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# HD74ALVC162836

20-bit Universal Bus Driver with 3-state Outputs

## HITACHI

ADE-205-207 (Z)

Preliminary

1st. Edition

January 1998

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### Description

This 20-bit universal bus driver is designed for 2.3 V to 3.6 V  $V_{cc}$  operation.

Data flow from A to Y is controlled by the output enable ( $\overline{OE}$ ) input. The device operates in the transparent mode when the latch enable ( $\overline{LE}$ ) input is low. When  $\overline{LE}$  is high, the A data is latched if the clock (CLK) input is held at a high or low logic level. If  $\overline{LE}$  is high, the A data is stored in the latch flip flop on the low to high transition of CLK. When  $\overline{OE}$  is high, the outputs are in the high impedance state.

To ensure the high impedance state during power up or power down,  $\overline{OE}$  should be tied to  $V_{cc}$  through a pullup resistor; the minimum value of the resistor is determined by the current sinking capability of the driver.

All outputs, which are designed to sink up to 12 mA, include 26  $\Omega$  resistors to reduce overshoot and undershoot.

### Features

- $V_{cc} = 2.3 \text{ V to } 3.6 \text{ V}$
- Typical  $V_{ol}$  ground bounce  $< 0.8 \text{ V}$  ( $@V_{cc} = 3.3 \text{ V}$ ,  $T_a = 25^\circ\text{C}$ )
- Typical  $V_{oh}$  undershoot  $> 2.0 \text{ V}$  ( $@V_{cc} = 3.3 \text{ V}$ ,  $T_a = 25^\circ\text{C}$ )
- High output current  $\pm 12 \text{ mA}$  ( $@V_{cc} = 3.0 \text{ V}$ )
- All outputs have equivalent 26  $\Omega$  series resistors, so no external resistors are required.

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**Function Table**

| Inputs          |                 |            |   | Output Y   |
|-----------------|-----------------|------------|---|------------|
| $\overline{OE}$ | $\overline{LE}$ | CLK        | A |            |
| H               | X               | X          | X | Z          |
| L               | L               | X          | L | L          |
| L               | L               | X          | H | H          |
| L               | H               | $\uparrow$ | L | L          |
| L               | H               | $\uparrow$ | H | H          |
| L               | H               | L or H     | X | $Y_0^{*1}$ |

