

HD151015

9 bit Level Shifter/Transceiver With 3 State Outputs

REJ03D0300-0500

Rev.5.00

May 10, 2006

Description

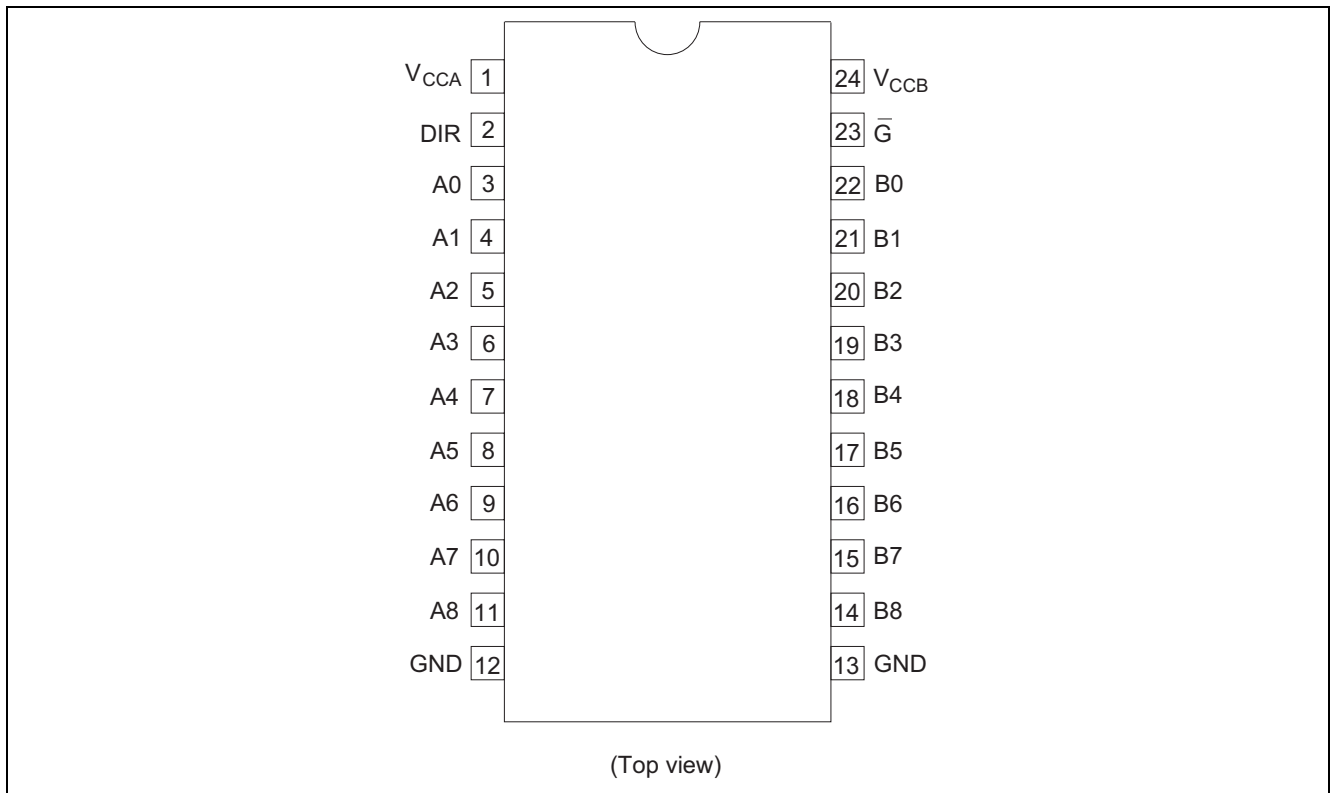
The HD151015 is an IC which consists of 9 bus transceivers (three state output) in a 24 pin package. Signals are transmitter from A to B when the direction control input (DiR) is at a high level, and from B to A when DiR is at a low level. When the enable input (\bar{G}) is high, A and B are isolated. 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 (\bar{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 ($V_{CCB} \geq V_{CCA} - 0.5$ V)
- Wide operating temperature range: $T_a = -40$ to 85°C
- Ordering Information

Part Name	Package Type	Package Code (Previous Code)	Package Abbreviation	Taping Abbreviation (Quantity)
HD151015TEL	TSSOP-24 pin	PTSP0024JB-A (TTP-24DBV)	T	EL (1,000 pcs/reel)

