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# HD74ALVCH16334

16-bit Universal Bus Driver with 3-state Outputs

## HITACHI

ADE-205-212 (Z)  
Preliminary  
1st. Edition  
December 1997

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### Description

This HD74ALVCH16334 is a 16-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.

Active bus hold circuitry is provided to hold unused or floating inputs at a valid logic level.

### 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  $\pm 24 \text{ mA}$  (@ $V_{CC} = 3.0 \text{ V}$ )
- Bus hold on data inputs eliminates the need for external pullup / pulldown resistors

**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	↑	L	L
L	H	↑	H	H
L	H	L or H	X	$Y_0^{*1}$

H : High level

L : Low level

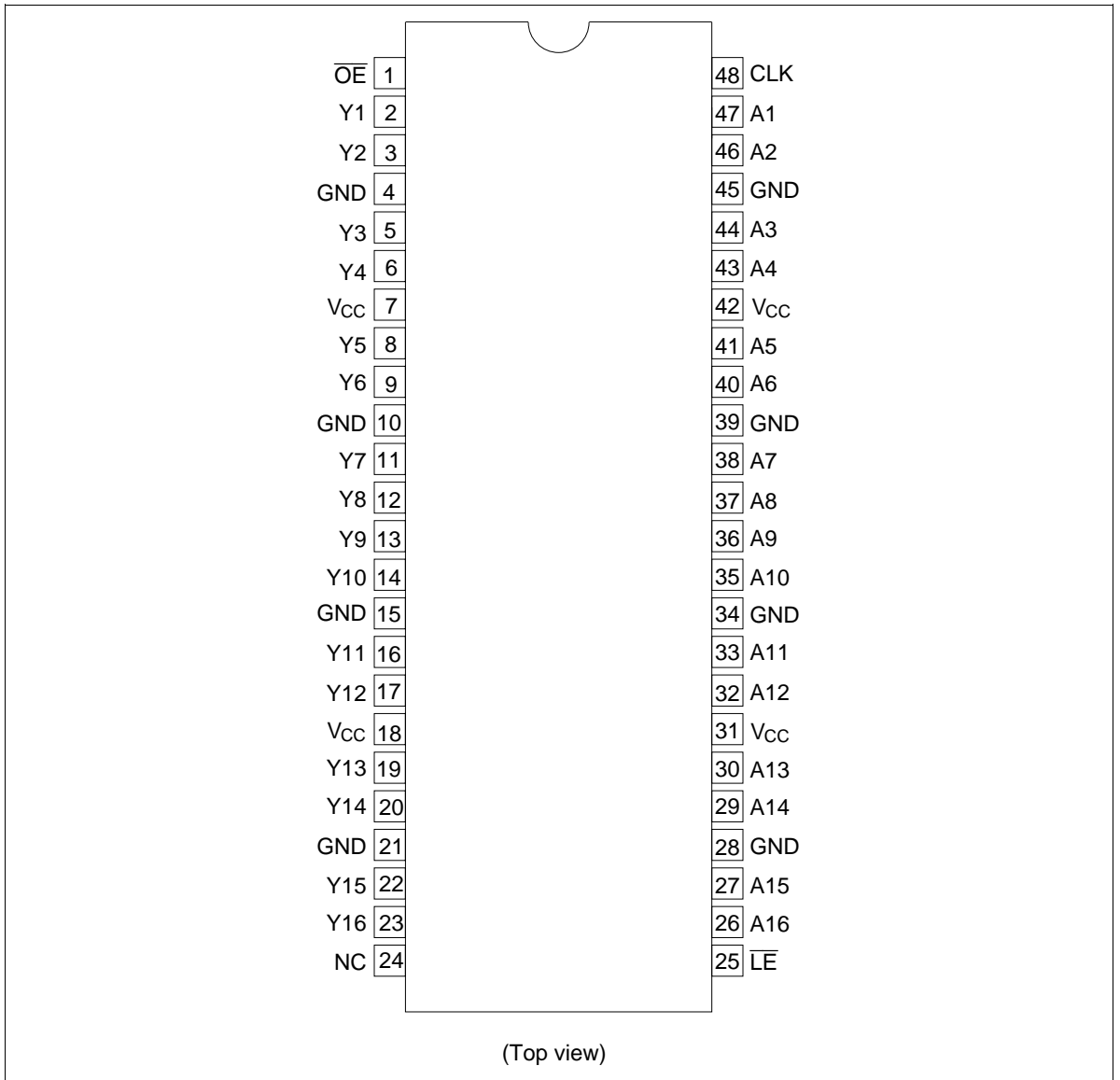
X : Immaterial

Z : High impedance

↑ : Low to high transition

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

Pin Arrangement



## 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	$I_{OK}$	$\pm 50$	mA	$V_O < 0$ or $V_O > V_{CC}$
Continuous output current	$I_O$	$\pm 50$	mA	$V_O = 0$ to $V_{CC}$
