# 74AXP1G04

## Low-power inverter

Rev. 1 — 25 August 2014 Product data sheet

## 1. General description

The 74AXP1G04 is a single inverting buffer.

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; $C_{PD}$ = 2.3 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
- 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 |
| 74AXP1G04GM | –40 °C to +85 °C | XSON6 | plastic extremely thin small outline package; no leads; 6 terminals; body 1 × 1.45 × 0.5 mm | SOT886 |
| 74AXP1G04GN | –40 °C to +85 °C | XSON6 | extremely thin small outline package; no leads; 6 terminals; body 0.9 × 1.0 × 0.35 mm | SOT1115 |
| 74AXP1G04GS | –40 °C to +85 °C | XSON6 | extremely thin small outline package; no leads; 6 terminals; body 1.0 × 1.0 × 0.35 mm | SOT1202 |
| 74AXP1G04GX | –40 °C to +85 °C | X2SON5 | plastic thermal enhanced extremely thin small outline package; no leads; 5 terminals; body 0.8 × 0.8 × 0.35 mm | SOT1226 |

## 4. Marking

**Table 2. Marking**

| Type number | Marking code[1] |
|---|---|
| 74AXP1G04GM | rC |
| 74AXP1G04GN | rC |
| 74AXP1G04GS | rC |
| 74AXP1G04GX | rC |

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

## 5. Functional diagram

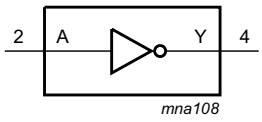



**Fig 1. Logic symbol**

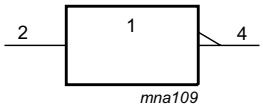



**Fig 2. IEC logic symbol**

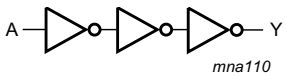
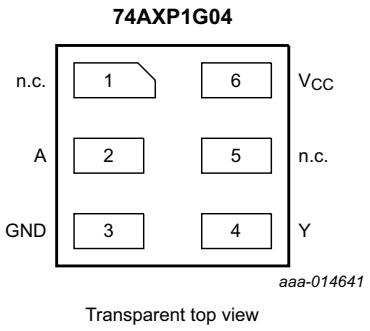



**Fig 3. Logic diagram**

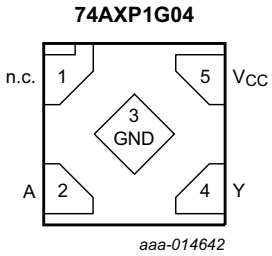
# 6. Pinning information

## 6.1 Pinning




Transparent top view

**Fig 4. Pin configuration SOT886, SOT1115 and SOT1202 (XSON6)**




Transparent top view

**Fig 5. Pin configuration SOT1226 (X2SON5)**

## 6.2 Pin description

**Table 3. Pin description**

| Symbol | Pin | | Description |
|---|---|---|---|
| | 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[1]**

| Input | Output |
|---|---|
| **A** | **Y** |
| L | H |
| H | L |

[1] H = HIGH voltage level; L = LOW voltage level.

# 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 | [1] | −0.5 | +3.3 | V |
| $I_{OK}$ | output clamping current | $V_O < 0$ V | −50 | - | mA |
| $V_O$ | output voltage | [1] | −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.

