

# 74LVC2GU04-Q100

Dual unbuffered inverter

Rev. 7 — 25 August 2023

Product data sheet

## 1. General description

The 74LVC2GU04-Q100 is a dual unbuffered inverter. 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 environments.

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 1.65 V to 5.5 V
- Overvoltage tolerant inputs to 5.5 V
- High noise immunity
- $\pm 24$  mA output drive ( $V_{CC} = 3.0$  V)
- CMOS low power dissipation
- Latch-up performance exceeds 250 mA
- Complies with JEDEC standard no. 8-1A
- ESD protection:
  - HBM: ANSI/ESDA/JEDEC JS-001 class 2 exceeds 2000 V
  - CDM: ANSI/ESDA/JEDEC JS-002 class C3 exceeds 1000 V
- Multiple package options

## 3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
<a href="#">74LVC2GU04GW-Q100</a>	-40 °C to +125 °C	TSSOP6	plastic thin shrink small outline package; 6 leads; body width 1.25 mm	<a href="#">SOT363-2</a>
<a href="#">74LVC2GU04GV-Q100</a>	-40 °C to +125 °C	SC-74; TSOP6	plastic surface-mounted package; 6 leads	<a href="#">SOT457</a>
<a href="#">74LVC2GU04GM-Q100</a>	-40 °C to +125 °C	XSON6	plastic extremely thin small outline package; no leads; 6 terminals; body 1 × 1.45 × 0.5 mm	<a href="#">SOT886</a>

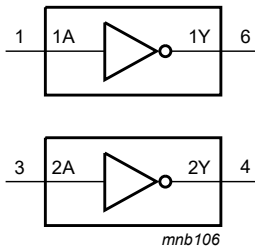
## 4. Marking

Table 2. Marking codes

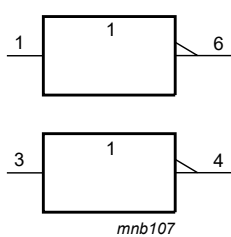
Type number	Marking [1]
74LVC2GU04GW-Q100	YD
74LVC2GU04GV-Q100	VU4
74LVC2GU04GM-Q100	YD

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

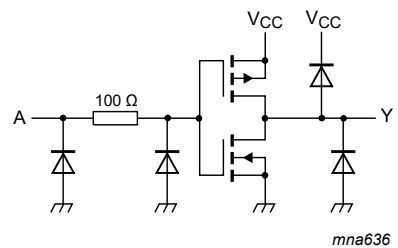
## 5. Functional diagram



**Fig. 1. Logic symbol**



**Fig. 2. IEC logic symbol**

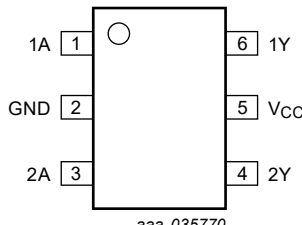


**Fig. 3. Logic diagram (one gate)**

## 6. Pinning information

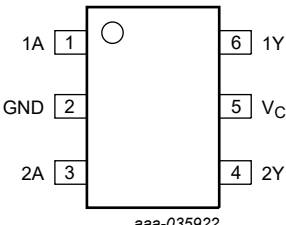
### 6.1. Pinning

**GW package**  
SOT363-2 (TSSOP6)



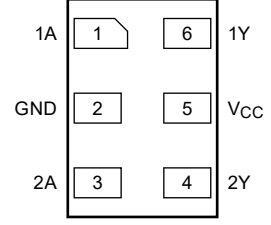
aaa-035770

**GV package**  
SOT457 (SC-74; TSOP6)



aaa-035922

**GM package**  
SOT886 (XSON6)



Transparent top view  
aaa-035771

### 6.2. Pin description

Table 3. Pin description

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

## 7. Functional description

**Table 4. Function table**

*H = HIGH voltage level; L = LOW voltage level.*

Input	Output
nA	nY
L	H
H	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	+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	$V_O < 0$ V	-50	-	mA
$V_O$	output voltage	Active mode	[1] -0.5	$V_{CC} + 0.5$	V
$I_O$	output current	$V_O = 0$ V to $V_{CC}$	-	$\pm 50$	mA
$I_{CC}$	supply current		-	100	mA
$I_{GND}$	ground current		-100	-	mA
$T_{stg}$	storage temperature		-65	+150	°C
$P_{tot}$	total power dissipation	$T_{amb} = -40$ °C to +125 °C	[2] -	250	mW

