



HD151015

9 bit Level Shifter/Transceiver With 3 State Outputs

REJ03D0300-0500

Rev.5.00

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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 (\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.

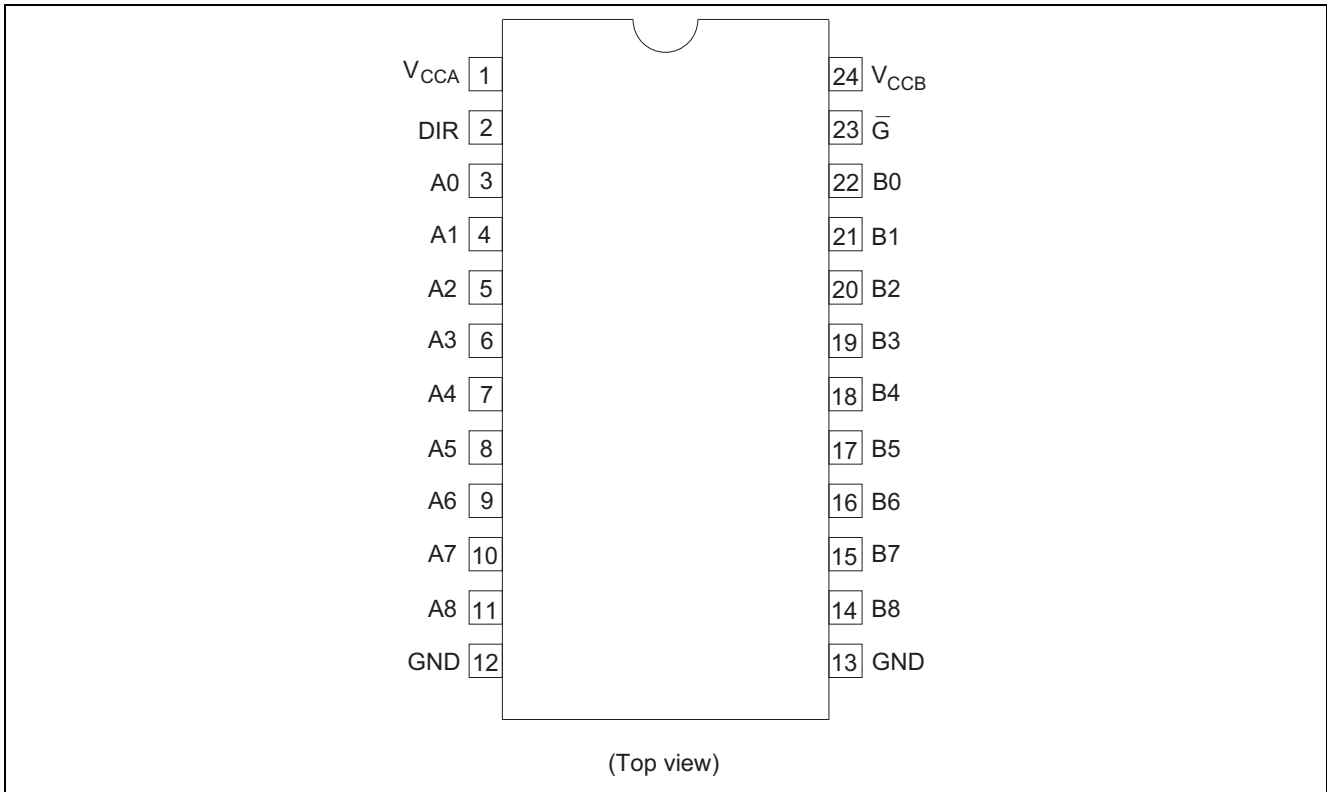
Features

- 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 | Tstg | -65 to +150 | °C | |