# 9. Recommended operating conditions

**Table 6. 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 | $T_{amb}$ = –40 °C to +85 °C | | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | Min | Typ 25 °C | Max 25 °C | Max 85 °C | |
| $V_{IH}$ | HIGH-level input voltage | $V_{CC}$ = 0.75 V to 0.85 V | 0.75$V_{CC}$ | - | - | - | V |
| | | $V_{CC}$ = 1.1 V to 1.95 V | 0.65$V_{CC}$ | - | - | - | V |
| | | $V_{CC}$ = 2.3 V to 2.7 V | 1.6 | - | - | - | V |
| $V_{IL}$ | LOW-level input voltage | $V_{CC}$ = 0.75 V to 0.85 V | - | - | 0.25$V_{CC}$ | 0.25$V_{CC}$ | V |
| | | $V_{CC}$ = 1.1 V to 1.95 V | - | - | 0.35$V_{CC}$ | 0.35$V_{CC}$ | 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 | - | - | - | V |
| | | $I_O$ = –2 mA; $V_{CC}$ = 1.1 V | 0.825 | - | - | - | V |
| | | $I_O$ = –3 mA; $V_{CC}$ = 1.4 V | 1.05 | - | - | - | V |
| | | $I_O$ = –4.5 mA; $V_{CC}$ = 1.65 V | 1.2 | - | - | - | V |
| | | $I_O$ = –8 mA; $V_{CC}$ = 2.3 V | 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 |
| $\Delta I_{OFF}$ | 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 or $V_{CC}$; $I_O$ = 0 A [1] | - | 0.01 | 0.3 | 0.6 | μA |
| $\Delta I_{CC}$ | 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 Figure 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 to Y; see Figure 6 [2][3] | | | | | | |
| | | $V_{CC}$ = 0.75 V to 0.85 V | 3 | 11 | 33 | 2 | 100 | ns |
| | | $V_{CC}$ = 1.1 V to 1.3 V | 1.8 | 4.3 | 7.0 | 1.7 | 7.3 | ns |
| | | $V_{CC}$ = 1.4 V to 1.6 V | 1.5 | 3.1 | 4.7 | 1.3 | 5.1 | ns |
| | | $V_{CC}$ = 1.65 V to 1.95 V | 1.2 | 2.6 | 3.8 | 1.1 | 4.1 | ns |
| | | $V_{CC}$ = 2.3 V to 2.7 V | 1.0 | 2.0 | 2.8 | 0.9 | 3.1 | ns |
| $t_t$ | transition time | $V_{CC}$ = 2.7 V; see Figure 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 | - | 2.3 | - | - | - | pF |
| | | $V_{CC}$ = 1.1 V to 1.3 V | - | 2.3 | - | - | - | pF |
| | | $V_{CC}$ = 1.4 V to 1.6 V | - | 2.4 | - | - | - | pF |
| | | $V_{CC}$ = 1.65 V to 1.95 V | - | 2.4 | - | - | - | pF |
| | | $V_{CC}$ = 2.3 V to 2.7 V | - | 2.7 | - | - | - | pF |

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

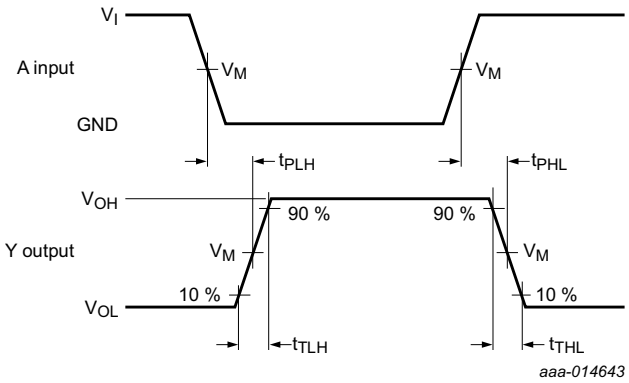
[2] $t_{pd}$ is the same as $t_{PLH}$ and $t_{PHL}$.

[3] For additional propagation delay values at different load capacitances, see Figure 7 to Figure 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).
$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + C_L \times V_{CC}^2 \times f_o$ 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



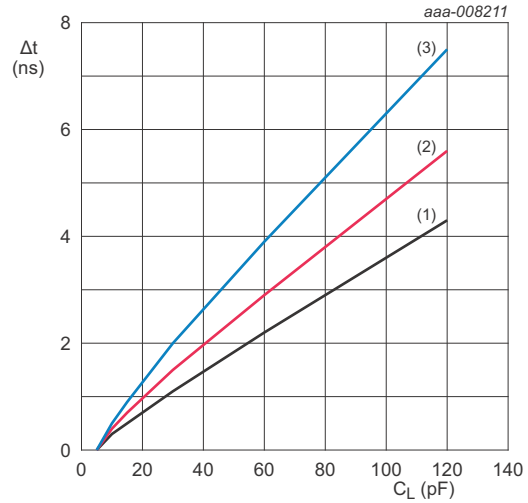

Measurement points are given in Table 9.

