# 74HC2G02-Q100; 74HCT2G02-Q100

**Dual 2-input NOR gate** 

Rev. 2 — 26 July 2018

**Product data sheet** 

## 1. General description

The 74HC2G02-Q100; 74HCT2G02-Q100 is a dual 2-input NOR gate. Inputs include clamp diodes. This enables 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
- Wide supply voltage range from 2.0 V to 6.0 V
- Input levels:
  - For 74HC2G02-Q100: CMOS level
  - For 74HCT2G02-Q100: TTL level
- · Symmetrical output impedance
- · High noise immunity
- Complies with JEDEC standard no. 7A (4.5 V to 5.5 V)
- Low power dissipation
- · Balanced propagation delays
- Multiple package options
- 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  $\Omega$ )

# 3. Ordering information

**Table 1. Ordering information** 

able 1. Grading information							
Type number	Package	ckage					
	Temperature range	Name	Description	Version			
74HC2G02DP-Q100	-40 °C to +125 °C	TSSOP8	plastic thin shrink small outline package;	SOT505-2			
74HCT2G02DP-Q100	-		8 leads; body width 3 mm; lead length 0.5 mm				
74HC2G02DC-Q100	-40 °C to +125 °C	VSSOP8	plastic very thin shrink small outline package;	SOT765-1			
74HCT2G02DC-Q100	-		8 leads; body width 2.3 mm				



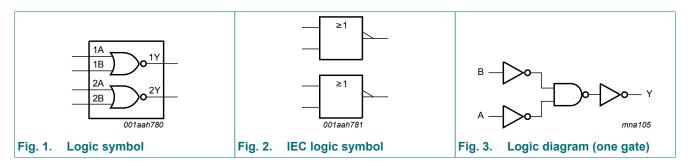
# 4. Marking

## Table 2. Marking code

Type number	Marking code [1]
74HC2G02DP-Q100	H02
74HCT2G02DP-Q100	T02
74HC2G02DC-Q100	H02
74HCT2G02DC-Q100	T02

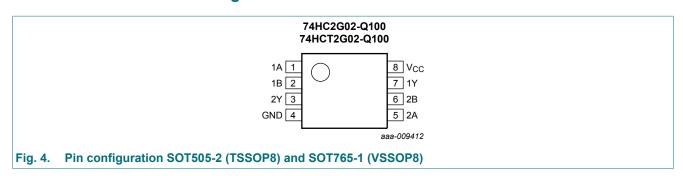
<sup>[1]</sup> The pin 1 indicator is located on the lower left corner of the device, below the marking code.

# 5. Functional diagram



# 6. Pinning information

# 6.1. Pinning



## 6.2. Pin description

Table 3. Pin description

Symbol	Pin	Description
1A, 2A	1, 5	data input
1B, 2B	2, 6	data input
GND	4	ground (0 V)
1Y, 2Y	7, 3	data output
V <sub>CC</sub>	8	supply voltage

# 7. Functional description

#### **Table 4. Function table**

 $H = HIGH \ voltage \ level; \ L = LOW \ voltage \ level.$ 

Input	Output	
nA	nB	nY
L	L	Н
L	Н	L
Н	L	L
Н	Н	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 <sub>IK</sub>	input clamping current	$V_I < -0.5 \text{ V or } V_I > V_{CC} + 0.5 \text{ V}$ [1]	-	±20	mA
I <sub>OK</sub>	output clamping current	$V_O < -0.5 \text{ V or } V_O > V_{CC} + 0.5 \text{ V}$ [1]	-	±20	mA
Io	output current	$V_{\rm O} = -0.5 \text{ V to } (V_{\rm CC} + 0.5 \text{ V})$ [1]	-	25	mA
I <sub>CC</sub>	supply current	[1]	-	50	mA
$I_{GND}$	ground current	[1]	-50	-	mA
T <sub>stg</sub>	storage temperature		-65	+150	°C
$P_D$	dynamic power dissipation	$T_{amb} = -40  ^{\circ}\text{C} \text{ to } +125  ^{\circ}\text{C}$ [2]	-	300	mW

