

74LV1T00

2-input single supply translating NAND gate

Rev. 5 — 7 December 2023

Product data sheet

1. General description

The 74LV1T00 is a single, level translating 2-input NAND gate. The low threshold inputs support 1.8 V input logic at $V_{CC} = 3.3$ V and can be used in 1.8 V to 3.3 V level up translation. In addition, the 5 V tolerant input pins enable level down translation (3.3 V to 2.5 V output at $V_{CC} = 2.5$ V). The output level is referenced to the supply voltage and supports 1.8 V, 2.5 V, 3.3 V and 5.0 V CMOS levels. The wide V_{CC} range permits the generation of output levels to connect to controllers or processors.

2. Features and benefits

- Single supply voltage translator at 1.8 V, 2.5 V, 3.3 V and 5.0 V
- Up translation
 - 1.2 V to 1.8 V at $V_{CC} = 1.8$ V
 - 1.5 V to 2.5 V at $V_{CC} = 2.5$ V
 - 1.8 V to 3.3 V at $V_{CC} = 3.3$ V
 - 3.3 V to 5.0 V at $V_{CC} = 5.0$ V
- Down translation
 - 3.3 V to 1.8 V at $V_{CC} = 1.8$ V
 - 3.3 V to 2.5 V at $V_{CC} = 2.5$ V
 - 5.0 V to 3.3 V at $V_{CC} = 3.3$ V
- 5 V tolerant inputs
- Latch-up performance exceeds 250 mA per JESD 78 Class II
- 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 $+85$ °C and from -40 °C to $+125$ °C

3. Applications

- Portable applications
- PC and notebooks
- Industrial controller
- Telecom

4. Ordering information

Table 1. Ordering information

| Type number | Package | | | |
|----------------------------|-------------------|--------|--|---------------------------|
| | Temperature range | Name | Description | Version |
| 74LV1T00GW | -40 °C to +125 °C | TSSOP5 | plastic thin shrink small outline package; 5 leads; body width 1.25 mm | SOT353-1 |
| 74LV1T00GV | -40 °C to +125 °C | SC-74A | plastic surface-mounted package; 5 leads | SOT753 |
| 74LV1T00GX | -40 °C to +125 °C | X2SON5 | plastic thermal enhanced extremely thin small outline package; no leads; 5 terminals; body 0.8 × 0.8 × 0.32 mm | SOT1226-3 |

5. Marking

Table 2. Marking

| Type number | Marking code ^[1] |
|-------------|-----------------------------|
| 74LV1T00GW | Sa |
| 74LV1T00GV | Sa |
| 74LV1T00GX | Sa |

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

6. Functional diagram

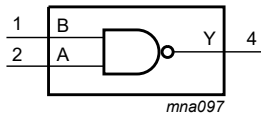


Fig. 1. Logic symbol

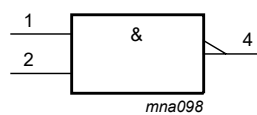


Fig. 2. IEC logic symbol

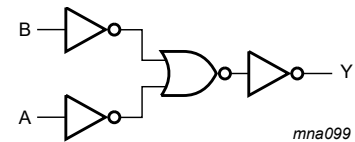


Fig. 3. Logic diagram

7. Pinning information

7.1. Pinning

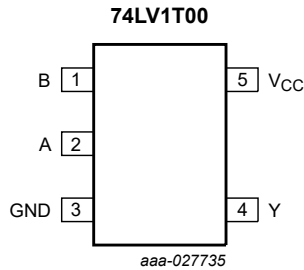


Fig. 4. Pin configuration SOT353-1 (TSSOP5) and SOT753 (SC-74A)

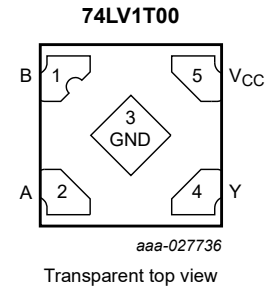


Fig. 5. Pin configuration SOT1226-3 (X2SON5)

7.2. Pin description

Table 3. Pin description

| Symbol | Pin | Description |
|-----------------|-----|----------------|
| B | 1 | data input |
| A | 2 | data input |
| GND | 3 | ground (0 V) |
| Y | 4 | data output |
| V _{CC} | 5 | supply voltage |

8. Functional description

Table 4. Function table

H = HIGH voltage level; L = LOW voltage level.

