

## N-Channel Enhancement Mode Power MOSFET

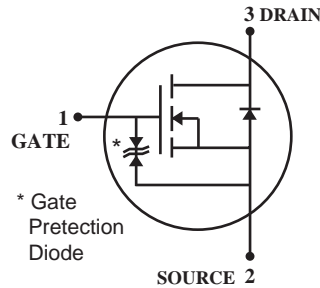
**(Pb)** Lead(Pb)-Free

### Features:

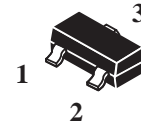
- \* Low Gate Voltage Threshold  $V_{GS(th)}$  to Facilitate Drive Circuit Design.
- \* Low Gate Charge for Fast Switching.
- \* ESD Protected Gate.
- \* Minimum Breakdown Voltage Rating of 30V.

### Application:

- \* Level Shifters
- \* Level Switches
- \* Low Side Load Switches
- \* Portable Applications



**DRAIN CURRENT**  
**0.5 AMPERES**  
**DRAIN SOURCE VOLTAGE**  
**30 VOLTAGE**



**SOT-23**

### Maximum Ratings ( $T_A=25^\circ\text{C}$ Unless Otherwise Specified)

Rating	Symbol	Value	Unit
Drain-Source Voltage	$V_{DS}$	30	V
Gate-Source Voltage	$V_{GS}$	$\pm 20$	
Continuous Drain Current <sup>1</sup> , Steady State ( $T_A=25^\circ\text{C}$ ) ( $T_A=85^\circ\text{C}$ )	$I_D$	0.5	A
		0.37	
Power Dissipation <sup>1</sup> , Steady State	$P_D$	0.69	W
Continuous Drain Current <sup>1</sup> , $t < 10\text{s}$ ( $T_A=25^\circ\text{C}$ ) ( $T_A=85^\circ\text{C}$ )	$I_D$	0.56	A
		0.40	
Power Dissipation <sup>1</sup> , $t < 5\text{s}$	$P_D$	0.83	W
Pulsed Drain Current	$I_{DM}$	1.7	A
Maximum Junction-ambient , Steady State <sup>1</sup> , $t < 10\text{s}$ <sup>1</sup> , Steady State <sup>2</sup>	$R_{\theta JA}$	180	$^\circ\text{C/W}$
		150	
		300	
Operating Junction Temperature Range	$T_J$	+150	$^\circ\text{C}$
Storage Temperature Range	$T_{stg}$	-55~+150	$^\circ\text{C}$
Source Current (Body Diode)	$I_S$	1.0	A
Lead Temperature for Soldering Purposes (1/8" from case 10s)	$T_L$	260	$^\circ\text{C}$

Note: 1. Surface-mounted on FR4 board using 1 in sq pad size (Cu area = 1.127 in sq [1 oz] including traces).  
 2. Surface-mounted on FR4 board using the minimum recommended pad size.

### Device Marking

2N4003K = TR8

**Electrical Characteristics** ( $T_A=25^\circ\text{C}$  Unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
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**Static**

Drain-Source Breakdown Voltage $V_{GS}=0, I_D=100\mu\text{A}$	$V_{(BR)DSS}$	30	-	-	V
Gate-Source Threshold Voltage <sup>3</sup> $V_{DS}=V_{GS}, I_D=250\mu\text{A}$	$V_{GS(Th)}$	0.8	-	1.6	
Gate-Source Leakage Current $V_{GS}=\pm 10\text{V}$	$I_{GSS}$	-	-	$\pm 1.0$	$\mu\text{A}$
Zero Gate Voltage Drain Current ( $T_J=25^\circ\text{C}$ ) $V_{DS}=30\text{V}, V_{GS}=0$	$I_{DSS}$	-	-	1	$\mu\text{A}$
Drain-Source On-Resistance <sup>3</sup> $V_{GS}=2.5\text{V}, I_D=10\text{mA}$ $V_{GS}=4.0\text{V}, I_D=10\text{mA}$	$R_{DS(on)}$	-	1.5 1.0	2.0 1.5	$\Omega$
Forward Transconductance <sup>3</sup> $V_{DS}=3.0\text{V}, I_D=10\text{mA}$	$g_{fs}$	-	0.33	-	S

