# 74AHC1GU04

## Inverter

Rev. 6 — 12 January 2022 Product data sheet

## 1. General description

The 74AHC1GU04 is a single unbuffered inverter. Inputs are overvoltage tolerant. This feature allows the use of these devices as translators in mixed voltage environments.

## 2. Features

- Wide supply voltage range from 2.0 to 5.5 V
- Overvoltage tolerant inputs to 5.5 V
- High noise immunity
- CMOS low power dissipation
- Latch-up performance exceeds 100 mA per JESD 78 Class II Level A
- Symmetrical output impedance
- ESD protection:
  - HBM JESD22-A114E: exceeds 2000 V
  - MM JESD22-A115-A: exceeds 200 V
  - CDM JESD22-C101C: exceeds 1000 V
- Specified from -40 °C to +125 °C

## 3. Ordering information

**Table 1. Ordering information**

| Type number | Package | | | |
|---|---|---|---|---|
| | Temperature range | Name | Description | Version |
| 74AHC1GU04GW | -40 °C to +125 °C | TSSOP5 | plastic thin shrink small outline package; 5 leads; body width 1.25 mm | SOT353-1 |
| 74AHC1GU04GV | -40 °C to +125 °C | SC-74A | plastic surface-mounted package; 5 leads | SOT753 |

## 4. Marking

**Table 2. Marking codes**

| Type number | Marking |
|---|---|
| 74AHC1GU04GW | AD |
| 74AHC1GU04GV | AU4 |

## 5. Functional diagram

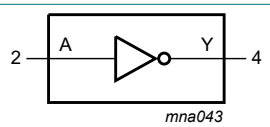



Fig. 1. Logic symbol

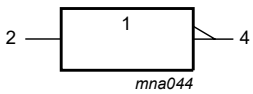



Fig. 2. IEC logic symbol

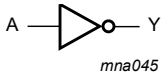



Fig. 3. Logic diagram

# 6. Pinning information

## 6.1. Pinning

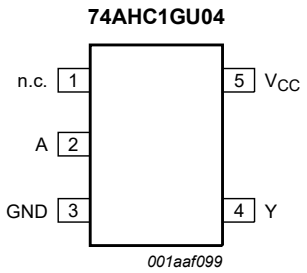



**Fig. 4. Pin configuration SOT353-1 (TSSOP5) and SOT753 (SC-74A)**

## 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 | Output |
|---|---|
| **A** | **Y** |
| L | H |
| H | L |

# 8. Limiting values

**Table 5. Limiting values**

*In accordance with the Absolute Maximum Rating System (IEC 60134).*

| Symbol | Parameter | Conditions | Min | Max | Unit |
|---|---|---|---|---|---|
| $V_{CC}$ | supply voltage | | -0.5 | +7.0 | V |
| $I_{IK}$ | input clamping current | $V_I$ < -0.5 V | -20 | - | mA |
| $V_I$ | input voltage | [1] | -0.5 | +7.0 | V |
| $I_{OK}$ | output clamping current | $V_O$ < -0.5 V or $V_O$ > $V_{CC}$ + 0.5 V | - | ±20 | mA |
| $I_O$ | output current | -0.5 V < $V_O$ < $V_{CC}$ + 0.5 V | - | ±25 | mA |
| $I_{CC}$ | supply current | | - | 75 | mA |
| $I_{GND}$ | ground current | | -75 | - | 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 input and output voltage ratings may be exceeded if the input and output current ratings are observed.
[2] 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 | | 2.0 | 5.0 | 5.5 | V |
| $V_I$ | input voltage | | 0 | - | 5.5 | V |
| $V_O$ | output voltage | | 0 | - | $V_{CC}$ | V |
| $T_{amb}$ | ambient temperature | | -40 | +25 | +125 | °C |
| Δt/ΔV | input transition rise and fall rate | $V_{CC}$ = 3.3 V ± 0.3 V | - | - | 100 | ns/V |
| | | $V_{CC}$ = 5.0 V ± 0.5 V | - | - | 20 | ns/V |

