74HC2G00; 74HCT2G00

Dual 2-input NAND gate

Rev. 03 — 5 April 2006 Product data sheet

1. General description

The 74HC2G00; 74HCT2G00 is a high-speed Si-gate CMOS device.

The 74HC2G00; 74HCT2G00 provides the 2-input NAND function.

2. Features

- Wide supply voltage range from 2.0 V to 6.0 V
- Symmetrical output impedance
- High noise immunity
- Low power dissipation
- Balanced propagation delays
- Multiple package options
- ESD protection:
  - HBM EIA/JESD22-A114-C exceeds 2000 V
  - MM EIA/JESD22-A115-A exceeds 200 V

3. Quick reference data

Table 1. Quick reference data

GND = 0 V; T_{amb} = 25 °C; $t_r = t_f \leq 6$ ns.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
74HC2G00							
t_{PHL}, t_{PLH}	propagation delay nA, nB to nY	V_{CC} = 4.5 V; C_L = 50 pF		-	9	-	ns
C_i	input capacitance			-	1.5	-	pF
C_{PD}	power dissipation capacitance	per gate; V_I = GND to V_{CC}	[1]	-	10	-	pF

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Table 1. Quick reference data *...continued*

GND = 0 V; T_{amb} = 25 °C; $t_r = t_f \leq 6$ ns.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
74HCT2G00							
t_{PHL}, t_{PLH}	propagation delay nA, nB to nY	V_{CC} = 4.5 V; C_L = 50 pF		-	12	-	ns
C_i	input capacitance			-	1.5	-	pF
C_{PD}	power dissipation capacitance	per gate; V_I = GND to (V_{CC} – 1.5 V)	[1]	-	10	-	pF

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

4. Ordering information

Table 2. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74HC2G00				
74HC2G00DP	–40 °C to +125 °C	TSSOP8	plastic thin shrink small outline package; 8 leads; body width 3 mm; lead length 0.5 mm	SOT505-2
74HC2G00DC	–40 °C to +125 °C	VSSOP8	plastic very thin shrink small outline package; 8 leads; body width 2.3 mm	SOT765-1
74HCT2G00				
74HCT2G00DP	–40 °C to +125 °C	TSSOP8	plastic thin shrink small outline package; 8 leads; body width 3 mm; lead length 0.5 mm	SOT505-2
74HCT2G00DC	–40 °C to +125 °C	VSSOP8	plastic very thin shrink small outline package; 8 leads; body width 2.3 mm	SOT765-1

5. Marking

Table 3. Marking code

Type number	Marking code
74HC2G00DP	H00
74HC2G00DC	H00
74HCT2G00DP	T00
74HCT2G00DC	T00

6. Functional diagram

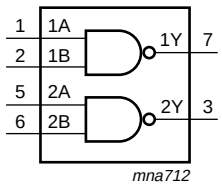


Fig 1. Logic symbol

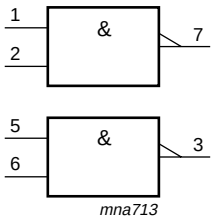


Fig 2. IEC logic symbol

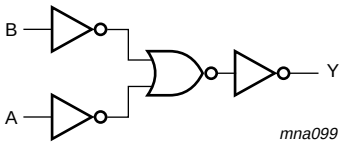


Fig 3. Logic diagram (one driver)

7. Pinning information

7.1 Pinning

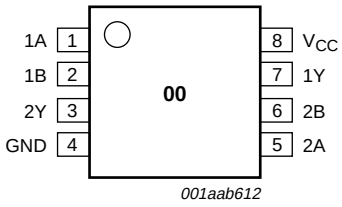


Fig 4. Pin configuration

7.2 Pin description

Table 4. Pin description

Symbol	Pin	Description
1A	1	data input 1A
1B	2	data input 1B
2Y	3	data output 2Y
GND	4	ground (0 V)
2A	5	data input 2A
2B	6	data input 2B
1Y	7	data output 1Y
V_{CC}	8	supply voltage

8. Functional description

8.1 Function table

Table 5. Function table[1]

Input		Output
nA	nB	nY
L	L	H
L	H	H
H	L	H
H	H	L

[1] H = HIGH voltage level;
L = LOW voltage level.

