
HD151015

9 bit Level Shifter/Transceiver With 3 State Outputs

HITACHI

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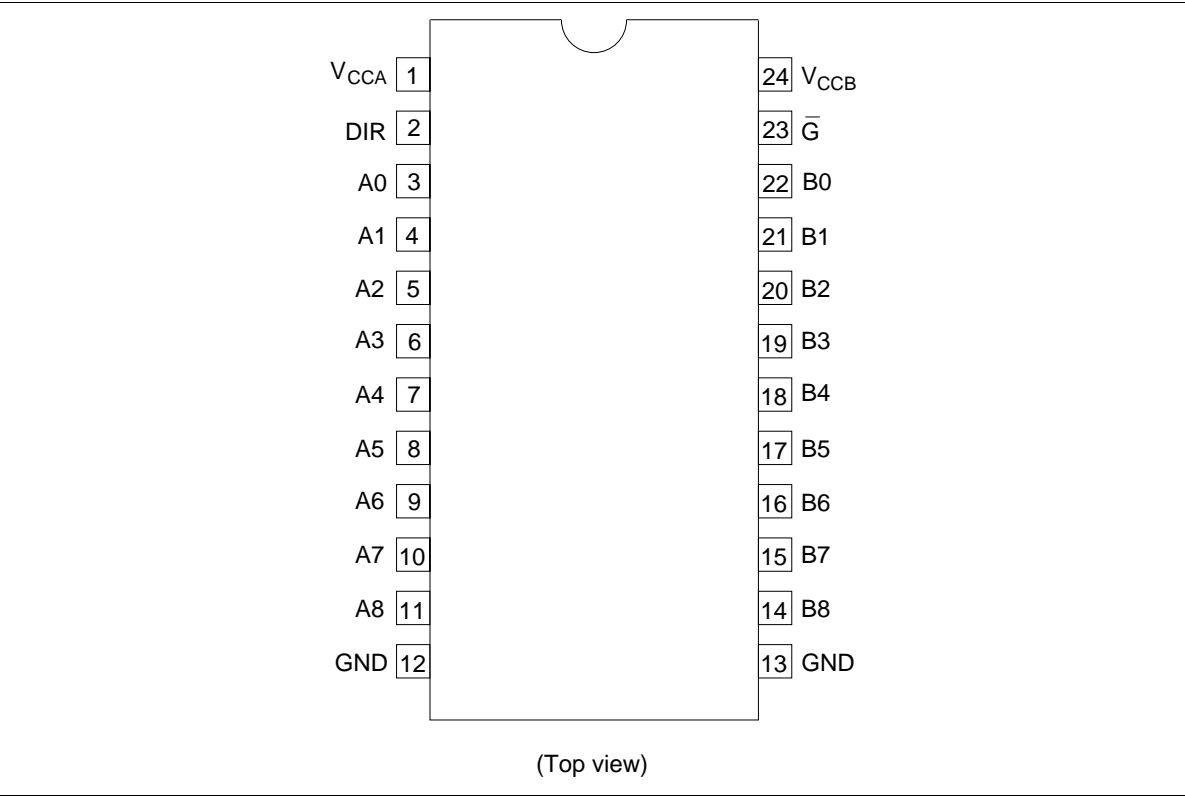
Description

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:
 $V_{CCA} = V_{CCB} = 2 \text{ to } 6 \text{ V}$ ($V_{CCB} \leq V_{CCA} - 0.5 \text{ V}$)
- 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	

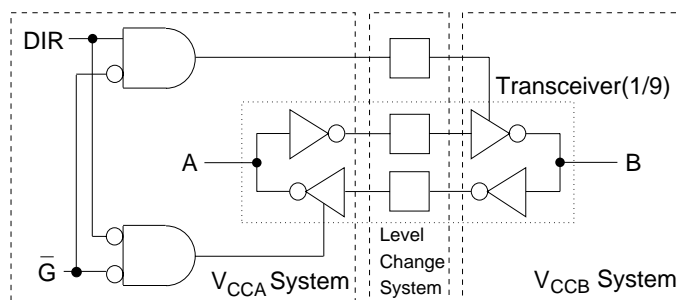
Note: 1. The absolute maximum ratings are values which must not individually be exceeded, and furthermore, no two of which may be realized at the same time.

