DUAL 2-INPUT NAND GATE WITH OPEN-DRAIN OUTPUTS

Description

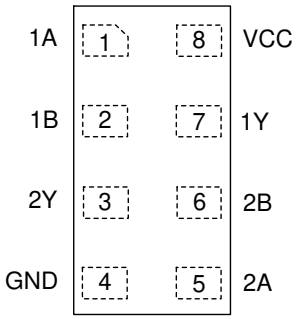
The 74LVC2G38 is a dual, two input NAND gate with open-drain outputs. Both gates have open-drain outputs designed for operation over a power supply range of 1.65V to 5.5V. The device is fully specified for partial power down applications using I_{OFF}. The I_{OFF} circuitry disables the output preventing damaging current backflow when the device is powered down. Each gate performs the positive Boolean function

$$Y = \overline{A \bullet B} \text{ or } Y = \overline{A} + \overline{B}$$

It is understood that the logical HIGH output level is a result of pull-up resistor.

Pin Assignments

(Top View)



X2-DFN2010-8
X2-DFN1410-8
X2-DFN1210-8

Features

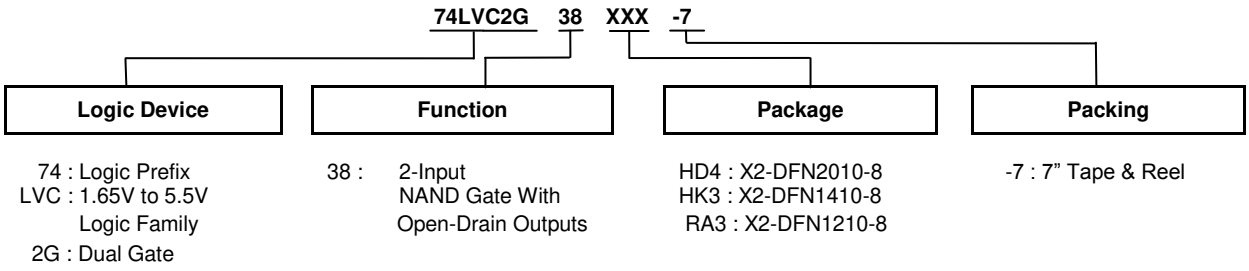
- Wide Supply Voltage Range from 1.65V to 5.5V
- Outputs Sink 24mA at Vcc = 3.3V
- CMOS Low Power Consumption
- I_{OFF} Supports Partial-Power-Down Mode Operation
- Inputs accept up to 5.5V
- Schmitt Trigger Action at all inputs makes the circuit tolerant for slower input rise and fall times. The hysteresis is typically 100mV at V_{CC} = 3.0V
- ESD Protection Exceeds JESD 22
  - 2000-V Human Body Model (A114)
  - Exceeds 1000-V Charged Device Model (C101)
- Latch-Up Exceeds 100mA per JESD 78, Class I
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**

Applications

- Voltage Level Shifting
- General Purpose Logic
- Power Down Signal Isolation
- Wide Array of Products Such as:
  - PCs, Networking, Notebooks, Netbooks, PDAs
  - Tablet Computers, E-readers
  - Computer Peripherals, Hard Drives, CD/DVD ROMs
  - TVs, DVDs, DVRs, Set Top Boxes
  - Cell Phones, Personal Navigation / GPS
  - MP3 Players, Cameras, Video Recorders

Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant.
2. See http://www.diodes.com/quality/lead_free.html for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

Ordering Information (Note 4)



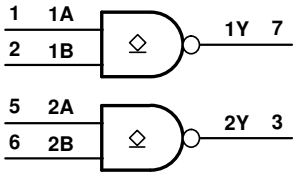
Device	Package Code	Package (Note 5)	Package Size	7" Tape and Reel (Note 6)	
				Quantity	Part Number Suffix
74LVC2G38HD4-7	HD4	X2-DFN2010-8	1.95mm x 1.0mm x 0.4mm 0.5mm lead pitch	5,000/Tape & Reel	-7
74LVC2G38HK3-7	HK3	X2-DFN1410-8	1.35mm x 1.0mm x 0.35mm 0.4mm lead pitch	5,000/Tape & Reel	-7
74LVC2G38RA3-7	RA3	X2-DFN1210-8	1.2mm x 1.0mm x 0.35mm 0.3mm lead pitch	5,000/Tape & Reel	-7

Notes: 4. For packaging details, go to our website at http://www.diodes.com/products/packages.html.
5. Pad layout as shown in Diodes Incorporated's package outline PDFs, which can be found on our website at http://www.diodes.com/package-outlines.html.
6. The taping orientation is located on our website at http://www.diodes.com/datasheets/ap02007.pdf.

