

# DATA SHEET

## **74LVC14A**

Hex inverting Schmitt-trigger with 5V  
tolerant input

Product specification

1998 Apr 28

Hex inverting Schmitt-trigger with 5V tolerant input

74LVC14A

FEATURES

- Wide supply voltage range of: 1.2 V to 3.6 V
- In accordance with JEDEC standard no. 8-1A
- Inputs accept voltages up to 5.5 V
- CMOS low power consumption
- Direct interface with TTL levels

APPLICATIONS

- Wave and pulse shapers for highly noisy environments
- Astable multivibrators
- Monostable multivibrators

QUICK REFERENCE DATA

GND = 0 V; T<sub>amb</sub> = 25°C; t<sub>r</sub> ≤ t<sub>f</sub> ≤ 2.5 ns

| SYMBOL                             | PARAMETER                              | CONDITIONS                                         | TYPICAL | UNIT |
|------------------------------------|----------------------------------------|----------------------------------------------------|---------|------|
| t <sub>PHL</sub> /t <sub>PLH</sub> | Propagation delay<br>nA to nY          | C <sub>L</sub> = 50 pF;<br>V <sub>CC</sub> = 3.3 V | 4       | ns   |
| C <sub>I</sub>                     | Input capacitance                      |                                                    | 3.5     | pF   |
| C <sub>PD</sub>                    | Power dissipation capacitance per gate | Notes 1 and 2                                      | 25      | pF   |

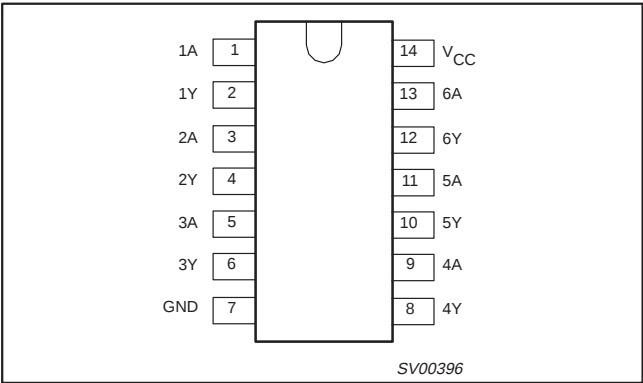
NOTES:

1. C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> in μW)  
 $P_D = C_{PD} \times V_{CC}^2 \times f_i + \sum (C_L \times V_{CC}^2 \times f_o)$  where:  
f<sub>i</sub> = input frequency in MHz; C<sub>L</sub> = output load capacity in pF;  
f<sub>o</sub> = output frequency in MHz; V<sub>CC</sub> = supply voltage in V;  
∑ (C<sub>L</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>o</sub>) = sum of the outputs.
2. The condition is V<sub>I</sub> = GND to V<sub>CC</sub>.

ORDERING INFORMATION

| PACKAGES                    | TEMPERATURE RANGE | OUTSIDE NORTH AMERICA | NORTH AMERICA | DWG NUMBER |
|-----------------------------|-------------------|-----------------------|---------------|------------|
| 14-Pin Plastic SO           | −40°C to +85°C    | 74LVC14A D            | 74LVC14A D    | SOT108-1   |
| 14-Pin Plastic SSOP Type II | −40°C to +85°C    | 74LVC14A DB           | 74LVC14A DB   | SOT337-1   |
| 14-Pin Plastic TSSOP Type I | −40°C to +85°C    | 74LVC14A PW           | 74LVC14APW DH | SOT402-1   |

PIN CONFIGURATION



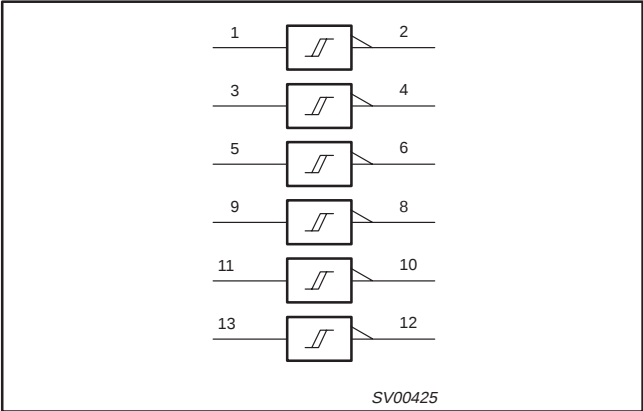
PIN DESCRIPTION

| PIN NUMBER         | SYMBOL          | NAME AND FUNCTION       |
|--------------------|-----------------|-------------------------|
| 1, 3, 5, 9, 11, 13 | 1A – 6A         | Data inputs             |
| 2, 4, 6, 8, 10, 12 | 1Y – 6Y         | Data outputs            |
| 7                  | GND             | Ground (0 V)            |
| 14                 | V <sub>CC</sub> | Positive supply voltage |

