74LVC2G14-Q100

Dual inverting Schmitt trigger with 5 V tolerant input

Rev. 1 — 15 November 2013 Product data sheet

1. General description

The 74LVC2G14-Q100 provides two inverting buffers with Schmitt-trigger input. It can transform slowly changing input signals into sharply defined, jitter-free output signals.

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. Schmitt-trigger action at the inputs makes the circuit tolerant of slower input rise and fall time. This device is fully specified for partial power-down applications using I_{OFF}. The I_{OFF} circuitry disables the output, preventing the damaging backflow current through the device when it is powered down.

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
- 5 V tolerant inputs for interfacing with 5 V logic
- High noise immunity
- Complies with JEDEC standard:
  - JESD8-7 (1.65 V to 1.95 V)
  - JESD8-5 (2.3 V to 2.7 V)
  - JESD8B/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)
- ±24 mA output drive (V_{CC} = 3.0 V)
- CMOS low power consumption
- Latch-up performance exceeds 250 mA
- Direct interface with TTL levels
- Unlimited rise and fall times
- Input accepts voltages up to 5 V
- Multiple package options

3. Applications

- Wave and pulse shaper

- Astable multivibrator
- Monostable multivibrator

4. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74LVC2G14GW-Q100	–40 °C to +125 °C	SC-88	plastic surface-mounted package; 6 leads	SOT363
74LVC2G14GV-Q100	–40 °C to +125 °C	TSOP6	plastic surface-mounted package (TSOP6); 6 leads	SOT457

5. Marking

Table 2. Marking codes

Type number	Marking code[1]
74LVC2G14GW-Q100	VK
74LVC2G14GV-Q100	V14

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

6. Functional diagram

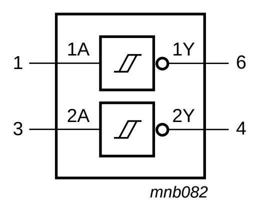


Fig 1. Logic symbol

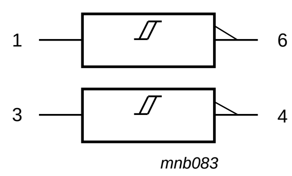


Fig 2. IEC logic symbol

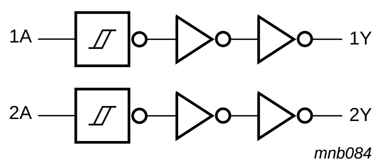


Fig 3. Logic diagram

7. Pinning information

7.1 Pinning

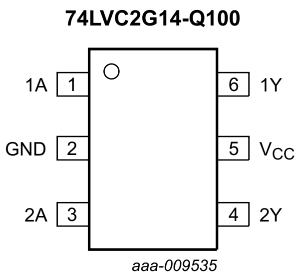


Fig 4. Pin configuration SOT363 and SOT457

7.2 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 input

8. Functional description

Table 4. Function table[1]

Input	Output
nA	**nY**
L	H
H	L

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

9. 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	$V_O > V_{CC}$ or $V_O < 0$ V		-	±50	mA
V_O	output voltage	Active mode	[1][2]	–0.5	V_{CC} + 0.5	V
		Power-down mode	[1][2]	–0.5	+6.5	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]	-	250	mW
T_{stg}	storage temperature			–65	+150	°C

[1] The 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 TSOP6 packages: above 87.5 °C the value of P_{tot} derates linearly with 4.0 mW/K.

10. Recommended operating conditions

Table 6. Recommended operating conditions

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
		Power-down mode; V_{CC} = 0 V	0	-	5.5	V
T_{amb}	ambient temperature		–40	-	+125	°C