Pin Descriptions

Pin Name	Pin No.	Description
1A	1	Data Input
1B	2	Data Input
2Y	3	Data Output (Open Drain)
GND	4	Ground
2A	5	Data Input
2B	6	Data Input
1Y	7	Data Output (Open Drain)
V_{CC}	8	Supply Voltage

Logic Diagram



Function Table

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

Absolute Maximum Ratings (Notes 7 & 8)

Symbol	Description	Rating	Unit
ESD HBM	Human Body Model ESD Protection	2	kV
ESD CDM	Charged Device Model ESD Protection	1	kV
V_{CC}	Supply Voltage	-0.5 to +6.5	V
V_I	Input Voltage	-0.5 to +6.5	V
V_O	Output Voltage -Active Mode	-0.5 to +6.5	V
	Output Voltage Power Down Mode	-0.5 to +6.5	V
I_{IK}	Input Clamp Current $V_I < 0$	-50	mA
I_{OK}	Output Clamp Current ($V_O < 0$)	-50	mA
I_O	Continuous Output Current (V_O = 0 to 5.5V)	50	mA
I_{CC}	Continuous Current Through V_{CC}	100	mA
I_{GND}	Continuous Current Through GND	-100	mA
T_J	Operating Junction Temperature	-40 to +150	°C
T_{STG}	Storage Temperature	-65 to +150	°C

Notes: 7. Stresses beyond the absolute maximum may result in immediate failure or reduced reliability. These are stress values and device operation should be within recommend values.
8. Forcing the maximum allowed voltage could cause a condition exceeding the maximum current or conversely forcing the maximum current could cause a condition exceeding the maximum voltage. The ratings of both current and voltage must be maintained within the controlled range.

Recommended Operating Conditions (Note 9)

Symbol	Parameter		Min	Max	Unit
V_{CC}	Operating Voltage	Operating	1.65	5.5	V
		Data Retention Only	1.5	—	
V_I	Input Voltage		0	5.5	V
V_O	Output Voltage Active Mode		0	5.5	V
	Output Voltage Power-Down Mode		0	5.5	
I_{OL}	Low-Level Output Current	V_{CC} = 1.65V	—	4	mA
		V_{CC} = 2.3V	—	8	
		V_{CC} = 2.7V	—	12	
		V_{CC} = 3.0V	—	16	
			—	24	
		V_{CC} = 4.5V	—	32	
$\Delta t/\Delta V$	Input Transition Rise or Fall Rate	V_{CC} = 1.65V to 2.7V	—	20	ns/V
		V_{CC} = 2.7V to 5.5V	—	10	
T_A	Operating Free-Air Temperature		-40	+125	°C

Note: 9. Unused inputs should be held at V_{CC} or Ground.

Electrical Characteristics (All typical values are at T_A = +25°C)

Symbol	Parameter	Test Conditions	V_{CC}	-40°C to +85°C			-40°C to +125°C		Unit
				Min	Typ.	Max	Min	Max	
V_{IH}	High-Level Input Voltage	—	V_{CC} = 1.65V to 1.95V	0.65 x V_{CC}	—	—	0.65 x V_{CC}	—	V
			V_{CC} = 2.3V to 2.7V	1.7	—	—	1.7	—	
			V_{CC} = 2.7V to 3.6V	2.0	—	—	2.0	—	
			V_{CC} = 4.5V to 5.5V	0.7 x V_{CC}	—	—	0.7 x V_{CC}	—	
V_{IL}	Low-Level Input Voltage	—	V_{CC} = 1.65V to 1.95V	—	—	0.35 x V_{CC}	—	0.35 x V_{CC}	V
			V_{CC} = 2.3V to 2.7V	—	—	0.7	—	0.7	
			V_{CC} = 2.7V to 3.6V	—	—	0.8	—	0.8	
			V_{CC} = 4.5V to 5.5V	—	—	0.3 x V_{CC}	—	0.3 x V_{CC}	
V_{OL}	Low-Level Output Voltage	I_{OL} = 100µA	1.65V to 5.5V	—	0	0.1	—	0.1	V
		I_{OL} = 4mA	1.65V	—	0.08	0.45	—	0.7	
		I_{OL} = 8mA	2.3V	—	0.14	0.3	—	0.45	
		I_{OL} = 12mA	2.7V	—	0.19	0.4	—	0.6	
		I_{OL} = 16mA	3V	—	0.25	0.4	—	0.6	
		I_{OL} = 24mA		—	0.37	0.55	—	0.8	
		I_{OL} = 32mA	4.5V	—	0.43	0.55	—	0.8	
I_I	Input Current	V_I = 5.5V or GND	0V to 5.5V	—	± 0.1	±5	—	± 20	µA
I_{OFF}	Power Down Leakage Current	V_I or V_O = 5.5V	0V	—	± 0.1	±10	—	±20	µA
I_{CC}	Supply Current	V_I = 5.5V or GND I_O = 0A	1.65V to 5.5V	—	0.1	10	—	40	µA
ΔI_{CC}	Additional Supply Current	One input at V_{CC} – 0.6V Other inputs at V_{CC} or GND	2.3V to 5.5V	—	5	500	—	5,000	µA
C_I	Input Capacitance	V_I = V_{CC} or GND	3.3V	—	2.5	—	—	—	pF

