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

| PRODUCT SUMMARY | | | |
|---|---|---|---|
| $V_{DS}$ (V) | $R_{DS(on)}$ (Ω) | $I_D$ (A) | $Q_g$ (Typ.) |
| 60 | 0.012 at $V_{GS}$ = 10 V | 60[d] | 33 |

## FEATURES

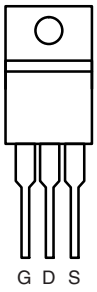
- **Halogen-free According to IEC 61249-2-21 Definition**
- TrenchFET® Power MOSFET
- 100 % $R_g$ Tested
- 100 % UIS Tested
- Compliant to RoHS Directive 2002/95/EC

RoHS COMPLIANT
HALOGEN FREE Available

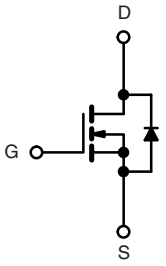
## APPLICATIONS

- Synchronous Rectifier
- Power Supplies

**TO-220AB**




Top View




N-Channel MOSFET

**Ordering Information:** SUP60N06-12P-E3 (Lead (Pb)-free)
SUP60N06-12P-GE3 (Lead (Pb)-free and Halogen-free)

| ABSOLUTE MAXIMUM RATINGS $T_C$ = 25 °C, unless otherwise noted | | | | |
|---|---|---|---|---|
| **Parameter** | | **Symbol** | **Limit** | **Unit** |
| Drain-Source Voltage | | $V_{DS}$ | 60 | V |
| Gate-Source Voltage | | $V_{GS}$ | ± 20 | |
| Continuous Drain Current ($T_J$ = 150 °C) | $T_C$ = 25 °C | $I_D$ | 60[d] | A |
| | $T_C$ = 70 °C | | 54[d] | |
| Pulsed Drain Current | | $I_{DM}$ | 80 | |
| Avalanche Current | | $I_{AS}$ | 40 | |
| Single Avalanche Energy[a] | L = 0.1 mH | $E_{AS}$ | 80 | mJ |
| Maximum Power Dissipation[a] | $T_C$ = 25 °C | $P_D$ | 100[b] | W |
| | $T_A$ = 25 °C[c] | | 3.25 | |
| Operating Junction and Storage Temperature Range | | $T_J$, $T_{stg}$ | - 55 to 150 | °C |

| THERMAL RESISTANCE RATINGS | | | |
|---|---|---|---|
| **Parameter** | **Symbol** | **Limit** | **Unit** |
| Junction-to-Ambient (PCB Mount)[c] | $R_{thJA}$ | 40 | °C/W |
| Junction-to-Case (Drain) | $R_{thJC}$ | 1.25 | |

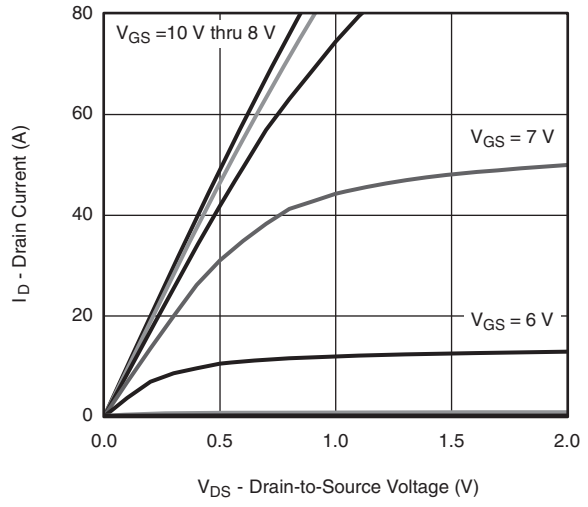
Notes:
a. Duty cycle ≤ 1 %.
b. See SOA curve for voltage derating.
c. When Mounted on 1" square PCB (FR-4 material).
d. Package limited.

