

# DATA SHEET

## **74LVC245A; 74LVCH245A**

Octal bus transceiver with direction pin with 5 V tolerant input/outputs (3-state)

Product specification  
Supersedes data of 2002 Jun 20

2003 May 07

## Octal bus transceiver with direction pin with 5 V tolerant input/outputs (3-state)

## 74LVC245A; 74LVCH245A

### FEATURES

- 5 V tolerant inputs/outputs for interfacing with 5 V logic
- Wide supply voltage range from 1.2 to 3.6 V
- CMOS low power consumption
- Direct interface with TTL levels
- Inputs accept voltages up to 5.5 V
- High-impedance when  $V_{CC} = 0$  V
- bus-hold on all data inputs (74LVCH245A only)
- Complies with JEDEC standard no. 8-1A
- ESD protection:  
HBM EIA/JESD22-A114-A exceeds 2000 V  
MM EIA/JESD22-A115-A exceeds 200 V
- Specified from  $-40$  to  $+85$  °C and  $-40$  to  $+125$  °C.

### DESCRIPTION

The 74LVC245A/74LVCH245A 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 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 and 5 V environment.

The 74LVC245A/74LVCH245A is an octal transceiver with non-inverting 3-state bus compatible outputs in both send and receive directions.

The 74LVC245A/74LVCH245A has an output enable ( $\overline{OE}$ ) input for easy cascading and a send/receive (DIR) input for direction control.  $\overline{OE}$  controls the outputs so that the buses are effectively isolated.

### QUICK REFERENCE DATA

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

| SYMBOL            | PARAMETER   | CONDITIONS                      | TYPICAL | UNIT |
|-------------------|---|---------------------------------|---------|------|
| $t_{PHL}/t_{PLH}$ | propagation delay $A_n$ to $B_n$ , $B_n$ to $A_n$ | $C_L = 50$ pF; $V_{CC} = 3.3$ V | 2.9     | ns   |
| $C_I$             | input capacitance                                 |                                 | 4.0     | pF   |
| $C_{I/O}$         | input/output capacitance                          |                                 | 10.0    | pF   |
| $C_{PD}$          | power dissipation capacitance per buffer          | $V_{CC} = 3.3$ V; notes 1 and 2 | 15      | pF   |

### Notes

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

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

$f_i$  = input frequency in MHz;

$f_o$  = output frequency in MHz;

$C_L$  = output load capacitance in pF;

$V_{CC}$  = supply voltage in Volts;

$N$  = total load switching outputs;

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

2. The condition is  $V_I = \text{GND to } V_{CC}$ .

Octal bus transceiver with direction pin with 5 V tolerant  
input/outputs (3-state)74LVC245A;  
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## ORDERING INFORMATION

| TYPE NUMBER  | TEMPERATURE RANGE | PACKAGE |          |          |          |
|--------------|-------------------|---------|----------|----------|----------|
|              |                   | PINS    | PACKAGE  | MATERIAL | CODE     |
| 74LVC245AD   | -40 to +125 °C    | 20      | SO20     | plastic  | SOT163-1 |
| 74LVCH245AD  | -40 to +125 °C    | 20      | SO20     | plastic  | SOT163-1 |
| 74LVC245ADB  | -40 to +125 °C    | 20      | SSOP20   | plastic  | SOT339-1 |
| 74LVCH245ADB | -40 to +125 °C    | 20      | SSOP20   | plastic  | SOT339-1 |
| 74LVC245APW  | -40 to +125 °C    | 20      | TSSOP20  | plastic  | SOT360-1 |
| 74LVCH245APW | -40 to +125 °C    | 20      | TSSOP20  | plastic  | SOT360-1 |
| 74LVC245ABQ  | -40 to +125 °C    | 20      | DHVQFN20 | plastic  | SOT764-1 |
| 74LVCH245ABQ | -40 to +125 °C    | 20      | DHVQFN20 | plastic  | SOT764-1 |

## FUNCTION TABLE

See note 1.

| INPUT                  |     | INPUT/OUTPUT |       |
|------------------------|-----|--------------|-------|
| $\overline{\text{OE}}$ | DIR | $A_n$        | $B_n$ |
| L                      | L   | A = B        | input |
| L                      | H   | input        | B = A |
| H                      | X   | Z            | Z     |

## Note

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

## PINNING

| PIN | SYMBOL | DESCRIPTION             |
|-----|--------|-------------------------|
| 1   | DIR    | direction control input |
| 2   | $A_0$  | data input/output       |
| 3   | $A_1$  | data input/output       |
| 4   | $A_2$  | data input/output       |
| 5   | $A_3$  | data input/output       |
| 6   | $A_4$  | data input/output       |
| 7   | $A_5$  | data input/output       |
| 8   | $A_6$  | data input/output       |
| 9   | $A_7$  | data input/output       |
| 10  | GND    | ground (0 V)            |

| PIN | SYMBOL                 | DESCRIPTION                      |
|-----|------------------------|----------------------------------|
| 11  | $B_7$                  | data input/output                |
| 12  | $B_6$                  | data input/output                |
| 13  | $B_5$                  | data input/output                |
| 14  | $B_4$                  | data input/output                |
| 15  | $B_3$                  | data input/output                |
| 16  | $B_2$                  | data input/output                |
| 17  | $B_1$                  | data input/output                |
| 18  | $B_0$                  | data input/output                |
| 19  | $\overline{\text{OE}}$ | output enable input (active LOW) |
| 20  | $V_{CC}$               | supply voltage                   |

Octal bus transceiver with direction pin with 5 V tolerant input/outputs (3-state)

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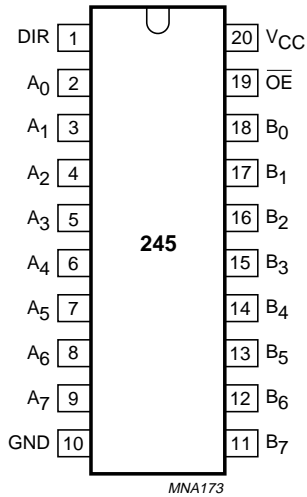
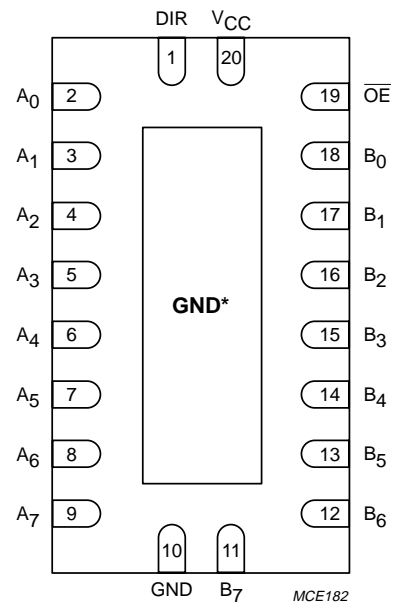


Fig.1 Pin configuration SO20 and (T)SSOP20.



