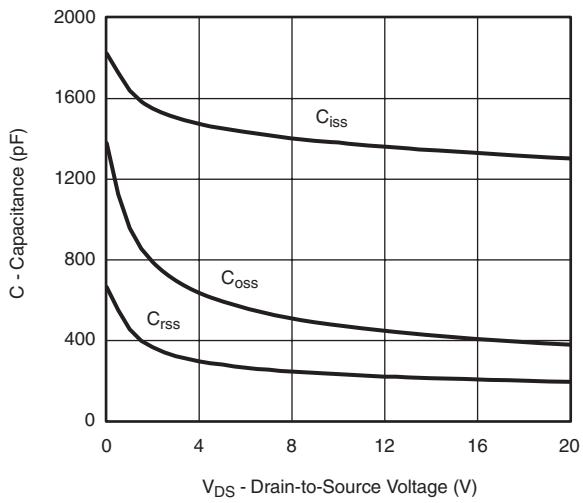

**Output Characteristics**



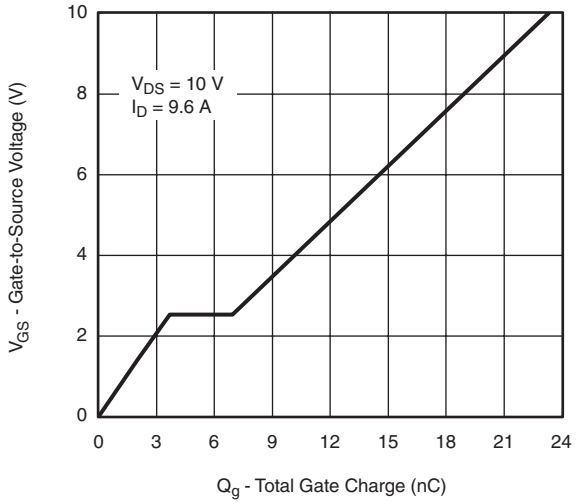

**Transfer Characteristics**



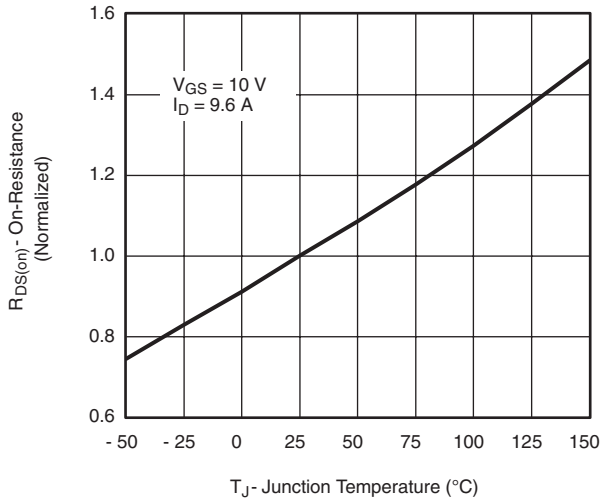

**On-Resistance vs. Drain Current**




**Capacitance**

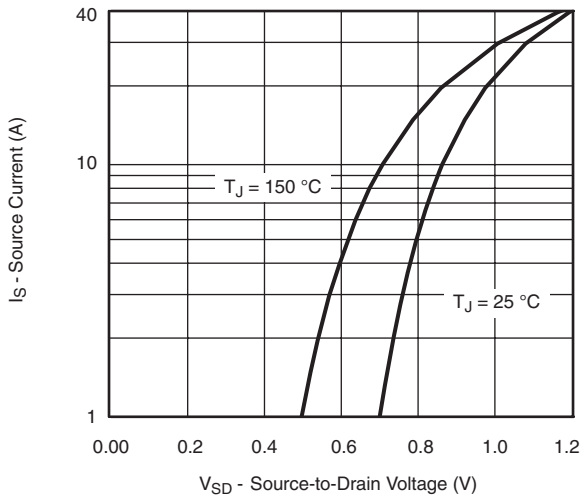



**Gate Charge**

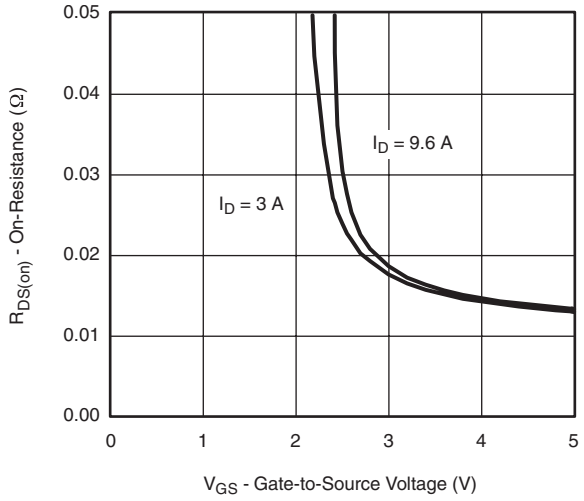



**On-Resistance vs. Junction Temperature**

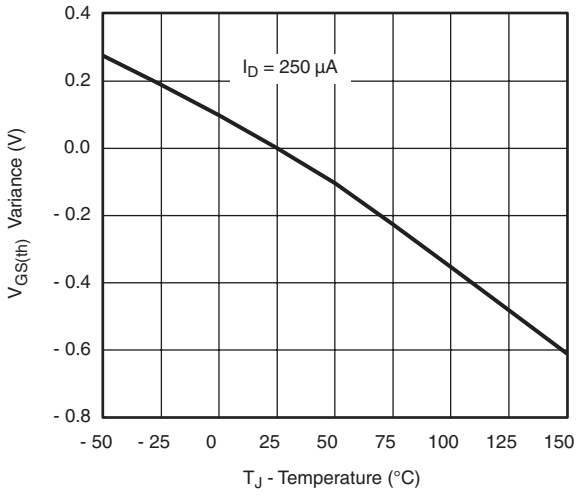
## N-CHANNEL TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



