# DATA SHEET

## 74LVC86A
Quad 2-input exclusive OR gate

Product specification
Supercedes data of 1997 Aug 11
IC24 Data Handbook

1998 Apr 28



Philips
Semiconductors

# Quad 2-input exclusive OR gate 74LVC86A

## FEATURES

- Wide supply range of 1.2V to 3.6V
- Complies with JEDEC standard no. 8-1A
- Inputs accept voltages up to 5.5V
- CMOS low power consumption
- Direct interface with TTL levels
- 5-volt tolerant inputs, for interfacing with 5-volt logic

## DESCRIPTION

The 74LVC86A is a high-performance, low-power, low-voltage Si-gate CMOS device that is pin and superior to most advanced CMOS compatible TTL families.

Inputs can be driven from either 3.3 V or 5 V devices. This feature allows the use of these devices as translators in a mixed 3.3 V/5 V environment.

The 74LVC86A provides the 2-input EXCLUSIVE-OR function.

## QUICK REFERENCE DATA

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

| SYMBOL | PARAMETER | CONDITIONS | TYPICAL | UNIT |
|---|---|---|---|---|
| $t_{PHL}$<br>$t_{PLH}$ | Propagation delay<br>nA, nB to nYn | $C_L$ = 50 pF;<br>$V_{CC}$ = 3.3 V | 3.0 | ns |
| $C_I$ | Input capacitance | | 5.0 | pF |
| $C_{PD}$ | Power dissipation capacitance per gate | $V_{CC}$ = 3.3 V, $V_I$ = GND to $V_{CC}$[1] | 28 | pF |

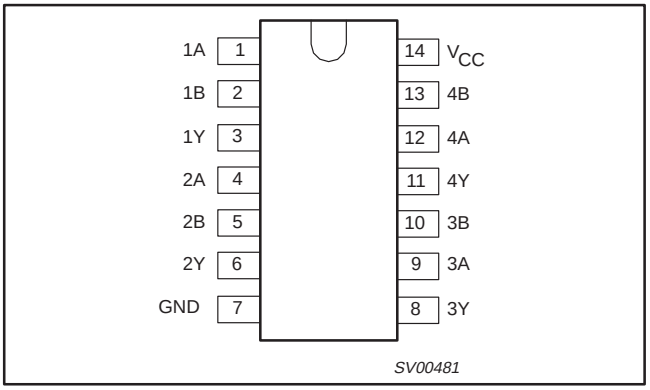
**NOTE:**

1. $C_{PD}$ is used to determine the dynamic power dissipation ($P_D$ in μW)
   $P_D = C_{PD} \times V_{CC}^2 \times f_i + \Sigma (C_L \times V_{CC}^2 \times f_o)$ where:
   $f_i$ = input frequency in MHz; $C_L$ = output load capacity in pF;
   $f_o$ = output frequency in MHz; $V_{CC}$ = supply voltage in V;
   $\Sigma (C_L \times V_{CC}^2 \times f_o)$ = sum of the outputs.

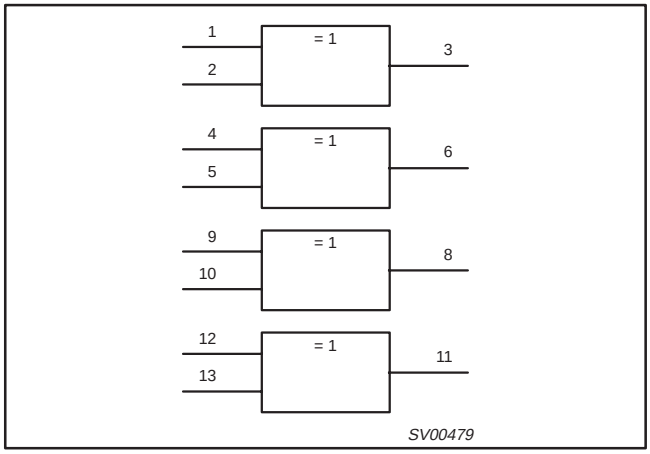
## ORDERING INFORMATION

| PACKAGES | TEMPERATURE RANGE | OUTSIDE NORTH AMERICA | NORTH AMERICA | PKG. DWG. # |
|---|---|---|---|---|
| 14-Pin Plastic DIL | –40°C to +85°C | 74LVC86A N | 74LVC86A N | SOT27-1 |
| 14-Pin Plastic SO | –40°C to +85°C | 74LVC86A D | 74LVC86A D | SOT108-1 |
| 14-Pin Plastic SSOP Type II | –40°C to +85°C | 74LVC86A DB | 74LVC86A DB | SOT337-1 |
| 14-Pin Plastic TSSOP Type I | –40°C to +85°C | 74LVC86A PW | 74LVC86APW DH | SOT402-1 |

