Quad 2-input NOR gate

Rev. 1 — 23 May 2013

**Product data sheet** 

### 1. General description

The 74AHC02-Q100; 74AHCT02-Q100 is a high-speed Si-gate CMOS device and is pin compatible with Low-power Schottky TTL (LSTTL). It is specified in compliance with JEDEC standard No. 7-A.

The 74AHC02-Q100; 74AHCT02-Q100 provides a quad 2-input NOR function.

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

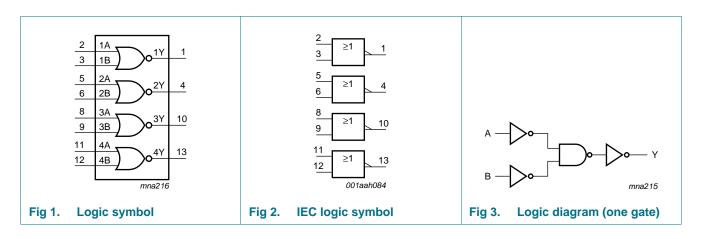
- Automotive product qualification in accordance with AEC-Q100 (Grade 1)
  - ◆ Specified from -40 °C to +85 °C and from -40 °C to +125 °C
- Balanced propagation delays
- All inputs have a Schmitt-trigger action
- Inputs accept voltages higher than V<sub>CC</sub>
- Input levels:
  - For 74AHC02-Q100: CMOS level
  - For 74AHCT02-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					
74AHC02-Q100									
74AHC02D-Q100	–40 °C to +125 °C	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1					
74AHC02PW-Q100	–40 °C to +125 °C	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	SOT402-1					
74AHC02BQ-Q100	–40 °C to +125 °C	DHVQFN14	plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 14 terminals; body $2.5 \times 3 \times 0.85$ mm	SOT762-1					
74AHCT02-Q100									
74AHCT02D-Q100	–40 °C to +125 °C	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1					
74AHCT02PW-Q100	–40 °C to +125 °C	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	SOT402-1					
74AHCT02BQ-Q100	–40 °C to +125 °C	DHVQFN14	plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 14 terminals; body 2.5 $\times$ 3 $\times$ 0.85 mm	SOT762-1					

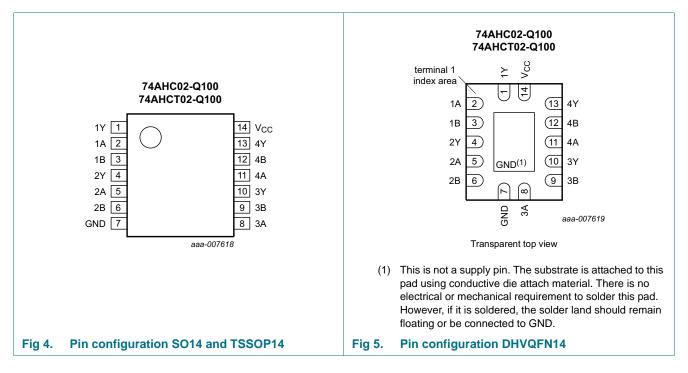
## 4. Functional diagram



Quad 2-input NOR gate

### 5. Pinning information

### 5.1 Pinning



### 5.2 Pin description

Table 2.	Pin description	
Symbol	Pin	Description
1Y	1	data output
1A	2	data input
1B	3	data input
2Y	4	data output
2A	5	data input
2B	6	data input
GND	7	ground (0 V)
3A	8	data input
3B	9	data input
3Y	10	data output
4A	11	data input
4B	12	data input
4Y	13	data output
V <sub>CC</sub>	14	supply voltage

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### 6. Functional description

	Table 3	. Fund	ction ta	ble <sup>[1]</sup>
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Input	Output	
nA	nB	nY
L	L	Н
X	Н	L
Н	Х	L

[1] H = HIGH voltage level;

L = LOW voltage level;

X = don't care.