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

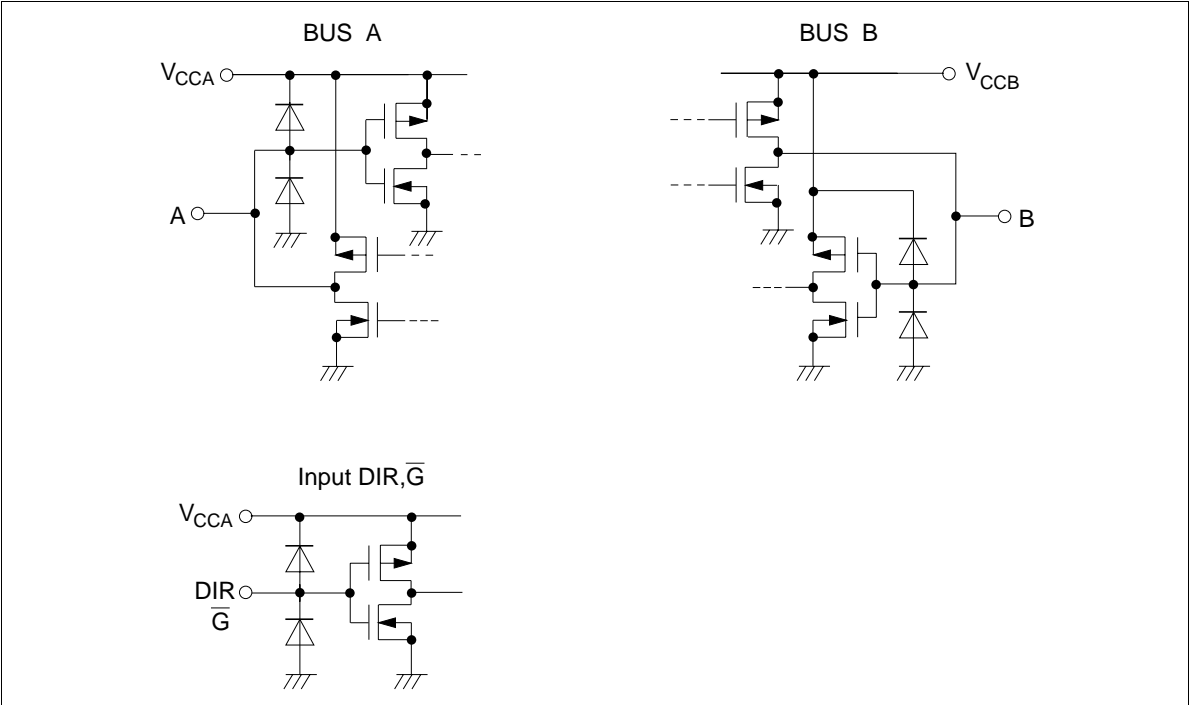
Switching Characteristics

Ta = 25°C
VCCA = 3.0 V, VCCB = 5.0 V

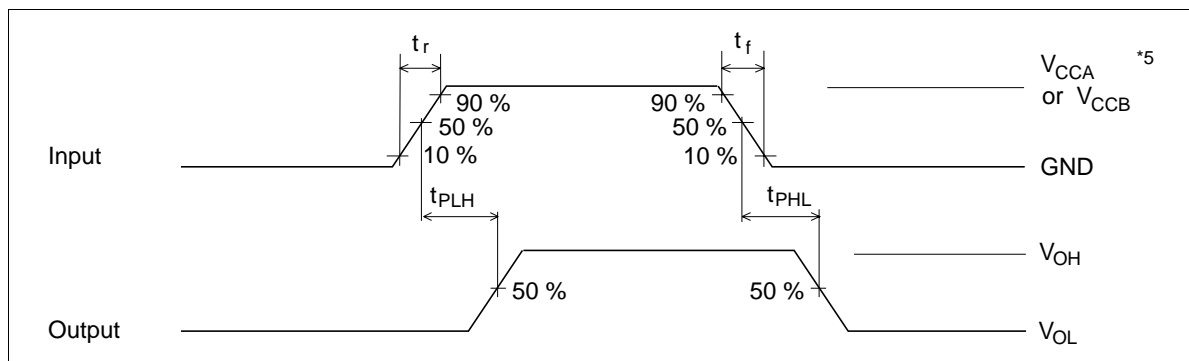
Ta = -40 to 85°C
VCC = 2.7 V, VCCB = 4.5 V