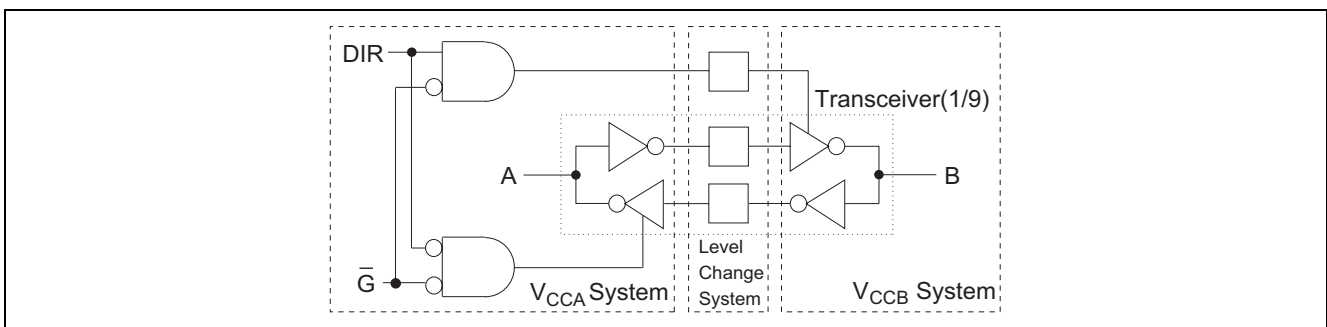
Note: 1. The absolute maximum ratings are values which must not individually be exceeded, and furthermore, no two of which may be realized at the same time.

Recommended Operating Conditions

| Item | Symbol | Rating | Unit | Conditions |
|--|---------------------------------|----------------------|------|---|
| Supply voltage | V _{CCA, B} | 2.0 to 6.0 | V | V _{CCB} ≥ 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

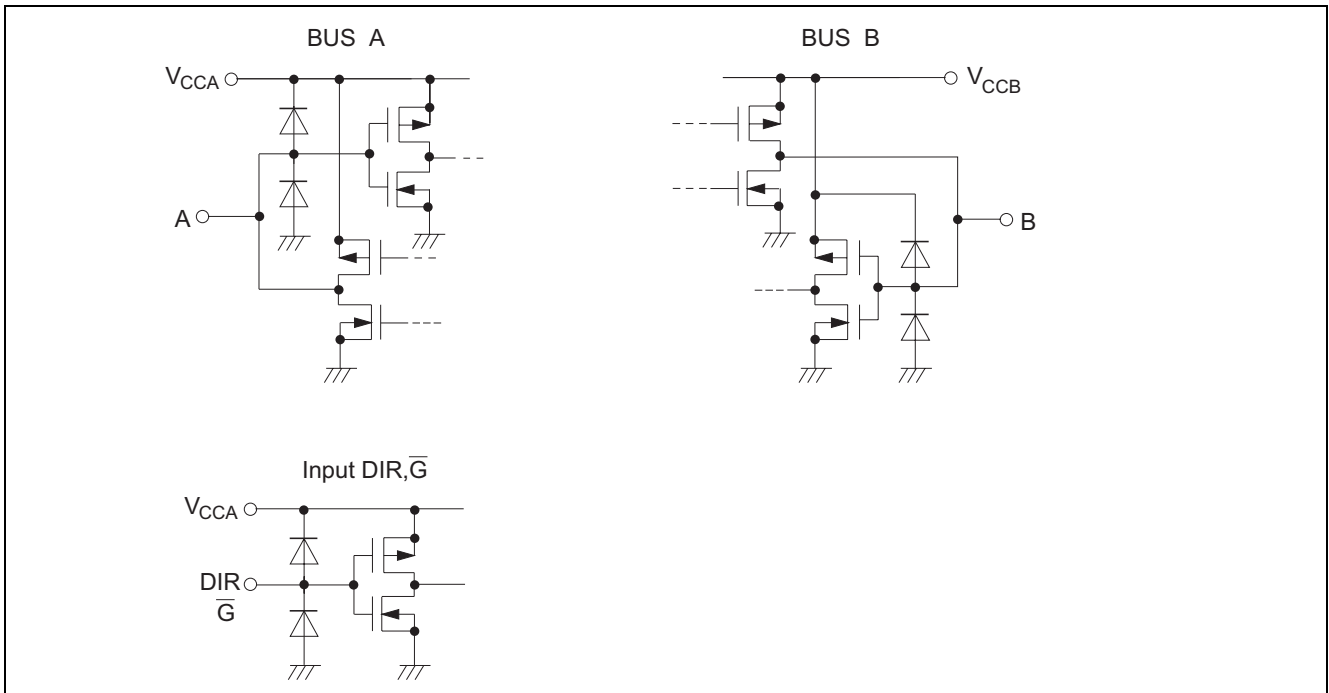
| Item | Sym- bol | V _{CCA} (V) | V _{CCB} (V) | Ta = 25°C | | | Ta = -40 to 85°C | | Unit | Conditions | | |
|--------------------------|--------------------|-------------------------|-------------------------|-----------|-------|------|------------------|------|------|---|-------------------------|---|
| | | | | 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} = 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 μA | 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

