

LSF0102; LSF0202

2-bit bidirectional multi-voltage level translator; open-drain; push-pull

Rev. 5 — 24 June 2024

Product data sheet

1. General description

The LSF0102 and LSF0202 are both 2 channel bidirectional multi-voltage level translators for open-drain and push-pull applications. The LSF0102 and LSF0202 support up to 100 MHz up translation and ≥ 100 MHz down translation at ≤ 30 pF capacitive load. There is no need for a direction pin which minimizes system effort. Both support 5 V tolerant I/O pins for compatibility with TTL levels in a variety of applications. The ability to set up different voltage translation levels on each channel makes the device very flexible and suitable for a lot of different applications.

LSF0102 and LSF0202 differ in pin assignment only.

2. Features and benefits

- Bidirectional voltage translation with no direction pin
- Up translation
 - ≤ 100 MHz; $C_L = 30$ pF
 - ≤ 50 MHz; $C_L = 50$ pF
- Down translation
 - ≥ 100 MHz; $C_L = 30$ pF
 - ≥ 50 MHz; $C_L = 50$ pF
- Hot insertion
- Bidirectional voltage level translation between:
 - 0.95 V and 1.8 V, 2.5 V, 3.3 V and 5.0 V
 - 1.2 V and 1.8 V, 2.5 V, 3.3 V and 5.0 V
 - 1.8 V and 2.5 V, 3.3 V and 5.0 V
 - 2.5 V and 3.3 V and 5.0 V
 - 3.3 V and 5.0 V
- Low standby current
- 5 V tolerant I/O pins to support TTL
- Low R_{ON} provides less signal distortion
- High-impedance I/O pins for $EN = Low$
- Both, LSF0102 and LSF0202 support flow-through pinout for easy PCB trace routing
- Latch-up performance exceeds 100 mA per JESD78 class II level A
- ESD protection:
 - HBM: ANSI/ESDA/JEDEC JS-001 class 2 exceeds 2000 V
 - CDM: ANSI/ESDA/JEDEC JS-002 class C3 exceeds 1000 V
- Specified from -40 °C to $+125$ °C

3. Applications

- GPIO, MDIO, PMBus, SMBus, SDIO, UART, I²C, and other interfaces in Telecom infrastructure
- Industrial
- Personal computing

4. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
LSF0102DP	-40 °C to +125 °C	TSSOP8	plastic thin shrink small outline package; 8 leads; body width 3 mm; lead length 0.5 mm	SOT505-2
LSF0102DC LSF0202DC	-40 °C to +125 °C	VSSOP8	plastic very thin shrink small outline package; 8 leads; body width 2.3 mm	SOT765-1
LSF0102GS LSF0202GS	-40 °C to +125 °C	XSON8	extremely thin small outline package; no leads; 8 terminals; body 1.35 × 1.0 × 0.35 mm	SOT1203
LSF0102GX	-40 °C to +125 °C	X2SON8	plastic thermal enhanced extremely thin small outline package; no leads; 8 terminals; body 1.35 × 0.8 × 0.32 mm	SOT1233-2

5. Marking

Table 2. Marking

Type number	Marking code ^[1]
LSF0102	
LSF0102DP	h2
LSF0102DC	h2
LSF0102GS	h2
LSF0102GX	h2
LSF0202	
LSF0202DC	h6
LSF0202GS	h6

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

6. Functional diagram

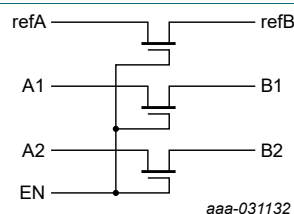
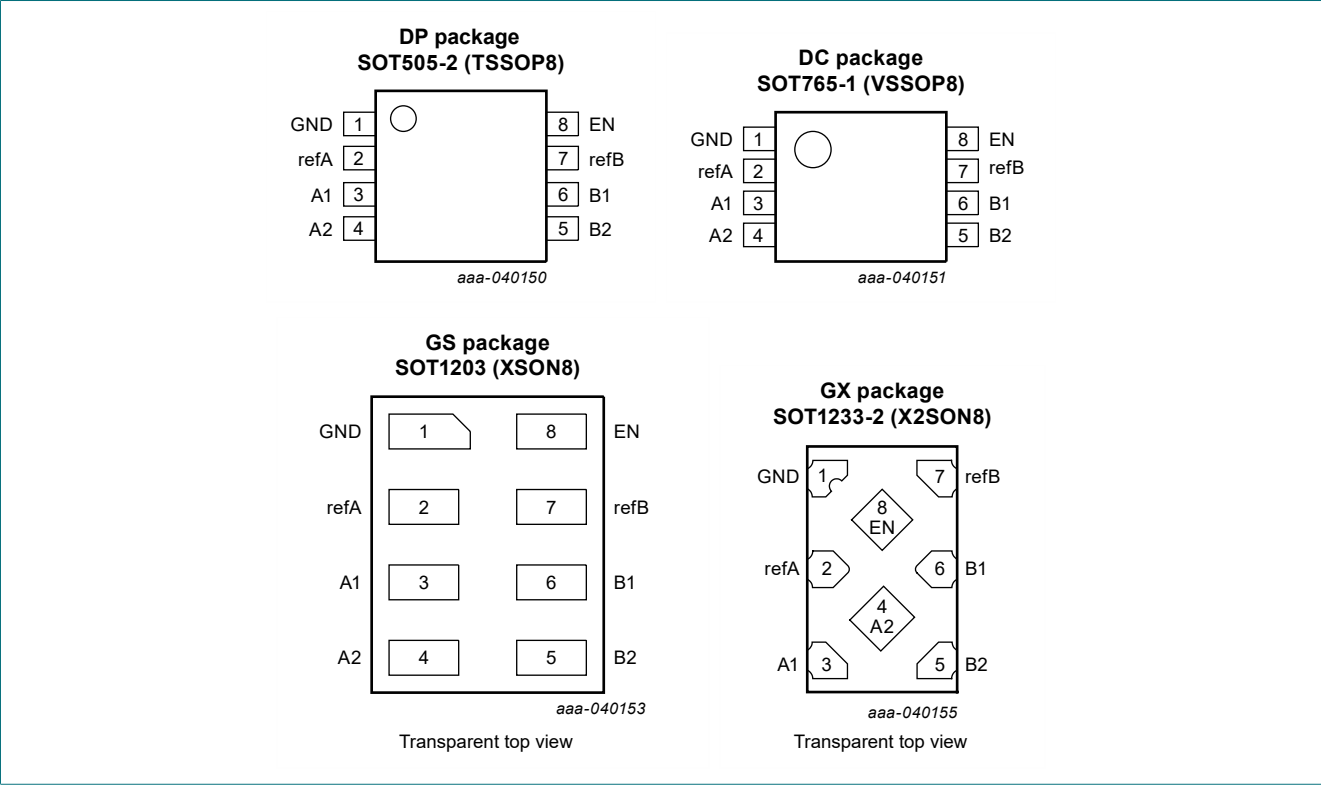