Pin Arrangement



Function Table

Inputs		Outputs
\bar{G}	DIR	
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	$^{\circ}C$	

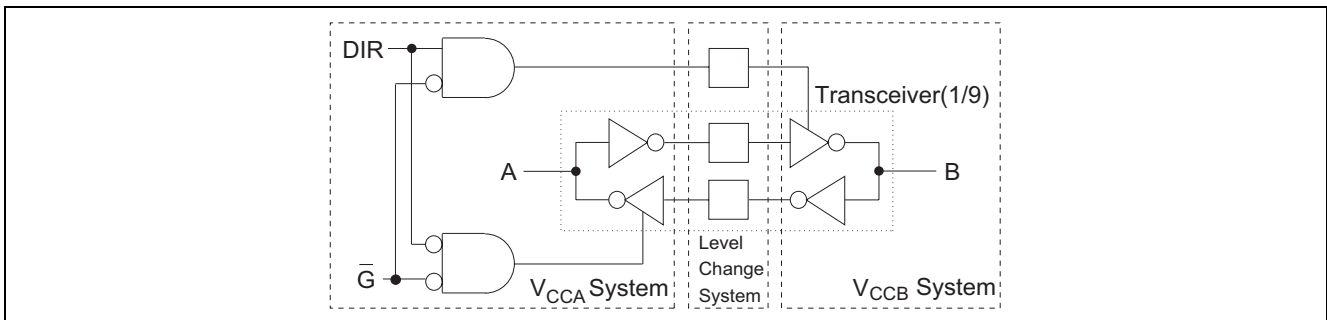
Note: 1. The absolute maximum ratings are values which must not individually be exceeded, and furthermore, no two of which may be realized at the same time.

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, \bar{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

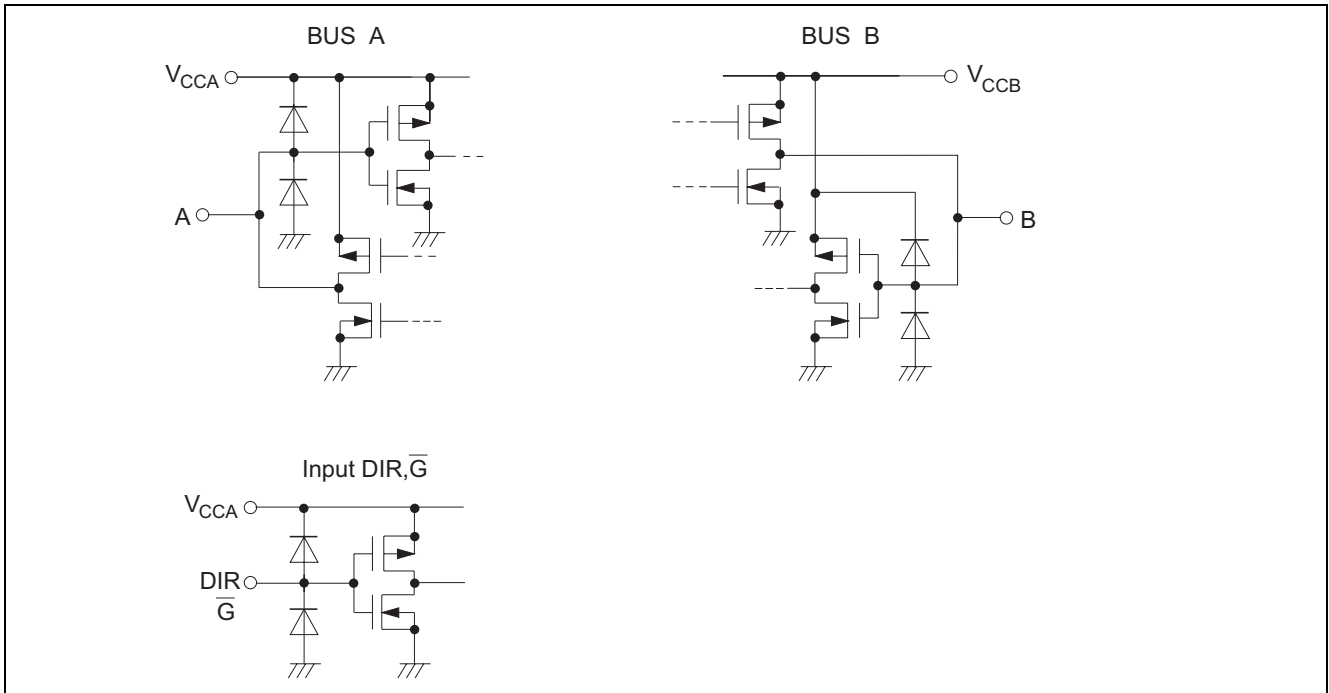
Item	Sym- bol	V_{CCA} (V)	V_{CCB} (V)	$T_a = 25^\circ\text{C}$			$T_a = -40 \text{ to } 85^\circ\text{C}$		Unit	Conditions		
				Min	Typ	Max	Min	Max				
Input Voltage	V_{IH}	3.0	3.0	2.1	1.5	—	2.1	—	V	$V_{OUT} = 0.1 \text{ V}$ or $V_{CC} - 0.1 \text{ V}$		
		4.5	4.5	3.15	2.25	—	3.15	—				
		5.5	5.5	3.85	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	$V_{IN} = V_{IL}$ or V_{IH} , $I_{OH} = -50 \mu\text{A}$	A* ¹	
		2.7	4.5	4.4	4.49	—	4.4	—		$V_{IN} = V_{IL}$ 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} or V_{IH}	$I_{OH} = -12 \text{ mA}$	B
	V_{OL}	2.7	4.5	—	0.001	0.1	—	0.1	V	$V_{IN} = V_{IL}$ or V_{IH} , $I_{OL} = 50 \mu\text{A}$	A.B	
		2.7	4.5	—	—	0.32	—	0.37	V	$V_{IN} = V_{IL}$ or V_{IH} , $I_{OL} = 12 \text{ mA}$	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 Current	I_{CCAB}	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

