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## 4-Bit Bi-directional Level Shifter with Automatic Direction Controller

## 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, 5-µA Max $I_{CC}$

- $I_{off}$ Supports Partial-Power-Down Mode Operation

- Latch-Up Performance Exceeds 100mA Per JESD 78, Class II

- ESD Protection Exceeds JESD 22

A Port
- ◆2500-V Human-Body Model (A114-F)
- ◆200-V Machine Model (A115-A)
- ◆1500-V Charged-Device Model (C101D)

B Port
- ◆15-kV Human-Body Model (A114-F)
- ◆200-V Machine Model (A115-A)
- ◆1500-V Charged-Device Model (C101D)

## Description

This 4-bit non-inverting 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 $V_{CCB}$.
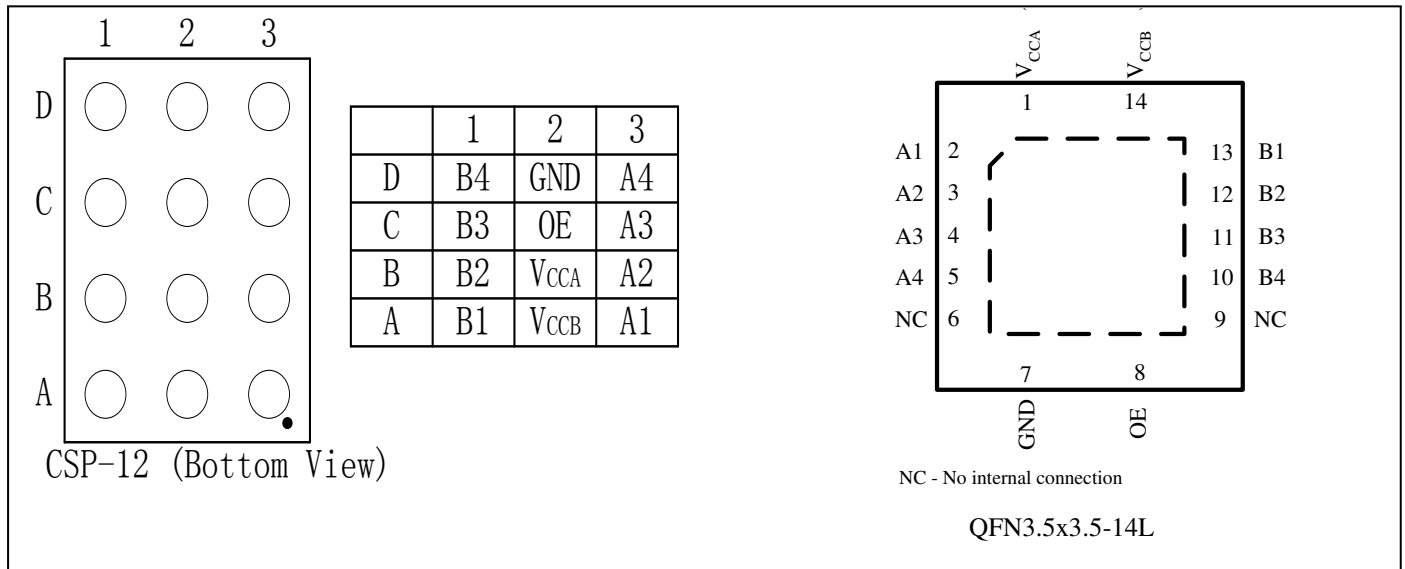
When the output-enable (OE) input is low, all outputs are placed in the high-impedance state.

The PI4ULS5V104 is designed so that the OE input circuit is supplied by $V_{CCA}$.

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.

## Pin Configuration



| | 1 | 2 | 3 |
|---|---|---|---|
| D | B4 | GND | A4 |
| C | B3 | OE | A3 |
| B | B2 | $V_{CCA}$ | A2 |
| A | B1 | $V_{CCB}$ | A1 |

CSP-12 (Bottom View)



NC - No internal connection

QFN3.5x3.5-14L

## Pin Description

| Pin Name | Description |
|---|---|
| $V_{CCA}$ | A-port supply voltage 1.2 V $\leq V_{CCA} \leq$ 3.6 V and $V_{CCA} \leq V_{CCB}$. |
| A1 | Input/output 1. Referenced to $V_{CCA}$. |
| A2 | Input/output 2. Referenced to $V_{CCA}$. |
| A3 | Input/output 3. Referenced to $V_{CCA}$. |
| A4 | Input/output 4. Referenced to $V_{CCA}$. |
| GND | Ground |
| OE | 3-State output. Pull OE low to place all outputs in 3-state mode. Referenced to $V_{CCA}$. |
| B4 | Input/output 4. Referenced to $V_{CCB}$. |
| B3 | Input/output 3. Referenced to $V_{CCB}$. |
| B2 | Input/output 2. Referenced to $V_{CCB}$. |
| B1 | Input/output 1. Referenced to $V_{CCB}$. |
| $V_{CCB}$ | B-port supply voltage 1.65 V $\leq V_{CCB} \leq$ 5.5 V. |

