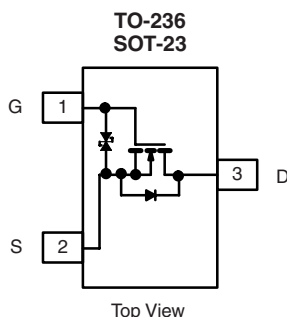


# N-Channel 60-V (D-S) MOSFET

## PRODUCT SUMMARY

$V_{DS}$ (V)	$R_{DS(on)}$ ( $\Omega$ )	$I_D$ (mA)
60	2 at $V_{GS} = 10$ V	300



2N7002K (7K)\*  
\* Marking Code

**Ordering Information:** 2N7002K-T1  
2N7002K-T1-E3 (Lead (Pb)-free)  
2N7002K-T1-GE3 (Lead (Pb)-free and Halogen-free)

## FEATURES

- **Halogen-free According to IEC 61249-2-21 Definition**
- Low On-Resistance: 2  $\Omega$
- Low Threshold: 2 V (typ.)
- Low Input Capacitance: 25 pF
- Fast Switching Speed: 25 ns
- Low Input and Output Leakage
- TrenchFET® Power MOSFET
- 2000 V ESD Protection
- Compliant to RoHS Directive 2002/95/EC



**RoHS\***  
COMPLIANT  
HALOGEN  
**FREE**  
Available

## BENEFITS

- Low Offset Voltage
- Low-Voltage Operation
- Easily Driven Without Buffer
- High-Speed Circuits
- Low Error Voltage

## APPLICATIONS

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

## 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>	$T_A = 25$ °C	$I_D$	mA
	$T_A = 100$ °C	300	
Pulsed Drain Current <sup>a</sup>	$I_{DM}$	800	
Power Dissipation <sup>b</sup>	$T_A = 25$ °C	$P_D$	W
	$T_A = 100$ °C	0.35	
Maximum Junction-to-Ambient <sup>b</sup>	$R_{thJA}$	350	°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.

b. Surface Mounted on FR4 board.

\* 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. <sup>a</sup>	Max.	
Static						
Drain-Source Breakdown Voltage	V <sub>DS</sub>	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 10 μA	60			V
Gate-Threshold Voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA	1		2.5	
Gate-Body Leakage	I <sub>GSS</sub>	V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ± 20 V			± 10	μA
		V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ± 15 V			1	
		V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ± 10 V			± 150	nA
		V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ± 10 V, T <sub>J</sub> = 85 °C			± 1000	
		V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ± 5 V			± 100	
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> = 60 V, V <sub>GS</sub> = 0 V			1	μA
		V <sub>DS</sub> = 60 V, V <sub>GS</sub> = 0 V , T <sub>J</sub> = 125 °C			500	
On-State Drain Current <sup>a</sup>	I <sub>D(on)</sub>	V <sub>GS</sub> = 10 V, V <sub>DS</sub> = 7.5 V	800			mA
		V <sub>GS</sub> = 4.5 V, V <sub>DS</sub> = 10 V	500			
Drain-Source On-Resistance <sup>a</sup>	R <sub>DS(on)</sub>	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 500 mA			2	Ω
		V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 200 mA			4	
Forward Transconductance <sup>a</sup>	g <sub>fs</sub>	V <sub>DS</sub> = 10 V, I <sub>D</sub> = 200 mA	100			mS
Diode Forward Voltage	V <sub>SD</sub>	I <sub>S</sub> = 200 mA, V <sub>GS</sub> = 0 V			1.3	V
Dynamic <sup>a</sup>						
Total Gate Charge	Q <sub>g</sub>	V <sub>DS</sub> = 10 V, V <sub>GS</sub> = 4.5 V I <sub>D</sub> ≅ 250 mA		0.4	0.6	nC
Input Capacitance	C <sub>iss</sub>	V <sub>DS</sub> = 25 V, V <sub>GS</sub> = 0 V f = 1 MHz		30		pF
Output Capacitance	C <sub>oss</sub>			6		
Reverse Transfer Capacitance	C <sub>rss</sub>			2.5		
Switching <sup>a, b, c</sup>						
Turn-On Time	t <sub>d(on)</sub>	V <sub>DD</sub> = 30 V, R <sub>L</sub> = 150 Ω			25	ns
Turn-Off Time	t <sub>d(off)</sub>	I <sub>D</sub> ≅ 200 mA, V <sub>GEN</sub> = 10 V, R <sub>G</sub> = 10 Ω			35	

