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# HD151015

## 9 bit Level Shifter/Transceiver With 3 State Outputs

# HITACHI

ADE-205-039C (Z)  
3rd. Edition  
Jun. 1993

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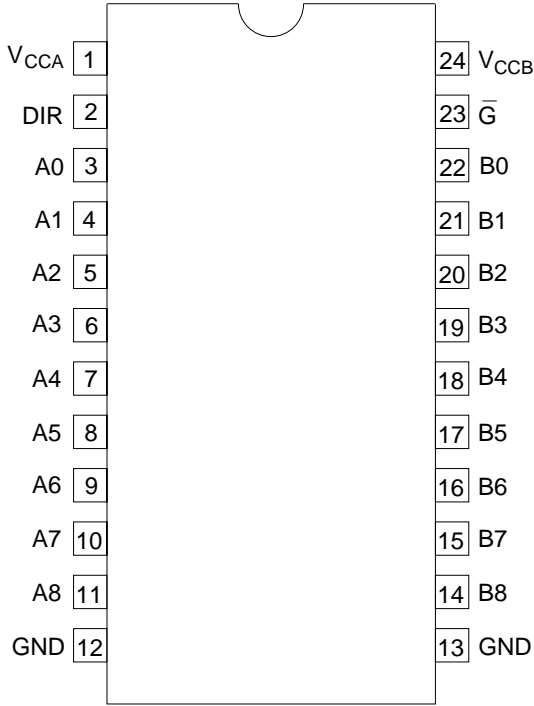
### Description

The HD151015 is an IC which consists of 9 bus transceivers (three state output) in a 24 pin package. Signals are transmitter from A to B when the direction control input (DiR) is at a high level, and from B to A when DiR is at a low level. When the enable input ( $\overline{G}$ ) is high, A and B are isolated. And this product has two terminals ( $V_{CCA}$ ,  $V_{CCB}$ ),  $V_{CCA}$  is connected with control input and A bus side,  $V_{CCB}$  is connected with B bus side.  $V_{CCA}$  and  $V_{CCB}$  are isolated. Consequently, it is best to change the level in case of two supply voltage coexist on one board and application of power management.

### 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 voltages to  $V_{CCA}$  and  $V_{CCB}$ .
- This product is able to the power management : Turn on and off the supply on  $V_{CCB}$  side with providing the supply of  $V_{CCA}$ .  
(Enable input ( $\overline{G}$ ) : High level)
- Inputs and outputs are CMOS level, and the power dissipation is the same as CMOS standard logic.
- Wide operating supply voltage range:  
 $V_{CCA} = V_{CCB} = 2$  to  $6$  V ( $V_{CCB} \leq V_{CCA} - 0.5$  V)
- Wide operating temperature range:  $T_a = -40$  to  $85^\circ\text{C}$

## Pin Arrangement



(Top view)

## Function Table

### Inputs

$\bar{G}$	DIR	Outputs
L	L	B data to A bus
L	H	A data to B bus
H	X	Z

H : High level

L : Low level

Z : High Impedance

X : Immaterial

**Absolute Maximum Ratings**

Item	Symbol	Rating	Unit	Conditions
Supply Voltage	$V_{CCA}, V_{CCB}$	-0.5 to +7.0	V	
Input Diode Current	$I_{IK}$	-20	mA	$V_I = -0.5$
		20	mA	$V_I = V_{CC} + 0.5$
Input Voltage	$V_{IN}$	-0.5 to $V_{CC} + 0.5$	V	
Output Diode Current	$I_{OK}$	-50	mA	$V_O = -0.5$
		50	mA	$V_O = V_{CC} + 0.5$
Output Voltage	$V_{OUT}$	-0.5 to $V_{CC} + 0.5$	V	
Output Current	$I_O$	$\pm 50$	mA	
VCC or Ground Current	$I_{CC}$ or $I_{GND}$	$\pm 50$	mA	per output pin
Storage Temperature	Tstg	-65 to + 150	°C	