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

**Fig 6. The data input (A) to output (Y) propagation delays**

**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 | $0.5V_{CC}$ | $V_{CC}$ | ≤ 3.0 ns | $0.5V_{CC}$ |



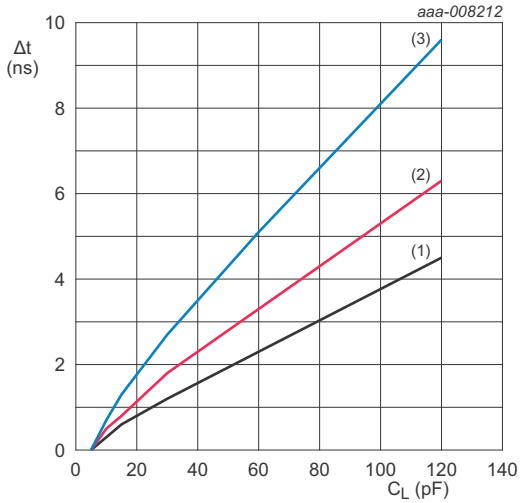

$T_{amb}$ = −40 °C to +85 °C unless otherwise specified.

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

(2) Typical: $T_{amb}$ = 25 °C; $V_{CC}$ = 2.5 V

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

**Fig 7. Additional $t_{pd}$ versus load capacitance**



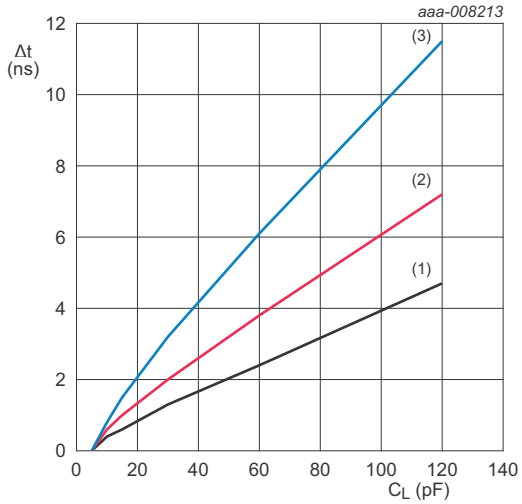

$T_{amb}$ = −40 °C to +85 °C unless otherwise specified.

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

(2) Typical: $T_{amb}$ = 25 °C; $V_{CC}$ = 1.8 V

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

**Fig 8. Additional $t_{pd}$ versus load capacitance**



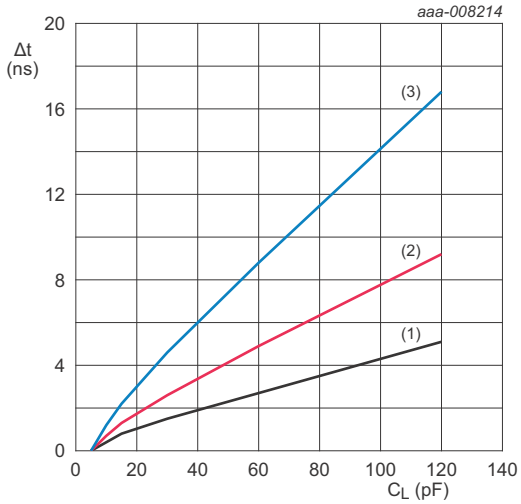

$T_{amb}$ = −40 °C to +85 °C unless otherwise specified.

(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**



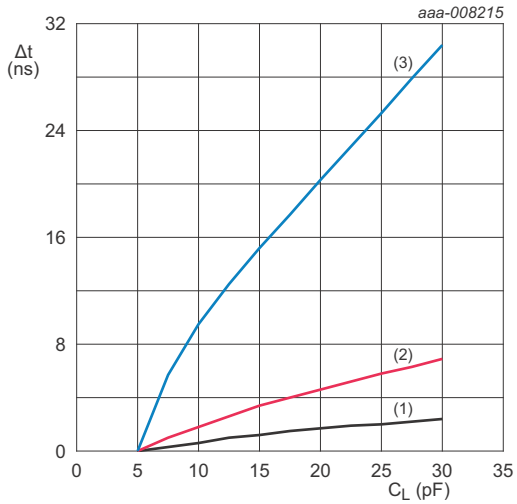

$T_{amb}$ = −40 °C to +85 °C unless otherwise specified.

