Small Signal MOSFET

60 V, 380 mA, Single, N−Channel, SOT−23

2N7002K, 2V7002K

V$_{(BR)DSS}$	R$_{DS(on)}$ MAX	I$_D$ MAX
60 V	1.6 Ω @ 10 V	380 mA
	2.5 Ω @ 4.5 V	

Features

- ESD Protected
- Low R$_{DS(on)}$
- Surface Mount Package
- 2V Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC−Q101 Qualified and PPAP Capable
- These Devices are Pb−Free, Halogen Free/BFR Free and are RoHS Compliant

Applications

- Low Side Load Switch
- Level Shift Circuits
- DC−DC Converter
- Portable Applications i.e. DSC, PDA, Cell Phone, etc.

SIMPLIFIED SCHEMATIC

(Top View)

SOT−23
CASE 318

MAXIMUM RATINGS (T$_J$ = 25°C unless otherwise stated)

Rating	Symbol	Value	Unit
Drain−to−Source Voltage	V$_{DSS}$	60	V
Gate−to−Source Voltage	V$_{GS}$	±20	V
Drain Current (Note 1) Steady State 1 sq in Pad T$_A$ = 25°C T$_A$ = 85°C	I$_D$	380 270	mA
Drain Current (Note 2) Steady State Minimum Pad T$_A$ = 25°C T$_A$ = 85°C	I$_D$	320 230	mA
Power Dissipation Steady State 1 sq in Pad Steady State Minimum Pad	P$_D$	420 300	mW
Pulsed Drain Current (t$_p$ = 10 μs)	I$_{DM}$	5.0	A
Operating Junction and Storage Temperature Range	T$_J$, T$_{STG}$	−55 to +150	°C
Source Current (Body Diode)	I$_S$	300	mA
Lead Temperature for Soldering Purposes (1/8″ from case for 10 s)	T$_L$	260	°C
Gate−Source ESD Rating (HBM, Method 3015)	ESD	2000	V

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.
1. Surface−mounted on FR4 board using 1 sq in pad size with 1 oz Cu.
2. Surface−mounted on FR4 board using 0.08 sq in pad size with 1 oz Cu.
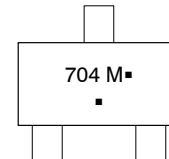
MARKING DIAGRAM

704 M▪

704 = Device Code
M = Date Code*
▪ = Pb−Free Package

(NOTE: Microdot may be in either location)

*Date Code orientation and/or location may vary depending upon manufacturing location.

ORDERING INFORMATION

Device	Package	Shipping†
2N7002KT1G, 2V7002KT1G	SOT−23 (Pb−Free)	3000 / Tape & Reel
2N7002KT7G	SOT−23 (Pb−Free)	3500 / Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

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THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Junction−to−Ambient − Steady State (Note 3)	$R_{\theta JA}$	300	°C/W
Junction−to−Ambient − t ≤ 5 s (Note 3)		92	
Junction−to−Ambient − Steady State (Note 4)		417	
Junction−to−Ambient − t ≤ 5 s (Note 4)		154	

3. Surface−mounted on FR4 board using 1 sq in pad size with 1 oz Cu.
4. Surface−mounted on FR4 board using 0.08 sq in pad size with 1 oz Cu.

ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise specified)