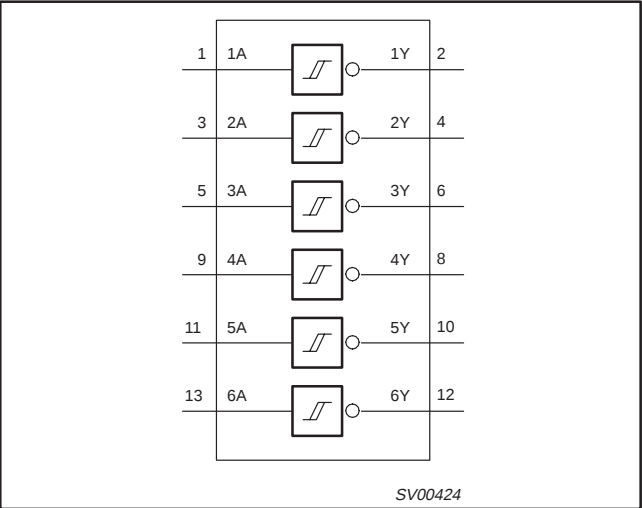
# Hex inverting Schmitt-trigger with 5V tolerant input

74LVC14A

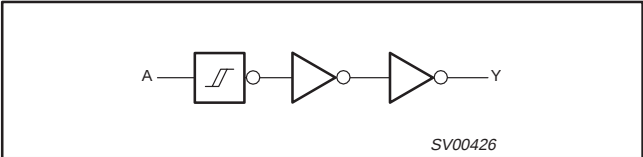
### LOGIC SYMBOL (IEEE/IEC)



### LOGIC SYMBOL



### LOGIC DIAGRAM (ONE SCHMITT-TRIGGER)



### FUNCTION TABLE

| INPUT | OUTPUT |
|-------|--------|
| nA    | nY     |
| L     | H      |
| H     | L      |

NOTES:  
H = HIGH voltage level  
L = LOW voltage level

### RECOMMENDED OPERATING CONDITIONS

| SYMBOL                          | PARAMETER                                         | CONDITIONS                    | LIMITS |                 | UNIT |
|---------------------------------|---------------------------------------------------|-------------------------------|--------|-----------------|------|
|                                 |                                                   |                               | MIN    | MAX             |      |
| V <sub>CC</sub>                 | DC supply voltage (for max. speed performance)    |                               | 2.7    | 3.6             | V    |
|                                 | DC supply voltage (for low-voltage applications)  |                               | 1.2    | 3.6             |      |
| V <sub>I</sub>                  | DC input voltage range                            |                               | 0      | 5.5             | V    |
| V <sub>I/O</sub>                | DC output voltage range; output HIGH or LOW state |                               | 0      | V <sub>CC</sub> | V    |
|                                 | DC input voltage range; output 3-State            |                               | 0      | 5.5             |      |
| T <sub>amb</sub>                | Operating free-air temperature range              |                               | -40    | +85             | °C   |
| t <sub>r</sub> , t <sub>f</sub> | Input rise and fall times                         | V <sub>CC</sub> = 1.2 to 2.7V | 0      | 20              | ns/V |
|                                 |                                                   | V <sub>CC</sub> = 2.7 to 3.6V | 0      | 10              |      |

# Hex inverting Schmitt-trigger with 5V tolerant input

74LVC14A

## ABSOLUTE MAXIMUM RATINGS<sup>1</sup>

In accordance with the Absolute Maximum Rating System (IEC 134).

Voltages are referenced to GND (ground = 0V).

| SYMBOL            | PARAMETER                                   | CONDITIONS                                | RATING                 | UNIT |
|-------------------|---------------------------------------------|-------------------------------------------|------------------------|------|
| $V_{CC}$          | DC supply voltage                           |                                           | −0.5 to +6.5           | V    |
| $I_{IK}$          | DC input diode current                      | $V_I < 0$                                 | −50                    | mA   |
| $V_I$             | DC input voltage                            | Note 2                                    | −0.5 to +6.5           | V    |
| $I_{OK}$          | DC output diode current                     | $V_O > V_{CC}$ or $V_O < 0$               | ± 50                   | mA   |
| $V_{IO}$          | DC output voltage; output HIGH or LOW       | Note 2                                    | −0.5 to $V_{CC} + 0.5$ | V    |
|                   | DC input voltage; output 3-State            | Note 2                                    | −0.5 to 6.5            |      |
| $I_O$             | DC output source or sink current            | $V_O = 0$ to $V_{CC}$                     | ± 50                   | mA   |
| $I_{GND}, I_{CC}$ | DC $V_{CC}$ or GND current                  |                                           | ± 100                  | mA   |
| $T_{stg}$         | Storage temperature range                   |                                           | −65 to +150            | °C   |
| $P_{TOT}$         | Power dissipation per package               |                                           |                        | mW   |
|                   | – plastic mini-pack (SO)                    | above +70°C derate linearly with 8 mW/K   | 500                    |      |
|                   | – plastic shrink mini-pack (SSOP and TSSOP) | above +60°C derate linearly with 5.5 mW/K | 500                    |      |

