

DATA SHEET

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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

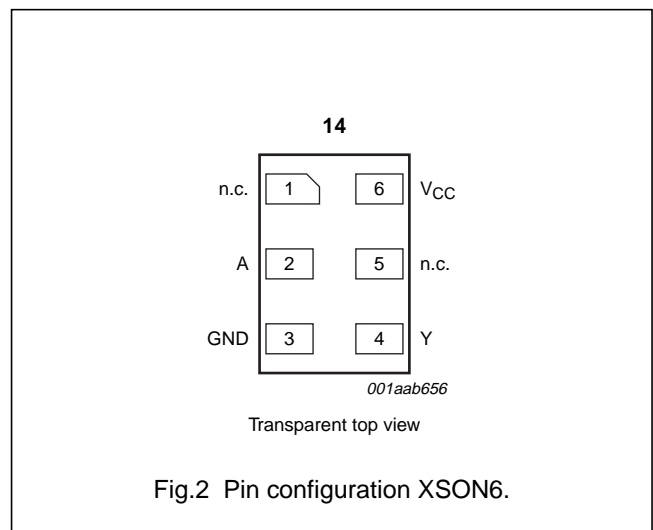
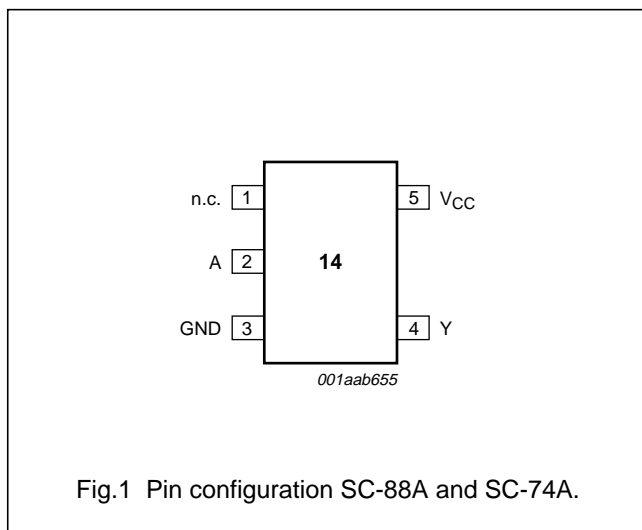
- H = HIGH voltage level;
L = LOW voltage level.

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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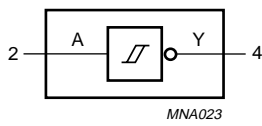


Fig.3 Logic symbol.

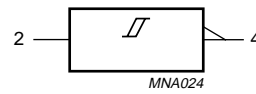


Fig.4 IEE/IEC logic symbol.

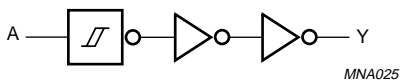


Fig.5 Logic diagram.

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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
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 _{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
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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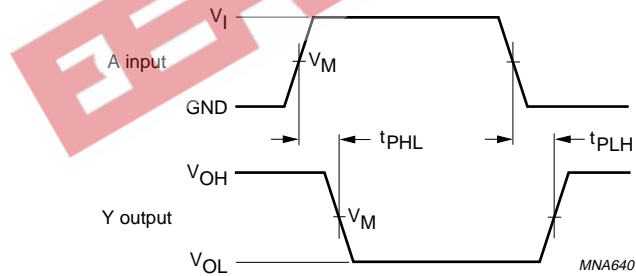
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AC CHARACTERISTICS

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



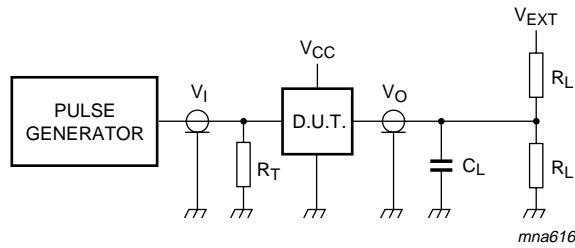
V _{CC}	V _M	INPUT	
		V _I	t _r = t _f
1.65 V to 1.95 V	0.5 × V _{CC}	V _{CC}	≤ 2.0 ns
2.3 V to 2.7 V	0.5 × V _{CC}	V _{CC}	≤ 2.0 ns
2.7 V	1.5 V	2.7 V	≤ 2.5 ns
3.0 V to 3.6 V	1.5 V	2.7 V	≤ 2.5 ns
4.5 V to 5.5 V	0.5 × V _{CC}	V _{CC}	≤ 2.5 ns

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

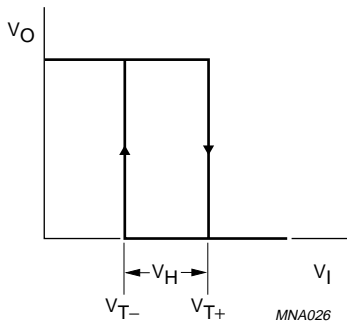


Fig.8 Transfer characteristic.

