

SINGLE 2 INPUT POSITIVE AND GATE WITH OPEN DRAIN OUTPUT
Description

The Advanced Ultra Low Power (AUP) CMOS logic family is designed for low power and extended battery life in portable applications.

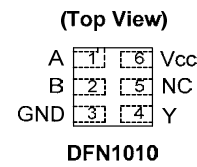
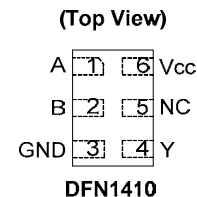
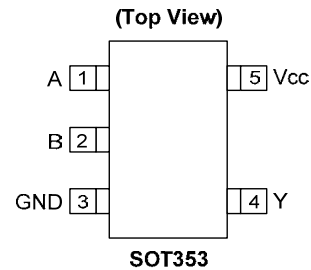
The AUP1G09 is a single AND gate with an open drain output designed for operation over a power supply range of 0.8V to 3.6V. The device is fully specified for partial power down applications using I_{OFF}. The I_{OFF} circuitry disables the output preventing damaging current backflow when the device is powered down. The gate performs the positive Boolean function:

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

Features

- Advanced Ultra Low Power (AUP) CMOS
- Supply Voltage Range from 0.8V to 3.6V
- 4mA Output Drive at 3.0V
- Low Static power consumption
 - I_{CC} < 0.9µA
- Low Dynamic Power Consumption
 - C_{PD} = 6 pF (Typical at 3.6V)
- Schmitt Trigger Action at All Inputs Make the Circuit Tolerant for Slower Input Rise and Fall Time. The hysteresis is typically 250 mV at V_{CC} = 3.0V
- I_{OFF} Supports Partial-Power-Down Mode Operation
- ESD Protection Exceeds JESD 22
 - 2000-V Human Body Model (A114-A)
 - Exceeds 1000-V Charged Device Model (C101C)
- Latch-Up Exceeds 100mA per JESD 78, Class II
- Range of Package Options SOT353, DFN1410, and DFN1010
- Leadless packages per JESD30E
 - DFN1010 denoted as X2-DFN1010-6
 - DFN1014 denoted as X2-DFN1014-6
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**

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> 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.

Pin Assignments

Applications

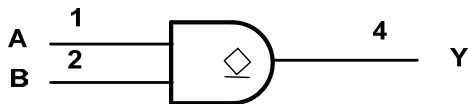
- Suited for battery and low power needs
- Wide array of products such as:
 - Tablets, E-readers
 - Cell Phones, Personal Navigation / GPS
 - MP3 players, Cameras, Video Recorders
 - PCs ultrabooks, notebooks, netbooks,
 - Computer peripherals, hard drives, CD/DVD ROM
 - TV, DVD, DVR, set top box

[Click here for ordering information, located at the end of datasheet](#)

Pin Descriptions

| Pin Name | Function |
|-----------------|----------------|
| A | Data Input |
| B | Data Input |
| GND | Ground |
| Y | Data Output |
| V _{CC} | Supply Voltage |

Logic Diagram



Function Table

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

Absolute Maximum Ratings (Note 4) (@T_A = +25°C, unless otherwise specified.)

| Symbol | Parameter | Rating | Unit |
|------------------|--|------------------------------|------|
| ESD HBM | Human Body Model ESD Protection | 2 | KV |
| ESD CDM | Charged Device Model ESD Protection | 1 | KV |
| V _{CC} | Supply Voltage Range | -0.5 to +4.6 | V |
| V _I | Input Voltage Range | -0.5 to +4.6 | V |
| V _O | Voltage applied to output in high or low state | -0.5 to V _{CC} +0.5 | 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 V _{CC}) | ±20 | mA |
| I _{CC} | Continuous Current Through V _{CC} | 50 | mA |
| I _{GND} | Continuous Current Through GND | -50 | mA |
| T _J | Operating Junction Temperature | -40 to +150 | °C |
| T _{STG} | Storage Temperature | -65 to +150 | °C |

Note: 4. 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.

