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# HD74ALVC165245A

## 16-Bit Dual-supply Bus Transceiver with 3-state Outputs

REJ03D0157-0200Z

Rev.2.00

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### Description

The HD74ALVC165245A has 16 bus transceivers with three state outputs in a 48-pin package. When (DIR) is high, data flows from the A inputs to the B outputs, and when (DIR) is low, data flows from the B inputs to the A outputs. A and B bus are separated by making enable input ( $\overline{OE}$ ) high level. This 16-bit non-inverting bus transceiver uses two separate power-supply rails.

And this product has two terminals ( $V_{CCA}$ ,  $V_{CCB}$ ),  $V_{CCA}$  is connected with A bus side,  $V_{CCB}$  is connected with control input and B bus.  $V_{CCA}$  and  $V_{CCB}$  are isolated.

The A port is designed to track  $V_{CCA}$ , which accepts voltages from 1.4 V to 3.6 V, and the B port is designed to track  $V_{CCB}$ , which operates at 1.2 V to 2.7 V. Therefore, Bidirectional broad voltage conversion is possible.

Low voltage and high-speed operation is suitable at the battery drive product (note type personal computer) and low power consumption extends the life of a battery for long time operation.

## Features

- This product function as level shift transceiver that change  $V_{CCA}$  input level to  $V_{CCB}$  output level,  $V_{CCB}$  input level to  $V_{CCA}$  output level by providing different supply voltage to  $V_{CCA}$  and  $V_{CCB}$ .
- $V_{CCA} = 1.4\text{ V to }3.6\text{ V}$ ,  $V_{CCB} = 1.2\text{ V to }2.7\text{ V}$  ( $V_{CCA} > V_{CCB}$ )
- All control input  $V_I$  (max) =  $3.6\text{ V}$  (@ $V_{CCB} = 0\text{ V to }3.6\text{ V}$ )
- All A bus side input outputs  $V_{IO}$  (max) =  $3.6\text{ V}$   
(@ $V_{CCA} = 0\text{ V}$  or output off state)
- All B bus side input outputs  $V_{IO}$  (max) =  $3.6\text{ V}$   
(@ $V_{CCB} = 0\text{ V}$  or output off state)
- High output current  

|                                                                     |                                                             |
|---------------------------------------------------------------------|-------------------------------------------------------------|
| A bus side: $\pm 4\text{ mA}$ (@ $V_{CCA} = 1.5 \pm 0.1\text{ V}$ ) | B bus side: $\pm 2\text{ mA}$ (@ $V_{CCB} = 1.2\text{ V}$ ) |
| $\pm 6\text{ mA}$ (@ $V_{CCA} = 1.8 \pm 0.15\text{ V}$ )            | $\pm 4\text{ mA}$ (@ $V_{CCB} = 1.5 \pm 0.1\text{ V}$ )     |
| $\pm 18\text{ mA}$ (@ $V_{CCA} = 2.5 \pm 0.2\text{ V}$ )            | $\pm 6\text{ mA}$ (@ $V_{CCB} = 1.8 \pm 0.15\text{ V}$ )    |
| $\pm 24\text{ mA}$ (@ $V_{CCA} = 3.3 \pm 0.3\text{ V}$ )            | $\pm 18\text{ mA}$ (@ $V_{CCB} = 2.5 \pm 0.2\text{ V}$ )    |
- Ordering Information

| Part Name          | Package Type | Package Code | Package      | Taping                  |
|--------------------|--------------|--------------|--------------|-------------------------|
|                    |              |              | Abbreviation | Abbreviation (Quantity) |
| HD74ALVC165245ATEL | TSSOP-48Pin  | TTP-48DBV    | T            | EL (1,000pcs / Reel)    |

## Function Table

### Inputs

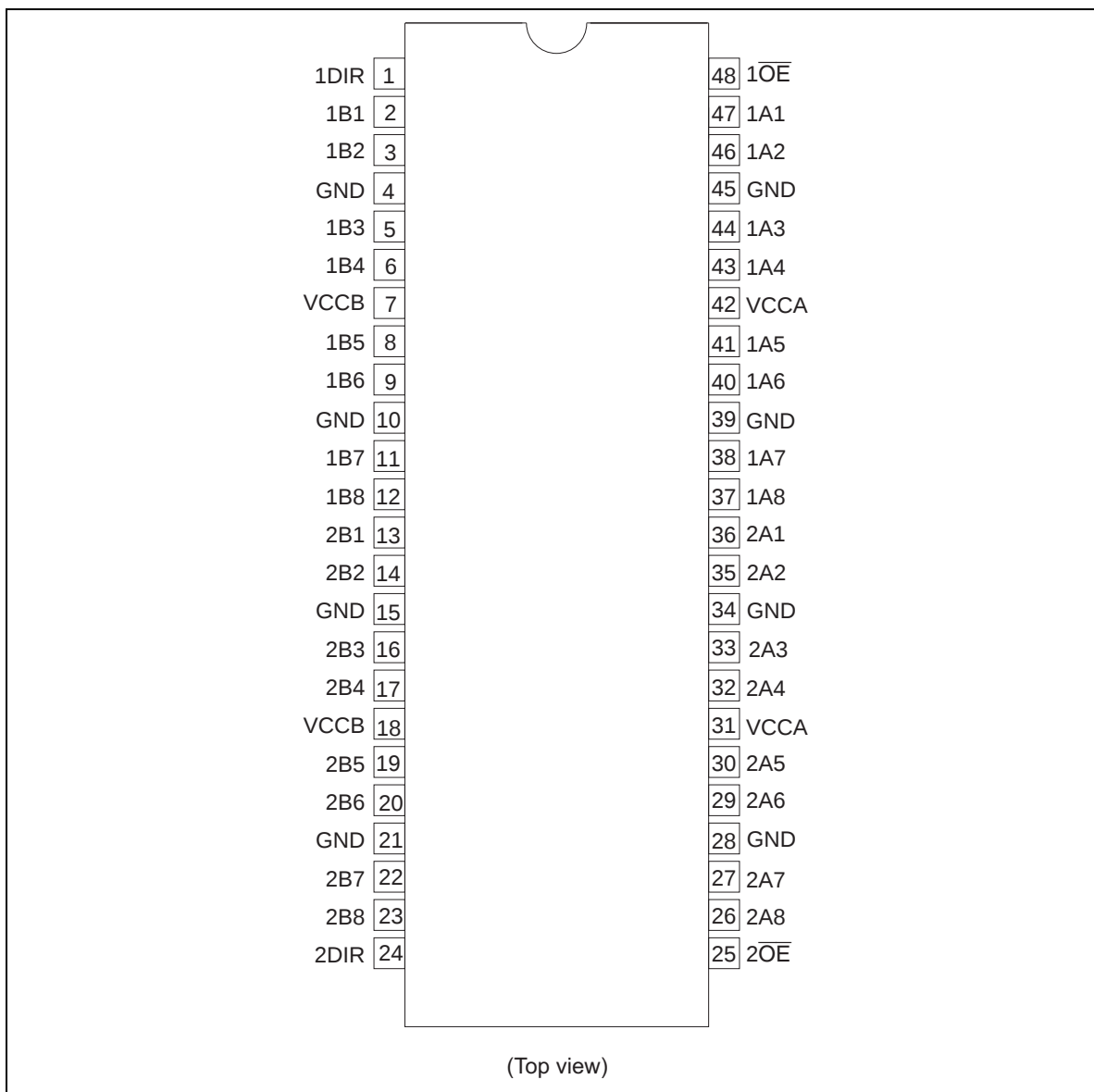
| $\overline{1OE}$ | 1DIR | Operation                   |
|------------------|------|-----------------------------|
| L                | L    | 1B1-1B8 data to 1A1-1A8 bus |
| L                | H    | 1A1-1A8 data to 1B1-1B8 bus |
| H                | X    | Z                           |