\* The die substrate is attached to this pad using conductive die attach material. It can not be used as a supply pin or input.

Fig.2 Pin configuration DHVQFN20.

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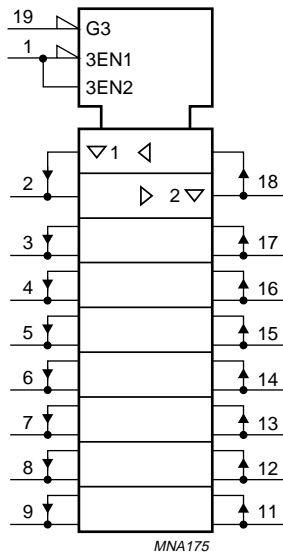


Fig.3 Logic symbol (IEEE/IEC).

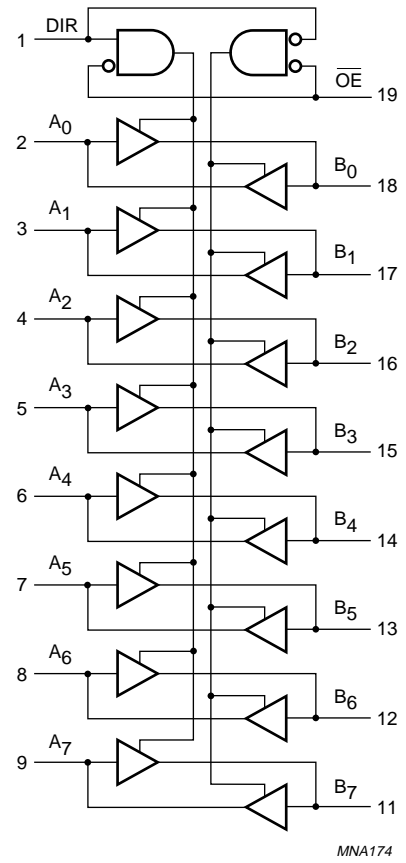


Fig.4 Logic symbol.

Octal bus transceiver with direction pin with 5 V tolerant  
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#### RECOMMENDED OPERATING CONDITIONS

| SYMBOL                          | PARAMETER                     | CONDITIONS                     | MIN. | MAX.            | UNIT |
|---------------------------------|-------------------------------|--------------------------------|------|-----------------|------|
| V <sub>CC</sub>                 | supply voltage                | for maximum speed performance  | 2.7  | 3.6             | V    |
|                                 |                               | for low-voltage applications   | 1.2  | 3.6             | 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>                | operating ambient temperature |                                | -40  | +125            | °C   |
| t <sub>r</sub> , t <sub>f</sub> | input rise and fall times     | V <sub>CC</sub> = 1.2 to 2.7 V | 0    | 20              | ns/V |
|                                 |                               | V <sub>CC</sub> = 2.7 to 3.6 V | 0    | 10              | ns/V |

#### 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 diode current            | V <sub>I</sub> < 0                                     | -    | -50                   | mA   |
| V <sub>I</sub>                     | input voltage                  | note 1   | -0.5 | +6.5                  | V    |
| I <sub>OK</sub>                    | output diode current           | V <sub>O</sub> > V <sub>CC</sub> or V <sub>O</sub> < 0 | -    | ±50                   | mA   |
| V <sub>O</sub>                     | output voltage                 | output HIGH or LOW state; note 1                       | -0.5 | V <sub>CC</sub> + 0.5 | V    |
|                                    |                                | output 3-state; note 1                                 | -0.5 | +6.5                  | V    |
| I <sub>O</sub>                     | output source or sink current  | V <sub>O</sub> = 0 to V <sub>CC</sub>                  | -    | ±50                   | mA   |
| I <sub>CC</sub> , I <sub>GND</sub> | V <sub>CC</sub> or GND current |  | -    | ±100                  | mA   |
| T <sub>stg</sub>                   | storage temperature            |  | -65  | +150                  | °C   |
| P <sub>tot</sub>                   | power dissipation              | T <sub>amb</sub> = -40 to +125 °C; note 2              | -    | 500                   | mW   |

#### Notes

- The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
- For SO20 packages: above 70 °C derate linearly with 8 mW/K.  
For SSOP20 and TSSOP20 packages: above 60 °C derate linearly with 5.5 mW/K.  
For DHVQFN20 packages: above 60 °C derate linearly with 4.5 mW/K.

