74AXP1G98

Low-power configurable multiple function gate Rev. 2 — 13 November 2015 P

Product data sheet

General description 1.

The 74AXP1G98 is a configurable multiple function gate with Schmitt-trigger inputs. The device can be configured as any of the following logic functions MUX, AND, OR, NAND, NOR, inverter and buffer. All inputs can be connected directly to V_{CC} or GND.

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.

Features and benefits 2.

- 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; $C_{PD} = 2.7 \text{ pF}$ at $V_{CC} = 1.2 \text{ V}$ (typical)
- Low static power consumption; I_{CC} = 1.0 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
- 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



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3. Ordering information

Table 1. Ordering information

| Type number | Package | Package | | | | | | |
|-------------|-------------------|---------|---|---------|--|--|--|--|
| | Temperature range | Name | Description | Version | | | | |
| 74AXP1G98GM | –40 °C to +85 °C | XSON6 | plastic extremely thin small outline package; no leads; 6 terminals; body 1 \times 1.45 \times 0.5 mm | SOT886 | | | | |
| 74AXP1G98GN | –40 °C to +85 °C | XSON6 | extremely thin small outline package; no leads; 6 terminals; body $0.9 \times 1.0 \times 0.35$ mm | SOT1115 | | | | |
| 74AXP1G98GS | –40 °C to +85 °C | XSON6 | extremely thin small outline package; no leads; 6 terminals; body $1.0 \times 1.0 \times 0.35$ mm | SOT1202 | | | | |

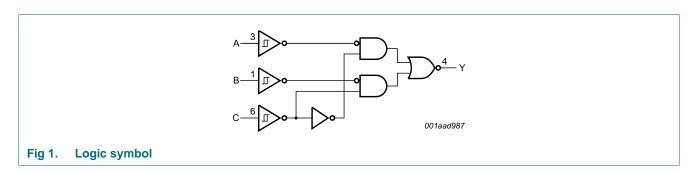
4. Marking

Table 2. Marking

| Type number | Marking code ^[1] |
|-------------|-----------------------------|
| 74AXP1G98GM | R9 |
| 74AXP1G98GN | R9 |
| 74AXP1G98GS | R9 |

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

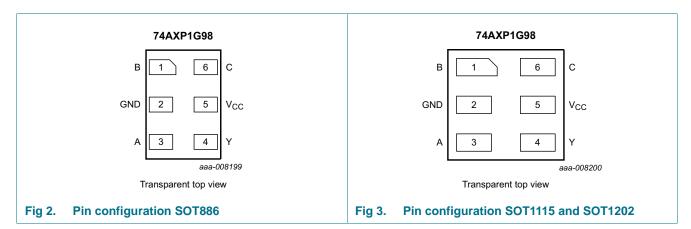
5. Functional diagram



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6. Pinning information

6.1 Pinning



6.2 Pin description

Table 3. Pin description

| Symbol | Pin | Description |
|-----------------|-----|----------------|
| В | 1 | data input |
| GND | 2 | ground (0 V) |
| А | 3 | data input |
| Υ | 4 | data output |
| V _{CC} | 5 | supply voltage |
| С | 6 | data input |

7. Functional description

Table 4. Function table[1]

| Input | Output | | |
|-------|--------|---|---|
| С | В | A | Υ |
| L | L | L | Н |
| L | L | Н | Н |
| L | Н | L | L |
| L | Н | Н | L |
| Н | L | L | Н |
| Н | L | Н | L |
| Н | Н | L | Н |
| Н | Н | Н | L |

^[1] H = HIGH voltage level;

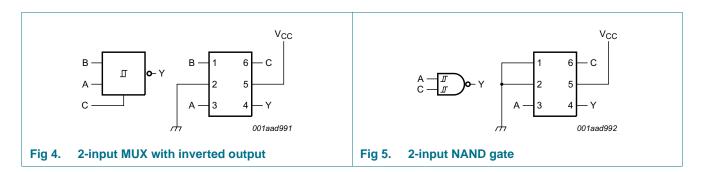
L = LOW voltage level.

