

# 74AXP1G58

## Low-power configurable multiple function gate

Rev. 3 — 16 September 2015

Product data sheet

### 1. General description

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The 74AXP1G58 is a configurable multiple function gate with Schmitt-trigger inputs. The device can be configured as any of the following logic functions AND, OR, NAND, NOR, XOR, 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. This device 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

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- 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;  $C_{PD} = 2.7$  pF at  $V_{CC} = 1.2$  V (typical)
- Low static power consumption;  $I_{CC} = 0.6$   $\mu$ 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			Version
	Temperature range	Name	Description	
74AXP1G58GM	-40 °C to +85 °C	XSON6	plastic extremely thin small outline package; no leads; 6 terminals; body 1 × 1.45 × 0.5 mm	SOT886
74AXP1G58GN	-40 °C to +85 °C	XSON6	extremely thin small outline package; no leads; 6 terminals; body 0.9 × 1.0 × 0.35 mm	SOT1115
74AXP1G58GS	-40 °C to +85 °C	XSON6	extremely thin small outline package; no leads; 6 terminals; body 1.0 × 1.0 × 0.35 mm	SOT1202
74AXP1G58GX	-40 °C to +85 °C	X2SON6	plastic thermal extremely thin small outline package; no leads; 6 terminals; body 1 × 0.8 × 0.35 mm	SOT1255

### 4. Marking

Table 2. Marking codes

Type number	Marking code <sup>[1]</sup>
74AXP1G58GM	RK
74AXP1G58GN	RK
74AXP1G58GS	RK
74AXP1G58GX	RK

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

### 5. Functional diagram

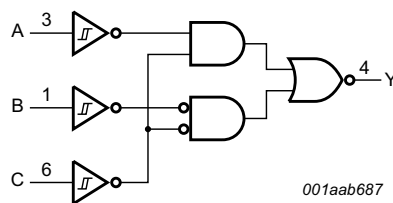
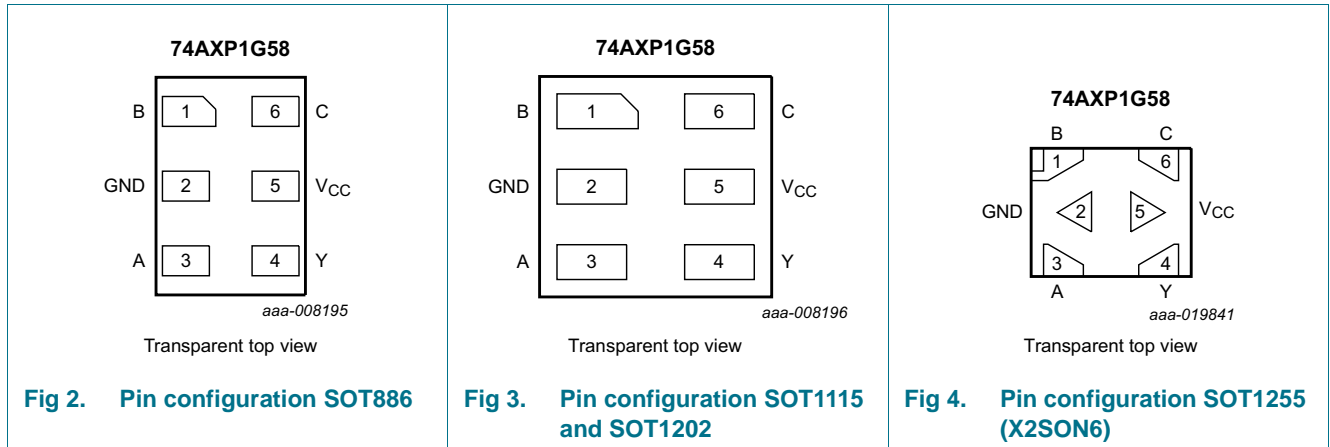


Fig 1. Logic symbol

## 6. Pinning information

### 6.1 Pinning



### 6.2 Pin description

Table 3. Pin description

Symbol	Pin	Description
B	1	data input
GND	2	ground (0 V)
A	3	data input
Y	4	data output
V <sub>CC</sub>	5	supply voltage
C	6	data input

## 7. Functional description

Table 4. Function table<sup>[1]</sup>

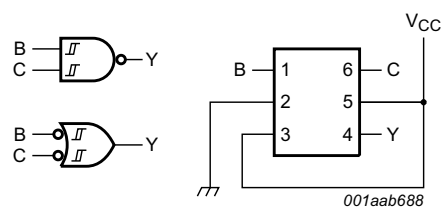
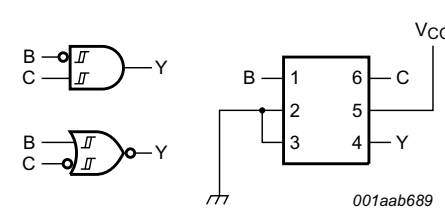
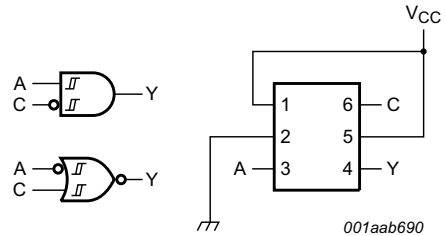
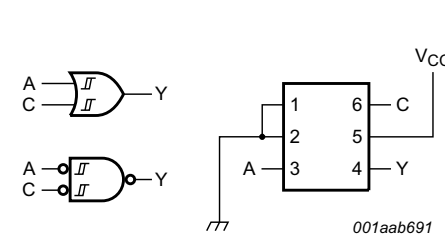
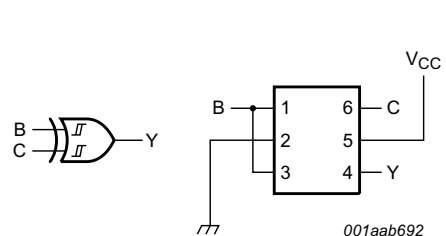
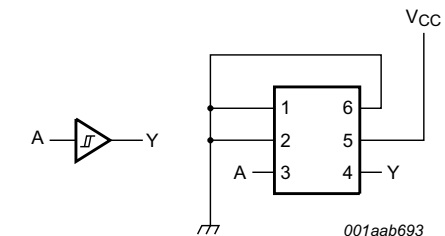
Input			Output
C	B	A	Y
L	L	L	L
L	L	H	H
L	H	L	L
L	H	H	H
H	L	L	H
H	L	H	H
H	H	L	L
H	H	H	L

