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DUAL 2-INPUT NAND GATE WITH OPEN-DRAIN OUTPUTS

Description

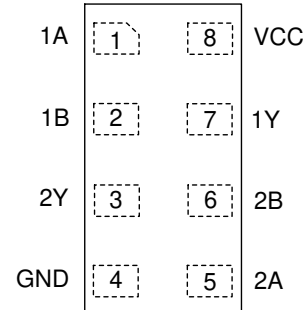
The 74LVC2G38 is a dual, two input NAND gate with open-drain outputs. Both gates have open-drain outputs designed for operation over a power supply range of 1.65V to 5.5V. The device is fully specified for partial power down applications using I_{OFF}. The I_{OFF} circuitry disables the output preventing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

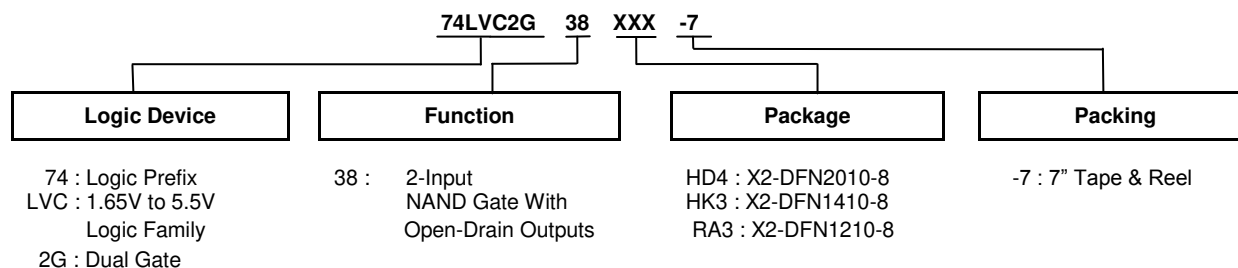
Features

- Wide Supply Voltage Range from 1.65V to 5.5V
- Outputs Sink 24mA at V_{CC} = 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.

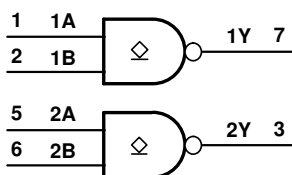
Ordering Information (Note 4)


| 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:
- 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 _{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 | | |
| | | V _{CC} = 4.5V | — | 32 | | |
| Δt/ΔV | 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 $T_A = +25^\circ\text{C}$)

| 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 | — | ± 0.1 | ± 5 | — | ± 20 | μA |
| I_{OFF} | Power Down Leakage Current | $V_I \text{ or } V_O = 5.5\text{V}$ | 0V | — | ± 0.1 | ± 10 | — | ± 20 | μA |
| 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 | μA |
| ΔI_{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 | μA |
| C_I | Input Capacitance | $V_I = V_{CC} \text{ or GND}$ | 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 | — | |

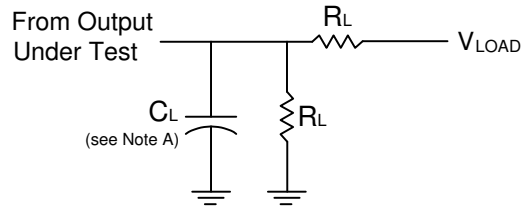
Note: 10. Test condition for each package type: Device mounted on FR-4 substrate PC board, 2oz copper, with minimum recommended pad layout.

Switching Characteristics

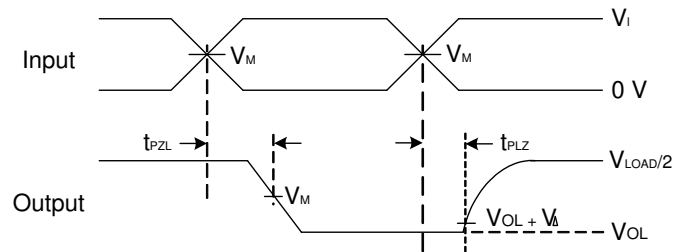
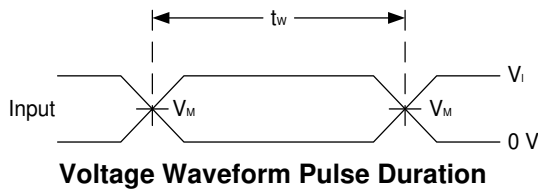
Typical Values at T_A = +25°C and nominal voltages 1.8V, 2.5V, 2.7V, 3.3V, and 5.0V. See Figure 1.

| 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_{Δ} |
|------------------|----------|--------------|------------|-------------------|-------|--------------|--------------|
| | V_I | t_r/t_f | | | | | |
| $1.8V \pm 0.15V$ | V_{CC} | $\leq 2ns$ | $V_{CC}/2$ | $2 \times V_{CC}$ | 30pF | 1k Ω | 0.15V |
| $2.5V \pm 0.2V$ | V_{CC} | $\leq 2ns$ | $V_{CC}/2$ | $2 \times V_{CC}$ | 30pF | 500 Ω | 0.15V |
| 2.7V | 2.7V | $\leq 2.5ns$ | 1.5V | 6V | 50pF | 500 Ω | 0.3V |
| $3.3V \pm 0.3V$ | 2.7V | $\leq 2.5ns$ | 1.5V | 6V | 50pF | 500 Ω | 0.3V |
| $5.0V \pm 0.5V$ | V_{CC} | $\leq 2.5ns$ | $V_{CC}/2$ | $2 \times V_{CC}$ | 50pF | 500 Ω | 0.3V |



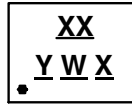
**Voltage Waveforms
Inverting and Non Inverting Outputs**

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 $\leq 10MHz$.
 - C. Inputs are measured separately one transition per measurement.

