

# 74LVCH322245A

32-bit bus transceiver with direction pin; 30 Ω series termination resistors; 5 V tolerant; 3-state

Rev. 4 — 20 December 2011

Product data sheet

## 1. General description

The 74LVCH322245A is a 32-bit transceiver featuring non-inverting 3-state bus compatible outputs in both send and receive directions. The device features four output enable ( $nOE$ ) inputs for easy cascading and four send/receive ( $nDIR$ ) inputs for direction control. Pin  $nOE$  controls the outputs so that the buses are effectively isolated. The device is designed with 30 Ω series termination resistors in both HIGH and LOW output stages to reduce line noise.

Inputs can be driven from either 3.3 V or 5 V devices. When disabled, up to 5.5 V can be applied to the outputs. These features allow the use of these devices in mixed 3.3 V and 5 V applications.

To ensure the high-impedance state during power-up or power-down, pin  $nOE$  should be tied to  $V_{CC}$  through a pull-up resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

Bus hold on data inputs eliminates the need for external pull-up resistors to hold unused inputs.

## 2. Features and benefits

- 5 V tolerant inputs/outputs for interfacing with 5 V logic
- Wide supply voltage range from 1.2 V to 3.6 V
- CMOS low power consumption
- MULTIBYTE flow-through standard pin-out architecture
- Low inductance multiple power and ground pins for minimum noise and ground bounce
- Direct interface with TTL levels
- Integrated 30 Ω termination resistors
- All data inputs have bus hold
- Complies with JEDEC standard:
  - ◆ JESD8-7A (1.65 V to 1.95 V)
  - ◆ JESD8-5A (2.3 V to 2.7 V)
  - ◆ JESD8-C/JESD36 (2.7 V to 3.6 V)
- ESD protection:
  - ◆ HBM JESD22-A114F exceeds 2000 V
  - ◆ MM JESD22-A115-B exceeds 200 V
  - ◆ CDM JESD22-C101E exceeds 1000 V
- Specified from -40 °C to +85 °C and -40 °C to +125 °C



- Packaged in plastic fine-pitch ball grid array package

### 3. Ordering information

**Table 1. Ordering information**

| Type number     | Package           |         |  |  | Version  |
|-----------------|-------------------|---------|--|--|----------|
|                 | Temperature range | Name    | Description  |  |          |
| 74LVCH322245AEC | –40 °C to +125 °C | LFBGA96 | plastic low profile fine-pitch ball grid array package;<br>96 balls; body 13.5 × 5.5 × 1.05 mm |  | SOT536-1 |

