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

| PRODUCT SUMMARY | | |
|---|---|---|
| $V_{(BR)DSS}$ (V) | $r_{DS(on)}$ (Ω) | $I_D$ (A) |
| 40 | 0.0055 @ $V_{GS}$ = 10 V | 60[a] |

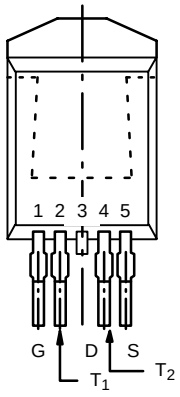
## FEATURES

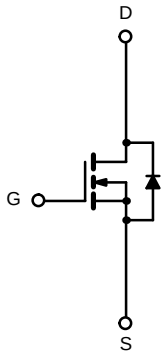
- TrenchFET® Power MOSFETS Plus Temperature Sensing Diode
- 175°C Junction Temperature
- New Low Thermal Resistance Package

## APPLICATIONS

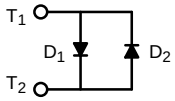
- Automotive
- Industrial

**$D^2PAK$-5L**




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 | |
| Continous 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).

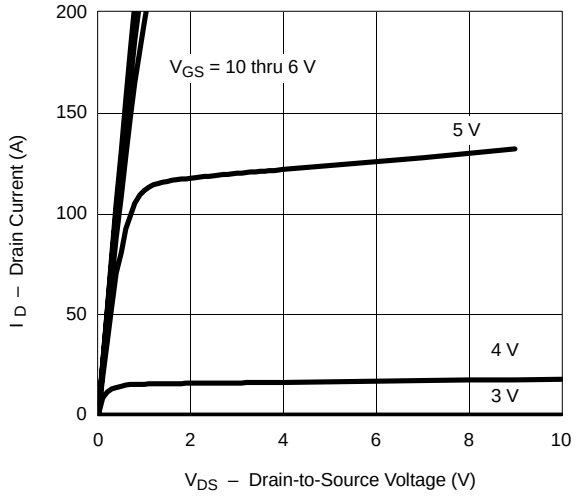
## MOSFET SPECIFICATIONS ($T_J$ = 25°C UNLESS OTHERWISE NOTED)

| Parameter | Symbol | Test Condition | 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 | 2 | | | |
| Gate-Body Leakage | $I_{GSS}$ | $V_{DS}$ = 0 V, $V_{GS}$ = ±20 V | | | ±100 | nA |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$ = 32 V, $V_{GS}$ = 0 V | | | 1 | µA |
| | | $V_{DS}$ = 32 V, $V_{GS}$ = 0 V, $T_J$ = 125°C | | | 50 | |
| | | $V_{DS}$ = 32 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, $I_D$ = 25 A | | 0.0044 | 0.0055 | Ω |
| | | $V_{GS}$ = 10 V, $I_D$ = 25 A, $T_J$ = 125°C | | | 0.0088 | |
| | | $V_{GS}$ = 10 V, $I_D$ = 25 A, $T_J$ = 175°C | | | 0.011 | |
| Sense Diode Forward Voltage | $V_{FD1}$ | $I_F$ = 50 µA | 655 | | 715 | mV |
| | $V_{FD2}$ | $I_F$ = 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 | | 6400 | | pF |
| Output Capacitance | $C_{oss}$ | | | 1100 | | |
| Reversen Transfer Capacitance | $C_{rss}$ | | | 630 | | |
| Total Gate Charge[c] | $Q_g$ | $V_{DS}$ = 20 V, $V_{GS}$ = 10 V, $I_D$ = 25 A | | 115 | 150 | nC |
| Gate-Source Charge[c] | $Q_{gs}$ | | | 35 | | |
| Gate-Drain Charge[c] | $Q_{gd}$ | | | 35 | | |
| Turn-On Delay Time[c] | $t_{d(on)}$ | $V_{DD}$ = 20 V, $R_L$ = 0.8 Ω<br>$I_D$ ≃ 25 A, $V_{GEN}$ = 10 V, $R_G$ = 2.5 Ω | | 15 | 20 | ns |
| Rise Time[c] | $t_r$ | | | 150 | 210 | |
| Turn-Off Delay Time[c] | $t_{d(off)}$ | | | 60 | 85 | |
| Fall Time[c] | $t_f$ | | | 80 | 110 | |
| **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 | | 45 | 70 | ns |
| Peak Reverse Recovery Current | $I_{RM(REC)}$ | | | 2.5 | 5 | A |
| Reverse Recovery Charge | $Q_{rr}$ | | | 0.06 | 0.18 | µC |

