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# HD74ALVC16835

18-bit Universal Bus Driver with 3-state Outputs

## HITACHI

ADE-205-192E (Z)  
Preliminary  
6th. Edition  
January 1999

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### Description

The HD74ALVC16835 is an 18-bit universal bus driver designed for 2.3 V to 3.6 V  $V_{CC}$  operation.

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

### Features

- Meets “PC SDRAM registered DIMM design support document, Rev. 1.2”
- $V_{CC} = 2.3 \text{ V to } 3.6 \text{ V}$
- 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  $\pm 24 \text{ mA}$  ( $@V_{CC} = 3.0 \text{ V}$ )

**Function Table****Inputs**

$\overline{OE}$	LE	CLK	A	Output Y
H	X	X	X	Z
L	H	X	L	L
L	H	X	H	H
L	L	↑	L	L
L	L	↑	H	H
L	L	H	X	$Y_0^{*1}$
L	L	L	X	$Y_0^{*2}$

H : High level

L : Low level

X : Immaterial

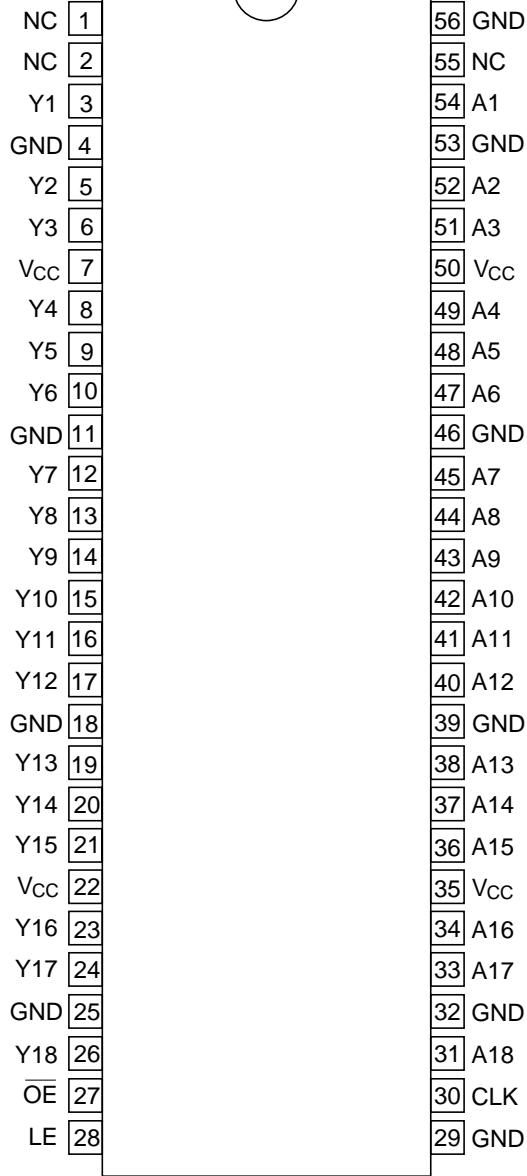
Z : High impedance

↑ : Low to high transition

Notes: 1. Output level before the indicated steady-state input conditions were established, provided that CLK was high before LE went low.

2. Output level before the indicated steady-state input conditions were established.

Pin Arrangement



(Top view)

**Absolute Maximum Ratings**

Item	Symbol	Ratings	Unit	Conditions
Supply voltage range	$V_{CC}$	-0.5 to 4.6	V	
Input voltage range <sup>1</sup>	$V_I$	-0.5 to 4.6	V	
Output voltage range <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>	$P_T$	1	W	TSSOP
Storage temperature range	$T_{stg}$	-65 to 150	$^\circ\text{C}$	

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 condition" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