(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**



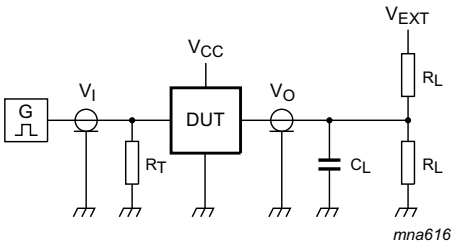

$T_{amb}$ = −40 °C to +85 °C unless otherwise specified.

(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.

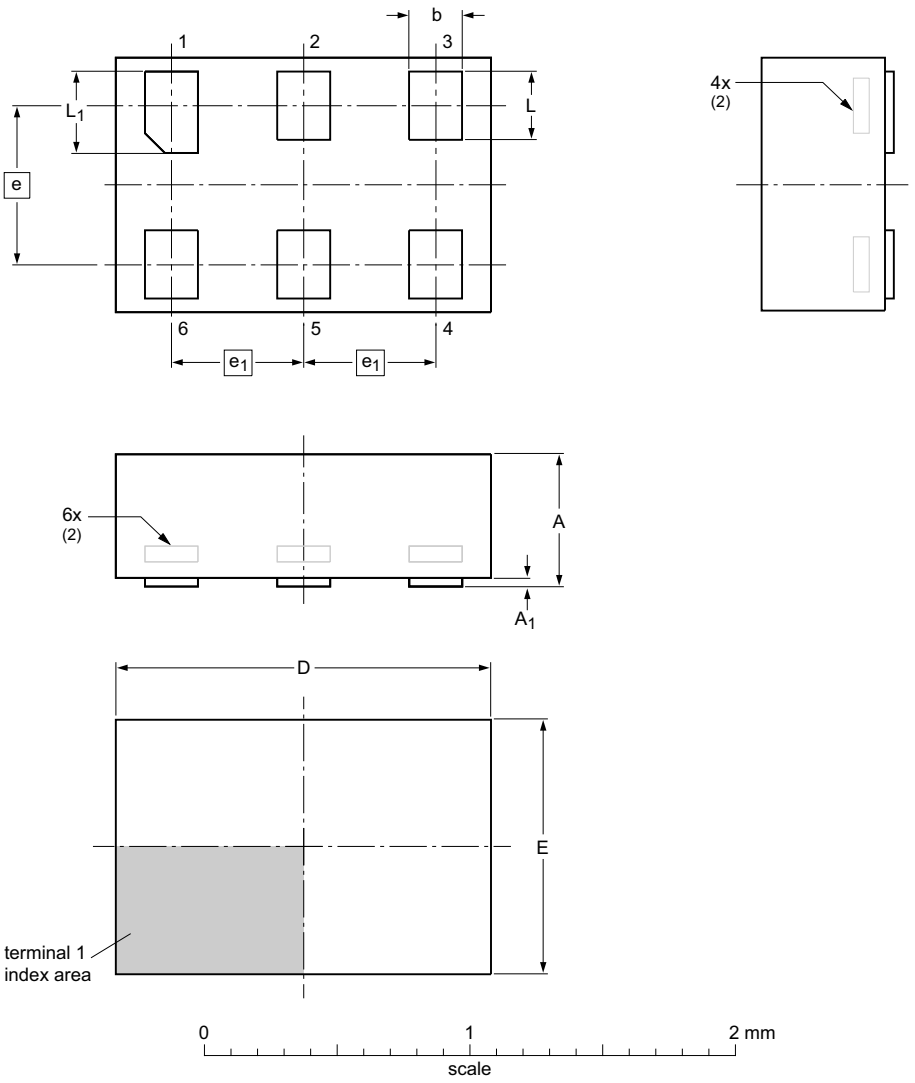
**Fig 12. Test circuit for measuring switching times**