9. Limiting values

Table 6. 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		-	±20	mA
I_{OK}	output clamping current	$V_O < –0.5$ V or $V_O > V_{CC} + 0.5$ V		-	±20	mA
I_O	output current	$V_O = –0.5$ V to $(V_{CC} + 0.5$ V)		-	25	mA
I_{CC}	quiescent supply current			-	50	mA
T_{stg}	storage temperature			–65	+150	°C
P_D	dynamic power dissipation	$T_{amb} = –40$ °C to +125 °C	[1]	-	300	mW

[1] Above 110 °C the value of P_D derates linearly with 8 mW/K.

10. Recommended operating conditions

Table 7. Recommended operating conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
74HC2G00						
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
t_r, t_f	input rise and fall time	$V_{CC} = 2.0$ V	-	-	1000	ns
		$V_{CC} = 4.5$ V	-	6.0	500	ns
		$V_{CC} = 6.0$ V	-	-	400	ns
74HCT2G00						
V_{CC}	supply voltage		4.5	5.0	5.5	V
V_I	input voltage		0	-	V_{CC}	V

Table 7. Recommended operating conditions *…continued*

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_O	output voltage		0	-	V_{CC}	V
T_{amb}	ambient temperature		–40	+25	+125	°C
t_r, t_f	input rise and fall time	V_{CC} = 4.5 V	-	6.0	500	ns

11. Static characteristics

Table 8. Static characteristics 74HC2G00

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
T_{amb} = –40 °C to +85 °C[1]						
V_{IH}	HIGH-state input voltage	V_{CC} = 2.0 V	1.5	1.2	-	V
		V_{CC} = 4.5 V	3.15	2.4	-	V
		V_{CC} = 6.0 V	4.2	3.2	-	V
V_{IL}	LOW-state input voltage	V_{CC} = 2.0 V	-	0.8	0.5	V
		V_{CC} = 4.5 V	-	2.1	1.35	V
		V_{CC} = 6.0 V	-	2.8	1.8	V
V_{OH}	HIGH-state output voltage	V_I = V_{IH} or V_{IL}				
		I_O = –20 µA; V_{CC} = 2.0 V	1.9	2.0	-	V
		I_O = –20 µA; V_{CC} = 4.5 V	4.4	4.5	-	V
		I_O = –20 µA; V_{CC} = 6.0 V	5.9	6.0	-	V
		I_O = –4.0 mA; V_{CC} = 4.5 V	4.13	4.32	-	V
		I_O = –5.2 mA; V_{CC} = 6.0 V	5.63	5.81	-	V
V_{OL}	LOW-state output voltage	V_I = V_{IH} or V_{IL}				
		I_O = 20 µA; V_{CC} = 2.0 V	-	0	0.1	V
		I_O = 20 µA; V_{CC} = 4.5 V	-	0	0.1	V
		I_O = 20 µA; V_{CC} = 6.0 V	-	0	0.1	V
		I_O = 4.0 mA; V_{CC} = 4.5 V	-	0.15	0.33	V
		I_O = 5.2 mA; V_{CC} = 6.0 V	-	0.16	0.33	V
I_{LI}	input leakage current	V_I = V_{CC} or GND; V_{CC} = 6.0 V	-	-	±1.0	µA
I_{CC}	quiescent supply current	per input pin; V_I = V_{CC} or GND; I_O = 0 A; V_{CC} = 6.0 V	-	-	10	µA
C_i	input capacitance		-	1.5	-	pF
T_{amb} = –40 °C to +125 °C						
V_{IH}	HIGH-state input voltage	V_{CC} = 2.0 V	1.5	-	-	V
		V_{CC} = 4.5 V	3.15	-	-	V
		V_{CC} = 6.0 V	4.2	-	-	V
V_{IL}	LOW-state input voltage	V_{CC} = 2.0 V	-	-	0.5	V
		V_{CC} = 4.5 V	-	-	1.35	V
		V_{CC} = 6.0 V	-	-	1.8	V