H : High level

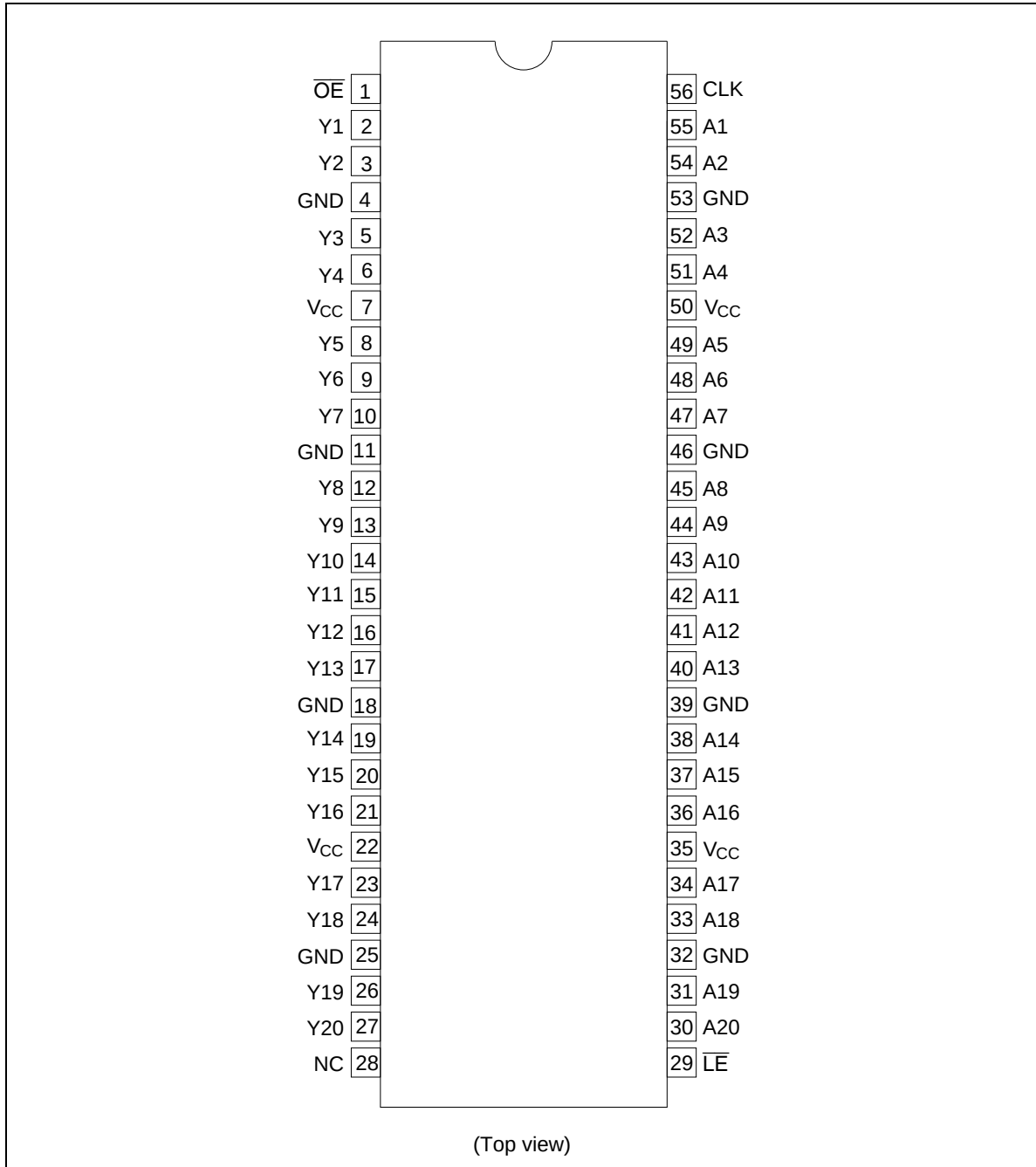
L : Low level

X : Immaterial

Z : High impedance

$\uparrow$  : Low to high transition

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

**Pin Arrangement**


## HD74ALVC162836

### Absolute Maximum Ratings

| Item                                                                               | Symbol                | Ratings                | Unit | Conditions                  |
|------------------------------------------------------------------------------------|-----------------------|------------------------|------|-----------------------------|
| Supply voltage                                                                     | $V_{CC}$              | −0.5 to 4.6            | V    |                             |
| Input voltage <sup>*1</sup>                                                        | $V_I$                 | −0.5 to 4.6            | V    |                             |
| Output voltage <sup>*1,2</sup>                                                     | $V_O$                 | −0.5 to $V_{CC} + 0.5$ | V    |                             |
| Input clamp current                                                                | $I_{IK}$              | −50                    | mA   | $V_I < 0$                   |
| 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 $V_{CC}$       |
| $V_{CC}$ , GND current / pin                                                       | $I_{CC}$ or $I_{GND}$ | ±100                   | mA   |                             |
| Maximum power dissipation at $T_a = 55^\circ\text{C}$ (in still air) <sup>*3</sup> | $P_T$                 | 1                      | W    | TSSOP                       |
| Storage temperature                                                                | $T_{stg}$             | −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.

