74LVC2GU04-Q100

Dual unbuffered inverter

Rev. 6 — 20 January 2022 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
- ±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:
  - 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
74LVC2GU04GW-Q100	-40 °C to +125 °C	TSSOP6	plastic thin shrink small outline package; 6 leads; body width 1.25 mm	SOT363-2
74LVC2GU04GV-Q100	-40 °C to +125 °C	SC-74; TSOP6	plastic surface-mounted package; 6 leads	SOT457
74LVC2GU04GM-Q100	-40 °C to +125 °C	XSON6	plastic extremely thin small outline package; no leads; 6 terminals; body 1 × 1.45 × 0.5 mm	SOT886

nexperia

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

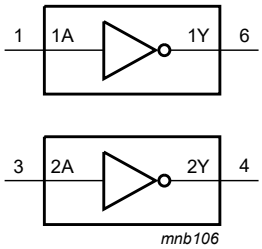


Fig. 1. Logic symbol

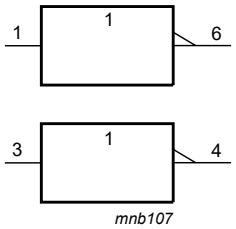


Fig. 2. IEC logic symbol

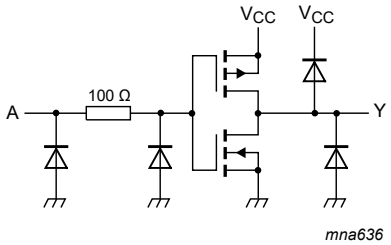


Fig. 3. Logic diagram (one gate)

6. Pinning information

6.1. Pinning

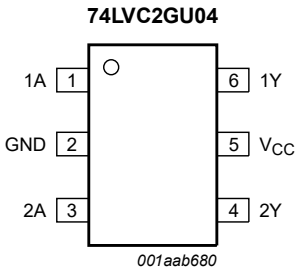
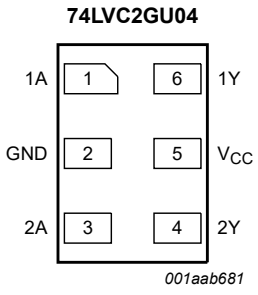


Fig. 4. Pin configuration SOT363-2 (TSSOP6) and SOT457 (SC-74; TSOP6)



Transparent top view

Fig. 5. Pin configuration SOT886 (XSON6)

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_{CC}	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}	-	±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
Δt/ΔV	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_{IH}	HIGH-level input voltage	V_{CC} = 1.65 V to 5.5 V	$0.75V_{CC}$	-	-	$0.8V_{CC}$	-	V
V_{IL}	LOW-level input voltage	V_{CC} = 1.65 V to 5.5 V	-	-	$0.25V_{CC}$	-	$0.2V_{CC}$	V
V_{OH}	HIGH-level output voltage	$V_I = V_{IH}$ or V_{IL}						
		I_O = -100 µA; V_{CC} = 1.65 V to 5.5 V	V_{CC} - 0.1	-	-	V_{CC} - 0.1	-	V
		I_O = -4 mA; V_{CC} = 1.65 V	1.2	-	-	0.95	-	V
		I_O = -8 mA; V_{CC} = 2.3 V	1.9	-	-	1.7	-	V
		I_O = -12 mA; V_{CC} = 2.7 V	2.2	-	-	1.9	-	V
		I_O = -24 mA; V_{CC} = 3.0 V	2.3	-	-	2.0	-	V
		I_O = -32 mA; V_{CC} = 4.5 V	3.8	-	-	3.4	-	V
V_{OL}	LOW-level output voltage	$V_I = V_{IH}$ or V_{IL}						
		I_O = 100 µA; V_{CC} = 1.65 V to 5.5 V	-	-	0.1	-	0.1	V
		I_O = 4 mA; V_{CC} = 1.65 V	-	-	0.45	-	0.7	V
		I_O = 8 mA; V_{CC} = 2.3 V	-	-	0.3	-	0.45	V
		I_O = 12 mA; V_{CC} = 2.7 V	-	-	0.4	-	0.6	V
		I_O = 24 mA; V_{CC} = 3.0 V	-	-	0.55	-	0.8	V
		I_O = 32 mA; V_{CC} = 4.5 V	-	-	0.55	-	0.8	V
I_I	input leakage current	V_I = 5.5 V or GND; V_{CC} = 0 V to 5.5 V	-	±0.1	±1	-	±1	µA
I_{CC}	supply current	V_I = 5.5 V or GND; I_O = 0 A; V_{CC} = 1.65 V to 5.5 V	-	0.1	4	-	4	µA
C_I	input capacitance	V_{CC} = 3.3 V; V_I = GND to V_{CC}	-	5	-	-	-	pF

