

# LSF0101

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

Rev. 4.1 — 25 July 2024

Product data sheet

## 1. General description

The LSF0101 is an 1 channel bidirectional multi-voltage level translator for open-drain and push-pull applications. It supports up to 100 MHz up translation and  $\geq 100$  MHz down translation at  $\leq 30$  pF capacitive load. There is no need for a direction pin which minimizes system effort. The LSF0101 supports 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.

## 2. Features and benefits

- Bidirectional voltage translation with no direction pin
- Up translation
  - $\leq 100$  MHz;  $C_L = 30$  pF
  - $\leq 50$  MHz;  $C_L = 50$  pF
- Down translation
  - $\geq 100$  MHz;  $C_L = 30$  pF
  - $\geq 50$  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  $EN = Low$ .
- 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
- Multiple package options
- Specified from  $-40$  °C to  $+125$  °C

## 3. Applications

- GPIO, MDIO, PMBus, SMBus, SDIO, UART, I<sup>2</sup>C, and other interfaces in Telecom infrastructure
- Industrial
- Personal computing

4. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
<a href="#">LSF0101GW</a>	-40 °C to +125 °C	TSSOP6	plastic thin shrink small outline package; 6 leads; body width 1.25 mm	<a href="#">SOT363-2</a>
<a href="#">LSF0101GM</a>	-40 °C to +125 °C	XSON6	plastic extremely thin small outline package; no leads; 6 terminals; body 1 × 1.45 × 0.5 mm	<a href="#">SOT886</a>
<a href="#">LSF0101GX</a>	-40 °C to +125 °C	X2SON6	plastic thermal enhanced extremely thin small outline package; no leads; 6 terminals; body 1.0 × 0.8 × 0.32 mm	<a href="#">SOT1255-2</a>

