

HD151015

9 bit Level Shifter/Transceiver With 3 State Outputs

 R04DS0043EJ0600
 (Previous: REJ03D0300-0500)

Rev.6.00

May 30, 2014

Description

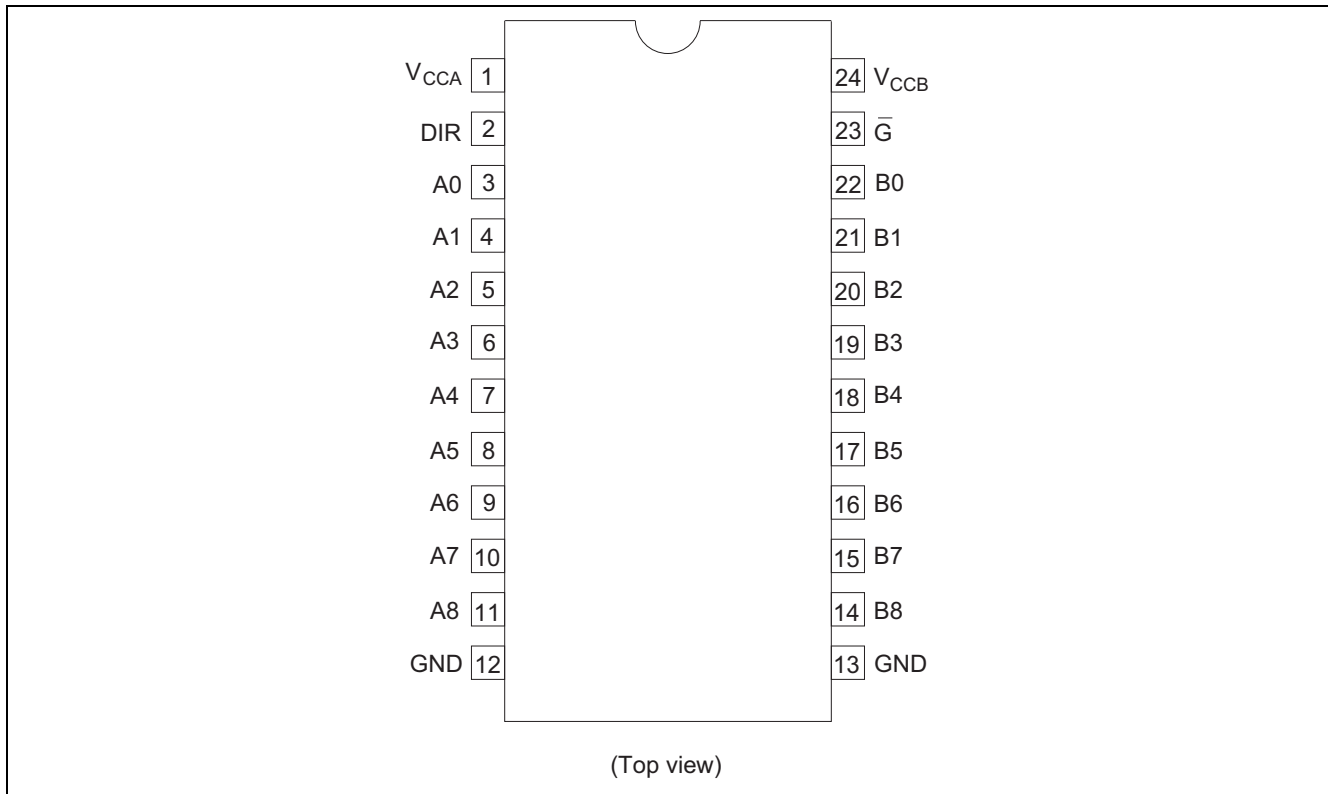
The HD151015 is an IC which consists of 9 bus transceivers (three state output) in a 24 pin package. Signals are transmitter from A to B when the direction control input (DiR) is at a high level, and from B to A when DiR is at a low level. When the enable input (\bar{G}) is high, A and B are isolated. 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)
151015TEL-E	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	°C	