Parameter	Symbol	Test Condition		Min	Typ	Max	Unit
OFF CHARACTERISTICS							
Drain−to−Source Breakdown Voltage	$V_{(BR)DSS}$	V_{GS} = 0 V, I_D = 250 μA		60			V
Drain−to−Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$				71		mV/°C
Zero Gate Voltage Drain Current	I_{DSS}	V_{GS} = 0 V, V_{DS} = 60 V	T_J = 25°C			1	μA
			T_J = 125°C			10	
		V_{GS} = 0 V, V_{DS} = 50 V	T_J = 25°C			100	nA
Gate−to−Source Leakage Current	I_{GSS}	V_{DS} = 0 V, V_{GS} = ±20 V				±10	μA
		V_{DS} = 0 V, V_{GS} = ±10 V				450	nA
		V_{DS} = 0 V, V_{GS} = ±5.0 V				150	nA
ON CHARACTERISTICS (Note 5)							
Gate Threshold Voltage	$V_{GS(TH)}$	V_{GS} = V_{DS}, I_D = 250 μA		1.0		2.3	V
Negative Threshold Temperature Coefficient	$V_{GS(TH)}/T_J$				4.0		mV/°C
Drain−to−Source On Resistance	$R_{DS(on)}$	V_{GS} = 10 V, I_D = 500 mA			1.19	1.6	Ω
		V_{GS} = 4.5 V, I_D = 200 mA			1.33	2.5	
Forward Transconductance	g_{FS}	V_{DS} = 5 V, I_D = 200 mA			530		mS
CHARGES AND CAPACITANCES							
Input Capacitance	C_{ISS}	V_{GS} = 0 V, f = 1 MHz, V_{DS} = 20 V			24.5	45	pF
Output Capacitance	C_{OSS}				4.2	8.0	
Reverse Transfer Capacitance	C_{RSS}				2.2	5.0	
Total Gate Charge	$Q_{G(TOT)}$	V_{GS} = 4.5 V, V_{DS} = 10 V; I_D = 200 mA			0.7		nC
Threshold Gate Charge	$Q_{G(TH)}$				0.1		
Gate−to−Source Charge	Q_{GS}				0.3		
Gate−to−Drain Charge	Q_{GD}				0.1		
SWITCHING CHARACTERISTICS, V_{GS} = V (Note 6)							
Turn−On Delay Time	$t_{d(ON)}$	V_{GS} = 10 V, V_{DD} = 25 V, I_D = 500 mA, R_G = 25 Ω			12.2		ns
Rise Time	t_r				9.0		
Turn−Off Delay Time	$t_{d(OFF)}$				55.8		
Fall Time	t_f				29		
DRAIN−SOURCE DIODE CHARACTERISTICS							
Forward Diode Voltage	V_{SD}	V_{GS} = 0 V, I_S = 200 mA	T_J = 25°C			0.8	1.2	V
			T_J = 85°C			0.7		

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.
5. Pulse Test: pulse width ≤ 300 μs, duty cycle ≤ 2%
6. Switching characteristics are independent of operating junction temperatures

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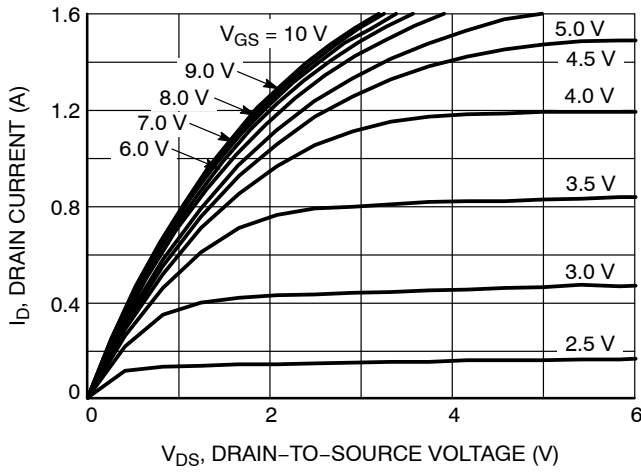
TYPICAL CHARACTERISTICS
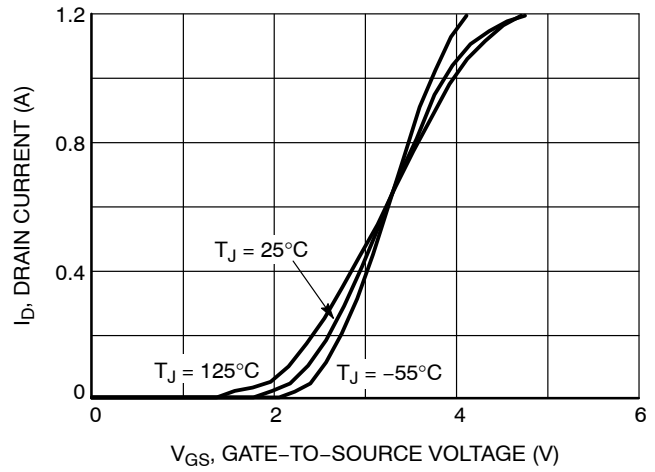

