

# 74LVC02A-Q100

## Quad 2-input NOR gate

Rev. 2 — 24 August 2020

Product data sheet

## 1. General description

The 74LVC02A-Q100 provides four 2-input NOR gates.

Inputs can be driven from either 3.3 V or 5 V devices. This feature allows the use of these devices as translators in mixed 3.3 V and 5 V applications.

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

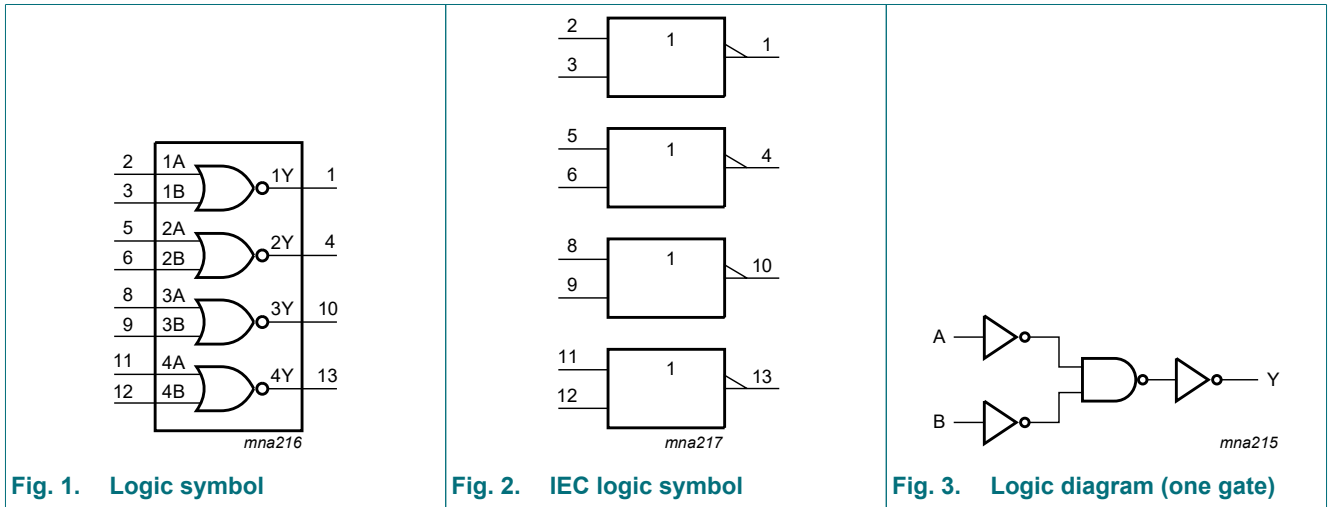
- Automotive product qualification in accordance with AEC-Q100 (Grade 1)
  - Specified from -40 °C to +85 °C and from -40 °C to +125 °C
- 5 V tolerant inputs for interfacing with 5 V logic
- Wide supply voltage range from 1.2 V to 3.6 V
- CMOS low power consumption
- Direct interface with TTL levels
- Complies with JEDEC standard:
  - JESD8-7A (1.65 V to 1.95 V)
  - JESD8-5A (2.3 V to 2.7 V)
  - JESD8-C/JESD36 (2.7 V to 3.6 V)
- 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
- DHVQFN package with Side-Wettable Flanks enabling Automatic Optical Inspection (AOI) of solder joints

