Low-power inverter with open-drain output

Rev. 2 — 20 July 2021

Product data sheet

1. General description

The 74AXP1G06 is a single inverter with open-drain output.

Schmitt-trigger action at the input makes the circuit tolerant of slower input rise and fall times.

This device ensures very low static and dynamic power consumption across the entire V_{CC} range from 0.7 V to 2.75 V. It is fully specified for partial power down applications using I_{OFF}. The I_{OFF} circuitry disables the output, preventing the potentially damaging backflow current through the device when it is powered down.

2. Features and benefits

- Wide supply voltage range from 0.7 V to 2.75 V
- Low input capacitance; C_I = 0.5 pF (typical)
- Low output capacitance; C_O = 0.7 pF (typical)
- Low dynamic power consumption; C_{PD} = 1.0 pF at V_{CC} = 1.2 V (typical)
- Low static power consumption; I_{CC} = 0.6 μA (85 °C maximum)
- High noise immunity
 - Complies with JEDEC standard:
 - JESD8-12A.01 (1.1 V to 1.3 V)
 - JESD8-11A.01 (1.4 V to 1.6 V)
 - JESD8-7A (1.65 V to 1.95 V)
 - JESD8-5A.01 (2.3 V to 2.7 V)
- ESD protection:
 - HBM ANSI/ESDA/JEDEC JS-001 Class 2 exceeds 2 kV
 - CDM JESD22-C101E exceeds 1000 V
- Latch-up performance exceeds 100 mA per JESD 78 Class II
- Input accepts voltages up to 2.75 V
- Low noise overshoot and undershoot < 10 % of V_{CC}
- I_{OFF} circuitry provides partial Power-down mode operation
- Multiple package options
- Specified from -40 °C to +85 °C

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3. Ordering information

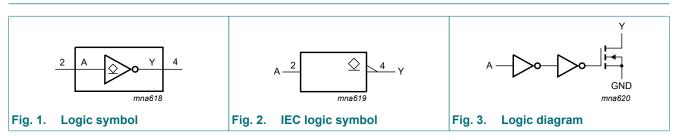
Type number	Package										
	Temperature range	Name	Description	Version							
74AXP1G06GM	-40 °C to +85 °C	XSON6	plastic extremely thin small outline package; no leads; 6 terminals; body 1 × 1.45 × 0.5 mm	SOT886							
74AXP1G06GN	-40 °C to +85 °C	XSON6	extremely thin small outline package; no leads; 6 terminals; body 0.9 × 1.0 × 0.35 mm	SOT1115							
74AXP1G06GS	-40 °C to +85 °C	XSON6	extremely thin small outline package; no leads; 6 terminals; body 1.0 × 1.0 × 0.35 mm	SOT1202							
74AXP1G06GX	-40 °C to +85 °C	X2SON5	plastic thermal enhanced extremely thin small outline package; no leads; 5 terminals; body 0.8 × 0.8 × 0.32 mm	SOT1226-3							

4. Marking

Table 2. Marking							
Type number	Marking code[1]						
74AXP1G06GM	rR						
74AXP1G06GN	rR						
74AXP1G06GS	rR						
74AXP1G06GX	rR						

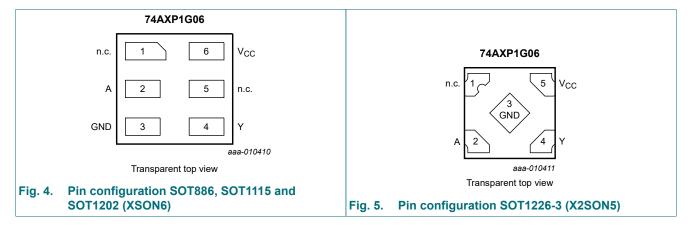
[1] The pin 1 indicator is located on the lower left corner of the device, below the marking code.

5. Functional diagram



6. Pinning information

6.1. Pinning



6.2. Pin description

Table 3. Pin description

Symbol	Pin	Pin					
	X2SON5	XSON6					
n.c.	1	1	not connected				
A	2	2	data input				
GND	3	3	ground (0 V)				
Y	4	4	data output				
n.c.	-	5	not connected				
V _{CC}	5	6	supply voltage				

7. Functional description

Table 4. Function table

H = HIGH voltage level; L = LOW voltage level; Z = high-impedance OFF-state.