## 7. 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 <sub>CC</sub>	supply voltage		-0.5	+7.0	V
VI	input voltage		-0.5	+7.0	V
I <sub>IK</sub>	input clamping current	V <sub>I</sub> < -0.5 V	<u>[1]</u> –20	-	mA
I <sub>OK</sub>	output clamping current	$V_{O}$ < -0.5 V or $V_{O}$ > $V_{CC}$ + 0.5 V	<u>[1]</u> –20	+20	mA
lo	output current	$V_{O} = -0.5 \text{ V} \text{ to } (V_{CC} + 0.5 \text{ V})$	-25	+25	mA
I <sub>CC</sub>	supply current		-	+75	mA
I <sub>GND</sub>	ground current		-75	-	mA
T <sub>stg</sub>	storage temperature		-65	+150	°C
P <sub>tot</sub>	total power dissipation	$T_{amb} = -40 \ ^{\circ}C \text{ to } +125 \ ^{\circ}C$	[2] _	500	mW

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

For SO14 packages: above 70 °C the value of P<sub>tot</sub> derates linearly at 8 mW/K.
 For TSSOP14 packages: above 60 °C the value of P<sub>tot</sub> derates linearly at 5.5 mW/K.
 For DHVQFN14 packages: above 60 °C the value of P<sub>tot</sub> derates linearly at 4.5 mW/K.

### 8. Recommended operating conditions

Table 5.	Operating conditions					
Symbol	Parameter	Conditions	Min	Тур	Max	Unit
74AHC02	2-Q100					
V <sub>CC</sub>	supply voltage		2.0	5.0	5.5	V
VI	input voltage		0	-	5.5	V
Vo	output voltage		0	-	V <sub>CC</sub>	V
T <sub>amb</sub>	ambient temperature		-40	+25	+125	°C
$\Delta t / \Delta V$	input transition rise and fall rate	$V_{CC}$ = 3.0 V to 3.6 V	-	-	100	ns/V
		$V_{CC}$ = 4.5 V to 5.5 V	-	-	20	ns/V

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Symbol	Parameter	Conditions	Min	Тур	Max	Unit
74AHCT	02-Q100					
V <sub>CC</sub>	supply voltage		4.5	5.0	5.5	V
VI	input voltage		0	-	5.5	V
Vo	output voltage		0	-	V <sub>CC</sub>	V
T <sub>amb</sub>	ambient temperature		-40	+25	+125	°C
$\Delta t / \Delta V$	input transition rise and fall rate	$V_{CC}$ = 4.5 V to 5.5 V	-	-	20	ns/V

