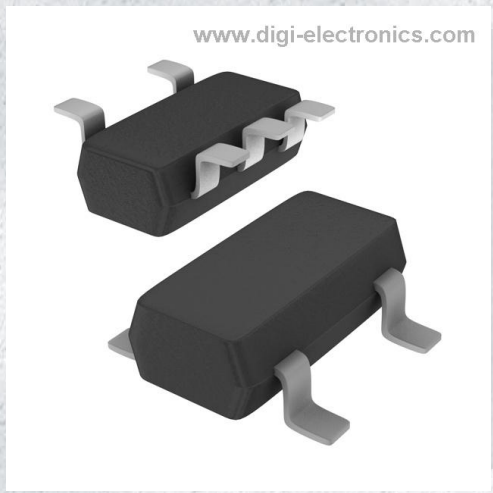
74HC1GU04GV-Q100,1 Datasheet



https://www.DiGi-Electronics.com

DiGi Electronics Part Number	74HC1GU04GV-Q100,1-DG
Manufacturer	Nexperia USA Inc.
Manufacturer Product Number	74HC1GU04GV-Q100,1
Description	IC INVERTER 1CH 1-INP SC74A
Detailed Description	Inverter IC 1 Channel SC-74A

Tel: +00 852-30501935

RFQ Email: Info@DiGi-Electronics.com

Purchase and inquiry

Manufacturer Product Number:	Manufacturer:
74HC1GU04GV-Q100,1	Nexperia USA Inc.
Series:	Product Status:
74HC	Active
Logic Type:	Number of Circuits:
Inverter	1
Number of Inputs:	Features:
1	-
Voltage - Supply:	Current - Quiescent (Max):
2V ~ 6V	20 µA
Current - Output High, Low:	Input Logic Level - Low:
2.6mA, 2.6mA	0.3V ~ 1.2V
Input Logic Level - High:	Max Propagation Delay @ V, Max CL:
1.7V ~ 4.8V	18ns @ 6V, 50pF
Operating Temperature:	Grade:
-40°C ~ 125°C	Automotive
Qualification:	Mounting Type:
AEC-Q100	Surface Mount
Supplier Device Package:	Package / Case:
SC-74A	SC-74A, SOT-753
Base Product Number:	
74HC1GU04	

Environmental & Export classification

RoHS Status:	Moisture Sensitivity Level (MSL):
ROHS3 Compliant	1 (Unlimited)
REACH Status:	ECCN:
REACH Unaffected	EAR99
HTSUS:	
8542.39.0001	

74HC1GU04-Q100

Single unbuffered inverter

Rev. 4 — 5 December 2023 Product data sheet

1. General description

The 74HC1GU04-Q100 is a single unbuffered inverter. Inputs include clamp diodes. This enables the use of current limiting resistors to interface inputs to voltages in excess of V_{CC}.

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 from -40 °C to +125 °C
- Wide supply voltage range from 2.0 to 6.0 V
- High noise immunity
- Symmetrical output impedance
- CMOS low power dissipation
- Balanced propagation delays
- Latch-up performance exceeds 100 mA per JESD 78 Class II Level B
- Complies with JEDEC standards
  - JESD8C (2.7 V to 3.6 V)
  - JESD7A (2.0 V to 6.0 V)
- 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			
	Temperature range	Name	Description	Version
74HC1GU04GW-Q100	-40 °C to +125 °C	TSSOP5	plastic thin shrink small outline package; 5 leads; body width 1.25 mm	SOT353-1
74HC1GU04GV-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]
74HC1GU04GW-Q100	HD
74HC1GU04GV-Q100	HU4

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

5. Functional diagram

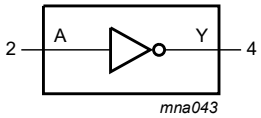


Fig. 1. Logic symbol

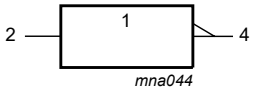


Fig. 2. IEC logic symbol

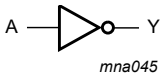


Fig. 3. Logic diagram

6. Pinning information

6.1. Pinning

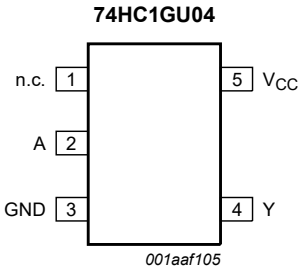


Fig. 4. Pin configuration SOT353-1 (TSSOP5) and SOT753 (SC-74A)