### Inputs

| $\overline{2OE}$ | 2DIR | Operation                   |
|------------------|------|-----------------------------|
| L                | L    | 2B1-2B8 data to 2A1-2A8 bus |
| L                | H    | 2A1-2A8 data to 2B1-2B8 bus |
| H                | X    | Z                           |

H : High level  
 L : Low level  
 X : Immaterial  
 Z : High impedance

### Pin Arrangement



### Absolute Maximum Ratings

| Item                                                                                  | Symbol                      | Ratings               | Unit             | Conditions                           |
|---------------------------------------------------------------------------------------|-----------------------------|-----------------------|------------------|--------------------------------------|
| Supply voltage                                                                        | $V_{CCA}, V_{CCB}$          | -0.5 to 4.6           | V                |                                      |
| Input voltage <sup>*1</sup>                                                           | $V_I$                       | -0.5 to 4.6           | V                | DIR, $\overline{OE}$                 |
| Input / output voltage                                                                | $V_{I/O}$                   | -0.5 to $V_{CCA}+0.5$ | V                | A port output "H" or "L"             |
|                                                                                       |                             | -0.5 to 4.6           |                  | A port output "Z" or $V_{CCA}$ : OFF |
|                                                                                       |                             | -0.5 to $V_{CCB}+0.5$ |                  | B port output "H" or "L"             |
|                                                                                       |                             | -0.5 to 4.6           |                  | B port output "Z" or $V_{CCB}$ : OFF |
| Input diode current                                                                   | $I_{IK}$                    | -50                   | mA               | $V_I < 0$                            |
| Output diode current                                                                  | $I_{OK}$                    | -50                   | mA               | $V_O < 0$                            |
|                                                                                       |                             | 50                    |                  | $V_O > V_{CC}+0.5$                   |
| Output current                                                                        | $I_O$                       | $\pm 50$              | mA               |                                      |
| $V_{CCA}, V_{CCB}, GND$ current                                                       | $I_{CCA}, I_{CCB}, I_{GND}$ | 100                   | mA               |                                      |
| Maximum power dissipation<br>at $T_a = 55^\circ\text{C}$ (in still air) <sup>*2</sup> | $P_T$                       | 850                   | mW               | TSSOP                                |
| Storage temperature                                                                   | $T_{stg}$                   | -65 to 150            | $^\circ\text{C}$ |                                      |

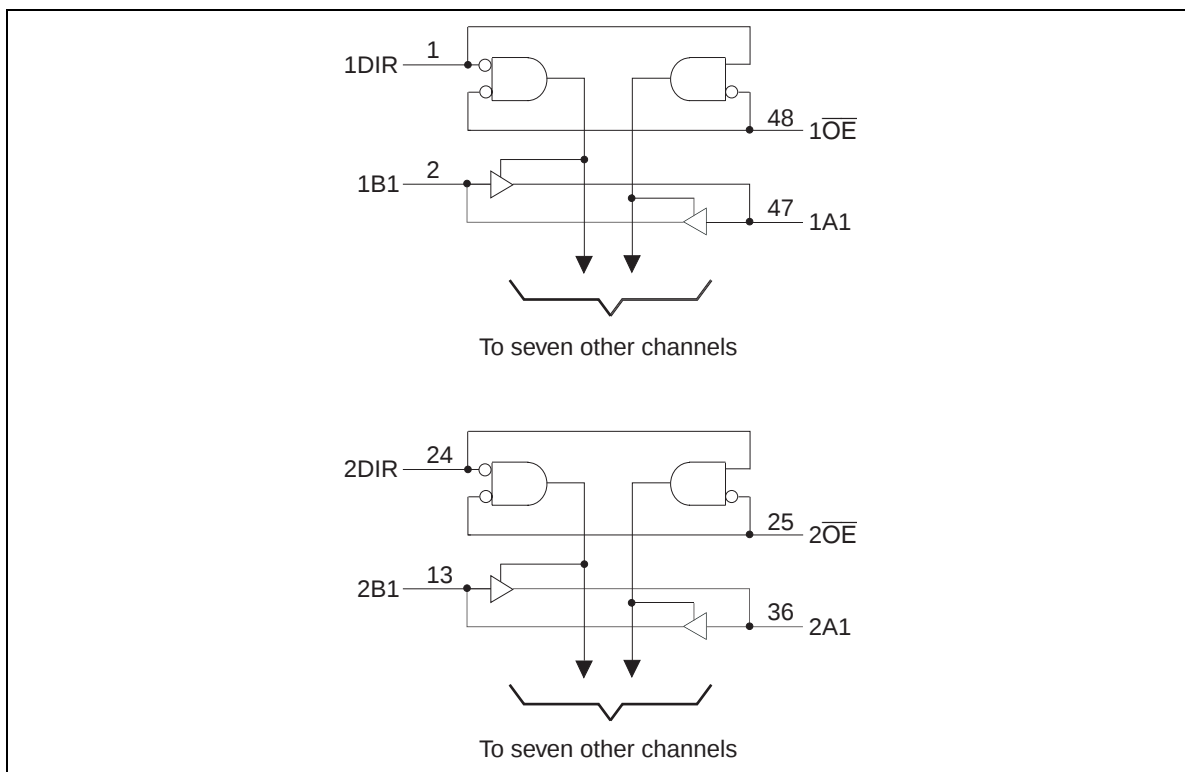
- Notes:     The absolute maximum ratings are values which must not individually be exceeded, and furthermore, no two of which may be realized at the same time.
1. The input and output voltage ratings may be exceeded even if the input and output clamp-current ratings are observed.
  2. The maximum package power dissipation was calculated using a junction temperature of  $150^\circ\text{C}$ .

## Recommended Operating Conditions

| Item                               | Symbol                | Ratings        | Unit   | Conditions                           |
|------------------------------------|-----------------------|----------------|--------|--------------------------------------|
| Supply voltage                     | $V_{CCB}$             | 1.2 to 2.7     | V      |                                      |
|                                    | $V_{CCA}$             | 1.4 to 3.6     |        |                                      |
| Input / output voltage             | $V_I$                 | 0 to 3.6       | V      | DIR, $\overline{OE}$                 |
|                                    | $V_{I/O}$             | 0 to $V_{CCA}$ |        | A port output "H" or "L"             |
|                                    |                       | 0 to 3.6       |        | A port output "Z" or $V_{CCA}$ : OFF |
|                                    |                       | 0 to $V_{CCB}$ |        | B port output "H" or "L"             |
|                                    |                       | 0 to 3.6       |        | B port output "Z" or $V_{CCB}$ : OFF |
| Output current                     | $I_{OHB}$             | -2             | mA     | $V_{CCB} = 1.2\text{ V}$             |
|                                    |                       | -4             |        | $V_{CCB} = 1.5\pm 0.1\text{ V}$      |
|                                    |                       | -6             |        | $V_{CCB} = 1.8\pm 0.15\text{ V}$     |
|                                    |                       | -18            |        | $V_{CCB} = 2.5\pm 0.2\text{ V}$      |
|                                    | $I_{OHA}$             | -4             |        | $V_{CCA} = 1.5\pm 0.1\text{ V}$      |
|                                    |                       | -6             |        | $V_{CCA} = 1.8\pm 0.15\text{ V}$     |
|                                    |                       | -18            |        | $V_{CCA} = 2.5\pm 0.2\text{ V}$      |
|                                    |                       | -24            |        | $V_{CCA} = 3.3\pm 0.3\text{ V}$      |
|                                    | $I_{OLB}$             | 2              |        | $V_{CCB} = 1.2\text{ V}$             |
|                                    |                       | 4              |        | $V_{CCB} = 1.5\pm 0.1\text{ V}$      |
|                                    |                       | 6              |        | $V_{CCB} = 1.8\pm 0.15\text{ V}$     |
|                                    |                       | 18             |        | $V_{CCB} = 2.5\pm 0.2\text{ V}$      |
|                                    | $I_{OLA}$             | 4              |        | $V_{CCA} = 1.5\pm 0.1\text{ V}$      |
|                                    |                       | 6              |        | $V_{CCA} = 1.8\pm 0.15\text{ V}$     |
|                                    |                       | 18             |        | $V_{CCA} = 2.5\pm 0.2\text{ V}$      |
|                                    |                       | 24             |        | $V_{CCA} = 3.3\pm 0.3\text{ V}$      |
| Input transition rise or fall time | $\Delta t / \Delta v$ | 10             | ns / V |                                      |
| Operating temperature              | $T_a$                 | -40 to 85      | °C     |                                      |

