

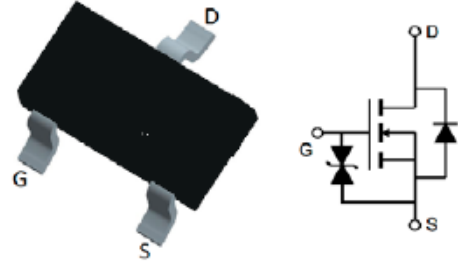
**Features**

- Low  $R_{DS(on)}$  @  $V_{GS}=10V$
- 5V Logic Level Control
- N Channel SOT23 Package
- HMB ESD Protection 2KV
- Pb-Free, RoHS Compliant

$V_{(BR)DSS}$	$R_{DS(ON)}$ Typ	$I_D$ Max
60V	2.2Ω @ 10V	0.3A
	2.8Ω @ 4.5V	

**Applications**

- Logic level translators
- High-speed line drivers
- Low-side load switch
- Switching circuits



**SOT23**

**Order Information**

Product	Package	Marking	Packing
2N7002K	SOT23	02K	3000PCS/Reel
2N7002K	SOT23	702K	3000PCS/Reel

**Absolute Maximum Ratings**

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

Symbol	Parameter	Rating	Unit
<b>Common Ratings (<math>T_A=25^{\circ}C</math> Unless Otherwise Noted)</b>			
$V_{GS}$	Gate-Source Voltage	±10	V
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	60	V
$T_J$	Maximum Junction Temperature	150	°C
$T_{STG}$	Storage Temperature Range	-50 to 150	°C
<b>Mounted on Large Heat Sink</b>			
$I_{DM}$	Pulse Drain Current Tested④	$T_A=25^{\circ}C$	1.2 A
$I_D$	Continuous Drain Current( $V_{GS}=4.5V$ )	$T_A=25^{\circ}C$	0.3 A
		$T_A=70^{\circ}C$	0.24 A
$P_D$	Maximum Power Dissipation	$T_A=25^{\circ}C$	0.3 W
		$T_A=70^{\circ}C$	0.2 W
$R_{\theta JA}$	Thermal Resistance Junction-Ambient	400	°C/W