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

[2] For SOT363-2 (TSSOP6) package:  $P_{tot}$  derates linearly with 3.7 mW/K above 83 °C.

For SOT457 (SC-74; TSOP6) package:  $P_{tot}$  derates linearly with 4.1 mW/K above 89 °C.

For SOT886 (XSON6) package:  $P_{tot}$  derates linearly with 3.3 mW/K above 74 °C.

## 9. Recommended operating conditions

**Table 6. Recommended operating conditions**

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{CC}$	supply voltage		1.65	-	5.5	V
$V_I$	input voltage		0	-	5.5	V
$V_O$	output voltage	Active mode	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	-	-	20	ns/V
		$V_{CC} = 2.7$ V to 5.5 V	-	-	10	ns/V

## 10. Static characteristics

**Table 7. 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> = 1.65 V to 5.5 V	0.75V <sub>CC</sub>	-	-	0.8V <sub>CC</sub>	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 1.65 V to 5.5 V	-	-	0.25V <sub>CC</sub>	-	0.2V <sub>CC</sub>	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 5.5 V	V <sub>CC</sub> - 0.1	-	-	V <sub>CC</sub> - 0.1	-	V
		I <sub>O</sub> = -4 mA; V <sub>CC</sub> = 1.65 V	1.2	-	-	0.95	-	V
		I <sub>O</sub> = -8 mA; V <sub>CC</sub> = 2.3 V	1.9	-	-	1.7	-	V
		I <sub>O</sub> = -12 mA; V <sub>CC</sub> = 2.7 V	2.2	-	-	1.9	-	V
		I <sub>O</sub> = -24 mA; V <sub>CC</sub> = 3.0 V	2.3	-	-	2.0	-	V
		I <sub>O</sub> = -32 mA; V <sub>CC</sub> = 4.5 V	3.8	-	-	3.4	-	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 5.5 V	-	-	0.1	-	0.1	V
		I <sub>O</sub> = 4 mA; V <sub>CC</sub> = 1.65 V	-	-	0.45	-	0.7	V
		I <sub>O</sub> = 8 mA; V <sub>CC</sub> = 2.3 V	-	-	0.3	-	0.45	V
		I <sub>O</sub> = 12 mA; V <sub>CC</sub> = 2.7 V	-	-	0.4	-	0.6	V
		I <sub>O</sub> = 24 mA; V <sub>CC</sub> = 3.0 V	-	-	0.55	-	0.8	V
		I <sub>O</sub> = 32 mA; V <sub>CC</sub> = 4.5 V	-	-	0.55	-	0.8	V
I <sub>I</sub>	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	-	±1	μA
I <sub>CC</sub>	supply current	V <sub>I</sub> = 5.5 V or GND; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 1.65 V to 5.5 V	-	0.1	4	-	4	μA
C <sub>I</sub>	input capacitance	V <sub>CC</sub> = 3.3 V; V <sub>I</sub> = GND to V <sub>CC</sub>	-	5	-	-	-	pF

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

## 11. Dynamic characteristics

**Table 8. Dynamic characteristics**

Voltages are referenced to GND (ground = 0 V). For test circuit see Fig. 5.

