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Team Nexperia

74HC03-Q100; 74HCT03-Q100

Quad 2-input NAND gate

Rev. 1 — 4 July 2013

Product data sheet

1. General description

The 74HC03-Q100; 74HCT03-Q100 is a quad 2-input NAND gate with open-drain outputs. Inputs include clamp diodes that enable the use of current limiting resistors to interface inputs to voltages in excess of $V_{\rm CC}$.

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
- Input levels:
 - ◆ For 74HC03-Q100: CMOS level
 - ◆ For 74HCT03-Q100: TTL level
- ESD protection:
 - ◆ MIL-STD-883, method 3015 exceeds 2000 V
 - ◆ HBM JESD22-A114F exceeds 2000 V
 - ♦ MM JESD22-A115-A exceeds 200 V (C = 200 pF, R = 0 Ω)
- Multiple package options

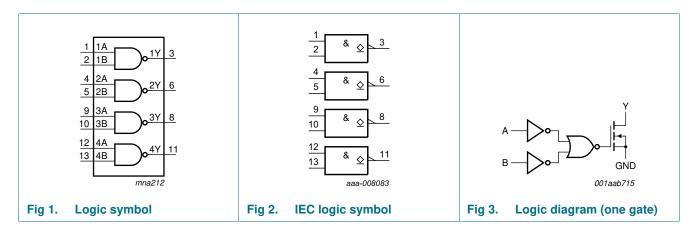
3. Ordering information

Table 1. Ordering information

Type number	Package								
	Temperature range	Name	Description	Version					
74HC03D-Q100	–40 °C to +125 °C	SO14	plastic small outline package; 14 leads; body width	SOT108-1					
74HCT03D-Q100			3.9 mm						
74HC03DB-Q100	–40 °C to +125 °C	SSOP14	plastic shrink small outline package; 14 leads; body	SOT337-1					
74HCT03DB-Q100			width 5.3 mm						
74HC03PW-Q100	–40 °C to +125 °C	TSSOP14		SOT402-1					
74HCT03PW-Q100			body width 4.4 mm						

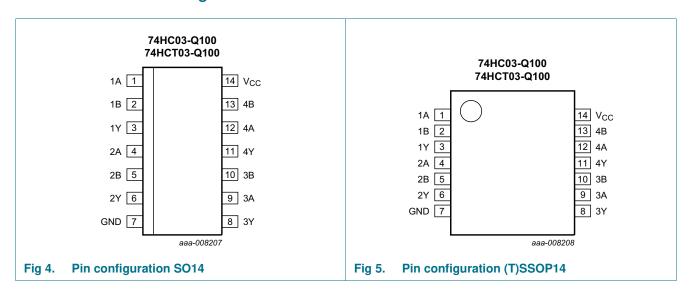


4. Functional diagram



5. Pinning information

5.1 Pinning



5.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
1A to 4A	1, 4, 9, 12	data input
1B to 4B	2, 5, 10, 13	data input
1Y to 4Y	3, 6, 8, 11	data output
GND	7	ground (0 V)
V _{CC}	14	supply voltage

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Functional description

Table 3. Function table[1]

Input		Output
nA	nB	nY
L	L	Z
L	Н	Z
Н	L	Z
Н	Н	L

^[1] H = HIGH voltage level; L = LOW voltage level; Z = high-impedance OFF-state.

Limiting values

Table 4. **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	V
V _O	output voltage		<u>[1]</u> –0.5	+7	V
I _{IK}	input clamping current	$V_I < -0.5 \text{ V or } V_I > V_{CC} + 0.5 \text{ V}$	[1] -	±20	mA
I _{OK}	output clamping current	$V_{O} < -0.5 \text{ V}$	[1] -	-20	mA
Io	output current	$-0.5 \text{ V} < \text{V}_{\text{O}}$	-	-25	mA
I _{CC}	supply current		-	50	mA
I_{GND}	ground current		-50	-	mA
T _{stg}	storage temperature		-65	+150	°C
P _{tot}	total power dissipation		[2]		
	SO14 and (T)SSOP14 packages		-	500	mW

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

Recommended operating conditions 8.