**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 kΩ | 0 V | 0 V | $2 \times V_{CC}$ |

## 13. Package outline

XSON6: plastic extremely thin small outline package; no leads; 6 terminals; body 1 x 1.45 x 0.5 mm SOT886




Dimensions (mm are the original dimensions)

| Unit | | A(1) | $A_1$ | b | D | E | e | $e_1$ | L | $L_1$ |
|---|---|---|---|---|---|---|---|---|---|---|
| mm | max | 0.5 | 0.04 | 0.25 | 1.50 | 1.05 | | | 0.35 | 0.40 |
| | nom | | | 0.20 | 1.45 | 1.00 | 0.6 | 0.5 | 0.30 | 0.35 |
| | min | | | 0.17 | 1.40 | 0.95 | | | 0.27 | 0.32 |

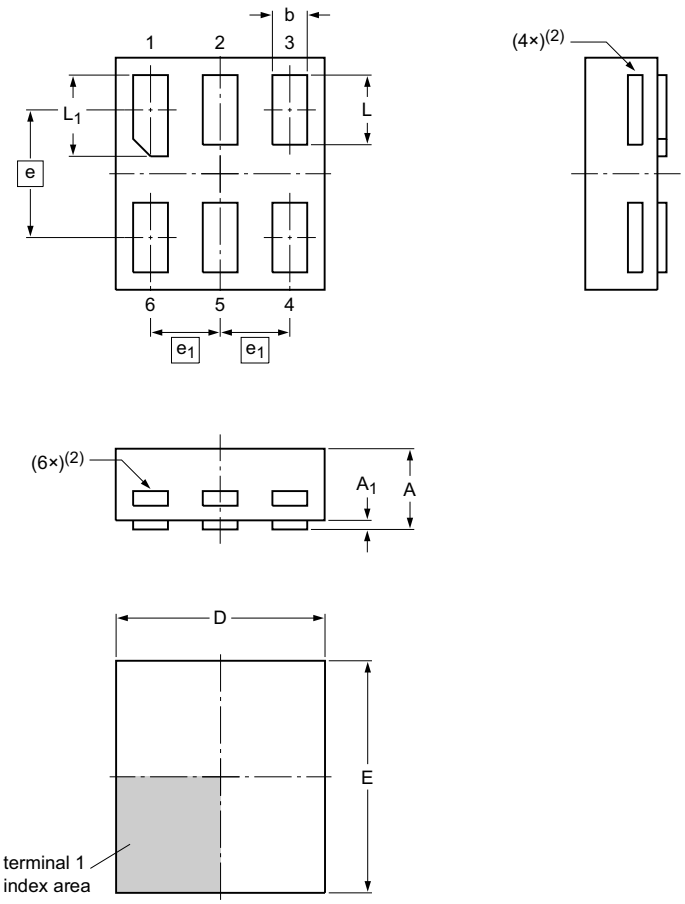
Notes
1. Including plating thickness.
2. Can be visible in some manufacturing processes.

*sot886_po*

| Outline version | References | | | | European projection | Issue date |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT886 | | MO-252 | | | | ~~04-07-22~~ 12-01-05 |

**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**




Dimensions

| Unit | | $A^{(1)}$ | $A_1$ | b | D | E | e | $e_1$ | L | $L_1$ |
|---|---|---|---|---|---|---|---|---|---|---|
| mm | max | 0.35 | 0.04 | 0.20 | 0.95 | 1.05 | | | 0.35 | 0.40 |
| | nom | | | 0.15 | 0.90 | 1.00 | 0.55 | 0.3 | 0.30 | 0.35 |
| | min | | | 0.12 | 0.85 | 0.95 | | | 0.27 | 0.32 |

