

## N-Channel Enhancement Mode Power MOSFET

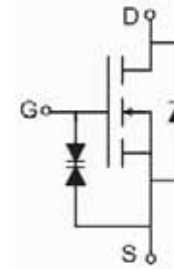
### General Features

- $V_{DS} = 60V, I_D = 0.3A$   
 $R_{DS(ON)} < 3\Omega @ V_{GS}=5V$   
 $R_{DS(ON)} < 2\Omega @ V_{GS}=10V$
- ESD Rating: HBM 2300V

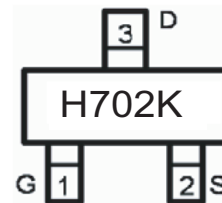
- High power and current handing capability
- Lead free product is acquired
- Surface mount package

### Application

- Direct logic-level interface: TTL/CMOS
- Drivers: relays, solenoids, lamps, hammers, display, memories, transistors, etc.
- Battery operated systems
- Solid-state relays
- P/N suffix V means AEC-Q101 qualified, e.g:2N7002KV
- Halogen-free



Schematic diagram



Marking and pin assignment



SOT-23 top view

### Package Marking And Ordering Information

Device Marking	Device	Device Package	Reel Size	Tape width	Quantity
H702K	2N7002K	SOT-23	Ø180mm	8 mm	3000 units

### Absolute Maximum Ratings ( $T_A=25^\circ C$ unless otherwise noted)

Parameter	Symbol	Limit	Unit
Drain-Source Voltage	$V_{DS}$	60	V
Gate-Source Voltage	$V_{GS}$	$\pm 20$	V
Continuous Drain Current ( $T_J = 150^\circ C$ )	$I_D$	$T_A = 25^\circ C$	0.3
		$T_A = 100^\circ C$	0.19
Drain Current-Pulsed (Note 1)	$I_{DM}$	0.8	A
Maximum Power Dissipation	$P_D$	0.35	W
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	-55 To 150	$^\circ C$

### Thermal Characteristic

Thermal Resistance, Junction-to-Ambient (Note 2)	$R_{\theta JA}$	350	$^\circ C/W$
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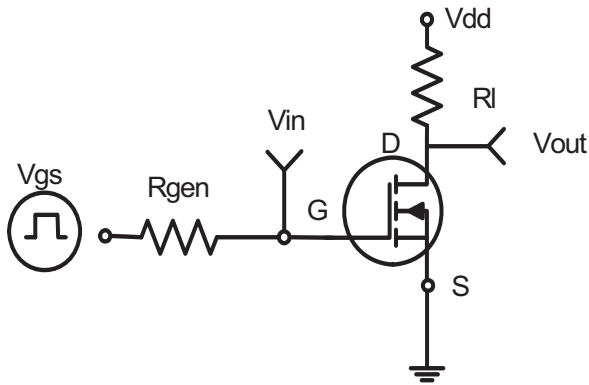
## Electrical Characteristics (T<sub>A</sub>=25°C unless otherwise noted)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
<b>Off Characteristics</b>						
Drain-Source Breakdown Voltage	BV <sub>DSS</sub>	V <sub>GS</sub> =0V, I <sub>D</sub> =250μA	60	68	-	V
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> =60V, V <sub>GS</sub> =0V	-	-	1	μA
Gate-Body Leakage Current	I <sub>GSS</sub>	V <sub>GS</sub> =±10V, V <sub>DS</sub> =0V	-	±100	±500	nA
		V <sub>GS</sub> =±20V, V <sub>DS</sub> =0V	-	±4	±10	uA
<b>On Characteristics</b> <sup>(Note 3)</sup>						
Gate Threshold Voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA	1	1.7	1.9	V
Drain-Source On-State Resistance	R <sub>DS(ON)</sub>	V <sub>GS</sub> =5V, I <sub>D</sub> =0.4A	-	1.3	3	Ω
		V <sub>GS</sub> =10V, I <sub>D</sub> =0.5A	-	1	2	Ω
Forward Transconductance	g <sub>FS</sub>	V <sub>DS</sub> =10V, I <sub>D</sub> =0.2A	0.1	-	-	S
<b>Dynamic Characteristics</b> <sup>(Note 4)</sup>						
Input Capacitance	C <sub>iss</sub>	V <sub>DS</sub> =25V, V <sub>GS</sub> =0V, F=1.0MHz	-	21	50	PF
Output Capacitance	C <sub>oss</sub>		-	11	25	PF
Reverse Transfer Capacitance	C <sub>rss</sub>		-	4.2	5	PF
<b>Switching Characteristics</b> <sup>(Note 4)</sup>						
Turn-on Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> =30V, I <sub>D</sub> =0.2A V <sub>GS</sub> =10V, R <sub>GEN</sub> =10Ω	-	10	-	nS
Turn-on Rise Time	t <sub>r</sub>		-	50	-	nS
Turn-Off Delay Time	t <sub>d(off)</sub>		-	17	-	nS
Turn-Off Fall Time	t <sub>f</sub>		-	10	-	nS
Total Gate Charge	Q <sub>g</sub>	V <sub>DS</sub> =10V, I <sub>D</sub> =0.3A, V <sub>GS</sub> =4.5V	-	1.7	3	nC
<b>Drain-Source Diode Characteristics</b>						
Diode Forward Voltage <sup>(Note 3)</sup>	V <sub>SD</sub>	V <sub>GS</sub> =0V, I <sub>S</sub> =0.2A	-	-	1.3	V
Diode Forward Current <sup>(Note 2)</sup>	I <sub>S</sub>		-	-	0.2	A