# 10. 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 | Typ | Max | Min | Max | Min | Max | |
| $V_{IH}$ | HIGH-level input voltage | $V_{CC}$ = 2.0 V | 1.7 | - | - | 1.7 | - | 1.7 | - | V |
| | | $V_{CC}$ = 3.0 V | 2.4 | - | - | 2.4 | - | 2.4 | - | V |
| | | $V_{CC}$ = 5.5 V | 4.4 | - | - | 4.4 | - | 4.4 | - | V |
| $V_{IL}$ | LOW-level input voltage | $V_{CC}$ = 2.0V | - | - | 0.3 | - | 0.3 | - | 0.3 | V |
| | | $V_{CC}$ = 3.0 V | - | - | 0.6 | - | 0.6 | - | 0.6 | V |
| | | $V_{CC}$ = 5.5 V | - | - | 1.1 | - | 1.1 | - | 1.1 | V |

| Symbol | Parameter | Conditions | 25 °C | | | -40 °C to +85 °C | | -40 °C to +125 °C | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | Min | Max | Min | Max | |
| $V_{OH}$ | HIGH-level output voltage | $V_I = V_{IH}$ or $V_{IL}$ | | | | | | | | |
| | | $I_O$ = -50 µA; $V_{CC}$ = 2.0 V | 1.9 | 2.0 | - | 1.9 | - | 1.9 | - | V |
| | | $I_O$ = -50 µA; $V_{CC}$ = 3.0 V | 2.9 | 3.0 | - | 2.9 | - | 2.9 | - | V |
| | | $I_O$ = -50 µA; $V_{CC}$ = 4.5 V | 4.4 | 4.5 | - | 4.4 | - | 4.4 | - | V |
| | | $I_O$ = -4.0 mA; $V_{CC}$ = 3.0 V | 2.58 | - | - | 2.48 | - | 2.40 | - | V |
| | | $I_O$ = -8.0 mA; $V_{CC}$ = 4.5 V | 3.94 | - | - | 3.8 | - | 3.70 | - | V |
| $V_{OL}$ | LOW-level output voltage | $V_I = V_{IH}$ or $V_{IL}$ | | | | | | | | |
| | | $I_O$ = 50 µA; $V_{CC}$ = 2.0 V | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | $I_O$ = 50 µA; $V_{CC}$ = 3.0 V | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | $I_O$ = 50 µA; $V_{CC}$ = 4.5 V | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | $I_O$ = 4.0 mA; $V_{CC}$ = 3.0 V | - | - | 0.36 | - | 0.44 | - | 0.55 | V |
| | | $I_O$ = 8.0 mA; $V_{CC}$ = 4.5 V | - | - | 0.36 | - | 0.44 | - | 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 | - | 1.0 | - | 2.0 | µA |
| $I_{CC}$ | supply current | $V_I = V_{CC}$ or GND; $I_O$ = 0 A; $V_{CC}$ = 5.5 V | - | - | 1.0 | - | 10 | - | 40 | µA |
| $C_I$ | input capacitance | | - | 1.5 | 10 | - | 10 | - | 10 | pF |

## 11. Dynamic characteristics

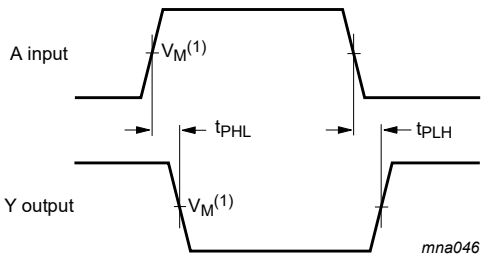
**Table 8. Dynamic characteristics**

*GND = 0 V; $t_r = t_f$ = ≤ 3.0 ns. For test circuit see Fig. 6.*

| 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 to Y; see Fig. 5 | [1] | | | | | | | | |
| | | $V_{CC}$ = 3.0 V to 3.6 V | [2] | | | | | | | | |
| | | $C_L$ = 15 pF | | - | 3.4 | 7.1 | 1.0 | 8.5 | 1.0 | 10.0 | ns |
| | | $C_L$ = 50 pF | | - | 4.9 | 10.6 | 1.0 | 12.0 | 1.0 | 13.5 | ns |
| | | $V_{CC}$ = 4.5 V to 5.5 V | [3] | | | | | | | | |
| | | $C_L$ = 15 pF | | - | 2.6 | 5.5 | 1.0 | 6.0 | 1.0 | 7.0 | ns |
| | | $C_L$ = 50 pF | | - | 3.6 | 7.0 | 1.0 | 8.0 | 1.0 | 9.0 | ns |
| $C_{PD}$ | power dissipation capacitance | per buffer; $V_I$ = GND to $V_{CC}$ | [4] | - | 14 | - | - | - | - | - | pF |