Notes:

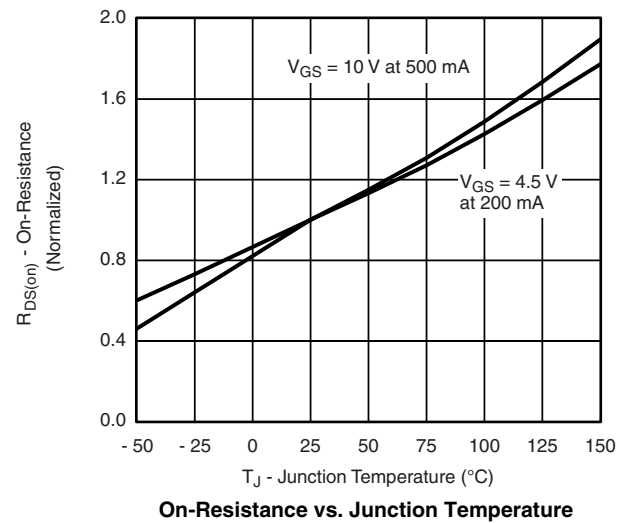
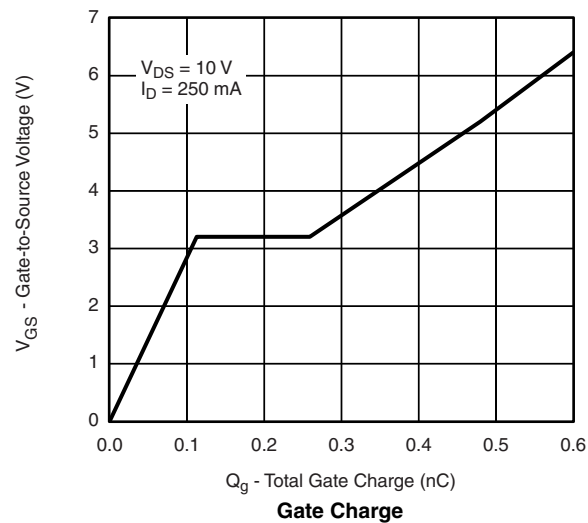
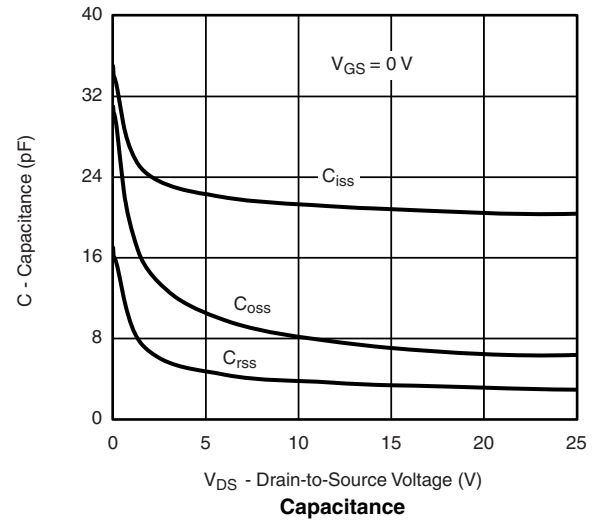
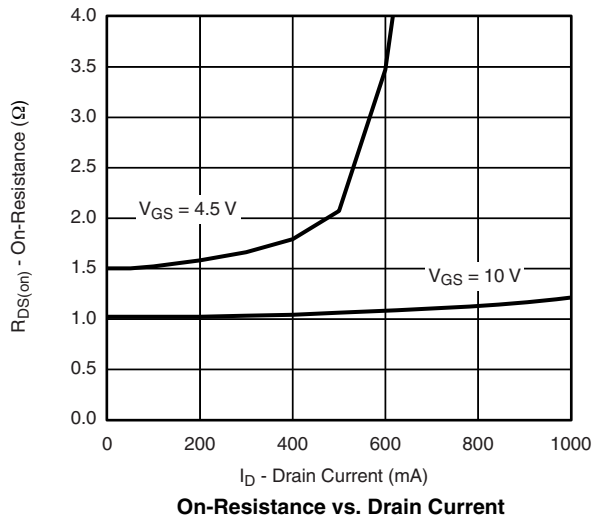
