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 VCCA 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} V_{CCA} – 0.5 V)
- Wide operating temperature range: Ta = –40 to 85°C

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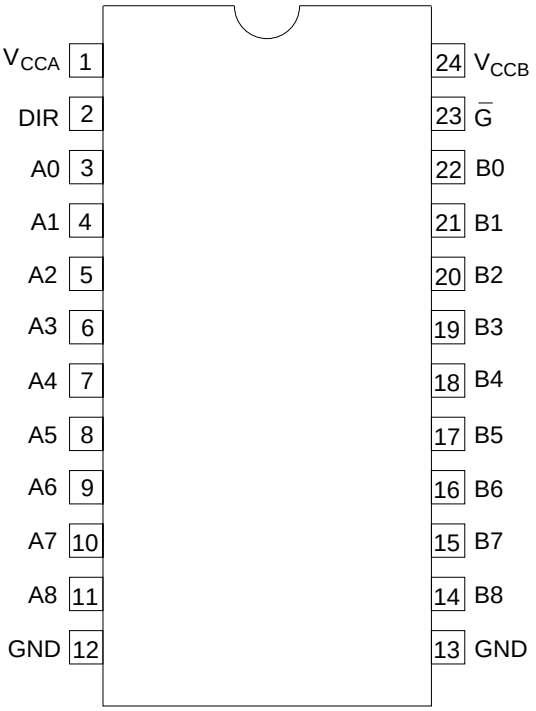
Pin Arrangement



(Top view)

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	Tstg	–65 to + 150	°C	

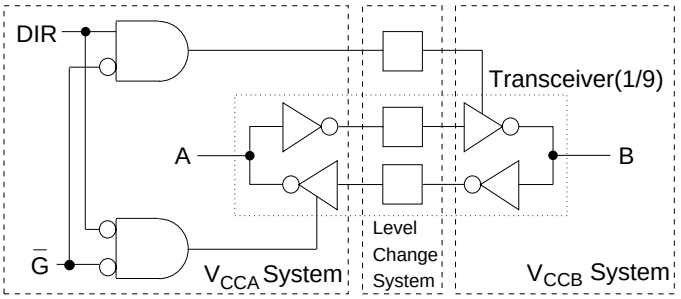
Note: 1. The absolute maximum ratings are values which must not individually be exceeded, and furthermore, no two of which may be realized at the same time.

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*[1]	t_r, t_f	8	ns/V	V_{CC}@3.0 V (Input DiR, $\overline{G}$, 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