#### 4. Functional diagram

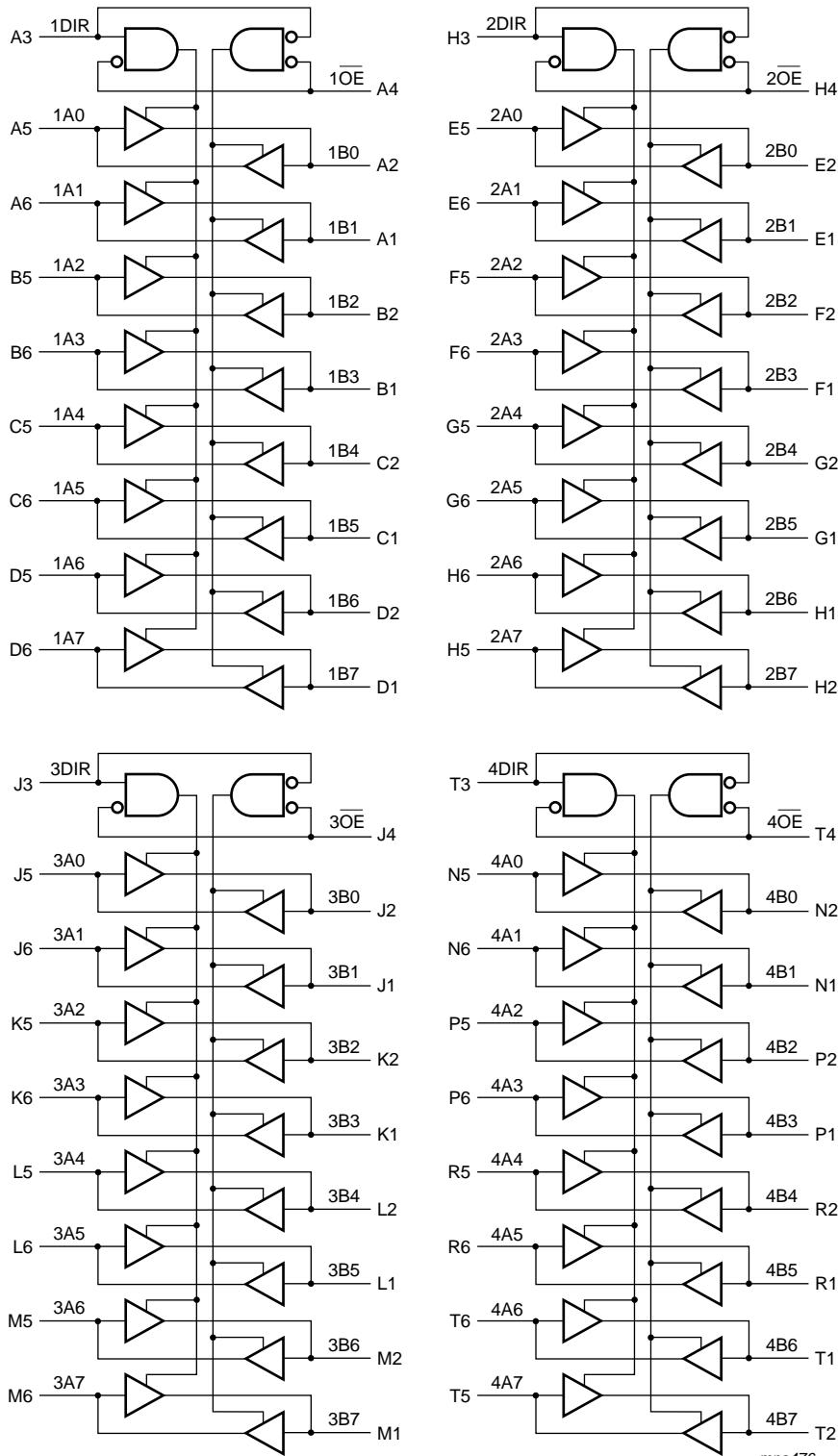


Fig 1. Logic symbol

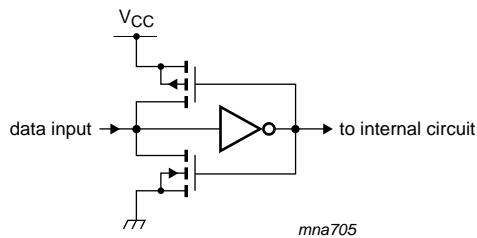


Fig 2. Bus hold circuit

## 5. Pinning information

### 5.1 Pinning

|   | mna475 |     |                 |     |                 |                 |      |      |     |                 |                 |     |                 |                 |      |     |
|---|--------|-----|-----------------|-----|-----------------|-----------------|------|------|-----|-----------------|-----------------|-----|-----------------|-----------------|------|-----|
| 6 | 1A1    | 1A3 | 1A5             | 1A7 | 2A1             | 2A3             | 2A5  | 2A6  | 3A1 | 3A3             | 3A5             | 3A7 | 4A1             | 4A3             | 4A5  | 4A6 |
| 5 | 1A0    | 1A2 | 1A4             | 1A6 | 2A0             | 2A2             | 2A4  | 2A7  | 3A0 | 3A2             | 3A4             | 3A6 | 4A0             | 4A2             | 4A4  | 4A7 |
| 4 | 1OE    | GND | V <sub>CC</sub> | GND | GND             | V <sub>CC</sub> | GND  | 2OE  | 3OE | GND             | V <sub>CC</sub> | GND | GND             | V <sub>CC</sub> | GND  | 4OE |
| 3 | 1DIR   | GND | V <sub>CC</sub> | GND | V <sub>CC</sub> | GND             | 2DIR | 3DIR | GND | V <sub>CC</sub> | GND             | GND | V <sub>CC</sub> | GND             | 4DIR |     |
| 2 | 1B0    | 1B2 | 1B4             | 1B6 | 2B0             | 2B2             | 2B4  | 2B7  | 3B0 | 3B2             | 3B4             | 3B6 | 4B0             | 4B2             | 4B4  | 4B7 |
| 1 | 1B1    | 1B3 | 1B5             | 1B7 | 2B1             | 2B3             | 2B5  | 2B6  | 3B1 | 3B3             | 3B5             | 3B7 | 4B1             | 4B3             | 4B5  | 4B6 |
|   | A      | B   | C               | D   | E               | F               | G    | H    | J   | K               | L               | M   | N               | P               | R    | T   |

