**DUAL 2-INPUT NOR GATE**

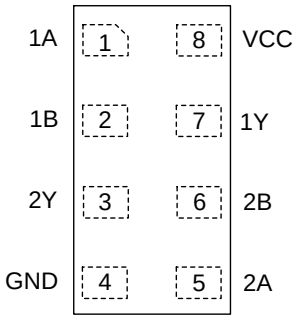
## Description

The 74LVC2G02 is a dual, two input NOR gate. Both gates have push-pull 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:

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

## Pin Assignments

(Top View)




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

## Features

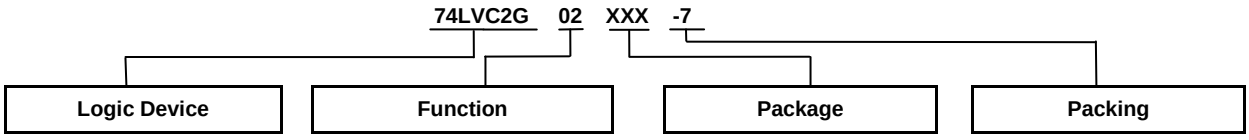
- Wide Supply Voltage Range from 1.65 to 5.5V
- ± 24mA Output Drive at 3.3V
- CMOS Low Power Consumption
- $I_{OFF}$ Supports Partial-Power-Down Mode Operation
- Inputs accept up to 5.5V
- Schmitt Trigger Action at all inputs makes the circuit tolerant for slower input rise and fall times. The hysteresis 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)




74 : Logic Prefix
LVC : 1.65V to 5.5V Logic Family
2G : Dual Gate

02 : 2-Input NOR Gate

HD4 : X2-DFN2010-8
HK3 : X2-DFN1410-8
RA3 : X2-DFN1210-8

-7 : 7" Tape & Reel

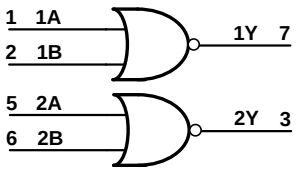
| Device | Package Code | Package (Note 5) | Package Size | 7" Tape and Reel (Note 6) | |
|---|---|---|---|---|---|
| | | | | Quantity | Part Number Suffix |
| 74LVC2G02HD4-7 | HD4 | X2-DFN2010-8 | 1.95mm x 1.0mm x 0.4mm<br>0.5 mm lead pitch | 5,000/Tape & Reel | -7 |
| 74LVC2G02HK3-7 | HK3 | X2-DFN1410-8 | 1.35mm x 1.0mm x 0.35mm<br>0.4 mm lead pitch | 5,000/Tape & Reel | -7 |
| 74LVC2G02RA3-7 | RA3 | X2-DFN1210-8 | 1.2mm x 1.0mm x 0.35mm<br>0.3 mm 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 |
| GND | 4 | Ground |
| 2A | 5 | Data Input |
| 2B | 6 | Data Input |
| 1Y | 7 | Data Output |
| $V_{CC}$ | 8 | Supply Voltage |