**Dynamic**

Input Capacitance $V_{GS}=0\text{V}, V_{DS}=5.0\text{V}, f=1.0\text{MHz}$	$C_{iss}$	-	21	-	pF
Output Capacitance $V_{GS}=0\text{V}, V_{DS}=5.0\text{V}, f=1.0\text{MHz}$	$C_{oss}$	-	19.7	-	
Reverse Transfer Capacitance $V_{GS}=0\text{V}, V_{DS}=5.0\text{V}, f=1.0\text{MHz}$	$C_{rss}$	-	8.1	-	

## Switching

Turn-on Delay Time <sup>4</sup> $V_{GS}=4.5V, V_{DD}=5.0V, I_D=0.1A, R_G=50\Omega$	$t_{d(on)}$	-	16.7	-	ns
Rise Time <sup>4</sup> $V_{GS}=4.5V, V_{DD}=5.0V, I_D=0.1A, R_G=50\Omega$	$t_r$	-	47.9	-	
Turn-off Delay Time <sup>4</sup> $V_{GS}=4.5V, V_{DD}=5.0V, I_D=0.1A, R_G=50\Omega$	$t_{d(off)}$	-	65.1	-	
Fall Time <sup>4</sup> $V_{GS}=4.5V, V_{DD}=5.0V, I_D=0.1A, R_G=50\Omega$	$t_f$	-	64.2	-	
Total Gate Charge $V_{GS}=5.0V, V_{DS}=24V, I_D=0.1A$	$Q_g$	-	1.15	-	nC
Threshold Gate Charge $V_{GS}=5.0V, V_{DS}=24V, I_D=0.1A$	$Q_{g(TH)}$	-	0.15	-	
Gate-Source Charge $V_{GS}=5.0V, V_{DS}=24V, I_D=0.1A$	$Q_{gs}$	-	0.32	-	
Gate-Drain Change $V_{GS}=5.0V, V_{DS}=24V, I_D=0.1A$	$Q_{gd}$	-	0.23	-	

## Source-Drain Diode Characteristics

Forward On Voltage $V_{GS}=0V, I_S=10mA$ $T_J=25^\circ C$ $T_J=125^\circ C$	$V_{SD}$	-	0.65 0.45	0.7 -	V
Reverse Recovery Time $V_{GS}=0V, I_S=10mA, dI_S/dt=8A/\mu s$	$t_{rr}$	-	14	-	nS

Note : 3. Pulse Test: pulse width  $\leq 300 \mu s$ , duty cycle  $\leq 2\%$ .

