

DATA SHEET

74LVC1G14

Single Schmitt-trigger inverter

Product specification
Supersedes data of 2002 Nov 19

2004 Sep 10

Single Schmitt-trigger inverter

74LVC1G14

FEATURES

- Wide supply voltage range from 1.65 V to 5.5 V
- 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).
- ± 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
- ESD protection:
 - HBM EIA/JESD22-A114-B exceeds 2000 V
 - MM EIA/JESD22-A115-A exceeds 200 V.
- Specified from -40 °C to $+85$ °C and -40 °C to $+125$ °C.

DESCRIPTION

The 74LVC1G14 is a high-performance, low-power, low-voltage, Si-gate CMOS device, superior to most advanced CMOS compatible TTL families.

The input 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 input makes the circuit tolerant for 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.

The 74LVC1G14 provides the inverting buffer function with Schmitt-trigger action.

QUICK REFERENCE DATA

Ground = 0 V; $T_{amb} = 25$ °C; $t_r = t_f \leq 2.5$ ns.

SYMBOL	PARAMETER	CONDITIONS	TYPICAL	UNIT
t_{PHL}/t_{PLH}	propagation delay A to Y	$V_{CC} = 1.8$ V; $C_L = 30$ pF; $R_L = 1$ k Ω	4.1	ns
		$V_{CC} = 2.5$ V; $C_L = 30$ pF; $R_L = 500$ Ω	2.8	ns
		$V_{CC} = 3.3$ V; $C_L = 50$ pF; $R_L = 500$ Ω	3.0	ns
		$V_{CC} = 5.0$ V; $C_L = 50$ pF; $R_L = 500$ Ω	2.2	ns
C_I	input capacitance		5	pF
C_{PD}	power dissipation capacitance per buffer	notes 1 and 2	15.4	pF

Notes

1. C_{PD} is used to determine the dynamic power dissipation (P_D in μ W).

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

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 = total switching outputs;

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

2. The condition is $V_I = GND$ to V_{CC} .

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FUNCTION TABLE

See note 1.

INPUT	OUTPUT
A	Y
L	H
H	L

Note

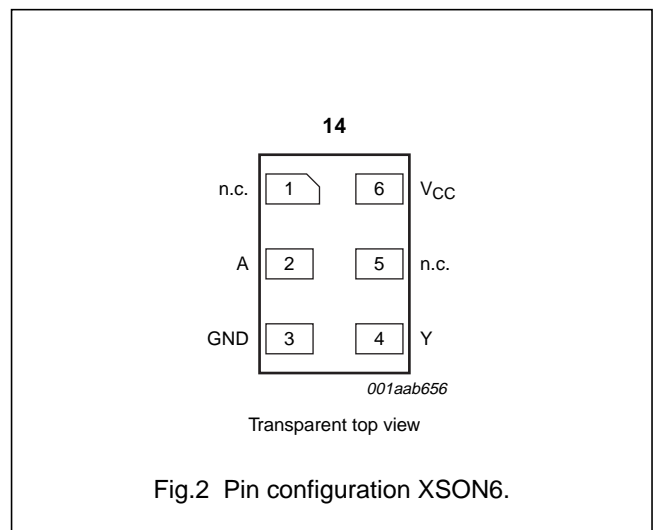
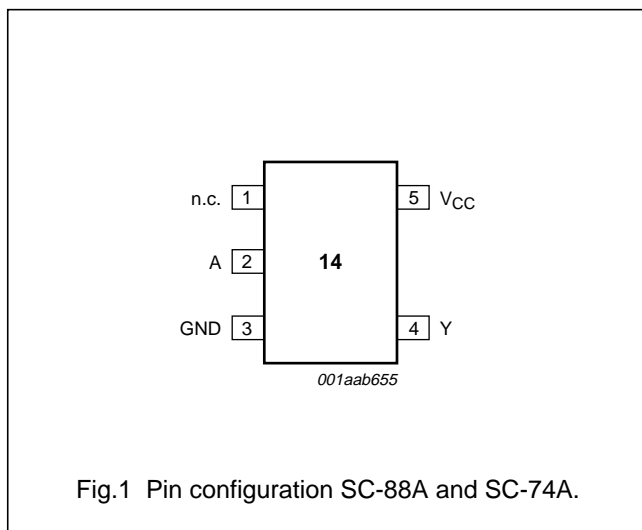
- 1. H = HIGH voltage level;
- L = LOW voltage level.