Table 8. Static characteristics 74HC2G00 *…continued*

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{OH}	HIGH-state output voltage	$V_I = V_{IH}$ or V_{IL}				
		I_O = –20 μA; V_{CC} = 2.0 V	1.9	-	-	V
		I_O = –20 μA; V_{CC} = 4.5 V	4.4	-	-	V
		I_O = –20 μA; V_{CC} = 6.0 V	5.9	-	-	V
		I_O = –4.0 mA; V_{CC} = 4.5 V	3.7	-	-	V
		I_O = –5.2 mA; V_{CC} = 6.0 V	5.2	-	-	V
V_{OL}	LOW-state output voltage	$V_I = V_{IH}$ or V_{IL}				
		I_O = 20 μA; V_{CC} = 2.0 V	-	-	0.1	V
		I_O = 20 μA; V_{CC} = 4.5 V	-	-	0.1	V
		I_O = 20 μA; V_{CC} = 6.0 V	-	-	0.1	V
		I_O = 4.0 mA; V_{CC} = 4.5 V	-	-	0.4	V
		I_O = 5.2 mA; V_{CC} = 6.0 V	-	-	0.4	V
I_{LI}	input leakage current	$V_I = V_{CC}$ or GND; V_{CC} = 6.0 V	-	-	±1.0	μA
I_{CC}	quiescent supply current	per input pin; $V_I = V_{CC}$ or GND; I_O = 0 A; V_{CC} = 6.0 V	-	-	20	μA

[1] Typical values are measured at T_{amb} = 25 °C.

Table 9. Static characteristics 74HCT2G00

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
T_{amb} = –40 °C to +85 °C[1]						
V_{IH}	HIGH-state input voltage	V_{CC} = 4.5 V to 5.5 V	2.0	1.6	-	V
V_{IL}	LOW-state input voltage	V_{CC} = 4.5 V to 5.5 V	-	1.2	0.8	V
V_{OH}	HIGH-state output voltage	$V_I = V_{IH}$ or V_{IL}; V_{CC} = 4.5 V				
		I_O = –20 μA	4.4	4.5	-	V
		I_O = –4.0 mA	4.13	4.32	-	V
V_{OL}	LOW-state output voltage	$V_I = V_{IH}$ or V_{IL}; V_{CC} = 4.5 V				
		I_O = 20 μA	-	0	0.1	V
		I_O = 4.0 mA	-	0.15	0.33	V
I_{LI}	input leakage current	$V_I = V_{CC}$ or GND; V_{CC} = 5.5 V	-	-	±1.0	μA
I_{CC}	quiescent supply current	per input pin; $V_I = V_{CC}$ or GND; I_O = 0 A; V_{CC} = 5.5 V	-	-	10	μA
ΔI_{CC}	additional quiescent supply current	$V_I = V_{CC}$ – 2.1 V; I_O = 0 A; V_{CC} = 4.5 V to 5.5 V	-	-	375	μA
C_i	input capacitance		-	1.5	-	pF
T_{amb} = –40 °C to +125 °C						
V_{IH}	HIGH-state input voltage	V_{CC} = 4.5 V to 5.5 V	2.0	-	-	V
V_{IL}	LOW-state input voltage	V_{CC} = 4.5 V to 5.5 V	-	-	0.8	V
V_{OH}	HIGH-state output voltage	$V_I = V_{IH}$ or V_{IL}; V_{CC} = 4.5 V				
		I_O = –20 μA	4.4	-	-	V
		I_O = –4.0 mA	3.7	-	-	V

Table 9. Static characteristics 74HCT2G00 *...continued*

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{OL}	LOW-state output voltage	$V_I = V_{IH}$ or V_{IL}; V_{CC} = 4.5 V				
		I_O = 20 µA	-	-	0.1	V
		I_O = 4.0 mA	-	-	0.4	V
I_{LI}	input leakage current	$V_I = V_{CC}$ or GND; V_{CC} = 5.5 V	-	-	±1.0	µA
I_{CC}	quiescent supply current	per input pin; $V_I = V_{CC}$ or GND; I_O = 0 A; V_{CC} = 5.5 V	-	-	20	µA
ΔI_{CC}	additional quiescent supply current	$V_I = V_{CC}$ − 2.1 V; I_O = 0 A; V_{CC} = 4.5 V to 5.5 V	-	-	410	µA

[1] Typical values are measured at T_{amb} = 25 °C.