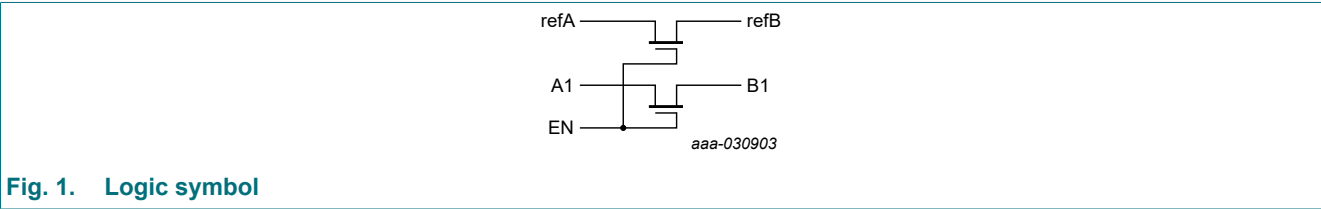
5. Marking

Table 2. Marking

Type number	Marking code[1]
LSF0101GW	h1
LSF0101GM	h1
LSF0101GX	h1

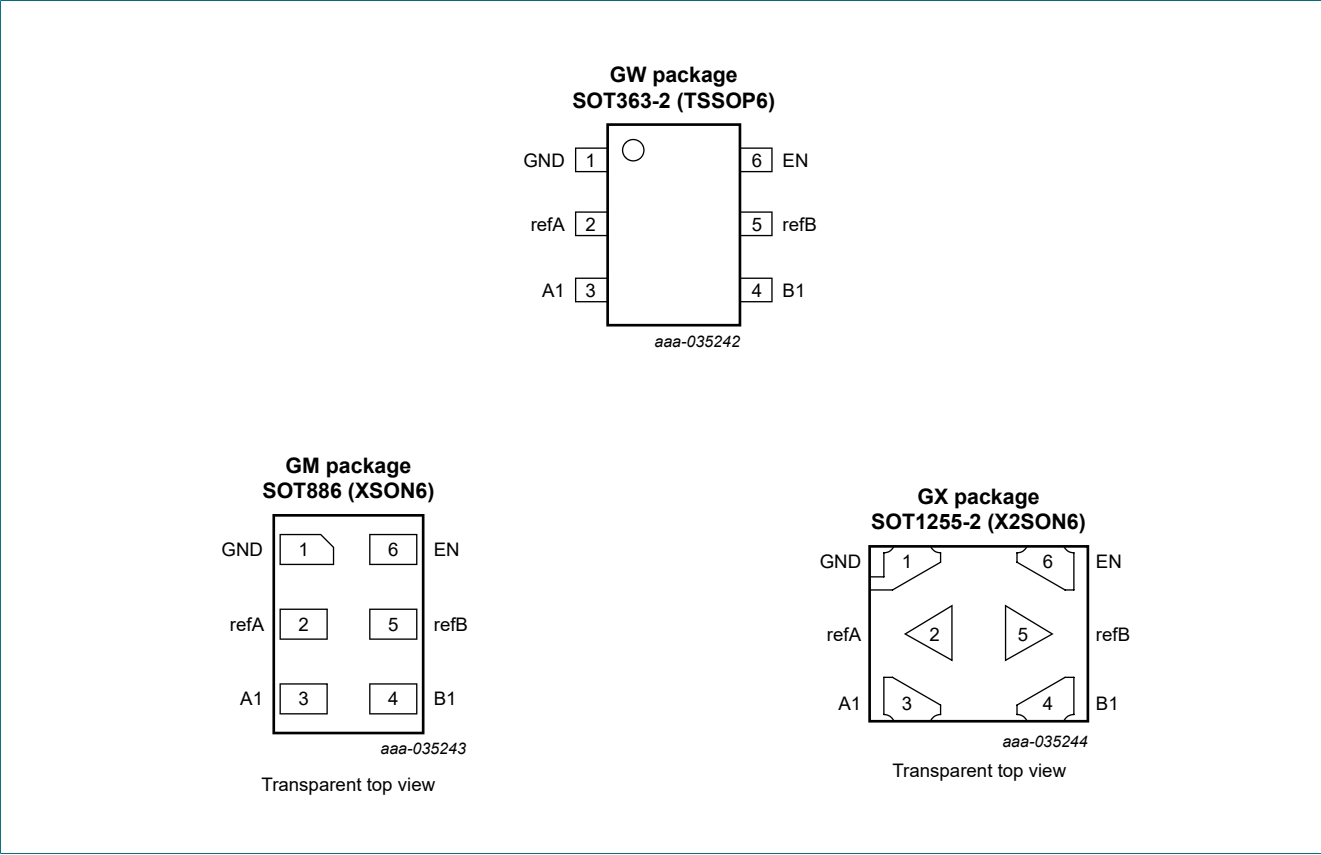
[1] The pin 1 indicator is located on the lower left corner of the device, below the marking code.

6. Functional diagram



7. Pinning information

7.1. Pinning



7.2. Pin description

Table 3. Pin description

Symbol	Pin	Description
GND	1	ground (0 V)
refA	2	reference voltage A
A1	3	data input/output A
B1	4	data input/output B
refB	5	reference voltage B
EN	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	A1, B1 channel
H	A1 = B1
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 <sub>I</sub>	input voltage	pins refA, refB, A1, B1 and EN [1]	-0.5	+7.0	V
I <sub>I/O</sub>	input/ouput current	pins refA, refB, A1 and B1; continuous channel current	-	+128	mA
I <sub>IK</sub>	input clamping current	V <sub>I</sub> < 0 V	-50	-	mA
T <sub>stg</sub>	storage temperature		-65	+150	°C
P <sub>tot</sub>	total power dissipation	T <sub>amb</sub> = -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 SOT363-2 (TSSOP6) package: P<sub>tot</sub> derates linearly with 3.7 mW/K above 83 °C.  
For SOT886 (XSON6) package: P<sub>tot</sub> derates linearly with 3.3 mW/K above 74 °C.  
For SOT1255-2 (X2SON6) package: P<sub>tot</sub> derates linearly with 3.3 mW/K above 75 °C.

10. Recommended operating conditions

Table 6. Recommended operating conditions

Symbol	Parameter	Conditions	Min	Max	Unit
V <sub>I</sub>	input voltage	pins refA, refB, A1, B1 and EN	0.0	5.0	V
I <sub>I/O</sub>	input/ouput current	pins refA, refB, A1 and B1; continuous channel current	-	+64	mA
T <sub>amb</sub>	ambient temperature		-40	+125	°C

