# N-Channel 40-V (D-S) MOSFET with Sensing Diode

| PRODUCT SUMMARY | | |
|---|---|---|
| $V_{(BR)DSS}$ (V) | $r_{DS(on)}$ (Ω) | $I_D$ (A) |
| 40 | 0.0045 at $V_{GS}$ = 10 V | 60[a] |
| | 0.0065 at $V_{GS}$ = 4.5 V | 20[a] |

## FEATURES

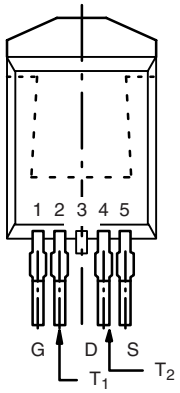
- TrenchFET® Power MOSFETS Plus Temperature Sensing Diode
- 175 °C Junction Temperature
- Low Thermal Resistance Package

Pb Available
RoHS* COMPLIANT

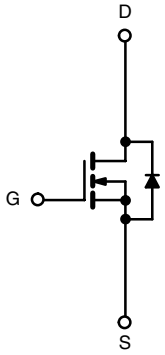
## APPLICATIONS

- Industrial

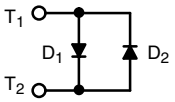
D²PAK-5L




**Ordering Information:** SUM60N04-05LT
SUM60N04-05LT-E3 (Lead (Pb)-free)




N-Channel MOSFET




| ABSOLUTE MAXIMUM RATINGS $T_C$ = 25 °C, unless otherwise noted | | | | |
|---|---|---|---|---|
| **Parameter** | | **Symbol** | **Limit** | **Unit** |
| Drain-Source Voltage | | $V_{DS}$ | 40 | V |
| Gate-Source Voltage | | $V_{GS}$ | ± 20 | |
| Continuous Drain Current ($T_J$ = 175 °C)[d] | $T_C$ = 25 °C | $I_D$ | 60[a] | A |
| | $T_C$ = 100 °C | | 60[a] | |
| Pulsed Drain Current | | $I_{DM}$ | 250 | |
| Continuous Diode Current (Diode Conduction)[d] | | $I_S$ | 60[a] | |
| Avalanche Current | | $I_{AR}$ | 60[a] | |
| Repetitive Avalanche Energy[b] | L = 0.1 mH | $E_{AR}$ | 180 | mJ |
| Maximum Power Dissipation[a] | $T_C$ = 25 °C | $P_D$ | 200[c] | W |
| | $T_A$ = 25 °C | | 3.75[d] | |
| Operating Junction and Storage Temperature Range | | $T_J$, $T_{stg}$ | - 55 to 175 | °C |

| THERMAL RESISTANCE RATINGS | | | | |
|---|---|---|---|---|
| **Parameter** | | **Symbol** | **Limit** | **Unit** |
| Junction-to-Ambient[d] | PCB Mount[d] | $R_{thJA}$ | 40 | °C/W |
| Junction-to-Case | | $R_{thJC}$ | 0.75 | |

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

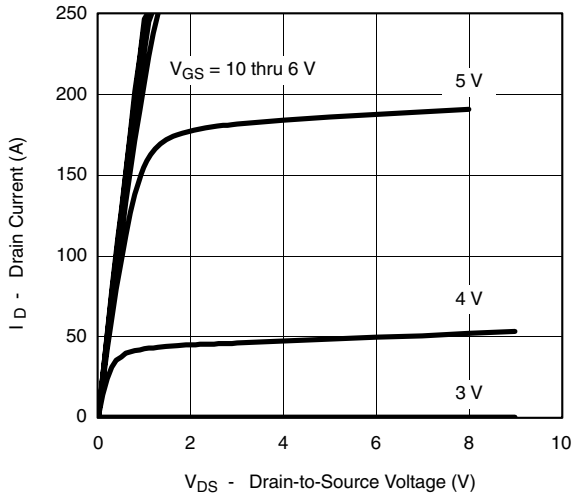
* Pb containing terminations are not RoHS compliant, exemptions may apply.