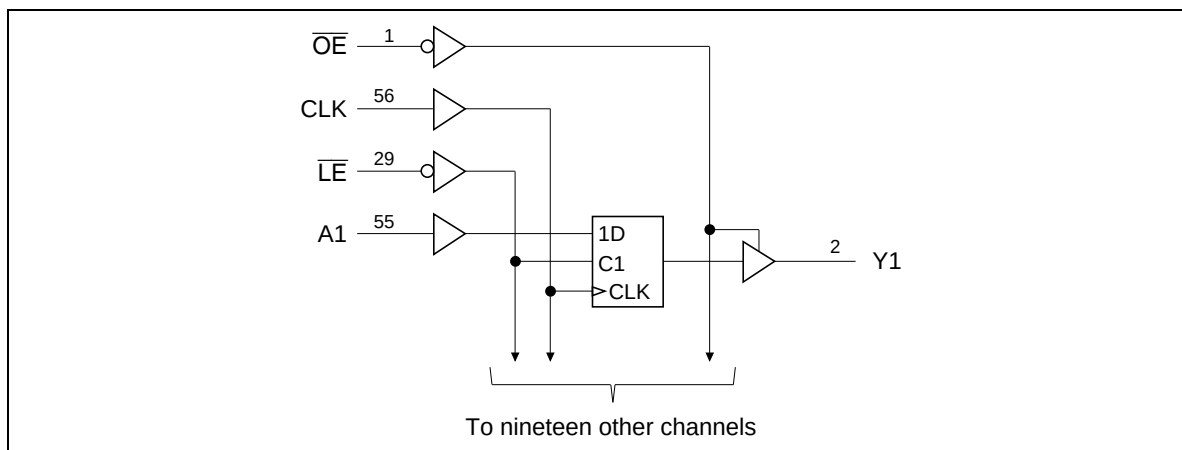
1. The input and output negative voltage ratings may be exceeded if the input and output clamp current ratings are observed.
2. This value is limited to 4.6 V maximum.
3. The maximum package power dissipation is calculated using a junction temperature of  $150^\circ\text{C}$  and a board trace length 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          | $I_{OH}$              | —   | −6       | mA     | $V_{CC} = 2.3\text{ V}$ |
|                                    |                       | —   | −8       |        | $V_{CC} = 2.7\text{ V}$ |
|                                    |                       | —   | −12      |        | $V_{CC} = 3.0\text{ V}$ |
| Low level output current           | $I_{OL}$              | —   | 6        | mA     | $V_{CC} = 2.3\text{ V}$ |
|                                    |                       | —   | 8        |        | $V_{CC} = 2.7\text{ V}$ |
|                                    |                       | —   | 12       |        | $V_{CC} = 3.0\text{ V}$ |
| Input transition rise or fall rate | $\Delta t / \Delta v$ | 0   | 10       | ns / V |                         |
| Operating temperature              | $T_a$                 | −40 | 85       | °C     |                         |