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

# 9. Recommended operating conditions

### Table 6. Recommended operating conditions

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

Symbol	Parameter	Conditions	74F	74HC2G02-Q100		74HCT2G02-Q100			Unit
			Min	Тур	Max	Min	Тур	Max	
V <sub>CC</sub>	supply voltage		2.0	5.0	6.0	4.5	5.0	5.5	V
VI	input voltage		0	-	V <sub>CC</sub>	0	-	V <sub>CC</sub>	V
Vo	output voltage		0	-	V <sub>CC</sub>	0	-	V <sub>CC</sub>	V
T <sub>amb</sub>	ambient temperature		-40	+25	+125	-40	+25	+125	°C
Δt/ΔV	input transition	V <sub>CC</sub> = 2.0 V	-	-	625	-	-	-	ns/V
	rise and fall rate	V <sub>CC</sub> = 4.5 V	-	1.67	139	-	1.67	139	ns/V
		V <sub>CC</sub> = 6.0 V	-	-	83	-	-	-	ns/V

<sup>[2]</sup> For TSSOP8 package: above 55 °C the value of P<sub>tot</sub> derates linearly with 2.5 mW/K.

For VSSOP8 package: above 110 °C the value of Ptot derates linearly with 8 mW/K.

# 10. Static characteristics

## **Table 7. Static characteristics**

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

Symbol	Parameter	Conditions	-4	-40 °C to +85 °C			-40 °C to +125 °C		
			Min	Typ [1]	Max	Min	Max		
74HC2G	02-Q100		<u>'</u>						
V <sub>IH</sub>	HIGH-level input	V <sub>CC</sub> = 2.0 V	1.5	1.2	-	1.5	-	V	
voltage		V <sub>CC</sub> = 4.5 V	3.15	2.4	-	3.15	-	V	
		V <sub>CC</sub> = 6.0 V	4.2	3.2	-	4.2	-	V	
V <sub>IL</sub>	LOW-level input	V <sub>CC</sub> = 2.0 V	-	0.8	0.5	-	0.5	V	
	voltage	V <sub>CC</sub> = 4.5 V	-	2.1	1.35	-	1.35	V	
		V <sub>CC</sub> = 6.0 V	-	2.8	1.8	-	1.8	V	
V <sub>OH</sub>	HIGH-level output	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>							
\	voltage	I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 2.0 V	1.9	2.0	-	1.9	-	V	
		I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 4.5 V	4.4	4.5	-	4.4	-	V	
		I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 6.0 V	5.9	6.0	-	5.9	-	V	
		$I_{O}$ = -4.0 mA; $V_{CC}$ = 4.5 V	4.13	4.32	-	3.7	-	V	
		$I_{O}$ = -5.2 mA; $V_{CC}$ = 6.0 V	5.63	5.81	-	5.2	-	V	
V <sub>OL</sub>	LOW-level output	$V_I = V_{IH}$ or $V_{IL}$							
	voltage	$I_{O}$ = 20 $\mu$ A; $V_{CC}$ = 2.0 $V$	-	0	0.1	-	0.1	V	
		$I_{O} = 20 \mu A; V_{CC} = 4.5 V$	-	0	0.1	-	0.1	V	
		$I_{O}$ = 20 $\mu$ A; $V_{CC}$ = 6.0 $V$	-	0	0.1	-	0.1	V	
		$I_{O}$ = 4.0 mA; $V_{CC}$ = 4.5 V	-	0.15	0.33	-	0.4	V	
		I <sub>O</sub> = 5.2 mA; V <sub>CC</sub> = 6.0 V	-	0.16	0.33	-	0.4	V	
l <sub>l</sub>	input leakage current	$V_I = V_{CC}$ or GND; $V_{CC} = 6.0 \text{ V}$	-	-	±1.0	-	±1.0	μΑ	
I <sub>CC</sub>	supply current	per input pin; $V_I = V_{CC}$ or GND; $I_O = 0$ A; $V_{CC} = 6.0$ V	-	-	10	-	20	μA	
Cı	input capacitance		-	1.5	-	-	-	pF	
<b>74HCT2</b>	G02-Q100						<u>'</u>		
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V	2.0	1.6	-	2.0	-	V	
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V	-	1.2	0.8	-	0.8	V	
V <sub>OH</sub> HIGH-level output		V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>							
	voltage	I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 4.5 V	4.4	4.5	-	4.4	-	V	
		$I_{O}$ = -4.0 mA; $V_{CC}$ = 4.5 V	4.13	4.32	-	3.7	-	V	
V <sub>OL</sub>	LOW-level output	$V_I = V_{IH}$ or $V_{IL}$							
	voltage	$I_{O}$ = 20 $\mu$ A; $V_{CC}$ = 4.5 $V$	-	0	0.1	-	0.1	V	
		I <sub>O</sub> = 4.0 mA; V <sub>CC</sub> = 4.5 V	-	0.15	0.33	-	0.4	V	