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

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_{CC} | supply voltage | | -0.5 | +7.0 | V |
| V_I | input voltage | | -0.5 | +7.0 | V |
| V_O | output voltage | output HIGH or LOW state | -0.5 | $V_{CC} + 0.5$ | V |
| | | output in power-off state | -0.5 | 4.6 | V |
| I_{IK} | input clamping current | $V_I < 0$ V | -20 | - | mA |
| I_{OK} | output clamping current | $V_O < 0$ V or $V_O > V_{CC}$ | - | ± 20 | mA |
| I_O | output current | $V_O = 0$ V to V_{CC} | - | ± 25 | 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 +125 °C | - | 250 | mW |

[1] If the input current ratings are observed, the minimum input voltage ratings may be exceeded.

[2] If the output current ratings are observed, the output voltage ratings may be exceeded.

[3] This value is limited to 7 V maximum.

[4] For SOT353-1 (TSSOP5) package: P_{tot} derates linearly with 3.3 mW/K above 74 °C.

For SOT753 (SC-74A) package: P_{tot} derates linearly with 3.8 mW/K above 85 °C.

For SOT1226-3 (X2SON5) package: P_{tot} derates linearly with 3.0 mW/K above 67 °C.

10. Recommended operating conditions

Table 6. Recommended operating conditions

Voltages are referenced to GND (ground = 0 V).

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---------------------|-------------------------------------|---------------------------|-----|-----|----------|------|
| V_{CC} | supply voltage | | 1.6 | 5.0 | 5.5 | V |
| V_I | input voltage | | 0 | - | 5.5 | V |
| V_O | output voltage | output HIGH or LOW state | 0 | - | V_{CC} | V |
| T_{amb} | ambient temperature | | -40 | +25 | +125 | °C |
| $\Delta t/\Delta V$ | input transition rise and fall rate | $V_{CC} = 1.8$ V to 5.0 V | - | - | 20 | ns/V |

11. Static characteristics

Table 7. Static characteristics

Voltages are referenced to GND (ground = 0 V).

