



# LSF0102-Q100

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

Rev. 4 — 24 June 2024

Product data sheet

## 1. General description

The LSF0102-Q100 is a 2 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 LSF0102-Q100 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.

This product has been qualified to the Automotive Electronics Council (AEC) standard Q100 (Grade 1) and is suitable for use in automotive applications.

## 2. Features and benefits

- Automotive product qualification in accordance with AEC-Q100 (Grade 1)
  - Specified from  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$
- 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  $EN = \text{Low}$ .
- 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

## 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="#">LSF0102DP-Q100</a> | -40 °C to +125 °C | TSSOP8 | plastic thin shrink small outline package; 8 leads; body width 3 mm; lead length 0.5 mm | <a href="#">SOT505-2</a> |
| <a href="#">LSF0102DC-Q100</a> | -40 °C to +125 °C | VSSOP8 | plastic very thin shrink small outline package; 8 leads; body width 2.3 mm              | <a href="#">SOT765-1</a> |

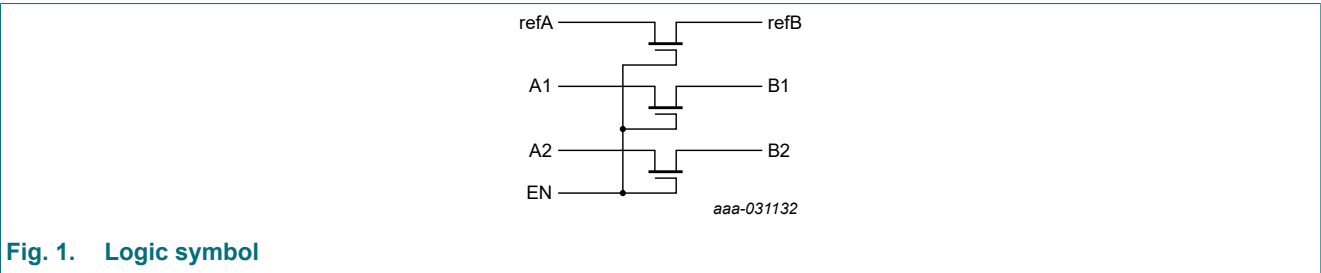
5. Marking

Table 2. Marking

| Type number    | Marking code[1] |
|----------------|-----------------|
| LSF0102DP-Q100 | h2              |
| LSF0102DC-Q100 | h2              |

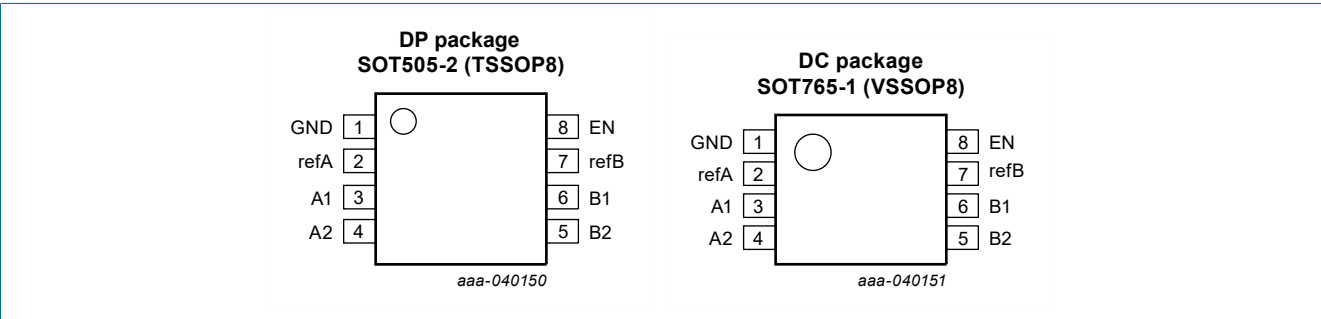
[1] The pin 1 indicator is located on the lower left corner of the device, below the marking code.