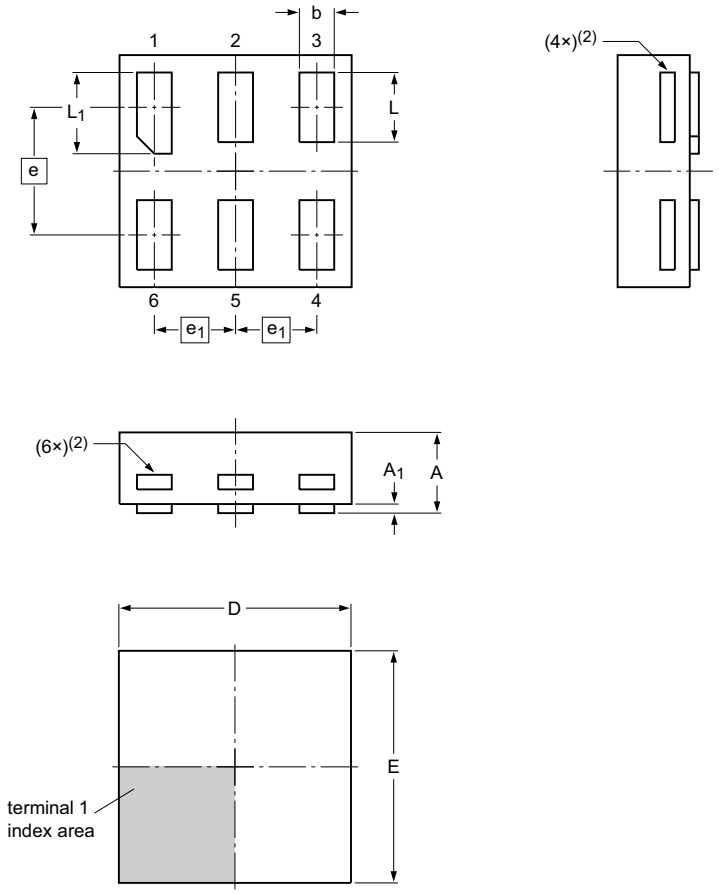
Note
1. Including plating thickness.
2. Visible depending upon used manufacturing technology.

*sot1115_po*

| Outline version | References | | | | European projection | Issue date |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT1115 | | | | | | ~~10-04-02~~ 10-04-07 |

**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**




Dimensions

| Unit | | A(1) | A1 | b | D | E | e | e1 | L | L1 |
|---|---|---|---|---|---|---|---|---|---|---|
| mm | max | 0.35 | 0.04 | 0.20 | 1.05 | 1.05 | | | 0.35 | 0.40 |
| | nom | | | 0.15 | 1.00 | 1.00 | 0.55 | 0.35 | 0.30 | 0.35 |
| | min | | | 0.12 | 0.95 | 0.95 | | | 0.27 | 0.32 |