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		$\overline{G} \rightarrow B$
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		$\overline{G} \rightarrow B$

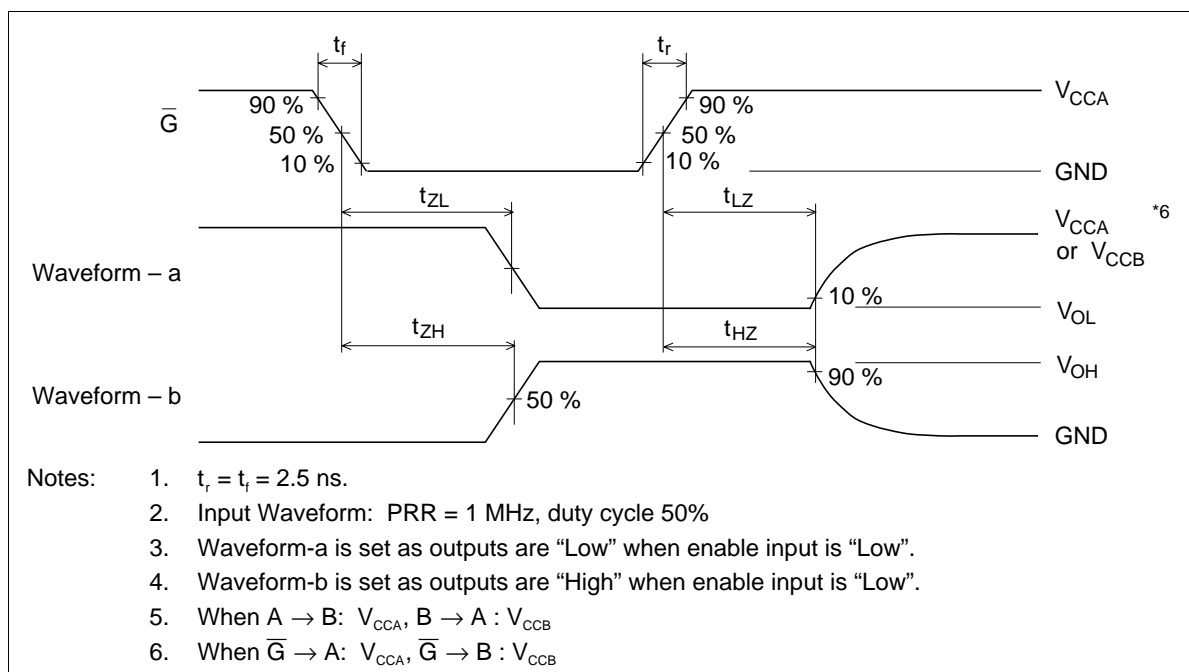
Input and Output Equivalent Circuit