6. Functional diagram



7. Pinning information

7.1. Pinning LSF0102



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        |
| A2     | 4   | data input/output A        |
| B2     | 5   | data input/output B        |
| B1     | 6   | data input/output B        |
| refB   | 7   | reference voltage B        |
| EN     | 8   | 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 <sub>I</sub>   | input voltage           | pins refA, refB, An, Bn and EN [1]                     | -0.5 | +7.0 | V    |
| I <sub>I/O</sub> | input/ouput current     | pins refA, refB, An and Bn; 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 SOT505-2 (TSSOP8) package: P<sub>tot</sub> derates linearly with 4.6 mW/K above 96 °C.  
For SOT765-1 (VSSOP8) package: P<sub>tot</sub> derates linearly with 4.9 mW/K above 99 °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, An, Bn and EN                         | 0.0 | 5.0  | V    |
| I <sub>I/O</sub> | input/ouput current | pins refA, refB, An and Bn; continuous channel current | -   | +64  | mA   |
| T <sub>amb</sub> | ambient temperature |                                                        | -40 | +125 | °C   |

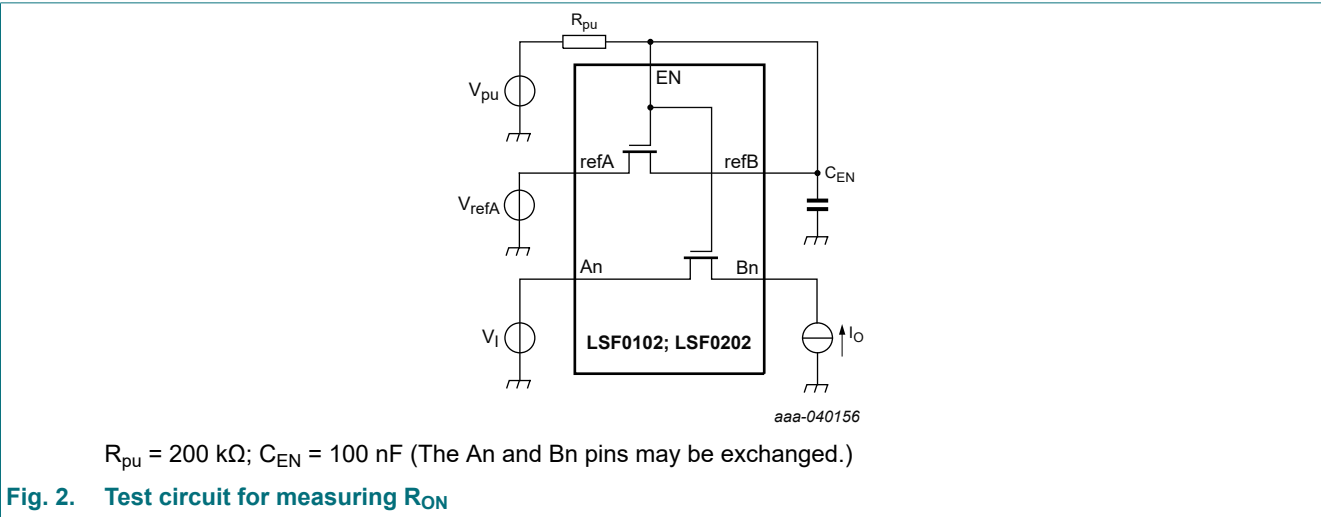
11. Static characteristics

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 An, Bn, 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 An, Bn; V <sub>O</sub> = 0 V or 3 V; V <sub>EN</sub> = 0.0 V       | -                                    | 3      | 6.0  | pF   |
| C <sub>io(on)</sub>  | ON-state input/output capacitance  | pins An, Bn; V <sub>O</sub> = 0 V or 3 V; V <sub>EN</sub> = 3.0 V       | -                                    | 6      | 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 | An to Bn or Bn to An;<br>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 | An to Bn or Bn to An;<br>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 | An to Bn or Bn to An;<br>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 | An to Bn or Bn to An;<br>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

