

**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.

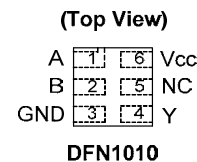
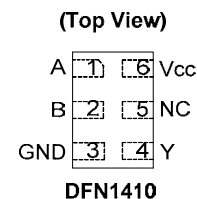
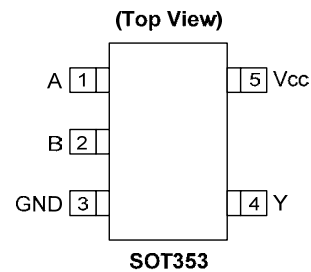
The AUP1G09 is a single AND gate with an open drain output designed for operation over a power supply range of 0.8V to 3.6V. The device is fully specified for partial power down applications using I<sub>OFF</sub>. The I<sub>OFF</sub> circuitry disables the output preventing damaging current backflow 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<sub>CC</sub> < 0.9µA
- Low Dynamic Power Consumption
  - C<sub>PD</sub> = 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<sub>CC</sub> = 3.0V
- I<sub>OFF</sub> 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**

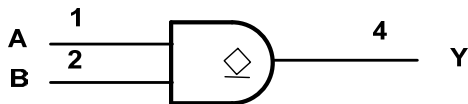
- Suited for battery and low power needs
- Wide array of products such as:
  - Tablets, E-readers
  - Cell Phones, Personal Navigation / GPS
  - MP3 players, Cameras, Video Recorders
  - PCs ultrabooks, notebooks, netbooks,
  - Computer peripherals, hard drives, CD/DVD ROM
  - TV, DVD, DVR, set top box

[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 <sub>cc</sub>	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<sub>A</sub> = +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 <sub>CC</sub>	Supply Voltage Range	-0.5 to +4.6	V
V <sub>I</sub>	Input Voltage Range	-0.5 to +4.6	V
V <sub>O</sub>	Voltage applied to output in high or low state	-0.5 to V <sub>CC</sub> +0.5	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 V <sub>CC</sub> )	±20	mA
I <sub>CC</sub>	Continuous Current Through V <sub>CC</sub>	50	mA
I <sub>GND</sub>	Continuous Current Through GND	-50	mA
T <sub>J</sub>	Operating Junction Temperature	-40 to +150	°C
T <sub>STG</sub>	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<sub>A</sub> = +25°C, unless otherwise specified.)

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

Note: 5. Unused inputs should be held at V<sub>CC</sub> or Ground.

**Electrical Characteristics** (@T<sub>A</sub> = +25°C, unless otherwise specified.)

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

**Electrical Characteristics** (cont.) (@T<sub>A</sub> = +25°C, unless otherwise specified.)

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

## Switching Characteristics

 $C_L=5\text{pF}$  see Figure 1

Parameter	From Input	TO OUTPUT	V <sub>CC</sub>	T <sub>A</sub> = +25°C			T <sub>A</sub> = -40°C to +85°C		T <sub>A</sub> = -40°C to +125°C		Unit
				Min	Typ	Max	Min	Max	Min	Max	
t <sub>pd</sub>	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	

 $C_L=10\text{pF}$  see Figure 1

Parameter	From Input	TO OUTPUT	V <sub>CC</sub>	T <sub>A</sub> = +25°C			T <sub>A</sub> = -40°C to +85°C		T <sub>A</sub> = -40°C to +125°C		Unit
				Min	Typ	Max	Min	Max	Min	Max	
t <sub>pd</sub>	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	

 $C_L=15\text{pF}$  see Figure 1

Parameter	From Input	TO OUTPUT	V <sub>CC</sub>	T <sub>A</sub> = +25°C			T <sub>A</sub> = -40°C to +85°C		T <sub>A</sub> = -40°C to +125°C		Unit
				Min	Typ	Max	Min	Max	Min	Max	
t <sub>pd</sub>	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	