Input	Output
Α	Y
L	Z
Н	L

8. Limiting values

Table 5. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	Min	Max	Unit
V _{CC}	supply voltage		-0.5	+3.3	V
I _{IK}	input clamping current	V ₁ < 0 V	-50	-	mA
VI	input voltage	[1	-0.5	+3.3	V
I _{ОК}	output clamping current	V _O < 0 V	-50	-	mA
Vo	output voltage	[1	-0.5	+3.3	V
I _O	output current	$V_{O} = 0 V \text{ to } V_{CC}$	-	±20	mA
I _{CC}	supply current		-	50	mA
I _{GND}	ground current		-50	-	mA
T _{stg}	storage temperature		-65	+150	°C
P _{tot}	total power dissipation	$T_{amb} = -40 \ ^{\circ}C \ to \ +85 \ ^{\circ}C$ [2	- 1	250	mW

[1] The minimum input and output voltage ratings may be exceeded if the input and output current ratings are observed.

For SOT886 (XSON6) package: P_{tot} derates linearly with 3.3 mW/K above 74 °C.
 For SOT1115 (XSON6) package: P_{tot} derates linearly with 3.2 mW/K above 71 °C.
 For SOT1202 (XSON6) package: P_{tot} derates linearly with 3.3 mW/K above 74 °C.

For SOT1226-3 (X2SON5) package: P_{tot} derates linearly with 3.0 mW/K above 67 $^\circ\text{C}.$

9. Recommended operating conditions

Table 6. Recommended operating conditions

Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	Min	Max	Unit
V _{CC}	supply voltage		0.7	2.75	V
VI	input voltage		0	2.75	V
Vo	output voltage	Active mode	0	V _{CC}	V
		Power-down mode; V _{CC} = 0 V	0	2.75	V
T _{amb}	ambient temperature		-40	+85	°C
Δt/ΔV	input transition rise and fall rate	$V_{CC} = 0.7 V \text{ to } 2.75 V$	0	200	ns/V

10. Static characteristics

Table 7. Static characteristics

At recommended operating conditions, unless otherwise specified; voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions		Ta	_{mb} = 25	°C	T _{amb} = -40 °	°C to +85 °C	Unit
				Min	Тур	Max	Min	Max	1
V _{IH}	HIGH-level input	V _{CC} = 0.75 V to 0.85 V		0.75V _{CC}	-	-	0.75V _{CC}	-	V
	voltage	V _{CC} = 1.1 V to 1.95 V		$0.65V_{CC}$	-	-	0.65V _{CC}	-	V
		V _{CC} = 2.3 V to 2.7 V		1.6	-	-	1.6	-	V
V _{IL}	LOW-level input	V _{CC} = 0.75 V to 0.85 V		-	-	0.25V _{CC}	-	0.25V _{CC}	V
	voltage	V _{CC} = 1.1 V to 1.95 V		-	-	0.35V _{CC}	-	0.35V _{CC}	V
		V _{CC} = 2.3 V to 2.7 V		-	-	0.7	-	0.7	V
V _{OL}		I _O = 20 μA; V _{CC} = 0.7 V		-	0.01	-	-	-	V
	voltage	I _O = 100 μA; V _{CC} = 0.75 V		-	-	0.1	-	0.1	V
		I _O = 2 mA; V _{CC} = 1.1 V		-	-	0.275	-	0.275	V
		I _O = 3 mA; V _{CC} = 1.4 V		-	-	0.35	-	0.35	V
		I _O = 4.5 mA; V _{CC} = 1.65 V		-	-	0.45	-	0.45	V
		I _O = 8 mA; V _{CC} = 2.3 V		-	-	0.7	-	0.7	V
I _I	input leakage current	V _I = 0 V to 2.75 V; V _{CC} = 0 V to 2.75 V	[1]	-	0.001	±0.1	-	±0.5	μA
I _{OZ}	OFF-state output current	$V_{I} = V_{IL}; V_{O} = 0 V \text{ to } 2.75 V$	[1]	-	0.02	±0.1	-	±0.5	μA
I _{OFF}	power-off leakage current	$V_1 \text{ or } V_0 = 0 \text{ V to } 2.75 \text{ V};$ $V_{CC} = 0 \text{ V}$	[1]	-	0.01	±0.1	-	±0.5	μA
∆I _{OFF}	additional power-off leakage current	V _I or V _O = 0 V or 2.75 V; V _{CC} = 0 V to 0.1 V	[1]	-	0.02	±0.1	-	±0.5	μA
I _{CC}	supply current	$V_{I} = 0 V \text{ or } V_{CC}; I_{O} = 0 A$	[1]	-	0.01	0.3	-	0.6	μA
ΔI _{CC}	additional supply current	$V_{I} = V_{CC} - 0.5 \text{ V}; I_{O} = 0 \text{ A};$ $V_{CC} = 2.5 \text{ V}$		-	2	100	-	150	μA

[1] All typical values are measured at V_{CC} = 1.2 V.