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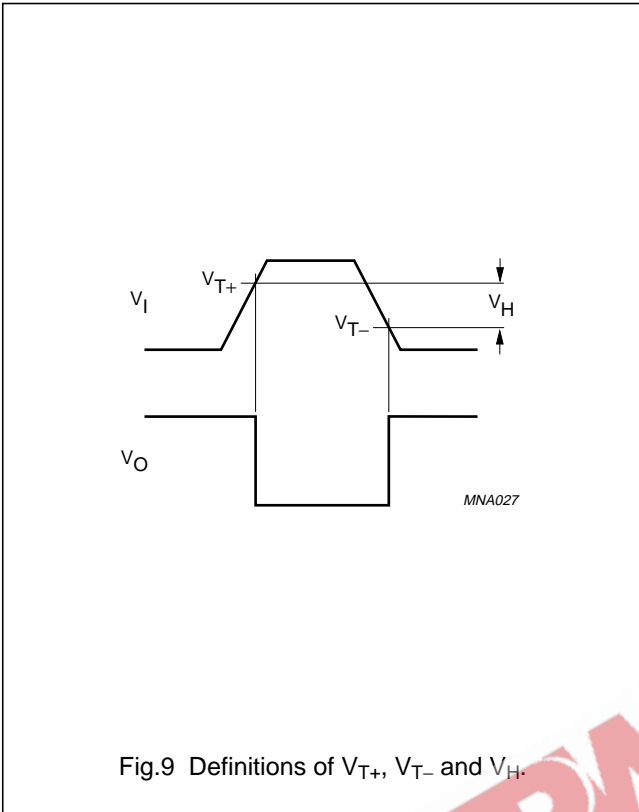


Fig.9 Definitions of V_{T+} , V_{T-} and V_H .

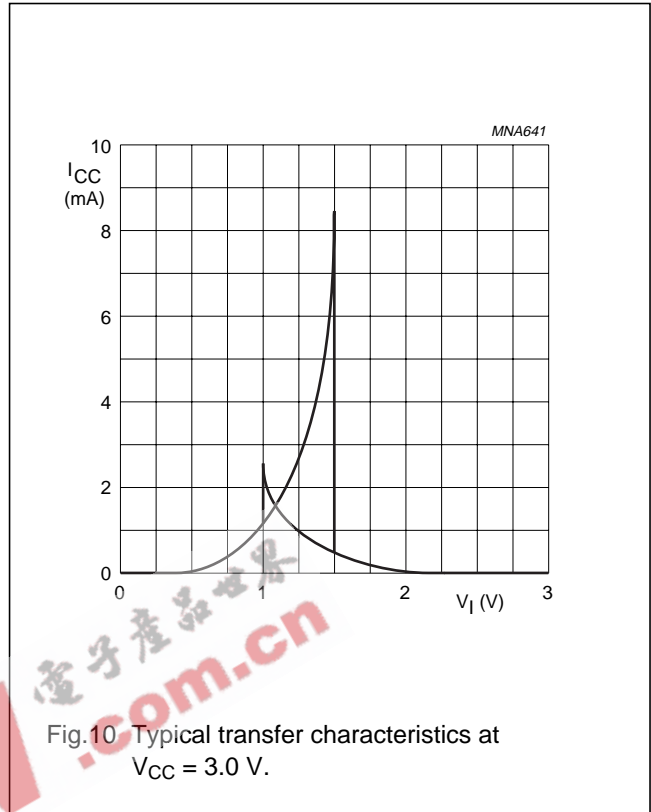


Fig.10 Typical transfer characteristics at $V_{CC} = 3.0\text{ V}$.

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.

