
HD151015

9 bit Level Shifter/Transceiver With 3 State Outputs

HITACHI

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

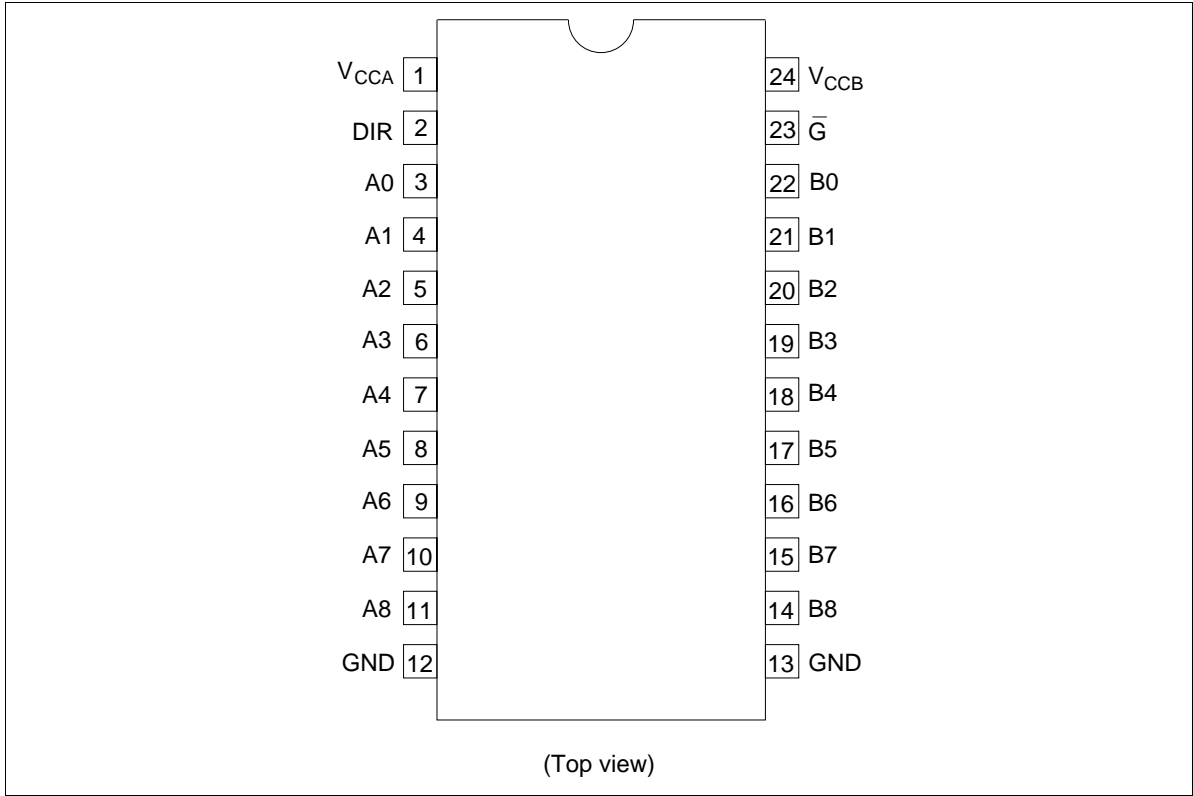
Description

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:
 $V_{CCA} = V_{CCB} = 2 \text{ to } 6 \text{ V } (V_{CCB} \leq V_{CCA} - 0.5 \text{ V})$
- Wide operating temperature range: $T_a = -40 \text{ to } 85^\circ\text{C}$

Pin Arrangement



Function Table

Inputs		
\overline{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	± 50	mA	
VCC or Ground Current	I_{CC} or I_{GND}	± 50	mA	per output pin
Storage Temperature	T_{stg}	-65 to + 150	°C	