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

Logic Diagram



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

| Item                     | Symbol           | V <sub>cc</sub> (V) | Min                  | Max  | Unit | Test Conditions                                                                                 |
|--------------------------|------------------|---------------------|----------------------|------|------|-------------------------------------------------------------------------------------------------|
| Input voltage            | V <sub>IH</sub>  | 2.3 to 2.7          | 1.7                  | —    | V    |                                                                                                 |
|                          |                  | 2.7 to 3.6          | 2.0                  | —    |      |                                                                                                 |
|                          | V <sub>IL</sub>  | 2.3 to 2.7          | —                    | 0.7  |      |                                                                                                 |
|                          |                  | 2.7 to 3.6          | —                    | 0.8  |      |                                                                                                 |
| Output voltage           | V <sub>OH</sub>  | 2.3 to 3.6          | V <sub>cc</sub> -0.2 | —    | V    | I <sub>OH</sub> = -100 µA                                                                       |
|                          |                  | 2.3                 | 1.9                  | —    |      | I <sub>OH</sub> = -4 mA, V <sub>IH</sub> = 1.7 V                                                |
|                          |                  | 2.3                 | 1.7                  | —    |      | I <sub>OH</sub> = -6 mA, V <sub>IH</sub> = 1.7 V                                                |
|                          |                  | 3.0                 | 2.4                  | —    |      | I <sub>OH</sub> = -6 mA, V <sub>IH</sub> = 2.0 V                                                |
|                          |                  | 2.7                 | 2.0                  | —    |      | I <sub>OH</sub> = -8 mA, V <sub>IH</sub> = 2.0 V                                                |
|                          |                  | 3.0                 | 2.0                  | —    |      | I <sub>OH</sub> = -12 mA, V <sub>IH</sub> = 2.0 V                                               |
|                          | V <sub>OL</sub>  | 2.3 to 3.6          | —                    | 0.2  |      | I <sub>OL</sub> = 100 µA                                                                        |
|                          |                  | 2.3                 | —                    | 0.4  |      | I <sub>OL</sub> = 4 mA, V <sub>IL</sub> = 0.7 V                                                 |
|                          |                  | 2.3                 | —                    | 0.55 |      | I <sub>OL</sub> = 6 mA, V <sub>IL</sub> = 0.7 V                                                 |
|                          |                  | 3.0                 | —                    | 0.55 |      | I <sub>OL</sub> = 6 mA, V <sub>IL</sub> = 0.8 V                                                 |
|                          |                  | 2.7                 | —                    | 0.6  |      | I <sub>OL</sub> = 8 mA, V <sub>IL</sub> = 0.8 V                                                 |
|                          |                  | 3.0                 | —                    | 0.8  |      | I <sub>OL</sub> = 12 mA, V <sub>IL</sub> = 0.8 V                                                |
| Input current            | I <sub>IN</sub>  | 3.6                 | —                    | ±5   | µA   | V <sub>IN</sub> = V <sub>cc</sub> or GND                                                        |
| Off state output current | I <sub>OZ</sub>  | 3.6                 | —                    | ±10  | µA   | V <sub>OUT</sub> = V <sub>cc</sub> or GND                                                       |
| Quiescent supply current | I <sub>cc</sub>  | 3.6                 | —                    | 40   | µA   | V <sub>IN</sub> = V <sub>cc</sub> or GND                                                        |
|                          | ΔI <sub>cc</sub> | 3.0 to 3.6          | —                    | 750  | µA   | V <sub>IN</sub> = one input at (V <sub>cc</sub> -0.6) V, other inputs at V <sub>cc</sub> or GND |

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### Switching Characteristics (Ta = -40 to 85°C)

| Item                                     | Symbol           | V <sub>cc</sub> (V) | Min | Typ | Max | Unit | FROM<br>(Input)        | TO<br>(Output) |  |  |
|------------------------------------------|------------------|---------------------|-----|-----|-----|------|------------------------|----------------|--|--|
| Maximum clock frequency f <sub>max</sub> |                  | 2.5±0.2             | 150 | —   | —   | MHz  |                        |                |  |  |
|                                          |                  | 2.7                 | 150 | —   | —   |      |                        |                |  |  |
|                                          |                  | 3.3±0.3             | 150 | —   | —   |      |                        |                |  |  |
| Propagation delay time                   | t <sub>PLH</sub> | 2.5±0.2             | 1.0 | —   | 3.8 | ns   | A                      | Y              |  |  |
|                                          | t <sub>PHL</sub> | 2.7                 | —   | —   | 4.6 |      |                        |                |  |  |
|                                          |                  | 3.3±0.3             | 1.2 | —   | 4.0 |      |                        |                |  |  |
|                                          |                  | 2.5±0.2             | 1.1 | —   | 4.9 |      | $\overline{\text{LE}}$ | Y              |  |  |
|                                          |                  | 2.7                 | —   | —   | 6.1 |      |                        |                |  |  |
|                                          |                  | 3.3±0.3             | 1.4 | —   | 5.1 |      |                        |                |  |  |
|                                          |                  | 2.5±0.2             | 1.0 | —   | 4.5 |      | CLK                    | Y              |  |  |
|                                          |                  | 2.7                 | —   | —   | 5.5 |      |                        |                |  |  |
|                                          |                  | 3.3±0.3             | 1.1 | —   | 5.0 |      |                        |                |  |  |
| Output enable time                       | t <sub>ZH</sub>  | 2.5±0.2             | 1.1 | —   | 5.5 | ns   | OE                     | Y              |  |  |
|                                          | t <sub>ZL</sub>  | 2.7                 | —   | —   | 6.5 |      |                        |                |  |  |
|                                          |                  | 3.3±0.3             | 1.2 | —   | 5.5 |      |                        |                |  |  |
| Output disable time                      | t <sub>HZ</sub>  | 2.5±0.2             | 1.0 | —   | 4.2 | ns   | OE                     | Y              |  |  |
|                                          | t <sub>LZ</sub>  | 2.7                 | —   | —   | 5.2 |      |                        |                |  |  |
|                                          |                  | 3.3±0.3             | 1.7 | —   | 5.1 |      |                        |                |  |  |
| Input capacitance                        | C <sub>IN</sub>  | 3.3                 | —   | 5.5 | —   | pF   | Control inputs         |                |  |  |
|                                          |                  | 3.3                 | —   | 6.0 | —   |      | Data inputs            |                |  |  |
| Output capacitance                       | C <sub>O</sub>   | 3.3                 | —   | 8.0 | —   | pF   | Outputs                |                |  |  |