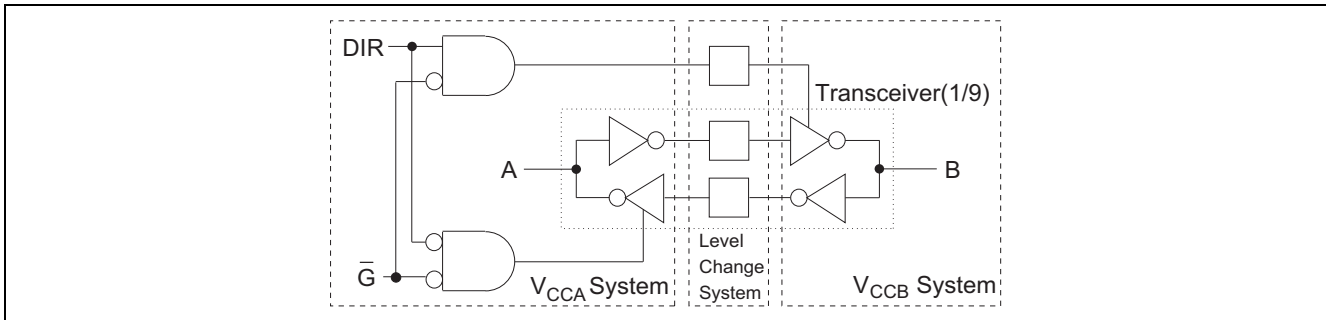
Note: 1. The absolute maximum ratings are values which must not individually be exceeded, and furthermore, no two of which may be realized at the same time.

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, \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

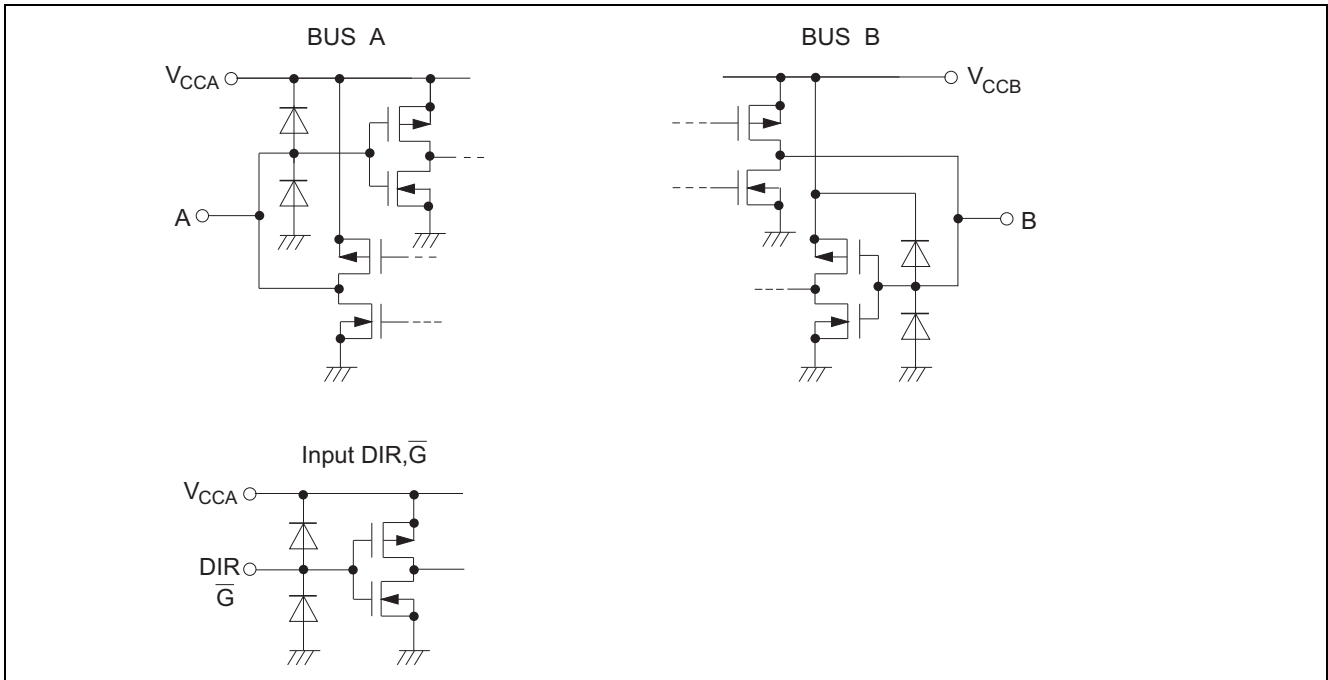
Item	Sym- bol	V_{CCA} (V)	V_{CCB} (V)	$T_a = 25^\circ C$			$T_a = -40$ to $85^\circ C$		Unit	Conditions		
				Min	Typ	Max	Min	Max				
Input Voltage	V_{IH}	3.0	3.0	2.1	1.5	—	2.1	—	V	$V_{OUT} = 0.1 V$ or $V_{CC} - 0.1 V$		
		4.5	4.5	3.15	2.25	—	3.15	—				
		5.5	5.5	3.85	2.75	—	3.85	—				
	V_{IL}	3.0	3.0	—	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} , $I_{OH} = -50 \mu A$	A* ¹	
		2.7	4.5	4.4	4.49	—	4.4	—		$V_{IN} = V_{IL}$ or V_{IH} , $I_{OH} = -50 \mu A$	B	
		2.7	4.5	2.3	—	—	2.2	—	V	$V_{IN} =$ V_{IL} or V_{IH}	$I_{OH} = -4 mA$	A
		2.7	4.5	3.9	—	—	3.8	—		$I_{OH} = -12 mA$	B	
	V_{OL}	2.7	4.5	—	0.001	0.1	—	0.1	V	$V_{IN} = V_{IL}$ or V_{IH} , $I_{OL} = 50 \mu A$	A.B	
		2.7	4.5	—	—	0.32	—	0.37		$V_{IN} = V_{IL}$ 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 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