| **SPECIFICATIONS** $T_J$ = 25 °C, unless otherwise noted | | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **Symbol** | **Test Conditions** | **Min.** | **Typ.** | **Max.** | **Unit** |
| **Static** | | | | | | |
| Drain-Source Breakdown Voltage | $V_{DS}$ | $V_{DS}$ = 0 V, $I_D$ = 250 µA | 60 | | | V |
| Gate Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 µA | 2.5 | | 4.5 | |
| Gate-Body Leakage | $I_{GSS}$ | $V_{DS}$ = 0 V, $V_{GS}$ = ± 20 V | | | ± 250 | nA |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$ = 60 V, $V_{GS}$ = 0 V | | | 1 | µA |
| | | $V_{DS}$ = 60 V, $V_{GS}$ = 0 V, $T_J$ = 125 °C | | | 50 | |
| | | $V_{DS}$ = 60 V, $V_{GS}$ = 0 V, $T_J$ = 150 °C | | | 250 | |
| On-State Drain Current[a] | $I_{D(on)}$ | $V_{DS}$ ≥ 10 V, $V_{GS}$ = 10 V | 80 | | | A |
| Drain-Source On-State Resistance[a] | $R_{DS(on)}$ | $V_{GS}$ = 10 V, $I_D$ = 30 A | | 0.0098 | 0.012 | Ω |
| | | $V_{GS}$ = 10 V, $I_D$ = 30 A, $T_J$ = 125 °C | | 0.0155 | 0.019 | |
| Forward Transconductance[a] | $g_{fs}$ | $V_{DS}$ = 15 V, $I_D$ = 15 A | | 37 | | S |
| **Dynamic[b]** | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{GS}$ = 0 V, $V_{DS}$ = 30 V, f = 1 MHz | | 1970 | | pF |
| Output Capacitance | $C_{oss}$ | | | 310 | | |
| Reverse Transfer Capacitance | $C_{rss}$ | | | 110 | | |
| Total Gate Charge[c] | $Q_g$ | $V_{DS}$ = 30 V, $V_{GS}$ = 10 V, $I_D$ = 20 A | | 33 | 55 | nC |
| Gate-Source Charge[c] | $Q_{gs}$ | | | 11 | | |
| Gate-Drain Charge[c] | $Q_{gd}$ | | | 9 | | |
| Gate Resistance | $R_g$ | f = 1 MHz | 0.3 | 1.4 | 2.8 | Ω |
| Turn-On Delay Time[c] | $t_{d(on)}$ | $V_{DD}$ = 30 V, $R_L$ = 1.53 Ω<br>$I_D$ ≅ 20 A, $V_{GEN}$ = 10 V, $R_g$ = 1 Ω | | 11 | 20 | ns |
| Rise Time[c] | $t_r$ | | | 11 | 20 | |
| Turn-Off Delay Time[c] | $t_{d(off)}$ | | | 16 | 30 | |
| Fall Time[c] | $t_f$ | | | 8 | 15 | |
| **Source-Drain Diode Ratings and Characteristics** $T_C$ = 25 °C[b] | | | | | | |
| Continuous Current | $I_S$ | | | | 60 | A |
| Pulsed Current | $I_{SM}$ | | | | 80 | |
| Forward Voltage[a] | $V_{SD}$ | $I_F$ = 10 A, $V_{GS}$ = 0 V | | 0.84 | 1.5 | V |
| Reverse Recovery Time | $t_{rr}$ | $I_F$ = 10 A, dI/dt = 100 A/µs | | 40 | 80 | ns |
| Peak Reverse Recovery Current | $I_{RM(REC)}$ | | | 3.2 | 5.0 | A |
| Reverse Recovery Charge | $Q_{rr}$ | | | 64 | 120 | nC |