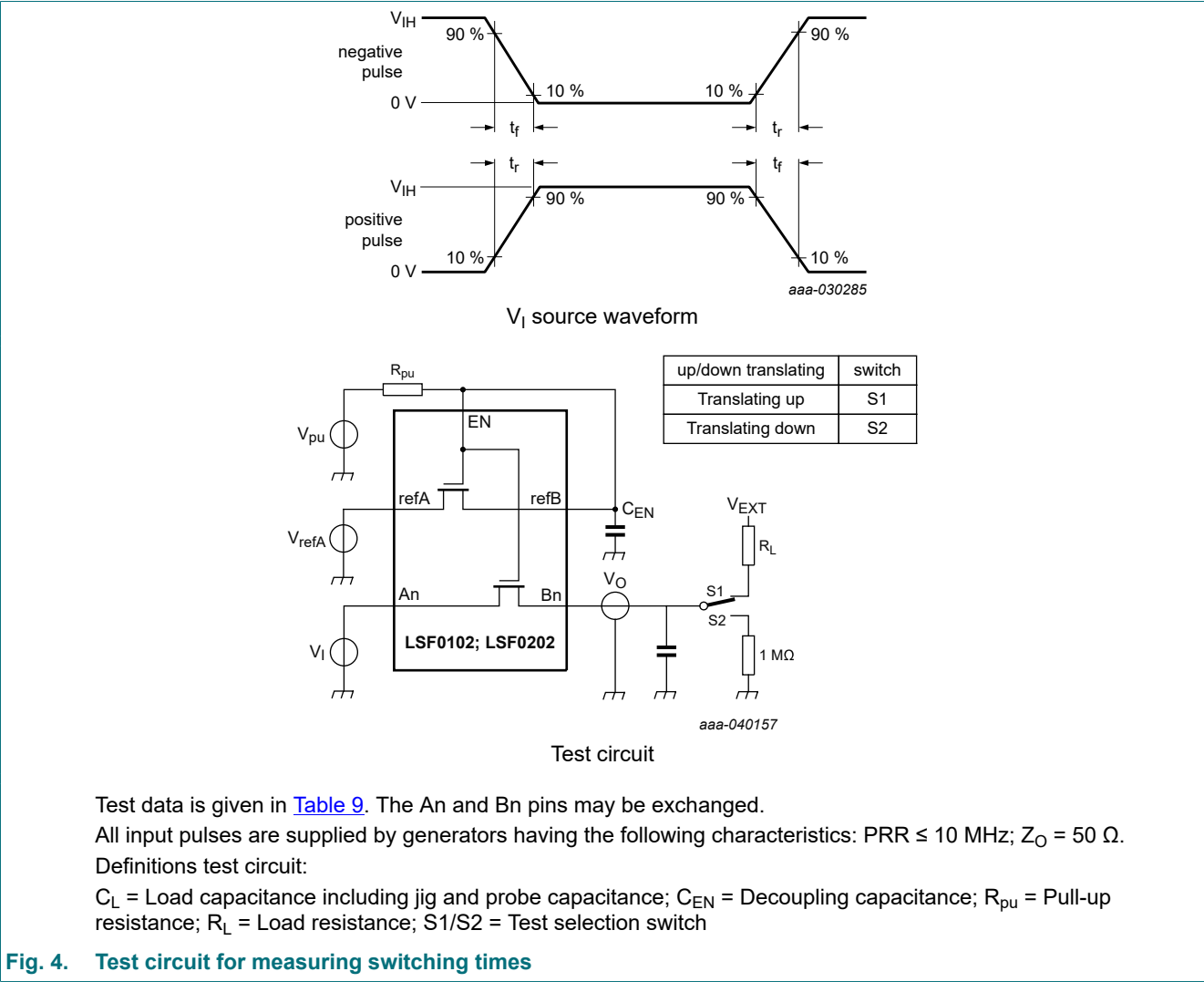
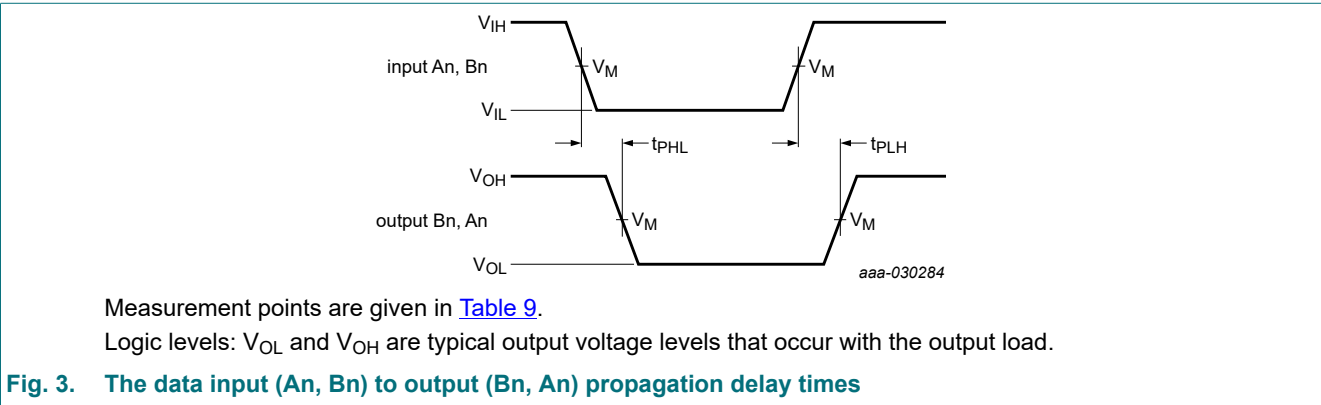


Table 9. Test data

| 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 °C.

