# UNISONIC TECHNOLOGIES CO., LTD

## UTXB0101      **Preliminary**      *CMOS IC*

# 1-BIT BIDIRECTIONAL LEVEL-SHIFTING AND VOLTAGE TRANSLATOR WITH AUTO DIRECTION-SENSING

SOT-26
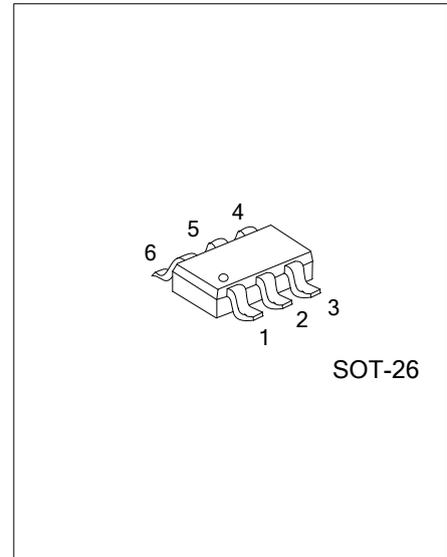
### ■ DESCRIPTION

This 1-bit noninverting translator uses two separate configurable power-supply rails. The A port is designed to track $V_{CCA}$. $V_{CCA}$ accepts any supply voltage from 1.2V to 3.6V. The B port is designed to track $V_{CCB}$. $V_{CCB}$ accepts any supply voltage from 1.65V to 5.5V. This allows for universal low-voltage bidirectional translation between any of the 1.2V, 1.5V, 1.8V, 2.5V, 3.3V, and 5V voltage nodes. $V_{CCA}$ should not exceed $V_{CCB}$.

When the output-enable (OE) input is low, all outputs are placed in the high-impedance state.

This device is fully specified for partial-power-down applications using $I_{OFF}$. The $I_{OFF}$ circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down.

To ensure the high-impedance state during power up or power down, OE should be tied to GND through a pull-down resistor; the minimum value of the resistor is determined by the current-sourcing capability of the driver.

### ■ FEATURES

* 1.2V to 3.6V on A Port and 1.65V to 5.5V on B Port ($V_{CCA} \leq V_{CCB}$)
* $V_{CC}$ Isolation Feature – If Either $V_{CC}$ Input Is at GND, All Outputs Are in the High-Impedance State
* OE Input Circuit Referenced to $V_{CCA}$
* Low Power Consumption, 5μA Max $I_{CC}$
* $I_{OFF}$ Supports Partial-Power-Down Mode Operation

### ■ APPLICATION

* Handset
* Smartphone
* Tablet
* Desktop PC

QW-R140-029.b

■ **ORDERING INFORMATION**

| Ordering Number | | Package | Packing |
|---|---|---|---|
| Lead Free | Halogen Free | | |
| UTXB0101L-AG6-R | UTXB0101G-AG6-R | SOT-26 | Tape Reel |

UTXB0101G-AG6-R

(1)Packing Type      (1) R: Tape Reel

(2)Package Type      (2) AG6: SOT-26

(3)Green Package      (3) G: Halogen Free and Lead Free, L: Lead Free

■ **MARKING**

```
  6   5   4
  ┐   ┐   ┐
 ┌─────────┐
 │ B0101   │
 │ °       │
 └─────────┘
  ┘   ┘   ┘
  1   2   3
```

■ **PIN CONFIGURATION**

```
        ┌─────────┐
VCCA │ 1  ○      6 │ VCCB
        │             │
GND  │ 2          5 │ OE
        │             │
A    │ 3          4 │ B
        └─────────┘
```
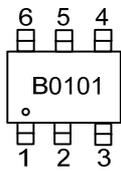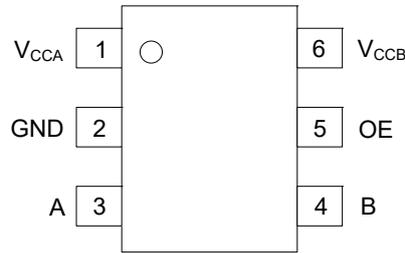
■ **PIN DESCRIPTION**

| PIN NO. | PIN NAME | I/O | DESCRIPTION |
|---|---|---|---|
| 1 | $V_{CCA}$ | | A-port supply voltage $1.2V \leq V_{CCA} \leq 3.6V$ and $V_{CCA} \leq V_{CCB.}$ |
| 2 | GND | | Ground |
| 3 | A | I/O | Input/output A. Referenced to $V_{CCA}$ |
| 4 | B | I/O | Input/output B. Referenced to $V_{CCB}$ |
| 5 | OE | I | 3-state output-mode enable. Pull OE low to place all outputs in 3-state mode. Referenced to $V_{CCA}$ |
| 6 | $V_{CCB}$ | | B-port supply voltage $1.65V \leq V_{CCB} \leq 5.5V$ |

Note: I=Input, O=Output, I/O=Input and Output.

■ **FUNCTION TABLE**

| SUPPLY VOLTAGE | | INPUTS | INPUTS/OUTPUT | |
|---|---|---|---|---|
| $V_{CCA}$ | $V_{CCB}$ | OE | An | Bn |
| $1.2V \sim V_{CCB}$ | $1.65V \sim 5.5V$ | L | Z | Z |
| $1.2V \sim V_{CCB}$ | $1.65V \sim 5.5V$ | H | Input or Output | Output or Input |
| GND (Note 2) | GND (Note 2) | X | Z | Z |

Notes: 1. H = High voltage level；L = Low voltage level；Z : High impedance OFF-state；X = Don't care.
     2. When either $V_{CCA}$ or $V_{CCB}$ is at GND level, the device goes into Power-down mode.