## Logic Diagram




## Function Table

| Inputs | | Output |
|---|---|---|
| A | B | Y |
| L | L | H |
| L | H | L |
| H | L | L |
| 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 $V_{CC}$ +0.5 | 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 OR $V_O$ > Vcc ) | ±50 | mA |
| $I_O$ | Continuous Output Current ($V_O$ = 0 to $V_{CC}$) | ±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 | $V_{CC}$ | V |
| | Output Voltage Power-Down Mode | | 0 | 5.5 | |
| $I_{OH}$ | High-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 | |
| $I_{OL}$ | 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 | |
| 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°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 $V_{CC}$ | |
| $V_{OH}$ | High-Level Output Voltage | $I_{OH}$ = -100µA | 1.65V to 5.5V | $V_{CC}$ – 0.1 | Vcc | — | $V_{CC}$ – 0.1 | — | V |
| | | $I_{OH}$ = -4mA | 1.65V | 1.2 | 1.53 | — | 0.95 | — | |
| | | $I_{OH}$ = -8mA | 2.3V | 1.9 | 2.13 | — | 1.7 | — | |
| | | $I_{OH}$ = -12mA | 2.7 | 2.2 | 2.5 | — | 1.9 | — | |
| | | $I_{OH}$ = -16mA | 3V | 2.4 | 2.7 | — | 2.2 | — | |
| | | $I_{OH}$ = -24mA | | 2.3 | 2.6 | — | 2.0 | — | |
| | | $I_{OH}$ = -32mA | 4.5V | 3.8 | 4.1 | — | 3.4 | — | |
| $V_{OL}$ | 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<br>$I_O$=0A | 1.65V to 5.5V | — | 0.1 | 10 | — | 40 | µA |
| $\Delta I_{CC}$ | Additional Supply Current | One input at $V_{CC}$ – 0.6V<br>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 | 18 | 18 | 19 | 22 | pF |

## Package Characteristics

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

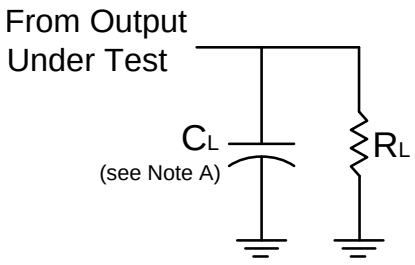
Note: 10. Test condition for each package type: Device mounted on FR-4 substrate PC board, 2oz copper, with minimum recommended pad layout.

## Switching Characteristics

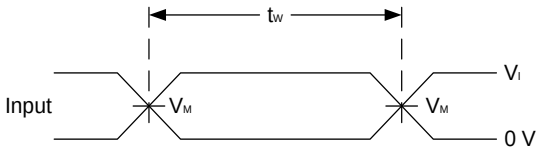
Typical Values at $T_A$ = +25°C and nominal voltages 1.8V, 2.5V, 2.7V, 3.3V, and 5.0V. See Figure 1.

| 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 | |
| $t_{pd}$ | A or B | Y | 1.8V ± 0.15V | 1.2 | 3.8 | 8.9 | 1.2 | 11.2 | ns |
| | | | 2.5V ± 0.2V | 0.8 | 2.4 | 5.4 | 0.8 | 6.8 | |
| | | | 2.7V | 0.8 | 3.2 | 6.0 | 0.8 | 7.5 | |
| | | | 3.3V ± 0.3V | 0.6 | 2.4 | 4.9 | 0.6 | 6.2 | |
| | | | 5.0V ± 0.5V | 0.6 | 1.8 | 4.3 | 0.6 | 5.5 | |