### NOTES:

- Stresses beyond those listed may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

## DC ELECTRICAL CHARACTERISTICS

Over recommended operating conditions. Voltages are referenced to GND (ground = 0V).

| SYMBOL           | PARAMETER                                         | TEST CONDITIONS                                                                                       | LIMITS                |                  |      | UNIT |
|------------------|---------------------------------------------------|-------------------------------------------------------------------------------------------------------|-----------------------|------------------|------|------|
|                  |                                                   |                                                                                                       | Temp = -40°C to +85°C |                  |      |      |
|                  |                                                   |                                                                                                       | MIN                   | TYP <sup>1</sup> | MAX  |      |
| V <sub>IH</sub>  | HIGH level Input voltage                          | V <sub>CC</sub> = 1.2V                                                                                | V <sub>CC</sub>       |                  |      | V    |
|                  |                                                   | V <sub>CC</sub> = 2.7 to 3.6V                                                                         | 2.0                   |                  |      |      |
| V <sub>IL</sub>  | LOW level Input voltage                           | V <sub>CC</sub> = 1.2V                                                                                |                       |                  | GND  | V    |
|                  |                                                   | V <sub>CC</sub> = 2.7 to 3.6V                                                                         |                       |                  | 0.8  |      |
| V <sub>OH</sub>  | HIGH level output voltage                         | V <sub>CC</sub> = 2.7V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = -12mA  | V <sub>CC</sub> - 0.5 |                  |      | V    |
|                  |                                                   | V <sub>CC</sub> = 3.0V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = -100μA | V <sub>CC</sub> - 0.2 | V <sub>CC</sub>  |      |      |
|                  |                                                   | V <sub>CC</sub> = 3.0V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = -18mA  | V <sub>CC</sub> - 0.6 |                  |      |      |
|                  |                                                   | V <sub>CC</sub> = 3.0V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = -24mA  | V <sub>CC</sub> - 0.8 |                  |      |      |
| V <sub>OL</sub>  | LOW level output voltage                          | V <sub>CC</sub> = 2.7V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = 12mA   |                       |                  | 0.40 | V    |
|                  |                                                   | V <sub>CC</sub> = 3.0V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = 100μA  |                       | GND              | 0.20 |      |
|                  |                                                   | V <sub>CC</sub> = 3.0V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = 24mA   |                       |                  | 0.55 |      |
| I <sub>I</sub>   | Input leakage current                             | V <sub>CC</sub> = 3.6V; V <sub>I</sub> = 5.5V or GND                                                  |                       | ± 0.1            | ± 5  | μA   |
| I <sub>CC</sub>  | Quiescent supply current                          | V <sub>CC</sub> = 3.6V; V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0                   |                       | 0.1              | 10   | μA   |
| ΔI <sub>CC</sub> | Additional quiescent supply current per input pin | V <sub>CC</sub> = 2.3V to 3.6V; V <sub>I</sub> = V <sub>CC</sub> - 0.6V; I <sub>O</sub> = 0           |                       | 5                | 500  | μA   |

### NOTE:

- All typical values are at  $V_{CC} = 3.3V$  and  $T_{amb} = 25^\circ C$ .

Hex inverting Schmitt-trigger with 5V tolerant input

74LVC14A

TRANSFER CHARACTERISTICS

Voltages are referenced to GND (ground = 0 V).

| SYMBOL          | PARAMETER                                       | T <sub>amb</sub> (°C) |                  |     | UNIT | TEST CONDITIONS     |                    |
|-----------------|-------------------------------------------------|-----------------------|------------------|-----|------|---------------------|--------------------|
|                 |                                                 | –40 TO +85            |                  |     |      | V <sub>CC</sub> (V) | WAVEFORMS          |
|                 |                                                 | MIN                   | TYP <sup>1</sup> | MAX |      |                     |                    |
| V <sub>T+</sub> | Positive-going threshold                        | –                     | –                | 1.2 | V    | 1.2                 | Figures 1 and 2    |
|                 |                                                 | 1.1                   | –                | 2.0 |      | 2.7                 |                    |
|                 |                                                 | 1.1                   | –                | 2.0 |      | 2.7 to 3.6          |                    |
| V <sub>T–</sub> | Negative-going threshold                        | 0                     | –                | –   | V    | 1.2                 | Figures 1 and 2    |
|                 |                                                 | 0.8                   | –                | 1.5 |      | 2.7                 |                    |
|                 |                                                 | 0.8                   | –                | 1.5 |      | 2.7 to 3.6          |                    |
| V <sub>H</sub>  | Hysteresis (V <sub>T+</sub> – V <sub>T–</sub> ) | –                     | –                | –   | V    | 1.2                 | Figures 1, 2 and 3 |
|                 |                                                 | 0.3                   | 0.4              | –   |      | 2.7                 |                    |
|                 |                                                 | 0.3                   | 0.45*            | –   |      | 2.7 to 3.6          |                    |

