

# 74LVC2952A

Octal registered transceiver with 5 V tolerant inputs/outputs;  
3-state

Rev. 02 — 29 June 2004

Product data sheet

## 1. General description

The 74LVC2952A is a high-performance, low power, low voltage, Si-gate CMOS device superior to most advanced CMOS compatible TTL families.

Inputs can be driven from either 3.3 V or 5 V devices. In 3-state operation, outputs can handle 5 V. These features allow the use of these devices as translators in a mixed 3.3 V and 5 V environment.

The 74LVC2952A is an octal non-inverting registered transceiver. Two 8-bit back-to-back registers store data flowing in both directions between two bidirectional buses. Data applied to the inputs is entered and stored on the rising edge of the clock (CPAB, CPBA) provided that the clock enable ( $\overline{\text{CEAB}}$ ,  $\overline{\text{CEBA}}$ ) input is LOW. The data is then present at the 3-state output buffers, but is only accessible when the output enable ( $\overline{\text{OEAB}}$ ,  $\overline{\text{OEBA}}$ ) input is LOW. Data flow from A inputs to B outputs is the same as for B inputs to A outputs.

## 2. Features

- 5 V tolerant inputs/outputs for interfacing with 5 V logic
- Supply voltage range from 1.2 V to 3.6 V
- CMOS low-power consumption
- Direct interface with TTL levels
- Inputs accept voltages up to 5.5 V
- Flow-through pin-out architecture
- Complies with JEDEC standard JESD8-B/JESD36
- ESD protection:
  - ◆ HBM EIA/JESD22-A114-B exceeds 2000 V
  - ◆ MM EIA/JESD22-A115-A exceeds 200 V.
- Specified from  $-40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$  and from  $-40\text{ }^{\circ}\text{C}$  to  $+125\text{ }^{\circ}\text{C}$ .

**PHILIPS**

### 3. Quick reference data

**Table 1: Quick reference data**

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

| Symbol                | Parameter                                  | Conditions                                     | Min     | Typ  | Max | Unit |
|-----------------------|--------------------------------------------|------------------------------------------------|---------|------|-----|------|
| $t_{PHL}$ , $t_{PLH}$ | propagation delay<br>CPAB, CPBA to An, Bn  | $C_L = 50\text{ pF}$ ; $V_{CC} = 3.3\text{ V}$ | -       | 3.6  | -   | ns   |
| $f_{max}$             | maximum clock frequency                    | $C_L = 50\text{ pF}$ ; $V_{CC} = 3.3\text{ V}$ | -       | 250  | -   | MHz  |
| $C_I$                 | input capacitance                          |                                                | -       | 5.0  | -   | pF   |
| $C_{I/O}$             | input/output capacitance                   |                                                | -       | 10.0 | -   | pF   |
| $C_{PD}$              | power dissipation<br>capacitance per latch | outputs enabled;<br>$V_{CC} = 3.3\text{ V}$    | [1] [2] | 15.0 | -   | pF   |

[1]  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu\text{W}$ ).

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

$N$  = total load switching outputs;

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

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

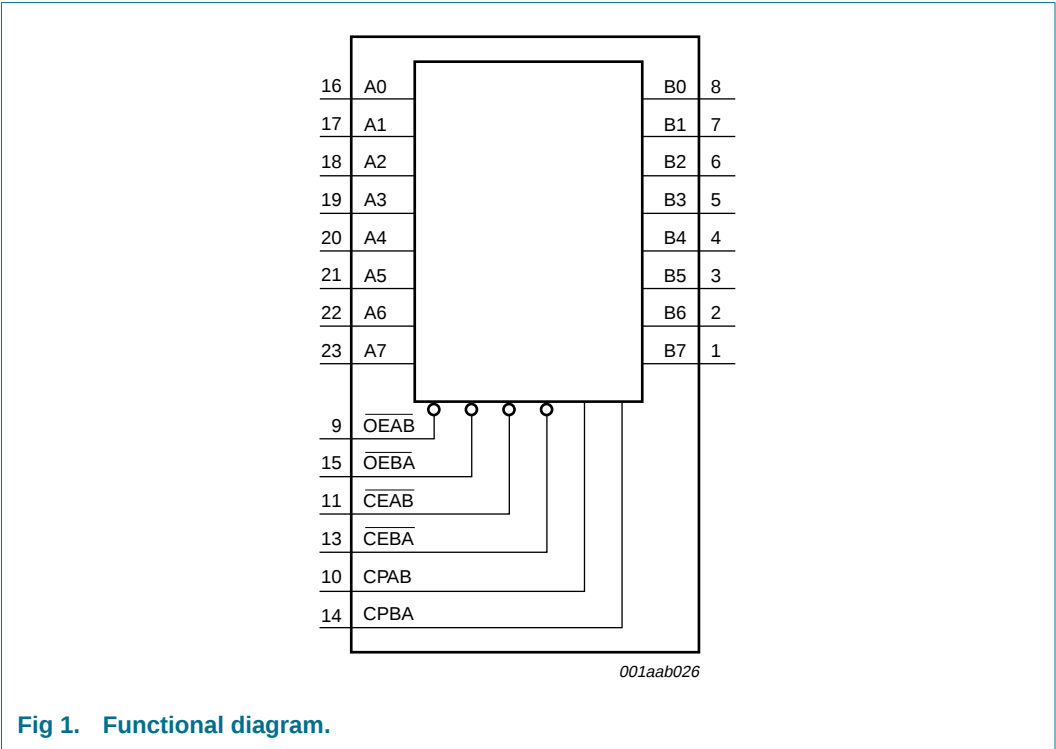
### 4. Ordering information

**Table 2: Ordering information**

| Type number  | Package           |         |                                                                        |          |
|--------------|-------------------|---------|------------------------------------------------------------------------|----------|
|              | Temperature range | Name    | Description                                                            | Version  |
| 74LVC2952AD  | -40 °C to +125 °C | SO24    | plastic small outline package; 24 leads; body width 7.5 mm             | SOT137-1 |
| 74LVC2952ADB | -40 °C to +125 °C | SSOP24  | plastic shrink small outline package; 24 leads; body width 5.3 mm      | SOT340-1 |
| 74LVC2952APW | -40 °C to +125 °C | TSSOP24 | plastic thin shrink small outline package; 24 leads; body width 4.4 mm | SOT355-1 |



5. Functional diagram



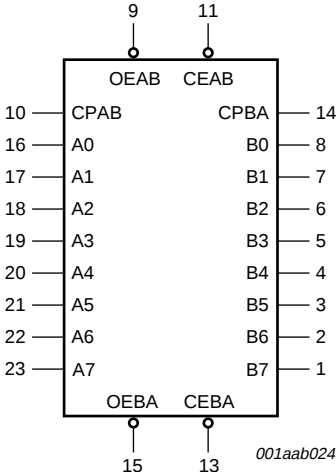


Fig 2. Logic symbol.

