

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

| PRODUCT SUMMARY | | | |
|-----------------|---------------------------|------------------|-----------|
| V_{DS} (V) | $r_{DS(on)}$ (Ω) | $V_{GS(th)}$ (V) | I_D (A) |
| 60 | 2 at $V_{GS} = 10$ V | 1.0 to 2.5 | 0.47 |
| | 4 at $V_{GS} = 4.5$ V | | 0.33 |

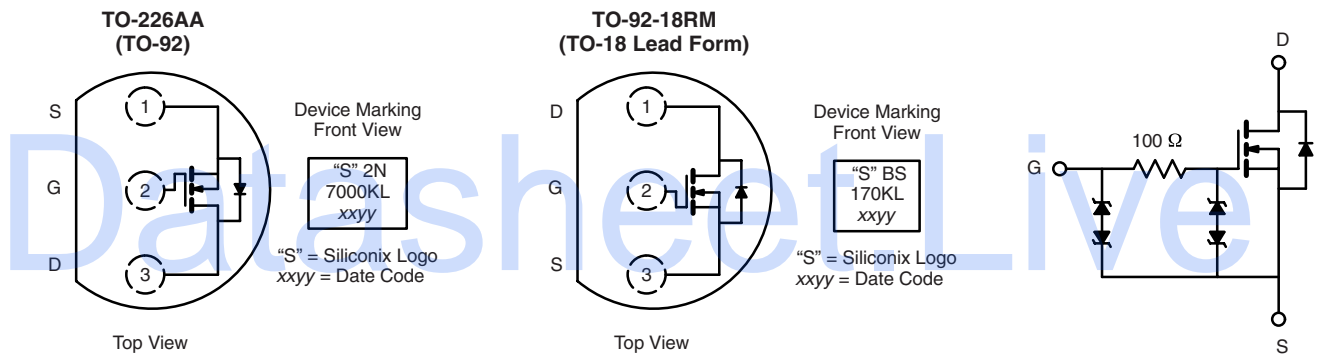
FEATURES

- TrenchFET[®] Power MOSFET
- ESD Protected: 2000 V


 Available
RoHS*
 COMPLIANT

APPLICATIONS

- Direct Logic-Level Interface: TTL/CMOS
- Solid-State Relays
- Drivers: Relays, Solenoids, Lamps, Hammers, Display, Memories, Transistors, etc.
- Battery Operated Systems



Ordering Information: 2N7000KL-TR1
 2N7000KL-TR1-E3 (Lead (Pb)-free)

Ordering Information: BS170KL-TR1
 BS170KL-TR1-E3 (Lead (Pb)-free)

| ABSOLUTE MAXIMUM RATINGS $T_A = 25$ °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) ^b | I_D | $T_A = 25$ °C | 0.47 | A |
| | | $T_A = 70$ °C | 0.37 | |
| Pulsed Drain Current ^a | I_{DM} | 1.0 | | |
| Power Dissipation | P_D | $T_A = 25$ °C | 0.8 | W |
| | | $T_A = 70$ °C | 0.51 | |
| Maximum Junction-to-Ambient | R_{thJA} | 158 | °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.