- NOTES:
- 1. All typical values are measured at T<sub>amb</sub> = 25°C
  - 2. The V<sub>IH</sub> and V<sub>IL</sub> from the DC family characteristics are superseded by the V<sub>T+</sub> and V<sub>T–</sub>.

TRANSFER CHARACTERISTIC WAVEFORMS

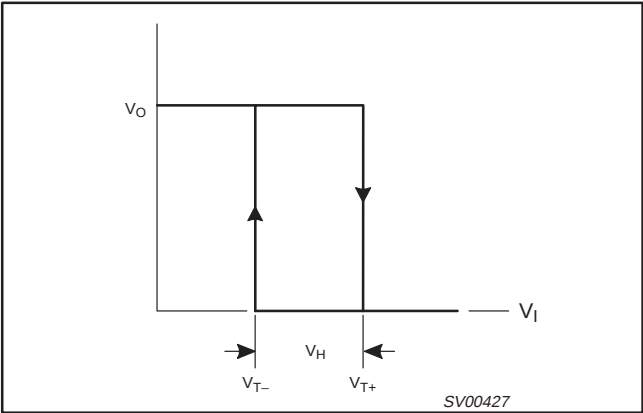


Figure 1. Transfer characteristic.

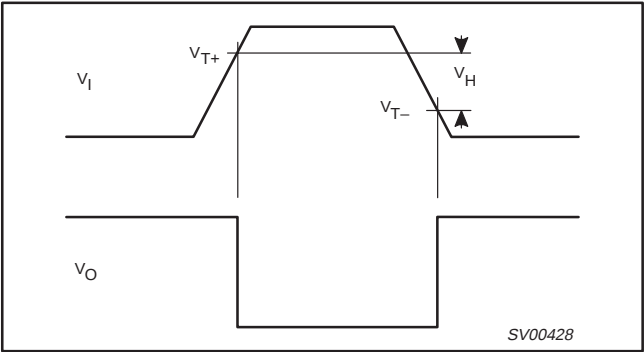


Figure 2. Definition of  $V_{T+}$ ,  $V_{T-}$  and  $V_H$ ; where  $V_{T+}$  and  $V_{T-}$  are between limits of 20% and 70%

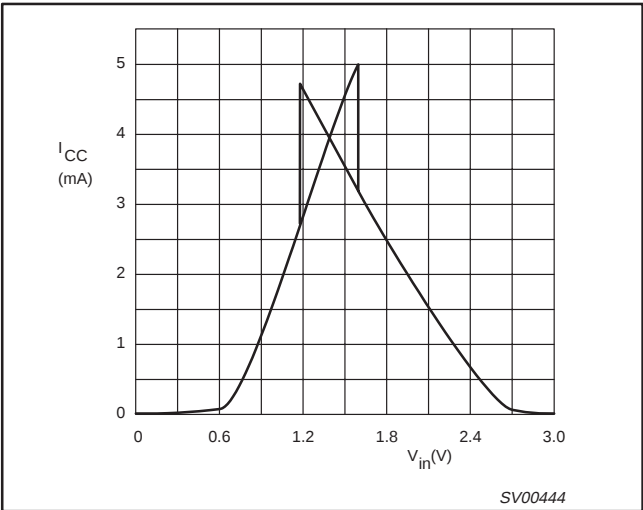


Figure 3. Typical 74LVC14 transfer characteristics;  $V_{CC} = 3.3$  V.