## 3. Ordering information

Table 1. Ordering information

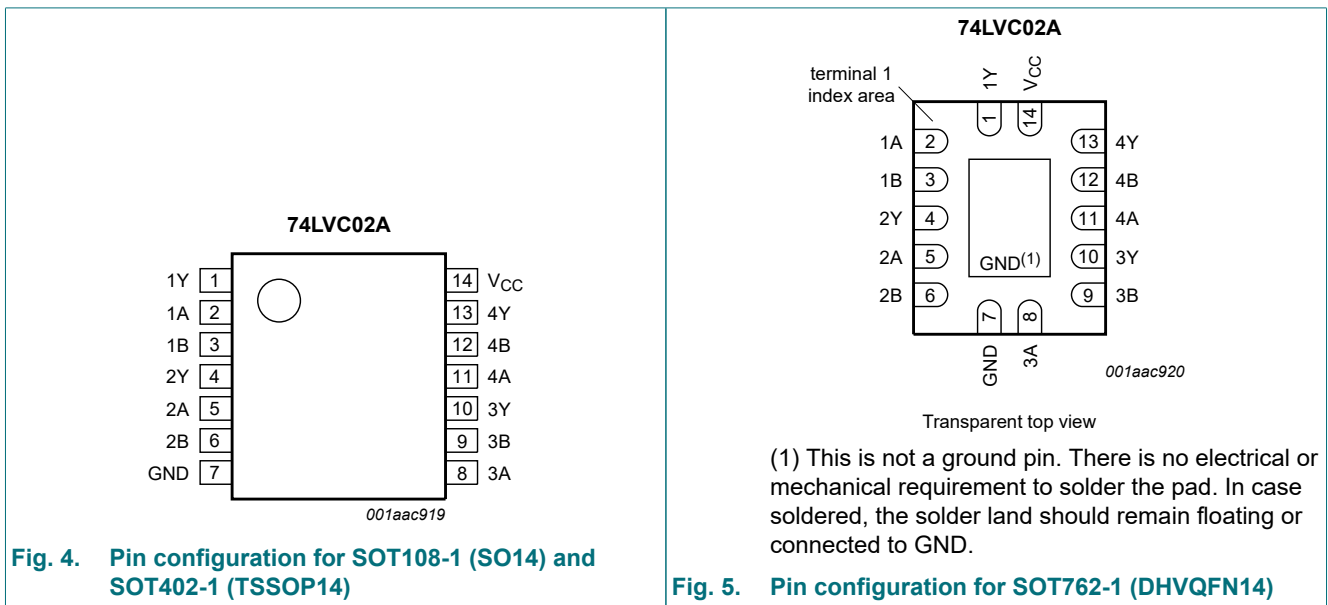
Type number	Package			
	Temperature range	Name	Description	Version
74LVC02AD-Q100	-40 °C to +125 °C	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1
74LVC02APW-Q100	-40 °C to +125 °C	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	SOT402-1
74LVC02ABQ-Q100	-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 × 3 × 0.85 mm	SOT762-1

### 4. Functional diagram



### 5. Pinning information

#### 5.1. Pinning



#### 5.2. Pin description

Table 2. Pin description

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

## 6. Functional description

**Table 3. Function table**

H = HIGH voltage level; L = LOW voltage level; X = don't care

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

## 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	+6.5	V
$I_{IK}$	input clamping current	$V_I < 0$ V	-50	-	mA
$V_I$	input voltage		[1] -0.5	+6.5	V
$I_{OK}$	output clamping current	$V_O > V_{CC}$ or $V_O < 0$ V	-	±50	mA
$V_O$	output voltage	output in HIGH or LOW-state	[2] -0.5	$V_{CC} + 0.5$	V
$I_O$	output current	$V_O = 0$ V to $V_{CC}$	-	±50	mA
$I_{CC}$	supply current		-	100	mA
$I_{GND}$	ground current		-100	-	mA
$P_{tot}$	total power dissipation	$T_{amb} = -40$ °C to $+125$ °C	[3] -	500	mW
$T_{stg}$	storage temperature		-65	+150	°C

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

[2] The output voltage ratings may be exceeded if the output current ratings are observed.

[3] For SOT108-1 (SO14) package:  $P_{tot}$  derates linearly with 10.1 mW/K above 100 °C.

For SOT402-1 (TSSOP14) package:  $P_{tot}$  derates linearly with 7.3 mW/K above 81 °C.

For SOT762-1 (DHVQFN14) package:  $P_{tot}$  derates linearly with 9.6 mW/K above 98 °C.

## 8. Recommended operating conditions

**Table 5. Recommended operating conditions**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{CC}$	supply voltage		1.65	-	3.6	V
		functional	1.2	-	-	V
$V_I$	input voltage		0	-	5.5	V
$V_O$	output voltage	output HIGH or LOW state	0	-	$V_{CC}$	V
$T_{amb}$	ambient temperature		-40	-	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC} = 1.65$ V to $2.7$ V	0	-	20	ns/V
		$V_{CC} = 2.7$ V to $3.6$ V	0	-	10	ns/V