| **MOSFET SPECIFICATIONS** $T_J$ = 25 °C, unless otherwise noted | | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **Symbol** | **Test Conditions** | **Min.** | **Typ.** | **Max.** | **Unit** |
| **Static** | | | | | | |
| Drain-Source Breakdown Voltage | $V_{(BR)DSS}$ | $V_{GS}$ = 0 V, $I_D$ = 250 µA | 40 | | | V |
| Gate-Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$ = $V_{GS}$, $I_{DS}$ = 250 µA | 1 | | 3 | |
| Gate-Body Leakage | $I_{GSS}$ | $V_{DS}$ = 0 V, $V_{GS}$ = ± 20 V | | | ± 100 | nA |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$ = 40 V, $V_{GS}$ = 0 V | | | 1 | µA |
| | | $V_{DS}$ = 40 V, $V_{GS}$ = 0 V, $T_J$ = 125 °C | | | 50 | |
| | | $V_{DS}$ = 40 V, $V_{GS}$ = 0 V, $T_J$ = 175 °C | | | 500 | |
| On-State Drain Current[a] | $I_{D(on)}$ | $V_{DS}$ = 5 V, $V_{GS}$ = 10 V | 120 | | | A |
| Drain-Source On-State Resistance[a] | $r_{DS(on)}$ | $V_{GS}$ = 10 V, $I_D$ = 60 A | | 0.0035 | 0.0045 | Ω |
| | | $V_{GS}$ = 4.5 V, $I_D$ = 20 A | | 0.0051 | 0.0065 | |
| | | $V_{GS}$ = 10 V, $I_D$ = 60 A, $T_J$ = 125 °C | | | 0.0069 | |
| | | $V_{GS}$ = 10 V, $I_D$ = 60 A, $T_J$ = 175 °C | | | 0.0086 | |
| Sense Diode Forward Voltage | $V_{FD1}$ and $V_{FD2}$ | $I_F$ = 50 µA | 655 | | 715 | mV |
| | | $I_F$ = 25 µA | 600 | | 660 | |
| Sense Diode Forward Voltage Increase | $\Delta V_F$ | From $I_F$ = 25 µA to $I_F$ = 50 µA | 30 | | 80 | |
| Forward Transconductance[a] | $g_{fs}$ | $V_{DS}$ = 15 V, $I_D$ = 20 A | | 35 | | S |
| **Dynamic[b]** | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{GS}$ = 0 V, $V_{DS}$ = 25 V, f = 1 MHz | | 6000 | | pF |
| Output Capacitance | $C_{oss}$ | | | 1100 | | |
| Reverse Transfer Capacitance | $C_{rss}$ | | | 700 | | |
| Total Gate Charge[c] | $Q_g$ | $V_{DS}$ = 20 V, $V_{GS}$ = 10 V, $I_D$ = 25 A | | 130 | | nC |
| Gate-Source Charge[c] | $Q_{gs}$ | | | 25 | | |
| Gate-Drain Charge[c] | $Q_{gd}$ | | | 40 | | |
| Turn-On Delay Time[c] | $t_{d(on)}$ | $V_{DD}$ = 20 V, $R_L$ = 0.8 Ω<br>$I_D \cong$ 25 A, $V_{GEN}$ = 10 V, $R_g$ = 2.5 Ω | | 15 | 20 | ns |
| Rise Time[c] | $t_r$ | | | 80 | 120 | |
| Turn-Off Delay Time[c] | $t_{d(off)}$ | | | 100 | 150 | |
| Fall Time[c] | $t_f$ | | | 100 | 150 | |
| **Source-Drain Diode Ratings and Characteristics** $T_C$ = 25 °C[b] | | | | | | |
| Continuous Current | $I_S$ | | | | 60 | A |
| Pulsed Current | $I_{SM}$ | | | | 200 | |
| Forward Voltage[a] | $V_{SD}$ | $I_F$ = 60 A, $V_{GS}$ = 0 V | | 1.0 | 1.5 | V |
| Reverse Recovery Time | $t_{rr}$ | $I_F$ = 60 A, di/dt = 100 A/µs | | 60 | 90 | ns |
| Peak Reverse Recovery Current | $I_{RM(REC)}$ | | | 2.1 | 4 | A |
| Reverse Recovery Charge | $Q_{rr}$ | | | 0.065 | 0.18 | µC |