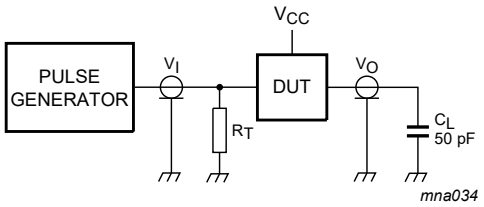
[1] $t_{pd}$ is the same as $t_{PLH}$ and $t_{PHL}$.
[2] Typical values are measured at $V_{CC}$ = 3.3 V.
[3] Typical values are measured at $V_{CC}$ = 5.0 V.
[4] $C_{PD}$ is used to determine the dynamic power dissipation $P_D$ (µW).
$P_D = C_{PD} \times V_{CC}^2 \times f_i + \Sigma(C_L \times V_{CC}^2 \times f_o)$ 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 Volts.

### 11.1. Waveform and test circuit




$V_M = 0.5 \times V_{CC}$; $V_I$ = GND to $V_{CC}$.

**Fig. 5. The input (A) to output (Y) propagation delay times**




Test data is given in Table 8.

Definitions for test circuit:

$C_L$ = Load capacitance including jig and probe capacitance;

$R_T$ = Termination resistance should be equal to output impedance $Z_o$ of the pulse generator.