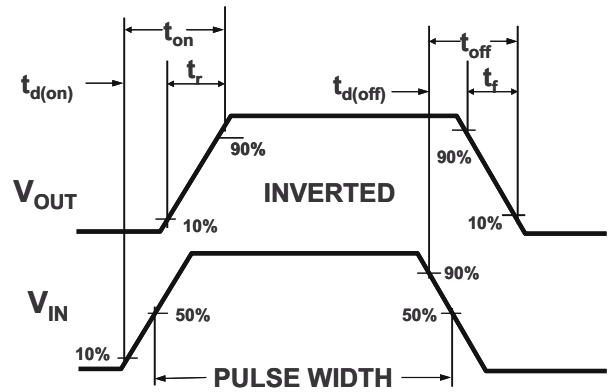
### Notes:

1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board, t ≤ 10 sec.
3. Pulse Test: Pulse Width ≤ 300μs, Duty Cycle ≤ 2%.
4. Guaranteed by design, not subject to production

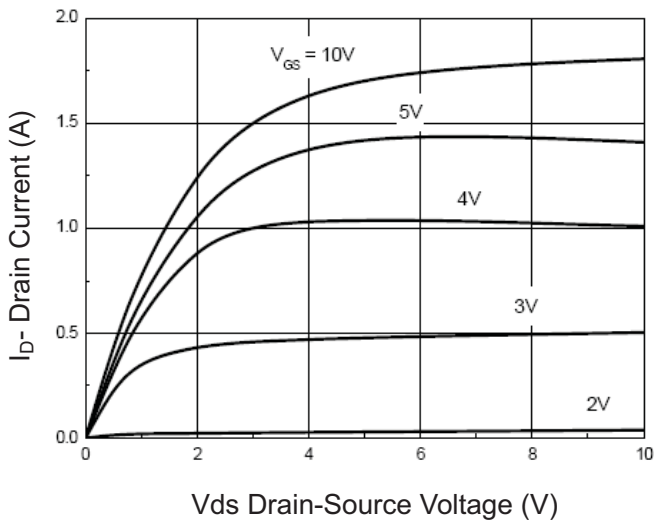
# RATING AND CHARACTERISTICS CURVES (2N7002K)