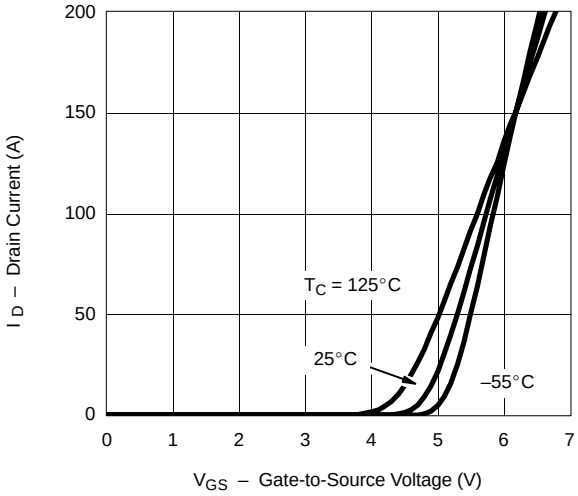
Notes:
a. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2%.
b. Guaranteed by design, not subject to production testing.
c. Independent of operating temperature.

## TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)

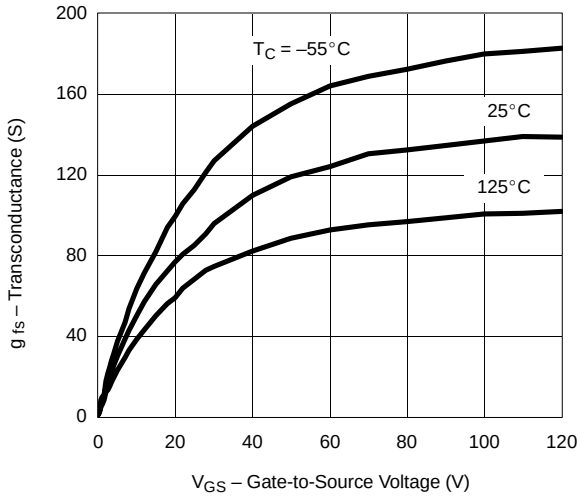
**Output Characteristics**



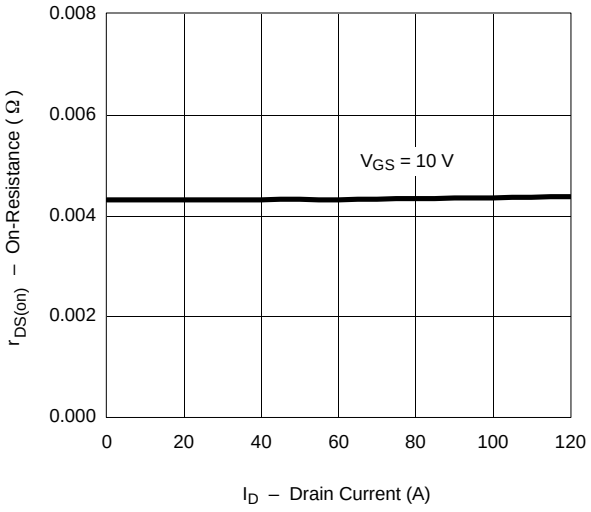