**Fig. 6. Test circuit for measuring switching times**

## 12. Typical transfer characteristics

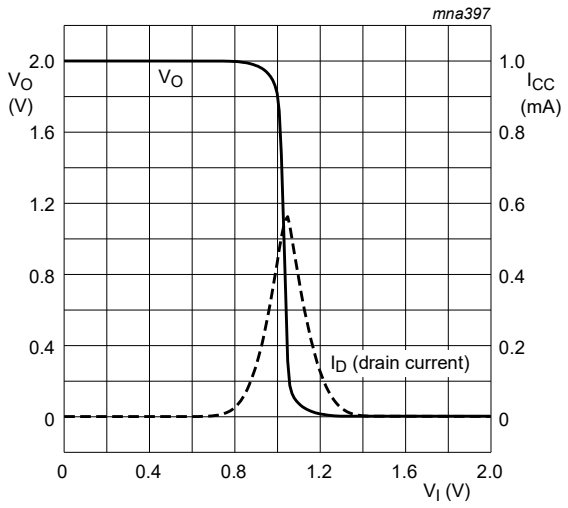



**Fig. 7. $V_{CC}$ = 2.0 V; $I_O$ = 0 A**

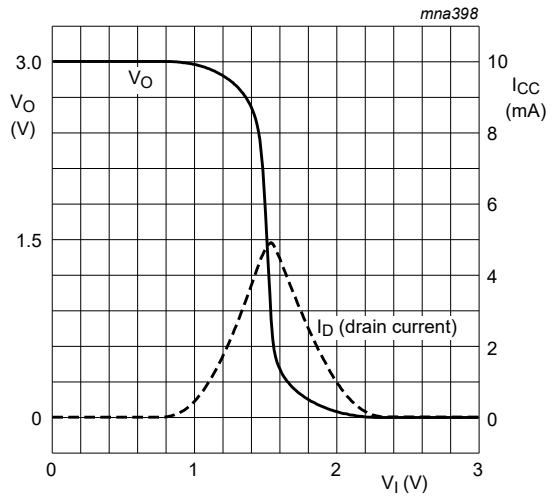



**Fig. 8. $V_{CC}$ = 3.0 V; $I_O$ = 0 A**

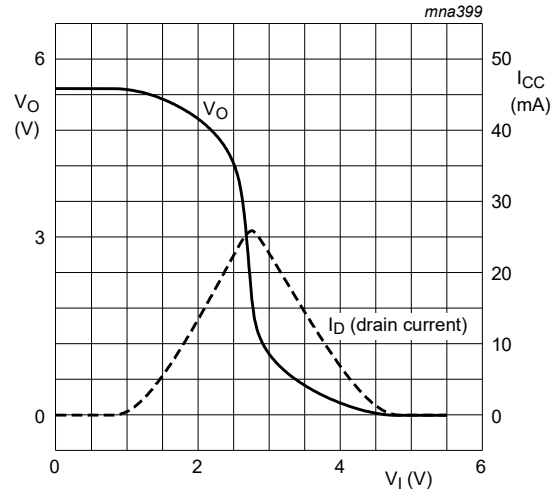
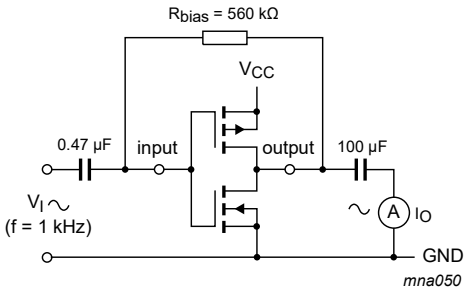
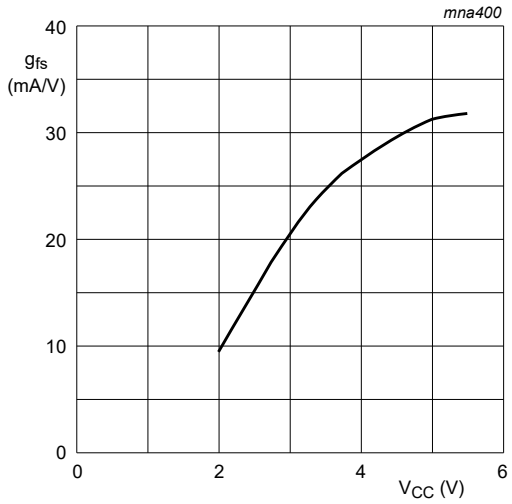



**Fig. 9. $V_{CC}$ = 5.5 V; $I_O$ = 0 A**




$g_{fs} = \Delta I_O/\Delta V_I$ at $V_O$ is constant

**Fig. 10. Test set-up for measuring forward transconductance**




$T_{amb}$ = 25 °C

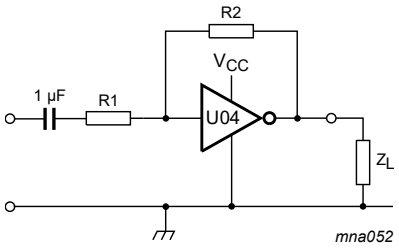
**Fig. 11. Typical forward transconductance ($g_{fs}$) as a function of the supply voltage**

# 13. Application information

Some applications are:

- Linear amplifier (see Fig. 12)
- In crystal oscillator design (see Fig. 13)

**Remark**: All values given are typical unless otherwise specified.

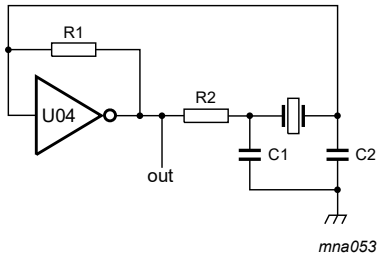



Maximum $V_{o(p-p)} = V_{CC}$ - 1.5 V centered at 0.5 × $V_{CC}$.

$$G_V = -\frac{G_{ol}}{1 + \frac{R1}{R2}(1 + G_{ol})}$$ where:

$G_{ol}$ = open loop gain;
$G_v$ = voltage gain;
R1 ≥ 3 kΩ, R2 ≤ 1 MΩ;
$Z_L$ > 10 kΩ; $G_{ol}$ = 20 (typ.);
Typical unity gain bandwidth product is 5 MHz.

**Fig. 12. Used as a linear amplifier**




C1 = 47 pF (typ.);
C2 = 22 pF (typ.);
R1 = 1 MΩ to 10 MΩ (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 V and f = 1 MHz.

