74LVCU04A

Hex unbuffered inverter

Rev. 12 — 20 January 2025

Product data sheet

1. General description

The 74LVCU04A is a hex 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.

2. Features and benefits

- Wide supply voltage range from 1.2 V to 3.6 V
- Inputs accept voltages up to 5.5 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:
 - HBM: ANSI/ESDA/JEDEC JS-001 class 2 exceeds 2000 V
 - CDM: ANSI/ESDA/JEDEC JS-002 class C3 exceeds 1000 V
- Specified from -40 °C to +85 °C and -40 °C to +125 °C

3. Ordering information

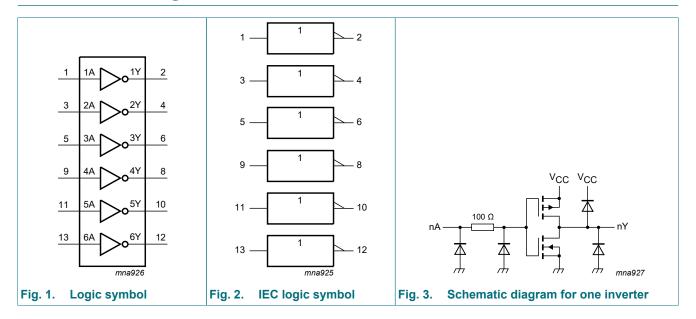
Table 1. Ordering information

Type number	Package						
	Temperature range	Name	Description	Version			
74LVCU04AD	-40 °C to +125 °C	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1			
74LVCU04APW	-40 °C to +125 °C	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	SOT402-1			
74LVCU04ABQ	-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			



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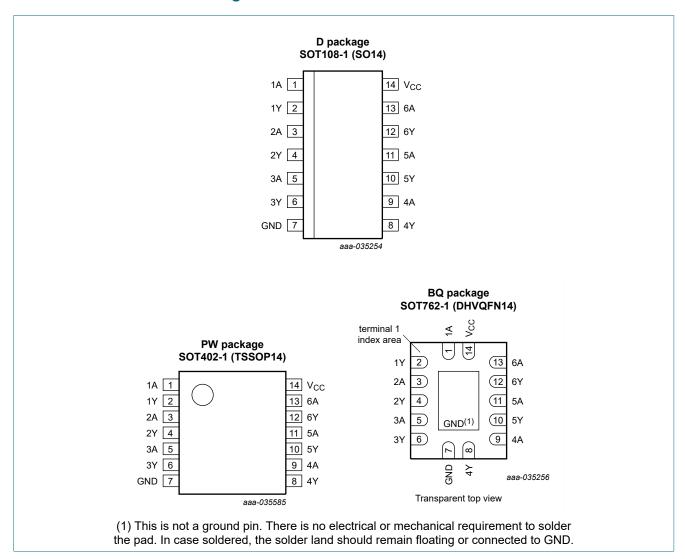
4. Functional diagram



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5. Pinning information

5.1. Pinning



5.2. Pin description

Table 2. Pin description

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

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6. Functional description

Table 3. Function table

H = HIGH voltage level; L = LOW voltage level

Input nA	Output nY
L	Н
Н	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
VI	input voltage		[1]	-0.5	+6.5	V
I _{OK}	output clamping current	$V_O > V_{CC}$ or $V_O < 0$ V		-	±50	mA
Vo	output voltage		[2]	-0.5	V _{CC} + 0.5	V
Io	output current	$V_O = 0 V \text{ to } V_{CC}$		-	±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	[3]	-	500	mW

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

8. Recommended operating conditions

Table 5. Recommended operating conditions

Symbol	Parameter	Conditions	Min	Тур	Max	Unit
V _{CC}	supply voltage		1.65	-	3.6	V
		functional	1.2	-	-	V
VI	input voltage		0	-	5.5	V
Vo	output voltage		0	-	V _{CC}	V
T _{amb}	ambient temperature	in free air	-40	-	+125	°C
Δt/ΔV	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

^[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.