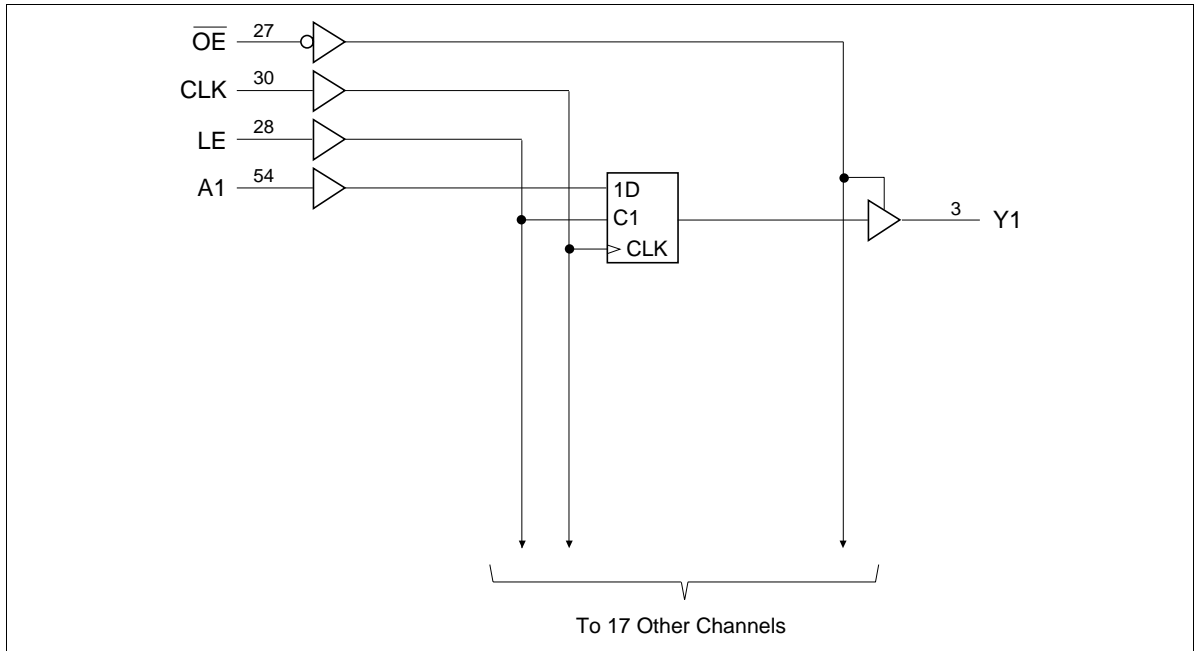
- Notes:
1. The input and output negative-voltage ratings may be exceeded if the input and output clamp current ratings are observed.
  2. The input and output positive-voltage ratings may be exceeded up to 4.6 V if the input and output clamp-current ratings are observed.
  3. The maximum power dissipation is calculated using a junction temperature of 150 $^\circ\text{C}$  and 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 free-air temperature	$T_a$	-40	85	$^\circ\text{C}$	

Note: Unused or floating control pins must be held high or low.

Logic Diagram



## Electrical Characteristics

Item	Symbol	$V_{CC}$ (V)	$T_a = -40 \text{ to } 85^\circ\text{C}$		Unit	Test Conditions
			Min	Max		
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	V	
		2.7 to 3.6	—	0.8		
Output voltage	$V_{OH}$	2.3 to 3.6	$V_{CC}-0.2$	—	V	$I_{OH} = -100 \mu\text{A}$
		2.3	2.0	—		$I_{OH} = -6 \text{ mA}, V_{IH} = 1.7 \text{ V}$
		2.3	1.7	—		$I_{OH} = -12 \text{ mA}, V_{IH} = 1.7 \text{ V}$
		2.7	2.2	—		$I_{OH} = -12 \text{ mA}, V_{IH} = 2.0 \text{ V}$
		3.0	2.4	—		$I_{OH} = -12 \text{ mA}, V_{IH} = 2.0 \text{ V}$
		3.0	2.0	—		$I_{OH} = -24 \text{ mA}, V_{IH} = 2.0 \text{ V}$
	$V_{OL}$	2.3 to 3.6	—	0.2	V	$I_{OL} = 100 \mu\text{A}$
		2.3	—	0.4		$I_{OL} = 6 \text{ mA}, V_{IL} = 0.7 \text{ V}$
		2.3	—	0.7		$I_{OL} = 12 \text{ mA}, V_{IL} = 0.7 \text{ V}$
		2.7	—	0.4		$I_{OL} = 12 \text{ mA}, V_{IL} = 0.8 \text{ V}$
		3.0	—	0.55		$I_{OL} = 24 \text{ mA}, V_{IL} = 0.8 \text{ V}$
Input current	$I_{IN}$	3.6	—	$\pm 5.0$	$\mu\text{A}$	$V_{IN} = V_{CC}$ or GND
Off state output current	$I_{OZ}$	3.6	—	$\pm 10$	$\mu\text{A}$	$V_{OUT} = V_{CC}$ or GND
Quiescent supply current	$I_{CC}$	3.6	—	40	$\mu\text{A}$	$V_{IN} = V_{CC}$ or GND
	$\Delta I_{CC}$	3.0 to 3.6	—	750	$\mu\text{A}$	One input at $(V_{CC}-0.6)\text{V}$ , other inputs at $V_{CC}$ or GND