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ [1]	Max	Min	Max	
t <sub>pd</sub>	propagation delay	nA to nY; see Fig. 4 [2]						
		V <sub>CC</sub> = 1.65 V to 1.95 V	0.5	2.3	5.0	0.5	6.3	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	0.3	1.8	4.0	0.3	5.0	ns
		V <sub>CC</sub> = 2.7 V	0.3	2.6	4.5	0.3	5.6	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	0.3	2.3	3.7	0.3	4.5	ns
		V <sub>CC</sub> = 4.5 V to 5.5 V	0.3	1.7	3.0	0.3	3.8	ns
C <sub>PD</sub>	power dissipation capacitance	V <sub>I</sub> = GND to V <sub>CC</sub> ; V <sub>CC</sub> = 3.3 V [3]	-	7.8	-			pF

[1] Typical values are measured at T<sub>amb</sub> = 25 °C and V<sub>CC</sub> = 1.8 V, 2.5 V, 2.7 V, 3.3 V and 5.0 V respectively.

[2] t<sub>pd</sub> is the same as t<sub>PLH</sub> and t<sub>PHL</sub>.

[3] C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> in μW).

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

f<sub>i</sub> = input frequency in MHz;

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

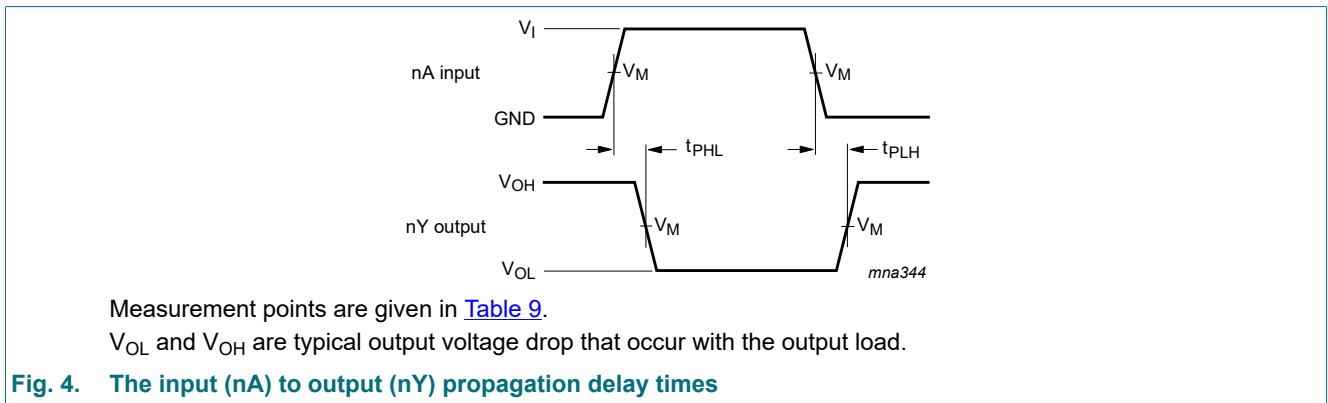
C<sub>L</sub> = output load capacitance in pF;

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

N = number of inputs switching;

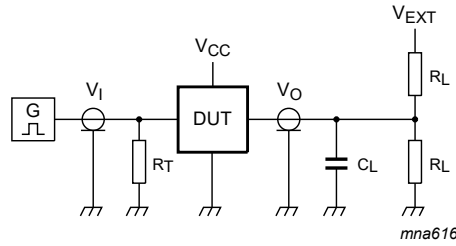
∑(C<sub>L</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>o</sub>) = sum of outputs.

### 11.1. Waveforms and test circuit



**Table 9. Measurement points**

Supply voltage	Input	Output
V <sub>CC</sub>	V <sub>M</sub>	V <sub>M</sub>
1.65 V to 1.95 V	0.5 × V <sub>CC</sub>	0.5 × V <sub>CC</sub>
2.3 V to 2.7 V	0.5 × V <sub>CC</sub>	0.5 × V <sub>CC</sub>
2.7 V	1.5 V	1.5 V
3.0 V to 3.6 V	1.5 V	1.5 V
4.5 V to 5.5 V	0.5 × V <sub>CC</sub>	0.5 × V <sub>CC</sub>



Test data is given in [Table 10](#).