**Transfer Characteristics**



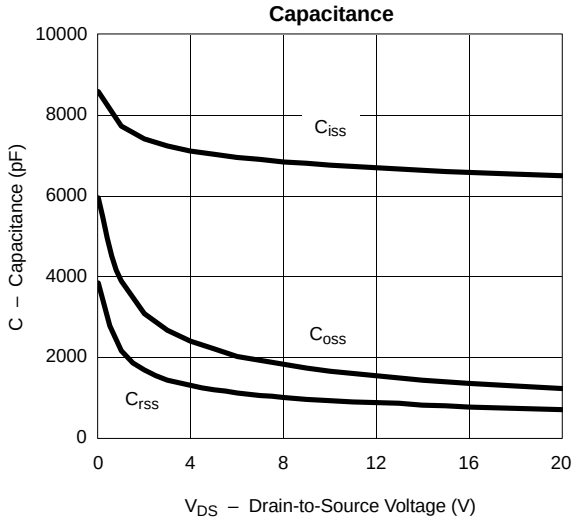

**Transconductance**



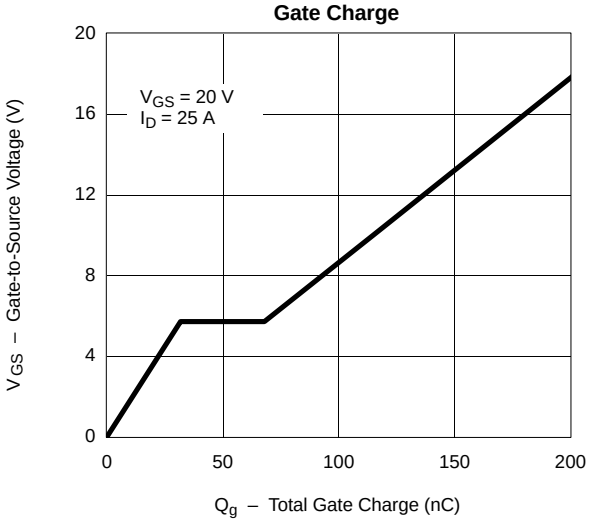

**On-Resistance vs. Drain Current**




**Capacitance**

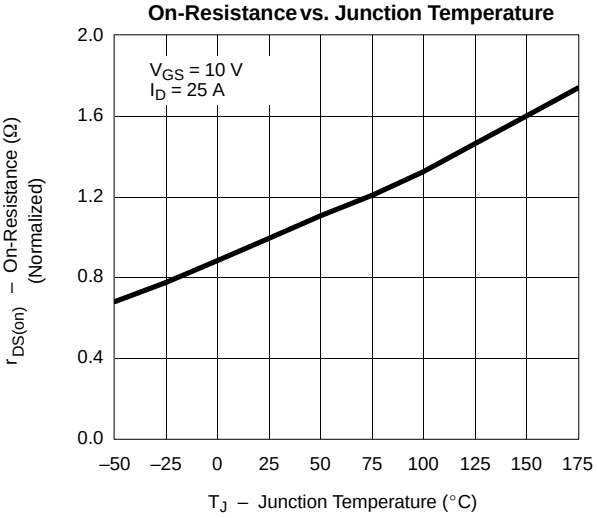



**Gate Charge**

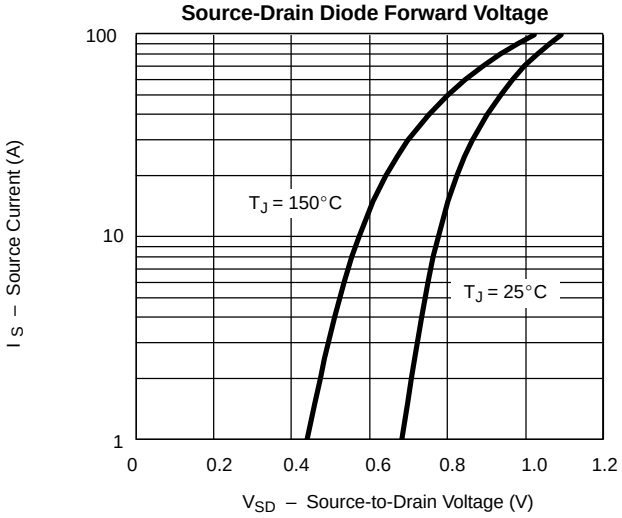


## TYPICAL CHARACTERISTICS (25°C UNLESS NOTED)

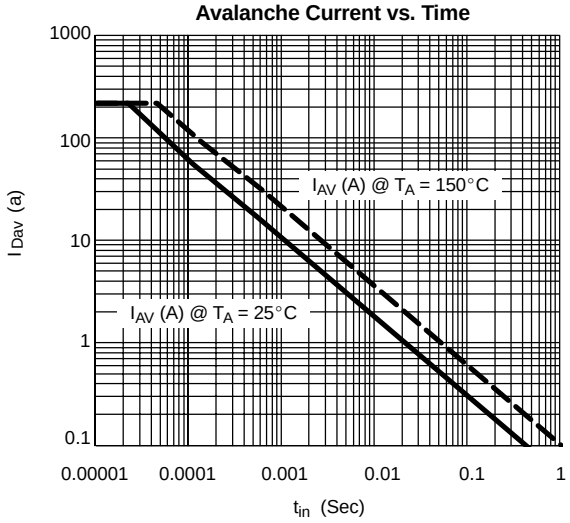
**On-Resistance vs. Junction Temperature**