Operating Characteristics

Parameter		Test Conditions	V_{CC} = 1.8V	V_{CC} = 2.5V	V_{CC} = 3.3V	V_{CC} = 5V	Unit
			Typ.	Typ.	Typ.	Typ.	
C_{pd}	Power Dissipation Capacitance	f = 10MHz	6	7	7	9	pF

Package Characteristics

Symbol	Parameter	Package	Test Conditions	Min	Typ.	Max	Unit
θ_{JA}	Thermal Resistance Junction-to-Ambient	X2-DFN2010-8	(Note 10)	—	313	—	°C/W
		X2-DFN1410-8		—	321	—	
		X2-DFN1210-8		—	395	—	
θ_{JC}	Thermal Resistance Junction-to-Case	X2-DFN2010-8	(Note 10)	—	145	—	°C/W
		X2-DFN1410-8		—	166	—	
		X2-DFN1210-8		—	236	—	

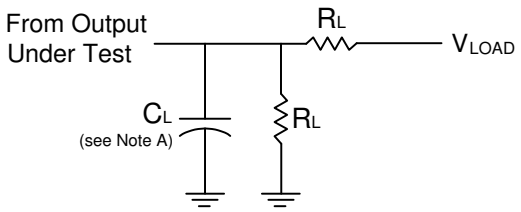
Note: 10. Test condition for each package type: Device mounted on FR-4 substrate PC board, 2oz copper, with minimum recommended pad layout.

Switching Characteristics

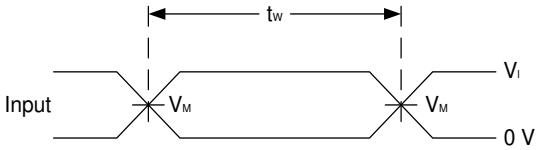
Typical Values at T_A = +25°C and nominal voltages 1.8V, 2.5V, 2.7V, 3.3V, and 5.0V. See Figure 1.

Parameter	From Input	To Output	V_{CC}	T_A = -40°C to +85°C			T_A = -40°C to +125°C		Unit
				Min	Typ	Max	Min	Max	
t_{PZL}	A or B	Y	1.8V ± 0.15V	1.2	3.0	8.6	1.2	10.8	ns
			2.5V ± 0.2V	0.7	1.8	4.8	0.7	6.0	
			2.7V	0.7	2.5	4.4	0.7	5.5	
			3.3V ± 0.3V	0.7	2.1	4.1	0.7	5.2	
			5.0V ± 0.5V	0.5	1.5	3.3	0.5	4.2	
t_{PLZ}	A or B	Y	1.8V ± 0.15V	1.2	3.0	8.6	1.2	10.8	ns
			2.5V ± 0.2V	0.7	1.8	4.8	0.7	6.0	
			2.7V	0.7	2.5	4.4	0.7	5.5	
			3.3V ± 0.3V	0.7	2.1	4.1	0.7	5.2	
			5.0V ± 0.5V	0.5	1.5	3.3	0.5	4.2	

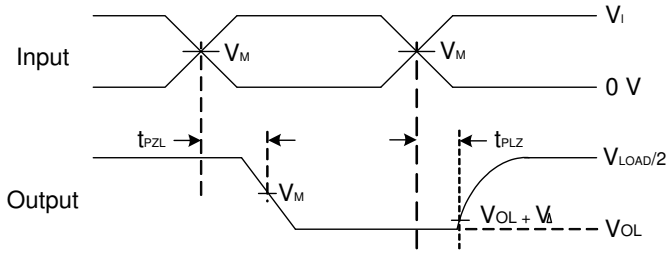
Parameter Measurement Information



V_{CC}	Inputs		V_M	V_{LOAD}	C_L	R_L	$V\Delta$
	V_I	t_r/t_f					
1.8V ± 0.15V	V_{CC}	≤2ns	$V_{CC}/2$	2 x V_{CC}	30pF	1kΩ	0.15V
2.5V ± 0.2V	V_{CC}	≤2ns	$V_{CC}/2$	2 x V_{CC}	30pF	500Ω	0.15V
2.7V	2.7V	≤2.5ns	1.5V	6V	50pF	500Ω	0.3V
3.3V ± 0.3V	2.7V	≤2.5ns	1.5V	6V	50pF	500Ω	0.3V
5.0V ± 0.5V	V_{CC}	≤2.5ns	$V_{CC}/2$	2 x V_{CC}	50pF	500Ω	0.3V