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

7.1 Logic configurations

Table 5. Function selection table

Logic function	Figure
2-input NAND	see <a href="#">Figure 5</a>
2-input NAND with both inputs inverted	see <a href="#">Figure 8</a>
2-input AND with inverted input	see <a href="#">Figure 6</a> and <a href="#">Figure 7</a>
2-input NOR with inverted input	see <a href="#">Figure 6</a> and <a href="#">Figure 7</a>
2-input OR	see <a href="#">Figure 8</a>
2-input OR with both inputs inverted	see <a href="#">Figure 5</a>
2-input XOR	see <a href="#">Figure 9</a>
Buffer	see <a href="#">Figure 10</a>
Inverter	see <a href="#">Figure 11</a>

 <p><b>Fig 5. 2-input NAND gate or 2-input OR gate with both inputs inverted</b></p>	 <p><b>Fig 6. 2-input AND gate with inverted B input or 2-input NOR gate with inverted C input</b></p>
 <p><b>Fig 7. 2-input AND gate with inverted C input or 2-input NOR gate with inverted A input</b></p>	 <p><b>Fig 8. 2-input OR gate or 2-input NAND gate with both inputs inverted</b></p>
 <p><b>Fig 9. 2-input XOR gate</b></p>	 <p><b>Fig 10. Buffer</b></p>

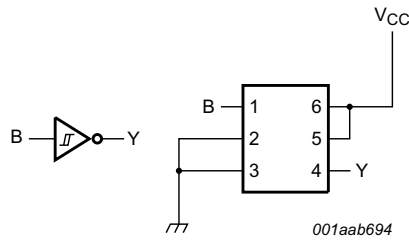


Fig 11. Inverter

## 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	$V_I < 0\text{ V}$	-50	-	mA
$V_I$	input voltage		-0.5	+3.3	V
$I_{OK}$	output clamping current	$V_O < 0\text{ V}$	-50	-	mA
$V_O$	output voltage		-0.5	+3.3	V
$I_O$	output current	$V_O = 0\text{ V to }V_{CC}$	-	$\pm 20$	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	$T_{amb} = -40\text{ °C to }+85\text{ °C}$	-	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
$V_I$	input voltage		0	2.75	V
$V_O$	output voltage	active mode	0	$V_{CC}$	V
		power-down mode; $V_{CC} = 0\text{ V}$	0	2.75	V
$T_{amb}$	ambient temperature		-40	+85	°C

## 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	$T_{amb} = -40\text{ °C to }+85\text{ °C}$				Unit
			Min	Typ 25 °C	Max 25 °C	Max 85 °C	
$V_{T+}$	positive-going threshold voltage	see <a href="#">Figure 12</a> and <a href="#">Figure 13</a>					
		$V_{CC} = 0.75\text{ V to }0.85\text{ V}$	$0.3V_{CC}$	-	$0.8V_{CC}$	$0.8V_{CC}$	V
		$V_{CC} = 1.1\text{ V to }1.95\text{ V}$	$0.4V_{CC}$	-	$0.7V_{CC}$	$0.7V_{CC}$	V
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	0.9	-	1.7	1.7	V
$V_{T-}$	negative-going threshold voltage	see <a href="#">Figure 12</a> and <a href="#">Figure 13</a>					
		$V_{CC} = 0.75\text{ V to }0.85\text{ V}$	$0.2V_{CC}$	-	$0.7V_{CC}$	$0.7V_{CC}$	V
		$V_{CC} = 1.1\text{ V to }1.95\text{ V}$	$0.3V_{CC}$	-	$0.6V_{CC}$	$0.6V_{CC}$	V
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	0.7	-	1.5	1.5	V
$V_H$	hysteresis voltage	see <a href="#">Figure 12</a> and <a href="#">Figure 13</a>					
		$V_{CC} = 0.75\text{ V to }0.85\text{ V}$	$0.06V_{CC}$	-	$0.5V_{CC}$	$0.5V_{CC}$	V
		$V_{CC} = 1.1\text{ V to }1.95\text{ V}$	$0.1V_{CC}$	-	$0.4V_{CC}$	$0.4V_{CC}$	V
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	0.2	-	1.0	1.0	V
$V_{OH}$	HIGH-level output voltage	$I_O = -20\text{ }\mu\text{A}; V_{CC} = 0.7\text{ V}$	-	0.69	-	-	V
		$I_O = -100\text{ }\mu\text{A}; V_{CC} = 0.75\text{ V}$	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 output voltage	$I_O = 20\text{ }\mu\text{A}; V_{CC} = 0.7\text{ V}$	-	0.01	-	-	V
		$I_O = 100\text{ }\mu\text{A}; V_{CC} = 0.75\text{ V}$	-	-	0.1	0.1	V
		$I_O = 2\text{ mA}; V_{CC} = 1.1\text{ V}$	-	-	0.275	0.275	V
		$I_O = 3\text{ mA}; V_{CC} = 1.4\text{ V}$	-	-	0.35	0.35	V
		$I_O = 4.5\text{ mA}; V_{CC} = 1.65\text{ V}$	-	-	0.45	0.45	V
		$I_O = 8\text{ mA}; V_{CC} = 2.3\text{ V}$	-	-	0.7	0.7	V
$I_I$	input leakage current	$V_I = 0\text{ V to }2.75\text{ V};$ $V_{CC} = 0\text{ V to }2.75\text{ V}$	[1]	0.001	$\pm 0.1$	$\pm 0.5$	$\mu\text{A}$
$I_{OFF}$	power-off leakage current	$V_I$ or $V_O = 0\text{ V to }2.75\text{ V};$ $V_{CC} = 0\text{ V}$	[1]	0.01	$\pm 0.1$	$\pm 0.5$	$\mu\text{A}$
$\Delta I_{OFF}$	additional power-off leakage current	$V_I$ or $V_O = 0\text{ V or }2.75\text{ V};$ $V_{CC} = 0\text{ V to }0.1\text{ V}$	[1]	0.02	$\pm 0.1$	$\pm 0.5$	$\mu\text{A}$
$I_{CC}$	supply current	$V_I = 0\text{ V or }V_{CC}; I_O = 0\text{ A}$	[1]	0.01	0.3	0.6	$\mu\text{A}$
$\Delta I_{CC}$	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	$\mu\text{A}$

