# HD74ALVCH16500

## 18-bit Universal Bus Transceivers with 3-state Outputs

HITACHI

ADE-205-167A (Z)
2nd. Edition
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## Description

Data flow in each direction is controlled by output enable (OEAB and $\overline{\text{OEBA}}$), latch enable (LEAB and LEBA), and clock ($\overline{\text{CLKAB}}$ and $\overline{\text{CLKBA}}$) inputs. For A to B data flow, the device operates in the transparent mode when LEAB is high. When LEAB is low, the A data is latched if $\overline{\text{CLKAB}}$ is held at a high or low logic level. If LEAB is low, the A bus data is stored in the latch flip flop on the high to low transition of $\overline{\text{CLKAB}}$. Output enable OEAB is active high. When OEAB is high, the B port outputs are active. When OEAB is low, the B port outputs are in the high impedance state. Data flow for B to A is similar to that of A to B but uses $\overline{\text{OEBA}}$, LEBA, and $\overline{\text{CLKBA}}$. The output enables are complementary (OEAB is active high, and $\overline{\text{OEBA}}$ is active low). Active bus hold circuitry is provided to hold unused or floating data inputs at a valid logic level.

## Features

- $V_{CC}$ = 2.3 V to 3.6 V
- Typical $V_{OL}$ ground bounce < 0.8 V (@$V_{CC}$ = 3.3 V, Ta = 25°C)
- Typical $V_{OH}$ undershoot > 2.0 V (@$V_{CC}$ = 3.3 V, Ta = 25°C)
- High output current ±24 mA (@$V_{CC}$ = 3.0 V)
- Bus hold on data inputs eliminates the need for external pullup / pulldown resistors

## Function Table [*3]

| Inputs | | | | Output B |
|---|---|---|---|---|
| **OEAB** | **LEAB** | **$\overline{\text{CLKAB}}$** | **A** | |
| L | X | X | X | Z |
| H | H | X | L | L |
| H | H | X | H | H |
| H | L | ↓ | L | L |
| H | L | ↓ | H | H |
| H | L | H | X | $B_0$ [*1] |
| H | L | L | X | $B_0$ [*2] |