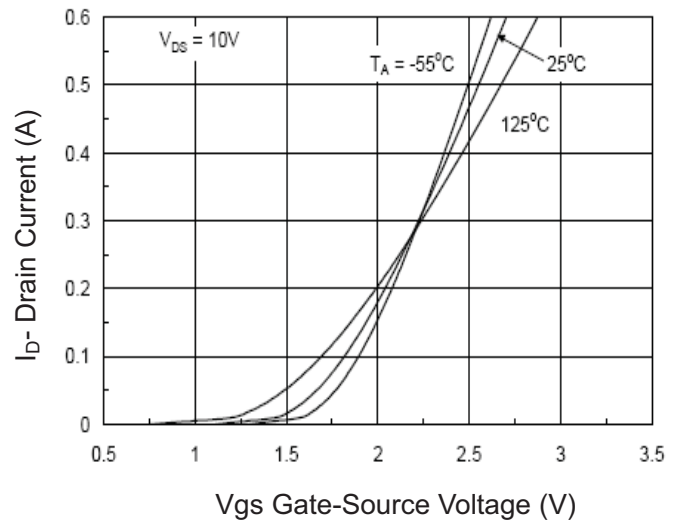
**Figure 1: Switching Test Circuit**



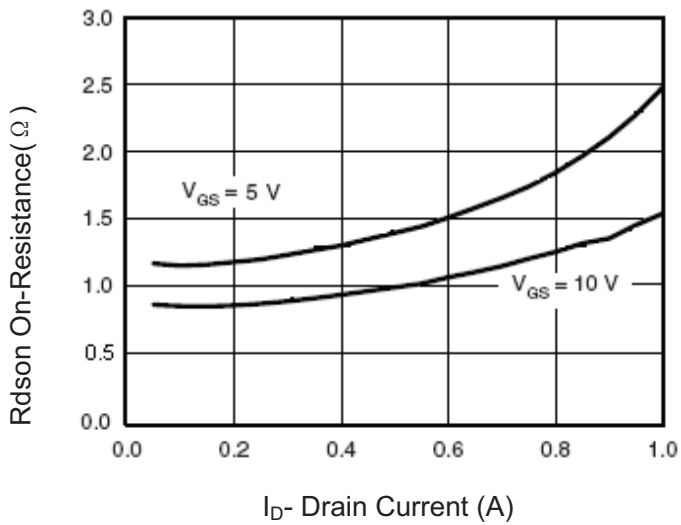
**Figure 2: Switching Waveforms**



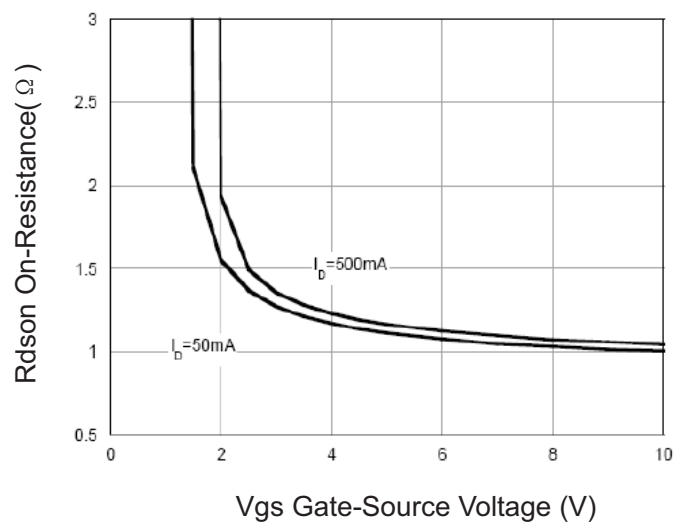
**Figure 3 Output Characteristics**



**Figure 4 Transfer Characteristics**

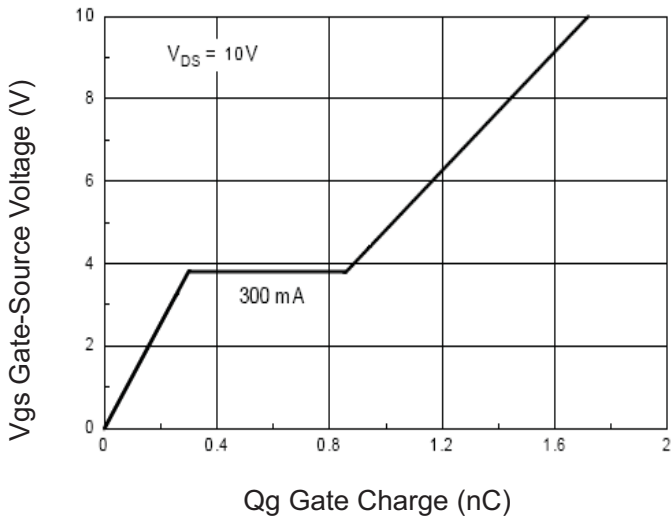