## PIN CONFIGURATION



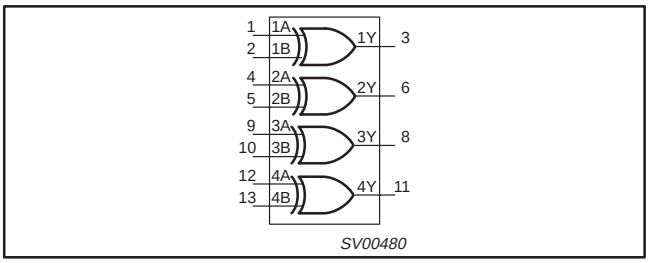

## LOGIC SYMBOL (IEEE/IEC)




## PIN DESCRIPTION

| PIN NUMBER | SYMBOL | FUNCTION |
|---|---|---|
| 1, 4, 9, 12 | 1A – 4A | Data inputs |
| 2, 5, 10, 13 | 1B – 4B | |
| 3, 6, 8, 11 | 1Y – 4Y | Data outputs |
| 7 | GND | Ground (0 V) |
| 14 | $V_{CC}$ | Positive supply voltage |

## LOGIC SYMBOL

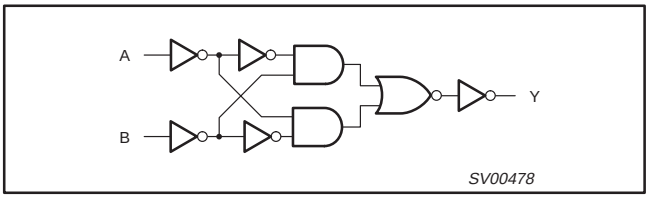



## FUNCTION TABLE

| INPUTS | | OUTPUTS |
|---|---|---|
| nA | nB | nY |
| L | L | L |
| L | H | H |
| H | L | H |
| H | H | L |

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

## LOGIC DIAGRAM (ONE GATE)




## RECOMMENDED OPERATING CONDITIONS

| SYMBOL | PARAMETER | CONDITIONS | LIMITS | | UNIT |
|---|---|---|---|---|---|
| | | | MIN | MAX | |
| $V_{CC}$ | DC supply voltage (for max. speed performance) | | 2.7 | 3.6 | V |
| | DC supply voltage (for low-voltage applications) | | 1.2 | 3.6 | |
| $V_I$ | DC Input voltage range | | 0 | 5.5 | V |
| $V_O$ | DC output voltage range | | 0 | $V_{CC}$ | V |
| $T_{amb}$ | Operating ambient temperature range in free-air | | –40 | +85 | °C |
| $t_r$, $t_f$ | Input rise and fall times | $V_{CC}$ = 1.2 to 2.7V<br>$V_{CC}$ = 2.7 to 3.6V | 0<br>0 | 20<br>10 | ns/V |

## ABSOLUTE MAXIMUM RATINGS[1]

Absolute Maximum Rating System (IEC 134)
Voltages are referenced to GND (ground = 0V)

| SYMBOL | PARAMETER | CONDITIONS | RATING | UNIT |
|---|---|---|---|---|
| $V_{CC}$ | DC supply voltage (for max. speed performance) | | –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 +5.5 | V |
| $I_{OK}$ | DC output diode current | $V_O > V_{CC}$ or $V_O < 0$ | ±50 | mA |
| $V_O$ | DC output voltage | Note 2 | –0.5 to $V_{CC}$ + 0.5 | V |
| $I_O$ | 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<br>– plastic mini-pack (SO)<br>– plastic shrink mini-pack (SSOP and TSSOP) | <br>above +70°C derate linearly with 8 mW/K<br>above +60°C derate linearly with 5.5 mW/K | <br>500<br>500 | mW |

**NOTES:**
1. 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.
2. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