11. Dynamic characteristics

Table 8. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V); for test circuit, see Fig. 12.

Symbol	Parameter	Conditions		Τa	_{mb} = 25	°C	T _{amb} = -40 °	°C to +85 °C	Unit
				Min	Typ[1]	Мах	Min	Мах]
t _{pd}	propagation	A to Y; see <u>Fig. 6</u>	[2] [3]						
	delay	V _{CC} = 0.75 V to 0.85 V		3	12	33	3	104	ns
		V _{CC} = 1.1 V to 1.3 V		2.2	5.1	7.9	2.0	8.3	ns
		V _{CC} = 1.4 V to 1.6 V		1.7	3.7	5.2	1.5	5.6	ns
		V _{CC} = 1.65 V to 1.95 V		1.4	3.5	5.3	1.2	5.6	ns
		V _{CC} = 2.3 V to 2.7 V		1.2	2.6	3.8	1.0	4.0	ns
t _t	transition time	V _{CC} = 2.7 V; see <u>Fig. 6</u>	[4]	-	-	-	0.9	-	ns
CI	input capacitance	V _I = 0 V or V _{CC} ; V _{CC} = 0 V to 2.75 V		-	0.5	-	-	-	pF
Co	output capacitance	V _O = 0 V; V _{CC} = 0 V		-	0.7	-	-	-	pF
C _{PD}		$f_i = 1 \text{ MHz}; V_I = 0 \text{ V to } V_{CC}$	[5]						
	capacitance	V _{CC} = 0.75 V to 0.85 V		-	0.9	-	-	-	pF
		V _{CC} = 1.1 V to 1.3 V		-	1.0	-	-	-	pF
		V _{CC} = 1.4 V to 1.6 V		-	1.0	-	-	-	pF
		V _{CC} = 1.65 V to 1.95 V		-	1.1	-	-	-	pF
		V _{CC} = 2.3 V to 2.7 V		-	1.3	-	-	-	pF

All typical values are measured at nominal V_{CC} . [1]

 t_{pd} is the same as t_{PZL} and t_{PLZ} . For additional propagation delay (t_{PZL}) values at different load capacitances see Fig. 7 to Fig. 11. [2] [3]

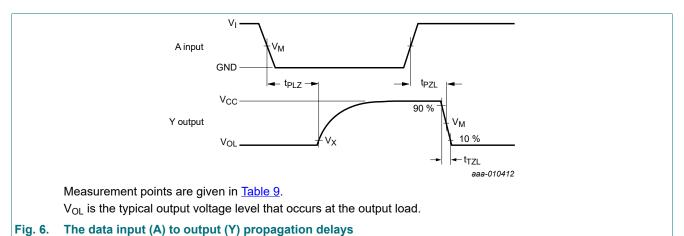
[4] t_t is the same as t_{TZL} and t_{TLZ} . [5] C_{PD} is used to determine the dynamic power dissipation (P_D in μ W). $P_D = C_{PD} \times V_{CC}^2 \times f_i + C_L \times V_{CC}^2 \times f_o$ where:

 f_i = input frequency in MHz;

fo = output frequency in MHz;

 C_{L} = output load capacitance in pF;

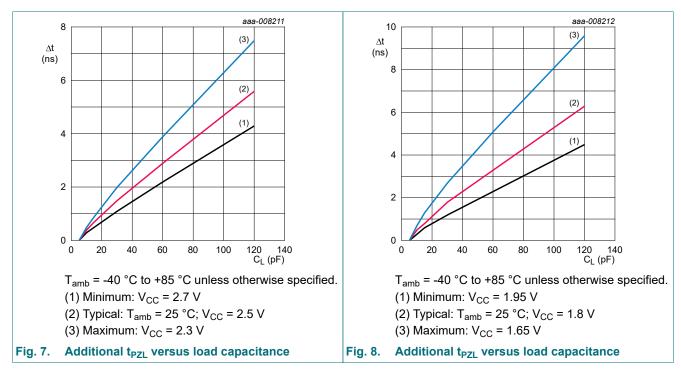
V_{CC} = supply voltage in V.

