

74LVC2GU04-Q100

Dual inverter

Rev. 1 — 31 July 2012

Product data sheet

1. General description

The 74LVC2GU04 provides two inverters. Each inverter is a single stage with unbuffered output.

The inputs can be driven from either 3.3 V or 5 V devices. This feature allows the use of this device in a mixed 3.3 V and 5 V environment.

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 $-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$ and from $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$
- Wide supply voltage range from 1.65 V to 5.5 V
- 5 V tolerant input/output for interfacing with 5 V logic
- High noise immunity
- ESD protection:
 - ◆ MIL-STD-883, method 3015 exceeds 2000 V
 - ◆ HBM JESD22-A114F exceeds 2000 V
 - ◆ MM JESD22-A115-A exceeds 200 V ($C = 200\text{ pF}$, $R = 0\text{ }\Omega$)
- $\pm 24\text{ mA}$ output drive ($V_{CC} = 3.0\text{ V}$)
- CMOS low power consumption
- Latch-up performance exceeds 250 mA
- Input accepts voltages up to 5 V
- Multiple package options

3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74LVC2GU04GW-Q100	$-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$	SC-88	plastic surface-mounted package; 6 leads	SOT363
74LVC2GU04GV-Q100	$-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$	TSOP6	plastic surface-mounted package (TSOP6); 6 leads	SOT457



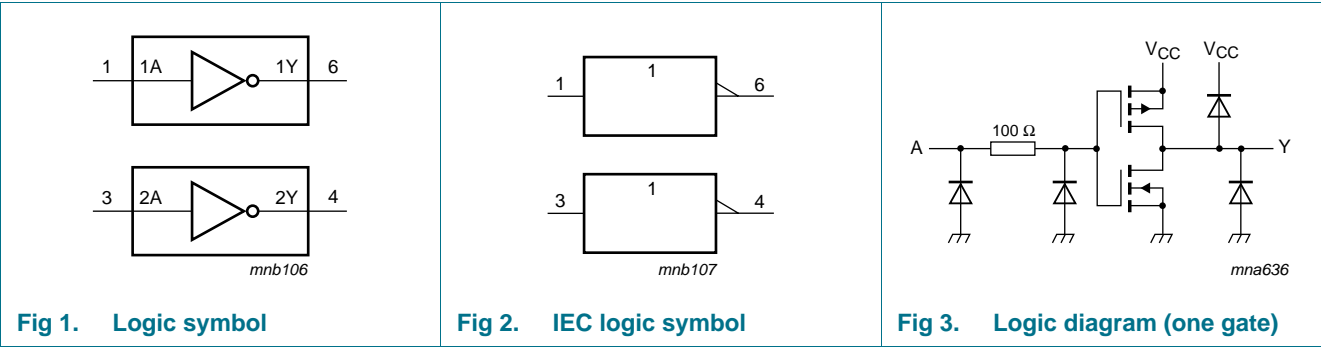
4. Marking

Table 2. Marking codes

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

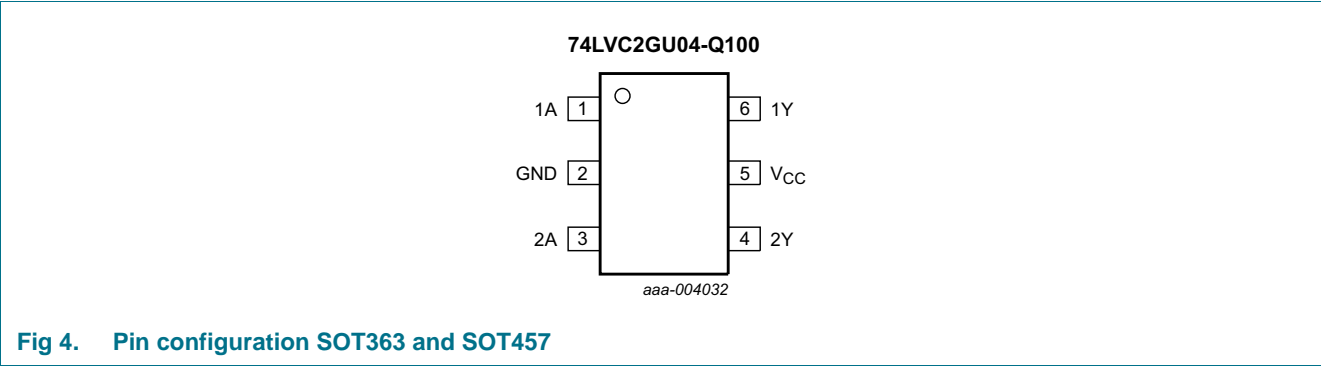
[1] The pin 1 indicator is located on the lower left corner of the device, below the marking code.