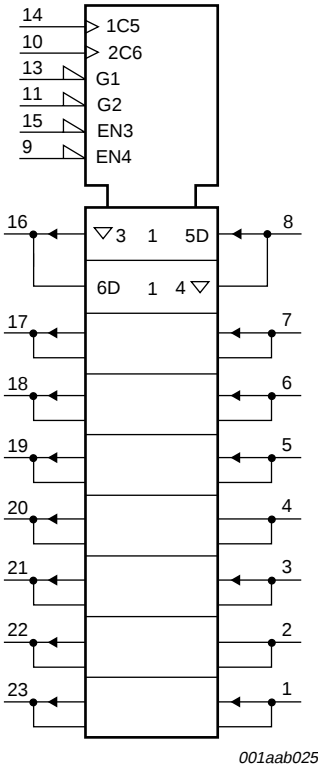


Fig 3. IEC logic symbol.

6. Pinning information

6.1 Pinning

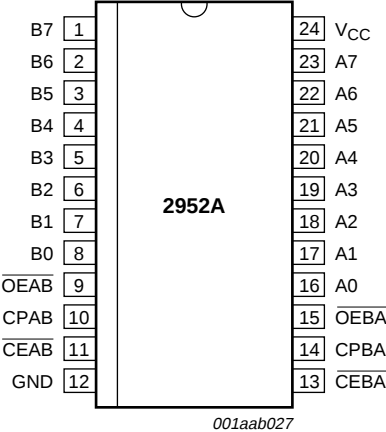


Fig 4. Pin configuration.

## 6.2 Pin description

**Table 3: Pin description**

| Symbol                   | Pin | Description                                      |
|--------------------------|-----|--------------------------------------------------|
| B7                       | 1   | B data input/output                              |
| B6                       | 2   | B data input/output                              |
| B5                       | 3   | B data input/output                              |
| B4                       | 4   | B data input/output                              |
| B3                       | 5   | B data input/output                              |
| B2                       | 6   | B data input/output                              |
| B1                       | 7   | B data input/output                              |
| B0                       | 8   | B data input/output                              |
| $\overline{\text{OEAB}}$ | 9   | A to B output enable input (active LOW)          |
| CPAB                     | 10  | A to B clock input (LOW-to-HIGH, edge-triggered) |
| $\overline{\text{CEAB}}$ | 11  | A to B clock enable input (active LOW)           |
| GND                      | 12  | ground (0 V)                                     |
| $\overline{\text{CEBA}}$ | 13  | B to A clock enable input (active LOW)           |
| CPBA                     | 14  | B to A clock input (LOW-to-HIGH, edge-triggered) |
| $\overline{\text{OEBA}}$ | 15  | B to A output enable input (active LOW)          |
| A0                       | 16  | A data input/output                              |
| A1                       | 17  | A data input/output                              |
| A2                       | 18  | A data input/output                              |
| A3                       | 19  | A data input/output                              |
| A4                       | 20  | A data input/output                              |
| A5                       | 21  | A data input/output                              |
| A6                       | 22  | A data input/output                              |
| A7                       | 23  | A data input/output                              |
| V <sub>CC</sub>          | 24  | supply voltage                                   |

## 7. Functional description

### 7.1 Function table

**Table 4:** Function table for register An or Bn <sup>[1]</sup>

| Operating mode | Input    |      |                                    | Internal latch |
|----------------|----------|------|------------------------------------|----------------|
|                | An or Bn | CPxx | $\overline{\text{CE}}_{\text{xx}}$ |                |
| Hold data      | X        | X    | H                                  | NC             |
| Load data      | L        | ↑    | L                                  | L              |
| Load data      | H        | ↑    | L                                  | H              |

**Table 5:** Function table for output enable <sup>[1]</sup>

| Operating mode  | Input $\overline{\text{OE}}_{\text{xx}}$ | Internal latch | Output An or Bn |
|-----------------|------------------------------------------|----------------|-----------------|
| Disable outputs | H                                        | X              | Z               |
| Enable outputs  | L                                        | L              | L               |
| Enable outputs  | L                                        | H              | H               |

- [1] H = HIGH voltage level;  
 L = LOW voltage level;  
 Z = high-impedance OFF-state;  
 NC = no change;  
 X = don't care;  
 ↑ = LOW-to-HIGH level transition.

## 8. Limiting values

**Table 6:** 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 |
|---------------------------------|--------------------------------|----------------------------------------------------------------|---------------------|-----------------------|------|
| $V_{\text{CC}}$                 | supply voltage                 |                                                                | -0.5                | +6.5                  | V    |
| $I_{\text{IK}}$                 | input diode current            | $V_{\text{I}} < 0 \text{ V}$                                   | -                   | -50                   | mA   |
| $V_{\text{I}}$                  | input voltage                  |                                                                | <sup>[1]</sup> -0.5 | +6.5                  | V    |
| $I_{\text{OK}}$                 | output diode current           | $V_{\text{O}} > V_{\text{CC}}$ or $V_{\text{O}} < 0 \text{ V}$ | -                   | ±50                   | mA   |
| $V_{\text{O}}$                  | output voltage                 | output HIGH or LOW state                                       | <sup>[1]</sup> -0.5 | $V_{\text{CC}} + 0.5$ | V    |
|                                 |                                | output 3-state                                                 | <sup>[1]</sup> -0.5 | +6.5                  | V    |
| $I_{\text{O}}$                  | output source or sink current  | $V_{\text{O}} = 0 \text{ V}$ to $V_{\text{CC}}$                | -                   | ±50                   | mA   |
| $I_{\text{CC}}, I_{\text{GND}}$ | $V_{\text{CC}}$ or GND current |                                                                | -                   | ±100                  | mA   |
| $T_{\text{stg}}$                | storage temperature            |                                                                | -65                 | +150                  | °C   |
| $P_{\text{tot}}$                | power dissipation              | $T_{\text{amb}} = -40 \text{ °C}$ to $+125 \text{ °C}$         | <sup>[2]</sup> -    | 500                   | mW   |

- [1] The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

- [2] For SO24 packages: above 70 °C the value of  $P_{\text{tot}}$  derates linearly with 5.5 mW/K.  
 For T(SSOP)24 packages: above 60 °C the value of  $P_{\text{tot}}$  derates linearly with 5.5 mW/K.

## 9. Recommended operating conditions

Table 7: Recommended operating conditions

| Symbol     | Parameter                     | Conditions                                 | Min | Typ | Max      | Unit |
|------------|-------------------------------|--------------------------------------------|-----|-----|----------|------|
| $V_{CC}$   | supply voltage                | for maximum speed performance              | 2.7 | -   | 3.6      | V    |
|            |                               | for low-voltage applications               | 1.2 | -   | 3.6      | V    |
| $V_I$      | input voltage                 |                                            | 0   | -   | 5.5      | V    |
| $V_O$      | output voltage                | output HIGH or LOW state                   | 0   | -   | $V_{CC}$ | V    |
|            |                               | output 3-state                             | 0   | -   | 5.5      | V    |
| $T_{amb}$  | operating ambient temperature | in free air                                | -40 | -   | +125     | °C   |
| $t_r, t_f$ | input rise and fall times     | $V_{CC} = 1.2 \text{ V to } 2.7 \text{ V}$ | 0   | -   | 20       | ns/V |
|            |                               | $V_{CC} = 2.7 \text{ V to } 3.6 \text{ V}$ | 0   | -   | 10       | ns/V |

