

## Description

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

The 74AUP1G86 is a single 2-input positive exclusive-OR gate with a standard push-pull 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:

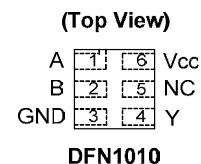
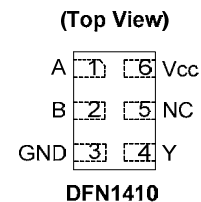
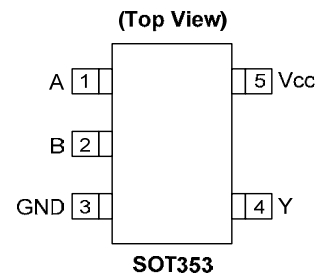
$$Y = A \oplus B \text{ or } Y = \bar{A}B + A\bar{B}$$

## 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> = 6.3pF (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](#)

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**Pin Descriptions**

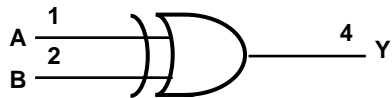
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Pin Name	Function
A	Data Input
B	Data Input
GND	Ground
Y	Data Output
Vcc	Supply Voltage

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**Logic Diagram**

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**Function Table**

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Inputs		Output
A	B	Y
L	L	L
L	H	H
H	L	H
H	H	L

**Absolute Maximum Ratings** (Note 4) (@ $T_A = +25^\circ\text{C}$ , 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 $V_{CC}$ )	$\pm 20$	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	$^\circ\text{C}$
$T_{STG}$	Storage Temperature	-65 to +150	$^\circ\text{C}$

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) (@ $T_A = +25^\circ\text{C}$ , 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
$I_{OH}$	High-Level Output Current	$V_{CC} = 0.8\text{V}$		-20	$\mu\text{A}$
		$V_{CC} = 1.1\text{V}$		-1.1	mA
		$V_{CC} = 1.4\text{V}$		-1.7	
		$V_{CC} = 1.65\text{V}$		-1.9	
		$V_{CC} = 2.3\text{V}$		-3.1	
		$V_{CC} = 3.0\text{V}$		-4	
$I_{OL}$	Low-Level Output Current	$V_{CC} = 0.8\text{V}$		20	$\mu\text{A}$
		$V_{CC} = 1.1\text{V}$		1.1	mA
		$V_{CC} = 1.4\text{V}$		1.7	
		$V_{CC} = 1.65\text{V}$		1.9	
		$V_{CC} = 2.3\text{V}$		3.1	
		$V_{CC} = 3.0\text{V}$		4	
$\Delta t/\Delta V$	Input Transition Rise or Fall Rate	$V_{CC} = 0.8\text{V}$ to $3.6\text{V}$		200	ns/V
$T_A$	Operating Free-Air Temperature		-40	+125	$^\circ\text{C}$

