



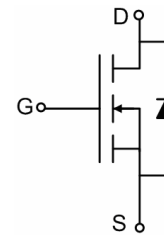
N-Channel Enhancement Mode Power MOSFET

General Features

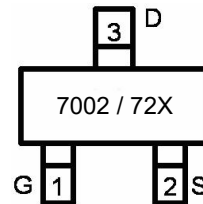
- $V_{DS} = 60V, I_D = 0.3A$
 $R_{DS(ON)} < 3\Omega @ V_{GS}=4.5V$
 $R_{DS(ON)} < 2.5\Omega @ V_{GS}=10V$
- Lead free product is acquired
- Surface mount package

Application

- Direct logic-level interface: TTL/CMOS
- Drivers: relays, solenoids, lamps, hammers, display, memories, transistors, etc.
- Battery operated systems
- Solid-state relays



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
7002 or 72X	2N7002X	SOT-23	Ø180mm	8 mm	3000 units

Absolute Maximum Ratings (TC=25°C unless otherwise noted)

Parameter	Symbol	Limit	Unit
Drain-Source Voltage	V_{DS}	60	V
Gate-Source Voltage	V_{GS}	±20	V
Drain Current-Continuous@ Current-Pulsed (Note 1)	I_D (TC=25°C)	0.3	A
	I_{DM}	0.8	A
Maximum Power Dissipation	P_D (TC=25°C)	0.85	W
Operating Junction and Storage Temperature Range	T_J, T_{STG}	-55 To 150	°C

Thermal Characteristic

Thermal Resistance, Junction-to-Ambient (Note 2)	$R_{\theta JA}$	556	°C/W
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	145	°C/W

Electrical Characteristics (TC=25°C unless otherwise noted)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Off Characteristics						
Drain-Source Breakdown Voltage	BV_{DSS}	$V_{GS}=0V, I_D=250\mu A$	60	67	-	V
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS}=60V, V_{GS}=0V$	-	-	1	μA



Gate-Body Leakage Current	I _{GSS}	V _{GS} =±20V,V _{DS} =0V	-	-	±100	nA
On Characteristics (Note 3)						
Gate Threshold Voltage	V _{GS(th)}	V _{DS} =V _{GS} ,I _D =250μA	1	1.6	2.5	V
Drain-Source On-State Resistance	R _{DS(ON)}	V _{GS} =4.5V, I _D =0.2A	-	1.3	3	Ω
		V _{GS} =10V, I _D =0.3A	-	1.2	2.5	Ω
Forward Transconductance	g _{FS}	V _{DS} =10V,I _D =0.2A	0.08	-	-	S
Dynamic Characteristics (Note4)						
Input Capacitance	C _{ISS}	V _{DS} =30V,V _{GS} =0V, F=1.0MHz	-	20	50	PF
Output Capacitance	C _{OSS}		-	10	25	PF
Reverse Transfer Capacitance	C _{RSS}		-	3.6	5	PF
Switching Characteristics (Note 4)						
Turn-on Delay Time	t _{d(on)}	V _{DD} =30V,I _D =0.2A V _{GS} =10V,R _{GEN} =10Ω	-	10	-	nS
Turn-on Rise Time	t _r		-	50	-	nS
Turn-Off Delay Time	t _{d(off)}		-	17	-	nS
Turn-Off Fall Time	t _f		-	10	-	nS
Total Gate Charge	Q _g	V _{DS} =10V,I _D =0.115A, V _{GS} =4.5V	-	1.7	3	nC
Drain-Source Diode Characteristics						
Diode Forward Voltage (Note 3)	V _{SD}	V _{GS} =0V,I _S =0.115A	-	-	1.2	V
Diode Forward Current (Note 2)	I _S		-	-	0.115	A

Notes:

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



Typical Electrical and Thermal Characteristics

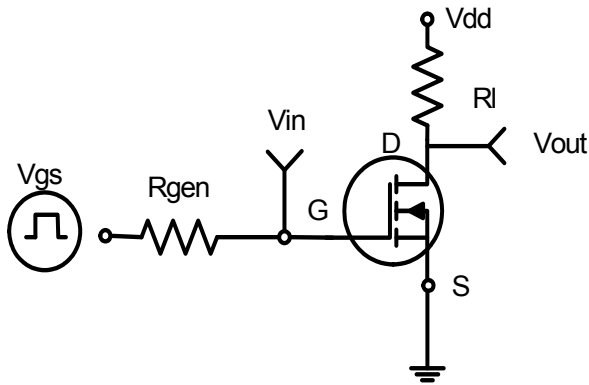


Figure 1: Switching Test Circuit

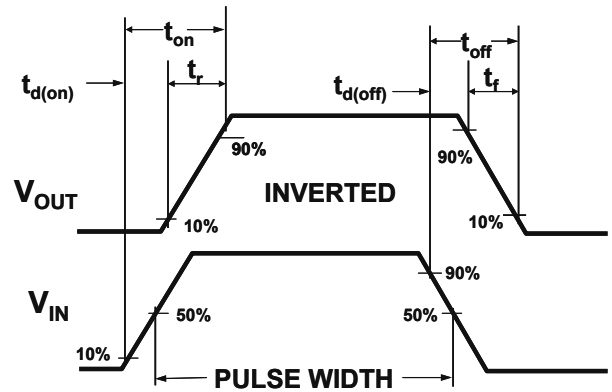


Figure 2: Switching Waveforms

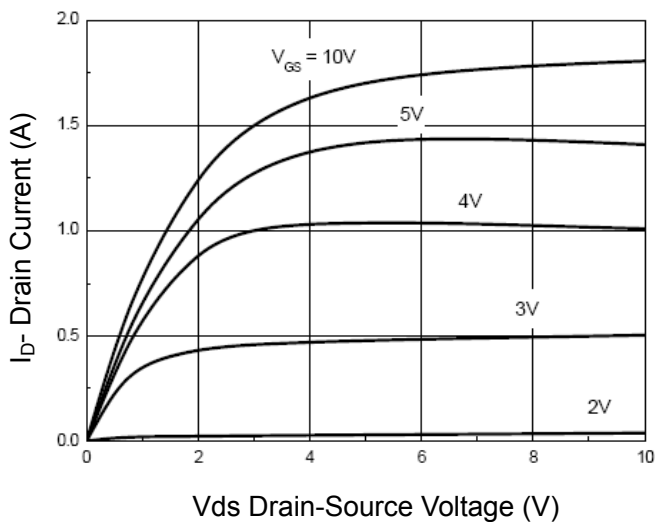


