



**THE DATASHEET OF
74LVC1GU04GW-Q100H**



74LVC1GU04-Q100

Unbuffered inverter

Rev. 5 — 7 September 2023

Product data sheet

1. General description

The 74LVC1GU04-Q100 is a single unbuffered inverter. The input can be driven from either 3.3 V or 5 V devices. This feature allows the use of this device in a mixed 3.3 V and 5 V environment.

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 °C to +85 °C and -40 °C to +125 °C
- Overvoltage tolerant inputs to 5.5 V
- Wide supply voltage range from 1.65 V to 5.5 V
- High noise immunity
- ± 24 mA output drive ($V_{CC} = 3.0$ V)
- CMOS low power dissipation
- Latch-up performance exceeds 250 mA
- 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. Ordering information

Table 1. Ordering information

| Type number | Package | | | Version |
|-----------------------------------|-------------------|--------|--|--------------------------|
| | Temperature range | Name | Description | |
| 74LVC1GU04GW-Q100 | -40 °C to +125 °C | TSSOP5 | plastic thin shrink small outline package; 5 leads; body width 1.25 mm | SOT353-1 |
| 74LVC1GU04GV-Q100 | -40 °C to +125 °C | SC-74A | plastic surface-mounted package; 5 leads | SOT753 |

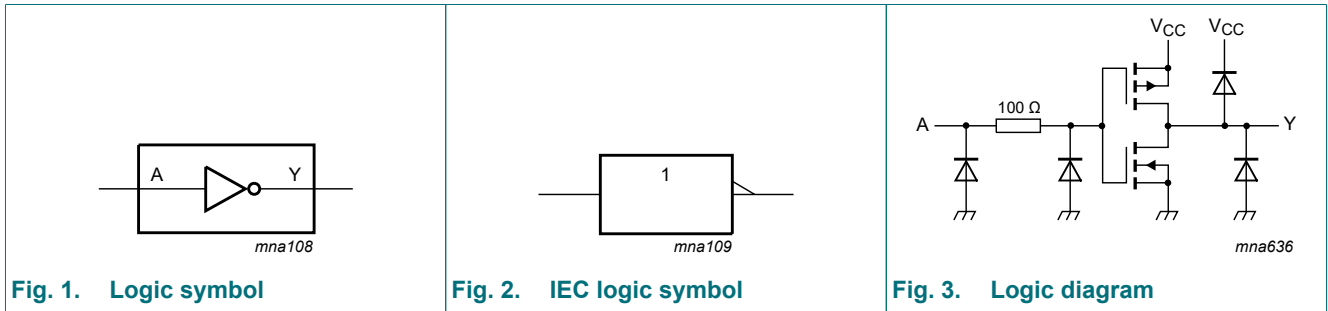
4. Marking

Table 2. Marking codes

| Type number | Marking ^[1] |
|-------------------|------------------------|
| 74LVC1GU04GW-Q100 | VD |
| 74LVC1GU04GV-Q100 | VU4 |