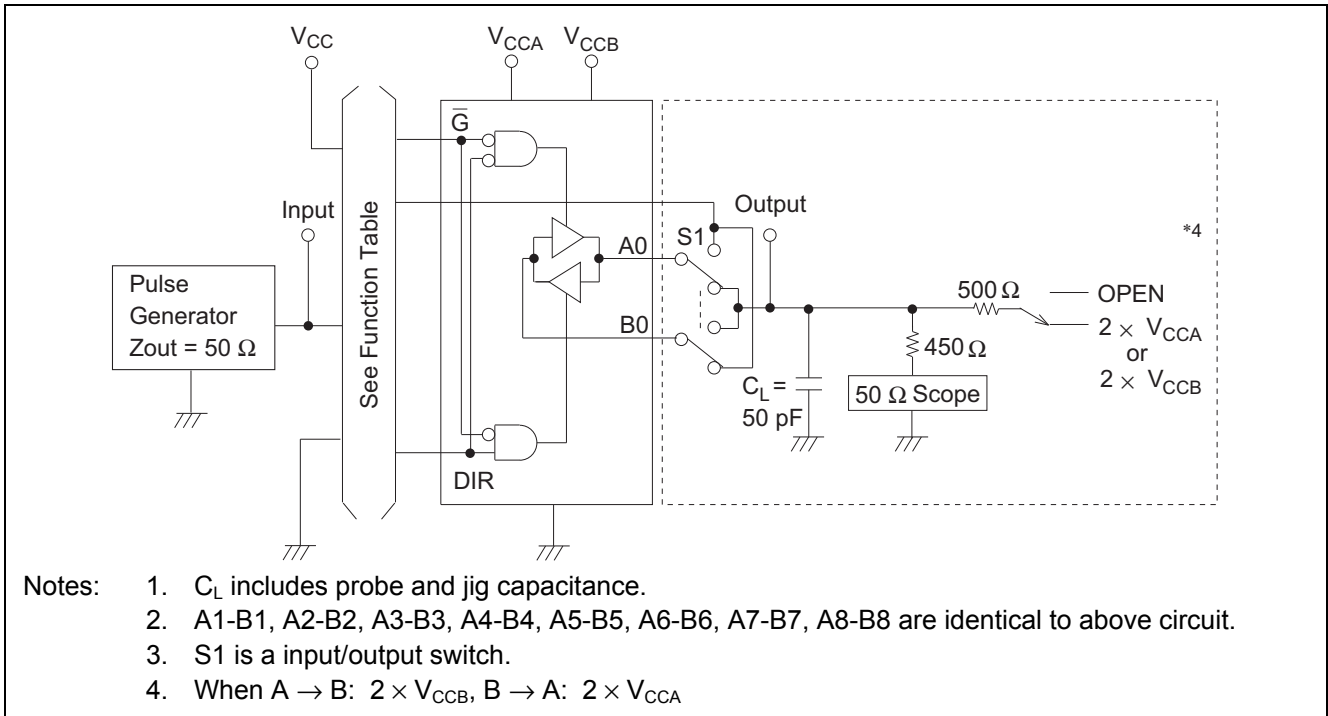
Item	Symbol	Ta = 25°C			Ta = -40 to 85°C		Unit	Conditions
		V _{CCA} = 3.0 V, V _{CCB} = 5.0 V			V _{CC} = 2.7 V, V _{CCB} = 4.5 V			
		Min	Typ	Max	Min	Max		
Propagation Delay Time	t _{PLH}	1.0	5.0	10.0	1.0	12.0	ns	B → A
		1.0	5.0	10.0	1.0	12.0		A → B
	t _{PHL}	1.0	5.0	10.0	1.0	12.0	ns	B → A
		1.0	5.0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