[1] All typical values are measured at V_{CC} = 3.3 V and at T_{amb} = 25 °C.

11. Dynamic characteristics

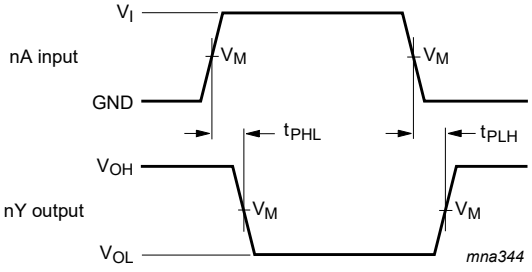
Table 8. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V). For test circuit see Fig. 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 to nY; see Fig. 6 [2]						
		V_{CC} = 1.65 V to 1.95 V	0.5	2.3	5.0	0.5	6.3	ns
		V_{CC} = 2.3 V to 2.7 V	0.3	1.8	4.0	0.3	5.0	ns
		V_{CC} = 2.7 V	0.3	2.6	4.5	0.3	5.6	ns
		V_{CC} = 3.0 V to 3.6 V	0.3	2.3	3.7	0.3	4.5	ns
		V_{CC} = 4.5 V to 5.5 V	0.3	1.7	3.0	0.3	3.8	ns
C_{PD}	power dissipation capacitance	V_I = GND to V_{CC}; V_{CC} = 3.3 V [3]	-	7.8	-			pF

[1] Typical values are measured at T_{amb} = 25 °C and V_{CC} = 1.8 V, 2.5 V, 2.7 V, 3.3 V and 5.0 V respectively.
[2] t_{pd} is the same as t_{PLH} and t_{PHL}.
[3] C_{PD} is used to determine the dynamic power dissipation (P_D in µW).
$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \sum(C_L \times V_{CC}^2 \times f_o)$ 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;
$\sum(C_L \times V_{CC}^2 \times f_o)$ = sum of outputs.

11.1. Waveforms and test circuit

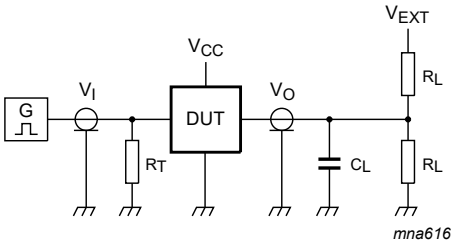


Measurement points are given in Table 9.
V_{OL} and V_{OH} are typical output voltage drop that occur with the output load.

Fig. 6. The input (nA) to output (nY) propagation delay times

Table 9. Measurement points

Supply voltage	Input	Output
V_{CC}	V_M	V_M
1.65 V to 1.95 V	0.5 × V_{CC}	0.5 × V_{CC}
2.3 V to 2.7 V	0.5 × V_{CC}	0.5 × V_{CC}
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_{CC}	0.5 × V_{CC}



Test data is given in Table 10.

Definitions for test circuit:

R_L = Load resistance;

C_L = Load capacitance including jig and probe capacitance;

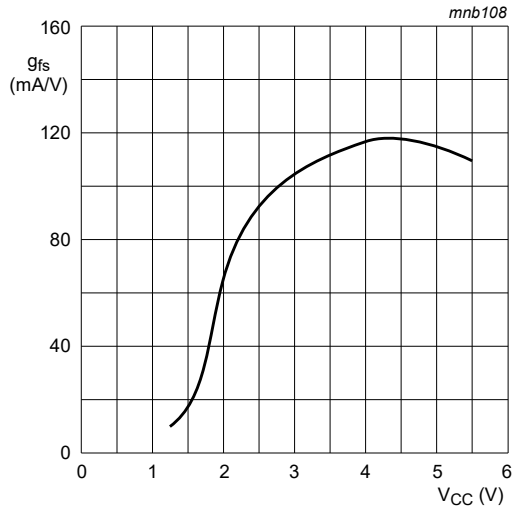
R_T = Termination resistance should be equal to the output impedance Z_o of the pulse generator;