Note: Unused or floating inputs must be held high or low.

## Block Diagram



## Electrical Characteristics

(Ta = -40 to 85°C)

| Item           | Symbol           | V <sub>CCB</sub> (V) | V <sub>CCA</sub> (V) | Min                    | Max                    | Unit | Test Conditions           |
|----------------|------------------|----------------------|----------------------|------------------------|------------------------|------|---------------------------|
| Input voltage  | V <sub>IHB</sub> | 1.2                  | 1.4 to 3.6           | V <sub>CCB</sub> ×0.75 | —                      | V    | B port                    |
|                |                  | 1.5±0.1              | 1.65 to 3.6          | V <sub>CCB</sub> ×0.70 | —                      |      | Control input             |
|                |                  | 1.8±0.15             | 2.3 to 3.6           | V <sub>CCB</sub> ×0.65 | —                      |      |                           |
|                |                  | 2.5±0.2              | 3.0 to 3.6           | 1.6                    | —                      |      |                           |
|                | V <sub>IHA</sub> | 1.2                  | 1.5±0.1              | V <sub>CCA</sub> ×0.70 | —                      |      | A port                    |
|                |                  | 1.2 to 1.6           | 1.8±0.15             | V <sub>CCA</sub> ×0.65 | —                      |      |                           |
|                |                  | 1.2 to 1.95          | 2.5±0.2              | 1.6                    | —                      |      |                           |
|                |                  | 1.2 to 2.7           | 3.3±0.3              | 2.0                    | —                      |      |                           |
|                | V <sub>ILB</sub> | 1.2                  | 1.4 to 3.6           | —                      | V <sub>CCB</sub> ×0.25 |      | B port                    |
|                |                  | 1.5±0.1              | 1.65 to 3.6          | —                      | V <sub>CCB</sub> ×0.30 |      | Control input             |
|                |                  | 1.8±0.15             | 2.3 to 3.6           | —                      | V <sub>CCB</sub> ×0.35 |      |                           |
|                |                  | 2.5±0.2              | 3.0 to 3.6           | —                      | 0.7                    |      |                           |
|                | V <sub>ILA</sub> | 1.2                  | 1.5±0.1              | —                      | V <sub>CCA</sub> ×0.30 |      | A port                    |
|                |                  | 1.2 to 1.6           | 1.8±0.15             | —                      | V <sub>CCA</sub> ×0.35 |      |                           |
|                |                  | 1.2 to 1.95          | 2.5±0.2              | —                      | 0.7                    |      |                           |
|                |                  | 1.2 to 2.7           | 3.3±0.3              | —                      | 0.8                    |      |                           |
| Output voltage | V <sub>OHB</sub> | 1.2                  | 1.4 to 3.6           | V <sub>CCB</sub> -0.2  | —                      | V    | I <sub>OH</sub> = -100 μA |
|                |                  |                      |                      | 0.9                    | —                      |      | I <sub>OH</sub> = -2 mA   |
|                |                  | 1.5±0.1              | 1.65 to 3.6          | V <sub>CCB</sub> -0.2  | —                      |      | I <sub>OH</sub> = -100 μA |
|                |                  |                      |                      | 1.1                    | —                      |      | I <sub>OH</sub> = -4 mA   |
|                |                  | 1.8±0.15             | 2.3 to 3.6           | V <sub>CCB</sub> -0.2  | —                      |      | I <sub>OH</sub> = -100 μA |
|                |                  |                      |                      | 1.25                   | —                      |      | I <sub>OH</sub> = -6 mA   |
|                |                  | 2.5±0.2              | 3.0 to 3.6           | V <sub>CCB</sub> -0.2  | —                      |      | I <sub>OH</sub> = -100 μA |
|                |                  |                      |                      | 1.7                    | —                      |      | I <sub>OH</sub> = -18 mA  |
|                | V <sub>OHA</sub> | 1.2                  | 1.5±0.1              | V <sub>CCA</sub> -0.2  | —                      |      | I <sub>OH</sub> = -100 μA |
|                |                  |                      |                      | 1.1                    | —                      |      | I <sub>OH</sub> = -4 mA   |
|                |                  | 1.2 to 1.6           | 1.8±0.15             | V <sub>CCA</sub> -0.2  | —                      |      | I <sub>OH</sub> = -100 μA |
|                |                  |                      |                      | 1.25                   | —                      |      | I <sub>OH</sub> = -6 mA   |
|                |                  | 1.2 to 1.95          | 2.5±0.2              | V <sub>CCA</sub> -0.2  | —                      |      | I <sub>OH</sub> = -100 μA |
|                |                  |                      |                      | 1.7                    | —                      |      | I <sub>OH</sub> = -18 mA  |
|                |                  | 1.2 to 2.7           | 3.3±0.3              | V <sub>CCA</sub> -0.2  | —                      |      | I <sub>OH</sub> = -100 μA |
|                |                  |                      |                      | 2.2                    | —                      |      | I <sub>OH</sub> = -24 mA  |

## Electrical Characteristics (Cont)

(Ta = -40 to 85°C)

