# N-Channel 60-V (D-S) MOSFET

**Zener Gate Protected**

| PRODUCT SUMMARY | | | |
|---|---|---|---|
| $V_{(BR)DSS}$ Min (V) | $r_{DS(on)}$ Max (Ω) | $V_{GS(th)}$ (V) | $I_D$ (A) |
| 60 | 5 @ $V_{GS}$ = 10 V | 0.8 to 2.5 | 0.31 |

## FEATURES

- Zener Diode Input Protected
- Low On-Resistance: 3 Ω
- Ultralow Threshold: 1.2 V
- Low Input Capacitance: 38 pF
- Low Input and Output Leakage

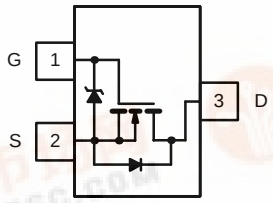
## BENEFITS

- Extra ESD Protection
- Low Offset Voltage
- Low-Voltage Operation
- High-Speed, Easily Driven
- Low Error Voltage

## APPLICATIONS

- Drivers: Relays, Solenoids, Lamps, Hammers, Displays, Memories, Transistors, etc.
- Battery Operated Systems
- Solid-State Relays
- Inductive Load Drivers

**SC-59**




Top View

VN10KC

Marking Code: F1*w*/*l*

F1 = Part Number Code for VN10KC
*w* = Week Code
*l*/ = Lot Traceability

## ABSOLUTE MAXIMUM RATINGS ($T_A$ = 25°C UNLESS OTHERWISE NOTED)

| Parameter | | Symbol | Limits | Unit |
|---|---|---|---|---|
| Drain-Source Voltage | | $V_{DS}$ | 60 | V |
| Gate-Source Voltage | | $V_{GS}$ | 15/–0.3 | |
| Continuous Drain Current ($T_J$ = 150°C) | $T_A$= 25°C | $I_D$ | 0.31 | A |
| | $T_A$= 100°C | | 0.20 | |
| Pulsed Drain Current[a] | | $I_{DM}$ | 0.6 | |
| Power Dissipation | $T_A$= 25°C | $P_D$ | 0.6 | W |
| | $T_A$= 100°C | | 0.24 | |
| Maximum Junction-to-Ambient | | $R_{thJA}$ | 208 | °C/W |
| Operating Junction and Storage Temperature Range | | $T_J$, $T_{stg}$ | –55 to 150 | °C |

Notes:
a. Pulse width limited by maximum junction temperature.

## SPECIFICATIONS ($T_A$ = 25°C UNLESS OTHERWISE NOTED)

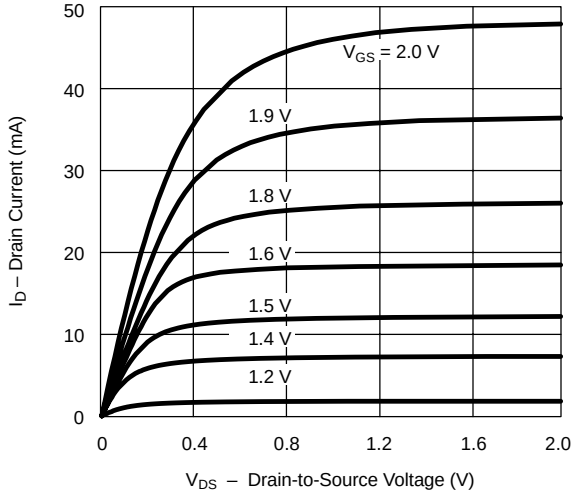
| Parameter | Symbol | Test Conditions | Typ[a] | Limits Min | Limits Max | Unit |
|---|---|---|---|---|---|---|
| **Static** | | | | | | |
| Drain-Source Breakdown Voltage | $V_{(BR)DSS}$ | $V_{GS}$ = 0 V, $I_D$ = 100 μA | 120 | 60 | | V |
| Gate-Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$ = $V_{GS}$, $I_D$ = 1 mA | 1.2 | 0.8 | 2.5 | |
| Gate-Body Leakage | $I_{GSS}$ | $V_{DS}$ = 0 V, $V_{GS}$ = 15 V | 1 | | 100 | nA |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$ = 48 V, $V_{GS}$ = 0 V | | | 10 | μA |
| | | $T_A$ = 125°C | | | 500 | |
| On-State Drain Current[b] | $I_{D(on)}$ | $V_{DS}$ = 10 V, $V_{GS}$ = 10 V | 1 | 0.75 | | A |
| Drain-Source On-Resistance[b] | $r_{DS(on)}$ | $V_{GS}$ = 5 V, $I_D$ = 0.2 A | 4 | | 7.5 | Ω |
| | | $V_{GS}$ = 10 V, $I_D$ = 0.5 A | 3 | | 5 | |
| | | $T_A$ = 125°C | 5.6 | | 9 | |
| Forward Transconductance[b] | $g_{fs}$ | $V_{DS}$ = 10 V, $I_D$ = 0.5 A | 300 | 100 | | mS |
| Common Source Output Conductance[b] | $g_{os}$ | $V_{DS}$ = 7.5 V, $I_D$ = 0.05 A | 0.2 | | | |
| **Dynamic** | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{DS}$ = 25 V, $V_{GS}$ = 0 V, f = 1 MHz | 38 | | 60 | pF |
| Output Capacitance | $C_{oss}$ | | 16 | | 25 | |
| Reverse Transfer Capacitance | $C_{rss}$ | | 2 | | 5 | |
| **Switching[c]** | | | | | | |
| Turn-On Time | $t_{ON}$ | $V_{DD}$ = 15 V, $R_L$ = 23 Ω<br>$I_D$ ≅ 0.6 A, $V_{GEN}$ = 10 V<br>$R_G$ = 25 Ω | 7 | | 10 | ns |
| Turn-Off Time | $t_{OFF}$ | | 9 | | 10 | |