## DC 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[1] | MAX | |
| $V_{IH}$ | HIGH level Input voltage | $V_{CC}$ = 1.2V | $V_{CC}$ | | | V |
| | | $V_{CC}$ = 2.7 to 3.6V | 2.0 | | | |
| $V_{IL}$ | LOW level Input voltage | $V_{CC}$ = 1.2V | | | GND | V |
| | | $V_{CC}$ = 2.7 to 3.6V | | | 0.8 | |
| $V_{OH}$ | HIGH level output voltage | $V_{CC}$ = 2.7V; $V_I$ = $V_{IH}$ or $V_{IL}$; $I_O$ = –12mA | $V_{CC}$ – 0.5 | | | V |
| | | $V_{CC}$ = 3.0V; $V_I$ = $V_{IH}$ or $V_{IL}$; $I_O$ = –100µA | $V_{CC}$ – 0.2 | $V_{CC}$ | | |
| | | $V_{CC}$ = 3.0V; $V_I$ = $V_{IH}$ or $V_{IL;}$ $I_O$ = –18mA | $V_{CC}$ – 0.6 | | | |
| | | $V_{CC}$ = 3.0V; $V_I$ = $V_{IH}$ or $V_{IL;}$ $I_O$ = –24mA | $V_{CC}$ – 0.8 | | | |
| $V_{OL}$ | LOW level output voltage | $V_{CC}$ = 2.7V; $V_I$ = $V_{IH}$ or $V_{IL}$; $I_O$ = 12mA | | | 0.40 | V |
| | | $V_{CC}$ = 3.0V; $V_I$ = $V_{IH}$ or $V_{IL}$; $I_O$ = 100µA | | | 0.20 | |
| | | $V_{CC}$ = 3.0V; $V_I$ = $V_{IH}$ or $V_{IL;}$ $I_O$ = 24mA | | | 0.55 | |
| $I_I$ | Input leakage current | $V_{CC}$ = 3.6V; $V_I$ = 5.5V or GND | | ±0.1 | ±5 | µA |
| $I_{CC}$ | Quiescent supply current | $V_{CC}$ = 3.6V; $V_I$ = $V_{CC}$ or GND; $I_O$ = 0 | | 0.1 | 10 | µA |
| $\Delta I_{CC}$ | Additional quiescent supply current per input pin | $V_{CC}$ = 2.7V to 3.6V; $V_I$ = $V_{CC}$ –0.6V; $I_O$ = 0 | | 5 | 500 | µA |

**NOTES:**
1. All typical values are at $V_{CC}$ = 3.3V and $T_{amb}$ = 25°C.

## AC CHARACTERISTICS

GND = 0 V; $t_r = t_f \leq$ 2.5 ns; $C_L$ = 50 pF; $R_L$ = 500Ω; $T_{amb}$ = –40°C to +85°C

| SYMBOL | PARAMETER | WAVEFORM | LIMITS | | | | | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $V_{CC}$ = 3.3V ±0.3V | | | $V_{CC}$ = 2.7V | | | $V_{CC}$ = 1.2V | |
| | | | MIN | TYP[1] | MAX | MIN | TYP[1] | MAX | TYP | |
| $t_{PHL}$/ $t_{PLH}$ | Propagation delay nA, nB to nY | Figures 1, 2 | 1.5 | 3.0 | 5 | 1.5 | 3.4 | 5.8 | 11 | ns |

**NOTE:**
1. These typical values are at $V_{CC}$ = 3.3V and $T_{amb}$ = 25°C.

## AC WAVEFORMS

$V_M$ = 1.5 V at $V_{CC} \geq$ 2.7 V
$V_M$ = 0.5 • $V_{CC}$ at $V_{CC}$ < 2.7 V
$V_{OL}$ and $V_{OH}$ are the typical output voltage drop that occur with the output load.