| Item                                                | Symbol            | V <sub>CCB</sub> (V) | V <sub>CCA</sub> (V) | Min | Max  | Unit | Test Conditions                                                                                           |
|-----------------------------------------------------|-------------------|----------------------|----------------------|-----|------|------|-----------------------------------------------------------------------------------------------------------|
| Output voltage                                      | V <sub>OLB</sub>  | 1.2                  | 1.4 to 3.6           | —   | 0.2  | V    | I <sub>OL</sub> = 100 μA                                                                                  |
|                                                     |                   |                      |                      | —   | 0.3  |      | I <sub>OL</sub> = 2 mA                                                                                    |
|                                                     |                   | 1.5±0.1              | 1.65 to 3.6          | —   | 0.2  |      | I <sub>OL</sub> = 100 μA                                                                                  |
|                                                     |                   |                      |                      | —   | 0.3  |      | I <sub>OL</sub> = 4 mA                                                                                    |
|                                                     |                   | 1.8±0.15             | 2.3 to 3.6           | —   | 0.2  |      | I <sub>OL</sub> = 100 μA                                                                                  |
|                                                     |                   |                      |                      | —   | 0.3  |      | I <sub>OL</sub> = 6 mA                                                                                    |
|                                                     |                   | 2.5±0.2              | 3.0 to 3.6           | —   | 0.2  |      | I <sub>OL</sub> = 100 μA                                                                                  |
|                                                     |                   |                      |                      | —   | 0.6  |      | I <sub>OL</sub> = 18 mA                                                                                   |
|                                                     | V <sub>OLA</sub>  | 1.2                  | 1.5±0.1              | —   | 0.2  |      | I <sub>OL</sub> = 100 μA                                                                                  |
|                                                     |                   |                      |                      | —   | 0.3  |      | I <sub>OL</sub> = 4 mA                                                                                    |
|                                                     |                   | 1.2 to 1.6           | 1.8±0.15             | —   | 0.2  |      | I <sub>OL</sub> = 100 μA                                                                                  |
|                                                     |                   |                      |                      | —   | 0.3  |      | I <sub>OL</sub> = 6 mA                                                                                    |
|                                                     |                   | 1.2 to 1.95          | 2.5±0.2              | —   | 0.2  |      | I <sub>OL</sub> = 100 μA                                                                                  |
|                                                     |                   |                      |                      | —   | 0.6  |      | I <sub>OL</sub> = 18 mA                                                                                   |
|                                                     |                   | 1.2 to 2.7           | 3.3±0.3              | —   | 0.2  |      | I <sub>OL</sub> = 100 μA                                                                                  |
|                                                     |                   |                      |                      | —   | 0.55 |      | I <sub>OL</sub> = 24 mA                                                                                   |
| Input current                                       | I <sub>IN</sub>   | 2.7                  | 3.6                  | —   | ±5.0 | μA   | V <sub>I</sub> = GND or V <sub>CCB</sub><br>Control input                                                 |
| Off state output current                            | I <sub>OZ</sub>   | 2.7                  | 3.6                  | —   | ±10  | μA   | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>                                                      |
| Output leak current                                 | I <sub>OFF</sub>  | 0                    | 0                    | —   | 10   | μA   | V <sub>IN</sub> , V <sub>OUT</sub> = 0 to 3.6 V                                                           |
| Quiescent supply current                            | I <sub>CCB</sub>  | 2.7                  | 3.6                  | —   | 20   | μA   | I <sub>O</sub> (B port) = 0,<br>A <sub>IN</sub> = V <sub>CCA</sub> or GND                                 |
|                                                     | I <sub>CCA</sub>  | 2.7                  | 3.6                  | —   | 20   |      | I <sub>O</sub> (A port) = 0,<br>B <sub>IN</sub> = V <sub>CCB</sub> or GND                                 |
|                                                     | I <sub>CCB</sub>  | 2.7                  | 3.6                  | —   | ±20  |      | V <sub>CCB</sub> ≤ (V <sub>IN</sub> , V <sub>OUT</sub> ) ≤ 3.6 V                                          |
|                                                     | I <sub>CCA</sub>  | 2.7                  | 3.6                  | —   | ±20  |      | V <sub>CCA</sub> ≤ (V <sub>IN</sub> , V <sub>OUT</sub> ) ≤ 3.6 V                                          |
| Increase in I <sub>CC</sub> per Input* <sup>1</sup> | ΔI <sub>CCB</sub> | 2.7                  | 3.6                  | —   | 750  | μA   | B port or control input<br>One input at V <sub>CCB</sub> -0.6 V<br>Other input at V <sub>CCB</sub> or GND |
|                                                     | ΔI <sub>CCA</sub> | 2.7                  | 3.6                  | —   | 750  | μA   | A port<br>One input at V <sub>CCA</sub> -0.6 V<br>Other input at V <sub>CCA</sub> or GND                  |

Notes: For condition shown as Min or Max use the appropriate values under recommended operating conditions.

1. This is the increase in supply current for each input that is at the specified TTL voltage level rather than V<sub>CC</sub> or GND.

## HD74ALVC165245A

### Capacitance

(Ta = 25°C)

| Item                       | Symbol           | V <sub>CCA</sub> (V) | V <sub>CCB</sub> (V) | Min | Typ | Max | Unit | Test Conditions                                                                                       |
|----------------------------|------------------|----------------------|----------------------|-----|-----|-----|------|-------------------------------------------------------------------------------------------------------|
| Control Input capacitance  | C <sub>IN</sub>  | 3.3                  | 2.5                  | —   | 4   | —   | pF   | V <sub>I</sub> = V <sub>CCB</sub> or GND                                                              |
| Input / output capacitance | C <sub>I/O</sub> | 3.3                  | 2.5                  | —   | 9   | —   | pF   | A port, V <sub>I</sub> = V <sub>CCA</sub> or GND,<br>B port, V <sub>I</sub> = V <sub>CCB</sub> or GND |

### Switching Characteristics

(Ta = -40 to 85°C)

- V<sub>CCB</sub> = 2.5±0.2 V, V<sub>CCA</sub> = 3.3±0.3 V

| Item                   | Symbol           | Min | Typ | Max | Unit | Test conditions                                  | From(Input)            | To(Output) |
|------------------------|------------------|-----|-----|-----|------|--------------------------------------------------|------------------------|------------|
| Propagation delay time | t <sub>PLH</sub> | 0.6 | —   | 4.0 | ns   | C <sub>L</sub> = 30 pF<br>R <sub>L</sub> = 500 Ω | B                      | A          |
|                        | t <sub>PHL</sub> | 0.6 | —   | 4.0 |      |                                                  |                        |            |
|                        | t <sub>PLH</sub> | 0.8 | —   | 4.4 |      |                                                  | A                      | B          |
|                        | t <sub>PHL</sub> | 0.8 | —   | 4.4 |      |                                                  |                        |            |
| Output enable time     | t <sub>ZH</sub>  | 0.6 | —   | 4.0 | ns   | C <sub>L</sub> = 30 pF<br>R <sub>L</sub> = 500 Ω | $\overline{\text{OE}}$ | A          |
|                        | t <sub>ZL</sub>  | 0.6 | —   | 4.0 |      |                                                  |                        |            |
|                        | t <sub>ZH</sub>  | 0.8 | —   | 4.6 |      |                                                  | $\overline{\text{OE}}$ | B          |
|                        | t <sub>ZL</sub>  | 0.8 | —   | 4.6 |      |                                                  |                        |            |
| Output disable time    | t <sub>HZ</sub>  | 0.6 | —   | 4.8 | ns   | C <sub>L</sub> = 30 pF<br>R <sub>L</sub> = 500 Ω | $\overline{\text{OE}}$ | A          |
|                        | t <sub>LZ</sub>  | 0.6 | —   | 4.8 |      |                                                  |                        |            |
|                        | t <sub>HZ</sub>  | 0.8 | —   | 4.4 |      |                                                  | $\overline{\text{OE}}$ | B          |
|                        | t <sub>LZ</sub>  | 0.8 | —   | 4.4 |      |                                                  |                        |            |

## Switching Characteristics (cont)

(Ta = -40 to 85°C)

