## 74HC11-Q100; 74HCT11-Q100

# Triple 3-input AND gate Rev. 2 — 22 March 2013

**Product data sheet** 

#### 1. **General description**

The 74HC11-Q100; 74HCT11-Q100 is a triple 3-input AND gate. Inputs include clamp diodes that enable the use of current limiting resistors to interface inputs to voltages in excess of V<sub>CC</sub>.

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
- Complies with JEDEC standard JESD7A
- Input levels:
  - ◆ For 74HC11-Q100: CMOS level
  - For 74HCT11-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

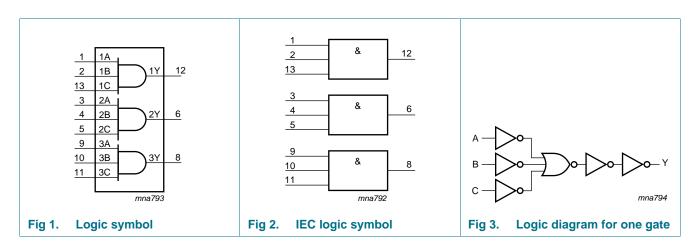
#### **Ordering information** 3.

Table 1. **Ordering information** 

Type number	Package							
	Temperature range	Name	Description	Version				
74HC11D-Q100 74HCT11D-Q100	–40 °C to +125 °C	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1				
74HC11PW-Q100 74HCT11PW-Q100	–40 °C to +125 °C	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	SOT402-1				

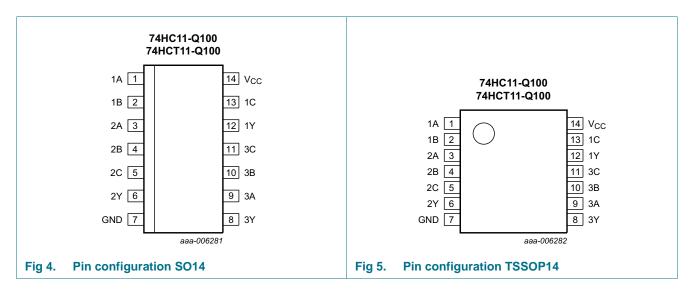


## 4. Functional diagram



## 5. Pinning information

#### 5.1 Pinning



#### 5.2 Pin description

Table 2. Pin description

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

74HC\_HCT11\_Q100

## 6. Functional description

Table 3. Function selection[1]

Input			Output
nA	nB	nC	nY
L	X	X	L
X	L	X	L
X	X	L	L
Н	Н	Н	Н

<sup>[1]</sup> 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
$V_{CC}$	supply voltage		-0.5	+7	V
I <sub>IK</sub>	input clamping current	$V_I < -0.5 \text{ V or } V_I > V_{CC} + 0.5 \text{ V}$	<u>[1]</u> -	±20	mA
I <sub>OK</sub>	output clamping current	$V_O < -0.5 \text{ V or } V_O > V_{CC} + 0.5 \text{ V}$	<u>[1]</u> -	±20	mA
Io	output current	$-0.5 \text{ V} < \text{V}_{\text{O}} < \text{V}_{\text{CC}} + 0.5 \text{ V}$	-	±25	mA
I <sub>CC</sub>	supply current		-	50	mA
$I_{GND}$	ground current		-50	-	mA
T <sub>stg</sub>	storage temperature		-65	+150	°C
P <sub>tot</sub>	total power dissipation	SO14 and TSSOP14 packages	[2] _	500	mW

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

<sup>[2]</sup> For SO14 package:  $P_{tot}$  derates linearly with 8 mW/K above 70 °C. For TSSOP14 packages:  $P_{tot}$  derates linearly with 5.5 mW/K above 60 °C.

