National Semiconductor

NC7SZ38
Tiny UHS 2-Input NAND Gate (Open Drain Output)

General Description

The NC7SZ38 is a single 2-Input NAND Gate with open drain output stage from National's Ultra High Speed Series of TinyLogic in the space saving TinyPak™ package. The device is fabricated with advanced CMOS technology to achieve ultra high speed with high output drive while maintaining low static power dissipation over a very broad V_{CC} operating range. The device is specified to operate over the 1.8V to 5.5V V_{CC} range. The inputs and output are high impedance when V_{CC} is 0V. Inputs tolerate voltages up to 6V independent of V_{CC} operating voltage. The open drain output stage will tolerate voltages up to 6V independent of V_{CC} when in the high impedance state.

Features

- Space saving 5-lead surface mount SOT23 package
- Open Drain output stage for OR tied applications
- Ultra High Speed; T_{PD} 2.4 ns Typ into 50 pF at 5V V_{CC}
- High Output Sink Drive; 24 mA at 3V V_{CC}
- Broad V_{CC} Operating Range; 1.8V to 5.5V
- Matches the performance of LCX when operated at 3.3V V_{CC}
- Power down high impedance inputs/output
- Overvoltage Tolerant inputs facilitate 5V to 3V translation
- Quiet Series™ noise/EMI reduction circuitry implemented

Ordering Code: See Section 3

Product Code	Package	Package Drawing	Package Top Mark	Supplied As
NC7SZ38M5	5-Pin SOT 23-5	MA05B	7Z38	250 Units on Tape and Reel
NC7SZ38M5X	5-Pin SOT 23-5	MA05B	7Z38	3k Units on Tape and Reel

Logic Symbol

IEEE/IEC

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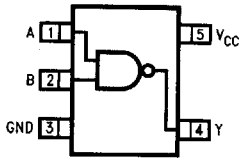
Connection Diagram

Pin Assignment for SOT23-5 Package



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Top View

Function Table

$Y = \overline{AB}$

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

H = HIGH Logic Level

L = LOW Logic Level

*H = HIGH Impedance output state (Open Drain)

Pin Descriptions

Pin Names	Description
A, B	Inputs
Y	Output

Absolute Maximum Ratings (Note 1)

Supply Voltage (V_{CC})	−0.5V to +6V
DC Input Voltage (V_{IN})	−0.5V to +6V
DC Output Voltage (V_{OUT})	−0.5V to +6V
DC Input Diode Current (I_{IK})	
@ V_{IN} < −0.5V	−50 mA
@ V_{IN} > 6V	+20 mA
DC Output Diode Current (I_{OK})	
@ V_{OUT} < −0.5V	−50 mA
@ V_{OUT} > 6V, V_{CC} = GND	+20 mA
DC Output Current (I_{OL})	+50 mA
DC V_{CC}/GND Current (I_{CC}/I_{GND})	±50 mA
Storage Temperature (T_{STG})	−65°C to +150°C
Junction Temperature under Bias (T_J)	150°C
Junction Lead Temp. (T1); (Soldering, 10 sec)	260°C
Package Power Dissipation @ +70°C	200 mW
ESD Tolerance (Human Body Model) MIL-STD-883D method 3015.7	1000V
DC Latchup Tolerance (JEDEC Method 17)	
Negative Source Current (NIT)	−500 mA
Positive Source Voltage (PVT)	+8V

Recommended Operating Conditions

Supply Voltage Operating (V_{CC})	1.8V to 5.5V
Supply Voltage Data Retention (V_{CC})	1.5V to 5.5V
Input Voltage (V_{IN})	0V to 5.5V
Output Voltage (V_{OUT})	0V to V_{CC}
Operating Temperature (T_{OPR})	−40°C to +85°C
Input Rise and Fall Time (t_r, t_f)	
V_{CC} = 1.8V, 2.5V ±0.2V	0 ns/V to 20 ns/V
V_{CC} = 3.3V ±0.3V	0 ns/V to 10 ns/V
V_{CC} = 5.0V ±0.5V	0 ns/V to 5 ns/V
Thermal Resistance (θ_{JA} in Free Air)	300°C/W

Note 1: *Absolute maximum ratings are DC values beyond which the device may be damaged or have its useful life impaired. The datasheet specifications should be met, without exception, to ensure that the system design is reliable over its power supply, ternperature, and output/input loading variables. National does not recommend operation outside datasheet specifications.*

