

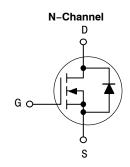
N-Channel Enhancement Mode Field Effect Transistor 2N7002L

Description

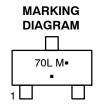
This N-channel enhancement mode field effect transistor is produced using high cell density, trench MOSFET technology. This product minimizes on-state resistance while providing rugged, reliable and fast switching performance. This product is particularly suited for low-voltage, low-current applications such as small servo motor control, power MOSFET gate drivers, logic level translator, high speed line drivers, power management/power supply, and switching applications.

Features

- High Density Cell Design for Low R_{DS(ON)}
- Voltage Controlled Small Signal Switch
- Rugged and Reliable
- High Saturation Current Capability
- Very Low Capacitance
- Fast Switching Speed
- This Device is Pb-Free and Halogen Free







70L = Device Code M = Date Code*

■ = Pb-Free Package (Note: Microdot may be in either location)

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

ORDERING INFORMATION

Device	Package	Shipping [†]		
2N7002L	SOT-23 (Pb-Free)	3000 / 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.

ABSOLUTE MAXIMUM RATINGS ($T_A = 25^{\circ}C$ unless otherwise noted)

Symbol	Parameter	Value	Unit
V _{DSS}	Drain-Source Voltage	60	V
V_{DGR}	Drain–Gate Voltage ($R_{GS} \le 1.0 \text{ M}\Omega$)	60	V
V _{GSS}	Gate-Source Voltage - Continuous - Non Repetitive (t _p < 50 μs)	±20 ±40	V
I _D	Maximum Drain Current - Continuous - Pulsed	115 800	mA
T _J , T _{STG}	Operating and Storage Temperature Range	-55 to +150	°C
T _L	Maximum Lead Temperature for Soldering Purposes, 1/16" from Case for 10 Seconds	300	°C

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.

THERMAL CHARACTERISTICS ($T_A = 25^{\circ}C$ unless otherwise noted) (Note 1)

Symbol	Parameter	Value	Unit
P _D	Maximum Power Dissipation	200	mW
	Derate Above 25°C	1.6	mW/°C
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	380	°C/W

ESD RATING (Note 2)

Symbol	Parameter	Value	Unit
HBM	Human Body Model per ANSI/ESDA/JEDEC JS-001-2012	50	V
CDM	Charged Device Model per JEDEC C101C	>2000	V

$\textbf{ELECTRICAL CHARACTERISTICS} \ (T_A = 25^{\circ}\text{C unless otherwise noted})$

Symbol	Parameter	Test Conditions	Min	Тур	Max	Unit
OFF CHARA	CTERISTICS			•		
BV _{DSS}	Drain-Source Breakdown Voltage	$V_{GS} = 0 \text{ V}, I_D = 10 \mu\text{A}$	60.0	65.2	-	V
I _{DSS}	Zero Gate Voltage Drain Current	V _{DS} = 60 V, V _{GS} = 0 V	_	0.024	1	μΑ
		V _{DS} = 60 V, V _{GS} = 0 V, T _J = 125°C	-	0.080	500	
I _{GSSF}	Gate-Body Leakage, Forward	V _{GS} = 20 V, V _{DS} = 0 V	-	0.107	100	nA
I _{GSSR}	Gate-Body Leakage, Reverse	$V_{GS} = -20 \text{ V}, V_{DS} = 0 \text{ V}$	_	-0.037	-100	nA
ON CHARAC	CTERISTICS (Note 3)					
V _{GS(th)}	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_{D} = 250 \mu A$	0.80	1.81	2.50	V
R _{DS(on)}	Static Drain-Source On-Resistance	V _{GS} = 10 V, I _D = 500 mA	-	3.35	7.50	Ω
		$V_{GS} = 10 \text{ V}, I_D = 500 \text{ mA}, \\ T_J = 100^{\circ}\text{C}$	-	5.62	13.50	
		$V_{GS} = 5 \text{ V}, I_D = 50 \text{ mA}$	-	2.68	7.50	
		V _{GS} = 5 V, I _D = 50 mA, T _J = 100°C	-	3.97	13.50	
V _{DS(ON)}	Drain-Source On-Voltage	V _{GS} = 10 V, I _D = 500 mA	_	1.68	3.75	V
		V _{GS} = 5 V, I _D = 50 mA	_	0.13	1.50	
I _{D(ON)}	On-State Drain Current	$V_{GS} = 10 \text{ V}, V_{DS} \ge 2 V_{DS(ON)}$	500	557	-	mA
		V _{GS} = 4.5 V, V _{DS} = 10 V	75	571	-	