## Maximum Ratings[*1]

| | | | Min. | Max. | Unit |
|---|---|---|---|---|---|
| $V_{CCA}$ | Supply voltage range | | -0.5 | 4.6 | V |
| $V_{CCB}$ | | | -0.5 | 6.5 | |
| $V_I$ | Input voltage range | A port | -0.5 | 4.6 | V |
| | | B port | -0.5 | 6.5 | |
| $V_O$ | Voltage range applied to any output in the high-impedance or power-off state | A port | -0.5 | 4.6 | V |
| | | B port | -0.5 | 6.5 | |
| $V_O$ | Voltage range applied to any output in the high or low state [*2] | A port | -0.5 | $V_{CCA}$ + 0.5 | V |
| | | B port | -0.5 | $V_{CCB}$ + 0.5 | |
| $I_{IK}$ | Input clamp current, $V_I < 0$ | | - | -50 | mA |
| $I_{OK}$ | Output clamp current, $V_O < 0$ | | - | -50 | mA |
| $I_O$ | Continuous output current | | - | ±50 | mA |
| $I_O$ | Continuous current through $V_{CCA}$, $V_{CCB}$, or GND | | - | ±100 | mA |
| $T_{stg}$ | Storage temperature range | | -65 | 150 | ℃ |

*1 Stresses greater than those listed under MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.
*2 The value of $V_{CCA}$ and $V_{CCB}$ are provided in the recommended operating conditions table.

## Recommend Operation Conditions [(1)(2)]

| Parameter | Description | | $V_{CCA}$ | $V_{CCB}$ | Min. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| $V_{CCA}$ | Supply voltage | | - | - | 1.2 | 3.6 | V |
| $V_{CCB}$ | | | - | - | 1.65 | 5.5 | |
| $V_{IH}$ | High-level input voltage | Data inputs | 1.2V to 3.6V | 1.65V to 5.5V | $V_{CCI}$ * 0.65[(3)] | $V_{CCI}$ | V |
| | | OE input | 1.2V to 3.6V | 1.65V to 5.5V | $V_{CCA}$ * 0.7 | 5.5 | |
| $V_{IL}$ | Low-level input voltage | Data inputs | 1.2V to 3.6V | 1.65V to 5.5V | 0 | $V_{CCI}$ * 0.35[(3)] | V |
| | | OE input | 1.2V to 3.6V | 1.65V to 5.5V | 0 | $V_{CCA}$* 0.3 | |
| $V_O$ | Voltage range applied to any output in the high-impedance or power-off state | A port | 1.2V to 3.6V | 1.65V to 5.5V | 0 | 3.6 | V |
| | | B port | | | 0 | 5.5 | |
| $\triangle t/\triangle v$ | Input transition rise or fall rate | A port inputs | 1.2V to 3.6V | 1.65V to 5.5V | - | 40 | ns/V |
| | | B port inputs | 1.2V to 3.6V | 1.65V to 3.6V | - | 40 | |
| | | | | 4.5V to 5.5V | - | 30 | |
| $T_A$ | Operating free-air temperature | | - | - | -40 | 85 | ℃ |

(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 3.6 V.