## 10. Static characteristics

Table 8: Static characteristics

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

| Symbol                                            | Parameter                                   | Conditions                                                                                      | Min            | Typ       | Max      | Unit          |
|---------------------------------------------------|---------------------------------------------|-------------------------------------------------------------------------------------------------|----------------|-----------|----------|---------------|
| $T_{amb} = -40 \text{ °C to } +85 \text{ °C}$ [1] |                                             |                                                                                                 |                |           |          |               |
| $V_{IH}$                                          | HIGH-level input voltage                    | $V_{CC} = 1.2 \text{ V}$                                                                        | $V_{CC}$       | -         | -        | V             |
|                                                   |                                             | $V_{CC} = 2.7 \text{ V to } 3.6 \text{ V}$                                                      | 2.0            | -         | -        | V             |
| $V_{IL}$                                          | LOW-level input voltage                     | $V_{CC} = 1.2 \text{ V}$                                                                        | -              | -         | GND      | V             |
|                                                   |                                             | $V_{CC} = 2.7 \text{ V to } 3.6 \text{ V}$                                                      | -              | -         | 0.8      | V             |
| $V_{OH}$                                          | HIGH-level output voltage                   | $V_I = V_{IH} \text{ or } V_{IL}$                                                               |                |           |          |               |
|                                                   |                                             | $I_O = -100 \text{ }\mu\text{A}; V_{CC} = 2.7 \text{ V to } 3.6 \text{ V}$ [2]                  | $V_{CC} - 0.2$ | $V_{CC}$  | -        | V             |
|                                                   |                                             | $I_O = -12 \text{ mA}; V_{CC} = 2.7 \text{ V}$                                                  | $V_{CC} - 0.5$ | -         | -        | V             |
|                                                   |                                             | $I_O = -18 \text{ mA}; V_{CC} = 3.0 \text{ V}$                                                  | $V_{CC} - 0.6$ | -         | -        | V             |
|                                                   |                                             | $I_O = -24 \text{ mA}; V_{CC} = 3.0 \text{ V}$                                                  | $V_{CC} - 0.8$ | -         | -        | V             |
| $V_{OL}$                                          | LOW-level output voltage                    | $V_I = V_{IH} \text{ or } V_{IL}$                                                               |                |           |          |               |
|                                                   |                                             | $I_O = 100 \text{ }\mu\text{A}; V_{CC} = 2.7 \text{ V to } 3.6 \text{ V}$ [2]                   | -              | GND       | 0.2      | V             |
|                                                   |                                             | $I_O = 12 \text{ mA}; V_{CC} = 2.7 \text{ V}$                                                   | -              | -         | 0.4      | V             |
|                                                   |                                             | $I_O = 24 \text{ mA}; V_{CC} = 3.0 \text{ V}$                                                   | -              | -         | 0.55     | V             |
| $I_{LI}$                                          | input leakage current                       | $V_I = 5.5 \text{ V or GND}; V_{CC} = 3.6 \text{ V}$                                            | -              | $\pm 0.1$ | $\pm 5$  | $\mu\text{A}$ |
| $I_{OZ}$                                          | 3-state output OFF-state current            | $V_I = V_{IH} \text{ or } V_{IL}; V_O = 5.5 \text{ V or GND}; V_{CC} = 3.6 \text{ V}$ [3]       | -              | 0.1       | $\pm 10$ | $\mu\text{A}$ |
| $I_{off}$                                         | power-off leakage current                   | $V_I \text{ or } V_O = 5.5 \text{ V}; V_{CC} = 0 \text{ V}$                                     | -              | 0.1       | $\pm 10$ | $\mu\text{A}$ |
| $I_{CC}$                                          | quiescent supply current                    | $V_I = V_{CC} \text{ or GND}; I_O = 0 \text{ A}; V_{CC} = 3.6 \text{ V}$                        | -              | 0.1       | 10       | $\mu\text{A}$ |
| $\Delta I_{CC}$                                   | additional quiescent supply current per pin | $V_I = V_{CC} - 0.6 \text{ V}; I_O = 0 \text{ A}; V_{CC} = 2.7 \text{ V to } 3.6 \text{ V}$ [2] | -              | 5         | 500      | $\mu\text{A}$ |
| $C_I$                                             | input capacitance                           |                                                                                                 | -              | 5.0       | -        | pF            |
| $C_{I/O}$                                         | input/output capacitance                    |                                                                                                 | -              | 10.0      | -        | pF            |

**Table 8:** Static characteristics ...continued

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

| Symbol                                     | Parameter                                         | Conditions                                                                                                   | Min                    | Typ | Max  | Unit |
|--------------------------------------------|---------------------------------------------------|--------------------------------------------------------------------------------------------------------------|------------------------|-----|------|------|
| <b>T<sub>amb</sub> = –40 °C to +125 °C</b> |                                                   |                                                                                                              |                        |     |      |      |
| V <sub>IH</sub>                            | HIGH-level input voltage                          | V <sub>CC</sub> = 1.2 V                                                                                      | V <sub>CC</sub>        | -   | -    | V    |
|                                            |                                                   | V <sub>CC</sub> = 2.7 V to 3.6 V                                                                             | 2.0                    | -   | -    | V    |
| V <sub>IL</sub>                            | LOW-level input voltage                           | V <sub>CC</sub> = 1.2 V                                                                                      | -                      | -   | 0    | V    |
|                                            |                                                   | V <sub>CC</sub> = 2.7 V to 3.6 V                                                                             | -                      | -   | 0.8  | V    |
| V <sub>OH</sub>                            | HIGH-level output voltage                         | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>                                                          |                        |     |      |      |
|                                            |                                                   | I <sub>O</sub> = –100 µA; V <sub>CC</sub> = 2.7 V to 3.6 V                                                   | V <sub>CC</sub> – 0.3  | -   | -    | V    |
|                                            |                                                   | I <sub>O</sub> = –12 mA; V <sub>CC</sub> = 2.7 V                                                             | V <sub>CC</sub> – 0.65 | -   | -    | V    |
|                                            |                                                   | I <sub>O</sub> = –18 mA; V <sub>CC</sub> = 3.0 V                                                             | V <sub>CC</sub> – 0.75 | -   | -    | V    |
|                                            |                                                   | I <sub>O</sub> = –24 mA; V <sub>CC</sub> = 3.0 V                                                             | V <sub>CC</sub> – 1    | -   | -    | V    |
| V <sub>OL</sub>                            | LOW-level output voltage                          | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>                                                          |                        |     |      |      |
|                                            |                                                   | I <sub>O</sub> = 100 µA; V <sub>CC</sub> = 2.7 V to 3.6 V                                                    | -                      | -   | 0.3  | V    |
|                                            |                                                   | I <sub>O</sub> = 12 mA; V <sub>CC</sub> = 2.7 V                                                              | -                      | -   | 0.6  | V    |
|                                            |                                                   | I <sub>O</sub> = 24 mA; V <sub>CC</sub> = 3.0 V                                                              | -                      | -   | 0.8  | V    |
| I <sub>LI</sub>                            | input leakage current                             | V <sub>I</sub> = 5.5 V or GND; V <sub>CC</sub> = 3.6 V                                                       | -                      | -   | ±20  | µA   |
| I <sub>OZ</sub>                            | 3-state output OFF-state current                  | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>O</sub> = 5.5 V or GND; V <sub>CC</sub> = 3.6 V | [3] -                  | -   | ±20  | µA   |
| I <sub>off</sub>                           | power-off leakage current                         | V <sub>I</sub> or V <sub>O</sub> = 5.5 V; V <sub>CC</sub> = 0 V                                              | -                      | -   | ±20  | µA   |
| I <sub>CC</sub>                            | quiescent supply current                          | V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 3.6 V                       | -                      | -   | 40   | µA   |
| ΔI <sub>CC</sub>                           | additional quiescent supply current per input pin | V <sub>I</sub> = V <sub>CC</sub> – 0.6 V; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 2.7 V to 3.6 V             | -                      | -   | 5000 | µA   |

[1] All typical values are measured at T<sub>amb</sub> = 25 °C.[2] These typical values are measured at V<sub>CC</sub> = 3.3 V.[3] For transceivers, the parameter I<sub>OZ</sub> includes the input leakage current.