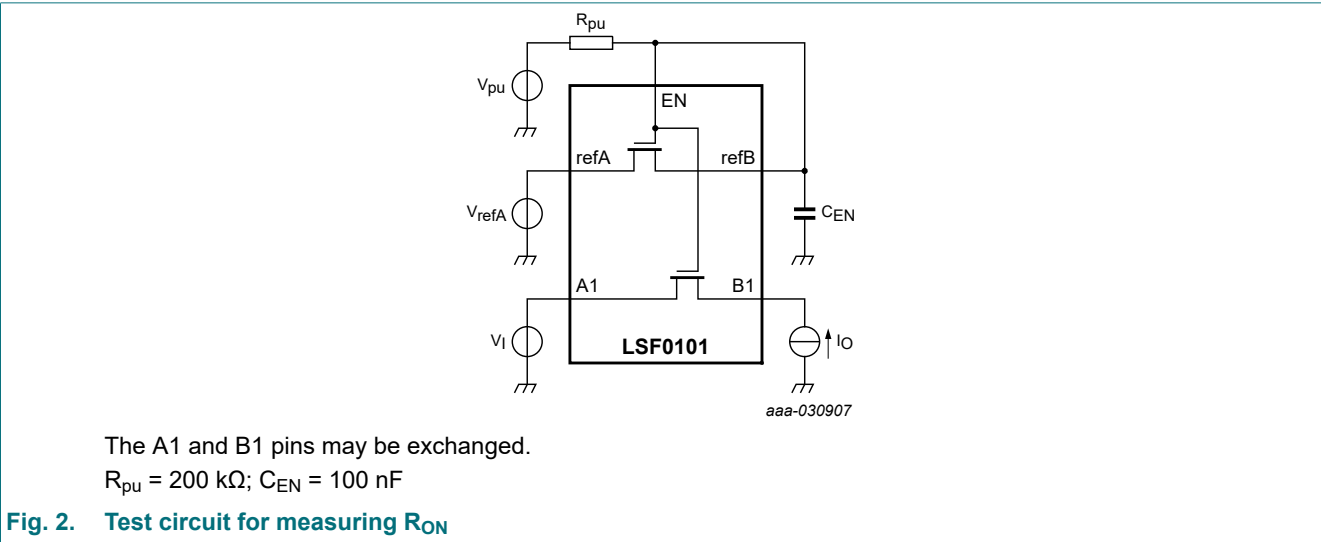
11. Static characteristics

Table 7. Static characteristics

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

Symbol	Parameter	Conditions	T <sub>amb</sub> = -40 °C to +125 °C			Unit
			Min	Typ[1]	Max	
V <sub>IK</sub>	input clamping voltage	V <sub>EN</sub> = 0 V; I <sub>I</sub> = -18 mA	-1.2	-	-	V
I <sub>I</sub>	leakage current	pins A1, B1, refA, refB and EN; V <sub>I</sub> = GND to 5.0 V	-	1	5	µA
C <sub>I</sub>	input capacitance	pins refA, refB and EN; V <sub>I</sub> = 0 V or 3 V	-	6	-	pF
C <sub>io(off)</sub>	OFF-state input/output capacitance	pins A1, B1; V <sub>O</sub> = 0 V or 3 V; V <sub>EN</sub> = 0.0 V	-	3.7	6.0	pF
C <sub>io(on)</sub>	ON-state input/output capacitance	pins A1, B1; V <sub>O</sub> = 0 V or 3 V; V <sub>EN</sub> = 3.0 V	-	6.0	12.5	pF
R <sub>ON</sub>	ON resistance	see Fig. 2 [2]				
		V <sub>I</sub> = 0 V; V <sub>pu</sub> = 5.0 V; I <sub>O</sub> = 64 mA				
		V <sub>refA</sub> = 3.3 V	-	3	-	Ω
		V <sub>refA</sub> = 1.8 V	-	4	-	Ω
		V <sub>refA</sub> = 1.0 V	-	7	-	Ω
		V <sub>I</sub> = 0 V; V <sub>pu</sub> = 5.0 V; I <sub>O</sub> = 32mA				
		V <sub>refA</sub> = 1.8 V	-	4	-	Ω
		V <sub>refA</sub> = 2.5 V	-	3	-	Ω
		V <sub>I</sub> = 1.8 V; V <sub>pu</sub> = 5.0 V; I <sub>O</sub> = 15 mA				
		V <sub>refA</sub> = 3.3 V	-	4	-	Ω
		V <sub>I</sub> = 1.0 V; V <sub>pu</sub> = 3.3 V; I <sub>O</sub> = 10 mA				
		V <sub>refA</sub> = 1.8 V	-	7	-	Ω
		V <sub>I</sub> = 0 V; V <sub>pu</sub> = 3.3 V; I <sub>O</sub> = 10 mA				
		V <sub>refA</sub> = 1.0 V	-	5	-	Ω
		V <sub>I</sub> = 0 V; V <sub>pu</sub> = 1.8 V; I <sub>O</sub> = 10 mA				
		V <sub>refA</sub> = 1.0 V	-	6	-	Ω

- [1] All typical values are measured at T<sub>amb</sub> = 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.