■ **BLOCK DIAGRAM**
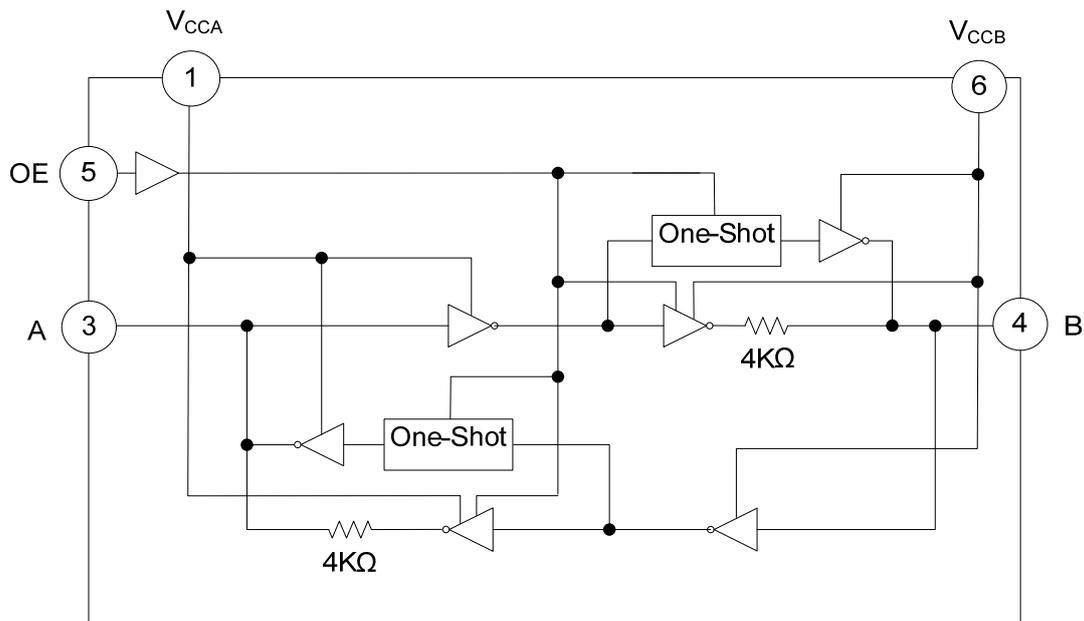
■ **ABSOLUTE MAXIMUM RATING** (Unless otherwise specified)

| PARAMETER | | SYMBOL | RATINGS | UNIT |
|---|---|---|---|---|
| Supply voltage | | $V_{CCA}$ | -0.5 ~ 4.6 | V |
| Supply voltage | | $V_{CCB}$ | -0.5 ~ 6.5 | V |
| Input voltage | A Port | $V_{IN}$ | -0.5 ~ 4.6 | V |
| | B port | | -0.5 ~ 6.5 | V |
| Voltage range applied to any output in the high-impedance or power-off state | A port | $V_{OUT}$ | -0.5 ~ 4.6 | V |
| | B Port | | -0.5 ~ 6.5 | V |
| Voltage range applied to any output in the high or low state | A Port | $V_{OUT}$ | -0.5 ~ $V_{CCA}$+0.5 | V |
| | B Port | | -0.5 ~ $V_{CCB}$+0.5 | V |
| Input clamp current | $V_{IN}$<0 | $I_{IK}$ | -50 | mA |
| Output clamp current | $V_{OUT}$<0 | $I_{OK}$ | -50 | mA |
| Continuous output current | | $I_{OUT}$ | ±50 | mA |
| Continuous current through $V_{CCA}$, $V_{CCB}$, or GND | | $I_{CC}$ / $I_{GND}$ | ±100 | mA |
| Storage Temperature | | $T_{STG}$ | -65 ~ +150 | °C |

Note: Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.

■ **RECOMMENDED OPERATING CONDITIONS** (Unless otherwise specified)

| PARAMETER | | SYMBOL | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|
| Supply Voltage | | $V_{CCA}$ | | | 1.2 | | 3.6 | V |
| Supply Voltage | | $V_{CCB}$ | | | 1.65 | | 5.5 | V |
| Input Voltage | | $V_{IN}$ | | | 0 | | $V_{CCI}$ | V |
| Output Voltage | A Port Inputs | $V_{OUT}$ | $V_{CCA}$=1.2V~3.6V, $V_{CCB}$=1.65V~5.5V | | 0 | | 3.6 | V |
| | B Port Inputs | | | | 0 | | 5.5 | V |
| High-Level Input Voltage | Data Inputs | $V_{IH}$ | $V_{CCA}$=1.2V~3.6V, $V_{CCB}$=1.65V~5.5V | | $V_{CCI}$ ×0.65 (Note 3) | | $V_{CCI}$ | V |
| | OE | | | | $V_{CCA}$ ×0.65 | | 5.5 | V |
| Low-Level Input Voltage | Data Inputs | $V_{IL}$ | $V_{CCA}$=1.2V~3.6V, $V_{CCB}$=1.65V~5.5V | | 0 | | $V_{CCI}$ ×0.35 (Note 3) | V |
| | OE | | | | 0 | | $V_{CCA}$ ×0.35 | V |
| Input Transition Rise or Fall Rate | A Port Inputs | Δt/Δv | $V_{CCA}$=1.2V~3.6V | $V_{CCB}$=1.65V~5.5V | | | 40 | ns/V |
| | B Port Inputs | | | $V_{CCB}$=1.65V~3.6V | | | 40 | ns/V |
| | | | | $V_{CCB}$=4.5V~5.5V | | | 30 | ns/V |
| Operating Temperature | | $T_A$ | | | -40 | | +125 | °C |

Notes: 1. The A and B sides of an unused data I/O pair must be held in the same state, i.e., both at $V_{CCI}$ or both at GND.

2. $V_{CCA}$ must be less than or equal to $V_{CCB}$ and must not exceed 3.6V.

3. $V_{CCI}$ is the supply voltage associated with the input port.