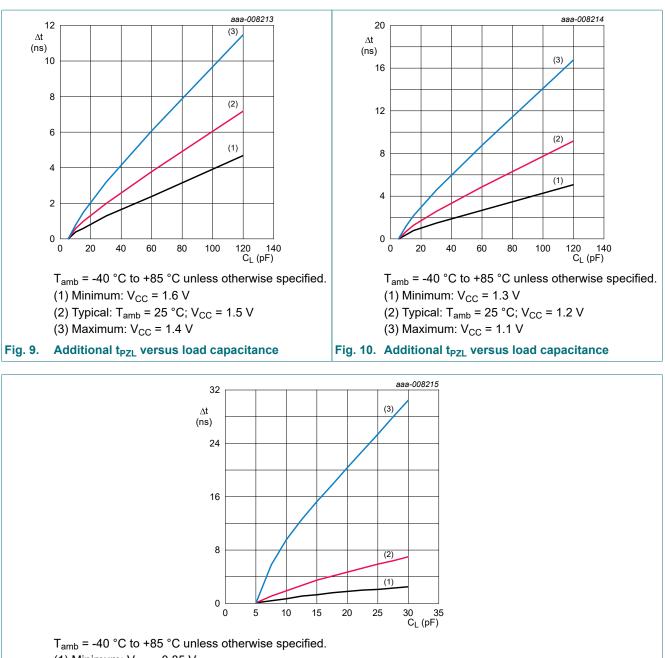


11.1. Waveform, graphs and test circuit

Table 9. Measurement points

Supply voltage	Input		Output			
V _{cc}	V _M	VI	t _r = t _f	V _M	V _x	
0.75 V to 1.6 V	0.5V _{CC}	V _{CC}	≤ 3.0 ns	0.5V _{CC}	V _{OL} + 0.1 V	
1.65 V to 2.7 V	0.5V _{CC}	V _{CC}	≤ 3.0 ns	0.5V _{CC}	V _{OL} + 0.15 V	



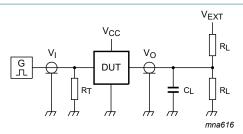


- (1) Minimum: V_{CC} = 0.85 V
- (2) Typical: T_{amb} = 25 °C; V_{CC} = 0.8 V
- (3) Maximum: V_{CC} = 0.75 V



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Test data is given in <u>Table 10</u>.

Definitions for test circuit:

R_L = Load resistance.

 C_{L} = Load capacitance including jig and probe capacitance.

 R_T = Termination resistance should be equal to the output impedance Z_o of the pulse generator.

 V_{EXT} = External voltage for measuring switching times.

Fig. 12. Test circuit for measuring switching times

Table 10. Test data

Supply voltage	Load		V _{EXT}		
V _{cc}	C _L R _L		t _{PLH} , t _{PHL}	t _{PZL} , t _{PLZ}	
0.75 V to 2.7 V	5 pF	10 kΩ	0 V	2 x V _{CC}	

12. Package outline

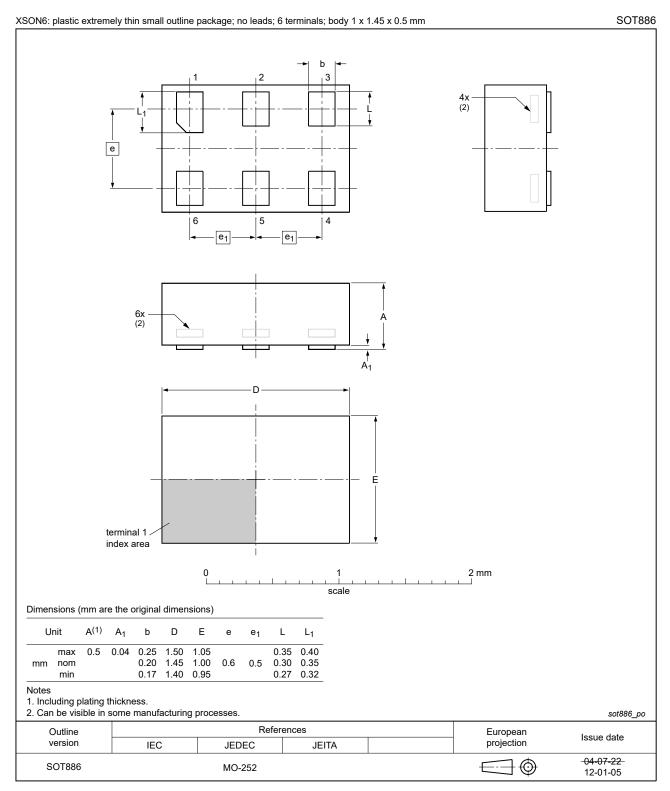
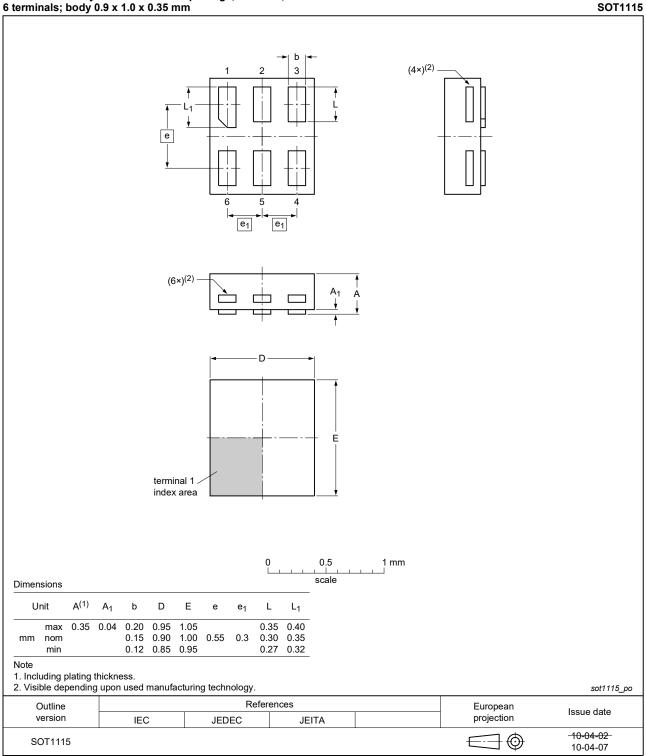