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

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 or $V_I > V_{CC} + 0.5$ V	[1]	-	±20	mA
I_{OK}	output clamping current	$V_O < -0.5$ V or $V_O > V_{CC} + 0.5$ V	[1]	-	±20	mA
I_O	output current	-0.5 V $< V_O < V_{CC} + 0.5$ V	[1]	-	±12.5	mA
I_{CC}	supply current			-	25	mA
I_{GND}	ground current			-25	-	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	6.0	V
V_I	input voltage		0	-	V_{CC}	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} = 2.0 V	-	-	625	ns/V
		V_{CC} = 4.5 V	-	-	139	ns/V
		V_{CC} = 6.0 V	-	-	83	ns/V

10. Static characteristics

Table 7. Static characteristics

Voltages are referenced to GND (ground = 0 V). All typical values are measured at T_{amb} = 25 °C.

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	
V_{IH}	HIGH-level input voltage	V_{CC} = 2.0 V	1.7	1.4	-	1.7	-	V
		V_{CC} = 4.5 V	3.6	2.6	-	3.6	-	V
		V_{CC} = 6.0 V	4.8	3.4	-	4.8	-	V
V_{IL}	LOW-level input voltage	V_{CC} = 2.0 V	-	0.6	0.3	-	0.3	V
		V_{CC} = 4.5 V	-	1.9	0.9	-	0.9	V
		V_{CC} = 6.0 V	-	2.6	1.2	-	1.2	V

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	
V_{OH}	HIGH-level output voltage	$V_I = V_{IH}$ or V_{IL}						
		I_O = -20 µA; V_{CC} = 2.0 V	1.8	2.0	-	1.8	-	V
		I_O = -20 µA; V_{CC} = 4.5 V	4.0	4.5	-	4.0	-	V
		I_O = -20 µA; V_{CC} = 6.0 V	5.5	6.0	-	5.5	-	V
		I_O = -2.0 mA; V_{CC} = 4.5 V	4.13	4.32	-	3.7	-	V
		I_O = -2.6 mA; V_{CC} = 6.0 V	5.63	5.81	-	5.2	-	V
V_{OL}	LOW-level output voltage	$V_I = V_{IH}$ or V_{IL}						
		I_O = 20 µA; V_{CC} = 2.0 V	-	0	0.2	-	0.2	V
		I_O = 20 µA; V_{CC} = 4.5 V	-	0	0.5	-	0.5	V
		I_O = 20 µA; V_{CC} = 6.0 V	-	0	0.5	-	0.5	V
		I_O = 2.0 mA; V_{CC} = 4.5 V	-	0.15	0.33	-	0.4	V
		I_O = 2.6 mA; V_{CC} = 6.0 V	-	0.16	0.33	-	0.4	V
I_I	input leakage current	$V_I = V_{CC}$ or GND; V_{CC} = 6.0 V	-	-	1.0	-	1.0	µA
I_{CC}	supply current	$V_I = V_{CC}$ or GND; I_O = 0 A; V_{CC} = 6.0 V	-	-	10	-	20	µA
C_I	input capacitance		-	5	-	-	-	pF

11. Dynamic characteristics

Table 8. Dynamic characteristics

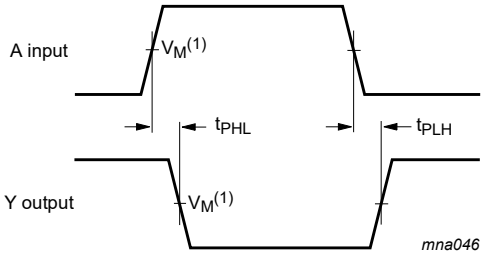
GND = 0 V; $t_r = t_f$ = 6.0 ns; For test circuit see Fig. 6. All typical values are measured at T_{amb} = 25 °C.