Table 5. **Recommended operating conditions**

Voltages are referenced to GND (ground = 0 V)

74HC HCT03 Q100

Symbol	Parameter	Conditions	74	74HC03-Q100			74HCT03-Q100		
			Min	Тур	Max	Min	Тур	Max	
V_{CC}	supply voltage		2.0	5.0	6.0	4.5	5.0	5.5	V
V_{I}	input voltage		0	-	V_{CC}	0	-	V_{CC}	V
Vo	output voltage		0	-	V_{CC}	0	-	V_{CC}	V
T _{amb}	ambient temperature		-40	+25	+125	-40	+25	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC} = 2.0 \text{ V}$	-	-	625	-	-	-	ns/V
		$V_{CC} = 4.5 \text{ V}$	-	1.67	139	-	1.67	139	ns/V
		$V_{CC} = 6.0 \text{ V}$	-	-	83	-	-	-	ns/V

For SO14 package: Ptot derates linearly with 8 mW/K above 70 °C. For (T)SSOP14 packages: Ptot derates linearly with 5.5 mW/K above 60 °C.

9. Static characteristics

Table 6. Static characteristics

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

Symbol	Parameter	Conditions		25 °C		–40 °C t	o +85 °C	-40 °C to	o +125 °C	Unit	
			Min	Тур	Max	Min	Max	Min	Max		
74HC03	-Q100		'			1		1	'		
V _{IH}	HIGH-level	$V_{CC} = 2.0 \text{ V}$	1.5	1.2	-	1.5	-	1.5	-	٧	
	input voltage	$V_{CC} = 4.5 \text{ V}$	3.15	2.4	-	3.15	-	3.15	-	٧	
		$V_{CC} = 6.0 \text{ V}$	4.2	3.2	-	4.2	-	4.2	-	٧	
V_{IL}	LOW-level	$V_{CC} = 2.0 \text{ V}$	-	8.0	0.5	-	0.5	-	0.5	٧	
	input voltage	$V_{CC} = 4.5 \text{ V}$	-	2.1	1.35	-	1.35	-	1.35	٧	
		$V_{CC} = 6.0 \text{ V}$	-	2.8	1.8	-	1.8	-	1.8	٧	
V_{OL}	LOW-level	$V_I = V_{IH}$ or V_{IL}									
	output voltage	$I_O = 20 \mu A; V_{CC} = 2.0 V$	-	0	0.1	-	0.1	-	0.1	٧	
		$I_O = 20 \mu A; V_{CC} = 4.5 V$	-	0	0.1	-	0.1	-	0.1	٧	
		$I_O = 20 \mu A; V_{CC} = 6.0 V$	-	0	0.1	-	0.1	-	0.1	٧	
		$I_O = 4.0 \text{ mA}; V_{CC} = 4.5 \text{ V}$	-	0.15	0.26	-	0.33	-	0.4	٧	
		$I_O = 5.2 \text{ mA}; V_{CC} = 6.0 \text{ V}$	-	0.16	0.26	-	0.33	-	0.4	٧	
l _I	input leakage current	$V_I = V_{CC}$ or GND; $V_{CC} = 6.0 \text{ V}$	-	0.1	-	-	±1	-	±1	μА	
loz	OFF-state output current	per input pin; $V_l = V_{lL}$; $V_O = V_{CC}$ or GND; other inputs at V_{CC} or GND; $V_{CC} = 6.0 \text{ V}$; $I_O = 0 \text{ A}$	-	-	±0.5	-	±5.0	-	±10	μΑ	
I _{CC}	supply current	$V_I = V_{CC}$ or GND; $I_O = 0$ A; $V_{CC} = 6.0$ V	-	2.0	-	-	20	-	40	μΑ	
Cı	input capacitance		-	3.5	-	-	-	-	-	pF	
74HCT0	3-Q100										
V_{IH}	HIGH-level input voltage	$V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$	2.0	1.6	-	2.0	-	2.0	-	V	
V _{IL}	LOW-level input voltage	$V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$	-	1.2	8.0	-	0.8	-	0.8	V	
V _{OL}	LOW-level	$V_I = V_{IH}$ or V_{IL} ; $V_{CC} = 4.5 \text{ V}$									
	output voltage	I _O = 20 μA	-	0	0.1	-	0.1	-	0.1	٧	
		I _O = 4.0 mA	-	0.15	0.26	-	0.33	-	0.4	٧	
I	input leakage current	$V_I = V_{CC}$ or GND; $V_{CC} = 5.5 \text{ V}$	-	-	±0.1	-	±1	-	±1	μА	
loz	OFF-state output current	per input pin; $V_I = V_{IL}$; $V_O = V_{CC}$ or GND; other inputs at V_{CC} or GND; $V_{CC} = 5.5 \text{ V}$; $I_O = 0 \text{ A}$	-	-	±0.5	-	±5.0	-	±10	μΑ	