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

10.1 Waveform transfer characteristics

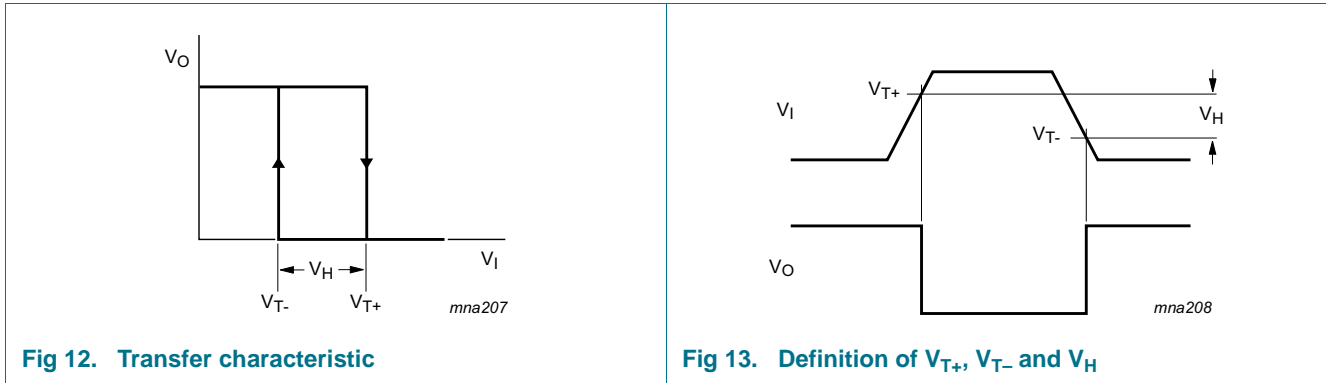


Fig 12. Transfer characteristic

Fig 13. Definition of  $V_{T+}$ ,  $V_{T-}$  and  $V_H$

11. Dynamic characteristics

Table 9. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V); for test circuit, see Figure 20.

Symbol	Parameter	Conditions	$T_{amb} = 25\text{ }^{\circ}\text{C}$			$T_{amb} = -40\text{ }^{\circ}\text{C to } +85\text{ }^{\circ}\text{C}$		Unit
			Min	Typ <sup>[1]</sup>	Max	Min	Max	
$t_{pd}$	propagation delay	A, B and C to Y; see Figure 14 [2][3]						
		$V_{CC} = 0.75\text{ V to } 0.85\text{ V}$	3.0	14	46	1	152	ns
		$V_{CC} = 1.1\text{ V to } 1.3\text{ V}$	2.3	5.0	8.3	2.1	8.7	ns
		$V_{CC} = 1.4\text{ V to } 1.6\text{ V}$	1.9	3.7	5.6	1.7	6.0	ns
		$V_{CC} = 1.65\text{ V to } 1.95\text{ V}$	1.6	3.1	4.7	1.4	5.1	ns
		$V_{CC} = 2.3\text{ V to } 2.7\text{ V}$	1.3	2.4	3.5	1.1	3.9	ns
$t_t$	transition time	$V_{CC} = 2.7\text{ V}$ ; see Figure 14 [4]	-	-	-	1.0	-	ns
$C_I$	input capacitance	$V_I = 0\text{ V or } V_{CC}$ ; $V_{CC} = 0\text{ V to } 2.75\text{ V}$	-	0.5	-	-	-	pF
$C_O$	output capacitance	$V_O = 0\text{ V}$ ; $V_{CC} = 0\text{ V}$	-	1.0	-	-	-	pF
$C_{PD}$	power dissipation capacitance	$f_i = 1\text{ MHz}$ ; $V_I = 0\text{ V to } V_{CC}$ [5]						
		$V_{CC} = 0.75\text{ V to } 0.85\text{ V}$	-	2.5	-	-	-	pF
		$V_{CC} = 1.1\text{ V to } 1.3\text{ V}$	-	2.6	-	-	-	pF
		$V_{CC} = 1.4\text{ V to } 1.6\text{ V}$	-	2.7	-	-	-	pF
		$V_{CC} = 1.65\text{ V to } 1.95\text{ V}$	-	2.9	-	-	-	pF
		$V_{CC} = 2.3\text{ V to } 2.7\text{ V}$	-	3.3	-	-	-	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 15 to Figure 19.
- [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  $\mu\text{W}$ ).  
 $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + C_L \times V_{CC}^2 \times f_o$  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.