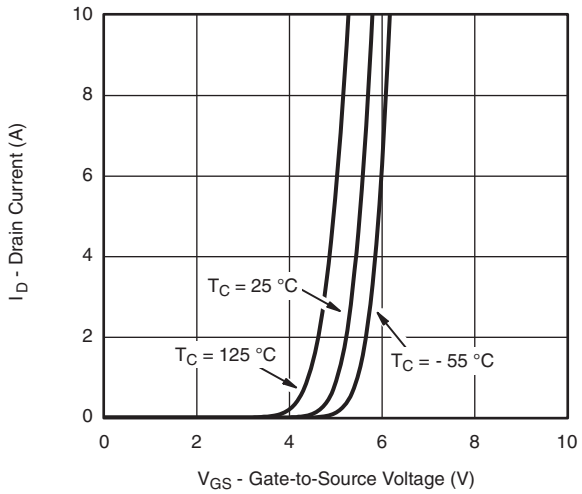
Notes:
a. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %.
b. Guaranteed by design, not subject to production testing.
c. Independent of operating temperature.

*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.*

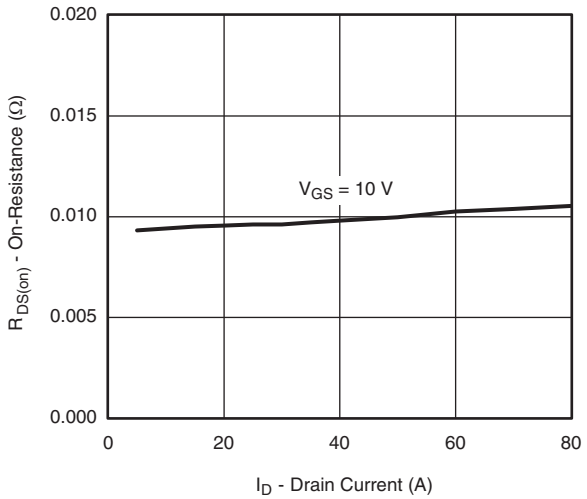
## TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