Symbol	Parameter	Conditions	-40	-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ [1]	Max	Min	Max	
II	input leakage current	$V_I = V_{CC}$ or GND; $V_{CC} = 5.5 \text{ V}$	-	-	±1.0	-	±1.0	μΑ
I <sub>CC</sub>		$V_I = V_{CC}$ or GND; $I_O = 0$ A; $V_{CC} = 5.5$ V	-	-	10	-	20	μΑ
ΔI <sub>CC</sub>	additional supply current	per input; $V_{CC} = 4.5 \text{ V to } 5.5 \text{ V};$ $V_I = V_{CC} - 2.1 \text{ V}; I_O = 0 \text{ A}$	-	-	375	-	410	μΑ
Cı	input capacitance		-	1.5	-	-	-	pF

<sup>[1]</sup> All typical values are measured at  $T_{amb}$  = 25 °C.

# 11. Dynamic characteristics

## **Table 8. Dynamic characteristics**

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

Symbol Parameter		Conditions		-40 °C to +85 °C			-40 °C to +125 °C		Unit
				Min	Typ [1]	Max	Min	Max	
74HC2G	02-Q100		'						
t <sub>pd</sub>	propagation delay	nA and nB to nY; see Fig. 5	[2]						
		V <sub>CC</sub> = 2.0 V		-	26	95	-	110	ns
		V <sub>CC</sub> = 4.5 V		-	9	19	-	22	ns
		V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF		-	9	-	-	-	ns
		V <sub>CC</sub> = 6.0 V		-	8	16	-	20	ns
t <sub>t</sub>	transition time	see Fig. 5	[3]						
		V <sub>CC</sub> = 2.0 V		-	19	95	-	125	ns
		V <sub>CC</sub> = 4.5 V		-	7	19	-	25	ns
		V <sub>CC</sub> = 6.0 V		-	5	16	-	20	ns
C <sub>PD</sub>	power dissipation capacitance	$V_I = GND \text{ to } V_{CC}$	[4]	-	10	-	-	-	pF
<b>74HCT2</b>	G02-Q100		'						
t <sub>pd</sub>	propagation delay	nA and nB to nY; see Fig. 5	[2]						
		V <sub>CC</sub> = 4.5 V		-	12	24	-	29	ns
		V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF		-	12	-	-	-	ns
t <sub>t</sub>	transition time	V <sub>CC</sub> = 4.5 V; see <u>Fig. 5</u>	[3]	-	6	19	-	22	ns
C <sub>PD</sub>			[4]	-	10	-	-	-	pF

- [1] All typical values are measured at  $T_{amb}$  = 25 °C.
- [2]  $t_{pd}$  is the same as  $t_{PLH}$  and  $t_{PHL}$ .
- [3]  $t_t$  is the same as  $t_{TLH}$  and  $t_{THL}$ .
- [4]  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  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<sub>o</sub> = output frequency in MHz;

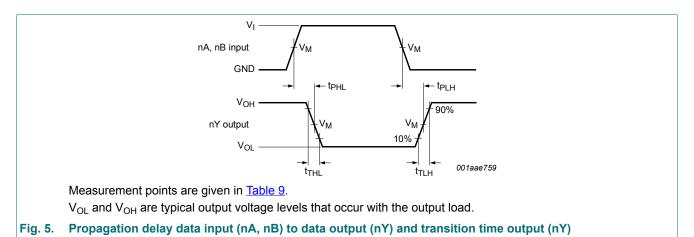
 $C_L$  = output load capacitance in pF;

