74HC1GU04

Single unbuffered inverter

Rev. 6 — 25 July 2018

Product data sheet

1. General description

The 74HC1GU04 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}.

2. Features and benefits

- Symmetrical output impedance
- Wide operating voltage range from 2.0 V to 6.0 V
- Low power dissipation
- Balanced propagation delays
- SOT353-1 and SOT753 package options

3. Ordering information

Table 1. Ordering information

Type number	Package			Version
	Temperature range	Name	Description	
74HC1GU04GW	-40 °C to +125 °C	TSSOP5	plastic thin shrink small outline package; 5 leads; body width 1.25 mm	SOT353-1
74HC1GU04GV	-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	HD
74HC1GU04GV	HU4

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

5. Functional diagram

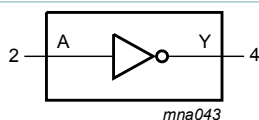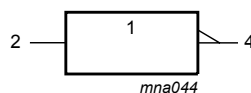Fig. 1.   Logic symbol
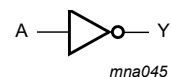
mna043

Fig. 2.   IEC logic symbol

mna044

Fig. 3.   Logic diagram

mna045

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6. Pinning information

6.1. Pinning

74HC1GU04

n.c. 1 ☐ 5 ☐ V_CC

A 2 ☐

GND 3 ☐ 4 ☐ Y

001aaf105
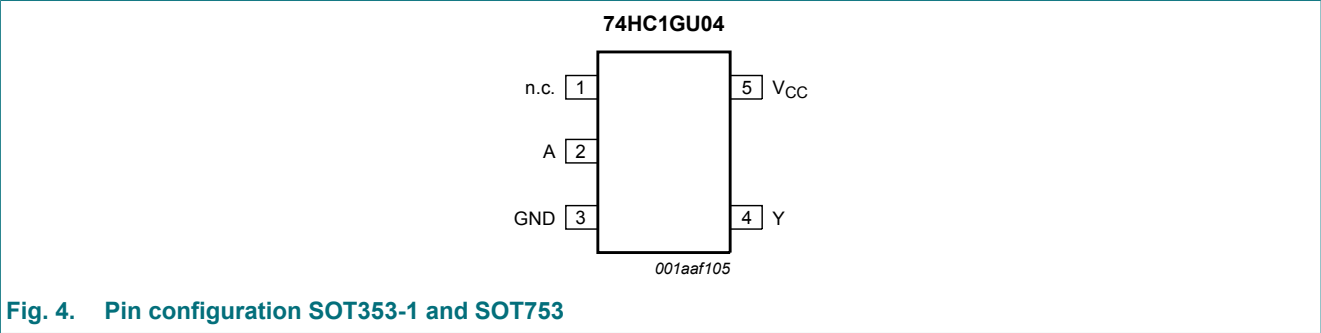
Fig. 4.   Pin configuration SOT353-1 and SOT753

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]	-	200	mW

[1] The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
[2] Above 55 °C the value of P_{tot} derates linearity with 2.5 mW/K.

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
$\Delta t/\Delta V$	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