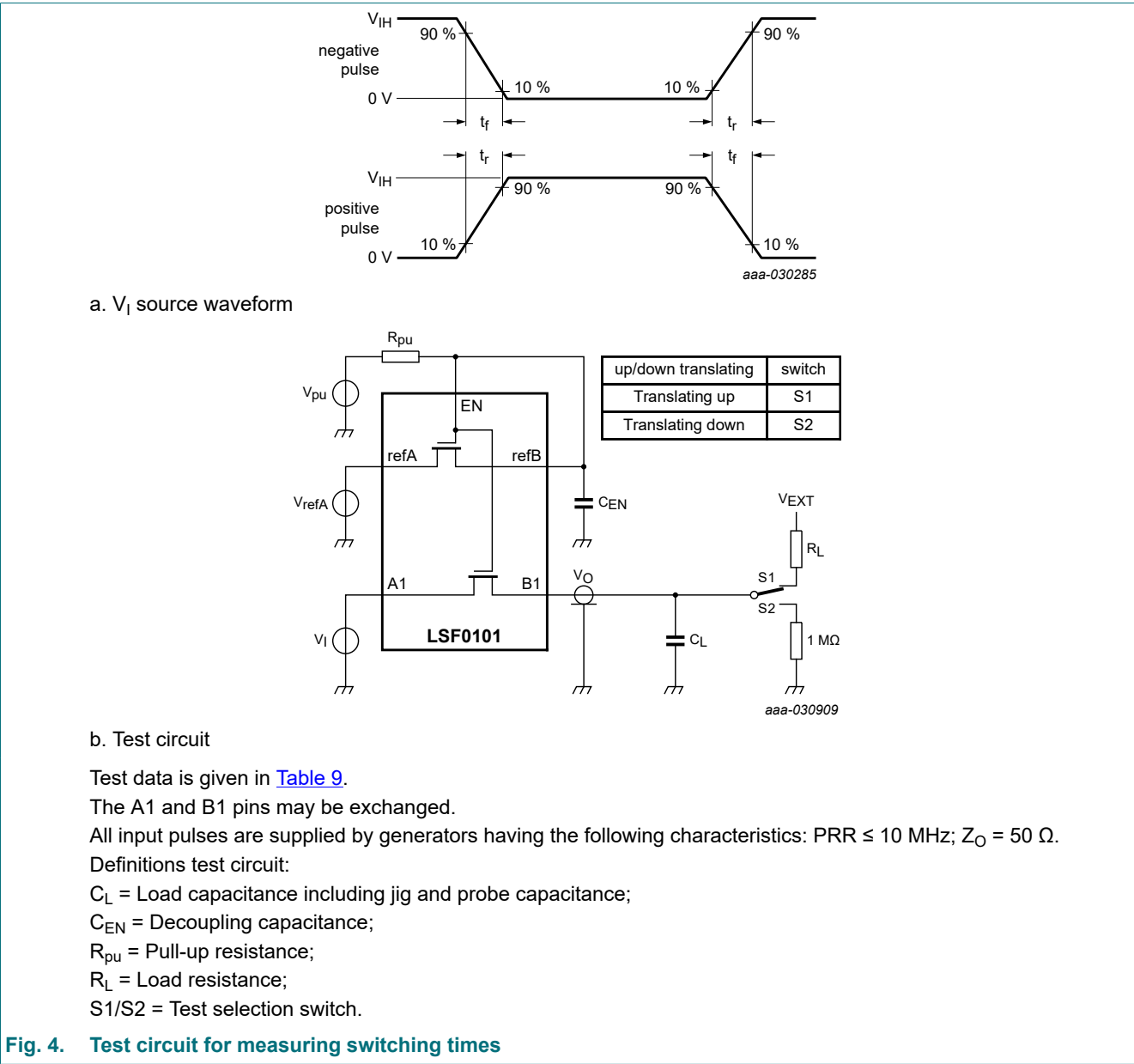
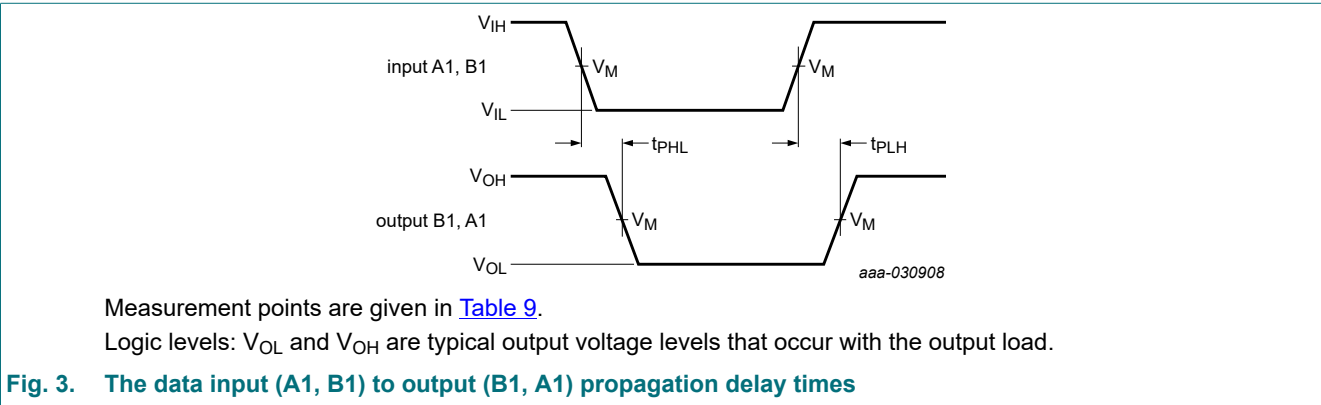
12. Dynamic characteristics