## 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	to +85 °C	–40 °C t	o +125 °C	C Unit
			Min	Тур	Max	Min	Max	Min	Max	
74AHC0	2-Q100					1				
V <sub>IH</sub>	HIGH-level	V <sub>CC</sub> = 2.0 V	1.5	-	-	1.5	-	1.5	-	V
	input voltage	V <sub>CC</sub> = 3.0 V	2.1	-	-	2.1	-	2.1	-	V
		V <sub>CC</sub> = 5.5 V	3.85	-	-	3.85	-	3.85	-	V
V <sub>IL</sub>	LOW-level	V <sub>CC</sub> = 2.0 V	-	-	0.5	-	0.5	-	0.5	V
	input voltage	V <sub>CC</sub> = 3.0 V	-	-	0.9	-	0.9	-	0.9	V
		V <sub>CC</sub> = 5.5 V	-	-	1.65	-	1.65	-	1.65	V
V <sub>ОН</sub>	HIGH-level output voltage	$V_{I} = V_{IH} \text{ or } V_{IL}$								
		$I_{O}$ = -50 $\mu$ A; $V_{CC}$ = 2.0 V	1.9	2.0	-	1.9	-	1.9	-	V
		$I_{O} = -50 \ \mu\text{A}; \ V_{CC} = 3.0 \ \text{V}$	2.9	3.0	-	2.9	-	2.9	-	V
		$I_O = -50 \ \mu\text{A}; \ V_{CC} = 4.5 \ \text{V}$	4.4	4.5	-	4.4	-	4.4	-	V
		$I_{O} = -4.0 \text{ mA}; V_{CC} = 3.0 \text{ V}$	2.58	-	-	2.48	-	2.40	-	V
		$I_{O} = -8.0 \text{ mA}; V_{CC} = 4.5 \text{ V}$	3.94	-	-	3.80	-	3.70	-	V
V <sub>OL</sub>	LOW-level	$V_{I} = V_{IH} \text{ or } V_{IL}$								
	output voltage	$I_0 = 50 \ \mu A; \ V_{CC} = 2.0 \ V$	-	0	0.1	-	0.1	-	0.1	V
		$I_0 = 50 \ \mu A; \ V_{CC} = 3.0 \ V$	-	0	0.1	-	0.1	-	0.1	V
		$I_0 = 50 \ \mu A; \ V_{CC} = 4.5 \ V$	-	0	0.1	-	0.1	-	0.1	V
		$I_0 = 4.0 \text{ mA}; V_{CC} = 3.0 \text{ V}$	-	-	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	input leakage current	V <sub>I</sub> = 5.5 V or GND; V <sub>CC</sub> = 0 V to 5.5 V	-	-	0.1	-	1.0	-	2.0	μA
lcc	supply current		-	-	2.0	-	20	-	40	μA
CI	input capacitance		-	3	10	-	10	-	10	pF

capacitance

**Quad 2-input NOR gate** 

Symbol	Parameter	Conditions		25 °C		-40 °C	to +85 °C	–40 °C t	o +125 °C	Unit
			Min	Тур	Max	Min	Max	Min	Max	
74AHCT	02-Q100					1				
V <sub>IH</sub>	HIGH-level input voltage	$V_{CC}$ = 4.5 V to 5.5 V	2.0	-	-	2.0	-	2.0	-	V
V <sub>IL</sub>	LOW-level input voltage	$V_{CC}$ = 4.5 V to 5.5 V	-	-	0.8	-	0.8	-	0.8	V
V <sub>OH</sub>	HIGH-level output voltage	$V_{I}$ = $V_{IH}$ or $V_{IL};V_{CC}$ = 4.5 V								
		I <sub>O</sub> = -50 μA	4.4	4.5	-	4.4	-	4.4	-	V
		I <sub>O</sub> = -8.0 mA	3.94	-	-	3.80	-	3.70	-	V
V <sub>OL</sub>	LOW-level	$V_{I} = V_{IH} \text{ or } V_{IL}; V_{CC} = 4.5 \text{ V}$								
	output voltage	I <sub>O</sub> = 50 μA	-	0	0.1	-	0.1	-	0.1	V
		l <sub>O</sub> = 8.0 mA	-	-	0.36	-	0.44	-	0.55	V
lı	input leakage current	$V_I = 5.5 V \text{ or GND};$ $V_{CC} = 0 V \text{ to } 5.5 V$	-	-	0.1	-	1.0	-	2.0	μΑ
I <sub>CC</sub>	supply current		-	-	2.0	-	20	-	40	μΑ
∆l <sub>CC</sub>	additional supply current	per input pin; $V_I = V_{CC} - 2.1 \text{ V};$ other pins at $V_{CC}$ or GND; $I_O = 0 \text{ A}; V_{CC} = 4.5 \text{ V}$ to 5.5 V	-	-	1.35	-	1.5	-	1.5	mA
CI	input capacitance		-	3	10	-	10	-	10	рF

#### Static characteristics ... continued Table 6.

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

# **10. Dynamic characteristics**

#### Table 7. **Dynamic characteristics**

Voltages are referenced to GND (ground = 0 V); for test circuit see Figure 7.

