

**DUAL 2-INPUT NAND GATE WITH OPEN-DRAIN OUTPUTS**

**Description**

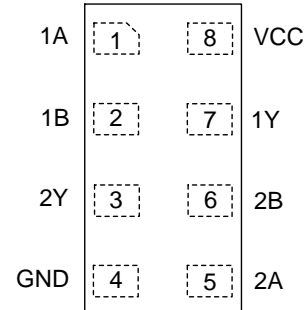
The 74LVC2G38 is a dual, two input NAND gate with open-drain outputs. Both gates have open-drain outputs designed for operation over a power supply range of 1.65V to 5.5V. The device is fully specified for partial power down applications using I<sub>OFF</sub>. The I<sub>OFF</sub> circuitry disables the 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

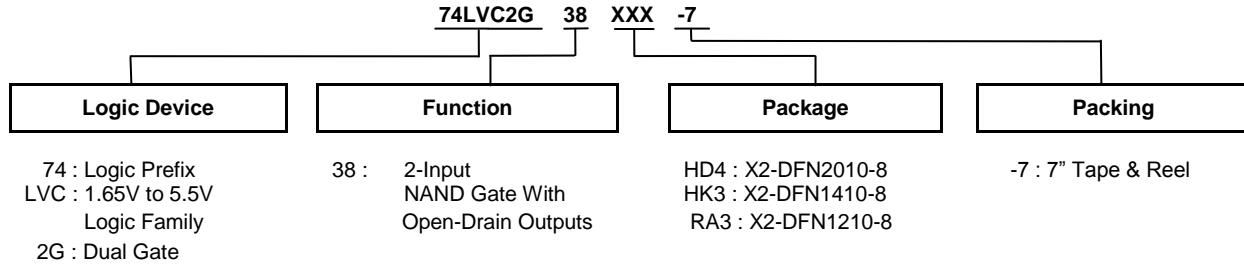
**Features**

- Wide Supply Voltage Range from 1.65V to 5.5V
- Outputs Sink 24mA at V<sub>cc</sub> = 3.3V
- CMOS Low Power Consumption
- I<sub>OFF</sub> 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<sub>cc</sub> = 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](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.

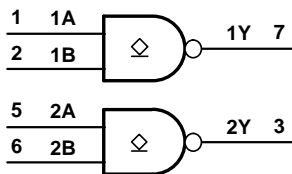
**Ordering Information** (Note 4)


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 <sub>CC</sub>	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 <sub>CC</sub>	Supply Voltage	-0.5 to +6.5	V
V <sub>I</sub>	Input Voltage	-0.5 to +6.5	V
V <sub>O</sub>	Output Voltage -Active Mode	-0.5 to +6.5	V
	Output Voltage Power Down Mode	-0.5 to +6.5	V
I <sub>IK</sub>	Input Clamp Current V <sub>I</sub> < 0	-50	mA
I <sub>OK</sub>	Output Clamp Current (V <sub>O</sub> < 0)	-50	mA
I <sub>O</sub>	Continuous Output Current (V <sub>O</sub> = 0 to 5.5V)	50	mA
I <sub>CC</sub>	Continuous Current Through V <sub>CC</sub>	100	mA
I <sub>GND</sub>	Continuous Current Through GND	-100	mA
T <sub>J</sub>	Operating Junction Temperature	-40 to +150	°C
T <sub>STG</sub>	Storage Temperature	-65 to +150	°C

- Notes:
- 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.
  - 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 <sub>CC</sub>	Operating Voltage	Operating	1.65	5.5	V	
		Data Retention Only	1.5	—		
V <sub>I</sub>	Input Voltage		0	5.5	V	
V <sub>O</sub>	Output Voltage Active Mode		0	5.5	V	
	Output Voltage Power-Down Mode		0	5.5		
I <sub>OL</sub>	Low-Level Output Current	V <sub>CC</sub> = 1.65V	—	4	mA	
		V <sub>CC</sub> = 2.3V	—	8		
		V <sub>CC</sub> = 2.7V	—	12		
		V <sub>CC</sub> = 3.0V	—	16		
		V <sub>CC</sub> = 4.5V	—	32		
Δt/ΔV	Input Transition Rise or Fall Rate		V <sub>CC</sub> = 1.65V to 2.7V	—	20	ns/V
			V <sub>CC</sub> = 2.7V to 5.5V	—	10	
T <sub>A</sub>	Operating Free-Air Temperature		-40	+125	°C	

- Note: 9. Unused inputs should be held at V<sub>CC</sub> or Ground.