5. Functional diagram



6. Pinning information

6.1 Pinning



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^[1]

Input	Output
nA	nY
L	H
H	L

[1] H = HIGH voltage level; L = LOW voltage level.

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][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
T _{stg}	storage temperature		-65	+150	°C
P _{tot}	total power dissipation	T _{amb} = -40 °C to +125 °C	^[3] -	250	mW

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

[2] When V_{CC} = 0 V (Power-down mode), the output voltage can be 5.5 V in normal operation.

[3] For SC-88 and SC-74 packages: above 87.5 °C the value of P_{tot} derates linearly with 4.0 mW/K.

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	$V_{CC} = 1.65 \text{ V to } 2.7 \text{ V}$	-	-	20	ns/V
		$V_{CC} = 2.7 \text{ V to } 5.5 \text{ V}$	-	-	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	Min	Typ	Max	Unit
$T_{amb} = -40 \text{ °C to } +85 \text{ °C}$ [1]						
V_{IH}	HIGH-level input voltage	$V_{CC} = 1.65 \text{ V to } 5.5 \text{ V}$	$0.75 \times V_{CC}$	-	-	V
V_{IL}	LOW-level input voltage	$V_{CC} = 1.65 \text{ V to } 5.5 \text{ V}$	-	-	$0.25 \times V_{CC}$	V
V_{OH}	HIGH-level output voltage	$V_I = V_{IH} \text{ or } V_{IL}$				
		$I_O = -100 \text{ }\mu\text{A};$ $V_{CC} = 1.65 \text{ V to } 5.5 \text{ V}$	$V_{CC} - 0.1$	-	-	V
		$I_O = -4 \text{ mA}; V_{CC} = 1.65 \text{ V}$	1.2	-	-	V
		$I_O = -8 \text{ mA}; V_{CC} = 2.3 \text{ V}$	1.9	-	-	V
		$I_O = -12 \text{ mA}; V_{CC} = 2.7 \text{ V}$	2.2	-	-	V
		$I_O = -24 \text{ mA}; V_{CC} = 3.0 \text{ V}$	2.3	-	-	V
		$I_O = -32 \text{ mA}; V_{CC} = 4.5 \text{ V}$	3.8	-	-	V
V_{OL}	LOW-level output voltage	$V_I = V_{IH} \text{ or } V_{IL}$				
		$I_O = 100 \text{ }\mu\text{A};$ $V_{CC} = 1.65 \text{ V to } 5.5 \text{ V}$	-	-	0.1	V
		$I_O = 4 \text{ mA}; V_{CC} = 1.65 \text{ V}$	-	-	0.45	V
		$I_O = 8 \text{ mA}; V_{CC} = 2.3 \text{ V}$	-	-	0.3	V
		$I_O = 12 \text{ mA}; V_{CC} = 2.7 \text{ V}$	-	-	0.4	V
		$I_O = 24 \text{ mA}; V_{CC} = 3.0 \text{ V}$	-	-	0.55	V
		$I_O = 32 \text{ mA}; V_{CC} = 4.5 \text{ V}$	-	-	0.55	V
I_I	input leakage current	$V_I = 5.5 \text{ V or GND};$ $V_{CC} = 0 \text{ V to } 5.5 \text{ V}$	[2] -	± 0.1	± 5	μA
I_{CC}	supply current	$V_I = 5.5 \text{ V or GND}; I_O = 0 \text{ A};$ $V_{CC} = 1.65 \text{ V to } 5.5 \text{ V}$	-	0.1	10	μA
C_I	input capacitance	$V_{CC} = 3.3 \text{ V}; V_I = \text{GND to } V_{CC}$	-	5	-	pF