Notes
a. For DESIGN AID ONLY, not subject to production testing.
b. Pulse test: PW ≤ 300 μs duty cycle ≤ 2%.
c. Switching time is essentially independent of operating temperature.

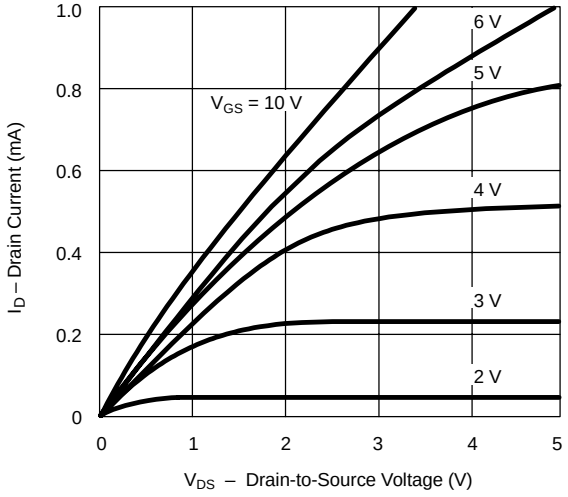
VNDP06

## TYPICAL CHARACTERISTICS ($T_A$ = 25°C UNLESS OTHERWISE NOTED)

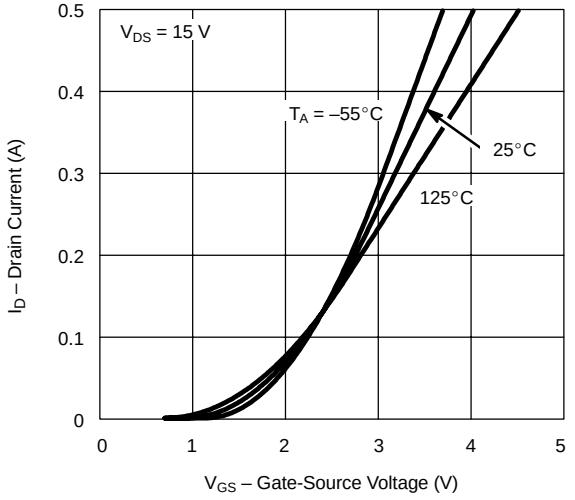
**Ohmic Region Characteristics**



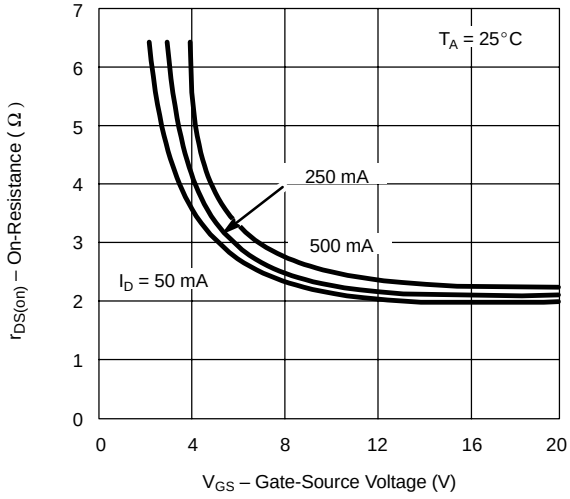

**Output Characteristics for Low Gate Drive**



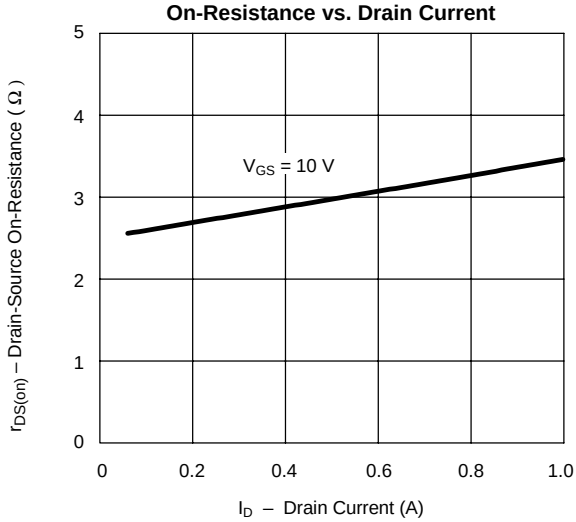