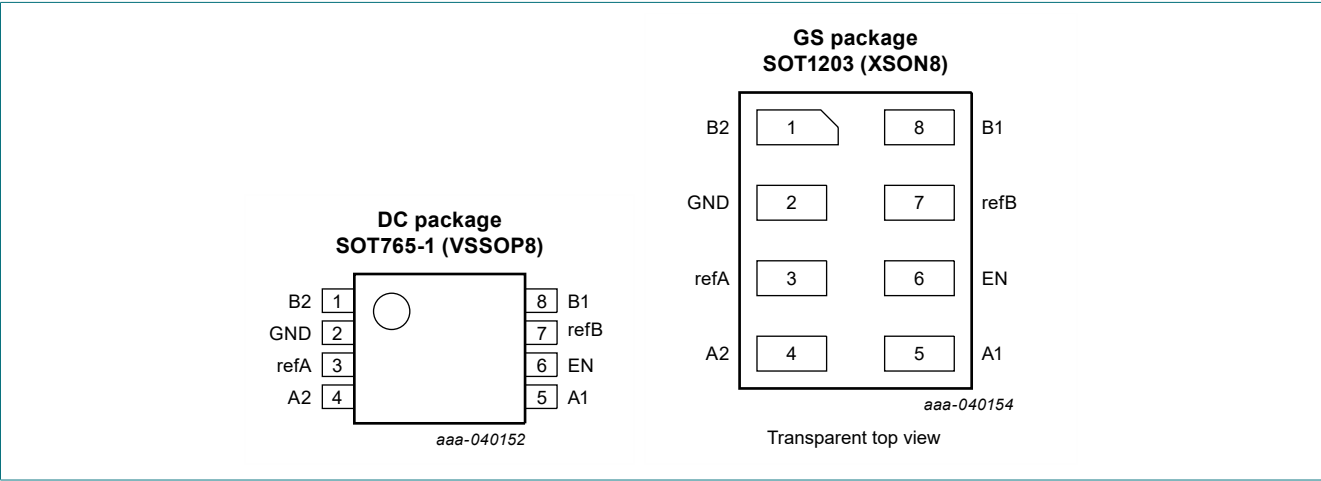
Fig. 1. Logic symbol

7. Pinning information

7.1. Pinning LSF0102



7.2. Pinning LSF0202



7.3. Pin description

Table 3. Pin description

Symbol	Pin		Description
	LSF0102	LSF0202	
GND	1	2	ground (0 V)
refA	2	3	reference voltage A
A1	3	5	data input/output A
A2	4	4	data input/output A
B2	5	1	data input/output B
B1	6	8	data input/output B
refB	7	7	reference voltage B
EN	8	6	enable input (active HIGH)

8. Functional description

Table 4. Function table

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

Input	input/output
EN	An, Bn channel
H	An = Bn
L	Z

9. 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 _I	input voltage	pins refA, refB, An, Bn and EN [1]	-0.5	+7.0	V
I _{I/O}	input/ouput current	pins refA, refB, An and Bn; continuous channel current	-	+128	mA
I _{IK}	input clamping current	V _I < 0 V	-50	-	mA
T _{stg}	storage temperature		-65	+150	°C
P _{tot}	total power dissipation	T _{amb} = -40 °C to +125 °C [2]	-	250	mW

- [1] The minimum input voltage rating may be exceeded if the input current rating is observed.
- [2] For SOT505-2 (TSSOP8) package: P_{tot} derates linearly with 4.6 mW/K above 96 °C.
For SOT765-1 (VSSOP8) package: P_{tot} derates linearly with 4.9 mW/K above 99 °C.
For SOT1203 (XSON8) package: P_{tot} derates linearly with 3.6 mW/K above 81 °C.
For SOT1233-2 (X2SON8) package: P_{tot} derates linearly with 7.7 mW/K above 118 °C.