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## DC CHARACTERISTICS

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

| SYMBOL                                 | PARAMETER                                   | TEST CONDITIONS  |                     | MIN.                  | TYP. <sup>(1)</sup> | MAX. | UNIT |
|--|---|--|---------------------|-----------------------|---------------------|------|------|
|  |   | OTHER  | V <sub>CC</sub> (V) |                       |                     |      |      |
| <b>T<sub>amb</sub> = -40 to +85 °C</b> |   |  |                     |                       |                     |      |      |
| V <sub>IH</sub>                        | HIGH-level input voltage                    |  | 1.2                 | V <sub>CC</sub>       | -                   | -    | V    |
|  |   |  | 2.7 to 3.6          | 2.0                   | -                   | -    | V    |
| V <sub>IL</sub>                        | LOW-level input voltage                     |  | 1.2                 | -                     | -                   | 0    | V    |
|  |   |  | 2.7 to 3.6          | -                     | -                   | 0.8  | V    |
| V <sub>OH</sub>                        | HIGH-level output voltage                   | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>I <sub>O</sub> = -100 µA<br>I <sub>O</sub> = -12 mA<br>I <sub>O</sub> = -18 mA<br>I <sub>O</sub> = -24 mA | 2.7 to 3.6          | V <sub>CC</sub> - 0.2 | V <sub>CC</sub>     | -    | V    |
|  |   |  | 2.7                 | V <sub>CC</sub> - 0.5 | -                   | -    | V    |
|  |   |  | 3.0                 | V <sub>CC</sub> - 0.6 | -                   | -    | V    |
|  |   |  | 3.0                 | V <sub>CC</sub> - 0.8 | -                   | -    | V    |
| V <sub>OL</sub>                        | LOW-level output voltage                    | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>I <sub>O</sub> = 100 µA<br>I <sub>O</sub> = 12 mA<br>I <sub>O</sub> = 24 mA                               | 2.7 to 3.6          | -                     | 0                   | 0.2  | V    |
|  |   |  | 2.7                 | -                     | -                   | 0.4  | V    |
|  |   |  | 3.0                 | -                     | -                   | 0.55 | V    |
| I <sub>LI</sub>                        | input leakage current                       | V <sub>I</sub> = 5.5 V or GND; note 2  | 3.6                 | -                     | ±0.1                | ±5   | µA   |
| I <sub>OZ</sub>                        | 3-state output OFF-state current            | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ;<br>V <sub>O</sub> = 5.5 V or GND;<br>notes 2 and 3   | 3.6                 | -                     | ±0.1                | ±5   | µA   |
| I <sub>off</sub>                       | power off leakage supply                    | V <sub>I</sub> or V <sub>O</sub> = 5.5 V   | 0.0                 | -                     | ±0.1                | ±10  | µA   |
| I <sub>CC</sub>                        | quiescent supply current                    | V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0  | 3.6                 | -                     | 0.1                 | 10   | µA   |
| ΔI <sub>CC</sub>                       | additional quiescent supply current per pin | V <sub>I</sub> = V <sub>CC</sub> - 0.6 V; I <sub>O</sub> = 0   | 2.7 to 3.6          | -                     | 5                   | 500  | µA   |
| I <sub>BH(L)</sub>                     | bus-hold LOW sustaining current             | V <sub>I</sub> = 0.8 V; notes 4, 5 and 6   | 3.0                 | 75                    | -                   | -    | µA   |
| I <sub>BH(H)</sub>                     | bus-hold HIGH sustaining current            | V <sub>I</sub> = 2.0 V; notes 4, 5 and 6   | 3.0                 | -75                   | -                   | -    | µA   |
| I <sub>BH(LO)</sub>                    | bus-hold LOW overdrive current              | notes 4, 5 and 7   | 3.6                 | 500                   | -                   | -    | µA   |
| I <sub>BH(HO)</sub>                    | bus-hold HIGH overdrive current             | notes 4, 5 and 7   | 3.6                 | -500                  | -                   | -    | µA   |

## Octal bus transceiver with direction pin with 5 V tolerant input/outputs (3-state)

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74LVCH245A

| SYMBOL                                  | PARAMETER                                       | TEST CONDITIONS  |                     | MIN.                   | TYP. <sup>(1)</sup> | MAX. | UNIT |
|---|---|--|---------------------|------------------------|---------------------|------|------|
|   |   | OTHER  | V <sub>CC</sub> (V) |                        |                     |      |      |
| <b>T<sub>amb</sub> = -40 to +125 °C</b> |   |  |                     |                        |                     |      |      |
| V <sub>IH</sub>                         | HIGH-level input voltage                        |  | 1.2                 | V <sub>CC</sub>        | –                   | –    | V    |
|   |   |  | 2.7 to 3.6          | 2.0                    | –                   | –    | V    |
| V <sub>IL</sub>                         | LOW-level input voltage                         |  | 1.2                 | –                      | –                   | 0    | V    |
|   |   |  | 2.7 to 3.6          | –                      | –                   | 0.8  | V    |
| V <sub>OH</sub>                         | HIGH-level output voltage                       | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>I <sub>O</sub> = -100 μA<br>I <sub>O</sub> = -12 mA<br>I <sub>O</sub> = -18 mA<br>I <sub>O</sub> = -24 mA | 2.7 to 3.6          | V <sub>CC</sub> - 0.3  | –                   | –    | V    |
|   |   |  | 2.7                 | V <sub>CC</sub> - 0.65 | –                   | –    | V    |
|   |   |  | 3.0                 | V <sub>CC</sub> - 0.75 | –                   | –    | V    |
|   |   |  | 3.0                 | 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><br>I <sub>O</sub> = 100 μA<br>I <sub>O</sub> = 12 mA<br>I <sub>O</sub> = 24 mA                               | 2.7 to 3.6          | –                      | –                   | 0.3  | V    |
|   |   |  | 2.7                 | –                      | –                   | 0.6  | V    |
|   |   |  | 3.0                 | –                      | –                   | 0.8  | V    |
| I <sub>LI</sub>                         | input leakage current                           | V <sub>I</sub> = 5.5 V or GND; note 2  | 3.6                 | –                      | –                   | ±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> ;<br>V <sub>O</sub> = 5.5 V or GND;<br>notes 2 and 3   | 3.6                 | –                      | –                   | ±20  | μA   |
| I <sub>off</sub>                        | power off leakage supply                        | V <sub>I</sub> or V <sub>O</sub> = 5.5 V   | 0.0                 | –                      | –                   | ±20  | μA   |
| I <sub>CC</sub>                         | quiescent supply current                        | V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0  | 3.6                 | –                      | –                   | 40   | μA   |
| ΔI <sub>CC</sub>                        | additional quiescent supply current per in. pin | V <sub>I</sub> = V <sub>CC</sub> - 0.6 V; I <sub>O</sub> = 0   | 2.7 to 3.6          | –                      | –                   | 5000 | μA   |
| I <sub>BH(L)</sub>                      | bus-hold LOW sustaining current                 | V <sub>I</sub> = 0.8 V; notes 4, 5 and 6   | 3.0                 | 60                     | –                   | –    | μA   |
| I <sub>BH(H)</sub>                      | bus-hold HIGH sustaining current                | V <sub>I</sub> = 2.0 V; notes 4, 5 and 6   | 3.0                 | -60                    | –                   | –    | μA   |
| I <sub>BH(LO)</sub>                     | bus-hold LOW overdrive current                  | notes 4, 5 and 7   | 3.6                 | 500                    | –                   | –    | μA   |
| I <sub>BH(HO)</sub>                     | bus-hold HIGH overdrive current                 | notes 4, 5 and 7   | 3.6                 | -500                   | –                   | –    | μA   |

**Notes**

- All typical values are measured at V<sub>CC</sub> = 3.3 V and T<sub>amb</sub> = 25 °C.
- For bus-hold parts, the bus-hold circuit is switched off when V<sub>I</sub> > V<sub>CC</sub> allowing 5.5 V on the input terminal.
- For I/O ports the parameter I<sub>OZ</sub> includes the input leakage current.
- Valid for data inputs of bus-hold parts (74LVCH245A) only.
- For data inputs only, control inputs do not have a bus-hold circuit.
- The specified sustaining current at the data input holds the input below the specified V<sub>I</sub> level.
- The specified overdrive current at the data input forces the data input to the opposite logic input state.