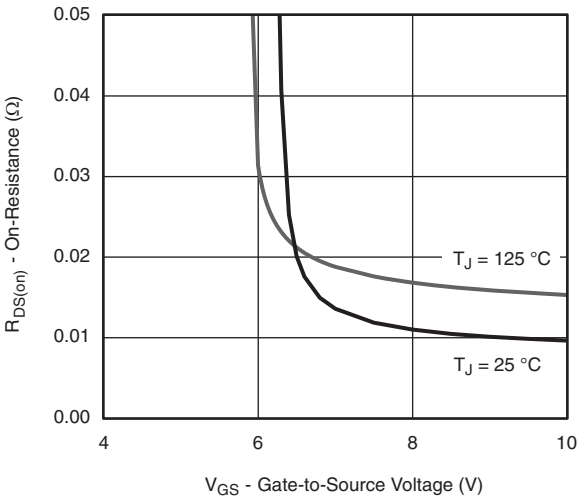

**Output Characteristics**



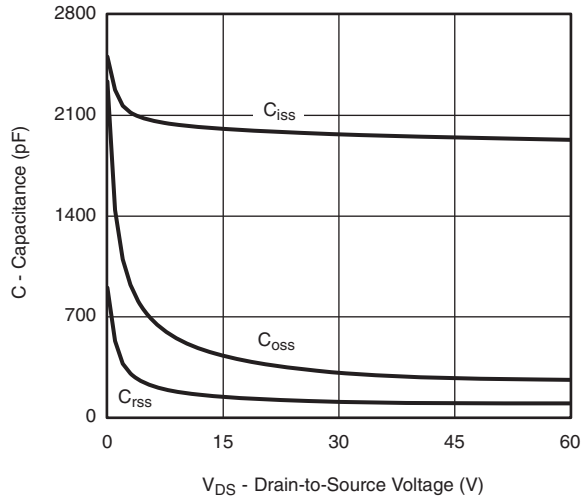

**Transfer Characteristics**



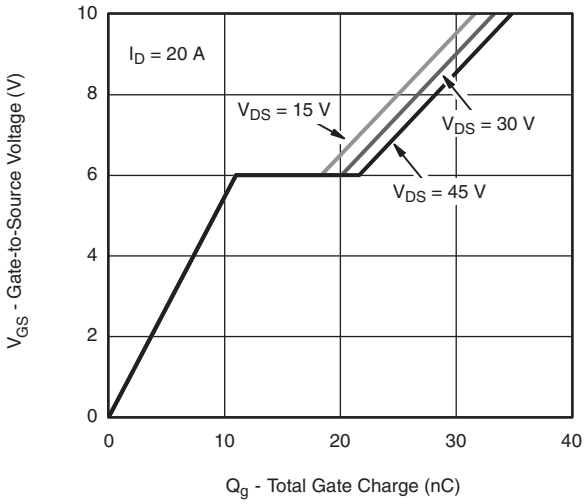

**On-Resistance vs. Drain Current**




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

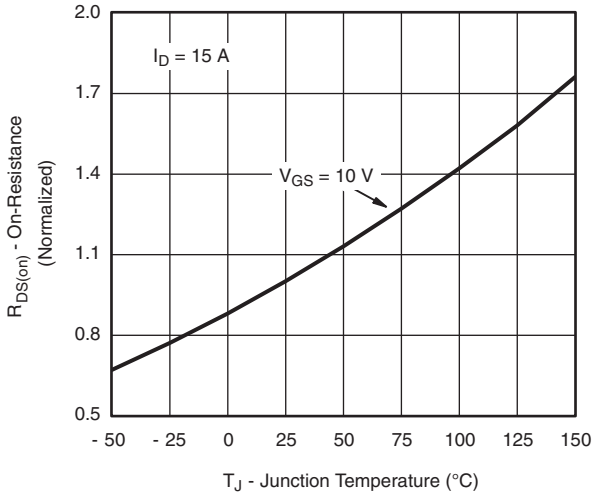



**Capacitance**

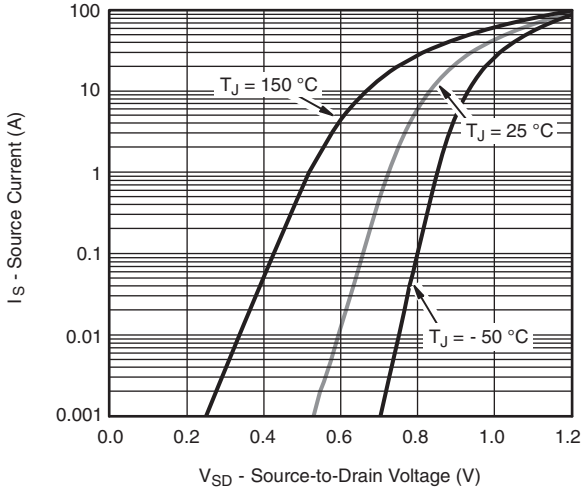



**Gate Charge**

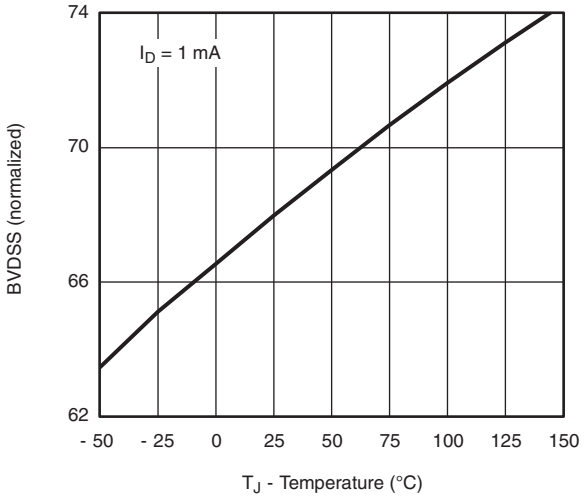
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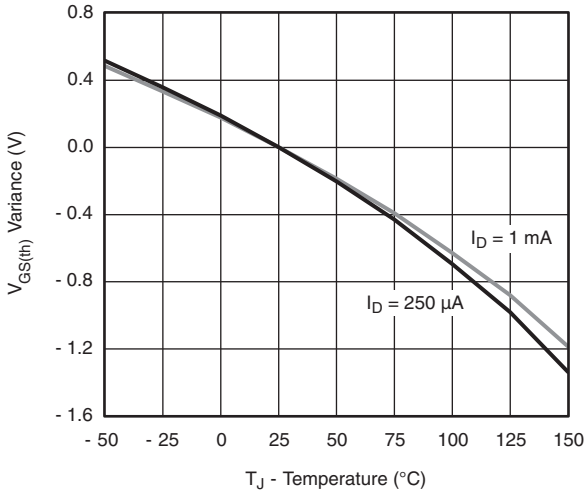