Fig. 13. Package outline SOT886 (XSON6)

74AXP1G06

XSON6: extremely thin small outline package; no leads; 6 terminals; body 0.9 x 1.0 x 0.35 mm





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terminals; body	/ 1.0 x	1.0 x	0.35 n	nm										SOT
			e	↓		-e ₁ -	2		- <u>+</u> <u>+</u> -		(4×) ⁽²			
			(6×)(2) —] [† A ↓				
			termina index a				- D		- E					
Dimensions							0		0.5 cale	1 r 	nm			
Unit A ⁽¹⁾	A ₁	b	D	Е	е	e ₁	L	L ₁						
mm nom min	5 0.04	0.15	1.05 1.00 0.95	1.00	0.55	0.35	0.30	0.40 0.35 0.32						
Note 1. Including plating 2. Visible dependi	g thickne	ess.	manufa	oturin	a techr	nloav								sot1202_
Outline		useu I	nanula	Journ	y ieun		eferen	ces				Eur	opean	
version		IEC	;		JED			JEIT	٩			pro	ection	Issue date
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Fig. 15. Package outline SOT1202 (XSON6)

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5 terminals; body 0.8 x 0.8 x 0.32 mm SOT1226-3 С Seating Plane ____y _C____ 5x X Α В D E A₃ pin 1 . index area A₁ pin 1 е index area b // y1 C → 2 ^(4x) v M C A B φ w M C t L (4x) Ŧ 3 (6x) 1 5 4 1 mm 0 scale Dimensions (mm are the original dimensions) Unit A_1 D Dh Е А b Κ L A₃ е v w у У1 max 0.35 0.04 mm nom 0.32 0.02 0.85 0.30 0.85 0.80 0.25 0.80 0.25 0.27 0.10 0.20 0.50 0.22 0.1 0.05 0.05 0.05 (Typ.) 0.00 0.20 0.20 0.17 min 0.30 0.00 0.75 0.15 sot1226-3_po References Outline European Issue date version IEC projection JEDEC EIAJ -19-11-06-19-11-07 \bigcirc SOT1226-3 - - -

X2SON5: plastic thermal enhanced extremely thin small outline package; no leads; 5 terminals; body 0.8 x 0.8 x 0.32 mm

Fig. 16. Package outline SOT1226-3 (X2SON5)

13. Abbreviations

Table 11. Abbreviations							
Acronym	Description						
CDM	Charged Device Model						
DUT	Device Under Test						
ESD	ElectroStatic Discharge						
НВМ	Human Body Model						

14. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes	
74AXP1G06 v.2	20210720	Product data sheet	-	74AXP1G06 v.1	
Modifications:	 SOT1226 (X2SON5) package changed to SOT1226-3 (X2SON5) package. <u>Table 5</u>: Derating values for P_{tot} total power dissipation updated. 				
74AXP1G06 v.1	20140115	Product data sheet	-	-	

74AXP1G06

15. Legal information

Data sheet status

Document status [1][2]	Product status [3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
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