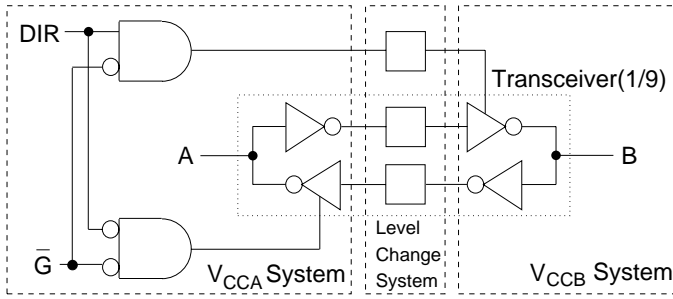
Note: 1. The absolute maximum ratings are values which must not individually be exceeded, and furthermore, no two of which may be realized at the same time.

**Recommended Operating Conditions**

Item	Symbol	Rating	Unit	Conditions
Supply voltage	$V_{CCA, B}$	2.0 to 6.0	V	$V_{CCB} \geq V_{CCA} - 0.5$ V
Input voltage	$V_{IN}$	0 to $V_{CC}$	V	
Output voltage	$V_{OUT}$	0 to $V_{CC}$	V	
Operating Temperature	$T_A$	-40 to +85	°C	
Input Rise and Fall Time* <sup>1</sup>	$t_r, t_f$	8	ns/V	$V_{CC}@3.0$ V (Input DiR, $\bar{G}$ , A)
				$V_{CC}@4.5$ V (Input B)
				$V_{CC}@5.5$ V (Input B)

Note: 1. The item guarantees maximum limit when one input switches.  
Waveform: Refer to test circuit of switching characteristics.

## Logick Diagram



## Electrical Characteristics

Item	Sym- bol	$V_{CCA}$ (V)	$V_{CCB}$ (V)	$T_a = 25^\circ\text{C}$			$T_a = -40$ to $85^\circ\text{C}$		Unit	Conditions
				Min	Typ	Max	Min	Max		
Input Voltage	$V_{IH}$	3.0	3.0	2.1	1.5	—	2.1	—	V	$V_{OUT} = 0.1\text{ V or } V_{CC} - 0.1\text{ V}$
		4.5	4.5	3.15	2.25	—	3.15	—		
		5.5	5.5	3.85	2.75	—	3.85	—		
	$V_{IL}$	3.0	3.0	—	1.5	0.9	—	0.9	V	$V_{OUT} = 0.1\text{ V or } V_{CC} - 0.1\text{ V}$
		4.5	4.5	—	2.25	1.35	—	1.35		
		5.5	5.5	—	2.75	1.65	—	1.65		
Output Voltage	$V_{OH}$	2.7	4.5	2.6	2.69	—	2.6	—	V	$V_{IN} = V_{IL} \text{ or } V_{IH}, I_{OH} = -50\ \mu\text{A A}^{*1}$
		2.7	4.5	4.4	4.49	—	4.4	—		$V_{IN} = V_{IL} \text{ or } V_{IH}, I_{OH} = -50\ \mu\text{A B}$
		2.7	4.5	2.3	—	—	2.2	—	V	$V_{IN} =$ $I_{OH} = -4\ \text{mA A}$
		2.7	4.5	3.9	—	—	3.8	—		$V_{IL} \text{ or } V_{IH}$ $I_{OH} = -12\ \text{mA B}$
	$V_{OL}$	2.7	4.5	—	0.001	0.1	—	0.1	V	$V_{IN} = V_{IL} \text{ or } V_{IH}, I_{OL} = 50\ \mu\text{A A,B}$
		2.7	4.5	—	—	0.32	—	0.37	V	$V_{IN} = V_{IL} \text{ or } V_{IH}, I_{OL} = 12\ \text{mA A,B}$
Input Current	$I_{IN}$	3.3	5.5	—	—	$\pm 0.1$	—	$\pm 1.0$	$\mu\text{A}$	$V_{IN} = V_{CC} \text{ or GND}$
Off State Output Current	$I_{OZ}$	3.3	5.5	—	—	$\pm 0.5$	—	$\pm 5.0$	$\mu\text{A}$	$V_{IN}(\overline{G}) = V_{IH}, V_{IN} = V_{CC} \text{ or GND},$ $V_{OUT} = V_{CC} \text{ or GND}$
Supply Current	$I_{CCA,B}$	3.3	5.5	—	—	8.0	—	80	$\mu\text{A}$	$V_{IN} = V_{CC} \text{ or GND}$
	$I_{CCA}$	5.5	0	—	—	8.0	—	80	$\mu\text{A}$	$V_{IN} = V_{CC} \text{ or GND}, \text{ B Input OPEN}$