# UTXB0101 **Preliminary** *CMOS IC*

■ **ELECTRICAL CHARACTERISTICS** (Unless otherwise specified)

| PARAMETER | | SYMBOL | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|
| Port A Output High Voltage | | $V_{OHA}$ | $V_{CCA}$=1.2V, $I_{OH}$=-20µA | | | 1.1 | | V |
| | | | $V_{CCA}$=1.4V~3.6V, $I_{OH}$=-20µA | | $V_{CCA}$-0.4 | | | V |
| Port A Output Low Voltage | | $V_{OLA}$ | $V_{CCA}$=1.2V, $I_{OL}$=20µA | | | 0.3 | | V |
| | | | $V_{CCA}$=1.4V~3.6V, $I_{OL}$=20µA | | | | 0.4 | V |
| Port B Output High Voltage | | $V_{OHB}$ | $V_{CCB}$=1.65V~5.5V, $I_{OH}$=-20µA | | $V_{CCB}$-0.4 | | | V |
| Port B Output Low Voltage | | $V_{OLB}$ | $V_{CCB}$=1.65V~5.5V, $I_{OL}$=20µA | | | | 0.4 | V |
| Input Leakage Current | OE | $I_{I(LEAK)}$ | $V_{CCA}$=1.2V~3.6V, $V_{CCB}$=1.65V~5.5V | | | | ±1 | µA |
| Power OFF Leakage Current | A Port | $I_{OFF}$ | $V_{CCA}$=0V, $V_{CCB}$=0V~5.5V | | | | ±1 | µA |
| | B Port | | $V_{CCA}$=0V~3.6V, $V_{CCB}$=0V | | | | ±1 | µA |
| High-Impedance State Output Current | A or B Port | $I_{OZ}$ | OE=GND, $V_{CCA}$=1.2V~3.6V, $V_{CCB}$=1.65V~5.5V | | | | ±1 | µA |
| Quiescent Supply Current | | $I_{CCA}$ | $V_I$=$V_{CCI}$ or GND $I_O$=0A | $V_{CCA}$=1.2V, $V_{CCB}$=1.65V~5.5V | | | 0.06 | | µA |
| | | | | $V_{CCA}$=1.4V~3.6V, $V_{CCB}$=1.65V~5.5V | | | | 3 | µA |
| | | | | $V_{CCA}$=3.6V, $V_{CCB}$=0V | | | | 2 | µA |
| | | | | $V_{CCA}$=0V, $V_{CCB}$=5.5V | | | | -2 | µA |
| | | $I_{CCB}$ | | $V_{CCA}$=1.2V, $V_{CCB}$=1.65V~5.5V | | | 3.4 | | µA |
| | | | | $V_{CCA}$=1.4V~3.6V, $V_{CCB}$=1.65V~5.5V | | | | 5 | µA |
| | | | | $V_{CCA}$=3.6V, $V_{CCB}$=0V | | | | -2 | µA |
| | | | | $V_{CCA}$=0V, $V_{CCB}$=5.5V | | | | 2 | µA |
| | | $I_{CCA}$+$I_{CCB}$ | | $V_{CCA}$=1.2V, $V_{CCB}$=1.65V~5.5V | | | 3.5 | | µA |
| | | | | $V_{CCA}$=1.4V~3.6V, $V_{CCB}$=1.65V~5.5V | | | | 8 | µA |
| | | $I_{CCZA}$ | | $V_{CCA}$=1.2V, $V_{CCB}$=1.65V~5.5V OE=GND | | | 0.05 | | µA |
| | | | | $V_{CCA}$=1.2V, $V_{CCB}$=1.4V~3.6V OE=GND | | | | 3 | µA |
| | | $I_{CCZB}$ | | $V_{CCA}$=1.2V, $V_{CCB}$=1.65V~5.5V OE=GND | | | 3.3 | | µA |
| | | | | $V_{CCA}$=1.2V, $V_{CCB}$=1.4V~3.6V OE=GND | | | | 5 | µA |
| Input Capacitance | OE | $C_{IN}$ | $V_{CCA}$=1.2V~3.6V, $V_{CCB}$=1.65V~5.5V | | | 2.5 | | pF |
| Output Capacitance | A Port | $C_{IO}$ | | | | 5 | | pF |
| | B Port | | | | | 11 | | pF |

Notes: 1. $V_{CCA}$ must be less than or equal to $V_{CCB}$, and $V_{CCA}$ must not exceed 3.6V.
2. $V_{CCI}$ is the supply voltage associated with the input port.
3. $V_{CCO}$ is the supply voltage associated with the output port.

■ **SWITCHING CHARACTERISTICS** (Unless otherwise specified)