 $C_L=30\text{pF}$  see Figure 1

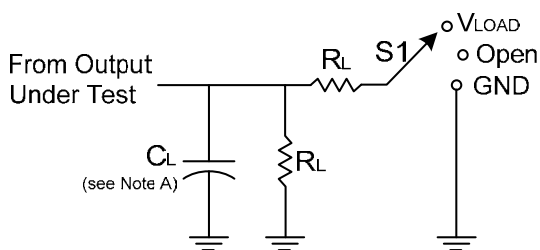
Parameter	From Input	TO OUTPUT	V <sub>CC</sub>	T <sub>A</sub> = +25°C			T <sub>A</sub> = -40°C to +85°C		T <sub>A</sub> = -40°C to +125°C		Unit
				Min	Typ	Max	Min	Max	Min	Max	
t <sub>pd</sub>	A	Y	0.8V		27						ns
			1.2V ± 0.1V	3.6	9.5	19.5	3.2	21.8	3.2	24	
			1.5V ± 0.1V	2.9	8.5	16.1	2.6	13.6	2.6	15	
			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<sub>A</sub> = +25°C, unless otherwise specified.)

Parameter		Test Conditions		V <sub>CC</sub>	Typ	Unit
C <sub>pd</sub>	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 <sub>i</sub>	Input Capacitance	V <sub>i</sub> = V <sub>CC</sub> or GND		0V or 3.3V	1.5	pF
θ <sub>JA</sub>	Thermal Resistance Junction-to-Ambient	SOT353	(Note 6)		371	°C/W
		X2-DFN1410-6		430		
		X2-DFN1010-6		445		
θ <sub>JC</sub>	Thermal Resistance Junction-to-Case	SOT353	(Note 6)		143	°C/W
		X2-DFN1410-6		190		
		X2-DFN1010-6		250		

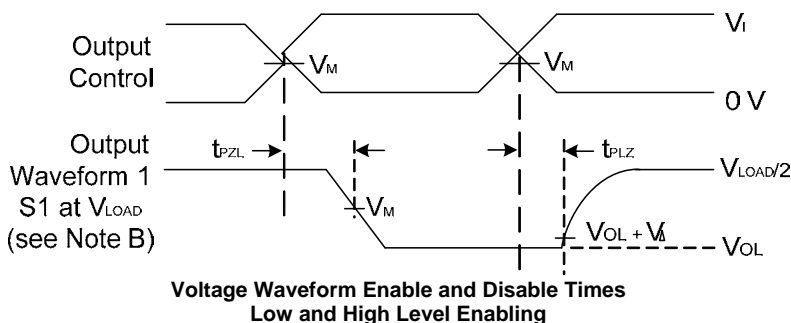
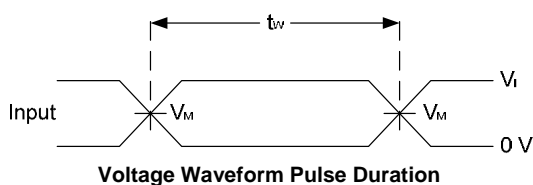
Notes: 6. Test condition for SOT353, X2-DFN1410-6, and X2-DFN1010-6 devices mounted on FR-4 substrate PC board, 2oz copper, with minimum recommended pad layout.