## 11. Dynamic characteristics

**Table 9:** Dynamic characteristicsGND = 0 V; see [Figure 8](#) for test circuit.

| Symbol                                        | Parameter                                             | Conditions                       | Min     | Typ | Max | Unit |
|-----------------------------------------------|-------------------------------------------------------|----------------------------------|---------|-----|-----|------|
| <b>T<sub>amb</sub> = –40 °C to +85 °C [1]</b> |                                                       |                                  |         |     |     |      |
| t <sub>PHL</sub> , t <sub>PLH</sub>           | propagation delay CPBA, CPAB to An and Bn             | see <a href="#">Figure 5</a>     |         |     |     |      |
|                                               |                                                       | V <sub>CC</sub> = 1.2 V          | -       | 16  | -   | ns   |
|                                               |                                                       | V <sub>CC</sub> = 2.7 V          | 1.5     | 4.4 | 8.6 | ns   |
|                                               |                                                       | V <sub>CC</sub> = 3.0 V to 3.6 V | [2] 1.5 | 3.6 | 7.6 | ns   |
| t <sub>PZH</sub> , t <sub>PZL</sub>           | 3-state output enable time<br>OEBA, OEAB to An and Bn | see <a href="#">Figure 7</a>     |         |     |     |      |
|                                               |                                                       | V <sub>CC</sub> = 1.2 V          | -       | 16  | -   | ns   |
|                                               |                                                       | V <sub>CC</sub> = 2.7 V          | 1.5     | 4.7 | 8.6 | ns   |
|                                               |                                                       | V <sub>CC</sub> = 3.0 V to 3.6 V | [2] 1.0 | 3.9 | 7.6 | ns   |

**Table 9: Dynamic characteristics ...continued**GND = 0 V; see [Figure 8](#) for test circuit.

| Symbol                                                                                       | Parameter                                              | Conditions                                 | Min       | Typ  | Max | Unit |
|----------------------------------------------------------------------------------------------|--------------------------------------------------------|--------------------------------------------|-----------|------|-----|------|
| $t_{PHZ}, t_{PLZ}$                                                                           | 3-state output disable time<br>OEBA, OEAB to An and Bn | see <a href="#">Figure 7</a>               |           |      |     |      |
|                                                                                              |                                                        | $V_{CC} = 1.2 \text{ V}$                   | -         | 8    | -   | ns   |
|                                                                                              |                                                        | $V_{CC} = 2.7 \text{ V}$                   | 1.5       | 3.8  | 7.6 | ns   |
|                                                                                              |                                                        | $V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$ | [2] 1.5   | 3.4  | 6.6 | ns   |
| $t_W$                                                                                        | clock pulse width HIGH or LOW CPAB or CPBA             | see <a href="#">Figure 5</a>               |           |      |     |      |
|                                                                                              |                                                        | $V_{CC} = 1.2 \text{ V}$                   | -         | -    | -   | ns   |
|                                                                                              |                                                        | $V_{CC} = 2.7 \text{ V}$                   | 3.0       | 1.5  | -   | ns   |
|                                                                                              |                                                        | $V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$ | [2] 3.0   | 1.5  | -   | ns   |
| $t_{su}$                                                                                     | set-up time HIGH or LOW<br>An, Bn to CPAB, CPBA        | see <a href="#">Figure 6</a>               |           |      |     |      |
|                                                                                              |                                                        | $V_{CC} = 1.2 \text{ V}$                   | -         | -    | -   | ns   |
|                                                                                              |                                                        | $V_{CC} = 2.7 \text{ V}$                   | 1.7       | -    | -   | ns   |
|                                                                                              |                                                        | $V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$ | [2] +1.3  | -0.5 | -   | ns   |
|                                                                                              | set-up time HIGH or LOW<br>CEAB, CEBA to CPAB, CPBA    | see <a href="#">Figure 6</a>               |           |      |     |      |
|                                                                                              |                                                        | $V_{CC} = 1.2 \text{ V}$                   | -         | -    | -   | ns   |
|                                                                                              |                                                        | $V_{CC} = 2.7 \text{ V}$                   | 1.3       | -    | -   | ns   |
|                                                                                              |                                                        | $V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$ | [2] +1.1  | -0.5 | -   | ns   |
|                                                                                              | hold time An, Bn to CPAB, CPBA                         | see <a href="#">Figure 6</a>               |           |      |     |      |
|                                                                                              |                                                        | $V_{CC} = 1.2 \text{ V}$                   | -         | -    | -   | ns   |
|                                                                                              |                                                        | $V_{CC} = 2.7 \text{ V}$                   | 1.5       | -    | -   | ns   |
|                                                                                              |                                                        | $V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$ | [2] 1.5   | 0.6  | -   | ns   |
| $t_h$                                                                                        | hold time CEAB, CEBA to CPAB, CPBA                     | see <a href="#">Figure 6</a>               |           |      |     |      |
|                                                                                              |                                                        | $V_{CC} = 1.2 \text{ V}$                   | -         | -    | -   | ns   |
|                                                                                              |                                                        | $V_{CC} = 2.7 \text{ V}$                   | 1.4       | -    | -   | ns   |
|                                                                                              |                                                        | $V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$ | [2] +1.1  | -0.6 | -   | ns   |
|                                                                                              | maximum clock pulse frequency                          | see <a href="#">Figure 5</a>               |           |      |     |      |
|                                                                                              |                                                        | $V_{CC} = 1.2 \text{ V}$                   | -         | -    | -   | MHz  |
|                                                                                              |                                                        | $V_{CC} = 2.7 \text{ V}$                   | 150       | -    | -   | MHz  |
|                                                                                              |                                                        | $V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$ | [2] 150   | 250  | -   | MHz  |
|                                                                                              | skew                                                   | [3]                                        | -         | -    | 1.0 | ns   |
|                                                                                              | power dissipation capacitance per latch                | outputs enabled; $V_{CC} = 3.3 \text{ V}$  | [4] [5] - | 15.0 | -   | pF   |
| <b><math>T_{amb} = -40 \text{ }^{\circ}\text{C to } +125 \text{ }^{\circ}\text{C}</math></b> |                                                        |                                            |           |      |     |      |
| $t_{PHL}, t_{PLH}$                                                                           | propagation delay CPBA, CPAB to An, Bn                 | see <a href="#">Figure 5</a>               |           |      |     |      |
|                                                                                              |                                                        | $V_{CC} = 1.2 \text{ V}$                   | -         | -    | -   | ns   |
|                                                                                              |                                                        | $V_{CC} = 2.7 \text{ V}$                   | 1.5       | -    | 11  | ns   |
|                                                                                              |                                                        | $V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$ | 1.5       | -    | 9.5 | ns   |
| $t_{PZH}, t_{PZL}$                                                                           | 3-state output enable time<br>OEBA, OEAB to An, Bn     | see <a href="#">Figure 7</a>               |           |      |     |      |
|                                                                                              |                                                        | $V_{CC} = 1.2 \text{ V}$                   | -         | -    | -   | ns   |
|                                                                                              |                                                        | $V_{CC} = 2.7 \text{ V}$                   | 1.5       | -    | 11  | ns   |
|                                                                                              |                                                        | $V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$ | 1.0       | -    | 9.5 | ns   |

