

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

PRODUCT SUMMARY			
$V_{DS}$ (V)	$r_{DS(on)}$ ( $\Omega$ )	$V_{GS(th)}$ (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

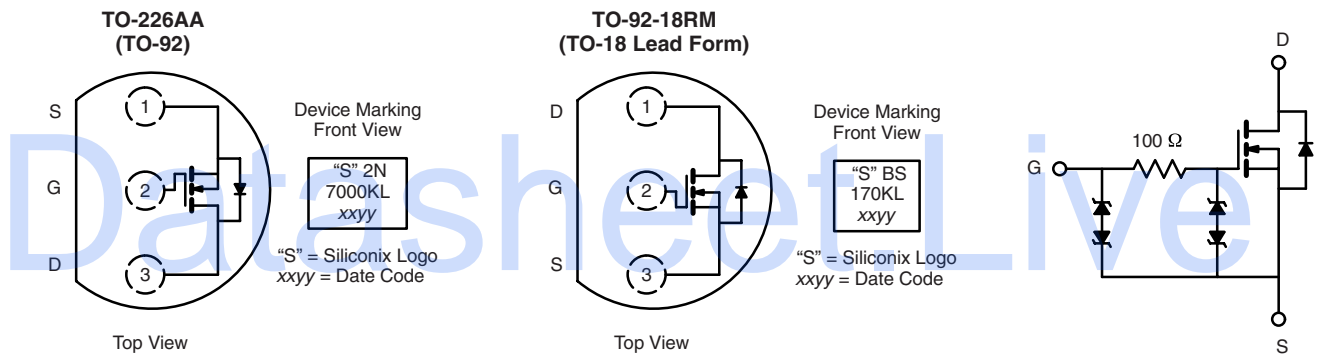
### FEATURES

- TrenchFET<sup>®</sup> Power MOSFET
- ESD Protected: 2000 V


 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	$V_{GS}$	$\pm 20$		
Continuous Drain Current ( $T_J = 150$ °C) <sup>b</sup>	$I_D$	$T_A = 25$ °C	A	
		$T_A = 70$ °C		
Pulsed Drain Current <sup>a</sup>	$I_{DM}$	1.0		
Power Dissipation	$P_D$	$T_A = 25$ °C	W	
		$T_A = 70$ °C		
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.

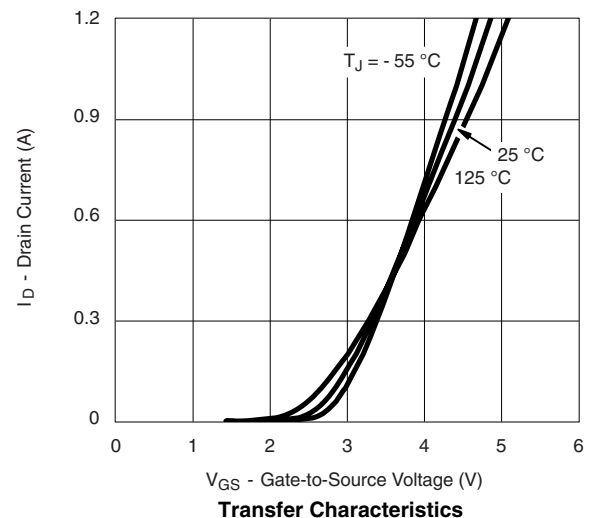
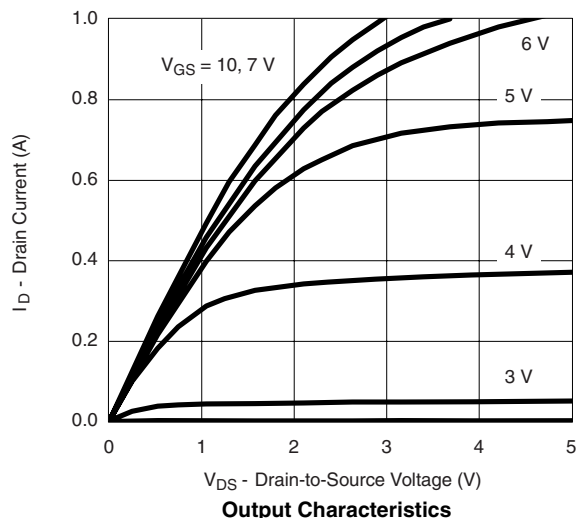
SPECIFICATIONS $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted						
Parameter	Symbol	Test Conditions	Limits			Unit
			Min	Typ	Max	
<b>Static</b>						
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 10\text{ }\mu\text{A}$	60			V
Gate-Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$	1	2.0	2.5	
Gate-Body Leakage	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = \pm 10\text{ V}$			$\pm 1$	$\mu\text{A}$
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 <sup>b</sup>	$I_{D(on)}$	$V_{GS} = 10\text{ V}, V_{DS} = 7.5\text{ V}$ $V_{GS} = 4.5\text{ V}, V_{DS} = 10\text{ V}$	0.8 0.5			A
Drain-Source On-Resistance <sup>b</sup>	$r_{DS(on)}$	$V_{GS} = 10\text{ V}, I_D = 0.5\text{ A}$ $V_{GS} = 4.5\text{ V}, I_D = 0.2\text{ A}$		1.1 1.6	2 4	
Forward Transconductance <sup>b</sup>	$g_{fs}$	$V_{DS} = 10\text{ V}, I_D = 0.5\text{ A}$		550		ms
Diode Forward Voltage	$V_{SD}$	$I_S = 0.3\text{ A}, V_{GS} = 0\text{ V}$		0.87	1.3	V
<b>Dynamic<sup>b</sup></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		pF
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:

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

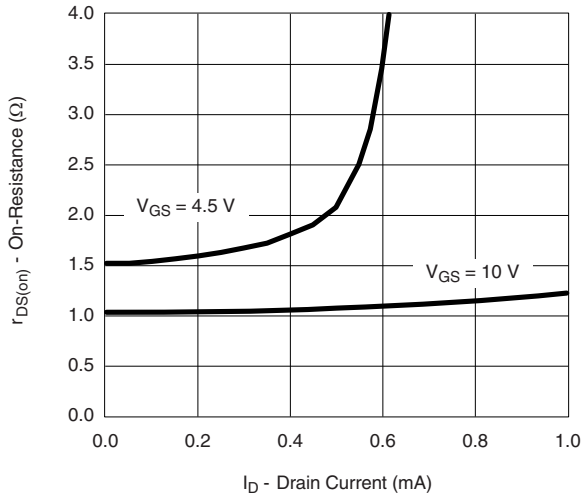
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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

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

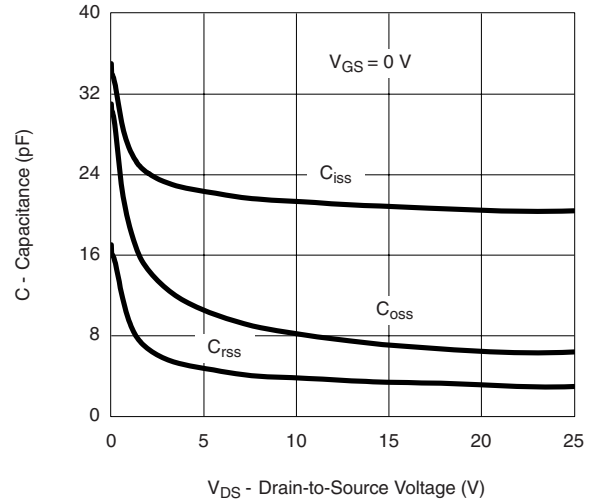




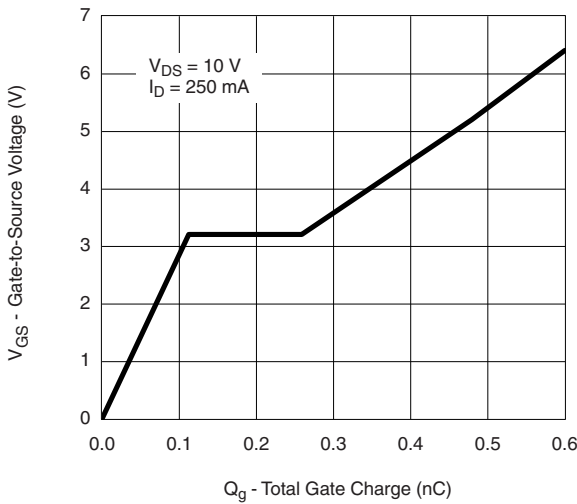
**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



