FAIRCHILD SEMICONDUCTOR™

July 1999
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74VCX38

Low Voltage Quad 2-Input NAND Gate with Open Drain Outputs and 3.6V Tolerant Inputs and Outputs

General Description

The VCX38 contains four 2-input NAND gates with open drain outputs. This product is designed for low voltage (1.65V to 3.6V) V_{CC} applications with I/O compatibility up to 3.6V.

The VCX38 is fabricated with advanced CMOS technology to achieve high-speed operation while maintaining CMOS low power dissipation.

Features

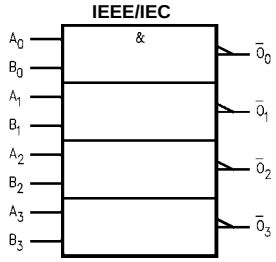
- 1.65V-3.6V V_{CC} supply operation
- 3.6V tolerant inputs and outputs
- t_{PD}
  - 2.8 ns max for 3.0V to 3.6V V_{CC}
  - 3.7 ns max or 2.3V to 2.7V V_{CC}
  - 6.7 ns max for 1.65V to 1.95V V_{CC}
- Power-off high impedance inputs and outputs
- Static Drive (I_{OL})
  - ±24 mA @ 3.0V V_{CC}
  - ±18 mA @ 2.3V V_{CC}
  - ±6 mA @ 1.65V V_{CC}
- Uses patented Quiet Series™ noise/EMI reduction circuitry
- Latchup performance exceeds 300 mA
- ESD performance:
  - Human body model > 2000V
  - Machine model > 250V

Ordering Code:

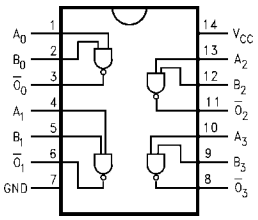
Order Number	Package Number	Package Description
74VCX38M	M14A	14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-120, 0.150" Narrow
74VCX38MTC	MTC14	14-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide

Devices also available in Tape and Reel. Specify by appending the suffix letter "X" to the ordering code.

Logic Symbol



Connection Diagram



Pin Descriptions

Pin Names	Description
A_n, B_n	Inputs
$\overline{O}_n$	Outputs

Quiet Series™ is a trademark of Fairchild Semiconductor Corporation.

Absolute Maximum Ratings (Note 1)

Supply Voltage (V_{CC})	−0.5V to +4.6V
DC Input Voltage (V_I)	−0.5V to +4.6V
Output Voltage (V_O) (Note 2)	−0.5V to +4.6V
DC Input Diode Current (I_{IK})	
$V_I < 0V$	−50 mA
DC Output Diode Current (I_{OK})	
$V_O < 0V$	−50 mA
DC Output Source/Sink Current (I_{OL})	+50 mA
DC V_{CC} or Ground Current per	±100 mA
Supply Pin (I_{CC} or Ground)	
Storage Temperature Range (T_{stg})	−65°C to +150°C

Recommended Operating Conditions (Note 3)

Power Supply	
Operating	1.65V to 3.6V
Data Retention Only	1.2V to 3.6V
Input Voltage	−0.3V to 3.6V
Output Voltage (V_O)	0V to V_{CC}
Output Current in I_{OL}	
V_{CC} = 3.0V to 3.6V	±24 mA
V_{CC} = 2.3V to 2.7V	±18 mA
V_{CC} = 1.65V to 2.3V	±6 mA
Free Air Operating Temperature (T_A)	−40°C to +85°C
Minimum Input Edge Rate ($\Delta t/\Delta V$)	
V_{in} = 0.8V to 2.0V, V_{CC} = 3.0V	10 ns/V

Note 1: The "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the Electrical Characteristics tables are not guaranteed at the Absolute Maximum Ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

Note 2: I_O Absolute Maximum Rating must be observed.