$V_{CC}$ , GND current / pin	$I_{CC}$ or $I_{GND}$	$\pm 100$	mA	
Maximum power dissipation at $T_a = 55^\circ\text{C}$ (in still air) <sup>3</sup>	$P_T$	0.85	W	TSSOP
Storage temperature	$T_{stg}$	-65 to 150	$^\circ\text{C}$	

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.

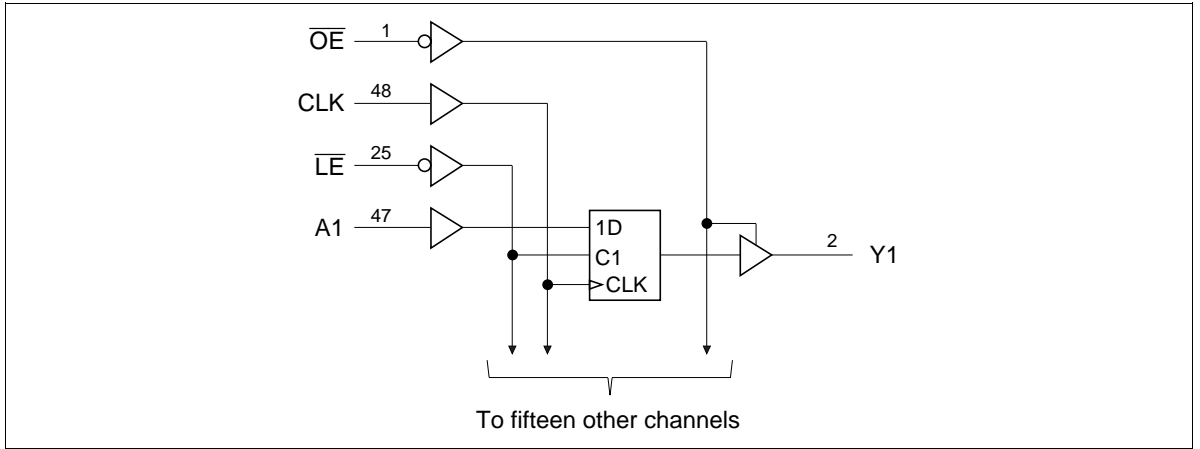
1. The input and output negative voltage ratings may be exceeded if the input and output clamp current ratings are observed.
2. This value is limited to 4.6 V maximum.
3. The maximum package power dissipation is calculated using a junction temperature of  $150^\circ\text{C}$  and a board trace length 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	$I_{OH}$	—	-12	mA	$V_{CC} = 2.3\text{ V}$
		—	-12		$V_{CC} = 2.7\text{ V}$
		—	-24		$V_{CC} = 3.0\text{ V}$
Low level output current	$I_{OL}$	—	12	mA	$V_{CC} = 2.3\text{ V}$
		—	12		$V_{CC} = 2.7\text{ V}$
		—	24		$V_{CC} = 3.0\text{ V}$
Input transition rise or fall rate	$\Delta t / \Delta v$	0	10	ns / V	
Operating temperature	$T_a$	-40	85	$^\circ\text{C}$	