Symbol	Parameter	Conditions		-40 °C to +85 °C			-40 °C to +125 °C		Unit
				Min	Typ	Max	Min	Max	
t_{pd}	propagation delay	A to Y; see Fig. 5	[1]						
		V_{CC} = 2.0 V; C_L = 50 pF		-	10	90	-	105	ns
		V_{CC} = 4.5 V; C_L = 50 pF		-	7	18	-	21	ns
		V_{CC} = 6.0 V; C_L = 50 pF		-	6	15	-	18	ns
		V_{CC} = 5.0 V; C_L = 15 pF		-	5	-	-	-	ns
C_{PD}	power dissipation capacitance	V_I = GND to V_{CC}	[2]	-	14	-	-	-	pF

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

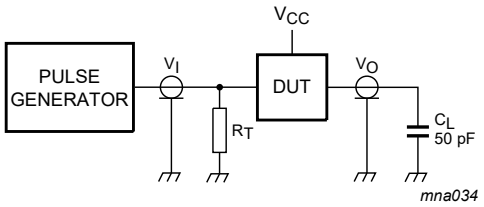
[2] C_{PD} is used to determine the dynamic power dissipation P_D (µW).
$P_D = C_{PD} \times V_{CC}^2 \times f_i + \sum(C_L \times V_{CC}^2 \times f_o)$ where:
f_i = input frequency in MHz;
f_o = output frequency in MHz;
C_L = output load capacitance in pF;
V_{CC} = supply voltage in Volts.

11.1. Waveform and test circuit



V_M (1) = 0.5 × V_{CC}; V_I = GND to V_{CC}.

Fig. 5. Input to output propagation delays



Test data is given in Table 8.

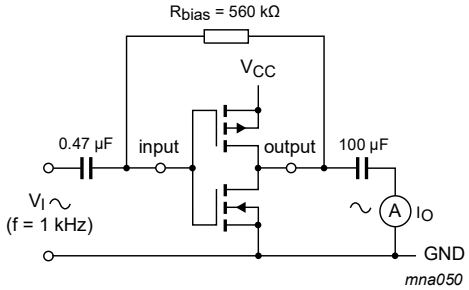
DUT = Device Under Test

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.

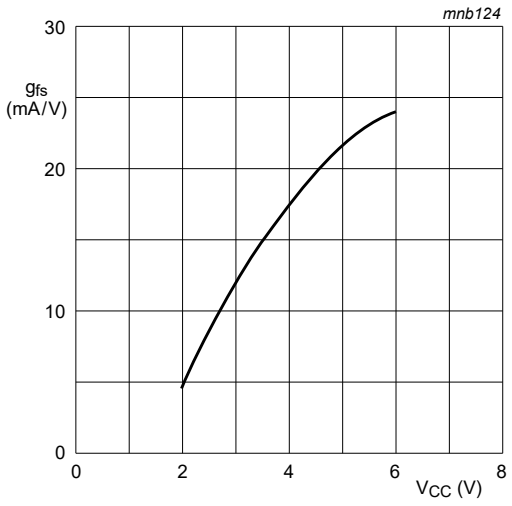
Fig. 6. Test circuit for measuring switching times