Waveforms-1

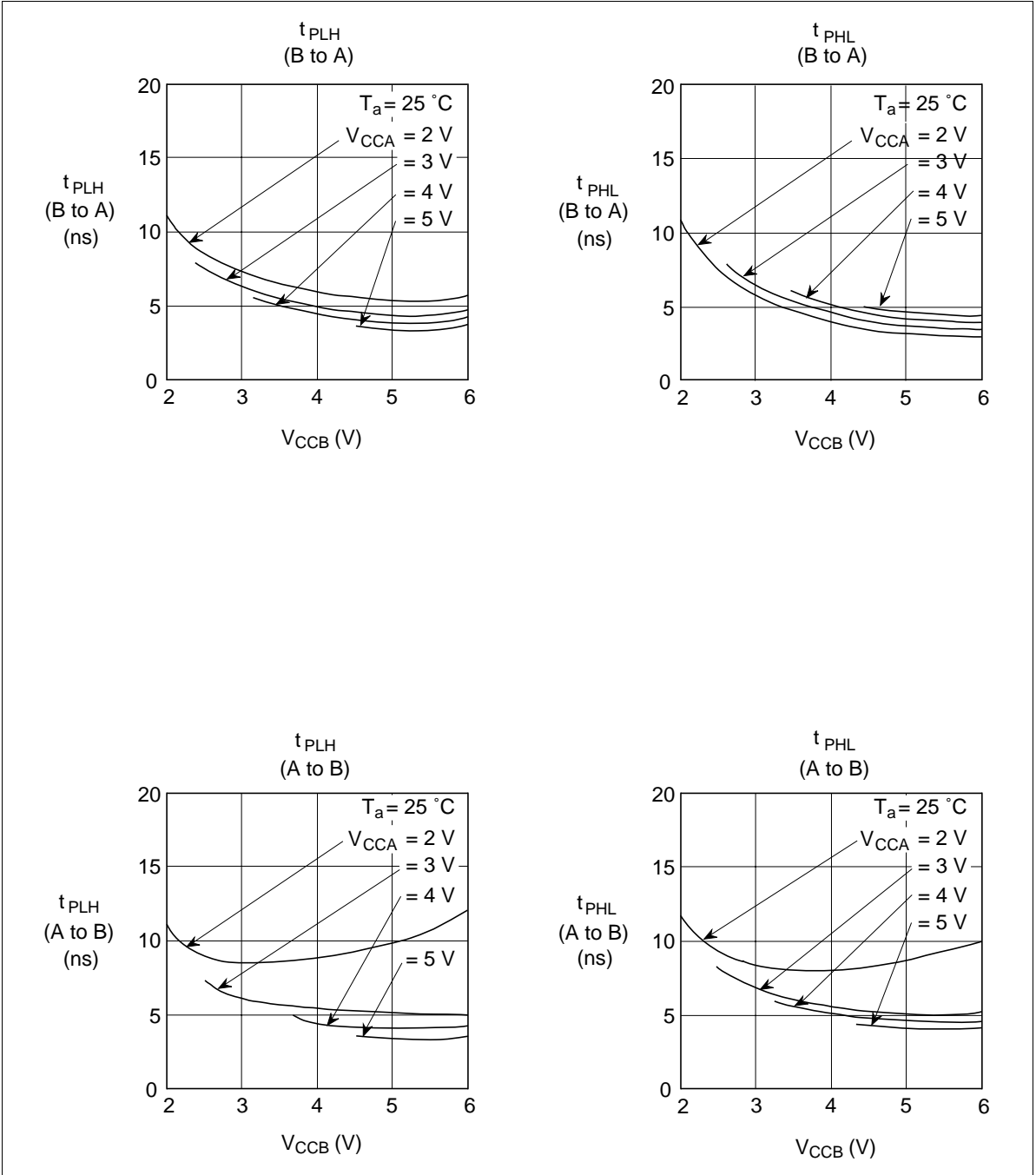


Waveforms-2

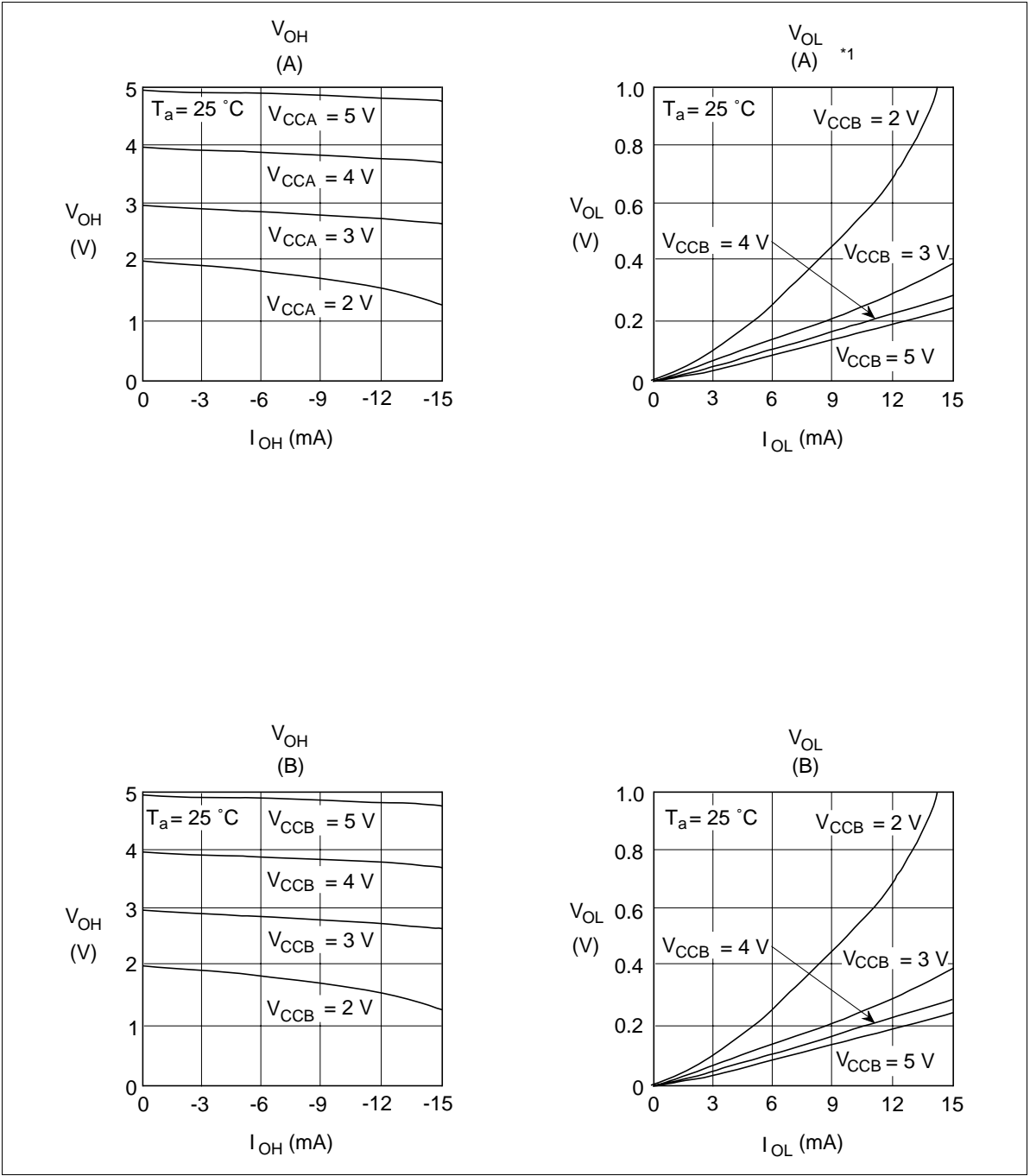


Typical Characteristic Curves

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

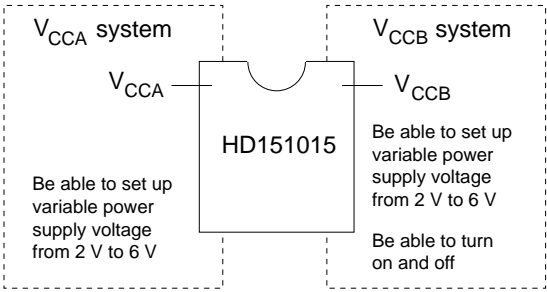


Output Voltage vs Output Current



Application

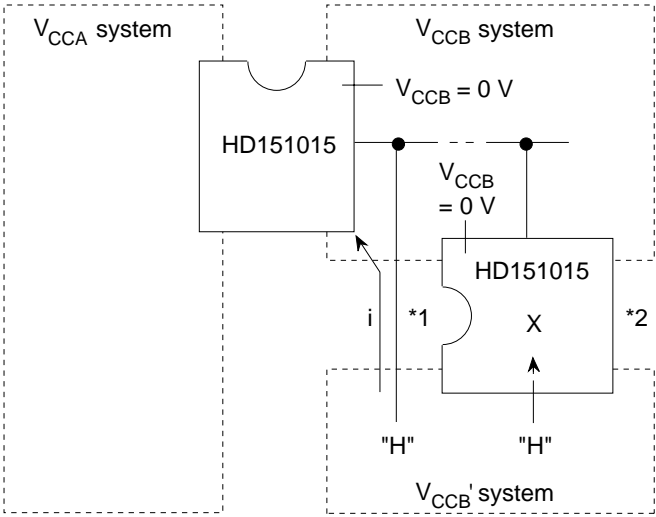
For power management system (1)



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.

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