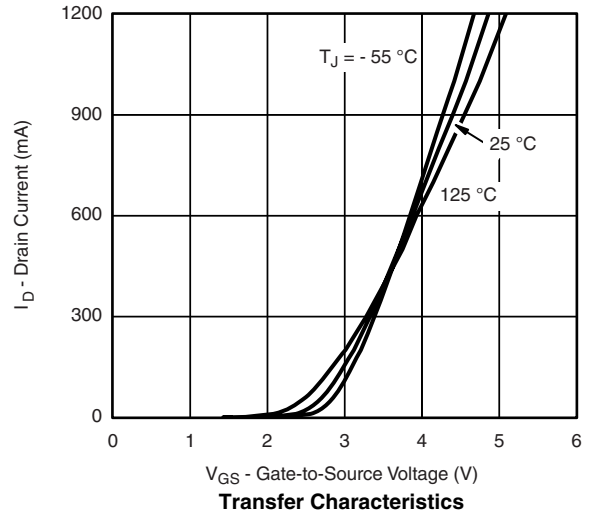
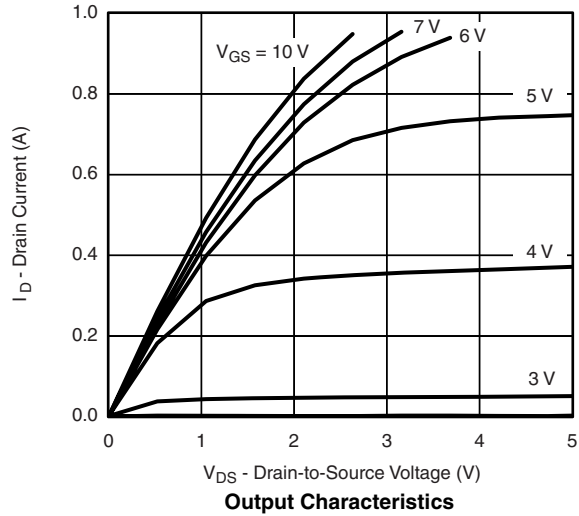
a. For DESIGN AID ONLY, not subject to production testing.