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

Fig. 7. Test circuit for measuring switching times

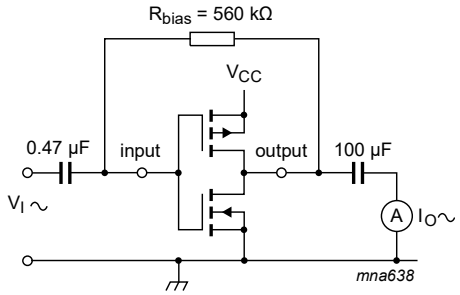
Table 10. Test data

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}	≤ 2.0 ns	30 pF	1 kΩ	open
2.3 V to 2.7 V	V_{CC}	≤ 2.0 ns	30 pF	500 Ω	open
2.7 V	2.7 V	≤ 2.5 ns	50 pF	500 Ω	open
3.0 V to 3.6 V	2.7 V	≤ 2.5 ns	50 pF	500 Ω	open
4.5 V to 5.5 V	V_{CC}	≤ 2.5 ns	50 pF	500 Ω	open



T_{amb} = 25 °C.

Fig. 8. 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.

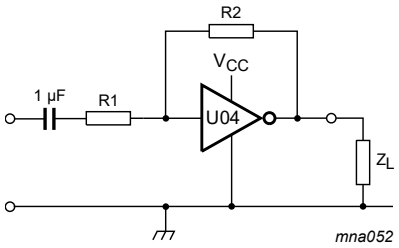
Fig. 9. Test set-up for measuring forward transconductance

12. Application information

Some applications are:

- Linear amplifier (see Fig. 10)
- In crystal oscillator design (see Fig. 11)

Remark: All values given are typical unless otherwise specified.



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

$$A_u = -\frac{G_{OL}}{1 + \frac{R1}{R2}\left(1 + G_{OL}\right)}$$

G_{OL} = open loop gain.

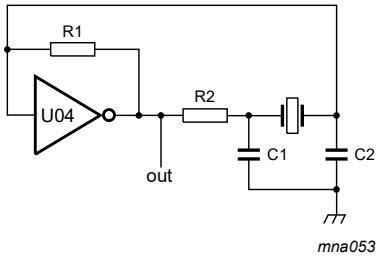
A_u = voltage amplification.

R1 ≥ 3 kΩ, R2 ≤ 1 MΩ.

Z_L > 10 kΩ; G_{OL} = 20 (typical).

Typical unity gain bandwidth product is 5 MHz.

Fig. 10. Linear amplifier configuration



C1 = 47 pF (typical).

C2 = 22 pF (typical).