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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).
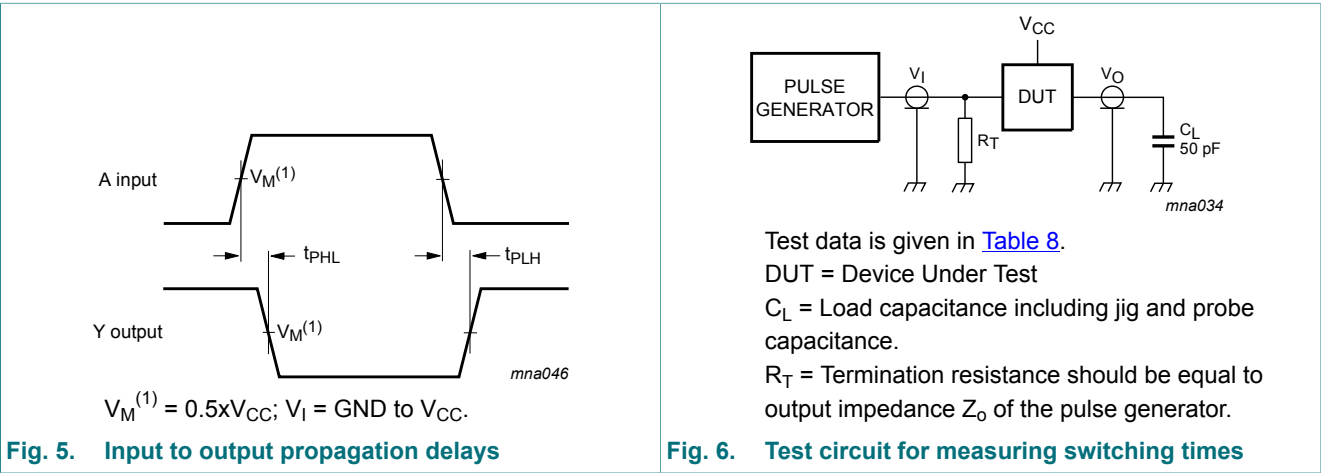 $P_D = C_{PD} \times V_{CC}^2 \times f_i + \sum(C_L \times V_{CC}^2 \times f_o)$ where:
   f_i = input frequency in MHz;
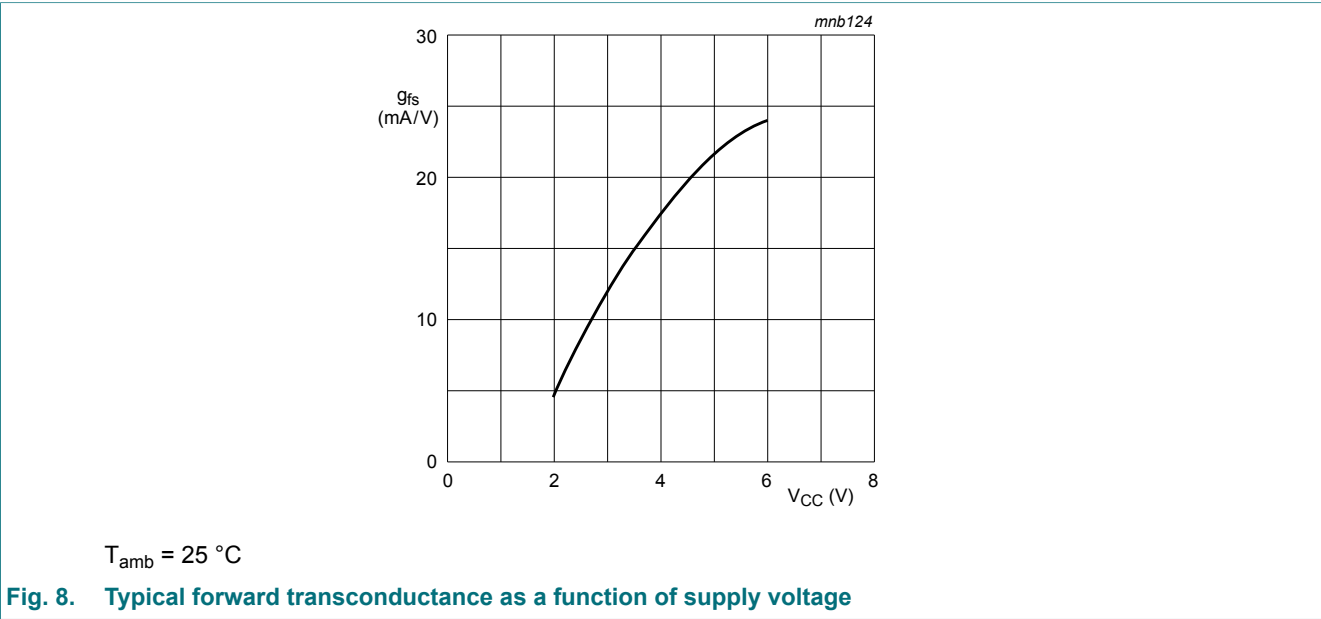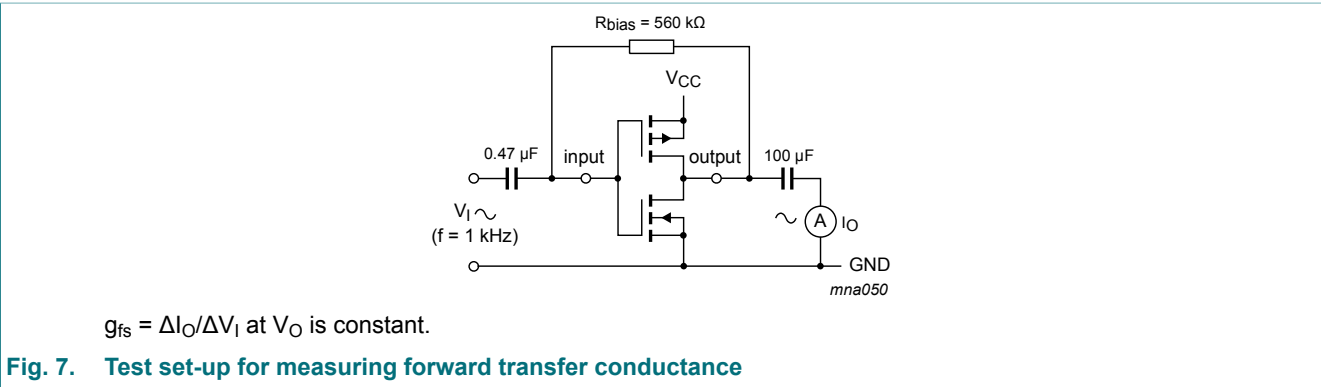 f_o = output frequency in MHz;
   C_L = output load capacitance in pF;