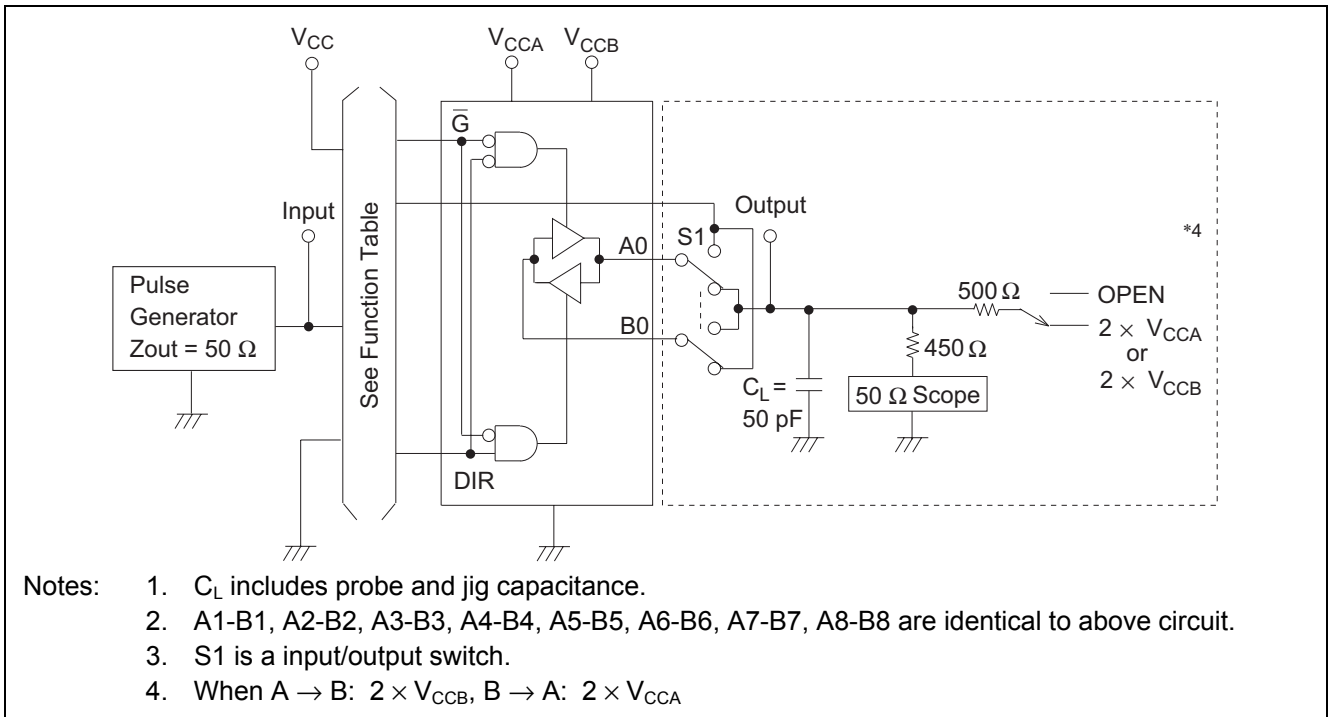
Item	Symbol	Ta = 25°C			Ta = -40 to 85°C		Unit	Conditions
		VCCA = 3.0 V, VCCB = 5.0 V			VCC = 2.7 V, VCCB = 4.5 V			
		Min	Typ	Max	Min	Max		
Propagation Delay Time	t _{PLH}	1.0	5.0	10.0	1.0	12.0	ns	B → A
		1.0	5.0	10.0	1.0	12.0		A → B
	t _{PHL}	1.0	5.0	10.0	1.0	12.0	ns	B → A
		1.0	5.0	10.0	1.0	12.0		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