10. Recommended operating conditions

Table 6. Recommended operating conditions

Symbol	Parameter	Conditions	Min	Max	Unit
V _I	input voltage	pins refA, refB, An, Bn and EN	0.0	5.0	V
I _{I/O}	input/ouput current	pins refA, refB, An and Bn; continuous channel current	-	+64	mA
T _{amb}	ambient temperature		-40	+125	°C

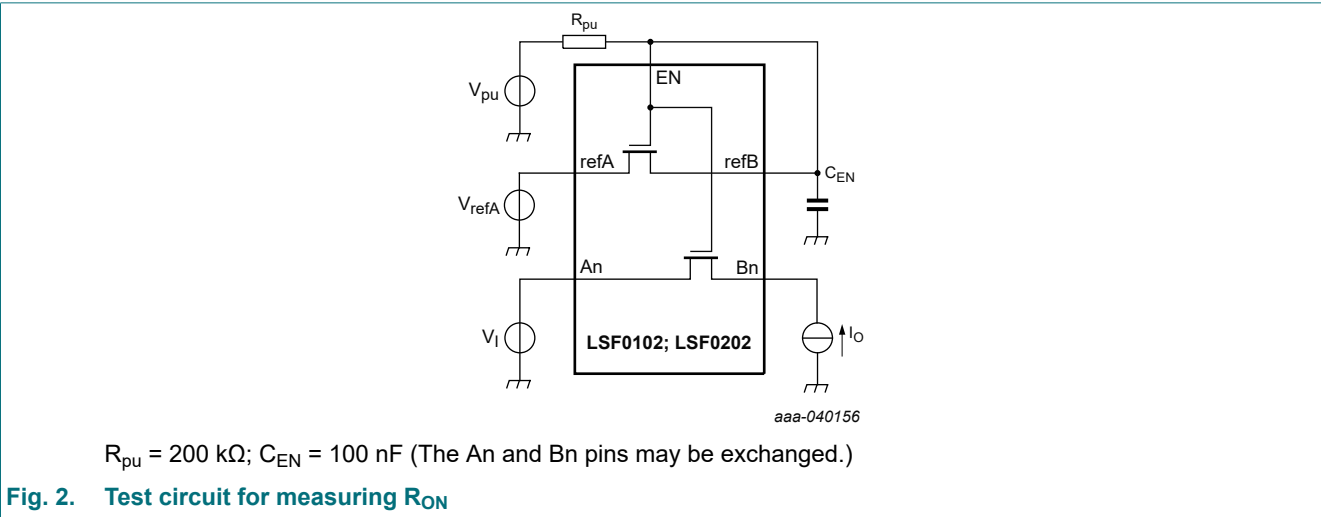
11. Static characteristics

Table 7. Static characteristics

At recommended operating conditions voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	T _{amb} = -40 °C to +125 °C			Unit
			Min	Typ[1]	Max	
V _{IK}	input clamping voltage	V _{EN} = 0 V; I _I = -18 mA	-1.2	-	-	V
I _I	leakage current	pins An, Bn, refA, refB and EN; V _I = GND to 5.0 V	-	1	5	µA
C _I	input capacitance	pins refA, refB and EN; V _I = 0 V or 3 V	-	6	-	pF
C _{io(off)}	OFF-state input/output capacitance	pins An, Bn; V _O = 0 V or 3 V; V _{EN} = 0.0 V	-	3	6.0	pF
C _{io(on)}	ON-state input/output capacitance	pins An, Bn; V _O = 0 V or 3 V; V _{EN} = 3.0 V	-	6	12.5	pF
R _{ON}	ON resistance	see Fig. 2 [2]				
		V _I = 0 V; V _{pu} = 5.0 V; I _O = 64 mA				
		V _{refA} = 3.3 V	-	3	-	Ω
		V _{refA} = 1.8 V	-	4	-	Ω
		V _{refA} = 1.0 V	-	7	-	Ω
		V _I = 0 V; V _{pu} = 5.0 V; I _O = 32mA				
		V _{refA} = 1.8 V	-	4	-	Ω
		V _{refA} = 2.5 V	-	3	-	Ω
		V _I = 1.8 V; V _{pu} = 5.0 V; I _O = 15 mA				
		V _{refA} = 3.3 V	-	4	-	Ω
		V _I = 1.0 V; V _{pu} = 3.3 V; I _O = 10 mA				
		V _{refA} = 1.8 V	-	7	-	Ω
		V _I = 0 V; V _{pu} = 3.3 V; I _O = 10 mA				
		V _{refA} = 1.0 V	-	5	-	Ω
		V _I = 0 V; V _{pu} = 1.8 V; I _O = 10 mA				
		V _{refA} = 1.0 V	-	6	-	Ω

- [1] All typical values are measured at T_{amb} = 25 °C.
- [2] Measured by the voltage drop between the An and Bn pins at the indicated current through the switch. ON resistance is determined by the lowest voltage of the two (An or Bn) pins.