- V<sub>CCB</sub> = 1.8±0.15 V, V<sub>CCA</sub> = 3.3±0.3 V

| Item                   | Symbol           | Min | Typ | Max | Unit | Test conditions        | From(Input)            | To(Output) |
|------------------------|------------------|-----|-----|-----|------|------------------------|------------------------|------------|
| Propagation delay time | t <sub>PLH</sub> | 0.6 | —   | 5.1 | ns   | C <sub>L</sub> = 30 pF | B                      | A          |
|                        | t <sub>PHL</sub> | 0.6 | —   | 5.1 |      | R <sub>L</sub> = 500 Ω |                        |            |
|                        | t <sub>PLH</sub> | 1.5 | —   | 6.2 |      |                        | A                      | B          |
|                        | t <sub>PHL</sub> | 1.5 | —   | 6.2 |      |                        |                        |            |
| Output enable time     | t <sub>ZH</sub>  | 0.6 | —   | 5.1 | ns   | C <sub>L</sub> = 30 pF | $\overline{\text{OE}}$ | A          |
|                        | t <sub>ZL</sub>  | 0.6 | —   | 5.1 |      | R <sub>L</sub> = 500 Ω |                        |            |
|                        | t <sub>ZH</sub>  | 1.5 | —   | 8.2 |      |                        | $\overline{\text{OE}}$ | B          |
|                        | t <sub>ZL</sub>  | 1.5 | —   | 8.2 |      |                        |                        |            |
| Output disable time    | t <sub>HZ</sub>  | 0.6 | —   | 5.6 | ns   | C <sub>L</sub> = 30 pF | $\overline{\text{OE}}$ | A          |
|                        | t <sub>LZ</sub>  | 0.6 | —   | 5.6 |      | R <sub>L</sub> = 500 Ω |                        |            |
|                        | t <sub>HZ</sub>  | 0.8 | —   | 4.5 |      |                        | $\overline{\text{OE}}$ | B          |
|                        | t <sub>LZ</sub>  | 0.8 | —   | 4.5 |      |                        |                        |            |

- V<sub>CCB</sub> = 1.5±0.1 V, V<sub>CCA</sub> = 3.3±0.3 V

| Item                   | Symbol           | Min | Typ | Max  | Unit | Test conditions        | From(Input)            | To(Output) |
|------------------------|------------------|-----|-----|------|------|------------------------|------------------------|------------|
| Propagation delay time | t <sub>PLH</sub> | 0.6 | —   | 5.5  | ns   | C <sub>L</sub> = 30 pF | B                      | A          |
|                        | t <sub>PHL</sub> | 0.6 | —   | 5.5  |      | R <sub>L</sub> = 500 Ω |                        |            |
|                        | t <sub>PLH</sub> | 1.5 | —   | 5.5  |      |                        | A                      | B          |
|                        | t <sub>PHL</sub> | 1.5 | —   | 5.5  |      |                        |                        |            |
| Output enable time     | t <sub>ZH</sub>  | 0.6 | —   | 6.0  | ns   | C <sub>L</sub> = 30 pF | $\overline{\text{OE}}$ | A          |
|                        | t <sub>ZL</sub>  | 0.6 | —   | 6.0  |      | R <sub>L</sub> = 500 Ω |                        |            |
|                        | t <sub>ZH</sub>  | 1.5 | —   | 10.0 |      |                        | $\overline{\text{OE}}$ | B          |
|                        | t <sub>ZL</sub>  | 1.5 | —   | 10.0 |      |                        |                        |            |
| Output disable time    | t <sub>HZ</sub>  | 0.6 | —   | 6.0  | ns   | C <sub>L</sub> = 30 pF | $\overline{\text{OE}}$ | A          |
|                        | t <sub>LZ</sub>  | 0.6 | —   | 6.0  |      | R <sub>L</sub> = 500 Ω |                        |            |
|                        | t <sub>HZ</sub>  | 1.5 | —   | 6.0  |      |                        | $\overline{\text{OE}}$ | B          |
|                        | t <sub>LZ</sub>  | 1.5 | —   | 6.0  |      |                        |                        |            |

## Switching Characteristics (cont)

(Ta = -40 to 85°C)

- V<sub>CCB</sub> = 1.2 V, V<sub>CCA</sub> = 3.3±0.3 V

| Item                   | Symbol           | Min | Typ | Max | Unit | Test conditions        | From(Input)     | To(Output) |
|------------------------|------------------|-----|-----|-----|------|------------------------|-----------------|------------|
| Propagation delay time | t <sub>PLH</sub> | —   | 3.5 | —   | ns   | C <sub>L</sub> = 30 pF | B               | A          |
|                        | t <sub>PHL</sub> | —   | 3.5 | —   |      | R <sub>L</sub> = 500 Ω |                 |            |
|                        | t <sub>PLH</sub> | —   | 4.5 | —   |      |                        | A               | B          |
|                        | t <sub>PHL</sub> | —   | 4.5 | —   |      |                        |                 |            |
| Output enable time     | t <sub>ZH</sub>  | —   | 5.5 | —   | ns   | C <sub>L</sub> = 30 pF | $\overline{OE}$ | A          |
|                        | t <sub>ZL</sub>  | —   | 5.5 | —   |      | R <sub>L</sub> = 500 Ω |                 |            |
|                        | t <sub>ZH</sub>  | —   | 9.0 | —   |      |                        | $\overline{OE}$ | B          |
|                        | t <sub>ZL</sub>  | —   | 9.0 | —   |      |                        |                 |            |
| Output disable time    | t <sub>HZ</sub>  | —   | 4.5 | —   | ns   | C <sub>L</sub> = 30 pF | $\overline{OE}$ | A          |
|                        | t <sub>LZ</sub>  | —   | 4.5 | —   |      | R <sub>L</sub> = 500 Ω |                 |            |
|                        | t <sub>HZ</sub>  | —   | 5.5 | —   |      |                        | $\overline{OE}$ | B          |
|                        | t <sub>LZ</sub>  | —   | 5.5 | —   |      |                        |                 |            |

- V<sub>CCB</sub> = 1.8±0.15 V, V<sub>CCA</sub> = 2.5±0.2 V

| Item                   | Symbol           | Min | Typ | Max | Unit | Test conditions        | From(Input)     | To(Output) |
|------------------------|------------------|-----|-----|-----|------|------------------------|-----------------|------------|
| Propagation delay time | t <sub>PLH</sub> | 0.8 | —   | 5.5 | ns   | C <sub>L</sub> = 30 pF | B               | A          |
|                        | t <sub>PHL</sub> | 0.8 | —   | 5.5 |      | R <sub>L</sub> = 500 Ω |                 |            |
|                        | t <sub>PLH</sub> | 1.5 | —   | 5.8 |      |                        | A               | B          |
|                        | t <sub>PHL</sub> | 1.5 | —   | 5.8 |      |                        |                 |            |
| Output enable time     | t <sub>ZH</sub>  | 0.8 | —   | 5.3 | ns   | C <sub>L</sub> = 30 pF | $\overline{OE}$ | A          |
|                        | t <sub>ZL</sub>  | 0.8 | —   | 5.3 |      | R <sub>L</sub> = 500 Ω |                 |            |
|                        | t <sub>ZH</sub>  | 1.5 | —   | 8.3 |      |                        | $\overline{OE}$ | B          |
|                        | t <sub>ZL</sub>  | 1.5 | —   | 8.3 |      |                        |                 |            |
| Output disable time    | t <sub>HZ</sub>  | 0.8 | —   | 5.2 | ns   | C <sub>L</sub> = 30 pF | $\overline{OE}$ | A          |
|                        | t <sub>LZ</sub>  | 0.8 | —   | 5.2 |      | R <sub>L</sub> = 500 Ω |                 |            |
|                        | t <sub>HZ</sub>  | 0.8 | —   | 4.6 |      |                        | $\overline{OE}$ | B          |
|                        | t <sub>LZ</sub>  | 0.8 | —   | 4.6 |      |                        |                 |            |

## Switching Characteristics (cont)

(Ta = -40 to 85°C)

