

## 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:

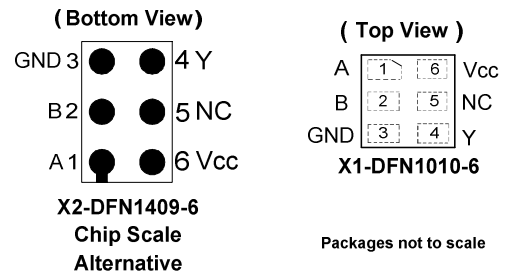
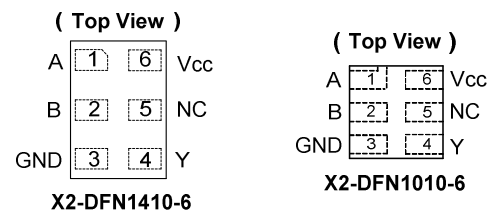
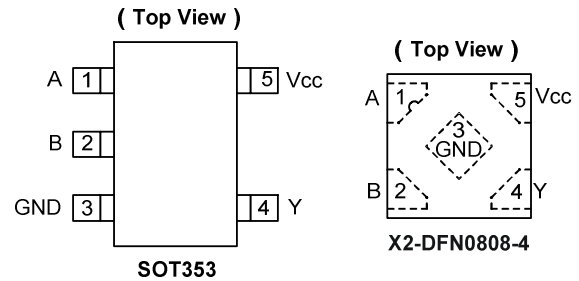
$$Y = A \cdot B \text{ or } Y = \overline{\overline{A + B}}$$

## 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 makes 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)  
Exceeds 1000-V Charged Device Model (C101)
- Latch-Up Exceeds 100mA per JESD 78, Class I
- Leadless Packages Named per JESD30E
- Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- Halogen and Antimony Free. "Green" Device (Note 3)**

- Notes:
- No purposely added lead. Fully EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant.
  - 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.
  - Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

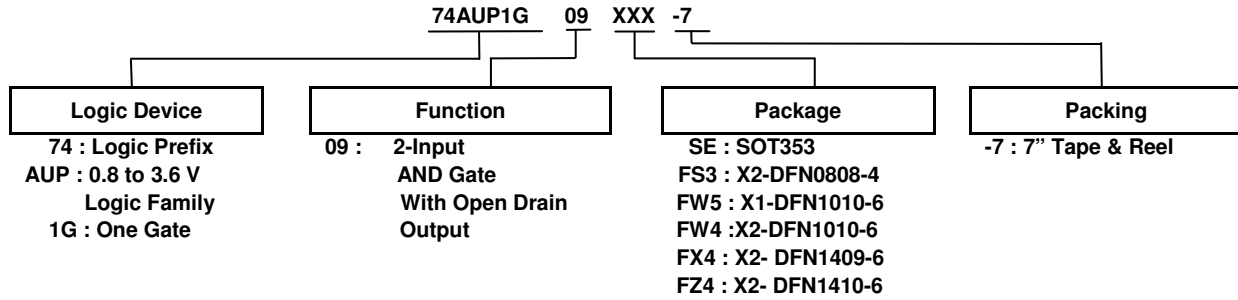
## Pin Assignments



## 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, SSDs, CD/DVD ROMs
  - TVs, DVDs, DVRs, Set-Top Boxes

## Ordering Information



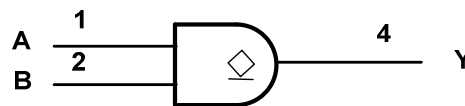
Device	Package Code	Package (Notes 4 & 5)	Package Size	7" Tape and Reel	
				Quantity	Part Number Suffix
74AUP1G09SE-7	SE	SOT353	2.0mm x 2.0mm x 1.1mm 0.65 mm lead pitch	3,000/Tape & Reel	-7
74AUP1G09FS3-7	FS3	X2-DFN0808-4	0.8mm x 0.8mm x 0.35mm 0.5 mm pad pitch (diamond)	5,000/Tape & Reel	-7
74AUP1G09FW5-7	FW5	X1-DFN1010-6	1.0mm x 1.0mm x 0.5mm 0.35 mm pad pitch	5,000/Tape & Reel	-7
74AUP1G09FW4-7	FW4	X2-DFN1010-6	1.0mm x 1.0mm x 0.4mm 0.35 mm pad pitch	5,000/Tape & Reel	-7
74AUP1G09FX4-7	FX4	X2-DFN1409-6 Chip Scale Alternative	1.4mm x 0.9mm x 0.4mm 0.5 mm pad pitch	5,000/Tape & Reel	-7
74AUP1G09FZ4-7	FZ4	X2-DFN1410-6	1.4mm x 1.0mm x 0.4mm 0.5 mm pad pitch	5,000/Tape & Reel	-7