Table 7. Static characteristics ...continued

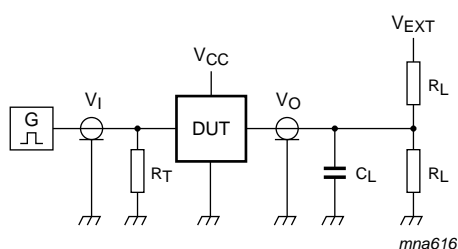
At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
T_{amb} = -40 °C to +125 °C						
V _{IH}	HIGH-level input voltage	V _{CC} = 1.65 V to 5.5 V	0.8 × V _{CC}	-	-	V
V _{IL}	LOW-level input voltage	V _{CC} = 1.65 V to 5.5 V	-	-	0.2 × V _{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
		I _O = -4 mA; V _{CC} = 1.65 V	0.95	-	-	V
		I _O = -8 mA; V _{CC} = 2.3 V	1.7	-	-	V
		I _O = -12 mA; V _{CC} = 2.7 V	1.9	-	-	V
		I _O = -24 mA; V _{CC} = 3.0 V	2.0	-	-	V
		I _O = -32 mA; V _{CC} = 4.5 V	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	V
		I _O = 4 mA; V _{CC} = 1.65 V	-	-	0.7	V
		I _O = 8 mA; V _{CC} = 2.3 V	-	-	0.45	V
		I _O = 12 mA; V _{CC} = 2.7 V	-	-	0.6	V
		I _O = 24 mA; V _{CC} = 3.0 V	-	-	0.8	V
		I _O = 32 mA; V _{CC} = 4.5 V	-	-	0.8	V
I _I	input leakage current	V _I = 5.5 V or GND; V _{CC} = 0 V to 5.5 V	-	-	±20	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	-	-	40	μA

[1] All typical values are measured at T_{amb} = 25 °C.[2] These typical values are measured at V_{CC} = 3.3 V.

Table 9. Measurement points

Supply voltage	Input	Output
V_{CC}	V_M	V_M
1.65 V to 1.95 V	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$
2.3 V to 2.7 V	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$
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	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$



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 6. 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 k Ω	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

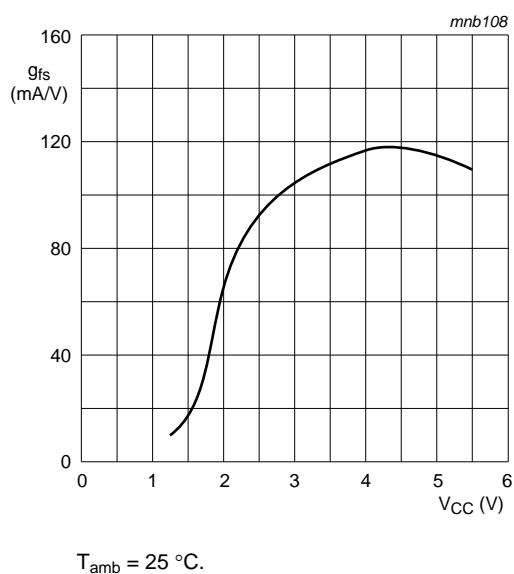
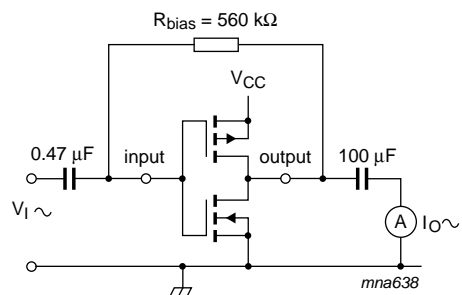


Fig 7. Typical forward transconductance as a function of supply voltage



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

 $f_j = 1 \text{ kHz.}$

V_O is constant.

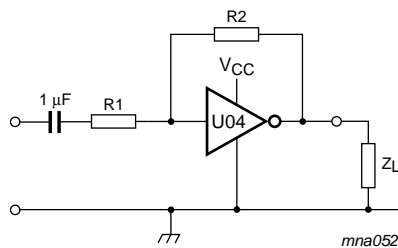
Fig 8. Test set-up for measuring forward transconductance

13. Application information

Some applications are:

- Linear amplifier (see [Figure 9](#))
- Crystal oscillator design (see [Figure 10](#))

Remark: All values given are typical unless otherwise specified.



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

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

G_{OL} = open loop gain.

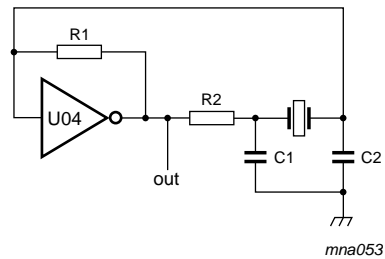
A_u = voltage amplification.

$R1 \geq 3 \text{ k}\Omega$, $R2 \leq 1 \text{ M}\Omega$.

