



## 2N7002

**MOSFET**

# N-CHANNEL ENHANCEMENT MODE FIELD EFFECT TRANSISTOR

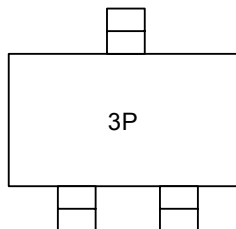
### ■ DESCRIPTION

The UTC **2N7002** has been designed to minimize on-state resistance while provide rugged, reliable, and fast switching performance. It can be used in most applications requiring up to 400mA DC and can deliver pulsed currents up to 2A. The product is particularly suited for low voltage, low current applications such as small servo motor control, power MOSFET gate drivers, and other switching applications

### ■ FEATURES

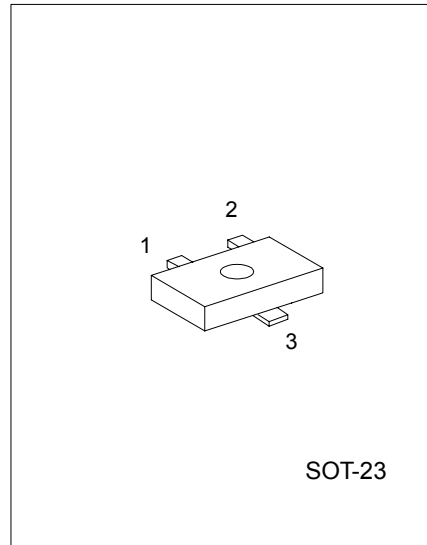
- \* High density cell design for low  $R_{DS(ON)}$ .
- \* Voltage controlled small signal switch
- \* Rugged and reliable
- \* High saturation current capability

### ■ MARKING



### ■ ORDERING INFORMATION

Order Number		Package	Packing
Normal	Lead free		
2N7002-AE3-R	2N7002L-AE3-R	SOT-23	Tape Reel



\*Pb-free plating product number: 2N7002L

### ■ PIN CONFIGURATION

PIN NO.	PIN NAME
1	SOURCE
2	GATE
3	DRAIN

■ ABSOLUTE MAXIMUM RATINGS (Ta=25°C unless otherwise noted.)

PARAMETER	SYMBOL	RATINGS	UNIT
Drain-Source Voltage	V <sub>DSS</sub>	60	V
Drain-Gate Voltage (R <sub>GS</sub> ≤ 1MΩ)	V <sub>DGR</sub>	60	V
Gate Source Voltage	V <sub>GSS</sub>	±20	V
		±40	
Maximum Drain Current	I <sub>D</sub>	115	mA
		800	
Maximum Power Dissipation	P <sub>D</sub>	200	mW
Derated above 25°C		1.6	mW/°C
Operating Temperature	T <sub>OPR</sub>	0 ~ +70	°C
Storage Temperature	T <sub>STG</sub>	-40 ~ +150	

■ THERMAL CHARACTERISTICS

PARAMETER	SYMBOL	RATINGS	UNIT
Thermal Resistance, Junction to Ambient	θ <sub>JA</sub>	625	°C/W

■ ELECTRICAL CHARACTERISTICS (T<sub>A</sub>=25°C, unless otherwise specified.)

PARAMETER	SYMBOL	TEST CONDITIONS	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> =10μA	60			V
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> =60V, V <sub>GS</sub> =0V T <sub>J</sub> =125°C			0.5	mA
					1	μA
Gate-Body leakage, Forward	I <sub>GSSF</sub>	V <sub>GS</sub> =20V, V <sub>DS</sub> =0V			100	nA
Gate-Body leakage Reverse	I <sub>GSSR</sub>	V <sub>GS</sub> =-20V, V <sub>DS</sub> =0V			-100	nA
<b>ON CHARACTERISTICS (Note)</b>						
Gate Threshold Voltage	V <sub>GS(th)</sub>	V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> =250μA	1	2.1	2.5	V
Drain-Source On-Voltage	V <sub>DS(ON)</sub>	V <sub>GS</sub> = 10V, I <sub>D</sub> =500mA V <sub>GS</sub> = 5.0V, I <sub>D</sub> =50mA		0.6	3.75	V
				0.09	1.5	
On-State Drain Current	I <sub>D(ON)</sub>	V <sub>GS</sub> =10V, V <sub>DS</sub> ≥2V <sub>DS(ON)</sub>	500	2700		mA
Static Drain-Source On-Resistance	R <sub>DS(ON)</sub>	V <sub>GS</sub> = 10V, I <sub>D</sub> =500mA T <sub>J</sub> =100°C V <sub>GS</sub> = 5.0V, I <sub>D</sub> =50mA T <sub>J</sub> =100°C		1.2	7.5	Ω
				1.7	13.5	
				1.7	7.5	
			2.4	13.5		
Forward Transconductance	g <sub>FS</sub>	V <sub>DS</sub> ≥2V <sub>DS(ON)</sub> , I <sub>D</sub> =200mA	80	320		mS
<b>DYNAMIC CHARACTERISTICS</b>						
Input Capacitance	C <sub>iss</sub>	V <sub>DS</sub> =25V, V <sub>GS</sub> =0V, f=1.0MHz		20	50	pF
Output Capacitance	C <sub>oss</sub>			11	25	pF
Reverse Transfer Capacitance	C <sub>riss</sub>			4	5	pF
Turn-On Time	t <sub>ON</sub>	V <sub>DD</sub> =30V, R <sub>L</sub> =150Ω I <sub>D</sub> =200mA, V <sub>GS</sub> =10V R <sub>GEN</sub> =25Ω			20	nS
Turn-Off Time	t <sub>OFF</sub>	V <sub>DD</sub> =30V, R <sub>L</sub> =25Ω I <sub>D</sub> =200mA, V <sub>GS</sub> =10V R <sub>GEN</sub> =25Ω			20	nS
<b>DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS</b>						
Drain-Source Diode Forward Voltage	V <sub>SD</sub>	V <sub>GS</sub> =0V, I <sub>S</sub> =115mA (Note )		0.88	1.5	V
Maximum Pulsed Drain-Source Diode Forward Current	I <sub>SM</sub>				0.8	A
Maximum Continuous Drain-Source Diode Forward Current	I <sub>S</sub>				115	mA