Hex inverting Schmitt-trigger with 5V tolerant input

74LVC14A

AC CHARACTERISTICS

GND = 0 V;  $t_r = t_f \leq 2.5\text{ ns}$ ;  $C_L = 50\text{ pF}$ ;  $R_L = 500\Omega$ ;  $T_{\text{amb}} = -40^\circ\text{C}$  to  $+85^\circ\text{C}$

| SYMBOL            | PARAMETER                     | WAVEFORM    | LIMITS                   |                  |     |                 |     |     |                 | UNIT |
|-------------------|-------------------------------|-------------|--------------------------|------------------|-----|-----------------|-----|-----|-----------------|------|
|                   |                               |             | $V_{CC} = 3.3V \pm 0.3V$ |                  |     | $V_{CC} = 2.7V$ |     |     | $V_{CC} = 1.2V$ |      |
|                   |                               |             | MIN                      | TYP <sup>1</sup> | MAX | MIN             | TYP | MAX | TYP             |      |
| $t_{PHL}/t_{PLH}$ | Propagation delay<br>nA to nY | Figure 1, 2 | 1.5                      | 4.5              | 6.4 | 1.5             | 5.0 | 7.5 | 18              | ns   |

NOTE:

1. These typical values are at  $V_{CC} = 3.3V$  and  $T_{\text{amb}} = 25^\circ\text{C}$ .

AC WAVEFORMS

$V_M = 1.5\text{ V}$  at  $V_{CC} \geq 2.7\text{ V}$

$V_M = 0.5 \cdot V_{CC}$  at  $V_{CC} < 2.7\text{ V}$

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

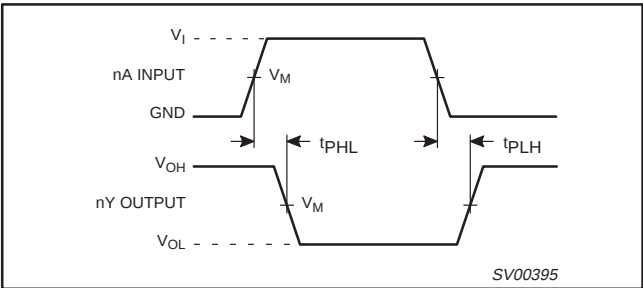


Figure 1. Input (nA) to output (nY) propagation delays.

TEST CIRCUIT

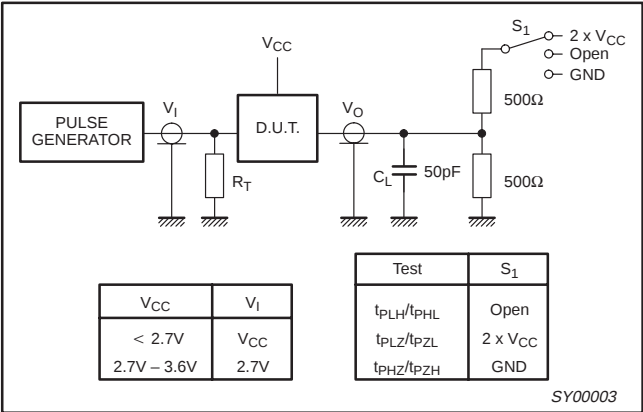


Figure 2. Load circuitry for switching times.

APPLICATION INFORMATION

All values given are typical unless otherwise specified.

Note to Figure 7:  $f = \frac{1}{T} \approx \frac{1}{0.8 \times RC}$

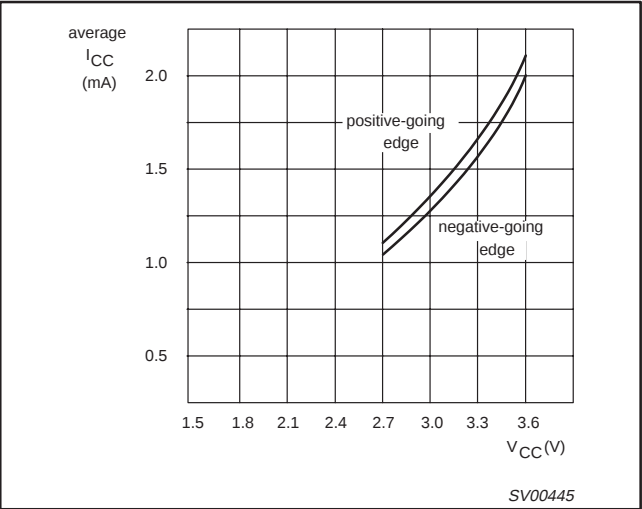


Figure 3. Average  $I_{CC}$  for LVC Schmitt-trigger devices; linear change of  $V_i$  between 0.8 V to 2.0 V.