## 9. Static characteristics

**Table 6. Static characteristics**

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

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit		
			Min	Typ[1]	Max	Min	Max			
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 1.2 V	1.08	-	-	1.08	-	V		
		V <sub>CC</sub> = 1.65 V to 1.95 V	0.65 × V <sub>CC</sub>	-	-	0.65 × V <sub>CC</sub>	-	V		
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.7	-	-	1.7	-	V		
		V <sub>CC</sub> = 2.7 V to 3.6 V	2.0	-	-	2.0	-	V		
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 1.2 V	-	-	0.12	-	0.12	V		
		V <sub>CC</sub> = 1.65 V to 1.95 V	-	-	0.35 × V <sub>CC</sub>	-	0.35 × V <sub>CC</sub>	V		
		V <sub>CC</sub> = 2.3 V to 2.7 V	-	-	0.7	-	0.7	V		
		V <sub>CC</sub> = 2.7 V to 3.6 V	-	-	0.8	-	0.8	V		
V <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>								
		I <sub>O</sub> = -100 μA; V <sub>CC</sub> = 1.65 V to 3.6 V	V <sub>CC</sub> - 0.2	-	-	V <sub>CC</sub> - 0.3	-	V		
		I <sub>O</sub> = -4 mA; V <sub>CC</sub> = 1.65 V	1.2	-	-	1.05	-	V		
		I <sub>O</sub> = -8 mA; V <sub>CC</sub> = 2.3 V	1.8	-	-	1.65	-	V		
		I <sub>O</sub> = -12 mA; V <sub>CC</sub> = 2.7 V	2.2	-	-	2.05	-	V		
		I <sub>O</sub> = -18 mA; V <sub>CC</sub> = 3.0 V	2.4	-	-	2.25	-	V		
V <sub>OL</sub>	LOW-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>								
		I <sub>O</sub> = 100 μA; V <sub>CC</sub> = 1.65 V to 3.6 V	-	-	0.2	-	0.3	V		
		I <sub>O</sub> = 4 mA; V <sub>CC</sub> = 1.65 V	-	-	0.45	-	0.65	V		
		I <sub>O</sub> = 8 mA; V <sub>CC</sub> = 2.3 V	-	-	0.6	-	0.8	V		
		I <sub>O</sub> = 12 mA; V <sub>CC</sub> = 2.7 V	-	-	0.4	-	0.6	V		
I <sub>I</sub>	input leakage current	I <sub>O</sub> = 24 mA; V <sub>CC</sub> = 3.0 V	-	-	0.55	-	0.8	V		
		V <sub>CC</sub> = 3.6 V; V <sub>I</sub> = 5.5 V or GND	-	±0.1	±5	-	±20	μA		
		I <sub>CC</sub>	supply current	V <sub>CC</sub> = 3.6 V; V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A	-	0.1	10	-	40	μA
		ΔI <sub>CC</sub>	additional supply current	per input pin; V <sub>CC</sub> = 2.7 V to 3.6 V; V <sub>I</sub> = V <sub>CC</sub> - 0.6 V; I <sub>O</sub> = 0 A	-	5	500	-	5000	μA
		C <sub>I</sub>	input capacitance	V <sub>CC</sub> = 0 V to 3.6 V; V <sub>I</sub> = GND to V <sub>CC</sub>	-	4.0	-	-	-	pF

[1] All typical values are measured at V<sub>CC</sub> = 3.3 V (unless stated otherwise) and T<sub>amb</sub> = 25 °C.

## 10. Dynamic characteristics

**Table 7. Dynamic characteristics**

Voltages are referenced to GND (ground = 0 V). For test circuit see Fig. 7.

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	
$t_{pd}$	propagation delay	nA, nB to nY; see Fig. 6 [2]						
		$V_{CC} = 1.2\text{ V}$	-	14	-	-	-	ns
		$V_{CC} = 1.65\text{ V to }1.95\text{ V}$	0.5	4.0	8.6	0.5	10.1	ns
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	1.0	2.4	4.9	1.0	5.7	ns
		$V_{CC} = 2.7\text{ V}$	1.0	2.5	5.1	1.0	6.5	ns
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	1.0	2.2	4.4	1.0	5.5	ns
$t_{sk(o)}$	output skew time	$V_{CC} = 3.0\text{ V to }3.6\text{ V}$ [3]	-	-	1.0	-	1.5	ns
$C_{PD}$	power dissipation capacitance	per gate; $V_I = \text{GND to } V_{CC}$ [4]						
		$V_{CC} = 1.65\text{ V to }1.95\text{ V}$	-	2.5	-	-	-	pF
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	-	5.7	-	-	-	pF
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	-	8.5	-	-	-	pF

[1] Typical values are measured at  $T_{amb} = 25\text{ °C}$  and  $V_{CC} = 1.2\text{ V}, 1.8\text{ V}, 2.5\text{ V}, 2.7\text{ V},$  and  $3.3\text{ V}$  respectively.

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

[3] Skew between any two outputs of the same package switching in the same direction. This parameter is guaranteed by design.

[4]  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu\text{W}$ ).