| PARAMETER | SYMBOL | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| Propagation Delay<br>From Input (A) to Output (B) | $t_{PD}$ | $V_{CCA}$=1.2V | $V_{CCB}$=1.8V | | 8.9 | | ns |
| | | | $V_{CCB}$=2.5V | | 7.7 | | ns |
| | | | $V_{CCB}$=3.3V | | 7.3 | | ns |
| | | | $V_{CCB}$=5V | | 4.5 | | ns |
| | | $V_{CCA}$=1.5V±0.1V | $V_{CCB}$=1.8V±0.15V | 1.4 | | 12.9 | ns |
| | | | $V_{CCB}$=2.5V±0.2V | 1.2 | | 10.1 | ns |
| | | | $V_{CCB}$=3.3V±0.3V | 1.1 | | 10 | ns |
| | | | $V_{CCB}$=5V±0.5V | 0.8 | | 9.9 | ns |
| | | $V_{CCA}$=1.8V±0.15V | $V_{CCB}$=1.8V±0.15V | 1.6 | | 11 | ns |
| | | | $V_{CCB}$=2.5V±0.2V | 1.4 | | 7.7 | ns |
| | | | $V_{CCB}$=3.3V±0.3V | 1.3 | | 6.8 | ns |
| | | | $V_{CCB}$=5V±0.5V | 1.2 | | 6.5 | ns |
| | | $V_{CCA}$=2.5V±0.2V | $V_{CCB}$=2.5V±0.2V | 1.1 | | 6.3 | ns |
| | | | $V_{CCB}$=3.3V±0.3V | 1.0 | | 5.2 | ns |
| | | | $V_{CCB}$=5V±0.5V | 0.9 | | 4.7 | ns |
| | | $V_{CCA}$=3.3V±0.3V | $V_{CCB}$=3.3V±0.3V | 0.9 | | 4.7 | ns |
| | | | $V_{CCB}$=5V±0.5V | 0.8 | | 4.0 | ns |
| Propagation Delay<br>From Input (B) to Output (A) | | $V_{CCA}$=1.2V | $V_{CCB}$=1.8V | | 9.4 | | ns |
| | | | $V_{CCB}$=2.5V | | 8.4 | | ns |
| | | | $V_{CCB}$=3.3V | | 8.0 | | ns |
| | | | $V_{CCB}$=5V | | 7.5 | | ns |
| | | $V_{CCA}$=1.5V±0.1V | $V_{CCB}$=1.8V±0.15V | 0.9 | | 14.2 | ns |
| | | | $V_{CCB}$=2.5V±0.2V | 0.7 | | 12 | ns |
| | | | $V_{CCB}$=3.3V±0.3V | 0.4 | | 11.7 | ns |
| | | | $V_{CCB}$=5V±0.5V | 0.3 | | 13.7 | ns |
| | | $V_{CCA}$=1.8V±0.15V | $V_{CCB}$=1.8V±0.15V | 1.5 | | 12 | ns |
| | | | $V_{CCB}$=2.5V±0.2V | 1.3 | | 8.4 | ns |
| | | | $V_{CCB}$=3.3V±0.3V | 1.0 | | 7.6 | ns |
| | | | $V_{CCB}$=5V±0.5V | 0.9 | | 7.1 | ns |
| | | $V_{CCA}$=2.5V±0.2V | $V_{CCB}$=2.5V±0.2V | 1.2 | | 6.6 | ns |
| | | | $V_{CCB}$=3.3V±0.3V | 1.1 | | 5.1 | ns |
| | | | $V_{CCB}$=5V±0.5V | 0.9 | | 4.1 | ns |
| | | $V_{CCA}$=3.3V±0.3V | $V_{CCB}$=3.3V±0.3V | 1.0 | | 4.9 | ns |
| | | | $V_{CCB}$=5V±0.5V | 0.9 | | 4.5 | ns |
| Enable Time<br>From Input (OE) to Output (A / B) | $t_{en}$ | $V_{CCA}$=1.2V | $V_{CCB}$=1.8V | | 1 | | μs |
| | | | $V_{CCB}$=2.5V | | 1 | | μs |
| | | | $V_{CCB}$=3.3V | | 1 | | μs |
| | | | $V_{CCB}$=5V | | 1 | | μs |
| | | $V_{CCA}$=1.5V±0.1V | $V_{CCB}$=1.8V±0.15V | | | 1 | μs |
| | | | $V_{CCB}$=2.5V±0.2V | | | 1 | μs |
| | | | $V_{CCB}$=3.3V±0.3V | | | 1 | μs |
| | | | $V_{CCB}$=5V±0.5V | | | 1 | μs |
| | | $V_{CCA}$=1.8V±0.15V | $V_{CCB}$=1.8V±0.15V | | | 1 | μs |
| | | | $V_{CCB}$=2.5V±0.2V | | | 1 | μs |
| | | | $V_{CCB}$=3.3V±0.3V | | | 1 | μs |
| | | | $V_{CCB}$=5V±0.5V | | | 1 | μs |
| | | $V_{CCA}$=2.5V±0.2V | $V_{CCB}$=2.5V±0.2V | | | 1 | μs |
| | | | $V_{CCB}$=3.3V±0.3V | | | 1 | μs |
| | | | $V_{CCB}$=5V±0.5V | | | 1 | μs |
| | | $V_{CCA}$=3.3V±0.3V | $V_{CCB}$=3.3V±0.3V | | | 1 | μs |
| | | | $V_{CCB}$=5V±0.5V | | | 1 | μs |