Note: 5. Unused inputs should be held at  $V_{CC}$  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>OH</sub>	High-Level Output Voltage	I <sub>OH</sub> = -20μA	0.8V to 3.6V	V <sub>CC</sub> - 0.1		V <sub>CC</sub> - 0.1		V
		I <sub>OH</sub> = -1.1mA	1.1V	0.75 X V <sub>CC</sub>		0.7 X V <sub>CC</sub>		
		I <sub>OH</sub> = -1.7mA	1.4V	1.11		1.03		
		I <sub>OH</sub> = -1.9mA	1.65V	1.32		1.3		
		I <sub>OH</sub> = -2.3mA	2.3V	2.05		1.97		
		I <sub>OH</sub> = -3.1mA		1.9		1.85		
		I <sub>OH</sub> = -2.7mA	3V	2.72		2.67		
		I <sub>OH</sub> = -4mA		2.6		2.55		
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	0 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		0.6	μA
ΔI <sub>OFF</sub>	Delta Power Down Leakage Current	V <sub>I</sub> or V <sub>O</sub> = 0V to 3.6V	0 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	One input at V <sub>CC</sub> -0.6V Other inputs at V <sub>CC</sub> or GND	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 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 2.7 V	1.6		
			3.0V to 3.6V	2.0		
V <sub>IL</sub>	Low-Level Input Voltage		0.8V to 1.65V		0.25 X V <sub>CC</sub>	V
			1.65V to 1.95V		0.30 X V <sub>CC</sub>	
			2.3V to 2.7V		0.7	
			3.0V to 3.6V		0.9	
V <sub>OH</sub>	High-Level Output Voltage	I <sub>OH</sub> = -20μA	0.8V to 3.6V	V <sub>CC</sub> - 0.11		V
		I <sub>OH</sub> = -1.1mA	1.1V	0.6 X V <sub>CC</sub>		
		I <sub>OH</sub> = -1.7mA	1.4V	0.93		
		I <sub>OH</sub> = -1.9mA	1.65V	1.17		
		I <sub>OH</sub> = -2.3mA	2.3V	1.77		
		I <sub>OH</sub> = -3.1mA		1.67		
		I <sub>OH</sub> = -2.7mA	3V	2.40		
		I <sub>OH</sub> = -4 mA		2.30		
V <sub>OL</sub>	High-Level Input Voltage	I <sub>OL</sub> = 20μA	0.8V to 3.6V		0.11	V
		I <sub>OL</sub> = 1.1mA	1.1V		0.33 X V <sub>CC</sub>	
		I <sub>OL</sub> = 1.7mA	1.4V		0.41	
		I <sub>OL</sub> = 1.9mA	1.65V		0.39	
		I <sub>OL</sub> = 2.3mA	2.3V		0.36	
		I <sub>OL</sub> = 3.1mA			0.50	
		I <sub>OL</sub> = 2.7mA	3V		0.36	
		I <sub>OL</sub> = 4mA			0.50	
I <sub>I</sub>	Input Current	A or B Input V <sub>I</sub> = GND to 3.6V	0 to 3.6V		±0.75	μA
I <sub>OFF</sub>	Power Down Leakage Current	V <sub>I</sub> or V <sub>O</sub> = 0 to 3.6V	0		±3.5	μA
ΔI <sub>OFF</sub>	Delta Power Down Leakage Current	V <sub>I</sub> or V <sub>O</sub> = 0 to 3.6V	0 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 Other inputs at V <sub>CC</sub> or GND	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 or B	Y	0.8V		21.2						ns
			1.2V ± 0.1V	2.3	5.9	13.1	2.1	14.3	2.1	15.8	
			1.5V ± 0.1V	1.8	4.1	7.7	1.6	8.8	1.6	9.7	
			1.8V ± 0.15V	1.5	3.3	5.9	1.4	6.9	1.4	7.6	
			2.5V ± 0.2V	1.2	2.6	4.4	1.1	5.3	1.1	5.9	
			3.3V ± 0.3V	1.0	2.3	4.0	0.9	4.7	0.9	5.2	

 $C_L=10\text{pF}$  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 or B	Y	0.8V		24.7						ns
			1.2V ± 0.1V	2.6	6.8	14.8	2.4	16.2	2.4	17.9	
			1.5V ± 0.1V	2.2	4.8	8.7	1.9	10.0	1.9	11.0	
			1.8V ± 0.15V	1.8	3.9	6.7	1.7	8.0	1.7	8.8	
			2.5V ± 0.2V	1.5	3.1	5.2	1.4	6.2	1.4	6.9	
			3.3V ± 0.3V	1.3	2.98	4.8	1.3	5.6	1.3	6.2	

 $C_L=15\text{pF}$  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 or B	Y	0.8V		28.2						ns
			1.2V ± 0.1V	3.0	7.6	16.5	2.7	18.1	2.7	20.0	
			1.5V ± 0.1V	2.4	5.3	9.6	2.2	11.3	2.2	12.5	
			1.8V ± 0.15V	2.1	4.4	7.5	1.9	9.0	1.9	9.9	
			2.5V ± 0.2V	1.8	3.6	5.9	1.6	7.0	1.6	7.7	
			3.3V ± 0.3V	1.6	3.3	5.4	1.5	6.4	1.5	7.1	