**Electrical Characteristics** (All typical values are at  $T_A = +25^\circ\text{C}$ )

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	—	$V_{CC} = 1.65\text{V to } 1.95\text{V}$	$0.65 \times V_{CC}$	—	—	$0.65 \times V_{CC}$	—	V
			$V_{CC} = 2.3\text{V to } 2.7\text{V}$	1.7	—	—	1.7	—	
			$V_{CC} = 2.7\text{V to } 3.6\text{V}$	2.0	—	—	2.0	—	
			$V_{CC} = 4.5\text{V to } 5.5\text{V}$	$0.7 \times V_{CC}$	—	—	$0.7 \times V_{CC}$	—	
$V_{IL}$	Low-Level Input Voltage	—	$V_{CC} = 1.65\text{V to } 1.95\text{V}$	—	—	$0.35 \times V_{CC}$	—	$0.35 \times V_{CC}$	V
			$V_{CC} = 2.3\text{V to } 2.7\text{V}$	—	—	0.7	—	0.7	
			$V_{CC} = 2.7\text{V to } 3.6\text{V}$	—	—	0.8	—	0.8	
			$V_{CC} = 4.5\text{V to } 5.5\text{V}$	—	—	$0.3 \times V_{CC}$	—	$0.3 \times V_{CC}$	
$V_{OL}$	Low-Level Output Voltage	$I_{OL} = 100\mu\text{A}$	1.65V to 5.5V	—	0	0.1	—	0.1	V
		$I_{OL} = 4\text{mA}$	1.65V	—	0.08	0.45	—	0.7	
		$I_{OL} = 8\text{mA}$	2.3V	—	0.14	0.3	—	0.45	
		$I_{OL} = 12\text{mA}$	2.7V	—	0.19	0.4	—	0.6	
		$I_{OL} = 16\text{mA}$	3V	—	0.25	0.4	—	0.6	
		$I_{OL} = 24\text{mA}$		—	0.37	0.55	—	0.8	
		$I_{OL} = 32\text{mA}$	4.5V	—	0.43	0.55	—	0.8	
$I_I$	Input Current	$V_I = 5.5\text{V or GND}$	0V to 5.5V	—	$\pm 0.1$	$\pm 5$	—	$\pm 20$	$\mu\text{A}$
$I_{OFF}$	Power Down Leakage Current	$V_I \text{ or } V_O = 5.5\text{V}$	0V	—	$\pm 0.1$	$\pm 10$	—	$\pm 20$	$\mu\text{A}$
$I_{CC}$	Supply Current	$V_I = 5.5\text{V or GND}$ $I_O = 0\text{A}$	1.65V to 5.5V	—	0.1	10	—	40	$\mu\text{A}$
$\Delta I_{CC}$	Additional Supply Current	One input at $V_{CC} - 0.6\text{V}$ Other inputs at $V_{CC}$ or GND	2.3V to 5.5V	—	5	500	—	5,000	$\mu\text{A}$
$C_I$	Input Capacitance	$V_I = V_{CC} \text{ or GND}$	3.3V	—	2.5	—	—	—	pF

## Operating Characteristics

Parameter		Test Conditions	V <sub>CC</sub> = 1.8V	V <sub>CC</sub> = 2.5V	V <sub>CC</sub> = 3.3V	V <sub>CC</sub> = 5V	Unit
			Typ.	Typ.	Typ.	Typ.	
C <sub>pd</sub>	Power Dissipation Capacitance	f = 10MHz	6	7	7	9	pF

## Package Characteristics

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

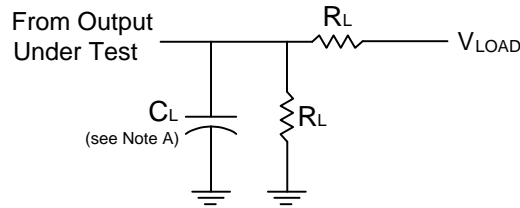
Note: 10. Test condition for each package type: Device mounted on FR-4 substrate PC board, 2oz copper, with minimum recommended pad layout.

## Switching Characteristics

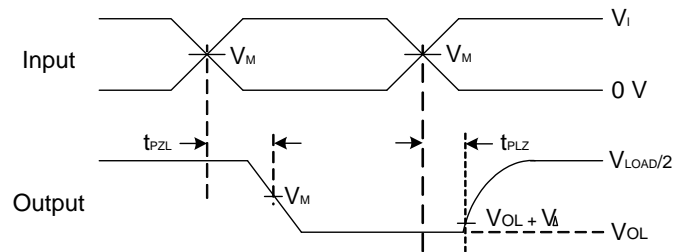
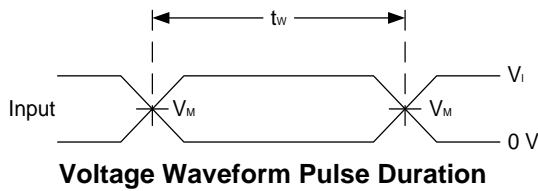
Typical Values at T<sub>A</sub> = +25°C and nominal voltages 1.8V, 2.5V, 2.7V, 3.3V, and 5.0V. See Figure 1.