Symbol	Parameter	Conditions			25 °C		-40 °C	to +85 °C	–40 °C t	o +125 °C	Unit
			_	Min	Typ <mark>[1]</mark>	Max	Min	Max	Min	Max	
74AHC0	2-Q100										
I	propagation	nA, nB to nY; see Figure 6	[2]								
	delay	$V_{CC} = 3.0 \text{ V} \text{ to } 3.6 \text{ V}$									
		C <sub>L</sub> = 15 pF		-	3.9	7.9	1.0	9.5	1.0	10.0	ns
		C <sub>L</sub> = 50 pF		-	5.5	11.4	1.0	13	1.0	14.5	ns
		$V_{CC}$ = 4.5 V to 5.5 V									
		C <sub>L</sub> = 15 pF		-	2.9	5.5	1.0	6.5	1.0	7.0	ns
		C <sub>L</sub> = 50 pF			4.2	7.5	1.0	8.5	1.0	9.5	ns
C <sub>PD</sub>	power dissipation capacitance	$\label{eq:CL} \begin{split} &C_L = 50 \text{ pF};  \text{f}_i = 1 \text{ MHz}; \\ &V_I = \text{GND to } V_{\text{CC}} \end{split}$	<u>[3]</u>	-	7.0	-	-	-	-	-	pF

capacitance

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Voltages	Voltages are referenced to GND (ground = 0 V); for test circuit see <u>Figure 7</u> .										
Symbol	Parameter	Conditions		25 °C		C _40 °C to +85 °C		–40 °C to +125 °C		Unit	
			Min	Typ[1]	Max	Min	Max	Min	Max		
74AHCT02-Q100; V <sub>CC</sub> = 4.5 V to 5.5 V											
P۵	propagation	nA, nB to nY; see Figure 6	1								
	delay	C <sub>L</sub> = 15 pF	-	3.8	5.5	1.0	6.5	1.0	7.0	ns	
		C <sub>L</sub> = 50 pF	-	5.1	7.5	1.0	8.5	1.0	9.5	ns	
C <sub>PD</sub>	power dissipation capacitance	$C_L = 50 \text{ pF}; f_i = 1 \text{ MHz};$ $V_I = \text{GND to } V_{CC}$	<u> </u> _	8.0	-	-	-	-	-	pF	

#### Table 7. Dynamic characteristics ...continued

[1] Typical values are measured at nominal supply voltage (V<sub>CC</sub> = 3.3 V and V<sub>CC</sub> = 5.0 V).

#### [2] $t_{pd}$ is the same as $t_{PLH}$ and $t_{PHL}$ .

[3]  $C_{PD}$  is used to determine the dynamic power dissipation (P<sub>D</sub> in  $\mu$ W).

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

 $f_i$  = input frequency in MHz;

 $f_o =$  output frequency in MHz;

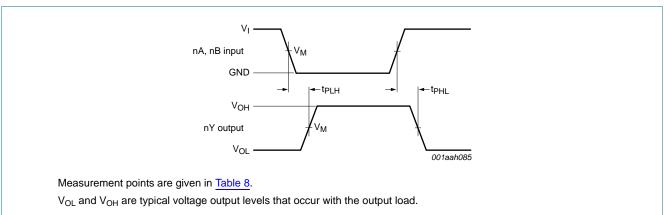
 $C_L$  = output load capacitance in pF;

 $V_{CC}$  = supply voltage in V;

N = number of inputs switching;

