

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:

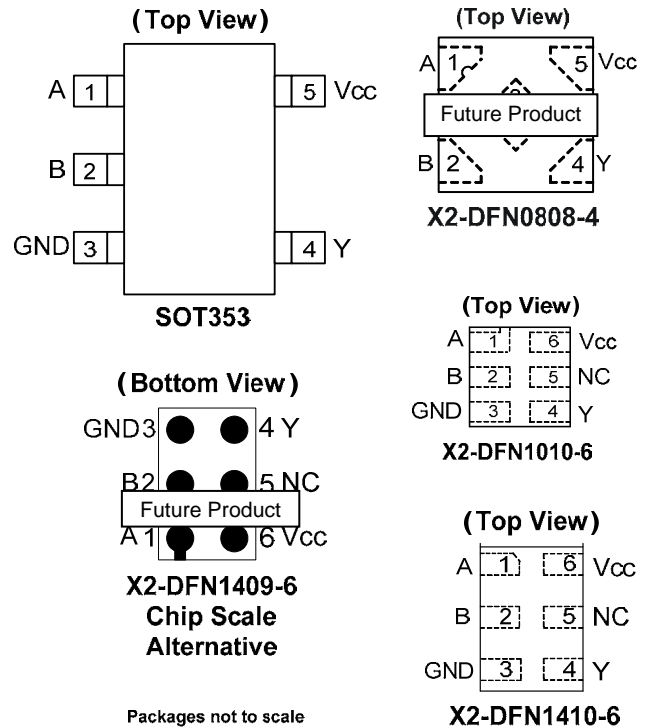
$$Y = A \cdot B \text{ or } Y = \overline{\overline{A + B}}$$

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_{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
- Leadless packages named per JESD30E
- **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

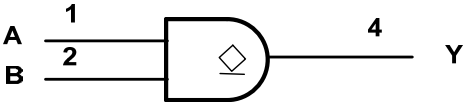
- Suited for battery and low power needs
- Wide array of products such as:
 - Tablets, E-readers
 - Cell Phones, Personal Navigation / GPS
 - MP3 players, Cameras, Video Recorders
 - PCs ultrabooks, notebooks, netbooks,
 - Computer peripherals, hard drives, CD/DVD ROM
 - TV, DVD, DVR, set top box

[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) (@ $T_A = +25^\circ\text{C}$, 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})	± 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_{OL}	Low-Level Output Current	$V_{CC} = 0.8\text{V}$	20	μA
		$V_{CC} = 1.1\text{V}$	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 3.6V	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_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}	Low-Level Output 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}	Low-Level Output 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

 $C_L=5\text{pF}$ 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	

 $C_L=10\text{pF}$ 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	

 $C_L=15\text{pF}$ 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	

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

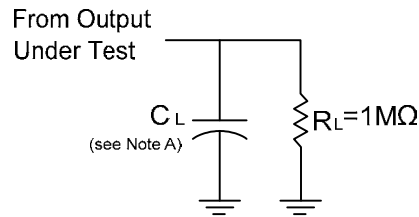
Parameter	From Input	TO OUTPUT	V _{CC}	T _A = +25°C			T _A = -40°C to +85°C		T _A = -40°C to +125°C		Unit
				Min	Typ	Max	Min	Max	Min	Max	
t _{pd}	A	Y	0.8V		27						ns
			1.2V ± 0.1V	3.6	9.5	19.5	3.2	21.8	3.2	24	
			1.5V ± 0.1V	2.9	8.5	16.1	2.6	13.6	2.6	15	
			1.8V ± 0.15V	2.6	7.7	15.2	2.3	13.3	2.3	14.6	
			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	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 _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-DFN0808-4		430		
		X2-DFN1010-6		445		
		X2-DFN1409-6		470		
		X2-DFN1410-6		460		
θ _{JC}	Thermal Resistance Junction-to-Case	SOT353	(Note 6)		143	°C/W
		X2-DFN0808-4		240		
		X2-DFN1010-6		250		
		X2-DFN1409-6		275		
		X2-DFN1410-6		265		

Note: 6. Test condition for , SOT353, X2-DFN0808-4., X2-DFN1010-6 X2-DFN1409-6 and X2-DFN1410-6: Device mounted on FR-4 substrate PC board, 2oz copper, with minimum recommended pad layout.