| Symbol | Parameter | Conditions | 25 °C | | -40 °C to +85 °C | | -40 °C to +125 °C | | Unit |
|---|---------------------------|--|-----------------------|------|-----------------------|-------|-----------------------|-------|------|
| | | | Min | Max | Min | Max | Min | Max | |
| V _{IH} | HIGH-level input voltage | V _{CC} = 1.65 V to 1.8 V | 0.94 | - | 1.0 | - | 1.0 | - | V |
| | | V _{CC} = 2.0 V | 0.99 | - | 1.03 | - | 1.03 | - | V |
| | | V _{CC} = 2.25 V to 2.5 V | 1.135 | - | 1.18 | - | 1.18 | - | V |
| | | V _{CC} = 2.75 V | 1.21 | - | 1.23 | - | 1.23 | - | V |
| | | V _{CC} = 3.0 V to 3.3 V | 1.35 | - | 1.37 | - | 1.37 | - | V |
| | | V _{CC} = 3.6 V | 1.47 | - | 1.48 | - | 1.48 | - | V |
| | | V _{CC} = 4.5 V to 5.0 V | 2.02 | - | 2.03 | - | 2.03 | - | V |
| | | V _{CC} = 5.5 V | 2.10 | - | 2.11 | - | 2.11 | - | V |
| V _{IL} | LOW-level input voltage | V _{CC} = 1.65 V to 2.0 V | - | 0.58 | - | 0.55 | - | 0.55 | V |
| | | V _{CC} = 2.25 V to 2.75 V | - | 0.75 | - | 0.71 | - | 0.71 | V |
| | | V _{CC} = 3.0 V to 3.6 V | - | 0.80 | - | 0.65 | - | 0.65 | V |
| | | V _{CC} = 4.5 V to 5.5 V | - | 0.80 | - | 0.80 | - | 0.80 | V |
| V _{OH} | HIGH-level output voltage | V _I = V _{IH} or V _{IL} ; | | | | | | | |
| | | V _{CC} = 1.65 V to 5.5 V; I _O = -20 µA | V _{CC} - 0.1 | - | V _{CC} - 0.1 | - | V _{CC} - 0.1 | - | V |
| | | V _{CC} = 1.65 V; I _O = -2 mA | 1.28 | - | 1.21 | - | 1.21 | - | V |
| | | V _{CC} = 1.8 V; I _O = -2 mA | 1.5 | - | 1.45 | - | 1.45 | - | V |
| | | V _{CC} = 2.3 V; I _O = -2.3 mA | 2.0 | - | 2.0 | - | 2.0 | - | V |
| | | V _{CC} = 2.3 V; I _O = -3 mA | 2.0 | - | 1.93 | - | 1.93 | - | V |
| | | V _{CC} = 2.5 V; I _O = -3 mA | 2.25 | - | 2.15 | - | 2.15 | - | V |
| | | V _{CC} = 3.0 V; I _O = -3 mA | 2.78 | - | 2.7 | - | 2.7 | - | V |
| | | V _{CC} = 3.0 V; I _O = -5.5 mA | 2.6 | - | 2.49 | - | 2.49 | - | V |
| | | V _{CC} = 3.3 V; I _O = -5.5 mA | 2.9 | - | 2.8 | - | 2.8 | - | V |
| | | V _{CC} = 4.5 V; I _O = -4 mA | 4.2 | - | 4.1 | - | 4.1 | - | V |
| | | V _{CC} = 4.5 V; I _O = -8 mA | 4.1 | - | 3.95 | - | 3.95 | - | V |
| V _{CC} = 5.0 V; I _O = -8 mA | 4.6 | - | 4.5 | - | 4.5 | - | V | | |
| V _{OL} | LOW-level output voltage | V _I = V _{IH} or V _{IL} | | | | | | | |
| | | V _{CC} = 1.65 V to 5.5 V; I _O = 20 µA | - | 0.1 | - | 0.1 | - | 0.1 | V |
| | | V _{CC} = 1.65 V; I _O = 2 mA | - | 0.2 | - | 0.25 | - | 0.25 | V |
| | | V _{CC} = 2.3 V; I _O = 2.3 mA | - | 0.1 | - | 0.15 | - | 0.15 | V |
| | | V _{CC} = 2.3 V; I _O = 3 mA | - | 0.15 | - | 0.2 | - | 0.2 | V |
| | | V _{CC} = 3.0 V; I _O = 3 mA | - | 0.1 | - | 0.15 | - | 0.15 | V |
| | | V _{CC} = 3.0 V; I _O = 5.5 mA | - | 0.2 | - | 0.252 | - | 0.252 | V |
| | | V _{CC} = 4.5 V; I _O = 4 mA | - | 0.15 | - | 0.2 | - | 0.2 | V |
| V _{CC} = 4.5 V; I _O = 8 mA | - | 0.3 | - | 0.35 | - | 0.35 | V | | |
| I _I | input leakage current | V _I = V _{CC} or GND; V _{CC} = 0 V to 5.5 V | - | ±0.1 | - | ±1 | - | ±1 | µA |
| I _{CC} | supply current | V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 1.8 V, 2.5 V, 3.3 V, 5.0 V | - | 1 | - | 10 | - | 10 | µA |

| Symbol | Parameter | Conditions | 25 °C | | -40 °C to +85 °C | | -40 °C to +125 °C | | Unit |
|-----------------|---------------------------|--|-------|------|------------------|-----|-------------------|-----|---------------|
| | | | Min | Max | Min | Max | Min | Max | |
| ΔI_{CC} | additional supply current | per input pin; $V_{CC} = 1.8\text{ V}$; $V_I = 0.3\text{ V}$ or 1.1 V ; $I_O = 0\text{ A}$; other pins at V_{CC} or GND | - | 10 | - | 10 | - | 10 | μA |
| | | per input pin; $V_{CC} = 5.5\text{ V}$; $V_I = 0.3\text{ V}$ or 3.4 V ; $I_O = 0\text{ A}$; other pins at V_{CC} or GND | - | 1.35 | - | 1.5 | - | 1.5 | mA |