H : High level

L : Low level

X : Immaterial

Z : High impedance

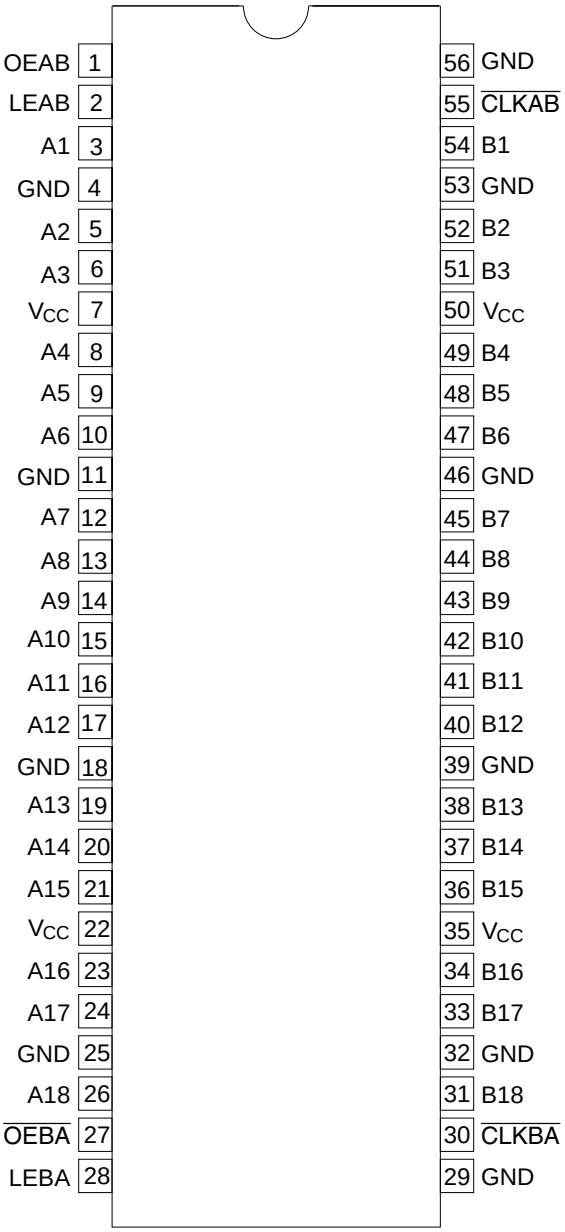
↓ : High to low transition

Notes: 1. Output level before the indicated steady state input conditions were established.

2. Output level before the indicated steady state input conditions were established, provided that $\overline{\text{CLKAB}}$ was low before LEAB went low.

3. A to B data flow is show; B to A flow is similar but uses $\overline{\text{OEBA}}$, LEBA, and $\overline{\text{CLKBA}}$.

## Pin Arrangement




(Top view)

## Absolute Maximum Ratings

| Item | Symbol | Ratings | Unit | Conditions |
|---|---|---|---|---|
| Supply voltage | $V_{CC}$ | –0.5 to 4.6 | V | |
| Input voltage [*1, 2] | $V_I$ | –0.5 to 4.6 | V | Except I/O ports |
| | | –0.5 to $V_{CC}$ +0.5 | | I/O ports |
| Output voltage [*1, 2] | $V_O$ | –0.5 to $V_{CC}$ +0.5 | V | |
| Input clamp current | $I_{IK}$ | –50 | mA | |
| Output clamp current | $I_{OK}$ | ±50 | mA | $V_O < 0$ or $V_O > V_{CC}$ |
| Continuous output current | $I_O$ | ±50 | mA | $V_O$ = 0 to $V_{CC}$ |
| | | ±100 | | |
| Maximum power dissipation at Ta = 55°C (in still air) [*3] | $P_T$ | 1 | W | TSSOP |
| Storage temperature | Tstg | –65 to 150 | °C | |

Notes: Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute maximum rated conditions for extended periods may affect device reliability.