11.1 Waveforms and graphs

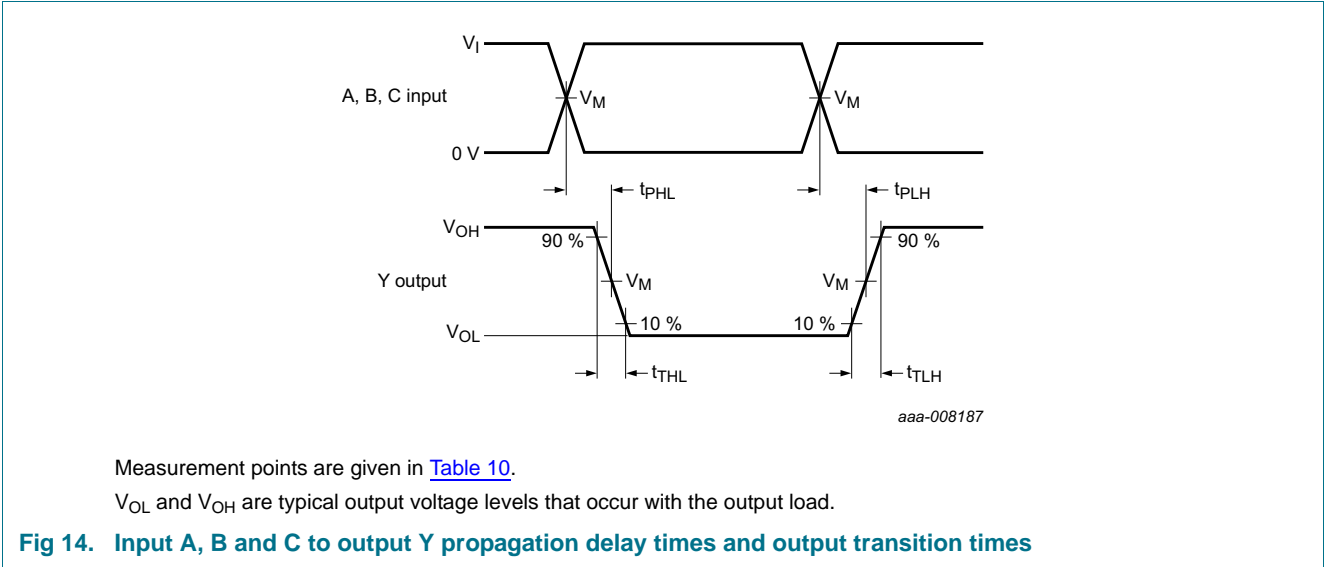
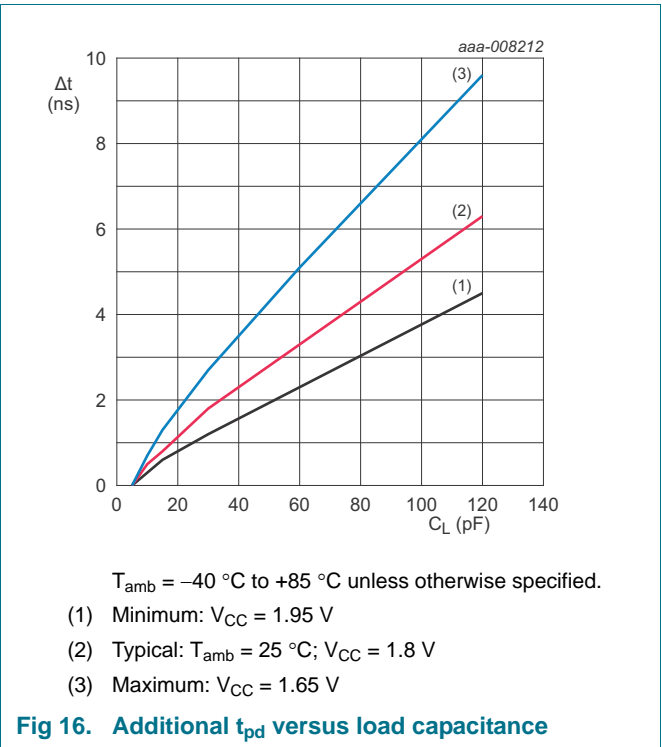
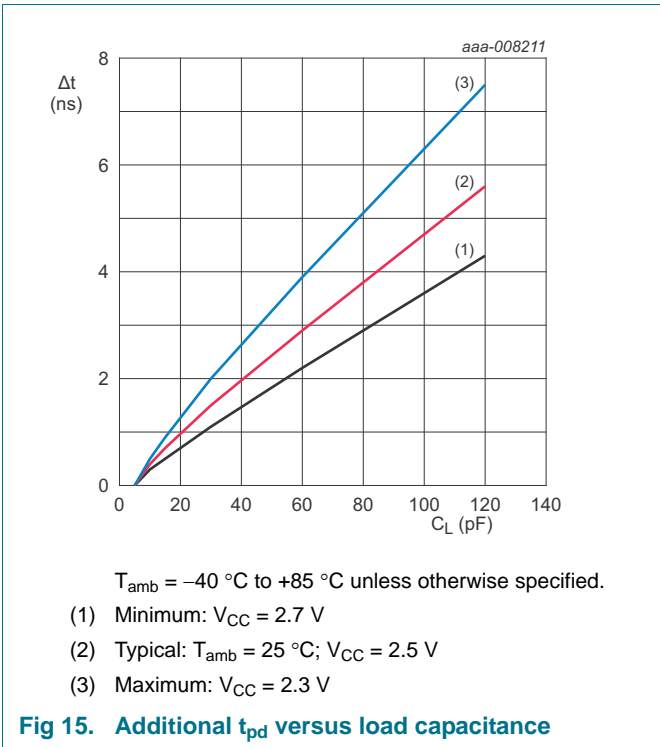
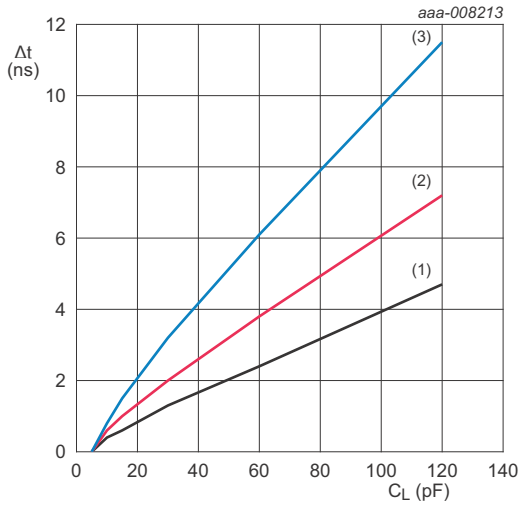