■ **SWITCHING CHARACTERISTICS (Cont.)**

| PARAMETER | | SYMBOL | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|
| Disable Time From Input (OE) to Output (A) | | $t_{dis}$ | $V_{CCA}$=1.2V | $V_{CCB}$=1.8V | | 23 | | ns |
| | | | | $V_{CCB}$=2.5V | | 20 | | ns |
| | | | | $V_{CCB}$=3.3V | | 19 | | ns |
| | | | | $V_{CCB}$=5V | | 19 | | ns |
| | | | $V_{CCA}$=1.5V±0.1V | $V_{CCB}$=1.8V±0.15V | 5.9 | | 31 | ns |
| | | | | $V_{CCB}$=2.5V±0.2V | 5.7 | | 25.9 | ns |
| | | | | $V_{CCB}$=3.3V±0.3V | 5.6 | | 23 | ns |
| | | | | $V_{CCB}$=5V±0.5V | 5.7 | | 22.4 | ns |
| | | | $V_{CCA}$=1.8V±0.15V | $V_{CCB}$=1.8V±0.15V | 5.9 | | 31 | ns |
| | | | | $V_{CCB}$=2.5V±0.2V | 5.1 | | 21.3 | ns |
| | | | | $V_{CCB}$=3.3V±0.3V | 5.0 | | 19.3 | ns |
| | | | | $V_{CCB}$=5V±0.5V | 5.0 | | 17.4 | ns |
| | | | $V_{CCA}$=2.5V±0.2V | $V_{CCB}$=2.5V±0.2V | 5.1 | | 21.3 | ns |
| | | | | $V_{CCB}$=3.3V±0.3V | 4.6 | | 15.2 | ns |
| | | | | $V_{CCB}$=5V±0.5V | 4.6 | | 13.2 | ns |
| | | | $V_{CCA}$=3.3V±0.3V | $V_{CCB}$=3.3V±0.3V | 4.6 | | 15.2 | ns |
| | | | | $V_{CCB}$=5V±0.5V | 4.3 | | 12.1 | ns |
| Disable Time From Input (OE) to Output (B) | | | $V_{CCA}$=1.2V | $V_{CCB}$=1.8V | | 25 | | ns |
| | | | | $V_{CCB}$=2.5V | | 22 | | ns |
| | | | | $V_{CCB}$=3.3V | | 21 | | ns |
| | | | | $V_{CCB}$=5V | | 21 | | ns |
| | | | $V_{CCA}$=1.5V±0.1V | $V_{CCB}$=1.8V±0.15V | 5.4 | | 30.3 | ns |
| | | | | $V_{CCB}$=2.5V±0.2V | 4.9 | | 22.8 | ns |
| | | | | $V_{CCB}$=3.3V±0.3V | 4.8 | | 20 | ns |
| | | | | $V_{CCB}$=5V±0.5V | 4.9 | | 19.5 | ns |
| | | | $V_{CCA}$=1.8V±0.15V | $V_{CCB}$=1.8V±0.15V | 5.4 | | 30.3 | ns |
| | | | | $V_{CCB}$=2.5V±0.2V | 4.4 | | 20.8 | ns |
| | | | | $V_{CCB}$=3.3V±0.3V | 4.2 | | 17.9 | ns |
| | | | | $V_{CCB}$=5V±0.5V | 4.3 | | 16.3 | ns |
| | | | $V_{CCA}$=2.5V±0.2V | $V_{CCB}$=2.5V±0.2V | 4.4 | | 20.8 | ns |
| | | | | $V_{CCB}$=3.3V±0.3V | 3.8 | | 16 | ns |
| | | | | $V_{CCB}$=5V±0.5V | 3.9 | | 13.9 | ns |
| | | | $V_{CCA}$=3.3V±0.3V | $V_{CCB}$=3.3V±0.3V | 3.8 | | 16 | ns |
| | | | | $V_{CCB}$=5V±0.5V | 3.4 | | 13.2 | ns |
| Rise and Fall Time | A Port Rise And Fall Times | $t_{rA}, t_{fA}$ | $V_{CCA}$=1.2V | $V_{CCB}$=1.8V | | 4.2 | | ns |
| | | | | $V_{CCB}$=2.5V | | 4.2 | | ns |
| | | | | $V_{CCB}$=3.3V | | 4.2 | | ns |
| | | | | $V_{CCB}$=5V | | 4.2 | | ns |
| | | | $V_{CCA}$=1.5V±0.1V | $V_{CCB}$=1.8V±0.15V | 1.4 | | 5.1 | ns |
| | | | | $V_{CCB}$=2.5V±0.2V | 1.4 | | 5.1 | ns |
| | | | | $V_{CCB}$=3.3V±0.3V | 1.4 | | 5.1 | ns |
| | | | | $V_{CCB}$=5V±0.5V | 1.4 | | 5.1 | ns |
| | | | $V_{CCA}$=1.8V±0.15V | $V_{CCB}$=1.8V±0.15V | 1.0 | | 4.2 | ns |
| | | | | $V_{CCB}$=2.5V±0.2V | 1.1 | | 4.1 | ns |
| | | | | $V_{CCB}$=3.3V±0.3V | 1.1 | | 4.1 | ns |
| | | | | $V_{CCB}$=5V±0.5V | 1.1 | | 4.1 | ns |
| | | | $V_{CCA}$=2.5V±0.2V | $V_{CCB}$=2.5V±0.2V | 0.8 | | 3.0 | ns |
| | | | | $V_{CCB}$=3.3V±0.3V | 0.8 | | 3.0 | ns |
| | | | | $V_{CCB}$=5V±0.5V | 0.8 | | 3.0 | ns |
| | | | $V_{CCA}$=3.3V±0.3V | $V_{CCB}$=3.3V±0.3V | 0.7 | | 2.5 | ns |
| | | | | $V_{CCB}$=5V±0.5V | 0.7 | | 2.5 | ns |

■ **SWITCHING CHARACTERISTICS (Cont.)**

| PARAMETER | | SYMBOL | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|
| Rise and Fall Time | B Port Rise And Fall Times | $t_{rB}$, $t_{fB}$ | $V_{CCA}$=1.2V | $V_{CCB}$=1.8V | | 2.1 | | ns |
| | | | | $V_{CCB}$=2.5V | | 1.5 | | ns |
| | | | | $V_{CCB}$=3.3V | | 1.2 | | ns |
| | | | | $V_{CCB}$=5V | | 1.1 | | ns |
| | | | $V_{CCA}$=1.5V±0.1V | $V_{CCB}$=1.8V±0.15V | 0.9 | | 4.5 | ns |
| | | | | $V_{CCB}$=2.5V±0.2V | 0.6 | | 3.2 | ns |
| | | | | $V_{CCB}$=3.3V±0.3V | 0.5 | | 2.8 | ns |
| | | | | $V_{CCB}$=5V±0.5V | 0.4 | | 2.7 | ns |
| | | | $V_{CCA}$=1.8V±0.15V | $V_{CCB}$=1.8V±0.15V | 0.9 | | 4.5 | ns |
| | | | | $V_{CCB}$=2.5V±0.2V | 0.6 | | 3.2 | ns |
| | | | | $V_{CCB}$=3.3V±0.3V | 0.5 | | 2.8 | ns |
| | | | | $V_{CCB}$=5V±0.5V | 0.4 | | 2.7 | ns |
| | | | $V_{CCA}$=2.5V±0.2V | $V_{CCB}$=2.5V±0.2V | 0.7 | | 3.0 | ns |
| | | | | $V_{CCB}$=3.3V±0.3V | 0.5 | | 2.8 | ns |
| | | | | $V_{CCB}$=5V±0.5V | 0.4 | | 2.7 | ns |
| | | | $V_{CCA}$=3.3V±0.3V | $V_{CCB}$=3.3V±0.3V | 0.5 | | 2.3 | ns |
| | | | | $V_{CCB}$=5V±0.5V | 0.4 | | 2.7 | ns |
| Data Rate | | $f_{data}$ | $V_{CCA}$=1.2V, $V_{CCB}$=1.8V~5V | | | 20 | | Mbps |
| | | | $V_{CCA}$=1.5V±0.1V, $V_{CCB}$=1.65V~5.5V | | | | 40 | Mbps |
| | | | $V_{CCA}$=1.8V±0.15V, $V_{CCB}$=1.65V~5.5V | | | | 60 | Mbps |
| | | | $V_{CCA}$=2.5V±0.2V, $V_{CCB}$=2.3V~5.5V | | | | 100 | Mbps |
| | | | $V_{CCA}$=3.3V±0.3V, $V_{CCB}$=3.0V~5.5V | | | | 100 | Mbps |
| Pulse Duration | Data Inputs | $t_W$ | $V_{CCA}$=1.2V, $V_{CCB}$=1.8V~5V | | | 50 | | ns |
| | | | $V_{CCA}$=1.5V±0.1V, $V_{CCB}$=1.65V~5.5V | | 25 | | | ns |
| | | | $V_{CCA}$=1.8V±0.15V, $V_{CCB}$=1.65V~5.5V | | 17 | | | ns |
| | | | $V_{CCA}$=2.5V±0.2V, $V_{CCB}$=2.3V~5.5V | | 10 | | | ns |
| | | | $V_{CCA}$=3.3V±0.3V, $V_{CCB}$=3.0V~5.5V | | 10 | | | ns |