Recommended Operating Conditions (Note 5) (@T_A = +25°C, unless otherwise specified.)

| Symbol | Parameter | Min | Max | Unit |
|-----------------|------------------------------------|--------------------------------|-----------------|------|
| V _{CC} | Operating Voltage | 0.8 | 3.6 | V |
| V _I | Input Voltage | 0 | 3.6 | V |
| V _O | Output Voltage | 0 | V _{CC} | V |
| I _{OL} | Low-Level Output Current | V _{CC} = 0.8V | 20 | μA |
| | | V _{CC} = 1.1V | 1.1 | |
| | | V _{CC} = 1.4V | 1.7 | |
| | | V _{CC} = 1.65V | 1.9 | |
| | | V _{CC} = 2.3V | 3.1 | |
| | | V _{CC} = 3.0V | 4 | |
| Δt/ΔV | Input Transition Rise or Fall Rate | V _{CC} = 0.8V to 3.6V | 200 | ns/V |
| T _A | Operating Free-Air Temperature | -40 | 125 | °C |

Note: 5. Unused inputs should be held at V_{CC} or Ground.

Electrical Characteristics (@T_A = +25°C, unless otherwise specified.)

| Symbol | Parameter | Test Conditions | V _{CC} | T _A = +25°C | | T _A = -40°C to 85°C | | Unit |
|-------------------|----------------------------------|---|-----------------|------------------------|------------------------|--------------------------------|------------------------|------|
| | | | | Min | Max | Min | Max | |
| V _{IH} | High-Level Input Voltage | | 0.8V to 1.65V | 0.80 X V _{CC} | | 0.80 X V _{CC} | | V |
| | | | 1.65V to 1.95V | 0.65 X V _{CC} | | 0.65 X V _{CC} | | |
| | | | 2.3V to 2.7V | 1.6 | | 1.6 | | |
| | | | 3.0V to 3.6V | 2.0 | | 2.0 | | |
| V _{IL} | Low-Level input voltage | | 0.8V to 1.65V | | 0.30 X V _{CC} | | 0.30 X V _{CC} | V |
| | | | 1.65V to 1.95V | | 0.35 X V _{CC} | | 0.35 X V _{CC} | |
| | | | 2.3V to 2.7V | | 0.7 | | 0.7 | |
| | | | 3.0V to 3.6V | | 0.9 | | 0.9 | |
| V _{OL} | High-Level Input Voltage | I _{OL} = 20μA | 0.8V to 3.6V | | 0.1 | | 0.1 | V |
| | | I _{OL} = 1.1mA | 1.1V | | 0.3 X V _{CC} | | 0.3 X V _{CC} | |
| | | I _{OL} = 1.7mA | 1.4V | | 0.31 | | 0.37 | |
| | | I _{OL} = 1.9mA | 1.65V | | 0.31 | | 0.35 | |
| | | I _{OL} = 2.3mA | 2.3V | | 0.31 | | 0.33 | |
| | | I _{OL} = 3.1mA | | | 0.44 | | 0.45 | |
| | | I _{OL} = 2.7mA | 3V | | 0.31 | | 0.33 | |
| | | I _{OL} = 4mA | | | 0.44 | | 0.45 | |
| I _I | Input Current | A or B Input V _I = GND to 3.6V | 0V to 3.6V | | ± 0.1 | | ± 0.5 | μA |
| I _{OFF} | Power Down Leakage Current | V _I or V _O = 0V to 3.6V | 0 | | ± 0.2 | | ± 0.5 | μA |
| I _{OZ} | Z State Leakage Current | V _O = 3.6V V _I = 3.6V | 3.6V | | ± 0.2 | | ± 0.5 | μA |
| ΔI _{OFF} | Delta Power Down Leakage Current | V _I or V _O = 0V to 3.6V | 0V to 0.2V | | 0.2 | | 0.6 | μA |
| I _{CC} | Supply Current | V _I = GND or V _{CC} I _O = 0 | 0.8V to 3.6V | | 0.5 | | 0.9 | μA |
| ΔI _{CC} | Additional Supply Current | Input at V _{CC} -0.6V | 3.3V | | 40 | | 50 | μA |

Electrical Characteristics (cont.) (@T_A = +25°C, unless otherwise specified.)