Figure 1. On−Region Characteristics

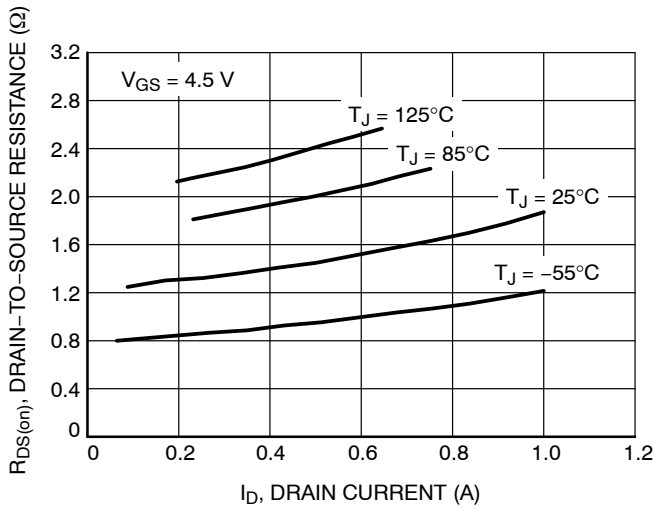Figure 2. Transfer Characteristics

Figure 3. On−Resistance vs. Drain Current and Temperature
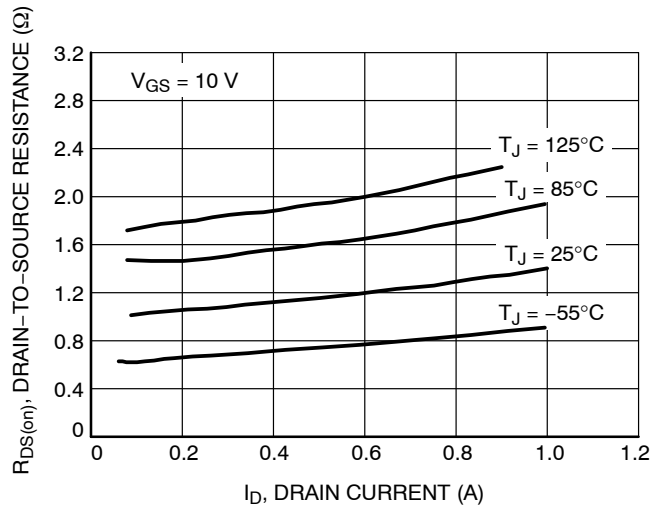

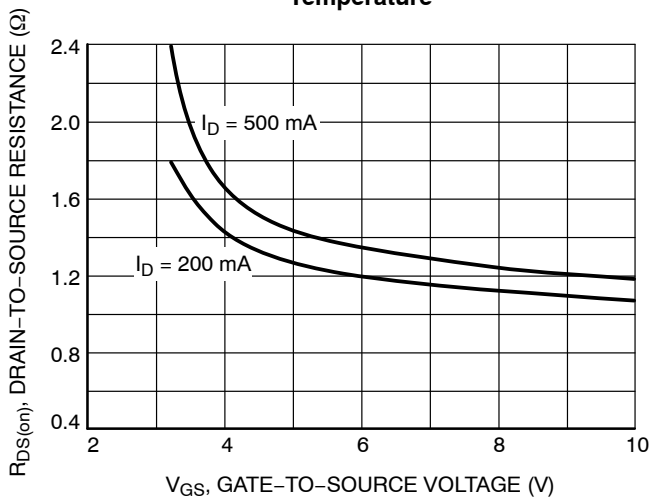Figure 4. On−Resistance vs. Drain Current and Temperature

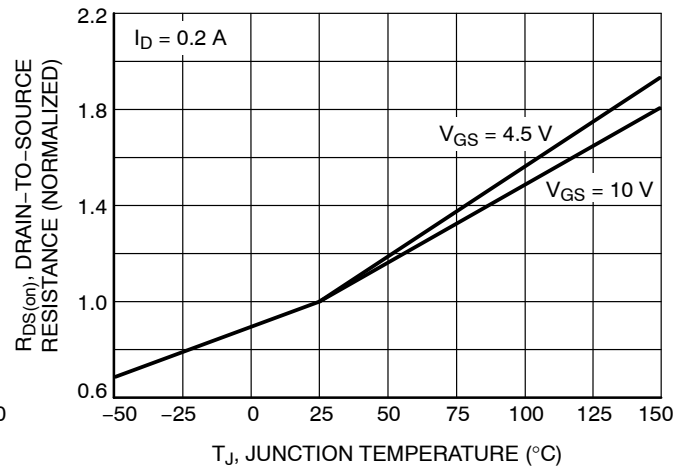Figure 5. On−Resistance vs. Gate−to−Source Voltage