ORDERING INFORMATION

TYPE NUMBER	PACKAGE					
	TEMPERATURE RANGE	PINS	PACKAGE	MATERIAL	CODE	MARKING
74LVC1G14GW	-40 °C to +125 °C	5	SC-88A	plastic	SOT353	VF
74LVC1G14GV	-40 °C to +125 °C	5	SC-74A	plastic	SOT753	V14
74LVC1G14GM	-40 °C to +125 °C	6	XSON6	plastic	SOT886	VF

PINNING

PIN SC-88A; SC-74A	PIN XSON6	SYMBOL	DESCRIPTION
1	1	n.c.	not connected
2	2	A	data input A
3	3	GND	ground (0 V)
4	4	Y	data output Y
-	5	n.c.	not connected
5	6	V _{CC}	supply voltage



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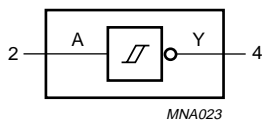


Fig.3 Logic symbol.

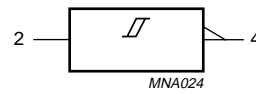


Fig.4 IEE/IEC logic symbol.

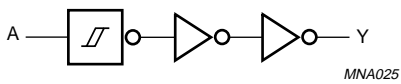


Fig.5 Logic diagram.

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RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	CONDITIONS	MIN.	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}	operating ambient temperature		-40	+125	°C

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 diode current	$V_I < 0$ V	-	-50	mA
V_I	input voltage	note 1	-0.5	+6.5	V
I_{OK}	output diode current	$V_O > V_{CC}$ or $V_O < 0$ V	-	±50	mA
V_O	output voltage	active mode; notes 1 and 2	-0.5	$V_{CC} + 0.5$	V
		Power-down mode; notes 1 and 2	-0.5	+6.5	V
I_O	output source or sink current	$V_O = 0$ V to V_{CC}	-	±50	mA
I_{CC}, I_{GND}	V_{CC} or GND current		-	±100	mA
T_{stg}	storage temperature		-65	+150	°C
P_D	power dissipation	$T_{amb} = -40$ °C to +125 °C	-	250	mW

Notes

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.

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DC CHARACTERISTICS

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

SYMBOL	PARAMETER	TEST CONDITIONS		MIN.	TYP. ⁽¹⁾	MAX.	UNIT
		OTHER	V _{CC} (V)				
T_{amb} = -40 °C to +85 °C							
V _{OL}	LOW-level output voltage	V _I = V _{CC} or GND					
		I _O = 100 μA	1.65 to 5.5	–	–	0.1	V
		I _O = 4 mA	1.65	–	–	0.45	V
		I _O = 8 mA	2.3	–	–	0.3	V
		I _O = 12 mA	2.7	–	–	0.4	V
		I _O = 24 mA	3.0	–	–	0.55	V
		I _O = 32 mA	4.5	–	–	0.55	V
V _{OH}	HIGH-level output voltage	V _I = V _{CC} or GND					
		I _O = -100 μA	1.65 to 5.5	V _{CC} - 0.1	–	–	V
		I _O = -4 mA	1.65	1.2	–	–	V
		I _O = -8 mA	2.3	1.9	–	–	V
		I _O = -12 mA	2.7	2.2	–	–	V
		I _O = -24 mA	3.0	2.3	–	–	V
		I _O = -32 mA	4.5	3.8	–	–	V
I _{LI}	input leakage current	V _I = 5.5 V or GND	3.6	–	±0.1	±5	μA
I _{off}	power OFF leakage current	V _I or V _O = 5.5 V	0	–	±0.1	±10	μA
I _{CC}	quiescent supply current	V _I = V _{CC} or GND; I _O = 0 A	5.5	–	0.1	10	μA
ΔI _{CC}	additional quiescent supply current per pin	V _I = V _{CC} - 0.6 V; I _O = 0 A	2.3 to 5.5	–	5	500	μA