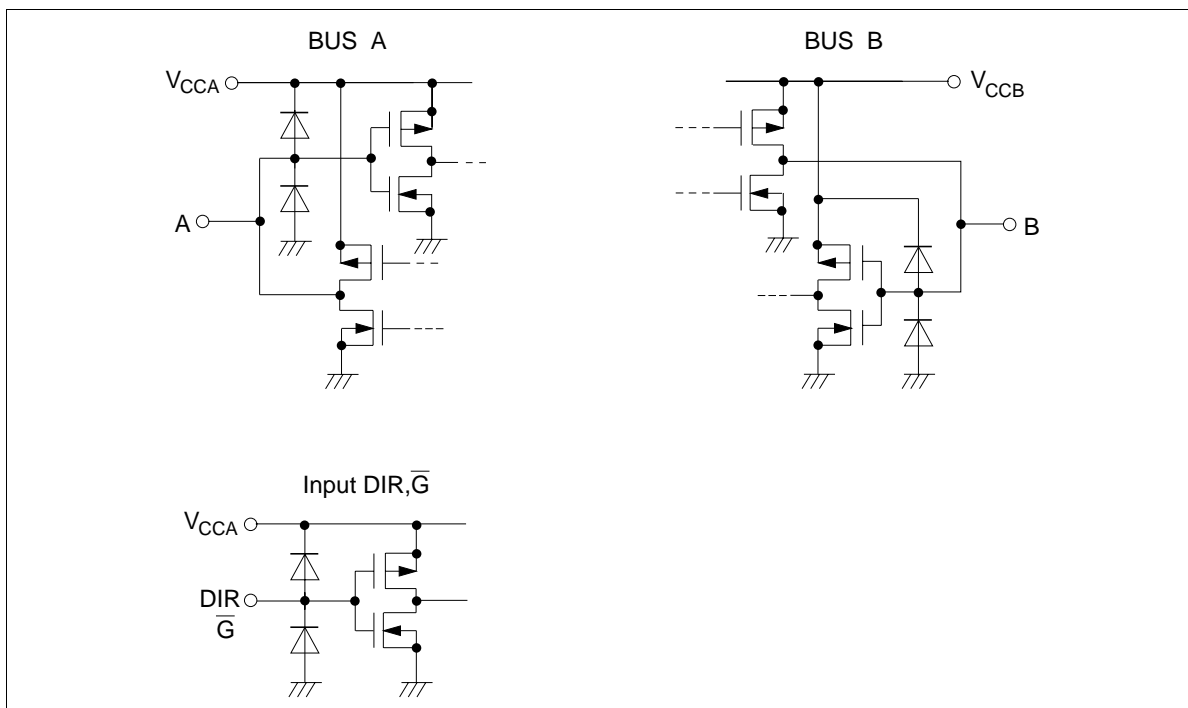
Note: 1. A: Output A, B: Output B, A.B: Output A.B

Switching Characteristics

$T_a = 25^{\circ}\text{C}$   $T_a = -40 \text{ to } 85^{\circ}\text{C}$   
 $V_{CCA} = 3.0 \text{ V}, V_{CCB} = 5.0 \text{ V}$   $V_{CC} = 2.7 \text{ V}, V_{CCB} = 4.5 \text{ V}$