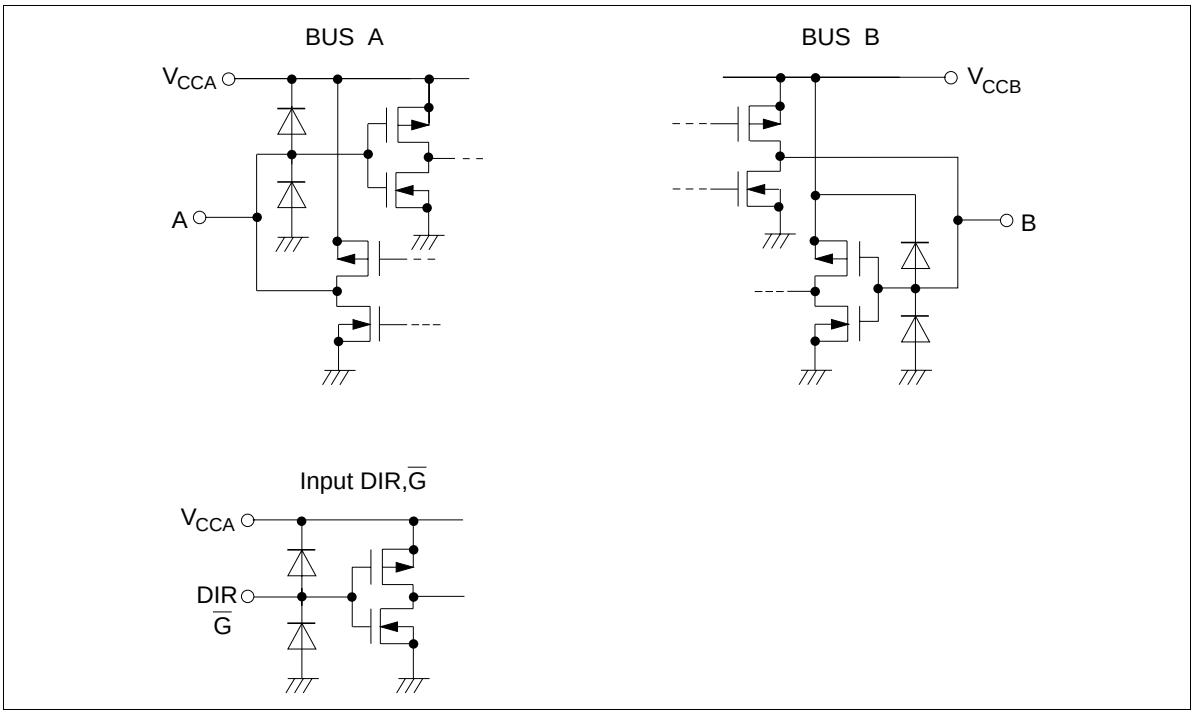
Item	Sym-bol	V_{CCA} (V)	V_{CCB} (V)	Ta = 25°C Min	Typ	Max	Ta = –40 to 85°C Min	Max	Unit	Conditions
Input Voltage	V_{IH}	3.0	3.0	2.1	1.5	—	2.1	—	V	V_{OUT} = 0.1 V or V_{CC} – 0.1 V
		4.5	4.5	3.15	2.25	—	3.15	—		
		5.5	5.5	3.85	2.75	—	3.85	—		
	V_{IL}	3.0	3.0	—	1.5	0.9	—	0.9	V	V_{OUT} = 0.1 V or V_{CC} – 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	$V_{IN}(\overline{G})$ = V_{IH}, V_{IN} = V_{CC} or GND, V_{OUT} = V_{CC} or GND
Supply Current	$I_{CCA.B}$	3.3	5.5	—	—	8.0	—	80	µA	V_{IN} = V_{CC} or GND
	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

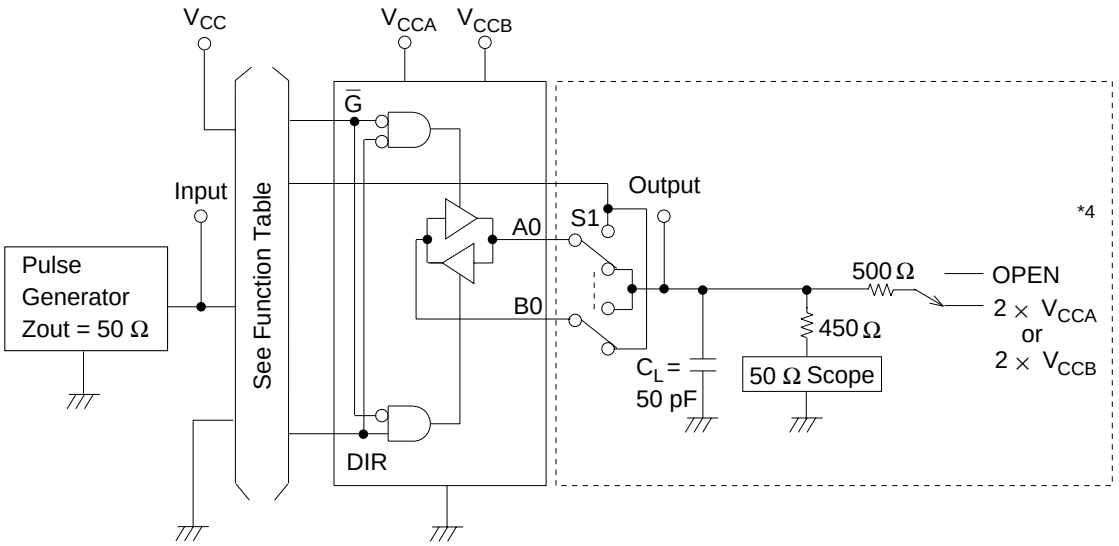
		Ta = 25°C V_{CCA} = 3.0 V, V_{CCB} = 5.0 V			Ta = –40 to 85°C V_{CC} = 2.7 V, V_{CCB} = 4.5 V			
Item	**Symbol**	**Min**	**Typ**	**Max**	**Min**	**Max**	**Unit**	**Conditions**
Propagation Delay Time	t_{PLH}	1.0	5.0	10.0	1.0	12.0	ns	B → A
		1.0	5.0	10.0	1.0	12.0		A → B
	t_{PHL}	1.0	5.0	10.0	1.0	12.0	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	$\overline{G}$ → A
		1.0	8.0	16.0	1.0	20.0		$\overline{G}$ → B
	t_{ZL}	1.0	9.0	16.0	1.0	20.0	ns	$\overline{G}$ → A
		1.0	9.0	16.0	1.0	20.0		$\overline{G}$ → A
Output Disable Time	t_{HZ}	1.0	9.0	16.0	1.0	20.0	ns	$\overline{G}$ → A
		1.0	9.0	16.0	1.0	20.0		$\overline{G}$ → B
	t_{LZ}	1.0	8.0	16.0	1.0	20.0	ns	$\overline{G}$ → A
		1.0	8.0	16.0	1.0	20.0		$\overline{G}$ → B