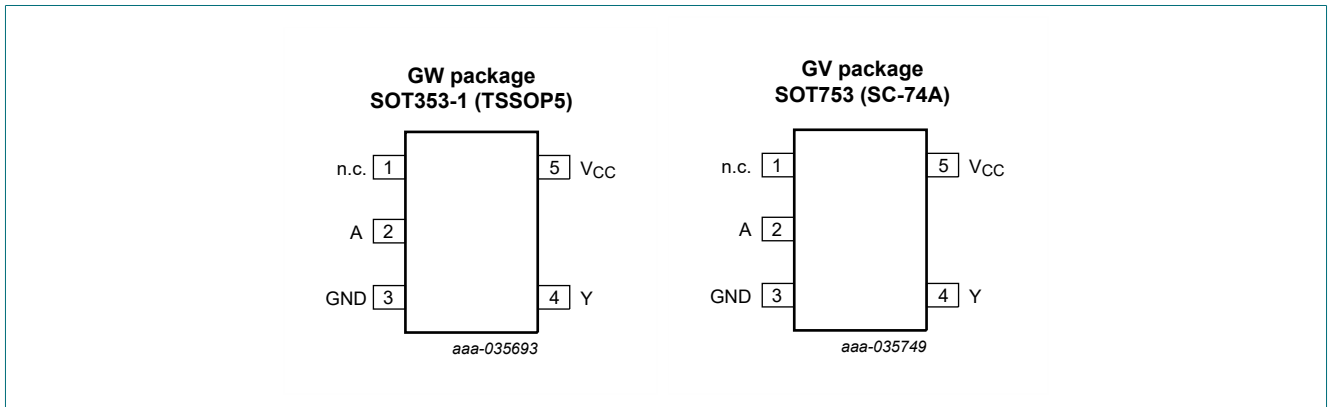
[1] The pin 1 indicator is located on the lower left corner of the device, below the marking code.

5. Functional diagram



6. Pinning information

6.1. Pinning



6.2. Pin description

Table 3. Pin description

| Symbol | Pin | Description |
|-----------------|-----|----------------|
| n.c. | 1 | not connected |
| A | 2 | data input |
| GND | 3 | ground (0 V) |
| Y | 4 | data output |
| V _{CC} | 5 | supply voltage |

7. Functional description

Table 4. Function table

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

| Input (A) | Output (Y) |
|-----------|------------|
| L | H |
| H | L |

8. 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 | +6.5 | V |
| I_{IK} | input clamping current | $V_I < 0$ V | - | -50 | mA |
| V_I | input voltage | [1] | -0.5 | +6.5 | V |
| I_{OK} | output clamping current | $V_O > V_{CC}$ or $V_O < 0$ V | - | ± 50 | mA |
| V_O | output voltage | Active mode [1][2] | -0.5 | $V_{CC} + 0.5$ | V |
| I_O | output current | $V_O = 0$ V to V_{CC} | - | ± 50 | mA |
| I_{CC} | supply current | | - | +100 | mA |
| I_{GND} | ground current | | - | -100 | mA |
| P_{tot} | total power dissipation | $T_{amb} = -40$ °C to $+125$ °C [3] | - | 250 | mW |
| T_{stg} | storage temperature | | -65 | +150 | °C |

[1] The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

[2] When $V_{CC} = 0$ V (Power-down mode), the output voltage can be 5.5 V in normal operation

[3] 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.

9. 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 | | 1.65 | - | 5.5 | V |
| V_I | input voltage | | 0 | - | 5.5 | V |
| V_O | output voltage | Active mode | 0 | - | V_{CC} | V |
| T_{amb} | ambient temperature | | -40 | - | +125 | °C |
| $\Delta t/\Delta V$ | input transition rise and fall rate | $V_{CC} = 1.65$ V to 2.7 V | 0 | - | 20 | ns/V |
| | | $V_{CC} = 2.7$ V to 5.5 V | 0 | - | 10 | ns/V |