**On-Resistance vs. Junction Temperature**



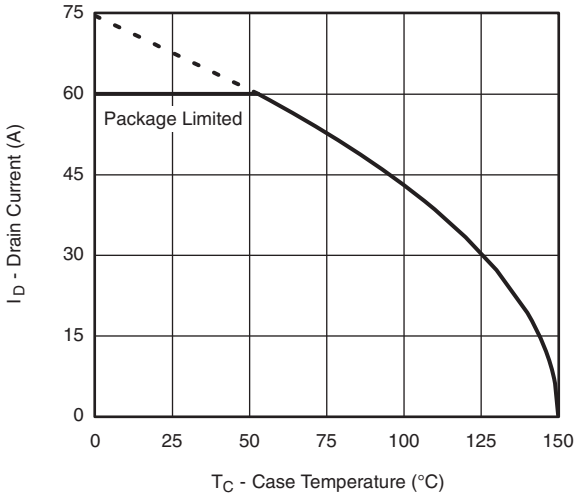

**Source-Drain Diode Forward Voltage**




**Drain-Source Breakdown vs. Junction Temperature**

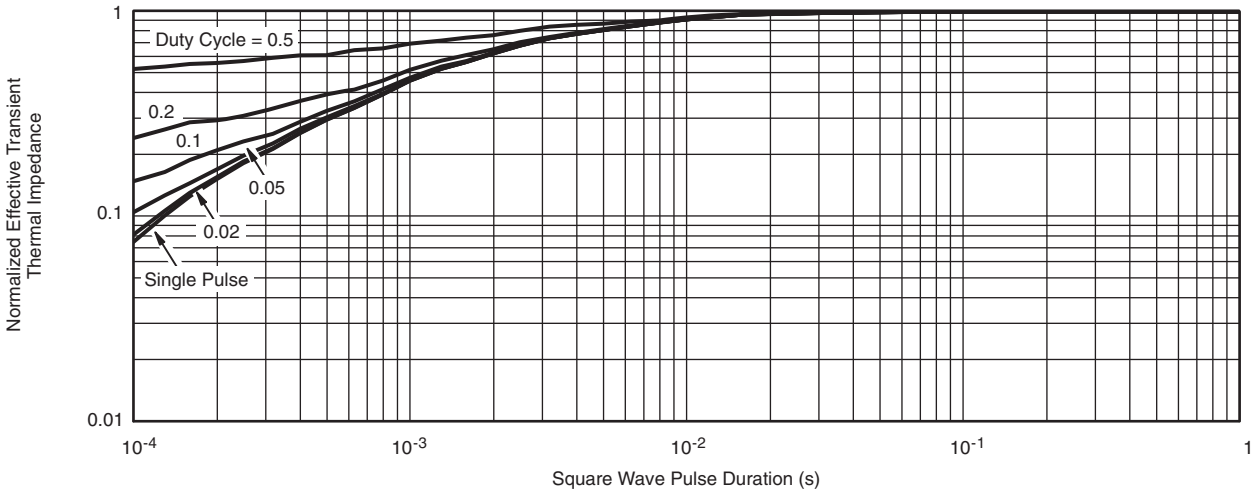



**Threshold Voltage**




**Maximum Drain Current vs. Case Temperature**

## TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted




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

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