

74AXP1G00

Low-power 2-input NAND gate

Rev. 2 — 6 July 2021

Product data sheet

1. General description

The 74AXP1G00 is a single 2-input NAND gate.

Schmitt-trigger action at all inputs 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; $C_O = 1.0$ pF (typical)
- Low dynamic power consumption; $C_{PD} = 2.5$ pF at $V_{CC} = 1.2$ V (typical)
- Low static power consumption; $I_{CC} = 0.6$ μ A (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
- Inputs accept 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

3. Ordering information

Table 1. Ordering information

| Type number | Package | | | |
|-------------|-------------------|--------|--|-----------|
| | Temperature range | Name | Description | Version |
| 74AXP1G00GM | -40 °C to +85 °C | XSON6 | plastic extremely thin small outline package; no leads; 6 terminals; body 1 × 1.45 × 0.5 mm | SOT886 |
| 74AXP1G00GN | -40 °C to +85 °C | XSON6 | extremely thin small outline package; no leads; 6 terminals; body 0.9 × 1.0 × 0.35 mm | SOT1115 |
| 74AXP1G00GS | -40 °C to +85 °C | XSON6 | extremely thin small outline package; no leads; 6 terminals; body 1.0 × 1.0 × 0.35 mm | SOT1202 |
| 74AXP1G00GX | -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] |
|-------------|-----------------|
| 74AXP1G00GM | rA |
| 74AXP1G00GN | rA |
| 74AXP1G00GS | rA |
| 74AXP1G00GX | rA |

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

5. Functional diagram

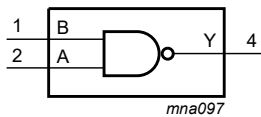


Fig. 1. Logic symbol

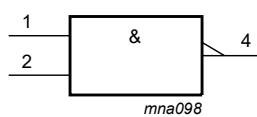


Fig. 2. IEC logic symbol

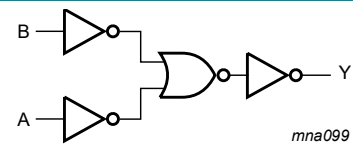
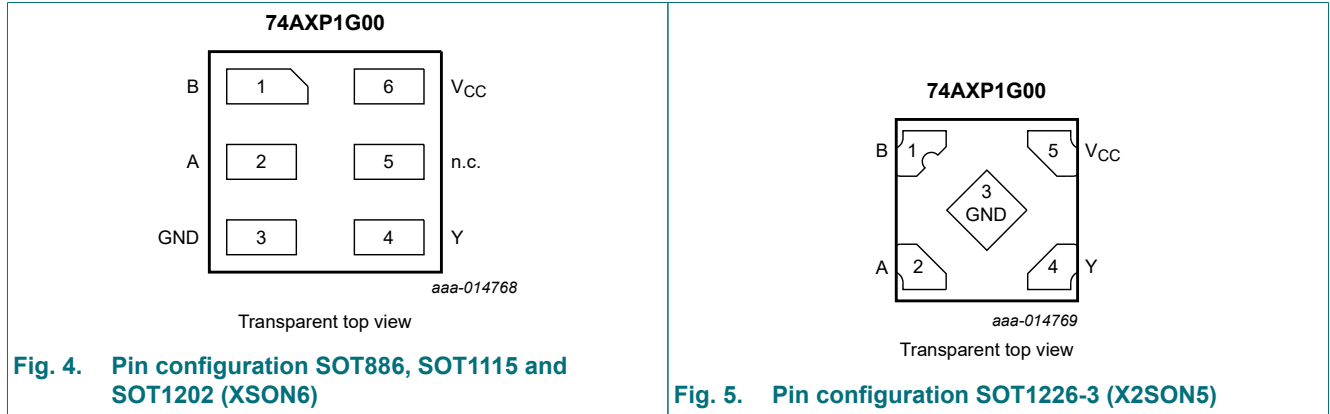


Fig. 3. Logic diagram

6. Pinning information

6.1. Pinning



6.2. Pin description

Table 3. Pin description

| Symbol | Pin | | Description |
|-----------------|--------|-------|----------------|
| | X2SON5 | XSON6 | |
| B | 1 | 1 | data input |
| 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.