Input and Output Equivalent Circuit



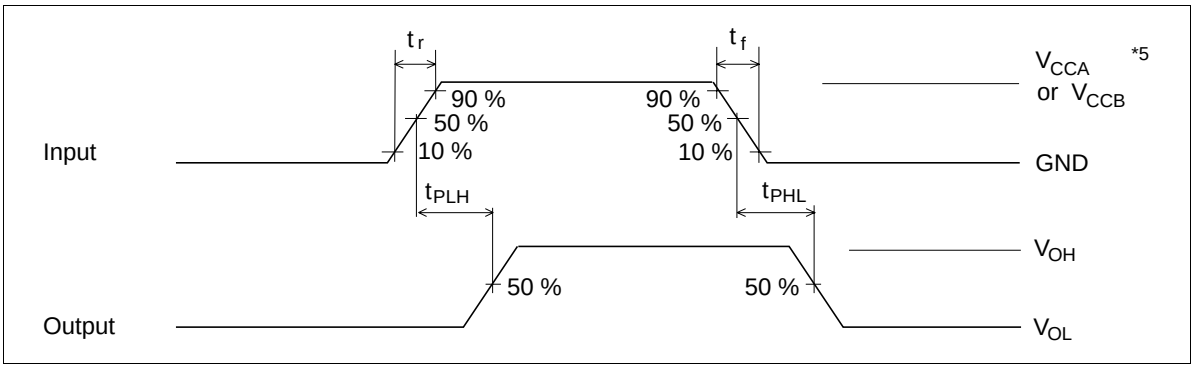
Switching Time Test Method

Test Circuit

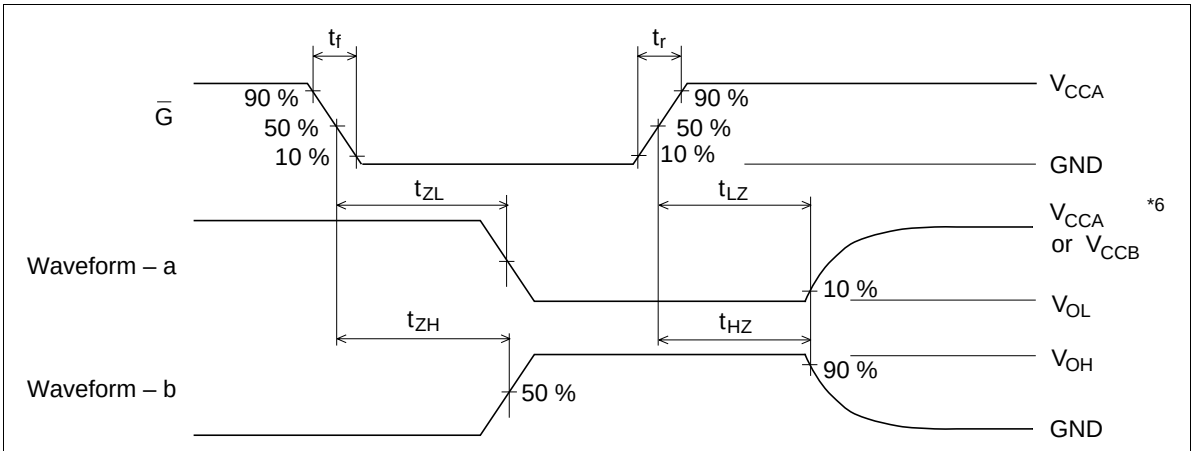


Notes:
1. C_L includes probe and jig capacitance.
2. A1-B1, A2-B2, A3-B3, A4-B4, A5-B5, A6-B6, A7-B7, A8-B8 are identical to above circuit.
3. S1 is a input/output switch.
4. When A → B: 2 × V_{CCB}, B → A: 2 ¥ V_{CCA}