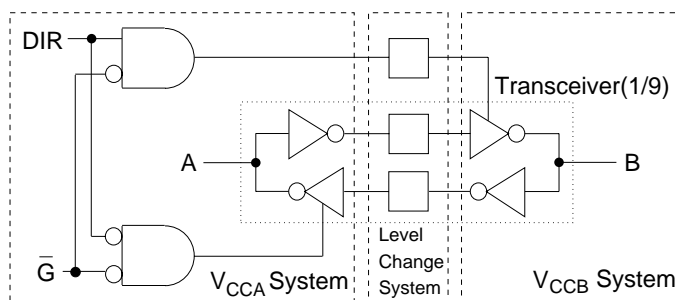
Note: 1. The absolute maximum ratings are values which must not individually be exceeded, and furthermore, no two of which may be realized at the same time.

Recommended Operating Conditions

Item	Symbol	Rating	Unit	Conditions
Supply voltage	$V_{CCA, B}$	2.0 to 6.0	V	$V_{CCB} \geq V_{CCA} - 0.5 \text{ V}$
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* ¹	t_r, t_f	8	ns/V	$V_{CC}@3.0 \text{ V (Input DiR, } \overline{G}, A)$
				$V_{CC}@4.5 \text{ V (Input B)}$
				$V_{CC}@5.5 \text{ V (Input B)}$

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)	Ta = 25°C			Ta = -40 to 85°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 V or V _{CC} - 0.1 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 V or V _{CC} - 0.1 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} or V _{IH} , I _{OH} = -50 μA A*1
		2.7	4.5	4.4	4.49	—	4.4	—		V _{IN} = V _{IL} or V _{IH} , I _{OH} = -50 μA B
		2.7	4.5	2.3	—	—	2.2	—	V	V _{IN} = I _{OH} = -4 mA A
		2.7	4.5	3.9	—	—	3.8	—		V _{IL} or V _{IH} I _{OH} = -12 mA B
	V _{OL}	2.7	4.5	—	0.001	0.1	—	0.1	V	V _{IN} = V _{IL} or V _{IH} , I _{OL} = 50 μA A.B
		2.7	4.5	—	—	0.32	—	0.37	V	V _{IN} = V _{IL} or V _{IH} , I _{OL} = 12 mA A.B
Input Current	I _{IN}	3.3	5.5	—	—	±0.1	—	±1.0	μA	V _{IN} = V _{CC} or GND
Off State Output Current	I _{OZ}	3.3	5.5	—	—	±0.5	—	±5.0	μA	V _{IN} (\bar{G}) = V _{IH} , V _{IN} = V _{CC} or GND, V _{OUT} = V _{CC} or GND
Supply	I _{CCA,B}	3.3	5.5	—	—	8.0	—	80	μA	V _{IN} = V _{CC} or GND
Current	I _{CCA}	5.5	0	—	—	8.0	—	80	μA	V _{IN} = V _{CC} or GND, B Input OPEN