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

Item	Symbol	V <sub>CC</sub> (V)	Min	Typ	Max	Unit	From (Input)	To (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	—	4.2	ns	A	Y		
		2.7	—	—	4.2					
	t <sub>PHL</sub>	3.3±0.3	1.0	—	3.6					
		2.5±0.2	1.3	—	5.0				LE	Y
			2.7	—	—	4.9				
			3.3±0.3	1.3	—	4.2				
		2.5±0.2	1.4	—	5.5	CLK				Y
		2.7	—	—	5.2					
		3.3±0.3	1.4	—	4.5					
		3.3±0.3	1.4	—	4.5					
Output enable time	t <sub>ZH</sub>	2.5±0.2	1.4	—	5.5	ns	OE	Y		
		2.7	—	—	5.6					
	t <sub>ZL</sub>	3.3±0.3	1.1	—	4.6					
Output disable time	t <sub>HZ</sub>	2.5±0.2	1.0	—	4.5	ns	OE	Y		
		2.7	—	—	4.3					
	t <sub>LZ</sub>	3.3±0.3	1.3	—	3.9					
Input capacitance	C <sub>IN</sub>	3.3	3.0	4.5	7.0	pF	Control inputs			
		3.3	3.0	6.0	9.0		Data inputs			
Output capacitance	C <sub>O</sub>	3.3	3.0	7.0	9.0	pF	Y ports			

## 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	2.2	—	—	ns	Data before CLK↑
		2.7	2.1	—	—		
		3.3±0.3	1.7	—	—		
		2.5±0.2	1.9	—	—		Data before LE↓
		2.7	1.6	—	—	ns	CLK "H"
		3.3±0.3	1.5	—	—		
		2.5±0.2	1.3	—	—		Data before LE↓
		2.7	1.1	—	—	ns	CLK "L"
3.3±0.3	1.0	—	—				
Hold time	t <sub>h</sub>	2.5±0.2	0.6	—	—	ns	Data after CLK↑
		2.7	0.6	—	—		
		3.3±0.3	0.7	—	—		
		2.5±0.2	1.4	—	—	ns	Data after LE↓
		2.7	1.7	—	—		CLK "H" or "L"
		3.3±0.3	1.4	—	—		
Pulse width	t <sub>w</sub>	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	—	—	ns	CLK "H" or "L"
		2.7	3.3	—	—		
		3.3±0.3	3.3	—	—		

## Switching Characteristics (Ta = 0 to 85°C)

Item	Symbol	V <sub>CC</sub> (V)	Min	Typ	Max	Unit	FROM (Input)	TO (Output)	
Propagation delay time	C <sub>L</sub> =0pF <sup>*1</sup> t <sub>PLH</sub> , t <sub>PHL</sub>	3.3±0.165	0.9	—	2.0	ns	A	Y	
		3.3±0.165	1.0	—	4.5				
		C <sub>L</sub> =0pF <sup>*1</sup>	3.3±0.165	1.5	—	3.0	ns	CLK	Y
			3.3±0.165	1.7	—	4.5			
		C <sub>L</sub> =50pF	3.3±0.165	1.7	—	4.8	ns	CLK, A	Y
Output rise / fall time	C <sub>L</sub> =50pF t <sub>TLH</sub> , t <sub>THL</sub> <sup>*1</sup>	3.3±0.165	1.0	—	2.5	volts/ ns		Y	

Notes: 1. This parameter is characterized but not tested.