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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 +8	5 °C	-40 °C to	+125 °C	Unit
			Min	Typ [1]	Max	Min	Max	
V _{IH}	HIGH-level	$V_{OL(max)} = 0.5 \text{ V}; I_O = -100 \mu\text{A}$						
	input voltage	V _{CC} = 1.2 V	1.08	-	-	1.12	-	V
		V _{CC} = 1.65 V to 1.95 V	1.3	-	-	1.5	-	V
		V _{CC} = 2.3 V to 2.7 V	1.8	-	-	2.0	-	V
	V _{CC} = 3.0 V	2.0	-	-	2.4	-	V	
		V _{CC} = 3.6 V	2.4	-	-	2.8	-	V
V _{IL} LOW-level input voltage	$V_{OH(min)} = V_{CC} - 0.5 \text{ V};$ $I_O = -100 \mu\text{A}$							
		V _{CC} = 1.2 V	-	-	0.12	-	0.1	V
	V _{CC} = 1.65 V to 1.95 V	-	-	0.6	-	0.4	V	
		V _{CC} = 2.3 V to 2.7 V	-	-	0.6	-	0.5	V
		V _{CC} = 3.0 V	-	-	1.0	-	0.6	V
		V _{CC} = 3.6 V	-	-	1.2	-	0.7	V
V _{OH}	HIGH-level	V _I = GND						
outpu	output voltage	V _{CC} = 3.0 V; I _O = -100 μA	V _{CC} - 0.2	-	-	V _{CC} - 0.3	-	V
		V _{CC} = 1.65 V; I _O = -4 mA	1.2	-	-	1.05	-	V
		V _{CC} = 2.3 V; I _O = -8 mA	1.8	-	-	1.65	-	V
		$V_{CC} = 2.7 \text{ V}; I_{O} = -12 \text{ mA}$	2.2	-	-	2.05	-	V
		$V_{CC} = 3.0 \text{ V}; I_{O} = -18 \text{ mA}$	2.4	-	-	2.25	-	V
		$V_{CC} = 3.0 \text{ V}; I_{O} = -24 \text{ mA}$	2.2	-	-	2.0	-	V
V _{OL}	LOW-level	$V_I = V_{CC}$						
	output voltage	V _{CC} = 3.0 V; I _O = 100 μA	-	-	0.20	-	0.60	V
		V _{CC} = 1.65 V; I _O = 4 mA	-	-	0.45	-	0.65	V
		V _{CC} = 2.3 V; I _O = 8 mA	-	-	0.60	-	0.80	V
		V_{CC} = 2.7 V; I_{O} = 12 mA	-	-	0.40	-	0.60	V
		$V_{CC} = 3.0 \text{ V}; I_{O} = 24 \text{ mA}$	-	-	0.55	-	0.80	V
l _l	input leakage current	V _{CC} = 3.6 V; V _I = 5.5 V or GND	-	±0.1	±5	-	±20	μΑ
I _{CC}	supply current	$V_{CC} = 3.6 \text{ V}; V_{I} = V_{CC} \text{ or GND}; I_{O} = 0 \text{ A}$	-	0.1	10	-	40	μΑ
Δl _{CC}	additional supply current	per input pin; $V_{CC} = 2.7 \text{ V to } 3.6 \text{ V};$ $V_1 = V_{CC} - 0.6 \text{ V}; I_O = 0 \text{ A}$	-	5	500	-	5000	μΑ
C _I	input capacitance	V_{CC} = 0 V to 3.6 V; V_{I} = GND to V_{CC}	-	5.5	-	-	-	pF

^[1] All typical values are measured at V_{CC} = 3.3 V (unless stated otherwise) and T_{amb} = 25 °C.

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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	5 °C	-40 °C to	+125 °C	Unit
				Min	Typ [1]	Max	Min	Max	
t _{pd}	propagation delay	nA to nY; see Fig. 4	[2]						
		V _{CC} = 1.2 V		-	6.0	-	-	-	ns
		V _{CC} = 1.65 V to 1.95 V		0.3	3.7	7.8	0.3	9.0	ns
		V _{CC} = 2.3 V to 2.7 V		0.5	2.2	4.4	0.5	5.2	ns
		V _{CC} = 2.7 V		0.5	2.0	4.5	0.5	6.0	ns
		V _{CC} = 3.0 V to 3.6 V		0.5	2.0	4.0	0.5	5.0	ns
t _{sk(o)}	output skew time	V _{CC} = 3.0 V to 3.6 V	[3]	-	-	1.0	-	1.5	ns
C _{PD}	power dissipation	per inverter; V_I = GND to V_{CC}	[4]						
	capacitance	V _{CC} = 1.65 V to 1.95 V		-	2.3	-	-	-	pF
		V _{CC} = 2.3 V to 2.7 V		-	5.5	-	-	-	pF
		V _{CC} = 3.0 V to 3.6 V		-	8.4	-	-	-	pF