12. Dynamic characteristics

Table 8. Switching characteristics
GND = 0 V; for waveform see Fig. 3; for test circuit see Fig. 4

Symbol	Parameter	Conditions	T _{amb} = -40 °C to +125 °C			Unit
			Min	Typ[1]	Max	
Translating down						
t _{PLH}	LOW to HIGH propagation delay	An to Bn or Bn to An;				
		V _{IH} = V _{pu} = V _{refA} + 1 V				
		V _{refA} = 1.5 V; C _L = 15 pF	-	0.35	-	ns
		V _{refA} = 1.5 V; C _L = 30 pF	-	0.8	-	ns
		V _{refA} = 1.5 V; C _L = 50 pF	-	1.2	-	ns
		V _{refA} = 2.3 V; C _L = 15 pF	-	0.3	-	ns
		V _{refA} = 2.3 V; C _L = 30 pF	-	0.7	-	ns
		V _{refA} = 2.3 V; C _L = 50 pF	-	1.1	-	ns
t _{PHL}	HIGH to LOW propagation delay	An to Bn or Bn to An;				
		V _{IH} = V _{pu} = V _{refA} + 1 V				
		V _{refA} = 1.5 V; C _L = 15 pF	-	0.5	-	ns
		V _{refA} = 1.5 V; C _L = 30 pF	-	1.0	-	ns
		V _{refA} = 1.5 V; C _L = 50 pF	-	1.3	-	ns
		V _{refA} = 2.3 V; C _L = 15 pF	-	0.4	-	ns
		V _{refA} = 2.3 V; C _L = 30 pF	-	0.8	-	ns
		V _{refA} = 2.3 V; C _L = 50 pF	-	1.2	-	ns
Translating up						
t _{PLH}	LOW to HIGH propagation delay	An to Bn or Bn to An;				
		V _{IH} = V _{refA} ; V _{EXT} = V _{pu} = V _{refA} + 1 V				
		V _{refA} = 1.5 V; C _L = 15 pF	-	0.5	-	ns
		V _{refA} = 1.5 V; C _L = 30 pF	-	0.9	-	ns
		V _{refA} = 1.5 V; C _L = 50 pF	-	1.1	-	ns
		V _{refA} = 2.3 V; C _L = 15 pF	-	0.4	-	ns
		V _{refA} = 2.3 V; C _L = 30 pF	-	0.8	-	ns
		V _{refA} = 2.3 V; C _L = 50 pF	-	1.0	-	ns
t _{PHL}	HIGH to LOW propagation delay	An to Bn or Bn to An;				
		V _{IH} = V _{refA} ; V _{EXT} = V _{pu} = V _{refA} + 1 V				
		V _{refA} = 1.5 V; C _L = 15 pF	-	0.6	-	ns
		V _{refA} = 1.5 V; C _L = 30 pF	-	1.1	-	ns
		V _{refA} = 1.5 V; C _L = 50 pF	-	1.3	-	ns
		V _{refA} = 2.3 V; C _L = 15 pF	-	0.4	-	ns
		V _{refA} = 2.3 V; C _L = 30 pF	-	0.9	-	ns
		V _{refA} = 2.3 V; C _L = 50 pF	-	1.0	-	ns

[1] All typical values are measured at T_{amb} = 25 °C.