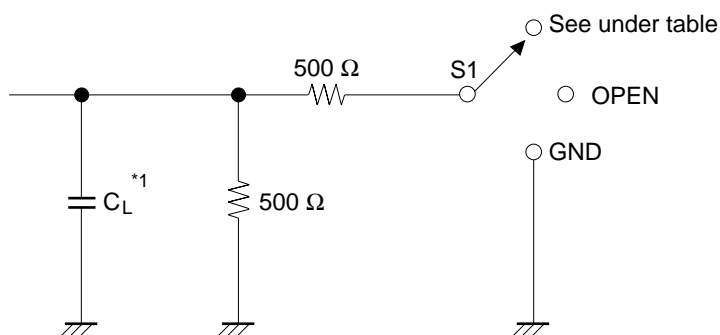
2. t<sub>SSO</sub> : Simultaneous switching output time.



Operating Characteristics (Ta = 25°C)

Item	Symbol	$V_{CC} = 2.5 \pm 0.2 \text{ V}$	$V_{CC} = 3.3 \pm 0.3 \text{ V}$	Unit	Test Conditions
Power dissipation capacitance	Outputs enable	$C_{pd}$	22.0	24.5	pF
	Outputs disable		5.0	6.0	

Test Circuit

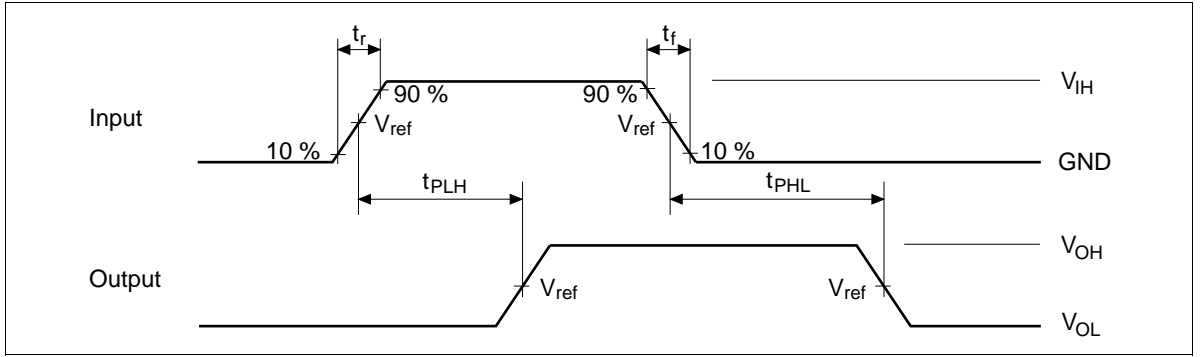


Load Circuit for Outputs

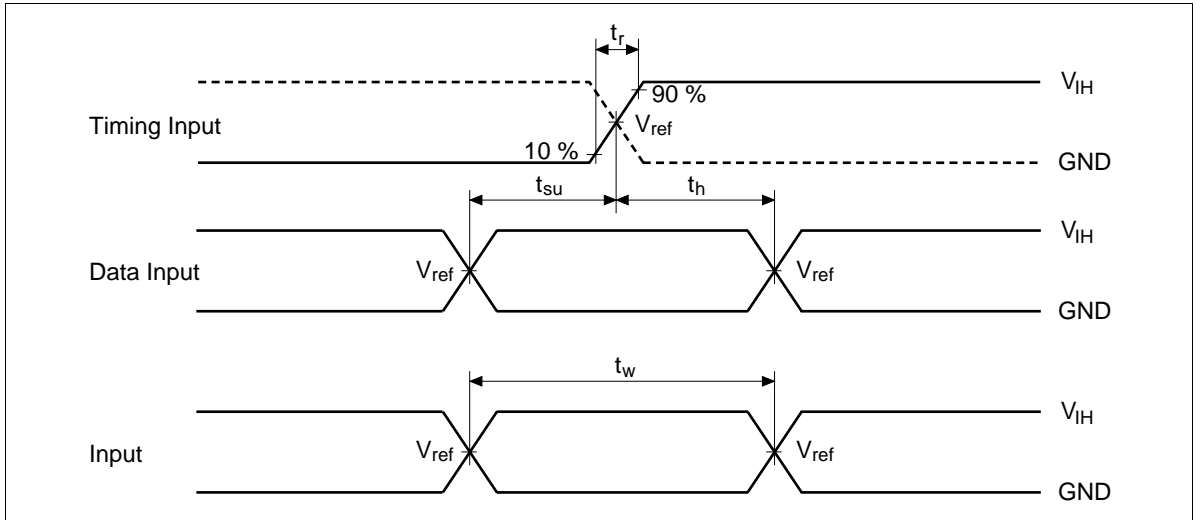
Symbol	$V_{CC}=2.5 \pm 0.2 \text{ V}$	$V_{CC}=2.7 \text{ V}, 3.3 \pm 0.3 \text{ V}$
$t_{PLH} / t_{PHL}$	OPEN	OPEN
$t_{su} / t_h / t_w$	OPEN	OPEN
$t_{ZH} / t_{HZ}$	GND	GND
$t_{ZL} / t_{LZ}$	$2 \times V_{CC}$	6.0 V
$C_L$	30 pF	50 pF