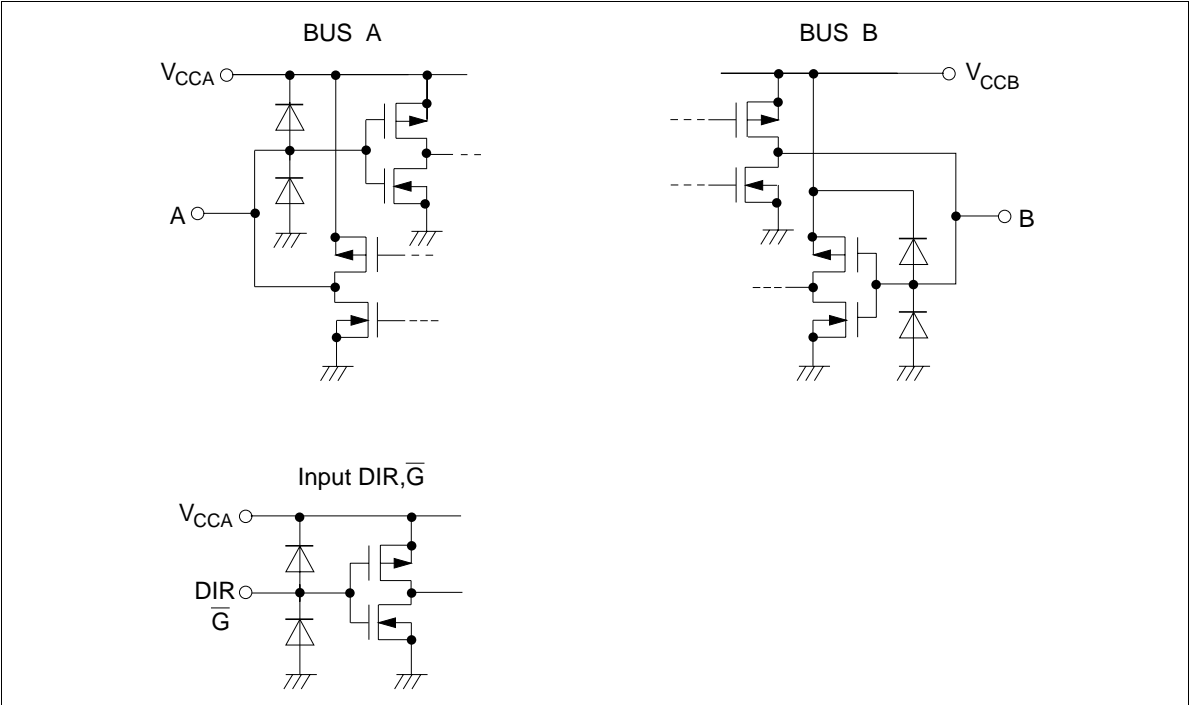
Note: 1. A: Output A, B: Output B, A.B: Output A.B

Switching Characteristics

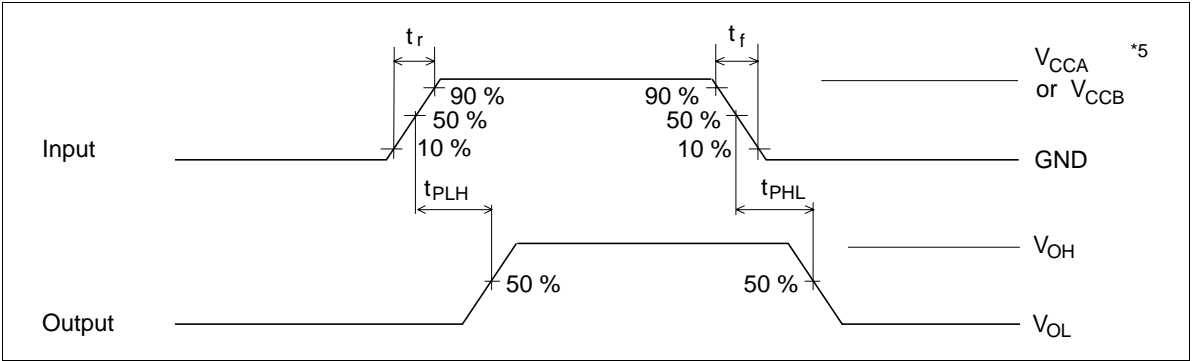
$T_a = 25^{\circ}\text{C}$ $T_a = -40 \text{ to } 85^{\circ}\text{C}$
 $V_{CCA} = 3.0 \text{ V}, V_{CCB} = 5.0 \text{ V}$ $V_{CC} = 2.7 \text{ V}, V_{CCB} = 4.5 \text{ V}$

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	$B \rightarrow A$
		1.0	5.0	10.0	1.0	12.0		$A \rightarrow B$
	t_{PHL}	1.0	5.0	10.0	1.0	12.0	ns	$B \rightarrow A$
		1.0	5.0	10.0	1.0	12.0		$A \rightarrow B$
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		$\overline{G} \rightarrow B$
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		$\overline{G} \rightarrow B$