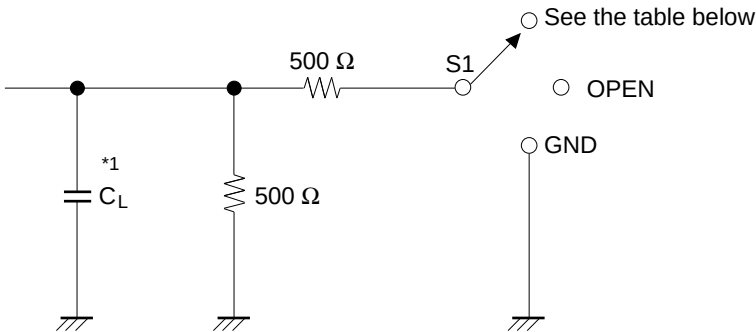
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### Switching Characteristics (Ta = -40 to 85°C) (cont)

| Item        | Symbol          | V <sub>cc</sub> (V) | Min | Typ | Max | Unit | FROM (Input)                  |
|-------------|-----------------|---------------------|-----|-----|-----|------|-------------------------------|
| Setup time  | t <sub>su</sub> | 2.5±0.2             | 1.4 | —   | —   | ns   | Data before CLK↑              |
|             |                 | 2.7                 | 1.7 | —   | —   |      |                               |
|             |                 | 3.3±0.3             | 1.5 | —   | —   |      |                               |
|             |                 | 2.5±0.2             | 1.2 | —   | —   |      | Data before $\overline{LE}$ ↑ |
|             |                 | 2.7                 | 1.6 | —   | —   |      | CLK "H"                       |
|             |                 | 3.3±0.3             | 1.3 | —   | —   |      |                               |
|             |                 | 2.5±0.2             | 1.4 | —   | —   |      | Data before $\overline{LE}$ ↑ |
|             |                 | 2.7                 | 1.5 | —   | —   |      | CLK "L"                       |
|             |                 | 3.3±0.3             | 1.2 | —   | —   |      |                               |
| Hold time   | t <sub>h</sub>  | 2.5±0.2             | 0.9 | —   | —   | ns   | Data after CLK↑               |
|             |                 | 2.7                 | 0.9 | —   | —   |      |                               |
|             |                 | 3.3±0.3             | 0.9 | —   | —   |      |                               |
|             |                 | 2.5±0.2             | 1.1 | —   | —   |      | Data after $\overline{LE}$ ↑  |
|             |                 | 2.7                 | 1.1 | —   | —   |      | CLK "H" or "L"                |
|             |                 | 3.3±0.3             | 1.1 | —   | —   |      |                               |
| Pulse width | t <sub>w</sub>  | 2.5±0.2             | 3.3 | —   | —   | ns   | $\overline{LE}$ "L"           |
|             |                 | 2.7                 | 3.3 | —   | —   |      |                               |
|             |                 | 3.3±0.3             | 3.3 | —   | —   |      |                               |
|             |                 | 2.5±0.2             | 3.3 | —   | —   |      | CLK "H" or "L"                |
|             |                 | 2.7                 | 3.3 | —   | —   |      |                               |
|             |                 | 3.3±0.3             | 3.3 | —   | —   |      |                               |