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

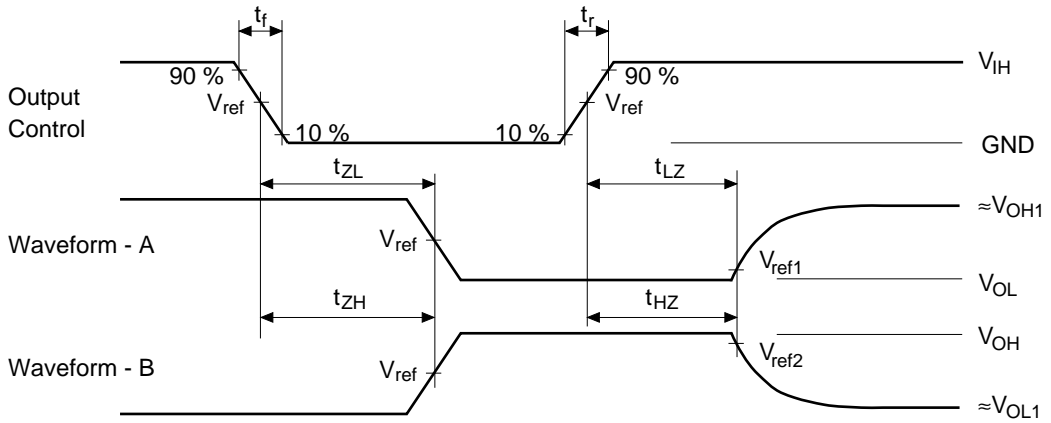
## Waveforms – 1