# Octal bus transceiver with direction pin with 5 V tolerant input/outputs (3-state)

## 74LVC245A; 74LVCH245A

### AC CHARACTERISTICS

GND = 0 V;  $t_r = t_f \leq 2.5$  ns.

| SYMBOL                                  | PARAMETER   | TEST CONDITIONS  |                     | MIN. | TYP.               | MAX. | UNIT |
|---|---|------------------|---------------------|------|--------------------|------|------|
|   |   | WAVEFORMS        | V <sub>CC</sub> (V) |      |                    |      |      |
| <b>T<sub>amb</sub> = -40 to +85 °C</b>  |   |                  |                     |      |                    |      |      |
| t <sub>PHL</sub> /t <sub>PLH</sub>      | propagation delay A <sub>n</sub> to B <sub>n</sub> , B <sub>n</sub> to A <sub>n</sub> | see Figs 5 and 7 | 1.2                 | –    | 17                 | –    | ns   |
|   |   |                  | 2.7                 | 1.5  | 3.4                | 7.3  | ns   |
|   |   |                  | 3.0 to 3.6          | 1.5  | 2.9 <sup>(1)</sup> | 6.3  | ns   |
| t <sub>PZH</sub> /t <sub>PZL</sub>      | 3-state output enable time<br>OE to A <sub>n</sub> , OE to B <sub>n</sub>             | see Figs 6 and 7 | 1.2                 | –    | 22                 | –    | ns   |
|   |   |                  | 2.7                 | 1.5  | 5.0                | 9.5  | ns   |
|   |   |                  | 3.0 to 3.6          | 1.5  | 4.0 <sup>(1)</sup> | 8.5  | ns   |
| t <sub>PHZ</sub> /t <sub>PLZ</sub>      | 3-state output disable time<br>OE to A <sub>n</sub> , OE to B <sub>n</sub>            | see Figs 6 and 7 | 1.2                 | –    | 12                 | –    | ns   |
|   |   |                  | 2.7                 | 1.5  | 3.6                | 8.0  | ns   |
|   |   |                  | 3.0 to 3.6          | 1.7  | 3.4 <sup>(1)</sup> | 7.0  | ns   |
| t <sub>sk(0)</sub>                      | skew  | note 2           |                     | –    | –                  | 1.0  | ns   |
| <b>T<sub>amb</sub> = -40 to +125 °C</b> |   |                  |                     |      |                    |      |      |
| t <sub>PHL</sub> /t <sub>PLH</sub>      | propagation delay A <sub>n</sub> to B <sub>n</sub> , B <sub>n</sub> to A <sub>n</sub> | see Figs 5 and 7 | 1.2                 | –    | –                  | –    | ns   |
|   |   |                  | 2.7                 | 1.5  | –                  | 9.5  | ns   |
|   |   |                  | 3.0 to 3.6          | 1.5  | –                  | 8.0  | ns   |
| t <sub>PZH</sub> /t <sub>PZL</sub>      | 3-state output enable time<br>OE to A <sub>n</sub> , OE to B <sub>n</sub>             | see Figs 6 and 7 | 1.2                 | –    | –                  | –    | ns   |
|   |   |                  | 2.7                 | 1.5  | –                  | 12.0 | ns   |
|   |   |                  | 3.0 to 3.6          | 1.5  | –                  | 11.0 | ns   |
| t <sub>PHZ</sub> /t <sub>PLZ</sub>      | 3-state output disable time<br>OE to A <sub>n</sub> , OE to B <sub>n</sub>            | see Figs 6 and 7 | 1.2                 | –    | –                  | –    | ns   |
|   |   |                  | 2.7                 | 1.5  | –                  | 10.0 | ns   |
|   |   |                  | 3.0 to 3.6          | 1.7  | –                  | 9.0  | ns   |
| t <sub>sk(0)</sub>                      | skew  | note 2           |                     | –    | –                  | 1.5  | ns   |

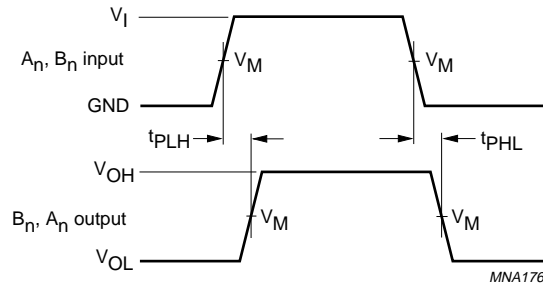
### Notes

1. Typical values are measured at V<sub>CC</sub> = 3.3 V.
2. Skew between any two outputs of the same package switching in the same direction. This parameter is guaranteed by design.

Octal bus transceiver with direction pin with 5 V tolerant input/outputs (3-state)

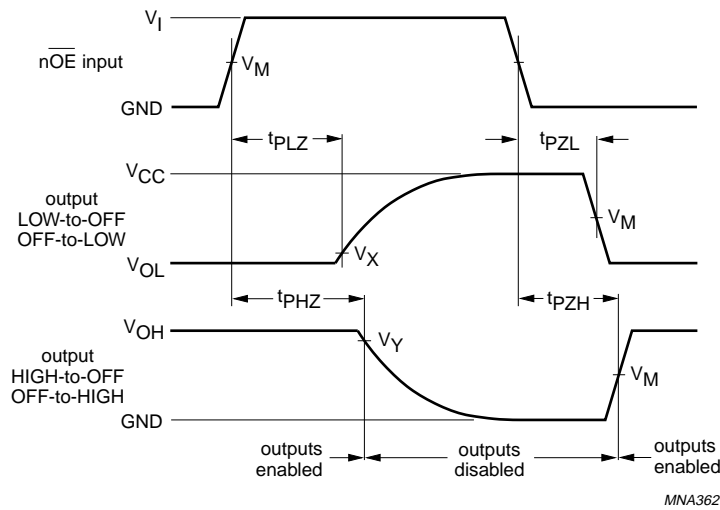
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AC WAVEFORMS



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

Fig.5 The inputs  $A_n$ ,  $B_n$  to outputs  $B_n$ ,  $A_n$  propagation delays.