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

Logic Diagram



# HD74ALVCH16334

## 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	2.0	—		I <sub>OH</sub> = -6 mA, V <sub>IH</sub> = 1.7 V
		2.3	1.7	—		I <sub>OH</sub> = -12 mA, V <sub>IH</sub> = 1.7 V
		2.7	2.2	—		I <sub>OH</sub> = -12 mA, V <sub>IH</sub> = 2.0 V
		3.0	2.4	—		I <sub>OH</sub> = -12 mA, V <sub>IH</sub> = 2.0 V
		3.0	2.0	—		I <sub>OH</sub> = -24 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> = 6 mA, V <sub>IL</sub> = 0.7 V
		2.3	—	0.7		I <sub>OL</sub> = 12 mA, V <sub>IL</sub> = 0.7 V
		2.7	—	0.4		I <sub>OL</sub> = 12 mA, V <sub>IL</sub> = 0.8 V
		3.0	—	0.55		I <sub>OL</sub> = 24 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
		2.3	45	—		V <sub>IN</sub> = 0.7 V
		2.3	-45	—		V <sub>IN</sub> = 1.7 V
		3.0	75	—		V <sub>IN</sub> = 0.8 V
		3.0	-75	—		V <sub>IN</sub> = 2.0 V
		3.6	—	±500		V <sub>IN</sub> = 0 to 3.6 V *1
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

Note: 1. This is the bus hold maximum dynamic current required to switch the input from one state to another.

**Switching Characteristics** ( $T_a = -40$  to  $85^\circ\text{C}$ )

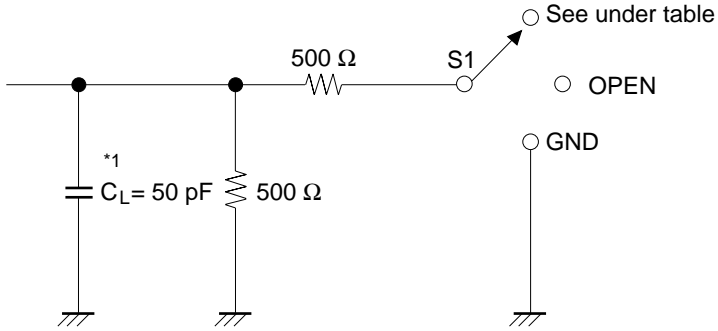
Item	Symbol	$V_{CC}$ (V)	Min	Typ	Max	Unit	FROM (Input)	TO (Output)	
Maximum clock frequency	$f_{max}$	2.5±0.2	150	—	—	MHz			
		2.7	150	—	—				
		3.3±0.3	150	—	—				
Propagation delay time	$t_{PLH}$	2.5±0.2	1.0	—	3.7	ns	A	Y	
		2.7	—	—	3.6				
		3.3±0.3	1.1	—	3.3				
	$t_{PHL}$	2.5±0.2	1.0	—	4.8		$\overline{LE}$	Y	
		2.7	—	—	4.4				
		3.3±0.3	1.3	—	4.4				
			2.5±0.2	1.0	—	4.4		CLK	Y
			2.7	—	—	4.1			
			3.3±0.3	1.0	—	4.1			
Output enable time	$t_{ZH}$	2.5±0.2	1.0	—	5.4	ns	$\overline{OE}$	Y	
		2.7	—	—	4.6				
		3.3±0.3	1.1	—	4.6				
Output disable time	$t_{HZ}$	2.5±0.2	1.0	—	4.1	ns	$\overline{OE}$	Y	
		2.7	—	—	4.4				
		3.3±0.3	1.7	—	4.4				
Input capacitance	$C_{IN}$	3.3	—	5.5	—	pF	Control inputs		
		3.3	—	6.0	—		Data inputs		
Output capacitance	$C_O$	3.3	—	8.0	—	pF	Outputs		