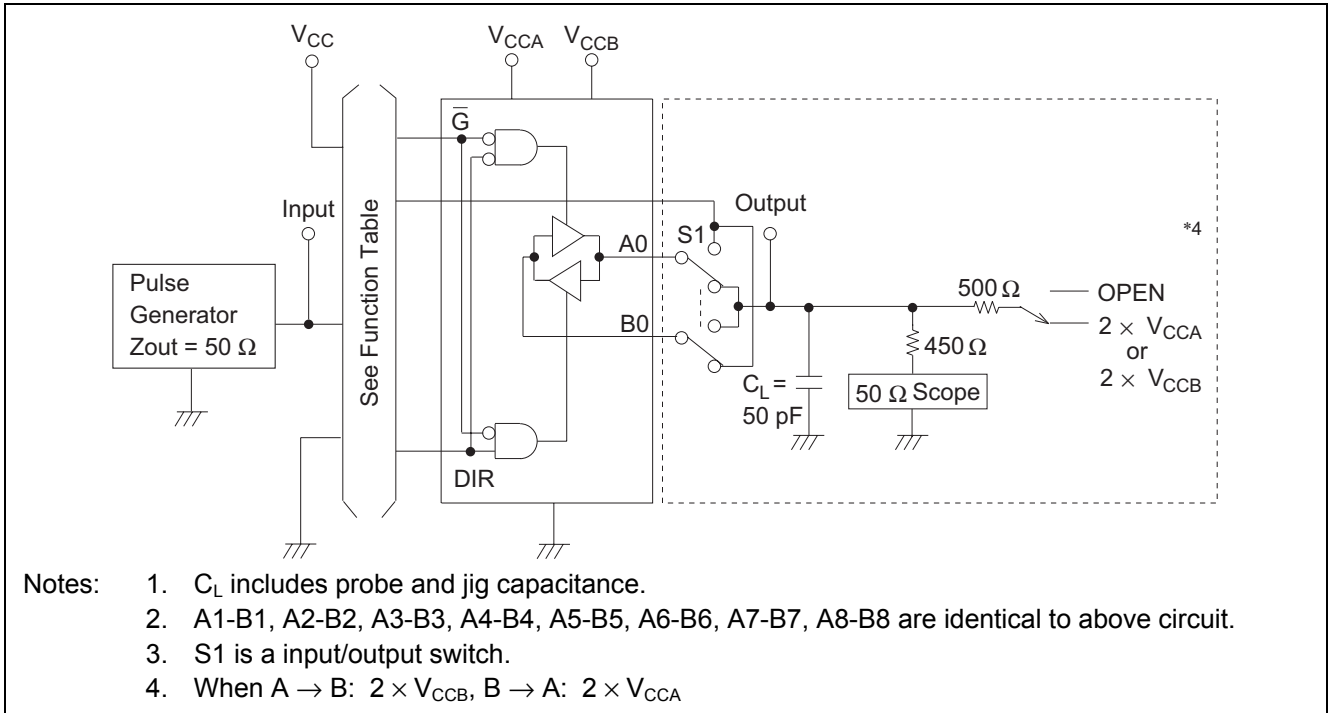
| Item | Symbol | Ta = 25°C | | | Ta = -40 to 85°C | | Unit | Conditions |
|------------------------|------------------|--|-----|------|---|------|------|--------------------|
| | | V _{CCA} = 3.0 V, V _{CCB} = 5.0 V | | | V _{CC} = 2.7 V, V _{CCB} = 4.5 V | | | |
| | | Min | Typ | Max | Min | Max | | |
| 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