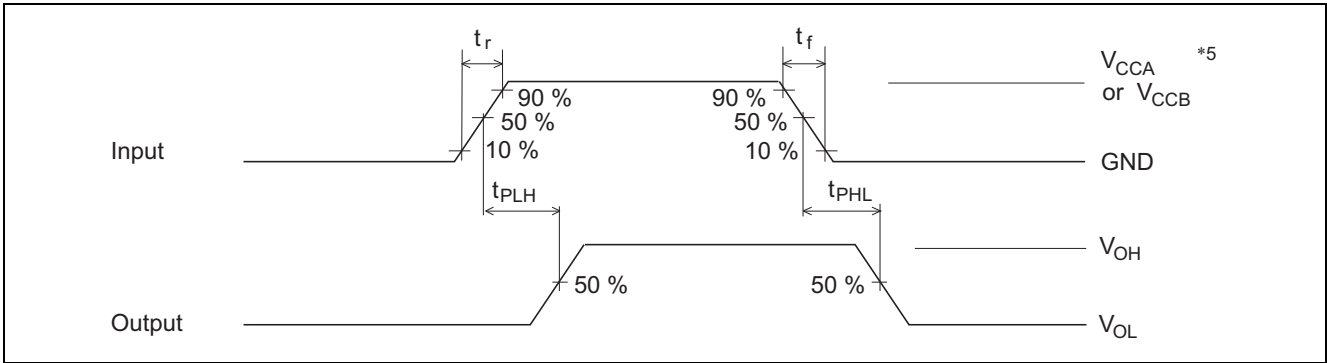


Switching Time Test Method

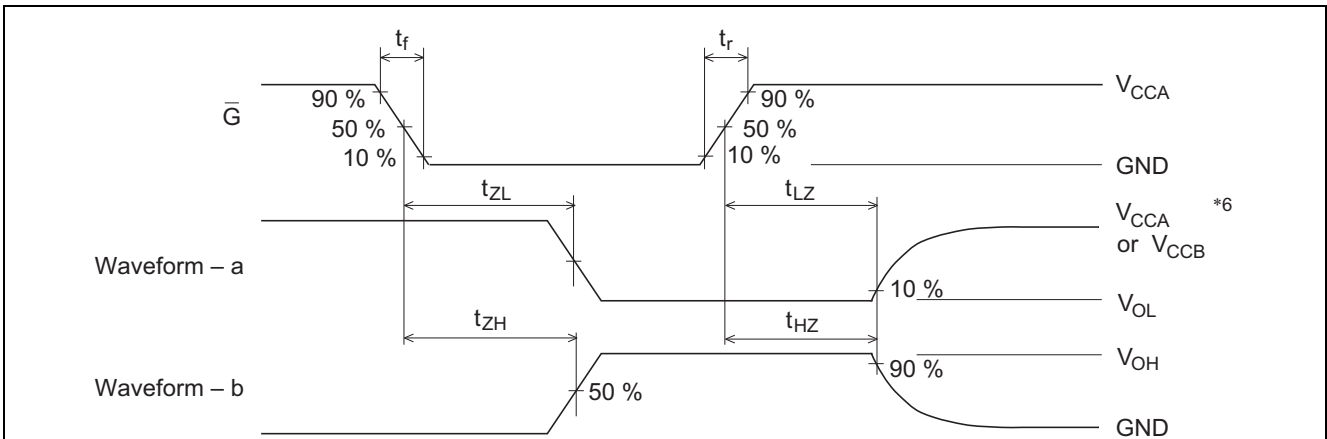
Test Circuit



Waveforms-1



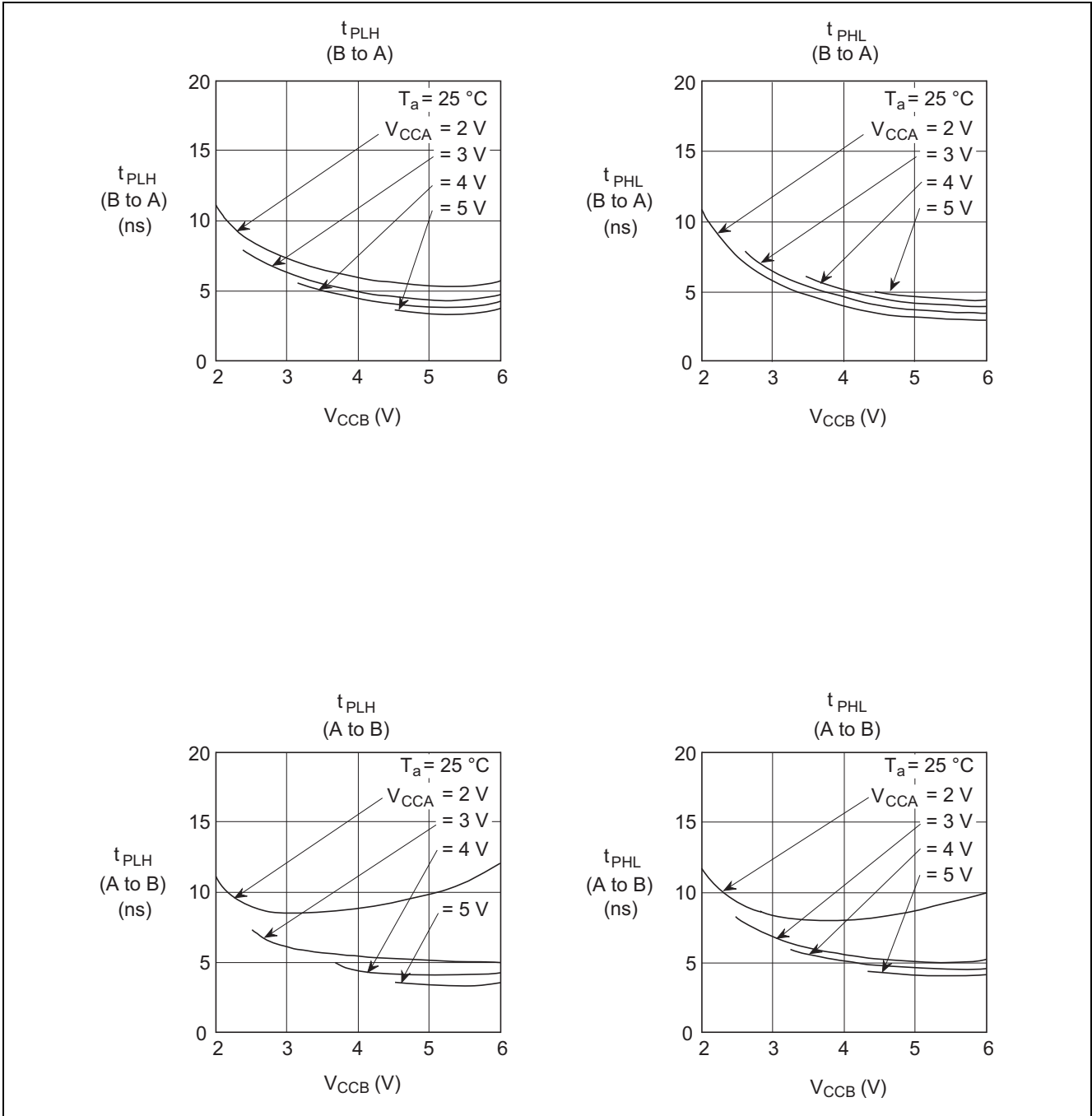
Waveforms-2



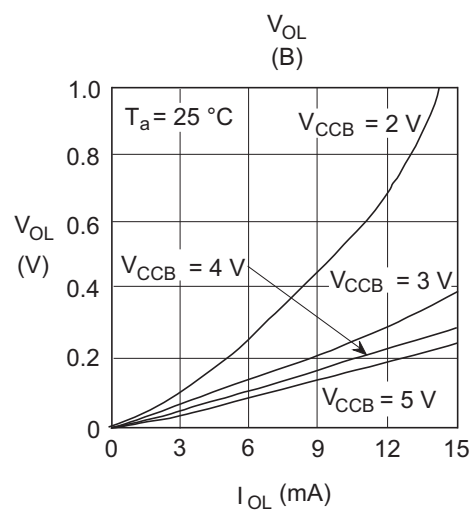