## 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	—	—		
		3.3±0.3	1.3	—	—		
		2.5±0.2	1.4	—	—		Data before $\overline{LE}$ ↑
		2.7	1.5	—	—		
		3.3±0.3	1.2	—	—		
Hold time	t <sub>h</sub>	2.5±0.2	0.9	—	—	ns	Data after CLK↑
		2.7	0.8	—	—		
		3.3±0.3	0.9	—	—		
		2.5±0.2	1.2	—	—		Data after $\overline{LE}$ ↑
		2.7	1.1	—	—		
		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



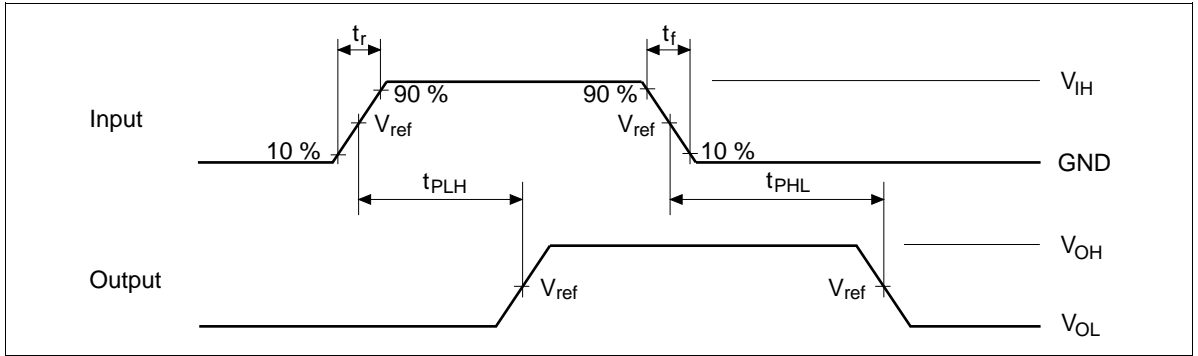
Load Circuit for Outputs

Symbol	$V_{CC}=2.5\pm 0.2V$	$V_{CC}=2.7V, 3.3\pm 0.3V$
$t_{PLH}/t_{PHL}$	OPEN	OPEN
$t_{su}/t_h/t_w$	OPEN	OPEN
$t_{ZH}/t_{HZ}$	GND	GND
$t_{ZL}/t_{LZ}$	$2 \times V_{CC}$	6.0 V

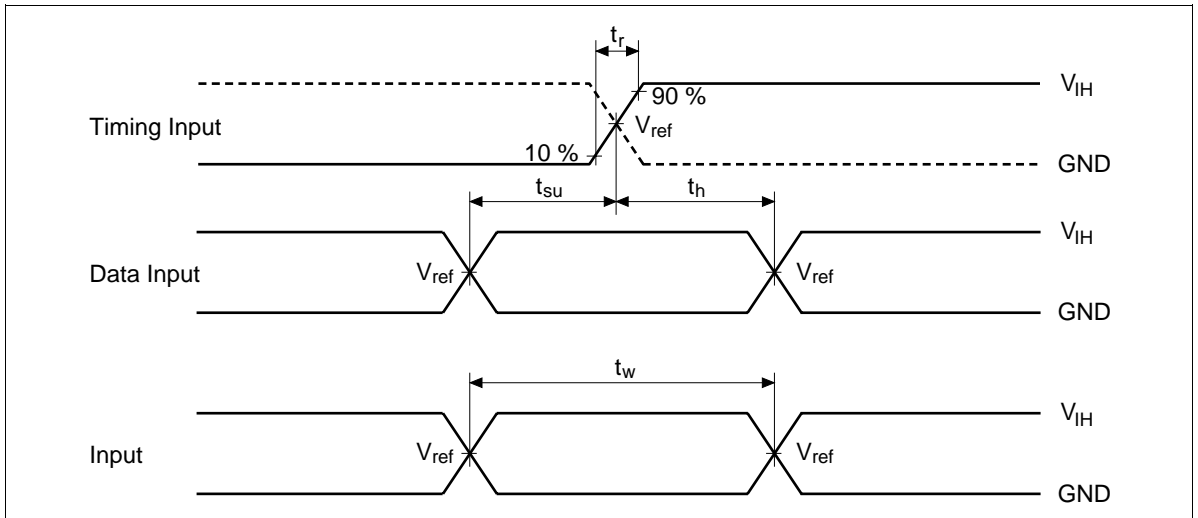
Note: 1.  $C_L$  includes probe and jig capacitance.