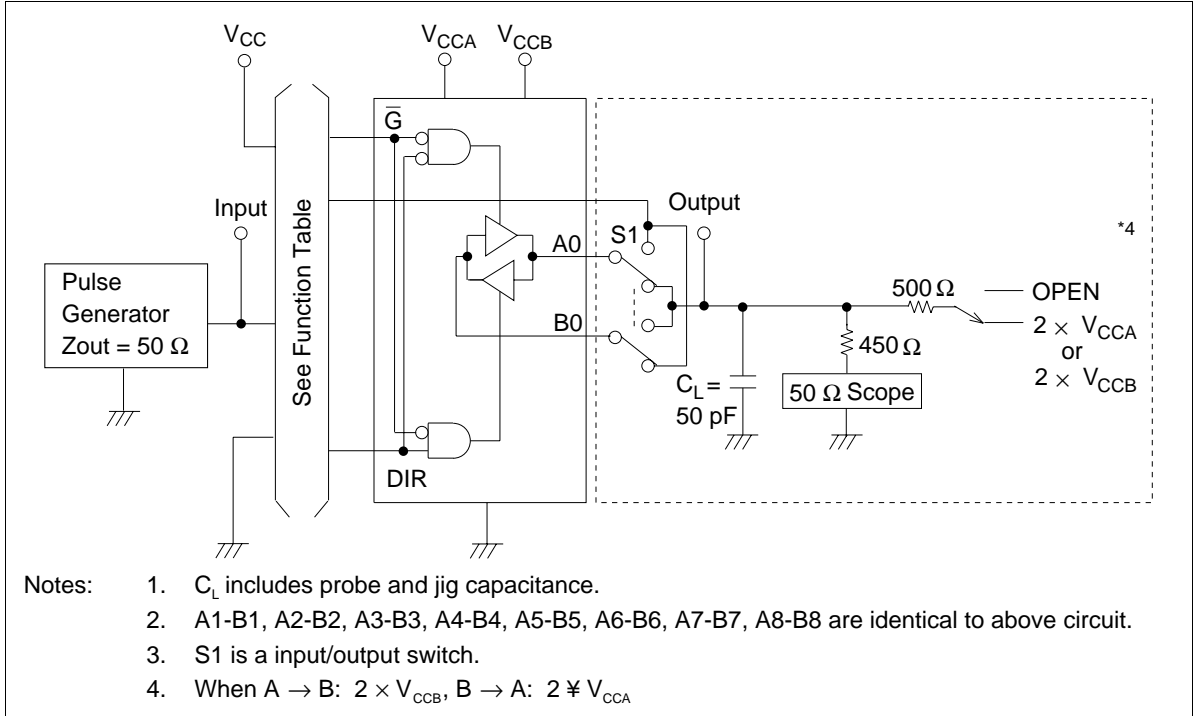
Item	Symbol	Min	Typ	Max	Min	Max	Unit	Conditions
Propagation Delay Time	$t_{PLH}$	1.0	5.0	10.0	1.0	12.0	ns	B → A
		1.0	5.0	10.0	1.0	12.0		A → B
	$t_{PHL}$	1.0	5.0	10.0	1.0	12.0	ns	B → A
		1.0	5.0	10.0	1.0	12.0		A → B
Output Enable Time	$t_{ZH}$	1.0	8.0	16.0	1.0	20.0	ns	$\overline{G} \rightarrow A$
		1.0	8.0	16.0	1.0	20.0		$\overline{G} \rightarrow B$
	$t_{ZL}$	1.0	9.0	16.0	1.0	20.0	ns	$\overline{G} \rightarrow A$
		1.0	9.0	16.0	1.0	20.0		$\overline{G} \rightarrow A$
Output Disable Time	$t_{HZ}$	1.0	9.0	16.0	1.0	20.0	ns	$\overline{G} \rightarrow A$
		1.0	9.0	16.0	1.0	20.0		$\overline{G} \rightarrow B$
	$t_{LZ}$	1.0	8.0	16.0	1.0	20.0	ns	$\overline{G} \rightarrow A$
		1.0	8.0	16.0	1.0	20.0		$\overline{G} \rightarrow B$