Fig 3. Pin configuration

### 5.2 Pin description

Table 2. Pin description

| Symbol            | Ball  | Description                      |
|-------------------|---|----------------------------------|
| nDIR (n = 1 to 4) | A3, H3, J3, T3  | direction control                |
| nOE (n = 1 to 4)  | A4, H4, J4, T4  | output enable input (active LOW) |
| 1A[0:7]           | A5, A6, B5, B6, C5, C6, D5, D6                                    | input or output                  |
| 1B[0:7]           | A2, A1, B2, B1, C2, C1, D2, D1                                    |                                  |
| 2A[0:7]           | E5, E6, F5, F6, G5, G6, H6, H5                                    |                                  |
| 2B[0:7]           | E2, E1, F2, F1, G2, G1, H1, H2                                    |                                  |
| 3A[0:7]           | J5, J6, K5, K6, L5, L6, M5, M6                                    |                                  |
| 3B[0:7]           | J2, J1, K2, K1, L2, L1, M2, M1                                    |                                  |
| 4A[0:7]           | N5, N6, P5, P6, R5, R6, T6, T5                                    |                                  |
| 4B[0:7]           | N2, N1, P2, P1, R2, R1, T1, T2                                    |                                  |
| GND               | B3, B4, D3, D4, E3, E4, G3, G4, K3, K4,<br>M3, M4, N3, N4, R3, R4 | ground (0 V)                     |
| V <sub>CC</sub>   | C3, C4, F3, F4, L3, L4, P3, P4                                    | supply voltage                   |

## 6. Functional description

**Table 3. Function selection<sup>[1]</sup>**

| Input |      | Output |        |
|-------|------|--------|--------|
| nOE   | nDIR | nAn    | nBn    |
| L     | L    | A = B  | inputs |
| L     | H    | inputs | B = A  |
| H     | X    | Z      | Z      |

[1] H = HIGH voltage level; L = LOW voltage level; X = don't care; Z = high-impedance OFF-state

## 7. Limiting values

**Table 4. 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 <sub>CC</sub>  | supply voltage          |  | -0.5                | +6.5                  | V    |
| I <sub>IK</sub>  | input clamping current  | V <sub>I</sub> < 0 V                                     | -50                 | -                     | mA   |
| V <sub>I</sub>   | input voltage           |  | <sup>[1]</sup> -0.5 | +6.5                  | V    |
| I <sub>OK</sub>  | output clamping current | V <sub>O</sub> > V <sub>CC</sub> or V <sub>O</sub> < 0 V | -                   | ±50                   | mA   |
| V <sub>O</sub>   | output voltage          | output HIGH or LOW state                                 | <sup>[2]</sup> -0.5 | V <sub>CC</sub> + 0.5 | V    |
|                  |                         | output 3-state   | <sup>[2]</sup> -0.5 | +6.5                  | V    |
| I <sub>O</sub>   | output current          | V <sub>O</sub> = 0 V to V <sub>CC</sub>                  | -                   | ±50                   | mA   |
| I <sub>CC</sub>  | supply current          |  | <sup>[3]</sup> -    | 200                   | mA   |
| I <sub>GND</sub> | ground current          |  | <sup>[3]</sup> -200 | -                     | mA   |
| T <sub>stg</sub> | storage temperature     |  | -65                 | +150                  | °C   |
| P <sub>tot</sub> | total power dissipation | T <sub>amb</sub> = -40 °C to +125 °C                     | <sup>[4]</sup> -    | 1000                  | mW   |

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

[2] The output voltage ratings may be exceeded if the output current ratings are observed.

[3] All supply and ground pins connected externally to one voltage source.

[4] Above 70 °C the value of P<sub>tot</sub> derates linearly with 1.8 mW/K.

## 8. Recommended operating conditions

**Table 5. Recommended operating conditions**

| Symbol           | Parameter                           | Conditions                        | Min  | Typ | Max             | Unit |
|------------------|-------------------------------------|-----------------------------------|------|-----|-----------------|------|
| V <sub>CC</sub>  | supply voltage                      |                                   | 1.65 | -   | 3.6             | V    |
|                  |                                     | functional                        | 1.2  | -   | -               | V    |
| V <sub>I</sub>   | input voltage                       |                                   | 0    | -   | 5.5             | V    |
| V <sub>O</sub>   | output voltage                      | output HIGH or LOW state          | 0    | -   | V <sub>CC</sub> | V    |
|                  |                                     | output 3-state                    | 0    | -   | 5.5             | V    |
| T <sub>amb</sub> | ambient temperature                 | in free air                       | -40  | -   | +125            | °C   |
| Δt/ΔV            | input transition rise and fall rate | V <sub>CC</sub> = 1.65 V to 2.7 V | -    | -   | 20              | ns/V |
|                  |                                     | V <sub>CC</sub> = 2.7 V to 3.6 V  | -    | -   | 10              | ns/V |