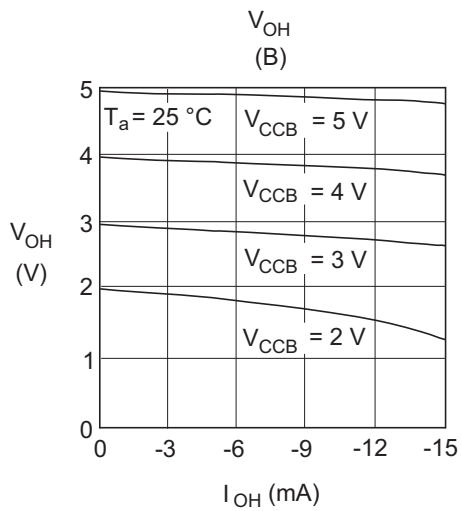
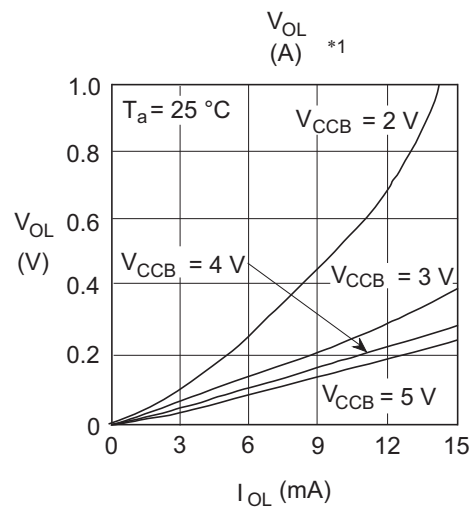
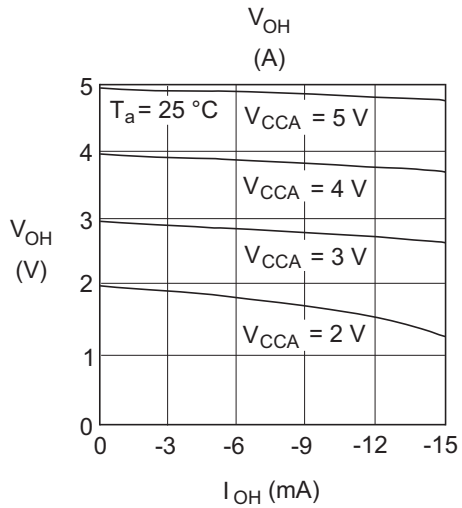
- Notes:
1. $t_r = t_f = 2.5$ ns.
 2. Input Waveform: PRR = 1 MHz, duty cycle 50%
 3. Waveform-a is set as outputs are "Low" when enable input is "Low".
 4. Waveform-b is set as outputs are "High" when enable input is "Low".
 5. When A \rightarrow B: V_{CCA} , B \rightarrow A : V_{CCB}
 6. When \bar{G}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