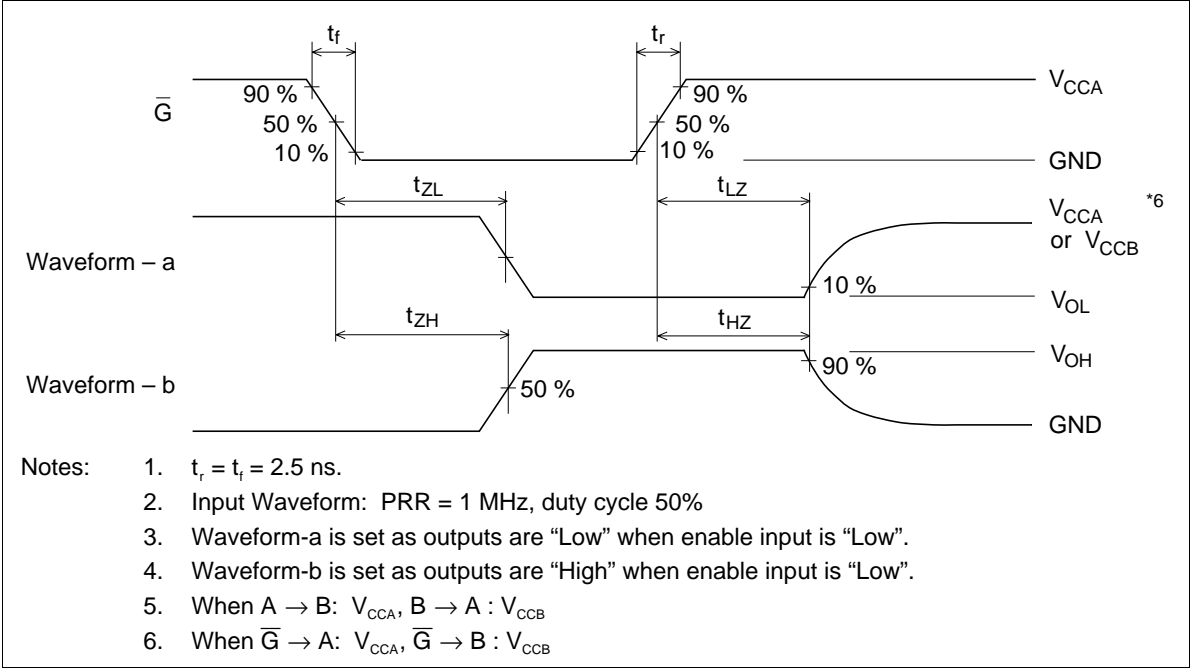
Input and Output Equivalent Circuit



Waveforms-1

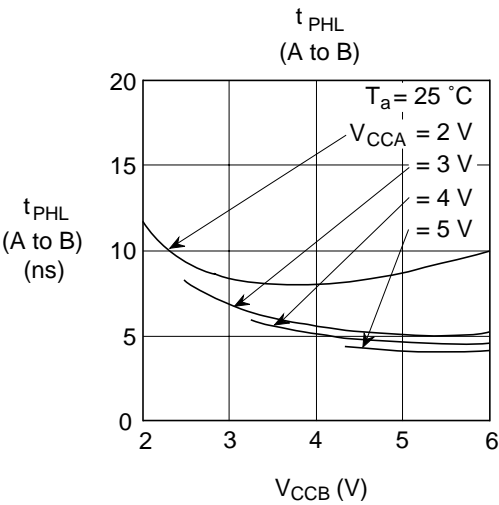