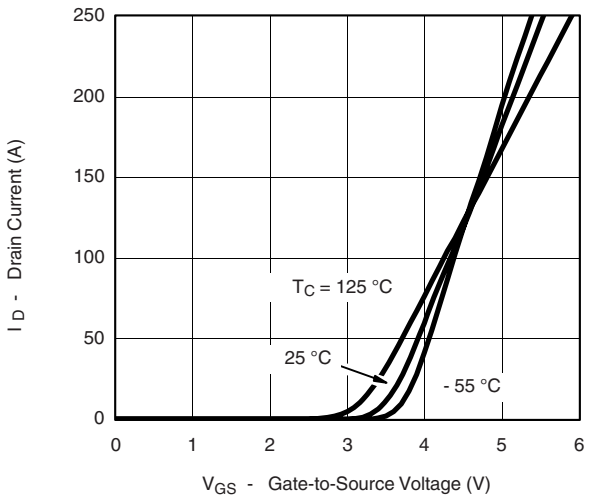
Notes:
a. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %.
b. Guaranteed by design, not subject to production testing.
c. Independent of operating temperature.

*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.*

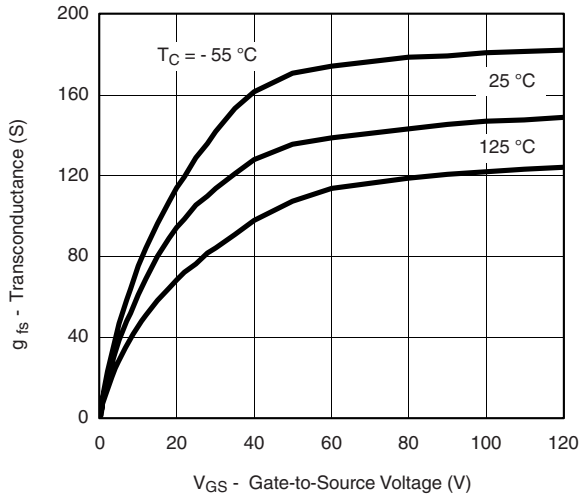
## TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