Notes: 4. Pad layout as shown on Diodes Inc. suggested pad layout document AP02001, which can be found on our website at <http://www.diodes.com/datasheets/ap02001.pdf>.  
5. The taping orientation is located on our website at <http://www.diodes.com/datasheets/ap02007.pdf>.

## Pin Descriptions

Pin Name	Function
A	Data Input
B	Data Input
GND	Ground
Y	Data Output
Vcc	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** (Notes 6 & 7) (@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 +4.6	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

- 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 8) (@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	3.6	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	mA	
		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: 8. 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>	Low-Level Output 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** (continued) (@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	—	0.25 x 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>	Low-Level Output 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

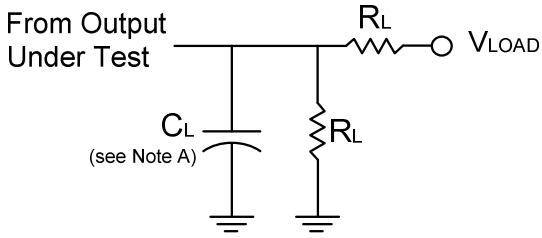
Parameter	From Input	TO OUTPUT	V <sub>CC</sub>	T <sub>A</sub> = +25°C			T <sub>A</sub> = -40°C to +85°C		T <sub>A</sub> = -40°C to +125°C		Unit
				Min	Typ	Max	Min	Max	Min	Max	
t <sub>pd</sub>	A	Y	0.8V	—	27	—	—	—	—	—	ns
			1.2V ± 0.1V	3.6	9.5	19.5	3.2	21.8	3.2	24	
			1.5V ± 0.1V	2.9	8.5	16.1	2.6	13.6	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	6.5	pF
				1.2V ± 0.1V	6.3	
				1.5V ± 0.1V	6.3	
				1.8V ± 0.15V	6.2	
				2.5V ± 0.2V	6.2	
				3.3V ± 0.3V	6.1	
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 9)	—	371	°C/W
		X2-DFN0808-4		—	430	
		X1-DFN1010-6		—	435	
		X2-DFN1010-6		—	445	
		X2-DFN1409-6		—	470	
		X2-DFN1410-6		—	460	
θ <sub>JC</sub>	Thermal Resistance Junction-to-Case	SOT353	(Note 9)	—	143	°C/W
		X2-DFN0808-4		—	240	
		X1-DFN1010-6		—	250	
		X2-DFN1010-6		—	250	
		X2-DFN1409-6		—	275	
		X2-DFN1410-6		—	265	

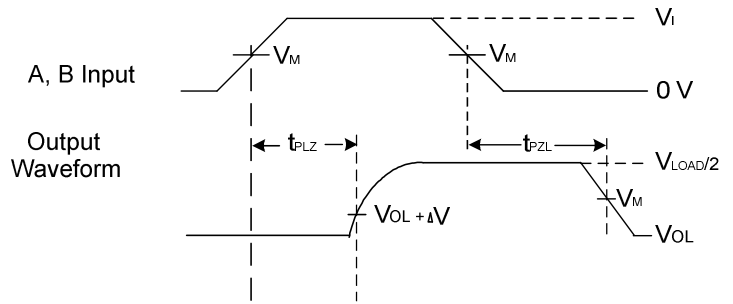
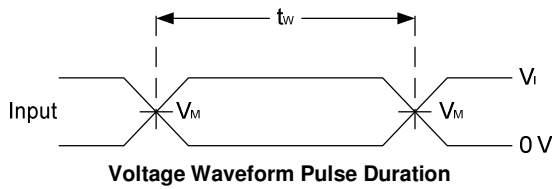
Note: 9. Test condition for each of the six package types: Device mounted on FR-4 substrate PC board, 2oz copper, with minimum recommended pad layout.