Note 3: Floating or unused inputs must be held HIGH or LOW

DC Electrical Characteristics ($2.7V < V_{CC} \leq 3.6V$)

Symbol	Parameter	Conditions	V_{CC} (V)	Min	Max	Units
V_{IH}	HIGH Level Input Voltage		2.7–3.6	2.0		V
V_{IL}	LOW Level Input Voltage		2.7–3.6		0.8	V
V_{OL}	LOW Level Output Voltage	I_{OL} = 100 μA	2.7–3.6		0.2	V
		I_{OL} = 12 mA	2.7		0.4	
		I_{OL} = 18 mA	3.0		0.4	
		I_{OL} = 24 mA	3.0		0.55	
I_I	Input Leakage Current	$0 \leq V_I \leq 3.6V$	2.7–3.6		±5.0	μA
I_{OFF}	Power-Off Leakage Current	$0 \leq (V_I, V_O) \leq 3.6V$	0		10	μA
I_{CC}	Quiescent Supply Current	$V_I = V_{CC}$ or GND	2.7–3.6		20	μA
		$V_{CC} \leq V_I \leq 3.6V$	2.7–3.6		±20	
ΔI_{CC}	Increase in I_{CC} per Input	$V_{IH} = V_{CC} - 0.6V$	2.7–3.6		750	μA

DC Electrical Characteristics ($2.3V \le V_{CC} \le 2.7V$)

Symbol	Parameter	Conditions	V_{CC} (V)	Min	Max	Units
V_{IH}	HIGH Level Input Voltage		2.3–2.7	1.6		V
V_{IL}	LOW Level Input Voltage		2.3–2.7		0.8	V
V_{OL}	LOW Level Output Voltage	I_{OL} = 100 µA	2.3–2.7		0.2	V
		I_{OL} = 12 mA	2.3		0.4	
		I_{OL} = 18 mA	2.3		0.6	
I_I	Input Leakage Current	$0 \le V_I \le 3.6V$	2.3–2.7		±5.0	µA
I_{OFF}	Power-Off Leakage Current	$0 \le (V_I, V_O) \le 3.6V$	0		10	µA
I_{CC}	Quiescent Supply Current	$V_I = V_{CC}$ or GND	2.3–2.7		20	µA
		$V_{CC} \le V_I \le 3.6V$	2.3–2.7		±20	

DC Electrical Characteristics ($1.65V \le V_{CC} < 2.3V$)

Symbol	Parameter	Conditions	V_{CC} (V)	Min	Max	Units
V_{IH}	HIGH Level Input Voltage		1.65–2.3	0.65 x V_{CC}		V
V_{IL}	LOW Level Input Voltage		1.65–2.3		0.35 x V_{CC}	V
V_{OL}	LOW Level Output Voltage	I_{OL} = 100 µA	1.65–2.3		0.2	V
		I_{OL} = 6 mA	1.65		0.3	
I_I	Input Leakage Current	$0 \le V_I \le 3.6V$	1.65–2.3		±5.0	µA
I_{OFF}	Power-Off Leakage Current	$0 \le (V_I, V_O) \le 3.6V$	0		10	µA
I_{CC}	Quiescent Supply Current	$V_I = V_{CC}$ or GND	1.65–2.3		20	µA
		$V_{CC} \le V_I \le 3.6V$	1.65–2.3		±20	

AC Electrical Characteristics (Note 4)

Symbol	Parameter	$T_A = -40°C$ to $+85°C$, C_L = 30 pF, R_L = 500Ω						Units
		V_{CC} = 3.3V ±0.3V		V_{CC} = 2.5V ±0.2V		V_{CC} = 1.8V ±0.15V		
		Min	Max	Min	Max	Min	Max	
t_{PZL} t_{PLZ}	Propagation Delay	0.6	2.8	0.8	3.7	1.0	6.7	ns
t_{OSHL} t_{OSLH}	Output to Output Skew (Note 5)		0.5		0.5		0.75	ns

Note 4: For C_L = 50 pF, add approximately 300 ps to the AC maximum specification.

Note 5: Skew is defined as the absolute value of the difference between the actual propagation delay for any two separate outputs of the same device. The specification applies to any outputs switching in the same direction, either HIGH-to-LOW (t_{OSHL}) or LOW-to-HIGH (t_{OSLH}).