| Input | Input | | Output |
|-------|-------|--|--------|
| A | B | | Y |
| L | L | | H |
| L | H | | H |
| H | L | | H |
| H | H | | 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 | $V_I < 0$ V | -50 | - | mA |
| V_I | input voltage | | -0.5 | +3.3 | V |
| I_{OK} | output clamping current | $V_O < 0$ V | -50 | - | mA |
| V_O | output voltage | | -0.5 | +3.3 | V |
| I_O | output current | $V_O = 0$ V 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 | $T_{amb} = -40$ °C to +85 °C | - | 250 | mW |

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

[2] 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 °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 |
| V_I | input voltage | | 0 | 2.75 | V |
| V_O | 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 |
| $\Delta t/\Delta V$ | input transition rise and fall rate | $V_{CC} = 0.7$ V 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 | T _{amb} = 25 °C | | | T _{amb} = -40 °C to +85 °C | | Unit |
|-------------------|--------------------------------------|---|--------------------------|-------|---------------------|-------------------------------------|---------------------|------|
| | | | Min | Typ | Max | Min | Max | |
| V _{IH} | HIGH-level input voltage | V _{CC} = 0.75 V to 0.85 V | 0.75V _{CC} | - | - | 0.75V _{CC} | - | V |
| | | 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 voltage | V _{CC} = 0.75 V to 0.85 V | - | - | 0.25V _{CC} | - | 0.25V _{CC} | V |
| | | 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 _{OH} | HIGH-level output voltage | I _O = -20 µA; V _{CC} = 0.7 V | - | 0.69 | - | - | - | V |
| | | I _O = -100 µA; V _{CC} = 0.75 V | 0.65 | - | - | 0.65 | - | V |
| | | I _O = -2 mA; V _{CC} = 1.1 V | 0.825 | - | - | 0.825 | - | V |
| | | I _O = -3 mA; V _{CC} = 1.4 V | 1.05 | - | - | 1.05 | - | V |
| | | I _O = -4.5 mA; V _{CC} = 1.65 V | 1.2 | - | - | 1.2 | - | V |
| | | I _O = -8 mA; V _{CC} = 2.3 V | 1.7 | - | - | 1.7 | - | V |
| V _{OL} | LOW-level output voltage | I _O = 20 µA; V _{CC} = 0.7 V | - | 0.01 | - | - | - | V |
| | | 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 _{OFF} | power-off leakage current | V _I or V _O = 0 V to 2.75 V; V _{CC} = 0 V [1] | - | 0.01 | ±0.1 | - | ±0.5 | µA |
| ΔI _{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 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 V; I _O = 0 A; V _{CC} = 2.5 V | - | 2 | 100 | - | 150 | µA |

[1] 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 | T _{amb} = 25 °C | | | T _{amb} = -40 °C to +85 °C | | Unit |
|-----------------|-------------------------------|--|--------------------------|--------|-----|-------------------------------------|-----|------|
| | | | Min | Typ[1] | Max | Min | Max | |
| t _{pd} | propagation delay | A, B to Y; see Fig. 6 [2] [3] | | | | | | |
| | | V _{CC} = 0.75 V to 0.85 V | 3 | 12 | 36 | 1 | 120 | ns |
| | | V _{CC} = 1.1 V to 1.3 V | 1.9 | 4.5 | 7.1 | 1.8 | 7.4 | ns |
| | | V _{CC} = 1.4 V to 1.6 V | 1.5 | 3.3 | 4.9 | 1.4 | 5.2 | ns |
| | | V _{CC} = 1.65 V to 1.95 V | 1.3 | 2.7 | 4.0 | 1.1 | 4.3 | ns |
| | | V _{CC} = 2.3 V to 2.7 V | 1.1 | 2.1 | 3.0 | 0.9 | 3.2 | ns |
| t _t | transition time | V _{CC} = 2.7 V; see Fig. 6 [4] | - | - | - | 1.0 | - | ns |
| C _I | input capacitance | V _I = 0 V or V _{CC} ; V _{CC} = 0 V to 2.75 V | - | 0.5 | - | - | - | pF |
| C _O | output capacitance | V _O = 0 V; V _{CC} = 0 V | - | 1.0 | - | - | - | pF |
| C _{PD} | power dissipation capacitance | f _i = 1 MHz; V _I = 0 V to V _{CC} [5] | | | | | | |
| | | V _{CC} = 0.75 V to 0.85 V | - | 2.4 | - | - | - | pF |
| | | V _{CC} = 1.1 V to 1.3 V | - | 2.5 | - | - | - | pF |
| | | V _{CC} = 1.4 V to 1.6 V | - | 2.5 | - | - | - | pF |
| | | V _{CC} = 1.65 V to 1.95 V | - | 2.6 | - | - | - | pF |
| | | V _{CC} = 2.3 V to 2.7 V | - | 3.0 | - | - | - | pF |