Test Circuit



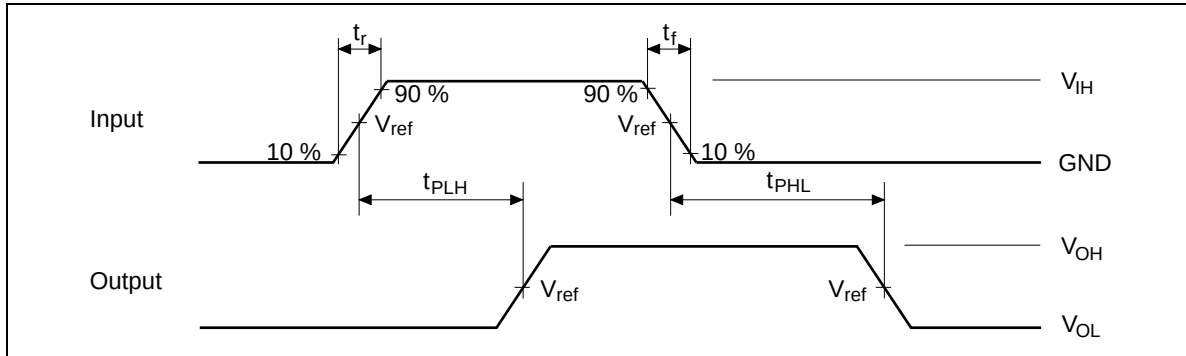
Load Circuit for Outputs

| Symbol                                          | V <sub>CC</sub> =2.5±0.2V | V <sub>CC</sub> =2.7V,<br>3.3±0.3V |
|-------------------------------------------------|---------------------------|------------------------------------|
| t <sub>PLH</sub> /t <sub>PHL</sub>              | OPEN                      | OPEN                               |
| t <sub>su</sub> /t <sub>h</sub> /t <sub>w</sub> |                           |                                    |
| t <sub>ZH</sub> /t <sub>HZ</sub>                | GND                       | GND                                |
| t <sub>ZL</sub> /t <sub>LZ</sub>                | 2 × V <sub>CC</sub>       | 6.0 V                              |
| C <sub>L</sub>                                  | 30 pF                     | 50 pF                              |

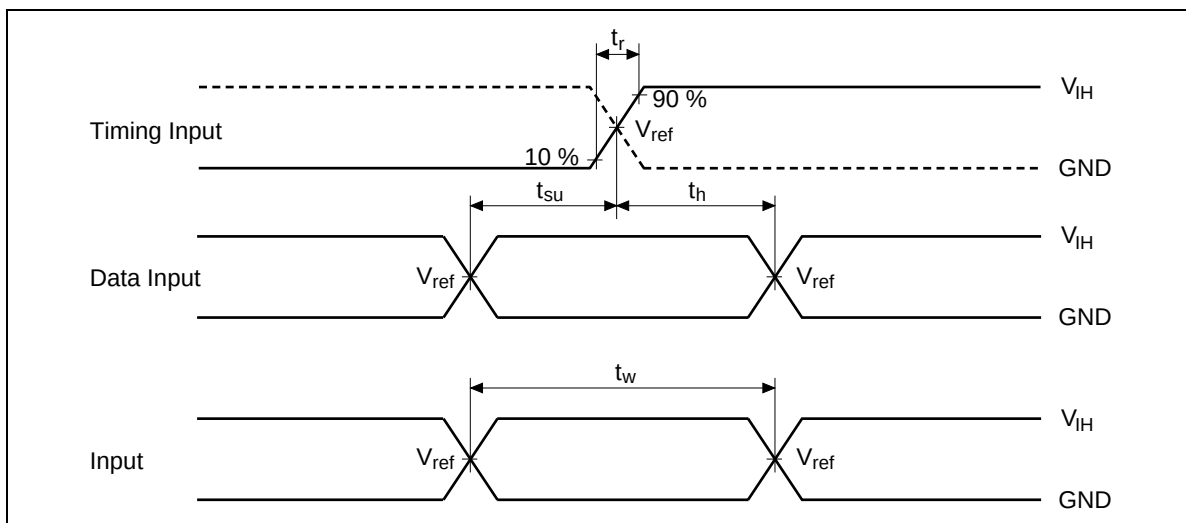
Note: 1. C<sub>L</sub> includes probe and jig capacitance.