| Symbol | Parameter | Test Conditions | V _{CC} | T _A = -40°C to +125°C | | Unit |
|-------------------|----------------------------------|--|-----------------|----------------------------------|------------------------|------|
| | | | | Min | Max | |
| V _{IH} | High-Level Input Voltage | | 0.8V to 1.65V | 0.80 X V _{CC} | | V |
| | | | 1.65V to 1.95V | 0.70 X V _{CC} | | |
| | | | 2.3V to 2.7V | 1.6 | | |
| | | | 3.0V to 3.6V | 2.0 | | |
| V _{IL} | Low-Level Input Voltage | | 0.8V to 1.65V | | 0.25X V _{CC} | V |
| | | | 1.65V to 1.95V | | 0.35 X V _{CC} | |
| | | | 2.3V to 2.7V | | 0.7 | |
| | | | 3.0V to 3.6V | | 0.9 | |
| V _{OL} | High-Level Input Voltage | I _{OL} = 20 μA | 0.8V to 3.6V | | 0.11 | V |
| | | I _{OL} = 1.1 mA | 1.1V | | 0.3 X V _{CC} | |
| | | I _{OL} = 1.7 mA | 1.4V | | 0.41 | |
| | | I _{OL} = 1.9 mA | 1.65V | | 0.39 | |
| | | I _{OL} = 2.3 mA | 2.3V | | 0.36 | |
| | | I _{OL} = 3.1 mA | | | 0.50 | |
| | | I _{OL} = 2.7 mA | 3V | | 0.36 | |
| | | I _{OL} = 4 mA | | | 0.50 | |
| I _I | Input Current | A or B Input V _I = GND to 3.6V | 0V to 3.6V | | ± 0.75 | μA |
| I _{OFF} | Power Down Leakage Current | V _I or V _O = 0V to 3.6V | 0 | | ± 3.5 | μA |
| I _{OZ} | Z State Leakage Current | V _O = 3.6V V _I = 3.6V | 3.6V | | ± 1.5 | μA |
| ΔI _{OFF} | Delta Power Down Leakage Current | V _I or V _O = 0V to 3.6V | 0V to 0.2V | | ± 2.5 | μA |
| I _{CC} | Supply Current | V _I = GND or V _{CC} , I _O = 0 | 0.8V to 3.6V | | 3.0 | μA |
| ΔI _{CC} | Additional Supply Current | Input at V _{CC} -0.6V | 3.3V | | 75 | μA |

Switching Characteristics

C_L=5pF see Figure 1

| Parameter | From Input | TO OUTPUT | V _{CC} | T _A = +25°C | | | T _A = -40°C to +85°C | | T _A = -40°C to +125°C | | Unit |
|-----------------|------------|-----------|-----------------|------------------------|------|------|---------------------------------|------|----------------------------------|------|------|
| | | | | Min | Typ | Max | Min | Max | Min | Max | |
| t _{pd} | A | Y | 0.8V | | 13.5 | | | | | | ns |
| | | | 1.2V ± 0.1V | 1.9 | 4.6 | 10.4 | 1.8 | 11.4 | 1.8 | 12.6 | |
| | | | 1.5V ± 0.1V | 1.5 | 3.3 | 6.5 | 1.4 | 7.4 | 1.4 | 8.2 | |
| | | | 1.8V ± 0.15V | 1.2 | 2.9 | 5.1 | 1.1 | 5.9 | 1.1 | 6.5 | |
| | | | 2.5V ± 0.2V | 1.0 | 2.4 | 4.4 | 0.9 | 4.6 | 0.9 | 4.9 | |
| | | | 3.3V ± 0.3V | 0.9 | 2.3 | 4.0 | 0.8 | 4.5 | 0.8 | 4.9 | |

C_L=10pF see Figure 1

| Parameter | From Input | TO OUTPUT | V _{CC} | T _A = +25°C | | | T _A = -40°C to +85°C | | T _A = -40°C to +125°C | | Unit |
|-----------------|------------|-----------|-----------------|------------------------|------|------|---------------------------------|------|----------------------------------|------|------|
| | | | | Min | Typ | Max | Min | Max | Min | Max | |
| t _{pd} | A | Y | 0.8V | | 16.3 | | | | | | ns |
| | | | 1.2V ± 0.1V | 2.3 | 5.6 | 12.3 | 2.1 | 13.7 | 2.1 | 15.1 | |
| | | | 1.5V ± 0.1V | 1.8 | 4.1 | 7.6 | 1.7 | 8.8 | 1.7 | 9.7 | |
| | | | 1.8V ± 0.15V | 1.6 | 3.2 | 7.3 | 1.4 | 7.1 | 1.4 | 7.0 | |
| | | | 2.5V ± 0.2V | 1.4 | 2.9 | 6.1 | 1.2 | 6.4 | 1.2 | 5.9 | |
| | | | 3.3V ± 0.3V | 1.3 | 2.9 | 5.7 | 1.1 | 5.4 | 1.1 | 5.9 | |