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

### 11. Waveforms



#### Fig 6. Input to output propagation delays

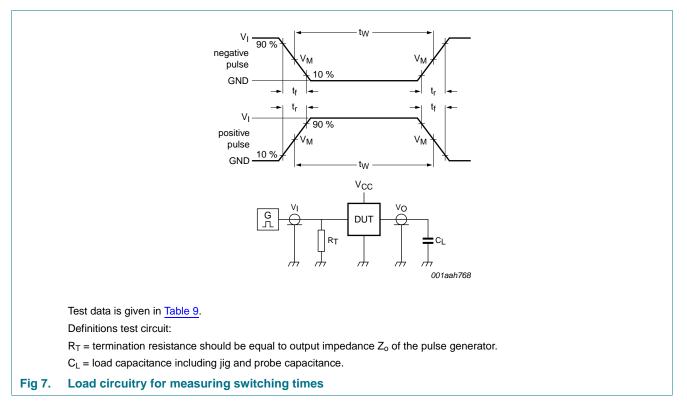
#### Table 8. Measurement points

Туре	Input	Output
	V <sub>M</sub>	V <sub>M</sub>
74AHC02-Q100	$0.5\times V_{CC}$	$0.5 \times V_{CC}$
74AHCT02-Q100	1.5 V	$0.5 \times V_{CC}$

### **NXP Semiconductors**

# 74AHC02-Q100; 74AHCT02-Q100

#### Quad 2-input NOR gate

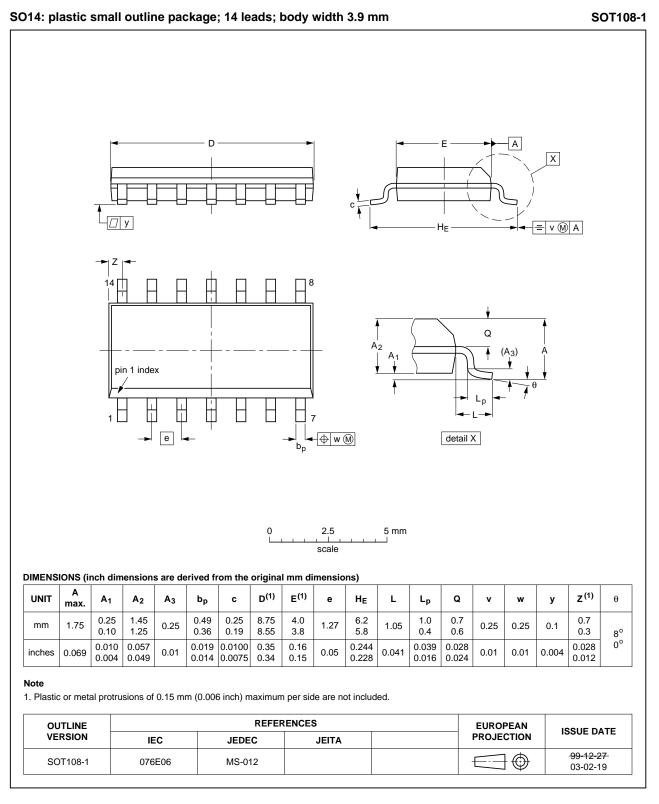


#### Table 9. Test data

Туре	Input		Load	Test
	VI	t <sub>r</sub> , t <sub>f</sub>	CL	
74AHC02-Q100	V <sub>CC</sub>	≤ 3.0 ns	15 pF, 50 pF	t <sub>PLH</sub> , t <sub>PHL</sub>
74AHCT02-Q100	3.0 V	≤ 3.0 ns	15 pF, 50 pF	t <sub>PLH</sub> , t <sub>PHL</sub>