Dynamic Switching Characteristics

Symbol	Parameter	Conditions	V_{CC} (V)	T_A = +25°C Typical	Units
V_{OLP}	Quiet Output Dynamic Peak V_{OL}	C_L = 30 pF, $V_{IH} = V_{CC}$, V_{IL} = 0V	1.8	0.25	V
			2.5	0.6	
			3.3	0.8	
V_{OLV}	Quiet Output Dynamic Valley V_{OL}	C_L = 30 pF, $V_{IH} = V_{CC}$, V_{IL} = 0V	1.8	–0.25	V
			2.5	–0.6	
			3.3	–0.8	

Capacitance

Symbol	Parameter	Conditions	T_A +25°C Typical	Units
C_{IN}	Input Capacitance	V_I = 0v OR V_{CC}, V_{CC} = 1.8V, 2.5V or 3.3V	6	pF
C_{OUT}	Output Capacitance	V_I = 0V or V_{CC}, V_{CC} = 1.8V, 2.5V or 3.3V	7	pF
C_{PD}	Power Dissipation Capacitance	V_I = 0V or V_{CC}, f = 10 MHz, V_{CC} = 1.8V, 2.5V or 3.3V	20	pF

AC Loading and Waveforms

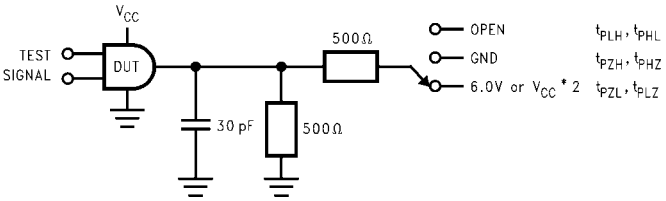


FIGURE 1. AC Test Circuit

TEST	SWITCH
t_{PZL}, t_{PLZ}	6V at V_{CC} = 3.3 ± 0.3V; V_{CC} × 2 at V_{CC} = 2.5V ± 0.2V; 1.8V

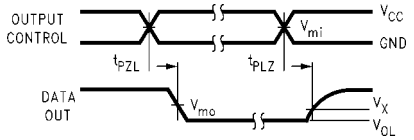
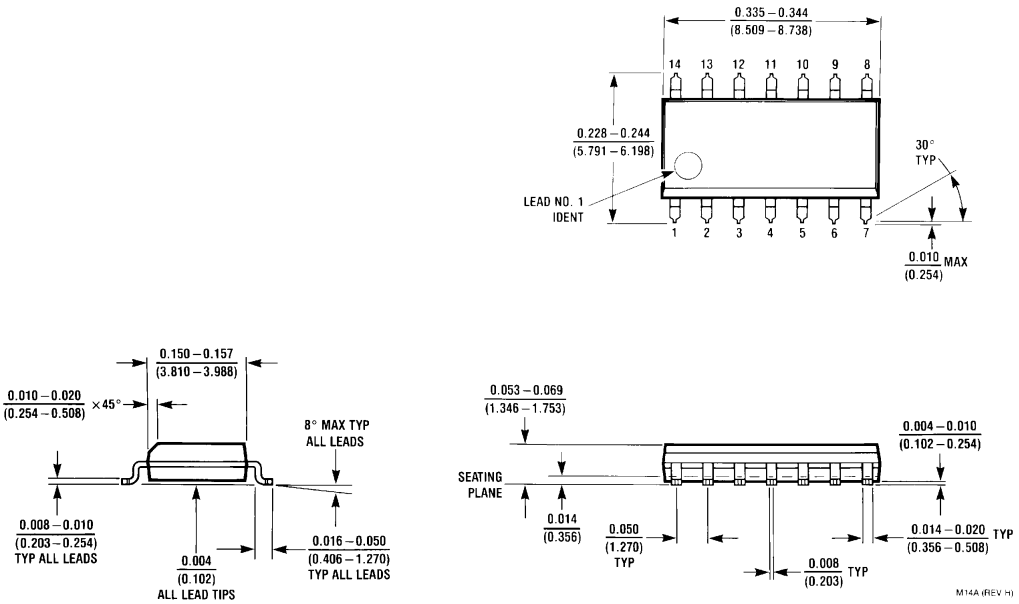