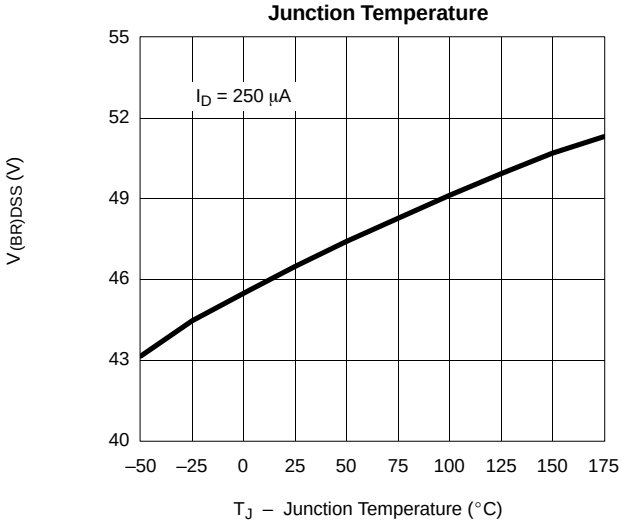

**Source-Drain Diode Forward Voltage**



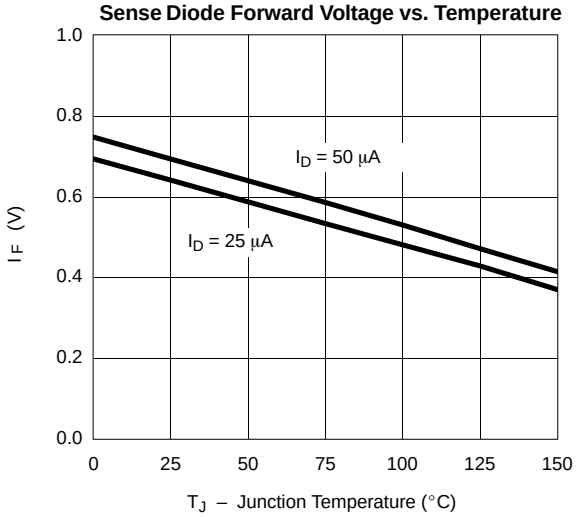

**Avalanche Current vs. Time**



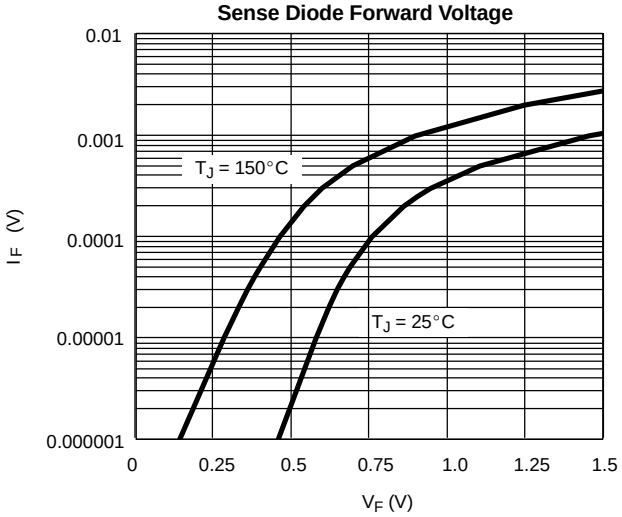

**Drain Source Breakdown vs. Junction Temperature**




**Sense Diode Forward Voltage vs. Temperature**

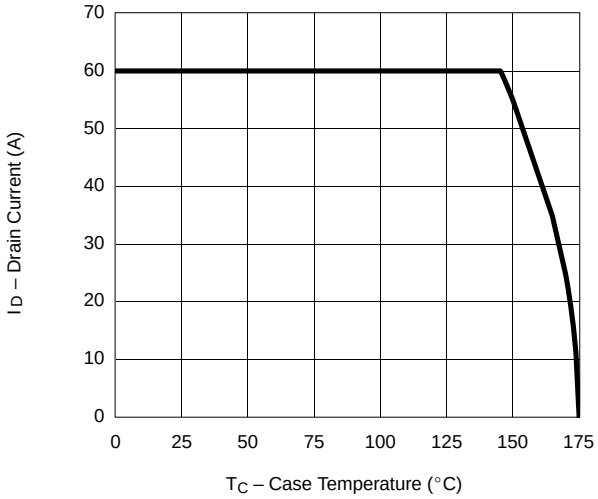



**Sense Diode Forward Voltage**

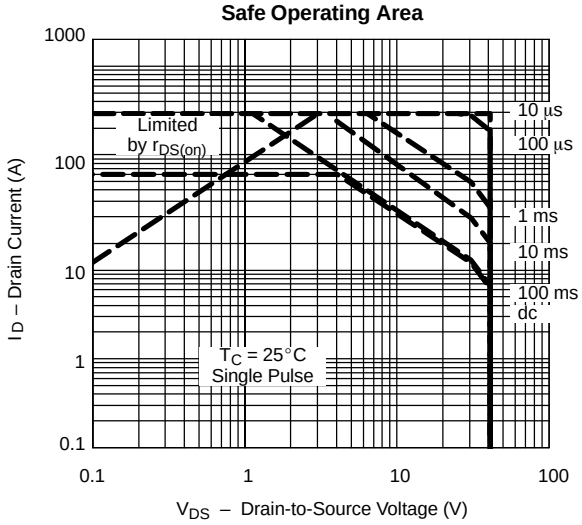


## THERMAL RATINGS

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




**Safe Operating Area**




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