## 9. Static characteristics

**Table 6. Static characteristics**

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

| Symbol           | Parameter                                  | Conditions  | -40 °C to +85 °C       |                    |                        | -40 °C to +125 °C      |                        | Unit |
|------------------|--|---|------------------------|--------------------|------------------------|------------------------|------------------------|------|
|                  |  |   | Min                    | Typ <sup>[1]</sup> | Max                    | Min                    | Max                    |      |
| V <sub>IH</sub>  | HIGH-level input voltage                   | V <sub>CC</sub> = 1.2 V   | 1.08                   | -                  | -                      | 1.08                   | -                      | V    |
|                  |  | V <sub>CC</sub> = 1.65 V to 1.95 V  | 0.65 × V <sub>CC</sub> | -                  | -                      | 0.65 × V <sub>CC</sub> | -                      | V    |
|                  |  | V <sub>CC</sub> = 2.3 V to 2.7 V  | 1.7                    | -                  | -                      | 1.7                    | -                      | V    |
|                  |  | V <sub>CC</sub> = 2.7 V to 3.6 V  | 2.0                    | -                  | -                      | 2.0                    | -                      | V    |
| V <sub>IL</sub>  | LOW-level input voltage                    | V <sub>CC</sub> = 1.2 V   | -                      | -                  | 0.12                   | -                      | 0.12                   | V    |
|                  |  | V <sub>CC</sub> = 1.65 V to 1.95 V  | -                      | -                  | 0.35 × V <sub>CC</sub> | -                      | 0.35 × V <sub>CC</sub> | V    |
|                  |  | V <sub>CC</sub> = 2.3 V to 2.7 V  | -                      | -                  | 0.7                    | -                      | 0.7                    | V    |
|                  |  | V <sub>CC</sub> = 2.7 V to 3.6 V  | -                      | -                  | 0.8                    | -                      | 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;<br>V <sub>CC</sub> = 1.65 V to 3.6 V  | V <sub>CC</sub> - 0.2  | V <sub>CC</sub>    | -                      | V <sub>CC</sub> - 0.3  | -                      | V    |
|                  |  | I <sub>O</sub> = -2 mA; V <sub>CC</sub> = 1.65 V  | 1.2                    | -                  | -                      | 1.05                   | -                      | V    |
|                  |  | I <sub>O</sub> = -4 mA; V <sub>CC</sub> = 2.3 V   | 1.8                    | -                  | -                      | 1.65                   | -                      | V    |
|                  |  | I <sub>O</sub> = -6 mA; V <sub>CC</sub> = 2.7 V   | 2.2                    | -                  | -                      | 2.05                   | -                      | V    |
|                  |  | I <sub>O</sub> = -12 mA; V <sub>CC</sub> = 3.0 V  | 2.2                    | -                  | -                      | 2.0                    | -                      | 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;<br>V <sub>CC</sub> = 1.65 V to 3.6 V   | -                      | -                  | 0.2                    | -                      | 0.3                    | V    |
|                  |  | I <sub>O</sub> = 2 mA; V <sub>CC</sub> = 1.65 V   | -                      | -                  | 0.45                   | -                      | 0.65                   | V    |
|                  |  | I <sub>O</sub> = 4 mA; V <sub>CC</sub> = 2.3 V  | -                      | -                  | 0.6                    | -                      | 0.8                    | V    |
|                  |  | I <sub>O</sub> = 6 mA; V <sub>CC</sub> = 2.7 V  | -                      | -                  | 0.4                    | -                      | 0.6                    | V    |
|                  |  | I <sub>O</sub> = 12 mA; V <sub>CC</sub> = 3.0 V   | -                      | -                  | 0.55                   | -                      | 0.8                    | V    |
| I <sub>I</sub>   | input leakage current <sup>[2]</sup>       | V <sub>CC</sub> = 3.6 V;<br>V <sub>I</sub> = 5.5 V or GND   | -                      | ±0.1               | ±5                     | -                      | ±20                    | μA   |
| I <sub>OZ</sub>  | OFF-state output current <sup>[2][3]</sup> | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>CC</sub> = 3.6 V;<br>V <sub>O</sub> = 5.5 V or GND;      | -                      | ±0.1               | ±5                     | -                      | ±20                    | μA   |
| I <sub>OFF</sub> | power-off leakage supply                   | V <sub>CC</sub> = 0 V; V <sub>I</sub> or V <sub>O</sub> = 5.5 V   | -                      | ±0.1               | ±10                    | -                      | ±20                    | μA   |
| I <sub>CC</sub>  | supply current                             | V <sub>CC</sub> = 3.6 V;<br>V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A                             | -                      | 0.1                | 40                     | -                      | 160                    | μA   |
| ΔI <sub>CC</sub> | additional supply current                  | per input pin;<br>V <sub>CC</sub> = 2.7 V to 3.6 V;<br>V <sub>I</sub> = V <sub>CC</sub> - 0.6 V; I <sub>O</sub> = 0 A | -                      | 5                  | 500                    | -                      | 5000                   | μA   |
| C <sub>I</sub>   | input capacitance                          | V <sub>CC</sub> = 0 V to 3.6 V;<br>V <sub>I</sub> = GND to V <sub>CC</sub>  | -                      | 5.0                | -                      | -                      | -                      | pF   |
| C <sub>I/O</sub> | input/output capacitance                   | V <sub>CC</sub> = 0 V to 3.6 V;<br>V <sub>I</sub> = GND to V <sub>CC</sub>  | -                      | 10.0               | -                      | -                      | -                      | pF   |
| I <sub>BHL</sub> | bus hold LOW current <sup>[4][5]</sup>     | V <sub>CC</sub> = 1.65; V <sub>I</sub> = 0.58 V   | 10                     | -                  | -                      | 10                     | -                      | μA   |
|                  |  | V <sub>CC</sub> = 2.3; V <sub>I</sub> = 0.7 V   | 30                     | -                  | -                      | 25                     | -                      | μA   |
|                  |  | V <sub>CC</sub> = 3.0; V <sub>I</sub> = 0.8 V   | 75                     | -                  | -                      | 60                     | -                      | μA   |