11. Static characteristics

Table 7. Static characteristics

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

Symbol	Parameter	Conditions	Min	Typ [1]	Max	Unit
T_{amb} = –40 °C to +85 °C						
V_{OH}	HIGH-level output voltage	$V_I = V_{T+}$ or V_{T-}				
		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	1.2	-	-	V
		I_O = –8 mA; V_{CC} = 2.3 V	1.9	-	-	V
		I_O = –12 mA; V_{CC} = 2.7 V	2.2	-	-	V
		I_O = –24 mA; V_{CC} = 3.0 V	2.3	-	-	V
		I_O = –32 mA; V_{CC} = 4.5 V	3.8	-	-	V
V_{OL}	LOW-level output voltage	$V_I = V_{T+}$ or V_{T-}				
		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	-	-	0.45	V
		I_O = 8 mA; V_{CC} = 2.3 V	-	-	0.3	V
		I_O = 12 mA; V_{CC} = 2.7 V	-	-	0.4	V
		I_O = 24 mA; V_{CC} = 3.0 V	-	-	0.55	V
		I_O = 32 mA; V_{CC} = 4.5 V	-	-	0.55	V
I_I	input leakage current	V_I = 5.5 V or GND; V_{CC} = 0 V to 5.5 V	-	±0.1	±5	μA
I_{OFF}	power-off leakage current	V_I or V_O = 5.5 V; V_{CC} = 0 V	-	±0.1	±10	μA
I_{CC}	supply current	V_I = 5.5 V or GND; V_{CC} = 1.65 V to 5.5 V; I_O = 0 A	-	0.1	10	μA
ΔI_{CC}	additional supply current	$V_I = V_{CC}$ – 0.6 V; I_O = 0 A; V_{CC} = 2.3 V to 5.5 V	-	5	500	μA
C_I	input capacitance	V_{CC} = 3.3 V; V_I = GND to V_{CC}	-	3.5	-	pF
T_{amb} = –40 °C to +125 °C						
V_{OH}	HIGH-level output voltage	$V_I = V_{T+}$ or V_{T-}				
		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	$V_I = V_{T+}$ or V_{T-}				
		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

Table 7. Static characteristics *…continued*

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

Symbol	Parameter	Conditions	Min	Typ [1]	Max	Unit
I_{OFF}	power-off leakage current	V_I or V_O = 5.5 V; V_{CC} = 0 V	-	-	±20	μA
I_{CC}	supply current	V_I = 5.5 V or GND; V_{CC} = 1.65 V to 5.5 V; I_O = 0 A	-	-	40	μA
ΔI_{CC}	additional supply current	$V_I = V_{CC} - 0.6$ V; I_O = 0 A; V_{CC} = 2.3 V to 5.5 V	-	-	5000	μA

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

Table 8. Transfer characteristics

Voltages are referenced to GND (ground = 0 V; for test circuit, see Figure 6

Symbol	Parameter	Conditions	−40 °C to +85 °C			−40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	
V_{T+}	positive-going threshold voltage	see Figure 7 and Figure 8						
		V_{CC} = 1.8 V	0.70	1.10	1.50	0.70	1.70	V
		V_{CC} = 2.3 V	1.00	1.40	1.80	1.00	2.00	V
		V_{CC} = 3.0 V	1.30	1.76	2.20	1.30	2.40	V
		V_{CC} = 4.5 V	1.90	2.47	3.10	1.90	3.30	V
		V_{CC} = 5.5 V	2.20	2.91	3.60	2.20	3.80	V
V_{T-}	negative-going threshold voltage	see Figure 7 and Figure 8						
		V_{CC} = 1.8 V	0.25	0.61	0.90	0.25	1.10	V
		V_{CC} = 2.3 V	0.40	0.80	1.15	0.40	1.35	V
		V_{CC} = 3.0 V	0.60	1.04	1.50	0.60	1.70	V
		V_{CC} = 4.5 V	1.00	1.55	2.00	1.00	2.20	V
		V_{CC} = 5.5 V	1.20	1.86	2.30	1.20	2.50	V
V_H	hysteresis voltage	$(V_{T+} - V_{T-})$; see Figure 7, Figure 8 and Figure 9						
		V_{CC} = 1.8 V	0.15	0.49	1.00	0.15	1.20	V
		V_{CC} = 2.3 V	0.25	0.60	1.10	0.25	1.30	V
		V_{CC} = 3.0 V	0.40	0.73	1.20	0.40	1.40	V
		V_{CC} = 4.5 V	0.60	0.92	1.50	0.60	1.70	V
		V_{CC} = 5.5 V	0.70	1.02	1.70	0.70	1.90	V

[1] All typical values are measured at T_{amb} = 25 °C

12. Dynamic characteristics

Table 9. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V); for test circuit, see Figure 6.

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 Figure 5	[2]						
		V_{CC} = 1.65 V to 1.95 V		1.0	5.6	11.0	1.0	12.0	ns
		V_{CC} = 2.3 V to 2.7 V		0.5	3.7	6.5	0.5	7.2	ns
		V_{CC} = 2.7 V		0.5	4.1	7.0	0.5	7.7	ns
		V_{CC} = 3.0 V to 3.6 V		0.5	3.9	6.0	0.5	6.7	ns
		V_{CC} = 4.5 V to 5.5 V		0.5	2.7	4.3	0.5	4.7	ns
C_{PD}	power dissipation capacitance	V_I = GND to V_{CC}; V_{CC} = 3.3 V	[3]	-	18.1	-	-	-	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).