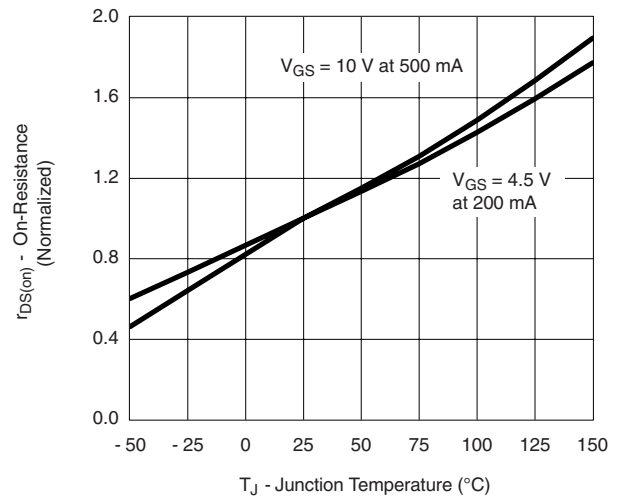
**On-Resistance vs. Drain Current**



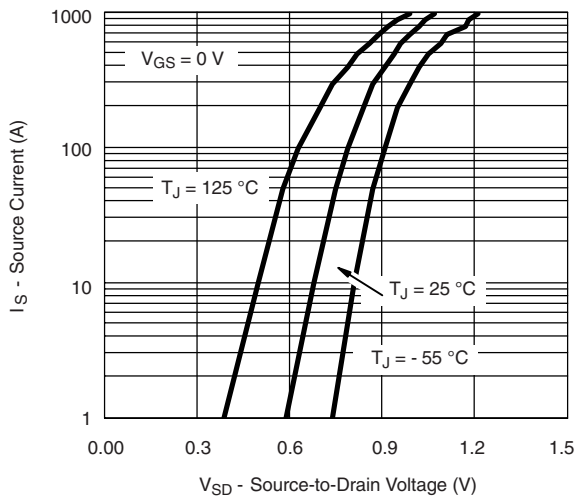
**Capacitance**



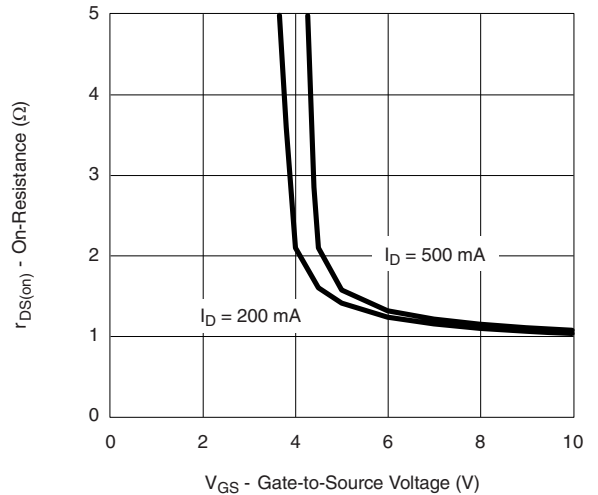
**Gate Charge**



**On-Resistance vs. Junction Temperature**

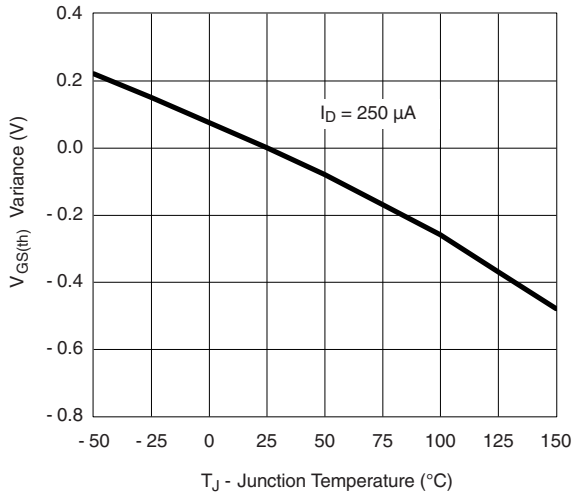


**Source-Drain Diode Forward Voltage**

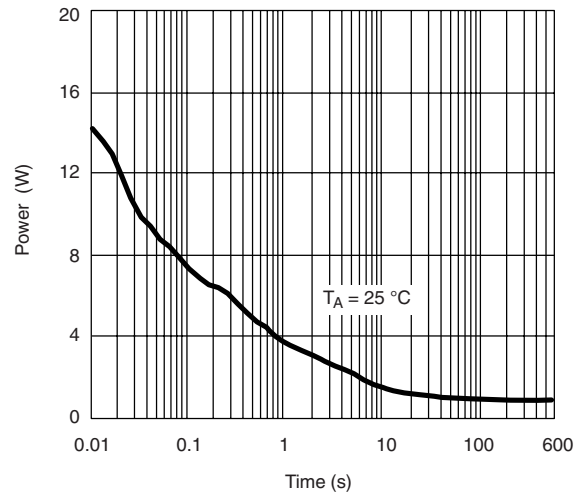