Voltage Waveform Pulse Duration



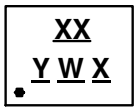
Voltage Waveforms
Inverting and Non Inverting Outputs

Figure 1. Load Circuit and Voltage Waveforms

Notes: A. Includes test lead and test apparatus capacitance.
B. All pulses are supplied at pulse repetition rate ≤ 10MHz.
C. Inputs are measured separately one transition per measurement.

Marking Information

(Top View)



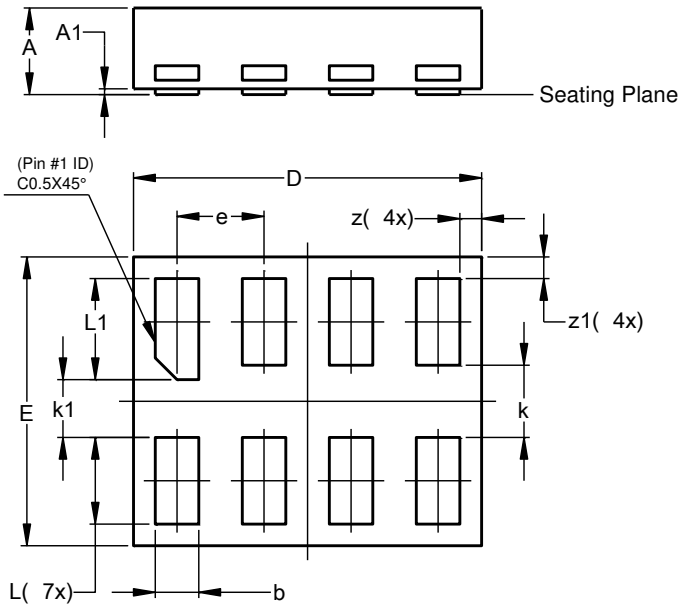
XX : Identification Code
Y : Year : 0~9
W : Week : A~Z : 1~26 week;
a~z : 27~52 week; z represents
52 and 53 week
X : Internal Code

Part Number	Package	Identification Code
74LVC2G38HD4-7	X2-DFN2010-8	9M
74LVC2G38HK3-7	X2-DFN1410-8	9N
74LVC2G38RA3-7	X2-DFN1210-8	9P

X2-DFN1210-8 Package Outline Dimensions

Please see http://www.diodes.com/package-outlines.html for the latest version.

X2-DFN1210-8

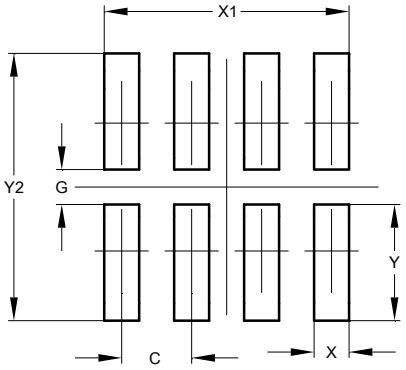


X2-DFN1210-8			
Dim	**Min**	**Max**	**Typ**
A	-	0.35	0.30
A1	0	0.03	0.02
b	0.10	0.20	0.15
D	1.15	1.25	1.20
E	0.95	1.05	1.00
e	-	-	0.30
k	-	-	0.25
k1	-	-	0.20
L	0.25	0.35	0.30
L1	0.30	0.40	0.35
z	0.050	0.100	0.075
z1	0.050	0.100	0.075
All Dimensions in mm			

Suggested Pad Layout

Please see http://www.diodes.com/package-outlines.html for the latest version.