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted) (continued)

Symbol	Parameter	Test Conditions	Min	Тур	Max	Unit		
ON CHARACTERISTICS (Note 3)								
9FS	Forward Trans-conductance	$V_{DS} \ge 2 V_{DS(ON)}$, $I_D = 200 \text{ mA}$	80	214	-	mS		
DYNAMIC CH	DYNAMIC CHARACTERISTICS							
C _{iss}	Input Capacitance	V _{DS} = 25 V, V _{GS} = 0 V, f = 1.0 MHz	_	12.8	50	pF		
C _{oss}	Output Capacitance		-	3.25	25			
C _{rss}	Reverse Transfer Capacitance		-	1.52	5			
R _G	Gate Resistance	V _{GS} = 0 V, f = 1.0 MHz	-	22.2	-	Ω		
SWITCHING	CHARACTERISTICS (Note 3)							
t _{on}	Turn-On Time	$\begin{aligned} &V_{DD} = 30 \text{ V, R}_{L} = 150 \ \Omega, \\ &I_{D} = 200 \text{ mA, V}_{GS} = 10 \text{ V,} \\ &R_{GEN} = 25 \ \Omega \end{aligned}$	-	4.35	20	ns		
t _{off}	Turn-Off Time		_	15.6	20	ns		
DRAIN-SOUP	DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS							
I _S	Maximum Continuous Drain-Source Diode Forward Current		-	-	115	mA		
I _{SM}	Maximum Pulsed Drain-Source Diode Forward Current		-	-	0.8	Α		
V _{SD}	Drain-Source Diode Forward Voltage	$V_{GS} = 0 \text{ V}, I_{S} = 115 \text{ mA (Note 3)}$	-	0.818	1.5	V		

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.

R_{θJA} is the sum of the junction–to–case and case–to–ambient thermal resistance where the case thermal reference is defined as the solder mounting surface of the drain pins. R_{θJC} is guaranteed by design while R_{θCA} is determined by the user's board design.
 q a) 380°C/W when mounted on a minimum pad.