V<sub>CC</sub> = supply voltage in V;

N = number of inputs switching;

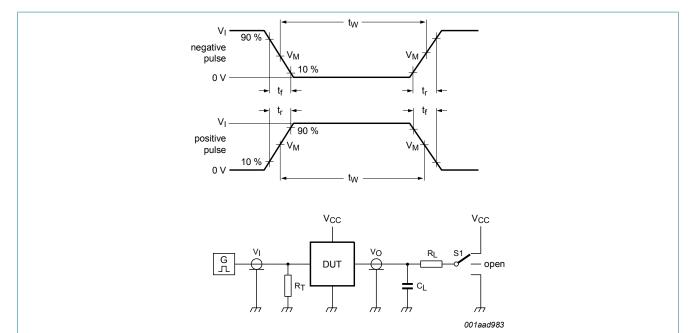
 $\Sigma(C_L \times V_{CC}^2 \times f_0) = \text{sum of outputs.}$ 

## 11.1. Waveforms and test circuit



**Table 9. Measurement points** 

	Туре	Input	Output
		V <sub>M</sub>	V <sub>M</sub>
	74HC2G02-Q100	0.5 × V <sub>CC</sub>	0.5 × V <sub>CC</sub>
	74HCT2G02-Q100	1.3 V	1.3 V



Test data is given in Table 10.

Definitions for test circuit:

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

C<sub>L</sub> = Load capacitance including jig and probe capacitance.

R<sub>L</sub> = Load resistance.

S1 = Test selection switch.

## Fig. 6. Test circuit for measuring switching times

Table 10. Test data

Туре	Input L		Load	S1 position	
	V <sub>I</sub>	t <sub>r</sub> , t <sub>f</sub>	CL	R <sub>L</sub>	t <sub>PHL</sub> , t <sub>PLH</sub>
74HC2G02-Q100	GND to V <sub>CC</sub>	≤ 6 ns	15 pF, 50 pF	1 kΩ	open
74HCT2G02-Q100	GND to 3 V	≤ 6 ns	15 pF, 50 pF	1 kΩ	open

# 12. Package outline

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

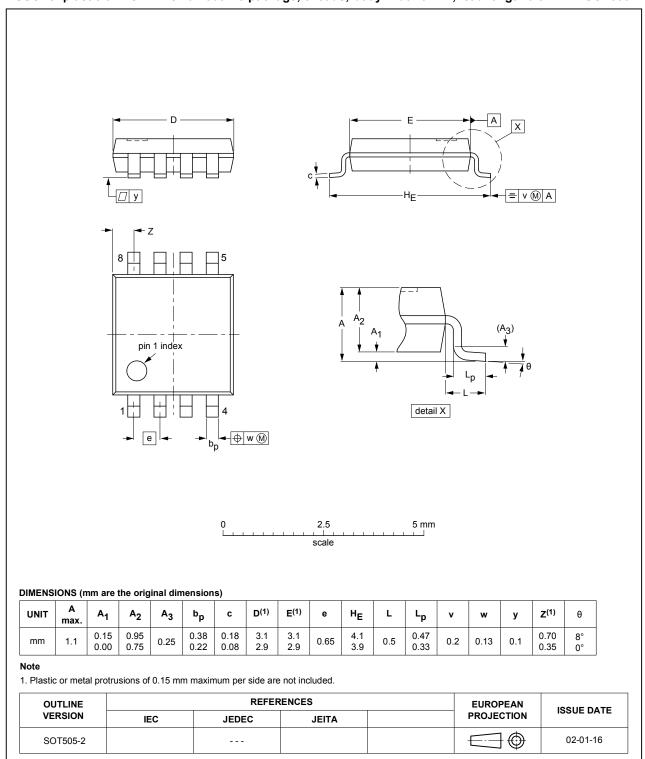


Fig. 7. Package outline SOT505-2 (TSSOP8)