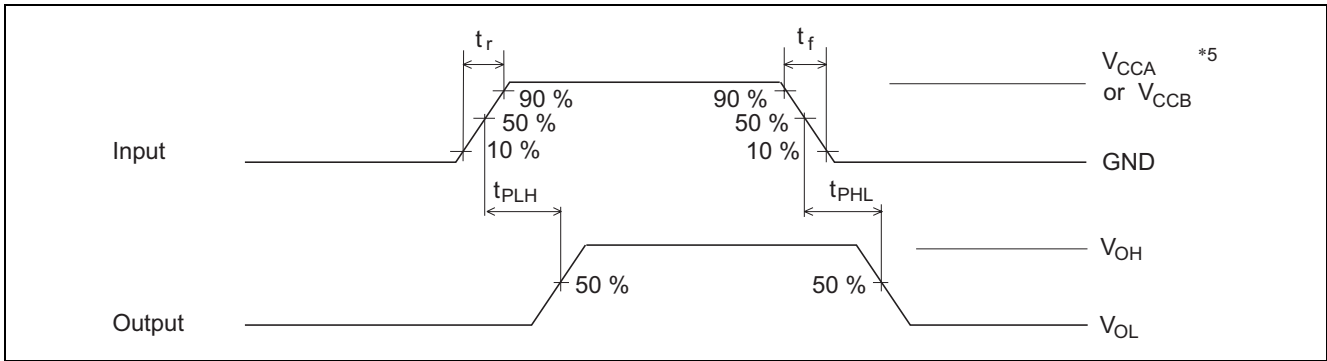


Switching Time Test Method

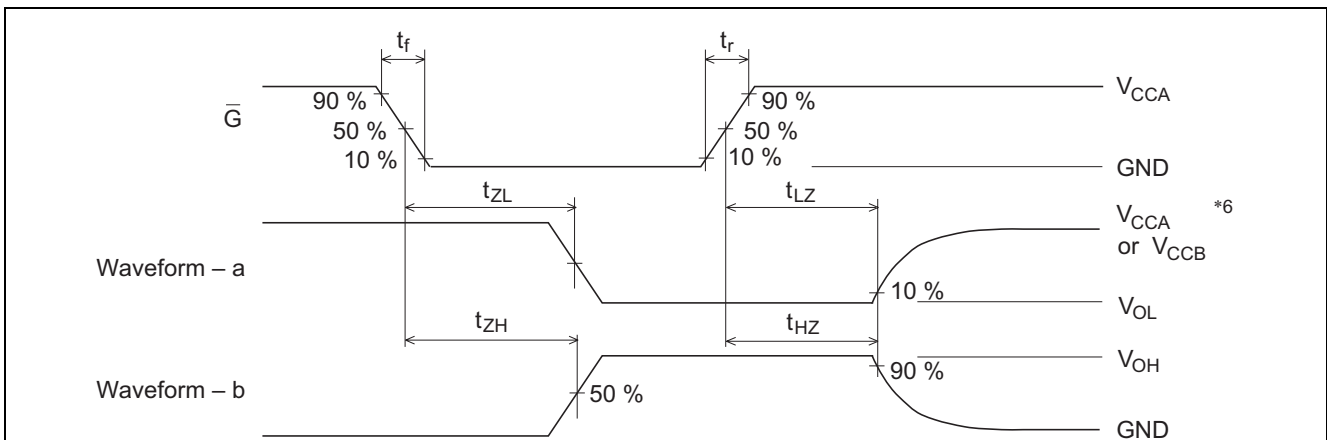
Test Circuit



Waveforms-1



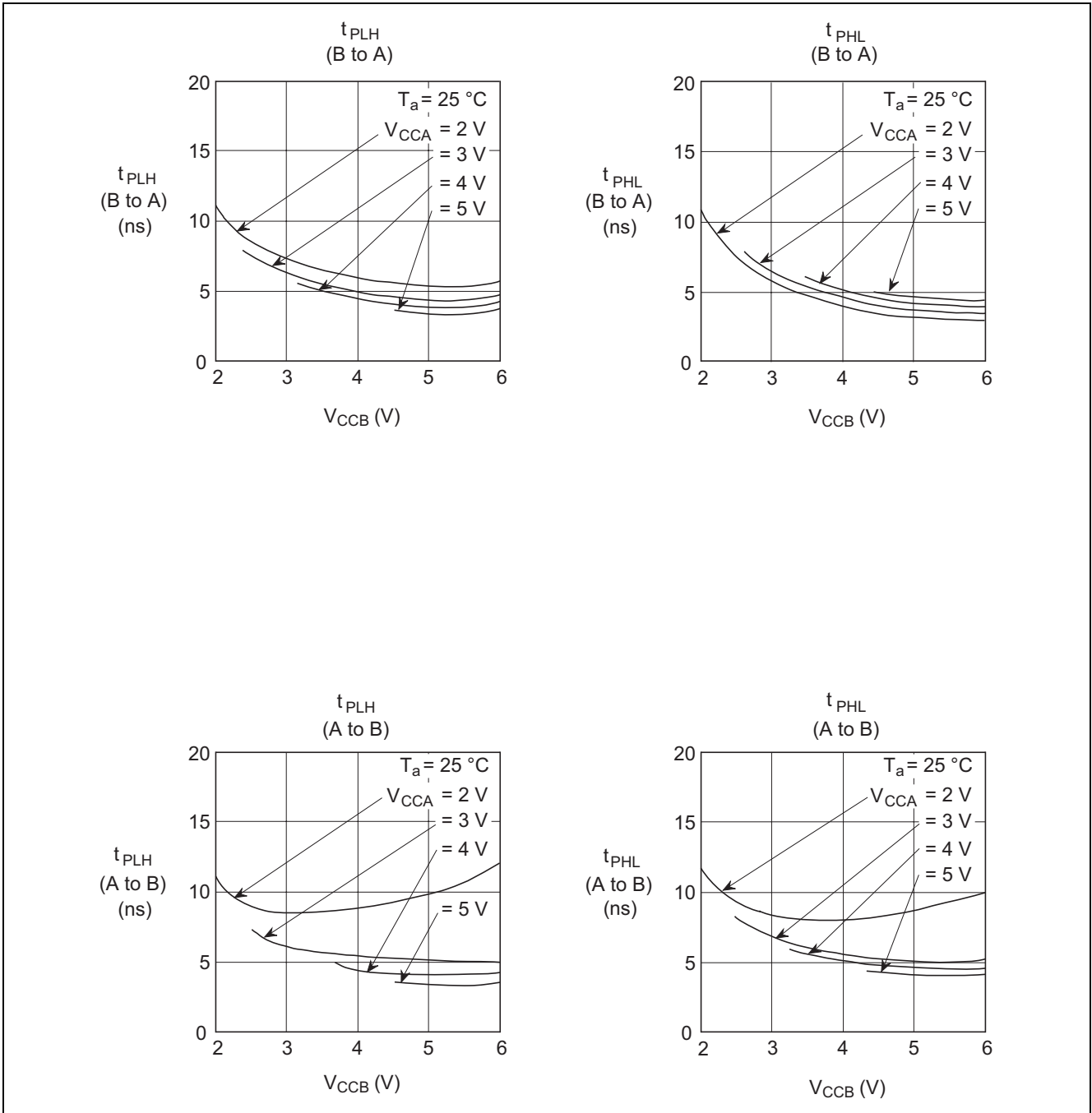
Waveforms-2



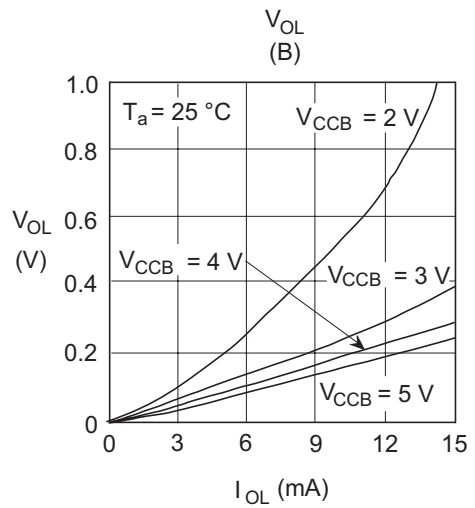