**Table 9: Dynamic characteristics ...continued**GND = 0 V; see [Figure 8](#) for test circuit.

| Symbol             | Parameter                                           | Conditions                                 | Min | Typ | Max | Unit |
|--------------------|-----------------------------------------------------|--------------------------------------------|-----|-----|-----|------|
| $t_{PHZ}, t_{PLZ}$ | 3-state output disable time<br>OEBA, OEAB to An, Bn | see <a href="#">Figure 7</a>               |     |     |     |      |
|                    |                                                     | $V_{CC} = 1.2 \text{ V}$                   | -   | -   | -   | ns   |
|                    |                                                     | $V_{CC} = 2.7 \text{ V}$                   | 1.5 | -   | 9.5 | ns   |
|                    |                                                     | $V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$ | 1.5 | -   | 8.5 | ns   |
| $t_W$              | clock pulse width HIGH or LOW CPAB or CPBA          | see <a href="#">Figure 5</a>               |     |     |     |      |
|                    |                                                     | $V_{CC} = 1.2 \text{ V}$                   | -   | -   | -   | ns   |
|                    |                                                     | $V_{CC} = 2.7 \text{ V}$                   | 3.0 | -   | -   | ns   |
|                    |                                                     | $V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$ | 3.0 | -   | -   | ns   |
| $t_{su}$           | set-up time HIGH or LOW<br>An, Bn to CPAB, CPBA     | see <a href="#">Figure 6</a>               |     |     |     |      |
|                    |                                                     | $V_{CC} = 1.2 \text{ V}$                   | -   | -   | -   | ns   |
|                    |                                                     | $V_{CC} = 2.7 \text{ V}$                   | 1.7 | -   | -   | ns   |
|                    |                                                     | $V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$ | 1.3 | -   | -   | ns   |
|                    | set-up time HIGH or LOW<br>CEAB, CEBA to CPAB, CPBA | see <a href="#">Figure 6</a>               |     |     |     |      |
|                    |                                                     | $V_{CC} = 1.2 \text{ V}$                   | -   | -   | -   | ns   |
|                    |                                                     | $V_{CC} = 2.7 \text{ V}$                   | 1.3 | -   | -   | ns   |
|                    |                                                     | $V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$ | 1.1 | -   | -   | ns   |
|                    | hold time An, Bn to CPAB, CPBA                      | see <a href="#">Figure 6</a>               |     |     |     |      |
|                    |                                                     | $V_{CC} = 1.2 \text{ V}$                   | -   | -   | -   | ns   |
|                    |                                                     | $V_{CC} = 2.7 \text{ V}$                   | 1.5 | -   | -   | ns   |
|                    |                                                     | $V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$ | 1.5 | -   | -   | ns   |
| $t_h$              | hold time CEAB, CEBA to CPAB, CPBA                  | see <a href="#">Figure 6</a>               |     |     |     |      |
|                    |                                                     | $V_{CC} = 1.2 \text{ V}$                   | -   | -   | -   | ns   |
|                    |                                                     | $V_{CC} = 2.7 \text{ V}$                   | 1.4 | -   | -   | ns   |
|                    |                                                     | $V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$ | 1.1 | -   | -   | ns   |
|                    | maximum clock pulse frequency                       | see <a href="#">Figure 5</a>               |     |     |     |      |
|                    |                                                     | $V_{CC} = 1.2 \text{ V}$                   | -   | -   | -   | MHz  |
|                    |                                                     | $V_{CC} = 2.7 \text{ V}$                   | 150 | -   | -   | MHz  |
|                    |                                                     | $V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$ | 150 | -   | -   | MHz  |
|                    | skew                                                | <a href="#">[3]</a>                        | -   | -   | 1.5 | ns   |
|                    |                                                     |                                            |     |     |     |      |

[1] All typical values are measured at  $T_{amb} = 25 \text{ }^{\circ}\text{C}$ .[2] These typical values are measured at  $V_{CC} = 3.3 \text{ V}$ .

[3] Skew between any two outputs of the same package switching in the same direction. This parameter is guaranteed by design.

[4]  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu\text{W}$ ). $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o)$  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; $N$  = total load switching outputs; $\Sigma(C_L \times V_{CC}^2 \times f_o)$  = sum of the outputs.[5] The condition is  $V_i = \text{GND to } V_{CC}$ .

12. Waveforms

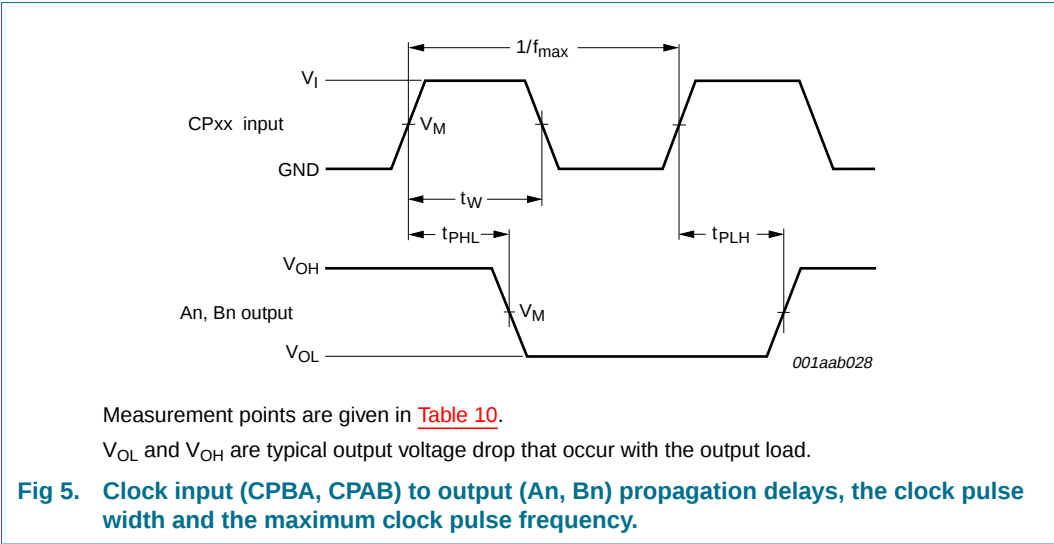


Table 10: Measurement points

| Supply voltage      | Input               | Output              |
|---------------------|---------------------|---------------------|
| $V_{CC}$            | $V_M$               | $V_M$               |
| $< 2.7\text{ V}$    | $0.5 \times V_{CC}$ | $0.5 \times V_{CC}$ |
| $\geq 2.7\text{ V}$ | 1.5 V               | 1.5 V               |