12. Dynamic characteristics

Table 8. Dynamic characteristics

$GND = 0\text{ V}$. For test circuit, see Fig. 7.

| Symbol | Parameter | Conditions | 25 °C | | | -40 °C to +85 °C | | -40 °C to +125 °C | | Unit |
|----------|-------------------------------|--|-------|------|------|------------------|------|-------------------|------|------|
| | | | Min | Typ | Max | Min | Max | Min | Max | |
| t_{pd} | propagation delay | A, B to Y; see Fig. 6 [1] | - | - | - | - | - | - | - | - |
| | | $V_{CC} = 1.8\text{ V}$; $C_L = 15\text{ pF}$ | - | 6.4 | 10.2 | - | 11.5 | - | 12.3 | ns |
| | | $V_{CC} = 1.8\text{ V}$; $C_L = 30\text{ pF}$ | - | 7.5 | 12.0 | - | 13.4 | - | 14.4 | ns |
| | | $V_{CC} = 2.5\text{ V}$; $C_L = 15\text{ pF}$ | - | 4.5 | 6.9 | - | 7.8 | - | 8.4 | ns |
| | | $V_{CC} = 2.5\text{ V}$; $C_L = 30\text{ pF}$ | - | 5.3 | 8.0 | - | 9.1 | - | 9.7 | ns |
| | | $V_{CC} = 3.3\text{ V}$; $C_L = 15\text{ pF}$ | - | 3.7 | 5.6 | - | 6.2 | - | 6.6 | ns |
| | | $V_{CC} = 3.3\text{ V}$; $C_L = 30\text{ pF}$ | - | 4.3 | 6.4 | - | 7.1 | - | 7.6 | ns |
| | | $V_{CC} = 5.0\text{ V}$; $C_L = 15\text{ pF}$ | - | 3.1 | 4.2 | - | 4.6 | - | 4.8 | ns |
| | | $V_{CC} = 5.0\text{ V}$; $C_L = 30\text{ pF}$ | - | 3.6 | 4.8 | - | 5.2 | - | 5.5 | ns |
| C_I | input capacitance | $V_I = V_{CC}$ or GND; $V_{CC} = 3.3\text{ V}$ | - | 1.5 | 10 | - | 10 | - | 10 | pF |
| C_O | output capacitance | $V_O = V_{CC}$ or GND; $V_{CC} = 3.3\text{ V}$ | - | 2.5 | - | - | - | - | - | pF |
| C_{PD} | power dissipation capacitance | per buffer; $V_I = GND$ to V_{CC} ; $C_L = 30\text{ pF}$; $f = 10\text{ MHz}$ [2] | - | - | - | - | - | - | - | - |
| | | $V_{CC} = 1.8\text{ V}$ | - | 4.0 | - | - | - | - | - | pF |
| | | $V_{CC} = 2.5\text{ V}$ | - | 5.3 | - | - | - | - | - | pF |
| | | $V_{CC} = 3.3\text{ V}$ | - | 7.1 | - | - | - | - | - | pF |
| | | $V_{CC} = 5.0\text{ V}$ | - | 11.2 | - | - | - | - | - | pF |

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

[2] C_{PD} is used to determine the dynamic power dissipation (P_D in μW).

$$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \sum(C_L \times V_{CC}^2 \times f_o) \text{ where:}$$

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;

$\sum(C_L \times V_{CC}^2 \times f_o)$ = sum of the outputs.