## Waveforms – 2



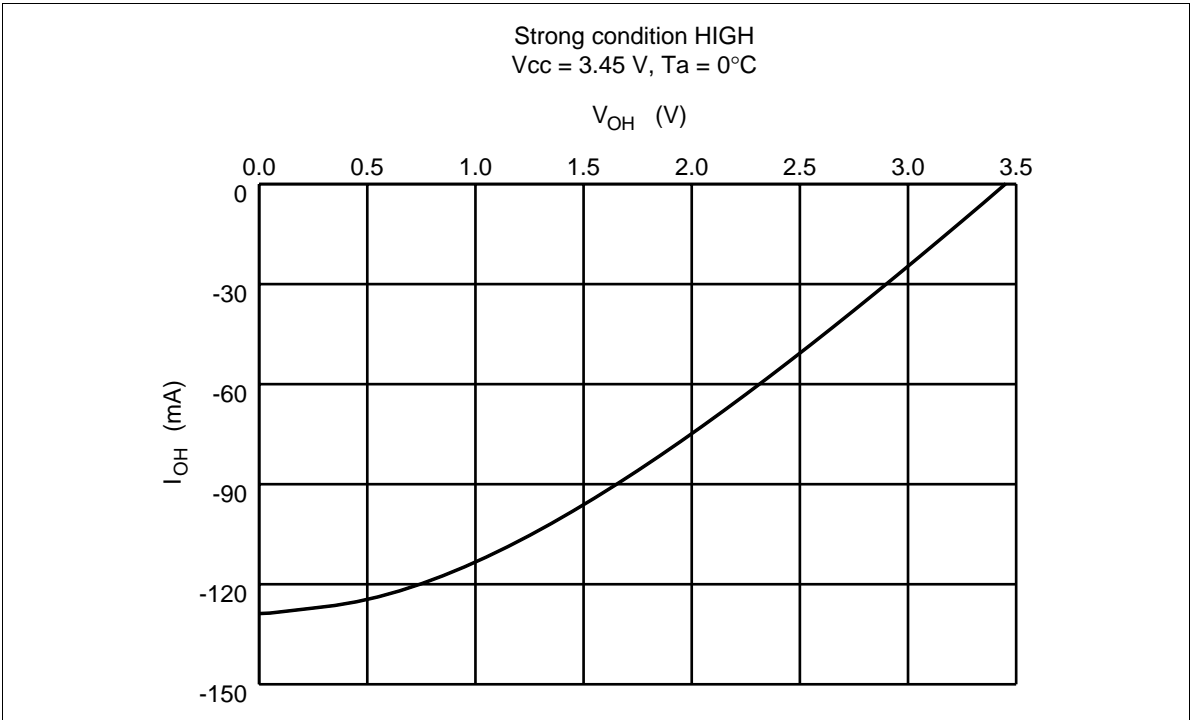
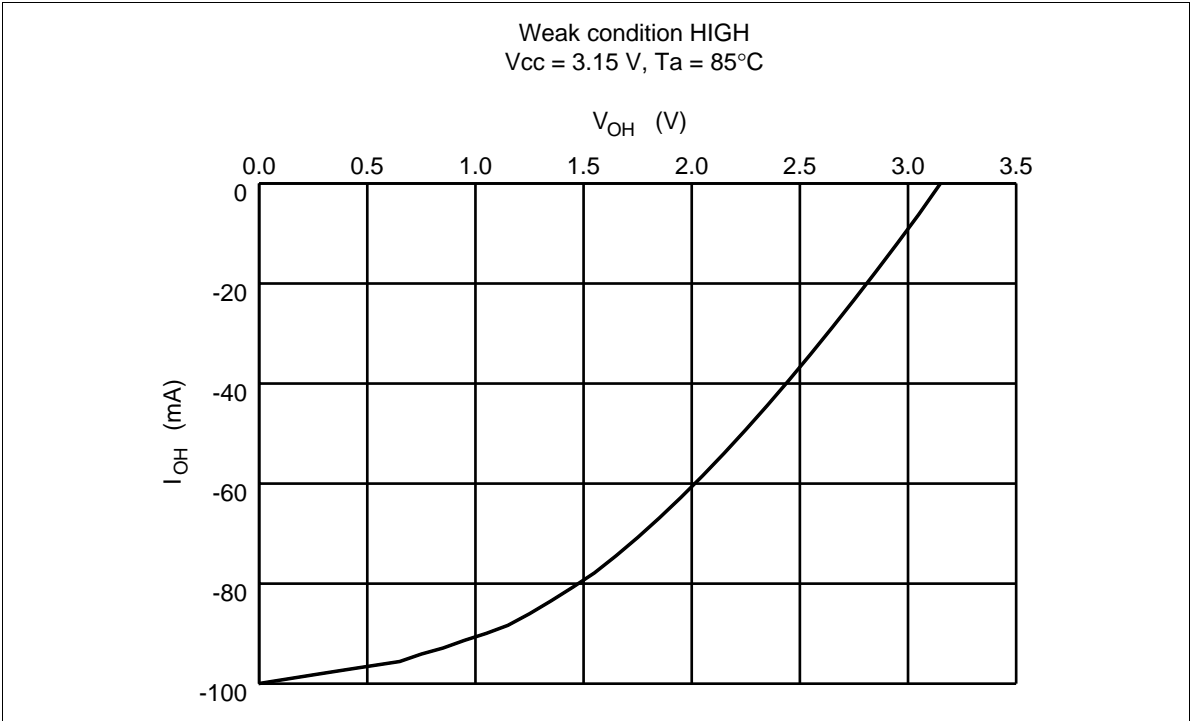
Waveforms – 3