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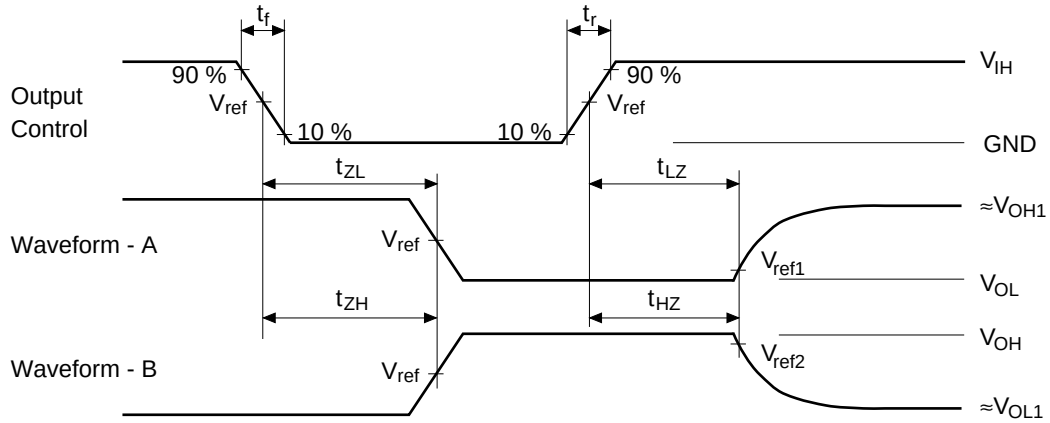
### Waveforms – 1



### Waveforms – 2



Waveforms – 3



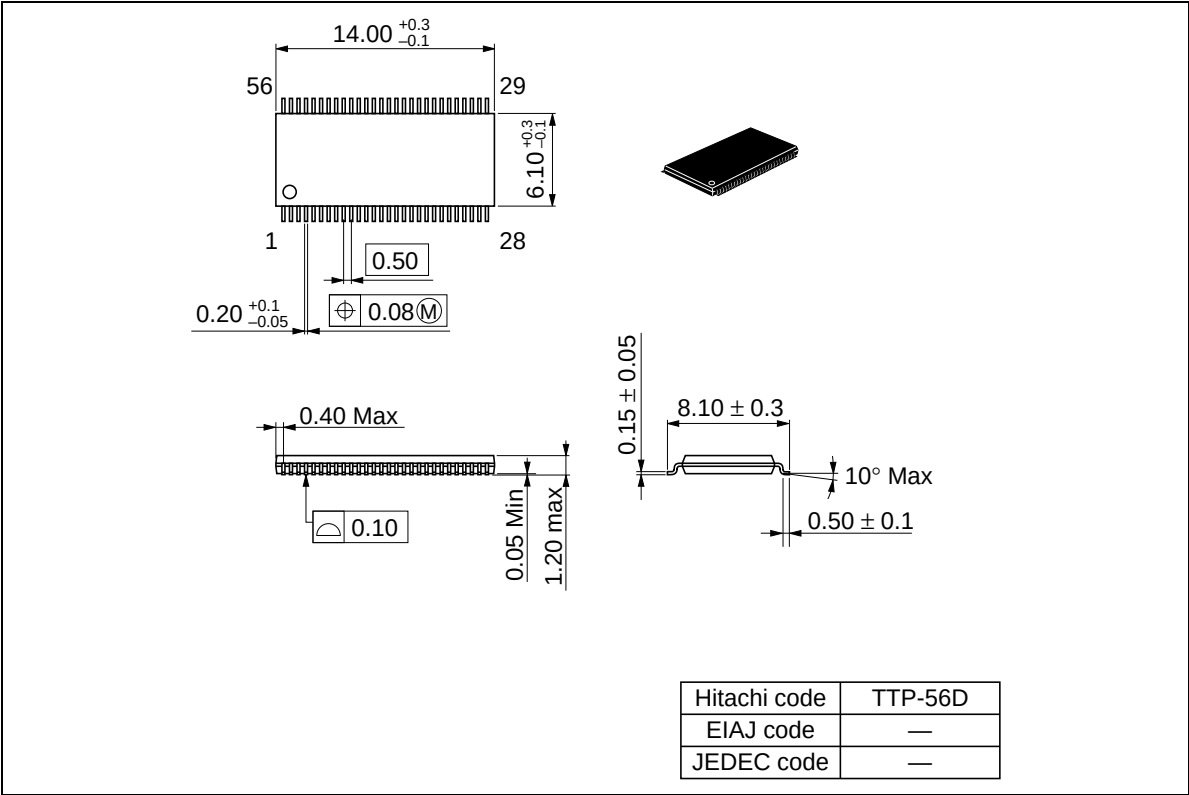
| TEST       | $V_{CC}=2.5\pm0.2V$ | $V_{CC}=2.7V, 3.3\pm0.3V$ |
|------------|---------------------|---------------------------|
| $V_{IH}$   | $V_{CC}$            | 2.7 V                     |
| $V_{ref}$  | $1/2 V_{CC}$        | 1.5 V                     |
| $V_{ref1}$ | $V_{OL} + 0.15 V$   | $V_{OL} + 0.3 V$          |
| $V_{ref2}$ | $V_{OH} - 0.15 V$   | $V_{OH} - 0.3 V$          |
| $V_{OH1}$  | $V_{CC}$            | 3.0 V                     |
| $V_{OL1}$  | GND                 | GND                       |