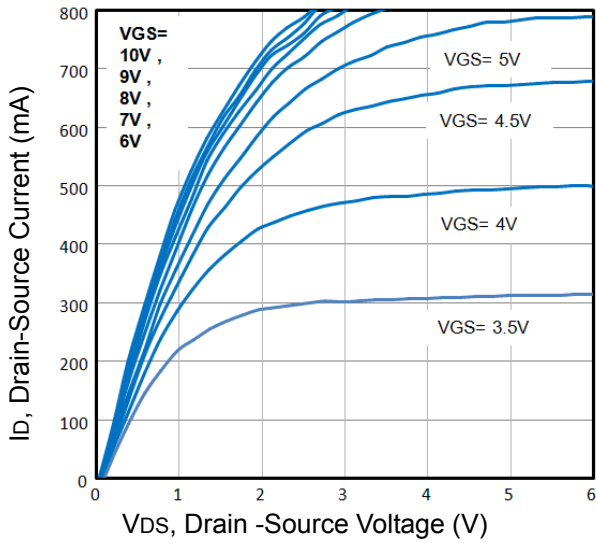
Symbol	Parameter	Condition	Min	Typ	Max	Unit
<b>Static Electrical Characteristics @ T<sub>J</sub> = 25°C (unless otherwise stated)</b>						
V <sub>(BR)DSS</sub>	Drain-Source Breakdown Voltage	V <sub>GS</sub> =0V I <sub>D</sub> =250μA	60	--	--	V
I <sub>DSS</sub>	Zero Gate Voltage Drain Current(T <sub>A</sub> =25°C)	V <sub>DS</sub> =60V, V <sub>GS</sub> =0V	--	--	1	μA
	Zero Gate Voltage Drain Current(T <sub>A</sub> =125°C)	V <sub>DS</sub> =48V, V <sub>GS</sub> =0V	--	--	100	uA
I <sub>GSS</sub>	Gate-Body Leakage Current	V <sub>GS</sub> =±10V, V <sub>DS</sub> =0V	--	--	±10	uA
V <sub>GS(TH)</sub>	Gate Threshold Voltage	V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA	1.0	1.5	2.5	V
R <sub>DS(ON)</sub>	Drain-Source On-State Resistance②	V <sub>GS</sub> =10V, I <sub>D</sub> =0.3A	--	2.2	4	Ω
R <sub>DS(ON)</sub>	Drain-Source On-State Resistance②	V <sub>GS</sub> =4.5V, I <sub>D</sub> =0.3A	--	2.8	6	Ω
<b>Dynamic Electrical Characteristics @ T<sub>J</sub> = 25°C (unless otherwise stated)</b>						
C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> =30V, V <sub>GS</sub> =0V, f=1MHz	--	16	--	pF
C <sub>oss</sub>	Output Capacitance		--	3.8	--	pF
C <sub>rss</sub>	Reverse Transfer Capacitance		--	0.6	--	pF
Q <sub>g</sub>	Total Gate Charge	V <sub>DS</sub> =30V I <sub>D</sub> =0.5A, V <sub>GS</sub> =10V	--	0.72	--	nC
Q <sub>gs</sub>	Gate Source Charge		--	0.15	--	nC
Q <sub>gd</sub>	Gate Drain Charge		--	0.22	--	nC
<b>Switching Characteristics</b>						
t <sub>d(on)</sub>	Turn on Delay Time	V <sub>DD</sub> =30V, I <sub>D</sub> =0.3A, R <sub>G</sub> =3.3Ω, V <sub>GS</sub> =10V	--	5	--	ns
t <sub>r</sub>	Turn on Rise Time		--	3.3	--	ns
t <sub>d(off)</sub>	Turn Off Delay Time		-	18	--	ns
t <sub>f</sub>	Turn Off Fall Time		--	5.2	--	ns
<b>Source Drain Diode Characteristics</b>						
I <sub>SD</sub>	Source drain current(Body Diode)	T <sub>A</sub> =25°C	--	--	0.5	A
V <sub>SD</sub>	Forward on voltage②	T <sub>J</sub> =25°C, I <sub>SD</sub> =0.5A, V <sub>GS</sub> =0V	--	0.73	1.2	V

Notes:

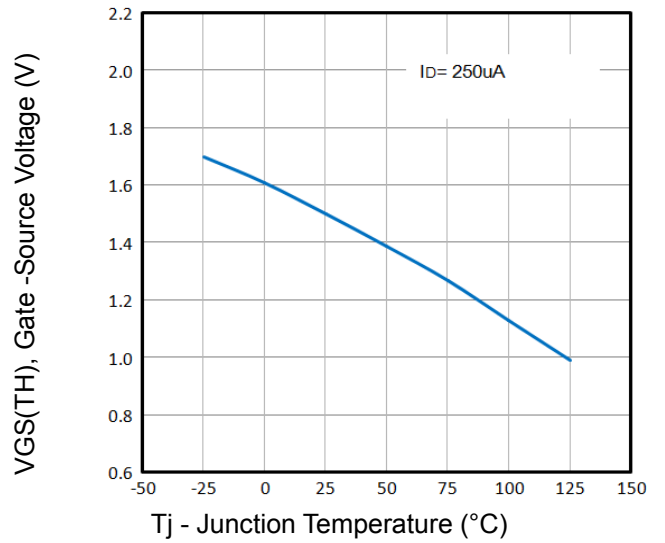
① Pulse width limited by maximum allowable junction temperature

②Pulse test ; Pulse width≤300μs, duty cycle≤2%.