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

[2] t_{pd} is the same as t_{PLH} and t_{PHL}.

[3] For additional propagation delay values at different load capacitances, see Fig. 7 to Fig. 11.

[4] t_t is the same as t_{THL} and t_{TLH}.

[5] C_{PD} is used to determine the dynamic power dissipation (P_D in μW).

$$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + C_L \times V_{CC}^2 \times f_o \text{ where:}$$

f_i = input frequency in MHz;

f_o = output frequency in MHz;

C_L = output load capacitance in pF;

V_{CC} = supply voltage in V;

N = number of inputs switching.

11.1. Waveforms, graphs and test circuit

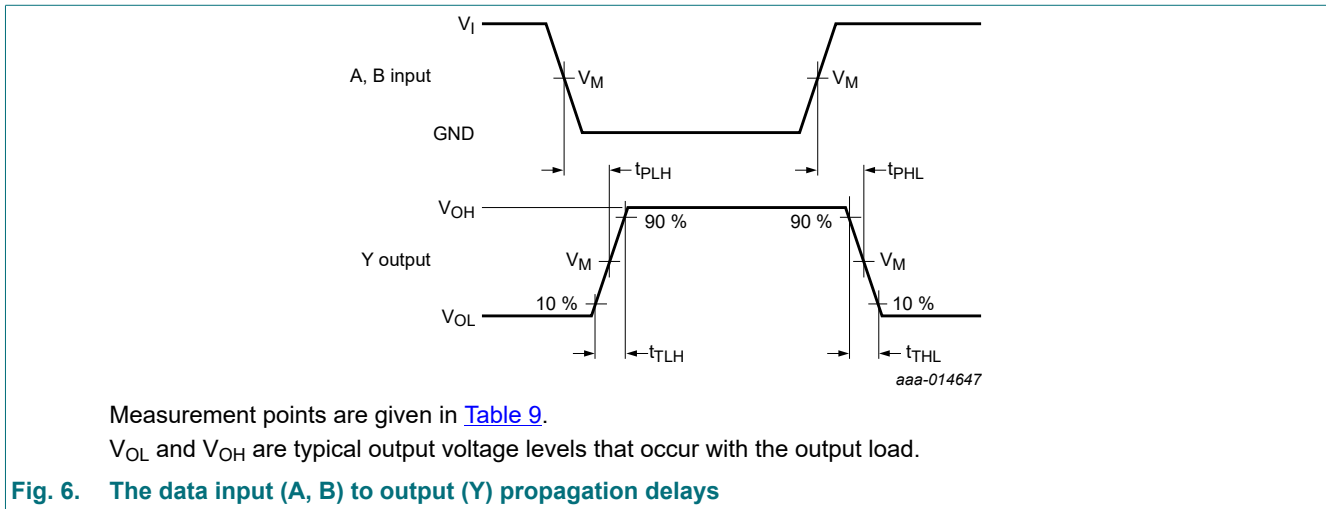
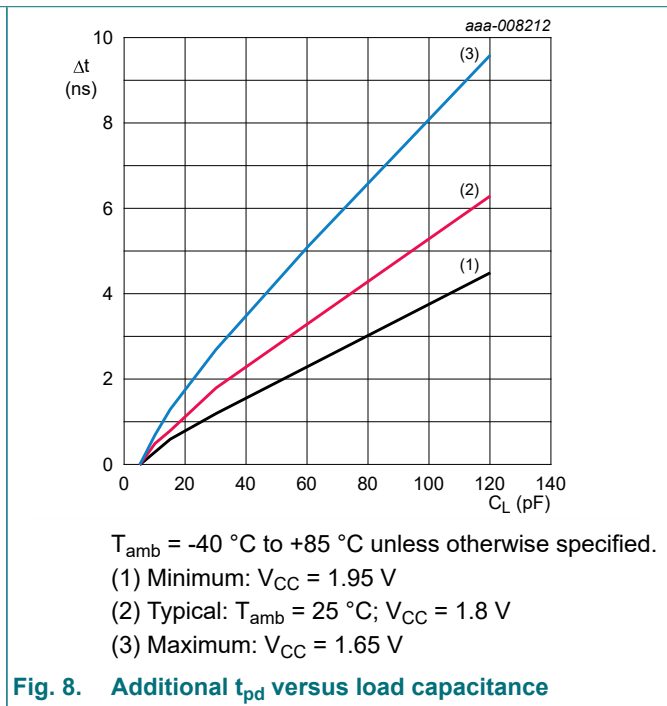
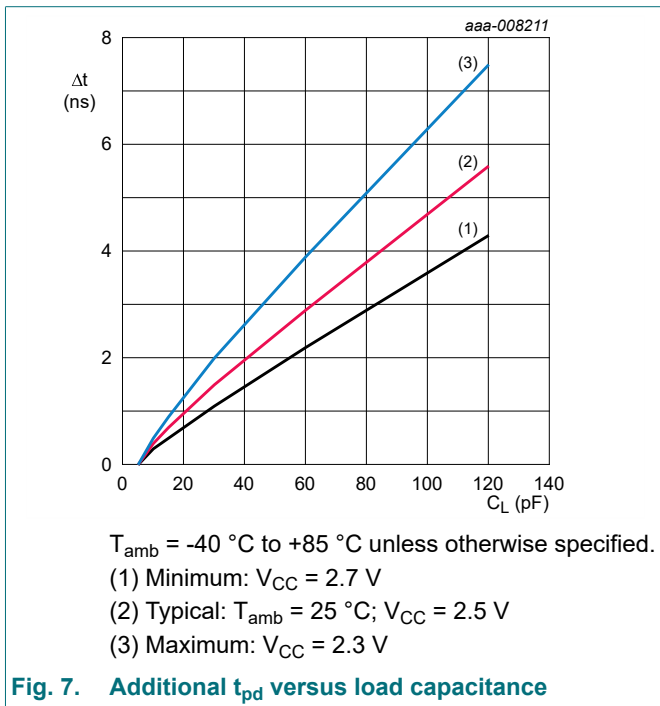
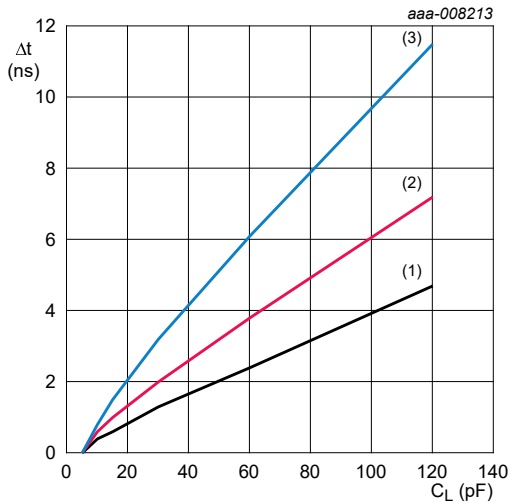


Table 9. Measurement points

| Supply voltage | Input | | | Output |
|-----------------|---------------------|----------|---------------|---------------------|
| V_{CC} | V_M | V_I | $t_r = t_f$ | V_M |
| 0.75 V to 2.7 V | $0.5 \times V_{CC}$ | V_{CC} | ≤ 3.0 ns | $0.5 \times V_{CC}$ |

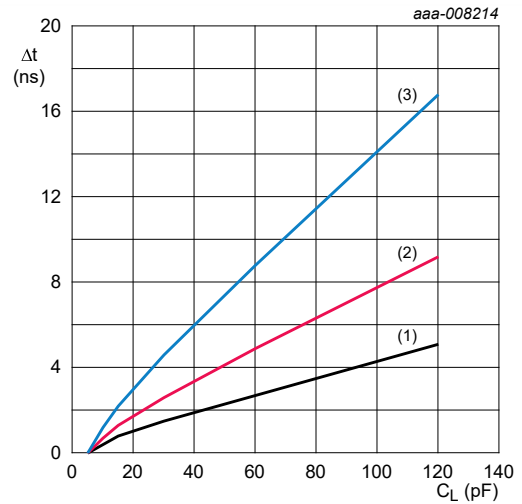




$T_{amb} = -40$ °C to $+85$ °C unless otherwise specified.