Note: Pulse Test: Pulse Width≤300μs, Duty Cycle≤2.0%

■ TEST CIRCUIT AND WAVEFORM

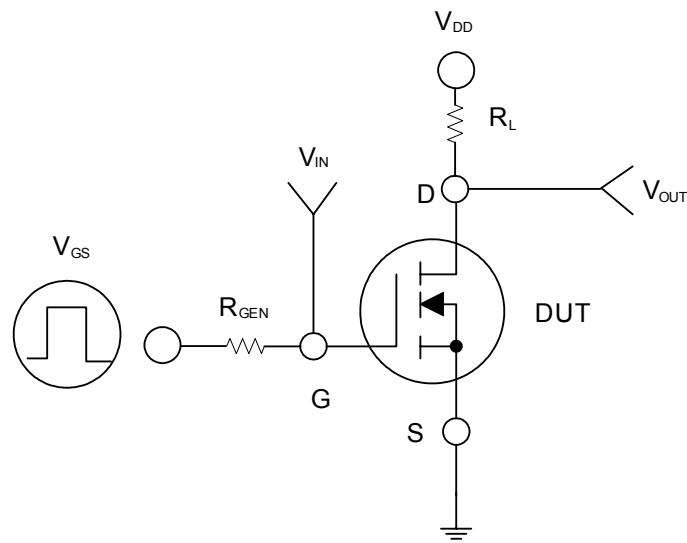


Figure 1

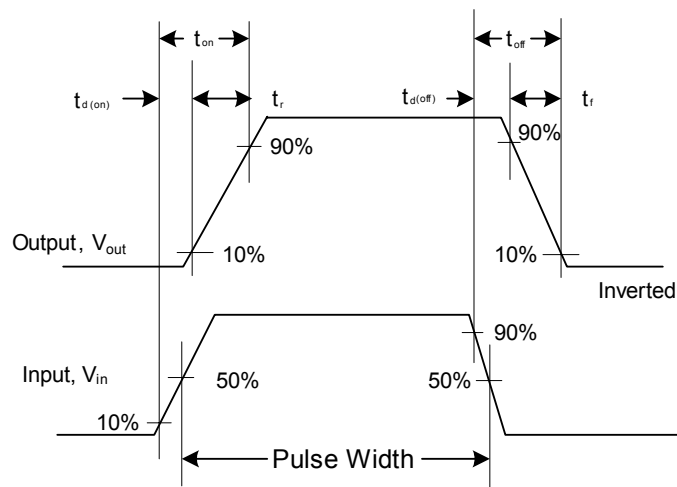


Figure 2. Switching Waveforms

■ TYPICAL CHARACTERISTICS

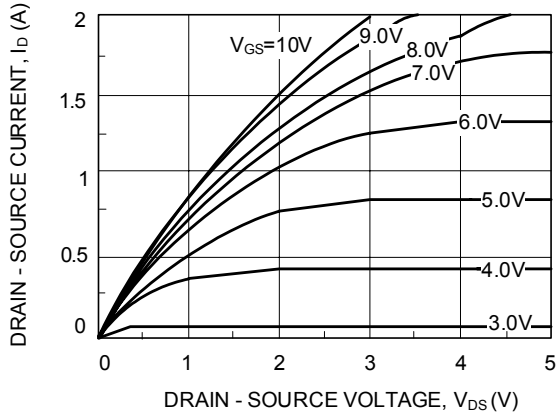


Figure 3. On-Region Characteristics

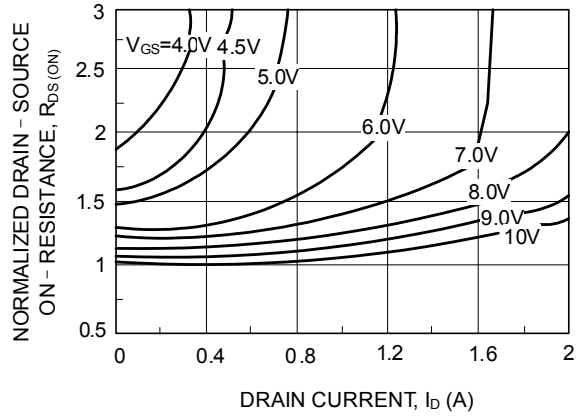


Figure 4. On-Resistance Variation with Gate Voltage and Drain Current

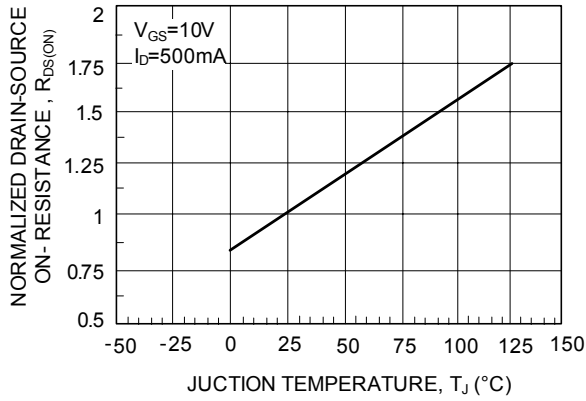