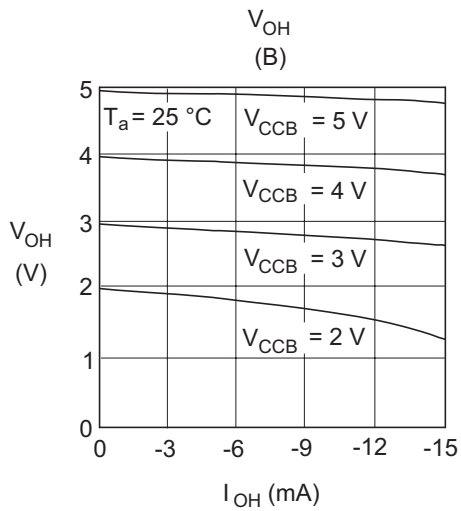
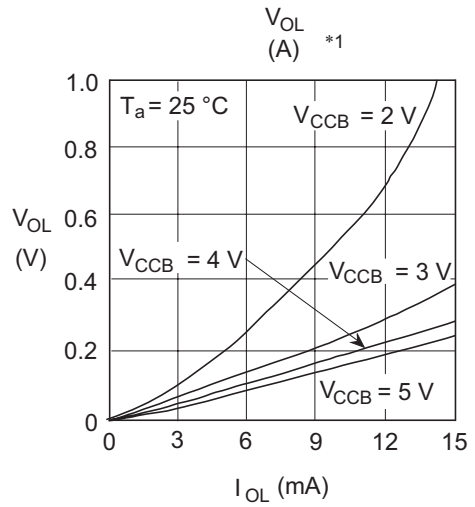
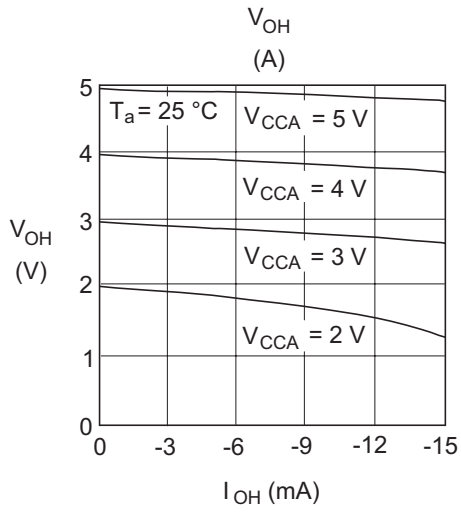
- Notes:
1. $t_r = t_f = 2.5$ ns.
 2. Input Waveform: PRR = 1 MHz, duty cycle 50%
 3. Waveform-a is set as outputs are "Low" when enable input is "Low".
 4. Waveform-b is set as outputs are "High" when enable input is "Low".
 5. When A \rightarrow B: V_{CCA} , B \rightarrow A : V_{CCB}
 6. When $\bar{G}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