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

Symbol	Parameter	Conditions	T <sub>amb</sub> = -40 °C to +125 °C			Unit
			Min	Typ[1]	Max	
Translating down						
t <sub>PLH</sub>	LOW to HIGH propagation delay	A1 to B1 or B1 to A1;				
		V <sub>IH</sub> = V <sub>pu</sub> = V <sub>refA</sub> + 1 V				
		V <sub>refA</sub> = 1.5 V; C <sub>L</sub> = 15 pF	-	0.35	-	ns
		V <sub>refA</sub> = 1.5 V; C <sub>L</sub> = 30 pF	-	0.8	-	ns
		V <sub>refA</sub> = 1.5 V; C <sub>L</sub> = 50 pF	-	1.2	-	ns
		V <sub>refA</sub> = 2.3 V; C <sub>L</sub> = 15 pF	-	0.3	-	ns
		V <sub>refA</sub> = 2.3 V; C <sub>L</sub> = 30 pF	-	0.7	-	ns
		V <sub>refA</sub> = 2.3 V; C <sub>L</sub> = 50 pF	-	1.1	-	ns
t <sub>PHL</sub>	HIGH to LOW propagation delay	A1 to B1 or B1 to A1;				
		V <sub>IH</sub> = V <sub>pu</sub> = V <sub>refA</sub> + 1 V				
		V <sub>refA</sub> = 1.5 V; C <sub>L</sub> = 15 pF	-	0.5	-	ns
		V <sub>refA</sub> = 1.5 V; C <sub>L</sub> = 30 pF	-	1.0	-	ns
		V <sub>refA</sub> = 1.5 V; C <sub>L</sub> = 50 pF	-	1.3	-	ns
		V <sub>refA</sub> = 2.3 V; C <sub>L</sub> = 15 pF	-	0.4	-	ns
		V <sub>refA</sub> = 2.3 V; C <sub>L</sub> = 30 pF	-	0.8	-	ns
		V <sub>refA</sub> = 2.3 V; C <sub>L</sub> = 50 pF	-	1.2	-	ns
Translating up						
t <sub>PLH</sub>	LOW to HIGH propagation delay	A1 to B1 or B1 to A1;				
		V <sub>IH</sub> = V <sub>refA</sub> ; V <sub>EXT</sub> = V <sub>pu</sub> = V <sub>refA</sub> + 1 V				
		V <sub>refA</sub> = 1.5 V; C <sub>L</sub> = 15 pF	-	0.5	-	ns
		V <sub>refA</sub> = 1.5 V; C <sub>L</sub> = 30 pF	-	0.9	-	ns
		V <sub>refA</sub> = 1.5 V; C <sub>L</sub> = 50 pF	-	1.1	-	ns
		V <sub>refA</sub> = 2.3 V; C <sub>L</sub> = 15 pF	-	0.4	-	ns
		V <sub>refA</sub> = 2.3 V; C <sub>L</sub> = 30 pF	-	0.8	-	ns
		V <sub>refA</sub> = 2.3 V; C <sub>L</sub> = 50 pF	-	1.0	-	ns
t <sub>PHL</sub>	HIGH to LOW propagation delay	A1 to B1 or B1 to A1;				
		V <sub>IH</sub> = V <sub>refA</sub> ; V <sub>EXT</sub> = V <sub>pu</sub> = V <sub>refA</sub> + 1 V				
		V <sub>refA</sub> = 1.5 V; C <sub>L</sub> = 15 pF	-	0.6	-	ns
		V <sub>refA</sub> = 1.5 V; C <sub>L</sub> = 30 pF	-	1.1	-	ns
		V <sub>refA</sub> = 1.5 V; C <sub>L</sub> = 50 pF	-	1.3	-	ns
		V <sub>refA</sub> = 2.3 V; C <sub>L</sub> = 15 pF	-	0.4	-	ns
		V <sub>refA</sub> = 2.3 V; C <sub>L</sub> = 30 pF	-	0.9	-	ns
		V <sub>refA</sub> = 2.3 V; C <sub>L</sub> = 50 pF	-	1.0	-	ns

[1] All typical values are measured at T<sub>amb</sub> = 25 °C.