- (1) Minimum: $V_{CC} = 1.6$ V
- (2) Typical: $T_{amb} = 25$ °C; $V_{CC} = 1.5$ V
- (3) Maximum: $V_{CC} = 1.4$ V

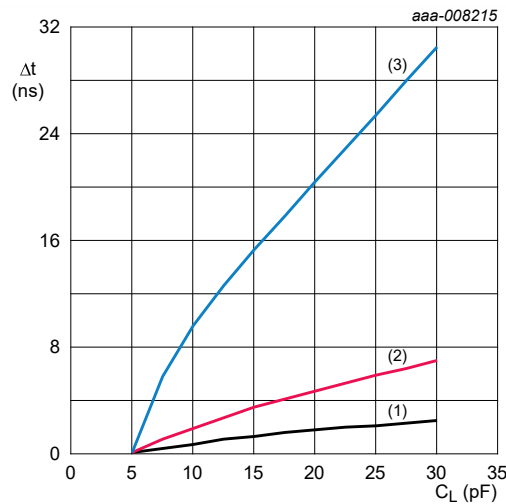
Fig. 9. Additional t_{pd} versus load capacitance



$T_{amb} = -40$ °C to $+85$ °C unless otherwise specified.

- (1) Minimum: $V_{CC} = 1.3$ V
- (2) Typical: $T_{amb} = 25$ °C; $V_{CC} = 1.2$ V
- (3) Maximum: $V_{CC} = 1.1$ V

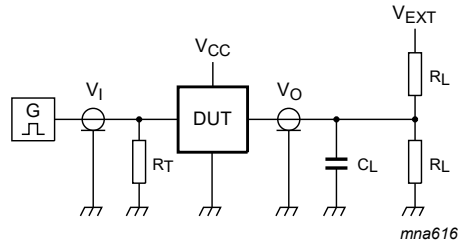
Fig. 10. Additional t_{pd} versus load capacitance



$T_{amb} = -40$ °C to $+85$ °C unless otherwise specified.

- (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

Fig. 11. Additional t_{pd} versus load capacitance



Test data is given in [Table 10](#).

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_{PZH}, t_{PHZ} | t_{PZL}, t_{PLZ} |
| 0.75 V to 2.7 V | 5 pF | 10 k Ω | 0 V | 0 V | $2 \times V_{CC}$ |

12. Package outline

XSON6: plastic extremely thin small outline package; no leads; 6 terminals; body 1 x 1.45 x 0.5 mm