11.2. Additional characteristics



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

Fig. 7. Test set-up for measuring forward transconductance



T_{amb} = 25 °C

Fig. 8. Typical forward transconductance as a function of supply voltage

11.3. Typical transfer characteristics

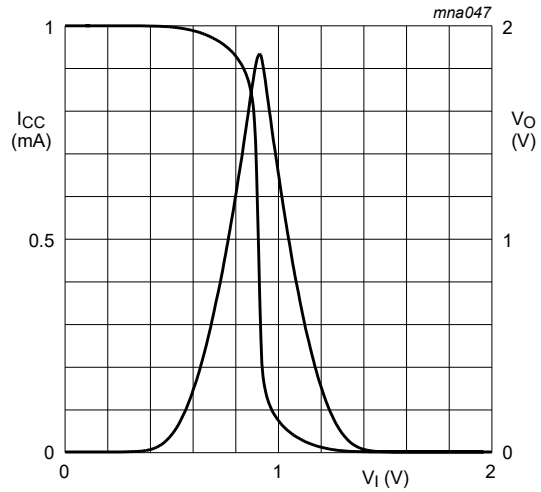


Fig. 9. V_{CC} = 2.0 V; I_O = 0 A

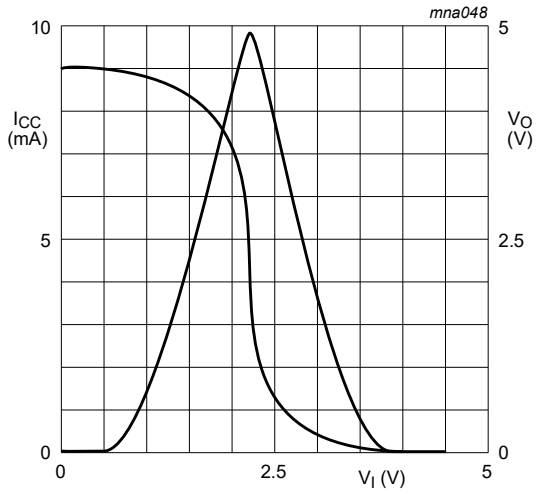


Fig. 10. V_{CC} = 4.5 V; I_O = 0 A

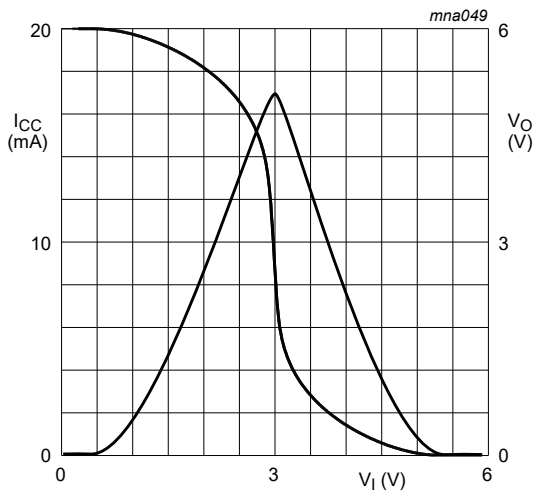


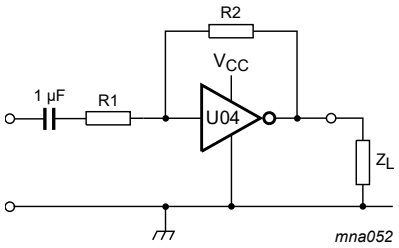
Fig. 11. V_{CC} = 6.0 V; I_O = 0 A

12. 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}.

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

G_{ol} = open loop gain

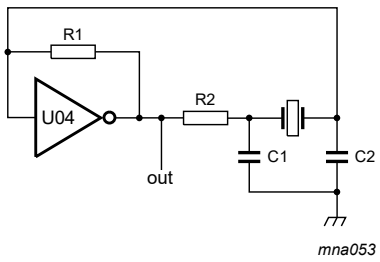
G_v = voltage gain

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

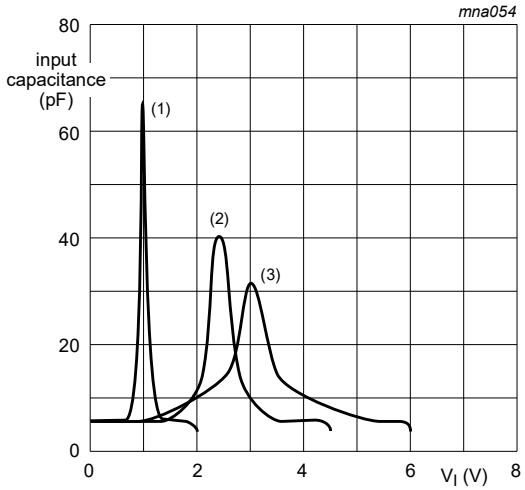
Table 9. External components for resonator (f < 1 MHz)

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	2.2 MΩ	220 kΩ	56 pF	20 pF
16 kHz to 24.9 kHz	2.2 MΩ	220 kΩ	56 pF	10 pF
25 kHz to 54.9 kHz	2.2 MΩ	100 kΩ	56 pF	10 pF
55 kHz to 129.9 kHz	2.2 MΩ	100 kΩ	47 pF	5 pF
130 kHz to 199.9 kHz	2.2 MΩ	47 kΩ	47 pF	5 pF
200 kHz to 349.9 kHz	2.2 MΩ	47 kΩ	47 pF	5 pF
350 kHz to 600 kHz	2.2 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