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SYMBOL	PARAMETER	TEST CONDITIONS		MIN.	TYP. ⁽¹⁾	MAX.	UNIT
		OTHER	V _{CC} (V)				
T_{amb} = -40 °C to +125 °C							
V _{OL}	LOW-level output voltage	V _I = V _{CC} or GND					
		I _O = 100 μA	1.65 to 5.5	–	–	0.1	V
		I _O = 4 mA	1.65	–	–	0.7	V
		I _O = 8 mA	2.3	–	–	0.45	V
		I _O = 12 mA	2.7	–	–	0.6	V
		I _O = 24 mA	3.0	–	–	0.8	V
V _{OH}	HIGH-level output voltage	V _I = V _{CC} or GND					
		I _O = -100 μA	1.65 to 5.5	V _{CC} - 0.1	–	–	V
		I _O = -4 mA	1.65	0.95	–	–	V
		I _O = -8 mA	2.3	1.7	–	–	V
		I _O = -12 mA	2.7	1.9	–	–	V
		I _O = -24 mA	3.0	2.0	–	–	V
I _{LI}	input leakage current	V _I = 5.5 V or GND	3.6	–	–	±100	μA
		I _O = 0 A	0	–	–	±200	μA
I _{off}	power OFF leakage current	V _I or V _O = 5.5 V	0	–	–	±200	μA
I _{CC}	quiescent supply current	V _I = V _{CC} or GND; I _O = 0 A	5.5	–	–	200	μA
I _{CC}	additional quiescent supply current per pin	V _I = V _{CC} - 0.6 V; I _O = 0 A	2.3 to 5.5	–	–	5000	μA

Note

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

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TRANSFER CHARACTERISTICS

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

SYMBOL	PARAMETER	TEST CONDITIONS		MIN.	TYP. ⁽¹⁾	MAX.	UNIT
		OTHER	V _{CC} (V)				
T_{amb} = -40 °C to +85 °C							
V _{T+}	positive-going threshold voltage	see Figs. 8 and 9	1.8	0.82	1.0	1.14	V
			2.3	1.03	1.2	1.40	V
			3.0	1.29	1.5	1.71	V
			4.5	1.84	2.1	2.36	V
			5.5	2.19	2.5	2.79	V
V _{T-}	negative-going threshold voltage	see Figs. 8 and 9	1.8	0.46	0.6	0.75	V
			2.3	0.65	0.8	0.96	V
			3.0	0.88	1.0	1.24	V
			4.5	1.32	1.5	1.84	V
			5.5	1.58	1.8	2.24	V
V _H	hysteresis voltage (V _{T+} - V _{T-})	see Figs. 8 and 9	1.8	0.26	0.4	0.51	V
			2.3	0.28	0.4	0.57	V
			3.0	0.31	0.5	0.64	V
			4.5	0.40	0.6	0.77	V
			5.5	0.47	0.6	0.88	V
T_{amb} = -40 °C to +125 °C							
V _{T+}	positive-going threshold voltage	see Figs. 8 and 9	1.8	0.79	–	1.14	V
			2.3	1.00	–	1.40	V
			3.0	1.26	–	1.71	V
			4.5	1.81	–	2.36	V
			5.5	2.16	–	2.79	V
V _{T-}	negative-going threshold voltage	see Figs. 8 and 9	1.8	0.46	–	0.78	V
			2.3	0.65	–	0.99	V
			3.0	0.88	–	1.27	V
			4.5	1.32	–	1.87	V
			5.5	1.58	–	2.27	V
V _H	hysteresis voltage (V _{T+} - V _{T-})	see Figs. 8 and 9	1.8	0.19	–	0.51	V
			2.3	0.22	–	0.57	V
			3.0	0.25	–	0.64	V
			4.5	0.34	–	0.77	V
			5.5	0.41	–	0.88	V

Note1. All typical values are measured at T_{amb} = 25 °C.

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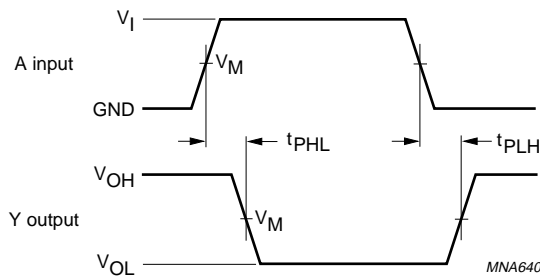
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AC CHARACTERISTICS

GND = 0 V; $t_r = t_f \leq 2.0$ ns.