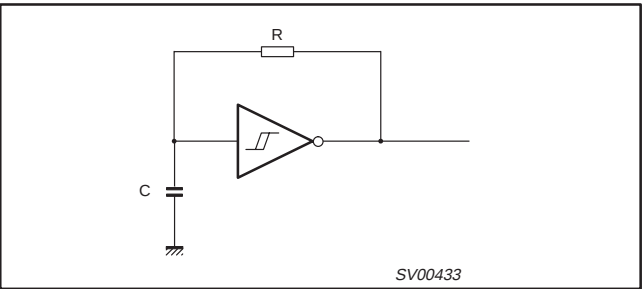


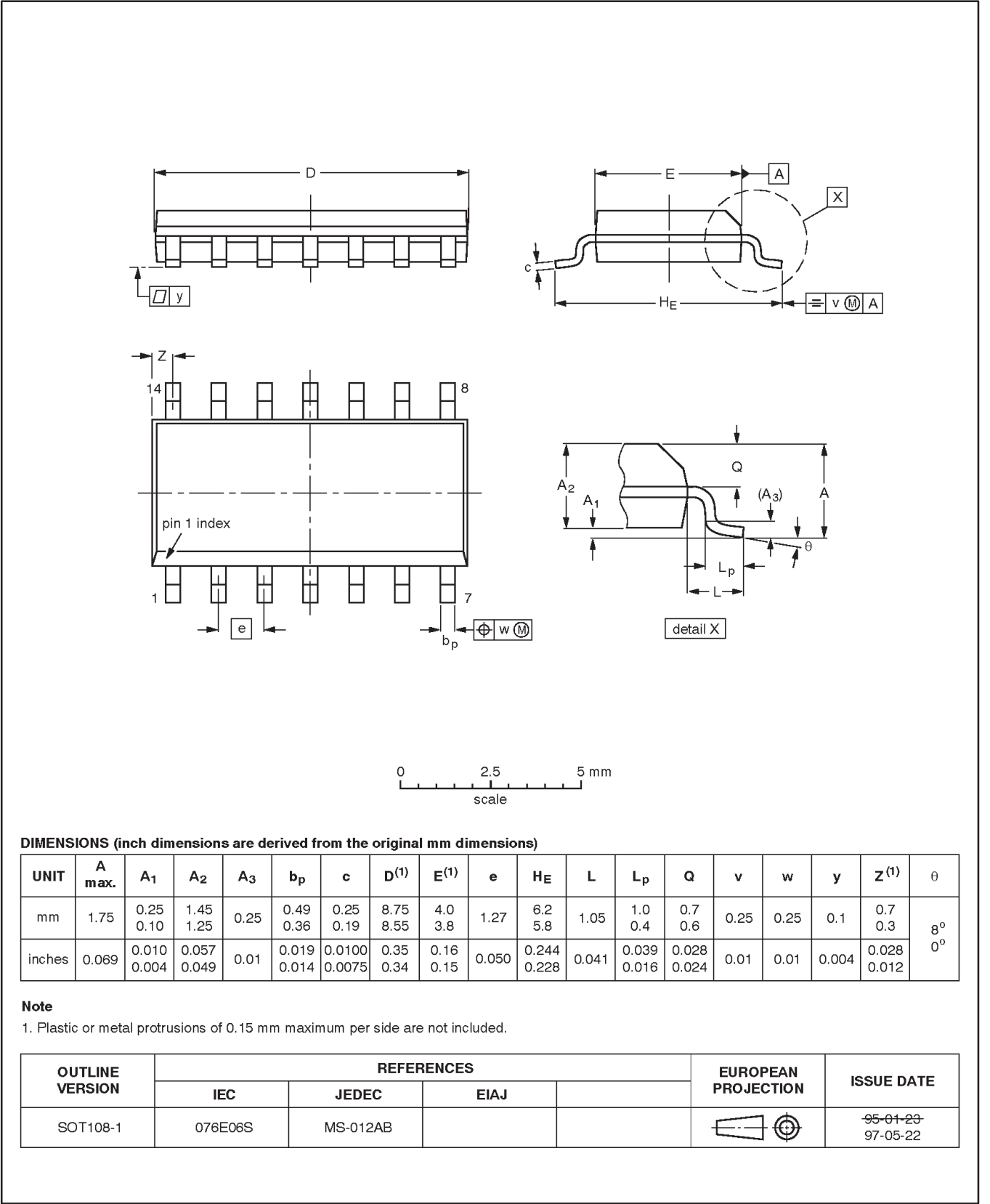
Figure 4. Relaxation oscillator using the LVC14.