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7.1 Logic configurations

Table 5. Function selection table

| Logic function | Figure |
|--------------------------------------|---------------|
| 2-input MUX with inverted output | see Figure 4 |
| 2-input NAND | see Figure 5 |
| 2-input NOR with one input inverted | see Figure 6 |
| 2-input AND with one input inverted | see Figure 6 |
| 2-input NAND with one input inverted | see Figure 7 |
| 2-input OR with one input inverted | see Figure 7 |
| 2-input NOR | see Figure 8 |
| Buffer | see Figure 9 |
| Inverter | see Figure 10 |



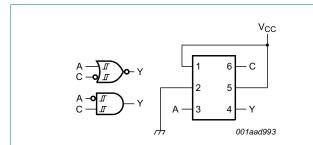


Fig 6. 2-input AND gate with input A inverted or 2-input NOR gate with inverted C input

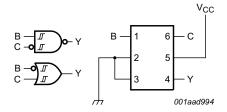
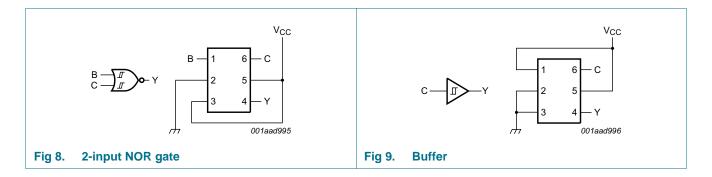
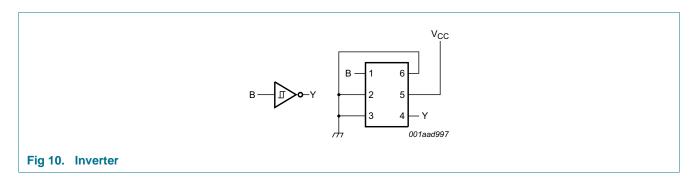


Fig 7. 2-input OR gate with input B inverted or 2-input NAND gate with input C inverted



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8. Limiting values

Table 6. 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 |
| VI | input voltage | | [1] -0.5 | +3.3 | V |
| I _{OK} | output clamping current | V _O < 0 V | -50 | - | mA |
| Vo | output voltage | | [1] -0.5 | +3.3 | V |
| Io | output current | $V_O = 0 \text{ V to } V_{CC}$ | - | ±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 | $T_{amb} = -40 ^{\circ}\text{C} \text{ to } +85 ^{\circ}\text{C}$ | - | 250 | mW |

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

9. Recommended operating conditions

Table 7. 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 |

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10. Static characteristics

Table 8. Static characteristics

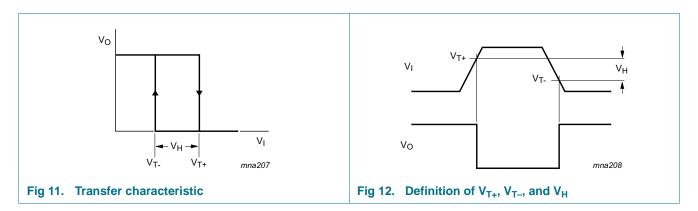
At recommended operating conditions, unless otherwise specified; voltages are referenced to GND (ground = 0 V).