Parameter Measurement Information



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

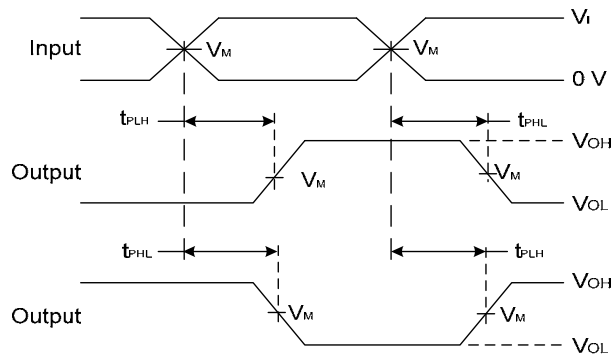
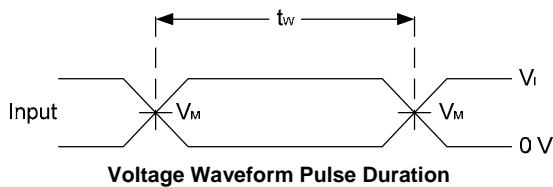
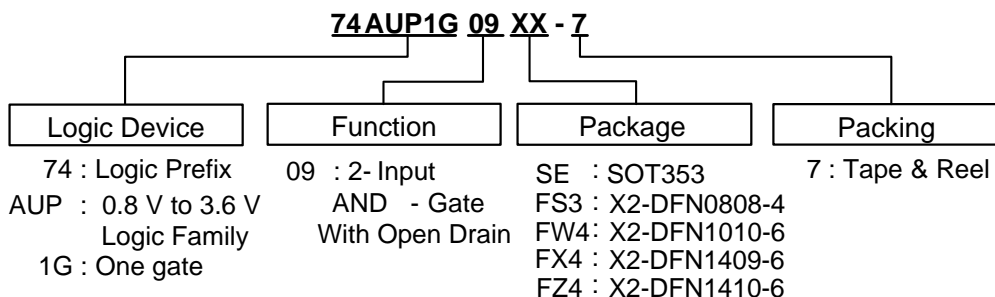


Figure 1 Load Circuit and Voltage Waveforms

- Notes:
- A. Includes test lead and test apparatus capacitance.
 - B. All pulses are supplied at pulse repetition rate ≤ 10MHz.
 - C. Inputs are measured separately one transition per measurement.
 - D. t_{PLH} and t_{PHL} are the same as t_{PD} .

Ordering Information



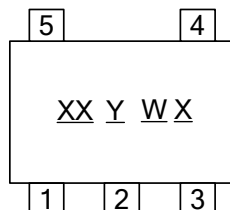
Device	Package Code	Packaging	7" Tape and Reel (Note 7)	
			Quantity	Part Number Suffix
74AUP1G09SE-7	SE	SOT353	3000/Tape & Reel	-7
74AUP1G09FS3-7**	FS3	X2-DFN0808-4	5000/Tape & Reel	-7
74AUP1G09FW4-7	FW4	X2-DFN1010-6	5000/Tape & Reel	-7
74AUP1G09FX4-7**	FX4	X2-DFN1409-6	5000/Tape & Reel	-7
74AUP1G09FZ4-7	FZ4	X2-DFN1410-6	5000/Tape & Reel	-7

Note: 7. The taping orientation is located on our website at <http://www.diodes.com/datasheets/ap02007.pdf>
 ** Future Products – Contact your Diodes sales representative for availability.

Marking Information

(1) SOT353

(Top View)

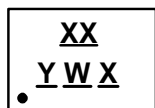


XX : Identification code
Y : Year 0~9
W : Week : A~Z : 1~26 week;
 a~z : 27~52 week; z represents
 52 and 53 week
X : A~Z : Internal code

Part Number	Package	Identification Code
74AUP1G09SE	SOT353	XR

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

(Top View)



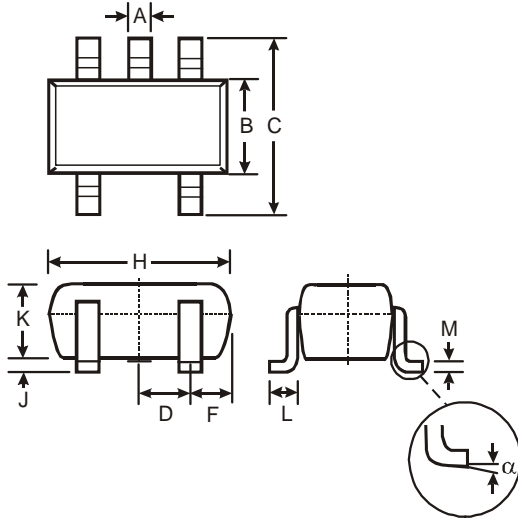
XX : Identification Code
Y : Year : 0~9
W : Week : A~Z : 1~26 week;
 a~z : 27~52 week; z represents
 52 and 53 week
X : A~Z : Internal code

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

Package Outline Dimensions (All dimensions in mm.)