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

## DC Electrical Characteristics [(1)(2)]

| Parameter | | Test Conditions | V_CCA | V_CCB | T_A = 25°C | | | -40 to 85°C | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Min | Typ | Max | Min | Max | |
| V_OHA | | I_OH = -20µA | 1.2V | - | 1.0 | 1.1 | 1.2 | - | - | V |
| | | | 1.4V to 3.6V | | - | - | - | V_CCA - 0.4 | - | |
| V_OLA | | I_OL = 20µA | 1.2V | - | 0.0 | 0.09 | 0.4 | - | - | V |
| | | | 1.4V to 3.6V | | - | - | - | - | 0.4 | |
| V_OHB | | I_OH = -20µA | - | 1.65V to 5.5V | - | - | - | V_CCB - 0.4 | | V |
| V_OLB | | I_OL = 20µA | - | 1.65V to 5.5V | - | - | - | - | 0.4 | V |
| I_I | OE | V_I = V_CCI or GND | 1.2 to 3.6V | 1.65V to 5.5V | - | - | ±1 | - | ±2 | µA |
| I_off | A port | V_I or V_O = 0 to 3.6V | 0V | 0V to 5.5V | - | - | ±1 | - | ±2 | µA |
| | B port | V_I or V_O = 0 to 5.5V | 0 to 3.6V | 0V | - | - | ±1 | - | ±2 | |
| I_OZ | A or B port | OE = GND | 1.2 to 3.6V | 1.65V to 5.5V | - | - | ±1 | - | ±2 | µA |
| I_CCA | | V_I = V_CCI or GND, Io = 0 | 1.2V | 1.65V to 5.5V | 0.0 | 0.06 | 5.0 | - | - | µA |
| | | | 1.4V to 3.6V | 1.65V to 5.5V | - | - | - | - | 5 | |
| | | | 3.6V | 0V | - | - | - | - | 2 | |
| | | | 0V | 5.5V | - | - | - | - | -2 | |
| I_CCB | | V_I = V_CCI or GND, Io = 0 | 1.2V | 1.65V to 5.5V | 0 | 2.3 | 5 | - | - | µA |
| | | | 1.4V to 3.6V | 1.65V to 5.5V | - | - | - | - | 5 | |
| | | | 3.6V | 0V | - | - | - | - | -2 | |
| | | | 0V | 5.5V | - | - | - | - | 2 | |
| I_CCA + I_CCB | | V_I = V_CCI or GND, Io = 0 | 1.2V | 1.65V to 5.5V | 0.0 | 2.4 | 10 | - | - | µA |
| | | | 1.4V to 3.6V | 1.65V to 5.5V | - | - | - | - | 8 | |
| I_CCZA | | V_I = V_CCI or GND, Io = 0, OE = GND | 1.2V | 1.65V to 5.5V | 0.0 | 0.05 | 0.4 | - | - | µA |
| | | | 1.4V to 3.6V | 1.65V to 5.5V | - | - | - | - | 5 | |
| I_CCZB | | V_I = V_CCI or GND, Io = 0, OE = GND | 1.2V | 1.65V to 5.5V | 0.0 | 2.3 | 5.0 | - | - | µA |
| | | | 1.4V to 3.6V | 1.65V to 5.5V | - | - | - | - | 5 | |
| Ci | OE | - | 1.2 to 3.6V | 1.65V to 5.5V | - | 3 | - | - | 4 | pF |
| Cio | A port | - | 1.2 to 3.6V | 1.65V to 5.5V | - | 5 | - | - | 6 | pF |
| | B port | | | | - | 11 | - | - | 14 | |

(1) V_CCI is the supply voltage associated with the input port.
(2) V_CCO is the supply voltage associated with the output port.

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## AC Electrical Characteristics

### Timing requirements

a.    $T_A = 25℃$, $V_{CCA} = 1.2V$

| | | | $V_{CCB} = 1.8V$ | $V_{CCB} = 2.5V$ | $V_{CCB} = 3.3V$ | $V_{CCB} = 5V$ | Unit |
|---|---|---|---|---|---|---|---|
| | | | TYP | TYP | TYP | TYP | |
| Data rate | | | 20 | 20 | 20 | 20 | Mbps |
| $t_W$ | Pulse duration | Data inputs | 50 | 50 | 50 | 50 | ns |

b.    $T_A = 25℃$, $V_{CCA} = 1.5±0.1V$

| | | | $V_{CCB}=1.8±0.15V$ | | $V_{CCB}=2.5±0.2V$ | | $V_{CCB}=3.3±0.3V$ | | $V_{CCB}=5±0.5V$ | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX | |
| Data rate | | | - | 40 | - | 40 | - | 40 | - | 40 | Mbps |
| $t_W$ | Pulse duration | Data inputs | 25 | - | 25 | - | 25 | - | 25 | - | ns |

c.    $T_A = 25℃$, $V_{CCA} = 1.8±0.15V$

| | | | $V_{CCB}=1.8±0.15V$ | | $V_{CCB}=2.5±0.2V$ | | $V_{CCB}=3.3±0.3V$ | | $V_{CCB}=5±0.5V$ | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX | |
| Data rate | | | - | 60 | - | 60 | - | 60 | - | 60 | Mbps |
| $t_W$ | Pulse duration | Data inputs | 17 | - | 17 | - | 17 | - | 17 | - | ns |