**Fig. 13. Crystal oscillator configuration**

**Table 9. External components for resonator (f < 1 MHz)**

*All values given are typical and must be used as an initial set-up.*

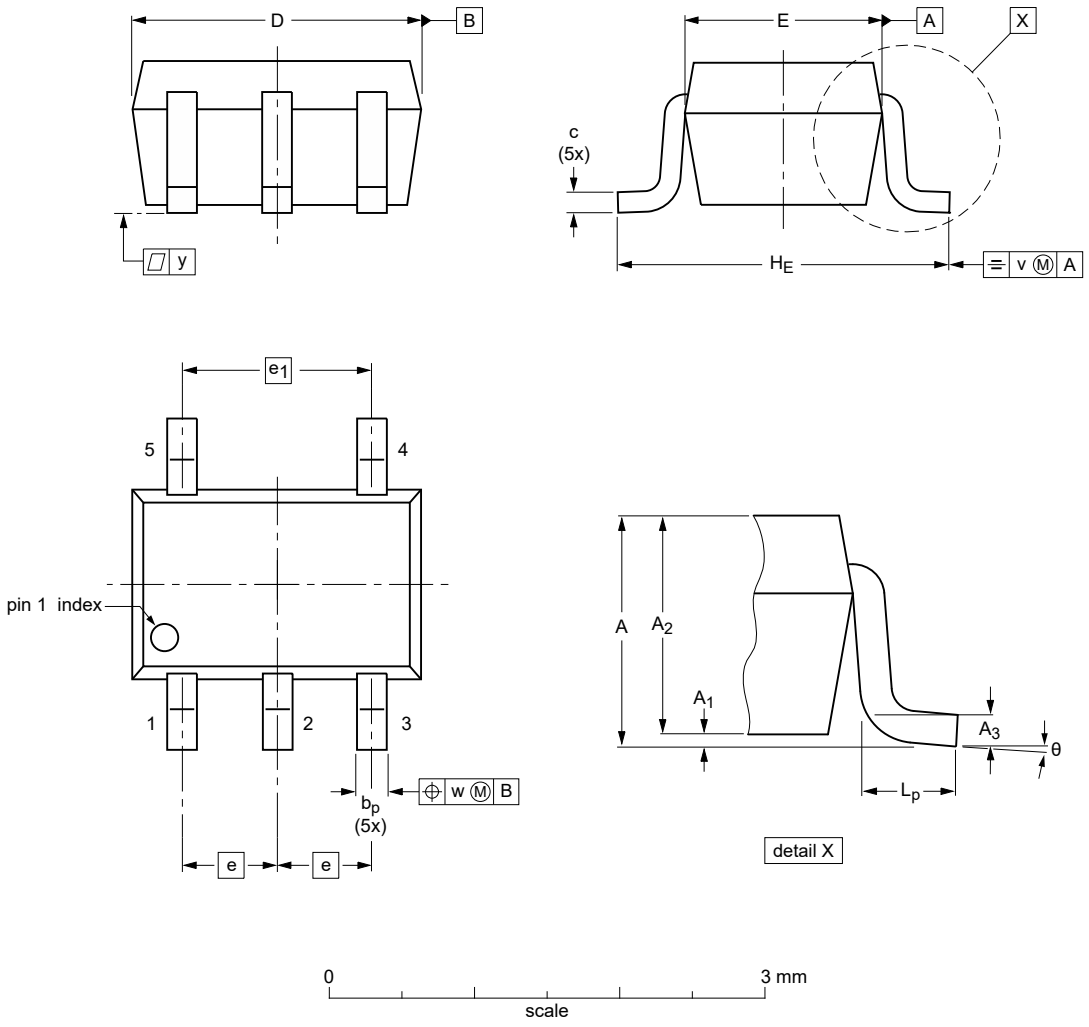
| Frequency | R1 | R2 | C1 | C2 |
|---|---|---|---|---|
| 10 kHz to 15.9 kHz | 22 MΩ | 220 kΩ | 56 pF | 20 pF |
| 16 kHz to 24.9 kHz | 22 MΩ | 220 kΩ | 56 pF | 10 pF |
| 25 kHz to 54.9 kHz | 22 MΩ | 100 kΩ | 56 pF | 10 pF |
| 55 kHz to 129.9 kHz | 22 MΩ | 100 kΩ | 47 pF | 5 pF |
| 130 kHz to 199.9 kHz | 22 MΩ | 47 kΩ | 47 pF | 5 pF |
| 200 kHz to 349.9 kHz | 22 MΩ | 47 kΩ | 47 pF | 5 pF |
| 350 kHz to 600 kHz | 22 MΩ | 47 kΩ | 47 pF | 5 pF |