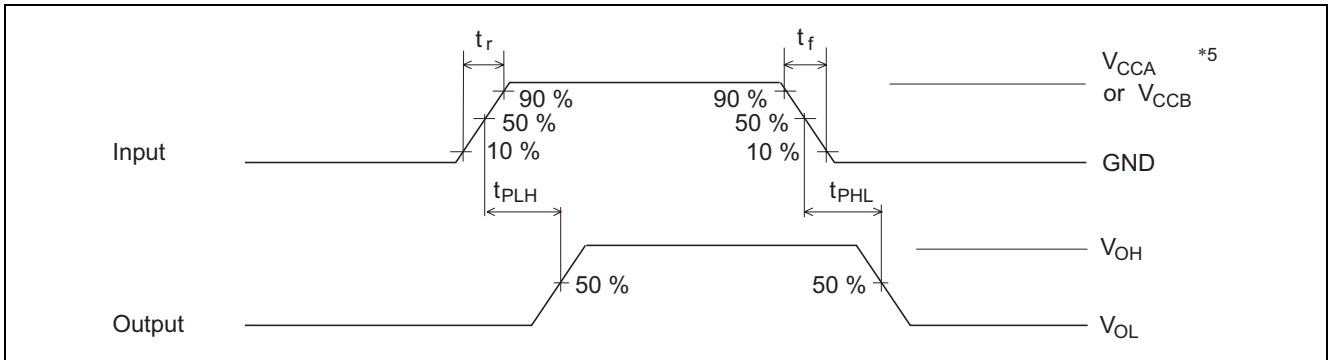


Switching Time Test Method

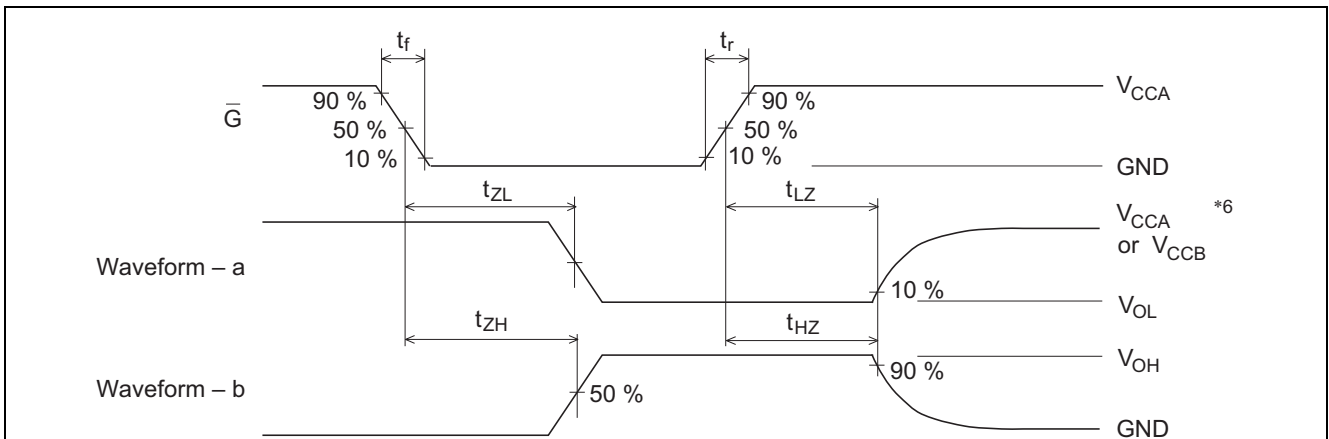
Test Circuit



Waveforms-1



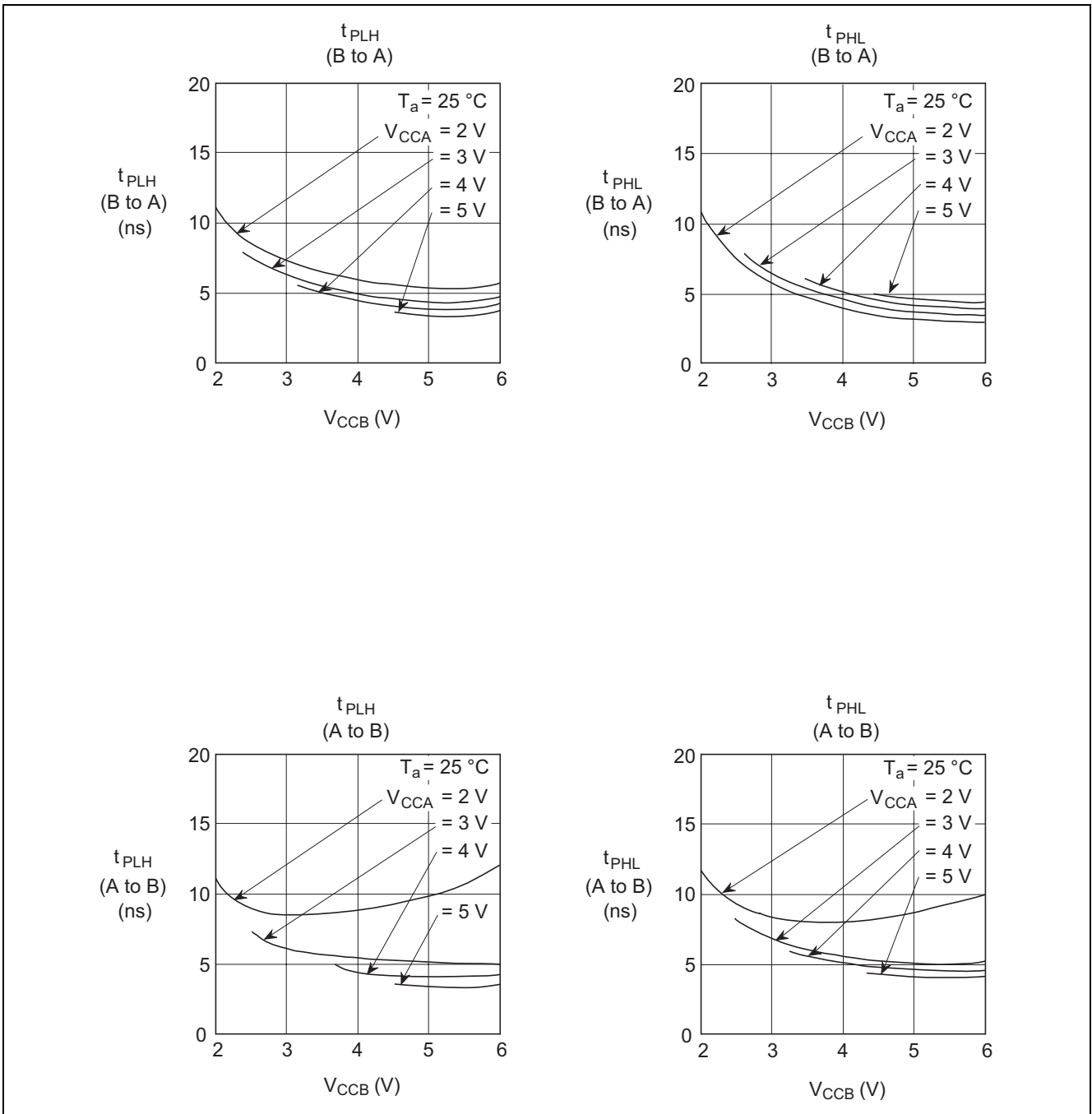
Waveforms-2



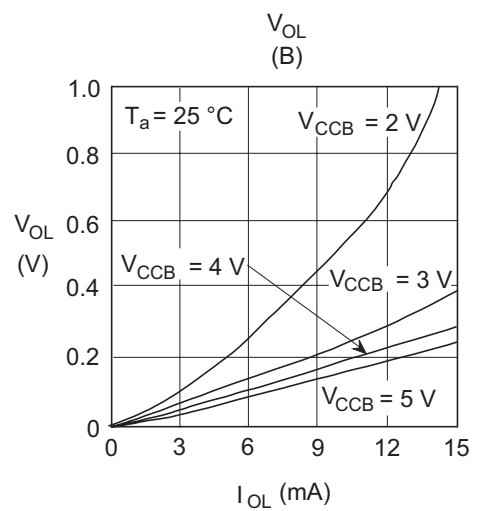