Hex inverting Schmitt-trigger with 5V tolerant input

74LVC14A

SO14: plastic small outline package; 14 leads; body width 3.9 mm

SOT108-1

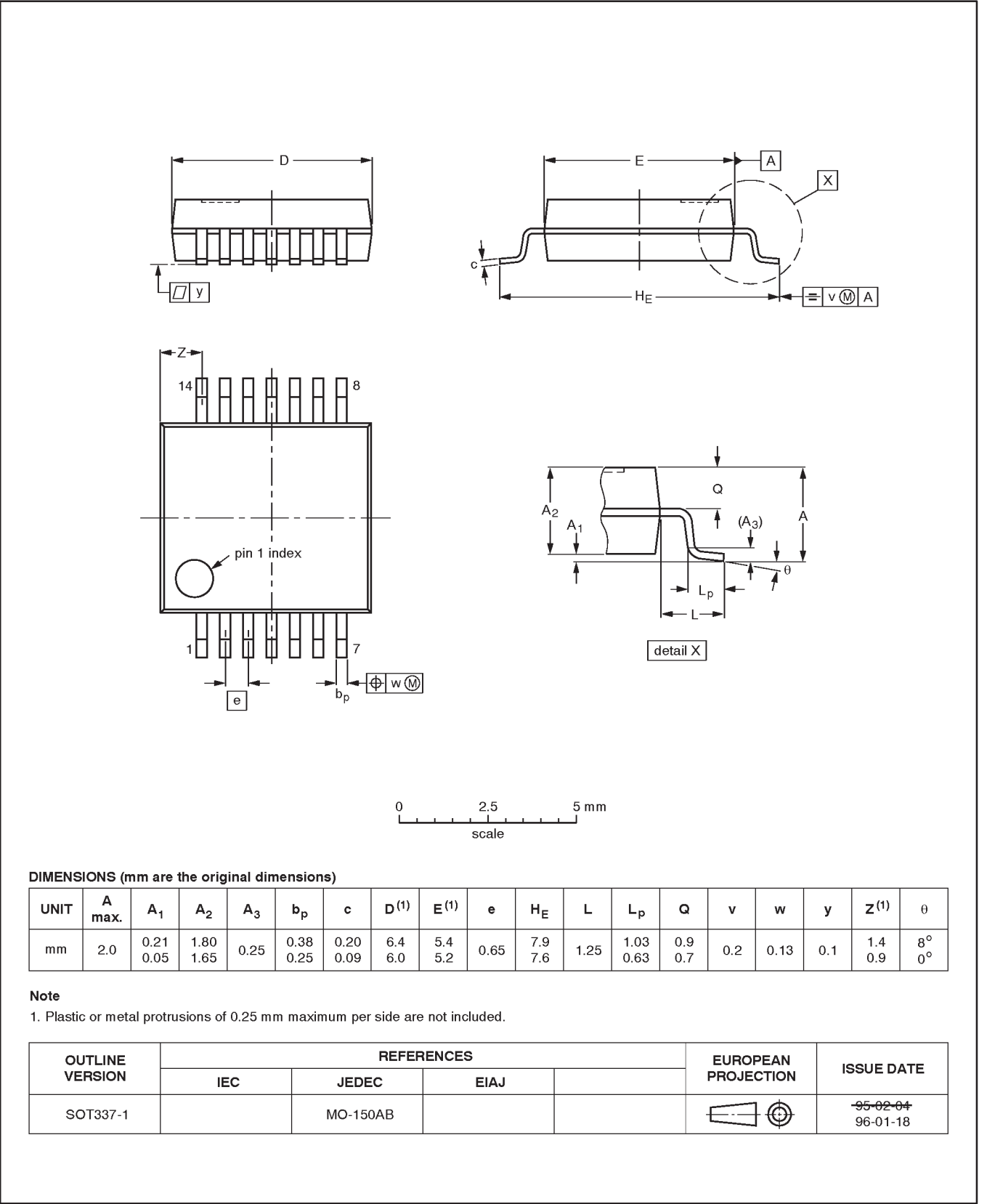


Hex inverting Schmitt-trigger with 5V tolerant input

74LVC14A

SSOP14: plastic shrink small outline package; 14 leads; body width 5.3 mm

SOT337-1

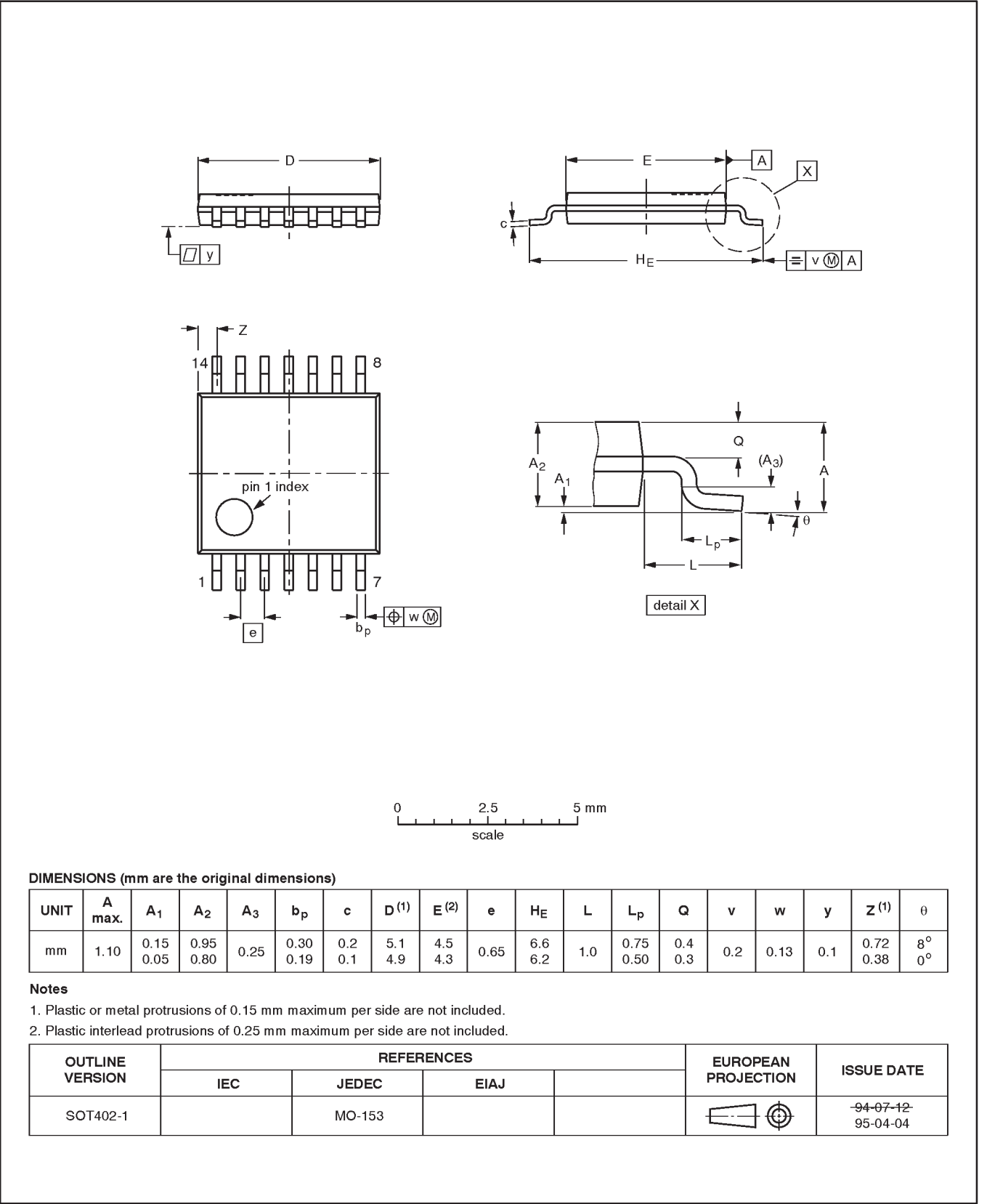


Hex inverting Schmitt-trigger with 5V tolerant input

74LVC14A

TSSOP14: plastic thin shrink small outline package; 14 leads; body width 4.4 mm

SOT402-1



## Hex inverting Schmitt-trigger with 5V tolerant input

74LVC14A

## Data sheet status

| Data sheet status         | Product status | Definition [1]                                                                                                                                                                                                                                             |
|---------------------------|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Objective specification   | Development    | This data sheet contains the design target or goal specifications for product development. Specification may change in any manner without notice.                                                                                                          |
| Preliminary specification | Qualification  | This data sheet contains preliminary data, and supplementary data will be published at a later date. Philips Semiconductors reserves the right to make changes at any time without notice in order to improve design and supply the best possible product. |
| Product specification     | Production     | This data sheet contains final specifications. Philips Semiconductors reserves the right to make changes at any time without notice in order to improve design and supply the best possible product.                                                       |

[1] Please consult the most recently issued datasheet before initiating or completing a design.

## 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 134). 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.

**Application information** — Applications that are described herein for any of these products are for illustrative purposes only. Philips Semiconductors make no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

## Disclaimers

**Life support** — These products are not designed for use in life support appliances, devices or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips Semiconductors customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips Semiconductors for any damages resulting from such application.

**Right to make changes** — Philips Semiconductors reserves the right to make changes, without notice, in the products, including circuits, standard cells, and/or software, described or contained herein in order to improve design and/or performance. Philips Semiconductors assumes no responsibility or liability for the use of any of these products, conveys no license or title under any patent, copyright, or mask work right to these products, and makes no representations or warranties that these products are free from patent, copyright, or mask work right infringement, unless otherwise specified.

Philips Semiconductors  
811 East Arques Avenue  
P.O. Box 3409  
Sunnyvale, California 94088-3409  
Telephone 800-234-7381

© Copyright Philips Electronics North America Corporation 1998  
All rights reserved. Printed in U.S.A.

print code

Date of release: 07-98

Document order number:

9397-750-04484

*Let's make things better.*