10. Static characteristics

Table 7. Static characteristics

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

| Symbol | Parameter | Conditions | Min | Typ[1] | Max | Unit |
|---|---------------------------|---|------------------------|--------|------------------------|------|
| T_{amb} = -40 °C to +85 °C | | | | | | |
| V _{IH} | HIGH-level input voltage | V _{CC} = 1.65 V to 5.5 V | 0.75 × V _{CC} | - | - | V |
| V _{IL} | LOW-level input voltage | V _{CC} = 1.65 V to 5.5 V | - | - | 0.25 × V _{CC} | V |
| V _{OH} | HIGH-level output voltage | V _I = V _{IH} or V _{IL} | | | | |
| | | I _O = -100 μA; V _{CC} = 1.65 V to 5.5 V | V _{CC} - 0.1 | - | - | V |
| | | I _O = -4 mA; V _{CC} = 1.65 V | 1.2 | - | - | V |
| | | I _O = -8 mA; V _{CC} = 2.3 V | 1.9 | - | - | V |
| | | I _O = -12 mA; V _{CC} = 2.7 V | 2.2 | - | - | V |
| | | I _O = -24 mA; V _{CC} = 3.0 V | 2.3 | - | - | V |
| | | I _O = -32 mA; V _{CC} = 4.5 V | 3.8 | - | - | V |
| V _{OL} | LOW-level output voltage | V _I = V _{IH} or V _{IL} | | | | |
| | | I _O = 100 μA; V _{CC} = 1.65 V to 5.5 V | - | - | 0.1 | V |
| | | I _O = 4 mA; V _{CC} = 1.65 V | - | - | 0.45 | V |
| | | I _O = 8 mA; V _{CC} = 2.3 V | - | - | 0.3 | V |
| | | I _O = 12 mA; V _{CC} = 2.7 V | - | - | 0.4 | V |
| | | I _O = 24 mA; V _{CC} = 3.0 V | - | - | 0.55 | V |
| | | I _O = 32 mA; V _{CC} = 4.5 V | - | - | 0.55 | V |
| I _I | input leakage current | V _I = 5.5 V or GND; V _{CC} = 0 V to 5.5 V | - | ±0.1 | ±1 | μA |
| I _{CC} | supply current | V _I = 5.5 V or GND; I _O = 0 A; V _{CC} = 1.65 V to 5.5 V | - | 0.1 | 4 | μA |
| C _I | input capacitance | V _{CC} = 3.3 V; V _I = GND to V _{CC} | - | 6 | - | pF |

| Symbol | Parameter | Conditions | Min | Typ[1] | Max | Unit |
|--|---------------------------|---|-----------------------|--------|-----------------------|------|
| T_{amb} = -40 °C to +125 °C | | | | | | |
| V _{IH} | HIGH-level input voltage | V _{CC} = 1.65 V to 5.5 V | 0.8 × V _{CC} | - | - | V |
| V _{IL} | LOW-level input voltage | V _{CC} = 1.65 V to 5.5 V | - | - | 0.2 × V _{CC} | V |
| V _{OH} | HIGH-level output voltage | V _I = V _{IH} or V _{IL} | | | | |
| | | I _O = -100 μA; V _{CC} = 1.65 V to 5.5 V | V _{CC} - 0.1 | - | - | V |
| | | I _O = -4 mA; V _{CC} = 1.65 V | 0.95 | - | - | V |
| | | I _O = -8 mA; V _{CC} = 2.3 V | 1.7 | - | - | V |
| | | I _O = -12 mA; V _{CC} = 2.7 V | 1.9 | - | - | V |
| | | I _O = -24 mA; V _{CC} = 3.0 V | 2.0 | - | - | V |
| | | I _O = -32 mA; V _{CC} = 4.5 V | 3.4 | - | - | V |
| V _{OL} | LOW-level output voltage | V _I = V _{IH} or V _{IL} | | | | |
| | | I _O = 100 μA; V _{CC} = 1.65 V to 5.5 V | - | - | 0.1 | V |
| | | I _O = 4 mA; V _{CC} = 1.65 V | - | - | 0.7 | V |
| | | I _O = 8 mA; V _{CC} = 2.3 V | - | - | 0.45 | V |
| | | I _O = 12 mA; V _{CC} = 2.7 V | - | - | 0.6 | V |
| | | I _O = 24 mA; V _{CC} = 3.0 V | - | - | 0.80 | V |
| | | I _O = 32 mA; V _{CC} = 4.5 V | - | - | 0.80 | V |
| I _I | input leakage current | V _I = 5.5 V or GND; V _{CC} = 0 V to 5.5 V | - | ±0.1 | ±1 | μA |
| I _{CC} | supply current | V _I = 5.5 V or GND; I _O = 0 A; V _{CC} = 1.65 V to 5.5 V | - | - | 4 | μA |

[1] All typical values are measured at V_{CC} = 3.3 V and T_{amb} = 25 °C.