 Table 6.
 Static characteristics ...continued

At recommended operating conditions; 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	Тур	Max	Min	Max	Min	Max	
I _{CC}	supply current	$V_I = V_{CC}$ or GND; $I_O = 0$ A; $V_{CC} = 5.5$ V	-	-	2.0	-	20	-	40	μΑ
Δl _{CC}	additional supply current	per input pin; $\begin{split} &V_I = V_{CC} - 2.1 \text{ V; } I_O = 0 \text{ A;} \\ &\text{other inputs at } V_{CC} \text{ or GND;} \\ &V_{CC} = 4.5 \text{ V to } 5.5 \text{ V} \end{split}$	-	100	360	-	450	-	490	μА
Cı	input capacitance		-	3.5	-	-	-	-	-	pF

10. Dynamic characteristics

Table 7. Dynamic characteristics

 $GND = 0 \ V; \ C_L = 50 \ pF;$ for load circuit, see <u>Figure 7</u>.

Symbol	Parameter	Conditions			25 °C		-40 °C to +125 °C		Unit
			Ī	Min	Тур	Max	Max (85 °C)	Max (125 °C)	
74HC03-	Q100								
t _{pd}	propagation delay	nA, nB to nY; see Figure 6	<u>[1]</u>						
		$V_{CC} = 2.0 \text{ V}$		-	28	95	120	145	ns
		V _{CC} = 4.5 V		-	10	19	24	29	ns
		$V_{CC} = 5.0 \text{ V}; C_L = 15 \text{ pF}$		-	8	-	-	-	ns
		V _{CC} = 6.0 V		-	8	16	20	25	ns
t _t	transition time	see Figure 6	[2]						
		V _{CC} = 2.0 V		-	19	75	95	110	ns
		V _{CC} = 4.5 V		-	7	15	19	22	ns
		$V_{CC} = 6.0 \text{ V}$		-	6	13	16	19	ns
C_{PD}	power dissipation capacitance	per package; $V_I = GND$ to V_{CC}	[3]	-	4	-	-	-	pF

Table 7. Dynamic characteristics ...continued $GND = 0 \ V; \ C_L = 50 \ pF; \ for load circuit, see Figure 7.$

Symbol	Parameter	Conditions		25 °C			-40 °C to	-40 °C to +125 °C		
				Min	Тур	Max	Max (85 °C)	Max (125 °C)		
74HCT03	3-Q100		,			•	'	'		
t _{pd} pr	propagation delay	nA, nB to nY; see Figure 6	<u>[1]</u>							
		$V_{CC} = 4.5 \text{ V}$		-	12	24	30	36	ns	
		$V_{CC} = 5.0 \text{ V}; C_L = 15 \text{ pF}$		-	10	-	-	-	ns	
t _t	transition time	V _{CC} = 4.5 V; see Figure 6	[2]	-	7	15	19	22	ns	
C_{PD}	power dissipation capacitance	per package; $V_I = \text{GND to V}_{CC} - 1.5 \text{ V}$	[3]	-	4	-	-	-	pF	

- [1] t_{pd} is the same as t_{PLZ} and t_{PZL} .
- [2] t_t is the same as t_{THL} .
- [3] C_{PD} is used to determine the dynamic power dissipation (P_D in μW):

 $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \sum (C_L \times V_{CC}^2 \times f_o)$ where:

f_i = input frequency in MHz;

f_o = output frequency in MHz;

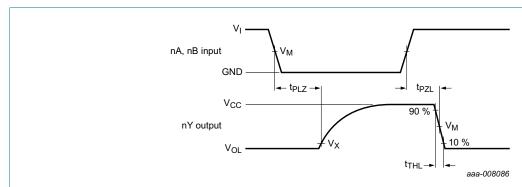
C_L = output load capacitance in pF;

V_{CC} = supply voltage in V;

N = number of inputs switching;