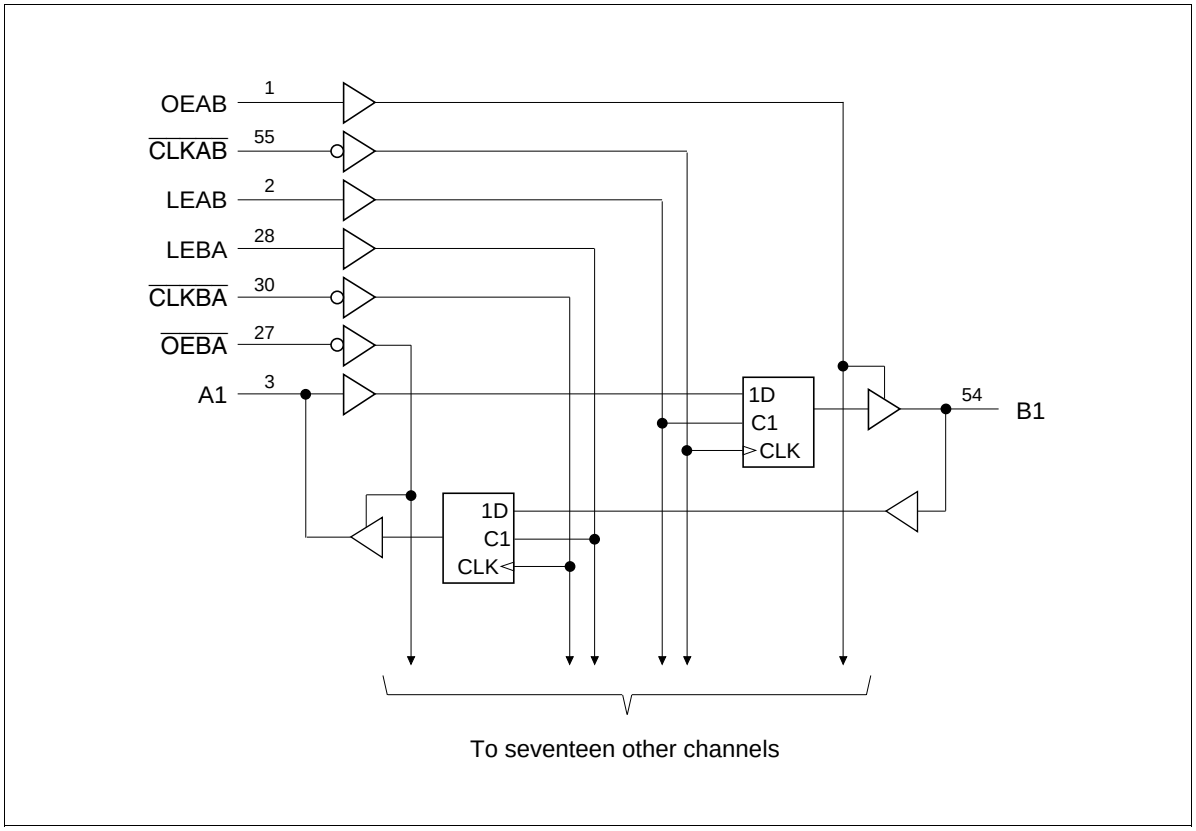
1. The input and output negative voltage ratings may be exceeded if the input and output clamp current ratings are observed.
2. This value is limited to 4.6 V maximum.
3. The maximum package power dissipation is calculated using a junction temperature of 150°C and a board trace length of 750 mils.

## Recommended Operating Conditions

| Item | Symbol | Min | Max | Unit | Conditions |
|---|---|---|---|---|---|
| Supply voltage | $V_{CC}$ | 2.3 | 3.6 | V | |
| Input voltage | $V_I$ | 0 | $V_{CC}$ | V | |
| Output voltage | $V_O$ | 0 | $V_{CC}$ | V | |
| High level output current | $I_{OH}$ | — | –12 | mA | $V_{CC}$ = 2.3 V |
| | | — | –12 | | $V_{CC}$ = 2.7 V |
| | | — | –24 | | $V_{CC}$ = 3.0 V |
| Low level output current | $I_{OL}$ | — | 12 | mA | $V_{CC}$ = 2.3 V |
| | | — | 12 | | $V_{CC}$ = 2.7 V |
| | | — | 24 | | $V_{CC}$ = 3.0 V |
| Input transition rise or fall rate | $\Delta t / \Delta v$ | 0 | 10 | ns / V | |
| Operating temperature | Ta | –40 | 85 | °C | |

Note: Unused control inputs must be held high or low to prevent them from floating.