d.    $T_A = 25℃$, $V_{CCA} = 2.5±0.2V$

| | | | $V_{CCB}=2.5±0.2V$ | | $V_{CCB}=3.3±0.3V$ | | $V_{CCB}=5±0.5V$ | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| | | | MIN | MAX | MIN | MAX | MIN | MAX | |
| Data rate | | | - | 100 | - | 100 | - | 100 | Mbps |
| $t_W$ | Pulse duration | Data inputs | 10 | - | 10 | - | 10 | - | ns |

e.    $T_A = 25℃$, $V_{CCA} = 3.3±0.3V$

| | | | $V_{CCB}=3.3±0.3V$ | | $V_{CCB}=5±0.5V$ | | Unit |
|---|---|---|---|---|---|---|
| | | | MIN | MAX | MIN | MAX | |
| Data rate | | | - | 100 | - | 100 | Mbps |
| $t_W$ | 10 | - | 10 | - | 10 | - | ns |

### Switching characteristics

a.    $T_A = 25℃$, $V_{CCA} = 1.2V$

| Parameter | From (INPUT) | To (OUTPUT) | $V_{CCB}=1.8V$ | $V_{CCB}=2.5V$ | $V_{CCB}=3.3V$ | $V_{CCB}=5V$ | Unit |
|---|---|---|---|---|---|---|---|
| | | | TYP | TYP | TYP | TYP | |
| $t_{pd}$ | A | B | 6.9 | 5.7 | 5.3 | 5.5 | ns |
| | B | A | 7.4 | 6.4 | 6 | 5.8 | |
| $t_{en}$ | OE | A | 0.2 | 0.2 | 0.2 | 0.2 | μs |
| | | B | 0.2 | 0.2 | 0.2 | 0.2 | |
| $t_{dis}$ | OE | A | 0.4 | 0.4 | 0.4 | 0.4 | μs |
| | | B | 0.2 | 0.2 | 0.2 | 0.2 | |
| $t_{rA}$, $t_{fA}$ | A-port rise and fall times | | 4.2 | 4.2 | 4.2 | 4.2 | ns |
| $t_{rB}$, $t_{fB}$ | B-port rise and fall times | | 2.1 | 1.5 | 1.2 | 1.1 | ns |
| $t_{SK(O)}$ | Channel-to-channel skew | | 0.5 | 0.5 | 0.5 | 1.4 | ns |
| Max data rate | - | | 20 | 20 | 20 | 20 | Mbps |

b.    $T_A = 25℃$, $V_{CCA} = 1.5±0.1V$

| Parameter | From (INPUT) | To (OUTPUT) | $V_{CCB}=1.8±0.15V$ | | $V_{CCB} = 2.5±0.2V$ | | $V_{CCB}=3.3±0.3V$ | | $V_{CCB} = 5±0.5V$ | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX | |
| $t_{pd}$ | A | B | 1.4 | 12.9 | 1.2 | 10.1 | 1.1 | 10 | 0.8 | 9.9 | ns |
| | B | A | 0.9 | 14.2 | 0.7 | 12 | 0.4 | 11.7 | 0.3 | 13.7 | |
| $t_{en}$ | OE | A | - | 0.5 | - | 0.5 | - | 0.5 | - | 0.5 | µs |
| | | B | - | 0.5 | - | 0.5 | - | 0.5 | - | 0.5 | |
| $t_{dis}$ | OE | A | - | 0.5 | - | 0.5 | - | 0.5 | - | 0.5 | µs |
| | | B | - | 0.5 | - | 0.5 | - | 0.5 | - | 0.5 | |
| $t_{rA}$, $t_{fA}$ | A-port rise and fall times | | 1.4 | 5.1 | 1.4 | 5.1 | 1.4 | 5.1 | 1.4 | 5.1 | ns |
| $t_{rB}$, $t_{fB}$ | B-port rise and fall times | | 0.9 | 4.5 | 0.6 | 3.2 | 0.5 | 2.8 | 0.4 | 2.7 | ns |
| $t_{SK(O)}$ | Channel-to-channel skew | | - | 0.5 | - | 0.5 | - | 0.5 | - | 0.5 | ns |
| Max data rate | | | 40 | - | 40 | - | 40 | - | 40 | - | Mbps |