Table 10. Measurement points

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

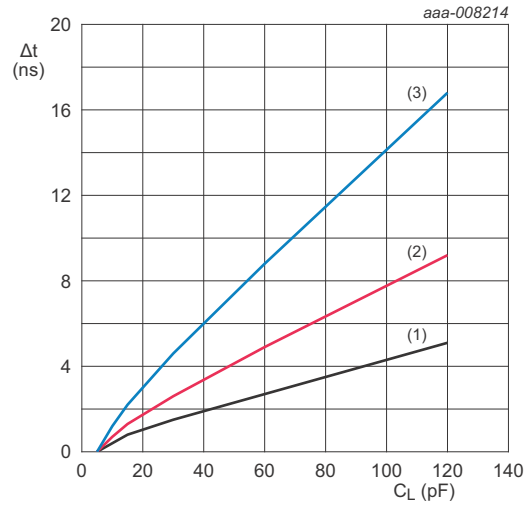






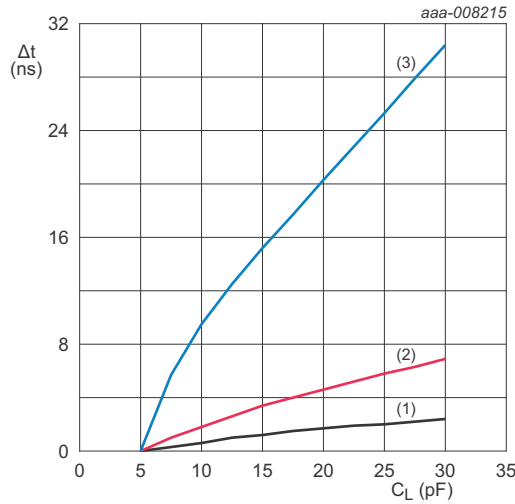
- $T_{amb} = -40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$  unless otherwise specified.
- (1) Minimum:  $V_{CC} = 1.6\text{ V}$
  - (2) Typical:  $T_{amb} = 25\text{ }^{\circ}\text{C}$ ;  $V_{CC} = 1.5\text{ V}$
  - (3) Maximum:  $V_{CC} = 1.4\text{ V}$

Fig 17. Additional  $t_{pd}$  versus load capacitance



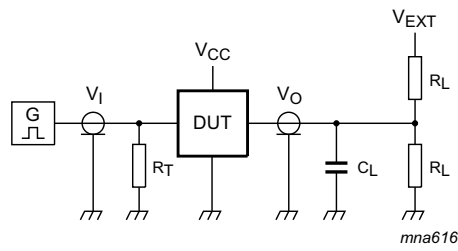
- $T_{amb} = -40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$  unless otherwise specified.
- (1) Minimum:  $V_{CC} = 1.3\text{ V}$
  - (2) Typical:  $T_{amb} = 25\text{ }^{\circ}\text{C}$ ;  $V_{CC} = 1.2\text{ V}$
  - (3) Maximum:  $V_{CC} = 1.1\text{ V}$

Fig 18. Additional  $t_{pd}$  versus load capacitance



- $T_{amb} = -40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$  unless otherwise specified.
- (1) Minimum:  $V_{CC} = 0.85\text{ V}$
  - (2) Typical:  $T_{amb} = 25\text{ }^{\circ}\text{C}$ ;  $V_{CC} = 0.8\text{ V}$
  - (3) Maximum:  $V_{CC} = 0.75\text{ V}$

Fig 19. 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  $Z_o$  of the pulse generator.

