National Semiconductor

December 1996

NC7S02
Tiny 2-Input NOR Gate

General Description

The NC7S02 is a single 2-Input high performance CMOS NOR Gate in National's TinyPak™ package. Advanced Silicon Gate CMOS fabrication assures high speed and low power circuit operation over a broad V_{CC} range. ESD protection diodes inherently guard both inputs and output with respect to the V_{CC} and GND rails. Three stages of gain between inputs and outputs assures high noise immunity and reduced sensitivity to input edge rate.

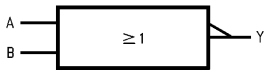
Features

- Space saving TinyPak package, 5-lead surface mount SOT-23 package
- High Speed; T_{PD} 3.5 ns typ
- Low Quiescent Power; $I_{CC} < 1\ \mu A$
- Balanced Output Drive; 2 mA I_{OL}, -2 mA I_{OH}
- Broad V_{CC} Operating Range; 2V–6V
- Balanced Propagation Delays
- Specified for 3V operation

Product Code	Package	Package Drawing	Package Top Mark	Supplied As
NC7S02M5	5-Pin SOT-23-5	MA05B	7S02	250 Units on Tape and Reel
NC7S02M5X	5-Pin SOT-23-5	MA05B	7S02	3k Units on Tape and Reel

Logic Symbol

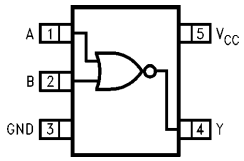
IEEE/IEC



TL/F/12140–1

Connection Diagram

Pin Assignment for SOT-23-5 Package



TL/F/12140–2

(Top View)

Function Table

$$Y = \overline{A + B}$$

Inputs		Output
A	B	Y
L	L	H
L	H	L
H	L	L
H	H	L

H = HIGH Logic Level
L = LOW Logic Level

Pin Descriptions

Pin Names	Description
A, B	Inputs
Y	Output

TinyPak™ is a trademark of National Semiconductor Corporation.

Absolute Maximum Ratings (Note 1)

Supply Voltage (V_{CC})	−0.5V to +7.0V
DC Input Diode Current (I_{IK})	
@ $V_I \leq -0.5V$	−20 mA
@ $V_I \geq V_{CC} + 0.5V$	+20 mA
DC Input Voltage (V_I)	−0.5V to V_{CC} + 0.5V
DC Output Diode Current (I_{OK})	
@ $V_O < -0.5V$	−20 mA
@ $V_O > V_{CC} + 0.5V$	+20 mA
DC Output Voltage (V_O)	−0.5V to V_{CC} + 0.5V
DC Output Source or Sink Current (I_O)	±12.5 mA
DC V_{CC} or Ground Current per Output Pin (I_{CC} or I_{GND})	±25 mA
Storage Temperature (T_{STG})	−65°C to +150°C
Junction Temperature (T_J)	150°C
Lead Temp. (T_L); (Soldering, 10 sec.)	260°C
Power Dissipation (P_D)	200 mW

Note 1: Absolute maximum ratings are those values beyond which damage to the device may occur. The databook specifications should be met, without exception, to ensure that the system design is reliable over its power supply, temperature, and output/input loading variables. National does not recommend operation of circuits outside databook specifications.

ESD Tolerance (Human Body Model) MIL-STD-883D Method 3015.7	> 1000V
DC Latchup Tolerance Source Current (JEDEC Method 17)	±500 mA

Recommended Operating Conditions

Supply Voltage (V_{CC})	2.0V–6.0V
Input Voltage (V_I)	0V–V_{CC}
Output Voltage (V_O)	0V–V_{CC}
Operating Temperature (T_A)	−40°C–+85°C
Input Rise and Fall Time	
V_{CC} @ 2.0V	0–1000 ns
V_{CC} @ 3.0V	0–750 ns
V_{CC} @ 4.5V	0–500 ns
V_{CC} @ 6.0V	0–400 ns
Thermal Resistance (θ_{JA})	275°C/W