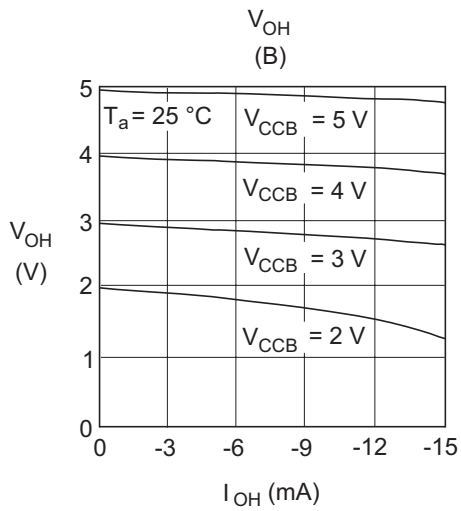
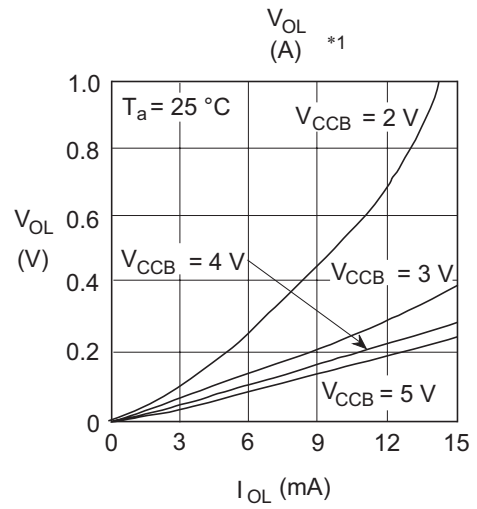
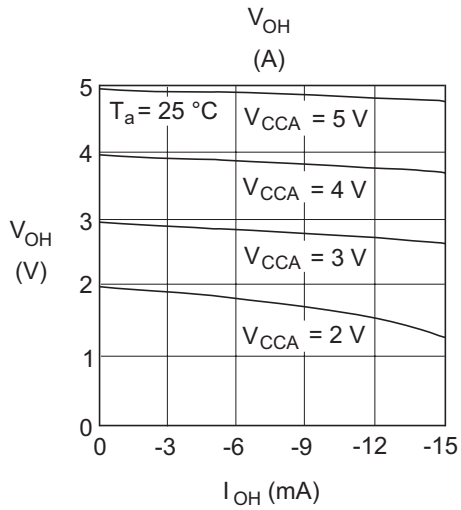
- Notes:
1. $t_r = t_f = 2.5 \text{ ns}$.
 2. Input Waveform: PRR = 1 MHz, duty cycle 50%
 3. Waveform-a is set as outputs are "Low" when enable input is "Low".
 4. Waveform-b is set as outputs are "High" when enable input is "Low".
 5. When $A \rightarrow B$: V_{CCA} , $B \rightarrow A$: V_{CCB}
 6.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