- $V_{CCB} = 1.5 \pm 0.1$  V,  $V_{CCA} = 2.5 \pm 0.2$  V

| Item                   | Symbol    | Min | Typ | Max  | Unit | Test conditions      | From(Input)     | To(Output) |
|------------------------|-----------|-----|-----|------|------|----------------------|-----------------|------------|
| Propagation delay time | $t_{PLH}$ | 1.5 | —   | 6.0  | ns   | $C_L = 30$ pF        | B               | A          |
|                        | $t_{PHL}$ | 1.5 | —   | 6.0  |      | $R_L = 500$ $\Omega$ |                 |            |
|                        | $t_{PLH}$ | 1.5 | —   | 6.0  |      |                      | A               | B          |
|                        | $t_{PHL}$ | 1.5 | —   | 6.0  |      |                      |                 |            |
| Output enable time     | $t_{ZH}$  | 0.8 | —   | 7.0  | ns   | $C_L = 30$ pF        | $\overline{OE}$ | A          |
|                        | $t_{ZL}$  | 0.8 | —   | 7.0  |      | $R_L = 500$ $\Omega$ |                 |            |
|                        | $t_{ZH}$  | 1.5 | —   | 10.0 |      |                      | $\overline{OE}$ | B          |
|                        | $t_{ZL}$  | 1.5 | —   | 10.0 |      |                      |                 |            |
| Output disable time    | $t_{HZ}$  | 1.5 | —   | 6.0  | ns   | $C_L = 30$ pF        | $\overline{OE}$ | A          |
|                        | $t_{LZ}$  | 1.5 | —   | 6.0  |      | $R_L = 500$ $\Omega$ |                 |            |
|                        | $t_{HZ}$  | 1.5 | —   | 6.0  |      |                      | $\overline{OE}$ | B          |
|                        | $t_{LZ}$  | 1.5 | —   | 6.0  |      |                      |                 |            |

- $V_{CCB} = 1.2$  V,  $V_{CCA} = 2.5 \pm 0.2$  V

| Item                   | Symbol    | Min | Typ | Max | Unit | Test conditions      | From(Input)     | To(Output) |
|------------------------|-----------|-----|-----|-----|------|----------------------|-----------------|------------|
| Propagation delay time | $t_{PLH}$ | —   | 3.5 | —   | ns   | $C_L = 30$ pF        | B               | A          |
|                        | $t_{PHL}$ | —   | 3.5 | —   |      | $R_L = 500$ $\Omega$ |                 |            |
|                        | $t_{PLH}$ | —   | 4.5 | —   |      |                      | A               | B          |
|                        | $t_{PHL}$ | —   | 4.5 | —   |      |                      |                 |            |
| Output enable time     | $t_{ZH}$  | —   | 6.0 | —   | ns   | $C_L = 30$ pF        | $\overline{OE}$ | A          |
|                        | $t_{ZL}$  | —   | 6.0 | —   |      | $R_L = 500$ $\Omega$ |                 |            |
|                        | $t_{ZH}$  | —   | 9.0 | —   |      |                      | $\overline{OE}$ | B          |
|                        | $t_{ZL}$  | —   | 9.0 | —   |      |                      |                 |            |
| Output disable time    | $t_{HZ}$  | —   | 5.0 | —   | ns   | $C_L = 30$ pF        | $\overline{OE}$ | A          |
|                        | $t_{LZ}$  | —   | 5.0 | —   |      | $R_L = 500$ $\Omega$ |                 |            |
|                        | $t_{HZ}$  | —   | 5.5 | —   |      |                      | $\overline{OE}$ | B          |
|                        | $t_{LZ}$  | —   | 5.5 | —   |      |                      |                 |            |

**Switching Characteristics (cont)**

(Ta = -40 to 85°C)

- $V_{CCB} = 1.5 \pm 0.1$  V,  $V_{CCA} = 1.8 \pm 0.15$  V

| Item                   | Symbol    | Min | Typ | Max  | Unit | Test conditions    | From(Input)     | To(Output) |
|------------------------|-----------|-----|-----|------|------|--------------------|-----------------|------------|
| Propagation delay time | $t_{PLH}$ | 1.5 | —   | 7.0  | ns   | $C_L = 30$ pF      | B               | A          |
|                        | $t_{PHL}$ | 1.5 | —   | 7.0  |      | $R_L = 500 \Omega$ |                 |            |
|                        | $t_{PLH}$ | 1.5 | —   | 7.0  |      |                    | A               | B          |
|                        | $t_{PHL}$ | 1.5 | —   | 7.0  |      |                    |                 |            |
| Output enable time     | $t_{ZH}$  | 1.5 | —   | 8.0  | ns   | $C_L = 30$ pF      | $\overline{OE}$ | A          |
|                        | $t_{ZL}$  | 1.5 | —   | 8.0  |      | $R_L = 500 \Omega$ |                 |            |
|                        | $t_{ZH}$  | 1.5 | —   | 10.0 |      |                    | $\overline{OE}$ | B          |
|                        | $t_{ZL}$  | 1.5 | —   | 10.0 |      |                    |                 |            |
| Output disable time    | $t_{HZ}$  | 1.5 | —   | 7.0  | ns   | $C_L = 30$ pF      | $\overline{OE}$ | A          |
|                        | $t_{LZ}$  | 1.5 | —   | 7.0  |      | $R_L = 500 \Omega$ |                 |            |
|                        | $t_{HZ}$  | 1.5 | —   | 6.0  |      |                    | $\overline{OE}$ | B          |
|                        | $t_{LZ}$  | 1.5 | —   | 6.0  |      |                    |                 |            |

- $V_{CCB} = 1.2$  V,  $V_{CCA} = 1.8 \pm 0.15$  V

| Item                   | Symbol    | Min | Typ | Max | Unit | Test conditions    | From(Input)     | To(Output) |
|------------------------|-----------|-----|-----|-----|------|--------------------|-----------------|------------|
| Propagation delay time | $t_{PLH}$ | —   | 4.5 | —   | ns   | $C_L = 30$ pF      | B               | A          |
|                        | $t_{PHL}$ | —   | 4.5 | —   |      | $R_L = 500 \Omega$ |                 |            |
|                        | $t_{PLH}$ | —   | 5.0 | —   |      |                    | A               | B          |
|                        | $t_{PHL}$ | —   | 5.0 | —   |      |                    |                 |            |
| Output enable time     | $t_{ZH}$  | —   | 6.5 | —   | ns   | $C_L = 30$ pF      | $\overline{OE}$ | A          |
|                        | $t_{ZL}$  | —   | 6.5 | —   |      | $R_L = 500 \Omega$ |                 |            |
|                        | $t_{ZH}$  | —   | 9.0 | —   |      |                    | $\overline{OE}$ | B          |
|                        | $t_{ZL}$  | —   | 9.0 | —   |      |                    |                 |            |
| Output disable time    | $t_{HZ}$  | —   | 5.5 | —   | ns   | $C_L = 30$ pF      | $\overline{OE}$ | A          |
|                        | $t_{LZ}$  | —   | 5.5 | —   |      | $R_L = 500 \Omega$ |                 |            |
|                        | $t_{HZ}$  | —   | 5.5 | —   |      |                    | $\overline{OE}$ | B          |
|                        | $t_{LZ}$  | —   | 5.5 | —   |      |                    |                 |            |

## Switching Characteristics (cont)

(Ta = -40 to 85°C)