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

$f_i$  = input frequency in MHz;  $f_o$  = output frequency in MHz

$C_L$  = output load capacitance in pF

$V_{CC}$  = supply voltage in Volts

$N$  = number of inputs switching

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

10.1. Waveforms and test circuit

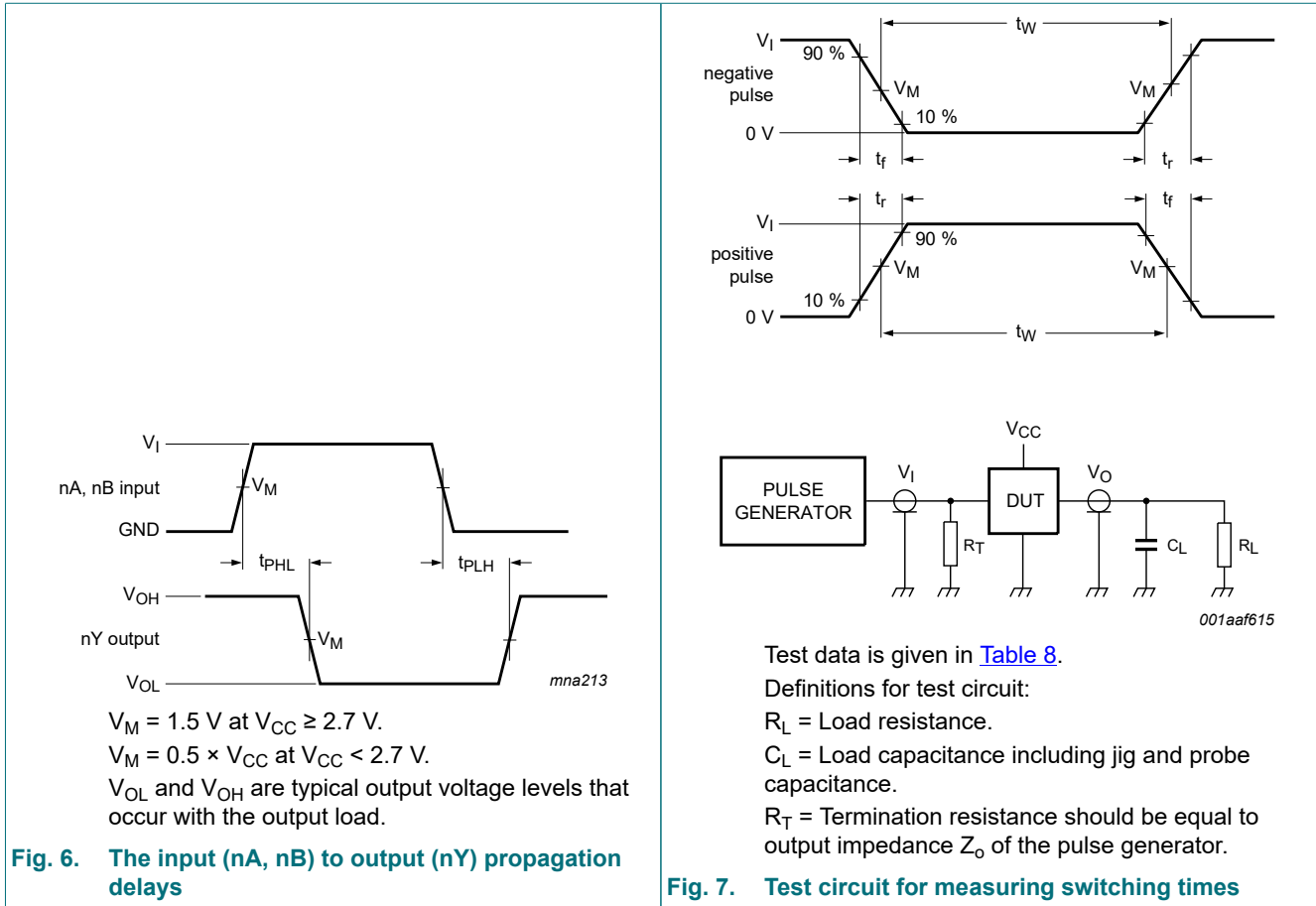


Table 8. Test data

Supply voltage	Input		Load	
	$V_I$	$t_r, t_f$	$C_L$	$R_L$
1.2 V	$V_{CC}$	$\leq 2 \text{ ns}$	30 pF	1 k $\Omega$
1.65 V to 1.95 V	$V_{CC}$	$\leq 2 \text{ ns}$	30 pF	1 k $\Omega$
2.3 V to 2.7 V	$V_{CC}$	$\leq 2 \text{ ns}$	30 pF	500 $\Omega$
2.7 V	2.7 V	$\leq 2.5 \text{ ns}$	50 pF	500 $\Omega$
3.0 V to 3.6 V	2.7 V	$\leq 2.5 \text{ ns}$	50 pF	500 $\Omega$

### 11. Package outline

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

SOT108-1



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

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

SOT402-1



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



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)

## 12. Abbreviations

Table 9. Abbreviations

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

## 13. Revision history

Table 10. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LVC02A_Q100 v.2	20200824	Product data sheet	-	74LVC02A_Q100 v.1
Modifications:	<ul style="list-style-type: none"> <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> <li><a href="#">Section 2</a> updated.</li> <li><a href="#">Table 4</a>: Derating values for <math>P_{tot}</math> total power dissipation have been updated.</li> <li>Package outline drawing of SOT762-1 (<a href="#">Fig. 10</a>) updated.</li> </ul>			
74LVC02A_Q100 v.1	20130404	Product data sheet	-	-

## 14. Legal information

### 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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