DC Electrical Characteristics

Symbol	Parameter	V_{CC} (V)	NC7S02 $T_A = +25°C$			NC7S02 $T_A = -40°C$ to $+85°C$		Units	Conditions
			Min	Typ	Max	Min	Max		
V_{IH}	High Level Input Voltage	2.0	1.50			1.50		V	
		3.0	2.10			2.10			
		4.5	3.15			3.15			
		6.0	4.20			4.20			
V_{IL}	Low Level Input Voltage	2.0			0.50		0.50	V	
		3.0			0.90		0.90		
		4.5			1.35		1.35		
		6.0			1.80		1.80		
V_{OH}	High Level Output Voltage	2.0	1.90	2.0		1.90		V	$I_{OH} = -20\ \mu A$
		3.0	2.90	3.0		2.90			$V_{IN} = V_{IL}$
		4.5	4.40	4.5		4.40			
		6.0	5.90	6.0		5.90			
		3.0	2.68	2.85		2.63		V	$V_{IN} = V_{IL}$ $I_{OH} = -1.3$ mA
		4.5	4.18	4.35		4.13			$I_{OH} = -2$ mA
		6.0	5.68	5.85		5.63			$I_{OH} = -2.6$ mA
V_{OL}	Low Level Output Voltage	2.0		0.0	0.10		0.10	V	$I_{OL} = 20\ \mu A$
		3.0		0.0	0.10		0.10		$V_{IN} = V_{IH}$ or V_{IL}
		4.5		0.0	0.10		0.10		
		6.0		0.0	0.10		0.10		
		3.0		0.1	0.26		0.33	V	$V_{IN} = V_{IH}$ or V_{IL} $I_{OL} = 1.3$ mA
		4.5		0.1	0.26		0.33		$I_{OL} = 2$ mA
		6.0		0.1	0.26		0.33		$I_{OL} = 2.6$ mA
I_{IN}	Input Leakage Current	6.0			±0.1		±1.0	μA	$V_I = V_{CC}$, GND
I_{CC}	Quiescent Supply Current	6.0			1.0		10.0	μA	$V_I = V_{CC}$, GND

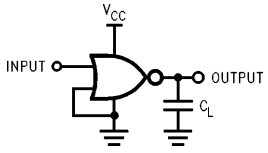
AC Electrical Characteristics

Symbol	Parameter	V_{CC} (V)	NC7S02 $T_A = +25°C$			NC7S02 $T_A = -40°C$ to $+85°C$		Units	Conditions	Fig. No.
			Min	Typ	Max	Min	Max			
t_{PLH},	Propagation Delay	5.0		3.5	15			ns	$C_L = 15$ pF	
t_{PHL}		2.0		19	100		125		$C_L = 50$ pF	1, 2
		3.0		10.5	27		35	ns		
		4.5		7.5	20		25			
		6.0		6.5	17		21			
t_{TLH},	Output Transition Time	5.0		3	10			ns	$C_L = 15$ pF	
t_{THL}		2.0		25	125		155		$C_L = 50$ pF	1, 2
		3.0		16	35		45			
		4.5		11	25		31	ns		
		6.0		9	21		26			
*C_{IN}	*Input Capacitance	Open		2	10		10	pF		
C_{PD}	Power Dissipation Capacitance	5.0		6				pF	(Note 1)	3

*Parameter guaranteed by design. Not tested.

Note 1: C_{PD} is defined as the value of the internal equivalent capacitance which is derived from dynamic operating current consumption (I_{CCD}) at no output loading and operating at 50% duty cycle. (See *Figure 3*.)

C_{PD} is related to I_{CCD} dynamic operating current by the expression: $I_{CCD} = (C_{PD})(V_{CC})(f_{IN}) + (I_{CC}\text{static})$.

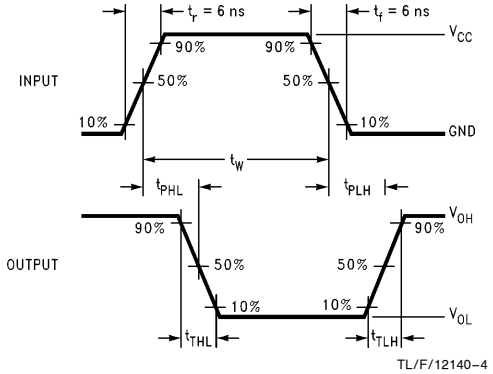


TL/F/12140–3

FIGURE 1. AC Test Circuit

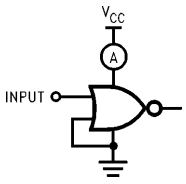
Note 2: C_L includes load and stray capacitance

Note 3: Input PRR = 1.0 MHz; t_W = 500 ns



TL/F/12140–4

FIGURE 2. AC Waveforms



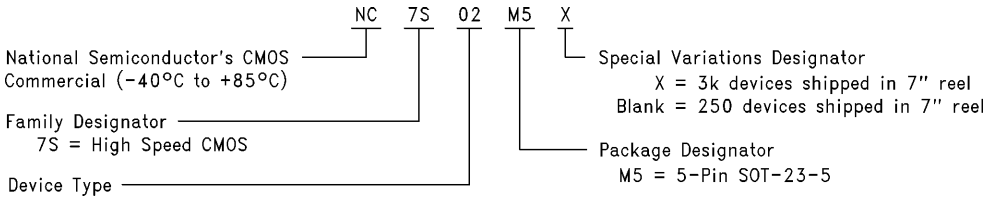
TL/F/12140–5

FIGURE 3. I_{CCD} Test Circuit

Note 4: Input = AC Waveform;
PRR = variable; Duty Cycle = 50%

Ordering Information

The device number is used to form part of a simplified purchasing code where the package type and temperature range are defined as follows:



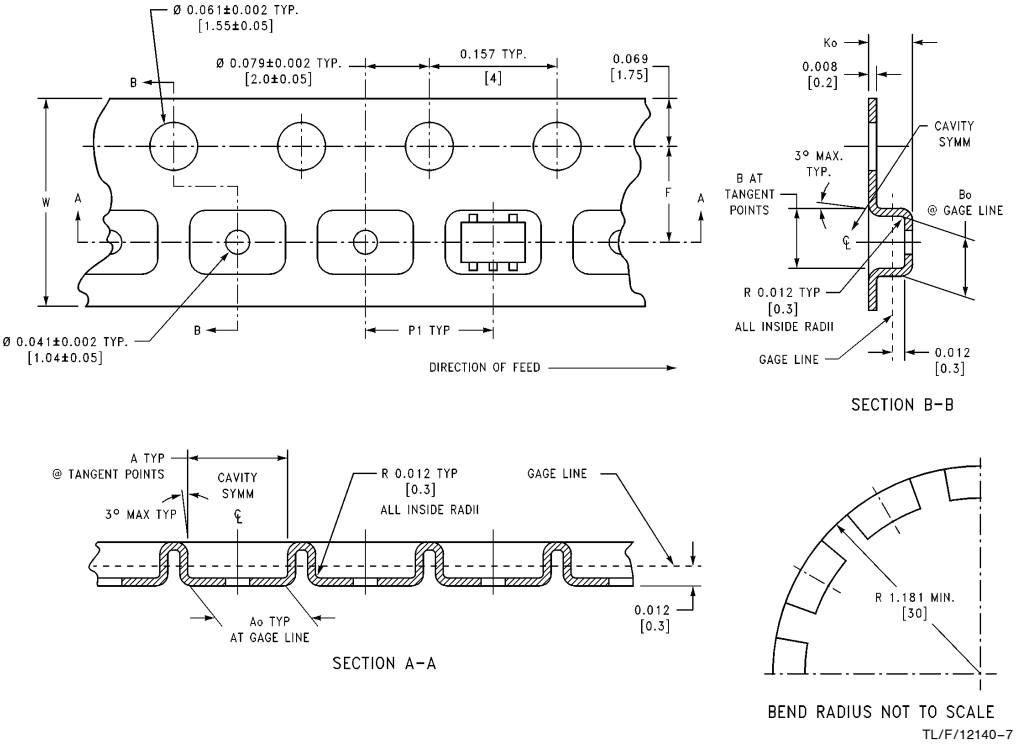
TL/F/12140–6

SOT-23-5 Tape and Reel Specification

Tape Format

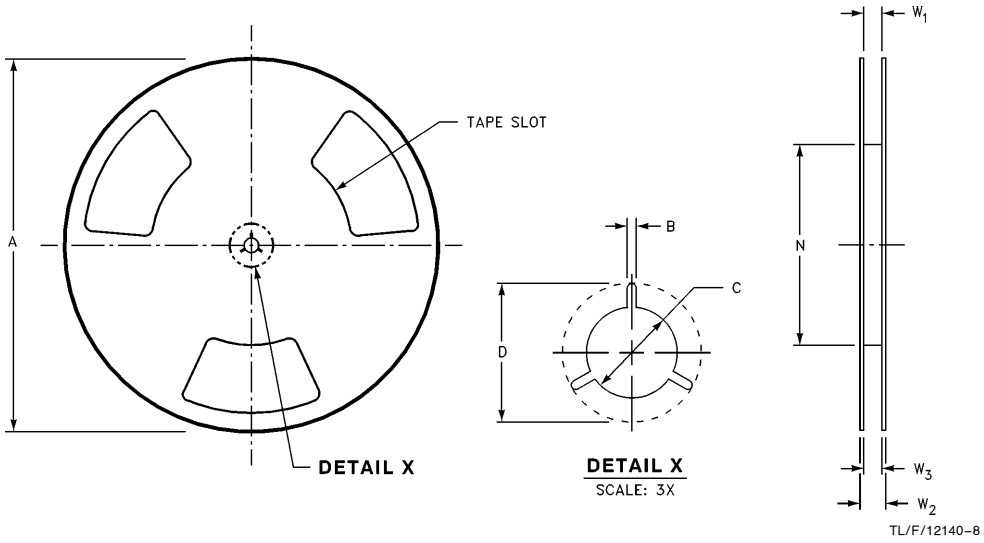
Tape Section	# Cavities	Cavity Status	Cover Tape Status
Leader (Start End)	0 (min)	Empty	Sealed
	75 (min)	Empty	Sealed
Carrier	3000	Filled	Sealed
	250	Filled	Sealed
Trailer (Hub End)	125 (min)	Empty	Sealed
	0 (min)	Empty	Sealed