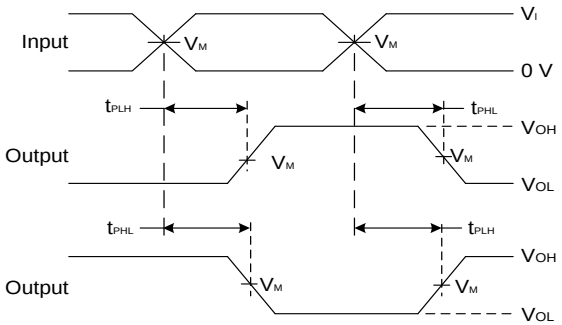
## Parameter Measurement Information




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




**Voltage Waveform Pulse Duration**



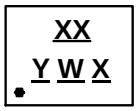

**Voltage Waveform Propagation Delay Times Inverting and Non Inverting Outputs**

**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.
D. $t_{PLH}$ and $t_{PHL}$ are the same as $t_{pd}$.

## Marking Information

**(Top View)**



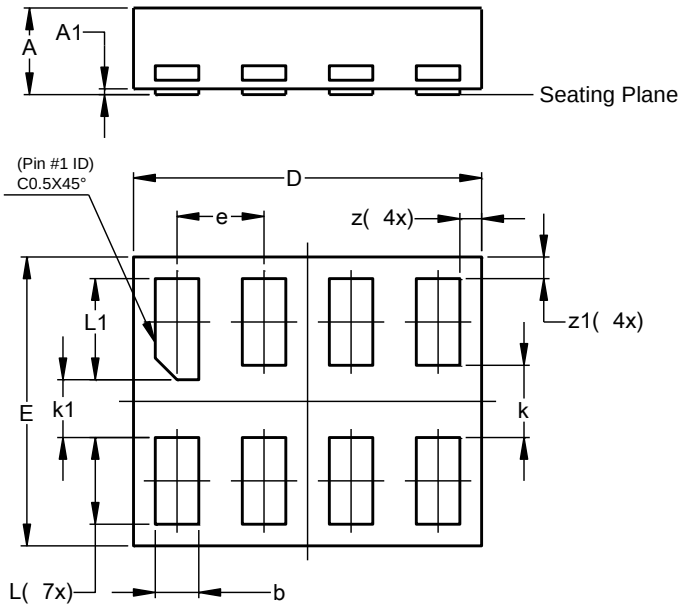

XX : Identification Code
Y : Year : 0~9
W : Week : A~Z : 1~26 week;
a~z : 27~52 week; z represents
52 and 53 week
X : Internal Code

| Part Number | Package | Identification Code |
|---|---|---|
| 74LVC2G02HD4-7 | X2-DFN2010-8 | 9B |
| 74LVC2G02HK3-7 | X2-DFN1410-8 | 9C |
| 74LVC2G02RA3-7 | X2-DFN1210-8 | 9D |

## X2-DFN1210-8 Package Outline Dimensions

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

**X2-DFN1210-8**

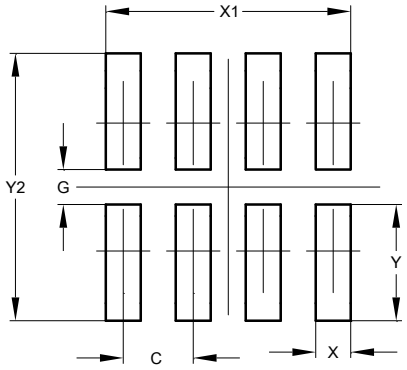



| X2-DFN1210-8 | | | |
|---|---|---|---|
| **Dim** | **Min** | **Max** | **Typ** |
| **A** | - | 0.35 | 0.30 |
| **A1** | 0 | 0.03 | 0.02 |
| **b** | 0.10 | 0.20 | 0.15 |
| **D** | 1.15 | 1.25 | 1.20 |
| **E** | 0.95 | 1.05 | 1.00 |
| **e** | - | - | 0.30 |
| **k** | - | - | 0.25 |
| **k1** | - | - |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

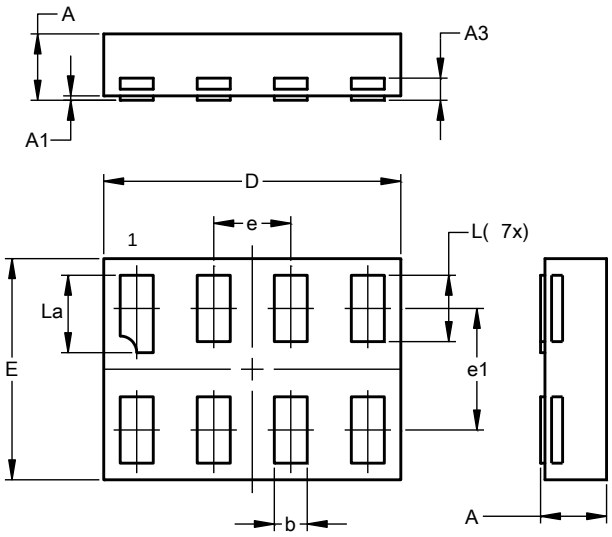



| Dimensions | Value (in mm) |
|---|---|
| **C** | 0.300 |
| **G** | 0.150 |
| **X** | 0.150 |
| **X1** | 1.050 |
| **Y** | 0.500 |
| **Y1** | 1.150 |