Typical Characteristic Curves

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



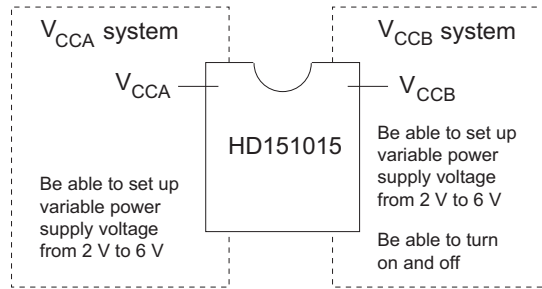
Output Voltage vs Output Current



Note: 1. V_{OL} (A) does not depend on V_{CCA}

Application

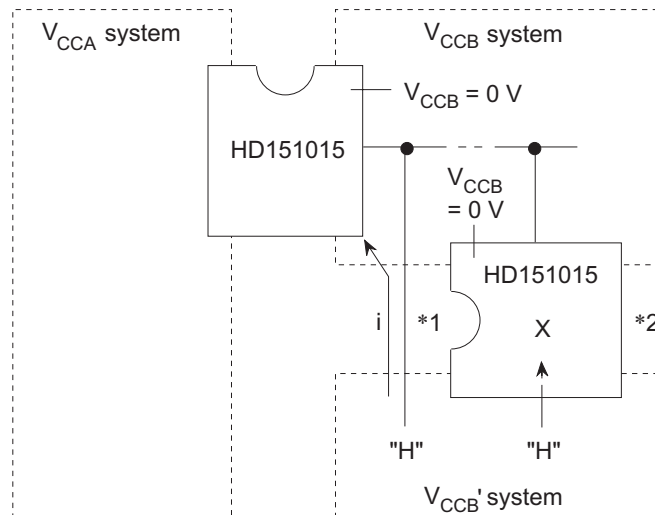
For power management system (1)



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)

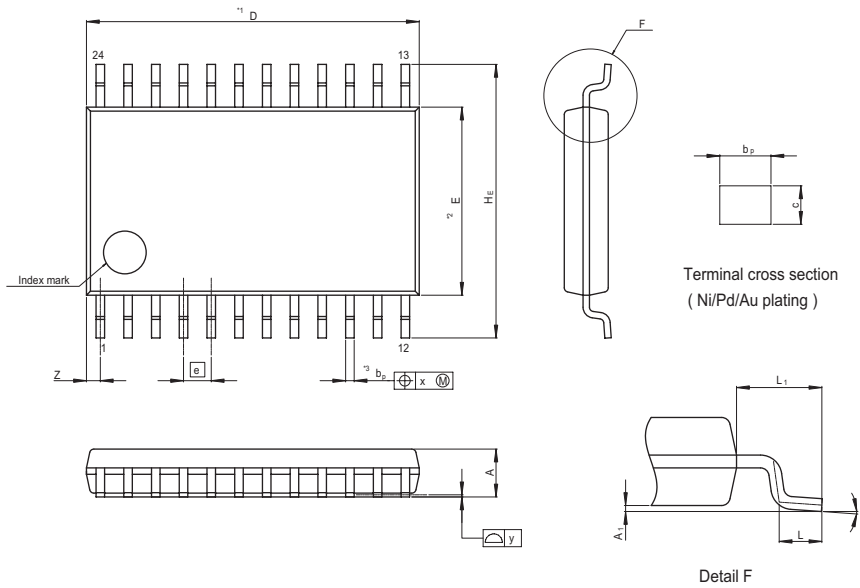
This is cause of malfunction. In order to prevent this problem, I recommend using this device for interface to each power block. (refer to *²)

[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

JEITA Package Code	RENESAS Code	Previous Code	MASS[Typ.]
P-TSSOP24-4.4x7.8-0.65	PTSP0024JB-A	TTP-24DBV	0.08g



NOTE)
 1. DIMENSIONS**1 (Nom)**AND**2"
 DO NOT INCLUDE MOLD FLASH.
 2. DIMENSION**3"DOES NOT
 INCLUDE TRIM OFFSET.

Reference Symbol	Dimension in Millimeters		
	Min	Nom	Max
D	—	7.80	8.10
E	—	4.40	—
A ₂	—	—	—
A ₁	0.03	0.07	0.10
A	—	—	1.10
b _P	0.15	0.20	0.25
b ₁	—	—	—
c	0.10	0.15	0.20
c ₁	—	—	—
θ	0°	—	8°
H _E	6.20	6.40	6.60
Ⓜ	—	0.65	—
x	—	—	0.13
y	—	—	0.10
Z	—	—	0.65
L	0.4	0.5	0.6
L ₁	—	1.0	—

Keep safety first in your circuit designs!

1. Renesas Technology Corp. puts the maximum effort into making semiconductor products better and more reliable, but there is always the possibility that trouble may occur with them. Trouble with semiconductors may lead to personal injury, fire or property damage.
Remember to give due consideration to safety when making your circuit designs, with appropriate measures such as (i) placement of substitutive, auxiliary circuits, (ii) use of nonflammable material or (iii) prevention against any malfunction or mishap.