b. Pulse test:  $PW \leq 300\text{ }\mu\text{s}$  duty cycle  $\leq 2\%$ .

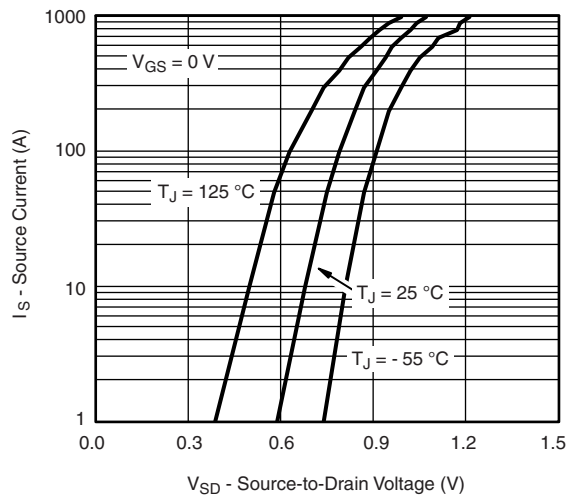
c. Switching time is essentially independent of operating temperature.

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.

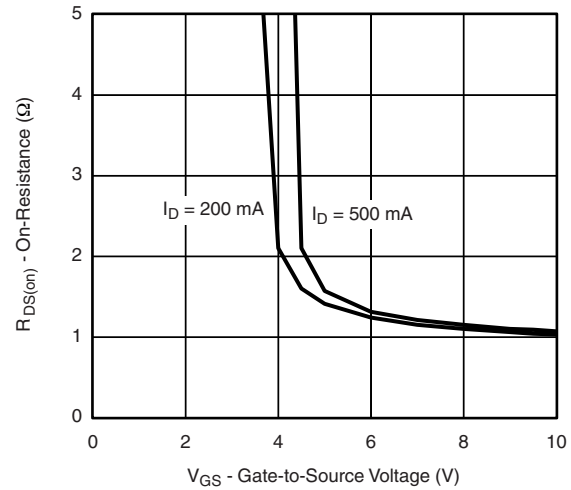
## TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



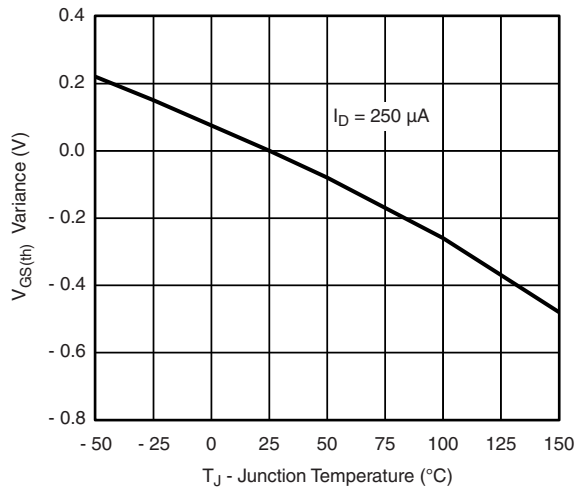
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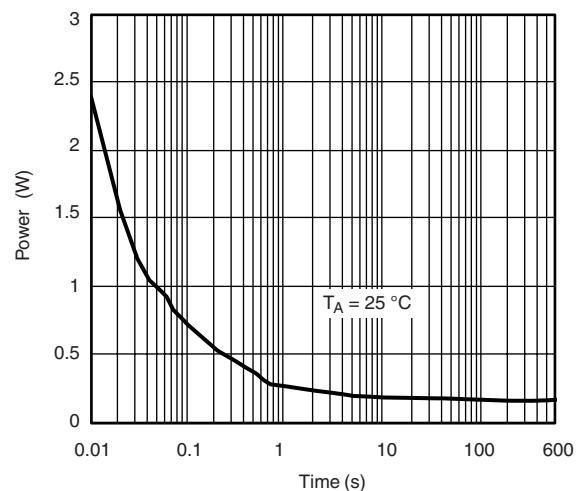
Source-Drain Diode Forward Voltage