Input and Output Equivalent Circuit

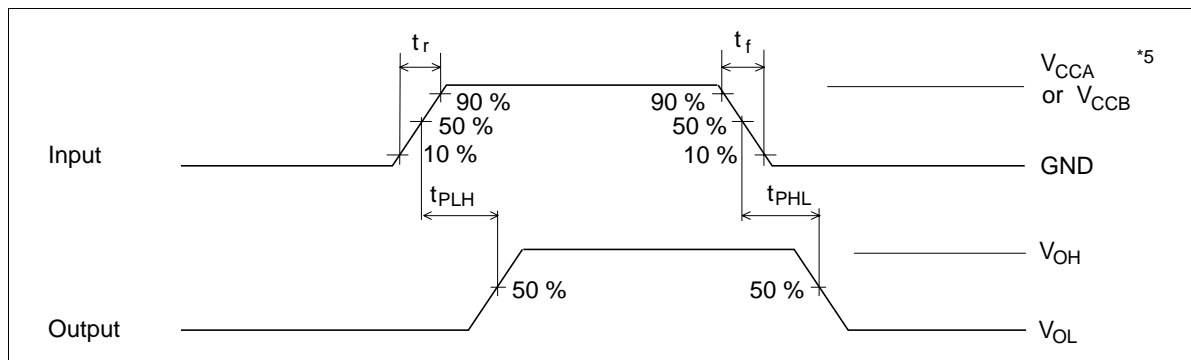


## Switching Time Test Method

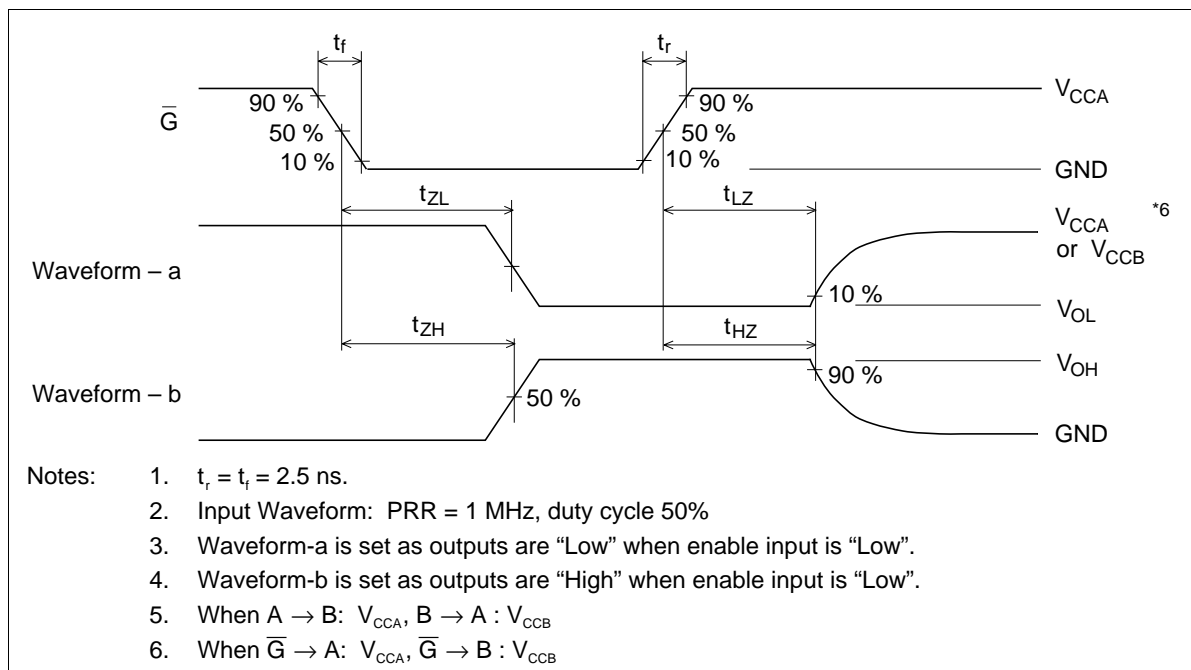
### Test Circuit



Waveforms-1