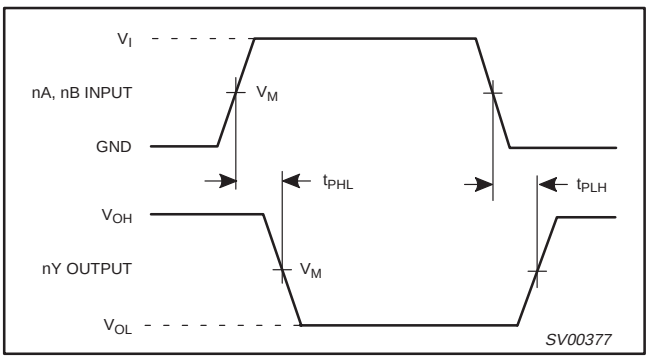



**Figure 1. Input (nA, nB) to output (nY) propagation delays**

## TEST CIRCUIT

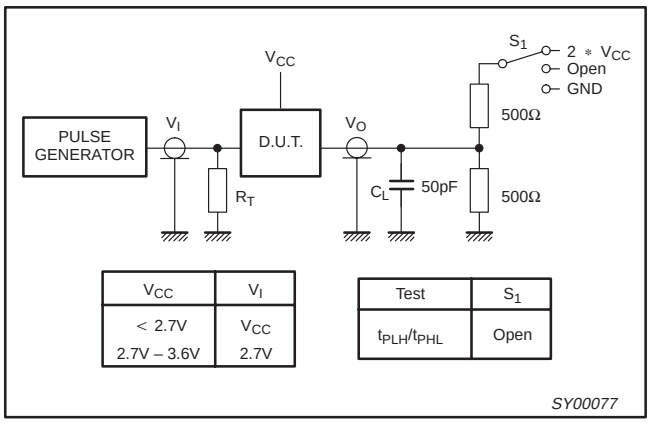
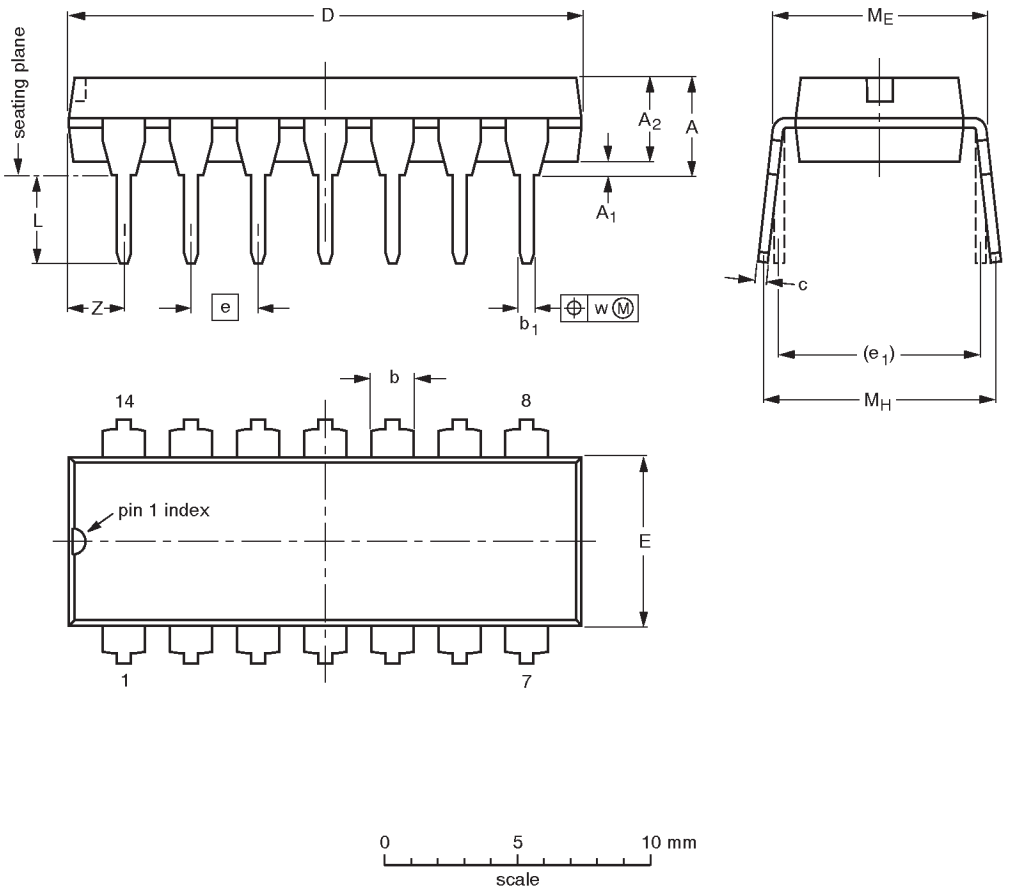