11. Dynamic characteristics

Table 8. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V). For test circuit see Fig. 7.

| Symbol | Parameter | Conditions | -40 °C to +85 °C | | | -40 °C to +125 °C | | Unit |
|-----------------|-------------------------------|---|------------------|--------|-----|-------------------|-----|------|
| | | | Min | Typ[1] | Max | Min | Max | |
| t _{pd} | propagation delay | A to Y; see Fig. 4 [2] | | | | | | |
| | | V _{CC} = 1.65 V to 1.95 V | 0.3 | 1.7 | 5.0 | 0.3 | 6.5 | ns |
| | | V _{CC} = 2.3 V to 2.7 V | 0.3 | 1.3 | 4.0 | 0.3 | 5.5 | ns |
| | | V _{CC} = 2.7 V | 0.5 | 1.7 | 5.0 | 0.5 | 6.5 | ns |
| | | V _{CC} = 3.0 V to 3.6 V | 0.5 | 1.6 | 3.7 | 0.5 | 5.0 | ns |
| | | V _{CC} = 4.5 V to 5.5 V | 0.5 | 1.3 | 3.0 | 0.5 | 4.0 | ns |
| C _{PD} | power dissipation capacitance | V _I = GND to V _{CC} ; V _{CC} = 3.3 V [3] | - | 14.9 | - | - | - | pF |

[1] Typical values are measured at T_{amb} = 25 °C and V_{CC} = 1.8 V, 2.5 V, 2.7 V, 3.3 V and 5.0 V respectively.

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

[3] 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;

∑(C_L × V_{CC}² × f_o) = sum of outputs.

11.1. Waveform and test circuit

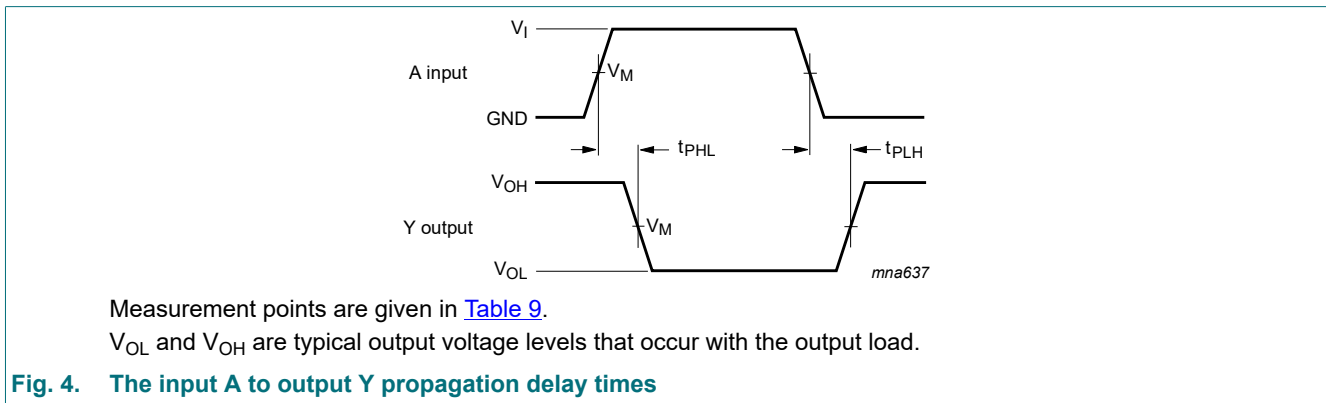
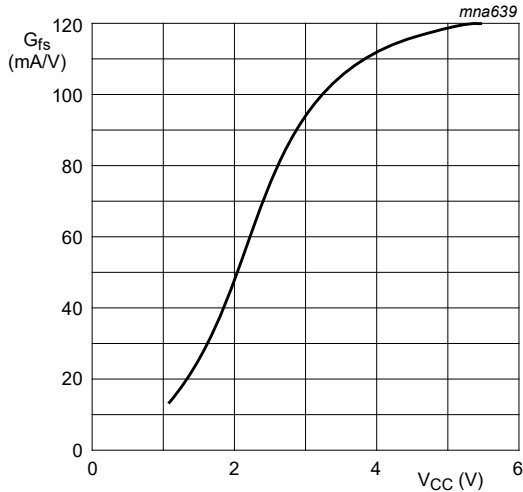