Figure 5. On-Resistance Variation with Temperature

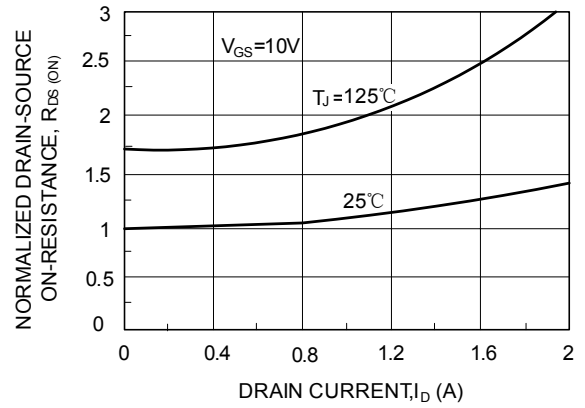


Figure 6. On-Resistance Variation with Drain Current and Temperature

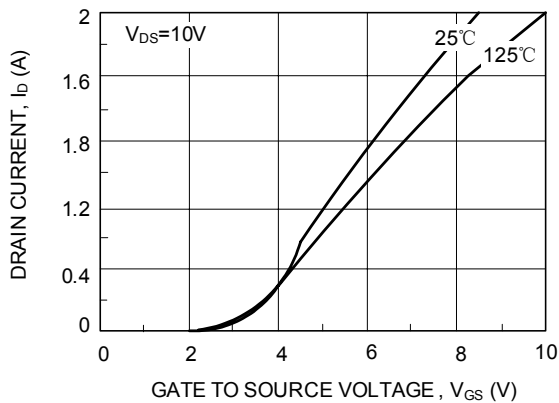


Figure 7. Transfer Characteristics

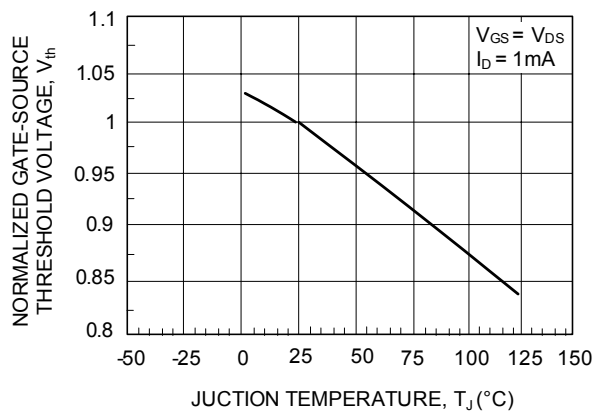


Figure 8. Gate Threshold Variation with Temperature

## TYPICAL CHARACTERISTICS (cont.)

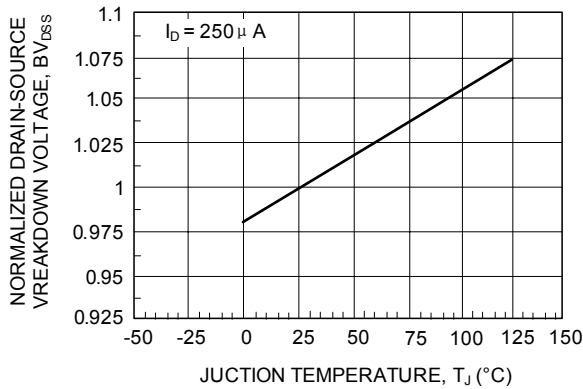


Figure 9. Breakdown Voltage Variation with Temperature