| Symbol | Parameter | Conditions | | T _{amb} = -40 °C to +85 °C | | | | |
|------------------|--|---|------------|-------------------------------------|-----------|--------------------|--------------------|----|
| | | | | Min | Typ 25 °C | Max 25 °C | Max 85 °C | |
| V _{T+} | positive-going | see Figure 11 and Figure 12 | | | | | | |
| | threshold voltage | V _{CC} = 0.75 V to 0.85 V | | 0.3V _{CC} | - | 0.8V _{CC} | 0.8V _{CC} | V |
| | | V _{CC} = 1.1 V to 1.95 V | | 0.4V _{CC} | - | 0.7V _{CC} | 0.7V _{CC} | V |
| | | V _{CC} = 2.3 V to 2.7 V | | 0.9 | - | 1.7 | 1.7 | V |
| V_{T-} | negative-going | see Figure 11 and Figure 12 | | | | | | |
| | threshold voltage | V _{CC} = 0.75 V to 0.85 V | | 0.2V _{CC} | - | 0.7V _{CC} | 0.7V _{CC} | V |
| | | V _{CC} = 1.1 V to 1.95 V | | 0.3V _{CC} | - | 0.6V _{CC} | 0.6V _{CC} | V |
| | | V _{CC} = 2.3 V to 2.7 V | | 0.7 | - | 1.5 | 1.5 | V |
| V _H | hysteresis | see Figure 11 and Figure 12 | | | | | | |
| | voltage | V _{CC} = 0.75 V to 0.85 V | | 0.06V _{CC} | - | 0.5V _{CC} | 0.5V _{CC} | V |
| | | V _{CC} = 1.1 V to 1.95 V | | 0.1V _{CC} | - | 0.4V _{CC} | 0.4V _{CC} | V |
| | | V _{CC} = 2.3 V to 2.7 V | | 0.2 | - | 1.0 | 1.0 | V |
| V _{OH} | HIGH-level output voltage | $I_O = -20 \mu A; V_{CC} = 0.7 V$ | | - | 0.69 | - | - | V |
| | | $I_O = -100 \mu A; V_{CC} = 0.75 V$ | | 0.65 | - | - | - | V |
| | | $I_O = -2 \text{ mA}; V_{CC} = 1.1 \text{ V}$ | | 0.825 | - | - | - | V |
| | | $I_O = -3 \text{ mA}; V_{CC} = 1.4 \text{ V}$ | | 1.05 | - | - | - | V |
| | | $I_O = -4.5 \text{ mA}; V_{CC} = 1.65 \text{ V}$ | | 1.2 | - | - | - | V |
| | | $I_O = -8 \text{ mA}; V_{CC} = 2.3 \text{ V}$ | | 1.7 | - | - | - | V |
| V _{OL} | LOW-level | $I_O = 20 \mu A; V_{CC} = 0.7 V$ | | - | 0.01 | - | - | V |
| | output voltage | $I_O = 100 \mu A; V_{CC} = 0.75 V$ | | - | - | 0.1 | 0.1 | V |
| | | I _O = 2 mA; V _{CC} = 1.1 V | | - | - | 0.275 | 0.275 | V |
| | | $I_O = 3 \text{ mA}; V_{CC} = 1.4 \text{ V}$ | | - | - | 0.35 | 0.35 | V |
| | | I _O = 4.5 mA; V _{CC} = 1.65 V | | - | - | 0.45 | 0.45 | V |
| | | $I_O = 8 \text{ mA}; V_{CC} = 2.3 \text{ V}$ | | - | - | 0.7 | 0.7 | V |
| lı | 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 | μА |
| I _{OFF} | power-off leakage current | V_{I} or $V_{O} = 0$ V to 2.75 V; $V_{CC} = 0$ V | <u>[1]</u> | - | 0.01 | ±0.1 | ±0.5 | μΑ |
| ΔI_{OFF} | additional power-off leakage current | $V_1 \text{ or } V_O = 0 \text{ V or } 2.75 \text{ V};$ $V_{CC} = 0 \text{ V to } 0.1 \text{ V}$ | <u>[1]</u> | - | 0.02 | ±0.1 | ±0.5 | μА |
| I _{CC} | supply current | $V_I = 0 \text{ V or } V_{CC}; I_O = 0 \text{ A}$ | <u>[1]</u> | - | 0.01 | 0.3 | 0.6 | μΑ |
| Δl _{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 | μΑ |

^[1] Typical values are measured at V_{CC} = 1.2 V.

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10.1 Waveform transfer characteristics



11. Dynamic characteristics

Table 9. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V); for test circuit, see Figure 19.

| Symbol | Parameter | Conditions | | T _{amb} = 25 °C | | $T_{amb} = -40^{\circ}$ | Unit | |
|-----------------|--------------------|--|-----|--------------------------|-----|-------------------------|------|----|
| | | | Min | Typ[1] | Max | Min | Max | |
| t _{pd} | propagation delay | A, B, C to Y; see Figure 13 | | | | | | |
| | | V _{CC} = 0.75 V to 0.85 V | 3 | 13 | 64 | 2 | 166 | ns |
| | | V _{CC} = 1.1 V to 1.3 V | 2.0 | 4.9 | 8.9 | 2.0 | 9.3 | ns |
| | | V _{CC} = 1.4 V to 1.6 V | 1.7 | 3.7 | 6.0 | 1.6 | 6.4 | ns |
| | | V _{CC} = 1.65 V to 1.95 V | 1.4 | 3.1 | 5.0 | 1.3 | 5.3 | ns |
| | | V _{CC} = 2.3 V to 2.7 V | 1.2 | 2.4 | 3.8 | 1.1 | 4.1 | ns |
| t _t | transition time | V _{CC} = 2.7 V; see <u>Figure 13</u> [4] | - | - | - | 1.0 | - | ns |
| Cı | input capacitance | $V_I = 0 \text{ V or } V_{CC};$ $V_{CC} = 0 \text{ V to } 2.75 \text{ V}$ | - | 0.5 | - | - | - | pF |
| Co | output capacitance | $V_{O} = 0 \text{ V}; V_{CC} = 0 \text{ V}$ | - | 1.0 | - | - | - | pF |