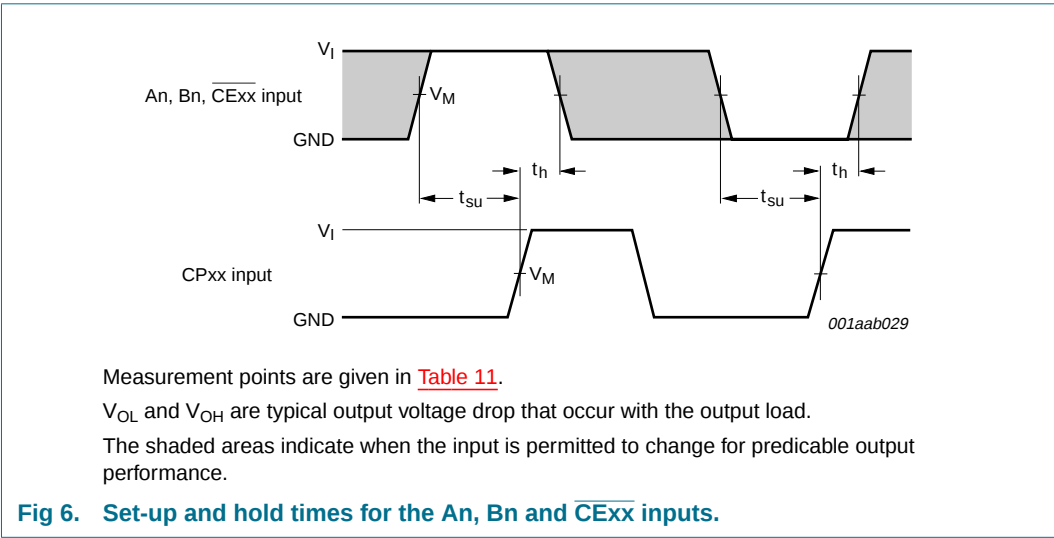


Table 11: Measurement points

| Supply voltage      | Input               | Output              |
|---------------------|---------------------|---------------------|
| $V_{CC}$            | $V_M$               | $V_M$               |
| $< 2.7\text{ V}$    | $0.5 \times V_{CC}$ | $0.5 \times V_{CC}$ |
| $\geq 2.7\text{ V}$ | 1.5 V               | 1.5 V               |

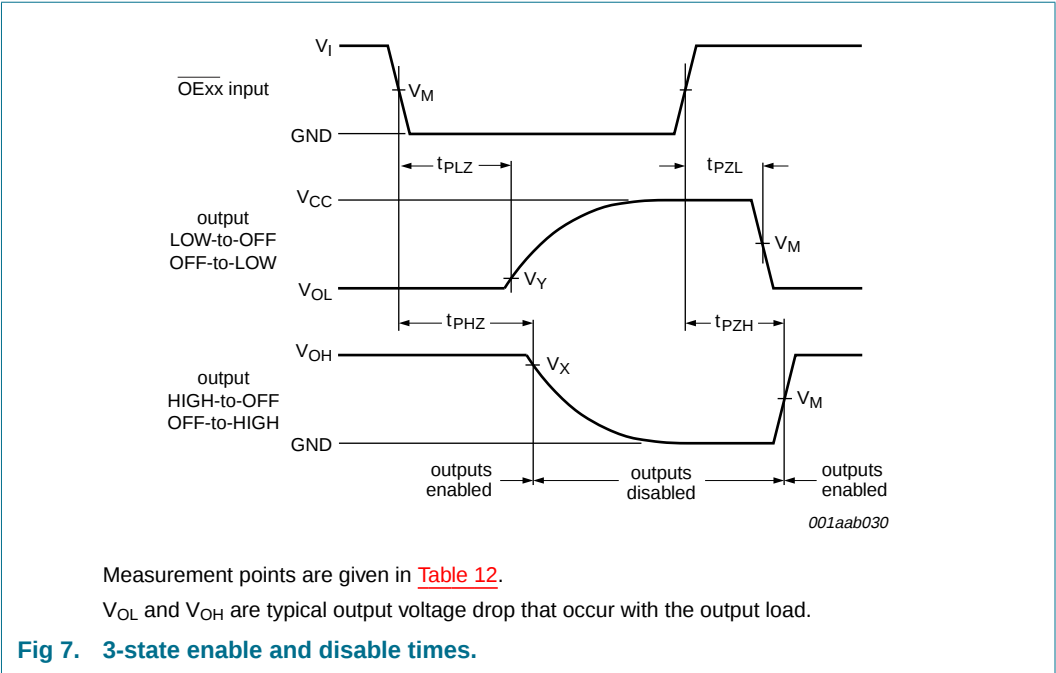


Table 12: Measurement points

| Supply voltage      | Input               | Output              |                              |                              |
|---------------------|---------------------|---------------------|------------------------------|------------------------------|
| $V_{CC}$            | $V_M$               | $V_M$               | $V_X$                        | $V_Y$                        |
| $< 2.7\text{ V}$    | $0.5 \times V_{CC}$ | $0.5 \times V_{CC}$ | $V_{OL} + 0.1 \times V_{CC}$ | $V_{OH} - 0.1 \times V_{CC}$ |
| $\geq 2.7\text{ V}$ | $1.5\text{ V}$      | $1.5\text{ V}$      | $V_{OL} + 0.3\text{ V}$      | $V_{OH} - 0.3\text{ V}$      |

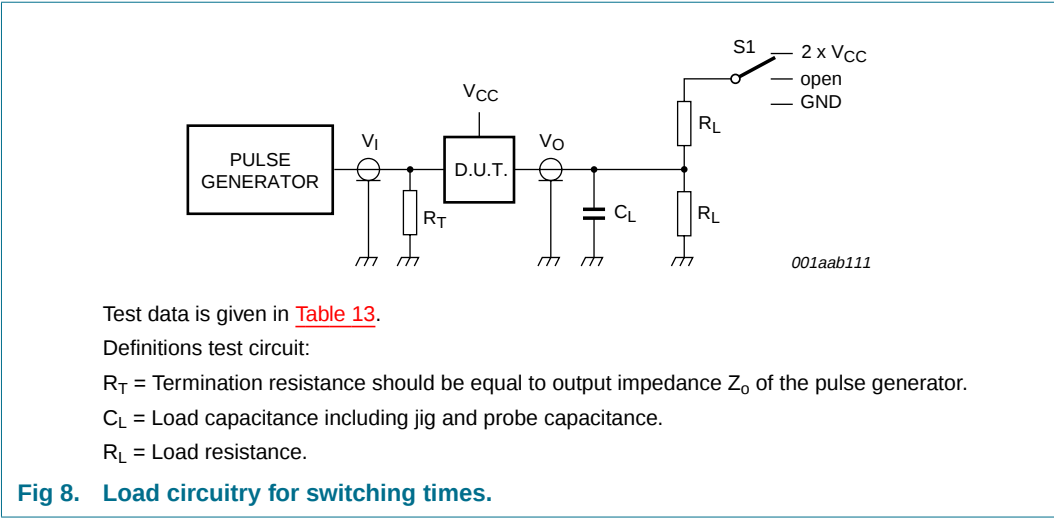


Table 13: Test data

| Supply voltage | Input    |               | Load  |                             | S1                 |                    |                    |
|----------------|----------|---------------|-------|-----------------------------|--------------------|--------------------|--------------------|
| $V_{CC}$       | $V_I$    | $t_r, t_f$    | $C_L$ | $R_L$                       | $t_{PLH}, t_{PHL}$ | $t_{PZH}, t_{PHZ}$ | $t_{PZL}, t_{PLZ}$ |
| 1.2 V          | $V_{CC}$ | $\leq 2.5$ ns | 50 pF | 500 $\Omega$ <sup>[1]</sup> | open               | GND                | $2 \times V_{CC}$  |
| 2.7 V          | 2.7 V    | $\leq 2.5$ ns | 50 pF | 500 $\Omega$                | open               | GND                | $2 \times V_{CC}$  |
| 3.0 V to 3.6 V | 2.7 V    | $\leq 2.5$ ns | 50 pF | 500 $\Omega$                | open               | GND                | $2 \times V_{CC}$  |

[1] The circuit performs better when  $R_L = 1000 \Omega$ .