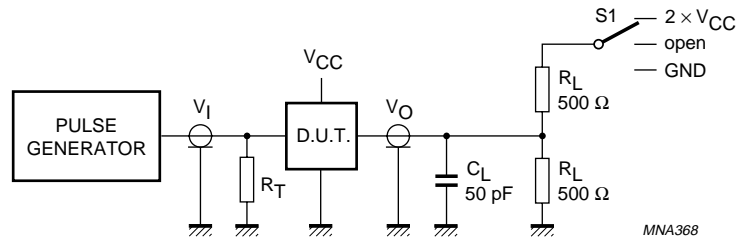
$V_M = 1.5\text{ V}$  at  $V_{CC} \geq 2.7\text{ V}$ ;  
 $V_M = 0.5V_{CC}$  at  $V_{CC} < 2.7\text{ V}$ ;  
 $V_X = V_{OL} + 0.3\text{ V}$  at  $V_{CC} \geq 2.7\text{ V}$ ;  
 $V_X = V_{OL} + 0.1\text{ V}$  at  $V_{CC} < 2.7\text{ V}$ ;  
 $V_Y = V_{OH} - 0.3\text{ V}$  at  $V_{CC} \geq 2.7\text{ V}$ ;  
 $V_Y = V_{OH} - 0.1\text{ V}$  at  $V_{CC} < 2.7\text{ V}$ .

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

Fig.6 3-state enable and disable times.

Octal bus transceiver with direction pin with 5 V tolerant input/outputs (3-state)

74LVC245A;  
74LVCH245A



| SWITCH POSITION   |                   |
|-------------------|-------------------|
| TEST              | SWITCH            |
| $t_{PLH}/t_{PHL}$ | open              |
| $t_{PLZ}/t_{PZL}$ | $2 \times V_{CC}$ |
| $t_{PHZ}/t_{PZH}$ | GND               |

| $V_{CC}$              | $V_I$           |
|-----------------------|-----------------|
| $< 2.7 \text{ V}$     | $V_{CC}$        |
| $2.7 - 3.6 \text{ V}$ | $2.7 \text{ V}$ |

Definitions for test circuit:

$R_L$  = Load resistor.

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

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

Fig.7 Load circuitry for switching times.

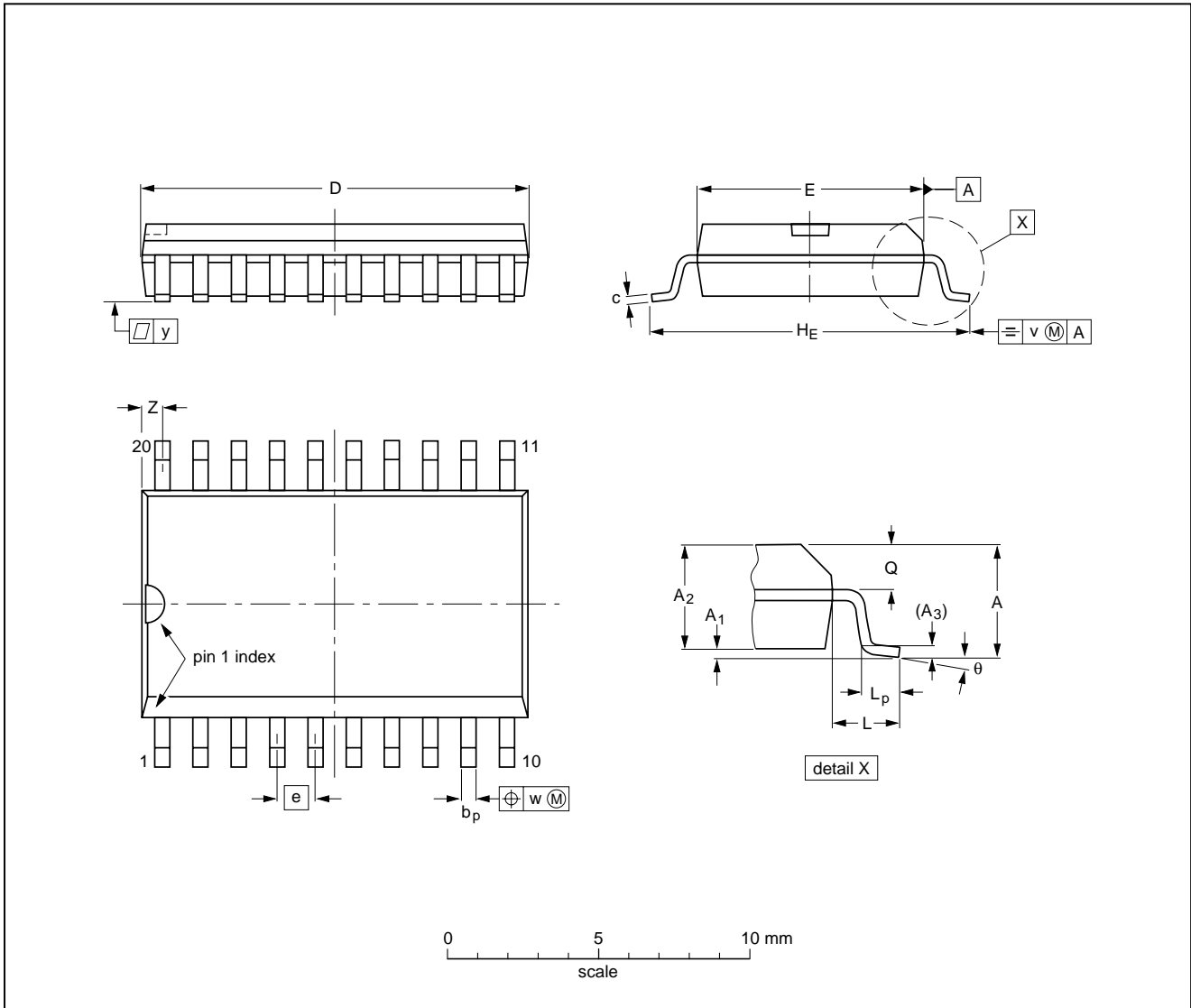
Octal bus transceiver with direction pin with 5 V tolerant input/outputs (3-state)

74LVC245A;  
74LVCH245A

PACKAGE OUTLINES

SO20: plastic small outline package; 20 leads; body width 7.5 mm

SOT163-1



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

| UNIT   | A max. | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | b <sub>p</sub> | c              | D <sup>(1)</sup> | E <sup>(1)</sup> | e    | H <sub>E</sub> | L     | L <sub>p</sub> | Q              | v    | w    | y     | Z <sup>(1)</sup> | θ        |
|--------|--------|----------------|----------------|----------------|----------------|----------------|------------------|------------------|------|----------------|-------|----------------|----------------|------|------|-------|------------------|----------|
| mm     | 2.65   | 0.3<br>0.1     | 2.45<br>2.25   | 0.25           | 0.49<br>0.36   | 0.32<br>0.23   | 13.0<br>12.6     | 7.6<br>7.4       | 1.27 | 10.65<br>10.00 | 1.4   | 1.1<br>0.4     | 1.1<br>1.0     | 0.25 | 0.25 | 0.1   | 0.9<br>0.4       | 8°<br>0° |
| inches | 0.1    | 0.012<br>0.004 | 0.096<br>0.089 | 0.01           | 0.019<br>0.014 | 0.013<br>0.009 | 0.51<br>0.49     | 0.30<br>0.29     | 0.05 | 0.419<br>0.394 | 0.055 | 0.043<br>0.016 | 0.043<br>0.039 | 0.01 | 0.01 | 0.004 | 0.035<br>0.016   |          |