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

f_i = input frequency in MHz;

f_o = output frequency in MHz;

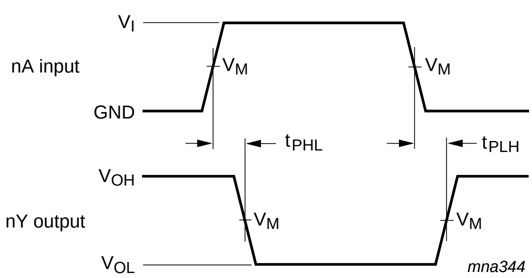
C_L = output load capacitance in pF;

V_{CC} = supply voltage in V;

N = number of inputs switching;

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

13. Waveforms



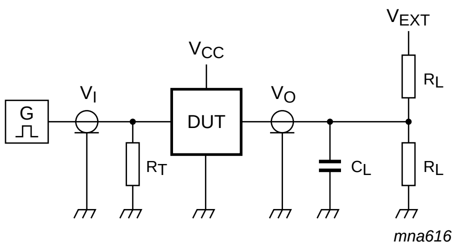
Measurement points are given in Table 10.

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

Fig 5. The data input (nA) to output (nY) propagation delays

Table 10. 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 11.

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. Load circuitry for switching times

Table 11. 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

14. Waveforms transfer characteristics

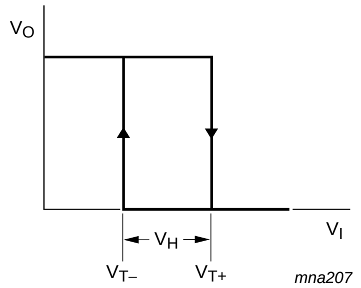
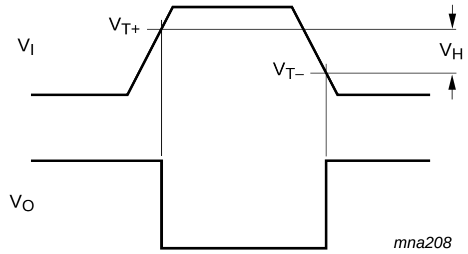
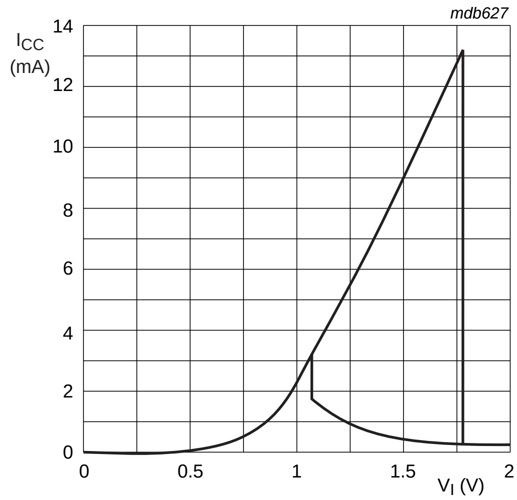


Fig 7. Transfer characteristic



V_{T+} and V_{T-} limits at 70 % and 20 %.

Fig 8. Definition of V_{T+}, V_{T-} and V_H



V_{CC} = 3.0 V

Fig 9. Typical transfer characteristics

15. Application information

The slow input rise and fall times cause additional power dissipation, which can be calculated using the following formula:

$P_{add} = f_i \times (t_r \times \Delta I_{CC(AV)} + t_f \times \Delta I_{CC(AV)}) \times V_{CC}$ where:

P_{add} = additional power dissipation (μW);

f_i = input frequency (MHz);

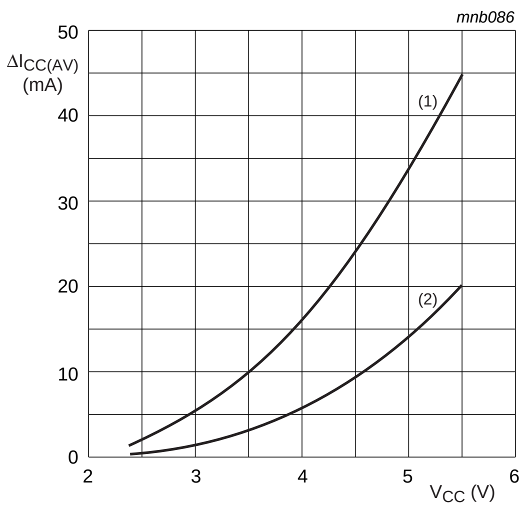
t_r = input rise time (ns); 10 % to 90 %;

t_f = input fall time (ns); 90 % to 10 %;

$\Delta I_{CC(AV)}$ = average additional supply current (μA).