Waveforms-1



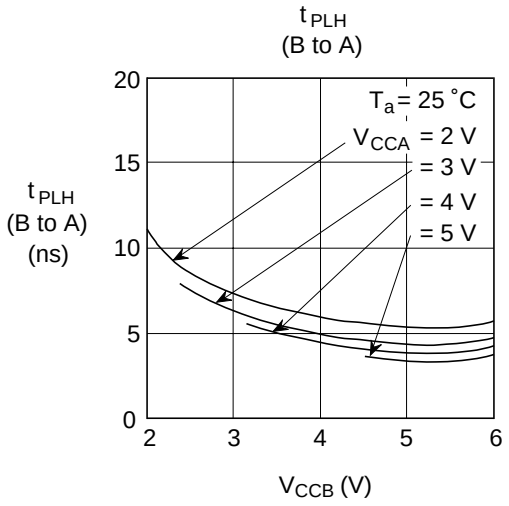
Waveforms-2

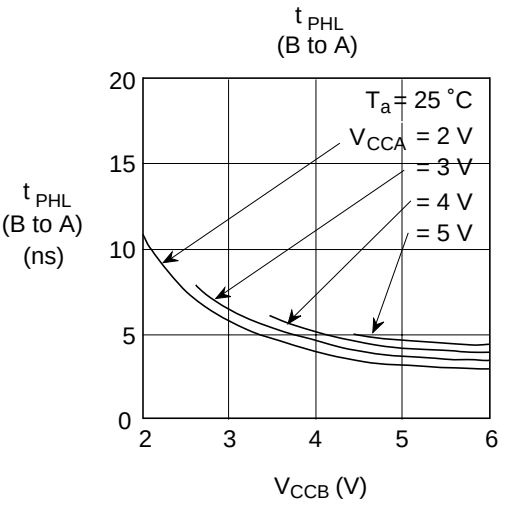


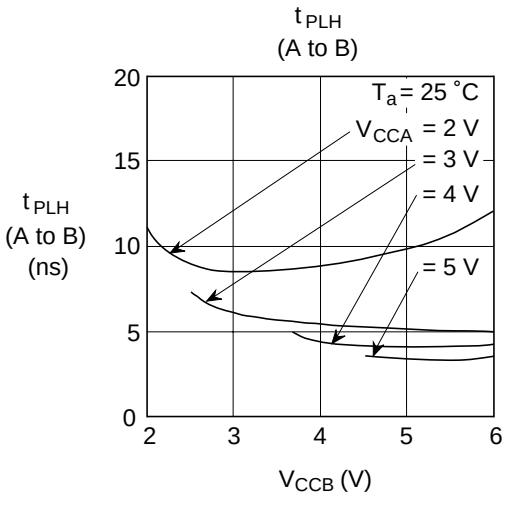
Notes:
1. $t_r = t_f = 2.5$ ns.
2. Input Waveform: PRR = 1 MHz, duty cycle 50%
3. Waveform-a is set as outputs are “Low” when enable input is “Low”.
4. Waveform-b is set as outputs are “High” when enable input is “Low”.
5. When A $\rightarrow$ B: V_{CCA}, B $\rightarrow$ A : V_{CCB}
6. When $\overline{G}$ $\rightarrow$ A: V_{CCA}, $\overline{G}$ $\rightarrow$ B : V_{CCB}

