

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

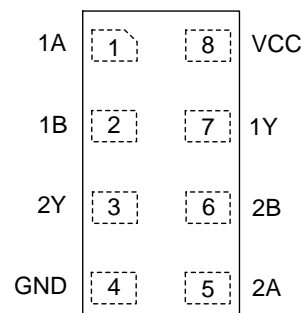
The 74LVC2G38 is a dual, two input NAND gate with open-drain outputs. Both gates have open-drain outputs designed for operation over a power supply range of 1.65V to 5.5V. The device is fully specified for partial power down applications using I<sub>OFF</sub>. The I<sub>OFF</sub> circuitry disables the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

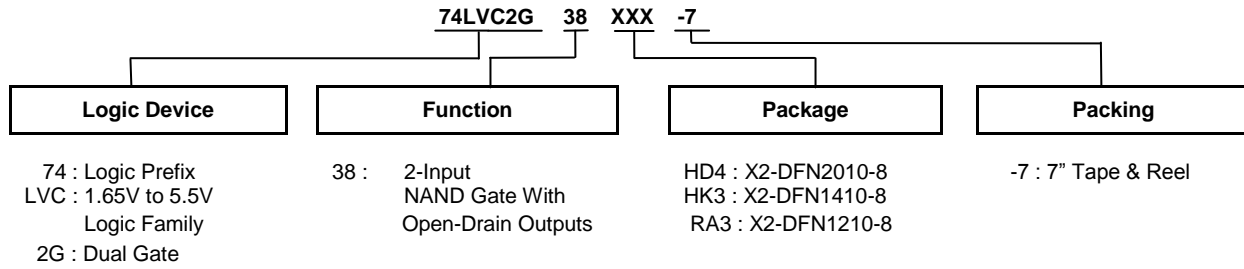
- Wide Supply Voltage Range from 1.65V to 5.5V
- Outputs Sink 24mA at V<sub>CC</sub> = 3.3V
- CMOS Low Power Consumption
- I<sub>OFF</sub> Supports Partial-Power-Down Mode Operation
- Inputs accept up to 5.5V
- Schmitt Trigger Action at all inputs makes the circuit tolerant for slower input rise and 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.

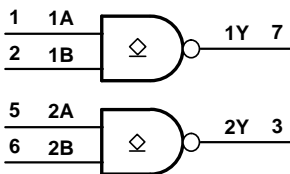
**Ordering Information** (Note 4)


| 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<br>0.5mm lead pitch  | 5,000/Tape & Reel         | -7                 |
| 74LVC2G38HK3-7 | HK3          | X2-DFN1410-8     | 1.35mm x 1.0mm x 0.35mm<br>0.4mm lead pitch | 5,000/Tape & Reel         | -7                 |
| 74LVC2G38RA3-7 | RA3          | X2-DFN1210-8     | 1.2mm x 1.0mm x 0.35mm<br>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             | $V_I = 5.5\text{V or GND}$<br>$I_O = 0\text{A}$                        | 1.65V to 5.5V                           | —                    | 0.1       | 10                   | —                    | 40                   | $\mu\text{A}$ |
| $\Delta I_{CC}$ | Additional Supply Current  | One input at $V_{CC} - 0.6\text{V}$<br>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  | —   |      |

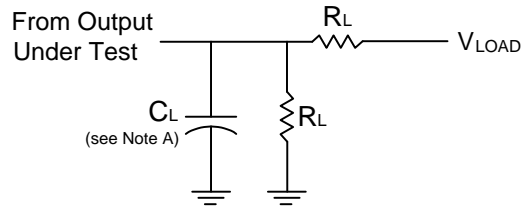
Note: 10. Test condition for each package type: Device mounted on FR-4 substrate PC board, 2oz copper, with minimum recommended pad layout.

## Switching Characteristics

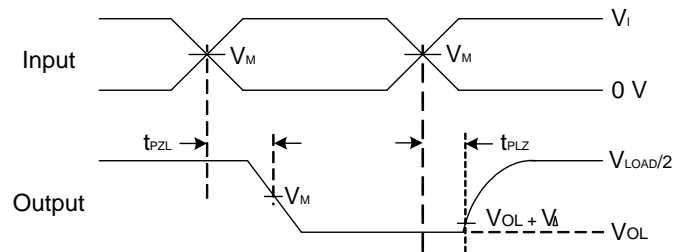
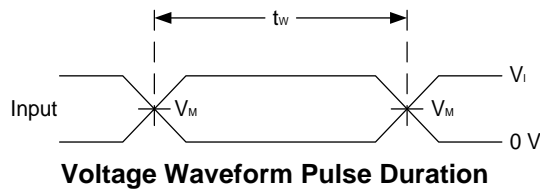
Typical Values at T<sub>A</sub> = +25°C and nominal voltages 1.8V, 2.5V, 2.7V, 3.3V, and 5.0V. See Figure 1.