**Table 10. Optimum value for R2**

| Frequency | R2 | Optimum for |
|---|---|---|
| 3 kHz | 2.0 kΩ | minimum required $I_{CC}$ |
| | 8.0 kΩ | minimum influence due to change in $V_{CC}$ |
| 6 kHz | 1.0 kΩ | minimum required $I_{CC}$ |
| | 4.7 kΩ | minimum influence by $V_{CC}$ |
| 10 kHz | 0.5 kΩ | minimum required $I_{CC}$ |
| | 2.0 kΩ | minimum influence by $V_{CC}$ |
| 14 kHz | 0.5 kΩ | minimum required $I_{CC}$ |
| | 1.0 kΩ | minimum influence by $V_{CC}$ |
| >14 kHz | - | replace R2 by C3 with a typical value of 35 pF |

## 14. Package outline

**TSSOP5: plastic thin shrink small outline package; 5 leads; body width 1.25 mm** **SOT353-1**




Dimensions (mm are the original dimensions)

| Unit | | A | $A_1$ | $A_2$ | $A_3$ | $b_p$ | c | $D^{(1)}$ | $E^{(1)}$ | e | $e_1$ | $H_E$ | $L_p$ | v | w | y | θ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | max | 1.1 | 0.1 | 1.0 | 0.15 | 0.30 | 0.25 | 2.2 | 1.35 | 0.65 | 1.3 | 2.4 | 0.46 | 0.3 | 0.1 | 0.1 | 8° |
| | min | 0.8 | 0 | 0.8 | | 0.15 | 0.08 | 1.8 | 1.15 | | | 1.8 | 0.26 | | | | 0° |

Note

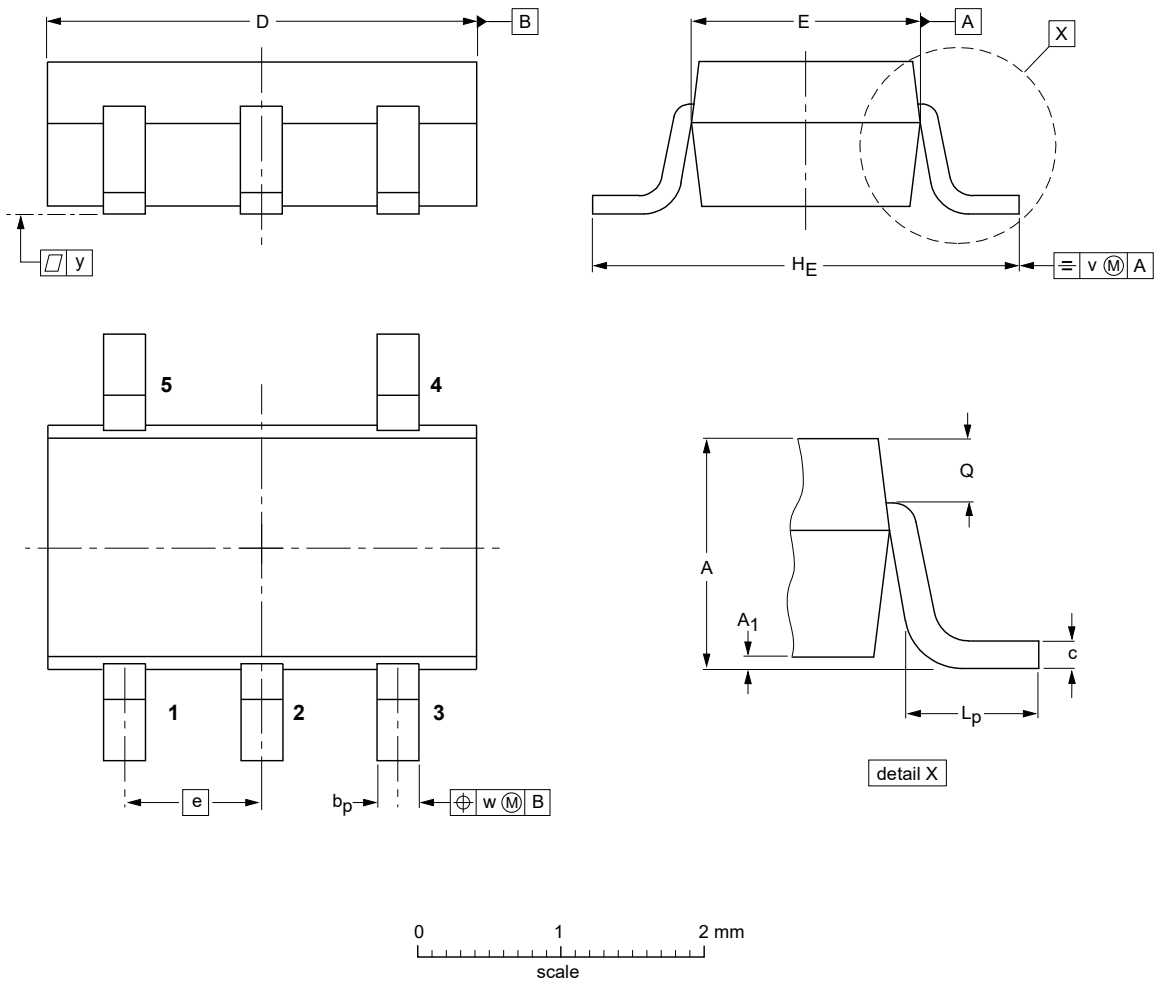
1. Plastic or metal protrusions of 0.2 mm maximum per side are not included.