**Parameter Measurement Information**



TEST	Condition
$t_{PLZ}$ (see Notes D and E)	Vload
$t_{PZL}$ (see Notes D and F)	Vload

Vcc	Inputs		VM	VLOAD	CL	RL	VΔ
	VI	tr/td					
0.8 V	Vcc	≤3ns	Vcc/2	2 X Vcc	5, 10, 15, 30 pF	5KΩ	0.1V
1.2 V±0.1 V	Vcc	≤3ns	Vcc/2	2 X Vcc	5, 10, 15, 30 pF	5KΩ	0.1V
1.5 V±0.1 V	Vcc	≤3ns	Vcc/2	2 X Vcc	5, 10, 15, 30 pF	5KΩ	0.15V
1.8 V±0.15 V	Vcc	≤3ns	Vcc/2	2 X Vcc	5, 10, 15, 30 pF	5KΩ	0.15V
2.5 V±0.2 V	Vcc	≤3ns	Vcc/2	2 X Vcc	5, 10, 15, 30 pF	5KΩ	0.15V
3.3 V±0.3 V	Vcc	≤3ns	Vcc/2	2 X Vcc	5, 10, 15, 30 pF	5KΩ	0.3V



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

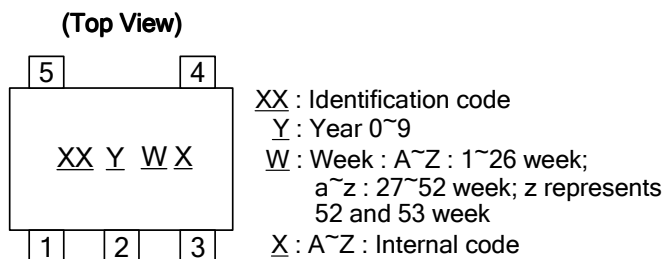
**Figure 1 Load Circuit and Voltage Waveforms**

- 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  $t_{PD}$ .



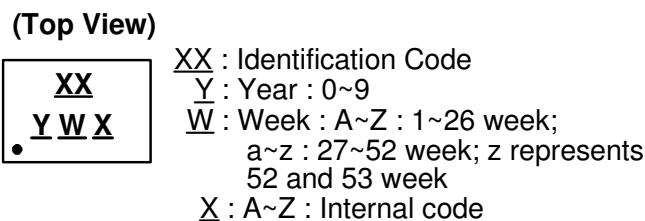
**Marking Information**

(1) SOT353



Part Number	Package	Identification Code
74AUP1G09SE	SOT353	XR

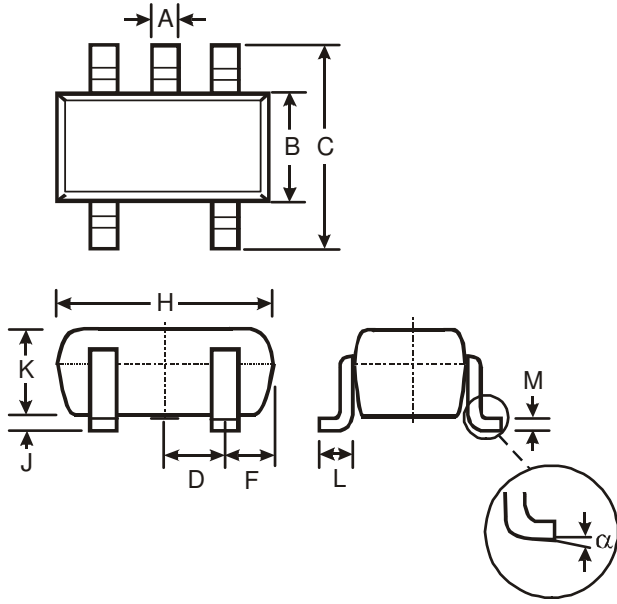
(2) X2-DFN0808-4, X1-DFN1010-6, X2-DFN1010-6, X2-DFN1409-6 and X2-DFN1410-6



Part Number	Package	Identification Code
74AUP1G09FS3	X2-DFN0808-4	YU
74AUP1G09FW5	X1-DFN1010-6	Q8
74AUP1G09FW4	X2-DFN1010-6	XR
74AUP1G09FX4	X2-DFN1409-6	HG
74AUP1G09FZ4	X2-DFN1410-6	XR