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

**Fig 20. 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 k $\Omega$	0 V	0 V	$2V_{CC}$

12. Package outline

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

SOT886

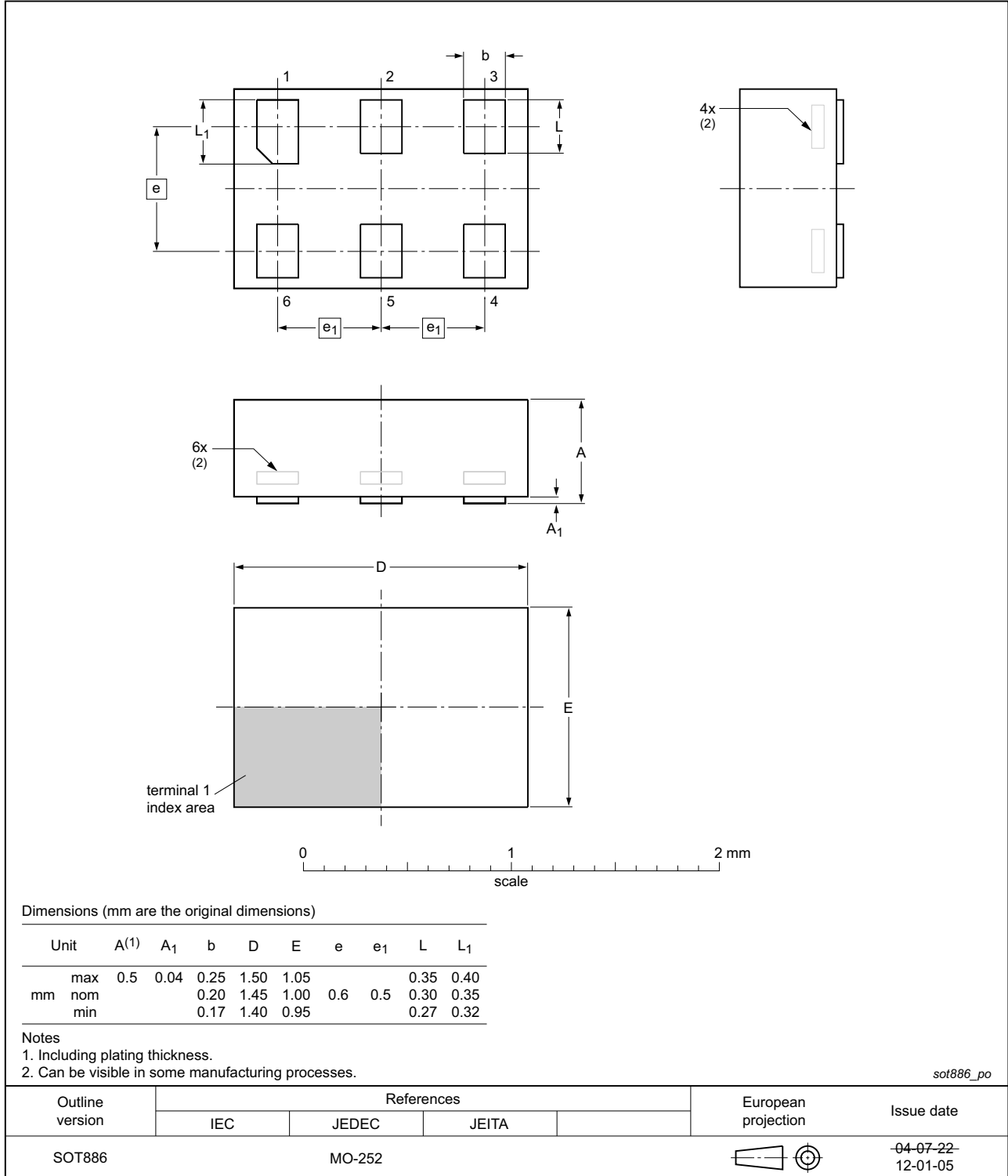


Fig 21. Package outline SOT886 (XSON6)