- [1] Typical values are measured at T_{amb} = 25 °C and V_{CC} = 1.2 V, 1.8 V, 2.5 V, 2.7 V, and 3.3 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 μ 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_o = output frequency in MHz

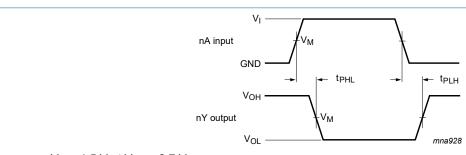
C_L = output load capacitance in pF

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



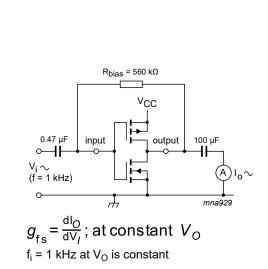
 V_M = 1.5 V at $V_{CC} \ge 2.7$ V;

 $V_{M} = 0.5 \times V_{CC} \text{ at } V_{CC} < 2.7 \text{ V};$

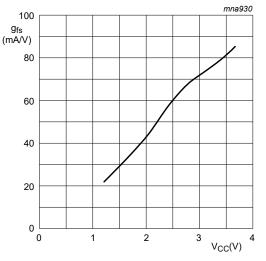
V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.

Fig. 4. Input (nA) to output (nY) propagation delays

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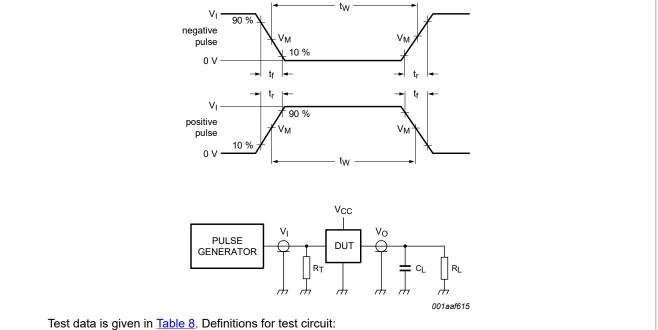


Test setup for measuring forward Fig. 5. transconductance



 $T_{amb} = 25 \, ^{\circ}C$

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



 R_{I} = Load resistance.

C_L = Load capacitance including jig and probe capacitance.

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

Test circuit for measuring switching times Fig. 7.

Table 8. Test data

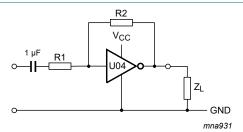
Supply voltage	Input		Load	
V _{CC}	V _I	t _r , t _f	CL	R _L
1.2 V	V _{CC}	≤ 2 ns	30 pF	1 kΩ
1.65 V to 1.95 V	V _{CC}	≤ 2 ns	30 pF	1 kΩ
2.3 V to 2.7 V	V _{CC}	≤ 2 ns	30 pF	500 Ω
2.7 V	2.7 V	≤ 2.5 ns	50 pF	500 Ω
3.0 V to 3.6 V	2.7 V	≤ 2.5 ns	50 pF	500 Ω

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11. Application information

Some applications for the 74LVCU04A are:

- Linear amplifier: see Fig. 8
- · Crystal oscillator designs; see Fig. 9
- Astable multivibrator; see Fig. 10



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

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

G_{OL} = loop gain.

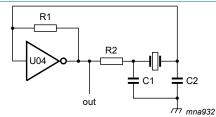
A_u = voltage amplification.

 $R1 \ge 3 \text{ k}\Omega, R2 \le 1 \text{ M}\Omega$

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

Typical unity gain bandwidth product is 5 MHz.