SYMBOL	PARAMETER	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
		OTHER	V _{CC} (V)				
T_{amb} = -40 °C to +85 °C							
t _{PHL} /t _{PLH}	propagation delay A to Y	see Figs 6 and 7	1.65 to 1.95	1.0	4.1	11.0	ns
			2.3 to 2.7	0.7	2.8	6.5	ns
			2.7	0.7	3.2	6.5	ns
			3.0 to 3.6	0.7	3.0	5.5	ns
			4.5 to 5.5	0.7	2.2	5.0	ns
T_{amb} = -40 °C to +125 °C							
t _{PHL} /t _{PLH}	propagation delay A to Y	see Figs 6 and 7	1.65 to 1.95	1.0	–	14.0	ns
			2.3 to 2.7	0.7	–	8.5	ns
			2.7	0.7	–	8.5	ns
			3.0 to 3.6	0.7	–	7.0	ns
			4.5 to 5.5	0.7	–	6.5	ns

AC WAVEFORMS



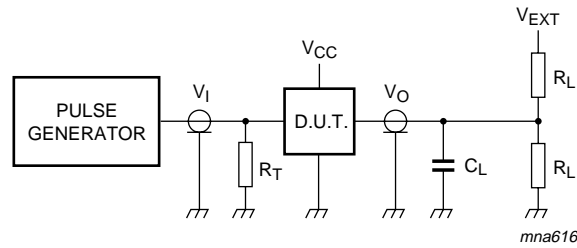
V _{CC}	V _M	INPUT	
		V _I	t _r = t _f
1.65 V to 1.95 V	0.5 × V _{CC}	V _{CC}	≤ 2.0 ns
2.3 V to 2.7 V	0.5 × V _{CC}	V _{CC}	≤ 2.0 ns
2.7 V	1.5 V	2.7 V	≤ 2.5 ns
3.0 V to 3.6 V	1.5 V	2.7 V	≤ 2.5 ns
4.5 V to 5.5 V	0.5 × V _{CC}	V _{CC}	≤ 2.5 ns

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

Fig.6 Input A to output Y propagation delay times.

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V _{CC}	V _I	C _L	R _L	V _{EXT}		
				t _{PLH} /t _{PHL}	t _{PZH} /t _{PHZ}	t _{PZL} /t _{PLZ}
1.65 V to 1.95 V	V _{CC}	30 pF	1 kΩ	open	GND	2 × V _{CC}
2.3 V to 2.7 V	V _{CC}	30 pF	500 Ω	open	GND	2 × V _{CC}
2.7 V	2.7 V	50 pF	500 Ω	open	GND	6 V
3.0 V to 3.6 V	2.7 V	50 pF	500 Ω	open	GND	6 V
4.5 V to 5.5 V	V _{CC}	50 pF	500 Ω	open	GND	2 × V _{CC}

Definitions for test circuit:

R_L = Load resistor.

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.

Fig.7 Load circuitry for switching times.

TRANSFER CHARACTERISTIC WAVEFORMS

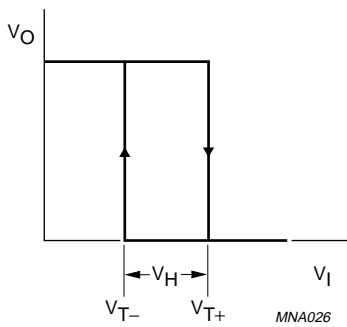


Fig.8 Transfer characteristic.

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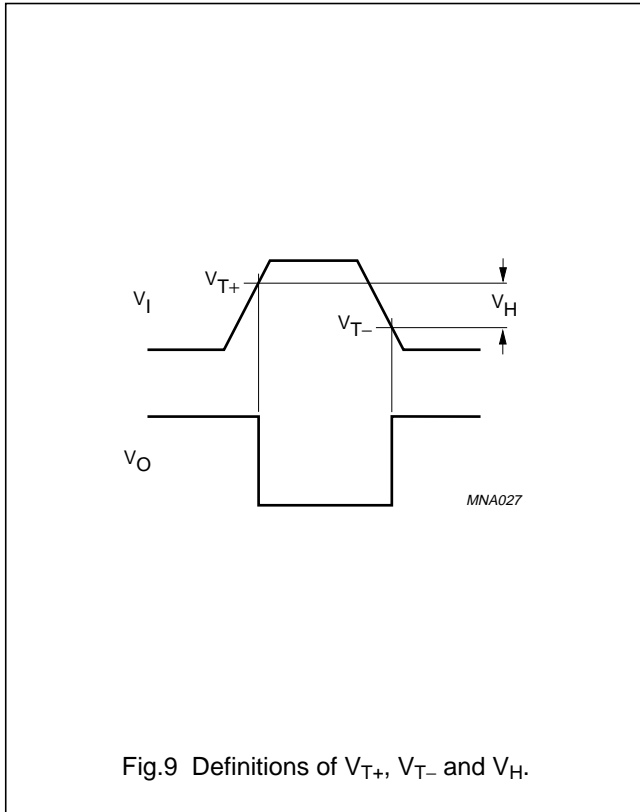