12. Dynamic characteristics

Table 10. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V); for test circuit see Figure 6.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
74HC2G00							
T_{amb} = −40 °C to +85 °C[1]							
t_{PHL}, t_{PLH}	propagation delay nA, nB to nY	see Figure 5					
		V_{CC} = 2.0 V		-	25	95	ns
		V_{CC} = 4.5 V		-	9	19	ns
		V_{CC} = 6.0 V		-	7	16	ns
t_{THL}, t_{TLH}	output transition time	see Figure 5					
		V_{CC} = 2.0 V		-	18	95	ns
		V_{CC} = 4.5 V		-	6	19	ns
		V_{CC} = 6.0 V		-	5	16	ns
C_{PD}	power dissipation capacitance	per buffer; V_I = GND to V_{CC}	[2]	-	10	-	pF
T_{amb} = −40 °C to +125 °C							
t_{PHL}, t_{PLH}	propagation delay nA, nB to nY	see Figure 5					
		V_{CC} = 2.0 V		-	-	110	ns
		V_{CC} = 4.5 V		-	-	22	ns
		V_{CC} = 6.0 V		-	-	20	ns
t_{THL}, t_{TLH}	output transition time	see Figure 5					
		V_{CC} = 2.0 V		-	-	125	ns
		V_{CC} = 4.5 V		-	-	25	ns
		V_{CC} = 6.0 V		-	-	20	ns
74HCT2G00							
T_{amb} = −40 °C to +85 °C[1]							
t_{PHL}, t_{PLH}	propagation delay nA, nB to nY	V_{CC} = 4.5 V; see Figure 5		-	12	24	ns
t_{THL}, t_{TLH}	output transition time	V_{CC} = 4.5 V; see Figure 5		-	6	19	ns

Table 10. Dynamic characteristics *…continued*

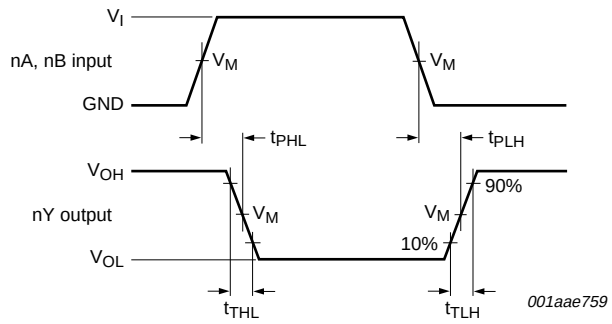
Voltages are referenced to GND (ground = 0 V); for test circuit see Figure 6.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
C_{PD}	power dissipation capacitance	per buffer; V_I = GND to (V_{CC} – 1.5 V)	[2]	-	10	-	pF
T_{amb} = –40 °C to +125 °C							
t_{PHL}, t_{PLH}	propagation delay nA, nB to nY	V_{CC} = 4.5 V; see Figure 5		-	-	29	ns
t_{THL}, t_{TLH}	output transition time	V_{CC} = 4.5 V; see Figure 5		-	-	22	ns

[1] Typical values are measured at T_{amb} = 25 °C.

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

13. Waveforms



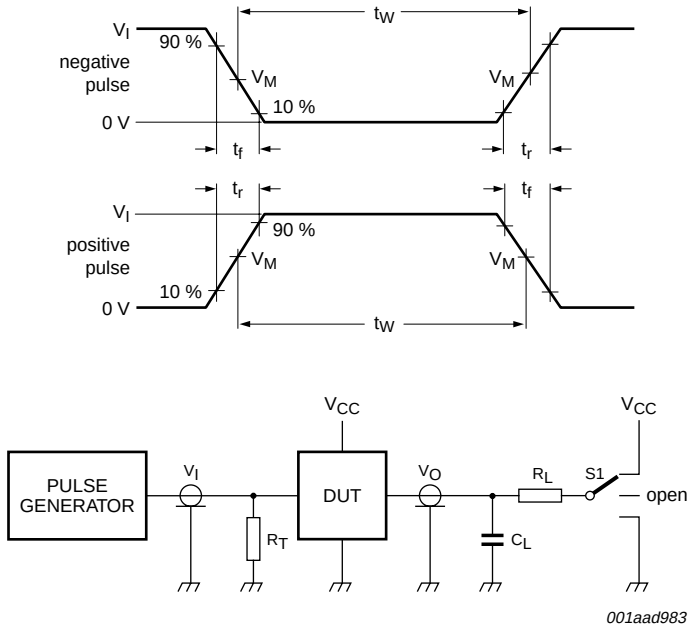
Measurement points are given in Table 11.