C_L=15pF see Figure 1

| Parameter | From Input | TO OUTPUT | V _{CC} | T _A = +25°C | | | T _A = -40°C to +85°C | | T _A = -40°C to +125°C | | Unit |
|-----------------|------------|-----------|-----------------|------------------------|------|------|---------------------------------|------|----------------------------------|------|------|
| | | | | Min | Typ | Max | Min | Max | Min | Max | |
| t _{pd} | A | Y | 0.8V | | 19.0 | | | | | | ns |
| | | | 1.2V ± 0.1V | 2.6 | 7.6 | 14.2 | 2.4 | 15.8 | 2.4 | 17.4 | |
| | | | 1.5V ± 0.1V | 2.1 | 6.5 | 12.1 | 1.9 | 12.7 | 1.9 | 12.9 | |
| | | | 1.8V ± 0.15V | 1.9 | 5.5 | 9.6 | 1.7 | 10.1 | 1.7 | 10.3 | |
| | | | 2.5V ± 0.2V | 1.6 | 4.6 | 8.1 | 1.5 | 9.1 | 1.5 | 9.3 | |
| | | | 3.3V ± 0.3V | 1.6 | 4.1 | 7.5 | 1.4 | 8.3 | 1.4 | 9.1 | |

C_L=30pF see Figure 1

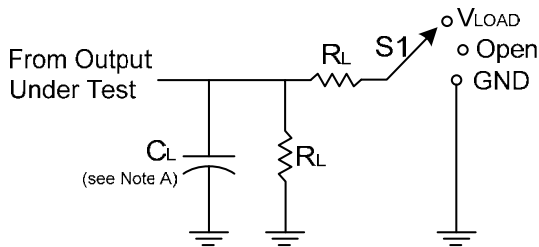
| Parameter | From Input | TO OUTPUT | V _{CC} | T _A = +25°C | | | T _A = -40°C to +85°C | | T _A = -40°C to +125°C | | Unit |
|-----------------|------------|-----------|-----------------|------------------------|-----|------|---------------------------------|------|----------------------------------|------|------|
| | | | | Min | Typ | Max | Min | Max | Min | Max | |
| t _{pd} | A | Y | 0.8V | | 27 | | | | | | ns |
| | | | 1.2V ± 0.1V | 3.6 | 9.5 | 19.5 | 3.2 | 21.8 | 3.2 | 24 | |
| | | | 1.5V ± 0.1V | 2.9 | 8.5 | 16.1 | 2.6 | 13.6 | 2.6 | 15 | |
| | | | 1.8V ± 0.15V | 2.6 | 7.7 | 15.2 | 2.3 | 13.3 | 2.3 | 14.6 | |
| | | | 2.5V ± 0.2V | 2.4 | 7 | 13.1 | 2.1 | 13.3 | 2.1 | 13.5 | |
| | | | 3.3V ± 0.3V | 2.3 | 6.5 | 12.7 | 2.1 | 12.9 | 2.1 | 12.9 | |

Operating and Package Characteristics (@T_A = +25°C, unless otherwise specified.)

| Parameter | Test Conditions | V _{CC} | Typ | Unit | |
|-----------------|--|---|--------------|------|------|
| C _{pd} | Power Dissipation Capacitance | f = 1MHz No Load | 0.8V | 2.6 | pF |
| | | | 1.2V ± 0.1V | 2.8 | |
| | | | 1.5V ± 0.1V | 2.9 | |
| | | | 1.8V ± 0.15V | 3.1 | |
| | | | 2.5V ± 0.2V | 3.6 | |
| | | | 3.3V ± 0.3V | 4.2 | |
| C _i | Input Capacitance | V _i = V _{CC} or GND | 0V or 3.3V | 1.5 | pF |
| θ _{JA} | Thermal Resistance Junction-to-Ambient | SOT353 | (Note 6) | 371 | °C/W |
| | | X2-DFN1410-6 | | 430 | |
| | | X2-DFN1010-6 | | 445 | |
| θ _{JC} | Thermal Resistance Junction-to-Case | SOT353 | (Note 6) | 143 | °C/W |
| | | X2-DFN1410-6 | | 190 | |
| | | X2-DFN1010-6 | | 250 | |

Notes: 6. Test condition for SOT353, X2-DFN1410-6, and X2-DFN1010-6 devices mounted on FR-4 substrate PC board, 2oz copper, with minimum recommended pad layout.