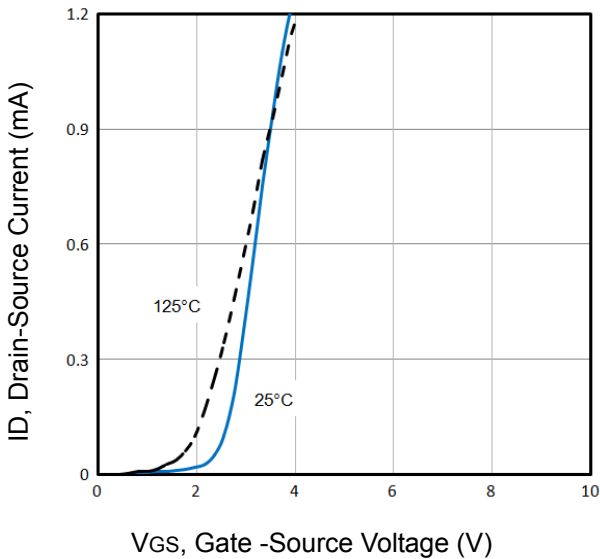
**Typical Characteristics**



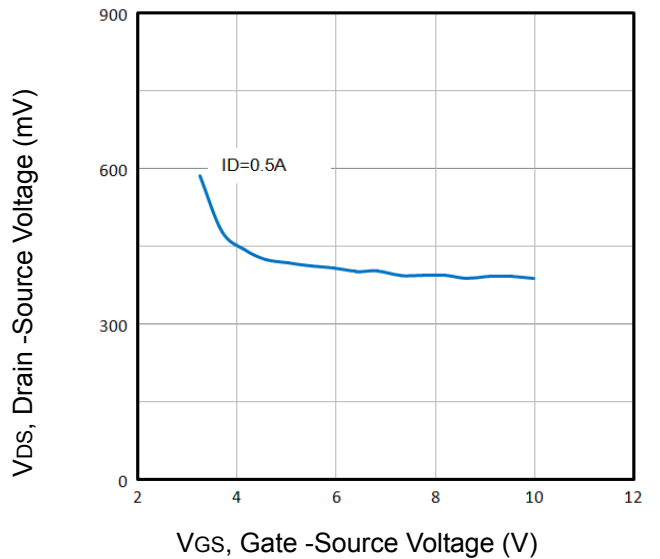
**Fig1.** Typical Output Characteristics



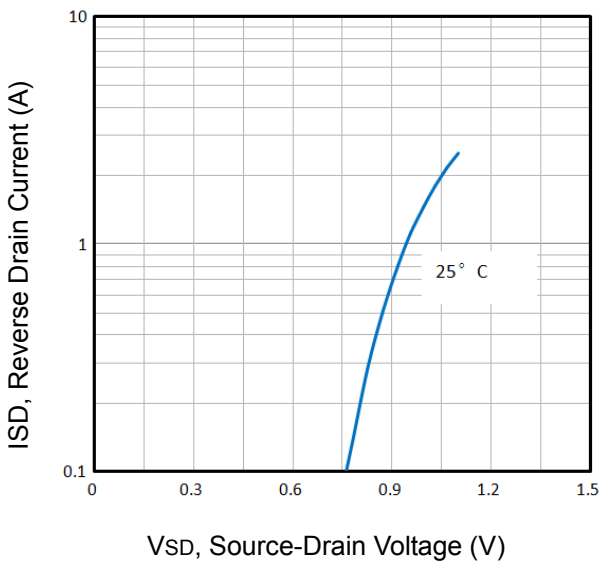
**Fig2.** Normalized Threshold Voltage Vs. Temperature