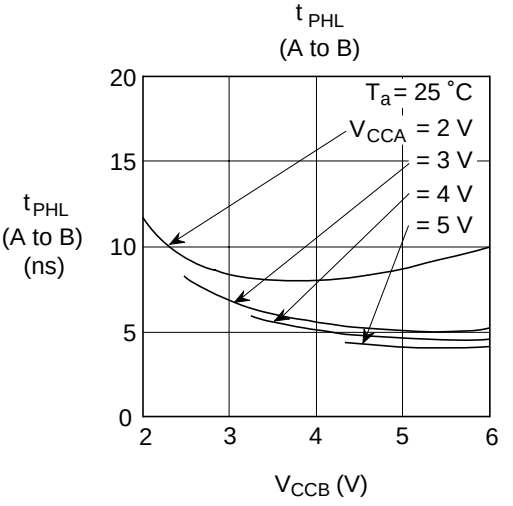
Typical Characteristic Curves

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

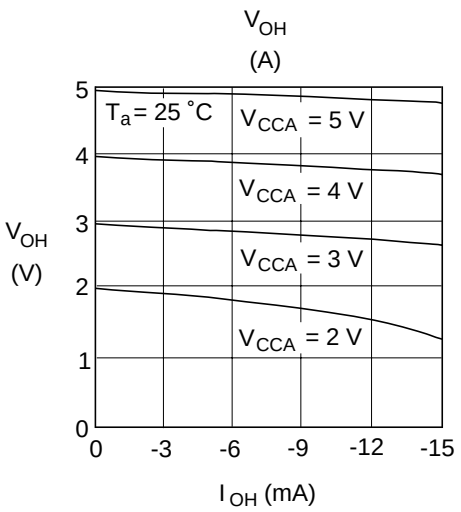


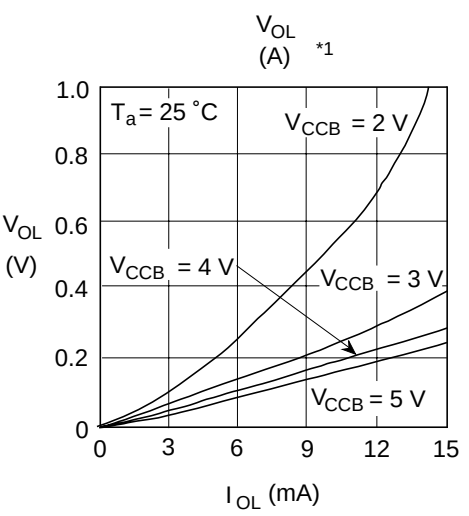


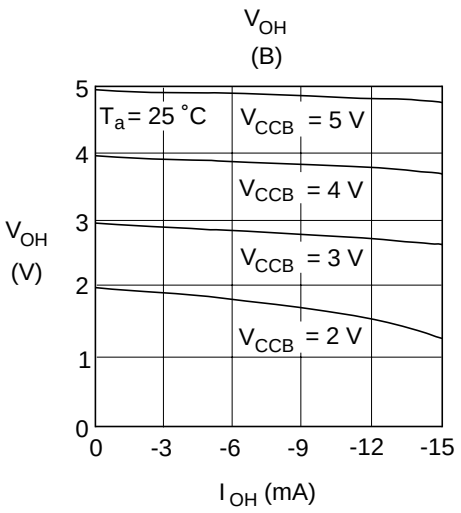


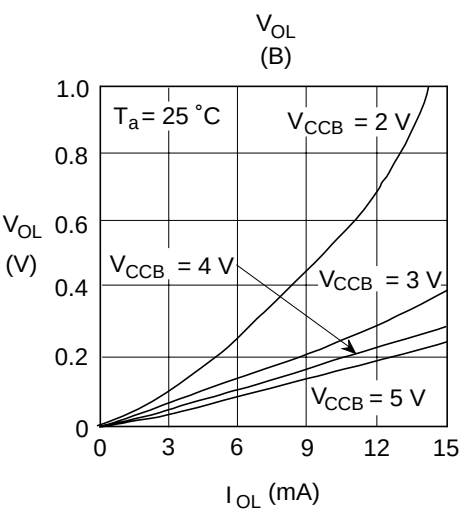


Output Voltage vs Output Current



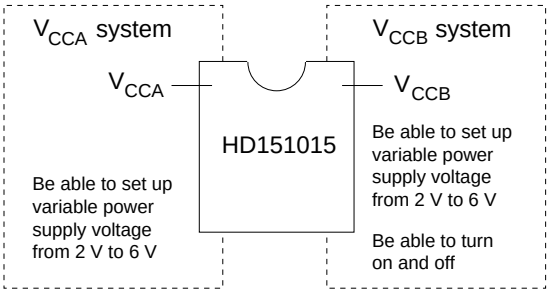






Application

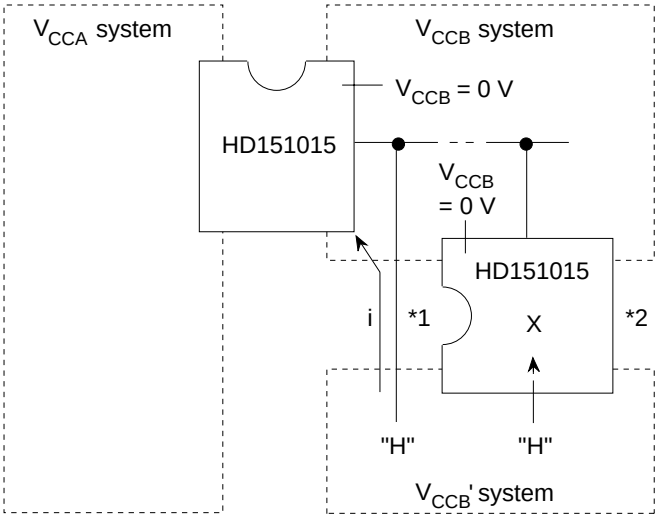
For power management system (1)