**Table 6. Static characteristics ...continued**

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

| Symbol    | Parameter   | Conditions                       | -40 °C to +85 °C |                    |     | -40 °C to +125 °C |     | Unit    |
|-----------|---|----------------------------------|------------------|--------------------|-----|-------------------|-----|---------|
|           |   |                                  | Min              | Typ <sup>[1]</sup> | Max | Min               | Max |         |
| $I_{BHH}$ | bus hold HIGH current <sup>[4][5]</sup>           | $V_{CC} = 1.65$ ; $V_I = 1.07$ V | -10              | -                  | -   | -10               | -   | $\mu A$ |
|           |   | $V_{CC} = 2.3$ ; $V_I = 1.7$ V   | -30              | -                  | -   | -25               | -   | $\mu A$ |
|           |   | $V_{CC} = 3.0$ ; $V_I = 2.0$ V   | -75              | -                  | -   | -60               | -   | $\mu A$ |
| $I_{BHO}$ | bus hold LOW overdrive current <sup>[4][6]</sup>  | $V_{CC} = 1.95$ V                | 200              | -                  | -   | 200               | -   | $\mu A$ |
|           |   | $V_{CC} = 2.7$ V                 | 300              | -                  | -   | 300               | -   | $\mu A$ |
|           |   | $V_{CC} = 3.6$ V                 | 500              | -                  | -   | 500               | -   | $\mu A$ |
| $I_{BHO}$ | bus hold HIGH overdrive current <sup>[4][6]</sup> | $V_{CC} = 1.95$ V                | -200             | -                  | -   | -200              | -   | $\mu A$ |
|           |   | $V_{CC} = 2.7$ V                 | -300             | -                  | -   | -300              | -   | $\mu A$ |
|           |   | $V_{CC} = 3.6$ V                 | -500             | -                  | -   | -500              | -   | $\mu A$ |

[1] All typical values are measured at  $V_{CC} = 3.3$  V and  $T_{amb} = 25$  °C.[2] The bus hold circuit is switched off when  $V_I > V_{CC}$  allowing 5.5 V on the input terminal.[3] For I/O ports the parameter  $I_{OZ}$  includes the input leakage current.

[4] Valid for data inputs only. Control inputs do not have a bus hold circuit.

[5] The specified sustaining current at the data input holds the input below the specified  $V_I$  level.

[6] The specified overdrive current at the data input forces the data input to the opposite logic input state.

## 10. Dynamic characteristics

**Table 7. Dynamic characteristics**Voltages are referenced to GND (ground = 0 V). For test circuit see [Figure 6](#).

| Symbol    | Parameter         | Conditions   | $T_{amb} = -40$ °C to +85 °C |                    |      | $-40$ °C to +125 °C |      | Unit |
|-----------|-------------------|--|------------------------------|--------------------|------|---------------------|------|------|
|           |                   |  | Min                          | Typ <sup>[1]</sup> | Max  | Min                 | Max  |      |
| $t_{pd}$  | propagation delay | nAn to nBn; nBn to nAn; see <a href="#">Figure 4</a> <sup>[2]</sup>      |                              |                    |      |                     |      |      |
|           |                   | $V_{CC} = 1.2$ V   | -                            | 12                 | -    | -                   | -    | ns   |
|           |                   | $V_{CC} = 1.65$ V to 1.95 V  | 1.5                          | 6.6                | 16.0 | 1.5                 | 18.4 | ns   |
|           |                   | $V_{CC} = 2.3$ V to 2.7 V  | 1.0                          | 3.5                | 7.8  | 1.0                 | 9.1  | ns   |
|           |                   | $V_{CC} = 2.7$ V   | 1.0                          | 3.5                | 6.7  | 1.0                 | 9.5  | ns   |
| $t_{en}$  | enable time       | $\overline{OE}$ to nAn, nBn; see <a href="#">Figure 5</a> <sup>[2]</sup> |                              |                    |      |                     |      |      |
|           |                   | $V_{CC} = 1.2$ V   | -                            | 18                 | -    | -                   | -    | ns   |
|           |                   | $V_{CC} = 1.65$ V to 1.95 V  | 2.0                          | 7.7                | 17.2 | 2.0                 | 19.8 | ns   |
|           |                   | $V_{CC} = 2.3$ V to 2.7 V  | 1.5                          | 4.3                | 9.4  | 1.5                 | 10.9 | ns   |
|           |                   | $V_{CC} = 2.7$ V   | 1.5                          | 4.6                | 8.5  | 1.5                 | 9.5  | ns   |
| $t_{dis}$ | disable time      | $\overline{OE}$ to nAn, nBn; see <a href="#">Figure 5</a> <sup>[2]</sup> |                              |                    |      |                     |      |      |
|           |                   | $V_{CC} = 1.2$ V   | -                            | 10                 | -    | -                   | -    | ns   |
|           |                   | $V_{CC} = 1.65$ V to 1.95 V  | 2.8                          | 4.6                | 11.0 | 2.8                 | 12.7 | ns   |
|           |                   | $V_{CC} = 2.3$ V to 2.7 V  | 1.0                          | 2.6                | 6.3  | 1.0                 | 7.3  | ns   |
|           |                   | $V_{CC} = 2.7$ V   | 1.5                          | 3.4                | 7.5  | 1.5                 | 11.0 | ns   |
|           |                   | $V_{CC} = 3.0$ V to 3.6 V  | 1.5                          | 3.2                | 6.5  | 1.5                 | 8.5  | ns   |