FIGURE 2. Waveform for Open Drain, Inverting and Non-inverting Functions

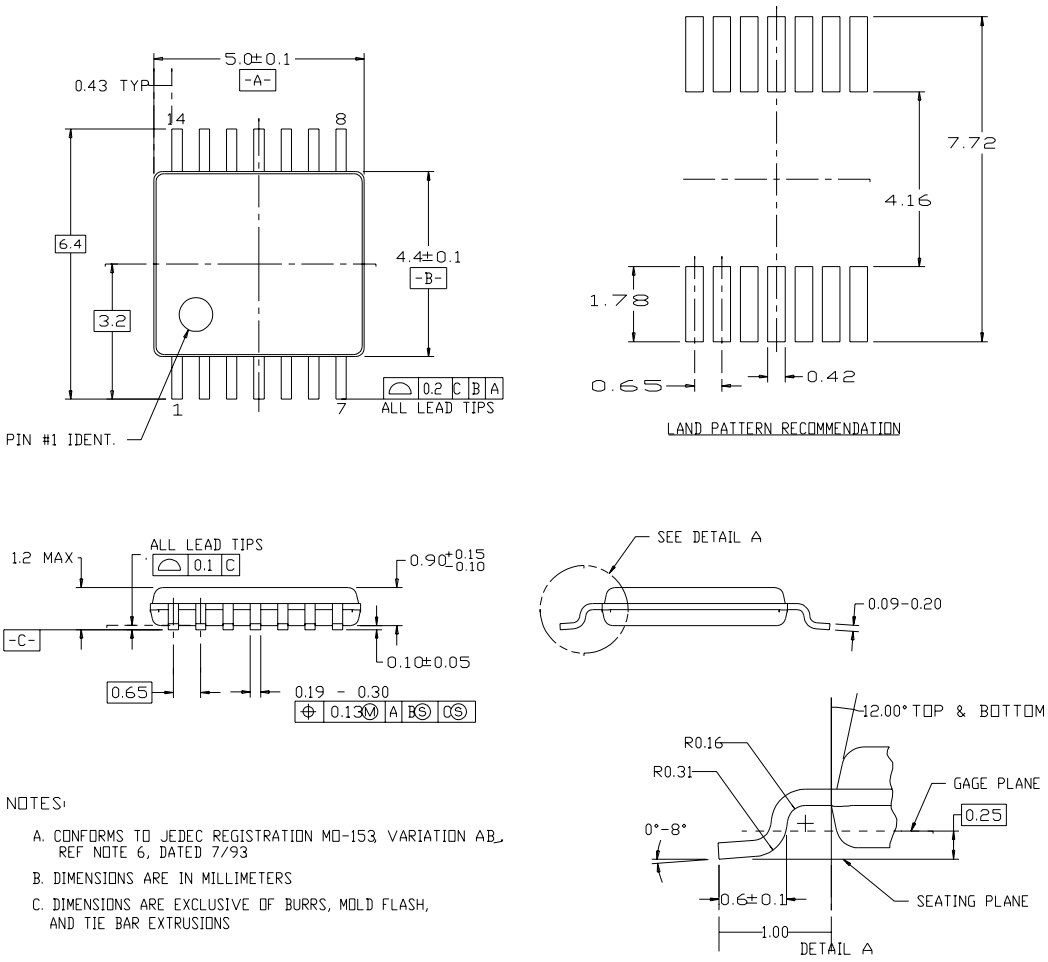
Symbol	V_{CC}		
	3.3V ± 0.3V	**2.5V ± 0.2V**	**1.8V ± 0.15V**
V_{mi}	1.5V	$V_{CC}/2$	$V_{CC}/2$
V_{mo}	1.5V	$V_{CC}/2$	$V_{CC}/2$
V_x	V_{OL} + 0.3V	V_{OL} + 0.15V	V_{OL} + 0.15V

Physical Dimensions inches (millimeters) unless otherwise noted



14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-120, 0.150” Narrow
Package Number M14A

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



NOTES:

A. CONFORMS TO JEDEC REGISTRATION MO-153, VARIATION AB, REF NOTE 6, DATED 7/93

B. DIMENSIONS ARE IN MILLIMETERS

C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS

14-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide
Package Number MTC14

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