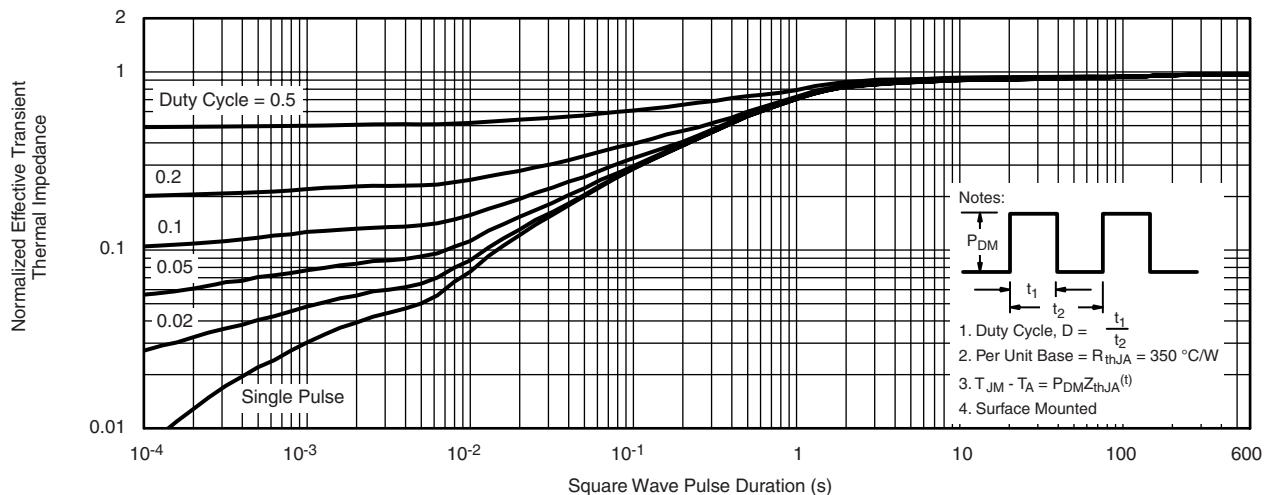
On-Resistance vs. Gate-Source Voltage



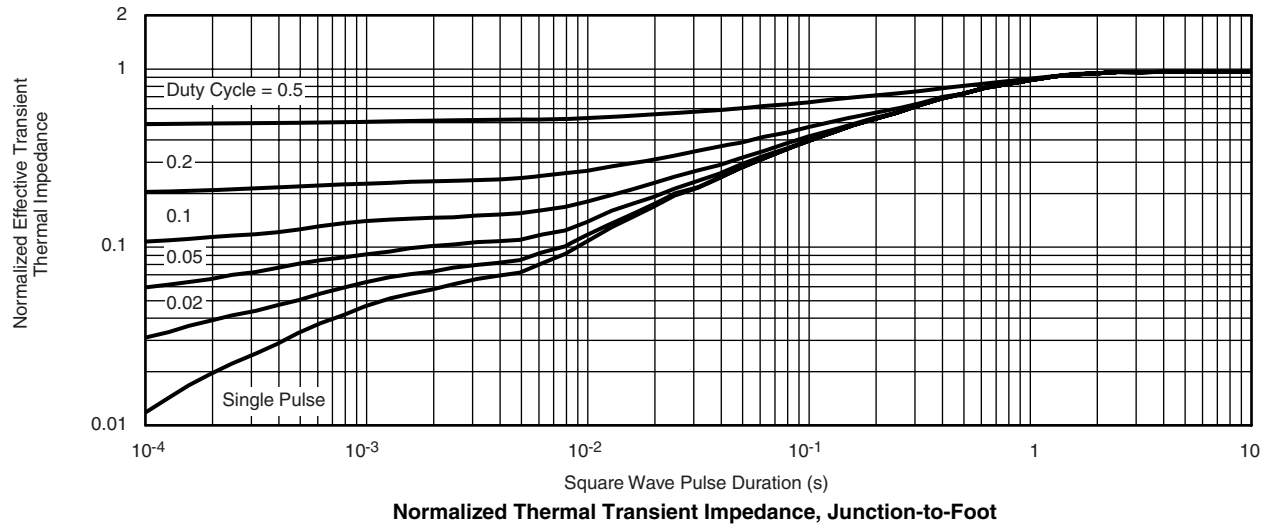
Threshold Voltage Variance Over Temperature



Single Pulse Power, Junction-to-Ambient



Normalized Thermal Transient Impedance, Junction-to-Ambient

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


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