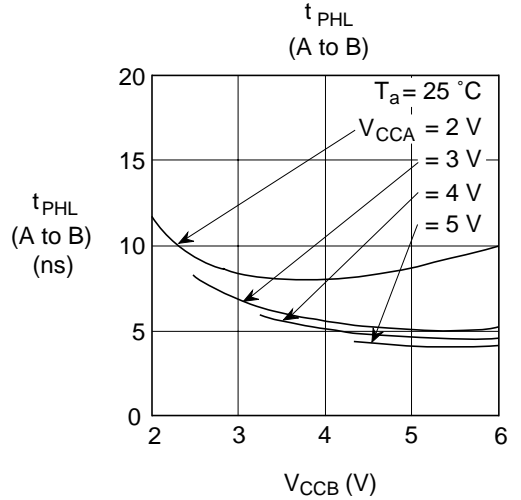
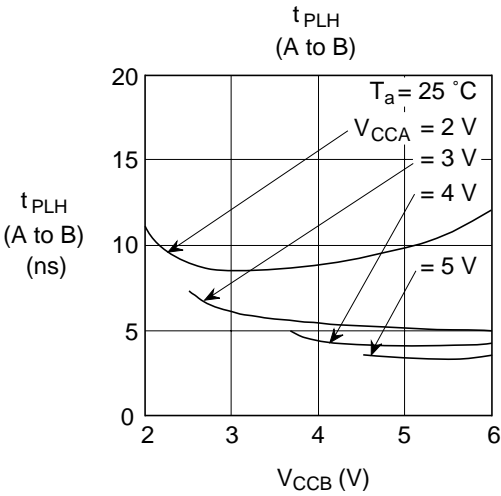
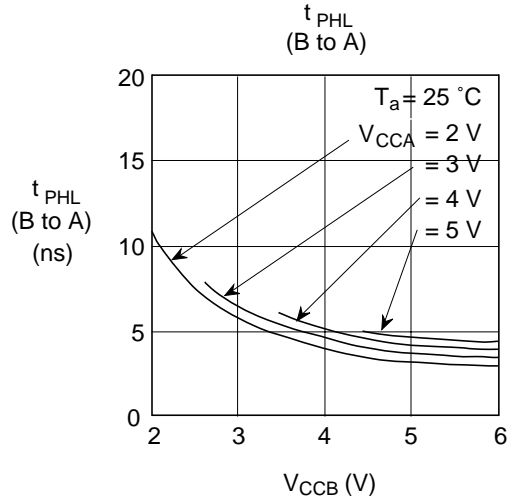
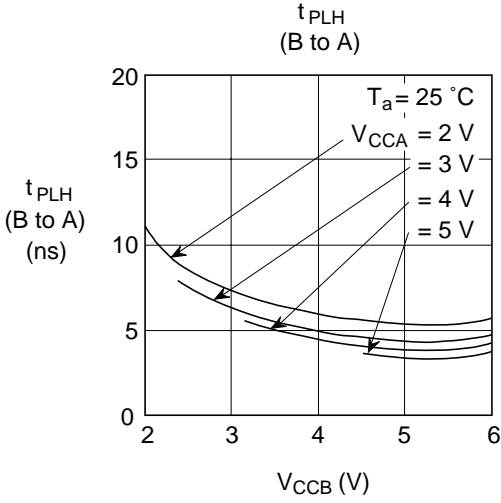