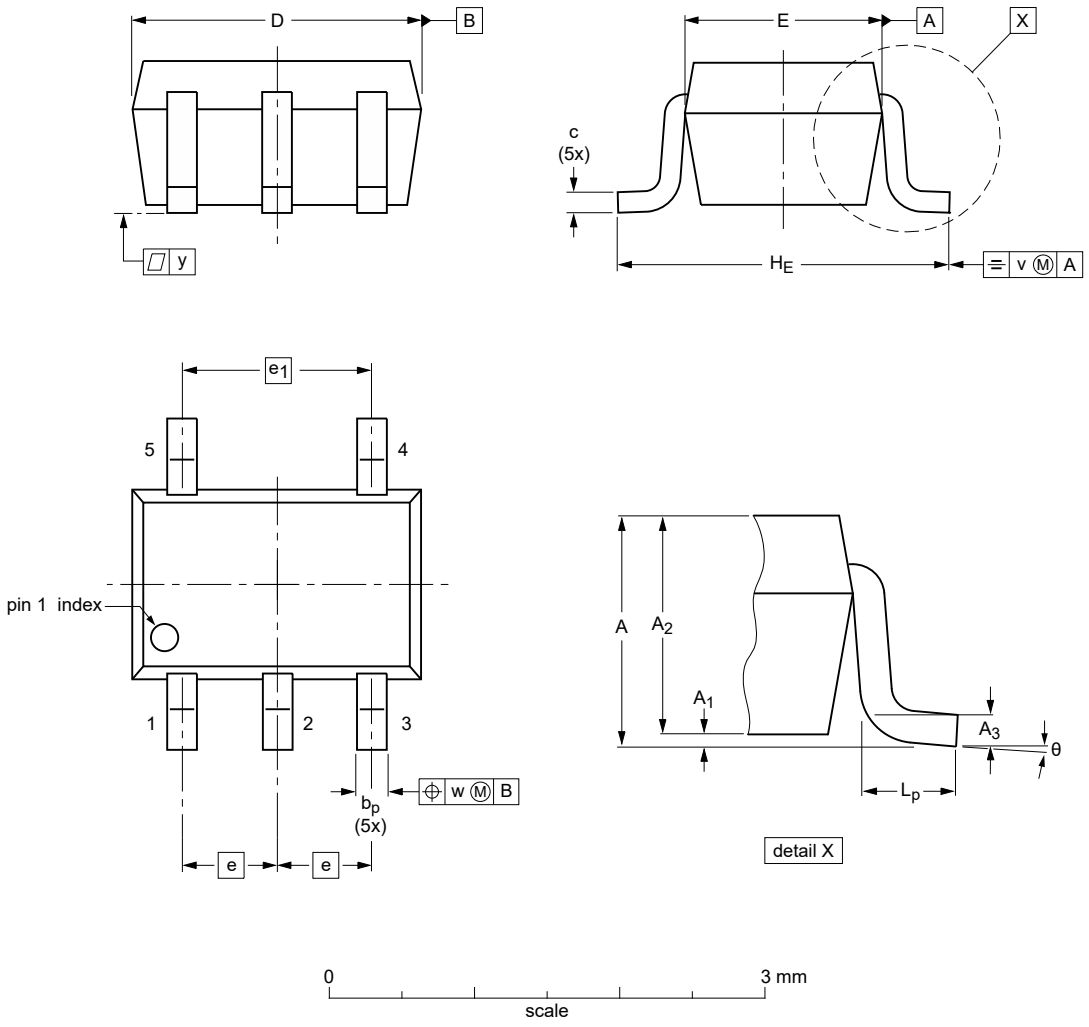


(1) V_{CC} = 2.0 V
(2) V_{CC} = 4.5 V
(3) V_{CC} = 6.0 V

Fig. 14. Typical input capacitance as a function of the input voltage

13. 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

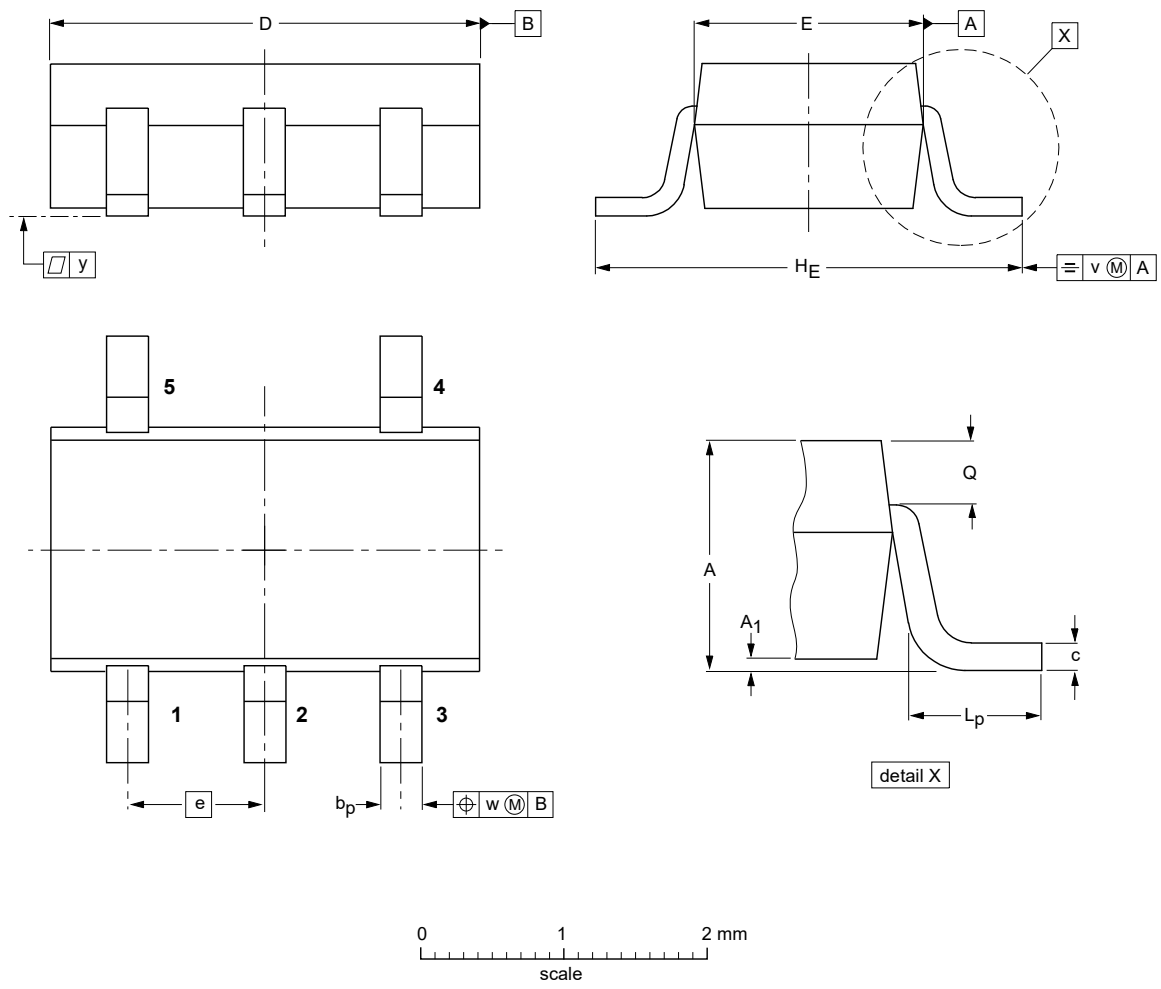
1. Plastic or metal protrusions of 0.2 mm maximum per side are not included.

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. 15. 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 0.9	0.100 0.013	0.40 0.25	0.26 0.10	3.1 2.7	1.7 1.3	0.95	3.0 2.5	0.6 0.2	0.33 0.23	0.2	0.2	0.1

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

Fig. 16. Package outline SOT753 (SC-74A)

14. Abbreviations

Table 11. Abbreviations

Acronym	Description
CDM	Charged Device Model
CMOS	Complementary Metal-Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
JEDEC	Joint Electron Device Engineering Council

15. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74HC1GU04_Q100 v.4	20231205	Product data sheet	-	74HC1GU04_Q100 v.3
Modifications:	• Section 2: ESD specification updated according to the latest JEDEC standard.			
74HC1GU04_Q100 v.3	20220204	Product data sheet	-	74HC1GU04_Q100 v.2
Modifications:	• Section 2 updated. • Section 8: Derating values for P_{tot} total power dissipation updated. • Fig. 15: Package outline drawing SOT353-1 (TSSOP5) has been changed.			
74HC1GU04_Q100 v.2	20180725	Product data sheet	-	74HC1GU04_Q100 v.1
Modifications:	• 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. • Fig. 8: forward transconductance graph added.			
74HC1GU04_Q100 v.1	20120821	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".
[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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