Fig.9 Definitions of V_{T+} , V_{T-} and V_H .

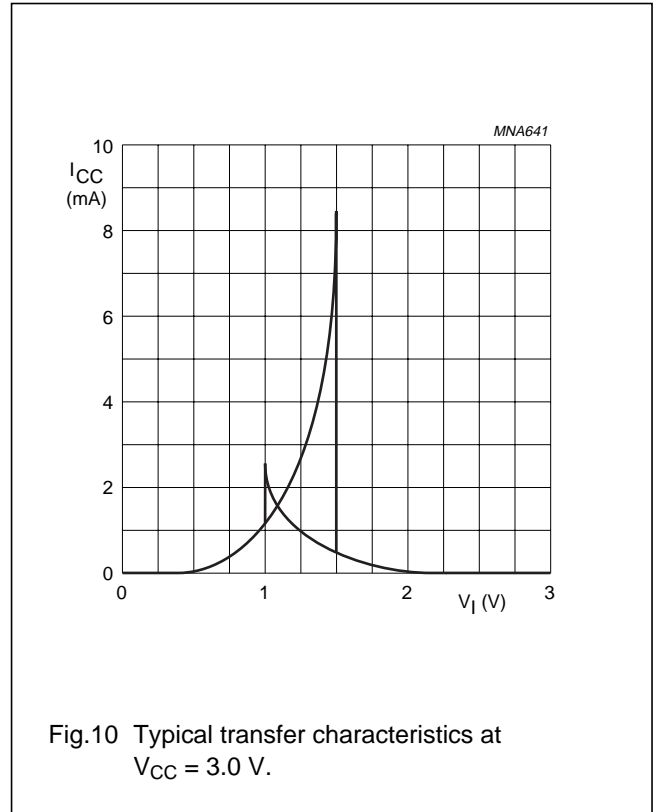


Fig.10 Typical transfer characteristics at $V_{CC} = 3.0\text{ V}$.

APPLICATION INFORMATION

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

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

- P_{ad} = 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 %;
- $I_{CC(AV)}$ = average additional supply current (μA).

Average I_{CC} differs with positive or negative input transitions, as shown in Fig.11.

An example of a relaxation circuit using the 74LVC1G14 is shown in Fig.12.

Remark to the application information

All values given are typical values unless otherwise specified.

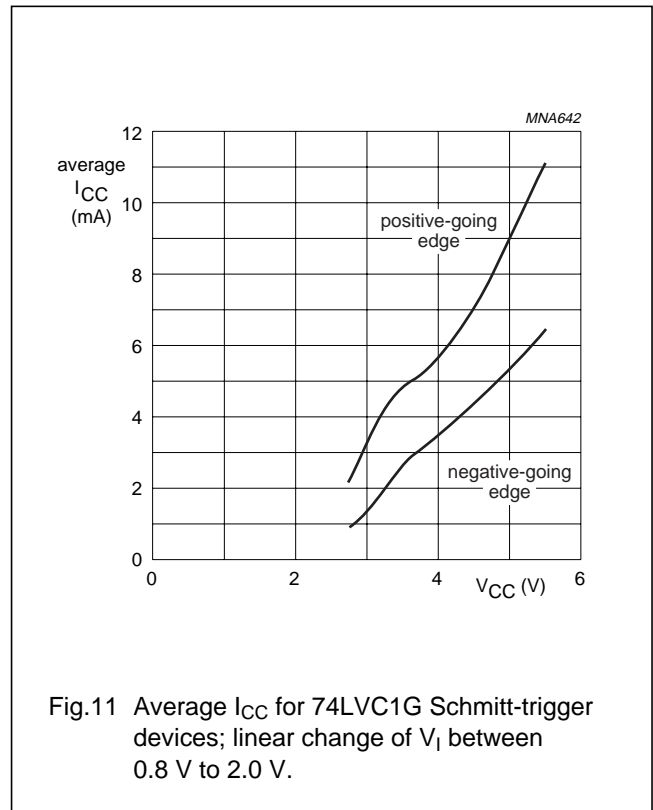
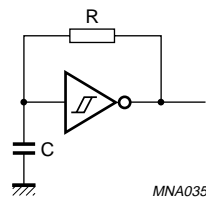