Fig. 8. 74LVCU04A used as linear amplifier



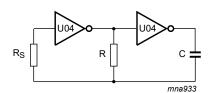
 $C_1 = 47 pF (typical)$

 C_2 = 22 pF (typical)

 $R_1 = 1$ to 10 M Ω (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 at V_{CC} = 3 V and f = 1 MHz)

Fig. 9. 74LVCU04A used as crystal oscillator



 $f = \frac{1}{T} \approx \frac{1}{2.2RC}$

 $R_S \approx 2R$.

The average I_{CC} is approximately 3.5 + 0.05 f (MHz) × C (pF) [mA] at V_{CC} = 3.0 V.

Fig. 10. 74LVCU04A used as astable multivibrator

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12. Package outline

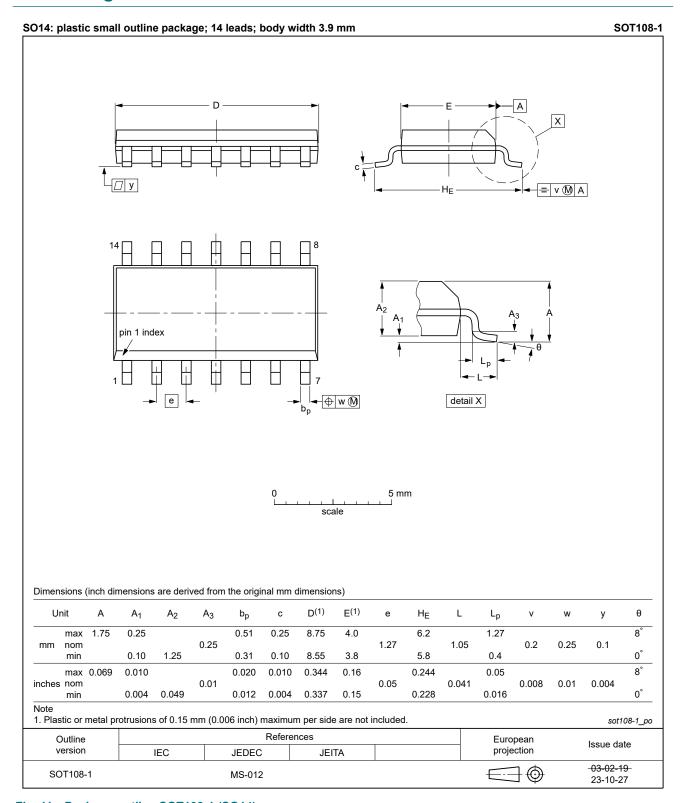


Fig. 11. Package outline SOT108-1 (SO14)

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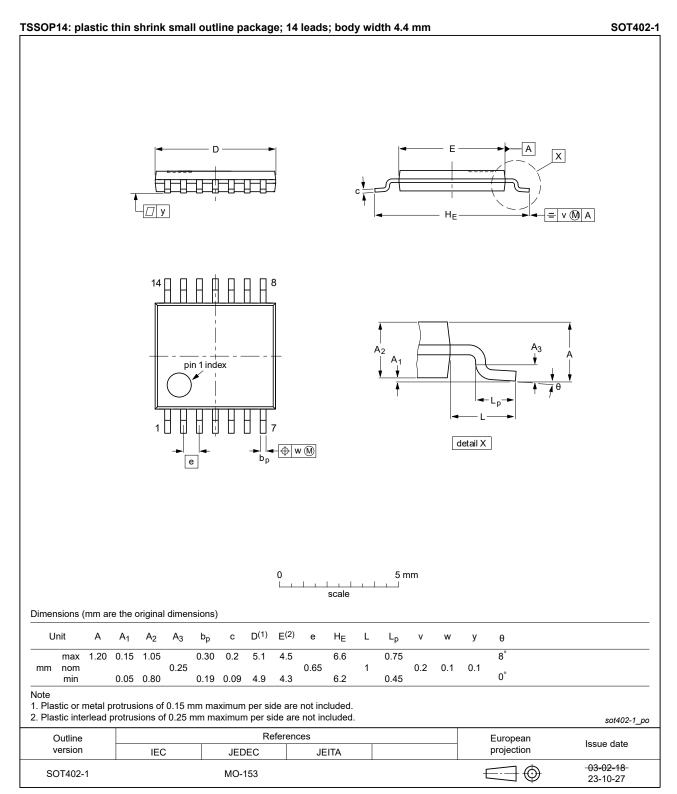