Fig. 4. The input A to output Y propagation delay times

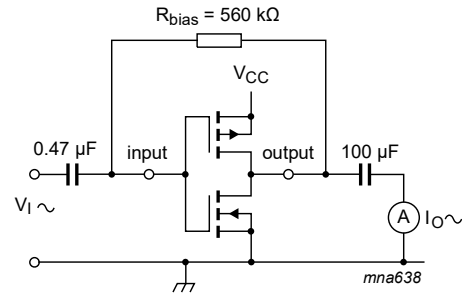
Table 9. Measurement points

| Supply voltage | Input | Output |
|------------------|-----------------------|-----------------------|
| V _{CC} | V _M | V _M |
| 1.65 V to 1.95 V | 0.5 × V _{CC} | 0.5 × V _{CC} |
| 2.3 V to 2.7 V | 0.5 × V _{CC} | 0.5 × V _{CC} |
| 2.7 V | 1.5 V | 1.5 V |
| 3.0 V to 3.6 V | 1.5 V | 1.5 V |
| 4.5 V to 5.5 V | 0.5 × V _{CC} | 0.5 × V _{CC} |



T_{amb} = 25 °C.

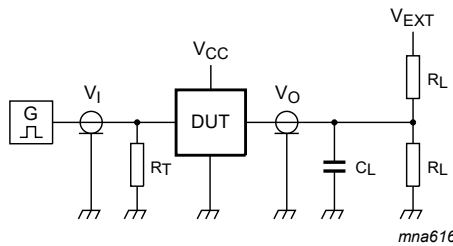
Fig. 5. Typical forward transconductance as a function of supply voltage



$$G_{fs} = \frac{\Delta I_O}{\Delta V_I}$$

f_i = 1 kHz at V_O is constant

Fig. 6. Test set-up for measuring forward transconductance



Test data is given in [Table 10](#).

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. 7. Test circuit for measuring switching times

Table 10. Test data

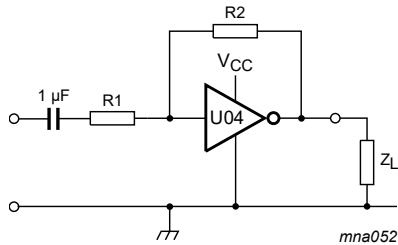
| Supply voltage | Input | | Load | | V _{EXT} |
|------------------|-----------------|---------------------------------|----------------|----------------|-------------------------------------|
| V _{CC} | V _I | t _r = t _f | C _L | R _L | t _{PLH} , t _{PHL} |
| 1.65 V to 1.95 V | V _{CC} | ≤ 2.0 ns | 30 pF | 1 kΩ | open |
| 2.3 V to 2.7 V | V _{CC} | ≤ 2.0 ns | 30 pF | 500 Ω | open |
| 2.7 V | 2.7 V | ≤ 2.5 ns | 50 pF | 500 Ω | open |
| 3.0 V to 3.6 V | 2.7 V | ≤ 2.5 ns | 50 pF | 500 Ω | open |
| 4.5 V to 5.5 V | V _{CC} | ≤ 2.5 ns | 50 pF | 500 Ω | open |

12. Application information

Some applications are:

- Linear amplifier (see [Fig. 8](#))
- In crystal oscillator design (see [Fig. 9](#))

Remark: All values given are typical unless otherwise specified.



$$V_{o(p-p)} = V_{CC} - 1.5 \text{ V centered at } 0.5V_{CC}$$

$$A_u = - \frac{G_{OL}}{1 + \frac{R1}{R2}(1 + G_{OL})}$$

G_{OL} = loop gain.