Waveforms-2



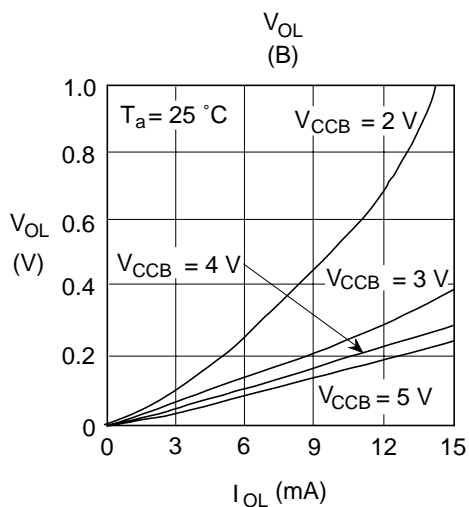
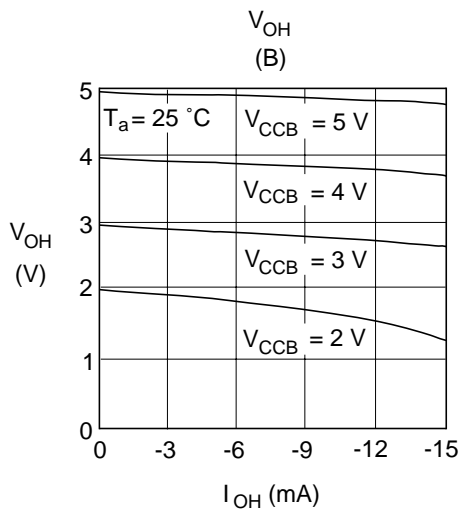
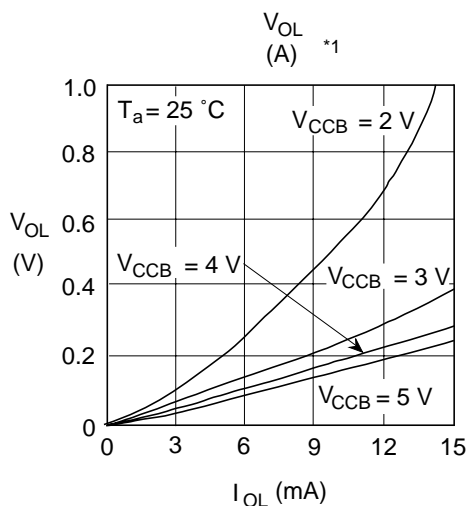
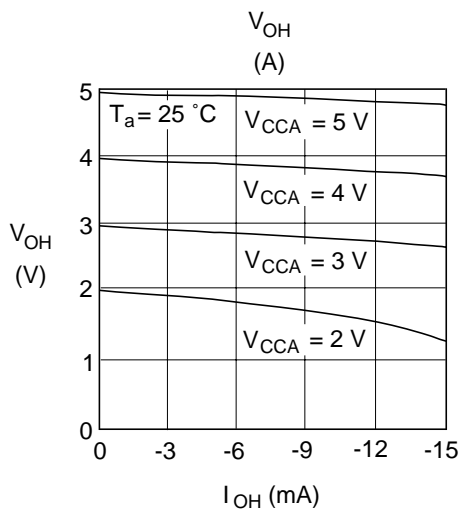
Typical Characteristic Curves

Propagation Delay Times vs Power Supply ( $V_{CCA}$ ,  $V_{CCB}$ )



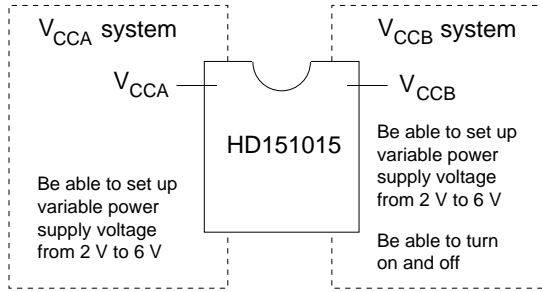


Output Voltage vs Output Current



## Application

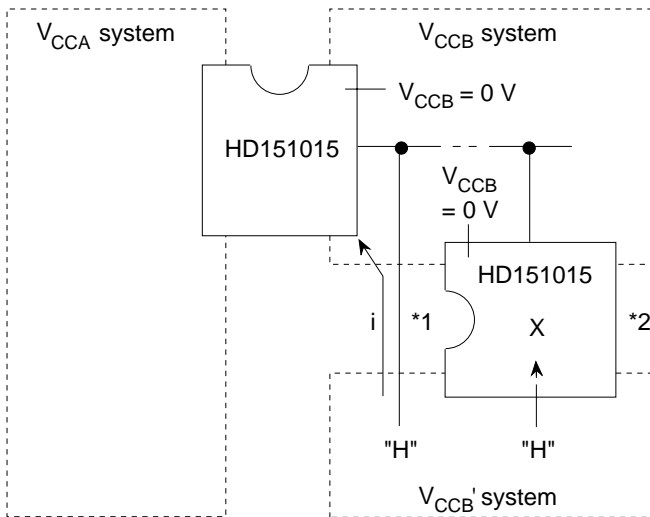
### For power management system (1)



Note: HD151015 is also used for power management system. We show some Examples.