Note

1. Plastic or metal protrusions of 0.15 mm (0.006 inch) maximum per side are not included.

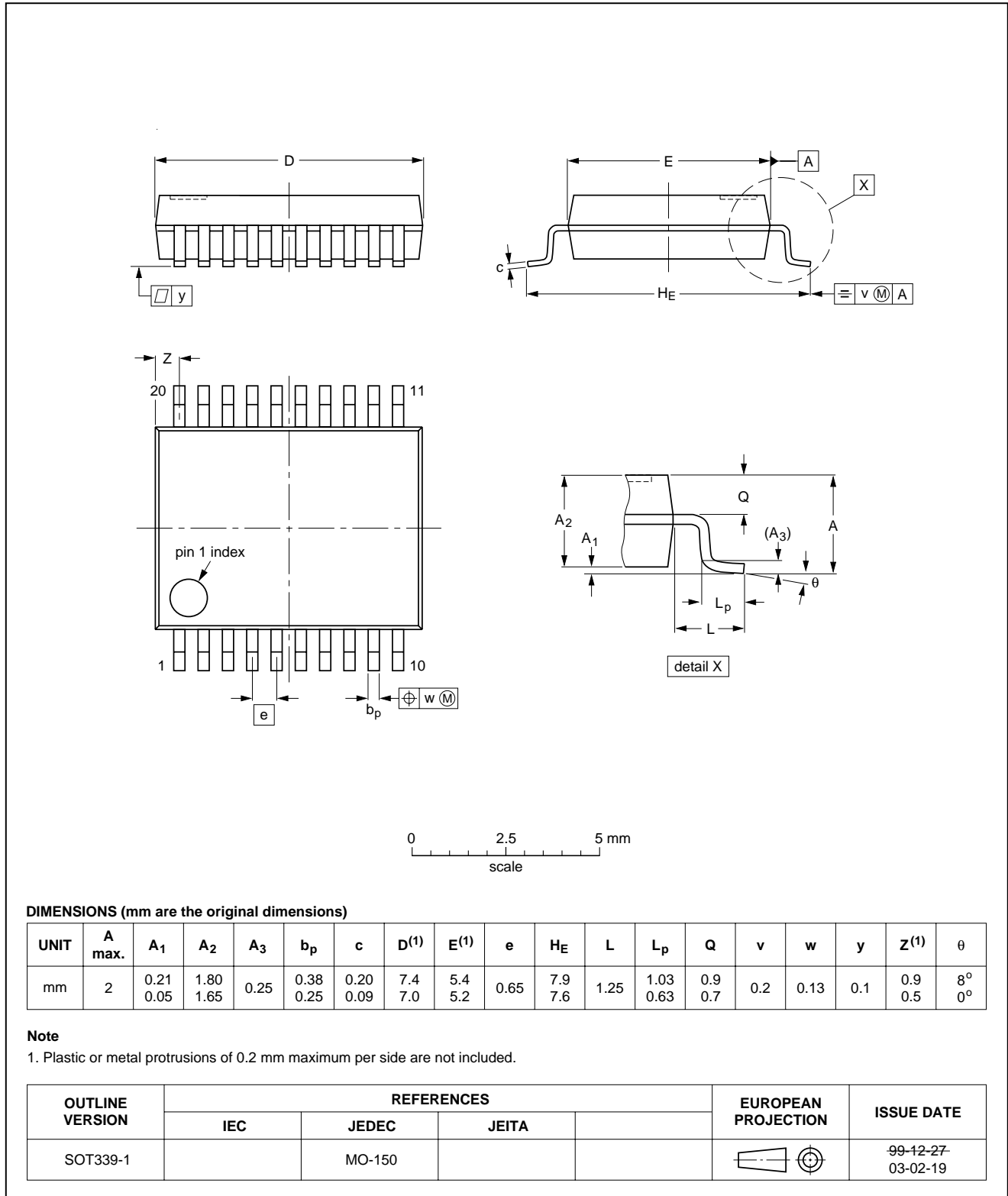
| OUTLINE VERSION | REFERENCES |        |       |  | EUROPEAN PROJECTION | ISSUE DATE           |
|-----------------|------------|--------|-------|--|---------------------|----------------------|
|                 | IEC        | JEDEC  | JEITA |  |                     |                      |
| SOT163-1        | 075E04     | MS-013 |       |  |                     | 99-12-27<br>03-02-19 |

Octal bus transceiver with direction pin with 5 V tolerant input/outputs (3-state)