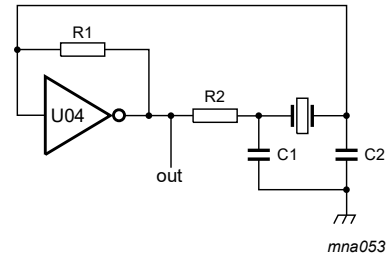
A_u = voltage amplification.

$R1 \geq 3 \text{ k}\Omega$, $R2 \leq 1 \text{ M}\Omega$

$Z_L > 10 \text{ k}\Omega$; $A_{OL} = 20$ (typ.)

Typical unity gain bandwidth product is 5 MHz.

Fig. 8. Used as a linear amplifier



$C1 = 47 \text{ pF}$ (typ.)

$C2 = 22 \text{ pF}$ (typ.)

$R1 = 1 \text{ M}\Omega$ to $10 \text{ M}\Omega$ (typ.)

$R2$ optimum value depends on the frequency and required stability against changes in V_{CC} or average minimum I_{CC} (I_{CC} is typically 2 mA at $V_{CC} = 3.3 \text{ V}$ and $f = 10 \text{ MHz}$).

Fig. 9. Crystal oscillator configuration

13. Package outline

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

SOT353-1

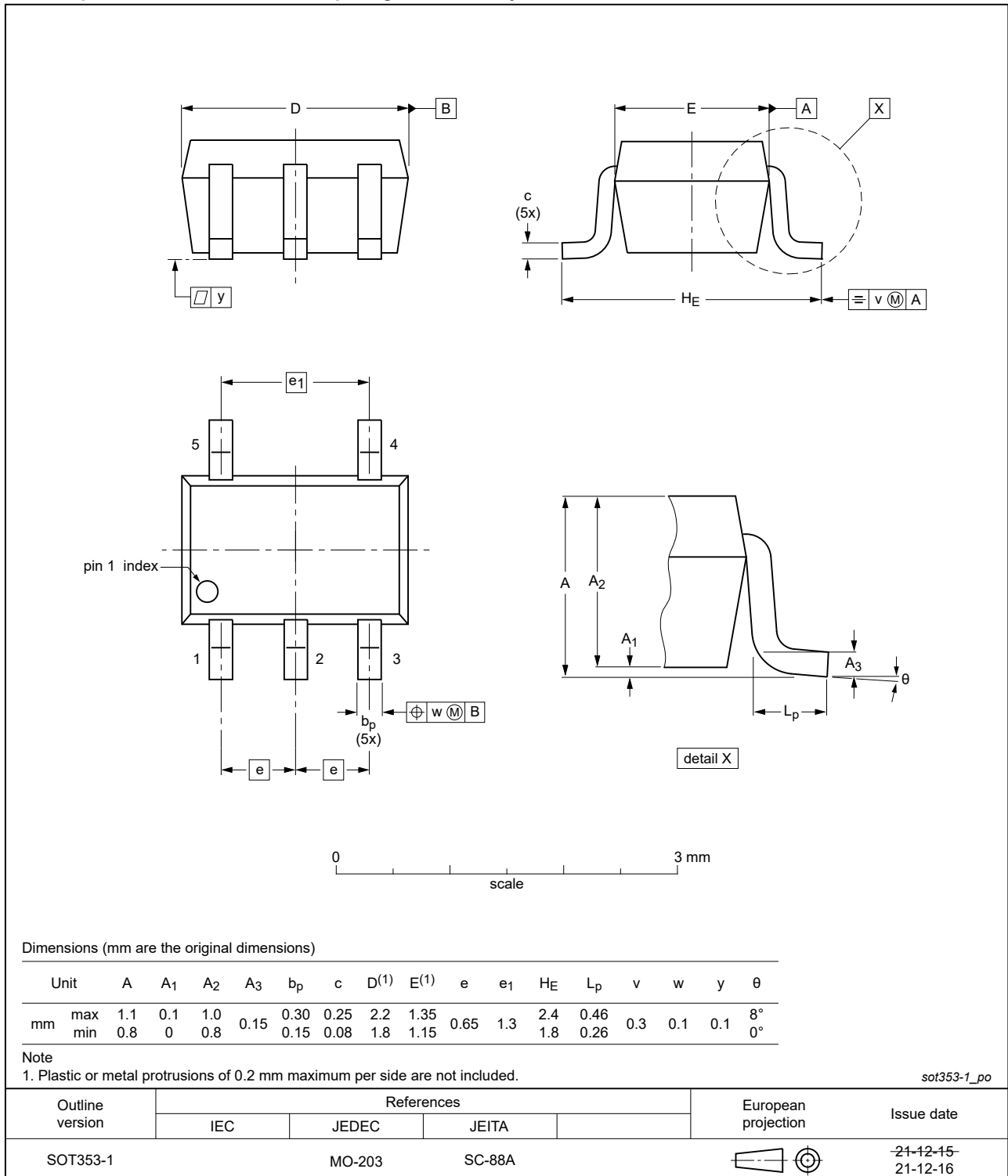


Fig. 10. Package outline SOT353-1 (TSSOP5)