13. Package outline

SO24: plastic small outline package; 24 leads; body width 7.5 mm

SOT137-1

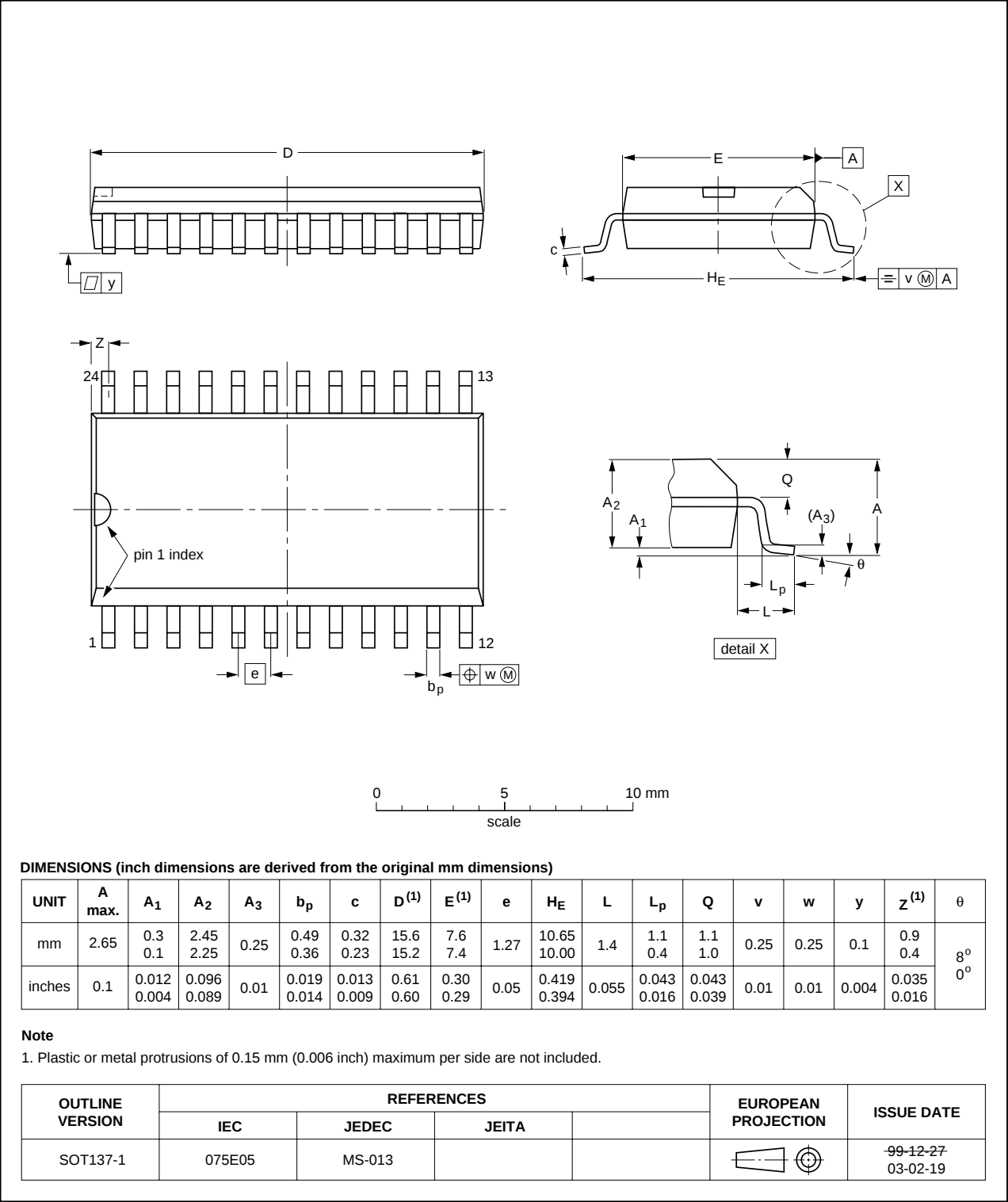


Fig 9. Package outline SO24.