## **Recommended operating conditions**

Table 5. **Recommended operating conditions** 

Voltages are referenced to GND (ground = 0 V)

Symbol	Parameter	Conditions	74HC11-Q100			74HCT11-Q100			Unit
			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	-	+125	-40	-	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC} = 2.0 \text{ V}$	-	-	625	-	-	-	ns/V
		V <sub>CC</sub> = 4.5 V	-	1.67	139	-	1.67	139	ns/V
		$V_{CC} = 6.0 \text{ V}$	-	-	83	-	-	-	ns/V

## **Static characteristics**

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 +125 °C		Unit
			Min	Тур	Max	Min	Max	Min	Max	
74HC11-	·Q100						1	1		
V <sub>IH</sub>	HIGH-level	$V_{CC} = 2.0 \text{ V}$	1.5	1.2	-	1.5	-	1.5	-	V
	input voltage	$V_{CC} = 4.5 \text{ V}$	3.15	2.4	-	3.15	-	3.15	-	V
		$V_{CC} = 6.0 \text{ V}$	4.2	3.2	-	4.2	-	4.2	-	V
$V_{IL}$	LOW-level	V <sub>CC</sub> = 2.0 V	-	0.8	0.5	-	0.5	-	0.5	V
	input voltage	V <sub>CC</sub> = 4.5 V	-	2.1	1.35	-	1.35	-	1.35	V
		$V_{CC} = 6.0 \text{ V}$	-	2.8	1.8	-	1.8	-	1.8	V
V <sub>OH</sub>	HIGH-level	$V_I = V_{IH}$ or $V_{IL}$								
	output voltage	$I_{O} = -20 \mu A; V_{CC} = 2.0 V$	1.9	2.0	-	1.9	-	1.9	-	V
		$I_{O} = -20 \mu A; V_{CC} = 4.5 V$	4.4	4.5	-	4.4	-	4.4	-	V
		$I_{O} = -20 \mu A; V_{CC} = 6.0 V$	5.9	6.0	-	5.9	-	5.9	-	V
		$I_{O} = -4.0 \text{ mA}; V_{CC} = 4.5 \text{ V}$	3.98	4.32	-	3.84	-	3.7	-	V
		$I_{O} = -5.2 \text{ mA}; V_{CC} = 6.0 \text{ V}$	5.48	5.81	-	5.34	-	5.2	-	V
$V_{OL}$	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	V
		$I_O = 20 \mu A; V_{CC} = 4.5 V$	-	0	0.1	-	0.1	-	0.1	V
		$I_O = 20 \mu A; V_{CC} = 6.0 V$	-	0	0.1	-	0.1	-	0.1	V
		$I_O = 4.0 \text{ mA}; V_{CC} = 4.5 \text{ V}$	-	0.15	0.26	-	0.33	-	0.4	V
		$I_O = 5.2 \text{ mA}; V_{CC} = 6.0 \text{ V}$	-	0.16	0.26	-	0.33	-	0.4	V
l <sub>l</sub>	input leakage current	$V_I = V_{CC}$ or GND; $V_{CC} = 6.0 \text{ V}$	-	-	±0.1	-	±1	-	±1	μΑ
I <sub>CC</sub>	supply current	$V_I = V_{CC}$ or GND; $I_O = 0$ A; $V_{CC} = 6.0 \text{ V}$	-	-	2.0	-	20	-	40	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 t	o +85 °C	-40 °C to +125 °C		Unit
			Min	Тур	Max	Min	Max	Min	Max	
Cı	input capacitance		-	3.5	-	-	-	-	-	pF
74HCT1	1-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 <sub>OH</sub>	HIGH-level	$V_I = V_{IH}$ or $V_{IL}$ ; $V_{CC} = 4.5 \text{ V}$								
	output voltage	$I_{O} = -20 \mu A$	4.4	4.5	-	4.4	-	4.4	-	V
		$I_{O} = -4.0 \text{ mA}$	3.98	4.32	-	3.84	-	3.7	-	V
$V_{OL}$		$V_I = V_{IH}$ or $V_{IL}$ ; $V_{CC} = 4.5 \text{ V}$								
	output voltage	$I_O = 20 \mu A; V_{CC} = 4.5 V$	-	0	0.1	-	0.1	-	0.1	V
I <sub>I</sub>	input leakage current	$V_I = V_{CC}$ or GND; $V_{CC} = 5.5 \text{ V}$	-	-	±0.1	-	±1	-	±1	μΑ
I <sub>CC</sub>	supply current	$V_I = V_{CC}$ or GND; $I_O = 0$ A; $V_{CC} = 5.5$ V	-	-	2.0	-	20	-	40	μΑ
Δl <sub>CC</sub>	additional supply current	per input pin; $V_I = V_{CC} - 2.1 \text{ V}; I_O = 0 \text{ A};$ other inputs at $V_{CC}$ or GND; $V_{CC} = 4.5 \text{ V}$ to 5.5 V	-	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 test circuit see <u>Figure 7</u>.