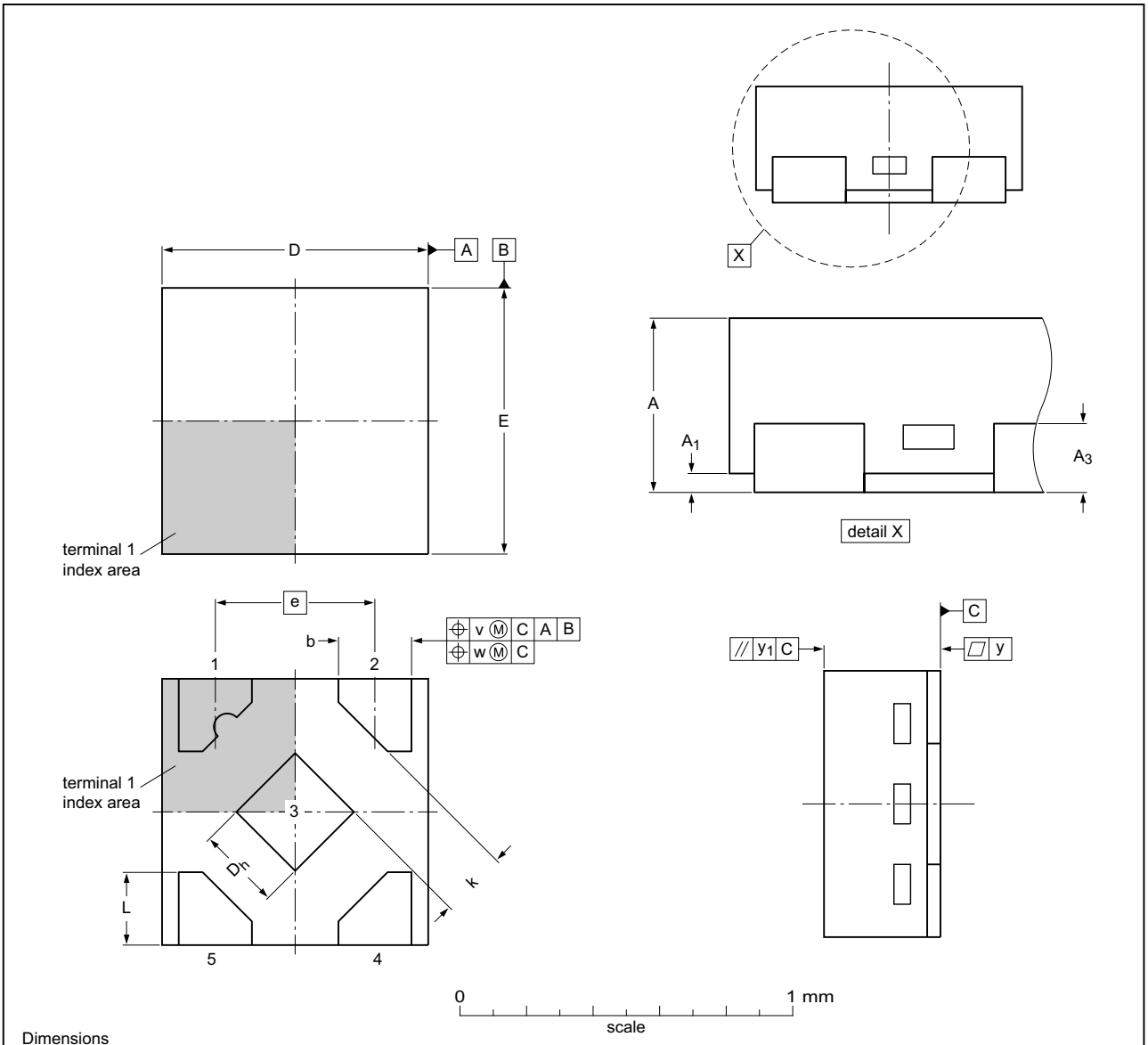
Note
1. Including plating thickness.
2. Visible depending upon used manufacturing technology.

*sot1202_po*

| Outline version | References | | | | European projection | Issue date |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT1202 | | | | | | ~~10-04-02~~ 10-04-06 |

**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 0.35 mm** **SOT1226**




Dimensions

| Unit | | A(1) | $A_1$ | $A_3$ | D | $D_h$ | E | b | e | k | L | v | w | y | $y_1$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | max | 0.35 | 0.04 | 0.128 | 0.85 | 0.30 | 0.85 | 0.27 | | | 0.27 | | | | |
| | nom | | | | 0.80 | 0.25 | 0.80 | 0.22 | 0.48 | | 0.22 | 0.1 | 0.05 | 0.05 | 0.05 |
| | min | | | 0.040 | 0.75 | 0.20 | 0.75 | 0.17 | | 0.20 | 0.17 | | | | |

Note
1. Dimension A is including plating thickness.
2. Plastic or metal protrusions of 0.075 mm maximum per side are not included.

*sot1226_po*

| Outline version | References | | | | European projection | Issue date |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | EIAJ | | | |
| SOT1226 | | | | | | ~~12-04-10~~ 12-04-25 |

**Fig 16. Package outline SOT1226 (X2SON5)**

## 14. Abbreviations

**Table 11. Abbreviations**

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

## 15. Revision history

**Table 12. Revision history**

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| 74AXP1G04 v.1 | 20140825 | Product data sheet | - | - |

# 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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## 18. Contents





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**Date of release: 25 August 2014**

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