c.    $T_A = 25℃$, $V_{CCA} = 1.8±0.15V$

| Parameter | From (INPUT) | To (OUTPUT) | $V_{CCB}=1.8±0.15V$ | | $V_{CCB}=2.5±0.2V$ | | $V_{CCB}=3.3±0.3V$ | | $V_{CCB}=5±0.5V$ | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | MIN | MAX | MIN | MAX | MIN | MAX | MIN | MAX | |
| $t_{pd}$ | A | B | 1.6 | 11 | 1.4 | 7.7 | 1.3 | 6.8 | 1.2 | 6.5 | ns |
| | B | A | 1.5 | 12 | 1.3 | 8.4 | 1 | 7.6 | 0.9 | 7.1 | |
| $t_{en}$ | OE | A | - | 0.3 | - | 0.25 | | 0.25 | - | 0.25 | µs |
| | | B | - | 0.3 | - | 0.25 | | 0.25 | - | 0.25 | |
| $t_{dis}$ | OE | A | - | 0.5 | - | 0.5 | | 0.5 | - | 0.5 | µs |
| | | B | - | 0.5 | - | 0.5 | | 0.5 | - | 0.5 | |
| $t_{rA}$, $t_{fA}$ | A-port rise and fall times | | 1 | 4.2 | 1 | 4.1 | 1 | 4.1 | 1 | 4.1 | ns |
| $t_{rB}$, $t_{fB}$ | B-port rise and fall times | | 0.9 | 4.5 | 0.6 | 3.2 | 0.5 | 2.8 | 0.4 | 2.7 | ns |
| $t_{SK(O)}$ | Channel-to-channel skew | | - | 0.5 | - | 0.5 | - | 0.5 | - | 0.5 | ns |
| Max data rate | | | 60 | - | 60 | - | 60 | - | 60 | - | Mbps |

d.    $T_A = 25℃$, $V_{CCA} = 2.5±0.2V$

| Parameter | From (INPUT) | To (OUTPUT) | $V_{CCB}=2.5±0.2V$ | | $V_{CCB}=3.3±0.3V$ | | $V_{CCB}=5±0.5V$ | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| | | | MIN | MAX | MIN | MAX | MIN | MAX | |
| $t_{pd}$ | A | B | 1.1 | 6.3 | 1.0 | 5.2 | 0.9 | 4.7 | ns |
| | B | A | 1.2 | 6.6 | 1.1 | 5.1 | 0.9 | 4.4 | |
| $t_{en}$ | OE | A | - | 0.25 | - | 0.2 | - | 0.2 | µs |
| | | B | - | 0.25 | - | 0.2 | - | 0.2 | |
| $t_{dis}$ | OE | A | - | 0.5 | - | 0.4 | - | 035 | µs |
| | | B | - | 0.5 | - | 0.4 | - | 0.35 | |
| $t_{rA}$, $t_{fA}$ | A-port rise and fall times | | 0.8 | 3.0 | 0.8 | 3.0 | 0.8 | 3.0 | ns |
| $t_{rB}$, $t_{fB}$ | B-port rise and fall times | | 0.7 | 3.0 | 0.5 | 2.8 | 0.4 | 2.7 | ns |
| $t_{SK(O)}$ | Channel-to-channel skew | | - | 0.5 | - | 0.5 | - | 0.5 | ns |
| Max data rate | | | 100 | - | 100 | - | 100 | - | Mbps |

e.  $T_A = 25℃$, $V_{CCA} = 3.3±0.3V$

| Parameter | From (INPUT) | To (OUTPUT) | $V_{CCB}=3.3±0.3V$ MIN | $V_{CCB}=3.3±0.3V$ MAX | $V_{CCB}=5±0.5V$ MIN | $V_{CCB}=5±0.5V$ MAX | Unit |
|---|---|---|---|---|---|---|---|
| $t_{pd}$ | A | B | 0.9 | 4.7 | 0.8 | 4.0 | ns |
| | B | A | 1.0 | 4.9 | 0.9 | 3.8 | |
| $t_{en}$ | OE | A | - | 0.2 | - | 0.2 | μs |
| | | B | - | 0.2 | - | 0.2 | |
| $t_{dis}$ | OE | A | - | 0.3 | - | 0.3 | μs |
| | | B | - | 0.3 | - | 0.3 | |
| $t_{rA}$, $t_{fA}$ | A-port rise and fall times | | 0.7 | 2.8 | 0.7 | 2.8 | ns |
| $t_{rB}$, $t_{fB}$ | B-port rise and fall times | | 0.5 | 2.7 | 0.4 | 2.7 | ns |
| $t_{SK(O)}$ | Channel-to-channel skew | | - | 0.5 | - | 0.5 | ns |
| Max data rate | - | | 100 | - | 100 | - | Mbps |