**Table 7. Dynamic characteristics ...continued**Voltages are referenced to GND (ground = 0 V). For test circuit see [Figure 6](#).

| Symbol      | Parameter                     | Conditions                                  | $T_{amb} = -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$ |                    | $-40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$ |     | Unit |     |    |
|-------------|-------------------------------|---|--|--------------------|---|-----|------|-----|----|
|             |                               |   | Min  | Typ <sup>[1]</sup> | Max   | Min |      |     |    |
| $t_{sk(o)}$ | output skew time              | $V_{CC} = 3.0\text{ V}$ to $3.6\text{ V}$   | [3]  | -                  | -   | 1.0 | -    | 1.5 | ns |
| $C_{PD}$    | power dissipation capacitance | per buffer; $V_I = \text{GND}$ to $V_{CC}$  | [4]  |                    |   |     |      |     |    |
|             |                               | $V_{CC} = 1.65\text{ V}$ to $1.95\text{ V}$ |  | -                  | 10.4  | -   | -    | pF  |    |
|             |                               | $V_{CC} = 2.3\text{ V}$ to $2.7\text{ V}$   |  | -                  | 14.0  | -   | -    | pF  |    |
|             |                               | $V_{CC} = 3.0\text{ V}$ to $3.6\text{ V}$   |  | -                  | 17.2  | -   | -    | pF  |    |

[1] Typical values are measured at  $T_{amb} = 25^{\circ}\text{C}$  and  $V_{CC} = 2.5\text{ V}$ ,  $2.7\text{ V}$ , and  $3.3\text{ V}$  respectively.[2]  $t_{pd}$  is the same as  $t_{PLH}$  and  $t_{PHL}$ . $t_{en}$  is the same as  $t_{PZL}$  and  $t_{PZH}$ . $t_{dis}$  is the same as  $t_{PLZ}$  and  $t_{PHZ}$ .

[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  $\mu\text{W}$ ).

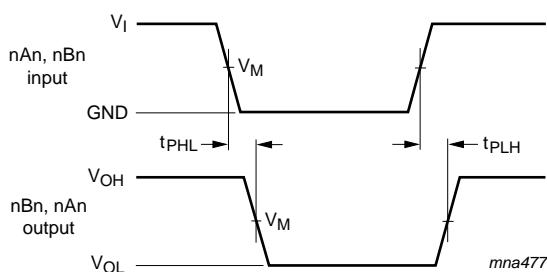
$$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \sum(C_L \times V_{CC}^2 \times f_o)$$

 $f_i$  = input frequency in MHz;  $f_o$  = output frequency in MHz $C_L$  = output load capacitance in pF $V_{CC}$  = supply voltage in Volts