Fig. 12. Package outline SOT402-1 (TSSOP14)

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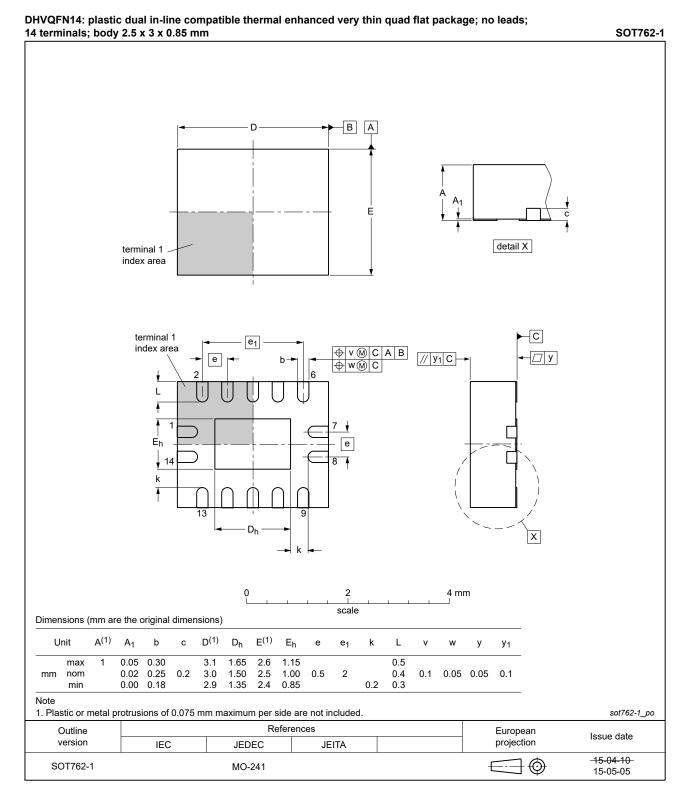


Fig. 13. Package outline SOT762-1 (DHVQFN14)

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13. Abbreviations

Table 9. Abbreviations

Acronym	Description
CDM	Charged Device Model
CMOS	Complementary Metal-Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
TTL	Transistor-Transistor Logic

14. Revision history

Table 10. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LVCU04A v.12	20250120	Product data sheet	-	74LVCU04A v.11
Modifications:	• <u>Table 6</u> : V _C	_{L(max)} at T _{amb} = +125 °C	and V _{CC} = 2.7 V ch	anged to 0.6 V.
74LVCU04A v.11	20240228	Product data sheet	-	74LVCU04A v.10
Modifications:	• Fig. 11, Fig and MO-15	•	SOP package outlin	e drawings to JEDEC MS-012
74LVCU04A v.10	20230830	Product data sheet	-	74LVCU04A v.9
Modifications:	Section 1 uSection 2: I	pdated. ESD specification update	d according to the la	atest JEDEC standard.
74LVCU04A v.9	20210331	Product data sheet	-	74LVCU04A v.8
	Legal textsType numbSection 1 u	of Nexperia. have been adapted to th er 74LVCU04ADB (SOT) pdated. Derating values for P _{tot} to	337-1 / SSOP14) re	moved.
74LVCU04A v.8	20151218	Product data sheet	-	74LVCU04A v.7
Modifications:	Descriptive	title updated. Added "un	buffered" (errata).	
74LVCU04A v.7	20111117	Product data sheet	-	74LVCU04A v.6
Modifications:	Legal page<u>Table 6</u>, bo	s updated. dyrow Δl _{CC} : condition V _C	_C changed.	
74LVCU04A v.6	20110809	Product data sheet	-	74LVCU04A v.5
	20040312	Product specification	-	
74LVCU04A v.5	20040012	•		74LVCU04A v.4
	20030901	Product specification	-	74LVCU04A v.4 74LVCU04A v.3
74LVCU04A v.4		·	-	
74LVCU04A v.5 74LVCU04A v.4 74LVCU04A v.3 74LVCU04A v.2	20030901	Product specification	-	74LVCU04A v.3

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15. 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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