Typical Characteristic Curves

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



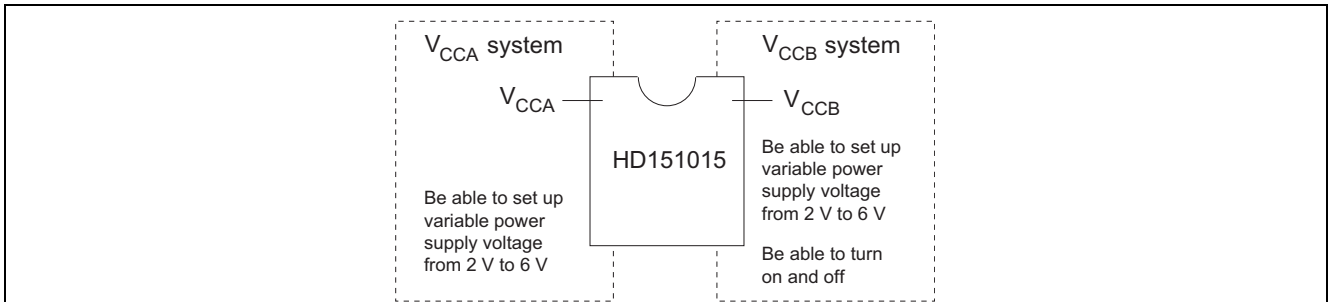
Output Voltage vs Output Current



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

Application

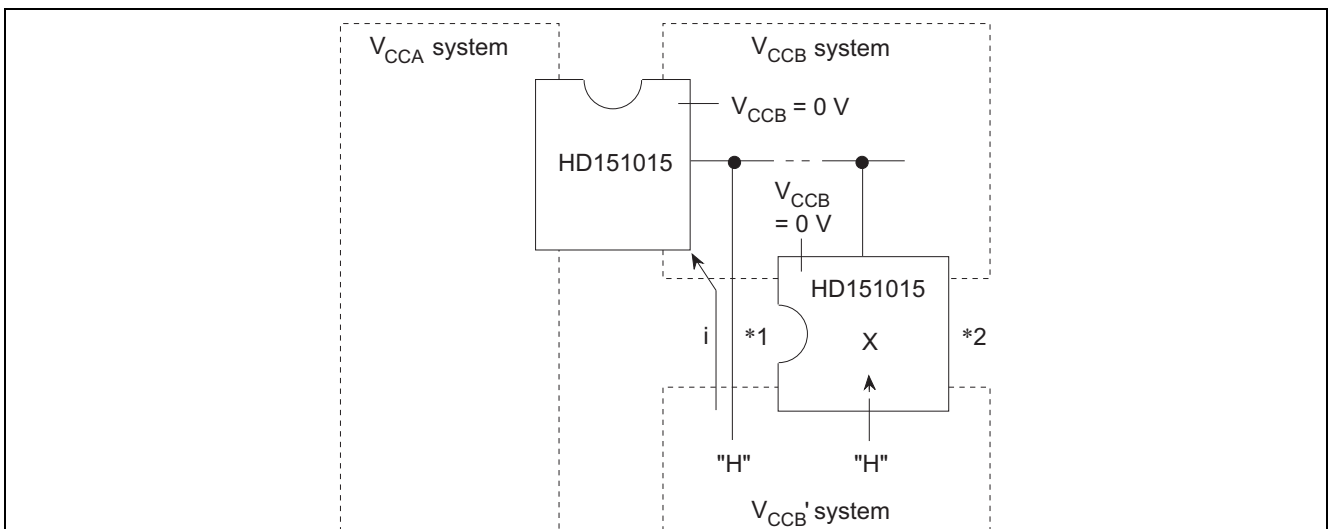
For power management system (1)



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)

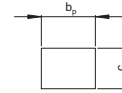
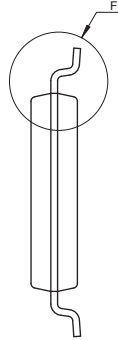
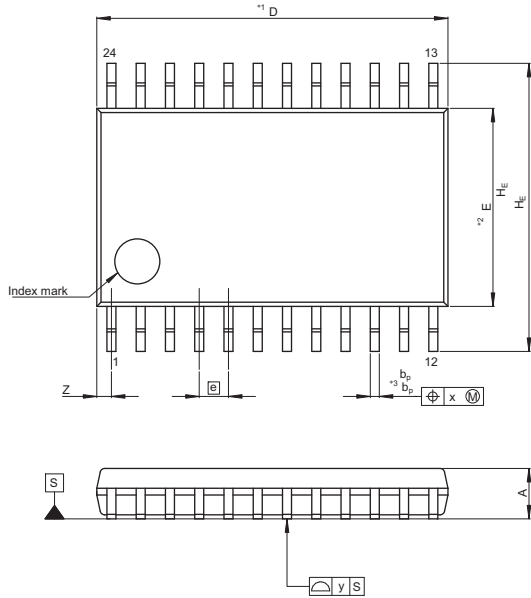
This is cause of malfunction. In order to prevent this problem, I recommend using this device for interface to each power block. (refer to *²)

[Cautions on using]

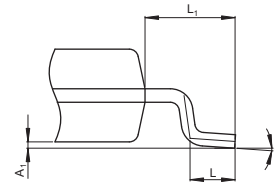
Please use this IC on condition of V_{CCA} usually ON, because if you use it on condition of V_{CCA} being OFF, V_{CCB} being ON, it will be troubled.

Package Dimensions

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



Terminal cross section
(Ni/Pd/Au plating)



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
e	—	0.65	—
x	—	—	0.13
y	—	—	0.10
Z	—	—	0.65
L	0.4	0.5	0.6
L ₁	—	1.0	—

