HALOGEN

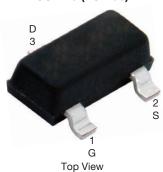
FREE



Vishay Siliconix

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

### SOT-23 (TO-236)



Marking code: 7K

PRODUCT SUMMARY				
V <sub>DS</sub> (V)	60			
$R_{DS(on)}$ max. ( $\Omega$ ) at $V_{GS} = 10 \text{ V}$	2			
Q <sub>g</sub> typ. (nC)	0.4			
I <sub>D</sub> (A)	0.3			
Configuration	Single			

#### **FEATURES**

Low on-resistance: 2 Ω
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

 Material categorization: for definitions of compliance please see <a href="https://www.vishav.com/doc?99912">www.vishav.com/doc?99912</a>

#### Note

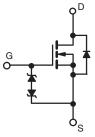
\* This datasheet provides information about parts that are RoHS-compliant and / or parts that are non RoHS-compliant. For example, parts with lead (Pb) terminations are not RoHS-compliant. Please see the information / tables in this datasheet for details

### **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



N-Channel MOSFET

ORDERING INFORMATION				
Package	SOT-23			
Lead (Pb)-free	2N7002K-T1-E3			
Lead (Pb)-free and halogen-free	2N7002K-T1-GE3			

<b>ABSOLUTE MAXIMUM RATINGS</b> (T <sub>A</sub> = 25 °C, unless otherwise noted)					
PARAMETER		SYMBOL	LIMIT	UNIT	
Drain-source voltage		$V_{DS}$	60	V	
Gate-source voltage		$V_{GS}$	± 20	٧	
Continuous drain current (T <sub>.J</sub> = 150 °C) <sup>b</sup>	T <sub>A</sub> = 25 °C	- I <sub>D</sub>	0.3	А	
Continuous drain current (1) = 150 C) 5	T <sub>A</sub> = 100 °C		0.19		
Pulsed drain current <sup>a</sup>		$I_{DM}$	0.8		
Power dissipation <sup>b</sup>	T <sub>A</sub> = 25 °C	В	0.35	W	
Power dissipation 5	T <sub>A</sub> = 100 °C	- P <sub>D</sub>	0.14		
Maximum junction-to-ambient <sup>b</sup>		$R_{thJA}$	350	°C/W	
Operating junction and storage temperature range		T <sub>J,</sub> T <sub>stg</sub>	-55 to +150	°C	

#### Notes

- a. Pulse width limited by maximum junction temperature
- b. Surface mounted on FR4 board



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PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP. a	MAX.	UNIT	
Static				•			
Drain-source breakdown voltage	V <sub>DS</sub>	$V_{GS} = 0 \text{ V}, I_D = 10 \mu\text{A}$	60	-	-	V	
Gate-threshold voltage	V <sub>GS(th)</sub>	$V_{DS} = V_{GS}, I_{D} = 250 \mu A$	1	-	2.5	V	
Gate-body leakage		$V_{DS} = 0 \text{ V}, V_{GS} = \pm 20 \text{ V}$	-	-	± 10	μА	
		$V_{DS} = 0 V, V_{GS} = \pm 15 V$		-	1		
	I <sub>GSS</sub>	$V_{DS} = 0 \text{ V}, V_{GS} = \pm 10 \text{ V}$	-	-	± 150	150	
		$V_{DS} = 0 \text{ V}, V_{GS} = \pm 10 \text{ V}, T_{J} = 85 ^{\circ}\text{C}$	-	-	± 1000 nA		
		$V_{DS} = 0 V$ , $V_{GS} = \pm 5 V$	-	-	± 100		
Zero gate voltage drain current		V <sub>DS</sub> = 60 V, V <sub>GS</sub> = 0 V	-	-	1		
	I <sub>DSS</sub>	$V_{DS}$ = 60 V, $V_{GS}$ = 0 V, $T_J$ = 125 °C		-	500	μA	
On-state drain current <sup>b</sup>		$V_{GS} = 10 \text{ V}, V_{DS} = 7.5 \text{ V}$	800	-	-	mA	
	I <sub>D(on)</sub>	V <sub>GS</sub> = 4.5 V, V <sub>DS</sub> = 10 V	500	-	-		
Drain-source on-resistance <sup>b</sup>	В	$V_{GS} = 10 \text{ V}, I_D = 500 \text{ mA}$		-	2	Ω	
	R <sub>DS(on)</sub>	$V_{GS} = 4.5 \text{ V}, I_D = 200 \text{ mA}$	-	-	4		
Forward transconductance b	9 <sub>fs</sub>	$V_{DS} = 10 \text{ V}, I_{D} = 200 \text{ mA}$	100	-	-	mS	
Diode forward voltage	$V_{SD}$	$I_S = 200 \text{ mA}, V_{GS} = 0 \text{ V}$	-	-	1.3	V	
Dynamic <sup>a, b</sup>							
Total gate charge	Qg	$V_{DS}$ = 10 V, $V_{GS}$ = 4.5 V $I_{D}$ $\cong$ 250 mA	-	0.4	0.6	nC	
Input capacitance	C <sub>iss</sub>		-	30	-		
Output capacitance	C <sub>oss</sub>	$V_{DS} = 25 \text{ V}, V_{GS} = 0 \text{ V}$ f = 1 MHz	-	6	-	pF	
Reverse transfer capacitance	C <sub>rss</sub>	1 – 1 141112	-	2.5	-		
Switching <sup>a, c</sup>							
Turn-on time	t <sub>d(on)</sub>	$V_{DD} = 30 \text{ V}, R_{I} = 150 \Omega$	-	-	25		
Turn-off time	t <sub>d(off)</sub>	$I_D \cong 200 \text{ mA}, V_{GEN} = 10 \text{ V}, R_g = 10 \Omega$	-	-	35	ns	