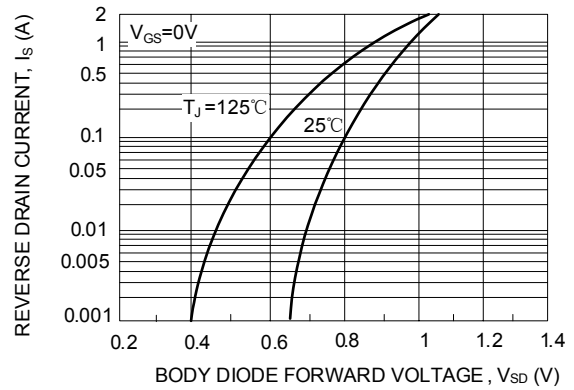


Figure 10. Body Diode Forward Voltage Variation with Temperature

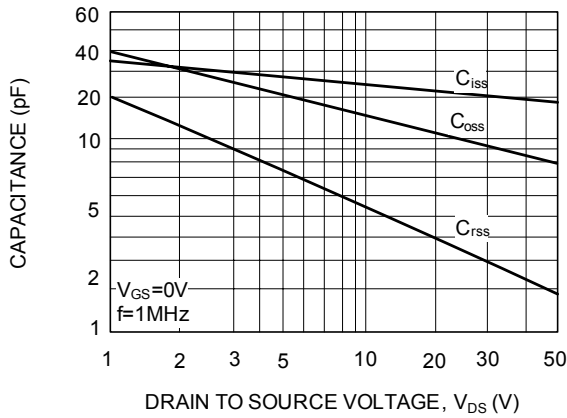


Figure 11. Capacitance Characteristics

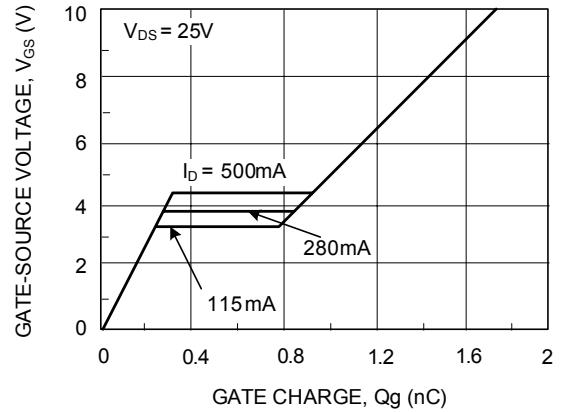


Figure 12. Gate Charge Characteristics

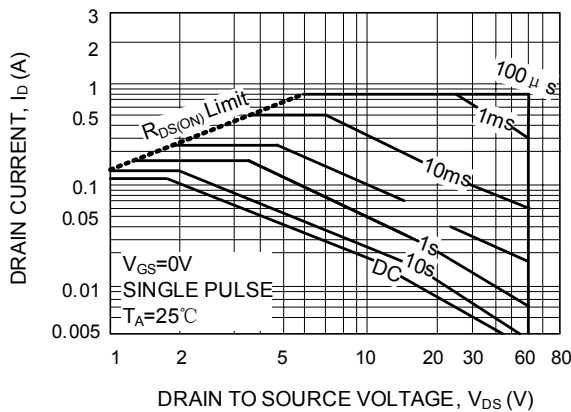


Figure 13. Maximum Safe Operating Area

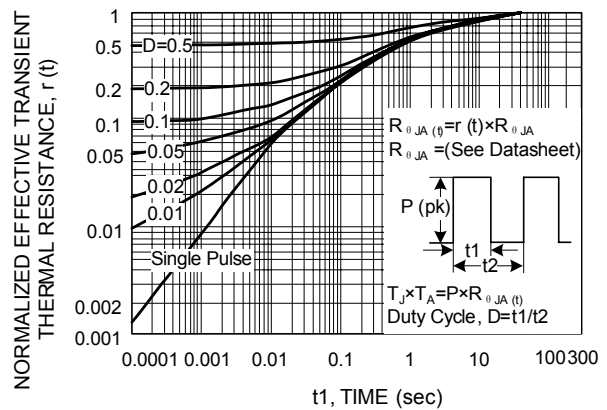


Figure 14. Transient Thermal Response Curve

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