**Parameter Measurement Information**



TEST	S1	R <sub>L</sub>
t <sub>PLZ</sub> /t <sub>PZL</sub>	V <sub>load</sub>	5KΩ

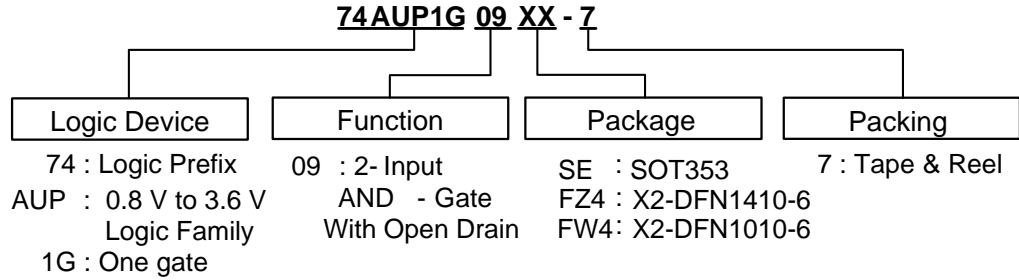
V <sub>CC</sub>	Inputs		V <sub>M</sub>	V <sub>LOAD</sub>	C <sub>L</sub>	VΔ
	V <sub>i</sub>	t <sub>r</sub> /t <sub>f</sub>				
0.8V	V <sub>CC</sub>	≤3ns	V <sub>CC</sub> /2	2 X V <sub>CC</sub>	5, 10, 15, 30pF	0.1V
1.2V±0.1V	V <sub>CC</sub>	≤3ns	V <sub>CC</sub> /2	2 X V <sub>CC</sub>	5, 10, 15, 30pF	0.1V
1.5V±0.1V	V <sub>CC</sub>	≤3ns	V <sub>CC</sub> /2	2 X V <sub>CC</sub>	5, 10, 15, 30pF	0.1V
1.8V±0.15V	V <sub>CC</sub>	≤3ns	V <sub>CC</sub> /2	2 X V <sub>CC</sub>	5, 10, 15, 30pF	0.15V
2.5V±0.2V	V <sub>CC</sub>	≤3ns	V <sub>CC</sub> /2	2 X V <sub>CC</sub>	5, 10, 15, 30pF	0.15V
3.3V±0.3 V	V <sub>CC</sub>	≤3ns	V <sub>CC</sub> /2	2 X V <sub>CC</sub>	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<sub>PD</sub> is the same as t<sub>PLZ</sub> and t<sub>PZL</sub>.

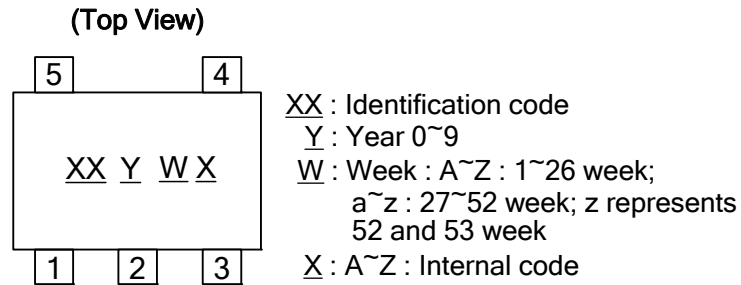
## Ordering Information



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

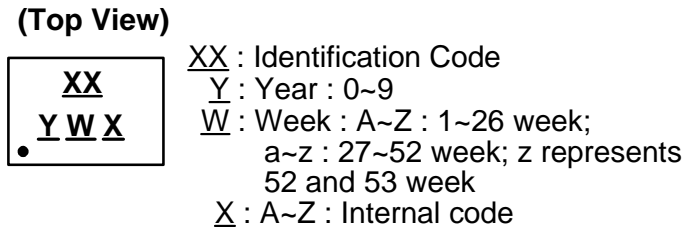
## Marking Information

(1) SOT353



Part Number	Package	Identification Code
74AUP1G09SE	SOT353	XR

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



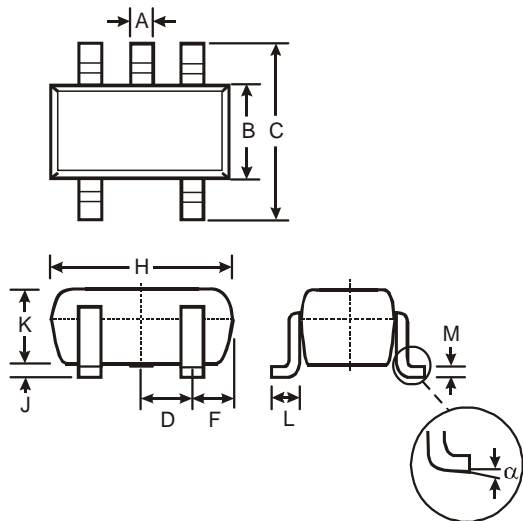
Part Number	Package	Identification Code
74AUP1G09FZ4	X2-DFN1410-6	XR
74AUP1G09FW4	X2-DFN1010-6	XR