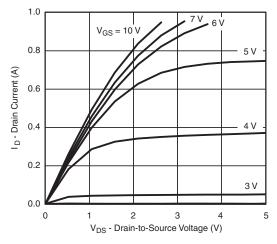
#### Notes

- a. For DESIGN AID ONLY, not subject to production testing
- b. Pulse test: pulse width  $\leq$  300  $\mu s$  duty cycle  $\leq$  2 %
- c. Switching time is essentially independent of operating temperature

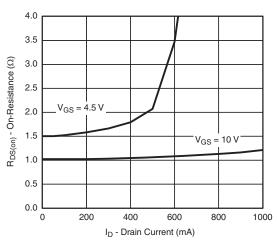
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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



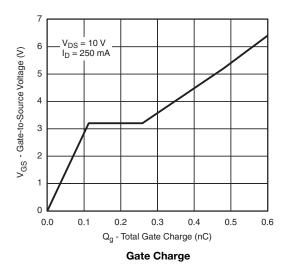
## TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

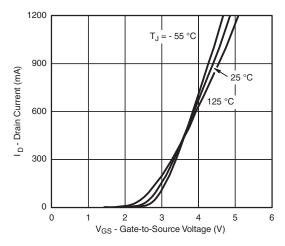


#### **Output Characteristics**

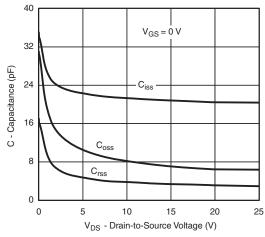


On-Resistance vs. Drain Current

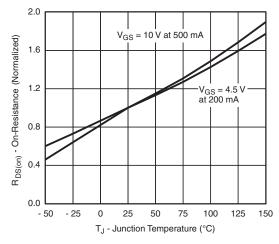




**Transfer Characteristics** 



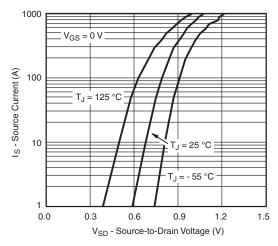
Capacitance



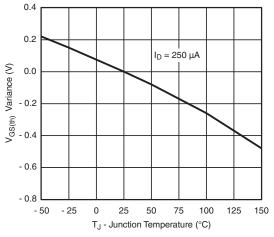
On-Resistance vs. Junction Temperature



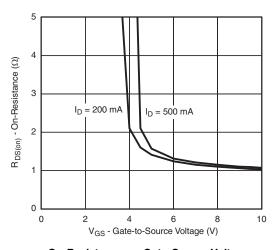
## TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



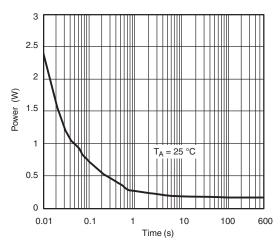
Source-Drain Diode Forward Voltage



**Threshold Voltage Variance Over Temperature** 



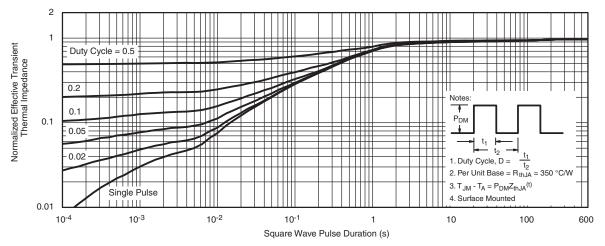
On-Resistance vs. Gate-Source Voltage



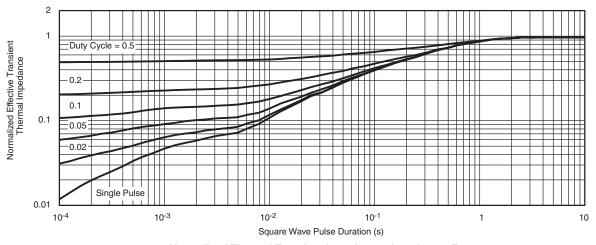
Single Pulse Power, Junction-to-Ambient



## TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



Normalized Thermal Transient Impedance, Junction-to-Ambient



Normalized Thermal Transient Impedance, Junction-to-Foot

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## SOT-23 (TO-236): 3-LEAD







Dim	MILLIMETERS		INCHES		
	Min	Max	Min	Max	
Α	0.89	1.12	0.035	0.044	
A <sub>1</sub>	0.01	0.10	0.0004	0.004	
A <sub>2</sub>	0.88	1.02	0.0346	0.040	
b	0.35	0.50	0.014	0.020	
С	0.085	0.18	0.003	0.007	
D	2.80	3.04	0.110	0.120	
E	2.10	2.64	0.083	0.104	
E <sub>1</sub>	1.20	1.40	0.047	0.055	
е	0.95 BSC		0.0374 Ref		
e <sub>1</sub>	1.90 BSC		1.90 BSC 0.0748 Ref		
L	0.40	0.60	0.016	0.024	
L <sub>1</sub>	0.64 Ref		0.025 Ref		
S	0.50 Ref		0.020 Ref		
q	3°	8°	3°	8°	
FCN: S-03946-Rev K 09-	lul-01	•			

ECN: S-03946-Rev. K, 09-Jul-01

DWG: 5479

Document Number: 71196 www.vishay.com 09-Jul-01



## **RECOMMENDED MINIMUM PADS FOR SOT-23**



Recommended Minimum Pads Dimensions in Inches/(mm)

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APPLICATION NOTE



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