N = number of inputs switching

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

## 11. Waveforms

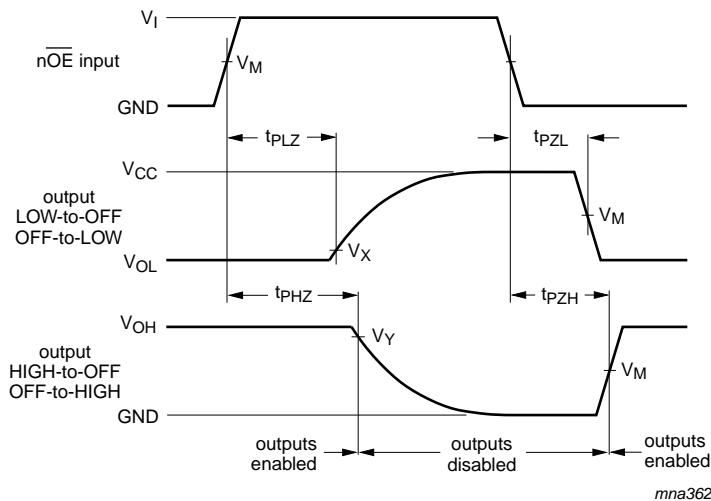


$$V_M = 1.5\text{ V at } V_{CC} \geq 2.7\text{ V.}$$

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

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

**Fig 4. The input (nAn, nBn) to output (nBn, nAn) propagation delays**



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

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

$$V_X = V_{OL} + 0.3 \text{ V at } V_{CC} \geq 2.7 \text{ V;}$$

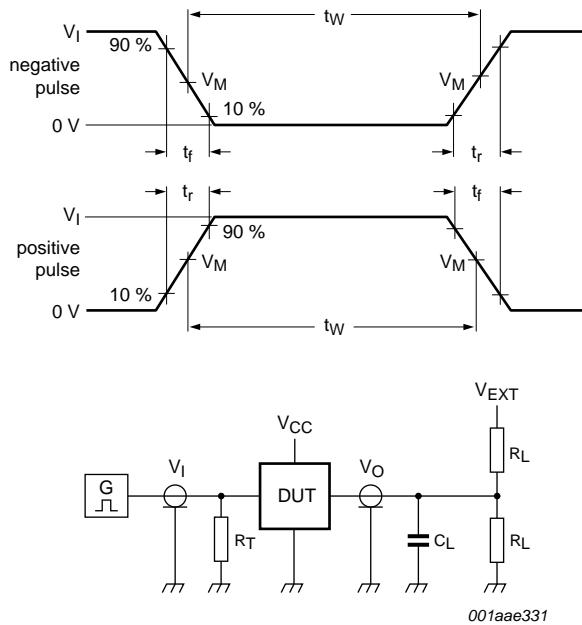
$$V_X = V_{OL} + 0.15 \text{ V at } V_{CC} < 2.7 \text{ V;}$$

$$V_Y = V_{OH} - 0.3 \text{ V at } V_{CC} \geq 2.7 \text{ V;}$$

$$V_Y = V_{OH} - 0.15 \text{ V at } V_{CC} < 2.7 \text{ V.}$$

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

**Fig 5.** 3-state enable and disable times.



Test data is given in [Table 8](#).

Definitions for test circuit:

$R_L$  = Load resistance.

$C_L$  = Load capacitance including jig and probe capacitance.

$R_T$  = Termination resistance should be equal to output impedance  $Z_o$  of the pulse generator.

$V_{EXT}$  = External voltage for measuring switching times.

**Fig 6. Load circuitry for switching times**

**Table 8. Test data**

| Supply voltage   | Input    |               | Load  |       | $V_{EXT}$          |                    |                    |
|------------------|----------|---------------|-------|-------|--------------------|--------------------|--------------------|
|                  | $V_I$    | $t_r, t_f$    | $C_L$ | $R_L$ | $t_{PLH}, t_{PHL}$ | $t_{PLZ}, t_{PZL}$ | $t_{PHZ}, t_{PZH}$ |
| 1.2 V            | $V_{CC}$ | $\leq 2$ ns   | 30 pF | 1 kΩ  | open               | $2 \times V_{CC}$  | GND                |
| 1.65 V to 1.95 V | $V_{CC}$ | $\leq 2$ ns   | 30 pF | 1 kΩ  | open               | $2 \times V_{CC}$  | GND                |
| 2.3 V to 2.7 V   | $V_{CC}$ | $\leq 2$ ns   | 30 pF | 500 Ω | open               | $2 \times V_{CC}$  | GND                |
| 2.7 V            | 2.7 V    | $\leq 2.5$ ns | 50 pF | 500 Ω | open               | $2 \times V_{CC}$  | GND                |
| 3.0 V to 3.6 V   | 2.7 V    | $\leq 2.5$ ns | 50 pF | 500 Ω | open               | $2 \times V_{CC}$  | GND                |

## 12. Package outline

LFBGA96: plastic low profile fine-pitch ball grid array package; 96 balls; body 13.5 x 5.5 x 1.05 mm SOT536-1