| 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 <sub>CC</sub> | Inputs          |                                | V <sub>M</sub>     | V <sub>LOAD</sub>   | C <sub>L</sub> | R <sub>L</sub> | V <sub>Δ</sub> |
|-----------------|-----------------|--------------------------------|--------------------|---------------------|----------------|----------------|----------------|
|                 | V <sub>I</sub>  | t <sub>r</sub> /t <sub>f</sub> |                    |                     |                |                |                |
| 1.8V ± 0.15V    | V <sub>CC</sub> | ≤2ns                           | V <sub>CC</sub> /2 | 2 x V <sub>CC</sub> | 30pF           | 1kΩ            | 0.15V          |
| 2.5V ± 0.2V     | V <sub>CC</sub> | ≤2ns                           | V <sub>CC</sub> /2 | 2 x V <sub>CC</sub> | 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 <sub>CC</sub> | ≤2.5ns                         | V <sub>CC</sub> /2 | 2 x V <sub>CC</sub> | 50pF           | 500Ω           | 0.3V           |

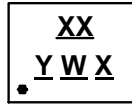


**Figure 1. Load Circuit and Voltage Waveforms**

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

**Marking Information**

(Top View)



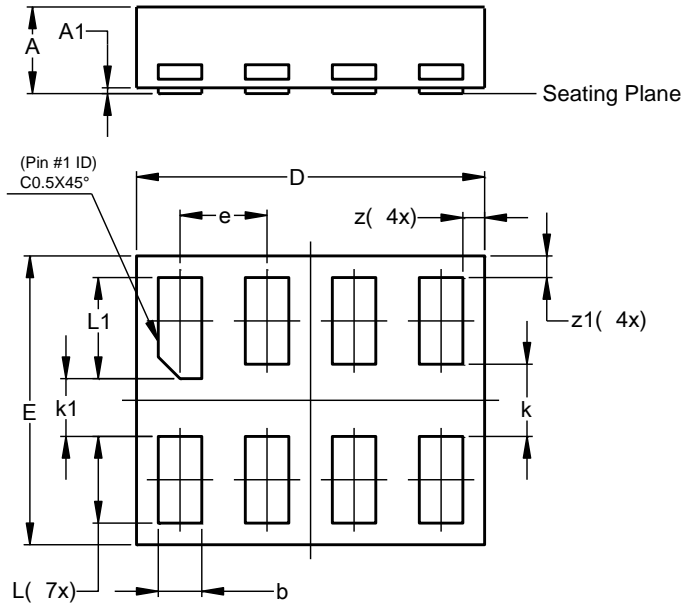
XX : Identification Code  
Y : Year : 0~9  
W : Week : A~Z : 1~26 week;  
 a~z : 27~52 week; z represents  
 52 and 53 week  
X : Internal Code

| 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

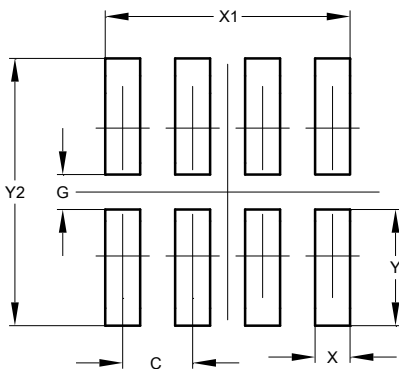


| X2-DFN1210-8         |       |       |       |
|----------------------|-------|-------|-------|
| Dim                  | Min   | Max   | Typ   |
| A                    | -     | 0.35  | 0.30  |
| A1                   | 0     | 0.03  | 0.02  |
| b                    | 0.10  | 0.20  | 0.15  |
| D                    | 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         |

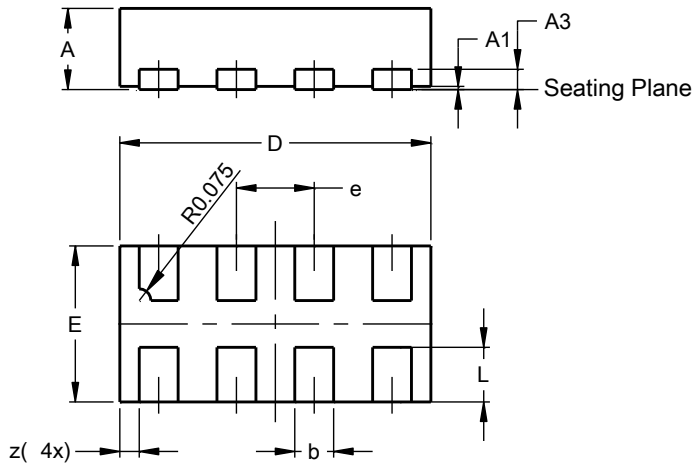




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X2-DFN2010-8

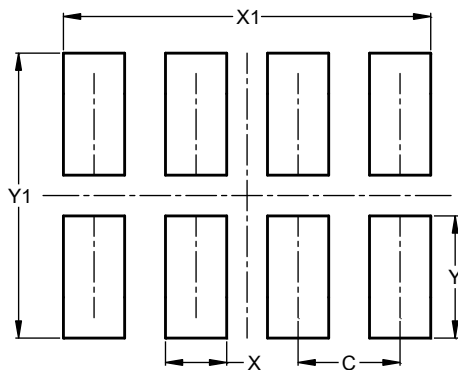


| X2-DFN2010-8         |       |      |       |
|----------------------|-------|------|-------|
| Dim                  | Min   | Max  | Typ   |
| A                    | --    | 0.40 | --    |
| A1                   | 0.00  | 0.05 | 0.02  |
| A3                   | --    | --   | 0.13  |
| b                    | 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         |