- V<sub>CCB</sub> = 1.2 V, V<sub>CCA</sub> = 1.5±0.1 V

| Item                   | Symbol           | Min | Typ | Max | Unit | Test conditions        | From(Input)            | To(Output) |
|------------------------|------------------|-----|-----|-----|------|------------------------|------------------------|------------|
| Propagation delay time | t <sub>PLH</sub> | —   | 5.5 | —   | ns   | C <sub>L</sub> = 30 pF | B                      | A          |
|                        | t <sub>PHL</sub> | —   | 5.5 | —   |      | R <sub>L</sub> = 500 Ω |                        |            |
|                        | t <sub>PLH</sub> | —   | 5.5 | —   |      |                        | A                      | B          |
|                        | t <sub>PHL</sub> | —   | 5.5 | —   |      |                        |                        |            |
| Output enable time     | t <sub>ZH</sub>  | —   | 7.5 | —   | ns   | C <sub>L</sub> = 30 pF | $\overline{\text{OE}}$ | A          |
|                        | t <sub>ZL</sub>  | —   | 7.5 | —   |      | R <sub>L</sub> = 500 Ω |                        |            |
|                        | t <sub>ZH</sub>  | —   | 9.0 | —   |      |                        | $\overline{\text{OE}}$ | B          |
|                        | t <sub>ZL</sub>  | —   | 9.0 | —   |      |                        |                        |            |
| Output disable time    | t <sub>HZ</sub>  | —   | 6.5 | —   | ns   | C <sub>L</sub> = 30 pF | $\overline{\text{OE}}$ | A          |
|                        | t <sub>LZ</sub>  | —   | 6.5 | —   |      | R <sub>L</sub> = 500 Ω |                        |            |
|                        | t <sub>HZ</sub>  | —   | 5.5 | —   |      |                        | $\overline{\text{OE}}$ | B          |
|                        | t <sub>LZ</sub>  | —   | 5.5 | —   |      |                        |                        |            |

## Operating Characteristics

| Item                          | Symbol          | V <sub>CCA</sub> (V) | V <sub>CCB</sub> (V) | Min | Typ | Max | Unit | Test Conditions                  |
|-------------------------------|-----------------|----------------------|----------------------|-----|-----|-----|------|----------------------------------|
| Power dissipation capacitance | C <sub>PD</sub> | 3.3                  | 2.5                  | —   | 40  | —   | pF   | f = 10 MHz<br>C <sub>L</sub> = 0 |

## Power-up considerations

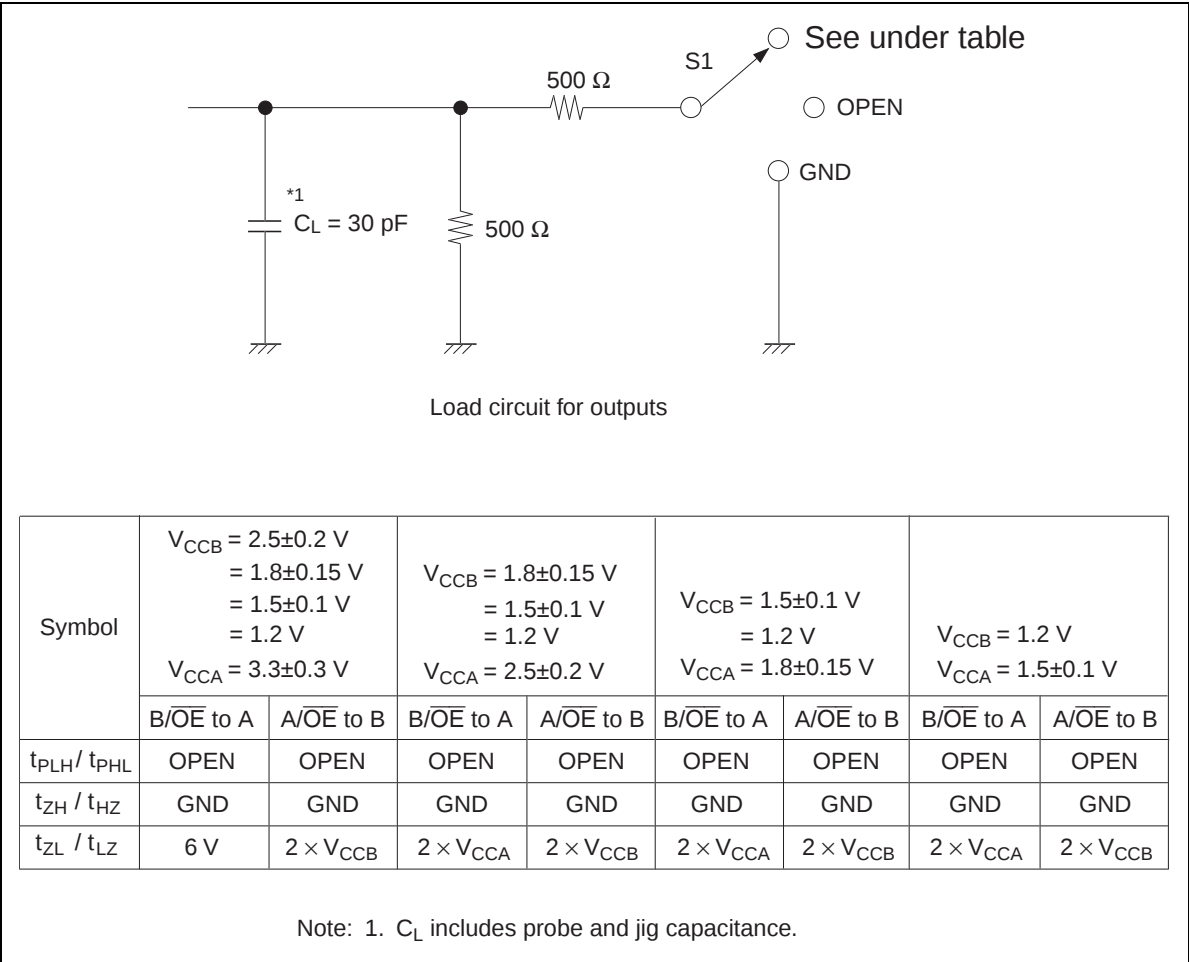
Level-translation devices offer an opportunity for successful mixed-voltage signal design.

A proper power-up sequence always should be followed to avoid excessive supply current, bus contention, oscillations, or other anomalies caused by improperly biased device pins.

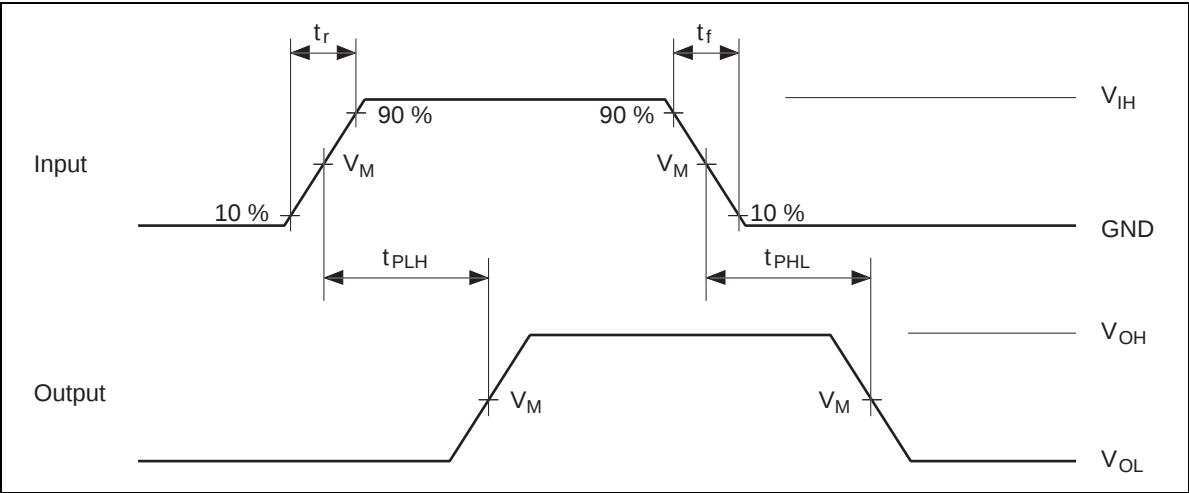
Take these precautions to guard against such power-up problems.