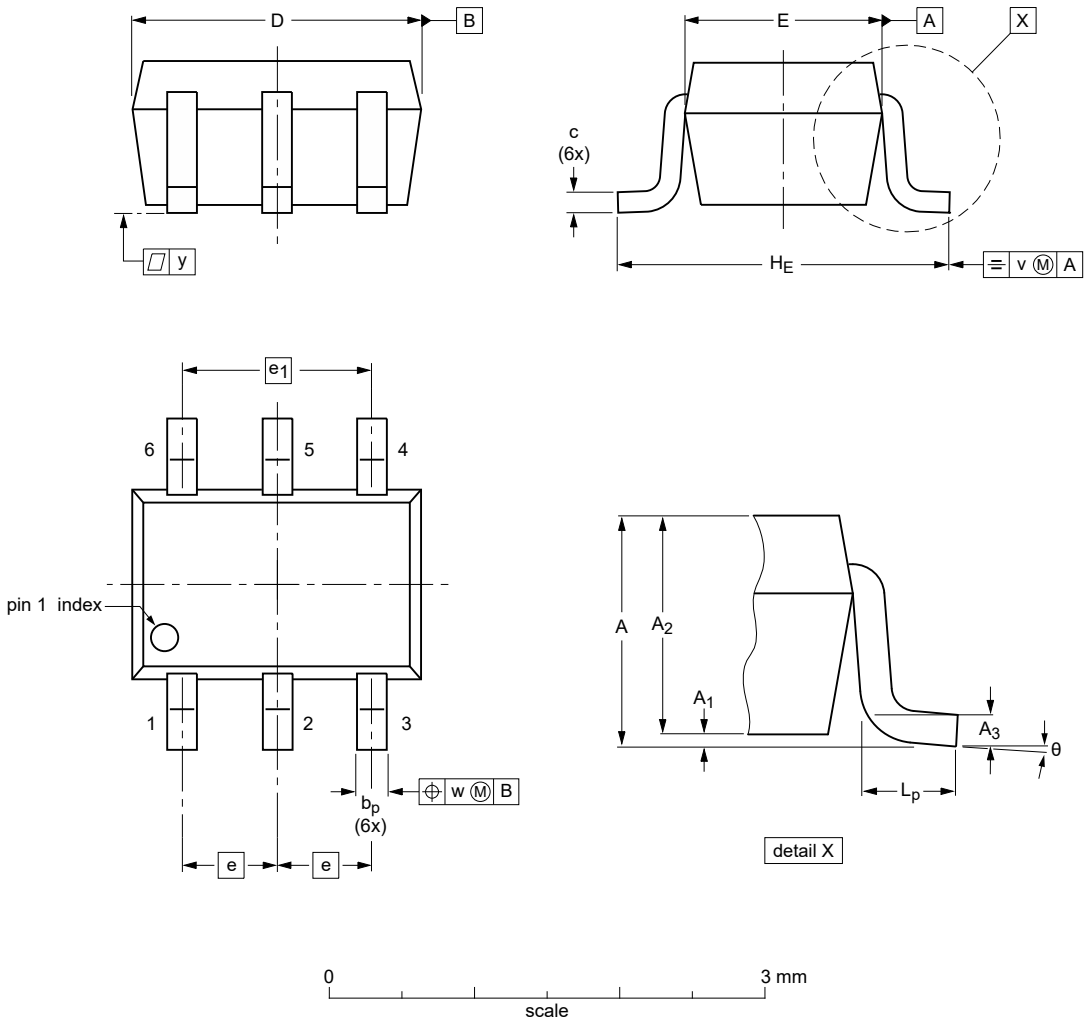
R1 = 1 MΩ to 10 MΩ (typical).

R2 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 V and f = 10 MHz).

Fig. 11. Crystal oscillator configuration

13. Package outline

TSSOP6: plastic thin shrink small outline package; 6 leads; body width 1.25 mm **SOT363-2**



Dimensions (mm are the original dimensions)

Unit		A	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	e_1	H_E	L_p	v	w	y	θ
mm	max	1.1	0.1	1.0	0.15	0.30	0.25	2.2	1.35	0.65	1.3	2.4	0.46	0.3	0.1	0.1	8°
	min	0.8	0	0.8		0.15	0.08	1.8	1.15			1.8	0.26				0°