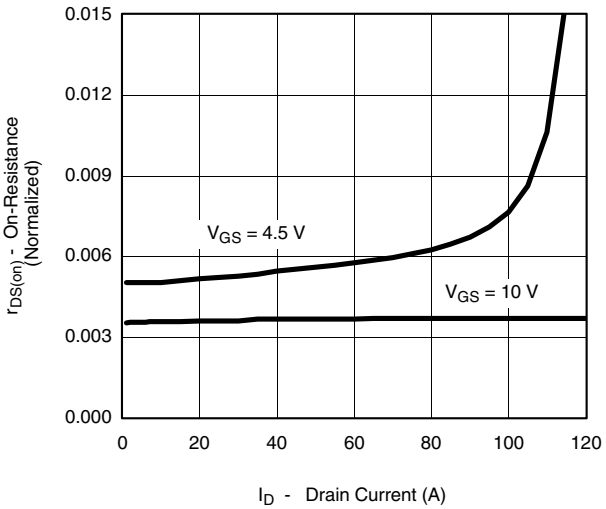

**Output Characteristics**



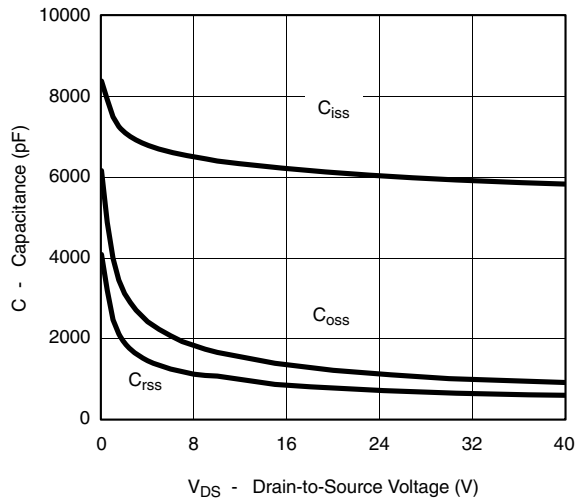

**Transfer Characteristics**



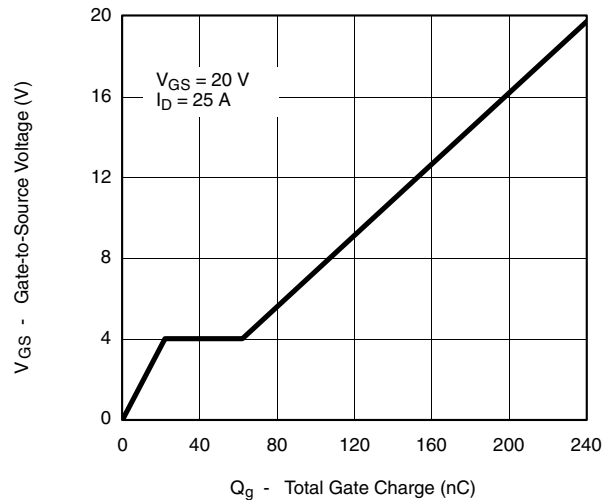

**Transconductance**




**On-Resistance vs. Drain Current**

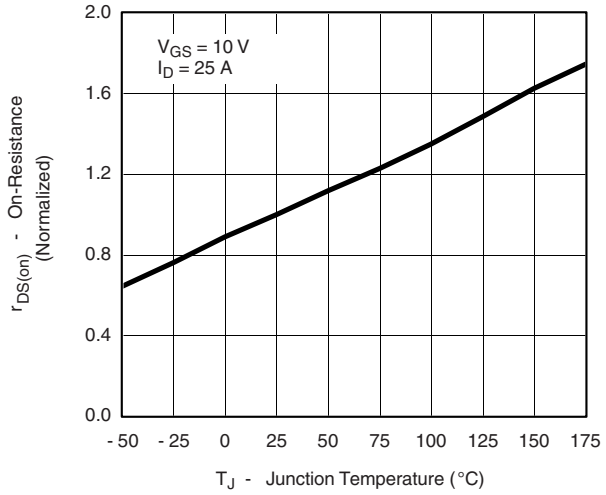



**Capacitance**

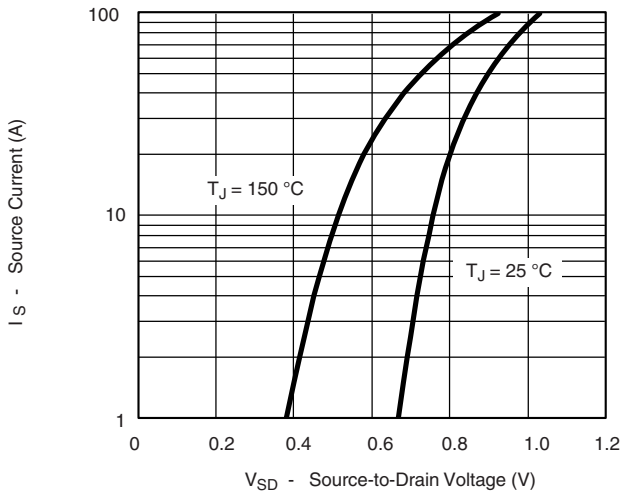



**Gate Charge**

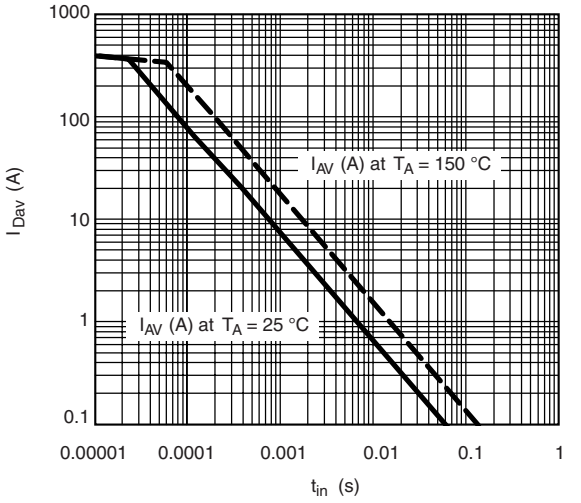
## TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