1. For  $V_{CCA}$  side  
Be able to switch fast mode ( $V_{CCA} = 5\text{ V}$ ) and power save mode ( $V_{CCA} = 3\text{ V}$ )
2. For  $V_{CCB}$  side  
Be able to switch normal mode ( $V_{CCB} = 5\text{ V}$ ) and suspend mode ( $V_{CCB} = 0\text{ V}$ )
3. For both side  
Be able to switch fast mode ( $V_{CCA} = 5\text{ V}$ ) and power save mode ( $V_{CCA} = 3\text{ V}$ )  
(When  $V_{CCA} = V_{CCB}$ , in this case, please switch  $V_{CCA}$  and  $V_{CCB}$  simultaneously.)

### For power management system (2) (Common bus line in different power system)



HD151015 uses conventional CMOS input circuit. So, you have to care of designing in case of common bus line in different power block. We show one example.

In this case, if  $V_{CCB}$  become turn off, current flows from bus line to  $V_{CCB}$ . (refer to  $*1$ )

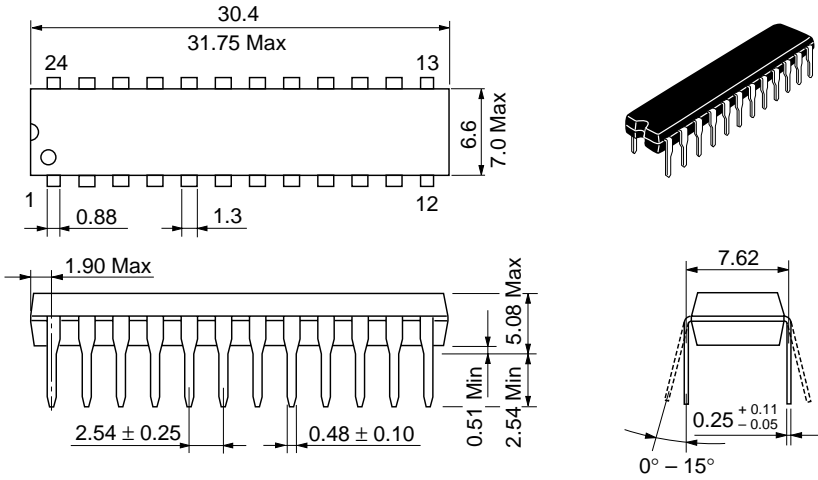
This is cause of malfunction. In order to prevent this problem, I recommend using this device for interface to each power block. (refer to  $*2$ )

[Cautions on using]

Please use this IC on condition of  $V_{CCA}$  usually ON, because if you use it on condition of  $V_{CCA}$  being OFF,  $V_{CCB}$  being ON, it will be troubled.

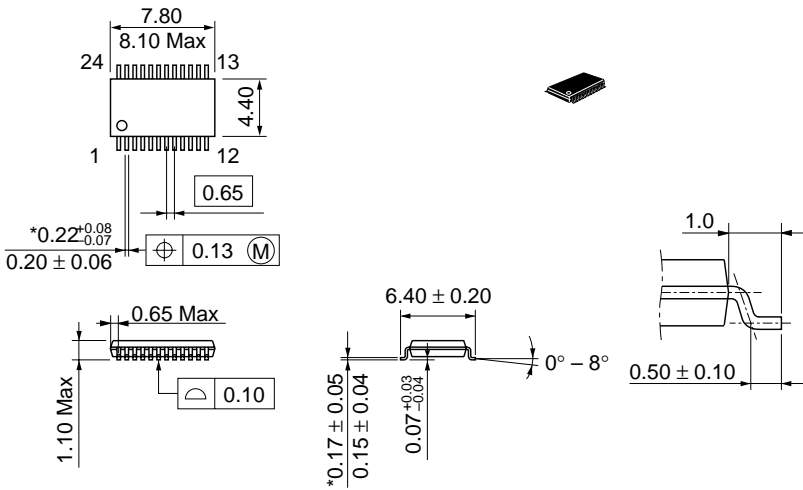
## Package Dimensions

Unit: mm



Hitachi Code	DP-24N
JEDEC	—
EIAJ	Conforms
Mass (reference value)	1.84 g

Unit: mm



\*Dimension including the plating thickness  
Base material dimension

Hitachi Code	TTP-24DB
JEDEC	—
EIAJ	—
Mass (reference value)	0.08 g

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