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

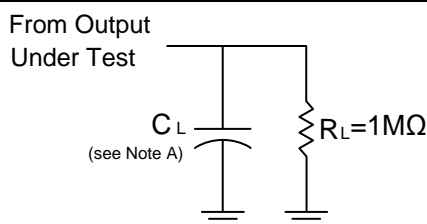
Parameter	From Input	TO OUTPUT	V <sub>CC</sub>	T <sub>A</sub> = +25°C			T <sub>A</sub> = -40°C to +85°C		T <sub>A</sub> = -40°C to +125°C		Unit
				Min	Typ	Min	Min	Max	Min	Max	
t <sub>pd</sub>	A or B	Y	0.8V		38.5						ns
			1.2V ± 0.1V	3.9	9.9	21.5	3.5	24.1	3.5	26.6	
			1.5V ± 0.1V	3.2	6.9	12.5	2.8	14.8	2.8	16.3	
			1.8V ± 0.15V	2.8	5.7	9.8	2.5	11.7	2.5	12.9	
			2.5V ± 0.2V	2.4	4.7	7.6	2.2	9.1	2.2	10.1	
			3.3V ± 0.3V	2.2	4.4	7.1	2.1	8.3	2.1	9.2	

**Operating and Package Characteristics** (@ $T_A = +25^\circ\text{C}$ , unless otherwise specified.)

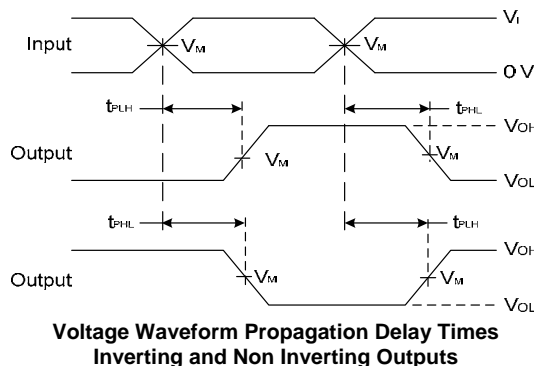
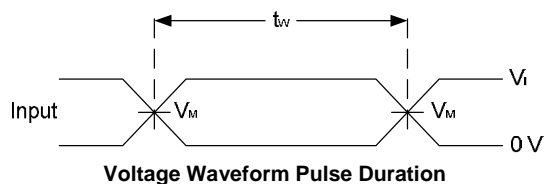
Parameter		Test Conditions		$V_{CC}$	Typ	Unit
$C_{pd}$	Power Dissipation Capacitance	$f = 1\text{MHz}$ No Load		0.8V	6.7	pF
				$1.2\text{V} \pm 0.1\text{V}$	6.6	
				$1.5\text{V} \pm 0.1\text{V}$	6.5	
				$1.8\text{V} \pm 0.15\text{V}$	6.5	
				$2.5\text{V} \pm 0.2\text{V}$	6.4	
				$3.3\text{V} \pm 0.3\text{V}$	6.3	
$C_i$	Input Capacitance	$V_i = V_{CC}$ or GND		0 or 3.3V	1.5	pF
$\theta_{JA}$	Thermal Resistance Junction-to-Ambient	SOT353	(Note 6)		371	$^\circ\text{C/W}$
		X2-DFN1410-6		430		
		X2-DFN1010-6		445		
$\theta_{JC}$	Thermal Resistance Junction-to-Case	SOT353	(Note 6)		143	$^\circ\text{C/W}$
		X2-DFN1410-6		190		
		X2-DFN1010-6		250		