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

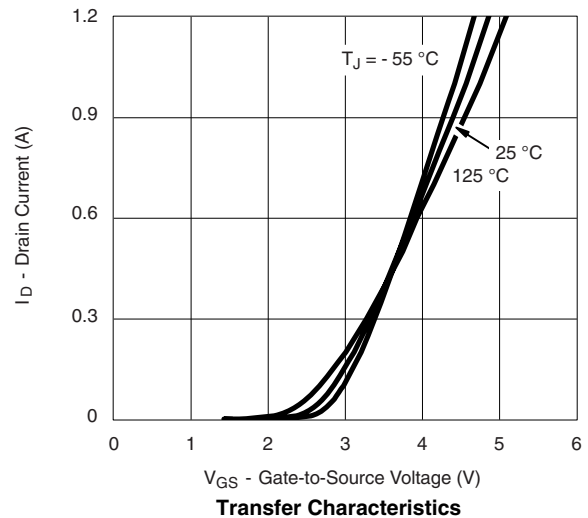
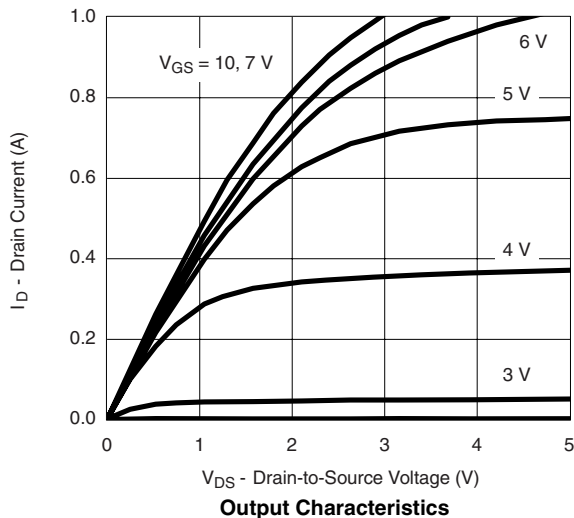
| SPECIFICATIONS $T_A = 25\text{ }^\circ\text{C}$, unless otherwise noted | | | | | | |
|--|---------------|--|------------|------------|---------|---------------|
| Parameter | Symbol | Test Conditions | Limits | | | Unit |
| | | | Min | Typ | Max | |
| Static | | | | | | |
| Drain-Source Breakdown Voltage | $V_{(BR)DSS}$ | $V_{GS} = 0\text{ V}, I_D = 10\text{ }\mu\text{A}$ | 60 | | | V |
| Gate-Threshold Voltage | $V_{GS(th)}$ | $V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$ | 1 | 2.0 | 2.5 | |
| Gate-Body Leakage | I_{GSS} | $V_{DS} = 0\text{ V}, V_{GS} = \pm 10\text{ V}$ | | | ± 1 | μA |
| Zero Gate Voltage Drain Current | I_{DSS} | $V_{DS} = 60\text{ V}, V_{GS} = 0\text{ V}$ $V_{DS} = 60\text{ V}, V_{GS} = 0\text{ V}, T_J = 55\text{ }^\circ\text{C}$ | | | 1 10 | |
| On-State Drain Current ^b | $I_{D(on)}$ | $V_{GS} = 10\text{ V}, V_{DS} = 7.5\text{ V}$ $V_{GS} = 4.5\text{ V}, V_{DS} = 10\text{ V}$ | 0.8 0.5 | | | A |
| Drain-Source On-Resistance ^b | $r_{DS(on)}$ | $V_{GS} = 10\text{ V}, I_D = 0.5\text{ A}$ $V_{GS} = 4.5\text{ V}, I_D = 0.2\text{ A}$ | | 1.1 1.6 | 2 4 | |
| Forward Transconductance ^b | g_{fs} | $V_{DS} = 10\text{ V}, I_D = 0.5\text{ A}$ | | 550 | | ms |
| Diode Forward Voltage | V_{SD} | $I_S = 0.3\text{ A}, V_{GS} = 0\text{ V}$ | | 0.87 | 1.3 | V |
| Dynamic^b | | | | | | |
| Total Gate Charge | Q_g | $V_{DS} = 10\text{ V}, V_{GS} = 4.5\text{ V}$ $I_D \cong 0.25\text{ A}$ | | 0.4 | 0.6 | nC |
| Gate-Source Charge | Q_{gs} | | | 0.11 | | |
| Gate-Drain Charge | Q_{gd} | | | 0.15 | | μF |
| Gate Resistance | R_g | | 173 | | | |
| Turn-On Time | $t_{d(on)}$ | $V_{DD} = 30\text{ V}, R_L = 150\text{ }\Omega$ $I_D \cong 0.2\text{ A}, V_{GEN} = 10\text{ V}, R_G = 10\text{ }\Omega$ | | 3.8 | 10 | ns |
| | t_r | | | 4.8 | 15 | |
| Turn-Off Time | $t_{d(off)}$ | | | 12.8 | 20 | |
| | t_f | | | 9.6 | 15 | |