Definitions for test circuit:

$R_L$  = Load resistance;

$C_L$  = Load capacitance including jig and probe capacitance;

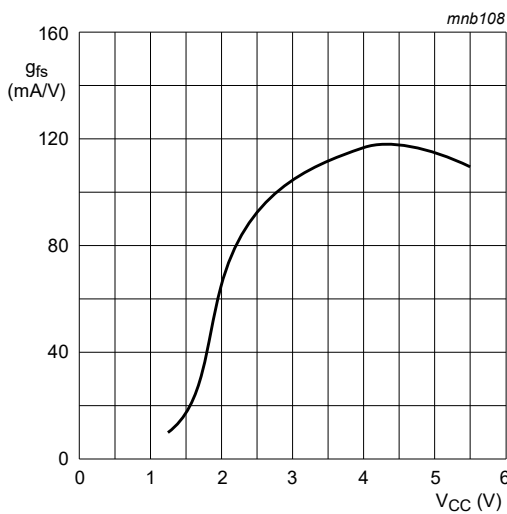
$R_T$  = Termination resistance should be equal to the output impedance  $Z_o$  of the pulse generator;

$V_{EXT}$  = External voltage for measuring switching times.

**Fig. 5. Test circuit for measuring switching times**

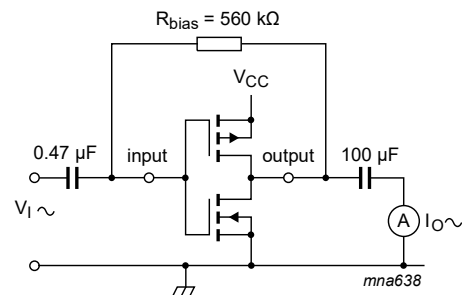
**Table 10. Test data**

Supply voltage	Input		Load		$V_{EXT}$
$V_{CC}$	$V_I$	$t_r = t_f$	$C_L$	$R_L$	$t_{PLH}, t_{PHL}$
1.65 V to 1.95 V	$V_{CC}$	$\leq 2.0$ ns	30 pF	1 k $\Omega$	open
2.3 V to 2.7 V	$V_{CC}$	$\leq 2.0$ ns	30 pF	500 $\Omega$	open
2.7 V	2.7 V	$\leq 2.5$ ns	50 pF	500 $\Omega$	open
3.0 V to 3.6 V	2.7 V	$\leq 2.5$ ns	50 pF	500 $\Omega$	open
4.5 V to 5.5 V	$V_{CC}$	$\leq 2.5$ ns	50 pF	500 $\Omega$	open



$T_{amb} = 25$  °C.

**Fig. 6. Typical forward transconductance as a function of supply voltage**



$$g_{fs} = \frac{\Delta I_O}{\Delta V_I}$$

$f_i = 1$  kHz.

$V_O$  is constant.

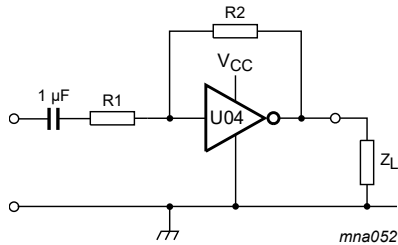
**Fig. 7. Test set-up for measuring forward transconductance**

## 12. Application information

Some applications are:

- Linear amplifier (see [Fig. 8](#))
- In crystal oscillator design (see [Fig. 9](#))

**Remark:** All values given are typical unless otherwise specified.



$$V_{o(p-p)} = V_{CC} - 1.5 \text{ V centered at } 0.5V_{CC}.$$

$$A_u = - \frac{G_{OL}}{1 + \frac{R_1}{R_2} (1 + G_{OL})}$$

$G_{OL}$  = open loop gain.