Marking Information

(Top View)



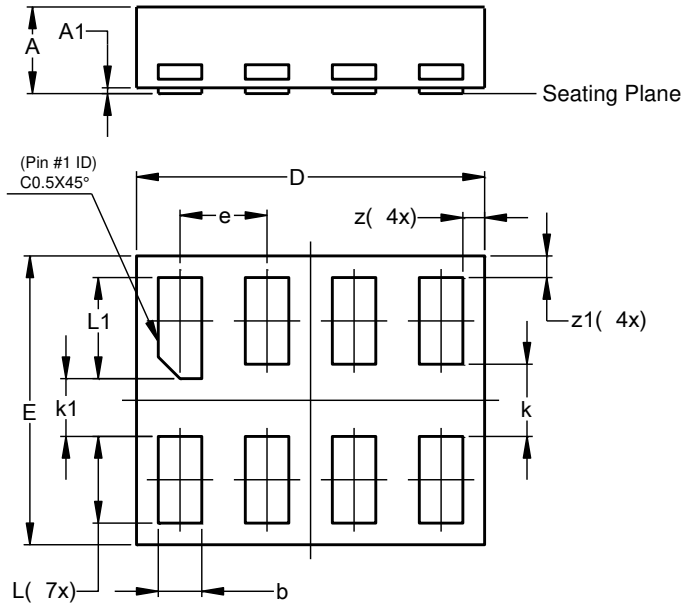
XX : Identification Code
Y : Year : 0~9
W : Week : A~Z : 1~26 week;
 a~z : 27~52 week; z represents
 52 and 53 week
X : Internal Code

| 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

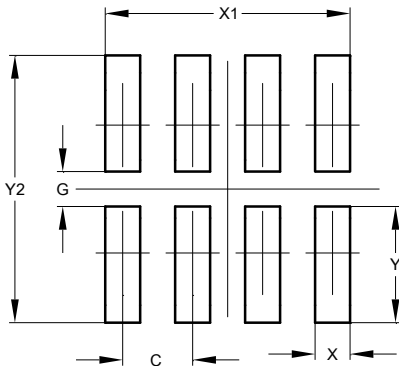


| X2-DFN1210-8 | | | |
|----------------------|-------|-------|-------|
| Dim | Min | Max | Typ |
| A | - | 0.35 | 0.30 |
| A1 | 0 | 0.03 | 0.02 |
| b | 0.10 | 0.20 | 0.15 |
| D | 1.15 | 1.25 | 1.20 |
| E | 0.95 | 1.05 | 1.00 |
| e | - | - | 0.30 |
| k | - | - | 0.25 |
| k1 | - | - | 0.20 |
| L | 0.25 | 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

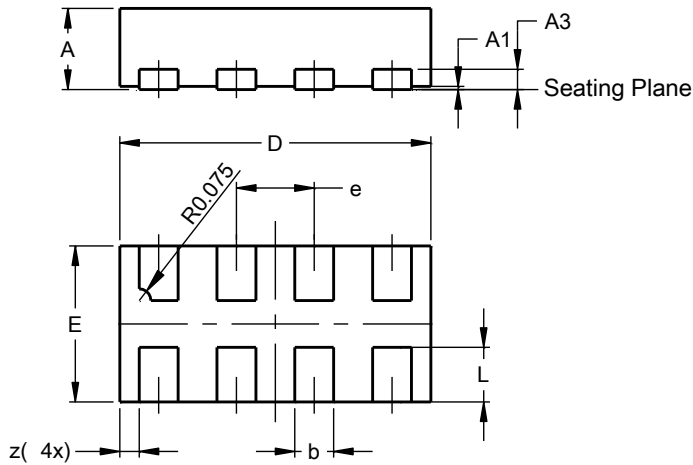


| Dimensions | Value (in mm) |
|------------|---------------|
| C | 0.300 |
| G | 0.150 |
| X | 0.150 |
| X1 | 1.050 |
| Y | 0.500 |
| Y1 | 1.150 |

X2-DFN2010-8 Package Outline Dimensions

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

X2-DFN2010-8

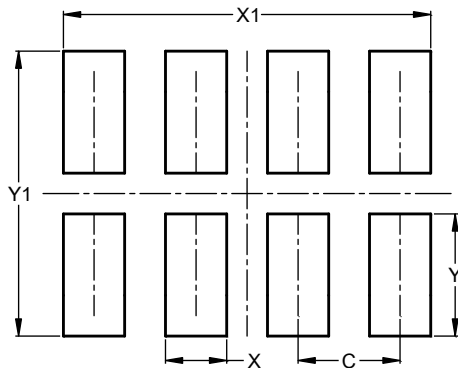


| X2-DFN2010-8 | | | |
|----------------------|-------|------|-------|
| Dim | Min | Max | Typ |
| A | -- | 0.40 | -- |
| A1 | 0.00 | 0.05 | 0.02 |
| A3 | -- | -- | 0.13 |
| b | 0.20 | 0.30 | 0.25 |
| D | 1.950 | 2.05 | 2.00 |
| E | 0.95 | 1.05 | 1.00 |
| e | -- | -- | 0.50 |
| L | 0.30 | 0.40 | 0.35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