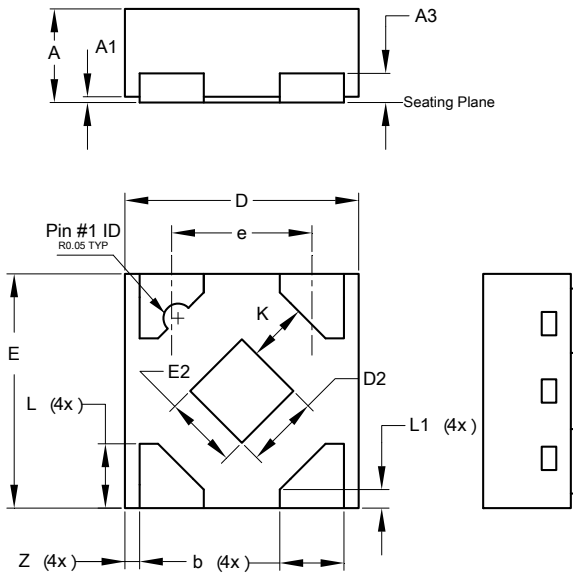
Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for latest version.

(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-DFN0808-4

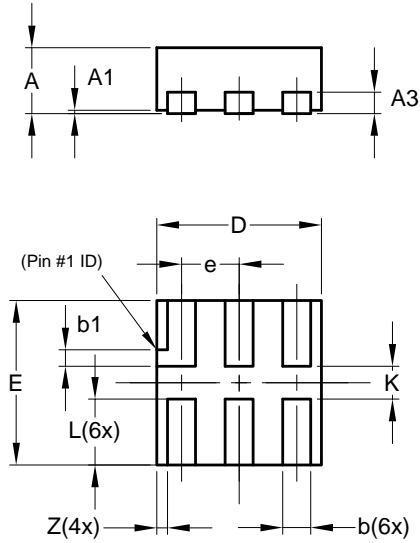


X2-DFN0808-4			
Dim	Min	Max	Typ
A	0.25	0.35	0.30
A1	0	0.04	0.02
A3	-	-	0.13
b	0.17	0.27	0.22
D	0.75	0.85	0.80
D2	0.15	0.35	0.25
E	0.75	0.85	0.80
E2	0.15	0.35	0.25
e	-	-	0.48
K	0.20	-	-
L	0.17	0.27	0.22
L1	0.02	0.12	0.07
Z	-	-	0.05
All Dimensions in mm			

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

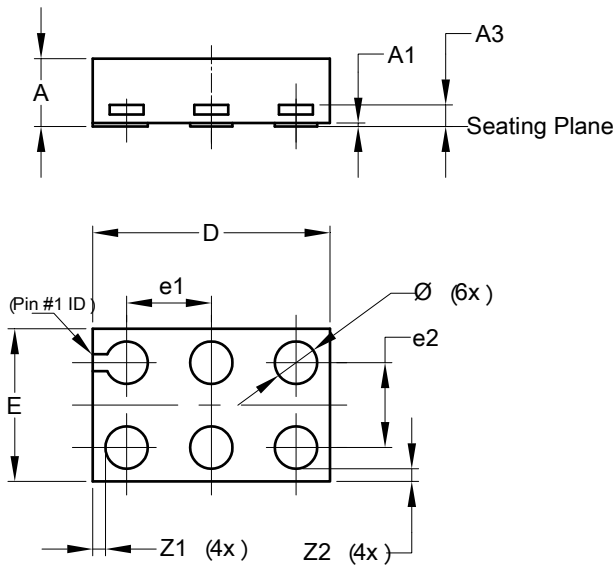
Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for latest version.