74LVC245A;  
74LVCH245A

SSOP20: plastic shrink small outline package; 20 leads; body width 5.3 mm

SOT339-1

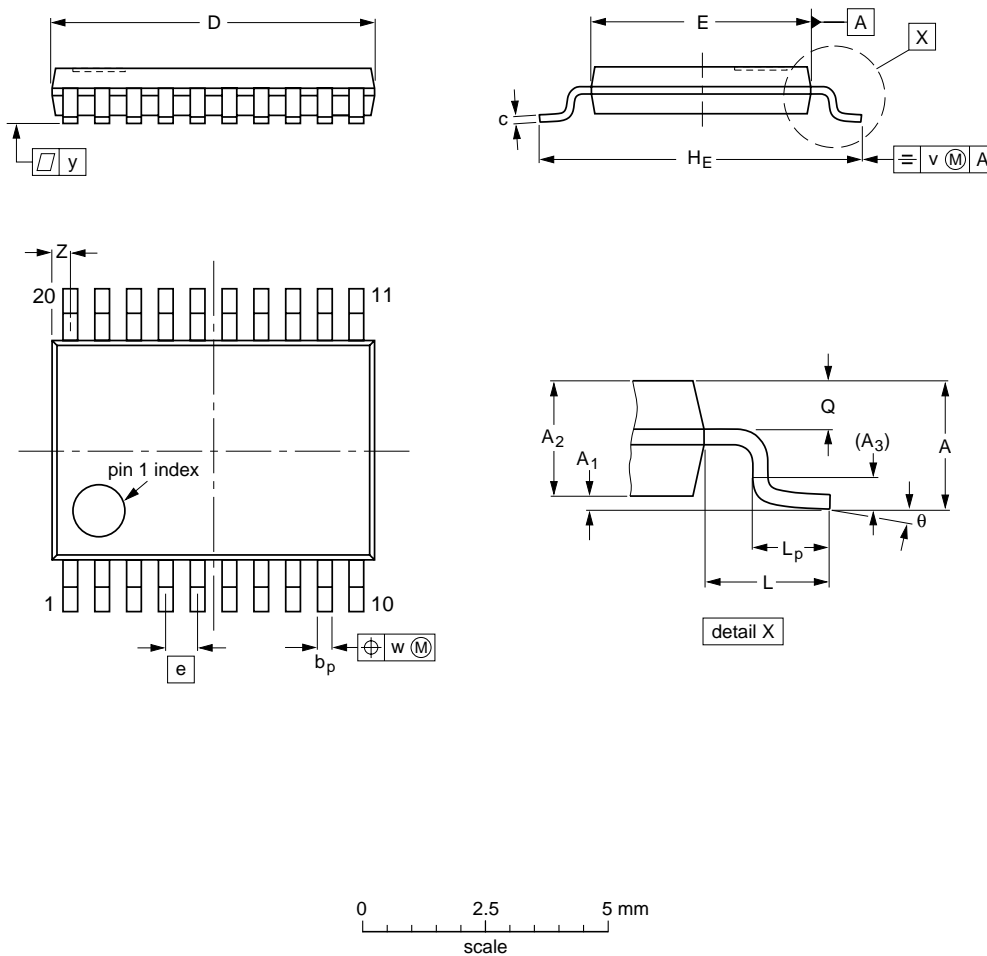


Octal bus transceiver with direction pin with 5 V tolerant input/outputs (3-state)

74LVC245A;  
74LVCH245A

TSSOP20: plastic thin shrink small outline package; 20 leads; body width 4.4 mm

SOT360-1



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

| UNIT | A max. | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | b <sub>p</sub> | c          | D <sup>(1)</sup> | E <sup>(2)</sup> | e    | H <sub>E</sub> | L | L <sub>p</sub> | Q          | v   | w    | y   | z <sup>(1)</sup> | θ        |
|------|--------|----------------|----------------|----------------|----------------|------------|------------------|------------------|------|----------------|---|----------------|------------|-----|------|-----|------------------|----------|
| mm   | 1.1    | 0.15<br>0.05   | 0.95<br>0.80   | 0.25           | 0.30<br>0.19   | 0.2<br>0.1 | 6.6<br>6.4       | 4.5<br>4.3       | 0.65 | 6.6<br>6.2     | 1 | 0.75<br>0.50   | 0.4<br>0.3 | 0.2 | 0.13 | 0.1 | 0.5<br>0.2       | 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.

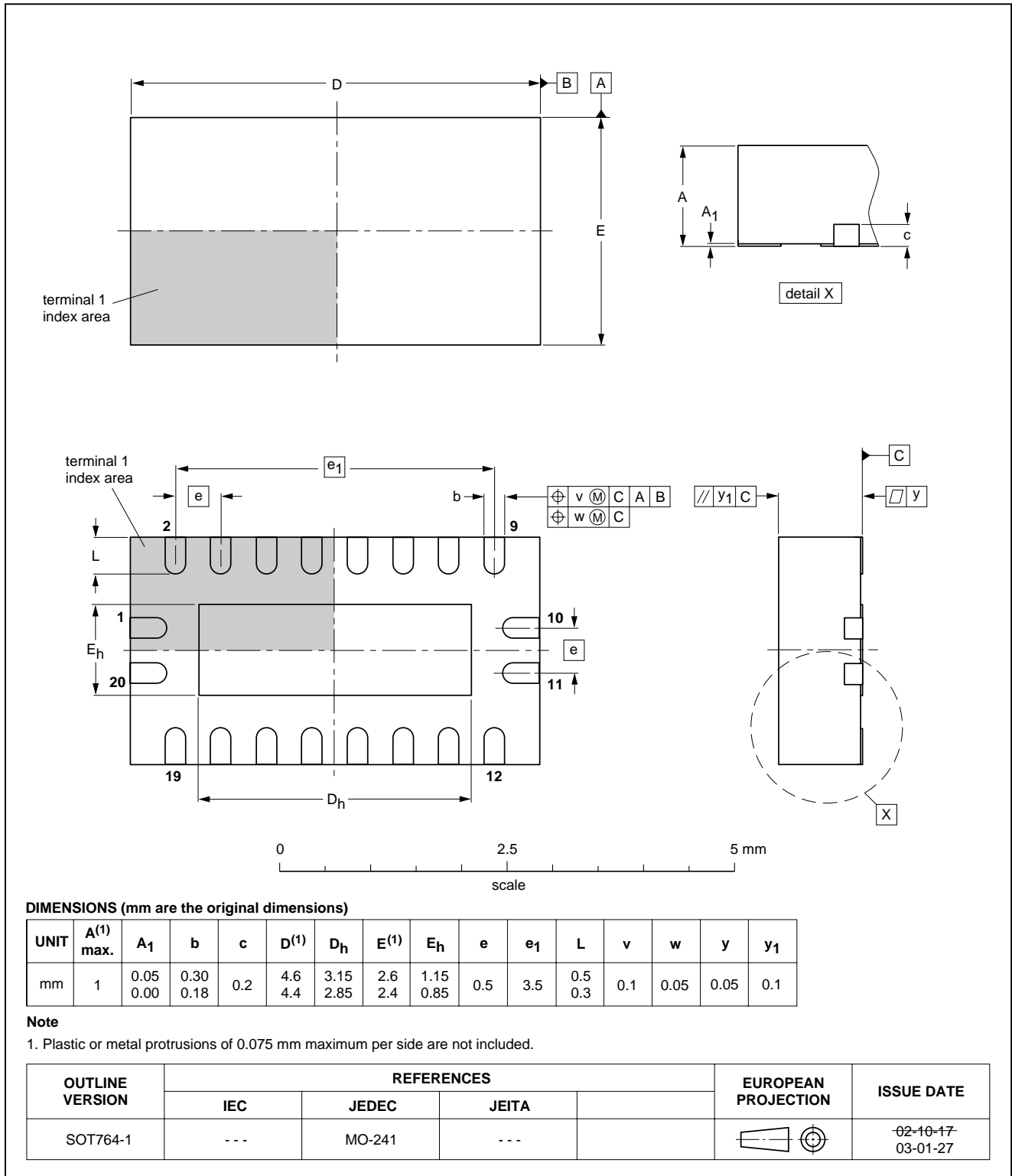
| OUTLINE VERSION | REFERENCES |        |       |  | EUROPEAN PROJECTION | ISSUE DATE            |
|-----------------|------------|--------|-------|--|---------------------|-----------------------|
|                 | IEC        | JEDEC  | JEITA |  |                     |                       |
| SOT360-1        |            | MO-153 |       |  |                     | 99-12-27-<br>03-02-19 |