**Figure 5 Drain-Source On-Resistance**

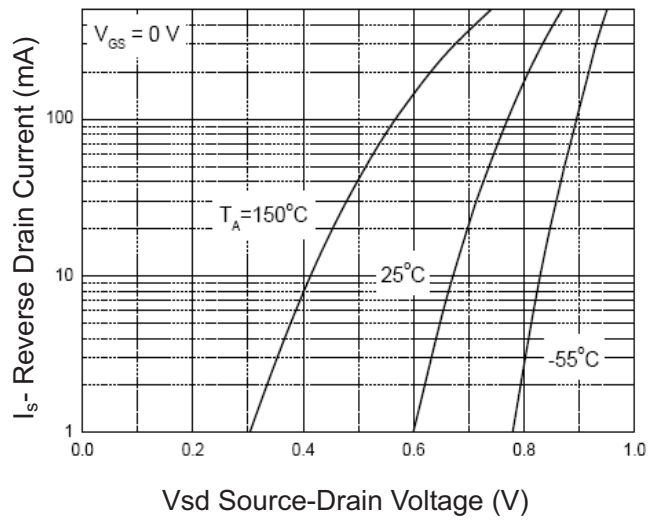


**Figure 6 Rds(on) vs Vgs**

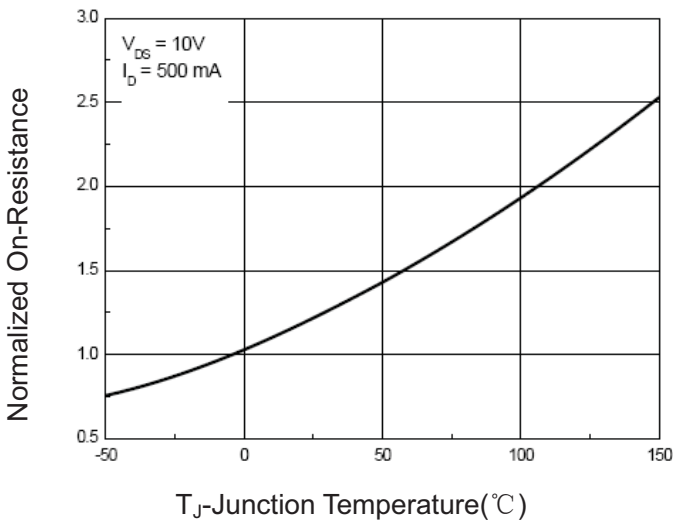
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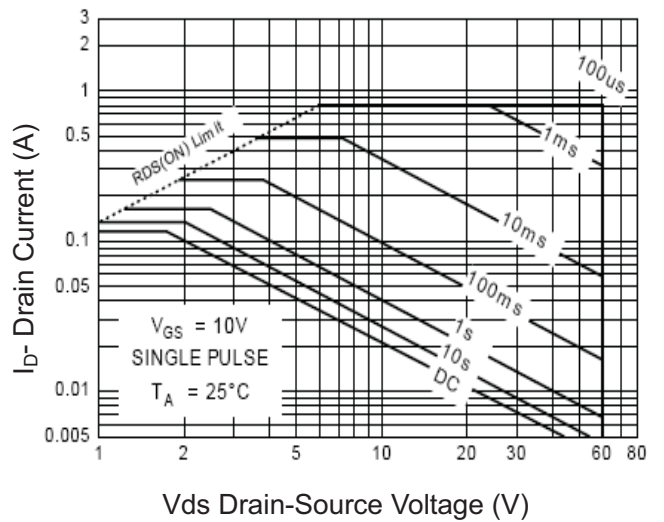
**Figure 7 Gate Charge**