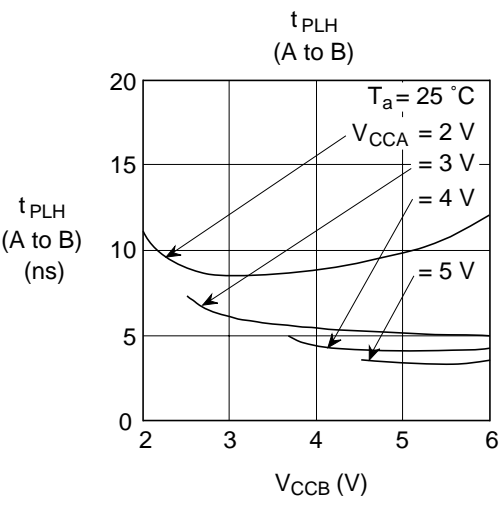
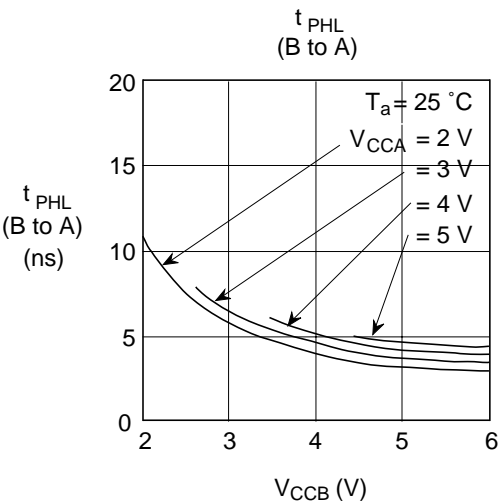
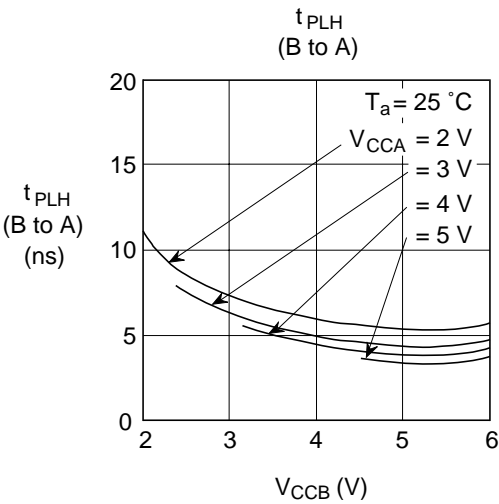