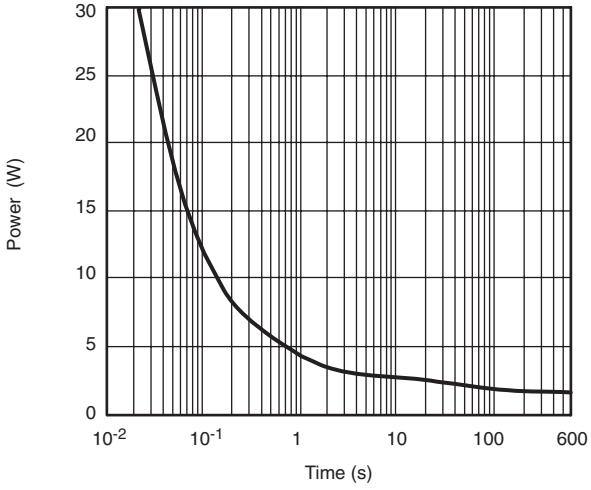

**Source-Drain Diode Forward Voltage**



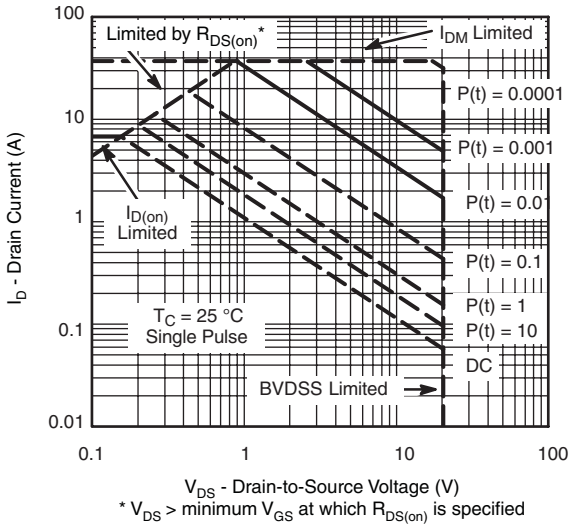

**On-Resistance vs. Gate-to-Source Voltage**




**Threshold Voltage**



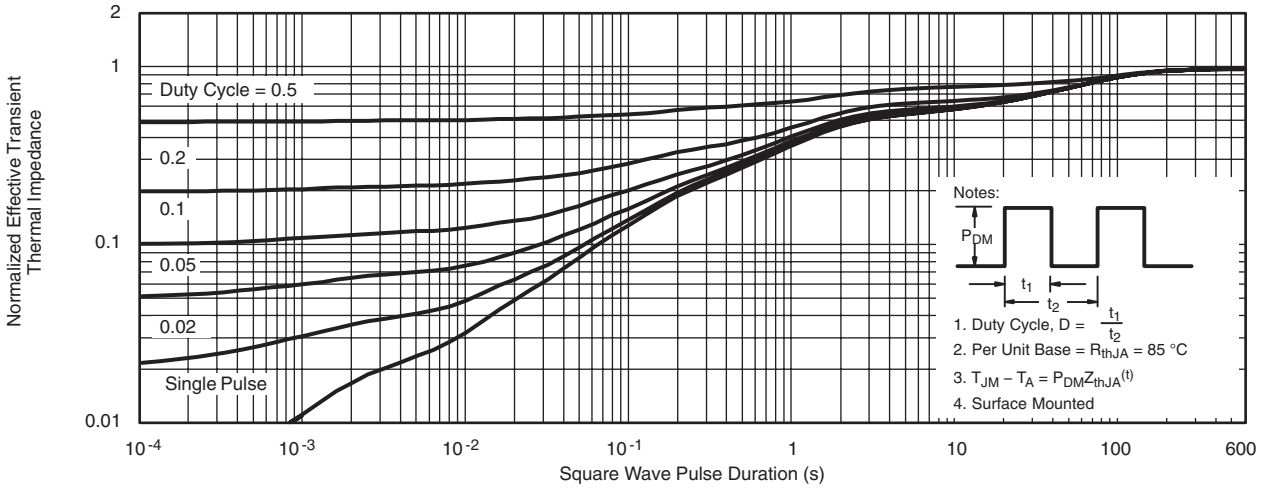

**Single Pulse Power**



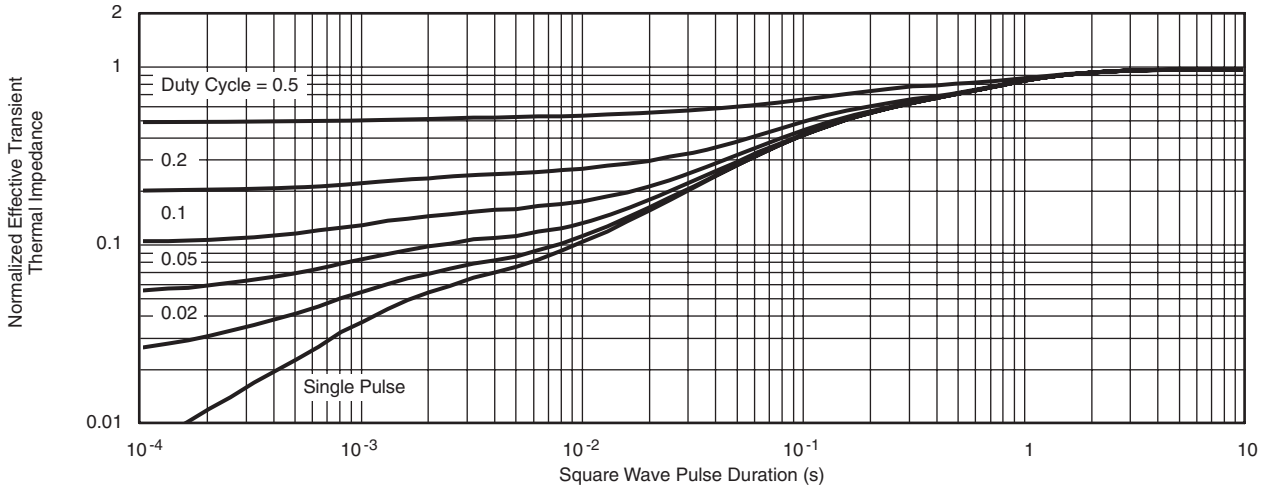

* $V_{DS}$ > minimum $V_{GS}$ at which $R_{DS(on)}$ is specified