Fig.11 Average I_{CC} for 74LVC1G Schmitt-trigger devices; linear change of V_I between 0.8 V to 2.0 V.

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$$f = \frac{1}{T} = \frac{1}{0.5 \times RC}$$

Fig.12 Example of a relaxation oscillator.

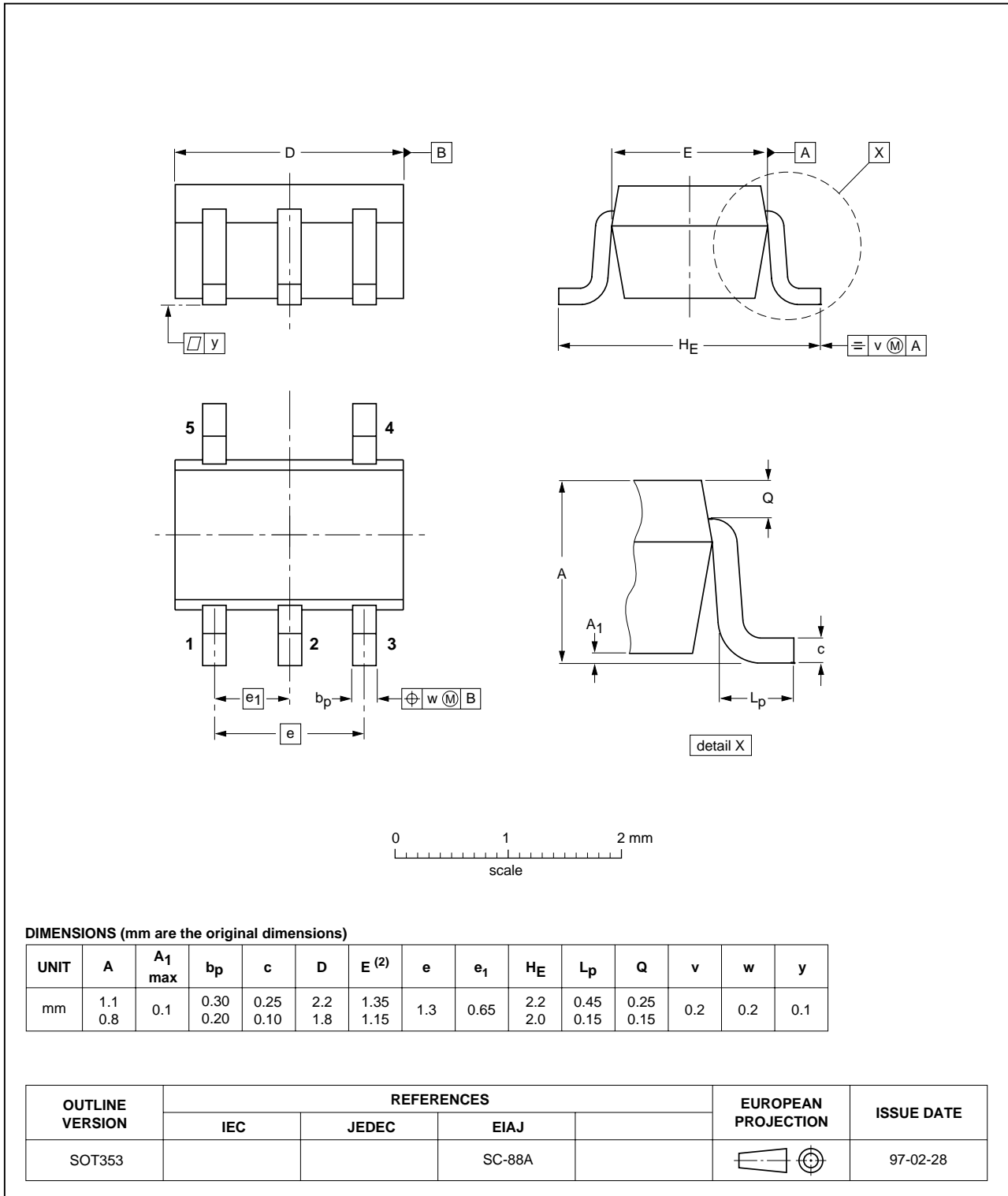
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PACKAGE OUTLINES