Figure 6. On−Resistance Variation with Temperature
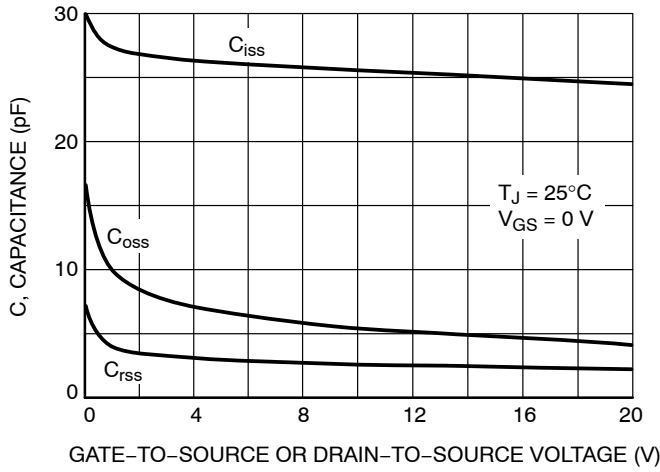
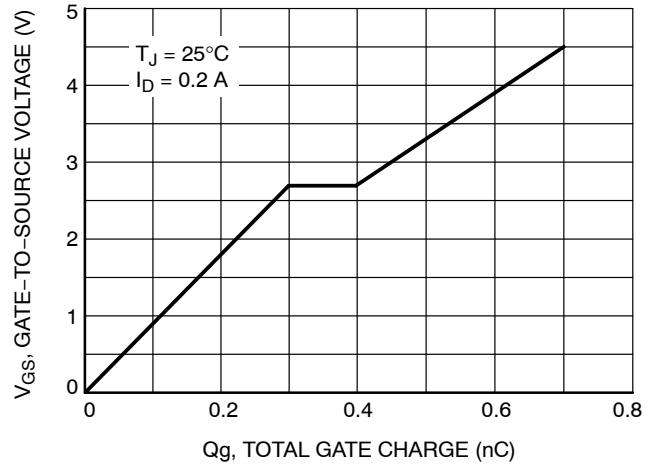## TYPICAL CHARACTERISTICS

Figure 7. Capacitance Variation

Figure 8. Gate−to−Source and Drain−to−Source Voltage vs. Total Charge
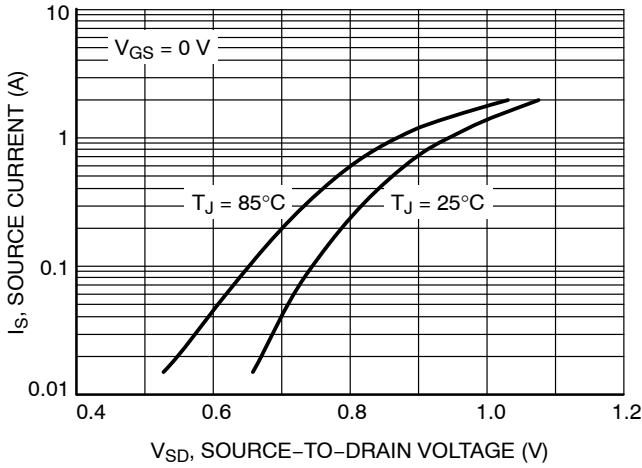
Figure 9. Diode Forward Voltage vs. Current
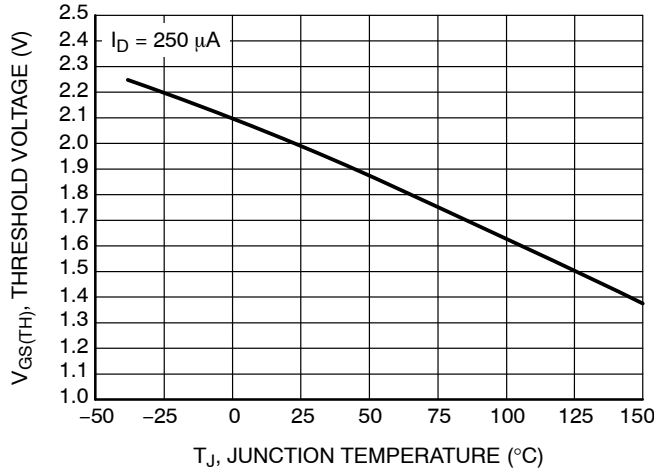
Figure 10. Threshold Voltage with Temperature