**Figure 2. Load circuitry for switching times.**

**DIP14: plastic dual in-line package; 14 leads (300 mil)** **SOT27-1**




**DIMENSIONS (inch dimensions are derived from the original mm dimensions)**

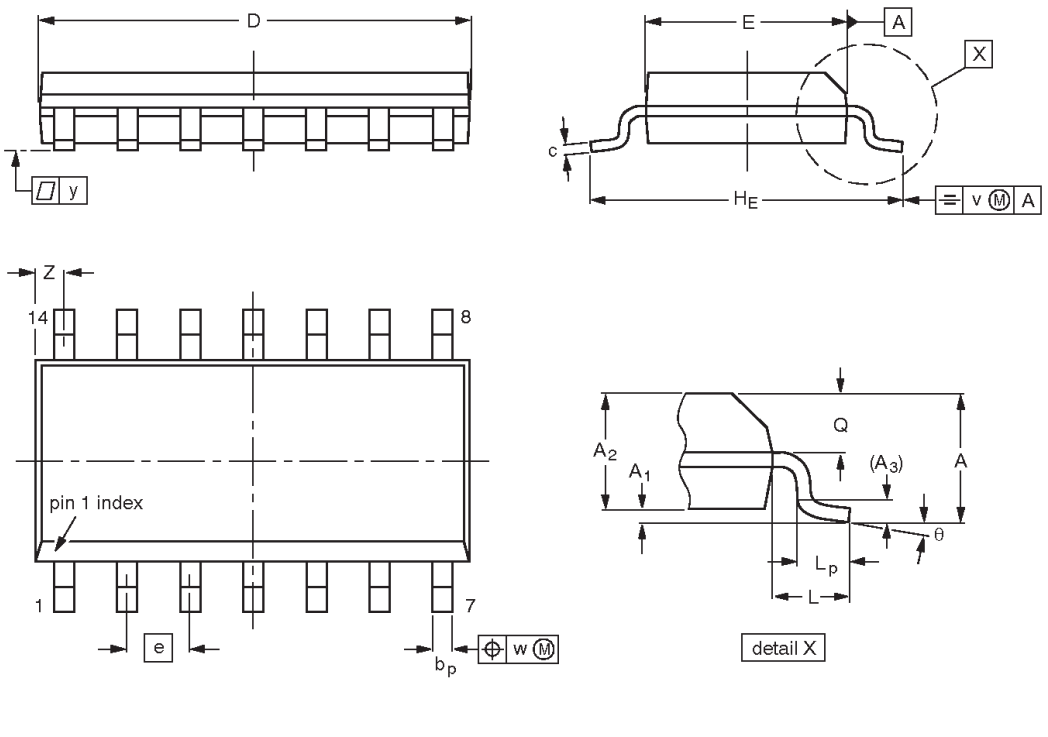
| UNIT | A max. | $A_1$ min. | $A_2$ max. | b | $b_1$ | c | D (1) | E (1) | e | $e_1$ | L | $M_E$ | $M_H$ | w | Z (1) max. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 4.2 | 0.51 | 3.2 | 1.73<br>1.13 | 0.53<br>0.38 | 0.36<br>0.23 | 19.50<br>18.55 | 6.48<br>6.20 | 2.54 | 7.62 | 3.60<br>3.05 | 8.25<br>7.80 | 10.0<br>8.3 | 0.254 | 2.2 |
| inches | 0.17 | 0.020 | 0.13 | 0.068<br>0.044 | 0.021<br>0.015 | 0.014<br>0.009 | 0.77<br>0.73 | 0.26<br>0.24 | 0.10 | 0.30 | 0.14<br>0.12 | 0.32<br>0.31 | 0.39<br>0.33 | 0.01 | 0.087 |

**Note**

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | EIAJ | | | |
| SOT27-1 | 050G04 | MO-001AA | | | | ~~92-11-17~~<br>95-03-11 |