4. Switching characteristics are independent of operating junction temperatures.

## TYPICAL PERFORMANCE CURVES ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

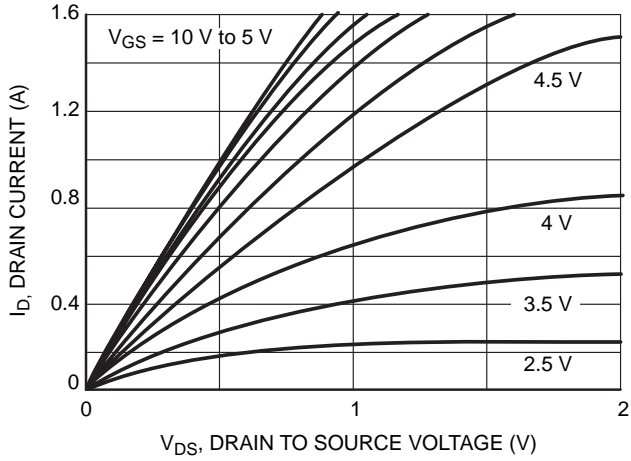


Figure 1. On Region Characteristics

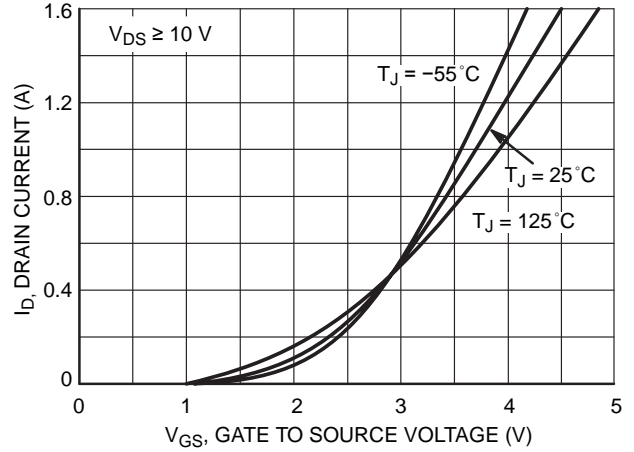


Figure 2. Transfer Characteristics

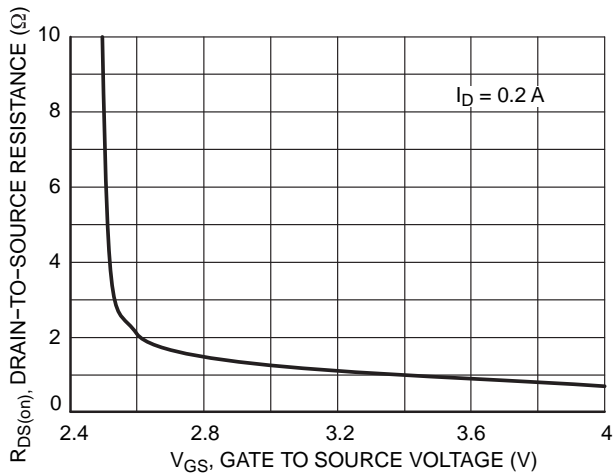


Figure 3. On Resistance vs. Gate to Source Voltage

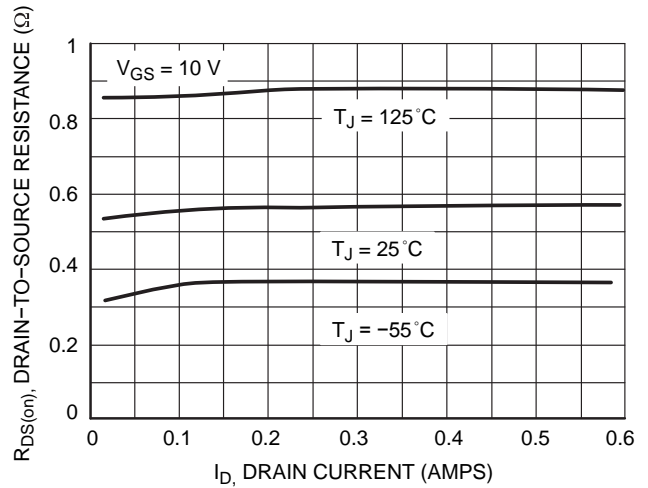


Figure 4. On Resistance vs. Drain Current and Temperature

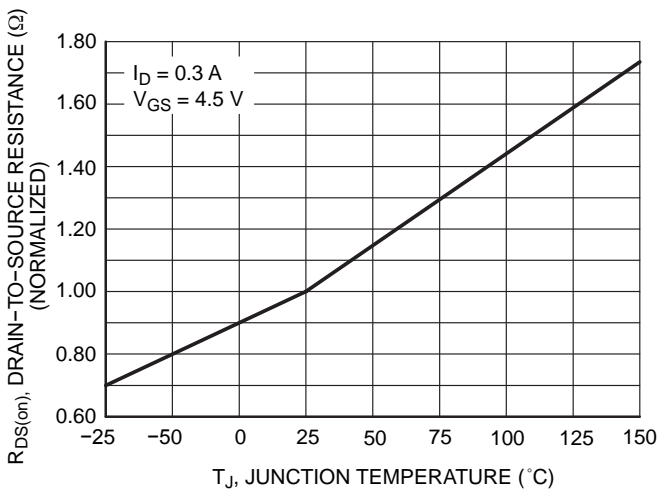


Figure 5. On Resistance Variation with Temperature