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TYPICAL CHARACTERISTICS
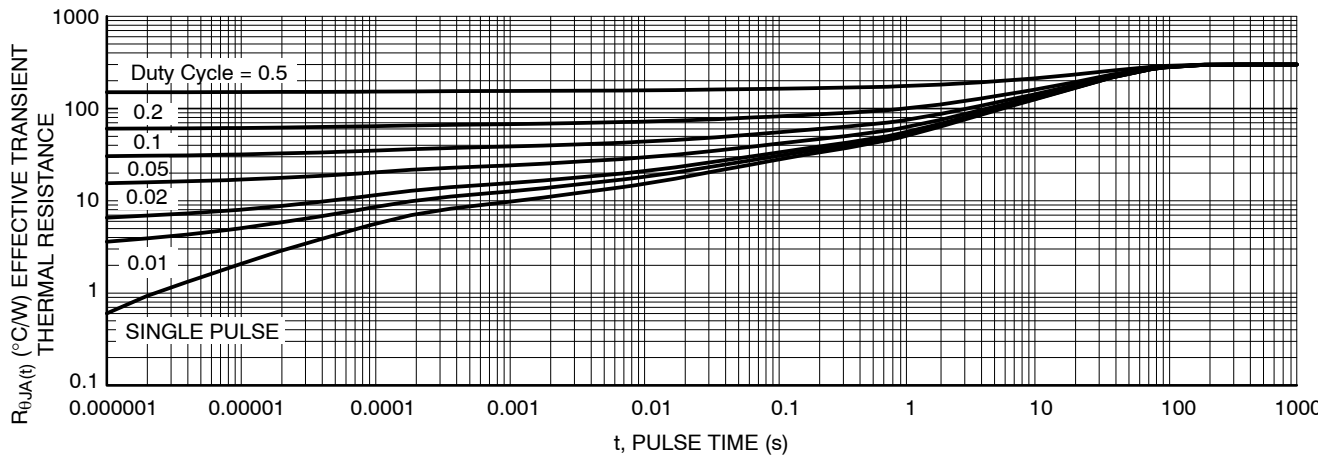
Figure 11. Thermal Response – 1 sq in pad
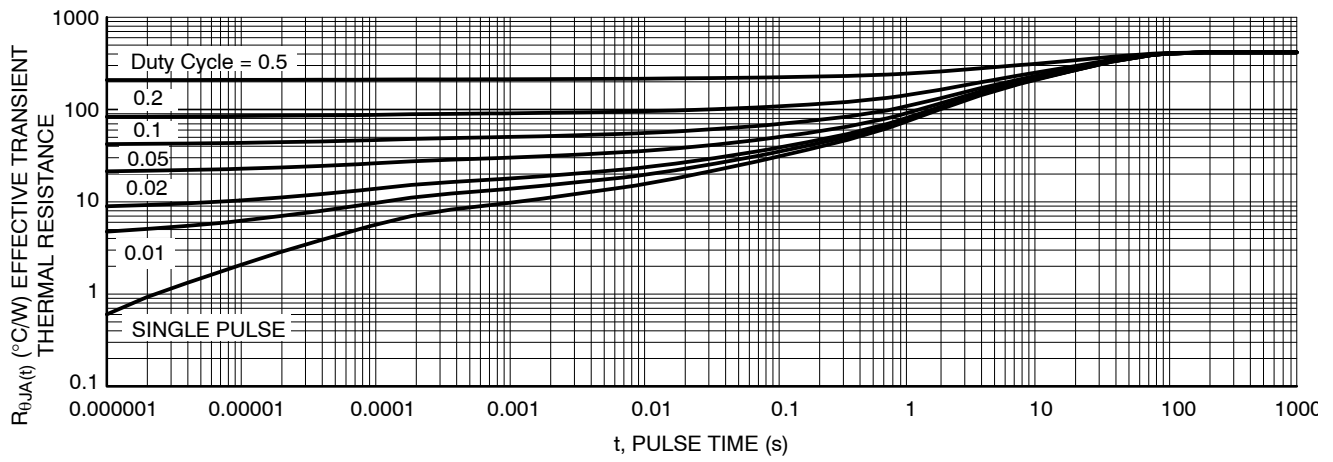
Figure 12. Thermal Response – minimum pad

ADDITIONAL INFORMATION

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