SSOP24: plastic shrink small outline package; 24 leads; body width 5.3 mm

SOT340-1

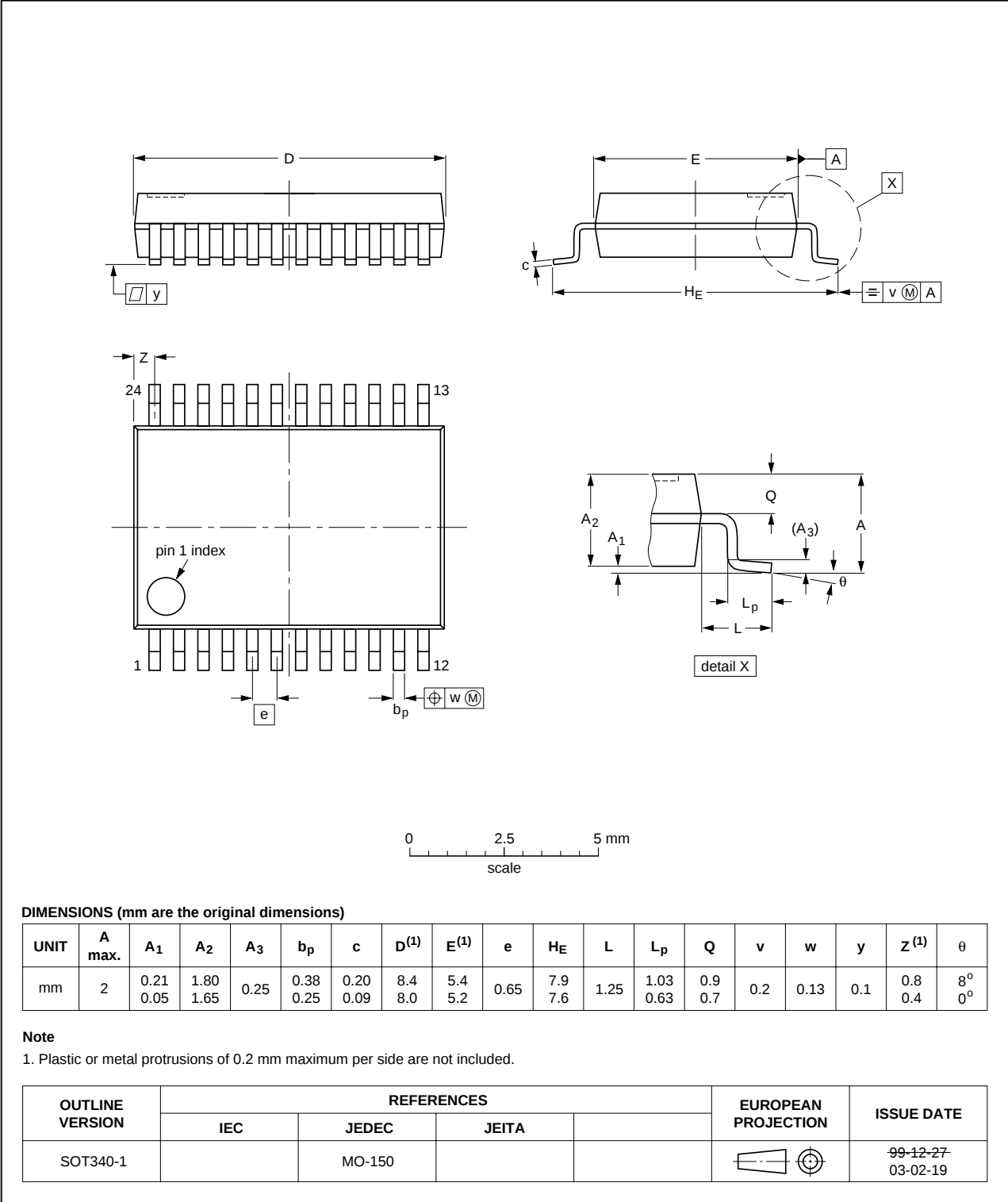


Fig 10. Package outline SSOP24.

TSSOP24: plastic thin shrink small outline package; 24 leads; body width 4.4 mm

SOT355-1

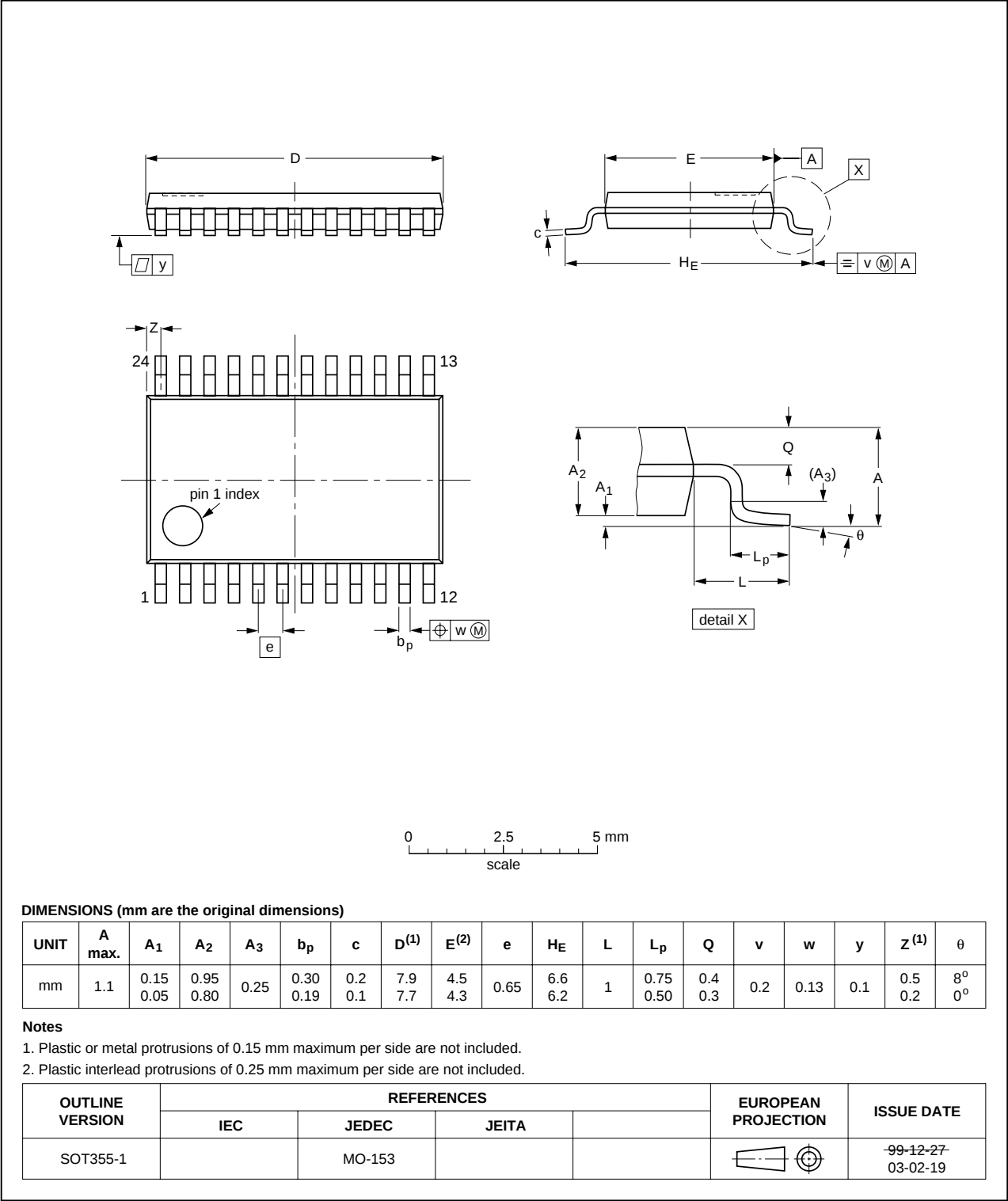


Fig 11. Package outline TSSOP24.

## 14. Revision history

Table 14: Revision history

| Document ID                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Release date | Data sheet status     | Change notice | Order number   | Supersedes   |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-----------------------|---------------|----------------|--------------|
| 74LVC2952A_2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 20040629     | Product data sheet    | -             | 9397 750 13251 | 74LVC2952A_1 |
| Modifications:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |              |                       |               |                |              |
| <ul style="list-style-type: none"><li>• The format of this data sheet has been redesigned to comply with the new presentation and information standard of Philips Semiconductors</li><li>• <a href="#">Table 1</a>: changed various values</li><li>• <a href="#">Table 8</a>: changed maximum value of <math>I_{OZ}</math> from <math>\pm 5 \mu A</math> to <math>\pm 10 \mu A</math></li><li>• <a href="#">Table 8</a>: added values for <math>T_{amb} = -40^\circ C</math> to <math>+125^\circ C</math></li><li>• <a href="#">Table 9</a>: changed various values</li><li>• <a href="#">Table 9</a>: added values for <math>T_{amb} = -40^\circ C</math> to <math>+125^\circ C</math>.</li></ul> |              |                       |               |                |              |
| 74LVC2952A_1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 19980729     | Product specification | -             | 9397 750 04524 | -            |

## 15. Data sheet status

| Level | Data sheet status <sup>[1]</sup> | Product status <sup>[2] [3]</sup> | 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.                                                                                                    |
| II    | Preliminary data                 | Qualification                     | This data sheet contains data from the preliminary specification. Supplementary data will be published at a later date. Philips Semiconductors reserves the right to change the specification without notice, in order to improve the design and supply the best possible product.             |
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[1] Please consult the most recently issued data sheet before initiating or completing a design.

[2] The product status of the device(s) described in this data sheet may have changed since this data sheet was published. The latest information is available on the Internet at URL <http://www.semiconductors.philips.com>.

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

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