SOT886

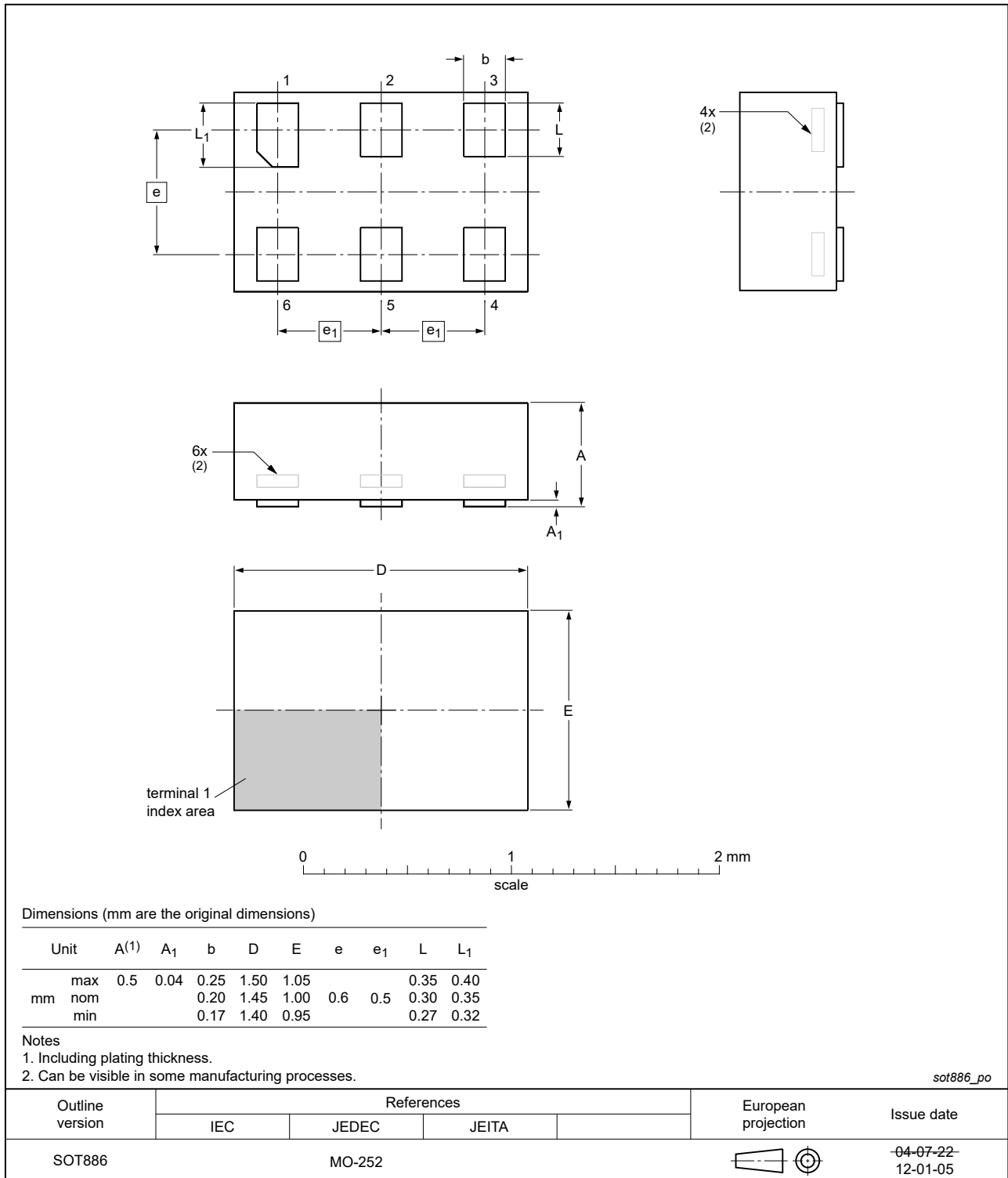


Fig. 13. Package outline SOT886 (XSON6)

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

SOT1115



Fig. 14. Package outline SOT1115 (XSON6)

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

SOT1202



Fig. 15. Package outline SOT1202 (XSON6)

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

SOT1226-3



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 |
| HBM | Human Body Model |

14. Revision history

Table 12. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|----------------|---|--------------------|---------------|---------------|
| 74AXP1G00 v.2 | 20210706 | Product data sheet | - | 74AXP1G00 v.1 |
| Modifications: | <ul style="list-style-type: none"> SOT1226 (X2SON5) package changed to SOT1226-3 (X2SON5) package. Table 5: Derating values for P_{tot} total power dissipation updated. | | | |
| 74AXP1G00 v.1 | 20140924 | Product data sheet | - | - |

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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- [2] The term 'short data sheet' is explained in section "Definitions".
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Contents

| | |
|--|-----------|
| 1. General description | 1 |
| 2. Features and benefits | 1 |
| 3. Ordering information | 2 |
| 4. Marking | 2 |
| 5. Functional diagram | 2 |
| 6. Pinning information | 3 |
| 6.1. Pinning..... | 3 |
| 6.2. Pin description..... | 3 |
| 7. Functional description | 3 |
| 8. Limiting values | 4 |
| 9. Recommended operating conditions | 4 |
| 10. Static characteristics | 5 |
| 11. Dynamic characteristics | 6 |
| 11.1. Waveforms, graphs and test circuit..... | 7 |
| 12. Package outline | 10 |
| 13. Abbreviations | 14 |
| 14. Revision history | 14 |
| 15. Legal information | 15 |

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Date of release: 6 July 2021