   V_{CC} = supply voltage in Volts.
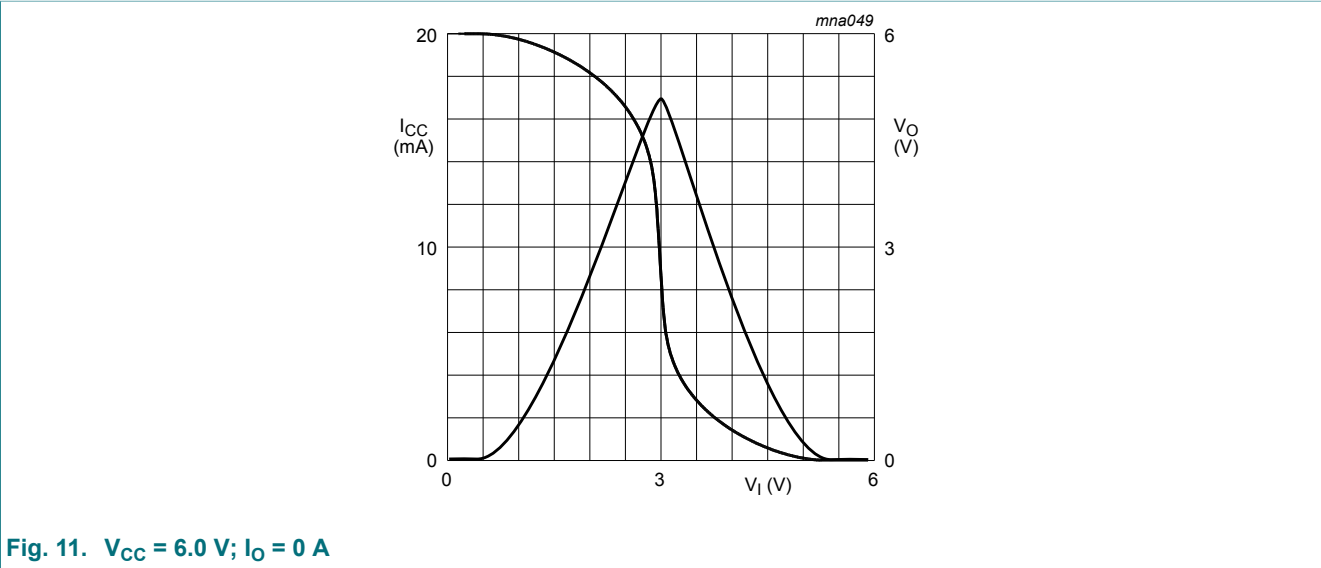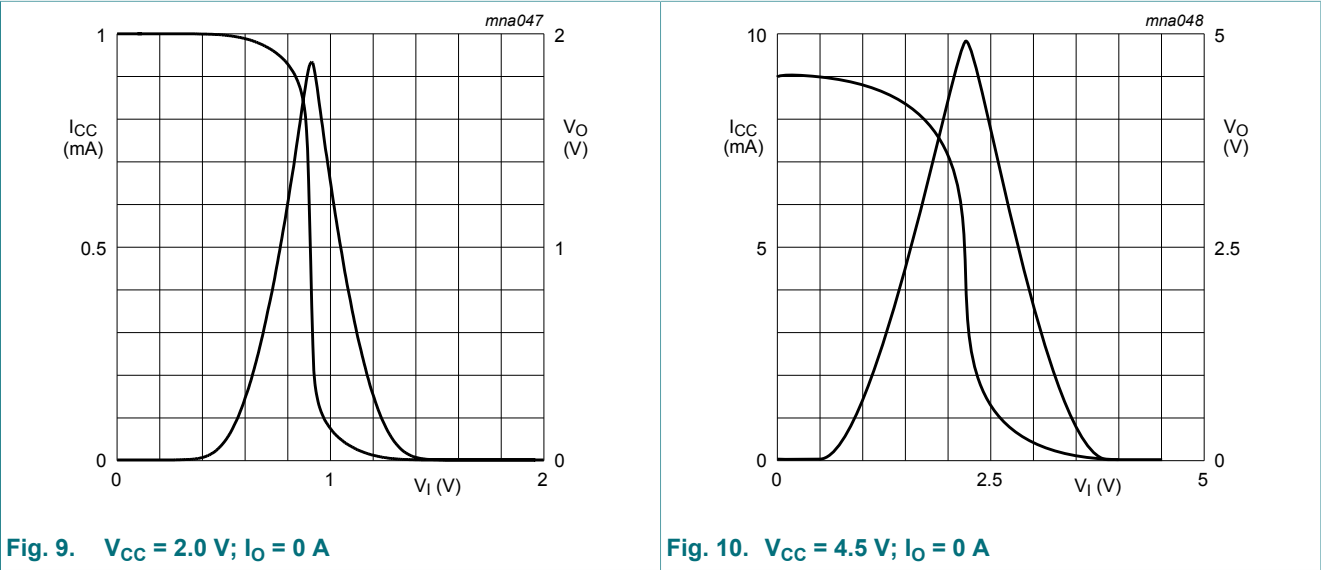
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11.1. Waveform and test circuit