Waveforms-2

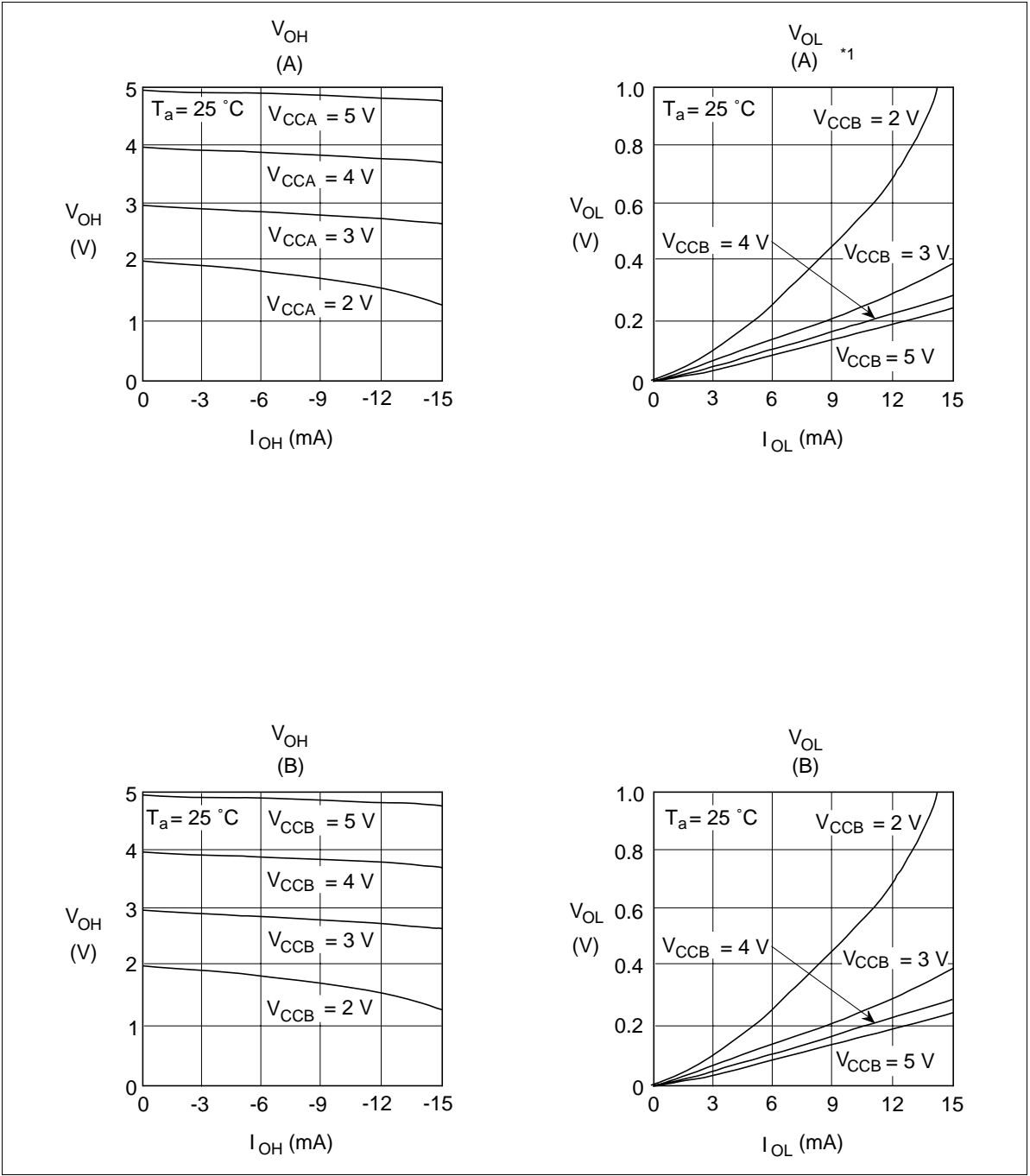


Typical Characteristic Curves

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

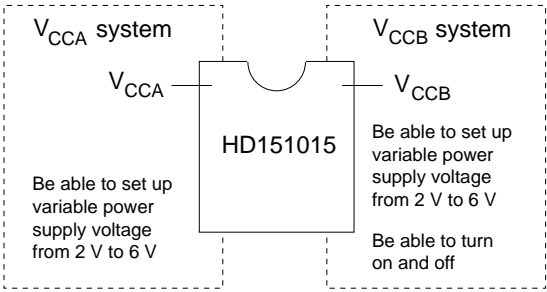


Output Voltage vs Output Current



Application

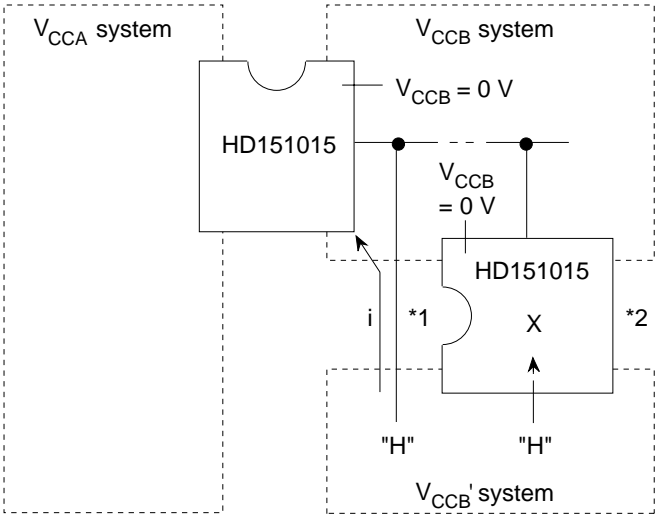
For power management system (1)



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.