## Logic Diagram



## Electrical Characteristics (Ta = –40 to 85°C)

| Item | Symbol | $V_{CC}$ (V) [*1] | Min | Max | Unit | Test Conditions |
|---|---|---|---|---|---|---|
| Input voltage | $V_{IH}$ | 2.3 to 2.7 | 1.7 | — | V | |
| | | 2.7 to 3.6 | 2.0 | — | | |
| | $V_{IL}$ | 2.3 to 2.7 | — | 0.7 | | |
| | | 2.7 to 3.6 | — | 0.8 | | |
| Output voltage | $V_{OH}$ | Min to Max | $V_{CC}$–0.2 | — | V | $I_{OH}$ = –100 µA |
| | | 2.3 | 2.0 | — | | $I_{OH}$ = –6 mA, $V_{IH}$ = 1.7 V |
| | | 2.3 | 1.7 | — | | $I_{OH}$ = –12 mA, $V_{IH}$ = 1.7 V |
| | | 2.7 | 2.2 | — | | $I_{OH}$ = –12 mA, $V_{IH}$ = 2.0 V |
| | | 3.0 | 2.4 | — | | $I_{OH}$ = –12 mA, $V_{IH}$ = 2.0 V |
| | | 3.0 | 2.0 | — | | $I_{OH}$ = –24 mA, $V_{IH}$ = 2.0 V |
| | $V_{OL}$ | Min to Max | — | 0.2 | | $I_{OL}$ = 100 µA |
| | | 2.3 | — | 0.4 | | $I_{OL}$ = 6 mA, $V_{IL}$ = 0.7 V |
| | | 2.3 | — | 0.7 | | $I_{OL}$ = 12 mA, $V_{IL}$ = 0.7 V |
| | | 2.7 | — | 0.4 | | $I_{OL}$ = 12 mA, $V_{IL}$ = 0.8 V |
| | | 3.0 | — | 0.55 | | $I_{OL}$ = 24 mA, $V_{IL}$ = 0.8 V |
| Input current | $I_{IN}$ | 3.6 | — | ±5 | µA | $V_{IN}$ = $V_{CC}$ or GND |
| | $I_{IN (hold)}$ | 2.3 | 45 | — | | $V_{IN}$ = 0.7 V |
| | | 2.3 | –45 | — | | $V_{IN}$ = 1.7 V |
| | | 3.0 | 75 | — | | $V_{IN}$ = 0.8 V |
| | | 3.0 | –75 | — | | $V_{IN}$ = 2.0 V |
| | | 3.6 | — | ±500 | | $V_{IN}$ = 0 to 3.6 V |
| Off state output current [*2] | $I_{OZ}$ | 3.6 | — | ±10 | µA | $V_{OUT}$ = $V_{CC}$ or GND |
| Quiescent supply current | $I_{CC}$ | 3.6 | — | 40 | µA | $V_{IN}$ = $V_{CC}$ or GND |
| | $\Delta I_{CC}$ | 3.0 to 3.6 | — | 750 | µA | $V_{IN}$ = one input at ($V_{CC}$–0.6) V, other inputs at $V_{CC}$ or GND |

Notes: 1. For conditions shown as Min or Max, use the appropriate values under recommended operating conditions.

2. For I/O ports, the parameter $I_{OZ}$ includes the input leakage current.

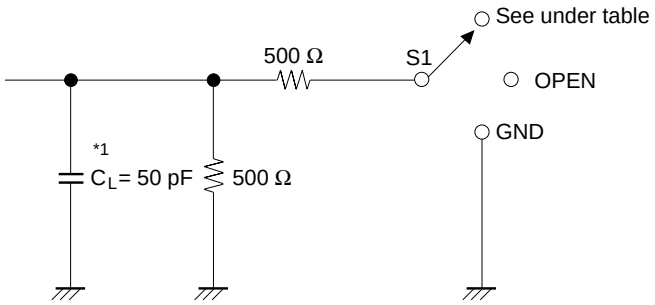
**Switching Characteristics** (Ta = –40 to 85°C)