Parameter	From Input	To Output	V <sub>CC</sub>	T <sub>A</sub> = -40°C to +85°C			T <sub>A</sub> = -40°C to +125°C		Unit
				Min	Typ	Max	Min	Max	
t <sub>PZL</sub>	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 <sub>PLZ</sub>	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		$V_M$	$V_{LOAD}$	$C_L$	$R_L$	$V_{\Delta}$
	$V_I$	$t_r/t_f$					
$1.8V \pm 0.15V$	$V_{CC}$	$\leq 2ns$	$V_{CC}/2$	$2 \times V_{CC}$	30pF	1k $\Omega$	0.15V
$2.5V \pm 0.2V$	$V_{CC}$	$\leq 2ns$	$V_{CC}/2$	$2 \times V_{CC}$	30pF	500 $\Omega$	0.15V
2.7V	2.7V	$\leq 2.5ns$	1.5V	6V	50pF	500 $\Omega$	0.3V
$3.3V \pm 0.3V$	2.7V	$\leq 2.5ns$	1.5V	6V	50pF	500 $\Omega$	0.3V
$5.0V \pm 0.5V$	$V_{CC}$	$\leq 2.5ns$	$V_{CC}/2$	$2 \times V_{CC}$	50pF	500 $\Omega$	0.3V

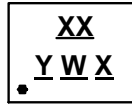


**Figure 1. Load Circuit and Voltage Waveforms**

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

**Marking Information**

(Top View)



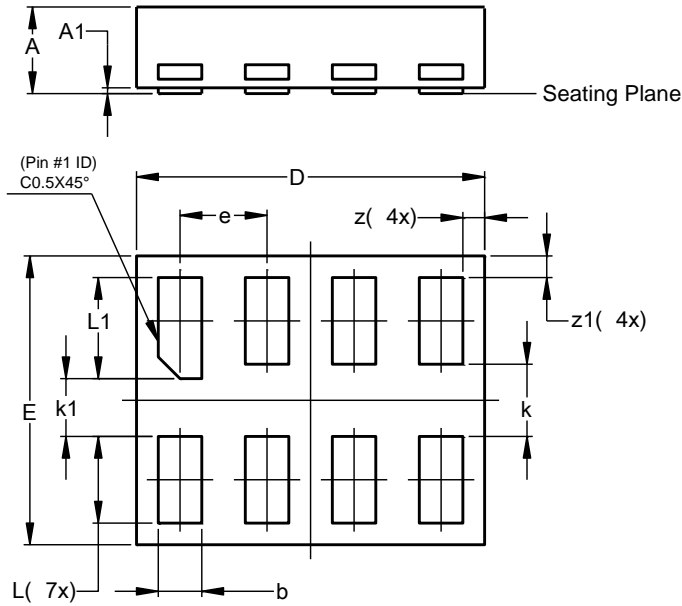
XX : Identification Code  
Y : Year : 0~9  
W : Week : A~Z : 1~26 week;  
 a~z : 27~52 week; z represents  
 52 and 53 week  
X : Internal Code

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

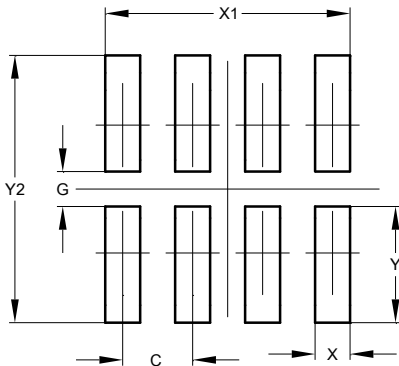


X2-DFN1210-8			
Dim	Min	Max	Typ
A	-	0.35	0.30
A1	0	0.03	0.02
b	0.10	0.20	0.15
D	1.15	1.25	1.20
E	0.95	1.05	1.00
e	-	-	0.30
k	-	-	0.25
k1	-	-	0.20
L	0.25	0.35	0.30
L1	0.30	0.40	0.35
z	0.050	0.100	0.075
z1	0.050	0.100	0.075
All Dimensions in mm			