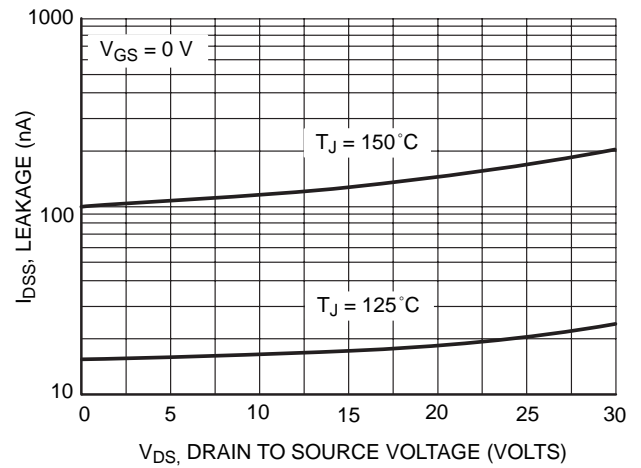


Figure 6. Drain to Source Leakage Current vs. Voltage

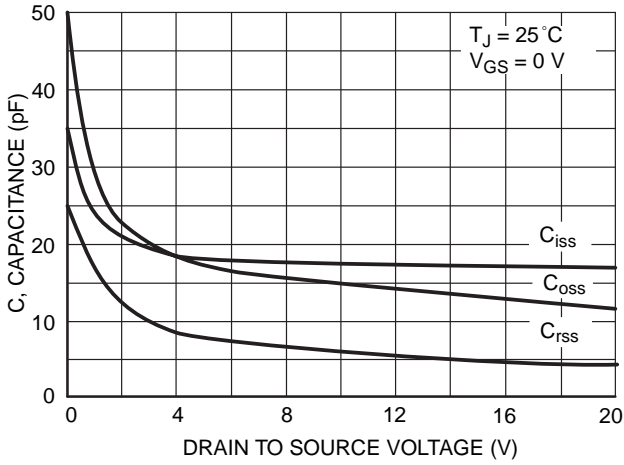


Figure 7. Capacitance Variation

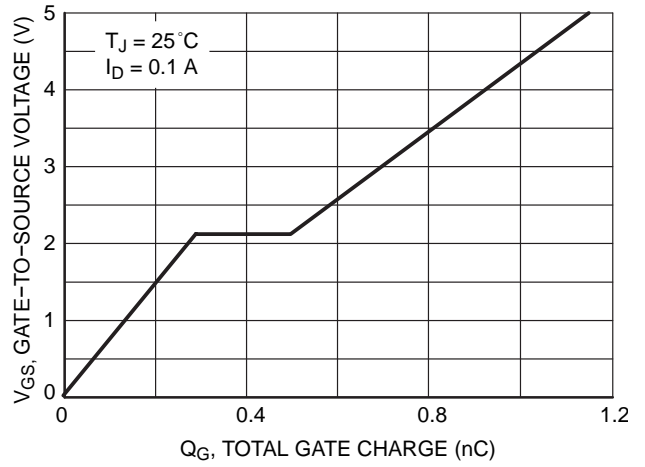


Figure 8. Gate to Source & Drain to Source Voltage vs. Total Charge

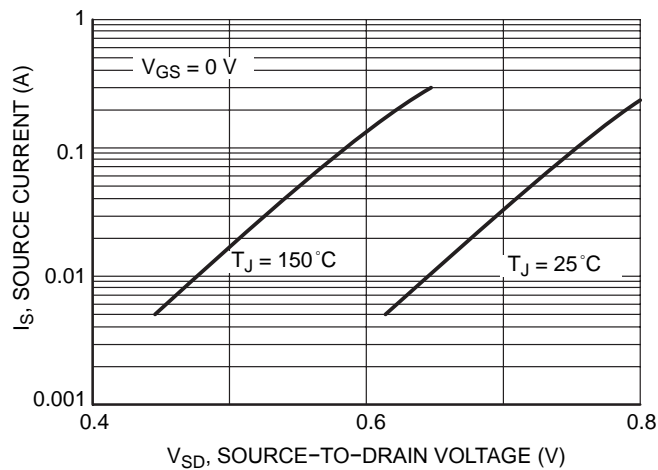
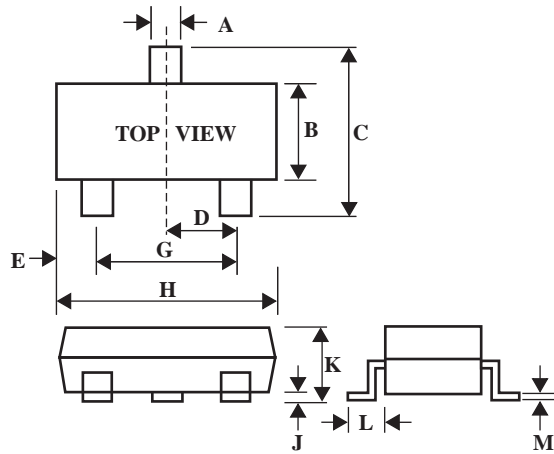


Figure 9. Diode Forward Voltage vs. Current

SOT-23 Outline Dimension

Unit:mm



SOT-23		
Dim	Min	Max
A	0.35	0.51
B	1.19	1.40
C	2.10	3.00
D	0.85	1.05
E	0.46	1.00
G	1.70	2.10
H	2.70	3.10
J	0.01	0.13
K	0.89	1.10
L	0.30	0.61
M	0.076	0.25