| Item | Symbol | $V_{cc}$ (V) | Min | Typ | Max | Unit | FROM (Input) | TO (Output) |
|---|---|---|---|---|---|---|---|---|
| Maximum clock frequency | $f_{max}$ | 2.5±0.2 | 150 | — | — | MHz | | |
| | | 2.7 | 150 | — | — | | | |
| | | 3.3±0.3 | 150 | — | — | | | |
| Propagation delay time | $t_{PLH}$ | 2.5±0.2 | 1.0 | — | 5.1 | ns | A or B | B or A |
| | $t_{PHL}$ | 2.7 | — | — | 4.7 | | | |
| | | 3.3±0.3 | 1.0 | — | 3.9 | | | |
| | | 2.5±0.2 | 1.0 | — | 5.9 | | LEAB or | A or B |
| | | 2.7 | — | — | 5.5 | | LEBA | |
| | | 3.3±0.3 | 1.0 | — | 4.7 | | | |
| | | 2.5±0.2 | 1.0 | — | 6.1 | | $\overline{\text{CLKAB}}$ or | A or B |
| | | 2.7 | — | — | 6.6 | | $\overline{\text{CLKBA}}$ | |
| | | 3.3±0.3 | 1.1 | — | 5.5 | | | |
| Output enable time | $t_{ZH}$ | 2.5±0.2 | 1.0 | — | 5.7 | ns | $\overline{\text{OEAB}}$ | B |
| | $t_{ZL}$ | 2.7 | — | — | 5.4 | | | |
| | | 3.3±0.3 | 1.0 | — | 4.6 | | | |
| | | 2.5±0.2 | 1.0 | — | 6.1 | | $\overline{\text{OEBA}}$ | A |
| | | 2.7 | — | — | 6.2 | | | |
| | | 3.3±0.3 | 1.0 | — | 5.2 | | | |
| Output disable time | $t_{HZ}$ | 2.5±0.2 | 1.7 | — | 6.2 | ns | $\overline{\text{OEAB}}$ | B |
| | $t_{LZ}$ | 2.7 | — | — | 5.7 | | | |
| | | 3.3±0.3 | 1.5 | — | 5.0 | | | |
| | | 2.5±0.2 | 1.0 | — | 5.4 | | $\overline{\text{OEBA}}$ | A |
| | | 2.7 | — | — | 4.6 | | | |
| | | 3.3±0.3 | 1.0 | — | 4.3 | | | |
| Input capacitance | $C_{IN}$ | 3.3 | — | 4.0 | — | pF | Control inputs | |
| Output capacitance | $C_{IN/O}$ | 3.3 | — | 8.0 | — | pF | A or B ports | |

**Switching Characteristics** (Ta = –40 to 85°C) (Cont)

| Item | Symbol | $V_{cc}$ (V) | Min | Typ | Max | Unit | FROM (Input) |
|---|---|---|---|---|---|---|---|
| Setup time | $t_{su}$ | 2.5±0.2 | 1.7 | — | — | ns | Data before $\overline{CLK}\downarrow$ |
| | | 2.7 | 1.4 | — | — | | |
| | | 3.3±0.3 | 1.3 | — | — | | |
| | | 2.5±0.2 | 1.1 | — | — | | Data before LE↓ |
| | | 2.7 | 1.0 | — | — | | $\overline{CLK}$ "H" |
| | | 3.3±0.3 | 1.0 | — | — | | |
| | | 2.5±0.2 | 1.9 | — | — | | Data before LE↓ |
| | | 2.7 | 1.6 | — | — | | $\overline{CLK}$ "L" |
| | | 3.3±0.3 | 1.4 | — | — | | |
| Hold time | $t_h$ | 2.5±0.2 | 1.7 | — | — | ns | Data after $\overline{CLK}\downarrow$ |
| | | 2.7 | 1.6 | — | — | | |
| | | 3.3±0.3 | 1.3 | — | — | | |
| | | 2.5±0.2 | 2.0 | — | — | | Data after LE↓ |
| | | 2.7 | 1.8 | — | — | | $\overline{CLK}$ "H" |
| | | 3.3±0.3 | 1.5 | — | — | | |
| | | 2.5±0.2 | 1.6 | — | — | | Data after LE↓ |
| | | 2.7 | 1.5 | — | — | | $\overline{CLK}$ "L" |
| | | 3.3±0.3 | 1.2 | — | — | | |
| Pulse width | $t_w$ | 2.5±0.2 | 3.3 | — | — | ns | LE "H" |
| | | 2.7 | 3.3 | — | — | | |
| | | 3.3±0.3 | 3.3 | — | — | | |
| | | 2.5±0.2 | 3.3 | — | — | | $\overline{CLK}$ "H" or "L" |
| | | 2.7 | 3.3 | — | — | | |
| | | 3.3±0.3 | 3.3 | — | — | | |