(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			

(4) X2-DFN1409-6

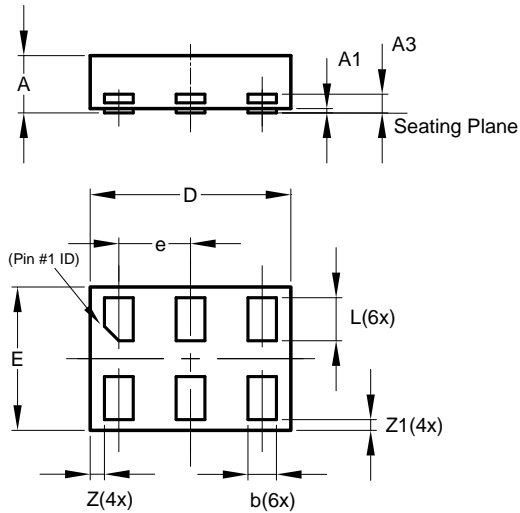


X2-DFN1409-6			
Dim	Min	Max	Typ
A	-	0.40	0.39
A1	0	0.05	0.02
A3	-	-	0.13
Ø	0.20	0.30	0.25
D	1.35	1.45	1.40
E	0.85	0.95	0.90
e1	-	-	0.50
e2	-	-	0.50
Z1	-	-	0.075
Z2	-	-	0.075
All Dimensions in mm			

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

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

(5) X2-DFN1410-6

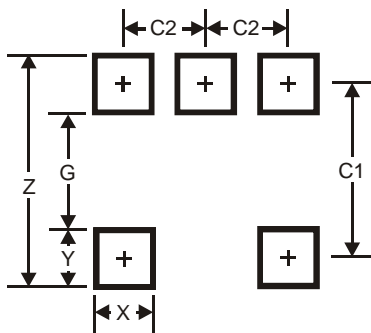


X2-DFN1410-6			
Dim	Min	Max	Typ
A	—	0.40	0.39
A1	0.00	0.05	0.02
A3	—	—	0.13
b	0.15	0.25	0.20
D	1.35	1.45	1.40
E	0.95	1.05	1.00
e	—	—	0.50
L	0.25	0.35	0.30
Z	—	—	0.10
Z1	0.045	0.105	0.075
All Dimensions in mm			

Suggested Pad Layout

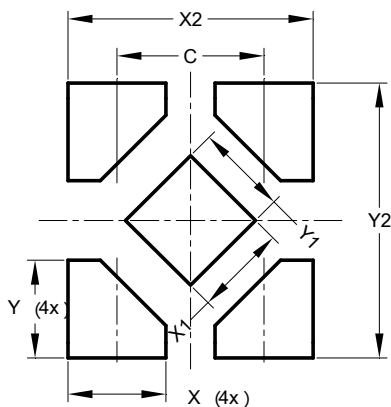
Please see AP02001 at <http://www.diodes.com/datasheets/ap02001.pdf> for the latest version

(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-DFN0808-4

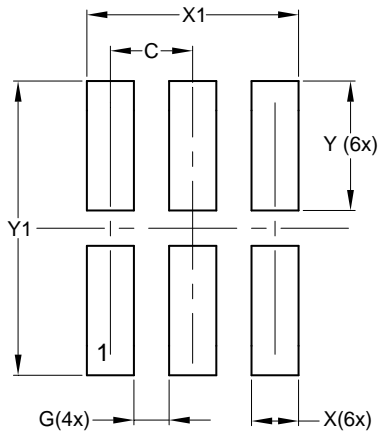


Dimensions	Value (in mm)
C	0.480
X	0.320
X1	0.300
X2	0.800
Y	0.320
Y1	0.300
Y2	0.900

Suggested Pad Layout

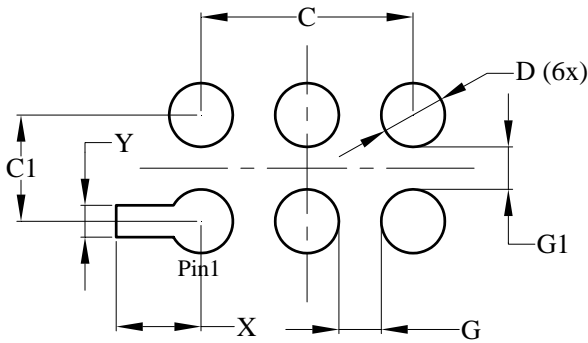
Please see AP02001 at <http://www.diodes.com/datasheets/ap02001.pdf> for the latest version

(3) X2-DFN1010-6



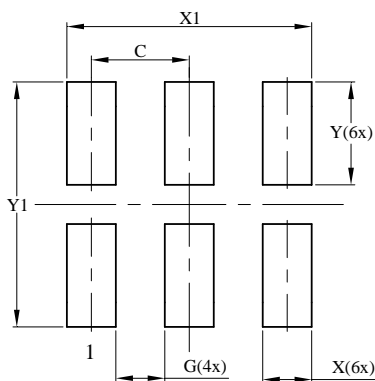
Dimensions	Value (in mm)
C	0.350
G	0.150
X	0.200
X1	0.900
Y	0.550
Y1	0.350

(4) X2-DFN1409-6



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

(5) 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

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