**Quad 2-input NOR gate** 

### 12. Package outline



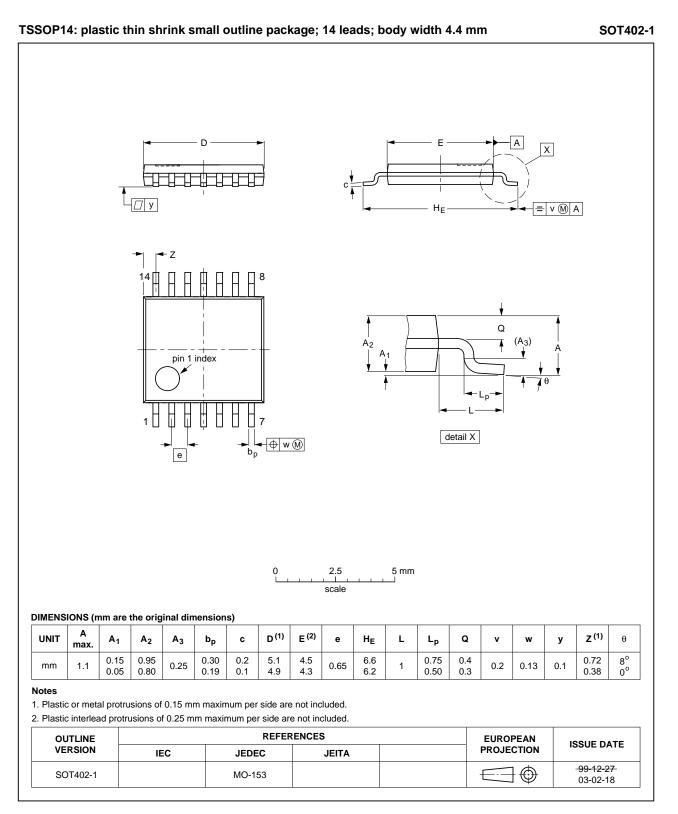
#### Fig 8. Package outline SOT108-1 (SO14)

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74AHC\_AHCT02\_Q100

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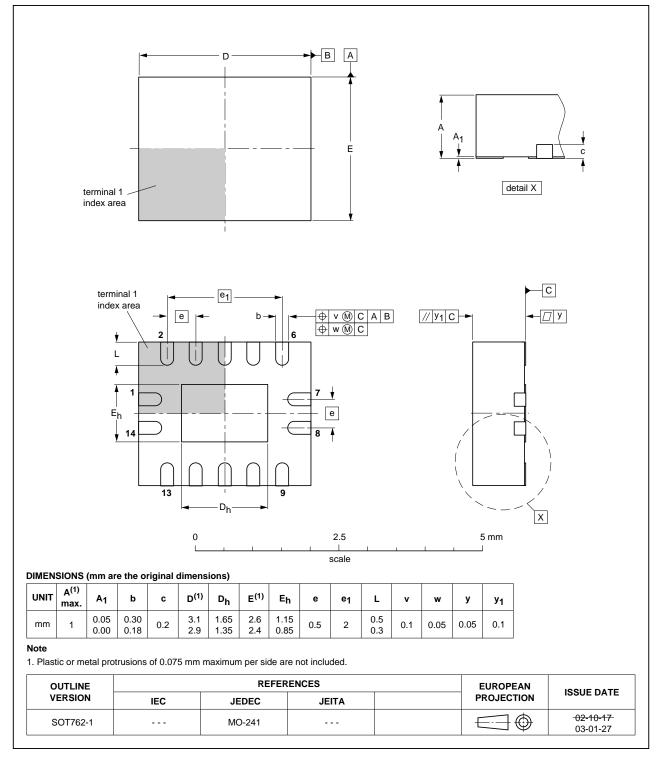
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#### Fig 9.Package outline SOT402-1 (TSSOP14)

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DHVQFN14: plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 14 terminals; body 2.5 x 3 x 0.85 mm SOT762-1

#### Fig 10. Package outline SOT762-1 (DHVQFN14)

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Quad 2-input NOR gate

# **13. Abbreviations**

Table 10. Abbreviations		
Acronym	Description	
CDM	Charge Device Model	
CMOS	Complementary Metal-Oxide Semiconductor	
DUT	Device Under Test	
ESD	ElectroStatic Discharge	
HBM	Human Body Model	
LSTTL	Low-power Schottky Transistor-Transistor Logic	
MIL	Military	
MM	Machine Model	
TTL	Transistor-Transistor Logic	

## 14. Revision history

#### Table 11.Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74AHC_AHCT02_Q100 v.1	20130523	Product data sheet	-	-

### 15. Legal information

#### 15.1 Data sheet status

Document status[1][2]	Product status <sup>[3]</sup>	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
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