**On-Resistance vs. Gate-Source Voltage**

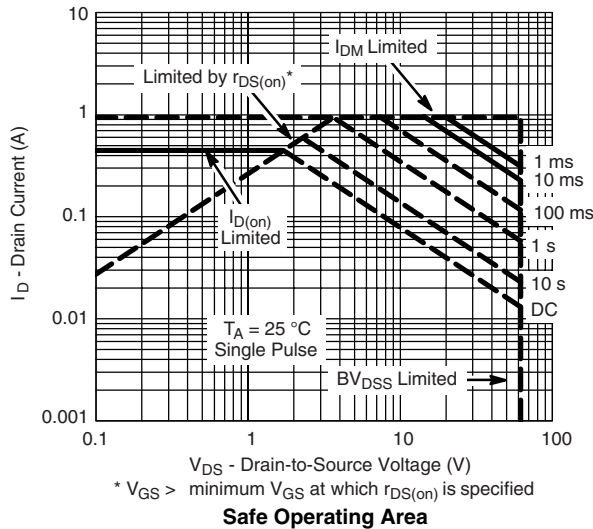
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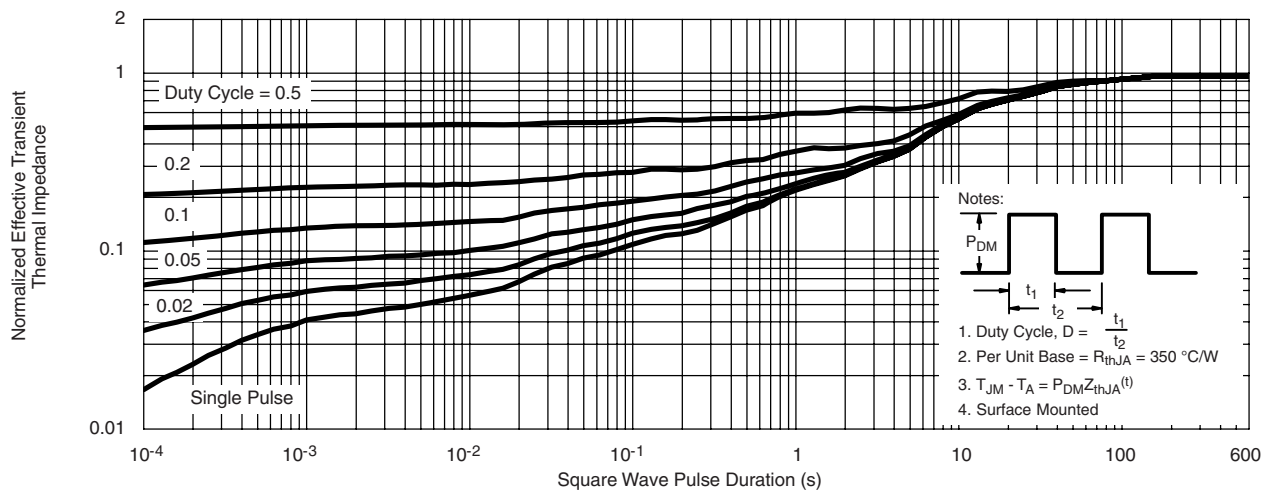
**Threshold Voltage Variance Over Temperature**



**Single Pulse Power, Junction-to-Ambient**



**Safe Operating Area**



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

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