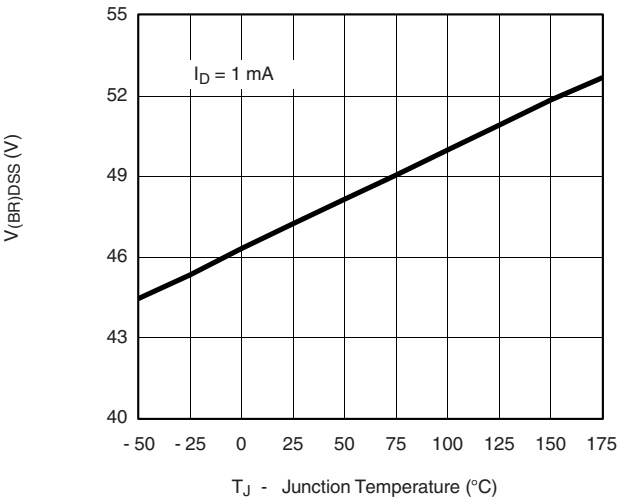

**On-Resistance vs. Junction Temperature**



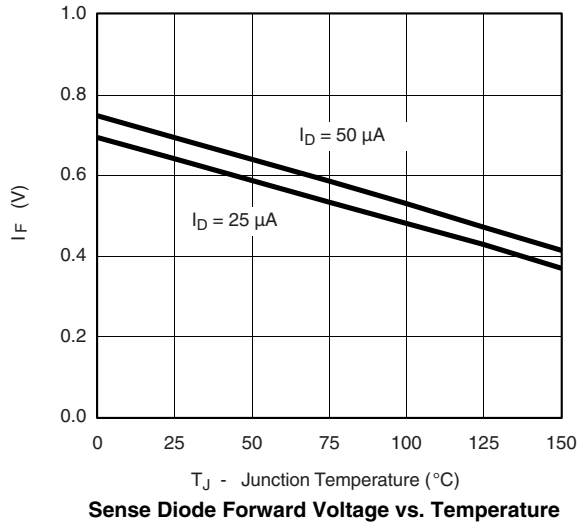

**Source-Drain Diode Forward Voltage**



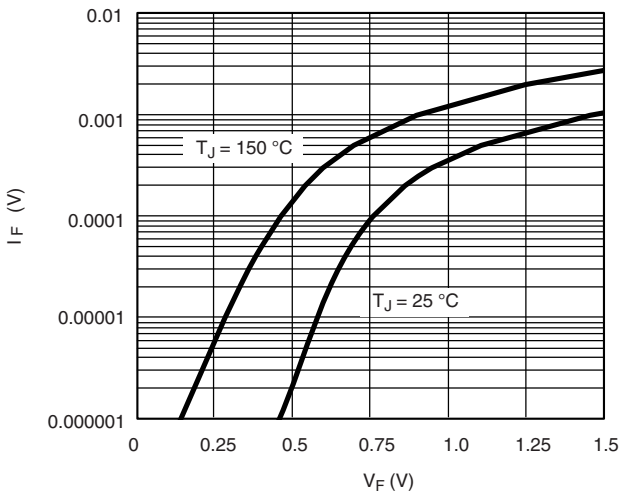

**Avalanche Current vs. Time**




**Drain Source Breakdown vs. Junction Temperature**

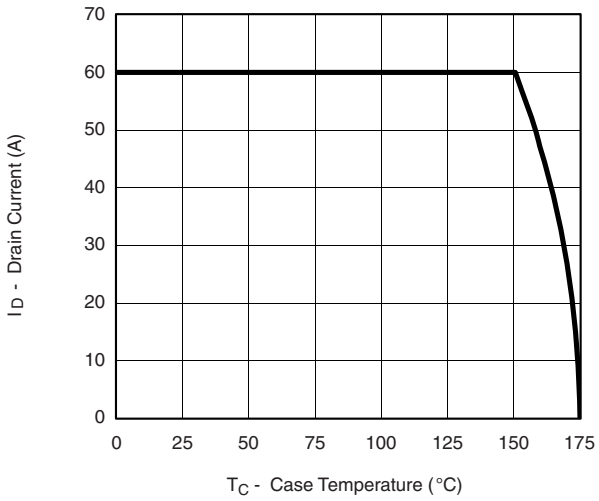