Notice

1. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation of these circuits, software, and information in the design of your equipment. Renesas Electronics assumes no responsibility for any losses incurred by you or third parties arising from the use of these circuits, software, or information.
2. Renesas Electronics has used reasonable care in preparing the information included in this document, but Renesas Electronics does not warrant that such information is error free. Renesas Electronics assumes no liability whatsoever for any damages incurred by you resulting from errors in or omissions from the information included herein.
3. Renesas Electronics does not assume any liability for infringement of patents, copyrights, or other intellectual property rights of third parties by or arising from the use of Renesas Electronics products or technical information described in this document. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
4. You should not alter, modify, copy, or otherwise misappropriate any Renesas Electronics product, whether in whole or in part. Renesas Electronics assumes no responsibility for any losses incurred by you or third parties arising from such alteration, modification, copy or otherwise misappropriation of Renesas Electronics product.
5. Renesas Electronics products are classified according to the following two quality grades: "Standard" and "High Quality". The recommended applications for each Renesas Electronics product depends on the product's quality grade, as indicated below.
"Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; and industrial robots etc.
"High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control systems; anti-disaster systems; anti-crime systems; and safety equipment etc.
Renesas Electronics products are neither intended nor authorized for use in products or systems that may pose a direct threat to human life or bodily injury (artificial life support devices or systems, surgical implantations etc.), or may cause serious property damages (nuclear reactor control systems, military equipment etc.). You must check the quality grade of each Renesas Electronics product before using it in a particular application. You may not use any Renesas Electronics product for any application for which it is not intended. Renesas Electronics shall not be in any way liable for any damages or losses incurred by you or third parties arising from the use of any Renesas Electronics product for which the product is not intended by Renesas Electronics.
6. You should use the Renesas Electronics products described in this document within the range specified by Renesas Electronics, especially with respect to the maximum rating, operating supply voltage range, movement power voltage range, heat radiation characteristics, installation and other product characteristics. Renesas Electronics shall have no liability for malfunctions or damages arising out of the use of Renesas Electronics products beyond such specified ranges.
7. Although Renesas Electronics endeavors to improve the quality and reliability of its products, semiconductor products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Further, Renesas Electronics products are not subject to radiation resistance design. Please be sure to implement safety measures to guard them against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a Renesas Electronics product, such as safety design for hardware and software including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult, please evaluate the safety of the final products or systems manufactured by you.
8. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. Please use Renesas Electronics products in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive. Renesas Electronics assumes no liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
9. Renesas Electronics products and technology may not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations. You should not use Renesas Electronics products or technology described in this document for any purpose relating to military applications or use by the military, including but not limited to the development of weapons of mass destruction. When exporting the Renesas Electronics products or technology described in this document, you should comply with the applicable export control laws and regulations and follow the procedures required by such laws and regulations.
10. It is the responsibility of the buyer or distributor of Renesas Electronics products, who distributes, disposes of, or otherwise places the product with a third party, to notify such third party in advance of the contents and conditions set forth in this document, Renesas Electronics assumes no responsibility for any losses incurred by you or third parties as a result of unauthorized use of Renesas Electronics products.
11. This document may not be reproduced or duplicated in any form, in whole or in part, without prior written consent of Renesas Electronics.
12. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products, or if you have any other inquiries.
(Note 1) "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its majority-owned subsidiaries.
(Note 2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.



SALES OFFICES

Renesas Electronics Corporation

<http://www.renesas.com>

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

Renesas Electronics America Inc.
2801 Scott Boulevard Santa Clara, CA 95050-2549, U.S.A.
Tel: +1-408-586-6000, Fax: +1-408-588-6130

Renesas Electronics Canada Limited
1101 Nicholson Road, Newmarket, Ontario L3Y 9C3, Canada
Tel: +1-905-898-5441, Fax: +1-905-898-3220

Renesas Electronics Europe Limited
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K.
Tel: +44-1628-585-100, Fax: +44-1628-585-900

Renesas Electronics Europe GmbH
Arcadiastrasse 10, 40472 Düsseldorf, Germany
Tel: +49-211-6503-0, Fax: +49-211-6503-1327

Renesas Electronics (China) Co., Ltd.
Room 1709, Quantum Plaza, No.27 ZhiChunLu Haidian District, Beijing 100191, P.R.China
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

Renesas Electronics (Shanghai) Co., Ltd.
Unit 301, Tower A, Central Towers, 555 Langao Road, Putuo District, Shanghai, P. R. China 200333
Tel: +86-21-2226-0888, Fax: +86-21-2226-0999

Renesas Electronics Hong Kong Limited
Unit 1601-1613, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong
Tel: +852-2265-6688, Fax: +852 2886-9022/9044

Renesas Electronics Taiwan Co., Ltd.
13F, No. 363, Fu Shing North Road, Taipei 10543, Taiwan
Tel: +886-2-8175-9600, Fax: +886 2-8175-9670

Renesas Electronics Singapore Pte. Ltd.
80 Bendemeer Road, Unit #06-02 Hyflux Innovation Centre, Singapore 339949
Tel: +65-6213-0200, Fax: +65-6213-0300

Renesas Electronics Malaysia Sdn.Bhd.
Unit 906, Block B, Menara Amcorp, Amcorp Trade Centre, No. 18, Jin Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: +60-3-7955-9390, Fax: +60-3-7955-9510

Renesas Electronics Korea Co., Ltd.
12F., 234 Teheran-ro, Gangnam-Ku, Seoul, 135-920, Korea
Tel: +82-2-558-3737, Fax: +82-2-558-5141