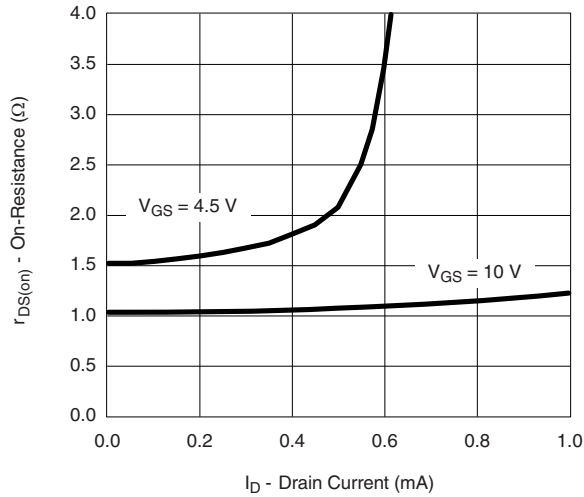
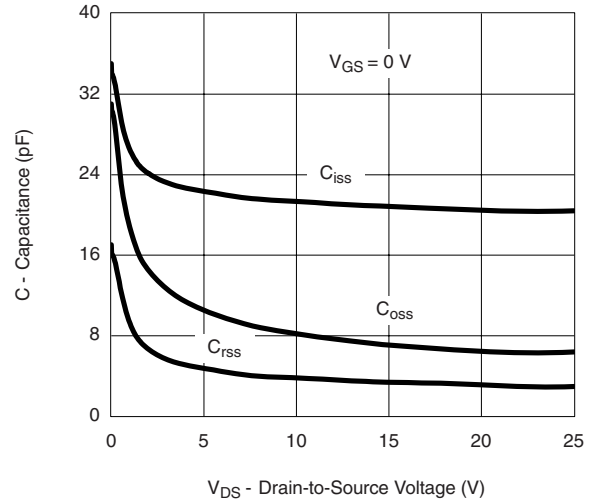
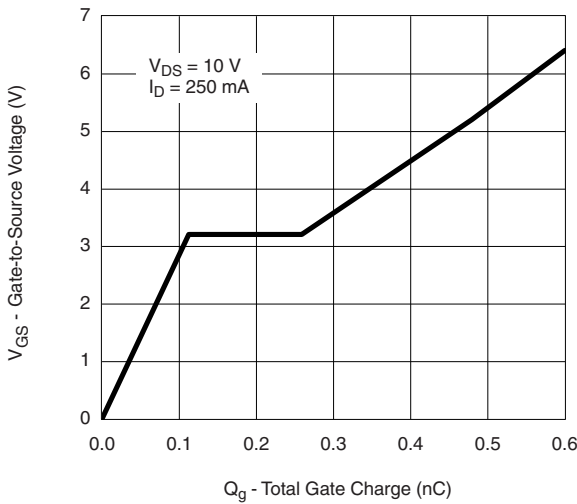