 $\sum (C_L \times V_{CC}^2 \times f_o) = \text{sum of outputs.}$

11. Waveforms



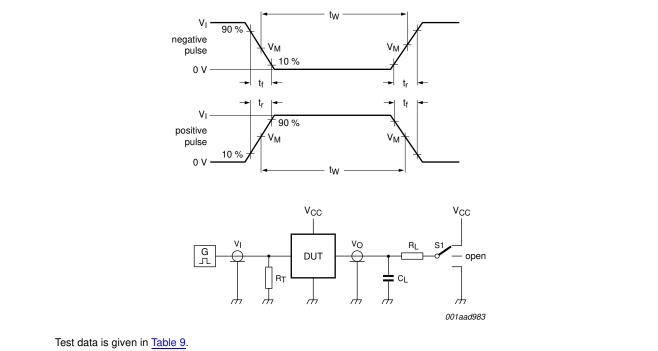
Measurement points are given in Table 8.

 $\ensuremath{V_{\text{OL}}}$ and $\ensuremath{V_{\text{OH}}}$ are typical voltage output levels that occur with the output load.

Fig 6. Input to output propagation delays

Table 8. Measurement points

Туре	Input	Output				
	V _M	V _M	V _X			
74HC03-Q100	0.5V _{CC}	0.5V _{CC}	0.1V _{CC}			
74HCT03-Q100	1.3 V	1.3 V	0.1V _{CC}			



Definitions test circuit:

 R_T = termination resistance should be equal to output impedance Z_0 of the pulse generator.

 C_L = load capacitance including jig and probe capacitance.

Test circuit for measuring switching times Fig 7.

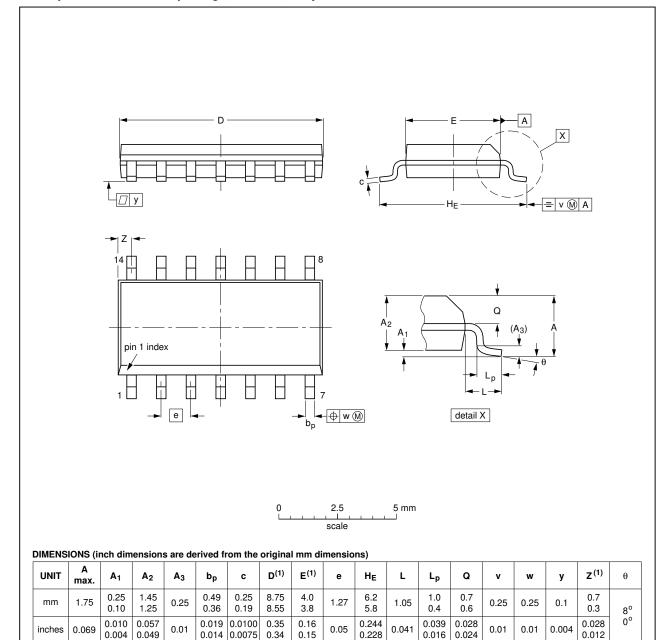
Table 9. **Test data**

Туре	Input L		Load	Load		
	VI	t _r , t _f	CL	R _L	t _{PZL} , t _{PLZ}	
74HC03-Q100	V _{CC}	6 ns	15 pF, 50 pF	1 kΩ	V _{CC}	
74HCT03-Q100	3.0 V	6 ns	15 pF, 50 pF	1 kΩ	V _{CC}	

12. Package outline

SO14: plastic small outline package; 14 leads; body width 3.9 mm

SOT108-1



Note

1. Plastic or metal protrusions of 0.15 mm (0.006 inch) maximum per side are not included.

OUTLINE		REFER	EUROPEAN	ISSUE DATE		
VERSION	IEC	JEDEC	JEITA	PROJECTION	ISSUE DATE	
SOT108-1	076E06	MS-012			99-12-27 03-02-19	

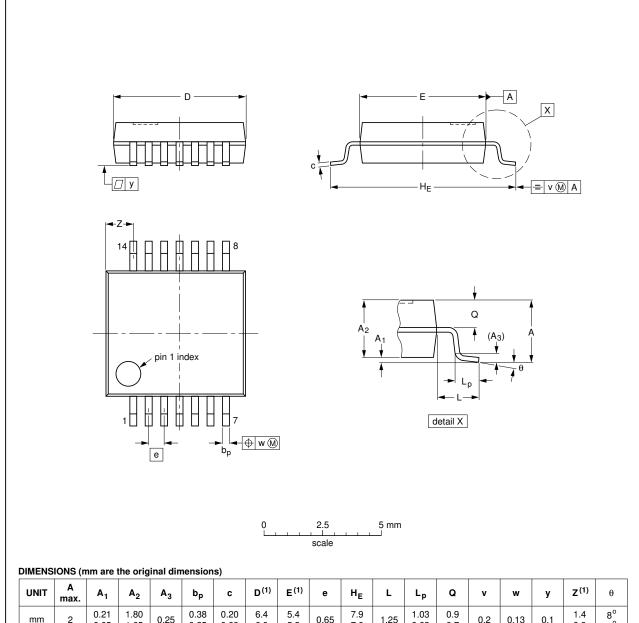
Fig 8. Package outline SOT108-1 (SO14)