Logic levels: V_{OL} and V_{OH} are typical output voltage drop that occur with the output load.

Fig 5. Propagation delay data input (nA, nB) to data output (nY) and transition time output (nY)

Table 11. Measurement points

Type	Input	Output
	V_M	V_M
74HC2G00	0.5 × V_{CC}	0.5 × V_{CC}
74HCT2G00	1.3 V	1.3 V



Test data is given in Table 12.

Definitions for test circuit:

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

C_L = Load capacitance including jig and probe capacitance

R_L = Load resistor

S1 = Test selection switch

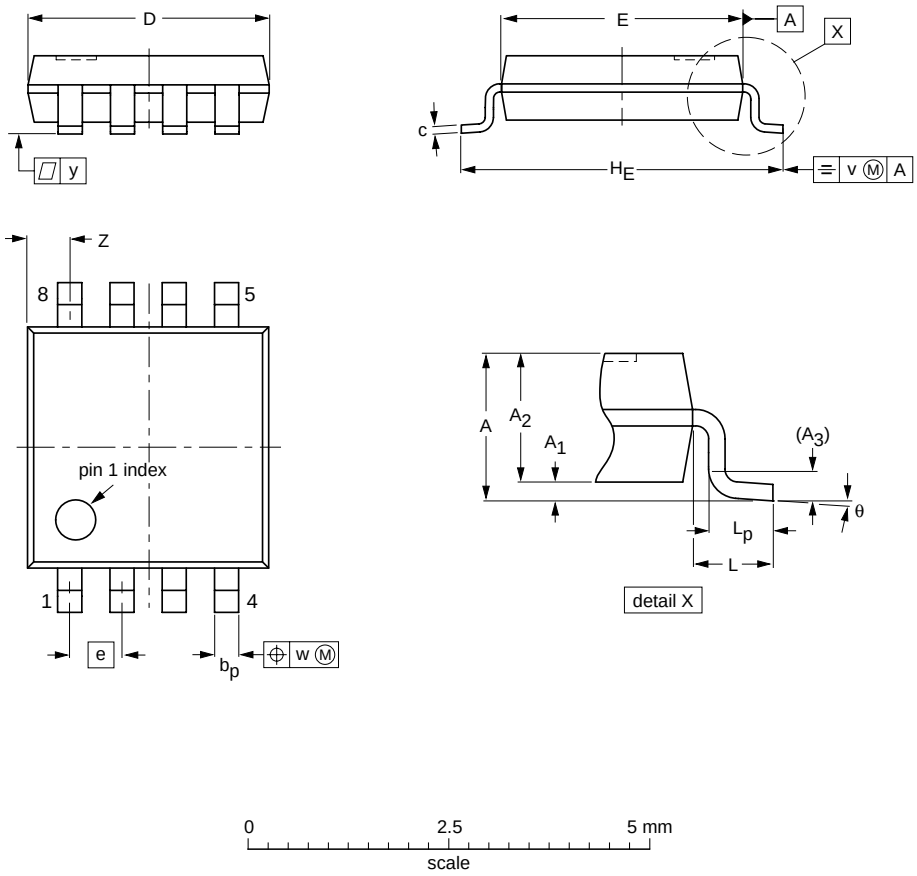
Fig 6. Load circuitry for measuring switching times

Table 12. Test data

Type	Input		Load		S1 position		
	V_I	t_r, t_f	C_L	R_L	t_{PHL}, t_{PLH}	t_{PZH}, t_{PHZ}	t_{PZL}, t_{PLZ}
74HC2G00	V_{CC}	≤ 6 ns	50 pF	1 kΩ	open	GND	V_{CC}
74HCT2G00	3 V	≤ 6 ns	50 pF	1 kΩ	open	GND	V_{CC}

14. Package outline

TSSOP8: plastic thin shrink small outline package; 8 leads; body width 3 mm; lead length 0.5 mm SOT505-2



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	v	w	y	$Z^{(1)}$	θ
mm	1.1	0.15 0.00	0.95 0.75	0.25	0.38 0.22	0.18 0.08	3.1 2.9	3.1 2.9	0.65	4.1 3.9	0.5	0.47 0.33	0.2	0.13	0.1	0.70 0.35	8° 0°