Plastic surface mounted package; 5 leads

SOT353

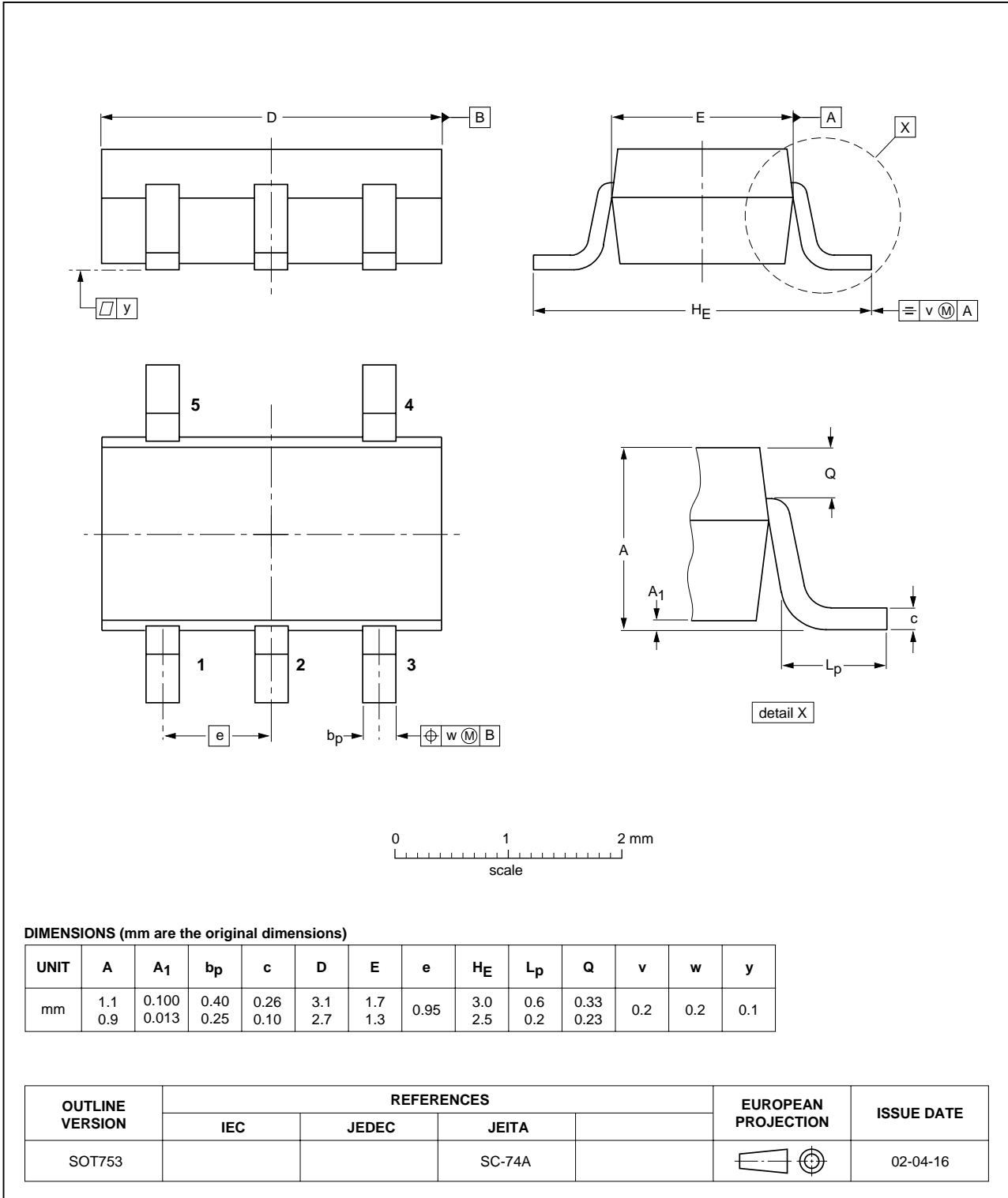


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Plastic surface mounted package; 5 leads