*sot353-1_po*

| Outline version | References | | | | European projection | Issue date |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT353-1 | | MO-203 | SC-88A | | | ~~21-12-15~~ 21-12-16 |

**Fig. 14. Package outline SOT353-1 (TSSOP5)**

**Plastic surface-mounted package; 5 leads** **SOT753**




**DIMENSIONS (mm are the original dimensions)**

| UNIT | A | $A_1$ | $b_p$ | c | D | E | e | $H_E$ | $L_p$ | Q | v | w | y |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1.1<br>0.9 | 0.100<br>0.013 | 0.40<br>0.25 | 0.26<br>0.10 | 3.1<br>2.7 | 1.7<br>1.3 | 0.95 | 3.0<br>2.5 | 0.6<br>0.2 | 0.33<br>0.23 | 0.2 | 0.2 | 0.1 |

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT753 | | | SC-74A | | | ~~02-04-16~~<br>06-03-16 |

**Fig. 15. Package outline SOT753 (SC-74A)**

## 15. Abbreviations

**Table 11. Abbreviations**

| Acronym | Description |
|---|---|
| CDM | Charged Device Model |
| DUT | Device Under Test |
| ESD | ElectroStatic Discharge |
| HBM | Human Body Model |
| MM | Machine Model |

## 16. Revision history

**Table 12. Revision history**

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| 74AHC1GU04 v.6 | 20220112 | Product data sheet | - | 74AHC1GU04 v.5 |
| Modifications: | • The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia.<br>• Legal texts have been adapted to the new company name where appropriate.<br>• Section 1 and Section 2 updated.<br>• Fig. 14: Package outeline drawing for SOT353-1 (TSSOP5) has changed.<br>• Table 5: Derating values for $P_{tot}$ total power dissipation updated. | | | |
| 74AHC1GU04 v.5 | 20070710 | Product data sheet | - | 74AHC1GU04 v.4 |
| Modifications: | • The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.<br>• Legal texts have been adapted to the new company name where appropriate.<br>• Package SOT353 changed to SOT353-1 in Section 3 and Section 14.<br>• Quick reference data and Soldering sections removed. | | | |
| 74AHC1GU04 v.4 | 20020528 | Product specification | - | 74AHC1GU04 v.3 |
| 74AHC1GU04 v.3 | 20020215 | Product specification | - | 74AHC1GU04 v.2 |
| 74AHC1GU04 v.2 | 20010427 | Product specification | - | 74AHC1GU04 v.1 |
| 74AHC1GU04 v.1 | 19990519 | Product specification | - | - |

# 17. 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".
[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the internet at https://www.nexperia.com.

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