12.1. Waveforms and test circuit

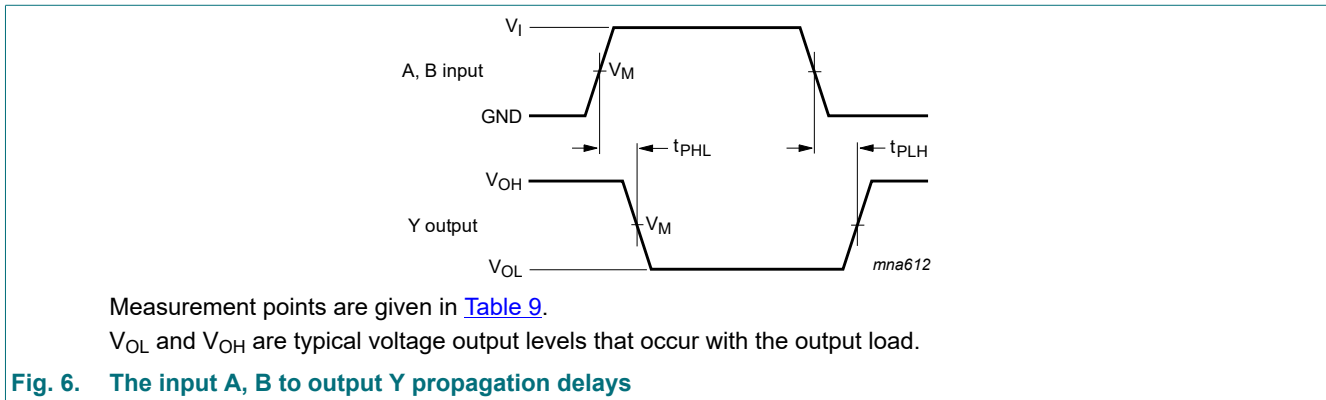


Table 9. Measurement points

| Input | Output |
|------------------|---------------------|
| V_M | V_M |
| $0.5 \times V_I$ | $0.5 \times V_{CC}$ |