SOT753

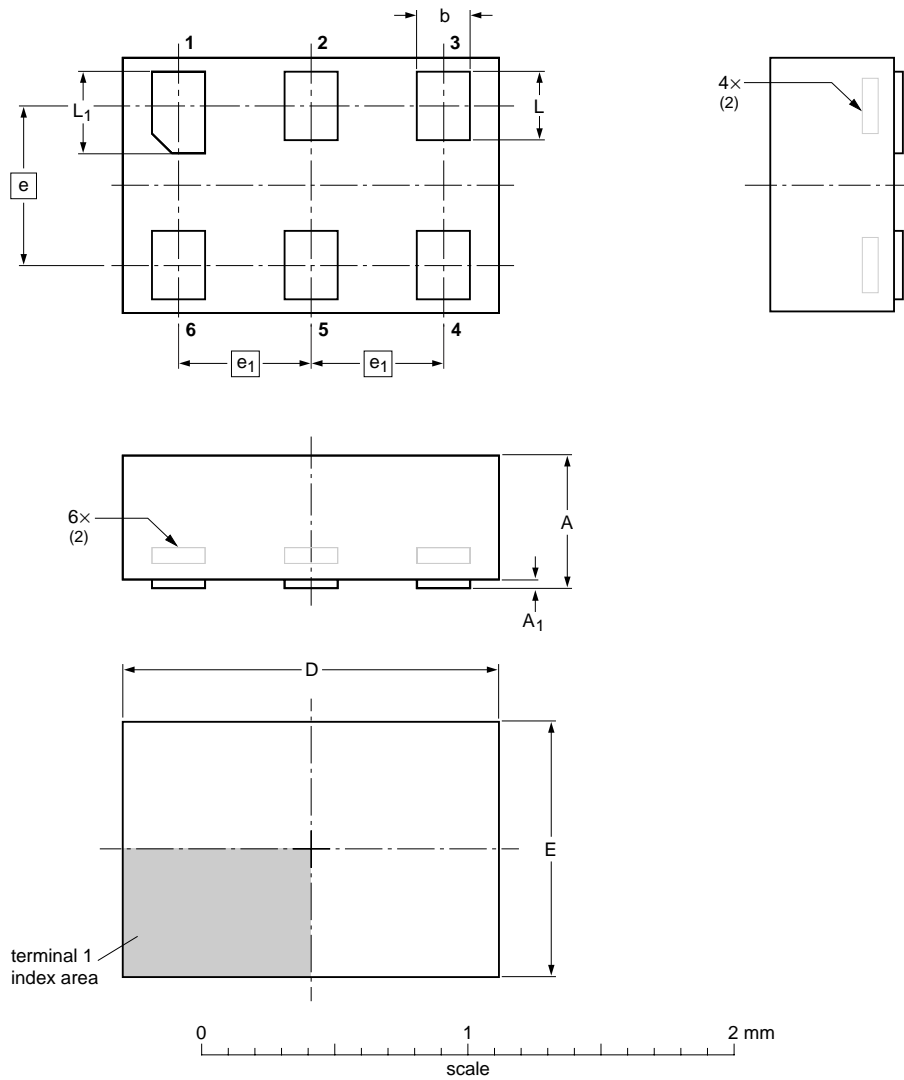


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XSON6: plastic extremely thin small outline package; no leads; 6 terminals; body 1 x 1.45 x 0.5 mm

SOT886



DIMENSIONS (mm are the original dimensions)

UNIT	A ⁽¹⁾ max	A ₁ max	b	D	E	e	e ₁	L	L ₁
mm	0.5	0.04	0.25 0.17	1.5 1.4	1.05 0.95	0.6	0.5	0.35 0.27	0.40 0.32

Notes

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

OUTLINE VERSION	REFERENCES			EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA		
SOT886		MO-252			04-07-15 04-07-22

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DATA SHEET STATUS

LEVEL	DATA SHEET STATUS ⁽¹⁾	PRODUCT STATUS ⁽²⁾⁽³⁾	DEFINITION
I	Objective data	Development	This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.
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3. For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

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