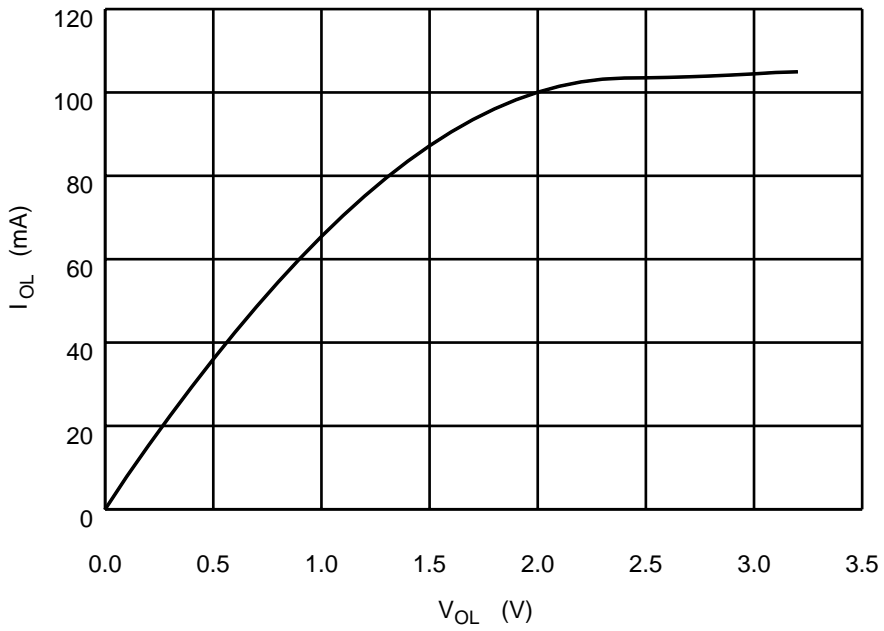
TEST	$V_{CC}=2.5\pm 0.2V$	$V_{CC}=2.7V, 3.3\pm 0.3V$
$V_{IH}$	$V_{CC}$	2.7 V
$V_{ref}$	$1/2 V_{CC}$	1.5 V
$V_{ref1}$	$V_{OL} + 0.15 V$	$V_{OL} + 0.3 V$
$V_{ref2}$	$V_{OH} - 0.15 V$	$V_{OH} - 0.3 V$
$V_{OH1}$	$V_{CC}$	3.0 V
$V_{OL1}$	GND	GND

- Notes:
1. All input pulses are supplied by generators having the following characteristics :  
 $PRR \leq 10 \text{ MHz}$ ,  $Z_o = 50 \Omega$ ,  $t_r \leq 2.0 \text{ ns}$ ,  $t_f \leq 2.0 \text{ ns}$ . ( $V_{CC} = 2.5\pm 0.2 V$ )  
 $PRR \leq 10 \text{ MHz}$ ,  $Z_o = 50 \Omega$ ,  $t_r \leq 2.5 \text{ ns}$ ,  $t_f \leq 2.5 \text{ ns}$ . ( $V_{CC} = 2.7 V, 3.3\pm 0.3 V$ )
  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 outputs are measured one at a time with one transition per measurement.