$V_M^{(1)} = 0.5 \times V_{CC}$; 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 transfer conductance**

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)

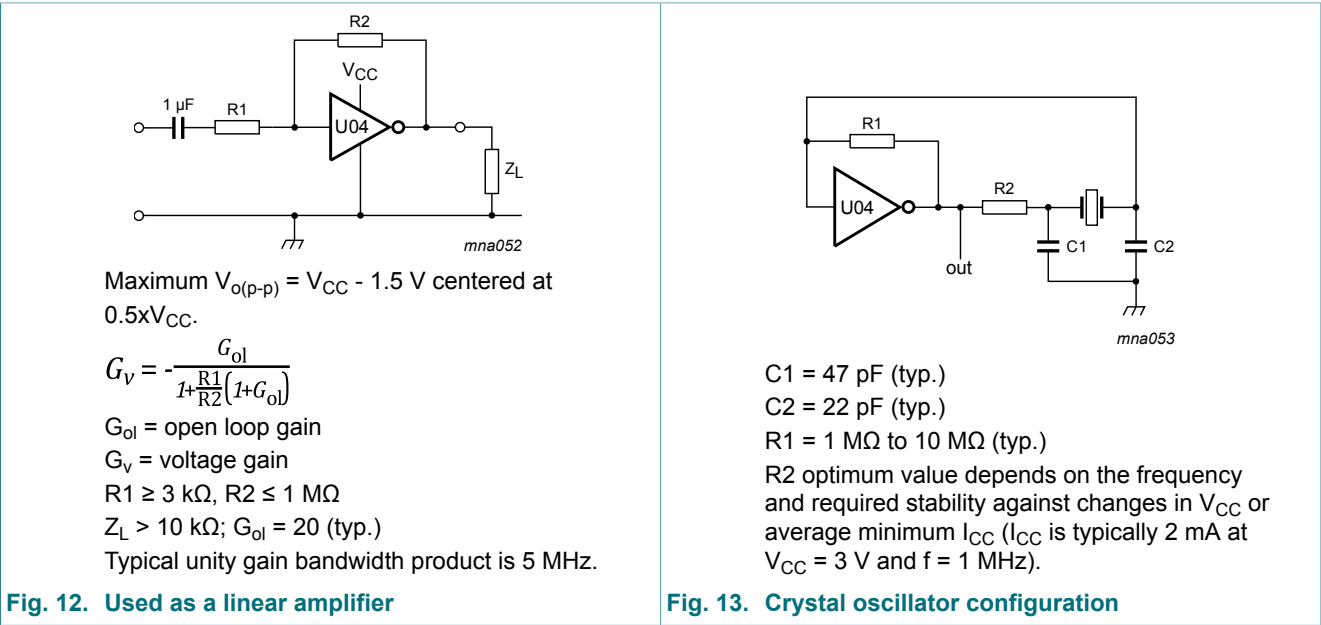**Remark:** All values given are typical unless otherwise specified.

Maximum $V_{o(p-p)}$ = V_{CC} - 1.5 V centered at 0.5xV_{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
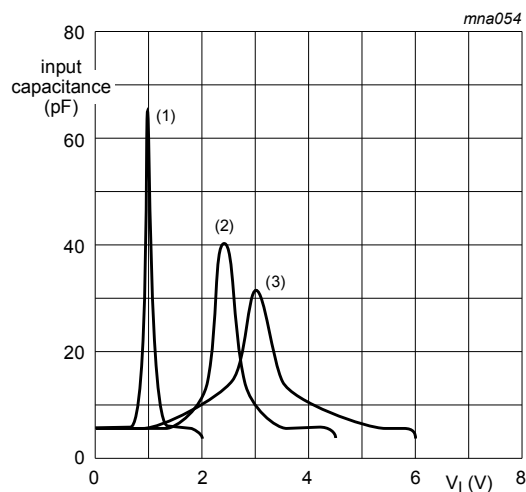
(1) V_{CC} = 2.0 V
(2) V_{CC} = 4.5 V
(3) V_{CC} = 6.0 V