Figure 3 Output Characteristics

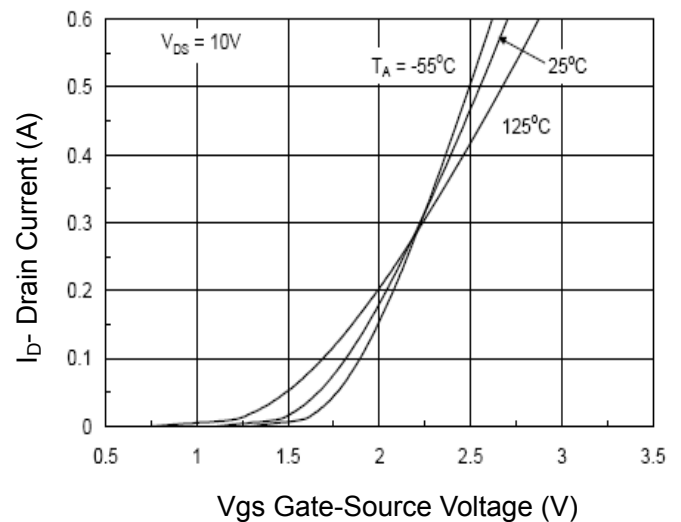


Figure 4 Transfer Characteristics

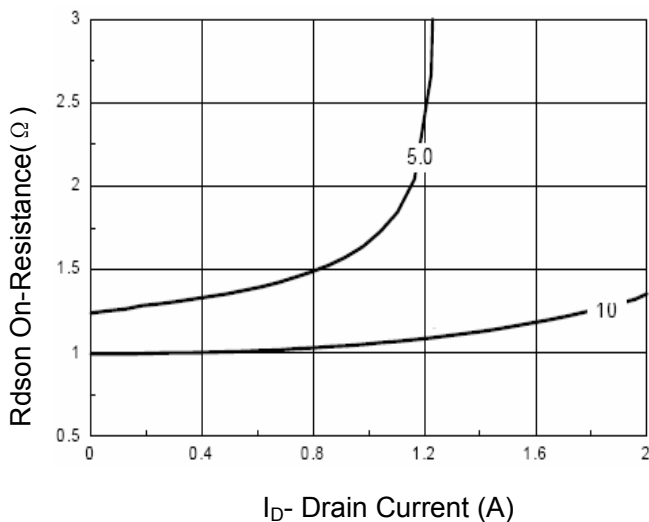


Figure 5 Drain-Source On-Resistance

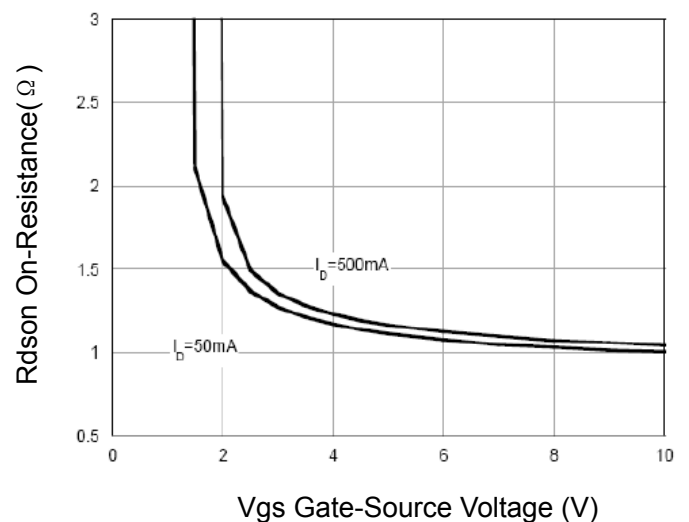


Figure 6 Rdson vs Vgs

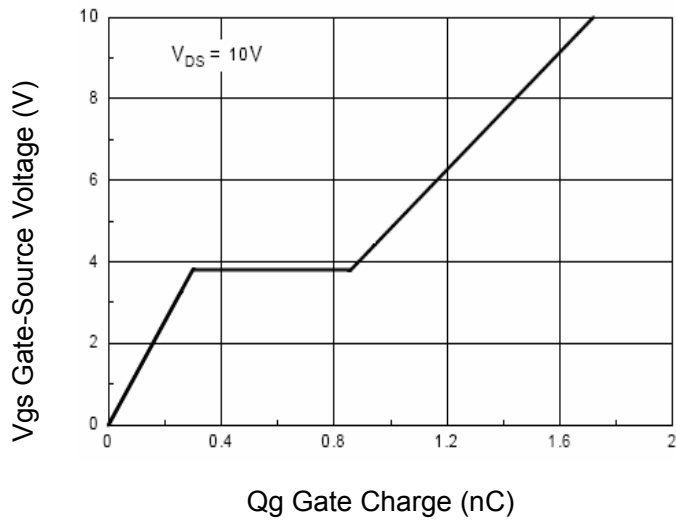