Note

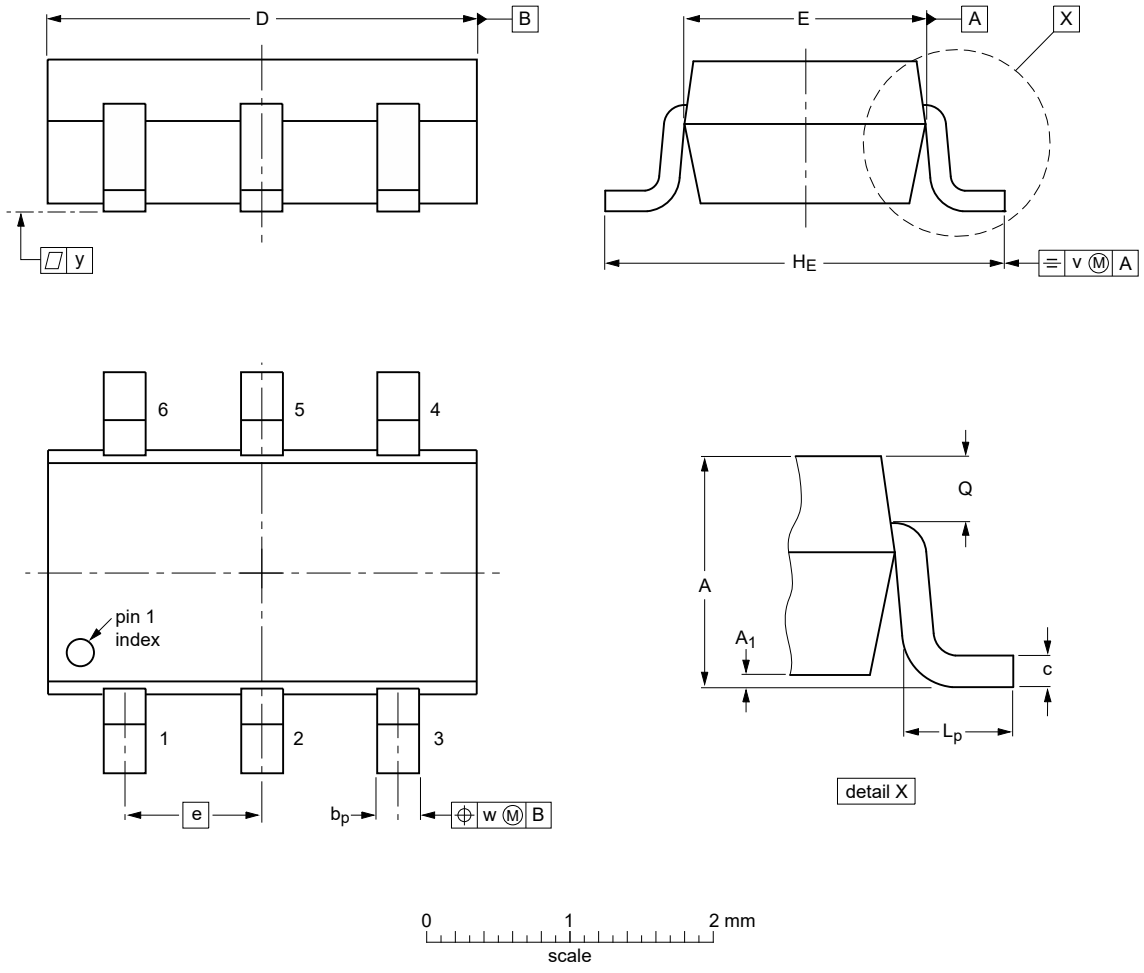
1. Plastic or metal protrusions of 0.2 mm maximum per side are not included.

sot363-2_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT363-2		MO-203	SC-88A			~~21-12-15~~ 21-12-16

Fig. 12. Package outline SOT363-2 (TSSOP6)

Plastic, surface-mounted package (SC-74; TSOP6); 6 leads **SOT457**



Dimensions (mm are the original dimensions)