12.1. Waveforms and test circuit

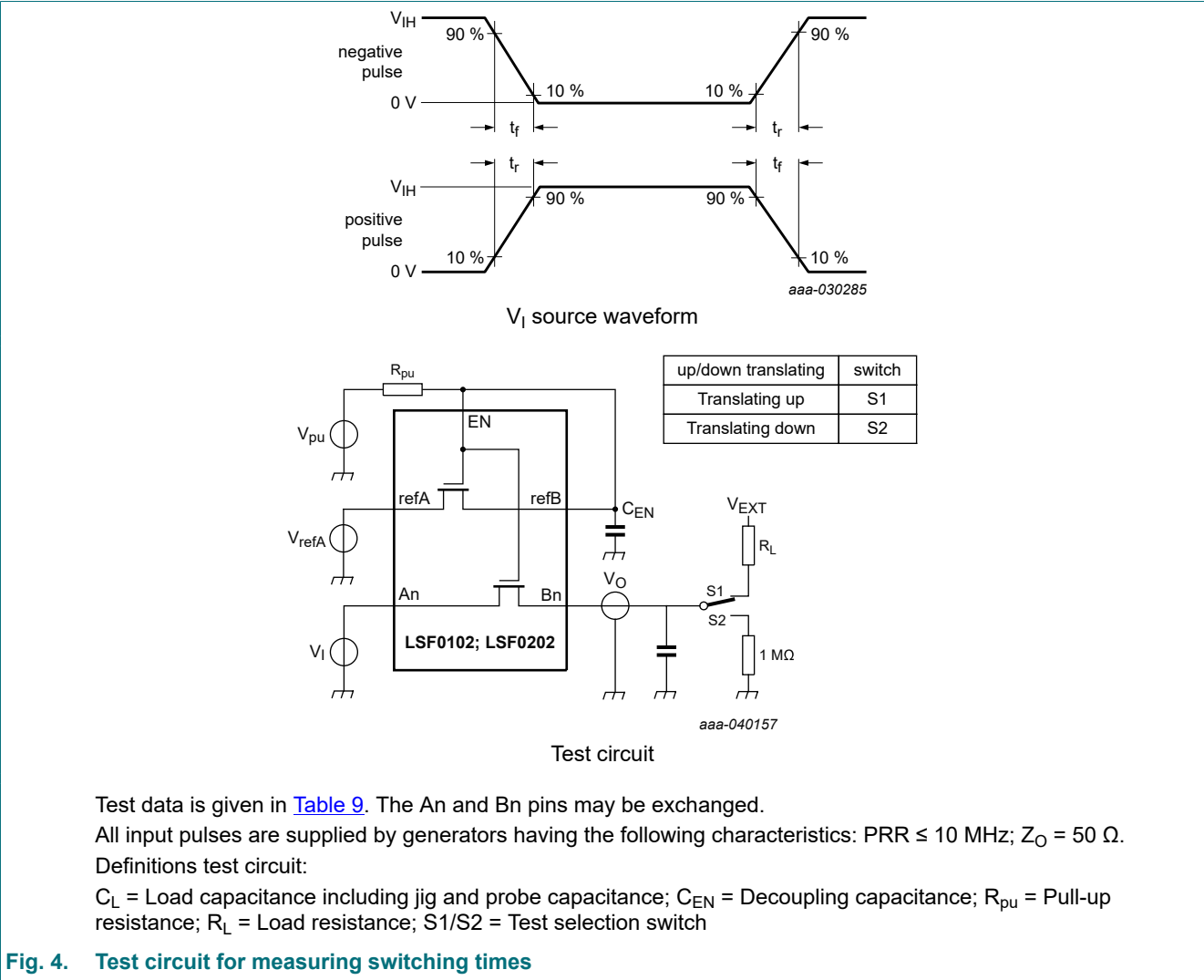
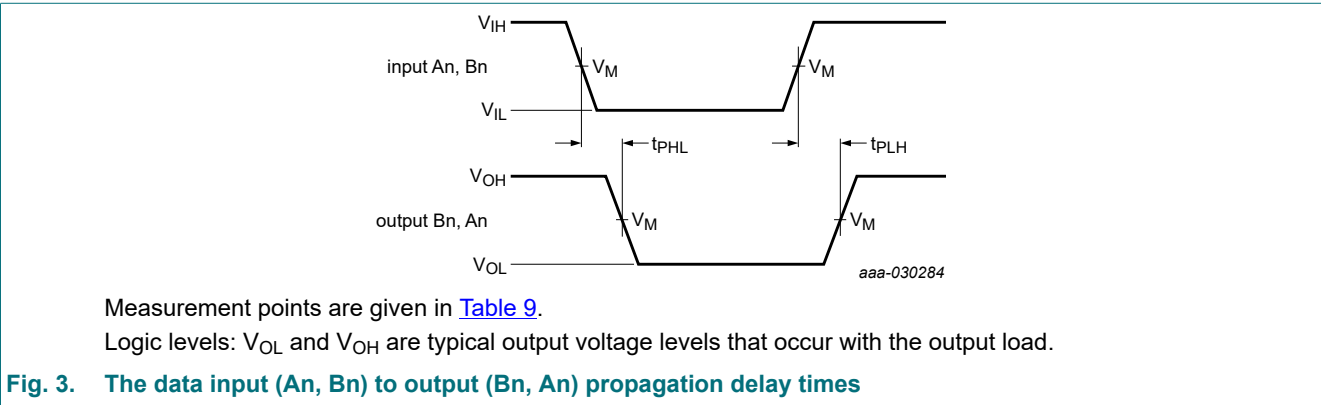


Table 9. Test data

Input		Output	Load			
t_r, t_f	V_M	V_M	C_L	C_{EN} [1]	R_L [1]	R_{pu}
≤ 2 ns	$0.5V_{refA}$	$0.5V_{refA}$	15 pF, 30 pF, 50 pF	100 nF	300 Ω	200 kΩ

[1] All typical values are measured at $T_{amb} = 25\ ^\circ\text{C}$.

13. Package outline

TSSOP8: plastic thin shrink small outline package; 8 leads; body width 3 mm; lead length 0.5 mm SOT505-2