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Table 9. Dynamic characteristics ...continued

Voltages are referenced to GND (ground = 0 V); for test circuit, see Figure 19.

| Symbol | Parameter | Conditions T _{amb} | | T _{amb} = 25 °C | | $T_{amb} = -40^{\circ}$ | Unit | |
|---|---|------------------------------------|-----|--------------------------|-----|-------------------------|------|----|
| | | | Min | Typ[1] | Max | Min | Max | |
| C _{PD} power dissipation capacitance | $f_i = 1 \text{ MHz}; V_I = 0 \text{ V to } V_{CC}$ [5] | | | | | | | |
| | capacitance | V _{CC} = 0.75 V to 0.85 V | - | 2.6 | - | - | - | pF |
| | | V _{CC} = 1.1 V to 1.3 V | - | 2.7 | - | - | - | pF |
| | | V _{CC} = 1.4 V to 1.6 V | - | 2.8 | - | - | - | pF |
| | | V _{CC} = 1.65 V to 1.95 V | - | 3 | - | - | - | pF |
| | | V _{CC} = 2.3 V to 2.7 V | - | 3.3 | - | - | - | pF |

- [1] All typical values are measured at nominal $V_{\mbox{\scriptsize CC}}$.
- [2] t_{pd} is the same as t_{PLH} and t_{PHL} .
- [3] For additional propagation delay values at different load capacitances, see Figure 14 to Figure 18.
- [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;

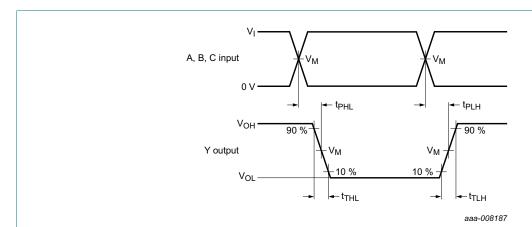
 f_o = output frequency in MHz;

C_L = output load capacitance in pF;

 V_{CC} = supply voltage in V;

N = number of inputs switching.

12. Waveforms



Measurement points are given in Table 10.

 $V_{\mbox{\scriptsize OL}}$ and $V_{\mbox{\scriptsize OH}}$ are typical output voltage levels that occur with the output load.

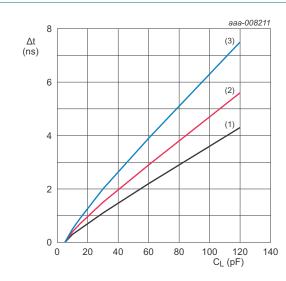
Fig 13. Input A, B and C to output Y propagation delay times and output transition time

Table 10. Measurement points

| Supply voltage | ipply voltage Input | | | | | |
|-----------------|---------------------|-----------------|-------------|--------------------|--|--|
| V _{CC} | V _M | VI | $t_r = t_f$ | V_{M} | | |
| 0.75 V to 2.7 V | 0.5V _{CC} | V _{CC} | ≤ 3.0 ns | 0.5V _{CC} | | |

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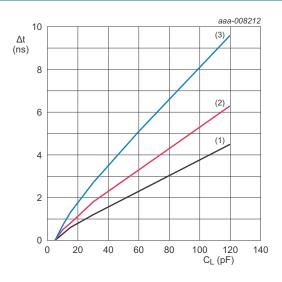
 T_{amb} = -40 °C to +85 °C unless otherwise specified.

(1) Minimum: $V_{CC} = 2.7 \text{ V}$

(2) Typical: $T_{amb} = 25 \,^{\circ}C$; $V_{CC} = 2.5 \,^{\circ}V$

(3) Maximum: $V_{CC} = 2.3 \text{ V}$

Fig 14. Additional tpd versus load capacitance



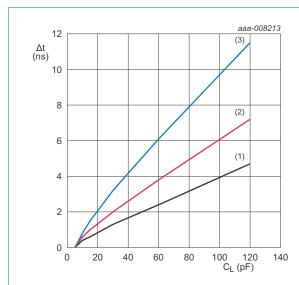
 $T_{amb} = -40$ °C to +85 °C unless otherwise specified.