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

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])

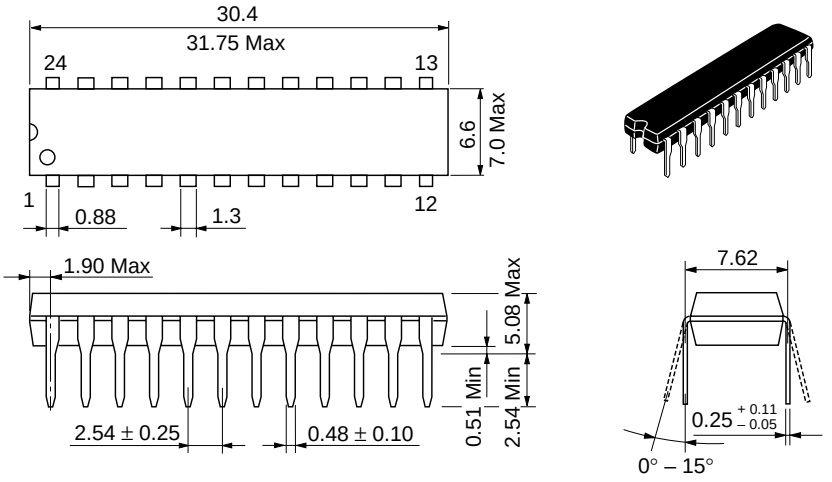
This is cause of malfunction. In order to prevent this problem, I recommend using this device for interface to each power block. (refer to *[2])

[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.

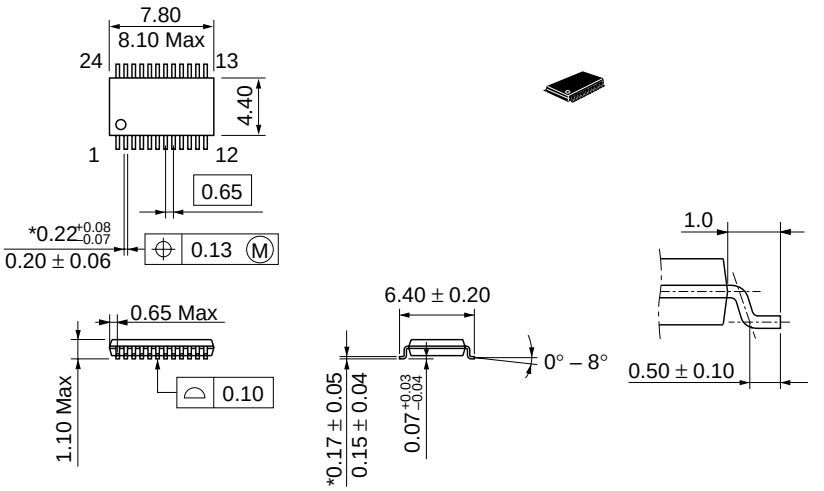
Package Dimensions

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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