■ **OPERATING CHARACTERISTICS** (Unless otherwise specified)

| PARAMETER | | SYMBOL | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|
| Power Dissipation Capacitance | A Port Input B Port Output | $C_{PDA}$ | $C_L=0$, $f=10MH_Z$ $t_r=t_f=1nS$ OE=$V_{CCA}$ (Output Enabled) | $V_{CCA}=1.2V$ $V_{CCB}=5V$ | | 7.8 | | pF |
| | | | | $V_{CCA}=1.2V$ $V_{CCB}=1.8V$ | | 8.0 | | pF |
| | | | | $V_{CCA}=1.5V$ $V_{CCB}=1.8V$ | | 8.0 | | pF |
| | | | | $V_{CCA}=1.8V$ $V_{CCB}=1.8V$ | | 7.0 | | pF |
| | | | | $V_{CCA}=2.5V$ $V_{CCB}=2.5V$ | | 7.0 | | pF |
| | | | | $V_{CCA}=2.5V$ $V_{CCB}=5V$ | | 8.0 | | pF |
| | | | | $V_{CCA}=3.3V$ $V_{CCB}=3.3\sim5V$ | | 8.0 | | pF |
| | B Port Input A Port Output | | | $V_{CCA}=1.2V$ $V_{CCB}=5V$ | | 12 | | pF |
| | | | | $V_{CCA}=1.2V$ $V_{CCB}=1.8V$ | | 11 | | pF |
| | | | | $V_{CCA}=1.5V$ $V_{CCB}=1.8V$ | | 11 | | pF |
| | | | | $V_{CCA}=1.8V$ $V_{CCB}=1.8V$ | | 11 | | pF |
| | | | | $V_{CCA}=2.5V$ $V_{CCB}=2.5V$ | | 11 | | pF |
| | | | | $V_{CCA}=2.5V$ $V_{CCB}=5V$ | | 11 | | pF |
| | | | | $V_{CCA}=3.3V$ $V_{CCB}=3.3\sim5V$ | | 11 | | pF |
| | A Port Input B Port Output | | $C_L=0$, $f=10MH_Z$ $t_r=t_f=1nS$ OE=GND (Output Disabled) | $V_{CCA}=1.2V$ $V_{CCB}=5V$ | | 0.01 | | pF |
| | | | | $V_{CCA}=1.2V$ $V_{CCB}=1.8V$ | | 0.01 | | pF |
| | | | | $V_{CCA}=1.5V$ $V_{CCB}=1.8V$ | | 0.01 | | pF |
| | | | | $V_{CCA}=1.8V$ $V_{CCB}=1.8V$ | | 0.01 | | pF |
| | | | | $V_{CCA}=2.5V$ $V_{CCB}=2.5V$ | | 0.01 | | pF |
| | | | | $V_{CCA}=2.5V$ $V_{CCB}=5V$ | | 0.01 | | pF |
| | | | | $V_{CCA}=3.3V$ $V_{CCB}=3.3\sim5V$ | | 0.01 | | pF |