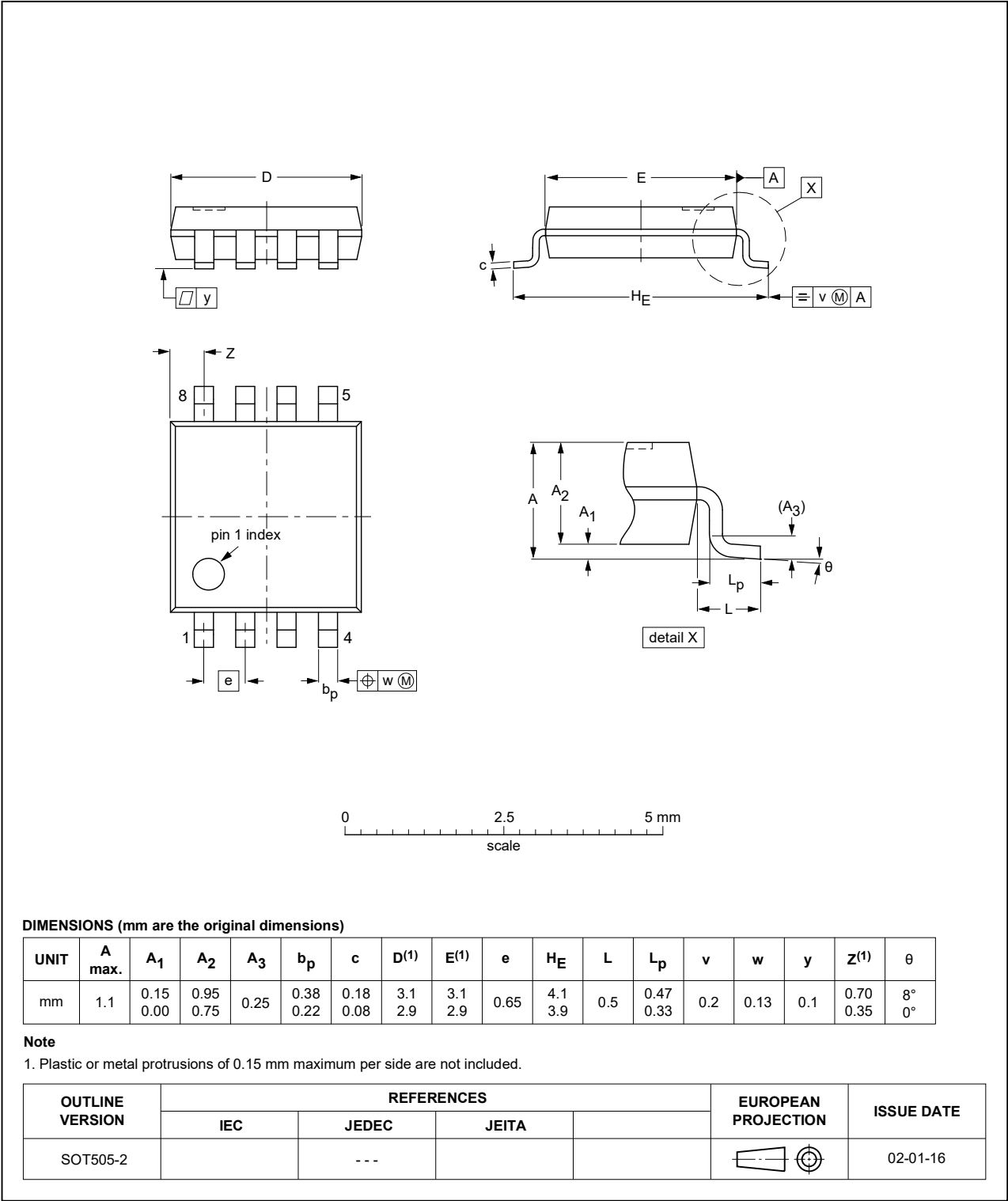


Fig. 5. Package outline SOT505-2 (TSSOP8)

VSSOP8: plastic very thin shrink small outline package; 8 leads; body width 2.3 mm