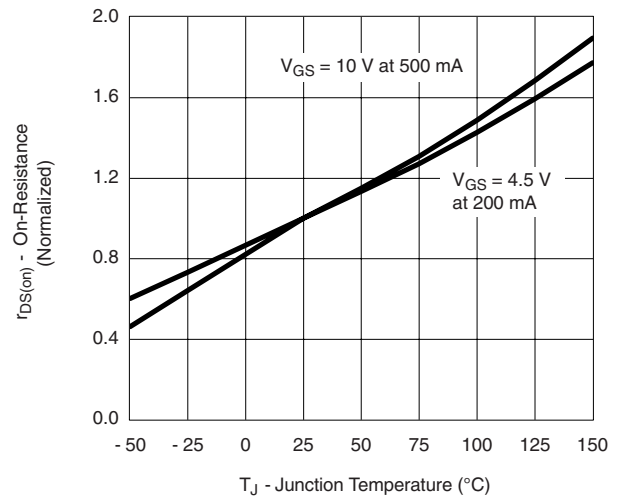
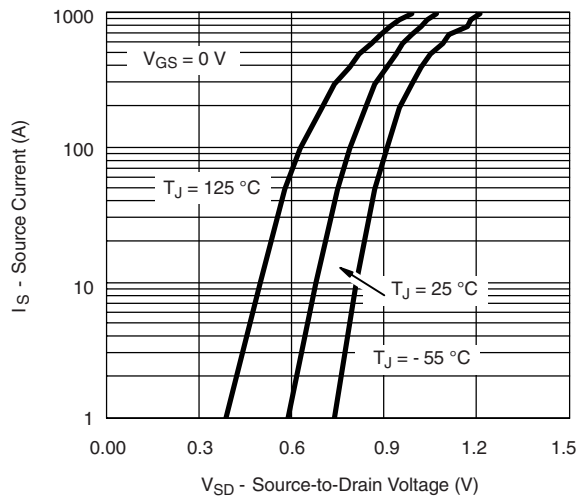
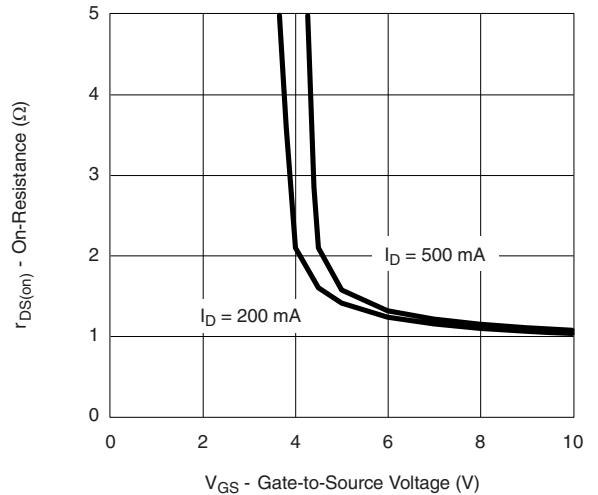
Notes:

- a. Pulse test: $PW \leq 300\text{ }\mu\text{s}$ duty cycle $\leq 2\%$.
- b. Guaranteed by design, not subject to production testing.

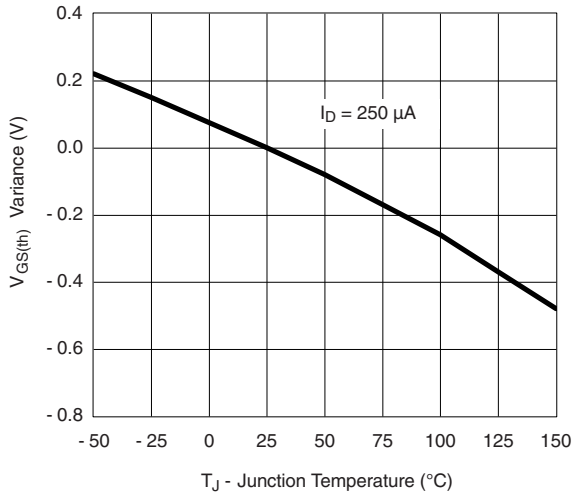
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

TYPICAL CHARACTERISTICS $25\text{ }^\circ\text{C}$, unless otherwise noted

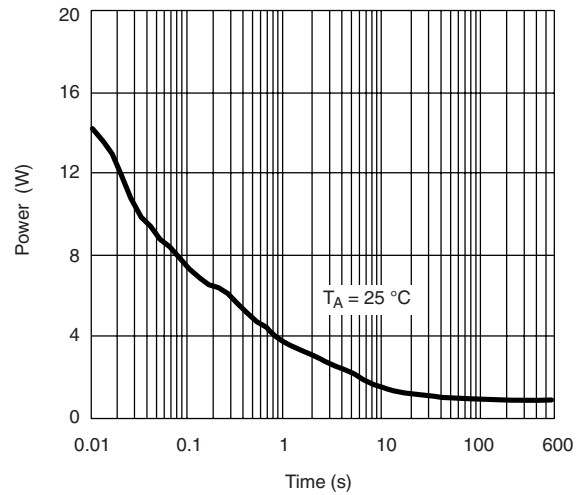


TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted

On-Resistance vs. Drain Current

Capacitance

Gate Charge

On-Resistance vs. Junction Temperature

Source-Drain Diode Forward Voltage

On-Resistance vs. Gate-Source Voltage

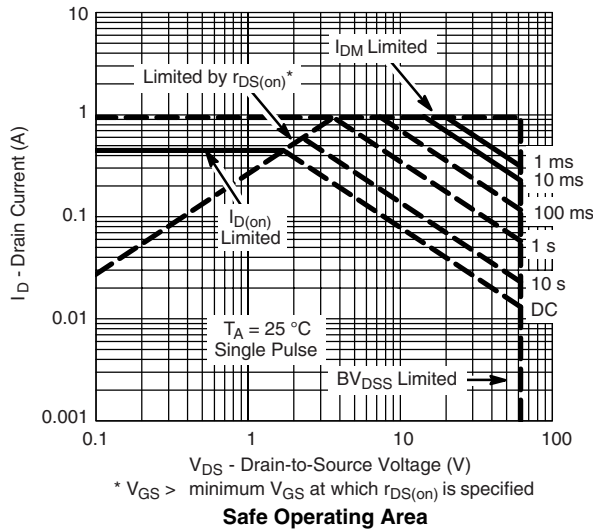
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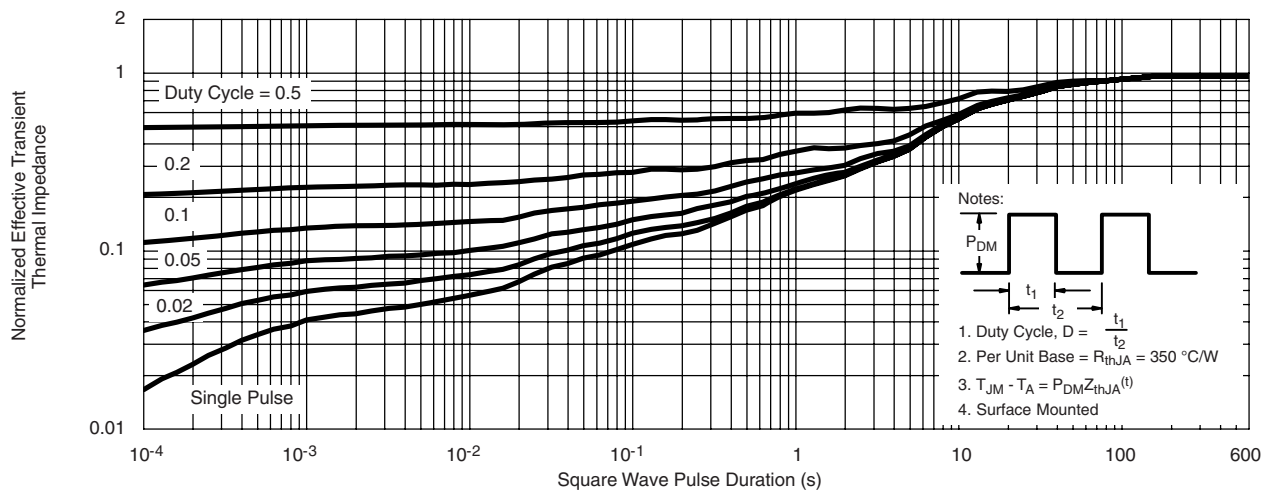
Threshold Voltage Variance Over Temperature



Single Pulse Power, Junction-to-Ambient



Safe Operating Area



Normalized Thermal Transient Impedance, Junction-to-Ambient

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