## Suggested Pad Layout

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

X2-DFN1210-8



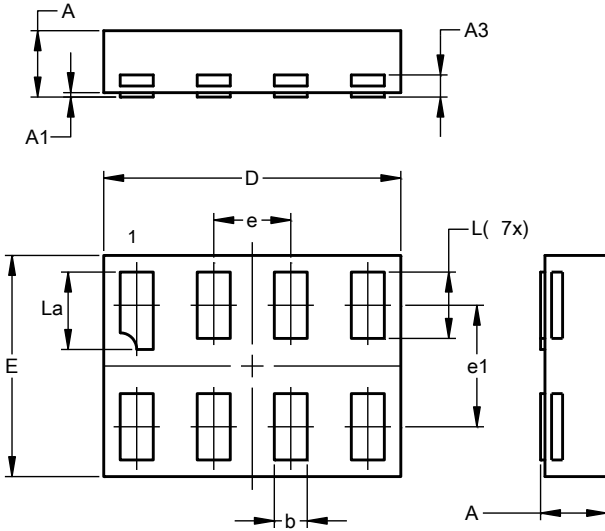
Dimensions	Value (in mm)
C	0.300
G	0.150
X	0.150
X1	1.050
Y	0.500
Y1	1.150



**X2-DFN1410-8 Package Outline Dimensions**

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

**X2-DFN1410-8**

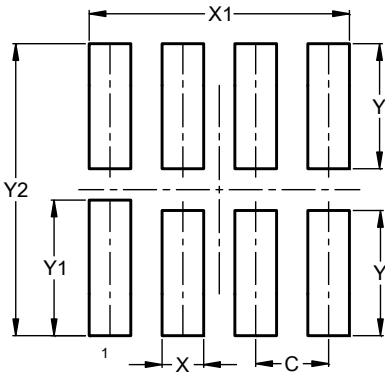


X2-DFN1410-8			
Dim	Min	Max	Typ
A	0.30	0.35	0.33
A1	0.00	0.03	0.02
A3	--	--	0.10
b	0.12	0.20	0.15
D	1.30	1.40	1.35
E	0.95	1.05	1.00
e	--	--	0.35
e1	--	--	0.55
L	0.27	0.35	0.30
L1	0.32	0.40	0.35
All Dimensions in mm			

**Suggested Pad Layout**

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

**X2-DFN1410-8**

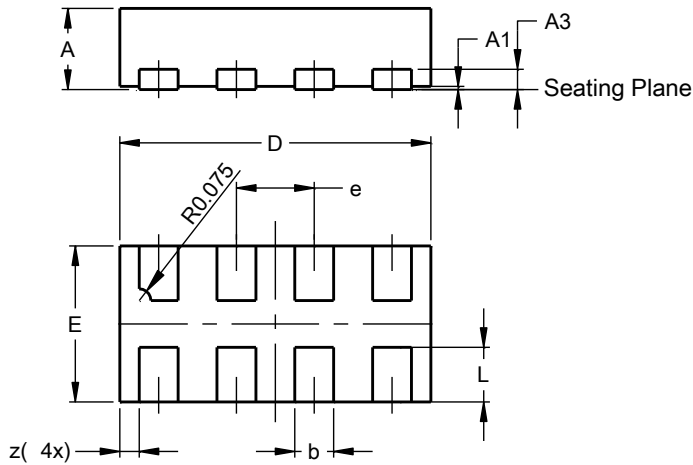


Dimensions	Value (in mm)
C	0.350
X	0.200
X1	1.250
Y	0.600
Y1	0.650
Y2	1.400

## X2-DFN2010-8 Package Outline Dimensions

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

X2-DFN2010-8

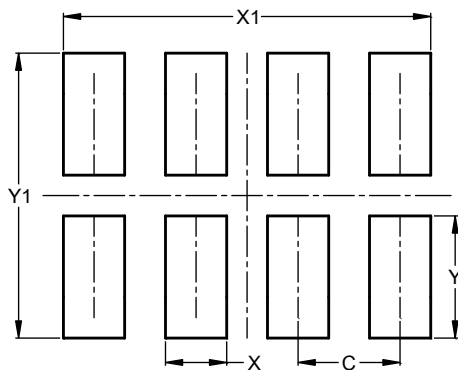


X2-DFN2010-8			
Dim	Min	Max	Typ
A	--	0.40	--
A1	0.00	0.05	0.02
A3	--	--	0.13
b	0.20	0.30	0.25
D	1.950	2.05	2.00
E	0.95	1.05	1.00
e	--	--	0.50
L	0.30	0.40	0.35
z	--	--	0.125
All Dimensions in mm			

## 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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