Symbol P	Parameter	Conditions		25 °C			-40 °C to +125 °C		Unit
				Min	Тур	Max	Max (85 °C)	Max (125 °C)	
74HC11-	Q100					'	'		
t <sub>pd</sub>	propagation delay	nA, nB to nY; see Figure 6	<u>[1]</u>						
	V <sub>CC</sub> = 2.0 V		-	32	100	125	150	ns	
		V <sub>CC</sub> = 4.5 V		-	12	20	25	30	ns
		$V_{CC} = 5.0 \text{ V}; C_L = 15 \text{ pF}$		-	9	-	-	-	ns
		V <sub>CC</sub> = 6.0 V		-	10	17	21	26	ns
t <sub>t</sub>	transition time	see Figure 6	[2]						
		V <sub>CC</sub> = 2.0 V		-	19	75	95	110	ns
		V <sub>CC</sub> = 4.5 V		-	7	15	19	22	ns
		V <sub>CC</sub> = 6.0 V		-	6	13	16	19	ns
$C_{PD}$	power dissipation capacitance	per package; $V_I = GND$ to $V_{CC}$	[3]	-	18	-	-	-	pF

Table 7. Dynamic characteristics

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

Symbol	Parameter	Conditions		25 °C			-40 °C to	Unit	
			Min		Тур	Max	Max (85 °C)	Max (125 °C)	
74HCT11	1-Q100								
t <sub>pd</sub> p	propagation delay	nA, nB to nY; see Figure 6	<u>[1]</u>						
		$V_{CC} = 4.5 \text{ V}$		-	16	24	30	36	ns
		$V_{CC} = 5.0 \text{ V}; C_L = 15 \text{ pF}$		-	11	-	-	-	ns
t <sub>t</sub>	transition time	V <sub>CC</sub> = 4.5 V; see Figure 6	[2]	-	7	15	19	22	ns
$C_{PD}$	power dissipation capacitance	per package; V <sub>I</sub> = GND to V <sub>CC</sub> – 1.5 V	<u>[3]</u>	-	20	-	-	-	pF

- [1]  $t_{pd}$  is the same as  $t_{PHL}$  and  $t_{PLH}$ .
- [2]  $t_t$  is the same as  $t_{THL}$  and  $t_{TLH}$ .
- [3]  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu W$ ):

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

 $f_i$  = input frequency in MHz;

f<sub>o</sub> = output frequency in MHz;

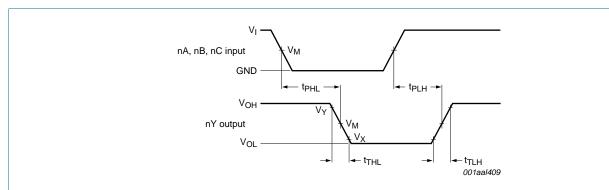
C<sub>L</sub> = output load capacitance in pF;

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

N = number of inputs switching;

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

### 11. Waveforms



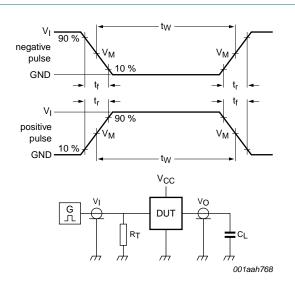
Measurement points are given in Table 9.

 $V_{\mbox{\scriptsize OL}}$  and  $V_{\mbox{\scriptsize OH}}$  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 <sub>M</sub>	V <sub>M</sub>	V <sub>X</sub>	V <sub>Y</sub>				
74HC11-Q100	0.5V <sub>CC</sub>	0.5V <sub>CC</sub>	0.1V <sub>CC</sub>	0.9V <sub>CC</sub>				
74HCT11-Q100	1.3 V	1.3 V	0.1V <sub>CC</sub>	0.9V <sub>CC</sub>				



Test data is given in Table 9.

Definitions 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.