## Operating Characteristics

| Parameter | | Test Conditions | $V_{CCA}$ 1.2V / $V_{CCB}$ 5V TYP | $V_{CCA}$ 1.2V / $V_{CCB}$ 1.8V TYP | $V_{CCA}$ 1.5V / $V_{CCB}$ 1.8V TYP | $V_{CCA}$ 1.8V / $V_{CCB}$ 1.8V TYP | $V_{CCA}$ 2.5V / $V_{CCB}$ 2.5V TYP | $V_{CCA}$ 2.5V / $V_{CCB}$ 5V TYP | $V_{CCA}$ 3.3V / $V_{CCB}$ 3.3V to 5.5V TYP | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| $C_{pdA}$ | A-port input, B-port output. | $C_L=0$, f=10 MHz, tr = $t_f$ =1ns, OE=$V_{CCA}$ (outputs enabled) | 7.8 | 10 | 9 | 8 | 8 | 8 | 9 | pF |
| | B-port input, A-port output. | | 12 | 11 | 11 | 11 | 11 | 11 | 11 | |
| $C_{pdB}$ | A-port input, B-port output. | | 38.1 | 28 | 28 | 28 | 29 | 30 | 30 | |
| | B-port input, A-port output. | | 25.4 | 18 | 18 | 18 | 18 | 21 | 21 | |
| $C_{pdA}$ | A-port input, B-port output. | $C_L=0$, f = 10 MHz, tr = $t_f$ =1ns, OE=GND (outputs disabled) | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | |
| | B-port input, A-port output. | | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | |
| $C_{pdB}$ | A-port input, B-port output. | | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.03 | |
| | B-port input, A-port output. | | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.02 | 0.04 | |

## Test Circuit

1>  Load circuit for Max data rate, pulse duration propagation delay output rise and fall time measurement
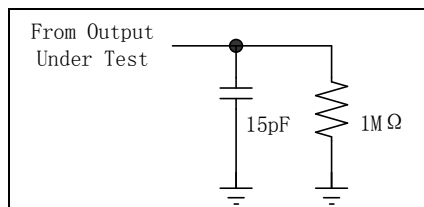


2>  Load circuit for enable/disable time measurement



| TEST | S1 |
|---|---|
| $t_{PZL}$/$t_{PLZ}$ | 2*Vcco |
| $t_{PHL}$/$t_{PHZ}$ | Open |
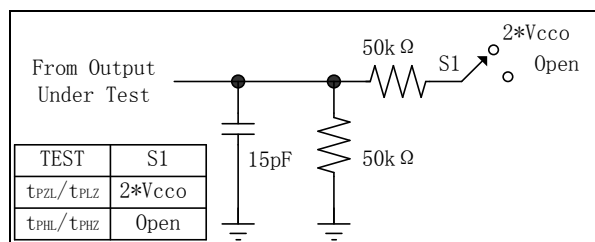
3>  Timing Definitions for Propagation Delays and Enable/Disable  Measurement
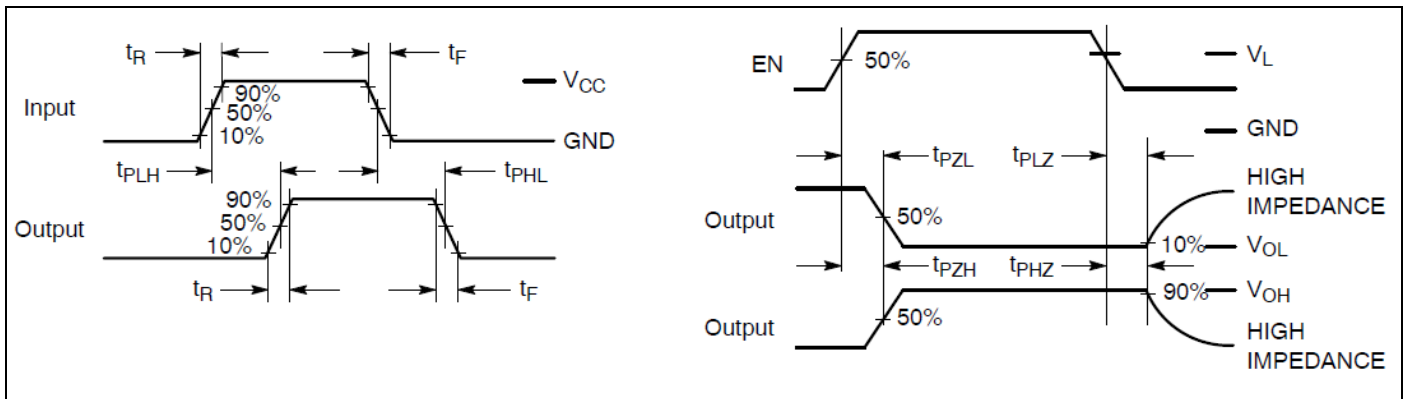
4> Voltage waveforms pulse duration
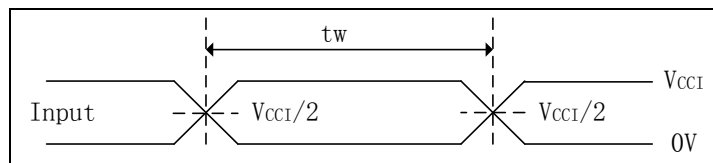