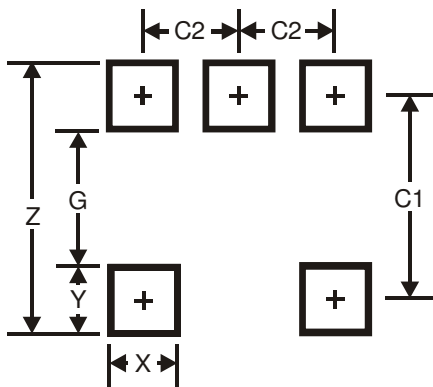
**SOT353 Package Outline Dimensions and Suggested Pad Layout**

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



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°	-

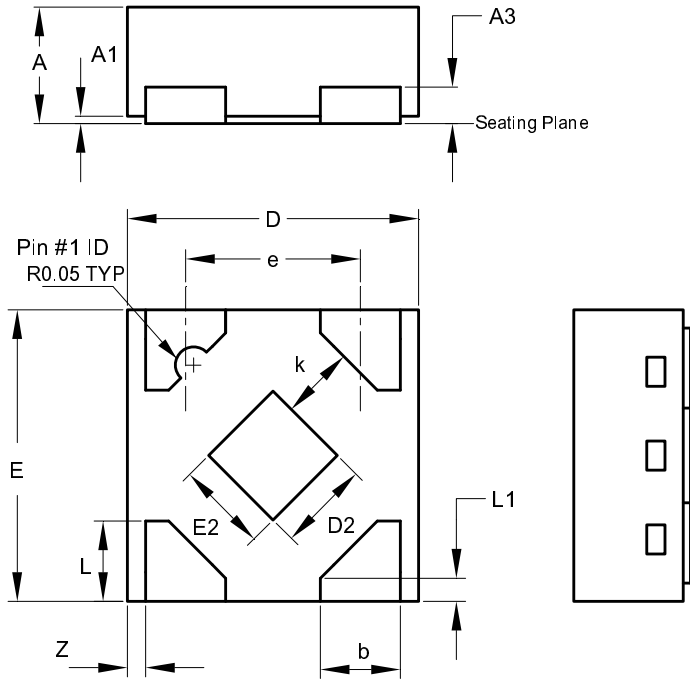
All Dimensions in mm



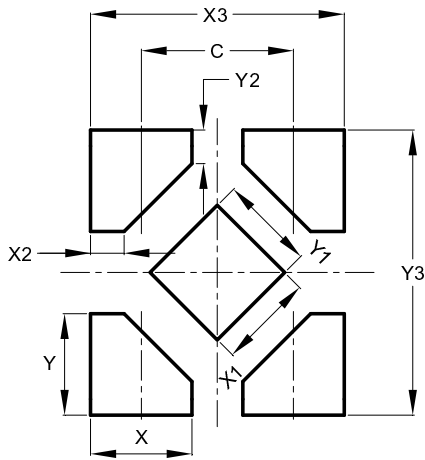
Dimensions	Value (in mm)
Z	2.5
G	1.3
X	0.42
Y	0.6
C1	1.9
C2	0.65

**X2-DFN0808-4 Package Outline Dimensions and Suggested Pad Layout**

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



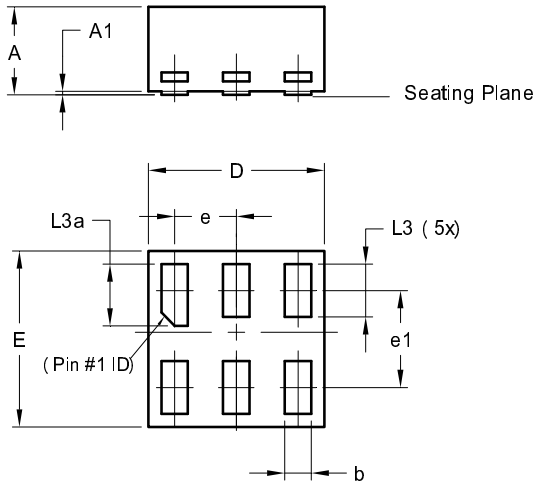
X2-DFN0808-4			
Dim	Min	Max	Typ
A	0.25	0.35	0.30
A1	0	0.04	0.02
A3	-	-	0.13
b	0.17	0.27	0.22
D	0.75	0.85	0.80
D2	0.15	0.35	0.25
E	0.75	0.85	0.80
E2	0.15	0.35	0.25
e	-	-	0.48
K	0.20	-	-
L	0.17	0.27	0.22
L1	0.02	0.12	0.07
Z	-	-	0.05
All Dimensions in mm			