X2-DFN1210-8

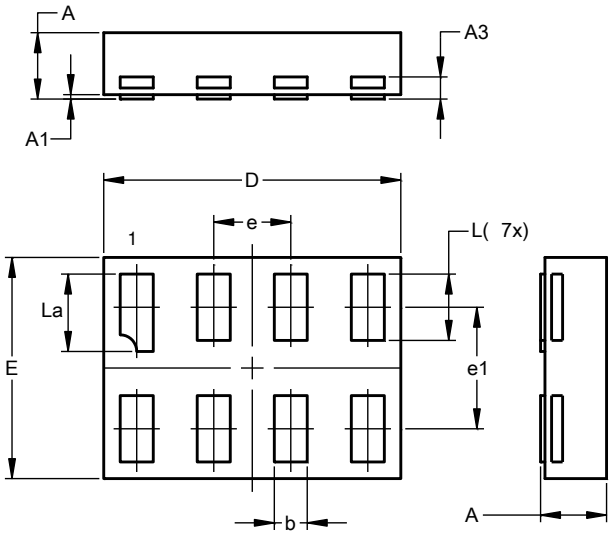


Dimensions	Value (in mm)
C	0.300
G	0.150
X	0.150
X1	1.050
Y	0.500
Y1	1.150

X2-DFN1410-8 Package Outline Dimensions

Please see http://www.diodes.com/package-outlines.html for the latest version.

X2-DFN1410-8

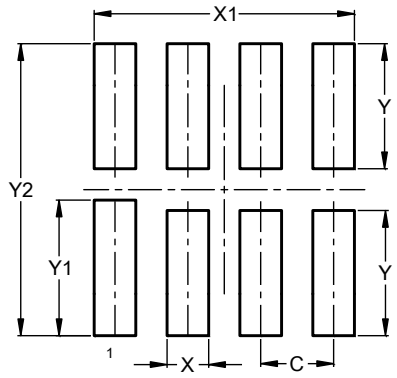


X2-DFN1410-8			
Dim	**Min**	**Max**	**Typ**
A	0.30	0.35	0.33
A1	0.00	0.03	0.02
A3	--	--	0.10
b	0.12	0.20	0.15
D	1.30	1.40	1.35
E	0.95	1.05	1.00
e	--	--	0.35
e1	--	--	0.55
L	0.27	0.35	0.30
L1	0.32	0.40	0.35
All Dimensions in mm			

Suggested Pad Layout

Please see http://www.diodes.com/package-outlines.html for the latest version.

X2-DFN1410-8

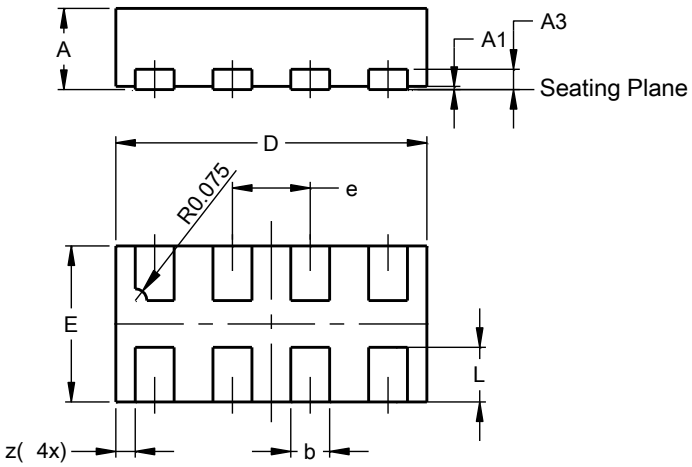


Dimensions	Value (in mm)
C	0.350
X	0.200
X1	1.250
Y	0.600
Y1	0.650
Y2	1.400

X2-DFN2010-8 Package Outline Dimensions

Please see http://www.diodes.com/package-outlines.html for the latest version.

X2-DFN2010-8

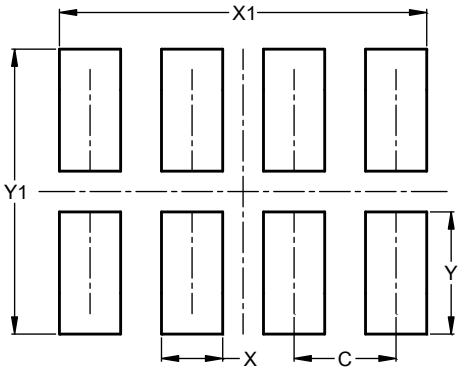


X2-DFN2010-8			
Dim	**Min**	**Max**	**Typ**
A	--	0.40	--
A1	0.00	0.05	0.02
A3	--	--	0.13
b	0.20	0.30	0.25
D	1.950	2.05	2.00
E	0.95	1.05	1.00
e	--	--	0.50
L	0.30	0.40	0.35
z	--	--	0.125
All Dimensions in mm			

Suggested Pad Layout

Please see http://www.diodes.com/package-outlines.html for the latest version.

X2-DFN2010-8



Dimensions	Value (in mm)
C	0.500
X	0.300
X1	1.800
Y	0.600
Y1	1.400

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