**SO14: plastic small outline package; 14 leads; body width 3.9 mm** **SOT108-1**




**DIMENSIONS (inch dimensions are derived from the original mm dimensions)**

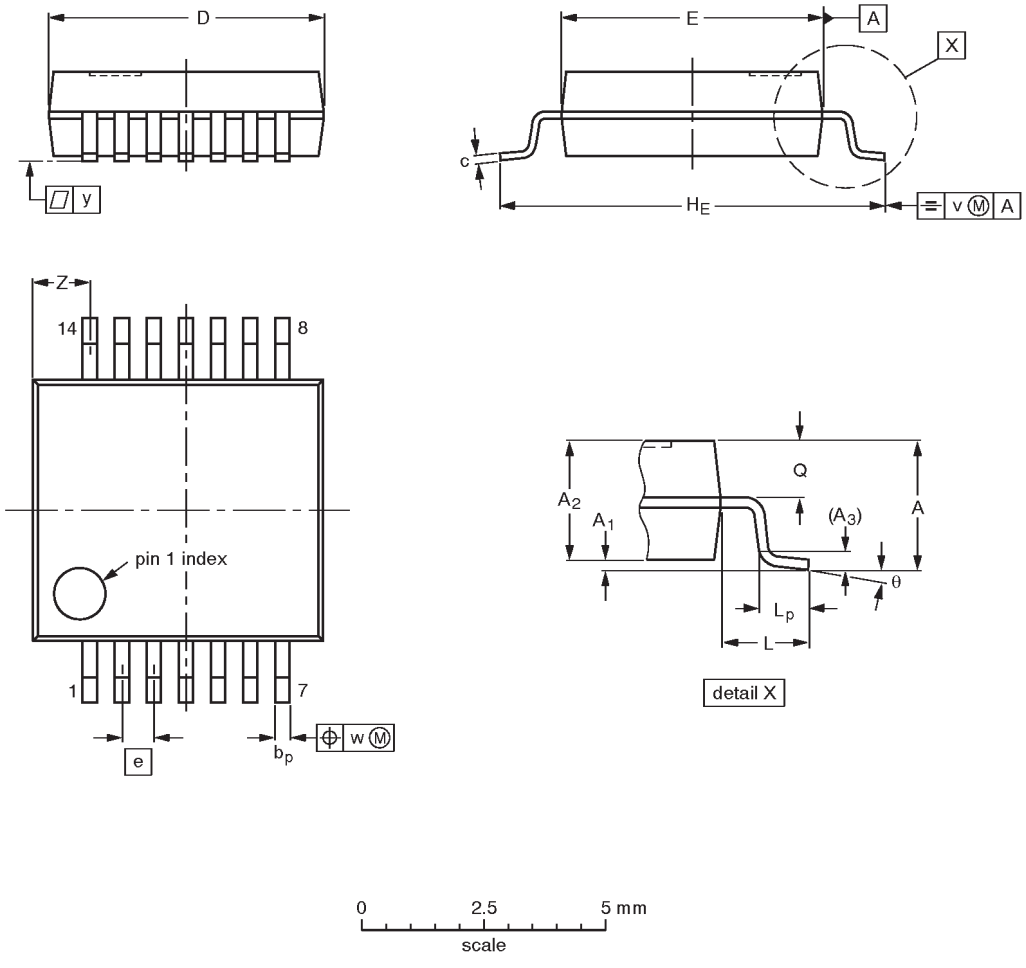
| UNIT | A max. | $A_1$ | $A_2$ | $A_3$ | $b_p$ | c | $D^{(1)}$ | $E^{(1)}$ | e | $H_E$ | L | $L_p$ | Q | v | w | y | $Z^{(1)}$ | θ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1.75 | 0.25<br>0.10 | 1.45<br>1.25 | 0.25 | 0.49<br>0.36 | 0.25<br>0.19 | 8.75<br>8.55 | 4.0<br>3.8 | 1.27 | 6.2<br>5.8 | 1.05 | 1.0<br>0.4 | 0.7<br>0.6 | 0.25 | 0.25 | 0.1 | 0.7<br>0.3 | $8^o$<br>$0^o$ |
| inches | 0.069 | 0.010<br>0.004 | 0.057<br>0.049 | 0.01 | 0.019<br>0.014 | 0.0100<br>0.0075 | 0.35<br>0.34 | 0.16<br>0.15 | 0.050 | 0.244<br>0.228 | 0.041 | 0.039<br>0.016 | 0.028<br>0.024 | 0.01 | 0.01 | 0.004 | 0.028<br>0.012 | |

**Note**

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | EIAJ | | | |
| SOT108-1 | 076E06S | MS-012AB | | | | ~~95-01-23~~<br>97-05-22 |