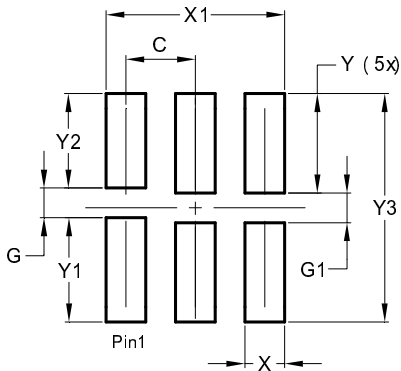
Dimensions	Value
C	0.480
X	0.320
X1	0.300
X2	0.106
X3	0.800
Y	0.320
Y1	0.300
Y2	0.106
Y3	0.900

**X1-DFN1010-6 Package Outline Dimensions and Suggested Pad Layout**

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



X1-DFN1010-6			
Dim	Min	Max	Typ
A	-	0.50	0.39
A1	-	0.04	-
b	0.12	0.20	0.15
D	0.95	1.050	1.00
E	0.95	1.050	1.00
e	0.35 BSC		
e1	0.55 BSC		
L3	0.27	0.30	0.30
L3a	0.32	0.40	0.35
<b>All Dimensions in mm</b>			

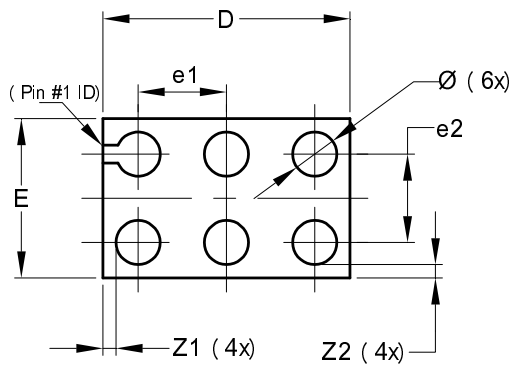
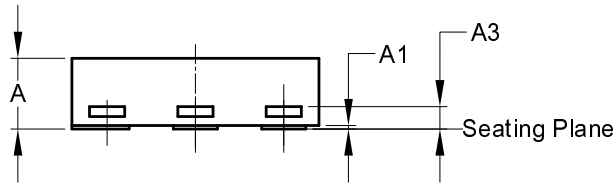


Dimensions	Value (in mm)
C	0.350
G	0.150
G1	0.150
X	0.200
X1	0.900
Y	0.500
Y1	0.525
Y2	0.475
Y3	1.150

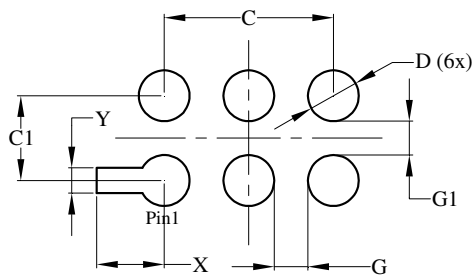


**X2-DFN1409-6 Package Outline Dimensions and Suggested Pad Layout**

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



X2-DFN1409-6			
Dim	Min	Max	Typ
A	-	0.40	0.39
A1	0	0.05	0.02
A3	-	-	0.13
Ø	0.20	0.30	0.25
D	1.35	1.45	1.40
E	0.85	0.95	0.90
e1	-	-	0.50
e2	-	-	0.50
Z1	-	-	0.075
Z2	-	-	0.075
All Dimensions in mm			



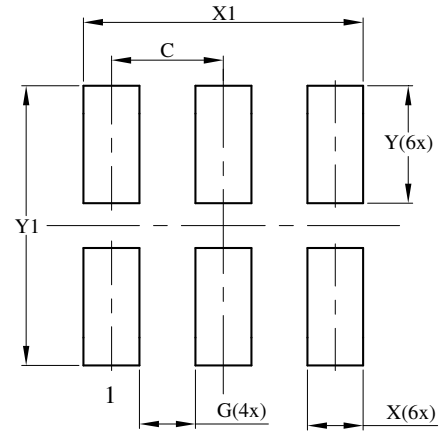
Dimensions	Value (in mm)
C	1.000
C1	0.500
D	0.300
G	0.200
G1	0.200
X	0.400
Y	0.150

**X2-DFN1410-6 Package Outline Dimensions and Suggested Pad Layout**

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



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			



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

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- Поставка образцов и прототипов;
- Техническая поддержка проекта;
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