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**
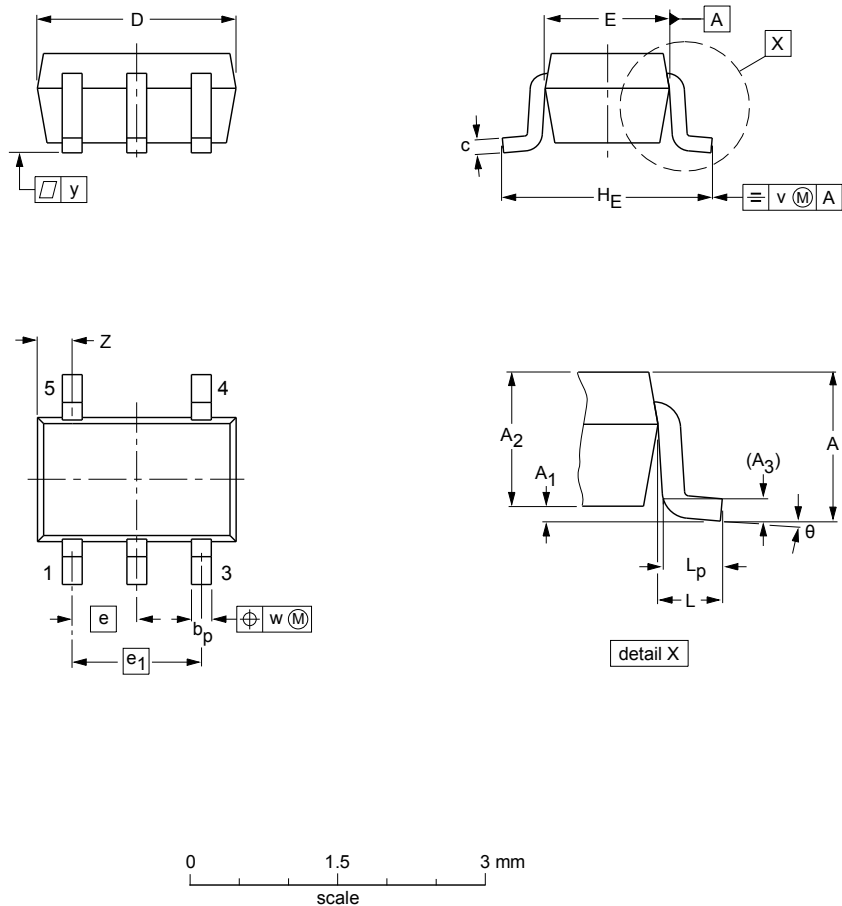
DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A₁	A₂	A₃	bₚ	c	D(1)	E(1)	e	e₁	H_E	L	L_p	v	w	y	Z(1)	θ
mm	1.1	0.1 0	1.0 0.8	0.15	0.30 0.15	0.25 0.08	2.25 1.85	1.35 1.15	0.65	1.3	2.25 2.0	0.425	0.46 0.21	0.3	0.1	0.1	0.60 0.15	7° 0°

Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT353-1		MO-203	SC-88A			00-09-01 03-02-19

Fig. 15. Package outline SOT353-1 (TSSOP5)

Plastic surface-mounted package; 5 leads SOT753

DIMENSIONS (mm are the original dimensions)