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SSOP14: plastic shrink small outline package; 14 leads; body width 5.3 mm

SOT337-1



UNIT	A max.	A ₁	A ₂	A ₃	bp	С	D ⁽¹⁾	E ⁽¹⁾	е	HE	L	Lp	Q	v	w	у	Z ⁽¹⁾	θ
mm	2	0.21 0.05	1.80 1.65	0.25	0.38 0.25	0.20 0.09	6.4 6.0	5.4 5.2	0.65	7.9 7.6	1.25	1.03 0.63	0.9 0.7	0.2	0.13	0.1	1.4 0.9	8° 0°

Note

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

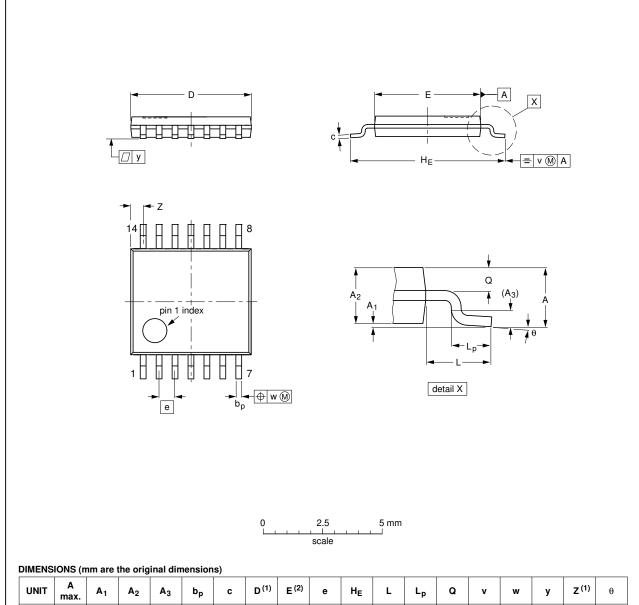
OUTLINE		REFER	EUROPEAN	ISSUE DATE		
VERSION	IEC	JEDEC	JEITA		PROJECTION	ISSUE DATE
SOT337-1		MO-150				99-12-27 03-02-19

Fig 9. Package outline SOT337-1 (SSOP14)

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TSSOP14: plastic thin shrink small outline package; 14 leads; body width 4.4 mm

SOT402-1



UNIT	A max.	A ₁	A ₂	A ₃	bp	С	D ⁽¹⁾	E ⁽²⁾	е	HE	L	Lp	Q	v	w	у	Z ⁽¹⁾	θ
mm	1.1	0.15 0.05	0.95 0.80	0.25	0.30 0.19	0.2 0.1	5.1 4.9	4.5 4.3	0.65	6.6 6.2	1	0.75 0.50	0.4 0.3	0.2	0.13	0.1	0.72 0.38	8° 0°

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- 2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

OUTLINE		REFER	EUROPEAN	ISSUE DATE		
VERSION	IEC	JEDEC	JEITA		PROJECTION	ISSUE DATE
SOT402-1		MO-153				99-12-27 03-02-18

Fig 10. Package outline SOT402-1 (TSSOP14)

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13. Abbreviations

Table 10. Abbreviations

Acronym	Description
CMOS	Complementary Metal-Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
НВМ	Human Body Model
LSTTL	Low-power Schottky Transistor-Transistor Logic
MM	Machine Model
TTL	Transistor-Transistor Logic

14. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74HC_HCT03_Q100 v.1	20130704	Product data sheet	-	-

11 of 14

15. Legal information

15.1 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.

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- [2] The term 'short data sheet' is explained in section "Definitions"
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74HC03-Q100; 74HCT03-Q100

Quad 2-input NAND gate

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