- Notes:
1. All input pulses are supplied by generators having the following characteristics :  
 $PRR \leq 10 \text{ MHz}$ ,  $Z_o = 50 \Omega$ ,  $t_f \leq 2.0 \text{ ns}$ ,  $t_r \leq 2.0 \text{ ns}$ . ( $V_{CC} = 2.5\pm0.2 \text{ V}$ )  
 $PRR \leq 10 \text{ MHz}$ ,  $Z_o = 50 \Omega$ ,  $t_f \leq 2.5 \text{ ns}$ ,  $t_r \leq 2.5 \text{ ns}$ . ( $V_{CC} = 2.7 \text{ V}, 3.3\pm0.3 \text{ V}$ )
  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.

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Package Dimensions

Unit : mm



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# HITACHI

## **Hitachi, Ltd.**

Semiconductor & IC Div.  
Nippon Bldg., 2-6-2, Ohte-machi, Chiyoda-ku, Tokyo 100, Japan  
Tel: Tokyo (03) 3270-2111  
Fax: (03) 3270-5109

### **For further information write to:**

Hitachi America, Ltd.  
Semiconductor & IC Div.  
2000 Sierra Point Parkway  
Brisbane, CA. 94005-1835  
U S A  
Tel: 415-589-8300  
Fax: 415-583-4207

Hitachi Europe GmbH  
Electronic Components Group  
Continental Europe  
Dornacher Straße 3  
D-85622 Feldkirchen  
München  
Tel: 089-9 91 80-0  
Fax: 089-9 29 30 00

Hitachi Europe Ltd.  
Electronic Components Div.  
Northern Europe Headquarters  
Whitebrook Park  
Lower Cookham Road  
Maidenhead  
Berkshire SL6 8YA  
United Kingdom  
Tel: 0628-585000  
Fax: 0628-778322

Hitachi Asia Pte. Ltd.  
16 Collyer Quay #20-00  
Hitachi Tower  
Singapore 0104  
Tel: 535-2100  
Fax: 535-1533

Hitachi Asia (Hong Kong) Ltd.  
Unit 706, North Tower,  
World Finance Centre,  
Harbour City, Canton Road  
Tsim Sha Tsui, Kowloon  
Hong Kong  
Tel: 27359218  
Fax: 27306071