13. Package outline

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

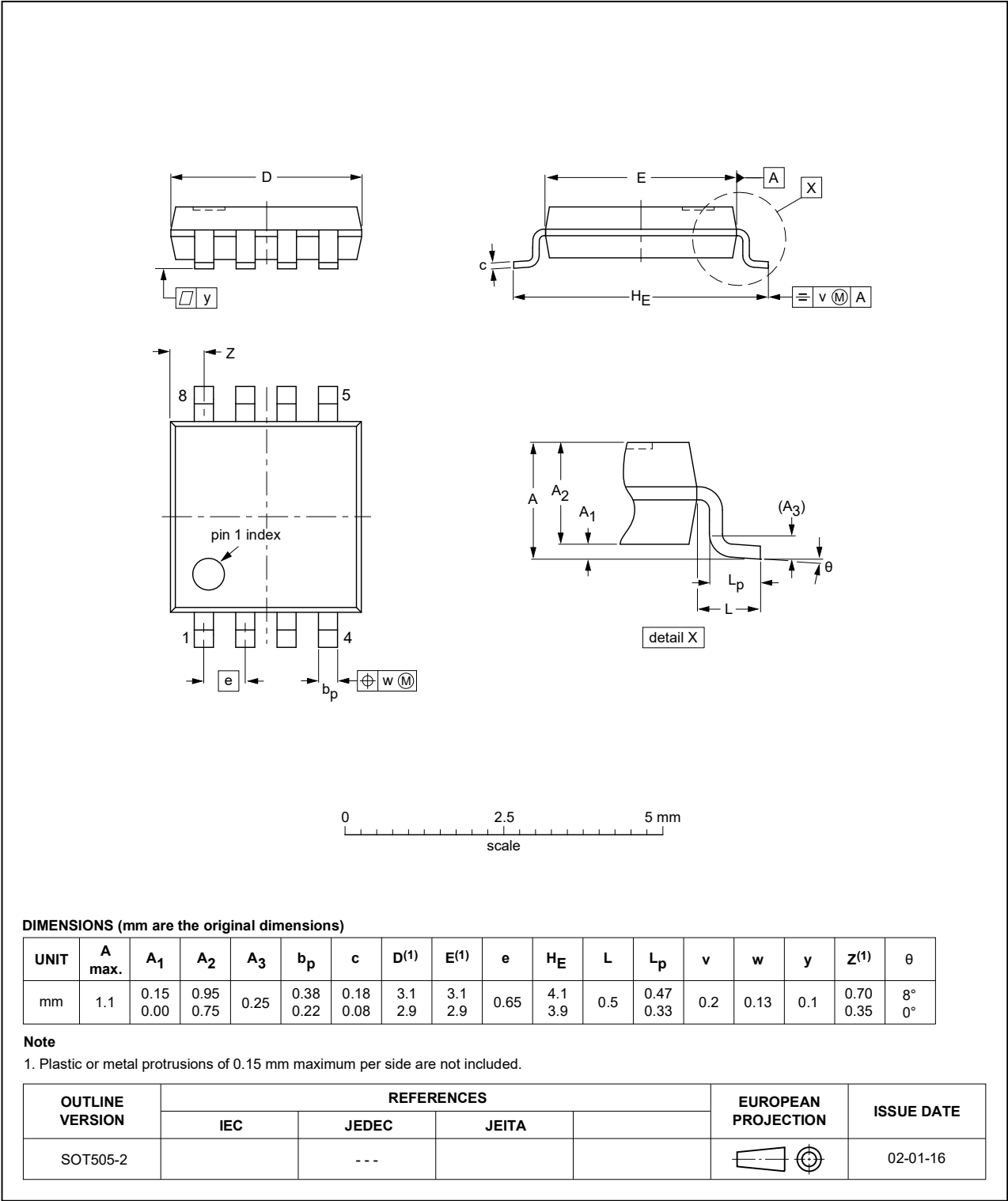


Fig. 5. Package outline SOT505-2 (TSSOP8)