Fig 7. Test circuit for measuring switching times

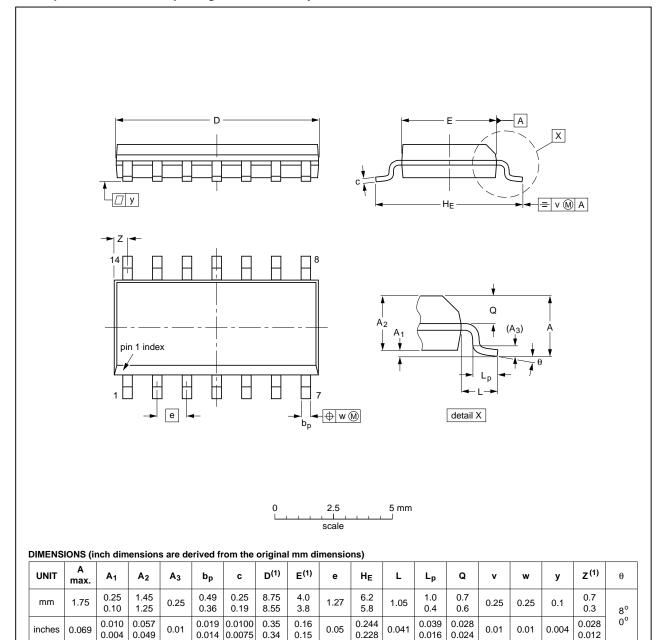
Table 9. Test data

Туре	Input L		Load	Test
	V <sub>I</sub>	t <sub>r</sub> , t <sub>f</sub>	CL	
74HC11-Q100	V <sub>CC</sub>	6.0 ns	15 pF, 50 pF	t <sub>PLH</sub> , t <sub>PHL</sub>
74HCT11-Q100	3.0 V	6.0 ns	15 pF, 50 pF	t <sub>PLH</sub> , t <sub>PHL</sub>

## 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 VERSION		REFER	EUROPEAN	ISSUE DATE	
	IEC	JEDEC	JEITA	PROJECTION	ISSUE DATE
SOT108-1	076E06	MS-012			<del>99-12-27</del> 03-02-19

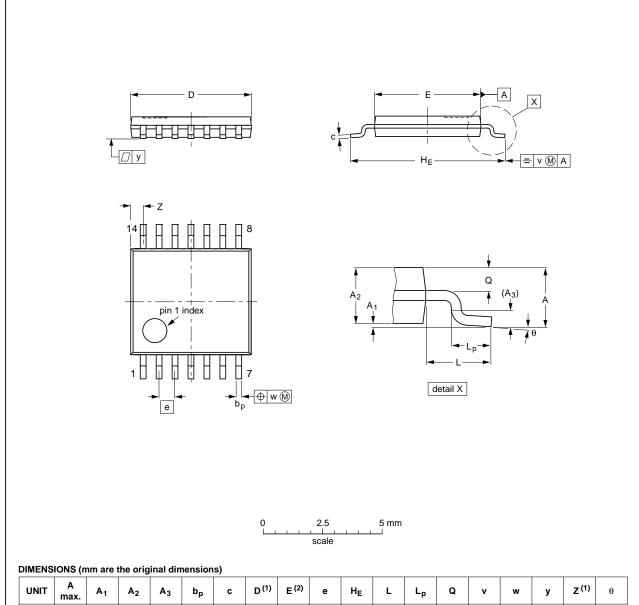
Fig 8. Package outline SOT108-1 (SO14)

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

SOT402-1



UNIT	A max.	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	bp	С	D <sup>(1)</sup>	E <sup>(2)</sup>	е	HE	L	Lp	Q	v	w	у	Z <sup>(1)</sup>	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°

- 1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
- 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				<del>99-12-27</del> 03-02-18	

Fig 9. Package outline SOT402-1 (TSSOP14)

74HC\_HCT11\_Q100

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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
MIL	Military
TTL	Transistor-Transistor Logic

## 14. Revision history

#### Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74HC_HCT11_Q100 v.2	20130322	Product data sheet	-	74HC_HCT11_Q100 v.1
Modifications:	<ul> <li>Section 2 "Feat</li> </ul>	ures and benefits" remove	ed redundant temperat	ure range
74HC_HCT11_Q100 v.1	20130228	Product data sheet	-	-

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#### 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.

- [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"
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- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

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).



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