Cautions

1. Hitachi neither warrants nor grants licenses of any rights of Hitachi's or any third party's patent, copyright, trademark, or other intellectual property rights for information contained in this document. Hitachi bears no responsibility for problems that may arise with third party's rights, including intellectual property rights, in connection with use of the information contained in this document.
2. Products and product specifications may be subject to change without notice. Confirm that you have received the latest product standards or specifications before final design, purchase or use.
3. Hitachi makes every attempt to ensure that its products are of high quality and reliability. However, contact Hitachi's sales office before using the product in an application that demands especially high quality and reliability or where its failure or malfunction may directly threaten human life or cause risk of bodily injury, such as aerospace, aeronautics, nuclear power, combustion control, transportation, traffic, safety equipment or medical equipment for life support.
4. Design your application so that the product is used within the ranges guaranteed by Hitachi particularly for maximum rating, operating supply voltage range, heat radiation characteristics, installation conditions and other characteristics. Hitachi bears no responsibility for failure or damage when used beyond the guaranteed ranges. Even within the guaranteed ranges, consider normally foreseeable failure rates or failure modes in semiconductor devices and employ systemic measures such as fail-safes, so that the equipment incorporating Hitachi product does not cause bodily injury, fire or other consequential damage due to operation of the Hitachi product.
5. This product is not designed to be radiation resistant.
6. No one is permitted to reproduce or duplicate, in any form, the whole or part of this document without written approval from Hitachi.
7. Contact Hitachi's sales office for any questions regarding this document or Hitachi semiconductor products.

HITACHI

Hitachi, Ltd.

Semiconductor & Integrated Circuits.
Nippon Bldg., 2-6-2, Ohite-machi, Chiyoda-ku, Tokyo 100-0004, Japan
Tel: Tokyo (03) 3270-2111 Fax: (03) 3270-5109

URL	North America	: http://semiconductor.hitachi.com/
	Europe	: http://www.hitachi-eu.com/hel/ecg
	Asia	: http://sicapac.hitachi-asia.com
	Japan	: http://www.hitachi.co.jp/Sicd/indx.htm

For further information write to:

Hitachi Semiconductor (America) Inc. 179 East Tasman Drive, San Jose, CA 95134 Tel: <1> (408) 433-1990 Fax: <1> (408) 433-0223	Hitachi Europe GmbH Electronic Components Group Dornacher Straße 3 D-85622 Feldkirchen, Munich Germany Tel: <49> (89) 9 9180-0 Fax: <49> (89) 9 29 30 00
	Hitachi Europe Ltd. Electronic Components Group. Whitebrook Park Lower Cookham Road Maidenhead Berkshire SL6 8YA, United Kingdom Tel: <44> (1628) 585000 Fax: <44> (1628) 585160

Hitachi Asia Ltd. Hitachi Tower 16 Collyer Quay #20-00, Singapore 049318 Tel: <65>-538-6533/538-8577 Fax: <65>-538-6933/538-3877 URL: http://www.hitachi.com.sg	Hitachi Asia Ltd. (Taipei Branch Office) 4/F, No. 167, Tun Hwa North Road, Hung-Kuo Building, Taipei (105), Taiwan Tel: <886>-(2)-2718-3666 Fax: <886>-(2)-2718-8180 Telex: 23222 HAS-TP URL: http://www.hitachi.com.tw
---	---

Hitachi Asia (Hong Kong) Ltd.
Group III (Electronic Components)
7/F., North Tower,
World Finance Centre,
Harbour City, Canton Road
Tsim Sha Tsui, Kowloon,
Hong Kong
Tel: <852>-(2)-735-9218
Fax: <852>-(2)-730-0281
URL: <http://www.hitachi.com.hk>

Copyright © Hitachi, Ltd., 2000. All rights reserved. Printed in Japan.
Colophon 2.0

HITACHI