$\Delta I_{CC(AV)}$ differs with positive or negative input transitions, as shown in Figure 10.

An example of a relaxation circuit using the 74LVC2G14-Q100 is shown in Figure 11.

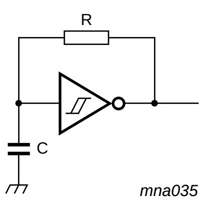


Linear change of V_I between 0.8 V to 2.0 V. All values given are typical unless otherwise specified.

(1) Positive-going edge.

(2) Negative-going edge.

Fig 10. Average I_{CC} as a function of V_{CC}

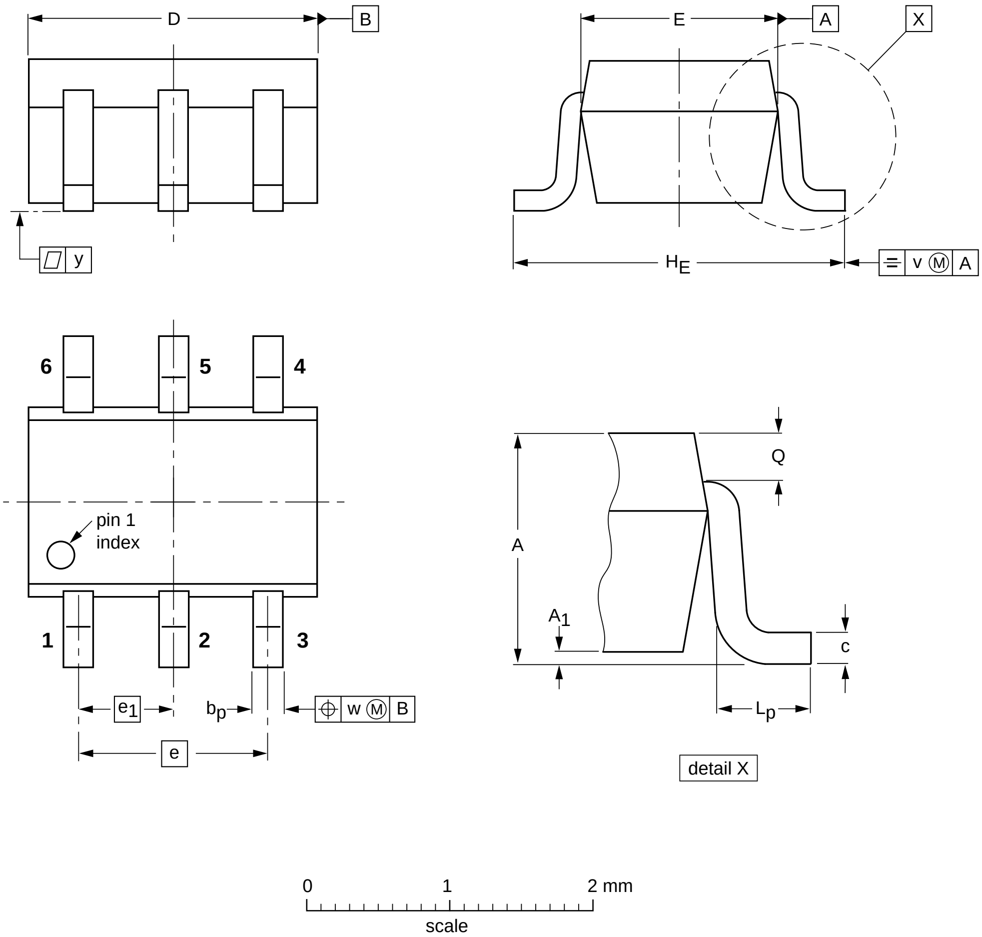


$$f = \frac{1}{T} \approx \frac{1}{0.8 \times RC}$$

Fig 11. Relaxation oscillator

16. Package outline

Plastic surface-mounted package; 6 leads **SOT363**



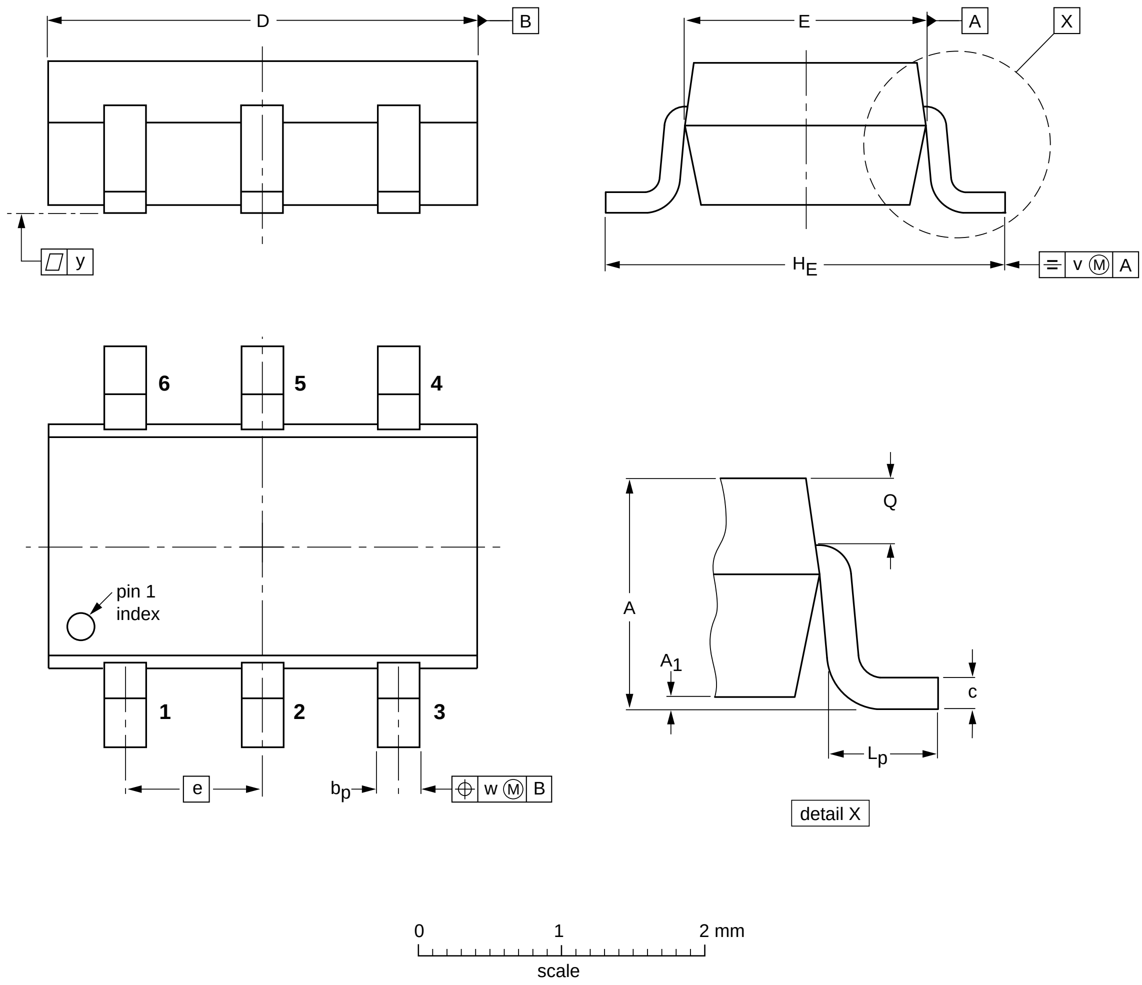
DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1 max	b_p	c	D	E	e	e_1	H_E	L_p	Q	v	w	y
mm	1.1 0.8	0.1	0.30 0.20	0.25 0.10	2.2 1.8	1.35 1.15	1.3	0.65	2.2 2.0	0.45 0.15	0.25 0.15	0.2	0.2	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT363			SC-88			~~04-11-08~~ 06-03-16

Fig 12. Package outline SOT363 (SC-88)

Plastic surface-mounted package (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	1.1 0.9	0.1 0.013	0.40 0.25	0.26 0.10	3.1 2.7	1.7 1.3	0.95	3.0 2.5	0.6 0.2	0.33 0.23	0.2	0.2	0.1

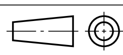
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT457			SC-74			~~05-11-07~~ 06-03-16

Fig 13. Package outline SOT457 (TSOP6)

17. Abbreviations

Table 12. Abbreviations

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

18. Revision history

Table 13. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LVC2G14_Q100 v.1	20131115	Product data sheet	-	-

19. Legal information

19.1 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.
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 URL http://www.nxp.com.

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