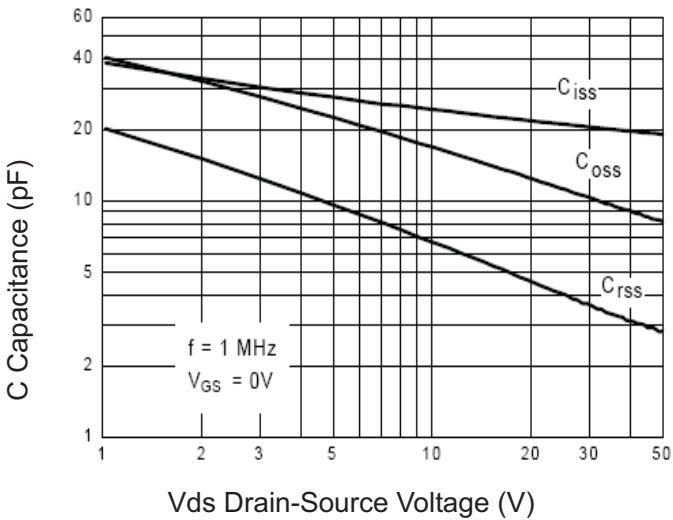
**Figure 8 Source-Drain Diode Forward**



**Figure 9 Drain-Source On-Resistance**

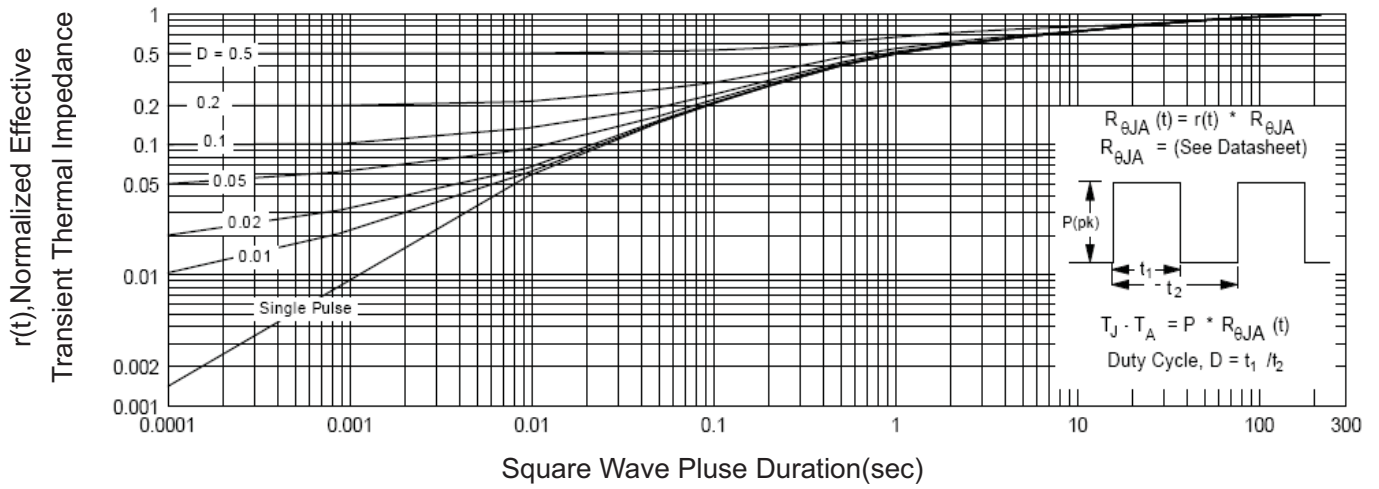


**Figure 10 Safe Operation Area**



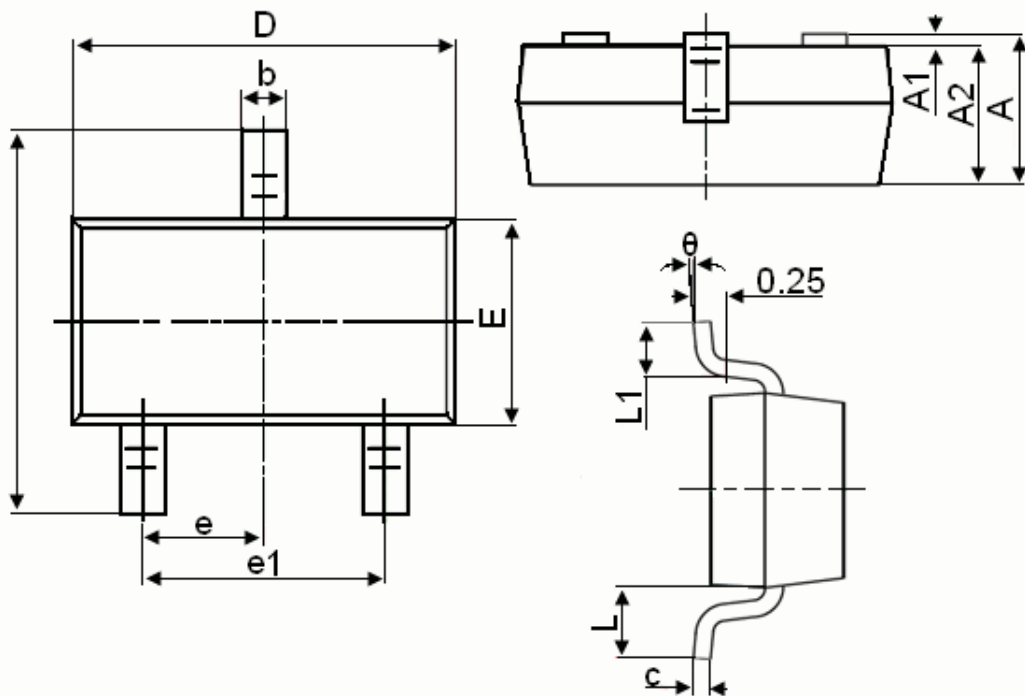
**Figure 11 Capacitance vs Vds**

## RATING AND CHARACTERISTICS CURVES (2N7002K)



**Figure 12 Normalized Maximum Transient Thermal Impedance**

## SOT-23 Package Information



Symbol	Dimensions in Millimeters	
	MIN.	MAX.
A	0.900	1.150
A1	0.000	0.100
A2	0.900	1.050
b	0.300	0.500
c	0.080	0.150
D	2.800	3.000
E	1.200	1.400
E1	2.250	2.550
e	0.950TYP	
e1	1.800	2.000
L	0.550REF	
L1	0.300	0.500
θ	0°	8°

### Notes

1. All dimensions are in millimeters.
2. Tolerance  $\pm 0.10\text{mm}$  (4 mil) unless otherwise specified
3. Package body sizes exclude mold flash and gate burrs. Mold flash at the non-lead sides should be less than 5 mils.
4. Dimension L is measured in gauge plane.
5. Controlling dimension is millimeter, converted inch dimensions are not necessarily exact.

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