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

SOT1115

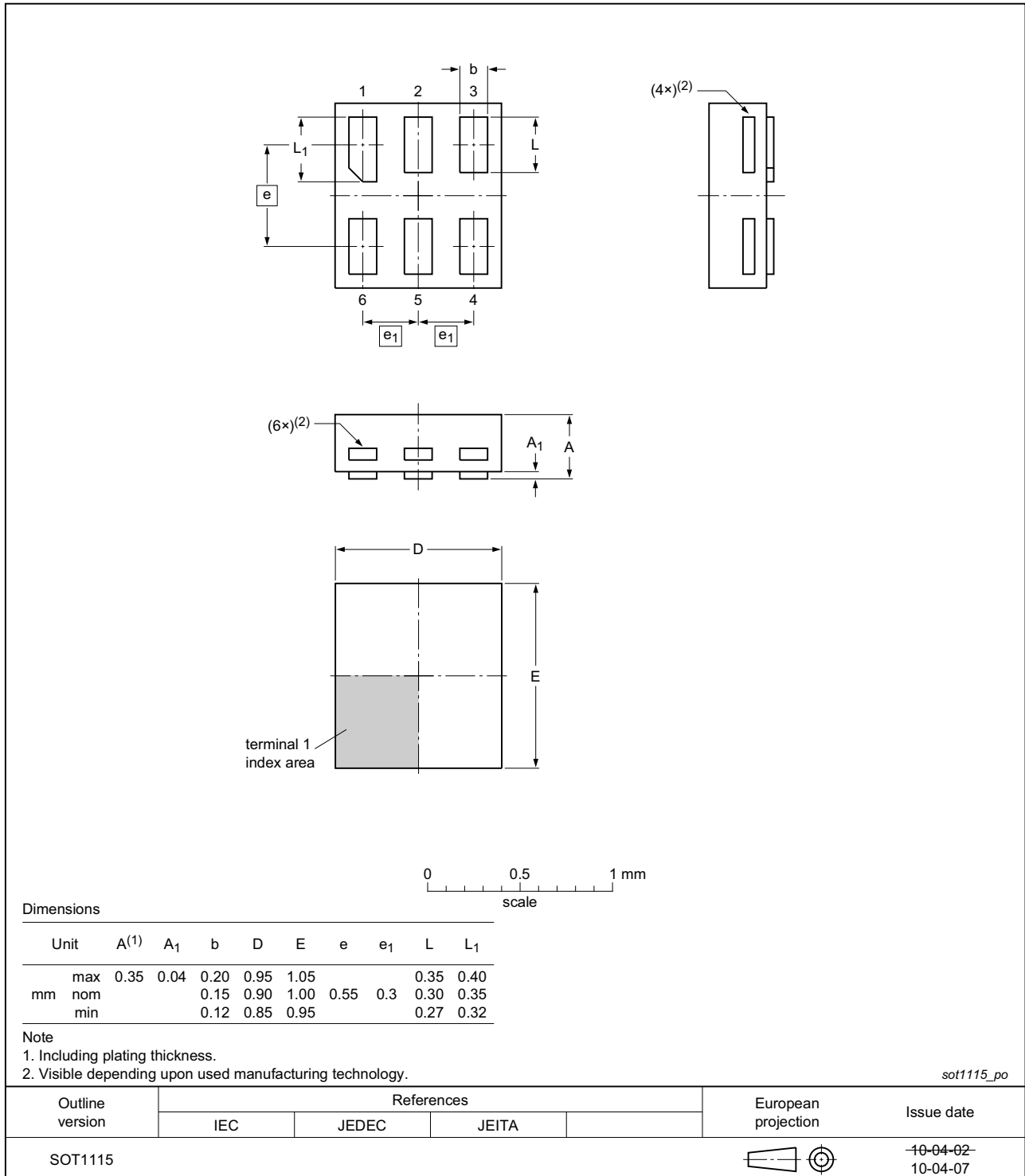


Fig 22. Package outline SOT1115 (XSON6)

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

SOT1202

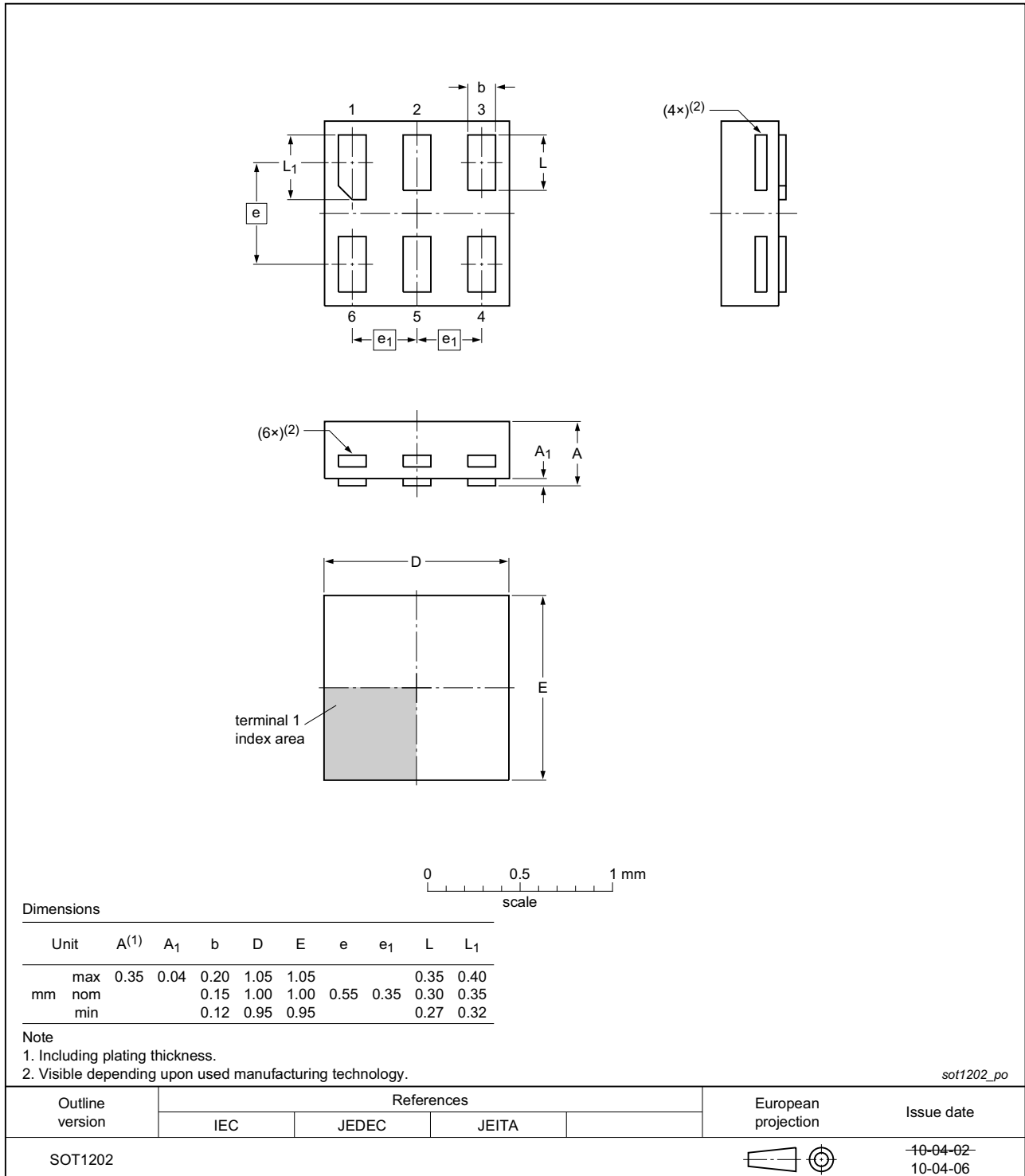


Fig 23. Package outline SOT1202 (XSON6)