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

**Parameter Measurement Information**



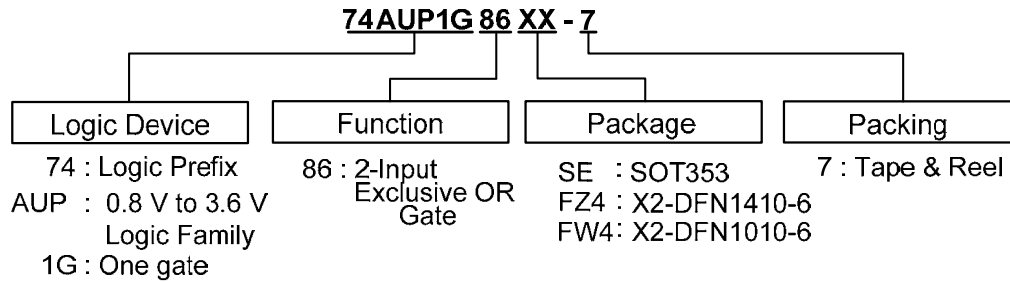
$V_{CC}$	Inputs		$V_M$	$C_L$
	$V_i$	$t_r/t_f$		
0.8V	$V_{CC}$	$\leq 3\text{ns}$	$V_{CC}/2$	5, 10, 15, 30pF
$1.2\text{V} \pm 0.1\text{V}$	$V_{CC}$	$\leq 3\text{ns}$	$V_{CC}/2$	5, 10, 15, 30pF
$1.5\text{V} \pm 0.1\text{V}$	$V_{CC}$	$\leq 3\text{ns}$	$V_{CC}/2$	5, 10, 15, 30pF
$1.8\text{V} \pm 0.15\text{V}$	$V_{CC}$	$\leq 3\text{ns}$	$V_{CC}/2$	5, 10, 15, 30pF
$2.5\text{V} \pm 0.2\text{V}$	$V_{CC}$	$\leq 3\text{ns}$	$V_{CC}/2$	5, 10, 15, 30pF
$3.3\text{V} \pm 0.3\text{V}$	$V_{CC}$	$\leq 3\text{ns}$	$V_{CC}/2$	5, 10, 15, 30pF



**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  $\leq 10\text{ MHz}$ .
  - C. Inputs are measured separately one transition per measurement.
  - D.  $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{PD}$ .

## Ordering Information

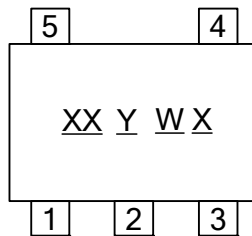


Part Number	Package Code	Packaging	7" Tape and Reel	
			Quantity	Part Number Suffix
74AUP1G86SE-7	SE	SOT353	3000/Tape & Reel	-7
74AUP1G86FZ4-7	FZ4	X2-DFN1410-6	5000/Tape & Reel	-7
74AUP1G86FW4-7	FW4	X2-DFN1010-6	5000/Tape & Reel	-7

## Marking Information

### (1) SOT353

(Top View)

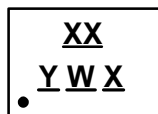


XX : Identification code  
Y : Year 0~9  
W : Week : A~Z : 1~26 week;  
a~z : 27~52 week; z represents  
52 and 53 week  
X : A~Z : Internal code

Part Number	Package	Identification Code
74AUP1G86SE	SOT353	XW

### (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

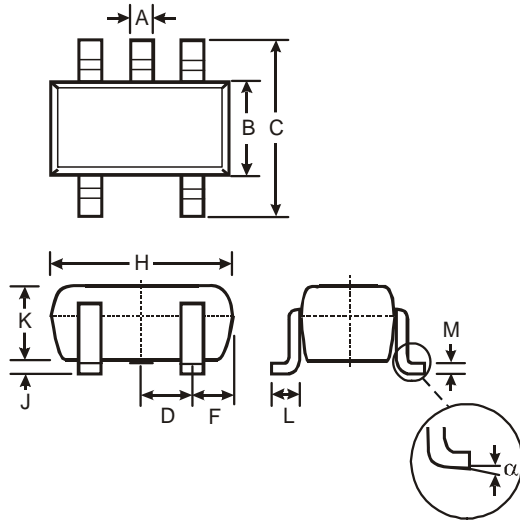
Part Number	Package	Identification Code
74AUP1G86FZ4	X2-DFN1410-6	XW
74AUP1G86FW4	X2-DFN1010-6	XW