• **Test Circuit**

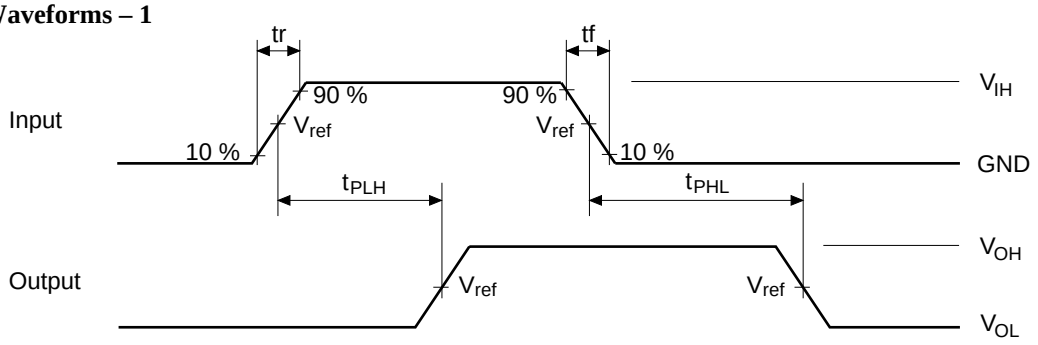



Load Circuit for Outputs

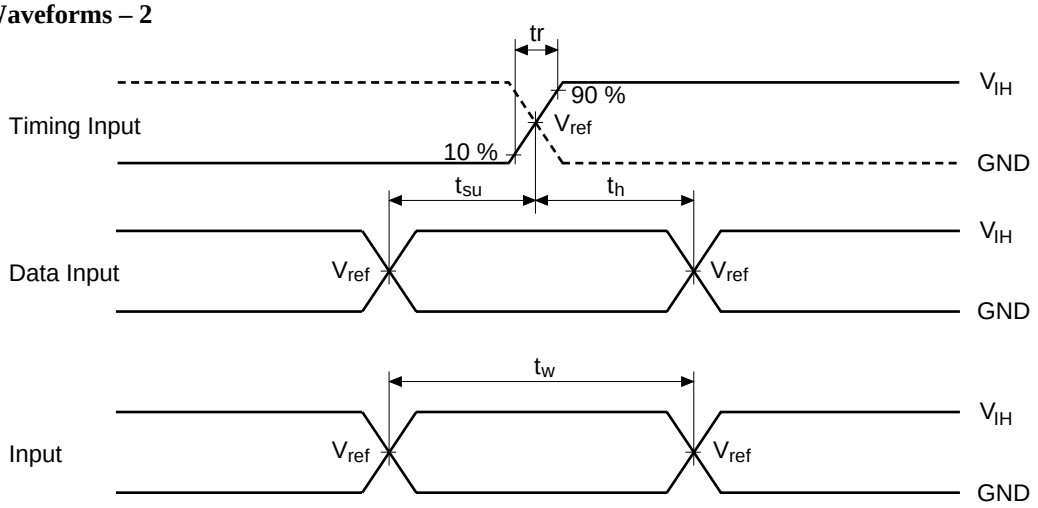
| Symbol | Vcc=2.5±0.2V | Vcc=2.7V, 3.3±0.3V |
|---|---|---|
| $t_{PLH}$/ $t_{PHL}$ | OPEN | OPEN |
| $t_{su}$ / $t_h$ / $t_w$ | | |
| $t_{ZH}$/ $t_{HZ}$ | GND | GND |
| $t_{ZL}$/ $t_{LZ}$ | 4.6 V | 6.0 V |

Note: 1. $C_L$ includes probe and jig capacitance.