**Safe Operating Area**

## N-CHANNEL TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted

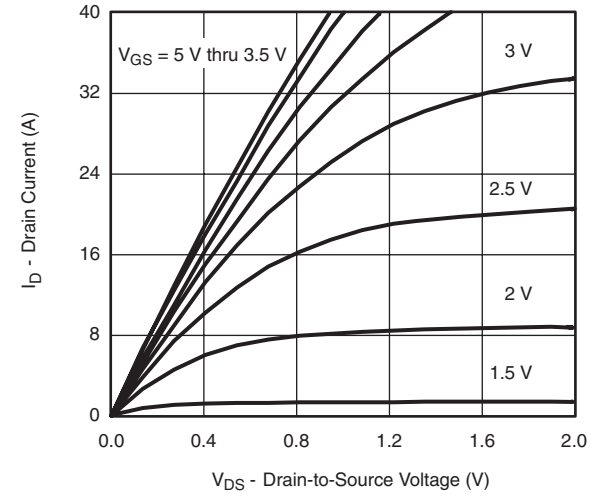



**Normalized Thermal Transient Impedance, Junction-to-Ambient**

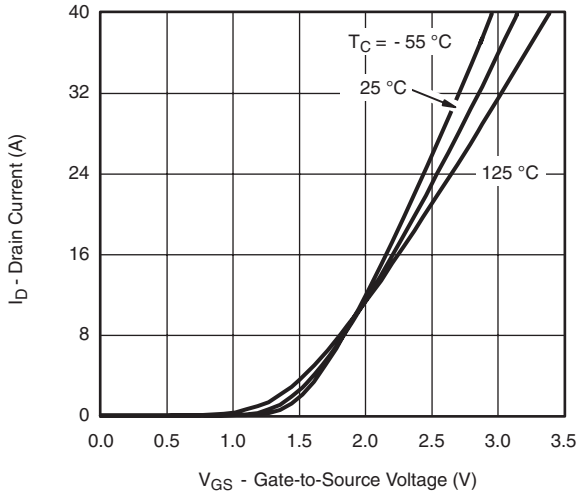



**Normalized Thermal Transient Impedance, Junction-to-Foot**

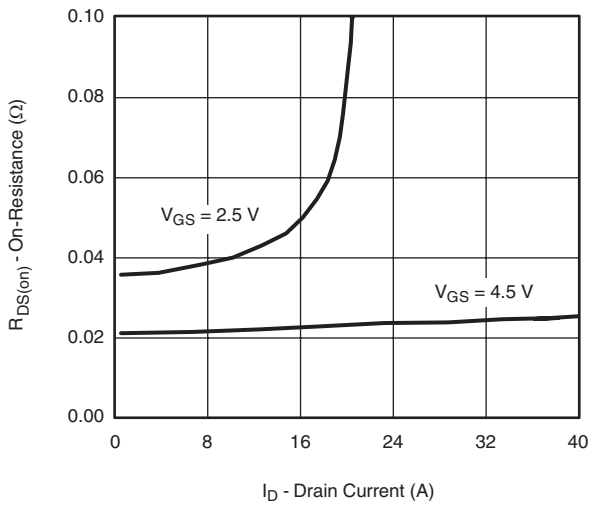
## P-CHANNEL TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