12.1. Waveforms and test circuit



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

Table 9. Test data

Input		Output	Load			
t <sub>r</sub> , t <sub>f</sub>	V <sub>M</sub>	V <sub>M</sub>	C <sub>L</sub>	C <sub>EN</sub> [1]	R <sub>L</sub> [1]	R <sub>pu</sub>
≤ 2 ns	0.5 × V <sub>refA</sub>	0.5 × V <sub>refA</sub>	15 pF, 30 pF, 50 pF	100 nF	300 Ω	200 kΩ

[1] All typical values are measured at T<sub>amb</sub> = 25 °C.



13. Package outline

TSSOP6: plastic thin shrink small outline package; 6 leads; body width 1.25 mm

SOT363-2

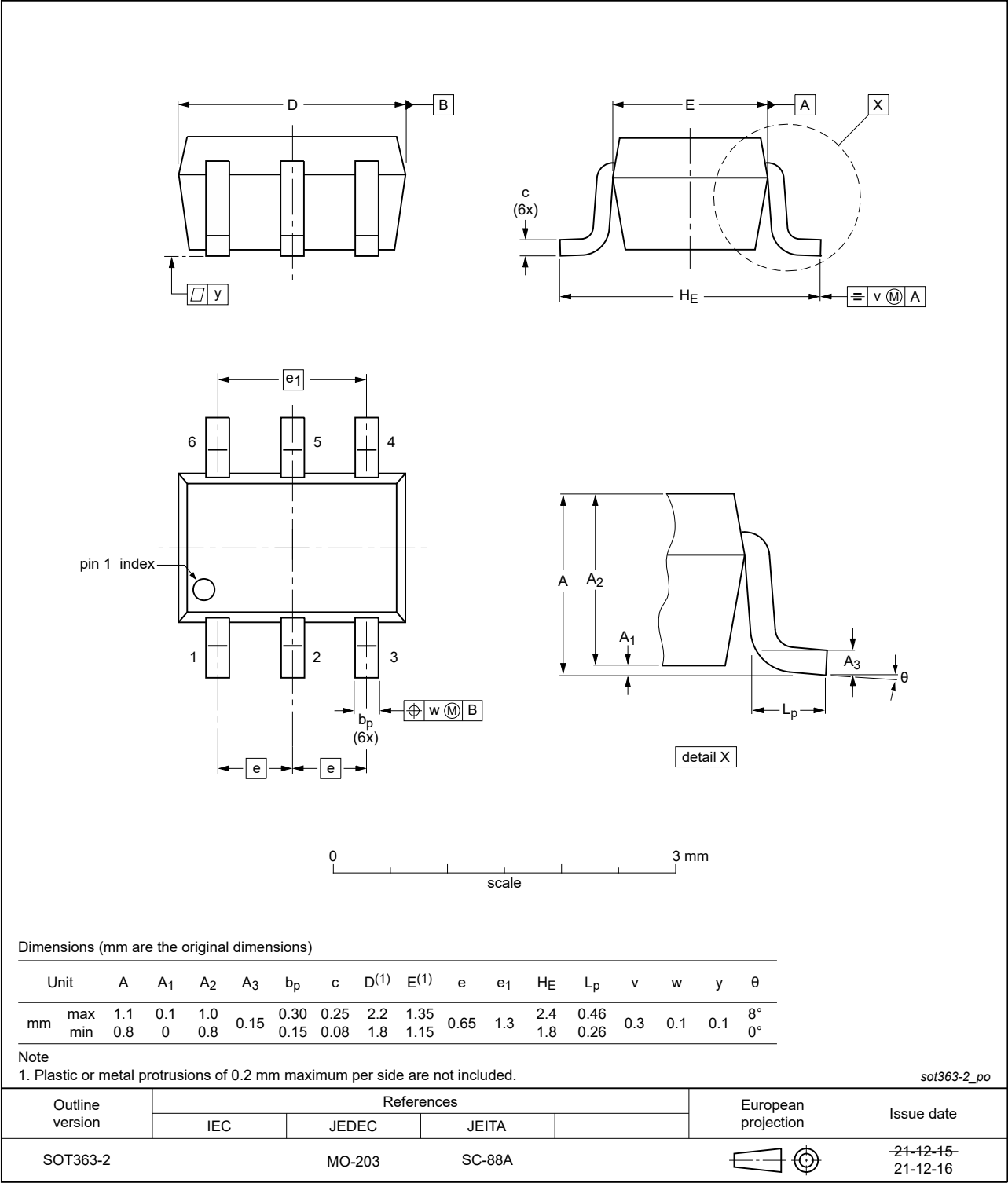


Fig. 5. Package outline SOT363-2 (TSSOP6)