The diagram shows an HD151015 IC connected to two power supply systems: V_{CCA} system and V_{CCB} system. The V_{CCA} system is on the left, and the V_{CCB} system is on the right. The IC has two pins labeled V_{CCA} and V_{CCB} . Text boxes provide instructions for each system:

- V_{CCA} system:** Be able to set up variable power supply voltage from 2 V to 6 V.
- V_{CCB} system:** Be able to set up variable power supply voltage from 2 V to 6 V. Be able to turn on and off.

Note: HD151015 is also used for power management system. We show some Examples.

- For V_{CCA} side
Be able to switch fast mode ($V_{CCA} = 5\text{ V}$) and power save mode ($V_{CCA} = 3\text{ V}$)
- For V_{CCB} side
Be able to switch normal mode ($V_{CCB} = 5\text{ V}$) and suspend mode ($V_{CCB} = 0\text{ V}$)
- 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)

The diagram shows two HD151015 ICs connected to three power supply systems: V_{CCA} system, V_{CCB} system, and V_{CCB}' system. The V_{CCA} system is on the left, the V_{CCB} system is on the top right, and the V_{CCB}' system is on the bottom right. The top HD151015 has its V_{CCB} pin connected to the V_{CCB} system. The bottom HD151015 has its V_{CCB} pin connected to the V_{CCB}' system. A common bus line connects the two V_{CCB} pins. The bus line is labeled $V_{CCB} = 0\text{ V}$ at both ends. The bottom HD151015 has an input pin labeled 'i' connected to a high level ('H') and an output pin labeled 'X' connected to a high level ('H'). Annotations *1 and *2 point to the bus line and the bottom HD151015 respectively.

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)

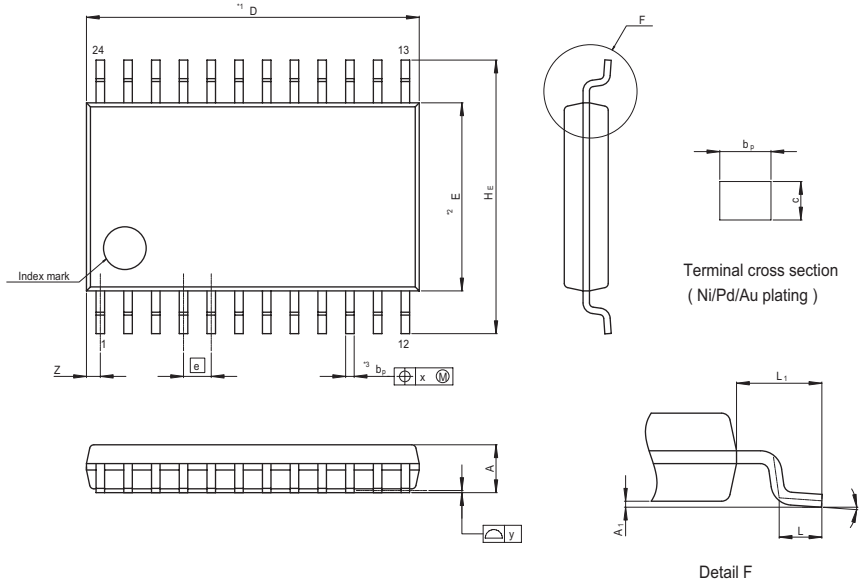
This is cause of malfunction. In order to prevent this problem, I recommend using this device for interface to each power block. (refer to *2)

[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 | — |

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