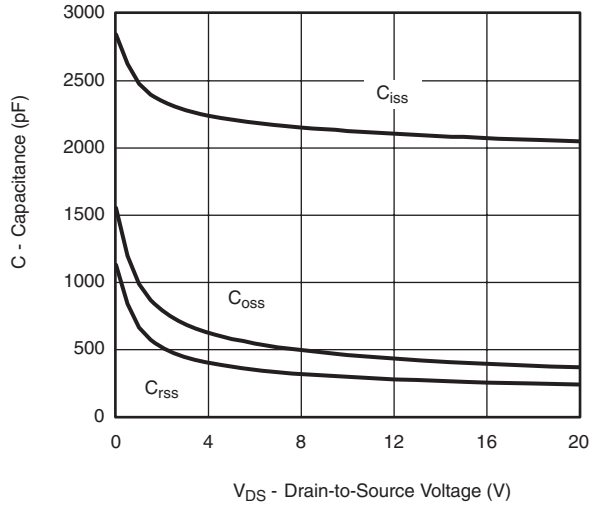

**Output Characteristics**



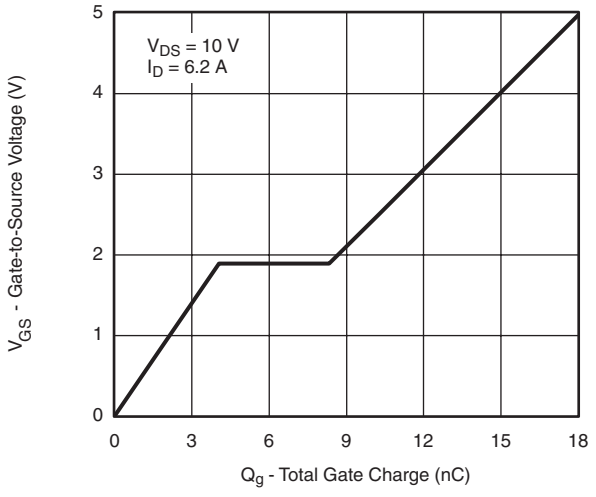

**Transfer Characteristics**



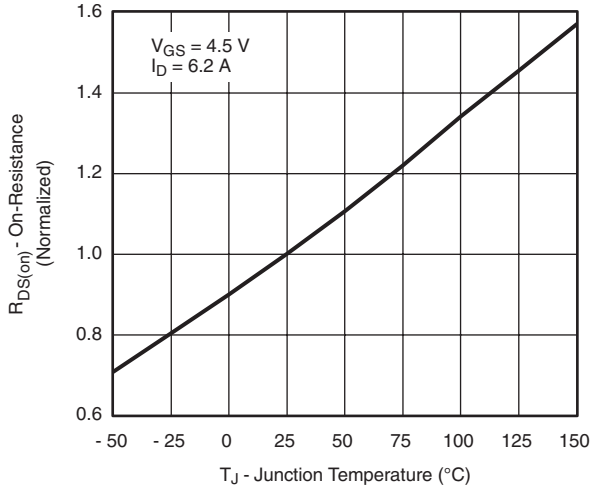

**On-Resistance vs. Drain Current**




**Capacitance**

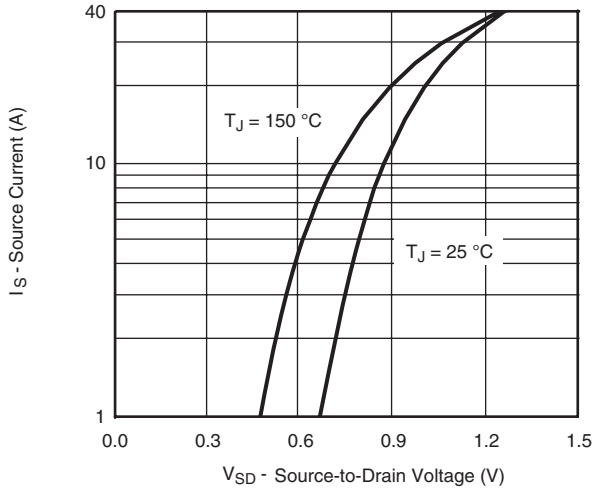