2. ESD values are in typical, no over-voltage rating is implied, ESD CDM zap voltage is 2000 V maximum.

3. Pulse test: pulse width \leq 300 μ s, duty cycle \leq 2.0%.

TYPICAL CHARACTERISTICS

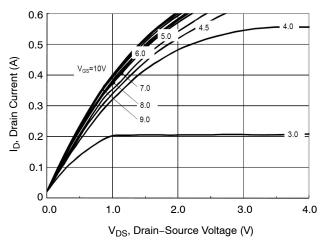


Figure 1. On-Region Characteristics

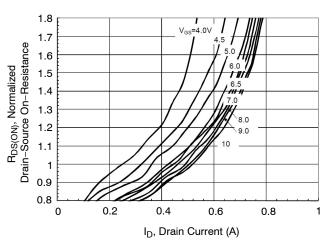


Figure 2. On-Resistance Variation with Gate Voltage and Drain Current

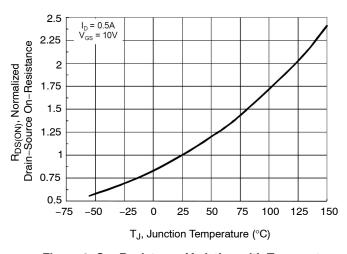


Figure 3. On–Resistance Variation with Temperature

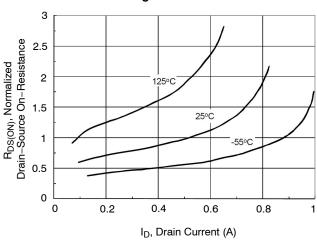


Figure 4. On–Resistance Variation with Drain Current and Temperature

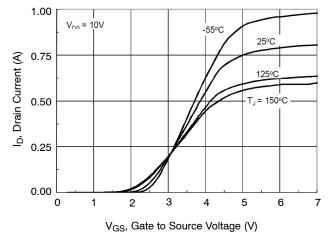


Figure 5. Transfer Characteristics

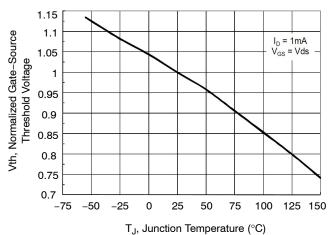
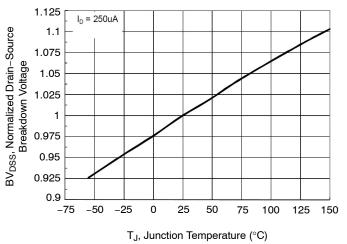


Figure 6. Gate Threshold Variation with Temperature

TYPICAL CHARACTERISTICS (continued)



 $V_{GS} = 0V$ Reverse Drain Current (A) 0.1 T_J= 125°C -55°C 0.01 <u>ŵ</u> 0.001 0.4 0.2 0.6 8.0 1.0 1.2 1.4 V_{SD}, Body Diode Forward Voltage (V)

Figure 7. Breakdown Voltage Variation with Temperature

Figure 8. Body Diode Forward Voltage Variation with Source Current and Temperature

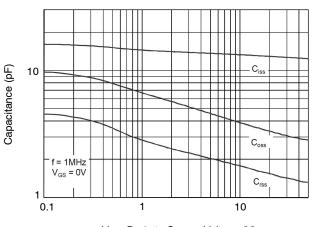




Figure 9. Capacitance Characteristics

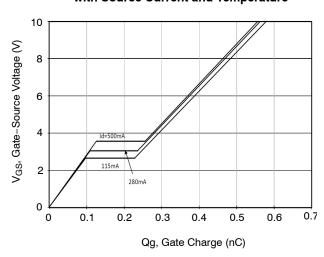


Figure 10. Gate Charge Characteristics

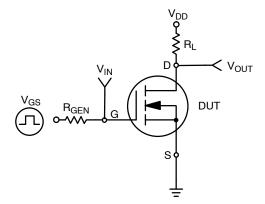


Figure 11.

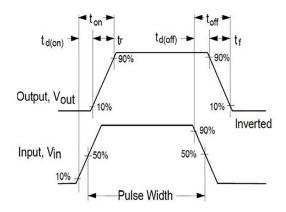


Figure 12. Switching Waveforms

TYPICAL CHARACTERISTICS (continued)

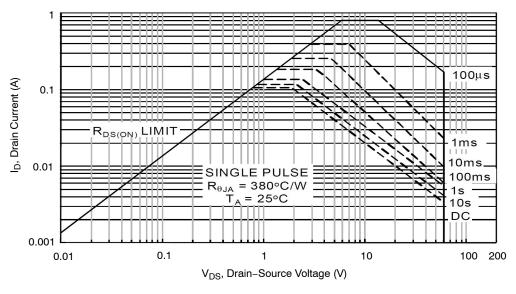


Figure 13. Maximum Safe Operating Area

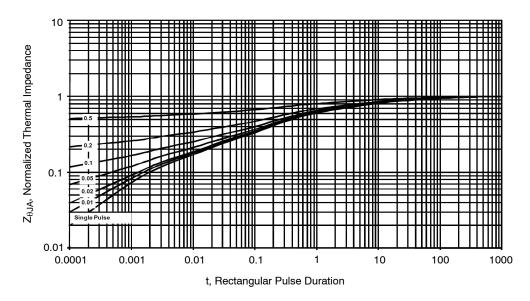


Figure 14. Transient Thermal Response Curve

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