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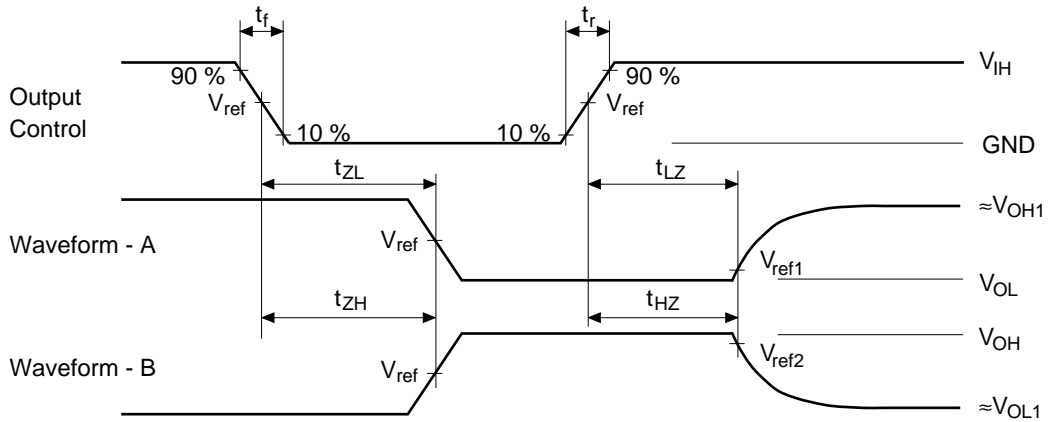
## Waveforms – 1



## Waveforms – 2



Waveforms – 3



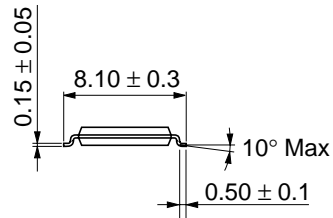
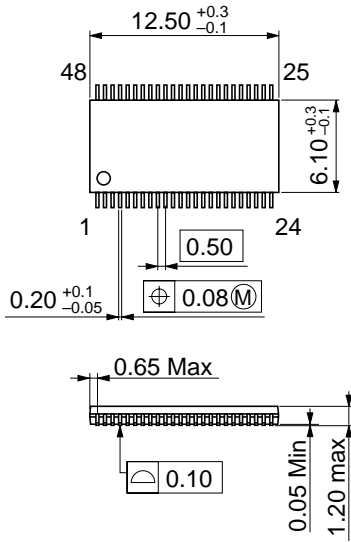
TEST	$V_{CC}=2.5\pm0.2V$	$V_{CC}=2.7V, 3.3\pm0.3V$
$V_{IH}$	$V_{CC}$	2.7 V
$V_{ref}$	$1/2 V_{CC}$	1.5 V
$V_{ref1}$	$V_{OL} + 0.15 V$	$V_{OL} + 0.3 V$
$V_{ref2}$	$V_{OH} - 0.15 V$	$V_{OH} - 0.3 V$
$V_{OH1}$	$V_{CC}$	3.0 V
$V_{OL1}$	GND	GND

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

# HD74ALVCH16334

## Package Dimensions

Unit : mm



Hitachi code	TTP-48DC
EIAJ code	—
JEDEC code	—

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