**Gate Charge**

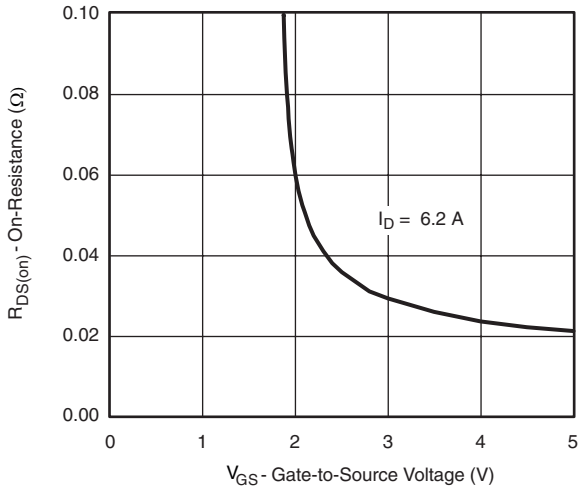



**On-Resistance vs. Junction Temperature**

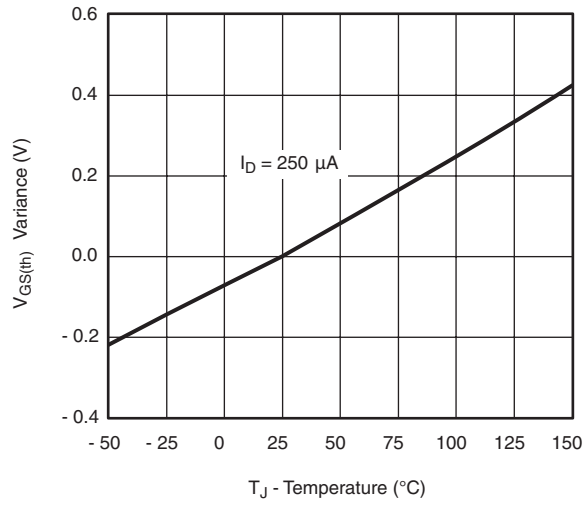
## P-CHANNEL TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