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

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

SOT886

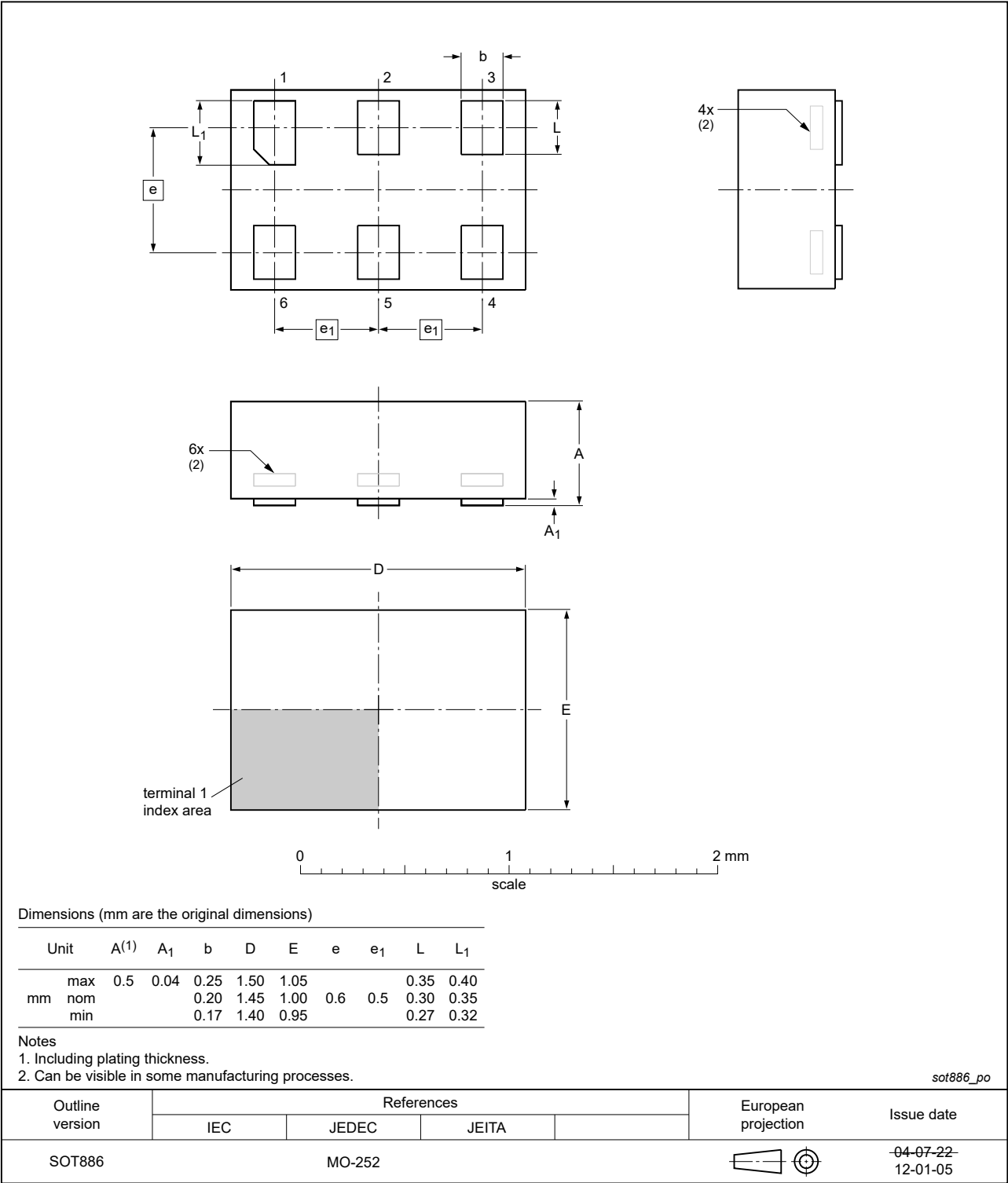


Fig. 6. Package outline SOT886 (XSON6)

X2SON6: plastic thermal enhanced extremely thin small outline package; no leads;  
6 terminals; body 1.0 x 0.8 x 0.32 mm