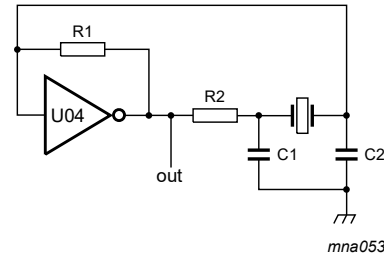
$A_u$  = voltage amplification.

$R_1 \geq 3 \text{ k}\Omega$ ,  $R_2 \leq 1 \text{ M}\Omega$ .

$Z_L > 10 \text{ k}\Omega$ ;  $G_{OL} = 20$  (typical).

Typical unity gain bandwidth product is 5 MHz.

**Fig. 8. Linear amplifier configuration**



$C_1 = 47 \text{ pF}$  (typical).

$C_2 = 22 \text{ pF}$  (typical).

$R_1 = 1 \text{ M}\Omega$  to  $10 \text{ M}\Omega$  (typical).

$R_2$  optimum value depends on the frequency and required stability against changes in  $V_{CC}$  or average minimum  $I_{CC}$  ( $I_{CC}$  is typically 2 mA when  $V_{CC} = 3.3 \text{ V}$  and  $f = 10 \text{ MHz}$ ).

**Fig. 9. Crystal oscillator configuration**

### 13. Package outline

TSSOP6: plastic thin shrink small outline package; 6 leads; body width 1.25 mm

SOT363-2



Fig. 10. Package outline SOT363-2 (TSSOP6)



Plastic, surface-mounted package (SC-74; TSOP6); 6 leads

SOT457



Fig. 11. Package outline SOT457 (SC-74; TSOP6)

XSON6: plastic extremely thin small outline package; no leads; 6 terminals; body 1 x 1.45 x 0.5 mm

SOT886



Fig. 12. Package outline SOT886 (XSON6)

## 14. Abbreviations

Table 11. Abbreviations

Acronym	Description
CMOS	Complementary Metal-Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model

## 15. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LVC2GU04_Q100 v.7	20230825	Product data sheet	-	74LVC2GU04_Q100 v.6
Modifications:	<ul style="list-style-type: none"> <li><a href="#">Section 2</a>: ESD specification updated according to the latest JEDEC standard..</li> </ul>			
74LVC2GU04_Q100 v.6	20220120	Product data sheet	-	74LVC2GU04_Q100 v.5
Modifications:	<ul style="list-style-type: none"> <li>Package SOT363 (SC-88) changed to SOT363-2 (TSSOP6).</li> </ul>			
74LVC2GU04_Q100 v.5	20210419	Product data sheet	-	74LVC2GU04_Q100 v.4
Modifications:	<ul style="list-style-type: none"> <li><a href="#">Section 1</a> updated.</li> <li><a href="#">Section 8</a>: Derating values for <math>P_{tot}</math> total power dissipation updated.</li> </ul>			
74LVC2GU04_Q100 v.4	20190211	Product data sheet	-	74LVC2GU04_Q100 v.3
Modifications:	<ul style="list-style-type: none"> <li>Type number 74LVC2GU04GM-Q100 (SOT886/XSON6) added.</li> </ul>			
74LVC2GU04_Q100 v.3	20181009	Product data sheet	-	74LVC2GU04_Q100 v.2
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 1</a>: Typo corrected in General description.</li> </ul>			
74LVC2GU04_Q100 v.2	20161214	Product data sheet	-	74LVC2GU04_Q100 v.1
Modifications:	<ul style="list-style-type: none"> <li><a href="#">Section 10</a>: The maximum limits for leakage current and supply current have changed.</li> </ul>			
74LVC2GU04_Q100 v.1	20120731	Product data sheet	-	-

## 16. 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.

- [1] Please consult the most recently issued document before initiating or completing a design.
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