Parameter Measurement Information



| TEST | S1 | R _L |
|------------------------------------|-------------------|----------------|
| t _{PLZ} /t _{PZL} | V _{load} | 5KΩ |

| V _{CC} | Inputs | | V _M | V _{LOAD} | C _L | V _Δ |
|-----------------|-----------------|--------------------------------|--------------------|---------------------|-----------------|----------------|
| | V _i | t _r /t _f | | | | |
| 0.8V | V _{CC} | ≤3ns | V _{CC} /2 | 2 X V _{CC} | 5, 10, 15, 30pF | 0.1V |
| 1.2V±0.1V | V _{CC} | ≤3ns | V _{CC} /2 | 2 X V _{CC} | 5, 10, 15, 30pF | 0.1V |
| 1.5V±0.1V | V _{CC} | ≤3ns | V _{CC} /2 | 2 X V _{CC} | 5, 10, 15, 30pF | 0.1V |
| 1.8V±0.15V | V _{CC} | ≤3ns | V _{CC} /2 | 2 X V _{CC} | 5, 10, 15, 30pF | 0.15V |
| 2.5V±0.2V | V _{CC} | ≤3ns | V _{CC} /2 | 2 X V _{CC} | 5, 10, 15, 30pF | 0.15V |
| 3.3V±0.3 V | V _{CC} | ≤3ns | V _{CC} /2 | 2 X V _{CC} | 5, 10, 15, 30pF | 0.3V |

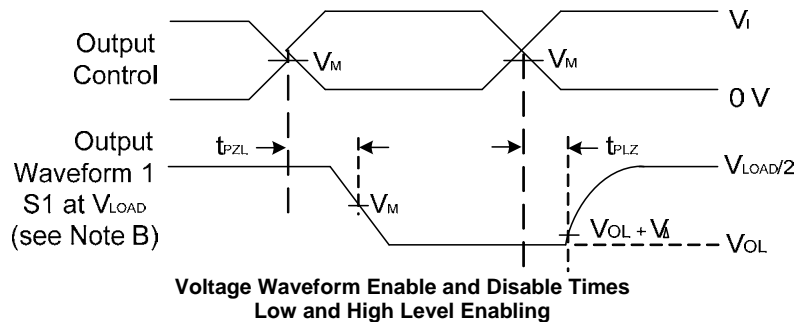
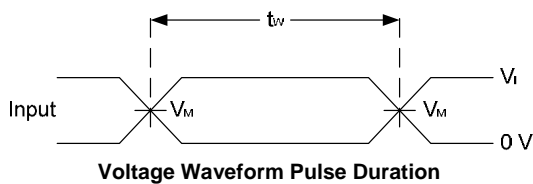
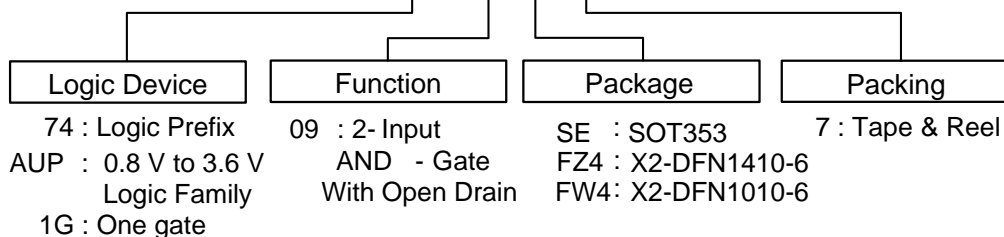


Figure 1. Load Circuit and Voltage Waveforms

- Notes:
- A. Includes test lead and test apparatus capacitance.
 - B. All pulses are supplied at pulse repetition rate ≤ 10 MHz.
 - C. Inputs are measured separately one transition per measurement.
 - D. For the open drain device the specified propagation delay t_{PD} is the same as t_{PLZ} and t_{PZL}.