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

SOT765-1

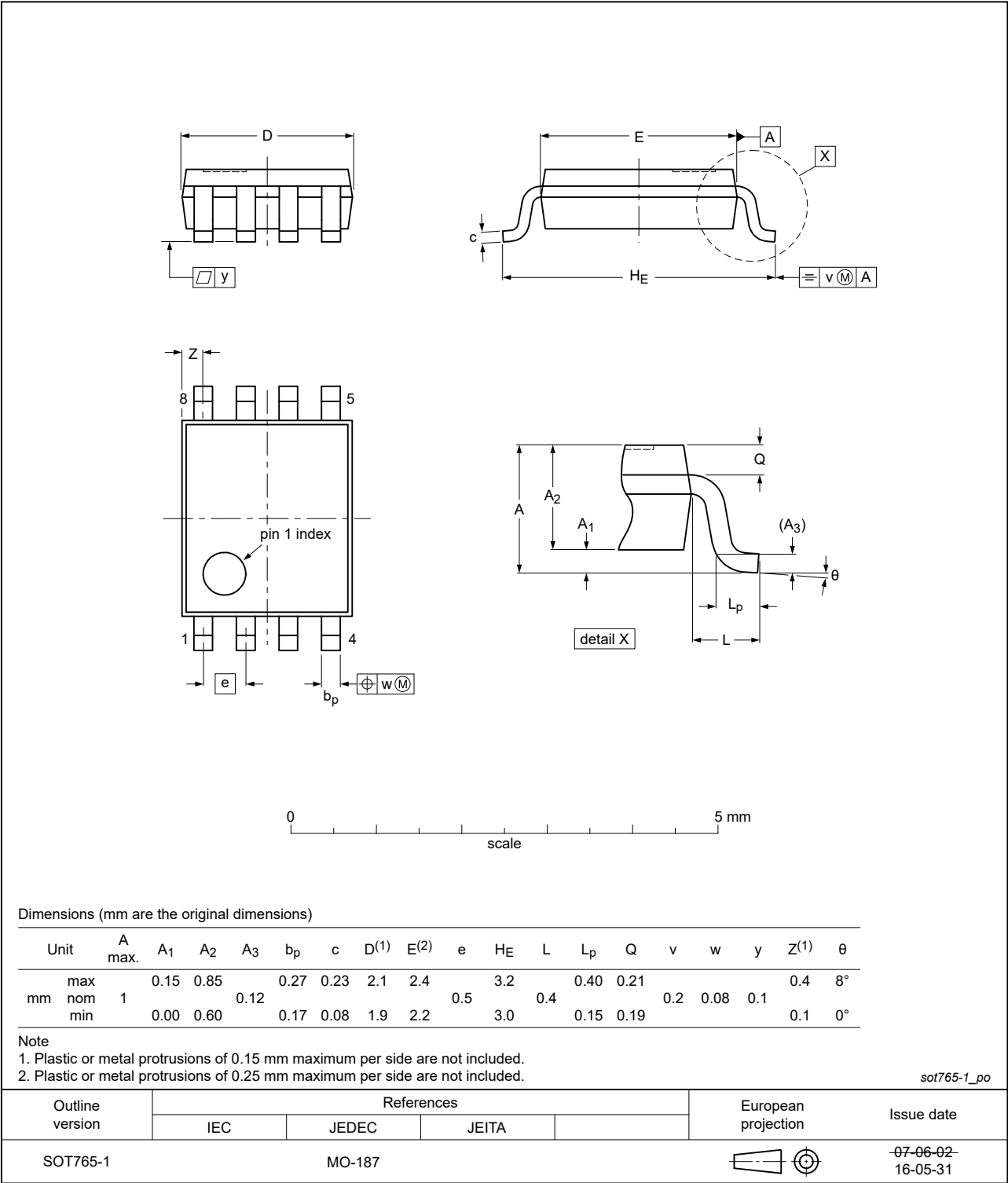


Fig. 6. Package outline SOT765-1 (VSSOP8)

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 <sup>2</sup> 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_Q100 v.4 | 20240624                                                               | Product data sheet | -             | LSF0102_Q100 v.3 |
| Modifications:   | • <a href="#">Section 7</a> : pin configuration drawings updated.      |                    |               |                  |
| LSF0102_Q100 v.3 | 20231128                                                               | Product data sheet | -             | LSF0102_Q100 v.2 |
| Modifications:   | • <a href="#">Section 2</a> : up- and down-translation typo corrected. |                    |               |                  |
| LSF0102_Q100 v.2 | 20200904                                                               | Product data sheet | -             | LSF0102_Q100 v.1 |
| Modifications:   | • Type number LSF0102DC-Q100 (SOT765-1/VSSOP8) added.                  |                    |               |                  |
| LSF0102_Q100 v.1 | 20200611                                                               | Product data sheet | -             | -                |

16. Legal information

Data sheet status

| Document status<br>[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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