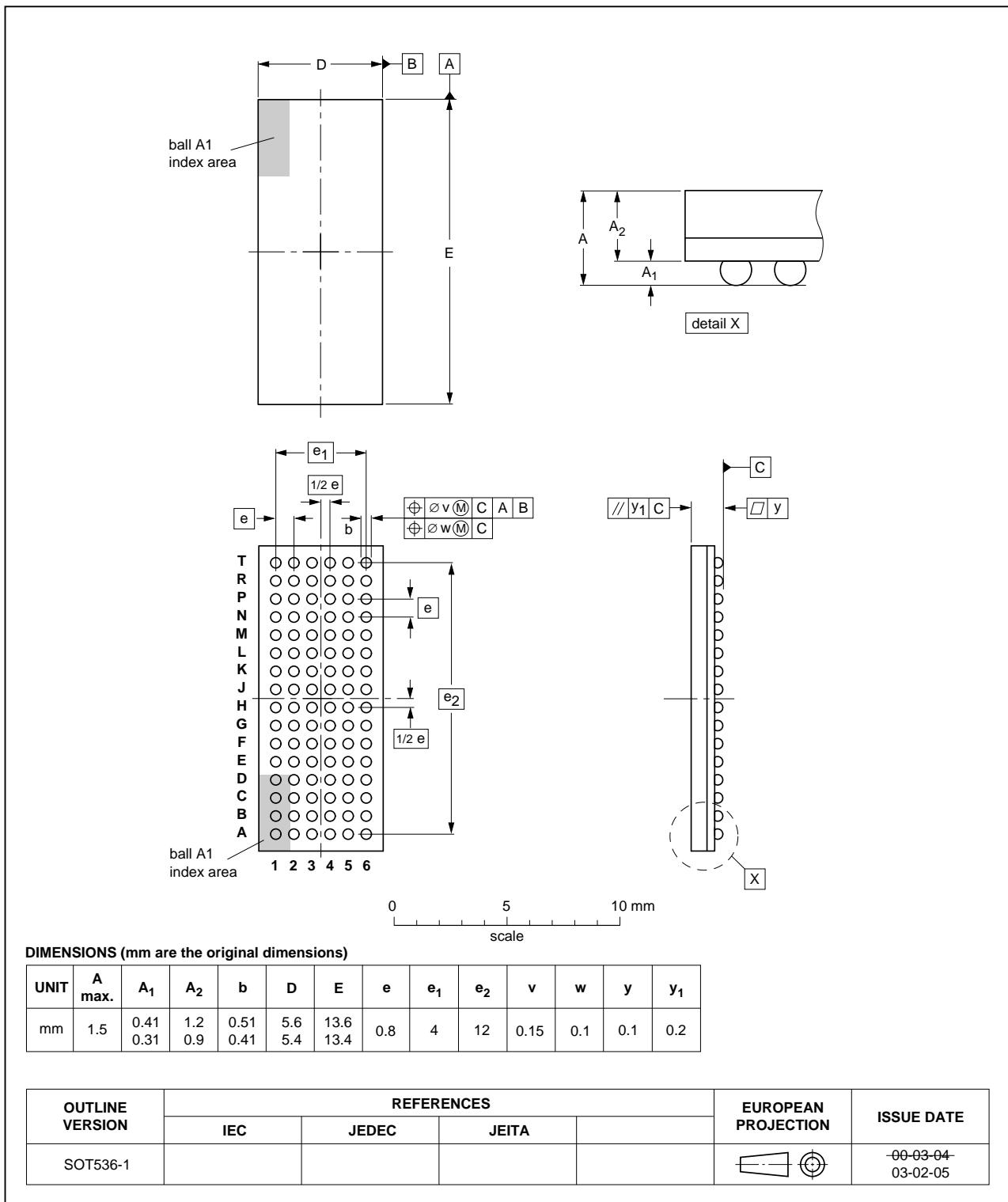


Fig 7. Package outline SOT536-1 (LFBGA96)

## 13. Abbreviations

**Table 9. Abbreviations**

| Acronym | Description                 |
|---------|-----------------------------|
| CDM     | Charged Device Model        |
| DUT     | Device Under Test           |
| ESD     | ElectroStatic Discharge     |
| HBM     | Human Body Model            |
| MM      | Machine Model               |
| TTL     | Transistor-Transistor Logic |

## 14. Revision history

**Table 10. Revision history**

| Document ID           | Release date | Data sheet status  | Change notice | Supersedes            |  |
|-----------------------|--------------|--|---------------|-----------------------|--|
| 74LVCH322245A v.4     | 20111220     | Product data sheet   | -             | 74LVCH322245A v.3     |  |
| Modifications:        |              | • <a href="#">Table 4</a> , <a href="#">Table 5</a> , <a href="#">Table 6</a> , <a href="#">Table 7</a> and <a href="#">Table 8</a> : values added for lower voltage ranges. |               |                       |  |
| 74LVCH322245A v.3     | 20070820     | Product specification  | -             | 74LVCH322245A v.2     |  |
| 74LVCH322245A v.2     | 20040506     | Product specification  | -             | 74LVC_LVCH322245A v.1 |  |
| 74LVC_LVCH322245A v.1 | 19990901     | -  | -             | -                     |  |

## 15. Legal information

### 15.1 Data sheet status

| Document status <sup>[1][2]</sup> | Product status <sup>[3]</sup> | Definition  |
|-----------------------------------|-------------------------------|---|
| Objective [short] data sheet      | Development                   | This document contains data from the objective specification for product development. |
| Preliminary [short] data sheet    | Qualification                 | This document contains data from the preliminary specification.                       |
| Product [short] data sheet        | Production                    | This document contains the product specification.                                     |

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

[2] The term 'short data sheet' is explained in section "Definitions".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL <http://www.nxp.com>.

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