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

Typical unity gain bandwidth product is 5 MHz.

Fig 9. Linear amplifier configuration



$C1 = 47 \text{ pF}$ (typical).

$C2 = 22 \text{ pF}$ (typical).

$R1 = 1 \text{ M}\Omega$ to $10 \text{ M}\Omega$ (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 at $V_{CC} = 3.3 \text{ V}$ and $f = 10 \text{ MHz}$).

Fig 10. Crystal oscillator configuration

14. Package outline

Plastic surface-mounted package; 6 leads SOT363

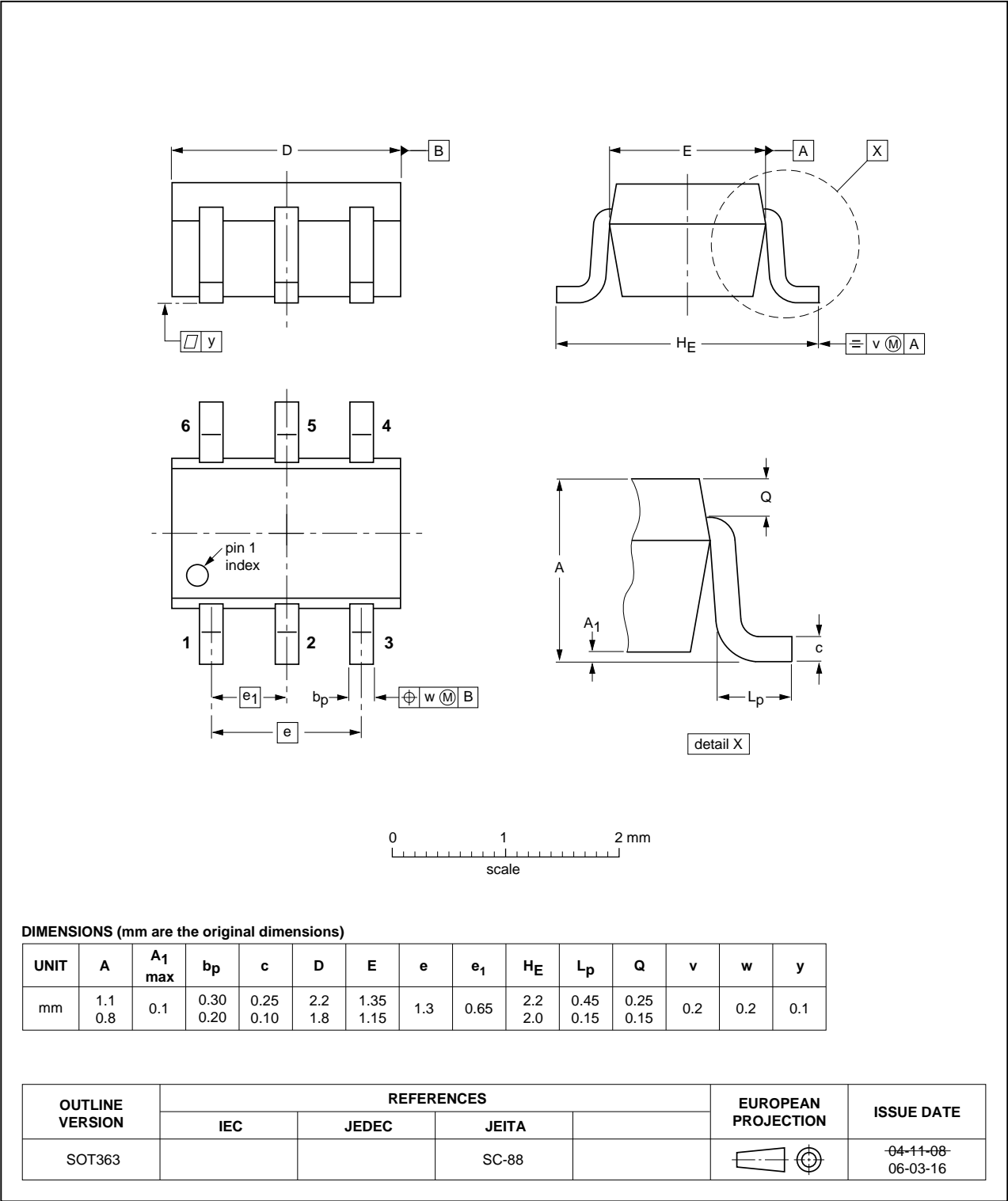


Fig 11. Package outline SOT363 (SC-88)