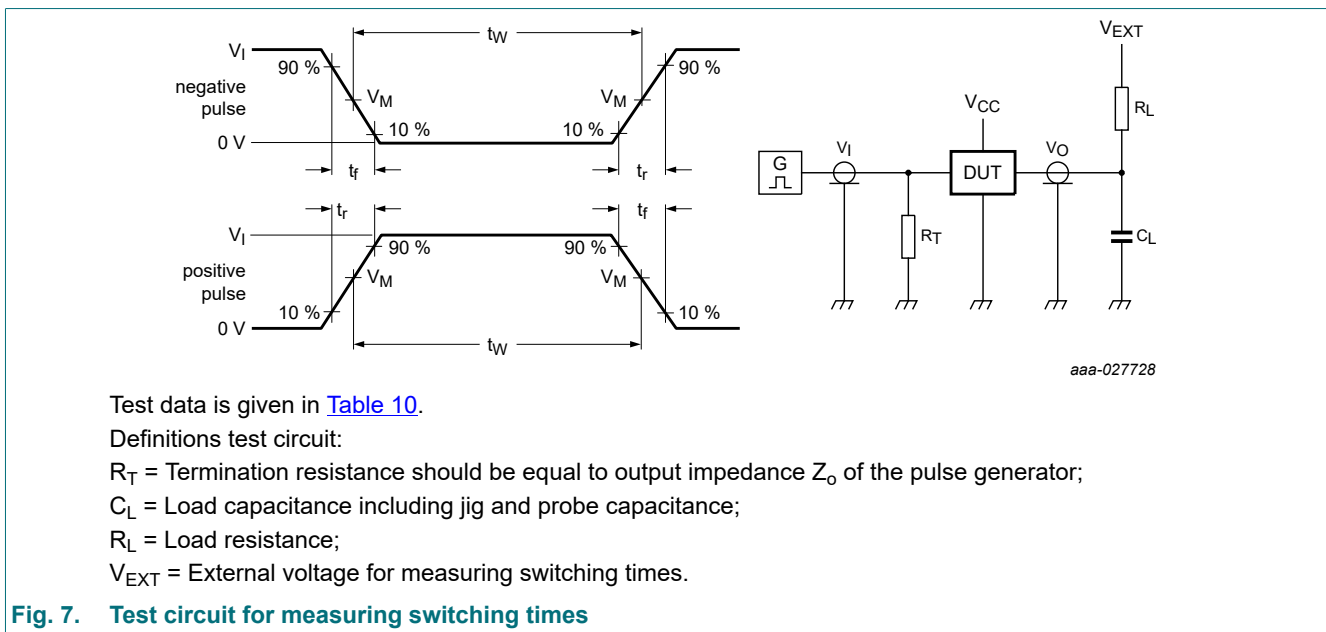


Table 10. Test data

| Supply voltage | Input | | | Load | | V_{EXT} | | |
|----------------|----------|-------------------------|-----------|--------------|-------------|--------------------|--------------------|--------------------|
| | V_I | $\Delta t/\Delta V$ [1] | f_{max} | C_L | R_L | t_{PLH}, t_{PHL} | t_{PZH}, t_{PHZ} | t_{PZL}, t_{PLZ} |
| 1.8 V | V_{CC} | ≤ 1.0 ns/V | 15 MHz | 15 pF, 30 pF | 1M Ω | GND | GND | V_{CC} |
| 2.5 V | V_{CC} | ≤ 1.0 ns/V | 25 MHz | 15 pF, 30 pF | 1M Ω | GND | GND | V_{CC} |
| 3.3 V | 3 V | ≤ 1.0 ns/V | 50 MHz | 15 pF, 30 pF | 1M Ω | GND | GND | V_{CC} |
| 5.0 V | 3 V | ≤ 1.0 ns/V | 50 MHz | 15 pF, 30 pF | 1M Ω | GND | GND | V_{CC} |

[1] $dV/dt \geq 1.0$ V/ns

13. Package outline

TSSOP5: plastic thin shrink small outline package; 5 leads; body width 1.25 mm

SOT353-1



Fig. 8. Package outline SOT353-1 (TSSOP5)

Plastic surface-mounted package; 5 leads

SOT753



Fig. 9. Package outline SOT753 (SC-74A)

X2SON5: plastic thermal enhanced extremely thin small outline package; no leads;
5 terminals; body 0.8 x 0.8 x 0.32 mm

SOT1226-3



Fig. 10. Package outline SOT1226-3 (X2SON5)

14. Abbreviations

Table 11. Abbreviations

| Acronym | Description |
|---------|---|
| CDM | Charge Device Model |
| CMOS | Complementary Metal Oxide Semiconductor |
| 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 |
|----------------|---|--------------------|---------------|--------------|
| 74LV1T00 v.5 | 20231207 | Product data sheet | - | 74LV1T00 v.4 |
| Modifications: | <ul style="list-style-type: none"> Section 2: ESD specification updated according to the latest JEDEC standard. | | | |
| 74LV1T00 v.4 | 20220204 | Product data sheet | - | 74LV1T00 v.3 |
| Modifications: | <ul style="list-style-type: none"> Fig. 8: Package outline drawing for SOT353-1 (TSSOP5) has changed. | | | |
| 74LV1T00 v.3 | 20210518 | Product data sheet | - | 74LV1T00 v.2 |
| Modifications: | <ul style="list-style-type: none"> SOT1226 (X2SON5) package changed to SOT1226-3 (X2SON5) package. | | | |
| 74LV1T00 v.2 | 20191203 | Product data sheet | - | 74LV1T00 v.1 |
| Modifications: | <ul style="list-style-type: none"> Type number 74LV1T00GV (SOT753/SC-74A) added. Table 5: Derating values for P_{tot} total power dissipation updated. | | | |
| 74LV1T00 v.1 | 20171122 | 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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Contents

| | |
|---|-----------|
| 1. General description | 1 |
| 2. Features and benefits | 1 |
| 3. Applications | 1 |
| 4. Ordering information | 2 |
| 5. Marking | 2 |
| 6. Functional diagram | 2 |
| 7. Pinning information | 3 |
| 7.1. Pinning..... | 3 |
| 7.2. Pin description..... | 3 |
| 8. Functional description | 3 |
| 9. Limiting values | 4 |
| 10. Recommended operating conditions | 4 |
| 11. Static characteristics | 5 |
| 12. Dynamic characteristics | 6 |
| 12.1. Waveforms and test circuit..... | 7 |
| 13. Package outline | 8 |
| 14. Abbreviations | 11 |
| 15. Revision history | 11 |
| 16. Legal information | 12 |

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