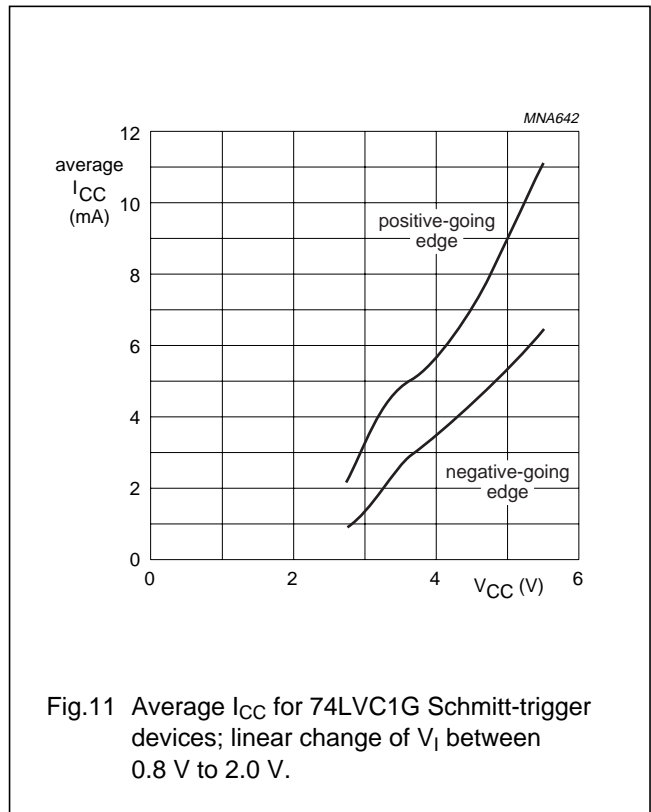
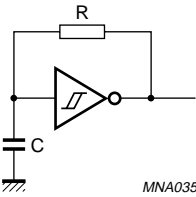


Fig.11 Average I_{CC} for 74LVC1G Schmitt-trigger devices; linear change of V_I between 0.8 V to 2.0 V.

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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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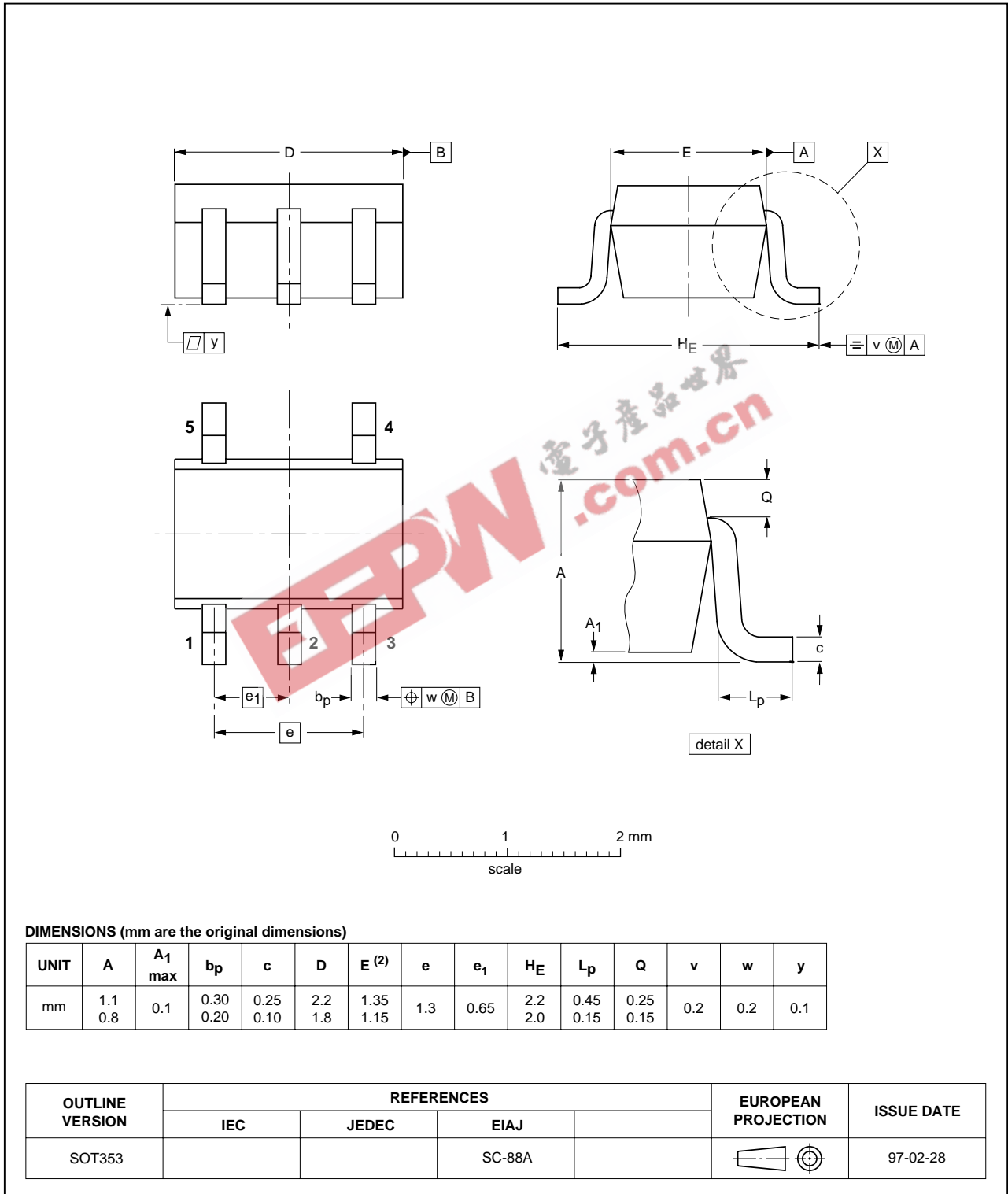
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PACKAGE OUTLINES