Tape Dimensions inches (millimeters)



8 mm	0.130 (3.3)	0.124 (3.15)	0.130 (3.3)	0.126 (3.2)	0.138 ± 0.002 (3.5 ± 0.05)	0.055 ± 0.004 (1.4 ± 0.11)	0.157 (4)	0.315 ± 0.012 (8 ± 0.3)
Tape Size	DIM A	DIM Ao	DIM B	DIM Bo	DIM F	DIM Ko	DIM P1	DIM W

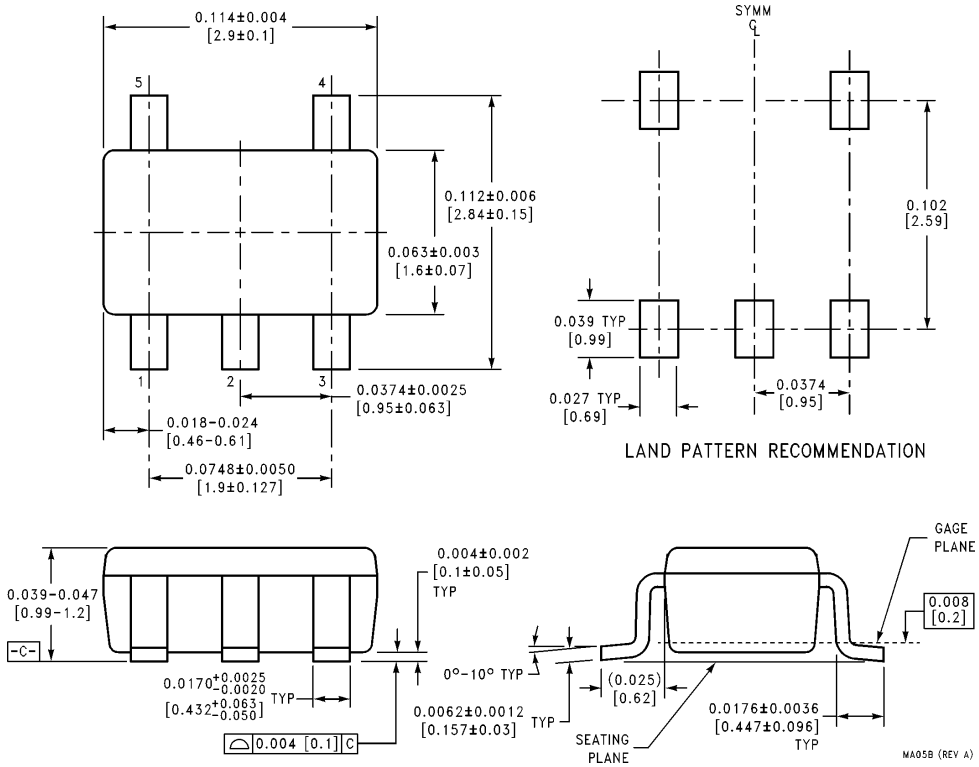
Reel Dimensions inches (millimeters)



TL/F/12140–8

8 mm	7.00 (177.8)	0.059 (1.50)	0.512 (13.00)	0.795 (20.20)	2.165 (55.00)	0.331 + 0.059/−0.000 (8.40 | 1.50/−0.00)	0.567 (14.40)	W1 + 0.078/−0.039 (W1 | 2.00/−1.00)
Tape Size	A	B	C	D	N	W1	W2	W3

Physical Dimensions inches (millimeters) unless otherwise noted



5-Lead Molded SOT-23, Enhanced Thermal
NS Package Number MA05B

LIFE SUPPORT POLICY

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

National Semiconductor Corporation
Americas
Tel: 1(800) 272-9959
Fax: 1(800) 737-7018
Email: support@nsc.com
http://www.national.com

National Semiconductor Europe
Fax: +49 (0) 180-530 85 86
Email: europe.support@nsc.com
Deutsch Tel: +49 (0) 180-530 85 85
English Tel: +49 (0) 180-532 78 32
Français Tel: +49 (0) 180-532 93 58
Italiano Tel: +49 (0) 180-534 16 80

National Semiconductor Southeast Asia
Fax: (852) 2376 3901
Email: sea.support@nsc.com

National Semiconductor Japan Ltd.
Tel: 81-3-5620-7561
Fax: 81-3-5620-6179