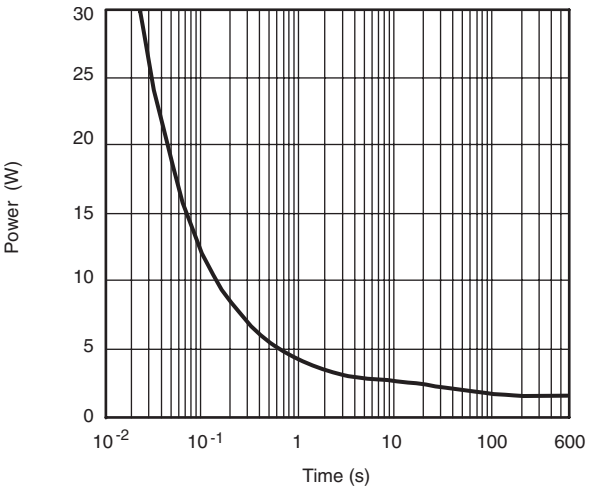

**Source-Drain Diode Forward Voltage**



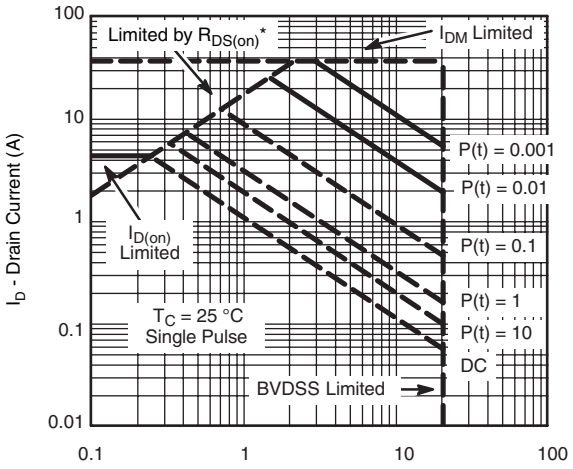

**On-Resistance vs. Gate-to-Source Voltage**




**Threshold Voltage**

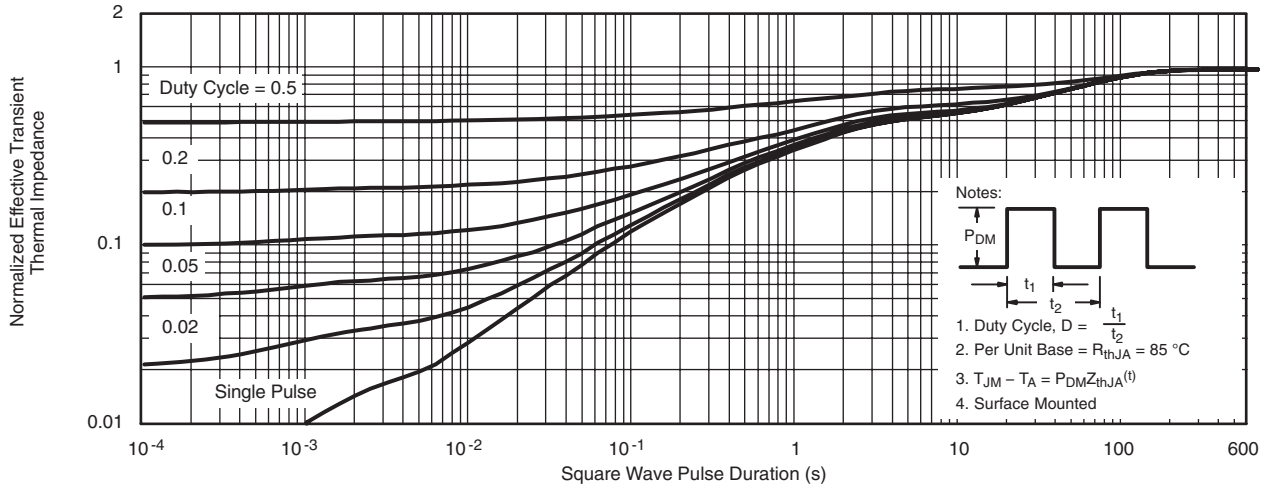



**Single Pulse Power**

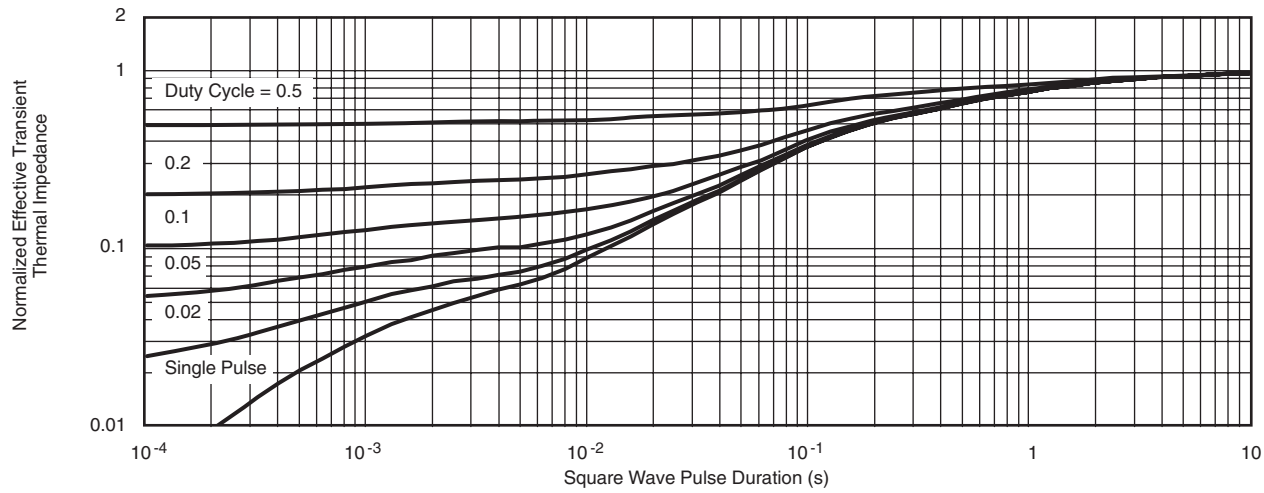



**Safe Operating Area**

## P-CHANNEL TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted




**Normalized Thermal Transient Impedance, Junction-to-Ambient**




**Normalized Thermal Transient Impedance, Junction-to-Foot**

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