■ **OPERATING CHARACTERISTICS (Cont.)**

| PARAMETER | | SYMBOL | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|
| Power Dissipation Capacitance | B Port Input A Port Output | $C_{PDA}$ | $C_L=0$, f=10MHz $t_r=t_f=1nS$ OE=GND (Output Disabled) | $V_{CCA}=1.2V$ $V_{CCB}=5V$ | | 0.01 | | pF |
| | | | | $V_{CCA}=1.2V$ $V_{CCB}=1.8V$ | | 0.01 | | pF |
| | | | | $V_{CCA}=1.5V$ $V_{CCB}=1.8V$ | | 0.01 | | pF |
| | | | | $V_{CCA}=1.8V$ $V_{CCB}=1.8V$ | | 0.01 | | pF |
| | | | | $V_{CCA}=2.5V$ $V_{CCB}=2.5V$ | | 0.01 | | pF |
| | | | | $V_{CCA}=2.5V$ $V_{CCB}=5V$ | | 0.01 | | pF |
| | | | | $V_{CCA}=3.3V$ $V_{CCB}=3.3\sim5V$ | | 0.01 | | pF |
| | A Port Input B Port Output | $C_{PDB}$ | $C_L=0$, f=10MHz $t_r=t_f=1nS$ OE=$V_{CCA}$ (Output Enabled) | $V_{CCA}=1.2V$ $V_{CCB}=5V$ | | 38.1 | | pF |
| | | | | $V_{CCA}=1.2V$ $V_{CCB}=1.8V$ | | 28 | | pF |
| | | | | $V_{CCA}=1.5V$ $V_{CCB}=1.8V$ | | 29 | | pF |
| | | | | $V_{CCA}=1.8V$ $V_{CCB}=1.8V$ | | 29 | | pF |
| | | | | $V_{CCA}=2.5V$ $V_{CCB}=2.5V$ | | 29 | | pF |
| | | | | $V_{CCA}=2.5V$ $V_{CCB}=5V$ | | 29 | | pF |
| | | | | $V_{CCA}=3.3V$ $V_{CCB}=3.3\sim5V$ | | 30 | | pF |
| | B Port Input A Port Output | | | $V_{CCA}=1.2V$ $V_{CCB}=5V$ | | 25.4 | | pF |
| | | | | $V_{CCA}=1.2V$ $V_{CCB}=1.8V$ | | 18 | | pF |
| | | | | $V_{CCA}=1.5V$ $V_{CCB}=1.8V$ | | 17 | | pF |
| | | | | $V_{CCA}=1.8V$ $V_{CCB}=1.8V$ | | 17 | | pF |
| | | | | $V_{CCA}=2.5V$ $V_{CCB}=2.5V$ | | 18 | | pF |
| | | | | $V_{CCA}=2.5V$ $V_{CCB}=5V$ | | 20 | | pF |
| | | | | $V_{CCA}=3.3V$ $V_{CCB}=3.3\sim5V$ | | 21 | | pF |

# UTXB0101     **Preliminary**     *CMOS IC*

■    **OPERATING CHARACTERISTICS (Cont.)**

| PARAMETER | | SYMBOL | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|
| Power Dissipation Capacitance | A Port Input B Port Output | $C_{PDB}$ | $C_L$=0, f=10MHz $t_r=t_f$=1nS OE=GND (Output Disabled) | $V_{CCA}$=1.2V $V_{CCB}$=5V | | 0.01 | | pF |
| | | | | $V_{CCA}$=1.2V $V_{CCB}$=1.8V | | 0.01 | | pF |
| | | | | $V_{CCA}$=1.5V $V_{CCB}$=1.8V | | 0.01 | | pF |
| | | | | $V_{CCA}$=1.8V $V_{CCB}$=1.8V | | 0.01 | | pF |
| | | | | $V_{CCA}$=2.5V $V_{CCB}$=2.5V | | 0.01 | | pF |
| | | | | $V_{CCA}$=2.5V $V_{CCB}$=5V | | 0.01 | | pF |
| | | | | $V_{CCA}$=3.3V $V_{CCB}$=3.3~5V | | 0.02 | | pF |
| | B Port Input A Port Output | | | $V_{CCA}$=1.2V $V_{CCB}$=5V | | 0.01 | | pF |
| | | | | $V_{CCA}$=1.2V $V_{CCB}$=1.8V | | 0.01 | | pF |
| | | | | $V_{CCA}$=1.5V $V_{CCB}$=1.8V | | 0.01 | | pF |
| | | | | $V_{CCA}$=1.8V $V_{CCB}$=1.8V | | 0.01 | | pF |
| | | | | $V_{CCA}$=2.5V $V_{CCB}$=2.5V | | 0.01 | | pF |
| | | | | $V_{CCA}$=2.5V $V_{CCB}$=5V | | 0.01 | | pF |
| | | | | $V_{CCA}$=3.3V $V_{CCB}$=3.3~5V | | 0.03 | | pF |

■ **TEST CIRCUIT AND WAVEFORMS**

**LOAD CIRCUIT**
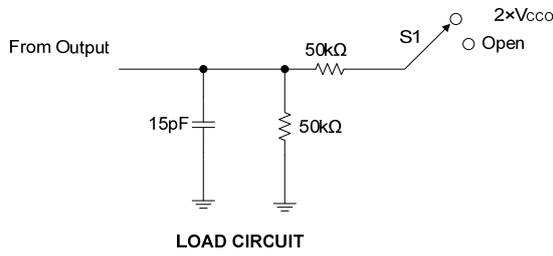
| TEST | S1 |
|------|-----|
| $t_{PZL}/t_{PLZ}$ | $2 \times V_{CCO}$ |
| $t_{PHZ}/t_{PZH}$ | Open |
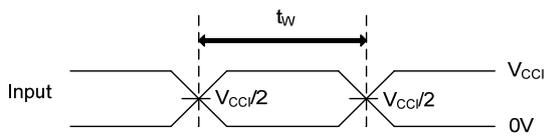
**PULSE DURATION**
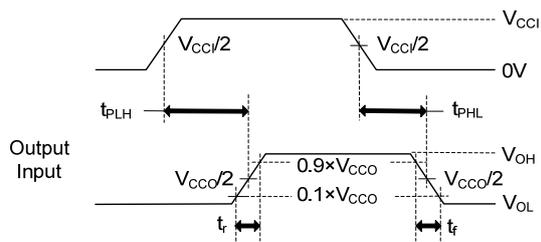
**PROPAGATION DELAY TIMES**
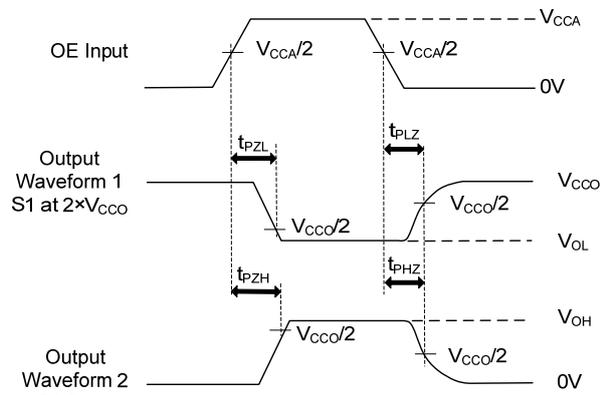
**ENABLE AND DISABLE TIMES**

Notes: 1. $C_L$ includes probe and jig capacitance.
  2. The outputs are measured one at a time, with one transition per measurement.
  3. $t_{PD}$ is the same as $t_{PLH}$ and $t_{PHL}$.
  4. $t_{en}$ is the same as $t_{PZL}$ and $t_{PZH}$.
     $t_{dis}$ is the same as $t_{PLZ}$ and $t_{PHZ}$.
  5. $V_{CCI}$ is the $V_{CC}$ associated with the input port.
  6. $V_{CCO}$ is the $V_{CC}$ associated with the output port.
  7. All parameters and waveforms are not applicable to all devices.