UNIT	A	A₁	bₚ	c	D	E	e	H_E	Lₚ	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
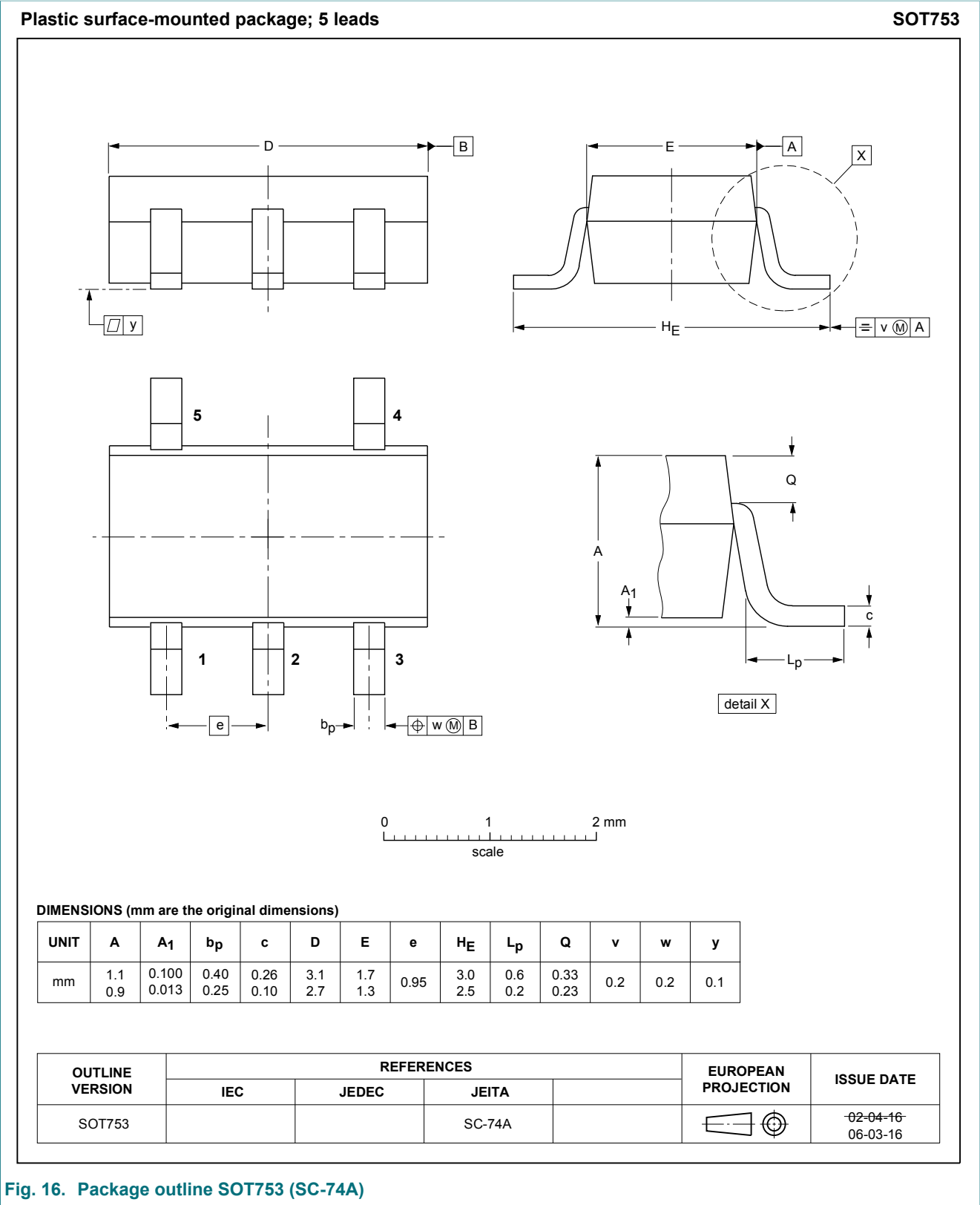
Fig. 16. Package outline SOT753 (SC-74A)

14. Abbreviations

Table 11. Abbreviations

Acronym	Description
CMOS	Complementary Metal-Oxide Semiconductor
DUT	Device Under Test

15. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74HC1GU04 v.6	20180725	Product data sheet	-	74HC1GU04 v.5
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 v.5	20070710	Product data sheet	-	74HC1GU04 v.4
Modifications:	•	The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.		
	•	Legal texts have been adapted to the new company name where appropriate.		
	•	Package SOT353 changed to SOT353-1 in Table 1 and Fig. 15.		
	•	Quick Reference Data and Soldering sections removed.		
	•	Section 2 updated.		
74HC1GU04 v.4	20020527	Product specification	-	74HC1GU04 v.3
74HC1GU04 v.3	20020513	Product specification	-	74HC1GU04 v.2
74HC1GU04 v.2	20010427	Product specification	-	74HC1GU04 v.1
74HC1GU04 v.1	19981118	Product specification	-	-

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.

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[2]   The term 'short data sheet' is explained in section "Definitions".

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Телефон: +7 495 668-12-70 (многоканальный)

Факс: +7 495 668-12-70 (доб.304)

E-mail: info@moschip.ru

Skype отдела продаж:
moschip.ru   moschip.ru_6
moschip.ru_4   moschip.ru_9