Plastic surface-mounted package; 5 leads

SOT753

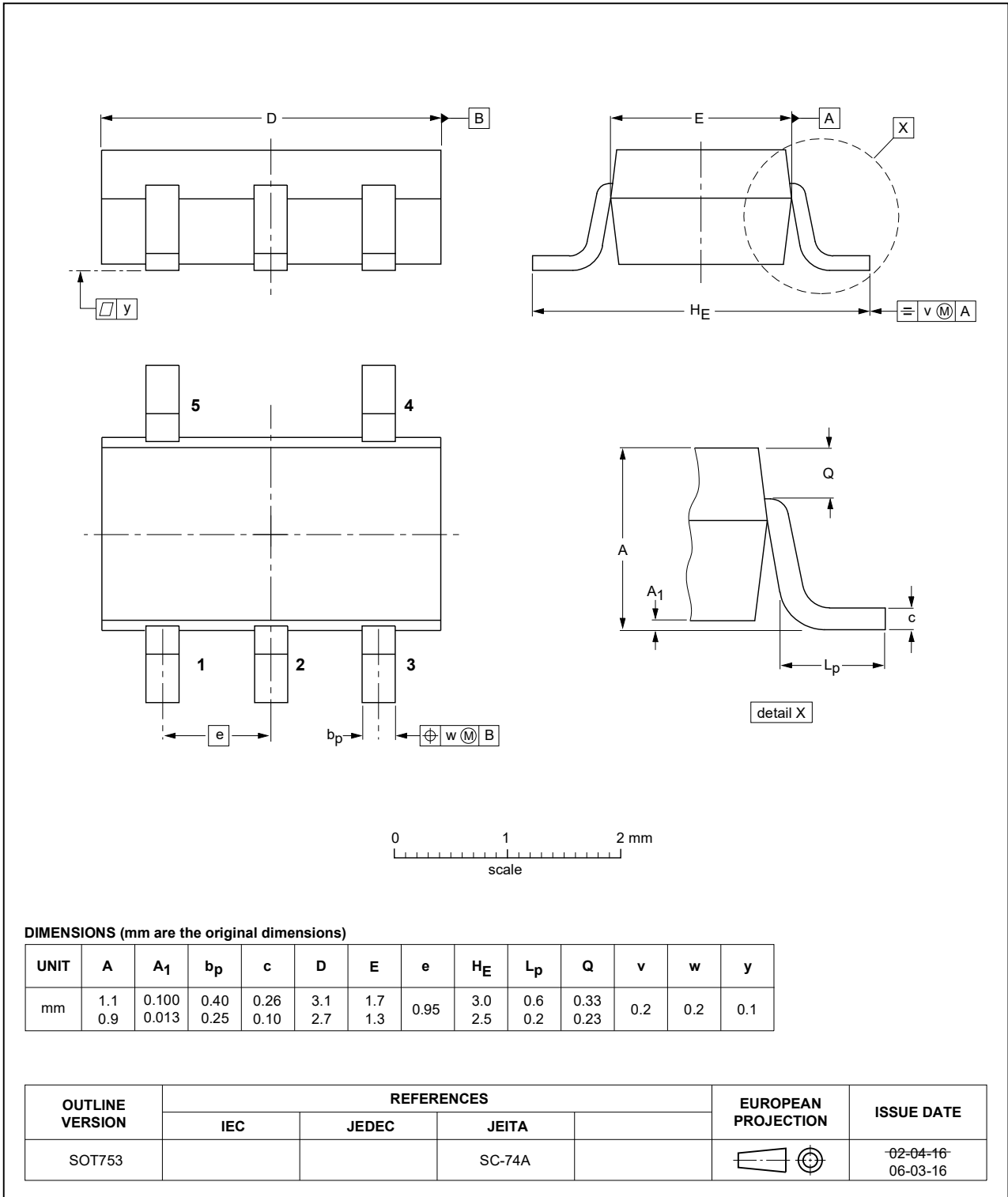


Fig. 11. Package outline SOT753 (SC-74A)

14. Abbreviations

Table 11. Abbreviations

| Acronym | Description |
|---------|---|
| 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 |
|---------------------|---|--------------------|---------------|---------------------|
| 74LVC1GU04_Q100 v.5 | 20230907 | Product data sheet | - | 74LVC1GU04_Q100 v.4 |
| Modifications: | <ul style="list-style-type: none"> Section 1 and Section 2 updated. | | | |
| 74LVC1GU04_Q100 v.4 | 20220112 | Product data sheet | - | 74LVC1GU04_Q100 v.3 |
| Modifications: | <ul style="list-style-type: none"> Fig. 10: Package outline drawing SOT353-1 (TSSOP5) has changed. | | | |
| 74LVC1GU04_Q100 v.3 | 20210927 | Product data sheet | - | 74LVC1GU04_Q100 v.2 |
| Modifications: | <ul style="list-style-type: none"> Section 1 and Section 2 updated. Table 5: Derating values for P_{tot} total power dissipation updated. The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia. Legal texts have been adapted to the new company name where appropriate. | | | |
| 74LVC1GU04_Q100 v.2 | 20161213 | Product data sheet | - | 74LVC1GU04_Q100 v.1 |
| Modifications: | <ul style="list-style-type: none"> Table 7: The maximum limits for leakage current and supply current have changed. | | | |
| 74LVC1GU04_Q100 v.1 | 20130514 | 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. |
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Contents

| | |
|--|-----------|
| 1. General description | 1 |
| 2. Features and benefits | 1 |
| 3. Ordering information | 1 |
| 4. Marking | 1 |
| 5. Functional diagram | 2 |
| 6. Pinning information | 2 |
| 6.1. Pinning..... | 2 |
| 6.2. Pin description..... | 2 |
| 7. Functional description | 2 |
| 8. Limiting values | 3 |
| 9. Recommended operating conditions | 3 |
| 10. Static characteristics | 4 |
| 11. Dynamic characteristics | 6 |
| 11.1. Waveform and test circuit..... | 6 |
| 12. Application information | 8 |
| 13. Package outline | 9 |
| 14. Abbreviations | 11 |
| 15. Revision history | 11 |
| 16. Legal information | 12 |

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