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

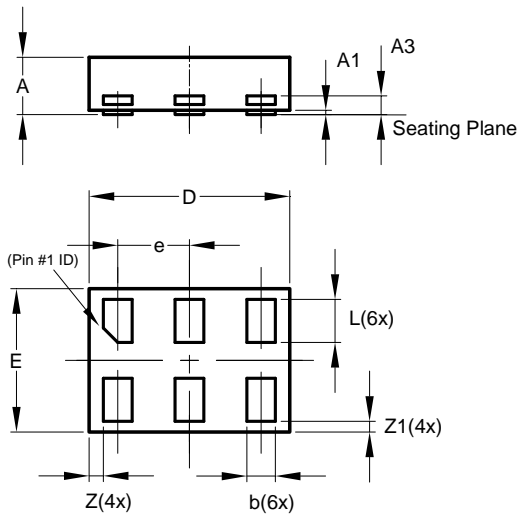
Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for latest version.

**(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**

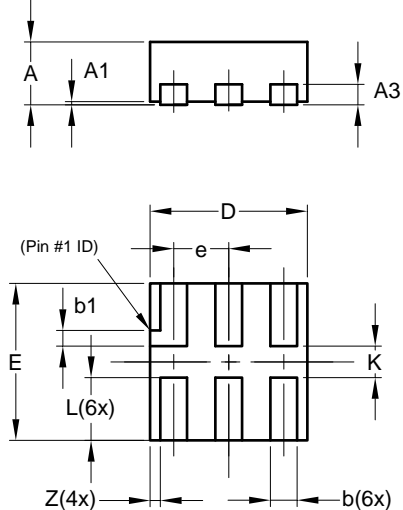


X2-DFN1410-6			
Dim	Min	Max	Typ
A	—	0.40	0.39
A1	0.00	0.05	0.02
A3	—	—	0.13
b	0.15	0.25	0.20
D	1.35	1.45	1.40
E	0.95	1.05	1.00
e	—	—	0.50
L	0.25	0.35	0.30
Z	—	—	0.10
Z1	0.045	0.105	0.075
All Dimensions in mm			

**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**

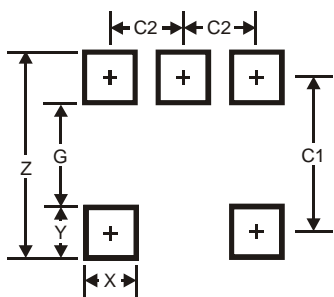


X2-DFN1010-6			
Dim	Min	Max	Typ
A	—	0.40	0.39
A1	0.00	0.05	0.02
A3	—	—	0.13
b	0.14	0.20	0.17
b1	0.05	0.15	0.10
D	0.95	1.05	1.00
E	0.95	1.05	1.00
e	—	—	0.35
L	0.35	0.45	0.40
K	0.15	—	—
Z	—	—	0.065
All Dimensions in mm			

**Suggested Pad Layout**

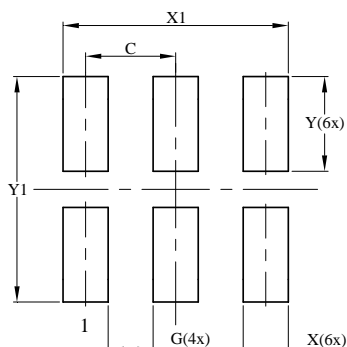
Please see AP02001 at <http://www.diodes.com/datasheets/ap02001.pdf> for the latest version

**(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**

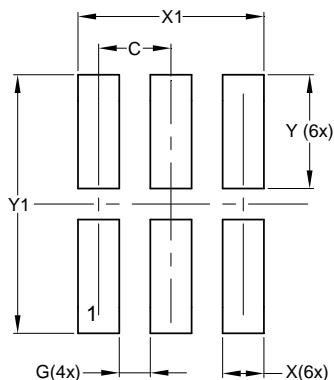


Dimensions	Value (in mm)
C	0.500
G	0.250
X	0.250
X1	1.250
Y	0.525
Y1	1.250

### 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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