5> Notes

A. $C_L$ includes probe and jig capacitance.

B. All input pulses are supplied by generators having the following characteristics: PRR_10 MHz, $Z_O$ = 50 W, dv/dt ≥ 1 V/ns.

C. The outputs are measured one at a time, with one transition per measurement.

D. $t_{PLH}$ and $t_{PHL}$ are the same as tpd.

E. $V_{CCI}$ is the $V_{CC}$ associated with the input port.

F. $V_{CCO}$ is the $V_{CC}$ associated with the output port.

G. All parameters and waveforms are not applicable to all devices.

## Block Diagram

**Figure1. Architecture of PI4ULS5V104 I/O Cell**
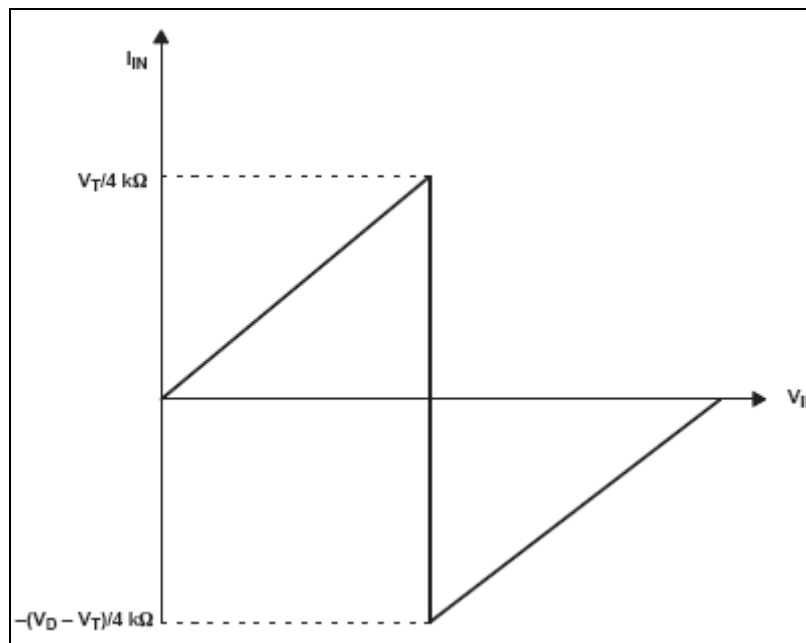


**Figure2. Typical $I_{IN}$ vs. $V_{IN}$ Curve**

**Note:**
A. VT is the input threshold voltage of the PI4ULS5V104 (typically $V_{CCI}/2$).
B. VD is the supply voltage of the external driver.

## Mechanical Information

**TQFN3.5x3.5-14**



| PKG. | DIMENSIONS(MM) | |
|---|---|---|
| SYMBOL | Min | Max |
| A | 0.80 | 0.90 |
| A1 | 0.00 | 0.05 |
| A3 | 0.20 REF | |
| D | 3.42 | 3.58 |
| E | 3.42 | 3.58 |
| D1 | 1.95 | 2.15 |
| E1 | 1.95 | 2.15 |
| b | 0.20 | 0.30 |
| e | 0.50 TYP | |
| e1 | 1.50 TYP | |
| L | 0.32 | 0.48 |

TOP VIEW

BOTTOM VIEW

SIDE VIEW

PIN1 Index Area

Note:
1. Ref: JEDEC MO-288B

DATE: 06/18/13

DESCRIPTION: 14-Pin, TQFN, 3.5x3.5

PACKAGE CODE:  ZB  (ZB14)