(1) Minimum: $V_{CC} = 1.95 \text{ V}$

(2) Typical: $T_{amb} = 25 \, ^{\circ}C$; $V_{CC} = 1.8 \, V$

(3) Maximum: $V_{CC} = 1.65 \text{ V}$

Fig 15. Additional t_{pd} versus load capacitance



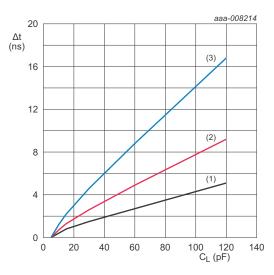
 $T_{amb} = -40 \, ^{\circ}\text{C}$ to +85 $^{\circ}\text{C}$ unless otherwise specified.

(1) Minimum: $V_{CC} = 1.6 \text{ V}$

(2) Typical: $T_{amb} = 25 \,^{\circ}\text{C}$; $V_{CC} = 1.5 \,^{\circ}\text{V}$

(3) Maximum: $V_{CC} = 1.4 \text{ V}$

Fig 16. Additional tpd versus load capacitance



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

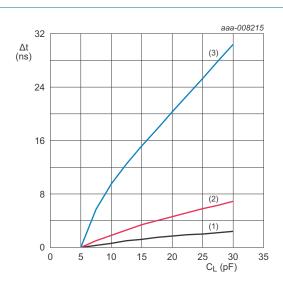
(1) Minimum: $V_{CC} = 1.3 \text{ V}$

(2) Typical: $T_{amb} = 25 \, ^{\circ}C$; $V_{CC} = 1.2 \, V$

(3) Maximum: $V_{CC} = 1.1 \text{ V}$

Fig 17. Additional t_{pd} versus load capacitance

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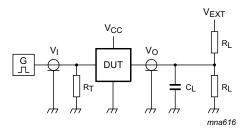
 T_{amb} = -40 °C to +85 °C unless otherwise specified.

(1) Minimum: $V_{CC} = 0.85 \text{ V}$

(2) Typical: $T_{amb} = 25 \, ^{\circ}C; \, V_{CC} = 0.8 \, V$

(3) Maximum: $V_{CC} = 0.75 \text{ V}$

Fig 18. Additional t_{pd} versus load capacitance



Test data is given in Table 11.

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_0 of the pulse generator.

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

Fig 19. Test circuit for measuring switching times

Table 11. 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 kΩ | 0 V | 0 V | 2 × V _{CC} | |

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13. Package outline

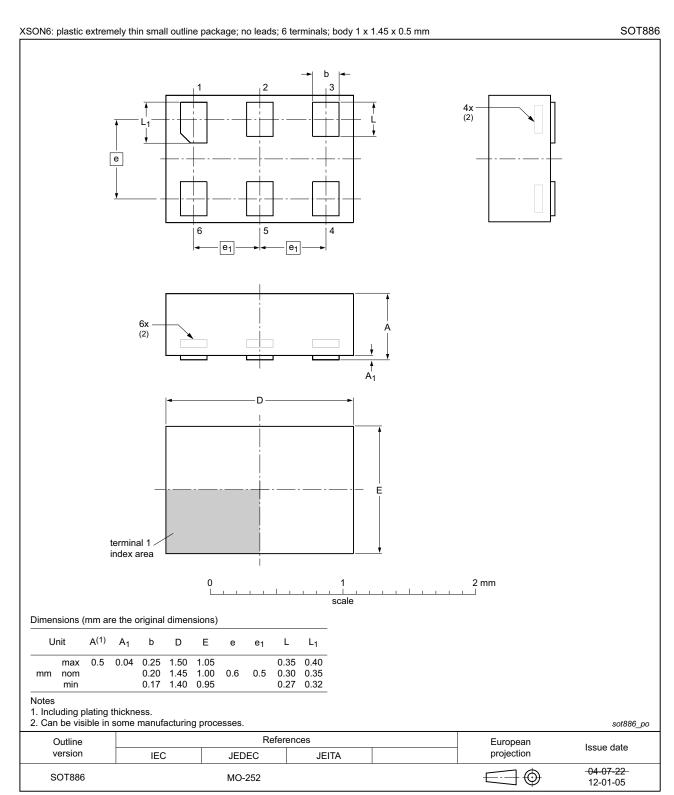


Fig 20. Package outline SOT886 (XSON6)