Electrical Characteristics

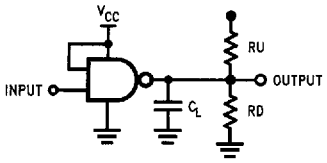
Symbol	Parameter	V_{CC} (V)	NC7SZ38 T_A = +25°C			NC7SZ38 T_A = −40°C to +85°C		Units	Conditions	
			Min	Typ	Max	Min	Max			
V_{IH}	High Level Input Voltage	1.8 2.3 to 5.5	0.75 V_{CC} 0.7 V_{CC}			0.75 V_{CC} 0.7 V_{CC}		V		
V_{IL}	Low Level Input Voltage	1.8 2.3 to 5.5			0.25 V_{CC} 0.3 V_{CC}		0.25 V_{CC} 0.3 V_{CC}	V		
I_{LKG}	High Level Output Leakage	5.5			±5		±10	μA	V_{IN} = V_{IH} or V_{IL} V_{OUT} = V_{CC} or GND	
V_{OL}	Low Level Output Voltage	1.8 2.3 3.0 4.5		0.0 0.0 0.0 0.0	0.1 0.1 0.1 0.1		0.1 0.1 0.1 0.1	V	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 100 μA
		2.3 3.0 3.0 4.5		0.10 0.15 0.22 0.22	0.3 0.4 0.55 0.55		0.3 0.4 0.55 0.55	V		I_{OL} = 8 mA I_{OL} = 16 mA I_{OL} = 24 mA I_{OL} = 32 mA
I_{IN}	Input Leakage Current	5.5			±1		±10	μA	V_{IN} = 5.5V, GND	
I_{OFF}	Power Off Leakage Current	0.0			1		10	μA	V_{IN} or V_{OUT} = 5.5V	
I_{CC}	Quiescent Supply Current	5.5			2.0		20	μA	V_{IN} = 5.5V, GND	

AC Electrical Characteristics

Symbol	Parameter	V_{CC} (V)	NC7SZ38 $T_A = +25°C$			NC7SZ38 $T_A = -40°C$ to $+85°C$		Units	Conditions	Fig. No.
			Min	Typ	Max	Min	Max			
t_{PZL}	Propagation Delay	1.8	1.5	5.4	10.5	1.5	11.0	ns	C_L = 50 pF RU = 500Ω RD = 500Ω VI = 2 × V_{CC}	1, 2
		2.5 ±0.2	0.8	3.5	7.0	0.8	7.5			
		3.3 ±0.3	0.8	2.8	5.0	0.8	5.2			
		5.0 ±0.5	0.5	2.2	4.3	0.5	4.5			
t_{PLZ}	Propagation Delay	1.8	1.5	4.6	10.5	1.5	11.0	ns	C_L = 50 pF RU = 500Ω RD = 500Ω VI = 2 × V_{CC}	1, 2
		2.5 ±0.2	0.8	3.0	7.0	0.8	7.5			
		3.3 ±0.3	0.8	2.1	5.0	0.8	5.2			
		5.0 ±0.5	0.5	1.3	4.3	0.5	4.5			
C_{IN}	Input Capacitance	0		4				pF		
C_{OUT}	Output Capacitance	0		5				pF		
C_{PD}	Power Dissipation Capacitance	3.3		5.1				pF	(Note 1)	3
		5.0		7.3						

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:

$$I_{CCD} = (C_{PD})(V_{CC})(f_{IN}) + (I_{CC} \text{ static}).$$



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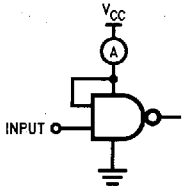
Note 2: C_L includes load and stray capacitance

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

FIGURE 1. AC Test Circuit



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Note 4: Input = AC Waveform; $t_r = t_f$ = 1.8 ns
PRR = 10 MHz; Duty Cycle = 50%

FIGURE 3. I_{CCD} Test Circuit

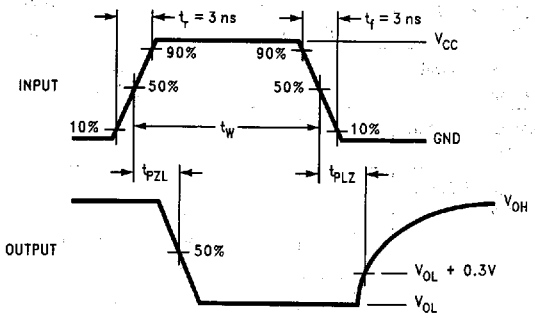

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FIGURE 2. AC Waveforms

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

All dimensions are in inches [millimeters]