Figure 7 Gate Charge

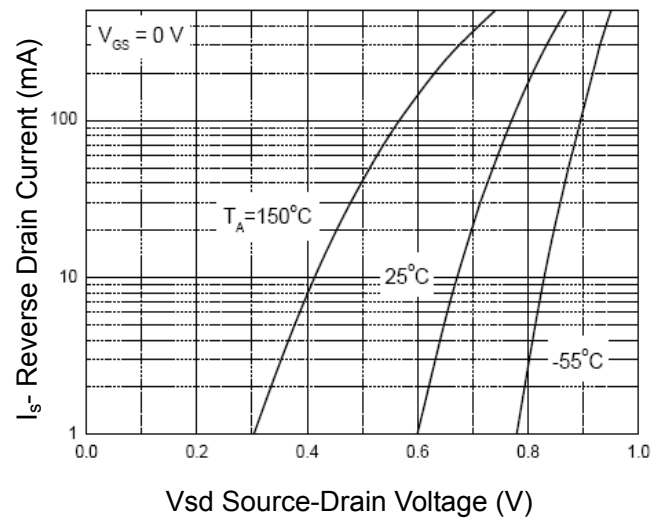


Figure 8 Source-Drain Diode Forward

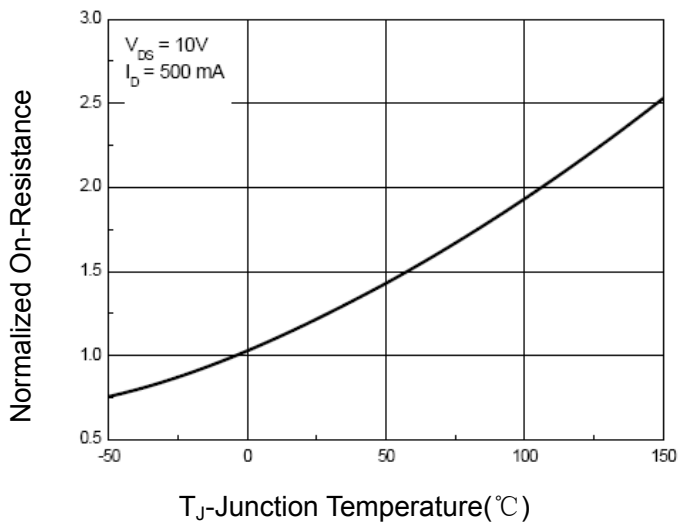


Figure 9 Drain-Source On-Resistance

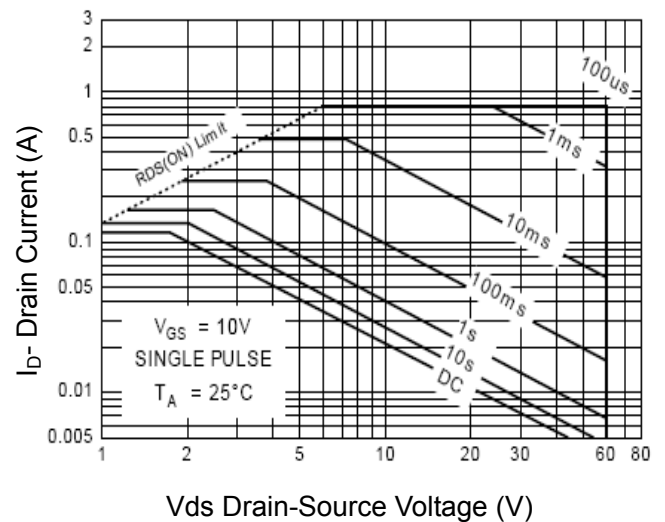


Figure 10 Safe Operation Area

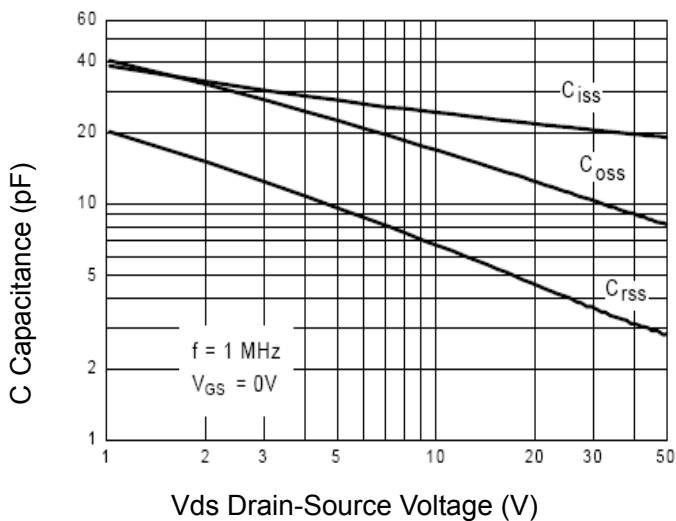