1. Connect ground before any supply voltage is applied.
2. Next, power up the control side of the device.  
(Power up of V<sub>CCB</sub> is first. Next power up is V<sub>CCA</sub>.)
3. Tie  $\overline{\text{OE}}$  to V<sub>CCB</sub> with a pullup resistor so that it ramps with V<sub>CCB</sub>.
4. Depending on the direction of the data path, DIR can be high or low.  
If DIR high is needed (A data to B bus), ramp it with V<sub>CCB</sub>. Otherwise, DIR low is needed (B data to A bus), ramp it with GND.

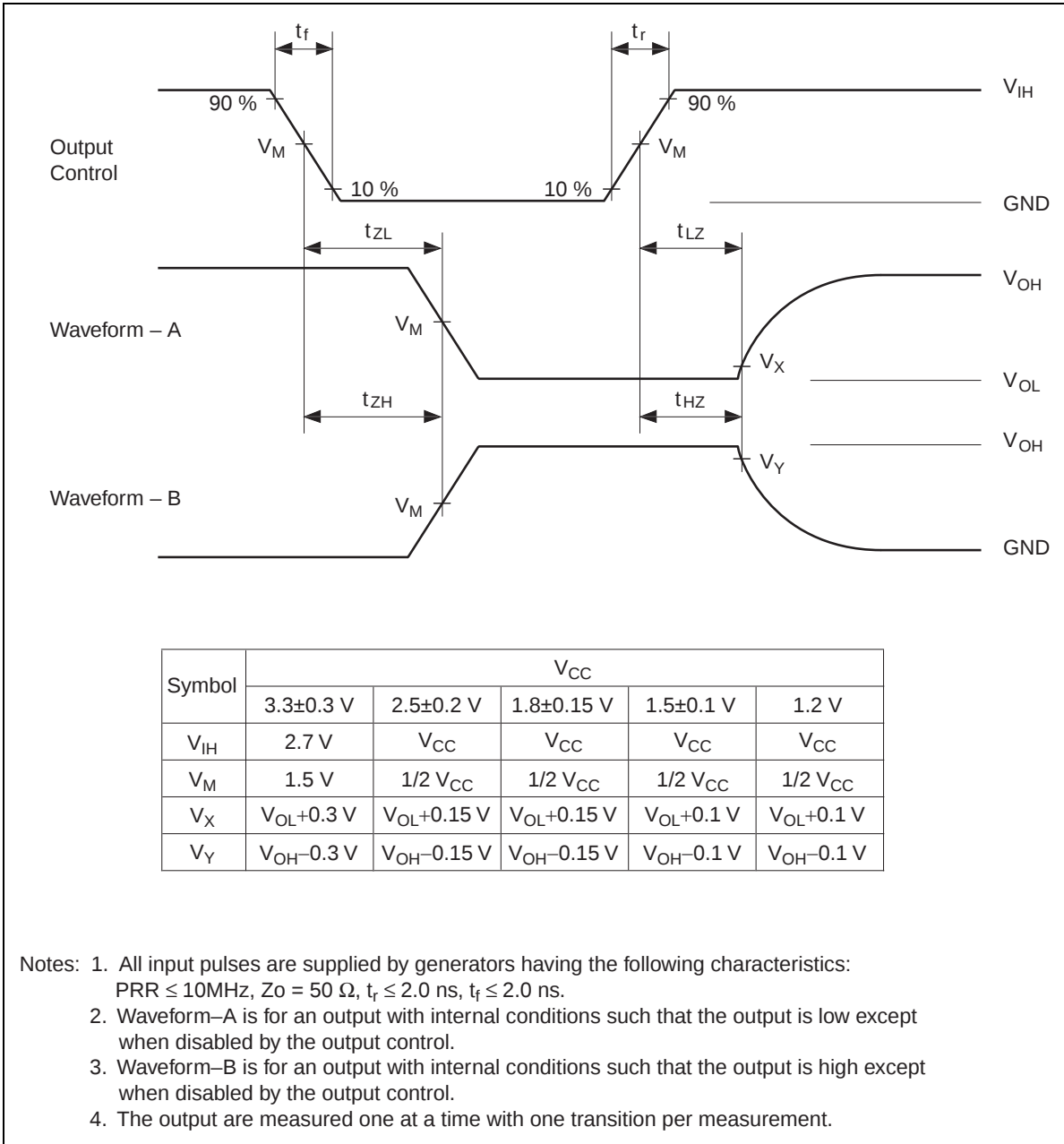
**Test Circuit**



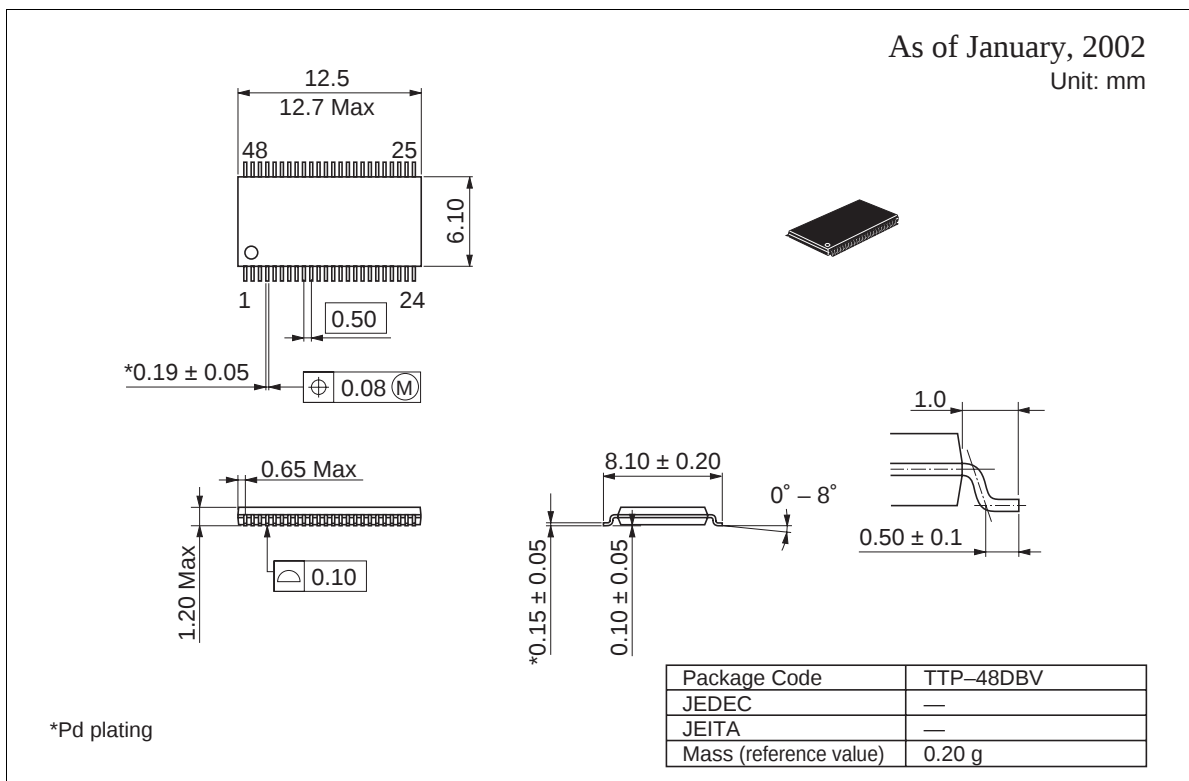
**Waveforms – 1**



**Waveforms – 2**



## Package Dimensions



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