8 / 12

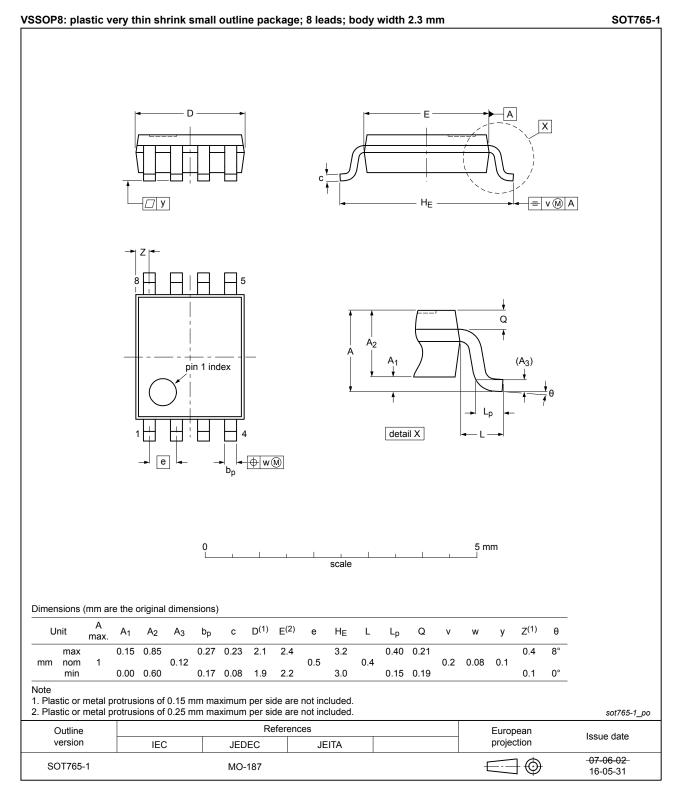


Fig. 8. Package outline SOT765-1 (VSSOP8)

# 13. Abbreviations

## **Table 11. Abbreviations**

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

# 14. Revision history

## Table 12. Revision history

14400 12111011010111101011						
Document ID	Release date	Data sheet status	Change notice	Supersedes		
74HC_HCT2G02_Q100 v.2	20180726	Product data sheet	-	74HC_HCT2G02_Q100 v.1		
Modifications:	<ul> <li>The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia.</li> <li>Legal texts have been adapted to the new company name where appropriate.</li> </ul>					
74HC_HCT2G02_Q100 v.1	20131111	Product data sheet	-	-		

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Document status [1][2]	Product status [3]	Definition
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# **Contents**

1. General description	1
2. Features and benefits	1
3. Ordering information	1
4. Marking	2
5. Functional diagram	2
6. Pinning information	2
6.1. Pinning	2
6.2. Pin description	
7. Functional description	3
8. Limiting values	3
9. Recommended operating conditions	3
10. Static characteristics	4
11. Dynamic characteristics	5
11.1. Waveforms and test circuit	6
12. Package outline	8
13. Abbreviations	10
14. Revision history	10
15. Legal information	11

For more information, please visit: http://www.nexperia.com For sales office addresses, please send an email to: salesaddresses@nexperia.com Date of release: 26 July 2018

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Компания «Океан Электроники» является официальным дистрибьютором и эксклюзивным представителем в России одного из крупнейших производителей разъемов военного и аэрокосмического назначения «JONHON», а так же официальным дистрибьютором и эксклюзивным представителем в России производителя высокотехнологичных и надежных решений для передачи СВЧ сигналов «FORSTAR».



**«JONHON»** (основан в 1970 г.)

Разъемы специального, военного и аэрокосмического назначения:

(Применяются в военной, авиационной, аэрокосмической, морской, железнодорожной, горно- и нефтедобывающей отраслях промышленности)

«**FORSTAR**» (основан в 1998 г.)

ВЧ соединители, коаксиальные кабели, кабельные сборки и микроволновые компоненты:

(Применяются в телекоммуникациях гражданского и специального назначения, в средствах связи, РЛС, а так же военной, авиационной и аэрокосмической отраслях промышленности).



Телефон: 8 (812) 309-75-97 (многоканальный)

Факс: 8 (812) 320-03-32

Электронная почта: ocean@oceanchips.ru

Web: http://oceanchips.ru/

Адрес: 198099, г. Санкт-Петербург, ул. Калинина, д. 2, корп. 4, лит. А