Figure 11 Capacitance vs Vds

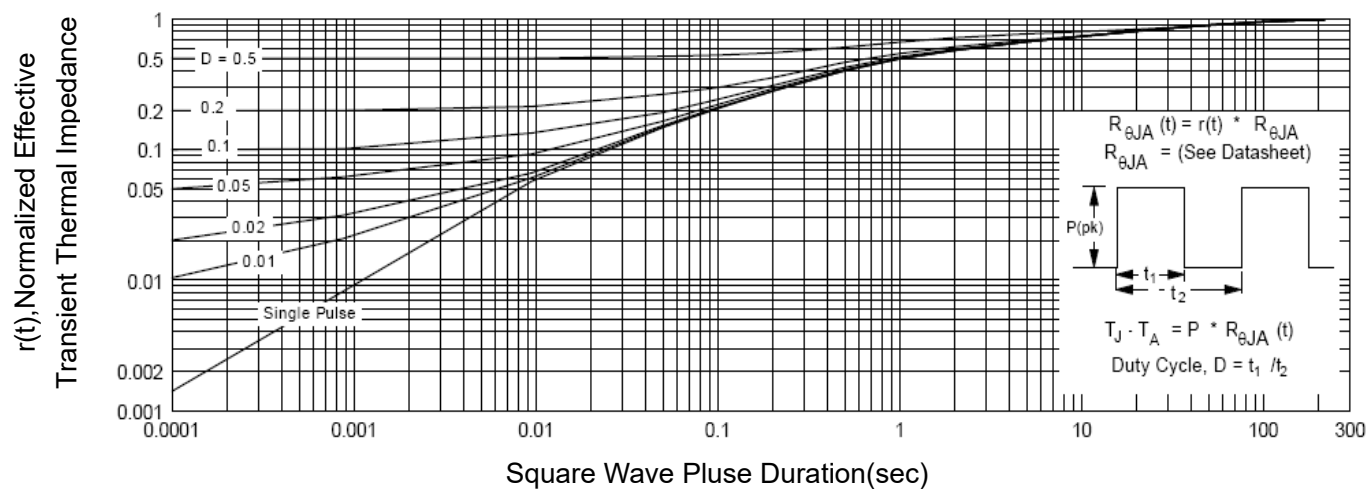
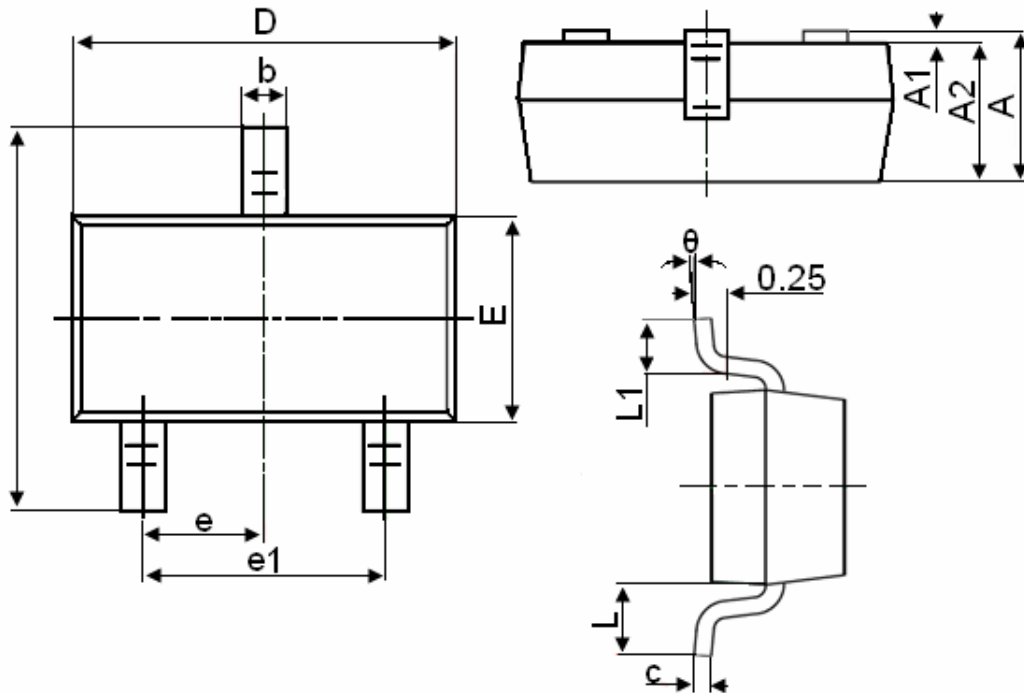


Figure 12 Normalized Maximum Transient Thermal Impedance



SOT-23 Package Information

N-Channel Enhancement Mode Power MOSFET



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.