**Transfer Characteristics**



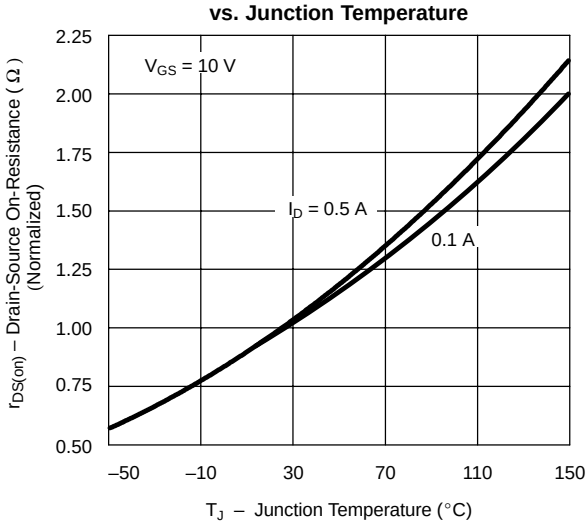

**On-Resistance vs. Gate-to-Source Voltage**




**On-Resistance vs. Drain Current**

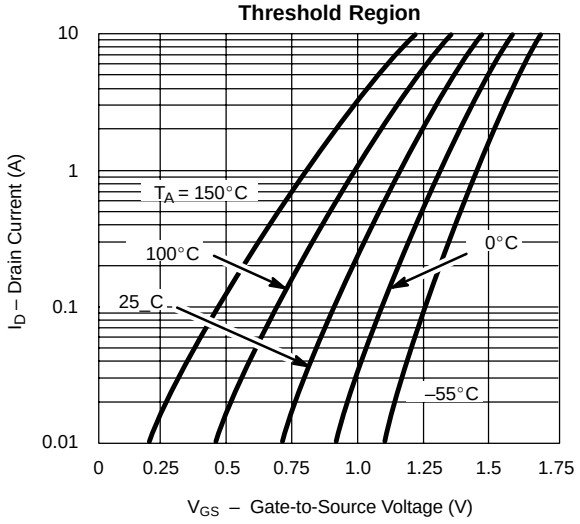



**Normalized On-Resistance vs. Junction Temperature**

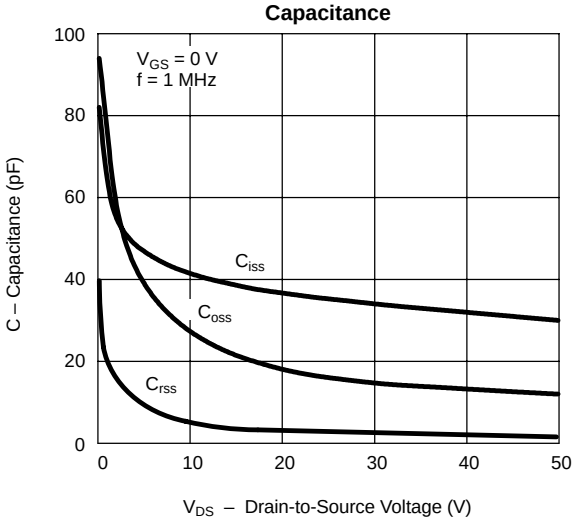


## TYPICAL CHARACTERISTICS ($T_A$ = 25°C UNLESS OTHERWISE NOTED)

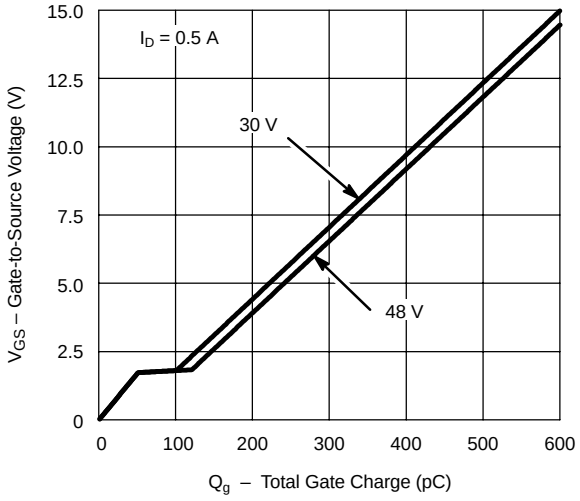
**Threshold Region**




**Capacitance**




**Gate Charge**




**Load Condition Effects on Switching**