Plastic surface-mounted package (TSOP6); 6 leads

SOT457

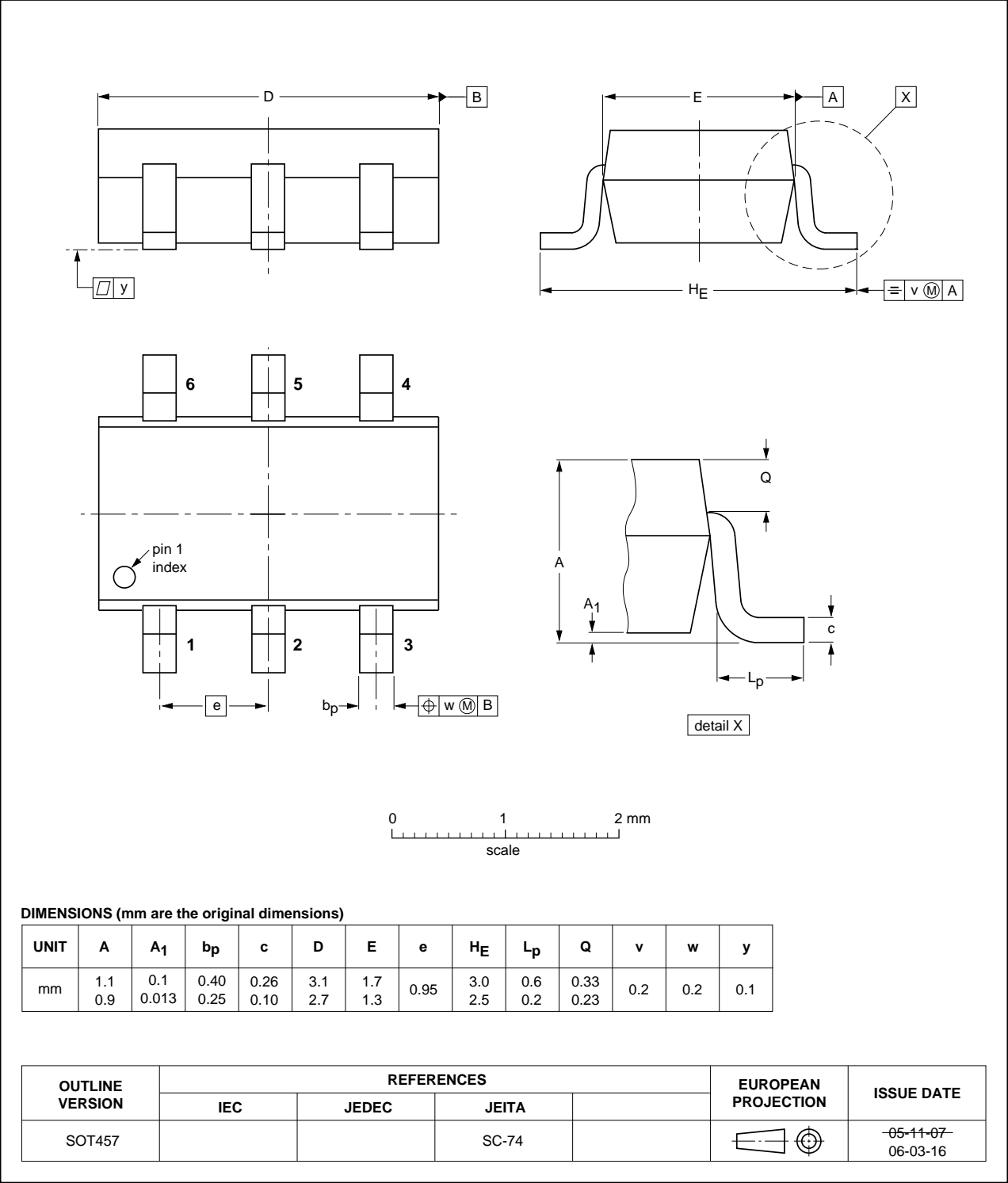


Fig 12. Package outline SOT457 (TSOP6)

15. Abbreviations

Table 11. Abbreviations

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

16. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LVC2GU04_Q100 v.1	20120731	Product data sheet	-	-

17. Legal information

17.1 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.
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Product [short] data sheet	Production	This document contains the product specification.

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[2] The term 'short data sheet' is explained in section "Definitions".

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