Notes regarding these materials

1. These materials are intended as a reference to assist our customers in the selection of the Renesas Technology Corp. product best suited to the customer's application; they do not convey any license under any intellectual property rights, or any other rights, belonging to Renesas Technology Corp. or a third party.
2. Renesas Technology Corp. assumes no responsibility for any damage, or infringement of any third-party's rights, originating in the use of any product data, diagrams, charts, programs, algorithms, or circuit application examples contained in these materials.
3. All information contained in these materials, including product data, diagrams, charts, programs and algorithms represents information on products at the time of publication of these materials, and are subject to change by Renesas Technology Corp. without notice due to product improvements or other reasons. It is therefore recommended that customers contact Renesas Technology Corp. or an authorized Renesas Technology Corp. product distributor for the latest product information before purchasing a product listed herein.
The information described here may contain technical inaccuracies or typographical errors.
Renesas Technology Corp. assumes no responsibility for any damage, liability, or other loss rising from these inaccuracies or errors.
Please also pay attention to information published by Renesas Technology Corp. by various means, including the Renesas Technology Corp. Semiconductor home page (<http://www.renesas.com>).
4. When using any or all of the information contained in these materials, including product data, diagrams, charts, programs, and algorithms, please be sure to evaluate all information as a total system before making a final decision on the applicability of the information and products. Renesas Technology Corp. assumes no responsibility for any damage, liability or other loss resulting from the information contained herein.
5. Renesas Technology Corp. semiconductors are not designed or manufactured for use in a device or system that is used under circumstances in which human life is potentially at stake. Please contact Renesas Technology Corp. or an authorized Renesas Technology Corp. product distributor when considering the use of a product contained herein for any specific purposes, such as apparatus or systems for transportation, vehicular, medical, aerospace, nuclear, or undersea repeater use.
6. The prior written approval of Renesas Technology Corp. is necessary to reprint or reproduce in whole or in part these materials.
7. If these products or technologies are subject to the Japanese export control restrictions, they must be exported under a license from the Japanese government and cannot be imported into a country other than the approved destination.
Any diversion or reexport contrary to the export control laws and regulations of Japan and/or the country of destination is prohibited.
8. Please contact Renesas Technology Corp. for further details on these materials or the products contained therein.



RENESAS SALES OFFICES

<http://www.renesas.com>

Refer to "<http://www.renesas.com/en/network>" for the latest and detailed information.

Renesas Technology America, Inc.

450 Holger Way, San Jose, CA 95134-1368, U.S.A
Tel: <1> (408) 382-7500, Fax: <1> (408) 382-7501

Renesas Technology Europe Limited

Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K.
Tel: <44> (1628) 585-100, Fax: <44> (1628) 585-900

Renesas Technology (Shanghai) Co., Ltd.

Unit 204, 205, AZIACenter, No.1233 Lujiazui Ring Rd, Pudong District, Shanghai, China 200120
Tel: <86> (21) 5877-1818, Fax: <86> (21) 6887-7898

Renesas Technology Hong Kong Ltd.

7th Floor, North Tower, World Finance Centre, Harbour City, 1 Canton Road, Tsimshatsui, Kowloon, Hong Kong
Tel: <852> 2265-6688, Fax: <852> 2730-6071

Renesas Technology Taiwan Co., Ltd.

10th Floor, No.99, Fushing North Road, Taipei, Taiwan
Tel: <886> (2) 2715-2888, Fax: <886> (2) 2713-2999

Renesas Technology Singapore Pte. Ltd.

1 Harbour Front Avenue, #06-10, Keppel Bay Tower, Singapore 098632
Tel: <65> 6213-0200, Fax: <65> 6278-8001

Renesas Technology Korea Co., Ltd.

Kukje Center Bldg. 18th Fl., 191, 2-ka, Hangang-ro, Yongsan-ku, Seoul 140-702, Korea
Tel: <82> (2) 796-3115, Fax: <82> (2) 796-2145

Renesas Technology Malaysia Sdn. Bhd

Unit 906, Block B, Menara Amcorp, Amcorp Trade Centre, No.18, Jalan Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: <603> 7955-9390, Fax: <603> 7955-9510