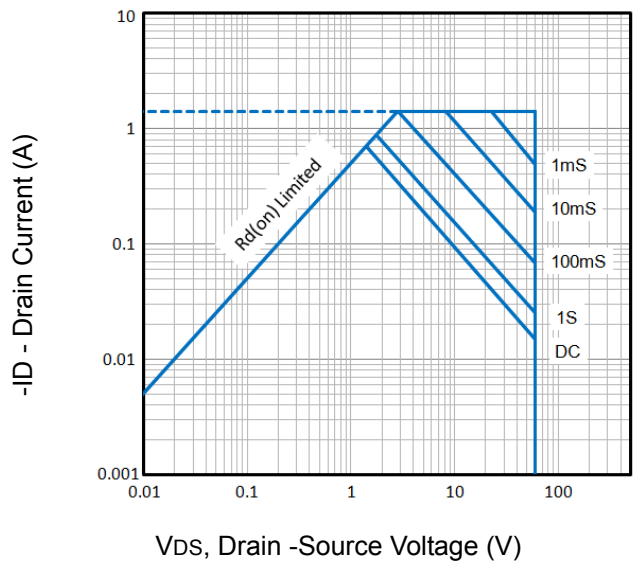
**Fig3.** Typical Transfer Characteristics



**Fig4.** Drain -Source Voltage vs Gate -Source Voltage



**Fig5.** Typical Source-Drain Diode Forward Voltage



**Fig6.** Maximum Safe Operating Area

Typical Characteristics

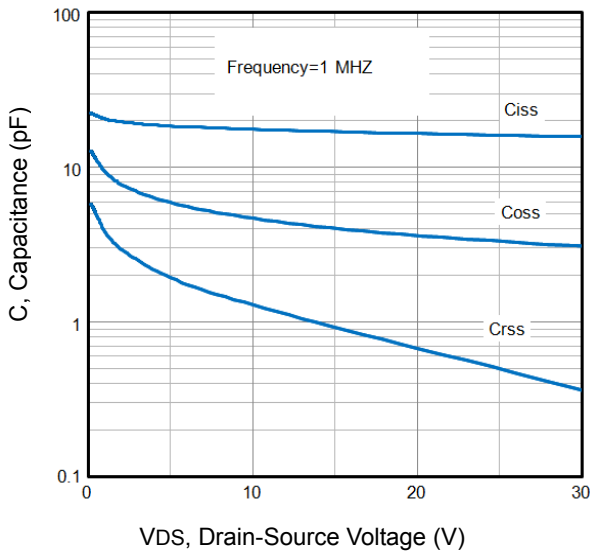


Fig7. Typical Capacitance Vs. Drain-Source Voltage