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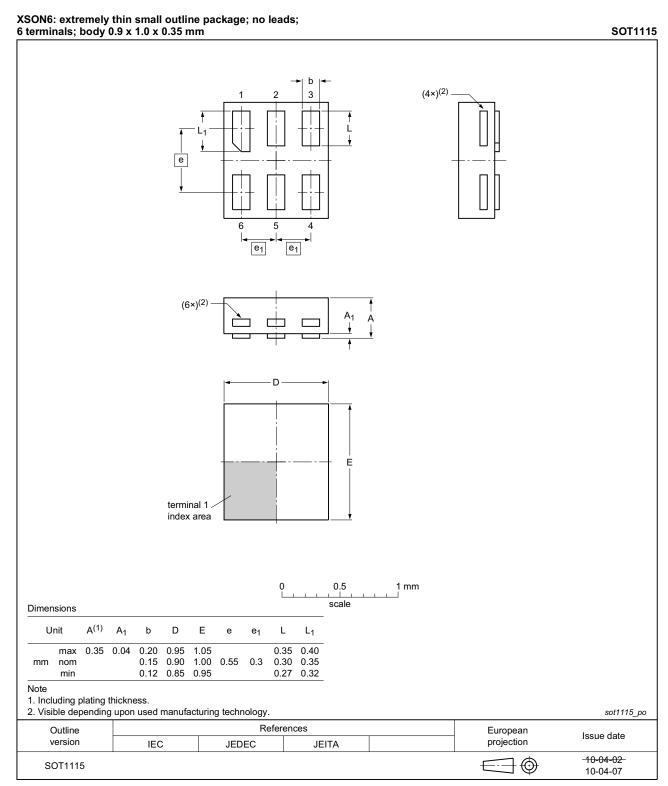


Fig 21. Package outline SOT1115 (XSON6)

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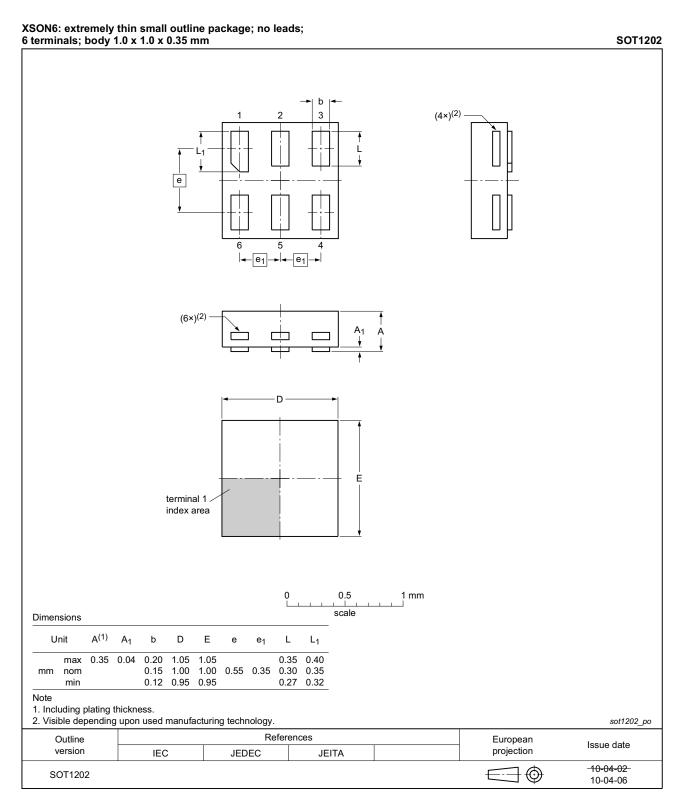


Fig 22. Package outline SOT1202 (XSON6)

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14. Abbreviations

Table 12. Abbreviations

| Acronym | Description |
|---------|-------------------------|
| CDM | Charged Device Model |
| DUT | Device Under Test |
| ESD | ElectroStatic Discharge |
| HBM | Human Body Model |

15. Revision history

Table 13. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes | |
|----------------|---|------------------------|---------------|---------------|--|
| 74AXP1G98 v.2 | 20151113 | Product data sheet | - | 74AXP1G98 v.1 | |
| Modifications: | Specification status changed to product data sheet. | | | | |
| 74AXP1G98 v.1 | 20130625 | Preliminary data sheet | - | - | |

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16. Legal information

16.1 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. |
| Preliminary [short] data sheet | Qualification | This document contains data from the preliminary specification. |
| Product [short] data sheet | Production | This document contains the product specification. |

- [1] Please consult the most recently issued document before initiating or completing a design.
- [2] The term 'short data sheet' is explained in section "Definitions"
- [3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL http://www.nexperia.com.

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