Ordering Information

74AUP1G 09 XX - 7

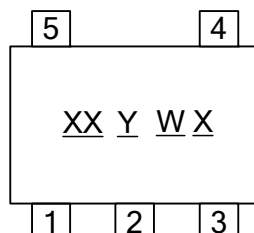


| Part Number | Package Code | Packaging | 7" Tape and Reel | |
|----------------|--------------|--------------|------------------|--------------------|
| | | | Quantity | Part Number Suffix |
| 74AUP1G09SE-7 | SE | SOT353 | 3000/Tape & Reel | -7 |
| 74AUP1G09FZ4-7 | FZ4 | X2-DFN1410-6 | 5000/Tape & Reel | -7 |
| 74AUP1G09FW4-7 | FW4 | X2-DFN1010-6 | 5000/Tape & Reel | -7 |

Marking Information

(1) SOT353

(Top View)

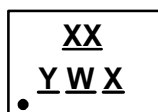


XX : Identification code
Y : Year 0~9
W : Week : A~Z : 1~26 week;
a~z : 27~52 week; z represents
52 and 53 week
X : A~Z : Internal code

| Part Number | Package | Identification Code |
|-------------|---------|---------------------|
| 74AUP1G09SE | SOT353 | XR |

(2) X2-DFN1410-6 and X2-DFN1010-6

(Top View)



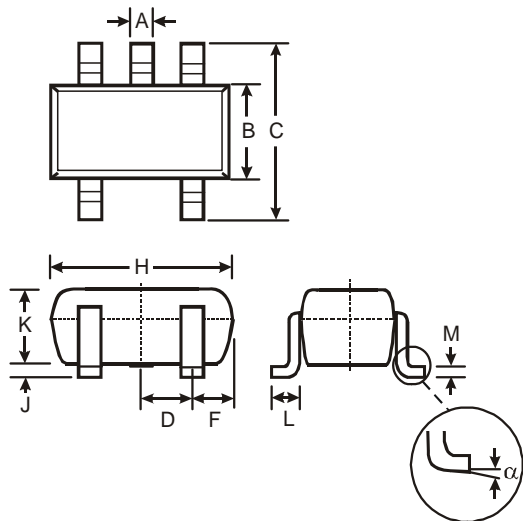
XX : Identification Code
Y : Year : 0~9
W : Week : A~Z : 1~26 week;
a~z : 27~52 week; z represents
52 and 53 week
X : A~Z : Internal code

| Part Number | Package | Identification Code |
|--------------|--------------|---------------------|
| 74AUP1G09FZ4 | X2-DFN1410-6 | XR |
| 74AUP1G09FW4 | X2-DFN1010-6 | XR |

Package Outline Dimensions (All dimensions in mm.)

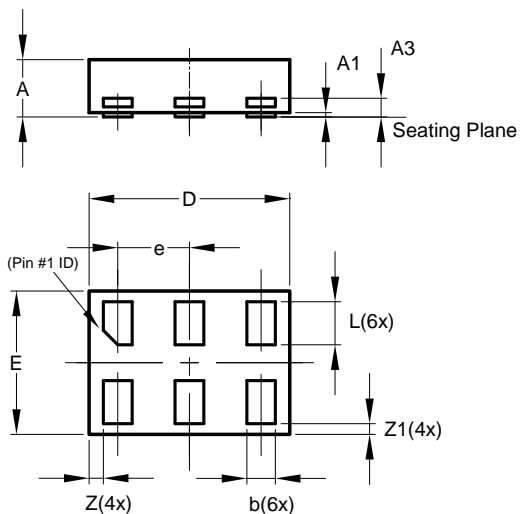
Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for latest version.

(1) SOT353



| SOT353 | | | |
|----------------------|----------|------|-------|
| Dim | Min | Max | Typ |
| A | 0.10 | 0.30 | 0.25 |
| B | 1.15 | 1.35 | 1.30 |
| C | 2.00 | 2.20 | 2.10 |
| D | 0.65 Typ | | |
| F | 0.40 | 0.45 | 0.425 |
| H | 1.80 | 2.20 | 2.15 |
| J | 0 | 0.10 | 0.05 |
| K | 0.90 | 1.00 | 1.00 |
| L | 0.25 | 0.40 | 0.30 |
| M | 0.10 | 0.22 | 0.11 |
| α | 0° | 8° | - |
| All Dimensions in mm | | | |