**Sense Diode Forward Voltage vs. Temperature**

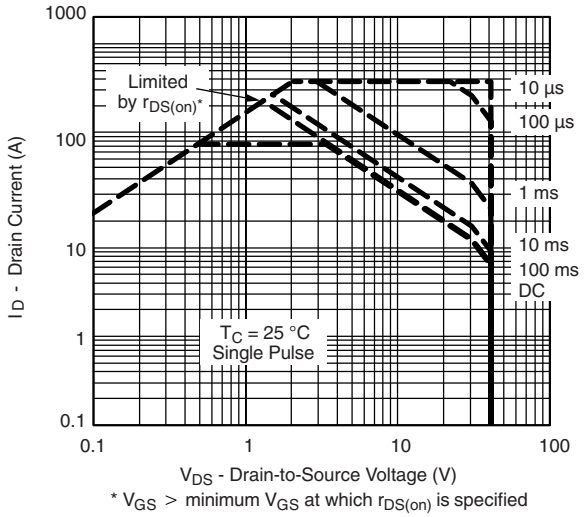



**Sense Diode Forward Voltage**

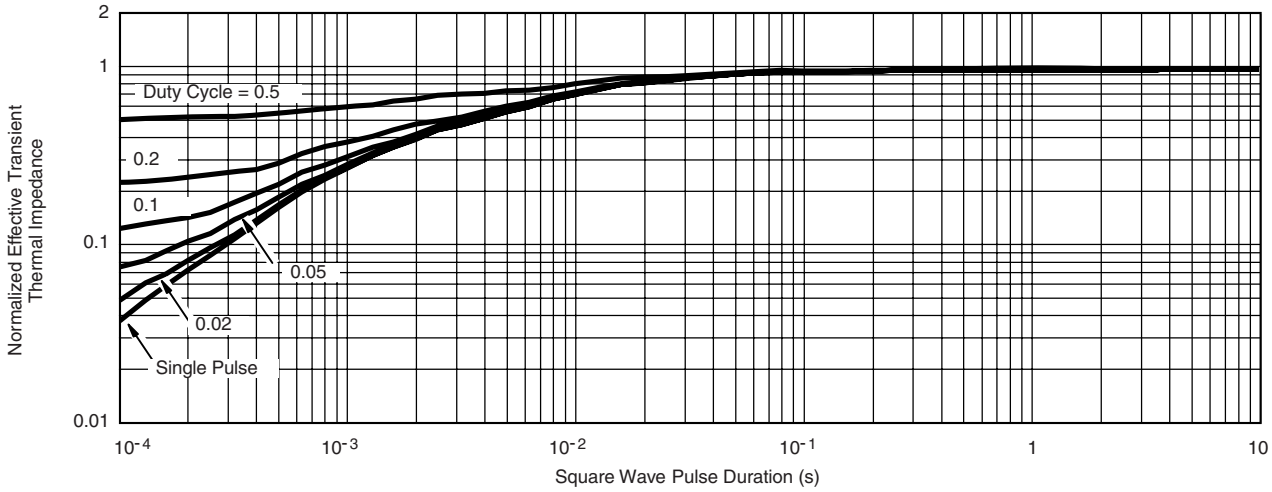
## THERMAL RATINGS




**Maximum Avalanche and Drain Current vs. Case Temperature**




**Safe Operating Area**




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

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