Plastic surface mounted package; 5 leads

SOT353

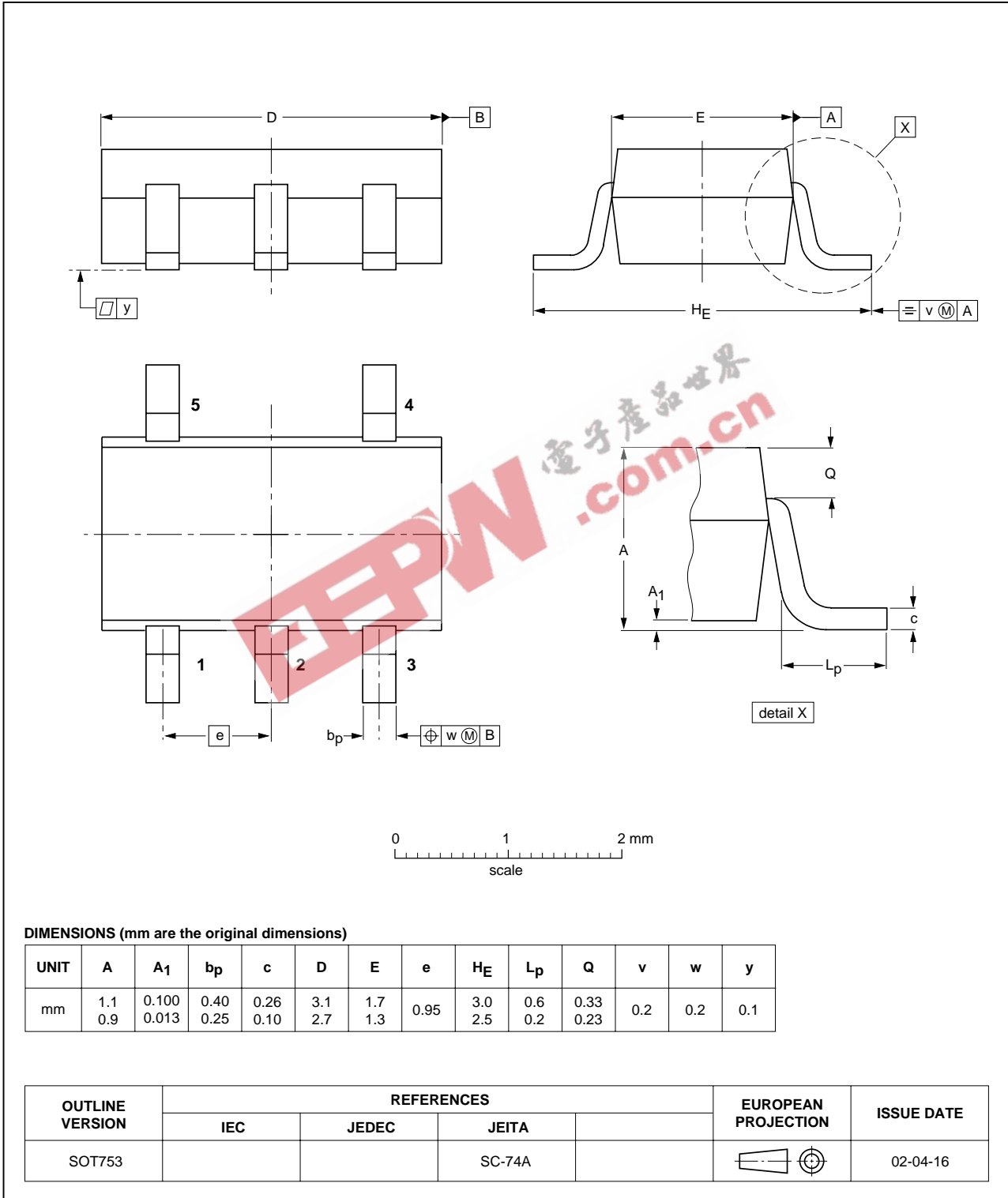


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Plastic surface mounted package; 5 leads

SOT753

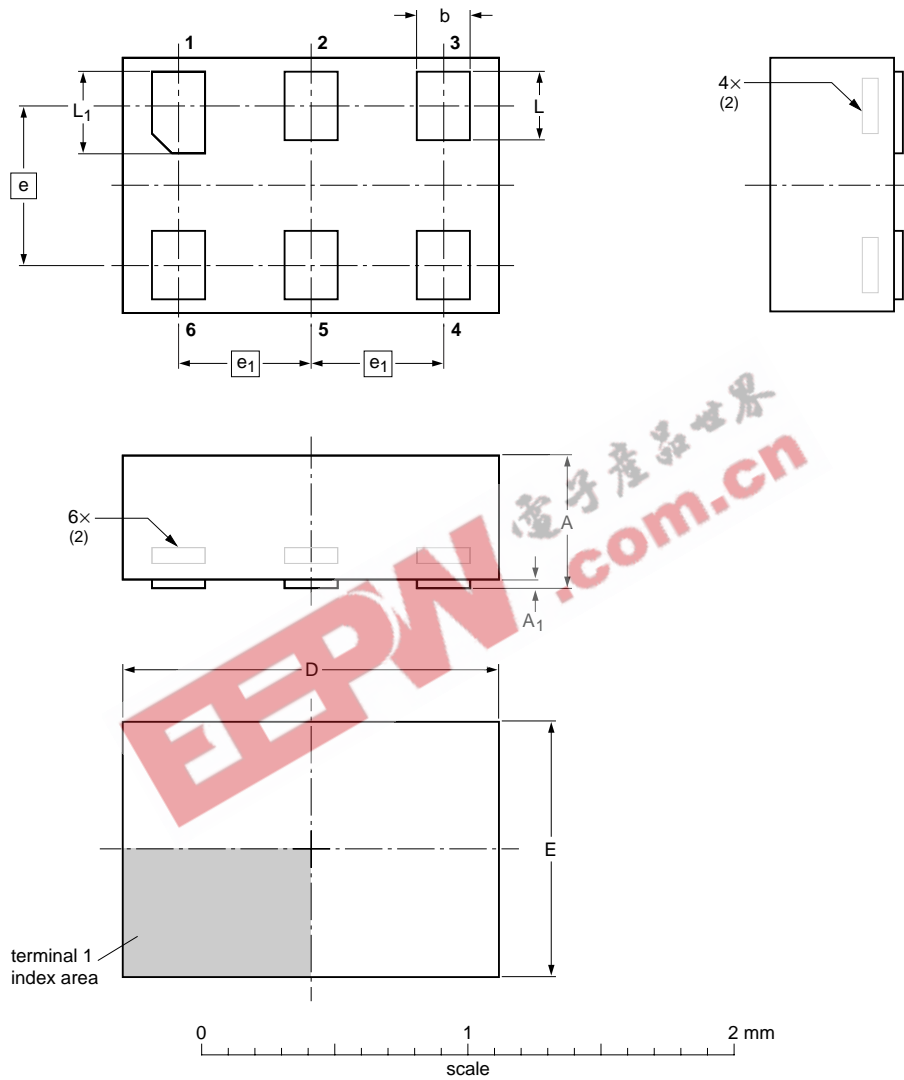


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XSON6: plastic extremely thin small outline package; no leads; 6 terminals; body 1 x 1.45 x 0.5 mm

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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Notes

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3. For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

DEFINITIONS

Short-form specification — The data in a short-form specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.

Limiting values definition — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

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