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

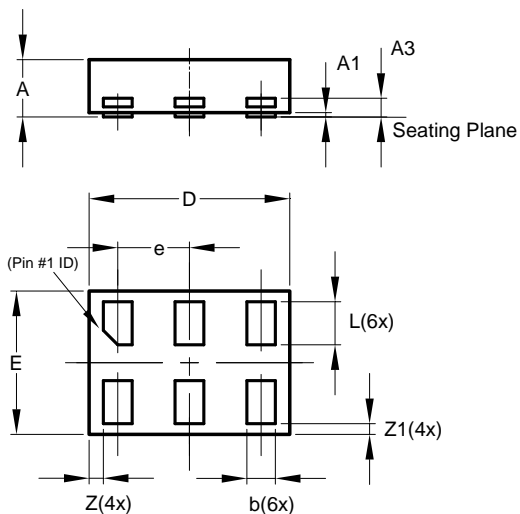
Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for latest version.

**(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**

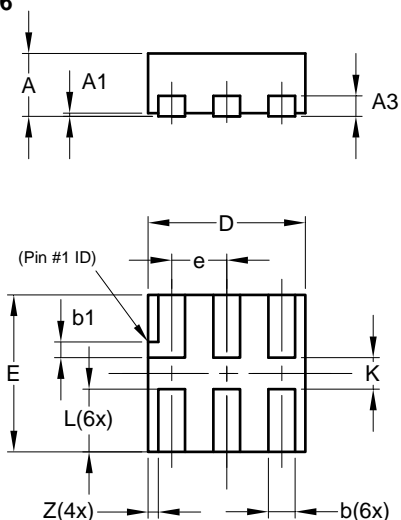


X2-DFN1410-6			
Dim	Min	Max	Typ
A	—	0.40	0.39
A1	0.00	0.05	0.02
A3	—	—	0.13
b	0.15	0.25	0.20
D	1.35	1.45	1.40
E	0.95	1.05	1.00
e	—	—	0.50
L	0.25	0.35	0.30
Z	—	—	0.10
Z1	0.045	0.105	0.075
All Dimensions in mm			

**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**

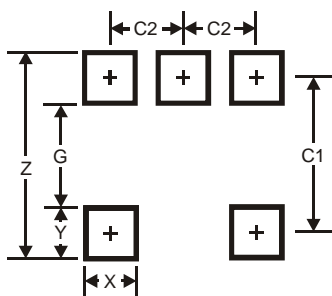


X2-DFN1010-6			
Dim	Min	Max	Typ
A	—	0.40	0.39
A1	0.00	0.05	0.02
A3	—	—	0.13
b	0.14	0.20	0.17
b1	0.05	0.15	0.10
D	0.95	1.05	1.00
E	0.95	1.05	1.00
e	—	—	0.35
L	0.35	0.45	0.40
K	0.15	—	—
Z	—	—	0.065
All Dimensions in mm			

**Suggested Pad Layout**

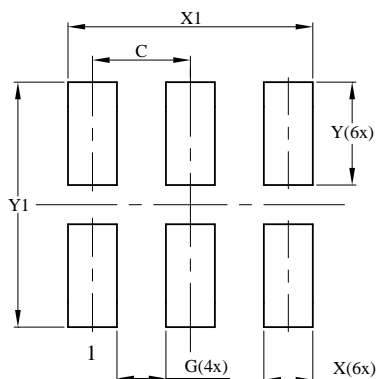
Please see AP02001 at <http://www.diodes.com/datasheets/ap02001.pdf> for the latest version

**(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**

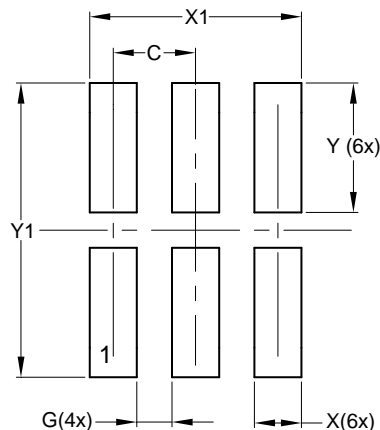


Dimensions	Value (in mm)
C	0.500
G	0.250
X	0.250
X1	1.250
Y	0.525
Y1	1.250

## 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)
<b>C</b>	0.350
<b>G</b>	0.150
<b>X</b>	0.200
<b>X1</b>	0.900
<b>Y</b>	0.550
<b>Y1</b>	1.250

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