SOT765-1

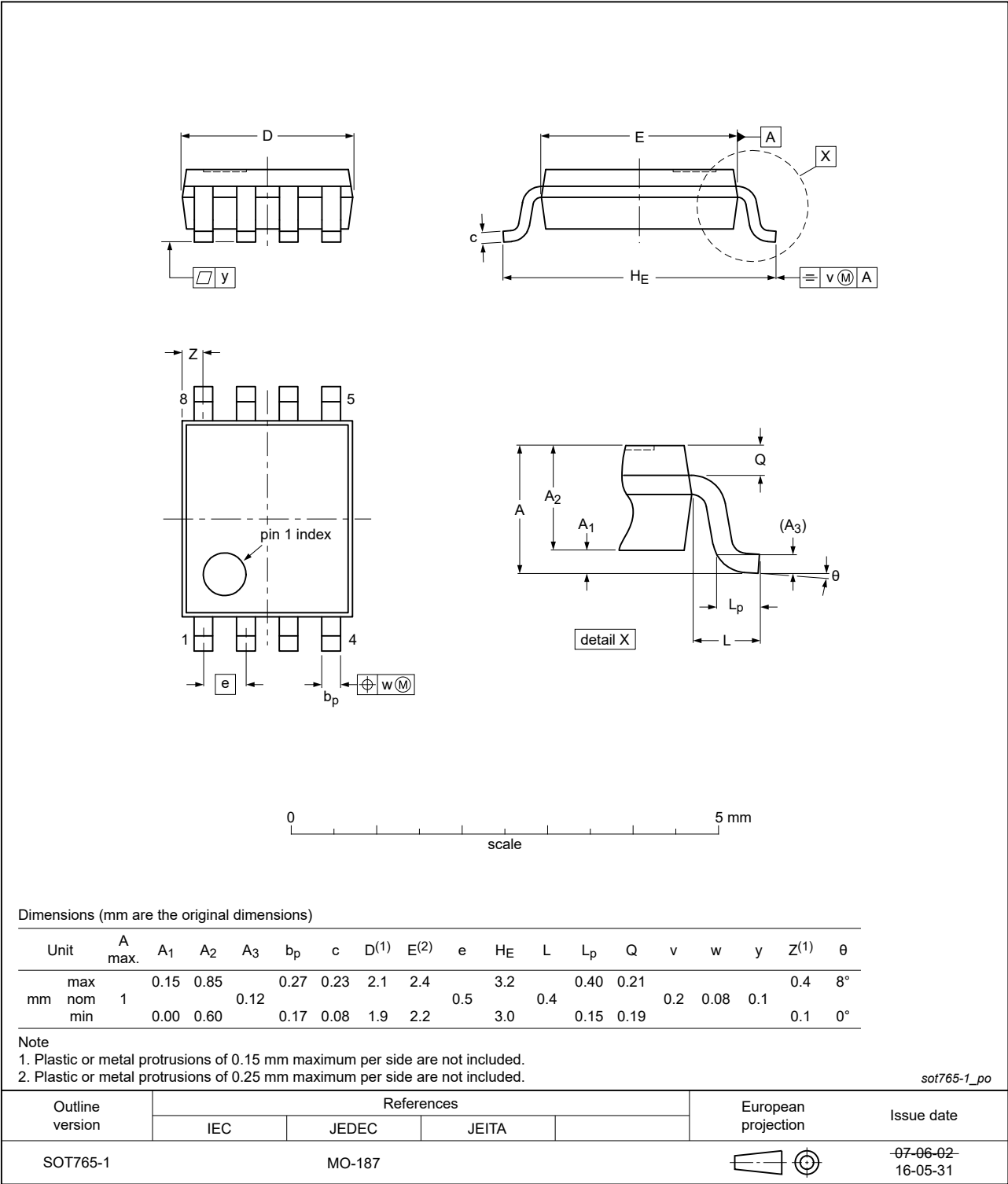


Fig. 6. Package outline SOT765-1 (VSSOP8)

XSON8: extremely thin small outline package; no leads;
8 terminals; body 1.35 x 1.0 x 0.35 mm

SOT1203

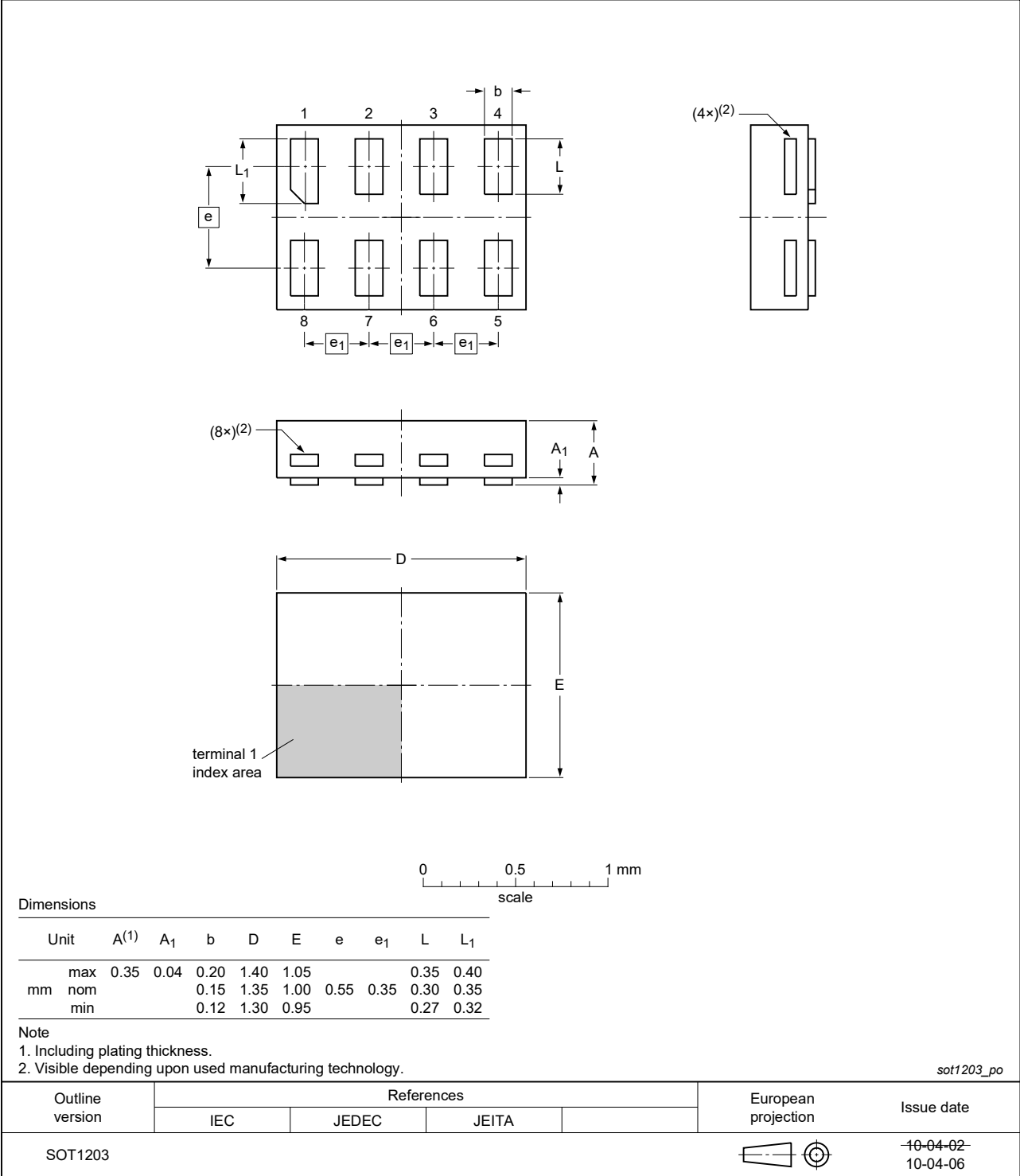


Fig. 7. Package outline SOT1203 (XSON8)

X2SON8: plastic thermal enhanced extremely thin small outline package; no leads;
8 terminals; body 1.35 x 0.8 x 0.32 mm