## X2-DFN1410-8 Package Outline Dimensions

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

**X2-DFN1410-8**

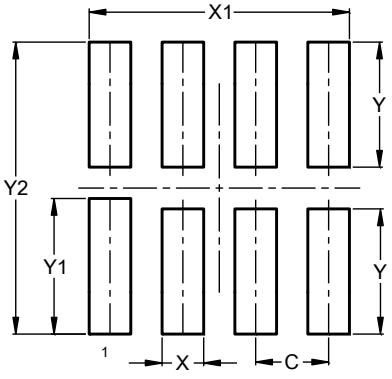



| X2-DFN1410-8 | | | |
|---|---|---|---|
| **Dim** | **Min** | **Max** | **Typ** |
| **A** | 0.30 | 0.35 | 0.33 |
| **A1** | 0.00 | 0.03 | 0.02 |
| **A3** | -- | -- | 0.10 |
| **b** | 0.12 | 0.20 | 0.15 |
| **D** | 1.30 | 1.40 | 1.35 |
| **E** | 0.95 | 1.05 | 1.00 |
| **e** | -- | -- | 0.35 |
| **e1** | -- | -- | 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**

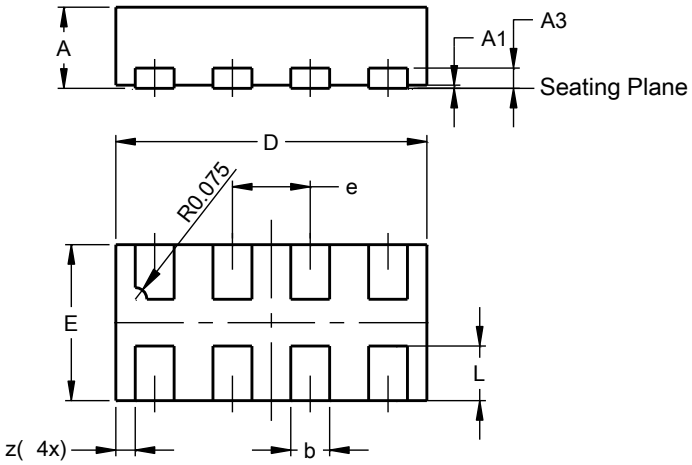



| Dimensions | Value (in mm) |
|---|---|
| **C** | 0.350 |
| **X** | 0.200 |
| **X1** | 1.250 |
| **Y** | 0.600 |
| **Y1** | 0.650 |
| **Y2** | 1.400 |

## X2-DFN2010-8 Package Outline Dimensions

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

**X2-DFN2010-8**

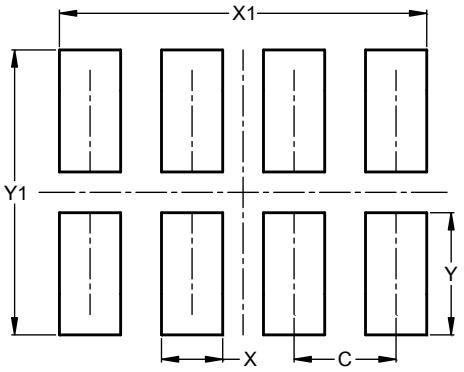



| X2-DFN2010-8 | | | |
|---|---|---|---|
| **Dim** | **Min** | **Max** | **Typ** |
| **A** | -- | 0.40 | -- |
| **A1** | 0.00 | 0.05 | 0.02 |
| **A3** | -- | -- | 0.13 |
| **b** | 0.20 | 0.30 | 0.25 |
| **D** | 1.950 | 2.05 | 2.00 |
| **E** | 0.95 | 1.05 | 1.00 |
| **e** | -- | -- | 0.50 |
| **L** |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