**SSOP14: plastic shrink small outline package; 14 leads; body width 5.3 mm** **SOT337-1**




**DIMENSIONS (mm are the original dimensions)**

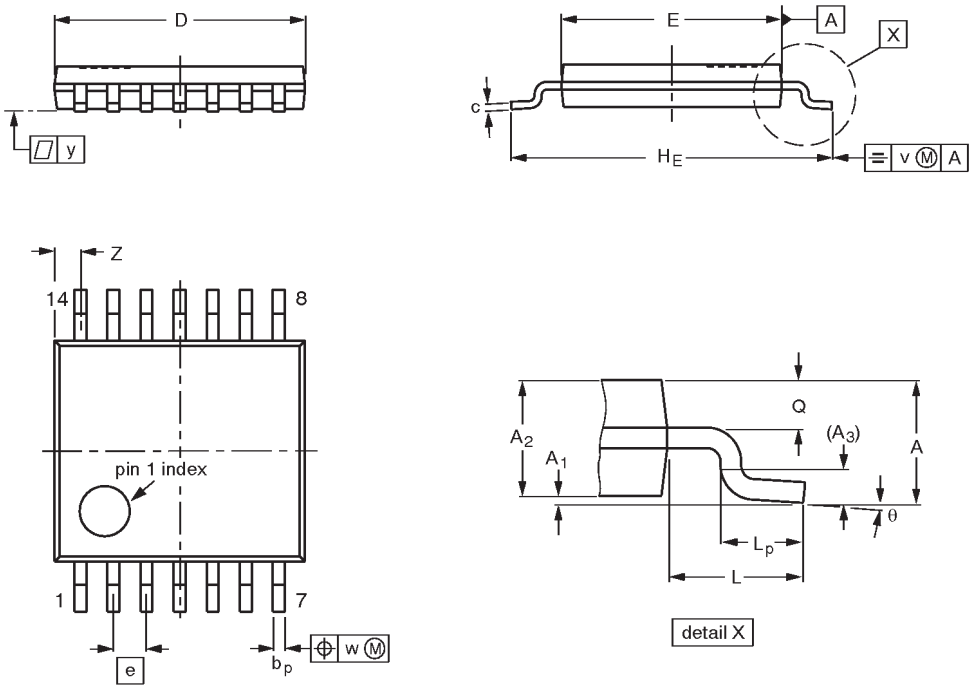
| UNIT | A max. | $A_1$ | $A_2$ | $A_3$ | $b_p$ | c | D (1) | E (1) | e | $H_E$ | L | $L_p$ | Q | v | w | y | Z (1) | θ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 2.0 | 0.21<br>0.05 | 1.80<br>1.65 | 0.25 | 0.38<br>0.25 | 0.20<br>0.09 | 6.4<br>6.0 | 5.4<br>5.2 | 0.65 | 7.9<br>7.6 | 1.25 | 1.03<br>0.63 | 0.9<br>0.7 | 0.2 | 0.13 | 0.1 | 1.4<br>0.9 | 8°<br>0° |

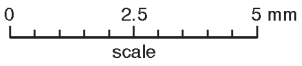
**Note**

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | EIAJ | | | |
| SOT337-1 | | MO-150AB | | | | ~~95-02-04~~<br>96-01-18 |

**TSSOP14: plastic thin shrink small outline package; 14 leads; body width 4.4 mm** **SOT402-1**




**DIMENSIONS (mm are the original dimensions)**

| UNIT | A max. | $A_1$ | $A_2$ | $A_3$ | $b_p$ | c | D (1) | E (2) | e | $H_E$ | L | $L_p$ | Q | v | w | y | Z (1) | θ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1.10 | 0.15<br>0.05 | 0.95<br>0.80 | 0.25 | 0.30<br>0.19 | 0.2<br>0.1 | 5.1<br>4.9 | 4.5<br>4.3 | 0.65 | 6.6<br>6.2 | 1.0 | 0.75<br>0.50 | 0.4<br>0.3 | 0.2 | 0.13 | 0.1 | 0.72<br>0.38 | 8°<br>0° |

**Notes**

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | EIAJ | | | |
| SOT402-1 | | MO-153 | | | | ~~94-07-12~~<br>95-04-04 |

**NOTES**

## DEFINITIONS

| Data Sheet Identification | Product Status | Definition |
|---|---|---|
| *Objective Specification* | Formative or in Design | This data sheet contains the design target or goal specifications for product development. Specifications may change in any manner without notice. |
| *Preliminary Specification* | Preproduction Product | 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* | Full 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. |



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