DOCUMENT CONTROL #: PD-2154      REVISION: --

13-0193

**CSP-12**



TOP VIEW

Bottom View
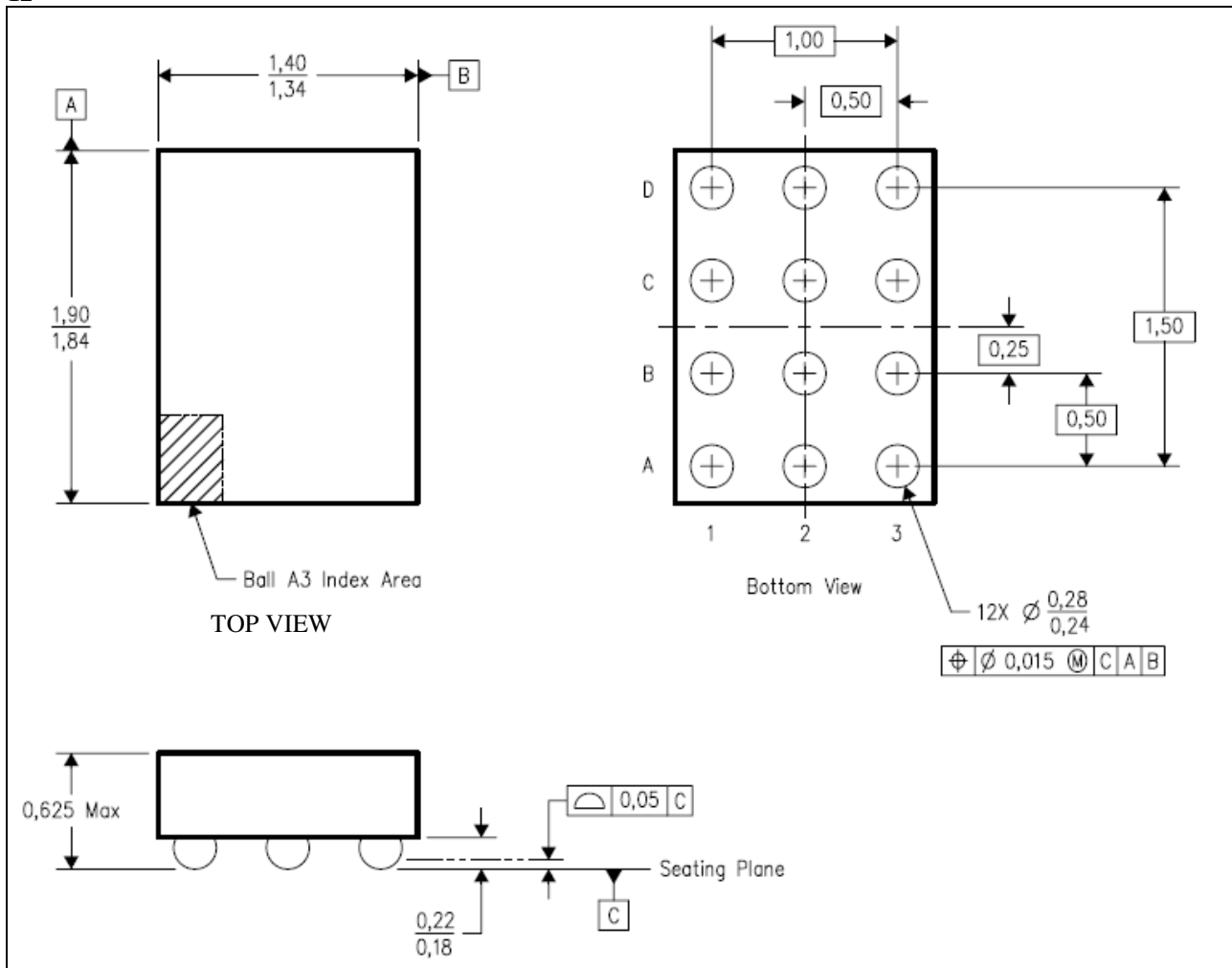
**For latest package info.**
please check: http://www.diodes.com/design/support/packaging/pericom-packaging/packaging-mechanicals-and-thermal-characteristics/

## Ordering Information

| Part Number | Package Code | Package |
|---|---|---|
| PI4ULS5V104ZBEX | ZB | 14-pin, 3.5X3.5 (TQFN) |
| PI4ULS5V104GAEX | GA | 12-pin, 1.37X1.87 Wafer Level (CSP) |

**Notes:**
• Thermal characteristics can be found on the company web site at www.diodes.com/design/support/packaging/
• E = Pb-free and Green
• X suffix = Tape/Reel