■ **DETAILED DESCRIPTION**

**Overview**

The **UTXB0101** device is a 1-bit directionless level-shifting and voltage translator specifically designed for translating logic voltage levels. The A port accepts I/O voltages ranging from 1.2V to 3.6V, while the B port is able to accept I/O voltages from 1.65V to 5.5V. The device is a buffered architecture with edge rate accelerators (one-shots) to improve the overall data rate. This device can only translate push-pull CMOS logic outputs. If for open-drain signal translation, see UTC UTXS010X products.

**Architecture**

The **UTXB0101** architecture (see Figure 1) does not require a direction-control signal to control the direction of data flow from A to B or from B to A. In a DC state, the output drivers of the **UTXB0101** can maintain a high or low, but are designed to be weak, so that they can be overdriven by an external driver when data on the bus starts flowing the opposite direction.

The output one-shots detect rising or falling edges on the A or B ports. During a rising edge, the one-shot turns on the PMOS transistors (T1, T3) for a short duration, which speeds up the low-to-high transition. Similarly, during a falling edge, the one-shot turns on the NMOS transistors (T2, T4) for a short duration, which speeds up the high-to-low transition. The typical output impedance during output transition is 70Ω at $V_{CCO}$ = 1.2V to 1.8V, 50Ω at $V_{CCO}$ = 1.8V to 3.3V, and 40Ω at $V_{CCO}$ = 3.3V to 5V.
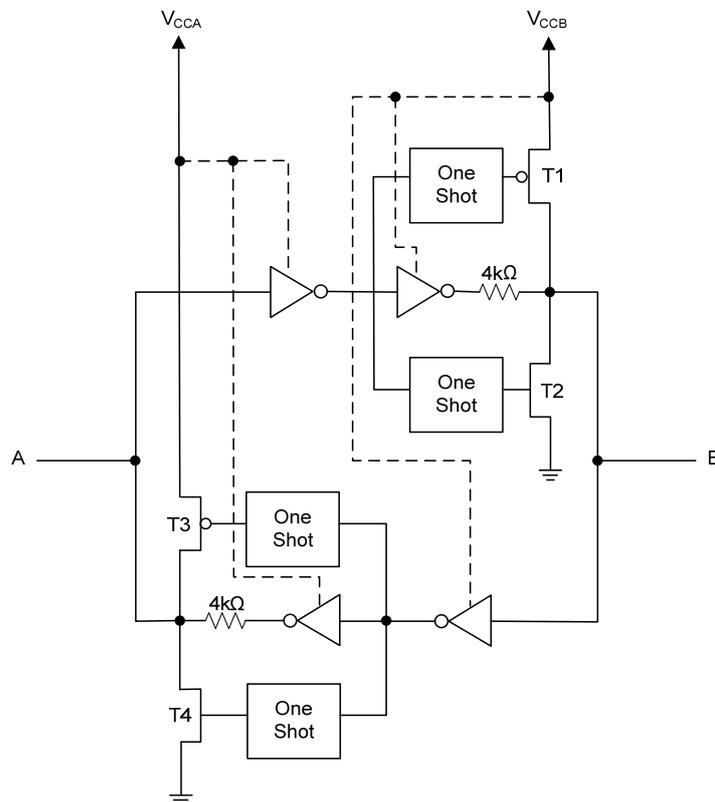


**Figure 1. Architecture of UTXB0101 I/O Cell**

■ **DETAILED DESCRIPTION (Cont.)**

**Power-Up**

During operation, ensure that $V_{CCA} \leq V_{CCB}$ at all times. During power up sequencing, $V_{CCA} \geq V_{CCB}$ does not damage the device, so any power supply can be ramped up first. The **UTXB0101** has circuitry that disables all output ports when either $V_{CC}$ is switched off ($V_{CCA/B}$=0V) and are placed in high-impedance state.

**Enable and Disable**

The **UTXB0101** has an OE input that is used to disable the device by setting OE=LOW, which places all I/Os in the high-impedance (Hi-Z) state. The disable time ($t_{dis}$) indicates the delay between when OE goes low and when the outputs are actually disabled (Hi-Z). The enable time ($t_{en}$) indicates the amount of time the user must allow for the one-shot circuitry to become operational after OE is taken high.

**Pull-up or Pull-down Resistors on I/O Lines**

The **UTXB0101** is designed to drive capacitive loads of up to 70pF. The output drivers of the **UTXB0101** have low-DC drive strength. If pull-up or pull-down resistors are connected externally to the data I/Os, their values must be kept higher than 50kΩ to ensure that they do not contend with the output drivers of the **UTXB0101**.

For the same reason, the **UTXB0101** should not be used in applications such as $I^2C$ or 1-Wire where an open drain driver is connected on the bidirectional data I/O. For these applications, use a device from the UTC UTXS010X series of level translators.

**Device Functional Modes**

The **UTXB0101** device has two functional modes, enabled and disabled. To disable the device set the OE input low, which places all I/Os in a high-impedance state. Setting the OE input high will enable the device.

■ **TYPICAL APPLICATION CIRCUIT**