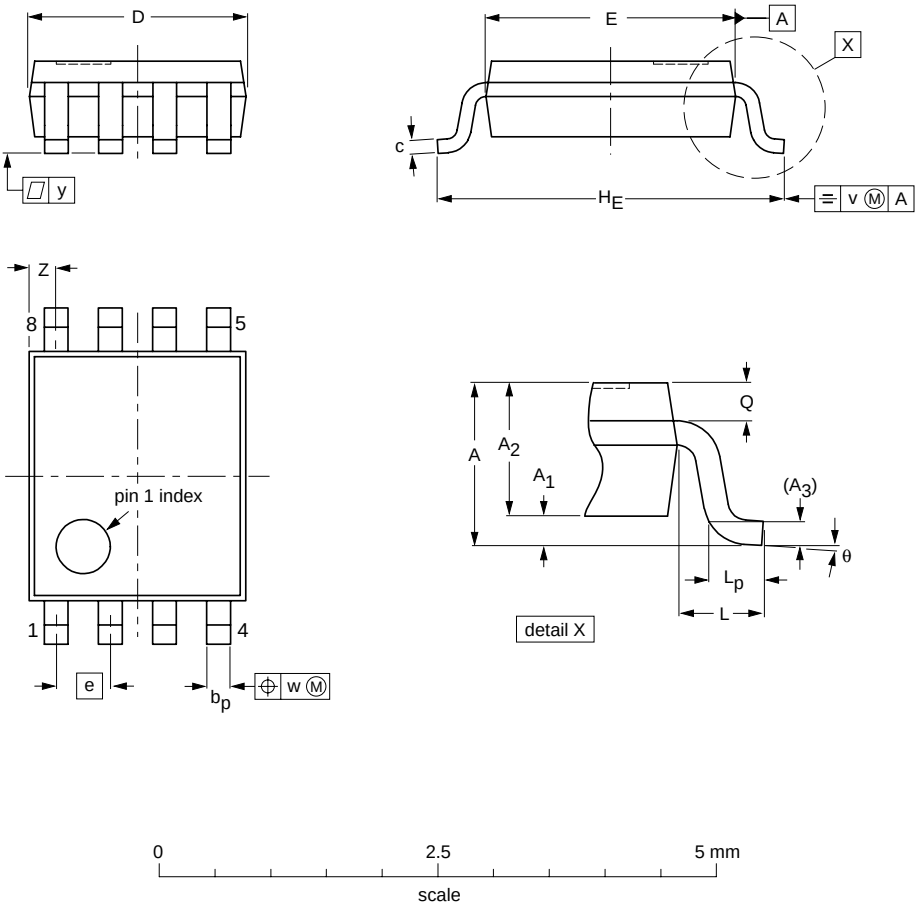
Note

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			
SOT505-2		- - -				02-01-16

Fig 7. Package outline SOT505-2 (TSSOP8)

VSSOP8: plastic very thin shrink small outline package; 8 leads; body width 2.3 mm **SOT765-1**



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(2)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	1	0.15 0.00	0.85 0.60	0.12	0.27 0.17	0.23 0.08	2.1 1.9	2.4 2.2	0.5	3.2 3.0	0.4	0.40 0.15	0.21 0.19	0.2	0.13	0.1	0.4 0.1	8° 0°

Notes

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT765-1		MO-187				02-06-07

Fig 8. Package outline SOT765-1 (VSSOP8)

15. Abbreviations

Table 13. Abbreviations

Acronym	Description
CMOS	Complementary Metal Oxide Semiconductor
ESD	ElectroStatic Discharge
HBM	Human Body Model
MM	Machine Model

16. Revision history

Table 14. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74HC_HCT2G00_3	20060405	Product data sheet	-	74HC_HCT2G00_2
Modifications:	• The format of this data sheet has been redesigned to comply with the new presentation and information standard of Philips Semiconductors. • Changed the Marking code: see Table 3.			
74HC_HCT2G00_2 (9397 750 10563)	20030212	Product specification	-	74HC_HCT2G00_1
74HC_HCT2G00_1 (9397 750 09974)	20020710	Product specification	-	-

17. Legal information

17.1 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 URL http://www.semiconductors.philips.com.

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Date of release: 5 April 2006

Document identifier: 74HC_HCT2G00_3