SOT1255-2

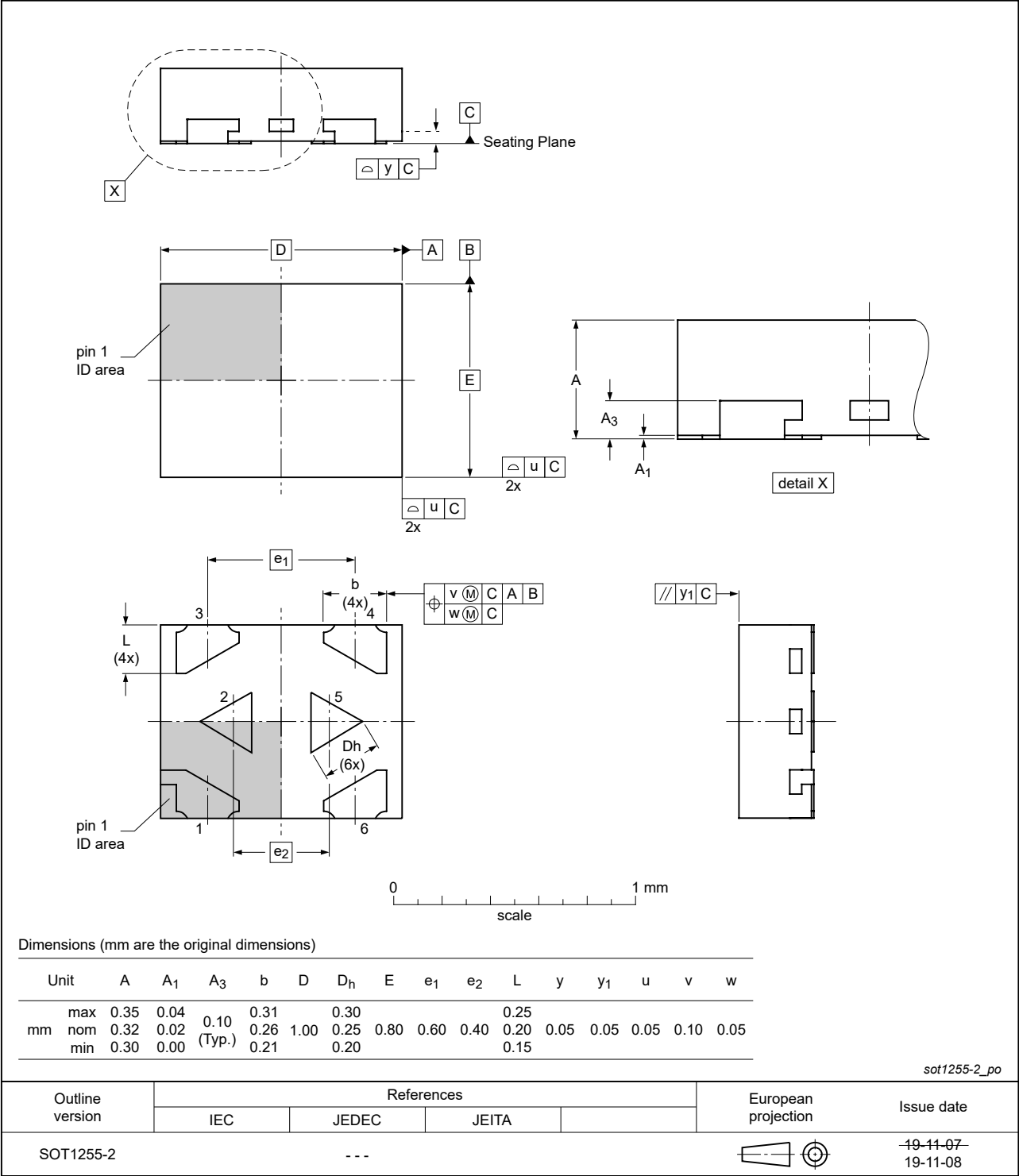


Fig. 7. Package outline SOT1255-2 (X2SON6)

14. Abbreviations

Table 10. Abbreviations

Acronym	Description
ANSI	American National Standards Institute
CDM	Charged Device Model
CMOS	Complementary Metal Oxide Semiconductor
ESD	ElectroStatic Discharge
ESDA	ElectroStatic Discharge Association
HBM	Human Body Model
JEDEC	Joint Electron Device Engineering Council
PCB	Printed Circuit Board
PRR	Pulse Rate Repetition
TTL	Transistor-Transistor Logic

15. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
LSF0101 v.4.1	20240725	Product data sheet	-	LSF0101 v.4
LSF0101 v.4	20231127	Product data sheet	-	LSF0101 v.3
Modifications:	<ul style="list-style-type: none"><li><a href="#">Section 2</a>: up- and down-translation typo corrected.</li></ul>			
LSF0101 v.3	20220208	Product data sheet	-	LSF0101 v.2
Modifications:	<ul style="list-style-type: none"><li>Package SOT363 (SC-88) changed to SOT363-2 (TSSOP6).</li></ul>			
LSF0101 v.2	20200923	Product data sheet	-	LSF0101 v.1.1
Modifications:	<ul style="list-style-type: none"><li>Type number LSF0101GW (SOT363/SC-88) added.</li></ul>			
LSF0101 v.1.1	20200626	Product data sheet	-	LSF0101 v.1
Modifications:	<ul style="list-style-type: none"><li>Type number LSF0101GW (SOT363/SC-88) is in development and removed from this product data sheet. Preliminary data sheet is available upon request.</li></ul>			
LSF0101 v.1	20200414	Product data sheet	-	-

## 16. Legal information

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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.
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