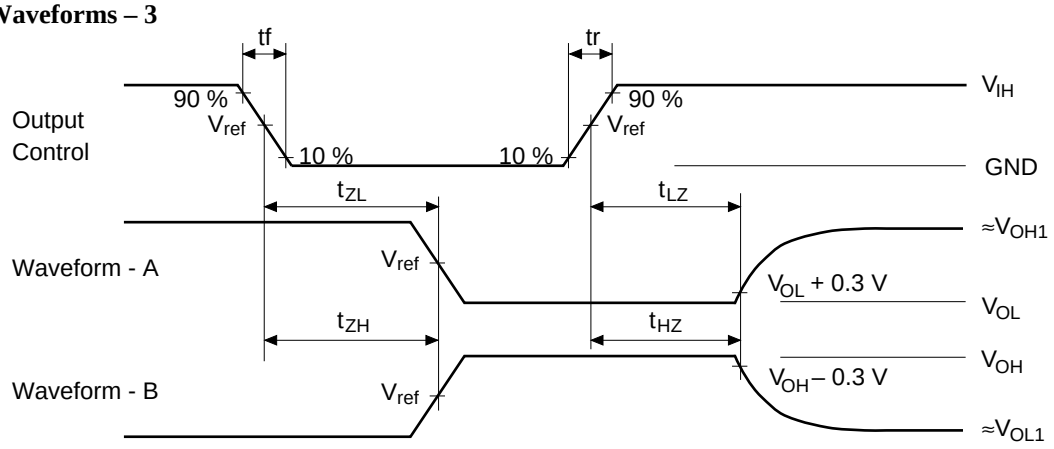
• **Waveforms – 1**




• **Waveforms – 2**



• **Waveforms – 3**

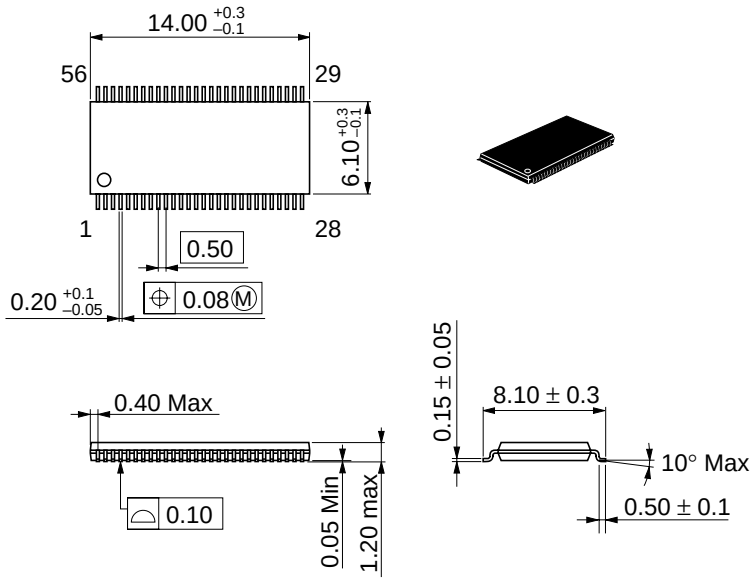



| TEST | Vcc=2.5±0.2V | Vcc=2.7V, 3.3±0.3V |
|---|---|---|
| $V_{IH}$ | 2.3 V | 2.7 V |
| $V_{ref}$ | 1.2 V | 1.5 V |
| $V_{OH1}$ | 2.3 V | 3.0 V |
| $V_{OL1}$ | GND | GND |

Notes: 1. All input pulses are supplied by generators having the following characteristics: PRR ≤ 10 MHz, Zo = 50 Ω, tr ≤ 2.5 ns, tf ≤ 2.5 ns.
2. Waveform – A is for an output with internal conditions such that the output is low except when disabled by the output control.
3. Waveform – B is for an output with internal conditions such that the output is high except when disabled by the output control.
4. The output are measured one at a time with one transition per measurement.

## Package Dimensions

**Unit : mm**

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