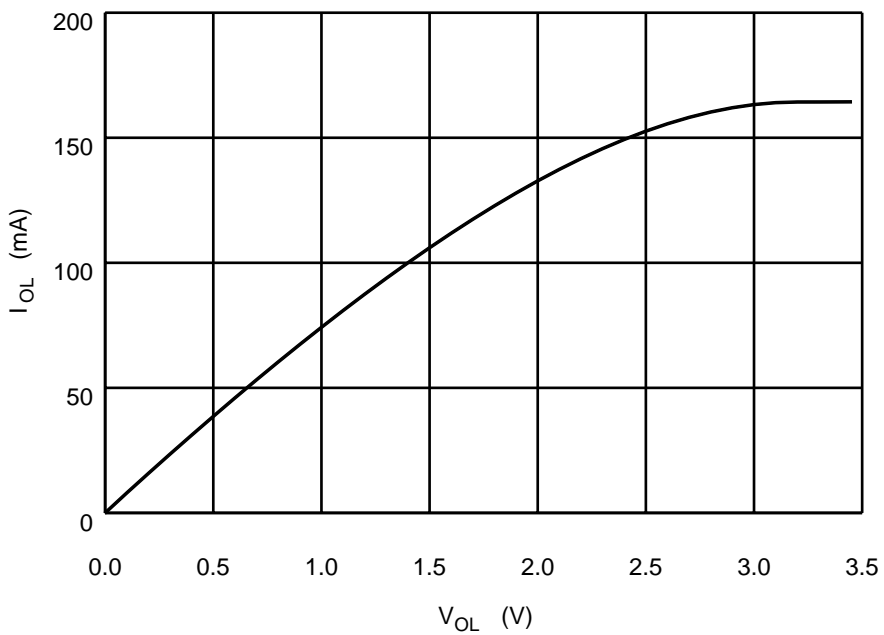
## IV Characteristics for Register Output (Measured value)



Weak condition LOW  
 $V_{CC} = 3.15\text{ V}$ ,  $T_a = 85^\circ\text{C}$

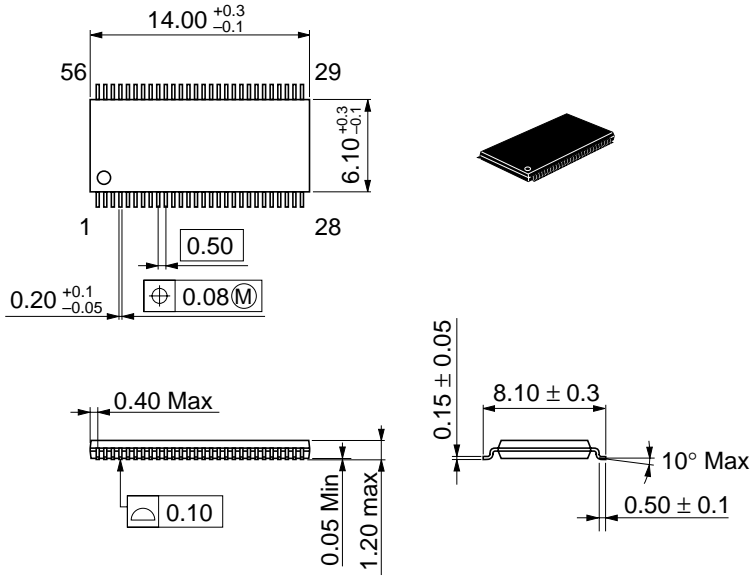


Strong condition LOW  
 $V_{CC} = 3.45\text{ V}$ ,  $T_a = 0^\circ\text{C}$



## Package Dimensions

Unit : mm



Hitachi code	TTP-56D
EIAJ code	—
JEDEC code	—

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