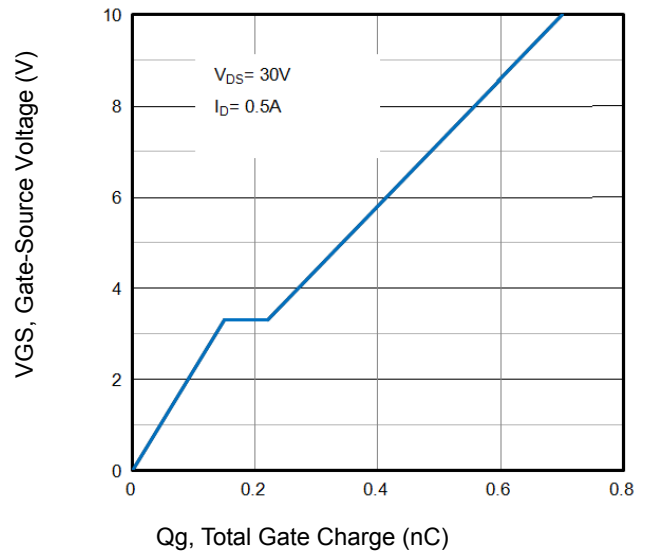


Fig8. Typical Gate Charge Vs. Gate-Source Voltage

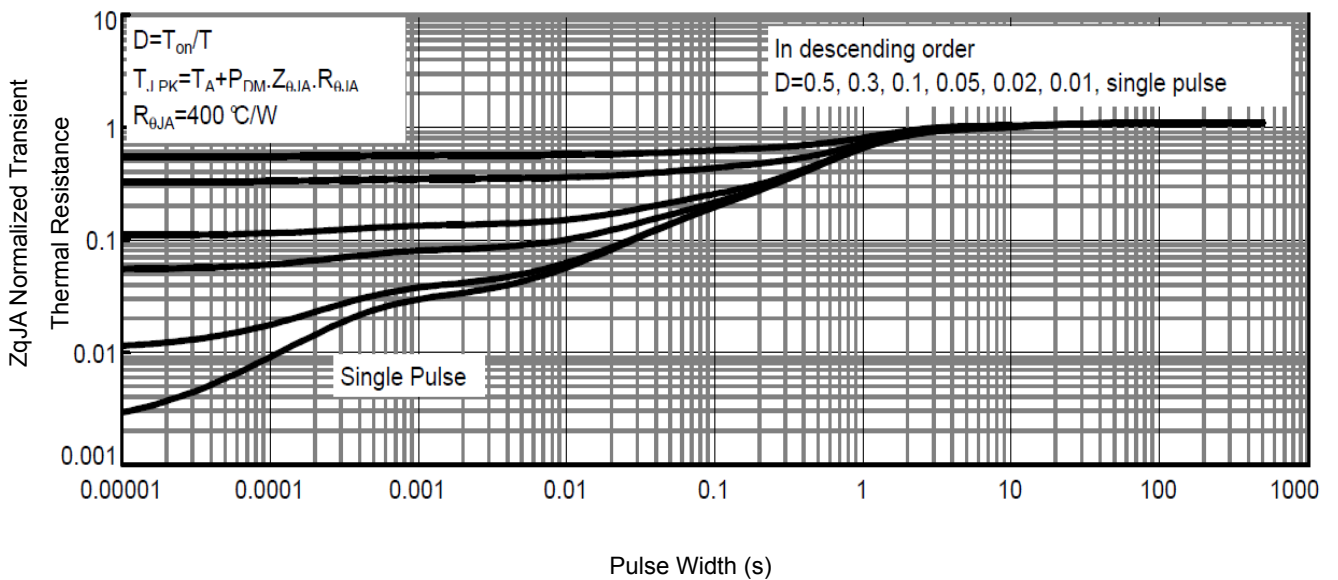


Fig9. Normalized Maximum Transient Thermal Impedance

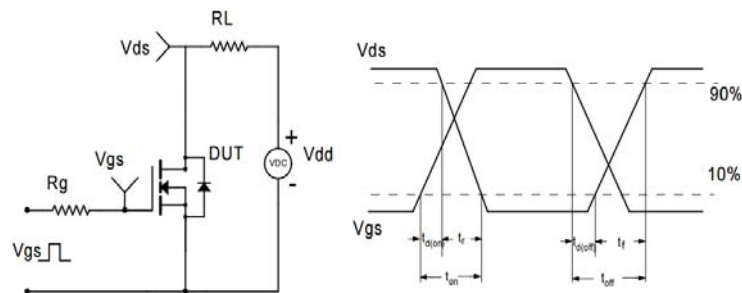
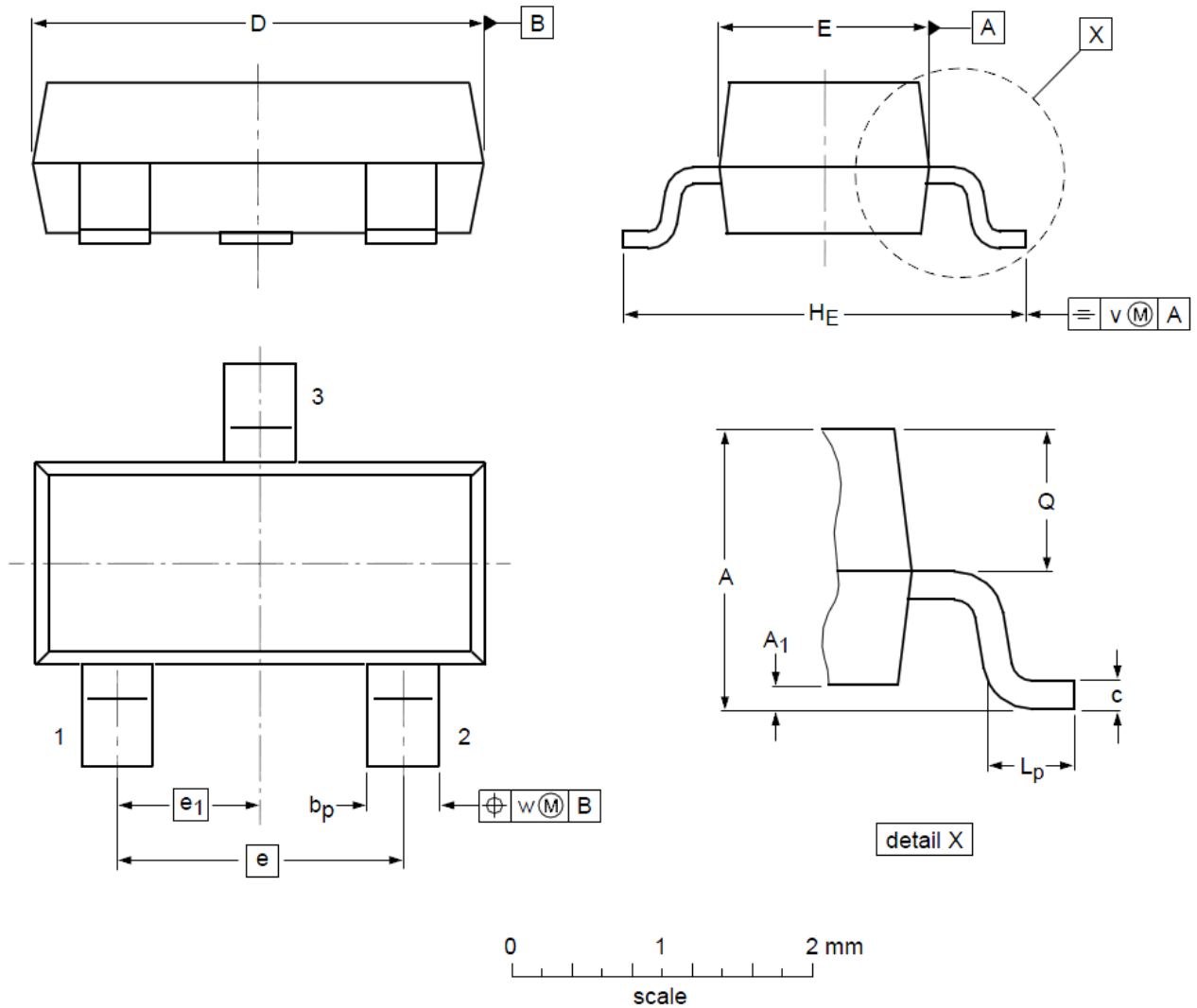


Fig10. Switching Time Test Circuit and waveforms

SOT23 Mechanical Data



DIMENSIONS ( unit : mm )

Symbol	Min	Typ	Max	Symbol	Min	Typ	Max
A	0.90	1.01	1.15	A <sub>1</sub>	0.01	0.05	0.10
b <sub>p</sub>	0.30	0.42	0.50	c	0.08	0.13	0.15
D	2.80	2.92	3.00	E	1.20	1.33	1.40
e	--	1.90	--	e <sub>1</sub>	--	0.95	--
H <sub>E</sub>	2.25	2.40	2.55	L <sub>p</sub>	0.30	0.42	0.50
Q	0.45	0.49	0.55	v	--	0.20	--
w	--	0.10	--				