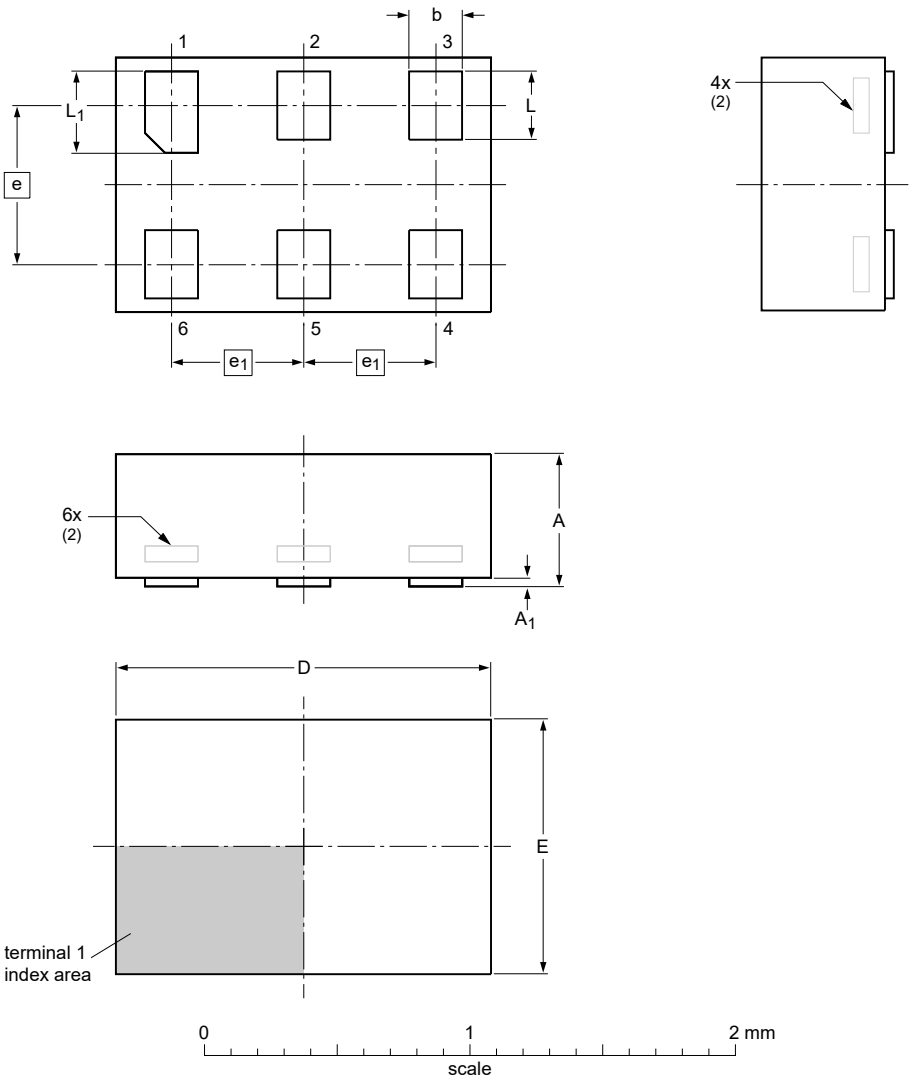
Unit		A	A_1	b_p	c	D	E	e	H_E	L_p	Q	v	w	y
mm	max	1.1	0.1	0.40	0.26	3.1	1.7		3.0	0.6	0.33	0.2	0.2	0.1
	nom							0.95						
	min	0.9	0.013	0.25	0.10	2.7	1.3		2.5	0.2	0.23			

sot457_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT457			SC-74			~~06-03-16~~ 18-11-27

Fig. 13. 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



Dimensions (mm are the original dimensions)

Unit		A(1)	A_1	b	D	E	e	e_1	L	L_1
mm	max	0.5	0.04	0.25	1.50	1.05			0.35	0.40
	nom			0.20	1.45	1.00	0.6	0.5	0.30	0.35
	min			0.17	1.40	0.95			0.27	0.32

Notes
1. Including plating thickness.
2. Can be visible in some manufacturing processes.

sot886_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT886		MO-252				~~04-07-22~~ 12-01-05

Fig. 14. 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
MIL	Military
MM	Machine Model

15. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LVC2GU04_Q100 v.6	20220120	Product data sheet	-	74LVC2GU04_Q100 v.5
Modifications:	• Package SOT363 (SC-88) changed to SOT363-2 (TSSOP6).			
74LVC2GU04_Q100 v.5	20210419	Product data sheet	-	74LVC2GU04_Q100 v.4
Modifications:	• Section 1 updated. • Section 8: Derating values for P_{tot} total power dissipation updated.			
74LVC2GU04_Q100 v.4	20190211	Product data sheet	-	74LVC2GU04_Q100 v.3
Modifications:	• Type number 74LVC2GU04GM-Q100 (SOT886/XSON6) added.			
74LVC2GU04_Q100 v.3	20181009	Product data sheet	-	74LVC2GU04_Q100 v.2
Modifications:	• The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia. • Legal texts have been adapted to the new company name where appropriate. • Section 1: Typo corrected in General description.			
74LVC2GU04_Q100 v.2	20161214	Product data sheet	-	74LVC2GU04_Q100 v.1
Modifications:	• Section 10: The maximum limits for leakage current and supply current have changed.			
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.
[2] The term 'short data sheet' is explained in section "Definitions".
[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the internet at https://www.nexperia.com.

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