Octal bus transceiver with direction pin with 5 V tolerant input/outputs (3-state)

74LVC245A;  
74LVCH245A

DHVQFN20: plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 20 terminals; body 2.5 x 4.5 x 0.85 mm

SOT764-1



## Octal bus transceiver with direction pin with 5 V tolerant input/outputs (3-state)

74LVC245A;  
74LVCH245A

### SOLDERING

#### Introduction to soldering surface mount packages

This text gives a very brief insight to a complex technology. A more in-depth account of soldering ICs can be found in our *"Data Handbook IC26; Integrated Circuit Packages"* (document order number 9398 652 90011).

There is no soldering method that is ideal for all surface mount IC packages. Wave soldering can still be used for certain surface mount ICs, but it is not suitable for fine pitch SMDs. In these situations reflow soldering is recommended.

#### Reflow soldering

Reflow soldering requires solder paste (a suspension of fine solder particles, flux and binding agent) to be applied to the printed-circuit board by screen printing, stencilling or pressure-syringe dispensing before package placement.

Several methods exist for reflowing; for example, convection or convection/infrared heating in a conveyor type oven. Throughput times (preheating, soldering and cooling) vary between 100 and 200 seconds depending on heating method.

Typical reflow peak temperatures range from 215 to 250 °C. The top-surface temperature of the packages should preferably be kept:

- below 220 °C for all the BGA packages and packages with a thickness  $\geq 2.5$  mm and packages with a thickness  $< 2.5$  mm and a volume  $\geq 350$  mm<sup>3</sup> so called thick/large packages
- below 235 °C for packages with a thickness  $< 2.5$  mm and a volume  $< 350$  mm<sup>3</sup> so called small/thin packages.

#### Wave soldering

Conventional single wave soldering is not recommended for surface mount devices (SMDs) or printed-circuit boards with a high component density, as solder bridging and non-wetting can present major problems.

To overcome these problems the double-wave soldering method was specifically developed.

If wave soldering is used the following conditions must be observed for optimal results:

- Use a double-wave soldering method comprising a turbulent wave with high upward pressure followed by a smooth laminar wave.
- For packages with leads on two sides and a pitch (e):
  - larger than or equal to 1.27 mm, the footprint longitudinal axis is **preferred** to be parallel to the transport direction of the printed-circuit board;
  - smaller than 1.27 mm, the footprint longitudinal axis **must** be parallel to the transport direction of the printed-circuit board.

The footprint must incorporate solder thieves at the downstream end.

- For packages with leads on four sides, the footprint must be placed at a 45° angle to the transport direction of the printed-circuit board. The footprint must incorporate solder thieves downstream and at the side corners.

During placement and before soldering, the package must be fixed with a droplet of adhesive. The adhesive can be applied by screen printing, pin transfer or syringe dispensing. The package can be soldered after the adhesive is cured.

Typical dwell time is 4 seconds at 250 °C.

A mildly-activated flux will eliminate the need for removal of corrosive residues in most applications.

#### Manual soldering

Fix the component by first soldering two diagonally-opposite end leads. Use a low voltage (24 V or less) soldering iron applied to the flat part of the lead. Contact time must be limited to 10 seconds at up to 300 °C.

When using a dedicated tool, all other leads can be soldered in one operation within 2 to 5 seconds between 270 and 320 °C.



Octal bus transceiver with direction pin with 5 V tolerant  
input/outputs (3-state)

74LVC245A;  
74LVCH245A

#### Suitability of surface mount IC packages for wave and reflow soldering methods

| PACKAGE <sup>(1)</sup>  | SOLDERING METHOD                  |                       |
|---|-----------------------------------|-----------------------|
|   | WAVE                              | REFLOW <sup>(2)</sup> |
| BGA, LBGA, LFBGA, SQFP, TFBGA, VFBGA  | not suitable                      | suitable              |
| DHVQFN, HBCC, HBGA, HLQFP, HSQFP, HSOP, HTQFP,<br>HTSSOP, HVQFN, HVSON, SMS | not suitable <sup>(3)</sup>       | suitable              |
| PLCC <sup>(4)</sup> , SO, SOJ   | suitable                          | suitable              |
| LQFP, QFP, TQFP   | not recommended <sup>(4)(5)</sup> | suitable              |
| SSOP, TSSOP, VSO, VSSOP   | not recommended <sup>(6)</sup>    | suitable              |

#### Notes

- For more detailed information on the BGA packages refer to the “(LF)BGA Application Note” (AN01026); order a copy from your Philips Semiconductors sales office.
- All surface mount (SMD) packages are moisture sensitive. Depending upon the moisture content, the maximum temperature (with respect to time) and body size of the package, there is a risk that internal or external package cracks may occur due to vaporization of the moisture in them (the so called popcorn effect). For details, refer to the Drypack information in the “Data Handbook IC26; Integrated Circuit Packages; Section: Packing Methods”.
- These packages are not suitable for wave soldering. On versions with the heatsink on the bottom side, the solder cannot penetrate between the printed-circuit board and the heatsink. On versions with the heatsink on the top side, the solder might be deposited on the heatsink surface.
- If wave soldering is considered, then the package must be placed at a 45° angle to the solder wave direction. The package footprint must incorporate solder thieves downstream and at the side corners.
- Wave soldering is suitable for LQFP, TQFP and QFP packages with a pitch (e) larger than 0.8 mm; it is definitely not suitable for packages with a pitch (e) equal to or smaller than 0.65 mm.
- Wave soldering is suitable for SSOP, TSSOP, VSO and VSSOP packages with a pitch (e) equal to or larger than 0.65 mm; it is definitely not suitable for packages with a pitch (e) equal to or smaller than 0.5 mm.

Octal bus transceiver with direction pin with 5 V tolerant  
input/outputs (3-state)

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#### 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.  |
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Octal bus transceiver with direction pin with 5 V tolerant  
input/outputs (3-state)

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74LVC245A;  
74LVCH245A

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**NOTES**

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