(2) X2-DFN1410-6

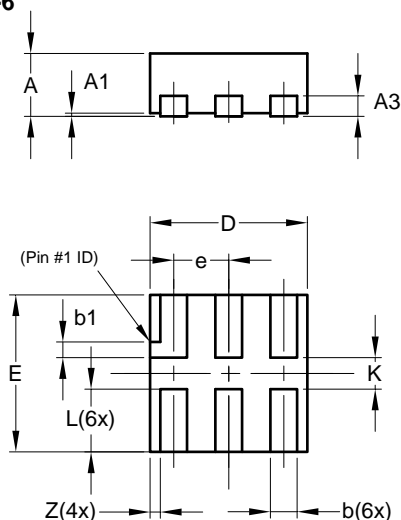


| X2-DFN1410-6 | | | |
|----------------------|-------|-------|-------|
| Dim | Min | Max | Typ |
| A | — | 0.40 | 0.39 |
| A1 | 0.00 | 0.05 | 0.02 |
| A3 | — | — | 0.13 |
| b | 0.15 | 0.25 | 0.20 |
| D | 1.35 | 1.45 | 1.40 |
| E | 0.95 | 1.05 | 1.00 |
| e | — | — | 0.50 |
| L | 0.25 | 0.35 | 0.30 |
| Z | — | — | 0.10 |
| Z1 | 0.045 | 0.105 | 0.075 |
| All Dimensions in mm | | | |

Package Outline Dimensions (cont.) (All dimensions in mm.)

Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for latest version.

(3) X2-DFN1010-6

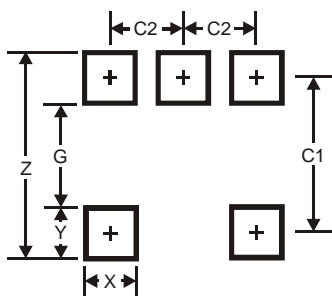


| X2-DFN1010-6 | | | |
|----------------------|------|------|-------|
| Dim | Min | Max | Typ |
| A | — | 0.40 | 0.39 |
| A1 | 0.00 | 0.05 | 0.02 |
| A3 | — | — | 0.13 |
| b | 0.14 | 0.20 | 0.17 |
| b1 | 0.05 | 0.15 | 0.10 |
| D | 0.95 | 1.05 | 1.00 |
| E | 0.95 | 1.05 | 1.00 |
| e | — | — | 0.35 |
| L | 0.35 | 0.45 | 0.40 |
| K | 0.15 | — | — |
| Z | — | — | 0.065 |
| All Dimensions in mm | | | |

Suggested Pad Layout

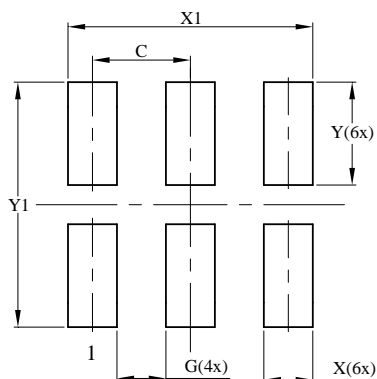
Please see AP02001 at <http://www.diodes.com/datasheets/ap02001.pdf> for the latest version

(1) SOT353



| Dimensions | Value (in mm) |
|------------|---------------|
| Z | 2.5 |
| G | 1.3 |
| X | 0.42 |
| Y | 0.6 |
| C1 | 1.9 |
| C2 | 0.65 |

(2) X2-DFN1410-6

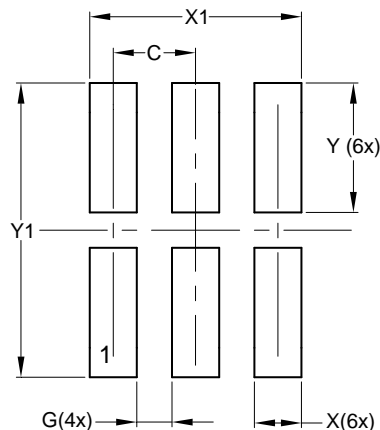


| Dimensions | Value (in mm) |
|------------|---------------|
| C | 0.500 |
| G | 0.250 |
| X | 0.250 |
| X1 | 1.250 |
| Y | 0.525 |
| Y1 | 1.250 |

Suggested Pad Layout (cont.)

Please see AP02001 at <http://www.diodes.com/datasheets/ap02001.pdf> for the latest version.

(3) X2-DFN1010-6



| Dimensions | Value (in mm) |
|------------|---------------|
| C | 0.350 |
| G | 0.150 |
| X | 0.200 |
| X1 | 0.900 |
| Y | 0.550 |
| Y1 | 1.250 |

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