**X2SON6: plastic thermal enhanced extremely thin small outline package; no leads;  
6 terminals; body 1.0 x 0.8 x 0.35 mm**

SOT1255

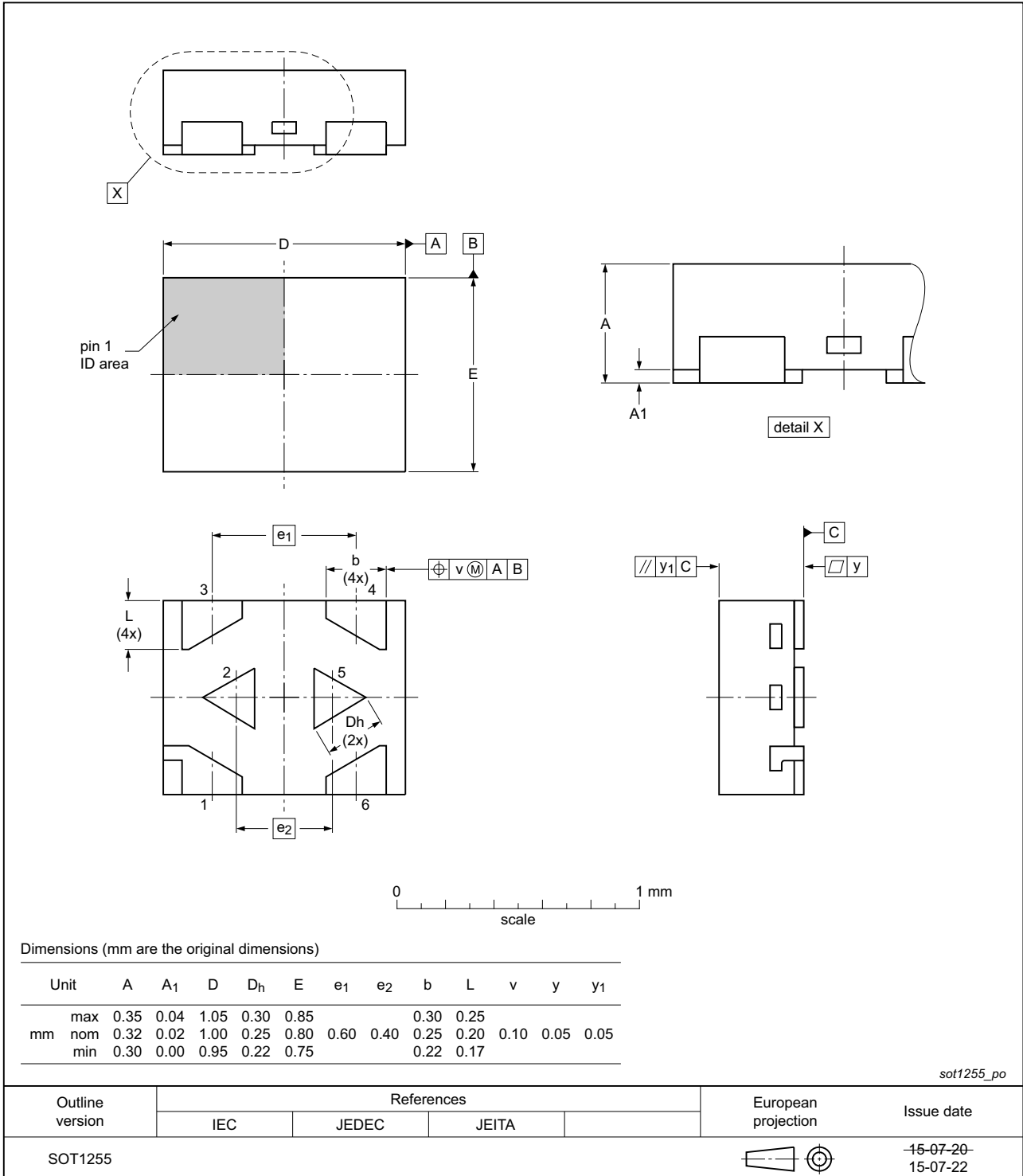


Fig 24. Package outline SOT1255 (X2SON6)

## 13. Abbreviations

Table 12. Abbreviations

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

## 14. Revision history

Table 13. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74AXP1G58 v.3	20150916	Product data sheet	-	74AXP1G58 v.2
Modifications:	<ul style="list-style-type: none"> <li>Added type number 74AXP1G58GX (SOT1255/X2SON6).</li> </ul>			
74AXP1G58 v.2	20140724	Product data sheet	-	74AXP1G58 v.1
Modifications:	<ul style="list-style-type: none"> <li>Data sheet status changed to product data sheet.</li> </ul>			
74AXP1G58 v.1	20130625	Preliminary data sheet	-	-

## 15. Legal information

### 15.1 Data sheet status

Document status <sup>[1][2]</sup>	Product status <sup>[3]</sup>	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>.

### 15.2 Definitions

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## 16. Contact information

For more information, please visit: <http://www.nexperia.com>

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