SOT1233-2

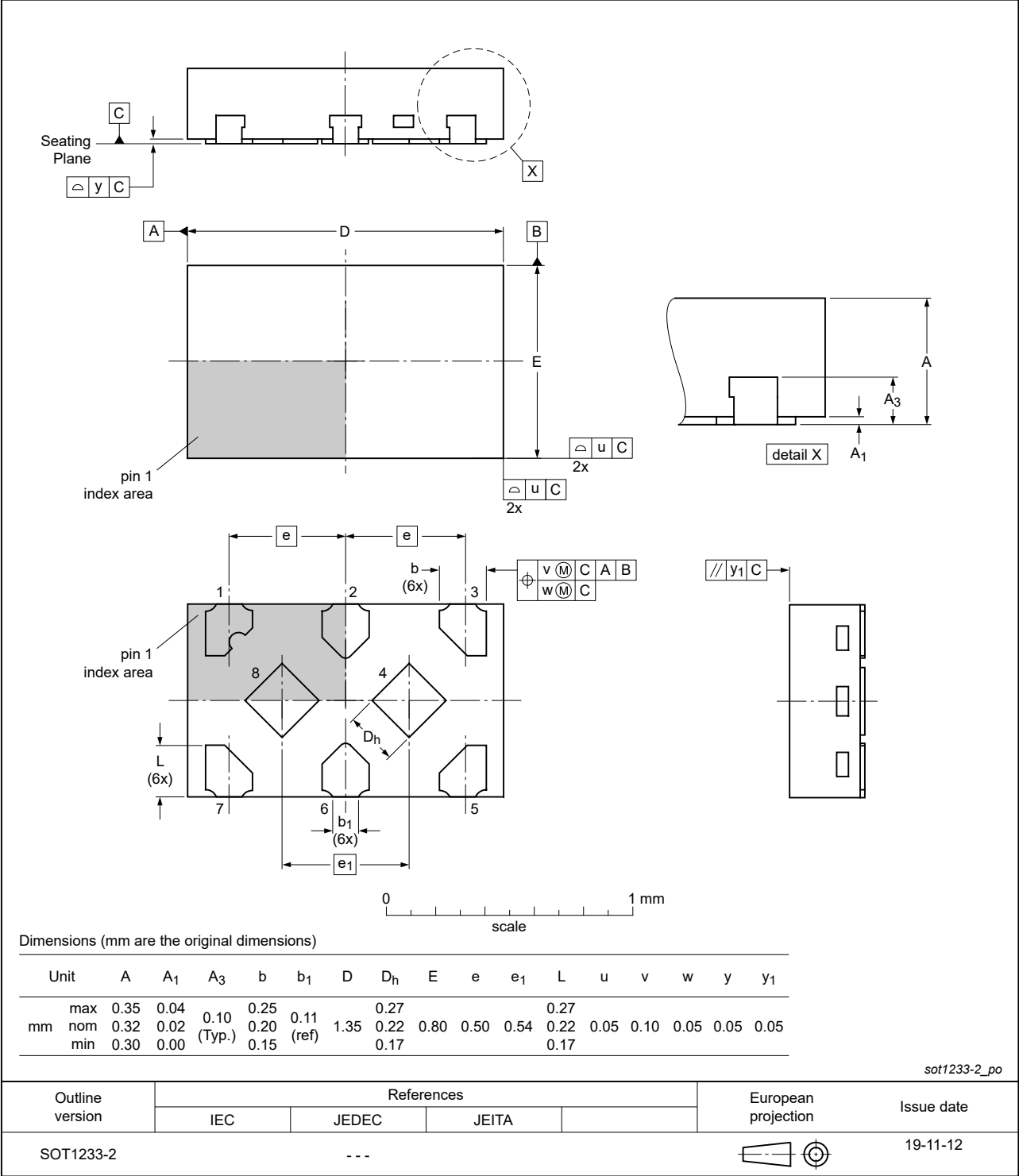


Fig. 8. Package outline SOT1233-2 (X2SON8)

14. Abbreviations

Table 10. Abbreviations

Acronym	Description
ANSI	American National Standards Institute
CDM	Charged Device Model
ESD	ElectroStatic Discharge
ESDA	ElectroStatic Discharge Association
GPIO	General Purpose Input/Output
HBM	Human Body Model
I ² c	Inter-Integrated Circuit
JEDEC	Joint Electron Device Engineering Council
MDIO	Management Data Input/Output
PCB	Printed Circuit Board
PRR	Pulse Rate Repetition
PMBus	Power Management Bus
SDIO	Secure Digital Input/Output
SMBus	System Management Bus
TTL	Transistor-Transistor Logic
UART	Universal Asynchronous Receiver-Transmitter

15. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
LSF0102_0202 v.5	20240624	Product data sheet	-	LSF0102 v.4
Modifications:	• Type numbers LSF0202DC (SOT765-1/VSSOP8) and LSF0202GS (SOT1203/XSON8) added.			
LSF0102 v.4	20231128	Product data sheet	-	LSF0102 v.3
Modifications:	• Section 2 : up- and down-translation typo corrected.			
LSF0102 v.3	20200904	Product data sheet	-	LSF0102 v.2
Modifications:	• Type number LSF0102DC (SOT765-1/VSSOP8) added.			
LSF0102 v.2	20200818	Product data sheet	-	LSF0102 v.1
Modifications:	• LSF0102GS (SOT1203/XSON8) and LSF0102GX (SOT1233-2/X2SON8) are in production. Removed note from ordering information . • Type number LSF0102DC (SOT765-1/VSSOP8) is in development and removed from this product data sheet. A preliminary data sheet is available upon request.			
LSF0102 v.1	20200414	Product data sheet	-	-

16. 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.
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".
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